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Re-conceptualizing the Anthropocene: A call for collaboration

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ABSTRACT

Since it was first proposed in 2000, the concept of the Anthropocene has evolved in breadth and diversely. The concept encapsulates the new and unprecedented planetary-scale changes resulting from societal transformations and has brought to the fore the social drivers of global change. The concept has revealed tensions between generalized interpretations of humanity's contribution to global change, and interpretations that are historically, politically and culturally situated. It motivates deep ethical questions about the politics and economics of global change, including diverse interpretations of past causes and future possibilities. As such, more than other concepts, the Anthropocene concept has brought front-and-center epistemological divides between and within the natural and social sciences, and the humanities. It has also brought new opportunities for collaboration. Here we explore the potential and challenges of the concept to encourage integrative understandings of global change and sustainability. Based on bibliometric analysis and literature review, we discuss the now wide acceptance of the term, its interpretive flexibility, the emerging narratives as well as the debates the concept has inspired. We argue that without truly collaborative and integrative research, many of the critical exchanges around the concept are likely to perpetuate fragmented research agendas and to reinforce disciplinary boundaries. This means appreciating the strengths and limitations of different knowledge domains, approaches and perspectives, with the concept of the Anthropocene serving as a bridge, which we encourage researchers and others to cross. This calls for institutional arrangements that facilitate collaborative research, training, and action, yet also depends on more robust and sustained funding for such activities. To illustrate, we briefly discuss three overarching global change problems where novel types of collaborative research could make a difference: (1) Emergent properties of socioecological systems; (2) Urbanization and resource nexus; and (3) Systemic risks and tipping points. Creative tensions around the Anthropocene concept can help the research community to move toward new conceptual syntheses and integrative action-oriented approaches that are needed to producing useful knowledge commensurable with the challenges of global change and sustainability.

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1. Introduction

The concept of the Anthropocene has evolved in breadth and diversely since it was first proposed in 2000 (Crutzen and Stoermer, 2000; Crutzen, 2002), now ranging from a proposed

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definition of a new geological epoch, a widely-used metaphor for global change, a novel analytical framework, a meme about the relationship of society to nature, and the framing for new and contested cultural narratives. At its core, the concept of the Anthropocene encapsulates the unprecedented planetary-scale changes resulting from societal transformations, at least since the European industrial revolution and particularly over the past 65 years of world development. We have now documented the linked and global scale impacts of these changes including past, present, and anticipated future changes in climate, biodiversity, ocean acidification, atmospheric composition, radioactive and artifacts deposits, soil and water quality and sediment flows (MA, 2005; UNEP, 2012; IPCC, 2014; Steffen et al., 2015a; Waters et al., 2016). It has brought to the fore the social drivers of global change, including changes in technology, resource consumption, population and settlement patterns, mobility, cultures and ideas, communication, and trade, as well as civil and military conflicts. Few global change science concepts have enjoyed such a broad and rapid uptake in technical and public discourses, despite a long history of scholarship exploring human interactions with the global environment.

Worster (1988:6) argued that ' . . . planetary history has been fundamentally environmental history' and that the writing of such history goes back at least to Georges-Louis Leclerc's *Des epochs de la nature* (1779). Since then, geographers, Earth scientists, environmental historians, philosophers, archaeologists and anthropologists have been concerned with how people and nature at the planetary scale have influenced each other (Turner et al., 1990; Bonneuil and Fressoz, 2013; Robin et al., 2013; Hamilton et al., 2015). Over the past 40 years, a rich array of concepts and narratives that encapsulate the imprint of human societies on the global environment have emerged, including the "anthroscene" (Revkin, 1992), "socioscene", "technoscene", "capitaloscene", "econoscene" (Malm and Hornborg, 2014), "anthroposphere" (Baccini and Brunner, 2012), among many others. However, apart from the Club of Rome's World3 model (Meadows et al., 1972) and the Gaia hypothesis (Lovelock, 1972), both foundational to Earth system science, all of these earlier and more recent understandings of human action on the planet differ significantly from the concept of the Anthropocene as it is understood today. As also noted by Hamilton and Grinevalt (2015), the Anthropocene, as proposed by Crutzen in 2000, is based on the concept of the *Earth system*, a single complex system at the planetary level with its own emergent properties, states and modes of functioning. The Anthropocene thus represents *a state change in the Earth system* (Waters et al., 2016), viewed of an interdependent social–ecological system. This differs from earlier ideas of human pressures, arising from a combination of population growth and economic and technical change, having an impact on natural systems, whether local or global.

The concept of the Anthropocene as a state-change of the Earth system has proven to be a powerful bridging concept in the natural sciences, as it requires the full range of relevant disciplines to understand how such a system functions and how it is changing. It has progressively gained importance in the social sciences and humanities, offering an interface for engagement in global change issues (Palsson et al., 2013; Castree et al., 2014). Furthermore, because the Earth system science approach seeks to embrace people and society as embedded in the Earth system, the Anthropocene concept offers the opportunity for bridging across disciplines and approaches in increasingly open systems of knowledge production (Gibbons, 1999). In other words, the Anthropocene concept requires the full inclusion of the analysis of the economic, demographic, ecological, political, symbolic, and cultural aspects of globally interconnected societies just as much as it needs to draw on oceanography, the atmospheric sciences, earth sciences, glaciology and the palaeo-environmental sciences.

And yet, the Anthropocene concept has also brought front and center tensions and epistemological divides between and within the natural and social sciences, and the humanities. The Anthropocene concept calls for a radical recasting of the dualistic ways that researchers, analysts, and commentators think about interactions between two historically distinct worlds: the world of social, economic and political systems and processes, and the biophysical systems of the planet (Chakrabarty, 2009). It motivates deep ethical questions about the politics and economics of global change, including diverse interpretations of past causes and future possibilities. Importantly, it reveals a tension between a generalized interpretation of humanity's contribution to global change, where "humans" are seen as the culprits as a unitary global force, and interpretations that are much more differentiated and more historically, politically and culturally situated (Biermann et al., 2016 this issue). If human agency is reduced to a single, undifferentiated force driving change at a global scale, thus downplaying historical, cultural, political, and economic differences within and across regions, the fundamental dynamics which social change brings to the Anthropocene could not be captured (Malm and Hornborg, 2014). This means that the Anthropocene inevitably invites different, in some cases perhaps incommensurable perspectives to examine past changes and future possibilities (Biermann et al., 2012; Bai et al., 2015). As such, the concept has motivated divergent visions for collaborations around research and action in global change and sustainability, with some calling for stronger integration of social sciences and humanities and Earth system science and others cautioning against it (Chakrabarty, 2009; Biermann et al., 2015; Palsson et al., 2013; Ogden et al., 2013; Berkhout, 2014; Malm and Hornborg, 2014; Dalby, 2015; Lövbrand et al., 2015). These divergences in such a conceptual debate are not surprising; however, as we argue in this article, it is now equally important to move forward to fully make use of the potential of an integrative understanding of the Anthropocene.

This article thus explores how the Anthropocene concept can encourage more inclusive understandings of global change and sustainability, as well as the predicaments faced by such understandings. Based on bibliometric analysis and literature review, among others, we discuss the broad acceptance of the term, its interpretive flexibility, the emerging narratives, and the debates it has inspired. While the research communities have made significant advances in integrating the social and environmental dimensions of global change, significant tensions remains, which stand in the way of advances in understandings and potential actions to address global change and sustainability. To get the most out of the Anthropocene concept, these tensions must be addressed in a collaborative manner. This will open-up new ways of resolving some of the conceptual and methodological challenges of studying complex, non-linear, accelerated social–environmental problems that are emblematic of the current new epoch in planetary history.

The analytical challenges revealed through the Anthropocene concept call for the research community to work together in novel ways on research approaches that embrace complexity and reflexivity. We argue that without truly collaborative and integrative research, many of the critical exchanges around the Anthropocene concept are likely to perpetuate fragmented research agendas and to reinforce disciplinary boundaries and stereotypes. At the very least, this means recognizing and appreciating the strengths and limitations of different knowledge domains, approaches and methodologies (Poteete et al., 2010). It also calls for breaking up some of the remaining barriers between knowledge systems (Tengö et al., 2014; Díaz et al., 2015), and across North-South divides, for which the Anthropocene might serve as a

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