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GLOBAL CLIMATE OBSERVING SYSTEM

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TOPC Terrestrial Observation Panel for Climate

17th Session of the GCOS/GTOS/WCRP Terrestrial Observation Panel for Climate

(TOPC-17)

WSL, Birmensdorf, Switzerland

16-18 March 2015

GCOS-189

WCRP-12/2015

WCRP World Climate Research Programme

Chair, Publications Board

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Note this report does not describe all the presentations but summarises the discussions and actions agreed. Presentations are made available at:

http://www.wmo.int/pages/prog/gcos/index.php?name=TOPC-XVII

Following this meeting a joint session of TOPC and AOPC was held on the 18th March 2015. A note of this session included in appendix 3, and the presentations are available at:

http://www.wmo.int/pages/prog/gcos/index.php?name=TOPC-AOPC

A summary of all the actions from the TOPC meeting and the joint session are included in Appendix 5

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1 Opening of the Meeting

Presentation	
Swiss Federal Research Institute WSL, Forest, Snow and Landscapes	Konrad Steffen
The Terrestrial Observation Panel for Climate	Konrad Steffen

The meeting opened with a welcome to WSL by Konrad Steffen to all participants (Appendix 6). The agenda (Appendix 1) was adopted with the following considerations:

- The overall aim of this meeting was to review the status of the terrestrial Essential Climate Variables (ECVs) in preparation for the status report. TOPC members need to confirm that all current ECVs to describe terrestrial systems are required and to identify missing variables that should be considered for inclusion.
- As there are term limits to panel membership, to plan for the future, potential new members need to be identified. It is important to increase the geographical, thematic and gender diversity of TOPC members and expand membership to the permitted maximum of 12. It will be important to ensure that TOPC has the range of expertise to cover all the ECVs and to invite members from Asia, South America, and developing countries.
- TOPC is facing future challenges on how to connect the different ECVs, on their accuracy requirements, finding “homes” for ECVs and financing workshops. The scope of climate change monitoring is increasing, as GCOS now has to consider a requirement to address adaption and mitigation more explicitly with a shifting emphasis towards climate services. This is particularly an issue for terrestrial panel. Adaption has links to food and water security. However how much can TOPC do in addition to what it is doing already? There will be a need for new partners to make new products.
- In the past, GCOS was not well connected with the modelling community; it was rather an opportunistic then systematic approach. This seems to be a major shortcoming and needs to be addressed in the future. The TOPC chair represents the GCOS terrestrial panel at the WCRP data panel and he will attend the next WCRP Data Advisory Council meeting in Reading, UK in July 2-3, 2015

2 Update on programme activities

2.1 GCOS and TOPC

Presentation	
TOPC-17 and AOPC-20, Report from the Director	Carolin Richter

TOPC is part of broader network of climate monitoring systems and there is a need to maintain the panels activity and to explain its role to others working related fields. There is now a TOPC brochure[1] and comments on this would be very useful, as we want to update it annually.

The main topics for this year are the Status Report followed by the Implementation Plan. Their schedules are:

Status Report

- June/July 2015: Public Review
- September 28, 2015: consideration by GCOS Steering Committee
- October 2015: Submission to UNFCCC for consideration at COP21/MOP11 in Paris

Implementation Plan:

- October 2015: Start Drafting
- March 2-4, 2016:GCOC Science Conference
- June/July 2016, Public Review
- October 2016: Submission to UNFCCC for consideration at COP22/MOP12

Other issues include:

- There have been contacts with the Food and Agriculture Organization (FAO) about the Global Terrestrial Observing System (GTOS) and some FAO internal discussions on the continuation of the GTOS programme, though these may not lead to concrete activities this year. TOPC needs to wait for the results of the latest contacts with FAO, and revisit that issue next year (2016) before deciding what to do about a coordination mechanism for global terrestrial observations. If there will be no progress by then, TOPC recommends cutting formal ties with GTOS as that organization has been inactive since late 2011.
- WDAC (WCRP Data Advisory Council) is the body that fosters GTOS and the World Climate Research programme (WCRP) expert discussions on data and observations, but there have been no joint activities recently. However, the chair of TOPC (Konrad Steffen) will attend the 4th session of the WDAC, which will be held from 2-3 July 2015, at ECMWF, Reading, UK.

[1] http://www.wmo.int/pages/prog/gcos/documents/GCOS_TOPC_web.pdf

- The 17th Session of the WMO Congress this year will update the GCOS resolution. There should also be an update of the Memorandum of Understanding with WMO addressing the GCOS programme review.

ACTION	Task	Deadline	Responsibility
1 (A2.1) from TOPC XVI	GCOS to discuss with FAO about the potential future of GTOS.	On-going. Awaiting reply from FAO this month.	GCOS Secretariat, GCOS SC Chairman, TOPC Chairman, WMO Management (DSG)

2.2 GCOS Cooperation Mechanism (GCM)

Most of the work of the GCM is with atmospheric domain: traditional networks from meteorological services. It operates in regions of WMO addressing specific challenges. Support activities have traditionally catered to the monitoring of severe weather but will expand to also emphasize food security and include agricultural measurements to address concerns about drought, for instance. There is a trial project on improving the observing systems for river runoff. The aim is to ensure observations are continued at critical sites so the data will be available for further use. This is where GCM could be more involved on a technical level to help.

GCM runs a trust fund that uses the limited funding available to re-establish and support measurements that could include the terrestrial domain as well. However GCOS needs to find a way of fostering the investments into terrestrial observing systems. There is money for climate services – some of which is for observations so there is scope if good cases can be identified.

The relationship between TOPC and the modelling community needs to be strengthened. The European Space Agency (ESA) Climate Change Initiative (CCI) has a climate model user addressing some EVSs of global relevance. ECVs can either be used to verify model output at singular locations, (e.g. Intergovernmental Panel for Climate Change's Working Group I (IPCC WG I)), or as boundary conditions (input parameters) - both are important for the modelling community. The WMO Integrated Global Observing System (WIGOS) aims to integrate these measurements but currently sites often make more measurements than are considered by models There is also an issue in the Antarctic where records have gaps or are too short to be considered as a climate data record.

GCM is looking more at long-term commitments though it is a challenge to set up networks without long-term support.

2.3 GEO Update

Presentation	
Group on Earth Observations (GEO) - 2015 Update -	André Obregón

GCOS is a participating organisation in GEO. In the future, within the new GEO work plan, the Climate Societal Benefit Area (SBA) becomes a cross-cutting issue.

GEO recognises GCOS as the climate observing component of the Global Earth Observing System of Systems (GEOSS) and wants to use the "Convening power of GEO" to represent GCOS to GEO communities and so increase GCOS visibility. GEO will re-enforce the GCOS message to national GEO representatives.

There are clearly areas of common interest, e.g. GEO Cold regions, the Global Observation for Forest Cover and Land Dynamics (GOFC-GOLD), and GEO Global Drought Monitor Portal (GDMP). Water cycle and soil moisture are areas where network coordination and data sharing will be important. GEO focuses on leveraging existing systems and advocating national investment and open data sharing. GEO can re-enforce GCOS goals and objectives. GEO intends to reach ministerial levels.

GEO intends to improve data availability by getting letters of commitment of effort and moving away from informal efforts to more specific targets for each organisation. Data access is through the Global Earth Observation System of Systems (GEOSS) - no real delivery but access and data ownership is transferred. Guaranteeing long-term access to data is an issue.

The draft GEO plan, item 7, discusses the formal relationship between GEO and GCOS. The GEO plan does not mention variables, it is at a higher, more strategic, level, but these are needed to advocate requirements for observations. The SBAs will define suite of observational needs.

ACTION	Task	Deadline	Responsibility
17/1	Comment on GEO Draft plan	May 2015	GCOS Secretariat

3 Update on observational needs for climate change mitigation and adaptation

3.1 GCOS/UNFCCC/IPCC Workshop 'Enhancing observations to support preparedness and adaptation in a changing climate – Learning from the Fifth IPCC Assessment Report'

Presentation	
TOPC-17 and AOPC-20, Report from the Director	Carolin Richter

GCOS in collaboration with the Intergovernmental Panel on Climate Change (IPCC) and the United Nations Framework Convention on Climate Change (UNFCCC) brought together more than 70 participants for a workshop on *Enhancing observations to support preparedness and adaptation in a changing climate – Learning form the IPCC Fifth Assessment Report* at the UN Campus in Bonn, Germany, 10-12 February 2015. Participants represented the UNFCCC Secretariat and Parties, GCOS, IPCC and other United Nations Secretariat units and bodies, and academic, governmental and non-governmental experts.

The goals of the workshop were to:

1. Assess the key findings and recommendations of the IPCC in the context of data availability to inform implementation of adaptation planning and strategies;
2. Define the core sets of data, data characteristics, and information technologies needed to maintain the minimum acceptable level of stewardship in the management of resources and infrastructure;
3. Characterize the climate data needs of the key sectors including the financial services and development sectors;
4. Assess the adequacy of national and regional networks and records for detection of climate trends to inform global, regional and national assessments of climate change and for developing regional and national climate risk profiles; and
5. Identify paths for addressing institutional and local capacities (including National Meteorological and Hydrological Services) needed to observe, monitor, rescue, archive, and process and sustain climate data and networks.

Workshop participants considered the observational and research needs that could enhance systematic observations and related capacity, especially in developing countries, and aid in assessing the risks of climate changing and support adaptation planning. Building on the findings of the Working Group II (WGII) report to the IPCC Fifth Assessment Report (IPCC AR5) and the strategic technical guidance from the GCOS Workshop on 'Observations for Adaptation to Climate Variability and Change', which had been held in February 2013, participants identified the needs across adaptation sectors.

The workshop participants agreed that adaptation planning and assessment requires a combination of baseline climate data and information, coupled with sector-specific and other economic and demographic data at regional, national and local scales. Good, publicly available and standardized data on the vulnerability of key sectors to the impacts of climate change across these spatial scales are essential. The participants also noted the need to enhance climate observations systems with a special emphasis on land and oceans as well as the intersection of the two.

The workshop report is being finalised and will be made available shortly on the GCOS web site.

GCOS observations, together with other data, underpin climate services, assessment, policy etc. but the links between the Terrestrial and Ocean observing systems need to be better developed. There should be ECV champions and international data centres for all ECVs.

Temperature and precipitation are crucial for adaption planning but are needed at high spatial (a few 10s of metres) and temporal resolutions. Generally, users of data for adaptation planning do not look at GEO or GCOS data.

Local data are needed to calibrate model outputs to local conditions to understand impact of future events on local topography, land cover etc.

Developing countries often have insufficient measurement stations to meaningfully address their climate, environmental and development issues compared to developed countries that are well measured. Limited resources can lead to conflict between long-term widespread measurements and local detailed measurements.

A workshop was held by the IPCC WG I and WCRP on data gaps, but there is a need to communicate the outcomes to data providers[2].

3.2 Joint GCOS/GOFC-GOLD Workshop on 'Observations for Climate Change Mitigation'

Presentation	
Workshop on Observations for Climate Change Mitigation: a brief summary	Martin Herold

ECV observation progress has largely focused on IPCC WP I – type users concerned with the "science". The importance of the terrestrial domain is increasing in climate science while the human dimension is largely absent in ECVs. The workshop considered that the attention of the GCOS in future should be to:

- Review existing and consider new ECVs that are related to climate change mitigation and adaptation. However, TOPC has no expertise in this area and would need to adjust the panel membership accordingly. How to address this will be considered in developing the TOPC work plan.
- Identify and address gaps and requirements for observations to support their use in monitoring to support research into mitigation;
- Provide guidance for technical communities to advise data producers (e.g., space agencies, observation networks) and data users (those involved in mitigation and climate science community);

In considering land based ECVs such as land use, biomass and soil carbon, TOPC should consider links between the ECVs and IPCC Agriculture, Forestry and Other Land Use (AFOLU) requirements (especially the six land categories) and how the ECV relate to efforts such as the Global Forest Observation Initiative

[2] The report of this meeting was published after the TOPC meeting: *IPCC AR5: Lessons Learnt for Climate Change: Research and WCRP*. Workshop held at the International Space Science Institute, Bern, Switzerland 8–10 September 2014: WCRP Report No. 5 / 2015

(GFOI). Important issues to be addressed include how to map globally land use change in IPCC land categories; land use change after deforestation as this affects emissions; and Nitrogen- and Phosphorus-cycles which are also important.

4 Space-based Observations and Validation

4.1 Report of GCOS space Rapporteur

Presentation	
Report from GCOS Space Rapporteur, including CEOS/CGMS Working Group Climate activities and ECV Inventory Development	Robert Husband

An overview of the activities of the recent CEOS/CGMS Working Climate was provided, with a special emphasis on the ECV-Inventory (http://ecv-inventory.com/ecv-inventory). TOPC members are invited to review the ECV Inventory site, which is a consolidated repository of space-based climate data records, and forward any comments to the GCOS Space Rapporteur.

Although the ECV Inventory is a repository for space-based climate data records, the inventory infrastructure is also used to host in situ climate data records which, however, are not managed by the CEOS/CGMS Working Group on Climate.

It was noted that the WMO Observing System Capability Analysis and Review (OSCAR) database contains detailed observational data and underpins, and supports, the development of WMO observational requirements. However this database focuses on observations rather than climate data records (in contrast to the ECV inventory).

Concerning the new GCOS Implementation Plan, it was emphasised that that there is a need to maintain consistency between the inventory and this plan. Therefore, coordination with the CEOS/CGMS Working Group on Climate should be foreseen during the process of drafting the new plan.

Whilst GCOS needs to be careful in changing ECV requirements, the Implementation Plan should allow flexibility to meet evolving and expanding users needs, noting this may involve quite a lot of effort for many partners.

4.2 CEOS Cal/Val activities

Presentation	
Land Product Validation (LPV), Sub-group Update	Gabriela Schaepman-Strub

There is a web site, lpvs.gsfc.nasa.gov, which gives further information. The previous Implementation Plan presented the idea of a land surface network for validation.

Land Surface Temperature is not yet an ECV. Measurements have been made with differing definitions.

ACTION	Task	Deadline	Responsibility
17/2	There is a need for expertise for albedo and Leaf Area Index (LAI). Liaise with the CEOS/CGMS community who make proposals. (see 17/12, 17/13)	December 2015	TOPC Chair GCOS Secretariat

5 Adequacy of Terrestrial ECVs

5.1 Carbon Cycle

Presentation	
A preliminary review on some carbon related ECVs	Antonio Bombelli

To fully report on the carbon cycle, additional information is needed including large CO2 sources, major CH4 sources, net ecosystem exchange (NEE), water vapour exchange and evapo-transpiration - (FLUXNET) and other socio-economic variables.

While the impact of human activities on the global climate, and long-term trends, is clear, and TOPC has focused on ECVs that measure these changes globally, there is also a need for more detailed local measurements of human activities that impact atmospheric variability. In the future, technological advances will generate better instruments with higher spatial resolution, and that, in turn, may help identify and better characterize large individual sources of CO_2 emissions.

There is increasing uncertainty in energy emissions due to increasing fossil fuel use in Asia but current technologies are unable to provide better remote measurements of large point sources of greenhouse gases.

TOPC should ensure the internal consistency between variables in future plans, e.g., between the energy and carbon cycles. There are a number of overlapping ECVs, for example, Sea Level, Surface Temperature, Albedo and Surface Radiation Budget and a coordination between these activities is needed.

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5.2 Cryosphere and Oceans

Presentation	
Ice Sheets	Konrad Steffen

Areas of overlap with OOPC and AOPC include sea level, surface temp, albedo and surface energy balance.

Possible additional ECV include:

- Ice shelves and ice tongues
- Snow and ice albedo
- Land surface temp (perhaps radiation temp)
- Land surface radiation budget
- Soil temperature
- Lake and river ice

Gravity (such as generated by the GRACE mission) is a critical observation for some ECVs but probably is not an ECV itself. This can be included in a section on observation systems. There are other examples of products that are essential to monitoring of ECV but are not ECV themselves, e.g. topography and precision orbits.

ACTION	Task	Deadline	Responsibility
17/3	Ensure that importance of ancillary measurements needed to produce EVCs (e.g., gravity measurements, precision orbits, topography) is identified and promoted by TOPC/GCOS. In particular highlight in Status Report & Implementation Plan	On-going. Status Report & Implementation Plan Deadlines	All

Approaches to measuring under ocean ice are being developed; TOPC and OOPC should collaborate in this area.

ACTION	Task	Deadline	Responsibility
3 (A2.1.1-II) from TOPC XVI	OOPC to identify the current monitoring status of the variable biogeochemical fluxes, as well as to foster contact with potential data centres. Report back to TOPC.	Open.	OOPC Members

5.3 Water Cycles

Oral Presentation	
CHT-H	Wolfgang Grabs

Established jointly by WMO and GCOS in 2000, the Global Terrestrial Network for Hydrology (GTN-H) programme is undergoing significant changes. Its present coordination is executed by the Federal Institute of Hydrology in Koblenz, Germany and more details of the program can be viewed under http://www.gtn-h.info/. The most important development is its strong anchoring of activities in GEOSS, namely serving as the observational component of the Integrated Global Water Cycle Observations Community of Practice (IGWCO-CoP). Likewise, GTN-H participates in the Task Team Earth Observations that had been set up through GEOSS in support of the development of the Earth Observation component of the envisaged Sustainable Development Goal 6 (Water).

Complementary to CEOS activities in monitoring, GTN-H strives to cover the terrestrial component of water and climate-related earth observations. A concept paper is under development to outline the contributions GTN-H can make in this respect.

The coming 7th session of the Coordination Panel of GTN-H will take place on 16-17 June 2015 in Koblenz, Germany. GCOS/TOPC has been invited to attend the panel session. Specific focus will be the development of products from data holdings of the federated data centres, the definition of core networks, development of partner networks with collaborating institutions and the strategic setting of GTN-H in support of GEO and its implementation plan and the Sustainable Development Goal process in the coming years.

Participants were further informed that the UNEP Global Data Base on Water Quality (GEMS/Stat) is now hosted at the Federal Institute of Hydrology in Germany, just as the Global Run-off Data Centre (GRDC) operating under the auspices of WMO, and that a Global Water Data Centre has been recently established that seeks to develop and publish joint products of GRDC and GEMS/Stat.

There is a FAO data base, AQUASTAT, on water use but it does not have a clear data source or temporal coverage. Thus GTH-H has drawn a line between water resource and water use. There will be a meeting on this topic.

ACTION	Task	Deadline	Responsibility
17/4	Extend invite from GNT-H and GRDC SC to GCOS and TOPC (15-17 June 2015)	April 2015	Wolfgang Grabs

The aim is to generate products: e.g., fluxes of isotopes, hydrological normal, river nutrients, and global nutrient export from watersheds. It would be very useful to know about extremes. GTN-H is also looking at using indicators as a measurement of change. However, no clearly required ECV was identified.

Investments are needed for in-situ networks and for supporting network partners; recognition of the global water information data centre would help. CEOS has looked at EO and is well resourced but GTN-H are not well resourced. GTN-H will produce a paper to see what can be done.

Again the need to link between ECVs was discussed e.g., understanding how snowmelt feeds into river runoff.

5.4 Discussion

In the general discussion over the adequacy of the current ECVs and the need for new ECV it was noted that none of the existing ECVs were questioned, however there is a need for secondary information to generate some ECVs and that GCOS does need to establish a way of dealing with cross-cutting issues.

Several items were discussed as potential new ECVs including measurement of fluxes (gases and energy). However, considering the principles for an item to be an ECV - Relevance, Feasibility, Cost-Effectiveness and Data Heritage - the following changes to the list of ECVs was agreed:

1. Add ice shelves to ice sheets ECV
2. Land Surface temperature should be an ECV if a clear, measureable definition can be agreed
3. Albedo should be measured over the oceans as well as land and so links to OOPC.

ACTION	Task	Deadline	Responsibility
17/5	Speak to Dr. Darren Ghent who leads up the ESA GlobTemp project about Land Surface Temperature	June 2015	Kevin Tansey
17/6	Set up a small working group to produce a definition based on radiative temperature to determine if a Land Surface Temperature ECV can be agreed.	June 2015	Konrad Steffen; Gabriela Schaepman-Strub;

6 ECV-Based Evaluation of the Overall Terrestrial Monitoring System

6.1 Cryospheric ECVs

6.1.1 Snow Cover

Presentation	
Snow Cover ECV	Richard Armstrong

Snow cover is highly sensitive to climate change. The parameters to be measured are area, depth, water equivalent, and wetness (liquid water content). Snow reports, form national metrological services, can be used but extractions need to be done. Snow cover data are held in the National Snow and Ice Data Center **(**NSIDC).

6.1.2 Glaciers

Presentation	
Global Terrestrial Network for Glaciers: Monitoring of an ECV in a Research Based Environment	Michael Zemp

The TOPC appreciated the work done to establish the GTN-P data centre and its on-going efforts to improve the archive.

TOPC agreed that the use of Digital Object Identifier (DOI) to locate data sets should be encouraged as well as the open publication of data sets. This is very important for a number of reasons including, ensuring the long-term availability and access to data sets, allowing authors and contributors to datasets appropriate acknowledgements and credit and gives fixed term projects the ability to contribute there data to long term archives.

ACTION	Task	Deadline	Responsibility
17/7	Send letter from GCOS to science community encouraging use of DOI (see Michel Zemp's last slide)	June 2015	GCOS Director

6.1.3 Ice Sheets

Presentation	
Ice Sheets	Konrad Steffen

Ice sheet balance is important, in particular to assess and predict sea level rise, and the uncertainty is currently large. This can be improved by reducing the uncertainty on the various components, including precipitation, melt and ice flow.

An institution to host ice sheet data at the global level is currently lacking, though NSIDC could potentially perform that function. GCOS should send a letter to NSIDC (cc NASA ESA) to explore this possibility.

ACTION	Task	Deadline	Responsibility
17/8	Send letter to NSIDC cc NASA ESA on hosting Ice sheet ECV at NSIDC	June 2015	GCOS Director

6.1.4 Permafrost

Presentation	
Global Terrestrial Network for Permafrost GTN-P	J Noetzli
The Global Terrestrial Network for Permafrost GTN-P Database	Boris Biskaborn

The PAGE21 (Changing permafrost in the Arctic and its Global Effects in the 21st Century) project will stop in December 2015 and so funding for GTN-P secretariat will also terminate. Long-term operation and checking standardisation and comparability of the data are needed. This is a broader problem – research data is acquired but there are no funds for archives of data for longer term. No institution has expressed a long-term commitment to or vested interest in maintaining this archive yet.

The status of the carbon pool is currently a critical research issue that is being modelled. Also, the current distribution of boreholes in not representative, there are too few sites to give a clear signal. This ECV measures depth and temperature – not carbon so it should work with the soil carbon ECV.

ACTION	Task	Deadline	Responsibility
17/9	Send letter to AWI to further support GTN-P database and PAGE21 related activities	June 2015	GCOS Director
17/10	Produce text on need for long-term commitment to data archives – in particular, archiving and open access to data from EU research projects and twinning partners. Ensure this issue is in Implementation Plan.	July 2015	Simon Eggleston draft and circulate it for comments to TOPC

6.2

6.3 Hydrological ECVs

6.3.1 River Discharge

Presentation	
ECV River Discharge and the Global Terrestrial Network for River Discharge GTN-R	Ulrich Looser

The GTN-H is evolving at a very slow rate, but some progress had been made with data updates from several countries, inclusion on additional stations identified by individual countries and offerings to make a limited set of data freely available. However in general there has been a poor response of National Hydrological Services (NHS) due to a range of issues including: quality control of data taking time; devolution of monitoring responsibilities to regional bodies; more commercial monitoring with limited data access for scientific use unwillingness to share data with trans-boundary data with neighbouring countries.

For atmospheric data clear data exchange mechanisms exist, based on obvious needs. Describing these needs could be an attempt in improving the response of agencies making hydrological observations.

ACTION	Task	Deadline	Responsibility
17/11	Draft a letter of rational for pristine river basins, and river data with the first draft by a climatologist (suggestion was made by Wolfgang Grabs, so maybe he can make the first stab on it).	July 2015	Wolfgang Grabs

6.3.2 Lakes

Presentation	
Activity of International Data Centre on Hydrology of Lakes and Reservoirs (HYDROLARE)	Valery Vuglinsky

It is difficult to get data for lakes so a list of 79 priority lakes has been developed. SWAT (Soil and Water Assessment Tool) data will give altimetry pole to pole in 2017.

Depending on the size of lakes, the results of satellite water level measurements can still contain substantial errors that depend on the size of the lakes ranging from several decimetres for small lakes, to an accuracy of only few centimetres for large lakes. Generally, these data enable the general assessment of seasonal and long-term water level trends. Further, in situ, validation of these data through ground networks as well as improvements in satellite water level measurement techniques are necessary.

Lake water temperature and ice thickness are indicators of climate change. Additional information could be included, such as temperature, ice cover and breakup, would link to other ECVs but, to date, there are no products which demonstrated such links.

ACTION	Task	Deadline	Responsibility
17/29	Continue to improve the Lakes ECV by: 1) Improve the technique of satellite water level measurements by comparative analysis of the results of satellite and in situ observations to explore the impact of different factors on the accuracy of satellite water level measurements. 2) Establish trial products - lakes surface temperature and ice thickness change - for the last 25-30 years using in-situ observations.	2017 2017	Legos/CNES HYDROLARE HYDROLARE

6.3.3 Soil Moisture

Presentation	
Soil Moisture ECV: Status 2015	Wolfgang Wagner

Soil moisture is also measured from satellites. The International Soil Moisture Network (ISMN) funding is scheduled to stop in spring 2016 with no replacement yet identified. The Soil Moisture Active Passive (SMAP) mission launched 25 January 2015 and is preparing for routine data collection starting in the summer of 2015. The 3rd Soil Moisture Validation & Application Workshop is being organised in February 2016, by MIT in cooperation with NASA, Colorado State University and WMO. Phase 2 of the ESA CCI soil moisture programme has recently started that will build on data sets already available to the climate community.

6.4 Biological, Ecological and Other ECVs

6.4.1 Albedo, FAPAR and LAI

Presentation	
Albedo, FAPAR and LAI: Status on the implementation of ECVS	Verstraete

Traceability from space to ground measurements is difficult as ground observations may be significantly different than space measurements. LAI is subject to larger uncertainties than FAPAR but is needed to estimate evapotranspiration and water interception, as well as in many agricultural applications, etc.

A central data centre is needed for all of these to bring some consistency to these data similar to the glacier data centre. Albedo, FAPAR and LAI are all in some ways measures of radiation and should be derived using compatible algorithms to ensure they remain consistent with one another. As for other ECVs, it may be sufficient that a data centre holds metadata for well-described datasets, rather than the data itself. There

are others who could derive these products beyond space agencies and the data centre could aim to link with existing sites but these tend to be research based rather than operational long-term monitoring.

TOPC noted that

- Albedo, FAPAR and LAI should be derived simultaneously with compatible algorithms to ensure consistency. Albedo, FAPAR and LAI all depend on radiation budget and so consideration should be given to linking these ECVs together with radiation budget. The only group doing these together is JRC.
- The accuracy and performance of the retrieval of these ECVs hinges on the reliability of other variables (e.g. clouds and aerosols).
- Differences between available products need to be further investigated and documented.
- More and better in-situ measurements are also needed, though significant progress and notable efforts have been accomplished by the CEOS Land Product Validation (LPV) subgroup (See http://lpvs.gsfc.nasa.gov/
- While Space Agencies are currently generating these products on the basis of existing instruments, it would be helpful to secure a strong commitment to ensure the continuing production and delivery of these outcomes, and especially to identify an institution ready, willing and able to serve as a central portal and champion for these ECVs.

To address these issues TOPC proposes a joint GCOS/CEOS workshop.

ACTION	Task	Deadline	Responsibility
17/12	Explore how to set up collection of metadata to facilitate consistency and access to Albedo, FAPAR and LAI.	September 2015 (in time new for implementation plan)	TOPC Chair
17/13	Determine if it is possible to organise a GCOS/CEOS workshop to look at production of these albedo, FAPAR and LAI ECVs together with the radiation budget. Participation should include users as well. Consider enlarging this workshop to other related ECVs, for example soil moisture.	June 2015	GCOS Secretariat & TOPC Chair

6.4.2 Land Cover

Presentation	
Update on Observing Land Cover as Essential Climate Variable	Brice Mora

There is a need to improve coordination and explanation of Global Land Cover (GLC) reference data products. The GOFC-GOLD portal aims to facilitate access and provide guidance for a better use of such datasets. There are difficulties to engage communities in interpretation of very high spatial resolution (VHSR) data to develop reference datasets suitable for validation of land cover maps. The development of VHSR reference datasets remains then a challenge.

The ESA Climate Change Initiative (ESA CCI) provides land cover state and condition products. It is now possible to produce such products routinely. Feasibility studies are underway to expand the GLC map time series to the 1980's. However the resolution of the current products (300 m) is not suitable for some adaption applications. First Landsat-scale (30m) GLC maps are becoming also available (e.g., Globeland30 project from National Geomatics Centre of China). Prototypes at high spatial resolution (10 m) are being developed over some test regions (Africa) by ESA. Such higher spatial resolution provides more information but also generates new classification challenges that still need to be tackled by R&D efforts (e.g., shadows).

Access to land use and land management information, beyond land cover, is one important need expressed by different user communities (e.g., agriculture, forest monitoring). Such information is still difficult to obtain.

There is an emerging trend moving towards *Hypercube* information systems, i.e., in-the-cloud storage of massive Earth Observation time-series datasets, to allow faster data access and computations. It can be expected such distributed information systems will be routinely used for large-scale land cover mapping within less than a decade.

6.4.3 Above Ground Biomass and Soil Carbon

Presentation	
Current capabilities for Observing Forest Above Ground Biomass	Shaun Quegan

Currently there are no good space-based measurements but GEDI (planned for the International Space Station in 2018) and ESA's BIOMASS mission (planned for 2020) should provide new data in the future. Current global products, while giving similar global totals, have significant differences in the geographical distribution of biomass leading to a lack of confidence in all these products. There are unlikely to be significant changes in above-ground biomass monitoring in next few years, until these missions star to acquire data..

FAO holds large amounts of data on forests (e.g., the Forest Resources Assessment (FRA)) but may not be the best place to host information about global biomass products, as these are independent of national reporting and are observation-based rather than using reports from countries.

There will be a GEOConnecting (an assessment of network gaps and introducing the concept of essential variables, EV) Workshop on EVs 15-18 June 2015 in Bari, Italy.

JRC is the de facto centre for soil carbon data. The global Soil Organic Matter Network (SOMNET) was established with GCOS and the International Geosphere-Biosphere Programme (IGPB) but does not appear to be active.

ACTION	Task	Deadline	Responsibility
17/14	Identify a champion on soil carbon (it used to be Han Dolman). Identify status of SOMNET and what could be done to re-activate it.	September 2015 (in time for new implementation plan drafting)	TOPC Chair

6.4.4 Fire Disturbance

Presentation	
Fire Disturbance Activities in 2014	Kevin Tansey

Progress against actions identified in the current Implementation Plan was discussed. Task T35 "to reanalyse the historical fire disturbance satellite data (1982-)" seems to have not progressed as intended. This is likely due to AVHRR data not being consistently available and more emphasis given to current and future observations. Glocal products are now available since 1999. Task T38, "make gridded burnt area, active fire, and Fire Radiative Power (FRP) products available through links from a single International Data Portal", may need to be reconsidered as data are tending to be published from data producers' sites or through sites that provide added value such as the Global Fire Emissions Database (GFED). During Phase 1 of the ESA CCI programme, user requirements were specified. Work in that project, complemented by effort from NASA science teams and academic institutions in the US and Europe, have highlighted a gap between product expectation and state of the art in global fire disturbance products. Dr. Tansey, supported by TOPC and CEOS LPV, offered to work with partners in ESA, NASA, GOFC-GOLD and IBBI (International Biomas Burning Initiative) networks to undertake a review of requirements that would be consistent with the Requirements Database. Dr. Tansey offered to undertake this task during 2015.

ACTION	Task	Deadline	Responsibility
17/15	Review the ECV Fire disturbance requirements	September 2015 (in time for new implementation plan drafting)	Kevin Tansey

6.5 Update on the GCOS Status Report

Presentation	
Update on the GCOS Status Report	Adrian Simmons

The initial drafts of the Status Report are being produced with a view to have a final version in October 2015. In September, it will be presented to the Steering Committee and then to the UNFCCC in time for COP21. The draft will be made available for public review in June and July 2015 and so contributions from TOPC and agreement of the draft is needed in May.

The CEOS response to GEO Carbon can be used in the Status Report.

ACTION	Task	Deadline	Responsibility
17/16	Review sections for Status report in next 2 weeks Review status of actions from IP	April 2105	All
17/17	Get input on Water Use for Status Report, contact Nienke Ansems, IGRAC, NL also Graham Alabaster: alabasterg@who.int Rifat Hossain :hossainr@who.int	April 2015	Simon Eggleston

6.6 Recommendations for the next GCOS Implementation Plan

TOPC agreed the following changes for the next Implementation Plan:

1) Rename Ice Sheets to Ice Sheets and Ice Shelves
2) Rename ***Glaciers and Ice Caps*** to ***Glaciers*** (while "Ice Caps" is deleted from the name to avoid confusion the definition be make it clear what is included including floating ice tongues)
3) A new ECV ***Land Surface Temperature*** was proposed, dependent on the development of a clear definition and explanation of the use and need for this ECV. Thermal flux is perhaps what can be measured. A small working group will work on the definition.
4) ***Lake and River Ice*** is a potential new ECV. Some data are already being stored at NSIDC with eight Arctic countries planning to bring data together. The UNEP Global Outlook also had a chapter on this. The University of Wisconsin Long-Term Ecological Research (LTER) has a long data series ending in 2009 of lake and river freeze and breakup.
5) A section in the Status Report and Implementation Plan is needed on ancillary measurements that are required such as precision orbits for altimetry, gravity and a terrain model.
6) Energy Fluxes may be essential but many are probably infeasible to measure globally.
7) Estimates of anthropogenic Green House Gas (GHG) Emissions are mainly done via statistics but are not globally measureable at the present time. While the possible future contribution of satellite-based measurements should be discussed in the Implementation Plan, the measurement of anthropogenic fluxes form space is unlikely to be practical in the foreseeable future.

7 AOPC/TOPC/OOPC Cross-cutting issues

ECV may have a home in one panel but some have considerable overlap with other panels, e.g.,

- Albedo is a joint property of the underlying surface (land or ocean) and the atmosphere, its value can be affected by a range of processes, including clouds, black carbon on snow and sea surface condition.
- The Carbon Cycle links to GHGs, land use, fire, soil carbon, soil moisture.
- Hydrological Cycle links Soil moisture, evapotranspiration, precipitation, land use, melting snow and glaciers, lake level and area – volume changes in lakes, ice sheets and, to some extent, water use.
- Aerosol issues and clouds impact on precipitation

Information on extreme events would be very useful both to understand and manage present conditions, as well as to monitor changes. However, documenting extreme events is challenging because of the relative rarity of occurrence and of the possibly short period in which they take place, e.g. precipitation over sub-daily timescales. This needs to be discussed with the Disaster and Risk Reduction (DRR) community.

Water use is important, especially for irrigation and agriculture, and can be significantly impacted by climate change. Snow making in countries like Switzerland can also be a significant impact on water availability.

An upcoming issue is water used and exported in products, the so-called “Green Water”.

7.1 Review of Action Items

The panel agreed that all of the outstanding actions were closed except for those listed below.

Outstanding Actions from TOPC XVI

#	ACTION	STATUS	RESPONSIBILITY
1 (A2.1)	GCOS to discuss with FAO about the potential future of GTOS.	On-going. Awaiting reply from FAO this month.	GCOS Secretariat, GCOS SC Chairman, TOPC Chairman, WMO Management (DSG)
3 (A2.1.1-II)	OOPC to identify the current monitoring status of the variable biogeochemical fluxes, as well as to foster contact with potential data centres. Report back to TOPC.	Open.	OOPC Members
11 (A4.5-II)	GCOS to discuss with GTNs about a potential Memorandum of Understanding (or something similar) to recognize the networks as official GTN	Issue will be raised at the next GTN-H	GCOS Secretariat, TOPC Chairman, GTN/partner

#	ACTION	STATUS	RESPONSIBILITY
	partners and data contributors.	meeting in Koblenz, Germany (June 2015).	network representatives
14 (A6.3-II)	***From TOPC-XV:*** Provide feedback to the GOSIC ECV data access matrix – relevant ECV panel experts need to check and update the individual ECV definition/text, suggest more links to data sets if appropriate.	Open.	TOPC Members in their area of expertise, GOSIC Representative
21 (A8.3-I)	GCOS to build-up a framework for terrestrial ECVs that identifies a main assigned operational data centre (and a scientific focal point) for each ECV.	Ongoing.	GCOS Secretariat, TOPC Members in their area of expertise

8 TOPC Terms of Reference

TOPC agreed terms of reference. These are attached as appendix 2.

9 TOPC Work Plan 2015-2018

There was a general discussion around a future work plan for TOPC. The Implementation Plan will say how GCOS as a whole intends to address its strategy, and TOPC needs to consider how it will implement this in practice and what its vision for itself is.

TOPC should address the climate science of mitigation and adaptation and so will be guided by problems with clear societal benefits. In the past, TOPC has had some significant impacts, for example on satellite data collection and the development of fire monitoring network, and the new Implementation Plan should address what TOPC can concentrate on in the next few years.

Areas discussed included

- The coherence of ECVs, some ECVs are generated independently while they are physically linked, for example Albedo, LAI and FAPAR;
- Looking at Energy fluxes and related ECVs;
- Improving links with the climate change modelling community.

TOPC could propose workshop with relevant experts from the Europe (e.g. the Copernicus programme), the USA, China, Japan and elsewhere to address these issues and increase involvement beyond Europe and the USA.

TOPC also should creating new relationships with those working on the science of mitigation and adaptation.

ACTION	Task	Deadline	Responsibility
17/18	TOPC Members provide ideas for Work Plan – vision for next five years and specific actions to GCOS Secretariat, and agree work plan	Send by End June	TOPC Members to send to GCOS Secretariat
17/19	Finalise work plan by August 2015	August	TOPC to discuss and agree

10 AOB

TOPC would like to hold a TOPC workshop on a specific scientific issue one a year with funds from GCOS office.

ACTION	Task	Deadline	Responsibility
17/20	Explore the feasibility of holding annual TOPC workshops focusing specific topics	June 2015	TOPC Chair and GCOS Secretariat

TOPC panel members are nearing the end of their current terms. TOPC should find new members, trying to keep a mix of existing and new members, and increasing the diversity of the existing membership. The panel can have up to 12 members.

ACTION	Task	Deadline	Responsibility
17/21	Make proposals for new panel members. Try to extend membership and its diversity. Send any proposals to Konrad Steffen copied to Simon Eggleston	end- July	TOPC Chair, GCOS Chair and GCOS Secretariat

Appendix 3 provides a summary of the Advisory Group on the GCOS networks, GUAN and GSN, which had been held preceding the AOPC meeting, on 17 March 2015. The Implementation Manager is also looking into possible activities of relevance for TOPC, and hence the attached notes will provide information and motivation.

Appendix 5 gives a summary list of actions for ease of reference.

The GCOS Secretariat and the panel participants expressed their sincere gratitude to the host of the meeting, Konrad Steffen and his assistant Rosmarie Buechi. The TOPC benefited greatly from the provision of excellent meeting facilities and enjoyed thoroughly the generous hospitality of WSL.

11 TOPC AOPC Joint Session

The TOPC Meeting was followed by a joint session of TOPC and the Atmospheric Observation Panel for Climate (AOPC). A note of this session is attached as Appendix 3.

Appendix 1 Agenda

Joint Session of the GCOS/GTOS/WCRP Terrestrial Observation Panel for Climate (TOPC) and the GCOS/GTOS/WCRP Atmospheric Observation Panel for Climate (AOPC) 16th-17th March 2015

Monday, 16th March 2015				
9.00 – 10.45	1. Opening of the Meeting (15')			
	1.1 Welcome and introductions	1.1	Steffen/Richter	
	1.2 Adoption of Agenda	1.2	Steffen	
	1.3 Conduct of the Meeting	1.3	Steffen/Richter	
	2. Update on programme activities (90')			
	2.1 GCOS Update	2.1	Richter	Status of next GCOS Assessment cycle, future expectations of TOPC. Update on AOPC & OOPC to prepare for TOPC/AOPC joint day
	2.2 GCOS Cooperation Mechanism (GCM)	2.2	Oakley	Update on GCM; Potential input from/benefit for TOPC. Recommendations from TOPC members for certain GCM projects.
	2.3 GEO Update	2.3	Obrégon	Update on GEO activities, the new Implementation Plan, discussion on SBA Climate.

10.45 – 11.00 Coffee Break				
11.00 – 12.30	3. Update on observational needs for climate change mitigation and adaptation (40')			
	3.1 GCOS/UNFCCC/IPCC Workshop 'Enhancing observations to support preparedness and adaptation in a changing climate – Learning from the Fifth IPCC Assessment Report'	3.1	Richter	Update on outcomes of the workshop, which was held from 10-12 February 2015. Discussion on how TOPC experts can support future GCOS activities in regard to adaptation to climate change.
	3.2 Joint GCOS/GOFC-GOLD Workshop on 'Observations for Climate Change Mitigation'	3.2	Herold	Update on outcomes of the workshop, which was held from 5-7 May 2014. Discussion on how TOPC experts can support future GCOS activities in regard to climate change mitigation measures.
	4. Space-based Observations and Validation (50')			
	4.1 Report from GCOS Space Rapporteur, including CEOS Climate activities and ECV Inventory / ESA Climate Change Initiative	4.1	Husband	
	4.2 CEOS Cal/Val activities	4.2	Schaepman-Strub	
12.30 – 13.30 Lunch Break				
13:30-15:30	5 Adequacy of Terrestrial ECVs.			
	5.1 Cross-Cutting Issues			
	5.1.1 Carbon Cycle		Bombelli	A series of cross-cutting talks to start a discussion about the adequacy of existing ECV and if there are missing ECV, especially at the boundary between domains Terrestrial/Ocean/Atmosphere. Topics are suggestions, could also consider users e.g. disasters….
	5.1.2 Cryosphere and Oceans		Steffen	
	5.1.3 Water Cycles		Grabs	
	5.2. Discussion	5.2	All	Are the existing ECVs adequate? How to improve coverage

				of these issues?
15.30 – 16.45 Coffee Break				
16:45 – 18:15	6. ECV-BASED EVALUATION OF THE OVERALL TERRESTRIAL MONITORING SYSTEM			
	6.1 Cryospheric ECVs	6.1		Cryospheric experts in their area of expertise to report on current scientific gaps, issues of concern, and what is expected from TOPC to further observations.
	Snow Cover		Armstrong	
	Glaciers and Ice Caps		Zemp	
	Ice Sheets		Steffen	
	Permafrost		Noetzli/Biskaborn	
	6.2 Hydrological ECVs	6.2		Hydrological experts in their area of expertise to report on current scientific gaps, issues of concern, and what is expected from TOPC to further observations.
	River Discharge		Looser	
	Water Use			
	Ground water		Ansems	
	Lakes		Vuglinsky/Crétaux	
	Soil Moisture		Steffen	
18.15 End of Day 1				

	Tuesday, 17th March 2015			
9.00 – 11.00	6.3 Biological/Ecological/Other ECVs	6.3		Biological/ecological experts in their area of expertise to report on current scientific gaps, issues of concern, and what is expected from TOPC to further observations.
	Albedo		Verstraete	
	FAPAR		Verstraete	
	Leaf Area Index		Verstraete	
	Land Cover		Mora	
	Above Ground Biomass		Quegan	
	Soil Carbon		Quegan	
	Fire Disturbance		Tansey	
	6.4 Update on the GCOS Status Report	6.4	Simmons	Update on the current status of the chapter on terrestrial ECVs.
	6.5. Recommendations for the next GCOS Implementation Plan	6.6	All	What needs to be done for missing ECVs? TOPC to recommend new ECVs or delete old ones?
	11:00– 11:15 Coffee Break			
11:15 -12:45	7. Discussion of AOPC/TOPC/OOPC Cross-cutting issues	7	All	Where is the key potential for a stronger future collaboration? What are the main issues of discussion? Where would the TOPC experts like to see stronger involvement from AOPC experts?
	7.1 Review of Action Items	7.1	Steffen/Richter	Review of last years' actions

	12.45 – 13.45 LUNCH			
13.00 - 15.30	8 TOPC Terms of Reference	8	Eggleston/Steffen	After circulation of current TORs for discussion in 2014, TOPC should agree on a final version.
	9 TOPC Work Plan 2015-2018	9	Eggleston/Steffen	To further stronger engagement with the other panels, TOPC should agree on focus issues for the next 2-3 years.
	15.30 – 16.45 Coffee Break			
16.45 -18.00	10. Wrap-Up	10		
	11 Closure	11		
	11.1 AOB, Next session	11.1		

19.00 Group Dinner HOSTED by WSL

Appendix 2 Terms of Reference

Terms of Reference of the Terrestrial Observation Panel for Climate (TOPC)

Agreed, Zurich, 17 March 2015.

Introduction

Three science panels have been established co-sponsored by the GCOS Steering Committee and by the World Climate Research Programme (WCRP) to define the observations needed in each of the three main global domains – atmosphere, oceans and land – to prepare specific programme elements and to make recommendations for implementation. The Terrestrial Observation Panel for Climate (TOPC) is also sponsored by the Global Terrestrial Observing System (GTOS).

The Terrestrial Observation Panel for Climate (TOPC) was set up to develop a balanced and integrated system of in situ, air- and space borne observations of the terrestrial ecosystem. The Panel focuses on the identification of terrestrial observation requirements, assisting the establishment of observing networks for climate, providing guidance on observation standards and norms, facilitating access to ECV and climate data and information and its assimilation, and promoting climate studies and assessments.

Terms of Reference

1. To define the requirements for long-term monitoring of terrestrial properties for climate and climate change, adaption and mitigation as part of the essential climate variables (ECV);
2. To liaise with relevant research and operational communities to identify measurable terrestrial (biosphere, cryosphere, and hydrosphere) properties and attributes which
    - control the physical, biological and chemical processes affecting climate,
    - are themselves affected by climate change, are indicators of climate change and provide information on impacts of climate change;
3. To assess and monitor the adequacy of terrestrial observing networks (in-situ, air borne and satellite-based) and their archival and quality control at international data centres, promote their integration and the development of their capacity to measure and assess terrestrial properties and exchange climate data and information;
4. To identify gaps in present systems and design, promote and periodically revise plans for a long-term systematic observing system that fills these gaps, makes the data available and so better serves the needs of the research and operational communities;
5. Help develop a process for on-going evaluation of the observing system and data centres in liaison with users of the data, based on the optimum suite of platforms and processing capabilities for required variables, spatial and temporal scales and accuracy.;
6. To promote and guide the establishment platforms that enable cooperation between data suppliers and user communities with the goal to establish high-quality and sustainable ECV production;
7. To act as focal points for each ECV and area of expertise;

8. To coordinate activities with other global observing system panels and task groups to ensure consistency of requirements with the overall programmes;
9. Publish and update GCOS/GTOS studies and planning documents, such as the implementation plan and satellite supplement;
10. To liaise with the other GCOS panels, WCRP steering groups, councils and other relevant entities, such as WMO Commissions, CEOS, GFCS, Future Earth, WIGOS and IPCC, on terrestrial climate observing system issues, and also to other GTOS panels, where relevant.
11. Carry out agreed assignments from the GCOS, WCRP and GTOS Steering Committees;
12. Report regularly to the GCOS Steering Committee, the GTOS Steering Committee and the WCRP Data Advisory Council on issues related to the terrestrial component of GCOS.
13. Meet regularly to review progress and address identified issues with the global observing system for climate.

Appendix 3 The Joint Session

Joint Session of the Session of the

GCOS/GTOS/WCRP Terrestrial Observation Panel for Climate (TOPC) and the GCOS/GTOS/WCRP Atmospheric Observation Panel for Climate (AOPC)

18th March 2015

1 Opening of the Meeting

The meeting was chaired by Stephen Briggs (GCOS Steering Committee Chairman), Konrad Steffen (TOPC Chairman), Kenneth Holmlund (AOPC Chairman), Albert Klein-Tank (Vice-Chairman of AOPC).

A revised agenda was proposed and agreed (Annex I)

2 Collaboration with WCRP

Presentation	
WCRP update, AOPC-TOPC session	Michel Rixen

The WCRP Data Advisory Council has created a new Surface Flux Task Team comprised of Carol Anne Clayson (lead, WHOI), Pierre-Philippe Mathieu (ESA), Brian Ward (NUI-G), Jörg Schultz (EUMETSAT) and Peter Gleckler (PCMDI). They are developing a ToR and candidate membership recommendations to address: near-term flux discussion items; flux – ECV cross walk; gaps in Observing Systems; cross community tracking of surface flux activities; and a WCRP single point-of-contact.

Inputs are requested for a Copernicus reanalysis workshop on observational requirements to be held on 29 June – 1 July 2015 at ECMWF followed by the fifth session of the WCRP Data Advisory Council (WDAC) 2 – 3 July 2015.

WDAC has cooperated on the development of the http://ecv-inventory.com/ecv-inventory in cooperation with WG Climate, GCOS and WMO. Initially satellite data, but in-situ data will also be implemented.

There will be a Year of Polar Prediction (YOPP) Planning Summit 13-15 July 2015, WMO, Geneva and this is an opportunity for GCOS Panel experts to participate.

Action	Task	Deadline	Responsibility
17/22	Identify GCOS presentation in Year of Polar Prediction (YOPP) Planning Summit 13-15 July 2015, WMO, Geneva	April 2015	GCOS Secretariat

GEWEX has formulated specific data needs including a Grand Challenge GC on extremes, high elevation precipitation and land surface information. These needs are being re-thought into cycles. There is also a need of validation networks.

JSC-36 will meet on 8 – 10 April 2015 to discuss the new framework.

Action	Task	Deadline	Responsibility
17/23	GCOS Panels to discuss how to possibly engage in new potential areas: urban and mega cities, decadal predictions, planet data initiative, expanded mandate into VIA and other services	December 2015	All Panel Co-chairs

WCRP has links to climate services but does not deliver them: it is not in the WCRP mandate.

It is not clear that there is a need for any new ECV.

Presentation	
ENSO 1/2014-3/15, A brief review	D. E. Harrison

Recent observations point to a progressive warming of the ocean surface (an incipient El Niño) but models diverge considerably in their predictions: some clarification on the extent and severity of this event is expected after June. So far there has not been a large effect or a major global event. There have been large changes in the observing system but no identifiable long-term trends in La Nino and Southern Oscillation (SO).

There is no consensus on the need for more atmospheric observations and El Niño forecasts are not really good enough for operational use.

3 Implementation Plan

Presentation	
The New GCOS Implementation Plan	Alan Belward

Alan Belward will lead the drafting activities for the new Implementation Plan, which his intended to be finally submitted to COP22 in 2016. He outlined the draft Table of Contents and introduced the pathway to the final document.

Action	Task	Deadline	Responsibility
17/24	Send formal invitation to SC-23 in Cape Town to Alan Belward	April 2015	GCOS Secretariat

Action	Task	Deadline	Responsibility
17/25	Panel Chairs to send nominees to IP writing team	August 2015	Panel Chairs, GCOS Secretariat

4 Proposals for input to Implementation Plan

TOPC noted that there may be a new satellite supplement but this would be written in 2017, after the completion of the new Implementation Plan, but there has been no decision to date. However, this supplement would be very useful for the satellite agencies. There may also be a need for an in-situ supplement as well. Following their consideration of the new Implementation Plan the UNFCCC COP might ask the space agencies to react to the 2016 plan.

The new Implementation Plan should prioritise actions, which should be measurable.

All parties should be careful in documenting observations for biogeophysical cycles, as this will show the incompleteness of the observing system, e.g. the ECVs do not cover all the carbon cycle. GCOS will try to address and to fill the gaps.

Regional aspect will need to be covered in the adaptation / mitigation section. The section on how global observing systems in countries could be developed in a way that serves GCOS.

While future satellite observations should be considered in the Implementation Plan, detailed requirements should be left to the satellite supplement, as requirements are quantified only in the supplement. Global Cycles

4.1 Global Energy Cycle

Presentation	
Energy Cycles in the global climate system	Martin Wild

The revised energy balance figures in the IPCC AR5 are consistent with observations (BSRN, and CERES, EBAF and TOA fluxes)

There is a difference between the energy cycle over land and over the oceans. However, for land, the mean downward radiative fluxes have the largest discrepancies and observational data are needed to constrain the variations (GEBA sites). The surface short wave downward flux is estimated using model biases (CMIP5) against BSRN.

Uncertainties remain in surface albedo in SH/LH fluxes.

The energy balance in the ocean, as measured by ARGO, indicates that 93% of additional energy goes into the ocean.

The observations (BSRN) measure the greenhouse effect at the earth's surface as a change of 2 Wm-2/decade. This compares well with models estimates of h 1.7-2.2 Wm-2/decade (noting that decadal changes can be observed) and we now have a good understanding of the energy budget.

Solar radiation changes are also measured. There are 56 sites in Europe (Global Energy Balance Archive (GEBA). Observations of a polluted atmosphere (example sulphur dioxide and aerosols) and cleaner atmosphere due to implementation of pollution control policies can observe the impact of the policies. This pollution reduces the solar radiation reaching the ground and can impact a number of variable such Daily Temperature Range (DTR, Tmin, Tmax). Trends in the effect of aerosols after 2000 are unclear due in to increases in emissions in China and India, no trend in Japan and reductions some other regions. The southern hemisphere is less affected.

This can also impact the global water cycle: variations in observed precipitation are in line with variations in surface net radiation. However, there is an on-going debate on apparent inconsistencies between observed global energy and water cycle.

4.2 Global Carbon Cycle

Presentation	
Carbon	James Butler

Action	Task	Deadline	Responsibility
17/26	Clarify list of constituents for ECV for atmospheric composition (CO_2, CH_4, NO_2, other long-lived greenhouse gases and pre-cursors).	September 2015 (in time new for implementation plan drafting)	GCOS Secretariat

There was a discussion about the need for an ECV "2-degree target" to monitor progress toward this target, but it is unclear what this would be and if it could be measured.

Atmospheric concentration measurements, from satellites and in-situ cannot yet replace inventories of emissions constructed using the IPCC Guidelines although they do have a role in validating emission estimates. The emission estimates made using the IPCC are the basis for mitigation policy, targets and agreements. Atmospheric concentration and surface temperature measurements indicate the success of these policies. It is possible to envisage how emissions could be monitored remotely using satellites and ground based measurements but the technologies and infrastructure are unlikely to be available for at least 20 years if developments start now. A dialog with the IPCC may help indicate ways forward.

Measurements need validation and the relationship between satellite (total column) and surface measurements (flasks) needs to be fully understood. It is important not to oversell the capabilities of satellite observations.

It is also important to continually look at new technologies, e.g., space-based LIDAR observations (profiles) of CO_2.

4.3 The Hydrological Cycle

Presentation	
Hydrological Cycle	Andreas Becker

The quality of precipitation gridded products is good, as they are quality controlled and processed. However, while the volume of data collected is increasing, a significant fraction of these observations is not being made available. Data availability is a critical issue and a major cause of uncertainty in the water balance. Countries do apply conditions on the use of data so this may be a data policy issue. The next Implementation Plan should discuss improvements in remote and in-situ measurements.

Developing a systems approach to monitoring environmental cycles would mean we could measure, as a minimum, stocks and fluxes for each cycle. This would be more systematic., however there are practical considerations – not all the items measureable, e.g. NPP.

New ECVs about isotopes should be considered, as these can be markers or indicators that help develop understanding of CO_2, ice, water vapour etc. Switzerland has introduced these as "national ECVs".

Another potential ECV is evaporation and/or transpiration.

However GCOS needs to be rigorous and conservative in adopting new ECVs or in changing the requirements of others, especially because space agencies have based their plans on the existing ECV requirements.

4.4 Discussion

Radiation fluxes at top of atmosphere are measured but there are only local, uncoordinated and generally inaccessible measures of sensible and latent heat or heat into ground and sea. A proposal for the future would be to see if the entire energy balance at the surface as well as at the top of the atmosphere can be systematically measured.

Latent heat is a key link between energy and water cycle and it would be good to ensure consistency between two cycles. There are some regional fluxes available. WCRP is working on some of these fluxes so GCOS would need to collaborate with them on the scientific aspects. They could be included as part of "surface energy budget". One issue is whether global or land and sea data are enough to drive models and what resolution is needed.

Accuracy is not just about the precision of data but the consistency and coherence of all ECVs. The ECVs should give a holistic view of the planet. Radiation is important for both terrestrial and atmospheric panels.

Climate engineering is another potential user of GCOS type data. It is not clear whether the available data are useful and sufficient to tackle this problem. Could the observation system pick up the signal of geo-engineering?

GCOS should work with WCRP in dealing with this topic.

UNFCCC is GCOS's primary customer but the ECVs are also important to the understanding of other biogeochemical cycles, as well as to address the other Rio conventions (desertification and biodiversity). Specifically, data about extremes are needed to deal with Disaster and Risk Reduction (DRR).

The meeting considered the current list of ECVs and how they related to the 3 cycles discussed and to each panel (see Table 1 below). While it is not finalised, it is included here to inform future cross-panel discussions.

5 AOB

It was agreed that the joint meeting was useful.

Revised panel membership should ensure gender balance as well as regional balance as far as possible.

More cross-panel links are needed to cover ECVs that relate to the different domains. The panel co-chairs need to monitor progress and ensure these links are maintained.

Action	Task	Deadline	Responsibility
17/27	Appoint a panel member to attend other panels. There should be a standing invitation for panel chairs to attend meetings	Before next panel meeting	GCOS Secretariat
17/28	Ensure actions are delegated and consider an executive group to oversee progress.	June 2015	Panel Chairs

Table 1 Consideration of ECVs and 3 Environmental Cycles

			Energy Cycle	Hydrological Cycle	Carbon Cycle
Atmosphere	Surface	Air temperature	Major3	Minor	Minor
		Wind Speed and direction	Minor	Minor	Minor
		Water Vapour	Minor	Major2	-
		Pressure	-	-	-
		Precipitation	Major2	Major2	Major2
		Surface Radiation Budget	Major2	Major2 (driver)	Major1
	Upper Air	Temperature	Major	minor	-
		Wind speed and direction	Minor	Major2	Minor
		Water Vapour	Minor	Major2	-
		Cloud Properties	Minor	Major1	Minor
		TOA Earth radiation budget (inc Solar irrad)	Major3	Minor	-
	Comp	Carbon Dioxide	Minor	-	Major2
		Methane+ LL GHGs	Minor	-	Major2
		Ozone and Aerosol, + precursers.	Minor	Minor	Minor
Oceanic	Surface	Sea Surface Temperature	Major 3	Major3	Minor
		Sea Surface Salinity	Minor	Major2	Minor
		Sea Level	-	Major3	-
		Sea State	Minor	Major3	Minor
		Sea Ice	Minor	Minor	-
		Surface Current	Minor	Minor	Minor
		Ocean Colour	Minor	-	Major2
		Carbon Dioxide pp	-	-	Major2
		Ocean Acidity	-	-	Major2
		Phytoplankton	-	-	Major1
	Subsurface	Temperature	Major 2	Minor	Minor
		Salinity	Minor	Minor	Minor
		Current	Minor	Minor	Minor
		Nutrients	-	-	Major2
		Carbon Dioxide pp	-	-	Major2
		Ocean Acidity	-	-	Major2
		Oxygen	-	-	Major2
		Tracers	Minor	Minor	Minor
Terrestrial		River Discharge	Minor	Major1	Minor
		Water Use	-	Major1	-
		Ground Water	-	Major2	-
		Lakes	-	Major3	-
		Snow Cover	Minor	Major1	-
		Glaciers and ice caps	Minor	Major1	-
		Ice sheets	Minor	Major2	-
		Permafrost	-	Minor	Major1
		Albedo	Major1	Minor	-
		Land Cover (inc. vegetation type)	Minor	Minor	Major2
		Fraction Absorbed PAR	Minor	Minor	Major2
		Leaf area index	Minor	Minor	Major2
		Above ground biomass	-	Minor	Major1
		Soil Carbon	-	-	Major1
		Fire disturbance	-	-	Major2
		Soil Moisture	Minor	Major1	Major1

Notes:

1) This table has not been checked or reviewed and is not definitive.
2) Major indicates a significant relevance, Minor a lesser relevance and "–" small or none
3) Major3: adequate/mature measurements; Major2: measurements that can be used, Major1: emerging observation

ANNEX 1 Agenda of Joint Session

Joint Session of the Session of the GCOS/GTOS/WCRP Terrestrial Observation Panel for Climate (TOPC) and the GCOS/GTOS/WCRP Atmospheric Observation Panel for Climate (AOPC)

18th March 2015

Wednesday, 18th March 2015.				
Chairs: Steven BRIGGS, Konrad STEFFAN, Kenneth HOLMLUND, Albert KLEIN-TANK				
09:00-10:45	1. Opening of the Meeting (15')			
	1.1 Welcome and introductions	1.1	Chairs	
	2. Collaboration with WCRP (60')			
	2.1 WCRP Update (WDAC, CliC, GEWEX) and expectations from the WCRP Climate Modelling Community with special regard to terrestrial observations	2.1	Rixen	Expectations from WCRP – how TOPC will fit into the overall WCRP structure and its core projects; WCRP input for new GCOS IP.
10.45 – 11.00 Coffee Break				
11:00 - 12:45	3 Implementation Plan			
	3.1 Introduction to Plan	3.1	Belward	Introduce IP and progress
	4 Proposals for input to Implementation Plan			
	Discussion & agree proposals	4.1	(30')	
	5 Global Cycles			
	5.1 Global Energy Cycle	5.1	Wild	Martin Wild, ETH Zurich Global Energy Cycle

12.45 – 13.45 Lunch Break				
	5.2 Carbon Cycle	5.2	Butler	
	5.3 Hydrological Cycle	5.3	Becker	
	5.4 Discussions on the cycles and ECVs	5.4		
15.30 – 15.45 Coffee Break				
15.45 – 18.00	Continue Discussions on the cycles and ECVs			
	AOB	6.1		

Appendix 4 Summary Notes on AGG

Changes to the GSN/GUAN Networks

GSN

Canada has informed GCOS of 4 closures and suggested 4 new sites (all less than a km away).

Jordan has informed of 2 closures and suggested 2 new sites.

GCOS needs to respond to both countries to accept the changes and modify the master GSN list.

GUAN

3 sites are not reporting since 2012/3 – Karachi, Honiara and Port Moresby.

AGG suggests that these three sites be removed from the GUAN list.

Project Reports

a) Madagascar for GSN

Reporting better, but much of this comes from the original manned stations and not the AWSs? Software is working better and we're getting CLIMATs from the manned stations!

Project has problems with BUFR, but these are issues with BUFR and not this particular project.

Issues/Lessons learned: (1) Can we get the parallel measurements from the manned and AWS sites? These are useful to look as they are for a tropical location.

(2) AWSs require the replacement of SIM Cards every year. System works when the power is up. Power outages at the centre mean that get out when down.

(3) Better if data went to the cloud and not to the centre, but this would have data issues with the NMS.

(4) Can the missing CLIMATs be rescued from the NMS if the project goes back to the country?

b) Angola and DRC – projects in abeyance. Equipment is at the HQ in the country, but no way of getting this to the stations. There is an African technician, supported by GCOS, who is now able to be sent to countries for assistance.

c) GUAN

Gan and Harare have had their hydrogen generators repaired.

Yerevan – GCOS is supplying sondes.

Hydrogen Generators, Lack of sondes and communication issues are the main cause of poor performance.

Monitoring

GSN and also RBCN statistics on performance come from NCDC/NCEI. How many people use these? Why are there slight differences with those from DWD/JMA? There is a need to check membership lists to ensure all are using the same one.

GUAN

It was recognized that there is a need to boost Pacific Islands for GUAN. East African performance is poor for GUAN. There have been no requests for assistance.

Actions from 2014

Little progress seems to have been made from our meeting at ISPRA last year.

- Strengthening membership of GSN and GUAN
- Manual for Congress
- CCI Data Rescue
- Tiered Networks

Role on Monitoring Centres - several appear to be doing nothing. There is a need to reinvigorate some.

BUFR – based on a recent presentation from the Met Office to ECMWF

Summary points

(1) ECMWF were not making much use of significant levels compared to the Met Office.
(2) It is now possible to take account of position of the sonde during the ascent. Position unique to BUFR. It has been noticed that some launch sites differ from the positions in Volume A.
(3) 55% of countries using reformatted TEMPs for BUFR! This needs to improve.
(4) 15% of native BUFR - mainly Europe, Canada and Mexico.
(5) Operational centres will whitelist BUFR stations then use.

Presentation also discussed SYNOP data availability in BUFR. Similar issues in that many are just putting data into BUFR, so not taking advantage of its greater potential to include more information.

For both U/A and SYNOP messages in BUFR, it is vital that the coding is correct and that operational centres can decode the message.

In terms of strengthening GSN and GUAN, we need to do….

(1) CCL and CBS have both recognized that we need a Daily CLIMAT message. CBS developed a template for 'daily CLIMAT' messages. According to information received by AGG this is expected to be classified 'operational' as of 6 May 2015. It will take some time for countries and users to take advantage of this.
(2) The CBS Lead Centres are not always working – Chile, Iran, Mozambique, Morocco. Centres at BAS, NCDC, DWD and JMA are working. When will the next lead centres meet next?
(3) Convert the AGG into a WG of AOPC?
(4) Update regulations, 144 and 182

Other issues

(1) Indian sondes? 4 seem to be producing good data according to Tim. Emails to India haven't been answered. AGG would like to add these 4 sites to the GUAN. Informal discussions will take place,
(2) Russian network – will go back to two sondes per day from April 1. Went to one a day from Jan 1, 2015.
(3) NCDC Archive is what NCDC collects and not what DWD/JMA monitor. Does this matter?
(4) WWR volume for 2000s will be finished this year. This helps a lot in Africa and South America. Has there been any progress in getting WWR onto a more frequent timetable?

Appendix 5 Summary of Actions

Table 2 Outstanding Actions from TOPC XVI

ACTION	Task	Deadline	Responsibility
1 (A2.1)	GCOS to discuss with FAO about the potential future of GTOS.	On-going. Awaiting reply from FAO this month.	GCOS Secretariat, GCOS SC Chairman, TOPC Chairman, WMO Management (DSG)
3 (A2.1.1-II)	OOPC to identify the current monitoring status of the variable biogeochemical fluxes, as well as to foster contact with potential data centres. Report back to TOPC.	Open.	OOPC Members
11 (A4.5-II)	GCOS to discuss with GTNs about a potential Memorandum of Understanding (or something similar) to recognize the networks as official GTN partners and data contributors.	Issue will be raised at the next GTN-H meeting in Koblenz, Germany (June 2015).	GCOS Secretariat, TOPC Chairman, GTN/partner network representatives
14 (A6.3-II)	***From TOPC-XV:*** Provide feedback to the GOSIC ECV data access matrix – relevant ECV panel experts need to check and update the individual ECV definition/text, suggest more links to data sets if appropriate.	Open.	TOPC Members in their area of expertise, GOSIC Representative
21 (A8.3-I)	GCOS to build-up a framework for terrestrial ECVs that identifies a main assigned operational data centre (and a scientific focal point) for each ECV.	On-going.	GCOS Secretariat, TOPC Members in their area of expertise

Table 3 TOPC XVII Actions

ACTION	Task	Deadline	Responsibility
17/1	Comment on GEO Draft plan	May 2015	GCOS Secretariat
17/2	There is a need for expertise for albedo and Leaf Area Index (LAI). Liaise with the CEOS/CGMS community who make proposals. (see 17/12, 17/13)	December 2015	TOPC Chair GCOS Secretariat
17/3	Ensure that importance of ancillary measurements needed to produce EVCs (e.g., gravity measurements, precision orbits, topography) is identified and promoted by TOPC/GCOS. In particular highlight in Status Report & Implementation Plan	On-going. Status Report & Implementation Plan Deadlines	All
17/4	Extend invite from GNT-H and GRDC SC to GCOS and TOPC (15-17 June 2015)	April 2015	Wolfgang Grabs
17/5	Speak to Dr Darren Ghent who leads up the ESA GlobTemp project about Land Surface Temperature	June 2015	Kevin Tansey
17/6	Set up a small working group to produce a definition based on radiative temperature to determine if a Land Surface Temperature ECV can be agreed.	June 2015	Konrad Steffen; Gabriela Schaepman-Strub;
17/7	Send letter from GCOS to science community encouraging use of DOI (see Michel Zemp's last slide)	June 2015	GCOS Director
17/8	Send letter to NSIDC cc NASA ESA on hosting Ice sheet ECV at NSIDC	June 2015	GCOS Director
17/9	Send letter to AWI to further support GTN-P database and PAGE21 related activities	June 2015	GCOS Director
17/10	Produce text on need for long-term commitment to data archives – in particular, archiving and open access to data from EU research projects and twinning partners. Ensure this issue is in Implementation Plan.	July 2015	Simon Eggleston draft and circulate it for comments to TOPC
17/11	Draft a letter of rational for pristine river basins, and river data with the first draft by a climatologist (suggestion was made by Wolfgang Grabs, so maybe he can make the first stab on it).	July 2015	Wolfgang Grabs
17/12	Explore how to set up collection of metadata to facilitate consistency and access to Albedo, FAPAR and LAI.	September 2015 (in time for new	TOPC Chair

ACTION	Task	Deadline	Responsibility
		implementation plan)	
17/13	Determine if it is possible to organise a GCOS/CEOS workshop to look at production of these albedo, FAPAR and LAI ECVs together with the radiation budget. Participation should include users as well. Consider enlarging this workshop to other related ECVs, for example soil moisture.	June 2015	GCOS Secretariat & TOPC Chair
17/14	Identify a champion on soil carbon (it used to be Han Dolman). Identify status of SOMNET and what could be done to re-activate it.	September 2015 (in time for new implementation plan drafting)	TOPC Chair
17/15	Review the ECV Fire disturbance requirements	September 2015 (in time for new implementation plan drafting)	Kevin Tansey
17/16	Review sections for Status report in next 2 weeks Review status of actions from IP	April 2105	All
17/17	Get input on Water Use for Status Report, contact Nienke Ansems, IGRAC, NL also Graham Alabaster: alabasterg@who.int Rifat Hossain :hossainr@who.int	April 2015	Simon Eggleston
17/18	TOPC Members provide ideas for Work Plan – vision for next five years and specific actions to GCOS Secretariat, and agree work plan	Send by End June	TOPC Members to send to GCOS Secretariat
17/19	Finalise work plan by August 2015	August	TOPC to discuss and agree
17/20	Explore the feasibility of holding annual TOPC workshops focusing specific topics	June 2015	TOPC Chair and GCOS Secretariat
17/21	Make proposals for new panel members. Try to extend membership and its diversity. Send any proposals to Konrad Steffen copied to Simon Eggleston	end- July	TOPC Chair, GCOS Chair and GCOS Secretariat
17/22	Identify GCOS presentation in Year of Polar Prediction (YOPP) Planning Summit 13-15 July 2015, WMO, Geneva	April 2015	GCOS Secretariat

ACTION	Task	Deadline	Responsibility
17/23	GCOS Panels to discuss how to possibly engage in new potential areas: urban and mega cities, decadal predictions, planet data initiative, expanded mandate into VIA and other services	December 2015	All Panel Co-chairs
17/24	Send formal invitation to SC-23 in Cape Town to Alan Belward	April 2015	GCOS Secretariat
17/25	Panel Chairs to send nominees to IP writing team	August 2015	Panel Chairs, GCOS Secretariat
17/26	Clarify list of constituents for ECV for atmospheric composition (CO_2, CH_4, NO_2, other long-lived greenhouse gases and pre-cursors).	September 2015 (in time new for implementation plan drafting)	GCOS Secretariat
17/27	Appoint a panel member to attend other panels. There should be a standing invitation for panel chairs to attend meetings	Before next panel meeting	Panel Chairs, GCOS Secretariat
17/28	Ensure actions are delegated and consider an executive group to oversee progress.	June 2015	Panel Chairs
17/29	Continue to improve the Lakes ECV by: 1) Improve the technique of satellite water level measurements by comparative analysis of the results of satellite and in situ observations to explore the impact of different factors on the accuracy of satellite water level measurements. 2) Establish trial products - lakes surface temperature and ice thickness change - for the last 25-30 years using in-situ observations.	2017 2017	Legos/CNES HYDROLARE HYDROLARE

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