

WORLD METEOROLOGICAL ORGANIZATION GLOBAL CRYOSPHERE WATCH

REPORT No. 11

FINAL REPORT OF THE STEERING GROUP MEETING, THIRD SESSION

Boulder, Colorado, USA
10-11 December 2015



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EXECUTIVE SUMMARY

The Third Session of the Global Cryosphere Watch (GCW) Steering Group (GSG) was held at the University of Colorado, Boulder, Colorado, USA from December 10-11, 2015 and hosted by the Cooperative Institute for Research in Environmental Sciences (CIRES).

The meeting began with a discussion on the status of CryoNet and its pre-operational testing phase. The final concept document describing GCW Surface Observing Network was accepted by the GSG with suggested clarifications. A work-plan was developed for the preparation of the GCW Guide to Cryospheric Practices and GCW Manual on Best Cryospheric Practices. The engagement of experts from different countries and regions as well as community feedback was seen as essential in order to gain global acceptance. The CryoNet Team has started the process to determine a viable minimum program of cryosphere observations at CryoNet stations and sites. The aim is to identify variables which could be measured and the “expected minimum frequency of observations at CryoNet stations”.

It was noted that the GCW design is broadly consistent with the WMO Technical Regulations and the Manual on the WMO Integrated Global Observing System (WIGOS). The GCW network design principles document aims to be submitted at the 2016 Inter-Commission Coordination Group on the WIGOS (ICG-WIGOS) meeting or later if further work is required.

The CryoNet Team proposed a procedure of evaluating stations/sites for inclusion in the GCW surface network which will be tested against the stations/sites currently in the pre-operational testing phase. Also discussed were issues concerning stations operated by national entities other than the NMHS; a written agreement between these stations/sites and the Permanent Representative (PR) of the WMO Member must be reached. An agreement must also be reached when an agency in one country operates a station/site in another country and in the case of a mobile platform operating in international waters by an international consortium.

The meeting followed with a discussion on regional GCW/CryoNet activities, in particular the inclusion of 12 regional CryoNet and contributing stations in the pre-operational testing phase from South America. It was also recognized that increased co-operation with partner organizations, such as UNESCO IHP, is crucial. As for the 3rd Pole activities, better engagement with the operational agencies will be strengthened. A revised CryoNet Team workplan was presented for the 2016 - early 2017 period and it was suggested to have a CryoNet meeting in a tropical region to discuss all tropical cryospheric components.

The Integrated Products Working Group noted that many products could be developed for GCW in addition to snow which are relevant for operational activities at the European Centre for Medium Range Weather Forecasts (ECMWF). New teams need to be identified with active leaders and members who can initiate activities.

The participants were then presented a summary of the progress and status of the Snow Watch Team. Six priorities for action were identified at the Toronto GCW Snow-Watch workshop (January 2013). The development of “snow anomaly trackers” was recognized as a useful product for monitoring daily changes on the hemispheric scale. It was asked if this product could be done at a regional or finer scale, which could be used by Polar Regional Climate Centre (PRCC) and give visibility to GCW. A snow dataset inventory was made available on the GCW website allowing users to compare potential differences between information sources.

The meeting followed with a review of the status of the GCW Portal, including interoperability with CryoNet sites. An updated diagram of portal interconnections was provided. It was noted that the portal is currently not hosting any data although this option could be investigated but the issue of long term cost must be recognized. Other issues raised for discussion were: filtering of harvested metadata; use and consistency of controlled vocabularies; brokering and cleaning/validation of harvested metadata for WMO Information System (WIS) compliance; duplication of metadata; and interaction with WIGOS/WIS/GTS. It was noted that it would be more efficient for GCW to use the internet for real-time exchange of some datasets rather than the Global Telecommunication System (GTS). Related issues need to be discussed with WIS and WIGOS and it was noted that it could be beneficial for the Portal Team Chair to engage in ICG-WIGOS.

The integration of data from CryoNet sites into the GCW Portal has begun. The implementation of interfaces to metadata for SLF-Davos is currently being tested. Further work is required to achieve interoperability at the data level and data segmentation for real time exchange. From this, preliminary versions of the GCW Portal Interoperability Guidelines and GCW Portal Operations Manual have been developed in order to guide CryoNet sites in the dialogue with the GCW Portal Team.

A summary of the status and development of the GCW website was presented to the participants. The Website Team needs to be enlarged to meet the growing needs and complexities of GCW. It was suggested to initiate a GCW newsletter once the GCW Project Office is staffed to add visibility as an outreach mechanism. The glossary continues to grow, an activation of a Terminology Team would provide a focus for further development and a three phase work plan for consideration by the GSG (Annexes 9 and 10) was proposed, which includes revision of station/site questionnaire, additional ice products, and finalizing new trackers.

The GCW working structure was updated with new teams being established and clearly defined reporting requirements. These principles were approved by the GSG and will be submitted to The WMO Executive Council Panel of Experts on Polar and High Mountain Observations, Research and Services (EC-PHORS) for their review and acceptance. Membership of GSG also changed with two new nominees recommended, approval will be sought from EC-PHORS. Membership of GCW Teams was also discussed and modification to its structure agreed upon. It was recognized that communications with the GCW focal points and partners must be maintained and are fundamental to GCW's long term success.

Following-up from Cg-17 decisions it was recognized that GCW needs to be seen across WMO and to partners in particular the scientific community. Examples of possible ways which this could be accomplished were discussed. GCW also needs to support/contribute to the development of PRCC as well as the Global Integrated Polar Prediction System (GIPPS) and the Year of Polar Prediction (YOPP) which are all under the purview of EC-PHORS.

The meeting followed with discussion of outreach activities. It was noted that GCW handouts needed to be updated with GCW's new structure. GCW has to be visible and active within WMO bodies and a list of meetings at which GCW presence would be beneficial was established.

The GSG was briefed on the process for staffing the new GCW Project Office. Working Groups (WGs) and Teams were asked to submit requests for activities and meeting support over the next two years. The priority is to support the GSG and then the key activities of the WGs.

The meeting finished with an open discussion on miscellaneous activities which included inquiries on a letter of support from EC-PHORS for projects such as the proposal for an IPCC Special Report on mountain regions from Mountain Research Initiative, and updates for the website of the WG and Teams' activities.

TABLE OF CONTENTS

EXECUTIVE SUMMARY	ii
1. ORGANIZATION OF THE MEETING	3
2. CRYONET	4
3. SNOW WATCH	8
4. GCW PORTAL	10
5. GCW WEBSITE	11
6. GCW WORKING STRUCTURE	12
7. MAINSTREAM AND IMPLEMENT GCW IN WMO PROGRAMMES	14
8. OUTREACH ACTIVITIES	16
9. WORK PLAN	16
10. OTHER BUSINESS	17
11. CLOSURE OF MEETING	18
ANNEX 1: AGENDA	19
ANNEX 2: LIST OF PARTICIPANTS	21
ANNEX 3: CRYONET TEAM WORK PLAN 2015-2017	23
ANNEX 4: GCW SURFACE OBSERVING NETWORK	25
ANNEX 5: DEVELOPMENT OF A GCW GUIDE AND MANUAL FOR BEST PRACTICES	29
ANNEX 6: DRAFT PROCEDURE FOR ACCEPTANCE OF NEW STATIONS INTO GCW	30
ANNEX 7: LIST OF EXISTING GCW AND CRYONET STATIONS AND SITES	32
ANNEX 8: WORK PLAN FOR THE WMO GCW SNOW WATCH GROUP FOR THE PERIOD 2015 – 2016	34
ANNEX 9: INFORMATION AND SERVICES WORKING GROUP WORK PLAN, 2015-2017 .	36
ANNEX 10: GCW TERMINOLOGY TEAM: PAN-CRYOSPHERIC GLOSSARY	40
ANNEX 11: GCW WORKING STRUCTURE	42
ANNEX 12: GUIDELINES FOR GCW STEERING GROUP MEMBERSHIP	43

ANNEX 13:	MEMBERSHIP OF GCW STEERING GROUP, WORKING GROUPS AND TEAMS	44
ANNEX 14:	GLOBAL CRYOSPHERE WATCH (GCW) - RESOLUTION 43 (Cg-17).....	46
ANNEX 15:	MEETINGS OF REGIONAL ASSOCIATIONS AND TECHNICAL COMMISSIONS 2016-2019 FOR WHICH GCW INPUT WILL BE REQUIRED	49
ANNEX 16:	REPRESENTATION AT OTHER BODIES AND MEETINGS	50
ANNEX 17:	ACTION SHEETS - SECOND SESSION OF THE GCW STEERING GROUP, COPENHAGEN (21-23 JANUARY 2015).....	54
ANNEX 18:	LIST OF ACTION ITEMS ARISING FROM THE MEETING	57
ANNEX 19:	LIST OF ACTIONS ARISING FROM THE JOINT CRYONET TEAM AND PORTAL & WEBSITE TEAMS MEETINGS	63

MEETING REPORT

1. ORGANIZATION OF THE MEETING

1.1. **Welcome and opening:** The Third Session of the Global Cryosphere Watch (GCW) Steering Group (GSG) was held at the University of Colorado, Boulder, Colorado, USA from 10 to 11 December 2015 and hosted by the Co-operative Institute for Research in Environmental Sciences (CIRES). The Director of CIRES, Dr. Waleed Abdalati, welcomed the group to the University. He emphasized the importance of people working on the type of observational activities in which GCW is engaged. To many this may seem boring, but the consistency and quality of data, and integration of data sets, are foundational to cryospheric science and research. He noted that CIRES has research ongoing in virtually all components of the cryosphere, including modelling and monitoring initiatives.

Dr. Wenjian Zhang welcomed the group on behalf of the World Meteorological Organization. He emphasized that GCW is a new WMO priority and links strongly to other priority issues e.g. WIGOS/WIS and the Global Framework for Climate Services (GFCS). He referred participants to Resolution 43 of Cg-17 which decided to mainstream and implement GCW in WMO Programmes as a cross-cutting activity. He noted that the word “cryosphere” is referred to on 79 pages of the 200-page World Meteorological Congress’ summary. Dr. Zhang laid out the challenges ahead, particularly addressing what we wish to achieve by 2020 when we are to go operational. The Working Groups and Task Teams must have clear actions and tasks; GSG guidance is essential as this body is responsible to all Members and partners. Working with external partners is a challenge that WIGOS, for example, does not have, yet this partnership is essential for success.

The Chair of the GCW Steering Group (GSG), Dr. Árni Snorrason, also welcomed the members of the GSG. He thanked the individuals and teams for the work done both in advance of, and at, Cg-17 to get GCW approved. Our collective challenge is now to implement GCW.

1.2 **Adoption of the agenda:** The programme (**ANNEX 1**) for the meeting was adopted with minor amendments. For the future, reports will be received from the Working Groups on behalf of the WG and all of their teams. WG chairs will participate in the GSG meeting.

ACTION: For future meetings, the agenda will be arranged by Working Groups (Observations, Integrated Products, and Information and Services). The WG chair or co-chair will present to the GSG on behalf of the WG and its teams (Secretariat action).

1.3 **Working arrangements:** The group discussed working arrangements during the meeting, but also secretariat support expected during the upcoming year. Dr. Zhang provided the current status for GCW. The plan is to have Miroslav Ondráš engaged to help support GCW until the GCW Project Office (PO) position is filled. Etienne Charpentier will support EC-PHORS and GCW. The process of staffing has started and it is hoped that final approval to proceed will be received early in 2016. D/OBS will keep the GSG Chair and vice-chair informed of progress. In addition to the GCW PO staff, D/OBS will continue to look for additional support. Currently, an intern (Clément Hutin) has been providing very valuable support on data availability for CryoNet stations in the pre-operational test phase, on gathering best practices and on building the glossary. Similar support for team leads would be valuable and GSG members were asked to see if they might be able to offer short-term contracts or interns or students to help implementing GCW. GSG members need to be active in seeking support for the activities. The chair reminded participants that the secretariat manages the project, but the Members (countries) provide the manpower to

deliver the project. Countries active in PHORS and GCW have committed to GCW so appropriate enquiries for support are reasonable. GCW must expand beyond the people engaged now.

Action: The chair of the GSG asks the Secretariat to formulate an appropriate letter that each GSG member could use to communicate to their PR seeking support for human resources for GCW tasks as well as asking for a contribution to GCW Trust Fund.

Action: D/OBS will keep the GSG, through the chair and vice-chair, apprised of the ongoing status for staffing the GCW PO position.

1.4 **Participant introductions:** Participants are listed in **ANNEX 2**. Charles Fierz participated remotely and the GSG thanks him for his “late night” contributions. Aimee Devaris has resigned from the GSG as she changed job position.

OBSERVATIONS WORKING GROUP

2. CRYONET

2.1 **Status of CryoNet and its pre-operational testing phase:** Wolfgang Schöner led the discussion of the CryoNet Team deliberations at the CryoNet Team meeting in Boulder, December 9-11, 2015 (see presentation [GCW-CryoNet-GSG-Boulder.pptx](#)). The GSG reviewed the work plan for the last year (see **ANNEX 3**). The “GCW Surface Observing Network” is comprised of CryoNet and contributing stations. The updated document describing this Network, including finalization of the station/site concept and revised minimum requirements proposed at the CryoNet meeting, was discussed by the GSG. A few suggested clarifications were incorporated and the final concept document was accepted by the GSG (**ANNEX 4**) for inclusion in all GCW documents, including the GCW Primer.

ACTION: The Secretariat shall ensure that the final concept document of the GCW Observing Network is used to update all relevant GCW documents.

ACTION: The need for common wording in documents was discussed; it was decided that the “*components of the cryosphere*” and “*component variables*”, rather than *elements and parameters*, respectively would be used.

A summary of the progress to date of the Best Practices Team on compiling guidelines, best practices and standards was discussed based on discussions at the CryoNet Team meeting. An outline and timeline were developed for preparing a 30-40 page GCW Guide to Cryospheric Practices and then a more comprehensive Manual of Best Practices (see **ANNEX 5**). In-situ and satellite based observations would be included. Engagement of experts from different countries and regions will be essential. Experts will be drawn from GCW teams and working groups and nominees through national focal points and partner organizations. The Best Practices Team may establish small sub-groups to work on individual components. The guide and manual will include best practices suitable for research and operational purposes. The GSG was informed that it was recommended that drafts of the components be posted on the GCW website as “Draft for Comments” seeking community feedback. Then the documents would go to CBS and CIMO as they are part of WIGOS. An essential step is to ensure community consultation and feedback so there is global acceptance.

ACTION: The GSG fully endorsed that the Best Practices Team and Secretariat must ensure community consultation and feedback so there is global acceptance of the Guides and Manual.

The CryoNet Team has started the process to determine a viable minimum program of cryosphere observations at CryoNet stations and sites using manual and automatic observing methods and remote sensing information. The Team shared their initial effort ([GCW-CryoNet-Minimum-Programme-of-Sites_2015-12-07.xlsx](#)) to identify the variables which could be measured. A draft is available for snow, glaciers and ice caps, ice sheets, permafrost, and sea-ice. There is still a need for lake/river ice information and the CryoNet Team identified potential experts who could help with this. The GSG suggested that this aspect of the program would be better called the “expected minimum frequency of observations at CryoNet stations”. Agreement on these tables is needed to identify common variables for stations and sites.

Michele Citterio leads the task on GCW network design principles. The GSG was pleased to learn that the overall GCW design is broadly consistent with Technical Regulations (WMO-No.49) Manual on the WMO Integrated Global Observing System as per v0.11 (2015 edition), in particular section 2.2.2.1 and Appendix 2.1 on Observing System Network Design (OSND) Principles. GCW is included in the Manual on WIGOS; hence changes are submitted to ICG-WIGOS which in turn reports to Executive Council (EC). The design document should not be unnecessarily rushed for the April meeting. The GSG Chair recommended that GCW submit what is available at the 2016 ICG-WIGOS meeting, and if the document still needs work, then it be submitted to the November meeting of CBS for review and then to ICG-WIGOS in early 2017.

ACTION: The GSG agreed that GCW must continue to be represented at the next WIGOS design team meeting, preferably by Michele Citterio if he is available.

ACTION: The Secretariat will co-ordinate with the Chair and vice-chair of Observations WG on the documents available and the process for submission to ICG WIGOS.

Pre-operational testing is an essential step in the development of CryoNet. A sub-group of the CryoNet Team will conduct this evaluation phase and it is in the process of doing so. The Team presented the proposed procedure of evaluating a station or site for inclusion in the GCW surface network (see **ANNEX 6**). The procedures will be first tested against the stations/sites already accepted for the pre-operational testing phase. The GSG discussed the issue of stations that are operated by national entities other than the NMHS. In such cases, there must be a written agreement between that entity and the PR of the country. Likewise there is the question of an agreement when an agency in one country operates a station/site in another country. D/OBS will follow up on such situations within WMO. For stations that are located in a country other than that of the proponent, a copy of the agreement to operate in that country and to share data as per GCW requirements must be provided. The PR of the country in which the station is located must be informed that the station could become part of CryoNet. For the mobile platforms operating in international waters by an international consortium, endorsement is done by the designated PR of the concerned countries with concurrence by the chair of the relevant consortium.

ACTION: The GSG accepted the proposed procedure for testing on the stations/sites submitted for the pre-operational phase.

ACTION: The Secretariat will provide the Observations Working Group with examples of agreements for operation of GCW stations by an agency other than the NMHS, and on the

form of agreements between international partners (e.g. for GAW stations). This will ensure common wording among WMO programs and departments.

ACTION: Vasily Smolyanitsky will provide wording of an agreement for the case of a mobile platform operating in international waters by an international consortium which will guide development of a GCW agreement if such instances were to arise.

ACTION: Secretariat will finalize ANNEX 6 for implementation, as required (i.e. item 3).

ACTION: The Observations WG was reminded that the GCW and CryoNet station list has to be updated before Congress every 4 years for approval by Congress, as is the case for AntON. The Secretariat was asked to initiate such list which could be provided to EC-PHORS, EC and Congress as required.

2.2 List of stations of CryoNet for consideration by EC-PHORS and EC-68: The draft list of CryoNet stations which was to have been considered by GSG and EC-68, including a draft resolution on CryoNet was not available, as the final list cannot be completed until the selection procedure is in place and the selection completed. The list of GCW and CryoNet stations and sites under consideration are given in **ANNEX 7**. It was noted that the last column on “type” of station/site has to be updated in accordance with the new station/site description given in **ANNEX 4**. The Team established to do the selection will use remote discussion. The Secretariat can set up WebEx communication for these discussions.

ACTION: The GSG emphasized that the list of stations and associated resolution should be available by the end of September 2016 to allow for translation into all WMO languages before the CBS meeting. The list can be included as an Annex in the GCW report to CBS. The Secretariat is asked to coordinate with the CryoNet Team chair to facilitate this process.

ACTION: The list of stations for EC has to be submitted to EC-PHORS for their approval. This can be done by email as necessary. The Secretariat is asked to co-ordinate.

2.3 Regional GCW/CryoNet activities: The GSG was very pleased with the continuing GCW interest in South America. It was noted that 12 regional CryoNet and Contributing stations are included in the pre-operational testing phase of CryoNet. It was noted that IHP has an important presence in South America and this led to discussion on how GCW (and WMO) can work more effectively with UNESCO IHP on alpine/glacier initiatives. UNESCO IHP has established a Central Asian Regional Glaciological Centre in Kazakhstan and that a similar centre was being considered for South America. As well, a joint South American meeting on glacier research is being proposed for 2016 to UNESCO IHP and GCW WMO. Support from both agencies would be sought. Gino Casassa emphasized that there is a synergy with UNESCO which GCW needs to exploit. This workshop would offer the opportunity to merge operational and research activities. The GSG recommended that GCW should include support for this workshop in its budget planning.

ACTION: The GSG will identify funds in its budget for 2016 to support the joint South American workshop with UNESCO. (Action on Secretariat)

An update of outstanding actions from the first CryoNet Asia workshop is needed, including progress on establishing a Regional WG. The very limited engagement of the operational agencies, notably the NMHSs, was identified as a weakness. D/OBS will discuss further with CMA.

ACTION: The Chair of the GCW Steering Group will contact Xiao Cunde requesting a written update on the open and ongoing action items from the 1st Asia CryoNet meeting (Annex 3). The report is required by January 15 (before the Salekhard meeting). **NOTE:** This was done subsequent to the GSG; the reply indicated that there was no further information available from countries surrounding China.

ACTION: The GSG supported the CryoNet Team's desire for broader representation from Asia CryoNet and that a second representative to work with Cunde would be beneficial given the size and diversity of the Asia CryoNet region. The Chair of the CryoNet Team will discuss this further at the Salekhard meeting.

ACTION: Noting the need for a stronger link between CAS, CMA and GCW, GSG requested D/OBS to discuss with CMA about its involvement and potential contributions to GCW. Qin Dahe will also be consulted on this issue.

The Chair of the GSG noted that GCW received Member support at Cg-17 from tropical regions and that it was suggested to have a CryoNet meeting in a tropical region, such as Africa or Malaysia. In Africa, the meeting should include all components of the cryosphere, from glaciers in Tanzania and Kenya to snow issues of North Africa. It will be necessary to engage national agencies and NMHSs as well as international scientists. The GSG requested the Observations Working Group to assess the feasibility, scope and logistics for such a workshop for inclusion as a discussion item in the GCW report to CBS in fall 2016.

ACTION: GSG requested the Observations WG, with the support of the Secretariat, to investigate holding a meeting with a tropical focus, including definition of the scope and possible timing and identification of a local host(s) and potential participants for such a workshop.

2.4 Work Plan: A revised work plan was presented for the 2015 - early 2017 period (see ANNEX 3). The GSG agreed with the focused effort (as defined in items 13-16, ANNEX 3) to complete v1 of the list of CryoNet stations and sites for approval by GSG, EC-PHORS, and CBS. This is the core of the pre-operational testing phase. The Team suggested a joint Observations WG and Portal Team meeting in the February 2017 time frame would be beneficial.

ACTION: The GSG will include funds in the GCW budget to support the CryoNet expert sub-group meeting to finalize the list of approved CryoNet and Contributing stations/sites.

INTEGRATED PRODUCTS WORKING GROUP

Kari Luojus noted that many products could be developed for GCW in addition to snow, including:

- lake and river ice: freeze-up/break-up, thickness, snow on ice;
- sea ice: extent, concentration, type (age), thickness, motion, temperature, snow on ice;
- glaciers, ice caps, ice sheets: mass balance (accumulation/ablation), thickness, area, length (geometry), firn temperature, velocity, snowline/equilibrium line, icebergs, snow on ice;
- frozen ground/permafrost: soil temperature/thermal state, active layer thickness, borehole temperature, extent, snow cover.

ECMWF has noted that the products listed are relevant for Operational activities at ECMWF and that gridded global 1km products can be readily up-taken. New teams need to be identified with active leaders and members who can initiate activities. This is needed soon in order to have accepted products for going operational in 2020. The GSG accepted this challenge. It was recommended that a Sea Ice Team and a Glacier Team should be created. It was also suggested by Kari Luojus that having a chair of the WG would help get teams other than Snow Watch moving forward. Gino Casassa (Chile) agreed to lead a team to work on glacier products and he will ask Martin Sharp (Canada) for cooperation. Wolfgang Schöner agreed to join the subgroup. It was noted that there are two ongoing IACS Working Groups on related topics which may be helpful to the subgroup: <http://www.cryosphericsscience.org/workingGroups.html>.

ACTION: The GSG needs to name a Chair for the Integrated Products WG and recommend leads and members for the new product teams. Recommendations will be sought from all GCW participants.

ACTION: The GSG Chair will discuss the issue of a chair of the WG with the PR of Finland.

3. SNOW WATCH

3.1 Status of Snow Watch and outcomes of actions: [Document 3.1](#) and the presentation ([WMO GCW Integrated Products WG Snow Watch update GSG Dec 2015 final.pptx](#)) provided participants with a comprehensive summary of the progress of the Team since its inception in 2013. Six priorities for action were identified at that meeting and there has been substantial progress in a very short period of time. The GSG commended the Team on their effort. The task to improve the real time flow and access to in situ snow measurements (e.g. non-reporting of snow depths by some countries) has been very successful with countries beginning to exchange data. There are still gaps in the USA and China, although the USA is working on providing data. The Chair suggested providing an update as more stations come on line so that Members can see the improvements.

ACTION: The Team is asked to prepare a “news item” when there is an update in snow reporting that could be used for the website and made available for broader distribution in WMO. This offers recognition to Members’ efforts.

The development of “snow anomaly trackers” by Finland (FMI) and Canada (CMC) are very useful for monitoring daily changes on the hemispheric scale. It was asked if this product could be done at a regional scale, e.g. North America, Eurasia, or finer which would provide a cryosphere product for use by the Polar Regional Climate Centre (PRCC). This could give visibility for GCW while reducing efforts by the PRCC.

ACTION: It was suggested that the option of producing regional snow trackers be discussed with the countries involved in PRCC. For Canada, it was suggested Ross Brown (co-lead of Snow Watch) could speak with Chantale Côté in Montreal.

A snow dataset inventory has been established to allow users of datasets to compare potential differences between information sources. The inventory is available on the GCW website and currently includes 60 dataset entries:

- 18 satellite-derived snow products and datasets
- 20 analyses, reanalyses and reanalysis-driven snow products and datasets
- 22 in-situ snow products and datasets

The inventory has been announced on CRYOLIST to seek further inputs, but also specific requests within countries such as Russia and China could identify datasets that could be made more widely available. The inventory will be updated as required; new datasets can be forwarded to the Snow Watch Team (Ross Brown) and after review they will be provided to the Website and Outreach Team for posting. This topic will be added to the Team's workshop in June for further discussion. It was also recommended that the data sources identified in the inventory should be linked through the GCW portal. The task on PI self-assessment is still being discussed and could be part of the product inventory initiative. This will be discussed further in the upcoming workshop.

ACTION: The Team should discuss at its June Workshop how to expand the dataset inventory and include data from additional countries.

ACTION: The data sources identified in the inventory should be linked to the GCW data catalogue and the Portal.

The Team continued to contribute to the activities to standardize snow-related nomenclature, and promote standards and best practices as a contribution to CryoNet. The Team will provide information and expertise to the Best Practices Team and Terminology Team as required.

An update on the major snow intercomparison project, SnowPEX, initiated by Snow Watch and supported by ESA was provided (see presentation noted above). The questions being addressed by SnowPEX include:

- How accurate can we observe seasonal snow parameters (extent, mass) for different environments and surface classes and monitor their variability from space on a hemispheric / global scale (methods protocols for validation)?
- Study the agreement / disagreement of global / hemispheric satellite snow extent and SWE products?
- Spatial pattern of retreat of seasonal snow?
- Study the trend of seasonal snow parameters using satellite products, identify the spatial pattern of the changes, and study the uncertainty of these values?

Snow extent, SWE and model products are being used in the intercomparisons. Initial results show very large differences among the products and even among snow model outputs on a climatological basis and year-to-year. The GSG complimented both the Snow Watch and the SnowPEX Team for this excellent scientific contribution and emphasized the importance of these types of intercomparisons for all cryosphere products. The results will be especially relevant for YOPP as snow extent and snow water equivalent are two important parameters for the YOPP modellers. Knowing the limitations of these products will be very useful.

ACTION: A report on this activity which could be put on the WMO home page would be very interesting. The Team is asked to discuss what they wish to advertise to the broader WMO community and provide feedback to the Secretariat for follow-up action.

ACTION: The Team and the Secretariat are asked to draft a letter to the PRs on the benefits of exchanging snow depth data and the current options for doing this; PRs would also be asked to provide the reason why their country may not be able to do this.

ACTION: Slides used in the Snow Watch presentation should be made available to the chairs of EC-PHORS for use in their EC presentation.

3.2 Work Plan: The GSG reviewed the Team's work plan given in **ANNEX 8** and was very satisfied with the progress. The work plan will be updated after the Team's meeting in June. It was noted that early engagement of the Portal Team in the discussion of a data centre to host a global historical in situ snow data archive (task 11) would be beneficial in ensuring interoperability of the dataset.

ACTION: The GSG agreed that adequate funds should be made available to support the participation of Snow Watch Team members and selected experts at the Snow Watch meeting/workshop in June 2015, Columbus, Ohio, USA.

INFORMATION AND SERVICES WORKING GROUP

4. GCW PORTAL

4.1 Status of the development of GCW Portal, including interoperability with CryoNet sites: The Chair of the Portal Team presented a very useful update ([gcw-201512-dmstatus-joint.pdf](#)) of the status and plans for the GCW Portal Data Catalogue and the issues which need to be addressed by the Team, as well as [Document 4.1](#) submitted prior to the meeting. An updated diagram of portal interconnections was provided. It was noted that this is not all automatic as there is human interface to catch errors. The GSG was reminded that the Portal is not currently hosting data, although this option could be investigated, recognizing that long term cost is an issue.

Several issues were raised for discussion, including the filtering of harvested metadata and use of controlled vocabularies, brokering and cleaning/validation of harvested metadata for WIS compliance, consistency of controlled vocabularies, duplication of metadata, and interaction with WIGOS/WIS/GTS. There was discussion about the controlled vocabularies used both within WMO (WIS, WIGOS, Climate services, etc.) and with the broader scientific community (e.g. ICSU). For example, ICSU is good at archiving while WMO is good at operational exchange. With WMO now concerned about end-to-end data management, there has to be agreement on vocabularies; these may need to be developed, e.g. by the GCW terminology team for cryospheric purposes. It was noted that codes.wmo.int is not yet sufficiently populated. WIS and WIGOS have to be on the same page. With respect to data exchange, it could be more efficient for GCW to use the internet for real-time exchange of some datasets rather than the GTS due to the limited bandwidth on the GTS and sometimes limits on the user community side. All these issues need to be discussed within WMO, especially with WIS and WIGOS. Sue Barrell emphasized that WMO needs to engage partners to ensure all parties' interests are properly aligned and asked how WIGOS could help. She noted that it would be beneficial to have the Portal Chair engaged in ICG-WIGOS.

ACTION: The GSG requested Sue Barrell (CBS), D/OBS and Øystein Godøy (on behalf of GCW) to articulate the common issues and to identify follow-on actions for WMO.

ACTION: The Chair of the Portal Team, on behalf of GCW, was requested to engage WIS and WIGOS on vocabulary, metadata standards, data exchange and related matters to ensure a common approach is implemented.

Work on the integration of data from CryoNet sites into the Data Portal was initiated. Work with SLF-Davos has resulted in the implementation of interfaces to metadata for SLF-Davos. These interfaces are currently being tested; initial testing has been successful and metadata will be integrated in the searchable catalogue if tests are successful. The integration currently is only at the metadata level. Further work is required to achieve interoperability at the data level and data

segmentation for real time exchange. Tests are also being conducted with Sonnblick and Sodankylä. Based on the experience from working with these stations, preliminary versions of the [GCW Portal Interoperability Guidelines](#) and [GCW Portal Operations Manual](#) have been developed. The intention of these documents is to guide CryoNet sites in the dialogue with the Portal Team as it is expected that many sites do not have interoperable data management systems. In this context, the experience from the dialogue with SLF-Davos is invaluable and encouraging. The plan is to distribute the two documents to CryoNet sites once they have been finalized. The GSG commended the efforts of the Portal Team in developing GCW's modern data management system.

4.2 Work Plan: The chair provided an updated work plan for the team for the 2015-2017 period (see **ANNEX 9**). The GSG fully supported this effort and asked to be kept informed of issues which should be discussed by EC-PHORS and/or raised with WMO Programmes.

5. GCW WEBSITE (including Outreach and Terminology)

5.1 Status and development of the GCW website: The Chair of the Website and Outreach Team, Jeff Key, provided a summary of activities ([GCW website update4GSG 1215.pptx](#)) over the last year, including progress on the glossary. A webpage to show surface network sites by category and a database table and search tool for the Snow Watch inventory were completed. The station/site questionnaire underwent some significant changes after the Copenhagen meeting as can be seen online. Additional products were added to "Cryosphere Now". New code had to be developed for many of these initiatives, including a complete re-write of the code for the "Cryosphere in the News" news feed. As part of the outreach effort, the GCW handouts and poster were updated for distribution at Cg-17 and are available for download from the website.

The Website and Outreach Team needs to be enlarged to meet the growing needs and complexities of GCW. Contributors of assessments are needed. It would be useful to include more pictures and videos and to have some more graphics for glaciers, permafrost and South American activities. Gino Casassa will offer contributions for South America. A GCW Newsletter could be initiated once the GCW Project Office is staffed. The GSG recognized the effort that it has taken to keep the website current and informative, and especially thanked Jeff Key for his added role as webmaster. The GSG also recognized the help that a student or intern can provide in moving initiatives forward and asked GSG members to seek such support for all GCW endeavours.

ACTION: The GSG asked all members to identify and seek both human and financial resources to conduct specific tasks such as data processing and development of products for the website.

ACTION: The GSG recognized the importance of communicating the existence of the GCW website to the broader community. The GSG Chair requested that the Secretariat should contact PRs asking them to link the GCW website to their national website, if possible.

ACTION: The Website and Outreach Team was asked to contact the chair of APECS to discuss broadening GCW's communication within their community.

The glossary continues to grow and now has over 2500 entries from 19 different sources. The chair of the Team thanked Clément Hutin, an intern in the Secretariat, for his valuable support in expanding the glossary. Activation of a Terminology Team would provide a focus for further development of the GCW glossary. Gino Casassa, proposed lead for the new team, offered a three

phase work plan for consideration by the GSG (see **ANNEXES 9 and 10**). To implement such a "pan-cryospheric" glossary will require collaboration from the cryosphere community at-large and also ideally the endorsement of all relevant cryosphere organizations. The GCW glossary terms will ultimately be included in WMO's METEOTERM.

ACTION: The GSG approved the activation of the Terminology Team, led by Gino Casassa, and the proposed work plan.

ACTION: The Secretariat, on behalf of the Terminology Team, was requested to discuss the development of the glossary with the WMO department responsible for terminology so that GCW efforts can be properly aligned with METEOTERM and the ultimate need for high quality translation.

5.2 Work Plan: Based on discussions at the previous joint CryoNet, Portal and Website Team meetings, an updated plan for the next 2 years was prepared (see **ANNEX 9**). Plans include further revision of the station/site questionnaire based on the new CryoNet structure defined at this meeting, adding additional ice products suggested by M. Drinkwater, and finalizing and adding some new trackers. In the longer term making the GCW more mobile friendly is envisioned. GCW refers routinely to "meeting user needs" and it should discuss how survey(s) of user needs might be conducted, such as ones done by IICWG and the EU Project CryoLand.

ACTION: The Secretariat, in consultation with the Website and Outreach Team, was asked to help with making the website more mobile friendly and to discuss with WMO Communications Department on enhanced communications for GCW to help broaden its reach, including the use of social media.

6. GCW WORKING STRUCTURE

The team updated its working structure as shown in **ANNEX 11**. New teams were established and reporting requirements more clearly defined. These changes will allow GCW to deliver its activities more efficiently, strengthen the engagement of partners and meet WMO requirements as identified at Cg-17. These principles were approved by the GSG and will be submitted to EC-PHORS for their review and acceptance.

The GSG also adopted a set of principles to guide future GCW membership (**ANNEX 12**) and these will be forwarded to EC-PHORS for their concurrence.

6.1 Membership of GSG: There were some changes in the GSG membership. Aimee Devaris has stepped down as she changed jobs in Alaska, moving to the USGS. The GSG thanked Aimee for her contribution to GCW and PHORS, and noted that she could help GCW strengthen their relationship with the cryosphere activities of the USGS. Jenny Baeseman has changed positions and is now Executive Secretary for SCAR. It is hoped that Jenny will be able to continue her involvement with GCW. Two new nominees were recommended as GSG members: Hugues Lantuit (Germany) as a replacement for Hans-Wolfgang Hubberten; and Carven Scott (USA) as a replacement for Aimee Devaris. The GSG strongly supported these nominees and will seek approval from EC-PHORS. The GSG also approved the recommendation that an alternate may be named when a GSG member is unable to attend a meeting. It will seek EC-PHORS approval for this.

ACTION: WMO Secretariat will prepare the relevant input to EC-PHORS for approval of Hugues Lantuit and Carven Scott as members of the GSG.

ACTION: The GSG approved that a GSG member may name an alternate to attend a meeting on their behalf if they cannot participate. The Secretariat, on behalf of the GSG will seek EC-PHORS approval to enact this option.

6.2 Membership of GCW Teams: There was a general discussion on the structure of the WGs and Teams and the updated structure is given in **ANNEX 11**. It was agreed that a chair or co-chair of a WG could also be a lead or co-lead of one of its Teams. Leads have to be able to influence the direction of GCW and have authority to influence outcomes. It is important to have someone who is able to infuse collective ideas on how to move forward and create positive momentum.

The Integrated Products WG will add two new teams – the Sea Ice Team and the Glacier Team. In both cases there will be consultation with partner organizations to assess what is being done and define where there are gaps. For sea ice, the IICWG, ETSI and the CliC Sea Ice WG will be contacted. Jeff Key will lead developing the strategy for defining gaps. For glaciers, Gino Casassa offered to lead development of defining potential gaps that GCW could address, including development of trackers for glaciers which could be done in collaboration with GTN-G and IACS. As noted above, the Chair of the GSG will discuss filling the chair of the Integrated Products WG with the PR of Finland.

Permafrost was also identified as a potential Team, probably within the Observations WG. The chair of the Observations WG will discuss with new GSG member Hugues Lantuit on the establishment of this Team to help focus GCW's permafrost efforts in collaboration with partners.

It was also recognized that there is benefit to having Regional GCW WGs which could foster GCW goals on a regional basis. A successful South America Regional WG was established as an outcome of the first South American GCW/CryoNet meeting and an Asia Regional WG is being established as an outcome of the 1st and 2nd GCW/CryoNet workshops. These WGs will provide liaison with RA III and II, respectively.

The membership of all teams and WGs is given in **ANNEX13**. The GSG approved the nomination of 11 new members to GCW. As well, the GSG thanked the many existing members who agreed to take on additional duties with other teams.

ACTION: All WG chairs were asked to provide the GSG chair and vice-chair and the Secretariat with an update of significant accomplishments of the WG and its teams by the end of April 2016 for updating the GCW report to EC-68.

6.3 Engagement of GCW Focal Points: It is essential that the Secretariat keep regular communications with the GCW focal points ([Doc. 6.3](#)). An immediate request would be to ask them to establish communication with national focal points for partners, including IPA, IASC, SCAR, IACS including WGMS, and WIGOS. Once it is feasible to start a GCW Newsletter, focal points could be asked for contributions.

ACTION: The Secretariat is requested to compile the lists of focal points for partner organizations, including IPA, IASC, SCAR, IACS & WGMS, and WIGOS and provide these to national GCW focal points for their use in establishing national initiatives.

6.4 Partnership: Partnerships are fundamental to GCW's long term success. GCW has established effective liaison with PSTG, IASC, SCAR, IPA, IACS, IICWG, ETSI, etc. There was specific discussion about engaging INARCH (the International Network for Alpine Research catchment Hydrology). Partnering with INARCH is seen as a very good opportunity and important for GCW and EC-PHORS. GCW needs to establish a connection and determine how to extend this into EC-PHORS to enhance its arctic hydrology experience. ICIMOD (International Centre for Integrated Mountain Development) participated in the 1st Asian GCW/CryoNet workshop. It was agreed that GCW needs to follow up with them to re-invigorate contact and potential co-operation in the 3rd Pole Region. Likewise, GCW must be aware of how it might contribute to large international experiments, which may have a cryosphere aspect in their work, such as GIPPS, YOPP or TIPEX (Third Tibetan Plateau Atmospheric Scientific Experiment). The Secretariat is well positioned to follow-up on such potential interactions.

ACTION: Wolfgang Schöner and Barry Goodison will contact John Pomeroy, who is INARCH chair, to discuss appropriate linkages for GCW and for CryoNet as several INARCH sites could be CryoNet station/sites (and vice versa).

ACTION: The Secretariat, on behalf of the GSG, is requested to liaise with ICIMOD to identify potential areas of co-operation and to strengthen national engagement in GCW.

7. MAINSTREAM AND IMPLEMENT GCW IN WMO PROGRAMMES

7.1 Follow-up of Congress 17 decisions: Resolution 43 (Cg-17) decided to mainstream and implement GCW in WMO Programmes as a cross-cutting activity and that implementation activities will be undertaken during the next financial period as one of the major efforts of the Organization with the goal that GCW should become operational (see **ANNEX 14**). GCW needs to be seen across WMO and participation in Technical Commissions and Regional Association meetings is one option. Likewise it needs to be visible to partners, and especially to the scientific community which is not fully aware of GCW and the potential of its activities. GCW needs to define its needs and articulate what it can offer for these groups. For example, IICWG already follows GCW needs to see how it might contribute. D/OBS provided a table of Meetings of Regional Associations and Technical Commissions 2016-2019 for which GCW input will be required (see **ANNEX 15**). He emphasized the need for GCW to tie into these meetings through reporting (as part of WIGOS and/or EC-PHORS) and possibly attendance. For example, GCW should consider a side meeting at the WMO Bureau and EC-68 in June to demonstrate its accomplishments, demonstrate its need for resources and articulate what support is needed from EC Members.

ACTION: D/OBS suggested that Etienne Charpentier could develop a document to articulate GCW's potential interactions within WMO over the next 2 years for review by the GSG.

WIGOS, like GCW, is a WMO priority. GCW is a component of WIGOS and a strong relationship between the two is essential. Sue Barrell discussed [WIGOS](#) and its plan for its pre-operational phase. The GSG and CryoNet Team need to review the WIGOS pre-operational phase to ensure GCW connects to WIGOS properly. Logically, GCW will use what WIGOS is doing at the regional and national level as GCW moves down to that scale. Sue Barrell has been designated as the contact for all WIGOS issues.

ACTION: CryoNet Team should review the WIGOS pre-operational plan to ensure CryoNet is being developed in a manner that will easily integrate into WIGOS at all scales.

7.2 Support/contribution to Polar Regional Climate Centre: The WMO Executive Council, at its 65th Session (2013), agreed that EC-PORS, the Global Cryosphere Watch (GCW), the Commission for Climatology (CCI), the Commission for Basic Systems (CBS) and the concerned regional associations should work in close cooperation to develop the Polar RCCs (PRCCs). As a first step, the focus is on the Arctic Polar Region, including elaborating the PRCC concept taking the form of an RCC-Network. Mandatory Functions of a Regional Climate Centre includes: operational activities for long range forecasts (LRF); operational activities for climate monitoring; operational data services to support LRF and climate monitoring; and training in the use of operational RCC products and services. Highly Recommended functions include: climate prediction and climate projection; non-operational data services; coordination functions; training and capacity development; and research and development. The above generic functions allow PRCCs to facilitate, *inter alia*: strengthened collaboration among NMHS on polar matters; specific regional products such as sub-seasonal forecasts because seasonal prediction skill may be low in the polar region; development of sector-specific products; and stereographic projections including improved imagery (e.g. satellite); and activities for user engagement such as regional or national climate outlook forums, during which users of PRCC products can learn about the products. [Doc. 7.2 PRCC Annex](#) provided the concept note on a PRCC. [Doc. 7.2 PRCC](#) offers suggestions on what GCW might offer in support.

Barry Goodison, Vasily Smolyanitsky, Rick Thoman and Jeff Key participated in the first Scoping Workshop on Climate Services for Polar Regions: Establishing Polar Regional Climate Centres Towards Implementing an Arctic PRCC-Network in November 2015. Barry Goodison presented a paper on GCW at the meeting; the presentation to the GSG ([PRCC for GSG.pptx](#)) outlined what GCW might offer to the PRCC and provides the outcomes of the workshop. The next steps includes countries providing national contributions (those represented in EC-PHORS) to the Secretariat, specifying products/services for Arctic-RCC-Network, as well as areal coverage, temporal scale, their specific contributions and capabilities, and commitments in concrete terms; also other potential contributors. At the moment GCW can contribute through national submissions, but this will overlook the regional integration that GCW can provide. A GCW focal point(s) is needed to follow this initiative.

At the Website and Portal Teams' meeting prior to this meeting, Rick Thoman provided a very informative overview ([Alaska monitoring](#)) of the products provided by NWS Alaska for "cryosphere and climate monitoring". There were many good examples of products they prepare, including some on impacts. Although regional, GCW should consider including these on the website. These are the type of value-added products that GCW could develop, in cooperation with Members, on a pan-Arctic basis as cryospheric products available through the Polar Regional Climate Centre. They have several lake/river ice products, an area where GCW is currently weak. They have also incorporated traditional knowledge in producing user driven products

ACTION: The GSG suggested Rick Thoman, through the US PRCC team, and Vasily Smolyanitsky, through the Russian PRCC team, are best positioned to promote the development of regional cryospheric products as a GCW contribution for the PRCC and asked them to initiate contact on behalf of GCW.

ACTION: The GSG requested that the Secretariat ask Rick Thoman and Vasily Smolyanitsky to serve as focal points for further GCW involvement in PRCC development, as both are currently engaged in this activity nationally.

7.3 Support/contribution to GIPPS and YOPP: The Secretariat provided a very good background paper ([Document 7.3](#)) on GIPPS and YOPP and some potential linkages to GCW.

The GSG Chair participated in the YOPP 2015 workshop and reported that YOPP is keen to work with GCW. They are interested in the products produced and in the observations collected through CryoNet and Contributing Stations and with their connection to the GCW Portal. Vasily Smolyanitsky was asked to interact on behalf of the Sea Ice Team, as he also has links through IICWG and ETSI. The outcomes of SnowPEX will be especially useful. Mark Drinkwater noted that YOPP has spoken with PSTG. A strong linkage must be maintained with YOPP as it develops for the mutual benefit of all groups, especially since all are under the purview of EC-PHORS.

ACTION: The GSG requested all WG chairs and co-chairs and Team leads and co-leads to review the YOPP plans and identify where their activities could contribute to YOPP and where YOPP activities could help their activities. They are to provide the Secretariat with their initial comments before the end of February 2016.

7.4 Draft Resolution on CryoNet to EC-68: As the list of stations will now be finalized for EC in 2017, a draft resolution is not required for EC-68.

8. OUTREACH ACTIVITIES:

8.1 Update of the GCW Handouts: [Document 8.1](#) provides the current handouts produced for Cg-17. The GSG thanked everyone responsible for producing these valuable outreach materials. It was noted that the handouts need to be updated with GCW's new structure and with any other changes approved at the GSG and the Joint CryoNet and Website and Portal Team meetings. It was recommended that a version number and date be added to each handout so that everyone can easily determine that they have the most recent version. Mark Drinkwater noted that the PSTG has done a brochure on how they support cryosphere activities; it was suggested that a link could be provided from this document to the GCW website.

ACTION: The Secretariat is requested to interact with the Teams that prepared Handouts to ensure they are updated as required on a regular basis and certainly before Executive Council.

8.2 Representation at other bodies and meetings: GCW Members were active in promoting GCW at other meetings. Known interactions are provided in **ANNEX 16**. This table should be kept up-to-date by the Secretariat based on submissions by members. GCW also has to be visible and active within WMO bodies (technical commissions (e.g. CBS, CHy, CCI, JCOMM) and regional associations). ANNEX 15 provides a list of meetings at which GCW presence would be beneficial. The GSG chair and vice-chair and the Secretariat will identify opportunities for GCW participation. All WGs and Teams are asked to inform the Secretariat when they have activities/interactions with WMO bodies.

ACTION: The GSG requested all WG chairs and Team leads/co-leads to keep the Secretariat updated on interactions/presentations related to GCW with WMO bodies and partners and other external bodies.

ACTION: The GSG requested the Secretariat to keep ANNEX 16 up-to-date.

9. WORK PLAN

9.1 Review of Actions from previous meeting: Actions from the previous meeting were reviewed and updated as required (see **ANNEX 17**). Actions requiring follow-up are highlighted in

yellow in ANNEX 17. The GSG members were reminded that there needs to be correspondence with the PR when a meeting is being hosted by a country, even if other than the NMHS. This is required to initiate a meeting form within WMO and hence initiate invitations and costing of a meeting.

9.2 Update GSG Action sheets: An action sheet will be prepared by the Secretariat summarizing actions from this meeting.

ACTION: Secretariat is requested to prepare the action sheet for the GSG meeting.

9.3 GCW Project Office/Officer: D/OBS briefed the GSG on the process for staffing the new GCW Scientific Officer, or Project Manager. If staffing is approved to proceed, the position could be advertised by March 2016 with staffing soon after EC. If the position is not approved until EC, staffing would not be completed until the end of the year. If budget allows, D/OBS hopes to have Miroslav Ondráš provide some additional support. Etienne Charpentier also supports GCW.

9.4 Support for GCW Teams/Portal/Website: WGs and Teams are asked to submit their requests for activities and meetings support over the next 2 years. Overall priority is to support the GSG and then the key activities of the WGs. WGs and Teams should also indicate in writing what is needed for specific projects. Chairs should note when additional funds from other sources are being used to support an activity or meeting. Currently, funding will come from the regular budget (mostly for the staff position) and the Trust Fund for activities. Other internal WMO sources will also be approached, such as the GFCS, Training and the Regional Associations. The GSG was reminded of the earlier discussion on seeking national support through student funding, contributions to a specific project and contributions to the Trust Fund.

ACTION: The GSG requested all WG chairs/co-chairs to develop a list of activities and proposed meetings until end of 2017 for which support is sought, including proposed dates, venue, and cost and other available funding. These should be in order of priority and be submitted to the chair and vice-chair by mid-February 2016. These are needed for planning purposes by GCW and WMO and the partners.

Note: A first list was submitted for 2016 and early 2017 only.

10. OTHER BUSINESS

Wolfgang Schöner asked about a securing letter of support from EC-PHORS for projects, such as the proposal for an IPCC Special Report on mountain regions from Mountain Research Initiative (MRI, office at Switzerland) being submitted to the IPCC headquarters before April 2016. It was suggested that he prepares a draft, send it to the chair and/or vice chair for review and forwarding to Bruce Angle who can arrange for co-chair signature (NOTE: Bruce Angle retires March 31). This should not be left to the last minute. An abstract or summary of the proposal should be attached for reference for the chairs – they do check what such letters are for! The letter should clearly show how the proposal fits the EC-PHORS (and hence WMO) objectives and its projects.

Jeff Key asked WG and Team leads to provide updates for the website of their activities, which don't require EC-PHORS approval.

ACTION: The GSG requested WGs and Teams to continue to recommend new team members to the GSG for approval, even between meetings. Nominations should be sent to the chair and vice-chair with a cc to the Secretariat.

- 10.1 Next GCW Steering Group meeting:** Three options were offered:
- With the next Observation and Information & Services WG meetings (early 2017, place TBD)
 - With the next EC-PHORS meeting (late 2016-early 2017, Argentina?)
 - With a CryoNet Tropical Region workshop (perhaps in Africa or Malaysia)

Currently, the first suggestion is the “working option” as the third will require considerable effort for CryoNet to organize a tropical session successfully.

- 10.2 The list of action items arising from this Meeting and from the joint fourth CryoNet Team and third Portal & Website teams meetings are provided in Annex 18 and Annex 19 respectively.

11. CLOSURE OF MEETING (15h45)

**GLOBAL CRYOSPHERE WATCH (GCW)
GCW Steering Group Meeting
Third Session**

AGENDA

VENUE: University of Colorado, Boulder, Colorado, USA

DATE/TIME: 10 December 2015 09.00 to 1 December 2015 16.00

- 1. ORGANIZATION OF THE MEETING** (A. Snorrason)
 - 1.1 Welcome and opening (A. Snorrason/W. Zhang)
 - 1.2 Adoption of the agenda (A. Snorrason)
 - 1.3 Working arrangements (A. Snorrason/S. Starkweather)
 - 1.4 Participant introductions (participants)

- 2. CRYONET**
 - 2.1 Status of CryoNet and its pre-operational testing phase (W. Schöner)
 - 2.2 List of stations of CryoNet for consideration by EC-PHORS and EC-68 (W. Schöner)
 - 2.3 Regional GCW/CryoNet activities
 - 2.4 Work Plan (W. Schöner)

- 3. SNOW WATCH**
 - 3.1 Status of Snow Watch and outcomes of actions (incl., data exchange, zero snow depth reporting, SnowPEX, data inventory) (K. Luoju or R. Brown)
 - 3.2 Work Plan (K. Luoju, R. Brown et al.)

- 4. GCW PORTAL**
 - 4.1 Status of the development of GCW Portal, including interoperability with CryoNet sites (Ø. Godøy)
 - 4.2 Work Plan (Ø. Godøy)

- 5. GCW WEBSITE**
 - 5.1 Status and development of the GCW website (J. Key)
 - 5.1 Work Plan (J. Key)

- 6. GCW Working Structure**
 - 6.1 Membership of GSG (A. Snorrason)
 - 6.2 Membership of GCW Teams (Chairs of the Working Groups)
 - 6.3 Engagement of GCW Focal Points
 - 6.4 Partnership

- 7. Mainstream and Implement GCW in WMO Programmes**
 - 7.1 Follow-up of Congress 17 decisions
 - 7.2 Support/contribution to Polar Regional Climate Centre
 - 7.3 Support/contribution to GIPPS and YOPP
 - 7.4 Draft Resolution on CryoNet to EC-68 (W. Schöner)

8. OUTREACH ACTIVITIES (A. Snorrason/WMO Secretariat)

- 8.1 Update of the GCW Handouts
- 8.2 Representation at other bodies and meetings

9. WORK PLAN

- 9.1 Review of Actions from previous meeting
- 9.2 Update GSG Action sheets
- 9.3 GCW Project Office/Officer
- 9.4 Support for GCW Teams/Portal/Website

10. OTHER BUSINESS

- 10.1 Next GCW Steering Group meetings (A. Snorrason)

12. CLOSURE OF MEETING (17h45) (A. Snorrason /WMO Secretariat)

**GLOBAL CRYOSPHERE WATCH (GCW)
GCW Steering Group Meeting
Third Session**

Boulder, Colorado, USA
10-11 December 2015

LIST OF PARTICIPANTS

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ANNEX 3

CRYONET TEAM WORK PLAN 2015-2017

Activity	Deliverable	Deadline	Responsible	Members	Status	Comment
1.Update documents for Cg-17		2015-01	Secretariat		DONE	
2.Update GCW regulatory material		ongoing until 2016-01	Secretariat		DONE	
3.Editing of questionnaires by expert	Questionnaire update	2015-02-08	Gino Casassa, Jeff Key		DONE	
4.Update CryoNet Primer	CryoNet Primer	01-2016	Wolfgang Schöner	CryoNet team	OPEN	Need decision from Boulder meeting because site concept was revised
5.Review available and proposed GCW agreed observing practices	GCW agreed practices	11-2015	Porsteinn Porsteinsson, Charles Fierz	Gino Casassa, Michele Citterio, Wolfgang Schöner, Vasily Smolyanitsky, additional experts for cryo-components TBD	DONE	ESTABLISHED AS A NEW TEAM
6.Developing the process for assessment of sites proposed to CryoNet	Document on procedure for assessment of CryoNet sites	2015-11	Sandy Starkweather, Jeff Key	CryoNet team	DONE	
7.Consider defining minimum program for CryoNet sites	Document on minimum program for CryoNet sites	2015-11	Wolfgang Schöner	Charles Fierz, Michele Citterio, Christophe Genthon, Vasily Smolyanitsky, lake ice	OPEN	Draft available for snow, glaciers & ice caps, ice sheets, permafrost, sea ice
8.Selection of CryoNet sites	List of CryoNet sites for EC	2015-12	Wolfgang Schöner	CryoNet team	OPEN	Based on the new accepted concept of stations and sites this has to be evaluated by an expert team (CryoNet & external expert for cryo-components)
9.CryoNet team meeting	Report	3days in 12-2015	Wolfgang Schöner	Secretariat	DONE	suggested location: Boulder, suggested date: week before AGU2015

10.Joint CryoNet-Portal team meeting	Report	1day in 12-2015	Wolfgang Schöner, Øystein Godøy	Secretariat	DONE	Topic for meeting (beside others): How will CryoNet (meta)data be integrated into GCW portal?
11.2nd CryoNet Asia workshop	Report	3 days 02-2016	Vasily Smolyanitsky	Secretariat, Wolfgang Schöner		
12.Joint UNESCO-GCW-CryoNet meeting in SA	Report	10-2015	Gino Casassa		DONE	Join activities of GCW and UNESCO
13.Expert team for assessing proposed CryoNet stations and sites	Document	2016-01	Wolfgang Schöner	Secretariat, Charles Fierz		Experts for all components are needed, input from partner organisations (IPA/GTN_P, WGMS/GTN_G, IACS, ...) will be requested
14.Expert team meeting for selection of CryoNet sites	Report	ca. 2016-07	Wolfgang Schöner	Secretariat		need items 4, 6, 9, 13 to be done, meeting to be prepared by video-conference in advance
15.v1 of list of CryoNet stations & sites for approval by CryoNet team	Document	2016-09	Wolfgang Schöner			
16.v1 of list of CryoNet stations & sites for approval by GSG, EC-PHORS, CBS	Document	2016-09-30	Wolfgang Schöner	Secretariat		
17.Information on assessment to PRs and to station/site proposers	Letter	2016-12	Secretary	Wolfgang Schöner		
18.CryoNet team meeting	Report	2017-02	Wolfgang Schöner	Secretariat		
19.Joint CryoNet-, Best Practices- and Portal team meeting	Report	2017-02	Øystein Godøy, Wolfgang Schöner	Secretariat		

GCW SURFACE OBSERVING NETWORK

The GCW surface observation network builds on existing cryosphere observing programmes and promotes the addition of standardized cryospheric observations to existing facilities in order to create more robust environmental observatories. The basic component of the GCW network, including its core network called *CryoNet*, is the *station*. A station could measure one or more components of the cryosphere and one or more variables of each component, for example depth and density of the component snow.

All types of GCW stations need to make their data, metadata and observation procedures available in a timely manner, preferably to a data centre that is interoperable with the GCW portal (GCW station requirements). Observations are made and quality controlled according to CryoNet best practices.

A CryoNet station must meet the minimum set of requirements, which includes providing ancillary meteorological measurements. Potential attributes of CryoNet stations are given below. All stations will be either Primary or Reference.

- Primary - Have a target (intent) of long-term operation and have at least a 4-year initial commitment.
- Reference - Have a long-term operational commitment and long-term (more than 10 years) data records.

CryoNet stations may also have one or more additional attributes:

- Cal/val - the station is being used for calibration and/or validation of satellite products and/or (earth system) models, or it has been used for such purposes in the past and it still provides the needed facilities.
- Research - the station has a broader research focus related to the cryosphere.

Minimum requirements of a CryoNet Station:

1. Meeting Core CryoNet Measurement Requirements

The station shall measure at least one of the variables of one of the cryosphere components (i.e. snow, solid precipitation, lake and river ice, sea ice, glaciers and ice caps, ice sheets, permafrost and frozen ground). The station location is chosen such that cryospheric measurements are representative of the surrounding region, and such representativeness needs to be clearly described by the applicant.

2. Commitment of Operational Continuity

The station must be active. The responsible agencies are committed, to the extent reasonable, to sustaining long-term observations of at least one cryosphere component. There must be a commitment to continue measurements for a minimum of four (4) years.

3. Metadata Up to Date and Available

The station metadata (including all needed metadata describing the station

characteristics and observational programme information) are kept up-to-date and available through the GCW portal as the interface to the WIGOS Information Resource (WIR).

4. Compliance with Agreed Regulatory Practice

The station observational procedures, the instruments and method of observations, quality control practices, etc., should follow GCW endorsed regulations, manuals, guides and to the extent possible the recommended best practices.

5. Data and Ancillary Data Freely Available

Data shall be made freely available, and whenever possible, in (near-) real time; In situ ancillary meteorological observations, as required in the CryoNet best practices, shall also be available with documented quality.

6. Competency of staff

Personnel must be trained in the operation and maintenance of the station.

A GCW CryoNet site generally encompasses an area greater than a conventional observing station, and has two or more active GCW surface-based stations with varying capabilities that are operated as a coordinated unit. At least one station has to be a CryoNet station. A site may comprise several micro-climatological regions or extend over larger altitudinal gradients. Thus, further ancillary meteorological stations are part of a site. Different partners may operate the stations, but they are coordinated through one agency or institute. Each CryoNet site has to provide a concept describing the research approach and the site management (e.g. cooperation between different partners).

Typically, sites have a broader research focus related to the cryosphere compared to stations. Whereas simple sites investigate the cryosphere only, integrated sites aim at providing a better understanding of the cryosphere and/or its linkages to other components of the earth system, for example, the atmosphere, the hydrosphere, the biosphere, the oceans, soil, vegetation, etc.

Potential attributes:

- Basic: monitor single or multiple components of the cryosphere
- Integrated: monitor at least two components of the cryosphere and at least one other component of the earth system. Integrated sites are particularly important for the study of feedbacks and complex interactions between these components.

Requirements for GCW CryoNet site:

- A site comprises at least one GCW CryoNet station
- Integrated sites have technical supporting staff
- Integrated sites have training capability
- has a long-term financial commitment
- Data are made freely available, and whenever possible, in (near-)real time.

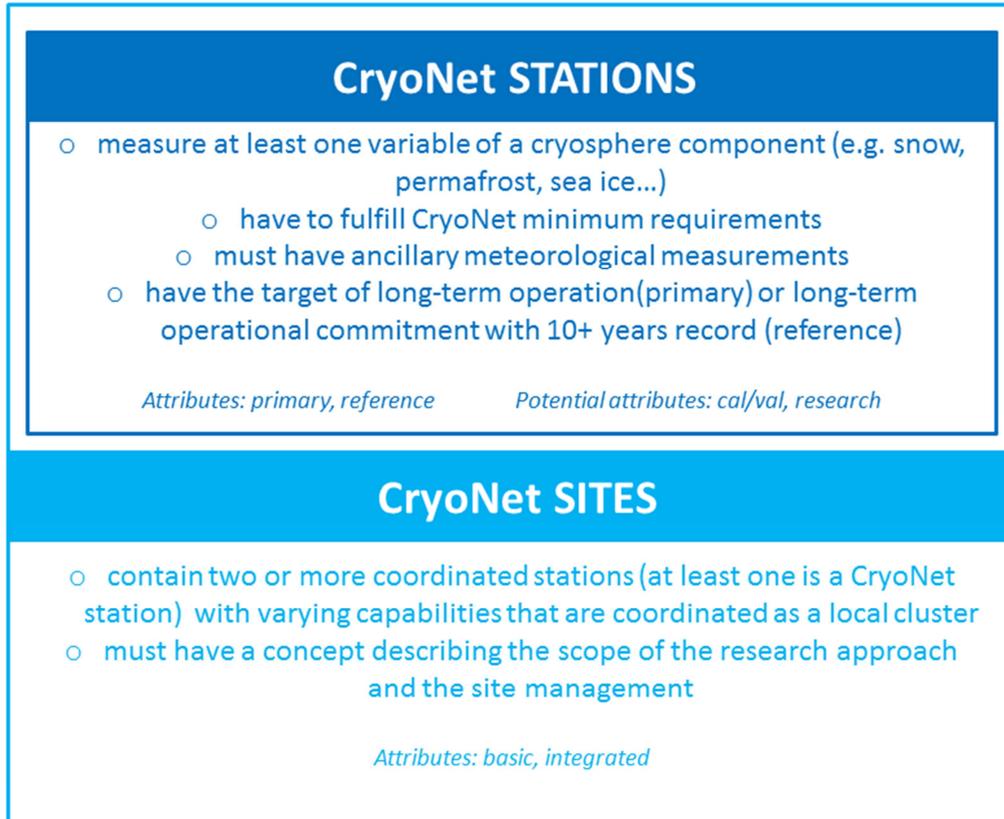


Figure 1: Properties of CryoNet Stations and CryoNet Sites.

A GCW contributing station is required to measure at least one variable of at least one cryosphere component (e.g. snow, permafrost, sea ice...). Contributing stations are those that provide useful measurements of the cryosphere but do not fulfil CryoNet minimum requirements, or in some other way do not provide the quality and consistency of data required by CryoNet stations, for example, where data records may be short or with large gaps. These stations may be in remote, hard to access regions where cryospheric observations are scarce or in regions where they complement other cryospheric measurements. Mobile platforms such as ships, drifting stations and buoys may also be contributing stations.

Potential attributes:

- Reference: have a long-term operational commitment and/or long-term (more than 10 years) data records.

Synoptic/climate stations of the NMHSs measuring cryospheric variables to WMO standards, and providing their metadata and data via WIS and WIGOS, could fulfill the necessary requirements in order to contribute to GCW and to be accepted as stations in the GCW observing system.

As encouraged by GCOS, GCW will facilitate the establishment of high-latitude stations with co-located measurements of key variables, especially permafrost and snow cover, thus enhancing

GCOS/GTOS Networks for Permafrost (GTN-P), Glaciers (-G) and Hydrology (-H) and including the measurements of solid precipitation. In addition, monitoring of aerosol contamination of surface snow (dust, black carbon, heavy metals, etc.) will also be encouraged to link with existing atmospheric measurements from the GAW network. GAW stations and WCRP/Coordinated Energy and Water Cycle Observations Project (CEOP) reference sites in cold climates are potential candidates. Community monitoring also offers new network opportunities for GCW.

Members, through their GCW focal points, and participants in CryoNet workshops have recommended potential stations and sites. Many Members have proposed contributing to GCW through their sites in Europe, Asia, North America, and South America. For example, China has established sites in the “Third Pole” region where the High Asian cryosphere (HAC) serves as the Asian “water tower” for over a billion people. Finland has the Sodankylä-Pallas site in the boreal forest. Its infrastructure is designed for integrated monitoring of soil-snow-vegetation-atmosphere interaction and provides reference measurements for satellite sensors and model development on a continuous basis. Some of the atmospheric observatory sites operated by the International Arctic Systems for Observing the Atmosphere (IASOA) program are being expanded to include measurements of surface properties, including permafrost, making them ideal for inclusion in CryoNet. Current IASOA member observatories include Barrow-USA, Eureka and Alert-Canada, Summit-Greenland, Ny-Alesund-Norway, Abisko-Sweden, Pallas and Sodankylä-Finland, Tiksi and Cherski-Russia, and the Arctic Drifting Station-Russia. Various countries in South America have proposed glacier stations.

GCW will drive performance and provide motivation for high quality observations. Being a GCW station or CryoNet site means being part of an international, operational, global observing system and thus providing observations of known quality for research and knowledge beyond a site’s local region.

The process of selecting GCW (CryoNet) stations and CryoNet sites for the GCW network is in its initial stage (see <http://globalcryospherewatch.org/cryonet/stations.php>). It will be completed by May 2016.

Space agencies, particularly through the WMO Polar Space Task Group (PSTG), and modelling groups such as ECMWF will provide guidance in the development of the surface observing network, given the importance of in situ observations for the validation of satellite products and model parameterization. For ECMWF this is possible via OSSE (Observing System Simulate Experiments) or via assimilation of Intense Observing Period (as for instance during YOPP) that can inform which data can provide crucial information and shall be made into a regular in-situ observing station.

DEVELOPMENT OF A GCW GUIDE AND MANUAL FOR BEST PRACTICES

Draft suggestion for a Work Plan/Timeline

Best practices team: Charles Fierz (WSL/SLF), Þorsteinn Þorsteinsson (IMO), Michele Citterio (GEUS), Wolfgang Schöner (UGraz), Vasily Smolyanitsky (AARI), Jeff Key (NOAA)

January-February 2016:

- Continued survey of existing manuals and reports.
- Focal points contacted and asked to deliver information about national reports/manuals.
- As a global effort GCW must produce a Guide and a Manual that will reflect specific conditions characterizing the cryosphere in different regions.

End of February:

- Short summary document and new draft work plan distributed to entire CryoNet group and GCW Steering Group.

March-April 2016:

- Decide what can be extracted from older reports/manuals (with permission), and what new developments in measurement techniques/data reduction need to be emphasised in a new guide/manual.

End of May 2016:

- Draft of the structure of a new GCW Guide to cryospheric practices ready (formal writing will start when the structure has been decided).
- Ideas for the structure of a GCW Manual being developed simultaneously.
- Collaboration with COST group on snow-related best practices?
- Relation to CIMO guide?
- Have outline/draft ready for September CBS meeting
- Input/feedback from WMO expert groups at this stage.

September-December 2016:

- Writing starts, 1st version of Guide ready by the end of the year.

Mid-year 2017:

- *GCW Guide to the Cryosphere* published
- Plans for *GCW Manual on Best Cryospheric Practices* fully developed

Mid-year 2017 – Congress 2019:

- Work on Manual: Compilation, discussion, writing, editing, publishing.
- **2020:** GCW in operational phase

DRAFT PROCEDURE FOR ACCEPTANCE OF NEW STATIONS INTO GCW

GCW is open to any station that makes measurements of the cryosphere, but seeks to design a network that advances WMO's scientific and operational objectives. The process of evaluating a station or site for inclusion in the GCW surface network is described below. It is the same for stations and sites, CryoNet and contributing, unless indicated otherwise.

1. A representative of the station or site (hereafter, the "applicant" and the "station") completes and submits the station questionnaire (the "application") on the GCW website (globalcryospherewatch.org/cryonet/questionnaire).
 - It is recommended, though not required, that the applicant present the station at a GCW meeting before beginning the application process.
 - By submitting the application for a core station, the applicant is implicitly agreeing that the station meets the CryoNet Minimum Requirements. A commitment to longevity, data quality, and data distribution is particularly important.
2. Core sites must also submit a site concept paper.
3. For stations that are operated by the WMO Member's NMHS, the WMO Permanent Representative (PR) of the station's operating country sends a letter of endorsement to WMO. For stations that are operated by other national entities, there must be a written agreement between that entity and the PR. For stations that are located in a country other than that of the proponent, the agreement to operate in that country and to share data as per GCW requirements must be provided. The PR of the country in which the station is located must be informed that the station could become part of CryoNet. For the mobile platforms operating in international waters by an international consortium, endorsement is done by the designated PR of the concerned countries with concurrence by the chair of the relevant consortium.
4. The application is examined by the WMO Secretariat for completeness.
5. The GCW CryoNet Team, in consultation with relevant experts, evaluates the application. This is normally done annually, but may be expedited in some situations. There are no site visits.
6. If the Team recommends that the station **not** be included in the GCW surface network, feedback is provided to the applicant. The application can be modified and resubmitted at any time.
7. If the Team recommends that the station be included in the network, the GCW Steering Group (GSG) makes its determination. This is normally done at GSG annual meetings. If the GSG recommends that the station **not** be included in the GCW surface network, feedback is provided to the applicant.
8. If the GSG recommends the station for inclusion in the network, the station is conditionally accepted and enters a one-year trial period. The station shall operate according to the Minimum Requirements, including the submission of data and metadata.
9. If the GSG recommends the station for inclusion in the network, the final approval is made by the WMO Executive Council (EC). EC meets annually.

Each CryoNet station will be evaluated annually by the Team to ensure that it continues to meet the Minimum Requirements. If it does not, a timeline for correcting deficiencies will be mutually agreed upon by the Team and the station representatives. If no agreement can be reached, the station will be removed from the CryoNet network or, by mutual agreement, will become a contributing station.

A change in the station type, core or contributing, requires reapplication. This entails a modification to the original application, resubmission, and re-evaluation by the Team and GSG. It does not require approval by EC.

Stations may be withdrawn at any time from the GCW surface network by request, in writing, of the station owners/operators.

When an application is submitted via the online questionnaire process, the station is listed on the GCW website as “candidate”. It is not yet part of the GCW surface network. When the GCW Steering Group recommends stations for inclusion in the surface network, for all practical purposes they are part of the GCW network and will be listed on the website accordingly. They are not, however, officially part of the network until approved by EC.

LIST OF EXISTING GCW AND CRYONET STATIONS AND SITES

Existing CryoNet Sites

Station/Site	Operating Country	Location	Type
1 SIGMA-A	Japan	Greenland	Basic
2 PROMICE Greenland Ice Sheet Monitoring Network	Denmark	Greenland	Basic
3 Sonnblick	Austria	Austria	Integrated
4 Qilianshan Station of Glaciology and Ecologic Environment	China	China	Basic
5 Sodankylä-Pallas	Finland	Finland	Integrated
6 Qilian	China	China	Integrated
7 Tanggula Cryosphere and Environment Observation Station	China	China	Basic
8 Eureka	Canada	Canada	Basic
9 Hofsjökull	Iceland	Iceland	Basic
10 Antisana 15 alfa	Ecuador	Ecuador	Basic
11 Zongo Glacier	France	Bolivia	Integrated
12 Morenas Coloradas Rockglacier	Argentina	Argentina	Basic
13 Quelccaya Ice Cap	USA	Peru	Basic
14 Weissfluhjoch - Davos	Switzerland	Switzerland	Integrated
15 Glaciar Norte	Mexico	Mexico	Basic
16 Saint-Sorlin Glacier	France	France	Integrated
17 Argentiere Glacier	France	France	Integrated
18 Mer de Glace Glacier	France	France	Basic
19 Gebroulaz Glacier	France	France	Basic
20 Xidatan	China	China	Integrated
21 Tanggula	China	China	Integrated
22 Tiksi	Russia	Russia	Integrated

Station/Site	Operating Country	Location	Type
23 Ice Base Cape Baranova	Russia	Russia	Integrated
24 Vuriloches	Argentina	Argentina	Basic
25 Aonikenk	Argentina	Argentina	Basic
26 Barrow Baseline Observatory	USA	USA	Integrated
27 Tianshan	China	China	Basic
28 Zackenberg	Denmark	Greenland	Integrated
29 The Koxkar Glacier Camp (KGC)	China	China	Integrated
30 Syowa	Japan	Antarctica	Integrated
31 SIGMA-B	Japan	Greenland	Basic
32 Dome-C	France-Italy	Antarctica	Basic
33 Spasskaya Pad (Yakutsk)	Japan	Russia	Integrated
34 Forni Glacier	Italy	Italy (Europe)	Basic
35 Valle Nevado	Chile	Chile	Basic
36 Col de Porte	France	France	Integrated

Existing Contributing Sites

Station/Site	Operating Country	Location	Type
1 Yanamarey	Peru	Peru	n/a
2 Gueshgue	Peru	Peru	n/a
3 Artesonraju	Peru	Peru	n/a
4 Mocho-Choshuenco Volcano	Chile	Chile	n/a

Existing Candidate Sites

Station/Site	Operating Country	Location	Category	Type
1 Glaciar Conejeras	Colombia	Colombia	Core	Basic

**WORK PLAN FOR THE WMO GCW SNOW WATCH GROUP¹
FOR THE PERIOD 2015-2016**

No.	Task	Deliverable/ Activity	Due	Responsible	Status	Comment
1	Organize a follow-up Snow Watch meeting in 2015-2016 time frame	Snow Watch meeting	End of 2016	Luojus , Brown, Derksen, Robinson	OK	13-14 June 2015, Columbus, Ohio, OSU campus, prior to ESC 2016
2	Organize periodic (quarterly/bi-yearly) teleconferences to follow the progress of Snow Watch activities	Minutes of telecon.	continuous	Luojus , Brown	on-going	
3	Populate the Snow Watch team with suitable additional people	Updated team listing on GCW website	03/2015	Brown , Luojus, Derksen, Robinson	OK	S. Helfrich (NOAA) and P. Rosnay (ECMWF) have been added to the team
4	Prepare a note (doc/ppt) on progress (and impact) of real-time exchange of snow obs and GCW-suggestion for future actions to be presented at Cg17		04/2015	Luojus , De Rosnay	OK	Material intended for round-table discussion before congress;
5	Prepare a poster (also suitable as a handout) on Snow Watch activities to be presented (at/before?) Cg17		04/2015	Luojus , Brown, Derksen, Robinson	OK	Material intended for WMO congress (May-June 2015)
6	Include Øystein and Jeff Key with the preparations for snow inventory		03/2015	Brown	OK	Maturity aspects (Jeff); vocabulary made compatible with portal (Øystein)
7	Develop and maintain GCW Snow Products inventory	Snow products inventory on the GCW-website	06/2015	Brown	on-going	1st version to be available by February 2015
8	Identify person(s) to assist Jeff in developing Snow Watch section of the GCW website	"Snow Watch" section of the GCW website	06/2015	Derksen , Luojus	?	
9	Liaise with ESA SnowPEX consortium		06/2015	Luojus , Derksen	OK	WMO GCW was presented at the SnowPEX workshop in Boulder, Sept. 2015

¹ Team composition: Ross Brown, Kari Luojus, Chris Derksen, David Robinson, Patricia de Rosnay, Sean Helfrich, Samantha Pull

10	Prepare information on SnowPEX project to GCW website		By end of 2015	Derksen, Luojus		
11	Liaise with the people working on development of the global archive of historical in situ snow data (follow up from ECMWF workshop 10/2014)		By end of 2015	Brown, Luojus, Derksen		

Updated: 17 November 2015

INFORMATION AND SERVICES WORKING GROUP WORK PLAN, 2015-2017

#	Task	Deliverable/activity	Due	Responsible	Status	Comment
<i>Portal Team:</i>						
1.1	Integrate relevant data centres	Much of the data that is relevant for GCW is hosted by non WMO data centres. Using relevant networks like CLIC, ICSU WDS, WIS and others, relevant data centres are identified and contacted.	Continuous	Øystein Godøy METNO Team	Ongoing	Integration of data centres depends on the availability of metadata interoperability interfaces.
1.2	Software development	The GCW catalogue is depending on contributing data centres and the description these provide of their data. As this documentation varies in structure and content, translations are required to provide a unified search interface to all data. This requires continuous adaptation of the software as well as implementation of semantic translations. Interfaces to data are also likely to evolve over time and the software need to be adapted accordingly to provide higher order services on data where possible.	Continuous	Øystein Godøy METNO Team	Ongoing	
1.3	Establish GCW Catalogue Interoperability Forum	Based on the data centres already integrated with the GCW catalogue a GCW interoperability group is identified. This group will act as reference group for the development of interoperability guidelines. The group cooperates using electronic tools.	2016Q1	Øystein Godøy	Not formally started	Pending first version of interoperability guidelines
1.4	Develop catalogue interoperability guidelines	As GCW depends on a number of data centres that belong to different data management frameworks or are independent, it is useful to develop a formal document of the interoperability standards supported as well as references to relevant documentation developed by e.g. WMO, ICSU WDS, Research Data Alliance and GEOSS. The purpose is to have material on best practise that may help data centres establish machine interfaces that are support the distributed nature of GCW data management while acknowledging that GCW depends on a heterogeneous community.	Draft 2015Q3 2016Q3	Øystein Godøy Portal Team	Started	This depends on the involvement of a GCW interoperability forum as well as the GCW Portal Team for liaison with external activities. First version available. Must be available for CBS, i.e. September.
1.5	Establish the GCW catalogue as a WIS DCPC	Following the joint CryoNet and Web Portal meeting the Davos June 2014, steps to establish the GCW catalogue as WIS DCPC is being taken. This process includes planning of the necessary steps prior to sending a formal application to WMO and subsequently the formal process of evaluation of the proposal by WMO before a potential acceptance.	Approved DCPC by 2016Q4	Bard Saadatnejad (Øystein Godøy)	Started	Due estimate taking into account the approval process of WMO. Pending updated WIS implementation plan at METNO.

#	Task	Deliverable/activity	Due	Responsible	Status	Comment
1.6	Analyse the problem of duplication of metadata through harvesting	Duplication of metadata records in global catalogues may arise from metadata harvesting as the same metadata may have many paths to a global catalogue. The intention is to describe this problem and to identify potential solutions including those identified by other efforts (e.g. RDA, WMO, ICSU).	2015Q4	Øystein Godøy Portal Team	Started	Related to WIS/WIGOS activities.
1.7	Develop a GCW Catalogue Operations Manual	Development of a GCW Catalogue Operations Manual will increase the transparency of the GCW Catalogue. It will address issues raised in this work plan and provide the basis for bilateral agreements with contributing data centres.	Draft 2015Q4 2016Q3	Øystein Godøy (Steve Foreman) Portal Team	Started	First version available. Must be available for CBS, i.e. September.
1.8	Develop bilateral agreements with contributing data centres	To avoid duplication of data in global catalogues like WIS and GEOSS, bilateral agreements with contributing data centres are required to define whether harvested metadata should be exposed using machine interfaces by the GCW catalogue or not. A template for agreements has to be developed. While WIS has formal procedures for interaction between data centres, many of the GCW contributing data centres are not WMO members and a pragmatic approach is required to slightly formalise the interaction (e.g. expected service level and error handling) between the GCW catalogue and contributing data centres.	Draft 2016Q1 Continuous	Øystein Godøy (Steve Foreman)	Planning	This may be separated in two issues. One relating to exposure towards WIS and one on the relation between WIS and GEOSS. If there is a mechanism determining selective exposure of metadata between WIS and GEOSS that can be utilised in this context. The reference group for this work is the GCW Catalogue Interoperability Group. Check e.g. how this is handled in GAW.
1.9	Adapt harvested metadata to WMO requirements	The metadata harvested by the GCW catalogue comes from a variety of data centres using a number of standards that differs from the WMO standards. Harvested metadata must be adapted to WMO requirements prior to potential exposure through WIS.	Continuous	Bard Saadatnejad (Øystein Godøy) METNO Team	Ongoing	Exposure of harvested metadata through WIS depends on the consent of the originating data centre. It is especially important to avoid duplication of records in GEOSS as WIS is connected to GEOSS. Tools for adaptation of metadata are being developed, but procedures are required as well.

#	Task	Deliverable/activity	Due	Responsible	Status	Comment
1.1 0	Connect GCW catalogue to WMO GTS for datasets generated by non-WMO members	Much of the GCW community and datasets are external to WMO. Some of these datasets may be useful in real time applications and to support this the GCW catalogue must be able to provide these data on GTS upon request from the GCW community.	2017Q4	Øystein Godøy METNO Team	Planning	<p>Pending interoperability guidelines and availability of interoperability interfaces for data.</p> <p>Real time access to requested data can also be supported through Internet, but without the guaranteed timeliness of WMO GTS. GTS connection requires a justified request from the GCW user community.</p>
1.1 1	Interaction with GCW user community	In order to continuously adapt the system requirements for the GCW Portal, the GCW user community (including the CryoNet sites) is consulted. Specifically is ongoing GCW activities like Snow Watch important for continuous communication.	Continuous	Øystein Godøy	Started	<p>In the initial phase this is done through joint CryoNet and Portal meetings and through interaction at various conferences.</p> <p>Presentations of GCW Portal made at SciDataCon2014, ADC2014/2015, PDF II.</p>
1.1 2	Interaction with relevant WMO activities	In order to link GCW activities to relevant WMO activities mutual representation in working bodies and exchange of working documents is required.	Continuous	Øystein Godøy	Started	<p>Participation in TT-WMD. This requires support from the WMO secretariat.</p>
1.1 3	Integration of Snow Watch Archive with the GCW Portal	The Snow Watch team is planning to develop an archive for snow products. This archive must be structured and documented for integration with the GCW Portal. The Portal team will contribute to design and definition of interfaces.	2016Q4	Øystein Godøy Kari Luojus	Not started	
1.1 4	Integration of Snow Watch inventory with the GCW Portal	The Snow Watch team has created an inventory of relevant snow products. This is available in the website, but should be complemented with metadata pointing to actual data in the GCW Portal.	2016Q4	Øystein Godøy Kari Luojus	Not started	
1.1 5	Testing against selected CryoNet stations	Development of exchange interfaces for metadata and data between CryoNet stations Weissfluhjoch, Sonnblick and Sodankylä and the GCW Portal. Testing of flows and update of the interoperability guidance material.	2016Q4	Øystein Godøy Kari Luojus Wolfgang Schöner Charles Fierz	Started	
1.1 6	Joint CryoNet, Best practices and Portal Meeting	Meeting to discuss publication and sharing of CryoNet datasets.	2017Q1	Øystein Godøy Wolfgang Schöner	Not started	

#	Task	Deliverable/activity	Due	Responsible	Status	Comment
1.1 7	Transformation of controlled vocabularies to machine readable form	The vocabularies developed to describe the scientific parameters measured/estimated in the cryospheric components must be available in machine readable form and cross walked to other vocabularies.	2017Q4	Øystein Godøy	Not started	Depends on the results of the terminology team. It is important that vocabularies suitable for description of the variables handled in datasets are generated.
1.1 8	Integration of CryoNet data in the GCW Portal	Dedicated effort to integrate CryoNet data streams (real time and archived) in the GCW Portal. The dedicated effort is focusing on Sonnblick, Sodankylä and Weissfluhjoch since interfaces to these have been tested. Other potential stations can be included in the effort provided they have established the proper interoperability interfaces.	2017Q4	Øystein Godøy Kari Luojus Wolfgang Schöner Charles Fierz	Started	
<i>Website and Outreach Team:</i>						
2.1	Revise station questionnaire based on new CryoNet structure	The CryoNet station-site structure was revised in December 2015. The questionnaire will be modified accordingly.	February 2016	Jeff Key	Not started	
2.2	Add additional products to the Cryosphere Now pages	Some new products are available, notably sea ice thickness from ESA and JAXA.	March 2016	Jeff Key	Started	
2.3	Add additional "trackers"	Add trackers for surface temperature, albedo, and sea ice thickness.	March 2016	Jeff Key	Started	
2.4	Update glossary and requirements as needed	Add additional glossary terms and sources as needed. Update observational requirements as needed.	Continuous	Jeff Key	Ongoing	
<i>Terminology Team</i>						
3.1	Establish partnerships for glossary development	Partnerships with other organizations that have cryosphere interests, notably IACS, will foster community consensus for the glossary definitions. Jointly formulate a plan for completing the GCW Cryosphere Glossary.	Dec 2016	Charles Fierz, Gino Casassa, Jeff Key	Started	
3.2	Update glossary with additional sources	Add IPCC cryosphere term definitions to the glossary	Sept 2016	Jeff Key, Gino Casassa, Charles Fierz	Started	

**GLOBAL CRYOSPHERE WATCH (GCW)
TERMINOLOGY TEAM**

Pan-Cryospheric Glossary

GCW has now incorporated the following 19 existing snow & ice glossaries (<http://globalcryospherewatch.org/reference/glossary.php>) including some 2500 cryospheric terms, 1500 of which are unique:

1. Australian Bureau of Meteorology
2. ASPECT
3. Canada National Climate Archive
4. Environment Canada
5. EU Climate-ADAPT
6. IACS-UNESCO Seasonal Snow on the Ground
7. IACS-UNESCO Glacier Mass Balance
8. IPCC WGII AR5
9. NOAA Hydrologic Terms
10. NOAA Snow/Ice
11. NSIDC
12. Sea ice nomenclature WMO No. 259, TP 145
13. USGS Glossary of Glacier Terminology
14. USGS Glossary of Selected Glacier-Related Terminology
15. UK Antarctic Place-Names Committee
16. WMO METEOTERM
17. WMO Sea Ice Nomenclature Version 1.0 by Bushuyev
18. IPCC AR5 WG1 Glossary
19. UNESCO-WMO International Glossary of Hydrology

GCW is considering incorporating the following 6 glossaries:

Multi-Language Glossary of Permafrost and Related Ground Ice Terms. 1998, revised 2005. IPA. <http://nsidc.org/fqdc/glossary/>

Terminological Guide of the South American Geocryology. D. Trombotto, P. Wainstein & L. Arenson. 2014.

Glossary of Permafrost and Related Ground-Ice Terms. National Research Council of Canada. 1988.

The Dictionary of Physical Geography, 4th Edition
<http://www.wiley.com/WileyCDA/WileyTitle/productCd-111878233X.html>

Illustrated Glossary of Snow and Ice. 1973. Terence E. Roberts, Brian Birley, Swithinbank, Charles, Armstrong.
<http://www.amazon.com/illustrated-Glossary-Snow-Terence-Armstrong/dp/0901021016>

Photo glossary of glaciological terms
<http://www.swisseduc.ch/glaciers/glossary/>

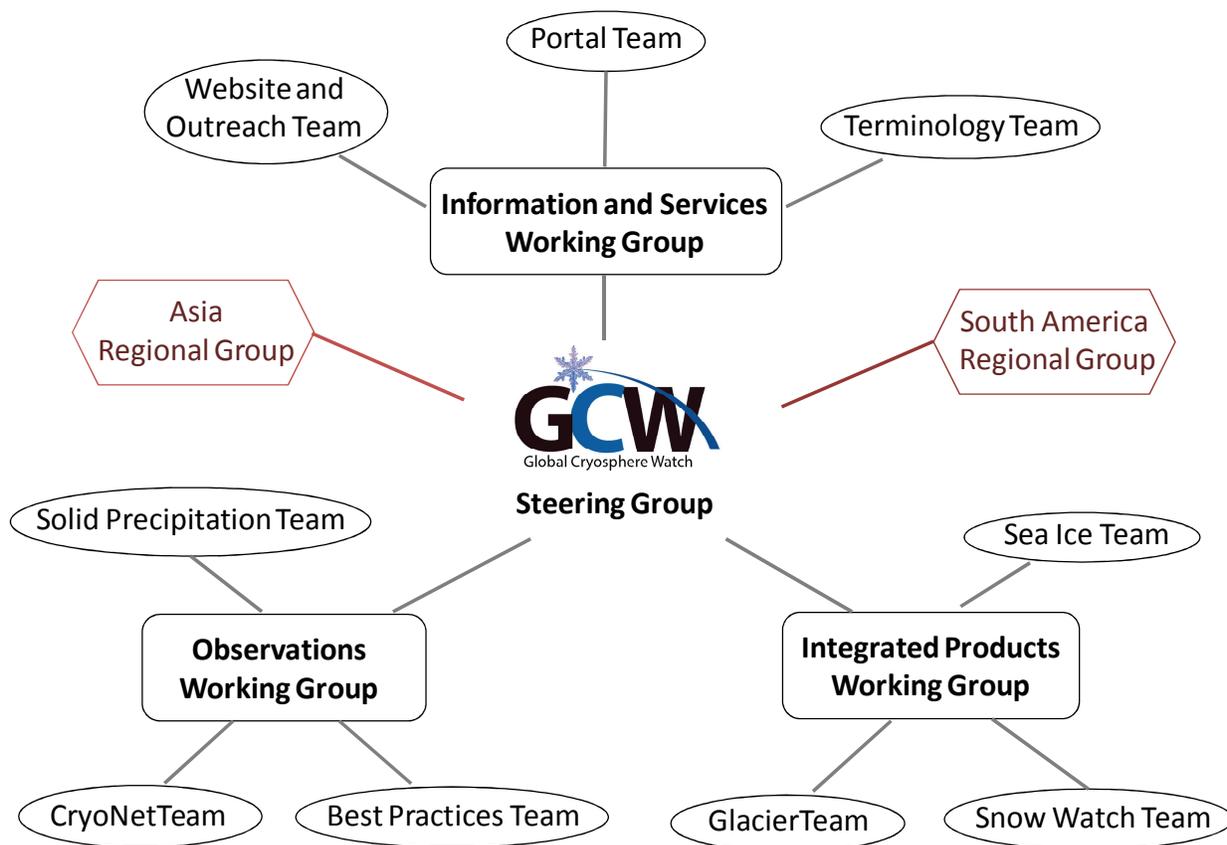
GCW plans to enrich at first the glossary database with existing and authoritative published glossaries. In that regard suggestions from the community are being sought of relevant glossaries not already considered.

A second stage of the GCW "pan-cryospheric glossary" is to select a few hundred, or better even more than 1000, key concepts (entries) for which already existing definitions largely agree within different glossaries.

A third stage would be to discuss and agree upon a definition for concepts where the different existing glossaries do not completely agree, or do not agree at all, by either adapting existing definitions, or by creating a new consensus definition. For this stage expert groups for each cryospheric element (sea ice, glaciers, ice sheets, seasonal snow, lake & river ice, frozen ground) would have to be established, ideally from different backgrounds, different organizations and different nationalities. By and large, this last stage will definitely be the most challenging, although the "controversial" list of concepts is expected to be rather short.

In summary, it would be fantastic for the purpose of implementing such a "pan-cryospheric" glossary to draw on the collaboration from the cryosphere community at-large and also ideally the endorsement of all relevant Cryosphere Organizations.

GCW WORKING STRUCTURE



GUIDELINES FOR GCW STEERING GROUP MEMBERSHIP

The GCW is growing quickly and the GSG recognized that a set of principles would be useful to guide GCW in the nomination and selection of members to the GSG and constituent bodies, as outlined below.

Candidates for GCW membership on GSG, constituent bodies, working groups, task teams, or rapporteurs for GCW related activities will be nominated and selected on the basis of their expertise, knowledge and experience, and ability to commit time to GCW, with an aim to achieve representation from all relevant thematic components of the cryosphere. Following that, and to the extent possible, efforts will be made to achieve regional balance and gender balance. Nominations must be vetted through the Steering Group, with the assistance of the WMO Secretariat on any required WMO correspondence.

Candidates for the GCW Steering Group may be nominated by PRs with WMO or through Technical Commissions or partner organizations and selected on the basis of their expertise, knowledge and experience, with an aim to achieve representation from all relevant thematic components of the cryosphere. Following that, and to the extent possible, efforts will be made to achieve regional balance and gender balance. Nominations will be considered by EC-PHORS and approved by WMO Executive Council.

The number of members of the GCW Steering Group may be limited by EC-PHORS; each member which will undertake a two-year term, renewable. The Steering Group will be authorized to provide high-level policy and technical guidance and serve as liaison with WMO through EC-PHORS. Chairs of GCW working groups, or their designated alternate, will be members of the Steering Group invited to Steering Group meetings, ex officio. The Steering Group may invite other experts as appropriate to a meeting. Steering Group members may identify an alternate to act on their behalf if they are unable to attend a meeting.

Meetings of the Steering Group will take place normally once per year and will be funded through WMO. Meetings of working groups and task teams will depend on the availability of resources. It is expected that, to the extent possible, use of technical tools such as video conferencing (i.e. WebEx) will be employed to ensure that funding is available to support the work itself.

EC-PHORS will designate the chair and vice-chair of the GSG.

MEMBERSHIP OF GCW STEERING GROUP, WORKING GROUPS AND TEAMS

#	Name of Expert	GSG	Observations WG				Integrated Products WG				Information & Services WG			
			WG	CryoNet Team	Best Practices Team	Solid Precip Team	WG	Snow Watch Team	Sea Ice Team	Glacier Team	WG	Portal Team	Website & Outreach Team	Terminology Team
1	Árni Snorrason	Chair												
2	Jenny Baeseman (SCAR)	✓										✓		
3	Sue Barrell (WIGOS)	✓												
4	Gino Casassa	✓		✓					✓					Lead
5	Michele Citterio	✓	Co-chair	✓	✓									✓
6	Mark Drinkwater (Chair, PSTG)	✓												
7	Charles Fierz	✓		✓	Co-Lead							✓		✓
8	Øystein Godøy	✓									Chair	Lead		✓
9	Barry Goodison	Vice chair												
10	Jeff Key	✓		✓	✓				✓		Co-Chair		Lead	✓
11	Hugues Lantuit	tbc												
12	Kari Luojus	✓		✓		Co-Chair	Co-Lead					✓		
13	Tetsuo Ohata	✓												✓
14	Carven Scott	tbc												
15	Vasily Smolyanitsky	✓	✓	✓	✓	Co-Chair			✓					✓
16	Wolfgang Schöner	✓	Chair	✓	✓					✓		✓		
17	Cunde Xiao	✓		✓										✓
18	Christophe Genthon			✓										
19	Þorsteinn Þorsteinsson			✓	Co-Lead							Data Policy		
20	Sandy Starkweather			✓								✓		✓
21	Hironori Yabuki			✓								✓		✓
22	Rodica Nitu					Interim Lead								
23	Ross Brown							Co-Lead						
24	Chris Derksen							✓						
			WG	CryoNet Team	Best Practices Team	Solid Precip Team	WG	Snow Watch Team	Sea Ice Team	Glacier Team	WG	Portal Team	Website & Outreach Team	Terminology Team

			WG	CryoNet Team	Best Practices Team	Solid Precip Team	WG	Snow Watch Team	Sea Ice Team	Glacier Team	WG	Portal Team	Website & Outreach Team	Terminology Team
25	Sean Helfrich							✓						
26	Samantha Pullen							✓						
27	Dave Robinson							✓						
28	Patricia de Rosnay							✓						
29	Julie Friddell											✓		
30	Bard Saadatnejad											✓		
31	Rick Thoman												✓	
32	Tómas Jóhannesson											Data Policy		
33	Giovanni Macelloni			✓										
34	Angel Corona			✓										
35	Eric Holloway				✓									
36	Peter Pulsifer											✓		
37	Julia Boike			✓										
38	Tony Worby								✓					
39	Rainer Prinz			tbd						tbd				
40	Petra Heil				✓									
41	Lynn Yarmey											✓		

NOTE: New members are included in « red » text;

tbc – recommended by GSG, awaiting PHORS approval

tbd – recommended as team member – to be confirmed

GLOBAL CRYOSPHERE WATCH (GCW)**Resolution 43 (Cg-17)**

THE WORLD METEOROLOGICAL CONGRESS,

Noting:

- (1) Resolution 60 (Cg-XVI) – Global Cryosphere Watch (GCW),
- (2) The Sixteenth Congress decision to develop the Global Cryosphere Watch as an IPY legacy with the goal of achieving an operational GCW,
- (3) That the GCW working structure has been initiated and significant progress has been made towards an operational GCW, including building the core, standardized GCW observing network - CryoNet,
- (4) The GCW Implementation Plan developed under the auspices of the Executive Council,

Considering:

- (1) The cryosphere is global, existing in various forms spanning all latitudes and occurring in approximately one hundred countries in addition to the Antarctic continent,
- (2) The cryosphere is an integrative element within the climate system and provides one of the most useful indicators of climate change, yet it is arguably the most under-sampled domain in the climate system,
- (3) Cryosphere-related feedbacks in the amplification of climate change cause impacts on weather, climate and hydrology globally,
- (4) The cryosphere, its changes and their impacts, has received increased scientific scrutiny and continuous attention by decision-makers and coverage by the media creating an unparalleled demand for authoritative information on past, present and future states of the world's snow and ice resources,
- (5) The GCW is a significant component of the World Meteorological Organization Integrated Global Observing System (WIGOS) and the WMO Information System (WIS), particularly in promoting interoperable and reference observations, and near real-time data and information exchange,
- (6) The GCW is recognized as a significant contribution to developing and implementing cryosphere observations and services within the Global Framework on Climate Services (GFCS),

- (7) The GCW can only succeed through the work of WMO Members in partnership with other organizations which have cryospheric interests,
- (8) That the development of GCW has progressed with the limited resources allocated by Cg-XVI and with support from extrabudgetary resources,

Appreciating:

- (1) The important contributions Members, international partner organizations and programmes make towards the development of GCW,
- (2) The relevant work undertaken by Members, the Executive Council, regional associations, technical commissions, the EC Panel of Experts on Polar Observations, Research and Services (EC-PORS) on the development and implementation of the GCW initiative launched by Sixteenth Congress,
- (3) The contributions of Members to the PORS Trust Fund in support of GCW development,

Decides to mainstream and implement GCW in WMO Programmes as a cross-cutting activity;

Decides further that implementation activities will be undertaken during the next financial period as one of the major efforts of the Organization with the goal that GCW should become operational;

Invites partner organizations to:

- (1) Collaborate with WMO on the implementation of the GCW;
- (2) Support the implementation of GCW by providing both human and financial resources;

Requests the Executive Council to:

- (1) Establish a mechanism to steer and monitor the activity and to achieve the broadest possible collaboration and cooperation;
- (2) Ensure the active participation and representation of the principal bodies concerned and also the participation, as appropriate, of technical experts and representatives of agencies undertaking observing and research initiatives relevant to the cryosphere;

Requests the regional associations and technical commissions to include this activity in their work programmes in order to fully accommodate the cross-programme nature of GCW;

Urges Members:

- (1) To develop their observing systems to support the observing component of GCW;
- (2) To coordinate their WIGOS and WIS implementation activities with GCW implementation;
- (3) To provide experts to participate in the GCW-related work;

- (4) To provide both human and financial resources to help support the implementation of GCW;
- (5) To support regional and global GCW implementation activities, including the establishment of the operational CryoNet, the core, standardized GCW Network;
- (6) To keep the Secretary-General informed about their GCW implementation activities;
- (7) To share relevant experience and cooperate with one another in implementing GCW, including assistance to Members with specific GCW implementation needs;

Requests the Secretary-General:

- (1) To ensure, to the extent possible within available resources, management of, and provide support to, the implementation of the GCW;
- (2) To establish a GCW Coordination/Project Office;
- (3) To coordinate and collaborate GCW activities with the United Nations system organizations and other relevant international organizations and programmes.

Note: This resolution replaces Resolution 60 (Cg-XVI), which is no longer in force

Meetings of Regional Associations and Technical Commissions 2016-2019 for which GCW Input will be Required

	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
2016						FINAC WMO Bureau EC-68			RA II-16		CBS-16 China	CHy-15 Italy
2017				RA IV-17		FINAC WMO Bureau EC-69	CAS-17 Indonesia		RAVI-17	JCOMM-5 Indonesia		RA V-17
2018			CCI-17 Morocco/ Chile	CAGM-17 Korea		FINAC WMO Bureau EC-70	CAeM-16 Geneva		CIMO-17 Turkey	RAI-17 I B C S - 3		RA III-17
2019					FINAC WMO Bureau Cg-18/CICG	EC-71						

REPRESENTATION AT OTHER BODIES AND MEETINGS

No.	Name	Body	Meeting	Details
1.	Øystein Godøy	ICSU/CODATA SciDataCon	New Delhi, India 2-5 Nov. 2014	Oral presentation on GCW metadata handling and experience during the session on Towards a Global Metadata Interoperability Network: Experiences and Technologies for Linking Catalogues
		SAON/IASC Arctic Data Committee	Potsdam, Germany, 10-11 Nov. 2014	No presentation, only GCW information during discussions to raise the awareness on GCW in polar data management communities
		ICG-WIGOS Task Team on WIGOS Metadata	Antalya, Turkey 20-23 Oct. 2015	
		WMO Polar & High Mountain Activities, Side Event at Cg-17	Geneva, 28 May 2015	Support provided to Rob Vertessy on GCW Data Portal
2.	Sue Barrell	ICG-WIGOS	Geneva, 16-20 Feb. 2015	Development of the WIGOS Framework for submission to Cg17, especially including the WIGOS Regulatory Material, Metadata Profile and Information Resource, and formulation of the proposed WIGOS Pre-operational Phase, which will have a major focus on national and regional implementation of WIGOS. Cg17 subsequently designated WIGOS as one of the WMO priorities for the 2016-19 financial period and agreed to proceed to the WIGOS Pre-operational Phase (WPP), with the Plan for the WPP to be submitted for approval by EC68 in June 2016
3.	Samantha Pullen	COST ES1404 Management Committee	Grenoble 18-19 th March 2015	UK representative on the Management Committee of COST ES1404: "A European network for a harmonised monitoring of snow for the benefit of climate change scenarios, hydrology and numerical weather prediction". Presented progress on improving SYNOP snow-reporting practices, which is a Snow Watch activity.
		2 nd International		Presented SYNOP snow-reporting

		Satellite Snow Products Intercomparison Workshop	14-16 Sep. 2015, Boulder	practices in the “Snow Extent Products
4.	Jeff Key	CliC (WCRP Climate and Cryosphere) Scientific Steering Group	Boulder, Colorado USA, 9-11 Feb. 2015	Recommendations for CliC-GCW collaboration were discussed
		Second SnowPEX workshop	Boulder, Colorado USA 14-16 Sep. 2015	GCW perspectives on product intercomparisons were presented and discussed
		Polar Space Task Group (PSTG)	Oberpfaffenhofen, 5-7 October 2015	Representing GCW by WebEx, provided ppt presentation on GCW
		WMO Polar & High Mountain Activities, Side Event at Cg-17	Geneva, 28 May 2015	Support provided to Rob Vertessy on GCW Website
		WIGOS Space 2040 workshop	Geneva , 18-20 Nov. 2015	Presentation on the GCW perspective
5.	Árni Snorrason (with support from Barry Goodison)	World Meteorological Congress	Geneva, 25 May – 12 June 2015	Presenting GCW documents to the Congress
		WMO Polar & High Mountain Activities, Side Event at Cg-17	Geneva, 28 May 2015	Presenting GCW and Cryosphere observations
6.	Mark Drinkwater	WMO Polar & High Mountain Activities, Side Event at Cg-17	Geneva, 28 May 2015	Presenting Polar Space initiatives
		Polar Space Task Group (PSTG-5) and PSTG SAR Coordination Working Group (SAR-CWG-4)	Oberpfaffenhofen, 5-7 October 2015	Chairing the PSTG and participating in SAR-CWG-4
7.	Charles Fierz	WMO Polar & High Mountain Activities, Side Event at Cg-17	Geneva, 28 May 2015	Presenting High Mountain regions
8.	Vasily Smolyanitsky	GFCS TT on Monitoring and Evaluation of implementation of the GFCS and on Operational and Resource plan for the GFCS for the period 2015 – 2018	Geneva, Switzerland, 27-30 Apr 2015	Representing JCOMM; Input to GFCS plan in parts related to marine meteorology

		JCOMM ET on Marine Climatology 5 th session	Geneva, Switzerland, 22-25 June 2015	Report to ETMC on ETSI and GCW activities as ETSI chair; development of sea ice climatology as a part of the MCDS; harmonization issues of sea ice and open ocean documentation.
		International Ice Charting Working Group	16 th session, Rostock, Germany, 19-24 Oct 2015	National representative, ETSI and WMO representative; presentation of JCOMM and GCW activities relevant to IICWG, ensuring proper interaction between the IICWG as a technical forum and JCOMM and GCW
9.	Wolfgang Schöner	SSW-2015	Toyama, Japan 23-30 Apr. 2015	Oral presentation: The Global Cryosphere Watch (GCW) Surface Observations Programme CryoNet Co-Organising of the Session "Remote Sensing of the Arctic System"
		ESA-Workshop on Novel Mission Concepts for Snow and Cryosphere Research	ESA-ESTEC, Netherlands 16-17 Sep. 2014	Oral presentation: The Global Cryosphere Watch (GCW) Surface Observations Programme CryoNet
10.	Patricia de Rosnay	COST ES1404 Management committee meeting	KO meeting on 10 November 2014	UK representative on the Management Committee of COST ES1404: "A European network for a harmonised monitoring of snow for the benefit of climate change scenarios, hydrology and numerical weather prediction". Elected co-chair of the COST action ES1404.
			Management committee meeting, Brussels, on 4-5 June 2015	Presented the Snow Watch initiative to improve snow reports availability on the GTS. Discussion on the complementarities between Snow Watch and COST action ES1404.
			Management committee meeting, combined with the 6 th National seminar on Snow on the day of PyRy, Helsinki, Finland, on 2-4 November 2015	Keynote talk on snow data assimilation for NWP, highlighting importance of in situ snow depth observations for NWP and synergies between Snow Watch and COST actions to improve snow reports availability.
		IUGG conference	Prague, 26 June	Participation funded by the COST action on snow. Invited talk with

			2015	presentation of Snow Watch initiative and COST action to improve the availability of in situ snow depth observations for NWP.
11.	Barry Goodison Jeff Key Vasily Smolyanitsky Rick Thoman	Scoping Workshop on Climate Services for Polar regions: Establishing PRCC towards implementing and Arctic PRCC-Network	Geneva, Switzerland, 17-19 November 2015	Discuss potential role/expectations of GCW in a PRCC
12.	Charles Fierz	COST Action HarmoSnow ES 1404	Bruxelles, Belgium, 4 June 2015	Recommendation to co-ordinate efforts with GCW
13.	Charles Fierz	Informal meeting with representative of UNESCO-IHP (Anil Mishra)	Prague, Czech Republic 25 June 2015	Discussion about possible collaboration in terms of education outreach, with both IACS & GCW
14.	Charles Fierz	Bureau Meeting of the International Association of Cryospheric Sciences (IACS)	Prague, Czech Republic 29 June 2015	Info to IACS; Bureau agrees that participation in both GCW and EC-PHORS are in line with IACS objectives.

**ACTION SHEETS - SECOND SESSION OF THE GCW STEERING GROUP, COPENHAGEN
(21-23 JANUARY 2015)**

N°	Action	Responsible	Deadline	Status/ Deadline
1	Use the figure of the new CryoNet site type definitions in every communications and presentations and update all existing documentations (i.e. the GCW-IP, WIGOS Manual, GCW document to Cg-17, etc.) and the GCW Website accordingly.	All	On-going	Done
2	Send a letter to PRs to seek their approval on the list of identified sites to be included in the pre-operational testing phase.	Secretariat	Before Cg-17	Done
3	Set up a “test session” to harvest data/metadata from Sonnblick and Davos sites into the GCW Data Portal.	Portal and the CryoNet Teams	December 2015	Done
4	Ø. Godøy to present the GCW Data Portal at the Congress side event.	Ø. Godøy	May 2015	Done
5	V. Smolyanitsky to provide information on sea ice to populate the GCW Website.	V. Smolyanitsky	May 2015	Done
6	Foster collaboration between the Snow Watch Team, the National Snow and Ice Data Center (NSIDC) and the ESA SnowPEX consortium.	Snow Watch Team	On-going	
7	Send an email to Matthias Barnhart to ask whether he is still interested to be part of the CryoNet team since he has not been active for a while.	Secretariat	March 2015	No longer a member: letter of thanks to be sent by Secretariat
8	Organize a meeting of the Best Practices team before EC-67 (2016).	Secretariat CryoNet Teams	March 2016	
9	Inform ICG-WIGOS Chair that A. Snorrason will represent GCW in ICG-WIGOS.	A. Snorrason	On-going	A. Snorrason unable to attend; Sue Barrell will represent GCW.
10	Nominate GCW representatives to liaise with the ICG-WIGOS Task Teams.	GSG Secretariat		Follow up with Secretariat on current status

11	Designate someone to assist A. Snorrason in preparing documents and presentations (e.g. Power point slides).	Secretariat	On-going	Done
12	M. Citterio to provide additional names for other potential talks to A. Snorrason.	M. Citterio	April 2015	Done
13	C. Fierz to give a talk about High Mountains as part of the panel presentations at the Congress Side Event.	C. Fierz	May 2015	Done
14	Create hand-out on the GCW Website.	Secretariat GCW Website Team		Done
15	Create posters on GCW (from hand-outs), GCW Data Portal, Snow Watch and CryoNet.	Secretariat	April 2015	Done
16	M. Ondráš to send the final version of the GCW-IP to the team for review.	M. Ondráš		Done
17	A. Snorrason to inform EC-PORS members on the on-going work of GSG.	A. Snorrason	Sep. 2015	Done
18	WMO Secretariat to draft a resolution on CryoNet and to make it circulated between the GSG members.	Secretariat	June 2015	Done
19	GSG members to activate their contacts in order to raise more resources for GCW from their respective countries.	GSG members	On-going	
20	Establish a primary list of cryospheric terms (before any definition).	Terminology Team	On-going	
21	Send hand-outs to GCW Focal Points.	Secretariat	On-going	Notify focal points when handouts updated on website
22	Develop a map on the GCW Website to display locations of the Focal Points.	GCW Website Team		
23	The Secretariat will provide the GIPPS and YOPP Implementation Plans to the GSG members.	Secretariat	April 2015	Done
24	M. Citterio and W. Schöner to first review the GIPPS and YOPP Implementation Plans and secondly, to draft an initial plan of action for GCW.	M. Citterio W. Schöner	December 2015	

25	J. Key to summarize ideas evoked by GSG and to formulate a response to J. Baeseman.	J. Key		Done
26	GSG to liaise with the CIMO focal point for the follow-up.	GSG	On-going	On-going Secretariat to confirm who is CIMO FP for GCW
27	Populate the GCW Website and Outreach Team and develop a strategy to improve the visibility of GCW inside and outside WMO.	GSG Secretariat	May 2015	Team established Strategy under development
28	Organize regular teleconferences between GSG and the Working Group leaders to oversee the furtherance of the identified activities.	GSG Secretariat	On-going	
29	Update the GCW-IP and the Terms of Reference of the newly established GCW Working Groups accordingly to the new structure of GCW.	GSG Secretariat		Done
30	Contact Walt Meier in order to know if he would agree to chair the Integrated Products Working Group.	GSG Secretariat		Done; unable to chair WG
31	Contact Giovanni Macelloni to know in which task team, according to the new GCW structure, he would like to actively contribute to.	Secretariat	March 2015	Done
32	Formalize the nomination of experts to GCW teams through PRs.	Secretariat	On-going	

LIST OF ACTION ITEMS ARISING FROM THIS MEETING

No.	Ref.	Action item	By whom	Deadline
Organization of the meeting				
1	1.2	For future meetings, the agenda will be arranged by Working Group – Observations, Integrated Products, Information and Services. The WG chair or co-chair will present to the GSG on behalf of the WG and its teams.	WG chair	
2	1.3	The chair of the GSG asks the Secretariat to formulate an appropriate letter that each GSG member could use to communicate to their PR seeking support for human resources for GCW tasks as well as asking for a contribution to GCW Trust Fund.	Secretariat	
3	1.3	D/OBS will keep the GSG, through the chair and vice-chair, apprised of the ongoing status for staffing the GCW position.	D/OBS	
CryoNet				
4	2.1	The Secretariat shall ensure that the final concept document of the GCW Observing Network is used to update all relevant GCW documents.	Secretariat	
5	2.1	The need for common wording in documents was discussed; it was decided that the “components of the cryosphere” and “component variables”, rather than elements and parameters, respectively would be used.	GSG, all Teams and Secretariat	
6	2.1	The GSG fully endorsed that the Best Practices Team and Secretariat must ensure community consultation and feedback so there is global acceptance of the Guides and Manual.	Secretariat	
7	2.1	The GSG agreed that GCW must continue to be represented at the next WIGOS design team meeting, preferably by Michele Citterio if he is available.	M. Citterio (if available)	
8	2.1	The Secretariat will co-ordinate with the Chair and vice-chair of Observations WG on the documents available and the process for submission to ICG WIGOS.	Secretariat	
9	2.1	The GSG accepted the proposed procedure for testing on the stations/sites submitted for the pre-operational phase.	CryoNet Team	
10	2.1	The Secretariat will provide the Observations Working Group with examples of agreements for operation of GCW stations by an agency other than the NMHS, and on the form of agreements between international partners (e.g. for GAW stations). This will ensure common wording among WMO programs and departments.	Secretariat	

No.	Ref.	Action item	By whom	Deadline
11	2.1	Vasily Smolyanitsky will provide wording of an agreement for the case of a mobile platform operating in international waters by an international consortium which will guide development of a GCW agreement if such instances were to arise.	V. Smolyanitsky	
12	2.1	Secretariat will finalize ANNEX 6 for implementation, as required (i.e. item 3).	Secretariat	
13	2.1	The Observations WG was reminded that the GCW and CryoNet station list has to be updated before Congress every 4 years for approval by Congress, as is the case for AntON. The Secretariat was asked to initiate such list which could be provided to PHORS, EC and Congress as required.	Secretariat Observations WG	
14	2.2	The GSG emphasized that the list of stations and associated resolution should be available by the end of September 2016 to allow for translation into all WMO languages before the CBS meeting. The list can be included as an Annex in the GCW report to CBS. The Secretariat is asked to coordinate with the CryoNet chair to facilitate this process.	CryoNet chair Secretariat	
15	2.2	The list of stations for EC has to be submitted to EC-PHORS for their approval. This can be done by email as necessary. The Secretariat is asked to co-ordinate.	Secretariat	
16	2.3	The GSG will identify funds in its budget for 2016 to support the joint South American workshop with UNESCO. (Secretariat to action)	Secretariat	
17	2.3	The Chair of the GCW Steering Group will contact Xiao Cunde requesting a written update on the open and ongoing action items from the 1st Asia CryoNet meeting (Annex 3). The report is required by January 15 (before the Salekhard meeting). NOTE: This was done subsequent to the GSG; the reply indicated that there was no further information available from countries surrounding China.	Chair of the GCW Steering Group	15th January 2016
18	2.3	The GSG supported the CryoNet Team's desire for broader representation from Asia CryoNet and that a second representative to work with Cunde would be beneficial given the size and diversity of the Asia CryoNet region. The Chair of the CryoNet Team will discuss this further at the Salekhard meeting.	Chair of the CryoNet Team	
19	2.3	Noting the need for a stronger link between CAS, CMA and GCW, GSG requested D/OBS to discuss with CMA about its involvement and potential contributions to GCW. Qin Dahe will also be consulted on this issue.	D/OBS	
20	2.3	GSG requested the Observations WG, with the support of the Secretariat, to investigate holding a meeting with a tropical focus, including definition of the scope and possible timing and identification of a local host(s) and potential participants for such a workshop.	Observations WG Secretariat	

No.	Ref.	Action item	By whom	Deadline
21	2.4	The GSG will include funds in the GCW budget to support the CryoNet expert sub-group meeting to finalize the list of approved CryoNet and Contributing stations/sites.	GSG	
22	2.4	The GSG needs to name a Chair for the Integrated Products WG and recommend leads and members for the new product teams. Recommendations will be sought from all GCW participants.	GSG	
23	2.4	The GSG Chair will discuss the issue of a chair of the WG with the PR of Finland.	GSG Chair	
Snow Watch				
24	3.1	The team is asked to prepare a “news item” when there is an update in snow reporting that could be used for the website and made available for broader distribution in WMO. This offers recognition to Members’ efforts.	Snow watch team	
25	3.1	It was suggested that the option of producing regional snow trackers be discussed with the countries involved in PRCC. For Canada, it was suggested Ross Brown (co-lead of Snow Watch) could speak with Chantale Coté in Montreal.	R. Brown Snow Watch Team?	
26	3.1	The Team should discuss at its June Workshop how to expand the dataset inventory and include data from additional countries.	Snow Watch Team	
27	3.1	The data sources identified in the inventory should be linked to the GCW data catalogue and the Portal.	Snow Watch Team and Ø. Godøy	
28	3.1	A report on this activity which could be put on the WMO home page would be very interesting. The Team is asked to discuss what they wish to advertise to the broader WMO community and provide feedback to the Secretariat for follow-up action.	Snow Watch Team	
29	3.1	The Team and the Secretariat are asked to draft a letter to the PRs on the benefits of exchanging snow depth data and the current options for doing this; PRs would also be asked to provide the reason why their country may not be able to do this.	Snow Watch Team and Secretariat	
30	3.1	Slides used in the Snow Watch presentation should be made available to the chairs of EC-PHORS for use in their EC presentation.	Secretariat	
31	3.2	The GSG agreed that adequate funds should be made available to support the participation of Snow Watch Team members and selected experts at the June Snow Watch meeting/workshop in Columbus, Ohio, USA.	GSG and Secretariat	
GCW Portal				

No.	Ref.	Action item	By whom	Deadline
32	4.1	The GSG requested Sue Barrell (CBS), D/OBS and Øystein Godøy (on behalf of GCW) to articulate the common issues and to identify follow-on actions for WMO.	S. Barrell D/OBS Ø. Godøy	
33	4.1	The Chair of the Portal Team, on behalf of GCW, was requested to engage WIS and WIGOS on vocabulary, metadata standards, data exchange and related matters to ensure a common approach is implemented.	Chair of the Portal Team	
GCW Website				
34	5.1	The GSG asked that all members to identify and seek both human and financial resources to conduct specific tasks such as data processing and development of products for the website.	All members	
35	5.1	The GSG recognized the importance of communicating the existence of the website to the broader community. The GSG Chair requested that the Secretariat should contact PRs asking them to link the GCW website to their national website, if possible.	Secretariat	
36	5.1	The Outreach Team was asked to contact the chair of APECS to discuss broadening GCW's communication within their community.	Outreach Team	
37	5.1	The GSG approved the activation of the Terminology Team, led by Gino Casassa, and the proposed work plan.	Gino Casassa and Secretariat	
38	5.1	The Secretariat, on behalf of the Terminology Team, was requested to discuss the development of the glossary with the WMO department responsible for terminology so that GCW efforts can be properly aligned with METEOTERM and the ultimate need for high quality translation.	Secretariat	
39	5.2	The Secretariat, in consultation with the Website and Outreach Team, was asked to help with making the website more mobile friendly and to discuss with WMO Communications Department on enhanced communications for GCW to help broaden its reach, including the use of social media.	Secretariat Website and Outreach Team	
GCW Working Structure				
40	6.1	WMO Secretariat will prepare the relevant input through EC-PHORS to Executive Council for approval of Hugues Lantuit and Carven Scott as members of the GSG.	Secretariat	
41	6.1	The GSG approved that a GSG member may name an alternate to attend a meeting on their behalf if they cannot participate. The Secretariat, behalf of the GSG will seek EC-	Secretariat	

No.	Ref.	Action item	By whom	Deadline
		PHORS approval to enact this option.		
42	6.2	All WG chairs were asked to provide the GSG chair and vice-chair and the Secretariat with an update of significant accomplishments of the WG and its teams by the end of May 2016 for updating the GCW report to EC-68.	All WG chairs	
43	6.3	The Secretariat is requested to compile the lists of focal points for partner organizations, including IPA, IASC, SCAR, IACS & WGMS, and WIGOS and provide these to national GCW focal points for their use in establishing national initiatives.	Secretariat	
44	6.4	Wolfgang Schöner and Barry Goodison will contact John Pomeroy, who is INARCH chair, to discuss appropriate linkages for GCW and for CryoNet as several INARCH sites could be CryoNet station/sites (and vice versa).	W. Schöner B. Goodison	
45	6.4	The Secretariat, on behalf of the GSG, is requested to liaise with ICIMOD to identify potential areas of co-operation and to strengthen national engagement in GCW.	Secretariat	
Mainstream and Implement GCW in WMO Programmes				
46	7.1	D/OBS suggested that Etienne Charpentier could develop a document to articulate GCW's potential interactions within WMO over the next 2 years for review by the GSG.	E. Charpentier	
47	7.1	CryoNet should review the WIGOS pre-operational plan to ensure CryoNet is being developed in a manner that will easily integrate into WIGOS at all scales.	CryoNet Team	
48	7.2	The GSG suggested Rick Thoman, through the US PRCC team, and Vasily Smolyanitsky, through the Russian PRCC team, are best positioned to promote the development of regional cryospheric products as a GCW contribution for the PRCC and asked them to initiate contact on behalf of GCW.	R. Thoman V. Smolyanitsky	
49	7.2	The GSG requested that the Secretariat ask Rick Thoman and Vasily Smolyanitsky to serve as focal points for further GCW involvement in PRCC development, as both are currently engaged in this activity nationally.	Secretariat R. Thoman V. Smolyanitsky	
50	7.3	The GSG requested all WG chairs and co-chairs and Team leads and co-leads to review the YOPP plans and identify where their activities could contribute to YOPP and where YOPP activities could help their activities. They are to provide the Secretariat with their initial comments before the end of February 2016.	All WG chairs, co-chairs, Team leads and co-leads	
Outreach Activities				
51	8.1	The Secretariat is requested to interact with the Teams that prepared Handouts to	Secretariat	

No.	Ref.	Action item	By whom	Deadline
		ensure they are updated as required on a regular basis and certainly before Executive Council.	Teams that prepared Handouts	
52	8.2	The GSG requested all WG chairs and Team leads/co-leads to keep the Secretariat updated on interactions/presentations related to GCW with WMO bodies and partners and other external bodies.	WG chairs, Team leads, co-leads	
53	8.3	The GSG requested the Secretariat to keep ANNEX 16 up-to-date.	Secretariat	
Work Plan				
54	9.2	Secretariat is requested to prepare the action sheet for the GSG meeting.	Secretariat	
55	9.4	The GSG requested all WG chairs/co-chairs to develop a list of activities and proposed meetings until end of 2017 for which support is sought, including proposed dates, venue, and cost and other available funding. These should be in order of priority and be submitted to the chair and vice-chair by mid-February 2016. These are needed for planning purposes by GCW and WMO and the partners. Note: A first list was submitted for 2016 and early 2017 only	All WG chairs, co-chairs	
Other Business				
56	10	The GSG requested WGs and Teams to continue to recommend new team members to the GSG for approval, even between meetings. Nominations should be sent to the chair and vice-chair with a cc to the Secretariat.	WGs and Teams	

**LIST OF ACTION ITEMS ARISING FROM THE JOINT FOURTH CRYONET TEAM AND THIRD PORTAL & WEBSITE TEAMS MEETINGS
(Boulder, Colorado, USA, 7-9 December, 2015)**

No.	Ref.	Action item	By whom	Deadline
CryoNet				
1	2.1	Take the lead in coordinating the establishment of regional working groups, as appropriate, with support from regional experts.	Secretariat	
2	2.1	Discuss setting up an “issue tracking” system for keeping track of progress between meetings with Øystein Godøy for implementation.	Secretariat, Ø. Godøy	
3	2.2	Will continue building interactions and partnerships with communities such as HarmoSnow, IASC, EU-PolarNet and the EU JPI, both within Europe and globally.	W. Schöner + support of GCW experts	
4	2.2	Contact John Pomeroy, who is INARCH chair, to discuss appropriate linkages for GCW and for CryoNet as several INARCH sites could be CryoNet station/sites (and vice versa).	W. Schöner & B. Goodison	
5	2.2	Work with the CryoNet and Portal Teams to assess the appropriate approach for including CryoNet sites/stations metadata in OSCAR/Surface.	Secretariat, W. Schöner, Ø. Godøy	
6	2.3	Asked to review the WMO Trip Report of the meeting with UNESCO (Meeting File/Meeting Form No: S-OME 187-2011) and to provide an update and follow-up on actions/activities and recommendations since the meeting.	Secretariat	
7	2.3	Include funds in their 2016 budget proposal to support one participant from each Andean country to participate in the 2016 joint WMO/UNESCO workshop. (UNESCO would be asked for the same support)	Chair, Vice-chair of GSG	
8	2.3	Contact WMO Education and Training Programme about possible support of this workshop activity and to identify opportunities for collaboration and funding for	W. Zhang	

No.	Ref.	Action item	By whom	Deadline
		GCW to provide training sessions to build capacity.		
9	2.4	Contact Xiao Cunde requesting a written update on the open and ongoing action items from the 1st Asia CryoNet meeting (Annex 3).	Chair of GSG	January 15
10	2.4	Given the size and diversity of the Asia CryoNet region, the CryoNet Team felt there was a need for need more representation from Asia CryoNet and that a second representative to work with Xiao Cunde would be beneficial. The Chair of the CryoNet Team will discuss this further at the Salekhard meeting.	W. Zhang	
11	2.4	Noting the need for a stronger link between CAS, CMA and GCW, D/OBS will discuss with CMA about its involvement and potential contributions to GCW. Qin Dahe will also be consulted on this issue.	W. Zhang	
12	2.5.1	The Table in ANNEX 5, and on the website, needs to be updated to reflect the new CryoNet structure for stations and sites.	W. Schöner M. Citterio C. Fierz J. Key	
13	2.5.2	A sub-group was established to evaluate the stations that have been approved for pre-operational testing: Wolfgang Schöner, V. Smolyanitsky, Michele Citterio, Charles Fierz, permafrost rep (from GTN-P steering community), and lake ice (possibly a SWIPA author).	W. Schöner V. Smolyanitsky C. Fierz M. Citterio permafrost rep lake ice rep	
14	2.5.2	Ask Vladimir Romanovsky to help evaluate permafrost and the Alaska NWS River Forecast Center for a river/lake ice expert as they still do operational measurements.	R. Thoman	
15	2.5.2	The CryoNet document and the selection process should be forwarded to GCW partners to assess if requirements are clear (e.g. WIGOS, WIS, WGMS, GTN-P, GTN-G, IPA, GCOS, GAW, IACS, and IHP)	Secretariat	

No.	Ref.	Action item	By whom	Deadline
16	2.5.2	The CryoNet Team is completing templates from questionnaires and getting information on time steps of observations. Identify specific tasks and appropriate actions.	Secretariat W. Schöner	
17	2.5.3	Finalize the revised minimum requirements for a CryoNet station/site and ensure these are included in the relevant GCW documents.	CryoNet Team Secretariat	
18	2.5.6	The “GCW surface observing network” is comprised of CryoNet and contributing stations. This is a type of tiered network. This wording has to be rationalized to ensure consistency in all GCW documents.	All Teams and Secretariat	
19	2.5.6	GCW needs to have a representative at the next WIGOS design team meeting.	M. Citterio (if available)	
20	2.5.6	The updated version of the CryoNet Network Design document will be sent to all CryoNet team members for comment by January 8, 2016.	M. Citterio and Secretariat	
21	2.5.6	GCW is included in the WIGOS manual; hence changes are submitted to ICG-WIGOS which in turn reports to Executive Council (EC). This document should not be rushed for the April meeting. The GSG Chair recommended that GCW submit what is available at the 2016 ICG-WIGOS meeting, and if the document still needs work, then it be submitted to the November meeting of CBS for review and then to ICG-WIGOS in early 2017.	Secretariat to co- ordinate with Chair and vice- chair of Observations WG	2016 ICG- WIGOS meeting
22	2.5.6	The CryoNet Team is to finalize ANNEX 8, revising as appropriate (e.g. minimum requirements) and with Secretariat support, ensure that all GCW documents reflect the revised structure of the surface observing network.	CryoNet Team	
23	2.5.7	Secretariat to check for letters received to date.	Secretariat	
24	2.5.7	Determine a procedure for sharing with other centers.	Ø. Godøy, C. Fierz, Secretariat (support)	

No.	Ref.	Action item	By whom	Deadline
25	2.5.7	Draft procedure is to be finalized, with support from Secretariat.	Secretariat	January 31, 2016
26	2.5.8	Follow up on the submission of the Formigal questionnaire (contact Samuel Buisan).	J. Key	
27	2.5.9	A small data policy group (Øystein Godøy, Þorsteinn Þorsteinsson, Thomas Jóhannesson) was established to review data policies and prepare a draft GCW data policy for review before the next meeting. Þorsteinn and Thomas will take the lead.	Ø. Godøy Þ. Þorsteinsson T. Jóhannesson	
28	2.5.9	The issue of data exchange and hence data policy will need to be discussed at the Salekhard CryoNet meeting. The outcome of the discussion is to be provided to the data policy group.	Secretariat	
29	2.6	The list and associated resolution should be available by the end of September 2016 to allow for translation into all WMO languages before the CBS meeting. Secretariat will coordinate with the CryoNet chair to facilitate this process.	Secretariat CryoNet chair	End of September 2016
30	2.7.3	The Primer should be ready for the CBS meeting. The document will need to be translated so it should be ready by end of September. Wolfgang Schöner will lead completion of the document which must be reviewed by the CryoNet Team and Observations WG before submission to CBS.	W. Schöner CryoNet Team Observations WG	End of September 2016
31	2.7.3	Engage a person to prepare the lake ice section. (Rick Thoman will ask the Alaska NWS River Forecast Center for expert to join the CryoNet team).	R. Thoman	
32	2.7.4	Recommend to the GSG the creation of a Best Practices Task Team under the Observations Working Group.	GCW Steering Group	
33	2.7.4	Guide where there should be consultation and to manage the internal WMO process.	Secretariat	
34	2.7.4	Ensure community consultation and feedback so there is global acceptance of the Guides and Manual.	Best Practices Team	

No.	Ref.	Action item	By whom	Deadline
			Secretariat	
Portal				
35	3.3.1	Ask WMO, through the Secretariat, to engage with ICSU on data management issues.	GSG Secretariat	
36	3.3.3	CryoNet Team, WIS, and data centers should be asked for their advice and feedback on the guidelines proposed.	GSG	
37	3.3.4	The GSG, CryoNet Team, WIS, and data centers should be asked for their advice and feedback on the proposed manual.	Ø. Godøy	
38	3.3.5	Continuing the support for seeking accessibility of data from CryoNet sites.	Secretariat C. Hutin	
39	3.3.6	The current drafts (guide to CryoNet sites in the dialogue with the GCW Portal team) should be sent to Steve Foreman to review and submit to the WIS OPAG as documents for ultimate approval by CBS.	Ø. Godøy	
40	3.3.6	The following experts are recommended to be members of the Portal Team: Hironori Yabuki, Julie Friddell, Peter Pulsifer, and Lynn Yarmey; the GSG is requested to approve.	GSG	
41	3.3.6	The Team is asked to consider the need for a data management expert for high mountain regions.	Portal Team	
42	3.3.6	The chair was asked to prepare a workplan for the next 2 years; this has been completed and is included in ANNEX 12.	Ø. Godøy	
Website				
43	4.2	Provide information to add real-time data for the Southern Hemisphere.	G. Casassa	
44	4.2	Glaciers at CryoNet sites could be added to glacier sections.	CryoNet Team	
45	4.2	Further discussion is required to identify how GCW can get both human and	?	

No.	Ref.	Action item	By whom	Deadline
		financial resources to conduct specific tasks such as data processing and development of products for the website.		
46	4.2	The Website Team will initiate inclusion of these regional products on the website.	Website Team	
47	4.2	Rick Thoman, through the US PRCC team, will promote the development of such cryospheric products as a regional pan-Arctic cryosphere product for the PRCC.	R. Thoman	
48	4.5	The team was asked to address how GCW trackers can be included in WMO's Annual Climate Statement. The Secretariat will discuss with Omar Baddour who is responsible for producing the statement.	Secretariat	
Other business				
49	7.	Team leads are requested to share funding opportunities with other team leads and with team members.	Team leads	
50	7.	It is recognized that team leads and members are very busy and students or interns could help with writing proposals as well as providing support to team leads. Secretariat and Team leads should identify opportunities to support the project in this manner.	Secretariat Team leads	
51	7.	The group was informed that ECMWF will run a Climate Change Service, for which validation of models will require long-term observations. Wolfgang Schöner will follow up with Gianpaolo Balsamo on this potential link.	W. Schöner	
52	7.	Sue Barrell will keep GCW informed of Australian opportunities which may evolve from a review of their Antarctic program.	S. Barrell	
53	7.	Mark Drinkwater will keep GCW informed of potential opportunities related to the validation of Copernicus.	M. Drinkwater	
54	7.	It was noted that funding for ETSI was in doubt and they asked whether GCW could help, although GCW has no funding allocated for this activity. Secretariat is asked to investigate the situation and advise the GSG Chair and vice-chair on this situation.	Secretariat	

No.	Ref.	Action item	By whom	Deadline
55	7.	There needs to be a concerted effort to engage young scientists in GCW, drawing on the accomplishments of APECS. An invitation should be extended to a representative of APECS, or someone like Jenny Baeseman with a strong background in engaging young scientists, to participate in next year's GSG meeting.	GSG	