# “Global Climate Observing System: up-date and next plans 2015-2016”

**Carolin Richter**

**Director, GCOS Secretariat**

**8 April 2015, WCRP JSC-36, Geneva, Switzerland**

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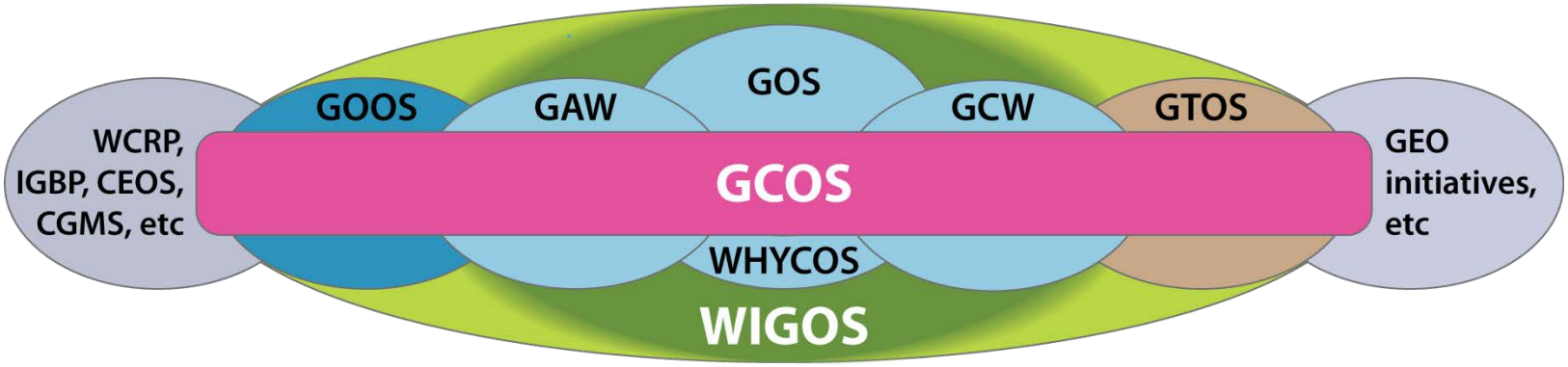
# GCOS and WIGOS

**GCOS covers the climate components of WMO and co-sponsored observing systems for atmosphere, ocean and land, and other climate-observation initiatives:**




**WIGOS provides a new framework for integration and coordination**

**Mutual interests include network design and designation**

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# Evolution of the observing system – robust conclusions since 2013

**Some continuing concerns, including**

- deterioration of some *in situ* networks; lack of progress in filling gaps in others
- limited provision for limb sounding
- little movement on reference measurement from space

**but many improvements (that need sustaining) including**

- quantity and quality of data from several *in situ* sources, including radiosondes
- quantity, quality and variety of data from satellites
- recovery and reprocessing of past data, both *in situ* and remotely sensed
- reanalysis, with coupling of atmosphere to ocean and land, and inclusion of chemistry
- conventional analysis of instrumental records
- converging temperature information from various observational and model datasets

**and evolving requirements**

- e.g. for global, ground-based, soil-moisture data to complement remote sensing and reanalysis

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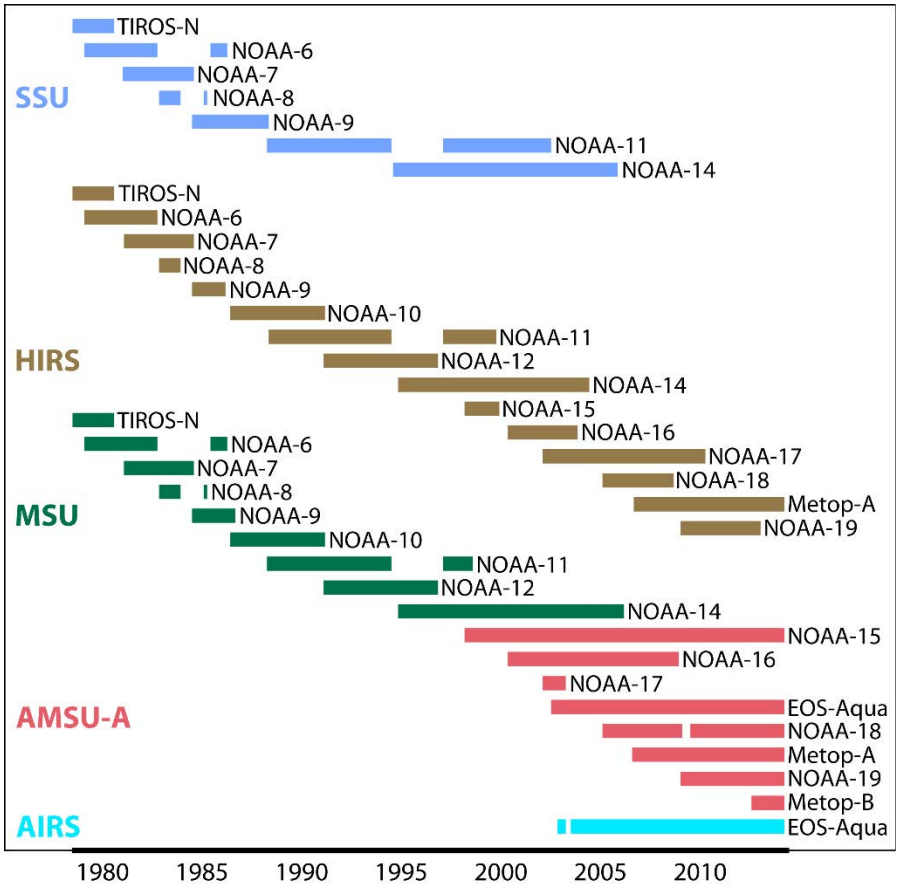
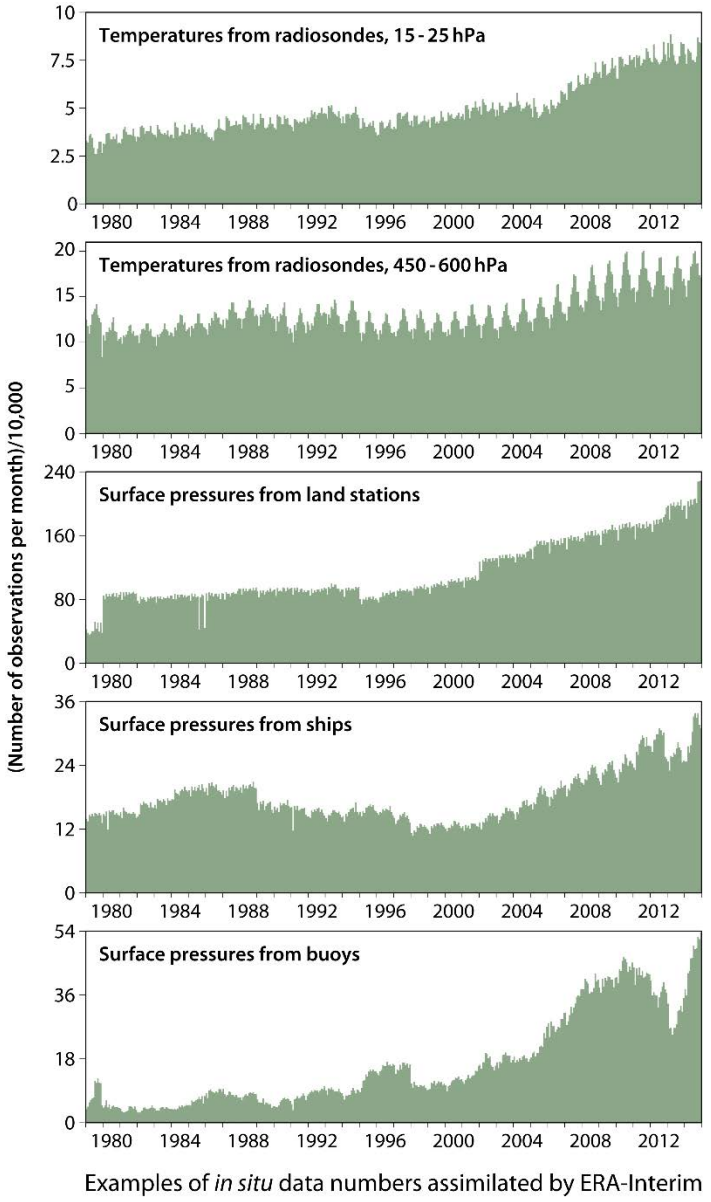
# Evolution of elements of the observing system (1979-2014)




Coverage is for SSU-1, HIRS-2, MSU-4, AMSU-A10, AIRS-40. Data from IASI and NPP could not be used in 2006 version of assimilation system frozen for ERA-Interim. Data from FY-3 are a candidate for use in future reanalyses




Examples of *in situ* data numbers assimilated by ERA-Interim

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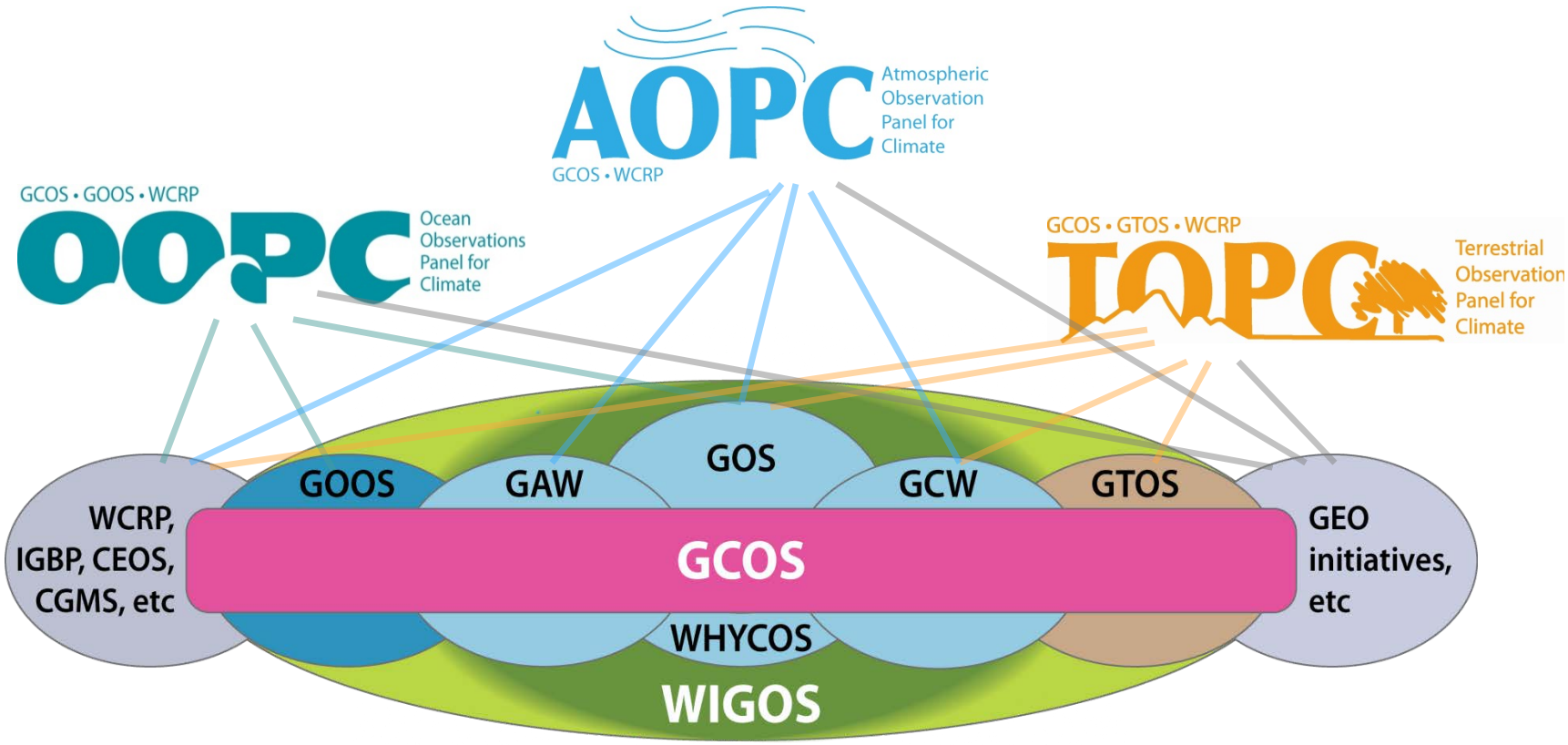
# WCRP sponsored Expert Panels

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# Co-sponsored GCOS/WCRP panels & related interactions

## Atmospheric Observation Panel for Climate (AOPC)

- has most direct interaction with WMO/WIGOS/CCI; GRUAN governance is an example

## Ocean Observations Panel for Physics and Climate (OOPC)

- co-sponsored by GOOS, reactivated following GOOS reorganization; support now based in GCOS office

## Terrestrial Observation Panel for Climate (TOPC)

- Co-sponsored by FAO, Secretariat of GTOS is non-functional at FAO; new arrangements are needed

## WCRP Data Advisory Council (dropped its "O" for "observations", used to be WOAP)

- Includes panel chairs, CEOS, CGMS and IGBP; important for advancing joint interests

## CEOS, CGMS and WMO Space Programme

- engagement continues to be active, e.g. on architecture for monitoring from space

# Co-sponsored GCOS/WCRP panels & related interactions

## Atmospheric Observation Panel for Climate (AOPC)

AOPC Atmospheric Observation Panel for Climate
GCOS • WCRP

**Last meeting: 17 – 20 April 2015, Zürich (back-to-back with TOPC)**

- Platform for discussions on the climate-components of existing research and operational atmospheric observing systems and the related programmes, including important cross-cutting links to the World Climate Research Programme (WCRP) as well as to the Global Atmosphere Watch (GAW) Programme.

- Focus is on the GCOS Surface Network (GSN), the GCOS Upper-Air Network (GUAN) and the GCOS Reference Upper-Air Network (GRUAN).

- The Panel in its future sessions will continue to advise explicitly on climate-observing elements of the WMO Integrated Global Observing System (WIGOS), and seek to ensure that there is full cooperation between GCOS, WIGOS and WIS as they develop.

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TOPC Terrestrial Observation Panel for Climate

# Strong partnerships with the Global Terrestrial Networks (GTNs) on lakes, permafrost, glaciers, rivers, and hydrological issues.

| Name of Network | Additional information | Areas of particular focus | GTN-related ECVs | Data information |
|---|---|---|---|---|
| Global Terrestrial Network for Glaciers (GTN-G) | | Climate Change - Human Settlements - Land Resources - Sustainable Development - Global Sea Level Rise - Water Resources - Natural Hazards | Snow Cover, Glaciers and Ice Caps, Ice Sheets, (Sea Level) | On global scale; regularly updated information on glacier distribution and changes; fluctuations database at WGMS with > 3,500 glaciers since 19th century; inventory database at NSIDC with > 100,000 glaciers from mid 20th and early 21st centuries |
| Global Terrestrial Network for Hydrology (GTN-H) | | Agriculture - Biodiversity - Climate Change - Desertification - Forests - Health - Human Settlements - Land Resources - Sustainable Development - Water and Sanitation | Precipitation, Water Vapour, River Discharge, Ground Water, Water Use, Lakes, Glaciers and Ice Caps, Soil Moisture | On global and regional scale (national monitoring programmes, science programmes); data from 1900 onwards (single variables, discontinuous) |
| Global Terrestrial Network for Lakes (GTN-L) | Sub-network of the Global Terrestrial Network for Hydrology (GTN-H) | Biodiversity - Climate Change - Human Settlements - Land Resources - Sustainable Development | Lakes (Lake Level, Lake Area, Water Temperature, Ice Thickness) | Mainly on regional basis (> 600 water level reference stations); monthly and annual data input |
| Global Terrestrial Network for Permafrost (GTN-P) | | Biodiversity - Climate Change - Human Settlements - Land Resources - Sustainable Development | Permafrost, (Ice Sheets, Snow Cover) | Mainly on regional and national basis (80-site network under IPA's Circumpolar Active Layer Monitoring (CALM); inventory and metadata for > 200 boreholes of varying depths) |
| Global Terrestrial Network for Rivers (GTN-R) | Sub-network of the Global Terrestrial Network for Hydrology (GTN-H) | Agriculture - Climate Change - Desertification - Health - Human Settlements - Land Resources - Sustainable Development - Water and Sanitation | River Discharge, (Water Use, Lakes, Soil Moisture) | Mainly on regional basis (> 450 river discharge reference stations); daily data input; highly dependent on data provided by National Hydrological Services (NHS) |

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# Ocean Observations panel for Physics and Climate (OOPC)

- Next: 14-17th April 2015, Sendai, Japan.
- OOPC focus on progress against Work Plan.
- Parallel with GOOS Biogeochemistry
- Focus of joint discussions
  - Emerging issues for next GCOS IP: i.e. Ocean Acidification, De-oxygenation
  - Changes to ECVs for Carbon System, Nutrients, etc.
  - Common platforms, observing system design and targets, etc.

Credit: Dr Katy Hill (GCOS, OOPC Secretariat), AOPC-20, 17 April 2015

# Potential Joint activities: TOPC (and perhaps also AOPC?)

- **Observing the Ice-Ocean Interface**
  - Arctic and Antarctic are seeing rapid changes: melting ice shelves from warmer ocean, iceberg carving, sea ice changes (arctic/antarctic), changes in ocean circulation, esp. ventilation, deep watermass formation and fate.
  - Southern Ocean Observing System (SOOS) has published a Strategy for Observing Under the ice.
  - Opportunity to connect up ice/ocean observing system design and coordination.

- Note from the OOPC Co-Chair, Mark Bourassa:
  - *'Many of the changes in the Arctic/Antarctic are linked to changes in the atmosphere (wind circulation, cloud cover, radiation) so there is also a good connection to AOPC. The ice concentration also changes the albedo. So this might be a good topic for all three panels, although TOPC and OOPC have a closer connection.'*

# Potential Joint activities: AOPC.

- **Observing Air Sea Fluxes (OOPC, AOPC)**
  - Existing reference sites on both Ocean and Land for higher quality fluxes.
  - For Ocean, often calculate bulk Fluxes (e.g. OceanSITES) and calls them ‘Flux sites).
  - Potential/need for definition of fluxes ECVs and their direct measurement (verses ‘bulk estimates’).

# ECVs and the relation to Earth-Life-cycles

**GCOS Joint Panel (AOPC-TOPC) session on 18 March 2015;**

**Input for new Implementation Plan:**

**Assessing the major and minor contributions of ECVs for:**

- **Energy Cycle**
- **Hydrological Cycle**
- **Carbon Cycle**

| | | | Energy Cycle | Hydrological Cycle | Carbon Cycle |
|---|---|---|---|---|---|
| Atmosphere | Surface | Air temperature | ■ | | |
| | | Wind Speed and direction | | | |
| | | Water Vapour | | ■ | |
| | | Pressure | | | |
| | | Precipitation | | ■ | |
| | | Surface Radiation Budget | ■ | | |
| | Upper Air | Temperature | | | |
| | | Wind speed and direction | | | |
| | | Water Vapour | | ■ | |
| | | Cloud Properties | | | |
| | | TOA Earth radiation budget (inc. Solar irrad.) | ■ | | |
| | Comp | Carbon Dioxide | | | ■ |
| | | Methane+ LL GHGs | | | ■ |
| | | Ozone and Aerosol, + precursers. | | | |
| Oceanic | Surface | Sea Surface Temperature | ■ | | |
| | | Sea Surface Salinity | | | |
| | | Sea Level | | ■ | |
| | | Sea State | | ■ | |
| | | Sea Ice | | | |
| | | Surface Current | | | |
| | | Ocean Colour | | | ■ |
| | | Carbon Dioxide pp | | | ■ |
| | | Ocean Acidity | | | ■ |
| | | Phytoplankton | | | ■ |
| | Subsurface | Temperature | ■ | | |
| | | Salinity | | | |
| | | Current | | | |
| | | Nutrients | | | ■ |
| | | Carbon Dioxide pp | | | ■ |
| | | Ocean Acidity | | | ■ |
| | | Oxygen | | | ■ |
| | | Tracers | | | |
| | | Biodiversity and Habitat | | | ■ |
| Terrestrial | | River Discharge | | ■ | |
| | | Water Use | | ■ | |
| | | Ground Water | | ■ | |
| | | Lakes | | ■ | |
| | | Snow Cover | | ■ | |
| | | Glaciers and ice caps | | ■ | |
| | | Ice sheets | | ■ | |
| | | Permafrost | | | |
| | | Albedo | ■ | | |
| | | Land Cover (inc. vegetation type) | | | ■ |
| | | Fraction Absorbed PAR | | | ■ |
| | | Leaf area index | | | ■ |
| | | Above ground biomass | | | ■ |
| | | Soil Carbon | | | ■ |
| | | Fire disturbance | | | ■ |
| | | Soil Moisture | | ■ | |
| | | Terrestrial Biodiversity & Habitat | | | ■ |



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# Plans 2015 - 2016

# GCOS Continuous Improvement & Assessment Cycle

**The GCOS programme has started the process for:**

- a 2015 report on the progress and status of climate observation
- a new "Implementation Plan" in 2016, which should 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
- statements of specific requirements for products
  - from both *in situ* networks and the space-based component
  - and from integration of the data provided by both

either embedded in the main Plan or as separate supplement(s)

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# GCOS Status Report - some of the ways we are assessing progress and current status

**By evaluating responses to actions from 2010 Implementation Plan**

Action A2: Obtain further progress in the systematic international exchange of … hourly SYNOP reports and monthly CLIMAT reports ...

Action A3: Ensure sustained operation of surface met. stations addressing national and sub-national needs … implement additional stations ...

Action C13: Collect, digitize and analyse … historical … data records … and submit to International Data Centres

**By evaluating network performance and data-centre holdings**

**By relating to key uncertainties identified in IPCC AR5, and issues raised by WCRP, other programmes, workshops, etc.**

**Drawing heavily on input provided by panel members and others who have completed "ECV tables"**

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# GCOS Status Report - Schedule

**March/April:** Finish domain sections and work on general ones

**May:** Complete General Sections and Executive Summary

- will need input from Panel Chairs (or their representatives)

**June/July:** Make version openly available for review

**July/Aug:** Respond to review comments and update

**September:** Finalise

Obtain Steering Committee approval

Submit to Sponsors and UNFCCC

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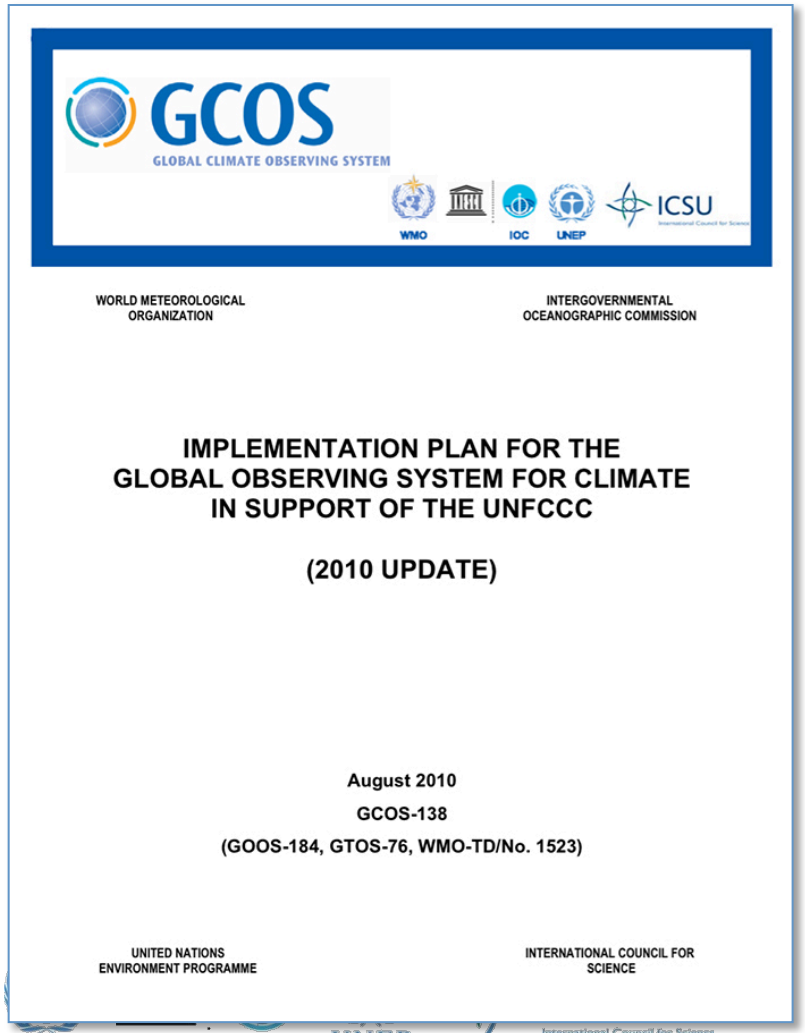
# NEW GCOS IP

## From



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WORLD METEOROLOGICAL ORGANIZATION

INTERGOVERNMENTAL OCEANOGRAPHIC COMMISSION

**IMPLEMENTATION PLAN FOR THE GLOBAL OBSERVING SYSTEM FOR CLIMATE IN SUPPORT OF THE UNFCCC**

**(2010 UPDATE)**

August 2010

GCOS-138

(GOOS-184, GTOS-76, WMO-TD/No. 1523)

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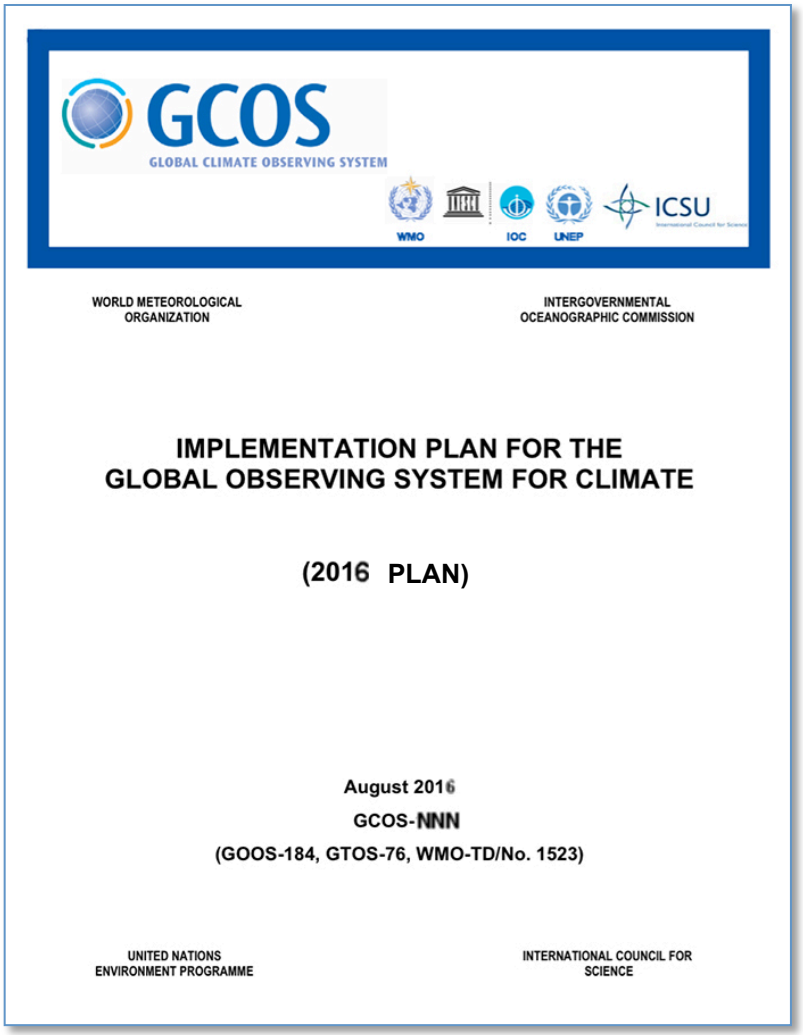
## To



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INTERGOVERNMENTAL OCEANOGRAPHIC COMMISSION

**IMPLEMENTATION PLAN FOR THE GLOBAL OBSERVING SYSTEM FOR CLIMATE**

**(2016 PLAN)**

August 2016

GCOS-NNN

(GOOS-184, GTOS-76, WMO-TD/No. 1523)

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# NEW GCOS IP - Content

- Overall message: continuity with progress
- Primary purpose (UNFCCC) remains intact
- Broader context of implementation introduced
  - ① Energy, water and carbon cycles reinforced
  - ② Cross-convention use of observations (UNFCCC, CBD, UNCCD) proposed
  - ③ Adaptation + Mitigation framed
  - ④ Climate Services acknowledged
- Supporting observations introduced
  gravity, DEM, orbit restitution...
  - The list of ECVs may be updated
  - Planning for an updated Sat. Supplement are TBD

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# Supporting Climate Services

- **Observations for Adaptation to Climate Variability and Change, February 2013, Offenbach**
- **Enhancing observations to support preparedness and adaptation in a changing climate – Learning from the Fifth IPCC Assessment Report (AR5), *February 2015, UNFCCC, Bonn, Germany***
- **Observations for Climate Change Mitigation , May 2014, Geneva, Switzerland**

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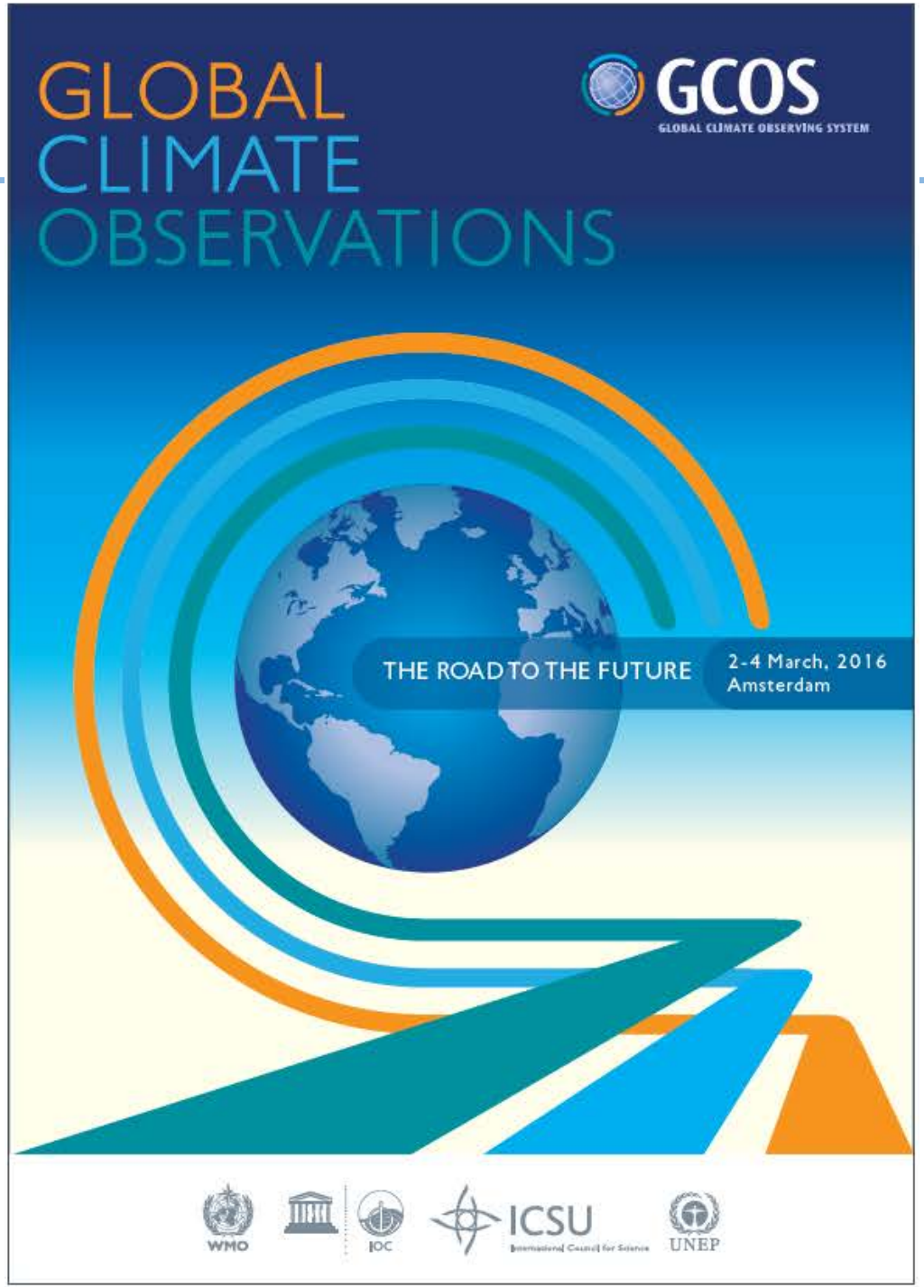
# GCOS International Science Conference

## 2 – 4 March 2016

## Royal Academy of Arts and Sciences, Amsterdam, The Netherlands

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**Carolin Richter (crichter@wmo.int)**
**gcos.wmo.int**

GCOS Steering Committee will meet
28 Sep – 2 Oct 2015, Cape Town, RZA

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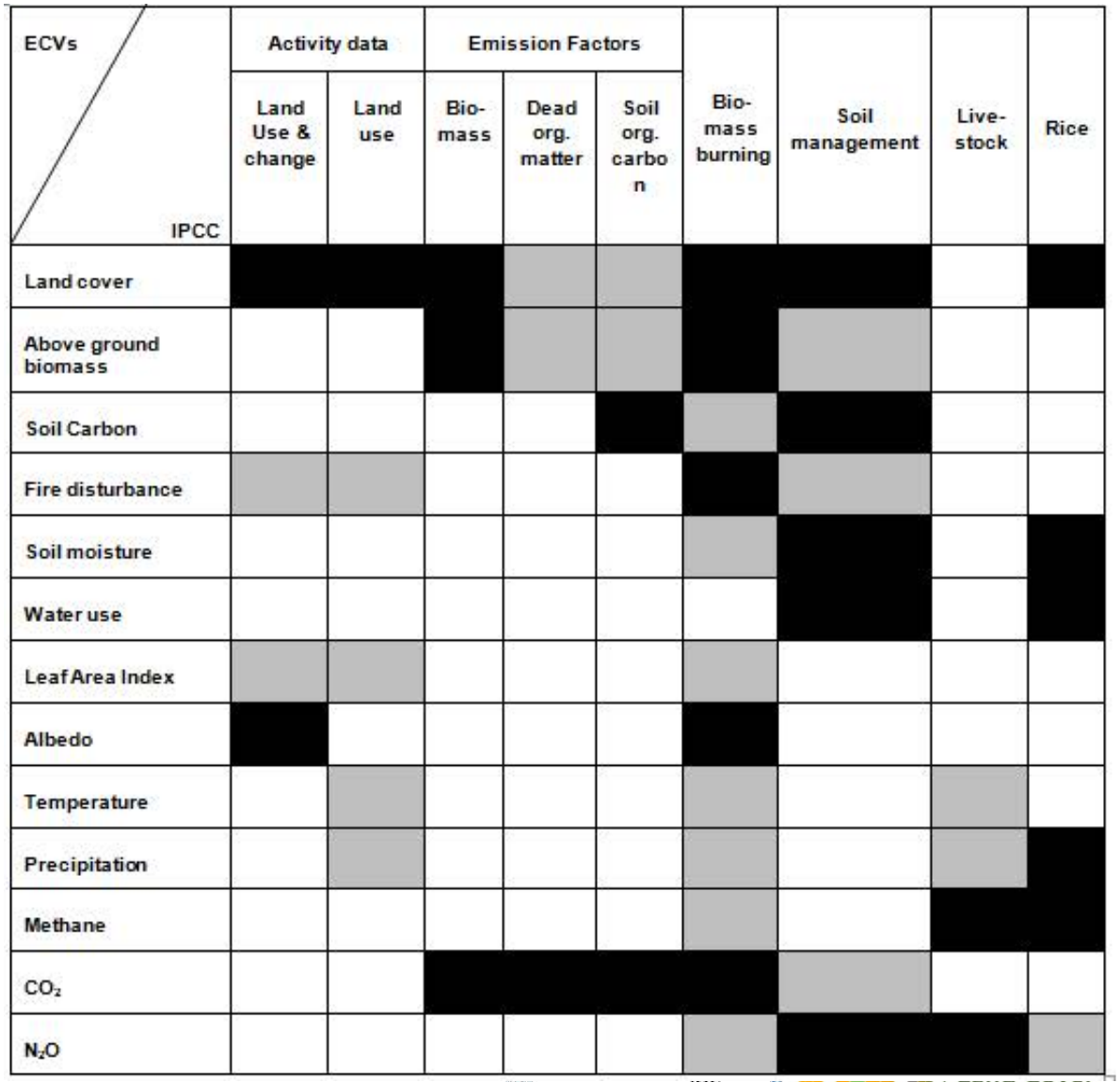
# Mitigation Workshop, 2014, Data requirements: linking ECVs to IPCC Good Practice Guidance

**Table shows relationship between ECVs that could be potentially used to support emissions estimates using the IPCC guidelines:**

- Strong relationship between emission components
- Some relationship
- No clear relationship

**IPCC has published guidance and guidelines providing methodologies to estimate national anthropogenic emissions and removals of greenhouse gases.**

**Focus on anthropogenic GHG emissions and removals.**




Project Office

# Observation Requirements for Adaptation Planning

**Common themes regarding observation requirements:**

- Need for higher spatial and temporal resolution ("smallest pixel is too large");
- Need to focus on regions where climate change will have significant sector effects and where there are vulnerable populations;
- Need to develop infrastructure and governance to support sustained data rescue (historical data is highly valuable, but data rescue is very expensive);
- Need to support research initiatives such as PROVIA and Future Earth.
- Improve climate observations systems with a special emphasis on Terrestrial and Ocean and where the two meet.

# Scope of GCOS

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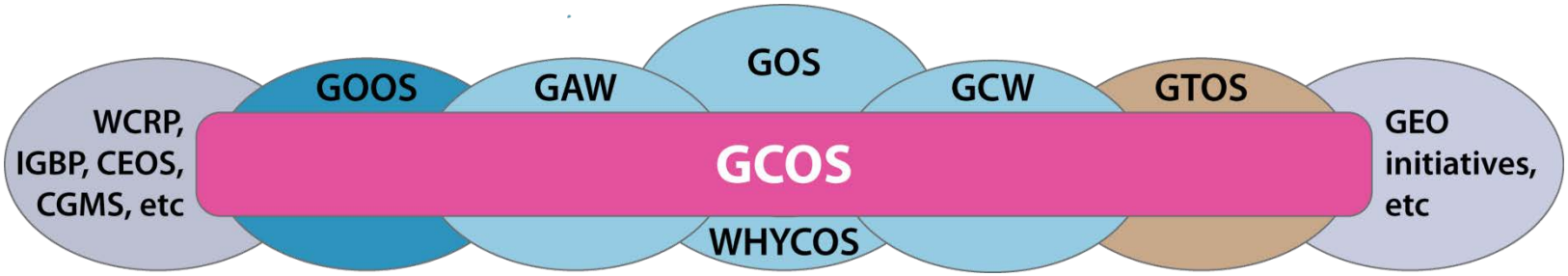


**GCOS assesses progress and requirements, advises on implementation report and plan to be submitted to sponsors and UNFCCC in 2015/16**

**GCOS provides some assistance with implementation; funds provided in past year by Germany, Japan, Greece (through GFCS) and UK**

**GCOS Network Manager (since 2013) is supported by the UK (until 2017)**

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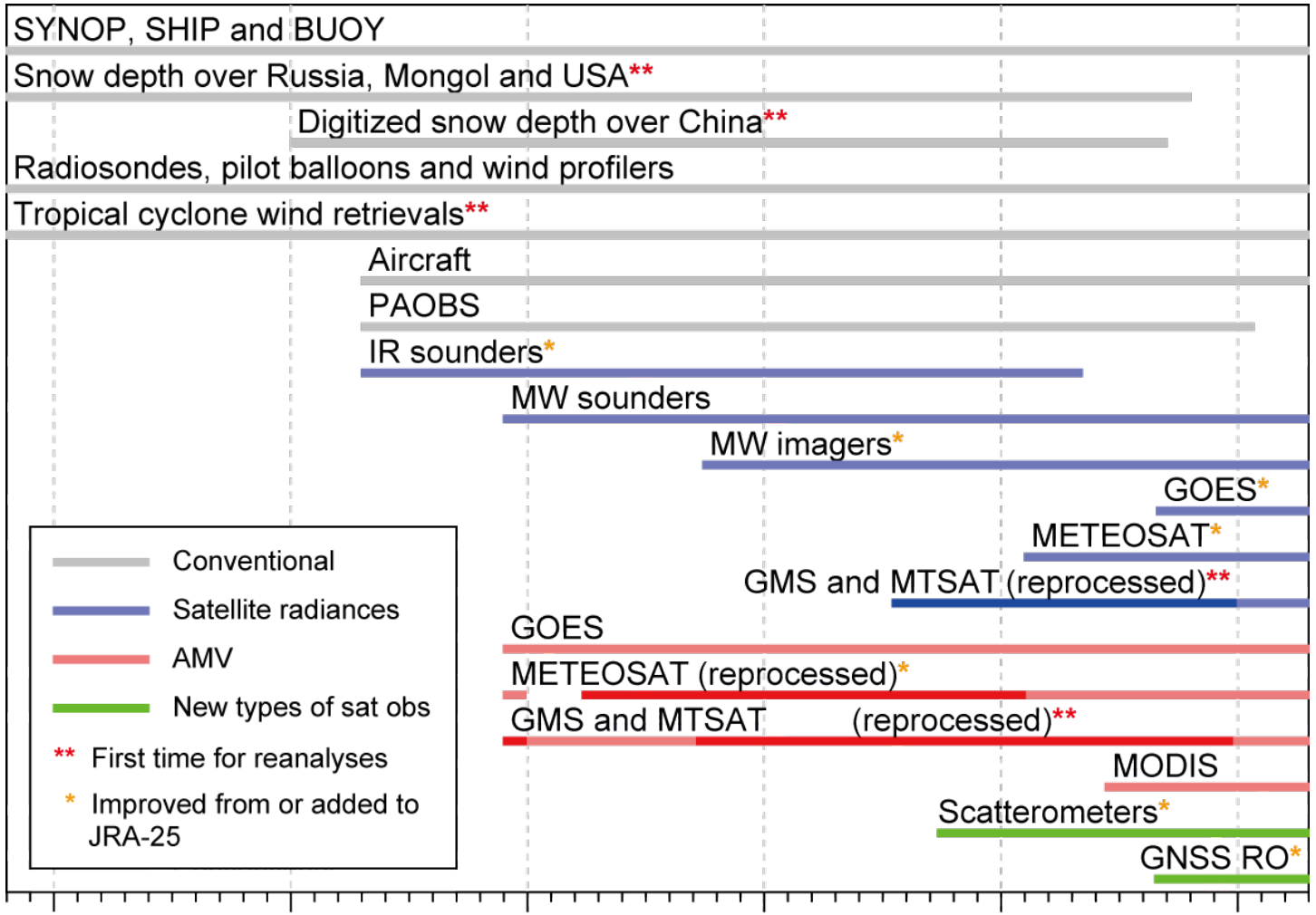
# Evolution of the observing system





**Types of data assimilated in JMA's new. JRA-57.25 reanalysis (as of April 2015)**

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# GCOS Status Report - the assessment cycle

## Following the Second Adequacy Report in 2003, GCOS produced:

–an Implementation Plan in 2004

–a Supplement to the Plan in 2006 on requirements for satellite-based data products

–a Progress Report in 2009

–an updated Implementation Plan in 2010

–an updated Satellite Supplement in 2011

## UNFCCC/SBSTA:

–welcomed the 2010 Plan and urged Parties to work towards implementation

–invited a subsequent progress report and encouraged a review of adequacy

–welcomed the timetable proposed by GCOS for

- a Status Report in 2015
- a new Implementation Plan in 2016