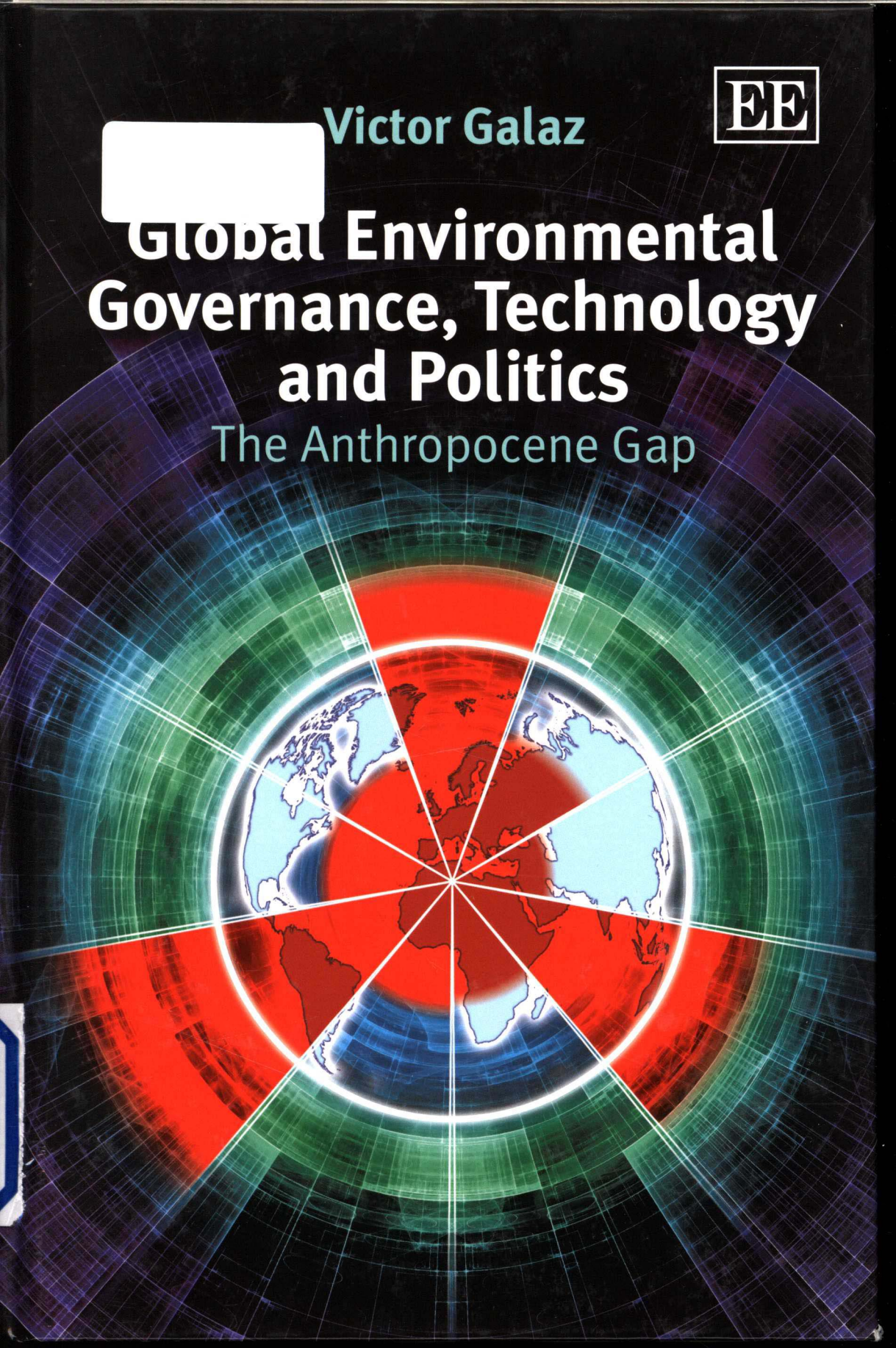


Victor Galaz



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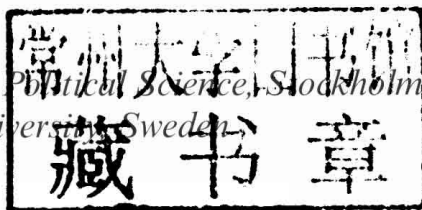


Global Environmental Governance, Technology and Politics

The Anthropocene Gap

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Global Environmental Governance, Technology and Politics

To my beloved children, Elias, Astrid and Ivan.



Preface The ‘Anthropocene Gap’

The idea to write a book about governance and technology in a possibly new geological era dominated by humans, was born in May 2012 in the corridors of a gloomy and dark building in the industrial outskirts of London. Renowned Earth system scientist Timothy M. Lenton had just finished presenting a paper at a scientific conference on the likely transgression of an Arctic ‘tipping point’ in the next decades. In short, this implies that the North Pole could be largely ice-free in summer, inducing drastic changes in one of planet Earth’s critical climate regulating levers with profound global consequences.

One could really feel the odd mixture between curiosity and nervousness amongst the audience. As we all left the room, I was immediately handed a colorful leaflet from what I thought, was a conference participant. After a closer look, I understood that the leaflet in fact was a call from a non-governmental organization called *The Arctic Methane Emergency Group* (AMEG). The group suggested putting a break on ice melting in the Arctic region, by reflecting away solar radiation through a geoengineering technology called ‘cloud brightening’. In short, by deploying large fleets of ships with the ability to eject salt particles into the atmosphere, thereby brightening clouds and initiating a cooling of the areas.¹

As I walked to the next session, it also became increasingly evident to me that there was no obvious scientific or political arena able to handle these intermingled scientific and social debates about potentially catastrophic Earth system ‘tipping points’, and suggested remedial but highly controversial technologies. Of course these issues were, and still are, debated in different international arenas – including the meetings of the parties of the Convention on Biological Diversity. But there really was no potent legal setting and international arena with the capacities to seriously investigate, discuss and govern these highly contested issues.

Then it hit me. This call by AMEG wasn’t a unique and peculiar event at the fringes of sustainability science. On the contrary, it very much captured what I perceived and still perceive as the most critical challenges facing environmental politics and society in this new era of rapid environmental change: Earth system complexity and ‘tipping points’, technological change and the fragmented nature of governance in the Anthropocene.

As I elaborate in this book, the combination of these three issues creates a whole new set of institutional challenges that we as social scientists (or more precisely, political scientists) have just started to come to grips with.

This last claim might seem overstretched considering the long history of groundbreaking studies of global environmental problems and their institutional dimensions, championed by prominent social science scholars such as Oran Young, Nobel Laureate Elinor Ostrom and Frank Biermann. As I elaborate in-depth in this book, the political and institutional implications posed by the Anthropocene run deeper than currently has been acknowledged in current debates. The difficulties we all – citizens, scholars, decision-makers, business leaders and a flurry of non-governmental actors – have in grappling, analysing and responding to these issues, is what I explore as the 'Anthropocene Gap'.

WHAT THIS BOOK IS NOT

Global environmental change, emerging technologies and politics are issues that could very well fill a whole library. My ambition is obviously more modest. This is not a book about climate or biodiversity politics, environmental policy, or governance for sustainable development in general. Nor is it an analysis of 'green' technologies such as solar power; of how social media can support environmental awareness; nor an attempt to settle the debate between so-called techno-utopians and promoters of environmental doomsday scenarios. Instead, this is essentially a book about new institutional and political challenges posed by the interplay between rapid nonlinear global environmental change and emerging technologies.

This might very well be considered an extremely narrow perspective for such contested and multifaceted issues, and I agree. Current discussions about sustainability, politics and technology are immensely rich thanks to the vigorous long-term commitment from fellow scholars, entrepreneurs, activists, politicians and others. Whenever the analysis here feels too limiting, I would modestly urge the reader to keep in mind that institutions matter. That is, humanly devised institutions, and the way we organize the interplay between state and non-state actors (what I call *governance*), have repeatedly been proven to play a fundamental role in shaping, and responding to environmental change.² This insight applies all the way from locally contrived rules to govern forests, to global commons such as climate change and the ozone layer. Hence despite its limited focus, this book should be viewed as a contribution to intense and ongoing debates about how humanity is to navigate environmental change of an

unprecedented scale and complexity. My approach to governance analysis is both analytical and normative. By that I mean that I combine an empirical and theoretical understanding of societies' capacities to steer environmental change, with a normative ambition to bring out shortcomings, and possible ways ahead (Dingwerth and Pattberg 2006).

As some readers might notice, I take on this task inspired by what some have denoted a 'resilience lens', that is, a focus on the ability of institutions and governance to grapple with change, surprise and multiple interactions between human–environmental systems (Gunderson and Holling 2002, Folke et al. 2005).

COMPLEXITY AND CONNECTEDNESS

The need for the social sciences to critically explore the political and institutional implications of rapid environmental change is urgent. Well-known terms like 'limits to growth', 'the great acceleration', 'planetary boundaries', 'a planet under pressure', and 'a new geological era' have one important thing in common: the attempt to capture the vast challenges posed by interacting global environmental stresses and a new proposed (in other words, debated) geological epoch on a planet fundamentally shaped by humans – the Anthropocene.

Despite an increased interest in these challenges and this proposed new geological epoch, we know surprisingly little about its implications for current debates on institutions and global environmental change. And scholars of environmental governance are only at the very beginning of grasping these deep repercussions.

This book presents and elaborates one key hypothesis: we are in the midst of an 'Anthropocene Gap', that is, a time where we are unable to grapple, analyse and respond to the major implications induced by our transgression into a human-dominated planet.³ These three interrelated gaps can be summarized as follows: our *mental models and causal beliefs* (Lynam and Brown 2011) are being seriously challenged by the complexity, scale and speed of global environmental change; our *analytical approaches* (and here I focus on political science) are increasingly failing us as we gain increasing insights about the anatomy of Earth system change; and as a result, our *political institutions* at multiple levels of social organization are unable to effectively respond to novel risks and opportunities induced by interacting environmental, political and technological change. It is a bold statement, I know, and I will return to these acclaimed gaps explicitly in the synthesis chapter.

In this book I combine theoretical work, with in-depth analysis of

four case studies. The cases range from the governance of (1) 'planetary boundaries', (2) geoengineering, (3) emerging infectious diseases, and (4) algorithmic trade in financial and commodity markets. While these might seem like very different issue areas, they all illustrate complementary aspects of critical, yet poorly understood institutional and political challenges posed by complexity and connectedness in social–ecological or human–environmental systems (to be defined in the next chapter).

STRUCTURE OF THIS BOOK

This book consists of two main parts. The first part is mainly theoretical and looks at current debates on global environmental change and complexity from a governance perspective. Chapter 1 *Planetary terra incognita* is an introduction, but also a summary of the critique of the notions of the Anthropocene and 'planetary boundaries'. I will not only put these terms in the context of similar notions such as the 'great acceleration' and 'limits to growth', but also provide a summary of current scientific and policy debates of the concept's validity and practical usefulness. The chapter concludes with my position in this scientifically and politically contested area.

In Chapter 2 *Governance and complexity* I explore key properties of complex systems that are of relevance for governance scholars. Here I try to present an overview of the governance challenges posed by complexity with a special emphasis on thresholds or 'tipping points'. This chapter also includes a synthesis of multidisciplinary insights on how social actors – ranging from policy-makers to artificial agents – perceive and respond to threshold behavior in human–environmental systems. I also link advances in 'early warnings' of pending catastrophic shifts in ecosystems, with some theoretical implications for governance (for example, early warning and response challenges). The chapter ends with a presentation of three 'governance puzzles', which will conclude the synthesis chapter of the book.

The second part of the book consists of in-depth analyses of four different case studies. Chapter 3, *Earth system complexity* discusses recent attempts by Earth system scientists to define a 'safe operating space' for human activity at the Earth scale. These so called 'planetary boundaries' are nine, possibly nonlinear Earth system processes that in addition to climate impacts, include ozone depletion, atmospheric aerosol loading, ocean acidification, global freshwater use, chemical pollution, land system change, biodiversity, and global nutrient cycles. In this chapter, I elaborate key international governance challenges posed by the notion of 'planetary boundaries', some emerging political tensions, misunderstandings, and some constructive ways to analyse these from a governance perspective.

The chapter also includes an elaboration of how global organizational networks of various forms attempt to respond to global ‘tipping point’ behavior.

Chapter 4 *Epidemics and supernetworks* instead focuses on the complex institutional and governance challenges posed by emerging infectious diseases (EIDs) such as animal influenzas (for example, ‘avian influenza’ and ‘swine flu’), and hemorrhagic fevers such as Lassa fever and Henipah virus. While this might sound like an odd focus for a book on environmental change and complexity, it should be noted that diseases such as these are driven not only by increasing connectivity through trade and travel, but also by environmental factors such as land use change, climate change and rapid urbanization. In this chapter I explore how international actors such as the World Health Organization try to grapple with epidemic surprise in terms of early warning and response. Here I also explore the role information and communication technologies play in the way international actors collaborate across cross-national networks, and how these networks interact with more formal institutions such as the International Health Regulations.

Suggestions of large-scale technological interventions to combat climate change that a decade ago would have been discarded as science fiction are slowly moving toward the center of international climate change discussions, science, and politics. Chapter 5 *Engineering the planet* elaborates the intriguing governance challenges created by the development of geoengineering technologies – another illuminating example of the ‘Anthropocene Gap’. The emphasis here is on the intricate governance challenges posed by emerging and converging technologies as we enter a new geological epoch. I explore regulatory gaps and the complex actor constellations in this domain, as well as the poorly understood and contested trade-off between innovation and precaution in a new setting characterized by rapid and nonlinear environmental and technological change.

In the last case study chapter (Chapter 6), I analyse another emerging technology with implications for our ability to govern global change in the Anthropocene: algorithmic trade in commodity markets. While market-based conservation policies, and the ‘neoliberalization’ of natural resources has already induced considerable academic debate (Arsel and Büscher 2012), the approach in this book is different, and focuses more on the dynamics of financial–ecological connectedness and their underlying technologies. Algorithmic trading (sometimes denoted as ‘automatized trade’, ‘high frequency trade’, ‘computer based trading’ or ‘robot trade’) is having profound impacts in the way and speed in which financial assets are traded. The capacities of computer algorithms to process increasing amounts of market information including financial news items, and

conduce extremely rapid and complex trading patterns are clearly on the rise. As I intend to show, the rapid advancement of algorithmic trade pose until now unexplored environmental governance challenges due to the increased connectivity between financial markets, commodity markets, and ecosystem services on the ground.

The last chapter sums up the whole book and tries to show how we can start bridging the 'Anthropocene Gap'. It draws together key common conclusions across the cases, and links back to emerging theories on governance for sustainability in the Anthropocene. Hence this chapter summarizes theoretical insights related to the ability of governance – including institutions and networks at multiple levels – to cope with human–environmental complexity and connectivity at multiple temporal and spatial scales.

A THEORETICAL CONTRIBUTION

The issues elaborated in this book hopefully draw broader interest than for scholars of environmental governance. Governments constantly struggle to reconcile the need for institutional stability and flexibility through collaboration, institutional innovation and soft-steering instruments. Charles Perrow's (1984) now classic book *Normal Accidents* provides a detailed elaboration of the generics of complex technological systems and the type of organizations able to cope with their associated risks (see also literature on 'High Reliability Organizations'). Moreover, governance scholars such as Jan Kooiman, Jon Pierre and Guy B. Peters, present interesting insights related to the ability of governance systems to cope with change and uncertainty. Researchers following the innovative path laid out by the late Elinor Ostrom, have also shown an increased interest in the role of polycentric governance for more flexible and robust forms of steering in complex settings.

The issues explored in this book – such as coordination in multi-level networks, institutional flexibility, diversity and robustness – hence are strongly linked to governance analysis in general (for example, Pierre and Peters 2005, Kooiman 2003). This book therefore aims to contribute to this wider (in a sense non-environmental) theoretical debate, identify strengths and weaknesses in our understanding, and build an argument firmly anchored in rich case studies.

The issues explored here are several. What characterizes international institutions able to detect and respond to 'global human–environmental surprises' of great importance to human well-being? Are international institutions able to address complex Earth system interactions? And

is it at all possible to create rules that are strong enough to ‘weed out’ technologies that carry considerable ecological risk, but still allow for novelty, fail-safe experimentation, and continuous learning? These are far from easy questions, and my intention is not to present simple answers, robust hypothesis testing or quick-fix solutions. My ambition instead, is to portray an extremely exciting evolving landscape of emerging issues, puzzles, and controversies at the very heart of debates on global environmental change, politics and technology.

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and colleague, made my life as a scientist considerably more fun than it normally would be. Carl Folke – I wouldn't be the sort of multidisciplinary scientist and optimist I am today without his energetic support and leadership over the years at both CTM and the Resilience Centre. The 'Wolfpack' (you know who you are), and the brilliant DJs, artists and musicians at SoundCloud.com have constantly injected me with positive energy, and made the last writing year (almost) a pleasure.

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1. Planetary *terra incognita*

The year 2016 will be critical for the history of planet Earth. This is the year when the International Geological Congress will meet to finally settle the debate of whether humanity formally has entered a new geological epoch: the Anthropocene. This might seem like a superfluous subject for a scientific meeting to discuss considering the explosion of the concept in current policy and scientific debates. Not only did *The Economist* and *National Geographic* already in May 2011 produce special issues on this new era; in 2012, the British Broadcasting Corporation (BBC) broadcasted a series of documentaries on the ‘human epoch’, and publishing giant Elsevier inaugurated the new journal *Anthropocene* in 2013. Yet, the scientific debate has not been settled. And similarly contested concepts attempting to define humanity’s impact on Earth – such as ‘the great acceleration’ and ‘planetary boundaries’ – are widely circulated amongst academics, concerned non-governmental organizations and policy-makers.

Any institutional and political analysis of global environmental change on a human-dominated planet, should build on a firm understanding of these concepts and their associated scientific and political debates. As I will elaborate, these disputes are becoming increasingly intense and difficult for outsiders to grapple. The reason I believe is simple: as research insights from the Earth system sciences gradually propagate through media and policy discussions, they renew existing environmental political controversies. This time, the debates are not only the familiar ones, such as the contested tension between economic growth and sustainability. Instead, they have a new focus on Earth system complexity, and unprecedented trade-offs in time and space.

In this chapter, I briefly summarize what some have called the ‘Anthropocene debate’, as well as current contentious discussions about the role of Earth system science and ‘planetary boundaries’ in political decision-making. I also discuss the critical role that perceptions about technological change play in this debate, and identify three overarching governance challenges (or ‘puzzles’) that I intend to explore in the concluding part of the book.

As I intend to show, the interesting question is not whether a new human-dominated geological era is formally here, nor whether the

proposed transgression of ‘planetary boundaries’ should be reframed as ‘planetary opportunities’. The truly exciting questions emerge as we try to unpack the novel institutional and political challenges that surface as humanity increases its domination over a complex Earth system.

THE ANTHROPOCENE DEBATE

Global environmental change has been on the international political agenda for decades. Some would trace it back to the first UN-led international meeting on sustainability in Stockholm 1972. As Robert Boardman argues, the origins of scientifically grounded studies of the Earth system can be traced to the eighteenth century, and especially the transformative developments in geology as a scientific discipline (Boardman 2010, p. 57).

Earth system sciences has always influenced, and been influenced by, broader social and ontological debates. In short, political, religious, cultural, institutional and other societal factors, substantially shape and frame perceptions about the Earth system (Boardman 2010, p. 71). There is no reason to believe that current notions of the Anthropocene and associated concepts such as ‘planetary boundaries’ are an exception. Uhrqvist and Lövbrand (2009) explore these issues in an interesting Foucauldian analysis, suggesting that Earth system science is not only a scientific endeavor, but should also be viewed as playing a key role in knowledge production and therefore in ‘the formation of governmental practices’ (p. 3). The Earth system science community, through its methodologies, international research programs and technologies ‘has made the Earth System seem stable, comparable and diagnosable and hereby open for government intervention’ (p. 21).

Processes of knowledge production hence matter. My position in this discussion is different, and my main argument is that these debates should not lead us to believe that we can overlook the institutional and political implications of the human enterprise entering the Anthropocene epoch. Will Steffen, Paul Crutzen and John McNeill (2007) sum the state of knowledge elegantly:

The term [...] suggests that the Earth has now left its natural geological epoch, the present interglacial state called the Holocene. Human activities have become so pervasive and profound that they rival the great forces of Nature and are pushing the Earth into planetary *terra incognita*. The Earth is rapidly moving into a less biologically diverse, less forested, much warmer and probably wetter and stormier state. (p. 614)

The notion of the Anthropocene is often traced back to earlier talks and papers by Paul Crutzen (for example, Crutzen 2002), but the proposition