

# **Global Cryosphere Watch**

**WMO IPY Intercommission Task Group**

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Geneva, Switzerland**

**Dr. B. Goodison, Chair, CliC SSG  
and Environment Canada  
Dr V. Ryabinin, WCRP/CliC**



The cryosphere collectively describes elements of the earth system containing **water in its frozen state** and includes **sea ice, lake and river ice, snow cover, solid precipitation, glaciers, ice caps, ice sheets, permafrost and seasonally frozen ground.**



The cryosphere exists at all latitudes and in about one hundred countries.



# Media and Policy Perspectives

## Socio-economic Impacts

**Inuit say spring in the Arctic is becoming more dangerous**



**No turning back on arctic warming**



**Warning for the North; Polar bears could face extinction as global climate change warms the Arctic**

**Melting Ice sheets, glaciers and global sea level rise**



**Thawing permafrost, GHG emission and coastal erosion**



**Farmers worried about absence of snow**

**Tourism at risk**



**Disappearing Glaciers Menace Water Supplies**



**Damage to buildings and infrastructure**

**Floods feared as glaciers melt**

# Cryospheric Information and Knowledge

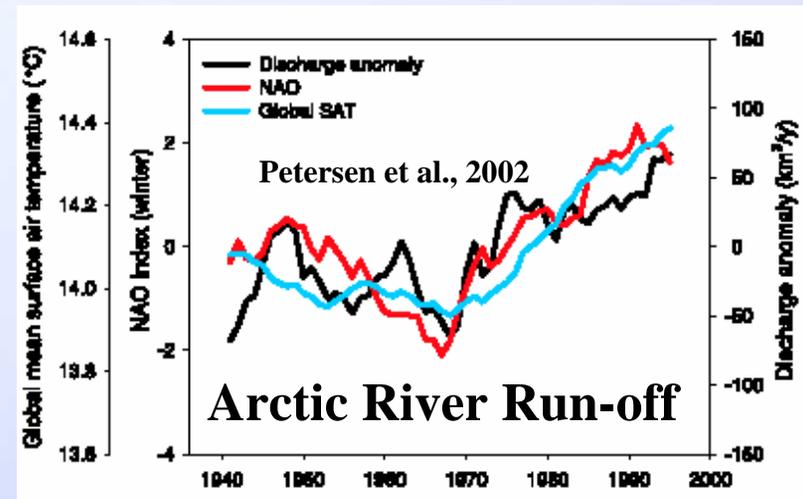
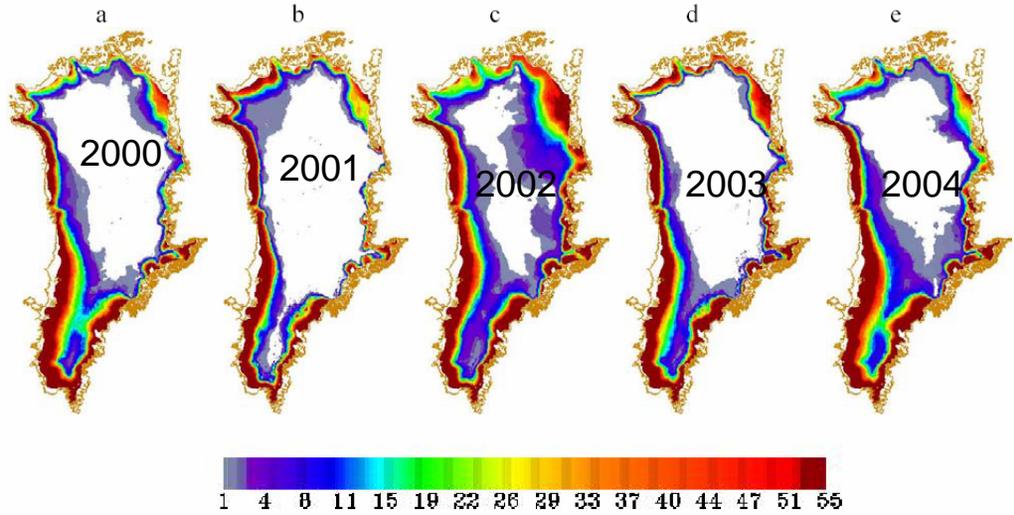
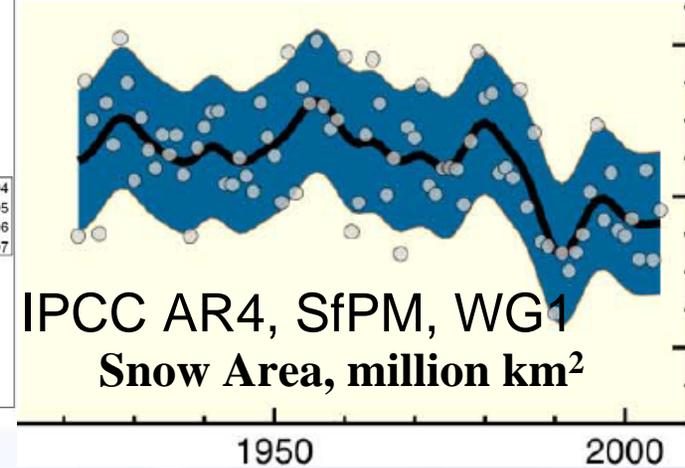
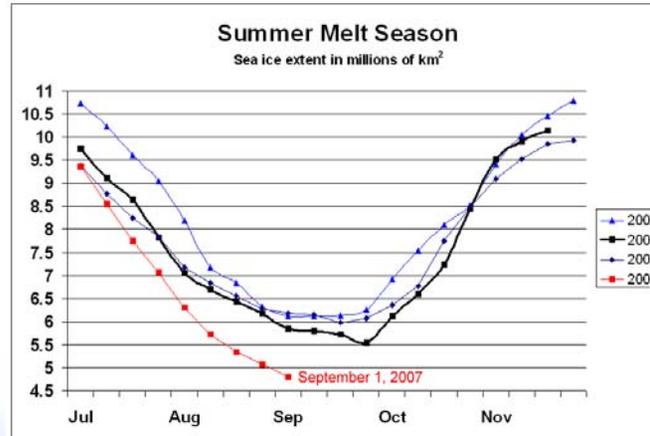
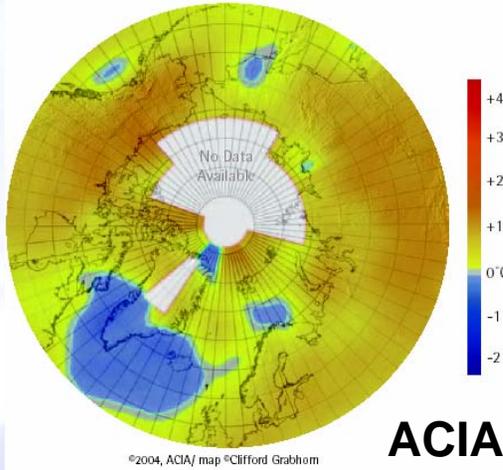
## Importance of the Cryosphere for Society

|              |         |
|--------------|---------|
| Disasters    | ★ ★     |
| Health       | ★ ★     |
| Energy       | ★ ★ ★   |
| Climate      | ★ ★ ★ ★ |
| Water        | ★ ★ ★ ★ |
| Weather      | ★ ★ ★   |
| Ecosystems   | ★ ★ ★   |
| Agriculture  | ★ ★     |
| Biodiversity | ★ ★     |



+ Transport ★ ★ ★ ★

# Observed changes

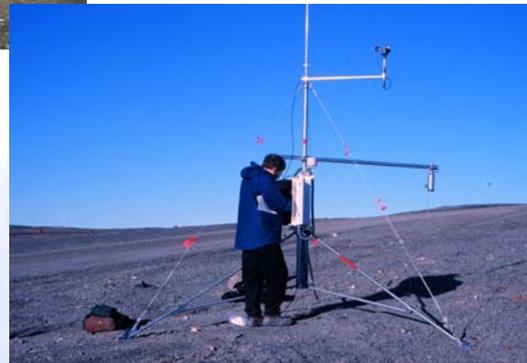


Melt extent and duration (number of days) from QuikSCAT, 2000-2004 (Source: Wang and Sharp, 2006)

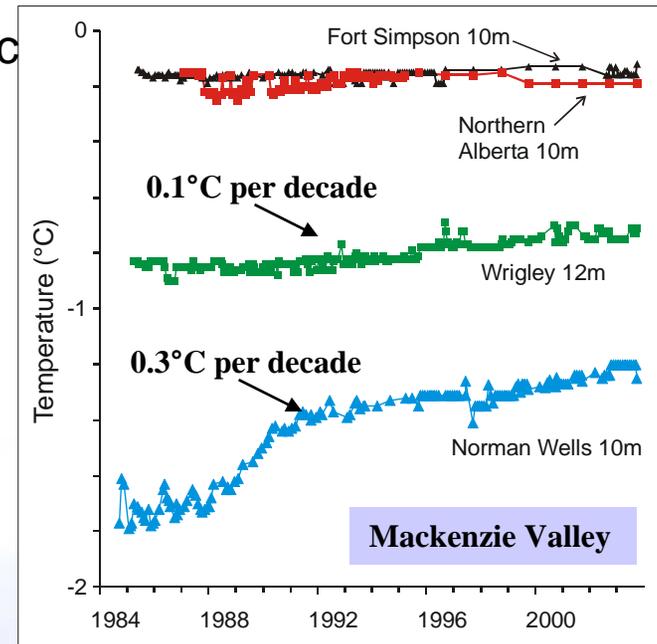
Has a separate cryosphere chapter in the IPCC Fourth Assessment!

# Trends in Permafrost Temperature across the Canadian Arctic

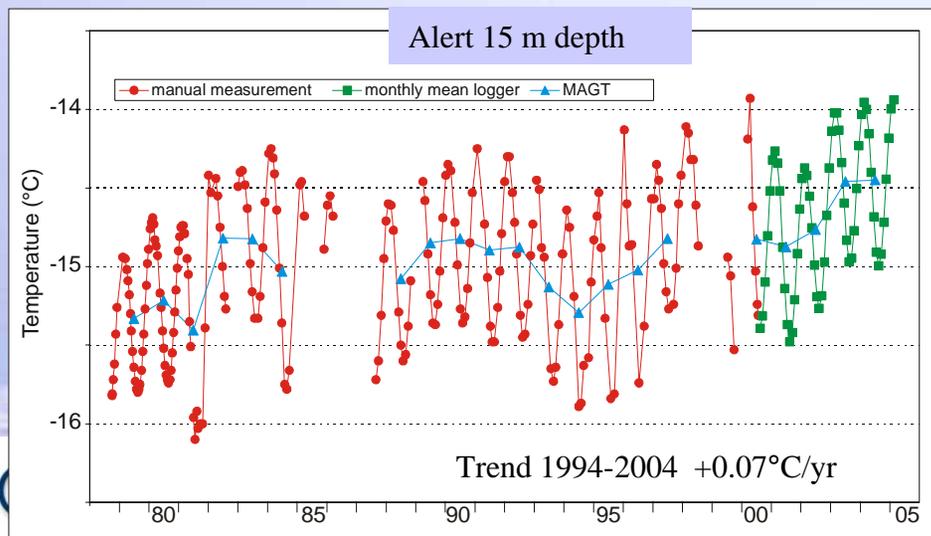
## Arctic



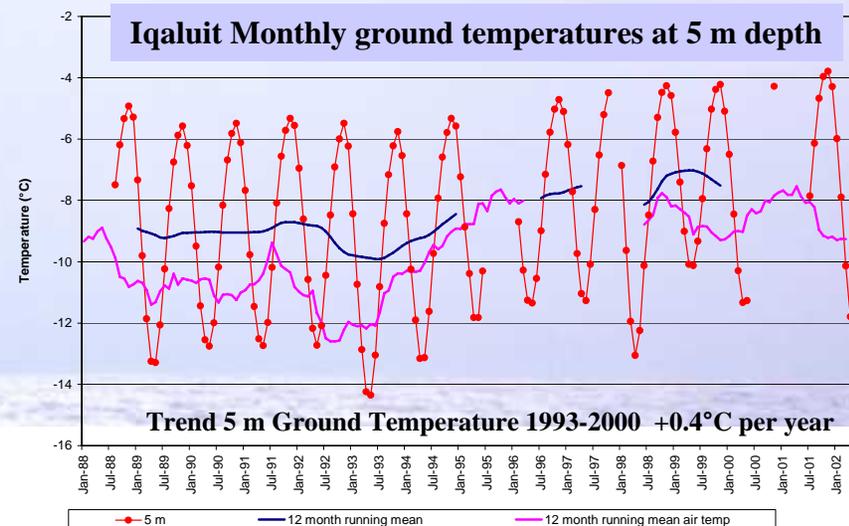
## Western Arctic



## High Arctic



## Eastern Arctic



# Glaciers

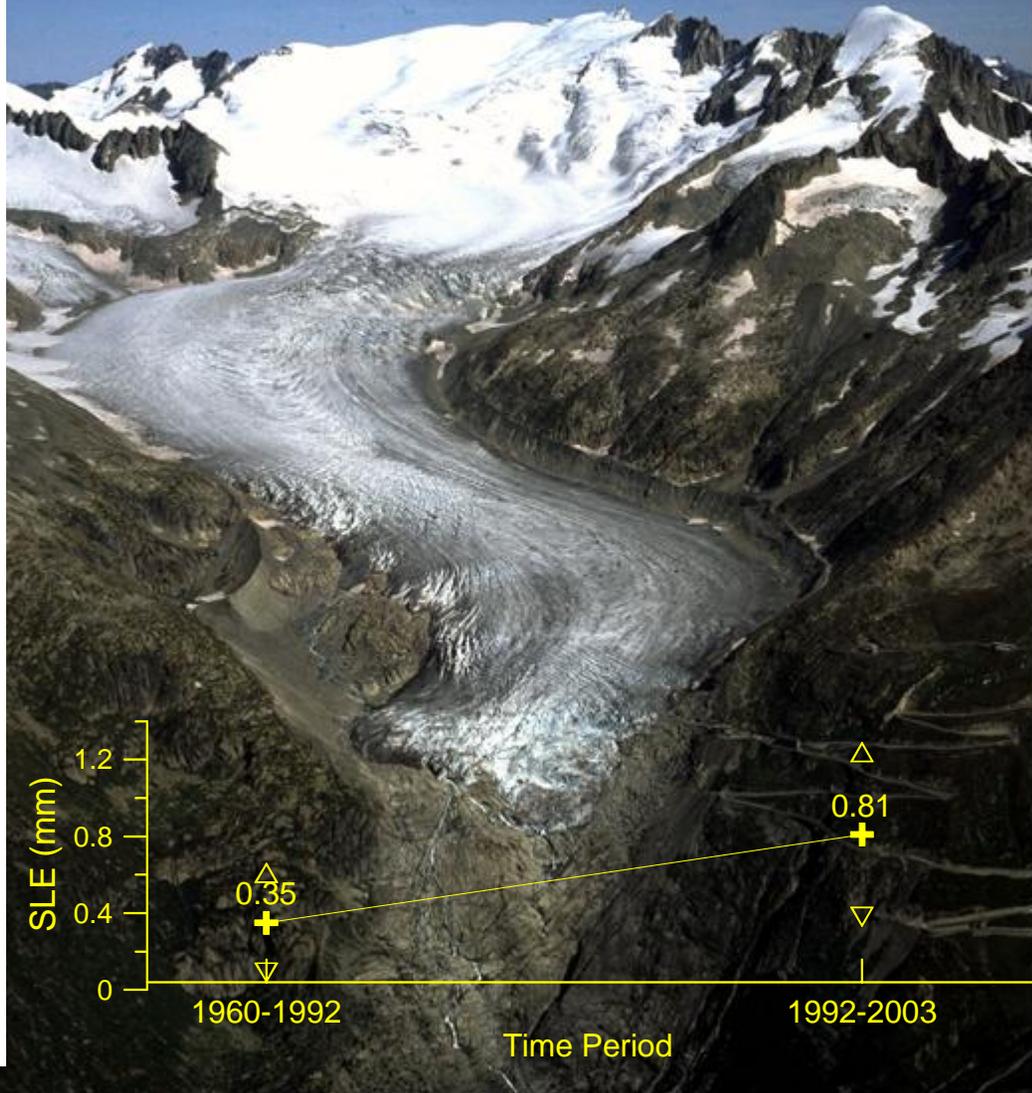
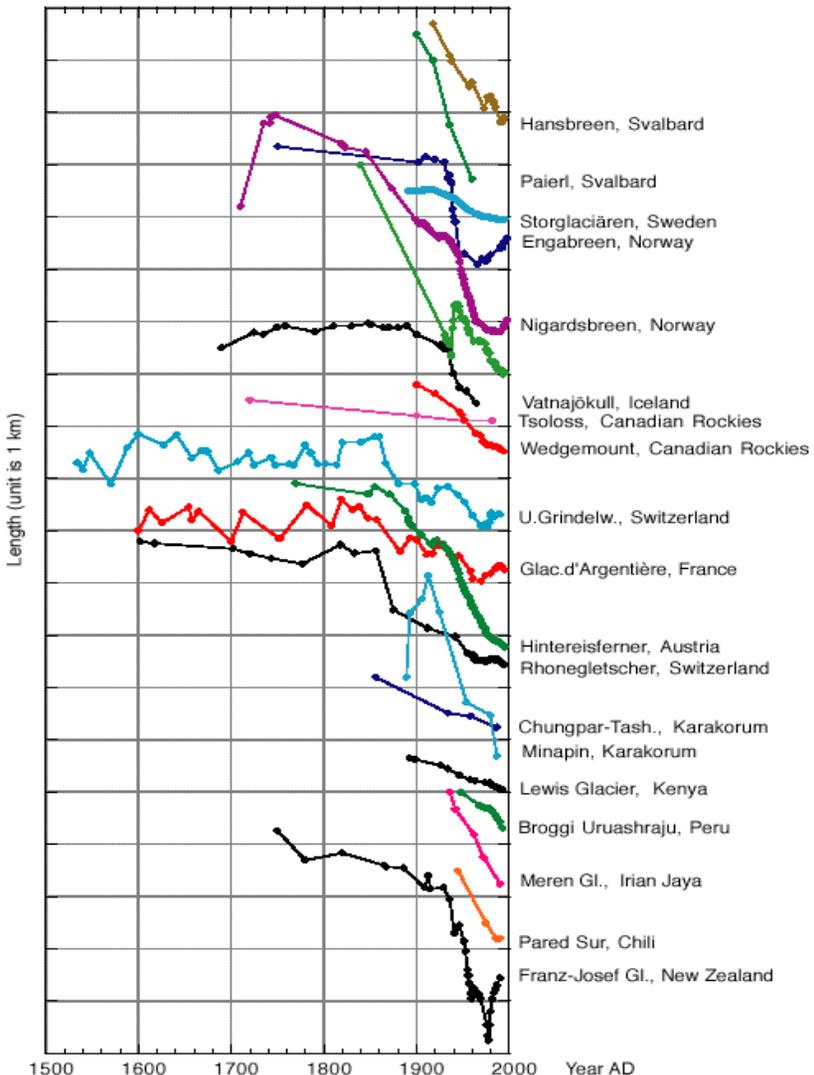
Period: 1960/61 - 2002/2003

Global Area:  $785 \cdot 10^3 \text{ km}^2$

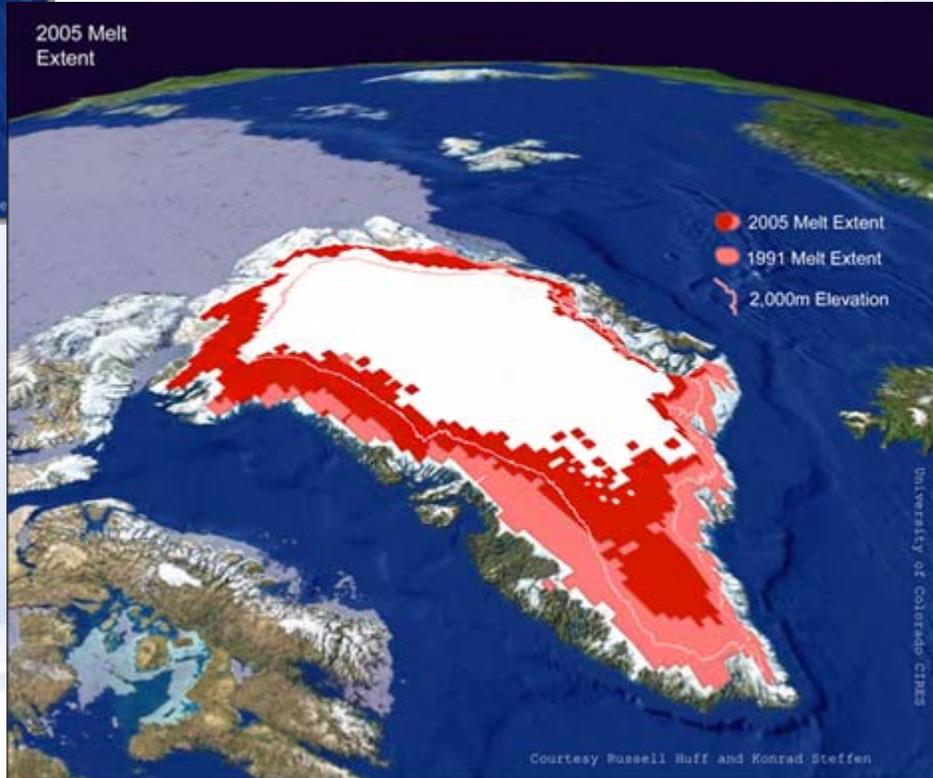
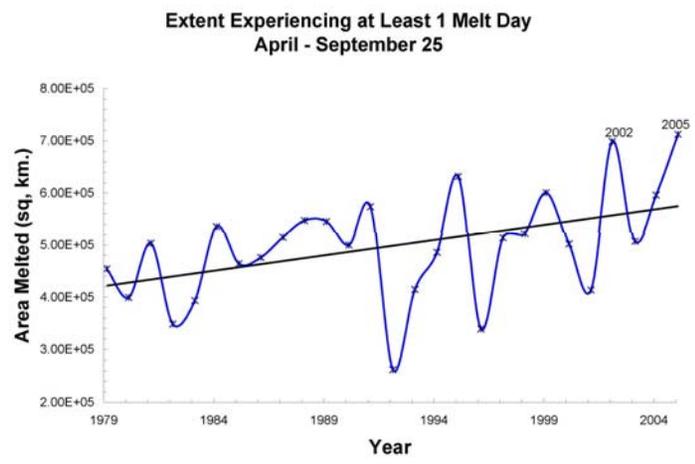
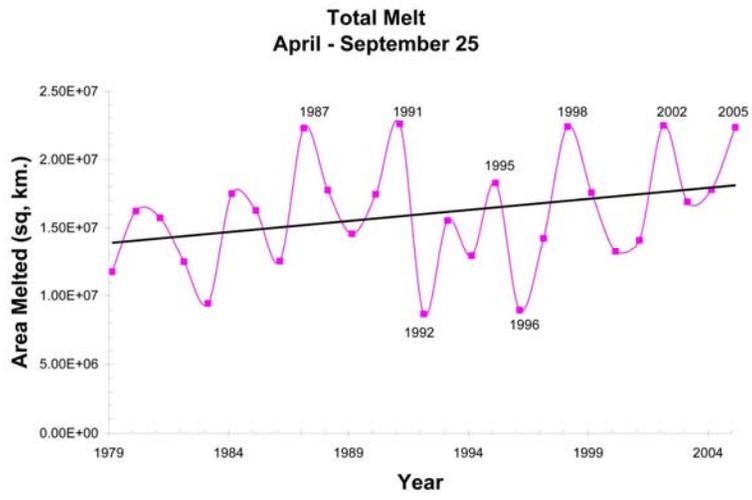
Specific balance:  $-233 \text{ kg m}^{-2} \text{ a}^{-1}$

Mass balance  $-183 \text{ Gt a}^{-1}$

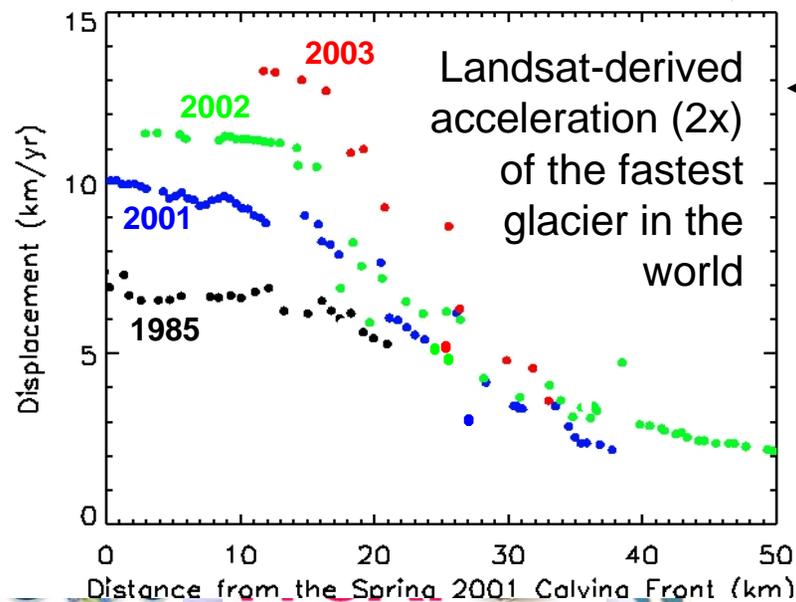
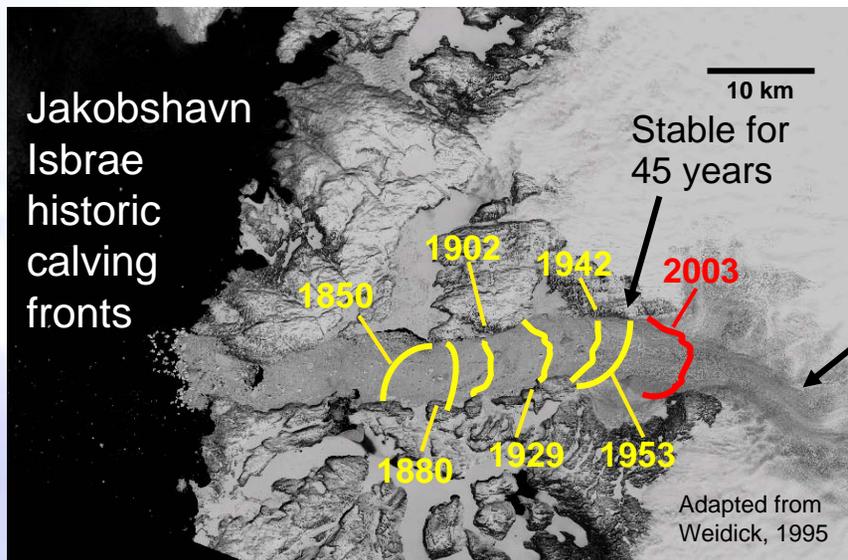
SLE  $0.51 \pm 0.32 \text{ mm}$



# Greenland Ice sheet Melt Extent 2005 – another record melt year



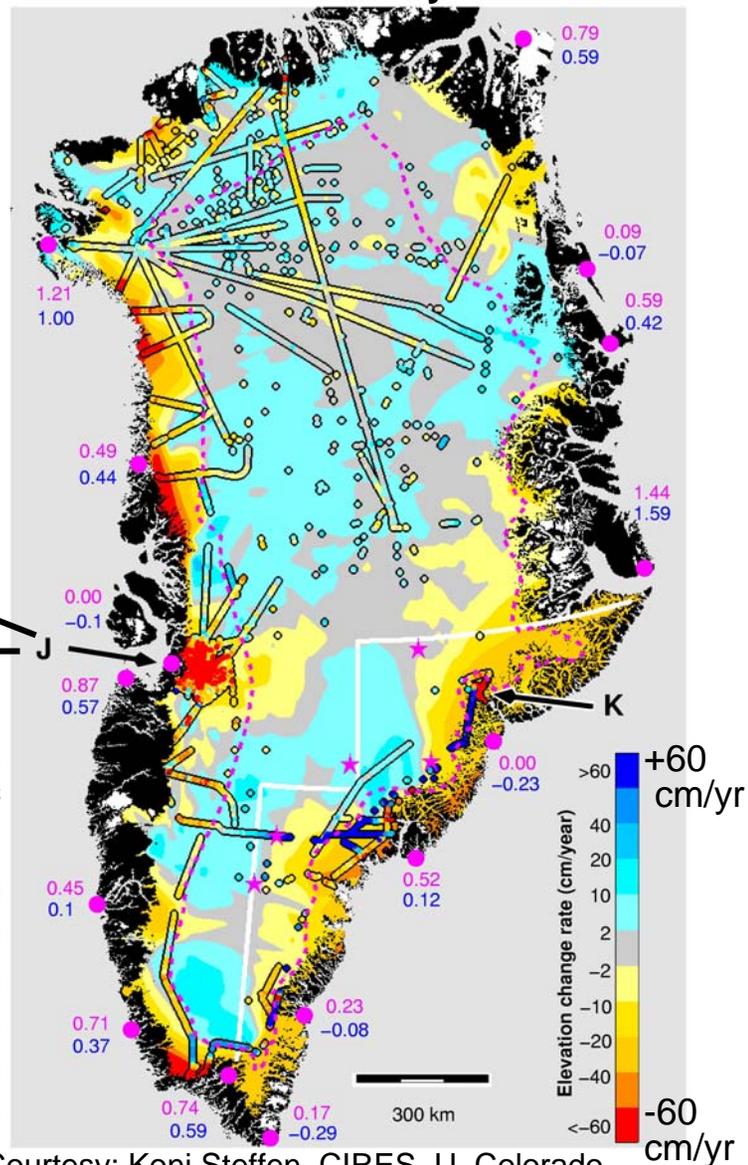
# Greenland Margins

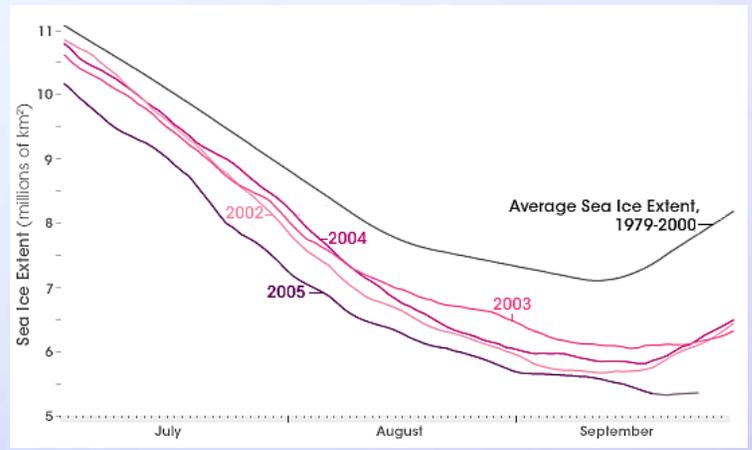
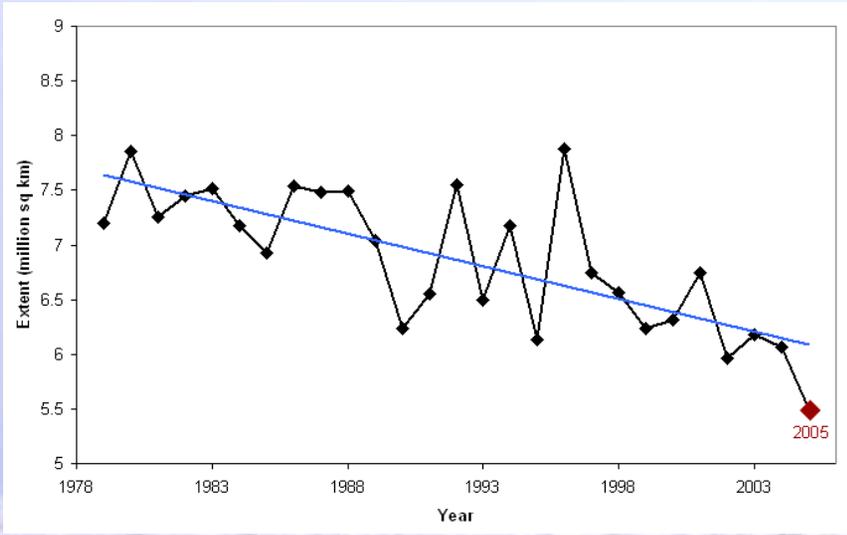
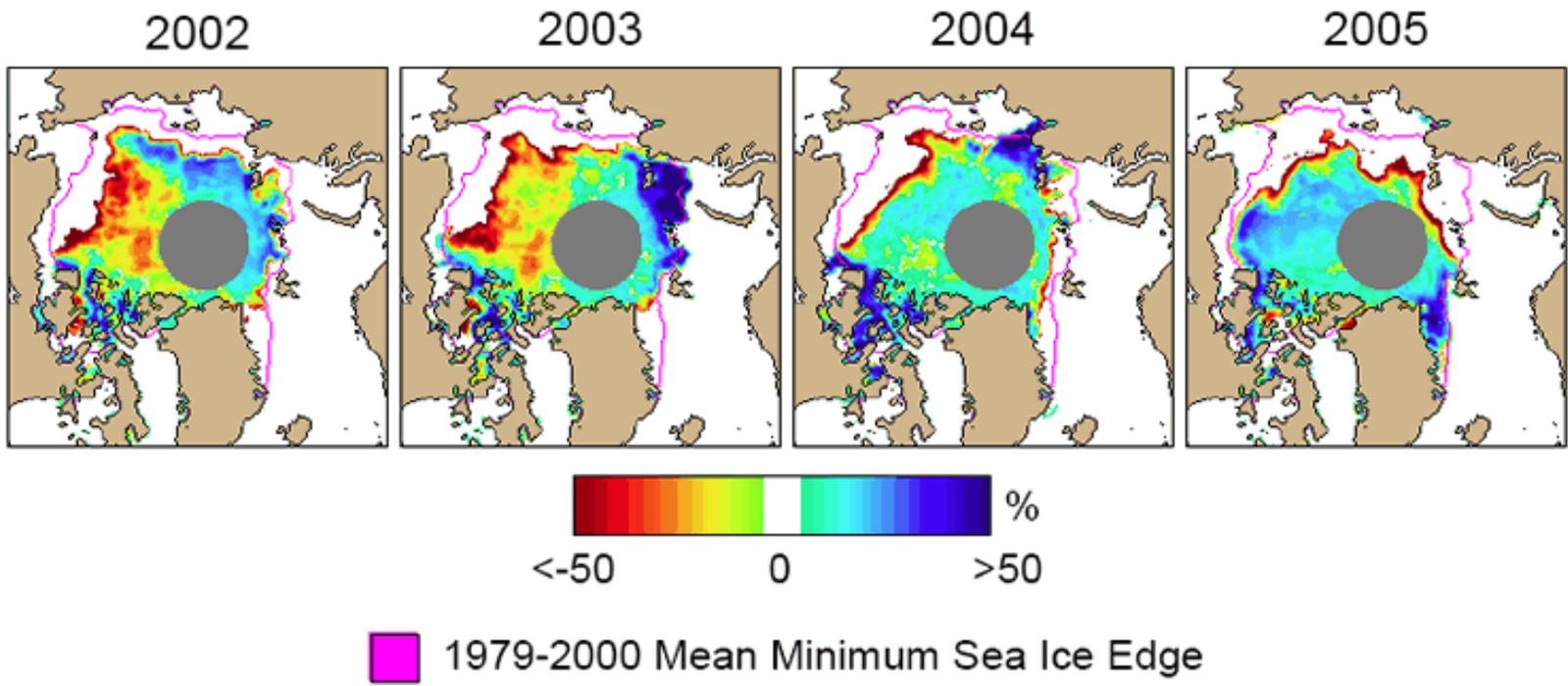


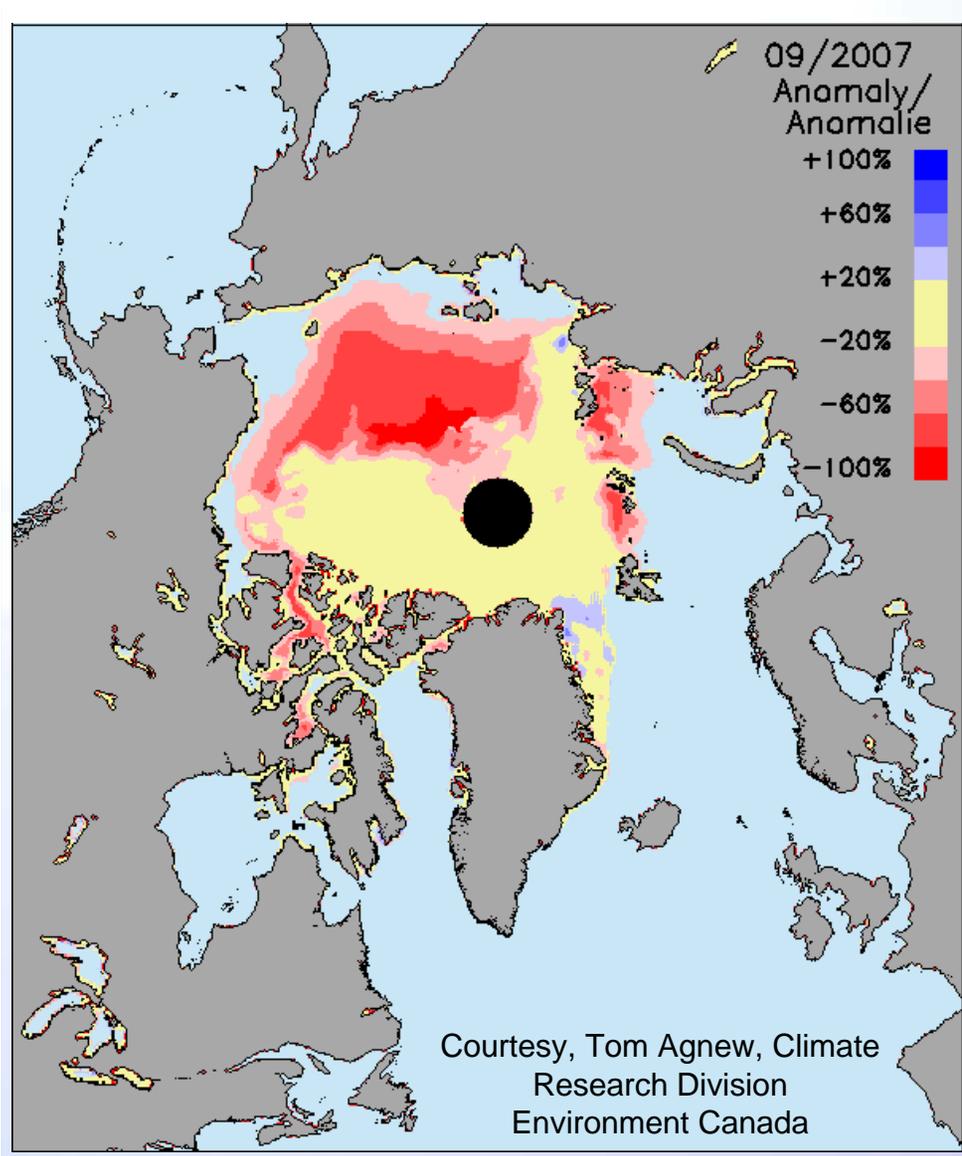
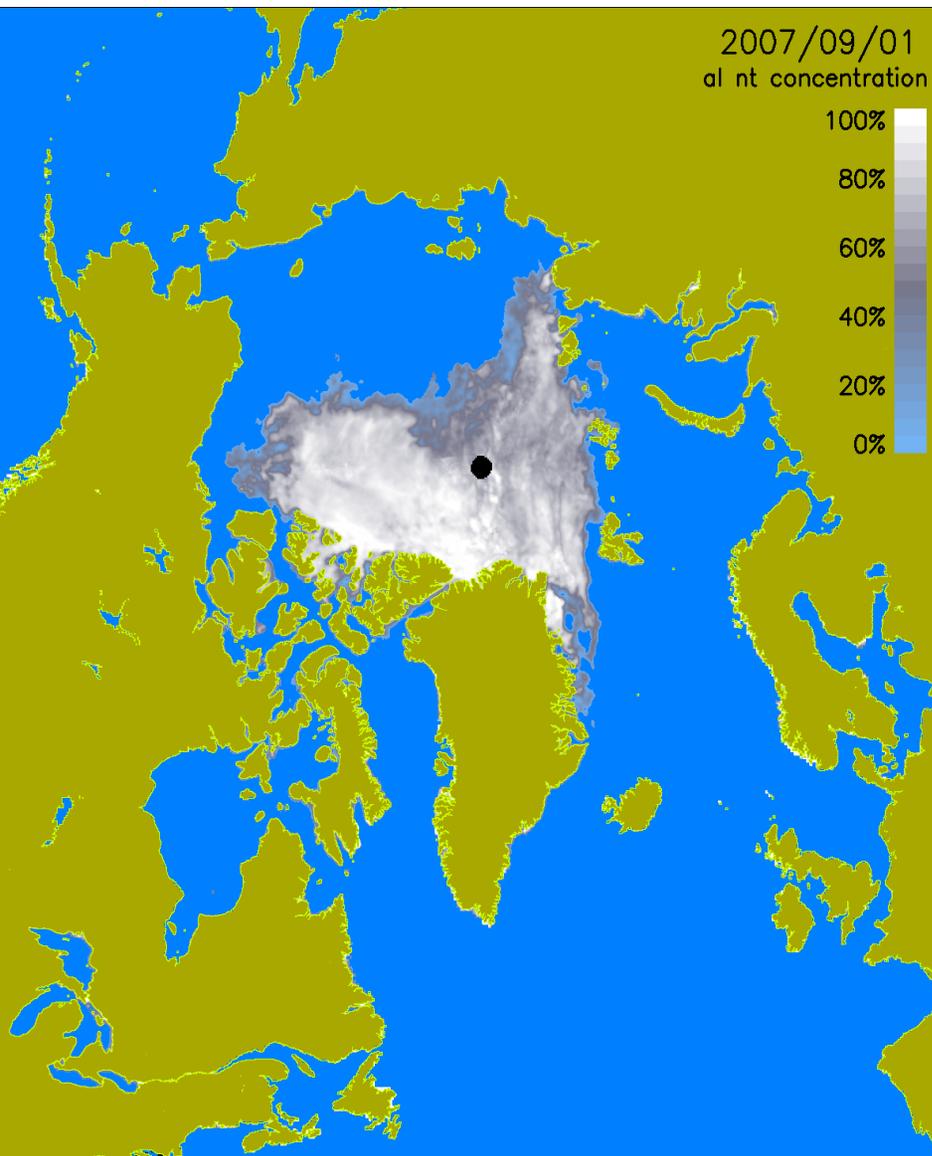
World Climate Research Programme

1997-2003 doubling of neg. balance to 100 km<sup>3</sup>/yr (.20 mm/yr sea level rise) over mid/late 1990s rate

## Airborne Laser Altimetry: 1993-2003



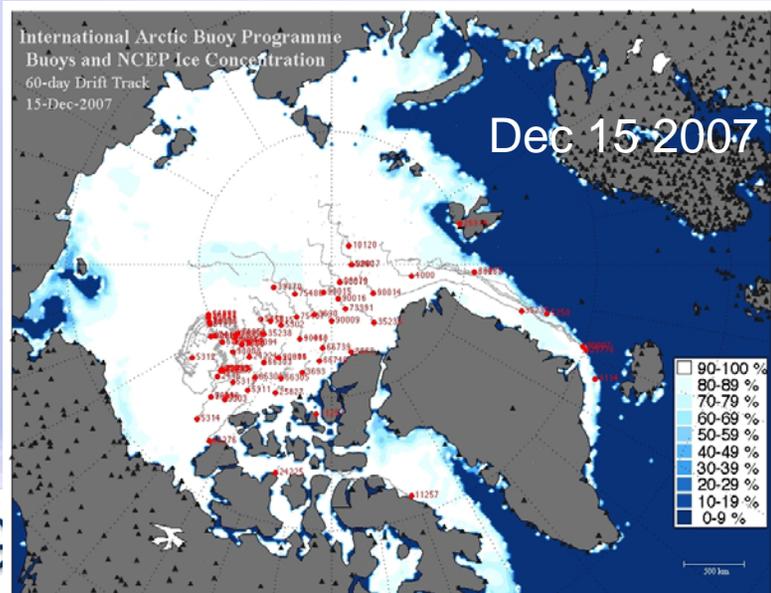
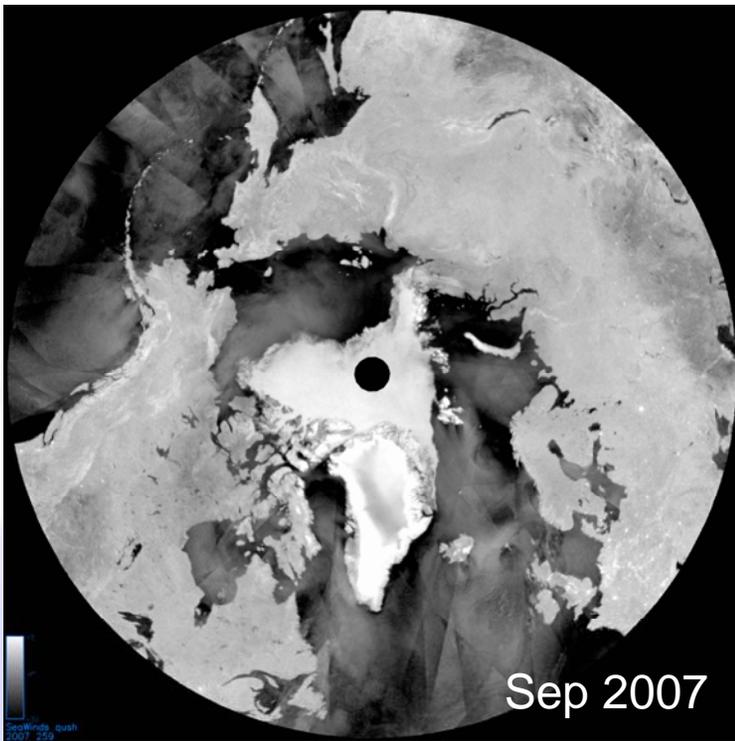




Sea Ice Concentration (%) Sept 1 2007 and anomalies

Sea ice cover this year has been 23 per cent smaller than the previous record low set in 2005 and 39 per cent less than average





Change in Arctic Ice Conditions  
 Sep 2007-December 2007



2007

An international partnership for  
cooperation in Earth observations

# Cryosphere Theme Goals

To create a framework for improved coordination of cryospheric observations conducted by research, long-term scientific monitoring, and operational programmes;

To achieve better availability and accessibility of data and information needed for both operational services and research;

To strengthen national and international institutional structures responsible for cryospheric observations;

To increase resources for ensuring the transition of research-based cryosphere observing projects to sustained observations.

**The Cryosphere Theme was approved by IGOS  
Partners IGOS-P-14, Paris, 30 May 2007**

- User-requirement product driven
- Has **a ~10 year time frame**
- Goal 1: **resources** for observations
- Goal 2: stronger **commitment** by observing system operators **to sustain the observing system**
- Goal 3: **better coordination**

## Cryosphere

- is undergoing dramatic changes, mostly as a consequence of climate change, and provides best indicator for it
- is one of the most under-sampled elements within the climate system
- is important (water, climate, transport, etc.)

**WMO Congress-XV (May 2007)**  
supported IPY/cliC proposal to  
establish a  
**GLOBAL CRYOSPHERE WATCH**  
**(GCW)**



# Global Cryosphere Watch- A WMO Initiative

*“The 15th WMO 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 requested the WMO Inter-commission Task Group on IPY to establish an ad-hoc expert group to explore the possibility of creation of such global system and prepare recommendations for its development.”*

## Considerations

- **IPY 2007-2008** identified Shrinking Snow and Ice: Rapid Changes in Polar Regions as the first of four key issues requiring urgent attention
- **IPCC WG 1 and 2** reports highlighted for first time importance of the cryosphere, observed changes of some elements of global cryosphere and potential impacts on societies and countries;
- the development of the conceptual framework for the Cryosphere Observing System (**CryOS**)
- **ACIA and ICARPII** identified the cryosphere as a critical element in monitoring and understanding changes in the Arctic System;
- **SAON** provides unique opportunity to collaborate to sustain and integrate Arctic observing systems and networks over the long term;
- Congress - IPY should be considered as a “pilot project” for the establishment of integrated observing systems over the globe”
- cryosphere is an integrative element within climate system and **indicator of climate change**

# ***GLOBAL CRYOSPHERE WATCH:***

***research, observation, monitoring, assessment, product development  
and prediction***

## ***Proposed mission would:***

- implement the IGOS Cryosphere Theme (CryOS)
- make reliable, comprehensive observations of the elements of the cryosphere through an integrated observing approach on global and regional scales, in collaboration with other international programmes and agencies;
- provide the scientific community with the means to predict the future state of the cryosphere;
- facilitate assessment of changes in the cryosphere and their impact, and to use this information to aid the detection of climate change
- organize assessments of changes in regional and global components of the cryosphere to support decision making and policy development in support of formulating environmental policy.
- provide authoritative information on the current state and projected fate of the cryosphere for use by the media, public, decision and policy makers

# ***Global Cryosphere Watch - Initial Concept -1***

- **GCW will contribute to WMO's integrated observing and information systems and to the Global Climate Observing System network (like GAW does).**
- **It will cover all aspects of the cryosphere and be an intergovernmental mechanism for supporting key cryospheric *in-situ* and remote-sensing observations** - while implementing the recommendations of the IGOS Cryosphere Theme.
- **In collaboration with other international programmes and agencies, the proposed GCW will provide reliable, comprehensive observations of the components of the cryosphere** through an integrated observing approach on global and regional scales, serving the needs of climate, water, weather and environmental science.

# *Global Cryosphere Watch - Initial Concept (2)*

- GCW will **work with, and build on, existing programs** such as the GTN-G, GTN-P, GTN-H, and work with external partners such as space agencies and World Data Centers for Glaciology.
- GCW is envisioned to include “cold GAW-like stations” - key stations/sites working on a coherent agreed program on monitoring of changes in all components of the cryosphere, producing valuable long-term records, covering key areas of the globe with cryospheric observations.
- GCW **will contribute to GEOSS** through the implementation of CryOS and as an IPY Legacy for observation, monitoring and provision of data and information.
- Goal of GCW would be to **establish a one-stop portal for authoritative up-to-date cryosphere data and products/information**, helping existing elements to be better integrated and contributing to a global data system.

# ***Global Cryosphere Watch - Initial Concept - 3***

- GCW would provide the **integrating mechanism** needed to ensure better quality of data and metadata, and ensure comparison of algorithms and the evaluation of products.
- will also ensure the means to provide the scientific community with good-quality data to **predict the future state of the cryosphere**, resulting in **improved prediction of the earth system** over a wide range of time and space scales, and facilitate assessment of changes in the cryosphere and their impact on climate, water and weather.
- will use information to aid the detection of climate change and organize assessments of changes in regional and global components of the cryosphere **to support decision making and policy development**.
- GCW will help IPY cryospheric projects to develop elements of a lasting observing system that will benefit science in the future.
- GCW will have **direct application to societal benefit areas**

# Consultations

**Response has been enthusiastic to date** and the need for an integrated view of the cryosphere has been emphasized, building on and integrating what may be done currently. It has also been noted that for GCW to be successful, countries and agencies must first demonstrate the importance of the cryosphere to national and/or regional issues, and then how it will contribute to our understanding at the global scale.

- *Key North American cryosphere scientists from NMHS's, academia and other agencies (GCOS Secretariat and Executive*
- *TOPC Executive Committee – endorse GCW*
- *WMO Secretariat from World Climate Program, World Climate Research Programme, Hydrology and Water Resources Department, Atmospheric Research and Environment Programme,*
- *CliC (Climate and Cryosphere) Science Steering Group*
- *CLIVAR Science Steering Group*
- *Sustained Arctic Observing Networks Workshop*
- *International Permafrost Association*
- *GEO Secretariat*
- *IPY Joint Committee*
- *Asia-CliC 2nd Conference*

# Establishing of GCW ad hoc group

As requested by Cg XV the Intercommission Task Group (ITG) on IPY in January 2008 has established an ad-hoc expert group under chairmanship of Dr B. Goodison (Canada).

The Group would consist of the representatives of WMO programmes, technical commissions, partner organizations, user groups, Data Centres, and Member-countries with cryospheric responsibilities.

Group would have the responsibility to prepare a scoping document to define the feasibility of developing and implementing a CGW.

A final feasibility study is expected for April 2009 to report to EC-LXI in June 2009.

# Ad-Hoc Expert Team on GCW (ToR) -1

The team would have the responsibility to prepare a scoping document to **define the feasibility of developing and implementing a Global Cryosphere Watch within WMO.** The document should include, but not be limited to:

- Definition of GCW rationale, mission, goals, short and long-term objectives and implementation principles to address the general concept discussed above;
- Identification of the development of focal areas to be implemented;
- identification and engagement of WMO programmes, activities and technical commission and key Partners from other existing Centers and organizations who would contribute to, and be part of , the development and implementation of GCW;
- documenting Members' and other users' needs for cryospheric information, particularly for climate, water, weather and environmental applications and prediction;
- documenting data, information and products currently made available which could be included in a GCW;

# Ad-Hoc Expert Team on GCW (ToR)-2

- identifying cryosphere information sources and systems to be part of GCW;
- recommending a structure for the Global Cryosphere Watch
  - a road-map for GCW;
- recommending how IGOS-P cryosphere theme recommendations can be implemented with GCW framework;
- identifying resources to support the ongoing operation of a GCW, nationally, regionally and at the Secretariat level;
- recommending on the implementation of a WMO Global Cryosphere Watch, with an accompanying timeline;
- The contents of this document may be modified to address issues as they arise. Draft report/recommendations will be provided to the IPY ITG in January 2009; a final feasibility study is expected for April 2009, in time for WMO EC in June 2009.

***A New Opportunity***

***WMO Initiative:  
Global Cryosphere Watch***

***Thank you***