REPORT No. 14

WORLD METEOROLOGICAL ORGANIZATION
GLOBAL CRYOSPHERE WATCH

FINAL REPORT OF THE CRYONET TEAM MEETING, FIFTH SESSION

Graz, Austria
20-22 September 2016

GCW
Global Cryosphere Watch

World Meteorological Organization
Weather · Climate · Water

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EXECUTIVE SUMMARY

The fifth session of the CryoNet Team was held at the University of Graz, Department of Geography and Regional Science, from 20 to 22 September 2016.

The Team reviewed the CryoNet Asia and CryoNet Latin America developments, including 3rd Pole activities.

The Team reviewed the process and criteria for assessment of stations/site that will be followed in the selection of stations for CryoNet. It will be submitted to the GCW Steering Group (GSG) for approval. The Team reviewed the minimum program for CryoNet stations/sites for all types of stations/sites and cryospheric components.

The Team reviewed the pre-operational testing of CryoNet, such as compliance with CryoNet Concept, minimum requirements, updated application questionnaire and data/metadata accessibility via GCW Data Portal. It reviewed the correctness and relevance of information provided in the GCW Station/Site application Questionnaires for some examples of submissions. Full analysis will be made after the meeting for agreement by the end of 2017 with the list of stations/sites to be included into CryoNet and the list of contributing stations.

The Team discussed the requirements for real-, near-, and non-real time international exchange of data from the CryoNet stations/sites, and discussed the data policy to be applied for CryoNet and Contributing stations. Noting that the WMO data policies did not entirely cover the scope of GCW data exchange requirements, the meeting agreed to develop a specific GCW data policy for consideration by the GCW Steering Committee and WMO Executive Bodies.

The Team agreed that guidance should be developed for the collection and distribution of cryospheric and associated meteorological data from the CryoNet Sites/Stations and GCW contributing stations. Efforts required in this regard will be included in the CryoNet team workplan.

The meeting reviewed actions agreed by the previous CryoNet as well as the GCW Steering Group meetings and updated their status as needed. It also reviewed and updated its Work Plan, as appropriate.

The Team agreed that a report should be prepared and submitted to the GCW Steering Group. The report will include a draft WMO Executive Council Resolution on CryoNet, through which EC will establish CryoNet. The report will then be submitted by GSG (Jan. 2017) to EC-PHORS (March 2017) then to EC-69 (mid-2017).

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WORKSHOP REPORT

1. ORGANIZATION OF THE MEETING

1.1 Welcome and Opening of the meeting

1.1.1 The fifth session of the CryoNet Team opened at 09:00 hours on Tuesday, 20 September 2016 at the premises of the University of Graz, Department of Geography and Regional Science (Austria).

1.1.2 The CryoNet Team Chair, Dr Wolfgang Schöner (Austria) welcomed the participants, and stressed that this was an important meeting tasked primarily to select stations that would constitute the GCW core network CryoNet. He wished for a successful meeting.

1.1.3 Mr Etienne Charpentier (Secretariat) also welcomed all participants on behalf of the Secretary General of WMO, Dr Petteri Taalas. He thanked the University of Graz, Department of Geography and Regional Science for hosting the meeting.

1.1.4 He recalled about most recent WMO Executive Council 68th Session (EC-68, Geneva, Switzerland, 15-24 June 2016) decisions relevant to the Global Cryosphere Watch (GCW) where the CryoNet concept has been endorsed and the EC Panel of Experts on Polar and High Mountain Observations, Research and Services (EC-PHORS) requested to draft a Resolution for the EC 69th Session in 2017. Such draft Resolution based in particular on CryoNet team recommendations with regard to Site and Station selection will have to be submitted to EC-PHORS-7, Ushuaia, Argentina, 21-24 March 2017, via the GCW Steering Committee, which is planned to meet in Cambridge, United Kingdom, 16-20 January 2017.

1.1.5 He also informed the meeting about the forthcoming 16th Session of the WMO Commission for Basic Systems (CBS-16, Guangzhou, China, 23 to 29 November 2016) and draft Recommendations and Decisions that are relevant to the GCW. In particular, there will be a proposed update to the Manual on WIGOS, which includes the minimum requirements for CryoNet Sites and Stations. CBS-16 will also be expected to recommend that (i) Members, through a partnership among national research institutes, universities and academia, contribute their respective stations to CryoNet, according to a concept endorsed by Decision 7(1)/1 (EC-68); (ii) Regional Associations should consider relevant CryoNet stations for the Regional Basic Observing Networks (RBON); and (iii) Members, that did not nominate Focal Point(s), should do this with a view of taking part in the development of the GCW surface observing network; several focal points may represent national GCW partners. The list of participants is given in Annex 2.

1.2 Adoption of the Agenda

1.2.1 The Provisional Agenda, as contained in Annex 1 was adopted by the meeting.

1.3 Working Arrangements

1.3.1 The work of the meeting was conducted as a committee of the whole. The session and documentation was in English only.

1.3.2 The Team agreed on its working hours and adopted a tentative time table for consideration of the various agenda items.

1.3.3 The Secretariat introduced the documentation plan of the meeting, available at http://www.wmo.int/pages/prog/www/OSY/Meetings/GCW-CryoNet-Graz2016/GCW-CNT5.html. The Chair thanked all those who have contributed to the documentation plan.

1.4 Introductions of participants

1.4.1 The chair of the CryoNet Team invited the participants to introduce themselves.

2. DEVELOPMENT OF CRYONET

2.1 Review of Actions from previous meetings

2.1.1 The meeting reviewed actions agreed by the previous CryoNet as well as the GCW Steering Group meetings. The updated status of actions is provided in Annex 4.

2.2 Review of the CryoNet Team Work Plan

2.2.1 The Team reviewed and update its Work Plan, as appropriate. The updated workplan is provided in Annex 5.

2.3 Report on the CryoNet South America activities

2.3.1 Gino Casassa (Chile) reported on CryoNet relevant activities in the South America.

2.3.2 He particularly reported on the outcome of the 1st CryoNet South America meeting, which was held in Santiago, Chile from 27 to 28 October 2014. He noted that although good progress was made at the meeting, follow up activities have been slower.

2.3.3 Other activities included: (i) the impact of glacier retreat in the Andes has been assessed; (ii) a glacier mass balance manual was published (in Spanish); (iii) two white papers on tropical Andes and Southern Andes were published; (iv) two courses on mass balance and glacier measurements were held in La Paz, Bolivia, 10-15 July 2016, and in Memdoza Argentina, 4-8 August 2014; (v) an international forum of Glaciers and Mountain Ecosystems was held in Huaraz, Peru from 10 to 13 August 2016,

2.3.4 The Team noted that the next CryoNet Latin America workshop has been postponed to 2017. It was proposed that the 1-week workshop would include a 3-day training course on measurements for cryosphere monitoring (snow, maybe glaciers), including field work.

2.3.5 The Team agreed that Guidelines for Cryospheric measurements in Antarctica will have to be produced as part of the Best Practices Team activities. It requested Christophe Genthon (France) to act as a focal point for providing input in this regard (***action; C. Genthon, 23 Sep. 2016***).

2.3.6 Gino Casassa was requested to finalize the proposal with programme for the next workshop (***action; G. Casassa; end 2016***).

2.4 Report on the CryoNet Asia, including 3rd Pole activities

2.4.1 Vasily Smolyanitsky (Russian Federation) reported on relevant CryoNet activities in Asia, including those in the 3rd Pole Region. He particularly reported on the following outcome of the 2nd CryoNet/Asia Workshop, which was held in Salekhard, Russian Federation, from 2 to 5 February 2016:

- National reports from China, Japan, Kazakhstan, Kyrgyzstan, Mongolia, Nepal, Pakistan, the Russian Federation, Tajikistan, and Uzbekistan were received at the workshop. Noting negative mass balance of many glaciers observed in Asia in the last few decades, the workshop stressed that focus should be placed on the Third Pole region;
- Based on the WMO RRR process, gaps with regard to cryospheric measurements by component were identified in the RA-II, in particular for high elevation regions over 4000-5000 m, an *ad hoc* high elevation regions Steering Group was set;
- The workshop was briefed on standards and best practices for cryospheric observations, complemented by field test measurements on the Ob' river;
- Seven CryoNet Sites were proposed for the Arctic and sub-Arctic region, and 26 Sites for the High Mountain region;

- Finally, the workshop proposed establishing a regional CryoNet-Asia Working Group (WG/CryoNet/Asia) whereby its Chair would be reporting to the GCW Steering Group and the WMO Regional Association II.

2.4.2 The Team requested the Secretariat to contact participants of the Salekhard workshop and Permanent Representatives as appropriate and ask them to submit the questionnaire about their Country candidate Sites and Stations no later than 31 October (***action; Secretariat; ASAP***).

2.4.3 Dongqi Zhang (China) reported on Third Pole activities related to GCW, and particularly on:

(i) cryospheric observations in the Third Pole region, i.e. glacier observations by the Chinese Academy of Sciences (CAS), snow cover measurements by the China Meteorological Administration (CMA), and frozen ground/permafrost by CAS and CMA;
(ii) High-cold region Observation and Research Network for Land surface processes & Environment of China (HORN)(17stations, CAS);
(iii) Cryospheric observation stations of the State Key Laboratory of Cryospheric Sciences (SKLCS, CAS);
(iv) CMA commitment made at the first CryoNet-Asia Workshop (Beijing, China, 2014) to promote the development of GCW in the following two ways: (1) as a data node of GTS, National Meteorological Information Centre, CMA is willing to undertake the data collection and transmission for Asia Cryospheric data; and (2) by sharing data in the area of Tibet to support GCW establishing a global CryoNet earlier; and
(v) brief introduction of Third Tibetan Plateau Atmospheric Scientific Experiment (TIPEX-III).

2.5 Status of CryoNet

2.5.1 The Chair of the CryoNet Team, Dr Wolfgang Schöner (Austria) briefed the Team on the activities done and deliberations achieved since its meeting in Boulder, Colorado, USA. He reported on the history of CryoNet development and achievements of the CryoNet Team so far. He explained the concept of CryoNet Sites and Stations.

2.5.2 The Team recalled that (i) the Executive Council at its 68th Session endorsed the concept note for CryoNet Sites and Stations, and that (ii) the minimum requirements for CryoNet Sites/Stations are proposed for inclusion in a revised version of the Manual on WIGOS, for which a draft Recommendation is being submitted to the 16th Session of the Commission for Basic Systems (CBS-16, Guangzhou, China, 23 to 29 November 2016).

2.5.3 At this point, 36 CryoNet stations and sites as well as one contributing station have been approved by the WMO Congress (Cg-17, 2015) on trial basis for pre-operational testing. Additionally, there are candidates for 22 contributing stations, and 56 CryoNet Stations/Sites.

2.5.4 It was noted that considering changes that have been proposed to the CryoNet Site/Station concept and minimum requirements, not all of the questionnaires have been updated accordingly. The meeting requested the Secretariat to remind the focal points about the need to check the information entered in the questionnaires and invite them to update them if necessary (***action; Secretariat; 30 Oct. 2016***).

2.5.5 The Team agreed to review the 36 Sites/Stations that have been approved by Cg-17 on a trial basis, with the view to check their compliance with the new station/site concept and the minimum requirements, and possibly propose changing Sites to Stations if necessary.

2.5.1 Pre-operational testing

2.5.1.1 The Team reviewed the pre-operational testing of CryoNet, such as compliance with CryoNet Concept, minimum requirements, updated application questionnaire and data/metadata accessibility via GCW Data Portal.

2.5.2 Review of Station/Site Questionnaire

2.5.2.1 Dr Jeff Key (USA) reported on the status of the GCW Website and questionnaire, and planned developments. Recent developments since December 2015 included:

- the selection of station and site types and their attributes to account for recent changes in the definitions has been reworked in January 2016;
- major revision was made in May 2016 (added fields specific to sites, revised site/station and CryoNet/Contributing selections, added altitude, changed landscape types);
- problem with having more than one questionnaire open at a time in multiple browser tabs was fixed in August 2016 (previously, doing so could have resulted in lost data and/or data being switched between questionnaires);
- Since September 2016, Site web pages now automatically include a list of the site's stations.

2.5.2.2 Upcoming changes include (i) password reset option, (ii) ability to assign a questionnaire to more than one person; and (iii) possibility to delete and copy questionnaires.

2.5.2.3 The Team reviewed the correctness and relevance of information provided in the GCW Station/Site application Questionnaires for all submissions. The Station/Site questionnaire as discussed at the meeting is reflected in the website questionnaire, which will now be frozen in terms of the recorded information about candidate Sites and Stations and according to the Teams' discussion at this meeting (***action; J. Key; 1 Oct. 2016***).

2.5.3 List of stations/sites proposed for CryoNet and contributing stations

2.5.3.1 The Team was informed on the preliminary analysis of stations/sites that were proposed to be included in CryoNet or in the contributing stations.

2.5.4 Review of the Process for assessment of stations/sites

2.5.4.1 The Team reviewed the process and criteria for assessment of stations/site that will be followed in the selection of stations for CryoNet.

2.5.4.2 The Team requested the Secretariat to develop templates of (i) CryoNet Site/Station commitment letter and (ii) national agreement for the management of CryoNet Site/Stations at the national level (***action; Secretariat; end 2016***).

2.5.4.3 The Team further requested the Secretariat to check the procedures used by the WMO Commission for Atmospheric Sciences (CAS) regarding the selection of Global Atmosphere Watch (GAW) stations and investigate whether the GCW procedure for CryoNet Site/Stations selection could be adjusted in a way consistent with the CAS procedure (***action; Secretariat; 31 Oct. 2016***).

2.5.4.4 The Team agreed to introduce categories of CryoNet measurements based on their importance to the GCW program:

- *Recommended variables*: Those that are essential for CryoNet and for fulfilling the GCW objectives (the list of recommended variables is defined through expert assessment to be made by the CryoNet Team). The list of recommended variables (for each component) will be used in order to determine whether the candidate Site/Station should be accepted as CryoNet Site/Station on the basis of its measurement programme; and

- *Desired variables*: Optional but important measurements that support CryoNet and GCW objectives (i.e. variables that are not directly used for GCW products, but known as essential parameters of cryosphere change).
- Required variables: At present, only a core set of meteorological observations are required. These include air temperature, air humidity, wind speed and wind direction. In the future

The lists of required, recommended and desired measurements have been compiled for each component of the cryosphere and for surface meteorology are available in Annex 6 of this report. As the GCW evolves, some or all of the variables that are currently listed as recommended may become required. The designation of each measurement as required, recommended, or optional will be specified in GCW Best Practices Manual and GCW Best Practices Guide, which are currently being developed.

Candidate Sites/Stations measuring recommended variables or/and desired variables of one Cryosphere component, and meeting all other conditions for being CryoNet Site/Station (e.g. minimum requirements) are especially suited for CryoNet.

2.5.4.5 To provide additional information on the evaluation process, a footnote will be added to the Application Process description (http://globalcryospherewatch.org/cryonet/application_process.html):

"In order to ensure a unique, high-quality network of surface observations, stations and sites are evaluated for inclusion in CryoNet based on a number of factors. Fulfilling the minimum requirements does not in itself guarantee acceptance as a CryoNet station. Other criteria that are considered by the CryoNet Team when evaluating applications include (1) the number of recommended variables that are measured [link to lists], (2) the continuity and length of the data record, (3) the extent to which data are available and accessible, (4) sustainability of the station, (5) conformity to GCW best practices, and (6) the location and representativeness of the proposed station relative to the geographic distribution of existing CryoNet stations."

2.5.4.6 The distribution of variables in the two categories above for each Cryosphere component is provided in Annex 6.

2.5.4.7 The Team requested Jeff Key to update the questionnaire according to the two categories of variables above (***action; J. Key; 1 Oct. 2016***).

2.5.4.8 When developing the list of variables in the categories above (2.5.4.4) and for each of the Cryosphere components (Snow, Glaciers, Permafrost, Sea ice, river/lake ice, Ice sheet), the team agreed that the requirements as expressed in the WMO Rolling Review of Requirements database (OSCAR/Requirements) and the Statements of Guidance for the 14 WMO Application Areas, together with the requirements from the IGOS Cryosphere Theme Report should be considered.

2.5.4.9 The Team requested Kari Luojus (Finland) to investigate with the GCW Integrated Products Working Group and the Snow Watch Team whether there are any GCW observational user requirements that are independent from existing WMO Application Areas, that could be identified and documented in OSCAR/Requirements. In that case, the Team also requested Mr Luojus to develop a two-pager making the case of introducing new Application Area(s) in the WMO Rolling Review of Requirements (***action; K. Luojus; end 2017***).

2.5.4.10 The process by which proposed stations and sites are evaluated was approved by the GCW Steering Group in December 2015. It is described at http://globalcryospherewatch.org/cryonet/application_process.html. In order to make it clear to applicants that meeting the minimum requirements is only part of the evaluation process, the Team agreed on text that describes in more detail the criteria used by the CryoNet Team in its evaluation of proposed stations and sites. Annex 7 provides the

modified application process, with the new text included in the footnote. This will be submitted to the GCW Steering Group (GSG) for approval.

2.5.4.11 The Team agreed to still accept submissions of CryoNet Sites and Stations in the questionnaire through 15 October 2016. Questionnaire information should be checked and updated as necessary and according to the Team's decision. The Team agreed on the following steps:

1. Following up from the previous communication of the Secretariat dated 24 May 2016, the Secretariat shall inform again the Focal Points and candidate Sites/Stations contact points about new definition of Sites and Stations, the Team's decisions with regard to the evaluation requirements and process, and ask them to update the questionnaires accordingly, and their confirmation in writing no later than 15 October 2016 that they have made the required update (***action; Secretariat; asap***). Sites/Stations for which confirmation will have been received will be evaluated in the first round (i.e. targeting EC-69 approval in 2017). For other Sites/Stations for which no confirmation will have been received, they will remain as candidates in the next round (i.e. for evaluation after EC-69).
2. The evaluation process will then be tested on the basis of the agreed criteria and using a few examples of candidates Sites/Stations (***action; W. Schöner; 15 Oct. 2016***)
3. The evaluation should be coordinated and completed by Wolfgang Schöner with final concurrence by the Team via email (***action; W. Schöner; 15 Nov. 2016***).
4. The Secretariat will then seek commitment letter from the PRs for which Sites/Stations have succeeded the evaluation (***action; Secretariat; 15 Dec. 2016***).

2.5.5 Review of minimum program for CryoNet stations/sites

2.5.4.11 The Team reviewed the minimum program for CryoNet stations/sites for all types of stations/sites and cryospheric components. The agreed updated version is provided in Annex 6.

2.5.6 Short introduction to breakout groups for minimum program for CryoNet stations/sites

2.5.6.1 The Team decided to establish the following breakout groups during the course of the Team meeting with the view to refine the minimum program for CryoNet stations/sites (i.e. variables to observe as per 2.5.4.4, the frequency of the measurements and what standards to use):

- Snow
- Glaciers
- Permafrost
- Sea ice, river/lake ice
- Ice sheet

2.5.7 Selection of newly proposed stations/sites for CryoNet and contributing stations

2.5.7.1 The Team agreed that the actual selection of Sites/Stations based on process and criteria agreed at the meeting could be achieved shortly after the meeting. The Team requested W. Schöner to perform the selection and to provide the proposed list to the Team via email no later than 15 October 2016 (***action; W. Schöner; 15 Oct. 2016***).

2.5.8 Identification of data for real-, near-, and non-real time international exchange

2.5.8.1 The Team discussed the requirements for real-, near-, and non-real time international exchange of data from the CryoNet stations/sites.

2.5.8.2 The Team requested the CryoNet Team Chair to approach the GSG and invite it to agree on a workplan for providing a list of GCW products with the variables required by these products, and with indication whether the data for each variable will be required for exchange in [near]real-time, or in delayed mode (***action; W. Schöner; Jan 2017***).

2.5.9 GCW/CryoNet Data Policy

2.5.9.1 The Team discussed the data policy to be applied for CryoNet and Contributing stations. The following WMO data policies were discussed:

- Resolution 40 (Cg-12) – WMO Policy and Practice for the Exchange of Meteorological and Related Data and Products including Guidelines on Relationships in Commercial Meteorological Activities.
- Resolution 25 (Cg-13) – Exchange of Hydrological Data and Products.
- Resolution 60 (Cg-17) – WMO Policy for the International Exchange of Climate Data and Products to Support the Implementation of the Global Framework for Climate Services. Data specified in the Resolution should be made accessible on a free and unrestricted basis. This Resolution particularly includes climate relevant cryospheric data, in particular snow cover, snow depth, glacial monitoring, permafrost and lake and river ice.

2.5.9.2 In addition, the meeting also considered the following data policies:

- Stability and Variations of Arctic Land Ice, Nordic Project (SVALI) data policy.
- International Polar Year (IPI) data policy.

2.5.9.3 A proposal was made for data preservation, to ensure the long-term preservation and sustained access to GCW data. A long term solution would require a financial commitment.

2.5.9.4 Noting that the WMO data policies did not entirely cover the scope of GCW data exchange requirements, the meeting requested Þorsteinn Þorsteinsson (Iceland) to coordinate the development of a specific GCW data policy for consideration by the GCW Steering Committee and the Executive Council or Congress. It requested Team members to provide Mr Þorsteinsson with their feedback on elements to be considered in a GCW data policy no later than 15 October 2016 (***action; Team members; 15 October 2016***), and Mr Þorsteinsson to develop a draft for review by the Team by 15 November 2015 (***action; Þ. Þorsteinsson; 15 Nov. 2016***). The draft policy should then be endorsed by the Team for its submission to the GCW Steering Committee at its next meeting in January 2017 (***action; W. Schöner; 15 Dec. 2016***).

2.5.10 Interfacing CryoNet stations/sites metadata/data with the GCW Data Portal - status and next steps

2.5.10.1 Øystein Godøy (Norway) informed the meeting on the current status of the GCW Portal and its interaction with the selected CryoNet stations. Special emphasis was put on the lessons learned interacting with the Davos community building metadata interoperability into their legacy data management system for CryoNet station Weissfluhjoch.

2.5.10.2 Discussion focused on how to achieve metadata and data interoperability with CryoNet stations. Following the development with Davos, discussions with Sodankylä and Sonnblick will continue and emphasis is put on achieving metadata and data interoperability. It was noted that OPENDAP and Climate and Forecast (CF) convention could be used to assure interoperability at the data level. The GCW Interoperability Guidelines, e.g. with list of available software and implementation solutions, will be further developed in dialogue with the 3 CryoNet stations. How to pursue this is decided between Kari Luojus (Sodankylä), Wolfgang Schöner (Sonnblick), Charles Fierz (Weissfluhjoch) and Øystein Godøy within 2016Q4 (***action; Ø. Godøy et al.; 31 Dec. 2016***).

2.5.10.3 Interaction between the GCW Portal and OSCAR is to be discussed between Øystein Godøy (GCW) and Jörg Klausen (OSCAR) (***action; Ø. Godøy et al.; 31 Dec. 2016***). Potential solutions include setting up an interface for editing WIGOS metadata through the GCW Portal and using the same functionality directly through OSCAR (harvesting GCW relevant information from OSCAR). The Questionnaire can also be used to convert the CryoNet Stations/Sites metadata in XML for automatically uploading them in OSCAR/Surface, though this will require further investigation. Some institutes operating CryoNet Sites/Stations could also have the option of developing their own database of station metadata, and then have the metadata submitted to OSCAR/Surface via machine to machine interface with OSCAR/Surface. Details are to be investigated and documented for further decision within the GCW community. The timeline of this depends on the development of machine and human interfaces to OSCAR as well as OSCAR user approval procedures. A document outlining the possible solutions will be provided by the Portal team within 2017Q2 (***action; Ø. Godøy; 30 June 2017***).

2.5.10.4 If OSCAR will have to be used for the collection of metadata from the CryoNet Stations and contributing stations, the Team agreed that the WMO Members should be invited to facilitate the nomination of GCW OSCAR/Surface focal points at the national level. The focal points would be given credentials and privileges for directly entering and editing the metadata of national GCW CryoNet Sites and contributing stations in OSCAR. This could be promoted through the development of Technical Regulations for inclusion in the WIGOS Manual. The Secretariat was requested to propose the timeline for developing such materials in liaison with Ø. Godøy (***action; Secretariat; 30 June 2017***).

2.5.10.5 The Team requested the Chair of the CryoNet Team, Wolfgang Schöner, to ask the GCW Steering Group GSG to consider tasking the GCW Integrated Products Working Group to define the data requirements (***action; W. Schöner; Jan. 2017***).

2.5.11 Preliminary discussion on procedures for data exchange, including data formats and a need to update BUFR

2.5.11.1 The Team discussed the procedures that should be applied for CryoNet and contributing stations to exchange data internationally through GTS/WIS, either directly through a local NMHS or GCW Data Portal or through a bilateral arrangements with an identified organization that would collect and convert received data into the WMO format – BUFR.

2.5.11.2 The Team agreed with the principle that the meteorological data from CryoNet Sites/Stations and GCW contributing stations should be distributed on GTS, and that their instrument/platform metadata should be submitted to OSCAR/Surface so that the users of the data can understand the conditions under which the measurements are made, and thereby interpret the data, even though standards for instruments and methods of observation may not be systematically followed.

2.5.11.3 The Team agreed that the GCW Portal could be seen as one mechanism for the submission of GCW data in [near]real-time and their insertion on GTS as appropriate. The Portal should also act as a repository of GCW data and their further distribution to GCW users.

2.5.11.4 The Team also agreed that the data could be formatted in NetCDF, and then automatically translated into BUFR through the GCW Data Portal. It was noted that some standard names in the CF convention might be needed, and action taken to have them added. The Team also agreed that the NMHSs should be requested to assist the Site/Stations operators with regard to the formatting and distribution of their data in [near]real-time. It requested the Secretariat to draft an Executive Council Decision for consideration by the Team via email, and then the GSG, and EC-PHORS at their next meetings (***action; Secretariat; asap***).

2.5.11.5 The Team agreed that guidance should be developed for the collection and distribution of Cryospheric and associated Meteorological data from the CryoNet

Sites/Stations and GCW contributing stations. Efforts required in this regard should be included in the CryoNet team workplan (***action; W. Schöner; asap***). Regarding GTS distribution of sea-ice, lake/river ice, and snow on ice data, the Team agreed to invite the JCOMM Task Team on Table Driven Codes (TT-TDC) to define and develop a BUFR template. It requested Vasily Smolyanitsky to approach the TT-TDC in this regard, and invite the TT-TDC to collaborate with the JCOMM Expert Team on Sea-Ice (ETSI) in this regard (***action; V. Smolyanitsky; asap***).

2.5.12 General discussion on CryoNet: What could be achieved so far, what got lost, where should be invested in the future (in-session, chaired by W. Schöner)

2.5.12.1 This item was covered through discussion under other agenda items.

2.5.13 Update of the CryoNet team members (W. Schöner)

2.5.13.1 The Team agreed that there was no need to update the Team's membership at this point. However, in order to improve the expertise of the team with respect to permafrost and sea-ice it decided to suggest the nomination of Dr. Annett Bartsch (Austria) and Dr. Petra Heil (Australia) for approval by the next GSG meeting.

2.6 Draft list of CryoNet stations for consideration by GSG, EC-PHORS-7 and EC-69

2.6.1 See paragraph 2.5.7.

2.7 GCW/CryoNet basic documents – status and way forward

2.7.1 The Team reviewed a status of the GCW/CryoNet basic documents and discussed the way forward to finalize them. Final documents will be submitted to GSG, EC-PHORS and eventually to EC for consideration and or approval.

2.7.2 The Team noted that the CryoNet Primer is the basic document, but it needs to be updated with description of the evaluation process, and other considerations of the meeting (station within a station, we don't have a site within a site, etc.) (***action; W. Schöner; 15 December 2016***)

3. FUTURE ACTIVITIES

3.1 Next meetings and/or workshops (W. Schöner/V. Smolyanitsky/ C. Xiao/GCW-PO)

3.1.1 The Team reviewed the list of planned GCW meetings, including:

- 4th GCW Steering Group meeting, Cambridge, United Kingdom, 16-20 January 2017
- CryoNet-6, Cambridge, UK, 16-20 Jan. 2017
- AHECO Project meeting, Bishkek, Kyrgyzstan late Feb. 2017
- EC-PHORS-7, Ushuaiia, Argentina, 21-24 March 2017
- 2nd Best Practices Team meeting, Iceland or Davos, March 2017
- CryoNet with Tropical focus, Arusha, Tanzania, 3-7 July 2017
- UNESCO GCW Latin America for Glaciers workshop (TBD)
- GCW Website & Outreach team (late 2017)
- GCW Portal team (late 2017)

3.1.2 The Team noted that the Team members who are also members of the GSG could be addressing most of the CryoNet Team issues during the next GSG during the week of 16-20 January 2017.

3.1.3 The Secretariat was requested to discuss with the co-chairs of GSG the scope of the CryoNet workshop with Tropical focus workshop in Tanzania (***action; Secretariat; Jan. 2017***).

3.2 The AHECO Project and involvement of GCW (GCW-PO)

3.2.1 The meeting reviewed status of the AHECO Project initiated by the CryoNet Asia workshop (Salekhard, Russian Federation, February 2016).

3.2.2 The Team recalled that the AHECO Project is aiming to address the current lack of high quality datasets in the Asian high mountain cryosphere, in the mountain ranges of Himalayas, Karakorum, Hindukush, Pamir, Tien Shan and Altai, and the need to improve dialogue among researchers interested in such data to promote data accessibility and exchange, modeling and forecasting activities. The AHECO Project will facilitate the establishment of CryoNet stations in these high mountains. Coordinated observations between high and low elevation stations will be facilitated followed by a comparison of in-situ observational data and measurements with the reanalysis data.

3.2.3 New high elevation cryosphere data provided with the help of the AHECO Project will improve the regional and local energy balance/atmosphere circulation models and assist in the study of modern and past climate variability and water resources changes in Asia.

3.3.4 At this point, the project is proposed to be implemented in the following phases:

1. Definition Phase (2016-2017)
2. Development Plan Phase (2018-2019)
3. Implementation Phase (2020-2022)

3.3.5 A first workshop is planned in Bishkek, Kyrgyzstan in late February 2017 to make progress with regard to the definition phase of the project.

3.3.6 The meeting proposed to finalize the CryoNet Asia working Group during the AHECO workshop in February 2017 (***action; Secretariat; Feb. 2017***).

3.3 Future cooperation with partners (W. Schöner/GCW)

3.3.1 Wolfgang Schöner addressed the future cooperation with partners. The cooperation was a strong signal at the start-up phase of GCW but decreased during the implementation phase. As the cooperation with partners is key for GCW it should be strengthened in the coming phase. The chair of the CryoNet Team will ask the GSG for activity (***action; W. Schöner; Jan 2017***)

3.4 Action Sheets from this meeting (W. Schöner/GCW-PO)

3.4.1 The Team agreed on actions from this meeting (Annex 3).

4. REPORT TO GCW STEERING GROUP

4.1 Report to GSG

4.1.1 The Team agreed to prepare a report to the GCW Steering Group that will eventually be submitted to EC-PHORS session for consideration (***action; W. Schöner & Secretariat; 15 Dec. 2016***).

4.2 Draft Resolution to EC-69 on CryoNet

4.2.1 The Team requested the Secretariat in liaison with the Chair, and on the basis of the Team's discussion during the meeting to develop a draft EC Resolution on CryoNet, through which EC will establish CryoNet (***action; Secretariat; 15 Dec. 2016***).

5. ANY OTHER BUSINESS

5.1 The meeting discussed GCW Metadata and updated its workplan accordingly (Annex 5).

6. CLOSURE OF MEETING (18h00)

6.1 The Chair thanked the participants and the Secretariat for contributing to the successful outcome of the meeting. The participants agreed that this has been a very productive meeting.

6.2 The meeting closed at 18.00 hours on Thursday, 22 September 2016.

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ANNEX 1

AGENDA

(Fifth CryoNet team meeting, Graz, Austria, 20-22 September 2016)

VENUE: University of Graz, Department of Geography and Regional Science, Heinrichstrasse 36

DATE/TIME: 20 September 2016 09.00 to 22 September 2016 18.00

1. ORGANIZATION OF THE MEETING (Chair W. Schöner)

- 1.1 Welcome and Opening of the meeting (W. Schöner & C/OSD)
- 1.2 Adoption of the Agenda (W. Schöner)
- 1.3 Working Arrangements (W. Schöner)
- 1.4 Introductions of participants (participants)

2. DEVELOPMENT OF CRYONET

- 2.1 Review of Actions from previous meetings (GCW-PO)
- 2.2 Review of the CryoNet Team Work Plan (W. Schöner)
- 2.3 Report on the CryoNet South America activities (G. Casassa)
- 2.4 Report on the CryoNet Asia, including 3rd Pole activities (V. Smolyanitsky & C. Xiao)
- 2.5 Status of CryoNet (W. Schöner)
  - 2.5.1 Pre-operational testing (W. Schöner)
  - 2.5.2 List of stations/sites proposed for CryoNet and contributing stations (W. Schöner/GCW-PO)
  - 2.5.3 Review of Station/Site Questionnaire (J. Key, W. Schöner)
  - 2.5.4 Review of the Process for assessment of stations/sites (W. Schöner & S. Starkweather)
  - 2.5.5 Review of minimum program for CryoNet stations/sites (W. Schöner with help from Ch. Fierz, M. Citterio, CH. Genthon, V. Smolyanitsky, J. Boike)
  - 2.5.6 Selection of newly proposed stations/sites for CryoNet and contributing stations (in-session, chaired by W. Schöner)
  - 2.5.7 Identification of data for real-, near-, and non-real time international exchange (W. Schöner with help from Ch. Fierz, M. Citterio and V. Smolyanitsky)
  - 2.5.8 GCW/CryoNet Data Policy (Þ. Þorsteinsson)
  - 2.5.9 Interfacing CryoNet stations/sites metadata/data with the GCW Data Portal - status and next steps, (Ø. Godøy)
  - 2.5.10 Preliminary discussion on procedures for data exchange, including data formats and a need to update BUFR (V. Smolyanitsky, Þ. Þorsteinsson & GCW-PO)
- 2.6 Draft list of CryoNet stations for consideration by GSG, EC-PHORS-7 and EC-69 (GCW-PO)

2.7 GCW/CryoNet basic documents – status and way forward (W. Schöner, GCW-PO)

3. FUTURE ACTIVITIES

3.1 Next meetings and/or workshops (W. Schöner/V. Smolyanitsky/ C. Xiao/GCW-PO)

3.2 Action Sheets from this meeting (W. Schöner/GCW-PO)

4. REPORT TO GCW STEERING GROUP

4.1 Report to GSG (W. Schöner/GCW-PO)

4.2 Draft Resolution to EC-69 on CryoNet (GCW-PO)

5. ANY OTHER BUSINESS (W. Schöner)

6. CLOSURE OF MEETING (18h00) (W. Schöner/WMO Secretariat)

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ANNEX 2

LIST OF PARTICIPANTS

(Fifth CryoNet team meeting, Graz, Austria, 20-22 September 2016)

Name	Institution/Affiliation	E-mail
Wolfgang Schöner Chair of the CryoNet Team	University of Graz, Dept. of Geography, Heinrichstrasse 36, 8010 Graz, Austria	wolfgang.schoener@uni-graz.at
Michele Citterio Member	GEUS - Geological Survey of Denmark and Greenland, Copenhagen, Denmark	mcit@geus.dk
Charles Fierz Member	WSL Institute for Snow and Avalanche Research SLF, and International Association of Cryospheric Sciences (IACS), Davos, Switzerland	fierz@slf.ch
Jeff Key Member	Cooperative Institute for Meteorological Satellite Studies, University of Wisconsin-Madison, 1225 West Dayton Street, Madison WI 53562, USA	jkey@ssec.wisc.edu
Kari Luojus Member	Finnish Meteorological Institute (FMI), Helsinki, Finland	kari.luojus@fmi.fi
Vasily Smolyanitsky Member	Arctic and Antarctic Research Institute, St. Petersburg, Russian Federation	vms@aari.aq
Gino Casassa Member	Centro de Estudios Científicos, Chile, Vice-chair of CliC Scientific Steering Group (SSG), Punta Arenas, Chile	gcasassa@cecs.cl
Dongqi Zhang (attending on behalf of Team member Cunde Xiao)	Chinese Academy of Meteorological Sciences China Meteorological Administration Beijing China	zhangdq@camscma.cn
Christophe Genthon Member	LGGE, Grenoble, France	genthon@lgge.obs.ujf-grenoble.fr
Þorsteinn Þorsteinsson Member	Icelandic Meteorological Office, Reykjavík, Iceland	thor@vedur.is

Hironori Yabuki Member	Japan Agency for Marine-Earth Science and Technology, Yokosuka, Japan	yabuki@jamstec.go.jp
Giovanni Macelloni Member	Consiglio Nazionale delle ricerche - istituto di fisica applicata "Nell o Carrara", Firenze, Italy	g.macelloni@ifac.cnr.it
Angel Corona Member	NOAA-National Weather Service, 222 West 7th Avenue, Anchorage, AK, USA	angel.corona@noaa.gov
Annett Bartsch Member	Central Institute for Meteorology and Geodynamics, Vienna, Austria	annett.bartsch@zamg.ac.at
Øystein Godøy Invited expert	Norwegian Meteorological Institute, Oslo, Norway	o.godoy@met.no
Etienne Charpentier Chief, Observing Systems Division	WMO Secretariat, 7bis, avenue de la Paix, CH 1211 Geneva, Switzerland	echarpentier@wmo.int
Rodica Nitu GCW Project Officer	WMO Secretariat, 7bis, avenue de la Paix, CH 1211 Geneva, Switzerland	rnitu@wmo.int

ANNEX 3

LIST OF ACTION ITEMS ARISING FROM THE MEETING

(Fifth CryoNet team meeting, Graz, Austria, 20-22 September 2016)

Ref.	***Action item***	***By whom***	***Deadline***
2.3.5	to act as a focal point for providing input regarding Guidelines for Cryospheric measurements in Antarctica	C. Genthon	23 Sep. 2016
2.3.6	to finalize the proposal with programme for the next workshop	G. Casassa	end 2016
2.4.2	to contact participants of the Salekhard workshop and Permanent Representatives as appropriate and ask them to submit the questionnaire about their Country candidate Sites and Stations no later than 31 October	Secretariat	ASAP
2.5.4	to remind the focal points about the need to check the information entered in the questionnaires and invite them to update them if necessary	Secretariat	30 Oct. 2016
2.5.2.3	To freeze the Station/Site website questionnaire in terms of the recorded information about candidate Sites and Stations and according to the Teams' discussion at this meeting	J. Key	1 Oct. 2016
2.5.4.2	to develop templates of (i) CryoNet Site/Station commitment letter and (ii) national agreement for the management of CryoNet Site/Stations at the national level	Secretariat	end 2016
2.5.4.3	to check the procedures used by the WMO Commission for Atmospheric Sciences (CAS) regarding the selection of Global Atmosphere Watch (GAW) stations and investigate whether the GCW procedure for CryoNet Site/Stations selection could be adjusted in a way consistent with the CAS procedure	Secretariat	31 Oct. 2016
2.5.4.6	to update the questionnaire according to the two categories of variables above	J. Key	1 Oct. 2016
2.5.4.8	to investigate with the GCW Integrated Products Working Group and the Snow Watch Team whether there are any GCW observational user requirements that are independent from existing WMO Application Areas, that could be identified and documented in OSCAR/Requirements. In that case, the Team also requested Mr Luojus to develop a two-pager making the case of introducing new Application Area(s) in the WMO Rolling Review of Requirements	K. Luojus	end 2017
2.5.4.10 (1)	Following up from the previous communication of the Secretariat dated 24 May 2016, to inform again the Focal points and candidate Sites/Stations contact points about new definition of Sites and Stations, the Team's decisions with regard to the evaluation requirements and process, and ask them to update the questionnaires accordingly, and their confirmation in writing no later than 15 October 2016 that they have made the required update	Secretariat	asap
2.5.4.10 2.	to test the evaluation process on the basis of the agreed criteria and using a few examples of candidates Sites/Stations	W. Schöner	15 Oct. 2016
2.5.4.10 3.	to coordinate the evaluation of CryoNet Sites/Stations and seek final concurrence by the Team via email	W. Schöner	15 Nov. 2016

Ref.	***Action item***	***By whom***	***Deadline***
2.5.4.10 4.	to seek commitment letter from the PRs for which Sites/Stations have succeeded the evaluation	Secretariat	15 Dec. 2016
2.5.7.1	to perform the selection and to provide the proposed list to the Team via email no later than 15 October 2016	W. Schöner	15 Oct. 2016
2.5.8.2	to approach the GSG and invite the Team to agree on a workplan for providing a list of GCW products with the variables required by these products, and with indication whether the data for each variable will be required for exchange in [near]real-time, or in delayed mode	W. Schöner	Jan 2017
2.5.9.4	to provide Mr Þorsteinsson with their feedback on elements to be considered in a GCW data policy no later than 15 October 2016	Team members	15 October 2016
2.5.9.4	to develop a draft for review by the Team by 15 November 2015	Þ. Þorsteinsson	15 Nov. 2016
2.5.9.4	to have the draft policy endorsed by the Team for its submission to the GCW Steering Committee at its next meeting in January 2017	W. Schöner	15 Dec. 2016
2.5.10.2	together with Kari Luojus (Sodankylä), Wolfgang Schöner (Sonnblick), Charles Fierz (Weissfluhjoch) and Øystein Godøy, to investigate and propose how to pursue achieving metadata and data interoperability with CryoNet stations	Ø. Godøy et al.	31 Dec. 2016
2.5.10.3	to discuss interaction between the GCW Portal and OSCAR with Jörg Klausen (OSCAR)	Ø. Godøy et al.	31 Dec. 2016
2.5.10.3	to have the Portal Team to provide a document outlining the possible solutions	Ø. Godøy	30 June 2017
2.5.10.4	to propose the timeline for developing such materials concerning submission of GCW station metadata to OSCAR in liaison with Ø. Godøy	Secretariat	30 June 2017
2.5.10.5	to ask the GCW Steering Group GSG to consider tasking the GCW Integrated Products Working Group to define the data requirements	W. Schöner	Jan. 2017
2.5.11.4	to draft an Executive Council Decision requesting NMHSs to assist the Site/Stations operators with regard to the formatting and distribution of their data in [near]real-time. Draft Decision to then be submitted via email to the Team for its consideration	Secretariat	asap
2.5.11.5	to include in the CryoNet Team workplan efforts required to develop guidance for the collection and distribution of Cryospheric and associated Meteorological data from the CryoNet Sites/Stations and GCW contributing stations	W. Schöner	asap
2.5.11.5	to approach the JCOMM Task Team on Table Driven Codes (TT-TDC) regarding GTS distribution of sea-ice, lake/river ice, and snow on ice data, and invite the TT-TDC to collaborate with the JCOMM Expert Team on Sea-Ice (ETSI) in this regard	V. Smolyanitsky	asap
2.7.2	to update the Primer document with description of the evaluation process, and other considerations of the meeting (station within a station, we don't have a site within a site, etc.)	W. Schöner	15 December 2016
3.1.3	to discuss with the co-chairs of GSG the scope of the CryoNet with Tropical focus workshop in Tanzania	Secretariat	Jan. 2017
3.3.6	to finalize the CryoNet Asia working Group during the AHECO workshop in February 2017	Secretariat	Feb. 2017
4.1.1	to prepare a report to the GCW Steering Group that will eventually be submitted to EC-PHORS session for consideration	W. Schöner & Secretariat	15 Dec. 2016
4.2.1	Secretariat in liaison with the Chair, and on the basis of the Team's discussion during the	Secretariat	15 Dec. 2016

Ref.	***Action item***	***By whom***	***Deadline***
	meeting to develop a draft EC Resolution on CryoNet, through which EC will establish CryoNet		

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ANNEX 4

STATUS OF ACTIONS FROM PREVIOUS MEETINGS RELEVANT TO THE CRYONET TEAM

ACTIONS ARISING FROM:

- **THE JOINT FOURTH CRYONET TEAM AND THIRD PORTAL & WEBSITE TEAMS MEETINGS (Boulder, Colorado, USA, 7-9 December 2015); GSG3**
- **GSG-3 (Boulder, Colorado, USA, 10-11 December, 2015); CN4**

NOTE: the items in gray are completed and will be rearranges in a future version.

No.	*Ref.*	*Action item*	*By whom*	*Deadline/Comments*
CryoNet				
1	2.1 CN4	Discuss setting up an "issue tracking" system for keeping track of progress between meetings with Øystein Godøy for implementation. Trello might be an option; recommended previously (https://trello.com/)	**Secretariat, Ø. Godøy**	GCW-PO will maintain the list of actions and find a simple method to update and inform; (Nov 2016);
2	2.1 GSG3	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**	• Template of a Letter of endorsement by PRs prepared and available on the web • Example of a draft agreement (Aides Mémoires) with partners available GCW-PO to provide templates (CryoNet-5)
3	2.1 GSG3	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 Secretariat**	DONE; Clarification to cover a station operating in the waters of a different country: ensure that

No.	*Ref.*	*Action item*	*By whom*	*Deadline/Comments*
				available.
4	1.3 GSG3	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**	Done, 6.4.2016
5	2.1 GSG3	The Secretariat shall ensure that the final concept document of the GCW Observing Network is used to update all relevant GCW documents.	**Secretariat**	ongoing
6	2.1 GSG3	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**	ongoing
7	2.3 CN4	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 for GSG4	**Secretariat**	Three recommendations were proposed: 1. Integrate UNESCO contributions into GCW Implementation Plan – **Done** 2. GCW-PO to ensure UNESCO representation on GSG; invite representative the GSG mtg in **Jan 2017:** 3. Implement joint activities as per GCW IP: (a) Evaluate existing terminologies: **Terminology Team**; (b) liaise with UNESCO – **contact established** with Director General showed full support to GCW, no resources

No.	Ref.	Action item	By whom	Deadline/Comments
				available at UNESCO. 4. GCW-PO to explore an agreement with UNESCO (MoU) for advancing the GCW agenda.
8	2.1 CN4	Take the lead in coordinating the establishment of regional working groups, as appropriate, with support from regional experts.	**Secretariat**	Europe: may not be needed (see #3) Africa: July 2017 AHECO: Feb 2017 Latin America: 2017
9	2.3 GSG3	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. CLOSED: new action will be initiated on the organization of the Workshop	**Observations WG** **Secretariat**	Email to Tanzania on 6.4.2016 ; mtg with PR of Tanzania on 7.4.2016, PR agreed to organize this workshop in Arusha, in the first week of July 2017, confirmation received by email, local org. committee is being established.
10	2.3 SGS3 & 2.3 CN4	The GSG will identify funds in its budget for 2016 to support one participant from each Andean country to participate in the 2016 WMO/UNESCO joint South American workshop (Secretariat to action); discussed at CryoNet 5 UNESCO would be asked for the same support)	**Secretariat/ Chair, Vice-chair of GSG** **Gino Casassa**	Planned for 2017, early planning for training +meeting for a total of 5 days.
11	2.2 CN4	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**	Ongoing;
12	2.2 CN4	Contact John Pomeroy, chair of INARCH, to discuss linkages for GCW / CryoNet: several INARCH sites could be CryoNet station/sites (and vice	**W. Schöner &**	GCW-PO to follow up

No.	*Ref.*	*Action item*	*By whom*	*Deadline/Comments*
	& 6.4 GSG3	versa).	**B. Goodison**	
13	2.2 CN4	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**	The Portal Team to test whether the available metadata is translated through the Portal to OSCAR. ACTION: Portal team to clarify the functionality of Portal re metadata to OSCAR req.
14	2.3 GSG3	Contact WMO Education and Training Programme about possible support of this workshop activity and to identify opportunities for collaboration and funding for GCW to provide training sessions to build capacity.	**W. Zhang** GCW-PO	GCW-PO to follow up with Education and Training Programme and report back prior to GSG.
15	2.4CN; 2.3 GSG3	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 completed
16	2.4CN; 2.3 GSG3	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 ; D/OBS Chair of the CryoNet Team GCW-PO**	Completed at the 2nd CryoNet Asia workshop?
17	2.4CN; 2.3 GSG3	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 D/OBS GCW-PO**	GCW-PO to follow up and report back prior to GSG.
18	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**	Done

No.	*Ref.*	*Action item*	*By whom*	*Deadline/Comments*
			C. Fierz **J. Key**	
193	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**	Done
20	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**	**Done;** CryoNet Concept document sent to FP on 8.4.2016 with a request to inform their partners; also sent to WIGOS, WIS, WGMS, GTN-P, GTN-G, IPA, GCOS, GAW, IACS and IHP on 8.4.2016.
21	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**	DONE
22	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**	**Done;** Minimum RQ finalized; WIGOS Manual revised
23	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**	**Done**
24	2.5.6 CN5 & GSG3	GCW needs to have a representative at the next WIGOS design team meeting. NEW ACTION: to engage GSG and the Integrated Products WG (start with the Snow Watch Team) to ensure continuity of representation of GCW at these meetings (discussed at CryoNet-5)	**M. Citterio (if available)** **GSG, Integrated**	M. Citterio participated in IPET-OSDE, April 2016: DONE Identify future

No.	*Ref.*	*Action item*	*By whom*	*Deadline/Comments*
			products WG and GCW-PO	participation and continuous engagement
25	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**	DONE
26	2.7.4	Guide where there should be consultation and to manage the internal WMO process.	**Secretariat**	ongoing
27	7.1 GSG3	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**	
28	2.1 GSG3 & 2.5.6 CN4	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. GCW is included in the WIGOS manual; hence changes are submitted to ICG-WIGOS which in turn reports to Executive Council (EC). The GSG Chair recommended that GCW submit what is available at the 2016 ICG-WIGOS meeting, and if it needs work, submit it 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 GCS-PO will follow up and report on progress
29	2.1 GSG3	The Observations WG was reminded that the GCW and CryoNet station list has to be approved by Congress; thus, it needs to be updated before Congress every 4 years, 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**	The 2016 draft list will be elaborated by CryoNet Team, 20-22 September 2016; Deferred to CryoNet-5
30	2.2 GSG3	The GSG emphasized that the list of stations and associated resolution should be available by the end of September 2016 before the CBS meeting, included as an Annex in the GCW report to CBS.	**CryoNet chair** **Secretariat**	Task may need to be delayed due to delay of CryoNet Team mtg Deferred to CryoNet-5
31	2.2 GSG3	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**	March 2017
32	2.5.6	The CryoNet Team is to finalize ANNEX 8 (GCW Surface Observing Network), revising as appropriate (e.g. minimum requirements) and with Secretariat support, ensure that all GCW documents reflect the revised	**CryoNet Team**	Ongoing Documented in the

No.	Ref.	Action item	By whom	Deadline/Comments
		structure of the surface observing network.		Implementation Plan
33	2.5.7	Secretariat to check for letters received to date.	**Secretariat**	**Done**, All sites approved for pre-operational testing by Cg-17 were endorsed by the respective PRs
34	2.5.7	Determine a procedure on data accessibility and quality control, to ensure the interoperability with the GCW Portal, for sharing with other centers.	**Ø. Godøy,** **C. Fierz,** **Secretariat (support)**	GSG-4
35	2.5.7	Draft procedure is to be finalized, with support from Secretariat. Review the GAW procedures and identify common approaches	**Secretariat**	January 31, 2016 Annex to CryoNet -5 meeting report; Follow up on progress prior to the GSG-4
36	2.5.8	Follow up on the submission of the Formigal questionnaire (contact Samuel Buisan).	**J. Key**	**Done**
37	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 Tómas will take the lead.	**Ø. Godøy** **Þ. Þorsteinsson** **T. Jóhannesson**	Update provided at the CryoNet -5 meeting Sept, 2016 Follow up requested, as per meeting report.
38	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**	**No action needed** as there is no real outcome of the Salekhard workshop, except that it stressed that data needed to be accessible in order to be utilized.
39	2.6	The list and associated resolutions 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	**Secretariat** **CryoNet chair**	End of September 2016 Action redefined during

No.	*Ref.*	*Action item*	*By whom*	*Deadline/Comments*
		facilitate this process.		CryoNet-5 meeting.
40	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 Action redefined during CryoNet-5 meeting.
41	2.7.3 CN4 & 2.5.2 GSG3	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. 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** **GCW-PO**	GCW-PO to provide updates on progress. The Best Practices Team will reach out to this community seeking expert contribution to developing the GCW Guide and Manual
43	2.1 GSG3	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**	DONE
44	2.7.4	Recommend to the GSG the creation of a Best Practices Task Team under the Observations Working Group.	**GCW Steering Group**	**Done**
45	2.7.4	Ensure community consultation and feedback so there is global acceptance of the Guides and Manual.	**Best Practices Team** **Secretariat**	After development the draft will be published for comments by the community
46	2.4 GSG3	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. Need to establish other Teams targeting other components; needs to find alternatives **Consider additional resources and approaches to address the engagement of the same experts in more than one WG or Team.**	**GSG** **Secretariat**	Co-chairs of the WG Integrated Products nominated (k. Luojos & V. Smolynitsky) Additional experts needed to take on tasks

No.	*Ref.*	*Action item*	*By whom*	*Deadline/Comments*
Portal				
47	3.3.1	Ask WMO, through the Secretariat, to engage with ICSU on data management issues.	**GSG** **Secretariat**	
48	3.3.3	CryoNet Team, WIS, and data centers should be asked for their advice and feedback on the guidelines proposed.	**GSG**	
49	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**	
50	3.3.5	Continuing the support for seeking accessibility of data from CryoNet sites.	**Secretariat**	
51	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**	Yes, when available
52	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**	PR were requested to endorse these nominations in May 2016: DONE
53	3.3.6	The Team is asked to consider the need for a data management expert for high mountain regions.	**Portal Team**	
54	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				
55	4.2	Provide information to add real-time data for the Southern Hemisphere.	**G. Casassa**	
56	4.2	Glaciers at CryoNet sites could be added to glacier sections.	**CryoNet Team**	
57	4.2	Further discussion is required to identify how GCW can get both human and financial resources to conduct specific tasks such as data processing and development of products for the website.	**?**	
58	4.2	The Website Team will initiate inclusion of these regional products on the website.	**Website Team**	On-going
59	4.2	Rick Thoman, through the US PRCC team, will promote the development of such cryospheric products as a regional pan-Arctic cryosphere product	**R. Thoman**	

No.	*Ref.*	*Action item*	*By whom*	*Deadline/Comments*
		for the PRCC.		
60	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				
61	7.	Team leads are requested to share funding opportunities with other team leads and with team members.	**Team leads**	
61	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**	
63	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**	
64	7.	Sue Barrell will keep GCW informed of Australian opportunities which may evolve from a review of their Antarctic program.	**S. Barrell**	
65	7.	Mark Drinkwater will keep GCW informed of potential opportunities related to the validation of Copernicus.	**M. Drinkwater**	
66	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**	
67	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**	

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ANNEX 5

UPDATED CRYONET TEAM WORKPLAN (2015 – 2018)

No	Task	Deliverable	Deadline	Responsible	Status	Comment
1	Update documents for Cg-17		Jan.2015	GCW-PO	DONE	
2	Update GCW regulatory material		ongoing until EC-69 (June2017)	GCW-PO	DONE	
3	Update application questionnaires	Updated Questionnaires	Mar. 2016	**Jeff Key** Wolfgang Schöner Charles Fierz	DONE	
4	Finalize CryoNet Primer	CryoNet Primer published as GCW Report	Dec.2016	**Wolfgang Schöner** with help from all members GCW-PO	Draft 0.6 available	Discussed at CryoNet and Best Practices Teams meetings, Sept. 2016 Needs to be updated with description of the evaluation process, and other considerations of the meeting (station within a station, we don't have a site within a site, etc.)

5	Review available and proposed GCW agreed observing practices	GCW agreed practices available in the GCW Guide and Manual	Guide: Jan. 2017 Manual: Dec. 2018	**Þorsteinn Þorsteinsson** **Charles Fierz** Gino Casassa Michele Citterio Wolfgang Schöner Vasily Smolyanitsky additional experts for cryo- components TBD	Closed	Task handed over to the Best Practices Team
6	Developing the process for assessment of sites proposed to CryoNet	Procedure published as GCW Report	Sep. 2016	**Sandy Starkweather, Jeff Key** with help from all members GCW-PO	DONE	Agreed at CryoNet Team meeting, Sept. 2016
7	Define minimum program for CryoNet stations/sites	Minimum program published as GCW Report	Dec-2016	**Wolfgang Schöner** Charles Fierz Michele Citterio Christophe Genthon Vasily Smolyanitsky lake ice	Done for snow, glaciers & ice caps, ice sheets, permafrost, sea ice	Agreed at CryoNet Team meeting, Sept. 2016
8	Evaluate CryoNet Pre-operational phase	Report available to CryoNet Team mtg	Sep.2016	**Wolfgang Schöner** with help from all members and GCW-PO	Preliminary results were discussed by GSG in Dec. 2015	Discussed at CryoNet Team meeting, Sept. 2016
9	Selection of stations to be included into CryoNet	List of CryoNet stations for consideration by GSG, EC-PHORS and EC-69	Dec.2016	**Wolfgang Schöner** with help from all members and GCW-PO	Almost completed; pre-evaluation is being done by an Uni Graz expert team	To be completed in October 2016 after CryoNet Team meeting, Sept. 2016, and according to agreed criteria

10	Define GCW/CryoNet Data Policy	Data Policy document available for GSG consideration	Jan. 2017	**Þorsteinn Þorsteinsson Tómas Jóhanesson** GCW-PO	Open	Discussed at CryoNet Team meeting, Sept. 2016. Team agreed on the need to develop GCW data policy
11	Identification of data for real-, near- and non-real time international exchange	Proposal available for GSG consideration	Jan. 2017	**Wolfgang Schöner** Charles Fierz Michele Citterio Christophe Genthon, Vasily Smolyanitsky Julia Boike	Open	Discussed at CryoNet Team meeting, Sept. 2016. The Team requested the CryoNet Team Chair to approach the GSG and invite it to agree on a workplan for providing a list of GCW products with the variables required by these products, and with indication whether the data for each variable will be required for exchange in [near]real-time, or in delayed mode
12	Define procedures for data exchange, including data formats and a need to update BUFR	Proposal available for GSG consideration	Jan. 2017	**Þorsteinn Þorsteinsson Vasily Smolyanitsky GCW-PO**	Open	Discussed at CryoNet Team meeting, Sept. 2016, and progress made. Team will propose Executive Council Decision requesting NMHSs to assist the Site/Stations operators with regard to the

						formatting and distribution of their data in [near]real-time

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ANNEX 6

RECOMMENDED AND DESIRED VARIABLES FOR CRYONET SITES/STATIONS

GLACIERS and ICE CAPS	Recommended minimum frequency of observations at CryoNet stations							
	Timescale							
Variable	hourly	daily	weekly	bi-weekly	monthly	seasonal	yearly	multi-year
Surface accumulation (point)	**A**					**M**		
Surface ablation (point)	**A**						**M**	
Surface mass balance (glacier wide)							**M**	
Surface mass balance (point)	**A**						**M**	
Glacier area (glacier wide)								**M**
Surface accumulation (glacier wide)							**M**	
Surface ablation (glacier wide)							**M**	
Basal Ablation (point)	**A**						**M**	
Surface mass balance (glacier wide)							**M**	
Glacier thickness (point)								**M**
Glacier volume (glacier wide)								**M**
Glacial runoff	**A**							
Calving flux (point)							**A/M**	
Ice velocity (point)		**A**					**M**	
Ice/firn temperature profile (point)	**A**							

Blue shading/fill indicates recommended measurements for CryoNet stations

Green shading/fill indicates optional measurements for CryoNet stations

A: automatic, M: manual

RECOMMENDED AND DESIRED VARIABLES FOR CRYONET SITES/STATIONS

SNOW/SOLID PRECIPITATION	**Recommended minimum frequency of observations at CryoNet stations**							
	Timescale							
Variable	hourly	daily	weekly	bi-weekly	monthly	half-yearly	yearly	multi-year
Snow on the ground (According to WMO code 0975: State of ground with snow or measurable ice cover.)		**M**(S)						
Snow depth (including stake farms and snow courses)	**A**(S, G, SI, LRI)	**M**(S)		**M**(SI, LRI)			**M**(G, IS)	
Snow depth (including stake farms and snow courses)	**A**(IS, P)	**M**(P)		**M**(S)				
Snow water equivalent	**A**(S)			**M**(S)			**M**(G, IS)	
Solid precipitation (Requires both amount and type of precipitation to be measured)	**A**(S)							
Snow profiles (density, grain shape & size, hardness, liquid water content, salinity, temperature)				**M**(S)			**M**(IS)	
Snow profiles (density, grain shape & size, hardness, liquid water content, salinity, temperature)				**M**(SI, LRI)				
Depth of snowfall		**M**(S)						
Water equivalent of snowfall		**M**(S)						
Snow cover extent	**A**(SI, LRI)			**M**(SI, LRI)				
Snow chemistry				**M**(S, IS)				
Snow surface temperature	**A**(S, SI)			**M**(SI)				
Snow temperature	**A**(S)							
Drifting snow	**A**(S)	**M**(S)						
Specific surface area				**M**(S)			**M**(IS)	

Blue shading/fill indicates recommended measurements for CryoNet stations

Green shading/fill indicates optional measurements for CryoNet stations

A: automatic, M: manual

S: snow, G: glaciers, IS: ice sheets, ISV: ice shelves, P: permafrost, SFG: seasonally frozen ground, SI: sea ice, LRI: lake and river ice

RECOMMENDED AND DESIRED VARIABLES FOR CRYONET SITES/STATIONS

ICE SHEETS	Recommended minimum frequency of observations at CryoNet stations							
	Timescale							
Variable	hourly	daily	weekly	bi-weekly	monthly	seasonal	yearly	multi-year
Surface accumulation (point)		**A**						
Surface ablation (point)		**A**						
Surface mass balance (point)		**A**					**M**	
Ice sheet thickness (point)								**M**
Ice velocity (point)					**A**			
Ice/firn temperature profile (point)	**A**							

Blue shading/fill indicates recommended measurements for CryoNet stations

Green shading/fill indicates optional measurements for CryoNet stations

A: automatic, M: manual

RECOMMENDED AND DESIRED VARIABLES FOR CRYONET SITES/STATIONS

PERMAFROST	Recommended minimum frequency of observations at CryoNet stations							
Variable	**Timescale**							
	hourly	daily	weekly	bi-weekly	monthly	half-yearly	yearly	multi-year
Ground temperature	**A**							
Active layer thickness		**A**					**M**	
Rock glacier creep velocity						**M**		
Rock glacier discharge	**M**							
Rock glacier spring temperature	**M**							
seasonal frost heath/subsidence							**M**	
surface elevation change								**M**
ground ice volume							**M**	
coastal retreat							**M**	
soil moisture		**A**			**M**			

Blue shading/fill indicates recommended measurements for CryoNet stations

Green shading/fill indicates optional measurements for CryoNet stations

A: automatic, M: manual

RECOMMENDED AND DESIRED VARIABLES FOR CRYONET SITES/STATIONS

SEASONALLY FROZEN GROUND	Recommended minimum frequency of observations at CryoNet stations							
Variable	**Timescale**							
	hourly	daily	weekly	bi-weekly	monthly	half-yearly	yearly	multi-year
Ground temperature	**A**							

Blue shading/fill indicates recommended measurements for CryoNet stations

Green shading/fill indicates optional measurements for CryoNet stations

A: automatic, M: manual

RECOMMENDED AND DESIRED VARIABLES FOR CRYONET SITES/STATIONS

SEA ICE	Recommended minimum frequency of observations at CryoNet stations							
	Timescale							
Variable	hourly	daily	weekly	bi-weekly	monthly	half-yearly	yearly	multi-year
Sea ice thickness	**A**			**M**				
Sea ice freeboard	**A**			**M**				
Sea ice concentration		**A, M**						
Sea ice class (pack, fast ice)		**M**						
Sea ice type (level/rafted/ridged & floe descriptor)		**M**						
Form of ice (floe size)			**M**					
Stage of ice development			**M**					
Sea ice phenomena (dates of freeze-up, fast-ice formation/breakout, melt onset, break-up)			**A/M**				**M**	
Sea ice stage of melting		**M**						
Sea ice openings (leads, polynyas, cracks)		**A**						
Sea ice velocity	**A**	**M**						
Sea ice deformation (divergence/convergence)	**A**	**M**						
Sea ice ridge height	**A**	**M**						
Sea ice ridge cover (concentration of ice ridges)	**A**	**M**						
Sea ice draft				**M**				
Sea ice salinity profile (vertical)				**M**				
Sea ice stratigraphy				**M**				
Surface temperature (surface-air interface)	**A**							
Sea ice temperature profile (vertical)	**A**			**M**				

Blue shading/fill indicates recommended measurements for CryoNet stations

Green shading/fill indicates optional measurements for CryoNet stations

A: automatic, M: manual

RECOMMENDED AND DESIRED VARIABLES FOR CRYONET SITES/STATIONS

LAKE ICE	Recommended minimum frequency of observations at CryoNet stations							
Variable	**Timescale**							
	hourly	daily	weekly	bi-weekly	monthly	half-yearly	yearly	multi-year
Ice thickness	**A**			**M**				
Ice conditions (concentration, stage of development, form of ice, edge)		**M**						
Ice phenomena (dates of freeze-up, fast ice formation, melt onset, break-up)							**M**	
Stage of melting		**M**						
Surface temperature	A							
Ice openings (leads, polynyas, cracks)		M						
Ice dynamics (motion, compression, ridges height, ridges concentration)		M						
Ice structure				M				
Ice mass balance	A							

Blue shading/fill indicates recommended measurements for CryoNet stations

Green shading/fill indicates optional measurements for CryoNet stations

A: automatic, M: manual

RECOMMENDED AND DESIRED VARIABLES FOR CRYONET SITES/STATIONS

ICE SHELVES	Recommended minimum frequency of observations at CryoNet stations							
	Timescale							
Variable	hourly	daily	weekly	bi-weekly	monthly	seasonal	yearly	multi-year
Basal Ablation							**A/M**	
Ice velocity		**A**					**M**	

Blue shading/fill indicates recommended measurements for CryoNet stations

Green shading/fill indicates optional measurements for CryoNet stations

A: automatic, M: manual

RECOMMENDED AND DESIRED VARIABLES FOR CRYONET SITES/STATIONS

ICEBERGS	Recommended minimum frequency of observations at CryoNet stations							
	Timescale							
Variable	hourly	daily	weekly	bi-weekly	monthly	half-yearly	yearly	multi-year
Land based or drifting manned station:								
Iceberg position		**M**						
Iceberg form, size		**M**						
Concentration (distance) of icebergs		**M**						
Shipborne manned station:								
Iceberg position	**M**							
Iceberg form, size	**M**							
Concentration (distance) of icebergs	**M**							

Blue shading/fill indicates recommended measurements for CryoNet stations

Green shading/fill indicates optional measurements for CryoNet stations

A: automatic, M: manual

RECOMMENDED AND DESIRED VARIABLES FOR CRYONET SITES/STATIONS

SURFACE METEOROLOGY	Required and recommended minimum frequency of observations at CryoNet stations							
	Timescale							
Variable	hourly	daily	weekly	bi-weekly	monthly	half-yearly	yearly	multi-year
Air temperature	**A**							
Air humidity	**A**							
Wind speed	**A**							
Wind direction	**A**							
Incoming shortwave radiation	**A**							
Reflected shortwave radiation	**A**							
Incoming longwave radiation	**A**							
Outgoing longwave radiation	**A**							
Air pressure	**A**							
Precipitation	**A**							

Yellow shading/fill indicate required meteorological measurements for CryoNet stations

Blue shading/fill indicates recommended measurements for CryoNet stations

Green shading/fill indicates optional measurements for CryoNet stations

A: automatic, M: manual

ANNEX 7

PROPOSED MODIFICATION TO THE APPLICATION PROCESS DESCRIPTION

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, core (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. In addition to the online questionnaire, a letter of endorsement is required before the station/site receives final approval. It is recommended that it be provided earlier, rather than later, in the process. For stations that are operated by the WMO Member's national meteorological or hydrological service (NMHS), the WMO Permanent Representative (PR) of the station's operating country must provide a letter of endorsement to WMO. (Click here for an example.) For stations that are operated by other national entities, there must be a written agreement between that entity and the PR, and the PR must provide a letter of endorsement to WMO. (Click here for an example.) 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.
3. The application is examined by the WMO Secretariat for completeness.
4. The GCW CryoNet Team, in consultation with relevant experts, evaluates the application[1]. This is normally done annually, but may be expedited in some situations. There are no site visits.
5. If the Team recommends that the station not be included in the GCW surface network, feedback is provided to the applicant on the results of the assessment. The application can be modified and resubmitted at any time.
6. 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 GSG recommends that the station not be included in the GCW surface network, feedback is provided to the applicant.
7. If 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.

[1] In order to ensure a unique, high-quality network of surface observations, stations and sites are evaluated for inclusion in CryoNet based on a number of factors. Fulfilling the minimum requirements does not in itself guarantee acceptance as a CryoNet station. Other criteria that are considered by the CryoNet Team when evaluating applications include (1) the number of recommended variables that are measured (see the lists), (2) the continuity and length of the data record, (3) the extent to which data are available and accessible, (4) sustainability of the station, (5) conformity to GCW best practices, and (6) the location and representativeness of the proposed station relative to the geographic distribution of existing CryoNet stations.

8. GSG informs the EC-PHORS at EC-PHORS regular meetings, regarding the selection of stations for the CryoNet network. EC-PHORS meets every 12-15 months.
9. EC-PHORS, upon recommendation from GSG, approves and submits the list of selected stations for approval by the WMO Executive Council (EC). EC meets annually.
10. The approval process following the GSG decision takes place in parallel with the one-year trial period.

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.

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