Permafrost and Active Layer

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Permafrost

- ground (soil or rock and included ice or organic material) that remains at or below 0°C for at least two consecutive years; four permafrost zones
- Direct indicator of climate change
- Effects by climate → permafrost: erosion, water drainage, carbon release
- Effects on the climate → releases heat, affects moisture in an area, affects carbon cycle

Active Layer Thickness

- Ground layer in permafrost area that annually thaws
- Essential Climate Variable

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Permafrost and Vegetation

Permafrost matters for vegetation

- Thin active layer: no support for tree‘s roots (tundra, polar desert)
- Permafrost preventing water drainage
- Warm season: water collects on surface (kept by underlying permafrost layer, can be utilized by plants



Vegetation matters for permafrost

Plants absorb solar energy → Preventing permafrost thawing

Damaged plant cover → Permafrost thawing, ground collapse
Permafrost thawing → erosion, affect plants (f.e. drunken forests)

Permafrost Measurements

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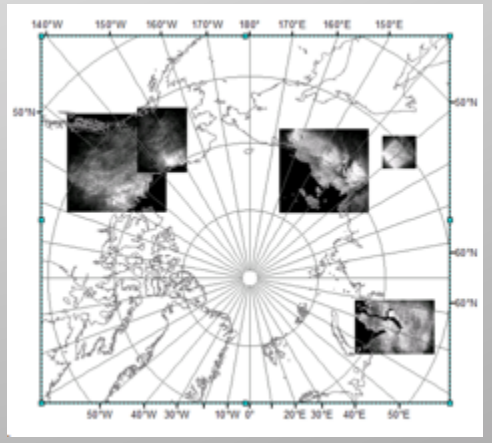
Methods

- Boreholes with thermistors
- Active Layer Grids
- Remote sensing (satellite data on surface temperature and soil moisture)



Data Collection

– Websites, Word and Excel sheets, differences between labs, no standards

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GTN-P Data Management System

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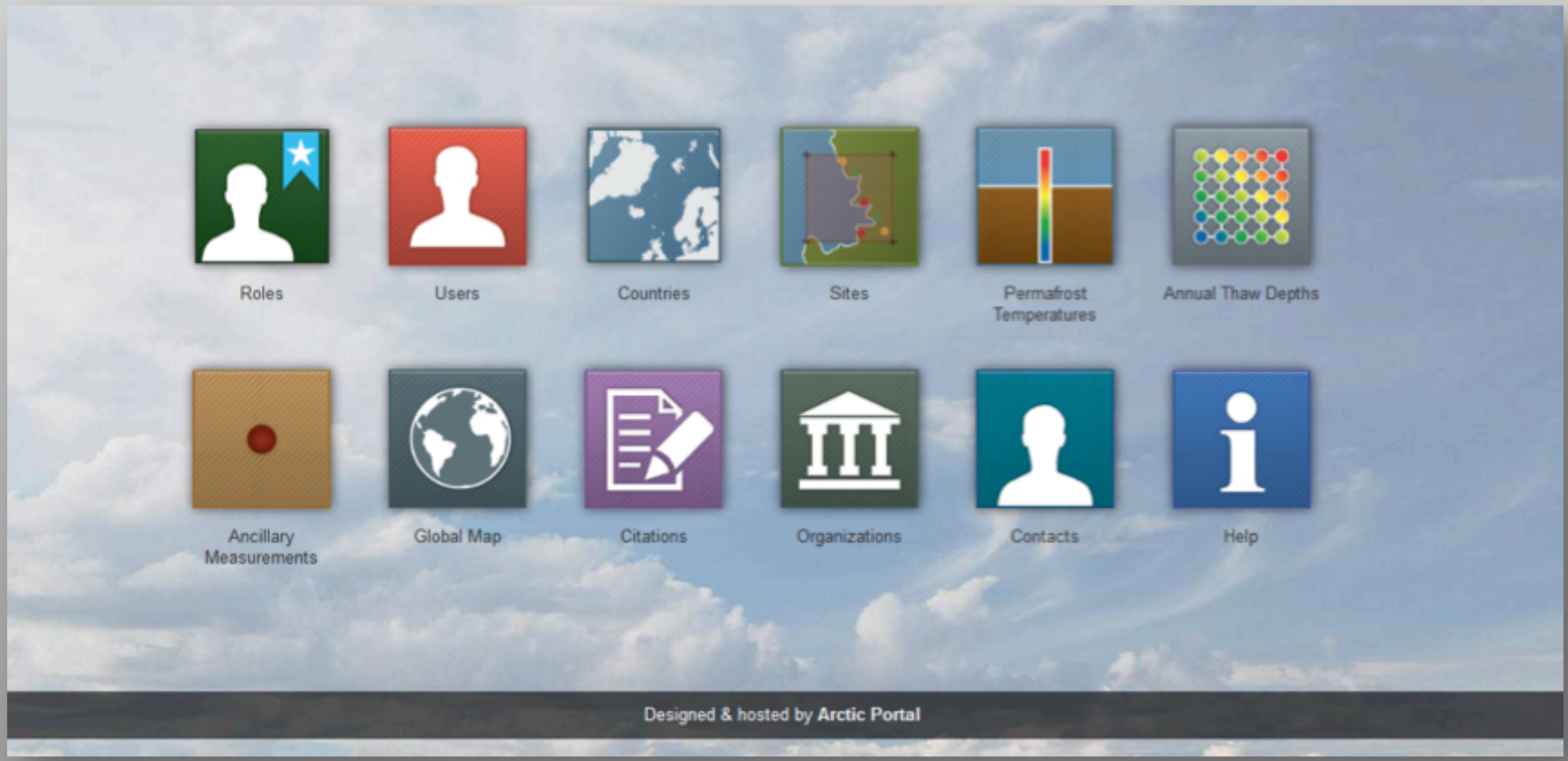
gtnpdatabase.org (PAGE 21 Work Package)



GTN-P Data Management System Main interface

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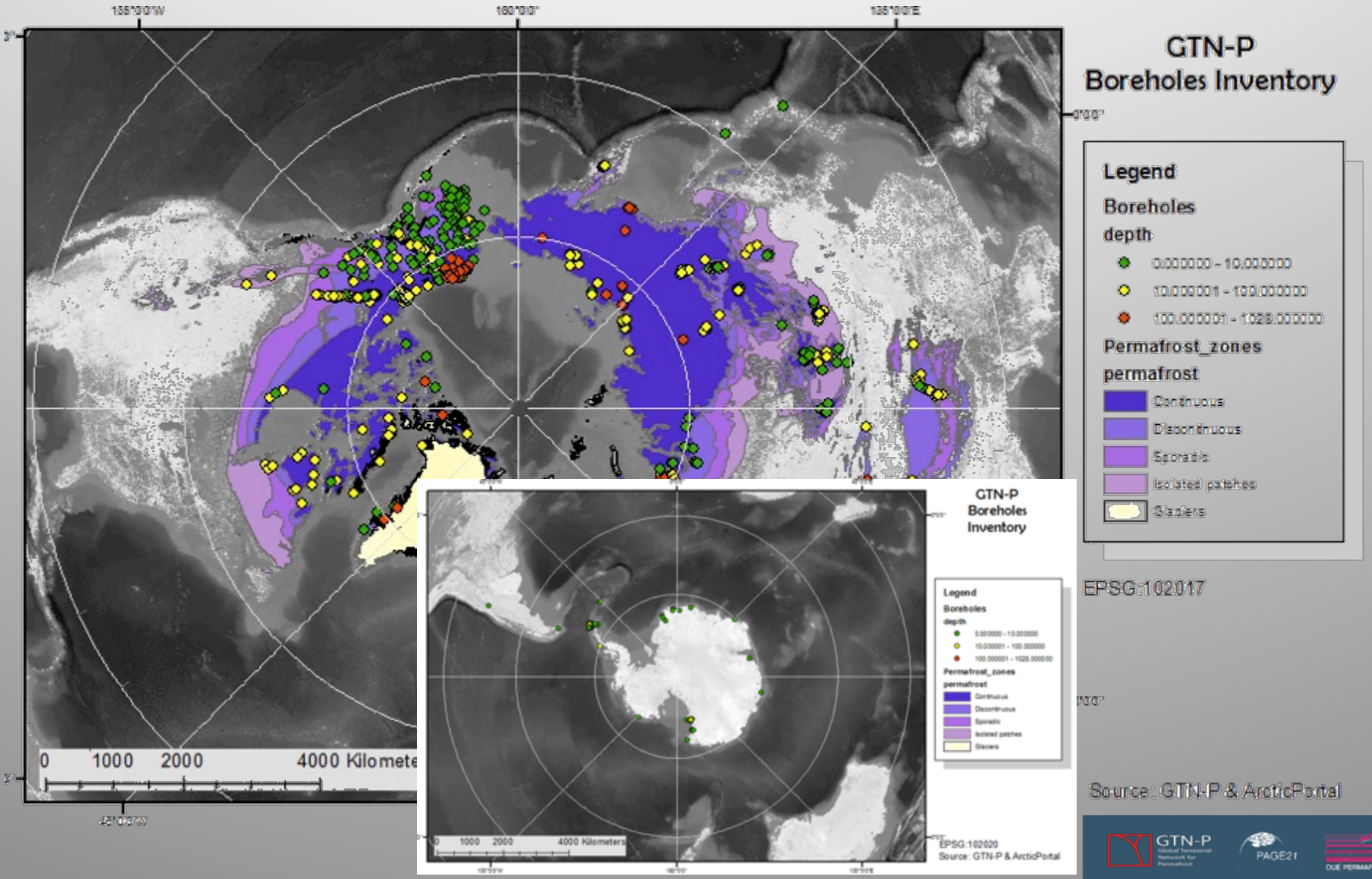
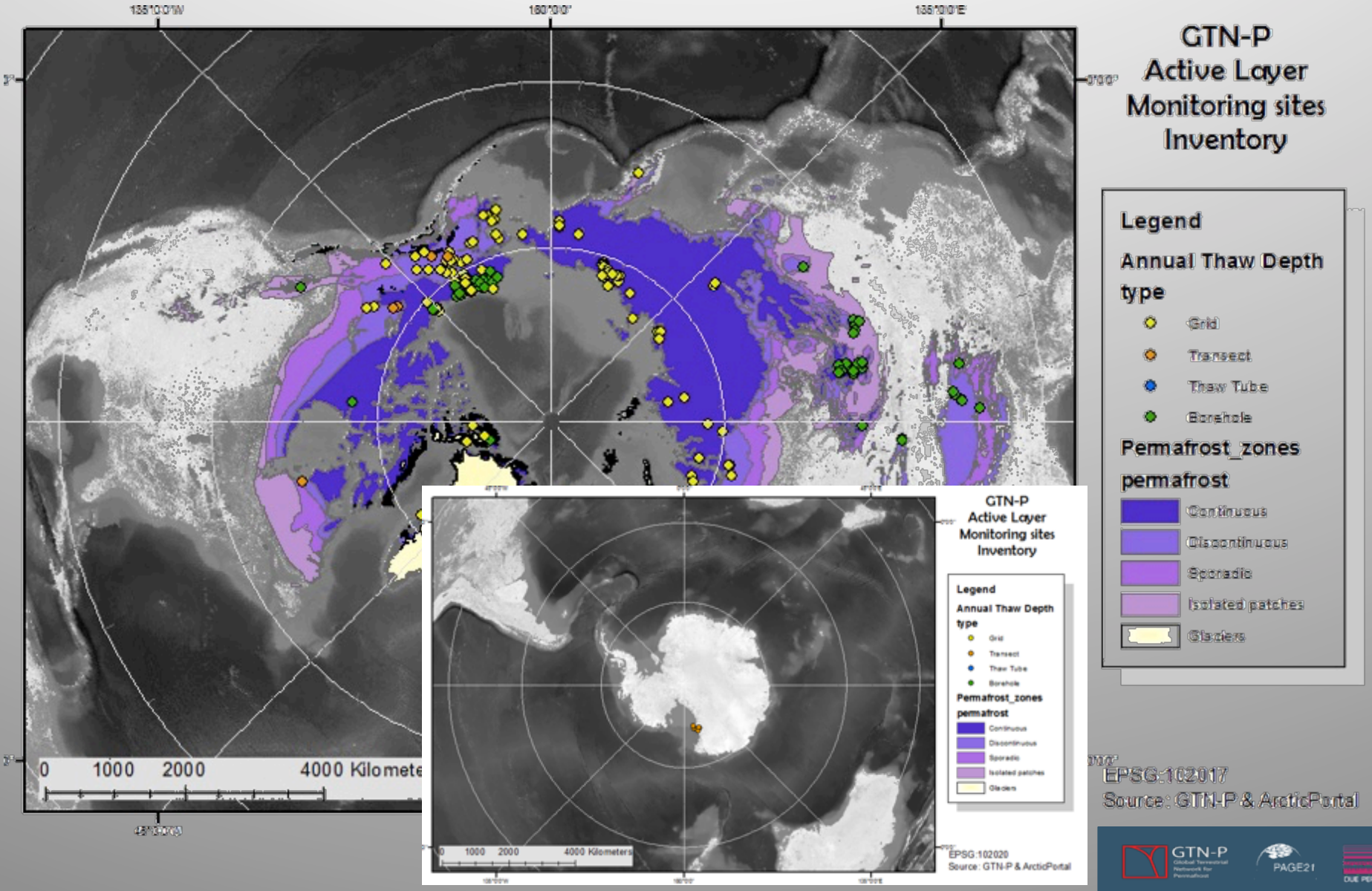
Boreholes


GTN-P
Boreholes Inventory
Legend
Boreholes
depth
0.000000 - 10.000000
10.000001 - 100.000000
100.000001 - 1028.000000
Permafrost_zones
permafrost
Continuous
Discontinuous
Sporadic
Isolated patches
Glaciers
EPSG:102017
0 1000 2000 4000 Kilometers
Source: GTN-P & ArcticPortal
EPSG:102020

Active layer monitoring sites



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ESA DUE Permafrost

- The main purpose of the ESA DUE Permafrost project is to define, demonstrate and validate, permafrost monitoring information service from local to large scale, mainly towards climate change studies and addressing the pan-boreal/arctic zone.
- Permafrost is a subsurface phenomenon and cannot be directly observed with satellite data. Yet, monitoring can be done based on indicators and via permafrost models.

Variable	Sensor	Spatial Coverage	Temporal Coverage	Resolution	Frequency
Surface Temperature	AATSR	panarctic	2005-2009	25 km x 25 km	Monthly
	MODIS	panarctic	since 2000	25 km x 25 km	Monthly
			since 2007		Weekly
		regional[1]	since 2007	1 km x 1 km	Monthly, weekly
Surface Soil Moisture	Metop ASCAT	panarctic	since 2007	25 km x 25 km	Weekly

Products

Land surface temperature
Snow
Land cover
Terrain
Landsurface hydrology

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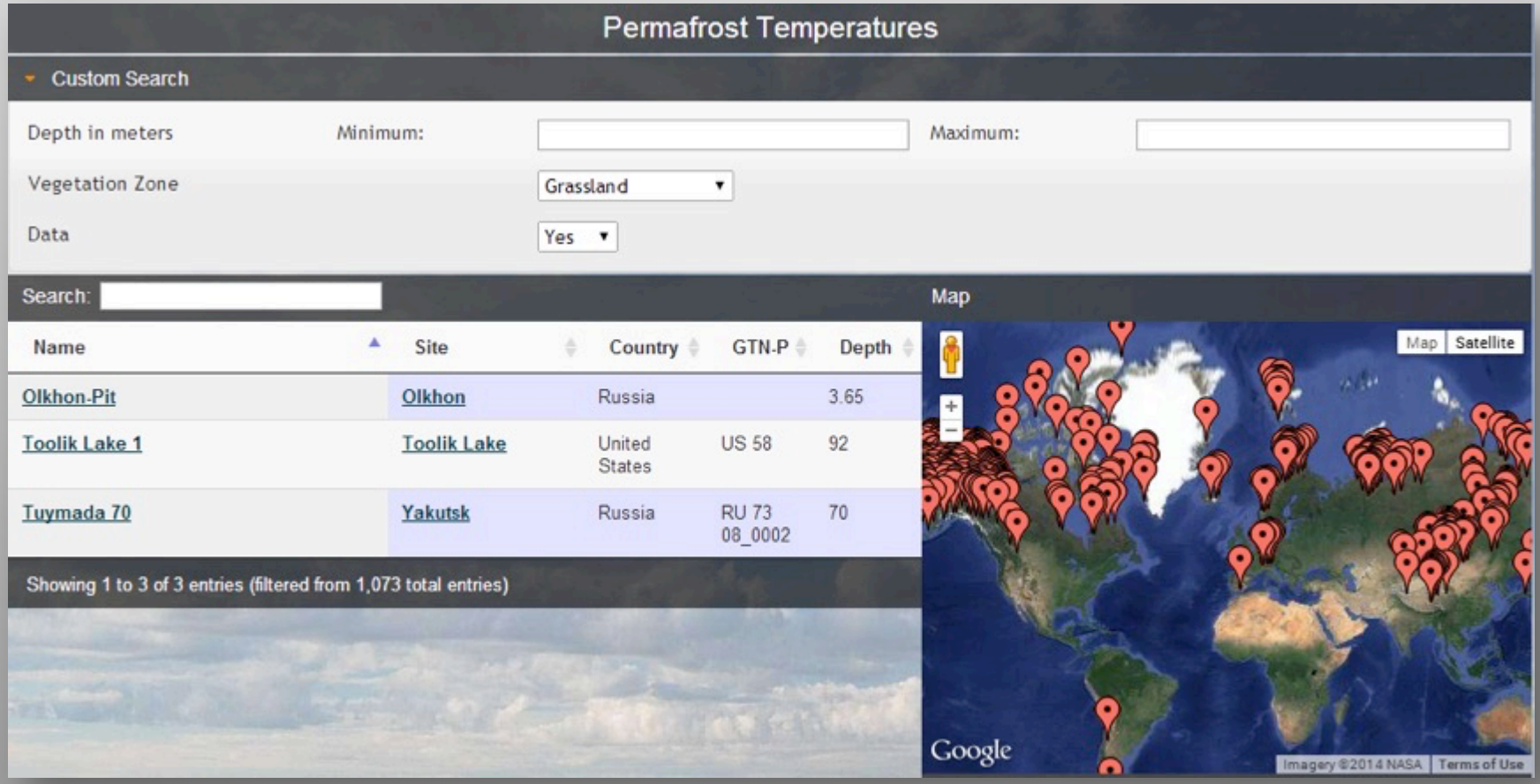

Perform a detailed search through permafrost temperature sites

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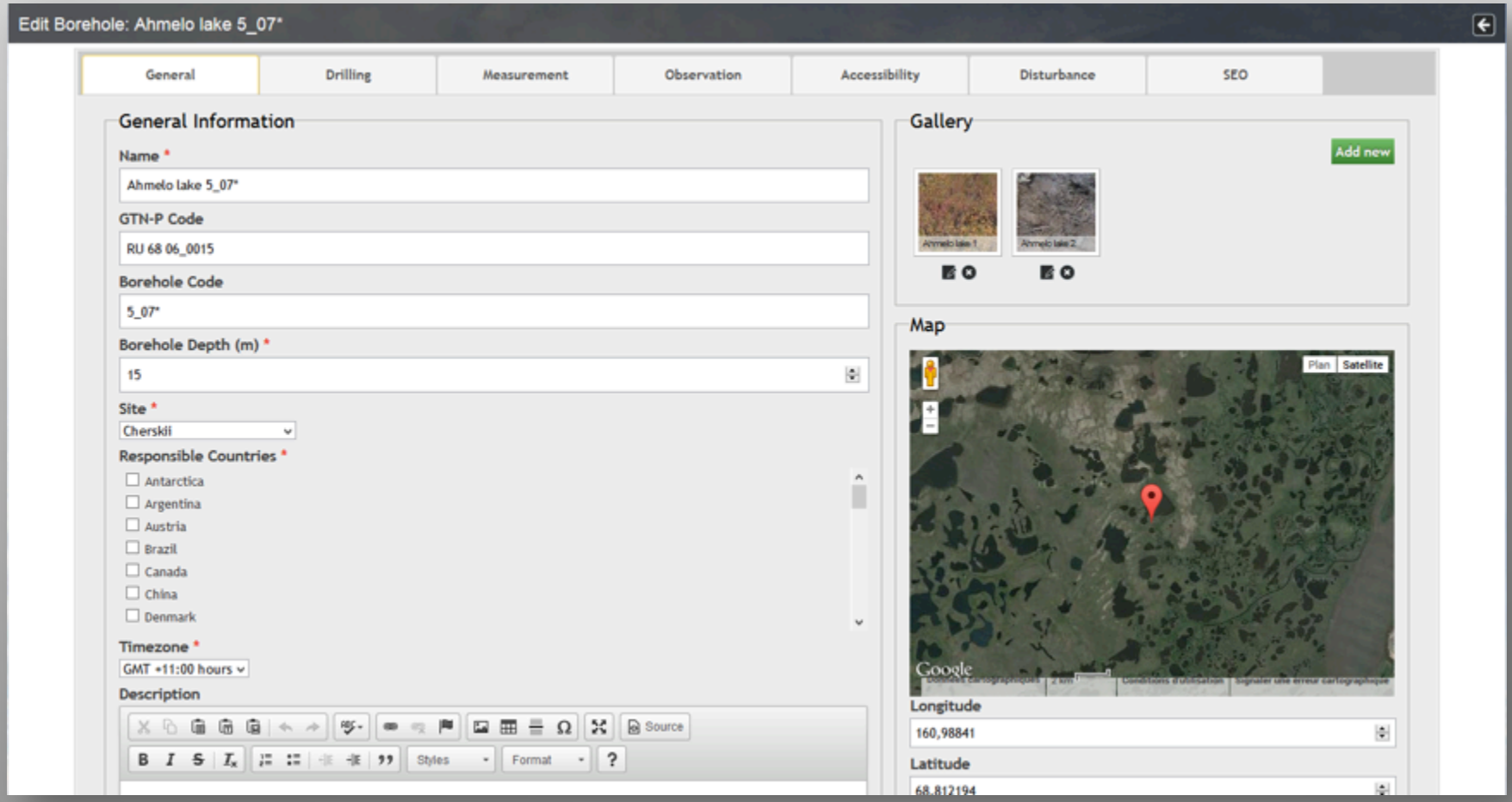

Edit Add a new Monitoring Site

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Online Data visualization

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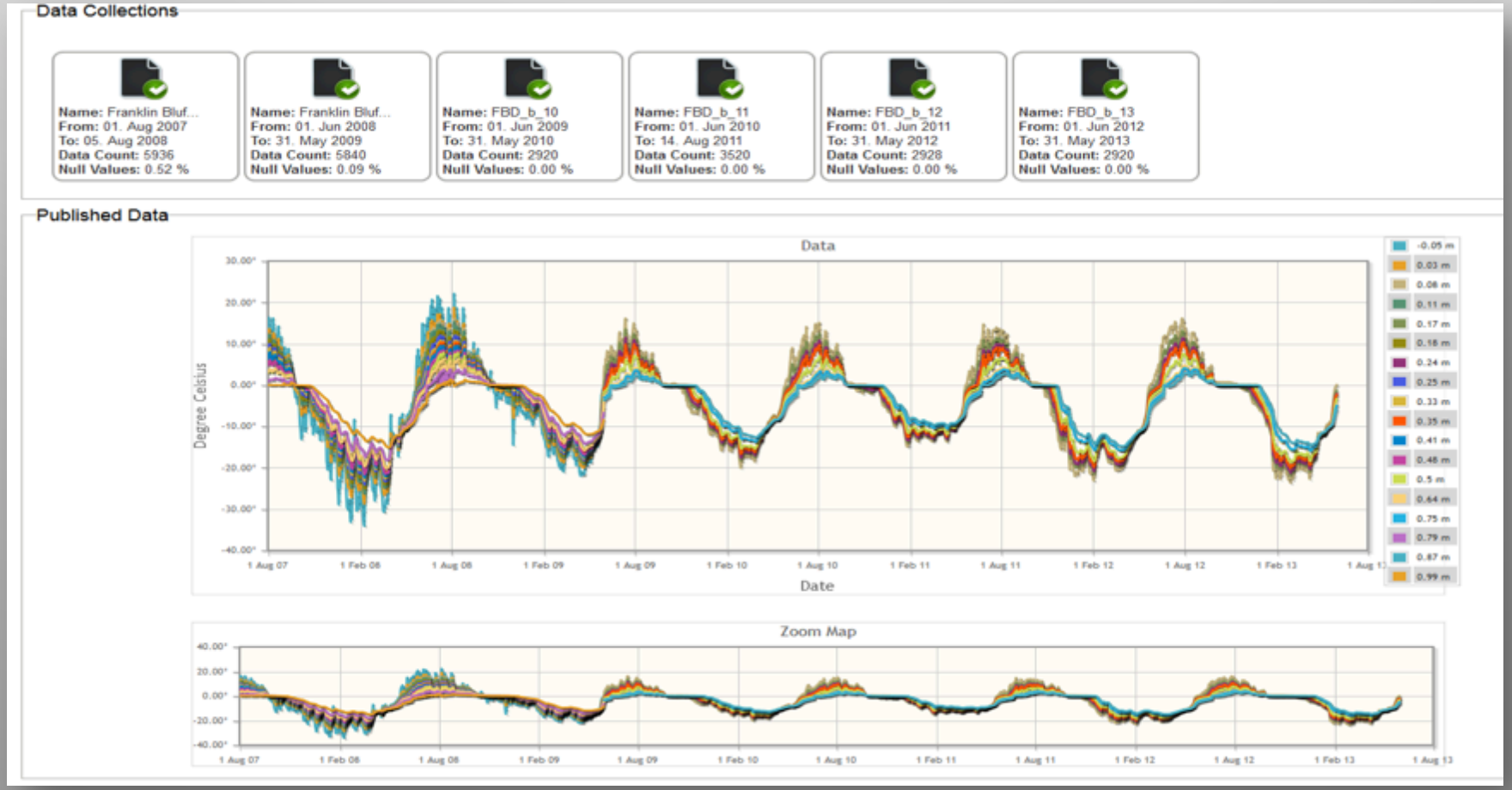
Ground Temperature



Edit Add a new dataset

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Online Data visualization

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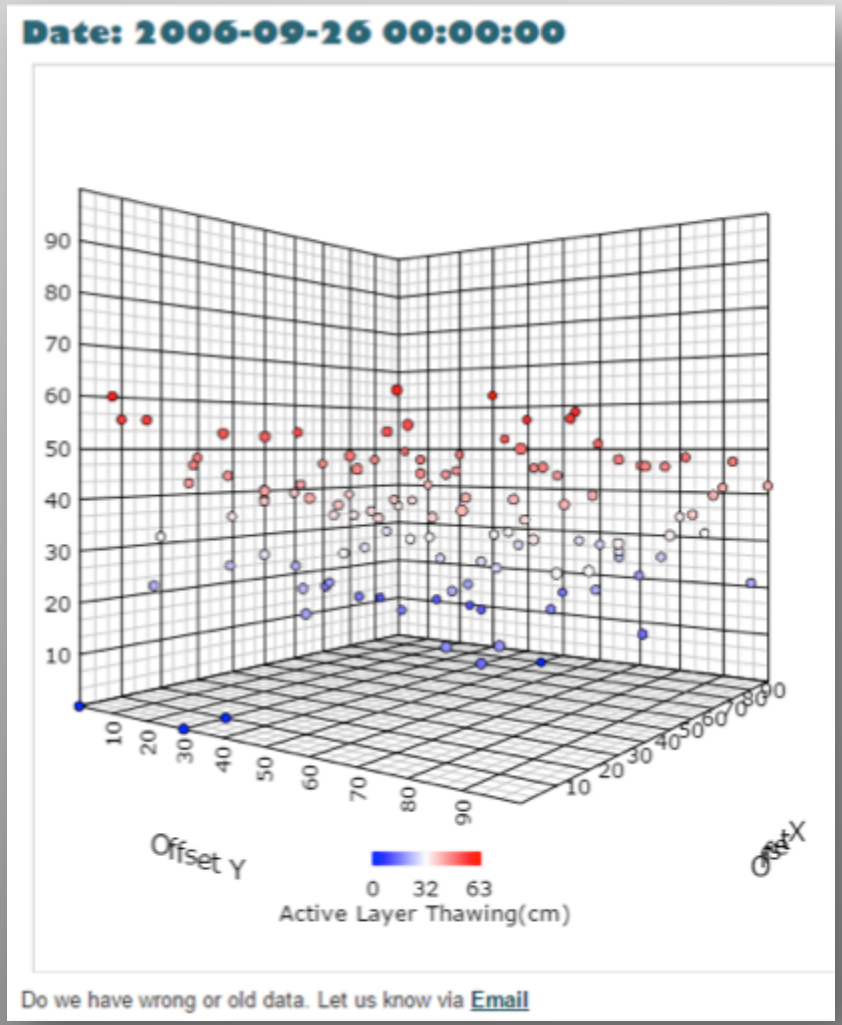
Active layer Thawing



Data Collections

Name: R36_andryushk...
From: 22. Sep 2005
To: 17. Sep 2011
Data Count: 1573
Null Values: 3.12 %

Published Data

2005-09-22 00:00:00 2006-06-21 00:00:00 2006-09-26 00:00:00
2011-09-17 00:00:00

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Factsheet

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Update from October 2014

- Total number of data: 3317721
- Total number of datasets: 1 361
  - Surface Temperature (Satellite): 869, datasets from 2000-2013
  - Ground Temperature: 144, datasets from 1982-2014
  - Active Layer Thickness: 75, datasets from 1992-2012
  - Surface Soil Moisture (Satellite): 75, datasets from 1992-2012
  - Air Temperature: 30, datasets from 2001-2013
  - Surface Temperature: 24, datasets from 2001-2013
- Number of boreholes: 1 077
- Number of active layer monitoring sites: 242
- Deepest borehole: 1028 m (Marryatt K-71, Canada)
- Longest Ground Temperature Record: 30 years, 1 month, 17 days (Umabybyt 20, Russia)

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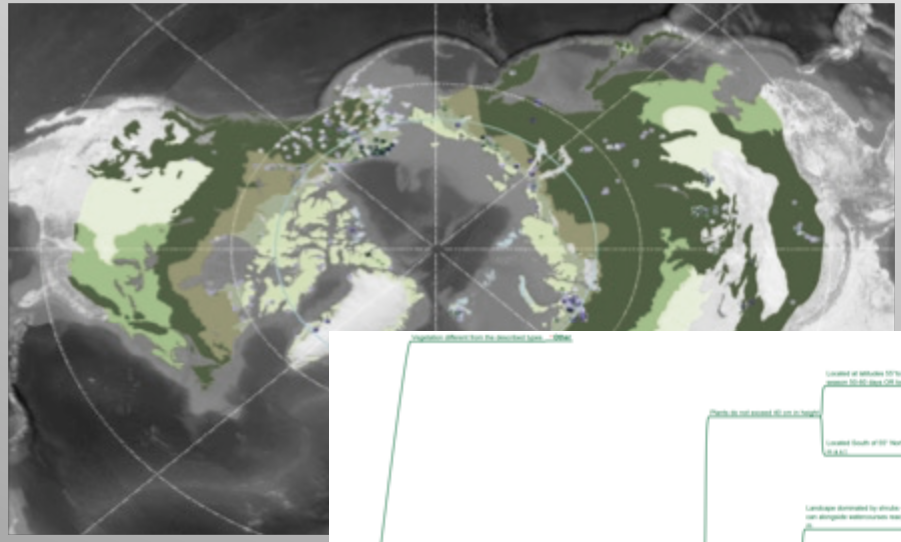
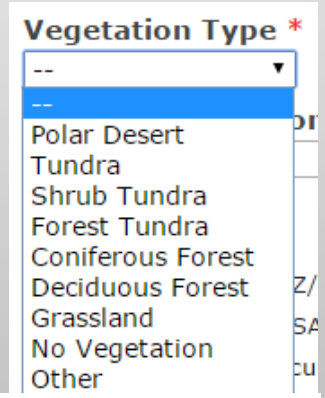
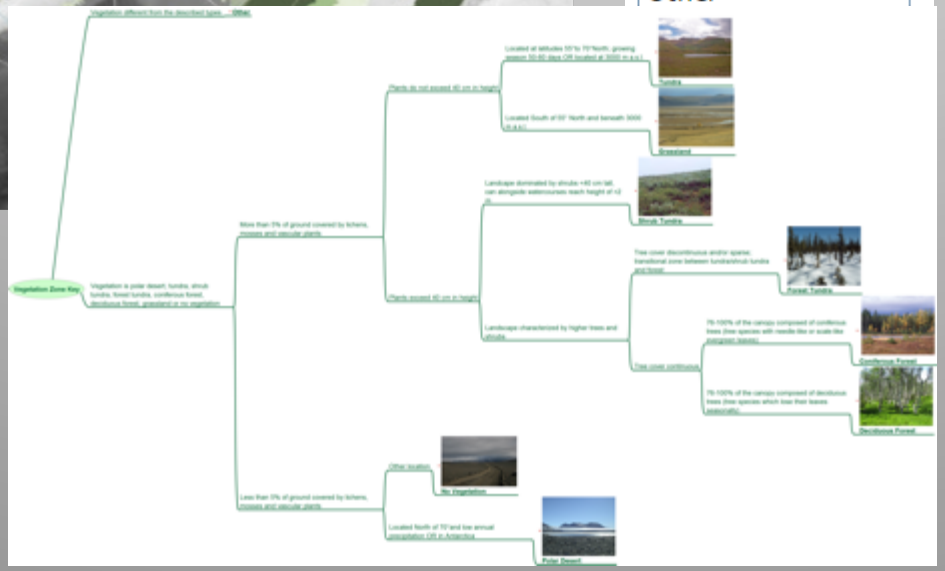
Vegetation Zones

Assessing Vegetation Zones

- 9 vegetation zones
- Tutorial with decisive attributes, distribution and characteristic species
- Support for assessing vegetation zones







Herrschel Island

- The lengthening growing season on Herschel Island and slightly warmer winter temperatures in some years has led to an increase in the active layer depth over the last three decades.
- measuring the plants in the 12 long-term plots in two of the island's vegetation zones

Vegetation Zones

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Crossing metadata with vegetation

Analysis: boreholes per vegetation zones

- Coniferous Forest: 123=11.4%
- Deciduous Forest: 27=2.5%
- Forest Tundra: 127=11.8%
- Grassland: 89=8.3%
- No Vegetation: 129=12%
- Polar Desert: 38=3.5%
- Shrub Tundra: 121=11.2%
- Tundra: 296=27.5%
- Other: 127=11.8%

ALL: 1,077

- Monitoring long-term changes in vegetation, hence climate change






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Thank you!

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SEVENTH FRAMEWORK PROGRAMME

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GLOBAL CLIMATE OBSERVING SYSTEM

GTOS
GLOBAL TERRESTRIAL OBSERVING SYSTEM