

**WORLD METEOROLOGICAL ORGANIZATION**

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**COMMISSION FOR BASIC SYSTEMS**  
OPEN PROGRAMMME AREA GROUP ON  
INTEGRATED OBSERVING SYSTEMS

ITEM: 4.4

**IMPLEMENTATION-COORDINATION TEAM  
ON INTEGRATED OBSERVING SYSTEM  
(ICT-IOS)**  
*Eighth Session*

Original: ENGLISH

GENEVA, SWITZERLAND, 7 – 10 APRIL 2014

**REVIEW OF THE STATUS OF THE SURFACE-BASED COMPONENTS OF THE GOS  
CRYONET OF THE GLOBAL CRYOSPHERE WATCH (GCW)**

*(Submitted by the Secretariat)*

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**SUMMARY AND PURPOSE OF DOCUMENT**

The document provides information on the status of implementation of the CryoNet of the Global Cryosphere Watch (GCW).

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**ACTION PROPOSED**

The Meeting is invited to note the information contained in this document when discussing how it organises its work and formulates its recommendations.

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- Appendices:**
- A.** Terms of Reference of the GCW Cryonet Team
  - B.** Site requirements for inclusion in Cryonet
  - C.** Initial Cryonet sites
  - D.** GCW Cryonet Team workplan

## DISCUSSION

### 1. BACKGROUND

One of the immediate priorities in the Global Cryosphere Watch (GCW) development and implementation is to establish the core network of GCW surface measurement sites – CryoNet. CryoNet is one part of the whole GCW observing system, which is, in turn, a component observing system of the WMO Integrated Global Observing System (WIGOS). CryoNet covers all components of the cryosphere (glaciers, ice shelves, ice sheets, snow, permafrost, sea ice, river/lake ice) through an extensive approach of in-situ observations. CryoNet will build on existing cryosphere observing programmes and promote the addition of standardized cryospheric observations to existing facilities in order to create more robust environmental observatories.

### 2. CRYONET STRUCTURE AND IMPLEMENTATION

#### 2.1 *Structure of CryoNet*

Being a 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. Satellite 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.

The GCW Steering Group (GSG) agreed that while CryoNet is a core network it needs to be global and an effort should be made to identify suitable sites which would provide appropriate global representation. GSG also agreed that there may be a regional extension to CryoNet, such as CryoNet-Asia and this development will be driven by respective regional groups that may be established according to WMO Regions, as appropriate.

To meet different user-needs and because of the spatially distributed nature of different components of the cryosphere, the CryoNet network of in-situ observations is structured into three different classes of sites: Baseline, Reference, and Integrated sites. All sites make measurements according to GCW agreed practices:

- **Baseline** sites make measurements of at least one element of the cryosphere; e.g. snow, permafrost, sea ice, or glaciers. The cryosphere is one “sphere” of the climate system. Other spheres are atmosphere, biosphere, and lithosphere. Therefore, baseline sites are “single sphere”. Baseline sites should be targeted towards long-term, sustainable measurements.

- **Reference** sites are the key sites of CryoNet with respect to the assessment of long-term changes of the cryosphere as well as for the validation of satellite data and cryospheric models. Reference sites may be for a single cryosphere component or for as many cryospheric components as can be measured at the site. Sites can either be a single station or several stations or field sites covering a larger region. To be accepted as a reference site, measurements must be done according to GCW agreed practices and the site must have provided continuous measurements over a long-term period.

Ideally, reference sites are sites currently in operation, but they could be stations that are no longer operating if the data are relevant.

• **Integrated** sites are to promote, through worldwide scientific collaboration, progress in the scientific understanding of the physical processes that change the cryosphere. These sites allow integration of situ and space-based observations and create platforms of cryospheric observatories. Monitoring at integrated sites may cover multiple components of the cryosphere with a highly process orientated approach. Thus these sites are ideal places for understanding the interaction between the atmosphere and the various cryospheric components. Integrated sites can either be a single station or several stations or field sites covering a larger region. Because of the high level of measurements, integrated sites have on-site technical staff. In general these sites are supported by long-term financial commitments running standard monitoring programs of the cryosphere.

## **2.2 GCW Steering Group Meeting**

The first meeting of the GCW Steering Group (GSG) was held in Reykjavik, Iceland from 23 to 24 January 2014. The GSG elected Dr Árni Snorrason as GSG Chair and Dr Barry Goodison as Vice-Chair. The GSG approved several activities to move CryoNet forward; notably, the GSG:

- Revised and approved “Requirements for Site Inclusion in CryoNet” (see Annex B).
- Reviewed the Site Questionnaire elaborated by the CryoNet Team that is to be completed by the candidate sites to show their intention to become a part of CryoNet and to provide necessary metadata allowing an assessment to be done for a selection of appropriate sites.
- Discussed in detail the CryoNet network structure of different site types.
- Approved an initial list of fourteen sites for inclusion in CryoNet (see Annex C). The evaluation of other candidate sites is underway and it is expected that many more sites will be included in CryoNet when submitted for approval by WMO Congress in 2015 through an appropriate resolution. By this act, the CryoNet will enter into an operational phase.
- Noted that CryoNet does not include all of the observing stations and networks that would contribute to GCW.
- Noted that the practices related to CryoNet will be developed by the CryoNet Team complemented by best practices to be developed by the GCW Infrastructure and Practices Team.

## **3. RECENT ACTIVITIES**

### **3.1 Asia CryoNet Meeting**

GCW held its First Asia CryoNet meeting in Beijing, China, 2-5 December 2013, hosted by the China Meteorological Administration (CMA). CryoNet is the surface-based network of WMO's Global Cryosphere Watch (GCW) initiative. The focus of this meeting was snow and ice measurements in the "Third Pole" (Himalaya) region. Participants were from China, Pakistan, India, Japan, Russia, Kyrgyzstan, Kazakhstan, Tajikistan, Uzbekistan, USA, Canada, Austria, Italy, and Switzerland. The U.S. Department of State (through WMO) and CMA provided funding for the meeting.

### **3.2 CryoNet Team Meeting**

GCW held a "CryoNet" Team meeting in Reykjavik, Iceland, 20-22 January 2013. The meeting was hosted by the Icelandic Met Office. Participants were from Iceland, Finland, Norway, Denmark, France, Austria, the Netherlands, U.S., Canada, Japan, China, and Australia. CryoNet can only be successful in close collaboration with all organizations, agencies, groupings and entities active in the cryospheric monitoring. It strongly relies on WMO and its experience in standardization of practices, but partnership is critical.

### **3.3 EC-PORS Fifth Session**

The Fifth Session of the Executive Council Panel of Experts on Polar Observations, Research, and Services (EC-PORS) was hosted by Victoria University of Wellington (VUW) and the New Zealand MetService in Wellington, New Zealand, 25-28 February 2014, with support from the National Institute of Water and Atmospheric Research (NIWA), the Antarctic Research Centre (ARC) and the Ministry of Business Innovation and Employment (MBIE).

The Panel approved the process for the establishment of CryoNet, including its initial sites and criteria for inclusion of the candidate sites into CryoNet.

### **3.4 Forthcoming meetings**

#### *Joint CryoNet and Portal Teams meeting*

A Joint CryoNet and Portal Teams meeting is being planned for June 2014 in Davos, Switzerland. The emphasis for this meeting is to have the CryoNet questionnaire available via the portal/website of GCW and to address several aspects of data management. A case study of one CryoNet station (or a few stations) will be performed during the meeting. This requires both the CryoNet and the Portal teams to work together. Compared to earlier GCW meetings, this would be a more technical meeting.

#### *South America CryoNet meeting*

GSG recognizes the necessity to organize a workshop in the South America in order to fill the gap in the CryoNet representation (spatial distribution of stations in Southern Hemisphere) and to bring together the South American community involved in CryoNet. This South America CryoNet meeting is being planned for fall 2014 in Santiago, Chile, at the Chilean Water Agency offices or at the Met office involving regional operational and research organizations, institutes and agencies.

## APPENDIX A

### TERMS OF REFERENCE OF THE GCW CRYONET TEAM

(Draft Approved by the GCW Steering Group, First session  
Reykjavik, Iceland, 20-22 January 2014)

Under the general guidance of the GCW Steering Group (GSG), the *CryoNet Team* will be responsible for the establishment and subsequent operations of the core surface-based observational network called CryoNet. Especially, it will:

- 1) Develop practices for CryoNet design and evolution;
- 2) Identify, in coordination with the GCW focal points of WMO Members and those of partners, suitable observing sites for CryoNet surface-based observational network;
- 3) Submit the initial list of stations of CryoNet for consideration by GCW Steering Group (GSG) and EC-PORS;
- 4) Regularly review and update the list of CryoNet stations;
- 5) Review available observing practices currently used in cryospheric measurement;
- 6) Propose and/or develop best practices for CryoNet stations for consideration by GSG and EC-PORS;
- 7) Develop relevant CryoNet sections to be included in the WMO Technical Regulations and in the WIGOS Manual;
- 8) Develop data policy and identify data management practices, including archiving, data sharing and data exchange and interoperability arrangements, for consideration by GSG and EC-PORS;
- 9) Liaise with managers of CryoNet stations on aspects related to the CryoNet work programme at their stations;
- 10) Organize implementation and training workshops to supervise the development of CryoNet;
- 11) Report annually to GSG, including recommendations for CryoNet operation and development;
- 12) Provide annual reports to all stakeholders, as appropriate through GCW website and/or Newsletter.

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## **APPENDIX B**

### **SITE REQUIREMENTS FOR INCLUSION IN CRYONET**

1. The site location is chosen such that, for the variables measured, it is spatially/temporally representative for measuring one or several components of the cryosphere.
  2. User needs have been considered in the observation design process.
  3. CryoNet sites have to be active and perform sustained observations according to CryoNet agreed practices.
  4. Technical personnel are trained in the operation and maintenance of the equipment.
  5. For all CryoNet sites, there is an intent by the responsible agencies to sustain long-term observations of at least one of the CryoNet variables. Reference sites have a continuous record of at least 10 years of cryospheric observations (using CryoNet agreed practices). Integrated sites measure at least three components of the cryosphere as well as their interactions with other Earth spheres.
  6. The relevant CryoNet observations are of documented quality. The measurements are made and quality controlled according to CryoNet agreed practices.
  7. Associated standard meteorological in situ observations, when necessary for the accurate determination and interpretation of the GCW variables, are made with documented quality.
  8. A station logbook for observations and activities that may affect observations is maintained and used in the data validation process.
  9. The data and metadata including changes in instrumentation, traceability and observation procedures are submitted in a timely manner to a data centre that is interoperable with the GCW portal.
  10. The station characteristics and observational programme information are kept up-to-date in the GCW station information database. Station metadata are also provided to the WMO Operational Information Resource (WIR) and maintained regularly.
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**APPENDIX C****INITIAL CRYONET SITES**

ID	Station	Elevation (m)	Country	Region	Type
1	<a href="#">Sodankylä</a>	180	Finland	Europe	Integrated
2	<a href="#">Zackenberg</a>	0-1500	Greenland/Denmark	Europe	Integrated
3	<a href="#">Sonnblick</a>	3105	Austria	Europe	Integrated
4	<a href="#">Weissfluhjoch/Davos</a>	2540	Switzerland	Europe	Integrated
5	<a href="#">SIGMA-A</a>	1490	Greenland/Denmark	Europe	Baseline
6	<a href="#">PROMICE (20+ stations across Greenland)</a>	270-1850	Greenland/Denmark	Europe	Baseline
7	<a href="#">Eureka</a>	610	Canada	North America	Reference
8	<a href="#">Barrow</a>	11	USA	North America	Reference
9	<a href="#">Tiksi</a>	n/a	Russian Federation	Asia	Integrated
10	<a href="#">Cape Baranova</a>	30	Russian Federation	Asia	Baseline
11	<a href="#">Tianshan</a>	2130	China	Asia	Integrated
12	<a href="#">Mt. Everest</a>	5210	China	Asia	Baseline
13	<a href="#">Yakutsk</a>	220	Russian Federation	Asia	Integrated
14	<a href="#">Dome C</a>	3222	n/a	Antarctica	Reference

## APPENDIX D

## GCW CRYONET TEAM WORK PLAN

N°	Task	Deliverable / Activity	Due	Responsible	Status	Comment
1	Primer to CryoNet	Technical report	April 2014	W. Schöner, C. Genthon, V. Smolyanitsky	Draft version	
2	Text for WIGOS section for WMO TR 49	Document	May 2014	W. Schöner, J. Key, B. Goodison		
3	Chapter 6 for WIGOS Manual	Document	May 2014	W. Schöner, J. Key, B. Goodison		
4	Minimum requirements for site inclusion in CryoNet	Document	Feb. 2014	W. Schöner	Draft version	
5	Site questionnaire (metadata information)	Document	Feb. 2014	J. Key, S. Starkweather	Draft version	In scoop with Portal Team
6	TOR for CryoNet	Document	Jan. 2014	B. Goodison	Done	
7	List of CryoNet candidate sites (including metadata)	Document	Jan. 2014	J. Key		
8	List of initial CryoNet sites	Document	Jan. 2014	J. Key		
9	Draft CryoNet Data Policies	Document	Feb. 2014	W. Schöner, T. Johannesson, T. Thorsteinsson		
10	South America CryoNet Meeting	Workshop	Oct. 2014	G. Casassa		Resources required
11	Design Principles of CryoNet	Document	May 2014	M. Citterio, V. Smolyanitsky, T. Ohata		
12	CryoNet Portal Team Meeting (including data management)	Meeting	June 2014	J. Key, C. Fierz		Resources required
13	Review of Best Practices	Document	2015	C. Fierz, M. Citterio, B. Goodison		