

# Summary Report of the Eleventh Session of the Terrestrial Observation Panel for Climate of the Global Climate Observing System and Global Terrestrial Observing System

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## Acronyms

|           |  |
|-----------|--|
| CEOS      | Committee on Earth Observation Satellites                  |
| CNRS      | Centre national de la recherche scientifique               |
| COP       | Conference of the Parties                                  |
| CTDC      | Centre for Terrestrial Carbon Dynamics                     |
| ECVs      | Essential Climate Variables                                |
| ETN-R     | European Terrestrial Network for River Discharge           |
| FRP       | Fire radiative power                                       |
| GCOS      | Global Climate Observing System                            |
| GCOS IP   | Global Climate Observing System Implementation Plan        |
| GCOS PR   | Global Climate Observing System 2009 Progress Report       |
| GCOS SC   | Global Climate Observing System Steering Committee         |
| GEO       | Group on Earth Observations                                |
| GGMS      | Global Groundwater Monitoring System                       |
| GOFC/GOLD | GTOS Panels on Global Observation of Forest and Land Cover |
| GRACE     | Gravity Recovery and Climate Experiment                    |
| GRDC      | Global Runoff Data Centre                                  |
| GTNs      | Global Terrestrial Networks                                |
| GTN-G     | Global Terrestrial Network for Glaciers                    |
| GTN-GW    | Global Monitoring of Groundwater Resources                 |
| GTN-H     | Global Terrestrial Network for Hydrology                   |
| GTN-P     | Global Terrestrial Network for Permafrost                  |
| GTN-R     | Global Terrestrial Network for River Discharge             |
| GTOS      | Global Terrestrial Observing System                        |
| GTOS SC   | Global Terrestrial Observing System Steering Committee     |
| IES       | Institute for Environment and Sustainability               |
| EC        | European Commission  |
| IGBP      | International Geosphere-Biosphere Programme                |
| IGOS      | Integrated Global Observing Strategy                       |
| IGRAC     | International Groundwater Resources Assessment Centre      |
| IP        | Implementation Plan  |
| IPCC      | Intergovernmental Panel on Climate Change                  |
| ISO       | International Organization for Standardization             |
| JRC       | Joint Research Centre                                      |
| LCCS      | Land Cover Classification System                           |
| NRC       | Environment, Climate Change and Bioenergy Division         |
| SBSTA     | Subsidiary Body for Scientific and Technological Advice    |
| TCO       | Terrestrial Carbon Observations                            |
| TOPC      | Terrestrial Observation Panel for Climate                  |
| UNEP      | United Nations Environment Programme                       |
| UNESCO    | UN Educational Scientific and Cultural Organization        |
| UNFCCC    | United Nations Framework Convention on Climate Change      |
| WCRP      | World Climate Research Programme                           |

# 1. Meeting Report

## 1.1. TOPC: Introduction and Background

TOPC is an expert panel co-sponsored by the GTOS and GCOS programmes and liaises with relevant research and operational communities to identify measurable terrestrial properties and attributes that control the physical, biological and chemical processes affecting climate, are themselves affected by climate change, or serve as indicators of climate change. The TOPC 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 climate data and information and its assimilation, and promoting climate studies and assessments. The chair of the TOPC is a subsidiary member of the steering committees for GTOS and GCOS and reports the results of TOPC deliberations to these bodies.

Members and other invitees attended the Eleventh Session of the TOPC conference on 29-30 October in FAO Headquarters (Rome, Italy) to continue deliberations on issues related to terrestrial observations for climate.

## 1.2. Welcome and Approval of Agenda

Han Dolman (Chair of TOPC) welcomed meeting participants and provided a brief background of TOPC and efforts to date. The Agenda was also approved and amended through the course of the meeting to devote sufficient time for each Agenda item.

Konrad Steffen (cryosphere/ice sheets expert) was unable to attend. Wilfried Haeberli covered cryosphere-related issues in the meeting. Michel M. Verstraete (JRC) was unable to attend and was represented by Bernard Pinty. Jan Polcher was unable to attend. See Annex-IV for list of participants.

## 1.3. Clarification of TOPC mandate and IGOL role

The mandate of TOPC was discussed with members and new participants, and clarified. In particular, the difference between standards and observational needs was explained TOPC is driving the technical initiatives of several IGOS themes (cryosphere, land cover, water) so TOPC work is in high demand and considered essential. The IGOS themes are currently being folded into Communities of Practice under GEO.

The core business of TOPC in the current meeting is ECV development and to have a critical examination of current standards reports for ECVs that will be printed for UNFCCC COP-14 in Poznan, Poland (1-13 December 2008).

Stephan Bojinski (GCOS) added that the TOPC provides valuable work. For example, GCOS produced the satellite supplement to the GCOS IP for space agencies (e.g., under CEOS) who have taken up the requirements very seriously and are trying to follow through with them. For example, the EUMETSAT Climate Monitoring Satellite Applications Facility has been using those requirements as a basis for their product development. Therefore, regular updates of those requirements by GCOS panels, including by TOPC, remains very important. TOPC is therefore of great value to the climate change community, in particular of course, in regards to terrestrial based observations.

#### 1.4. TOPC Terms of Reference (TOR)

Stephan Bojinski stated that TOPC's current TORs seem very specific and appear to be more as a workplan. Therefore, the TORs need to be more general to illustrate the mandate and functions of TOPC more meaningfully.

Action 1: The current ("old") TORs to be put into the meeting report as an Annex (see TOR at [www.wmo.int/pages/prog/gcos/index.php?name=topc](http://www.wmo.int/pages/prog/gcos/index.php?name=topc)) and include Annex-III of the 2007 TOPC report and re-label it as "Work Plan 2007-2011". (Qamar, DONE)

Action 2: Update TORs in the GTOS website accordingly as well as on the GOSIC website (<http://gotic.org/gtos/TOPC-prog-overview.htm>). Send an e-mail to Christina Lief ([christina.lief@noaa.gov](mailto:christina.lief@noaa.gov)) for this purpose. (Qamar)

#### 1.5. Status of Global Terrestrial Networks (GTNs)

Global Terrestrial Network – Rivers (GTN-R) (Ulrich Looser):

##### Update

- Station selection in the GTN-R could be confirmed for 185 stations together with the National Hydrological Services
- Station selection for 265 stations is still pending
- 10 countries provided historical data for the confirmed stations
- 11 countries provide station metadata

- 3 countries provide daily near real-time discharge data

#### Issues to consider

- Need to highlight that GTN-R relevant countries should participate through assisting with station selection and the provision of metadata, historical data and near real-time discharge data for the selected stations.
- General awareness-raising on the need for free and unrestricted exchange of hydro-meteorological data is required, e.g. on the part of the WMO Commission for Hydrology.
- General awareness-raising on the need for long, uninterrupted river discharge data records, especially for pristine basins and sea outlet stations. Appeal to the National Hydrological Services to especially sustain those stations on a long term basis.

#### Pristine Basins:

- WMO and UNESCO to meet to discuss a strategy and action plan to establish a pristine basin river discharge monitoring network. (Meeting dates have been postponed several times.).

#### Actions GTN-R:

Action 3: After approval by the Commission for Hydrology in November 2008, approach all 82 GTN-R countries, with the assistance of the WMO, to inform them on the status of the GTN-R and the country specific situation (GRDC).

Action 4: Request non-participating countries to contribute to the GTN-R (GRDC).

Action 5: Finalise station selection (GRDC)

Action 6: Extend metadata and historical data collection for confirmed GTN-R station (GRDC).

Action 7: Extend near real-time data transfer (GRDC).

Action 8: Adopt near real-time data collection software to GTN-R requirements (GRDC).

Action 9: Explore funding mechanisms for the management, extension and operation of the GTN-R as part of the HARON proposal for funding to the European Commission (WMO; GCOS; GEO).

Action 10: Explore funding mechanisms for infrastructure investments to equip and maintain neglected GTN-R network stations (WMO; GCOS; GEO).

#### Pristine Basins:

Action 11: Contact the WMO Hydrological Commission on the pristine areas and basins initiative and other related activities to assess the need to create an advisory group (as proposed by the GCOS SC) (WMO, GCOS).

Action 12: After approval by the Commission for Hydrology in November 2008, approach all WMO member countries with the assistance of the WMO to request identification of pristine basins and the provision of metadata and historical discharge data for inclusion into the GRDC database (WMO, GCOS).

#### Global Terrestrial Network – Lakes (GTN-L) (Vuglinsky; Cretaux):

Action 13: SHI /HYDROLARE and CNES/LEGOS to agree on a collaborative agreement that would facilitate the contribution of the Hydroweb database (a database for lake level and surface variations from satellite remote sensing: radar altimetry and multi-spectral imagery) to HYDROLARE, noting the complementary nature of both efforts. Both institutions will work in cooperation on the implementation of an interface between Hydroweb data base and Hydrolare data centre. Exchange of bilateral visits between CNES/LEGOS and HYDROLARE in 2009 should be encouraged for this purpose, including the HYDROLARE Steering Committee meeting in July 2009 (Vuglinsky, Cretaux).

Action 14: Make corrections on the current version of ECV T4: Water level in lakes and reservoirs, water storage:

- Shorten the Executive summary up to 2 pages (Vuglinsky)
- Verify the text of the sub-chapter 3.2 Satellite measurements (Cretaux)

Priority: Specify the list of Priority Lakes in Global Terrestrial Network Lakes (GTN-L)

Action 15: Make a sorting of lakes based on their purpose:

- Choose lakes that are indicators of climate change (Vuglinsky)

- Choose lakes that are actively used in industry (Vuglinsky)
- Choose lakes that play an important role for other ECVs (Vuglinsky)
- Review list of lakes in GTN-L for relevance and currency, in collaboration with the community (TOPC and partner institutions, e.g., CNES/LEGOS)

#### Action 16: Obtain ISO Standards for channels (Vuglinsky)

On the question of lake freeze-up and break-up data, the session noted that different methodologies existed in different countries to carry out observations, leading to different results. These data were important indicators for climate impacts, and should be included in the GTN-L data collection effort, and not in the cryosphere. Further, the frozen state of rivers should be considered within the framework of the Global Terrestrial Network Hydrology (GTN-H).

#### Global Terrestrial Network – Glaciers (GTN-G) (Haeberli):

GTN-G has been in existence since the late 1990s. The Global Hierarchical Observing Strategy (GHOST) foresaw the provision of layers of data and information for terrestrial observation that helped both in developing the glacial network and permafrost network. Data was being submitted in the beginning according to this strategy. The work of TOPC has been very successful in supporting GTN-G activities.

There is a clearly defined responsible organization for this ECV (WGMS together with NSIDC and GLIMS), a well developed strategy, important new activities (such as the ESA-funded GlobGlacier project) and most recent publications and assessments (Glacier Mass Balance Bulletin, Global Glacier Changes: facts and figures by UNEP/WGMS 2008). The continuation of LANDSAT-, SPOT- or ASTER-type satellite missions will be absolutely essential and new InSAR-missions for DEM production should be planned. National funding for WGMS is now strongly improved but international funding remains weak. Accumulation patterns remain a difficult part of the monitoring/modelling scheme. Important new aspects concern the introduction of uncertainty ratings for mass balance and timely replacement of mass balance observations on small/vanishing glaciers by corresponding monitoring on larger glaciers with longer life time. With the increasing signs of "down-wasting", disintegration and collapse" rather than "active retreat" of glaciers, the use of data on cumulative length change for assessing the representativeness of the much less numerous mass balance series must be replaced by DEM differencing.

Haeberli emphasized the importance of correct terminology: there is a clear distinction between continental ice sheets (i.e., Greenland and Antarctica)

and glaciers/ice caps. Further questions are what does and does not constitute land ice.

### Current priorities

**Action 17: Definitive installation of the new lead structure (steering committee) for GTN-G as cooperation between WGMS, NSIDC and GLIMS under the auspices of the International Association of Cryospheric Sciences (IACS/IUGG).**

### Future priorities

Further the systematic integration of modern technologies (remote sensing, digital terrain information, geo-informatics) by internationally coordinated programmes such as GLIMS and now GlobGlacier.

### Recent developments

There are clear signs of accelerated melting in many regions from in-situ and remote sensing observations. First, assessment of spatial representativeness of few mass balance time series from DEM differencing for large glacier ensembles. Many activities exist related to numerical modelling of glaciers (e.g., by calculating the energy balance) but also an increasing mix of measured and modelled data.

### Other issues to consider

The GTOS/TOPC philosophy and the GHOST strategy connecting detailed local measurements for process understanding and model development/calibration with global coverage at pixel resolution are most helpful, but still need better recognition in the specialized scientific community. Also, IPCC could make better use of the applied strategy and corresponding multilevel information.

### Global Terrestrial Network – Permafrost (GTN-P) (Haeberli):

This network has a clearly defined responsible organization (International Permafrost Association IPA) and is still in an active build-up process. Main emphasis should be on installation of additional borehole sites for observation on the Thermal State of Permafrost (TSP), remote data acquisition in connection with other observations, and creation of a monitoring network for seasonally frozen ground in connection with WMO and cold regions meteorological stations. Data rescue must continue and up-scaling must be done with numerical models for complex topography and surface characteristics (vegetation, wind drift), requiring high-resolution DEMs. IPY is expected to contribute essentially to such goals. The application of gravity information from air/space to assess subsurface mass changes (ice loss) should be investigated as a research topic. Funding for data management is still missing and must be improved in order to also allow for

periodical publications and assessments, given that the visibility of permafrost measurements in the public and in the scientific community is still low.

The mountain component of permafrost is missing. It may be good to involve some mountain experts in the TOPC to provide valuable perspectives in this area. The list of colleagues who are responsible for GTN-P contains a number of internationally recognized experts for high-latitude lowland permafrost. This could increase the credibility and the activity of the network.

The TSP/CALM Manual mentions "vertical displacement" as an important part of active layer thickness measurements, but the ECV description does not. Vertical displacement *must* be measured in a reasonable way and with appropriate frequency/accuracy in order to enable correct interpretation of climate change effects. Furthermore, a strong recommendation is also needed that information on soil humidity and snow cover (thickness, duration, water equivalent) should also be collected for process understanding and analysis/numerical modelling of measured data.

The original ECV GTN-P was just "Permafrost" - no seasonally frozen ground. Active layer observations belong to seasonally frozen ground. This term, however, also includes seasonally frozen ground outside permafrost areas which is a completely different field. Operational in-situ measurements of that variable are probably rather spotty and may be marginally representative in many regions. Space-borne observations may become available in the future but so far remain a research topic. IPA is a clearly defined responsible organization for permafrost but probably not for seasonally frozen ground. This means that another responsible organisation would have to be found. In addition, the climatic significance would have to be more exactly described (keeping in mind that ECVs are "essential" - not "every" - climate variable(s)).

In short: should GTN-P really have the addition of "seasonally frozen ground" or would it not be better to come back to "Permafrost" alone (the term "active layer" is commonly understood to be related to permafrost)?

**Action 18: Review the definition of the permafrost ECV during the update of the GCOS IP planned for 2009 (Bojinski, Haeberli).**

Snow cover (Haeberli):

Current *in-situ* networks for snow are still insufficient and must urgently start to be improved. This is a very difficult task but must now be undertaken, beginning with parts already available (for instance Canadian

daily snow data or long-term measurement series in the Alps or in the former Soviet Union.

**Action 19:** Due to a substantial gap associated with snow in the observing system, seek a snow specialist replacement for Haeberli as a TOPC member in 2009, who can take a strong initiative in this important area (Dolman).

GTN-Carbon (Valentini; Bombelli):

TCO will work in close cooperation with TOPC for any issues linking the carbon cycle to the climate system.

TCO will support TOPC for the proposal of a new ECV: "Terrestrial Carbon Fluxes". Understanding and managing GHGs fluxes (emissions and sinks) contributes to a better understanding of global change drivers and possible mitigation options.

**Action 20:** Consider carbon fluxes as a possible addition to the list of ECVs during the planned update of the GCOS IP (Dolman, Bombelli; Bojinski).

## 1.6. Terrestrial Framework and Standards Development

Latham (GTOS Programme Director) discussed the importance and need of a comprehensive framework for global terrestrial observations. This enabled participants to understand the policy dimension of climate change at the international level, particularly related to the UNFCCC COP, SBSTA and ISO. The joint UN-ISO mechanism option for the standardization of key terrestrial essential climate variables will bring together the knowledge and expertise of respective UN agencies and ISO through its technical committees TC207 (environmental management) and TC211 (Geographic information/Geomatics), and possibly other relevant technical committees (such as TC113 on hydrometry). The engagement of national bodies in the use of these standards remains an ongoing challenge.

GTOS with partners has been acting on a request by the UNFCCC COP to develop a framework for the preparation of guidance materials, standards and reporting guidelines for terrestrial observing systems for climate, and associated data and products. GTOS prepared and submitted progress reports to two SBSTA meetings and now intends to present a specific proposal for SBSTA-30 in June 2009. The efforts of TOPC are important as its technical expertise and input will contribute to the development of standards towards such a mechanism.

**Action 21:** TOPC should remain in liaison with WMO and FAO in defining its role within the ISO-based terrestrial framework

Standards and ECV development (see <http://www.fao.org/gtos/pubs.html>).

The assessment of the development of standards for the current 13 terrestrial ECVs was discussed by Sessa and other participants to ensure continued relevance to observations stakeholders and to take into account current technologies and observational capacities. The review process should be undertaken through the examination of current literature (especially the IGOS reports) and assessment should take into consideration the needs of a broad spectrum of end users, its observational importance and the feasibility of undertaking the measurement.

#### Fire(Tansey):

Kevin Tansey gave a short presentation on the Fire Disturbance ECV. Fire is an emitter of GHG and aerosols into the atmosphere is an indicator of land cover/use change and under climate change scenarios, the impacts and feedbacks of fire on vegetation need to be established.

The current state of the art, includes products of burned area, namely MODIS, L3JRC, GlobCarbon plus a significant amount of regional data. At present there are no standards on validation or intercomparisons. Flaming fire detection products include MODIS, WFA, EUMETSAT, TRMM. A number of these include estimates of the fire radiative power considered to be related to the total biomass consumed (an indicator of severity). A number of emissions databases exist. There are a number of limitations for the successful detection of an active fire.

Activities focusing on validation and standardisation of methods are limited at present but improving. No true validation of a global product exist, it is more of an evaluation of existing products. Validation data is geographically limited; there is a reliance on secondary ground data (normally based on Landsat pairs). The community agrees on the need for validation protocols. Validation tools and standards are being planned under Geoland2, MODIS & CEOS. A report is being prepared for discussion in early 2009.

Currently, GCOS IP targets are not being met in terms of reporting accuracy. A dedicated fire mission comprising thermal, near and middle IR observations providing near daily coverage at resolutions greater than 250m is needed to reduce the impact of cloud cover. A wide swath thermal imager for active fire detection and FRP estimates is also needed. Investigations of the use of radar imagery are necessary.

**Action 22: Update the ECV T13: Fire Disturbance. Assess the status of the development of standards for the Terrestrial Essential Climate Variables**

document. Discussion points including updating the status of FRP developments, report on how future ESA Sentinel and geostationary missions will contribute to this effort and to report on the understanding of the status of ground fire detection and monitoring. (Tansey, GOF-C-GOLD)

Action 23: Establish validation protocols working through CEOS LPV and other partners. A concerted effort is required to implement them. The EC FP7 GMES fast track land service GEOLAND2 project has a burnt area validation component. (Tansey)

Action 24: Going back to 1982 with the AVHRR products, there needs to be similar accuracy assessment effort preferably to CEOS Stage 3. A 1km AVHRR initiative is needed - which could go back to 92 with gap filling in 1999. (Tansey, TOPC, GOF-C-GOLD)

Action 25: Work towards a centralized facility. The community has developed a Land Measurement Portal which includes fire (<http://landportal.gsfc.nasa.gov/>) that could be managed at any location - at this time NASA has stepped up. The idea of a centralized facility for all fire data seems to be a long way off at this time - given the various interoperability efforts which are underway in the various agencies. A different approach might be to work/push for one location (portal) where all fire products are listed with active links to data, including validation data with the published accuracy assessment and an informed description/guide for the user community as to which data are appropriate for which broad kind of analysis. Once we have operational agencies with operational fire products and move out of the research domain then perhaps we can revisit centralization issue. (Tansey, TOPC, GTOS Sec.)

## 1.7. Progress Report of the GCOS IP

Stephan Bojinski discussed two items: (i) GCOS 2009 Progress Report (GCOS PR); (ii) GCOS Implementation Plan (GCOS IP). The structure of the GCOS PR was explained, and included an overview and context of the information and feedback needed for the terrestrial domain. The GCOS IP was to be used as background material. Furthermore, a writing strategy was proposed: main drafting was to be done by GTOS technical Panel Chairs and partner observing systems (GOOS, GTOS, WMO/WIGOS) through the GCOS Secretariat. The Progress Report is to be submitted to the UNFCCC for consideration at SBSTA-30 in June 2009. The document was discussed in more detail in a meeting at WMO headquarters in Geneva in November 2008 and will be available for open review by early April 2009. The aim is to finalize the GCOS Progress Report by mid-2009.

Feedback for the new GCOS IP is to be based on an update (and not rewrite) of the 2004 GCOS IP, and is to take into account developments in the past five years, including:

- Satellites: mission plans, reprocessing
- Adaptation: regional issues, impact & vulnerabilities
- Mitigation: carbon monitoring, REDD
- IPCC AR4, GEO/GEOSS, WMO Integrated Observing Systems
- Informed by 2009 Progress Report

Particular attention is to be given to areas that need to be strengthened or that have gaps, including issues related to the cryosphere, atmospheric chemistry and carbon. Moreover, there should be a clear distinction between continuous observation needs and research observations. Other issues to consider include cross-ECV issues and a revised ECV list. Though feedback for the GCOS IP is still open, the following are two examples of input provided by meeting participants:

- Famiglietti added a short section on groundwater monitoring (combining satellites with models and insitu data.) Riccardo Valentini suggested addition of a new ECV 'carbon fluxes'
- Vuglinsky said there are only 150 lakes in the GCOS IP that needs to be revised and updated.

## 1.8. Liaison to other coordination groups

TOPC noted the following recommendations from panels related to the World Climate Research Programme:

The WCRP/GCOS Observations and Assimilation Panel (WOAP) recommended that "TOPC should consider the organization of some workshops and related activities to promote the development of land-domain datasets that meet the GCMPs" (WOAP-3; 4.6)

The WCRP Climate and Cryosphere Project (CliC) recommended that: "CliC SSG should liaise with TOPC in the framework of the GCW to develop a project to develop a global climatology of snow water eq" (3.8)

## 1.9. Future Meetings

The venue of the next TOPC meeting (4-5 November 2009) is yet to be determined.

GTOS will participate in the UNFCCC COP-14 in Poznan Poland in December 2008. GTOS will have a booth and side event entitled "Enhancing country preparedness for post-Kyoto monitoring, assessment and action". The GTOS booth will have full draft ECV documents for selected ECVs for visitors. The draft documents will be finalized by SBSTA-30 (Bonn, June 2009).

The following is the side event schedule:

- 18:00 John Zillman (GCOS Steering Committee Chairman)  
Opening of the session and general remarks
- 18:05 John Latham (GTOS Programme Director)  
The need for standards and the development of a UN and International Organization for Standardization (ISO) terrestrial framework mechanism
- 18:15 Peter Holmgren (Director, Environment, Climate Change and Bioenergy Division, FAO)  
Requirements for improved observations and access to satellite data as a critical preparatory process for the UN-REDD Programme
- 18:25 Riccardo Valentini (TCO Chair)  
Terrestrial Carbon Observations and REDD potential in Sub-Saharan Africa as an example of global carbon monitoring
- 18:35 Wilfried Haeberli (GTN-G)  
The importance of monitoring networks for snow and ice in view to changing water resources and flood hazards at local to continental and global scales

18:45 William Westermeyer (GCOS Secretariat)

GTN-H the vital framework for global monitoring of rivers, lakes, precipitation and other key elements of the water cycle vital for adapting to climate change.

18:55 Kevin Tansey (University of Leicester)

Fire disturbances impact on climate, ecosystems and humans. Status and needs for mapping, monitoring, validation and standardization are summarised.

19:05 Discussion and questions 19:25 Wrap up and closure

## Annex I: TOPC Terms of Reference

- Recognizing the need for specific and technical input concerning terrestrial observations for climate purposes, the sponsoring organizations of GTOS and the GCOS have jointly established TOPC with the following terms of reference:
- To define the requirements for long-term monitoring of terrestrial properties for climate and climate change;
- 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;
- To assess and monitor the adequacy of terrestrial observing networks (in-situ, satellite-based) and promote the development of their capacity to measure terrestrial properties and exchange climate data and information;
- 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;
- To coordinate activities with other global observing system panels and task groups to ensure consistency of requirements with the overall programmes;
- Publish and update GCOS/GTOS studies and planning documents;
- Carry out agreed assignments from the GCOS and GTOS Steering Committees;
- Report regularly to the GCOS and GTOS Steering Committees.

## Annex II: TOPC Work Plan (2007 – 2011)

- To identify key ECV's that play a role in feedbacks (amplification and impacts) within the climate system (snow, glaciers, lake level) and reassess whether current approaches to their measurement is adequate.
- Increased attention on coordination and long term maintenance of in situ networks to establish both independent bottom up data sets of ECV's and data sets required for calibration and validation of Earth Observation data.
- Investigate how a number of current research networks (e.g. Fluxnet, LTER's) can be effectively adopted (or endorsed) by GCOS/GTOS terrestrial networks.
- Promote the development of data integration and assimilation techniques for the terrestrial domain.
- Ensure that the five current Global Terrestrial Networks (hydrology, glaciers, permafrost, rivers, lakes) are fully implemented.
- Through GCOS and GTOS maintain strong links with SBSTA and UNFCCC and relevant international research programmes (e.g. WCRP, IGBP) in defining key requirements for observations of the terrestrial ECV's.
- Contribute to the 2009 GCOS progress report to the UNFCCC.
- Link with international opportunities to promote the need for continued observations such as the International Polar Year 2007-2008 ([www.ipy.org](http://www.ipy.org)), the International Year of Planet Earth 2007 - 2009 ([www.esfs.org](http://www.esfs.org)) and subsequent initiatives.
- Maintain engagement of CEOS to ensure delivery of required satellite observations as stated in the GCOS 107 report.
- Maintain engagement with efforts to establish international (continental) terrestrial observation networks.
- Liaise with GTOS wherever appropriate, e.g. in the establishment of guidelines and standards for the observation of terrestrial ECVs.
- Liaise with GCOS and GTOS science Panels on issues of common interest.

## Annex III: List of Actions

Action 1: The current (“old”) TORs to be put into the meeting report as an Annex (see TOR at [www.wmo.int/pages/prog/gcos/index.php?name=topc](http://www.wmo.int/pages/prog/gcos/index.php?name=topc)) and include Annex-III of the 2007 TOPC report and re-label it as “Work Plan 2007-2011”. (Qamar, DONE)

Action 2: Update TORs in the GTOS website accordingly as well as on the GOSIC website (<http://gosis.org/gtos/TOPC-prog-overview.htm>). Send an e-mail to Christina Lief ([christina.lief@noaa.gov](mailto:christina.lief@noaa.gov)) for this purpose. (Qamar)

Action 3: After approval by the Commission for Hydrology in November 2008, approach all 82 GTN-R countries, with the assistance of the WMO, to inform them on the status of the GTN-R and the country specific situation (GRDC).

Action 4: Request non-participating countries to contribute to the GTN-R (GRDC).

Action 5: Finalise station selection (GRDC)

Action 6: Extend metadata and historical data collection for confirmed GTN-R station (GRDC).

Action 7: Extend near real-time data transfer (GRDC).

Action 8: Adopt near real-time data collection software to GTN-R requirements (GRDC).

Action 9: Explore funding mechanisms for the management, extension and operation of the GTN-R as part of the HARON proposal for funding to the European Commission (WMO; GCOS; GEO).

Action 10: Explore funding mechanisms for infrastructure investments to equip and maintain neglected GTN-R network stations (WMO; GCOS; GEO).

Action 11: Contact the WMO Hydrological Commission on the pristine areas and basins initiative and other related activities to assess the need to create an advisory group (as proposed by the GCOS SC) (WMO, GCOS).

Action 12: After approval by the Commission for Hydrology in November 2008, approach all WMO member countries with the assistance of the WMO to request identification of pristine basins and the provision of metadata and

historical discharge data for inclusion into the GRDC database (WMO, GCOS).

Action 13: SHI /HYDROLARE and CNES/LEGOS to agree on a collaborative agreement that would facilitate the contribution of the Hydroweb database (a database for lake level and surface variations from satellite remote sensing: radar altimetry and multi-spectral imagery) to HYDROLARE, noting the complementary nature of both efforts. Both institutions will work in cooperation on the implementation of an interface between Hydroweb data base and Hydrolare data centre. Exchange of bilateral visits between CNES/LEGOS and HYDROLARE in 2009 should be encouraged for this purpose, including the HYDROLARE Steering Committee meeting in July 2009 (Vuglinsky, Cretaux).

Action 14: Make corrections on the current version of ECV T4: Water level in lakes and reservoirs, water storage:

- Shorten the Executive summary up to 2 pages (Vuglinsky)
- Verify the text of the sub-chapter 3.2 Satellite measurements (Cretaux)

Action 15: Make a sorting of lakes based on their purpose:

- Choose lakes that are indicators of climate change (Vuglinsky)
- Choose lakes that are actively used in industry (Vuglinsky)
- Choose lakes that play an important role for other ECVs (Vuglinsky)
- Review list of lakes in GTN-L for relevance and currency, in collaboration with the community (TOPC and partner institutions, e.g., CNES/LEGOS)

Action 16: Obtain ISO Standards for channels (Vuglinsky).

Action 17: Definitive installation of the new lead structure (steering committee) for GTN-G as cooperation between WGMS, NSIDC and GLIMS under the auspices of the International Association of Cryospheric Sciences (IACS/IUGG).

Action 18: Review the definition of the permafrost ECV during the update of the GCOS IP planned for 2009 (Bojinski, Haeberli).

Action 19: Due to a substantial gap associated with snow in the observing system, seek a snow specialist replacement for Haeberli as a TOPC member in 2009, who can take a strong initiative in this important area (Dolman).

Action 20: Consider carbon fluxes as a possible addition to the list of ECVs during the planned update of the GCOS IP (Dolman, Bombelli; Bojinski).

Action 21: TOPC should remain in liaison with WMO and FAO in defining its role within the ISO-based terrestrial framework

Action 22: Update the ECV T13: Fire Disturbance. Assess the status of the development of standards for the Terrestrial Essential Climate Variables document. Discussion points including updating the status of FRP developments, report on how future ESA Sentinel and geostationary missions will contribute to this effort and to report on the understanding of the status of ground fire detection and monitoring. (Tansey, GOFC-GOLD)

Action 23: Establish validation protocols working through CEOS LPV and other partners. A concerted effort is required to implement them. The EC FP7 GMES fast track land service GEOLAND2 project has a burnt area validation component. (Tansey)

Action 24: Going back to 1982 with the AVHRR products, there needs to be similar accuracy assessment effort preferably to CEOS Stage 3. A 1km AVHRR initiative is needed - which could go back to 92 with gap filling in 1999. (Tansey, TOPC, GOFC-GOLD)

Action 25: Work towards a centralized facility. The community has developed a Land Measurement Portal which includes fire (<http://landportal.gsfc.nasa.gov/>) that could be managed at any location - at this time NASA has stepped up. The idea of a centralized facility for all fire data seems to be a long way off at this time - given the various interoperability efforts which are underway in the various agencies. A different approach might be to work/push for one location (portal) where all fire products are listed with active links to data, including validation data with the published accuracy assessment and an informed description/guide for the user community as to which data are appropriate for which broad kind of analysis. Once we have operational agencies with operational fire products and move out of the research domain then perhaps we can revisit centralization issue. (Tansey, TOPC, GTOS Sec.)

## Annex IV: Meeting Agenda

**30 October 2008:** FAO HQ, Rome Italy

1. Welcome and introduction (H. Dolman)
2. Review of Agenda (all)
3. Brief introduction of each member (all)
4. Role of TOPC in GCOS & GTOS (H. Dolman/S. Bojinski/J. Latham)
5. Report from GCOS Steering Committee 2008 (H. Dolman)
6. Progress/update of actions in 10th Session TOPC Report (2007), including development of carbon observations, soil moisture, relation to TCO (All)
7. Status of Standards and Guidelines for Terrestrial ECVs (GTOS) (R. Sessa)
  - Pertinent documents:
    - Terrestrial Essential Climate Variables for Climate Change Assessment, Mitigation and Adaptation
    - Folder with all ECV documents
8. Fire: products, disturbance and evolution (K. Tansey)
9. GTN's overview
  - 9.1. GTN-G/permafrost (Haeberli)
  - 9.2. GTN-R (Looser)
  - 9.3. GTN-GW (Famiglietti)
  - 9.4. GTN-H/lakes (V. Vuglinsky)
  - 9.5. Lake monitoring from space in support of GTN-L (J. Crétaux)
  - 9.6. Overview of carbon networks (R. Valentini / A. Bombelli)
10. 2009 GCOS Progress Report: Assessment of progress against Terrestrial component of GCOS Implementation Plan (S. Bojinski)
11. 2009 GCOS Progress Report: feedback from participants (all)
12. ECV review in relation to IGOS documents; Update of GCOS IP (all)
  - Pertinent documents:
    - GCOS Implementation Plan
    - GCOS Progress Report
    - IGOS Reports
13. Establishment of Terrestrial Framework: Status, plans and roles of TOPC/GTOS (J. Latham)
  - Pertinent documents:
    - GTOS terrestrial ECV activities
    - GTOS terrestrial framework activities
14. Future actions (H. Dolman; all)
  - Meeting summary
  - Follow-up actions
15. Calendar and future meetings (H. Dolman; all)
  - Next TOPC Meeting (2009)
  - UNFCCC COP XIV (Poland)—TOPC participation
  - Other
16. Meeting close (30 October AOB)

## Annex V: Meeting Participants

| Participants              | Affiliation  | Theme of expertise                               |
|---------------------------|--|--|
| <b>Han Dolman</b>         | TOPC Chair<br>Faculty of Earth and Life Sciences<br>Vrije Universiteit Amsterdam<br>1081 HV Amsterdam, Netherlands<br>Phone: +31-20-5987358/7303<br>Fax: +31-20-5989940<br>E-mail: han.dolman@geo.falw.vu.nl   | Land surface processes, carbon cycle             |
| <b>James Famiglietti</b>  | Earth System Science<br>3317 Croul Hall<br>University of California, Irvine<br>Irvine, CA 92697-3100<br>Phone: +1-(949) 824-9434<br>Fax: +1-(949) 824-3874<br>E-mail: jfamigli@uci.edu   | Hydrology, GRACE, groundwater and related themes |
| <b>Wilfried Haerberli</b> | Director<br>Physical Geography Division<br>Geographisches Institut - Physical Geography<br>Universität Zürich<br>Winterthurerstr. 190 – Irchel<br>CH-8057 Zürich, Switzerland<br>Phone: +41-(0)44 635 51 20<br>Fax: +41-(0) 44 635 40 04<br>E-mail: haerberli@geo.unizh.ch | Glaciers, permafrost and related themes          |
| <b>Ulrich Looser</b>      | Head<br>Global Runoff Data Centre (GRDC)<br>Federal Institute of Hydrology (BfG)<br>Am Mainzer Tor 1<br>56068 Koblenz Germany<br>E-mail: looser@bafg.de<br>phone: +49-(0)261 1306 5224<br>fax: +49-(0)261 1306 5722  | Surface hydrology and related themes             |
| <b>Valery Vuglinsky</b>   | State Hydrological Institute of<br>Roshydromet<br>23, Second Line<br>SU-199053 St. Petersburg / Russia<br>Phone: +7-812 323-3458<br>Fax: +7-812 323-1028<br>E-mail: VVuglins@VV4218.spb.edu  | Lake hydrology and related themes                |
| <b>Stephan Bojinski</b>   | GCOS Secretariat<br>c/o World Meteorological Organization<br>7 bis, avenue de la Paix<br>P.O. Box 2300<br>1211 Geneva 2<br>Switzerland<br>Phone: +41-(0)22 730 80 67<br>E-Mail: sbojinski@wmo.int  | Secretariat GCOS: climate related themes         |

| Participants                 | Affiliation  | Theme of expertise  |
|------------------------------|--|---|
| <b>Antonio Bombelli</b>      | TCO<br>FAO, Italy<br>E-mail: antonio.bombelli@fao.org  | Carbon and related themes   |
| <b>Bernard Pinty</b>         | Joint Research Centre (JRC)<br>European Commission Italy<br>E-mail: bernard.pinty@jrc.it   | Remote sensing of land surface processes and related themes   |
| <b>Riccardo Valentini</b>    | Chair of TCO<br>Italy<br>E-mail: rik@unitus.it   | Carbon and related themes   |
| <b>Kevin Tansey</b>          | Admissions Tutor<br>Lecturer in Remote Sensing<br>Department of Geography<br>University of Leicester<br>Leicester, LE1 7RH<br>UK<br>Phone: +44-(0)116 2523859<br>Fax: +44-(0)116 2523854<br>Email: kjt7@le.ac.uk             | Fire and related themes   |
| <b>Shaun Quegan</b>          | Centre for Terrestrial Carbon Dynamics (CTCD)<br>University of Sheffield<br>Hicks Building<br>Hounsfield Road<br>Sheffield S3 7RH<br>Tel: +44-(0)114 222 3778<br>Fax: +44-(0)114 222 3809<br>Email: s.quegan@sheffield.ac.uk | Carbon, land cover and related themes   |
| <b>Jean-Francois Cretaux</b> | CNES/Legos<br>14 Av Edouard Belin,<br>31400 Toulouse<br>France<br>Phone: +33-5-61332989<br>Fax: +33-5-61253205<br>E-mail: jean-francois.cretaux@cnes.fr  | Hydroweb database and related themes.<br>Comments on improved list of lakes in GTN-L. Collaboration with V. Vuglinsky (Linking CNES/LEGOS efforts in deriving lake level and volume variations from space and linking those activities to the emerging Hydrolare International Lake Data Centre in St. Petersburg.) |
| <b>John Latham</b>           | GTOS Programme Director<br>GTOS Secretariat, Italy<br>E-mail: john.latham@fao.org  | Terrestrial observations and relevant themes  |
| <b>Zubair Qamar</b>          | GTOS Programme Officer<br>GTOS Secretariat, Italy<br>E-mail: zubair.qamar@fao.org  | Coordinator of TOPC panel meeting   |
| <b>Reuben Sessa</b>          | Environment Officer, NR, FAO, Italy<br>E-mail: reuben.sessa@fao.org  | ECVs and standards documents update and related themes  |

## Annex VI: TOPC Panel Members

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