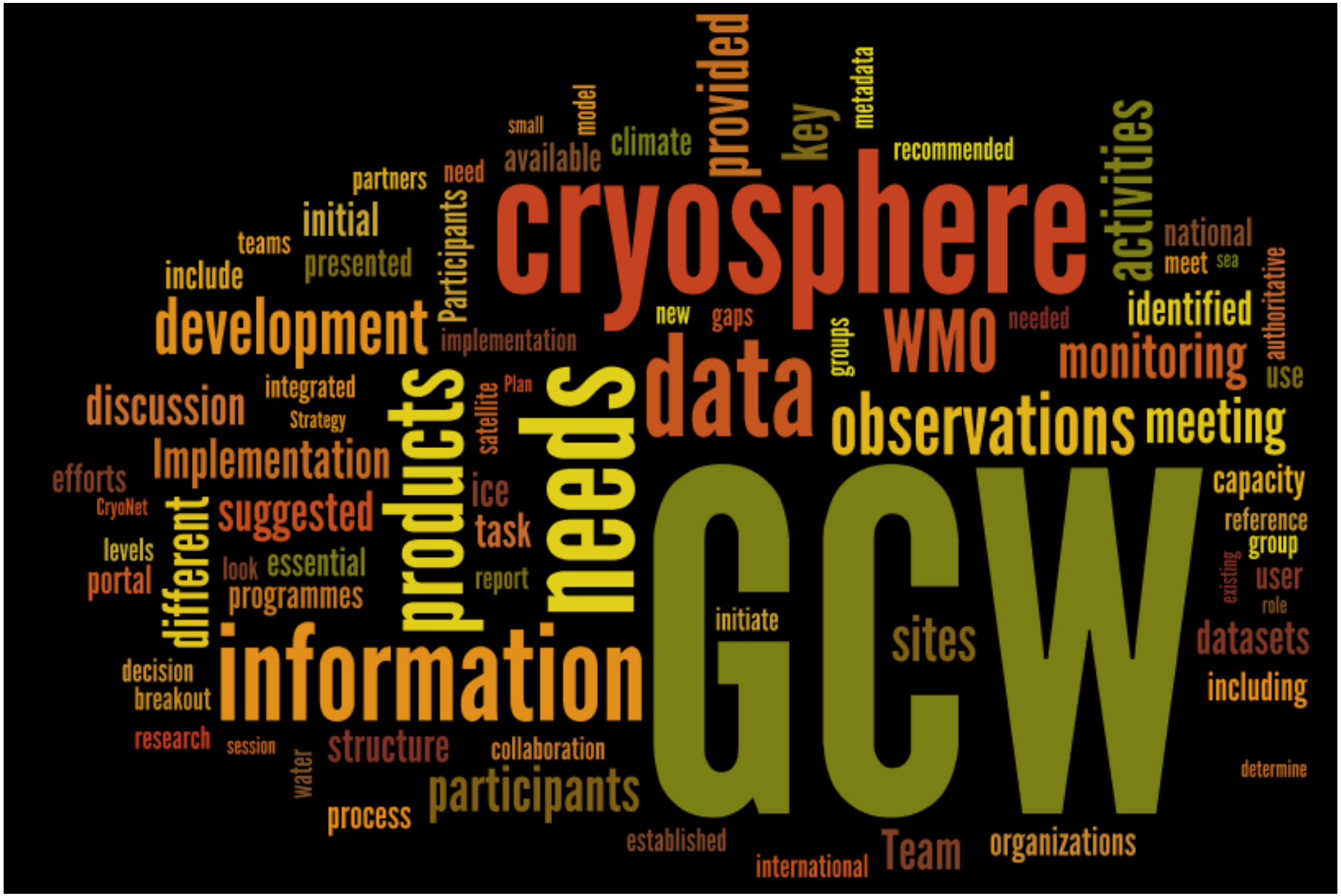
World Meteorological Organization

Working together in weather, climate and water

Global Cryosphere Watch (GCW)

ESA/EUMETSAT Workshop on European Satellite Snow Monitoring
Darmstadt, Germany December 4-5 2012

Dr. Barry Goodison, Scientific Officer
WMO Observing and Information Systems Department
(Retired, Environment Canada)



GCW when fully implemented is much more than observations and monitoring

GCW MISSION and KEY TASKS

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

Tasks:

- Implement recommendations of the IGOS Cryosphere Theme ("CryOS")
- Initiate pilot and demonstration projects
- Establish a network of surface sites, called "CryoNet"
- Establish Best Practices and standards for Surface Measurements
- Select candidate products for GCW
- Develop a web portal and interoperability for cryosphere users and providers
- Assess user needs and requirements
- Capacity development
- Communication and outreach
- Monitor Scientific Progress (added by WMO Congress)

A global priority for all time and space scales:
weather, climate water and related environmental matters

Observing Systems Working Group
(Jeff Key and Wolfgang Schoener)

- *will address capabilities and needs for surface-based and satellite observations*

CryoNet Team

- establish the surface-based network of reference sites and supersites; define types of surface sites, e.g., supersites, reference sites, and/or integrated sites operating a sustained, standardized programme for observing (standards, guidelines and best practices) and monitoring cryospheric variables; develop formal procedures for establishing the GCW network, evaluate potential supersites, and determine data availability and exchange.

Requirements and Capabilities Team

- will assess user needs; periodically review and update observing system requirements and capabilities and contribute to the WMO RRR database; link to the WMO Polar Space Task Group (PSTG).

Infrastructure and Practices Team

- will conduct an inventory of the current network, including infrastructure and practices, compile best practices, guidelines, and standards, determine what should be measured, and facilitate interaction and collaboration between the scientific and operational communities.

Products and Services Working Group

(Jim Abraham and Walt Meier)

- *will decide which products and services GCW will provide, develop the "clearinghouse" for products and services, develop data policies for GCW.*

Products Team

- will select a set of key GCW datasets; develop inventory of candidate products; includes intercomparison of products to assess quality and ensure an authoritative basis; develop data policies. Terminology sub-group will develop/evaluate glossaries, terminologies, vocabularies, and ontologies.

Portal Team

- will develop the web portal; evaluate candidate products, including meteorological data, and prepare an initial plan for development including linking to data contributors, testing by partners, working with national focal points, and developing documentation for outside use; will work through interoperability issues with data centres and other programmes.

Outreach Team

- will be an authoritative voice on cryosphere issues, to speak to the media and policymakers, develop outreach products, facilitate training of students and early career scientists, work with social media, and issue newsletters.

RESPONDING TO USER NEEDS – CONSULTATION, ENGAGEMENT, FEEDBACK

Changes in the cryosphere can have significant impacts on water supply, transportation, infrastructure, hunting, fisheries, recreation, ecology over range of time & space scales

Sea level rise threatens vital infrastructure.

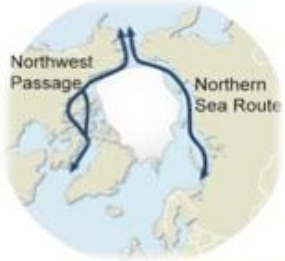
Changes in sea-ice affect access to the polar oceans and resources, tourism, and security. Declining summer sea-ice affects ocean circulation and weather patterns.

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.



Issue: Perspective and Scale

Modeling

Remote Sensing

Field Measurements

Regional and Global

10s of km

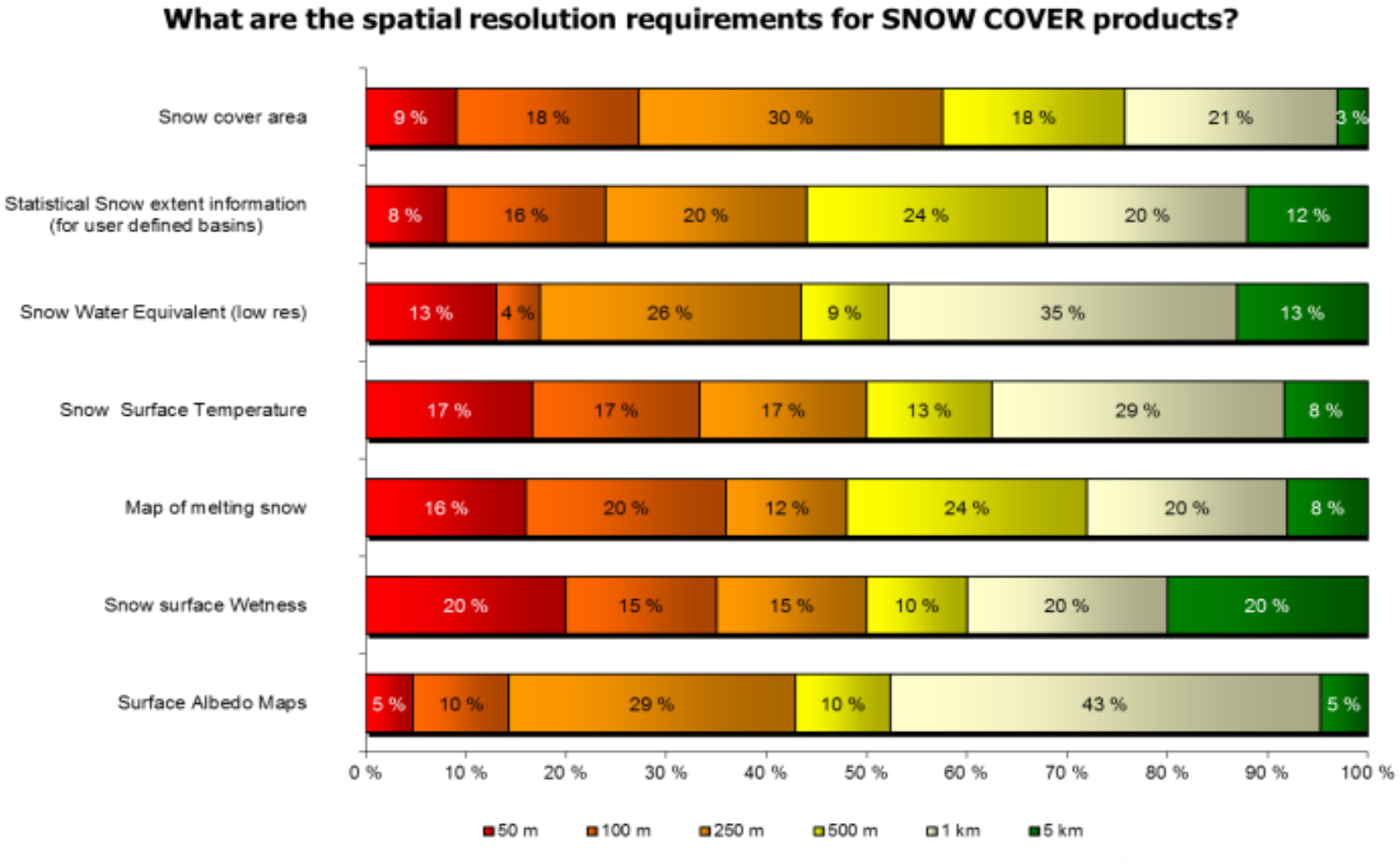
100s of meters

Point

= Calibration/Validation Scales

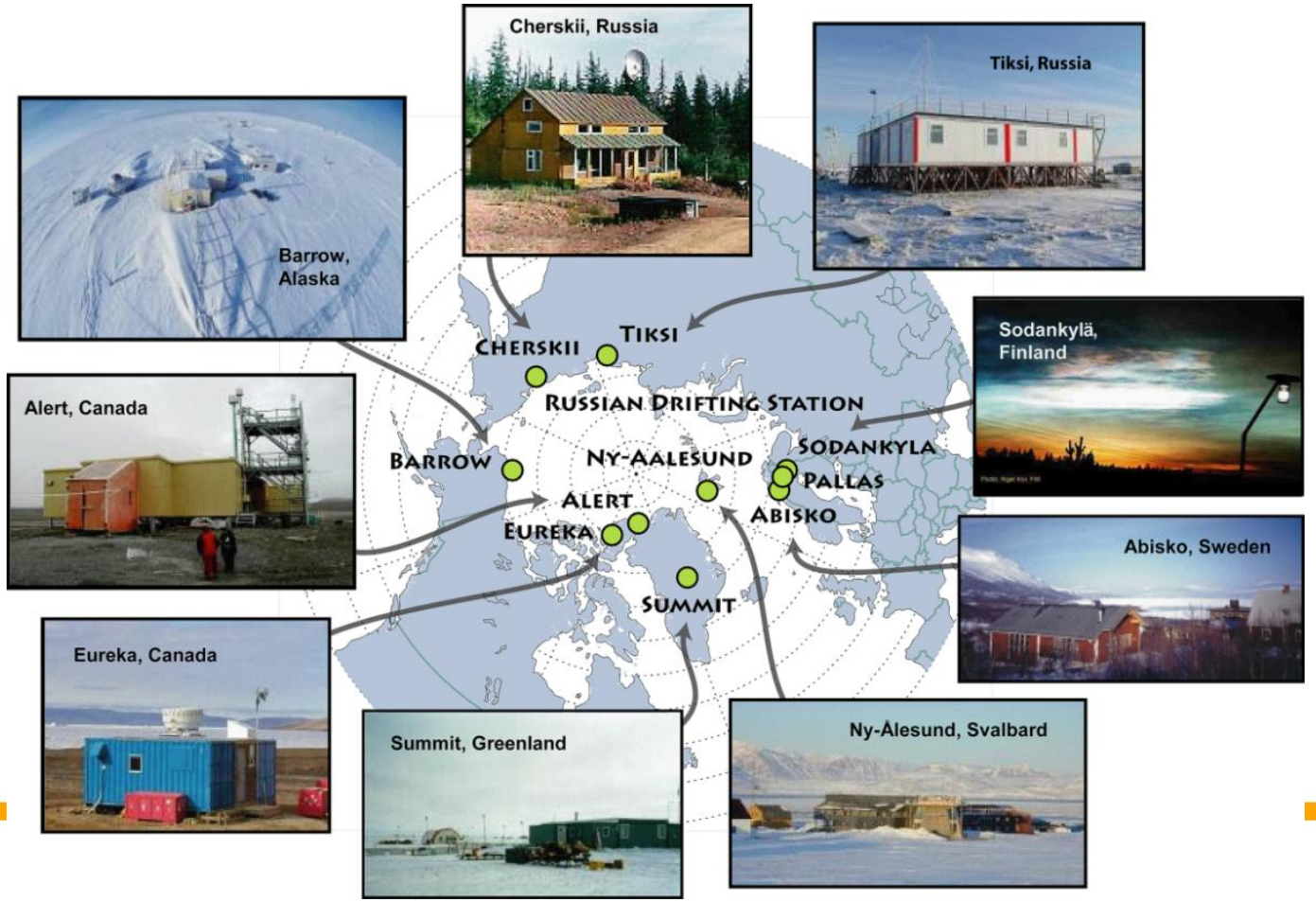
From Waleed Abdalati ICARPII

Spatial Resolution required for Snow Cover Products



Developing CryoNet
(over 80 suggested sites/networks)

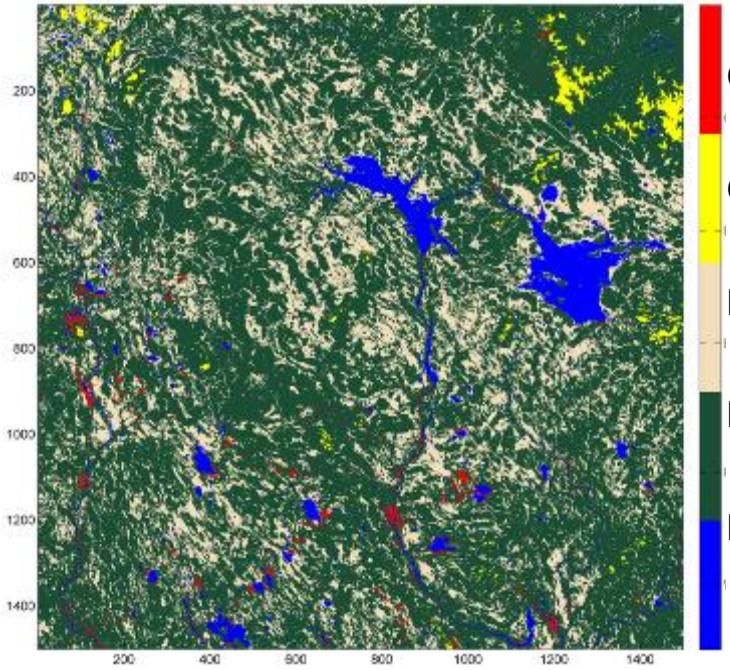
International Arctic Systems for Observing the Atmosphere and Surface (IASOAS): Consortium of sustained, ground-based international multi-disciplinary observatories.



Northern Finland test area

Northern Finland test area
300x300 km

Sodankylä-Pallas CAL/VAL
area 150x150 km



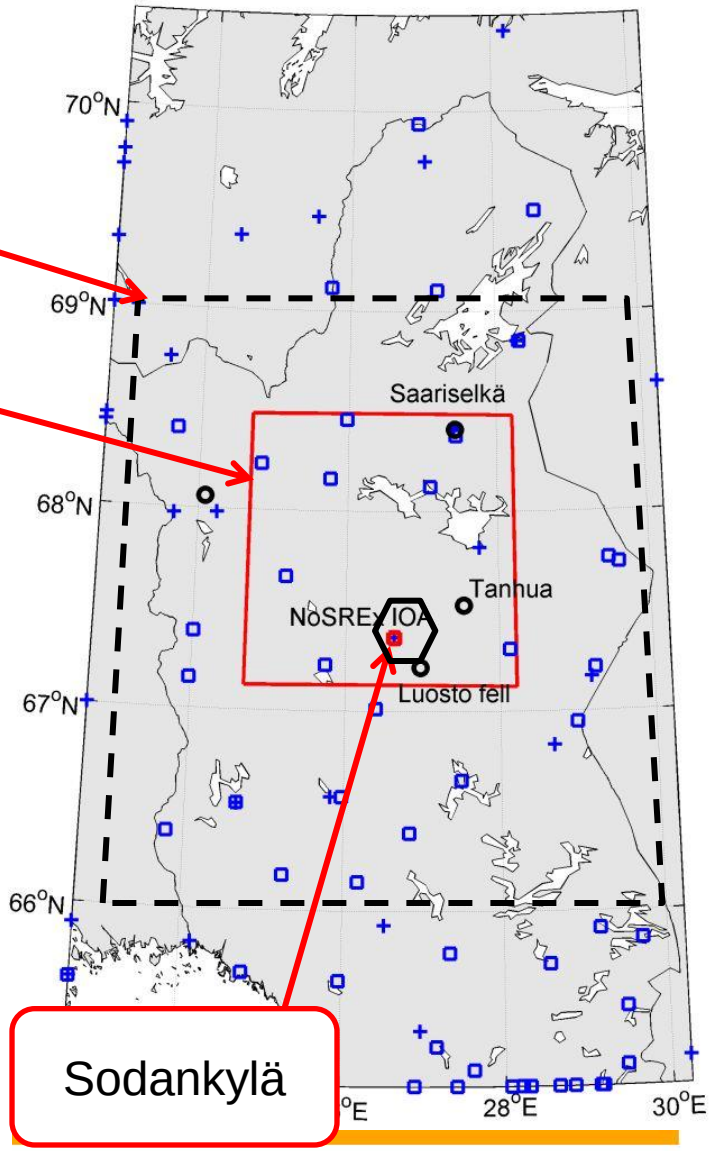
Other 0.8 %

Open (”barren”) 1.2 %

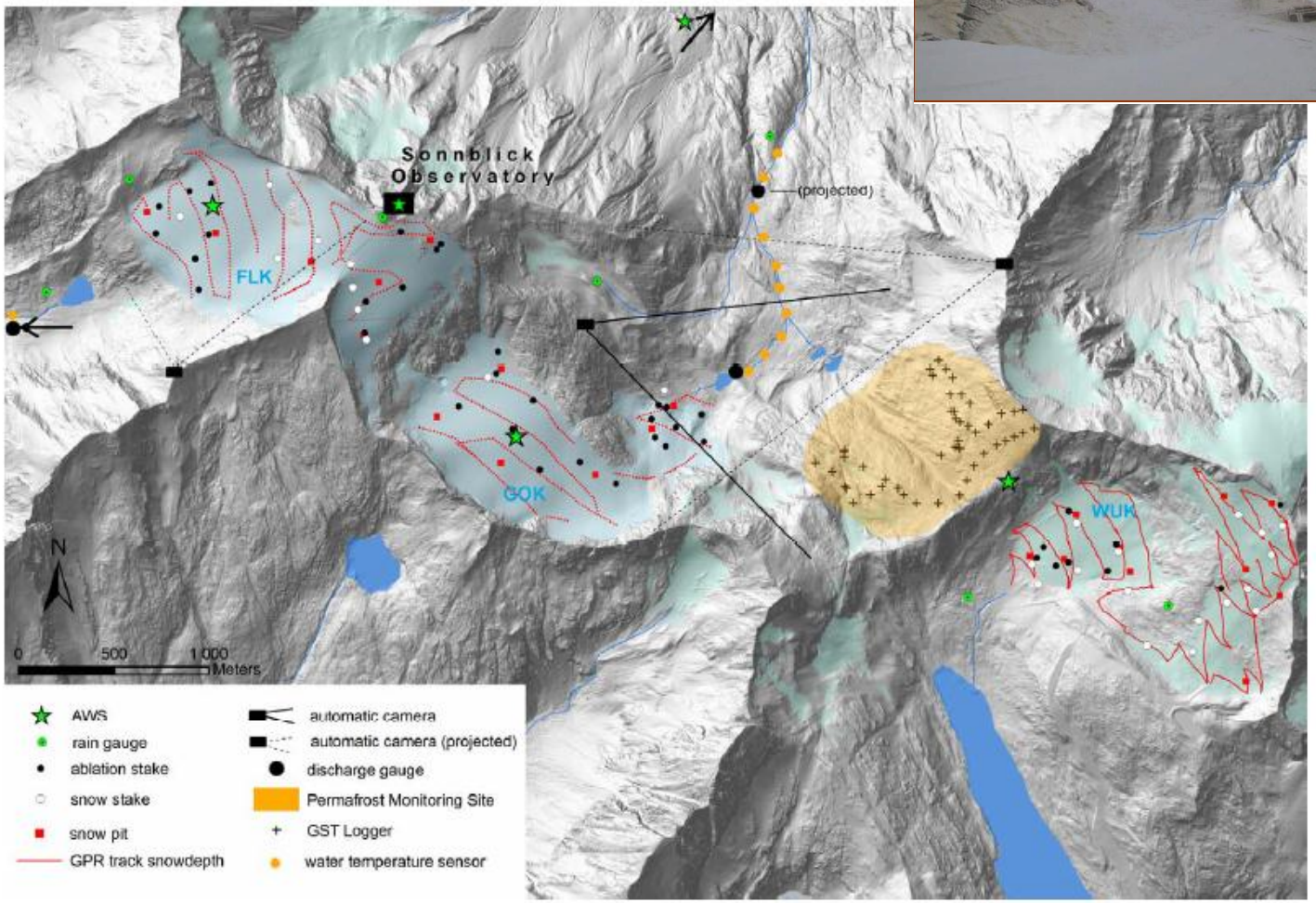
Bog 23.3 %

Forest 70.9 %

Lakes & rivers 3.7 %



SONNBLICK network:



Partnership in Standardization

Cooperation Agreement with ISO (2008):

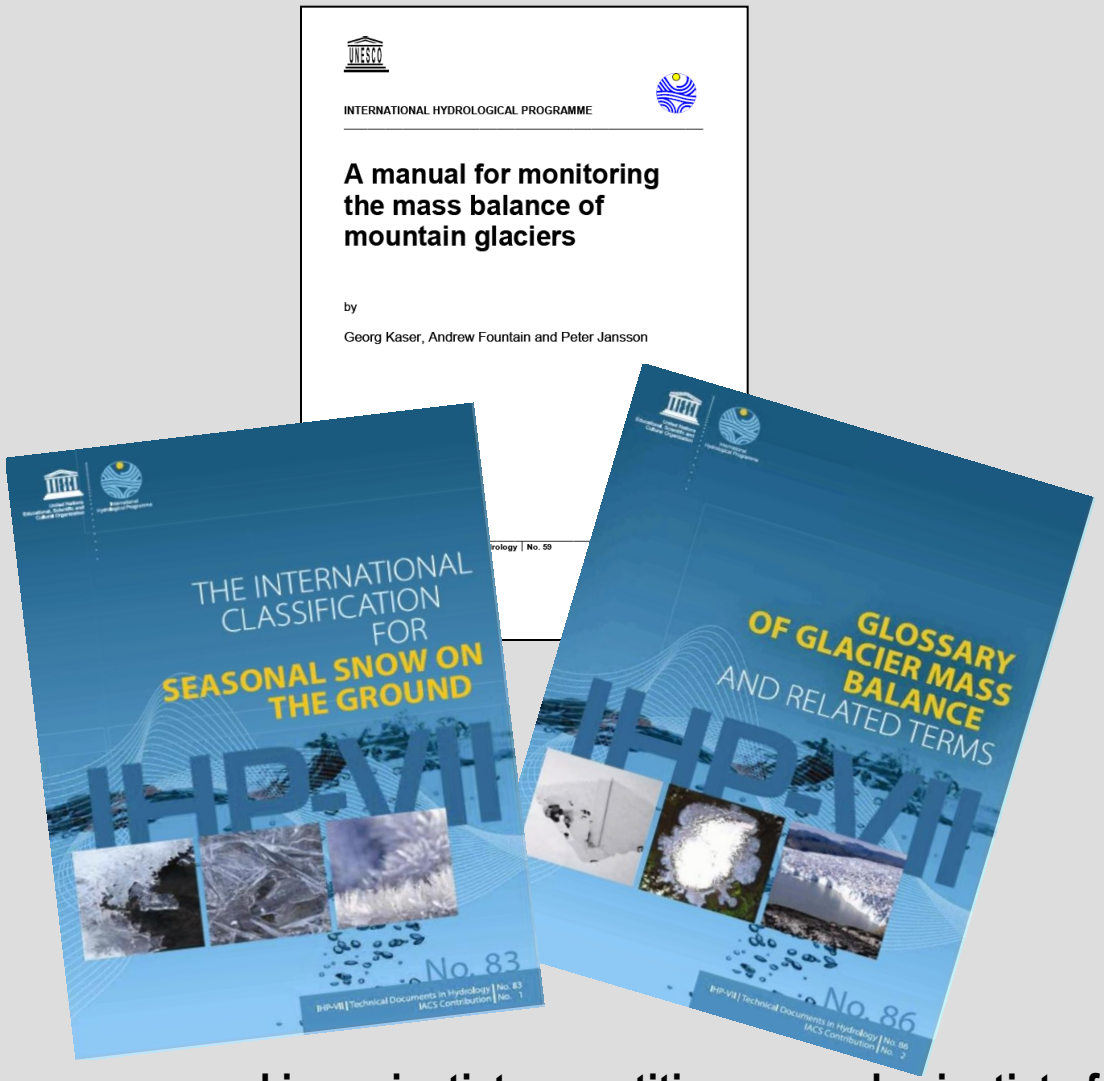
1. Development of **joint** ISO/WMO tech standards
2. WMO **existing** standards can become ISO standards
3. WMO retains primary **control** of its **own** standards
4. Underlines **authority** of WMO standards and enhances international **recognition** WMO standards

- **Need for GCW standards to be promoted to ISO standards?**

Working Arrangements with CIPM (2002):

- Ensuring **traceability** of measurements to SI
- Part of MRA: mutual **recognition** of standards & calibration & measurement certificates
- **Need for GCW measurements to be traceable to SI?**

WORKING GROUPS



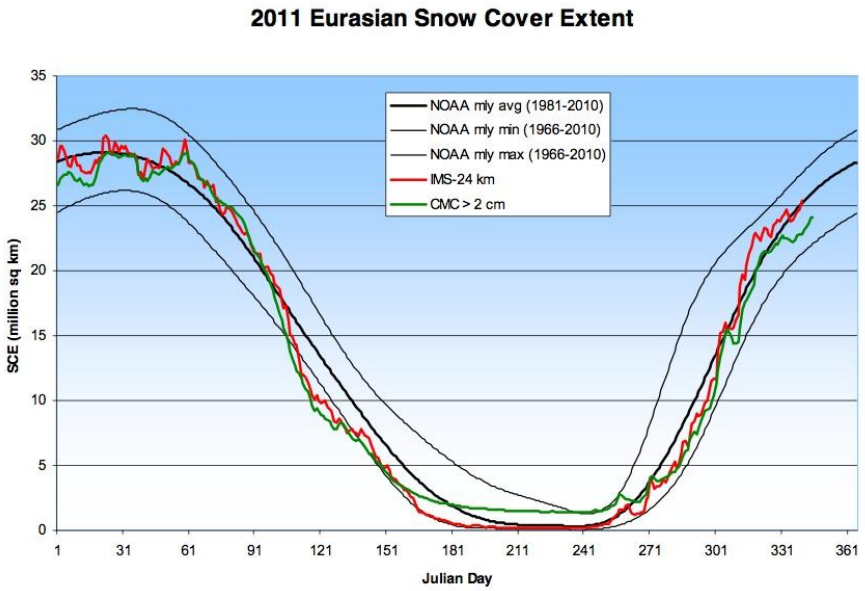
"IUGG urges snow and ice scientists, practitioners, and scientists from related disciplines to adopt these new schemes as standards."

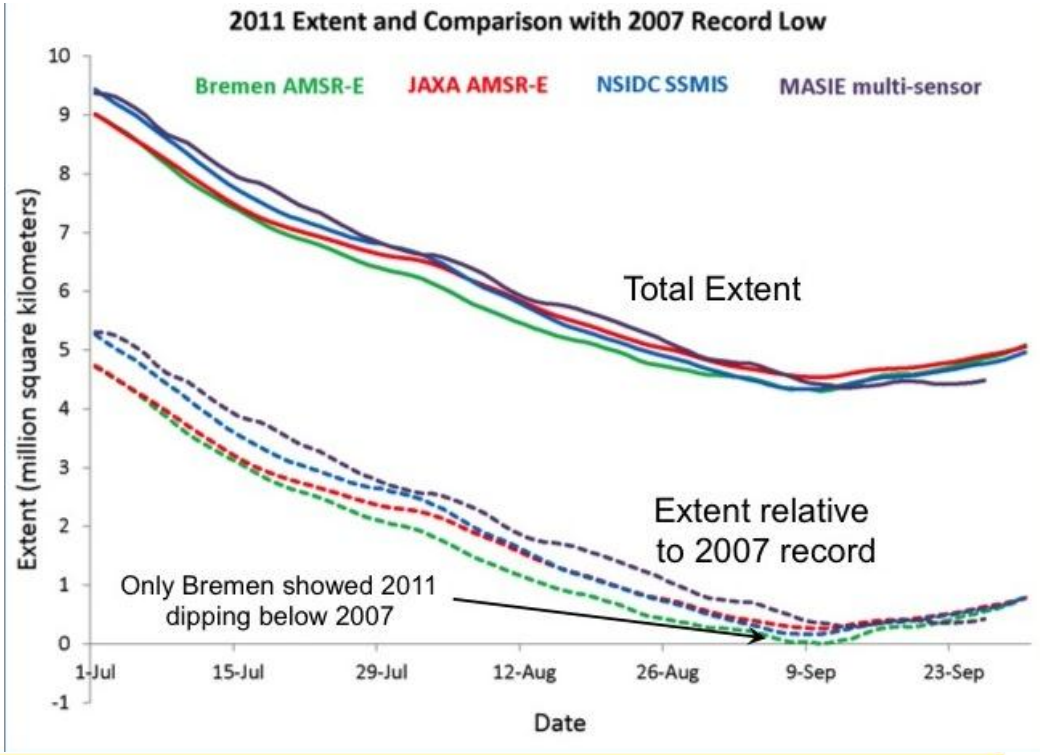
http://www.cryosphericsciences.org/products.html

IACS

Challenge: Product Selection

Product intercomparisons and error assessments are important





Observational Challenge: Snow Depth Data

Snow depth observations from synoptic stations (Eric Brun, MeteoFrance):

- GCW to launch an initiative aiming at:
  - identification of historical in-situ snow depth records on a worldwide basis
  - definition of the best way to process and control them in a common way
  - processing of these historical records by a task team gathering representatives of the concerned met services and snow scientists in order to feed-up a specific quality controlled data base
  - **real-time processing of snow depth record** to increment the data base (like GPCC for precipitation).
  - the identification of a **worldwide network of reference sites** with long-term snow-depth records to be preserved in the future.
- with CBS and concerned met services, clarify the observation of the absence of snow on the ground in synoptic messages, which does not seem to be the case presently
- To **exchange all snow depth data** (issue of "essential") – requires CBS engagement and updates to Manual on the GOS

Snow Products

GCW-Snow Watch

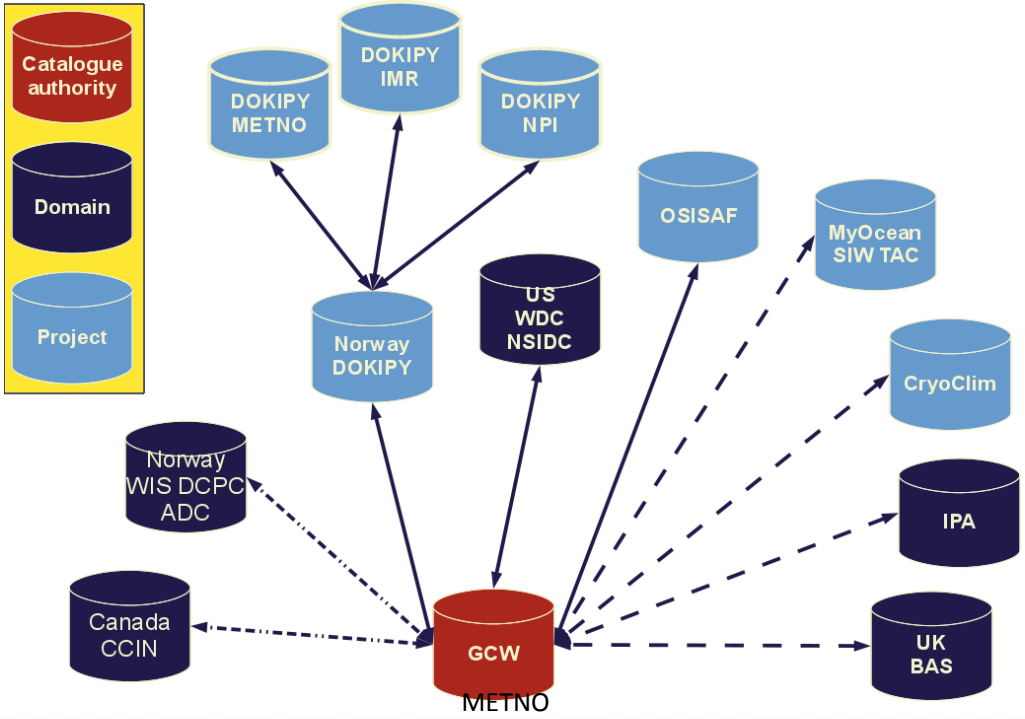
- development of pilot GCW product of near real-time hemispheric snow cover monitoring (SCE); then - real-time tracking of other snow components (e.g. SWE, depth, snow onset date, snow-off date)
- science advisory group to determine inclusion of regional snow cover monitoring initiatives, development of new products such a spatial maps of snow accumulation anomalies, enhanced data exchange, establishment of "reference" climatologies for anomaly tracking, incorporating snow-related initiatives from national GCW planning activities – relevant to the discussion at this workshop
- Use GCW Portal based on interoperability with contributing data centres

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.

Facilitating Knowledge to Action



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
- uses WIS, INSPIRE, GEOSS protocols

Table 2. Key GCW Implementation Activities

(Global activities shaded yellow, regional shaded green, national shaded grey)

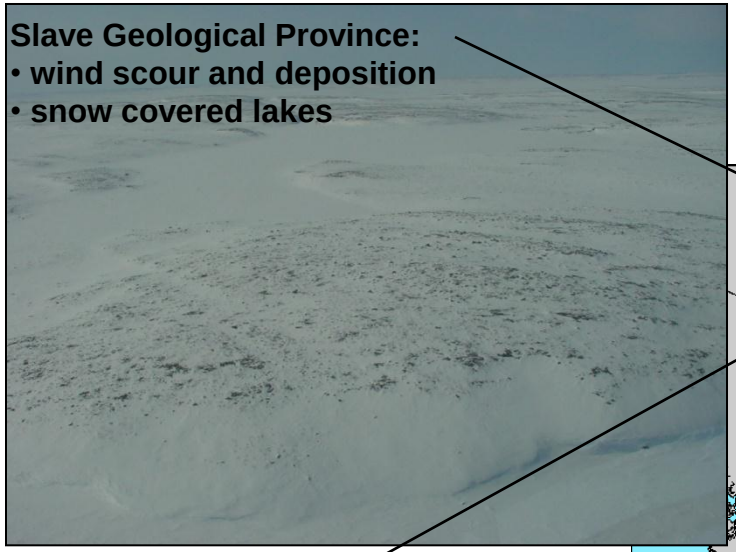
Task #	Activities	Responsibilities		Time Frame
		Lead	Other Stakeholders	
1. Governance				
1.1	Create an Advisory Group (AG)	EC-PORS	-	2012
1.2	Create a Management Board (MB)	EC-PORS, AG	-	2012
1.3	Establish working groups and task teams	AG, MB	-	2012
1.4	Establish national GCW groups	Members	-	2012-2015
1.5	Define a GCW WMO Program	EC-PORS, AG	-	Before Cg-XVII
1.6	Annual assessment of progress (indicators of success)	AG	WGs and Task Teams	Annually
2. Observing System and Products				
2.1	Select appropriate CryOS recommendations for GCW implementation	AG, MB, WGs	-	2012
2.2	Initiate pilot and demonstration projects	WGs	Members, …	2012-2016
2.3	Create an inventory of the current network and measurement practices	Infrastructure and Practices Team	NMHSs, research partners	2012-2013
2.4	Establish a network of surface sites (CryoNet)	CryoNet Team	NMHSs, research institutions	Ongoing
2.5	Select candidate products for GCW	Products Team	Focal Points	2012-2015
2.5.1	Perform satellite and in situ product intercomparisons	Products Team	PSTG, Focal Points, NMHSs	2012-2015
2.5.2	Historical data sets (data rescue; e.g., snow depth)	Products Team	NMHSs, data centres	2012-2015
2.6	Develop a web portal	Portal Team	MetNo, NSIDC	2012
2.7	Asess user needs and requirements; contribute to RRR	Requirements & Capabilities Team	NMHSs	2012-2015
2.8	Establish best practices and measurement standards	Infrastructure and Practices Team	NMHSs	2012-2015
2.9	Evaluate existing terminologies or glossaries; create or update as necessary	Products Team	Members, UNESCO, research partners	2012-2015
2.10	Annual State of the Cryosphere assessments	Products Team	-	Annually
3. Capacity Building				
3.1	Provide assistance to Members to introduce and implement GCW nationally			Ongoing
3.2	Develop GCW guidelines, training materials, and other relevant documentation			Ongoing
3.3	Develop partnerships with NMHs and international bodies.		NMHSs, international bodies such as IPA, GCOS, IASC, etc.	Ongoing
4. Outreach				
4.1	Develop information website	Portal Team, Outreach Team	-	2012
	Create outreach materials (handouts,	Outreach Team		

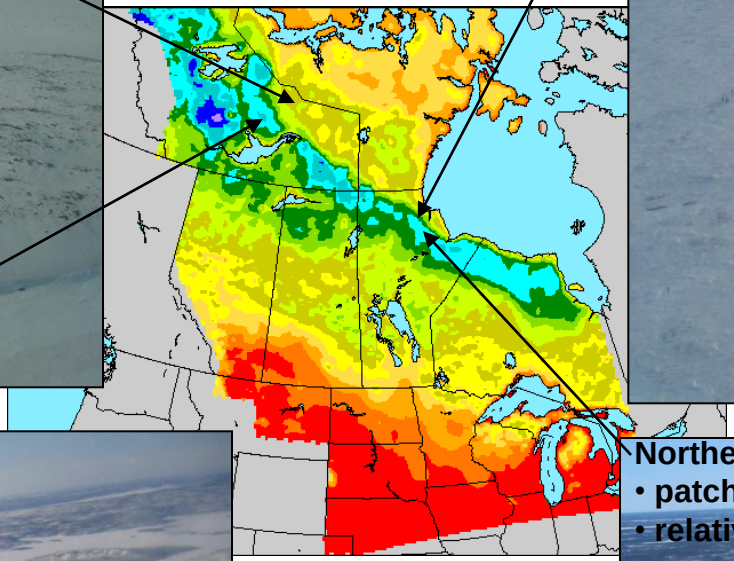
GLOBAL CRYOSPHERE WATCH (GCW)

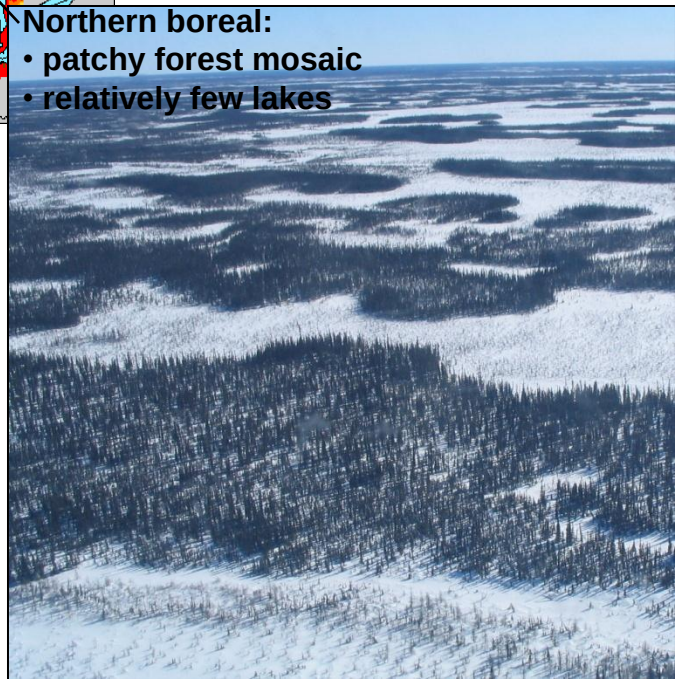
2013 Plans:

- Snow Watch workshop, Toronto, Jan 28-30 2013;
- action on follow-on activities from 3 workshops to date
- Update list of GCW focal points
- Seek approval from EC PORS on:
  - advisory group; management group; Implementation Plan for submission to EC for approval
  - Relationship with GEO and its proposed cold region/cryosphere initiative
- Portal and website activated to community
- Initiate:
  - CryoNet manual;
  - Designate first CryoNet sites;
  - tasks on guidelines, best practices and vocabulary with partners (with appropriate task meetings)
  - Feasibility of community based monitoring
- Development of a distributed IPO?

Do we know what we are really observing and modelling?

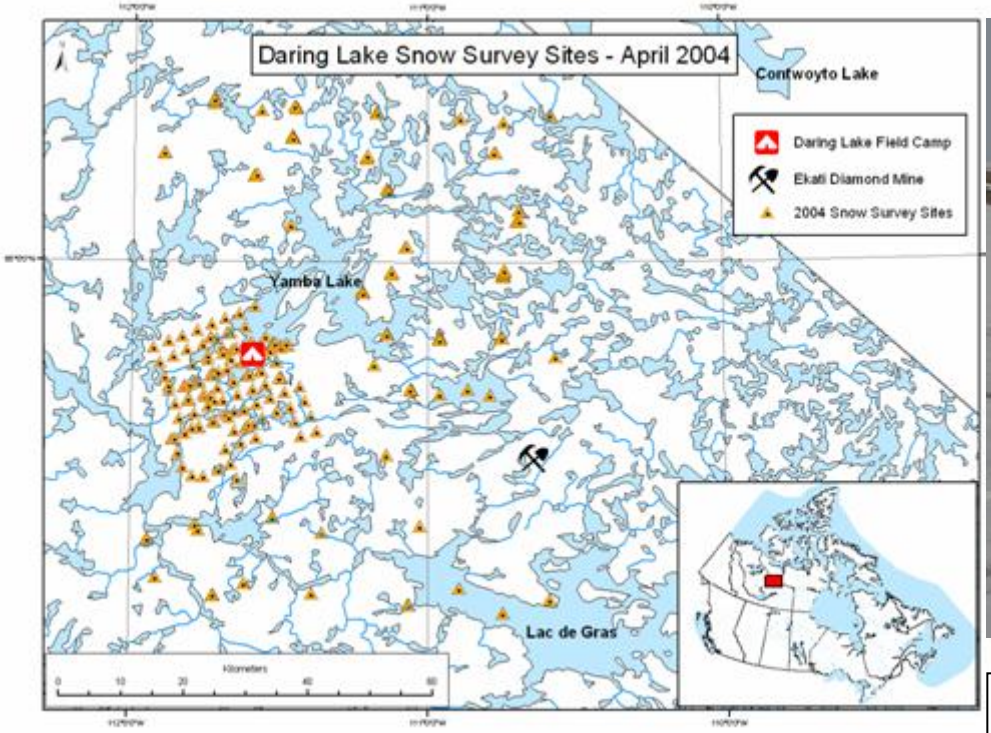


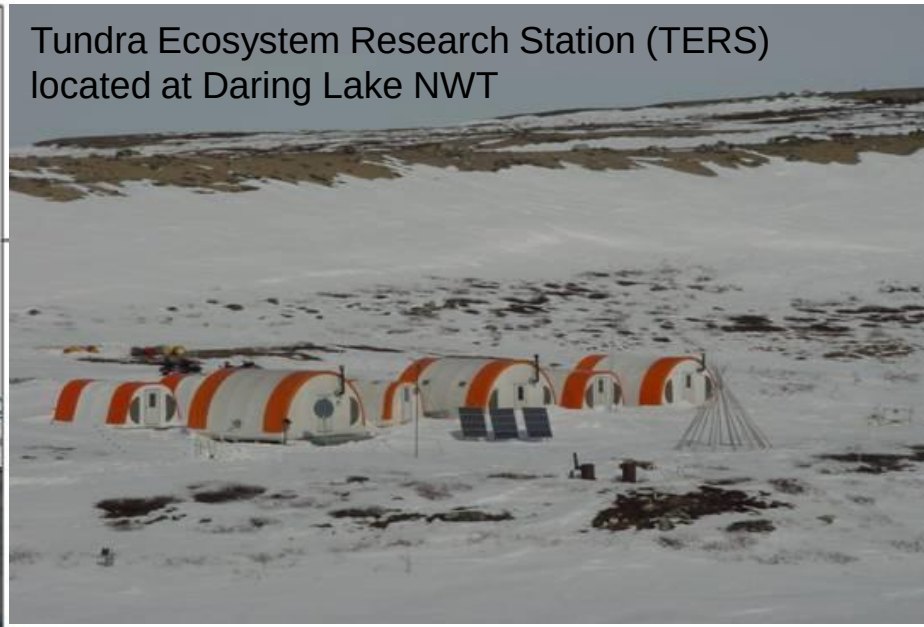


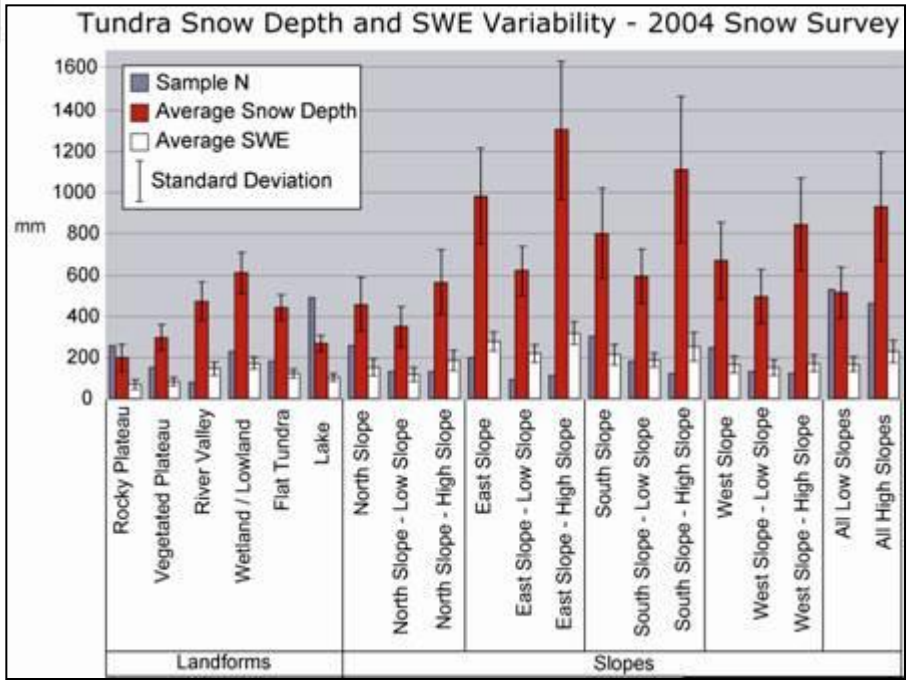


C. Derksen
Environment Canada

2004 Tundra Snow Survey Results







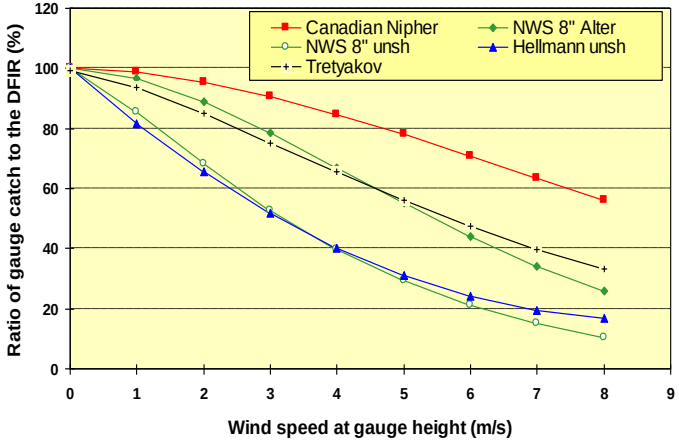
- Present passive microwave SWE retrievals (<100 mm) characterize SWE in open, wind-swept areas.
- Challenges in this environment include:
  - high snow density (up to 500 kg/m^3)
  - high SWE in confined drift areas – slope and aspect are significant
  - unresolved role of lake ice – fraction? ground-fast vs. floating?

Quantification of Cold Region Precipitation – An Ongoing Challenge

- *development of data sets, adjusted for known systematic errors, suitable for hydrological and climate modelling*
- *through IGOS-P and with others (CIMO, GCW, GCOS), update observing procedures and standards for cryospheric variables*
- *Development and assessment of new technologies for precipitation measurement in cold climate regions is essential – IPWG, WCRP*
- *WMO/CIMO/GCW focus on Precip in Cold Regions – strong link with GPCC*
- *GPM - Ground Validation in high latitudes*
- *What do modellers and remote sensing specialists need to validate precipitation in cold climates?*
- *What can we do for determining precipitation in data sparse regions, such as polar and alpine?*

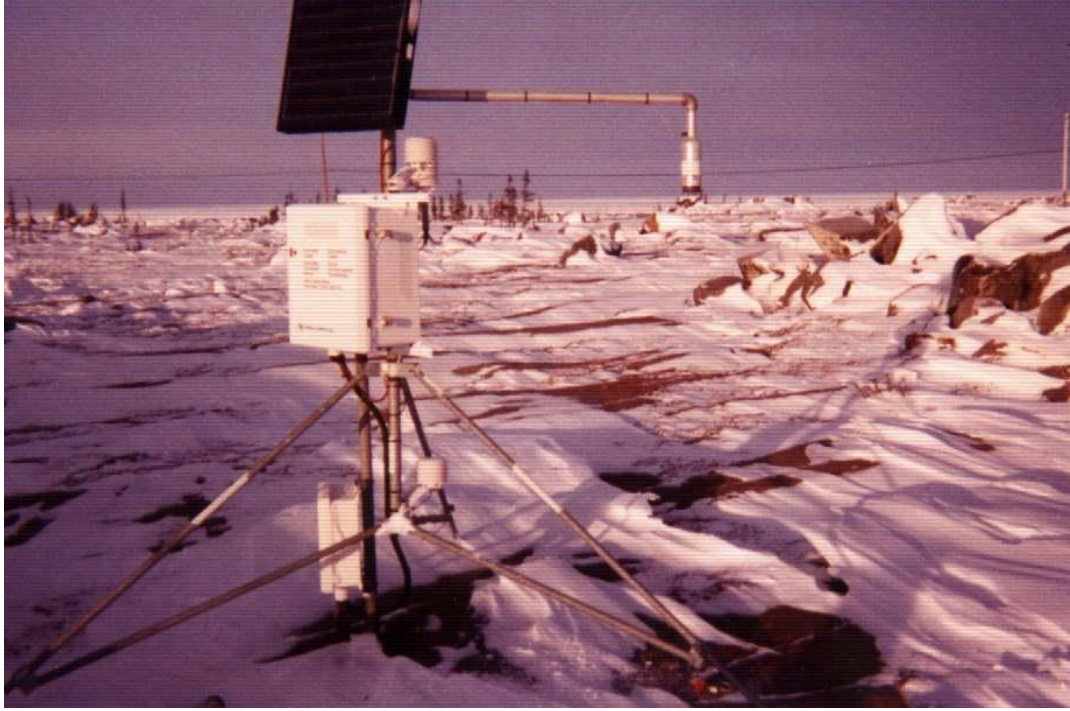
SPICE – *WMO/CIMO Solid Precipitation Measurement Intercomparison*

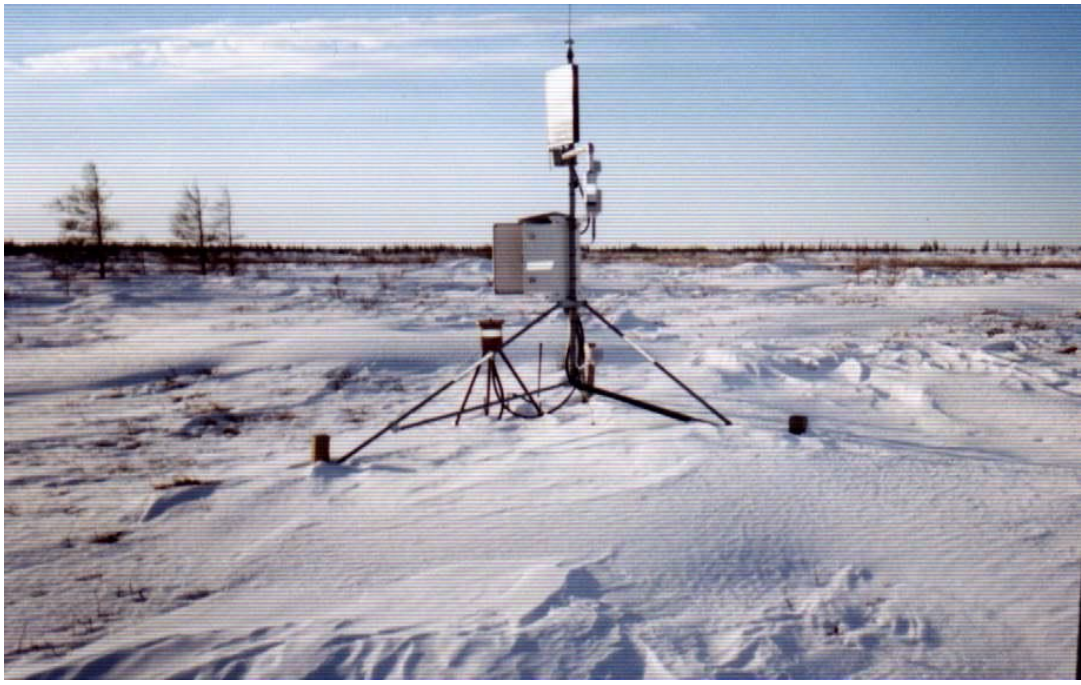
Impact of automation



AWS – Model and Satellite Validation

- Churchill RCT1 (top)
  Dec 2000
  Huge rocks create deep drifts, dry patches
- RCT2 (bottom) Mar 2003
  Open tundra with small obstacles creates
  20-30 cm drifts
- Flagging of trees points away from Hudson's Bay
- Dialogue between modellers and network operations
- CIMO intercomparison on solid precipitation, snowfall, snow depth measurements in various regions of the world (multi-sites) is important





European Satellite Snow Monitoring: Some Thoughts

SnowSTAR 2007 traverse across the Canadian tundra: challenges of deriving an areal SWE estimate

Henry Huntington

Points that GCW has to Consider: relevant to European satellite snow monitoring?

- time and space scale of global/regional product(s) – snow extent, depth, SWE, albedo? wetness? on sea ice/ice masses? snowpack chemistry?
- global vs regional; alpine vs continental
- production of standardized products, consistent over time that meet user needs
- incorporation of in-situ data; data fusion and merging of time series
- production of products that can be matched to models & satellite products of varying scales
- evaluation (validation, intercomparison) of product(s); sustainability of products; freely available and accessible