GCOS
GLOBAL CLIMATE OBSERVING SYSTEM

WMO IOC UNEP ICSU International Council for Science

WORLD METEOROLOGICAL ORGANIZATION

INTERGOVERNMENTAL OCEANOGRAPHIC COMMISSION

REPORT OF THE

SCOPING MEETING FOR THE ASSESSMENT OF THE ADEQUACY OF THE GLOBAL OBSERVING SYSTEM FOR CLIMATE

(Geneva, Switzerland, 12-13 December 2013)

GCOS – 178

UNITED NATIONS ENVIRONMENT PROGRAMME

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REPORT OF THE SCOPING MEETING FOR THE ASSESSMENT OF THE ADEQUACY OF THE GLOBAL OBSERVING SYSTEM FOR CLIMATE

1. Introduction and Rationale for the Scoping Meeting

The Chair of the Scoping Meeting, Adrian Simmons, welcomed all participants, who either attended in person or remotely using WebEx tools. The list of participants can be found in Annex 1.

He recalled that at the 21st Session of the GCOS Steering Committee, held from 22 to 24 October 2013, the GCOS Secretariat was requested to start the next round of assessment of the adequacy of the global observing system for climate. First, the GCOS Secretariat should convene a scoping meeting to be held 12-13 December 2013, immediately following the Meeting of the WMO Executive Council Working Group on Climate and Related Weather, Water and Environmental Matters, to take advantage of the expertise available in-house and account for the discussions of Working Group Members on the newly reconstituted World Climate Programme (WCP). Second, 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. Third, the GCOS Director should develop a budget, time line and preliminary work plan.

The Chair stressed that the next GCOS progress report and implementation plan must be highly relevant to WMO programmes, especially in the light of the evolving Global Framework for Climate Services (GFCS). He was therefore particularly pleased to see the WMO Integrated Global Observing System (WIGOS), the World Climate Data and Monitoring Programme (WCDMP) and the WCP, all of which would contribute to the GFCS, represented at the scoping meeting. Reminding meeting attendees that research, modelling and prediction are a fundamental pillar of the GFCS, he welcomed also the attendance of a representative of the World Climate Research Programme (WCRP).

The Chair pointed out, that the United Nations Framework Convention on Climate Change (UNFCCC) has formulated broader interests and needs in climate observations, with new emphasis on adaptation, loss and damage due to climate change, and forest monitoring. He also referred to the Group on Earth

Observations (GEO) and its cross-cutting actions and initiatives in these and related areas, including global agricultural monitoring and carbon observation and analysis.

The Chair referred to the draft agenda of the scoping meeting (Annex 2) and expressed his hope that the group would discuss a potential road map and scope of the assessment process.

2. Milestones of the GCOS Assessment Cycle

The Chair recalled the milestones of the GCOS reporting and assessment cycle:

- 1995: Plan for the Global Climate Observing System (GCOS), Publication No. GCOS-14; GCOS Plan for Space-based Observations, Publication No. GCOS-15
- 1998: Report on the Adequacy of the Global Climate Observing Systems – United Nations Framework Convention on Climate Change, Publication No. GCOS-48, COP-4, Buenos Aires, Argentina
- 2003: Second Report on the Adequacy of the Global Observing Systems for Climate in Support of the UNFCCC, Publication No. GCOS-82, COP-9, Milan, Italy
- 2004: Implementation Plan for the Global Observing System for Climate in Support of the UNFCCC, Publication No. GCOS-92, COP-10, Buenos Aires, Argentina
- 2006: Systematic Observation Requirements for Satellite-based Products for Climate – Supplemental Details to the Satellite-based Component of the Implementation Plan for the Global Observing System for Climate in Support of the UNFCCC, Publication No. GCOS-107
- 2009: Progress Report on the Implementation of the Global Observing System for Climate in Support of the UNFCCC 2004–2008, Publication No. GCOS 129, COP-15, Copenhagen, Denmark
- 2010: Implementation Plan for the Global Observing System for Climate in Support of the UNFCCC (2010 Update), Publication No. GCOS-138, COP-16, Cancun, Mexico
- 2011: Systematic Observation Requirements for Satellite-based Products for Climate Supplemental details to the satellite-based component of the Implementation Plan for the Global Observing System for Climate in Support of the UNFCCC - 2011 Update

3. Outcome of GCOS Steering Committee Discussions

At the latest meeting of the Steering Committee for GCOS, held from 22 to 24 October 2013, members recommended that GCOS should assess wider needs than those of the UNFCCC, addressing the multiple requirements and multiple applications of observations and Essential Climate Variable (ECV) datasets. The question was raised as to whether and how GCOS should deal with specific requirements (e.g., coming from the GFCS) for data on 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. At that Steering Committee meeting, the GCOS Director suggested that both 'near-term' and 'long-term' requirements should be assessed. The Steering Committee 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 and datasets are needed to meet local needs. The Steering Committee members decided that the report to be prepared for submission to the sponsors and 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 observation and identifying gaps. It would be followed by a new implementation plan that would draw on its conclusions.

The Steering Committee agreed that the fundamental structure of the plan 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 include integrated views of the ECVs, indicating how consistent data on groups of them are needed to quantify better the basic climate cycles and the factors contributing to changes in high-impact ECVs such as sea-level. It should also indicate how the needs of specific user sectors and regions are taken into account. The Steering Committee recognized that past supplements covering satellite data products had proved useful to the space agencies, and it was agreed that requirements for products based on *in situ* observations should also be provided in future. There was also common understanding that the benefits in delivering ECVs of a combined set of space-based observations and in-situ observations needs to be more strongly advocated. 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 included as an annex, to be referenced with the new actions.

As a next step, the Steering Committee 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 the Committee on Earth Observation Satellites (CEOS) and the Coordination Group for Meteorological Satellites (CGMS)), IPCC Working Groups, Future Earth, the Programme of Research on Climate Change Vulnerability, Impacts and Adaptation (PROVIA) and Disaster Risk Reduction, and engage with GEO and its Societal Benefit Area (SBA) 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.

4. Scoping of the Report

The Chair asked meeting attendees to discuss whether the progress report should be based on a broader base of information than the actions of the 2010 GCOS Implementation Plan would provide. It was the common view of the group that this progress report and its process should be transparent and sufficiently complete to serve as a basis for the new implementation plan. It should include information on the basic status of observation and related data arrangements for each ECV, even if not related to a specific action in the 2010 Plan. Its findings should also include a discussion of the observation of any variables that are not classified as ECVs but are to be considered for inclusion in the ECV list in the new implementation plan, and should point to any ECVs that are regarded as redundant or better replaced by alternative, related variables. It was generally understood that all observing systems contributing data relating to climate should be assessed.

4.1 Information Sources

Chair noted that the scope of the next progress report would require that good use be made of existing sources of information. He also advocated that attention be paid from the start on identification or production of good-quality illustrations. The annual Bulletin of the American Meteorological Society (BAMS) article and WMO publications on the state of the global climate were identified as potential resources. The progress report should draw on the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) and in particular the findings on key uncertainties in the report of Working Group I, which had been published in September 2013. With respect to the report of IPCC Working Group II, which will be released in March 2014, participants agreed with a proposal from WG II author Roger Pulwarty that a workshop should be held in response to the report, with an emphasis on disaster risk reduction. This workshop should invite representatives of the GEO Societal Benefit Area Water, of the GFCS, of the International Strategy for Disaster Reduction community, and of GOOS (as oceans have been addressed quite prominently in the WG II report). Preparation of the new implementation plan needs to take account of the development of the WMO Integrated Global Observation System (WIGOS), for which the Implementation Plan for the Evolution of the Global Observing Systems currently makes considerable reference to the 2010 GCOS Implementation Plan. The new plan will also take into account the implementation planning for the GFCS and the Global Ocean Observing System (GOOS).

The WCRP representative suggested also engaging with the Global Energy and Water Cycle Experiment (GEWEX) project, in particular with regard to its activities on fluxes. He also pointed to the Earth System Grid Federation's cross-cutting interests related to observations and reanalyses for serving WCRP's Coupled Model Intercomparison Projects (CMIP).

The representative of the World Climate Data and Monitoring Programme (WCDMP) pointed to the fact that in particular with regard to temperature and precipitation the World Data Centres in Asheville, USA, and Obninsk, Russia, should be involved, as well the Global Precipitation Climatology Centre (GPCC) in

Offenbach, Germany. He pointed to the 12 Global Producing Centres (GPCs) which are WMO-certified centres that assist WMO Members by providing operational long-range forecasts on the global scale as input for regional and national climate services. Further, he proposed contact with the Regional Climate Centres (RCCs), as GPCs and RCCs constitute integral components of WMO's Global Data Processing and Forecasting System (GDPFS) underpinning the generation of climate information products by National Meteorological and Hydrological Services (NMHSs). He recommended contacting the chairmen of the Open Panel of CCl Experts for Climate Data Management (OPACE-1) of the WMO Commission for Climatology (CCl). He also suggested involving experts from NOAA and the UK Met Office, as these two national services contribute in particular to the global annual statements of the climate. Finally he noted that the next GCOS Progress Report as well as the upcoming revision of the GCOS Implementation Plan constitute major information sources for refining and tackling priority tasks of the GFCS Observation and Monitoring pillar.

The Chair of the meeting noted that AOPC included members from NOAA's NCDC, the GPCC at DWD, and the UK Met Office, and one of the co-Chairs of OPACE-1 had attended AOPC sessions as the representative of CCl. This should facilitate the required interactions, as AOPC would be actively involved in the assessment and planning process.

The GEO representative identified two additional groups, CEOS and CGMS that should be involved, in particular through their joint Working Group on Climate.

Further, with regard to the interaction with GFCS, it was pointed out that there will be also a need for tailored data to meet emerging requirements in impact assessments.

A draft template for nominating an essential ocean variable (EOV), developed for GOOS and reproduced in Annex 4, was presented to the meeting. In discussing this, participants made it clear that the progress report should not assess the observational capabilities of the WMO Global Observing Systems or the ocean observing networks *per se*, but focus on the observational capabilities for climate applications. The Chair noted that the GCOS panel experts had been requested to assist in up-dating WMO's OSCAR (Observing Systems Capabilities Analysis and Review) database, which already carries information similar to some of that included in the EOV template. The template nevertheless provided useful input to the consideration of the information to be gathered for each ECV, reported in the following section.

In further discussion, it was noted that the set of ECVs might change. For example, the ocean observation community are proposing an alternative set of biogeochemical variables, and phenological observations are important for the terrestrial observation community and activities linked with agriculture. Meeting the needs for climate data of United Nations (UN) conventions other than that on climate change, for example the UN Convention on Biological Diversity, might require additional ECVs.

It was also pointed out that a public review process will be needed and that the GCOS Secretariat will have to be transparent on how consultations will be conducted and responses handled.

The Chair provided a provisional list of sources that will provide some of the information needed, to be reviewed and refreshed in finalising this report of the meeting (Annex 3).

4.2 Information needed for ECVs

It was agreed that in assessing progress and drawing up the new implementation plan, experts for each of the physical domains will need to cover each domain ECV by ECV. The status report should confirm the relevance of each ECV or otherwise explain why the ECV was considered to be no longer required or better replaced by a related variable or group of variables. Progress should be categorised subjectively in the range “good” to “poor” as adopted in the 2009 report. Conclusions should be backed by statistics related to the availability and quality of observations and data products where possible; where such information is lacking, this should be identified as a deficiency.

Further, participants discussed the usefulness of inter-relating ECVs in groups or clusters. This would be useful for activities led by WCRP because they need to characterise the fluxes needed to describe the energy, water and carbon cycles. The clustering of ECVs was also seen as relevant to the observational characterisation of phenomena such as tropical cyclones, or to climate-change indices. Participants considered that it would be helpful in the course of assessing progress and developing the plan to create matrices that relate the individual ECVs to specific climate cycles, phenomena and applications.

Participants also discussed the usefulness of observations that are not identified as essential for the global climate, but may be important locally, for example fog days or phenological data. It was also noted that paleoclimatological data plays an important role in the science of climate change. It was suggested to include text which would discuss “impact variables”, such as “coral reef cover” which is an Essential Biodiversity Variable, or other variables that can be considered as health indicators.

It was proposed furthermore to draw on climate change detection indices which are used in climate impact studies and can be related to climate services, and which would help in assessing adequacy. Reference was made to the WMO CCl/CLIVAR/JCOMM Expert Team on Climate Change Detection and Indices (ETCCDI) and to the CLIMDEX project website which produces datasets for indices of climate extremes, www.climdex.org.

It was considered important that the report point out the achievements the ECV concept has made with regard to systematic observation of climate, and in general highlight where the GCOS programme has made a difference. The Chair noted that a paper on the ECV concept was under “minor revision” for publication in the Bulletin of the American Meteorological Society and could be drawn on or

referred to in this regard. He also reminded the group that designating a station as a member of a GCOS network can be of significant value, in a national context, as it may mean that the station receives higher priority when it comes to maintenance and sustained funding. One considerable achievement was the establishment of the GCOS Reference Upper-Air Network (GRUAN). Another prime example was the recognition of ECVs by the space agencies, both generally through the CEOS responses to previous GCOS Implementation Plans, and specifically through particular activities of which the European Sapce Agency's Climate Change Initiative was particularly noteworthy for its use of the ECV concept as a basis. Specific agency-wide initiatives such as the development of the Architecture for Climate Monitoring from Space and the CEOS/CGMS/WMO ECV Inventory of climate datasets should also be cited.

The group also discussed the extent to which the status of observation of each ECV should be assessed for global, regional and local scale. The Chair proposed to take all scales into account wherever appropriate and practical, because the global picture is in general made up of observations that are in essence local. It would not be practical to cover all local deficiencies in observation, but important regional variations in data coverage and generic needs for local observation should be identified. There would inevitably be differences between ECVs, as some require true global coverage, whilst others are only relevant for particular regions or locations. It must be made clear that different ECVs require different network densities and measurement quality to be 'adequate'. For example, greenhouse gases can be measured adequately at a few places, whereas this would not be adequate for precipitation. Requirements vary on an ECV by ECV basis partly because of user needs but also partly because of the intrinsic nature of the ECVs and their time and space scales.

There could also be differences from one application to another for a particular ECV. Considerations specific to an individual ECV should be included in the text discussing that ECV, but there should also be a wider cross-cutting discussion of what the GCOS programme understands by the word "global" as applied to the observation of climate.

It was also felt that the progress report should also include a discussion on the quality of networks, covering how they have improved or degraded, and identifying perceived threats. Discussion of cost issues would be appropriate in the progress report, as costs had been indicated in the earlier GCOS Implementation Plans.

Finally, it was considered important to take into account what the user of ECV data would like to see validated. In this regard, the assessment process should discuss how data on the ECVs can be used to discuss the attribution of extreme events to climate change, or how ECVs can address loss and damage associated with climate-change impacts. It was pointed out that specific information on attribution of events can be drawn from publications of Peterson et al. in the editions of the Bulletin of the American Meteorological Society in 2012 and 2013. The Chair noted that the GCOS community is not as closely linked to the user community for specific sectorial benefit areas as GEO is, for example, and he saw

an opportunity for the GCOS Secretariat to liaise with the GEO Secretariat, for instance in the upcoming GEO work plan symposium or existing task teams. Similar remarks could be made with regard to the GFCS.

Annex 5 is a draft list of information items which need to be assembled for each ECV, drawn up by the Chair following the overall discussion, to be reviewed and refreshed in finalising this report of the meeting.

4.3 Timescales for Assessment Cycle – Ten-year vision and five-year targets

The Chair suggested aligning the new implementation plan with a vision to 2025, as this would tie in with the next implementation plan of the GEO and with the WIGOS planning process, which includes the Implementation Plan for the Evolution of the Global Observing System (GOS) in 2025. The GOOS community also aligns its implementation plan with its ten-yearly "taking-stock" conferences; the first so-called "OceanObs" conference took place in 1999; the second one in 2009, and the third assembly is already planned for 2019. Participants noted that the overall performance for satellite systems or network performance can be assessed in 10-year intervals, but budgets and plans for some observing systems are often based on shorter periods. Also, the IPCC assessment cycle is repeated every six years or so, and the WMO Commission for Climatology operates in four-yearly cycles.

The group strongly recommended that the new GCOS implementation plan present a 10-year vision, but set initial five-year targets where appropriate, to enable a review of progress and an update of the plan as needed at the five-year stage. These time scales would allow alignment to existing long-term observation and research strategies, but enable a more timely response to be given to requests from sponsors, the UNFCCC and other stakeholders.

5. Road Map for 2014 to 2016

The Chair outlined the envisaged GCOS work plan for the years from 2014 to 2016. The progress report will be prepared for submission to the sponsors and UNFCCC Parties **in the course of 2014 and early 2015, to be submitted to the UNFCCC Secretariat in late summer (August) 2015.** It will document how actions in the 2010 Implementation Plan have been or are being addressed, reviewing the overall status of each ECV and identifying gaps.

The new Implementation Plan should include a chapter on the 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 October 2015**, with **finalization in summer 2016** for delivery to meet the timescale that had already been indicated to the UNFCCC Subsidiary Body for Scientific and Technological Advice (SBSTA).

The GCOS Secretariat should take advantage of experts and discussions on the status of ECVs at the following key meetings:

- Terrestrial Observation Panel for Climate (TOPC),16th session, 10-11 March 2014
- Atmospheric Observation Panel for Climate (AOPC), network workshop and 19th session, 9 – 11 April 2014
- GEO Work Plan Symposium, possibly 28 April – 2 May 2014
- WCRP Data Advisory Council (WDAC), 6-7 May 2014
- Ocean Observations Panel for Climate (OOPC), 17th session, 21-24 July 2014
- EUMETSAT/WCRP Climate Symposium, 13-17 October 2014

All GCOS panels will need to be engaged in the process. They will need to be given explicit tasks and guidance how to address cycles, and how to cluster the variables.

In addition, the GCOS Secretariat is asked to organise:

- A workshop with IPCC WG II and the disaster risk community;
- A small workshop on observations for mitigation with GOFC-GOLD, which is already under preparation and tentatively scheduled for 5-9 May or 12-16 May 2014;
- A workshop, early in 2015, to map out the implementation plan, because this will need a wide ranging discussion, for example on the revision of the ECV list and on the documentation of the procedures.

The writing of the progress report should start around November 2014. The GCOS Secretariat is requested to provide a plan on how to resource the additional needed meetings and the writing process, which itself is likely to require small team meetings, and possibly an analysis of the National Reports to the UNFCCC on systematic observation that are due by 1 January 2014.

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Annex 2: Agenda

AGENDA

Scoping Meeting
for the Assessment of the Adequacy of the
Global Observing System for Climate.

Chairman: Adrian Simmons (Chairman of the GCOS Steering Committee and the GCOS/WCRP Atmospheric Observation Panel for Climate)

Thursday 12 December 2013, Salle 7Jura:
15 00 - 17 00 hrs

- Objectives of a scoping meeting
- What happened in the past: history of progress / adequacy reports
- Findings of last progress report, identified gaps
- Expectations for a new progress report
- Continuity of the progress report
- Scope and structure of the new progress report
- Integration with the Implementation Plan

Friday 13 December 2013, 09 - 12 00 hrs, Salle 7Jura

- Summary of Thursday's discussion
- Discussion on who else should be on board - as leader, as expert
- Road map
- Next steps

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Annex 3: Sources and References

GCOS documents available at http://www.wmo.int/pages/prog/gcos/index.php?name=Publications:

GCOS-82, 2003: Second Report on the Adequacy of the Global Observing Systems for Climate in Support of the UNFCCC

GCOS-92, 2004: Implementation Plan for the Global Observing System for Climate in Support of the UNFCCC

GCOS-107, 2006: Systematic Observation Requirements for Satellite-based Products for Climate Supplemental details to the satellite-based component of the Implementation Plan for the Global Observing System for Climate in Support of the UNFCCC

GCOS-129, 2009: Progress Report on the Implementation of the Global Observing System for Climate in support of the UNFCCC 2004-2008

GCOS-138, 2010: Implementation Plan for the Global Observing System for Climate in Support of the UNFCCC (2010 Update)

GCOS-143, 2010: Guideline for the Generation of Datasets and Products Meeting GCOS Requirements

GCOS-154, 2011: Systematic Observation Requirements for Satellite-based Products for Climate Supplemental details to the satellite-based component of the Implementation Plan for the Global Observing System for Climate in Support of the UNFCCC - 2011 Update

GCOS-166, 2013: GCOS Workshop on Observations for Adapting to Climate Variability and Change. Offenbach, Germany, 26-28 February 2013

Unpublished GCOS paper: Technical Support Paper for the Second Adequacy Report

Bojinski et al., 2014 Essential Climate Variables: an integrated concept that supports climate research, applications, and policy. Submitted to Bull. Amer. Meteor. Soc.

Framework for Ocean Observing

GFCS Implementation Plan, especially Annex III on the Observation and Monitoring Component

Implementation Plan for the Evolution of Global Observing Systems

WMO network monitoring for GSN and GUAN

WMO Rolling Review of Requirements, Observing Systems Capabilities Analysis and Review Tool (OSCAR)

Relevant WMO manuals and guides

Outcomes of the 2014 GCOS and GOFC-GOLD workshop on observations for some aspects of mitigation

A 2014 study report on Observations and Integrated Earth System Science being developed under the auspices of COSPAR

Trenberth, K.E., R.A. Anthes, A. Belward, O. Brown, E. Haberman, T.R. Karl, S. Running, B. Ryan, M. Tanner, and B. Wielicki, 2012: Challenges of a sustained climate observing system. In Climate Science for Serving Society: Research, Modelling and Prediction Priorities, Hurrell, J.W. and Asrar, G., Eds., Springer, 485p. ISBN 978-94-007-6691-4.

2013 SPARC Data Requirements Workshop conclusions

2013/2014 IPCC Fifth Assessment Report (WG1, WG2, WG3?)

National reports to UNFCCC on systematic observation due by 1 January 2014

2014 EUMETSAT/WCRP Climate Symposium

GOOS planning

GEO implementation planning for period to 2025

Architecture for Climate Monitoring from Space

CEOS/CGMS/WMO ECV Inventory database

GEO assessments of requirements

ESA CCI report on user requirements

WMO annual statement on the climate

BAMS annual statement on the climate

Annex 4: Draft Template for an Essential Ocean Variable

Nomination of an Essential Ocean Variable (EOV)

EOV Information	
Name of EOV	e.g. SST
Sub-Variables	e.g. Skin/Bulk SST
Derived Products	e.g. Heat flux
Supporting variables	
Contact/Lead Expert(s)	e.g. Group for High Resolution Sea Surface Temperature (GHRSST) Project.

Requirements Settings					
Responsible GOOS Panel **Reporting Mechanism(s)**	e.g. OOPC e.g. GCOS Implementation Plan				
Readiness Level [1]	Mature				
Societal Benefit Area(s) **Societal drivers**					
Scientific Application(s)					
Phenomena to capture.	e.g. Diurnal Cycle	e.g. Seasonal Cycle			
Temporal Scales of the phenomena					
Spatial scales of phenomena					
Magnitudes/range of the signal, thresholds to capture			.		

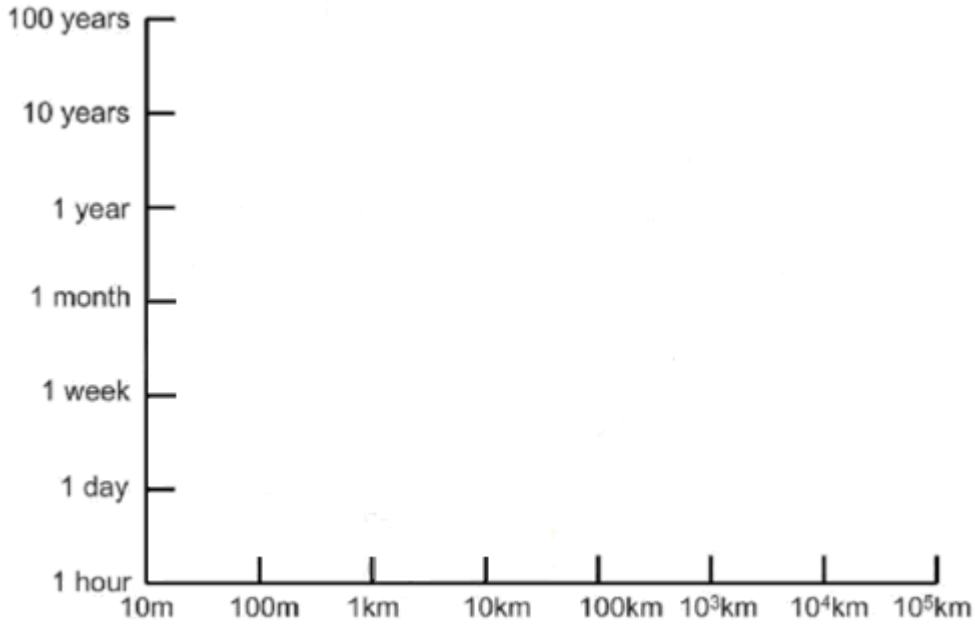

Figure 1: Draw Scales of phenomena to be addressed, and fill in the magnitude of the signal to capture.

Observation Deployment & Maintenance					
Observing Elements	e.g. Satellites	e.g. Moorings	e.g. Drifters		
Phenomena addressed					
Readiness Level [1]					
Spatial scales					
Temporal scale					
Relevant measured variables					
Sensor(s)/Technique					
Accuracy/Uncertainty estimate (units).					

Future observing Elements					
Observing Elements					
Readiness Level [1]					
Spatial scales					
Temporal scale					
Time-scale until part of observing system					
Relevant measured parameter(s)					
Sensor(s)/Technique					
Accuracy/Uncertainty estimate (units).					

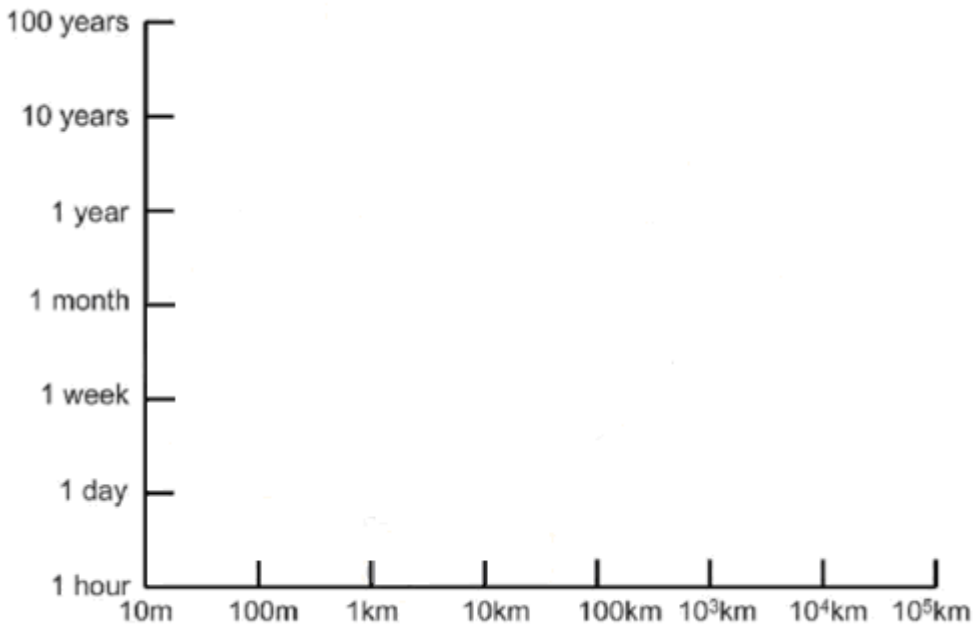

Figure 2. Draw in the observation scales of the component networks.

Data & Information Creation			
	e.g. Merged Satellite/In Situ SST	**Gridded in situ SST Product**	**Gridded in situ SST climatology**
Readiness Level [1]			
Oversight & Coordination	GHRSST	HADSST	
Data Centre/repository			
Data Stream delivery and QC…			
Derived Products			

Links & References	
Links* (especially regarding Background & Justification)	
Links for Contributing Networks	
Data References	

[1] **Framework Processes and Readiness Levels** (from the Framework for Ocean Observing [FOO]).

Highest Readiness Level

	Requirements	Observations	Data & Information
Mature	Measurement validated through peer review, implemented at regional and/or global scales and capable of being sustained.	Following validation of observation via peer review of specifications and documentation, system is in place globally and indefinitely.	Validation of data policy via routinely available and relevant information products.
Pilot	Measurement and sampling strategy verified at sea. Autonomous deployment in an operational environment.	Establishment of international governance mechanism, international commitments, and sustaining components. Maintenance and servicing logistics negotiated.	Data management Practices determined and tested for quality and accuracy throughout the system. Creation of draft data policy.
Concept	Need for information identified and characteristics determined. Feasibility study of measurement strategy and technology.	The system is articulated, capability is documented and tested. Proof of concept validated by a basin scale feasibility test.	Data model is articulated, expert review of interoperability strategy. Verification of model with actual observational unit.

Lowest Readiness Level

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Annex 5: ECV items of information

Below is a draft of the list of information items that it is proposed to assemble for each ECV, to the extent applicable. It incorporates some of the items from the draft template proposed for the nomination of GOOS Essential Ocean Variables (Annex 4). The information assembled will be used in drawing up both the Progress Report and the Implementation Plan.

In due course relevant items will be needed for identified new ECVs.

Name of ECV: ***To be pre-filled***

Subsidiary variables: *List these for those ECVs that are not a single biogeophysical variable, but rather comprise a family of subsidiary variables.*

Supplementary measured variables: *For ECVs for which products may be derived from measurements of dependent quantities, e.g. IR and MW radiances, and GPS bending angles, for atmospheric temperatures.*

ECV Group membership*: Identify groups to which ECV belongs, for example groups of variables related to the energy, hydrological or carbon cycles, or sea-level change.*

Applications: *List key applications such as scientific understanding, climate-change monitoring, attribution, model initialisation and/or validation, and provision of service to end users (mentioning sector covered).*

Phenomena and indices: *As discussion of climate change often involves changes in frequency or intensity of extreme events such as tropical cyclones, or indices such as number of frost days, it should be noted whether the ECV in question contributes to characterisation of a key phenomenon or index linked to climate variability and change.*

Uncertainties identified by IPCC: *List the main uncertainties linked to observation and/or data products for the ECV, as identified in AR5; this should include the "key uncertainties" listed in the WG I Technical Summary and others in the body of the reports that are considered important.*

Pre-existing summary text on the ECV: ***This may be pre-filled*** *where it can be found in existing GCOS documents and text is judged to be reasonably up-to-date, but could otherwise be added if there is text to hand from other sources. It should comprise a single or small number of paragraphs, and could apply to groups of ECVs rather than a single one. If it does apply to more than one ECV there is no need to repeat the text for each, but the original entry should be cross-referenced for other ECVs in the group.*

Non-climate applications of observation: *e.g. for weather forecasting. These may be covered already in pre-existing summary text.*

Contributing observing networks, systems or approaches: *List the principal source(s) of data on the ECV.*

Links and references to observational methods and standards: *This could, for example, be to WMO Manuals and Guides, or to the proposed EOV specifications of observation deployment and maintenance for the ocean ECVs. This need not include generally applicable guidance such as the GCOS Climate Monitoring Principles and Dataset*

Guidelines. If material is judged to be in need of updating (as has been indicated for the GTOS Terrestrial ECV Reports) this should be noted.

Requirements for spatial and temporal scale, accuracy/uncertainty and stability: *This could be done by reference (to OSCAR database if entry is up-to-date, to proposed EOV specifications, to entries in Satellite Supplement reproduced below), but should otherwise be discussed more explicitly. Any distinctions between requirements for observations and for data products should be noted.*

Arrangements for observational monitoring: *List what, if anything, is in place or needed for routinely checking functioning of observing system.*

Changes in observation: *List recent and planned future changes to observing networks, systems and methods. Discuss perceived threats.*

Observational performance: *Should build on immediately preceding entries, and give quantitative information on performance: spatial and temporal coverage, accuracy and stability (i.e. quality as well as quantity), where possible. Provision of graphs or tables (or pointers to where the underlying data can be found) is needed here (or under item below on assessment of progress on action.)*

Data recovery: *List opportunities, progress, needs and obstacles as appropriate.*

Data centres: *List principal international data centres or national/regional centres with substantial holdings of global observations and/or data products.*

Data products: *List the types of processed product that are needed/available. Identify issues.*

Product oversight and coordination: *Identify which if any international groups or other bodies have a role here.*

Product assessments: *List any independent assessments of products that have been carried out or are in progress. Summarise conclusions reached.*

Action from IP-10: ***To be pre-filled.*** *If action is in a domain, but not attached to a single ECV, it will be assigned to first ECV to which it applies. Actions designated as cutting across domains will be reviewed in a second step.*

Assessment of progress on action: *Short text, quantitative where possible, with graph or table if readily available and message is clear. Provide subjective ranking on five-point scale denoting progress as good, good-moderate, moderate, moderate-low and low. See 2009 Progress Report. Flag if there has been absolutely no progress; we could have this as sixth category if needed.*

Product requirement from 2011 Satellite Supplement: ***To be pre-filled.*** *Requirements designated as cutting across domains will be reviewed in a second step.*

Progress towards meeting product requirement: *Short text. Not much time has passed since 2011 supplement. However it may be appropriate to refer back to corresponding requirement in the original 2006 supplement or to 2006 and 2012 CEOS responses.*

General links and references: *Provide any key web links or references that are in addition to the more specific ones listed earlier.*

Expert group or individual: *Provide name here if panel does not have expertise to complete some sections, and has taken input from, or input needs to be taken from, another expert group or individual.*

Identify a lead for an ECV to be tasked with canvassing a broad range of peers in forming an initial text.

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