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International Geosphere–Biosphere Programme and Earth system science: Three decades of co-evolution

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ABSTRACT

The maturing of Earth system science as a discipline has underpinned the development of concepts such as the Anthropocene and planetary boundaries. The International Geosphere–Biosphere Programme's (IGBP) scientific and institutional history is deeply intertwined with the development of the concept of the Earth as a system as well as the discipline of Earth system science. Here we frame the broader programme of IGBP through its core projects and programme-level activities and illustrate this co-evolution. We identify and discuss three phases in the programme's history. In its first phase beginning in 1986, IGBP focused on building international networks and global databases that were key to understanding Earth system component processes. In the early 2000s IGBP's first major synthesis and associated activities promoted a more integrated view of the Earth system informed by greater emphasis on interdisciplinarity. Human actions were seen as an integral part of the Earth system and the concept of the Anthropocene came to the fore. In recent years IGBP has increased focus on sustainability and multifaceted engagement with policy processes. IGBP closed at the end of 2015 after three decades of coordinating international research on global change. The programme's longevity points to its capacity to adapt its scientific and institutional structures to changing scientific and societal realities. Its history may offer lessons for the emerging Future Earth initiative as it seeks to rally international collaborative research around sustainability and solutions.

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1. Introduction

The concept of the Earth as a system, the academic discipline of Earth system science and the institutions created to understand processes that determine the past, present and future of the Earth are now well established. Founded in 1986, the International Geosphere–Biosphere Programme (IGBP) has had a pivotal role in the evolution of these ideas and institutions. Indeed, it has helped drive new levels of international coordination and interdisciplinary cooperation in pursuit of fundamental knowledge "that will serve as the basis for assessing likely future changes on the Earth in the next 100 years" (IGBP, 1986). This task required the development and use of some of the most significant conceptual frameworks of the Earth as a system and the impact of change on it. IGBP evolved in a context of international scientific collaboration that began in the early 20th century: this context was shaped by growing concerns about the environment as well as by the forces of globalization (Uhrqvist, 2014a,b).

In anticipation of the ending of IGBP in 2015, following three decades of intense activity, in 2012 the programme launched an overarching synthesis with three principal strands: Earth system science, the Anthropocene, and core-project history and accomplishments. The present paper is a contribution to both the first and third strands. The overall objectives of this paper are to provide: (1) a broader programme-level framing for the individual IGBP core-project synthesis papers in this volume (Suni et al., 2015;

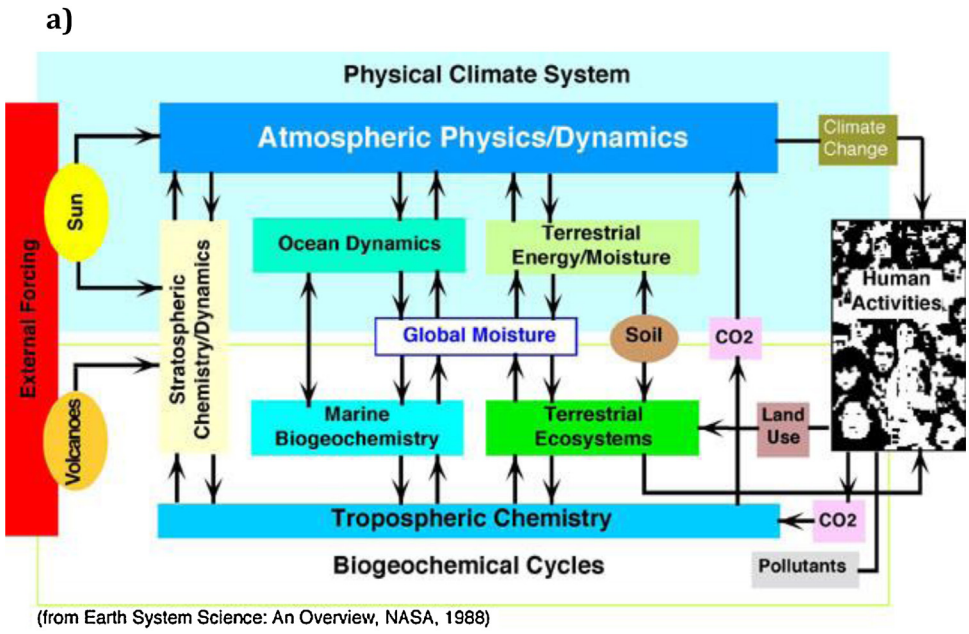

Fig. 1. (a) A conceptual model of the Earth system from NASA's Earth System Sciences Committee (NASA Advisory Council, 1986) often referred to as the Bretherton diagram. (b) IGBP phase 2 structure in which core projects conformed to either individual components of the Earth system, the interfaces between them, or integration across the Earth system components (Box 1 and Fig. 2).