

ATTACHMENT G

GCOS - OBSERVATIONAL NEEDS FOR ASSESSING IMPACTS OF, VULNERABILITY AND ADAPTATION TO, CLIMATE VARIABILITY AND CHANGE: CONCLUSIONS FROM THE FOURTH ASSESSMENT REPORT OF IPCC (INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE) WORKING GROUP II

Introduction

One of the six main long-term objectives of the Global Climate Observing System (GCOS) is to ensure the adequacy of data for 'Assessing impacts of, vulnerability and adaptation to, climate variability and change, eg in relation to terrestrial ecosystems and sea level' (WMO, Sixth Long-term Plan, 2004).

2 The primary international assessment mechanism for research into climate change impacts, adaptation and vulnerability is Working Group II of the Intergovernmental Panel on Climate Change (IPCC). Its Fourth Assessment Report (AR4), completed in April 2007, took stock of the main findings in the rapidly expanding impacts, adaptation and vulnerability literature, including an extensive literature dealing with observed impacts and their relation to observed climate change.

3 The Working Group II Report included a core of 15 chapters in two major Sections (Sections B and C), focused respectively on 'systems and sectors' and 'regions' for each of which the guidance to Lead Authors required that the final part of each chapter identify, in the light of the assessment, 'key uncertainties, research gaps and priorities'. Most Chapter Lead Authors included at least short sections on future needs.

4 These were brought together, in the draft Summary for Policy Makers (SPM) and Technical Summary (TS) submitted to the Eighth Session of Working Group II (Brussels, 2-5 April 2007) in final sections entitled, respectively:

- SPM - Systematic observing and research needs (Section E)
- TS - Advances in knowledge and future research needs (Section TS 6).

5 The emphasis on observation needs in support of impact and adaptation assessment and research had been particularly championed by Working Group II Co-chair, Dr Osvaldo Canziani of Argentina, who stressed the observational needs issue in his opening address at Brussels. The text for the draft SPM on observing and research needs was coordinated by Working Group II Bureau Member, Dr John Stone of Canada, who had earlier played a key role in international discussions in the late 1990s on the future development and governance of GCOS.

6 The IPCC procedures are such that draft SPMs are reviewed, amended and approved on a line-by-line basis by intergovernmental sessions of the Working Groups with the finally approved versions sometimes differing substantially from the draft. On the other hand, the Technical Summary and Underlying Chapters remain essentially as finalised by the Lead Authors after several rounds of peer and government review.

7 Considerations related to the adequacy of observations for assessment of climate change impacts, adaptation and vulnerability were ubiquitous in the Brussels discussions of Working Group II and much of the controversy at the session related to Lead Author judgements on the confidence level of their findings resulting from data inadequacies. However, due to severe over-run of session time, and because of some expected disagreement by several delegations on parts of the SPM draft on 'Systematic observing and research needs', a much shortened version, referring to the Technical Summary and Chapters for detail, was prepared and approved in the final plenary meeting.

8 The following paras summarise the main GCOS-relevant conclusions from the Working Group II AR4 and provide some additional background, where relevant, from the discussions at the session.

Summary for Policy Makers (SPM)

9 Following the final government review of the draft SPM, the text of the concluding section (Section E 'Systematic observing and research needs') of the SPM submitted for line-by-line approval in Brussels read as follows:

"This fourth Working Group II Assessment of the IPCC has benefited from the significant increase in research studies over the past few years inspired in part by the needs identified in the Third Assessment Report. However, many of these needs are still valid and require continued scientific, technical, financial and operational efforts in order to provide policy-makers with the information needed for climate change risk-management. Among these needs are:

- **enhancement of networks of systematic observations of key elements of physical, biological, managed and human systems affected by climate change particularly in regions where such networks have been identified as insufficient;** (bold face added)
- development of hazard warning systems enabling the dissemination of early alert warnings regarding climate hazards and risks;
- continued research on the attribution of observed impacts of climate change to natural and anthropogenic forcings;
- research into understanding and managing physical, biological and, in particular, human systems where there is a risk of irreversible change due to climate and other stresses;
- an increased understanding of the potential costs of impacts due to various amounts of climate change, of damages avoided by different levels of emissions reduction, and of costs and benefits of options for adapting to these impacts and managing the risks;
- studies to explore how adapting to climate change and pursuing sustainable development can be complementary, and to identify what are the barriers to effective adaptation;
- further research to achieve a better understanding of how multiple stresses interact to increase vulnerability of natural, managed and human systems; and

- further work in communicating uncertainty and risk in ways that inform decision makers.

In general, it is true that research into the impacts of climate change, and the potential for adaptation continues to lag in developing countries, and effort is required to redress this imbalance."

10 During the review of earlier sections of the SPM, (especially Section B dealing with 'Current knowledge about observed impacts of climate change on the natural and human environment' and Section C dealing with 'Current knowledge about future impacts'), virtually all sectoral and regional chapter Lead Authors and many delegations drew attention to the problems of data inadequacy for impacts research in their sectors and regions, and some draft text had been prepared to attempt to further strengthen/elaborate the observational needs statement (ie that bolded in paragraph 9 above) during the session review of Section E. However, with the session going through the night of Thursday 5 April, the GCOS Steering Committee Chairman spoke off-line with the meeting Chair (Dr Martin Parry) and suggested that the best thing might be to let the text go through unamended. In the event, the discussion did not reach Section E for the first time until 5.00am Friday 6 April and, to avert a potential debate, the IPCC Chairman, Dr Rajendra Pachauri, intervened to suggest that, while Section E was very important, it might prove difficult to get agreement to some of the individual bullets. He proposed, instead, a shorter summary text including a reference to the Technical Summary and Chapters for detail. Dr Parry elaborated on Dr Pachauri's intervention by explaining that several governments had argued that a Section E is not needed and he invited Dr Stone to explain the background to the development of the Section. Following Dr Stone' explanation of the process of consolidation of Chapter inputs to produce the draft Section E, and an impassioned plea in support of GCOS and observations by Dr Canziani (the only explicit mention of GCOS during the entire session), Dr Parry proposed the approval of the Lead Authors' text 'en bloc' rather than line-by-line. However, at this stage, the US delegation intervened to say that such a section is not needed. Sudan supported the section with one small change but the Australian delegation supported the US and the Chairman opted for the Pachauri approach, with an objection recorded by Sudan, and (in line with his earlier stance on Observer interventions) the Chairman declining to recognise the WMO/GCOS request to intervene. The approved text for Section E, which was not reopened in the later review of the completed SPM text during the morning, thus read:

"E. Systematic observing and research needs

Although science to provide policy makers with information about climate change impacts and adaptation potential has improved since the Third Assessment, it still leaves many important questions to be answered. The chapters of the Working Group II report include a number of judgements about priorities for further **observation** (bolding added) and research, and this advice should be considered seriously (a list of these recommendations is given in the Technical Summary Section TS-6)."

Technical Summary

11 The Section TS-6 (Advances in knowledge and future research needs) of the Technical Summary contains two sub-sections on 'Advances in Knowledge' and 'Future research needs'.

12 The only sector-explicit reference to observations in 'Advances in Knowledge' reads ' the principle advances in knowledge have been much more monitoring of observed effects and recognition that climate is having a discernible impact on many natural systems'.

13 The sub-section on 'Future research needs' includes a sub-sub-section on 'Observations, monitoring and attribution' which reads:

"Large area long-term field studies are required to evaluate observed impacts of climate change on managed and unmanaged systems and human activities. This will enable improved understanding of where and when impacts become detectable, where the hotspots lie, and why some areas are more vulnerable than others. High quality observations are essential for full understanding of causes, and for unequivocal attribution of present-day trends to climate change.

Timely monitoring of the pace of approaching significant thresholds (such as abrupt climate change thresholds) is required."

Chapter on Observed Changes

14 Chapter 1 of the Working Group II AR4 deals with 'Assessment of observed changes and responses in natural or managed systems'. The main references to observations in its 'Future needs' sub-section (entitled 'Learning from observed responses - vulnerability, adaptation and research needs') include the following:

"Evidence is primarily found in places where warming is most pronounced. Documentation of observed changes in tropical regions is still sparse."

"There is a noticeable lack of geographic balance in data and literature on observed changes in natural and managed systems, with marked paucity in developing countries."

"There is a need to improve the observations networks and to enhance research capability on changes in physical, biological, and socio-economic systems, particularly in regions with sparse data."

Chapters on Systems and Sectors

15 The final section of Chapter 2 on 'New Assessment Methods and Characterisation of Future Conditions' includes a statement that ' . . . future research efforts need to address a set of methodological, technical and information gaps that call for:

- Enhanced observation networks and improved access to existing data. CCI/V studies have growing requirements for data describing present-day

environmental and socio-economic conditions. Some regions, especially in developing countries, have limited access to existing data and urgent attention is required to arrest the decline of observation networks. Integrated monitoring systems are needed for observing human-environment interactions.'

16 Chapter 3 on 'Freshwater Resources and their Management' concludes with the statement that:

"Progress in research depends on improvement in data availability, calling for enhancement of monitoring endeavours worldwide, addressing the challenges posed by projected climate change to freshwater resources and reversing the tendency of shrinking observation networks. Broadening access to available observation data is a pre-requisite condition to improve understanding of the ongoing changes. Relatively short hydrometric records can underplay the full extent of natural variability and confound detection studies, while long-term river flow reconstruction can place record trends and extremes in a broader context. Data on water use, water quality and sediment transport are even less available."

17 Chapter 4 on 'Ecosystems, their Properties, Goods and Services', surprisingly, did not include explicit reference to observational needs in its final section on 'Key uncertainties and research priorities'. Similarly, Chapter 5 on 'Food, Fibre and Forest Products' referred only indirectly to observational needs in its table of research priorities through reference to 'FACE type experiments needed on expanded range of crops, pastures, forests and locations, especially in developing countries."

18 Chapter 6 on 'Coastal Systems and Low-lying Areas' included as its first-listed research priority"

"Establishing better baselines of actual coastal changes, including local factors and sea-level rise and the climate and non-climate drivers, through additional observations and expanded monitoring. This would help to better establish the causal links between climate and coastal change which tend to remain inferred rather than observed and support model development."

19 Chapter 7 on 'Industry, Settlement and Society' included as its final paragraph:

"Underlying all of these research needs are often very serious limitations on available data to support valid analysis, especially data on nature-society linkages and data on relatively detailed-scale contexts in both developed and developing countries (eg Wilbanks *et al.* 2003a). If information about possible impacts, vulnerabilities, and adaptation potentials for industry, settlement, and society is to be substantially improved, serious attention is needed to establishing improved data sources on human-environmental relationships in both developing and developed countries, improving the integration of physical and earth science data from space-based and in-situ observation systems with socioeconomic data, and improving the ability to associate data systems with high-priority questions."

20 Chapter 8 on 'Human Health' included a number of statistics on data inadequacies with the following paragraph from its final section on 'Key Uncertainties and research priorities' as probably the most important:

"More empirical epidemiologic research on the observed health effects of climate change have been published since the TAR and the few national health impact assessments that have been conducted have provided valuable information on population vulnerability. However, the lack of appropriate longitudinal health data makes attribution of adverse health outcomes to observed climate trends difficult. Further, most studies focused on middle- and high-income countries. Gaps in information persist on trends in climate, health, and environment from low-income countries where data are limited and other health priorities take precedence for research and policy development. Climate change-related health impact assessments in low- and middle-income countries will be instrumental in guiding adaptation projects and investments."

Chapters on Regions

21 The Chapter (9) on Africa makes frequent indirect references to data inadequacies in virtually all impact sectors but does not include any direct statement on future observational needs.

22 The Chapter (10) on Asia, on the other hand, identifies in a list of nine specific research priorities:

"Enhancing capability to establish and maintain observation facilities and to collect and compile climatic, social and biophysical data; and
Improvement of information-sharing and data networking via climate change in the region."

22 The Chapter (11) on Australia and New Zealand adopts a sectoral approach to the identification of research priorities and does not refer to observational needs as such.

23 The Chapter (12) on Europe identifies as the first of six research needs on the impact of climate change:

"Improved long-term monitoring of climate-sensitive physical (eg cryosphere), biological (ecosystem) and social sectors (tourism, health).

24 The Chapter (13) on Latin America refers only briefly in its final section to 'lack of well distributed and reliable observing systems' and 'lack of adequate monitoring systems' but, in its Executive Summary, includes the following explicit statement in para 1:

"Recent developments in meteorological forecasting techniques could improve the necessary information for people's welfare and security. However, the lack of modern observation equipment; the badly required upper air information, the low density of weather stations, the unreliability of their

reports and the lack of the monitoring of climate variables hinder the quality of forecasts with adverse effects on the public, lowering their appreciation of applied meteorological services, as well as their trust on climate records. These shortcomings also affect hydrometeorological observing services, with a negative impact on the quality of the early warnings and alert advisories."

25 The Chapter (14) on North America includes no strong explicit reference to observational needs.

26 The Chapter (15) on Polar Regions notes that the harsh polar environment 'constrains data collection and means that observational networks are sparse and mostly only recently established'. It includes a set of uncertainties and associated recommendations, four of which relate to observations, as follows:

Uncertainty	Recommendation
Detection and projection of changes in terrestrial, freshwater and marine Arctic and Antarctic biodiversity and implications for resource-use and climatic feedbacks	Further development of integrated monitoring networks and manipulation experiments; improved collation of long-term data sets; increased use of traditional knowledge and development of appropriate methods
Current and future regional carbon balances over Arctic landscapes and polar oceans, and their potential to drive global climate change	Expansion of observational and monitoring networks and modelling strategies
The combined role of Arctic freshwater discharge, formation/melt of sea ice and melt of glaciers/ice sheets in the Arctic and Antarctic on global marine processes including the thermohaline circulation	Integration of hydrologic and cryospheric monitoring and research activities focusing on freshwater production and responses of marine systems
Model projections of Antarctic and Arctic systems that include thresholds, extreme events, step-changes and non-linear interactions, particularly those associated with phase-changes produced by	Appropriate interrogation of existing long-term data sets to focus on non-linearities; development of models that span scientific disciplines and reliably predict linearities and feedback processes.

27 The Chapter (16) on Small Islands includes two major sub-sections of its section on 'Key uncertainties and research gaps', the first of which is entitled 'Observations and climate change science' and includes the following three key points:

- Ongoing observation is required to monitor the *rate and magnitude* of changes and impacts, over different spatial and temporal scales. In-situ observation of sea level should be strengthened to understand the components of relative sea-level change on regional and local scales. While there has been considerable progress in regional projections of sea level since the TAR, such projections have not been fully utilised in small islands because of the greater uncertainty attached to them, as opposed to global projections;

- Since the TAR it has also been recognised that other climate change-induced factors will likely have impacts on coastal systems and marine territories of small islands, including rises in sea temperature and changes in ocean chemistry and wave climate. Monitoring of these and other marine variables in the seas adjacent to small islands would need to be expanded and projections developed;
- Supporting efforts by small islands and their partners to arrest the decline of, and expand observational networks, should be continued. The Pacific Islands-Global Climate Observing System (PI-GCOS), and the Intergovernmental Oceanographic Commission Sub-Commission in the Caribbean and Adjacent Regions - Global Ocean Observing System (IOCARIBE-GOOS) are two examples of regional observing networks whose coverage should be expanded to cover other island regions;

the last of which contains one of the few explicit references to GCOS in the Working Group II report.