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Legal Techniques for Dealing with Scientific Uncertainty: The Contribution of International Environmental Law

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ABSTRACT

The article analyzes how scientific uncertainty is handled in international environmental law. The author identifies ten legal techniques used for this purpose (i.e. precautionary reasoning, framework-protocol approach, advisory scientific bodies, law-making by treaty bodies, managerial approaches to compliance, prior informed consent, environmental impact assessment and monitoring, provisional measures, evidence, and facilitated liability) and link them to four different stages of the development of environmental regimes (i.e. advocacy, design, implementation, reparation). These techniques are illustrated by reference to some fifteen environmental treaties and other instruments, as well as through a detailed case-study focusing on the climate change regime.

INTRODUCTION

Since the modern inception of international environmental law (IEL) back in the late 1960s, proponents of an international regulation of environmental issues have struggled against scientific uncertainty and economic hostility. From a political standpoint, these two obstacles have often been closely intertwined, as economic hostility has heavily relied upon the considerable scientific uncertainty underlying most environmental challenges at different stages of their understanding and recognition to downplay the legitimacy of environmental regulation. Perhaps the most prominent illustration of this latter point is provided by the historical development of the climate change regime.¹

However, even when considered objectively, scientific uncertainty remains a major obstacle to the elaboration of efficient environmental regulation. Whether it is to gain momentum for the introduction of such regulation or to design a resilient regulatory system or, still, to ensure its effective implementation or the reparation of breaches, scientific uncertainty raises daunting challenges. One interesting avenue to address these challenges has been the development of a number of legal techniques to deal with scientific uncertainty. By such legal techniques, I understand a broad array of rules, principles and mechanisms grounded on IEL that provide guidance on the steps to be taken at different stages of the development of an international regime facing scientific uncertainty. In order to better understand the operation of such techniques it is important to further specify the contours of the challenges raised by scientific uncertainty.

In its seminal work published in 1921, the economist Frank Knight introduced an important distinction between uncertainty and risk. Knight famously noted that:

"Uncertainty must be taken in a sense radically distinct from the familiar notion of Risk, from which it has never been properly separated [...] The essential fact is that 'risk' means in some cases a quantity susceptible of measurement, while at other times it is something distinctly not of this character; and there are far-reaching and crucial differences in the bearings of the phenomena depending on which of the two is really present and operating [...] It will appear

¹ See WEART, S.H., *A History of Global Warming*, Cambridge: Harvard University Press, 2007, chapters 7-9.

that a measurable uncertainty, or 'risk' proper, as we shall use the term, is so far different from an unmeasurable one that it is not in effect an uncertainty at all."²

Thus, Knight uses the term uncertainty to refer to cases in which the probability of alternative future scenarios cannot be determined, whereas the term risk is left for cases where the relative probabilities of alternative future scenarios can be determined (quantified) and at least one of these scenarios is undesirable. In the context of environmental regulation, the term uncertainty normally applies to (i) the initial identification of a phenomenon, (ii) the increasing understanding of the processes that govern it, (iii) the forecast of its likely consequences, whether positive or negative, and, as the case may be, (iv) the processes that can be triggered to manage it. It is unclear at which particular point the uncertainty surrounding a given phenomenon is sufficiently dissipated for such phenomenon to become a risk. Intuitively, one may consider that the more the predictability of a given phenomenon increases and its implications are better understood (i.e. once step (iii) is reached), the better the potential "risk" arising from this phenomenon can be circumscribed and addressed.

To take again the example of climate change, the research on climate change was initially intended to explain pre-historical ice ages (or climate modification for military purposes) rather than future global warming,³ and, for a long time, it was unable to determine with any accuracy the relative probability of alternative future scenarios.⁴ It was only with the advent and subsequent refinement of computer models that global warming technically became a risk.⁵ The policy actions accompanying the move from scientific uncertainty to the recognition of a risk followed a recognizable pattern going from the increasing allocation of research funds to the actual adoption of mitigation and adaptation measures. As I will discuss later, most of the legal techniques that have been developed in IEL focus on risks (i.e. partial scientific uncertainty) rather than on uncertainty, even those that come into play at early stages of regime development.

The purpose of this article is to survey several illustrations from IEL in order to map the techniques currently available, link them to each stage of regime development, and then discuss their operation in practice. After a brief discussion of the concept of international regimes and their dynamics (I), I analyze a number of legal techniques used to deal with scientific uncertainty at different stages of development of international environmental regimes (II) and then explore the operation of some of the techniques surveyed in the context of the climate change regime (CCR) (III).

I. REGIMES AND REGIME DEVELOPMENT

A. *The theory of regimes*

The theory of regimes is well known to both political scientists and international lawyers.⁶ I will therefore limit my survey to only those concepts that provide the basic structure underlying the analysis conducted in the following sections.

² Knight, F.H., *Risk, Uncertainty, and Profit*, Boston: Hart, Schaffner & Marx, 1921, par. II.26.

³ See WEART, S.H., *A History of Global Warming ...*, chapters 1-2.

⁴ *Id.*, chapter 6.

⁵ *Id.*; Intergovernmental Panel for Climate Change, *Fourth Assessment Report: Climate Change 2007* (hereafter "IPCC Fourth Assessment").

⁶ For useful surveys of regime theory see SIMMONS, B., STEINBERG, R. (eds.), *International Law and International Relations*, Cambridge: Cambridge University Press, 2006; ARMSTRONG, D., FARRELL, T., LAMBERT, H., *International Law and International Relations*, Cambridge: Cambridge University Press, 2007; RITTBERGER, V. (ed.), *Regime Theory and International Relations*, Oxford: Oxford University Press, 1993; HASENCLEVER, A., MAYER, P., RITTBERGER, V., *Theories of International Regimes*, Cambridge: Cambridge

The context in which regime theory emerged considerably influenced its theoretical premises. In the aftermath of the Second World War, a controversy arose between international legal scholars and political scientists regarding the effectiveness and even the very existence of international law.⁷ In such context, the theory of regimes appeared as an attempt at providing political grounding to international law or, as noted by one distinguished commentator, as an attempt at “[r]einventing international law in rational choice language.”⁸

A classical work on regime theory by Stephen Krasner defines a regime as “[a set] of implicit or explicit principles, norms, rules, and decision-making procedures around which actors’ expectations converge in a given area of international relations”⁹. This characterization raises of course further questions of definition of its main components. Krasner explains the meaning of such components as follows:

“[p]rinciples are beliefs of fact, causation, and rectitude. Norms are standards of behavior defined in terms of rights and obligations. Rules are specific prescriptions or proscriptions for action. Decision-making procedures are prevailing practices for making and implementing collective choice”¹⁰

A more detailed understanding of these concepts calls for some additional comments. First, regimes must be understood as something more than temporary arrangements or agreements that govern particular *ad hoc* questions based on short-term calculations of interest. Regimes are only relevant if they are based on something more than mere short-term calculations. There must exist some sense of general obligation, which could be compared (although not simply equated) to the legal concept of *opinio juris*.¹¹

A second observation concerns the basic distinction between principles and norms on the one hand, and rules and procedures on the other. The normative dimension or “sense of general obligation” is found above all in principles and norms. Only principles and norms provide the basic defining characteristics of a regime. Rules and procedures also enjoy some degree of normativity, but they have a hierarchically lower position in that there can be many rules and decision-making procedures that are consistent with the same

University Press, 2000. Some of the most influential work on this topic took environmental regimes as the starting-point: YOUNG, O. R., *International Cooperation: Building Regimes for Natural Resources and the Environment*, Ithaca: Cornell University Press, 1989; YOUNG, O.R., *Governance in World Affairs*, Ithaca: Cornell University Press, 1999. The theory of regimes has been criticized by other schools of international relations theory. Realists have argued that regimes are mere façades hiding power politics. Liberalists have challenged the use of the State as the analytical unit in regime theory. Constructivists have argued that regimes theory does not sufficiently take into account that institutions may shape the preferences of actors over time and therefore preferences should not be regarded as purely exogenous variables. For an overview of this criticism see DANISH, K.W., International Relations Theory, in BODANSKY, D., BRUNNÉE, J., HEY, E. (eds), *The Oxford Handbook of International Environmental Law*, Oxford: Oxford University Press, 2007, pp. 205 *et seq.*

⁷ For an insightful account of this controversy see SLAUGHTER-BURLEY, A.-M., International Law and International Relations Theory : A Dual Agenda in *American Journal of International Law*, vol. 87, 1993, pp. 205 *et seq.*

⁸ *Id.*, p. 220. Or as Robert Keohane, a political scientist, puts it: "political scientists have discovered what to lawyers seems obvious : rules structure politics", Keohane, R., International Relations and International Law : Two Optics, in *Harvard International Law Journal*, vol. 38, 1997, p. 488.

⁹ KRASNER, S., Structural causes and regimes consequences : regimes as intervening variables, in KRASNER, S. (ed.), *International Regimes*, Ithaca: Cornell University Press, 1983, p. 2.

¹⁰ *Id.*

¹¹ See the classical works of: KUNZ, J. L., The Nature of Customary International Law, in *American Journal of International Law*, vol. 47, 1953, pp. 662 *et seq.*; GUGGENHEIM, P., L'origine de la notion de l'*opinio juris sive necessitatis* comme deuxième élément de la coutume dans l'histoire du droit des gens, in *Mélanges en l'honneur de Jules Basdevant*, Pedone: Paris, 1960, pp. 258 *et seq.* In the words of Krasner "[i]t is the infusion of behaviour with principles and norms that distinguishes regime-governed activity in the international system from more conventional activity, guided exclusively by narrow calculations of interest", KRASNER, S., *Structural causes and regimes consequences ...*, p. 3.

principles and norms.¹² This said, it is often difficult to distinguish rules from norms, and it seems more realistic to think of a regime as a set of “injunctions of greater or lesser specificity.”¹³

Third, the manner in which international regimes influence State behavior is not entirely clear. There are three basic views on the issue of regime significance. One view is that no pattern of behavior can last without generating a congruent regime.¹⁴ Another view is that only political and economic power relations are relevant to understand international politics, so the concept of regimes is a mere *façade*.¹⁵ A third (intermediate) position holds that international regimes can play a considerable role in structuring States behavior but only under certain restrictive conditions.¹⁶

Thus characterized, the concept of regime has been a powerful analytical tool in both the political science and international law literature. Although international lawyers are somewhat reluctant to use the concept in its technical meaning, their writings often refer to regimes in a broader sense (such as a treaty framework or a sub-field) that largely overlaps with the technical meaning.

B. Regime development

One important contribution of the literature on regimes has been to provide a conceptual framework for the analysis of international institutions as they emerge and evolve over time. Nowadays, the concept of dynamic regimes or, in the words of Thomas Gehring, of “dynamic environmental treaty systems” is well established in both the legal and the political science literature focusing on IEL.¹⁷ The origins of the current understanding can be traced back to the seminal works of Oran Young.

In an article published in 1982, that will be later taken up and refined in his subsequent work, Young noticed that “[t]he fact that international regimes are complex social institutions makes it tempting to approach them in static terms, abstracting them from the impact of time and social change.”¹⁸ But if a regime is to operate as intended, its

¹² Extrapolating some of the concepts of systems theory Krasner says that “[c]hanges in rules and decision-making procedures are changes within regimes ... [whereas] ... changes in principles and norms are changes of the regime itself”, KRASNER, S., *Structural causes and regimes consequences ...*, pp. 3-4.

¹³ As noted by Krasner: “[s]ome [of these injunctions] are far-reaching and extremely important. They may change only rarely. At the other extreme, injunctions may be merely technical, matters of convenience that can be altered without great political or economic impact. In-between are injunctions that are both specific enough that violations of them are in principle identifiable and that changes in them can be observed, and sufficiently significant that changes in them make a difference for the behaviour of actors and the nature of the international political economy. It is these intermediate injunctions – politically consequential but specific enough that violations and changes can be identified – that I take as the essence of international regimes”, *Id.*, p. 59.

¹⁴ See the contributions of Oran Young, Raymond Hopkins and Donald Puchala in KRASNER, S. (ed.), *International Regimes*, *supra* note 9.

¹⁵ See the contribution of Susan Strange in *Id.*

¹⁶ This was the dominant position at the time of Krasner’s work and was represented by the contributions of Arthur Stein, Robert Keohane, Robert Jervis and also, though to a less extent, by those of John Ruggie, Charles Lipson and Benjamin Cohen. It should be noted that the literature on regimes has since that time evolved towards a more liberal perspective, which analyses the impact of international institutions on State behaviour.

¹⁷ See GEHRING, T., Treaty-Making and Evolution, in BODANSKY, D., BRUNÉE, J., HEY, H. (eds.), *The Oxford Handbook of International Environmental Law*, Oxford: Oxford University Press, 2007, pp. 467-497; GEHRING, T., *Dynamic International Regimes: Institutions for International Environmental Governance*, Frankfurt: Peter Lang, 1994; DOWNS, G.W., DANISH, K.W., BARSOOM, P.N., The Transformational Model of International Regime Design: Triumph of Hope or Experience?, in *Columbia Journal of Transnational Law*, vol. 38, 2000, pp. 465 *et seq.* Gehring defines such systems as “issue-specific institutional structures that are purposively established, and maintained, by their member states to govern specific areas of international environmental relations.”, *Treaty-Making and Evolution ...*, p. 468.

¹⁸ YOUNG, O. R., Regime Dynamics: The Rise and Fall of International Regimes, in *International Organization*, vol. 36, 1982, p. 278. See also YOUNG, O.R., *Governance in World Affairs*, *supra* note 6.

dynamics cannot be overlooked. Young proceeded therefore to an orderly analysis of two aspects of such dynamics, namely the patterns of “regime formation” (emergence of social institutions) and the variables explaining “regime transformation” (“significant alterations in a regime’s structures of rights and rules, the character of its social choice mechanisms, and the nature of its compliance mechanisms”¹⁹). Regarding the former, Young argued that there are three types of order, according to their different formation paths, namely spontaneous orders, negotiated orders and imposed orders. As to the forces guiding regime transformation, the author referred to three of them, namely internal contradictions, shifts in underlying power structures and exogenous forces.

The distinction between regime formation and transformation as well as some of the more specific concepts attached to these stages of a regime’s life are particularly relevant for our purpose, as they provide a set of basic categories to structure the analysis conducted in the following sections. In this regard, each of two stages identified by Young can be further subdivided into two other stages.

Thus, in the formation of negotiated regimes, namely those characterized “by conscious efforts to agree on their major provisions, explicit consent on the part of individual participants, and formal expression of the results,”²⁰ I will further distinguish between an advocacy stage (stage 1) and a design stage (stage 2). Stage 1 will cover efforts aimed at advocating the need for a regime despite the uncertainties or (at best) the poorly understood risks relating to a given issue. Stage 2 encompasses efforts at designing an international regime that can deal with scientific and technological changes. For Young, such changes can be viewed as exogenous forces or, in other words, as “societal developments external to a specific regime (treated as one among many social institutions) [which] may lead to alterations in human behavior that undermine the essential elements of the regime.”²¹ In order to avoid that such forces render an international regime partially or totally obsolete, regimes that are developed to tackle issues characterized by considerable uncertainty can incorporate mechanisms to avoid obsolescence.

Regarding regime transformation, let me note first that, unlike Young, my focus will not be on why international regimes may “fall” after they have emerged but rather on how they can subsist without becoming scientifically or technologically obsolete. I will therefore use the expression “regime implementation” which is more adapted to refer to those techniques that help manage regime stress from scientific and technological changes. Again, I will make a distinction between two additional stages, one focusing on how uncertainties are managed in the implementation of a regime (stage 3) and the other on how they are retrospectively handled in case a risk materializes (stage 4). In more simple terms, stage 3 covers activities such as monitoring, updating and compliance, whereas stage 4 focuses on reparation for damages.

The foregoing considerations are summarized in Table I:

TABLE I: STAGES OF REGIME DEVELOPMENT

Regime formation	Stage 1:	Advocating the need for a regime despite uncertainty
	Stage 2:	Designing a regime dealing with uncertainty
Regime implementation	Stage 3:	Dealing with uncertainty in regime implementation
	Stage 4:	Dealing with uncertainty in reparation

¹⁹ YOUNG, O. R., *Regime Dynamics ...*, 291.

²⁰ *Id.*, p. 283.

²¹ *Id.*, p. 294. See also SKOLNIKOFF, E., *The Elusive Transformation: Science, Technology and the Evolution of International Politics*, Princeton: Princeton University Press, 1994.

In the following sections I will survey a number of legal techniques that have been developed in IEL to tackle risk and uncertainty at different stages of the development of an international regime.

II. TACKLING SCIENTIFIC UNCERTAINTY IN THEORY: LEGAL TECHNIQUES USED IN IEL

A. Overview of the techniques

The legal techniques that have been mobilized to deal with scientific uncertainty in the field of IEL differ considerably as to their nature, legal grounding and stage of intervention. Regarding their nature, some of these techniques, such as the precautionary principle or the provisions on State or civil responsibility/liability, should be understood as principles, norms or rules in the meaning specified above. Others, such as the establishment of scientific and monitoring bodies or the framework-protocol approach, are better described as decision making processes or architectural features. Still others, such as the international mechanisms on prior informed consent and prior impact assessment, are somewhat between the two, as they impose both an international obligation and a process.

These techniques also differ with respect to their legal grounding. Indeed, whereas, for instance, the international rules on civil liability of private operators²² can be linked to formal sources of international law (custom and treaty law, respectively), the legal grounding of precautionary reasoning²³ or of the rules on the international 'liability' of the State remains uncertain.²⁴

As to the stage of intervention of these techniques, whereas some, such as the precautionary principle, are likely to be mobilized early in the process of regime development, others intervene later, respectively at the design stage (such as the framework-protocol or the establishment of advisory bodies), the implementation stage (managerial approaches to compliance, including monitoring and financial mechanisms, prior informed consent and prior impact assessment) or the reparation stage (responsibility and liability). Of course, some techniques may have a broader scope of relevance. For instance, precautionary reasoning operates not only to gather momentum for the negotiation of a regime but also as an argument guiding decisions at later stages of regime development, including when it comes to evaluating State responsibility for preventing environmental damage. Similarly, whereas advisory bodies are design features, they deploy their activity at the implementation stage. This said, for clarity reasons it seems useful to discuss each technique at the stage where it is most characteristic.

Table II provides an overview of the main legal techniques operating at each stage of regime development:

²² See, for instance, the Paris Convention on Third Party Liability in the Field of Nuclear Energy, of 29 July 1960 ("Paris Convention on Nuclear Liability"); the Convention on the Liability of Operators of Nuclear Ships, 25 May 1962; the Brussels Convention on Third Party Liability in the Field of Nuclear Energy, of 31 January 1963; Vienna Convention on Civil Liability for Nuclear Damage, of 21 May 1963 ("Vienna Convention on Nuclear Damage"); the Joint Protocol Relating to the Application of the Vienna Convention on Civil Liability for Nuclear Damage and the Paris Convention on Third Party Liability in the Field of Nuclear Energy, of 21 September 1988 ("Joint Protocol on Nuclear Liability"); the International Convention on Civil Liability for Oil Pollution Damage, of 29 November 1969 ("Convention on Oil Pollution Damage"); the International Convention on Civil Liability for Bunker Oil Pollution Damage, of 27 March 2001 ("Bunker Oil Convention"); the International Convention on Liability and Compensation for Damage in Connection with the Carriage of Hazardous and Noxious Substances by Sea, of 3 May 1996 ("HNS Convention").

²³ See McINTYRE, MOSEDALE, T., The Precautionary Principle as a Norm of Customary International Law, in *Journal of Environmental Law*, vol. 9, 1997, pp. 221 *et seq.*

²⁴ See the discussion of facilitated liability *infra*.

TABLE II: LEGAL TECHNIQUES FOR DEALING WITH SCIENTIFIC UNCERTAINTY

Stage 1: Advocacy	(1) Precautionary reasoning
Stage 2: Design	(2) Framework-protocol approach (3) Advisory scientific bodies
Stage 3: Implementation	(4) Law-making by treaty bodies (5) Managerial approaches to compliance (6) Prior informed consent (PIC) (7) Environmental impact assessment and monitoring
Stage 4: Reparation	(8) Provisional measures (9) Evidence (10) Facilitated liability

In what follows, I analyze these techniques as well as the manner in which they operate at their corresponding stage of regime development.

B. Analysis of individual techniques

(1) Precautionary reasoning²⁵

Precautionary reasoning can intervene in different forms, from a mere adage (“better safe than sorry”) to a general “approach” (as advocated by the United States) to a principle or even a rule shifting the burden of proof.²⁶ Such diversity of forms stems from the fact that precaution is a multi-layered concept, involving both a broad consensual meaning and more specific controversial ones. It is hard to disagree with the adage that it is better to prevent the occurrence of risks than dealing with them once they have occurred. But when one tries to move beyond this broad consensual meaning onto more operational characterizations of precaution controversy becomes the rule.²⁷

This is not to say that precaution has not been received in international law or in international decisions. In fact, it appears in many national and international instruments, although in different forms,²⁸ as well as in a number of decisions from international adjudicatory bodies.²⁹ Commentators have identified a number of “legal functions”

²⁵ On precaution see O’RIORDAN, T., CAMERON, J. (eds.), *Interpreting the Precautionary Principle*, London: Cameron May, 1994; FREESTONE, D., HEY, E. (eds.), *The Precautionary Principle and International Law: The Challenge of Implementation*, The Hague: Kluwer, 1996; TROUWBORST, A., *Evolution and Status of the Precautionary Principle in International Law*, The Hague: Kluwer, 2002.

²⁶ See WIENER, J.B., Precaution, in BODANSKY, D., BRUNÉE, J., HEY, H. (eds.), *The Oxford Handbook of International Environmental Law ...*, pp. 597-612. For a detailed discussion of the different meanings that can be ascribed to the precautionary principle see BODANSKY, D., Deconstructing the Precautionary Principle, in CARON, D., SCHEIBER, H.N. (eds.), *Bringing New Law to Ocean Waters*, The Hague: Brill, 2004, pp. 381-391; SANDIN, P., Dimensions of the Precautionary Principle, in *Human and Ecological Risk Assessment*, vol. 5/5, 1999, pp. 889-907.

²⁷ On the difficulties of specifying the contents of the precautionary principle see STONE, C.D., Is there a Precautionary Principle, in *Environmental Law Reporter*, vol. 31, 2001, pp. 10789-10799.

²⁸ See VANDERZWAAG, D., The Precautionary Principle in Environmental Law and Policy: Elusive Rhetoric and First Embraces, in *Journal of Environmental Law and Practice*, vol. 8, 1999, pp. 355-375.

²⁹ See BIRNIE, P., BOYLE, A., REDGWELL, C., *International Law and the Environment*, Oxford: Oxford University Press, 2009, pp. 159-164 and references cited therein.

deployed by precaution and, more specifically, by the precautionary principle. Bodansky refers to the following three functions: (i) to exclude certain justifications (such as scientific uncertainty) for inaction; (ii) to justify otherwise questionable action; (iii) to require action.³⁰ He offers several illustrations of these functions. Function (i) is embodied in broad injunction made in Principle 15 of the Rio Declaration on Environment and Development, which states that “lack of scientific certainty shall not be used as a reason for postponing cost-effective measures.” This idea also appears in a number of international instruments, including the UNFCCC (art. 3.3), the POP Convention (art. 8.7(a)) or the CBD (preamble). The Biosafety protocol to this latter convention goes a step further and provides an illustration of function (ii). Indeed, art. 11.8 of this protocol states that:

“Lack of scientific certainty due to insufficient relevant scientific information and knowledge regarding the extent of the potential adverse effects of a living modified organism on the conservation and sustainable use of biological diversity in the Party of import, taking also into account risks to human health, shall not prevent that Party from taking a decision, as appropriate, with regard to the import of that living modified organism intended for direct use as food or feed, or for processing, in order to avoid or minimize such potential adverse effects.”

This provision echoes the trade dispute between the United States and the European Community usually referred to as *Beef Hormones*,³¹ where the latter unsuccessfully sought to justify import restrictions of US beef on the basis of the precautionary principle. The same problem may arise in the area of foreign investment, when the activities of a foreign investor are restricted by the host State on precautionary environmental grounds.³² An even stricter version of the precautionary principle, illustrating function (iii), is the one found in art. 3(2) of the 1992 Baltic Sea Convention,³³ pursuant to which States:

“[...] shall apply the precautionary principle, i.e., to take preventive measures when there is reason to assume that substances or energy introduced, directly or indirectly, into the marine environment may create hazards to human health, harm living resources and marine ecosystems, damage amenities or interfere with other legitimate uses of the sea even when there is no conclusive evidence of a causal relationship between inputs and their alleged effects.”

The functions identified by Bodansky, as well as the examples reviewed, tend to focus on already existing international regimes. They remain relevant nevertheless for the analysis of how precautionary reasoning may intervene before a regime has emerged. Indeed, in many cases precautionary reasoning appears in framework conventions, which need to be supplemented by more specific regulations to actually become a regime. In these cases, precautionary reasoning will help gather momentum for such more specific rules and process to develop or at least for increasing research efforts which, in turn, will catalyze the development of such rules and processes. I will discuss the example of the climate change regime later in this article. Here, I would like to focus rather on the issue of biosafety within the more general framework of the biodiversity regime.

Throughout the 1970s, with the advances in bioengineering technologies, the economic potential of biodiversity as a natural resource (later called “biological resources”) become increasingly clear. Developing countries, far richer in biodiversity than industrialized States, soon came to realize the importance of taking control of such resources. Within the context of the efforts undertaken since the early 1980s to elaborate

³⁰ See BODANSKY, D., *Deconstructing the Precautionary Principle ...*, pp. 383-386.

³¹ *EC – Hormones*, WT/DS26/AB/R; WT/DS48/AB/R.

³² See VINUALES, J.E., *Access to Water in Foreign Investment Disputes*, in *Georgetown International Environmental Law Review*, 2009, forthcoming; VINUALES, J.E., *Conflits de normes en droit international : normes environnementales vs. protection des investissements*, in SFDI, *Le droit international face aux enjeux environnementaux*, colloque d'Aix-en-Provence, Paris: Pedone, 2010, forthcoming.

³³ Convention on the Protection of the Marine Environment of the Baltic Sea Area, 1992, referred to in BODANSKY, D., *Deconstructing the Precautionary Principle ...*, p. 386.

an umbrella convention to provide coherence to several wildlife and habitat conventions already in existence, developing countries started to advocate for the regulation of the uses of biodiversity and biotechnology. This view, initially embodied in a project elaborated under the aegis of the United Nations Environmental Program (UNEP) in the late 1980s, eventually prevailed in the negotiations towards the adoption in 1992 of the CBD, which reflects a rather utilitarian view of biodiversity somewhat between conservation and exploitation.³⁴ Throughout the 1990s, the use of genetically modified organisms (GMOs) led to increasing economic tensions between the United States, the largest user of GMO crops, and a number of European States which imported US products, in a context of scientific uncertainty as to the potential risks entailed by GMOs. Although, to date, such risks remain to be proved,³⁵ the European Community and a number of developing countries prompted the adoption of a protocol to the CBD on a precautionary basis, namely the Biosafety Protocol, also known as the Cartagena Protocol. Article 1 of the Protocol stresses this fact by making an express reference to the precautionary principle as formulated in Principle 15 of the Rio Declaration.

(2) Framework-protocol approach³⁶

The need for the progressive completion of international environmental regimes discussed in the foregoing section has been recognized since the early days of environmental regulation. The pace of such completion and refinement is given by the evolving political consensus of member States, which is in turn considerably influenced by progress in the scientific understanding of the relevant environmental issues.³⁷

A recurrent legal technique in this regard is the use of a framework-protocol approach. This approach clearly illustrates the different levels at which operate the components of a regime. Framework conventions provide for broad principles and norms, as well as for an institutional architecture for the subsequent development of the regime, while protocols (as well as COP decisions, as discussed below) embody the more specific rules and decision-making procedures necessary for the implementation of the regime.

There are different types of protocols.³⁸ Among these we find those that are based on a framework convention and are intended to spell out and implement the principles and norms set out in such convention or a section thereof. Examples of this approach in the field of IEL include *inter alia* the protocols to the 1979 Convention on Long-Range Transboundary Air Pollution, the 1987 Montreal Protocol (as subsequently adjusted/amended) to the Vienna Convention on the Ozone Layer or the Kyoto Protocol to the UNFCCC. The scope of the relations between such protocols and the underlying convention varies from case to case, and may be specified in either the convention, the protocol or both. For instance, most provisions of the Vienna Convention on the Ozone Layer expressly refer to potential future protocols. The relations between the convention and the protocols are based, in essence, on the *lex specialis* principle, as specified in several of the convention's provisions.³⁹ This point is confirmed by art. 14 of the Montreal

³⁴ See KISS, A., BEURIER, J.-P., *Droit international de l'environnement*, Paris: Pedone, 2004, p. 366, par. 729.

³⁵ UN Food and Agriculture Organization, *The State of Food and Agriculture 2003-2004* (chapter 5).

³⁶ On this topic see: DOMINICÉ, C., *Observations sur le recours à la convention-cadre en matière environnementale*, in *Mélanges en l'honneur du Professeur Bruno Schmidlin*, Basel: Helbing & Lichtenhahn, 1998, pp. 249-259; HELFER, L., *Nonconsensual International Lawmaking*, in *University of Illinois Law Review*, 2008, pp. 71-125.

³⁷ On the influence of scientific progress on policy-making see ANDRESEN, S., BIRGER SKJAERSETH, J., *Science and Technology – From Agenda Setting to Implementation*, in BODANSKY, D., BRUNNÉE, J., HEY, E. (eds), *The Oxford Handbook of International Environmental Law ...*, pp. 182-202.

³⁸ See UNEP, *Training Manual on International Environmental Law*, par. 17.

³⁹ This is mostly the case for default procedures. See *inter alia* art. 9.2 ("The text of any proposed amendment to this Convention or to any protocol, except as may otherwise be provided in such protocol, shall be communicated to the Parties by the secretariat at least six months before the meeting at which it is proposed for

Protocol, which provides that “[e]xcept as otherwise provided in this Protocol, the provisions of the Convention relating to its protocols shall apply to this Protocol”.

More importantly for the purpose of our discussion, protocols are expressly intended to incorporate new scientific and technological data. The preamble of the Vienna Convention referred indeed to “the need for further research and systematic observations to further develop scientific knowledge of the ozone layer and possible adverse effects resulting from its modification” and the general obligations appearing in art. 2 of the convention (which in turn refers to obligations arising from protocols) are qualified by art. 2(4), pursuant to which: “The application of this article shall be based on relevant scientific and technical considerations.” The feedbacks between scientific progress and regulation underlying these provisions appear more clearly in the light of the critical advances that occurred between the signature of the Vienna Convention and the adoption of the Montreal Protocol.⁴⁰ Since the mid-1970s there had been a controversy over the destruction of ozone in the stratosphere. The existence of a “hole” in the ozone layer was eventually discovered by a British team in 1985, and it was linked to emissions of chlorofluorocarbons (CFCs). This link became again controversial, as industrial groups sought to disprove that their products were harmful.⁴¹ However, the controversy was short-lived as within two years the scientific basis of the link between the emission of CFCs and ozone depletion became solidly established. Faced with these scientific breakthroughs, States parties to the Vienna Convention had little choice but to react through the adoption of the Montreal Protocol, which specifically designated the substances to be subject to control.⁴²

(3) Advisory scientific bodies

Another design feature that focuses on the need for the progressive completion of international environmental regimes as scientific knowledge evolve is the establishment of advisory scientific bodies by multilateral environmental treaties. Of course, such treaty bodies play an important role also in the implementation of the regime, as will be discussed in the next section. Here, I will focus however on the inclusion of such a component in the design phase of an international regime.

Advisory scientific bodies have been established in the context of both older and more recent multilateral environmental treaties. Aside from the one established by the UNFCCC,⁴³ other examples include the committees established under the Ramsar Convention on Wetlands of 1971,⁴⁴ the regional Convention on Long-Range

adoption”); art. 10.2 (“Except as may be otherwise provided in any protocol with respect to its annexes, the following procedure shall apply to the proposal, adoption and entry into force of additional annexes to this Convention or of annexes to a protocol ... ”); art. 11.6 (“The provisions of this Article [Settlement of disputes] shall apply with respect to any protocol except as provided in the protocol concerned.”).

⁴⁰ I follow here the discussion in WEART, S., *The Discovery of Global Warming ...*, pp. 147-148.

⁴¹ Dominicé stresses the fact that at the time of the conclusion of the Vienna Convention, the scientific aspects of the problem were still subject to controversy, DOMINICE, C., *Observations sur le recours à la convention-cadre ...*, p. 251.

⁴² The list of substances initially identified in the Montreal Protocol has been regularly expanded by means of adjustments and amendments made to this protocol.

⁴³ Art. 9(1) of the UNFCCC provides that: “A subsidiary body for scientific and technological advice is hereby established to provide the Conference of the Parties and, as appropriate, its other subsidiary bodies with timely information and advice on scientific and technological matters relating to the Convention. This body shall be open to participation by all Parties and shall be multidisciplinary. It shall comprise government representatives competent in the relevant field of expertise. It shall report regularly to the Conference of the Parties on all aspects of its work.”

⁴⁴ Convention on Wetlands of International Importance, Especially as Waterfowl Habitat, of 2 February 1971 (“Ramsar Convention”). A panel of individual volunteer experts (Scientific and Technical Review Panel –

Transboundary Air Pollution (LRTAP Convention) of 1979,⁴⁵ the CBD,⁴⁶ the Convention on Desertification,⁴⁷ the Convention on Migratory Species,⁴⁸ and the POP Convention.⁴⁹ Their function is as a rule limited to the evaluation of scientific research conducted outside of the treaty context, and not to conduct primary research.⁵⁰ They operate therefore both as an instrument for staying abreast with scientific and technological progress and as a sort of gatekeepers for the filtering of the daunting amounts of information produced by interest groups and, more generally, by the so-called “epistemic communities”.⁵¹ The composition of such bodies is often politically-sensitive in that members are either party representatives⁵² or party-nominated⁵³ and they must be geographically representative.

STRP) was established in 1993, by COP resolution 5.5, in order to provide scientific and technical guidance to the convention’s COP, Standing Committee, and Secretariat.

⁴⁵ Convention on Long-Range Transboundary Air Pollution, of 13 November 1979. Art. 10(3) of the LRTAP Convention provides that: “The Executive Body shall utilize the Steering Body for the EMEP to play an integral part in the operation of the present Convention, in particular with regard to data collection and scientific cooperation.”

⁴⁶ Art. 25(1) of the CBD provides that: “A subsidiary body for the provision of scientific, technical and technological advice is hereby established to provide the Conference of the Parties and, as appropriate, its other subsidiary bodies with timely advice relating to the implementation of this Convention”.

⁴⁷ United Nations Convention to Combat Desertification in Those Countries Experiencing Serious Drought and/or Desertification, Particularly in Africa, of 17 June 1994 (“UNCCD”). Art. 24(1) of the UNCCD provides that: “A Committee on Science and Technology is hereby established as a subsidiary body of the Conference of the Parties to provide it with information and advice on scientific and technological matters relating to combating desertification and mitigating the effects of drought.”

⁴⁸ Convention on the Conservation of Migratory Species of Wild Animals, of 23 June 1979 (“CMS” or “Bonn Convention”). Art. VIII(1) of the CMS provides that: “At its first meeting, the Conference of the Parties shall establish a Scientific Council to provide advice on scientific matters.”

⁴⁹ Stockholm Convention on Persistent Organic Pollutants, of 22 May 2001 (“POP Convention” or “Stockholm Convention”). Art. 19(6)(a) of the POP Convention provides that: “The Conference of the Parties shall, at its first meeting, establish a subsidiary body to be called the Persistent Organic Pollutants Review Committee for the purposes of performing the functions assigned to that Committee by this Convention”.

⁵⁰ See GEHRING, T., *Treaty-making and Evolution* . . . , p. 483.

⁵¹ These communities have been defined as “networks of professionals with recognized expertise and competence in a particular domain and an authoritative claim to policy-relevant knowledge within that domain or issue-area”, HAAS, P., Introduction: Epistemic Communities and International Policy Coordination, in *International Organization*, vol. 46, 1992, p. 3.

⁵² For instance, pursuant to art. 9(1) of the UNFCCC, the Subsidiary Body for Scientific and Technological Advice consists of “government representatives competent in the relevant field of expertise”. A similar composition is contemplated in art. 25(1) of the CBD for the Subsidiary Body on Scientific, Technical and Technological Advice, and in art. 24(1) of the UNCCD for the Committee on Science and Technology.

⁵³ For instance, Art. 19(6)(a) of the POP Convention provides that the membership of the Persistent Organic Pollutants Review Committee “shall consist of government-designated experts in chemical assessment or management. The members of the Committee shall be appointed on the basis of equitable geographical distribution”. The members of the Ramsar Scientific and Technical Review Panel are elected by the Standing Committee, on the basis of nominations from the parties, on the same regional proportions used in the composition of the Standing Committee. They must be experts in the scientific areas required by the STRP’s work plan and they do not act as representatives of their countries. See Resolutions 5.5 (Kushiro, 1993), VII.2 (San José, 1999) and X.9 (Changwon, 2008). This latter resolution establishes current *modus operandi* and terms of reference applicable to the STRP. Interestingly, in its paragraph 14, this resolution acknowledges the important of the input from external experts (epistemic communities) for the work under the convention: “AGREES that in other work areas indicated in the Annexes to Resolution X.10, the Panel shall seek additional expertise as and when required through various means, including through collaboration with the scientific advisory bodies of other international conventions and agencies, and through the International Organization Partners, STRP invited observers, and STRP invited experts”.

(4) Law-making by treaty bodies⁵⁴

Another important technique which intervenes at the level of both regime completion and implementation is law-making by treaty bodies and specifically by the Conference of the Parties (COP).⁵⁵ As noted by Thomas Gehring:

“Environmental treaty systems are designed to facilitate and speed up the dynamic development of substantive regulations. Frequently, obligations are tightened with growing scientific and technological knowledge about a given problem and the gradual emergence of suitable abatement strategies.”⁵⁶

COPs are given law-making powers with varying scopes by their constituting instruments. These powers can focus on:⁵⁷ (i) internal regulations (essentially procedural, financial and administrative rules),⁵⁸ (ii) substantive decision-making (refinement of the substantive obligations assumed by States parties to the treaty), and (iii) external law-making (cooperation and standard-setting).⁵⁹ For purposes of the analysis conducted in this article, categories (i) and (ii) are concerned both with the design (refinement) and the implementation of a regime, whereas category (iii) focuses mainly on implementation. Moreover, only categories (ii) and (iii) are directly relevant for dealing with scientific uncertainty.

Regarding category (ii), substantive decision-making is important for expanding the scope of the treaty obligations to respond to scientific developments. Substantive decision-making can follow basically four avenues: amendments to the treaty, amendments to an annex to the treaty, adoption of a protocol (or the amendment of its text or its annexes), and a decision of the COP. The powers of COPs vary from one avenue to the other. Least formal avenues (those that do not require ratification by State parties) have sometimes been used to adopt controversial decisions.

An apposite example is given by art. 2.9(a)(1) of the Montreal Protocol, which facilitates the “adjustment” of the ozone depleting potentials (ODP) of the controlled substances appearing in Annex A of the protocol by way of a decision of the meeting of the parties. Letters (c) and (d) of this article specify that absent consensus, such decisions can be adopted by a specific majority and are binding on all parties without need for ratification.⁶⁰ This procedure is specifically aimed at keeping abreast with scientific advances, as stated in articles 2.9(a) and 6 as well as in Annex A of the Montreal Protocol.⁶¹

⁵⁴ On this issue see BODANSKY, D., The Legitimacy of International Governance: A Coming Challenge for International Environmental Law, in *American Journal of International Law*, vol. 93, 1999, pp. 596 *et seq.*; BRUNNÉE, J., COPing with Consent: Law-making under Multilateral Environmental Agreements, in *Leiden Journal of International Law*, vol. 15, 2002, pp. 1 *et seq.*; CHURCHILL, R.R., ULFSTEIN, G., Autonomous Institutional Arrangements in Multilateral Environmental Agreements: A Little-Noticed Phenomenon in International Law, in *American Journal of International Law*, vol. 94, 2000, pp. 623 *et seq.*; ULFSTEIN, G., Treaty bodies, in BODANSKY, D., BRUNÉE, J., HEY, H. (eds.), *The Oxford Handbook of International Environmental Law ...*, pp. 877 *et seq.*

⁵⁵ See GEHRING, T., *Treaty-making and Evolution ...*, p. 479.

⁵⁶ *Id.*, p. 468.

⁵⁷ These three categories are derived with minor adjustments from ULFSTEIN, G., *Treaty bodies ...*, pp. 880-888.

⁵⁸ Examples include adoption of the rules of procedure, financial rules and the budget, exclusion or suspension of voting rights, approval of credentials and appointments, admittance of observers, etc., see CHURCHILL, R.R., ULFSTEIN, G., *Autonomous Institutional Arrangements in Multilateral Environmental Agreements ...*, p. 631.

⁵⁹ Churchill and Ulfstein speak of “external capacity” of COPs and other institutions established by multilateral environmental treaties, namely their capacity to enter into agreements with States (e.g. headquarter agreements), international organizations (e.g. for the hosting of the MEA’s secretariat), or financial institutions (e.g. in connection with the Global Environmental Facility). See *id.*, pp. 647-655.

⁶⁰ Art. 2.9(d) of the Montreal Protocol provides that: “The decisions, which shall be binding on all Parties, shall forthwith be communicated to the Parties by the Depositary. Unless otherwise provided in the decisions, they

Another more recent illustration of the use of COP decision-making powers for the updating of a regime is the decision by the COP of the POP Convention, in May 2009, to include nine new chemicals in the list of substances controlled by the convention. According to the advance report currently available, during the discussions on the inclusion of these chemicals in the annexes to the convention, several representatives noted that "such inclusions would highlight the dynamic nature of the Convention and draw attention to its objective to protect human health and the environment."⁶² It is interesting to note, in connection with the discussion of advisory scientific bodies in the preceding section, that the inclusion of these chemicals was based on the risk profile and risk management evaluation conducted by POP Review Committee, a scientific subsidiary body of the COP.⁶³

With respect to category (iii), in recent times increased attention has been paid to the search for consistency in the work of different MEA treaty bodies.⁶⁴ In this connection, a number of initiatives have been launched regrouping treaty bodies from different MEAs. For instance, the scientific bodies established under the UNFCCC, the CBD and the UNCCD collaborate closely through a joint liaison group⁶⁵ in order to find synergies in a number of issues, including scientific cooperation and capacity-building. Similarly, the parties to the Basel, PIC and POP conventions have established an Ad Hoc Working Group on Enhancing Cooperation and Coordination among the Basel, Rotterdam and Stockholm Conventions⁶⁶ focusing on implementation and capacity-building strategies.

shall enter into force on the expiry of six months from the date of the circulation of the communication by the Depositary."

⁶¹ Art. 2.9(a) takes as the basis for adjustments "the assessments made pursuant to Article 6". These assessments are those conducted to keep abreast with scientific and technological developments. Article 6 states indeed that: "Beginning in 1990, and at least every four years thereafter, the Parties shall assess the control measures provided for in Article 2 and Articles 2A to 2I on the basis of available scientific, environmental, technical and economic information. At least one year before each assessment, the Parties shall convene appropriate panels of experts qualified in the fields mentioned and determine the composition and terms of reference of any such panels. Within one year of being convened, the panels will report their conclusions, through the Secretariat, to the Parties." In a footnote to Annex A of the protocol it is expressly noted that "[the] ozone depleting potentials are estimates based on existing knowledge and will be reviewed and revised periodically." So far, there have been five such adjustments, decided at the second, fourth, seventh, ninth and eleventh meetings.

⁶² See UNEP/POPS/COP.4/38, par. 76, and Annex 1 to this report (draft decisions SC/4-10 to SC/4-18).

⁶³ Art. 6 of the POP Convention.

⁶⁴ UNEP's Governing Council decision SS.VII/1 on international environmental governance, the Informal Consultative Process on the Institutional Framework for the United Nations' Environmental Activities and the 2005 World Summit Outcome calling for reduced fragmentation on environmental issues. For an overview of the challenges of fragmentation see OBERTHÜR, S., GEHRING, T. (eds.), *Institutional Interaction in Global Environmental Governance: Synergy and Conflict among International and EU Policies*, Cambridge MA: MIT Press, 2006.

⁶⁵ On the steps leading to this collaboration see the following link to the UNFCCC website: http://unfccc.int/cooperation_and_support/cooperation_with_international_organizations/items/2533.php (visited on 7 July 2009). In November 2004, the UNFCCC secretariat prepared a Note on Options for enhanced cooperation among the three Rio Conventions (FCCC/SBSTA/2004/INF.19). By March 2006, State parties submitted their views on the options contemplated (FCCC/SBSTA/2006/MISC.4). For an update on the development of these synergies see the report of the Joint Liaison Group, of 12 September 2007, available at: http://unfccc.int/files/cooperation_and_support/cooperation_with_international_organizations/application/pdf/ilg_8_report_final.pdf (visited on 7 July 2009).

⁶⁶ The Joint Group (<http://ahjwg.chem.unep.ch/>) was established by decision SC-2/15 adopted by COP of the POP Convention at its second meeting, decision RC-3/8 adopted by the COP of the PIC Convention at its third meeting and decision VIII/8 adopted by the COP of the Basel Convention at its eighth meeting, and was entrusted with the mandate of preparing joint recommendations on enhancing cooperation and coordination among the three conventions at the administrative and programmatic levels. The Joint Group's recommendations were recently adopted by the three COPs. See UNEP/POPS/COP.4/38, par. 170-175, and Annex 1 to this report (draft decisions SC-4/34).

(5) Managerial approaches to compliance⁶⁷

Traditional approaches of international politics virtually excluded the idea of normativity as playing an important role in the stability of the international society. From the 1980s onwards, however, another view started to develop based on the assumption that “norms provide the foundation for [the] compliance process.”⁶⁸ At the roots of this view, which will come to be known as the “managerial approach” to compliance, is the proposition that States act in good faith and, as a rule, do not engage in a treaty for merely tactical reasons. Thus, as noted by three commentators “[I]f a normative consensus on an issue area exists, then much initial compliance may be motivated by this consensus rather than by treaty compliance mechanisms”.⁶⁹ It follows, for the managerial approach, that there are several means to ensure compliance other than the traditional enforcement mechanisms such as liability and responsibility. The managerial approach devotes particular attention to transparency⁷⁰ and compliance management.

Even admitting good faith and spontaneous propensity to comply as the background assumption of the compliance dynamics, the attitude of a particular State will heavily depend on both its perception of other States behavior and of its individual situation. In this context:

“[t]ransparency fosters compliance by permitting actors to co-ordinate their behavior, reassuring actors who desire to co-operate but fear being ‘suckered’, and deterring actors contemplating non-compliance. In many instances, the actor’s independent responses to these forces will assure compliance. Where strategic interaction is insufficient, transparency allows other parties to observe deviations from prescribed conduct and to require that those deviations be accounted for and justified”⁷¹.

⁶⁷ See BROWN WEISS, E., JACOBSON, H.K. (eds.), *Engaging Countries: Strengthening Compliance with International Environmental Accords*, Cambridge MA: MIT Press, 1998; CHAYES, A., HANDLER CHAYES, A., MITCHELL, R.B., *Managing Compliance: A Comparative Perspective*, in BROWN WEISS, E., JACOBSON, H.K. (eds.), *Engaging Countries ...*, pp. 39-62; CHAYES, A., HANDLER CHAYES, A., *The New Sovereignty*, Harvard University Press, Cambridge MA, 1995.

⁶⁸ CHAYES, A., HANDLER CHAYES, A., MITCHELL, R.B., *Managing Compliance ...*, p. 42. In a previous influential contribution to the compliance literature, Abraham Chayes and Antonia Handler Chayes observed that “[i]n common experience, people – whether as a result of socialisation or otherwise – accept that they are obligated to obey the law. The existence of legal obligation, for most actors in most situations, translates into a presumption of compliance, in the absence of strong countervailing circumstances. So it is with states. It is often said that the fundamental norm of international law is *pacta sunt servanda* – treaties are to be obeyed. In the United States and many other countries, they become a part of the law of the land. Thus, a provision contained in an agreement to which a state has formally assented entails a legal obligation to obey and is presumptively a guide to action”, CHAYES, A., HANDLER CHAYES, A., *The New Sovereignty ...*, p. 8. Chayes and Handler Chayes refer in this connection to the works of F. Schauer (*Playing by the Rules: A Philosophical Examination of Rule-Based Decision-Making in Law and Life*, Clarendon Press, Oxford, 1991) and F. Kratochwil (*Rules, Norms and Decisions*, Cambridge: Cambridge University Press, 1989), who have pointed out that norms are themselves “reasons for action” and as such they have an independent weight on the decision-making process. In this sense “[n]orms help define the methods and terms of the continuing international discourse in which states seek to justify their actions”, *Id.* It would otherwise be inconceivable that diplomats and government leaders spend time, effort and resources in the negotiation, drafting and signature of international treaties. Moreover, if treaties had but a formal existence, why should a country refuse to ratify a given treaty. Moreover, States usually refer to legal norms to justify their behaviour, which by the same token reinforces the legitimacy of such norms and create expectations of conformity. In short, international agreements do matter and normativity is an essential factor in the compliance dynamics.

⁶⁹ CHAYES, A., HANDLER CHAYES, A., MITCHELL, R.B., *Managing Compliance ...*, p. 42.

⁷⁰ Chayes, Handler Chayes and Mitchell define transparency as “the adequacy, accuracy, availability, and accessibility of knowledge and information about the policies and activities of parties to the treaty, and of the central organisations established by it on matters relevant to compliance and effectiveness, and about the operation of the norms, rules, and procedures established by the treaty”, *Id.*

⁷¹ *Id.*, p. 43.

In other words, transparency is crucial to foster co-ordination, reassurance and deterrence. Although these three dimensions are closely related to each other,⁷² it is mainly the co-ordination problem that arises in connection with scientific uncertainty. Indeed, in some cases, developing countries lack the scientific capabilities to comply with an international regime, despite their inclination to do so. This was, for instance, a major component of the recent discussions at COP 4 of the POP Convention on the desirability of including nine new chemicals to the lists of controlled substances, and led to the adoption of a decision to increase the capabilities of such States.⁷³ Basic obligations such as inventorying and reporting may require scientific and technological capabilities that many countries do not have, and transparency cannot be build up without such basic obligations being reasonably fulfilled.⁷⁴ This is why, financial, technology transfer and capacity-building mechanisms are of paramount importance both generally for the implementation of a regime⁷⁵ and specifically for dealing with scientific and technological advances.

In such cases, the mere imposition of sanctions would be of little effect either in the short or in the longer term. Adversarial or accusatory models would thus be less suitable than an approach that understands compliance as an ongoing process of compliance management.⁷⁶ A more flexible and less suspicious approach should first be applied in

⁷² There are many cases in which States are far more interested in finding a uniform guide of behaviour than in the precise content of this guide. In such cases, usually referred to as «pure co-ordination problems», State's spontaneous propensity to comply will easily unleash if a good understanding of the rules is made possible. Thus, "[i]n a situation where the incentives for co-operative action are strong, little more may be needed than transparency of the rule system itself to induce compliance", *Id.*, p. 137. Co-ordination problems are however more complex than this simple logic may show. Many times, actors otherwise inclined to comply may fear to be put at a disadvantage if their complying behaviour is not matched by others. In this case, transparency can provide the necessary reassurance for spontaneous compliance to develop. In this context, transparency can be very useful because it "reassures parties that others are meeting their obligations; and if they are not, it permits a timely response", *Id.*, p. 44. But transparency does not only reassure those parties willing to comply, it also deters potential deliberate breaches. The more breaches are easily discovered, the more they are easily and immediately punished either by the system (if a central mechanism of sanctions is established) or by other States (unilaterally or collectively). Thus, transparency makes more difficult for deliberate defectors to get away with it. Here again, the managerial approach borrows rational choice arguments to endorse its propositions.

⁷³ See UNEP/POPS/COP.4/38, par. 77 and 103 reporting that "During the discussions under each chemical, some representatives noted the implications for developing countries and countries with economies in transition of listing new chemicals in the Convention. Observing that some of those countries were currently facing difficulties implementing the Convention, they pointed out that the addition of nine chemicals raised further financial and technical challenges. One representative said that while some technical and financial assistance had been provided it was insufficient to ensure the requisite capacity-building to meet the obligations of the Convention: the addition of new chemicals would only increase an already heavy burden. Another representative argued that financial and technical assistance should be comprehensive, adequate and foreseeable so as to help developing countries in their efforts to manage stocks and wastes and to process and treat contaminated areas [...] In the light of the discussion above on the inclusion of new chemicals in the annexes to the Convention, in particular in respect of the challenges that developing country Parties and Parties with economies in transition would face in implementing their obligations under the Convention with regard to such chemicals, the Conference agreed to entrust the Secretariat with preparation of a draft decision for consideration by the Conference on a programme of work aimed at helping Parties to meet those obligations." The draft decision appears in Annex 1 to the report (draft decision SC/4-19).

⁷⁴ The text of the draft decision SC/4-19 makes this link clear by referring in its preamble to the obligations of the Parties (particularly in art. 6) and to the need to render "timely and adequate technical assistance" pursuant to art. 12(1) of the POP Convention, see UNEP/POPS/COP.4/38, Annex I, draft decision SC/4-19.

⁷⁵ See BOISSON DE CHAZOURNES, L., Technical and Financial Assistance and Compliance: the Interplay, in BEYERLIN ... (eds.), *Ensuring Compliance with Multilateral Environmental Agreements*, 2006, pp. 273 *et seq.*

⁷⁶ This latter concept involves essentially three components: "1. Reviewing and assessing the performance of the parties in order to identify problems with the regime itself and to distinguish intentional violations from other types of non-compliance; 2. Ensuring that appropriate responses to non-compliance and violations produce and maintain a level of compliance acceptable to the regime parties; 3. Adjusting the rules to improve regime performance", CHAYES, A., HANDLER CHAYES, A., MITCHELL, R.B., *Managing Compliance ...*, p. 44.

order to identify the real causes of non-compliance and take suitable decision. As Chayes, Chayes and Mitchell put it :

“Although effective regime management requires distinguishing willful violation from unintentional non-compliance, the process starts with the assumption that all regime members are engaged in a common enterprise. Initially, assessments seek to discover how to improve individual and system performance. Secretariats and other parties give states ample – sometimes, it seems, excessive – opportunities to explain and justify their conduct. Technical or financial assistance may be provided. Promises of improvement contain increasingly concrete, detailed, and measurable undertakings. If resistance persists, however, states and the secretariat may take more confrontational stances and intensify pressures for compliance. This process creates pressures to correct suspect conduct attributable to inadvertence, misunderstanding, or inattention while identifying, exposing, and isolating deliberate offenders”⁷⁷

Thus, there is sort of transition phase that defines the type of violation and the more suitable response. If States are initially presumed to act in good faith, this presumption can be progressively reversed and the process may lead to the imposition of sanctions. This process is essentially interactive and aims at both affecting States’ behavior and adjusting or, if needed, revising some rules of the regime. An interesting illustration of this process is given by the Basel Convention regime.⁷⁸ Article 4(2) of the convention reflects the view that transboundary movements of hazardous wastes can be reduced not only by more stringent export controls but also through a reduction of waste generation at the source country as well as through local management and disposal of wastes. This in turn requires the building up of adequate capabilities in those States where the necessary technology is not available.⁷⁹ And, where the lack of such capabilities leads to non-compliance, the initial response takes the form of an inquiry into the root causes of such non-compliance and, if appropriate, technical and performance reporting assistance is provided.⁸⁰ If such assistance does not yield the expected results, the implementing committee can either provide additional assistance or issue a cautionary statement.⁸¹

⁷⁷ *Id.*

⁷⁸ Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal, of 22 March 1989 (“Basel Convention”).

⁷⁹ Art. 14(1) of the Basel Convention provides that: “The Parties agree that, according to the specific needs of different regions and subregions, regional or sub-regional centres for training and technology transfers regarding the management of hazardous wastes and other wastes and the minimization of their generation should be established [...]”.

⁸⁰ In 2002, the COP of the Basel Convention established a Mechanism for Promoting Implementation and Compliance (Decision VI/12), as a subsidiary body in the meaning of art. 15(5)(e). Art. 9 of the terms of reference (ToR) of the implement committee allows for a non-compliance procedure to be launched by the non-complying party, other party or the Secretariat. Pursuant to art. 19 of the ToR, in the “facilitation procedure” thus instituted the committee will seek to “[determine] the facts and root causes of the matter of concern and, assist in its resolution. As part of this process, the Committee may provide a Party, after coordination with that Party, with advice, non-binding recommendations and information relating to, inter alia [...] (b) Facilitation of assistance in particular to developing countries and countries with economies in transition, including on how to access financial and technical support, including technology transfer and capacity-building”.

⁸¹ Art. 20 of the ToR provides: “ If, after undertaking the facilitation procedure in paragraph 19 above and taking into account the cause, type, degree and frequency of compliance difficulties, as well as the capacity of the Party whose compliance is in question, the Committee considers it necessary in the light of paragraphs 1 and 2 to pursue further measures to address a Party’s compliance difficulties, it may recommend to the Conference of the Parties that it consider: (a) Further support under the Convention for the Party concerned, including prioritization of technical assistance and capacity-building and access to financial resources; or (b) Issuing a cautionary statement and providing advice regarding future compliance in order to help Parties to implement the provisions of the Basel Convention and to promote cooperation between all Parties.”

(6) Prior informed consent⁸²

An implementation difficulty related to the one discussed in the preceding paragraph, is the ability of developing countries to effectively manage, in addition to hazardous wastes, pesticides and industrial chemicals exported to their countries. Again, this is above all a matter of both administrative and scientific/technological capabilities. As noted in the report of the Commission on Environment and Development :

“Third World importers have no way to effectively control trade in chemicals that have been banned or severely restricted in exporting countries. Thus these countries badly need the infrastructure to assess the risks associated with chemical use”⁸³

The prior informed consent (PIC) mechanism as it later came to be known was a legal technique developed to deal with this difficulty. PIC must be viewed as both a principle and a procedure. As a principle, PIC has two main dimensions. First, “a requirement that when one State plans to operate in another State [...] it must seek that State’s prior informed consent”⁸⁴. Second, “a requirement emanating from indigenous rights that communities, particularly indigenous communities, have the right to give (or withhold) their free, prior informed consent to activities that affect them”.⁸⁵ It is the first dimension of the PIC principle that is relevant for our analysis.

It is unclear whether this principle has customary status in international law. Whether or not this is the case, the obligation of not only notifying but also obtaining the “informed consent” of another State appears in a number of multilateral environmental agreements in connection with specific activities.⁸⁶ Thus, under article 6(4) of the Basel Convention, transporting hazardous wastes through the territory of another State is subject to a PIC obligation. Similarly, art. 15(5) of the CBD, subjects the prospection for genetic resources in the territory of another State to a PIC obligation. Another more general example is provided by the system of the 1998 PIC Convention, which subjects to a PIC obligation exports of domestically banned or severally restricted chemicals that have been included in the convention’s Annex III (which currently covers 25 pesticides, 4 severely hazardous pesticide formulations and 11 industrial chemicals).

Such agreements spell out the PIC obligation by establishing a specific procedure to be followed, including, as the case may be, details as to infrastructure that must be set up domestically, the information to be provided to the importing State or the steps to be taken in case the importing State does not answer. The origins of the PIC procedure are to be found in the voluntary guidelines elaborated under the aegis of UNEP and the FAO.⁸⁷ Despite some differences in scope, the 1985 FAO International Code of Conduct on the Distribution and Use of Pesticides (the “Code”)⁸⁸ and the 1987 UNEP London Guidelines for the Exchange of Information on Chemicals in International Trade (the “Guidelines”),⁸⁹

⁸² On this issue see KRUEGER, J., *Information in International Environmental Governance: The Prior Informed Consent Procedure for Trade in Hazardous Chemicals and Pesticides*, Discussion Paper 2000-16, Kennedy School of Government, Harvard University, September 2000; KRUEGER, J., Prior Informed Consent and the Basel Convention: The Hazards of What Isn’t Known, in *Journal of Environment & Development*, vol. 7/2, 1998, pp. 115-137.

⁸³ World Commission on Environment and Development, *Our Common Future*, Annex to UN Doc. A/RES/3/217 A, p. 225.

⁸⁴ HUNTER, D., SALZMAN, J., ZAELEKE, D., *International Environmental Law and Policy*, 3rd edn., New York: Foundation Press, 2007, p. 528.

⁸⁵ *Id.*

⁸⁶ *See Id.*, p. 529.

⁸⁷ See MEKOUAR, M.A., Pesticides and Chemicals – The Requirement of Prior Informed Consent, in SHELTON, D. (ed), *Commitment and Compliance. The Role of Non-Binding Norms in the International Legal System*, Oxford: Oxford University Press, 2000, 146-163.

⁸⁸ Adopted by the FAO Conference by Res. 10/85 of 28 November 1985.

⁸⁹ Decision 15/30 of the Governing Council of UNEP of 25 May 1989.

both as amended in 1989, characterized PIC as a principle to be implemented by a specific procedure. Indeed, with some minor differences in wording (reflecting differences in substantive scope), art. 2 of the Code and paragraph 1(g),(h) of the Guidelines characterized PIC as:

“the principle that international shipment of a pesticide [or] a chemical that is banned or severely restricted in order to protect human health or the environment should not proceed without the agreement, where such agreement exists, or contrary to the decision of the designated national authority in the participating importing country”⁹⁰

In turn, the implementing procedure was characterized as: “the procedure for formally obtaining and disseminating the decisions of importing countries as to whether they wish to receive future shipments of pesticides [or] chemicals that have been banned or severely restricted.”⁹¹ The voluntary procedure established in the Code and the Guidelines was operational until February 2006, when the PIC Convention entered into force making the obligations constituting the PIC procedure legally binding.

(7) Environmental impact assessment and monitoring⁹²

Another technique that must be viewed as both a principle and a procedure is the environmental impact assessment (EIA) and monitoring of projects/activities⁹³ and plans/programmes⁹⁴ with potentially adverse environmental repercussions. EIAs seek to circumscribe *ex ante* the environmental risks created by such projects in order to assess the desirability of pursuing them. Such exercises are often difficult due to the considerable scientific uncertainties that must be overcome to circumscribe a “risk”. For this reason, they are often supplemented by the monitoring of the environmental risks anticipated as work on the project develops.

The scope and legal grounding of the so-called principle of EIA are not totally clear. References to the need to conduct an EIA prior to undertaking certain projects appear in both domestic⁹⁵ and international treaty law.⁹⁶ International soft law instruments also

⁹⁰ MEKOUAR, M.A., *Pesticides and Chemicals ...*, pp. 146-147.

⁹¹ *Id.*, p. 147.

⁹² On this topic see CRAIK, N., *The International Law of Environmental Impact Assessment*, Cambridge: Cambridge University Press, 2008; HOLDER, J., MCGILLIVRAY, D. (eds), *Taking Stock of Environmental Assessment: Law, Policy and Practice*, London: Routledge, 2007; GLASSON, J., THERIVEL, R., CHADWICK, A., *Introduction to Environmental Impact Assessment*, 2nd edn., London: UCL Press, 2005; WOOD, C., *Environmental Impact Assessment: A Comparative Review*, 2nd edn., Harlow: Longman, 2003; THERIVEL, R., PARTIDARIO, M.R. (eds.), *The Practice of Strategic Environmental Assessment*, London: Earthscan, 1996.

⁹³ See Appendix 1 to the UNECE Convention on Environmental Impact Assessment in a Transboundary Context of 25 February 1991 (also known as the “Espoo Convention”) lists the activities to which EIA shall apply. These include energy production utilities, metal smelters, chemical installations, motorway projects, trade and inland ports, waste disposal installations, large dams, pulp and paper mills, mining, etc., with some specifications.

⁹⁴ The Protocol on Strategic Environmental Assessment to the Espoo Convention, of 21 May 2003 (also known as the “SEA Protocol” or “Kiev Protocol”), will intervene (once in force) at a much earlier phase of the decision-making process than EIAs and focuses on “plans and programmes” or, in other words, on economic policies. I will come back to the relevance of this point in the discussion of the importance of this technique for dealing with scientific uncertainty.

⁹⁵ See UNECE, *Current Policies, Strategies and Aspects of Environmental Impact Assessment in a Transboundary Context*, 1996 (ECE/CEP/9), pp. 1 *et seq.*

⁹⁶ In addition to the Espoo Convention, see also art. 14 of the CBD, art. 4(1)(f) of the UNFCCC; art. 206 of UNCLOS; arts. 37(7)(d)-(e), 39(2)(c), and 54(3)(b) of the Wellington Convention on the Regulation of Antarctic Mineral Resources Activities of 2 June 1988; art. 14 of the ASEAN Agreement on the Conservation of Nature and Natural Resources of 9 July 1985; art. 13 of the Protocol Concerning Specially Protected Areas and Wildlife of 18 January 1990 (SPAW), and art. 8 of the Protocol for the Conservation and Management of Protected Marine and Coastal Areas of the South-East Pacific of 21 September 1989.

mention this principle.⁹⁷ For instance, Principle 17 of the Rio Declaration states that: "Environmental impact assessment, as a national instrument, shall be undertaken for proposed activities that are likely to have a significant adverse impact on the environment and are subject to a decision of a competent national authority." The principle and its link to environmental monitoring were also mentioned in the separate opinion of Judge Weeramantry in the case concerning the Gabčíkovo-Nagymaros Project.⁹⁸ The question of whether such principle is grounded in customary international law or not remains however unsettled and significantly depends upon the scope which is assigned to the principle (national, transboundary, global).⁹⁹ For the purposes of this article, however, this latter point is less important than the analysis of how EIA and monitoring is in fact used to deal with scientific uncertainty. This take us from EIA as a principle to EIA as a procedure.

The procedure varies considerably according to the underlying legal instrument. Some procedures involve only a few steps (preliminary assessment followed, if necessary, by a full EIA),¹⁰⁰ whereas others entail multiple steps and sometimes several EIAs.¹⁰¹ Similarly, the degree of public involvement in the EIA process also varies, ranging from privately conducted EIAs with more or less room for the intervention of public stakeholders to EIAs conducted by public inspectors.¹⁰² The contents of EIAs may also differ from one context to the other. For instance, art. 4(1) and Appendix II to the Espoo Convention require the following minimum contents:

- (a) A description of the proposed activity and its purpose ;
- (b) A description, where appropriate, of reasonable alternatives (for example, locational or technological) to the proposed activity and also the no-action alternative ;
- (c) A description of the environment likely to be significantly affected by the proposed activity and its alternatives ;
- (d) A description of the potential environmental impact of the proposed activity and its alternatives and an estimation of its significance ;
- (e) A description of mitigation measures to keep adverse environmental impact to a minimum ;
- (f) An explicit indication of predictive methods and underlying assumptions as well as the relevant environmental data used ;
- (g) An identification of gaps in knowledge and uncertainties encountered in compiling the required information ;
- (h) Where appropriate, an outline for monitoring and management programmes and any plans for post-project analysis ; and
- (i) A non-technical summary including a visual presentation as appropriate (maps, graphs, etc.).

These variations in the formulation of EIAs as to their number of steps, the degree of public involvement and their minimum contents are directly relevant for our purpose of

⁹⁷ See UNEP's Principles on Shared Natural Resources (1978), principle 4; UNEP Goals and Principles of Environmental Impact Assessment (1987); Principle 17 of the Rio Declaration; Agenda 21, Report of the UN Conference on Environment and Development, UN Doc A/CONF 151/26/Rev 1 (chapter 8.4(d)); art. 7 of the ILC Draft Articles on the Prevention of Transboundary Harm from Hazardous Activities (2001).

⁹⁸ Judge Weeramantry noted that: "Environmental law in its current state of development would read into treaties which may reasonably be considered to have a significant impact upon the environment, a duty of environmental impact assessment and this means also, whether the treaty expressly so provides or not, a duty of monitoring the environmental impacts of any substantial project during the operation of the scheme", Gabčíkovo-Nagymaros Project (Hungary/Slovakia), Separate opinion of Judge Weeramantry, p. 112. On the context of this opinion see: VINUALES, J.E., The Contribution of the International Court of Justice to the Development of International Environmental Law, in *Fordham International Law Journal*, vol. 32/1, December 2008, pp. 244-253.

⁹⁹ For recent surveys of this question see: HUNTER, D., SALZMAN, J., ZAELKE, D., *International Environmental Law ...*, pp. 531-533; BIRNIE, P., BOYLE, A., REDGWELL, C., *International Law and the Environment ...*, pp. 164-175.

¹⁰⁰ See art. 8 and Annex I of the Protocol on Environmental Protection to the Antarctic Treaty, of 4 October 1991, referred to by BIRNIE, P., BOYLE, A., REDGWELL, C., *International Law and the Environment ...*, p. 174.

¹⁰¹ *Id.*

¹⁰² *Id.*

understanding the role of EIAs in dealing with scientific uncertainty. Regarding steps, the higher the complexity and the longer the lifespan of a project, the higher the scientific uncertainty involved in the assessment of the risks presented by it. This explains why in such cases multiple EIAs may be conducted at different stages of the development of the project, as a form of monitoring its evolving environmental repercussions as well as the evolving scientific understanding of such repercussions. With respect to the degree of public involvement in and the minimum contents of EIAs, the aforementioned variations suggest that EIAs serve two different functions. The first is to circumscribe the environmental risks involved in undertaking or pursuing a project in the light of the scientific and technological knowledge at the time the EIA is conducted. The second is to legitimize, not only scientifically but also politically, the pursuit of a given initiative.

This second function can be illustrated by reference to the so-called strategic environmental assessments or “SEAs”, which focus on strategic policies even before any concrete action has been taken to implement them. Art. 4(2) of the SEA Protocol to the Espoo Convention will, once in force, require State parties to conduct:

“[a] strategic environmental assessment [...] for plans and programmes which are prepared for agriculture, forestry, fisheries, energy, industry including mining, transport, regional development, waste management, water management, telecommunications, tourism, town and country planning or land use, and which set the framework for future development consent for projects [... that require ...] an environmental impact assessment under national legislation”¹⁰³

Here, the emphasis of the environmental assessment is clearly on the desirability of a political choice rather than on the specific ecological processes that may be disturbed by pursuing a given project or activity. Although the scientific assessment of such policy choices remains important, it is relegated to a secondary position, behind the policy’s political desirability. This prioritization of the social function of environmental assessments is not only a feature of SEAs but also affects, to a significant extent, the more traditional EIAs of projects. This latter point is suggested by the case-law on the judicial review of EIAs. Whereas in the international trade context, the (quasi)judicial review of domestic risk assessment seems to be admitted,¹⁰⁴ the picture that emerges from the domestic case-law

¹⁰³ See art. 4(2) and Appendixes I and II to the SEA Protocol.

¹⁰⁴ Indeed, in the *EC – Hormones* case, the panel had considered that the risk assessment referred to in art. 5.1 of the SPS Agreement was a scientific examination of data and factual studies, as opposed to a policy exercise involving social value judgments (Panel report, par. 8.94). When reviewing the panel’s report, upon appeal by the EC, the WTO Appellate Body gave a broader interpretation of risk assessments and their relationship to SPS measures. It noted, in particular, that: “We do not believe that a risk assessment has to come to a monolithic conclusion that coincides with the scientific conclusion or view implicit in the SPS measure. The risk assessment could set out both the prevailing view representing the “mainstream” of scientific opinion, as well as the opinions of scientists taking a divergent view. Article 5.1 does not require that the risk assessment must necessarily embody only the view of a majority of the relevant scientific community. In some cases, the very existence of divergent views presented by qualified scientists who have investigated the particular issue at hand may indicate a state of scientific uncertainty. Sometimes the divergence may indicate a roughly equal balance of scientific opinion, which may itself be a form of scientific uncertainty. In most cases, responsible and representative governments tend to base their legislative and administrative measures on “mainstream” scientific opinion. In other cases, equally responsible and representative governments may act in good faith on the basis of what, at a given time, may be a divergent opinion coming from qualified and respected sources. By itself, this does not necessarily signal the absence of a reasonable relationship between the SPS measure and the risk assessment, especially where the risk involved is life-threatening in character and is perceived to constitute a clear and imminent threat to public health and safety. Determination of the presence or absence of that relationship can only be done on a case-to-case basis, after account is taken of all considerations rationally bearing upon the issue of potential adverse health effects.” (WT/DS26/AB/R; WT/DS48/AB/R, Panel Report circulated on 16 January 1998, par. 194). However, the Appellate Body concluded that the EC had not conducted an assessment in the meaning of art. 5.1 and 5.2 of the SPS Agreement, and confirmed the decision of the panel in this regard (par. 208). The possibility of reviewing the sufficiency of a risk assessment has been confirmed by the Appellate Body in *Japan – Apples* (WT/DS245/AB/R,

depicts EIAs as a tool “to assist the decision-maker and alert the public”,¹⁰⁵ rather than as comprehensive scientific assessments of the environmental risks.

This is not to say that this technique is not relevant for dealing with scientific uncertainty, even beyond the international trade context. As decision-making tools, EIAs play a significant advocacy role (gathering support, both socially and scientifically) either in favor or against a particular project or activity. Two apposite cases in this regard are the *Pulp Mills* dispute between Argentina and Uruguay before the ICJ¹⁰⁶ and *MOX plant* cases and arbitrations.¹⁰⁷ In both cases, the respective claimants raised the potential insufficiency on the EIA conducted by the respondent State and requested provisional measures on the basis of precautionary reasoning. Although the measures requested were not granted,¹⁰⁸ one interesting element that can be derived from these decisions is that, as in the international trade context, the minimum content of an EIA appears to reflect upon its scientific authoritativeness, which in turn may pave the way for either the judicial review of the measures taken on the basis of a deficient EIA or the grant of provisional relief.

(8) Provisional measures¹⁰⁹

Provisional measures intervene a step further than the techniques so far reviewed, at what has been characterized as the reparation stage. Such measures are, of course, not specific to IEL and are found in most areas of domestic, arbitral and international adjudication. They are however particularly relevant in the context of IEL, where damages are difficult to assess and full reparation can seldom be achieved. Therefore, in dealing with the conformity of a given set of acts with IEL it may sometimes be important to take preventive action before the merits of a dispute are fully assessed. Such was the argument of Argentina in its Request for the Indication of Provisional Measures in the *Pulp Mills* case as well as of Ireland in the *MOX plant* cases.

Regarding the *Pulp Mills* case, in its request of 4 May 2006, Argentina argued *inter alia* that the suspension of the construction authorizations issued by Uruguay to two pulp mills was necessary to prevent potentially irreparable damage to the ecosystem of the river Uruguay and the quality of its waters.¹¹⁰ In its Order of 13 July 2006, the Court recalled

26 November 2003), par. 202. In *EC – Biotechnology*, the WTO Panel found that the general moratorium applied by several EC countries was not justified under art. 5.1 of the SPS Agreement because it was not based on a sufficient risk assessment (WT/DS291, WT/DS292, WT/DS293, Panel Report circulated on 29 September 2006).

¹⁰⁵ See BIRNIE, P., BOYLE, A., REDGWELL, C., *International Law and the Environment ...*, p. 175, referring to: *Prineas v. Forestry Commission of New South Wales*, 49 IGERA (1983) 402; *Belize Alliance of Conservation Non-Governmental Organizations v. Department of Environment*, UKPC (2003) No. 63; *Marsh v. Oregon Natural Resources Council*, 490 US 360 (1989); *Robertson v. Methow Valley Citizens Council*, 490 US 332 (1989).

¹⁰⁶ *Pulp Mills on the River Uruguay* (Argentina v. Uruguay), Order on the Request for the Indication of Provisional Measures, of 13 July 2006 (“*Pulp Mills Order*”).

¹⁰⁷ The *MOX plant* case involves proceedings before four different fora, namely an arbitral tribunal under the OSPAR Convention, the ITLOS, an arbitral tribunal under Annex VII to UNCLOS, and the European Court of Justice. Here, I am only concerned with Ireland's requests for interim relief before ITLOS and the Annex VII Tribunal. See: *The Mox Plant Case* (Ireland v United Kingdom)(Provisional Measures) ITLOS Case No 10, decision of 3 December 2001 (“*MOX plant ITLOS Order*”); *The Mox Plant Case* (Ireland v United Kingdom), Annex VII Tribunal, Procedural Order No. 3 of 24 June 2003 (“*MOX Plant PO 3*”).

¹⁰⁸ See discussion *infra* point (8).

¹⁰⁹ On this topic see: ROSENNE, S, *Provisional Measures in International Law*, Oxford: Oxford University Press, 2005.

¹¹⁰ See *Pulp Mills, Request for the Indication of Provisional Measures submitted by Argentina on 4 May 2006*, par. 9 and 13. The original French texts run as follows: “9. La construction et la mise en service éventuelle des usines de pâte à papier certainement causent et sont susceptibles de causer des dommages à l'environnement de nature irréversible du fait de l'impact potentiel sur tout l'écosystème du fleuve Uruguay et sur la qualité de ses eaux. De tels dommages de nature irréversible annihileraient le droit de l'Argentine et de ses ressortissants à une exploitation et une utilisation rationnelles, équitables et raisonnables des ressources du fleuve [...] 13. Sans l'adoption des mesures conservatoires demandées, la mise en service des usines CM33 et Orion avant qu'un arrêt définitif soit rendu

with reference to its previous case-law that its power to indicate provisional measures was to be exercised “only if there is an urgent need to prevent irreparable prejudice to the rights that are the subject of the dispute before the Court has had an opportunity to render its decision.”¹¹¹ It then recognized Argentina’s concern to protect its natural environment and the quality of the water of the river Uruguay,¹¹² but concluded that there was “nothing in the record to demonstrate that the very decision by Uruguay to authorize the construction of the mills poses an imminent threat of irreparable damage to the aquatic environment of the River Uruguay.”¹¹³ Similarly, in the MOX plant case, Ireland argued before the ITLOS *inter alia* that :

“once plutonium is introduced into the MOX plant and it commences operations, some discharges into the marine environment will occur, with irreversible consequences. Further, the danger of radioactive leaks and emissions, whether as functions of the operation of the plant, or resulting from industrial accidents, terrorist attacks, or other causes, is greatly magnified”¹¹⁴

The Tribunal did not follow Ireland’s argument in this regard and concluded that, under the circumstances of the case, it “[did] not find that the urgency of the situation requires the prescription of the provisional measures requested by Ireland, in the short period before the constitution of the Annex VII arbitral tribunal.”¹¹⁵ In reaching this conclusion, the tribunal relied *inter alia* on the respondent’s argument that “Ireland ha[d] failed to supply proof that there will be either irreparable damage to the rights of Ireland or serious harm to the marine environment resulting from the operation of the MOX plant and that, on the facts of this case, the precautionary principle has no application.”¹¹⁶ This finding was later confirmed by the decision of the Annex VII Tribunal established to decide on Ireland’s claim under the UNCLOS.¹¹⁷

Despite the rejection of the measures requested by the claimants, both cases illustrate how the scientific uncertainty as to the effects of certain measures could potentially be dealt with by an international adjudicatory body, even before the merits are fully reviewed. Given the scientific uncertainties often characterizing environmental issues, such measures have been requested in several environment-related cases.¹¹⁸ Moreover, some environmental agreements specifically contemplate the prescription of provisional measures. Examples include, in addition to art. 290 of UNCLOS,¹¹⁹ which was at stake in

provoquerait des préjudices graves et irréversibles à la préservation de l'environnement de l'fleuve Uruguay et de ses zones d'influence ainsi que aux droits de l'Argentine et des habitants des zones avoisinantes sous sa juridiction.”

¹¹¹ *Pulp Mills Order*, par. 62, referring to the following ICJ case-law: *Passage through the Great Belt (Finland v. Denmark)*, *Provisional Measures*, Order of 29 July 1991, I.C.J. Reports 1991, p. 17, para. 23; *Certain Criminal Proceedings in France (Republic of the Congo v. France)*, *Provisional Measure*, Order of 17 June 2003, I.C.J. Reports 2003, p. 107, para. 22).

¹¹² *Pulp Mills Order*, par. 72.

¹¹³ *Id.*, par. 73. At par. 75, the Court stressed that: “Argentina has not provided evidence at present that suggests that any pollution resulting from the commissioning of the mills would be of a character to cause irreparable damage to the River Uruguay; whereas it is a function of CARU to ensure the quality of water of the river by regulating and minimizing the level of pollution; whereas, in any event, the threat of any pollution is not imminent as the mills are not expected to be operational before August 2007 (Orion) and June 2008 (CMB).”

¹¹⁴ *MOX plant ITLOS, Request for Provisional Measures and Statement of Case of Ireland, of 9 November 2001*, par. 145. At par. 148, Ireland further argued that: “the precautionary principle might usefully inform the assessment by the Tribunal of the urgency of the measures it is required to take in respect of the operation of the MOX plant”.

¹¹⁵ *MOX Plant ITLOS Order*, par. 81.

¹¹⁶ *Id.*, par. 75.

¹¹⁷ *MOX Plant PO 3*, par. 53-55.

¹¹⁸ *See*, in addition to the Pulp Mills and MOX Plant cases, also: [Trail Smelter Arbitration]; *Southern Bluefin Tuna Cases* (New Zealand v Japan; Australia v Japan)(Provisional Measures) ITLOS Nos 3 and 4, Order of 27 August 1999; *Land Reclamation* (Malaysia v Singapore)(Provisional Measures), ITLOS No. 12, Order of 8 October 2003.

¹¹⁹ Art. 290(1) and (5) of UNCLOS state: “1. If a dispute has been duly submitted to a court or tribunal which considers that *prima facie* it has jurisdiction under this Part or Part XI, section 5, the court or tribunal may

the MOX Plant cases, also art. 31 of the Agreement on Straddling and Highly Migratory Fish Stocks,¹²⁰ or art. 6 of Annex II to the CBD.¹²¹ It is also noteworthy that the Optional Rules for Arbitration of Disputes relating to Natural Resources and/or the Environment adopted in June 2001 by the Permanent Court of Arbitration ("PCA Optional Rules"), contain a specific provision on interim measures "to prevent serious harm to the environment".¹²² This is interesting because a number of MEAs refer to the PCA in their dispute settlement provisions.¹²³

(9) Evidence

Environmental disputes raise specific challenges with respect to the gathering and presentation of evidence. The significant scientific uncertainties involved in the assessment of the environmental repercussions of a given set of acts often require heavy reliance on scientific and technological knowledge in the form of expert reports.¹²⁴ Moreover, the results of such reports are often difficult to appraise by international adjudicatory bodies, not only because these latter are as a rule composed of lawyers without sufficient scientific background but also because the results of environmental expert reports are themselves subject to considerable scientific uncertainty. This raises in turn the question of the need for an adaptation of the standard and/or the burden of proof of environmental risks or damages.

An apposite illustration of these difficulties is offered by the *Gabcikovo-Nagymaros* case, before the ICJ.¹²⁵ Hungary sought to justify its non performance of a treaty with Slovakia for the construction of a system of dams by arguing *inter alia* that if it had indeed

prescribe any provisional measures which it considers appropriate under the circumstances to preserve the respective rights of the parties to the dispute or to prevent serious harm to the marine environment, pending the final decision [...] 5. Pending the constitution of an arbitral tribunal to which a dispute is being submitted under this section, any court or tribunal agreed upon by the parties or, failing such agreement within two weeks from the date of the request for provisional measures, the International Tribunal for the Law of the Sea or, with respect to activities in the Area, the Seabed Disputes Chamber, may prescribe, modify or revoke provisional measures in accordance with this article if it considers that *prima facie* the tribunal which is to be constituted would have jurisdiction and that the urgency of the situation so requires. Once constituted, the tribunal to which the dispute has been submitted may modify, revoke or affirm those provisional measures, acting in conformity with paragraphs 1 to 4."

¹²⁰ Agreement on Straddling and Highly Migratory Fish Stocks, of 4 August 1995. Art. 31(2) states: "Without prejudice to article 290 of the Convention, the court or tribunal to which the dispute has been submitted under this Part may prescribe any provisional measures which it considers appropriate under the circumstances to preserve the respective rights of the parties to the dispute or to prevent damage to the stocks in question, as well as in the circumstances referred to in article 7, paragraph 5, and article 16, paragraph 2."

¹²¹ Art 6 of Annex II to the CBD states: "The arbitral tribunal may, at the request of one of the parties, recommend essential interim measures of protection."

¹²² Art. 26(1) of the PCA Optional Rules states: " Unless the parties otherwise agree the arbitral tribunal may, at the request of any party and having obtained the views of all the parties, take any interim measures including provisional orders with respect to the subject-matter of the dispute it deems necessary to preserve the rights of any party or to prevent serious harm to the environment falling within the subject-matter of the dispute". For a commentary of the PCA Optional Rules see: RATLIFF, D.P., The PCA Optional Rules for Arbitration of Disputes Relating to Natural Resources and/or the Environment, in *Leiden Journal of International Law*, vol. 14, 2001, pp. 887-896.

¹²³ See: art. 18, CITES; art. 13 of the Convention on the Conservation of Migratory Species of Wild Animals, of 23 June 1979; Schedule to the Protocol to the Antarctic Treaty on Environmental Protection, of 4 October 1991; art. 14 of the Protocol on Civil Liability and Compensation for Damage Caused by the Transboundary Effects of Industrial Accidents on Transboundary Waters to the 1992 Conventions on the Protection and Use of Transboundary Watercourses and International Lakes and on the Transboundary Effects of Industrial Accidents, of 21 May 2003 (not yet in force).

¹²⁴ See SAVADOGO, L., Le recours des juridictions internationales à des experts, in *Annuaire français de droit international*, 2004, pp. 231-258.

¹²⁵ *Gabcikovo-Nagymaros Project (Hungary/Slovakia)*, Judgment, *I.C.J. Reports 1997*, p. 7 ("Gabcikovo-Nagymaros").

carried out the works as planned “the environment – and in particular the drinking water resources – in the area would have been exposed to serious dangers.”¹²⁶ Throughout the proceedings, both Hungary and Slovakia presented an “impressive amount of scientific material”, as acknowledged by the Court itself, to provide scientific grounding to their respective positions. The situation was particularly challenging for the Court. As noted by one prominent commentator, who was also counsel for Hungary in this case, the judges were not only called to understand the scientific intricacies of the matter but also to determine the relative merits of the scientific material presented by each party.¹²⁷ Eventually, however, the Court concluded that “it [was] not necessary in order to respond to the questions put to it in the Special Agreement for it to determine which of those points of view is scientifically better founded.”¹²⁸ Irrespective of whether this course of action was justified under the circumstances of the case or not, such a solution should be seen as an exception rather than as the rule in environmental disputes, as one can expect that, in such disputes, the relative merits of the competing scientific views advanced by the parties will likely be a major point to be decided by the tribunal.

An interesting technique to provide tribunals with the necessary scientific support for reaching a decision on such questions is the appointment by the tribunal of its own experts. Pursuant to art. 289 of UNCLOS:

“In any dispute involving scientific or technical matters, a court or tribunal exercising jurisdiction under this section may, at the request of a party or *proprio motu*, select in consultation with the parties no fewer than two scientific or technical experts chosen preferably from the relevant list prepared in accordance with Annex VIII, article 2, to sit with the court or tribunal but without the right to vote.”

A similar provision appears in art. 27(1) of the PCA Optional Rules, pursuant to which:

“After having obtained the views of the parties, the arbitral tribunal may upon notice to the parties appoint one or more experts to report to it, in writing, on specific issues to be determined by the tribunal. A copy of the expert’s terms of reference, established by the arbitral tribunal, shall be communicated to the parties.”

Such possibility is also contemplated in other areas of international adjudication, such as in art. 50 of the ICJ Statute,¹²⁹ art. 13(2) of WTO DSB Memorandum,¹³⁰ art. 1133 of NAFTA,¹³¹ art. 27 of the UNCITRAL Arbitration Rules,¹³² art. 36 of the 2006 ICSID

¹²⁶ *Id.*, par. 55.

¹²⁷ Pierre-Marie Dupuy writes in this respect that : “[d]u côté des juges, en effet, même si l’on doit supposer qu’ils sont prêts à tenter de comprendre un ensemble complexe et corrélié de démonstrations scientifiques et techniques, comme c’était en l’occurrence le cas, on ne peut que douter de leur aptitude à être capable d’arbitrer entre cet ensemble déjà très complexe de considérations et celles, tout aussi difficiles, que leur opposera la partie adverse”, DUPUY, P.-M., *L’invocation de l’état de nécessité écologique. Les enseignements tirés d’une étude de cas*, in SFDI, *La nécessité en droit international*, Paris: Pedone, 2007, p. 232. See also BREWER, S., *Scientific Expert Testimony and Intellectual Due Process*, in *Yale Law Journal*, vol. 107, 1998, pp. 1535-1681.

¹²⁸ *Gabcikovo-Nagymaros*, par. 55.

¹²⁹ The ICJ’s Statute provides in Art. 50 that: “The Court may, at any time, entrust any individual, body, bureau, commission, or other organization that it may select, with the task of carrying out an enquiry or giving an expert opinion.”

¹³⁰ Art. 13(2) of the Understanding on Rules and Procedures Governing the Settlement of Disputes states : “Panels may seek information from any relevant source and may consult experts to obtain their opinion on certain aspects of the matter. With respect to a factual issue concerning a scientific or other technical matter raised by a party to a dispute, a panel may request an advisory report in writing from an expert review group. Rules for the establishment of such a group and its procedures are set forth in Appendix 4.”

¹³¹ Art. 1133 of NAFTA (chapter 11) states: “Without prejudice to the appointment of other kinds of experts where authorized by the applicable arbitration rules, a Tribunal, at the request of a disputing party or, unless the disputing parties disapprove, on its own initiative, may appoint one or more experts to report to it in writing on

Arbitration Rules,¹³³ or art. 6 of the IBA Rules on the Taking of Evidence in International Commercial Arbitration.¹³⁴ The specific modalities of such consultation, including the selection of the expert, the cooperation of the parties, and the possibility for the parties to submit comments on the expert report or even subject the expert to oral cross-examination, are very important for the legitimacy of the end result.

An alternative technique is the possibility for the tribunal to request the parties non technical summaries or explanations of the scientific and/or technological issues relevant for deciding the dispute. For instance, art. 24(4) of the PCA Optional Rules provide that:

“[t]he arbitral tribunal may request the parties jointly or separately to provide a nontechnical document summarizing and explaining the background to any scientific, technical or other specialized information which the arbitral tribunal considers to be necessary to understand fully the matters in dispute.”

Despite the availability of such techniques, the scientific uncertainties underlying certain environmental disputes are sometimes such that the normal rules regarding the standard and/or the burden of proof¹³⁵ appear inadequate.¹³⁶ The basic rule remains that “[e]ach party shall have the burden of proving the facts relied on to support its claim or defense.”¹³⁷ However, in some hypothesis, the burden of proof could potentially be reversed. Such was indeed the proposal of the European Communities in connection with the burden of establishing the applicability of a GATT Article XX exception to accommodate trade measures adopted pursuant to a specific mandate in a MEA.¹³⁸ This is currently being examined in the context of the Doha negotiations. Another possibility is to maintain the burden of proof on the party making a claim but relaxing the standard for proving such claim. This was the approach followed by the WTO Appellate Body in *EC Hormones*¹³⁹ and is arguably also the approach so far taken by the ITLOS in assessing requests for provisional measures.¹⁴⁰ Still another approach is to shift the burden of proof

any factual issue concerning environmental, health, safety or other scientific matters raised by a disputing party in a proceeding, subject to such terms and conditions as the disputing parties may agree.”

¹³² Art. 27(1) of the UNCITRAL Arbitration Rules states: “The arbitral tribunal may appoint one or more experts to report to it, in writing, on specific issues to be determined by the tribunal. A copy of the expert’s terms of reference, established by the arbitral tribunal, shall be communicated to the parties.”

¹³³ Art. 36 of the ICSID Arbitration Rules (as amended in 2006) states: “Notwithstanding Rule 35 the Tribunal may:(a) admit evidence given by a witness or expert in a written deposition; and (b) with the consent of both parties, arrange for the examination of a witness or expert otherwise than before the Tribunal itself. The Tribunal shall define the subject of the examination, the time limit, the procedure to be followed and other particulars. The parties may participate in the examination.” A similar provision appears in Art. 43 of the ICSID Additional Facility (Arbitration) Rules.

¹³⁴ Art. 6(1) of the IBA Rules of the Taking of Evidence in International Commercial Arbitration states: “The Arbitral Tribunal, after having consulted with the Parties, may appoint one or more independent Tribunal-Appointed Experts to report to it on specific issues designated by the Arbitral Tribunal. The Arbitral Tribunal shall establish the terms of reference for any Tribunal-Appointed Expert report after having consulted with the Parties. A copy of the final terms of reference shall be sent by the Arbitral Tribunal to the Parties.”

¹³⁵ For a comparative discussion of these two concepts and the applicable rules in international adjudication see: SANTULLI, C., *Droit du contentieux international ...*, par. 846-868.

¹³⁶ See: TRUILHÉ-MARENGO, E., Les règles relatives à la preuve: quelle place pour l’incertitude scientifique?, in MALJEAN-DUBOIS, S (ed.), *Droit de l’Organisation Mondiale du Commerce et protection de l’environnement ...*, pp. 443-460; MALJEAN-DUBOIS, S. (ed.), *Le droit de l’environnement comme exemple de la mondialisation des concepts juridiques: place et rôle des juridictions internationales et constitutionnelles*, Rapport final de recherche, May 2008, available at: http://www.gip-recherche-justice.fr/IMG/pdf/170-RF_Maljean-Dubois_Droit_Environ.pdf (visited on 16 July 2009), pp. 26-37.

¹³⁷ See art. 24(1) of the PCA Optional Rules.

¹³⁸ See Committee on Trade and Environment, *Resolving the Relationship Between WTO Rules and Multilateral Environmental Agreements*, communication by the European Communities of 19 October 2000 (WT/CTE/W/170).

¹³⁹ See EC Hormones, WT/DS26/AB/R, par. 97-109.

¹⁴⁰ See Southern Bluefin Tuna, par. 79; MOX plant, par. 53-55; Land reclamation, par. 96.

by prior agreement of the parties.¹⁴¹ For instance, the dumping of industrial waste at sea is banned unless it is previously established that it will not cause harm to the environment.¹⁴² This latter approach comes close to the concept of facilitated liability, which I discuss next.

(10) Facilitated liability

The term “facilitated liability” refers to a number of hypotheses where the claimant’s task in establishing that the respondent is at fault or in breach of an obligation is facilitated. Unlike international responsibility, international liability is not premised on fault or breach of an obligation, and it requires proof of damage. The scientific uncertainties raised by the complex ecological processes linking a set of acts to the occurrence of environmental damage can be dealt with, as discussed in the preceding section, by shifting the burden of proof of such damage or by relaxing the applicable standard of proof. However, even when such damage is sufficiently established, the author of the acts under review may argue that it took every reasonable step to prevent the damage (and that therefore, it is neither subjectively at fault nor objectively in breach of an obligation¹⁴³). Scientific uncertainty is relevant in this regard because what is reasonably required (either subjectively or objectively) by a prevention obligation depends upon the understanding of the links between certain acts and the environmental damage at stake. A way to handle the additional challenges derived from such scientific uncertainty at the reparation stage is to set up a facilitated liability regime.

Establishing liability may be facilitated by adjusting or eliminating the need to prove fault or breach. A possible adjustment could take the form of a shift in the burden of proof of due diligence from the claimant to the respondent. Thus, unless the respondent establishes that it acted with all due diligence, it will be held liable for the damage caused by its acts. This point could be illustrated by reference to the ILC 2001 Articles on prevention of transboundary environmental damage (“ILC Articles on prevention”)¹⁴⁴ and its 2006 Principles on the allocation of loss for such damage (“ILC Principles”).¹⁴⁵ Under these latter, States are as such not liable for injurious acts not prohibited by international law.¹⁴⁶ Instead, the ILC Principles channel liability to the operator of hazardous activities or, more

¹⁴¹ See BIRNIE, P., BOYLE, A., REDGWELL, C., *International Law and the Environment ...*, pp. 158-159.

¹⁴² See *Id.*, p. 159 referring to the 1996 Protocol to the London Convention, and art. 4 of the OSPAR Convention.

¹⁴³ As noted by Jiménez de Aréchaga: "The decisive consideration is that unless the rule of international law which has been violated specifically envisages malice or culpable negligence, the rules of international law do not contain a general floating requirement of malice or culpable negligence as a condition of responsibility", cited in BIRNIE, P., BOYLE, A., REDGWELL, C., *International Law and the Environment ...*, p. 215.

¹⁴⁴ See *Draft Articles on Prevention of Transboundary Harm from Hazardous Activities*, text adopted by the Commission at its fifty-third session, in 2001, and submitted to the General Assembly as a part of the Commission’s report covering the work of that session, *Official Records of the General Assembly, Fifty-sixth Session, Supplement No. 10 (A/56/10)*.

¹⁴⁵ See *Draft principles on the allocation of loss in the case of transboundary harm arising out of hazardous activities*, text adopted by the International Law Commission at its fifty-eighth session, in 2006, and submitted to the General Assembly as a part of the Commission’s report covering the work of that session (A/61/10), *Yearbook of the International Law Commission, 2006*, vol. II, Part Two.

¹⁴⁶ As noted in the introductory commentary to the ILC Principles: "even if the relevant State fully complies with its prevention obligations, under international law, accidents or other incidents may nonetheless occur and have transboundary consequences that cause harm and serious loss to other States and their nationals [...] It is important, as the preamble records, that those who suffer harm or loss as a result of such incidents involving hazardous activities are not left to carry those losses and are able to obtain prompt and adequate compensation. These draft principles establish the means by which this may be accomplished", *General Commentary*, para. 2-3. Article 4(5) of the ILC Principles contemplate however the possibility that a State may be led to grant compensation: "[i]n the event that the measures under the preceding paragraphs are insufficient to provide adequate compensation, the State of origin should also ensure that additional financial resources are made available." It is however for States to adopt sufficient measures to limit their liability in such cases.

precisely, direct States to adopt measures channeling liability to the operator in a manner that does not require proof of fault.¹⁴⁷ Leaving aside the controversial question of the legal status of this document, what is important for our discussion is that the system set out in the ILC Principles is one of strict liability. In case of transboundary damage arising from the activities of a private operator or the State (as an operator),¹⁴⁸ the victims would not need to prove either fault of the operator or breach by the State (as an operator) of its due diligence obligations. The underlying rationale of this advantage given to the potential claimants is explained as follows in the Commentary to the ILC Principles:

“Hazardous and ultrahazardous activities, the subject of the present draft principles, involve complex operations and carry with them certain inherent risks of causing significant harm. In such matters, it is widely recognized that it would be unjust and inappropriate to make the claimant shoulder a heavy burden of proof of fault or negligence in respect of highly complex technological activities whose risks and operation the concerned industry closely guards as a secret.”¹⁴⁹

However, the potential claimants still face the burden of proving causation. As noted by the Commentary:

“Strict liability may alleviate the burden that victims may otherwise have in proving fault of the operator but it does not eliminate the difficulties involved in establishing the necessary causal connection of the damage to the source of the activity. The principle of causation is linked to questions of foreseeability and proximity or direct loss.”¹⁵⁰

The Commentary is not clear on the extent to which strict liability may be avoided by the operator by invoking certain defences. Any limitations must in any case be consistent with Article 3 of the ILC Principles, namely to ensure prompt and adequate compensation for victims and to protect the environment.

The examples of strict liability channeled to the operator of the activity are numerous and include many treaties on liability for marine pollution, nuclear accidents, or other hazardous activities.¹⁵¹ The hypothesis of strict liability imposed on the State is much rarer and only appears to be contemplated for activities that were, at least initially, viewed as closely linked to governmental action.¹⁵² The main example of this more radical hypothesis is Article VII of the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space,¹⁵³ which states:

“Each State Party to the Treaty that launches or procures the launching of an object into outer space, including the Moon and other celestial bodies, and each State Party from whose territory or facility an object is launched, is internationally liable for damage to another State Party to the Treaty or to its natural or juridical persons by such object or its component parts on the Earth, in air space or in outer space, including the Moon and other celestial bodies.”

¹⁴⁷ Article 4(2) of the ILC Principles provide that the “measures [to be adopted by States] should include the imposition of liability on the operator or, where appropriate, other person or entity. Such liability should not require proof of fault.”

¹⁴⁸ The Commentary to the ILC Principles notes in this regard that “An operator may be a public or private entity. It is envisaged that a State could be an operator for purposes of the present definition”, ad. Art. 2, par. 33 *in fine*.

¹⁴⁹ *Commentary*, ad. Art. 4, par. 13.

¹⁵⁰ *Id.*, par. 16.

¹⁵¹ See BRUNNÉE, J., Of Sense and Sensibility: Reflections on International Liability Regimes as Tools for Environmental Protection, in *International and Comparative Law Quarterly*, vol. 53, 2004, pp. 351-368.

¹⁵² See KISS, A., SHELTON, D., Strict Liability in International Environmental Law, in NDIAYE, T.M., WOLFRUM, R. (eds.), *Liber Amicorum Judge Thomas A. Mensab*, 2007.

¹⁵³ Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and other Celestial Bodies, of 27 January 1967 (“Outer Space Treaty”).

Article 7 of the Outer Space Treaty is implemented by a Liability Convention¹⁵⁴ which provides for the absolute liability of the “launching State” (i.e. a State that launches or procures the launching of a space object, or from whose territory or facility a space object is launched¹⁵⁵) “for damage caused by its space object on the surface of the earth or to aircraft flight.”¹⁵⁶ The allocation of the burden to prove causation is not entirely clear. It appears that such burden is on the claimant, but the launching State may be exonerated from its absolute liability if it proves either of two circumstances which amount, in fact, to a concurrent cause, namely gross negligence or intent from the claimant.¹⁵⁷

III. TACKLING SCIENTIFIC UNCERTAINTY IN PRACTICE: THE CLIMATE CHANGE REGIME

A. Introductory observations

Several of the techniques I have so far reviewed can be illustrated by reference to the climate change regime (CCR). The choice of the CCR to analyze how these techniques operate in practice rests upon several considerations.

First, the redesign of the CCR is currently perhaps the foremost topic in international affairs, from the perspective of both industrialized and developing countries, and the significant divide between these two broad categories is at least in part characterized by their different level of scientific and technological development.

Second, the issue of climate change embodies as no other the complexity and breadth of what has been referred to as “second generation” environmental issues. This is largely because the substantial scientific uncertainties characterizing different dimensions of the problem, some of which (such as the role of clouds, aerosols and vegetation in the climate system) have been partly elucidated only in recent years.

Third, the international CCR is not exactly a “treaty-based regime” and may potentially distance itself from such a characterization somewhat more according to the outcome of the Copenhagen conference. Indeed, at the very least, the CCR includes the interactions between, on the one hand, the bodies and rules of the UNFCCC and its protocols, and, on the other hand, their loosely defined relationship with the work of the IPCC. In the future, the regime may potentially involve bilateral or selective multilateral “dialogues” among large emitters.

Fourth, the CCR provides particularly interesting examples of how the techniques reviewed operate at the four different stages of regime development identified in the second part of this article. This is also why the discussion in section (B) below is structured in four sub-sections, each dealing with each stage of regime development.

¹⁵⁴ *Convention on International Liability for Damage Caused by Space Objects*, of 29 March 1972 (“Liability Convention”).

¹⁵⁵ Liability Convention, Art. 1(c)(i)-(ii).

¹⁵⁶ *Id.*, Art. 2. The liability standard is different for damage caused to other space objects or persons traveling within such objects. Article 3 provides indeed that: “In the event of damage being caused elsewhere than on the surface of the earth to a space object of one launching State or to persons or property on board such a space object by a space object of another launching State, the latter shall be liable only if the damage is due to its fault or the fault of persons for whom it is responsible.”

¹⁵⁷ Art. VI(1) of the Liability Convention states: “Subject to the provisions of paragraph 2 of this Article, exoneration from absolute liability shall be granted to the extent that a launching State establishes that the damage has resulted either wholly or partially from gross negligence or from an act or omission done with intent to cause damage on the part of a claimant State or of natural or juridical persons it represents.”

B. *Scientific Uncertainty in the Climate Change Regime*

(1) Advocacy

There is arguably no single event or moment that marks the transition from the perception of climate change as an uncertain phenomenon to its understanding as a risk, in the meaning given by Knight. Such transition can more accurately be characterized as a process involving both scientific and political components, linked by a surge of media attention often relating to a specific event, such as a catastrophe or the publication of a report. My purpose here is not to provide an account of such process, which has already received sustained analysis.¹⁵⁸ Rather, I would like to illustrate the part played by precautionary reasoning in the emergence of the two main pillars of the CCR, namely the IPCC and the UNFCCC treaty-system.

In 1979, much as a result of the scientific uncertainty surrounding the interactions between, on the one hand, the atmosphere and, on the other hand, the oceans and vegetation, the International Council for Science (ICSU)¹⁵⁹ and the World Meteorological Organization (WMO) organized a World Climate Conference (WCC) to address the need for effective interdisciplinary discussions among climate experts. The WCC resulted in the creation of a World Climate Programme, with various branches including a World Climate Research Programme (WCRP). The WCRP was the successor of a previous research programme jointly organized by the ICSU and the WMO in 1967, mainly in order to put pressure on governments to provide funds for weather prediction and also for climate research.¹⁶⁰ The WCRP inherited much of this programme's structure, including the administrative support from the WMO as well as an independent scientific planning committee.¹⁶¹ As noted by Weart, the cautious concluding statement of the WCC that an increase in carbon dioxide concentration in the atmosphere may possibly result in significant and perhaps major changes in the global-scale climate "was hardly news, and it caught little public or political attention."¹⁶² Arguably, neither the scientific knowledge of climate change nor precautionary reasoning were by the late 1970s sufficient to prompt regulation at the international level.

This changed considerably during the 1980s, especially in the second half of that decade. In 1983, the US Environmental Protection Agency issued a report drawing attention on the potentially catastrophic consequences of a rise in global temperature, which should no longer be considered as "a theoretical problem but [as] a threat whose effects will be felt within a few years."¹⁶³ This report caught sufficient media attention to direct the interest of US politicians to the matter. From an international perspective, a series of scientific meetings were organized during the 1980s under the aegis of the ICSU, the WMO and UNEP, focusing on different aspects of climate change. In particular, at a meeting held in Villach, Austria, in 1985, experts from a number of both industrialized and developing countries reached a consensus on the possibility that human activity may cause global warming, which could in turn have very serious consequences. The final report, drafted by the influential Swedish scientist Bert Bolin, who had chaired the 1967 joint ICSU-WMO research programme, stated that "[a]s a result of the increasing concentrations of greenhouse gases, it is now believed that in the first half of the next century a rise of global mean temperature could occur which is greater than any in man's

¹⁵⁸ WEART, S.H., *A History of Global Warming ...*, *supra* footnote 1.

¹⁵⁹ Initially named International Council of Scientific Unions.

¹⁶⁰ WEART, S.H., *A History of Global Warming ...*, pp. 104-105.

¹⁶¹ See FLEAGLE, R.G., *Global Environmental Change: Interactions of Science, Policy, and Politics in the United States*. Westport: Praeger, 1994, p. 176.

¹⁶² WEART, S.H., *A History of Global Warming ...*, p. 112.

¹⁶³ SEIDEL, S., KEYES, D., *Can We Delay a Greenhouse Warming?* 2nd edn., Washington D.C.: Environmental Protection Agency, 1983, pp. ix, 7 (of section seven), cited in *Id.*, p. 141.

history.”¹⁶⁴ As the document makes it clear, this statement was based on a consensus reached by scientists from 29 developed and developing countries. Scientific uncertainty was starting to turn into risk assessment. The document did not provide much detail on different scenarios, but did refer to possible errors in its predictions.¹⁶⁵ Moreover, also throughout the 1980s, governments started to fund what came to be known as “impact studies”, namely assessments of the social and economic impact of climate change.¹⁶⁶

But scientific consensus was not necessarily sufficient, as such, to prompt concrete political action. The efforts of the ICSU, WMO and UNEP continued, however, and in 1986 they jointly established an Advisory Group on Greenhouse Gases (AGGG). The efforts conducted under these organizations, in a variety of other contexts, proved to be extremely useful in organizing a framework for scientific interdisciplinary exchanges among scientists. A major scientific breakthrough resulting from such interdisciplinary exchanges was the discovery in 1985 of “hole” in the ozone layer over Antarctica.¹⁶⁷ Such discovery prompted the strengthening of the shy regime initially contemplated in the 1985 Vienna Convention by the adoption of the 1987 Montreal Protocol. The protocol contributed in turn to give a sense of reality to the scientific processes taking place in the atmosphere and help gather momentum for the development of a regime dealing with climate change. It must be noted, in this connection, that the main substances targeted by the Montreal Protocol, namely chlorofluorocarbons (CFCs), had also been identified in the Villach statement as GHG responsible for the increase in global temperatures. The following year, three important events focusing specifically on climate change took place.

The first was a conference held in Toronto, Canada, as an extension of the Villach workshops. It was a meeting of expert scientists, as opposed to government representatives. The final report not only confirmed the scientific consensus that was slowly taking shape, but also, for the first time, called for governments to set specific targets for the reduction of GHG, following the Montreal Protocol’s model.¹⁶⁸

The second event was the establishment of the IPCC by the joint initiative of UNEP and the WMO in 1988. The document laying out the IPCC’s mandate, namely UN General Assembly resolution 43/53, of 6 December 1988, expressly referred to the momentum created by the Villach meeting, the Montreal Protocol, the initiatives of UNEP and the ICSU, as well as the work of the WMO towards the organization of a Second World Climate Conference.¹⁶⁹ And it was premised on the precautionary “concern that the emerging evidence indicates that continued growth in atmospheric concentrations of ‘greenhouse’ gases could produce global warming with an eventual rise in sea levels, the effects of which could be disastrous for mankind if timely steps are not taken at all levels.”¹⁷⁰ It was this same instrument that called upon the Secretary-General of the WMO and UNEP’s Executive Director, through the IPCC, to proceed to a comprehensive review of scientific evidence regarding climate change as well as *inter alia* to “the identification and

¹⁶⁴ BOLIN, B., Statement by the UNEP/WMO/ICSU International Conference, preface to BOLIN, B. et al. (eds.), *The Greenhouse Effect, Climatic Change, and Ecosystems. SCOPE Report No. 29*. Chichester: John Wiley, 1986, p. xx.

¹⁶⁵ “The most advanced experiments with general circulation models of the climatic system show increases of the global mean equilibrium surface temperature for a doubling of the atmospheric CO₂ concentration, or equivalent, of between 1.5 and 4.5 °C. Because of the complexity of the climatic system and the imperfections of the models, particularly with respect to ocean-atmosphere interactions and clouds, values outside this range cannot be excluded. The realization of such changes will be slowed by the inertia of the oceans, the delay in reaching the mean equilibrium temperatures corresponding to doubled greenhouse gas concentrations is expected to be a matter of decades.”, *id.*

¹⁶⁶ WEART, S.H., *A History of Global Warming ...*, p. 143.

¹⁶⁷ *Id.*, p. 147.

¹⁶⁸ *Id.*, p. 149.

¹⁶⁹ UN Doc. A/RES/43/53, of 6 December 1988, preamble.

¹⁷⁰ *Id.*

possible strengthening of relevant existing international legal instruments having a bearing on climate [... and ...] [e]lements for inclusion in a possible future international convention on climate.”¹⁷¹

These developments in turn prompted a third process, which eventually led to the adoption of the UNFCCC in 1992. The political process was difficult since the beginning. A large part of the mandate of the conference held in Ottawa in February 1989 to consider the elements of a future convention, was indeed to “identify areas where, for legal, technical or scientific reasons, a consensus may not be achievable and to suggest ways to overcome such obstacles.”¹⁷² In addition, the conclusion of the first assessment report of the IPCC left enough margin for economically driven scientific counter-arguments, funded by special interest groups from industry, particularly the fossil energy sector, such as the Global Climate Coalition. Indeed, the IPCC could not exclude that the increase in temperature “be largely due to natural variability.”¹⁷³

Notwithstanding the real uncertainties underlying the processes at the roots of climate change and their impact on human societies or the pressure exerted by interest-groups, the UNFCCC was eventually adopted largely on a precautionary basis, as acknowledged in its article 3(3). The negotiating history of this provision is particularly illuminating in this regard. During the sessions of the intergovernmental negotiating committee (INC), the representative of the Association of Small Island States (AOSIS), which was the staunchest advocate for the introduction of the precautionary principle in the text of the Convention, eloquently noted: “we do not have the luxury of waiting for conclusive proof, as some have suggested in the past. The proof, we fear, will kill us”.¹⁷⁴

(2) Design

Another important issue discussed at the INC concerns the design features of the regime envisioned and, more specifically, the strategic choice between a “framework” and a “substantive” convention.¹⁷⁵ The two basic precedents for the CCR were the LRTAP Convention and the Ozone Convention. In both cases, the approach followed was one consisting of a framework text to be completed by protocols. As already discussed, this approach has the advantage of catalyzing consensus on a broad text even when some of the States engaged in the process have yet to accept the need for regulation from a scientific perspective. As noted by Bodansky:

“States can begin to address a problem without waiting for a consensus to emerge on appropriate response measures, or even before there is agreement that a problem exists [...] For example, when both the ECE Long-Range Transboundary Air Pollution Convention (LRTAP) and the Vienna Convention for the Protection of the Ozone Layer (Vienna Ozone Convention) were adopted, some states remained unconvinced of the need for action. Nevertheless, even skeptical states acquiesced in the adoption of these conventions, since the conventions did not commit them to any specific measures. Later, when the scientific evidence became stronger, protocols could be adopted more quickly, since the framework conventions had cleared away many of the preliminary procedural and institutional issues”¹⁷⁶

¹⁷¹ *Id.*, par. 10(a), (d) and (e).

¹⁷² *Protection of the Atmosphere: Statement of the Meeting of Legal and Policy Experts*, Ottawa, Ontario, Canada, 22 February 1989, introduction, letter b.

¹⁷³ IPCC, First Assessment Report, Scientific Assessment, Report of Working Group I (1990), *Policymaker Summary*, Executive Summary, par. 4.

¹⁷⁴ Robert F. Van Lierop, Permanent Representative to the United Nations and Chairman of the Delegation of Vanuatu, Statement to the Plenary Session of the INC/FCCC, at 3, 5 February 1991, quoted in BODANSKY, D., *The United Nations Framework Convention on Climate Change ...*, p. 503.

¹⁷⁵ See BODANSKY, D., *The United Nations Framework Convention on Climate Change ...*, pp. 493-496.

¹⁷⁶ *Id.*, p. 494.

In the case of the CCR the situation was made even more complex by the existence of an ongoing body, such as the IPCC, specifically devoted to the assessment of the evidence of climate change. Some States considered that the numerous initiatives already taken in the area of climate change, and particularly the work of the IPCC, was a sufficient basis for adopting a more ambitious convention, with clear substantive contents, including commitments.¹⁷⁷ The divergence of views was apparent in the work of the INC. Countries such as Germany proposed the adoption of specific substantive measures on mitigation and adaptation, whereas countries such as the United States favored a substantively diluted but procedurally more ambitious text, contemplating a sophisticated architecture for future consensus, including a scientific advisory body.¹⁷⁸ The details here are less important than the overall tension between substantive and procedural ambition, and the design features associated with each approach. Eventually, this divergence resulted in a compromise “framework” convention, containing both substantive and procedural provisions, illustrated by provisions such as article 4 (commitments), article 7 (COP powers), article 9 (subsidiary body for scientific and technological advice - SBSTA) or article 17 of the UNFCCC (adoption of protocols).

These design features played an important role in both the adoption of the Kyoto Protocol in 1997 and, more recently, in the structuring of the process leading to the Copenhagen conference in December 2009. The framework-protocol approach and the SBSTA provided the UNFCCC with increased reactivity to the periodical review of scientific evidence on climate change performed by the IPCC. There is between these two pillars of the CCR a sort of informal cyclical process. As noted by Weart:

“Roughly twice a decade, the IPCC would analyze the most recent peer-reviewed research and issue a consensus statement about the prospects for climate change. That would lay the foundation for international negotiations, which would establish guidelines for individual national policies. Thus, after governments responded to the Rio convention (with inaction, as it happened), it was the scientists’ turn. They pursued research problems as usual, published the results in journals as usual, and discussed technicalities in conferences as usual, but to officialdom that was all in preparation for the next IPCC report, scheduled for 1995”¹⁷⁹

The ongoing research conducted by the IPCC, which will eventually lead to the adoption of the Second Assessment Report in 1995,¹⁸⁰ prompted another legal development. Indeed, in March 1995, the first COP of the UNFCCC discussed the issue of the adequacy of the commitments contemplated in article 4(2) letters (a) and (b) in the light of recent scientific evidence. The result was the adoption of COP Decision 1/CP.1, better known as the “Berlin Mandate”,¹⁸¹ which called for the strengthening of the commitments of Annex I countries “through the adoption of a protocol or another legal instrument” and effectively led to the adoption of the Kyoto Protocol two years later. The Berlin Mandate is a clear illustration of the interaction between the sophisticated procedural framework laid out in the UNFCCC and scientific advancement.

Another illustration of this mechanism is provided by the “negotiations round” prompted by the IPCC Fourth Assessment Report issued in November 2007.¹⁸² This time, the assessment of the IPCC was much more precise with respect to (a) the evidence of

¹⁷⁷ *Id.*, p. 495.

¹⁷⁸ *Id.*, p. 496.

¹⁷⁹ WEART, S.H., *A History of Global Warming ...*, p. 162.

¹⁸⁰ The IPCC published a report to the intention of the first COP of the UNFCCC: *Climate change, 1994 : radiative forcing of climate change and an evaluation of the IPCC IS92 emission scenarios*, Cambridge: Cambridge University Press, 1995.

¹⁸¹ Decision 1/CP.1, *Report of the Conference of the Parties on its First Session*, held at Berlin from 28 March to 7 April 1995, 6 June 1995, FCCC/CP/1995/7/Add.1.

¹⁸² See IPCC, Fourth Assessment Report, Synthesis Report, *Summary for Policymakers* (2007).

global warming, (b) the importance of human activities as a cause, and (c) the impacts of global warming. The IPCC Summary for Policymakers confidently stated that “[w]arming of the climate system is unequivocal”¹⁸³ and that “[m]ost of the observed increase in global average temperatures since the mid-20th century is very likely due to the observed increase in anthropogenic GHG concentrations.”¹⁸⁴ The work of the IPCC clearly shows the importance of turning “uncertainty” into “risk” for regulatory purposes. As noted by Edith Brown Weiss: “The Fourth Assessment’s temperature analysis is much more detailed and sophisticated than the earlier reports. It includes six separate scenario models, each with its own best estimate and range of temperature increases.”¹⁸⁵ The conclusions of the IPCC were very seriously taken into account at the UNFCCC COP held in December 2007 in Bali, Indonesia. The result was the adoption of a new mandate, usually referred to as the “Bali Roadmap”.¹⁸⁶ I do not intend to discuss the different components of the Bali Roadmap here, but only to illustrate of how two of the techniques reviewed in the second part of this article are being deployed to adapt to new scientific evidence.

After the IPCC’s fourth assessment, it became clear that the Kyoto commitments, even if fully respected, were utterly insufficient to attain the objective set in article 2 of the UNFCCC, namely “to achieve [...] stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system.”¹⁸⁷ Mainly for political reasons, the process was divided into two main avenues. The first avenue focused on amending the Kyoto Protocol to increase and enhance the commitments undertaken by Annex I countries. The efforts in this direction were entrusted to an Ad Hoc Working Group on Further Commitments for Annex I Parties under the Kyoto Protocol (AWG-KP).¹⁸⁸ The second avenue, which is in fact the one established by the so-called Bali Action Plan, focused instead on the adoption of a wholly new protocol at Copenhagen. This second process was entrusted to an Ad Hoc Working Group on Long-Term Cooperative Action under the Convention (AWG-LCA).¹⁸⁹ Interestingly, as part of this second process, the COP entrusted its scientific advisory body, the SBSTA, to undertake a “program of work on methodological issues” in connection with reduced emissions from deforestation and degradation (REDD) and issue recommendations for consideration by the COP in its subsequent session.¹⁹⁰ So far, the two processes have made considerable progress. The UNFCCC secretariat has recently received twelve proposals for the amendment of the Kyoto Protocol in accordance with its articles 20 and 21,¹⁹¹ including one from the European Community¹⁹² and another from 37

¹⁸³ *Id.*, par. 1.1.

¹⁸⁴ *Id.*, par. 2.4.

¹⁸⁵ BROWN WEISS, E., Preface to the Twentieth Anniversary Issue, in *Georgetown International Environmental Law Review*, vol. 20, 2008, p. 523.

¹⁸⁶ *Report of the Conference of the Parties on its Thirteenth Session*, held in Bali from 3 to 15 December 2007, 14 March 2008, FCCC/CP/2007/6/Add.1.

¹⁸⁷ Decision 1/CP.13 recognized *inter alia* that “deep cuts in global emissions will be required to achieve the ultimate objective of the Convention and emphasizing the urgency to address climate change as indicated in the Fourth Assessment Report of the Intergovernmental Panel on Climate Change”.

¹⁸⁸ Decision 1/CMP.1, Consideration of Commitments for Subsequent Periods for Parties Included in Annex I to the Convention under Article 3, Paragraph 9 of the Kyoto Protocol, FCCC/KP/CMP/2005/8/Add.1 (2006).

¹⁸⁹ Decision 1/CP.11, Dialogue on Long-Term Cooperative Action to Address Climate Change by Enhancing the Implementation of the Convention, FCCC/CP/2005/Add.1 (2006). The initial work of the Dialogue led to a report presented to COP-13. It was further reconducted under the form of a contact group which prepared a report, the contents of which were taken up in the Bali Action Plan (Decision 1/CP.13).

¹⁹⁰ Decision 2/CP.13, par. 7-8.

¹⁹¹ For an overview of other amendment proposals (including under article 3(9) of the Kyoto Protocol) see: Documentation to facilitate negotiations among Parties. Note by the Chair. Proposed amendments to the Kyoto Protocol pursuant to its Article 3, paragraph 9, Addendum, 1 July 2009, FCCC/KP/AWG/2009/10/Add.1;

non-Annex I countries (including Brazil, China and India),¹⁹³ as well as five proposals for the adoption of a new protocol under article 17 of the UNFCCC, including one from the United States.¹⁹⁴ These proposals, which are expected to be considered by the COP at its December 2009 session in Copenhagen, provide a good illustration of how the procedural sophistication of the framework may compensate for what appeared initially as a disappointing regime from a substantive point of view. The design features of the CCR help it adapt to scientific progress in the understanding of climate change.

(3) Implementation

The CCR also provides interesting illustrations of some of the legal techniques focusing on the implementation stage of regime development. These techniques are perhaps the most widely discussed components of the CCR in the IEL literature.¹⁹⁵

Of particular interest in this connection is the clean development mechanism (CDM) established in article 12 of the Kyoto Protocol as a flexibility mechanism to achieve compliance with quantified commitments as well as a tool for technology transfer to developing countries. A recent report analyzing 63 CDM projects registered by 1 January 2006 has reached the following conclusions:

“Technology originates from outside the host country in almost 50% of the evaluated projects. In the projects in which the technology originates from outside the host country, 80% use technology from the European Union. Technologies used in non-CO2 greenhouse gas and wind energy projects, and a substantial share of the hydropower projects, use technology from outside the host country, but biogas, agricultural and biomass projects mainly use local technology. The associated investment value with the CDM projects that transferred technology is estimated to be around 470 million Euros, with about 390 coming from the EU.”¹⁹⁶

Another recent report analyzing a broader number of projects (3296) reaches conclusions that seem consistent with the finding above:

“Roughly 36% of the projects accounting for 59% of the annual emission reductions claim to involve technology transfer. Technology transfer is more common for larger projects and projects with foreign participants. Technology transfer is very heterogeneous across project types and usually involves both knowledge and equipment. The technology originates mostly from Japan, Germany, the USA, France, and Great Britain. The rate of technology transfer is significantly higher than average for several host countries, including Bolivia, Ecuador, Guatemala, Honduras, Indonesia, Kenya, Malaysia, Mexico, Pakistan, South Africa, Sri Lanka, Thailand and Vietnam and significantly lower than average for Brazil, China, and India. As the number of projects increases, technology transfer occurs beyond the individual projects. This is observed for several project types in China and Brazil. For most project

Documentation to facilitate negotiations among Parties. Note by the Chair. Addendum. Other proposed amendments to the Kyoto Protocol, 1 July 2009, FCCC/KP/AWG/2009/10/Add.2.

¹⁹² Proposal from the Czech Republic and the European Commission on behalf of the European Community and its member States for an amendment to the Kyoto Protocol, 11 June 2009, FCCC/KP/CMP/2009/2.

¹⁹³ Proposal from Algeria, Benin, Brazil, Burkina Faso, Cameroon, Cape Verde, China, Congo, Democratic Republic of the Congo, El Salvador, Gambia, Ghana, India, Indonesia, Kenya, Liberia, Malawi, Malaysia, Mali, Mauritius, Mongolia, Morocco, Mozambique, Nigeria, Pakistan, Rwanda, Senegal, Seychelles, Sierra Leone, South Africa, Sri Lanka, Swaziland, Togo, Uganda, United Republic of Tanzania, Zambia and Zimbabwe for an amendment to the Kyoto Protocol, 15 June 2009, FCCC/KP/CMP/2009/7.

¹⁹⁴ Draft implementing agreement under the Convention prepared by the Government of the United States of America for adoption at the fifteenth session of the Conference of the Parties, 6 June 2009, FCCC/CP/2009/7.

¹⁹⁵ On the techniques for the implementation of the CCR see among many others: FREESTONE, D., STRECK, C. (eds.), *Legal Aspects of Implementing the Kyoto Protocol Mechanisms*, Oxford: Oxford University Press, 2005 (a second edition of this book is forthcoming in 2009).

¹⁹⁶ See DE CONNICK, H.C., HAAKE, F., VAN DER LINDEN, N.H., *Technology transfer in the Clean Development Mechanism*, (Energy Research Centre at The Netherlands), January 2007, citation refers to the abstract.

types, project developers appear to have a choice among a number of domestic and/or foreign technology suppliers.¹⁹⁷

Thus, there is some evidence that, aside from its operation as a flexibility implementation mechanism, is also contributing to the transfer of technology to developing countries, which in turn fosters compliance by these latter countries with their (loose) obligations under the Kyoto Protocol.

Other “managerial compliance” techniques would include, for instance, technology transfer through the Subsidiary Body on Implementation (SBI),¹⁹⁸ the financial assistance mechanisms available through the World Bank's Global Environmental Facility¹⁹⁹ or the Adaptation Fund currently being set up,²⁰⁰ or the use of COP decisions to revise the substantive obligations arising out of the Kyoto Protocol.²⁰¹ Other techniques discussed above are, at least for the time being, less relevant from the purpose of dealing with scientific uncertainty. This would be the case of the non-compliance procedure developed through COP decisions on the basis of article 18 of the Kyoto protocol,²⁰² to the extent that only Annex I (developed and transitional) countries have undertaken quantified commitments, and such countries are as a rule less challenged by the scientific and technological requirements for complying with their obligations under the CCR.

This said, another legal technique underlying this latter mechanism, namely regime development through law-making treaty bodies, remains very relevant for our purpose. An interesting example of how this technique may operate is given by the decision proposals put forward by the Chair of the AWG-KP in a May 2009 document compiling different proposals from States parties to the Kyoto Protocol. The section devoted to the scope of this document stresses that some of its annexes (I to IV) “cover only those proposals which Parties consider would not trigger amendments to the Kyoto Protocol”.²⁰³

Annex III includes, however, some proposals which would significantly modify the commitments undertaken by developed countries under the Kyoto Protocol in response to new scientific evidence provided in the IPCC Fourth Assessment Report. Thus, a COP decision proposal in connection with greenhouse gases, sectors and source categories seeks to reaffirm that “the actual emissions of hydrofluorocarbons, perfluorocarbons and sulphur hexafluoride, including new species identified by the Intergovernmental Panel on Climate Change in its Fourth Assessment Report, should be estimated, where data are available, and used for the reporting of emissions.”²⁰⁴ Another COP decision proposal in Annex III states the following:

“[the COP] [d]ecides that for the purposes of this agreement, the global warming potentials used to calculate the carbon dioxide equivalence of anthropogenic emissions by sources and removals by sinks of greenhouse gases listed in Annex A to the Kyoto Protocol shall be those provided by the Intergovernmental Panel on Climate Change in its Fourth Assessment

¹⁹⁷ See SERES, S., *Analysis of Technology Transfer in CDM Projects*, Report prepared for the Registration & Issuance Unit CDM/SDM (UNFCCC), December 2008, citation refers to the abstract.

¹⁹⁸ See Decision 4/CP.3.

¹⁹⁹ See *UNEP Training Manual on International Environmental Law*, chapter 6.

²⁰⁰ See Decision COP/MP3/1.

²⁰¹ See A text on other issues outlined in document FCCC/KP/AWG/2008/8, 14 May 2009, FCCC/KP/AWG/2009/8.

²⁰² This procedure is based on the work of a joint working group (JWG) established in COP-4, in 1998, which led to the negotiations in COP-6 bis (the “Bonn Agreement”) and COP-7, in 2001. After the Kyoto Protocol entered into force in 2005, the COP-11/CMP-1 “approved and adopted” the project, with essentially the same content as before (Decision -/CMP.1). As the compliance mechanism entitled the “Enforcement Branch” of the “Compliance Committee” to adopt binding measures, the mechanism should have required ratification by the State parties, in accordance with art. 18 of the Protocol. The situation has so far remained ambiguous, but has not prevented the mechanism from operating in practice.

²⁰³ See A text on other issues outlined in document FCCC/KP/AWG/2008/8 ... , par. 8.

²⁰⁴ *Id.*, p. 26.

Report based on the effects of the greenhouse gases over a 100-year time horizon. Any revision to a global warming potential by the Intergovernmental Panel on Climate Change subsequent to the Fourth Assessment Report or revisions of the approach used to calculate carbon dioxide equivalence shall apply only to commitments under Article 3 of the Kyoto Protocol in respect any commitment period adopted subsequent to that revision”²⁰⁵

Should a decision such as the two proposals I have just mentioned be adopted by the COP, serving as the Meeting of Parties to the Kyoto Protocol, that would amount to a scientific updating of the regime rules to take into account new evidence.

(4) Reparation

The applicability of the concept of reparation to the international regulation of climate change requires some preliminary clarifications. In the current state of the international CCR, the focus is clearly on prevention (through mitigation and compliance) rather than on reparation. There is, of course, an important component of reparation in the adaptation strategies contemplated by the CCR, but such component cannot easily be equated with the ordinary concept of reparation in general international law, as it is reflected by article 34 of the ILC Articles. This article contemplates three different forms of reparation, namely restitution, compensation and satisfaction. Only the first two forms are relevant for our discussion. Indeed, the victims of a violation of a rule potentially covering climate change issues (e.g. the principle *sic utero tuo ut alienum non laedas*,²⁰⁶ norms protecting cultural heritage²⁰⁷ as well as indigenous or other human rights²⁰⁸) may bring an action to request that the situation preceding the violation be reestablished and/or that any damages suffered be compensated. There is currently an increasing number of cases (mainly at the domestic level) where claims connected with climate change have been pursued in such a manner.²⁰⁹ This has come to be known as “climate change litigation”.²¹⁰

²⁰⁵ *Id.*

²⁰⁶ This principle underlies Principles 21 of the Stockholm Declaration and 2 of the Rio Declaration and has been considered by the International Court of Justice to be part of general international law, see *Legality of the Threat or Use of Nuclear Weapons*, Advisory Opinion, *I.C.J. Reports 1996*, p. 241, par. 29.

²⁰⁷ The World Heritage Convention has received several petitions raising the issue of the impact of climate change on the deterioration of certain World Heritage Sites (the Sagarmatha National Park in Nepal, Australia’s Great Barrier Reef and the city of Venice in Italy) protected by the UNESCO World Heritage Convention of 16 November 1972. The reaction has taken the form of “A Strategy to Assist States Parties to Implement Appropriate Management Responses” (<http://whc.unesco.org/uploads/news/documents/news-262-2.doc>) and of a “Policy document on the impacts of climate change on World Heritage properties, adopted by the UNESCO Assembly in October 2007 (Document WHC-07/16.GA/10 adopted by the 16th General Assembly of States Parties to the *World Heritage Convention*) and published in June 2008 (<http://whc.unesco.org/uploads/activities/documents/activity-397-2.pdf>).

²⁰⁸ This was argued in the at pages 70 et seq., with reference, *inter alia*, to the findings of the American Court of Human Rights in the *Awas Tingni* case. See *Petition to the Inter American Commission on Human Rights seeking Relief from Violations resulting from Global Warming caused by Acts and Omissions of the United States (the Inuit Petition)*, available at http://www.earthjustice.org/library/legal_docs/petition-to-the-inter-american-commission-on-human-rights-on-behalf-of-the-inuit-circumpolar-conference.pdf.

²⁰⁹ Shi-Ling Hsu identifies three main categories of actions brought: (1) Actions against governmental entities for acts or omissions relating to greenhouse gas emissions (this category includes *inter alia* the well-known cases *Massachusetts v. EPA*, before the United States Supreme Court, and the petition filed by the Inuit Circumpolar Conference against the United States before the Inter-American Commission on Human Rights); (2) Actions against governmental entities to force procedural consideration of global climate change impact (this category includes several domestic suits brought against regulatory agencies in the United States, Germany, Australia and New Zealand); (3) Civil lawsuits against private entities directly responsible for greenhouse gas emissions (this category includes *inter alia* *Comer v. Murphy Oil, USA*, an important class action brought by victims of Hurricane Katrina against oil and gas companies, electric utilities, and other companies in the United States, HSU, S.-L., *A Realistic Evaluation of Climate Change Litigation Through the Lens of a Hypothetical Lawsuit*, in *University of Colorado Law Review*, vol. 79/3, 2008, pp. 708-715.

Climate change litigation presents its practitioners with several challenges closely related to the specificities of the global warming phenomenon. From evidentiary rules to substantive issues of liability and causation, the difficulties involved in climate change litigation are largely dependent upon the complexity of the scientific processes linking (i) the emissions of a particular State, industry or company, and global warming, and (ii) global warming and the damage allegedly suffered or about to be suffered by the claimants. Here, I would like to discuss these two difficulties in the light of a number of examples.

Shi-Ling Hsu makes reference to different hypotheses. One would involve an action against major polluters (States or companies) by Tuvalu or another small island threatened in its existence by rising sea levels caused by climate change. The plausibility of such an hypothesis was confirmed in 2002, when Tuvalu actually raised the possibility of bringing an action against Australia and the United States on this grounds.²¹¹ Another hypothesis would be an action by the Inuit people against either the United States or polluting companies. Again, this hypothesis is far from representing an academic exercise, as evidenced by the petition filed in December 2006 by the Inuit Circumpolar Conference against the United States before the Inter-American Commission on Human Rights. Hsu focuses, however, on an action brought by the Inuit people against electricity companies on the bases of the common law tort of nuisance. For the purposes of my analysis, these hypothesis are useful because they show the scientific challenges that should be overcome for climate change litigation to become a regular cause of action.

The first and perhaps most important challenge is that of establishing causation. There are millions of sources of GHG emissions and the relation between each one of them and both global warming and its effects is virtually impossible to circumscribe. This is typically why expert reports would not as such be sufficient in the absence of a legal theory capable of bridging the gap between correlation and causation. The Inuit Petition stresses the correlation between the United States estimated historical emissions and 30% of the observed temperature increase of approximately 0,6° Celsius degrees in the period from 1850 and 2000.²¹² The petitioner acknowledges however that “the actual correlation between cumulative emissions and temperature increase is subject to some uncertainty.”²¹³ And even if it were not, the causation theories used in general international law are admittedly not adapted to substitute correlation for causation. This is therefore a matter of law and policy, rather than a pure scientific issue, at least under the current understanding of the climate systems as it arises from the IPCC Fourth Assessment Report. To make this point clearer one may refer to the thought experiment developed by Ronald Dworkin to illustrate the role of moral considerations in adjudication. Dworkin describes an imaginary case, that of Mrs. Sorenson:

“Mrs. Sorenson suffered from rheumatoid arthritis and for many years took a generic drug – inventum – to relieve her suffering. During that period inventum was manufactured and marketed under different trade names by eleven different pharmaceutical companies. In fact the drug had serious and undisclosed side-effects, of which the manufacturers should have known, and Mrs. Sorenson suffered permanent cardiac damage from taking it. She was unable to prove which manufacturer’s pills had actually injured her. She sued all the drug companies who had manufactured inventum, together, and her lawyers argued that each of them was liable to her in proportion to its share of the market in the drug over the years of her treatment. The drug companies replied that the plaintiff’s request was entirely novel and contradicted the long-established premise of tort law that no one is liable for injury he has

²¹⁰ For a recent overview of this emerging field see: BURNS, W.C.G., OSOFSKY, H.M. (eds.), *Adjudicating Climate Change. State, National and International Approaches*, Cambridge: Cambridge University Press, 2009.

²¹¹ See the news article “Tuvalu Steps Up Threat to Sue Australia, US”, by Kalinga Seneviratne, available at: <http://www.tuvaluislands.com/news/archived/2002/2002-09-10.htm>.

²¹² See Inuit Petition, pp. 68-69.

²¹³ *Id.*, p. 69.

not been shown to have caused. They said that since Mrs. Sorenson could not show that any particular defendant had injured her or even manufactured any of the inventum she took, she could recover against none of them”²¹⁴

Dworkin’s example is particularly apposite for the analysis of climate change litigation. First, one could without much difficulty substitute the Inuit people or Tuvalu for Mrs. Sorenson as well as the major historic polluters (either States or companies) for the drug manufacturers in this example. As in the Sorenson’s case, it cannot be determined whose emissions (drug) actually caused the damage (cardiac dysfunctions). What is clear is that emitters (drug companies) should have known, at least since the 1980s based on precautionary reasoning, that their activities have an impact on climate (undisclosed side effects of inventum). Second, the solution to the dilemma raised by the Sorenson case or in climate change litigation must be sought not in scientific certainty (for instance, through an expertise which would be capable of distinguishing among the different types of inventum manufactured by different companies and then link one of these to the Mrs. Sorenson’s cardiac dysfunctions) but in policy and law capable of dealing with scientific uncertainty. In Dworkin’s view, the adjudicatory body faced with such a case should “try to identify general principles that underlie and justify the settled law of product liability, and then apply those principles to this case.”²¹⁵ It may conclude that the drug companies are right or, rather, that Mrs. Sorenson is right, mainly on the basis of a policy assessment. The trouble with climate change litigation is that there does not seem to be a “settled law of climate change” the underlying principles of which could be sought. Most climate change litigation is based on specific statutes and common law theories, such as nuisance, which may deal with such a causation problem.²¹⁶ But the question remains open in international law.²¹⁷ This said, despite States’ general reluctance towards international rules imposing strict liability on them, the climate change litigation risks at the level of private operators is becoming increasingly recognized.²¹⁸

A second challenge that would have to be overcome for climate change litigation to become fully operational concerns the link between global warming and the damage claimed. Here, scientific expertise is critical. The impact of an overall increase in temperature would not be equally visible in every part of the world. That was a major point made in the Inuit Petition. In an interview given in connection with her appearance before the Inter-American Commission on Human Rights, the former chair of the Inuit Circumpolar Conference declared that:

“[the commission] wanted to hear the legal aspects, the broader issues of the connection between human rights and climate change, so we were able to testify on the broader larger picture of climate change and human rights, not just for Inuit but for vulnerable peoples of

²¹⁴ DWORKIN, R., Hart’s Postscript and the Point of Political Philosophy, in DWORKIN, R., *Justice in Robes*, London/Cambridge MA: Belknap/Harvard University Press, 2006, p. 141.

²¹⁵ DWORKIN, R., *Hart’s Postscript* ... , p. 143.

²¹⁶ Dworkin refers to a real case involving market-share liability, namely *Sindell v Abbott Labs*, 607 P.2d 924, 935-38 (1980), *Id.*, p. 283 (endnote 3). Hsu discusses cases that have imposed liability of a single polluter despite the presence of multiple contributors to the pollution problem, such as *California v. Gold Run Ditch & Mining*, 4 P.1152 (Cal. 1884); *Harley v. Merrill Brick Co.*, 48 N.W. 1000 (Iowa 1891); *Lockwood v. Lawrence*, 77 Me. 297 (Me. 1885); *Warren v. Parkhurst*, 92 N.Y.S. 725 (1904); *Woodyear v. Shaefer*, 57 Md. 1, 3(7)(Md. 1881); *Michie v. Great Lakes Steel Div.*, 495 F.2d 213, 215 (6th Cir. 1974); *Illinois v. Milwaukee*, 599 F.2d 151 (7th Cir. 1979), vacated 451 U.S. 304 (1981); *O’Connor v. Raymark Indus.*, 518 N.E. 2d 510, 513 (Mass. 1988), cited in HSU, S.-L., *A Realistic Evaluation of Climate Change Litigation* ... , pp. 749-751.

²¹⁷ See *supra* the discussion of facilitated liability in international law.

²¹⁸ The issue is starting to be introduced in the filings of publicly quoted companies, as noted by two recent reports, one commissioned by the Centre for Energy and Environmental Security, the Environmental Defense Fund and Ceres (DORAN, K., QUINN, E., ROBERTS, M., *Reclaiming Transparency in a Changing Climate: Trends in Climate Risk Disclosure by the S&P 500 from 1995 to the Present*, 2009) and the other by The Corporate Library (*Climate Risk Disclosure in SEC Filings*, June 2009).

the world [...] Most people have not made that connection and I think unless you're living in that situation where you see that automatic connection of an erosion or a destruction of your way of life it's hard to see that connection"²¹⁹

The Inuit Petition was supported by the findings of several scientific reports,²²⁰ including the 2004 Arctic Climate Impact Assessment, prepared by more than 300 scientists from 15 countries as well as six indigenous peoples organizations.²²¹ The Inter-American Commission did not take position on the merits of the Inuit Petition.²²² It is therefore unclear whether the scientific evidence currently available on the impact of global warming on the Arctic environment would be sufficient for litigation purposes before an international tribunal. Given the considerable uncertainty regarding the anticipated rise of the sea level, it is also unclear the extent to which small island nations would be capable of establishing a prejudice before an international tribunal.

In the light of these and other challenges, climate change litigation may admittedly not be an entirely satisfactory regulatory approach to scientific uncertainty in climate change issues.²²³ It has however the merit of making the urgent need for such regulation more concrete as well as to foster what is perhaps one of the most promising avenues for the implementation of IEL, namely decentralized enforcement.

CONCLUSION

Throughout the years, international environmental regimes have developed several techniques to deal with the scientific uncertainty that often characterizes their object of regulation. Those identified in this study are in my view the most significant ones, but there may be others. Giving a complete picture of such techniques is particularly difficult because (i) the same techniques may operate in different manners depending on the stage of regime development where they intervene (e.g. the precautionary principle as an advocacy tool or as an argument for shifting the burden of proof), and (ii) many of these techniques have many functions within an environmental regime, so one cannot exclude that a technique so far used for another unrelated purpose may at some point be mobilized to deal with scientific uncertainty (an example of such a general purpose technique is law-making by treaty bodies).

The impact of scientific uncertainty on the emergence and development of a regime is seldom a simple issue of scientific relevance. Different scientific views of an environmental issue are favored, and sometimes even fostered, by competing interest groups. States are also led to take position on such issues on the basis of both scientific evidence and other socio-economic or strategic considerations. To be effective or, at the very least, to remain relevant, international environmental regimes must tackle these daunting challenges. The techniques I have surveyed help face such challenges, with varying degrees of success from one regime to the other, as well as through time. Here, I would like to briefly summarize what I view as the main conceptual findings of this study.

²¹⁹ Activist tells U.S. panel Inuit lifestyle at risk (CTV.ca news), interview available at: http://www.ctv.ca/servlet/ArticleNews/story/CTVNews/20070301/arctic_warming_070301?s_name=Autos&no_ads=.

²²⁰ See Inuit Petition, Part IV, sections B and C.

²²¹ Available at: www.acia.uaf.edu.

²²² The Inuit Petition has stirred interest in the link between climate change as human rights. Interestingly, the United Nations Human Rights Council decided to study this issue further ("Human Rights and Climate Change", Resolution 7/23, of 28 March 2008), and later took position on this issue ("Human Rights and Climate Change", Resolution 10/4, of 25 March 2009).

²²³ For an analysis of climate change litigation as regulation see: STEWART, R., A New Generation of Environmental Regulation, in *Capital University Law Review*, vol. 29, 2001, pp. 21-182.

At the advocacy stage, when the difference between uncertainty and risk is not yet entirely clear, precautionary reasoning plays an important role in pushing advocacy efforts forward. The impact of precautionary reasoning seems to be a function of the public perception of the risks, even when such perception is not entirely supported by scientific evidence. This hypothesis is illustrated by the adoption of the Biosafety protocol, as an extension of the biodiversity regime. Conversely, it may happen that the public has difficulty understanding the need and urgency of taking action with respect to an environmental issue despite the growing scientific evidence pointing in this direction, as illustrated by the emergence of the climate change regime.

The path leading to the emergence of a regime is often reflected in the subsequent design of its basic architecture. The specific balance between procedural and substantive contents in the founding instrument of a regime seems to be the key in this respect. The Vienna Ozone Convention was adopted before major scientific breakthroughs showed the need and urgency to regulate ozone depleting substances. As a result, it had little substantive content, but it laid solid foundations for a framework-protocol approach that would enable the regime to react to subsequent scientific discovery, as was the case of the Montreal Protocol and its subsequent amendments and adjustments. By contrast, the design phase of the UNFCCC shows a different balance between procedural and substantive components, which can be explained by the considerable advance in the understanding of climate change processes catalyzed by the work of the IPCC.

Design features are naturally critical for the subsequent implementation of an environmental regime. Thus, substantive decision-making by treaty bodies is important for specifying/expanding the scope of the obligations undertaken by State parties in response to scientific developments, as illustrated by the adjustment of the ozone depleting potentials contemplated by the Montreal Protocol or by the initiative taken by the COP of the POP Convention to include nine new chemicals in the list of controlled substances. This latter example also shows the role of scientific advisory bodies created at the design stage. Indeed, the initiative of the POP Convention's COP followed the updating of the risk profile of those nine chemicals by the POP scientific advisory body. The need to deal with scientific uncertainty has also led States to recognize that a regime cannot simply impose obligations and expect its participants to comply but may also have to provide assistance for States to manage the scientific and technological challenges raised by such compliance. Managerial approaches to compliance (including non-compliance procedures and technical/financial assistance) recognize that at least part of the problem is that some States do not have the resources to understand or manage the risks associated with, for instance, chemicals or hazardous wastes. This is also the starting-point of other techniques such as prior informed consent or environmental impact assessment, which seek to ensure that States have at least the basic information necessary to know what they are doing when dealing with dangerous substances or activities.

Most of the techniques used in environmental regimes to handle scientific uncertainty are aimed at preventing environmental damage. However, scientific uncertainty also raise many challenges when such damage has occurred or is imminent, and the victims seek reparation. This is mainly because environmental damage requires complex evidentiary procedures and, even when such procedures are managed effectively, the scientific processes that must be established are often too difficult or indirect to fall within the scope of the traditional legal concepts of causation, damage or liability. This is why in some cases, environmental regimes provide for facilitated liability (as in the fields of marine pollution and nuclear activities) or adjusted evidentiary rules (as in the PCA Optional Rules).

The extrapolation of at least some of these techniques to other fields of international law where scientific uncertainty is recurrent should of course be assessed on a case-by-case basis. However, the possibility that a relatively recent field of international law such as IEL

may contribute its techniques to some of its elders constitutes additional evidence that IEL has by now reached maturity.