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CHANGES AND ENDINGS

**Dynamics of the Anthropocene from Earth
System Sciences to Critical International
Relations**

Dissertação de Mestrado

Dissertation presented to the Programa de Pós-Graduação em Relações Internacionais of the Instituto de Relações Internacionais, PUC-Rio, in partial fulfillment of the requirements for the degree of Mestre em Relações internacionais.

Advisor: Prof. James Casas Klausen

Rio de Janeiro

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Resumo

Dumas Neto, Maria Thereza; Klausen, James Casas (Orientador). **Mudanças e fins: Dinâmicas do Antropoceno de Ciências do Sistema Terrestre para Teoria Crítica de Relações Internacionais**. 2022. 178p. Dissertação de Mestrado – Instituto de Relações Internacionais, Pontifícia Universidade Católica do Rio de Janeiro.

O objetivo da dissertação é analisar criticamente o uso do conceito do Antropoceno pela linha crítica de teoria das Relações Internacionais. Isso se faz com um foco específico na origem do conceito em Ciência do Sistema Terrestre (CST), e através de uma discussão geral sobre autoridade científica atribuída à ciência moderna e suas conexões com práticas de *world-making*, entendidas especificamente como cosmologias científicas, e em relação com mobilização de propostas na política internacional. Nesse sentido, a discussão explora a construção de CST e propõe a formulação do Antropoceno como relacionada com os comprometimentos políticos dessa disciplina – a partir daí, sugere-se o uso da problematização Foucaultiana como forma de análise das soluções políticas ao Antropoceno propostas pela disciplina. A seguir, a dissertação conecta as Ciências do Sistema Terrestre com outros momentos de desenvolvimento da ciência moderna com o âmbito de mover uma discussão geral sobre o poder de uma autoridade científica legitimar formas de política internacional através de práticas de *world-making*. Com isso, a discussão expande em dois mundos e formulações de política internacional possíveis advindos de distintas interpretações do Antropoceno. Finalmente, no que se refere à literatura de Relações Internacionais, a dissertação avalia como a apropriação do conceito de Antropoceno a partir de CST é realizada, prestando atenção especificamente na chamada por uma mudança na ontologia da disciplina e na relação entendida como desejável entre teoria e prática política presente na literatura, ambos elementos associados à CST. Por último, a noção de problematização é retomada para se analisar as soluções políticas e intelectuais propostas pela literatura Crítica de Relações Internacionais em sua mobilização do Antropoceno.

Palavras-chave

Antropoceno; Ciência do Sistema Terrestre; Teoria Crítica de Relações Internacionais; crise climática, problematização Foucaultiana.

Abstract

Dumas Neto, Maria Thereza; Klausen, James Casas (Advisor). **Changes and endings: Dynamics of the Anthropocene from Earth System Sciences to Critical International Relations**. 2022. 178p. Dissertação de Mestrado – Instituto de Relações Internacionais, Pontifícia Universidade Católica do Rio de Janeiro.

This dissertation attempts to critically analyze the mobilization of the concept of the Anthropocene by Critical International Relations literature. It does so with a particular focus on the origins of the concept within Earth System Sciences (ESS), and within a more general discussion over the scientific authority of modern science and its connections to practices of world-making - discussed specifically in terms of scientific cosmologies - and propositions over international politics. As such, the discussion explores the construction of ESS and the formulation of the Anthropocene as related to the political commitments of the discipline and proposes the use of the Foucauldian problematization to analyze the political solutions stemming from the discipline. Then, the dissertation connects Earth System Sciences to other scientific endeavors, in a different historical context in order to move a more generalized discussion on the power of scientific authority to inform international politics through world-making practices. With that, the discussion lays out two possible worlds and political implications stemming from interpretations of the Anthropocene. Finally, within IR literature the dissertation assesses how the appropriation of the Anthropocene is conducted, paying particular attention to the call for an ontological shift within the discipline and to the specific relationship between theory and political action present in the literature, both elements connected to ESS. At last, the notion of problematization is brought back in order to analyze the intellectual and political solutions brought forth by Critical IR in their mobilization of the Anthropocene.

Key words

Anthropocene, Earth System Sciences, Critical International Relations, climate crisis, Foucauldian problematization.

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List of Abbreviations and Acronyms

ES	Earth system
ESM	Earth System Models
ESS	Earth System Sciences
GCM	General Circulation Model
IAM	Integrated Assessment Models
ICS	International Commission on Stratigraphy
IGY	International Geophysical Year
IR	International Relations
NASA	National Aeronautics and Space Administration
OAGCM	Oceanic and Atmospheric General Circulation Model
US	United States
USSR	Union of Soviet Socialist Republics

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Microbial Museum

April ship sets sail, sea freezes ripples, leaves Rothera behind. One hundred and fifty thousand years of snowfall in

cylindrical samples, bubble-wrapped, boxed in styrofoam, cores wrenched from ice caverns to Immingham.

Drill incises annulus ice cuttings spiral surface. Statistics held in water vapour measure up to eons of weather.

Blueprints of other lives, the oldest ice sequesters reservoirs of extinct creatures resurrected.

Suspending cable sonars frozen microbial cells immortal bugs from bacteriasicles emerge, grow, divide.

Prehistoric pestilence thaws, allows ancient genes to mix with modern ones. Skiing genotype slaloms through DNA markers,

mutating the ocean, creeping into the unsuspecting cells of species climbing the ladder to life.

The future is thawed, dispatched into a white out.

Maya Chowdhry, Fossil

The end we start from

Something had changed. Something fundamental. Measurements of carbon dioxide in ice cuttings in the arctic would eventually lead to the assertion of the geological power heralded by twenty first century humanity. The Anthropocene, connected firstly to crisis of the climate, but expanding to generalized political, economic, and social crisis in the world, seems to refer to the end of the world as we know it, as “[t]he Anthropocene alters not only global environmental landscapes but also the social, political and economic contour of human life” (Simangan, 2020, p. 223).

Asserting simultaneously the greatness in power of the human, in its capability to impact the physical world at a scale rivaling geological forces, and the greatness in power of nature, acting with a level of complexity and through unforeseen feedbacks in a way that it can no longer be controlled by the human, and effectively becoming an agent amongst human affairs, the epoch is ultimately characterized by ambivalence (Lövebrand et al, 2009, p. 11). Fundamentally, then, the Anthropocene is understood to break down the Human/Nature dichotomy, one of the most constitutive dichotomies of modernity (Dalby, 2011), and, in a snowballing effect, disrupts and puts into question everything else. Bluntly, “the Anthropocene era indeed changes everything” (Rothe, Muller and Chandler, 2021, p. 1).

Further, besides being understood as all-encompassing change to modern thought and politics, the Anthropocene is said to be constituted by change: given the constant movement and reactions of the complex systems that are associated with the Earth in the definition of the Anthropocene as a geological epoch, “[u]nexpected change is intrinsic” (Pereira, 2021, p. 25) to this time, to this concept.

In their turn, these changes, besides being the end of the world as we know it, politically and intellectually, could also be the end of the world itself: “severe, unprecedented human-induced changes to the physical framework that regulates the stability and resilience of the Earth system are risking irreversible ecological damage and the safe environmental conditions upon which modern societies depend” (Pereira, 2021, p. 25). Human induced changes to the environment then ultimately lead to an unsafe state of the world, which will, paradoxically, affect human societies and lives – “In December 2020 the United Nations published its annual Human Development Report, declaring that international politics had

entered a new ‘age of humans’, the Anthropocene, an age ‘in which the dominant risk to our survival is ourselves’” (Rothe, Muller and Chandler, 2021, p. 1).

So, changes and endings, crisis and urgency, are the constant elements weaved throughout the story this dissertation tells.

Because of all of the changes brought about and resulting from the Anthropocene, current modern political organizations and intellectual pursuits seem to be unequipped to deal with the challenges of the epoch (Dalby, 2011). Especially the current organization of international politics, with its statist territoriality, “proves to be outdated and ineffective in addressing the challenges in the Anthropocene” (Simangan, 2020, p. 26) – the Anthropocene is understood as an age with surpasses all scales contained by current intellectual and political thought, a “planetary-wide crisis” that transcends statist ontologies and operates at “unprecedented spatial, temporal and even existential scales” (Hamilton, 2016, p. 5). With that, the epoch seems to be fundamentally disruptive to the discipline of International Relations (IR), questioning “the traditional modes of conceptualizing International Relations” (Rothe, Muller and Chandler, 2021, p. 6).

Thus, in a way, the Anthropocene is also about the end of IR. Current understandings within the discipline are said to have failed to properly grasp the complex challenges of this new epoch (Harrington, 2016) – the ontology, imaginaries and main concepts of the discipline seem to be too connected to modern forms of politics and tied to the modern international. The advent of this new epoch, one that changes the basic premises of international politics, is then understood to break down with the binary assumptions of the discipline of IR in a way that the production of the literature does not reflect the “planetary reality” of the new issues in world politics.

Simultaneously, International Relations is considered a particularly good discipline to embrace the Anthropocene, given its fundamental premise of dealing with crisis, especially existential crisis (Fishel et al, 2017); its preoccupation with survival on a global scale (Mitchell, 2017); its commitment to tragedy as a focal point of politics (Harrington, 2016), besides generally referring to global processes of politics. Hence, although there is a criticized slowness of IR to react to this new knowledge of planetary changes (Rothe, Muller and Chandler, 2021; Simangan, 2020; Mitchell, 2017; Fagan, 2017; Harrington, 2016), the discipline has

increasingly made use of the Anthropocene concept – from panels, to congress themes, to number of publications, it has steadily become a more prevalent theme and central concept to discussions of international, global, politics (Simangan, 2020). This movement is the main focus of analysis of this dissertation.

The concept has been appropriated into IR mainly from the discipline of Earth System Sciences (ESS) (Hamilton, 2016). Appropriation of the concept from the natural sciences to disciplines of social sciences is thought of as swift, considering the concept is declared as a ‘boundary object’, “enabling communication between scholars spanning different branches of the physical, life, social sciences, and humanities, as well as the arts and designing” (Brondizio et al, 2016, p. 321). In this sense, although spanning from the natural sciences, a particular characteristic of the Anthropocene from its origins is its interdisciplinarity, holism, and capacity to encompass a multitude of areas.

Thus, if “[t]he history of modern social and political thought can be partly written as a review of the way specific images, metaphors, and models from, say, physics or theories of biological evolution have guided analyses of social and political change” (Walker, 1987, p. 75), this dissertation looks deeper in the mobilization of this scientific concept within analysis from International Relations regarding possibilities of international politics.

In short, the objective of this dissertation is to analyze the appropriation of the Anthropocene by International Relations literature, particularly Critical IR, paying attention to the political implications of the concept.

To do so, the research chooses to tell a story about the origins of the concept, in a narrative connecting scientific authority, practices of world-making, and formulations about international politics:

The first chapter, then, is concerned with the origins of the Anthropocene within Earth System Sciences. The discussion is moved by the questions: where did the Anthropocene concept come from? And, in which power relations is it embedded in? To answer them, the chapter traces the timeline of the discipline of ESS, the birth of the concept and its original meanings and mobilizations. It proposes to think of this ‘discovery’ as one with implicit political rationalities – a particular spatio-temporality that is constructed and is tied to politics. Hence, instead of understanding the concept merely as a description of current physical processes of the Earth, it aims at understanding how science shapes Anthropocene’s thought and

political possibilities encompassed by this new reality. Here, the Foucauldian proposition of “problematizations” is introduced, and will carry out as the main form of analysis throughout the text. In short, the chapter serves to introduce the Anthropocene within the particular rationalities of Earth System Sciences and set up its association to scientific authority.

From there, the second chapter centers around the questions: how does science take part in practices of world-making? And, how is the scientific concept of the Anthropocene part of those practices? It develops, then, a discussion about cosmologies, particularly scientific cosmologies, and starts to delve on the cosmological elements present on the Anthropocene. To speak of the connection between scientific authority and practices of world-making, the dissertation explores particularly the Copernican Revolution and examines the role of scientific legitimation to cosmological assertions and, consequently, to political purposes, considering the affirmation that Earth System Sciences are akin to a “second Copernican Revolution” (Schellnhuber, 1999) or, alternatively, to a “counter-Copernican Revolution” (Latour, 2014). Therefore, the chapter establishes how scientific authority legitimates practices of world-making and introduces how this can shape international politics by going over the impacts of the Anthropocene in the formulation of international governance regimes and the political rationalities implicit in them.

Finally, the third chapter conducts an examination of the use of the concept by Critical International Relations, through close reading of central texts: the “Manifesto of Planet Politics” (Burke et al, 2016) and the “Non-Manifesto for the Capitalocene” (Chandler et al, 2017), which are understood as a fertile ground for examination, as they lay out the main contention to have with ‘traditional’ modern IR, and the general political and intellectual objectives of mobilizing the Anthropocene within International Relations; they also showcase the tensions and multiplicities within the field. As such, the questions moving this final chapter are: what is the complete baggage of the Anthropocene before even entering IR? How does the concept affect the discipline? And which politics does critical International Relations create with the Anthropocene?

So, the chapter starts by finishing up a discussion on the multiplicity of cosmological elements present in the Anthropocene and moves completely into discussions of the international politics that are made possible by the narratives of

the concept. It then presents an overview and examinations of the texts, focusing on the dynamic of problematization over the issues the Anthropocene brings to IR, and to current organizations of international politics. Ultimately, it argues that although the political and disciplinary project of the Anthropocene within International Relations is varied, it falls within the limits of the formulation of the Anthropocene problem, particularly restricted, then, by the sense of crisis constantly associated to the epoch.

Importantly, although this research delves constantly in the scientific definition of the term and cautiously recounts natural scientific discussions in an amateur way, the goal of the text is not to evaluate the scientific claims pertaining to the Anthropocene, climate change, and environmental issues. The dissertation is not a claim regarding the reality of climate change and other concerns, it is rather a discussion about the shifts in power relations connected to these new scientific discoveries. In other words, although the dissertation delves into ESS findings and the scientific assertions about the Anthropocene, it does not do it with the aim of qualifying the correctness of these claims, but merely in analyzing what it allows for in terms of power relations and politics.

This dissertation is, ultimately, a story about origins – the origins of ESS, which led to the origins of the Anthropocene; origins of certain formats of modern science, and origins of particular narratives about the world; and how these legacies influence the way the concept can be mobilized, how it carries these legacies even if implicitly, how they create legitimate narratives, that allow for a certain reality. Like any origin story, it involves claiming and enacting a certain kind of power and authority (Haraway, 1989) - it legitimizes a narrative, and this research pays close attention to legitimate narratives. I don't intend to affirm that this is the only story about the Anthropocene in Critical International Relations, I mainly hope that this origin story reveals something useful about the discipline, and about the current stories about the end of the world – an origin story as an alternative to the narratives about ends. Firstly formulated as a stratigraphical unit of time, the Anthropocene in itself is a concept very concerned with beginnings, making explicit that the definition of a specific starting date to the epoch will have severe ethico-political consequences (Tresch and Zalasiewicz, 2013; Lewis and Maslin, 2015). Although recently constantly mobilized through the prism of the end of the world, the Anthropocene is as much about endings as it is about beginnings.

2

Tales of scientific authority: Earth System Sciences and the Anthropocene

The Anthropocene is a concept closely tied to the relatively new discipline of Earth System Sciences (ESS), an origin that gives it some aspect of scientific authority when it expands beyond the confines of its birthplace, and also an origin that is constantly alluded to in developments of the concept in other areas. Because of this, here is the chosen beginning of this story about the Anthropocene.

Thus, the chapter will proceed as follows: firstly, a historical overview of Earth System Sciences will be conducted, understanding that the process of development of the discipline imbues it with values and philosophies, marks its goals and understanding of the world; then, the chapter will explore the concept of the Anthropocene as it was spawned from ESS and analyze it from the questioning of how does this understanding of an stratigraphical era frames problems and possible futures for a unified Humanity.

Finally, the chapter will end by proposing a reading of Earth System Sciences as “not simply a domain of science, but also a [particular] form of politics” (Heyman and Dalmedico, 2019, p. 1139). Considering then the Anthropocene as a “solution formulation” (Steffen et al, 2011b) by framing the problem in a particular way, the final section will connect this proposition to the Foucauldian understanding of “problematization” and propose a shift from treating the Anthropocene as a descriptive concept regarding the physical processes of the Earth, to a productive formulation tied to particular possible solutions in terms of international politics.

2.1.

History of Earth System Sciences and the science of the Earth system

2.1.1.

Leading up to ESS

Although Earth System Science is currently considered a holistic and integrated endeavor, both regarding its object of study – the entirety of the Earth system (ES) – and its academic organization, understood as an international, interdisciplinary, and integrated area of research – tracing the history of the discipline can be useful to point out contextual characteristics that arose in different moments of ESS and served to shape its values, objectives, epistemologies and

ontology: foundational characteristics that serve to form current ESS ambitions and approaches, even though the context and positioning of the discipline changed.

Early ESS stems from what is defined as “classical climatology” – created in the 19th century, and associated mostly with Alexander von Humboldt, this climatology was mostly a local and descriptive discipline, which aimed to collect and catalog short-term meteorological data from which to derive patterns in order to better manage local endeavors such as agriculture and forestry (Heymann and Dalmedico, 2019). While “classical climatology thrived in the age of imperialism, with its population growth, burgeoning colonial aspirations and new demands for climate knowledge” (Heymann and Dalmedico, 2019, p. 1140), it lost both significance and support after World War II: developments during this period and the early Cold War would introduce new technologies, tools, and resources into the scientific undertaking, making the politics of science of the time take a pragmatic turn, with “a focus on operative, predictive results and application” (Heymann and Dalmedico, 2019, p. 1141).

This increasingly strong relationship between the sciences and the military came with great authority and expectations from the latter. This is the context where modern meteorology thrived and later where Earth System Science would be founded. ESS, then, is particularly associated with the National Aeronautics and Space Administration (NASA) and the technological space race that would allow for the “systematic and global-scale collection of geophysical data” (Lövebrand et al, 2009, p. 9).

At the same time that during this period the hunt for empirical data regarding the Earth, particularly through the launch of satellites, was related to matters of national security, military surveillance and the space race, being considered a strategic imperative (Steffen et al, 2020; Lövebrand et al, 2009; Conway, 2016), the military patronage given to Earth sciences and the technological apparatus surrounding the Earth and collecting its data would feed into the research and promote knowledge building in other stances. Indeed, one important event of the period is the International Geophysical Year (IGY) of 1957-1958, a research campaign organized between sixty-seven countries, which would have a “lasting transformation in the practices used to understand how the world works” (Steffen et al, 2020, p. 57). In this sense, there can be seen a simultaneity between national

interests and international aspirations amongst scientists acquiring and interpreting knowledge about the Earth.

Ultimately, the IGY, along with the so called “Blue Marble” photo of the Earth taken by NASA in 1972, represent the process of making the Earth system thinkable (Stubblefield, 2018), that is, conceiving the Earth system as an analytical category part of a particular form of representation and knowing of a phenomenon (Lövebrand et al, 2009); thus, the Earth system is created as an object in this format by its very study.



Figure 1: “Blue Marble” photo taken in 1972: “The Apollo 17 crew [...] caught this breathtaking view of our home planet as they were travelling to the moon on Dec. 7, 1972.” (Source: NASA)

So, during this phase of the (pre-)history of ESS still not as a formal, specialized discipline, and the first steps on the formulation of the Earth as the Earth system, a few aspects can be noticed which will affect the research culture of ESS (Heymann and Dalmedico, 2019):

One important element during this stage of the Cold War politics of science and military funding is a sense of techno-optimism: NASA’s Cold War projects were considered a feat of engineering gigantism, with the development and funding of new technologies and increasingly complex technological apparatus to collect data from around the world (Conway, 2016). This organizational complexity,

regarded as a techno-spectacle, feats of technology made to impress, is one of the key aspects regarding what would be the most important program for ESS, “Mission to Planet Earth” (later re-named the “Earth Science Enterprise”) (Conway, 2016). This enmeshing of technology and science, described by the term techno-science highlighting “how implicated science is and was in particular moments in the history of technology” (Wark, 2015: ebook), is a core feature of ESS until today, with technologies permeating the construction of the world accessed by Earth System Science through data collection and interpretation and also constituting an important feature for the management of the future of planet Earth (Steffen et al, 2015).

Furthermore, the context of the Cold War was a moment which focused on environmental and complex system sciences (Steffen et al, 2020). The element of the system itself was important, being a part heavily featured in what was called the “Cold War rationality”, which “describes the deep belief pervading this era that all systems, natural and social, could be understood, modelled, and controlled, provided sufficient resources were made available” (Heymann and Dalmedico, 2019, p. 1141). Added to that, the notion of mastery was prominent the relationship between science and politics – given the “ontology of the enemy” (Heymann and Dalmedico, 2019) of the time, the antagonism of the United States (US) and the Union of Soviet Socialist Republics (USSR) as the “basic category of the understanding of reality” the physical and Earth sciences founded by the American military complex had a clear goal established: that scientific knowledge and investment on research was meant to guide political decisions (Heymann and Dalmedico, 2019). In this sense, then, science:

[A]cquired a central place in the heart of American society, guided by key concepts such as internationalization, colonization, extension of inhabited spaces such as the Arctic and Antarctica, conquest of space, and fully mastering the physical environment of the Earth (Heymann and Dalmedico, 2019, p. 1141).

Simultaneously, during the 60’s and 70’s there was an increasing movement of cultural awareness regarding environmental issues, both within the scientific community and outside it (Steffen et al, 2020). Specifically, these decades are

generally considered one of the possible starting points for modern environmentalism, associated to counter-cultural movements of the 1960s in the US and Western Europe (Death, 2014). At the time, environmental discussions centered around human disruption and waste, associated with the finitude of resources, as “[c]onservation of resources linked up with the pollution discussions in this discourse of environment which arrived on the political scene as a series of protest movements in developed countries in the late 1960s and 1970s” (Dalby, 2014, p. 40).

These decades were marked by the understanding that a responsibility of “care” for the planet was necessary, as the first ‘Earth Day’ was established in April of 1970, with great rallies being “regarded by many as the birth of the modern environmental movement” (Death, 2014, p. 63). Famously, these concerns with waste and finitude were strongly associated with reformulation of Malthusian worries during the span of the 70s, with environmental discourse focusing on the proposition of “environmental limits”, reaching their apex in the Limits to Growth report of the Club of Rome (Dalby, 2014; Death, 2014). Linking the finitude of resources to economic and social collapse, “[t]he arguments about the limits to growth in the 1970s suggested that the planet was running out of essential resources so development would have to come to a halt one way or another” (Dalby, 2014, p. 41). Discussions over the problematics over these ideas, with criticisms stating that this re-utilization of essentially Neo-Malthusian views would negate the quality of life of economic development to poorer countries – eventually, through this line of criticism, the formulation of “sustainable development” would become paramount in environmental discourse from the 1980s on (Dalby, 2014).

For now, what is important to note is the close connection between popularized images of the Earth and discourses constructed around the desired relationship to it – a sense of responsibility over the planet, visions of finitude and limits, a unifying global glaze associated with international environmental movements, etc.:

The view from space produced a sense of both the Earth’s singularity and its fragility (DeLoughrey 2014, 266). The ‘blue marble’ images thus strongly resonated with emerging public concern with global environmental problems and scenarios of environmental collapse as, for example, developed in the prominent Club of Rome report Limits to Growth in 1972

(Meadows 1972). Whereas environmental problems had previously been conceived in local terms—for example, as environmental pollution of rivers—cybernetic systems theory and the iconic images of the ‘blue marble’ fostered the idea of global environmental change (Rothe and Banner, 2021, p. 121).

Further, this awareness was in the midst of era of transformation and unrest, where the political engagement of applied science turned to a response to perceptions of conflict and crisis – consequently, researchers turned their interest to studies of chaos and disorder, particularly theories of complexity, wherein “a comprehensive, global approach in dealing with complex problems became important” (Heymann and Dalmedico, 2019, p. 1143). In this sense, scientific reasoning focused on nonlinear relationships of causes and effects, expecting and hoping to deal with catastrophic events that could arise from a misstep within a chaotic world.

So far, a few elements can be highlighted, pointing to their future importance throughout the argument constructed in the three chapters: firstly, *the association between science and politics in a direct relationship between the construction of knowledge to assist in the formulation of proper political action*; secondly, *the association of environmental problems to figures of conflict and crisis, ultimately tied to urgency to act correctly and responsibly*. Also, alluded in the mention over the “Blue Marble” photo of the Earth, which introduced a new metaphysical relationship to the planet (Hamilton, 2016), and in the early computer projections of environmental disruption put forth by the Limits to Growth report, is the foreshadowed importance of *representations of the world*, an aspect which will be shown to be related to practices of world-making and construction of purposes and politics.

For now, the consequences of chaos and complexity were threefold – firstly, a strong language of concern around the relationship of Man with Nature was established, with the latter being considered a passive victim, endangered by human activity; secondly, there was an appeal to be made for interdisciplinarity: in order to comprehend a complex world, research had to be comprehensive of multiple areas of knowledge; thirdly, climate science was increasingly politicized and understood as a tool: “the idea of impending risks about future changes of climate” introduced “the politicization of climate science with increasing demands to

investigate climate change and serve politics” (Heymann and Dalmedico, 2019, p. 1143). Alongside it, was a push for the understanding of environmental issues in a global level – both within academia, related to computerized projection and international academic cooperation, and within social movements, considered a “new and powerful international political force” (Dalby, 2014, p. 40) and the entrance of issues related to the environment in the agenda of more international organizations (Death, 2014).

As a result, this focus on the relationship and impact of humanity and the environment, plus the aspiration of more interdisciplinary movements, would be discussed in a series of workshops and conference reports all throughout the 1980’s and culminate in a desire for “a new science of the Earth” (Steffen et al, 2020, p. 50), which was connected with the political ambition to change the Human impact in the environment (Steffen et al, 2020).

In this context, NASA proposed a program to advance that: Global Habitability was announced in 1982 at the UNISPACE meeting, proposing to investigate “long-term physical, chemical, and biological trends and changes in the Earth’s environment” (Tilford and Page, 1984 *apud* Conway, 2016, p. 259), particularly the effect of human’s activities on the planet. However, the program received international condemnation:

NASA had not told its European allies of the initiative, and the reality that the polar platforms would be collecting high-resolution imagery of every nation in the world didn’t go over well either with the Warsaw Pact nations or with the non-aligned nations. Global Habitability, as a result, also didn’t go very far (Conway, 2016, p. 259).

This is a moment that showcases a pervasive tension between the national and the international and foreshadows an issue of political imaginaries pertaining to the question of what is international politics. On the one hand, in multiple occasions it can be seen a friction between national politics and international desires – highlighted by the Cold War context, the worry around frontiers and national interest clashes with mentioned intellectual, in the case of the IGY, for example, and social, in the case of international environmental movements, move and desire towards a form of global politics, transcending national boundaries. Added to

technology collecting data representing a holistic globe, but owned by a particular nation, this tension is strong.

However, another set of questions opens by looking into this dichotomy of national/international interests and politics refers to what is global politics? In the framing of environmental issues as transcending national borders, the problems until now discussed are then ‘moved upwards’ to international organizations (or potentially ‘moved horizontally’ to networks of international social movements). In this case, the international is not necessarily conceived from itself, but from a unification, adding up, of nations.

This particular comprehension of international politics, referred to the modern international, a “historically specific form of political space” (Ruggie, 1998, p. 172), is particularly prevalent in political propositions stemming from ESS (as will be seen in section 3.2.2). However, the transcendence of national politics by overcoming also the modern international appears as another variable in this tension – in this case, the goal is of achieving new forms of political imaginary, beyond the national/international dichotomy; a possibility which will be explored in Chapter 4, through the notion of planetary politics.

Now, further, the tension between national/international forms of politics also makes explicit the question of who speaks for, and governs, humanity as a whole? Within the discussion of ESS, the politicization of science, and guidance, the role of the scientific expert seems to take an important place in international forms of modern politics pertaining to international environmental issues.

Going back to Global Habitability, then, despite the tensions present once again, leading to interruptions in certain data collection, the idea of the project led to a change in the Space Act, making the Earth sciences more prominent at NASA, and, in that same year the agency created an “advisory panel of scientists [...] to formulate a discipline around the idea of studying the Earth as a dynamic system” (Conway, 2016, p. 259). Led by Francis Bretherton, this moment would mark the founding of Earth System Science (Steffen et al, 2020).

2.1.2.

The Bretherton Diagram and the Earth system: A new way of conceptualizing the planet

At its core, Earth System Science is a form of conceptualizing and studying the planet as a single organism: Earth seen as “a set of interacting processes operating

on a wide range of spatial and temporal scales, rather than as a collection of individual components” (NASA, 1986 *apud* Lenton, 2016: ebook). The Earth system, then, was initially understood as consisting of:

the land, oceans, atmosphere and poles. It includes the planet’s natural cycles—the carbon, water, nitrogen, phosphorus, sulphur and other cycles—and deep Earth processes. Life too is an integral part of the Earth system. Life affects the carbon, nitrogen, water, oxygen and many other cycles and processes. The Earth system now includes human society. (The International Geosphere-Biosphere Programme, 1987 *apud* Chakrabarty, 2019, p. 11)

Although ESS is considered the first instance of “contemporary systems thinking [being] applied to the Earth” (Steffen et al, 2020, p. 54), the idea of the Earth as a “complex of mutually dependent and interacting parts” (Rispoli, 2020, p. 4) was not completely new, even in the history of Western Modern Sciences. To cite a few examples, some with more direct influence on Earth System Scientists than others: in the 18th century, the father of geology, James Hutton, already described the solid Earth as “not just a machine but also an organized body as it has a regenerative power” (*apud* Lenton, 2016: ebook). In 1926, Vladimir Vernadsky’s “The Biosphere” argued that life itself should be understood as the most important geological force that shapes the Earth (Lenton, 2016). Later, in 1958, an oceanographer, Alfred Redfield, proposed a series of mechanisms for what he understood to be “the biological control of chemical factors in the environment” (Lenton, 2016: ebook). It can be seen, thus, how this view of the planet permeated different areas of study, justifying that ESS be an interdisciplinary research endeavor – to be studied in conjunction, the multiple parts of the Earth System had to be brought together by multiple specialists.

One of the most influential holistic views of the Earth that serves as a precursor of ESS in Western Modern Sciences is the Gaia hypothesis developed by James Lovelock, and further developed with the microbiologist Lynn Margulis, during the 1960s and 1970s. The hypothesis stated that “life and its non-living environment on Earth form a self-regulating system that maintains the Earth’s climate and the composition of the atmosphere in a habitable state” (Lenton, 2016: ebook). Its main

importance was that, firstly, it comprehended the planet as more than the sum of its parts and, secondly, it considered that life itself was a part of the maintenance of the non-living cycles, which would challenge “a purely geo-physical conception of the planet” and transform “our view of the environment and nature” (Steffen et al, 2020, p. 56)¹.

Thus, “both Gaia and Earth System Science were based in a systems engineering view of the world [...] a profession that specialized in (nonliving) feedback control systems” (Conway, 2016, p. 261). Earth System Science as a term and a discipline and a denomination of the new way to conceptualize the Earth would officially come to be in the panel of scientists employed by NASA, later renamed the Earth System Committee (Steffen et al, 2020), in a 1986 report detailing their findings about the functioning of the planet. The most lasting legacy of the report is the so-called “Bretherton Diagram” (after the chair of the committee, Francis Bretherton) - the diagram proposes a new visual representation of the Earth, effectively representing the Earth System (Fig. 2).

¹ The Gaia hypothesis was impactful as a possible new comprehending of the world, pushing new research and consideration over different ontologies conceptualizing Man and Nature, particularly within the social sciences, having influenced thinkers such as Bruno Latour (see: Facing Gaia: Eight Lectures on the New Climatic Regime), where the poetical and political nature of naming “Gaia” served a philosophical and ethical purpose within the research (Chakrabarty, 2019). Within the biological sciences, however, the hypothesis was challenged and is still today debated over a teleological assumption that the regulation of the atmosphere was “by and for” the biota, implying purposefulness in the equilibrium of the environment (Lenton, 2016). Thus, although ESS does directly stem from contact with the research that developed the Gaia hypothesis, it is framed, even in its naming, as a less personified, and thus more “business as usual positive science”: “‘Gaia’ and the ‘Earth system’ are for us, close to being synonymous... [But] the ‘Earth system’... is... less personalized and polarized” (Lenton and Andrew Watson, 2011, p. vii-viii, *apud* Chakrabarty, 2019, p. 16). Still, the Gaia hypothesis and its impacts in the politics of the Anthropocene is further discussed along the dissertation, particularly in the section 4.1.

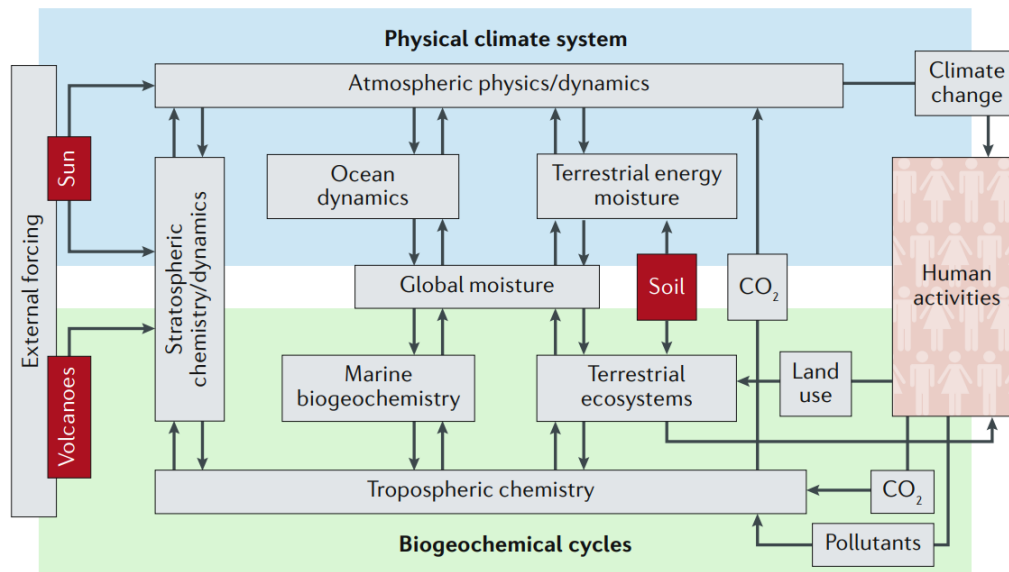


Figure 2: The NASA Bretherton diagram of the Earth System: “The classical, simplified depiction of the Earth System and its interactions. The focus is on the interactions between the geosphere and the biosphere, with human forcings represented as an outside force affecting the geosphere-biosphere system.” (Source: Steffen et al, 2020, p. 56).

The Bretherton Diagram did two important things for Earth System Sciences: it mapped and represented the Earth system, effectively constructing it as an object of study, and it also connected a range of already existing scientific subjects and communities (Steffen et al, 2020), reasoning for the interdisciplinarity “under the integrative banner of ‘Earth system science’” (Lenton, 2016: ebook).

In short, then, ESS affirms the Earth is a complex system that is capable of self-regulating automatically (Lenton, 2016). This is done through feedback loops: “Feedback refers to a chain of cause-and-effect that forms a closed loop. This means that information about the past or present state of part of a system can influence its present or future state” (Lenton, 2016: ebook). Feedback is an important part of systems theory and regulatory systems and can be either positive (which is an amplifying loop: any initial perturbation to the loop will be increased) or negative (which is, in contrast, a damping loop: the perturbation will trigger a response that halts it) – in this sense, following the properties of self-regulation, negative feedback loops are considered to be more common; however, self-regulation is not immutable, meaning that “if something hits the system too hard it may get propelled into an alternative state, by positive feedback” (Lenton, 2016: ebook). This kind of change involves “tipping points”, “where a small perturbation triggers a large response from a part of the Earth system, leading to abrupt and often irreversible changes” (Lenton, 2016: ebook).

Therefore, ESS works to identify the different feedback loops that regulate the Earth system and encompass different parts of the system. An important part of any systems thinking is establishing its boundaries, defining what is within the system and what is outside of it – in the case of the Earth system, defining it depends on what time-scale is being considered: a shorter time span, concerned with human impact on the environment over a few hundred years will exclude cycles that take place during millennia, such as tectonic cycling, weathering of the continents and the deposition of sediments in the oceans; on the other hand, if a longer timescale is considered, more is added into the system, going deeper into the Earth's crust and considering its relation with the mantle (Lenton, 2016). However, “all this leads to a rather fuzzy lower boundary to the Earth system” (Lenton, 2016: ebook), and thus for many in ESS the Earth is actually divided between two systems, the surface, which supports life, and inner Earth (Lenton, 2016).

To sum up the Earth system, it:

refers to the suite of interacting physical, chemical and biological global-scale cycles and energy fluxes that provide the life-support system for life at the surface of the planet. This [...] goes well beyond the notion that the geophysical processes encompassing the Earth's two great fluids—the ocean and the atmosphere—generate the planetary life-support system on their own. In our definition biological/ecological processes are an integral part of the functioning of the Earth System and not merely the recipient of changes in the coupled ocean-atmosphere part of the system. A second critical feature is that forcings and feedbacks within the Earth System are as important as external drivers of change, such as the flux of energy from the sun. Finally, the Earth System includes humans, our societies, and our activities; thus, humans are not an outside force perturbing an otherwise natural system but rather an integral and interacting part of the Earth System itself (Steffen et al, 2007, p. 615).

The Earth system and the Bretherton Diagram that illustrate it are essential elements regarding the importance of representation within the argument conducted throughout the dissertation. As was mentioned, it is only by making a realm thinkable that it is possible to render it governable and here imagetic representation

plays a crucial role in the formulation of what will further be specified as “the planetary”. From the first “Blue Marble” photograph taken from outer space, to the original (and then revised) forms of the Bretherton Diagram, to the development of virtual modelling of the Earth that will come up in further sections, there are many forms of visual world-making involved in the development of this political realm. This connection of visual representation to world-making will be further discussed in the next chapter, connected to a different scientific historical context, the Copernican Revolution. Now, it is important to note the prevalence of images that form imaginaries.

2.1.3.

The socio-political integration of ESS

With this mix of scientific and public excitement surrounding Earth Systems Science – a new interdisciplinary, complexity science that aspired to be comprehensive and holistic in its object of study, and also provide sensible and reliable information to policy debates regarding man-made change in the environment, ESS emerged with promise (Steffen et al, 2020). However, despite this first moment of creation and growth of Earth System Science within the NASA umbrella, the end of the Cold War disrupted the American regime of public funding of the big sciences (Conway, 2016). Most of the programs dealt with massive budget cuts and down scalation, including ESS endeavors. The big sciences, it seemed, were “irreversibly incorporated into the conventional political process, making it a creature of political democracy, its fortunes, like those of other interest groups, contingent on the outcome of the fray” (Kevles, 1995 *apud* Conway, 2016, p. 263) – thus, the budget to Mission to Planet Earth, the biggest program of exploring the Earth, and compiling ESS’s data at the time, was greatly downscaled from 1990 to 1995.

Still, this time sees changes in the global environment that bring about a different relevance to Earth exploration: “a shift towards a new ‘sovereignty bargain’ whereby states sacrifice some degree of autonomy and control for the benefit of space collaboration” (Lövebrand et al, 2009, p. 10). Accordingly, the importance of Earth System Sciences switches from a militarized world order to a global concern over the environment, connected to the end of the Cold War (Conway, 2016), multilateralism, and the push for more agendas relating to the environment in international forums and organizations (Death, 2014) – mostly, the

discussion in high rank spaces centers around the relationship between care for the planet and economic growth, within the context of sustainable development, “[d]esigned to promote economic activity that would not deny future generations the necessities for their livelihood” (Dalby, 2014, p. 41). In this context, ESS’s program acquires a newfound relevance within NASA’s organization, and expands into a global program, with greater foreign policy participation (Conway, 2016).

In this development of contemporary Earth System Science, its relevance becomes attached to global issues of man-made climate change and other changes to the environment – the focus on the Earth as an object and the consequences of environmental destruction being felt all around the globe, there is a push for “major institutional restructure built on a higher level of integration” (Steffen et al, 2020, p. 57). This means relying more on, and creating new, global intergovernmental organizations to build global observation systems (Edwards, 2010)².

This integration is epitomized in the launch of the Earth System Partnership (Lövebrand et al, 2009), affirmed in the Amsterdam Declaration in 2001 – the declaration, by voicing concern of the human effects in the environment, of the global change caused by humans, legitimizes the next step in integration of, firstly, Humanity and Nature, by affirming the humans as part of the environment, and capable of changing it on a global level; secondly, of the natural and social sciences: if Humans have a considerable impact on global change, and our social and economic organizations are a part of the Earth system, then the social sciences must be a part of the study of global change, leading to a “goal-oriented multi-disciplinarity” or “problem oriented interdisciplinarity” (Ehlers and Krafft, 2006); in its turn, this starting point of ‘goals’ leads to “an ethos of serving society with knowledge about climate change” (Heymann and Dalmedico, 2019, p. 1140), which justifies, thirdly, the integration of science and politics, understood as international policy proposals: the main goal of Earth System Science becomes “exploring policy options for tackling climate change” (Lenton, 2016: ebook), particularly in the use of models to project possible futures and outcomes regarding human actions; finally, all of these moves towards integration happen in an context of a push for global unification – by framing the climate problem as traversing borders and

² The details of the consequences related to the figure of the “globe” in terms of international politics centered around intergovernmental organizations is further discussed in section 3.3.2.

affecting the entirety of the Earth system, its study and solutions have to also transcend national divisions.

So, fittingly, the Amsterdam Declaration states that “The Earth System behaves as a single, self-regulating system comprised of physical, chemical, biological and human components, with complex interactions and feedbacks between the component parts” (Steffen et al, 2020, p. 57) and concludes:

A new system of global environmental science is required. This is beginning to evolve from complementary approaches of the international global change research programmes and needs strengthening and further development. It will draw strongly on the existing and expanding disciplinary base of global change science; integrate across disciplines, environment and development issues and the natural and social sciences; collaborate across national boundaries on the basis of shared and secure infrastructure; intensify efforts to enable the full involvement of developing country scientists; and employ the complementary strengths of nations and regions to build an efficient international system of global environmental science (Steffen et al, 2002 *apud* Ehlers and Krafft, 2006, p. 8).

Finally, one key element that gains even more prominence in the contemporary stage in the ‘science of integration’ (Lövebrand et al, 2009) that is Earth System Science is that of modelling:

An Earth system model is a representation of the surface Earth system in a computer program. Like all systems, the model’s boundaries have to be carefully defined. [...] Each time a component is added, a new set of feedbacks is introduced [...] What currently marks out an ‘Earth system’ model is the ability to translate human activities, such as the emissions of greenhouse gases and aerosols, into their climatic effects (Lenton, 2016: ebook).

Modelling, then, is a practice well-established in the Earth System Science community (Heymann and Dalmedico, 2019) and it is essentially a virtual representation constructed from mathematical models that expand from physical

data collected from around the world and from low-orbit satellites. Today, considering the expanse of technical instruments scattered around and above the Earth, the quantity of data acquired is enormous, and models have become standard as the “principal means of data collection, prediction, and decision making” (Edwards, 2010, p. xix) considering the inability to manually interpret every piece of data available. In this sense, models are understood to be the key element in transforming data into knowledge (Edwards, 2010):

in the arena of global change science, where wholly empirical methods are infeasible, computer modeling has become the central practice for evaluating truth claims; [they] are a key medium for translation and migration of data, methods, and guiding principles (Edwards, 1996, p. 4-5).

Therefore, all models are “a simulation type of representational technology” (Srnicek, 2013, p. 112) which arose with the technological development from World War II and slowly evolved and became more intricate, so that today there are multiple degrees of modelling, from simple, to intermediate complexity, to sophisticated, in a way that each type is able to compute and take into considerations more variables and scenarios (Lenton, 2016).

In general, there are two types of models: Earth System Models (ESM) and Integrated Assessment Models (IAM) (Edwards, 1996) – the first is a compilation of natural science efforts in adding oceanic and atmospheric general circulation models (OAGCMs) and result in climate simulation containing the natural world and assessing feedbacks between distinct physical elements. IAM’s, on the other hand, were originally conceived to input human action in the model from the start (instead of adding it as a last chain of feedbacks in ESM’s). In this sense, the main goal of Integrated Assessment Models is being able to visually see and further understand human impacts on the environment, and, even more, simulate costs and benefits of possible policy mitigations. Thus, IAM’s are “inherently policy-oriented” (Edwards, 1996, p. 3):

IAMs have a number of uses, for example, simulating costs of specific climate-stabilization policies, exploring climate risks and uncertainties based on a range of potential policies, identifying optimal policies for a specific climate target and

providing more general insights into feedbacks within the coupled system (Steffan et al, 2020, p. 59).

Models, then, can be seen to represent the multiple integrations highlighted and praised in the organization of Earth System Science: firstly, they both bring together scientists from multiple parts of the world and different institutions under the same work, and also construct digitally a unified globe; secondly, particularly IAM's attempt to unite the work of social and natural sciences and bridge Humanity and Nature as parts of the Earth system; lastly, the incorporation of models as tools for policymaking, best practices of international government, marks also an integration between politics and science (Srnicek, 2013).

In sum, Earth System Science is a discipline originated in the endeavors of classical climatology, but progressively formed as a distinct undertaking, shaped by historical and political moments, which added and shifted goals and characteristics, arriving at the core of the discipline today: *a holistic science of integration, understood as a tool to produce scientific knowledge to guide political decisions in regards to the relationship between Humanity and the planet, particularly to overcome and manage the climate crisis brought by anthropogenic changes to the environment*. In this context, one of the most important and impactful concepts to come out of ESS' research, which greatly influenced researches and politics beyond the discipline, is that of the Anthropocene.

2.2.

Marking the Start of the Anthropocene

2.2.1.

Tracing the Anthropocene Timeline

In general terms, the concept of Global Change relates to “the growing interference of human beings with the Earth's metabolism and its relation to the natural variability of the Earth System” (Mausser, 2006, p. 3) – it regards humanity's impact on the environment, in a way that changes the natural functioning of the planet. The term “global change” has been used in the sciences and public discourse since the 80's, calling attention to the manmade effects and changes in the environment on a very short timescale, which are not consistent with the natural cycles of the Earth system (Lenton, 2016). Above all, the term has mainly been articulated to propose a political stance of worry and call attention to the potential

impact of the ‘Human enterprise’ (Steffen et al, 2009) on the planet – a view which will be expanded and condensed in the concept of the Anthropocene.

Of course, thoughts about humanity’s impact on the planet in general were not new: already in 1864, G.P. Marsh, considered the first American environmentalist, published a comprehensive analysis of the changes in the earth surface caused by human action – “Man and Nature; Or, The Earth as modified by Human Action” “is an almost visionary anticipation of the late 20th century research agenda” (Ehlers and Krafft, 2006, p. 6). Even more, some discussions are said to directly influence the conception of the Anthropocene as an era, such as the Italian geologist Antonio Stoppani, who, in 1873, described the “Anthropozoic era” (Steffen et al, 2011a), an age where humanity’s actions are a “new telluric force which in power and universality may be compared to the greater forces of earth” (Crutzen, 2006, p. 13), or the idea of the “noosphere”, coined in 1924 and referring to the brainpower of Man, who founds the “world of thought” (Crutzen, 2006) by having the capacity to impact the Earth with its technosphere and industrial metabolism (Rispoli, 2020).

Truly, in some way or another, the call of attention for the potential impact of the human action has been present arguably since antiquity (Ehlers and Krafft, 2006). Still, this iteration, *the Anthropocene as a geological time unit*, is connected particularly with the figure of the Earth system and was born in a conference of Earth system scientists in Mexico “where the renowned chemist Paul Crutzen is said to have angrily remarked, ‘Stop using the word Holocene. We’re not in the Holocene any more. We are in the . . . the . . . the . . . the Anthropocene!’” (Steffen, 2013 *apud* Chakrabarty, 2018, p. 7). Later, in 2000, the term would be officialized by Crutzen and the biologist Eugene F. Stoermer – they state that elements such as the expansion of human and cattle population, urbanization, the use of land surface and more than half of all accessible fresh water, the exhausting of fossil fuels, species extinction, emission of greenhouse gases, loss of mangroves and sea warming, marks Humanity as a force of change on the earth and the atmosphere at a global scale, and so they attest that “it seems to us more than appropriate to emphasize the central role of mankind in geology and ecology by proposing to use the term ‘anthropocene’ for the current geological epoch” (Crutzen and Stoermer, 2000, p. 18).

The authors put the start of the Anthropocene in the latter part of the eighteenth century, marked by the analysis made of air trapped in polar ice, which attested the

growing global concentrations of greenhouse gases (Crutzen, 2002), and connected it to the invention of the steam engine, which would propel the Industrial Revolution³ (Crutzen and Stoermer, 2000).

In short, a few critical questions guide an analysis of the Anthropocene:

Is the imprint of human activity on the environment discernible at the global scale? How has this imprint evolved through time? – How does the magnitude and rate of human impact compare with the natural variability of the Earth’s environment? Are human effects similar to or greater than the great forces of nature in terms of their influence on Earth System functioning? – What are the socioeconomic, cultural, political, and technological developments that change the relationship between human societies and the rest of nature and lead to accelerating impacts on the Earth System? (Steffen et al, 2007, p. 614).

The analysis has to comprehend human impact in three axis: (1) scale – acknowledging the global scale of environmental degradation and the organizational hardships of dealing in such enormous terms; (2) speed – paying attention to how fast humanity is changing the natural world, especially considering the slowness of the natural cycles of change of the Earth system, which can last for millennia; (3) complexity – by seeing the Earth as one system, of which humanity is a part of, it becomes obsolete to think in terms of linear causes and effects in a way that instead of analyzing variables individually, one must study through intertwining elements (Steffen et al, 2011b).

³ The start of the Anthropocene is a constant debate within the scientific community: to accurately delimit the stratigraphical marker that measures humanity’s geological impact means defining what should be measured, what should be understood as impactful enough. For instance, there are many “early Anthropocene hypothesis” which defend that the beginning of the era should be put before the Industrial Revolution, marked by events such as the Neolithic revolution (Lenton, 2016) or the first use of fossil fuels in the Song dynasty (960-1279) in China (Steffen et al, 2011a), among others, which are mostly dismissed considering their limited energy supply with which to change the environment in a bigger scale (Lenton, 2016). Still, the different proposals all come with multiple political implications – pointing out a beginning means defining a cause, and, sometimes, a culprit in a way that “the formal definition of the Anthropocene makes scientists arbiters, to an extent, of the human-environment relationship, itself an act with consequences beyond geology” (Lewis and Maslin, 2015, p. 171). All of this to say that although the marker of the Industrial Revolution itself as the beginning of the Anthropocene is put into question for not being derived from a globally synchronous marker (Lewis and Maslin, 2015), the dissertation chooses to work within Stoermer and Crutzen’s timeline because it was the most successful in entering political discourse, influencing policy proposals until today.

The Anthropocene, then, is understood to come as a break from the Holocene – the “Recent Whole”, the post-glacial geological era, a stable epoch in the history of the Earth system (Crutzen, 2006). This stability is considered to be the key for the development of humanity (Steffen et al, 2011b). In this sense, it was the favorable environment of the Holocene which permitted the growth of human capabilities that would eventually lead to the Anthropocene.

So, the first stage of the era, as defined by researchers, is comprised of the Industrial Era (ca. 1800-1945) (Steffen et al, 2007) – although pre-industrial societies did modify the local environment, it isn’t until the Industrial Revolution that the ‘Human enterprise’ (Steffen et al, 2011a) has the ability to “equal or dominate the great forces of Nature in magnitude or rate” (Steffen et al, 2007, p. 615).

The importance of the first stage lies in the Enlightenment and the exploration and use of fossil fuel energy (Steffen et al, 2007): “the exploitation of concentrated fossil fuel energy triggered a massive expansion of population, material consumption, and associate waste products” (Lenton, 2016: ebook). Thus, the access and exploitation of fossil fuels resulted in “high energy societies”, stemming from England, but which slowly became commonplace around the globe (Steffen et al, 2007). The resulting accumulation of CO₂ in the Earth’s atmosphere, deriving from the consumption of fossil fuels, then, is understood as one of the first impacts on a global scale to the whole of the Earth system (Steffen et al, 2007).

However, “this first stage of the Anthropocene ended abruptly around 1945, when the most rapid and pervasive shift in the human-environment relationship began” (Steffen et al, 2007, p. 616-617), which would lead eventually to the second stage of the Anthropocene, called the Great Acceleration (ca. 1945-2015). Although the development of the ‘Human enterprise’ was growing steadily from the beginning of the first stage, it stalled from 1914 to 1945 due to conflicts in world politics and economic international flows, namely, World War I, the Great Depression, and World War II: “taken together they slowed population growth, checked—indeed temporarily reversed—the integration and growth of the world economy. They also briefly checked urbanization, as city populations led the way in reducing their birth rates” (Steffen et al, 2007, p. 618).

Still, the international institutions and technological development acquired after the end of the conflicts eventually firmly set growth as an important social value in post-War society:

New international institutions—the so-called Bretton Woods institutions—were formed to aid economic recovery and fuel renewed economic growth. Led by the USA, the world moved towards a system built around neo-liberal economic principles, characterized by more open trade and capital flows. The post-World War II economy integrated rapidly, with growth rates reaching their highest values ever in the 1950–1973 period. [Also] The war produced a cadre of scientists and technologists, as well as a spectrum of new technologies (most of which depended on the cheap energy provided by fossil fuels), that could then be turned towards the civil economy. Partnerships among government, industry and academia became common, further driving innovation and growth. More and more public goods were converted into commodities and placed into the market economy, and the growth imperative rapidly became a core societal value that drove both the socio-economic and the political spheres (Steffen et al, 2011a, p. 849).

Ultimately, this commitment to growth would greatly multiply the impact of humans to the Earth system, pushing Holocene equilibrium further and further away (Bai et al, 2016). There is a tension, however, regarding the general way that economic growth is referred to in the worsening of the climate crisis: on the one hand, the generalized understanding that human action and economic development is culpable of environmental troubles leaves aside the fact that it is practices of consumption in developed countries that “[have] been the more important driver of change” (Steffen et al, 2011b, p. 746) – in other words, although responsibility is universalized, developed countries generally appear as causing more impact to the equilibrium of the Earth. In this sense, “the Anthropocene concept has been criticized for being a predominantly ‘Northern’ frame that overlooks global inequalities and historical disparities, social and cultural differences and perspectives” (Brondizio et al, 2016, p. 332), particularly when the Anthropocene

narrative is framed around fossil fuel use and technological advancements (Brondizio et al, 2016).⁴

On the other hand, twenty-first century growth seems to have “become much more democratic” (Steffen et al, 2011a, p. 853), in the sense that developing nations have followed in trends of growth established, albeit maybe in a non-comparable way to developed countries. As mentioned, with the frame of sustainable development being one of the major prisms with which to conciliate economic growth to environmental responsibility (Dalby, 2014), and so the ‘growth imperative’ discussed in the quotation does play a part in a lot of definitions of economic plans.

In any case, a universalization of responsibility is shown to be present in the main narratives regarding the Anthropocene, something that will come up throughout the dissertation, and it is through disruptions from the figure of Humanity that the Earth system ultimately tips from the stability of the Holocene to the complexity of the Anthropocene.

2.2.2. The Age of Man

The Anthropocene as a stratigraphical unit, then, marks a new era in the Earth system: the age where man, as a single Humanity, causes fundamental changes on the functioning of the planet, at the scale and with the strength of natural geological forces. So, while the original Bretherton diagram acknowledged humans as a part of the ES, we were depicted as marginal features – therefore, the Anthropocene demands a change in the visualization of the ES, with humans as an integral part of it (Fig. 3), considering that “a human-inclusive Earth System implies that globalscale social and economic processes are now becoming significant features in the functioning of the System” (Steffen et al, 2011b, p.740):

⁴ For Global South readings of the Anthropocene see: Simangan (2020), Hazlett et al (2020), Marquardt (2018).

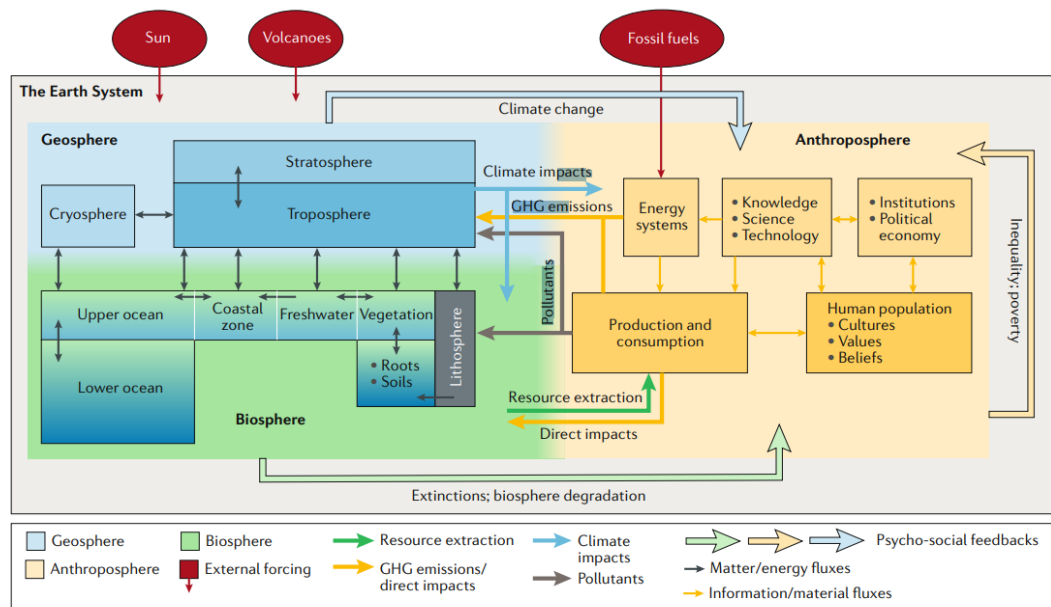


Figure 3: An updated conceptual representation of the Earth system: “A detailed systems diagram of the Earth System, inspired by the original Bretherton diagram, but with humans (the anthroposphere) as a fully integrative, interacting sphere. The internal dynamics of the anthroposphere are depicted as a production/consumption core driven by energy systems and modulated by human societies, as influenced by their cultures, values, institutions and knowledge. Interactions between the Anthropocene and the rest of the Earth System are two way” (Source: Steffen et al, 2020, p. 61)

Together, then, the Earth system and the Anthropocene emerge as a strong, universalizing, *spatio-temporality*: while the Earth system renders the entirety of the planet cognitively knowable (Srnicek, 2013) by scattering technology and acquiring data and resulting in the ES as the space where human action takes place, the Anthropocene is originally used as a unit of time⁵ that puts human action in focus, while also serving as bridging concept between the natural and social sciences (Brondizio et al, 2016). With that, both elements present as a scientifically grounded and universal spatio-temporality that opens a specific political sphere as thinkable, and thus, governable (Lövebrand et al, 2009). In this sense, the strength of both concepts lies in “how [they] can be used to guide attitudes, choices, policies, and actions that influence the future” (Bai et al, 2016, p. 351):

⁵ The Anthropocene as a stratigraphical unit of time is full of scientific contradictions and disputes and is not, as of the writing of this dissertation, a formally defined geological unit accepted by the International Commission on Stratigraphy (ICS), although a Working Group within the Commission is making a case for its acceptance within the Geological Time Scale. However, even being stratigraphically incoherent, the Anthropocene as a unit of time has been useful as a social focal point to direct actions regarding the anthropogenic impact on the planet (Autin and Holbrook, 2012) – thus the range of meanings surrounding the Anthropocene is vast (Bai et al, 2016; Brondizio et al, 2016) but are all somewhat anchored in the relationship between Human/Nature centered around time brought forth by Stoermer and Crutzen.

the Anthropocene does far more than label an epoch within an isolated field of study but promulgates modes of thought, engendering ways of seeing and engaging the world. And, even more disconcerting, the Anthropocene makes the Humanity and nature it imagines both knowable and thus governable in new ways (Stubblefield, 2018, p. 5).

In its formulation as the Age of Man, the role that humanity takes in this political sphere is one of guidance, as we enter what is understood as the stage three of the Anthropocene: “Stewards of the Earth System?” (ca. 2015-?) (Steffen et al, 2007). Now that Humanity is capable of conceptualizing its own participation in Earth’s changes, the species is understood to have an obligation and responsibility to take on the challenge of managing its relationship with the Earth system, along with managing the System itself (Steffen et al, 2011a; Steffen et al, 2011b; Crutzen, 2002). This recognition requires actions global in scale in a way that knowledge over humanity’s impact in the Earth system in the Anthropocene is now “filtering through to decision-making at many levels” (Steffen et al, 2007, p. 617-618).

Navigating the ‘Human enterprise’ in this spatio-temporality is based on Humanity’s “mental capabilities” (Steffen et al, 2011a) and ability to “produce and use the knowledge needed to define and influence trajectories of planetary development” (Bai et al, 2016: 352). In other words, *Earth System Science creates both the Earth system as an object of study and spatial unit, and the Anthropocene as a marker of anthropogenic changes and a temporal unit – together, this spatio-temporality delimits the possibilities of political action and ascribes the role of agent to Humanity, guided by the knowledge provided in Earth System Science research*. Here, this delimitation of space and time effectively holds humanity as a whole accountable for destabilizing the Earth system and responsible by affirming it as the steward of the human enterprise and the Earth system.

A few elements can be highlighted, then, considering their general importance within the discussion. One thing to keep attention to, is how a visual representation is once again at place in the formulation of this spatio-temporality – the revision of the Bretherton diagram brings a lot more focus on the role of Humanity. Contrasted to the original diagram, where the human was contained to a single variable, now a whole Anthroposphere opens up, making up half of the image, comparable to the Geosphere and the Biosphere. From the naming of the human realm, this new

diagram serves to compose what ended up being the main focus of the Anthropocene concept: the breakdown between divisions of Human and Nature.

In this formulation of the world, Humanity is formed as a universal category capable of mostly comprehending the world and mentally capable of being responsible for it. This visual form of world-making is then holistic and serves to form a spatio-temporality.

Together, the Earth system as a category of space and the Anthropocene as a unit of time seem to result in a re-formulation of the Anthropocene concept as a spatio-temporality, attached to forms of politics. Here, there can already be noticed a multiplicity in meanings connected to the Anthropocene, a concept attached to many areas and used in many ways. In any case, this specific formulation of the Anthropocene, tracing back to ESS and the conceptualization of the Earth system and to ESS and stratigraphy and ponderings of world history, is particularly important within the narrative being developed.

2.3.

Earth System Sciences: The Anthropocene as a diagnosis

2.3.1.

The Anthropocene as a solution formulation

To shortly recap, then, before finishing the chapter: Earth System Sciences is a discipline that proposed to study and envision the world through a holistic and unitary view, thus locating the space of the Earth system, in which multiple variables interact through feedbacks. The system originally includes humans as marginal actors that are capable of affecting it. However, when taking a closer look at the history and natural cycles of the Earth system, Humanity gains prominence as a major geological force, enacting global change and disrupting the functioning of the Earth system. *Together, the Earth system as an understanding of space and the Anthropocene as a stratigraphical unit pertaining to time effectively found the Anthropocene as a spatio-temporality connected to a political realm – a particular form of world-making.* In its endeavor, then, ESS effectively constructs the boundaries of political action by affirming the Anthropocene as a solution formulation: “as these twenty-first century problems become better understood, the focus turns toward finding solutions. One of the key developments in moving from problem definition to solution formulation is the concept of the Anthropocene.” (Steffen et al, 2011b, p. 741).

So, with the use of modelling to inform possible futures from different approaches and proposals and thus provide support through knowledge (Lövebrand et al, 2009), three different general proposals are usually listed within the discussion on managing the Anthropocene (Steffen et al, 2007): firstly, the business-as-usual, where humanity maintains the course of action that led to the unbalances in the Earth system in the first place; secondly, geoengineering, proposals of techno-fixes for the Earth system, that would, with the development and use of technology, return to a balanced state; thirdly, mitigation, which would involve the management of human's relationship with nature by establishing planetary boundaries that cannot be crossed. These last two options are usually understood to be in opposite ends of a spectrum, considering that while geoengineering assumes the expansion of human's interference in the ES, the limits put by planetary boundaries would mean the restraint of humanity's activities.

In short, geoengineering are technology-based projects to be deployed and installed in specific areas, to deal with specific imbalances within the Earth system, and thus manipulate the ES back to equilibrium (Stubblefield, 2018). The particular objectives, technologies and goals range depending on which particular ecological problem is being addressed, but generally are understood as a technical and scientific endeavor that reflect mastery over nature (Crist, 2007) and represent the greatness of science and human capabilities (Crutzen, 2002).

The projects are somewhat able to be broken down between (1) sequestering of carbon dioxide from the atmosphere, which will either be stored in some way or used as an energy source, and (2) technologies which aim to change the radiation balance on the planet by modifying the quantity of radiation absorbed by the Earth (Stubblefield, 2018). Some examples of geoengineering projects are: the purposeful spread of sulfur aerosols on the atmosphere, which would reflect incoming light and reduce the overall temperature of the planet (Stubblefield, 2018; Crist, 2007) or the sequestration of the carbon dioxide and its storage in underground reservoirs, so that it can potentially be released into the atmosphere again, in case temperatures drop too much (Steffen, 2007).

The downsides of geoengineering are framed in terms of governance and state sovereignty: being large scale projects with effects that would not be bounded to any national territory, especially the more popular projects regarding the dispersions of aerosols in the atmosphere, the problem with geoengineering

becomes “not how to get countries to do it, (but) the fundamental question of who should decide whether and how geo-engineering should be attempted – a problem of governance” (Steffen et al, 2011b, p. 752). In this sense, to work out the applicability of these projects does not necessarily involve pondering over their impact, but rather it is to find out a way of conciliating different cultures and ethics pertaining to different nationalities and build trust in international political regimes that would, ultimately, represent global interests to manage the Earth system through a scientifically advantageous geoengineering project (Steffen et al, 2011a).

In its turn, planetary boundaries are nine scientific quantified natural boundaries (climate change, biosphere integrity, land-system change, freshwater use, biochemical flows, ocean acidification, atmospheric aerosol loading, stratospheric ozone depletion, and novel entities) that are stated to cannot be crossed in order to maintain the stability of the Earth system; thus, they are used as a guide to govern and manage the relationship of human societies with the environment so that the system is regulated and maintained in a state of equilibrium:

Together, the set of boundaries represents the dynamic biophysical “space” of the Earth System within which humanity has evolved and thrived. The boundaries respect Earth’s “rules of the game” or, as it were, define the “planetary playing field” for the human enterprise. The thresholds in key Earth System processes exist irrespective of peoples’ preferences, values, or compromises based on political and socioeconomic feasibility (Röckstrom et al, 2009: np).

In order to thrive in the Earth system, then, projects based on the planetary boundaries philosophy propose precise calculations to measure the human-nature relation both globally and locally (Stubblefield, 2018) in order to develop strategies and meticulous guidelines. The extensive scientific research to adequately quantify and understand the nine boundaries and the relations between them are what is needed for Humanity to become “an active steward” (Röckstrom et al, 2009) and avoid social and environmental disruption to the development of human societies.

The issue with the planetary boundaries approach is also framed in terms of difficulties in appropriate international governance regimes (Röckstrom et al, 2009; Steffen et al, 2011b) – the problem is not necessarily the quantification and

delimitation of the boundaries, but rather the hardship in enforcing the administrative programs that would manage the impact on the planet, given the nature of informal compliance in international governance.

So, even though within this Anthropocene discourse the philosophies of geoengineering and planetary boundaries appear as opposite ends of a spectrum (Steffen et al, 2007), both actually exist within the possibilities delimited by the Anthropocene as a political realm and are thus founded *in the same premises and understandings of what is understood as a legitimate solution*. Firstly, both ideas aim for the continuous development and growth of human societies (Röckstrom, 2009; Steffen et al, 2011b) – in this sense, the ultimate goal of the successful management of the climate crisis and the return to a Holocene-like stability is the freedom for humanity to continue its development in terms of linear growth, and thus neither require critical thinking over capitalist values of development and growth, for instance.

Secondly, both work within the same managerial relationship with nature – although the understanding of humanity as a participant of the Earth system appears to change the ontological understanding of Man's relationship with Nature, these Anthropocene responses are presupposed on a relation of mastery and management of humans over the environment. Truly, the solutions proposed by ESS programs are based mostly on quantification and classification of parts of the environment so to “respond to and regulate Humanity's relation to nature” (Stubblefield, 2018, p. 2). This can be exemplified by the classification system of “geophysical goods and services”, for instance, which divide natural elements between provisioning goods and services (resources), supporting services, and regulating services, all of which must be maintained and managed in order to preserve equilibrium with the human enterprise within the Earth system (Steffen et al, 2011b). The entirety of the natural world is seen and understood in terms of exploration and use, interpreted through this lens of exploitation of a world that is useful to Humanity, exists to serve it.

Similarly, in the third place, both geoengineering and planetary boundaries programs presuppose a certain “appropriate human behaviour” (Crutzen, 2002, p. 23) – they create universal guidelines to be followed if what is considered to be a healthy Earth system and a healthy relation between humans and the environment is to be possible. It is in this sense that both approaches rely on the possibilities of

international governance regimes as possibilities for behavioral regulation around the globe⁶.

Finally, one of the key elements that circumscribe all proposals within Earth System Science discourse is the necessity for knowledge-based solutions that work with innovation and technology (Steffen et al, 2007): “[ESS] encourages the restriction of proposed solutions to the technical realm, by powerfully insinuating that the needed approaches are those that directly address the problem” (Crist, 2007, p. 33).

Ultimately, then, although there is a myriad of possibilities within geoengineering policies, planetary boundaries regulations, and any approach in-between, the fact that the Anthropocene as a solution formulation itself stems from a particular formulation of politics and government established by Earth System Sciences, any solution proposed is necessarily bound to the possibilities of the specificities in the formulation of the problem in the first place. In this case, the values within Earth System Sciences directly influence the solutions the discipline is able to provide.

This connection between the formulation of the problem and the possibilities of solutions will be discussed in the next section in general, regarding Foucault’s methodology of problematization, and in the particularities of the Anthropocene understood as a “solution formulation” created within the realms of Earth System Sciences.

2.3.2. Problematization of the Anthropocene

Much of the Anthropocene literature starts from the idea that the Anthropocene epoch is fundamentally a problem – the imbalances and disequilibrium of the Earth system for which Humanity is considered responsible, and the consequential social, political, and economical disruptions to this very Humanity are all framed as an urgent crisis, the ultimate problem humanity will have to face and a problem of its own creation. Therefore, by proposing to understand the concept instead as a “solution formulation” for the epoch, this ESS literature showcases one central dynamic embedded within the Anthropocene: that of problematization.

⁶ The specificities of governance are further developed in section 3.2.2.

Foucault (1984) very succinctly refers to problematization as “the development of a domain of acts, practices, and thoughts that seem to me to pose problems for politics” (Foucault, 1984, p. 114). In this sense, the author refers to politics as precisely the attempt to answer to created problems, difficulties created once an area of existence becomes denaturalized, stop being givens and arise as problems – there are, then, many possible solutions that are able to be proposed within the realm of possibilities, but the importance of critical work is precisely paying attention to the definition and delimitation of this realm, which happens precisely through the process of problematization.

Therefore, according to the author, for any behavior, any possibility of action, to become possible in itself, to enter the “realm of thought”, it must be first made uncertain, transformed into a problem. Once it has lost its familiarity, a domain of action will then present as difficulties for political action; thus, to any number of difficulties within social, economic, political, etc. spheres, a number of responses can be proposed (and usually are), sometimes even contradictory answers, which appear to be paradoxical amongst themselves. However, in this approach, what needs to be the focus of critical analysis is not the multiplicity of answers, but rather “what makes them simultaneously possible [...] the general form of problematization that has made [these solutions] possible” (Foucault, 1984, p. 118).

In this sense, problematization is the process of transformation from difficulties regarding a practice, to a “general problem for which one proposes diverse practical solutions” (Foucault, 1984, p. 118) and so this process, importantly, constructs the boundaries of possibility regarding what is understood as an appropriate response (Foucault, 1984). A critical analysis made inquiring over problematizations, then, an analysis with which Foucault (1984) aligns himself, is one “in which one tries to see how the different solutions to a problem have been constructed; but also how these different solutions result from a specific form of problematization” (Foucault, 1984, p. 118-119).

Further, Stengers (2021) associates Foucauldian problematization to influences from Gilles Deleuze and his formulations over ideas as “imperatives that force thinking” that when actualized as problems ultimately cannot be divorced from their origins, “from the imperative that generated them” (Stengers, 2021, p. 7). In this sense, the process of answering questions begins and is determined by the questioning imperative, in a way that the question and the answer are connected,

and questions cannot but be answered – hence, the formulation of a problem in itself is tied to its “field of solvability” (Stengers, 2021, p. 7), the realm that contains all possible answers, demarcated by the way the problem was posed.

Therefore, *the understanding of the Anthropocene as a “solution formulation” makes explicit the process of problematization at play in the construction of the concept*, making clear that “from its very conception, the Anthropocene has offered both name and response to ecological crises” (Stubblefield, 2018, p. 5) – in the formalization of the Anthropocene, Earth System Sciences has simultaneously described the problem Humanity is facing, and prescribed the possible solutions.

In short, in the process of the creation of ESS as a discipline, the Earth system is constructed as a spatial category and an object of study; along with the stratigraphical temporal category of the Anthropocene, result in the spatio-temporality of the Anthropocene, a realm of politics – in this process, the geological epoch is, in Foucault’s terms, made uncertain, a number of difficulties are created around it, and, ultimately, the Anthropocene enters the field of thought as a problem: the Anthropocene crisis, disequilibrium in the Earth system caused by anthropogenic action. Along with defining the crisis, a number of solutions are proposed, and the Anthropocene as a “solution formulation” is considered a productive way of framing the concept, so that it is helpful in reinstating equilibrium. However, through an analysis focused on the process of problematization, it is possible to see that the Anthropocene as problem and as a solution are one and the same, as the formulation of a problem requires an answer, and any possible response stems from the defined field of solvability (Stengers, 2021).

Going back to the analysis of the proposed solutions ranging from geoengineering to the actualization of planetary boundaries – it was shown that although both are considered to be opposite ends of a spectrum regarding interference with the ES, they actually work within the same logic of a managerial relationship of Humanity with nature, mediated by international governance. As described by Foucault: “it then appears that any new solution which might be added to the others would arise from current problematization, modifying only several of the postulates or principles on which one bases the responses that one gives” (Foucault, 1984, p. 119) – in this sense, given that the formulations of the Anthropocene problems remain roughly the same, continue constructed around the

same elements, any possible solution is already constrained by the realm of possibilities defined by the problem.

So, two elements are highlighted by this dissertation in its critical analysis of the problematization of the Anthropocene by Earth System Sciences: firstly, the element of chaos, aligned with urgency, and, secondly, that of universalizing tendencies.

Regarding the first elements, seeing that ESS stems from and makes use of sciences of complexity from its beginning as a discipline, chaos is an elementary feature of the Anthropocene. From the very conception of the Earth system as a complex system with unforeseeable feedback loops, to the worrying changes connected to the Anthropocene as a unit of time, chaos is foundational for the Anthropocene. The element of chaos is associated with urgency when considering the linear conception of time within stratigraphy:

Drawing on geologic time, the concept of the Anthropocene thus identifies humanity ('anthropos') as a singular subject and narrates the evolution of this actor in linear temporal terms – as an 'ambivalent odyssey of Man from hunter-gatherer to telluric force (Rothe, 2019, p. 147).

Chaos is transformed into collapse when entering political discourse – as talked about in earlier sections of this chapter, imbalances in the Earth system and general environmental crises are associated with economic and political crises and social collapse, as discourse is constructed around risk and security issues (Bai et al, 2016). Even further, within the literature of ESS, there is a belief that the equilibrium of the Holocene is what allowed for human civilization to develop, and, thus, the Anthropocene could mean possible destruction (Crutzen, 2006). Societal collapse is usually associated with scarcity, a strong worry stemming from the Blue Marble photo of the Earth and ESS' visual representation of the planet as finite (Miller and Edwards, 2001): by visually and conceptually representing the bounds of the Earth, its limits and completeness, the pictures resulted in contemplating the world as finite, indivisible, and inescapable (Miller and Edwards, 2001).

Truly, the catastrophism present in most of the literature projecting the future of the planet and of Humanity if anthropogenic impact to the Earth system remains steady (Bai et al, 2016) takes on an almost apocalyptic tone (Crist, 2007).

Ultimately, the association between crisis, destruction and linear time seem to connect to an eschatological temporality for the politics presented for the Anthropocene epoch - this will play an important role in the appropriation of the concept within International Relations, as will be discussed in Chapter 4.

In any case, it is seen, thus, that the element of crisis, and its association with urgency through linear conceptions of time and finite understanding of space, are central in the Anthropocene's original problematization through ESS.

A second element highlighted by the analysis is that of universalization and holism. Again, an elementary component of the Anthropocene, given the conceptualization of the Earth system as a totalizing conjunction of all elements of the planet and of Earth System Sciences as a holistic, mega-discipline capable of addressing any part of the complete whole, and presupposed on complete transdisciplinarity and breaking down of divisions between disciplines. During previous sections, the universalizing tendencies could be seen, for instance, while discussing the importance of integration within the Amsterdam Declaration. Stemming from ESS and speaking of imbalances to the ES, then, the Anthropocene is permeated by universalization, speaking of a totalizing space and of a universal form of Humanity, for example. This totalizing perspective is also connected to the Blue Marble world picture (Lövebrand et al, 2009) – the view from space made possible a unifying global gaze, totalizing and universal.

Thus, the element of representation appears as constant – from the Blue Marble picture to the Bretherton diagram and its successors, to the importance of digital modelling, forms of representation of the world are an integral part of the process of problematizing the Anthropocene. In this sense, *constructing a representation of reality acts as a form of world-making* connected to the formulation of possible answers in terms of politics, since “[o]bjects can only be governed when they are represented and conceptualized in a way that can enter the sphere of conscious political calculation” (Lövebrand et al, 2009, p. 11). As such, one defining feature of Earth System Sciences is the idea that its particular representation of reality is a better, more accurate one, that is able to define the Anthropocene problem and is better equipped to propose helpful solutions to it – regarding modelling, for example, one ESS modelers states: “Building models of these problems serves a dual purpose – it provides predictions, but also, in describing the model, you

describe the problem in a way that can really help policy-makers.” (Emmott et al, p. 109 *apud* Srnicek, 2013, p.142).

More on representation, world-making and politics will be discussed throughout the dissertation, but for now it is important to note how representations of the world, a practice of world-making, in this case in the form of the Earth system, is part of the process of problematization that will lead to the Anthropocene and, thus, part of the definition of the field of solvability to the crisis:

The power to act meaningfully in response to climate change is premised upon the capacity to ‘see nature’ – a capacity which is only possible by virtue of the heavy technological mediation this chapter has set out. GCMs [General Circulation Models], as representational technologies, have augmented the perceptual capacities of states and international organisations as a result (Srnicek, 2013, p. 143).

With that, defining a few characteristics that are part of the problematization of the Anthropocene – practices of accurate representations of the world and the elements of chaos and universalization – a few aspects present in the solutions proposed by Earth System Sciences can also be delineated: (1) a particular relationship between Humanity and Nature, presupposed on discipline and guidance; (2) a synchronic connection between science and politics; and (3) the use of governance as the means to solve the issues of the Anthropocene. These will be further addressed in section 3.3, but to briefly introduce them:

Within the umbrella of geoengineering and respect for the planetary boundaries, proposals stemming from ESS regarding solutions for the Anthropocene seem to be based on an idea of regaining control over the equilibrium of the Earth system through the definition of a proper relationship between Humanity and the planet, where Man becomes mature enough to understand its place in guiding himself and maintaining equilibrium of the planet:

Hopefully, in the future, the “anthropocene” will not only be characterised by continued human plundering of Earth’s resources and dumping of excessive amounts of waste products in the environment, but also by vastly improved technology and management, wise use of Earth’s resources, control of human

and domestic animal population, and overall careful manipulation and restoration of the natural environment (Crutzen, 2006, p. 17).

Thus, the proper relationship with Nature, one that controls it and keeps it within the defined limits of equilibrium, is related to Humanity's maturity, and relies on its discipline on a global level, and guidance of itself and of the world, while being mediated by technology and science.

Through the global picture and understanding the Earth system as the whole of the planet, solutions of the Anthropocene are thought of in terms of international governance, as ESS “[l]inks biophysical understanding of the Earth (state, fluxes, nonlinearities, tipping elements) to the policy and governance communities at the global level” (Steffen et al, 2020, p. 321). Simultaneously, any governance proposition is understood to be necessarily connected to the work of experts, in a way that knowledge formation and political propositions are linked, with scientific knowledge being formulated with the specific objective of guiding politics – in short, the problematization in question “involved the connection and conflation of science and governance. Scientists, the builders of the Earth system, fabricated two things at the same time, a system of knowledge production and a system of management of the Earth.” (Heymann and Dalmedico, 2019, p. 1146-1147). The capability of management on a planetary scale is connected to the global gaze constitutive of the formulation of the Anthropocene, given that “only with a view from space that (the illusion of) planetary management becomes possible” (Lövebrand et al, 2009, p. 11-12), so that the association between problem formulation and realm of possible solutions becomes evident.

Thus, although solutions proposed appear as natural, intuitive responses, they are bounded by the formulation of the problem. To put it simply:

Through problematizations, established forms of knowledge and taken-for-granted assumptions begin to crumble and novel entities or ideas emerge. Consider the example of climate change: through scientific research, political conventions, media debates and many other practices, climate change is turned into a political issue that calls for political regulation. Problematization here means “the gradual, contested and incomplete process of jointly dividing the multiform issue of global warming into more well-

delineated ‘problems’” (Blok 2014, 48) (Rothe and Benner, 2020, p. 117).

In this sense, instead of framing the solutions proposed as inevitable and intuitive, given their formulation from the realms of possibility stated by the problematization, it is important to state the forms of power at play when establishing the new accepted procedures and behaviors regarding human relationship to the environment. As such, the dissertation intends to propose a reading of the Anthropocene not as a descriptive concept, but *instead as part of a problematization that renders certain narratives and, therefore, forms of political action thinkable and legitimate*. In short,

the ease and frequency with which these claims are made perhaps reveals more about how the Anthropocene orients our own political subjectivity and rationality — our way of rendering reality thinkable — than it does about Nature, the planet or our modern geological epoch (Hamilton, 2016, p. 7).

This understanding of problematization as a fundamental dynamic of the formulation of the Anthropocene concept will be important in the analysis of the appropriation of the concept by International Relations literature – although some Critical IR makes a point to be critical of ESS, as will be shown, and thus put into question some of the answers provided by the discipline, it still works within the same dynamic of simultaneously describing the problem and prescribing solutions.

In other words, even when critical International Relations proposes different solutions to the problem of the Anthropocene, it ultimately still works within the characteristics of the formulated problem by ESS and, even more important, in the articulation of the Anthropocene, still mirrors the same movement of problematization described, providing a specific set of answers. Further, it will also be discussed how the literature nods at Earth System Sciences and the legitimacy of its findings as a starting point for the appropriation of the Anthropocene in IR – using the origins of the concept as an implicit claim for legitimate knowledge. Finally, as will be seen, also, the movement of problematization regarding the Anthropocene in IR simultaneously provides problems and answers to world politics *and* to defined shortcomings of the discipline itself.

3

Scientific Authority and World-Making: Cosmologies and the Anthropocene

The first chapter, then, started by tracing an overview of the discipline of Earth System Sciences as the starting point for the concept of the Earth system and subsequently of the Anthropocene. The discussions centered in ESS bring forth the key elements affirmed and defended within the age of the Anthropocene: integration; firstly, of Human and Nature; secondly, of natural and social sciences; lastly, of science and politics. This is supported in a new representation of the world, which is more scientifically accurate. The final part of the chapter locates the discipline of Earth System Sciences and the creation of the Anthropocene in a discussion of problematization and suggests the move from understanding the Anthropocene as a solution formulation concept to a form of world-making embedded in a system of knowledge.

From that, this chapter proposes a discussion on the power relations of scientific authority and world-making by taking as a starting point the colocation that Earth System Sciences made way for a “second Copernican Revolution” (Schellnhuber, 1999; Schellnhuber, Crutzen, Clark and Hunt, 2005; Ayestaran, 2008). By taking this affirmation to its limits, the chapter aims at developing the Anthropocene as a form of cosmological construction. To do so, the chapter will: (1) briefly introduce the terms with which to discuss cosmologies, their importance in the organization of society, and assert the possibility of scientific cosmologies; (2) explore the case of the ‘first’ Copernican Revolution, how it relates to the themes of Man/Nature, representation and scientific principles; and (3) go over precisely what the writers mean when talking of a supposed ‘second’ Copernican Revolution, develop the Anthropocene as a form of cosmological thinking in progress and explicit the relations between scientific authority and world-making through the case of ESS and the Anthropocene.

3.1.

A brief comment on cosmologies

In the most general way, a cosmology is defined as “the theory of the universe as an ordered whole, and of the general laws which govern it” (Howell, 2002, p. 196). It comes from the Greek word *kosmos*, which refers to the understanding of the universe as a harmonious system (Howell, 2002) – the harmonious *kosmos* came

out of chaos and cosmologies are seen as a form of humanity's inclination to classify its own existence (Howell, 2002). On the one hand, then: "A cosmology is any composition or cultural construct relating to the structure and process of systems of creation: the origins of physical elements of earthly or astronomical spheres, the genesis of the material world, the order and function of the observable universe" (Destro, 2010, p. 227).

As a way to specify and better understand what comprises a cosmology, International Relations theorist, Allan (2018), based on anthropological formulations of cosmology commented above, sketches five variables of a cosmology:

the fundamental units of matter, the forces that govern them, and categories of representation (ontology); the modes and procedures likely to produce reliable or true knowledge of the universe (episteme); the nature and direction of time (temporality); the origins and history of the universe (cosmogony); the role or place of humanity in the cosmos (destiny) (Allan, 2018, p. 11).

Nature, or the particular understanding of nature, also plays an important role in cosmological thinking (Allan, 2018) – a part of a cosmology is organizing and explaining the relationship between man and the world (Kuhn, 1995), which involves defining a figure of man, a figure of nature and how those relate. Thus, the very form of objectifying and defining nature serves as a foundation to establish man's place in the universe (Destro, 2010). In this sense, the very understanding of Man and Nature as separate self-contained entities that relate in a proper way is already a part of organizing man's place in the world, part of a cosmological comprehension.

It is important to keep in mind in this conceptualization that a cosmology would not be a simple additive process of the variables, but a construction resulting from the connections and interplay between them – no variable is autonomous, they affect each other mutually. In this sense, the objective is not to dissect each variable from a cosmological comprehending but be able to locate specificities that stand out in a way of thinking about the universe.

Finally, the dissertation adds ‘space’ to Allan’s temporality, given that, in general cultural history, both space and time and their formulation as spatio-temporality are “basic philosophical categories [...] comprehensive, universal, and essential” (Kern, 1983, p. 2). Acting together, space-time serves as a central anchor for schematizations on humanity’s existence and place within the universe (Kern, 1983).

Simultaneously, cosmology can be understood within a natural sciences scope as the study of the physical universe, beginning:

as a branch of theoretical physics through Einstein’s 1917 static model of the universe (Einstein 1917) and was developed in its early days particularly through the work of Lemaître (1927) [...] It has transitioned to an extremely active area of mainstream physics and astronomy, particularly due to the application to the early universe of atomic and nuclear physics, on the one hand, and to a flood of data coming in from telescopes operating across the entire electromagnetic spectrum on the other (Smeenk and Ellis, 2017: online).

Thus, throughout its development within natural sciences, physical cosmologies have “particular importance in terms of its implications for human life” (Smeenk and Ellis, 2017: online), its meanings and sense of purpose. In terms of the Anthropocene, Tresch and Zalasiewicz (2013), the first a professor of History and Sociology with training in Cultural Anthropology, the other a geologist, member of the Working Group of stratigraphy to officialize the Anthropocene as a geological epoch, discuss over the possibility of the Anthropocene being considered a change in cosmology. In their talk, they attempt to bridge natural and social comprehensions of cosmology, as the concept refers both to a change to the physical functioning of the Earth, brought about by studies in Earth and planetary sciences, but can also be expanded to a framework related to cultural meaning:

Tresch: to ask [if the Anthropocene is a cosmology] in terms of what is our system of belief not just about the physical world, but the system that includes the notion that there’s a division between the physical world and the world of meaning. What changes in our cosmology when we start to think of the Anthropocene? That

is, a natural world which is affected by, transformed by, human intentions and motivations (Tresch and Zalasiewicz, 2013, 6min29-6min53).

Here, it is interesting to note an indecisiveness to the role of the human within a cosmology between being a part of the system and being the arranger of the system; that is, through finding and ascribing the order within a universe, the human simultaneously sees itself as part of that world, and does not. For example, referring to the Earth system and to the Anthropocene, as showcased by the Bretherton diagram and its revision, the place of Humanity within the ES – both a part of the system, but also separated from it – involves what was called the “one system, two systems” contradiction (Moore, 2016 *apud* Stubblefield, 2018). That is, the conception and representation of the Earth system simultaneously locates Humanity as a part of natural systems of the earth (connected to the fundamental breakdown of divisions between Man and Nature) and does not:

On one hand, the Anthropocene recognizes that humans are a part of nature both acting upon and subject to the “great forces of nature”. Thus, humans are recognized as internal to the operations of natural systems (one system). On the other hand, Humanity is rendered as separate and distinct from nature, as Society and social organization are abstracted from the operations of nature (two systems) (Stubblefield, 2018, p. 7).

Still, with this caveat in mind, the main outcome of complex cosmological formulations, for the scope of the dissertation, is how a cosmology serves to define the purposes humanity should pursue (Allan, 2018). By defining the functionality of the universe, the position of man within a cosmology defines the meaning of human action (Kuhn, 1995) and constructs desires, ethics, goals, etc. deemed important to seek. In few words, cosmological formulations regard “how we conceptualize the role of humanity in the universe and thus to thinking about what purposes we should pursue” (Allan, 2018, p. 271); *they ascribe meaning and purpose for humanity as a whole.*

Thus, the focus on the Copernican Revolution, and on the possibility of a follow up thought the Anthropocene, is to trace cosmological shifts within the history of modern thought. A cosmological shift happens when “new ideas about

what exists, what counts as knowledge, time, the origins of the universe, and the place of humanity into the cosmos are introduced in political discourses” (Allan, 2018, p. 20). That is, to focus on these cosmological formulations and shifts can be a way to understand connections between world-making and politics.

As major and complex structures of thought, cosmologies are not complete schemes, totalities, static wholeness – on the contrary, given the amount of information and beliefs mobilized when composing a cosmology, it is inevitable that they are constantly in tension and in flux, containing pluralities and sometimes incongruences being worked at by different cosmologists. Instead of being a closed set of fixed ideas, cosmologies, are “compositions or configurations of cosmological elements that circulate in discourses” (Allan, 2018, p. 11).

As such, both in tracing cosmological images developed within the Copernican Revolution and proposing to read the Anthropocene as a cosmological possibility, the premise is not to fix a set of cosmological ideas as static, congruent, and finalized. The social discourses involved in formulating any cosmological framework are “incomplete, fragmented, and multiple” (Allan, 2018, p. 38). Also, new cosmological shifts do not completely eradicate and replace old world-making representations and ideas, rather, elements stack-up after each other, resulting in incongruencies, tensions, and changes arising from the interplay of ideas, for the search of resolutions, etc.:

Cosmological shifts do not necessarily replace or eliminate earlier cosmological elements in political discourses. But cosmological shifts do not cumulate in predictable ways either. Instead, cosmological shifts introduce nonlinear ruptures and reconfigurations that disorder and reorder discourses (Allan, 2018, p. 65).

In short, in the analysis, “cosmology” is a shorthand encompassing a complex array of relations between conceptual formulations of what counts as legitimate knowledge, the ontology of reality, its spatio-temporality, the history of the world, and Man’s place in it: “we are dealing less with a cohesive overarching interpretive framework than a set of cosmological elements that are variously used to shape purposes, justify institutional rules, and legitimate political hierarchies” (Allan, 2018, p. 39).

Traditionally, cosmologies are studied from an anthropological standpoint, and associated with mythological/mystical thinking (Destro, 2010; Howell, 2002). That means that modern western society is usually conceived as beyond cosmological thinking: that after the Scientific Revolution, which would have disenchanted the world, a society with science-driven values came about to shape modernity away from mythology (Allan, 2018). As such, “the history of non-Western international orders has been theorized in cosmological terms, but the cosmological history of the West is thought to end with the collapse of Latin Christendom” (Allan, 2018, p. 38).

This strict separation between pre-modern mythological societies, which would result in cosmological thinking, and secular science, which would not, is problematic in two levels. Firstly, succinctly put: “The God of a philosopher and his word are correlated” (Koyré, 1957, p. 100), that is to say, scientific endeavors, the problems that appear in groundbreaking scientific advances, are not necessarily separated from a religious and spiritual understanding of the world. Especially in the movements explored within the Copernican Revolution, a close reading of the texts makes it clear how the European scientific tradition is deeply embedded in interpretations of God and spirituality (Koyré, 1957; Gaukroger, 2007; Gaukroger, 2010). Even more recent works, firmly established in the disenchantment narrative, carry values, images and concepts stemming from the spiritual beliefs and motifs expressed in foundational scientific texts. Thus, even if superficially there is no religiosity, certain religious-specific understandings of concepts or definitions or problematizations carry over (Rothe, 2020).

The impossibility of a strict division of enquiry from spirituality is such that, in fact, the relationship between science and Christianity was a centrally important factor for the development of a scientific culture in European history:

The relation between natural philosophy and Christianity was a fundamental issue, because it was on this question, more than any other, that the ability of natural philosophy to establish itself—in the late seventeenth and early eighteenth centuries—as a permanent and integral feature of Western intellectual life depended. More particularly, what was at stake was the transformation of natural philosophy from a set of theories, and experimental and observational practices, of widely varying

levels of abstraction and no less widely differing degrees of success, dealing with various aspects of natural processes, into something that unified knowledge and was not only fundamental to, but in some ways constitutive of, our understanding of our place in the world (Gaukroger, 2010, p. 11-12).

This leads to, secondly, although sometimes understood as having purely instrumental goals, historically, scientific ideas have acted as to allow new images and possibilities regarding humanity's place in the cosmos (Allan, 2018; Gaukroger, 2007). Meaning that "the rise of scientific ideas did not drain political discourses of cosmological meaning" (Allan, 2018, p. 38), it simply developed a type of scientific cosmology that came to spread from the 1550's onwards, and eventually dominates global discourse, effectively acting as a productive power that helps give meaning to modern societies, and legitimate particular desires, interests and goals (Allan, 2018).

Even further, beyond the emergence of a scientific cosmology, the construction of a self-image of Western modernity predicated on a universal, neutral and rational scientific culture, *effectively changes what it means to understand the world and secures itself as the legitimate form of understanding the universe and our place in it* (Gaukroger, 2007). To put this outcome in other words: a historical movement, with close ties to Christendom and spirituality, defines the goals and methodologies of enquiry; it is understood that science "appeals solely to reason and experience, and is as a consequence untinged by historical or cultural factors, which can therefore be ignored, making science something that in essence has no context, historical or otherwise" (Gaukroger, 2007, p. 11); this allows for the emergence of a scientific culture, in which all values are subordinate to scientific ones (Gaukroger, 2010), and which is also fixed as fundamental to the self-image of modernity (Gaukroger, 2007); as a result "the issue is not just that science brought a new set of [...] values to the task of understanding the world and our place in it", i.e. a scientific cosmology, "but rather that it completely transformed the task, redefining the goals of enquiry" (Gaukroger, 2007, p. 1). In sum, scientific cosmologies can change, develop, strain, etc. but no other cosmology can claim the status of knower of reality.

Importantly to note here is the shifting in universality of values, from the universalism of Christianity to a universalism of modern science. The aspect of universalizing tendencies of the Anthropocene and of Earth System Science endeavors established in Chapter 2 (and which will come back in Chapter 4) here finds a connection within the history of modern science. Hence, in the ties between religiosity and science through the process of unfolding of a scientific culture, an element of universalism remained constant.

That being said, it is essential to recall again the plurality existent in the concept “cosmology”: to talk of a scientific cosmology is not to single out *one* scientific tradition and cosmology as a complete, fixed set of ideas, unquestionably established around all scientific traditions. In a few words:

In many cases, the cosmologists saw themselves as working within a single intellectual tradition, “science.” But this does not mean that it makes sense to theorize the effects of science in a monolithic way. Instead, we should examine how multiple, distinct scientific traditions were used to continually rework a set of foundational questions about what exists, how to produce knowledge, the nature of time, and human destiny (Allan, 2018, p. 65).

Finally, the last key element before moving on to exploring the Copernican and ‘second’ Copernican revolutions, is the element of the narrative power of a cosmology. It was said that cosmologies are significant because they are able to give meaning and purpose to a Humanity, which will influence a society’s political goals – what makes this possible is the resulting narrative that stems from a cosmology (Allan, 2018). In this sense, one can connect representations of reality with the narrative that develop from this particular form of representing the world. A set of images, then, represent how the universe is and place humans as actors “in narratives that structure time and space” (Allan, 2018, p. 12). Therefore, scientific cosmologies work to define the central metaphors that will construct the imaginary of existence and the role that Humanity must play in this story (Allan, 2018).

With that, a schematic review before moving on to the next section: to center at the relations of scientific authority and practices of world-making, this chapter begins by sketching out what are cosmologies in general (structures of the universe

and man's place in it) and scientific cosmologies in particular (cosmologies stemming from scientific practice and which are amidst a scientific culture that will prioritize scientific values as legitimate in understanding the world). Cosmologies are said to be plural and constantly changing as interacting with internal tensions and external claims to knowledge; their strength is in providing meaning and purpose for humanity by representing the universe in a particular way and reading existence through a narrative.

This is the background information needed to read the intricacies of scientific authority firstly in the Copernican Revolution and finally in the current moment of the Anthropocene, named by Earth System Science authors the “second” Copernican Revolution.

3.2.

The Copernican Revolution and the making of modern science

3.2.1.

General Pre-Copernican Formulations

The Copernican Revolution is the general name given to the scientific changes brought about by Nicolaus Copernicus (1473-1543) when he proposed a change from an earth-centric to a helio-centric conception of the universe. Starting, then, with Copernicus' ideas, developing throughout centuries and culminating in Isaac Newton's (1643-1727) “clockwork universe”, the Revolution is considered to be the beginnings of what would become Modern Science and modern cosmology. Despite the drastic changes that Copernicus' ideas would bring to scientific and cosmological discourse, his original book *De revolutionibus orbium coelestium* (On the Revolutions of the Celestial Spheres), published in 1543, dealt with mathematical problems of late medieval astronomy – a heliocentric drawing of the universe aimed mostly at solving mathematical minutia (Allan, 2018; Kuhn, 1995). In this sense, Copernicus' work is deeply embedded in the contextual astronomical discussions of his time – hence, this section will sketch the ideas with which Copernicus was conversing when writing *De revolutionibus*.

Firstly, as was said, cosmological perceptions have a deep connection with conceptualizations of nature, seeing that “in the history of European thought there have been three periods of constructive cosmological thinking, three periods, that is to say, when the idea of nature has come into the focus of thought” (Collingwood, 1945, p. 1) – namely, periods related to three different analogies regarding nature:

nature as an organism, nature as a machine, and nature as historical change (Collingwood, 1945).

Therefore, the first one, according to Collingwood (1945) is the Greek understanding of nature, which was based on an analogy that constructed nature as an intelligent organism. This view translates the human body into a figure of a natural body in a way that the individual human being:

By the work of his own self-consciousness he comes to think of himself as a body whose parts are in constant rhythmic motion, these motions being delicately adjusted to each other so as to preserve the vitality of the whole and at the same time he finds himself to be a mind directing the activity of this body in accordance with its own desires. The world of nature as a whole is then explained as a macrocosm analogous to this microcosm (Collingwood, 1945, p. 8).

As a consequence, this Ancient nature is in possession of a mind, an element that results in and implies a type or regularity and orderliness - this regularity and orderliness is, in fact, what allows the study of nature (Collingwood, 1945). Besides an intelligent mind, the Greek view of nature is also characterized by motion, which is attributed to the “vitality of the soul” (Collingwood, 1945, p. 3). Thus, nature is a world comprised of intelligent bodies in motion, a vast organism with a rational mind and a soul.

The ontology of nature and the epistemology of the sciences of nature are closely related (Collingwood, 1945). Indeed, the notion of knowledge (*episteme*) is being developed within this transition from the archaic to the classical period, related to the ability and possibility of a philosopher to “discover the truth of the matter” (Graukroger, 2007, p. 230). In a few words, this early origination of knowledge can be summed up by looking into Plato’s and Aristotle’s distinct cases against the sophists: “The philosophical project was defined in Plato and Aristotle in opposition to sophistry, and took two distinct forms: the search for a transcendent truth, and the discovery of underlying principles.” (Graukroger, 2007, p. 228).

Both philosophers were against the sophist’s endeavors of developing and using arguments with the purpose of bettering their reputations and winning discussions (Graukroger, 2007) – considering this a moral failure on the case of the

sophists, then, each philosopher would come to develop a particular understanding of philosophical practice as it pertains to the acquisition of knowledge: “we can say that Plato seeks to uncover transcendent truth [...] whereas Aristotle seeks to uncover explanations” (Graukroger, 2007, p. 233). Each such understanding will influence different traditions of knowledge, with the Platonist project guiding Christian theology, and the Aristotelian ideas aptly evolving into Aristotelian natural philosophy (Graukroger, 2007).

So, on the one hand, a Platonist or later Neo-Platonist tradition works with the assumption that there is a reality underlying the appearances of the senses – *the* transcendent truth where even reason, a product of judgement of appearances, was transcended. In this sense, the Platonist and Neo-Platonist movements were committed to reason as a way to reach a true reality, where knowledge would be untainted (Graukroger, 2007).

Aristotle, on the other hand, does not deny the apparent status of reality: his proposal is that the philosophical investigation should explain the reason, the account of a phenomena (Graukroger, 2007). Here, thus, knowledge is a systematic search for explanations through following a method that generates essential, not accidental, truths (Graukroger, 2007).

In broad terms:

Plato and Aristotle are each attempting to achieve the same end, namely the characterization of what it is that marks philosophical enquiry out from other forms of enquiry that reach conclusions by means of argument [...] Plato and Aristotle argue not as if sophists have a mistaken view on the aims of enquiry, but as if they have not even raised the question, remaining content simply to enquire, and as a consequence failing to distinguish appropriate from inappropriate forms of enquiry. It is with the raising of this question that philosophy begins (Graukroger, 2007, p. 235).

Each author offers an epistemological solution to the sophist’s moral failure. The notions of knowledge as the grasp of an essential truth or the creation of underlying principles are majorly important in the cosmological formulations of the following centuries: Copernican tradition will follow a Neo-Platonist tradition by

searching to the essence of nature, putting him in contrast with the Aristotelian episteme of his time⁷.

Aristotle's thoughts, then, "provided the starting point for most medieval and much Renaissance cosmological thought" (Kuhn, 1995, p. 78). Aristotle's influence is twofold: both his explanation of how the universe works and his attempt to organize natural knowledge in a systematic and coherent whole are important – both his ontology and his epistemology.

So, the Aristotelian Universe is characterized by the following main elements: (1) a separation of celestial and terrestrial spheres; (2) the Earth as the stable center of the universe; unique, central and immobile; (3) rest as the natural position of the terrestrial sphere; and (4) the universe as finite and full (Kuhn, 1995). Furthermore, Aristotle's Universe was self-contained and self-sufficient, aiming at a complete internal coherence and integration of astronomic and non-astronomical laws of nature (Kuhn, 1995). His notions of space and time were also specific to his cosmology – firstly, time was thought of cyclically, instead of in a linear fashion (Rudwick, 2014); and space was influenced by animistic ideas: instead of being physically neutral, it was thought of a "life space", connected to whatever exists within it (Kuhn, 1995, p. 97).

Aristotle was considered the last great cosmologist of antiquity, and Ptolemy, who lived a few centuries later, its last great astronomer (Kuhn, 1995) – Ptolemy developed the astronomical laws and notions of the two-sphere universe of the Aristotelian cosmology. Its name stems from the division of the Universe between an exterior celestial sphere for the stars, and an interior sphere for men:

The Aristotelian universe was built on the temporal-spiritual division of reality into two spheres: a terrestrial realm of change, variety, and decay; and a changeless, eternal celestial realm. Although the two realms had distinct properties, they were connected to one another by space-filling spheres. It was a "full

⁷ Harries (2001) affirms that the association of Platonism to the new science developed through Copernicus, particularly associating Neo-Platonism to Galileo, is a reading popularized by Cassirer (2000) [1963]. Harries (2001), however, argues for the focus on the tensions within this parallel, which is useful, but, for the author, not perfect, citing particularly a tendency implicit in Platonism to "downgrade the material world" (Harries, 2001, p. 272) and important differences between the Christian and the Platonic understandings of nature, differences that would create frictions in the Neo-Platonism of Copernicus, Galileo, and such new scientists. Hence, for more details and nuances in the duality between Aristotelianism and Platonism within the development of Sun centered astronomy see: Harries (2001) and Cassirer (2000) [1963].

universe,” without vacuums, in which planets and humans alike were connected by the movements of invisible space-filling spheres. The stability and centrality of the earth played a key role in this account. The earth provided the stable foundation necessary to sustain celestial motion (Allan, 2018, p. 91-92).

In this sense, Ptolemy’s astronomical conceptualization of the two-sphere universe is an astronomical, mathematical framework, constructed from observation associated as a fundamental structure for a more general cosmology (Kuhn, 1995). In sum, “it is a conceptual scheme, a theory, deriving from observations but simultaneously transcending them” (Kuhn, 1995, p. 36). Although not the only framework of the time, and also holder of many different cosmologies, the two sphere universe was the framework with the most adherents (Kuhn, 1995) and it centered the problem of planetary motions: “how are the complex and variable planetary motions to be reduced to a simple and recurrent order?” (Kuhn, 1995, p. 50); how and why do planets move forwards and retrogress? Here, the Earth was thought of as suspended and stationary at the very center of the second sphere, which carried the stars; the sun and planets, in their turn, moved in the space between the Earth and the celestial sphere:

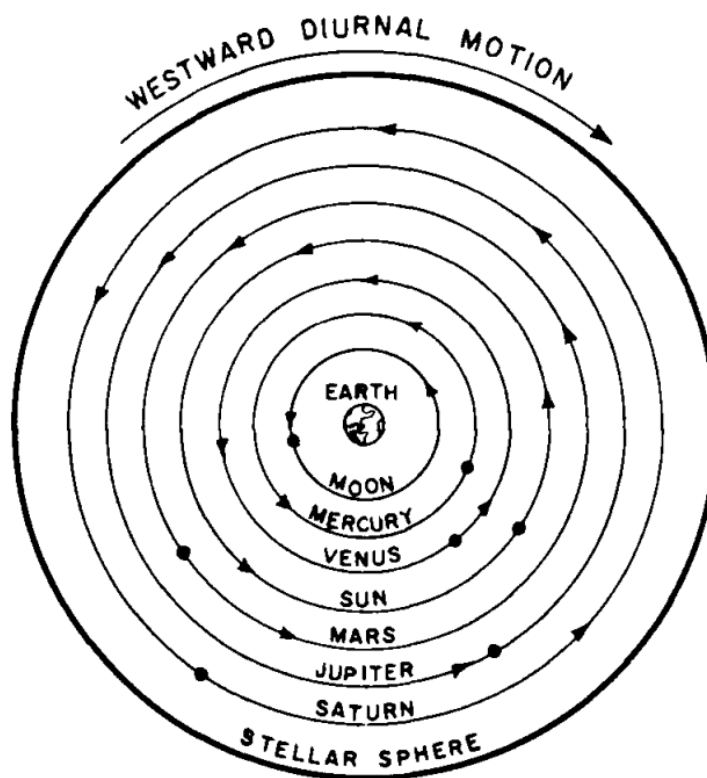


Figure 4: “Approximate planetary orbits in the two-sphere universe. The outermost circle is a cross section of the stellar sphere in the plane of the ecliptic” (Source: Kuhn, 1995, p. 53).

The problem of the planets, the attempt to understand and account for all of the irregularities in its visible movements was dealt with by Ptolemy’s tradition of sketching epicycles and eccentrics, accounting for the orbits that traced the movements (Kuhn, 1995). This system was incredibly versatile and became the norm when computing the movement of the planets – to accommodate variations, increase accuracy, etc. over the centuries astronomers would add and move epicycles and eccentrics. However, “they seldom or never sought fundamental modifications of that technique. The problem of the planets had become simply a problem of design, a problem to be attacked principally by the rearrangement of existing elements” (Kuhn, 1995, p. 73).

With that, “the Aristotelian world view was the single most important source and support for the pre-Copernican tradition of astronomical practice” (Kuhn, 1995, p. 95). However, this does not mean that the Aristotelian notions of the Universe were passed down throughout centuries without being challenged and changed by new thinkers, ideas, and re-structuring of society. On the contrary, although Aristotle’s and Ptolemy’s ideas were never cast aside and were brought into focus again during a specific moment of general reclamation of science and philosophy of the ancient world in the Renaissance, their texts and thoughts were transformed by translations, commentaries, order and limitation of acquisition, etc. (Kuhn, 1995). That is to say:

Copernicus’ teachers still believed that the structure of the universe was about as described by Aristotle and Ptolemy, and their beliefs place them in an ancient tradition. But their attitude toward those beliefs was not ancient. Conceptual schemes age with the succession of the generations that behold them (Kuhn, 1995, p. 100).

Thus, although the concepts used to explain, visualize, and understand the world remained the same, they were seen with new eyes. As a result, thinkers regarded new strengths and new weaknesses pertaining the concepts and ideas; also, new methods were used and reframed the studies and concepts; and, most importantly, the old problems that moved ancient thinkers changed, were reframed

by new purposes, transformed by interacting with new times. Hence, new problems, or new ways to interpret old problems now moved the ponderings over the functioning of the Universe (Kuhn, 1995).

In general, then, Copernicus wrote answering to the ancient texts recovered during his epoch – forming a transitional, conversational context between the Aristotelian and Ptolemaic traditions being incorporated in European thoughts and discourses amidst this moment of scientific development. The context is marked, then, firstly, by a cosmological discourse understood as divine providentialism, which “drew on the cosmological tenet that God created and controls the universe” (Allan, 2018, p. 80) in a way that God intervenes in everyday life and that all of nature, all of the creatures, are guided by the laws of God (Allan, 2018).

Secondly, ontologically, the world is divided in a dualism between spiritual and temporal domains, and while spiritual time is eschatological, earthly time is cyclical (Allan, 2018). Another ontological theme of the time is the Aristotelian doctrine of elemental naturalism, i.e., the world as comprised fundamentally of earth, water, air, and fire (Allan, 2018).

Finally, thirdly, the episteme of the time was a mixture and cross-contamination of ancient authorities and new modes and methods of knowledge, and also reliant on informal modes of knowledge (Allan, 2018). Two important models for obtaining and establishing knowledge residual from medieval times are casuistry and the patterning episteme (Allan, 2018). On the one hand, casuistry refers to the method of using biblical anecdotes to establish principles and facts (Allan, 2018)⁸. The patterning episteme, in its turn, refers to the acquisition of knowledge of a theme gained by mapping it to another phenomena - this episteme was supported by an organicist view of nature enfolded within divine providentialism: the world is one of complex patterns and:

Knowledge of the world was not achieved by constructing external representations of reality, but by revealing the non-mechanical connections within the world. Signs and symbols were not separate from the world, but rather they were part of it, given by it. Within the patterning episteme, it did not make sense

⁸ More about the use of biblical knowledge in scientific endeavors, specifically referring to the development of stratigraphy and Earth’s chronology, can be read in Rudwick (2014).

to provide chronological narration or conduct experiments that assumed isolable, individual entities that move autonomously through time and space. This was because reality was folded in on itself through a complex series of symbolic and organic links between elements (Allan, 2018, p. 91).

This is to show how cosmological and astronomical discourses carried over from antiquity mixed with different political contexts to create a complex foundation of the functionality of the universe: the two sphere universe and the Aristotelian world-view were a part of the cosmological discourse, epistemology and ontology of the late medieval Europe: “Fundamental astronomical concepts had become strands in a far larger fabric of thought, and the nonastronomical strands could be as important as the astronomical in binding the imagination of astronomers” (Kuhn, 1995, p. 77). Thus, even though Copernicus’ work was done in answer to mathematical discussions of astronomical diagrams the Copernican Revolution goes beyond a story of “astronomers and the skies” (Kuhn, 1995, p. 77) and *serves as a case showcasing the relationship between scientific developments and world-making endeavors*.

3.2.2. The Copernican Revolution

So, as was said, the publication of “*De revolutionibus orbium coelestium*” in 1543 by Nicolaus Copernicus is what marks the beginning of the shifting of ideas that characterizes The Copernican Revolution (Kuhn, 1995). In the *De revolutionibus*, Copernicus attempts to solve the problem of the planets within the Aristotelian and Ptolemaic traditions. In this sense, Copernicus and his work did not particularly set out to be revolutionary, but mainly wanted to work out the problem of the planets within a Hellenistic mathematical tradition and preserve the Aristotelian image of the universe (Allan, 2018).

However, Copernicus surmises that attempting to solve the problem of the planets with the traditional techniques is impossible: “there must, he concludes, be a fundamental error in the basic concepts of traditional planetary astronomy” (Kuhn, 1995, p. 139). So, in order to accurately represent the universe in precise mathematical terms and describe the movements of the planets without irregularity, Copernicus proposes that the sun be given some of the functions thus far attributed to the earth, and suggests that the earth, now a planet, also has motion (Allan, 2018;

Kuhn, 1995). This localized break with tradition is what would ultimately grow to be a scientific revolution stating a new cosmology – in this sense, “[t]he significance of the *De Revolutionibus* lies, then, less in what it says itself than in what it caused others to say [...] It is a revolution-making rather than a revolutionary text” (Kuhn, 1995, p. 135).

Thus, the Copernican astronomical system transposes the earth and the sun, proposing a heliocentric system with a planetary earth, which implies threefold motion – all while proposing new theories of motion that allow for the transposition while remaining as close to the Aristotelian universe as possible (Kuhn, 1995). When it is necessary to violate completely the traditional cosmology (such as when accounting for the size of the universe, for instance, given that Copernicus’ universe is at least 400000 times bigger than Ptolemy’s) “Copernicus seems to remain sublimely unaware of the break” (Kuhn, 1995, p. 160).

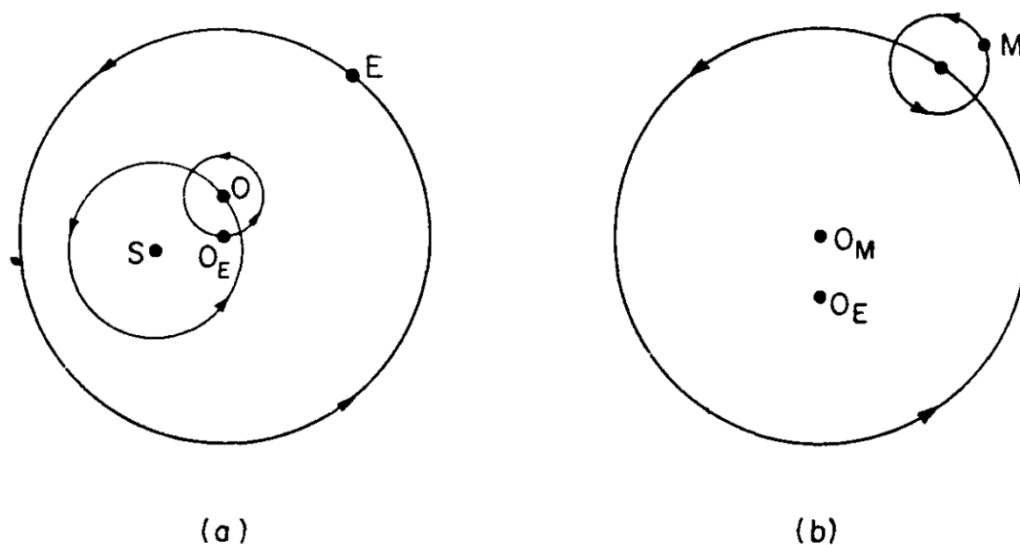


Figure 5: “Copernicus’ account of the motion of (a) the earth and (b) Mars. In (a) the sun is at S, and the earth, E, revolves on a circle whose center, O_e , revolves slowly about point O, which in turn revolves on a sun-centered circle. In (b) Mars is placed on an epicycle revolving on a deferent whose center, O_m , maintains a fixed geometric relation to the moving center O_e of the earth’s orbit” (Source: Kuhn, 1995, p. 170)

Hence, Copernicus states that one of the appealing elements of his system is aesthetic – sun centered astronomy has more geometric harmony and coherence (Kuhn, 1995). Even so, although the book “did convince a few of Copernicus’ successors that sun-centered astronomy held the key to the problem of the planets” (Kuhn, 1995, p. 172), the work was mostly read in spite of its cosmological

hypothesis. In general, it was possible to draw a separation between his mathematical devices and the physically real: astronomers could abstract the mathematical formulas and geometrical depictions from the accepted reality, which allowed for the spread of Copernicus' ideas, even if used for computations alone (Kuhn, 1995). In short, "using Copernicus' mathematical system without advocating the physical motion of the earth provided a convenient escape from the dilemma posed by the contrasting celestial harmonies and terrestrial discord of the *De Revolutionibus*" (Kuhn, 1995, p. 187). Being thus useful in accurate calculations of the motions of the planets, over the second half of the sixteenth century Copernicus' tables became a staple for astronomers (Kuhn, 1995), even if ignored or rejected outside of astronomical circles.

By proposing a movable, planetary earth, Copernicus does not just jumpstart the solution of the problem of the planets (by fundamentally changing the scope of the problem) – by providing more accurate mathematical descriptions of the movements of the planets, he, most importantly, *makes way for the possibility of new central problems to be proposed* (Kuhn, 1995). In this way, the *De revolutionibus* is considered a transitional text, and Copernicus neither an ancient nor a modern astronomer, but as providing a work where traditions merge:

That is why the *De Revolutionibus* could be the starting point for a new astronomical and cosmological tradition as well as the culmination of an old one [...] Their starting point was the earth's motion, which was all they necessarily took from Copernicus, and the problems to which they devoted themselves were not the problems of the old astronomy, which had occupied Copernicus, but the problems of the new sun-centered astronomy, which they discovered in the *De Revolutionibus*. Copernicus presented them with a set of problems that neither he nor his predecessors had had to face (Kuhn, 1995, p. 183).

One of such starting points provided by Copernicus' work, by those who chose to lead his ideas further, was the collapse of the separation between the terrestrial and the celestial spheres (Kuhn, 1995): if before there was a clear separation between the celestial region, the planets, and the terrestrial center, a supposition of planetary earth disrupts that. This change fundamentally "undermined the very foundations of the traditional cosmic world-order with its hierarchical structure and

qualitative opposition of the celestial realm of immutable being to the terrestrial or sublunar region of change and decay” (Koyré, 1957, p. 29). In sum, the changes were twofold: the heavens change, and the earth moves.

One important figure to help establish the mutability of the heavens is Tycho Brache, whose developments of techniques in astronomical observation acquire sufficient and accurate data to feed to Copernicus’ mathematical formulations (Kuhn, 1995). Brache began the practice of regularly conducting observations of the movements of the planets and, although himself was against the cosmological assertion of the earth’s motion, his data supported Copernicus’ theories given that no other design could account for his empirical findings (Kuhn, 1995). Regarding the mutability of the celestial region, up until then conceived as eternally immutable:

Late in 1572, when Brahe was at the beginning of his career in astronomy, a new celestial body appeared in the constellation Cassiopeia, directly across the pole from the Big Dipper [...] If it were a star, then the immutable heavens had changed, and the basic contrast between the superlunary region and the corruptible earth was in question. [...] If it were a star, the earth might more easily be conceived as a planet, for the transitory character of terrestrial affairs would now have been discovered in the heavens as well (Kuhn, 1995, p. 206-207).

Thus, the Copernican system kept developing its specificities and forming more robust details along with the appearance of new astronomical data. Here, Johannes Kepler is responsible for improving on the Copernican mathematical representational system by allowing it to stray further from a Ptolemaic system and fully developing a mathematical sun-centered planetary system that could accurately represent and calculate planetary positions and movements – with Kepler, the problem of the planetary motions is at last solved (Kuhn, 1995).

This focus and confidence in a mathematical representation of nature is considered a strong Neo-Platonic feature developed all throughout the Copernican Revolution (Kuhn, 1995; Koyré, 1957). This view considers that mathematical laws are the foundations of all natural phenomena (Kuhn, 1995), that nature is thus written in a mathematical language that can be deciphered: “the truth of nature

consists in mathematical facts, what is real and intelligible in nature is that which is measurable and quantitative” (Collingwood, 1945, p. 102). Even more, given that the notion of nature at the time was affiliated with God, here, mathematics represents God’s nature, a way to attain sacred knowledge (Kuhn, 1995; Koyré, 1957).

Along with mathematical representations of nature and thus a measurable and quantifiable world, during this time, astronomy develops as a properly empirical science: “its field is coextensive with that of observable data” (Koyré, 1957, p. 84). In this sense, a key feature within the Copernican Revolution is that of observation, sight (Koyré, 1957), and thus one of the most significant and notable figures is that of Galileu Galilei and the telescope.

Built in 1609, the telescope was a new technology that allowed a clearer and closer look into the skies, thus providing the first qualitatively new data about the heavens since antiquity (Kuhn, 1995). One of the effects of the telescope was providing straightforward and accessible non-mathematical data and documentation of the Copernican universe (Kuhn, 1995), therefore allowing for the main ideas to disperse beyond the circle of academics that could read, understand and engage with the mathematical minutiae that consisted the discussions so far – here, the dissolution of ideas would allow for such astronomical evidences to influence and change everyday practical and spiritual life (Kuhn, 1995).

In summary, Galileo’s original observations asserted four things: (1) with the telescope, more fixed stars could be seen in the night sky, which contended that the naturally visible does not exhaust the potentially visible; (2) the surface of the moon was visible and had an earthlike surface, with peaks and crevices, and (3) the Milky Way could be discerned as a conglomerate of stars, both observations were in support of the cosmic homogeneity presented by Copernicus when his ideas suggested the end of the separation between the terrestrial and the celestial planes; and, finally, (4) the moons of Jupiter were discovered, which “seemed to offer a miniature model of the solar system” (Harries, 2001, p. 265). These primary and other subsequent observations (such as observations of the phases of Venus’ movement) did not only fit precisely within Copernicus’ representation of the universe but were actually predicted by other Copernican astronomers: “their vision of the universe showed marked parallels to the universe that the telescope made manifest” (Kuhn, 1995, p. 224).

The telescope, in this manner, serves as a mediator and enhancer in humanity's task to interpret nature: "the development of these instruments serves the demand for ever more precise quantification. [There is a] conviction that such quantification helps us get closer to the truth" (Harries, 2001, p. 265). God, mathematics, truth, knowledge, empiricism, and quantification appear all connected, enveloped in the figure of the human and the development of science.

Importantly, along with a new perception of the cosmos, Copernicanism raised a whole new set of problems both within astronomical thought and outside of astronomy regarding the cosmological structures to depict the new universe:

A century after Copernicus' death his two-sphere framework had been replaced by a universe in which the stars were scattered here and there through an infinite space [...] By 1700 the unique earth, which Copernicus had reduced to but one of six planets, had become little more than a speck of cosmic dust (Kuhn, 1995, p. 232).

In this new cosmos, old questions of the functioning of the universe remained, but traditional answers were no longer applicable – in few words, "a new physics and a new cosmology were required before astronomy could again participate plausibly in a unified pattern of thought" (Kuhn, 1995, p. 230). It is said, then, that the work of Isaac Newton is the culmination of the Copernican Revolution, in that he resolves the remaining issues and makes it possible to link astronomy and physics in a generally cohesive cosmology.

One of the paths that lead from Copernicus' original insights in *De Revolutionibus* to the Newtonian universe that is considered the final form of the Copernican Revolution is the answer to the question: what moves the planets? (Kuhn, 1995)⁹. Before, with the separation between the celestial and terrestrial realms, the movement of planets was assumed to follow rules unknown and different than earthly natural laws, which allowed for several different answers within the traditional world-view – now, Copernicus' suggestion of uniformity

⁹ Another possible path connected to the move from the finite sun-centered original formulation of Copernicus' cosmos to the Newtonian universe is the links between Copernicus' ideas and formulations of corpuscular philosophy, better discussed in Chapter 7 of Kuhn (1995).

within both earth and heavens asks for a different approach to celestial physics, with unified terrestrial and celestial laws (Kuhn, 1995).

Attempting to explain the movements of the planets, Kepler was the first to model the solar system and the earth as a self-contained and self-governing machine (Kuhn, 1995). The analogy of nature as machinery keeps developing and has its apotheosis precisely with Galileo and the quantification of natural reality: “nothing is scientifically knowable except what is measurable” (Collingwood, 1945, p. 103). This is the final formation of a materialist ontology, where the moment properly defines nature as a scientific object to be studied and, consequently, the goals and methods of scientific enquiry. Switching the analogy of nature from organism to machine means the changes and movements of the natural world are no longer deliberate, moving towards final causes, but are, in fact, the most efficient and effective movements possible: nature’s processes “are not directed or orientated towards the realization of anything not yet existing, they are mere movements” (Collingwood, 1945, p. 103).

Through the development of ideas via the Copernican Revolution, the analogy of nature as machine would culminate in Newton’s clockwork world-machine: “the image of a universe in uniform motion, guided by natural laws, divinely created and controlled” (Allan, 2018, p. 93). As mentioned, Newton was instrumental in building coherence between physics, astronomy, and cosmology – in making sense of the laws that rule this new observed and charted universe where there was no distinction between terrestrial and celestial natural laws. The centrality of Newton’s thought was, thus, in proposing a “rational mechanics” that would expound the “science of motions resulting from any forces whatsoever” (Allan, 2018, p. 93). To this end, Newton presented universal laws of motion to explain the behavior of earthly and celestial objects alike” (Allan, 2018, p. 93). In this sense, the Newtonian method is understood as the search for natural laws, that would be able to impart the truth, the inner workings of the harmonious, orderly system that is the universe (Allan, 2018). Here, one can see the Neoplatonic parallels in the search for the true *modus operandi* of the world, the order behind the appearances of phenomena.

The universe of Newton’s corpuscular world machine, then, completes conceptually the Copernican Revolution by making the sun-centric, planetary-Earth astronomy physically and cosmologically plausible – Newton’s laws of motion and gravity bring coherence to this post-Aristotelian world. Most importantly, however,

this clockwork universe “was a new way of looking at nature, man and God – a new scientific and cosmologic perspective which, during the eighteenth and nineteenth centuries, repeatedly enriched the sciences and reshaped both religious and political philosophy” (Kuhn, 1995, p. 261).

Therefore, *the final cosmology of the Copernican Revolution brings about changes in regards to the understanding of space and time, as well as developing a different epistemology and ontology* compared to the Aristotelian Universe – in few words, “Newton takes up against Aristotle the Neoplatonic position” (Koyré, 1956, p. 161).

More at length, concerning time, instead of cyclical and eschatological time being divided between the celestial and earthly realms, Newton proposes “uniform, absolute, mathematical time” (Allan, 2018, p. 93). Time is, then, a reality in itself, existing without regards to anything external to it (Koyré, 1957). Time is, also, necessarily progressive; it unfolds and follows continually, always (Allan, 2018). Space, likewise, is thought of as absolute space, an existence in itself, in no need of substantiation from anything external to it; it “remains always similar and immovable” (Koyré, 1957, p. 161). Both of these elements, the creation of a different way to conceptualize space-time comes with metaphysical and cosmological implications (Koyré, 1957, p. 169).

Concerning ontology, the change was, as mentioned, a move towards a materialist ontology; and with reference to epistemology, the scientific developments, and developments on the very meaning of science, of the Copernican Revolution directly challenged the old patterning episteme (Allan, 2018). The mere change from an organicist to a mechanical comprehending of nature would erode support of a patterning episteme and move towards a representational episteme, based on a smooth translation from objects to a conceptual order – the aim is to “map reality with a system of quantitative signs” (Allan, 2016, p. 93). This means that, firstly, the mathematical investigation and representation of nature becomes the source of valid knowledge and, secondly, there is a strengthening of the idea of a true and accurate relationship between sign and referent (Allan, 2016). In short, the Copernican Revolution moved the legitimate acquisition of knowledge from a patterning (more Aristotelian inspired) episteme to a representational (more Neoplatonic inspired) episteme “in which the role of knowledge is to map reality from an objective, external standpoint” (Allan, 2018, p. 93).

Altogether,

From Copernicus to Newton, natural philosophers constituted a cosmological discourse with three main elements: a materialist and mechanist ontology; a representational episteme; and a new concept of time as an absolute, open plane. [...] [This cosmological configuration] was used to challenge and reconfigure political discourses. This cosmological shift in natural philosophy soon rippled through the fabric of thought, altering ideas in economic thought, political philosophy, and practical administration (Allan, 2018, p. 95).

In this sense, it can be seen how, by introducing new problems and small breaks with old systems of thought, Copernicus' original work ended up exhibiting how scientific discourses are embedded in a more general and comprehensive fabric of thought and world-making – his work ended up displaying the interconnectedness of astronomy, natural sciences, philosophy, and political interpretations of the Universe (Allan, 2018). *It serves as a fundamental moment that shows not only the creation of a scientific cosmology, but the construction of modern science in itself, the modern role of science as a discourse that has authority over cosmological discourse. Thus, the Copernican Revolution can be seen both as a heliocentric cosmology, and as key element in the link of scientific authority and world-making practices.*

3.2.3. Threefold outcomes

The Copernican Revolution is considered to be a revolution in ideas, but also a scientific revolution – an advancement in old theories by adding data, shifting views and adapting methods (Kuhn, 1995). In regards to science, then, the Copernican Revolution was simultaneously a moment of key developments in the *formation of modern science* (Koyré, 1957; Collingwood, 1945) and a key moment in *establishing the role of science*, in this iteration, in modern society (Kuhn, 1995; Graukroger, 2007). In other words, the structuring of science during the centuries that span the Copernican Revolution serve both to solidify the values, methods and goals of modern science and place it in a specific position within the organization of society, two things which feed into each other.

During this time, it is mostly with the work of Galileo that the elements of modern science “reaches maturity” (Collingwood, 1945, p. 103) with the definition of a proper object of study and a focus on quantification and observation. Moreover, in itself, the invention of the telescope and ramification it had regarding establishing the importance of observation, data collection and the jumpstart of an instrumental phase of science, which came to be solidified as a fundamental part of scientific inquiry in a sense that the development of science, from the invention of the telescope on “became so closely linked together with that of its instruments that every progress of the one implied and involved a progress of the other” (Koyré, 1957, p. 90).

The most important feature, regarding the discussion at hand, in Galileo’s iteration of science follows his affirmation that:

Philosophy is written in this grand book, the universe, which stands continually open to our gaze. But the book cannot be understood unless one first learns to comprehend such language and read the letters in which it is composed. It is written in the language of mathematics and its characters are triangles, circles, and other geometric figures without which it is humanly impossible to understand a single word of it; without these, one wanders about in a dark labyrinth (Galilei, *The Assayer*, p. 237-238 *apud* Harries, 2001, p. 265).

A few relevant things stand out in this assertion: (1) there is a truth, an underlying reality, that can be reached; and (2) human knowledge is capable of reaching this reality and this science is not only capable of affirming the truth, but the pursuit of truth and reality should fundamentally guide the pursuit of science (Harries, 2001). Galileo’s *claim to truth* is central to modern science. As a reminder, this belief in the search for a true reality which science could access comes from a Neoplatonism fostered throughout the Copernican Revolution – in so many words: “The Neoplatonist leaped at once from the changeable and corruptible world of everyday life to the eternal world of pure spirit, and mathematics showed him how to make the leap” (Kuhn, 1995, p. 128).

The search for this underlying truth requires, then, two things, according to Copernicus: any scientific presupposition has to align both with the best observation

and, following Ptolemy, with what we understand to be the essence of nature (Harries, 2001). To define this essence means a definition of an ontology of nature¹⁰, the object of study in question, “which in turn prescribes a certain form of description. A commitment to such a form of description is inseparably linked to the scientists’ claim to truth” (Harries, 2001, p. 235). Importantly, for Copernicus, is that truth is necessarily linked to freedom – the freedom to imagine new explanations, to analyze data, to conduct examinations, etc. (Harries, 2001).

Provided freedom, then, any unprejudiced observer is considered capable of claiming the truth (Harries, 2001). If before the truth could only be affirmed by theologians, through the reading of the Scripture, *now natural philosophers are the privileged custodians of the truth*, accessed not by theology, but by human reason, human means – an “anthropocentric conception of truth” (Harries, 2001, p. 276). Two things go hand in hand, then: an affirmation of the autonomy and authority of scientific reason and the affirmation of an anthropocentric humanism (Harries, 2001). Again, these feed into each other in the sense that science is the means that humanity has to access truth, thus, human reason is uplifted, which asserts that science is the better way to claim truth, and so on and so forth.

Therefore, this development of natural philosophy in proposing a new cosmology and establishing the position of science in modern society it “redefined humans [...] as reasoning, knowing beings capable of building cumulative knowledge of the world” (Allan, 2018, p. 95). In this sense, the very privileged place that science has as a claim to truth is irrevocably connected to a granting of authority to human reason:

Copernicus’s confidence in the astronomer’s ability to lay claim to truth seems to have its foundation in humanism [...] a humanism that fused pagan philosophy [...] with Christian themes and the Hermetic tradition. Faith in the attunement of human reason to reality triumphs here (Harries, 2001, p. 232).

¹⁰ Harries (2001) argues that this ontological formulation, for him connected to Christian humanism and the interpretation that “God created the world so that it could be known by us humans” (Harries, 2001, p. 241), results in an inherently aggressive and exploitative relationship to nature, culminating in the modern technological world “which looks at nature primarily as a source of materials” (Harries, 2001, p. 241). In this sense, a new relationship to nature would imply the necessity of a new ontology – more on this search for a new ontology, committed with an ethics of responsibility to the natural world, is discussed in Chapter 4.

Reason here is of great prominence – the universe is understood as governed by reason (even when divine reason) that can be comprehended and apprehended by humanity. Thus, not only science is capable of claiming truth, but, more so, the human has the ability of seizing truth through the scientific endeavor (Harries, 2001) – the human is not cut off from the truth, we can access it through science.

In this sense, the connection between the elements is noteworthy: *between a heliocentric cosmology, science as an institution, and human reason and anthropocentrism*. This connection is succinctly evidenced in the affirmation that Copernicus “meant to claim truth for his heliocentric view. Astronomy should offer us more than a calculus consistent with observations. Even if it might fall short of the mark, it should at least seek to describe reality. This assumption presupposes that we are not cut off from the truth.” (Harries, 2001, p. 227). The three sentences list the three elements: cosmology, science, and human reason.

The connection between these three features is through *authority*: the heliocentric cosmology constructed throughout the Copernican Revolution, instead of diminishing man in the grand scheme of things, places humanity as a symbol of authority:

It has often been pointed out [...] that the destruction of the cosmos, the loss, by the earth, of its central and thus unique (though by no means privileged) situation, led inevitably to the loss, by man, of his unique and privileged position in the theo-cosmic drama of the creation, of which man was, until then, both the central figure and the stake. [...] Yet this was not so in the beginning. The displacement of the earth from the centrum of the world was not felt to be a demotion. Quite the contrary (Koyré, 1957, p. 43).

That is because the breaking of the two-sphere universe, through the notion of planetary Earth, although literally de-centering men, “far from diminishing the scope of man’s powers, vastly enlarged it, for it taught him that scientific laws established by him on earth would hold good throughout the starry heavens” (Collingwood, 1945, p. 97). With the assertion that knowledge from the earth yields direct knowledge of the heavens (Kuhn, 1995), science suddenly has authority over

the truth spanning the entire universe, no longer limited in its scope just to earth's nature.

In short, the Copernican Revolution serves to assert three elements of modernity: *a scientific heliocentric cosmology that affirms the possibility of comprehensive knowledge, the establishment of the institution of science, avowed as the legitimate holder of truth, and a firming of the authority of human reason.* Of course, these relate in a multitude of ways – the cosmology developed affirms the excellence of human reason and simultaneously it is a faith in this reason that legitimates the cosmology at hand; an authority of human reason puts prominence in the scientific endeavor, which reiterates the importance of reason; etc.

As such, the Copernican Revolution is seen here both as a development of a scientific cosmology and the development of modern science as an endeavor that has authority to assert cosmological discourse – similarly, the dissertation proposes the reading of ESS as a descendant from this formulation of modern science *and* exploring the cosmological elements that stem from it in the form of the Anthropocene. So, with this understanding of the Copernican Revolution, the discussion will move on to assess the affirmation of Earth System Sciences as a second moment of a revolution and take a critical look at the role of ESS and the Anthropocene in these three aspects.

3.3.

Cosmological elements of the Anthropocene I: Earth System Sciences and the “second Copernican Revolution”

3.3.1.

The Anthropocene of the global subject

The Copernican Revolution is held as a key moment in western thought for it was paramount in the transition from the medieval to the modern period of western thought and society (Kuhn, 1995) – the revolution brought about astronomical, scientific, and philosophical changes; it altered western's man relationship to the universe and to God, changed itself the positioning of God in the universe, and altogether influenced the values and purposes of western man and society (Kuhn, 1995). A few hundred years later, now, in 1999, H. J. Schellnhuber put forth the idea of Earth System Sciences as being a second Copernican revolution and argued that:

optical magnification instruments once brought about the Copernican revolution that put the Earth in its correct astrophysical context. Sophisticated information-compression techniques [...] are now ushering in a second ‘Copernican’ revolution. The latter strives to understand the ‘Earth system’ as a whole and to develop, on this cognitive basis, concepts for global environmental management (Schellnhuber, 1999, p. 19).

In his article, Schellnhuber (1999) connects the scientific revolutions throughout western history through a line of technological advancements that augment human vision: firstly, the invention of a functioning microscope would be a turning point in scientific history, with the transcendence of natural limitation of the human eye there could finally be an exploration of a previously unknown microcosmos; simultaneously, the invention of the telescope was of great importance for the cosmological formulation of the Copernican Revolution, as was seen in the last section, a revolution that, for the author, “finally put the Earth in its correct astrophysical context” (Schellnhuber, 1999, p. 19). In short, for the author “when Enlightenment came, its ultimate triumph was based, literally, on light – the ability to process radiation received from objects of specific interest” (Schellnhuber, 1999, p. 19).

In this context, development of Earth System Sciences is understood along the same strands of optical amplification and augmentation, which will now allow for the comprehension and apprehension of the entirety of the Earth system in a culmination of technological developments and scientific advances that would result in a second Copernican revolution (Schellnhuber, 1999). Still, whereas the Copernican revolution consisted in a moving away from the Earth as a center of thought, and the placing of it amongst an infinite universe, “this new revolution will be in a way a reversal of the first: it will enable us to look back on our planet to perceive one single, complex, dissipative, dynamic entity, [...] the ‘Earth system’” (Schellnhuber, 1999, p. 20).

Therefore, the heart of this second Copernican revolution is the focus on a holistic view of the planet – to conceive it not as separate micro-dynamics, but as a whole entity in itself. In regards to technology, then, the author insists that the second Copernican revolution needs to be reliant in macroscopes to successfully achieve a complete vision of the Earth system (Schellnhuber, 1999). In contrast to

microscopes, macroscopes reduce the image viewed, thus “giving Earth-system scientists an objective distance from their specimens” (Schellnhuber, 1999, p. 20).

The author thus provides three possible ways to achieve the desired holistic perception: firstly, the ‘bird’s-eye’ principle, which consists in taking a panoramic view of the Earth from a distance, achieved, as was discussed in the first chapter, by the famed photograph taken in the 1960s, the “now-familiar image of our blue planet floating in the middle of a dark, cold nowhere” (Schellnhuber, 1999, p. 20); a second macroscopic technique is the digital-mimicry principle: a construction of the Earth System through simulation modelling, which can vary the focus and augmentation as needed; over the years, simulations of the Earth system became deeply embedded in ESS practices, a central part of the discipline, as was seen in Chapter 2; finally, the third macroscopic technique proposed by the author is the ‘Lilliput’ principle, which is the building of artificial biospheres in a small scale, that is, the physical reconstruction in a limited space of a grandiose part of the ecosphere, based on available data - so that “such a nano-planet can be conveniently scrutinized for operational stability or emerging self-organization processes” (Schellnhuber, 1999, p. 20). In pondering over the future of ESS and its macroscopic instruments, Schellnhuber states that most likely a mixture of the three techniques would be developed and flourish, particularly of the first two principles, which has indeed happened, as per the discussions of Chapter 2.

In any case, Schellnhuber argues that macroscopes are a “diagnostic instrument” (Schellnhuber, 1999, p. 20) and links Earth system scientists to *doctors of the Earth system* – he argues that, firstly, the Earth system is analogous to the human body, in a way that “the continuing investigation into the Earth’s physique is in many respects reminiscent of the exploration of the human body during the Renaissance” (Schellnhuber, 1999, p. 20), and, secondly, by knowing that the ES changes with the interference of human action, it is a matter of responsibility to form a human society that properly takes care and maintains the Earth System. In Earth System Sciences this medical analogy has developed, being understood that “scientific work became dressed with a considerable ethical task and responsibility” in a way that Earth system scientists became understood as “physician[s] of the Earth, one who sought knowledge with the purposes of healing the Earth” (Haymann and Dalmedico, 2019, p. 1145). In short, then, “the macroscope is a

diagnostic instrument, generating evidence necessary for treatment” (Schellnhuber, 1999, p. 20).

What this means for the author is that humanity is confronted with a control problem, geo-cybernetic in nature – what is understood as a ‘control problem’, in cybernetics, regards a system composed of variables, and the state of the system at future time is controlled by the choice of the control variables. The main ambition in a control problem is to move the system towards a specific optimal target state. In this sense, when the author refers to a control problem in respect to the Earth system, he envisions humanity’s task of maintaining this system, the planet, in an optimal target state – this undertaking, in its turn, is summed up in three main questions: “first, what kind of world do we have? Second, what kind of world do we want? Third, what must we do to get there?” (Schellnhuber, 1999, p. 20).

The system in question, the Earth system, in Schellnhuber’s mathematical abstraction is composed of two main components, the ecosphere (N) and the human factor (H), which are further broke down, the first in sub-spheres, and the second between an anthroposphere (A) and a global subject (S) – the anthroposphere being the “aggregate of all individual human lives, actions and products” (Schellnhuber, 1999, p. 20), a physical byproduct of the material existence of all humans; the global subject, in its turn “represents the collective action of humanity as a self-conscious control force” (Schellnhuber, 1999, p. 22). The global subject is a product of the second Copernican revolution, of the advancements and research in Earth System Sciences, and it will use the information acquired through ESS to manage and bring the Earth system back into a healthy, optimal state by establishing a global, cooperative system of universal values and decision-making:

The building and application of macroscopes will be of tremendous help to the global subject in finding its identity. An ever-evolving Earth-observation system will allow S to watch its own footprints on the ecosphere, and Earth-simulation models will enable S to make collective ‘rational choices’ on the system’s level. Finally, densely linked global institutions, as well as innumerable worldwide activists’ networks, will help enforce resolutions of S, such as those made in international environmental conventions. This is the emergence of a modern ‘Leviathan’ (Schellnhuber, 1999, p. 22).

In short, then, *by bringing the focus back to Earth and composing an Earth system, Earth System Sciences is a harbinger of a second ‘Copernican’ revolution in the sense that it would correctly represent the functioning of the Earth system and bring about a new formation of humanity, the global subject, whose purpose is to manage and care for the ES by keeping it in an optimal, healthy state.* ESS, thus, is a crucial part of political decision-making, by being the bringers of the revolution and holders of information regarding the diagnostics of the Earth. In order to complete the second Copernican revolution, then, humanity must accept this responsibility and become a global subject that will use the information and guidance of ESS to care for the Earth through globalized political action (Schellnhuber, 1999).

In the terms brought up in the last section, then, the second Copernican revolution consists in the formation of a particular scientific cosmology, a specific comprehending of the world and the place of the human within it; in this case, the Earth system, composed of an “unalterable symbiotic relationship” (Miller, 2003, p. 43) between Schellnhuber’s ecosphere and human factor, or Bretherton’s biogeochemical cycles and physical climate system and human activities, etc. Also, this moment relates to a particular place attributed to science, and the overall role of accurate science in guiding and keeping the ES healthy: it is through a second Copernican revolution that the correct human behavior in its relation to the ES will be achieved (Miller, 2003). Finally, the idea of the global subject brought about by the revolution, relates to the primacy of human reason, which is understood to be the prism with which to relate to the natural world. Also, morality and moralism appear as especially important in the political process in which ESS is involved (Heymann and Dalmedico, 2019) – there is an underlying implication of good science being able to define the correct, responsible and ethical way of organizing Humanity, dealing with climate problems, and overall managing the place of the human in the Earth system, a place of control and care.

The premise of a second Copernican revolution is furthered delved into with Schellnhuber, Crutzen, Clark and Hunt (2005) – they affirm that the Copernican Revolution was responsible for a more accurate picture of the cosmos, putting the Earth in its correct placement in the infinite universe, but it was also, most importantly, the first step in the journey towards the Enlightenment, the moment that properly developed the scientific principles of exact and objective reasoning:

“Thus the great Copernican Revolution generated a paradigm of science, where the lonely scholar wrestles with Nature in order to snatch some of her secrets encoded in mathematical formulae of utter beauty” (Schellnhuber et al, 2005, p. 7).

The authors argue, then, that a second Copernican Revolution is underway, stemming from the original one, but transcending it in three important ways: (1) by redirecting the focus of research from outer space back to Earth, now conceptualized as the Earth system; (2) by paying attention to the limitations of the understanding of a complex system, which presupposes nonlinearity and irreproducibility; and (3) by understanding that knowledge production is necessarily within a specific cultural-historical context, making the scientist also a part of the enquiry (Schellnhuber et al, 2005).

For the authors, these caveats permit the construction of a co-productive mode of knowledge production that allows for the second Copernican revolution to successfully establish a “new contract between science and society” (Schellnhuber et al, 2005, p. 7). Thus, Earth System Sciences pushed a new, post-Copernican, scientific paradigm that started with the conceptualization of the Earth system and culminates in the appropriate application of knowledge through global integration programs, such as the Amsterdam Declaration, mentioned in Chapter 2.

With that, considering that ESS provided a new picture of the Earth, a global Earth system, and solidified the role of science in global politics, the authors indicate that the second Copernican revolution encompasses a second Enlightenment (Ayestaran, 2008), mimicking the aftermath of the Copernican revolution narrated in the paper. So, while the Copernican revolution was understood as responsible for positioning the Earth and humanity in its appropriate astrophysical context, the second Copernican revolution would be tasked with putting humanity in its proper environmental nexus, defining and guiding the correct relation to the Earth system (Ayestaran, 2008; Miller, 2003) – essentially placing the human in its correct placement amongst the cosmos.

This guidance is connected to the notion of ‘noosphere’, mentioned in the last chapter, the pinnacle of human rationality, the sphere of human consciousness, which is what brought about the Anthropocene by its ability to influence the biosphere, what diagnosed the Anthropocene by its scientific capacity, and what is ultimately tasked and capable of correcting the course of human action and delineating a healthy relation with the Earth system. In short, then, regarding the

second Copernican revolution: “All these facts and data [relating to the Anthropocene] imply a new science paradigm. The study of the Earth system and the Anthropocene needs a new and global scientific program to develop a sustainable noosphere” (Ayestaran, 2008, p. 151).

Still, as it was discussed in the last section, the Copernican revolution was deeply related to cosmological elements that influenced the political narrative and understanding of goals and purposes of a specific formulation of humanity (Allan, 2018) – and in this sense, the conceptualization of the Earth system does appear to have cosmological elements, which can, however, be interpreted in different ways and construct different political narratives. In this case, within the argument of the second Copernican revolution, the cosmological elements of the Anthropocene follow a modernist logic (Allan, 2018), constructing the purposes of the noosphere, around the figure of the global subject¹¹.

The Earth system implies a change in the ontological and epistemic elements of the study of nature by “reconceptualizing the physical process” (Allan, 2018, p. 279) – if the Newtonian natural universe was analogous to a clockwork machine and is studied via the establishment of laws and understanding of regular motions, the Earth System, with its non-linear feedbacks and complexity, breaks away from such mechanical ontology and epistemology and rests on different analogies: “if the Earth system is a clockwork at all, then it is an organismic one that baffles our best anticipatory capacities” (Schellnhuber et al, 2005, p. 7).

According to Rudwick (2014), this loss of predictability is related to the deep history that accompanied the construction of the Earth system – with deep time as a change in temporality along with the change in spatiality predicated by the Earth system. In this sense, all of the data collection and research that led to the separation between the Holocene and the Anthropocene, that described the different phases and states of the Earth system, served to put into focus a timescale usually unimportant to politics, that of deep time, of stratigraphical time spanning millennia before human existence and history, time that constructs Earth’s deep history (Rudwick, 2014). Therefore, in general, “by embedding humans in geologic time, the Anthropocene narrative broadens time horizons” (Allan, 2018, p. 279) and

¹¹ A different interpretation of a possible cosmological formation related to the Anthropocene, with distinct political consequences, is discussed in section 4.1.

seems to be associated with complexity and non-linear processes of the Earth system:

ecology and complexity theory depict a world of active, nonlinear, and chaotic processes. The dominant temporality in Earth systems would not then be the linear development [...] but a dynamic interplay of organic and inorganic matters. Indeed, the Anthropocene may require us to grapple with multiple, overlapping temporalities that collide to produce unexpected outcomes (Allan, 2018, p. 279).

Time and space are thus characterized by complexity and chaos, two features apparent in the discussions of the second chapter, and one of the challenges of the Anthropocene and of Earth System Sciences is in dealing with such constant crisis, which leads to a particular relationship between past, present, and future. To start with, most of the research stemming from Earth System Sciences regarding the Anthropocene is very future-oriented: its goal is to simultaneously point to trends of destruction and decay and come up with solutions for a better possible future. In this sense, ESS builds the Anthropocene as a stratigraphical unit of time that closely follows anthropogenic destruction to the environment by tracing from the past and projecting a future, that must be escaped: “Navigating the Anthropocene requires a systematic thinking about the future, as both drivers and consequences (intended, unintended, and unanticipated) of societal actions accelerate and amplify, moving clearly away from a sustainable end” (Bai et al, 2016, p. 352). Thus, the ultimate goal of ESS is to “understand and shape” (Bai et al, 2016, p. 353) potential futures, through the practice and application of scientific methods.

Although forecasting of the future is never affirmed with absolute certainty (Bai et al, 2016), human’s cognitive limits and the possibilities of action regarding analysis of the future and future decision-making are constantly trying to be overcome through modelling. Modelling here takes a very important position within the methods used to analyze the world - models, then, “act to condense a dispersed spatiotemporal problem into an immediate and intuitive representation” (Srnicek, 2013, p. 147), by doing so, they accumulate data from the past, project it upon possible futures and allow for a normative interpretation of the value of that supposed simulation (Srnicek, 2013).

Thus, within Anthropocene thought, science and politics come together to analyze desirable futures (Brondizio et al, 2016) and trace current actions that will bring the world closer to these projections (Steffen et al, 2011b). In other words, ESS collects and uses data from the past, input this information to model simulations to help with political choices in the present, so that a future in chaos can be avoided. Hence, past, present and future are connected linearly, with a past in a state of equilibrium and balance which allowed for humans to develop (Crutzen, 2002), a present where crucial decisions are being made regarding “how the future *should* be” (Brondizio, 2016, p. 321, emphasis added), and a future constantly out of reach, but looming over, threateningly. Further, repeated simulations constantly reevaluate the future, as a way to reassess on current strategies (Srnicek, 2013).

This seems to be a part of the destiny envisaged for humanity in this particular narrative of the Anthropocene of the global subject – *the ability to diagnose the Anthropocene and prescribe the correct course of action for the mitigation of crisis means that within this cosmology the human, or specifically the rational human, is an active agent in the making of the world*, which is a recurring theme in Earth System Sciences literature: “the Anthropocene is the only -cene were the active agent within it is trying to define the -cene” (Bai et al, 2016, p. 17), or “at the global scale, this paradigm challenges humanity to become active stewards of our own life support system” (Steffen et al, 2011, p. 749). To be an agent, in this sense, means to be self-conscious (Steffen et al, 2007), and effectively achieve maturity (Lövebrand et al, 2009).

As was discussed, the transformation in man’s conception of the universe, and his purpose and relation to it, implicated here through the Anthropocene and the figure of the self-conscious global subject, is accompanied by transformations in man’s understanding of nature and how he relates to it (Kuhn, 1995). Also mentioned, was the fact that changes between cosmological formations are not complete ruptures and views seep into each other (Allan, 2018) – thus, even though indebted to Newtonian physics and embedded in these astronomical traditions of thought, other elements and developments on modern view of nature influence ESS’ construction of the natural world. This modern version of nature, then, has remnants from previous iterations, but is ultimately based on a different analogy:

As Greek natural science was based on the analogy between the macrocosm nature and the microcosm man, as man is revealed to himself in his own self-consciousness, as Renaissance natural science was based on the analogy between nature as God's handiwork and the machines that are the handiwork of man [...] so the modern view of nature, [...] is based on the analogy between the processes of the natural world as studied by natural scientists and the vicissitudes of human affairs as studied by historians (Collingwood, 1945, p. 9).

Thus Collingwood (1945) centers historical studies, and its particular ability to deal with change, as an important element to the formation in any modern conception of nature. Before, dealing with change, with processes in motion, was an issue that limited the answer to the question 'under what conditions is knowledge possible': knowledge construction, both for the Greeks and in Renaissance¹² thought, was presupposed on the idea that "nothing is knowable unless it is unchanging" (Collingwood, 1945, p. 11). As was seen in the last section, then, previous Renaissance cosmology posited the ability to produce knowledge about the natural world in the existence of a true, unchanging, reality, that was to be reached through the scientific endeavor; also, the apparent change which was perceived by the senses, the change of the "arrangements and dispositions" of the true underlying reality followed laws, which were themselves unchanging (Collingwood, 1945, p. 11). In contrast, however, by the 19th century, historians were considered to think scientifically about a human world of ceaseless change, a realm of human affairs with no underlying unchanging reality and no fixed laws: "[i]t had thus been proved by experiment that scientific knowledge was possible concerning objects that were constantly changing" (Collingwood, 1945, p. 13).

It is easy to see how this readjustment influences Earth System Sciences, starting from the understanding of Earth system scientist as historians of the Earth and of "human futurity" (Chakrabarty, 2019, p. 27) – the Anthropocene itself is rooted on change: stratigraphic change, the constant changes within the complex

¹² Here it is important to note that Collingwood (1945) uses the term Renaissance cosmology to refer to the specific view of nature during the sixteenth and seventeenth centuries. In his text, the author clarifies that the term should more accurately be 'post-Renaissance' considering the use of Renaissance to refer to an earlier historic period, "beginning in Italy with the humanism of the fourteenth century and continuing, in the same country, with the Platonic and Aristotelian cosmologies of that century and the fifteenth" (Collingwood, 1945, p. 4).

system that is the ES, and all of the subsequent changes, with the most pronounced being the breakdown of a complete separation between Man and Nature. So, with this supposed change in understanding of the natural world, now ever-changing, complex, and quickly spiraling out of control, it seems that the destiny within this framework of the Anthropocene, the purpose of human action “demands not that humans reduce their influence over the rest of nature nor does it demand fundamentally new relations between humans and nature but, rather, demands that humans take a firmer grasp upon nature, to supervise it, and regulate it” (Stubblefield, 2018, p. 8). In short, the purpose of the global subject becomes to find appropriate solutions to “reconcile nature and society” (Ehlers and Krafft, 2006, p. 6).

Thus, being an active agent in the Anthropocene, self-conscious, rational, and mature, would require actively designing a supervising system, to effectively guide and manage a sustainable relation between humans and the Earth system, on a global, universal, scale:

To develop a world-wide accepted strategy leading to sustainability of ecosystems against human induced stresses will be one of the greatest tasks of mankind, requiring intensive research efforts and wise application of the knowledge thus required in the noösphere (Crutzen, 2006, p. 17).

This, then, describes the entrance to the third stage of the Anthropocene, presupposed precisely on the human capacity to be self-aware of its impact in the Earth system and use its rationality to steer itself and the planet in a more healthy and stable direction (Steffen et al, 2011a) – to recall, as discussed in Chapter 2: the first stage of the epoch is considered the Industrial Era (1800-1945), where Man achieved the capacity to rival ‘the great forces of nature’ the second is the Great Acceleration (1945-2015), where human action picked up speed and impact around the globe, and, finally, the third stage, named “Stewards of the Earth System” refers to the newfound capacity of humans to steer the planet, pertaining to the new scientific discoveries on how the ES works. Here, one can see the inherited attitude endowed to modern sciences: “an unbounded faith in the power of human reason to solve the problems of nature” (Kuhn, 1995, p. 123).

In the case of the global subject, the subject of a world-wide noosphere, the relationship between humanity and the Earth system is to be managed through global governance systems.

3.3.2.

Steering the planet through international governance regimes

In his discussions of cosmology, Allan (2018) aims specifically to connect European scientific cosmologies to international orders in a way that the goals and purposes delineated by cosmological thought influence the understanding and objectives of a related international order. In short, he defines international orders as constant patterns of behavior and relationship between states, international organizations, and other international actors, and argues that:

cosmological ideas provide the discursive resources that constitute discourses of state purpose. [...] The central premise of my generative structure of international order is that beliefs, norms, goals, and values draw their meaning and appeal from ideas about ontology, episteme, and other cosmological elements (Allan, 2018, p. 33).

In this sense he delves into three different scientific cosmological formations and their relation to associated world orders throughout history (firstly, between 1550 and 1815 he connects natural philosophy with European balance of power; secondly, he investigates Darwinism, social knowledge and developmental ideas within the British Colonial Office and the League of Nations between 1850 and 1945; and finally, he links neoclassical economics and focuses on growth to the postwar international order and the World Bank between 1945 and 2015). Regarding the strength he attributes to ideas within scientific cosmologies to influence world orders, Allan (2018) points to three factors: (1) the transnational dissemination of the ideas, (2) their authority to be problem-solvers to international issues, (3) the ease with which to use them to “articulate universalist claims and naturalize goals” (Allan, 2018, p. 63).

In his conclusion, the author explores differing current cosmological formulations and speculates on the possibility of their influences in norms and values of an international order, amongst which the Anthropocene is included. With the elements of the Anthropocene discussed thus far, it is possible to locate how it

can be a scientific idea that “redefined humanity’s role in the cosmos [which] had major implications on discourses of political purpose” (Allan, 2018, p. 69) – having significance both through its cosmological formulations of nature and man’s purpose in regards to it, and of its establishing of the role of good science as guiding good politics, particularly international politics in a way that “Earth System Science seeks to foster rational and responsible choices on the system’s level” (Lövebrand et al, 2009, p. 10).

Thus, in the organization of a response to disequilibrium of the Earth system on an international level, scientists in general, and Earth System sciences in particular, takes on a crucial role of supervising the planet through its “expert knowledge and technological administration” (Stubblefield, 2018, p. 5) – in short, “scientific knowledge can be said to represent important ‘intellectual machinery’ for governments.” (Lövebrand et al, 2009, p. 9). In the case of modelling, for example, a technique used to describe specific problems stemming from the environmental crises and project possible solutions:

governments have progressively incorporated climate modelling centres into their circuits of knowledge production and decision. There has been a creation of two-way interactions between climate models and policymakers, fully integrating the two together into a single cognitive assemblage. Rather than scientists simply working on their own projects and eventually bringing issues to the political sphere, politics is now actively reciprocating the flow of information and dictating to modelling centres what information they require. As a result of this, governments are now seeking to integrate climate modelling not only as a tool to prove climate change, but also as a cognitive prosthesis for making decisions about adaptation (Srnicek, 2013, p. 135).

Modelling, in particular, is actively important in the formation of the proper space for governing the issues of the Anthropocene: as mentioned, one of the key elements in Earth System Sciences and in the imagining of the Earth system is the visualization of a unified globe – stemming from meteorology, the very construction of “technical systems for the gathering of global data helped to create global institutions and ways of thinking globally” (Edwards, 2019, p. xix) that

founded and maintain ESS' political understanding. In fact, the forms of satellite data-collection, and the original NASA picture of the Earth, which set up the structure of Earth System Science established from early on the “birds-eye” principle of the discipline, cited by Schellnhuber (1999): “the ability to obtain a panoramic view of the Earth by observing it from a distance” (Lövebrand et al, 2009, p. 9) which, in its turn, was formative in framing ESS and environmental concerns as global in nature (Lövebrand et al, 2009) and, as such, universal in nature, since “[r]ather than the view from nowhere [...] [these] global kinds of knowledge claim to offer the view from everywhere” (Hulme, 2019, p. 559, 561 *apud* Hamilton, 2016, p. 14).

Further into the history of the discipline, models would serve to firmly fix a global visualization of Earth system issues and thus promote an internationally integrated source of action. This unifying force of models is considered a great strength by not identifying winners and losers within costs and benefits of policy proposals in terms of national interest (Edwards, 1996) and consequently help in promoting “truly global interests” (Bai et al, 2016). In this sense, Earth System scientists and modelers actively work to construct a unifying view of the global environment (Miller and Edwards, 2001) in order to achieve a “globalist approach to global change politics” (Edwards, 1996, p. 7) that effectively moves responses from regional impacts to global management options (Mausser, 2006; Miller and Edwards, 2001).

As a consequence, this presupposes a “Humanity” as a universal, unified, and somewhat homogenous category: this Anthropocene “is involved in the making of a new kind of population, namely humankind for the first time understood as a major geological force” (Lövebrand et al, 2009, p. 8). Indeed, the basic premise of the Anthropocene concept as a diagnostic of anthropogenic impact in ecological trends is to encompass humankind as a species (Steffen et al, 2011a) – inserted in a diagram along with natural elements, Humans take a homogenized form representing the human species that will, as a whole, interact with the natural world.¹³

¹³ This construction of Humanity in a universal and homogenized form is commonly critiqued within literatures using the Anthropocene, as is pointed out in Chapter 4. Particularly, de-colonial and Global South readings of the Anthropocene criticize the pervasiveness of this reading that ignores inequalities and injustices amongst different nations and societies, especially in the context of

This universality, in fact, is aspired and aimed for within ESS writing, given that the goal of the solutions presented by the literature is to guide the world and Humanity, human society, acting together as one. Differences in values and desires amongst societies are understood to be a problem, given that this diversity would ultimately serve as egotistical self-interest and, thus, “make collective decisions about any planetary future highly difficult” (Bai et al, 2016, p. 355). In contrast, then, ESS tools serves as the better way to truly compose ideas and institutions for “managing [...] collective lives in global scale” (Miller and Edwards, 2001, p. 6).

To act as a collective within the Anthropocene is essentially the goal of Earth System Sciences in its merge with international institutionalism – the “Stage 3 of the Anthropocene” where Humanity takes the reins of its effect on the natural world as a collective species needs a unified understanding of the Human:

Humankind will remain a major geological force for many millennia, maybe millions of years, to come. To develop a *universally accepted* strategy to ensure the sustainability of Earth’s life support system against human-induced stresses is one of the greatest research and policy challenges ever to confront humanity. Can humanity meet this challenge? (Steffen et al, 2007, p. 619, emphasis added).

This collectiveness is directly connected with the projection of a desirable future: plans for tracing the future of Humanity aims at establishing “*our* core values” (Steffen et al, 2020, p. 60, emphasis added) and “*shared* visions and goals” (Bai et al, 2016, p. 357, emphasis added) in the development of political action regarding the relationship with the Earth system. Truly, differences amongst Humanity are seen as a problem to be overcome in the name of a universally accepted strategy:

Our point of departure is a recognized need for collective reflection on plausible and desirable futures in the Anthropocene. We consider desirable futures those futures that improve the chances for our societies to surmount the current crises, which

colonization and global capitalism. For more on a critique of a homogenized Humanity see: Chandler et al (2017) Simangan (2020), Schulz (2017), Malm and Hornbog (2014).

are influenced by disparate human values and aspirations (Bai et al, 2016, p. 352).

By centering the questions “what are the futures that *we* want? [...], how do *we* transform towards desirable futures?” (Bai et al, 2016, p. 354, emphasis added) ESS literature effectively regards a singular Humanity, with common interests, goals and social organizations, as a necessity in dealing with the challenges of the era – the Anthropocene is framed as a common crisis which requires a common solution.

In this sense, modelling as a practice that builds knowledge and bids political action and the political actors can be understood as a knowledge regime, a practice that constructs a new world in of itself (Heymann and Dalmedico, 2019). By choosing the variables that will be added in this rendering of reality, and defining the focus of the results, modelling as a tool becomes an effective political agent (Srnicek, 2013) and interferes and molds negotiation processes, action and nonaction (Heymann and Dalmedico, 2019). In other words:

even if the validity of the science is not questioned, GCMs [General Circulation Models] can still encode political assumptions – for instance, giving weight to problems that affect developing countries less than developed countries [...] In this regard, the choice of model outputs is partially political as well: what variable, for instance, does one choose to represent soil depletion or deforestation? In every case, predictions must be generated primarily with the needs of the user in mind (Srnicek, 2013, p. 146).

As a consequence, what the models do not reveal remain outside of the realm of possibilities for the world as any input of information “must be selected (or ignored)” (Srnicek, 2013, p. 146) and through these choices and compositions, and the further choice of which models will be chosen as “the one” to represent the results of research, they enact a way to formulate a shared comprehending and vision of the world that is being addressed (Heymann and Dalmedico, 2019). Ultimately, they bare “performative agency in [their] own right” (Heymann and Dalmedico, 2019, p. 1146).

In this sense, then, the scientific approach that renders the Earth system visual as a globe eventually served to bind science and political action (Heymann and

Dalmedico, 2019). In short, “building the weather and climate knowledge infrastructures spread a specific way of making global knowledge – one whose techniques, values, and implications now extend not only throughout the sciences but far beyond” (Edwards, 2010, p. xix). With that, *politics is effectively understood as rational decision-making* (Edwards, 1996) - here again, models are a crucial tool to expand the cognitive capabilities (Steffen et al, 2020) of policy-makers and move rational, logical and scientific grounded political decisions (Lenton, 2016).

The power enacted through ESS is thus productive, in constructing the globe as the space of the problem (and the solution), in formulating Humanity as a universal category, and in formulating proper political action as international governance regimes and rational decision-making. In few words:

this epistemological activity is central for the constitution of social order: ‘Through their day-to-day conceptual and practical work, scientists classify and reclassify the subjects and objects of nature and society, carving up the world into distinct ontological types and occasionally creating entirely new taxonomic categories’ (Miller, 2007, p. 338 *apud* Lövebrand et al, 2009, p. 8-9).

With that, the representation of politics becomes an international governance regime steered by ESS – the idea of the globe as a unified entity is translated into the political realm as an international governance regime, formulating a framework of Earth System governance, which “requires fundamental reorientation and restructuring of national and international institutions” (Biermann et al, 2012, p. 1306). Actions regarding the management of the climate crisis mostly pertain international decrees; goals of taking care of the environment or establishing limits of growth and implementation of sustainable development are understood to be necessarily pushed forwards in the international arena, particularly within the United Nations (UN) regime (e.g.: Burke and Fishel, 2016). The logic around the perceived strength of international institutions is that the consequences of the climate crisis are not bound by divisions of national territory, and thus, the way to deal with the problems must also overcome national barriers. So, around this logic, the most commonly accepted and defended way to deal with the climate crisis is through an international governance regime.

Usually conveyed through the shorthand of “governing without government”, governance regimes are treaties, rules and regulations that serve to define appropriate norms and behavior regarding a particular issue, so that, through compliance, encouragement through benefits and sanctioning and costs, each actor can regulate itself and keep itself within the desired and defined appropriate behavior. In short, “broadly speaking, ‘governance’ deals with managing, steering and guiding actions in the realm of public affairs” (Baker, 2014, p. 100), in this case, regarding the actions of nations within the international arena.

Mostly, this guiding and steering, with the shorthand of “command and control”, is made through regulations and sanctions (Baker, 2014), meaning that goals and principles are defined and agreed upon and put forth in a semi-voluntary way – with benefits for the actors that comply with it, and sanctions for those that do not: “most environmental agreements are only semi-voluntary, and there is typically some ‘carrot and stick’ involved in the form, for example, of tax reductions, retroactive penalties, threats of future regulation, or license requirements” (Baker, 2014, p. 102).

The concept of governance anchors the way society understands and addresses environmental issues (Baker, 2014) and, consequently, international governance regimes were always the main form of dealing with environmental issues. Governance, then, has influenced the comprehending of good environmental policies in two ways: firstly, by inquiring over which is the best style of governance, between a market-focused or a network-focused, for the best way to achieve the majority of environmental policy objectives, and, secondly, “it [governance] has been used to identify how society ought to be governed in pursuit of sustainable development” (Baker, 2014, p. 101). In this sense, then, the goal of the endeavor is already clearly defined: sustainable development in itself is not questioned but appears as an objectively good goal to aim for and the right way to organize the world society.

Over the years, the rise of environmental issues and the worsening of the climate crisis, both as a platform and as international occurrences, led to an increase in importance, attention, and investment towards global environmental governance (Baker, 2014). In short, global environmental governance is defined as “the establishment and operation of a set of rules of conduct that define practice, assign roles and guide interaction so as to enable state and non-state actors to grapple with

collective environmental problems within and across state boundaries” (Stokke 1997, p. 28 *apud* Baker, 2014, p. 102). Thus, one of the central characteristics of this ‘Earth System Governance’ framework (Biermann et al, 2014) is its universalization and naturalization, elements stressed by Allan (2018) when discussing the possibilities of cosmological discourses; specifically: “scientific discourses can be used to convince all states and groups that a given representation of the world is true and that attempts to govern it in one way rather than another are natural and necessary” (Allan, 2018, p. 69).

As a foundational characteristic, global environmental governance is enmeshed from its beginnings with the atmospheric sciences, which have “contributed in crucial ways to the creation and evolution of these new regimes” (Miller and Edwards, 2001, p. 3). As such, global environmental governance, the most robust and defended way of dealing with the current environmental crisis of the Anthropocene is, by default, an ensemble of “political and scientific institutions and networks” (Miller and Edwards, 2001, p. 3) in which science is tasked with “provid[ing] critical knowledge to help guide humanity’s path towards plausible, desirable and novel futures in the Anthropocene” (Bai et al, 2016, p. 358).

In this sense, by connecting science and politics in a way not just which grounds good individual policies, but also serving to help “set basic rules of standing and legislation for global environmental decisionmaking” (Miller and Edwards, 2001, p. 4) in a more general and universal way, this enmeshment of ESS and global environmental governance is, then, effectively creating a new space for government (Lövebrand et al, 2009), in which the construction of the category of the Earth system implies its protection, according to the set of rules and procedures of Earth System Governance in a sense that these “‘environmentalized’ places become spaces of supervision” (Luke, 1995, p. 65).

Concomitantly, a result of this use of Earth System Sciences in public arenas led to an inversion in the goals of the research overall: whereas “previously regional information was used to answer: ‘Is there an issue?’ now it’s more: ‘How do we respond?’” (Srnicek, 2013, p. 138). In other words, the co-production within this relationship has switched from science driven to policy-driven (Hayman and Dalmedico, 2019) meaning that while before the literature was engaged with defining the Anthropocene and delimiting the normal/abnormal state of the Earth system, now the primary focus of what became solution-oriented research is the

management of the ecological crisis (Stubblefield, 2018). With this, climate modelers in particular and ESS in general were granted a form of authority over global policy contexts (Miller and Edwards, 2011) and ultimately took part in:

delimiting the limits of legitimate scientific and political activity in international relations, thus contributing to the definitions of both “good science” and “good governance” that have characterized the operations of international organizations for much of the past half century (Miller and Edwards, 2001, p. 24).

Hence, international governance regimes are put forth as one possible answer for the Anthropocene crisis – here, connected to a particular narrative constructed from analysis of the Earth system and the Anthropocene affirmed by Earth System Sciences. In other words, there strengthening of international regimes are a specific form of international politics understood to be suited for the epoch, constructed through forms of world-building practices attached to cosmological interpretations of the Anthropocene legitimized by the scientific authority of ESS.

As will be discussed in the next chapter, this is one possible mobilization of the Anthropocene within International Relations literature in general; and governance regimes in particular appear as a possible solution (or at least part of the solution) pertaining to international politics in the Anthropocene epoch. However, Critical IR in particular draws much from another possibility of cosmological interpretation and world-making, which will be discussed next.

4

World-making and international politics: International Relations and the Anthropocene

Before moving on to the final chapter of the dissertation, then, a brief recapitulation of the discussion so far: the work started with an allusion of the Anthropocene as the ultimate world-changing moment, particularly regarding the breaking down of the separation between Humanity and Nature. The Anthropocene is, therefore, heralded by the discipline of Earth System Sciences, and interpreted as the end of the world, and appropriated within International Relations literature. In this movement, the Anthropocene is understood to be the possible end of IR, the threat of the very extinction of the discipline (Mitchell, 2017).

So, in order to explore the appropriation of the Anthropocene by International Relations, the first chapter dove into the origins of the concept; the second chapter broadened the discussion on knowledge production and modern science to locate the discovery of the Anthropocene within a bigger tradition of scientific inquiry and world-making practices; and now, finally, the dissertation will delve into how precisely the Anthropocene has been evolving within IR literature and how this relates to the self-image of the discipline and to the proposals over international politics that the discipline regards itself tasked with doing.

To do so, the chapter will move in the following direction: (1) the discussion on cosmology will be finalized by looking at different cosmological implications of the concept of the Anthropocene, which move a lot of the ethical and political commitments within International Relations Anthropocene literature; (2) such literature will be discussed, paying particular attention to two central texts that propose specific uses of the Anthropocene in the discipline, but also in general, making an overview of the camp; finally (3) a direct analysis of the appropriation will be conducted, going back to the dynamics of problematization, and proposing a re-reading of the IR texts within it.

4.1.

Cosmological elements of the Anthropocene II: Social Sciences and the “counter-Copernican Revolution”

As was mentioned in the introduction of the proposition of the conceptualization of the Anthropocene as a form of cosmological thought, the cosmological elements and interpretations of this time are multiple and develop in different directions; in the modern times, “[w]e are confronted not so much with a

new cosmology as with a large number of new cosmological experiments” (Collingwood, 1945, p. 9). In this sense, the Anthropocene time has two distinct possible cosmological narratives (Allan, 2018), one being the “modernist” conception of the Anthropocene (Allan, 2018) defined in the last chapter as the Anthropocene of the global subject, associated with the supposition of a second Copernican revolution.

On the other hand, a supposedly different narrative regarding the Anthropocene can be constructed around contrasting interpretation of the constellation of cosmological elements, more connected to the ethical implications of the Gaia hypothesis, mentioned in Chapter 2, and focusing on the idea that the Anthropocene “undermines representations of human mastery over nature” and thus “challenges the narrative that humans, and thus the state, can exert control over reality” (Allan, 2018, p. 281). This distinct reading of the Anthropocene can be seen, then, in some interpretations within the social sciences, which develop different narratives over Anthropocene time, space, and human destiny.

Chakrabarty (2009) initiated such discussions of multiplicity of interpretations by prompting a discussion on how history, as a discipline of the social sciences, was unequipped to process the crisis brought about by the Anthropocene, given that it “can precipitate a sense of the present that disconnects the future from the past by putting such a future beyond the grasp of historical sensibility” (Chakrabarty, 2009, p. 197). As such, the Anthropocene went to give way with the distinction between human history and natural history – now that humans are effectively considered geological agents, our relationship with nature is not merely interactive, we become a part of it, and with this “[a] fundamental assumption of Western (and now universal) political thought has come undone” (Chakrabarty, 2009, p. 207).

The author, then, moves to propose a new regime of historicity and new form of understanding time in a way that makes possible to comprehend human world history and Earth history simultaneously and enmesh these two scales of time:

The Anthropocene requires us to think on the two vastly different scales of time that Earth history and world history respectively involve: the tens of millions of years that a geological epoch usually encompasses [...] versus the five hundred years at most

that can be said to constitute the history of capitalism (Chakrabarty, 2018, p. 6).

The author argues that what justifies the necessity of connecting these two ways of thinking is a moral issue of responsibility, pertaining culpability and accountability: to have the capacity to take responsibility in this age of catastrophe is to translate accurately between Earth and human agency and thus have the correct vocabulary to analyze the crisis in the first place (Chakrabarty, 2018). Therefore, Chakrabarty moves to propose two translations required if one is to comprehend the Anthropocene: firstly, from “force” into “power” and, most importantly, between “Earth history” and “world history”.

The two types of temporal thinking, both geological time and historical time, are manmade concepts that contain multiple affective associations, but whereas crisis of world history, in this case verbalized as climate change, are associated with a variety of affects (hope, despair, denial, etc.) “most geological events do not undergo such affective processing” (Chakrabarty, 2018, p. 17). In this sense, the geological time studied by Earth System Sciences to develop and define the Anthropocene is completely “planet-centered”: “[t]he protagonist of Earth system history is thus the Earth system itself, not humans. Humans, in any case, come very late in that history” (Chakrabarty, 2018, p. 25). This kind of temporal thinking is one that makes possible the scientific formulation of the Anthropocene problem, however, it consists of a time scale “opposed to the [...] temporality of human history” (Chakrabarty, 2018, p. 22).

This means that in attempting to process and take responsibility, and in feeling the consequences of the Anthropocene crisis, “[t]he narrative of world history has now collided [...] with the much longer-term geological history of the planet or – as we now think of it – of the Earth system” (Chakrabarty, 2018, p. 23). Because of that, in the social sciences, particularly, Earth history tends to get replaced by human history when analyzing the current crisis, making humanity the sole focus of the framing of the Anthropocene problem (Chakrabarty, 2018).

Thus, the Anthropocene necessarily speaks two voices, requires thinking simultaneously in two ways, without one overtaking the other: human-centered and planet-centered thinking (Chakrabarty, 2018). *This ontological shift requires translations and innovations in conceptual vocabulary and political practices.* In

all of world history, political thought has been, uncritically, completely human-centric; however, the Anthropocene “confronts the political with forces and events that have the capacity to undo the political” (Clark, 2014, p. 27-28 *apud* Chakrabarty, 2018, p. 29). The Anthropocene temporality, understood in this way, challenges human-centric stabilities over the political by “bringing the geological time into the everyday” (Chakrabarty, 2018, p. 31) – in this sense, to adequately deal with the problem of the Anthropocene crisis, a new temporal sensitivity emerges. This new temporal understanding is, thus, part of the task of *reconfiguring the political* (Chakrabarty, 2018).

Still, temporalities emerge with spatialities, thus, along with the enmeshing of world and Earth times, the author talks of the emergency of a new spatial category, the planet:

It is my contention that when we read together—as we must—histories produced on these two registers [planetary and global; Earth and world], the category *planet* emerges as a category of humanist thought, a category of existential and, therefore, philosophical concern to humans (Chakrabarty, 2019, p. 2, emphasis on the original).

Chakrabarty, then, differs “planet” from earth, globe, and world – affirming that the category of planet “belongs to a domain where this planet reveals itself as an object of astronomical and geological studies and as a very special case containing the history of life” with the central aspect of the concept being that its dimensions “vastly out-scal[e] human realities of space and time” (Chakrabarty, 2019, p. 3).

Following this logic, other spatial categories used to refer to the materiality of the planet (world, earth, and globe) are constructed using the humans as a reference point, they are oriented from and towards the human. “Planet”, on the other hand, does not have a “communicative relationship to humans” (Chakrabarty, 2019, p. 4), it is indifferent to human existence. And although empirical relation to the planet has always existed, in the way of natural disasters pertaining deep earth (tsunamis, volcanic eruptions, earthquakes, etc.), it is only with the occurrence of the Anthropocene that “planet” as an intellectual, cognitive category is developed in humanist thought (Chakrabarty, 2019). The “planet” here, thus, is a translation of

the planet developed through ESS, which works within the planetary regime of historicity (Chakrabarty, 2019, p. 4).

To advance on the planet in humanist thought, then, the author goes on to differ it from the globe, a common category in the social sciences – here, the globe stems from narratives of globalization that affirm that humanity’s domination over the earth is complete (Chakrabarty, 2019). As such “[t]he globe of globalization embodies [a] anthropocentric and anthropological practice of representation” (Chakrabarty, 2019, p. 9), it pertains to a human narrative and is a construction of human sense over the world.

Although the history of globalization is related to the emergence of the planet, for it is the history of the global, the developments of technology during the Cold War, the space exploration, capitalism, militarization, etc. that allowed access to the Earth system and the planetary in the first place (Chakrabarty, 2019, p. 17), ultimately, ESS and planetary thinking “takes us away from earth – and human – bound imagination. For this reason, it also affects a profound unsettling in the narrative of globalization” (Chakrabarty, 2019, p. 10). The author argues that because the formulation of the planet in ESS is made by putting the earth in relation to other planets “the principles of representation involved are different from those involved in invoking the globe” (Chakrabarty, 2019, p. 10) – humans are not the center of the formulation, but rather life in general, the question over the possibility of habitability.

To put it shortly:

the Earth system of ESS is produced not simply by a physical view of the planet from outside but by reconstituting it into an abstract figure in the imagination with the help of the sciences—including information obtained from satellites positioned in space as well as from ancient ice-core samples—while keeping other planets always in view even if only implicitly. ESS produces a reconstituted planet, the Earth system, an entity no one ever encounters physically but that is, in Timothy Morton’s terms, an interconnected series of “hyperobjects”—such as a planetary climate system—(re)created by the use of big data (Chakrabarty, 2019, p. 16).

In other words, whereas the articulation of the global refer to human horizons of time, and to spaces referring to the development of human civilizations, the planetary goes beyond, spatially – deeper and above, relating to deep earth and to other planets - as well as temporally, working within multiple timescales, some compatible with humanity, and some not. Here, it can already be noted how political formulations related to the modern international could be put into the category of human-centered, and how a planet-centered mediation of the Anthropocene could be put forth as a way to develop new political imaginaries.

Importantly, however, just like discussions of multiple temporalities did not require a choice between the two, but a productive enmeshing of multiplicity, “thinking globally and thinking in a planetary mode are not either/or questions for humans” (Chakrabarty, 2018, p. 23). Instead, the productiveness of the differences comes from being at the cusp of both, constantly. As such, “[t]he two modes of thinking represent two different kinds of knowledge and, for humans, two different ways of comporting themselves to the world within which they find themselves” (Chakrabarty, 2019, p. 24). One consequence of the unhuman dimensions encompassed by the planetary, however, is the impetus to simply chose human-historical time and attempt to deal with the Anthropocene crisis via solely a human-centric framing.

These are changes in spatio-temporality, then, different than the ones previously discussed regarding cosmological elements of the Anthropocene – on the one hand, what was named the Anthropocene of the global subject starts from the lack of control brought by the Anthropocene, with its complexity, chaos, and crisis, and aims to regain control, through management of the Earth and new spaces of government. On the other hand, the now introduced planet-centered Anthropocene aims at expanding the imagined possibilities of politics by shifting from the human to the planet as a starting point of reference. Hence, while the Anthropocene of the global subject builds on the idea of a Second Copernican Revolution, with reference to the role of science in general and ESS in particular in formulating a new world and establishing its purpose within it (guidance of a better relationship between humans and the Earth system); the planet-centered Anthropocene suggests instead a counter-Copernican revolution, referencing the physical cosmology of the Anthropocene, that brings the Earth back to the center of thought:

For many thinkers, the possibility that we are living in a new geological era has cosmological significance. Latour argues that we are in the midst of a counter-Copernican revolution. Alexandre Koyré famously argued that the Copernican revolution created a cosmological shift by leading a movement from the closed to the infinite universe. In Copernicus' universe, the Earth was transformed from a finite, temporal epicentre into a whirling celestial body in an endless universe. Latour has suggested that the ecological sciences and the discovery of global warming are returning our attention from the infinite, endless heavens back to the finite Earth (Allan, 2018, p. 278).

In his essay, Latour (2014) affirms that in the Anthropocene “the Earth has now taken back all the characteristics of a full-fledged actor”, which resulted in a “new form of agency” (Latour, 2014, p. 3). The transformation of the Earth into an active agent is related to the end of distance and objectivity, or, as he argues, old notions of distance and objectivity: before, natural sciences were understood to be able to establish objective facts, observed from a distant place. The first issue regarding distance and objectivity was, then, to deal with the active role of scientists in the construction of purportedly objective facts; now, however, the problem moves one step further and does away with distance altogether: “a new problem arises: how to understand the active role of human agency not only in the construction of facts, but also in the very existence of the phenomena those facts are trying to document?” (Latour, 2014, p. 2).

For the author, this loss of distance, objectivity, and thus solid ground is part of a counter-Copernican revolution, in which science “is forcing our eyes to turn toward the Earth considered, once again, as a cesspool of conflict, decay, war, pollution, and corruption” (Latour, 2014, p. 4). In this age of change and disorder, where the distinction between subject/object no longer holds, the place and purpose of the human in the universe also changes – from being confronted with the agency of the Earth “we have to shift away from dreams of mastery as well as from the threat of becoming naturalized” (Latour, 2014, p. 5).

The author goes on, then, to explore what defines the being subject of the Earth, particularly exploring the potentialities of the figure of Gaia associated with a form of animism developed in the essay. What is important, however, is the author's

conclusion that to be a subject, in this new world, is to “*share agency with other subjects that have also lost their autonomy*” (Latour, 2014, p. 5, emphasis in the original) – his understanding of being human in the age of the Anthropocene is one of enmeshing and interconnectedness with things before thought of as mere objects, background; thus the purpose of this human understanding of itself in the world regards a distribution of agency amongst other subjects and a conceptualization of a new form of being with the world:

The point of living in the epoch of the Anthropocene is that all agents share the same shape-changing destiny, a destiny that cannot be followed, documented, told, and represented by using any of the older traits associated with subjectivity or objectivity. Far from trying to “reconcile” or “combine” nature and society, the task, the crucial political task, is on the contrary to distribute agency as far and in as differentiated a way as possible—until, that is, we have thoroughly lost any relation between those two concepts of object and subject that are no longer of any interest any more except in a patrimonial sense (Latour, 2014, p. 15).

This distribution of agency and search for a productive mixture of being in the world with different forms of subjects appears as the mediation between human-centric and planet-centric thinking present in the interpretations of spatio-temporality discussed – whereas the planet-centered spatio-temporality is ultimately unhuman, and cannot be grasped by ideal forms and values (Chakrabarty, 2019), through translation between global and planetary scales a form of politics that is a mixture of points of reference can become a possibility. In this sense, new forms of conceptualizing Nature and the relation of Humanity with Nature become possible – as Tresch and Zalasiewicz (2013) put in their discussion on the cosmological possibilities of the Anthropocene:

Tresch: We've begun to imagine that the world, the natural world, the nonhuman world, has capacities and thoughts, intentions. Or at least an ability to act in unpredictable ways, that make it somewhat similar to a human. [...] We grant it moral capacities just as we grant ourselves moral capacities [...]

Zalasiewicz: Well perhaps we can even think in the other way around, in that humans may have rather more of the qualities of the natural world than sometimes we flatter ourselves that we do not have. (Tresch and Zalasiewicz, 2013, 9min32-10min08).

One example, then, is from Latour (2014), where this translation, the ascribing of agency to the Earth, is an opportunity to expand political imagination and vocabulary through cosmopolitics.

To very briefly expand on cosmopolitics, it relates to “new modes of political engagement” (Mitchell, 2016, p. 17), developed from Isabelle Stengers’ formulations: “a politics rooted in acknowledgement of the multiple, diverse and constantly transforming beings that constitute the cosmos. Cosmopolitics is an orientation that works to create openness towards every being that may be affected by a political decision or action” (Mitchell, 2016, p. 11).

Meant to make the political process more difficult, cosmopolitics introduces multiple agents in the political arena, which force through with conflicting interests and cause hesitation and force attention to the multiplicity (Stengers, 2013). In this sense, humans are not the only political actors, but are only a part of a bigger arena. It is important to note that cosmopolitics is not based on a notion of equality – the beings involved are neither normatively nor ontologically treated as equals. What matters, instead, is the understanding that any being, regardless of equality, can intervene in ways that shape the political process, even in ways that are not accounted for in a human-oriented sense (Mitchell, 2015). These “obstructions, disruptions and disjunctures” caused by the account of awkward subjects “preserve the pluralism of politics and generate creative political action” (Mitchell, 2015, p. 11).

Thus, cosmopolitics has the ability to call into question and point to the limits of modern premises of human-centrism, individuality, and self-containment. It opens new possibilities for ethical contestation (Mitchell, 2015) and collaborations (Tsing, 2015). It shifts into a world of relationality and co-constitution (Stengers, 2013)¹⁴.

In short, then, the two takes on cosmological interpretations of the Anthropocene have different understandings on what it means to be human (Allan,

¹⁴ For more on cosmopolitics, see: Stengers (2010), Stengers (2011), Shaffner and Wardle (2017).

2018) and, therefore, on human destiny, our purposes, in this new age of the world. On the one hand, the second Copernican revolution constructs the human as the global subject, and enlightened subject whose purpose is to save and manage the Earth system given its privileged position as subject of knowledge to do so. On the other hand, the counter-Copernican revolution, by changing the focus to the Earth and its agency, and from humans to the connections amongst living and non-living organisms, the human breaks down into the posthuman, with cosmopolitical moral-ethical concerns in the forefront of its destiny on Earth. Ultimately, then, interpretations do not move coherently in a singular direction:

If one reads ESS as providing an (auto)biography of humans when humans have become a question for themselves, what indeed is that question that motivates this narrative? The question itself remains unasked but many second-order, derivative questions swim around in its gravitational field: Are humans now a “God Species”? Should humans make kin with other nonhuman beings? Should human societies aim to become a part of the natural systems of the planet? Will the Earth become an “intelligent” planet, thanks to the integration of the technosphere and the biosphere? (Chakrabarty, 2019, p. 30-31).

This multiple interpretations of the elements of the Anthropocene and its changes in spatio-temporality result in different forms of politics that are understood to be the realization of humanity’s destiny in such cosmological formulations – from international governance regimes steered by the global subject to cosmopolitics associated with a new way of being with the world. As will be seen, International Relations literature refers to both articulations in its theoretical-political concerns – in the search for proper political action to mitigate or navigate the Anthropocene, a series of solutions will be proposed, pointing both to stronger international institutions, and to a reconfiguration of the international. Here, the following discussed elements will appear as crucial in the development of the Anthropocene within the discipline: the search for a new/better vocabulary to analyze a fundamentally changed world, multiple mediations between human-centered and planet-centered thought, and strong ethical and moral concerns.

4.2.

The Anthropocene in International Relations: co-constitution of theory and politics

4.2.1.

General overview and central discussions

The Anthropocene as a concept and an epoch is said to be fundamentally disruptive to the social sciences, particularly because of its breakdown of the nature/culture divide in which many western elementary ideas rested on, and International Relations is no different: in short, literature in IR regarding the Anthropocene seems to generally propose that the world has changed and thus the discipline needs to change with it in order to properly analyze and propose solutions for the current crisis – IR so far has reflected a Holocene like state of equilibrium and the chaos and complexity of the Anthropocene represent a fundamentally different world that cannot be studied through traditional literature and concepts (Pereira, 2021, p. 24). Therefore, from this change, *International Relations literature appears to be using the Anthropocene as a world-making concept to simultaneously propose a new version of the discipline and a new form of international politics.*

The starting point, then, is the role of nature in conceptualizations of world-politics – which, after the breakdown of nature/culture is stated not to be just a background factor anymore (Dalby, 2011). The argument moved in Anthropocene-centered literature is that nature, up until now, has not been a major element in International Relations analysis of the world.

Therefore, the presence of the category of “nature” in International Relations theory, in itself, is nothing new (Corry, 2017) – to start with, IR’s disciplinary roots in geography result in the understanding of nature through the lens of geopolitics as a tradition that centered the natural world in analysis of world politics (Corry, 2017); utilizing Darwinian and Malthusian thought, geopolitics in this vein began 150 years ago and developed over the years encompassing a mix of “geography, demographics, evolutionary ideas, racial theory and realist doctrine” (Corry, 2017, p. 103). In short, in this appropriation of geopolitics in IR’s analysis of international power relations “nature provided resources and a physical backdrop or stage upon which vigorous racial groups and nations engaged in struggles for power and resources” (Corry, 2017, p. 104) – natural elements, in this sense, such as land and resources, are centered in the analysis of international relations, being interpreted

in terms of power, somewhat brought to the foreground, but understood as a static object.

However, post-World War II, it is stated that geography and geopolitics lost ground as legitimate analytical tools in International Relations (Corry, 2017), being re-labeled as a “pseudoscience” that led to “distortion” to any understanding of world politics (Morgenthau, 1985 [1948]: 174 *apud* Corry, 2017, p. 104). Current Anthropocene literature, then, affirms that while traditional realist theories did involve materialism, in form of technologies, resources, and territory, it was not necessarily codified as ‘nature’ and always as supplementary, underlying aspects of politics and interests (Corry, 2017).

From there, the argument affirms that most theoretical developments within the discipline worked to sideline nature as an important element of analysis even further, particularly through the epistemological stance of neorealism, which, by abstracting international politics into a model of regularities and structure makes nature simply a backdrop of political action in a way that “nature was ignored, or reduced to fungible resources of power” (Corry, 2017, p. 106).

When referring to neoliberal institutionalism, on the other hand, the Anthropocene starting point critique argues that its origins in liberal traditions that focused its attention on “rational actors, institutions, rules and incentives” which meant that “the physical and natural world became, if anything, even more consistently occluded from view” (Corry, 2017, p. 106). So, liberal thought, in general, is understood to be strongly human-centered and tended to understand the natural world as a stage where political actions take place, in the form of human action (Corry, 2017).

In this sense, these two main theoretical strands of the discipline of International Relations are understood to be comparable in their approaches regarding “nature”: relegating it as a background for human action and as an object, in the form of resources; in general, an anthropocentric conceptualization of nature was the norm:

Little wonder that IR is ill-suited to make sense of the contemporary condition. Its dominant paradigms – realism, liberalism, and constructivism – are determinedly statecentric [...] They may want more or less from the system, emphasise different causal principles, and have more or less hope, but they

are unified by [...] and an anthropocentric ontology (Burke et al, 2016, p. 15).

Even outside of the core literature of the discipline, continues the critique, nature is considered not an element taken seriously – while Marxism has materialism as a founding tenet, post-Marxist IR-approaches are stated to have chosen to focus less on the natural world, and human interaction with nature and more on “economic structures, dependency in terms of social and economic development and overarching ‘world systems’” (Corry, 2017, p. 107) and other non-material elements such as social organization and ideology (Corry, 2017). Simultaneously, the starting point for the Anthropocene in IR affirms that constructivist and post-structuralist approaches “did little to change the marginalization of ‘nature’ in IR” (Corry, 2017, p. 108) – both theoretical strands, even when leaving space for some materialism, focused, respectively, in norms and discourses (Corry, 2017).

In that context, the reappearance of nature as a focal point in International Relations was understood to be during the 1970s, in the particular form of “environment” (Corry, 2017) – as was discussed in Chapter 2, international movements of environmentalism and growing concern over human impacts in the natural world worked to construct the debilitated category of ‘environment’ as ‘an issue or problem to be managed’:

While military-related technologies such as satellites, space-travel and climate models prepared the way, environmental issues such as climate change were pushed by scientists, international organizations and popular environmental movements worried about environmental limits (Corry, 2017, p. 108).

Even in this case, however, nature, as environment, was said to be treated by IR literature not “as a constitutive factor underpinning world politics” (Corry, 2017, p. 108), but mostly through principles, rules, norms and procedures regarding regime theory and governance. Even more, the category of the “environment” was also, eventually, incorporated into realist literature, in the form of environmental security (or climate security), resource scarcity and conflict (Corry, 2017).

Hence, some of the literature engaging with the Anthropocene concept in International Relations uses it within these conventional vocabulary and research subjects in a way that the concept is specifically used “to reinject a sense of urgency into traditional discussions” (Simangan, 2020, p. 216). Thus, this strand of literature uses the epoch as a new backdrop for old concerns of the discipline, and maintain a focus on human-centered issues, now endangered by the chaos and crisis of the Anthropocene (Simangan, 2020).

Therefore, questions about “saving the planet” remain directed at “the conditions for maintaining human existence exactly as it is” (Death, 2014, p. 82) and political proposals remain within current modern political imaginaries – for example, by adjusting regimes of global environmental law and governance, such as revising the United Nations Charter to enlarge the role of experts (particularly Earth system scientists), establish a category of “crimes against biodiversity”, and divide states into “eco-regions”, so that global governance is less focused solely on human interests (Burke and Fishel, 2016); or, similarly, the push to use the Anthropocene as new example in a series of crisis of security, that puts humanity’s existence at stake, and thus utilize the concept in a way that it strengthens “IR’s central foci, which we might faithfully limit to war, security, and the effects of an anarchical international society on states” (Harrington, 2016, p. 2).

Alternatively to the use of nature as “environment” and the use of the Anthropocene as a way to further International Relations’ conventional research subjects and modern anthropocentric foundations, a critical strand of IR theory argues, then, for a *new conceptual vocabulary and, connected with it, a new political imagination*, both taking seriously the breakdown between the Nature/Culture divide and thus representing a new world in which nature takes the role of more than passive object (Corry, 2017; Simangan, 2020). Hence, critical scholarship embracing the Anthropocene more radically questions the foundations and objectives of IR – these texts “attempt to deconstruct conventional frameworks and then reconstruct them to align with the conceptual and practical demands of the Anthropocene” (Simangan, 2020, p. 217), affirming current theoretical developments of the discipline lacking in serious concern for the category of Nature.

In other words, this literature understands that this new epoch constitutes a fundamentally different world than the one interpreted by International Relations thus far, so, they push for a radical change to the discipline so it is better equipped

to analyze and propose solutions to the crisis of this new world (Simangan, 2020); particularly, the idea of an ontological change to the discipline of International Relations is of central importance, as there is “growing alarm in view of the self-imposed threats and security implications of a radically climate changed world, and mounting frustration with the failure of traditional IR theories and concepts to make analytical sense of the same” (Lövebrand et al, 2020, p. 5), as will be seen in the following section.

In general, then:

[T]he Anthropocene [is used] as a backdrop for conventional IR issues of politics and security, to create a sense of urgency and shed new light on the complexity of those issues. At the same time, the Anthropocene also serves as a new theoretical landscape for rethinking the ontologies and epistemologies of the discipline and has led some scholars to realize that IR’s theoretical foundations and the current international order are ill-equipped to address global environmental threats. This has inspired both critique and problem-solving (Simangan, 2020, p. 223).

As such, these multiple uses of the Anthropocene within IR literature led to different reconfigurations of the Earth as political spaces (Lövebrand et al, 2020). As was discussed in the last section, the category of the ‘planetary’ entered discourse and, therefore, “was born as a spatial political concept” (Rothe and Banner, 2021, p. 122). In this sense, there can be seen a translation between planet-centered, where the category of the planet is one of complete otherness and therefore cannot have normative or political connotations (Chakrabarty, 2019) and human-centered, where planetary is inscribed within ideals, ethics, and politics, the Anthropocene appears as “a discursive event that is actively involved in the (re) writing of space for global politics” (Lövebrand et al, 2020, p. 2).

In other words, the spatio-temporality related to the counter-Copernican revolution stems from the figure of the planet and from deep time, respectively; therefore, in themselves, are non-normative categories that refer to a physical reality beyond humanity; thus, the work of bringing these categories into political discourse is, as was also stated, one of mediation and translation between planet-centered and human-centered. The result would be an enmeshing of the two, by,

importantly, taking the planet as the starting point and in bringing it to the human realm, centering it and ascribing it some form of agency. Again, in general, while the second-Copernican revolution remains only within human-centered thought and thus politicizes space by taking it as a place of discipline and control, the counter-Copernican revolution works to mediate between planet-centered and human-centered, in this direction.

Thus, as mentioned, International Relations draws from both of these cosmological formulations of spatio-temporality and, in doing so, works around “reoccurring ontological claims, analytical themes and political concerns” (Lövebrand et al, 2020, p. 2), which results in three discourses over global political space, (1) the endangered world; (2) the entangled world; (3) the extractivist world (Lövebrand et al, 2020).

The endangered world, then, draws mostly from Earth System Sciences and the idea of a mature global subject that shapes the planet; it starts with a global scene marked by danger, chaos, and threats stemming from the disequilibrium brought about by the Anthropocene, which are connected with socio-economic turbulence, that puts Humanity at risk – thus, “in the endangered world it is the aggregated human effect on the Earth system that is the primary object of concern” (Lövebrand et al, 2020, p. 3). As already touched on in the last chapter, this literature understands the transnationality of the threats of the Anthropocene by spatializing the Earth in the figure of the globe – therefore, this builds on the current modern spatialization of the world defined by national borders and proposes a global-scale response, requiring the surpassing of national boundaries and cultural divides. Thus, this literature supports the development of strong global institutions and draws from “a long line of liberal institutionalist thinking to foster responsible Earth system stewardship” (Lövebrand et al, 2020, p. 3) along with a bigger participation of scientists and scientific assessments that will help plan for, and prevent, “the systemic risks and security implications of ecosystem change” (Lövebrand et al, 2020, p. 3) and thus strengthen effective governance.

The extractivist world, in its turn, unfolds into a neo-Marxist direction: instead of reading the Anthropocene as a geological marker of time or a critique of anthropocentric modernity, its interest lies with questioning “the global capitalist system and the monumental damage and injustice done by its ceaseless need for expansion, accumulation and extraction” (Lövebrand et al, 2020, p. 4). In this case,

the environmental crisis of the Anthropocene is understood as a problem of production regarding global capitalism and as such the concept cannot be used in an uncritical universalizing way – the extractivist world maintains the instability and uncertainty of the Anthropocene, a precarious political scenario and state of nature, but it refuses to condense multiple nations, societies and cultures into Humanity, affirming that “[a]lthough no one is immune to the [...] effects of [...] capitalism” it is crucially important to pay attention to “the diversity of human relations with nature and the political systems under which these relations emerge” (Lövebrand et al, 2020, p. 5). In this case, the literature of the extractivist world proposes systemic change to the international, exploring different, non-western, relations with nature (Simangan, 2020).

The entangled world, finally, draws from post-humanist IR literature and speaks of the Anthropocene as new a reality where humans, non-humans, and non-living things co-exist in complex entanglements; it is impossible to “go back” to Holocene stabilization and separations, or, conversely, to reverse the new planetary real through resolution and governing (Lövebrand et al, 2020). In spatial terms, it affirms the breakdown of modern territorialization of space and “presents a global scene of complex interconnections and interdependencies that cut across conventional geographical and temporal scales and species boundaries” (Lövebrand et al, 2020, p. 4); this connection beyond states and nations is necessary for a truly “worldly politics”. Therefore, the entangled world is both an environmental and a philosophical event, which “forces IR into an uncomfortable place” given that it disrupts the fundamental organizing categories of the discipline, such as “the logics of inclusion and exclusion; the idea of agency and a unified human subject; and the imagination of an intelligible world as a whole” (Lövebrand, 2020, p. 4), resulting in the urge for a new vocabulary to properly deal with this new reality and ontological change.

As will be seen, critical IR points to the three formulations of political space during the discussions developed in the Manifestoes, in a sort of ‘step by step’ formulation. While both texts point to the entangled world as the final goal of dealing with the Anthropocene – challenging the modern international and building a planetary politics – each points to other forms of politicizing space in the short term, proposing solutions both in terms of a new institutionalism and of challenging systemic oppressions. Interestingly, the mixture of short term and long term

solutions referring to different political spaces muddles any clear division between them.

Conversely to the multiple politicizations of the planetary space within International Relations literature, temporally there is a consistent nod to eschatology:

At the heart of the discourse thus is a linear eschatological notion of time that brings with it questions of finitude, irreversibility and temporal ending. Anthropocene discourse thus paints the picture of a threat that is not only irreversible but also both spatially as well as temporally *absolute* (Rothe, 2020, p. 147-148, emphasis on the original).

Throughout the dissertation, it was evident the linear temporality and the worry about a possible end of times that is pervasive in discourses and political projects related to the Anthropocene (Rothe, 2020). In relation to the possible ways of the world ending, three different temporal discourses appear as the most salient: (1) Eco-catastrophism; (2) Eco-modernism; and (3) Planetary Realism (Rothe, 2020). Even more, added to linear conceptions of time, there appears to be “different symbols, icons, imaginaries and storylines of Christian eschatology” (Rothe, 2020, p. 146) which appear rearticulated in the crisis of the Anthropocene.

Firstly, Eco-catastrophism has old roots in Thomas Malthus and further in Neo-Malthusian ideas all related to “projections of global collapse and the exhaustion of natural resources” (Rothe, 2020, p. 148), which were briefly discussed in Chapter 2. In terms of the Anthropocene, the author refers to the “Planetary Boundaries” (also mentioned in Chapter 2) as particularly Eco-catastrophic ideas, considering the linearity of the thresholds, where once they have been surpassed, there is no coming back: “The entire complexity and non-linearity of the Earth system is thus broken down into an image of linear movement towards a temporal threshold, which humanity (represented metaphorically by the person at the edge) must not cross” (Rothe, 2020, p. 149). Here, the images of the consequences of crossing such boundaries are associated to apocalyptic imaginary of destruction and the end of times and the political project constructed in order to avoid such dire consequences is the already discussed forms of planetary management through Earth system governance (Rothe, 2020).

Secondly, Eco-modernism, on the other hand, focuses on technology-oriented environmentalism in a way to emphasize human capacity to manipulate the Earth system and, thus, human responsibility to do so (Rothe, 2020). Discourses of eco-modernism can be evidenced by references to the ‘noosphere’ and proposals over geoengineering – in this case, similarly to Eco-catastrophism, the Anthropocene is seen as a moment of revelation, however “this revelation justifies a comprehensive human project of planetary experimentation” (Rothe, 2020, p. 159). The end of times, then, “must not be feared” as humans now have a capability of self-salvation, and thus through “continual experimentation, reflection and learning” referring to the Earth system and other natural workings salvation “becomes an eternal process” (Rothe, 2020, p. 160).

Finally, Planetary Realism “revolves the assumption that the end of times are neither near nor far but in fact already taking place” (Rothe, 2020, p. 153) – in this discourse, humanity is understood to be within temporalities way beyond our control, and should, then, embrace the uncertainty of the epoch. In terms of political projects, the central element is that of ‘resilience’, associated with complexity and uncertainty it “works through the (earth-)bounded rationality of resilient subjects, and mobilises their established forms of local forms and self-organising capacities for their own survival” (Rothe, 2020, p. 155).

In this sense, even though there are also three distinguishable temporalities within IR literature regarding the Anthropocene all of them work inside a linear, eschatological time, *theorizing about a world that is coming to an end*. Hence, along with the narrative of crisis permeating all of the interpretations of the Anthropocene discussed in the dissertation, this underlying notion of time that stresses the finitude of a current political present result in a sense of urgency ever present in discussions over the Anthropocene:

the visible hands of a *watch running down*, when what must be done is not merely expose its interior workings, but to re-imagine our entire structure of social-political time. This time is both much longer than our contemporary horizons, taking in hundreds and thousands of years, and much shorter, requiring ameliorative action *that should have begun yesterday* (Burke et al, 2016, p. 12, emphasis added).

It is important to pay attention to this urgency, and to the fact that it is often implicit in the discussions, as it is an important element of the critical literature of the Anthropocene in International Relations – crisis and urgency are elements already present in the original Earth System Sciences literature about the Anthropocene, and in the appropriation to IR they add onto each other being an important element in the limits of critique within the literature, as will be discussed further in the chapter.

For now, the discussion will move on to the analysis of the two Manifestos regarding possible mobilizations of the Anthropocene by International Relations literature, as they locate each other as opposite answers to the Anthropocene crisis in IR and in terms of international politics, showcase the breadth of solutions, political formulations, and inspirations in world-making in the foundations of the literature.

4.2.2. The Manifestoes

To start with, the “Planet Politics: A Manifesto from the End of IR” (Burke et al, 2016) begins with a call for a new political imagination stemming from the “ashes” of IR’s canonical texts – a simultaneous assertion of the end of discipline and the possibilities of a discipline yet to be. The authors define planet politics as “an alternative thought and process: a politics to nurture worlds for all humans and species co-living in the biosphere” (Burke et al, 2016, p. 2) and it is a necessary alternative to a current anthropocentric political imaginary and organization, given that it has disrupted and destroyed the world (thus leading it into the crisis of the Anthropocene) – in this sense, the only possibility of a an ethical future is a ontology based on entanglement of the human, the non-human, and the non-living (Burke et al, 2016).

Along with the world, also, International Relations both as a system of knowledge and as political practice “is undone by the reality of the planet” (Burke et al, 2016, p. 3). As such, both the discipline in itself and the politics it defends need updating – *this* is what is required and what it means to engage with the planetary real brought forth by climate sciences (Burke et al, 2016). IR, thus, is unequipped to deal with the reality of the Anthropocene given it cannot be captured by its disciplinary frameworks, that are hindered by being too nation-bound.

The authors state that the Anthropocene represents the power of social nature and that it is now turning against humanity; this power simultaneously threatens the world that International Relations studies and the discipline in itself: “[it] challenges our categories and methodologies. It demands we find accomplices in our discipline and beyond it. It demands a new global political project” (Burke et al, 2016, p. 4). Importantly for the discussion at hand, the authors begin the manifesto by drawing a parallel of the Anthropocene and the creation of nuclear weapons of mass destruction, citing that the latter was a disruptive chance “to give society the opportunity it desperately needs to adjust its politics to its physics” (Brodie, 1964, p. 23 *apud* Burke et al, 2016, p. 5) – maintaining the comparison, then, the approach to the Anthropocene the manifesto takes is that the world has fundamentally changed and it is necessary for IR to change as well so that it can adjust its analysis and recommendations to physical reality, this reality is established by Earth System Sciences (Burke et al, 2016). Here, the authors make an argument for interdisciplinarity, which is needed if the discipline is “to be able to analyse and respond to the rapidly evolving planetary real” (Burke et al, 2016, p. 7).

The central political argument of the manifesto, then, is a claim for a political imaginary based on the reality of interconnectedness – “our fundamental image of the world must be revolutionized. Our existence is neither international nor global, but planetary” (Burke et al, 2016, p. 6). As such, the world of power politics as understood in International Relations does not exist. So, to develop such ideas the authors lean into the interdisciplinarity by proposing the use of Röckstrom’s planetary boundaries model discussed in the second chapter to develop political institutions that effectively build an ethical relationship to the planetary – this renovating of IR would be part of the “creation of a new institutional and social scientific project that can provide political answers to the planetary questions that [ESS] raises so compellingly” (Burke et al, 2016, p. 8).

The crisis the discipline faces, then, concerns the challenge of equating “the planetary scale on which Earth System Science is producing knowledge about the earth” with “the planetary scale of actual and potential extinctions”, the death of the planet, and with “an ethical, moral, ontological and practical discourse that might be adequate to them” (Burke et al, 2016, p. 8). This task is described as “a project of reconfiguring the global to respond to the planetary” (Burke et al, 2016, p. 8-9),

that is, a mediation between the human-centered globe of International Relations and the planet that is brought forth by the hard sciences of ESS.

Constantly weaving the Anthropocene as the destruction of the planet and the destruction of International Relations and a necessary renovation of IR to study the planetary real and to propose solutions to it, the Manifesto states that the Anthropocene means that the planet is voicing limits to human freedom (it can be noted how the idea of limits is a part of Röckstrom's planetary boundaries, used by the text) (Burke et al, 2016). In this moment, the text evokes the strength of universality within the Anthropocene: although other authors choose to focus on the inequality between nations in the creation of the epoch, linking the crisis to capitalism and the power relations involved within it, Burke et al (2016), although not negating these critiques, instead state the problematic of understanding politics in this anthropocentric clash of human preferences and embrace the discussion over Humanity in a more universalized way.

The Manifesto continuously brings up the way of science, particularly ESS informing politics, but states that so far, the inclusion of scientific findings into the current international organizations, and organization of politics, has not been enough (Burke et al, 2016) – for instance, the authors cite the Kyoto Protocol and the Paris Agreement as failures to enact actual change. Therefore, the challenge is of using the reality of science to *reinvent* the political imaginary – hence, “our movement into the Anthropocene forces an ontological shift” (Burke et al, 2016, p. 12). This shift answers to the Cartesian separation of humanity and nature that underlies both the discipline of International Relations and international state practice, instead, the new ontology that accepts and builds on “social nature”, the idea that “human activity and nature are so bound together that they are existentially indistinguishable” (Burke et al, 2016, p. 12) – thus the Anthropocene breaks down with the idea of a human condition and redefines the human as such.

Moreover, in a direct critique to International Relations the authors once again make a parallel between the current crisis and the nuclear age, stating that, then, the discipline of IR had a clear vocation, to prevent the nuclear destruction of the world and construct cumulative knowledge for stewarding international politics in an armed and complicated world (Burke et al, 2016) and while there was a systemic failure to address all of the problems of an age, the focus somewhat made sense. Now however, even though “ecological catastrophe is unquestionably the gravest

security challenge to face this planet” (Burke et al, 2016, p. 14) IR has failed to take on an appropriate vocation for the times, which is especially troubling given that one of the biggest threats brought by the Anthropocene is that of mass extinction, another form of existential insecurity the discipline theoretically is capable of dealing with, but while “IR is one of few disciplines that is explicitly devoted to the pursuit of survival [...] it has almost nothing to say in the face of a possible mass extinction event” (Burke et al, 2016, p. 19).

That is stated to be because the discipline continues to be overly committed to its dominant paradigms (realism, liberalism, and constructivism) which are considered fundamentally problematic in this new planetary real, by having been conceived in a different international reality and thus being too state and human centric (Burke et al, 2016). Even dissident thought within the discipline, of which the authors cite feminism specifically, remain largely, if understandably, humanistic, and anthropocentric (Burke et al, 2016). As a consequence, IR lacks the conceptual and ethical vocabulary to articulate an analysis and response to the Anthropocene: “[t]rying to write from within IR, we find ourselves prisoners in our own vocation. We are speechless, or even worse, cannot find words to represent the world and those within it.” (Burke et al, 2016, p. 4)

As was mentioned, the manifesto blends between criticizing the discipline of IR and the politics in which IR bases itself; thus, the text goes on to propose a few specific international political propositions: firstly, the creation of a Coal Convention (similar to the Chemical and Biological Weapons Conventions) to control, regulate, and disincentivize the use of coal; secondly, the incorporation of non-human species and ecologies to international legal frameworks; as well as adjusting the participation of international institutions so that instead of being based on the representation of nations, other actors, such as earth system scientists, ecosystems in itself, and civil society groups would also have a voice – one given example would be the creation of Earth System Council (similar to the United Nations Security Council) (Burke et al, 2016). These would be examples of political projects that utilize current institutions and merge them with a new political ontology and scientific information to deal with the specific challenges of the Anthropocene.

Very important to the overall manifesto is the element of global ethics – a lot of the argument for a new ontology is an ethical, moral one, that honors the

coexistence physically stated by ESS and new findings of climate science by developing within an ethical framework. Part of this, then, is reflecting a worldliness of entanglement, the absence of true autonomy and separation between the parts, into global politics, planetary politics – while “[t]he formation of the Anthropocene reflects a particular type of worlding, one in which the Earth is treated as raw material for the creation of a world tailored to human needs”, conversely, “Planet Politics calls, instead, for a mode of worlding that is responsive to, and grounded in, the Earth” (Burke et al, 2016, p. 20). To do so, the manifesto defends that this politics requires the acceptance that this is an inescapable occurrence, not an option, choice, or obstacle, and the reframing of the interconnectedness of the planetary as a source of positive solidarity and gratitude (Burke et al, 2016).

In short then, the Planet Politics Manifesto is composed of three parts: (1) a detailed account of the Anthropocene crisis that marks current politics, and a connection of the political to the disciplinary within IR; (2) a critique of International Relations through the diagnosing of its shortcomings that make it incapable of dealing with the new planetary real; and (3) suggestions for the development of a better international politics and a better International Relations. In the words of the authors, the Manifesto is a mixture of “onto-political and interdisciplinary commitments” (Burke et al, 2016, p. 21).

From its publishing, the text has been engaged with in multiple ways, built upon and criticized by other authors within International Relations. One direct answer, through which the stage of possibilities of dealing with the Anthropocene in IR is set, is that of Chandler et al, 2017, beginning by stating: “Where we find ourselves in disagreement is with much of the analysis, logic, and proposals and, as a result, we feel compelled to write this article by way of a response” (Chandler et al, 2017, p. 2).

So, on the other hand, the “Anthropocene, Capitalocene and Liberal Cosmopolitan IR” (Chandler et al, 2017) is a response and critique to the Planet Politics Manifesto, stating that although Burke et al (2016) rhetorically appeal to critical perspectives, their analysis and suggestions are very traditional, particularly akin to 1990s liberal cosmopolitan democracy, because of that, their proposals eschew precisely the problems that are at stake in the Anthropocene (Chandler et al, 2017). The text, then, raises three specific critiques regarding the Planet Politics

manifesto: (1) the fact that its practical proposals seek only amelioration, not transformation of international politics; (2) that the uncritical approach to international law as an effective mechanism resorts to top-down coercion; and (3) that the manifesto de-politicizes itself by resorting in excess to abstract and idealist notions, such that of ‘global ethics’ (Chandler, et al, 2017).

The biggest concern the authors have with the Manifesto is that it is much too universalizing and pays little attention to global inequity and complex systemic issues, which fundamentally makes it too depoliticized (Chandler et al, 2017). As was mentioned, Burke et al (2016) chose to use a universalized notion of Humanity when talking about the Anthropocene problem, possible solutions, and limiting of human freedom; for Chandler et al (2017) this is a problem that underlies all of the other issues raised, given that it “overlooks historical patterns, causes and structures, and fails to consider contemporary patterns of resource extraction and offshoring” (Chandler et al, 2017, p. 4). In this sense, the fallback on amelioration is said to be neglecting the root causes of the problems of the Anthropocene, which the authors defend is not connected to some universalized notion of Humanity as a species, but rather related to social and systemic problems resulting from global capitalism (Chandler et al, 2017) – as such, the authors propose the change from Anthropocene to Capitalocene as the concept that defines the epoch, for better referring to the problems to be addressed.

Thus, while Burke et al (2016) criticize the state-centrism of International Relations and its politics, Chandler et al (2017) point that they still remain committed to other ideas of the discipline, particularly those of global governance, affirming that the authors “return to a staple of Liberal International Relations: the efficacy of international law to control the actions of states” (Chandler et al, 2017, p. 8). This means employing coercive institutions that wish to universally regulate the boundaries of the relationship of all people with nature – in a similar reasoning as developed in the second chapter, then, Chandler et al (2017) condemn these disciplining practices and affirm them precursors for authoritarianism, new international hierarchies, and exclusions. For the authors, relying on the reform of already existing international institutions is, therefore, a way of ignoring the systemic issues and violence present in their history and even to reinforce those violences, affirming that “there is an obvious danger that new cosmopolitan

international law will further reinforce international inequalities between the haves and have-nots” (Chandler et al, 2017, p.8-9).

The universalized view of humanity is also present in the critique over the abstractions chosen as key elements in the Planet Politics Manifesto, such as that of “global ethics”, to which the authors ask “[w]hat is the basis of their new ethics? Which established political or philosophical traditions might we draw on that ‘embrace worldliness’?” (Chandler et al, 2017, p. 11). Once again referring to authority and hierarchies present in the international, the authors are cautious over the global ethics referent to a “planet politics” that is a universalist abstraction that asserts itself as speaking for a planet or a species, affirming it as potentially violent in its application of universal resolutions for plural societies and connecting this abstract terms to traditional International Relations thinking, especially regarding literature on liberal forms of global governance (Chandler et al, 2017).

The authors connect these critiques directly to an uncritical use of Earth System Sciences to propose international politics: regarding the use of Röckstrom’s planetary boundaries model specifically and ESS generally in the development of the institutions and global governance Chandler et al (2017) conduct a similar argument over the problematics over disciplining, management, and regulation discussed in Chapters 2 and 3. They argue that the so-called politics of the Manifesto is indeed apolitical for having no notion of agency, endorsing an abstract species-based notion of the human, and ultimately reducing politics to “responding and managing what are understood to be the consequences of previous human actions” (Chandler et al, 2017, p. 22).

Further, they criticize the constitution of the planet in a human-centric fashion, by ascribing normativity and anthropocentric agency to it (Chandler et al, 2017) – this too is connected to ESS and the understanding of Earth System scientists being spokespersons for the planet and thus the human having access to “what the planet is ‘telling us’” (Chandler et al, 2017, p. 14) and thus describing a “planet politics”. For the authors, this is a form of “human exceptionalism” (Chandler et al, 2017, p. 14) that is considered constant in the Manifesto. Still, although criticizing the particular use of ESS to guide politics related to managerialism, disciplining, and control, the text seems to find some potential in ESS and the knowledge produced by it by stating that “[w]hat earth system science has emphasized from the 1970s is that the complex assemblage of multiple complex systems that make up ‘the planet’,

does not ‘tell us’ anything or ‘ask’ anything from ‘us’. The planet is indifferent” (Chandler et al, 2017, p. 14) and using this otherness and complexity to move their own proposal for ontological change.

Indeed, while strongly critical to the Planet Politics Manifesto, the authors of the “Non-Manifesto for the Capitalocene” (Chandler et al, 2017) seem to disagree with the political solutions of Burke et al (2016) and their take on an ontological change, but logically follow the necessity of one. In other words, the Non-Manifesto disagrees with the particularities of the solution offered by the Manifesto – the use of only the concept Anthropocene to diagnose the current world, employing managerial programs to international politics, utilizing an universalist notion of the human, etc. – *but seems to agree that a new, changed reality requires political and ontological change both at the level of international politics and within the discipline of International Relations*, albeit developed with a different set of ideas.

So, as was mentioned, Chandler et al (2017) choose to engage with the Anthropocene through the concept of the Capitalocene, a derivative term that intends to localize global capitalism at the center of responsabilization for the climate crisis, along with political and economic crises, and thus focus its analysis on systemic problematics associated with capitalism and its impacts in the natural world in a non-homogenized way throughout the world. In their words, the Capitalocene is a challenge both to international politics and to International Relations by refusing “to fall back into reinforcing the international arena as the source of politics and policy-making” (Chandler et al, 2017, p. 19).

Similar to the assertion brought with the Anthropocene, the center of Capitalocene disruption is the end of “all the liberal binaries, particularly that between culture and nature” (Chandler et al, 2017, p. 19) – in this sense, it questions all policy-making and political institutions that work in traditional modernist ways by making impossible to think as nature as something separate to be brought in as an afterthought and by thinking “the limits of modern science and top-down governance and fantasies of control” (Chandler et al, 2017, p. 20). Centrally both to IR and to international politics, the Capitalocene would mean a complete re-understanding of sovereignty (Chandler et al, 2017).

Further, similar to the call for an ontological shift made in the Manifesto, “[t]he Capitalocene heralds a change at the ontological level, at the level of how we understand what constitutes the subject matter itself” (Chandler et al, 2017, p. 20)

– it presents a new reality to be addressed and therefore shows a need “for a change in human consciousness” (Chandler et al, 2017, p. 22), along with notions of the political, and of the discipline of International Relations.

In regards of differences, the Non-Manifesto, presented with the same starting point, a crisis in the world, in international politics and in International Relations, using the term of the Capitalocene defends bottom up social and systemic change as a priority (Chandler et al, 2017) – they emphasize the necessity of dealing in pluralist terms and with issues of inequality and hegemony. The text suggests a few responses for living in an age of catastrophe: firstly, acknowledging the tragedy of living in a fundamentally transformative age; secondly, maintaining critical social analysis in the search for any possibility of emancipation within the entanglements of the Anthropocene/Capitalocene; thirdly, a different interpretation of ‘renaturalising’ politics, searching for political creativity, creative possibilities and potentials for a different imaginary of the posthuman (Chandler et al, 2017). The intent of the text is to search for ways of making “new worlds in the shell of the old” (Chandler et al, 2017, p. 24).

Importantly in their analysis of this new changed world is truly grasping the end of IR, as “[g]oing beyond IR is possible and also necessary once we radically redefine human agency as part of nature itself” (Chandler et al, 2017, p. 24) – in fact, International Relations is said to be actually an ill-suited discipline to deal with the entangled existence of the Anthropocene/Capitalocene, as it was born out of political theory and thus is founded around modernist binaries (Chandler et al, 2017). If the discipline is to even access and deal with the problems of the Capitalocene it needs to embrace interdisciplinarity, go beyond itself, and evolve with new vocabulary and concepts that better reflex the complexity of current ever-changing circumstances (Chandler et al, 2017). Particularly, as was mentioned, the issue of sovereignty, state-centrism, and the understanding of politics as the international arena are to be put in question (Chandler et al, 2017).

Discussions over the two possibilities laid out continued (e.g.: Fishel et al, 2017; Mitchell, 2017; Jackson, 2017) with the two texts being built upon in the development of the critical literature regarding the Anthropocene in IR. The texts outwardly define themselves as opposites, and indeed the presence of many differences is clear upon reading – using the terms discussed, Burke et al (2016) constructs mostly through the endangered world, particularly through the use of

Röckstrom's planetary boundaries, while Chandler et al (2017) seem to construct with the extractivist world by developing an argument in which a critique of capitalism and systemic power structures plays a major role. In terms of politics, the Manifesto gives a lot of importance to international law, institutions, and governance, while the Non-Manifesto focuses on a defense of bottom-up politics, local leadership and a critique of systemic capitalism and power structures that maintain inequality.

It is, however, interesting to pay attention to similarities amongst the texts: they both move towards the necessity of complete ontological change within the discipline of IR and regarding international politics; they both signal to the entangled world and to a form of politics that comes from the reality of entanglement and interconnectedness, either on terms of a new global politics, or of the posthuman, for example. Importantly, both of the texts weave International Relations and international politics in a co-constitutive relationship where theorizations in IR must answer to the crisis of international politics – as such, they both speak directly from/about the end of IR, and through proposing changes to the discipline, refer to necessary changes to international politics.

As was said, also, it is interesting to note the separation between the ultimate goal of constructing a new entangled planetary politics, while also mitigating the crisis within current political spaces – alluding to international institutionalism and local and systemic approaches – mix between multiple political constructions of space, with the discourses seeping into each other.

Considering these similarities, then, the next section will develop on the proposals for a new International Relations, capable of dealing with the Anthropocene crisis and reality. This is not intended to negate the differences between the two texts, but to see what can be revealed by a reading that focuses instead on the similarities and moments of identification between the two. As such the discussion will go on to sketch the main change heralded by the Anthropocene – the breakdown of the Nature/Culture divide - and propositions over a new ontology, political imaginary, and vocabulary capable of addressing the reality at hand. In short, the section will go over how the issues of the Anthropocene are laid out and the necessary changes referring to International Relations and, consequently, international politics.

4.2.3.

IR is dead, long live IR: a new ontology for a changed discipline

So, the Anthropocene seemingly represents the end of the world as we know it. As a consequence, social disciplines that study the world through and assumption of the separation between human and nature are no longer equipped to properly analyze it (Hamilton, 2013) – at least ever since the 18th century, it is stated that the social sciences work with the premise that to study the social world is to congeal the natural world as a backdrop, and that these two realms can be completely separated and sealed off from each other, assumptions developed from Cartesian and Kantian philosophies of the subject (Hamilton, 2013). However, “[t]he advent of the Anthropocene shatters the self-contained world of social analysis that is the terrain of modern social science” (Hamilton, 2013, online), it effectively makes it impossible, then, for the social sciences to maintain nature as a backdrop for human action and demands a new conceptualization of the social-natural world. Thus, only through renovation the disciplines of the social sciences can match the reality of the Anthropocene accessed through the natural sciences (Hamilton, 2013).

However, even while accepting the premise that nature is altogether excluded as an active agent in the social sciences, it cannot be said that the natural sciences have not influenced ideas over the functioning of society within the social sciences (Walker, 1987) – throughout the development of social sciences there are multiple instances of exchanging of ideas and models influencing and comparing the scientific study of the natural world to the possibility over the scientific inquiry of the social realm. In the case of modern International Relations then, the discipline was greatly affected by Newtonian ideas of natural laws in its desire to assert itself as a legitimate science (Kavalski, 2012; Pereira, 2021; Ruggie, 1998). In this sense, multiple IR theories have conceptualized the international arena as a closed system, where relations occur in a way from which laws can be drawn by analyzing dependent and independent variables: “[w]hat IR intends to produce in this way is a nearly mechanistic model of international politics” (Kavalski, 2012, p. 138) akin to the mechanistic Newtonian model of the universe discussed in Chapter 3.

In short:

A closed system has no interaction with its external environment, which means that it is not affected by outside agents or elements. Consequently, it is possible to more easily isolate variables and

observe causal consistencies. It is a linear and predictable system. Accordingly, IR's influential positivist and rationalist paradigms assume the existence of a static world outside that can be fully assimilated and anticipated. Analyses and explanations are generally rooted in the conviction that changes are gradual and phenomena follow linear trajectories (Pereira, 2021, p. 25).

The possibility of isolating variables is especially important because it makes possible the separation between the social and natural realms, between humans and non-human/non-living elements (Kavalski, 2012). Thus, Newtonian-inspired IR is understood to be inherently anthropocentric and is associated with Enlightenment ideas of a “makable world” (Kavalski, 2008 *apud* Kavalski, 2012) in which not only human/socio-political systems are both conceptually and in practice detached from nature, but also the human realm actively exerts control over the non-human environment.

As such, the biggest issue brought up with Newtonian modes of thinking international relation is that “fragmented and isolated analyses fail to capture the essence of the crisis facing the planet and prevent scholars and decision-makers from keeping pace with the unprecedented challenges of our time” (Pereira, 2021, p. 26)¹⁵. The request regarding the necessity of innovation of International Relations for it to deal with reality and propose solutions for the problems of the Anthropocene seems to be twofold: *to have nature as an active agent through an enmeshing between the natural and social world, and the updating of scientific ideas that influence the conceptualization of reality.*

In this sense, Newtonian influences are thought to restrict IR to a modernist episteme based on the separation between nature/culture that no longer has real connection to the current reality and that is a problem for the discipline (Rothe, Müller and Chandler, 2021) – the new reality of the world would need a different episteme, which, in the particular literature being discussed here, is related to Earth System Sciences and associated with sciences of complexity, given that “[t]he [inherent] complexity of the Anthropocene [...] makes the prevailing restrictive assumptions within the discipline obsolete” (Pereira, 2021, p. 25).

¹⁵ Ruggie (1998) affirms that a commitment to Newtonian thinking within International Relations is particularly connected to the “dominant positivist posture” in the discipline, which gives preference to concerns over method while leaving aside any consideration about epistemology and, even further, ontology.

Understood in this way, the modern episteme of the nature/culture divide that is part of the foundation of International Relations, what enabled the separation between the domestic and the international in the first place, to assure IR as an independent field of study, made the discipline unable to deal with the complex problems of the Anthropocene from the beginning of its issues (Rothe, Müller and Chandler, 2021). This episteme is connected, additionally, to a specific ontology of the international (Dalby, 2011) based on “an image of the [natural] world as an unmoving and uninterested landscape” (Harrington, 2016, p. 7). As mentioned, this “pure, static, and unmoving world” (Harrington, 2016, p. 11) allows humans to master, possess, and control it.

This modern ontology of the international is related to state-centric and global views and would only be fully overcome by an ontological shift within the discipline aligned with an epistemological change that would allow for International Relations to access the real and conceptualize the planetary (Pereira, 2021).

Until then, however, being epistemologically and ontologically attached to Holocene-worldly modern perspectives, the discipline is said to be unable to successfully provide political suggestions and solutions adequate to the Anthropocene. Hence, traditional linear problem-solving strategies are erroneously thought to be applicable to the complex problems of the Anthropocene (Rothe, Müller and Chandler, 2021) – this leads to three different kinds of failure: the failure of states “to adequately respond to overwhelming scientific evidence that warns us to adjust our ideas and behavior and prepare for a future unlike the past” (Harrington, 2016, p. 4), the general failure of International Relations to think in different terms and imagine a different world, and the potential failure of modern human societies to maintain their existence alongside a relationship to other forms of life (Harrington, 2016). In few words:

modernist conceptions of politics, of belonging and community, of ethics and ideas of human freedom and human exceptionalism, based on modernist epistemological and ontological assumptions of reason and causal linearity all need to be reformulated and reconsidered (Chandler, 2018, p. 19).

To sum up the issue raised, the critique moved by critical International Relations literature regarding the inadequacy of the discipline within the Anthropocene and pushing for a fundamental change to the field generally affirms that IR is founded through a modern episteme, associated with Newtonian ideas of closed systems and mechanics, and a particular ontology of the international that relegates the natural world to a static backdrop and asserts anthropocentric control over the world. However, developments in the natural sciences, particularly related to Earth System Sciences, have established a new reality, concerning the advent of the Anthropocene. Thus, any political imaginary and suggestion associated with the discipline is mismatched with the current reality of international politics in the Anthropocene. So, to properly politically respond to the problems of this changed world IR then needs an ontological shift that breaks down the nature/culture divide and embraces complexity and entanglements; along with a different epistemology that goes beyond Newtonian ideas and draws from interdisciplinarity, particularly from ESS, albeit critically.

The main problem International Relations confronts, then, is the search for accurate vocabulary, concepts and imaginaries, that align with the changed Anthropocene world, considering that “the discipline’s conventional structures and mainstream theories [were] constructed in and for a world very different from the one in which humanity currently lives” (Pereira, 2021, p. 21). But IR exists in a brand new world now and our old modern vocabulary is no longer useful *neither for correct analysis nor political action* (Hamilton, 2016, p. 20) – this truly postmodern, fragmented, complex, Anthropocene world evidences a shortcoming in the discipline, that cannot apprehend this world in its current ontological vocabulary. In short, “[w]e lack even an adequate vocabulary; and what we cannot describe, we cannot explain” (Ruggie, 1998, p. 175).

Different authors have different focuses on the specificity of the problematic vocabulary of IR: for instance, when approaching the difficulty the discipline has conceptualizing and dealing politically with the problem of extinction, an important problem of the Anthropocene, given it involves the sixth mass extinction, Mitchell (2017) points to the discipline’s inability to conceptualize extinction (an ontological problem) because of its fixation with survival (an ontic problem), while Harrington (2016) speaks of the discipline gap of vocabulary to deal politically with issues of such complexity and temporal and spatial scale.

But, in general, a few elements appear as constants in the diagnosing of problematic areas, even if the proposals on solutions differ: firstly, IR's anthropocentrism and limitation of agency, which leads to the need of new vocabulary that ascribes agency to the non-human and non-living or even puts into question the category of the human, and secondly, the further development of the concept of the planetary, a new vocabulary to put into question current spatial categories of the discipline, that are all too connected to the Holocene (Dalby, 2011).

So, in few words, the authors of critical literature regarding the Anthropocene in International Relations affirm that the discipline is unequipped conceptually and politically to deal with this changed world because of its connections to modern and Newtonian ontology and epistemology. Therefore, International Relations needs to renovate itself with the interconnected changes regarding a new vocabulary, a new ontology, and new political imagination. These are promoted by the discipline's appropriation of Earth System Sciences (Hamilton, 2016) and are developed through this association and other forms of interdisciplinarity.

Although none of the literature explicitly proposes that the movement in question is a call for a turn in the discipline, it can be useful to analyze the appropriation of the Anthropocene in these terms so that a few elements become evident. When examining the proliferating turns in International Relations through a sociological lens, Baele and Bettiza (2020) connect the act of 'turning' to discussions of the 'end of IR theory' debate of the 2010s¹⁶ and ascribe to 'turnists' a desire to bring into discussion metatheoretical questions regarding the knowledge construction of International Relations: "turns share a common desire to vigorously bring back metatheoretical discussions to the fore of IR [...] whereas simultaneously questioning the very status of IR as a discipline, especially one structured around well-defined isms" (Baele and Bettiza, 2020, p. 7). These two aspects are clear in the literature appropriating the Anthropocene, which rejects and questions the traditional theories of International Relations on the basis of their anthropocentrism and non-alignment with reality and push for epistemological overcoming of Newtonianism and, particularly, a new ontology for the discipline.

¹⁶ On 'the End of IR' debate, see: *European Journal of International Relations* (2013), Lake (2011), Sil and Katzenstein (2010), Sil and Katzenstein (2011), Sylvester (2007).

Rhetorically, the authors describe the anatomy of a turn as composed of three steps: firstly, the affirmation that a particular aspect of social reality “is everywhere in or deeply constitutive of world politics” (Baele and Bettiza, 2020, p. 15); but, secondly, this aspect is said to have been ignored by the discipline, which now needs to turn to it; however, in turning and taking account of this new part of social reality, IR’s foundations and traditions are overturned, or even the very boundaries of the discipline as a whole are put into question (Baele and Bettiza, 2020). Again, this movement is reminiscent of what was described in the beginning of the section, regarding the construction of the limits of traditional IR to deal with the particular problems of the Anthropocene, and particularly the potential of the Anthropocene to fundamentally change even what is the international studied by the discipline, shifting from international and global concerns to planetary ones, and thus putting into question what the discipline is itself.

When bringing forth this new aspect of social reality to be discussed, but that will fundamentally disrupt the discipline itself, the authors of the article state: “[r]ather than simply proposing an exercise in borrowing or inter-disciplinary exchange, turns signal a desire to transcend disciplinary boundaries drawing upon wider trans-disciplinary movements seeking to apply a novel ‘vision’” (Baele and Bettiza, 2020, p. 14). Once more, this push for a trans-disciplinarity of change is clear within the Anthropocene literature, that stems precisely from drawing Earth System Sciences into other disciplines and breaking down divisions between the social and natural sciences (Pereira, 2017) in order to construct a holistic knowledge endeavor capable of “effectively addressing the magnitude of contemporary transformations” (Pereira, 2021, p. 26).

In fact, an important aspect of the trans-disciplinarity of the literature related to the Anthropocene is that the transcendence of disciplinary boundaries is said to be needed not only so that International Relations stays relevant and capable to intellectually answer to the challenges of the epoch, but also so that it *politically* responds and brings solutions “for the collective problems that are risking life on Earth” (Pereira, 2021, p. 26).

In relation to the justification of such a move, the authors when investigating turns within International Relations connect them to a sense of urgency and crisis, another element brought up in the last section, and more generally throughout the

whole dissertation, when expanding on the literature on the Anthropocene in IR, they cite:

[T]ypically, the narrative required to justify and legitimate anti-mainstream discourse is one of “crisis” [...]: there is something fundamentally wrong with the discipline that needs to “urgently” be addressed, something that undermines its very identity and vocation. The discipline is portrayed as fundamentally at odds with its object of study (Hamati-Ataya, 2012, p. 637 *apud* Baele and Bettiza, 2020, p. 15).

As such, although the critical literature bringing the Anthropocene within International Relations does not state to be proposing a turn for the discipline akin other turns have been suggested, it is useful to read this literature alongside Baele and Bettiza’s (2020) exploration of turns in IR so that a few things comes into sharper focus: the complete call for re-thinking the discipline and the international, a push for more interdisciplinarity, a reliance on a state of crisis and urgency, and a focus on metatheoretical discussions over the epistemology and ontology of the discipline.

Ontology, then, is particularly important within the literature pertaining to the Anthropocene – the new world of the new epoch consists of a new reality and therefore necessarily necessitates a new ontology. Some authors affirm that the current ontology of International Relations is a remnant of its origins in Political Science (Pereira, 2017; Chandler et al, 2017) and to continue limited by what was called as the ontology of the international impedes IR of being relevant in the Anthropocene. Hence, a new *ontology of complexity* is proposed for the discipline. Related to the complexity paradigm, which directly challenges Newtonianism, an ontology of complexity would provoke “a reckoning with the multiple possibilities of becoming and becoming-other inherent in the pervasive ambiguity of global life” (Kavalski, 2012, p. 140) – that is because instead of the rigidity of Newtonian influences, complexity “challenges the Newtonian view of an orderly world and suggests that global interactions occur in a non-linear fashion” (Kavalski, 2012, p. 138).

In this sense, this ontology of complexity focuses on uncertainty, instability and unpredictability (Pereira, 2017) and would allow for a different understanding

of the international. Still, commitment to an ontology complexity poses methodological and epistemic challenges (Kavalski, 2012; Rothe, Müller and Chandler, 2021), bringing epistemology to the forefront of the literature in second place, with authors referring to a current epistemological crisis (Schultz, 2017), or the necessity of an Epistemic Revolution (Popolo, 2011 *apud* Kavalski, 2012). Therefore, within the texts, rethinking of epistemologies appear as a result of necessary changes in ontology.

It is important to note the ethical commitment understood as inherent within the ontology of complexity proposed – just as complex systems are used within Earth Systems Sciences to access the interconnectedness of the system, within IR, complexity is used to think interdependence and entanglement, stating that the Anthropocene epoch:

creates, modifies, and enhances multiple relationships of interdependence among human societies and generations. The Anthropocene generates a) a new dependence among states, inasmuch as even the most powerful states are not free from the negative consequences of poor environmental practices in places outside their national jurisdictions; b) a new dependence among societies as every global policy offers innumerable methods of local implementation with different levels of efficiency; c) new intergenerational dependencies caused by changes in the global system that occur over large time periods, so the measures taken now will have an unprecedented effect on future generations in an entirely new manner; (Pereira, 2017, p. 7).

In this sense, the Anthropocene and its ontology of complexity express a reality where humans, non-humans, and non-living elements co-exist in complex relations (Harrington, 2016) which is interpreted through a human centered lens to develop an ethical concern tied to Anthropocene politics and philosophy. As was discussed with Chakrabarty (2019), to refer to planet-centered categories is to deal with non-normativity and otherness beyond human constructions of morality and politics, in this sense, a complex physical connection between humans, non-humans, and non-living elements does not *inherently* have ethical implications, given it refers mostly to the “radical otherness of the planet” (Chakrabarty, 2019, p. 25). Thus, in constructing a specific ethical commitment associated with an ontology of

complexity, the authors of this critical literature are partaking in a mediation between the human-centered and planet-centered modes of thought discussed in the previous section.

As such, the ‘global ethics’ of entanglement developed by Burke et al (2016) – built upon the “goodness of *life itself*” (Burke et al, 2016, p. 19, emphasis on the original), the embracing of worldliness and understanding of interconnectedness through “positive solidarity” (p. 21) and with a sense of “gratitude” (p. 21) – and Chandler et al (2017) emancipatory perspective of entanglement – involving the acceptance of the tragedy of the times, a construction of new worlds from the destruction of the current one, and a commitment to posthuman communities - are a form of mediation between the neutral physical interconnectedness affirmed by the complexity in the world represented by ESS and a positive framing of entanglement for (more than) human ethics.

In any case, the movement generally takes the form of affirming that living within this universal entanglement of living and non-living forms and persisting with modernist modes of thinking and acting will be “the road to doom” (Chandler, 2018, p. 8). Hence, the translation of an ontology of complexity in International Relations leads to an ethical commitment with non-anthropocentrism (Kavalski, 2012), “relationality, and mutual vulnerability” which “may help us extend the compassion and care practices beyond the human” (Pereira, 2021, p. 31). Further, Brown (2022) understands this ontology of complexity as having the purpose to “unify physical and social ontology” (Brown, 2022, p. 5) related to a relational cosmological construction.

On the whole, this ontological shift is thought to help “us” socially and politically grasp other life forms “and their singular modes of being” (Mitchell, 2017, p. 7). One consequence of the ontology of complexity is that entanglements that negate a self-contained subject put into question what the human is – a basic category of modernist thought is rejected, which leads to the necessity of rethinking the structures stemming from it: for instance, our understanding of security (Mitchell, 2017; Harrington, 2016), of democracy (Burke and Fishel, 2016), etc. As a result, this literature brings on the question, in the form of a possibility (Chandler, 2018), of rethinking what is the international in the Anthropocene now that it can no longer be constricted by human-only relations and values. In other words, if what was referred to as the ontology of the international is connected to the politics of

the modern international, the resulting question from the push for an ontology of complexity is: *what form of international forms and politics does it create?*

Importantly for International Relations, a discipline thought in terms of space, but said to be currently trapped in modernist territorial thinking (Dalby, 2011), is a reconceptualization of space within this new international and international politics – here, the category of the planet is recurrently referred to within the literature pertaining to the Anthropocene in IR. Instead of defending an expansion of the category of the international, the authors generally talk of going *beyond* the international, affirming that the international that stems from the dichotomy of domestic/international refers to closed systems, and is thus connected to a Newtonian way of thinking, whereas an ontology of complexity connects to open systems (Pereira, 2017), which would then be represented by the changed vocabulary of the planet. To put it differently, if “the most distinct feature of modernity in international politics” is a particular form of territoriality “as the basis for organizing political life” (Ruggie, 1998, p. 192), the connection between spatiality and politics is updated with new vocabulary that better relates to the Anthropocene reality.

In this sense, the Anthropocene is said to present a challenge to the cartographical imagination of social sciences, and especially International Relations (Dalby, 2011), given that “[t]he international system’s territorial structure does not match the ecological map of the Earth” (Pereira, 2021, p. 23). As mentioned in past sections, the Anthropocene is argued to fundamentally disrupt state boundaries given that the ecological and social challenges related to it are global in nature; as a result, the current modern international, based on national divisions, is rejected both analytically and politically within the literature.

Along with it, the category of the global is referred to, but always in tension, given that although the global is understood as a form of unity required for the Anthropocene, it is originated in human-centered thinking. Thus, the planetary, in its planet-centered origins, and through mediation to human-centric forms and values, appears as the central spatial, analytical, and political category of the Anthropocene in International Relations. In short: “building a planetary picture of reality – and acting according to that image, is a *sine qua non* condition for effectively responding to the severity of the challenges of the Anthropocene” (Pereira, 2021, p. 22), be that the response is through strengthening international

institutions and law (Burke et al, 2016; Burke and Fishel, 2017; Fishel et al, 2017), systemic change to capitalist structures (Chandler et al, 2017), a philosophical project of cosmopolitics, or an allusion to multiple solutions, separated in short and long term changes:

the administrative practices of territorial entities are no longer the appropriate mode of thinking for the long-term future, if at least some notion of human security is taken seriously (Dalby, 2009b). They may be necessary in the short term, given the absence of appropriate institutions that can grapple with the important matters of how humanity as a whole decides what to produce and how to tackle the ecological disruptions that are compromising human security (Dalby, 2011, p. 144).

In this sense, the ontology of complexity and the planetary as a spatial category are connected to the search for and the possibility of a new political imaginary, moved by ethical concerns of entanglement, for the Anthropocene. Hence, despite a “temptation to map the idea of the Anthropocene into existing social theory” (Fishel et al, 2017, p. 3), the breaking down of binaries and divisions of this new epoch is said to fundamentally redefine politics, given that “[w]hereas, for the moderns, politics carved out a separate human sphere of freedom and autonomy in distinction from nature, for the no longer moderns of the Anthropocene the situation is reversed and it is the world itself that shapes and directs the content of politics” (Chandler, 2018, p. 15).

In general, the critical literature of the Anthropocene in International Relations connects the following elements in their urge for changes in the discipline: complete interdisciplinarity and search for a new vocabulary, a new ontology of complexity, universal ethics of entanglement, and a new political imagination. The desire, therefore, relates to the reconstruction of “core ontological, epistemological, and ethical concerns in the discipline” (Harrington, 2016, p. 20) so that IR is able to provide more responsible political solutions for the challenges of the Anthropocene.

In this movement, it is important to notice, then, the alignment between knowledge and political action – just as in the last chapters, when discussing the formulation of science in general and Earth System Sciences in particular as the legitimate mode of developing political action and specifically guiding humanity

through the Anthropocene. This IR literature affirms, in this sense, that the role of the discipline in this epoch is to think better international politics by adapting itself based on the changes in reality affirmed by ESS; “critique, therefore, is more than an approach or a process – it is also a product which can offer pragmatic solutions” (Simangan, 2020, p. 218).

So, if Earth System scientists are diagnosticians of the Earth (Schellnhuber, 1999) the authors of IR that appropriate the Anthropocene appear themselves as *diagnosticians of a discipline*: from this concept they point to the problems of current theoretical production and prescribe the correct solutions so that the discipline will appropriately respond to reality. The specific prescriptions can vary, although they generally allude to common necessities – use of knowledge stemming from ESS and other forms of trans-disciplinarity, adoption of a new ontology for the study of IR, commitment to a specific form of ethics, and formulation of a new political imaginary and form of international (planetary) politics. As mentioned, the texts are also generally embedded within an eschatological linear notion of time. Theory, in this case, takes on a problem-solving requirement as the role of knowledge produced within International Relations is understood as being able to provide solutions to the concrete crisis of the Anthropocene.

4.3. Appropriation of the Anthropocene

Before finalizing the discussion, then, a brief recapitulation of the movement of this chapter can be useful: the chapter started off from a discussion over scientific cosmologies – in a similar way that the Copernican Revolution established modern science as the legitimate authority to tell stories about humanity and ascribe them purpose, in the term of scientific cosmology, the dissertation proposes useful to understand Earth System Sciences as proposing a new form of cosmology, or organization of cosmological elements in the form of Anthropocene. In this way, the Anthropocene appears as a practice of world-making braced up in the scientific authority.

It was shown, also, how some formulations of the Anthropocene world suggest a specific view of international politics, in the form of international governance regimes. From there, this chapter started out transitioning from international politics to International Relations, in the finalization of the analysis on the mobilization of the Anthropocene by IR theory.

Then, the chapter moved on to examine how the Anthropocene is used in critical IR - the general starting point of the critique constructed that traditional International Relations theories do not take the element of nature seriously, and a deep dive into the two main manifestoes that articulate the necessity of the Anthropocene in the discipline. The section established the authors as diagnosticians of international politics and diagnosticians of International Relations, pointing out the problems with current political organizations and imaginaries and limitations of the discipline and how to utilize certain interpretations of the Anthropocene, from ESS and beyond, as a useful and etherical solutions.

Now, the chapter will finalize by returning to the formulation over the Foucauldian problematization, conducted in Chapter 2, to point out some limits to the critique conducted by IR literature in regards to the Anthropocene. Therefore, the section will, firstly placed IR's discussion within the same dynamic of problem – solution formulation established as constitutive of the Anthropocene in the second chapter. Moving backwards from the solutions discussed in the last section, the discussion will then point to a few elements located in the process of problematization of the Anthropocene within critical IR: namely, (1) the ever presence of crisis and a sense of urgency; (2) worries over legitimate knowledge, in a source to better represent reality; (3) anxieties over a lack of universalism; and (4) references to responsibility and maturity.

With that, the dissertation will finalize by pointing to possible limits to the critique conducted through the mobilization of the Anthropocene in critical IR by shifting once again to the political possibilities that stem from the problematization of the Anthropocene within IR.

So, first of all, and importantly, the connections of problem/solution in this literature seems to relate the discipline of International Relations with the conduct of international politics in a very particular way: the Anthropocene starts as a new problem in the realm of international politics that reflects in IR; it is then through “solving” the discipline, making it less outdated that a proper solution to the world of international politics can be presented. In other words, it appears that it is by proposing solutions to the Anthropocene problem within IR that the discipline will, in turn, be capable of providing better political solutions to the Anthropocene problem international politics – as the two texts state: “[w]e are concerned that

International Relations, as both a field of knowledge and a global system of institutions, is failing the planet” (Burke et al, 2016, p. 6) and “[w]e can agree that International Relations is inherently the discipline that has the responsibility for considering global processes, and that this is a responsibility it had thus far failed to shoulder” (Chandler et al, 2017, p. 27).

Therefore, instead of viewing and interpreting the Manifestoes as opposite, or wholly distinct propositions regarding international politics in the Anthropocene epoch and the state of IR, the dissertation proposes useful to read them both as variations within the same field of solvability: with restricted possibilities regarding the betterment of IR *and* changes to international politics. Hence, if the possibilities of solutions grasp the elements discussed previously – a new ontology of complexity, commitment to ethics of relationality, the new spatial category of the planetary, a new political imaginary and interdisciplinarity – a few elements appear in the formulation of the problem, which serve to emphasize the necessity for such changes and new formulations of vocabulary, and imaginary.

Firstly, then, the looming elements of a crisis, present throughout the dissertation. Within the appropriation of the Anthropocene, International Relations has been heralded as particularly capable of dealing with the urgency of the epoch for bring a discipline that thrives in the context of crisis, universal violence and existential threats (Fishel et al, 2017) - indeed, the element of crisis has been a constant in IR theory, being an important part in the discipline’s self-image (Souza, 2017). In this sense, “[c]risis has been present throughout the history of this discipline, either as a unique object of study [...] or else as the analytical condition of its existence” (Souza, 2017, p.11)

In this case, considering IR as a discipline *about* crisis is what makes it so conducive to study the Anthropocene, understood as the apex of social, political, and ecological crisis. When analyzing the role of “crisis” within International Relations, then, Souza (2017) traces the history and origins of the discipline related to a constant sense of crisis

A gnawing sense of crisis has in fact been a constant feature of the discipline [...] [early IR authors] all shared a certain sense of urgency to respond to some impending political crisis, both conceptually and politically. For all of them, it seemed clear that

the ideas men held about the world had a direct impact into the workings of such a world, and therefore, creating a better world – or simply countering the development of a tragic future – depended on the ability to formulate ideas, concepts or theories that could adequately comprehend and address the grave issues that afflicted politics in the twentieth century (Souza, 2017, p. 44).

Thus, discussions of International Relations were fundamentally connected to the crisis pertaining to the world the discipline developed in and to a desire to address them and, hopefully, fix them, or at least prevent circumstances of worsening. This is a dynamic explored and evidenced in the last section, in regards to the desire of IR literature to provide adequate solutions to a world in crisis.

At the same time, Souza (2017) calls attention to IR not only as a discipline *of* crisis, but a discipline constantly understood to be *in* crisis – starting from the debates over the “end of IR theory” (briefly touched on in the last section), and moving backwards to historically explore assertions over a “chronic ‘identity crisis’” (Souza, 2017, p. 11) of IR. Here, the discipline is one in constant turmoil over its own identity, object of study, main theories, and methodologies, while at the same time referring to a supposed past of coherence where the discipline was allegedly more resolved (Souza, 2017).

The internal crisis of IR theory was also previously alluded to when discussing turns and delving into the set-up of the problem that the Anthropocene brings to the discipline. Here, the concept is a potential destruction of the discipline, but also a means of reinvention. This movement, then, of association to crises within the discipline and beyond seems to be somewhat constitutive of the discipline – the Anthropocene, here, connects to a variety of allusions to crisis; a world in crisis, a discipline in crisis because of the end of the world, a discipline capable of dealing with the crisis of the world, etc. as “there is an ecological crisis, with possible civilization threatening potential, and [the] discipline of International Relations finds itself ill-equipped to engage with the issue” (Chandler et al, 2017, p. 2) and so “[w]e must face the true terror of this moment” (Burke et al, 2016, p. 2).

However,

As every political concept, that of crisis is not a purely descriptive and representational one which allows us to grasp instances of disorder and disruption of the normal structures of society; the concept of crisis is deeply productive of a temporal and political account of reality, in which certain forms of subjectivities are (re)produced by excluding alternative possibilities (Souza, 2017, p. 47).

Here, importantly to the discussion developed throughout the dissertation on the construction of the Anthropocene crisis in particular, connected to the role of the climate crisis pertaining narratives of ESS, is *crisis as prognosis*, developed by Souza through Koselleck (1988) [1959]. The author states that:

according to Koselleck, it is from medical terminology that the modern understandings of crisis derive their use, with the adoption of the term in Latin and its subsequent entrance in the national languages. In this realm, a crisis marks the turning point of an illness, when the patient's condition becomes critical (Souza, 2017, p. 80).

Of course, crisis, as a complex concept, has a metaphorical and general quality to it, “never stabiliz[ing] in a single coherent concept” (Souza, 2017, p. 81) – still, it is interesting to focus on the medical analogy, particularly when connecting it to Schellnhuber's (1999) allusion of Earth System scientist as diagnosticians of the Earth, tasked to generate treatments in the context of the Anthropocene. Here, just as the medical conceptualization of crisis was connected to the “body politic” since the 17th century (an important metaphor within classical IR references, such as Thomas Hobbes), related to political, social, and economic decisions (Souza, 2017), the medicalized crisis applies now to the entirety of the planet. Therefore, there appears to be a sliding of meanings, not only regarding the individual body and the state, but also the body and the planet.

Fittingly, then, Chandler et al (2017) start their essay referring to Gramsci's ‘interregnum’ aka ‘morbid symptoms’ pertaining to the current climate crisis:

Writing in the Prison Notebooks Gramsci described the moment as an ‘interregnum’ where many ‘morbid symptoms’ were evident. [...] [now] we appear to be surrounded by many ‘morbid

symptoms'. Within the human sphere, these are taking the form of political violence and an increased rhetorical violence amongst those who represent us. Looking out into the rest of nature there is the day-by-day drip-feed of news reporting on the devastation of our fellow species and landscapes, much linked to the issue of climate chaos (Chandler et al, 2017, p. 1-2).

With that, the connection of medicine and understanding of crisis therefore results in the dynamic of treatments, proposed solutions, as “crisis came to refer to the diagnosis of a crucial, critical moment which demands a solution” (Souza, 2017, p. 81) and, not only that, but a solution ultimately related to a “fundamental *change* in treatment” (Souza, 2017, p. 80, my emphasis). Hence, by understanding the prominence of crisis in the mobilization of the Anthropocene within Critical IR, particularly connected to a medical metaphor and to ESS’ interpretation of a medical metaphor, the radical change proposed in the solutions for international politics and International Relations is connected to dynamics spanning the origins of the concepts. In other words, by utilizing a medicalized analogy of crisis in the formulation of the problem of the Anthropocene within IR, the resulting field of solvability requires fundamental, radical change.

As mentioned, then, these authors become diagnosticians of IR, connected to diagnosticians of the Earth, and answer questions concerning the health of current IR related to the current world, its crisis and possible end. In short, “the allusion to the “health” of international relations theorizing is indicative of the way crisis narrative points us to the medical uses of crisis to diagnose the critical, turning point of an illness, which demands a change in the treatment that could lead to life or death.” (Souza, 2017, p. 40). In this sense, the disciplinary discussions developed by both texts refer to the necessity of changing International Relations so that it becomes apt and relevant to the context of the new epoch, as “[t]he problems lie in the way we think and are trained; in the subjects and approaches our discipline values and rewards” (Burke et al, 2016, p. 3) and the general prognosis for IR involves “[g]oing beyond IR” (Chandler et al, 2017, p. 24) or “the creation of a new field parallel to IR, or the recovery of an earlier notion of IR” (Burke et al, 2016, p. 8).

A second element that seems to be present in IR’s problematization of the Anthropocene is that of maturity and responsibility: *the maturity of man to*

understand his place in the universe and the responsibility to act in accordance with it. From the discussions of the Copernican Revolution Man's self-understanding was established as connected to an understanding of its correct place in the cosmos (Harries, 2001). This followed into the formulations of both the second-Copernican revolution and the counter-Copernican revolution – for all of their differences, the novelty of the Anthropocene is connected to the new placing of the Human in relation to the universe. In essence, the Anthropocene, by stating the Human as part of Nature, involves a re-placing of Man in the universe, be it as a vulnerable subject sharing agency with other living and non-living beings (Latour, 2014) or as a “self-conscious control force that has conquered the planet” (Schellnhuber, 1999, p. 22).

In its turn, this new correct understanding of the cosmos, the functioning of the Earth system, and the relation of Mankind to it results in a responsibility to act in accordance with it. Interestingly, the development of crisis in Koselleck's formulation comes to refer to the emergence of human responsibility in the insertion of the concept of crisis into the realm of human finitude: “Man is the only being that is morally responsible: for acting or refraining from acting [...] the appeal to crisis became a demand for immediate and adequate human action” (Souza, 2017, p. 82). Here, responsibility can take many forms, depending on the cosmological framing – from humanity becoming an ‘active agent’ in the managing of the Earth system, embodying the role of the global subject in the form of geoengineering, establishing of boundaries, strong international regimes and a general disciplinary regime managing a proper relationship to nature, to humanity giving up “dreams of mastery” (Latour, 2014), and re-formulating politics from this newfound placement of entanglement in a way to take into account other life forms and ways of being in the world.

As such, maturity and responsibility appear as important elements in the formulation of the Anthropocene problem – Humanity's maturity of understanding one's place in the world, sciences' maturity to correctly represent the world and take on its role in modern societies, referring to legitimation and scientific authority, even the maturity of the researcher in accepting that “the research community becomes part of their own riddles, the research specimens become part of their own explanations” (Schellnhuber et al, 2005, p. 7) comprehending their place in

knowledge production, their “active role [...] in the construction of facts” (Latour, 2014, p. 2)

As such, any possible solution to the Anthropocene is tied to a correct self-understanding in the entanglement of the cosmos and the actualization of its role in the world:

The Other is always already inside, so bound up with us in a common process that it no longer makes sense to speak of inside and outside. We cannot survive without accepting the cosmopolitan and enmeshed nature of this world. We are an array of bodies connected and interconnected in complex ways that have little to do with nationality (Burke et al, 2016, p. 4).

[I]s to retain and extend our practices of critical analysis and politics where we need to continue to demonstrate the responsibility of particular forms of social organization for our currently precarious condition. There are, in fact, many possibilities whereby a liberating and emancipatory perspective can be generated from the entanglements of the Anthropocene/Capitalocene (Chandler et al, 2017, p. 23).

It is difficult here not to draw a parallel to Kant’s maturity as Enlightenment. Enlightenment, in Kant’s discussion on the problem of authority, is the capacity for self-realization – to become self-determined and mature, “to use one’s own understanding without the guidance of another” (Kant, 1991 [1784], p. 54) and it is a necessary process of evolution and progress. Importantly, Enlightenment is a natural process of evolution and progress, that involves subjectivity – by internalizing sovereignty, man is not merely a subject under the sovereignty, but has a capacity for self-realization.

However, beginning his discussion, Kant refers to how easy it is for man to allow himself to remain under the guidance of another, be it motivated by laziness or cowardice: “it is difficult for each separate individual to work his way out of the immaturity which has become almost second nature to him” (Kant, 1991 [1784], p. 54). Also part of the difficulty to achieve maturity is the (self-)appointment of guardians, who are tasked with supervision and hinder the self-actualization of

others. Here, Kant mentions dogmas and formulas, and organizations represented by the officer, the tax-official, and the clergyman as deterrents to Enlightenment.

At the same time, enlightenment happens not only individually, but also as a collective process; even more, “there is more chance of an entire public enlightening itself. This is indeed almost inevitable, if only the public concerned is left in freedom” (Kant, 1991 [1784], p. 55). Here it is clear, through the allusion of inevitability, the naturalness of Kant’s proposed evolution – not only is enlightenment a positive process, but it is a natural part of the evolution of man, it is a natural part of History. The relationship between individual and public enlightenment, then, is important in its reciprocity - on the one hand, public enlightenment is promoted by enlightened individuals, as “there will always be a few who think for themselves [...] [they] will disseminate the spirit of rational respect for personal value and for the duty of all men to think for themselves” (Kant, 1991 [1784], p. 55). At the same time, an enlightened public will push for a space more conducive to the process.

Thus, Kant asserts that the key for the process of public enlightenment is freedom, “freedom to make *public use* of one’s reason in all matters” (Kant, 1991 [1784], p. 55, emphasis in the original). Hence, to deprive man from the free use of public reason “would be a crime against human nature, whose original destiny lies precisely in such progress” (Kant, 1991 [1784], p. 57). As such, although the author affirms that private use of reason can be obstructed, general enlightenment hinges on freedom.

It also interesting to note the linearity and importance of time in Kant’s discussion of maturity. In Kant’s attempt to solve the problem of authority, he provides a reading through History, the possibility of temporal linearity and progress: it is through an historical unfolding of time that the possibility of emancipation appears. In this sense, Kant proposes to think of politics temporally – his politics revolve around historical unfolding. Hence, the enlightenment of mankind (not just of the individual, or of a particular society) appears as historical, inevitable process of progress, albeit a slow one – “If it is now asked whether we at present live in an enlightened age, the answer is: No, but we do live in an age of enlightenment. As things are at present, we still have a long way to go” (Kant, 1991 [1784], p. 58). Kant’s proposition of maturity ascribes to this linear temporality in a way that the Enlightenment of men is natural and inevitable throughout the

advancement of history – the achievement of maturity, in this sense, is not a matter of faith, but a natural part of history, a natural process that takes generations, but will inevitably happen. That is not to say that naturalness equals the absence of conflict – but despite the presence of struggle, there is an implication that struggle and progress are linked.

However, despite the parallels, the connection between Kant's maturity and the maturity constructed as related to the Anthropocene does not go without tensions and contradictions, particularly referring to the role of guardians in Kant's formulation. In the author's discussion, maturity through Enlightenment hinges on the self-actualization of man's own understanding "without outside guidance" (Kant, 1991 [1784], p. 58), while maturity in the original problematization of the Anthropocene, within ESS depends specifically on the guidance of experts with correct knowledge to pertain to this reality. When appropriated to International Relations this guidance is translated into the role of science, and scientists, on the new organization of politics required for the epoch (in the case, for example, of reformulation of international institutions) or, more implicitly, on the affirmation of the physical interconnectedness of beings (which will lead to the maturity of understanding one's relation to the universe).

In its turn, then, thirdly, the possibility of achieving maturity, a correct understanding of reality and our place in it within the problematization of the Anthropocene, seems to be tied to the *use of legitimate knowledge*, and representations constructed by it. ESS and its representations of the planet through the formation of the Anthropocene play a fundamental part in IR's problematization of the Anthropocene, either directly or indirectly, as the figure of the Earth system, or of the associated Gaia, is the basis affirming interconnectedness and entanglement.

Central to the introduction of the discussion within the discipline is the 'planetary', attached to the representation of the Earth system – in this sense, the better representation of reality related to the construction of better knowledge seems to be foundational to the appropriation of the Anthropocene within IR. As ESS and "the complex assemblage of multiple complex systems that make up the 'planet'" (Chandler et al, 2017, p. 14) and the consequential embeddedness affirmed have strong impacts in politics and policy-making, and "Earth System Science, with its power computer models, its massive datasets and its complex understanding of

ecological systems” (Burke et al, 2016, p. 5) accurately establish the crisis pertaining to the planet.

In this sense, representations of the world associated with the Anthropocene are metaphysical (Hamilton, 2016, p. 19) – these representations, from the Earth system, the Bretherton diagrams, the images constructed through modelling, etc. always exist implicitly in the conceptualizations of political space. As such, these images, constructed within the assertion of a new reality through a form of scientific authority is always productive, in the sense that it involves values, narratives, and a specific understanding of reality (Hamilton, 2016). Further, the knowledge constructed in other scientific endeavors, particularly ESS, is understood as the productive place from which to develop a new political imaginary and vocabulary within IR.

Here, the figure of a completely connected planetary representation of reality plays a part both in the formulation of the problem and in the propositions for a solution – the new planetary real appears as a problem to be addressed through political conceptualizations of the planet. In short, “IR scholarship shares the basic assumption that ‘the Anthropocene’ is, in some form of another, an impending reality, a scientific fact. It is assumed as the new and self-evident background condition that humanity and international politics will soon, and must, engage” (Hamilton, 2016, p. 5) – therefore ESS and the Anthropocene seem to come into the literature as claims for legitimate knowledge stating a new reality, even if implicitly, as a point of entrance.

In terms of what this use of legitimate scientific knowledge pertaining reality in the problematization means for possible solutions, it seems that it ends up putting the possibility of solvability in the hands of a subject capable of constructing better knowledge. Be it in terms of climate experts (Burke and Fishel, 2016), local communities or indigenous leadership (as discussed by Rothe, 2020) the possibility of life in the Anthropocene seems to come to access to better knowledge, with an understanding that this would lead to better politics.

Lastly, the final element to be pointed out here as part of IR’s mobilization of the Anthropocene, is the apparent *anxiety over a lack of universalism*. The holistic tendencies associated with the Anthropocene have been present, and openly discussed, throughout the dissertation – from the complete interdisciplinary integration fought for in the creation of Earth System Sciences, to the figure of a

unified humanity referred to in the *Anthropos* of the epoch, to the focus on a holistic and complete planet referred to in the representations of earth, in the political project of global governance, and generally within discussions of environmental problems that are conceptualized in terms of being transboundary.

In certain terms, this impetus seems to also be present in the appropriation:

We are aware that even as we call for a unified planetary project of common and just survival, the world remains fractured between different states and communities: fractured by inequalities and differences in power, fractured by different experiences of development and need, and consumption and responsibility. For some, the Anthropocene is better described as the ‘Eurocene’ or the ‘Manthropocene’; for others, it may obscure the conflictive and power-saturated politics around fossil fuels and environmental change. Yet the Anthropocene also issues a profound challenge to politics: no longer is it legitimate to understand politics as the perennial clash between human preferences and interests, or indeed a bargaining of human interests against those of the ecology. The planet is telling us that there are limits to human freedom; there are freedoms and political choices we can no longer have (Burke et al, 2016, p. 9).

In this sense, certain aspects of the reading and political proposals can certainly be read as totalizing and all-encompassing, common critiques made to the original utilization of the term within Earth System Sciences. However, IR is no stranger to critiques over problematics of universalism, particularly stemming from decolonial and post-colonial literature¹⁷.

Thus, this sense of universalism does not go uncriticized in readings of the Manifestoes, and even in tensions amongst the two texts, as Chandler et al’s utilization of a Capitalocene serves precisely to contrast the dangerous universalism present in the Anthropocene of the Planet Politics Manifesto, affirming that “[t]here is an uncritical endorsement of our contemporary condition in terms of the ‘Anthropocene’ wherein ‘humanity’ is constituted as problematic per se [...] There

¹⁷ For decolonial readings of the Anthropocene, see: Schulz (2017), McEwan (2021), Satgar (2012), Yusoff (2019), Chakrabarty (2012), Whyte (2017).

are very significant oversights and risks in deploying a conflated conception of 'humanity'" (Chandler et al, 2017, p. 12). In short, the critique goes:

the 'Earth system' framework discussed in the Manifesto offers a vision very different from those embraced by traditional IR; yet it reproduces the idea that there is one, unified planet and that any single worldview can reflect it. Similarly, the concept of the 'Anthropocene', in its attempt to gain critical purchase on global crises, ironically encloses earth within the homogenizing envelope of 'human' activities, erasing the specificity of the relations and modes of organization that it encompasses (Mitchell, 2017, online).

However, other impetus for holism and universalism appears present in the mobilization of the Anthropocene in IR, if not in political projects, at least in other forms. Firstly, for example, the ontology of complexity and the ethics of entanglement articulated in the solution for the Anthropocene are inherently holistic, and, in fact, draw their usefulness precisely in the fact of their union of all things. The spatialization of the planetary, as well, much like its representational predecessors – the Blue Marble picture and the diagrams of the Earth system – is meant to be an all-encompassing category, capable of transcending the divisions that mark the modern international and its national boundaries.

In terms of transdisciplinarity, as well, there can be seen a push for a certain universalism – with the assertion that “[w]hat we also require is the exploration of ideas from outside the disciplinary prison” (Chandler et al, 2017, p. 28) forms of interdisciplinarity, going beyond IR, are essential in the formulation of solutions for the Anthropocene. This, of course, is similar in the movement discussed in Chapter 2, regarding the origins of Earth System Sciences itself in the move to go beyond disciplinary divisions between chemistry, astronomy, biology, etc.

Finally, it can be argued that a final universal tendency within the arguments of the literature pertains to the reference of the need to reconstruct International Relations as a whole – proposing a new ontology, ethical commitments, and spatial category for a renewed field of IR. Still, despite the accusatory tone pertaining to current and traditional theorizations within the discipline, there is not a lack of self-reflection regarding this particular totalization within the text, affirming that

“[a]cknowledging a new planetary real does not mean that all new scholarship must follow in the voice, or deploy the sensibilities, that we have developed here” (Burke et al, 2016, p. 23). Also, the authors end by stating that the tone of a Manifesto in itself reflects somewhat in the forcefulness and in the universalizing tone when criticizing the discipline (Burke et al, 2016).

As such, an impetus for holism can be seen as present within the problematization of the Anthropocene in IR, much like in the problematization within ESS discussed in Chapter 2, however it appears to be much more nuanced, self-critical, and somewhat aware of the problematics of universalism.

Also, added in the sketching of the terms that construct the problematization of the Anthropocene in IR, attention must be paid to the particularities of the *mediation* between the problem and the solution, returning to the translation between planet-centered and human-centered. As argued by Chakrabarty (2019), the Anthropocene ultimately refers to a fundamentally non-normative event, centering around deep time timescales that greatly overshadow the human and a conception of space spanning beyond political demarcations of it. In itself, the events of the Anthropocene are beyond the realm of the human (Tresch and Zalasiewicz, 2013).

As such, the literature of Critical IR that was mobilized conducts a positive mediation of the physical, non-normative, aspects of this new reality: the interconnectedness of a complex world is the starting point for building “the goodness of *life itself*” (Burke et al, 2016, p. 19, emphasis on the original) or “making a ‘stand for life!’” (Gibson et al *apud* Chandler et al, 2017, p. 23). Then, be it in the form of accepting tragedy and building upon the ruins of the world (Chandler et al, 2017) or through a global ethics and gratitude (Burke et al, 2016) there appears to be a specific positive mediation in the bringing of the Anthropocene to human-centric discourse, attached to specific ethical commitments related to the epoch – as “[w]e exist in social nature” (Burke et al, 2016, p. 12) and thus “[i]n a world of becoming, beyond the binaries of ‘Man’ and ‘Nature’, it is possible to develop creative and enabling perspectives of relational embeddedness that see the contingencies of the Anthropocene as an opportunity.” (Chandler et al, 2017, p. 25).

In short then, *the dissertation connects the appropriation of the Anthropocene by Critical International Relations literature to the appropriation of certain dynamics solidified in the origins of the concept within Earth System Sciences, particularly that of problematization.* In this sense, even when IR is critical of ESS’

specific values and propositions, it still carries elements of the original problematization. Hence, the proposal to read the two Manifestoes together, while both being critical over the other and locating themselves as opposites, serves to instead propose both as varied solutions within the determined field and, thus, both taking part in the problematization of the Anthropocene in the field, simultaneously as a political and theoretical issue. Much like the analysis conducted in Chapter 2 questioning the oppositeness of Geoengineering and the Planetary Boundaries proposals, here the proposal is to read the two Manifestoes as part of the same field of solvability.

So, the elements highlighted as part of the problematization are (1) the presence of a crisis (in the world and in IR); (2) the necessity of responsibility and maturity; (3) the role of legitimate knowledge and its representation of the world; (4) tendencies to universalism, even if not without internal tensions; and (5) a specific mediation from planet-centered to human centered interpretations of internationality in the Anthropocene related to positive interconnectedness.

In this analysis, the theoretical and political solutions proposed from both texts have their differences and similarities, as discussed at length in the last section, but ultimately are a part of the same field of solvability. Differences and arguments amongst the texts are mainly stated in terms of short-term solutions for international politics: with one text being understood as more institutionalist focused, with necessary strengthening of international laws and institutions (Burke et al, 2016) and the other arguing for the main importance of change to systemic power and economic structures, arguing for the democratic need for local changes (Chandler et al, 2017). At the same time, both ultimately signal to the long-term necessity of a changed, new and innovative international politics, in the form of the planetary. Instead of reading them as fundamentally different, then, the dissertation proposes that they both “share the same conceptual foundation” (Hamilton, 2016, p. 20). That is not to say that there are no differences between the two but propose a reading that they are variations on a theme – working with, criticizing, and developing from a similar set of dynamics embedded on the Anthropocene from its origins.

That is not to say that the process of problematization in itself is avoidable – as Foucault (1984) argues, a process of problematization is always present in the political. In this sense, the argument does not move in a way to abandon the process of problematization of the Anthropocene within IR, or even of this problematization

in particular. Even within this particular set of solutions, it is interesting to note how resignifications can take place: one example is Grove's (2015) essay regarding the constant presence of apocalypses and apocalyptic tones in texts discussing the Anthropocene. In it, the author uses many of the elements pointed out in the discussion so far – crisis and urgency, maturity, a push for interdisciplinarity and association with natural sciences, and a mediation between planet-centered and human-centered formulations – however, the essay makes a move to reframe and make new connections from these elements. For instance, in the association of the apocalypse with a Deleuzian interpretation in order to muddle the concept and encapsulate both destruction and fecundity through this use (Grove, 2015); or the open reworking of maturity away from Kant's enlightenment and towards an association with humility and tragedy (Grove, 2015). That is to say, even in the context of a particular problematization it is interesting to note the variety and creativity in solutions.

Still, conducting an analysis on the construction of the problematization can be useful to map precisely the multiplicity of solutions, limits related to them, and better understand how the concept is being mobilized within the discipline.

Lastly in the discussion, then, the dissertation will lay out a few limits to the critical scope of the Anthropocene in International Relations considering everything discussed so far. However, it is essential to state before that these final observations are not meant to be a comprehensive critique and serve merely to point out elements for further reflection; also, importantly, the discussions over the problematization of the Anthropocene carried out so far and the limits to be discussed about shortly do not mean to imply a complete dismissal over the use of the concept within the discipline, or even over this particular appropriation. These analyses are always made in the hopes that a new reading, a different framing, a careful critique, can be useful in locating strengths and weaknesses, in making explicit power relations, in providing reactions in a way to move theorization further, not dismiss it. Here, the attempt at a careful analysis is made *because* of fertile ground for ideas, not in spite of it.

With that, firstly, it can be pointed out that the use of the Anthropocene in this literature has a particular and limited formulation of theory. In a parallel way to the discussion on Chapter 2, and the final section of Chapter 3, on the development of scientific knowledge by ESS and climate scientists with the expressed purpose of

guiding political decisions, propositions regarding the Anthropocene in IR seem to be extremely connected to international politics in a very practical way. In this sense, the changes that the concept brings to theorizing in IR are apparently made in terms of practical oriented knowledge seeking the amelioration of the crisis in international politics, while signaling at a future fundamental change to the politics of the modern international. As a result, the literature seems to limit theorizing to problem solving, in a way neglecting other aspects of theorization.

In its turn, this desire for a knowledge capable of solving the problem seems connected to an attachment to a scientific authority that legitimates politics (Jackson, 2017, online). In fact, one common critique made particularly to the use of Earth System Sciences in an unquestioned way is the nod to a traditional mode of Enlightenment thinking connected to a rational autonomous individual who could control nature and imposed upon itself a universal reason (Schulz, 2017). In this sense, a literature that uncritically ascribes to an objective reality affirmed by ESS and gives no possibility for the use of localized, racialized, and indigenous forms of knowledge and ways of being in the world ultimately reinforces a “triumphant scientism” (Schulz, 2017, p. 57) associated with a universalized form of Western Modern Science already embedded in critiques.

Further, the ascribing of ESS as a “privileged discourse for accessing [the] ‘real’” (Jackson, 2017, online) and, not only that, but also legitimating political, ontological, and ethical commitments specifically on scientific grounds seems to claim “an epistemic status that places [ESS] outside of the political realm” (Thaddeus Jackson, 2017, online). As such, a form of epistemic authority is given to ESS, in a way that an authoritative form of science, again related to traditions of Western Modern Science, is granted political legitimacy and say over “the real” and how to properly scientifically analyze it (Jackson, 2017, online).

Besides that, there appears to be an implicit certainty on the idea that a better ontology – a scientific backed relational ontology – will automatically result in better politics. However, a change to a supposedly better ontology does not *necessarily* mean good politics or better ethics, as appears self-evident within the ontological solutions proposed.

Altogether, most of the limits to the critical literature explored in the dissertation seem connected to the mentioned sense of urgency associated to the eschatological understanding of time pervasive in the literature – resulting in a

feeling that time is running out and thus no mistakes can be made. Because of this particular finitude and anxiety over the end of the world, then, certain rhetoric becomes prevalent in the literature, particularly within the two texts discussed in the dissertation: the antagonism between solutions becomes necessary when one considers there is limited time for actuating the correct solution, in this sense, dialogue becomes difficult since there is no time to be wrong; further, there appears to be an impetus to congeal nuanced debates on problematics and power relations involved in parts of the solutions proposed given the urgency of the crisis; even the appeal to scientific authority can be read through a prism of longing for certainty amongst the complexity and imminence of endings; as well as moves towards a form of universalism in the desired solutions, given the magnitude of the crisis of the Anthropocene.

Returning to the linear time associated with the epoch, images, tones, and references to a form of apocalypse or end of the world appears to be mobilized as a way of summoning fears to move action (Crist, 2007). As a concept, apocalypse does not have a stable meaning, being flexible instead (Rothe, 2020) – it can rather be understood as a social ‘imaginary’, related to “a collectively shared set of narrative, symbols, values and images that help make sense of our world” (Rothe, 2020, p. 157). From the original narratives of the Anthropocene, especially when referring to the effects of climate change, apocalyptic thinking and representations manifests in a three-fold narrative structure:

one, an Earth-shattering calamity is forecast (or insinuated) to arrive at a future, albeit unspecified, time; two, it is nebulously portrayed as a single monumental catastrophe (adumbrated, perhaps, by a string of interconnected lesser catastrophes) that will affect everyone and everything; and three, it is suggested that human survival and the viability of civilization are at stake, with unprecedented levels of death, suffering, and social breakdown anticipated (Crist, 2007, p. 47).

Within IR, a discipline constituted by connections to crisis and threats, references and rhetoric related to the apocalypse refer both generally to existential fears, but also develop through rearticulation of imaginaries and narratives, symbols and icons specific to Christian eschatology (Rothe, 2020), in a way that politics of

crisis are insinuated into the planet political projects proposed for the Anthropocene. In this sense, the looming sense of crisis present in narratives of the epoch from its beginning add onto the attachment to crisis thinking within the discipline of International Relations – a discipline not only about crisis, but in crisis: “IR is already at an end. In fact [...] our fossil-fueled civilisation is also already at an end.” (Burke et al, 2016, p. 22), seemingly sustained by crisis.

Coming back to the central and constitutive role of crisis in International Relations, then, Souza (2017) states that despite of the constant presence of crisis in the discipline, there have been few inquiries on what it means and what are the effects of framing something as crisis. In this sense, IR theory seems to be constructed around a “politics of crisis” which limits the political possibilities of the discipline in a way that “this inability to think beyond a politics of crisis keeps international relations theory constantly tied to frames of intelligibility in which crisis is both the beginning and end of modern order” (Souza, 2017, p. 79).

With this context, considering the Anthropocene it is curious to note that, despite being framed as harbinger of near absolute change, the commitment of the discipline to a constant state of crisis remains unquestioned. If anything, IR’s connection to crisis seems to reinforce the allusions to an Anthropocene crisis made outside of the discipline and find a new justification for the relevance of the discipline.

In this sense, by reading the multiplicity of solutions brought up by Critical International Relations literature through the limits imposed by the process of problematization; that is, by reading the differences through possible similarities, attention is paid to continuity, instead of to change. In this sense, while the Anthropocene is constructed as a concept of changes and endings – to the separation of Nature/Culture, to formulations of modern politics, to the discipline of International Relations – within its mobilization in IR, feeding off of dynamics and elements present from the origins of the concept, some things remain constant: the relationship between legitimate knowledge and politics; the role of science and legitimate knowledge, at least since the Copernican Revolution, in having privileged access to reality; and, of course, the ever present centrality of crisis within the discipline of International Relations.

Thus, in a world where so much is said to have changed, it is interesting to note what appears to have remained the same.

5 Final Remarks

This closing section will review the discussion conducted, coming back to the questions posed in the introduction, and finish off with a few last remarks on the personal ambivalence that was writing this dissertation, allowing for a more personal tone in this final moment.

Going back to the beginning, then, the dissertation started by laying out the formulation of the Anthropocene as a concept about the end of the world and about the end of IR. The introduction pointed out the main threads that would be followed throughout the discussion: calls about changes, endings; crisis and urgency; and sketched the format of the narrative that would be developed, one connecting the scientific authority pertaining to affirmations made from Earth System Sciences to world-making practices carried out by the production of legitimate knowledge and, in its turn, linking these practices to formulations regarding international politics.

So, the opening chapter started firstly answering to the question: *where did the Anthropocene concept come from?* The origin story told in the dissertation located the inception of the Anthropocene in the discipline of Earth System Sciences, and, thus, started by sketching the origins and affiliations of the discipline itself. Connecting ESS to classical climatology, the values pre-formalization of ESS as a distinct discipline were associated with the Cold War, national security, and the space race – as such, highlighted elements such as techno-optimism, the centrality of sciences of complexity, the association between science and the military in a way to use scientific knowledge to guide political practices, and a desire to master nature already indicated further developments of the discipline.

Simultaneously, an important tension between national and international was made explicit: while the context of the Cold War emphasized national interests, a push for more international endeavors was seen in the transnational scientific cooperation of the International Geophysical Year, for example, and in international environmental movements. In fact, these international environmental movements would play a part in establishing a few other elements concerning the relationship between the natural world and humanity, such as a responsibility of care, worries about finitude and chaos (such as expressed by the Limits to Growth report), and the importance of a global gaze when dealing with environmental problems that transcend national borders.

In this context, Earth System Sciences is created as a distinct discipline, establishing a new representation of the planet in the form of the Earth system. Truly, the importance of representations of the world in the formulation of a political realm is a crucial part highlighted in the discussion. Earth System Sciences is formulated as a fundamentally interdisciplinary endeavor and holistic discipline, both relating to its own self-image and to its object of study – the Earth system is an all-encompassing spatial unit, harboring within it Humanity, as a species and universalized agent.

Post-Cold War, with environmental agendas growing within multilateral institutions, and a bigger transnational exchange of research, ESS is established as a science of integration – firstly between Humanity and Nature, effectively breaking down the Nature/Culture dichotomy by affirming humans as part of the ES; secondly, between the natural and social sciences; thirdly, between science and politics, with scientific research being understood to guide proper politics in the current crisis; and, finally, international integration, given the transnationality of the environmental problem.

In this context, the Anthropocene is a concept developed within ESS, related to the unusual changes to the Earth system – it refers to extensive anthropogenic impacts to the Earth and describes a possible stratigraphic unit of time.

So, in order to answer to the second question, *in which power relations is the Anthropocene embedded in*, the chapter goes on to develop the Anthropocene as a spatio-temporality related to a specific formulation of politics – by drawing together the Earth system as a unit of space and the Anthropocene epoch as a unit of time, the Anthropocene as a spatio-temporality emerges as a particular realm. Within the possibilities of the Anthropocene, then, certain solutions for the Anthropocene crisis appear as possible: the introduction of planetary boundaries or the operation of geoengineering projects. While these two possibilities are interpreted within ESS literature as being in opposed to one another, fundamentally at odds with each other, the dissertation proposes to read this understanding of the Anthropocene as a “solution formulation” as evidence of the dynamic of problematization at play within the concept. That is, although the possible solutions regarding the Anthropocene crisis appear as opposites, through an analysis of how the problem of the Anthropocene is constructed, one can read possible solutions limited by a particular field of solvability and hence connected to specific forms of politics.

In this sense, the chapter concludes by laying out the process of problematization of the Anthropocene conducted within Earth System Sciences, pointing to the following elements as part of the formulation of the problem: (1) the presence of chaos and collapse, aligned with crisis and urgency; (2) universalizing tendencies; and (3) the presence of representations of reality as world-making practices. With that, the field of solvability resulting from this problematization is marked by: (1) a particular relationship between Humanity and Nature, presupposed on discipline and guidance; (2) a synchronic connection between science and politics; and (3) the use of governance as the means to solve the issues of the Anthropocene.

The next chapter, then, starts by addressing the question *how does science take part in practices of world-making?* The discussion, then, briefly touches on cosmological formations, and specifically on the idea of scientific cosmologies. With that, the dissertation proposes the possibility of scientific formulations being responsible for defining the meaning and purpose of humanity, along with playing a part in delineating the understanding of Nature and the relation between Man and Nature within this particular cosmological context. As such, scientific cosmologies are understood as constitutive of our understanding of our place in the world.

To explore further this relationship between scientific authority and practices of world-making in the form of scientific cosmologies, the chapter delves into the happenings of the Copernican Revolution. In short, the discussion lays out how Copernicus' work, through attempting to solve the problem of planetary motions, ended up breaking with old traditions in collapsing the divisions between celestial and the terrestrial realm, and resulted in a new ordering of the Universe and conceptualization of Nature. Thus, by solving the old problems, Copernicus' work made way for a new set of problems to be worked on by following research. The section then ends by establishing a heliocentric cosmology, a particular formulation of science as an institution, and the prominence of human reason as threefold interconnected outcomes of the Copernican Revolution. In few words, the Revolution both represents a move to a heliocentric cosmology (and the consequences pertaining to this change) and the establishing of modern science as holder of legitimate authority to establish a cosmological discourse.

From there, to answer the next question posed on the introduction – *how is the scientific concept of the Anthropocene part of these practices of world-making?* –

the chapter examines the affirmation that Earth System Sciences is akin to a second Copernican Revolution and explores thus what the spatio-temporality of the Anthropocene can mobilize in terms of cosmological discourse and propose in terms of international politics.

In what is the first part of this cosmological exploration, the idea of the second Copernican Revolution starts from the affirmation that while Copernicus' heliocentrism determined the proper astrophysical context of the Earth, ESS similarly represent the correct reality in looking back to the planet and establishing the Earth system and regulating the correct placement of Humanity and its proper relationship to the natural world. In this context, ES scientists are put forth as doctors of the Earth system, capable and required to bring the system back to equilibrium and, hence, guide human action to that it is done. This was then named the Anthropocene of the global subject – rational and scientific; self-conscious and mature. Here, international politics takes the shape of international governance regimes. A few highlighted elements of this political formulation are, then, the presence of chaos and complexity; a linear understanding of time; the presence of the figure of the globe, attached to desires for unification and universalization; the understanding of politics as rational decision-making. In short, the representation of international politics associated with the world created by the Anthropocene of the global subject is one of international governance regimes steered by experts.

Conversely, the final chapter explores the alternative counter-Copernican Revolution in order to answer the first question proposed in the chapter, *what is the complete baggage of the Anthropocene before entering IR?* Here, the dissertation explores a different cosmological interpretation of the Anthropocene, one which aims at ascribing agency to the Earth and blurring of boundaries between planet and human. So, the section begins by laying out different forms of interpretation of the Anthropocene, between planet-centered and human-centered – it is established, therefore, that the physicality of the Anthropocene is inherently non-normative and outside of the human realm; hence, any ethico-political interpretation of the epoch is an act of mediation between planet-centered and human-centered. As such, the elements of mediation, translation, the desire for new vocabulary and new political imagination are introduced, and will carry out in the rest of the analysis. Here, then, international politics takes on a different form – even further, it is formulated as a

possibility to move beyond the international itself and constitute planetary politics as a new form of politics, alternative to the national/international dichotomy of the modern international.

From these two formulations over the possibilities of international politics in the Anthropocene, then, the chapter moves on to the question *how does the Anthropocene concept affects the discipline of International Relations?* To propose an answer, the discussion retells the point of entry of the concept in IR as the critique that the discipline traditionally does not take Nature seriously. In this sense, it is showed to be stated that while the Anthropocene fundamentally breaks down divisions between Nature/Culture, and thus gives prominence to the natural world, IR literature traditionally relegates Nature to the background. Hence, the Anthropocene concept mainly is mobilized within IR, and particularly within Critical IR, as a call for innovation of the discipline. In the use of the concept, then, it is seen that the planetary can be translated to different interpretations of political space, but that, importantly, the temporality of the Anthropocene is conceived of in terms of linear, eschatological time, fostering urgency regarding finitude and the end of times.

So, the chapter moves on to a close reading of two foundational texts regarding the mobilization of the Anthropocene within Critical IR: the Manifesto for Planet Politics and the Non-Manifesto for the Capitalocene. Firstly, the dissertation delves into their differences – their distinct understandings of the problem of the Anthropocene, and the culpabilities over the epoch; distinct formulation over global political spaces, proper international politics and solutions. However, the dissertation then proposes reading the texts through their similarities – namely, the call for a future planetary politics formulated through the conceptualization of an entangled world and their self-positioning as speaking from and about the end of IR and call for a renewed discipline. In this context, the dissertation then analyses the specific propositions for a new discipline of International Relations, connected to the new reality of the Anthropocene as established by Earth System Sciences: (1) a new ontology of complexity; (2) commitment to an ethics of relationality; (3) use of the spatial category of the planetary; (4) call for a new political imaginary and vocabulary; and (5) the need for interdisciplinarity.

Finally, then, the chapter asks *which form of politics does Critical IR create with the Anthropocene?* To answer this, the discussion frames the propositions so

far determined as the possible solutions proposed to the Anthropocene and comes back to the dynamic of problematization, arguing that the political and intellectual solutions mobilized by the literature, although varied, are contained within the same field of solvability. As such, the final section sketches the problematization of the Anthropocene – affirming that certain elements are a constant presence in the formulation of the problem: (1) a background of crisis and urgency; (2) worries over legitimate knowledge; (3) anxieties over a lack of universalism; and (4) references to responsibility and maturity. As such, the dissertation argues that although the Anthropocene is constantly framed through a narrative of changes and ends of the world, there is constancy in the elements used to construct the problem of the Anthropocene.

Lastly, I would like to end the dissertation in a personal tone, exploring and explaining a few internal motivations and discomforts while conducting this research. Specifically, I would like to end the dissertation on a note about ambivalence.

The Anthropocene is a very ambivalent concept and the paradoxes and tensions within it were what intrigued me about it in the first place – as Lövebrand et al (2009) puts it, the Anthropocene:

both challenges and reproduced the Enlightenment promise of human self-realisation, autonomy and control. While the Anthropocene imagery rests upon the daunting human transformations of the Earth's land surface, oceans and atmosphere [...] this imagery paradoxically mediates the very mentality that has brought about these transformations in the first place (Lövebrand et al, 2009, p. 8)

Depending on the text, the Anthropocene can mean humanity's greatest despair, or humanity's greatest show of power; our loss of control, or our ability to control the biggest system imaginable; a show of humility and connection to non-human elements, or a re-assertion of mastery. When starting to sketch this research, I did not understand how these two seemingly so opposite and distinct positions could exist together within the same concept. Further, it made me captivated over the certainty and self-assuredness of authors invoking the concept: how could such conviction come out of such an ambiguous concept? Even more, although presented

as a bridging concept, the multitude of different uses amongst thinkers seemed to make dialogue difficult, as different writers alluded to different meanings while using the same words.

Besides that, I had my own internal ambivalence about writing about the Anthropocene, and about Earth System Sciences. Most of my research comes from a personal fascination and wariness concerning natural sciences, their use within social sciences and the stabilization of natural discourses within these appropriations. Hence, I've generally been very invested in deconstructions of science and critiques over Western Modern Sciences – I've read about problems and suspicious over fixing unquestionable scientific knowledge and using this incontestability to move a particular form of politics. However, when I read invocations of ESS within social sciences the certainty of legitimate knowledge seemed appreciated, or even desirable. For me, this immediately posed the question: what was so different about this iteration of invoking science? What made *this* scientific authority desirable?

I think part of my answer lies within my own discomfort and ambivalence in criticizing uses of the Anthropocene. I wrote this dissertation while reading daily reports of record-breaking extreme temperatures all over the world, while reading about deforestation and forest fires, while a world-wide pandemic happened. It was difficult not to think in terms of crisis, not to feel a sense of urgency over a generalized state of the world. It was difficult to reconcile a form of critique of ESS, of mobilizations of the Anthropocene, with a sense of usefulness of urgency and desire for definitive solutions. It felt uncomfortable to criticize and point out possible limits to scientific texts, or to political texts using scientific ideas trying to ground and propose a way out.

During the research, I found surprising comfort in Foucault's (1984) affirmation: "[t]he person asking the questions is merely exercising the right that has been given [them]: to remain unconvinced, to perceive a contradiction, to require more information, to emphasize different postulated, to point out faulty reasoning, and so on" (Foucault, 1984, p. 111) – although ambivalent about my own proposition about examining Anthropocene discourse, and the usefulness of doing so in a world that I can sometimes feel like is ending.

I tried to deal with these two ambivalences while writing the text as best as I could. Firstly, I tried to read the multiplicity and seeming paradoxes of the concept

as constitutive of it, instead of as an incoherency – that is, I tried to read the diverseness of meanings as precisely what made the Anthropocene work the way that it did. Regarding my personal ambivalence with the argument, I tried to let my own desire to be convinced by the solutions proposed be useful in the reading of the texts – that is, to use my want for a productive mobilization of the concept and my belief in the value of it to move a critical reading that takes the texts, their ideas and their assumptions, seriously.

Further, I hope that the argument focusing on the limits of a nexus of changes and crisis is not read through a dichotomy between change and stagnation i.e. I hope my reading moving away from a focus on changes is not understood as a call for political sameness and so-called “business as usual” actions in the Anthropocene.

At last, I think an exposition and brief exploration on the inside tensions and frictions to the concept and to the work are important final remarks, as the acknowledgement over the constant presence of ambivalence within the making of this dissertation feels important to the reading of it.

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