

# CCI+ Info Day

- Permafrost

Frank Martin Seifert, ESRIN, 6 July 2017





# Permafrost and Climate

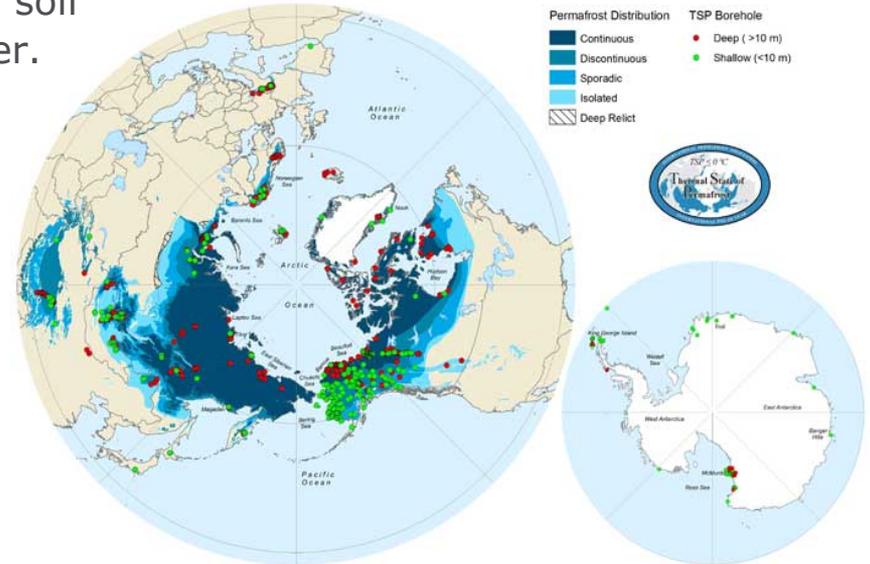


Permafrost is defined as sub-surface earth materials that remain continuously at or below 0°C for two or more consecutive years. Parameter is the ground temperature at specified depths.

Covering more than 25% of the Earth's surface, permafrost is one of the dominant landscape forming features surrounding the Arctic Ocean. Permafrost degradation due to thawing soils results in the release of greenhouse gases through soil respiration and decomposition of soil organic matter.

Mountain permafrost plays a different role than lowland circumpolar permafrost, as it affects people much more directly and short-term.

Permafrost plays a major roles in the climate system [GCOS-200]. Its changes may result in important impacts on terrain stability, coastal erosion, surface and subsurface water, the carbon cycle and vegetation development.





## GCOS Requirements

From GCOS no satellite product requirements are specified yet

### Requirements defined for *Permafrost* (2)

This table shows all related requirements. For more operations/filtering, please consult the full list of [Requirements](#)

Note: In reading the values, goal is marked **blue**, breakthrough **green** and threshold **orange**

Id	Variable	Layer	App Area	Uncertainty	Stability / decade	Hor Res	Ver Res	Obs Cyc	Timeliness	Coverage	Conf Level	Val Date	Source
401	Permafrost	Land surface	Hydrology	5		0.1 km		6 h	6 h	Global land	reasonable	2003-10-20	ET ODRRGOS
				8.5		1 km		14 h	17 h				
				25		100 km		3 d	6 d				
675	Permafrost	Land surface	Climate-TOPC	5		0.25 km		24 h	24 h	Global land	firm	2007-07-19	TOPC
				7		0.85 km		36 h	36 h				
				10		10 km		5 d	5 d				

WMO, OSCAR DB

## GCOS Actions (Implementation Plan GCOS-200)

- Action T33: Standards and practices for permafrost
- Action T34: Mapping of seasonal soil freeze/thaw



# Key Users of the Permafrost ECV



## European and international climate research organisations:

- Investigate permafrost distribution and thawing as input to global and regional climate models;
- Develop permafrost extend models;
- Perform Earth system modelling and the development and implementation of coupled land-atmosphere models;
- Research Carbon Feedbacks in the Climate System (WCRP Grand Challenge);
- Develop data assimilation for climate reanalyses (*e.g.* ERA5);
- Perform climate model inter-comparison and validation studies (*e.g.* CMIP6);
- Contribute research on the climate system to the IPCC scientific assessments.

## International Permafrost community:

- Monitoring of infrastructure in permafrost areas (*e.g.* pipelines, railways);
- Risk mitigation by observing mountain permafrost (*e.g.* landslide)





## **International Permafrost Association (IPA):**

IPA fosters permafrost research to the end of the Earth, disseminates knowledge concerning permafrost and promotes cooperation among national and international actors working on permafrost.

## **WCRP - Climate and Cryosphere project CliC**

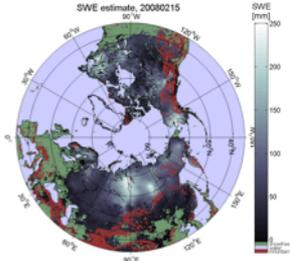
As core project of the WCRP CliC aims to improve understanding of the cryosphere and its interactions with the global climate system, and to enhance the ability to use parts of the cryosphere for detection of climate change.

## **Global Terrestrial Network for Permafrost (GTN-P):**

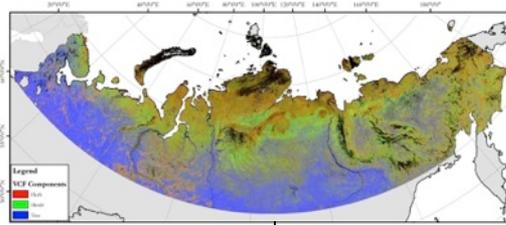
GTN-P is the primary international programme concerned with monitoring permafrost parameters. GTN-P was developed by IPA under the GCOS and the GTOS



# Permafrost, not directly observable, but ...

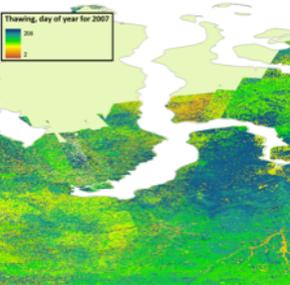
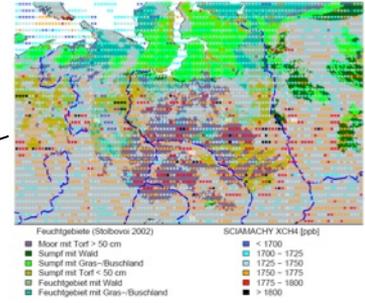


Snow Cover



Land Cover

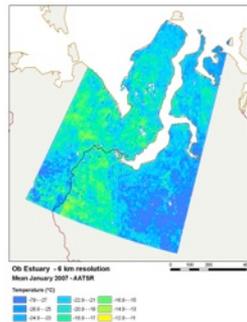
Methane



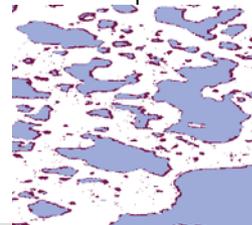
Freeze / Thawing



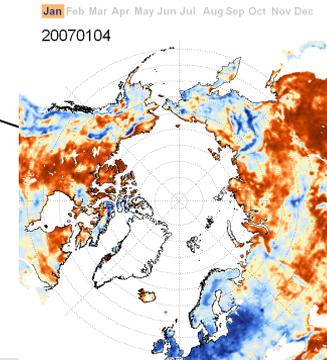
DEM



Land Surface Temperature



Water Bodies



Soil Moisture



# Permafrost: Satellite Instruments



**SAR:** ALOS-2, Sentinel-1, TerraSAR/TanDEM-X, COSMO-SkyMed, SAOCOM, NOVOSAR, NISAR, ALOS-1, ERS-1/-2, Envisat ASAR, JERS

**Passive Microwave Radiometer:** SSM/I, AMSR, SMMR, SSMIS, ...

**Scatterometer:** ASCAT

**Optical:** Sentinel-2, Landsat-8, RapidEye, VHR, Spot and Landsat series, ...

**Imaging Spectrometers:** MODIS, OLCI, MERIS, VIIRS, Spot-VGT, ....

**Radiometer:** AVHRR, ATSR, AATSR, ASTER, SMOS, SLSTR, ...



## Permafrost: Key Issues for CCI+ (1/2)



- Construction of a suite of EO-based products to provide enhanced analysis of long term changes in permafrost ecosystems: land cover, snow, land surface temperature, soil moisture, lakes, etc.
- Investigate use of time series from other ECVs and tailor them as input to permafrost ECV;
- Cooperation with International Permafrost Association to develop an update map of permafrost extent and production of consistent long-term time series (3 epochs);
- Intercomparison of permafrost retrieval models and their improvement exploiting existing and upcoming satellite instrument;
- Characterisation of mountain permafrost as local indicator for climate change and direct impact on the society in mountainous area;



## Permafrost: Key Issues for CCI+ (2/2)



- Linkage to existing key in-situ networks (e.g. GTN-P) and consolidation of related observations, supporting the development of standards and reference sites;
- Initialize and test the carbon cycle models that are embedded in the latest generation of climate models;
- Characterization of uncertainty and long-term stability of ECV permafrost;