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ORIGINAL PAPER

Building better science-policy interfaces for international environmental governance: assessing potential within the Intergovernmental Platform for Biodiversity and Ecosystem Services

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Abstract This article addresses implementation failure in international environmental governance by considering how different institutional configurations for linking scientific and policy-making processes may help to improve implementation of policies set out in international environmental agreements. While institutional arrangements for interfacing scientific and policy-making processes are emerging as key elements in the structure of international environmental governance, formal understanding regarding their effectiveness is still limited. In an effort to advance that understanding, we propose that science-policy interfaces can be understood as institutions and that implementation failures in international environmental governance may be attributed, in part, to *institutional mismatches* (sic. Young in Institutions and environmental change: Principal findings, applications, and research, MIT Press, Cambridge 2008) associated with poor design of these institutions. In order to investigate this proposition, we employ three analytical categories—*credibility, relevance* and *legitimacy*, drawn from Cash et al. Proc Natl Acad Sci 100(14):8086–8091, (2003), to explore basic characteristics of the institutions proscribed under two approaches to institutional design, which we term linear and collaborative. We then proceed to take a closer look at institutional mismatches that may arise with the operationalisation of the soon to be established Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES). We find that, while there are encouraging signs that institutions based on new agreements, such as the IPBES, have the potential to overcome many of the institutional mismatches we have identified, there remain substantial tensions between continuing reliance on the established linear approach and an emerging collaborative approach, which can be expected to continue undermining the credibility, relevance and legitimacy of these institutions, at least in the near future.

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Abbreviations

CBD	Convention on Biological Diversity
IMOSEB	International Mechanism of Scientific Expertise on Biodiversity
IPBES	Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services
IPCC	Intergovernmental Panel on Climate Change
MA	Millennium Ecosystem Assessment
SBSTTA	Subsidiary Body on Scientific, Technical and Technological Advice
UN	United Nations
UNEP	United Nations Environment Programme

1 Introduction

This article addresses implementation failure in international environmental governance: defined as 'failure to achieve aims and objectives stated in international environmental agreements'. One of the starkest recent examples is failure to fulfil the 2002 decision[1] to 'achieve by 2010 a significant reduction of the current rate of biodiversity loss at the global, regional and national level'. While many factors influence such failures, we focus here on one key factor central to environmental governance and yet poorly understood: the role that different institutional configurations of science-policy interfaces (SPI's) play in either contributing towards or resolving implementation failures.

Drawing on Vatn (2005) and Young (2008), we define SPI's as institutional arrangements that reflect cognitive models and provide normative structures, rights, rules and procedures that define and enable the social practice of linking scientific and policy-making processes. They assign roles to scientists, policy-makers, other relevant stakeholders and knowledge holders and help guide their interactions according to specific principles and purposes. If both the activities of making science, viewed as the systematic pursuit of knowledge, and of making policy (politics), viewed as the process of bargaining, negotiation and compromise (Pielke 2007) are influenced by institutional structures, then, by extension, their interactions should also be understood in institutional terms. In this paper, we aim to provide better understanding of how the configuration of SPI institutional arrangements is related to the effectiveness of international environmental agreements they are intended to support.

Following Vatn (2005), we understand institutions to be comprised of the cognitive models, normative structures and behavioural constraints that shape human interactions. Cognitive models, creating common frames of references and classifying relevant behaviour, 'constitute the basis for creating necessary meaning and order so that cooperation becomes possible' (Ibid, p. 206). Normative structures create 'the pressure placed on individuals to fulfil certain obligations and expectations' (Ibid, p. 207) that result from common values and the identification of normatively appropriate behaviour. And behavioural constraints resemble more general, often pre-given 'rules of the game' (Ibid, p. 205).

[1] http://www.cbd.int/2010-target (accessed 24 Jan. 2010).

SPIs have always been a part of governance (Jasanoff 1990; Toulmin 1990; Gould 2003), and they have come to play a decisive role in environmental governance (Young 2004; Miller and Erickson 2006; Pielke 2007), where they 'are rapidly emerging as key elements' (van den Hove 2007, p. 808). International environmental governance deals with complex, urgent realities of environmental degradation and resource conflicts. Here, international tensions are the rule rather than the exception, 'facts are uncertain, values in dispute, stakes high and decisions urgent' (Funtowicz and Ravetz 1991), and conventional wisdom for organising dialogue between science and policy-making is challenged in unprecedented ways (Farrell 2008). However, formal understanding regarding which SPI institutions are most appropriate for which types of environmental governance situation is still very limited.

Focusing on what Young (2009) calls, *institutional mismatches*—incompatibilities between the nature of a governance problem and the institutional arrangements established to address it—we suggest these may help explain why some SPI configurations turn out to be ineffective. To investigate this possibility, we work with the analytical categories of *credibility, relevance* and *legitimacy,* which Cash et al. (2003), based on the historical analyses, propose are key for judging the effectiveness of SPIs (see Fig. 1): *credibility* reflects the perceived validity of information, methods and procedures provided and applied via a SPI; *relevance* reflects the extent to which the work carried out within a SPI is responsive to the conditions and needs of the policy process; and *legitimacy* reflects the perceived fairness, balance and political acceptability of its outputs.

Using these ideas as a conceptual frame, we focus our analysis on the nascent Intergovernmental (science-policy) Platform on Biodiversity and Ecosystem Services (IPBES): one attempt to address *institutional mismatches* in the international biodiversity governance SPI arena. We seek to identify ways in which it may be possible for changes in the configuration of the IPBES to improve its effectiveness and therewith that of international biodiversity governance.[2] Employing this combination of Vatn's definition of institutions, Young's concept of institutional mismatches and Cash et al.'s criteria for evaluating the effectiveness of SPIs (see Fig. 1), we explore, on the one hand (1) how institutional mismatches arising with the SPI arrangements set out in the Busan Outcome[3] (UNEP 2010) may impede the effectiveness of the IPBES and, (2) on the other, to what degree the IPBES institutions specified in that agreement might serve as precedents for addressing institutional mismatches in global biodiversity governance.

[2] We note that existence of an appropriate SPI does not ensure more effective environmental governance and are in agreement with van den Hove and Chabason (2009, p. 8) when they argue that, "while the existence of well-functioning SPIs is a necessary condition of biodiversity and ecosystem services governance, it is in no way a sufficient condition.".

[3] The Busan Outcome is an international environmental governance agreement reached at the "Third ad hoc intergovernmental and multi-stakeholder meeting on an intergovernmental science policy platform on biodiversity and ecosystem services", which took place in Busan, Republic of Korea, 7–11 June 2010 [see http://www.unep.org/pdf/SMT_Agenda_Item_5-Busan_Outcome.pdf (accessed 26 Mar., 2011)] or Appendix 1 of this article. The terms of the Busan Outcome constitute the official, internationally negotiated basis upon which the operationalisation the IPBES will proceed. They have been endorsed by the Tenth Conference of the Parties to the Convention on Biological Diversity, which met in Nagoya, Japan, 18–29 October 2010, in its Decision VI, concerning Agenda item 4.3 [see http://www.cbd.int/cop/cop-10/doc/advance-final-unedited-texts/advance-unedited-version-ipbes-en.doc (accessed 26 Mar. 2011)] and on that basis have been designated by the 65th Session of the United Nations General Assembly, in Assembly Resolution A/C.2/65/L.43, Item 19, p. 4, as the principles that should guide the establishment of the IPBES [see http://daccess-dds-ny.un.org/doc/UNDOC/LTD/N10/634/99/PDF/N1063499.pdf?OpenElement (accessed 26 Mar., 2011)].

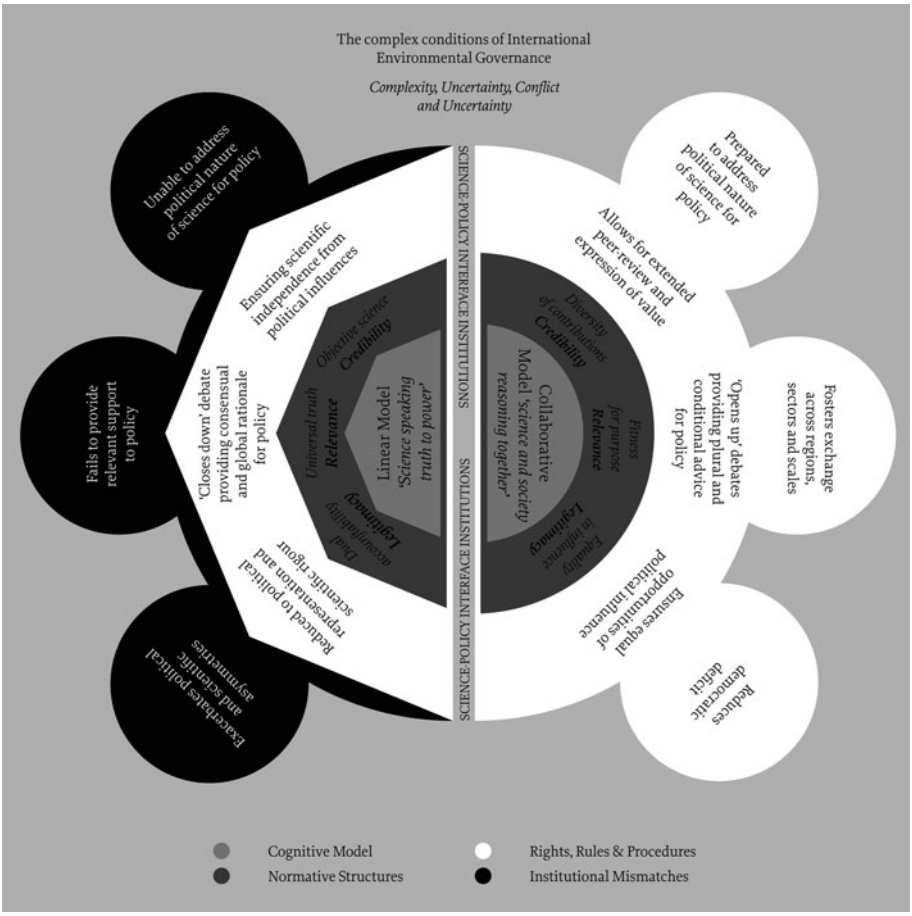

Fig. 1 Mismatch and match of linear versus collaborative science-policy interface institutions

2 Institutional mismatches of SPIs impeding environmental governance

Alarmed by the discrepancy between commitments and action in international environmental governance, in 2009, the United Nations (UN) General Assembly commissioned a round of '[i]nformal consultations of the General Assembly on the institutional framework for the UN's environment work'.[4] Based on the results of these consultations, the Executive Director of the UN Environment Programme concluded that 'the current system is inadequate to meet the environment and development challenges we are experiencing today, primarily due to lack of adequate financing, incoherence among bodies, weak linkages between science and policy, insufficient capacity at the national level to implement laws and policies, and a significant disconnect between the environmental and the

[4] see http://www.un.org/ga/president/63/PDFs/ReportIEG100209.pdf (accessed 13 Feb. 2011).

economic and social spheres.'[5] This statement identifies several areas for addressing implementation failures in global environmental governance, including the institutional structures of SPIs: 'linkages between science and policy'. Starting with a basic view of these institutions, informed by Vatn's (2005) definition, and using Young's concept of institutional mismatches, we can begin to identify obstacles to establishing more effective SPI institutions to support implementation of international environmental agreements.

Following Young (2004, p. 215), since institutions are social constructions, 'the[ir] establishment or refinement … involves acts of creation rather than processes of discovery'. So, we expect to find SPI institutions 'bearing the stamp of theories, discourses, ideologies, or, more generally, patterns of thought that were influential at the time of their formation (Ibid)'. The combination of this institutional history and the complexity of biodiversity governance place us within what Funtowicz and Ravetz (1991) call the domain of post-normal science, 'where facts are soft and values hard' (Funtowicz and Ravetz 1990). However, in global biodiversity governance, creative thinking—theories, discourses and ideologies—that is being used to develop new SPI institutions is still largely based on conventional assumptions that science produces hard facts and that these inform value-laden political decisions. By failing to take the complexity of this context into account, the agreements shaping international environmental governance's SPI institutions harbour unrealistic expectations that scientists should serve as 'Truth Sayers', in spite of strong indications that here scientists can hope, at best, to be 'Honest Brokers': collaboratively engaged, with policy-makers, in a constructive search for potentially suitable policy alternatives (Pielke 2007).

2.1 The linear model in environmental governance

The view of science-policy interrelations to be found in most international environmental agreements can be understood to follow what Pielke (2007) describes as the 'linear' cognitive model of SPIs. Following Pielke (2007, p. 12), we can distinguish between two aspects of this model: a general aspect, concerning how to make decisions about science, based on the idea that knowledge flows 'from basic research to applied research to development and ultimately societal benefits' and an applied aspect, which provides guidance concerning the role of science in decision making, suggesting that consensus on science will lead to consensus in politics and so to coordinated action—i.e. 'that specific knowledge or facts compel certain policy responses'. (Pielke 2007, p. 12)

This linear cognitive model is based on belief in a clear distinction between 'objective knowledge' and 'subjective values' (Weingart 1999) and presumes politically neutral scientists 'speak truth to power' (Weingart 1999), providing objective representations of reality, upon which decision makers take rational decisions subsequently implemented by administrators. Science is perceived as providing clear, 'hard' and objective facts, based on evidence and universal descriptions of reality, and policy is seen as the product of a rational, technically informed, instrumental decision process that moves through the distinct stages of agenda setting, decision making and implementation (Hill 1997). Turning to the three domains of SPI effectiveness proposed by Cash et al. (2003)—credibility, relevance and legitimacy—we now consider how the normative structures that emerge from this linear model help to shape expectations about the effectiveness of SPI institutions.

[5] http://www.unep.org/environmentalgovernance/LinkClick.aspx?fileticket=UQnLonMBYKQ%3D&tabid=341&language=en-US (accessed 13 Feb. 2011).

Beginning with *credibility*: on what basis are (1) the methods and procedures of a linear model-based SPI and (2) the information generated through its activities perceived to be valid? Here, Young (2004, p. 220) observes a 'built-in preferences for knowledge claims that can be justified as products of procedures conforming to mainstream conceptions of science'. According to his study of international environmental governance regimes, scientific knowledge is systematically perceived as more *credible* than, for example, traditional ecological knowledge, with greater credence granted to those 'arguments … presented in the form of scientific analyses' (Young 2004, p. 221). A normative standard for determining the credibility of linear SPI institutions is, then, the degree to which they rely on peer-reviewed scientific knowledge and preserve scientific independence from political influences.

Turning next to *relevance*: how is the work carried out within a linear model-based SPI expected to be responsive to the conditions and needs of the policy process it is intended to support? Here, *relevance* depends on the extent to which institutions are able to provide consensual, objective and universalisable (i.e. globally valid) rationales for policy action (sic. Lövbrand et al. 2009). Hajer and Wagenaar (2003) also observe a 'Russian doll' conception of political institutions in environmental governance that reflects linear model presumptions about relevance, where different organisational levels of governance are presumed to fit neatly one into the next and 'global solutions, which are then cascaded down through national, and implicitly sub-national, arenas of governance' (Bulkeley 2005, p. 879).

Finally, with respect to *legitimacy*: how are the outputs and procedures of a linear model-based SPI deemed to be fair, balanced and politically acceptable? The *legitimacy* of any SPI institution depends on links to the two life worlds from which it is constituted, i.e. science and politics (Guston 2001). With respect to politics, the linear model, with its origins in modern western philosophy, implicitly presumes a democratic politics. Here, political legitimacy is usually established through representative or delegated power, legitimised by public consent, normally through elections (Weingart 1999). With respect to science, the linear model collapses legitimacy into a more general authority, indeed responsibility, for science to 'speak truth to power.' In this way, standards for judging the legitimacy of SPI institutions are restricted to the matter of appropriate political representation, with the question of scientific legitimacy being referred back to domain of credibility, which is expected to ensure that what scientists speak to power is indeed the truth.

2.2 The complex conditions of international environmental governance

While the linear model of science-policy interrelations has served both science and politics well over the years, it is suitable only in the simplest of decision contexts (Pielke 2007)—where the issue in question 'can be adequately captured using a single perspective or description and by a standard model providing a satisfactory description or general solution through routine operations' (Gallopín et al. 2001, p. 7). In contrast, international environmental governance tends to be complex, uncertain and controversial, entailing a multiplicity of legitimate perspectives and discourses laden with conflicts over facts, interests and values. These cannot be adequately represented using a single perspective or description or by a single standard model or general solution.

Rethinking the interrelations of science and policy in this context of complexity and uncertainty, Nowotny et al. (2001, p. 21) argue that 'contemporary society is characterised—irreversibly—by pluralism and diversity' and that 'the great categorisations of the human enterprise produced by successive revolutions of modernity—scientific, political, cultural, industrial—around which the contemporary world is organised now appear to be

either in flux, eroded or socially contested'. Although science and politics are characterised by different discursive processes, rationalities, and norms (Jasanoff and Wynne 1998; Miller 2001; Pohl 2008), they are far from being sharply differentiated 'pure types' of social activities (van den Hove 2007). Instead, scientific and political practices have been shown to interact over a whole range of domains, through the constant intermingling of processes, products and actors, to the extent that scientific knowledge and political order can be understood to co-evolve (Toulmin 1990; van den Hove 2007; Nowotny et al. 2001; Jasanoff and Wynne 1998).

In international environmental governance, where there is irreducible uncertainty about the facts problem and multiple legitimate perspectives concerning what is at stake, fact claims and value judgements can no longer be meaningfully distinguished from one and the other (Funtowicz and Ravetz 1993). Addressing seemingly technical questions, such as which disciplines, methodologies, scales, variables, thresholds or boundaries should be employed to analyse, for example, a biodiversity management problem depends so heavily on how the problem is framed that the results of the scientific analysis cannot be treated as if they were isolated from their social–political (i.e. institutional) contexts (van den Hove 2007; Farrell 2005, 2008). In these situations, the production of scientific truth is more appropriately conceptualised as a concrete form of political power (sic Jasanoff 1990; Farrell 2008), wielded in complex political conditions, where there is 'uncertainty in the knowledge base, differences in framing the problem, and … inadequacy of the [linear model based] institutional arrangements at the science-policy interface' (van der Sluijs et al. 2005, p. 481). Under these conditions, new institutional structures are required, because 'the peer community reviewing the quality of a piece of scientific analysis is *automatically* extended [beyond the scientific community]' (Farrell 2011, p. 311 *emphasis added*).

2.3 Alternative models to interfacing science and policy

In recent years, a number of alternatives to the linear model have emerged.[6] Two features common to all these alternatives are: (1) questioning the presumption that there is always a clear separation between facts and value and (2) reference to some form of 'stakeholder model' (Pielke 2007, p. 14) that presumes complex interrelations between science and policy and recommends deliberation, collaborative evaluations and critiques that reach across epistemic frameworks. Here, the linear model aim of 'speaking truth to power' is replaced by the collaborative aim of 'reasoning together' -(Jasanoff 1998).

Returning to the SPI effectiveness criteria proposed by Cash et al. (2003)—credibility, relevance and legitimacy—we can now consider how these apply to a collaborative model. Starting with *credibility*: on what basis are (1) the methods and procedures of a collaborative model SPI and (2) the information generated through its activities perceived to be valid? Here, respect for complexity of both science-policy interrelations and environmental governance issues is required. As Miller and Erickson (2006, p. 300) put it, credibility can be judged here based on how well a SPI performs the 'stitching together [of] multiple knowledge systems that encompass divergent paradigms'. This requires institutional structures and processes that provide for the presence of different knowledge claims and for negotiations regarding which assumptions, choices, uncertainties and limits will be used to develop collaborative outputs (van den Hove 2007). The credibility of SPI outputs no longer depends only on technical verification of correctness (the role of conventional

[6] See for example, Jasanoff (1990), Latour (2004), Nowotny et al. (2001), Pielke (2007), Funtowicz and Ravetz (1990), Kates et al. (2001), van den Hove (2007), Farrell (2005).

scientific peer review) but also on the negotiated agreement of an extended peer community: concerned not only with factual accuracy but also with representativeness, appropriateness and relevance.

Here, 'science has exceedingly little capacity to reconcile differences in values' (Pielke 2007, p. 137). Credibility claims based on objectivity are replaced by claims based on usefulness: what Funtowicz and Ravetz (1992, p. 964) have called 'fitness for purpose'. In the complex situations of international environmental governance, characterised by conflicts over values and encumbered with inherent technical uncertainties, 'policy-makers frequently need new options, and not more science' (Pielke 2007, p. 140). With this shift, the credibility, a SPI's outputs, no longer based solely on peer review but also on the judgements of an extended peer community (sic Funtowicz and Ravetz 1990, 1992), become directly linked to its *relevance*, leading us to ask on what basis can the responsiveness of a collaborative model SPI be measured? In contrast to the linear model, which presumes the relevance of the SPI to be related to generating objectively universalisable facts that assist decision makers in 'closing down' policy debates, scholars such as Funtowicz and Ravetz (1990), Pielke (2007) and Stirling (2006) suggest a need for collaborative institutions that facilitate an 'opening up' of policy development processes: providing decision makers with 'plural and conditional advice: systematically revealing how alternative reasonable courses of action would appear preferable under different detailed 'framing assumptions' and showing how these dependencies relate to the real world' (Stirling 2006, p. 101). The presumption that scientific knowledge is automatically superior knowledge is replaced by the idea that all knowledge is conditional, positional and potentially relevant. Relevance no longer depends on reinforcing the scientific objectivity and universalisability of procedures and outcomes but on ensuring that they adequately represent the diversity of perspectives from which the policy problem can be viewed. As Jones (2002, p. 248) puts it: 'Attention needs to be turned away from trying to ascertain 'objective conditions' through more data and better science, towards understanding the plurality of constructions, how various assertions are made, how these are related to various interests of stakeholder groups and how outcomes are affected by power relations'.

As relevance becomes more closely linked to representativeness, it becomes linked to *legitimacy*. Here, we can ask on what basis might collaborative model-based institutions be perceived as fair, be balanced in their judgements and be expected to generate politically acceptable outputs? With regard to fairness, but also closely linked to the question of relevance, under a collaborative model SPIs concerned with questions of international environmental governance would need to include not only the voices of scientific experts and national representatives but also those of stateless, inter- and transnational actors with specific claims to represent *either* relevant knowledge *or* pertinent political viewpoints. Here, substantial difficulties arise regarding how to decide who may sit at the SPI table, since there is very little provision made in modern democratic theory for this type of complex, multi- and inter-scale representation (sic. Farrell 2004, 2005). While it is beyond the scope of this paper to attempt to resolve all these difficulties, which strike at the heart of modern democratic theory (sic Pellizzoni 2003; Farrell 2005), it seems clear that SPI institutions based on a collaborative model would need to move beyond the objective of negotiation and consensus building, to include formal provisions for building trust among a diverse set of actors who can not be expected to achieve parity of perspective but must nonetheless, somehow concur. Institutions reflecting a collaborative model of science-policy interrelations will require more than just representative political participation and more than just 'objective' scientific advice. Drawing on Rawls (1993) and Sen (1992), Knight and Johnson (1996, p. 296–299) argue that, in discursive democracy, political equality depends upon

equal opportunity of political influence. In the context of a collaborative model, we can understand this to mean equal access on the part of all actors to the aggregated resources of a SPI discourse, including, for example, access to *both* best available scientific and established, relevant traditional knowledge. Here, it is important to keep in mind that we are talking about a two-way project of trust and capacity building. That is to say, the legitimacy of a collaborative SPI for international environmental governance would depend not only on the ability of indigenous peoples to trust and collaborate effectively with scientists and policy-makers but also on the ability of scientists and policy-makers to trust and collaborate effectively with indigenous peoples, showing respect and regard for their knowledge claims, in spite of perhaps having difficulties understanding them.

2.4 Institutional mismatches

Recalling Young's definition of institutional mismatches (i.e. incompatibilities between the nature of a governance problem and the institutional arrangements established to address it), we suggest that there is a mismatch between the operating condition and the institutional arrangements for interfacing science and policy in international environmental governance. Specifically, we propose that arrangements based on a linear model view of science-policy interrelations are being employed in complex situations that call for use of a collaborative model view and that this undermines the credibility, relevance and legitimacy and thus the effectiveness of the associated SPIs.

Returning once again to the attributes of credibility, relevance and legitimacy, we can now consider how this mismatch plays out in practice. Starting with credibility, one of the most fundamental problems arising at the science-policy interface in international environmental governance is an inability to address adequately the increasing politicisation of science for policy (Pielke 2007; Farrell 2011; Hulme and Mahony 2010). Recalling the respective credibility criteria for the linear and collaborative models outlined earlier, it is possible to explain this inability as a symptom of the continued application of a linear model-based approach under conditions that require a collaborative model response. That is to say, in spite of much rhetoric regarding the need to open up discourse, current SPI institutions for international environmental governance, such as the Intergovernmental Panel on Climate Change (IPCC), still tend to reflect the presumption that it is always possible to distinguish clearly between facts and values and to preserve scientific independence from political influences. Because they exclude the possibility that the blurring of facts and values and politicising of scientific results is at times inevitable, linear model-based SPIs are ill-equipped to manage the political controversies that accompany the presence of a plurality of legitimate but contradictory knowledge claims (Funtowicz and Ravetz 1993; Farrell 2005). When the inevitably political character of these SPIs is not taken into account and the credibility of the outputs continues to depend on the professional standing of the contributing scientists, real political advantage is conferred on the scientific position (sic Farrell 2011). Under such conditions, it is hardly surprising that science becomes more and more used as a *tool of politics* as opposed to continuing to fulfil its traditional role of *informing policy*, with the result that 'political battles are played out in the language of science, often resulting in political gridlock and the diminishment of science as a resource for policy-making' (Pielke 2007, p. 10).

Turning next to the question of *relevance*, again we find a more or less *de facto* continuation of the linear model as a guide for the institutional design of SPI's for international environmental governance. Often the focus is on the identification of global, universal problems, with global agenda setting and general policy formulation and little

detail regarding policy implementation and analysis. This is well illustrated, e.g., in the recent evaluation of the fourth Global Environment Outlook (UNEP 2009b, p. 6), which finds that 'shifting demands for information—from problem identification … towards providing policy options' constitute a key challenge for ensuring the report's relevance. Trying to be policy relevant but not policy prescriptive, the reports generated by these SPI's tend to eschew value-laden analysis concerning how recommendations may affect people's daily lives (Pielke 2007; Norgaard 2008), focusing instead on global and universal points, which are presumed to be the appropriate domain of objective scientific advice. However, global resolution of complex issues does not automatically 'cascade' down to regional, national or local levels of social organisation, but is subject to a number of scale-related effects: e.g., differing socioeconomic and political contexts lead to different interpretations of priorities and policy instruments, compliance enforcement and knowledge systems vary from place to place, leading to different approaches to implementation (Young 2006). Failure to adequately address the sub-global level in policy development can be related to linear model thinking, which presumes that scientifically based solutions are globally relevant and thereby universally applicable. Policies developed without appreciation for how they will be evaluated, interpreted and implemented in diverse knowledge cultures, and without place-specific relevance often do not yield anticipated results. As Jasanoff and Martello (2004, p. 5) have emphasised, 'global solutions to environmental governance cannot realistically be contemplated without at the same time finding new opportunities for local self-expression'.

We also find the *legitimacy* of SPIs of international environmental governance compromised by institutional mismatches that are linked to continued reliance upon linear model-based institutional designs. Here, for example, asymmetries between how science serves particular interests in the North vs. in the South (Görg et al. 2007; Karlsson et al. 2007; Biermann 2000) illustrate how linear model-based claims to legitimacy, which are basically appeals to scientific objectivity, serve to reinforce particular political relations, thereby undermining collaborative legitimacy. Based on studies of the influence of global environmental assessments on international environmental negotiations (including the Global Biodiversity Assessment), Biermann (2000) argues that while there are situations where there is no bias in a number of instances, the influence of these assessments has been to the disadvantage of, or oblivious to, the interests of the global South. Here, reliance on the presumption that all good science is objective, equally valid and generalisable, in a situation more appropriately addressed using a collaborative model reinforces an illegitimate distribution of power. With respect to the complex problems of global environmental governance, science has lost its claim to legitimacy based on objectivity, yet power is still being vested in those who claim this scientific form of authority, perpetuating, even exacerbating the democratic deficit of international environmental governance (Miller and Erickson 2006; Biermann 2000). Indeed, the legitimacy of many prominent international institutional arrangements for interfacing science and policy has recently been called into question in, particularly by countries of the global South, for whom, as Najam (2005) argues, legitimacy is a primary concern, as they consider themselves to be systematically disempowered, marginalised and disenfranchised in global forums.

3 Attempts to address complex conditions

There is growing recognition of the need to design SPIs that engage effectively with the complexity of current global environmental problems and both cognitive and procedural

shifts towards new, complexity-sensitive ways of interfacing science and policy are evident in both science and in governance (e.g. Lubchenco 1997; UNEP 2009c). The institutional evolution of the IPCC over the past 30 years, for example, has included, for example, major revision of the review procedures and accommodation of more diverse regional sources of knowledge (Siebenhüner 2002; Hulme and Mahony 2010). Similarly, the Millennium Ecosystem Assessment (MA) and its follow-up initiative (ICSU 2008) have introduced mechanisms to allow for incorporation of traditional, indigenous and practitioners' knowledge and for execution of scale-dependent analyses (Norgaard 2007, 2008; Reid et al. 2006). Further indications of ongoing cognitive as well as structural shifts towards a more collaborative model can be seen in the more general reform of international environmental governance currently underway.[7] Important developments in this area include: (1) the Environment Watch Strategy for strengthening the scientific base of UNEP (UNEP 2009c, p. 12) and (2) the Bali Strategic Plan for Technology Support and Capacity-Building (UNEP 2005), in which the international community agreed to provide a more coherent, coordinated and effective delivery of environmental capacity building and technical support.

These reforms suggest a broad shift in global environmental governance, towards a more collaborative model of science-policy interrelations, where 'scientists [and policy-makers] use deliberative, democratic approaches in order to learn together and develop a shared understanding of complex systems' (Norgaard 2007, p. 381). However, in spite of widespread critique (Funtowicz and Ravetz 1993; Nowotny et al. 2001; Pielke 2007), the underlying assumptions of the linear model are still implicit in much of the global environmental policy discourse (Pielke 2007; Keller 2009; Owens 2005). The IPCC 'has [, for example,] come under heightened scrutiny about its impartiality with respect to climate policy and about the accuracy and balance of its reports' (IAC 2010, p. xii): criticised for being 'no longer fit for purpose … to deliver an exhaustive 'integrated' assessment of all relevant climate-change knowledge' (Hulme 2010, p. 730). Similarly, Norgaard (2008, p. 251), reflecting on his experience in the Millennium Ecosystem Assessment, proposes 'the problem is that earlier, narrow concepts about the nature of science still dominate and have structured our social organisation such that our efforts to coordinate our understanding and adapt it to the problems at hand are always seriously constrained.'

This is an expected feature of institutional mismatch situations. Young (2008) notes that established institutional paradigms can be highly resistant to change and institutional mismatches can be difficult to eliminate—even where there is general awareness of mismatches and their consequences. He proposes three causal explanation for this persistence: (1) limited systemic knowledge gives rise to 'false analogies,' assuming that institutional arrangements that are successful in one context will work well in other settings, (2) path dependency constrains institutional change as 'stakeholders become attached to the way things are done, existing social practices become routines, and the status quo turns into the default option' (Young 2006, p. 13) and (3) political resistance towards institutional change emerges as 'some actors or interest groups may well benefit, at least in the short run, from maintaining or even nurturing the growth of misfits' (Young 2008, p. 29). In ongoing attempts to address the institutional mismatches outlined above instances of all three of types of obstruction to change can be observed.

[7] This reform process was triggered by the 2000 Malmø Ministerial Declaration (UNEP 2000 Governing Council decision SS.VI/1; Annex), which called to review the requirements for a greatly strengthened institutional structure for international environmental governance, and the UN General Assembly resolution on the 2005 World Summit Outcome (General Assembly resolution 60/1 of September 2005, paragraph 169), setting the agenda for a UN system-wide coherence and reform.

As processes interfacing science and policy move towards more conceptual and methodological pluralism, Miller and Erickson (2006, p. 310) remind us to expect 'resistance among those who see the current impasse on climate change and biodiversity loss primarily in terms of either a failure by scientists to communicate the true extent and consequences of global environmental risks effectively or the unwillingness of political leaders and public to undertake necessary economic, social and political reforms'. Norgaard (2008, p. 238) goes further, predicting 'a period of great backlash where special interests are using older, narrower beliefs about science and governance to attack the new, not to replace them with the old but rather to replace rational governance with raw power politics'.[8] In the light of the emergence of these complex political/science conditions in international environmental governance, Farrell (2011, p. 311) argues, 'the question is not if, but how peer-review relationships between scientists and non-scientists can be managed in ways that favor production of good quality descriptions of complex problems'. Addressing this question, Norgaard (2008, p. 238) reminds would-be designers of SPIs 'to step back and see the big picture before developing recommendations about science and environmental governance', which is what we aim to do in the following section.

4 The IPBES a SPI for international biodiversity governance

Against the broader background presented previously, we now consider the specific case of the Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES), which the 65th session of the UN General Assembly requested be operationalised at the earliest opportunity (summarised in Table 1).[9] Final negotiations over the modalities and institutional arrangements of the IPBES will be based on the Busan Outcome, agreed in Busan, Republic of Korea in June 2010, which reflects the results of a series of three ad hoc intergovernmental and multi-stakeholder meetings held in November 2008, October 2009 and June 2010.[10] These three meetings were convened in response to international debate on how to improve interrelations between science and policy for international biodiversity governance, which have taken place against the backdrop of continuing degradation and loss of global biodiversity (Loreau and Oteng Yeboah 2006).[11]

Key issues of this debate are reflected in a gap analysis on SPI in biodiversity governance, undertaken by UNEP (2009a) and in the following comment from van den Hove and Chabason (2009, p. 3), drawn from discussion paper summarising the IPBES debate:

> 'Over the last two decades, our understanding and framing of the biodiversity issue has shifted from an approach focusing primarily on species, habitats and conservation, to a holistic approach focusing on conservation and sustainable uses of

[8] On this point see also Farrell (2008).

[9] A/RES/65/162, document A/65/436/Add.7; http://www.un.org/News/Press/docs//2010/ga11040.doc.htm (accessed 12 Feb. 2011).

[10] A first meeting was held in Putrajaya, Malaysia, in November 2008, a second meeting was held in Nairobi, Kenya, in October 2009, and a third meeting was held in Busan, South Korea, in June 2010. For more information on the IPBES process see http://www.ipbes.net.

[11] A French initiative that, during 2006 and 2007, prompted a series of studies, international and regional meetings, and statements exploring the needs, scope and options of an International Mechanism of Scientific Expertise on Biodiversity (http://www.imoseb.net); and the Millennium Assessment (MA) follow-up process, which was established as a response to the recommendations of two independent evaluations of the MA.

Table 1 Potential of the IPBES building a better SPI for international biodiversity governance

		Linear model aspects of the IPBES (based on the Busan Outcomes : UNEP 2010)	Collaborative model aspects of the IPBES (based on the Busan Outcomes : UNEP 2010)	Examples of opportunities for further improvement
Credibility	Aspects	Presumption of independent science conventional peer-review approach	Presumption that science-policy interface processes are politically and epistemologically complex commitment to rules and procedures that use of a mix of perspectives, methodological approaches and analytical and reviewing tools	Collaboration with the UN's Permanent Forum of Indigenous Peoples initiative
	Implications	Impedes potential to address politicisation of science limits capacity to understand complexity of the situation	Provides for developing ways to address the politicisation of science expands capacity to develop complex understanding of complex situations	Fosters inclusion of diverse knowledge claims
Relevance	Aspects	Strong tendency towards a centralised global structure	Focus on multiple levels of governance, and key thematic areas specific attention to questions of sustainable development, economics and social justice regard for policy implementation as an key component of the SPI work	Formalisation and resourcing of polycentric SPI networks across regions, sectors and scales
	Implications	Impedes development of suitably complex communication structures	Fosters capacity to draw on wide variety of data resources and types of knowledge fosters capacity develop information that is useful in practical, applied and operational contexts	Allows for a variety of place-specific institutional set-ups and management fosters contextual learning fosters communication and exchange across regions, sectors and scales
Legitimacy	Aspects	Capacity building seen only as western science skills training presumption that western science is superior to all other knowledge claims	Committed to facilitating effective engagement by a wide and globally representative range of actors	Link up new IPBES processes to existing regional and local environmental policy institutions include training in interdisciplinary science, knowledge brokering and sensitivity to knowledge system diversity within capacity building
	Implications	Fosters the continued marginalisation of local, indigenous and non-scientific perspectives	Provides for equality not only of status but also of opportunity to influence policy design	Enhances potential for long-term uptake and implementation of policies enhances the potential for achieving fair and balanced representations of the situations at issue

biodiversity and ecosystem services. This shift has created new challenges both for understanding and for policy-making. In particular, it generates the need to reinforce the knowledge and support available to decision makers in a manner adapted to the characteristics of the issue—i.e. complexity, multiple causalities, multiple scales and cross-sectorality—and to our governance and policy ambitions'.

Among the key findings of the UNEP (2009a, pp. 5–7), gap analysis were: (1) missing or incompletely implemented frameworks, (2) lack of regular processes providing periodic, timely and policy-relevant information and (3) insufficient coordination across the wide range of SPIs for the many multilateral environmental agreements and other bodies related to biodiversity and ecosystem services.

4.1 The IPBES' potential to address institutional mismatches

In the Busan Outcome (UNEP 2010), which is the official negotiated agreement reached during the final of the three ad hoc intergovernmental and multi-stakeholder meetings mentioned previously, it is agreed that the IPBES should 'be scientifically independent and ensure credibility, relevance and legitimacy through the peer review of its work and transparency in its decision making process' (UNEP 2010, p. 5). These presumptions, that science supporting international biodiversity governance can be independent from political influence and that conventional peer review can ensure the credibility and legitimacy of the IPBES, reflect a continuation of linear model thinking. However, the same text also proposes that the IPBES should 'use clear, transparent and scientific credible processes for the exchange, sharing and use of data, information and technologies from all relevant sources, including non-peer-reviewed literature, as appropriate' and 'recognise and respect the contribution of indigenous and local knowledge to the conservation and sustainable use of biodiversity and ecosystems' (UNEP 2010, p. 5). This reflects an appreciation for the complexity of the IPBES context and a commitment to adopt a more collaborative approach. By establishing rules and procedures that enable the recognition and judicious use of a mix of perspectives, methodological approaches and tools, and the accommodation of non-formal, undocumented and local knowledge, a collaborative IPBES can be expected to enjoy improved *credibility* and greater *legitimacy* in the complex context of global biodiversity governance because it expands both its knowledge base and the opportunities for local communities to influence its policy recommendations.

Previously we have proposed that, with regard to *relevance*, a linear model-based approach to science-policy interrelations presumes that the implementation and fairness of scientifically sound recommendations is a non-issue, since 'right' solutions are presumed to be automatically appropriate. Thus, the presence in the Busan Outcome of specific attention to questions of social justice and regional implementation reflects a more collaborative approach to the question of ensuring relevance, with the parties maintaining that biodiversity and ecosystem services are 'critically important for sustainable development and current and future human well-being, particularly with regard to poverty eradication' (UNEP 2010, p. 3) and suggesting that an IPBES should 'support policy formulation and implementation by identifying policy-relevant tools and methodologies' (UNEP 2010, p. 5). This call for the IPBES to give explicit attention to socioeconomic aspects of biodiversity and to strategies for policy implementation suggests that it will have better chances of developing institutional structures suitable for ensuring the relevance of its outputs for the complex context of global biodiversity governance.

However, also with respect to relevance, we see in the proposed IPBES only a weak basis for developing a SPI that facilitates good communication across and between the many scales and levels of the international environmental governance landscape. Although the parties to the Busan Outcome propose that 'the science-policy interface on biodiversity and ecosystem services must be strengthened at all levels' (UNEP 2010, p. 3) and that an IPBES should 'identify and prioritise key scientific information needed for policymakers at appropriate scales' (UNEP 2010, p. 3), including through global, regional and as necessary sub-regional assessments (UNEP 2010, p. 5), there is still a strong tendency in the document towards a centralised approach, more in keeping with linear model-based thinking that originally informed the structured of the IPCC. However, as Watson (2005, p. 472) argues, given the essential differences in the nature of the problems,[12] 'different social and political structures are needed to deal with global commons issues such as climate change versus issues of global concern such as biodiversity loss'. While issues such as climate change and stratospheric ozone depletion essentially require centralised global coordination to be governed effectively and equitably, for issues of biodiversity each level of governance (local, national, regional and international) requires its own set of concepts and institutions (Watson 2005; Berkes 2007). On the surface, the measures proposed in the Busan Outcome reflect an appreciation for this difference. However, since they do not commit to a setting up a collaborative SPI structure, we expect relevance will be a continuing problem for the IPBES.

Finally, with respect to *legitimacy*, the Busan Outcome states that the IPBES should 'recognise the unique biodiversity and scientific knowledge thereof within and among regions, and also recognise the need for the full and effective participation of developing countries and for balanced regional representation and participation in its structure and work' and that it should 'integrate capacity building into all relevant aspects of its work according to the priorities decided by the panel' (UNEP 2010, p. 5). On the one hand, this constitutes a clear step in the direction of opening up the biodiversity SPI to real engagement by a wide range of actors, which is in keeping with an institutional design based on a collaborative model. At present, global SPIs, relying predominantly on research results published in peer-reviewed journals of the North, 'may be less 'global' than they set out to be' (Karlsson et al. 2007, p. 680),[13] with 'global negotiations and policy [being] informed by what may be inappropriate Northern biased 'globalised' knowledge'. Karlsson et al. (2007, p. 680) argue that this asymmetry in scientific capacity eventually contributes to the imbalance in political power in international environmental governance, where the North often dominates the political agenda. Looking back over almost two decades of biodiversity governance, there is a marked tendency to focus on biodiversity conservation, primarily a Northern pre-occupation, instead of adopting a perspective directed towards sustainable use, equitable sharing of benefits and poverty eradication. The measures proposed by the IPBES have the potential to compensate for asymmetries in the abilities of

[12] Different to a *systemic* type of global change (such as climate change and stratospheric ozone depletion), where changes in the system at any locale can potentially affect its attributes anywhere else and may be caused by singular, distant and unevenly distributed human activities, global changes in biodiversity and ecosystems are for the most part *cumulative* in nature—an accumulation of changes that are local in domain which occur on a worldwide scale foremost as a consequence of widespread local human activity (e.g. economic development) (Turner et al. 1990).

[13] For example, Karlsson et al. (2007) find, when analysing scientific articles on environmental issues published in peer-reviewed journals that only thirteen per cent of these papers are based on research in ecosystems typical of the South, although such ecosystems account for more than half of the world's land area.

different actors involved in biodiversity governance, to help ensure that all the involved actors are able to critically evaluate scientifically reasoned justifications for policy choices (Miller and Erickson 2006). However, the emphasis on capacity building is primarily in terms of training people from the global South in the methods of Northern science. This is more consistent with a linear approach, adhering to the presumption that authority to speak must be derived either from political designation or scientific objectivity. In order to move beyond legitimacy principles anchored in linear model thinking, capacity building efforts would need to be expanded to include, for example, training in interdisciplinary science methods, knowledge brokering techniques and sensitivity to the global diversity of knowledge systems and to include, in particular, training for actors in the global North (see also UNEP 2009a).

4.2 Implications of the analysis

Our analysis suggests that there have been considerable efforts in designing the IPBES to embrace the complexity of what Castells (1996, p. 468) called the 'new social morphology of our [global] societies'. In many instances, the proposed IPBES reflects important elements of a more collaborative model of interfacing science and policy. However, the continuing strong presence of ideas grounded in the linear model and associated structures pulls in the other direction. Despite the fact that many, if not most, of the elements of a more collaborative model are either currently being discussed, firmly rooted in decisions already taken by the international community or could build on processes and programmes that are already in place, in many ways, the design of IPBES still reflects the modus operandi of the IPCC. In this respect, tensions arising within the process of building the IPBES can be understood to illustrate a more general struggle to develop new SPIs that address the institutional mismatches resulting from the persistence of simplistic cognitive models of global environmental governance in the context of complex conditions.

While this need not deter the IPBES design process from yielding collaborative SPI institutions, it is important to keep in mind, following Norgaard (2008, p. 247) that 'new ways of relating science to governance cannot simply be grafted onto the old philosophical underpinnings of science and governance'. To see how it may be possible to address and overcome these remnants of linear model thinking, we can return again to Young (2006, 2008) to consider the persistence of the identified institutional mismatches. As the development of the new IPBES institutions proceeds, questions need to be asked about: (1) the prevailing systemic understanding that underlies current institutional reasoning; (2) what alternative institutional configurations might help to break away from the systemic path dependencies associated with linear model thinking; and (3) the political implications of institutional changes that move an IPBES towards a more collaborative structure. Acknowledging the need to understand SPIs as institutional elements within the dimensions of power, conflict and antagonism inevitably increases their complexity and politicisation. However, ignoring it will guarantee that they 'both fail to live up to their potential as experiments in global democracy and also risk perpetuating deep-seated political inequalities and further exacerbating ideological divides in world affairs'. (Miller and Erickson 2006, p. 312)

Take for example the IPBES's potential shortcomings concerning the mobilisation of local ecological knowledge. Here, Bannister and Hardison (2006, p. 4) suggest that the key challenge is 'to move beyond merely accepting in principle the importance of traditional knowledge in policy-making related to biodiversity, to ensuring these knowledges and practices are fully considered and implemented in policy decisions in a more systematic

way'. Recently, the UN Permanent Forum of Indigenous Peoples organised a series of regional workshops (2006–2007) on the integration of traditional knowledge into relevant SPI processes, which resulted in the preparation of a guidance document on the subject (UNEP 2009a). If the IPBES were to be designed to work collaboratively, it would be in a position to take up this challenge and take advantage of a wide range of tested models and sophisticated innovative approaches to engaging local and indigenous ecological knowledge in ethical, equitable and meaningful ways.

Another opportunity to break with the linear model and move towards a more collaborative structure would be to open up the global-centric character of the IPBES's currently proposed governance structure. Here, the challenge, as stated by Gupta (2008, p. 231), is 'to match scales of explanations, processes and patterns in a realistic and effective way'. However, 'harness[ing] scale-dependent comparative advantages' (Cash and Moser 2000, p. 116) requires not only a good understanding of the different particularities of each level and of how these relate to and complement capacities at other levels but also the making of choices concerning which level(s) and across which scale(s) particular aspects of the biodiversity issue are to be addressed. These choices are neither unambiguous nor politically neutral but instead carry considerable influence in determining the types of problems that can be addressed, the actors to be involved, the modes of explanation that are allowed and the solutions that are likely to be proposed (Bulkeley 2005). Moving towards a more collaborative approach would require, as has been suggested by Jasanoff and Martello (2004), effective orchestration across scales and constant translation and deliberation back and forth across relatively well-articulated global, regional, national and local knowledge-power formations.

Stepping back to look at the overall project of setting up an IPBES and drawing on the work of Ostrom (2005) on collective-action problems, in particular, her suggestion that common-pool resources are most effectively managed by *polycentric networks*, we suggest that a collaborative model-based IPBES could be made up of a variety of institutional arrangements, each interfacing science and policy at different levels of governance and reaching across diverse regional and national contexts. In keeping with Ostrom's observations regarding common-pool resource management (Ostrom 2005; Dietz et al. 2003) and Young's (2008) observations on institutions of international environmental governance, more generally, Cash et al. (2003), looking at knowledge systems for environmental governance, have shown that it is often collaborative networks of a multiple interfaces, of various types, with complex, partly redundant and often layered institutional arrangements, that constitute the most effective configurations for managing the kinds of complex interrelations indicated by a collaborative model-based approach to SPI design. Distributing authority, resources and capacities across multiple institutions, rather than restricting them to a single central global authority, has the potential to allow for (1) greater flexibility in design and management and for adaptation to culturally appropriate styles of reasoning (improved relevance), (2) more contextual learning and deliberation in forums that are not as politically fraught as global governing institutions (improved credibility) and (3) to link up global environmental governance processes to regional and local policy institutions, enhancing the potential for long-term uptake and implementation of ideas and policies (improved legitimacy) (Miller and Erickson 2006; Berkes 2007). We expect that an IPBES based on such collaborative institutional structures, relying on institutional diversity and cross-network collaboration to collect and process knowledge about biodiversity loss, would be able to deal more effectively with the complexities of global biodiversity governance challenges because it would enjoy greater credibility, relevance and legitimacy (Cash et al. 2003; see also van den Hove and Chabason 2009).

5 Conclusions

In this paper, we set out to identify institutional mismatches in the structure of science-policy interfaces (SPIs) supporting global biodiversity governance, which we proposed impede the credibility, relevance and legitimacy of these institutions and thus also the effectiveness of international environmental governance. We have argued that institutional mismatches in these SPIs can be understood to come from continuing reliance on an inappropriate and simplistic linear model of science-policy interrelations and that an improvement in the effectiveness of current institutional arrangements could be expected to accompany a shift towards informing institutional design with a more complex, what we have termed collaborative, model of science-policy interrelations.

In evaluating the details of the planned IPBES, we have considered its potential to address the identified institutional mismatches and have found ample evidence that the IPBES could indeed constitute an important step towards adoption of collaborative model-based approach to SPI institutional design. However, we have also found that remnants of linear model-based thinking are still clearly present in the general institutional structures proposed for the IPBES. While the opportunity for an IPBES based on a collaborative model—i.e. a discursive, dynamic and polycentric network system of SPI institutions reaching across regions, sectors and scale—is there, overcoming continuing deference to underlying assumptions implicit in the older, more simplistic linear model of science-policy interrelations will not be easy.

As Young (2008) points out, institutional reform is directed by conscious action. Efforts to address institutional mismatches involve political processes and require explicit acts of institutional reform. The upcoming series of negotiations that will establish the final structure of the IPBES constitute an opportunity to adjust the cognitive models, normative structures and procedures of current institutional arrangements for interfacing science and policy in biodiversity governance. However, resistance to moving towards reliance on a collaborative model of science-policy interrelations is still evident and ideas reflecting linear model thinking continue to persist. This seems to be leading to a situation where, while the rhetoric is based on a collaborative model approach to the design of SPI institutions, the rules being established to regulate those institutions are still largely informed by thinking more in keeping with the linear approach. Hence, while there is reason to be optimistic, it seems that conscious intentional action to promote a collaborative model-based approach to institutional design will be required if the persistence of the linear model is to be overcome.

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