GCOS

GLOBAL CLIMATE OBSERVING SYSTEM

WMO IOC UNEP ICSU International Council for Science

WORLD METEOROLOGICAL ORGANIZATION

INTERGOVERNMENTAL OCEANOGRAPHIC COMMISSION

REPORT OF THE TWENTY-FIRST SESSION OF THE

WMO-IOC-UNEP-ICSU STEERING COMMITTEE FOR GCOS

(Offenbach, Germany, 22-24 October 2013)

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REPORT OF THE TWENTY-FIRST SESSION OF THE GCOS STEERING COMMITTEE

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REPORT OF THE TWENTY-FIRST SESSION OF THE GCOS STEERING COMMITTEE

1. Opening of the Session

The twenty-first session of the Global Climate Observing System (GCOS) Steering Committee (SC) was held at the German Meteorological Service, *Deutscher Wetterdienst* (DWD), in Offenbach, Germany from 22 to 24 October 2013.

This report provides an overview of the presentations and discussion at the session and identifies specific action items following from the deliberations of the SC.

The list of participants is provided in Annex 1, the final agenda for the session is given in Annex 2, a consolidated list of actions is given in Annex 3, and the list of the available documents is included as Annex 4.

1.1 Opening Remarks and Welcome by the Host

The Chair of the GCOS SC, Prof Adrian Simmons, formally opened the session on 22 October 2013 at 0900. He then invited the host of the session, the President of Deutscher Wetterdienst (DWD) and Permanent Representative of Germany with the World Meteorological Organization (WMO), Prof Gerhard Adrian, to give his welcoming remarks.

Prof Adrian warmly welcomed all participants to the DWD, and pointed out that this was the second time in 2013 that a GCOS meeting had been held in Offenbach, Germany, which underlined the great interest the DWD takes in activities related to climate observations. Prof Adrian furthermore announced that the first report on the German Climate Observing Systems, led by the German GCOS coordinator affiliated with the DWD, is now available in English. The report is a first inventory of available global observations for climate and their networks in Germany. He also informed the SC that the DWD operates stations of the GCOS Surface Network (GSN) and the GCOS Upper-Air Network (GUAN), and hosts and operates the GSN Monitoring Centre and the CBS Lead Centre for the GCOS Reference Upper-Air Network (GRUAN). The President of the DWD also informed participants that all key activities related to the GCOS programme are recognised by the German Government through the responsible Federal Ministry for Transport and Urban Building.

The SC Chair thanked Prof Gerhard Adrian for his hospitality and remarks. He then invited the SC Members and experts present to introduce themselves, initiating a 'tour de table'.

1.2 Sponsors' Expectations for the Meeting

Representatives from all four GCOS sponsor organizations briefly presented their expectations for not only the Steering Committee itself, but also on GCOS future activities in general. All representatives of the sponsor organizations expressed their appreciation for the current GCOS review process, which was seen to be an excellent opportunity to redefine

the expectations not only from the sponsors to GCOS, but also from GCOS towards the sponsors.

Mr Jeremiah Lengoasa, Deputy Secretary General of the WMO, welcomed SC Members and invited experts, and expressed his sincere appreciation to the representatives of the local host Deutscher Wetterdienst, Prof Gerhard Adrian, Mr Klaus-Jürgen Schreiber, and Mr Stefan Roesner. He noted that GCOS has an important role to play in climate change adaptation and mitigation, and that climate observations will be crucial for the success of both the WMO Integrated Global Observing System (WIGOS) and the Global Framework for Climate Services (GFCS). He highlighted the importance of access to data for the success of the GFCS, which currently shifts into next gear after establishing its governance mechanisms and agreeing its implementation plan. In addition to the availability of adequate physical climate data, the GFCS will also need socio-economic data and information.

Mr Lengoasa welcomed the GCOS review, and mentioned that the outcomes of the review will help to provide further momentum to the resolution of the resource challenge for GCOS. Most importantly, the review will help to sharpen the focus of the challenges the GCOS Secretariat, supporting the GCOS programme, will have to face in the future, and also of the critical work that the sponsor organizations support through various other programmes and activities. Furthermore, Mr Lengoasa updated SC Members and invited experts on the current situation of the Global Terrestrial Observing System (GTOS), and assured participants that WMO is committed to further engage in the deliberation on the future of the GTOS programme, and is planning a mission to the current host of the programme, the Food and Agriculture Organization (FAO), in agreement with other co-sponsors to discuss the programme.

Dr Albert Fischer, representing the Intergovernmental Oceanographic Commission (IOC) of the United Nations Educational, Scientific and Cultural Organization (UNESCO), noted that the links between the IOC and in particular the IOC-led Global Ocean Observing System (GOOS) and GCOS are stronger than ever. The ocean has always been a part of the climate observing system, but IOC and GCOS have in the past years developed stronger links between their secretariats, pushed in part by the UNESCO financial situation. Since late 2011, US voluntary financial contributions have not been able to be paid to UNESCO and therefore the OOPC Secretariat, which is funded in great part by the US voluntary contribution, is now incorporated within the GCOS Secretariat hosted at WMO headquarters in Geneva, Switzerland. Nevertheless, IOC has been able to continue investing in OOPC activities and meetings, and the GOOS Steering Committee has made it clear that in the face of resource constraints, OOPC and the climate and physical ocean observing system should receive priority over an expansion into other domains. GOOS is expanding its remit using the Framework for Ocean Observing (FOO) to new areas of requirements, and therefore to new domains of 'Essential Ocean Variables' (EOVs), a large number of which overlap with the GCOS Essential Climate Variables (ECVs).

Furthermore, IOC has participated in the ongoing review of GCOS, and has stressed the need for GCOS to proactively clarify its links to climate services and the GFCS, to observations needed for adaptation and mitigation to climate change, and to organizations and assessments that require sustained climate observations – the World Climate Research Programme (WCRP), the Intergovernmental Panel for Climate Change (IPCC) assessments, the International Council for Science (ICSU)'s Future Earth, and marine assessments such as the United Nations (UN) World Ocean Assessment. Linking to services is a very important way of attaching utility to observations, and in many cases, simple data products

are a key service upon which decisions are made. A link to services is also critical in developing capacity for services, adaptation, and for climate science.

Dr Ron Witt, representative of the United Nations Environment Programme (UNEP), stated that UNEP's main expectation was to find out and better understand what is on the horizon for GCOS in the coming years, and what UNEP, as one of the sponsors, can expect from GCOS in terms of new activities and products (also beyond those of the ECVs) that will help UNEP to better carry out its mandates. The discussion on the future GCOS work plan and other agenda items should allow for some reflection of what activities would be most useful from UNEP's perspective.

In 2012/2013, UNEP financially supported the GCOS Programme review process, as well as the 'GCOS Workshop on Observations for Adaptation to Climate Variability and Change', and offered to continue its support for targeted sectoral workshops beyond 2013. UNEP would like to further engage with GCOS on the following issues:

- the development of the 'UNEP-Live' platform, and how the key activities of GCOS can feed into that (e.g. data streams, indicators, climate change-related information, etc.),
- engagement with the UNEP Global Environmental Outlook, and how UNEP can look for complementarities with GCOS therein, and
- furthering the discussion of how the Global Programme of Research on Climate Change Variability, Impacts and Adaptation (PROVIA) initiative, for which UNEP runs the Secretariat and related support, and UNEP's main contribution to the GFCS, can better interface with GCOS as part of the World Climate Programme (WCP).

Dr Frans Berkhout made the statement from ICSU on behalf of Executive Director Steven Wilson, who unfortunately could not attend the SC Meeting. ICSU recognized the essential role that climate observations not only play not only in many of ICSU's programmes, but also in general. ICSU looked forward to hearing the outcome of the GCOS review, so as to better understand how ICSU as a sponsor can better support the programme. ICSU, as part of its current strategic plan, was committed to a review of all of its sponsorships of observational programmes.

1.3 Arrangements for the Session

Dr Carolin Richter, Director of the GCOS Secretariat, outlined the process of producing the report of the SC Meeting, noting that the draft session report would be developed from oral comments during discussion and presentations given during the meeting. She also noted that a completed list of actions discussed would be included in the report, and that the draft would be circulated to participants for comment prior to its finalization. The final version of the report would then be approved by the SC Chair in the light of comments received on the draft.

2. Chair's Introduction

Prof Adrian Simmons first introduced the agenda. Meeting in Offenbach has provided excellent opportunities to hear of the progress of the Sponsors' Review of GCOS from the Chair of the Review Board, and of the progress of the GFCS from the perspective of a member of the Management Committee. He also looked forward to learning more and discussing the progress of PROVIA and Future Earth, two other initiatives of GCOS

Sponsors. Also scheduled on the first day was the 2014-16 work plan for the GCOS Assessment Cycle, on which the views of the SC Members and other participants were eagerly sought. The agenda afforded opportunities later in the session to return to this topic.

The discussions of the work of the co-sponsored panels on the second day were particularly important this year, as both OOPC and TOPC had new Chairs, and OOPC was furthermore being revitalised in the context of reorganisation of GOOS, under the new Secretariat arrangements noted earlier. It was also important to consider the need for better handling of topics that cut across the work of more than one panel; a separate agenda item was devoted to this. New opportunities arising from the preparations of the Group on Earth Observation (GEO) for the second ten years of the Global Earth Observation System of Systems (GEOSS) would be discussed. The engagement of GCOS with the Space Agencies and the United Nations Framework Convention on Climate Change (UNFCCC) remained of vital importance, and would be considered on the second and third days respectively.

2.1 Approval of Agenda

The Chair asked SC Members if they had any questions about the final draft agenda or wished to propose modifications to it. The SC noted that the agenda could be adjusted, as necessary, as the session proceeded, and, on this basis, approved it (see Annex 2).

3. Future Work Plan for GCOS

3.1 GCOS Programme Review

The Chair of the GCOS Review Board, Mr Wolfgang Kusch, gave a brief status update on the progress of the programme review. He pointed out that one of the major outcomes of the review is the general recognition of the normative work of GCOS in defining guidelines and setting principles. Mr Kusch also highlighted that the outcomes of the review will show that a clear vision of the GCOS programme will be key for its future activities and success.

Mr Kusch recalled that the GCOS SC-XIX from 20 to 23 September 2011 in Reading, United Kingdom, welcomed an independent review of GCOS and appreciated the willingness of WMO to take the lead.

The Terms of Reference for the review are based on new developments in the Earth Observing (EO) programme community, which require a review of the objectives and mandates of the GCOS programme. These new developments include the establishment of the GEOSS and the increased attention countries give to climate change adaptation. On the horizon were the development and implementation of the GFCS, the WMO Integrated Global Observing System (WIGOS), and the findings of the IPCC Fifth Assessment Report, all of which will affect the GCOS programme. Also, the Subsidiary Body on Scientific and Technological Advice (SBSTA) of the UNFCCC have considered the timing of future contributions of GCOS to SBSTA that will assess the adequacy of climate observing systems, evaluate progress, and update implementation planning. Lastly, the programme review will provide the basis for eventually revising the GCOS Memorandum of Understanding and updating the GCOS strategic plan.

The SC expressed its appreciation of the invitation extended to its members to provide input for the review. Participants noted that the questionnaire included in the review

processes covers overlapping issues in some places, but generally welcomed the steps undertaken by the review board. Additionally, some SC Members and other participants underlined that some of the questions allude to the lack of staff, and the number of staff needed to cover all aspects of the programme adequately. Dr Stephen Briggs, as representative for the European Space Agency (ESA), praised the GCOS programme that did a good job in providing requirements for space-based climate observations in such difficult circumstances of scarce resources. The SC Chair and the representative of WMO, Dr Wenjiang Zhang, expressed their hope that the review would generate new synergies between the sponsors, which would result in an increase of resources for the GCOS programme. The discussion then turned to the renewed vision for GCOS, and that GCOS should build on its strengths in an institutional landscape that has changed in the past 20 years. Additionally, it was brought up that the relationship with GEOSS should be reviewed, as there is potential for improvement.

In conclusion, the sponsor representatives agreed that the timing of the review and the tentative publication date in April 2014 was ideal, as the WMO Executive Council is scheduled for June 2014, as are IOC's and UNEP's General Assemblies. ICSU voiced an invitation for a GCOS representative to participate in its General Assembly, which will be held in the beginning of September 2014. Decisions on a revised MoU could be taken by the WMO Congress in May 2015.

ACTION 1 – Collaboration with GEO: The GCOS Secretariat and the SC Chair should continue to work to improve collaboration with the GEO Secretariat on activities of mutual benefit.

3.2 Global Framework for Climate Services (GFCS)

Prof Adrian reported on recent developments in establishing the GFCS. He in focused particularly on the new GFCS governance body, the Intergovernmental Board on Climate Services (IBCS), which held its first meeting from 2-5 July 2013 in Geneva, Switzerland. The IBCS was established following a decision by the WMO Congress, and reports to it. It is chaired by Mr Anton Eliassen (Norway). Mr Laxman Singh Rathore (India) and Ms Linda Makuleni (South Africa) are the Vice-Chairs. Prof Adrian is one of the 28 Members of the IBCS Management Committee. Between regular IBCS Sessions, the Management Committee meets to lay out decisions, establish necessary substructures, and to function as the interface to the Partner Advisory Committee (PAC), if appropriate. The PAC is an open committee – a network that reports to the IBCS, and is open to delegates of all UN, international and non-governmental organizations. The Terms of Reference allow PAC representatives to speak at board meetings and to contribute to monitoring the GFCS strategy and implementation.

In addition to the so-called pillars, which describe the main components of GFCS infrastructure, the framework focuses on four priority areas, forming a matrix structure. The priority areas are: agriculture and food security, water, health and disaster risk reduction. Exemplars of projects from these areas are described in the User Interface annex of the GFCS Implementation Plan. The criteria for designation of eligible GFCS projects are still in development. As a next step, the IBCS Chair and Vice-Chairs are compiling a work programme on the basis of an analysis of existing decisions made by the IBCS, WMO Congress and WMO Executive Council. Finally, Prof Adrian stressed the current role of the WMO Information System (WIS) for data dissemination between met services worldwide. He explained the effort of expanding existing WMO policy, as outlined in WMO Resolutions

25 and 40, for the international exchange of climate data and products to support the implementation of the GFCS. It is hoped that partner organizations will follow this example of the forthcoming WMO data policy and provide additional information to be used in climate services. The updated WMO data policy will be presented to WMO Congress in 2015.

The importance of socio-economic data for climate services was noted in the subsequent discussion. It was expected to be even more difficult to achieve an open data policy for this type of data. It was also noted that UNFCCC and other bodies had adopted the GCOS alignment along variables, namely the ECVs, but that not all ECVs fall under the responsibility of meteorological services. Questioned on technical advisory arrangements for the GFCS, Prof Adrian recalled that the proposal for establishing a technical advisory committee was rejected and that the management committee could invite input from experts if required. On the other hand, having the same status as WMO's Technical Commissions, the IBCS cannot directly approach or task other commissions, but must go through the Executive Council or Congress.

Regarding the question of the role of GCOS in the overall GFCS governance, it was made clear that GCOS as a programme has to work through its sponsoring organizations, which (apart from WMO) may be members of the PAC. The contribution of the GCOS programme in general, along with its added value in particular to the 'Observations and Monitoring' pillar and how the GFCS pillars will interact, will be discussed at the next IBCS Management Committee meeting.

ACTION 2 – Development of GFCS: The SC Chair and GCOS Secretariat should continue to follow the development of the GFCS and its governance under the IBCS and report back to the Steering Committee with the aim of ensuring that GCOS contributes as fully as possible to the implementation of the GFCS.

3.3 Future Earth

Dr Frans Berkhout, the Interim Director of Future Earth, presented the concept and scope of this international research initiative developed by ICSU and its partners. Future Earth's main objective is to provide the knowledge required for society to face risks posed by global environmental change and to seize opportunities to move towards global sustainability. It will strengthen partnerships with policy-makers and other stakeholders to offer sustainability options and solutions in the wake of Rio+20. Future Earth is planned to be a global platform to facilitate an effective interdisciplinary collaboration across natural and social sciences, humanities, economics, and technology development to find the best scientific solutions to multi-faceted problems. Future Earth is further integrating existing global environmental change programmes to help develop a stronger and broader science community, and will therefore build on the success of the Diversitas Programme, the PAGES (Past Global Change) Programme from the International Geosphere-Biosphere Programme (IGBP), the International Human Dimensions Programme (IHDP), the Earth System Science Partnership (ESSP), and the WCRP.

The three proposed main research topics of Future Earth are named (1) Dynamic Planet – focusing on observations and models, as well as environmental and societal system trends, drivers and processes, and their interactions, (2) Global Development – dealing with knowledge for the needs of humanity for sustainable, secure and fair stewardship of food, water, biodiversity, energy, materials and other ecosystem functions and services, and (3) Transformations towards Sustainability – trying to understand transformation processes and

options, assessing how these relate to human values and behaviour, and evaluating strategies for governing and managing the global environment across sectors and scales. The GCOS community will primarily be related to the Dynamic Planet theme.

As Future Earth is still in interim mode, and the Science Committee for Future Earth has not yet met, no decisions have been made regarding the role that data assessment and observations will play in the future concept of Future Earth, and therefore GCOS' role has not yet been defined. Dr Berkhout underlined the importance of an engagement of the ICSU science community with data users to bring forward a co-design of solution-oriented research. Modelling and observations are naturally distributed amongst all Future Earth core projects, and the programme will therefore develop rationales for a cross-cutting modelling and observations effort. Key observation tasks for Future Earth that will become important for GCOS could include identifying and filling information gaps, and extending the scope and precision of climate observations, as well as integrating biophysical observations (real-time, crowd-sourced and open data, etc.), and supporting more integrated Earth System Science.

In the discussion that followed the presentation, participants wondered whether the envisaged Earth System Services should be seen as including Global Climate Services rather than complementing them. They looked for a clear indication of the added value that Future Earth would bring to the GFCS. It was noted that Future Earth should facilitate good interaction between the existing projects that will be carried forward under its umbrella.

ACTION 3 – Future Earth: The GCOS Secretariat should engage with representatives of Future Earth in a follow-up discussion on the interaction between GCOS and Future Earth once the Steering Committee for Future Earth has met and clearly defined its Terms of Reference regarding observations and modelling.

3.4 Global Programme of Research on Climate Change Vulnerability, Impacts and Adaptation (PROVIA)

Dr Richard Klein, member of the PROVIA Scientific Steering Committee, reported on the concept and the current status of PROVIA. The programme is conceived as a collaborative inter-agency initiative that builds on the convening power and expertise of UNEP, UNESCO, and WMO. PROVIA is currently funded and hosted mainly by UNEP, and has recently been approved as a component of the World Climate Programme (WCP) by the WMO Executive Council. PROVIA's main goal is to provide direction and improve international coherence for vulnerability, impacts and adaptation (VIA) research, and will thus contribute to the implementation of the Global Framework for Climate Services (GFCS), as it is designed to provide a platform for scientists working on VIA aspects of climate science.

Dr Klein presented PROVIA's main objectives: (1) to advance and coordinate policy-relevant research on climate change impacts, vulnerability and adaptation, (2) to guide investment in climate-change related research, (3) to communicate scientific information to governments and international agencies, and (4) to build research capacity, especially in developing countries. Dr Klein reminded GCOS Steering Committee members that the current discussion on data use and data availability for PROVIA is still in an early stage, and the programme is exploring the opportunities to collaborate with partners like GCOS, as PROVIA will provide less of an emphasis on climate data use.

Emphasis was placed on discussing how PROVIA can support GCOS, including the potential identification of gaps in monitoring climate and, in particular, variables that would

support assessment and implementation of adaptation to climate change. Furthermore, PROVIA research priorities stress the need to set up effective monitoring systems and indicators for tracking gradual changes and crossing of thresholds related not only to climate, but also ecological and socio-economic systems. PROVIA is currently discussing a potential development of a risk-based framework for indicators and monitoring, and expanding the scope and coherence of the global monitoring system to enhance understanding of vulnerability, impacts and adaptation, as well as advance detection and attribution to climate change impacts. In return, GCOS should explore how and which ECVs will support VIA assessments best, particularly as VIA research requires long-term, high-quality interdisciplinary data sets. GCOS could also contribute to climate information services that advance policy-relevant VIA-related research. The next Steering Committee Meeting of PROVIA will take place in Fortaleza, Brazil, from 10-11 May 2014, which will be followed by the Third International Climate Change Adaptation Conference from 12-16 May 2014.

It was identified in subsequent discussion that an opportunity for developing threads of collaboration between PROVIA and other elements of the WCP, GCOS in particular, would be provided at the December 2013 meeting of the WMO Executive Council Working Group on Climate and Related Weather, Water and Environmental Matters (ECWG-CWE), to which PROVIA had been invited. The Chair of the GCOS SC is an ex-officio member of this Working Group.

ACTION 4 – Engagement with PROVIA: GCOS and PROVIA should liaise at Secretariat and Steering Committee level to clearly define their fundamental linkages, and how climate observations can effectively support VIA research.

3.5 Observations for Adaptation

Dr Richter presented the scope and outcome of the 'Workshop on Observations Adaptation to Climate Variability and Change', held from 26 to 28 February 2013 at the headquarters of the German Meteorological Service (DWD) in Offenbach, Germany. GCOS, in cooperation with UNEP, the IOC of UNESCO and the Department of Energy and Climate Change (DECC) of the United Kingdom, brought together about 45 participants that included representatives of the GCOS community and representatives of sectors in which adaptation to climate change and variability is, or is likely to become, an important concern. The goals of the workshop were to produce statements on the adequacy of observations, to identify requirements for observations to support climate services and research, and to provide strategic guidance on steps the GCOS programme should take in the coming years to address the needs for observations for adaptation to climate variability and change. To meet these goals, focus was set on cross-cutting issues, including risk management, early warning systems, research, modelling and assessment, and data rescue. The workshop further considered perspectives from various sectors that will be strongly impacted by climate change adaptation, including water resource management, coastal zone management, health, forestry, agriculture, energy, and transport.

The workshop identified common themes regarding requirements for observations. On the one hand, there is a need to focus on observations with higher spatial and temporal resolution, specifically in regions where climate change will have significant effects on key sectors and where there are vulnerable populations. On the other hand, existing information will need to be presented in forms of relevance to users, which includes developing information and products in close consultation with those users, and to establish and

improve mechanisms to provide data access and data descriptions. As most of the adaptation actions will take place at a local and/or sub-national level, climate information used to support development, implementation and monitoring of such activities will be needed at the same level, though possibly with different requirements for each sector for which adaptation is a concern. Infrastructure and governance to support sustained data rescue will need to be developed, as well as to invest in the ground-based network of primary hydro-meteorological observations. Furthermore, close links to research initiatives such as PROVIA and Future Earth were recommended. There is a strong necessity to further discuss the topic of observation requirements for climate change adaptation, to be linked to potential workshops on observational needs for the GFCS.

Dr Roger Pulwarty, who joined the meeting by teleconference, pointed out that, in addition to the results Carolin Richter had already presented, the link was made to the insurance industry. In a paper prepared on the outcomes of the adaptation workshop, he aims to stress how future investment in observations can help in planning, particularly for disaster management and early warning. Other participants noted that though decisions are typically event-driven, a highly relevant time scale for adaptation is of the order of ten to fifteen years, where inter-decadal variability plays an important role. Good local monitoring provided important information for adaptation in addition to downscaled model projections and the insurance industry in particular relies much more heavily on it than has been publicized in the past. Decision-makers are currently not well-informed, and there is a strong need to advance observation in support of adaptation to climate change, in particular to meet requirements likely to emerge from the preparations of the UNFCCC and its Parties for the post-2015 process.

It was noted that in addition to requiring local observations, adaptation could draw on indigenous knowledge, and give more credit to the knowledge base in local communities. It was recognised, however, that GCOS could not fulfil a comprehensive local role, and that it was important both to make it clear where the boundaries of the programme lie and to identify the boundary organisations with which GCOS should interface. It was also remarked that many communities are not well adapted to current climate. Among the questions to be asked were how well observation is informing modelling, what new risks are emerging, and where observations has to be focussed to address the emerging risks.

ACTION 5 – Case studies showing the benefits of climate observation for adaptation: A few strong case studies should be developed to show the benefits of climate observations for adaptation (GCOS Secretariat, UNEP, GCOS Implementation Manager).

3.6 GCOS Assessment Cycle – Work Plan 2014 to 2016

The Director of the GCOS Secretariat, Dr Richter, presented the results of a preparatory meeting held on the afternoon prior to this SC session, to which the GCOS panel Chairs and additional experts had been invited to discuss the GCOS work plan for the years 2014 to 2016. The focus of the work will be on the assessment of progress in climate observations, in particular against the 2010 Implementation Plan, the adequacy of current and planned observations, and the required actions and data products. The Director proposed that the draft structure of the assessment report should address the following questions to achieve a sense of adequacy: Was your network used? What data sets were you using? Who are the main users of the data/products (operational, research, etc.)?

It was the common understanding of the SC, as discussed at previous sessions, that GCOS should assess wider needs than those of the UNFCCC, addressing the multiple requirements and multiple applications of observations and ECV datasets. The question was raised as to whether and how GCOS should deal with specific requirements (e.g. coming from the GFCS) to provide requirements for socio-economic variables. It must be assessed what new is needed (including possible new ECVs) in addition to updating the actions in the current GCOS Implementation Plan. The GCOS Director suggested that both 'near-term' and 'long-term' requirements should be assessed. The SC Members also agreed that the report should discuss adequacy as a function of scale. The GCOS programme is currently anchored on 'large' and 'global' scales, but global observations are needed to meet local needs. There is a need to discuss 'down-scaling', even if it does not provide a fully satisfactory substitute for local measurements.

The SC Members decided that the report to be prepared for submission to the sponsors and the UNFCCC Parties in 2015 should be a progress report, documenting how actions in the 2010 Implementation Plan have been or are being addressed, reviewing the overall status of observations and identifying gaps.

The new Implementation Plan should include an assessment of the adequacy of global observations for climate, which will draw on the progress report. A draft of the plan should be available for public review in late 2015, with finalization in late summer 2016 for delivery to meet the timescale that had already been indicated to SBSTA. The SC agreed that the fundamental structure should as before be built around the ECVs and required cross-cutting actions, include indicative costing of actions and identify the so-called 'agents of implementation'. It should nevertheless indicate how the needs of specific user sectors and regions are taken into account. The SC recognised that past supplements covering satellite data products had proven useful to the Space Agencies, and it was agreed that requirements for products based on *in-situ* observations should also be provided in the future. There was no decision made as to whether updated material should be an integral element of the new Implementation Plan, or should be published separately as one or two supplements. The actions recommended in the 2010 Update of the Implementation Plan should be indicated as an annex, to be referenced with the new actions.

The SC noted a provisional list of sources that will provide some of the information needed, or to be reviewed and updated:

- 2010 Update of the GCOS Implementation Plan
- GCOS Satellite Supplement (2011)
- Second GCOS Adequacy Report (2003)
- Technical Support Paper on the Second GCOS Adequacy Report (unpublished)
- GCOS Progress Report (2009), based on the GCOS Implementation Plan (2005)
- Activities related to ECV products (CEOS, GEO, ESA CCI)
- WMO GUAN and GSN monitoring
- WMO Rolling Review of Requirements, Observing Systems Capabilities Analysis and Review Tool (OSCAR)
- Guidance, best practices, standards, methodologies (mostly used at NMHS)

- Progress in frameworks (WIGOS, FOO, GFCS)
- Progress in GOFC-GOLD, GEO Carbon, etc.
- Outcomes of a proposed GCOS and GOFC-GOLD workshop on observations for some aspects of mitigation
- A study report on Observations and Integrated Earth System Science being developed under the auspices of the Commission of Space Research (COSPAR)

As a next step, the SC recommended that an individual should be identified to lead the preparation of the progress report. Furthermore, a board of representatives from different key domains (atmosphere, ocean, land) should be established. The experts on the board should be able to ensure links to the GCOS sponsors, data providers (including CEOS and CGMS), IPCC Working Groups, Future Earth, PROVIA and the UN Office for Disaster Risk Reduction (UNISDR), and engage with GEO and its Societal Benefit Areas (SBAs) leads. It was also suggested that the members of the board could also be involved in preparing the new implementation plan, which could go partly in parallel with the progress and adequacy assessment. The GCOS Secretariat was then asked to consolidate a roster of experts by 31 December 2013. In addition, the Director of the Secretariat was asked to provide a budget, time lines and a work plan.

ACTION 6 – Start of the assessment process: The GCOS Director should identify a lead for the review process by 31 December 2013, and establish a board represented by domain leads and key supporting experts. A budget, time line and preliminary work plan should also be developed.

ACTION 7 – Prepare for the next GCOS reporting cycle: A scoping meeting should be held in December 2013, immediately following the Meeting of the ECWG-CWE (SC Chair, GCOS Secretariat).

3.7 Summary Discussion of Agenda Item 3

In summary, the SC endorsed the way forward for the GCOS programme's assessment cycle. It reiterated its support for increased engagement with Future Earth and PROVIA once the scope for this becomes sufficiently clear. Involvement in the evolving activities around the GFCS remained of particular importance.

4. Forum of GCOS Expert Panels

4.1 Terrestrial Observation Panel for Climate

Prof Konrad Steffen, who took over the TOPC Chairship from Prof Han Dolman at the TOPC-XV in March 2013, presented participants with an update on current TOPC membership, TOPC's areas of focus by ECV, and the most important recommendations from TOPC-XV. Future challenges for TOPC will include defining a common integrator (i.e. data sets, common goals, etc.) for terrestrial ECVs, identify future steps on how to more strongly integrate cross-cutting terrestrial ECVs, i.e. albedo, ice sheets, etc., and organize workshops to gather the scientific and technical community around those identified cross-cutting ECVs, and to re-activate the GTOS partnership and support or find new supporting partners. The latter issue becomes increasingly important, as TOPC is effectively

strengthening its link with the Land Cover Project Office of the Global Observation of Forest Cover and Land Dynamics (GOFC-GOLD) Panel. The GCOS Secretariat and the Project Office of GOFC-GOLD will organise an expert workshop to consider the climate observation requirements for supporting mitigation of climate change, which will take place at WMO headquarters in May 2014. SC Members welcomed the idea, and supported the decision as mitigation to climate variability and climate change is an important concern.

Prof Steffen underlined the importance of supporting open access to *in situ* and satellite data, and for TOPC to further support observations for those existing terrestrial ECVs that have global significance, especially in a fast changing environment. TOPC Members will need to try to find a community agreement on how to specify standard observations and data formats for different ECVs. The SC welcomed TOPC's future intention to include a focus (through memberships, invited experts, observational requirements, etc.) on the major cycles (carbon, hydrological, and energy) and related processes.

Continuing a discussion that already begun at the opening of the session, participants expressed their concern over the unresolved situation of the GTOS Secretariat at the Food and Agriculture Organization (FAO) in Rome, Italy. Negotiations are underway to either to identify another sponsor or to redistribute GTOS' tasks and responsibilities to other bodies. Further discussion will take place after the outcomes of the Sponsors' Review of GCOS have been published in early 2014. The SC agreed on the desirability of updating as necessary the ECV documentation on terrestrial observables that had been produced by the GTOS Secretariat in 2008, recognising that the resources to do so would depend on what new arrangements are put in place regarding GTOS. The SC also noted that the idea of arranging ISO standardisation for terrestrial ECV observation was rejected by the TOPC. Prof Dolman recommended rather that activities be set up similar to those of the WMO Commission on Instruments and Methods of Observation (CIMO).

ACTION 8 – Workshop on observations for climate change mitigation: The GCOS Secretariat and the Project Office of GOFC-GOLD should organise a workshop that will identify observation needs in regard to some aspects of climate change mitigation.

ACTION 9 – Soil partnership: TOPC should liaise with the 'Global Soil Partnership' (with focus on soil moisture), which is supported by FAO to collect missing soil moisture data.

ACTION 10 – Continuing support for TOPC: The GCOS Secretariat and Sponsors should ensure adequate continuing support for TOPC and for terrestrial domain activities, including the preparation of the next progress report and implementation plan, in view of the continuing uncertainty over support for GTOS.

4.2 Ocean Observations Panel for Climate

Dr Albert Fischer, director of the Global Ocean Observing System (GOOS), gave an overview of the progress made in reorganizing the GOOS following the publication of the Framework for Ocean Observing (FOO), which includes the establishment of two new panels for Biogeochemistry and Biology. Dr Fischer also highlighted the role of OOPC in implementing the framework. As some ocean ECVs will be delivered under the brief of the OOPC, the panel will act as an 'information broker' between GOOS and GCOS.

New OOPC Co-Chair Dr Mark Bourassa (USA) began by highlighting the role of the ocean in the climate system, and noted the prominence of the ocean in the recently

published IPCC Working Group 1 report. Dr Bourassa then gave an overview of the status of the panel, which has two new Co-Chairs – himself and Dr Toshio Suga (Japan) – and a new programme officer, Dr Katy Hill, who is based at the GCOS secretariat. Dr Bourassa introduced the revised OOPC Terms of Reference for consideration by the GCOS Steering Committee. The OOPC met for its 16th session in September 2013 in Washington DC, and overlapped with the 5th session of the Joint WMO-IOC Technical Commission for Oceanography and Marine Meteorology (JCOMM) Observations Coordination Group (OCG). It was acknowledged that the Terms of Reference are very ambitious, with many connections to make. To focus future activities, OOPC is developing a 5-year work plan, and is keen to engage with the Terrestrial (TOPC) and Atmosphere (AOPC) panels to discuss the focus and timing of activities of mutual interest. More details on the meetings can be found on the meeting websites at www.ioc-goos.org/oopc16 and www.ioc-goos.org/ocg5.

OOPC Co-Chair Dr Toshio Suga introduced an immediate priority for OOPC, which is the evaluation of the Tropical Pacific Observing System (TPOS), motivated by the rapid decline in the performance of the Tropical Pacific TAO/TRITON mooring array. A workshop will be held in Scripps Institution of Oceanography, San Diego, USA from the 27th-30th January, for which Dr Suga is a Co-Chair of the Scientific Organizing Committee. The meeting is expected to provide clear recommendations as to how the observing system should evolve by 2020 to improve observing system robustness and resilience, and take a systems approach to responding to evolving requirements. More details on the workshop and its preparatory whitepaper process can be found on the meeting website at www.ioc-goos.org/tpos2020.

Dr Suga also highlighted priority areas for OOPC where cross-cutting activities with the Terrestrial and/or Atmosphere Panels would be welcome. It was also noted that OOPC needs to make connections to the biogeochemistry and biology panels of GOOS.

As input into the next round of progress and adequacy reporting, OOPC will look at expanded requirements for and implementation of Essential Climate Variables in coastal and shelf seas as well as the open ocean domain. Additionally, the evaluation of the TPOS will feed into the progress and adequacy reports. For the next version of the Implementation Plan, areas which OOPC anticipates including are the deep ocean, boundary currents, and coastal/shelf sea observations.

The SC discussed the draft revised OOPC Terms of Reference, and commended OOPC for a very well written proposal. It suggested that the other panels revisit their Terms of Reference, and consider revising them using an opening statement and structure similar to that developed by the OOPC.

The explicit connection to modelling and data assimilation communities was noted, and the nature of the connection to the GFCS was discussed. OOPC will likely connect to the GFCS through sponsoring programmes (GCOS, GOOS, WCRP). The formal connection will be through the programme sponsors, IOC and UNEP, who will be eligible for places on the Partnership Advisory Committee and WMO.

ACTION 11 – New OOPC Terms of Reference: OOPC should revise and finalize its Terms of Reference based on the discussion at the GCOS SC, and in consultation with GOOS and WCRP (OOPC Chairmen, OOPC Secretariat).

ACTION 12 – Consistency of Terms of Reference: AOPC and TOPC should consider their Terms of Reference, including the possible use of an opening statement similar to that

of OOPC, and are invited to make proposals for revised Terms of Reference for approval by the Steering Committee.

ACTION 13 – Status of the drifting buoy network: OOPC should report back to AOPC and the Steering Committee on the status of the drifting buoy network (OOPC).

4.3 Atmospheric Observation Panel for Climate

Dr Wenjiang Zhang, Director of the WMO Observations and Information Systems (OBS) Department, reported on the progress in implementation of the WMO Integrated Global Observing System (WIGOS), followed by AOPC Chair, Prof Adrian Simmons, reporting from the recent 18th Session of AOPC and on new observational datasets. Prof Simmons announced that the newest Japanese reanalysis, JRA-55, had been released shortly before the current session of the SC. He also drew attention to the identification of some key uncertainties in the recent IPCC Working Group I report, and noted some related recent results of improved assimilation of satellite and other data in reanalysis. The AOPC had noted "that expertise in satellite data and reanalysis production was under-represented in the author lists for parts of the fifth IPCC Assessment Report, and recommended that GCOS uses its observer status to advocate better representation from these communities in future IPCC assessments noting that the records and their scientific maturity were both increasing."

Prof Simmons showed monitoring results for the GCOS Surface (GSN) and the GCOS Upper-Air (GUAN) Networks, mentioning general concerns, but also positive development. The concerns comprised the need for a more timely network monitoring, better management of the implementation of change and better integration of *in situ* and space-based components. Positive developments included the increase of data availability, for example from ~30% to now ~50%-60% in RAI (Africa) over the past 15 years for the GSN.

Other data concerns included the poor status of the TAO moorings, loss of CO_2 measurements from NOAA ship transects and some surface sites, arrangements for the ICOADS data set, loss of Nauru as a GRUAN and BSRN site, and the failure of some countries to supply precipitation data to the GPCC. More positive developments were that the new GAW greenhouse gas stations have been established and that the loss of ozone measurements had turned out to be less severe than feared last year; the overall increase in holdings of data in archives, including rescued data, the gain of Ny-Ålesund as a GRUAN station, several Swiss capacity building initiatives, and the work of GAW towards proposing an aerosol network for recognition as a baseline observing network by GCOS.

Prof Simmons also informed the SC that the week of the next AOPC meeting in April 2014 would focus on the preparation for the new progress report and implementation plan, and would comprise:

(i) a two-day network workshop that would review the status, management and purpose of the GCOS networks, and consider new design criteria as appropriate, taking into account the need to link with WIGOS developments and the arrangements for supporting implementation;

(ii) a three-day AOPC session that would review progress and discuss key issues and requirements ECV by ECV, consider the case for additional atmospheric ECVs and discuss cross-cutting issues.

Prof Gerhard Adrian informed the SC that the DWD had received funds for the development of homogenized data sets from long upper-air records, such as the one at Lindenberg with more than 100 years of data.

4.4 GCOS Cooperation Mechanism

Mr Tim Oakley summarised his recent work as the GCOS Implementation Manager and the GCOS Cooperation Mechanism (GCM), referring to the information documents that had been provided before the meeting. Being relatively new in post, six months, he introduced himself to the Steering Committee and provided details on his career in the UK Met Office. The key points of his the presentation were the monitoring of the networks, recent and ongoing activities and the challenges being faced. Whilst much of the work of the implementation Manager is focused on the atmospheric domain, in particular GSN and GUAN, he stressed that the support activities and projects undertaken by the GCM could be relevant to all the GCOS domains.

Recent monitoring statistics on the performance of the GSN and GUAN networks show that many stations continue to fail to meet the minimum GCOS requirement. There has been a gradual improvement in availability over the years but several regions still have significant issues in the operation, maintenance and data transmission for their observing systems. As noted earlier by Prof Simmons, it had been recognised by AOPC that a network review, in terms of network design, priority and quality, is now needed and a two-day meeting to discuss this has been agreed in advance of the next panel meeting (7-8 April 2014).

The recent bi-annual meeting of the CBS Lead-centres for GCOS (Santiago 8th-10th October 2013) had proved successful, despite a number of the lead centres not being able to send a representative. Whilst much of the work of the lead centres is focused on the GSN CLIMAT message it was agreed that they would attempt to expand their monitoring responsibilities both to the Regional Baseline Climate Network (RBCN) and the GUAN. The meeting hosts, Meteorologica de Chile, were excellent, both in their hospitality and in their arrangements and were thanked by GCOS. Much of the discussions were connected with Quality Management, which in large part relies on the statistics/products of the GOSIC website. Unfortunately as this website is hosted by NOAA, who were shutdown during this period, the site was not available to the meeting. It was requested that GCOS contact NOAA on the importance of this website both for GCOS and the climate community.

Mr Oakley concluded his presentation with the challenges that are being faced for his work as Implementation Manager. Of particular concern is the reduced funding in support of the GCM which can be attributed to a number of reasons but the reality is the 'marketplace' is changing. The next GCM board meeting (Exeter, Feb 2014) will have to consider this and as to whether the GCM needs to change its approach/terms of reference in the future. A request from the meeting was to consider the representation of the CBS Lead-Centres/Monitoring Centres at the network review meeting in April 2014. It was agreed that this would be considered when agreeing the meeting participants.

ACTION 14 – Availability of GOSIC website: The GCOS Director and the SC Chair should jointly write to NOAA to communicate that operation of the GOSIC website should be regarded as essential in view of its use for network monitoring.

4.5 Cross-Cutting Issues for the Panels

Prof Han Dolman gave a presentation on 'Cross-cutting initiatives, or how to make GCOS more responsive and relevant.' He noted that the GCOS programme and particularly the concept of Essential Climate Variables has had much wider impact than originally thought. However, it was noted that work needed to be done to develop the ECV concept further. Currently it can be considered an *ad hoc* list of variables, which hasn't changed much; some key variables are missing, and there are also inconsistencies. For instance, some ECVs represent a process, and some are a defined measurable parameter. In describing ECVs, the rationale is only based on single variables, human-system variables are missing, the domains (Atmosphere, Terrestrial, Ocean) are not well linked with panels taking diverse approaches, and regional issues and gaps do not stand out.

Prof Dolman advocated that integration across the three GCOS observation panels could be motivated by the challenge of advancing the understanding of and tracking the major climate cycles - the energy cycle, the hydrological cycle and the carbon cycle. To improve our ability to capture these cycles, consistency of ECV definitions, observing system design, measurement accuracy, and data and information delivery would need to be considered. Examples where integration across the domains is needed include: the cryosphere and sea level, global surface air temperature increase and oceanic heat content, and rates, magnitudes and feedbacks in the global carbon cycle. The ultimate challenge is working towards closing the budgets of sea level, carbon, water and energy.

Recommendations on how to evolve the GCOS Implementation Plan into a more integrated view were made, including adopting a structure that reflects integration, rather than simply including a cross cutting chapter, strengthening the conceptual context for the ECVs, providing supplements on how the ECVs relate to the major climate cycles, strengthening integration between *in situ* and satellite observations, and data on human systems, identifying gaps, establishing more pro-active links with GEO, WCRP, UNFCCC, IPCC and sponsors, and providing a strong science-based vision including tackling issues around data quality and access.

The SC thanked Prof Dolman for an enlightening and thought-provoking talk, and discussed how best to address integrating and otherwise common issues in the future through joint panel meetings, themed workshops, etc. It was also suggested that, in addition to the fundamental scientific drivers of developing an observing system for climate, cross-cutting issues could be considered from an applications/outputs perspective (e.g. observations for seasonal forecasting, adaptation, etc.). Prof Dolman's recommendations would be kept to the fore in preparation of the new GCOS Implementation Plan.

4.6 Space-based observations

Dr Fellous reported on recent GCOS engagement, covering his participation as GCOS Space Rapporteur in a number of meetings held in late 2012 and earlier in 2013, where he presented GCOS status reports and plans, and provided some highlights on programmes (e.g. the CCI) and projects (e.g. satellite missions) of interest. In particular, he attended the CEOS Plenary in Bangalore (October 2012), GCOS Panel (AOPC and TOPC) meetings, and the "Climate from space week" in Geneva in February 2013. During that week, he represented GCOS at the CEOS WG Climate meeting, which discussed issues pertaining to the "Climate monitoring architecture from space" document, the ECV assessment, the ECV inventory questionnaire, and the use of maturity matrices. He also

reported on the achievements of the 8th SCOPE-CM Executive Panel meeting, which looked at the ten proposals received in response to a Call for Projects in Phase 2 released in the autumn of 2012. New SCM-Project Calls are anticipated on a yearly basis, with updated guidelines and criteria taking into account the experience and lessons learnt from on-going projects. Notably forthcoming projects should include a clear reference to GCOS defined ECVs, related ECV products and corresponding requirements.

Dr Fellous also reported on the highlights of the 41st meeting of the Coordinating Group on Meteorological Satellites (CGMS-41) held in Tsukuba, Japan in early July. He mentioned the letter recently sent by the SC Chair to the Chinese Meteorological Agency (CMA) highlighting that there are "plentiful reasons why routine observation from the early-morning as well as the mid-morning and afternoon polar orbits would be of significant benefit for climate monitoring and the development and evaluation of policy related to climate change." This letter responded to the announcement by the CMA of their intent to consider favourably the request to fly a FY-3 satellite in early morning orbit and their information on a tentative priority payload configuration for the FY-3 in that orbit. Furthermore, Dr Fellous commented on the discussion that took place at the CEOS/SIT Technical workshop held in early September in Pasadena, CA, USA, where the GCOS Director presented some thoughts on the evolution of the relationship between GCOS and the Space Agencies, including the expected impact on space-based observations of the results of the next GCOS report on adequacy of global observing systems for climate and of forthcoming new ECV requirements for space-based observations, etc. He concluded his presentation with an overview of recent new satellites of interest for the CGOS community, highlighting in particular the importance of the CEOS Virtual Constellations and the progress made throughout in international cooperation, as a powerful way to enhance and improve data access and sharing between nations.

The SC acknowledged the excellent relationship that had been developed with the Space Agencies and that it was important to keep this. It was noted that end users often do not know which observations are really needed to provide the required products and services. GCOS was seen to be an important interpreter of requirements and in stating these requirements had stimulated the organisation of a coherent response by CEOS on behalf of the Space Agencies.

ACTION 15 – Future engagement with the Space Agencies: The range of activities undertaken by the GCOS Space Rapporteur and other representatives of GCOS in engagement with the Space Agencies should be continued, including liaison with the Working Group on Climate, which was expected to move under the auspices of CGMS as well as CEOS, and review of SCOPE-CM activities, especially in regard to the oceanic and terrestrial domains.

4.7 Research & Science Assessments – the World Climate Research Programme

Dr Antonio Busalacchi, joining the meeting remotely as Chair of the Joint Scientific Committee of the World Climate Research Programme (WCRP), updated SC Members on recent and upcoming activities of the Programme, stressing the importance of 'actionable science', research for practical application, benefit and value of society. WCRP's future directions will need to ensure that it delivers into the GFCS and ICSU's Future Earth Initiative, and also the need to be more agile and flexible in responding to requirements and drivers.

WCRP has identified six grand challenges – regional climate information, regional sea-level rise, cryosphere in a changing climate, changes in water availability, science underpinning the prediction and attribution of extreme events, and clouds, circulation and climate sensitivity. Those challenges were identified following the WCRP Open Science Conference in 2011, which commissioned a set of white papers that were published both on the WCRP website and in the book 'Climate Science for Serving Society'. Dr Busalacchi also presented the recently revised structure of WCRP, which includes a new WCRP Working Group on Regional Climate, the main connection between WCRP, GFCS and Future Earth. At the end of his presentation, Dr Busalacchi underlined the importance of international cooperation, as well as of a stronger support for education, training and development of the next generation of climate experts and networks.

4.8 Global Earth Observation System of Systems (GEOSS)

Dr Stephen Briggs, speaking on behalf of the Group on Earth Observation (GEO) community, presented upcoming key GEO events in the timeframe 2014-2016. He reminded GCOS SC Members of the GEO Plenary and Ministerial Summit scheduled for the 15-17 January 2014 in Geneva, Switzerland, where arrangements for the development of a new Implementation Plan for 2016-2025 (to be endorsed in November 2015) will be agreed. Priorities of the new Implementation Plan will be (1) to address urgent global challenges, (2) to support sustainable development, and (3) to build on the accomplishments of GEO.

GCOS is considered to be the climate observation component of GEOSS, and is the task leader for GEO sub-task C2. Accelerated implementation of GCOS within the overall task Climate-01, which includes other tasks beyond the remit of GCOS, Dr Briggs stressed that GCOS needs to clearly define the role it intends to play in GEO, and the GCOS community should engage in providing input to the new GEO Implementation Plan.

The SC concurred with Dr Briggs concerning the GEO Implementation Plan. It was important that in the area of climate observations the GEO plan be aligned with GCOS' own planning if GCOS is to function effectively as the climate observing component of the GEOSS for its second ten years. It was noted that the GEO vision for 2025 as proposed for approval at the forthcoming GEO Plenary envisaged the continuation of its structuring into a single set of Societal Benefit Areas, and thus did not treat separately the climate, water and weather areas, a possibility that had been discussed at SC-XIX.

ACTION 16 – GEO: The SC Chair and GCOS Director should engage in the preparation of the 2016-2025 GEO Implementation Plan, and ensure consistency with the new GCOS Implementation Plan.

5. General Discussion

The SC further discussed some matters arising from the preparatory meeting held immediately prior to the SC session. The SC supported the suggestion that the individual GCOS panels should produce work plans, which may be done in conjunction with their reconsideration of their Terms of Reference. These work plans should in particular take into account cross-panel issues, including inter-domain fluxes. The plans should be developed in the light of recommendations of the Sponsors' Review Board, and the response of the sponsors to the Board's report, and would need to be consistent with the Strategic Plan for

GCOS that the SC had earlier envisaged developing once the outcome of the Review was clear, and with plans of the panels' co-sponsors.

The SC supported the idea that in order to strengthen the handling of cross-panel issues, each panel should be represented at the meetings of the other panels, and agreed that the panel meetings should be organized back-to-back (with a joint session) from time to time.

ACTION 17 – Work plans for the GCOS panels: AOPC and TOPC should develop work plans consistent with the overall GCOS strategic and implementation planning to be developed in the coming two to three years. The OOPC work plan should be kept aligned with the overall GCOS planning.

ACTION 18 – GCOS Panel meetings: The GCOS Secretariat and Panel Chairs, in liaison with co-sponsors of the panels, should plan back-to-back panel meetings from time to time, as appropriate, to foster cross-panel activities.

6. Climate Policy issues

Ms Rocio Lichte informed members of the SC that for the thirty-ninth session of the SBSTA (SBSTA-39), to be held from 11 to 16 November 2013 in Warsaw, Poland, GCOS was invited to give a two-minute statement to the SBSTA plenary under agenda item "Research and Systematic Observations". She pointed out that the UNFCCC Secretariat welcomed a written contribution on recent progress and future plans, which would be published at the website as an information document. This written contribution replaces the former 'miscellaneous documents', and will serve as the basis for the discussion of the delegations of the Parties. The statement and the contribution were prepared shortly after the SC meeting by the GCOS Secretariat, and can be found in Annex 4 of this report.

The next Conference of Parties (COP20) and SBSTA41, which will again focus on systematic observations, will take place in Lima, Peru, in 2014, followed by SBSTA43 and COP21 in Paris, France, in 2015.

ACTION 19 – GCOS Statement for SBSTA39: The GCOS Secretariat, in liaison with the SC Chair, should prepare oral and written statements for SBSTA-39.

7. Programme Administration / Secretariat

7.1 Budget

The Director of the GCOS Secretariat reviewed the GCOS budget for 2013. SC Members were informed that core and recurrent programme activities are not funded on a sustained basis. Dr Richter made clear that the GCOS programme is underfunded, and has only been able to run its core activities and a few additional activities in high-priority areas. The core activities of the programme need annual funding of approximately CHF 200,000.

She also stressed the general lack of staff resources. Ideally, the GCOS Secretariat would need dedicated programme officers to coordinate climate observations for each domain, i.e. atmosphere, land and oceans. Resources for this level of staffing would require about CHF 600,000 per year. Furthermore, the GCOS Cooperation Mechanism needs to be

managed by an implementation manager, which requires annual financial support of CHF 100,000 (including travel and meeting budget).

In addition, the Director of the Secretariat will need an additional amount of CHF 500,000 for the years 2014 and 2015 to organize the process of assessing the progress in the implementation of the global observing system for climate to be submitted as a report to the UNFCCC at the end of 2015, and to develop the draft of the new implementation plan to be ready for public review by then.

The SC expressed their concern that the Secretariat is currently not able to employ people for terms long enough to ensure adequate support of the GCOS programme. This was an important matter to be resolved by the sponsors in their response to the report of the Review Board. The SC noted that funding of some activities could be helped by their gaining operational status under the GFCS. Attaching specific foci to workshops that will help preparation of the progress report and implementation plan was identified as another way of attracting funding.

7.2 Review of actions from SC-XX (2012)

The SC Chair presented participants with the actions list from SC-XX, and noted that the great majority of the 41 actions had been completed. A few of the actions had not yet been completed, were currently ongoing or of unknown status, or were no longer relevant.

The SC Chair noted one outstanding action on the clarification and standardization of language, concerning such terms as “accuracy”, “stability”, and “systematic error”, possibly by developing a working paper on the subject. Further need for clarification had emerged over the past year. He proposed that this issue now be addressed within the process of developing the next progress report and implementation plan.

Other actions not completed were the proposed liaison with CIIFEN and the ICSU Africa Secretariat, as GCOS currently has no funding options to further regional activities. Another action still to be done was action 34, dealing with the publication of case studies that show the benefits of climate observations for adaptation. The representative of UNEP, Dr Ron Witt, offered that there might be opportunities for GCOS and UNEP to collaborate on this the future. This action has been restated as Action 5 of this report. Regarding action 16, which deals with a review of the SCOPE-CM activities, GCOS will soon have a new Space Rapporteur, who will start the review as soon as he has commenced his duties as Rapporteur.

7.3 Draft SC-XXI recommendations and actions

The GCOS Secretariat presented a draft of the recommendations and actions from discussions that arose during the SC meeting, which would be developed further in the drafting of this report. A full list of the actions from SC-XXI can be found in Appendix 3.

7.4 Next session

The Director of the GCOS Secretariat noted that there is a standing invitation from the China Meteorological Administration (CMA) to host a session in China. The representatives from sponsors UNEP and IOC discussed a potential hosting of the next SC meeting at their offices in Geneva, Switzerland, and Paris, France, respectively. Another

suggestion for the venue was Lisbon, Portugal. A decision would be made by the Director in liaison with the SC Chair.

The twenty-second meeting of the GCOS Steering Committee (SC-XXII) will take place from 23-25 September 2014.

8. Closure of the Session

The Chair thanked the experts and secretariat staff for their contributions to the meeting. Following *in camera* discussion of SC membership and roles, and external relationships, the Chair in turn thanked SC members, sponsor representatives and the GCOS Director for their contributions to the meeting and for the general support they had provided him. He also thanked the DWD for their exemplary hosting of the meeting. He declared the session closed at approximately 1700 on 24 October 2013.

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Annex 2: Final Agenda

FINAL AGENDA FOR SC-XXI

MONDAY, 21 OCTOBER 2013

14 30 – 17 30 hrs		**GCOS Panel Chairmen Caucus**	
		The Chairmen of the Expert Panels will discuss their panels' work plans and cross-cutting issues prior to the Steering Committee Meeting.	GCOS Secretariat staff, SC Chair / AOPC Chair, OOPC Co-Chairs, TOPC Chair not available
		GCOS Assessment Cycle – Work Plan 2014/16	*(TOPC Chair only available 22 – 23 Oct 2013)*
		How to conduct the assessment? Who should be involved in the process? How many workshops? Timeline and work plan. Result of discussion will be presented at item 3.6	

TUESDAY, 22 OCTOBER 2013

09 00 – 09 30 hrs	**1.**	**Opening of the Session**	
	1.1	**Opening Remarks and Welcome by the Host**	A. Simmons, DWD
	1.2	**Sponsors` Expectations for the Meeting** *Short introductory note by each representative of WMO, IOC, UNEP and ICSU*	J. Lengoasa (WMO), R. Witt (UNEP), A. Fischer (IOC), *ICSU (TBC)*
	1.3	**Arrangements for the Session**	C. Richter
09 30 – 10 00 hrs	**2.**	**Chair's Introduction**	**Adrian Simmons**
		Chair's expectations for the meeting; Open actions from last meeting in 2012; Initial Feedback from SC Members.	
	2.1	**Approval of Agenda**	A. Simmons
Sponsor10 00 – 15 30 hrs	**3**.	**Future Work Plan for GCOS**	**Adrian Simmons**
10 00 - 10 45 hrs	**3.1**	**GCOS Programme Review** *Report on the status of the review process;* *Q&A from SC Members to the Chair of Review Board.*	W. Kusch – *Chair of Review Board*
10 45 – 11 00 hrs		Break	

11 00 – 11 30 hrs	**3.2**	**Global Framework for Climate Services** *Outcome of the first Intergovernmental Board on Climate Services (IBCS) meeting 2 – 5 July 2013;* *The Plenary elected Anton Eliassen (Norway) as Chair, and Linda Makuleni (RZA)and L Rathore (India) as Vice-Co-Chairs;* *Management Committee member is the PR of Germany to WMO;* *Progress of the GFCS and the role of GCOS.*	Gerhard Adrian - *President of the DWD*
11 30 – 12 00 hrs	**3.3**	**Future Earth** *What are the requirements for observations and observing systems within the "Future Earth" concept?*	Frans Berkhout - *Interim Director of Future Earth*
12 00 – 12 30 hrs	**3.4**	**PROVIA** *How can GCOS engage with the PROVIA programme, in particular with regard to its planned adaptation activities? PROVIA is one element of the World Climate Programme, and so are GCOS, WCRP and the World Climate Services Programme (WCSP).* *Chair is Saleemul Huq (Director, ICCCAD, Bangladesh). Professor Klein is member of the Scientific Steering Committee.*	Ron Witt / Richard Klein
12 30 – 13 30 hrs		Break	
13 30 – 14 00 hrs	**3.5**	**Observations for Adaptation** *Summary of the Workshop February 2013*	A. Simmons, C. Richter
14 00 – 14 30 hrs	**3.6**	**GCOS Assessment Cycle – Work Plan 2014/16** Presentation of the discussions held on Monday 21 Oct during the Panel Chair caucus.	Carolin Richter
14 30 – 15 00 hrs	**3.7**	**Summary Discussion of Agenda Item 3**	
15 00 – 15 30 hrs		Break	
15 30 – 17 30 hrs	**4**.	**Forum of GCOS Expert Panels**	**Adrian Simmons**
15 30 – 16 30 hrs	**4.1**	**Terrestrial Domain - Terrestrial Observation Panel for Climate (TOPC)**	**Konrad Steffen**
		Discussions of status of engagement from partner observing systems, here the Global Terrestrial Observing System; *Report of the last panel meeting;* *Recommendations to the Steering Committee;* *How TOPC will contribute to the next*	

		assessment of adequacy of the global observing systems for climate? *Discussion of what the SC would like to see being part of the panel's future work, also taking into account the cross-cutting issues.*	
16 30 – 17 30 hrs		**Cont. Discussion of Agenda Item 3**	
adjourn			
Dinner		**Suggestion : Hessian Restaurant**	
		Called "Apfelwein Klein" offering local cuisine and cider near the river Main.	

WEDNESDAY, 23 OCTOBER 2013

09 00 – 16 15 hrs	**4.**	**Forum of GCOS Expert Panels (continued)**	
09 00 – 10 00 hrs	**4.2**	**Ocean Domain - Ocean Observations Panel for Climate (OOPC)**	**Marc Bourassa / Toshio Suga**
		Discussions of status of engagement from partner observing systems, here report of the GOOS and discussion about the Global Ocean Observing System – restructured. Report of the last panel meeting – decisions, recommendations to the Steering Committee Panel's work plan 2013/2014; OOPC has new ToR which needs to be approved by GCOS SC; How OOPC will contribute to the next assessment of adequacy of the global observing systems for climate? Discussion of what the SC would like to see being part of the panel's future work, also taking into account the cross-cutting issues.	
10 00 – 11 00 hrs	**4.3**	**Atmospheric Domain - Atmospheric Observation Panel for Climate (AOPC)**	**Adrian Simmons**
		Discussions of status of engagement from partner observing systems, here discussion about the progress in implementation of the WMO Integrated Global Observing System (WIGOS);	W. Zhang
		Report of the last panel meeting – decisions, recommendations to the Steering Committee Panel's work plan 2013/2014. How AOPC will contribute to the next assessment of adequacy of the global observing systems for climate? Discussion of what the SC would like to see being part of the panel's future work, also	A. Simmons

		taking into account the cross-cutting issues.	
11 00 – 11 15 hrs		Break	
11 15 – 12 00 hrs	**4.4**	**GCOS Cooperation Mechanism**	**Tim Oakley**
		Report of the Implementation Manager and how the GCOS Cooperation Mechanism relates to the panels work; Network meeting preceding the next AOPC session; List of projects and priorities ("Shopping list"); Report of CBS Lead Centre Meeting; Planning the next GCM Board Meeting (Partnership meeting)	
12 00 – 13 00 hrs	**4.5**	**Cross-Cutting Issues for the Panels**	**Han Dolman**
		How to better engage with actual panel cross-cutting initiatives i.e. cryosphere, carbon, hydro-cycles?	
13 00 – 14 00 hrs		Break	
14 00 – 15 00 hrs	**4.6**	**Space-based observations**	**Stephen Briggs**
14 00 – 14 30 hrs		*Report on GCOS` recent engagement*	J.-L. Fellous
14 30 – 15 00 hrs		*Discussion if space-based observations have been covered adequately: view of CEOS and CGMS*	
15 00 – 15 45 hrs	**4.7**	**Research & Science Assessments**	**Antonio Busalacchi (by remote)**
		WCRP perspective on GCOS panel activities	
15 45 – 16 15 hrs	**4.8**	**GEOSS**	**Stephen Briggs**
		GEO post-2015; GEO Ministerial January 2014, GCOS as SBA Climate, Monitoring and Evaluation Exercise of the SBA Climate	
16 15 – 16 45 hrs		Break	
16 45 – 18 00 hrs	**5**	**General Discussion**	**Adrian Simmons**
		Alignment of the Panels' work to GCOS overall work plan; input from the panel Chairmen caucus from Monday 21 Oct 2013.	
adjourn			

THURSDAY, 24 OCTOBER 2013

09 00 – 10 00	**6.**	**Climate Policy issues**	**R. Lichte (UNFCCC)**
		UNFCCC and SBSTA; *Discussion on GCOS` statement to be delivered to SBSTA at COP19*	
10 00 – 12 30 hrs	**7.**	**Programme Administration / Secretariat**	**Carolin Richter**
	7.1	Budget	
11 00 – 11 30 hrs		Break	
	7.2	Review of actions from SC-XX (2012)	
	7.3	Arrangements for SC-XXII (2014)	
	7.4	Draft SC-XXI recommendations and actions In particular decision regarding item 3.6	
12 30 – 13 30 hrs		Break **(Closure of meeting for invited experts)**	
13 30 – 17 00 hrs	**8.**	**In Camera Meeting**	**Adrian Simmons**
	8.1	General Steering Committee Membership and Related Issues	(*In Camera: SC Chair, D/GCOS, SC Members, Sponsor reps*)
15 00 – 15 30 hrs		Break	
	8.2	Review of Panel Membership	
	8.3	Next Session	
17 00 hrs		**Closure**	

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Annex 3: Consolidated List of Actions

CONSOLIDATED LIST OF ACTIONS

No.	Section	Subject	Action required	Next Steps	Status/Remarks	Responsible
1	3.1	Collaboration with GEO	The GCOS Secretariat and the SC Chair should continue to work to improve collaboration with the GEO Secretariat on activities of mutual benefit.		To do.	**SC Chair, GCOS Secretariat**
2	3.2	Development of GFCS	The SC Chair and GCOS Secretariat should continue to follow the development of the GFCS and its governance under the IBCS and report back to the Steering Committee with the aim of ensuring that GCOS contributes as fully as possible to the implementation of the GFCS.		To do.	**SC Chair, GCOS Secretariat**
3	3.3	Future Earth	The GCOS Secretariat should engage with representatives of Future Earth in a follow-up discussion on the interaction between GCOS and Future Earth once the Steering Committee for Future Earth has met and clearly defined its Terms of Reference regarding observations and modelling.	The Future Earth Secretariat will be up and running in 2015. This is when the GCOS Secretariat should actively engage with the Future Earth Director to discuss GCOS` engagement.	To do.	**GCOS Secretariat, Representative of Future Earth**
4	3.4	Engagement with PROVIA	GCOS and PROVIA should liaise at Secretariat and Steering Committee level to clearly define their fundamental linkages, and how climate observations can effectively support VIA research.	The next Steering Committee of PROVIA will take place in Brazil in 2014. D/GCOS to assess if attendance would be required.	To do.	**GCOS Secretariat, Representative of PROVIA**

No.	Section	Subject	Action required	Next Steps	Status/Remarks	Responsible
5	3.5	Case studies showing the benefits of climate observation for adaptation	A few strong case studies should be developed to show the benefits of climate observations for adaptation.	Keep track of UNEP's upcoming climate change adaptation publication; potentially link to UNEP climate change adaptation in Africa projects on GCOS website.	To do. Potential collaboration with UNEP.	**GCOS Secretariat, UNEP, GCOS Implementation Manager**
6	3.6	Start of the assessment process	The GCOS Director should identify a lead for the review process by 31 December 2013, and establish a board represented by domain leads and key supporting experts. A budget, time line and preliminary work plan should also be developed.	Dr Adrian Simmons will take the lead for the review process.	Done/Ongoing.	**GCOS Director**
7	3.6	Prepare for the next GCOS reporting cycle	A scoping meeting should be held in December 2013, immediately following the Meeting of the Executive Council Working Group on Climate and Related Weather, Water and Environmental Matters (ECWG-CWE).	Outcomes will directly feed into the GCOS assessment cycle.	Done.	**SC Chair, GCOS Secretariat**
8	4.1	Workshop on observations for climate change mitigation	The GCOS Secretariat and the Project Office of GOFC-GOLD should organise a workshop that will identify observation needs in regard to some aspects of climate change mitigation.	GCOS/GOFC-GOLD to organize. Workshop will take place at WMO headquarters in Geneva, Switzerland, in May 2014.	Ongoing	**GCOS Secretariat, TOPC Representative for ECV Land Cover**
9	4.1	Soil partnership	TOPC should liaise with the 'Global Soil Partnership' (with focus on soil moisture), which is supported by FAO to collect missing soil moisture data.	To get in contact with FAO/Global Soil Partnership.	To do.	**TOPC Panel Members, GCOS Secretariat**

No.	Section	Subject	Action required	Next Steps	Status/Remarks	Responsible
10	4.1	Continuing support for TOPC	The GCOS Secretariat and Sponsors should ensure adequate continuing support for TOPC and for terrestrial domain activities, including the preparation of the next progress report and implementation plan, in view of the continuing uncertainty over support for GTOS.		Ongoing. GCOS continues to support the annual TOPC sessions.	**GCOS Secretariat, Sponsors**
11	4.2	New OOPC Terms of Reference	OOPC should revise and finalise its Terms of Reference based on the discussion at the SC meeting, and in consultation with GOOS and WCRP.		To do.	**OOPC Chairs, OOPC Panel Members**
12	4.2	Consistency of Terms of Reference	AOPC and TOPC should consider their Terms of Reference, including the possible use of an opening statement similar to that of OOPC, and are invited to make proposals for revised Terms of Reference for approval by the Steering Committee.		To do.	**AOPC/TOPC Chairs, AOPC/TOPC Panel Members, GCOS Secretariat**
13	4.2	Status of the drifting buoy network	OOPC should report back to AOPC and the Steering Committee on the status of the drifting buoy network (OOPC).		To do.	**OOPC**
14	4.4	Availability of the GOSIC website	The GCOS Director and the SC Chair should jointly write to NOAA to communicate that operation of the GOSIC website should be regarded as essential in view of its use for network monitoring.	Get in contact with NOAA.	To do.	**SC Chair, GCOS Implementation Manager**

No.	Section	Subject	Action required	Next Steps	Status/Remarks	Responsible
15	4.6	Future engagement with the Space Agencies	The range of activities undertaken by the GCOS Space Rapporteur and other representatives of GCOS in engagement with the Space Agencies should be continued, including liaison with the Working Group on Climate, which was expected to move under the auspices of CGMS as well as CEOS, and review of SCOPE-CM activities, especially in regard to the oceanic and terrestrial domains.		To do.	**GCOS Space Rapporteur, SC Chair, GCOS Secretariat**
16	4.8	GEO	The SC Chair and GCOS Director should engage in the preparation of the 2016-2025 GEO Implementation Plan, and ensure consistency with the new GCOS Implementation Plan.	Director of GCOS to be present at GEO Plenary and Ministerial in January 2014.	To do.	**SC Chair, GCOS Director**
17	5.	Work plans for GCOS panels	AOPC and TOPC should develop work plans consistent with the overall GCOS strategic and implementation planning to be developed in the coming two to three years. The OOPC work plan should be kept aligned with the overall GCOS planning.		To do.	**Panel Chairs, AOPC/TOPC Panel Members**
18	5.	GCOS panel meetings	The GCOS Secretariat and Panel Chairs, in liaison with co-sponsors of the panels, should plan back-to-back panel meetings from time to time, as appropriate, to foster cross-panel activities.		To do.	**GCOS Secretariat, Panel Chairs**

No.	Section	Subject	Action required	Next Steps	Status/Remarks	Responsible
19	6.	GCOS statement for SBSTA-39	The GCOS Secretariat, in liaison with the SC Chair, should prepare oral and written statements for SBSTA-39.		Done. Statements can be found in Appendix 4.	**GCOS Director, GCOS Secretariat**

Annex 4: SBSTA-39 Statement

Statement of the Director of the GCOS Secretariat to SBSTA-39

Monday 11 November 2013, Warsaw, Poland

Thank you, Mr Chair.
As Director of the GCOS Secretariat, it is a pleasure to be able to report to you on behalf of our partner observing systems for climate. All of our partner systems are led by United Nations Organisations, supported by the International Council for Science, or are part of global frameworks for space-based and surface-based observations.

In my short report to you today, I want to emphasize the important role that SBSTA and the Conference of Parties has played in fulfilling actions identified in the Implementation Plan for the Global Observing System for Climate, since the plan was updated in 2010.

There have been quite a few building blocks for a GCOS in the recent past, and I would like to thank Parties who supported and contributed to these activities. Just to give you two light-house examples: there is ESA`s Climate Change Initiative, which is generating products based on GCOS` Essential Climate Variable concept, and the Copernicus Earth Observation Programme, which will include an operational service giving access to information for monitoring and predicting climate change.

GCOS would also like to thank the United States Geological Survey and NASA for the successful launch of Landsat 8 on 11th February this year. This assures continuity of one of the longest, unbroken records we have of changes to our Planet's land surface.

But, I also have to raise critical issues in particular on the traditional surface-based networks:

- Surface stations are still in need of system improvements, in particular in the less developed world. Here our experience is that little money can do a lot.
- Ocean observations from fixed moorings have been in dire straits, as ship time to maintain these systems has become unaffordable for the network owners. Governments need to adjust budgets well in advance to master the financial burden and achieve a balanced not a piecemeal evolution of the observing system.
- A framework for terrestrial observations will need to be revitalized to ensure continued global coordination. Here partners in the United Nations system have to agree on a way forward which will benefit all sides.

Nearly 10 years ago, Parties of this body helped establish the GCOS Cooperation Mechanism, which has enabled donor funds to be applied to support continued operation of key climatological stations that were at risk, but which now needs to be reinvigorated to avert decline in essential climate observations – for the atmosphere, oceans and land.

Finally, Mr Chair, SBSTA invited GCOS to report on its timetable for assessing the adequacy of global observations for climate. We have started the process of developing a report assessing the progress of global observations for climate, to be delivered for 2015, which will be followed by an implementation plan in 2016.

That concludes my statement today, Mr. Chair. Thank you.

Submission from the Global Climate Observing System (GCOS) to SBSTA-39 on agenda item 8 Research and systematic observation

5 November 2013

The Global Climate Observing System (GCOS)

Activity Report 2013

As an outcome of the Second World Climate Conference, the GCOS was established in 1992 to ensure that the observation and information needed to address climate-related issues are obtained and made available to all potential users. The goal of GCOS is that contributing observing systems together provide comprehensive information on the total climate system, involving a multidisciplinary range of physical, chemical, and biological properties and atmospheric, oceanic, hydrologic, cryospheric and terrestrial processes. GCOS is jointly sponsored by the World Meteorological Organization (WMO), the Intergovernmental Oceanographic Commission (IOC) of the United Nations Educational, Scientific and Cultural Organization (UNESCO), the United Nations Environment Programme (UNEP), and the International Council for Science (ICSU).

The 50 GCOS Essential Climate Variables (ECVs), set out in the 2010 GCOS Implementation Plan, are required to support the work of UNFCCC and the IPCC, and are both technically and economically feasible for systematic observation. It is these variables for which international exchange is required as a matter of priority for both current and historical observations.

The contributing systems include the climate-observing components of the IOC-led Global Ocean Observing System (GOOS), the FAO-led Global Terrestrial Observing System (GTOS), and the WMO Global Observing System (GOS) and Global Atmosphere Watch (GAW). A number of other research and operational systems in the domains of ocean, atmosphere, and land provide important contributions to GCOS as well. The observations themselves may be ground-based, or from airborne or satellite systems. GCOS is both supported by and supports the international scientific community, and the World Climate Research Programme (WCRP) co-sponsors the expert panels set up by GCOS for the atmospheric, oceanic and terrestrial domains (The Atmospheric Observation Panel for Climate – AOPC, the Terrestrial Observation Panel for Climate – TOPC, and the Ocean Observations Panel for Climate – OOPC). The composite observing system designated as the GCOS serves as the climate-observation component of the Global Earth Observation System of Systems (GEOSS).

At its 33rd session, the SBSTA invited the GCOS secretariat to report on progress made in the implementation of the 2010 updated GCOS implementation plan on a regular basis, at subsequent sessions of the SBSTA, as appropriate.

GCOS in support of the Global Framework for Climate Services and the UNFCCC

A strengthened GCOS will be important for the successful implementation of the Global Framework for Climate Services (GFCS), recognizing that observations and monitoring constitute one of the essential pillars of the GFCS. The implementation of improvements to the climate observing system will also support assessment and development of policy related to climate change. Currently, there are 138 actions identified in the 2010 GCOS Implementation Plan in support of the UNFCCC, which address many of the needs for climate observations that apply also to the GFCS.

At the 37th Session of the Subsidiary Body for Scientific and Technical Advice (SBSTA) of the UNFCCC in November 2012, GCOS was invited to submit a report on the assessment of the adequacy of global observations for climate to SBSTA in 2015, followed by a new Implementation Plan in 2016. The GCOS programme has started on the process of developing a report on the progress and status of climate observations. The report will be followed by the implementation plan, which will identify:

- continuing and new requirements, including a restatement of the rationale for the list of ECVs and possible amendment of the list;
- the adequacy of present arrangements for meeting the requirements;
- the additional actions needed, with indicative costs, performance indicators and potential agents for implementation.

The plan should actively support not only the UNFCCC, but also the GFCS and the new research programmes PROVIA and Future Earth discussed below. The content will draw on input from a review of the actions set out in the 2010 Implementation Plan, the 2014 National Communication reports under the UNFCCC, the 5th IPCC Assessment process (through one or two workshops that will include amongst others the participation of several lead authors from Working Groups I and II), and results and identified recommendations from the workshop on observations for adaptation discussed in the following section. The three GCOS scientific panels on atmospheric, terrestrial, and oceanic observations for climate will contribute to the work, and the process will also call on one or several writing-team meetings, consultations, and a public review.

Addressing the need for observation requirements for climate change adaptation

From 26-28 February 2013, GCOS, in cooperation with UNEP, the IOC of UNESCO and the Department of Energy and Climate Change (DECC) of the United Kingdom, brought together about 45 participants for a 'Workshop on Observations Adaptation to Climate Variability and Change' at the headquarters of the German Meteorological Service (DWD) in Offenbach, Germany. Participants included representatives of the GCOS community and representatives of sectors in which adaptation to climate change and variability is, or is likely to become, an important concern. The goals of the workshop were to produce statements on the adequacy of observations, to identify requirements for observations to support climate services and research, and to provide strategic guidance on steps the GCOS programme should take in the coming years to address the needs for observations for adaptation to climate variability and change. To meet these goals, focus was set on cross-cutting issues, including risk management, early warning systems, research, modeling and assessment, and data rescue. The workshop further considered perspectives from various different fields that will be strongly impacted by climate change adaptation, including water resource management, coastal zone management, health, forestry, agriculture, energy, and transport sectors.

The workshop identified common themes regarding observation requirements. The need is to focus on observations with higher spatial and temporal resolution, specifically in regions where climate change will have significant effects on key sectors and where there are vulnerable populations. Infrastructure and governance to support sustained data rescue will need to be developed, and close links to climate change adaptation research initiatives such as the Global Programme of Research on Climate Change Vulnerability, Impacts and Adaptation (PROVIA) and ICSU's Future Earth. Furthermore, existing information will need to be presented in forms of relevance to the users, which includes developing information and products in close consultation with those users, to invest in the ground-based network of primary hydro-meteorological observations, and to establish and improve mechanisms to provide data access and data descriptions. There is a strong necessity to further discuss the topic of observation requirements for climate change adaptation, which also will need to be

linked to potential workshops on observational needs for the GFCS. As most of the adaptation actions will take place at a local and/or sub-national level, climate information used to support development, implementation and monitoring of such activities will be needed at the same level, though possibly with different requirements for each sector for which adaptation is a concern.

The enabling of globally coordinated space-based observations for climate monitoring

The CEOS Response to the 2011 update to the Satellite Supplement to the GCOS Implementation Plan, coordinated with CGMS and other bodies, reinforces the needs called out by the GCOS Satellite Supplement and provides more detail on the deliverables, coordination, activities, and who within CEOS will lead the effort. The Response, considered by the 37th session of the SBSTA in Doha (26 November-7 December 2012) provided a view of what can be achieved with current funding and additional funding with respect to some 48 satellite-related actions in the GCOS Implementation Plan. Atmosphere, ocean, and terrestrial domain leads are specified for follow-up. These coordinate with CEOS working groups, CEOS virtual constellations, climate-related external groups (e.g., SCOPE-CM, GSICS, WCRP, CGMS), and experts to develop plans responding to the actions in the GCOS Implementation Plan via templates. It is expected that this new CEOS Response will help Space Agencies plan their climate change programmes.

The CEOS, CGMS and the WMO Space Programme invited GCOS in January 2013 to attend a meeting on the development of the architecture for climate monitoring from space, the third meeting of the CEOS Working Group on Climate and a meeting of the SCOPE-CM Executive Panel. These meetings discussed several issues, including the architecture for climate monitoring, an inventory of ECV datasets, identification of the maturity of datasets, and in-depth ECV assessment. The desirability of developing the ECV inventory to include datasets based on *in situ* as well as space-based observation was recognised, and steps to be taken towards achieving this were identified.

The ESA Climate Change Initiative (CCI) is pursuing its work on 14 ECVs started in 2010/11 for a first three-year phase, and will continue in a second phase running for another three years until end of 2016. Its main objective is to improve quality to meet climate needs and to ensure free open access to CCI data products, to promote wide exploitation of CCI data sets, to maximize scientific impact and to evolve from prototype to sustainable systems. The GCOS programme is considered as a high-level user and the Chair of the GCOS Steering Committee is actively involved in giving guidance and advice through membership of the ESA CCI science advisory body.

The GCOS Cooperation Mechanism to support climate observations in developing countries

Managing the impacts of climate change have and will present major challenges for developing countries. The information needed to design effective policies for mitigating the effects of – and adapting to – climate change and facilitating sustainable development fundamentally depends on the availability of climate observations. However, such observations must be of a high quality, have a long period of operations and be incorporated in a network of sufficient density to be useful in decision-making. Meeting these challenging requirements will be difficult for many developing countries unless they are provided with some, and often sustained, assistance. The GCOS Cooperation Mechanism directly contributes to fulfilling the repeated requests of the UNFCCC to provide financial and technical support developing countries to improve their climate observing systems, which will also contribute to meeting the countries' needs for improved global networks.

The GCOS Cooperation Mechanism was established to identify and make the most efficient use of resources available for improving climate observing systems in developing countries, particularly to enable them to collect exchange and utilize data on a continuing basis in pursuance of the UNFCCC. In recent years, several countries have provided funds and participated on the GCOS Cooperation Mechanism Donor Board. The GCOS sponsors are constantly seeking additional countries that are willing to participate towards the goal of improved climate observing networks in developing countries. Since 2005, the GCOS Cooperation Mechanism has received and distributed over 3 Million USD in support of the GCOS networks, primarily for the atmospheric domain through the GCOS Surface Network (GSN) and the GCOS Upper-Air Network (GUAN). The support provided has been wide-ranging and covers all aspects of the observing system life-cycle.

Successful GCOS Cooperation Mechanism implementation projects include the renovation of surface stations, the implementation of new upper-air systems, replacing and installing hydrogen generators, improved telecommunication and hosting technical workshops. In the 2012/2013 timeframe, the GCOS Cooperation Mechanism focused primarily on the GCOS upper-air and surface networks, working to improve the overall performance of these important baseline networks through direct renovation projects, the recent activities of the WMO Commission for Basic Systems (CBS) Lead Centres for GCOS, and various training workshops. Of particular relevance have been:

- the supply of radiosondes and balloons (to Gan, Maldives; Yeveran, Armenia; and Khartoum, Sudan), which was made possible through funding from Japan, Switzerland and the UK;
- the upgrade of eight GSN stations in Angola, which was funded by the Royal Netherlands Meteorological Institute (KNMI);
- the renovation of eleven stations in Madagascar (with funding from the UK Met Office), which are now using a local mobile phone SIM connection;
- organizing the bi-annual CBS Lead Centre Meeting for GCOS from 8-10 October 2013 in Chile, Santiago (and kindly hosted by the Dirección Meteorológica de Chile), which focused on Quality Management service provided by these Lead Centres in terms of monitoring the network, diagnosing any issues and the methods of communication, etc.;
- the update of minimum requirements for all GUAN stations, which includes the reporting of temperature and wind to 30 hPa and humidity to the tropopause (on at least 25 days each month).

GCOS Programme Review

The GCOS programme has had substantial success in the past 20 years, but several new developments and some emerging issues have given rise to the need to re-examine the mandate and terms of reference of GCOS. The GCOS Steering Committee at its 19th session in 2011 welcomed an independent review of GCOS and appreciated the willingness of WMO to take the lead in seeking to carry this out in 2013. The review board had held its first meeting from 26 to 27 March 2013, and its second meeting from 28 to 30 October 2013. The board is Chaired by Mr Wolfgang Kusch, former president of the Deutscher Wetterdienst (DWD), Germany, and is comprised out of individual experts nominated by each of the sponsoring organizations. The deliberations of the board and the report will be available to the public in the middle of 2014.

Key Accomplishments

The GCOS programme has had substantial success in the past 20 years, including the designation of atmospheric observing networks, facilitating the expansion of the terrestrial networks, establishing important links to the UNFCCC, defining the GCOS Climate

Monitoring Principles, implementing the concept of Essential Climate Variables (ECVs), producing Adequacy and Progress Reports of and Implementation Plans for the global climate observing system, promoting the development of Satellite Observing Systems for Climate, and implementing a GCOS Regional Workshop Programme. The GCOS programme appreciates the support it has received from Parties to the UNFCCC, and looks forward to continued support in the future, especially in assisting the programme in its assessments of the progress in climate observation and the adequacy of the current and foreseen provisions, in its identification of implementation actions, and in continuing to generate fundamental climate data records and ECV products, including from reprocessing of past data records.

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LIST OF GCOS PUBLICATIONS SINCE SC-XX

GCOS-164	Report of the Twentieth Session of the WMO-IOC-UNEP-ICSU Steering Committee for GCOS, Geneva, Switzerland, 4-7 September 2012
GCOS-165	GRUAN Implementation Plan 2013-2017 - June 2013
GCOS-166	GCOS Workshop on Observations for Adaptation to Climate Variability and Change, Offenbach, Germany, 26–28 February 2013
GCOS-167	Report of the Fifth GCOS Reference Upper-Air Network Implementation and Coordination Meeting (GRUAN ICM-5), De Bilt, the Netherlands, 25 February - 1 March 2013
GCOS-168	Summary Report of the Fifteenth Session of the GCOS/WCRP Terrestrial Observation Panel for Climate (TOPC), Geneva, Switzerland, 6-7 March 2013
GCOS-169	Summary Report and Recommendations from the Eighteenth Session of the GCOS/WCRP Atmospheric Observation Panel for Climate (AOPC), Geneva, Switzerland, 2-5 April 2013
GCOS-170	The GCOS Upper-Air Reference Network (GRUAN) MANUAL
GCOS-171	The GCOS Upper-Air Reference Network (GRUAN) GUIDE

GCOS LIST OF ACRONYMS AND ABBREVIATIONS

ACMAD	African Centre for Meteorological Applications for Development
ADB	Asian Development Bank
AfDB	African Development Bank
AGG	AOPC Advisory Group on GSN and GUAN
AIACC	Assessments of Impacts and Adaptation to Climate Change
AMIP	Atmospheric Model Intercomparison Project
AMMA	African Monsoon Multidisciplinary Analyses
AOML	Atlantic Oceanographic and Meteorological Laboratory
AOPC	Atmospheric Observation Panel for Climate
APN	Asia-Pacific Network
ASAP	Automated Shipboard Aerological Programme
ARM	Atmospheric Radiation Measurement Program
ASECNA	L'Agence pour la Sécurité de la Navigation Aérienne en Afrique et à Madagascar
AVHRR	Advanced Very High Resolution Radiometer
AREP	Atmospheric Research and Environment Programme (WMO)
AU	African Union
BAPMON	Background Air Pollution Monitoring Programme
BOM	Australian Bureau of Meteorology
BSRN	Baseline Surface Radiation Network
CAS	Commission for Atmospheric Sciences
CBD	Convention on Biological Diversity
CBS	Commission for Basic Systems (WMO)
CCCCC	Caribbean Community Climate Change Centre
CCD	Convention to Combat Desertification
CCDA	Climate Change and Development in Africa
CCD/A	Climate Change Detection and Attribution
CCl	Commission for Climatology (WMO)
CDAS	Climate Data Assimilation System
CEOP	Coordinated Enhanced Observing Period
CEOS	Committee on Earth Observation Satellites
CGMS	Coordination Group for Meteorological Satellites
CHy	Commission for Hydrology (WMO)
CICS	Cooperative Institute for Climate and Satellites
CIIFEN	Centro Internacional de Investigaciones para el Fenómeno El Niño
CLIC	Climate and Cryosphere Project (WCRP)
CLIMAT	Report of monthly means and totals from a WWW land station
ClimDev Africa	Climate for Development in Africa Programme
CLIPS	Climate Information and Prediction Services
CLIVAR	Climate Variability and Predictability (WCRP)
CLW	WMO Climate and Water Department
CMA	China Meteorological Administration
CMM	Commission for Marine Meteorology
COCOS	Coordination of Carbon Observing Systems
CONOPS	WIGOS Concept of Operations
COP	Conference of the Parties (to UNFCCC)
COPES	Coordinated Observation and Prediction of the Earth System

CSD	Commission on Sustainable Development
DAC	Data Assembly Centre
DAO	Data Assimilation Office
DARE	Data Rescue (WCDMP project)
DBCP	Data Buoy Cooperation Panel
DFID	Department For International Development (UK)
DIM	Data and Information Management
DOI	Digital Object Identifiers
DWD	Deutscher Wetterdienst
EC	European Community
EC	Executive Council (WMO)
ECMWF	European Centre for Medium-Range Weather Forecasts
ECVs	Essential Climate Variables
EEZ	Exclusive Economic Zone
EGOS	Evolution of the Global Observing Systems
ENSO	El Niño/Southern Oscillation
ESA	European Space Agency
ESGF	Earth System Grid Federation
ESSP	Earth System Science Partnership
ET-ODRRGOS	Expert Team on Observational Data Requirements and Redesign of the Global Observing System
ETSI	Expert Team on Sea Ice
EUMETSAT	European Organisation for the Exploitation of Meteorological Satellites
FAO	Food and Agriculture Organization of the United Nations
FAPAR	Fraction of Absorbed Photosynthetically Active Radiation
FCDR	Fundamental Climate Data Record
G3OS	GCOS, GOOS and GTOS
GAW	Global Atmosphere Watch
GAWSIS	GAW Station Information System
GCB	GCOS Cooperation Board
GCO	Global Carbon Observation
GCOS	Global Climate Observing System
GCM	Global Climate Model
GCMD	Global Change Master Directory
GCMPs	GCOS Climate Monitoring Principles
GCW	Global Cryosphere Watch
GDSIDB	Global Digital Sea-Ice Data Bank
GEF	Global Environment Facility
GEMS	Global Environment Monitoring System
GEO	Group on Earth Observations
GEO-BON	GEO Biodiversity Observation Network
GEOSS	Global Earth Observation System of Systems
GEWEX	Global Energy and Water Cycle Experiment
GFCS	Global Framework for Climate Services
GIP	GCOS Implementation Plan
GLIMS	Global Land Ice Measurements from Space
GLOSS	Global Sea Level Observing System
GMDSS	Global Maritime Distress and Safety System
GMES	Global Monitoring for Environment and Security
GODAE	Global Ocean Data Assimilation Experiment
GOFC	Global Observation of Forest Cover
GOFC-GOLD	Global Observation of Forest and Land Cover Dynamics

GOOS	Global Ocean Observing System
GOS	Global Observing System
GOSIC	Global Observing Systems Information Center
GPCC	Global Precipitation Climatology Centre
GPCP	Global Precipitation Climatology Project
GPS	Global Positioning System
GRACE	Gravity Recovery and Climate Experiment
GRDC	Global Runoff Data Centre
GRUAN	GCOS Reference Upper Air Network
GSICS	Global Space-Based Inter-Calibration System
GSN	GCOS Surface Network
GSNMC	GSN Monitoring Centre
GSSC	GOOS Scientific Steering Committee
GTN	Global Terrestrial Network
GTN-E	GTN-Ecosystems
GTN-G	GTN-Glaciers
GTN-H	GTN-Hydrology
GTN-L	GTN-Lakes
GTN-P	GTN-Permafrost
GTN-R	GTN-Rivers
GTN-SM	Global Terrestrial Network for Soil Moisture
GTOS	Global Terrestrial Observing System
GTS	Global Telecommunication System
GUAN	GCOS Upper-Air Network
HALOE	Halogen Occultation Experiment
HOPC	Hydrological Observation Panel for Climate
HWR	Hydrology and Water Resources (Department, WMO)
IAEA	International Atomic Energy Agency
IAOOS	Integrated Arctic Ocean Observing System
ICOS	Integrated Carbon Observation System
ICSU	International Council for Science
ICPAC	IGAD Climate Prediction and Application Centre
ICPC	Interagency Coordinating and Planning Committee for Earth Observations
IOCCP	International Ocean Carbon Coordination Project
IFAD	International Fund for Agricultural Development
IGBP	International Geosphere-Biosphere Programme
IGACO	Integrated Global Atmospheric Chemistry Observations (IGOS Theme)
IGAD	Intergovernmental Authority on Development (East Africa)
IGBP	International Geosphere-Biosphere Programme
IGOS	Integrated Global Observing Strategy
I-GOOS	Intergovernmental Committee for GOOS
IGOS-P	Integrated Global Observing Strategy Partnership
IGOSS	Integrated Global Ocean Services System
IICWG	International Ice Charting Working Group
IHDP	International Human Dimensions Programme
iLEAPS	Integrated Land Ecosystem–Atmosphere Processes Study
INCOIS	Indian National Centre for Ocean Information Services
IOC	Intergovernmental Oceanographic Commission
IOD	Indian Ocean Dipole
IODE	International Oceanographic Data and Information Exchange

IOS	Initial Operational System (GCOS); Integrated Observing System (GOOS)
IRDR	Integrated Research on Disaster Risk Programme IRDR
ISO	International Organization for Standardization
ISSC	International Social Science Council
IP-04	Implementation Plan for the Global Observing System for Climate in Support of the UNFCCC (2004)
IP-10	Implementation Plan for the Global Observing System for Climate in Support of the UNFCCC (2010)
IPCC	Intergovernmental Panel on Climate Change
IPY	International Polar Year
ISCCP	International Satellite Cloud Climatology Project
ISO	International Standards Organization
ISTI	International Surface Temperature Initiative
JCOMM	Joint Technical Commission for Oceanography and Marine Meteorology
JCOMMOPS	JCOMM Observing Platform Support Centre
JMA	Japan Meteorological Agency
JPO	Junior Professional Officer
JRC	Joint Research Centre (European Commission)
LAI	Leaf Area Index
LCA	Long-Term Cooperative Action
MCDW	Monthly Climatic Data of the World
MECE	Monitoring of Extreme Climate Events
MOU	Memorandum of Understanding
MPERSS	Marine Pollution Emergency Response Support System
MSC	Meteorological Service of Canada
MSU	Microwave Sounding Unit
NAPAs	National Adaptation Programmes of Action
NASA	National Aeronautics and Space Administration (USA)
NBCN	National Basic Climatological Network
NCAR	National Center for Atmospheric Research
NCDC	National Climatic Data Center
NCEP	National Center for Environmental Prediction
NDACC	Network for the Detection of Atmospheric Composition Change
NGDC	National Geophysical Data Center
NMHS	National Meteorological and Hydrological Service
NMS	National Meteorological Service
NOAA	National Oceanic and Atmospheric Administration
NPP	Net Primary Productivity
NPP	National Polar-orbiting Partnership
NWP	Numerical Weather Prediction
NWP	Nairobi Work Programme
OBS	WMO Observing and Information Systems Department
OOPC	Ocean Observations Panel for Climate
OPAG	Open Programme Area Group
OSEs	Observing System Experiments
OSSEs	Observing System Simulation Experiments
PAntOS	Pan-Antarctic Observing System
PAGES	Past Global Changes (within IGBP)
PCOF	Polar Climate Outlook Forum
PECS	Programme on Ecosystem Change and Society

PICO	Panel for the Integration of Coastal Observations (GTOS-GOOS)
PMEL	Pacific Marine Environmental Laboratory
POGO	Partnership for Observation of the Global Oceans
PSC	Polar Satellites Constellation
QC	Quality Control
RAP	Regional Action Plan
RBCN	Regional Basic Climatological Network
RCOF	Regional Climate Outlook Forum
RRR	Rolling Review of Requirements
RWP	Regional Workshop Programme
SAARC	South Asian Association for Regional Cooperation
SAFs	Satellite Application Facilities
SAG	Scientific Advisory Group (GAW)
SBI	Subsidiary Body for Implementation (UNFCCC/COP)
SBSTA	Subsidiary Body for Scientific and Technological Advice (UNFCCC/COP)
SC	Steering Committee
SCIAMACHY	SCanning Imaging Absorption SpectroMeter for Atmospheric CartograpHY
SCOPE-CM	Sustained Coordinated Processing of Environmental Satellite Data for Climate Monitoring
SHADOZ	Southern Hemisphere Additional Ozone-Sondes
SIA	Seasonal-to-Inter-annual Forecasting
SIP	Seasonal-to-Interannual Climate Prediction
SIT	Strategic Implementation Team (CEOS)
SMOS	Soil Moisture Observing System
SOG	Statement of Guidance
SOOP	Ships of Opportunity Programme
SOOS	Southern Ocean Observing System
SPARC	Stratospheric Processes and their Role in Climate
SPREP	South Pacific Regional Environment Programme
SST	Sea-Surface Temperature
START	System for Analysis, Research and Training
SURFA	Surface Flux Analysis Project
TAO	Tropical Atmosphere-Ocean Array
TCDR	Thematic Climate Data Record
TCO	Terrestrial Carbon Observations
TEMS	Terrestrial Ecosystems Monitoring Sites
TOMS	Total Ozone Mapping Spectrometer
TOPC	Terrestrial Observation Panel for Climate
ToR	Terms of Reference
TOVS	TIROS Operational Vertical Sounder
TRITON	Triangle Trans-Ocean Buoy Network
TSP	Technical Support Project
UKMO	United Kingdom Meteorological Office
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFCCC	United Nations Framework Convention on Climate Change
UOP	Upper Ocean Panel (WCRP/CLIVAR)
UTLS	Upper Troposphere Lower Stratosphere
USGS	United States Geological Survey
VCP	Voluntary Co-operation Programme

VOS	Voluntary Observing Ship(s)
VOSClim	Voluntary Observing Ships Climatology Programme
WCC-3	Third World Climate Conference
WCDMP	World Climate Data and Monitoring Programme
WCP	World Climate Programme
WCRP	World Climate Research Programme
WDAC	WCRP Data Advisory Council
WDC	World Data Centre
WDCGG	World Data Centre for Greenhouse Gases
WGCCD	Working Group on Climate Change Detection
WGCM	Working Group on Coupled Modelling
WGCV	Working Group on Calibration and Validation (CEOS)
WGNE	Working Group on Numerical Experimentation
WG-SP	Working Group on Surface Pressure
WHYCOS	World Hydrological Cycle Observing System
WIGOS	WMO Integrated Global Observation System
WIS	WMO Information System
WMO	World Meteorological Organization
WOAP	WCRP Observation and Assimilation Panel
WRAP	Worldwide Recurring ASAP Project
WWW	World Weather Watch (WMO)
XBT	Expendable Bathy Thermograph

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