



Global Cryosphere Watch

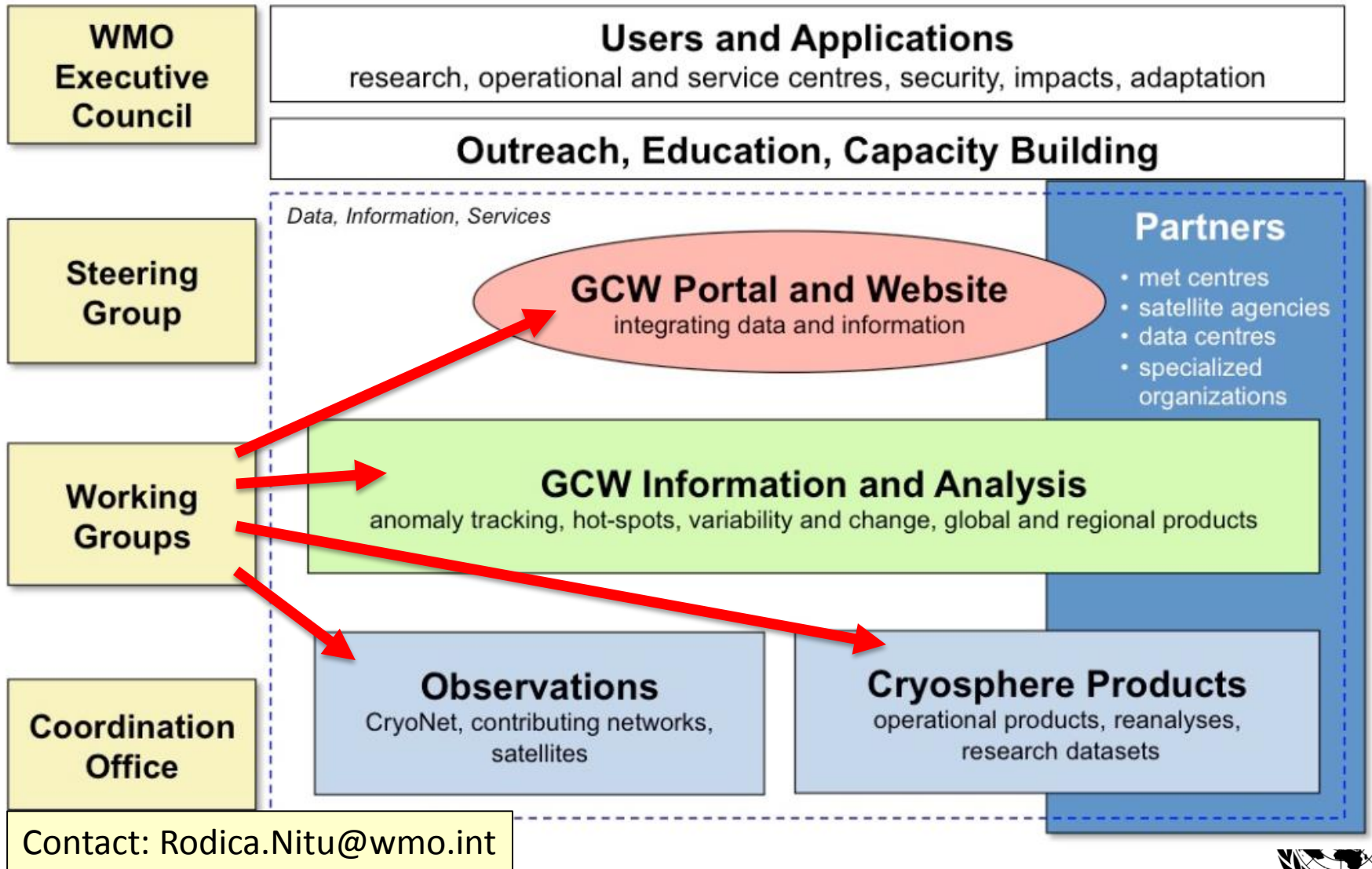
Potential linkages to COST Harmosnow



Wolfgang Schöner on behalf of the GCW team

University of Graz, Department of Geography and Regional Research,
Graz, Austria







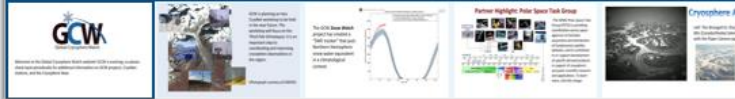
globalcryospherewatch.org

Highlights



Welcome to the Global Cryosphere Watch website! GCW is evolving, so please check back periodically for additional information on GCW projects, CryoNet stations, and the *Cryosphere Now*.

GCW website is now live!



Cryosphere in the News

Study finds earlier peak for Spain's glaciers
Mon, 26 Au
phys.org

Earlier peak for Spain's glaciers
Mon, 26 Au
feeds.sciencedaily.com

Frontal ablation and temporal variations in surface velocity of Livingston Island ice cap, Antarctica
2013-08-26
the-cryosphere-discuss.net

A statistical approach to refining snow water equivalent climatologies in Alpine terrain
2013-08-26
the-cryosphere-discuss.net

Dot Earth Blog: From the Fire Hose: Obama's Bus Stop in Gas Country, Al Gore's 'Category 6,' an Unplugging Climate Blogger
Fri, 23 Au

[More Cryosphere in the News »](#)

The Cryosphere Now

Sea and Freshwater Ice

Snow and Solid Precip

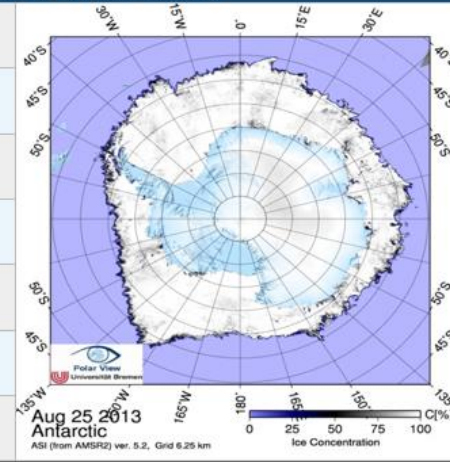
Glaciers & Ice Caps

Ice Sheets

Permafrost

Atmosphere

Satellite Products



GCW News and Highlights

Barry Goodison awarded the 2012 Patterson Distinguished Service Medal

WGMS Summer School on Mass Balance Measurements and Analysis 2013, 2-7 September

Third Meeting of the WMO Polar Space Task Group, 22-23 May 2013, Paris, France

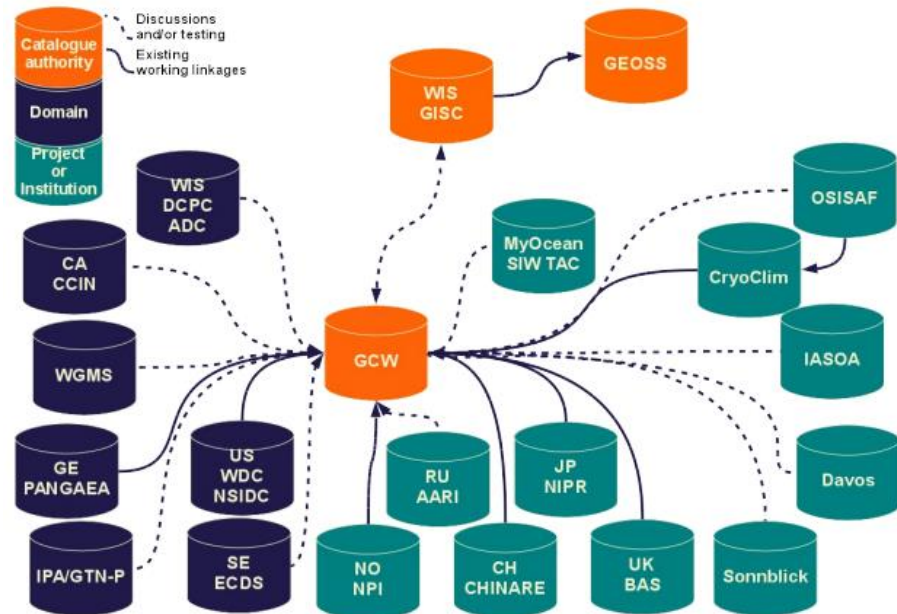
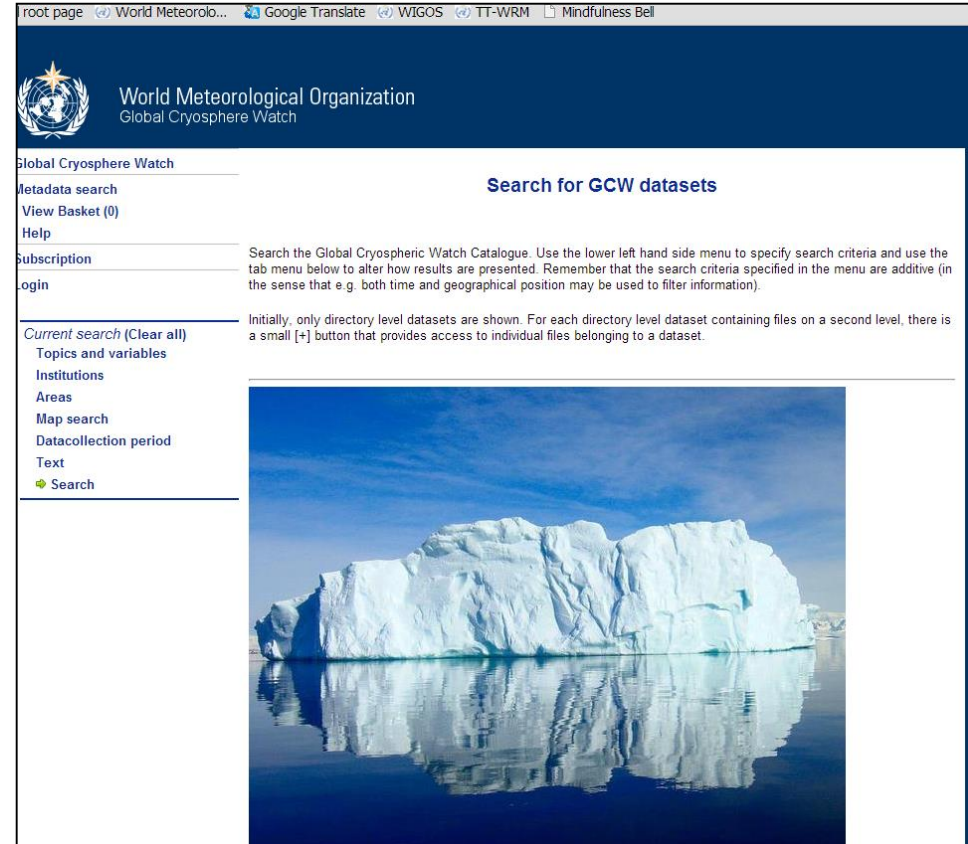
The new SWE Tracker is showing anomalously high snowfall in the Northern Hemisphere this winter!

Fourth Meeting of the WMO Panel on Polar Observations, Research, and Services, 13-15 March 2013, Lanzhou, China

The GCW Implementation Plan is now

[GCW News](#) | [Meetings](#) | [Calendar](#) »

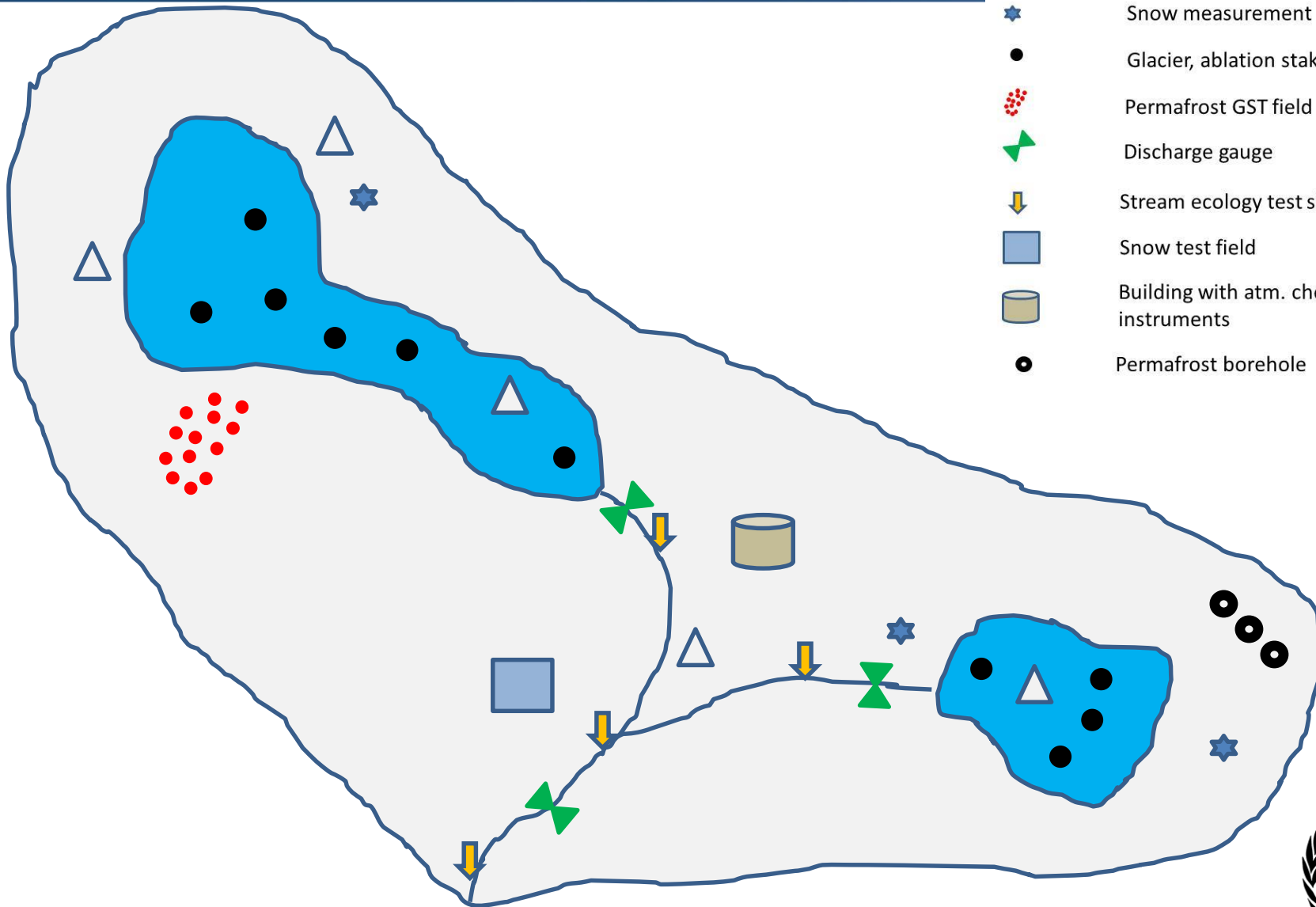


The screenshot shows the search interface for GCW datasets on the World Meteorological Organization website. The page includes a navigation menu with options like "Metadata search", "View Basket (0)", "Help", "Subscription", and "login". The main heading is "Search for GCW datasets". Below this, there is a search box and a "Search" button. A sidebar on the left lists search filters: "Current search (Clear all)", "Topics and variables", "Institutions", "Areas", "Map search", "Datacollection period", and "Text". A large image of an iceberg is displayed on the right side of the page.

Cryospheric surface observations have complex structure

- Glacier
- River
- AWS
- Snow measurement
- Glacier, ablation stake auto./man.
- Permafrost GST field
- Discharge gauge
- Stream ecology test site
- Snow test field
- Building with atm. chemistry instruments
- Permafrost borehole



CryoNet STATIONS

- measures at least one variable of a cryosphere component (e.g. snow, permafrost, sea ice...)
 - has to fulfill CryoNet minimum requirements
 - must have ancillary meteorological measurements
- has the target of long-term operation(primary) or long-term operational commitment with 10+ years record (reference)

Potential attributes: primary, reference, cal/val, research

CryoNet SITES

- contain two or more coordinated stations (at least one is a CryoNet station) with varying capabilities that are coordinated as a local cluster
- must have a concept describing the research approach and the site management

Potential attributes: basic, integrated



CryoNet Station Requirements

The minimum requirements of CryoNet stations are:

- 1. Meeting Core CryoNet Measurement Requirements:** The station shall measure at least one of the variables of one of the cryosphere components (i.e. snow, solid precipitation, lake and river ice, sea ice, glaciers, frozen ground and permafrost). The station location is chosen such that cryospheric measurements are representative of the surrounding region, and such representativeness needs to be clearly described.
- 2. Commitment of Operational Continuity:** The station must be active. The responsible agencies are committed, to the extent reasonable, to sustaining long-term observations of at least one cryosphere component. There must be a commitment to continue measurements for a minimum of four (4) years.
- 3. Metadata Up to Date and Availability:** The station metadata, including all metadata describing the station characteristics and observational programme, are kept up-to-date and available in the GCW Portal as the interface to the WIGOS Information Resource (WIR).
- 4. Compliance with Agreed Regulatory Practice:** The station observational procedures, the instruments and method of observations, quality control practices, etc., should follow GCW endorsed regulations, manuals, guides and, to the extent possible, the recommended best practices.
- 5. Data and Ancillary Data Freely Available:** Data are made freely available, and whenever possible in near real-time. In situ ancillary meteorological observations, as required by CryoNet best practices, must also be available with documented quality.
- 6. Competency of Staff:** Personnel must be trained in the operation and maintenance of the station.

CryoNet Observational Program (for snow/solid prec) to be approved by WMO



| SNOW/SOLID PRECIPITATION | | Recommended minimum frequency of observations at CryoNet stations | | | | | | |
|---|---------------------|---|--------|-------------|---------|-------------|----------|------------|
| Variable | Timescale | | | | | | | |
| | 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) | |
| | A(IS, P) | M(P) | | M(S) | | | | |
| Snow water equivalent | A(S) | | | M(S) | | | M(G, IS) | |
| Solid precipitation (Requires <u>both</u> amount and type of precipitation to be measured) | A(S) | | | | | | | |
| Snow profiles (grain size, crystal type, hardness, liquid water content) | | | | M(S, SI) | | | M(IS) | |
| | | | | M(SI, LRI) | | | | |
| Depth of snowfall | | M(S) | | | | | | |
| Water equivalent of snowfall | | M(S) | | | | | | |
| Snow cover extent | A(SI, LRI) | | | M(SI, LRI) | | | | |
| | | | | M(SI, LRI) | | | | |
| Snow profiles | | | | M(S,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



CryoNet Observational Program (ancillary meteo observations) to be approved by WMO



| SURFACE METEOROLOGY | Mandatory/recommended minimum frequency of observations at CryoNet stations | | | | | | | |
|-------------------------------|---|-------|--------|-----------|---------|-------------|--------|------------|
| Variable | Timescale | | | | | | | |
| | 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 mandatory 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



GCW Station Application Process

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, the following item 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 sends 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. 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. 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. 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 the GSG recommends that the station not be included in the GCW surface network, feedback is provided to the applicant.
7. If the GSG recommends the station for inclusion in the network, the station is conditionally accepted and enters a one-year trial period. The station shall operate according to the Minimum Requirements, including the submission of data and metadata.
8. If the GSG recommends the station for inclusion in the network, it will be presented to EC-PHORS for approval. EC-PHORS meets every 12-15 months.
9. If EC-PHORS approves the station, the final approval is made by the WMO Executive Council (EC). EC meets annually.

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

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





Welcome to the GCW Station/Site Questionnaire

This questionnaire system is for providing detailed information on potential GCW surface network stations or sites and for updating information on current stations and sites. The questionnaire is often used in preparation for a CryoNet workshop, later serving as an application for a station to be part of the GCW network. Presentation at a workshop is recommended but not required. The questionnaire must be completed online. [A preview \(PDF\) of the questionnaire is available.](#) Before beginning the questionnaire it is recommended that you read the following:

- [The application process](#)
- [Description of station and site types](#)
- [Station and site minimum requirements](#)

Questions? [Contact the CryoNet Team.](#)


Please login:

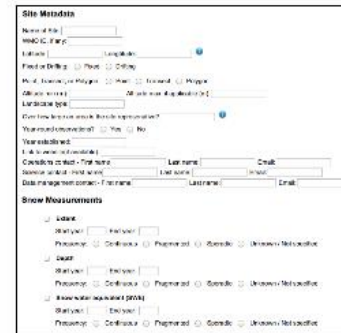
Email Address:

Password:

Login

or:

 Create a new account



The screenshot shows a form titled "Site Metadata" with various input fields and radio buttons. Fields include Name of site, WMO ID, Elevation, Longitude, and Latitude. There are also sections for "Snow Measurements" with checkboxes for "Snow" and "Snow Water Equivalent (SWE)".



Initial list of CryoNet stations and sites for pre-operation

| | Station/Site | Operating Country | Location | Type |
|----|---|-------------------|----------------|------------|
| 1 | SIGMA-A | Japan | Greenland | Basic |
| 2 | PROMICE Greenland Ice Sheet Monitoring Network | Denmark | Greenland | Basic |
| 3 | Sonnblick | Austria | Austria | Integrated |
| 4 | Qilianshan Station of Glaciology and Ecologic Environment | China | China | Basic |
| 5 | Sodankylä-Pallas | Finland | Finland | Integrated |
| 6 | Qilian | China | China | Integrated |
| 7 | Tanggula Cryosphere and Environment Observation Station | China | China | Basic |
| 8 | Eureka | Canada | Canada | Basic |
| 9 | Hofsjökull | Iceland | Iceland | Basic |
| 10 | Antisana 15 alfa | Ecuador | Ecuador | Basic |
| 11 | Zongo Glacier | France | Bolivia | Integrated |
| 12 | Morenas Coloradas Rockglacier | Argentina | Argentina | Basic |
| 13 | Quelccaya Ice Cap | USA | Peru | Basic |
| 14 | Weissfluhjoch - Davos | Switzerland | Switzerland | Integrated |
| 15 | Glaciar Norte | Mexico | Mexico | Basic |
| 16 | Saint-Sorlin Glacier | France | France | Integrated |
| 17 | Argentiere Glacier | France | France | Integrated |
| 18 | Mer de Glace Glacier | France | France | Basic |
| 19 | Gebroulaz Glacier | France | France | Basic |
| 20 | Xidatan | China | China | Integrated |
| 21 | Tanggula | China | China | Integrated |
| 22 | Tiksi | Russia | Russia | Integrated |
| 23 | Ice Base Cape Baranova | Russia | Russia | Integrated |
| 24 | Vuriloches | Argentina | Argentina | Basic |
| 25 | Aonikenk | Argentina | Argentina | Basic |
| 26 | Barrow Baseline Observatory | USA | USA | Integrated |
| 27 | Tianshan | China | China | Basic |
| 28 | Zackenbergl | Denmark | Greenland | Integrated |
| 29 | The Koxkar Glacier Camp (KGC) | China | China | Integrated |
| 30 | Syowa | Japan | Antarctica | Integrated |
| 31 | SIGMA-B | Japan | Greenland | Basic |
| 32 | Dome-C | France-Italy | Antarctica | Basic |
| 33 | Spasskaya Pad (Yakutsk) | Japan | Russia | Integrated |
| 34 | Forni Glacier | Italy | Italy (Europe) | Basic |
| 35 | Valle Nevado | Chile | Chile | Basic |
| 36 | Col de Porte | France | France | Integrated |



Criteria for assessment of CryoNet stations/sites



Stations:

- Application via questionnaire
- Acceptance of minimum requirements
- Long term commitment
- GCW Data policy acceptance (free access with accepted delay dependent on variable)
- Following GCW-CryoNet observational programme
- Accept GCW standards/guidelines for observations and data provision (→ GCW manual, currently under development)
- Letter of support from Permanent Representative (PR)

→ High potential for GCW-Harmosnow linkage/cooperation!

Sites:

- At least 2 stations, one is Cryonet station
- Sites needs a concept (stations need to be operated in a coordinated manner and objective)



Development of GCW Guide and GCW Manual:

GCW GUIDE (recommended practices in WMO):

- The first outline and assignment of work must be available for GSG-4 (16-20 January 2017)
- The final outline must be available for EC-PHORS-7 (end of March 2017)
- The GCW Guide must be published end of 2017

GCW MANUAL (standard practices in WMO):

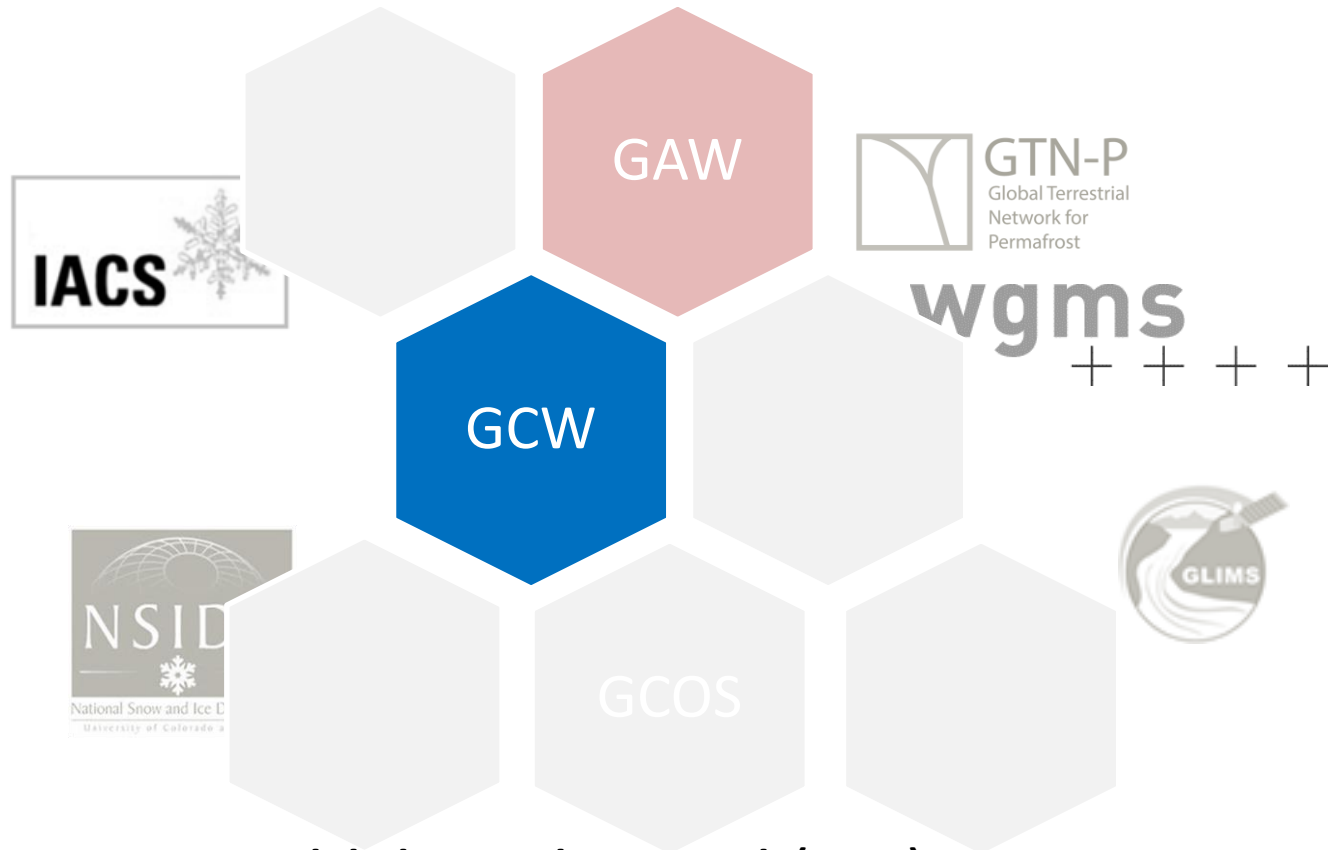
- Final draft ready for ICG-WIGOS (1 Q. 2018)
- Final draft ready for CBS-Ext.(2018) (3 Q. 2018)
- GCW Manual published by the end of 2018

Possible cooperation of Harnosnow with GCW: to develop the Guide and Manual for the snow chapter





GCW within WMO













Global Cryosphere Watch (GCW)

= the key programme of WMO (together with partners) for observing the cryosphere!



CryoNet stations and sites

-  CryoNet station ID Glacier
-  CryoNet station ID AWS
-  CryoNet station ID Snow measurement
-  CryoNet station ID ablation stake
-  CryoNet station ID GST test field
-  CryoNet station ID Discharge gauge
-  CryoNet station ID Stream ecology
-  CryoNet station ID Snow test field
-  CryoNet station ID atm. chemistry
-  CryoNet station ID Permafrost borehole

