



Global Cryosphere Watch (GCW) : protocols, observations, datasets, terminology in support of the provision of operational climate services for TP region

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Overview of the Global Cryosphere Watch

- ❖ GCW is the crosscutting activity area of WMO addressing the needs of its Members and their partners for **authoritative, actionable, and accessible science-based information** on the **state of the cryosphere** as a key component of **Earth system**.
- ❖ The observing component of GCW is a component of the WMO Integrated Global Observing System (WIGOS). Through WIGOS and the WMO Information System (WIS), GCW is providing a fundamental contribution to the Global Earth Observation System of Systems (GEOSS).
- ❖ GCW fulfills its objectives through a number of specific activities
 - ✓ developing a network of surface observations - CryoNet
 - ✓ developing measurement guidelines and best practices
 - ✓ refining observational requirements for the WMO Rolling Review of Requirements
 - ✓ contributing to WMO's space-based capabilities database
 - ✓ engaging in, and supporting, intercomparison of products
 - ✓ creating unique products, e.g., the SWE Tracker, in collaboration with partners

Home > activity areas > global cryosphere watch gcw

Global Cryosphere Watch (GCW)

- GCW Pre-operational Plan
- GCW Advisory Group
- GCW Meetings
- GCW Meeting Reports
- GCW Data Portal
- WMO No. 8 - Volume II - Measurement of Cryospheric Variables: Best Practices
- Cryosphere Assessments
- Cryosphere - a brief description
- Cryosphere Impacts and Applications
- Near Real Time Cryosphere Products
- Cryosphere: relevant references
- Cryosphere-relevant News
- Contacts

GCW is the crosscutting activity area of WMO addressing the needs of its Members and their partners for authoritative, actionable, and accessible science-based information on the state of the cryosphere as a key component of Earth system. GCW is mandated to support Members in sustainably enhancing their capabilities for observing all components of the cryosphere, for accessing and utilizing the cryospheric data and for developing value-added analyses and indicators based on in situ, space-based, and airborne observations of the cryosphere, as well as models, to meet defined information needs at the core of the WMO Strategic Plan, 2020-2023, and the WMO Water Ambitions.

In the context of the WMO Strategic Plan, the Earth is being considered as an integrated system of atmosphere, ocean, cryosphere, hydrosphere, biosphere and geosphere, which informs policies and decisions based on a deeper understanding of the physical, chemical, biological and human interactions that determine the past, current and future states of the Earth.

GCW DATA PORTAL Expand [+]

BEST PRACTICES Expand [+]

GCW CURRENT ACTIVITIES Expand [+]

GCW Substructures

Expert Teams:

- Cryosphere and Polar Observations (ET-CPO)
- Cryosphere and Polar Data Interoperability (ET-CPDI)
- Sea Ice Watch (ET-SIW)
- Snow Watch (ET-SW)

Task Teams:

- Cryosphere Observing Requirements (CRYORA)
- Glaciers and Ice Caps (GIC-TT)
- Permafrost (P-TT)

Coordinators:

- GCW Best Practices Coordinator (GCW-BPC)
- Polar Regional Climate Centres Focal Point (GCW-PRCC-FP)
- Cryosphere Bulletin Coordinator (CBC)

GCW National Focal Points

GCW top-level portals

<https://globalcryospherewatch.org>

The screenshot shows the homepage of the Global Cryosphere Watch website. At the top, it features the WMO logo and the title "Global Cryosphere Watch" with the tagline "Weather · Climate · Water". A navigation menu includes Home, About, News, Cryosphere Now, Surface, Satellites, Activities, Reference, Data Portal, and Outreach. The main content area is divided into several sections: "Highlights" with "Interesting Events" (ice circles, iceballs, sea ice leads, and orange snow), "Cryosphere in the News" (subglacial valleys in Greenland, sea ice drift in the Fram Strait, and a review article on terrestrial dissolved organic carbon), "The Cryosphere Now" (a sidebar with categories like Sea and Freshwater Ice, Snow and Solid Precip, Glaciers & Ice Caps, Ice Sheets, Permafrost, and Atmosphere, and a central graph titled "Glacier Mass Balance, 1962-2017"), and "GCW News" (2023 snow assessment, Northwest Passage opening, winter 2021-2022 assessment, new ice age product, 2019 sea ice assessment, and 2019 cryosphere trends).

<https://community.wmo.int/en/activity-areas/global-cryosphere-watch-gcw>

The screenshot shows the WMO Community Platform page for Global Cryosphere Watch (GCW). The header includes the WMO logo and "Community Platform". A navigation menu lists Home, Members, Governance, Activity Areas, Projects, Planning & Monitoring, WMO Website, Legacy Content, and Member Profiles. The breadcrumb trail is "Home > activity areas > global cryosphere watch gcw". The main heading is "Global Cryosphere Watch (GCW)". A list of links includes GCW Pre-operational Plan, GCW Advisory Group, GCW Meetings, GCW Meeting Reports, GCW Data Portal, WMO No. 8 - Volume II - Measurement of Cryospheric Variables: Best Practices, Cryosphere Assessments, Cryosphere - a brief description, Cryosphere Impacts and Applications, and Near Real Time Cryosphere Products. A vertical menu lists "Sea and Freshwater Ice", "Snow and Solid Precipitation", "Glaciers and Ice Caps", "Ice Sheets and Icebergs", "Permafrost", and "Atmosphere". Below this are three expandable boxes for "GCW DATA PORTAL", "BEST PRACTICES", and "GCW CURRENT ACTIVITIES". A "RELATED NEWS" section mentions "Snow Monitoring Competence Centre - Davos".

2 = =

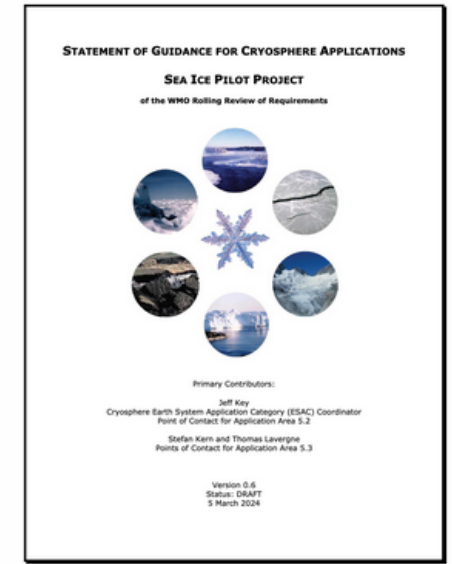
.....plus other WMO pages

GCW activities of benefit for TPRCC (1)

Statement of Guidance

An detailed analysis of gaps in the cryosphere observing system is underway, to be completed in early 2025. This involves an evaluation of current observational capabilities of the most impactful cryosphere variables, user requirements for those variables, an analysis of the gaps, and recommendations for filling those gaps. Results will be documented in a *Statement of Guidance for Cryosphere Observations* (SoG) as part of the WMO Rolling Review of Requirements (RRR) process. The sea ice portion is one of the RRR pilot projects. A draft SoG for sea ice is under review (early 2024).

Point of contact: Jeff Key (NOAA), Rodica Nitu (WMO)



CryoNet

CryoNet is the GCW network of surface stations. This project is establishing the the network. It is defining the types of sites, e.g., “supersites”, reference sites, and/or tiered sites in cold climate regions, on land or sea, operating a sustained, standardized programme for observing and monitoring as many cryospheric variables as possible. It is creating an inventory of the current network, working with site managers, developing formal procedures for establishing the GCW network, evaluating potential supersites, and determining data availability. The project will compile best practices, guidelines, and standards, determine what should be measured, and facilitate interaction and collaboration between the scientific and operational communities. [[More...](#)]



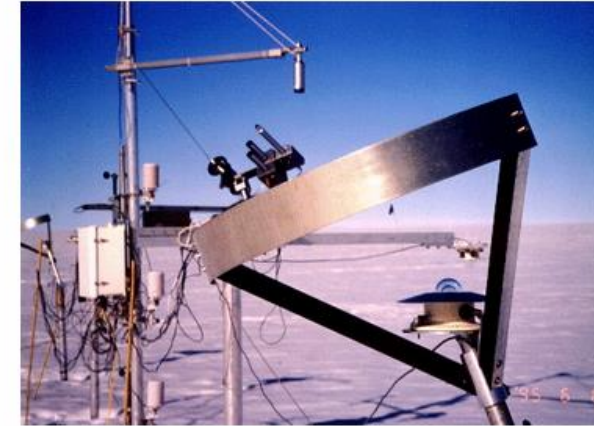
Point of contact: Wolfgang Schöner (Zentralanstalt für Meteorologie und Geodynamik)

GCW activities of benefit for TPRCC (2)

Measurement Standards and Best Practices

GCW is developing snow and ice measurement standards and best practices. They draw from existing measurement practices, where documented and accepted by cryospheric scientists. New practices will be created, as necessary. [\[More...\]](#)

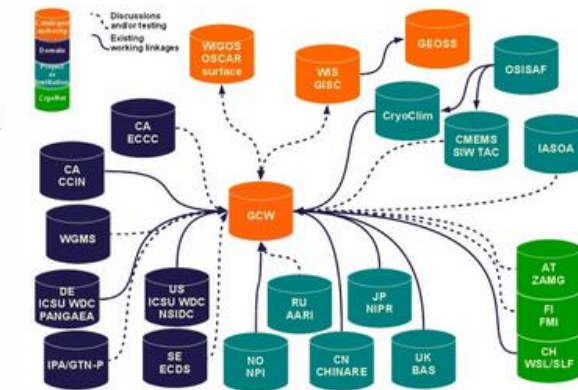
Point of contact: Charles Fierz (WSL/SLF) and Þorsteinn Þorsteinsson (IMO)



Data Portal and Data Interoperability

The Portal Team is working with CryoNet stations, data centres, and other projects on the metadata and data interoperability issues. A GCW Operational Manual for contributing data centres and a document on GCW Guidance for data centres contributing to GCW are being developed. Furthermore, a GCW Interoperability Package for CryoNet stations is being tested, as a demonstration project for coupling a small data centre of a CryoNet station with the GCW Data Portal. [\[More...\]](#)

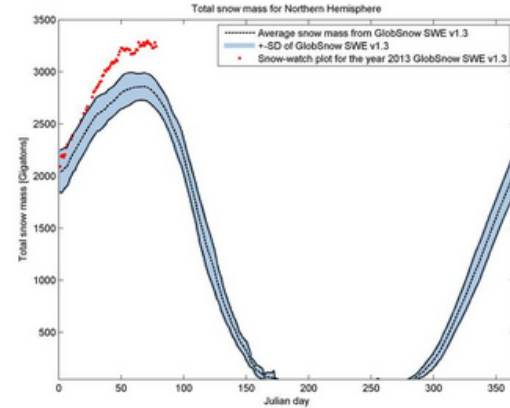
Point of contact: Øystein Godøy (Norwegian Meteorological Institute)



GCW activities of benefit for TPRCC (3)

Snow Watch

The main goals of Snow Watch are to assess the maturity and accuracy of snow products, improve the reporting of and access to in situ snow measurements, promote the exchange of snow data and information for snow cover monitoring, and identify critical snow-related issues that need to be addressed in GCW. Snow Watch is making major advances in snow cover observation, monitoring and exchange of data and products from in-situ and satellite sources as part of GCW's goal to provide authoritative cryospheric information. Team members are drawn from across the global snow community. [[More...](#)]

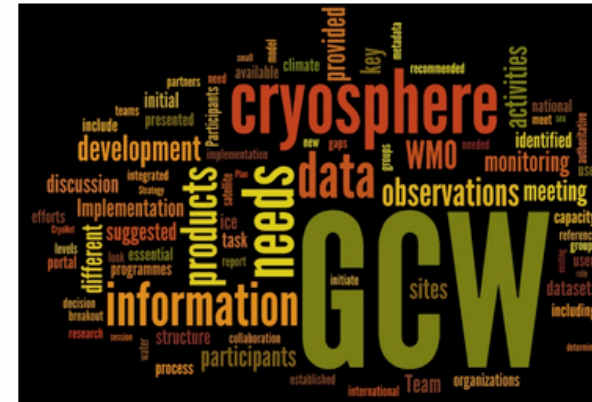


Point of contact: Ross Brown (Environment Canada) and Kari Luojus (Finnish Meteorological Institute)

Terminology

An official GCW Glossary of cryospheric terms is being created. As with measurement standards, existing glossaries will be used as a starting point and modified as necessary. A robust, though not exhaustive, compilation of existing glossaries is available in the Reference section of this website. [[More...](#)]

Point of contact: Gino Casassa (Geoestudios)



Accessing the GCW coordinated/produced metadata/data

Directly through the GCW portal

<https://globalcryospherewatch.org>

Through the GCW data portal as a dedicated WIGOS portal or any other WIGOS portal

<https://gcw.met.no>

Through the WMO OSCAR (Observing Systems Capability Analysis and Review Tool)

<https://oscar.wmo.int/surface/#/>

The screenshot shows the Global Cryosphere Watch website interface. At the top, there is a search bar and navigation links. Below the search bar, there are sections for 'Metadata search', 'View basket (0)', 'Help', 'Subscription', and 'Login'. A large text box explains that the catalog is not yet operational and that data is harvested from various sources. Below this, there are search filters for '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. At the bottom, there are logos for supporting organizations like the Norwegian Meteorological Institute and NSIDC, and a 'Powered by: METAMOD' logo.

The screenshot shows the Global Cryosphere Watch website homepage. It features a navigation bar with links for 'Home', 'About', 'News', 'Cryosphere Now', 'Surface', 'Satellites', 'Activities', 'Reference', 'Data Portal', and 'Outreach'. Below the navigation bar, there are several sections: 'Highlights' with 'Interesting Events' (ice circles, iceballs, sea ice leads, and orange snow), 'Cryosphere in the News' (subglacial valleys, sea ice drift, and review articles), 'The Cryosphere Now' (sea and freshwater ice, snow and solid precip, glaciers & ice caps, ice sheets, permafrost, atmosphere), and 'GCW News' (2023 snow assessment, early opening of Northwest Passage, snow assessment for winter 2021-2022, new ice age product, 2019 sea ice assessment, and cryosphere trends for 2019).

The screenshot shows the WMO OSCAR (Observing Systems Capability Analysis and Review Tool) website. It features a navigation bar with links for 'Home', 'Search', 'Critical review', 'About', 'New', 'Glossary', 'FAQ', 'Links', 'Support', 'Feedback', and 'Login'. Below the navigation bar, there are sections for 'Quick access' (Generate station report by: Station name, WIGOS Station Identifier, Generate station lists by: Country, Type, Class, Observed variable, Find people by: Contact name) and 'Filter map' (By program / network: WIGOS components, GOS, GAW, WMO, GCW). A map of the world shows station locations, with a legend for 'air', 'land or ocean surface', 'sub-surface', and 'lake or river'. The map also shows station status: Operational, Partly operational, Closed, Silent, and Unknown. A 'GCW' checkbox is highlighted in red in the 'Filter map' section.

Accessing the GCW observations – GCW portal -> CryoNET

CryoNET station == at least 1 cryosphere variables is observed following the WMO GCW protocol

Through the GCW portal

<https://globalcryospherewatch.org/cryonet/>

Select a station category: CryoNet Contributing CryoNet & Contributing Candidate All
 ...or a component: Snow Sea Ice Freshwater Ice Glaciers Ice Sheets Ice Shelves Icebergs
 Permafrost Seasonally Frozen Ground Basic Meteorology Surface Radiation

Station/Cluster	Operating Country	Location	Type
1 Qilian	China	China	CryoNet Station
2 Morenas Coloradas Rockglacier	Argentina	Argentina	Contributing Station
3 Fluela permafrost station (FLU)	Switzerland	Switzerland	CryoNet Station
4 Xidatan	China	China	CryoNet Station
5 Tanggula	China	China	CryoNet Station
6 Tiksi	Russia	Russia	CryoNet Station
7 Ice Base Cape Baranova	Russia	Russia	CryoNet Station
8 Vuriloches	Argentina	Argentina	CryoNet Station
9 Aonikenk	Argentina	Argentina	CryoNet Station
10 Barrow Baseline Observatory	USA	USA	CryoNet Station
11 Spasskaya Pad (Yakutsk)	Japan	Russia	CryoNet Station
12 Tavanbogd	Mongolia		CryoNet Station
13 Sodankyla Tahtela	Finland	Finland	CryoNet Station
14 Pallas-Kenttarova	Finland	Finland	CryoNet Station
15 Sonnblick Observatory	Austria	Austria	CryoNet Station
16 Wintergasse	Austria	Austria	Contributing Station
17 Zackenberg Research Station	Denmark	Greenland	Contributing Station
18 Suli station	China	China	CryoNet Station
19 Rothera	UK	Antarctica	CryoNet Station

GCW surface network, 2024

There are now 160 stations in the GCW surface network. Some are CryoNet stations; some are contributing stations. GCW also has affiliated networks.



Quick access

Generate station report by:
 Station name:

WIGOS Station Identifier:

Generate station lists by:
 Country:

Type:

Class:

Observed variable:

Find people by:
 Contact name:

Filter map

By program / network:
 WIGOS components
 ODS
 AW
 WHOS
 GCW

Welcome to OSCAR/Surface

OSCAR/Surface is the World Meteorological Organization's official repository of WIGOS metadata for all surface-based observing stations and platforms. For more details on OSCAR, please visit the About section. For additional information about WIGOS, visit the WIGOS Homepage.

air land or ocean surface sub-surface lake or river

Operational Partly operational Closed Silent Unknown

Latest news

Similar but less complete through the WMO OSCAR <https://oscar.wmo.int/surface/#/> as description of the stations belonging to different WMO programs is in the process of revision inside OSCAR

Accessing the GCW Recommended Variables for observations – GCW portal -> CryoNET-> Recommended Variables

SNOW/SOLID PRECIPITATION		Recommended minimum frequency of observations at CryoNet stations						
Variable	Timescale							
	hourly	daily	weekly	bi-weekly	monthly	half-yearly	yearly	
Snow on the ground (According to WMO code 0975: State of ground with snow or measurable ice cover)		M(S)						
Snow depth	A(S, G, SI, LRI)	M(S)						

LAKE ICE		Recommended minimum frequency of observations at CryoNet stations						
Variable	Timescale							
	hourly	daily	weekly	bi-weekly	monthly	half-yearly	yearly	
Ice thickness	A			M				
Ice concentration		A, M						
Ice class (pack, fast ice)		M						
Ice type (level/rafted/ridged & floe descriptor)		M						
Form of ice (floe size, fast ice width)			M					
Stage of ice development			M					

RIVER ICE		Recommended minimum frequency of observations at CryoNet stations						
Variable	Timescale							
	hourly	daily	weekly	bi-weekly	monthly	half-yearly	yearly	
Ice thickness	A							
Ice concentration								
Ice class (pack, fast ice)								
Ice type (level/rafted/ridged & floe descriptor)								
Form of ice (floe size, fast ice width)								
Stage of ice development								
Ice phenomena (dates of freeze-up, fast ice formation/breakout, melt onset, break-up)								
Ice stage of melting								
River ice jams and dams								
Flooding extent caused by jams and dams								
River icings (aufeis)								
Maximum level								
Areal extent of floating/grounded ice								

GLACIERS and ICE CAPS		Recommended minimum frequency of observations at CryoNet stations						
Variable	Timescale							
	hourly	daily	weekly	bi-weekly	monthly	half-yearly	yearly	
Surface accumulation (point)								
Surface ablation (point)								
Surface mass balance (glacier wide)								
Surface mass balance (point)								
Glacier area (glacier wide)								

PERMAFROST		Recommended minimum frequency of observations at CryoNet stations						
Variable	Timescale							
	hourly	daily	weekly	bi-weekly	monthly	half-yearly	yearly	
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								
ground ice volume							M	
coastal retreat							M	
soil moisture		A			M			

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

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

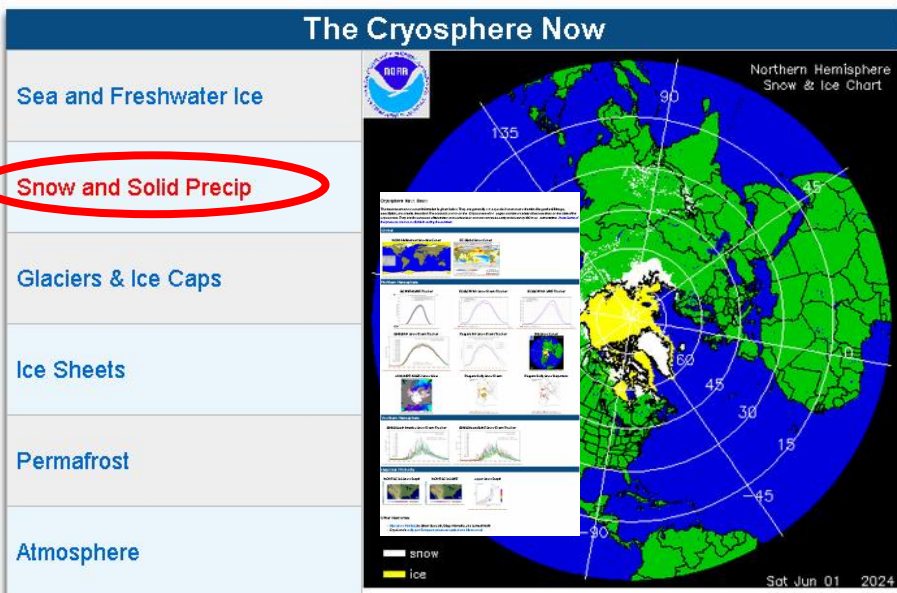
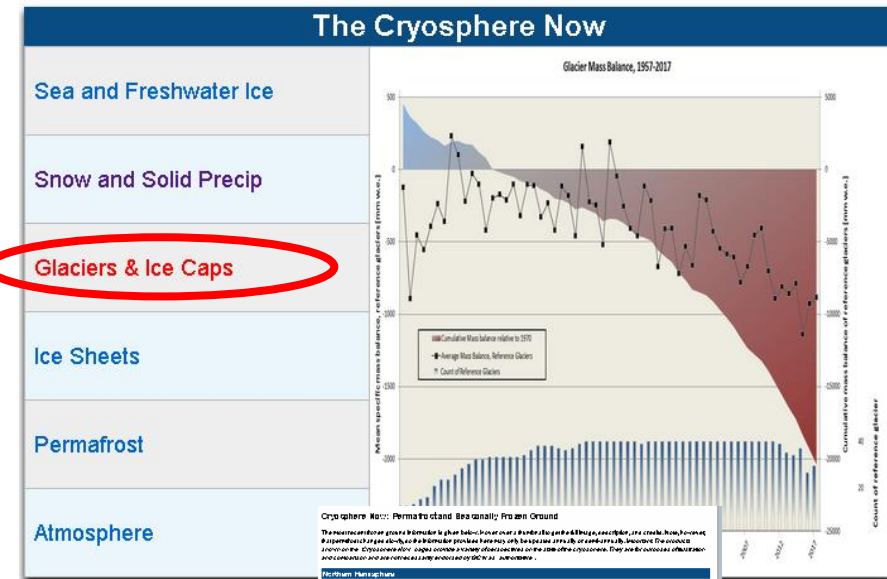
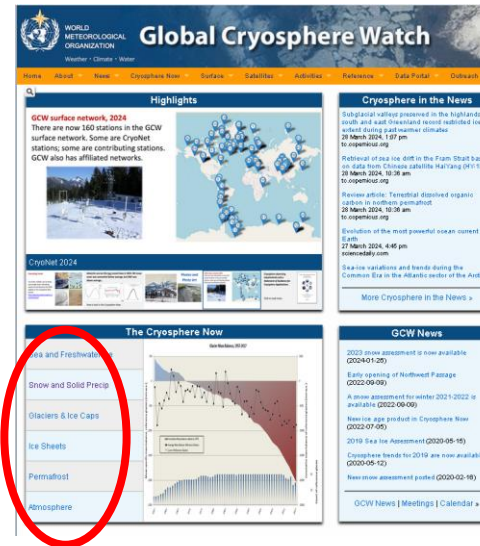
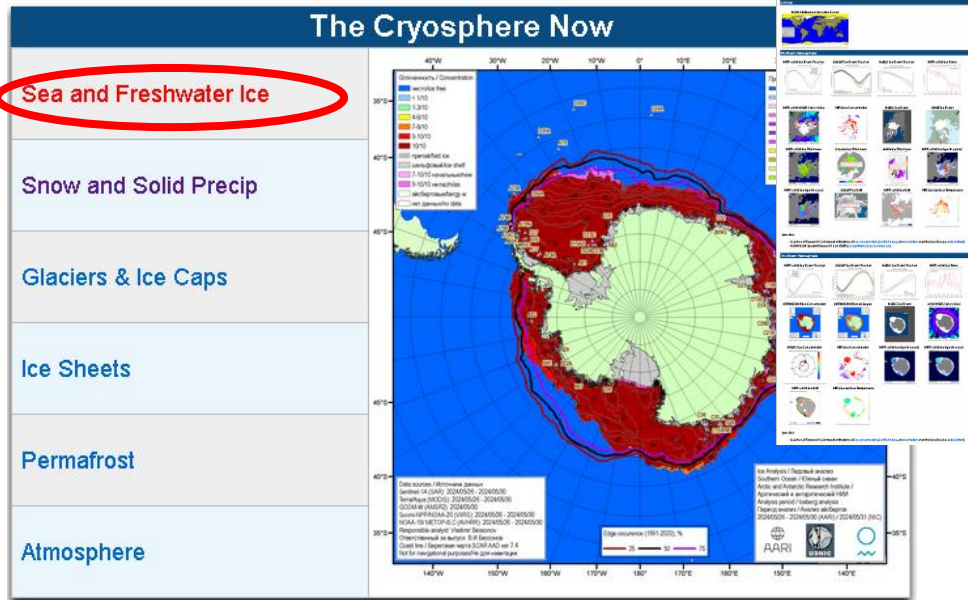
Blue shading/fill indicates recommended measurements for CryoNet stations
 Green shading/fill indicates desired measurements for CryoNet stations
 A: automatic, M: manual

Yellow shading/fill indicates required measurements for CryoNet stations

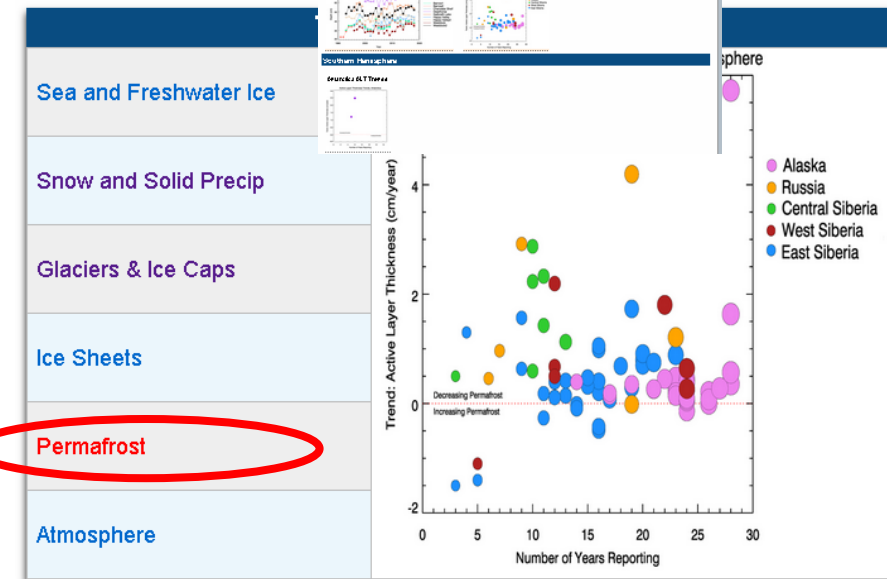
Similar set is available through the WMO OSCAR
<https://oscar.wmo.int/surface/>

Accessing the GCW indicators – GCW portal → Cryosphere now

https://globalcryospherewatch.org/state_of_cryo/

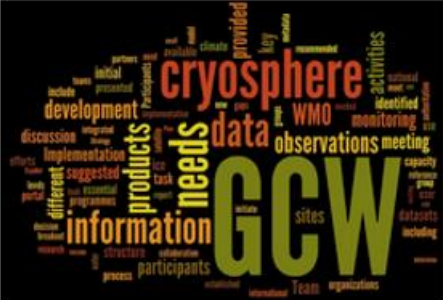


❖ "Cryosphere Now" pages provide a **variety of perspectives** on the state of the cryosphere for purposes of illustration and comparison



Accessing the GCW harmonized terminology – GCW portal → Glossary

<https://globalcryospherewatch.org/reference/glossary.php>



- ❖ The official GCW Glossary is in preparation. It will be formally vetted and then translated into the WMO languages over the coming years.
- ❖ At the moment, GCW has compiled a database of cryosphere terms from a variety of sources (see the pages) with 4174 entries from 27 sources; 2249 are unique.
- ❖ Separate entries are for ‘glaciers’, ‘freshwater ice’, ‘permafrost’, ‘precipitation’, ‘sea-ice’, ‘snow’ as well as ‘atmosphere’
- ❖ The GCW glossary will include and be consistent with the [recommended and desired variables](#) for CryoNET and also with GCW best practices for cryospheric measurements.
- ❖ The GCW glossary terms will ultimately be included in WMO’s centralized database of terms

Cryosphere element	Source:	Keyword:
<ul style="list-style-type: none"> Snow Sea Ice Freshwater Ice Glaciers 	<p>AMS - glossary of meteorology</p> <p>Australian Bureau of Meteorology 2016</p> <p>ASPECT 2012</p> <p>Bushuyev 2004</p>	<input type="text"/> <input type="button" value="Filter"/> <input type="button" value="Reset"/>

OR select the first letter of the term: [A](#) | [B](#) | [C](#) | [D](#) | [E](#) | [F](#) | [G](#) | [H](#) | [I](#) | [J](#) | [K](#) | [L](#) | [M](#) | [N](#) | [O](#) | [P](#) | [Q](#) | [R](#) | [S](#) | [T](#) | [U](#) | [V](#) | [W](#) | [X](#) | [Y](#) | [Z](#)

Term	Definition	Source
Ablation	The process by which ice and snow dissipate owing to melting and evaporation.	NOAA Glossary of Hydrologic Terms
Ablation	(1) combined processes (such as sublimation, fusion or melting, evaporation) which remove snow or ice from the surface of a glacier or from a snow-field; also used to express the quantity lost by these processes (2) reduction of the water equivalent of a snow cover by melting, evaporation, wind and avalanches.	NSIDC accessed 2016
Ablation	(1) All processes that reduce the mass of the glacier. (2) The mass lost by the operation of any of the processes of sense 1, expressed as a negative number. The main processes of ablation are melting and calving (or, when the glacier nourishes an ice shelf, ice discharge across the grounding line). On some glaciers sublimation, loss of windborne snow and avalanching are significant processes of ablation. 'Ablation', unqualified, is sometimes used as if it were a synonym of surface ablation, although internal ablation, basal ablation, and frontal ablation, especially calving, can all be significant in some contexts.	Cogley et al. IACS-UNESCO Glacier Mass Balance 2011
Ablation	Ablation refers to all processes by which snow, ice, or water in any form are lost from a glacier. Ablation is the loss of snow or ice by evaporation and melting. The rate at which ablation occurs depends on the atmospheric conditions present, such as air moisture content, solar radiation, temperature, and the reflectivity (Albedo) of the snow or ice surface. Fresh snow has a high albedo (0.7 to 0.9), indicating that 70 to 90 percent of the radiation received is reflected; glacier ice has a lower albedo of 0.2 to 0.4. Therefore, more radiation may be absorbed by glacier ice than by snow. Glaciers around the mountain receive different amounts of sunlight, so each glacier has its own characteristic ablation pattern.	Molnia USGS 2004
Ablation	The loss of ice and snow from a glacier system. This occurs through a variety of processes including melting and runoff, sublimation, evaporation, calving, and wind transportation of snow out of a glacier basin.	Molnia USGS 2004
Ablation	All processes that remove snow, ice, or water from a snowfield, glacier, etc., that is typically melt, evaporation, sublimation as well as wind erosion, avalanches, calving, etc.; in this sense, the opposite of accumulation. In many publications before 1980, ablation did not include mechanical removal of either snow or ice, i.e., wind erosion, avalanches, calving, etc.	Fierz et al. IACS-UNESCO Seasonal Snow on the Ground 2009



Thank you for attention!

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