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GCOS • WCRP



Terrestrial
Observation
Panel for
Climate

20th Session of the GCOS/WCRP Terrestrial Observation Panel for Climate (TOPC-20)

WMO, Geneva, Switzerland
19-21 March 2018

GCOS-219
WCRP-12/2018



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TABLE OF CONTENTS

1.	Opening of the Meeting.....	5
1.1	Welcome and introductions.....	5
1.2	Welcome by WMO.....	5
1.3	Adoption of Agenda.....	5
1.4	Introduction of Participants.....	5
1.5	Aims and expectations.....	5
2.	Updates and Information.....	6
2.1	Update from WCRP.....	6
2.2	Introduction to new GCOS Strategy.....	6
3.	TOPC-19 Action.....	7
3.1	Presentation of actions from TOPC-19 and discussion.....	7
3.2	Open and ongoing actions.....	8
4.	ECV Requirements.....	8
4.1	Introduction of ECV Requirements and need for updating them.....	8
4.2	Discussion.....	8
4.3	ECV Factsheets.....	8
4.4	Breakout Group Session.....	9
4.5	Breakout Group Reports and Summary.....	9
5.	Implementation Plan Actions.....	10
5.1	Overview of Actions.....	10
5.2	Breakout Group Session to discuss progress and issues arising from Implementation Plan Actions...	10
5.3	Breakout Group Reports and Summary.....	10
6.	GCOS Initiatives.....	11
6.1	Update of the Global terrestrial Network for Permafrost.....	11
6.2	GCOS Surface Reference Network.....	11
6.3	Identifying ECV to represent human adaptations to climate change.....	12
6.4	Task Teams on Lightning, Weather Radar and GRUAN.....	12
6.5	Discuss potential biosphere indicator.....	12
7.	Data Access.....	13
7.1	TOPC Website.....	13
8.	Next Steps.....	13
8.1	Discussion on how TOPC should work through 2018.....	13
8.2	Actions Arising.....	13
8.3	Date and time of next meeting.....	14
8.4	AOB and Meeting Closure.....	14

APPENDIX 1: Agenda..... 15
APPENDIX 2: List of Participants 17
APPENDIX 3: List of Actions from TOPC 20 20
APPENDIX 4: List of Action Rapporteurs..... 22

1. OPENING OF THE MEETING

1.1 Welcome and introductions

Carolin Richter, Director of the Global Climate Observing System (GCOS) Secretariat, welcomed the participants to the World Meteorological Organization (WMO) in Geneva, Switzerland. She was pleased that TOPC would hold this meeting here in the WMO headquarters since this also gives the opportunity to WMO to learn more about the important work of TOPC.

Stephen Briggs, Chair of the GCOS Steering Committee, also welcomed the participants and was pleased to attend the meeting as an ex-officio member.

Wolfgang Wagner, Chairman of TOPC, opened the 20th Session of the TOPC officially and thanked the Secretariat and WMO for hosting the meeting. He explained that it would be a working meeting with a strong focus on necessary work on ECV and only a few key talks.

1.2 Welcome by WMO

Deon Terblanche, acting Director of the World Climate Research Programme (WCRP) of WMO, welcomed the meeting participants at WMO and expressed his joy about hosting the meeting. The fact that TOPC is a joint panel between GCOS and WCRP would be very important since for both climate data is crucial. Observation, modelling and research communities need to collaborate in order to be able to help and guide climate policy to mitigate and adapt to climate change. The terrestrial aspect as represented by TOPC is an increasingly important component to close the gap in the main climate cycles, water, energy and carbon.

1.3 Adoption of Agenda

An additional presentation of Philippe Schoeneich, representative of the Global Terrestrial Network for Permafrost (GTN-P), about the new implementation plan of the GTN-P was included to the agenda and the agenda adopted.

1.4 Introduction of Participants

All participants introduced themselves. Huilin Li and Tom Painter sent apologies.

1.5 Aims and expectations

Wolfgang Wagner

[Aims and expectations](#)

Wolfgang Wagner presented the overall goals of the meeting. The panel should clarify crucial questions on whether it has the expertise to cover all Essential Climate Variables (ECVs) with its current membership. Since the membership of the panel is limited to twelve, there cannot be a specialized expert for all ECVs and ECV products., Therefore, the panel should connect very closely to the respective communities and reach out more in order to widen the spectrum. A special focus of this meeting would be on concrete actions, particularly on work on the ECVs including their requirements and how to increase community involvement. This includes a critical review of the current requirements.

Specific Panel tasks for this meeting were:

- Review of the adequacy of ECV observations
- Review of the ECV requirements
- How to monitor progress on IP actions as specified within GCOS-200

- ECV Factsheets

In order to work on these specific tasks, Wolfgang Wagner presented a web forum that was set up by his team at the Vienna University of Technology (TU Wien). It allows participants to post comments on specific discussion topics such as specific ECVs, Implementation Plan actions etc.

The panel agreed that the forum would be very useful and after a proof-of-concept it could be scaled up for the whole community.

2. UPDATES AND INFORMATION

2.1 Update from WCRP

Michel Rixen

[WCRP](#)

Michel Rixen presented an update for WCRP. The two overarching objectives of WCRP are to determine the climate predictability and the effect of human activities on the climate. Observations are critical across the entire WCRP enterprise, from process studies, to model development, initialization and verification, and there is a strong link to GCOS through the WCRP Data Advisory Council (WDAC).

Finally, the new WCRP strategy was presented to the panel. There is an explicit reference in the current draft strategic plan to a sustained observing systems and innovation, international coordinated field experiments, open data policies and interoperability, high-end data infrastructures and stronger WCRP-GCOS strategic alignment. The Implementation Plan will address WCRP-GCOS governance. In addition Michel Rixen explained that requirements for climate science will be derived from WCRP core projects like GEWEX.

After the presentation the participants discussed the data requirements and the difference between the application area “climate monitoring” and “climate science”. Process understanding was mentioned as main characteristic of climate science data and WCRP agreed that data for field experiments cannot be global. All agreed that it is necessary to provide explanations for the requirements as basis for discussions and that, in the future, more than one number should be provided. In principle the OSCAR approach should be followed to cover minimum, breakthrough and maximum requirements.

N°	Action	Who	When
14* ¹	Participate in review of WCRP Strategic Plan.	All	June 2018

2.2 Introduction to new GCOS Strategy

Stephen Briggs/
 Carolin Richter

[GCOS update](#)

Stephen Briggs and Carolin Richter presented an update of GCOS activities. Following action G3 and G4 of the GCOS Implementation Plan (GCOS-200), GCOS undertook the task to develop climate indicators, which was specifically noted by SBSTA. GCOS has now identified a set of Climate Indicators: surface temperature, ocean heat, atmospheric CO₂, sea level, ocean acidification, glacier mass balance and Arctic and Antarctic sea ice extent. These are meant to be used to tell stories about climate change in a way that can be

*¹ The Actions are numbered according to their due date, starting with the earliest, see Annex 3.

understood by non-experts. They are accompanied by a set of subsidiary indicators including extremes. Discussions on identifying a climate indicator for land surface, as phenology or greenness and for extremes are still ongoing and might be discussed during this TOPC meeting. Carolin Richter presented GCOS contribution to the Global Stocktake. The GCOS Steering Committee at its 25th meeting (GCOS SC-25) agreed to create a task force to determine how GCOS could contribute to the UNFCCC's Paris Agreement. The task force will also develop a plan for adaptation and mitigation that might then lead to the formation of a future GCOS panel on adaptation. The task force has identified several actions in the GCOS IP supporting Article 14 of the Paris agreement. Additionally, it has also identified new areas, such as monitoring of the urban areas, which will include the design of other urban based adaptation observations and the monitoring of the impacts of adaptation.

A document presenting the GCOS contribution to the UNFCCC's Paris Agreement is under preparation and once ready it will be shared with the UNFCCC and the GCOS Steering Committee. GCOS will also distribute the consolidated document to panel members. Carolin Richter presented the draft GCOS strategy plan, the GCOS Communication strategy and the time plan 2018-2023, which includes a joined panel meeting in 2019 in Morocco, a science conference, the revision of the status report, that identifies gaps and leads to recommendations and actions for the revision of the IP to be published in 2023. During the discussion following this presentation, it was noted that as a result of the ongoing dialog between GCOS and UNFCCC and the success of an Earth Information Day organized by GCOS for COP21, GCOS has been asked to organize a similar event for COP22.

During the discussion after the presentation the reasons for the planned joint panel meeting in 2019 were elaborated. These included preparation of the science meeting, discussing a way forward for observations for adaptation, hold cross-panel discussions especially discussing fluxes and to agree on a timeline for GCOS to be ready for the global stocktake in 2023. All participants agreed that it would be good to have such a joint panels meeting. It was explained that the Steering Committee would also be invited and at least some representatives would come.

N°	Action	Who	When
4	Send Space Agencies Response to Implementation Plan to Panel Members	GCOS Secretariat	After meeting
21	Provide feedback on GCOS Indicators how well these are presented.	All	When online

3. TOPC-19 ACTION

Simon Eggleston

[TOPC 19 Actions](#)

3.1 Presentation of actions from TOPC-19 and discussion

Simon Eggleston presented open actions from the last meeting and proposed a mechanism with ECV Stewards in order to have clearer responsibilities and hence more contributions from the panel also during the year.

3.2 Open and ongoing actions

Most actions at least partially addressed Open tasks were discussed and for all a way forward agreed. The panel agreed on the establishment of the ECV Stewards and it was decided to publish the names in order to allow credit for their efforts.

N°	Action	Who	When
6	Make list of ECV stewards and action rapporteurs public to allow credit for their efforts	GCOS Secretariat	End April

4. ECV REQUIREMENTS

4.1 Introduction of ECV Requirements and need for updating them

Simon Eggleston [Review of ECV requirements](#)

Simon Eggleston explained to the participants the current ECV requirements and how they have been developed and pointed to shortcomings in the process. He explained further what the requirements should reflect, i.e. the user needs assessed by the panels experts in regard of cost and feasibility. GCOS has started a new process that aims for updated ECV requirements in an updated Implementation Plan in 2022. The requirements should include three numbers for goal, breakthrough and threshold, similar to OSCAR. At the end he raised questions for discussion about gaps and improvements of the process.

4.2 Discussion

The participants agreed that reanalysis are of great importance when thinking about adaptation and this should be reflected in the requirements as well. It was mentioned that GCOS is the main source of information on data and shortcomings for the UNFCCC and its bodies and therefore very relevant. During the discussion all panel members supported the use of three numbers as explained in the presentation for the requirements in order to reflect the different needs with climate monitoring. It was decided to use the definitions of these three requirement levels from OSCAR.

Another main discussion point was the viewpoint of the requirements. Since the requirements should reflect the user needs, they should be instrument agnostic. However, the participants also mentioned that it is very difficult to come up with requirements without having certain platforms in mind and that there needs to be a realistic consideration of what is possible.

Other discussions covered the separation of precision and accuracy, uncertainty and error propagation, and the relation of temporal resolution and uncertainty.

4.3 ECV Factsheets

Wolfgang Wagner [ECV Requirement updates](#)

In his presentation Wolfgang Wagner explained the tasks for the panel related to the ECV. TOPC should revise the current table of ECV requirements from the GCOS-200 Implementation Plan according to WMO OSCAR database with a 3-level approach and the names should be discussed. Wolfgang Wagner also presented the new TOPC online forum (<https://board.geo.tuwien.ac.at/>) that was created by his working groups to facilitate internal TOPC discussions.

During the discussion it was agreed that context to the numbers are essential because without this context and justification, a discussion about the values is not possible.

4.4 Breakout Group Session

During the breakout group sessions three groups worked on the ECV requirements (cryosphere, biosphere and hydrosphere) with the following experts in each group:

- Biosphere: Nadine Gobron (lead), Kevin Tansey, Martin Herold, Pierre-Philippe Mathieu, Simon Eggleston
- Cryosphere: Michael Zemp (lead), Hiroyuki Enomoto, Philippe Schoeneich, Tim Oakley
- Hydrosphere: Wolfgang Wagner (lead), Mathew McCabe, Nigel tapper, Stephan Dietrich, Valentin Aich

Each group used the forum to update requirements for ECV products and test the forum. The groups started with the tasks but could not finalize them during the session due to time constraints.

4.5 Breakout Group Reports and Summary

In the summaries from the breakout groups the preliminary results and experiences with the new forum were exchanged. All participants found the forum very useful after they have been registered and started using it. In regard of the requirements several points were brought up:

- It is important to have a global scope for the requirements
- Uncertainty should reflect what information is needed from user
- Information should be provided by data providers like WGClimate on their uncertainty definitions and to ensure this should be in the responsibility of the respective ECV stewards

N°	Action	Who	When
5	Secretariat to prepare and upload factsheets to TOPC forum	GCOS Secretariat	Mid-April
7	Members to identify additional experts for ECV, not covered by panel, as indicated in TOPC forum	Panel members	End April
10	Contact Darren Ghent to confirm he is rapporteur and ECV Steward	GCOS Secretariat	End April
11	ECV Stewards to check and update factsheets	ECV Stewards	End May
12	ECV Stewards to fill out ECV requirements for each product on the TOPC forum	ECV Stewards	June 2018
17	Produce a consolidated proposal, after consulting other panels, for how to specify requirements, definitions, with 3 values if appropriate	GCOS Secretariat	For SC
19	Each ECV steward to identify gaps in monitoring guidance if appropriate (Action T4).	ECV Stewards	Dec 2018
20	Prepare for wider review of refined ECV Products requirements, based on forum discussions for consideration by panel	GCOS Secretariat	TOPC21

5. IMPLEMENTATION PLAN ACTIONS

5.1 Overview of Actions

Simon Eggleston

[IP Actions](#)

Simon Eggleston gave an overview on the actions in the GCOS-200 Implementation Plan that are relevant for TOPC. During the following discussion on the responsibilities for the actions, it was decided to establish “Action Rapporteurs” who are responsible to follow up on individual actions in the IP. These rapporteurs shall be published on the website in order to allow credit for their work. They do not have to be experts for the respective action but involve the community or specific partners in order to respond appropriately. The newly established TOPC forum shall be used by the rapporteurs to report on updates for their respective actions.

Another discussion covered the collaboration with the Ocean Observations Panel for Climate (OOPC) on coastal zone. The Secretariat was tasked to find out what major open questions are and contact the relevant persons.

In order to respond to the general action 4 on review of the monitoring guidance, the panel decided that each ECV Steward shall contribute input from their field. In regard of action 5 on metadata, Nadine Gobron volunteered to work with representatives of the other two GCOS science panels to establish guidelines for metadata.

N°	Action	Who	When
1	Represent TOPC in discussions on metadata with other GCOS science panels	Nadine Gobron	Ongoing
16	Liaise with ocean panel on what they want/need in coastal areas.	Simon Eggleston	For SC

5.2 Breakout Group Session to discuss progress and issues arising from Implementation Plan Actions

During the breakout group sessions three groups (cryosphere, biosphere and hydrosphere) worked on the open IP actions with the following experts in each group:

- Biosphere: Nadine Gobron (lead), Kevin Tansey, Martin Herold, Simon Eggleston
- Cryosphere: Michael Zemp (lead), Hiroyuki Enomoto, Philippe Schoeneich, Tim Oakley
- Hydrosphere: Wolfgang Wagner (lead), Mathew McCabe, Nigel Tapper, Stephan Dietrich, Valentin Aich

5.3 Breakout Group Reports and Summary

During the discussions within the Breakout Groups, a way forward for most actions was decided and the actions assigned to a rapporteur (see list Annex). The actions that could not be assigned yet due to a lack of experts were: 67, 69, 70, 71.

N°	Action	Who	When
8	Contact Han Dolman if he could be rapporteur for GHG fluxes	GCOS Secretariat	End April
9	Contact Huilin Li to confirm she is rapporteur and ECV Steward	GCOS Secretariat	End April
10	Contact Darren Ghent to confirm he is rapporteur and ECV Steward	GCOS Secretariat	End April
13	Action rapporteurs to continue to update progress on actions, on-going action. First version by June 2018, then to report by TOPC 21 on important actions.	Action rapporteurs	June 2018 & report to TOPC21

6. GCOS INITIATIVES

6.1 Update of the Global terrestrial Network for Permafrost

Philippe Schoeneich

[GTN-P](#)

Philippe Schoeneich reported about recent activities of the Global Terrestrial Network for Permafrost (GTN-P) and their new [implementation plan](#). He presented the new operational database for permafrost data and explained the new structure of GTN-P, which consist of a Steering Committee, and Advisory Board, a Secretariat and National correspondents. The global network as now 1360 boreholes of which 485 are with full data. The current main challenges of the network are funding, to ensure the continuation of the GTN-P Secretariat, the Data Management Structure with mirror sites in Germany and Russia, as well as field data acquisition. The network plans to define new products, including ground surface temperature, surface dynamics and thermokarst.

During the short discussion, it was suggested to have these very useful short reports regularly and if possible also from other networks.

6.2 GCOS Surface Reference Network

Nigel Tapper

[GSRN](#)

Nigel Tapper reported on the progress of the joint TOPC/AOPC task team for a GCOS Surface Reference Network. **Their** first Task Team Meeting was a successful meeting of the minds with some basic agreements to requirements, design principles, diversity of areas observed, and ECVs. The current concept builds on an paper (Thorne et al. 2018) that provides a firm underlying scientific foundation. The paper suggests to use existing reference observing systems (GRUAN and USCRN) as a model to begin from. They are currently drafting a document to give the GSRN a firm technical foundation. They also consider regular in-person meetings on an annual basis once the document is prepared.

During the discussion it was agreed that the tiered network approach (comprehensive, baseline and reference) would be important for this network and that there is still confusion about the GSRN being a baseline or a reference network. All agreed again that the GSRN shall be a reference network with stations in different climatic regions and not have the function of a baseline network. In general TOPC is content

with the current status of activities. TOPC advises the task team to consider spatial representativeness of the measurements on the sites. This means several spatially distributed measurement devices should be maintained in parallel, e.g. for precipitation and soil moisture in order to get a better understanding of the representativeness of the measurements.

N°	Action	Who	When
3	Maintain TOPC link with GCOS Surface Reference Network Task Team.	Nigel Tapper	Ongoing

6.3 Identifying ECV to represent human adaptations to climate change

Nigel Tapper

[Observations for Adaptation](#)

Nigel Tapper talked about how adaptation can be supported and measured by GCOS. He presented several measures for urban environments, agriculture and forestry as well as coastal infrastructure. Finally, he suggested to focus on Vegetation Fraction in cities (Urban Greening), which is a key adaptation measure for cities all over the world and relatively easy measurable with satellite imagery.

After the presentation the panel agreed that this was an excellent starting point and a plan should be developed. It was decided that Nigel Tapper should start drafting Terms of References for a task team on adaptation that will report to TOPC but also include non-panel members. The chair Wolfgang Wagner said that with the current panel composition, physical adaptation indicators can be monitored but when it comes to financial or social ones, TOPC cannot cover this in its current form. Steven Briggs, the chair of the GCOS Steering Committee proposed that the task team might become an additional panel for observations for adaptation.

N°	Action	Who	When
18	Task team on monitoring for adaptation. Draft & Agree ToR, Identify members. Interim report to next SC in October and final report to TOPC21.	Nigel Tapper is chair	SC and TOPC21

6.4 Task Teams on Lightning, Weather Radar and GRUAN

Valentin Aich

[TTLOCA, GRUAN, Radar](#)

Due to time constraints the presentation about progress of the Task Teams on Lightning, Weather Radar and the GCOS Upper Air Reference Network (GRUAN) could not be presented but are available for download.

6.5 Discuss potential biosphere indicator

Nadine Gobron

[Biosphere Global Climate Indicator](#)

Nadine Gobron presented several options for a biosphere indicator for the Global Climate Indicators. This included LAI and FAPAR and other integrated indicators. During the discussion the panel did not agree on an indicator since the proposal did not meet the requirements of being globally applicable and averaged to one global number or trend line. TOPC decided that additional suggestions should be brought to the TOPC online forum.

N°	Action	Who	When
2	Put potential/proposed ECV climate signals on TOPC forum for discussion and review by the panel	Panel Members	Ongoing

7. DATA ACCESS

7.1 TOPC Website

Wolfgang Wagner [TOPC Forum](#)

The TOPC forum website was already presented under point 4.3 by Wolfgang Wagner.

8. NEXT STEPS

8.1 Discussion on how TOPC should work through 2018

Wolfgang Wagner expressed his expectations that TOPC members should work on the ECV requirements and factsheets in the coming weeks. This exercise and all other discussions should be facilitated by the new TOPC Forum and he hope to get more feedback. A very important outcome of the meeting is the task team on observations for adaptation. In addition, the panel agreed to have quarterly teleconferences to assess the progress on the forum and other important issues.

N°	Action	Who	When
15	Arrange telcon for TOPC. 1st in June to assess progress on forum, 2nd in September to prepare for SC and 3rd in January to prepare for joint panel meeting in Morocco,	GCOS Secretariat and TOPC Chair	June, September, January

8.2 Actions Arising

Simon Eggleston [Actions](#)

Simon Eggleston presented a list of draft actions that have been collected during the meeting and the panel agreed to the final form attached in Annex 3.

8.3 Date and time of next meeting

As noted in section 2.2 above, the GCOS is proposing holding a joint GCOS Scientific Panels Meeting in 2019. The panel agreed to the best dates for the joint meeting would be the week 18-22 March 2019².

8.4 AOB and Meeting Closure

The meeting closed with thanks all panel members for contributions. TOPC also expressed its thanks WMO for hosting and supporting the meeting.

² Following the meeting the secretariat confirmed that these dates were acceptable for all the panels and will make arrangements to hold the meeting on these dates.

APPENDIX 1: Agenda

N°	Item	Presenter	Targeted outcome
1	Opening of the Meeting		
1.1	Welcome and introduction	Stephen Briggs & Wolfgang Wagner	
	Welcome to WMO	Deon Terblanche	
1.2	Adoption of Agenda	Wolfgang Wagner	
1.3	Introduction of participants	All	
1.4	Aims and expectations	Wolfgang Wagner	
2	Updates and information		
2.1	Update from WCRP	Michel Rixen	Information and discussion
2.2	Introduction to new GCOS Strategy	Stephen Briggs & Carolin Richter	
3	TOPC 19 Actions		
3.1	Presentation of actions from TOPC-19 and discussion	Simon Eggleston	A review of the actions from TOPC-19 and their outcomes
3.2	Open and ongoing actions	Discussion	
4	ECV Requirements		
4.1	An introduction to the ECV requirements in the Implementation Plan. What they represent, (user needs vs observational requirements) and how they will be revised.	Simon Eggleston	To provide a common understanding of how the ECV and ECV product requirements are determined and how they will be improved. Aim to achieve a common understanding of what the numbers represent.
4.2	Discussion	All	
4.3	ECV Factsheets	Valentin Aich	
4.4	BOGs Discuss: 1) The definition of each ECV and ECV Product as well as review the data sources 2) How well do the requirements represent user needs? 3) Are all the ECV products needed by users - are some observational steps? 4) How can the broader community, both science and user groups, be contacted for their ideas on revising the ECV requirements 5) Discuss issues that cut across other panels e.g. coastal waters (freshwater inputs, carbon transfers, mangroves and other land covers).		The requirements should be discussed and plans made to maximize the contributions to the refinement of the ECV requirements and ensure a consistent approach across all ECV

N°	Item	Presenter	Targeted outcome
4.5	BOGs Reports and Summary		
5	Implementation Plan Actions		
5.1	Overview of Actions	Simon Eggleston	All the relevant Implementation Plan actions should be considered and progress noted. Any issues or problems should be reported.
5.2	BOGs Discuss progress and issues arising from Implementation Plan actions	Discussion	
5.4	BOGs Reports and Summary	All	
6	GCOS Initiatives		
6.1	GCOS Surface Reference Network	Nigel Tapper	Possible TOPC involvement of these initiatives should be considered
6.2	Identifying ECV to represent human adaptations to climate change	Nigel Tapper	
6.3	Task Teams on Lightning, Weather Radar & GRUAN	Valentin Aich	
6.4	Discuss potential biosphere indicator	Nadine Gobron	The possibilities for a biomass indicator should be discussed
7	Data access etc.		
7.1	TOPC Website	Wolfgang Wagner	
8	Next Steps		
8.1	Discussion on how TOPC should work through 2018	Wolfgang Wagner	
8.2	Actions Arising	All	
8.3	Date and time of next meeting	All	
8.4	AOB and Meeting Closure	All	

APPENDIX 2: List of Participants

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APPENDIX 3: List of Actions from TOPC 20

N°	Action	Who	When
1	Represent TOPC in discussions on metadata with other GCOS science panels	Nadine Gobon	Ongoing
2	Put potential/proposed ECV climate signals on TOPC forum for discussion and review by the panel	Panel Members	Ongoing
3	Maintain TOPC link with GCOS Surface Reference Network Task Team.	Nigel Tapper	Ongoing
4	Send Space Agencies Response to Implementation Plan to Panel Members	GCOS Secretariat	After meeting
5	Secretariat to prepare and upload factsheets to TOPC forum	GCOS Secretariat	Mid-April
6	Make list of ECV stewards and action rapporteurs public to allow credit for their efforts	GCOS Secretariat	End April
7	Members to identify additional experts for ECV, not covered by panel, as indicated in TOPC forum	Panel members	End April
8	Contact Han Dolman if he could be rapporteur for GHG fluxes	GCOS Secretariat	End April
9	Contact Huilin Li to confirm she is rapporteur and ECV Steward	GCOS Secretariat	End April
10	Contact Darren Ghent to confirm he is rapporteur and ECV Steward	GCOS Secretariat	End April
11	ECV Stewards to check and update factsheets	ECV Stewards	End May
12	ECV Stewards to fill out ECV requirements for each product on the TOPC forum	ECV Stewards	June 2018
13	Action rapporteurs to continue to update progress on actions, on-going action. First version by June 2018, then to report by TOPC 21 on important actions.	Action rapporteurs	June 2018 & report to TOPC21
14	Participate in review of WCRP Strategic Plan.	All	June 2018
15	Arrange telcon for TOPC. 1st in June to assess progress on forum, 2nd in September to prepare for SC and 3rd in January to prepare for joint panel meeting in Morocco,	GCOS Secretariat and TOPC Chair	June, September, January
16	Liaise with ocean panel on what they want/need in coastal areas.	Simon Eggleston	For SC

N°	Action	Who	When
17	Produce a consolidated proposal, after consulting other panels, for how to specify requirements, definitions, with 3 values if appropriate	GCOS Secretariat	For SC
18	Task team on monitoring for adaptation. Draft & Agree ToR, Identify members. Interim report to next SC in October and final report to TOPC21.	Nigel Tapper is chair	SC and TOPC21
19	Each ECV steward to identify gaps in monitoring guidance if appropriate (Action T4).	ECV Stewards	Dec 2018
20	Prepare for wider review of refined ECV Products requirements, based on forum discussions for consideration by panel	GCOS Secretariat	TOPC21
21	Provide feedback on GCOS Indicators how well these are presented.	All	When online

APPENDIX 4: List of Action Rapporteurs

N°	Action	Rapporteur
1	Improve coordination of terrestrial observations	GCOS Secretariat
2	Develop joint plans for coastal zones	GCOS Secretariat
3	Terrestrial monitoring sites	GCOS Secretariat, Nigel Tapper
4	Review of monitoring guidance	GCOS Secretariat
5	Develop metadata	GCOS Secretariat
6	Identify capacity development needs	GCOS Secretariat
7	Exchange of hydrological data	GCOS Secretariat
8	Lakes and reservoirs: compare satellite and in situ observations	Stephan Dietrich
9	Submit historical and current monthly lake-level data	Stephan Dietrich
10	Develop additional products derived from Lake water-leaving reflectance for turbidity, chlorophyll and coloured dissolved organic matter	Stephan Dietrich
11	Confirm Global Terrestrial Network for River Discharge sites	Stephan Dietrich
12	National needs for river gauges	Stephan Dietrich
13	Establish a full-scale Global Groundwater Monitoring Information System (GGMS)	Stephan Dietrich
14	Operational groundwater monitoring from gravity measurements	Stephan Dietrich
15	Satellite soil-moisture data records	Stephan Dietrich
16	Multi-satellite, soil-moisture data services	Wolfgang Wagner
17	International soil-moisture network	Wolfgang Wagner
18	Regional high-resolution soil-moisture data record	Wolfgang Wagner
19	Maintain and extend the in situ mass balance network	Michael Zemp (WGMS)
20	Improve the funding situation for international glacier data centres	Michael Zemp (WGMS), Bruce Raup (GLIMS, NSIDC)
21	Encourage and enforce research projects to make their ECV-relevant observations available through the dedicated international data centres	GCOS Secretariat

N°	Action	Rapporteur
22	Global glacier inventory	Michael Zemp (WGMS), Bruce Raup (GLIMS/NSIDC)
23	Multi-decadal glacier inventories	Michael Zemp (WGMS), Bruce Raup (GLIMS, NSIDC)
24	Allocate additional resources to extend the geodetic dataset	Michael Zemp (WGMS),
25	Extend the glacier-front variation dataset both in space and in time	Michael Zemp (WGMS)
26	Glacier observing sites	Michael Zemp (WGMS), Bruce Raup (GLIMS, NSIDC)
27	Observations of glacier velocities	Michael Zemp (WGMS), Frank Paul (GLIMS)
28	Snow-cover and snowfall observing sites	Tom Painter
29	Integrated analyses of snow	Tom Painter
30	Ice-sheet measurements	Hiroiyuki Enomoto
31	Ice-sheet model improvement	Hiroiyuki Enomoto
32	Continuity of laser, altimetry and gravity satellite missions	Hiroiyuki Enomoto
33	Standards and practices for permafrost	Philippe Schoeneich
34	Mapping of seasonal soil freeze/thaw	Philippe Schoeneich
35	Ensure the consistency of the various radiant energy fluxes	Nadine Gobron
36	Climate change indicators for adaptation	Nigel Tapper
37	Quality of ground-based reference sites for FAPAR and LAI	Nadine Gobron
38	Improve snow and ice albedo products	Nadine Gobron
39	Improve in situ albedo measurements	Nadine Gobron
40	Production of climate data records for LAI, FAPAR and Albedo	Nadine Gobron
41	Evaluate LAI, FAPAR and Albedo	Nadine Gobron
42	Land-surface temperature: in situ protocols	Darren Ghent
43	Production of land-surface temperature datasets	Darren Ghent
44	Reprocessing land-surface temperature	Darren Ghent

N°	Action	Rapporteur
45	Land-surface temperature in situ network expansion	Darren Ghent
46	Land-surface temperature radiometric calibration	Darren Ghent
47	Land-cover experts	Martin Herold
48	Annual land-cover products	Martin Herold
49	Land-cover change	Martin Herold
50	Land-cover community consensus	Martin Herold
51	Deforestation	Martin Herold
52	Collaboration on above ground biomass	Martin Herold
53	Above-ground biomass validation strategies	Martin Herold
54	Above-ground biomass validation sites	Martin Herold
55	Above-ground biomass data access	Martin Herold
56	Above-ground biomass: forest inventories	Martin Herold
57	Soil carbon: carbon mapping	Kevin Tansey
58	Soil-carbon change	Kevin Tansey
59	Soil carbon – histosols	Kevin Tansey
60	Historic fire data	Kevin Tansey
61	Operational global burned area and fire radiative power	Kevin Tansey
62	Fire maps	Kevin Tansey
63	Fire validation	Kevin Tansey
64	Fire disturbance model development	Kevin Tansey
65	Anthropogenic water use	Nigel Tapper
66	Pilot projects: anthropogenic water use	Nigel Tapper
67	Improve global estimates of anthropogenic greenhouse-gas emissions	?
68	Use of satellites for Land use, land-use change and forestry emissions/removals	Simon Eggleston
69	Research on the land sink	?

N°	Action	Rapporteur
70	Use of Inverse modelling techniques to support emission inventories	?
71	Prepare for a carbon-monitoring system	?
72	Prepare for a latent and sensible heat flux ECV	Matthew McCabe

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