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INTERGOVERNMENTAL PANEL ON climate change

IPCC WORKING GROUP I – ELEVENTH SESSION
Bali, 26-29 October 2009

WG-I :11th /INF.1
(1.X.2009)
Agenda Item: 2
ENGLISH ONLY

WORKING GROUP I CONTRIBUTION TO THE IPCC FIFTH ASSESSMENT REPORT (AR5)

Background information

(Submitted by the Co-Chairs of Working Group I
on behalf of the Working Group I Bureau)

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**Working Group I Contribution to the
IPCC Fifth Assessment Report
Climate Change 2013: The Physical Science Basis**

Background to the Proposed Outline

(Submitted by the Co-Chairs of Working Group I
on behalf of the Working Group I Bureau)

1. Introduction

This document is provided by the Co-Chairs of Working Group I on behalf of the WGI Bureau for the information of delegates to the Eleventh Session of Working Group I in order to describe the broad structure and rationale of the Working Group I contribution to the IPCC Fifth Assessment Report (WGI AR5) as outlined in WGI-11/Doc.2.

2. The Consultation and Scoping Process

The proposed outline for the WGI AR5 is the result of a comprehensive consultation and scoping process. WGI has obtained a broad range of inputs on the scope of the WGI AR5 from the expert scientific community over the past 12 months. A series of WGI Bureau meetings and e-mail discussions were held to consider how best to combine the following:

- Outcome of the WCRP-GCOS-IGBP Workshop on Future Climate Change Research and Observations: Learning from the IPCC AR4, Sydney, Australia, October 2007;
- Feedback from experts who attended the joint IPCC-WCRP-IGBP Workshop on New Science Directions and Activities Relevant to the IPCC AR5, Hawaii, USA, March 2009;
- Input from WCRP, IGBP and their working groups, as well as from research groups around the world on relevant topics;
- Feedback from Coordinating Lead Authors of the WGI AR4 on what key emerging science issues needed to be addressed in the WGI AR5;
- Outcome of the discussions among invited international scientific experts from many countries in developing the proposed contents and structure of the report in preparation of, and at, the Scoping Meeting organised by the IPCC in July 2009 in Venice, Italy.

Comments on the policy-relevant, scientific and technical topics to be addressed in the AR5 were solicited from governments and observer organisations prior to the IPCC Scoping Meeting and were explicitly taken into account during the meeting (see document AR5 SCOP/INF.1). These comments have directly influenced the development of the broad structure of the WGI AR5, the approach to cross-WG issues including the cross-cutting methodologies and themes, and the proposed content of specific chapters. Comments were solicited subsequently on the outlines of the AR5 and the Synthesis Report following the Scoping Meeting. These comments have been taken into consideration as much as possible in developing the scope, content and proposed outline of the WGI AR5.

The comments and discussion arising from this extensive scoping process will be compiled by the WGI TSU into a document that will provide detailed background information for consideration by the Lead Authors in writing the WGI AR5. Consensus views expressed by delegates at this meeting, the Eleventh Session of Working Group I, will also be included in that document to Lead Authors.

3. Proposed Structure of the Report

The guiding principles underlying the WGI contribution to the AR5 are to assess with scientific rigour the physical science basis of climate change as it is firmly rooted in the published literature and to bring forward the robust results in such a way that is accessible and useful to the stakeholders.

Table 1. Chapter Structure and Indicative Page Distribution (in percent) for the Parts of the WGI AR5

Title	Pages %
Summary for Policymakers	-
Technical Summary	-
Chapter 1: Introduction	< 2
Chapter 2: Observations: Atmosphere and Surface	
Chapter 3: Observations: Ocean	
Chapter 4: Observations: Cryosphere	< 25
Chapter 5: Information from Paleo-Climate Archives	
Chapter 6: Carbon and Other Biogeochemical Cycles	15
Chapter 7: Clouds and Aerosols	
Chapter 8: Anthropogenic and Natural Radiative Forcing	
Chapter 9: Evaluation of Climate Models	25
Chapter 10: Detection and Attribution of Climate Change: from Global to Regional	
Chapter 11: Near-term Climate Change: Projections and Predictability	20
Chapter 12: Long-term Climate Change: Projections, Commitments and Irreversibility	
Chapter 13: Sea level Change	15
Chapter 14: Climate Phenomena and their Relevance for Future Regional Climate Change	
Annex I: Atlas of Global and Regional Climate Projections	-
Annex II: Glossary	-
Annex III: Acronyms and Regional Abbreviations	-
Annex IV: List of Authors	-
Annex V: List of Reviewers	-
Index	-

WGI's contribution to the IPCC AR5 will in general retain the overall approach and structure that has been developed in previous WGI assessment reports. This proceeds from observed changes to process understanding, and climate change projections (Table 1). The report will also include Frequently Asked Questions (FAQs) in each of the chapters, following the successful approach of WGI in AR4. The WGI contribution to AR5 will include several important new elements, intended to better reflect recent advances in scientific understanding of key topics in climate change research as well as the rapidly increasing breadth of knowledge available for assessment from the regions.

In particular, the WGI contribution will

- improve the treatment of **regional information** by specifically assessing key climate phenomena (monsoon, ENSO, etc.) and their relevance for future regional climate change in a separate chapter. Regional information will be included in all relevant chapters of the WGI report. In addition, an Atlas of Global and Regional Climate Projections will be provided as Annex I of the report. This Atlas, which will be compiled under the leadership of an Editorial Team, assisted by an Advisory Board¹, is planned to include maps for a limited number of physical variables directly simulated in comprehensive climate models for all regions, for a range of scenarios, and for a number of time horizons in the 21st century. This novel approach is intended to enhance the accessibility of the material to the users and stakeholders and ease the hand-over of relevant information from WGI to WGII;
- assess, for the first-time in a separate chapter, the science of **clouds and aerosols**, their interactions, and their role in climate change and climate change projections;
- provide an end-to-end assessment of **sea level change**, covering all science aspects related to past, present, and future sea level change ranging from observations, to process understanding, and to future projections;

¹ The **Editorial Team** consists of 4 members of the author teams of Chapters 11 and 12; The **Advisory Board** consists of 2 WGI Vice Chairs and one member selected from the author team of WGII.

- provide an end-to-end assessment of the **carbon cycle**, its interactions with other biogeochemical cycles, including the nitrogen cycle, effects on atmospheric composition and their role in the climate system;
- extend the coverage of climate change projections by assessing **near- and long-term projections** in two separate chapters, thereby bridging the gap between seasonal to interannual prediction and long-term climate projections and assessing near-term climate predictability.

The WGI contribution to AR5 will consist of a total of 14 topical chapters as indicated in Table 1 and in the draft outline (WGI-11/Doc.2).

The resulting structure of the WGI AR5 contribution can be summarized as follows:

- *Introduction (Chapter 1)*: this chapter will provide the rationale and key concepts of the WGI contribution, including the treatment of uncertainty and a short review of climate change projections from the First up to the Fourth Assessment Report.
- *Observations and Paleo-Climate Information (Chapters 2, 3, 4, and 5)*: this part of the report assesses information from all climate system components on climate variability and change as obtained from instrumental records and climate archives. It will cover all relevant aspects of the atmosphere up to the stratosphere, the land surface, the oceans, and the cryosphere. Information on the water cycle, including evaporation, precipitation, runoff, soil moisture, floods, drought, etc., will be assessed across these four chapters. Timescales from the present to decades (*Chapters 2, 3 and 4*) and from centuries to many millennia (*Chapter 5*) will be considered.
- *Process Understanding (Chapters 6 and 7)*: this section consists of two end-to-end chapters, covering all relevant aspects from observations, process understanding, to projections from global to regional scale. *Chapter 6* will cover the carbon cycle and its interactions with other biogeochemical cycles, in particular the nitrogen cycle, as well as feedbacks on the climate system. *Chapter 7* will treat in detail clouds and aerosols, their interactions and chemistry, the role of water vapour, as well as the feedbacks on the climate system.
- *From Forcing to Attribution of Climate Change (Chapters 8, 9, 10)*: in this part of the report, all the information on the different drivers (natural and anthropogenic) of climate change will be collected, expressed in terms of radiative forcing, and assessed (*Chapter 8*). As part of this, the science of metrics commonly used in the literature to compare radiative effects from a range of agents (GWP, GTP and others) will be covered. In *Chapter 9*, the hierarchy of climate models used in simulating past and present climate change will be assessed. Information regarding detection and attribution of changes on global to regional scales using these climate models, will also be assessed (*Chapter 10*).
- *Future Climate Change and Predictability (Chapters 11 and 12)*: this part of the report will assess projections of future climate change derived from climate models on time scales from decades to centuries at both global and regional scales, including mean changes, variability and extremes. Fundamental questions related to the predictability of climate as well as long-term climate change, climate change commitments, and inertia in the climate system will be addressed. This assessment will build on new model simulations using the most recent set of new emission scenarios, the so-called Representative Concentration Pathways (RCPs), the widely used SRES emission scenarios, as well as a range of idealized emission and concentration scenarios. Global and regional maps produced and assessed in these chapters will form the basis of Annex I: Atlas of Global and Regional Climate Projections.

- *Integration (Chapters 13 and 14)*: this part consists of two chapters that build on the previous chapters, integrating all relevant information for two key topics in WGI AR5: sea level change (*Chapter 13*) and climate phenomena across the regions (*Chapter 14*). *Chapter 13* is an end-to-end chapter assessing information on sea level change ranging from observations, process understanding, and projections from global to regional scales. This chapter will focus on (i) the quantification and uncertainty of the individual contributions to sea level change and their projections, and (ii) the assessment of ice sheet instabilities and implications for sea level. The chapter on Climate Phenomena (*Chapter 14*) will assess the most important modes of variability in the climate system and extreme events. Modes relevant across many regions are monsoon systems, El Niño-Southern Oscillation (ENSO), Pacific Decadal Oscillation (PDO), Quasi-Biennial Oscillation (QBO), North Atlantic Oscillation (NAO), and others. Furthermore, this chapter deals with interconnections between the climate phenomena, their regional expressions, and their relevance for future regional climate change. As an integration chapter, it will also build on the regional information assessed in the previous chapters.

With this structure, the WGI contribution to AR5 will cover all relevant aspects of the physical science basis of anthropogenic climate change on the full range of temporal (from seasonal to millennia) and spatial scales (from global to regional). The WGI assessment will specifically include (i) the couplings between physical and biogeochemical processes and their influence on the sensitivity of the climate system, (ii) irreversible changes in various components of the climate system, as well as (iii) the physical science basis of recently proposed geoengineering strategies involving carbon dioxide removal techniques and solar radiation management techniques. The WGI contribution to AR5 aims to remain comprehensive in scope and, if possible, shorter than the AR4.

4. Incorporation of Cross-Cutting Methodologies and Themes

The treatment of cross-cutting methodologies (CCMs) and cross-cutting themes (CCTs) in the AR5 was a subject that received special attention during the scoping process, as detailed in the Scoping Document (document XXXI/Doc.4). CCMs and CCTs have been chosen based on the importance of the topics, the information that is expected to be available for AR5, and taking into account planned IPCC Special Reports, Expert Meetings and Workshops. WGI AR5 will link to the other WGs as appropriate and will give special consideration to those cross-cutting methodologies and themes that have a home in the contribution on the physical science basis.

- *Consistent Evaluation of Uncertainties and Risks (CCM)*: the treatment of uncertainties in the WGI contribution will be laid out in *Chapter 1* of the report and will closely follow the AR4 WGI approach, which was to consistently apply the *Guidance Notes for Lead Authors of the IPCC Fourth Assessment Report on Addressing Uncertainties*.
- *Regional Aspects (CCM)*: regional integration is a key element of the WGI contribution to AR5. Regional information, if available, will be assessed in all chapters, with a special focus on regional climate change in *Chapters 11, 12, and 14* as well as in the Atlas of Global and Regional Climate Projections in Annex I. This Atlas will enhance the accessibility of the material for the users and stakeholders and ease the hand-over of relevant information from WGI to WGII.
- *Water and the Earth System (CCT)*: the water cycle and its role in the climate system is a key aspect for WGI in AR5, and will be addressed at several places in the WGI contribution. Observations and past records related to the water cycle will form a central part of *Chapters 2, 3, 4, and 5*. The end-to-end chapter on clouds and aerosols (*Chapter 7*) will extensively treat water vapour in the atmosphere. The chapters on model evaluation (*Chapter 9*), detection & attribution (*Chapter 10*), and the projections chapters (*Chapters 11 and 12*) will include assessments of key elements of the water cycle, e.g., precipitation. Extreme events involving the water cycle, such as heavy rainfall, floods, droughts, etc. will also be assessed in *Chapters 11, 12, and 14*.

- *Carbon Cycle, Including Ocean Acidification (CCT)*: the carbon cycle will have its own end-to-end chapter in the WGI contribution (*Chapter 6*) and will thus be assessed comprehensively. This chapter will also include an assessment of the interconnections between the carbon and other biogeochemical cycles, including the nitrogen cycle, and how these will in turn affect the carbon cycle and feedbacks between the carbon cycle and climate. Components of the carbon cycle, including physical-biogeochemical aspects of ocean acidification, will further be assessed in the observations and paleo-climate chapters (*Chapters 2, 3, 4, and 5*). This information will be central for the assessment of e.g., radiative forcing (atmospheric CO₂/CH₄ concentrations; *Chapter 8*) or long-term projections (*Chapter 12*). The long lifetime of an atmospheric CO₂ perturbation and the resulting long-term carbon cycle and climate change commitments will be addressed in *Chapter 12*. The associated ranges of model projected carbon emissions for scenarios with prescribed CO₂ concentrations or prescribed climate evolution will provide information that is relevant for WGIII.
- *Ice Sheets and Sea Level Rise (CCT)*: sea level changes, their causes and their regional expression will be comprehensively assessed in a separate end-to-end chapter (*Chapter 13*). This chapter will also treat the role of ice sheets and potential ice sheet instabilities on past and future sea level. The assessment of regional sea level change provides important regional information relevant for impacts studies and WGII.

5. Indicative Page Distribution

An indicative page distribution for each of the parts of the report as described in Section 3 of this document is given in Table 1 above. It is assumed that the total length of the WGI contribution to AR5 will be about 800 pages, not including Annexes. The Summary for Policymakers and the Technical Summary will be restricted to about 15 and 65 pages, respectively.