Status

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What is required?

**Time series** of GCOS parameters

- **Active layer thickness**
- **Permafrost temperature**

WMO OSCAR database, user survey etc.

- **Permafrost extent**

http://gsc.nrcan.gc.ca/permafrost/whatis_e.php
Spatial distribution through modelling using satellite data

Biskaborn et al. 2019, Nature Communications

Brown et al. 1997, based on mappings in the 1970s and 1980s
**Transient modelling** is required to produce **time slices**

- need of long-term records of
  - Land Surface Temperature,
  - Snow, and
  - suitable soil parameterization
CCI+ Permafrost method

Landsurface temperature

- 1997 - 2002
  • Downscaled and bias corrected ERA reanalyses data based on statistics of the overlap period between ERA reanalysis and MODIS LST

- 2002 – 2019
  • MODIS Landsurface temperature, gap-filled with reanalyses data
Overview CCI+ Permafrost products

Baseline products for **northern hemisphere (1km)**:
- Permafrost Temperature
- Active Layer Thickness
- Permafrost extent
- Harmonized borehole records database for calibration and validation
- Extended and improved DUE Permafrost freeze/thaw product for consistency check

Current version (May 2021): 1997-2019, CRDPv2

Animation: 2003-2017, CRDPv0
Overview CCI+ Permafrost products

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Conversion of frozen period length to ground temperature via empirical model
Overview CCI+ Permafrost products

Options “Rock glacier kinematics as a new parameter of the ECV permafrost”

- Three subprojects with regional focus (Romania, Norway and Switzerland)
- Supporting IPA action group
- Guidelines were applied by different institutes on 11 regions worldwide to produce RGIs including kinematics
- Kinematic time series were produced from DInSAR, SAR offset-tracking and matching of optical images on selected rock glaciers

Standard guidelines to produce homogeneous remote sensing based inventories of moving areas and kinematics-based rock glacier inventories kinematical time series have been developed thanks to the close collaboration with the international initiative IPA (International Permafrost Association) Action Group «Rock glacier inventories and kinematics»
Overview CCI+ Permafrost products

Further upcoming options products:

- Improved soil parameterization via landcover
- Multi-purpose freeze/thaw climate data record
Mean annual ground temperature

<table>
<thead>
<tr>
<th>Layer</th>
<th>Attribute</th>
<th>Units</th>
<th>Data type</th>
<th>notes</th>
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<tr>
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Year 2 product evaluation: bias of ~0.58°C and an RMSE of 1.41°C (MAGT <1°C, depth 1, 2, 5 and 10 m; 2003-2017)

1km, polar stereographic

Extent

ALT
Highlights CCI+ Permafrost

- Active layer thickness (ALT): news feature in Nature 2021

Monique Brouillette (2021): How microbes in permafrost could trigger a massive carbon bomb
Genomics studies are helping to reveal how bacteria and archaea influence one of Earth’s largest carbon stores as it begins to thaw. News Feature. Nature 591, 360-362 (2021), doi: https://doi.org/10.1038/d41586-021-00659-y
Coastal erosion in regions with increasing ground temperatures – local specific time series extraction

MAGT – Mean Annual Ground Temperature

Extension of Permafrost_cci data usage in ESA Polar Science Cluster project 'EO4PAC – Earth Observation for Permafrost dominated Arctic Coasts'
Highlights CCI+ Permafrost

Data available via a WebGIS which was setup as part of ESA DUE GlobPermafrost
Highlights CCI+ Permafrost

- Rock Glaciers Inventories including kinematics were produced on 11 regions worldwide (paper in preparation)

https://www.unifr.ch/geo/geomorphology/en/research/cci-permafrost.html
Outlook

Upcoming deliverables

- Product validation and intercomparison report
- Climate Assessment Report
  - Documentation of use cases
  - User feedback including this workshop

Key documents

<table>
<thead>
<tr>
<th>Document name</th>
<th>Version</th>
<th>Issue date</th>
<th>Download</th>
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<tr>
<td>D1.1 User Requirements Document (URD)</td>
<td>2.0</td>
<td>Nov. 30, 2020</td>
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<tr>
<td>D1.2 Product Specification Document (PSD)</td>
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<td>D1.3 Data Access Requirements Document (DARD)</td>
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<td>Dec. 22, 2020</td>
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<td>D2.1 Product Validation and Algorithm Selection Report (PVASR)</td>
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<td>D2.2 Algorithm Theoretical Basis Document (ATBD)</td>
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<td>D4.2 Climate Research Data Package (CRDP) Version 2</td>
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Rock glacier kinematics as new associated parameter of ECV permafrost
Boreholes

Ground temperature at 2 m depth - CRDPv2 regional average (spatial subset < 0°C at least 1 year)

Biskaborn et al. 2019, Nature Communications