# Governing a Planet under Pressure –
# Exploring Governance Dimensions of Planetary Boundaries

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*Presented at the Earth System Governance Conference, Amsterdam*

*1-4 December 2009*

**FIRST ROUGH DRAFT, DO NOT QUOTE**

## 1. Multiple Global Crises and 'Tipping Points'

The possible implications of abrupt climate change have induced considerable scientific and political attention the last few years. Some of this debate has evolved around the notion of interacting multiple crisis at the global scale (Walker *et al* 2009, Smith and Fishbacher 2009, Beck 2008). Other have evolved around the notion of possible 'thresholds' or 'tipping points' at the planetary scale. Crossing such critical thresholds can unleash feedback mechanisms that drive the Earth system into a much warmer, greenhouse gas-rich state (Steffen *et al* 2004, Lenton *et al* 2008). Earth system scientists are now also exploring additional – and often overseen – so called "planetary boundaries" (see Rockström *et al* 2009). These are nine Earth system processes that manifest themselves in different ways at the planetary level and include not only climate targets (such as 350 ppm), but also ozone depletion, atmospheric aerosol loading, ocean acidification, global freshwater use, chemical pollution, land system change, biodiversity, and biogeochemistry.

Drawing a "safe operating space for humanity" (Rockström *et al* 2009) is bound to be a highly controversial project. As a number of the responses to the Rockström and colleagues article in *Nature* demonstrate, the approach is seen as interesting and timely, but also to embed a range of profound uncertainties with unclear consequences for policy-making and institutional design (e.g. Schlesinger 2009, Bass 2009).

The following article explores the notion of "planetary boundaries" from the perspective of global governance or earth system governance (Biermann 2008, Biermann *et al* 2009b). As we intend to argue in this article, the global governance implications of defining "planetary boundaries" go well beyond discussions about the implications of institutional fragmentation and segmentation (Biermann and Pattberg 2008, Young *et al* 2008), the role of international agreements in dealing with global environmental change (Molina *et al* 2009, Mitchell 2003), and the challenges posed by uncertainties in long-term policy making at the international level (Underdal 2009). On the contrary, they highlight a number of poorly explored global governance challenges that stem from the multilevel and multisystem features of global environmental change (Steffen *et al* 2005, Walker *et al* 2009). In this article, we elaborate the following questions:

a) Which global governance challenges - both in terms of agency and architecture - emerge as the result of the possibilities of rapid, non-linear and multiscale and multisystem global environmental change?

b) How do actors at the international level, attempt to overcome the challenges posed by global institutional fragmentation and segmentation, *and* the interaction between "planetary boundaries"?

c) Which general lessons can be drawn for the study of “adaptiveness” in earth system governance?

We intend to answer these questions by combining a synthesis of existing research, with some new empirical analysis [NB: not complete]. In the latter case, we intend to explore what we see as poorly explored governance challenges placed at the interface between marine ecosystem degradation, ocean acidification and climate change. We do this through document studies and interviews with key players in the global arena, to map out emerging strategies to build cross-organizational and cross-level partnerships and networks for information dissemination, public outreach and lobbying.

The paper is organized in the following way. In the next part, we intend to briefly summarize some of the most profound and well-elaborated changes in governance at the international level. Our emphasis here is on the governance challenges posed by cross-system and cross-scale interactions in the Earth system. The third part moves beyond the theoretical literature, and unpacks some of the real-world problems that emerge at the interface between local and global change. Here we use the case of marine ecosystem degradation, ocean acidification and climate change to highlight cross-system and cross-scale interactions, and their institutional and actor-interplay challenges. This part then feeds in to an empirical analysis of how international actors - such as the Food and Agriculture Organization (FAO), the World Bank and a range of cross-national and non-state actors - attempt to overcome the dual challenges posed by complex earth system processes, and fragmented global environmental governance.

## 2. What's New? Global Governance and Cross-System Interactions

At the same time as the global economy and human activities overall are at a scale where they profoundly affect biophysical interactions between Earth systems processes, the global governance regimes at our disposal to steer these developments have gone through equally profound changes in the last two decades. Some analysts have called it the shift from "government" to "governance", or a shift from "old governance" to "new governance" (Börzel 2009, Pierre and Peters 2005, Radaelli 2003). Whatever it is called, it entails an increasingly *fragmented* system for steering societies, with much more diverse types of actors and organizations involved, and an increasingly *segmented* system, operating at multiple levels from local and regional up to the international and global level (Hooghe and Marks 2003, Biermann and Pattberg 2008, Young *et al* 2008). These shifts are paralleled by the rapid evolution of information and communication technologies that support not only rapid information flows, but also the emergence of networked forms of governance at international scales (Castells 2009, Galaz 2009).

The analysis made by Pahl-Wolst and colleagues (2008) is highly illustrative in this sense. As they note, while there is increasing evidence for the global coupledness of global water resources - through for example teleconnections and market flows - this is not matched by the features of global water governance (GWG). On the contrary, GWG is "diffuse, heterogeneous, and fragmented […]. The overall picture can be characterized as one of mobius web-type governance" (Pahl-Wolst *et al* 2008: 427). Similar arguments have been made for other global environmental change challenges such as the rapid depletion of global marine resources (Berkes *et al* 2006), global health (Sridhar *et al* 2009), climate change (Biermann *et al* 2009), ecosystem services (MEA 2005), deforestation (Dimitrov *et al* 2007), biodiversity (Siebenhuner 2007), and coral reef ecosystems (Dimitrov *et al* 2007).

This real shift in modes of governance is likely to involve both threats and opportunities for how we manage planetary boundary interactions. In the first case, because fragmented governance systems can degenerate into poor coordination, organizational conflict, negative institutional interactions and destructive free-riding behavior at multiple levels. In the second case, because this changing political landscape can provide the diversity, polycentricity and flexibility needed to deal with uncertainty, change and surprise (c.f. Low *et al* 2003, Dietz *et al* 2003, Folke *et al* 2005, Victor *et al* 2005).

It is nonetheless clear that a more multilevel and multi-actor governance regime will not in itself better cope with these governance challenges, but need to match the dynamics of complex biophysical systems (Young 2002, Galaz *et al* 2008). This design and fitting process cannot be theoretically deduced, but need to build on empirical lessons and good examples of interaction governance across scales from local to the global (c.f. Folke *et al* 2005, Olsson *et al* 2008, Galaz *et al* 2008, Young *et al* 2008). While the issue of "adaptiveness" is rapidly gaining leverage within the global environmental governance community (Biermann and Pattberg 2008), we would argue that the research community has made little progress in identifying the global governance challenges posed by:

i) non-linear dynamics (such as "tipping points" and hysteresis)
ii) multispeed changes (phases of both slow and rapid change)
iii) cross-system interplay (such as the interplay between and economic, social and ecological systems and "planetary boundaries")
iv) cross-level interactions (local to global).

Many of these points have been elaborated in detail in the social-ecological and natural science literature (e.g. Rockström *et al* 2009, Scheffer *et al* 2009, Steffen *et al* 2004, Gunderson and Holling 2002). Our point in this paper is that these dynamics pose a range of poorly explored global governance adaptiveness issues. These include challenges associated with *fragmented knowledge and early warnings*, absence of mechanisms for *responsibility and accountability* for cross-system interactions, *missing patterns of collaboration,* the failure design international regimes able to target not only incremental stresses, but also *system interactions,* and finally *the re-organization and transformation capacities* of cross-system governance arrangements.

All these issues are related to well-known dimensions of global environmental governance (Biermann and Pattberg 2008, Young *et al* 2008). That is, they all affect how we perceive the problem-solving capacity of international law and agreements, global environmental assessments, permanent global intergovernmental agencies, private governance arrangements such as international public-private partnerships, as well as the role of epistemic communities. In the following section, we highlight these multilevel governance challenges by taking a closer look at the interplay between the 'boundaries' (Rockström *et al* 2009) marine biodiversity, ocean acidification and climate change.

**3. Global Crises Play Out at the Local Scale**

Climate change is already having an impact on marine ecosystems, as illustrated by increasing ocean temperatures, increased ocean acidification (Caldeira and Wickett 2003), and melting sea ice in the Arctic (Walther *et al.* 2002, Serreze *et al.* 2007, Eisenman and Wettlaufer 2009). These interactive effects are not only ecological, such as changes in productivity and distribution of marine organisms (Kirby and Beaugrand 2009, Brander 2007, Beaugrand *et al* 2002), and bleaching of corals (Antony *et al*. 2008, Hoegh-Guldberg *et al.* 2007). These changes also have profound social, economical and political implications. One of the most debated ones relates to the security implications of a melting Artic region (Borgerson 2008). Other implications, which have received less media coverage and political attention, stem from the likely consequences of interactions between climate change, ocean acidification and loss of marine biodiversity on livelihoods and ecosystems at the local scale.

If coral reefs fail to adapt to increasing water temperatures and lower pH-levels, a substantial global reduction of coral reefs is likely within a few decades (Hoegh-Guldberg *et al* 2007). The loss of coral reefs would have enormous implications for the production of fish, and consequently also for the tens of millions of people who depend on coral reefs for their survival (Dulvy and Allison 2009). Conversely reef resilience to climate change is also influenced by fishing pressure (Bellwood *et al* 2004) exerted at multiple scales, from local to global actors (Thyresson *et al* in prep, Crona *et al* in press). This implies that the individual components of this tri-part problem complex (climate-marine biodiversity-ocean acidification) cannot be treated effectively if managed separately.

A good illustration of this interconnectedness is coastal social-ecological systems of the Western Indian Ocean (WIO). In these, and most other reef associated SES, corals and algae determine largely the structure of associated communities of fish and invertebrates (Hughes *et al* XX, Nyström *et al* 2008, McClanahan *et al* 2009). Fish provide the main link between coral reefs and social communities, represented at the local level by households. With a few exceptions, coastal households in the WIO region have a high degree of dependence on reef fisheries. By integrating social, environmental and ecological measures, McCalanahan *et al* (2009) analyzed which sub-regions of the WIO were most likely to be particularly vulnerable to climate change. Their results are important because they illustrate that understanding of adaptive capacity of social-ecological systems in the face of global environmental change and crossing of planetary boundaries requires an integration of social, environmental and ecological dimensions.

Another example from Western Africa, where dependence on marine and freshwater fisheries is also high, shows that social-ecological dynamics in the marine realm can have significant effects on terrestrial biodiversity (Brashares *et al* 2004). Additional examples are the cross-scale water, biodiversity and climatic implications of forest loss in Indonesia (Curran *et al* 2004) and Amazonia (Rockström *et al* 2009). These examples both reflect, and further emphasize the need to discuss planetary boundaries as integrated problem complexes. Hence while the notion of "Planetary Boundaries" and their interactions might seem abstract and vague in its policy implications (Doremus 2009), a range of examples show how these interactions already today, play out at the local, regional and transnational scale. In essence, these local examples indicate emerging global concerns. Next, we elaborate further on the implications of this for adaptiveness.

## 4. Governance Dimensions of Cross-System Interaction and Planetary Boundaries

The study of the institutional dimensions of global environmental change has a strong track record in the social sciences (e.g. Miles *et al* 2002, Young 2002). Important theoretical ground has for example been covered both amongst global environmental governance scholars (e.g. Biermann and Pattberg 2008, Webster 2008, Young *et al* 2008), as well as in the literature that explores networked forms of governing as a strategy to cope with uncertainty and complexity in natural resource management (e.g. Cash *et al* 2006, Brondizio *et al* 2009). This also includes research on adaptive and learning approaches to ecosystem management (e.g. Holling 1978, Lee 1999, Roe and van Eeten 2002, Fazey *et al* 2005). There is also considerable literature on how natural resource users adapt to changing circumstances and steer away from pending ecological crises (e.g. Berkes *et al* 2003, Gunderson *et al* 2006, Olsson *et al* 2008).

Dealing with the drivers and repercussions of transgressing planetary boundaries, is likely to involve a range of interventions at multiple levels of social organization. They may entail stronger enforcement of international environmental agreements, strengthening national regulatory and planning efforts, combat corruption, support participatory and adaptive modes of ecosystem management, and diversify the livelihoods of vulnerable groups (Chapin *et al* 2009, World Resources Institute 2008, Young 2008, Brondizio *et al* 2008, Nepstad *et al* 2002).

In this paper, we choose to focus on a set of *additional* and poorly explored topics that emerge at the interface between governance-oriented research, and the notion of cross-system interactions in planetary boundaries. This choice is not only due to space limitations, but also because they all highlight a range of unexplored challenges to "adaptiveness" in earth system governance (Biermann *et al* 2009), or global environmental governance.

a. *Fragmented knowledge and early warnings*

While there certainly has been a lot of discussion on how international organizations interact (e.g. Biermann and Siebenhuber 2009), we know little – if anything – about how these actors cope with a range of information management challenges, ranging from information collection, to information fusion and dissemination (Galaz 2009). The possibilities and limitations of early warning have been on the policy and research agenda in various sectors for quite some time. This includes early warning systems for extreme weather events associated with El Nino-Southern Oscillation dynamics (Glantz 2001); the rapid evolution of warning systems able to spot early emergences of infectious diseases (Galaz 2009); and warning systems for natural hazards such as tsunamis, flash floods and extreme weather events (Sorensen 2000). The ability of actors at the supra-national and international level, to obtain early warnings of pending crises that emerge as the result of cross-system interactions between planetary boundaries, is however considerably more complicated. The reason is two-fold.

First, abrupt ecological changes – such as collapsing coral reef ecosystems, rapid loss of fish stocks - stem from the combination of multiple systems, and multispeed and multilevel changes (see Rockström *et al* 2009, Walker *et al* 2009, Steffen *et al* 2004, Gunderson and Holling 2002 for additional examples). This requires a shift from monitoring systems that track changes in discrete events (say, number of reported eutrophication or invasive species events) to systems able to integrate information about changes in underlying social-ecological drivers, such as land-use change, changes in market pressure, coastal development, and technological change.

This information is dispersed among a wide set of separate monitoring systems, agencies and scientific communities. As Table 1 illustrates, the are a range of permanent international organizations and international non-governmental organizations acting on different aspects of the marine-climate-ocean acidification complex. For example, while FAO and ICES (International Council for the Exploration of the Sea) mainly focuses on fisheries statistics, the World Bank hosts a range of databases with indicators ranging from the quality of government, to environmental and development indicators. More integrated assessments are made by UNEP and their science centres, however based on highly fragmented data and no monitoring of threshold dynamics (Carpenter *et al* 2006).

**Table 1. International organizations at the interface between marine biodiversity - climate change and ocean acidification [NB: not complete].**

| *Organization* | *Responsibilities* | *Information capacities* |
|---|---|---|
| FAO | Food security including fisheries and marine resources through its department of fisheries and aquaculture. | Statistics about fisheries and aquaculture, including national profiles and aquatic species distribution maps |
| ICES | is a network of scientist that coordinates and promotes marine research on oceanography and marine living resources in the North Atlantic. | Scientists working through ICES gather information about the marine ecosystem, develop databases, conduct integrated ecosystem assessment, fish stock assessment and produce scientific advice (primarily in relation to fisheries management. |
| World Bank | Offers financial and technical assistance to developing countries. Supports a range of projects at both national and local level related to fisheries and aquaculture. | Has a range of databases based on country profiles and development indicators, as well as general environmental data. |
| IUCN | Global network of NGOs and governments that supports scientific research, manages field projects all over the world and brings governments, non-government organizations, United Nations agencies, companies and local communities together to develop and implement policy, laws and best practice. | |
| UNEP | Coordinates and supports a range of international projects around sustainable development, including capacity building, education, . Hosts a range of secretariats (e.g. CBD, Montreal Protocol). | Global and regional environmental assessments (e.g. GIWA, GEO-4, Africa Environment Outlook), GEO Data Portal, PEARL (Prototype Environmental Assessment and Reporting Landscape), including coastal and marine waters |
| World Fish Centre | | |
| UNDP | Has in general little involvement in marine issues, except through jointly administered programmes on climate change adaptation with UNEP in e.g. SE Asia. Also appear as implementing agency in some GEF projects. | Human Development Report |

**Comment:** The following table is based on information posted on the organizations official webpages and interviews with key actors (see appendix).

Second, information integration has proven to be not only a difficult technical issue, but in essence an institutional challenge. Differences in organizational goals, approach, culture, and structure sometimes account for the reluctance of agencies in general, to share information with each other, and with non-state actors (Parker and Stern 2002, Boin *et al* 2005). This could pose a tough challenge in settings where effective responses - i.e. acting before reaching critical ecological thresholds are transgressed - require prompt knowledge integration and coordinated action in multi-actor settings (Galaz *et al* 2009).

*b) Absence of mechanisms for legitimacy and accountability*

The challenges posed by an increased fragmentation of international institutions and actor settings, for the legitimacy and accountability for global governance are well known (e.g. Held 1999, Biermann *et al* 2009b) [i]. The steering of cross-system interactions in planetary boundaries is no exception. While some of the legitimacy can be viewed as stemming though the mechanisms of accountability of international bureaucracies (Biermann 2007, Keohane 2001), the fact that there are both overlap and gaps in the tasks promoted by international actors (Table 1), as well as a highly unstructured institutional architecture, add additional levels of legitimacy and accountability challenges.

In terms of *overlap*, the FAO has an explicit international mandate on questions regarding food security. This involves supporting support knowledge management, as well as the integrated management of landscapes and seascapes, [see FAO's Strategic Framework]. This mandate has clear overlaps with the mandates of UNDP (which include poverty reduction, the support of sustainable land management, and biodiversity conservation [see UNDP.org "What We Do"], of the UNEP (support ecosystem management, support a range of climate change programs), and the World Bank (provide low-interest loans and credits to agricultural development projects, and natural resource management initiatives including marine and coastal management).

While these sort of overlaps can be seen as a strength as it provides a system with poly-centric decision making, and high degrees of diversity in approaches (Low *et al* 2003, Folke *et al* 2005), it can also create clear collective action problems. As Rodhes (1996) quite pessimistically puts it: "In an interorganizational network, no one actor is responsible for an outcome […]. There is 'the problem of many hands' where so many people contribute that no one contribution can be identified; and if no one person can be held accountable after the event, then no one needs to behave responsibly beforehand (Rhodes 1996:663, see also Scott 2000). This problem is also associated with the risk of negative externalities, that is, the possibility that decentralized actions can lead actors to externalize the costs of their actions onto others (Keohane 2001, Barrett 2000). In a similar way, negative institutional interactions nay play out (Oberthur and Gehring 2006, Gehring and Oberthur 2008), an issue that covers many of the planetary boundaries, i.e. biodiversity (Rosendal 2001), global water governance (Pahl-Wostl *et al* 2008) and climate change (Biermann *et al* 2009). The issue is however even more critical for the case of governing planetary system *interactions* where international mandates are vague, international monitoring is weak or non-existing, and uncertainties are high.

The impacts of the rapid expansion of investments in biofuels on a range of planetary boundaries, such as biodiversity, water cycles, and land use change (UNEP 2009, Gerben-Leenes *et al* 2009, Tilman *et al* 2009) as well as local livelihoods (Cotula *et al* 2009) is illustrative in this sense. While the major drivers clearly play out on a global scale induced through global markets, the ability of the international system to intervene and buffer the social-ecological impacts is practically non-existing. That is, its impacts of the rapid expansion of biofuels on deforestation (no current regime existing except for REDD); hydrological cycles (no current regime existing); biodiversity (weak and ineffective); and increased global uses of phosphorous and nitrogen (non existing); is difficult if not impossible to deal with in the international arena considering due to the institutional context. To paraphrase the "institutional diagnostics" approach by put forward by Young (2008), this problem complex is neither well-understood, are likely to interplay with a range of environmental and non-environmental regimes, are difficult to "fit" to a range of multiple ecosystem dynamics, and involve a vast amount of heterogeneous actors.

Hence in these settings, accountability at the international level is highly fragmented, or at best available at the national level, despite its obvious cross-boundary impacts. Both Sweden and the United States for example, have had debates about how to better account for the secondary impacts of expanding biofuel production globally (Washington Post 2009, Swedish Parliament Interpellation 2008/09:463).

*c) Non-regimes and missing patterns of collaboration*

The failure design international regimes able to target not only incremental global environmental stresses, but also *system interactions.* Dimitrov and colleagues (2007) explore the role of "non-regimes" such as the failed attempts to reach international agreements on coral reef management, and forest degradation. While the literature on institutional interplay, interactions or interlinkages covers a range of topics (see Biermann *et al* 2009, Gehring and Oberthur 2008 for reviews), very few studies cover the sort of critical interactions identified by Earth System Science scholars (Steffen *et al* 2004, Rockström *et al* 2009).

To the list of non-regimes in global environmental governance, we can also add a long list of system interactions, such as the interplay between deforestation and their continental impacts through teleconnections on water flows (Rockström *et al* 2009), the interlinkage between losses of marine biodiversity and their impacts on the degradation of terrestrial ecosystems (Brashares *et al* 2004, Galaz *et al*, in print), or the impact of land-use change on marine and terrestrial biodiversity (Millennium Ecosystem Assessment 2005), and the connection between climate change, ocean acidification and marine resources explored in this article.

One particular example of the lack of effective governance of this last interaction is the recent call by a range of international actors. Some of the pressure has emerged from non-governmental organizations, and the scientific community (e.g. Hoegh-Guldberg *et al* 2007, Rogelj *et al* 2009). In June 1st 2009 for example, the national scientific academies of 70 nations issued a statement warning that the exclusive focus on climate change under the UN Framework Convention on Climate Change (UNFCCC) ignore the implications of ocean acidification. They also call for the reinvigoration of " […] action to reduce stressors, such as overfishing and pollution, on marine ecosystems to increase resilience to ocean acidification" (Inter Academy Panel 2009). In a similar way, the Assistant-Director General of FAO and the Executive Director of UNEP issued a joint statement urging decision-makers at the pre-COP 15 meeting in Bonn, to "include aquatic ecosystems, fisheries and aquaculture when formulating action to combat climate change" (FAO/UNEP 2009). This also included a joint policy brief issued by 11 international organizations, including the FAO, the World Bank, UNEP, WorldFish Center and UNESCO (FAO 2009).

d) *the re-organization and transformation capacities* of cross-system governance arrangements.

Agency – that is the ability to change the course of events or the outcome of processes - is diffused in these settings. This poses a transformation challenge. No one is responsible for taking action? Coordination? In addition, there is a possibility that networks become autonomous and resist central guidance (Rhodes 1996).

## 5. Governance at the Interface

Previous sections have focused on the obstacles and global governance challenges related to planetary boundaries and cross-system interactions. As we explored, there are considerable challenges related to the absence of cross-system monitoring, lack of regimes that address these interactions, as well as the challenges of transforming out of this highly fragmented governance architecture. Interesting enough however, there also seems to exist a range of initiatives and partnerships that could be viewed as self-organized responses to the inability of formal international agreements and regimes to deal with cross-system interactions. Hence they might provide some of the bridging functions identified by for example (Cash *et al* 2006, Olsson *et al* 2008, Brondizio *et al* 2009), but in this case with the ability to address cross-system interactions at the global scale.

Hence any analysis of the abilities of actors to deal with cross-system interactions of planetary boundaries is incomplete without an understanding of not only the institutional setting (section 4), but also emerging network patterns at the transnational and international level. The argument is simple. Countries and international organizations are not isolated actors acting in predictable ways under well-specified, formal international treaties. On the contrary, they collaborate, invest in joint projects, share information, and build alliances to better detect and respond to the challenges posed by social, ecological and technological change. The question is how to understand, analyze and denote these globally spanning, but also multilevel, collaboration patterns.

Network organizational forms use communication linkages to connect multiple organizations and people into new entities that build response capacity, i.e. that can share information, coordinate and provide tangible opportunity structures (Ansell 2006, Klinj and Koppenjan 2004). One more blunt way to put is that in a world where competencies and capacities are distributed globally, the “evolving, emerging network form *is* the organization” (Contractor *et al* 2006).

The initiative mentioned above between the FAO, UNEP, WorldFish and 13 additional international organizations is an interesting case in point. These sort of multi-organizational networks have a potential to deal with incremental change, uncertainty and surprise (Brondizio *et al* 2009, Folke *et al* 2005). Viewed from the challenges discussed in the previous section, network linkages across sectors and/or scales have the ability to facilitate information integration, support actors in their attempts to coordinate their actions, bridge the gap between fragmented international environmental regimes, and attempt to cope with the effects missed cross-system interactions and non-regimes. But, this is just a potential. We know little empirically about these partnerships and interconnected networks enhance the "fit" (Young 2002, Galaz *et al* 2008) between institutions and social-ecological dynamics. For example, we do not know where they emerge, what sort of "public goods" they create, and how they handle a range of difficult institutional and information processing issues.

Here we elaborate the issue by describe and illustrate emerging collaboration between international agencies, epistemic communities and non-governmental actors at the climate change - ocean acidification-biodiversity interface. Our ambition is to describe how this initiative emerged, its underlying motive, its capacity to address cross-system interactions as defined by planetary boundaries, and discuss its relation to formal international regimes. This analysis hence complements previous studies of global partnerships (Bäckstrand) and international organizations (Biermann and Siebenhuber 2009).

**Who they Are**

**What they Do**

**How it Started**

**Which Gaps they Fill**

**Table 2. International partnerships at the interface between climate change, ocean acidification and marine biodiversity**

## 6. Concluding comments

Linking back to PB. These sorts of collaborations probably emerge for other additional PB, they are however not explored at the moment. We also highlight missing actor linkages in fish-climate example. We have analyzed the problem at the global scale, but the issue is being addressed at lower institutional scales. Some of that emerges through the linkage of a range of diverse partnerships and networks including permanent international organizations, scientific collaborations and non-state actors. These invest considerably in collaborations and projects related to marine governance, climate change and aspects of ocean acidification.

However, the point that there currently are no formal agreements/mechanisms to cope with cross-system interactions is problematic. Risk of negative interactions with other regimes, weak enforcing capacity and limited and vulnerable funding. Non-regimes such as that for coral reef management and deforestation pose serious problems.

Climate-food-biodiversity interactions are complex enough at local scales, but eventually humanity is going to have to deal with their interactions at the global scale.

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## Table 2. Partnerships and Networks at the Interface

| Name of initiative | Type of initiative | Partners | Duration | Budget | Comment |
|---|---|---|---|---|---|
| EPOCA: European Project on Ocean Acidification | Research to identify social and ecological implications of acidification | 27 institutes in Belgium, France, Germany, Iceland, The Netherlands, Norway, Sweden, Switzerland, United Kingdom | Started June 2008; 4 years | 16.5 M€ | |
| The International Coral Reef Initiative (ICRI) | Identify strategies to conserve the world's coral reef resources | Governments of Australia, France, Japan, Jamaica, the Philippines, Sweden, the United Kingdom and the United States of America, among others. United Nations organizations, multilateral development banks, environmental and developmental NGOs, and the private sector | April 1995-ongoing | | ICRI has established The International Coral Reef Action Network (ICRAN), The Global Coral Reef Monitoring Network (GCRMN), Coral Reef Degradation in the Indian Ocean (CORDIO) and The International Coral Reef Information Network (ICRIN) |
| Reefs at risk revisited | Map-based assessment of threats to coral reefs | International Coral Reef Action Network (ICRAN), UNEP World Conservation Monitoring Centre (UNEP-WCMC), The Nature Conservancy, Global Coral Reef Monitoring Network (GCRMN), Reef Check, WorldFish Center, Conservation International, National Oceanic and Atmospheric Administration (NOAA), International Society for Reef Studies (ISRS), World Wildlife Fund, National Center for Ecological Analysis and Synthesis (NCEAS), Wildlife Conservation Society (WCS), Coral Reef Degradation in the Indian Ocean (CORDIO), Oceana, Coral Reef Initiatives for the Pacific (CRISP), University of the South Pacific, L'Institut de Recherche pour le Developpement (IRD), International Union for the Conservation of Nature (IUCN), Atlantic and Gulf Rapid Reef Assessment (AGRRA). | July 2008-2010 | | WRI lead continuation of the 1998 Reefs at risk program |
| Integrated Marine Biochemistry and Ecosystem Research IMBER | Research initiative to identify the most important science issues related to biological and chemical aspects of the ocean's role in global change and effects of global change on the ocean, with | International Geosphere-Biosphere Programme (IGBP), Scientific Committee on Oceanic Research (SCOR), individual researchers at various national research organizations. | Initiated by the IGBP/SCOR Ocean Futures Planning | The IPO has been funded by INSU-CNRS (105 K | The IMBER Iinternational Program Office (IPO) is located at the Institut Européen de la Mer (IUEM) in Brest, France. IUEM is a joint institute between CNRS and the University of |

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| | emphasis on important issues that are not major components of existing international projects. | | Committee in 2001 | Euros per year), IRD (50 K Euros per year), and Region of Brittany (33 K euros per year) and has secured funds until 2008. The IMBER IPO is also beneficiating from in-kind contribution from University of Western Brittany (11 K Euros per year). The IMBER IPO is currently staffed by three full time staff, (Executive Officer, Deputy | Western Brittany. Finacial support for IMBER and its interim Project Offices was provided by ICSU, IOC, IGBP, NIWA (New Zealand), Plymouth Marine Laboratory (United Kingdom), SCOR and the U.S. National Science Foundation. |

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|---|---|---|---|---|---|
| Integrated Marine Biochemistry and Ecosystem Research IMBER | Research initiative to identify the most important science issues related to biological and chemical aspects of the ocean's role in global change and effects of global change on the ocean, with emphasis on important issues that are not major components of existing international projects. | International Geosphere-Biosphere Programme (IGBP), Scientific Committee on Oceanic Research (SCOR), individual researchers at various national research organizations. | Initiated by the IGBP/SCOR Ocean Futures Planning Committee in 2001. | The IPO has been funded by INSU-CNRS (105 K Euros per year), IRD (50 K Euros per year), and Region of Brittany (33 K euros per year) and has secured funds until 2008. The IMBER IPO is also beneficiating from in-kind | The IMBER Iinternational Program Office (IPO) is located at the Institut Européen de la Mer (IUEM) in Brest, France. IUEM is a joint institute between CNRS and the University of Western Brittany. Finacial support for IMBER, and its interim Project Offices was provided by ICSU, IOC, IGBP, NIWA (New Zealand), Plymouth Marine Laboratory (United Kingdom), SCOR and the U.S. National Science Foundation. |

[i] By 'accountability' we mean the holding of public actors to the democratic will and promoting fairness and rationality in administrative decision-making (from Scott 2000, see also XXX).