PAGE21 WP5

Product Guide Circumpolar Landscape Units

VIENNA UNIVERSITY OF TECHNOLOGY
DEPARTMENT OF GEODESY AND GEOINFORMATION
RESEARCH GROUPS PHOTOGRAMMETRY & REMOTE SENSING

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This document is the product guide for the version 1 release of the circumpolar landscape units. It has been compiled for the PAGE21 project (FP7 – ENV - 2011 GRANT AGREEMENT NO: 282700), a project coordinated by the Alfred –Wegener -Institute for Polar and Marine Research. It is based on the deliverable document D5.2 'Upscaling of spatially explicit project results for the whole continental arctic region, for the 2000-2013 snow-free periods'

Consortium member:

Department of Geodesy and Geoinformation (GEO)
Research Group Remote Sensing
Vienna University of Technology
Gußhausstrasse 27-29/E122
1040 Vienna, Austria

permafrost@ipf.tuwien.ac.at
www.geo.tuwien.ac.at

Status:	Issue 1.0		
Authors:	Bartsch, A. (TUW), Kroisleitner C. (TUW), Widhalm, B. (TUW)		
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1 Contents

2 Dataset overview

This dataset provides landscape units for the pan-Arctic which have been derived for upscaling purposes as part of the PAGE21 work package 5.
Parameters relevant for geomorphological observations and carbon pools have been mostly selected from existing databases. The best differentiation of landscape units was obtained by using:
Topographic Wetness Index, SAR backscatter, Land Surface Temperature (July and August), unfrozen period length, the slope steeper than 3°, Mean annual Surface Temperature, day first frozen, day first unfrozen and Land surface temperature Amplitude (July and August).

This dataset comprises the landscape units as well as all input datasets (in case of applied post-processing of the original data source) in geotiff format.

More details on the retrieval and datasets is provided in Bartsch et al. 2016.

3 Data specification

3.1 File naming

File name: OOO_SSSSS_PPP_VVV_YYYYMMDD_ROI.EEE

Where
OOO="organisation", e.g. TUW
SSSSSS="mode " e.g. ISO = Isocluster
PPP="product"
VVV="product version"
YYYYMMDD= "acquisition date and time" (or year range YYYY_YYYY)
ROI = “region/site of interest” CIR - circumpolar”
EEE="file extension", e.g. tif

Product codes
LSU = Land Scape Units
WDB = Winter Backscatter in dB
AMP = Land Surface Temperature
MAX = Maximum
MST = Mean annual surface temperature
UFP = Unfrozen Period Length
FDF = First day Frozen
FDU = First day unfrozen
SLO = Slope

3.2 Data Description

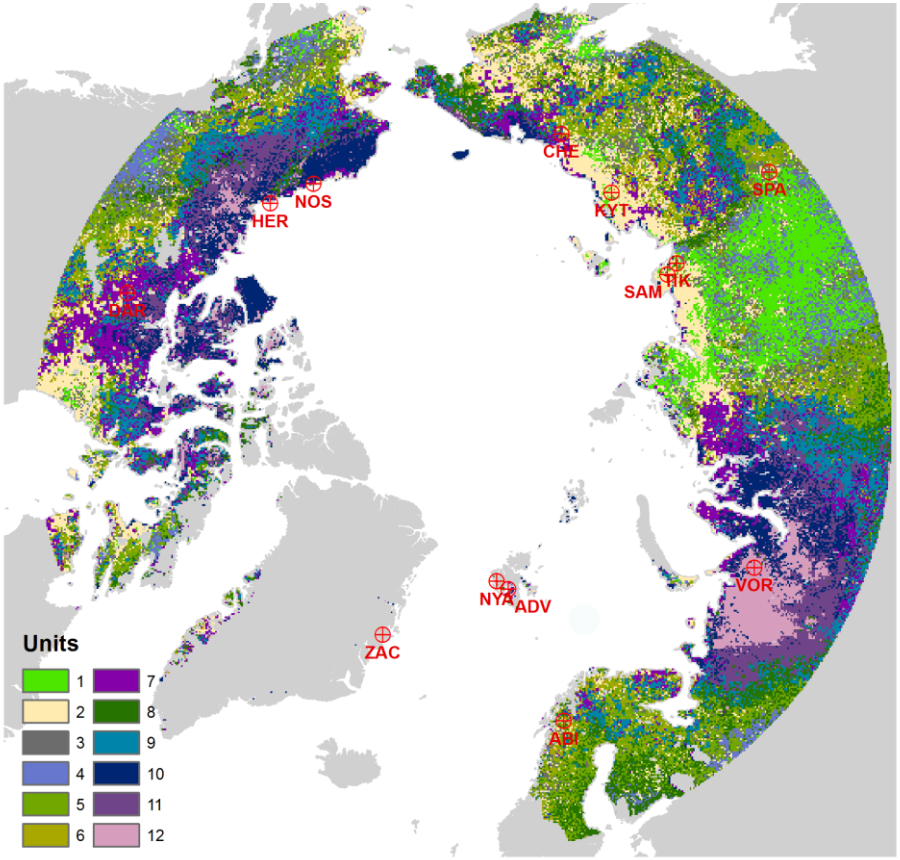

Figure 1: Circumpolar landscape units and location of PAGE21 sites

Table 1: Landscape units product description

Subject	Specification
Variable	Landscape units
Time period	different Input – Time periods, see Table 3
Coordinate system	Polar Stereographic
Spatial resolution	25km
Data format	Geo tif
Data fields	Circumpolar Unit : distinct Units (12) with specific properties

Table 2: Landscape unit description and PAGE21 sites (multiple allocation in transition zones)

Units	Site	Topography Average gradient+STD	Specific properties	Average days of unfrozen P.
Unit 1	SPA,TIK	1° / Stdv = 1°	low MAST, high JJA Amplitude	128
Unit 2	SPA, KYT, CHE, SAM,TIK	1° / Stdv = 2°	low MAST , low JJA Amplitude, Late first unfrozen day	114
Unit 3		3° / Stdv = 5°	medium first unfrozen day, low max LST	125
Unit 4		3° / Stdv = 4°	Medium STD of first unfrozen day and max LST, high average max JJA LST, low max LST summer amplitude	133
Unit 5	ABI	2° / Stdv = 4°	high MAST , high average max LST	138
Unit 6	ABI	2° / Stdv = 3°	High STD max LST and low STD for frozen/unfrozen day	130
Unit 7	DAR, ADV, NYA	1° / Stdv = 3°	Low MAST with low STD, medium LST summer amplitude	116
Unit 8		4° / Stdv = 6°	High MAST an high STD for unfrozen day	134
Unit 9	DAR	3° / Stdv = 5°	High max LST with medium STD	128
Unit 10	NOS, ADV	1° / Stdv = 1°	Low MAST with low STD, high summer LST amplitude, high STD for first unfrozen day	122
Unit 11	HER	1° / Stdv = 3°	high max LST amplitude with low max LST STD	135
Unit 12	VOR	1° / Stdv = 2°	Medium max LST with low STD	136

SPA = Spasskaya Pad, TIK = Tiksi, KYT = Kytalyk, CHE = Cherskii, SAM = Samoylov, TIK = , ABI = Abisko, DAR = Daring lake, NOS = Norh Slope, VOR = Vorkuta, HER = Herschel Island, ADV=Adventdalen, NYA=Ny Alesund

3.3 Input – Data Specification

Parameters which can be identified with satellite data and are relevant for soil processes and especially land-atmosphere exchange have been assessed for the retrieval of a circumpolar landscape units map as proposed in the Description of Work of the PAGE21 project.

In a first step these have been assessed for redundancy in information content. Correlations are presented in Bartsch et al. (2016) Several layers have been excluded due to high correlation with other layers (e.g. NDVI).

Table 3: Specifications and sources of used circumpolar datasets (from Bartsch et al. 2016). All datasets except the TWI have been post-processed by TU Wien before application within the frame work of PAGE21.

Derived parameter	Source	Spatial resolution	Time period
Topographic Wetness Index (TWI)	Marthews et al. 2015	0,004167 °	-
Slope > 3°	Santoro et al. 2012 (ESA DUE Permafrost)	100m	-
LST Maximum Summer (July/Aug)	MODIS, Duguay et al. 2014 (ESA DUE Permafrost)	25km	2000 - 2013
LST July/Aug amplitude		25km	2000 - 2013
MODIS mean annual surface temperature		25km	2000 - 2013
Length of unfrozen period in days	Metop ASCAT, Paulik et al. 2014 (ESA DUE Permafrost)	25km	2007 - 2013
Average first unfrozen day of year		25km	2007 - 2013
C-Band backscatter (SAR) (winter)	ENVISAT ASAR GM, Widhalm et al. 2015	1km	2005 - 2012

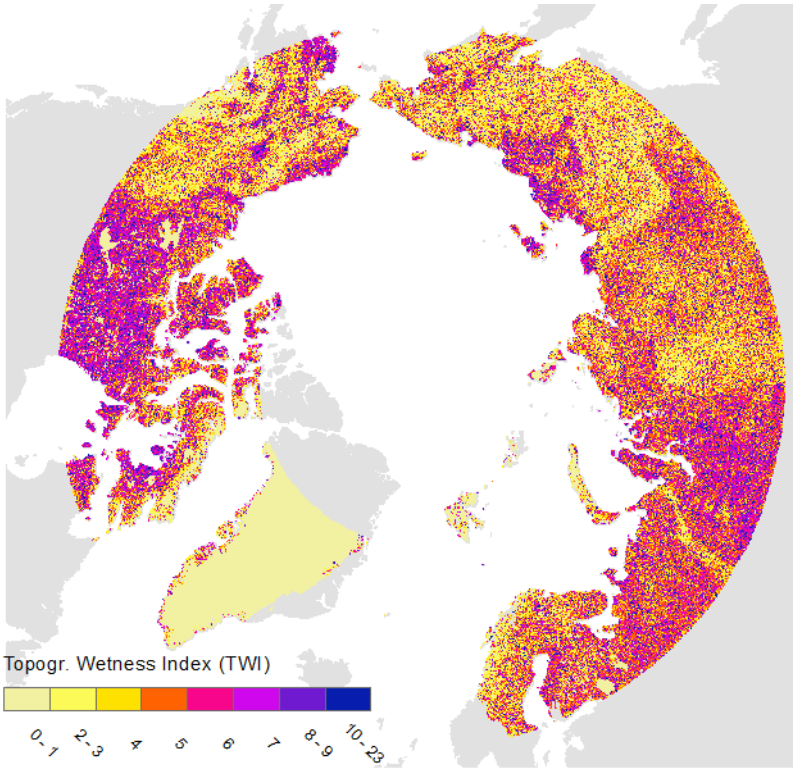

Figure 2: Circumpolar TWI (resampled to 25km²; source Marthews et al. 2015

3.3.1 C-Band Backscatter (SAR)

A circumpolar representative and consistent wetland map is required for a range of applications spanning from up-scaling of carbon fluxes and pools to climate modelling and wildlife habitat assessments. Currently available datasets lack sufficient accuracy and/or thematic detail in many regions of the Arctic. The development of the novel wetness level map has been described in Widhalm et al. (2015). Circumpolar ENVISAT ASAR GM backscatter (1km resolution, 500m nominal resolution) data have been explored in subarctic and arctic environments with special emphasis on spatial wetness patterns.

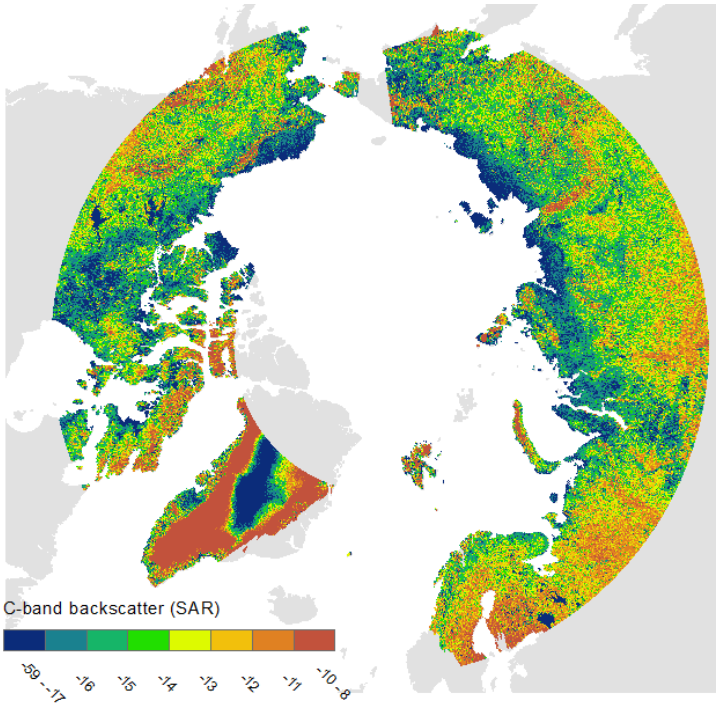

Figure 3: C-band winter backscatter from ENVISAT ASAR GM in dB (Widhalm et al. 2015)

3.3.2 MODIS MAST

This dataset provides the Mean Annual Surface Temperature for the pan-arctic area (60°N) derived from MODIS data for the years 2000-2013.

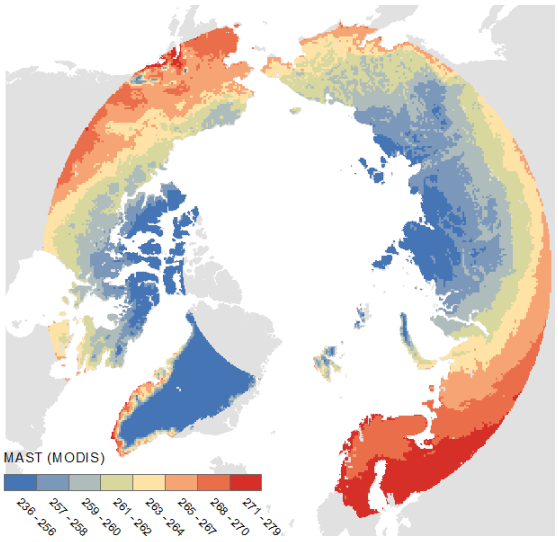

Figure 4: Mean annual surface temperature in Kelvin (derived from Duguay et al. 2014)

3.3.3 MODIS LST – Summer Amplitude

This dataset provides the Summer Amplitude of Surface Temperature for the pan-arctic area (60°N) derived from MODIS data for the years 2000-2013.

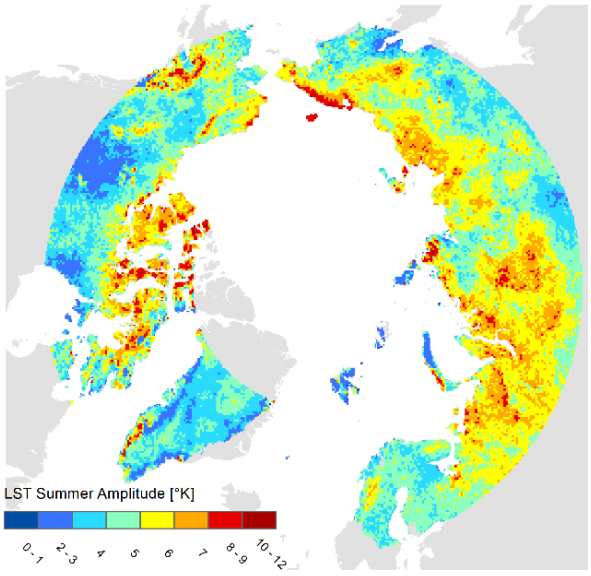

Figure 5: MODIS Landsurface temperature July/August Amplitude in Kelvin (derived from Duguay et al. 2014)

3.3.4 MODIS LST Summer – Maximum

This dataset provides the Summer (July,August) Maximum of Surface Temperature for the pan-arctic area (60°N) derived from MODIS data for the years 2000-2013.

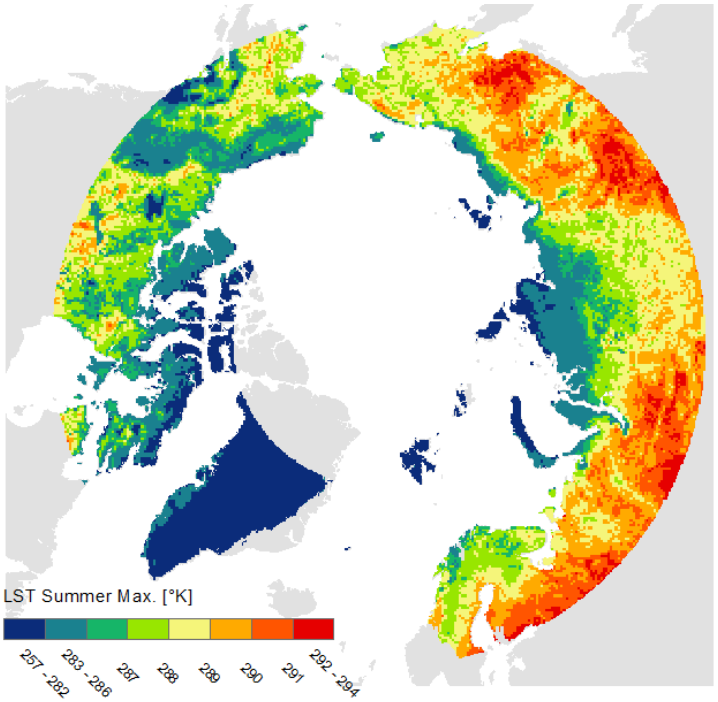

Figure 6: MODIS Landsurface temperature maximum in Kelvin (derived from Duguay et al. 2014)

3.3.5 Unfrozen period length

The unfrozen days dataset were produced using records for frozen/unfrozen land surface, which are available from Metop ASCAT (since 2007, Paulik et al. 2014). By subtracting the first unfrozen day from the first frozen day, the unfrozen Period was calculated.

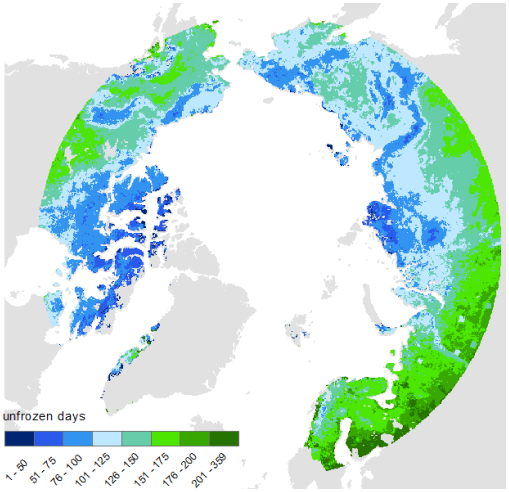

Figure 7: Length of unfrozen period in days (derived from Paulik et al. 2014)

3.3.6 First day frozen

The first day frozen dataset were produced using records for frozen/unfrozen land surface, which are available from Metop ASCAT (since 2007, Paulik et al. 2014). Starting with August, the first day frozen for every pixel where assigned with the day number of the year. An average were created for the 7 annual layers.

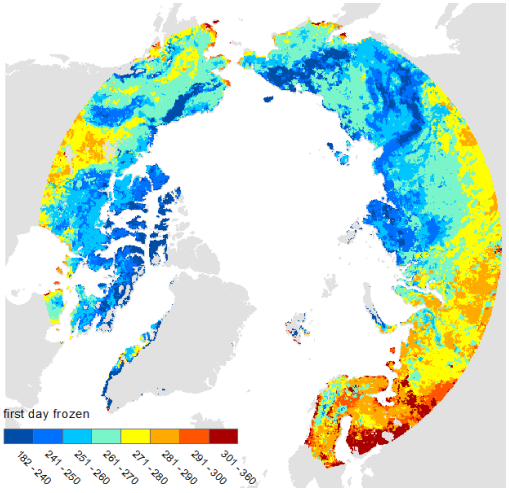

Figure 8: First day frozen (derived from Paulik et al. 2014)

3.3.7 First day unfrozen

The first day unfrozen dataset were produced using records for frozen/unfrozen land surface, which are available from Metop ASCAT (since 2007, Paulik et al. 2014). Starting with January, the first day unfrozen for every pixel where assigned with the day number of the year. An average were created for the 7 annual layers.

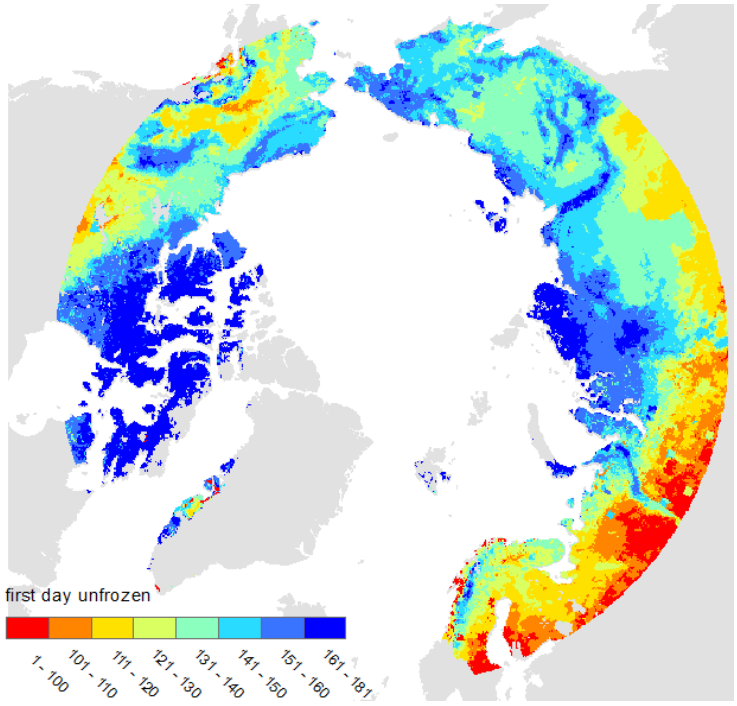

Figure 9: first day unfrozen (derived from Paulik et al. 2014)

3.3.8 Slope

This dataset provides the information if the area is flat (0) or sloped (1) with at least 3° gradient. It was produced using the circumpolar digital elevation model > 55° North (Santoro et al. 2012)

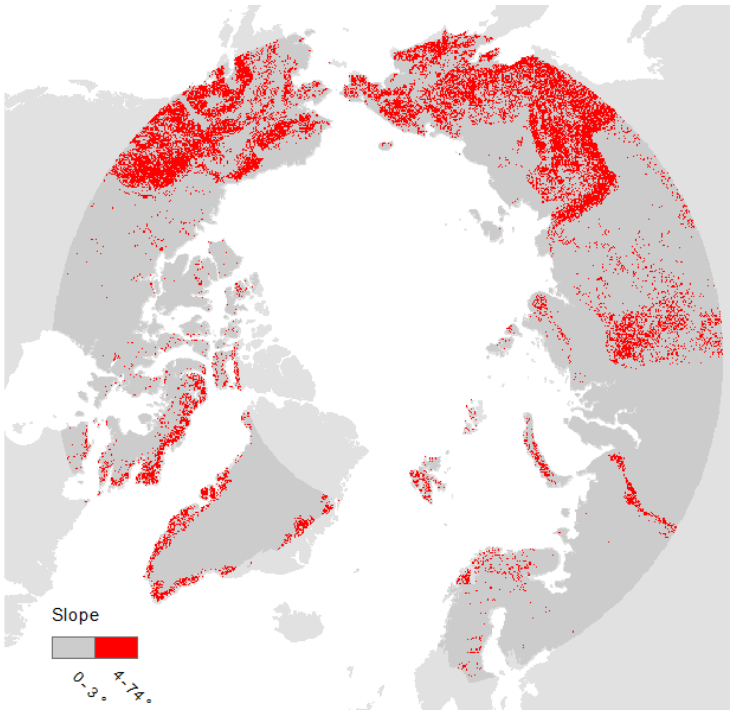

Figure 10: Slope units derived from Santoro et al. 2012

4 Data access and contact information

Data can be accessed via PANGAEA (www.pangaea.de) and should be cited as supplement to
Annett Bartsch, Christine Kroisleitner, Birgit Heim, (2016): An Assessment of Permafrost Long-term monitoring sites with circumpolar satellite derived datasets. Proceedings of the ESA Living Planet Symposium 2016. ESA SP-740.

For questions about the dataset, contact Annett.Bartsch@tuwien.ac.at.

Additional information on the Project can be found at www.page21.eu

5 References

Bartsch, A., Christine Kroisleitner, Birgit Heim, (2016): An Assessment of Permafrost Long-term monitoring sites with circumpolar satellite derived datasets. Proceedings of the ESA Living Planet Symposium 2016. ESA SP-740.

Duguay, Claude R; Soliman, Aiman; Hachem, Sonia; Saunders, William (2014): Circumpolar and regional Land Surface Temperature (version 2) with links to geotiff images (2007-01 to 2013-12). University of Waterloo, Canada, doi:10.1594/PANGAEA.836729

Marthews TR, Dadson SJ, Lehner B, Abele S & Gedney N (2015). High-resolution global topographic index values for use in large-scale hydrological modelling. Hydrology and Earth System Science 19:91-104.

Paulik, Christoph; Melzer, Thomas; Hahn, Sebastian; Bartsch, Annett; Heim, Birgit; Elger, Kirsten; Wagner, Wolfgang (2014): Circumpolar surface soil moisture and freeze/thaw surface status remote sensing products (version 4) with links to geotiff images and netCDF files (2007-01 to 2013-12). Department of Geodesy and Geoinformatics, TU Vienna, doi:10.1594/PANGAEA.832153.

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