



CONFERENCE OF THE PARTIES

**Report of the Conference of the Parties
on its thirteenth session, held in Bali
from 3 to 15 December 2007**

Addendum

Decision 11/CP.13¹

Reporting on global observing systems for climate

The Conference of the Parties,

Recalling decisions 4/CP.5, 5/CP.5, 11/CP.9 and 5/CP.10,

Noting the need to revise the “UNFCCC reporting guidelines on global climate change observing systems”² in order to reflect the priorities of the Global Climate Observing System implementation plan and incorporate the reporting on essential climate variables,

Recognizing the proposals made by the secretariat of the Global Climate Observing System,

Having considered the recommendations of the Subsidiary Body for Scientific and Technological Advice on this matter at its twenty-third, twenty-fifth and twenty-seventh sessions,³

1. *Adopts* the revised UNFCCC reporting guidelines on global climate change observing systems as contained in the annex to this decision;
2. *Decides* that these revised guidelines should take effect immediately for the preparation of detailed technical reports on systematic observations in accordance with the provisions of decisions 4/CP.5 and 5/CP.5;
3. *Requests* Parties included in Annex I to the Convention to continue providing such reports in conjunction with their national communications;
4. *Invites* Parties not included in Annex I to the Convention to provide such reports on a voluntary basis.

¹ The text of decision 11/CP.13 is reproduced here together with its annex for ease of reference. The text of the decision can also be found in document FCCC/CP/2007/6/Add.1.

² See decision 5/CP.5 and document FCCC/CP/1999/7, chapter III.

³ FCCC/SBSTA/2005/10, paragraph 97; FCCC/SBSTA/2006/11, paragraph 95; and FCCC/SBSTA/2007/16, paragraph 35.

ANNEX

Revised UNFCCC reporting guidelines on global climate change observing systems¹

I. Introduction

A. Objective

1. The purpose of these guidelines for reporting on systematic observation of the global climate system for Parties included in Annex I to the Convention (Annex I Parties) and, as appropriate, Parties not included in Annex I to the Convention (non-Annex I Parties), is to assist Parties in reporting their actions with regard to global climate observing systems; development of observational networks; and, as appropriate, providing support for non-Annex I Parties, as defined in Articles 4, paragraphs 1(g) and (h), 5 and 12, paragraph 1(b), of the Convention.

B. Structure

2. The information identified in these guidelines should be communicated by the Party in a single document and submitted to the Conference of the Parties (COP) through the secretariat, and shall be in one of the official languages of the United Nations. Parties may include a reference to a national focal point and/or website from which additional copies of the report may be obtained. The submitting Party may decide on the length of the report but every effort should be made to limit its length. Parties should also provide an electronic version of their reports to the secretariat.

II. Reporting

A. General approach to reporting on systematic observation

3. Parties should describe the status of their programmes for contributing observations of the essential climate variables (ECVs) to the international community² (for a complete list of the ECVs see appendix 2). The Implementation Plan³ for the Global Climate Observing System (GCOS implementation plan), which was developed specifically for the Convention, identifies those global observations of the climate system required by the Parties to the Convention. When preparing their reports, Parties should take note of the performance indicators that were included with each action contained in the GCOS implementation plan. Parties may, if they so wish, provide additional information to that covered in these guidelines, including maps of networks and details of participation in other programmes that will contribute observations of the ECVs, such as work on climate observations being undertaken in climate research programmes.

4. Parties may wish to prepare the report in five chapters. Chapter 1 would deal with a number of common elements, as outlined in paragraphs 5–11 below. Paragraphs 5, 6 and 7 deal with planning, implementation, quality control, international data exchange and data analysis. Paragraph 8 requests Annex I Parties to report on their capacity-building activities related to climate observations.

¹ A list of acronyms used in these guidelines is given in appendix 1.

² While these guidelines focus on the global requirements, the same observations are also required to support national and regional activities.

³ Implementation Plan for the Global Observing System for Climate in Support of the UNFCCC (WMO, 2004, available at <http://www.wmo.int/pages/prog/gcos/Publications/gcos-92_GIP.pdf>). The implementation plan was prepared by the GCOS secretariat at the request of the COP at its ninth session (decision 11/CP.9) and considered by the COP at its tenth session (decision 5/CP.10).

Paragraph 9 requests those Parties with palaeoclimate programmes to report on their activities in setting current climatic changes within a historical context. Paragraph 10 requests information on any difficulties encountered in using these guidelines and preparing the required report. The next three chapters of the report would deal with the technical aspects of the GCOS implementation plan; in them, Parties would provide detailed information on the ECV networks and/or systems they are operating and their response to the actions identified in the GCOS implementation plan. Chapter 2 would focus on the atmospheric ECVs as outlined in paragraphs 12–15 below. Chapter 3 would focus on the oceanic ECVs as outlined in paragraphs 16–20 below. Chapter 4 would focus on the terrestrial ECVs as outlined in paragraphs 21–25 below. The final chapter would be optional and could contain information on national climate programmes that is additional to that covered in these guidelines, such as work on climate observations being undertaken in climate research programmes and/or programmes that provide climate information at a higher resolution or frequency.

B. Chapter 1: Common issues

5. In describing their national programmes, Parties should, where relevant, report on actions they have undertaken to introduce and/or enhance national coordination, as well as planning activities for the production and adoption of their own national implementation plans for observing, archiving and analysing their national contribution of observations of the ECVs.

6. Parties should describe the efforts being undertaken to ensure that high-quality climate data records are collected, retained and made accessible for use by current and future generations of scientists and decision makers of all Parties by reporting on:

- (a) Any national policy or guidance that has been promulgated relevant to the international exchange of ECV data;
- (b) Any policy-level barriers to the international exchange of climate data and their provision to international data centres;
- (c) Efforts undertaken to ensure that ECV-observing activities adhere to the GCOS climate monitoring principles (GCMPs) adopted by the COP in decision 11/CP.9 (see appendix 3), including efforts undertaken to ensure that inhomogeneities resulting from changes in technology and observing practices are kept to a minimum and are capable of being effectively calculated and allowed for in the long-term climate record;
- (d) Difficulties encountered in protecting the integrity of their long-term climate data records and steps being taken or required to address those difficulties.

7. Parties should report on efforts undertaken to ensure that international data centres are established and/or strengthened for all the ECVs (see appendix 4). Specifically (full names and numbers of relevant actions in the GCOS implementation plan are given in quotes and parentheses):

- (a) Parties with responsibility for ECV international data centres, including those with responsibility for the World Data Centres, may wish to report on actions undertaken to “prepare the data sets and meta-data, including historical data records, for climate analyses and reanalyses” (C11);
- (b) Parties supporting data centres that undertake ECV analysis may wish to report on the actions undertaken to “establish sustainable systems for the routine and regular analysis of the ECVs including measures of uncertainty” (C12);

- (c) Parties supporting data centres that undertake reanalysis may wish to report on steps taken to “establish a sustained capacity for global climate reanalysis and ensure coordination and collaboration between reanalysis centres” (C13);
- (d) Parties supporting World Meteorological Organization (WMO) and Intergovernmental Oceanographic Commission centres for GCOS may wish to report on their experiences in diagnosing quality, availability and communications issues with climate data.

8. Parties should describe actual and/or planned activities for capacity-building in least developed countries, small island developing States and countries with economies in transition related to the collection, exchange and/or use of observations of the ECVs, including implementation of the regional action plans developed from the GCOS regional workshop programme. Included in this regard are activities undertaken through multilateral and/or bilateral technical cooperation programmes, including participation in the GCOS cooperation mechanism as encouraged by the COP in decision 5/CP.10.

9. Recognizing the importance of setting current climatic changes within a historical context, Parties are requested to report on initiatives undertaken to acquire palaeoclimate data, in particular activities to extend the data record in time and into new regions, and to improve the synthesis of these data.

10. Where information required in these guidelines cannot be provided, Parties should report on any difficulties encountered, needs that should be met to enable the reporting of such information in future, and steps being taken to improve the availability of information.

11. Multinational and international projects and organizations conducting climate observations, including multinational satellite agencies, are encouraged to report through the Party in which they are based.

C. Chapter 2: Atmospheric essential climate variables

12. Parties should, where relevant, describe their national contributions of the atmospheric ECV observations to the international community, paying special attention to the requirements outlined in the GCOS implementation plan.

13. To facilitate integration of the information contained in the national reports, Parties should complete tables 1a, 1b and 1c. These tables are designed to record information on the national contributions of observations from well-established systems and networks whose current operations can be quantified. Parties should also provide a narrative report on those atmospheric elements of the GCOS implementation plan that are less quantifiable with the aim of making changes and improvements to the climate observing system as a whole so that it meets the requirements of the Convention (see para. 15 below).

Table 1a. National contributions to the surface-based atmospheric essential climate variables

| Contributing networks specified in the GCOS implementation plan | ECVs^a | Number of stations or platforms currently operating | Number of stations or platforms operating in accordance with the GCMPs | Number of stations or platforms expected to be operating in 2010 | Number of stations or platforms providing data to the international data centres | Number of stations or platforms with complete historical record available in international data centres |
|---|---|--|---|---|---|--|
| GCOS Surface Network (GSN) | Air temperature | | | | | |
| | Precipitation | | | | | |
| Full World Weather Watch/Global Observing System (WWW/GOS) surface network | Air temperature, air pressure, wind speed and direction, water vapour | | | | | |
| | Precipitation | | | | | |
| Baseline Surface Radiation Network (BSRN) | Surface radiation | | | | | |
| Solar radiation and radiation balance data | Surface radiation | | | | | |
| Ocean drifting buoys | Air temperature, air pressure | | | | | |
| Moored buoys | Air temperature, air pressure | | | | | |
| Voluntary Observing Ship Climate Project (VOSCLIM) | Air temperature, air pressure, wind speed and direction, water vapour | | | | | |
| Ocean Reference Mooring Network and sites on small isolated islands | Air temperature, wind speed and direction, air pressure | | | | | |
| | Precipitation | | | | | |

^a Parties should note that the list of ECVs given for each network is indicative of the expected observations from that network. A single response/data entry is expected for each network except for those networks for which precipitation is reported, where a separate response/data entry is requested owing to its particular importance with regard to the Convention.

Table 1b. National contributions to the upper-air atmospheric essential climate variables

| Contributing networks specified in the GCOS implementation plan | ECVs | Number of stations or platforms currently operating | Number of stations or platforms operating in accordance with the GCMPs | Number of stations or platforms expected to be operating in 2010 | Number of stations or platforms providing data to the international data centres | Number of stations or platforms with complete historical record available in international data centres |
|--|---|--|---|---|---|--|
| GCOS Upper Air Network (GUAN) | Upper-air-temperature, upper-air wind speed and direction, upper-air water vapour | | | | | |
| Full WWW/GOS Upper Air Network | Upper-air-temperature, upper-air wind speed and direction, upper-air water vapour | | | | | |

Table 1c. National contributions to the atmospheric composition

| Contributing networks specified in the GCOS implementation plan | ECVs | Number of stations or platforms currently operating | Number of stations or platforms operating in accordance with the GCMPs | Number of stations or platforms expected to be operating in 2010 | Number of stations or platforms providing data to the international data centres | Number of stations or platforms with complete historical record available in international data centres |
|---|------------------------|--|---|---|---|--|
| World Meteorological Organization/ Global Atmosphere Watch (WMO/GAW) Global Atmospheric CO₂ & CH₄ Monitoring Network | Carbon dioxide | | | | | |
| | Methane | | | | | |
| | Other greenhouse gases | | | | | |

Table 1c (continued)

| Contributing networks specified in the GCOS implementation plan | ECVs | Number of stations or platforms currently operating | Number of stations or platforms operating in accordance with the GCMPs | Number of stations or platforms expected to be operating in 2010 | Number of stations or platforms providing data to the international data centres | Number of stations or platforms with complete historical record available in international data centres |
|---|--------------------------|---|--|--|--|---|
| WMO/GAW ozone sonde network ^a | Ozone | | | | | |
| WMO/GAW column ozone network ^b | Ozone | | | | | |
| WMO/GAW Aerosol Network ^c | Aerosol optical depth | | | | | |
| | Other aerosol properties | | | | | |

^a Including SHADOZ, NDACC, remote sensing and ozone sondes.

^b Including filter, Dobson and Brewer stations.

^c Including AERONET, SKYNET, BSRN and GAWPFR.

14. Satellite observations are essential to complete the information base for atmospheric observations. Therefore, Parties with space programmes involving Earth observations should comment on their plans to ensure availability of past and future data and metadata records of the satellite measurements for the atmospheric ECVs and associated global products contained in table 2.⁴

Table 2. Global products requiring satellite observations – atmospheric essential climate variables

| ECVs/ Global products requiring satellite observations | Fundamental climate data records required for product generation (from past, current and future missions) |
|--|--|
| Surface wind speed and direction Surface vector winds analyses, particularly from reanalysis | Passive microwave radiances and scatterometry |
| Upper-air temperature Homogenized upper-air temperature analyses: extended MSU-equivalent temperature record, new record for upper-troposphere and lower-stratosphere temperature using data from radio occultation, temperature analyses obtained from reanalyses | Passive microwave radiances, GPS radio occultation, high-spectral resolution IR radiances for use in reanalysis |
| Water vapour Total column water vapour over the ocean and over land, tropospheric and lower stratospheric profiles of water vapour | Passive microwave radiances, UV/VIS radiances, IR imagery and soundings in the 6.7µm band, microwave soundings in the 183 GHz band |

⁴ Derived from the document entitled *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*, WMO, 2006.

Table 2 (continued)

| ECVs/ Global products requiring satellite observations | Fundamental climate data records required for product generation (from past, current and future missions) |
|--|--|
| Cloud properties Cloud radiative properties (initially key ISCCP products) | VIS/IR imagery, IR and microwave soundings |
| Precipitation Improved estimates of precipitation, both as derived from specific satellite instruments and as provided by composite products | Passive microwave radiances, high-frequency geostationary IR measurements, active radar (for calibration) |
| Earth radiation budget Top-of-atmosphere Earth radiation budget on a continuous basis | Broadband radiances, spectrally-resolved solar irradiances, geostationary multi spectral imagery |
| Ozone Profiles and total column of ozone | UV/VIS and IR microwave radiances |
| Aerosol properties Aerosol optical depth and other aerosol properties | VIS/NIR/SWIR radiances |
| Carbon dioxide, methane and other long-lived greenhouse gases Distribution of greenhouse gases, such as CO ₂ and CH ₄ , of sufficient quality to estimate regional sources and sinks | NIR/IR radiances |
| Upper-air wind Upper-air wind analyses, particularly from reanalysis | VIS/IR imagery, Doppler wind lidar |
| Atmospheric reanalyses | Key FCDRs and products identified in this report, and other data of value to the analyses |

15. Parties are also requested to provide a narrative description of any actions they have taken in response to the following recommended actions on the atmospheric ECVs contained in the GCOS implementation plan (numbers of relevant actions in the plan are given in parentheses):

- (a) Applying the GCMPs to all surface climate networks (A3);
- (b) Incorporating atmospheric pressure sensors into drifting buoy programmes (A5);
- (c) Ensuring availability of three-hourly mean sea level pressure and wind speed and direction data from GSN stations (A10);
- (d) Implementing a reference network of high-altitude, high-quality radiosondes (A16);
- (e) Operating the WWW/GOS radiosonde network in full compliance with the GCMPs and coding conventions (A17);
- (f) Submitting metadata records and inter-comparisons for radiosonde observations to the specified international data centres (A18);
- (g) Developing a network of ground-based Global Positional System (GPS) receivers for measuring water vapour (A21);
- (h) Sustained measurements of the atmospheric composition ECVs, supplementary to those activities implicit in table 1c.

D. Chapter 3: Oceanic essential climate variables

16. Parties should, where relevant, describe their national contributions of oceanographic ECV observations to the international community, paying special attention to the requirements outlined in the GCOS implementation plan.

17. A brief narrative report is requested on their actions in nominating national focal points for implementation of the oceanic observing system for climate and establishing partnerships between the ocean research and operational communities.

18. To facilitate integration of the information contained in the national reports, Parties should complete tables 3a and 3b. These tables are designed to record information on the national contributions of observations from well-established systems and networks whose current operations can be quantified. Parties should provide a narrative report on those oceanic elements of the GCOS implementation plan that are less quantifiable with the aim of making changes and improvements to the climate observing system as a whole so that it meets the requirements of the Convention (see para. 20 below).

Table 3a. National contributions to the oceanic essential climate variables – surface

| Contributing Networks specified in the GCOS implementation plan | ECVs | Number of stations or platforms currently operating | Number of stations or platforms operating in accordance with the GCMPs | Number of stations or platforms expected to be operating in 2010 | Number of stations or platforms providing data to the international data centres | Number of stations or platforms with complete historical record available in international data centres |
|--|--|--|---|---|---|--|
| Global surface drifting buoy array on 5x5 degree resolution | Sea surface temperature, sea level pressure, position-change-based current | | | | | |
| GLOSS Core Sea-level Network | Sea level | | | | | |
| Voluntary observing ships (VOS) | All feasible surface ECVs | | | | | |
| Ship of Opportunity Programme | All feasible surface ECVs | | | | | |

Table 3b. National contributions to the oceanic essential climate variables – water column

| Contributing Networks specified in the GCOS implementation plan | ECVs | Number of stations or platforms currently operating | Number of stations or platforms operating in accordance with the GCMPs | Number of stations or platforms expected to be operating in 2010 | Number of stations or platforms providing data to the international data centres | Number of stations or platforms with complete historical record available in international data centres |
|--|---|--|---|---|---|--|
| Global reference mooring network | All feasible surface and subsurface ECVs | | | | | |
| Global tropical moored buoy network | All feasible surface and subsurface ECVs | | | | | |
| Argo network | Temperature, salinity, current | | | | | |
| Carbon inventory survey lines | Temperature, salinity, ocean tracers, biogeochemistry variables | | | | | |

19. Satellite observations are essential to complete the information base for oceanic ECV observations. Therefore, Parties with space programmes involving Earth observations should comment on their plans to ensure availability of past and future data and metadata records of the satellite measurements for the oceanic ECVs and associated global products contained in table 4.⁵

Table 4. Global products requiring satellite observations – oceans

| ECVs/ Global products requiring satellite observations | Fundamental climate data records required for product generation (from past, current and future missions) |
|---|--|
| Sea Ice Sea ice concentration | Microwave and visible imagery |
| Sea Level Sea level and variability of its global mean | Altimetry |
| Sea Surface Temperature Sea surface temperature | Single and multi-view IR and microwave imagery |

⁵ Derived from the document entitled *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*, WMO, 2006.

Table 4 (continued)

| ECVs/ Global products requiring satellite observations | Fundamental climate data records required for product generation (from past, current and future missions) |
|---|--|
| Ocean Colour Ocean colour and oceanic chlorophyll-a concentration derived from ocean colour | Multi-spectral VIS imagery |
| Sea State Wave height and other measures of sea state (wave direction, wavelength, time period) | Altimetry |
| Ocean Salinity Research towards the measurement of changes in sea surface salinity | Microwave radiances |
| Ocean Reanalyses Altimeter and ocean surface satellite measurements | Key FCDRs and products identified in this report, and other data of value to the analyses |

20. Parties are also requested to provide a narrative description of any actions they have taken in response to the following recommended actions on the oceanic ECVs contained in the GCOS implementation plan (numbers of relevant actions in the plan are given in parentheses):

- (a) Improving metadata acquisition and data management for the VOSclim subset of the VOS (O6);
- (b) Ensuring that high-frequency (hourly or less) sea level observations are available for all coastal tide gauges, including historical records, are corrected for sea level pressure and are submitted to the specified international data centres (O13);
- (c) Including sea level objectives in the capacity-building programmes of GOOS, JCOMM, WMO, other related bodies and the system-improvement programme of GCOS (O14);
- (d) Developing a robust programme to observe sea surface salinity, to include VOS ships, research ships, reference moorings and drifting buoys (O15);
- (e) Implementing a programme for measuring surface pCO₂ (O17);
- (f) Implementing a wave measurement component as part of the Surface Reference Mooring Network (O19);
- (g) Improving in situ sea ice observations from buoys, visual surveys (Ship of Opportunity Programme (SOOP) and aircraft) and upward-looking sonars, and implementing observations in the Arctic and Antarctic (O23);
- (h) Conducting the systematic global full-depth water column sampling of 30 sections repeated every 10 years (including ocean carbon inventory change) (O25);
- (i) Performing the 41 SOOP XBT/XCTD trans-oceanic sections (O26);
- (j) Developing capability for systematic measurement of biogeochemical and ecological ECVs (O30);
- (k) Supporting data rescue projects and implementing regional, specialized and global data and analysis centres (O36 and O37);

- (l) Developing plans and pilot projects for the production of global products based on data assimilation into models for all possible ECVs, including undertaking pilot projects of reanalysis of ocean data (O24, O41 and O40).

E. Chapter 4: Terrestrial essential climate variables

21. Parties should, where relevant, describe their national contributions of terrestrial ECV observations to the international community, paying special attention to the requirements outlined in the GCOS implementation plan.

22. As part of their report describing their national programmes, Parties should, where relevant, report on their efforts to introduce national coordination and planning of terrestrial programme activities.

23. To facilitate integration of the information contained in the national reports, Parties should complete table 5. This table is designed to record information on the national contributions of observations from well-established systems and networks whose current operations can be quantified. Parties should also provide a narrative report on those terrestrial elements of the GCOS implementation plan that are less quantifiable with the aim of making changes and improvements to the climate observing system as a whole so that it meets the requirements of the Convention (see para. 25 below).

Table 5. National contributions to the terrestrial domain essential climate variables

| Contributing networks specified in the GCOS implementation plan | ECVs | Number of stations or platforms currently operating | Number of stations or platforms operating in accordance with the GCMPs | Number of stations or platforms expected to be operating in 2010 | Number of stations or platforms providing data to the international data centres | Number of stations or platforms with complete historical record available in international data centres |
|--|-----------------------------|--|---|---|---|--|
| GCOS baseline river discharge network (GTN-R) | River discharge | | | | | |
| GCOS Baseline Lake Level/Area/Temperature Network (GTN-L) | Lake level/area/temperature | | | | | |
| WWW/GOS synoptic network | Snow cover | | | | | |

Table 5 (continued)

| Contributing networks specified in the GCOS implementation plan | ECVs | Number of stations or platforms currently operating | Number of stations or platforms operating in accordance with the GCMPs | Number of stations or platforms expected to be operating in 2010 | Number of stations or platforms providing data to the international data centres | Number of stations or platforms with complete historical record available in international data centres |
|--|---|--|---|---|---|--|
| GCOS glacier monitoring network (GTN-G) | Glaciers mass balance and length, also ice sheet mass balance | | | | | |
| GCOS permafrost monitoring network (GTN-P) | Permafrost borehole-temperatures and active-layer thickness | | | | | |

24. Satellite observations are essential to complete the information base for terrestrial ECV observations. Therefore, Parties with space programmes involving Earth observations should comment on their plans to ensure availability of past and future data and metadata records of the satellite measurements for the terrestrial ECVs and their associated global products contained in table 6.⁶

Table 6. Global products requiring satellite observations – terrestrial

| ECVs/ Global products requiring satellite observations | Fundamental climate data records required for product generation (from past, current and future missions) |
|---|--|
| Lakes Maps of lakes, lake levels, surface temperatures of lakes in the Global Terrestrial Network for Lakes | VIS/NIR imagery and radar imagery, altimetry, high-resolution IR imagery |
| Glaciers and ice caps Maps of the areas covered by glaciers other than ice sheets, ice sheet elevation changes for mass balance determination | High-resolution VIS/NIR/SWIR optical imagery, altimetry |
| Snow cover Snow areal extent | Moderate-resolution VIS/NIR/IR and passive microwave imagery |
| Albedo Directional hemispherical (black sky) albedo | Multispectral and broadband imagery |

⁶ Derived from the document entitled *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*, WMO, 2006.

Table 6 (continued)

| ECVs/ Global products requiring satellite observations | Fundamental climate data records required for product generation (from past, current and future missions) |
|---|--|
| Land cover Moderate-resolution maps of land-cover type, high-resolution maps of land-cover type, for the detection of land-cover change | Moderate-resolution multispectral VIS/NIR imagery, high-resolution multispectral VIS/NIR imagery |
| fAPAR Maps of fAPAR | VIS/NIR imagery |
| LAI Maps of LAI | VIS/NIR imagery |
| Biomass Research towards global, above-ground forest biomass and forest biomass change | L band/P band SAR, Laser altimetry |
| Fire disturbance Burnt area, supplemented by active fire maps and fire radiated power | VIS/NIR/SWIR/TIR moderate-resolution multispectral imagery |
| Soil moisture^a Research towards global near-surface soil moisture map (up to 10 cm soil depth) | Active and passive microwave |

^a Soil moisture is not listed as an ECV, but has been recognized in the GCOS implementation plan as an emerging ECV.

25. Parties are also requested to provide a narrative description of any actions they have taken in response to the following recommendations on the terrestrial ECVs contained in the GCOS implementation plan (numbers of relevant actions in the plan are given in parentheses):

- (a) Developing a global network of approximately 30 sites based on a progressive evolution of existing reference sites to monitor key biomes and provide the observations required for the calibration and validation of satellite data (T3);
- (b) Maintaining and expanding programmes for monitoring groundwater and aquifers;
- (c) Archiving and disseminating information related to irrigation and water resources (T9);
- (d) Strengthening existing sites for observing snow cover and snowfall and recovering and submitting historical data to the specified international data centres (T10);
- (e) Maintaining sites for observing glaciers and adding additional sites and infrastructure in Africa, the Himalayas, New Zealand and South America (T13);
- (f) Adding the 150 additional permafrost sites identified by GTN-P to cover the high mountains of Asia, Europe and the southern hemisphere, and the North American alpine lands and lowlands, and providing data to the specified international data centres (T16);
- (g) Reanalysing historical data concerning the terrestrial ECVs.

F. Chapter 5: Additional information

26. Parties may, if they wish, provide additional information on their national climate programmes that contribute observations of the ECVs not reported elsewhere in their reports, such as climate observations being undertaken in climate research programmes and/or programmes that provide climate information at a higher resolution or frequency.

Appendix 1**Definition of acronyms used in the guidelines**

| | |
|---------|--|
| AERONET | Aerosol Robotic Network |
| AOPC | Atmospheric Observation Panel for Climate |
| Argo | Global Array of Profiling Floats |
| ASDAR | aircraft to satellite data acquisition and relay |
| AVHRR | Advanced Very High Resolution Radiometer |
| BSRN | Baseline Surface Radiation Network |
| CAS | Commission for Atmospheric Sciences of the WMO |
| CBS | Commission for Basic Systems of the WMO |
| CCI | Commission for Climatology of the WMO |
| CDIAC | Carbon Dioxide Information Analysis Center |
| CEOS | Committee on Earth Observation Satellites |
| CGMS | Coordination Group for Meteorological Satellites |
| CHy | Commission for Hydrology of the WMO |
| DWD | Deutscher Wetterdienst (German Meteorological Service) |
| ECMWF | European Centre for Medium-Range Weather Forecasts |
| ECVs | essential climate variables |
| ETHZ | Eidgenössische Technische Hochschule Zürich (Swiss Federal Institute of Technology Zurich) |
| FAGS | Federation of Astronomical and Geophysical Data Analysis Services |
| fAPAR | Fraction of Absorbed Photosynthetically Active Radiation |
| FCDR | fundamental climate data record |
| GAW | Global Atmosphere Watch of the WMO |
| GAWPFR | Global Atmosphere Watch Precision Filter Radiometer network |
| GCMPs | GCOS Climate Monitoring Principles |
| GCOS | Global Climate Observing System |
| GDPFS | Global Data-Processing and Forecasting Systems of the WWW |
| GEO | Group on Earth Observations |
| GEOSS | Global Earth Observation System of Systems |
| GLOSS | Global Sea Level Observing System |
| GOOS | Global Ocean Observing System |
| GOS | Global Observing System of the WWW |
| GPCC | Global Precipitation Climatology Centre |
| GPS | Global Positioning System |
| GRDC | Global Runoff Data Centre |
| GSICS | Global Space-based Inter-Calibration System |
| GSN | GCOS Surface Network |
| GTN-G | Global Terrestrial Network – Glaciers |
| GTN-L | Global Terrestrial Network – Lakes |
| GTN-P | Global Terrestrial Network – Permafrost |
| GTN-R | Global Terrestrial Network – Rivers |
| GTSP | Global Temperature-Salinity Profile Program |
| GTOS | Global Terrestrial Observing System |
| GUAN | GCOS Upper Air Network |
| ICOADS | International Comprehensive Ocean–Atmosphere Data Set |
| ICSU | International Council for Science |
| IDC | international data centre |
| IGBP | International Geosphere–Biosphere Programme |

| | |
|---------|--|
| IOC | Intergovernmental Oceanographic Commission |
| IOCCG | International Ocean-Colour Coordinating Group |
| IOCCP | International Ocean Carbon Coordination Project |
| IPCC | Intergovernmental Panel on Climate Change |
| IP | implementation plan |
| IR | infrared |
| ISCCP | International Satellite Cloud Climatology Project |
| JCOMM | Joint WMO/IOC Technical Commission for Oceanography and Marine Meteorology |
| JMA | Japan Meteorological Agency |
| JRC | Joint Research Centre |
| LAI | leaf area index |
| MSC | Meteorological Service of Canada |
| MSU | microwave sounding unit |
| NASA | National Aeronautics and Space Administration |
| NCDC | National Climatic Data Center |
| NDACC | Network for the Detection of Atmospheric Composition Change |
| NIR | near-infrared |
| NOAA | National Oceanic and Atmospheric Administration |
| NSIDC | National Snow and Ice Data Center |
| RA | Regional Association of the WMO |
| RO | radio occultation |
| SAR | synthetic aperture radar |
| SHADOZ | Southern Hemisphere Additional Ozonesondes |
| SKYNET | Sky Radiometer Network |
| SLP | sea level pressure |
| SOOP | Ship of Opportunity Programme |
| SST | sea surface temperature |
| SWIR | short-wave infrared |
| TCDR | thematic climate data record |
| TIR | thermal infrared |
| UNEP | United Nations Environment Programme |
| UNESCO | United Nations Educational, Scientific and Cultural Organization |
| UV | ultraviolet |
| VIS | visible |
| VOS | voluntary observing ship |
| VOSCLIM | Voluntary Observing Ship Climate Project |
| WCRP | World Climate Research Programme |
| WDC | World Data Centre |
| WDC-GG | World Data Center for Greenhouse Gases |
| WGMS | World Glacier Monitoring Service |
| WMO | World Meteorological Organization |
| WOAP | WCRP Observation and Assimilation Panel |
| WODC | World Ocean Database Centre |
| WOUDC | World Ozone and Ultraviolet Radiation Data Centre |
| WRDC | World Radiation Data Centre |
| WWW | World Weather Watch of the WMO |
| XBT | expendable bathythermograph |
| XCTD | expendable conductivity, temperature and depth system |

Appendix 2**Essential climate variables****Table 7. Essential climate variables that can be feasibly measured globally and are highly relevant to the Convention**

| Domain | Essential climate variables |
|--|--|
| Atmospheric (over land, sea and ice) | <p>Surface: Air temperature, precipitation, air pressure, surface radiation budget, wind speed and direction, water vapour</p> <p>Upper-air: Earth radiation budget (including solar irradiance), upper-air temperature (including MSU radiances), wind speed and direction, water vapour, cloud properties</p> <p>Composition: Carbon dioxide, methane, ozone, other long-lived greenhouse gases,^a aerosol properties</p> |
| Oceanic | <p>Surface: Sea surface temperature, sea surface salinity, sea level, sea state, sea ice, current, ocean colour (for biological activity), carbon dioxide partial pressure</p> <p>Sub-surface: Temperature, salinity, current, nutrients, carbon, ocean tracers, phytoplankton</p> |
| Terrestrial^b | River discharge, water use, groundwater, lake levels, snow cover, glaciers and ice caps, permafrost and seasonally-frozen ground, albedo, land cover (including vegetation type), fraction of absorbed photosynthetically active radiation (fAPAR), leaf area index (LAI), biomass, fire disturbance |

^a Including nitrous oxide, chlorofluorocarbons, hydrochlorofluorocarbons, hydrofluorocarbons, sulphur hexafluoride and perfluorocarbons.

^b Includes run-off ($\text{m}^3 \text{s}^{-1}$), groundwater extraction rates ($\text{m}^3 \text{yr}^{-1}$) and location, snow cover extent (km^2) and duration, snow depth (cm), glacier/ice cap inventory and mass balance ($\text{kg m}^{-2} \text{yr}^{-1}$), glacier length (m), ice sheet mass balance ($\text{kg m}^{-2} \text{yr}^{-1}$) and extent (km^2), permafrost extent (km^2), temperature profiles and active layer thickness, above-ground biomass (t ha^{-1}), burnt area (ha), date and location of active fire, burn efficiency (percentages of vegetation burned per unit area).

Appendix 3

Global Climate Observing System climate monitoring principles

1. Effective monitoring systems for climate should adhere to the following principles:¹
 - (a) The impact of new systems or changes to existing systems should be assessed prior to implementation;
 - (b) A suitable period of overlap for new and old observing systems is required;
 - (c) The details and history of local conditions, instruments, operating procedures, data processing algorithms and other factors pertinent to interpreting data (i.e. metadata) should be documented and treated with the same care as the data themselves;
 - (d) The quality and homogeneity of data should be regularly assessed as a part of routine operations;
 - (e) Consideration of the needs for environmental and climate-monitoring products and assessments, such as Intergovernmental Panel on Climate Change assessments, should be integrated into national, regional and global observing priorities;
 - (f) Operation of historically-uninterrupted stations and observing systems should be maintained;
 - (g) High priority for additional observations should be focused on data-poor regions, poorly-observed parameters, regions sensitive to change, and key measurements with inadequate temporal resolution;
 - (h) Long-term requirements, including appropriate sampling frequencies, should be specified to network designers, operators and instrument engineers at the outset of system design and implementation;
 - (i) The conversion of research observing systems to long-term operations in a carefully-planned manner should be promoted;
 - (j) Data management systems that facilitate access, use and interpretation of data and products should be included as essential elements of climate monitoring systems.
2. Furthermore, operators of satellite systems for monitoring climate need to:
 - (a) Take steps to make radiance calibration, calibration-monitoring and satellite-to-satellite cross-calibration of the full operational constellation a part of the operational satellite system;

¹ The 10 basic principles (in paraphrased form) were included as an appendix to the UNFCCC reporting guidelines on global climate change observing systems which were adopted by decision 5/CP.5. The complete set of principles was adopted by the Congress of the World Meteorological Organization through Resolution 9 at its fourteenth session in May 2003, and agreed by the Committee on Earth Observation Satellites at its 17th Plenary Meeting in November 2003. The Conference of the Parties, by its decision 11/CP.9, requested that the 10 basic principles (in paraphrased form) be replaced by the complete set of principles in the UNFCCC reporting guidelines on global climate change observing systems.

- (b) Take steps to sample the Earth system in such a way that climate-relevant (diurnal, seasonal, and long-term interannual) changes can be resolved.
3. Thus satellite systems for climate monitoring should adhere to the following specific principles:
- (a) Constant sampling within the diurnal cycle (minimizing the effects of orbital decay and orbit drift) should be maintained;
 - (b) A suitable period of overlap for new and old satellite systems should be ensured for a period adequate to determine inter-satellite biases and maintain the homogeneity and consistency of time-series observations;
 - (c) Continuity of satellite measurements (i.e. elimination of gaps in the long-term record) through appropriate launch and orbital strategies should be ensured;
 - (d) Rigorous pre-launch instrument characterization and calibration, including radiance confirmation against an international radiance scale provided by a national metrology institute, should be ensured;
 - (e) On-board calibration adequate for climate system observations should be ensured and associated instrument characteristics monitored;
 - (f) Operational production of priority climate products should be sustained and peer-reviewed new products should be introduced as appropriate;
 - (g) Data systems needed to facilitate user access to climate products, metadata and raw data, including key data for delayed-mode analysis, should be established and maintained;
 - (h) Use of functioning baseline instruments that meet the calibration and stability requirements stated above should be maintained for as long as possible, even when these exist on decommissioned satellites;
 - (i) Complementary in situ baseline observations for satellite measurements should be maintained through appropriate activities and cooperation;
 - (j) Random errors and time-dependent biases in satellite observations and derived products should be identified.

Appendix 4

International data centres

International data centres have been established for many of the essential climate variables networks and systems. Additional centres will be added over time. The Global Climate Observing System (GCOS) secretariat maintains a current list of all international data centres associated with GCOS together with a list of current contacts at those centres.

Table 8. International data centres and archives – atmospheric domain

| Network or system | International data centres and archives | Coordinating bodies |
|--|---|----------------------------|
| Atmosphere surface | | |
| GCOS Surface Network (GSN) | GSN monitoring centre (DWD, JMA), GSN analysis centre (NCDC, Hadley Centre), GSN archive (WDC Asheville), CBS GCOS lead centres (JMA, NCDC and others), Global Precipitation Climatology Centre (GPCC, DWD) | AOPC with CBS |
| Full WWW/GOS synoptic network | Integrated Surface Hourly (WDC Asheville), Global Precipitation Climatology Centre (DWD) | CBS |
| National surface networks | National responsibility; submission to WDC, Global Precipitation Climatology Centre (DWD) | CCI, CBS, RAs |
| Baseline Surface Radiation Network (BSRN) | World Radiation Monitoring Centre (ETHZ) | WCRP |
| Solar radiation and radiation balance data | World Radiation Data Centre (WRDC St Petersburg) | CAS |
| Atmosphere upper-air | | |
| GCOS Upper Air Network (GUAN) | GUAN monitoring centres (ECMWF, Hadley Centre), GUAN analysis centres (Hadley Centre, NCDC), GUAN archive (WDC Asheville), CBS GCOS lead centre (NCDC) | AOPC with CBS |
| Full WWW/GOS Upper-Air Network | GDPFS world centres, GDPFS regional/specialized meteorological centres, WDC Asheville | CBS |
| Reference network high-altitude radiosondes | GUAN centres (proposed) | AOPC with WCRP |
| Aircraft (ASDAR etc.) | GDPFS world centres, GDPFS regional/specialized meteorological centres, WDC Asheville | CBS |
| Profiler (radar) network | GDPFS world centres, GDPFS regional/specialized meteorological centres, WDC Asheville | CBS |

Table 8 (continued)

| Network or system | International data centres and archives | Coordinating bodies |
|--|---|---------------------|
| Ground-based GPS receiver network | | |
| Atmosphere composition | | |
| GAW CO ₂ and CH ₄ monitoring network | WDC-GG (JMA), Carbon Dioxide Information Analysis Center (Oak Ridge National Laboratory) | CAS |
| WMO/GAW Ozonesonde Network WMO/GAW Column Ozone Network | WOUDC (MSC), NDACC archive, Norwegian Institute for Air Research, Southern Hemisphere Additional Ozonesondes (SHADOZ – NASA) archive | CAS |
| WMO/GAW Aerosol Network | AERONET, SKYNET, BSRN and GAWPFR data centres, World Data Centre for Aerosols (JRC Ispra) | CAS |

Table 9. International data centres and archives – oceanic domain

| Network or system | International data centres and archives | Coordination bodies |
|--|---|--------------------------|
| Surface drifting buoys | NCDC | JCOMM, ICOADS |
| Moored buoys | NCDC, WODC | JCOMM, ocean sites |
| Voluntary observing ships | VOSClm Data Centre, NCDC | JCOMM, ICOADS, VOSClm |
| Delayed-mode monthly and annual mean tide gauges | Permanent Service for Mean Sea Level, Proudman Laboratory | JCOMM, GLOSS |
| Real-time tide gauges | University of Hawaii Sea Level Center | JCOMM, GLOSS |
| Argo floats | Argo data centres, GTSP, WODC | Argo science team |
| Repeat XBT sections | GTSP, WODC | JCOMM, GTSP |
| Repeat hydrography/carbon sections | WODC, CDIAC | IOCCG, GCOS, WCRP |
| Sea ice variables | NSIDC | JCOMM, GCOS, WCRP |
| Ocean colour | None at present (GLOB COLOUR Pilot Project) | IOCCP |

Table 10. International data centres and archives – terrestrial domain

| Network or system | International data centre and archives | Coordinating bodies |
|---|--|--------------------------------------|
| Global Terrestrial Network – Glaciers | WGMS, NSIDC | ICSU, FAGS |
| Global Terrestrial Network – Lakes | None designated ^a | CHy |
| Global Terrestrial Network – Permafrost | NSIDC | International Permafrost Association |
| Global Terrestrial Network – Rivers | GRDC | CHy |
| Snow cover (WWW/GOS synoptic network) | NCDC, NSIDC | CBS |

^a International data centre responsibilities are in the process of being developed.