

**WORLD METEOROLOGICAL ORGANIZATION  
GLOBAL CRYOSPHERE WATCH**

REPORT No. 7  
2015

**Final Report of the Joint Second CryoNet and  
First Portal Teams Meeting**

Davos, Switzerland, 11 – 13 JUNE 2014



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## **1. ORGANIZATION OF THE MEETING**

The joint Second CryoNet Team and the First Portal Team meeting was held at the WSL Institute for Snow and Avalanche Research SLF in Davos, Switzerland. The meeting was organized by the CryoNet and Portal Teams of the Global Cryosphere Watch (GCW) respectively led by W. Schoener and Ø. Godøy.

On behalf of the Institute for Snow and Avalanche Research, C. Fierz welcomed participants and recalled that this meeting was organized to have the CryoNet questionnaire available via the portal/website of GCW and to address several aspects of data management. Case studies of few CryoNet stations will be performed during the meeting which involve that both the CryoNet and the Portal teams work together. He mentioned that compared to earlier GCW meetings, this should be more technical meeting. Furthermore, he provided the required logistic details during the period of the workshop and outlined working arrangements.

Dr W. Zhang, Director of the Observing and Information Systems Department of the World Meteorological Organization (WMO) welcomed participants. He mentioned that next week WMO will have its Sixty-sixth Executive Council session (EC-66) approximately one year before the WMO Seventeenth Congress. He underlined the critical importance of resolutions related to GCW and WIGOS for Congress. He further acknowledged the significant progress made in the recent development of the core GCW observing network and wished for a productive meeting on CryoNet and Portal issues.

Participants briefly introduced themselves and identified their interests and background relevant to the themes of the session. The final list of participants is attached as ANNEX 1.

Due to problem in transportation connexions the agenda was slightly changed to face delays of some participants. The meeting started with the session 4. The final programme is attached as ANNEX 2.

## **2. CRYONET AND PORTAL: BACKGROUND STATUS**

### **2.1 CryoNet and Portal: Background Status**

2.1.1 W. Schöner provided a report on the more recent activities related to CryoNet (e.g. meetings and workshop, site questionnaire, cryosphere stations inventory). He also introduced a number of activities relevant to CryoNet where engagement is needed, such as COST Action "Snow", EU funded Interact 2 and IAEA project for Polar Regions. It was suggested that WMO should participate to the COST Snow Action as well as WD 2 "Instrument and methods evaluation".

2.1.2 Despite his recent nomination as Professor at the University of Innsbruck, W. Schöner will continue to provide support to GCW and insure that the MetService of Austria will still be strongly involved.

### **2.2 Website and Portal, Status and development**

2.2.1 J. Key reported on the status of the GCW website which is the editorial interface and the primary entry point to GCW that provides information on GCW activities to the community. He introduced some new functionality added to the website (e.g. new web-based questionnaire and log in system for site operators, review of updated info and products).

2.2.2 The question on how to engage people to contribute to the GCW website (news, community announcements) was raised.

2.2.3 Ø. Godøy briefly outlined the purpose of the GCW Portal. As GCW is a WMO activity, the

GCW data catalogue is linked to the WMO Information System (WIS). The data centres contributing data to the GCW data catalogue are, however, not necessarily linked to WIS. Thus, a major effort of the GCW catalogue is to act as a broker between the operational community represented by WMO and the scientific community represented by independent data centres and related data centres, e.g. to ICSU World Data System.

2.2.4 Currently metadata describing datasets are harvested on a weekly basis from several data centres (i.e. NSIDC, BAS, NPI, METNO and CryoClim). Development in order to establish regular harvesting of metadata is on-going with the other data centres. Metadata are generally harvested using OAI-PMH. In some cases other protocols are used and most of the metadata received are formatted as GCMD DIF, while ISO19115 and FGDC are also used by some providers. The metadata received are translated into the WMO ISO19115 representation, but no linkage to WIS has been established yet pending development of proper validation mechanisms for the metadata received. Following the GSG meeting in Iceland, a preliminary monitoring system for the number of datasets served has been implemented. Harvesting is still only semi-automatic in order to better understand the nature of the metadata streams utilized (See Document 2.1.2).

2.2.5 The meeting underlined some critical point in the development of the GCW Portal. The most urgent point is to nominate membership for the Portal and Website team. A student should be hired to summarize important publications that might be of interest for the community and to update the website.

2.2.6 The attendees stressed the fact that for credibility reasons the website must be kept up to date, as it is the community's window into GCW. Other elements could represent important information to be added in the website, such as documentation on the Baltic sea ice extent. The GCW Implementation Plan (IP) should also be more visible in the website.

2.2.7 The data portal or data catalogue interface is available at <http://gcw.met.no/>

### **3. CRYONET ISSUES**

#### **3.1 Design Principles of CryoNet**

3.1.1 M. Citterio developed ideas on how CryoNet should be designed based on IPET-OSDE designed principles. He stressed the fact that observing networks should be designed to meet the requirements of multiple application areas within WMO and WMO co-sponsored programmes. In fact, CryoNet data are relevant to research, education and applications in the fields of glaciology, climatology, oceanography, weather forecasting, and climate change adaptation and mitigation. He recalled that one of the fundamental aspects of an observing network is to make observational data available to other WMO Members, at space-time resolutions and with a timeliness to meet the needs of regional and global applications. Another essential point is that observing networks should be designed to address stated user requirements. Furthermore, the design of new observing networks and changes to existing networks should ensure adequate consistency, quality and continuity of observations across the transition from the old system to the new.

3.1.2 It was noted that the main users of GCW should be identified in order to develop the Design principles of CryoNet and that a GCW reference person for requirements issues should be appointed. It was mentioned that the lead of the Requirement and Capabilities team could be the contact.

3.1.3 It was recognized that Google Drive would be the best platform to iteratively and simultaneously comment the design principles of CryoNet. It is intended that this document will be submitted to CBS in December for consideration.

3.1.4 An updated version of the document will circulate in the coming weeks (V. Smolyanitsky already provided some comments). Data sharing policies also need to be clearly defined and

written. Thorsten Thorstenson was asked in Reykjavik to provide a document on data policy. A reminder should be sent to him.

### **3.2 Finalizing the CryoNet questionnaire**

3.2.1 J. Key presented the updated version of the online CryoNet Site Questionnaire which is a system for providing detailed information on potential GCW surface network sites and for updating information on current sites. The questionnaire typically constitutes material in preparation for a CryoNet workshop and could eventually serve as an application for a site to be part of the GCW network.

3.2.2 During an in-session demonstration, the meeting was informed on the most recent changes/updates of the site questionnaire. General discussions led to a refinement of the design of the questionnaire and to more detailed questions and possibilities for a site manager to provide information about the measurements that are performed in their respective stations/platform/sites. CryoNet guidelines should, in this regard, be defined before asking site managers to apply.

3.2.3 Going through cryospheric components (e.g. glaciers, sea ice, snow) it was reminded that a permafrost expert was still missing in GCW membership.

### **3.3 Primer to CryoNet (approval of the technical report)**

3.3.1 Mainly due to workload and nomination of Wolfgang Schöner as professor at the University of Innsbruck, no significant editing or improvement has been made to the CryoNet Primer since the last meeting in Reykjavik. The document should circulate between people designated in Reykjavik (namely W. Schöner, C. Genthon and V. Smolyanitsky).

### **3.4 GCW section in the WIGOS Regulatory Material**

3.4.1 The meeting reviewed the WIGOS Regulatory Material Volume 1 -Part 1 version 04 and adjusted of several sentences. C.Fierz and W. Schöner proposed to adjust section on permafrost and CryoNet respectively. M. Ondras will later on adjust some other sentences and make the document circulated. It was also stipulated that stations/sites should be registered in both OSCAR and CryoNet.

3.4.2 The meeting agreed on the updated text of both Manual on WIGOS and Technical Regulations, Volume I.

## **4. PORTAL AND WEBSITE ISSUES**

### **4.1 Data management (nature of data and metadata), including Snow Watch Data Inventory**

4.1.1 The meeting noted the information provided on data management and discussed about the main challenges, which are mainly related to cultures and semantics. As indicated in this document "WMO has a culture for sharing data but the scientific community has not had this to the same extent, although a cultural shift is emerging, strongly encouraged by many funding agencies".

4.1.2 The meeting noted the importance of giving credit to the data provider and clearly citing publications/articles to encourage the scientific community to contribute. As citations relate to the next funding possibilities it is crucial to properly address this issue. This would allow GCW to be seen as a trustable mechanism. As an example, C. Fierz referred to a misunderstanding between GTN-P and other communities. He suggested using DOI.

4.1.3 It further expressed the need to set up a group on metadata for forthcoming task team meetings in order to address issues related inter alia to semantics and controlled vocabularies. It recalled that GCW should follow ISO standards notably the ISO 19115 which is an emerging

standard to follow. GCW needs to be stamped ISO. GAW's data management could be taken as an example.

4.1.4 It is also essential to avoid duplication of work (e.g. duplication of metadata in WIS discovery and WIGOS metadata). In this aspect, the meeting noted that Portal team members should participate to WIGOS Metadata meetings. It designated Ø. Godøy as the GCW contact with WIGOS Metadata team seconded by M. Citterio.

4.1.5 Attendees mentioned that it would have been interesting to invite Steve Foreman to participate in this meeting and suggested to invite him next time.

4.1.6 The meeting suggested to have a WMO representative to attend the geoscientific meeting in India (October 2014).

**Action 4.1.2:** Add citation information to metadata – It is already done in WIS discovery metadata under UML classes (CI).

**Action 4.1 4:** Invite GCW to metadata meetings – ICG WIGOS TT on Metadata – invite Ø. Godøy (assisted by M. Citterio).

**Action 4.1.6:** Scientific Data Conference Nov. 2014 – There is a need for WMO to participate.

## 4.2 Metadata for discovery and use

4.2.1 A document prepared for this workshop by Steve Forman provided information on metadata, interoperability and potential requirements for data exchange related to the Interoperability with the WMO Information System (WIS) (See Document 4.1.2).

4.2.2 The meeting discussions followed the content of this document with special emphases on the WIS Discovery Metadata which are detailed in Manual on WIS and on the WIGOS metadata detailed in the WIGOS Manual. The attendees noted that this metadata issue directly relates to controlled vocabulary and standards for data which should be the first thing to be defined for data exchange within CryoNet. A solution to tackle this problem could be to put terminology in the WIGOS Regulatory Material. Works done between the Snow Watch Group and ECMWF to define format exchange of snow data was given as an example.

4.2.3 It was recalled that if data are going to be provided through the GCW Portal, this has to be negotiated with data providers beforehand. In fact, the GCW Portal already provides some links to data owners. However, for a cost effective issue it would be important that data are still harvested by data providers. This is also a political issue.

4.2.4 The meeting further agreed to explore whether it would be appropriate to seek designation of the GCW Portal as a Data Collection or Production Centre (DCPC) for non-critical data. This would imply to follow procedure defined by the Commission on Basic Systems (CBS) which eventually could allow GCW to officially share data. Who is going to hold data for CryoNet remains an open question.

## 4.3 Identification of technology gaps (e.g. in metadata vocabularies)

4.3.1 Ø. Godøy introduced the topic on the identification of technology gaps and led the discussion. Through his presentation he showed that one of the main challenges faced by GCW in term of data exchange relates to translation of metadata and controlled vocabularies. In fact, much of the relevant data for GCW is generated and managed by scientists, institutions and data centers external to WMO and using different vocabularies. However, GCW data management must be compliant with WIS and WMO controlled vocabularies. This implies, inter alia, that machine readable implementations have to be developed in order to automatically and efficiently translate metadata and vocabularies (See Document 4.1.3).

4.3.2 From a scientific point of view an important aspect to consider when data translation is processed is the degree of acceptable loss of information since data translation always implies such a loss. Units of measured data are also important to consider (different systems from different countries). Furthermore, it was reminded that glossary should not be only a technical source of vocabulary but it should sound for scientists as well because it is the entrance for research. The Metadata and Terminology Group under the GCW Portal and Website team is in charge to manage these issues.

4.3.3 Several questions arose from the attendees but require further discussion (e.g. what must GCW do and what is done in other frameworks whether WMO or scientific? How do GCW activities relate to WMO activities in this field? How do GCW activities benefit from scientific efforts? Should scientific terminology and discovery metadata be translated in all UN languages?).

4.3.4 H. Yabuki demonstrated the DIAS (Data Integration and Analytical System) Interoperability Portal developed by the University of Tokyo and the Spatial Information Science Research Center. This web-based platform provides data/metadata search, technical term search and visualization of relations among dataset to very large-scale and various earth observation data registered in DIAS core system. The DIAS Interoperability Portal is available here: <http://dias.csis.u-tokyo.ac.jp/op/en/#2010-02-01>.

**Action 4.3.1:** Inform Ø. Godøy who can help him to establish controlled vocabularies.

#### 4.4 Definition of what constitutes a dataset and required granularity

4.4.1 Ø. Godøy briefly recalled that there is no strict definition of what constitutes a dataset since it mainly depends on the community and/or the data. This represents a challenge when sharing data external to the core community producing the data and choices directly affect the ability of non-familiar users to find and utilise the data. Consequently, the CryoNet perspectives on both the definition of datasets and on required metadata granularity represent the issues that require attention.

4.4.2 The meeting recognized the need to set up a group or at least a person to review the WMO MeteorTerm database in order to define missing input related to GCW (cryosphere) and to integrate terminology from other glossaries. Working together with the WIGOS team on metadata should ensure that the OSCAR database is also considered.

4.4.3 Question arose by S. Foreman are not answered yet but will be addressed by CryoNet team (e.g. what kind of data should be included?).

#### 4.5 Interfaces (protocols, formats, data models) to data both in a real time and archive perspective

4.5.1 Ø. Godøy recalled the purposes of protocols, formats and data models insuring interoperability with GCW Portal. Protocols and formats must provide access to relevant information and support timeliness and integrity of information. He provided the audience with a review of protocols used for both metadata and data. In case of metadata, protocols for the interoperability with the GCW Portal are OAI-PMH, OGC CSW, ISO23950/Z39.50, HTTP (FTP), SMTP. For data, protocols are of two types (i) Archive (HTTP (/FTP), OpENDAP, OGC WCS/WFS) and (ii) Real time (WMO GTS, HTTP(/FTP)). Formats for metadata are ISO19115 (WMO profile, other profiles), GCMD DIF, FGDC and other formats. For data, formats are the WMO BUFR, GRIB, NetCDF/CF, ESRI Shape, other (XML, HDF, ASCII). It was noted that NetCDF/CF is preferred as it also allows integrating different sets of data and because it is a format scientifically driven.

4.5.2 In a first step, metadata could be uploaded in FTP server until a clear protocol to ingest them into GCW Portal is defined. Metadata could also be sent alternatively in spreadsheet format and eventually converted to XML. In that case, a spreadsheet template would significantly help for



translation and ingestion. It was reminded that metadata should directly link to data and that data should be made freely available online.

4.5.3 The meeting recognized that one protocol for CryoNet candidate stations should be recommended but also admitted that “keeping the door open” for other protocols is necessary in order to remain flexible. Self-describing formats like netCDF/CF are encouraged but in this case pros and cons should be well explained.

4.5.4 The meeting agreed that a question related to protocols and formats should be implemented into the CryoNet questionnaire and then, based on the analysis of questionnaire responses, the best format and protocol will be defined to fit the GCW community.

**Action 4.5.3:** Inform every data provider that they should implement one of the agreed protocols for the metadata interoperability with the GCW Portal, such as: OAI-PMH, OGC CSW, ISO23950/Z39.50, HTTP (FTP), SMTP.

**Action 4.5.4:** Add into the CryoNet Site Questionnaire, questions on data and metadata formats and interfaces and then decide what should be the preferred formats.

#### 4.6 Procedures for approval of datasets

4.6.1 Ø. Godøy raised some critical questions related to a required procedure for approval of datasets submitted from providers; i.e. how do GCW move forward on the procedures for approving datasets? What is the preferred manner of tagging datasets as “GCW approved”? Does this imply accepting some data policy? Is there a GCW “license” for data? Could Polar Information Commons serve as a demonstrator?

4.6.2 The meeting recognized that policy and a detailed submission process should be defined before providers start to send their data and that a template would definitely facilitate the submission as stipulated earlier for protocols and formats. Furthermore, it was decided to set up a group to develop criteria for endorsement (with potentially different levels of approval) and designated J. Key as leader.

4.6.3 Attendees noted that prior approval of dataset some assessment of data maturity should be considered as well as an estimation of data lost during a translation process before the Portal is operational. It was recalled that all processes should be clearly defined in a so called “Product manual” which should describe the candidate's project and the dataset (documentation of data, templates, approval processing etc.). Furthermore, it was recalled that if dataset is approved by GCW it implicitly implies that provider accept or comply with GCW data policy.

4.6.4 Representing the International Association of Cryospheric Sciences (IACS), C. Fierz volunteered to contribute to this task with the aim to bring a scientific point of view. He also proposed to develop a template for documentation on data.

4.6.5 The meeting recalled that partner relationships should be taken into account when approving dataset. In that regard, it was mentioned that terms are important and should be chosen adequately (approve, endorse, certificate...).

**Action 4.6.5:** Some data and products should be endorsed by GCW, therefore, criteria should be established to define “GCW endorsed data” – J. Key and Ø. Godøy will lead this effort.

#### 4.7 Interoperability with WMO Information System (WIS) and also within the community

4.7.1 The meeting noted that the GCW Portal could use the WIS Discovery Metadata catalogue to provide users with access to additional information relevant to the cryosphere but that is not held on the GCW Portal itself. It further noted that, depending on the technology that is implemented in the portal, it is potentially possible for users to request data through the portal from direct links built

into the WIS Discovery Metadata records.

4.7.2 The meeting noted that interoperability between several data catalogues (e.g. RU-AARI, IPA-/GTN-P) is still in a developing phase where most of them are only a technological issue.

#### **4.8 Potential requirements to exchange information using GTS**

4.8.1 The meeting decided to identify if any information available through the portal needs to be widely distributed in a timely manner. It asked Ø. Godøy to investigate whether such a need exists and to liaise with the WIS team in the secretariat (wis-help@wmo.int).

**Action 4.8.1:** CryoNet Team should assess what kind of data should be exchanged in real-time, time critical data.

#### **4.9 Advertise website and portal**

4.9.1 J. Key provided a brief summary on the status of the GCW information website. He mentioned that both the GCW website and the GCW Data Portal are currently available to the public. The most significant near-future addition to the GCW website will be the CryoNet site Questionnaire (web-based application).

4.9.2 J. Key reminded the participants that neither the website nor the portal have been advertised/publicized much beyond the groups involved in GCW or the WMO Executive Council expert panel on Polar Observations, Research, and Service (EC-PORS).

4.9.3 The meeting noted that the next WMO Congress (Cg-17) in May 2015 would provide the best opportunity to advertise the GCW website and Portal and more generally the GCW initiative in its whole. Attendees discussed the possibility to create a side event with this purpose. A dedicated programme would have to be drafted.

**Action 4.9.3:** GCW Portal should become operational soonest possible to make GCW visible. Ø. Godøy will prepare a road map.

## **5. QUESTIONNAIRE IMPLEMENTATION**

### **5.1 CryoNet questionnaire availability via the GCW portal/website**

5.1.1 J. Key outlined the objectives of the site questionnaire. This questionnaire is developed to provide detailed information on a given CryoNet surface station. It will include site "metadata" such as the length of record, points of contact, and operating environment, as well as detailed information on the types of measurement made at the site. Furthermore, the questionnaire serves as an application to become part of CryoNet. Station representatives will complete the questionnaire online. The information from the questionnaire is stored in a database that will be used to automatically generate a web page for the site, accessed from the main CryoNet stations page.

5.1.2 The meeting decided to submit a draft questionnaire to several identified experts (e.g. on glaciers, on permafrost) for comments. C. Fierz, M. Citterio and J. Key will contribute to this task. Eventually, J. Key will update the questionnaire.

5.1.3 The CryoNet Questionnaire is available online.

### **5.2 Implementation and testing of the questionnaire (test of one CryoNet station or a few stations)**

5.2.1 The meeting reviewed all parameters implemented in the questionnaire and made

adjustments as necessary. This finalization of the questionnaire was made during the session through an example of a station managed by the Institut für Schnee- und Lawinenforschung (WSL) in Davos.

## **6. FUTURE MEETINGS**

### **6.1 GCW CryoNet South America Workshop**

6.1.1 The meeting defined the main purposes of the GCW CryoNet South America workshop which will help to identify stations in South America that could be included in the CryoNet network, discuss practices that should be applied and foster the development of cryospheric activities in the region. This workshop will also be a forum for communities to talk together. It is going to be a 3-days meeting including a fieldwork at a nearby weather station or glacier.

6.1.2 It was decided to invite representative people who work on cryospheric topics from South America but also from other countries in a view to link with other regions and institutions (e.g. Third Pole, Africa, UNESCO). GCW focal points (but without funding) and Permanent Representatives should be invited or at least informed. This workshop would also be an opportunity to engage new GCW partners.

6.1.3 As several participants speak Spanish, the meeting studied the possibility to find an interpreter for direct Spanish-English translation.

### **6.2 Next GCW Portal team meeting and CryoNet Asia workshop**

6.2.1 Dates and venue for the next GCW Portal Team meeting will be decided later.

6.2.2 The Second CryoNet Asia workshop initially planned in Tajikistan is postponed to 2015. Miroslav Ondras will contact Tajikistan to inform them.

## **7. ALL OTHER BUSINESS**

7.1.1 The meeting reaffirmed the need to take the opportunity to promote the GCW initiative (e.g. Opening side event for GCW Portal and Website, provide hand-outs, posters and flyers) at the next WMO Congress (Cg-17). The sort of CryoNet activities and the manner to promote them remain to be defined (e.g. poster, information brochure on GCW, communication with equipment vendors, and forum with industry).

7.1.2 The questionnaire should be included in the final report of the meeting. If the questionnaire is web-based then a link should be provided.

<http://globalcryospherewatch.org/cryonet/questionnaire/>

7.1.3 The meeting recognized the need to activate and populate the Outreach team.

## **8. WRAP-UP AND CLOSURE OF THE MEETING**

8.1.1 C. Fierz thanked all participants for contributing, and the Secretariat for assisting in the preparation of the meeting. The meeting closed at 12:30 on June 13 with all attendees expressing their deep appreciation to our hosts for outstanding arrangements.

# ANNEX

## Annex 2 MEETING AGENDA

### **1. Organization of the meeting**

- 1.1 Welcome
- 1.2 Introductions of Participants
- 1.3 Adoption of the Agenda
- 1.4 Working arrangements

### **2. CryoNet and Portal: Background and Status**

- 2.1 CryoNet, Status and Recent Activities
- 2.2 Website and Portal, Status and development

### **3. CryoNet issues**

- 3.1 Design Principles of CryoNet
- 3.2 Finalizing the CryoNet questionnaire
- 3.3 Primer to CryoNet (approval of the technical report)

### **3. CryoNet issues (Cont'd)**

- 3.4 GCW section in the WIGOS Regulatory Material

### **4. Portal issues**

- 4.1 Data management (nature of data and metadata), including Snow Watch Data Inventory
- 4.2 Metadata for discovery and use
- 4.3 Identification of technology gaps (e.g. in metadata vocabularies)

### **4. Portal issues (Cont'd)**

- 4.4 Definition of what constitutes a dataset and required granularity
- 4.5 Interfaces (protocols, formats, data models) to data both in a real time and archive perspective
- 4.6 Procedures for approval of datasets

### **4. Portal issues (Cont'd)**

- 4.7 Interoperability with WMO Information System (WIS) and also within the community
- 4.8 Potential requirements to exchange information using GTS
- 4.9 Advertise website and portal

### **5. Questionnaire implementation**

- 5.1 CryoNet questionnaire availability via the GCW portal/website
- 5.2 Implementation and testing of the questionnaire (test of one CryoNet station or a few stations)

### **6. Future meetings**

- 6.1 GCW CryoNet South-America meeting
- 6.2 Next GCW Portal team meeting

### **Wrap-Up and Closure of meeting**

## Annex 1

## LIST OF PARTICIPANTS

GCW Joint 2<sup>nd</sup> CryoNet & 1<sup>st</sup> Portal Teams meeting, Davos, Switzerland  
11-13 June 2014

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## Annex 3

### **ACTION SHEET**

**Action 4.1.2:** Add citation information to metadata – It is already done in WIS discovery metadata under UML classes (CI).

**Action 4.1 4:** Invite GCW to metadata meetings – ICG WIGOS TT on Metadata – invite Øystein Godøy (assisted by Michele Citterio).

**Action 4.1.6:** Scientific Data Conference Nov. 2014 – There is a need for WMO to participate.

**Action 4.3.1:** Inform Øystein Godøy who can help him to establish controlled vocabularies.

**Action 4.5.3:** Inform every data provider that they should implement one of the agreed protocols for the metadata interoperability with the GCW Portal, such as: OAI-PMH, OGC CSW, ISO23950/Z39.50, HTTP (FTP), SMTP.

**Action 4.5.4:** Add into the CryoNet Site Questionnaire, questions on data and metadata formats and interfaces and then decide what should be the preferred formats.

**Action 4.6.5:** Some data and products should be endorsed by GCW, therefore, criteria should be established to define “GCW endorsed data” – Jeff Key and Øystein Godøy will lead this effort.

**Action 4.8.1:** CryoNet Team should assess what kind of data should be exchanged in real-time, time critical data.

**Action 4.9.3:** GCW Portal should become operational soonest possible to make GCW visible. Øystein Godøy will prepare a road map.