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The Arduous Process of Climate Change Negotiations: How Science Can Facilitate the Desired Outcome

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Abstract

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Key words: science, climate change, UNFCCC, uncertainty, risk

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The arduous process of climate change negotiations: How science can facilitate the desired outcome

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Abstract

Effective interaction between climate science and policy is important for moving climate negotiations forward to reach an ambitious global climate change deal. Lack of progress in the United Nations Framework Convention on Climate Change (UNFCCC) negotiations during recent years is a good reason for taking a closer look at the process of climate science–policy interaction to identify and eliminate existing shortcomings hindering climate policymaking. This paper examines the current state of climate science–policy interaction and suggests ways to integrate scientific input into the UNFCCC process more effectively. Suggestions relate to improvement in institutional structures, processes and procedures of the UNFCCC and the Intergovernmental Panel on Climate Change (IPCC), quality of scientific input, credibility of scientific message and public awareness of climate change.

Key words: climate science, IPCC, climate negotiations, UNFCCC.

1. Introduction

Since the first successful decade of UN climate negotiations leading to the conclusion of the United Nations Framework Convention on Climate Change (UNFCCC) and its Kyoto Protocol, the global community has desperately been looking for ways to intensify the negotiating process aimed at striking a succeeding deal, which could ensure a safe pace of change in the climate system for future life on the planet. International climate negotiations apparently show signs of ossification: policymakers seem to have stopped learning from each other, making an agreement impossible.[2] In this regard, a constant flow of scientific and technical information, with its further processing into decisionmaking, is an important aspect of learning in international negotiations.[3] It is therefore worthwhile to examine the current state of climate science–policy interaction and identify issues, which might hamper the effective scientific input in climate policymaking required for the attainment of an ambitious negotiated outcome.

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[2] Depledge (2006), pp. 2 ff.

[3] Ibid., p. 3.

The input of scientific information to climate policy-making is crucial. It was due to scientists and their research on climate change that the world community turned its attention to the problem of climate change caused by human activities.[4] The efforts to fight climate change were eventually brought to the international level and culminated in the adoption of the United Nations General Assembly (UNGA) resolution on climate change and the conclusion of the UNFCCC and its Kyoto Protocol. Today, scientific research continues to inform international negotiations on the international climate regime, as well as national and regional climate policies.

However, the message that climate scientists send to policymakers is not entirely reflected in the policy response. The current international climate regime established under the UNFCCC with its normative and policy framework falls far short of ensuring the tolerable level of global warming of 2 °C advocated by scientists.[5] While the discrepancy between the scientific message and the policy response is mainly explained by the complexity and high costs of solutions to climate change[6], it might also be a result of the lack of effectiveness of science–policy interaction. In what follows, we will examine the extent to which the deficiency of scientific input is a consequence of structural and procedural shortcomings of the IPCC and the UNFCCC, as well as some other institutional failures.

2. Description of the current status

2.1. Input of science to international climate policymaking

Climate science played a crucial role in pushing the global community to act on climate change. Scientific research, which long preceded the reaction of the international community of policymakers, was essentially the first response to climate change.[7] Research on anthropogenic climate change was first conducted by individual scientists, and then taken up by the Intergovernmental Panel on Climate Change (IPCC) established under the umbrella of the United Nations (UN).[8]

The UN mandated the IPCC "to provide internationally co-ordinated scientific assessments of the magnitude, timing and potential environmental and socio-economic impact of climate change and realistic response strategies".[9] In defining the scope of its activities, the IPCC commits itself to concentrate *inter alia* "on actions in support of the UN Framework Convention on Climate Change process".[10]

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[4] Epps and Green (2010), pp. 44–45.
[5] Bausch and Mehling (2011), p. 10. The recent climate research signals that the climate change action should be stronger and more urgent than has so far been reflected in the Kyoto Protocol and other negotiated documents. With the current scale of global action, climate change is approaching an increase in temperature of 3.5–6 degrees Celsius by 2035 compared to the safe level of 2 degrees Celsius suggested in scientific assessments. See IEA (2011).
[6] Ibid., pp. 8-9.
[7] Research in human-induced climate change started in the middle of the twentieth century. In 1957, Roger Revelle and Hans Suess from the Scripps Institute of Oceanography in California expressed the first scientific concern about the effect of combustion of fossil fuels in human activities on the concentration of greenhouse gas (GHG) emissions in the atmosphere. See Houghton (2009), p. 23.
[8] See UNGA Resolution 43/53 of 6 December 1988.
[9] Ibid., para. 5.
[10] Principles Governing IPCC Work, para. 1.

The main outcomes of the IPCC's work are its assessment reports issued with an interval of five to seven years. To date the IPCC has produced four assessment reports, and the fifth one (AR5) is expected for 2014.[11] Importantly, the IPCC does not conduct research itself but collects and assesses scientific work on different disciplines, which relates to climate change, including social sciences.[12] It also provides scientific support to the work of the UNFCCC by making available methodological information on emissions inventories and other technical issues, which is used by governments and is at the core of the international climate regime.

The IPCC is a unique organization to the extent that it has a scientific as well as a political character. While scientists collect and assess scientific information related to climate change in assessment reports[13], politicians adopt the reports. The main decisionmaking body of the IPCC is the panel composed of government delegates,[14] who decide on the content of assessment reports, and approve, adopt and accept them.[15] Despite the participation of government representatives in its work, the IPCC positions itself as a policy neutral organization.[16] The IPCC does not give direct recommendations for the UNFCCC negotiators. Synthesis reports "address a broad range of policy-relevant but policy-neutral questions", while a summary for policymakers, which is usually part of any IPCC report (assessment, special or synthesis) "provides a policy-relevant but policy-neutral summary of that Report".[17] Such a neutral position of IPCC fits the conventional expectation that scientific results are impartial with respect to politics and policy.[18]

Notwithstanding its non-prescriptive character, IPCC reports have a considerable impact on the climate policymaking process.[19] The drafting of the UNFCCC was largely guided by the information contained in the First Assessment Report released in

[11] For a time schedule and details of preparation of the Fifth Assessment Report, see the official website of the IPCC at http://www.ipcc.ch/

[12] There are three IPCC Working Groups working on assessment reports in their respective fields of climate change-related science. Each Working Group issues an assessment report, which constitutes part of the consolidated assessment report. In addition, there are the Task Force on National Greenhouse Inventories, which works on developing internationally-accepted methodologies and software for calculating and reporting countries' emissions, and the IPCC Task Group on Data and Scenario Support for Impacts and Climate Analysis, which manages the IPCC data supporting the work of international scientists. See the IPCC official site at http://www.ipcc.ch/working_groups/working_groups.shtml

[13] Assessment work is done by thousands of scientists from different regions of the world, who work on chapters of assessment reports from their country-based offices on a voluntary (i.e. non-paid) basis.

[14] The IPCC is represented by governments of more than 120 countries, which are members of the UN and WMO.

[15] Paras. 4.4–4.6 of Appendix A to the Principles Governing IPCC Work: Procedures for the Preparation, Review, Acceptance, Adoption, Approval and Publication of IPCC Reports. See also WBCSD-Ecofys (2010), p. 41.

[16] Para. 4 of the Principles Governing IPCC Work states: "IPCC reports should be neutral with respect to policy, although they may need to deal objectively with scientific, technical and socio-economic factors relevant to the application of particular policies".

[17] Paras. 2 and 4.6.1 of the Procedures for the Preparation, Review, Acceptance, Adoption, Approval and Publication of IPCC Reports. It should also be mentioned that IPCC reports do not commission any new research either. See WBCSD-Ecofys (2010), p. 41.

[18] On the debate about the appropriateness of advocacy by environmental scientists, see Nelson and Vucetich (2009).

[19] Kohler et al. (2012), p. 67.

1990.[20] Since the conclusion of the UNFCCC, IPCC reports have been an important source of information for guiding decisions taken at the UNFCCC. In the current climate change negotiations, the Parties recognise the urgency of climate change action indicated in the Fourth Assessment Report (AR4).[21] A post-Kyoto climate treaty to be completed by 2015 would have to take into account the updated IPCC assessment of climate science and of climate change impacts. The Durban Platform, which launched a process for moving towards a post-Kyoto agreement, states that "an agreed outcome with legal force … shall raise the level of ambition and shall be informed, inter alia, by the Fifth Assessment Report of the Intergovernmental Panel on Climate Change…"[22] The Parties also clearly emphasized the role of the IPCC as a source of methodological information.[23]

It should be noted that the IPCC is a major but not the only source of scientific information for the UNFCCC. Scientific input is also provided by other stakeholders, including individual scientists, and business and environmental non-governmental organizations (BINGOs and ENGOs).[24] For instance, scientists are often included as advisors in official delegations of UNFCCC parties to Conferences of the Parties (COPs), and science is increasingly used as a basis for forming positions of individual countries in climate negotiations).[25] Business stakeholders actively participate in various COP side events where they communicate their positions, and their role in informing the UNFCCC negotiating process is increasing.[26] While the input of scientists is primarily needed for formulating strategies, the input of business is vital for implementing climate policies, especially those related to mobilization of financial resources to fight climate change, including investment and technology transfer. Also different international organizations (IOs) provide technical information and expertise to the UNFCCC. The UNFCCC, for instance, uses UNEP guidelines for reporting on

[20] In fact, scientific evidence of climate change as a global phenomenon, provided by the IPCC, was the main driving force of the establishment by the UN General Assembly of the Intergovernmental Negotiating Committee in 1990, which produced the draft framework convention at the UN Conference on Environment and Development in Rio de Janeiro in 1992. See Miller (2004), p. 50. It should however be noted that this was not the first time in the history of MEAs that scientific research in the area had preceded and stimulated international policymaking and action. In this sense, the inception of the international climate regime followed the model of the international regime of ozone layer protection where scientific work on the problem of the ozone layer preceded the conclusion of the Vienna Convention for the Protection of the Ozone Layer in 1985 and the Montreal Protocol in 1987. See Yamin and Depledge (2004), p. 466.

[21] See the Preamble to the Decision 1/CP.13 on the Bali Action Plan available at http://unfccc.int/resource/docs/2007/cop13/eng/06a01.pdf#page=3

[22] See para. 6 of the COP 17 Decision on the Establishment of an Ad Hoc Working Group on the Durban Platform for Enhanced Action, 1/CP.17, available at http://unfccc.int/resource/docs/2011/cop17/eng/09a01.pdf

[23] The Kyoto Protocol endorses use of methodologies "accepted by the IPCC" in Article 3.4 in relation to the development of modalities, rules and guidelines for calculating emissions in the land-use change sector and forestry, in Article 5.2 in relation to the establishment of national systems of estimation of emissions, and in Article 5.3 in relation to the calculation of global warming potential and the carbon dioxide equivalence of GHG emissions. Emissions inventory methodologies are developed in the IPCC by the IPCC Task Force on National Greenhouse Gas Inventories.

[24] On the role of different stakeholders in providing scientific input to the UNFCCC, see Lohan (2006), pp. 280–290.

[25] On the increasing role of scientists in the formation of the negotiation position of Russia in the UNFCCC negotiations, see Andonova and Alexieva (2012 forthcoming), p. 14.

[26] De Sépibus and Holzer (forthcoming).

vulnerability and adaptation, and the expertise of the UN Food and Agriculture Organization (FAO) on land-use, land-use change and forestry.[27]

2.2. The IPCC–UNFCCC interaction process

Scientific input to an environmental regime is generally supplied through two mechanisms: scientific assessments and scientific advice.[28] Scientific assessments involve the collection, evaluation and synthesis of scientific information and evidence; this is usually done by external organizations. Scientific advice consists of science-based recommendations on various policy issues commonly provided by an internal scientific advisory body of a multilateral environmental agreement (MEA).[29] In the climate regime, scientific assessments are mainly contributed by IPCC, while scientific and technical advice on the implementation of the Convention is provided by the UNFCCC Subsidiary Body on Scientific and Technological Advice (SBSTA), which also serves as the main channel for processing IPCC assessments and their incorporation into UNFCCC decisions.

The SBSTA is one of the permanent subsidiary bodies of the UNFCCC. It is a political body, as it is composed of UNFCCC national delegates negotiating on technical issues of climate policy rather than producing or assessing climate science. It is mandated to "provide the COP with timely information and advice on scientific and technological matters relating to the Convention".[30] Thus, in contrast to the IPCC, the SBSTA is authorized to directly advise climate negotiations. The SBSTA obtains scientific information from outside (including from IPCC reports) and makes it available for the COP decisionmaking process through its session reports, thus serving as a bridge between climate science and climate policy.[31]

The main interaction between the IPCC and the SBSTA occurs at the stage of defining the scope of IPCC reports, when the SBSTA gives its input in defining a set of policy-relevant questions to be addressed in research assessment.[32] The SBSTA is particularly involved in defining the content of synthesis reports, which combine the main findings of the three Working Groups reports with an emphasis on further application of the information to the policy.[33] The SBSTA also commissions the IPCC to prepare small reports on particular issues of climate change, either already covered by assessment reports (technical papers) or totally new ones (special reports). Furthermore, representatives of the UNFCCC Secretariat attend IPCC meetings at the invitation of IPCC chairs, while IPCC staff attends SBSTA sessions.[34] IPCC representatives are

[27] Yamin and Depledge (2004), p. 485. Scientific and technological support is also provided by the UNFCCC permanent bodies, such as the Subsidiary Body for Scientific and Technological Advice (SBSTA), whose role is discussed below.
[28] Glaser and Bates (2011), p. 5.
[29] It should be noted that in some MEAs, scientific assessments are also made by internal technical bodies, as is the case of the Scientific Assessment Panel of the Montreal Protocol.
[30] Art. 9.1 of the UNFCCC.
[31] Yamin and Depledge (2004), p. 465.
[32] The IPCC Third Assessment Report was the first one to consider input or requests on structure and content from the SBSTA.
[33] Importantly, government delegates attending IPCC plenaries are usually the same people, who work in the SBSTA.
[34] Yamin and Depledge (2004), p. 472.

regularly invited by the Chair of the SBSTA to speak at its sessions on various technical issues,[35] and the IPCC chair occasionally speaks at UNFCCC COP sessions presenting the latest IPCC reports and participating in question and answer sessions.[36] And what's more, the UNFCCC as a whole contributes to the IPCC budget together with the UNEP and the WMO and in addition to voluntary contributions from its member countries.[37]

2.3. Criticism of scientific input

Notwithstanding the long established interaction between climate science and policy, there is need for improvement. The IPCC input to the UNFCCC process has recently faced a strong wave of criticism, which was provoked by a number of mistakes made in AR4 and the assessment process itself. The IPCC, for example, admitted that a mistake occurred in the assessment of the rate of melting of Himalayan glaciers by Working Group II.[38] The IPCC attributed this mistake to "poorly substantiated estimates of rate of recession and date for the disappearance of Himalayan glaciers" and stated that the mistake happened because "the clear and well-established standards of evidence, required by the IPCC procedures, were not applied properly".[39]

Another acknowledged mistake concerns the estimation of the territory of the Netherlands that lies under sea level.[40] This mistake was eventually corrected by the Netherlands Environmental Assessment Agency, which was the source of the information.[41] The mistake was blamed on the Dutch Ministry of Transport, which confused the figures in the publications used by the Netherlands Environmental Assessment Agency and eventually by the IPCC Working Group II.[42]

These few errors in AR4 were enough to spur a new wave of climate science scepticism which had a negative influence on the general motivation and the level of ambition at the international climate talks. The scepticism was further fuelled by the

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[35] It should be noted however that the IPCC representatives never participate in climate negotiations; they always adopt a neutral position with regard to politics of climate change. See Yamin and Depledge (2004), p. 480.
[36] Lohan (2006), p. 276.
[37] Yamin and Depledge (2004), p. 474.
[38] With a reference to the World Wide Fund for Nature report, which was based on an unpublished source, para. 2 of section 10.6.2 of the Working Group II report states: "Glaciers in the Himalaya are receding faster than in any other part of the world (see Table 10.9) and, if the present rate continues, the likelihood of them disappearing by the year 2035 and perhaps sooner is very high if the Earth keeps warming at the current rate. Its total area will likely shrink from the present 500,000 to 100,000 km2 by the year 2035 (WWF, 2005)".
[39] See IPCC Statement on the Melting of Himalayan Glaciers of 20 January 2010, available at http://www.ipcc.ch/pdf/presentations/himalaya-statement-20january2010.pdf.
[40] The Working Group II report in the 3rd paragraph of section 12.2.3 on current adaptation and adaptive capacity in Europe, using the data of the Dutch Environmental Assessment Agency, contains a statement that 55% of the territory of the Netherlands lies below sea level, whereas the correct statement would be that 55% of the territory is susceptible to floods, as 26% of the territory is below sea level and another 29% is susceptible to river flooding.
[41] See "Correction wording flood risks for the Netherlands in IPCC report", available at http://www.pbl.nl/en/dossiers/Climatechange/content/correction-wording-flood-risks.
[42] See http://www.volkskrant.nl/vk/nl/2672/Wetenschap-Gezondheid/article/detail/979214/2010/02/20/Onder-waterniveau-maar-de-vraag-is-nog-even-welk-water.dhtml.

leakage of emails from the Climatic Research Unit of the University of East Anglia (United Kingdom) in the run-up to the Copenhagen COP in November 2009. The private correspondence was taken out of context to accuse scientists of conspiracy. Scientists responded to the accusations by giving assurance that "no individual scientist in the IPCC assessment process is in a position to change the conclusions, or to exclude relevant peer reviewed papers and scientific work from an IPCC Assessment Report".[43]

Faced with the criticism, the IPCC needs to learn how to deal with possible mistakes and better withstand powerful anti-climate policy propaganda of its opponents.[44] To this end, in 2010, the IPCC and the UN Secretary General commissioned the InterAcademy Council[45] to conduct a study on IPCC procedures. On completion of its study, the InterAcademy Council produced a report containing important recommendations, some of which have already been implemented by the IPCC. Building on these recommendations, we will further explore ways to improve the climate science–policy interface.

3. Ways of improving scientific input to the UNFCCC process

3.1. Guidelines from theory

There is a substantial body of research on the mutual influences of science and governance.[46] One of the most influential theories in this field is the theory of co-production, which is "the proposition that the ways in which we know and represent the world (both nature and society) are inseparable from the ways in which we choose to live in it".[47] This theory is particularly relevant for the realm of climate change. The interaction of climate science and climate policy is characterized by a long evolutionary transformation of the understanding of climate change as a local concern to its perception as a global challenge.

The role of climate science in shaping the perception of climate as a global phenomenon and in globalizing climate policy was crucial. Only when scientific understanding of climate as long trends in local weather changed in the late 1980s into the understanding of climate as a global climate system influenced by world oceans, winds, ice caps and other global factors, did changes in climate begin to be presented as a global challenge requiring a global policy response. Together with the new understanding of climate as a global phenomenon, the new idea about the role and

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[43] See "Statement by Working Group I of the Intergovernmental Panel on Climate Change on stolen emails from the Climatic Research Unit at the University of East Anglia, United Kingdom" of 4.12.2009, available at http://www.ipcc.ch/pdf/presentations/WGIstatement04122009.pdf

[44] A prominent example of a climate change denial campaign is *The Great Global Warming Swindle*, a documentary issued in the UK in early 2007 featuring interviews with scientists questioning the fact of global warming. Most of the scientific evidence presented in the film is either false or outdated. Nevertheless, the film has been a powerful tool used by climate sceptics to increase public mistrust in climate science and policy.

[45] The InterAcademy Council is an international organization formed by national science academies to produce reports on the areas of the global challenges, with recommendations for national governments and international organisations. See http://www.interacademycouncil.net/23450/27799.aspx

[46] See, e.g., Jasanoff (2004), Miller (2004), Weichselgartner (2011).

[47] Jasanoff (2004), p. 2.

jurisdiction of climate policy-related international institutions emerged.[48] As long as climate change and its consequences had only a local dimension, there was no justification for the creation of an international institution for dealing with the challenge.[49] However, when the IPCC began to base its assessments of climate on global climate models and revealed the global character of climate change, it showed the need for the formulation of global climate policy and the creation of an international climate change institution for global action on climate change.[50]

While co-production of climate science and politics continues, transformation of the perception of climate change is not yet finished. Unfortunately, the process faces the barriers of the traditional understanding of state sovereignty and international governance represented by nation states.[51] A truly global response to climate change requires a reconsideration of the concept of sovereignty on the basis of the emerging principle of common concern of humankind.[52] In accordance with the principle, if poor national management of the environment begins to threaten all life on the planet, there must be limits to the full jurisdiction of states over exploitation of natural resources and all states must contribute to global action against a global challenge. We believe that effective interaction between climate science and policy and increased input of science to the UNFCCC negotiation process can facilitate the necessary transformation in the minds of policymakers.

3.2. Science–policy interaction in other international regimes

An examination of science–policy interaction in other international regimes may provide important insights on how best to integrate scientific input into policy response. The input of science into policy is felt most in MEAs, and the international regime of ozone layer protection offers a best practice example in this respect. Scientific assessments and scientific advice, along with the availability of technological solutions, were crucial for the conclusion of the Montreal Protocol on substances that deplete the ozone layer.[53] The effectiveness of science–policy interaction under the Montreal Protocol is to a large extent attributed to the direct participation of scientists in policymaking through scientific and technical assessment bodies, which are all part of the structure of the treaty body.[54] In the Montreal Protocol negotiating process, an internationally recognized group of scientists directly participated in negotiations along with government delegates. A remarkable feature of the decisionmaking system under the Montreal Protocol is that scientific support is incorporated into the decisionmaking structure of the treaty. Technical and scientific advice is provided by three technical bodies: the Technical and Economic Assessment

[48] Miller (2004), p. 51.
[49] Earlier US National Academy of Sciences reports on climate change concluded that climate change poses a risk only for local communities and not for the planet as a whole. See Miller (2004), pp. 52-54.
[50] Some argue that globalization of climate policy has a negative side too. Global response to climate change is less concrete than it could have been at the level of local policies. It is also more difficult to mobilize resources for addressing a global risk than allocate resources for local needs. See Miller (2004), p. 63.
[51] Ibid., p. 63.
[52] Cottier (2012b), pp. 8-13.
[53] Morrisette (1989), p. 812.
[54] WBCSD-Ecofys (2010), pp. 42-43.

Panel (TEAP), the Scientific Assessment Panel, and the Environmental Effects Assessment Panel.[55] The TEAP, for instance, directly advises the Meeting of the Parties (MOP) when the MOP takes decisions on the measures under the Protocol, and makes suggestions for the future by issuing follow-up reports.[56] It makes direct recommendations for the parties. Members of the TEAP (22 people representing different geographical regions) are representatives of business and academia nominated by state parties but acting in their own capacity independent from their governments. The work of the TEAP is supported by various task forces of experts working on specific technical issues.

While scientific uncertainty has been a problem in the ozone layer protection regime, scientific knowledge about the stratospheric ozone layer has improved over time, and based on the updated knowledge, the Montreal Protocol has been amended four times since its conclusion.[57] Importantly, scientific findings on the links between ozone layer depletion and the incidence of skin cancer were particularly crucial for the conclusion of the agreement on phasing-out the use of ozone depleting substances. The threat of cancer raised public awareness and generated public support for the ozone layer protection regime.[58]

The Convention on Biological Diversity (CBD) and its Cartagena Protocol on Biosafety is another example of a strongly science-driven international framework. The science–policy interaction in the biodiversity regime is akin to the climate change model. However, while the Subsidiary Body on Scientific, Technical and Technological Advice has been part of the CBD body since the conclusion of the convention, the external source of scientific information for the biodiversity regime has been established only recently. In 2010, the task of conducting scientific assessments of global ecosystems was assigned to the Intergovernmental Platform on Biodiversity and Ecosystem Services, which functions similarly to the IPCC in the international climate regime.[59]

In international economic regimes, the role of science is less prominent than in MEAs. Unlike in MEAs, where science determines the whole strategy of environmental regimes, in international economic regimes, science represents the interests of environmental policy and sustainable development, which compete with the purely economic interests at the core of these regimes. The WTO Agreement, for instance, recognizes sustainable development as an accompanying objective to the overarching goal of promotion of trade and economic development.[60] Scientific evidence and scientific advice are mainly used in the WTO in dispute settlement, particularly in judgments about the legitimacy of trade-restrictive measures taken for public health and environmental policy reasons under the Agreement on the Application of Sanitary

[55] See http://ozone.unep.org/new_site/en/assessment_panels_main.php
[56] The requests for information are usually contained in decisions of the MOP. The TEAP also prepares annual progress reports on technical issues, which are commissioned by the parties. WBCSD-Ecofys (2010), p. 43.
[57] Glaser and Bates (2011), p. 9.
[58] Morrisette (1989), pp. 814-820.
[59] See http://www.ipbes.net/about-ipbes.html
[60] Preamble to the Marrakesh Agreement Establishing the World Trade Organization.

and Phytosanitary Measures (SPS Agreement) and the Agreement on Technical Barriers to Trade (TBT Agreement).[61] For instance, an SPS measure, which sets a level of protection that is higher than a relevant international standard, must be scientifically justified. With respect to a TBT measure, scientific evidence (although not required) can be used to assess the risks associated with the non-application of a measure. Science is thus used in the WTO to separate legitimate policy objectives from measures taken with protectionist intentions.[62] Science also guides trade policy related to SPS and TBT regulations at a national and regional level,[63] and informs legislative process in the WTO when it comes to adoption of decisions related to public health and the environment.[64]

The WTO does not have an internal body charged with assessing scientific information or providing scientific advice to the WTO adjudicative and legislative bodies. However, a WTO panel adjudicating on SPS measures usually needs to use the results of risk assessment to be able to judge whether existing scientific evidence on the matter at issue is sufficient to serve as grounds for application of trade-restrictive measures.[65] In judging such an issue, a panel may seek expertise from scientists, including experts from other international organizations and research institutions.[66] In other words, panels themselves engage in the scientific assessment process.

Scientific evidence used in WTO disputes is also often characterized by scientific uncertainty.[67] However, in contrast to MEAs, scientific evidence that a WTO Member may use to justify a measure must not necessarily be based on a scientific opinion expressed by the majority of scholars in the field, but on an opinion, which is qualified and respected.[68]

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[61] Scientific evidence also plays a role in disputes involving justification of measures under health and environmental exceptions under GATT Art. XX. See Green and Epps (2007), pp. 294-299.
[62] Ibid., p. 286.
[63] The SPS requirement to base a trade measure on scientific evidence limits the policy space for national governments as regards measures taken with protectionist purposes.
[64] See, e.g., the Doha Declaration on the TRIPS Agreement and Public Health.
[65] A panel is faced with a need to make a risk assessment when examining a measure on compliance with the obligation under SPS Art. 5.1 to base measures on an assessment of the risks to human, animal or plant life or health. In the *EC-Hormones* dispute, for instance, the panel undertook a health risk assessment of six cattle growth-stimulating hormones, when it examined the EU ban on imports of meat and meat products from cattle, which had been treated with any of those hormones. See http://www.wto.org/english/tratop_e/dispu_e/cases_e/ds26_e.htm
[66] For instance, in the *EC-Asbestos* case, the panel based its judgments about the French ban on products containing asbestos on the findings of the International Agency for Research on Cancer. See Green and Epps (2007), p. 296.
[67] Scientific uncertainty was particularly an issue in the famous *EC-Biotech* case. The US complained against the EU's moratorium on the approval of biotech products (food, feed and fibre), which was based on sparse scientific evidence and considerable scientific uncertainty about health effects of genetically modified products. Due to the scientific complexity of the issue, the WTO panel proceedings were unprecedentedly long lasting three years from 2003 to 2006. The panel ruled against the EU measure. However, largely supported by public opinion, the EU decided to keep the measure in force and face US trade retaliations. See http://www.wto.org/english/tratop_e/dispu_e/cases_e/ds291_e.htm
[68] *EC-Asbestos*, AB report, para. 178.

All in all, science is an important driver of international policymaking in the field of management of risks for human beings and the environment. However, modes of interaction vary from case to case, and depend largely on the regulatory object.

3.3. Addressing structural and procedural shortcomings

A fundamental question which needs to be answered is whether the "external scientific assessment-internal scientific advice" model is sufficiently effective in advancing the UNFCCC objectives. With respect to the reception of scientific input, it might be argued that science input to the UNFCCC would be greater if the SBSTA could assess scientific information itself and not just collect it from external sources. By only gathering information and not assessing it the SBSTA turns into a buffer between science and policymaking, hampering and slowing down the effective processing of scientific input to decisionmaking.[69] Yet, if assessments are made by the SBSTA, there is a risk that they will be biased. The SBSTA comprises different government delegates, who defend their national interests, whereas one merit of the IPCC assessments is that they are made by scientists acting in their own capacity and only approved by government delegates at the final stage.[70]

It might also be argued that the impact of climate science on international climate policymaking could have been much bigger, if countries had agreed at the beginning on the IPCC being a forum for negotiating the UNFCCC.[71] At the start of international climate negotiations, the UNEP, inspired by the success of the ozone layer protection regime, intended to copy the Montreal Protocol's model of direct participation of scientists in negotiations for the UNFCCC system. The Montreal Protocol model, however, was opposed by some countries in climate negotiations, including the US, which were afraid of the far-reaching liberties of scientists in political decisionmaking.[72]

While the idea of the IPCC becoming a forum for climate policy negotiations has not been realized, one question that arises is whether the IPCC can still be incorporated in the structure of the UNFCCC. Some may argue that the IPCC is a political body in any case and IPCC assessments are reviewed, approved and adopted by national delegates, most of whom are also engaged in climate negotiations at the UNFCCC. As mentioned above, there is an example of an effective "internal" scientific assessment process under the Montreal Protocol. However, the incorporation of a scientific assessment body into the UNFCCC structure might not work for the climate change regime. Climate science differs from the research on the ozone layer to the extent that climate science is much more complex, interdisciplinary and complicated. To ensure completeness, impartiality and effectiveness, climate change assessments need to be outsourced to an independent external body with its own rules and procedures and an established broad network of scientific experts. The political approval of such assessments seems also to be more feasible if they are made outside the UNFCCC

[69] Lohan (2006), p. 265.
[70] Glaser and Bates (2011), pp. 6-7.
[71] Miller (2004), p. 59.
[72] Ibid., p. 56.

political process. The latter holds particularly true given the extension of the scope of socioeconomic assessments in AR5.[73]

Another important issue related to the processing of science input is the timing of SBSTA sessions.[74] It might be more effective to hold SBSTA sessions before rather than simultaneously with COPs.[75] This could give COP delegates enough time to process scientific information provided by SBSTA and then use it at COP negotiations.

As regards the scientific input itself, one option would be to hold IPCC sessions in advance of COPs or SBSTA meetings.[76] This could enable the latest scientific information to be processed in time to make it available for use in negotiations. Yet, the effect of such changes would likely be limited. The major part of the agenda of annual IPCC plenary meetings covers procedural and organizational issues. With respect to the substance, annual plenary meetings occasionally deal with small reports (special and methodology reports) produced in the period between the issuance of assessment reports and independent from the latter. However, the main bulk of assessments with the potential to influence the UNFCCC negotiating process are delivered in principal assessments reports, which cannot be harmonized with the time schedule of policy negotiations as they reflect the irregular pace of scientific research.[77]

3.4. Improving scientific message

The experience of climate science-policy interaction over two decades shows a need for reinforcing and improving the quality of scientific message. Climate science is characterized by considerable uncertainty, which negatively influences the reception of scientific messages by policymakers and the public. While uncertainty is an inherent part of any scientific research, climate change-related uncertainty is politically salient and often used to call into question the credibility of climate research results. While there is no doubt that climate change is taking place and is mainly caused by human activities, there is uncertainty with respect to the pace of climate change and its effects.[78] Consequently, there is also uncertainty as to the timing and scale of action required to fight climate change, which can serve as an excuse for not moving on a global climate deal.

The next generation of IPCC assessments will certainly contribute to diminishing scientific uncertainty. However, it is essential for the effectiveness of scientific input

[73] While the contribution of the Working Group III to AR4 consisted of 13 chapters, the one in AR5 is planned to have 16 chapters, including equity issues, national and regional policies and international cooperation.
[74] On the importance of timing for the uptake of scientific advice by policymakers, see Kohler et al. (2012), pp. 74-75.
[75] The simultaneous holding of SBSTA and COP sessions can however be justified by costs saving considerations. See Lohan (2006), pp. 308-309.
[76] Lohan (2006), p. 280.
[77] It should be noted, however, that given that the agreed deadline for a post-Kyoto climate deal is 2015, IPCC AR5, which is expected in 2014, could provide a timely update of scientific knowledge, which could still be taken into consideration at the final stage of drafting an agreement.
[78] Houghton (2009), pp. 262-263.

that updated knowledge will duly be taken into consideration by policymakers and used as a basis for amendment of the UNFCCC or future climate agreements, as has been done with the Montreal Protocol.

In the meantime, to minimize the negative impact of uncertainty of climate science on credibility of its results, IPCC assessments should be accurate in giving statements and assigning probabilities to them. Since the preparation of AR4, all three IPCC Working Groups have been following common guidelines on the treatment of uncertainty in assessments. Scientists working on assessments usually deal with two types of uncertainty – "value uncertainty", when inaccurate data do not allow values to be assigned to certain phenomena, and "structural uncertainty", when, for instance, there is a lack of understanding of processes behind climate change or there are shortcomings in models.[79] "Value uncertainty" is communicated by assigning probabilities (likelihoods) based on statistical methods (e.g. "very likely", which corresponds to >90% probability, or "likely", which corresponds to >66% probability).[80] "Structural uncertainty" is defined qualitatively by assigning different levels of confidence to statements based on the level of evidence and the degree of agreement in expert judgements (e.g. "high confidence", "medium confidence" etc.).[81] Formulating key findings of assessments when evidence is not sufficient or data are missing presents a serious challenge for climate researchers. Inaccurate statements were a subject of criticism with respect to AR4, particularly the Summary for Policymakers written by Working Group II. On one hand, there are statements in the Summary that are formulated with high confidence despite being based on little evidence.[82] On the other hand, there are statements that have little practical value as they had to be formulated in very vague terms to be assigned high confidence.[83] The new guidelines on uncertainty treatment for lead authors of AR5, which have been revised to take into account the uncertainty-related inaccuracies of AR4 and the recommendations of the InterAcademy Council report, are aimed to increase accuracy and credibility of the forthcoming assessments.

Taking into account the criticism of AR4, it is also necessary to handle properly any possible mistakes made in future assessment reports in terms of public communication. An important step in this direction has been the recent adoption of the protocol for addressing possible errors in IPCC reports.[84] The IPCC Secretariat, which is designated to be the entry point for all claims of errors, maintains the internal error tracking system and works directly with the working group co-chairs to correct

[79] See The IPCC Assessments of Climate Change and Uncertainties, available at http://www.ipcc.ch/publications_and_data/ar4/wg1/en/ch1s1-6.html#footnote1
[80] For the full range of degrees of likelihood, see Guidance Note for Lead Authors of the IPCC Fifth Assessment Report on Consistent Treatment of Uncertainties, available at http://www.ipcc.ch/pdf/supporting-material/uncertainty-guidance-note.pdf
[81] Ibid., pp. 2-3.
[82] InterAcademy Council (2010), p. 61.
[83] Ibid., p. 62.
[84] IPCC Protocol for Addressing Possible Errors in IPCC Assessment Reports, Synthesis Reports, Special Reports or Methodology Reports, adopted by the Panel at its 33rd Session in Abu Dhabi, 10–13 May 2011.

mistakes (publishing the erratum on the IPCC webpage) and to inform claimants about the conclusion of the mistakes handling process.

An important question is whether IPCC reports should contain recommendations on the implementation of the Convention. While policy recommendations may add practical value and increase the applicability of scientific assessments, they may also call into question the impartiality of scientific research and thus undermine its credibility among the UNFCCC parties.[85] Yet, without compromising credibility, IPCC assessments could provide policymakers with the comparison between climate change action and inaction in terms of environmental, economic and social implications.[86] The choice between action and inaction would still be left to the policymakers, but this choice would then be well-informed.

With a view to increasing policy relevance, and given the complex nature of climate change, more weight should be given to conducting interdisciplinary research, which would combine research in natural sciences and socioeconomic disciplines. Research in socioeconomic disciplines, while being less quantitative, can offer ideas for sound policy responses. It is questionable, however, whether the effective combination of research in natural sciences with social, political and legal studies is possible. It is already difficult to produce interdisciplinary research within the socioeconomic field itself, when one attempts, for instance, to supplement economic models with legal analysis, to say nothing of adding a natural science dimension. However, scientists representing different scientific areas pertinent to climate change need to learn how to cooperate and to overcome barriers posed by different terminology and research methods.

Furthermore, more attention should be given to the language in which the scientific message is formulated and communicated. In order to be understood and then used in policymaking, the language of the scientific message has to be adjusted to be understandable by laypeople, as policymakers do not usually have a scientific background. It should be noted, however, that considerable progress has already been made in this respect, especially as regards the language of scientific message used in Summaries for Policymakers of the IPCC reports. Nevertheless, the language can be further simplified thus increasing the comprehensibility of the message.[87]

3.5. Addressing credibility issues of climate science

Credibility of climate research is another problematic issue of climate science–policy interaction. After more than two decades of IPCC activity, climate research is still characterized by considerable mistrust among policymakers and the public. As James Hansen, director of the NASA Goddard Institute for Space Studies recently warned "public scepticism about the threat of man-made climate change has increased despite

[85] There seems, however, to be no reason for climate science not to advocate certain policy choices. See Nelson and Vucetich (2009), p. 1096.
[86] Glaser and Bates (2011), p. 8.
[87] Ibid., p. 12.

the growing scientific consensus".[88] This mistrust is particularly strong in developing countries[89] and countries in transition (CIT). Dealing with the credibility issue requires understanding the reasons for mistrust.

One possible explanation for the existing mistrust of climate science is that "scientific judgments … inevitably involve tacit value assumptions and choices that can have important social and political consequences".[90] Science implicitly advocates certain policy choices.[91] Developing countries tend to believe that climate change science produced by developed countries promotes the interests of the developed world.[92] In reality, however, scientific assessments of climate change come into conflict with the economic interests of developing countries, most of which rely on fossil fuels in their economic growth. Climate science calls for a decrease in the use of fossil fuels and for sharing emissions reduction efforts among all countries. The latter is justified by the fact that some countries traditionally considered to be developing are not poor any longer. Thus, it seems that the credibility problem is to a large extent created artificially so that countries retain the possibility for unrestrained economic development.[93]

There is a close link between credibility of climate science and legitimacy of IPCC assessments. However, legitimacy does not seem to be an issue. It can be drawn from different aspects of the IPCC assessment process. First, the IPCC is a daughter organization of two UN agencies (the WMO and the UNEP) whose governing councils exercise supervision over its work, and the establishment of the IPCC was approved by the UN General Assembly.[94] Second, governments are extensively involved in the preparation and approval of assessment reports. The panel, which adopts (section by section) overview chapters of methodology reports and longer report parts of synthesis reports and approves (line by line) summaries for policymakers in the synthesis reports, consists of governmental representatives of practically all UN countries.[95] This implies a sort of international political acknowledgement of summarized scientific evidence of climate change and acceptance of the IPCC's work.[96] Governments also participate in the process of

[88] See http://www.telegraph.co.uk/earth/environment/climatechange/9192494/Climate-scientists-are-losing-the-public-debate-on-global-warming.html
[89] An exception is small-island developing states, which take seriously the warnings of scientists about the risk of inundation of their lands as a consequence of climate change. See Ashe, Lierop and Cherian (1999), p. 210.
[90] Miller (2004), p. 59.
[91] Nelson and Vucetich (2009), p. 1092.
[92] Rowe (2009), p. 597.
[93] Rowe, for instance, argues that mistrust of climate science is just used as grounds for not participating in the international efforts to fight climate change and for not sharing the costs of such efforts. See Rowe (2009), p. 597.
[94] UNGA Resolution A/RES/43/53. The IPCC shares its headquarters with the WMO in Geneva and it is sometimes guided in its work (e.g. election of staff) by the General Regulations of the WMO. See Yamin and Depledge (2004), pp. 469–470.
[95] Kohler et al. (2012), p. 64.
[96] The IPCC is characterized by universal participation. Currently 195 countries are members of the IPCC. Participation in the IPCC is open to all UN, WMO and UNEP members. See Principles Governing IPCC Work, para. 7. Summaries for policymakers present "a political-scientific hybrid"; it is "a politically negotiated document, but one that retains scientific rigour". See Yamin and Depledge (2004), p. 478.

reviewing Working Group assessment reports, sending their comments on each report to Working Group/Task Force Bureaus.[97] Third, the content of assessment reports is defined with inputs from the delegates to the SBSTA, membership of which overlaps with that of the UNFCCC. Fourth, IPCC assessments of climate change are mainly based on peer-reviewed literature, which attests to their scientific quality and creates trust in scientific inferences. Finally, the private sector is also engaged in the assessment. In particular, private sector representatives can be nominated and act as authors.[98]

The current lack of credibility, however, is likely to be the result of an unequal contribution of developing country scientists to the IPCC's work. The problem of limited participation of developing countries in IPCC assessments was especially acute in the first years of the IPCC. To increase the involvement of developing countries, in the early 1990s the IPCC introduced some important changes to its institutional procedures and structures. It enabled scientists from developing countries to participate in IPCC assessments along with scientists from developed nations. Representatives of developing countries were included at different management levels of the IPCC.[99] Furthermore, the IPCC committed itself to a more balanced consideration of scientific views of developed and developing countries. Despite these changes, however, the IPCC's scientific expertise is still dominated by scientists from developed countries, which is mainly a consequence of the lack of scientific resources in developing countries.[100] As a result, there is a predominance of "western" views in IPCC assessments and assumptions based on modelling of climate systems of the North, while the trends in climate systems of the South are often ignored.[101]

Apart from the geographical imbalance in the IPCC expertise, there are also some flaws in the IPCC assessment and review process, which negatively influence credibility and trust. For instance, the current review procedure allows for the same comments to be sent from different sources so that an opinion of a scientific minority lobbied through multiple channels may gain the biggest weight and eventually be put in the assessment report.[102] There is also a lack of anonymity, as authors' names are usually known to reviewers, which creates the risk of a biased review of a certain author's chapters.[103] Furthermore, there is insufficient consideration of reviewers' comments by lead authors in final reports. In this respect, the InterAcademy Council

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[97] See Procedures for the Preparation, Review, Acceptance, Adoption, Approval and Publication of IPCC Reports, para. 4.3.4.2.
[98] WBCSD-Ecofys (2010), p. 41.
[99] There are two chairs for each IPCC Working Group and the Task Force, one from a developed country and one from a developing one. Members of Working Groups' and Task Force's Bureau (and eventually the main IPCC Bureau) are equally represented by geographical regions. See Principles Governing IPCC Work, para. 5. Teams of coordinating lead authors and lead authors of chapters of Working Group assessment reports, which are representative of different geographical regions, include scientists from developing countries. See Procedures for the Preparation, Review, Acceptance, Adoption, Approval and Publication of IPCC Reports, para. 4.3.2, available at http://www.ipcc.ch/pdf/ipcc-principles/ipcc-principles-appendix-a-final.pdf
[100] Kohler et al. (2012), pp. 71-72. See also Lohan (2006), p. 273, and Miller (2004), p. 63.
[101] Miller (2004), p. 62.
[102] Lohan (2006), p. 273.
[103] Ibid., p. 273.

recommended that review editors of IPCC assessment reports prepare written summaries of the reviewers' main comments so that lead authors would be obliged to give detailed written feedback on the most important issues raised.[104] Another important factor in gaining credibility is the sources of scientific information used in the assessment process. The use of non-peer-reviewed sources was a point of criticism of AR4.[105] Therefore, where non-peer-reviewed sources are used, their inclusion needs to be warranted and indicated in reports.[106]

A necessary step in addressing the credibility problem is increasing the transparency of the IPCC assessment process. Scientists working on IPCC assessments must be ready to give explanations related to the working process and provide intermediate results of assessments in support of final conclusions.[107] It is also important to enable public access via the Internet to all literature and methodological materials used for assessments. The recently established IPCC Executive Committee, working on a permanent basis in the period between annual plenary sessions of the IPCC, should facilitate continuous communication between scientists and stakeholders (policymakers and the public) and enable the rapid and timely reaction of the scientific community to criticism related to credibility of IPCC assessments.[108]

3.6. Increasing public awareness

The issues of credibility and quality of climate science message are closely linked to the issue of public awareness. Public awareness of climate change and its impacts is crucial for generating public support for climate policy, which is currently lacking, especially in developing countries and CIT.[109] Increasing public awareness of human-induced climate change in developing countries is crucial for ensuring participation of these countries in global climate change actions and their cooperation in the formation of a post-Kyoto climate regime. The increased awareness of climate change in constituencies from developing countries would influence the position of representatives of developing countries in international climate negotiations facilitating consensus on global climate policy. There is a need to develop global

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[104] InterAcademy Council (2010), pp. 60-61.

[105] Pursuant to the IPCC procedures on the use of literature, it is allowed to use non-peer-reviewed, "grey", literature (except information from Internet blogs, networking sites, newspapers and broadcast media) provided that its quality and validity has been checked and it is made available for storage in the IPCC Secretariat. See Annex 2 of Procedures for the Preparation, Review, Acceptance, Adoption, Approval and Publication of IPCC Reports.

[106] InterAcademy Council (2010), p. 63.

[107] Glaser and Bates (2011), p. 8.

[108] The IPCC Executive Committee was established on recommendations of the InterAcademy Council. It comprises the IPCC Chairs, Working Groups and the Task Group on Inventories Co-Chairs, IPCC Vice-Chairs, the Head of Secretariat and four Chairs of Technical Support Units. See "Decisions Taken with Respect to the Review of IPCC Processes and Procedures/Governance and Management" IPCC 33rd Session, 10–13 May, Abu Dhabi.

[109] The position of the public on climate change in developing countries and CITs ranges from ignorance and indifference, resulting from the lack of information and poverty concerns, to a complete rejection of the phenomenon of climate change as such, supported by climate-sceptical views of local scientists and the expectation of positive consequences of climate change. See Luta *et al.* (2009), p. 12 and Rowe (2009), p. 593. At the same time, public support has recently started growing due to the increased awareness of opportunities that the Kyoto flexible mechanisms (CDM and JI) could offer in terms of investment and economic gains. See Andonova and Alexieva (2012 forthcoming), p. 15.

strategies of climate change communication, which closely relate to the exercise of human rights to freedom of information and expression.[110]

The IPCC can play a significant role in the creation of public awareness in developing countries. For instance, it could organize workshops and educational courses on climate science in developing countries, including training for government delegates. However, the problem is the limited financial resources. The IPCC budget is composed of the voluntary contributions of participating governments and grants from the core budgets of UNEP, WMO and UNFCCC, which are insufficient to support extensive outreach activities.[111]

Being a major tool of transfer of scientific information to the public, the media play an important role in the creation of public awareness about climate change. Given the economic, social and political dimensions of climate change and the urgency of policy responses, the relationship of climate scientists with the media and the public is crucial and even more important than for other areas of science. It is necessary to establish an effective interaction between scientists and the media to send the right message at the right time to the public and eventually to policymakers. However, this interaction is quite tricky. It is the nature of the media to look for sensational stories, which are not always important or based on facts.[112] Consequently, the scientific opinion that receives the most attention from the media is not necessarily the opinion that is supported by the majority of scientists. Thus, the interaction between scientists and the media requires special skills, especially on part of scientists, who are traditionally not used to publicizing their research. The organization of courses on communication with the media for scientists could help to build the skills needed. Such courses could be organized by the IPCC in various countries with a special focus on developing countries and CIT.[113]

Although in the end countries tend to interpret the climate science message from the position of their national interests, so that the same scientific data are interpreted differently by different countries, it is important to consider how scientists' tacit calls for action are presented to the public and policymakers.[114] So far, the message coming from the international climate science forum has been that climate change is the biggest human-induced environmental challenge, rather than being a political or economic dilemma, and that climate change is caused by physical properties of

[110] Cottier (2012a), p. 154.
[111] The annual budget of the IPCC in 2012 is slightly over 8 million CHF (Swiss franks). Its considerable portion goes on supporting the travel of experts to IPCC meetings and support of the work of chairs and co-chairs, while outreach activities are only covered by 140,000 CHF. See IPCC-XXXV/Doc. 2, p.10, http://www.ipcc.ch/meetings/session35/doc2_budget.pdf.
[112] For instance, the email leakage story on the eve of the 2009 Copenhagen climate conference was popularized by the media heating up the debate about the credibility of IPCC assessments and undermining the support of the public for climate policy. See Glaser and Bates (2011), p. 10.
[113] There is the IPCC fellowship programme for capacity building of developing countries' scientists funded by the Nobel Prize. There is, however, a need for a broader scale of capacity building. See InterAcademy Council (2010), p. 67.
[114] Rowe (2009), p. 597.

greenhouse gases rather than consumption (moral) failures.[115] In other words, diplomatic language is important for the transmission of scientific messages to ensure trust and cooperation among countries with different interests, social and political structures, and historical background.

4. Conclusions

Science is at the core of climate policymaking, and IPCC assessments are crucial for the progress in building the global climate change regime. We examined key elements of climate science–policy interaction, and have come up with a number of suggestions for improvement.

With respect to the procedures, processes and organizational structures of the IPCC and the UNFCCC related to the science–policy interaction, there seems to be no need for fundamental changes following a series of improvements which have already been made upon the recommendation of the 2010 InterAcademy Council report.[116] However, some minor changes are still desirable. They relate particularly to the timing of IPCC plenary meetings, which, to generate scientific input at the right time need to be held, where possible, before SBSTA and COP sessions, and the timing of SBSTA sessions, which, to give sufficient time for input processing, have to precede COPs. In general, processes and procedures related to climate science–policy interaction need to be reviewed regularly, including monitoring and evaluating the implementation of changes.

As regards scientific messages, the biggest challenge is uncertainty, which can be addressed by increasing the accuracy of scientific statements and assigned probabilities. Improving the quality of scientific message requires monitoring and minimizing the number of mistakes in assessments, and enhancing policy relevance of assessments by highlighting consequences of action and inaction, intensifying interdisciplinary research and simplifying the language of the scientific message.

The lack of credibility of climate research is to a large extent a consequence of countries' interests in unrestrained economic development based on the traditional use of fossil fuels. Mistrust is also generated by the unequal contribution of developing country scientists to the IPCC's work, which is a result of the lack of scientific resources in developing countries. Nevertheless, credibility of scientific assessments can be improved by enhancing transparency of the assessment process, including providing open access to information sources and intermediate results, and increasing the rigorousness of the review process.

Public awareness of climate change and its impacts is crucial for generating public support for climate change action. As public awareness is lacking, especially in developing countries and countries in transition, there is a need to develop strategies

[115] Rowe (2009), p. 597 with a reference to Demerrit, D. (2001) 'The Construction of Global Warming and the Politics of Science', Annals of the Association of American Geographers, 91, 2, p. 328. There is an argument that science is very political.

[116] See Decisions taken with respect to the review of IPCC process and procedures at the 32nd, 33rd and 34th IPCC sessions.

for climate science communication, including public education, training for policymakers, and interaction with media.

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