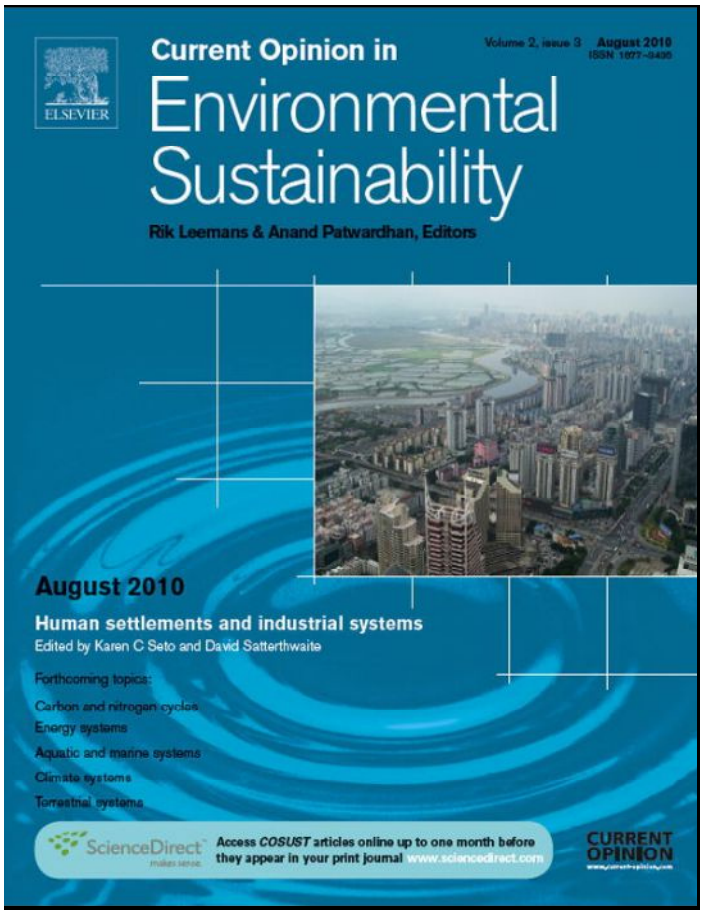
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Current Opinion in Environmental Sustainability

Strategy paper

Navigating the anthropocene: the Earth System Governance Project strategy paper

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In 2001, the Earth System Science Partnership declared an urgent need to develop 'strategies for Earth System management'. Yet what such strategies might be, how they could be developed and how effective, efficient and equitable such strategies would be, remain unspecified. We argue that the institutions, organizations and mechanisms by which humans currently govern their relationship with the natural environment and global biogeophysical systems are both insufficient and poorly understood. For this reason, we have developed, and present here, the science and implementation plan for the Earth System Governance Project, a new 10-year global research agenda under the auspices of the International Human Dimensions Programme on Global Environmental Change (IHDP) and the Earth System Science Partnership (ESSP).

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Current Opinion in Environmental Sustainability 2010, **2**:202–208

Received 8 April 2010; Accepted 21 April 2010
Available online 2nd June 2010

1877-3435/$ – see front matter
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DOI 10.1016/j.cosust.2010.04.005

Introduction

Human interference with planetary systems is increasing rapidly. Some observers recognize today the dawn of an entirely new era in planetary history, the 'anthropocene' [1]. The impacts of human activities are so pervasive and profound that they could inadvertently alter the Earth System in ways that may prove irreversible and inhospitable to humans [2–4]. Navigating the anthropocene has thus become a key challenge for policy-makers at all levels of decision-making, ranging from the need to limit human large-scale disturbance of natural biogeophysical cycles to the increasing exigency to prepare — politically, legally, socially and economically — for the adaptation to those global environmental changes that can no longer be avoided [5]. In recognition, the Earth System Science Partnership declared an 'urgent need' to develop 'strategies for Earth System management'. Yet what such strategies might be, how they could be developed and how effective, efficient and equitable such strategies would be, remain unspecified. It is apparent that the institutions, organizations and mechanisms by which humans currently govern their relationship with the natural environment and global biochemical systems are not only insufficient — they are also inadequately understood.

This is the rationale for the Earth System Governance Project, a new core project of the International Human Dimensions Programme on Global Environmental Change (IHDP). The 10-year global project aims to bring together researchers from a variety of disciplines and regions to study the governance dimensions of global environmental change in a co-ordinated, collaborative effort. The project

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builds on an earlier comparable initiative, the IHDP core project on the Institutional Dimensions of Global Environmental Change, which ended in 2007 [6,7,8••]. This article summarizes the science programme of the Earth System Governance Project. (For a full version of the science plan see [9••], available at www.earthsystemgovernance.org; a substantially extended version of the present summary is published as [10].)

Conceptualizing earth system governance

Traditional notions of environmental policy, pollution control and nature conservation do not capture current global developments that transform the biogeophysical cycles and processes of our planet. New perspectives and research are needed to understand the complex relation between global transformations of social and natural systems, including accelerating economic integration, globalization in all its forms, internationalization of policy processes, and multi-scale consequences of ecological transformation. Innovative research is needed also to analyze political options to govern sustainable development — taking into account not only political effectiveness and efficiency but also global and national justice and equity — and the need to bridge levels of analysis and disciplinary assumptions, methods and foci.

One of these new perspectives that we propose here is the concept of 'earth system governance' (developed in more detail in [11•,12]). We understand earth system governance as *the interrelated and increasingly integrated system of formal and informal rules, rule-making systems and actor-networks at all levels of human society (from local to global) that are set up to steer societies towards preventing, mitigating and adapting to global and local environmental change and, in particular, earth system transformation, within the normative context of sustainable development.*

Earth system governance stands at the interface of two broad strands of academic inquiry: governance theory and earth system analysis. Governance has been defined in a variety of ways, and there is no consensus amongst scholars on the core elements of this concept [13,14]. In most bodies of literature, the term governance denotes new forms of regulation, authority, legitimacy and steering that go beyond traditional hierarchical state activity. It usually implies some form of self-regulation by societal actors, private–public cooperation in solving societal problems, and new forms of multilevel policy. At the international level, the term 'global governance' is often used to describe processes of modern world politics, although here, too, no consensus on an appropriate definition has been reached [15,16]. Importantly, from local to international levels, the concept of 'governance' is not confined to states and governments as sole actors, but is marked by participation of myriad public and private non-state actors at all levels of decision-making, ranging from networks of experts, environmentalists and multinational corporations to new agencies set up by governments, such as intergovernmental bureaucracies.

Equally important for the notion of earth system governance is its link to earth system analysis. In the natural sciences, quantification and computer-based modelling has long been important to integrate understanding from different strands of research. Research on institutions and governance mechanisms is often viewed as part of this integrated effort and is formally included in most theoretical conceptualizations in this field [17]. In practice, however, it remains a major research challenge to establish to what extent institutional and governance research can contribute to, and integrate with, the more model-driven research programmes [11•]. On the one hand, scholars will thus need to continue pursuing research that is interdisciplinary across the social sciences and that follows the internal logic and particular theoretical, epistemological and methodological approaches of the social sciences and the humanities, which are often qualitative, case-based, context-dependent and reflexive. On the other hand, it is important and timely to also explore integrated approaches that seek novel ways of incorporating research on governance into earth system analysis. The Earth System Governance Project is designed to integrate both communities in a common quest for identifying and analyzing governance solutions to cope with the emergent threat of earth system transformation.

The core analytical problems in earth system governance research

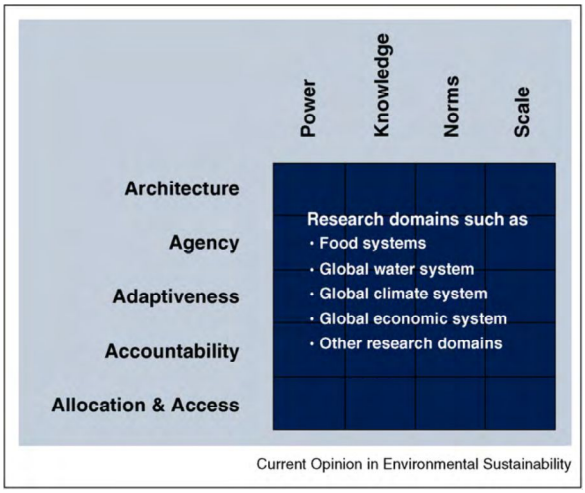
The Earth System Governance Project [9••] prioritizes five interdependent analytical problems (Figure 1). These are the problems of the overall *architecture* of earth system governance, of *agency* beyond the state and of the state, of the *adaptiveness* of governance mechanisms and processes, of their *accountability* and legitimacy and of modes of *allocation and access* in earth system governance [11•].

The problem of architecture

The first analytical problem is the study of overall governance architectures in earth system governance. We define governance architectures as the overarching system of public or private institutions, principles, norms, regulations, decision-making procedures and organizations that are valid or active in an issue area. Architecture can thus be described as the *meta-level* of governance (see in detail [18]). Research on governance architectures is still limited. Most institutional research has focused so far on single institutions, especially regarding international regulation. We now have a better understanding of the creation, maintenance and effectiveness of international environmental regimes and national policies, as well as better methodological tools to study these questions (e.g. [19,20]). In addition, at both national and international levels interactions and interlinkages between institutions have been a concern for many years. Examples include

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Figure 1



Schematic overview of the Science Plan of the Earth System Governance Project.

the analysis of environmental policy integration or of environmental governance in federal systems in which different jurisdictional competences at times overlap, or research on the vertical interaction of institutions in multilevel governance systems [21–25] and on the interactions of the increasing number of international environmental institutions [26,27].

The renewed research effort on governance architectures that we propose will continue and expand these lines of research along a number of questions: one research question is for instance how the performance of single environmental institutions is affected by their embeddedness in larger architectures. Research on architecture will also need to investigate the environmental consequences of non-environmental governance systems, continue to study vertical institutional interaction and the role of institutions within multilayered institutional systems, and analyze non-governance, that is, conflict areas where no effective systems of governance have been agreed upon (for example in the area of deforestation). Moreover, more research is needed on the overarching and cross-cutting norms of earth system governance and on the principles and norms that run through all, or through a large number of, institutions.

The problem of agency

The second analytical problem advanced by the Earth System Governance Project is agency. Many vital institutions of earth system governance are today inclusive of, or even driven by, non-state actors from the local to the global level. These often cut across public–private divides [28,29] and span the entire spectrum from public non-state, such as intergovernmental bureaucracies [30] or city governments [22,23], to public–private, such as environmentalist alliances [31,32], public/private partnerships [33] or scientific networks [34], to purely private actors, such as business associations [35] and corporations [36]. The activities of these non-state actors in earth system governance are not confined to protests, advocacy, lobbying or advising. Frequently, these actors become *agents* of earth system governance in that they substantively participate in rule-setting processes or at times negotiate their own global standards, as in the Forest Stewardship Council or the Marine Stewardship Council [37]. We define such agents in earth system governance as actors who have the ability to prescribe behaviour and to obtain the consent of the governed; an agent is an *authoritative actor* as a constituent part of the cumulative steering effort towards preventing, mitigating or adapting to earth system transformation.

Several broad research questions, each related to a broader social science debate, arise. First, what is agency for current earth system governance, and who are the agents of earth system governance? How do different agents exercise agency in earth system governance? Since different agents may become authoritative on different grounds, it is also important to enquire into the sources of authority. Finally, how can we evaluate the significance of agents and agency, and assess the effectiveness of different agents and their various means of exercizing agency?

The problem of adaptiveness

Adaptiveness is the third analytical problem that we advance here. Adaptiveness is an umbrella term for a set of related concepts — vulnerability [38], resilience [39,40], adaptation [41], robustness [42], adaptive capacity [43] or social learning [44] — to describe changes made by social groups in response to, or in anticipation of, challenges created through environmental change. Within the framework of earth system governance, the term adaptiveness includes the governance of adaptation to social–ecological change as well as the processes of change and adaptation within governance systems. We advance four main research questions under this theme.

First, what are the politics of adaptiveness? Adaptation can create winners and losers, by, for instance, shifting the distribution of benefits, of involuntary risks, or of power. We should therefore ask of adaptiveness: for whom and who benefits? Adaptive capacity is also often specific to the social–ecological system in question [45]. A second cluster of research questions addresses which governance processes foster adaptiveness. Thirdly, it will be important to look into attributes of governance systems that enhance capacities to adapt. A fourth research question is how, when and why adaptiveness influences earth system governance? This calls for deeper investigation of individual and collective behaviours that underlie adaptive-

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ness, and, in particular, those related to the exercise, allocation and shaping of power.

The problem of accountability and legitimacy

Earth system governance poses also important questions of accountability and legitimacy. Strong comprehensive governance architectures must be legitimate and accountable. Effective and possibly widely spread agency of non-state actors requires new conceptualizations of legitimacy and accountability beyond the nation state. Also, the adaptability of governance systems calls for special attention to their accountability and legitimacy. In public norm-setting, legitimacy may derive through the accountability of governments to their constituencies as well as through wider public scrutiny and acceptance of decisions and actions, that is, forms of discursive legitimacy [46]. Yet accountability through the ballot box has its limitations — not least because such channels are not relevant to many citizens who live in non-democratic states [47,48]. Many authors see a solution in the participation of private actors in earth system governance. However, the accountability and legitimacy of private actors themselves can be seen as problematic [12,49,50].

The problem of accountability comes thus down to four broad research questions: first, what are the sources of accountability and legitimacy in earth system governance? Second, what is the effect of different forms and degrees of accountability and legitimacy for the performance of governance systems? Third, transparency has been emphasized as one mechanism to secure accountability and legitimacy of earth system governance [51]. Yet the exact role and relevance of transparency is still insufficiently understood and requires further research on how mechanisms of transparency can ensure accountable and legitimate earth system governance. Fourth, in a more policy-oriented sense, what institutional designs can produce the accountability and legitimacy of earth system governance in a way that guarantees balances of interests and perspectives?

The problem of allocation and access

Who gets what, when, where and how is a key question of any politics. The pursuit of fair allocation and access, and the un-doing of perceived injustices, is a never-ending but meaningful goal. The impacts of global change pose additional challenges, for instance in the way that environmental risks are distributed across peoples and places or in the way that responses are favoured and supported by stronger societies [52]. This research theme is difficult also because what constitutes fair allocation and access is tangled up in details of both objectives and means to achieve them, as well as different disciplinary understandings. These vary widely and reflect beliefs about how the world is, or should be; they are also path-determined. There is some limited research on international environmental regimes emphasizing justice at the level of nation states. This needs to be strengthened in itself, yet also be complemented by research into allocation and access issues within states. Such research will have to tackle moral and ethical issues; it is here where questions of allocation can easily become trapped into forgetting the shaping contexts that empower and disenfranchize from the start [53].

We propose four sets of questions to guide research on the analytical problem of allocation and access. First, how can we reach interdisciplinary conceptualizations and definitions of allocation and access? Second, what is the relevance of questions of allocation and access in earth system governance? Third, what (overarching) principles underlie allocation and access? Fourth, what are the implications of current and alternative initiatives to improve allocation and access within earth system governance? How can these be redirected to the pursuit of fair allocation and access without reducing their effectiveness in addressing environmental consequences and drivers of global change?

Crosscutting themes

The five analytical problems are the basis of earth system governance research. They are all highly interlinked and share a number of crosscutting themes, that is, core concerns of the social sciences that are of fundamental relevance for the analysis of each analytical problem. Four crosscutting themes have been selected for closer examination within the Earth System Governance Project: these are power, knowledge, norms and scale (see [9••] in more detail).

Flagship activities

Whilst the science plan of the Earth System Governance Project can be applied to any given problem of global and local environmental change, we believe that a strong research programme will benefit from a clear focus on a limited area of empirical research. It thus seems useful to focus empirical research on a number of case study areas in which the investigation of the five A's — the analytical problems of architecture, agency, adaptiveness, accountability and allocation and access — will stand at the centre. These empirical areas are the 'flagship activities' of the Earth System Governance Project, which will at the same time be linked with joint ESSP projects to ensure the crosscutting nature of the Project.

As one example, the Earth System Governance Project will collaborate with the ESSP Global Water System Project in studying the problems of architecture, agency, adaptiveness, accountability and allocation and access with the example of local, national or global water regimes. The Global Water System Project aims to understand how humans are changing the global water cycle, the associated biogeochemical cycles and the biological components of the global water system, and what social feedbacks arise from these changes. The Project has three

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sub-questions: about the magnitudes of anthropogenic and environmental changes in the global water system and the key mechanisms by which they are induced; about the main linkages and feedbacks in the earth system that arise from changes in the global water system; and how resilient and adaptable the global water system is to change and what sustainable water management strategies are. This third question focuses on the institutional and governance dimension and will be the focus of the cooperation of the Global Water System Project with the Earth System Governance Project.

A second flagship activity of the Earth System Governance Project will be global climate governance. This activity will be linked to the research programme of the Global Carbon Project, a joint project under the Earth System Science Partnership. Even though the study of earth system governance goes beyond the core questions of the Global Carbon Project, there are complementarities between the two initiatives: studies of earth system governance in the context of coupled human and natural systems can be expected to yield insights related to the role of humans and societal institutions as drivers of change as well as the ways that humans are likely to organize themselves in the face of change. In particular, complementarities with the Global Carbon Project lie with Task 3.2.3 of its Science Plan that envisions research for designing carbon management institutions and multi-level governance for urban carbon management.

A third flagship of the Earth System Governance Project will be food systems. This interaction between earth system governance and food systems will be analyzed through collaboration with the Global Environmental Change and Food Systems (GECAFS) project, one of the joint projects of the Earth System Science Partnership. The goal of GECAFS is to determine strategies to cope with the impacts of global environmental change on food systems and to assess the environmental and socio-economic consequences of adaptive responses aimed at improving food security. There are strong institutional and governance questions underpinning GECAFS' analysis of food systems. These include the extent to which concerns about food systems are incorporated into global and regional environmental governance, for example into the adaptation or mitigation strand of the climate convention process or in environmental components of regional trade agreements; the ways in which the governance of the food system affects the earth system, for instance how the shifts to long global supply chains controlled by large private firms affect climate and land use; and the inadvertent impacts of earth system governance on food systems, for instance the interaction between biofuels, energy efficiency or carbon sequestration projects and food security. In many ways, earth system governance is integral to the GECAFS agenda, and the Earth System Governance Project provides an excellent opportunity to expand and strengthen understanding of food systems and security in the face of environmental change.

A fourth flagship research activity within the Earth System Governance Project will focus on the governance of key aspects of the global economic system that benefit from adopting a socio-ecological system framework to exploring these interactions. The Earth System Governance Project will concentrate here on few key issue areas that are not yet adequately addressed in existing international research efforts, with a particular focus on the five analytical problems of architecture, agency, adaptiveness, accountability and allocation and access.

Additional flagships activities will be explored, for example with the research programmes Land–Ocean Interactions in the Coastal Zone Project and the Global Land Project.

Crosscutting research and the engagement of other projects as flagship activities is no one-way street. On the contrary, research findings on one of the five analytical problems of the Earth System Governance Project, derived in one of the other global change projects, will be interesting also for all other global change projects dealing with similar problems. For example, research on allocation and access conducted in the areas of water governance, food governance or global economic governance, will be specific to their particular cases, yet will also yield new general insights useful for progress in the social sciences as a whole. The Earth System Governance Project is designed as the central nodal point within the global change research programmes to guide, organize and evaluate these various activities on governance in separate projects (see [9••], pp. 86–108 in more detail).

Policy relevance

The Earth System Governance Project, whilst primarily a scientific initiative, is also designed to assist policy. Significant policy-relevant contributions from research are expected in all five analytical problem areas. For example, the problem of the architecture of earth system governance is a key concern of current negotiations and political processes that are often faced with 'treaty congestion' and complex interlinkages between different institutions, for instance between multilateral environmental agreements and the World Trade Organization. 'Fragmented' governance architectures are also an increasing problem for decision-makers, particularly in climate policy. A related concern is the reform of the United Nations, for example with a view to the debate on a world environment organization. At national and local levels, architecture is a key concern for decision-makers dealing with policy integration, the comparative effectiveness of policy instruments and the integration of decision-making from international, national and local levels. Research on agency within the

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project will generate novel ideas on the integration of civil society actors in earth system governance, and on the advantages and disadvantages of private and public–private governance arrangements. Research on governance of adaptation and the adaptiveness of governance arrangements will inform policy-makers who have to deal with adapting political processes and policies to a changing world. The accountability and legitimacy of decision-making, from local to global levels, is equally a key problem for public policy. Finally, research on allocation and access as outlined here will help to improve governance outcomes and advance philosophical and ethical discourses on an equitable approach to earth system governance.

Conclusion

Earth system governance is one of the most difficult yet at the same time one of the most exciting and urgent research topics for the social sciences. The five analytical problems and four crosscutting research themes (Figure 1) of the Earth System Governance Project's science plan provide a starting point for advancing and integrating many different strands and disciplines of research. Moreover, the Earth System Governance Project will serve as nodal point within the global change research programmes to guide, organize and evaluate research on governance, thus strengthening and incorporating governance as a crosscutting theme within the IHDP and ESSP communities.

The Project was formally launched in 2009 and is now being implemented through a global alliance of Earth System Governance Research Centres; through a global network of associate faculty members and research fellows; through a global series of conferences; and through a multitude of research undertaken at the local, regional and global levels. (Comprehensive information on the Project is available at www.earthsystemgovernance.org.) The Earth System Governance Project is designed as a global, open and broad network of researchers interested in advancing knowledge on the governance of human–nature co-evolution at all levels, ranging from local decision-making to global regimes and organizations. We look forward to engaging with more and more researchers and communities as the Project evolves.

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