INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE

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MATTERS RELATED TO UNFCCC

Summary Report of the IPCC Expert Meeting on the Science of Alternative Metrics 18-20 March 2009, Oslo, Norway

(Submitted by Mr Thomas Stocker, Co-Chair of Working Group I
on behalf of the Scientific Steering Committee)

Note by the Secretariat:

Efforts are made to make an unedited version of the full report of the Expert Meeting available by the time the 30th Session of the IPCC will meet.

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Report

IPCC Expert Meeting on the Science of Alternative Metrics

18-20 March, 2009
The Grand Hotel, Oslo, Norway

Sponsored and hosted by the the Norwegian Pollution Control Authority (SFT)

Executive Summary

Based on the expert contributions and discussions at the Expert Meeting, and taking into account the current status of the science of alternative metrics reported in the scientific literature, the following key conclusions and recommendations to UNFCCC have been formulated in response to the UNFCCC request to IPCC and were unanimously agreed on by all meeting participants:

1. *Global Warming Potential (GWP) is a well defined metric based on radiative forcing that continues to be useful in a multi-gas approach. Shortcomings have been identified; however the scientific basis has not been fully established to address these shortcomings comprehensively in any currently discussed metric;*

2. *The effectiveness of the use of a given metric depends on the primary policy goal, for example to limit the long term temperature change, limit rates of change, avoid particular impacts, and balance costs and benefits. The GWP was not designed with a particular policy goal in mind. Depending on the specific policy goal or goals, alternative metrics may be preferable;*

3. *The GWP with the time horizon of 100 years is used in the Kyoto Protocol. The numerical value of the GWP can depend markedly on the choice of time horizon. The choice of any particular time horizon involves value judgments in terms of future commitment to radiative forcing;*

4. *Timely information on potential future policy goals would facilitate research on alternative metrics.*

1. Introduction

The UN Framework Convention on Climate Change Ad Hoc Working Group on Further Commitments for Annex I Parties under Kyoto Protocol (UNFCCC AWG-KP) after its sixth session (Accra, August 2008) has invited the Intergovernmental Panel on Climate Change (IPCC) to undertake further technical assessment of alternative common metrics which are used to calculate the CO_2 equivalence of anthropogenic emissions by sources, and removals by sinks, of greenhouse gases (GHGs) listed in Annex A to the Kyoto Protocol.

The Kyoto Protocol uses the established metric of "Global Warming Potentials" (GWP) and foresees regular review. In its contribution to the IPCC's Fourth Assessment Report (AR4) on the physical science basis of climate change, Working Group I (WGI) addressed this subject in Chapter 2 as comprehensively as possible given the literature available at that time. The subject matter is made complex because of differences in the physical and biogeochemical cycles of the various substances resulting in a large range of lifetimes, secondary effects caused by feedbacks, and economic dimensions of some applications of metrics. In its contribution to AR4 on the mitigation of climate change, Working Group III noted that despite the continuing scientific and economic debate on the use of GWPs, no alternative metric has attained comparable status.

The IPCC at its 29th Session (Geneva, September 2008) decided to give to the Bureau the authority to consider the matter further, including the planning of an Expert Meeting on the subject. At its 38th Session (Geneva, November 2008), the IPCC Bureau decided to task a small Steering Group, chaired by Thomas Stocker (Co-Chair of WGI), to convene an Expert Meeting on the Science of Alternative Metrics with the goal to review the basis of current scientific research on this topic, in particular to assess the status of knowledge on GWPs and Global Temperature Potentials (GTPs) and other more elaborate metrics, as well as any other recent developments since the AR4 to calculate CO_2 equivalence, including the timescales at which possible metrics can be applicable. Formulation of appropriate metrics involves consideration of policy goals, mitigation strategies, impacts, and the underlying physical science basis. Therefore, these issues are to be assessed across all three IPCC Working Groups and including information from the IPCC Task Force on Greenhouse Gas Inventories (TFI) and from the IPCC Task Group on Data and Scenario Support for Impact and Climate Analysis (TGICA) as appropriate.

2. Outline of the Expert Meeting

From 18 to 20 March 2009, 35 participants from around the world, including 21 selected world leading experts in the area of greenhouse gas metrics, gathered in Oslo to discuss and review the status of the science of alternative metrics. The expert meeting was sponsored and hosted by the the Norwegian Pollution Control Authority (SFT).

The specific goals of the meeting as introduced by Thomas Stocker, Co-Chair WGI, were to (i), provide an update of the latest scientific developments regarding GHG metrics since IPCC AR4; (ii), assess the complexities, uncertainties, merits and demerits of different metrics; (iii), discuss consequences of choices of metrics for the feasibility and costs of reaching defined climate targets; and (iv), produce a short report to be submitted to the IPCC Bureau and Plenary Meetings held in Antalya, Turkey, in April 2009.

The format of the expert meeting allowed for extensive discussions and exchange of ideas among all participants. The first day was dedicated to purely scientific presentations by the invited experts, including two keynote presentations and 16 shorter expert presentations. The keynote addresses were given by Keith Shine, focusing on GWPs, GTPs and short lived species, and by Pierre Friedlingstein, focusing on the long-lived GHG and the carbon cycle

perspective on the metrics issues. Days two and three were dedicated to discussions in either the plenary or in two topical breakout groups dealing with

Group 1: Assessing existing metrics and their possible improvements;
Group 2: Complexities in the climate system and their impacts on metrics.

Both groups were asked (i), to specifically report on major scientific developments since IPCC AR4, (ii) to identify major uncertainties associated with, e.g., lifetime, time horizon, or a single basket approach (Group 1), and, e.g., chemistry impacts or biogeochemical feedbacks (Group 2), (iii) to consider trade-offs between complexity and applicability of a metric, and (iv), to propose possible modifications of metrics for improvements in the future.

3. Expert Meeting Outcomes

As a result of the scientific presentations on day 1 and the dedicated and constructive discussions on days 2 and 3, three specific sets of recommendations, unanimously agreed on by all participants and directed to the following three groups of stakeholders, have been formulated:

1. to UNFCCC in response to the request to IPCC;
2. to the scientific community regarding research needs;
3. to the scoping of IPCC AR5 (including all three working groups).

The recommendations by the participants are based on considerations of the usefulness of any particular metric, on possible necessary refinements of metrics, on how to best address complexities of definitions of metrics, and on how to balance between scientific accuracy and suitability of a metric.

The key conclusions and recommendations to UNFCCC, as the main outcome from the Expert Meeting, are given in the Executive Summary. All three sets of recommendations by the participants are provided in the Appendix of this report and will be amplified in a extended report from the Expert Meeting currently in preparation at the WGI TSU with participation of a selected group of experts. This extended report from the Expert Meeting will also include all relevant administrative information including meeting agenda, list of participants, expert abstracts, etc. It will be presented to the IPCC Bureau and Plenary at the Plenary Meeting in April in Antalya, Turkey, and made available to UNFCCC at the Sessions of the UNFCCC Convention subsidiary bodies to be held in early June in Bonn, Germany.

Scientific Steering Committee:

T. Stocker (Chair of the SSC, Co-chair WGI), O. Davidson (IPCC Vice Chair), T. Hiraishi (Co-chair TFB) , R. Pichs-Madruga (Co-chair WGIII), S. Semenov (Vice-chair WGII)

Core Writing Team of the Expert Meeting Report:

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March 30, 2009

Appendix: Recommendations by the Participants of the Expert Meeting

Key Conclusions and Recommendations to UNFCCC:

1. Global Warming Potential (GWP) is a well defined metric based on radiative forcing that continues to be useful in a multi-gas approach. Shortcomings have been identified; however the scientific basis has not been fully established to address these shortcomings comprehensively in any currently discussed metric;
2. The effectiveness of the use of a given metric depends on the primary policy goal, for example to limit the long term temperature change, limit rates of change, avoid particular impacts, and balance costs and benefits. The GWP was not designed with a particular policy goal in mind. Depending on the specific policy goal or goals, alternative metrics may be preferable;
3. The GWP with the time horizon of 100 years is used in the Kyoto Protocol. The numerical value of the GWP can depend markedly on the choice of time horizon. The choice of any particular time horizon involves value judgments in terms of future commitment to radiative forcing;
4. Timely information on potential future policy goals would facilitate research on alternative metrics.

Recommendations to the Scientific Community regarding Research Needs:

1. Uncertainties
   - Characterize uncertainties for GTPs – climate sensitivity, ocean heat uptake, post-target time;
   - Probability Density Functions (PDFs) should be generated for indices in general, GWPs (on CO_2 AGWP and other AGWPs) and GTPs;
   - Characterize the uncertainty associated with ocean heat uptake, climate sensitivity, carbon cycle response and other processes in a hierarchy of climate models. On this basis, understand and communicate the simplifications embedded in reduced complexity models;
   - Continue to quantify magnitudes of indirect effects and interactions between different emissions;
   - Better understand and quantify the uncertainty in mitigation costs and climate change damages.
2. New and Refined Areas or Metrics
   - Develop metrics for policy targets other than limits to temperature change, such as the rate of temperature change, the integral of temperature change, and cost-benefit analysis approaches, or other climate variables, etc.;
   - Develop approaches to accounting for long-term outcomes such as consideration of post-target period for GTPs or post-horizon period for GWPs;
   - Comprehensively assess regional differences in emissions-to-impact relationships;
   - Determine the degree to which physical metrics approximate more comprehensive metrics that include economics;
   - Consider whether existing metrics are appropriate to account for geo-engineering proposals. For example, can critical sensitive areas be protected?
3. Relationship between Policy Frameworks and Metrics
   - Study implications of choice of alternative metrics for outcomes such as emissions of different gases, climate change outcomes, and costs (especially for specific countries or sectors);
   - Investigate the potential for extending the multi-gas strategy to short-lived pollutant emissions.

Recommendations to the Scoping of IPCC AR5:

1. It is important that the assessment of metrics in an integrated manner be included in the AR5 process with participation from all three working groups and TFI;
2. This process should include an assessment of, and if appropriate, numerical values for metrics that have been proposed in the literature;
3. The assessment should elucidate the relationship between physical metrics and more comprehensive metrics that include economics.