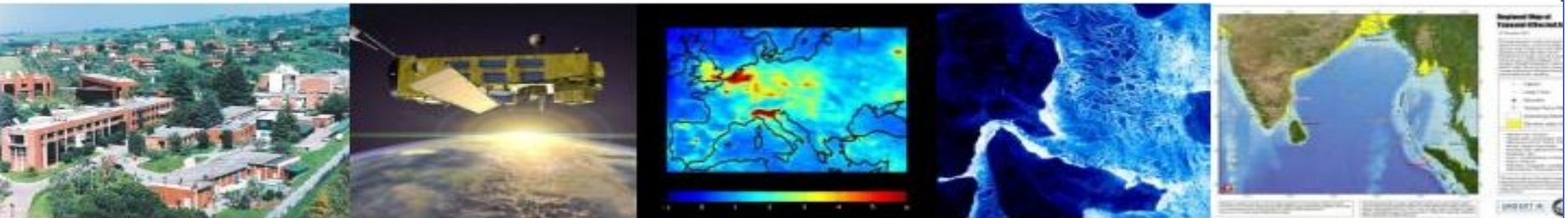


DUE Projects in the Cryosphere

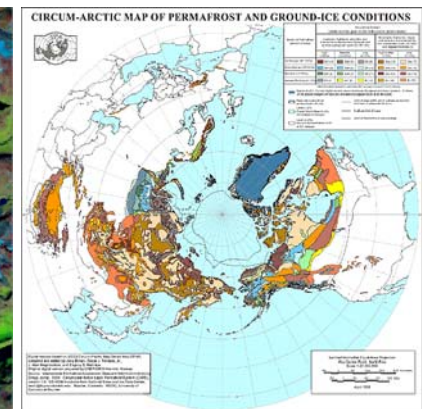
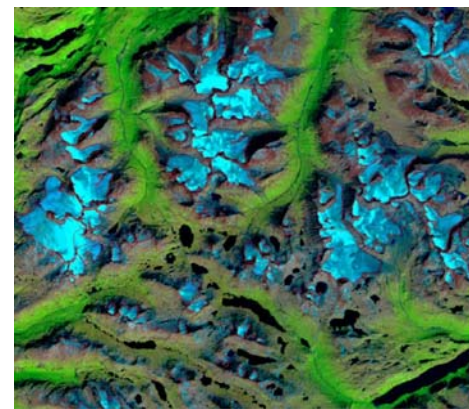
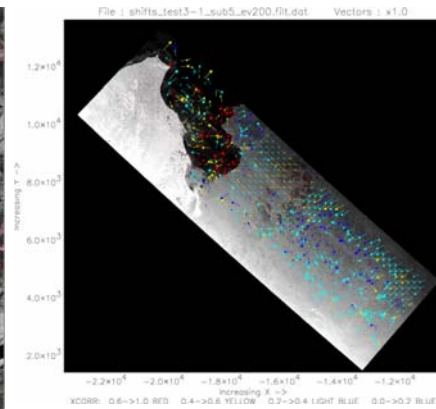
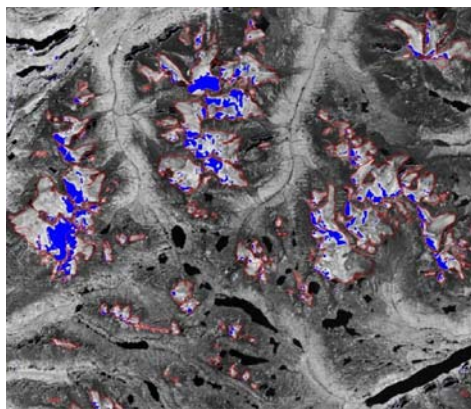
23 June 2009



Frank Martin Seifert
Directorate of EO Programmes
European Space Agency

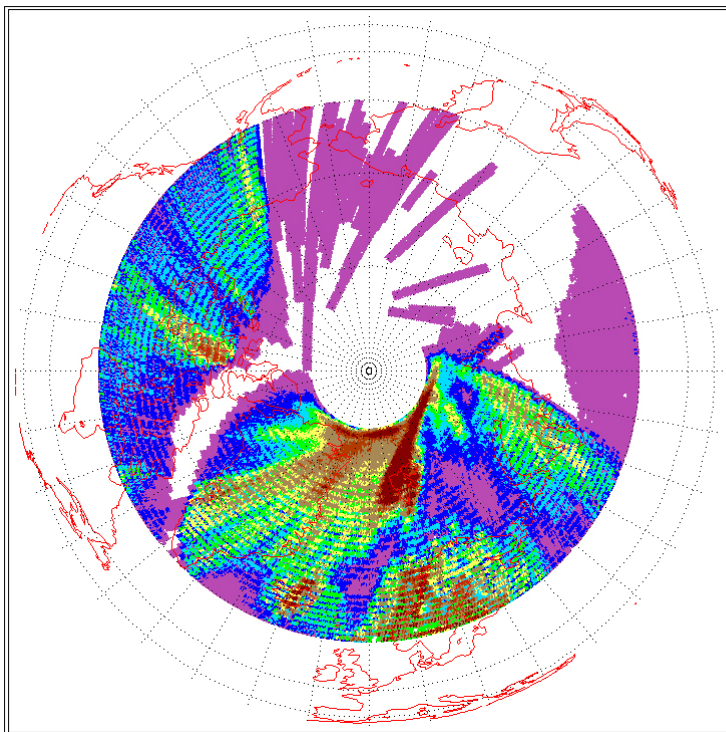
frank.martin.seifert@esa.int

- **GlobIce** – dynamic sea ice monitoring
- **GlobGlacier** – glacier inventory

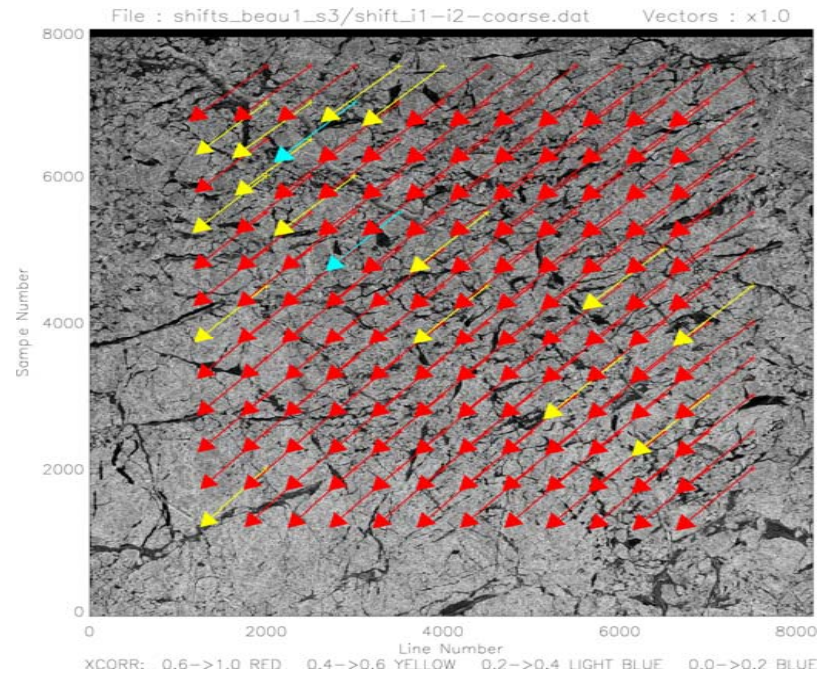
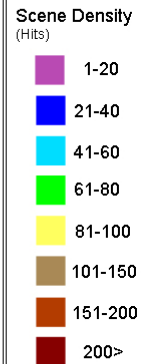


- **Permafrost** – EO support to permafrost monitoring
- **GlobSnow** – global snow information

- Sea ice motion and deformation mapping
- Seasonal cycle of sea ice in the Arctic
- Long-term changes in the cryosphere e.g. extent, volume and flux of sea ice, based on 14 year archive of ERS and ENVISAT (more than 500 000 SAR scenes)



ERS1&2
Time Period
Start: 1995/04/21
End: 2004/07/14



Users Organisations:

- CliC
- IGBP, WCRP
- Scientific communities

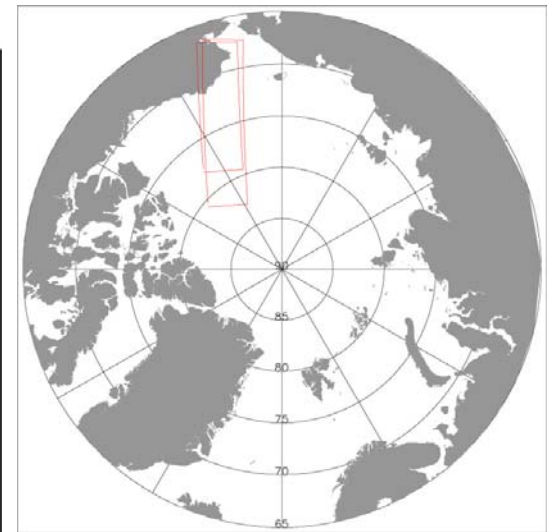
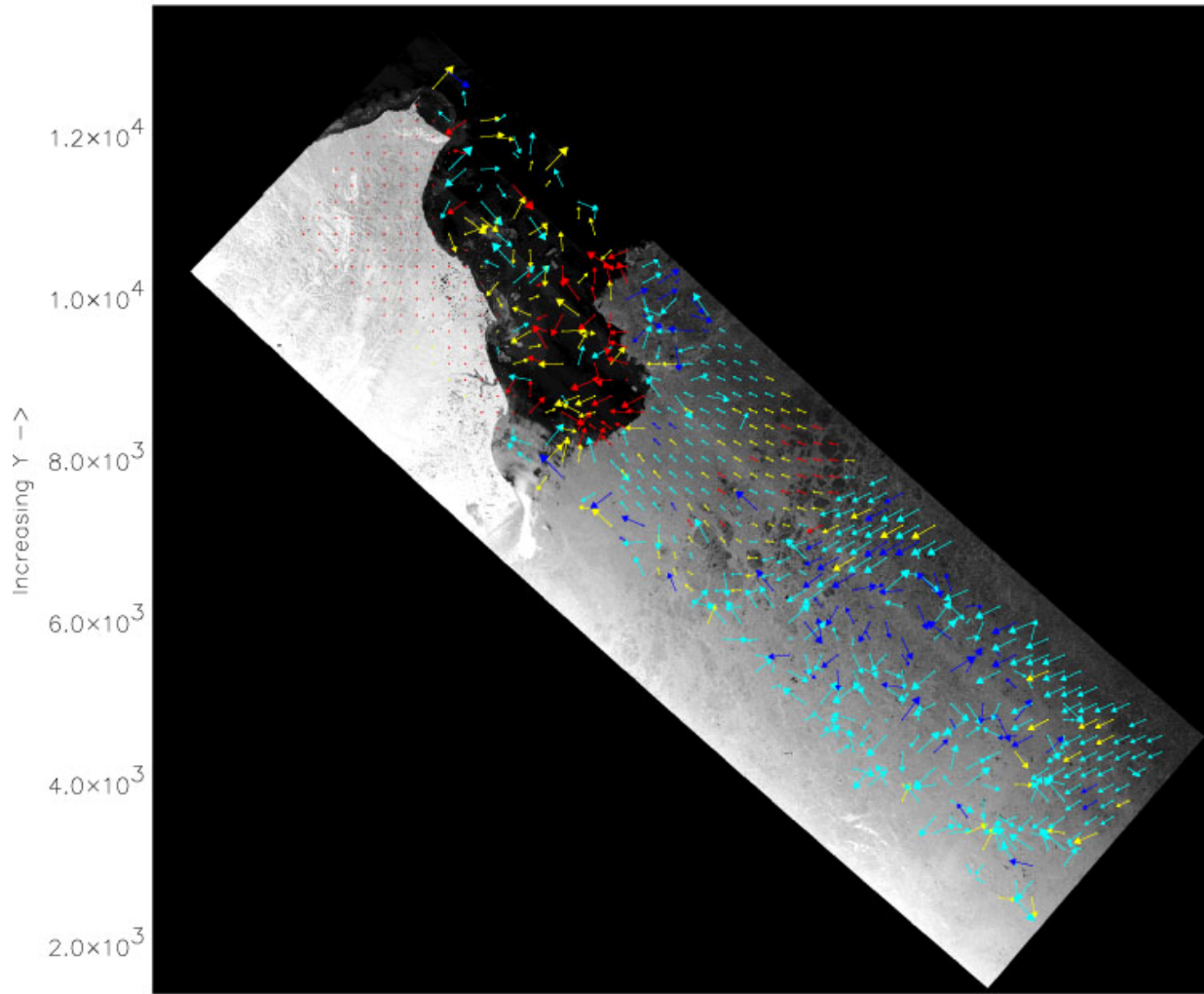


Team:

UCL, Kongsberg Spacetec, UK Met Office, AWI, IFREMER, JPL, Planetary Visions

File : shifts_test3-1_sub5_ev200.filt.dat

Vectors : x1.0



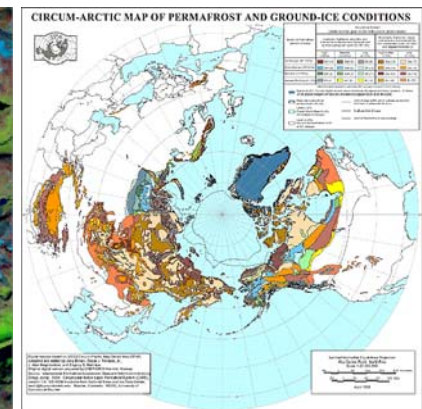
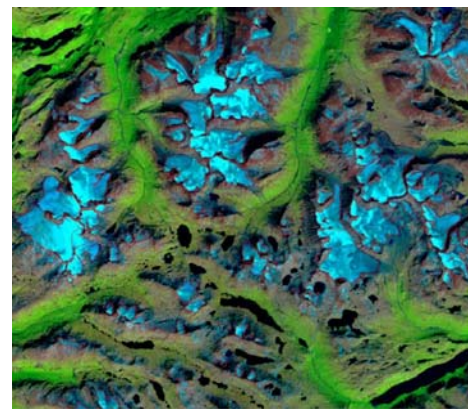
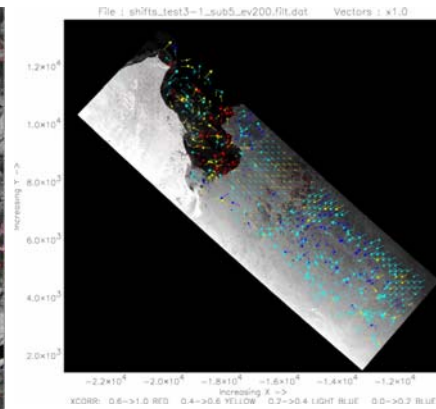
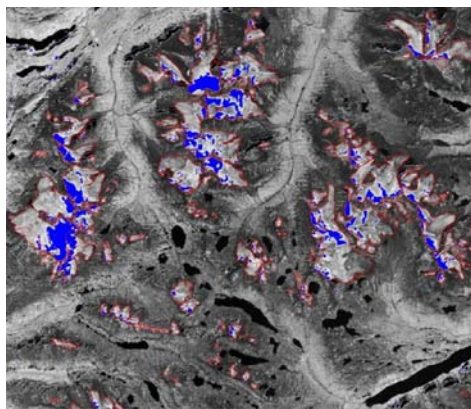
Sedna IPY ice camp



XCORR: 0.6->1.0 RED 0.4->0.6 YELLOW 0.2->0.4 LIGHT BLUE 0.0->0.2 BLUE

- **Image re-projection testing**
- **ERS motion - complete but insufficient for large area Lagrangian tracking**
- **ASAR based Lagrangian tracking based and validation with buoys - complete**
- **Connectivity database - in progress**
- **Basic prototyping software in place but further testing desirable to reduce risk**
- **CDR passed (SRD update, ADD, ICDi, ATD delivered, Validation Protocol (first issue))**
- **Redirect demonstration cases to use ASAR wide-swath acquisitions from 2005 to 2009**
- **Reconnect to user community**

- **GlobIce** – dynamic sea ice monitoring
- **GlobGlacier** – glacier inventory



- **Permafrost** – EO support to permafrost monitoring
- **GlobSnow** – global snow information

Objective:

Monitoring of selected glacier regions from all over the world over time going back 10 to 20 years.

ECV of the CEOS response to GCOS requirement endorsed by UNFCCC.

User Organisations:

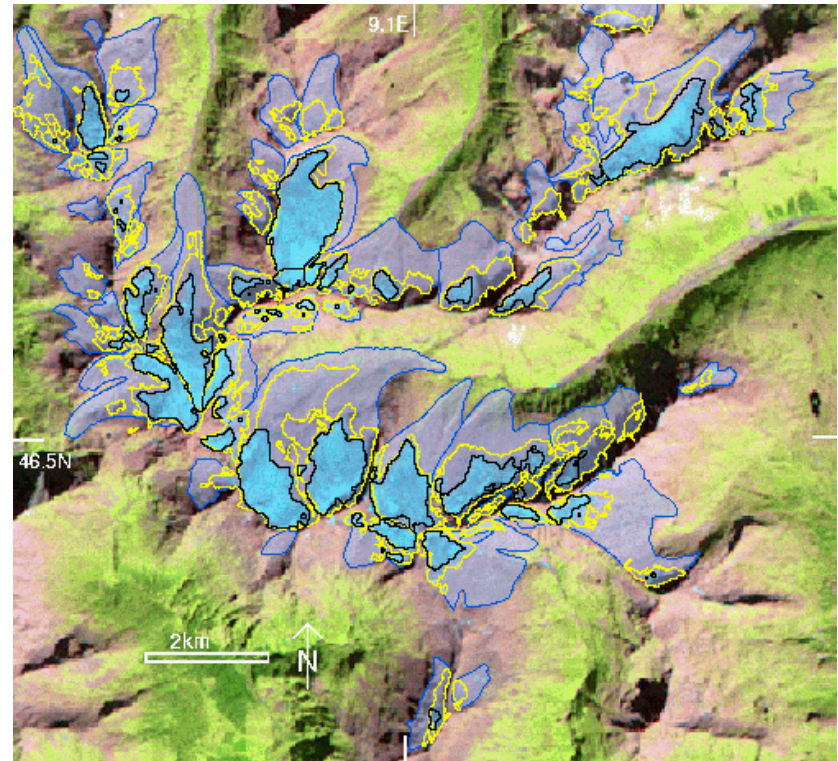
WGMS, GLIMS, MPI-Met, GEUS, NVE, WC2N (UNBC), IMAU, SED, ICIMOD

Project Outline:

- Kick-off Nov 2007 with 3 years duration
- Budget 1 Mio. €

Team

- Prime: University of Zurich
- Sub: ENVEO, GAMMA University of Edinburgh, University of Oslo

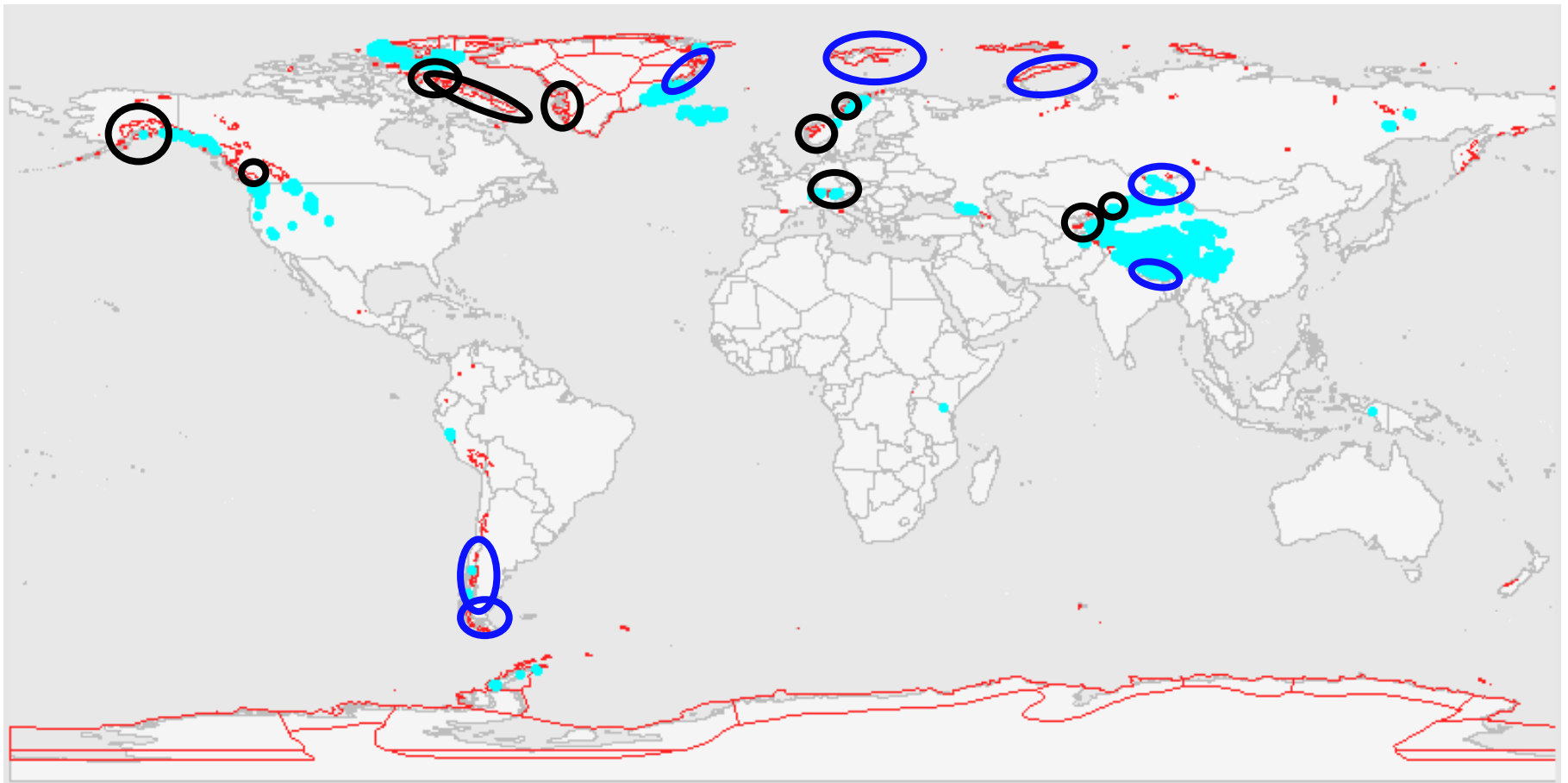


Glacier changes in the Rheinwald region (CH)

Products:

- ✓ Area: 20.000 glaciers
- ✓ Snowline: 20.000
- ✓ Terminus: 5.000
- ✓ Topography: 5.000
- ✓ Elevation change: 1.000
- ✓ Velocity: 200

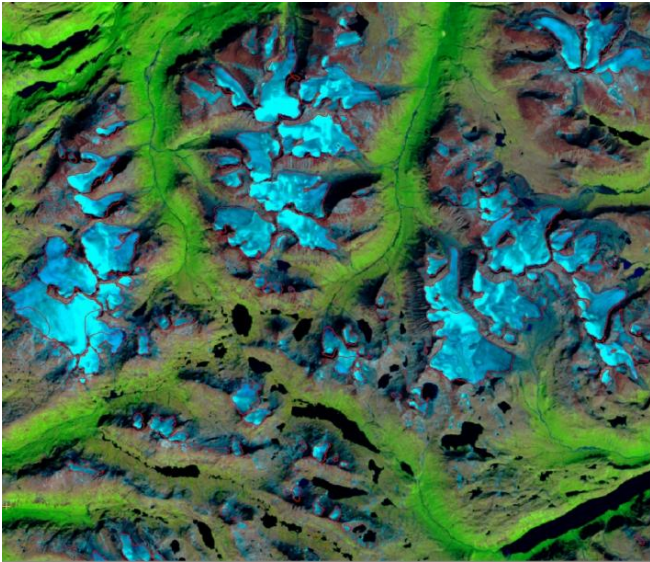




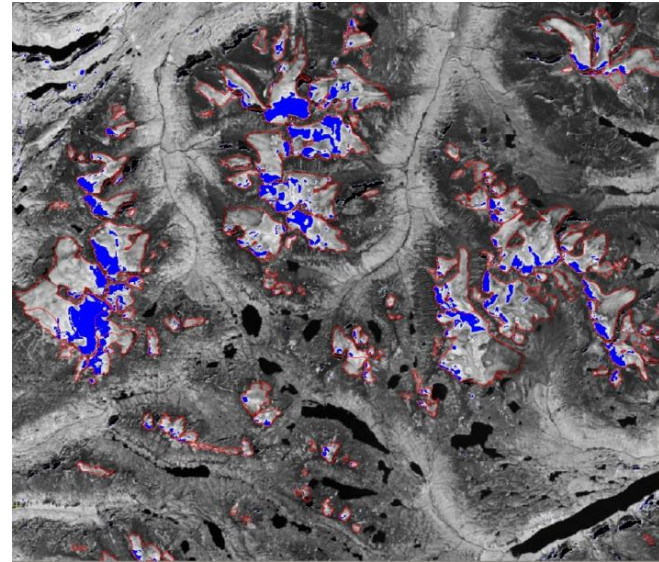
Phase 1

Phase 2

GLIMS database

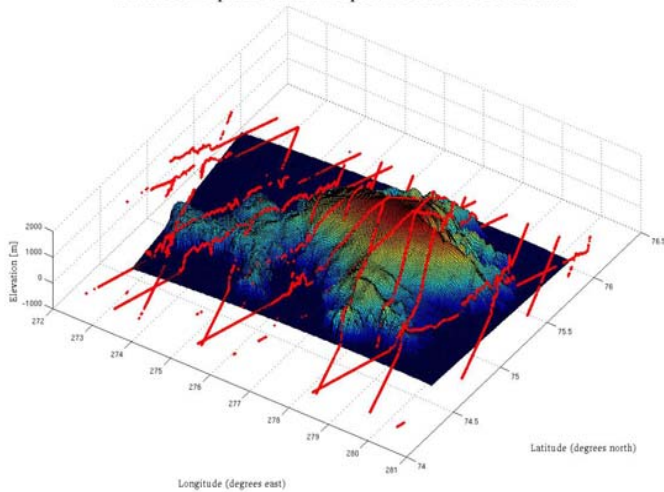


Snowline

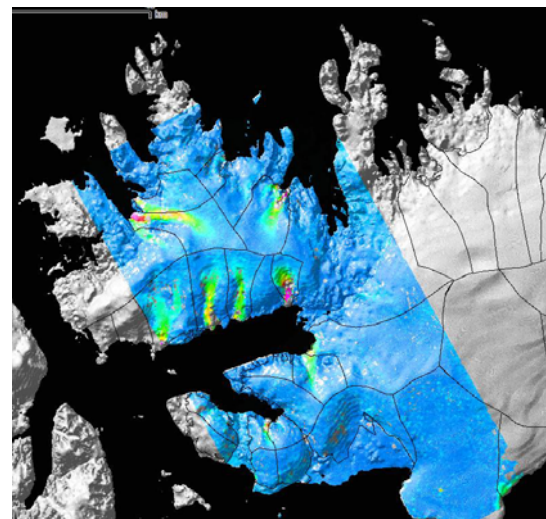


Snow and ice classification

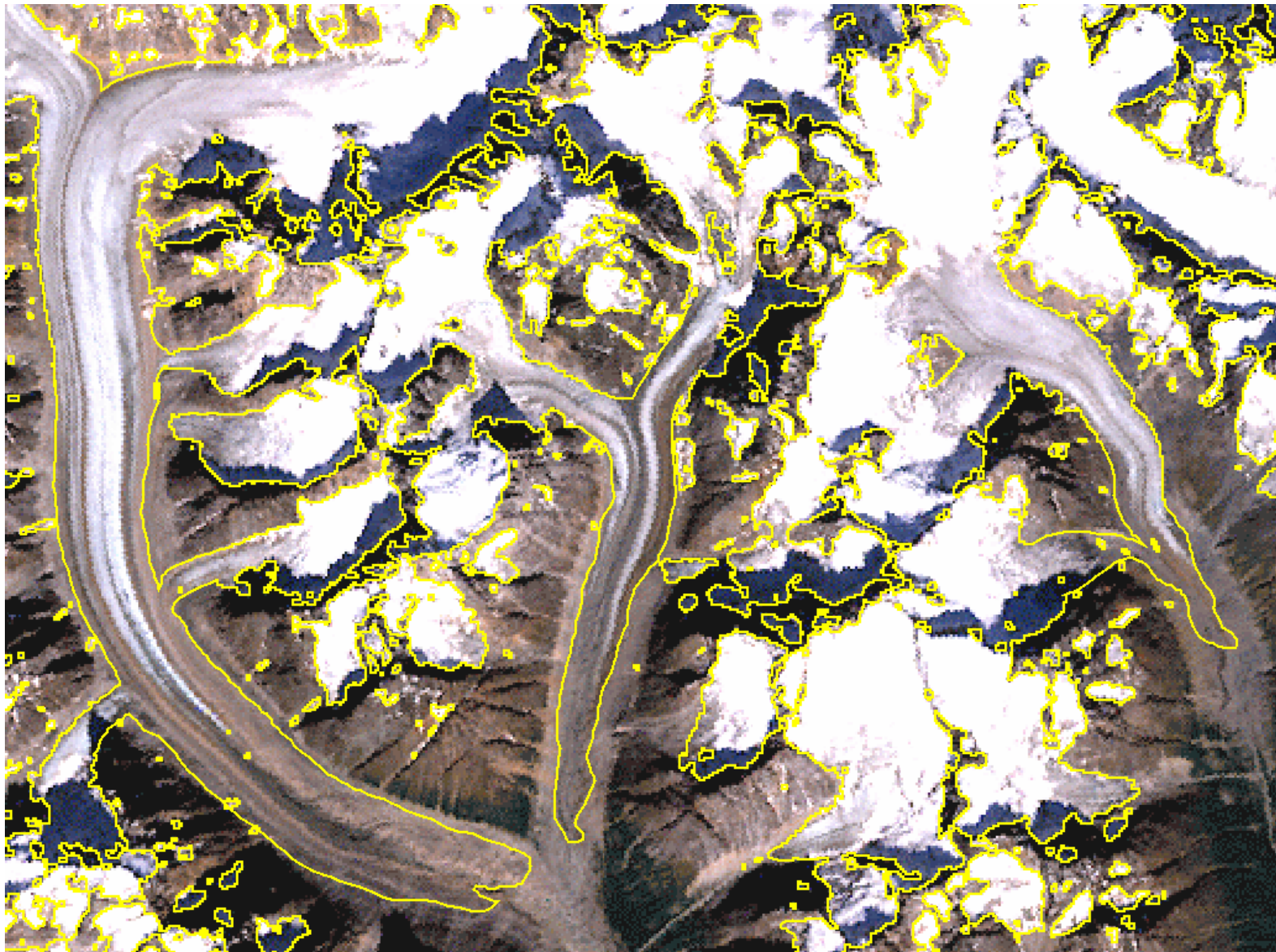
Devon Ice Cap DEM and example of IceSat GLIAS elevations



Topography



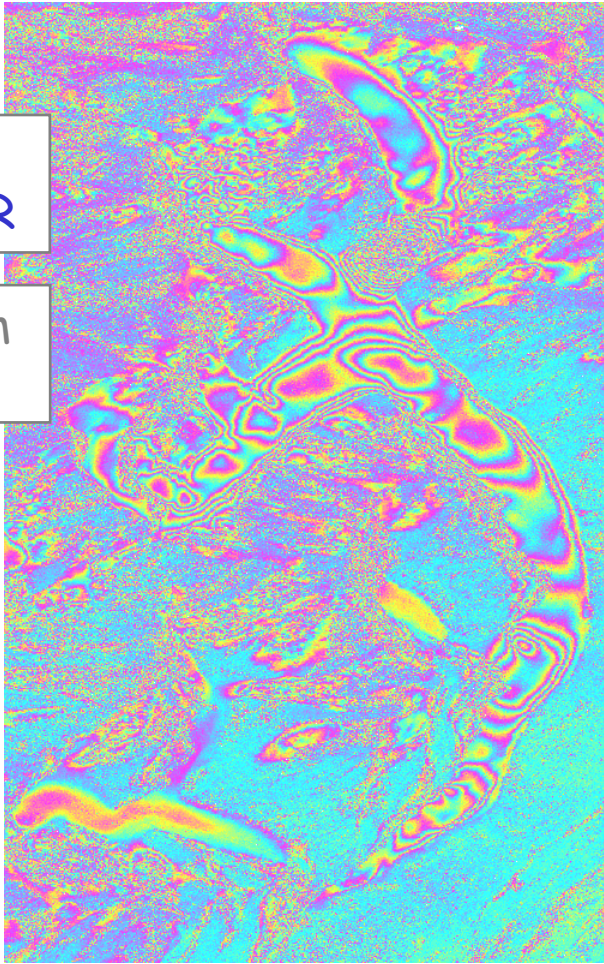
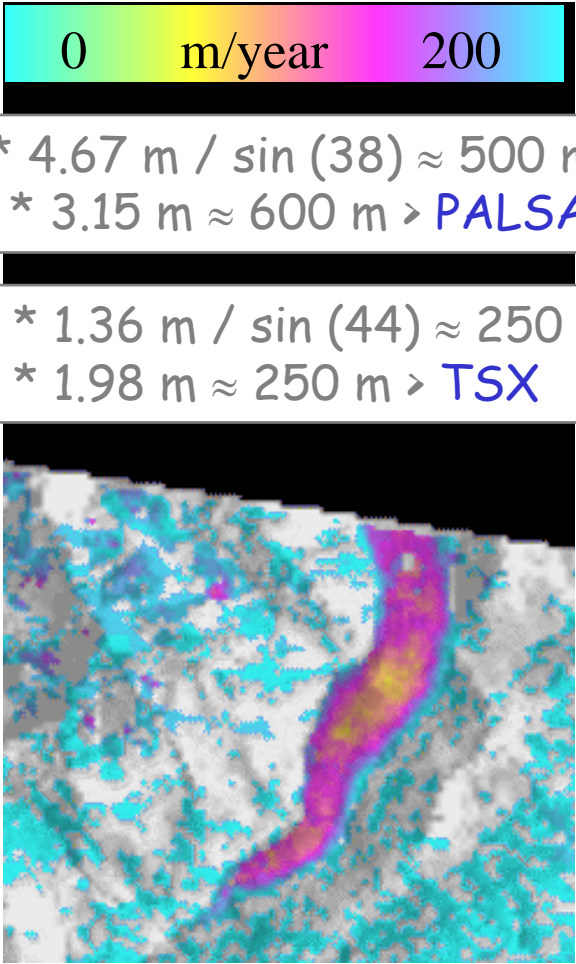
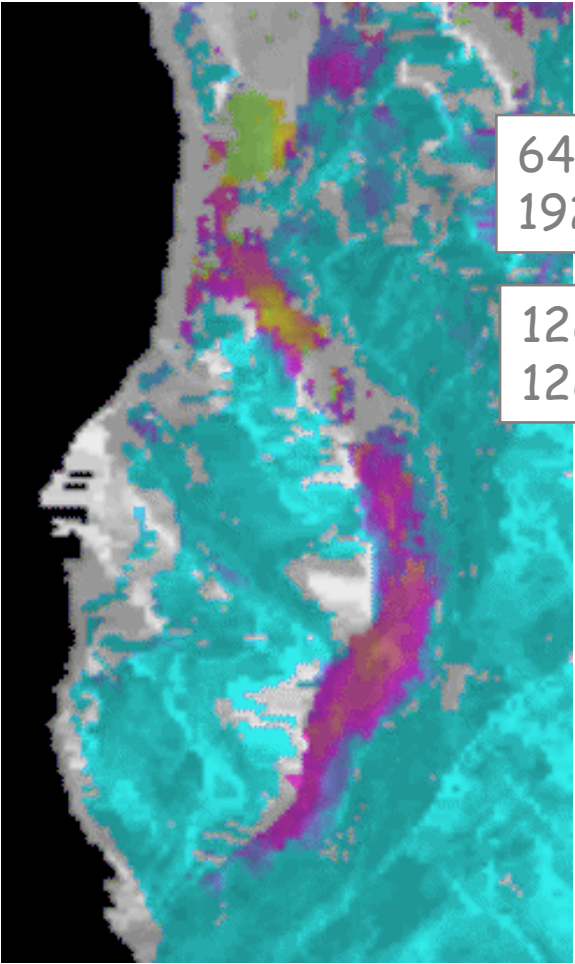
Velocity





$64 * 4.67 \text{ m} / \sin(38) \approx 500 \text{ m}$
 $192 * 3.15 \text{ m} \approx 600 \text{ m} > \text{PALSAR}$

$128 * 1.36 \text{ m} / \sin(44) \approx 250 \text{ m}$
 $128 * 1.98 \text{ m} \approx 250 \text{ m} > \text{TSX}$

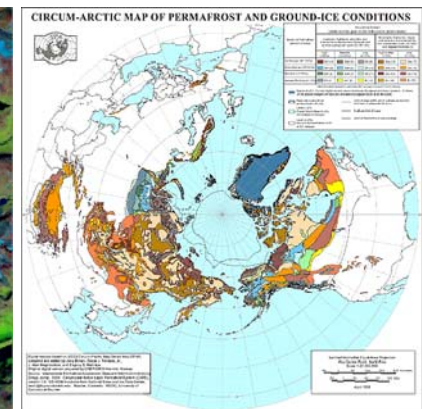
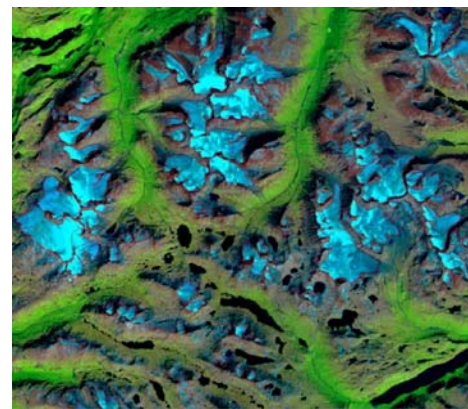
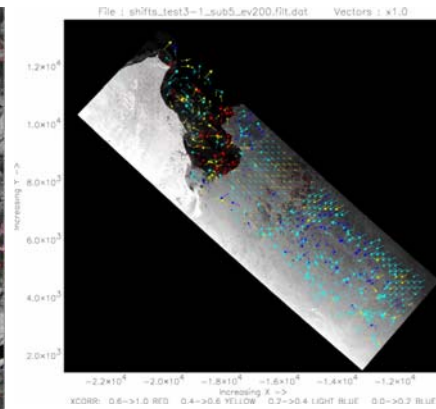
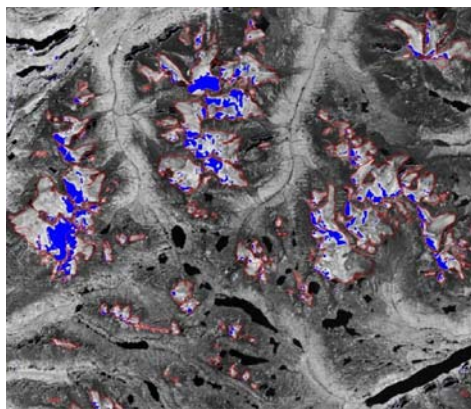


ALOS PALSAR
 09.09.06 – 29.10.06
 46 days, 300 m

TerraSAR-X
 11.08.08 – 22.08.08
 11 days, 280 m

ERS-1/2
 07.03.96 – 08.03.96
 1 day, 34 m

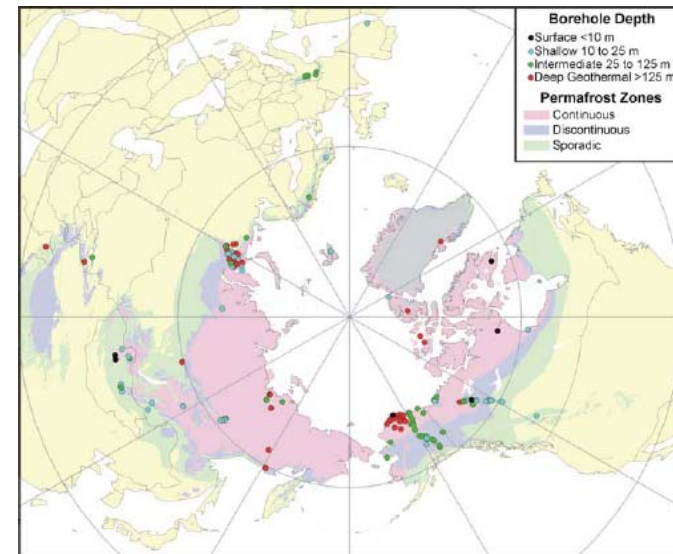
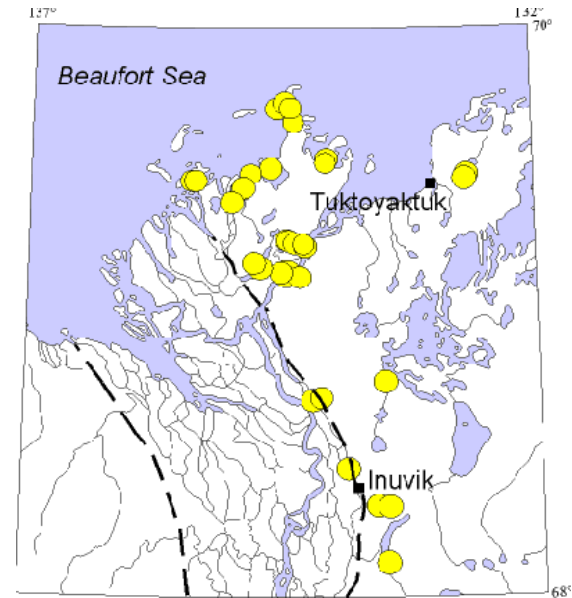
- **GlobIce** – dynamic sea ice monitoring
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- **Permafrost** – EO support to permafrost monitoring
- **GlobSnow** – global snow information

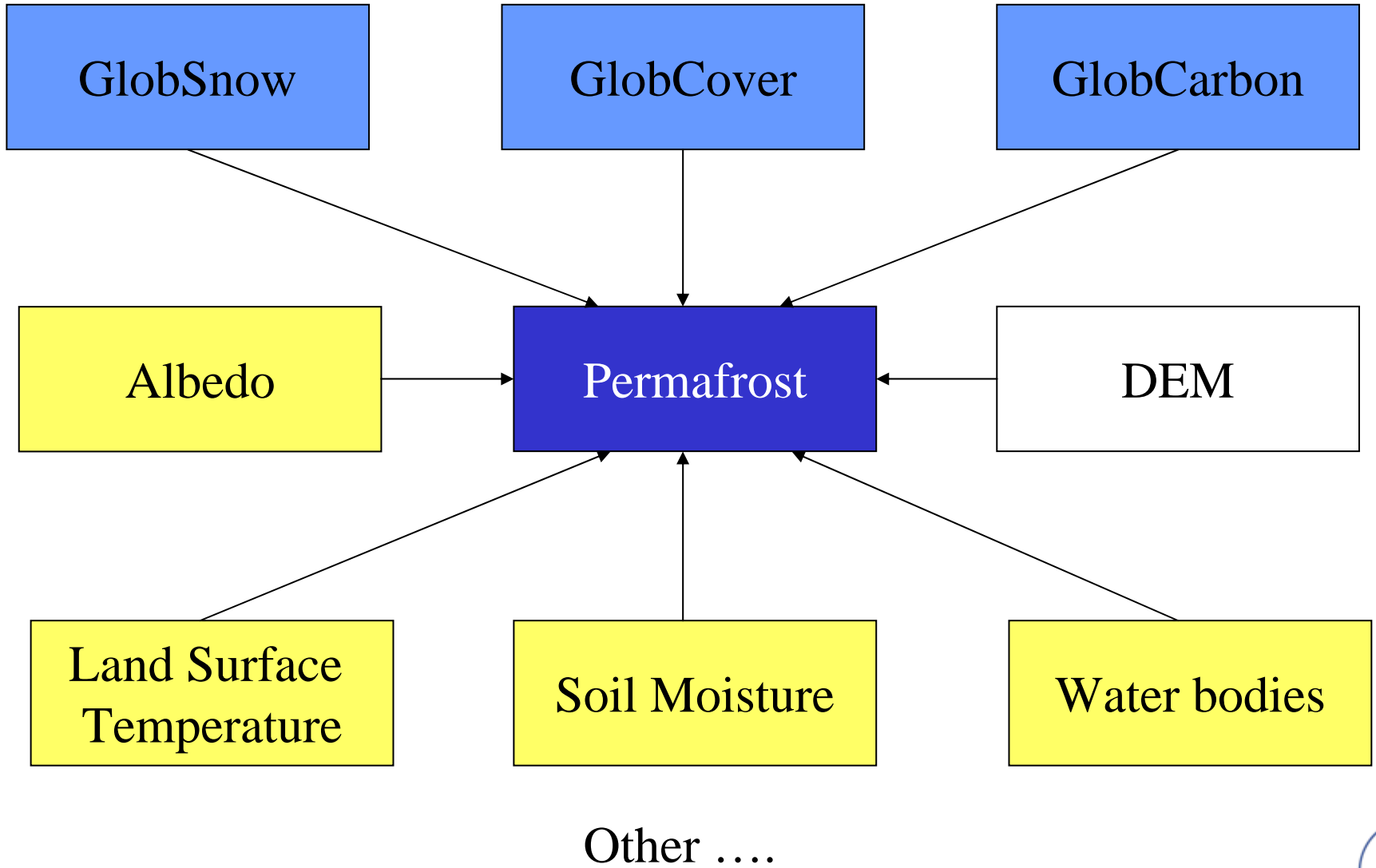
Motivation:

- * Permafrost is an environmental indicator on climate change
- * Thawing permafrost is a carbon source
- * Transport in boreal areas (roads, railways, pipelines) is affected by permafrost degradation
- * Thawing of permafrost in alpine areas raises the risks of landslides
- * ...

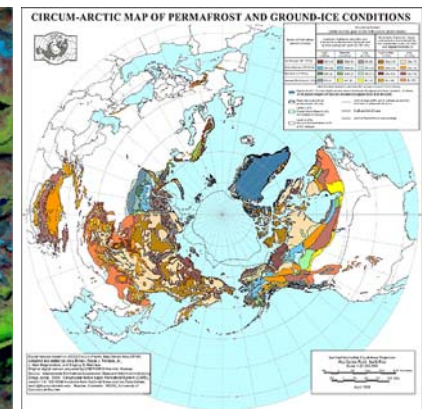
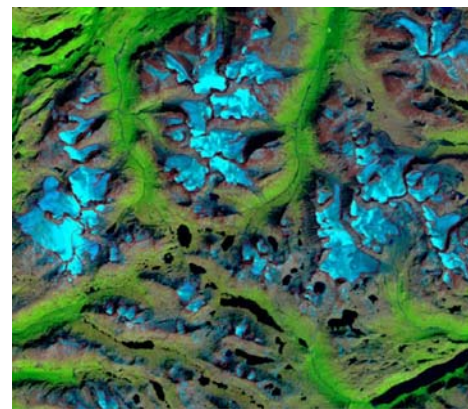
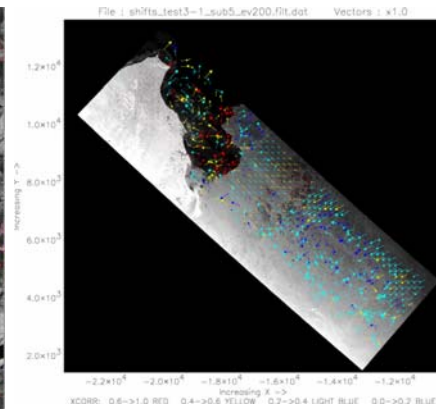
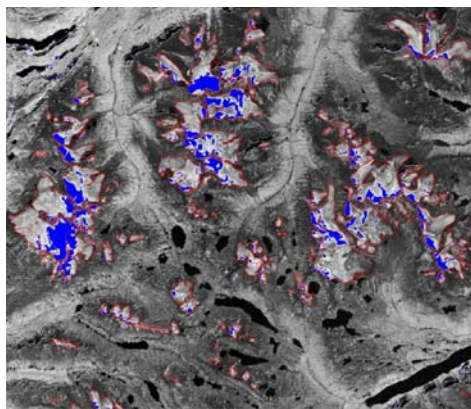


Courtesy Geological Survey of Canada

⇒ **Permafrost User Workshop
at AWI in Potsdam**



- **GlobIce** – dynamic sea ice monitoring
- **GlobGlacier** – glacier inventory



- **Permafrost** – EO support to permafrost monitoring
- **GlobSnow** – global snow information

Motivation:

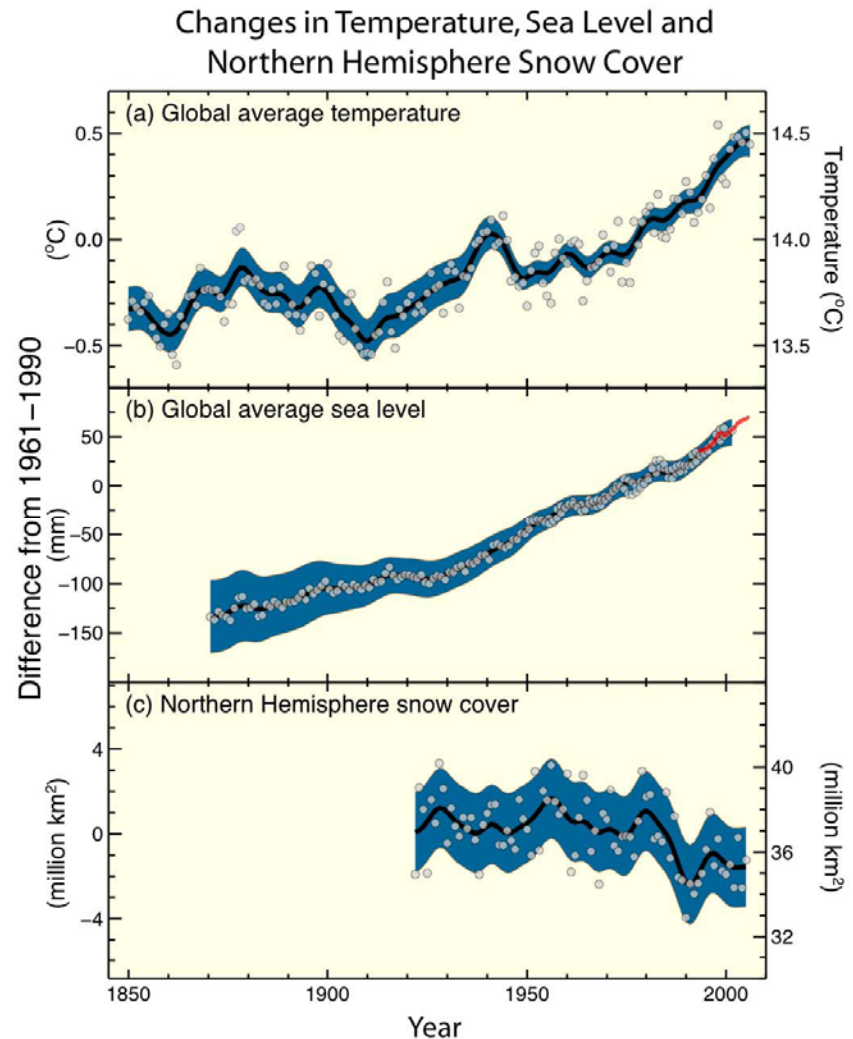
- * Global areal extent of snow recognized as Essential Climate Variable by GCOS
- * Snow plays a central role in hydrological cycle
- * Snow affects planetary albedo
- * Snow as indicator for climate change & variability

Objectives:

- * User requirement consolidation
- * Standardization and homogenization of data sets and algorithms required for a relevant FCDR
- * Demonstration and validation of a snow monitoring service in collaboration with user communities

Products:

- * Global areal snow extent
- * Snow depth
- * Snow water equivalent



IPCC report, 2007

Involved Users Organisations:

- * **MeteoSwiss**
- * **Finnish Environment Institute (SYKE)**
- * **World Climate Research Programme (WCRP)**
- * **Finnish Meteorological Institute (FMI)**
- * **NSIDC/CIRES**
- * **EURAC - Institute of Applied Remote Sensing**
- * **Canada Centre for Remote Sensing**
- * **EEA (European Environment Agency)**
- * **ECMWF**

Project Outline:

- * **3 years duration**
- * **Budget up to 1 Mio. €**
- * **Kick-off: November 2008**



Annual max. snow cover extent in both hemispheres (Global Outlook for Ice & Snow, UNEP 2007)