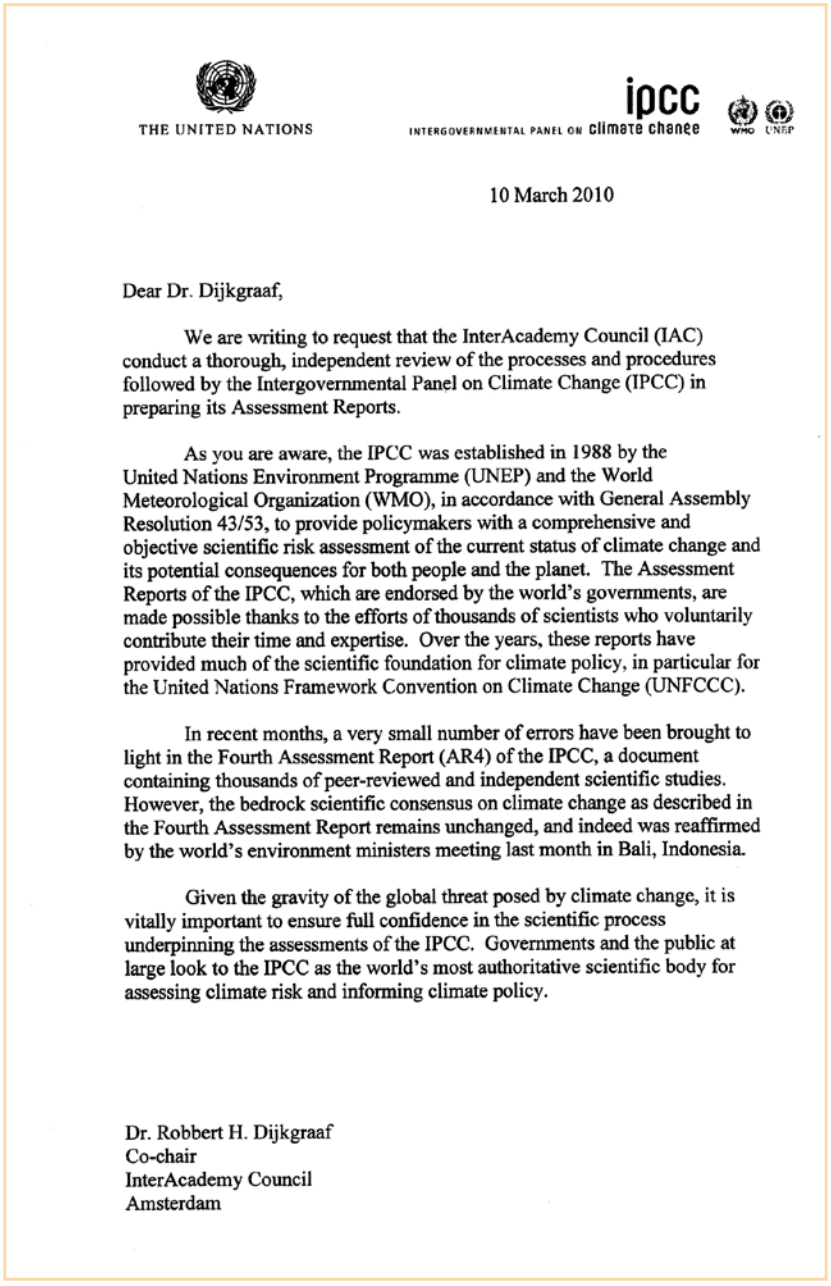
Appendix A Letters of request to the IAC Co-chairs



THE UNITED NATIONS

ipcc
INTERGOVERNMENTAL PANEL ON climate change

WMO UNEP

10 March 2010

Dear Dr. Dijkgraaf,

We are writing to request that the InterAcademy Council (IAC) conduct a thorough, independent review of the processes and procedures followed by the Intergovernmental Panel on Climate Change (IPCC) in preparing its Assessment Reports.

As you are aware, the IPCC was established in 1988 by the United Nations Environment Programme (UNEP) and the World Meteorological Organization (WMO), in accordance with General Assembly Resolution 43/53, to provide policymakers with a comprehensive and objective scientific risk assessment of the current status of climate change and its potential consequences for both people and the planet. The Assessment Reports of the IPCC, which are endorsed by the world's governments, are made possible thanks to the efforts of thousands of scientists who voluntarily contribute their time and expertise. Over the years, these reports have provided much of the scientific foundation for climate policy, in particular for the United Nations Framework Convention on Climate Change (UNFCCC).

In recent months, a very small number of errors have been brought to light in the Fourth Assessment Report (AR4) of the IPCC, a document containing thousands of peer-reviewed and independent scientific studies. However, the bedrock scientific consensus on climate change as described in the Fourth Assessment Report remains unchanged, and indeed was reaffirmed by the world's environment ministers meeting last month in Bali, Indonesia.

Given the gravity of the global threat posed by climate change, it is vitally important to ensure full confidence in the scientific process underpinning the assessments of the IPCC. Governments and the public at large look to the IPCC as the world's most authoritative scientific body for assessing climate risk and informing climate policy.

Dr. Robbert H. Dijkgraaf
Co-chair
InterAcademy Council
Amsterdam

As the IPCC embarks on its Fifth Assessment Report (AR5), it is imperative that its work be as accurate, objective, comprehensive and transparent as possible, and that the potential for any future errors is minimized. It is vitally important that every step of the assessment process be clear, consistent, and comprehensible. The IPCC must also be able to respond quickly and transparently to any questions of its work, recognizing that the world now operates in a 24-hour media cycle.

To this end, we, the Secretary-General of the United Nations, along with the Chair of the IPCC, are requesting that the IAC conduct an independent review of the IPCC processes and its procedures for preparing future Assessment Reports. Please find Terms of Reference attached for this independent review.

Consultations for conducting such a review were carried out within the United Nations system, in particular with the organizations sponsoring the IPCC, WMO and UNEP, as well as with the Vice-Chairs and Co-Chairs of the IPCC. Consultations were also held in February 2010 with environment ministers and senior government officials at the 11th Special Session of the UNEP Governing Council and Global Ministerial Environment Forum. While expressing support for the unique role and value of the IPCC, ministers also recommended the need for an independent review of the processes and procedures of the IPCC.

UNEP and WMO, the parent organizations of the IPCC, have agreed to provide administrative support and channel the necessary government funds to support this review.

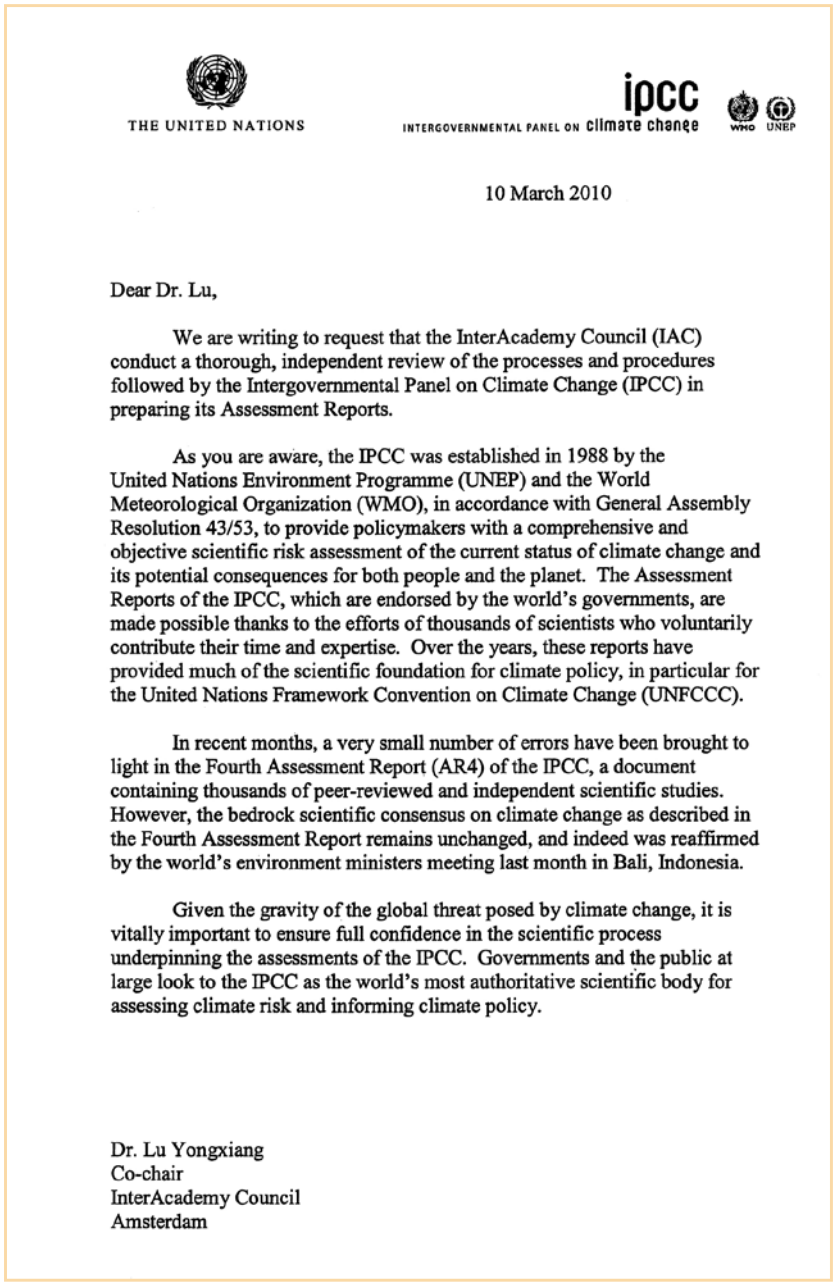
In order for the IPCC to benefit from the recommendations of the IAC in preparing its Fifth Assessment Report, we would ask you to submit your report by 31 August 2010. The results of the review will then be submitted for consideration and decision to the 32nd Session of the IPCC to be held in October 2010.

We would be grateful if you would accept this invitation, and look forward to a reply at your earliest convenience. A similar letter has been addressed to Dr. Lu Yongxiang.

Yours sincerely,

BAN Ki-moon
Secretary-General
United Nations

Dr. Rajendra K. Pachauri
Chairman
Intergovernmental Panel on Climate Change



THE UNITED NATIONS

ipcc
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Dr. Lu Yongxiang
Co-chair
InterAcademy Council
Amsterdam

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Yours sincerely,

BAN Ki-moon
Secretary-General
United Nations

Dr. Rajendra K. Pachauri
Chairman
Intergovernmental Panel on Climate Change

Independent Review of the IPCC Assessment Process

Terms of Reference

Background

By the 1980s, concerns about global climate change had become widespread. This catalyzed a demand for knowledge and action from governments, civil society, the UN and other stakeholders. Responding to the demand, and in keeping with UN General Assembly Resolution 43/53 of 6 December 1988, the United Nations Environment Program (UNEP) and the World Meteorological Organization (WMO) established the Intergovernmental Panel on Climate Change (IPCC) in 1988 to provide the governments with objective, comprehensive and up–to-date information about climate change and its implications. Therefore, the initial task for the IPCC was to prepare a comprehensive review and recommendations with respect to the state of knowledge of the science of climate change; social and economic impacts of climate change, and possible response strategies and elements for inclusion in a possible future international convention on climate.

Since its creation, the IPCC has developed into a unique global assessment process that builds on broad participation of the best experts from different backgrounds and viewpoints, a robust multi-stage review process and strong partnership between the scientific community and the governments. The most important outputs of this process have been comprehensive scientific assessment reports about climate change released in 1990, 1995, 2001 and 2007. The reports provided authoritative policy-relevant, but not policy-prescriptive information on key aspects of climate, such as the physical science basis, impacts of and vulnerability to climate change in human and natural systems, options for adapting to impacts of climate change, and options for mitigation.

The IPCC is in the process of commencing work on its 5th Assessment Report. It has been IPCC practice that the Panel, which meets at least once a year at the level of government representatives, reviews its structure at the beginning of every assessment cycle and agrees on the scope and focus of the upcoming report. The structure and outline of the 5th Assessment Report have been agreed in the year 2009. The Panel also reviews its principles and procedures at regular intervals.

In view of the relevance of the IPCC assessments for global and sub-global policy-making processes, and to reduce the occurrence and minimize the potential impact of errors in the preparation of reports, further strengthening the IPCC processes and procedures is necessary to ensure continued scientific credibility of its assessments. A proposal to carry out a review of IPCC processes and procedures was communicated by the IPCC Secretariat to IPCC member governments in mid-February 2010. This was supported by environment ministers and government delegations at the 11th Session of the UNEP Global Ministerial Environment Forum held at Bali during 24-26 February 2010.

Subsequently, the United Nations Secretary-General and the Chair of the IPCC have come to the conclusion that an independent review of the IPCC process and the procedures for preparing reports is desirable. The executive heads of the founders of the IPCC, the Executive Director of UNEP, and the Secretary-General of WMO, concur with this conclusion. Collectively, they have decided to entrust this task to the InterAcademy Council (IAC), because it embodies the collective expertise and experience of national academies from all regions of the world. The IAC has agreed to undertake this task.

In carrying out this task, it is expected that the IAC, through its networks of national academies of sciences, will engage high-profile experts from relevant fields to prepare a report that presents recommendations on possible revisions of the IPCC procedures and other measures and actions. The recommendations will allow the IPCC to respond to future challenges and ensure ongoing quality of its reports. The review should pay attention to all IPCC Working Groups and the Task Force, and address the specific challenges by integrating different disciplines including from the physical, natural, social and economic sciences.

Scope, Objectives and Expected Outputs

In undertaking its work, the IAC will take into account the "Principles Governing IPCC Work", including their Appendices: Appendix A "Procedures for the preparation, review, acceptance, adoption, approval and publication of the IPCC reports" and its Annexes (hereinafter referred to as IPCC Procedures); Appendix B "Financial Procedures for the IPCC"; and Appendix C "Rules of Procedures for the Election of the IPCC Bureau and Any Task Force Bureau". It will also review IPCC policies and processes for admitting observer organizations and other relevant guidelines. The IAC will agree on its own rules of procedure and workplan, which clearly illustrate how it will ensure achieving the objectives of the review, including the modalities for necessary consultations.

The proposed terms of reference for the review are:

1. Review IPCC procedures for preparing reports including:
   - Data quality assurance and data quality control;
   - Guidelines for the types of literature appropriate for inclusion in IPCC assessments, with special attention to the use of non peer-reviewed literature;
   - Procedures for expert and governmental review of IPCC material;
   - Handling of the full range of scientific views; and
   - Procedures for correcting errors identified after approval, adoption and acceptance of a report.

2. Analyze the overall IPCC process, including the management and administrative functions within the IPCC, and the role of UNEP and WMO, the United Nations system and other relevant stakeholders, with a view to strengthen and improve the efficiency of the assessment work and effectively ensure the consistent application of the IPCC Procedures.

3. Analyze appropriate communication strategies and the interaction of the IPCC with the media to ensure that the public is kept apprised of its work.

4. Prepare a report on the outcome of the consultations referred to above, including:
   - Methodology of the report preparation and measures taken to ensure high quality of the report findings;
   - Recommendations for amendments to the IPCC procedures;

- Recommendations concerning strengthening the IPCC process, institutions and management functions;
- Any other related recommendations;
- Outline of a plan for the implementation of recommendations.

General Principles of Work

1. The IAC will conduct its work independently according to its procedures for carrying out expert studies. Other than providing relevant information, neither IPCC, WMO nor UNEP will have any oversight or control over the review process.

2. The Co-Chairs of the IAC will transmit the final report to the Office of the United Nations Secretary-General and the IPCC Secretariat, with copies to the Executive Director of UNEP, and the Secretary-General of WMO.

Support for the Independent Review

1. Experts contributing to the review will do so without any remuneration for their services.

2. UNEP and WMO will provide technical and secretarial support and financial resources, as requested by the IAC and as mutually agreed.

Schedule of the Independent Review

Because the organizational work for the Fifth Assessment Report of the IPCC has already begun, it is urgent that the IAC submits its report at the latest by 31 August 2010, to allow for the submission of a document for consideration at the 32nd Session of the IPCC in October 2010. Timely submission is essential to allow governments to consider the Report in advance of the Session and to be prepared to decide on actions that may be necessary. In this way the findings of the review can be built into the fifth assessment cycle in its early stages.

Appendix B Questionnaire on IPCC processes and procedures

1. What role(s), if any, have you played in any of the IPCC assessment processes?
2. What are your views on the strengths and weaknesses of the following steps in the IPCC assessment process? Do you have any recommendations for improvement?
   a. Scoping and identification of policy questions
   b. Election of bureau including Working Group Co-chairs
   c. Selection of Lead Authors
   d. Writing of Working Group reports
   e. Review processes
   f. Preparation of the Synthesis Report, including the Summary for Policymakers
   g. Adoption of report by the IPCC Plenary
   h. Preparation of any special reports
3. What is your opinion on the way in which the full range of scientific views is handled?
4. Given the intergovernmental nature of IPCC, what are your views on the role of governments in the entire process?
5. Given that IPCC assessments consider a vast amount of literature, what are your views and suggestions for improvement on the sources of data and the comprehensiveness of the literature used, including non-peer-reviewed literature?
6. What are your views and suggestions regarding the characterization and handling of uncertainty in each of the Working Group reports and the Synthesis Report?
7. What is your view of how IPCC handles data quality assurance and quality control and identification and rectification of errors, including those discovered after publication?
8. What is your view of how IPCC communicates with the media and general public, and suggestions for improving it?
9. Comment on the sustainability of the IPCC assessment model. Do you have any suggestions for an alternative process?
10. Do you have any suggestions for improvements in the IPCC management, secretariat, and/or funding structure to support an assessment of this scale?
11. Any other comments

Appendix C Contributors to the review

The following individuals provided oral or written input to the Committee:

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D.J. Akerman, UK
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Claude Allegre, Institute of Geophysics of Paris, France
Myles Allen, University of Oxford, UK
Geoffrey Allen, Kobe Steel, UK
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David Andersson, Sweden
Meinrat O. Andreae, Max Planck Institute for Chemistry, Germany
Harold Annegarn, University of Johannesburg, South Africa
John Anthony, Canada
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Terry Barker, University of Cambridge, UK
Phoebe Barnard, South African National Biodiversity Institute, South Africa
Nicholas Barnes, Clear Climate Code Project
Vicente Barros, University of Buenos Aires, Argentina
Kieran Barry
Igor Bashmakov, Russian Centre for Energy Efficiency, Russia
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Marco Bindi, University of Florence, Italy
Nathan Bindoff, University of Tasmania, Australia
William Blakemore, journalist, USA
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Roxana Bojariu, National Meteorological Administration, Romania
Kansri Boonprakob, Ramkhamhaeng University, Thailand
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Paul Callander, Australia
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Carlo Carraro, University of Venice, Italy
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Piers Forster, University of Leeds, UK
Ursula Fuentes, Federal Ministry for the Environment, Germany
Thomas Fuller, journalist, USA
Amit Garg, Indian Institute of Management, Ahmedabad, India
Arthur Gar-Glahn, Ministry of Transport, Liberia
Roger F. Gay, Intelligent Systems Research Corp., USA
Theodore Gilles, professional energy engineer (retired), USA
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José Goldemberg, University of São Paulo, Brazil
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Brian Gray, Environment Canada, Canada
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Michael Grubb, Climate Strategies, UK
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Hein Haak, Royal Netherlands Meteorological Institute, Netherlands
Erik Haites, Margaree Consultants Inc., Canada
Troels Halken, Denmark
Joshua Halpern, Howard University, USA
Kirsten Halsnaes, UNEP Risø Centre, Denmark
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Dave Howarth, UK
Philip Howerton
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Sylvain Rodrigue
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Hans Schreuder, UK
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George Smith, University of Oxford, UK
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Youba Sokona, Sahara and Sahel Observatory, Tunisia
Mahmoud Solh, International Center for Agricultural Research in the Dry Areas, Syria
Richard Somerville, University of California, San Diego, USA
Gilles Sommeria, WMO (retired), France
Ray Soper, Australia
J. Richard Soulen, USA
Joachim H. Spangenberg, Sustainable Europe Research Institute, Germany
Sjoerd Stelling, Netherlands
Martin Stendel, Danish Meteorological Institute, Denmark
Nick Stern, London School of Economics, UK
William Stewart, former chief scientific adviser, UK
Peter Stilbs, Royal Institute of Technology, Sweden
Thomas F. Stocker, University of Bern, Switzerland

Bill Stoltzfus
John Stone, Carleton University, Canada
Peter Stott, Met Office, UK
Roger Street, UK Climate Impacts Programme, UK
R. Sukumar, Indian Institute of Science, India
M.S. Swaminathan, member of parliament, India
John Sweeney, National University of Ireland Maynooth, Ireland
Bill Sylla
Fredolin Tangang, National University of Malaysia, Malaysia
Stewart Telford, New Zealand
Christine Textor, German IPCC coordination office, Germany
Dennis Tirpak, International Institute of Sustainable Development, Canada, and World Resources Institute, USA
Paul Tjoen
Richard S.J. Tol, Economic and Social Research Institute, Ireland, and Free University Amsterdam, Netherlands
Kenneth M. Towe, USA
Manfred Treber, Germanwatch, Germany
Kevin Trenberth, National Center for Atmospheric Research, USA
David Trujillo, USA
Martiros Tsarukyan, Ministry of Nature Protection, Armenia
David Turkington, Hong Kong
Clive Turner, Eskom, South Africa
Jeroen van der Veer, Shell (retired), Netherlands
Jean-Pascal van Ypersele, Catholic University of Louvain, Belgium
Martine Vanderstraeten, Belgian Federal Public Planning Service for Science Policy, Belgium
Lorin L. Vant-Hull, University of Houston (retired), USA
David Vaughn, British Antarctic Survey, UK
Aviel Verbruggen, University of Antwerp, Belgium
Frank Vibert, London School of Economics, UK
Douglas Vickers
Roberto Villalobos, National Meteorological Institute, Costa Rica
Guido Visconti, University of L'Aquila, Italy
Hans von Storch, University of Hamburg, Germany
Milivoje Vukcevic, Serbia, UK
Lance Wallace, USA
David Warrilow, Department of Energy and Climate Change, UK
Warren Washington, National Center for Atmospheric Research, USA
Andrew Weaver, University of Victoria, Canada
Erik Wijsneus
Tom Wilbanks, Oak Ridge National Laboratory, USA
Jürgen Willebrand, Kiel University, Germany
Gordon Williams, Imperial College London, UK
Peter Wilson
Harald Winkler, University of Cape Town, South Africa
Jongikhaya Witi, Department of Environment Affairs, South Africa
Arnold Wolfendale, Durham University, UK
Poh Poh Wong, National University of Singapore, Singapore
David Wratt, National Institute for Water and Atmospheric Research, New Zealand
Kok Seng Yap, Malaysian Meteorological Department, Malaysia
Yee Cheong Dati Lee, Academy of Sciences, Malaysia
Gary Yohe, Wesleyan University, USA
Ron Zelius, UK
Eduardo Zorita, GKSS Research Centre, Germany
Françis William Zwiers, Environment Canada, Canada

Appendix D Excerpts of IPCC procedures

Selection of Lead Authors (IPCC, 1999, Section 4.2.2)

Coordinating Lead Authors and Lead Authors are selected by the relevant Working Group/Task Force Bureau, under general guidance and review provided by the Session of the Working Group or, in case of reports prepared by the Task Force on National Greenhouse Gas Inventories, the Panel, from those experts cited in the lists provided by governments and participating organisations, and other experts as appropriate, known through their publications and works. The composition of the group of Coordinating Lead Authors and Lead Authors for a section or chapter of a Report shall reflect the need to aim for a range of views, expertise and geographical representation (ensuring appropriate representation of experts from developing and developed countries and countries with economies in transition). There should be at least one and normally two or more from developing countries. The Coordinating Lead Authors and Lead Authors selected by the Working Group/Task Force Bureau may enlist other experts as Contributing Authors to assist with the work.

Procedure for using non-published/non-peer-reviewed sources in IPCC Reports (IPCC, 1999, Annex 2)

Because it is increasingly apparent that materials relevant to IPCC Reports, in particular, information about the experience and practice of the private sector in mitigation and adaptation activities, are found in sources that have not been published or peer-reviewed (e.g., industry journals, internal organisational publications, non-peer reviewed reports or working papers of research institutions, proceedings of workshops etc) the following additional procedures are provided. These have been designed to make all references used in IPCC Reports easily accessible and to ensure that the IPCC process remains open and transparent.

1. Responsibilities of Coordinating, Lead and Contributing Authors

Authors who wish to include information from a non-published/non-peer-reviewed source are requested to:

a. Critically assess any source that they wish to include. This option may be used for instance to obtain case study materials from private sector sources for assessment of adaptation and mitigation options. Each chapter team should review the quality and validity of each source

before incorporating results from the source into an IPCC Report.

b. Send the following materials to the Working Group/Task Force Bureau Co-Chairs who are coordinating the Report:
   - One copy of each unpublished source to be used in the IPCC Report
   - The following information for each source:
     * Title
     * Author(s)
     * Name of journal or other publication in which it appears, if applicable
     * Information on the availability of underlying data to the public
     * English-language executive summary or abstract, if the source is written in a non English language
     * Names and contact information for 1-2 people who can be contacted for more information about the source.

2. Responsibilities of the Review Editors

The Review Editors will ensure that these sources are selected and used in a consistent manner across the Report.

3. Responsibilities of the Working Group/Task Force Bureau Co-Chairs

The Working Group/Task Force Bureau Co-Chairs coordinating the Report will (a) collect and index the sources received from authors, as well as the accompanying information received about each source and (b) send copies of unpublished sources to reviewers who request them during the review process.

4. Responsibilities of the IPCC Secretariat

The IPCC Secretariat will (a) store the complete sets of indexed, non-published sources for each IPCC Report not prepared by a working group/ the Task Force on National Greenhouse Gas Inventories (b) send copies of non-published sources to reviewers who request them.

5. Treatment in IPCC Reports

Non-peer-reviewed sources will be listed in the reference sections of IPCC Reports. These will be integrated with references for the peer-reviewed sources. These will be integrated with references to the peer reviewed sources stating how the material can be accessed, but will be followed by a statement that they are not published.

IPCC review process (IPCC, 1999, Section 4 and Annex 1)

4.1 Introduction to review process

The review process generally takes place in three stages: expert review of IPCC Reports, government/expert review of IPCC Reports, government review of the Summaries for Policymakers, Overview Chapters and/or the Synthesis Report. Working Group/Task Force Bureau Co-Chairs should aim to avoid (or at least minimise) the overlap of government review periods for different IPCC Reports and with Sessions of the Conference of Parties of the United Nations Framework Convention of Climate Change and its subsidiary bodies.

Expert review should normally be eight weeks, but not less than six weeks, except to the extent decided by the Panel. Government and government/expert reviews should not be less than eight weeks, except to the extent decided by the Panel.

All written expert, and government review comments will be made available to reviewers on request during the review process and will be retained in an open archive in a location determined by the IPCC Secretariat on completion of the Report for a period of at least five years.

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4.2.4 REVIEW

Three principles governing the review should be borne in mind. First, the best possible scientific and technical advice should be included so that the IPCC Reports represent the latest scientific, technical and socio-economic findings and are as comprehensive as possible.

Secondly, a wide circulation process, ensuring representation of independent experts (i.e. experts not involved in the preparation of that particular chapter) from developing and developed countries and countries with economies in transition should aim to involve as many experts as possible in the IPCC process. Thirdly, the review process should be objective, open and transparent.

To help ensure that Reports provide a balanced and complete assessment of current information, each Working Group/Task Force Bureau should normally select two Review Editors per chapter (including the executive summaries) and per technical summary of each Report.

Review Editors should normally consist of a member of the Working Group/Task Force Bureau, and an independent expert based on the lists provided by governments and participating organisations. Review Editors should not be involved in the preparation or review of material for which

they are an editor. In selecting Review Editors, the Bureaux should select from developed and developing countries and from countries with economies in transition, and should aim for a balanced representation of scientific, technical, and socio-economic views.

4.2.4.1 First review (by experts)

First draft Reports should be circulated by Working Group/Task Force Bureau Co-Chairs for review by experts selected by the Working Group/Task Force Bureaux and, in addition, those on the lists provided by governments and participating organisations, noting the need to aim for a range of views, expertise, and geographical representation. The review circulation should include:

- Experts who have significant expertise and/or publications in particular areas covered by the Report.
- Experts nominated by governments as Coordinating Lead Authors, Lead Authors, contributing authors or expert reviewers as included in lists maintained by the IPCC Secretariat.
- Expert reviewers nominated by appropriate organisations.

The first draft Reports should be sent to Government Focal Points, for information, along with a list of those to whom the Report has been sent for review in that country.

The Working Group/Task Force Bureau Co-Chairs should make available to reviewers on request during the review process specific material referenced in the document being reviewed, which is not available in the international published literature.

Expert reviewers should provide the comments to the appropriate Lead Authors through the relevant Working Group/Task Force Bureau Co-Chairs with a copy, if required, to their Government Focal Point.

Coordinating Lead Authors, in consultation with the Review Editors and in coordination with the respective Working Group/Task Force Bureau Co-Chairs and the IPCC Secretariat, are encouraged to supplement the draft revision process by organising a wider meeting with principal Contributing Authors and expert reviewers, if time and funding permit, in order to pay special attention to particular points of assessment or areas of major differences.

4.2.4.2 Second review (by governments and experts)
A revised draft should be distributed by the appropriate Working Group/Task Force Bureau Co-chairs or through the IPCC Secretariat to governments through the designated Government Focal Points, and to all the coordinating lead authors, lead authors and contributing authors and expert reviewers.

Governments should send one integrated set of comments for each Report to the appropriate Working Group/Task Force Bureau Co-chairs through their Government Focal Points.

Non-government reviewers should send their further comments to the appropriate Working Group/Task Force Bureau Co-Chairs with a copy to their appropriate Government Focal Point.

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Annex 1: Tasks and responsibilities

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4. Expert reviewers
Function: To comment on the accuracy and completeness of the scientific/technical/socio-economic content and the overall scientific/technical/socio-economic balance of the drafts.

Comment: Expert reviewers will comment on the text according to their own knowledge and experience. They may be nominated by Governments, national and international organisations, Working Group/Task Force Bureaux, Lead Authors and Contributing Authors.

5. Review Editors
Function: Review Editors will assist the Working Group/Task Force Bureaux in identifying reviewers for the expert review process, ensure that all substantive expert and government review comments are afforded appropriate consideration, advise lead authors on how to handle contentious/controversial issues and ensure genuine controversies are reflected adequately in the text of the Report.

Comment: There will be one or two Review Editors per chapter (including their executive summaries) and per technical summary. In order to carry out these tasks, Review Editors will need to have a broad understanding of the wider scientific and technical issues being addressed. The workload will be particularly heavy during the final stages of the Report preparation. This includes attending those meetings where writing teams are considering the results of the two review rounds. Review Editors

are not actively engaged in drafting Reports and cannot serve as reviewers of those chapters of which they are Authors. Review Editors can be members of a Working Group/Task Force Bureau or outside experts agreed by the Working Group/Task Force Bureau.

Although responsibility for the final text remains with the Lead Authors, Review Editors will need to ensure that where significant differences of opinion on scientific issues remain, such differences are described in an annex to the Report. Review Editors must submit a written report to the Working Group Sessions or the Panel and where appropriate, will be requested to attend Sessions of the Working Group and of the IPCC to communicate their findings from the review process and to assist in finalising the Summary for Policymakers, Overview Chapters of Methodology Reports and Synthesis Reports. The names of all Review Editors will be acknowledged in the Reports.

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Uncertainty guidance for the Fourth Assessment Report (IPCC, 2005b)

The following notes are intended to assist Lead Authors (LAs) of the Fourth Assessment Report (AR4) to deal with uncertainties consistently. They address approaches to developing expert judgments, evaluating uncertainties, and communicating uncertainty and confidence in findings that arise in the context of the assessment process. Where alternative approaches are used in the relevant literature, those should be used but where possible related to the approaches given here. Further background material and more detailed coverage of these issues are available in the guidance paper on uncertainties developed for the Third Assessment Report [1] and the report of an IPCC Workshop on Uncertainty and Risk [2].

The working group reports will assess material from different disciplines and will cover a diversity of approaches to uncertainty, reflecting differences in the underlying literature. In particular, the nature of information, indicators and analyses used in the natural sciences is quite different from that used in the social sciences. WG I focuses on the former, WG III on the latter, and WG II covers both. The purpose of this guidance note is to define common approaches and language that can be used broadly across all three working groups. Each working group may need to supplement these notes with more specific guidance on particular issues consistent with the common approach given here.

Plan to treat issues of uncertainty and confidence

1. Consider approaches to uncertainty in your chapter at an early stage. Prioritize issues for analysis. Identify key policy relevant findings as they emerge and give greater attention to assessing uncertainties and confidence in those. Avoid trivializing statements just to increase their confidence.
2. Determine the areas in your chapter where a range of views may need to be described, and those where LAs may need to form a collective view on uncertainty or confidence. Agree on a carefully moderated (chaired) and balanced process for doing this.

Review the information available

3. Consider all plausible sources of uncertainty using a systematic typology of uncertainty such as the simple one shown in Table 1. Many studies have shown that structural uncertainty, as defined in Table 1, tends to be underestimated by experts [3]. Consider previous estimates of ranges, distributions, or other measures of uncertainty and the extent to which they cover all plausible sources of uncertainty.

Table 1. A simple typology of uncertainties

Type	Indicative examples of sources	Typical approaches or considerations
Unpredictability	Projections of human behaviour not easily amenable to prediction (e.g. evolution of political systems). Chaotic components of complex systems.	Use of scenarios spanning a plausible range, clearly stating assumptions, limits considered, and subjective judgments. Ranges from ensembles of model runs.
Structural uncertainty	Inadequate models, incomplete or competing conceptual frameworks, lack of agreement on model structure, ambiguous system boundaries or definitions, significant processes or relationships wrongly specified or not considered.	Specify assumptions and system definitions clearly, compare models with observations for a range of conditions, assess maturity of the underlying science and degree to which understanding is based on fundamental concepts tested in other areas.
Value uncertainty	Missing, inaccurate or non-representative data, inappropriate spatial or temporal resolution, poorly known or changing model parameters.	Analysis of statistical properties of sets of values (observations, model ensemble results, etc); bootstrap and hierarchical statistical tests; comparison of models with observations.

4. Assess issues of risk where supported by published work. Where probabilistic approaches are available, consider ranges of outcomes and their associated likelihoods with attention to outcomes of potential high consequence. An alternative approach is to provide information for decisions that would be robust in the sense of avoiding adverse outcomes for a wide range of future possibilities [4]. (Note that the term 'risk' has several different usages. If used it should be defined in context.)

Make expert judgments

5. Be prepared to make expert judgments and explain those by providing a traceable account of the steps used to arrive at estimates of uncertainty or confidence for key findings – e.g. an agreed hierarchy of information, standards of evidence applied, approaches to combining or reconciling multiple lines of evidence, and explanation of critical factors.
6. Be aware of a tendency for a group to converge on an expressed view and become overconfident in it [3]. Views and estimates can also become anchored on previous versions or values to a greater extent than is justified. Recognize when individual views are adjusting as a result of group interactions and allow adequate time for such changes in viewpoint to be reviewed.

Use the appropriate level of precision to describe findings

7. Assess the current level of understanding on key issues and precede statements on confidence or uncertainty with a general summary of the corresponding state of knowledge. Table 2 below provides a consistent language for this.
8. Develop clear statements for key findings that are quantitative and give explicit time frames as far as possible. Define carefully the corresponding variables or outcomes, their context, and any conditional assumptions. Where scenarios are used, explain the range of assumptions and how they affect the outcome. Then consider the most appropriate way to describe the relevant uncertainties or level of confidence by going as far down the hierarchy given below as you feel appropriate (from expressions of less to more confidence and less to more probabilistic approaches) [5]:
   A. *Direction of change is ambiguous or the issue assessed is not amenable to prediction:* Describe the governing factors, key indicators, and relationships. If a trend could be either positive or negative, explain the pre-conditions or evidence for each.
   B. *An expected trend or direction can be identified (increase, decrease, no significant change):* Explain the basis for this and the extent to which opposite changes would not be expected. Include changes that have a reasonable likelihood even where they are not certain. If you describe a collective level of confidence in words, use the language options in Table 2 or 3.

C. *An order of magnitude can be given for the degree of change (i.e. sign and magnitude to within a factor of 10):* Explain the basis for estimates given and indicate assumptions made. The order of magnitude should not change for reasonable ranges in such assumptions. If you describe a collective level of confidence in words, use the language options in Table 2 or 3.

D. *A range can be given for the change in a variable as upper and lower bounds, or as the 5th and 95th percentiles, based on objective analysis or expert judgment:* Explain the basis for the range given, noting factors that determine the outer bounds. If you cannot be confident in the range, use a less precise approach. If you describe a collective level of confidence or likelihood of an outcome in words, use the language options in Tables 3 or 4.

E. *A likelihood or probability of occurrence can be determined for an event or for representative outcomes, e.g. based on multiple observations, model ensemble runs, or expert judgment:* State any assumptions made and estimate the role of structural uncertainties. Describe likelihoods using the calibrated language given in Table 4 or present them quantitatively.

F. *A probability distribution can be determined for changes in a continuous variable either objectively or through use of a formal quantitative survey of expert views*: Present the PDF graphically and/or provide the 5th and 95th percentiles of the distribution. Explain the methodology used to produce the PDF, any assumptions made, and estimate the role of structural uncertainties.

Communicate carefully, using calibrated language

9. Be aware that the way in which a statement is framed will have an effect on how it is interpreted [6]. (A 10% chance of dying is interpreted more negatively than a 90% chance of surviving.) Use neutral language, avoid value laden statements, consider redundant statements to ensure balance (e.g. chances of dying and of surviving), and express different but comparable risks in a consistent way.
10. To avoid the uncertainty perceived by the reader being different from that intended, use language that minimizes possible misinterpretation and ambiguity. Note that terms such as 'virtually certain', 'probable', or 'likely', can engage the reader effectively, but may be interpreted very differently by different people unless some calibration scale is provided [7].

11. Three forms of language are given in Tables 2, 3 and 4 to describe different aspects of confidence and uncertainty and to provide consistency across the AR4.
12. Table 2 considers both the amount of evidence available in support of findings and the degree of consensus among experts on its interpretation. The terms defined here are intended to be used in a relative sense to summarize judgments of the scientific understanding relevant to an issue, or to express uncertainty in a finding where there is no basis for making more quantitative statements. A finer scale for describing either the amount of evidence (columns) or degree of consensus (rows) may be introduced where appropriate, however, if a mid-range category is used authors should avoid over-using that as a 'safe' option that communicates little information to the reader. Where the level of confidence is '*high agreement much evidence*', or where otherwise appropriate, describe uncertainties using Table 3 or 4.

Table 2. Qualitatively defined levels of understanding

Level of agreement or consensus ↑			
	High agreement limited evidence	...	High agreement much evidence
	...	...	...
	Low agreement limited evidence	...	Low agreement much evidence

Amount of evidence (theory, observations, models) →

13. A *level of confidence*, as defined in Table 3, can be used to characterize uncertainty that is based on expert judgment as to the correctness of a model, an analysis or a statement. The last two terms in this scale should be reserved for areas of major concern that need to be considered from a risk or opportunity perspective, and the reason for their use should be carefully explained.

Table 3. Quantitatively calibrated levels of confidence

Terminology	Degree of confidence in being correct
Very high confidence	At least 9 out of 10 chance of being correct
High confidence	About 8 out of 10 chance
Medium confidence	About 5 out of 10 chance
Low confidence	About 2 out of 10 chance
Very low confidence	Less than 1 out of 10 chance

14. *Likelihood*, as defined in Table 4, refers to a probabilistic assessment of some well defined outcome having occurred or occurring in the future. The categories defined in this table should be considered as having 'fuzzy' boundaries. Use other probability ranges where more appropriate but do not then use the terminology in table 4. Likelihood may be based on quantitative analysis or an elicitation of expert views. The central range of this scale should not be used to express a lack of knowledge – see paragraph 12 and Table 2 for that situation. There is evidence that readers may adjust their interpretation of this likelihood language according to the magnitude of perceived potential consequences [8].

Table 4. Likelihood scale

Terminology	Likelihood of the occurrence/outcome
Virtually certain	> 99% probability of occurrence
Very likely	> 90% probability
Likely	> 66% probability
About as likely as not	33 to 66% probability
Unlikely	< 33% probability
Very unlikely	< 10% probability
Exceptionally unlikely	< 1% probability

15. Consider the use of tabular, diagrammatic or graphical approaches to show the primary sources of uncertainties in key findings, the range of outcomes, and the factors and relationships determining levels of confidence.

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5. Kandlikar, M., J. Risbey, and S. Dessai. 2005. Representing and Communicating Deep Uncertainty in Climate Change Assessments, *Comptes Rendu Geosciences* **337**, 443-451.
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Appendix E Committee biographies

Harold T. SHAPIRO, President Emeritus of Princeton University and the University of Michigan, is a Professor of Economics and Public Affairs in the Department of Economics and the Woodrow Wilson School of Public and International Affairs at Princeton University. His fields of special interest in economics include econometrics, bioethics, science policy and the evolution of postsecondary education. He joined the faculty of the University of Michigan, where in 1977 he was named Vice President for Academic Affairs and elected President in 1980. In 1988, he took office as President of Princeton University, serving in that position until 2001 when he became President Emeritus. He continued to teach during his presidencies at both Princeton and Michigan. He served as a member and Vice Chair of the President's Council of Advisers on Science and Technology from 1990 to 1992 during the administration of President George H.W. Bush. He also served President Bill Clinton's administration as Chair of the National Bioethics Advisory Commission from 1996 to 2001. He is author of several books, including A Larger Sense of Purpose: Higher Education and Society (Princeton University Press, 2005). In 2000, he received the Council of Scientific Society Presidents Citation for Outstanding Leadership. In 2008, he was awarded the Clark Kerr Medal for Distinguished Leadership in Higher Education, presented annually by the University of California, Berkeley, Academic Senate. He also received the William D. Carey Award for Leadership in Science Policy from the American Association for the Advancement of Science. He is an elected member of the Institute of Medicine of the U.S. National Academy of Sciences and the American Philosophical Society. He is a Fellow of the College of Physicians of Philadelphia, an active Member of the European Academy of Sciences and Arts, and a Fellow of the American Association for the Advancement of Science. Dr. Shapiro received his undergraduate degree from McGill University in 1956 and his Ph.D. from Princeton in 1964, both in economics.

Roseanne DIAB is the Executive Officer of the Academy of Science of South Africa (ASSAf) and Emeritus Professor and Honorary Senior Research Associate at the University of KwaZulu-Natal in Durban. She is a member of ASSAf and is recognized for her research contributions in the field of atmospheric sciences, particularly air quality and tropospheric ozone. She chairs the Editorial Board of the South African Journal of Science, and serves on the Editorial Boards of the South African Geographic Journal and Atmospheric Environment. Dr. Diab has been a Fulbright senior research scholar, and has served as a member of a number of international commissions, including the Commission on Atmospheric Chemistry and Global Pollution (CACGP), the International Ozone Commission (IOC), and the Scientific Steering Committee of Stratospheric Ozone Processes and their Role in Climate (SPARC). She is a fellow of the South African Geographical Society and of the University of Natal. Dr. Diab has a Ph.D. in Environmental Sciences from the University of Virginia, Charlottesville (USA).

Carlos Henrique de BRITO CRUZ is the Scientific Director of the São Paulo Research Foundation (FAPESP), in Brazil, and Professor at the 'Gleb Wataghin' Physics Institute at the University of Campinas (Unicamp). Previously he served as Rector of the University of Campinas (Unicamp; 2002-2005), President of FAPESP (1996-2002), Dean of Research at Unicamp (1994-1998) and as Director of the Gleb Wataghin Physics Institute at Unicamp (1991-1994 and 1998-2002). From 1995 to 1999 served as Vice President of the Brazilian Physics Society (SBF). Prof. Brito Cruz served in several committees in funding agencies, science-related organizations, and universities, and presently he presides over the Council for Technology and Competitiveness at the Federation of Industries of the State of São Paulo (FIESP) and is a member of the Telefónica I+D Advisory Board and the Microsoft Research External Research Advisory Board. His research interests are the study of ultrafast phenomena using femtosecond lasers, in which he leads a research laboratory at the Physics Institute at Unicamp, and science policy. In 2000 he was awarded the Order of Scientific Merit by the President of Brazil for his contributions to science and technology, and in 2004 he received the 'Conrado Wessel' General Science Prize for his scientific career. Prof. Brito Cruz has been faculty at Unicamp since 1982. Prof. Brito Cruz graduated in Electronics Engineering from the Aeronautics Technology Institute (ITA) in 1978, received a M.Sc. degree in physics in 1980, and a D.Sc. degree in physics in 1983, both from the 'Gleb Wataghin'

Physics Institute at Unicamp. He is a member of the Academy of Sciences of the State of São Paulo (ACIESP) and the Brazilian Academy of Sciences (ABC).

Maureen CROPPER is a Professor of Economics at the University of Maryland, a Senior Fellow at Resources for the Future, and a former Lead Economist at the World Bank. She has served as chair of the Environmental Protection Agency's Science Advisory Board Environmental Economics Advisory Committee and as president of the Association of Environmental and Resource Economists. She is a member of the U.S. National Academy of Sciences and a Research Associate of the National Bureau of Economic Research. Her research has focused on valuing environmental amenities (especially environmental health effects), on the discounting of future health benefits, and on the tradeoffs implicit in environmental regulations. Her current research focuses on energy efficiency in India, on the impact of climate change on migration, and on the benefits of collective action in pandemic flu control. Dr. Cropper received a B.A. in Economics from Bryn Mawr College (summa cum laude, 1969) and a Ph.D. in Economics from Cornell University (1973).

FANG Jingyun is Cheung Kong Professor and Chair, Department of Ecology, College of Urban and Environmental Sciences, Peking University, Beijing. He also serves as Academic Director of the College of Urban and Environmental Sciences, where he also has taught as a professor since 1997. His research interests include terrestrial carbon cycle, biodiversity and biogeography of plants, and applications of remote sensing in ecology. From 1995 to 1997, he was Senior Scientist and Associate Director at Key Laboratory of Systems Ecology, Chinese Academy of Science. He worked as an assistant from May 1989 to November 1992, then as an associate scientist from December 1992 to December 1994 in the Center for Eco-Environmental Sciences, Chinese Academy of Sciences. He is a member of the Academy of Sciences for the Developing World (TWAS) and the Chinese Academy of Sciences. He has been awarded the HeLiangHeLi Science and Technology Progress Award (Life Science); Chang Jiang Scholars Achievement Award, China Ministry of Education and Hong Kong Li Ka Shing Foundation; National Natural Science Award of the State Council (the second class); and Natural Science Award of the China Ministry of Education (the first class). He was also a recipient of the Yangtze Scholarship, China Ministry of Education and Yangtze Group. Dr. Fang holds a Ph.D. in biology from Osaka City University (Osaka, Japan).

Louise O. FRESCO is currently University Professor, University of Amsterdam, The Netherlands, where she concentrates on issues of sustainability, food and agriculture, and scientific policy. She is a recognized global leader in issues of food and agriculture and a member of the Royal Netherlands Academy of Arts and Sciences, and foreign member of the Royal Swedish Academy of Agriculture and Forestry and the Spanish Real Academia de Ingeniería. She worked at the United Nations Food and Agriculture Organization (FAO) from 1997 through to 2006 – first as Director of Research, Extension and Training, and later as Assistant Director-General covering agriculture, biodiversity, water, climate change, soils, plant animal production, veterinary health, and food and nutrition. She has extensive understanding of international environmental negotiations and UN processes and has participated in many of the major environmental treaty meetings. Dr. Fresco obtained a Ph.D. in tropical agronomy (cum laude) from Wageningen University. She held the chair of plant production systems and led the Department of Agronomy, where she pioneered many interdisciplinary research programs, including land use and soil nutrient modeling. She has published over 100 scientific papers, three books (reports written while at the UN were not published by name), and hundreds of articles on popular science in Dutch. She served extensively on boards and evaluation committees for several Consultative Group on International Agricultural Research (CGIAR) centers. She was the founding chair of LUCC, a joint IGBP and IHDP program on climate, land use, and cover change. She is a member of the Socio-Economic Council of The Netherlands, the highest advisory body of the country. Beyond her scientific work, she serves as a non-executive director of Unilever International and as a board member of Rabobank, one of the largest cooperative banks in the world. She is deeply committed to shaping policy on sustainable agriculture and food consumption, the effects of climate change on vegetation and land use, and forging partnerships between the scientific, government and the non-governmental and private sector communities.

Syukuro MANABE is a meteorologist who pioneered the use of computers to simulate global warming and natural climate variations. He is currently a senior meteorologist at the Program in Atmospheric and Oceanic Science, Princeton University. Working at the Geophysical Fluid Dynamics Laboratory of the National Oceanic and Atmospheric Administration (NOAA), first in Washington, D.C., and later in Princeton, New Jersey, he worked with director Joseph Smagorinsky to develop three-dimensional models and applied them to studying climatic change. In 1958, he came to the United States to work at the General Circulation Research Section of the U.S. Weather Bureau, now the Geophysical Fluid Dynamics Laboratory of NOAA, continuing until 1997. He also served as a lecturer with the rank of professor in the Atmospheric and Ocean Science Program at Princeton University. From 1997

to 2001, he worked at the Frontier Research System for Global Change in Japan serving as Director of the Global Warming Research Division. He is a member of the U.S. National Academy of Sciences, and a foreign member of Japan Academy, Academia Europaea, and the Royal Society of Canada. In 1992, he was the first recipient of the Blue Planet Prize of the Asahi Glass Foundation. In 1997, he was awarded the Volvo Environmental Prize from the Volvo Environmental Foundation. He has also been honored with the American Meteorological Society's Carl-Gustaf Rossby Research Medal, the American Geophysical Union's Revelle Medal, and the Milutin Milankovitch Medal from the European Geophysical Society. Dr. Manabe received a Ph.D. from the University of Tokyo in 1958.

Goverdhan MEHTA is National Research Professor and Lilly-Jubilant Chair, School of Chemistry, University of Hyderabad, Hyderabad, India. He is a leading researcher in the area of chemical sciences and specializes in the area of organic chemistry. He is author of over 400 research papers and has delivered over 200 lectures in major conferences around the world. He is on the editorial boards of leading international journals in chemical sciences and organic chemistry and serves on the advisory boards of many research and development outfits and foundations worldwide. He has previously held positions as the Director of the Indian Institute of Science (1998-2005) and the President (Vice Chancellor) of the University of Hyderabad (1994-1998). He has been the President of the Indian National Science Academy (1999-2001), founding Co-Chair of the InterAcademy Council (2001-2006), and President of the International Council for Science (2005-2008). He is a Fellow of the Royal Society, Foreign Member of the Russian Academy of Sciences, and Fellow of the Academy of Sciences of the Developing World (TWAS). Among the more than 30 medals and awards and numerous honorary doctorate degrees, he was awarded the civilian honor of Padma Sri (2000) by the President of India and Chevalier de la Legion d'Honneur (2004) by the President of France. He is deeply interested in issues related to science and policy, science for sustainable development and is passionately committed to promoting and fostering international collaboration in science and technology with the object of bridging the knowledge divide.

Mario MOLINA was a co-recipient (along Paul J. Crutzen and F. Sherwood Rowland) of the 1995 Nobel Prize in Chemistry for his role in elucidating the threat to the Earth's ozone layer of chlorofluorocarbon gases. Between 1974 and 2004, he held research and teaching posts at the University of California, Irvine, the Jet Propulsion Laboratory at Caltech, and the Massachusetts Institute of Technology (MIT) where he was an institute professor. On July 1, 2004, he joined the Department of Chemistry and Biochemistry and the Center for Atmospheric Sciences at the Scripps Institution of Oceanography at the University of California, San Diego. He is a member of the Pontifical Academy of Sciences, U.S. National Academy of Sciences, U.S. Institute of Medicine, and El Colegio Nacional of Mexico. He serves on the board of the John D. and Catherine T. MacArthur Foundation, and he also sits on the U.S. President's Committee of Advisers in Science and Technology. He is president of the Center for Strategic Studies in Energy and the Environment in Mexico City. He has also received more than 20 honorary degrees. Asteroid 9680 Molina is named in his honor. After completing his basic studies in Mexico City and Switzerland, Dr. Molina earned a bachelor's degree in chemical engineering at the National Autonomous University of Mexico in 1965; a postgraduate degree from the Albert Ludwigs University of Freiburg, West Germany in 1967; and a doctoral degree in chemistry from the University of California, Berkeley, in 1972. He was an author of the IPCC Fourth Assessment Report.

Sir Peter WILLIAMS FRS is Honorary Treasurer and Vice President of the Royal Society and Chairman of the National Physical Laboratory. He is a Trustee of Marie Curie Cancer Care. Previously, he was Chancellor of the University of Leicester, a non-executive director of GKN plc and of W.S. Atkins plc, Chairman and Chief Executive of Oxford Instruments plc, Deputy Chief Executive of VG Instruments Ltd., Master of St. Catherine's College Oxford, Chairman of Trustees of the Science Museum, Chairman of the Engineering & Technology Board, and Chairman of the Particle Physics and Astronomy Research Council. He was knighted in 1998 and is a Fellow of the Royal Society and of the Royal Academy of Engineering. Sir Peter has a Ph.D. in physics from Cambridge and began his academic career in Cambridge and Imperial College and then moved into private industry in 1975, returning to academic life as Master of St. Catherine's Oxford in 2000.

Ernst-Ludwig WINNACKER is Secretary-General of the Human Frontier Science Program (HSFP). He was the first Secretary-General of the European Research Council (January 2007 - June 2009). In 1980 he took up the position of Full Professor at the Institute of Biochemistry at the Ludwig Maximilians University of Munich. From 1984 to 1997, he was Director of the Laboratory of Molecular Biology, the University of Munich Gene Center. From 1998 until the end of 2006, he served as President of the German Research Foundation (DFG). From 2003 to 2004 he was Chairman of the European Heads of Research Councils (EUROHORCs). Among other memberships, he is a member of the U.S. Institute of Medicine and of the German National Academy of Sciences Leopoldina. Dr. Winnacker holds a Dr. honoris causa from the University of Veterinary Medi-

cine in Vienna. He is the recipient of the 2009 International Science and Technology Cooperation Award of the People's Republic of China, of the Order of the Rising Sun, Gold and Silver Star of Japan (2009), and of the Commanders' Cross of the Order of Merit of the Republic of Poland (2007). He was named a Chevalier de la Legion d'Honneur in 2006 and received the Commander's Cross of the Order of Merit of the Federal Republic of Germany in 2006. Dr. Winnacker, who is the author of several books and textbooks, among them 'From Genes to Clones,' studied chemistry at the Swiss Federal Institute of Technology (ETH Zurich) where he obtained his Ph.D. in 1968, and completed postdoctorates at the University of California in Berkeley and the Karolinska Institute in Stockholm from 1968 to 1972.

ZAKRI Abdul Hamid is Science Adviser to the Government of Malaysia, advising the Prime Minister and the Cabinet on issues related to science, technology, and innovation. He holds the Tuanku Chancellor Chair at Universiti Sains Malaysia. He was the former Director of the Institute of Advanced Studies, United Nations University, and Co-Chair of the Millennium Ecosystem Assessment. He is a member of the Arab Fund Fellowship Program, Senior Advisory Group on Technical Assistance and Cooperation of the International Atomic Energy Agency (IAEA), and the Executive Board of International Council for Science (ICSU). He served as the Secretary-General of the Society for the Advancement of Breeding Researches in Asia and Oceania (SABRAO) from 1981-1989 and was Deputy Vice Chancellor at Universiti Kebangsaan Malaysia from 1992-2000. He was the Founding President of the Genetics Society of Malaysia. His professional interests include biodiplomacy, education for sustainable development, and biotechnology and biodiversity policies for developing countries. Recipient of a Fulbright-Hays Fellowship (1981) and a Gold Medal Award from the Rotary Research Foundation (1999), he is a Fellow of the Academy of Sciences Malaysia, the Academy of Sciences of the Developing World (TWAS), the World Academy of Art and Science, and the Islamic World Academy of Sciences. In 1998 he received the Langkawi Award, a national laureate for outstanding contribution in the field of environment in Malaysia. Three species known to science are named after him: a beetle (Paleosepharia zakrii); a cicada (Pomponia zakrii), and a pitcher plant (Nepenthes zakriana).

Appendix F Acronyms and abbreviations

AR4	Fourth Assessment Report
CLA	Coordinating Lead Author
FAQ	Frequently Asked Questions
FAR	First Assessment Report
IAC	InterAcademy Council
IPCC	Intergovernmental Panel on Climate Change
LA	Lead Author
NAS	National Academy of Sciences
NRC	National Research Council
RE	Review Editor
SAR	Second Assessment Report
SRES	Special Report on Emissions Scenarios
TAR	Third Assessment Report
UN	United Nations
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
WMO	World Meteorological Organization