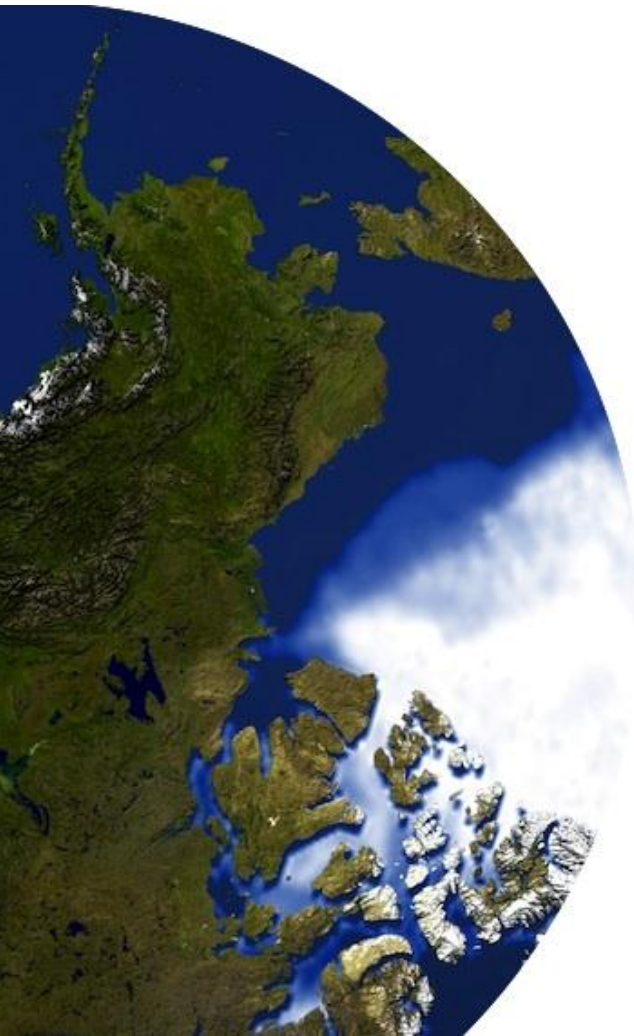


# A Global Cryosphere Watch

Jeff Key<sup>1</sup> and Barry Goodison<sup>2</sup>

<sup>1</sup>*NOAA/NESDIS, Madison, Wisconsin USA*

<sup>2</sup>*World Meteorological Organization, Geneva, Switzerland*



Tiksi Science Team Meeting, 18-20 September 2012, Saint Petersburg





The **cryosphere** collectively describes elements of the earth system containing **water in its frozen state** and includes:

**snow cover, solid precipitation, sea ice, lake and river ice, glaciers, ice caps, ice sheets, ice shelves, permafrost and seasonally frozen ground.**



The cryosphere is **global**, ~100 countries



# The Cryosphere is Important

Changes in the cryosphere can have significant impacts on water supply, transportation, infrastructure, hunting, fisheries, recreation, and ecology.

**Sea level rise** threatens vital infrastructure.

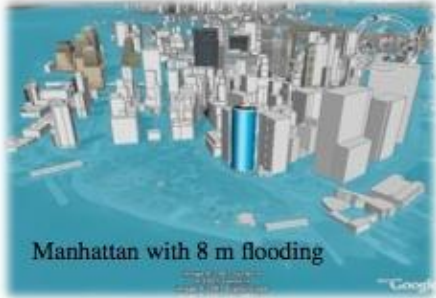
Changes in sea-ice affect **access to the polar oceans and resources, tourism, and security**. Declining summer sea-ice affects ocean circulation and weather patterns.

**Natural hazards** such as icebergs, avalanches and glacier outburst floods create risks.

**Permafrost thawing impacts infrastructure** and is potentially a major source of **methane**, a greenhouse gas.

Changes in the cryosphere impact **water supply, food production, freshwater ecosystems, hydropower production**, and the risk of floods and droughts.

Retreating sea ice results in a **loss of habitat** for mammals such as polar bears and seals.



# A Few Motivating Questions



- Climate: How exactly has the cryosphere been **changing**? (what, where, and how well we need to measure)
- Climate: What are the **consequences of recent changes** in the cryosphere? (feedbacks and interactions in physical, biological)
- Weather Prediction: Which snow and ice measurements are most needed to **improve weather prediction**? (requirements)
- Societal needs: What observations do we need to produce better forecasts of **sea level rise**?
- Societal needs, climate: How do changes in the cryosphere impact **water supply, agriculture, transportation, infrastructure (permafrost), hazards, and health**?



# Global Cryosphere Watch (GCW)



The 16<sup>th</sup> World Meteorological Congress approved GCW in May 2011

The 15th World Meteorological Congress (May 2007) welcomed the proposal of Canada that WMO will create a **Global Cryosphere Watch** which would be an important component of the **IPY legacy**. Congress recommended that the WMO Inter-

IPY to group to explore the creation of such global system and prepare recommendations for its development.

A legacy of IPY

A component of WIGOS

A contribution to GEOSS

GCW is overseen by the WMO panel on Polar Observations, Research, and Services (EC-PORS), which has members from NOAA and NSF





# GCW MISSION

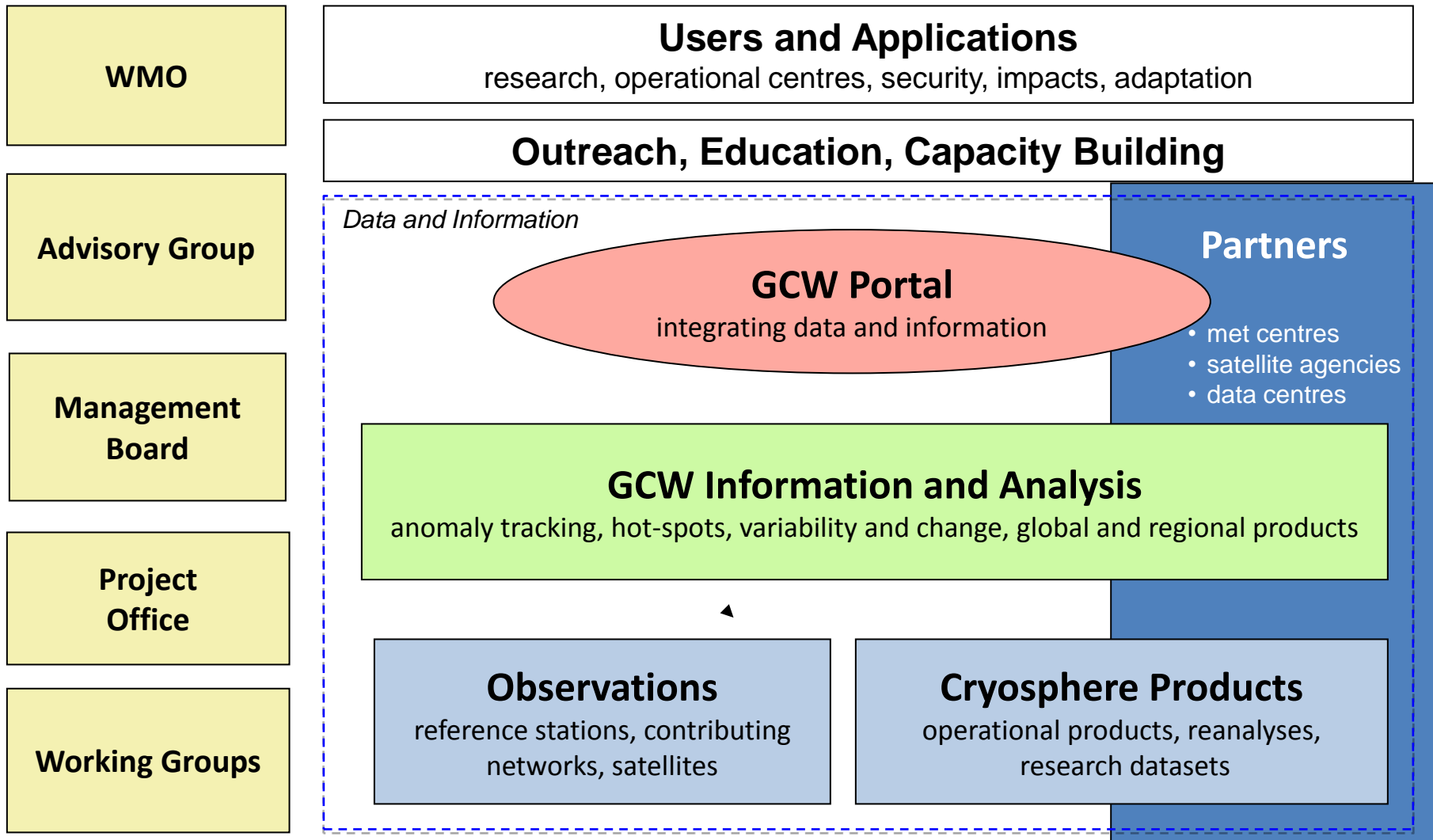
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*GCW will provide authoritative, clear, and useable data, information, and analyses on the past, current and future state of the cryosphere to meet the needs of WMO Members and partners in delivering services to users, the media, public, decision and policy makers.*

GCW will include observations, monitoring, assessment, product development, prediction, and research.

***GCW is not assuming the mandate of any of its partners/collaborators.*** Instead, GCW enables partners/collaborators to exercise their mandate effectively.

# Organization: GCW Conceptual Framework



# Feature Comparison

| Feature                                       | NSIDC | GCOS | GCW |
|---|-------|------|-----|
| Data archival and distribution                | ■     |      | ○   |
| Web data portal                               | ■     |      | ■   |
| Analysis                                      | ■     |      | ■   |
| Monitoring                                    | ○     |      | ■   |
| Product intercomparisons                      | ○     | ○    | ■   |
| Integrated products                           | ○     |      | ○   |
| Assess observational requirements             |       | ■    | ■   |
| Assess user needs                             | ○     | ○    | ■   |
| Measurement standards and best practices      |       | ○    | ■   |
| Observational network                         |       |      | ■   |
| Observing system coordination and development |       | ■    | ■   |
| Compilation of Terminology/Vocabulary         |       |      | ■   |
| Capacity development                          |       |      | ■   |

■ Definitely

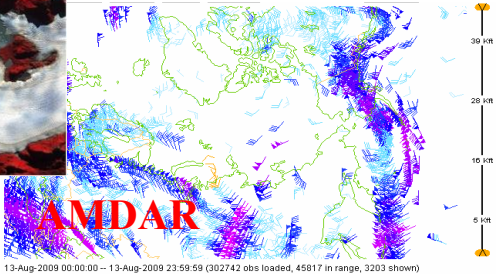
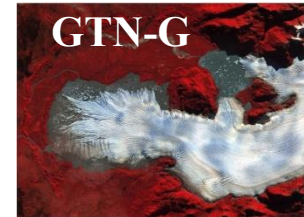
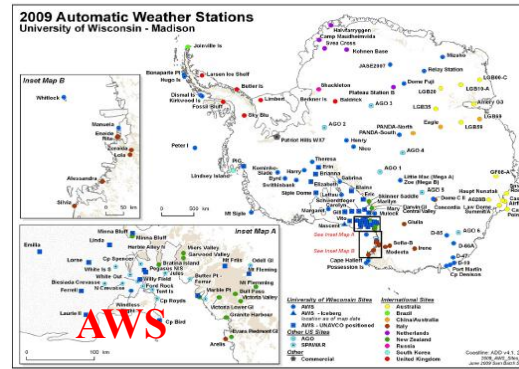
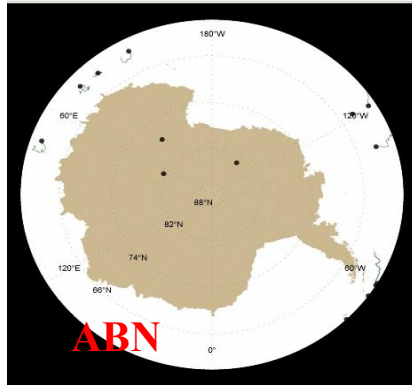
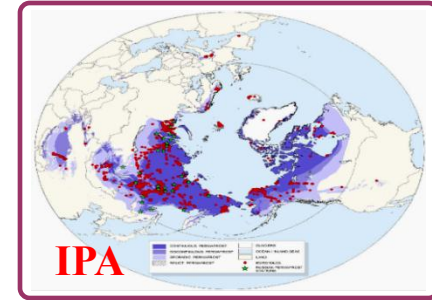
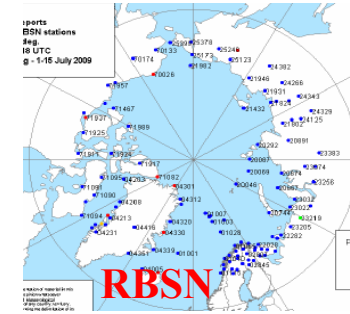
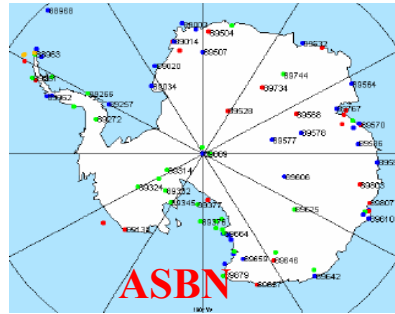
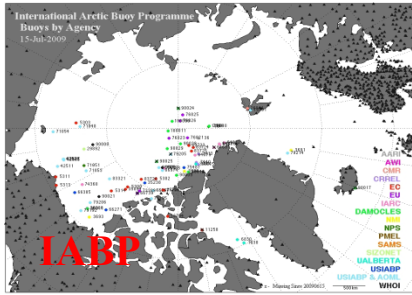
○ Partially





# Challenge: Sustaining Networks

*Sustaining and funding networks in remote harsh, cold environments and new networks established during IPY*

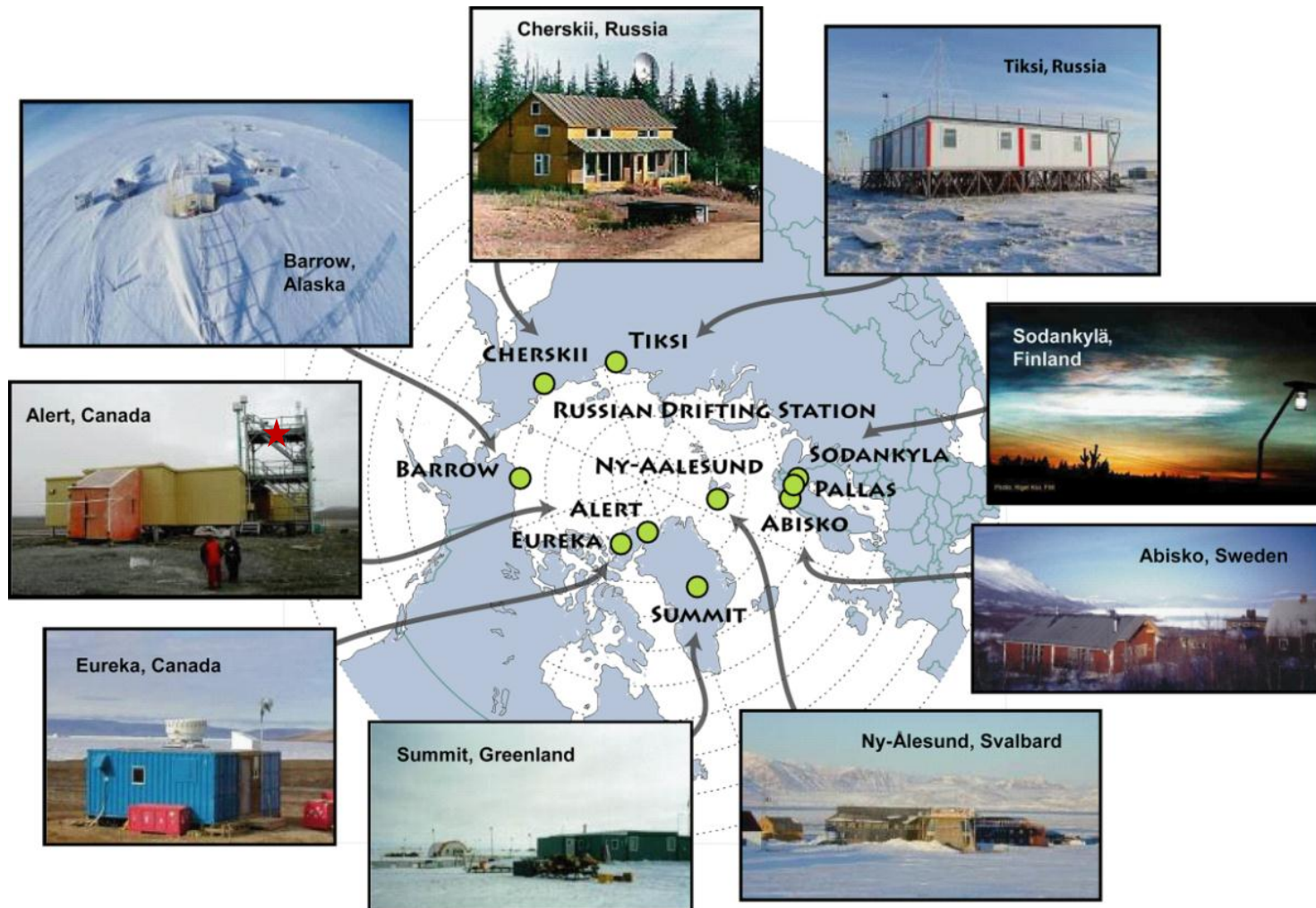


- Joint Programmes**
- GAW
  - WCRP
  - Arctic HYCOS
  - GCOS (GOOS, GTN-P, GTN-G)

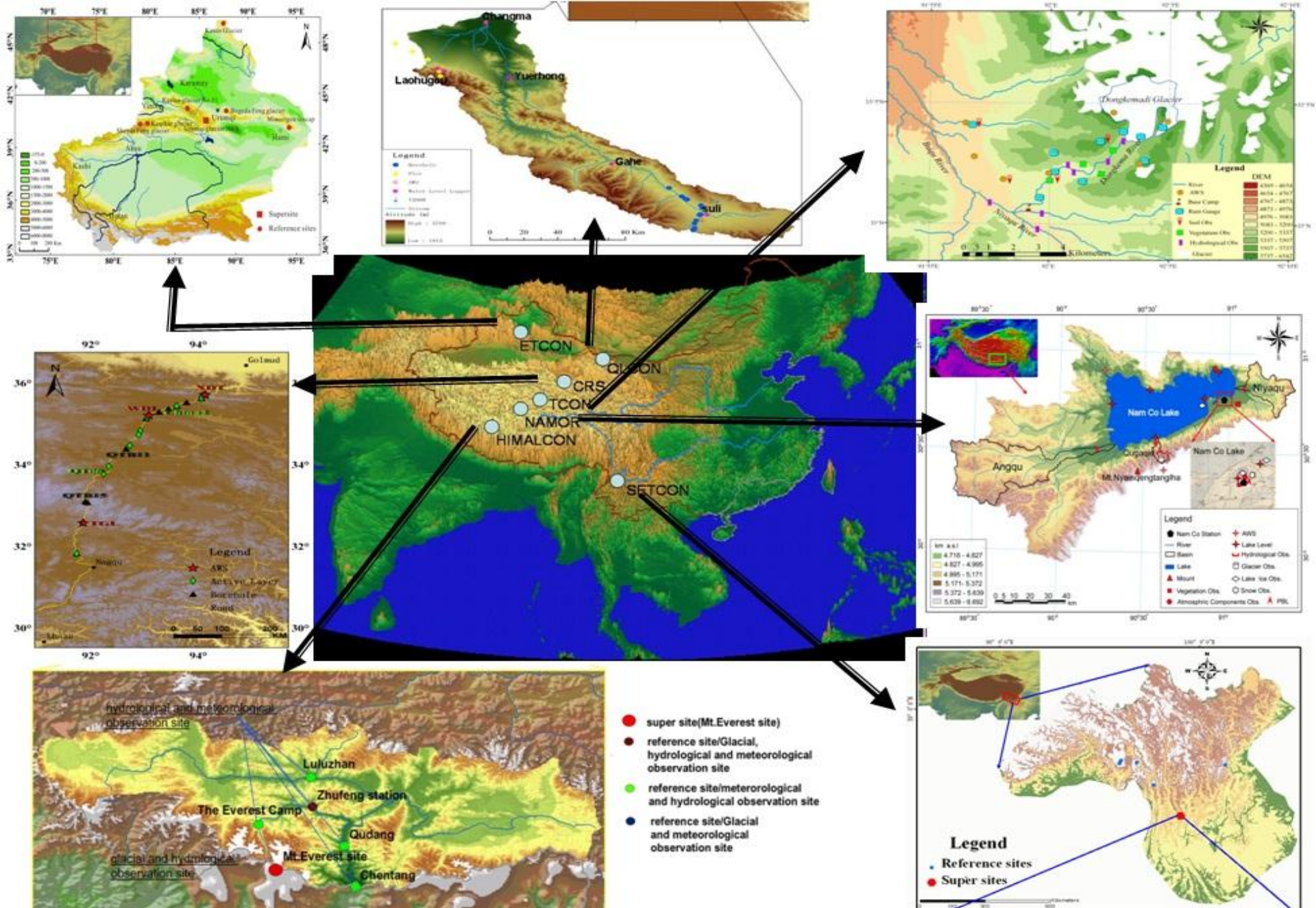
13-Aug-2009 00:00:00 - 13-Aug-2009 23:59:59 (302742 obs loaded, 45817 in range, 3203 shown)

# Challenge: Develop CryoNet

**International Arctic Systems for Observing the Atmosphere and Surface (IASOAS):** Consortium of sustained, ground-based international multi-disciplinary observatories.







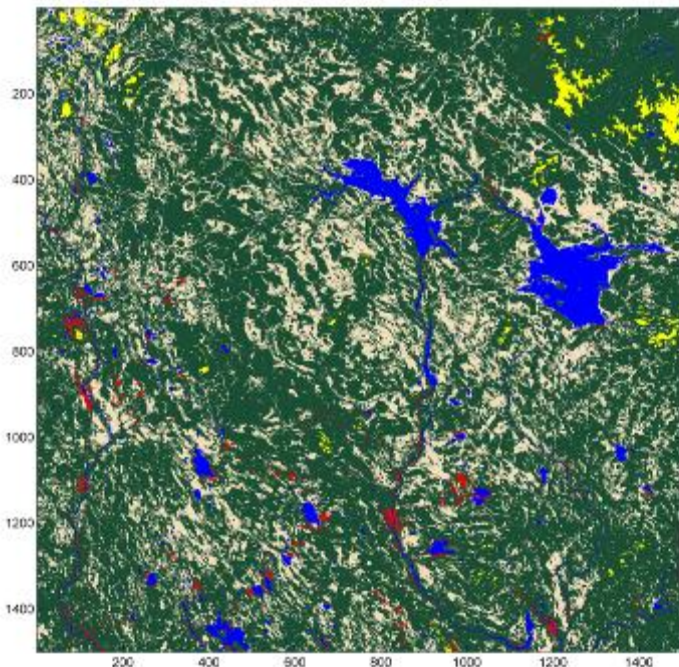
# Re-designed HAC network, 7 supersites



# Northern Finland test area

Northern Finland test area  
300x300 km

Sodankylä-Pallas CAL/VAL  
area 150x150 km



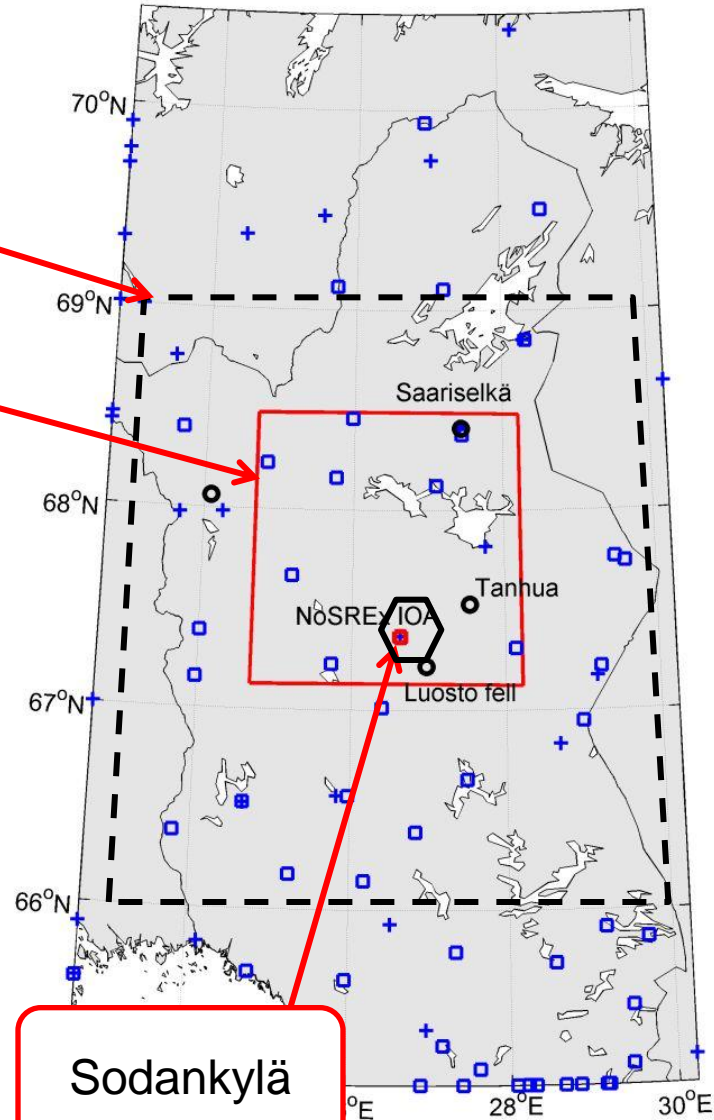
Other 0.8 %

Open ("barren") 1.2 %

Bog 23.3 %

Forest 70.9 %

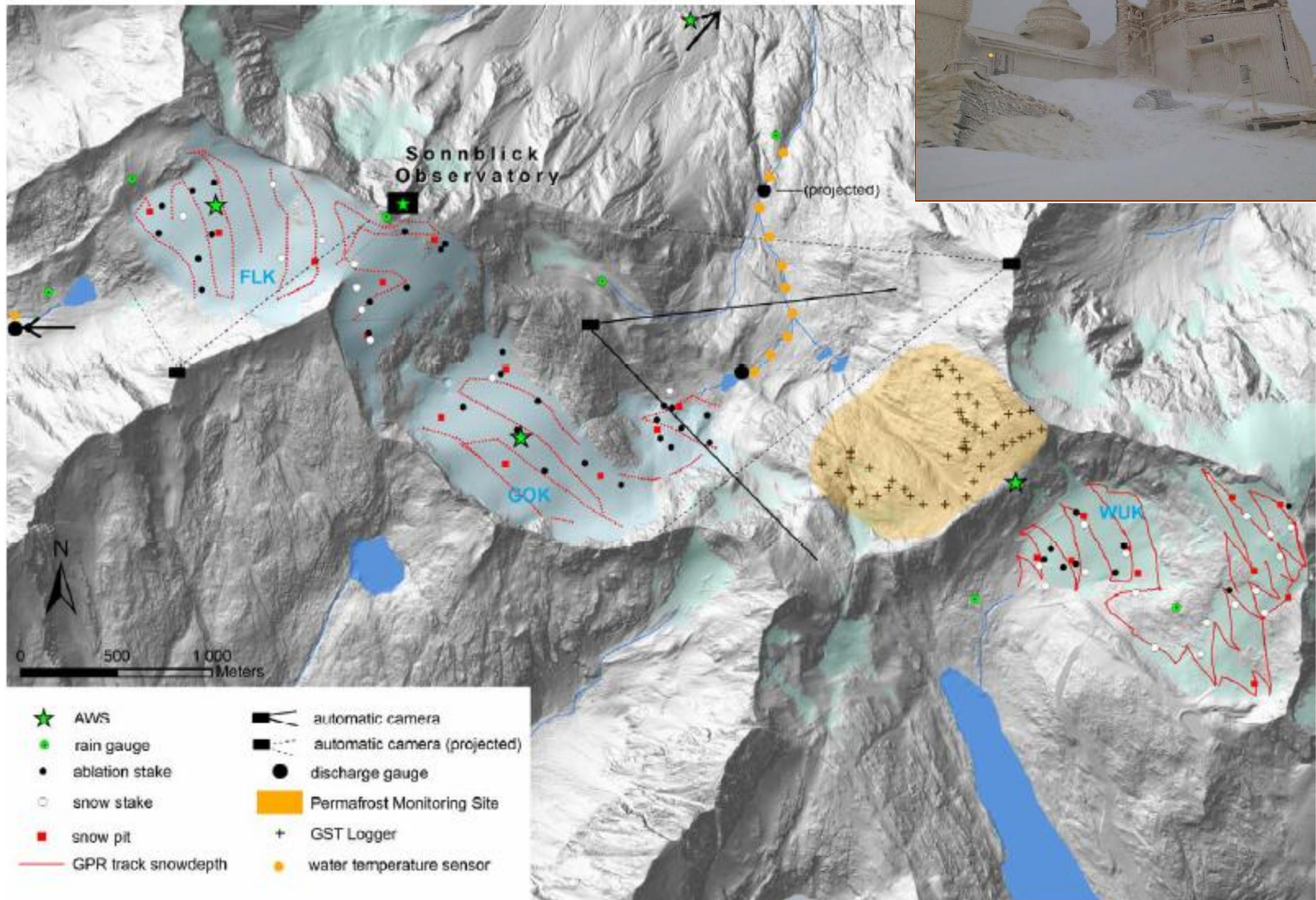
Lakes & rivers 3.7 %



Sodankylä



# SONNBLICK network:



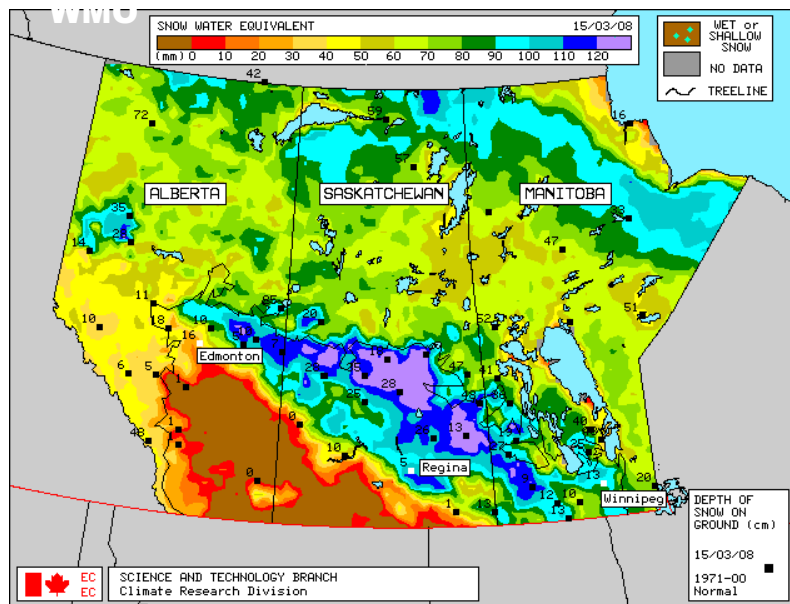


# Concordia

A French-Italian station, in the heart of Antarctica

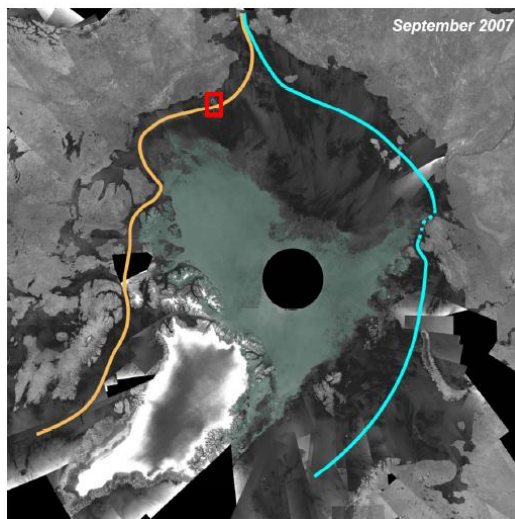


# Challenge: Product Selection

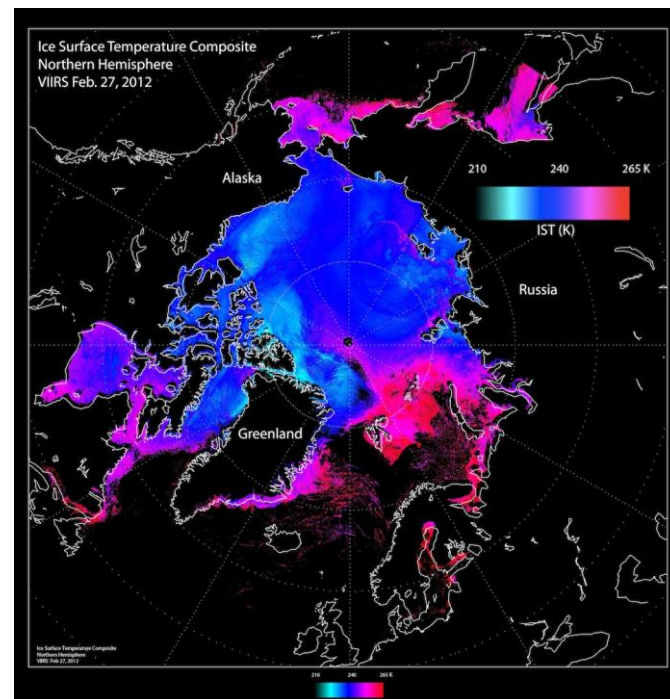


*SWE derived from SSM/I for Western Canada*

- Routine evaluation of products
- Robust algorithms for climate use
- Product intercomparisons
- Products meet user needs
- Sustainable product development and production
- Transfer from research to operations



*Envisat ASAR mosaic sea ice for September 2007*



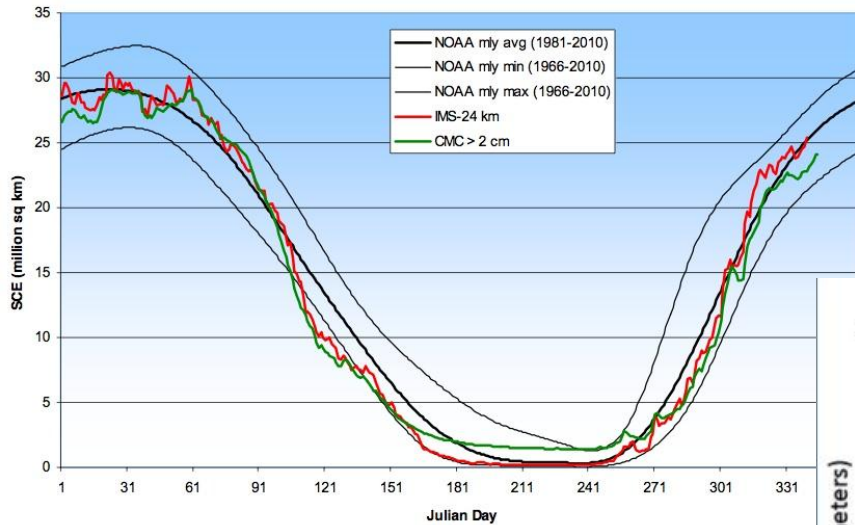
*Ice surface temperature from NPP VIIRS*



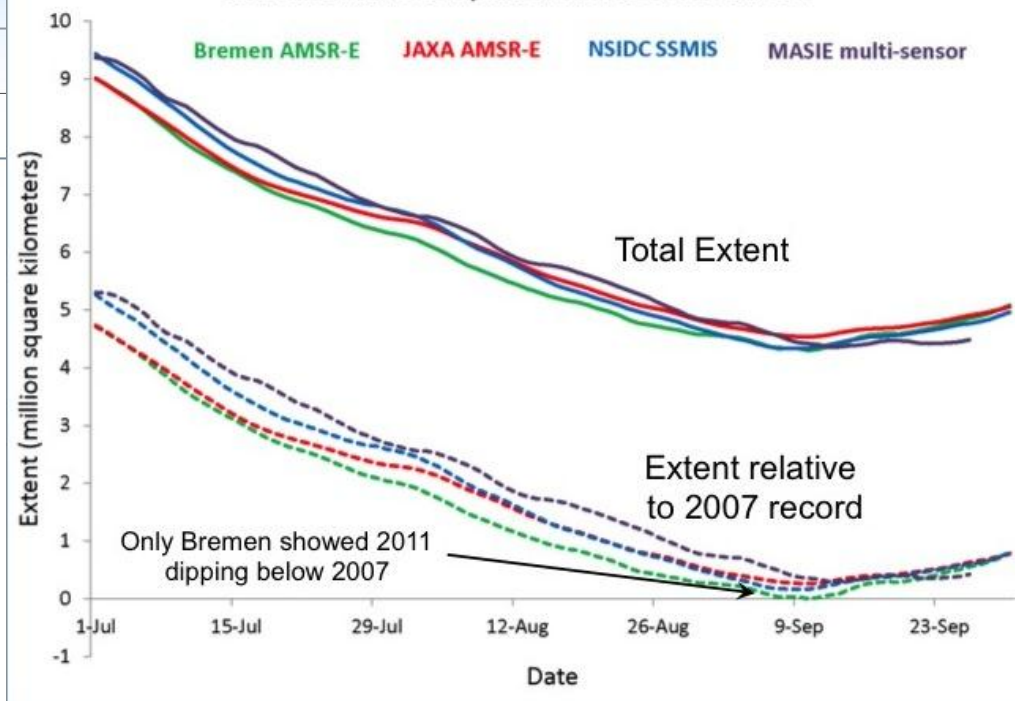
# Challenge: Product Selection, cont.

Product intercomparisons and error assessments are important.

2011 Eurasian Snow Cover Extent



2011 Extent and Comparison with 2007 Record Low



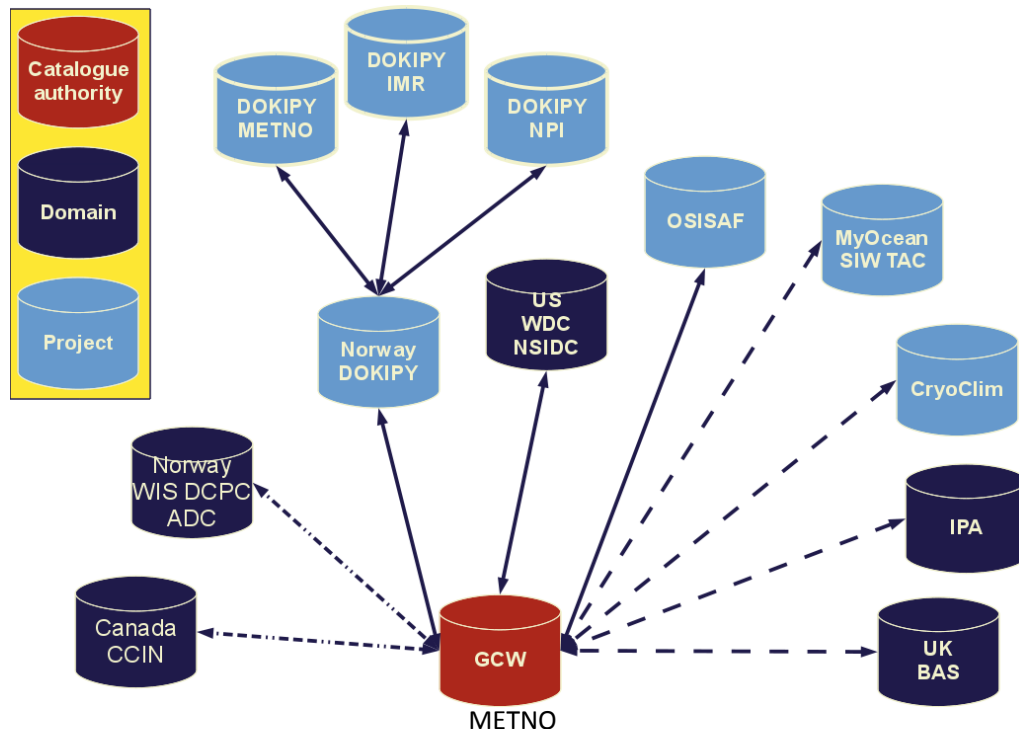




# ***BRINGING USERS AND PROVIDERS TOGETHER***

## ***ROLE of GCW WEB PORTAL***

The GCW web portal will provide the **ability to exchange cryosphere data, metadata, information and analyses** among a distributed network of providers and users in **support of informed decision-making**.



### **Data quality, sharing and access are fundamental principles**

- improve access to, and utilization of observations and products from WMO and other observing systems and from national and international data centres
- **built using the principles developed for IPY2007-2008.**
- facilitates the interaction between users and providers of the products



# Status



## Definition and Organization

- **GCW was approved as a WMO initiative** in May 2011. It has a small budget. We are now in the implementation phase.
- The **First GCW Implementation Meeting** was held November 2011. Participants were from 17 countries and at least 18 agencies, institutions, and international bodies.
- The GCW **organizational structure has been defined**. Membership in an Advisory Group and a Management Board is now being considered.
- GCW is overseen by the WMO Executive Council expert panel on Polar Observations, Research, and Services (**EC-PORS**).
- GCW is a component of the WMO Integrated Global Observing System (**WIGOS**).



# Status, cont.



## Task Progress

- CryoNet: Surface measurement **sites are being identified**. Many have been “offered”, e.g., Sodankylä, China, Sonnblick, IASOA(S)
- **Site types are being defined** (supersites, reference sites, observation sites)
- **Inventories of satellite and surface products** for GCW are being developed.
- The first **CryoNet workshop** will take place in November (Vienna). A **Snow Watch Workshop** is being planned
- Many **partnerships** have been confirmed.
- A **web portal** prototype has been developed. An information web site is under construction.
- The **GCW Implementation Plan** has been drafted and is under review.

# Needs and Questions



- **Surface Observations:**
  - What types of cryosphere measurements are made at Tiksi? (Snow, ice, permafrost). Snow obs from 1977; permafrost recently added, ...
  - What is planned? Will IASOA be adding more surface measurements?
  - What are the measurements methods and standards? Would Tiksi scientists be willing to contribute to assessing measurement standards and requirements?
- **Data exchange:** What is the data exchange policy for snow/ice obs?
- **Satellite products:** Which satellite products can help you?



