



AVHRR Curation Project - Keeping 40 years of European AVHRR-LAC data alive

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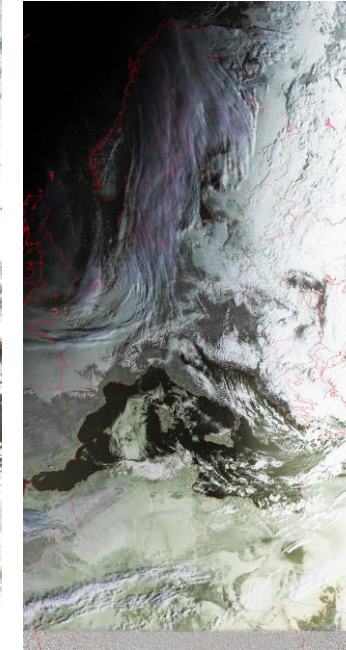
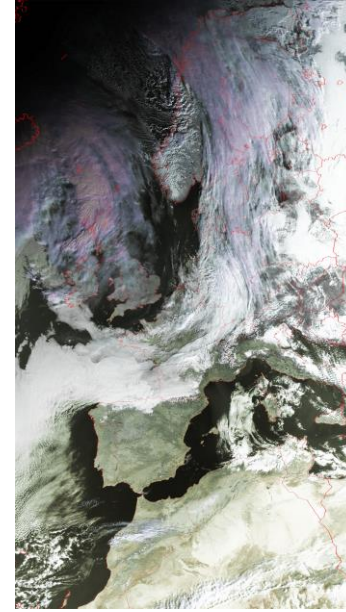
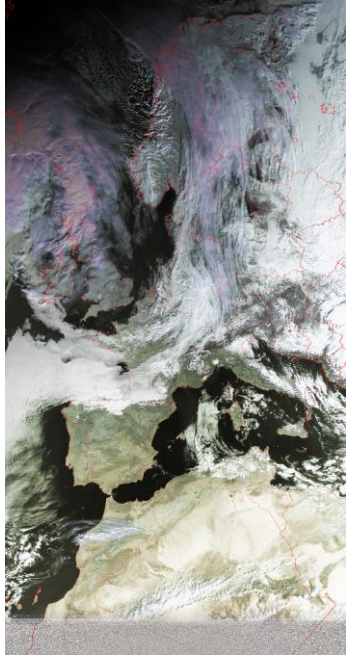
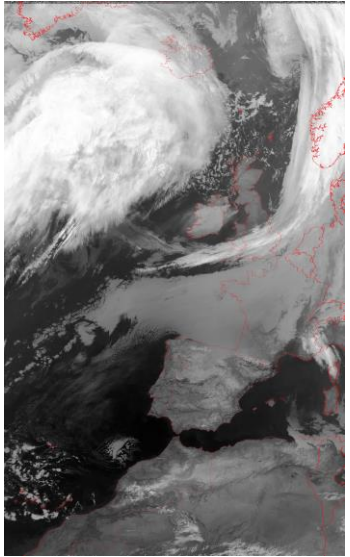
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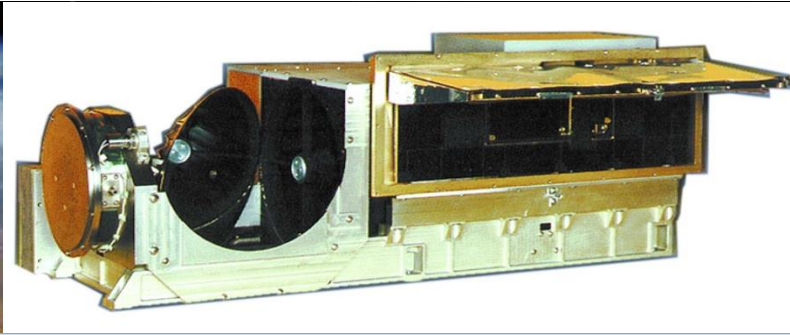
³Rhea Group for ESA



10-11 overflights in 24h; archived and processed at our facilities.

05. February 2023

AVHRR – Advanced Very High Resolution Radiometer (1980 – ca. 2027)

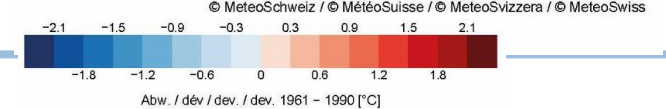
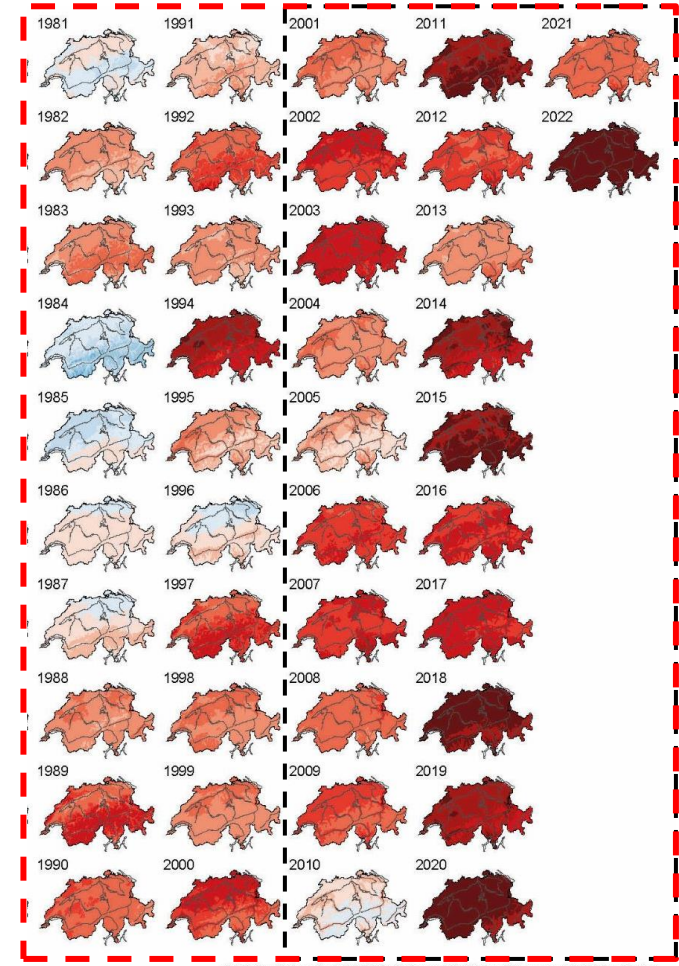
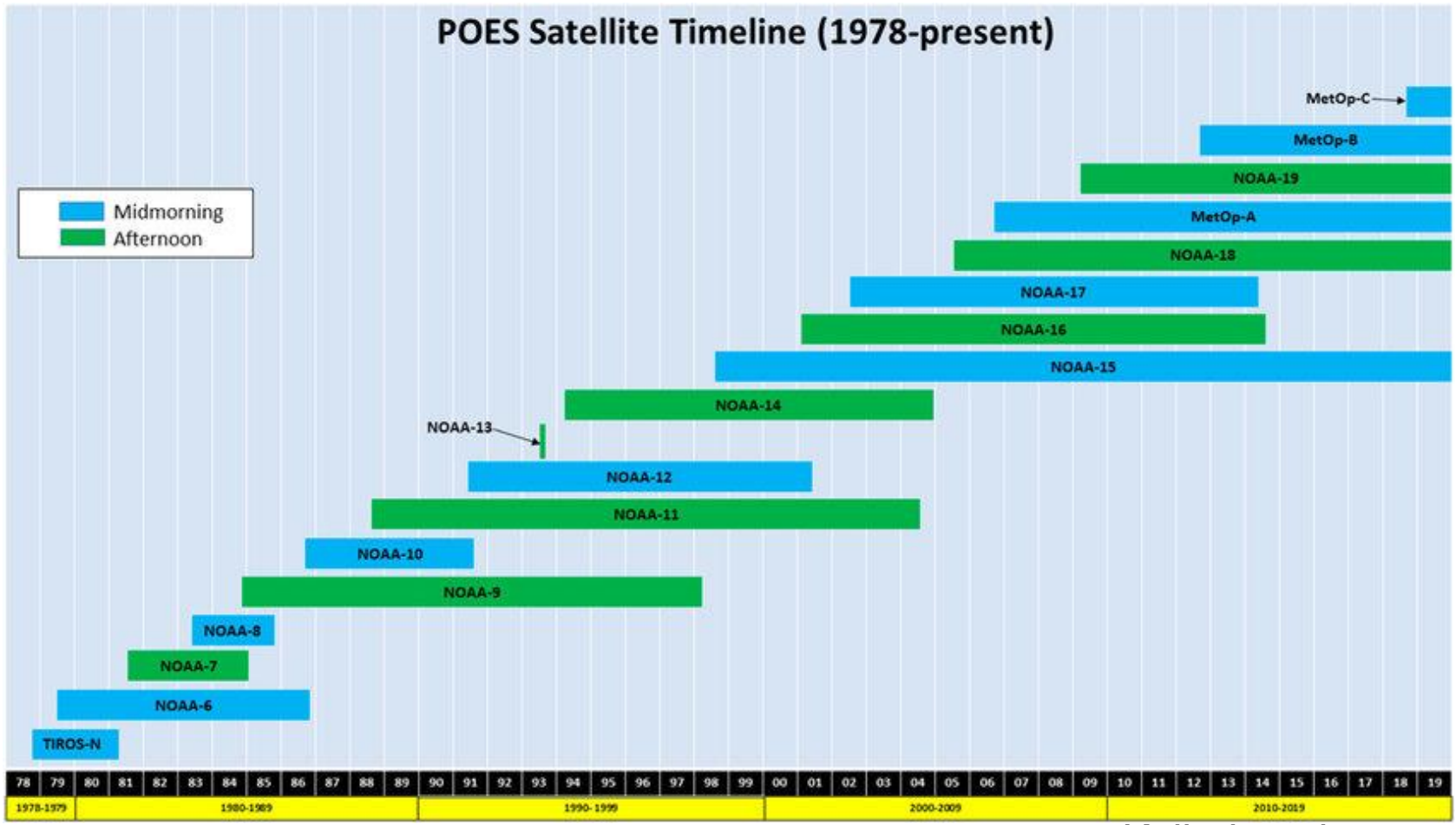


- > NOAA-satellites (1980 – ca. 2024)
- > MetOp-satellites (2006 – ca. 2027)
- > AVHRR: 30cm x 36cm x 80cm (32 kg)

AVHRR/3 Channel Characteristics (since 1998)

Channel Number	Resolution at Nadir	Wavelength (um)	Typical Use
1	1.09 km	0.58 - 0.68	Daytime cloud and surface mapping
2	1.09 km	0.725 - 1.00	Land-water boundaries
3A	1.09 km	1.58 - 1.64	Snow and ice detection
3B	1.09 km	3.55 - 3.93	Night cloud mapping, sea surface temperature
4	1.09 km	10.30 - 11.30	Night cloud mapping, sea surface temperature
5	1.09 km	11.50 - 12.50	Sea surface temperature

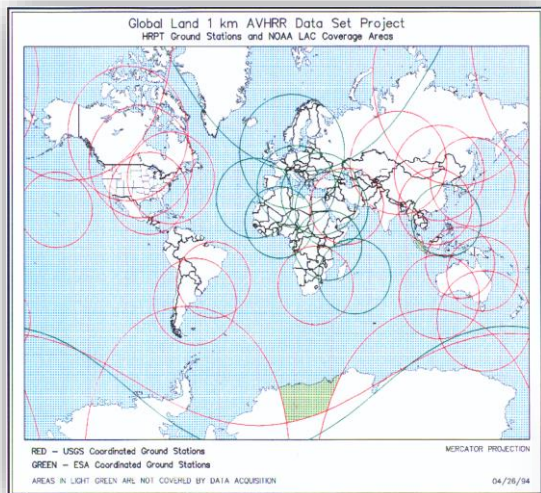
Unique Time Series of more than 40 years based on similar AVHRR sensor to support climate change studies



Kalluri et al. 2019

Motivation for the co-operation: ESA Heritage Mission Team and University of Bern

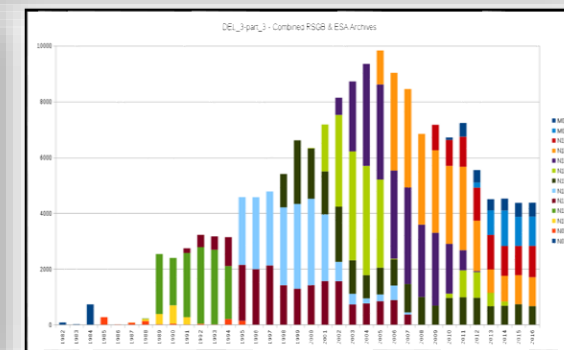
- > Heritage program for third party missions
- > Support climate change initiative and other projects related to climate change studies



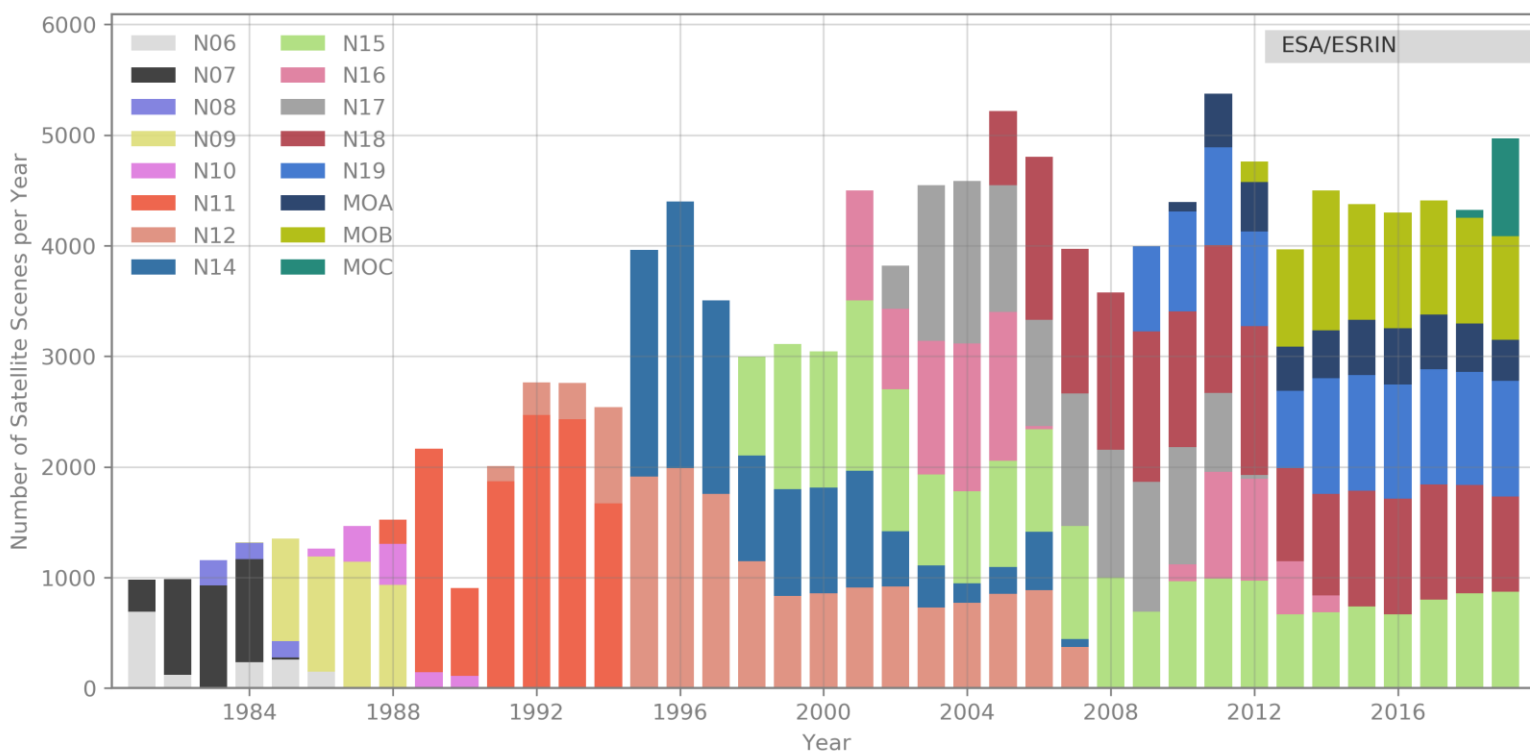
AVHRR data archived
on optical disks and
magnetic tapes in
ESRIN



- > UniBern – long tradition of AVHRR reception and processing
- > We see the need to make historical data accessible to the public and keep the data alive for an unlimited time.



European 1-km AVHRR archive hosted at ESA includes data from University of Bern, Dundee Satellite Receiving Station and ESA holdings. Period: 1981 - 2020



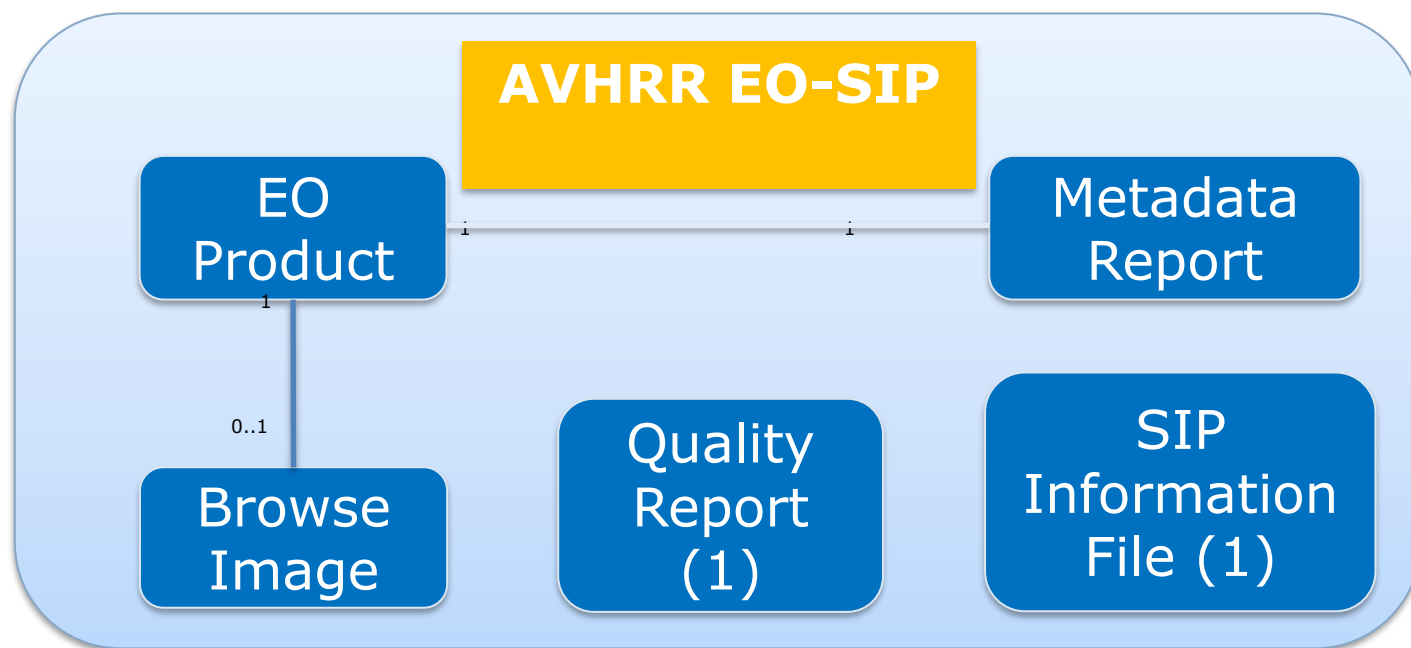
- Two-ten overpasses per day.
- Dataset consists of more than **250.000 data products** harmonized and consolidated through a dedicated ESA project (Heritage Space Programme).
- All accessible **free of charge via ESA dissemination services.**
- **Archived for unlimited time by ESA.**
- Processing to Level-1c planned.

Procedure to compile an open accessible AVHRR data set via ESA dissemination service

- > WP_1: *Inventory and gaps identification of AVHRR UniBe data incl. ESA data holdings*
- > WP_2: *Consolidation procedure and reprocessing definition; development of software to re-format the different flavors of archived AVHRR data and fill the meta file.*
- > WP_3: *AVHRR Master data set consolidation and reprocessing at UniBe Linux Cluster; transfer of software and scripts to ESA for own re-processing.*
- > WP_4: *AVHRR European Master data set validation (test of readability, check of consistency of all files in EO-SIP)*
- > WP_5: *Consolidation of AVHRR preserved data set composition*
- > WP_6: *Transfer of all re-processed AVHRR data in level 1b (1981 – 2020) to ESA to be included in EARTH ONLINE.*

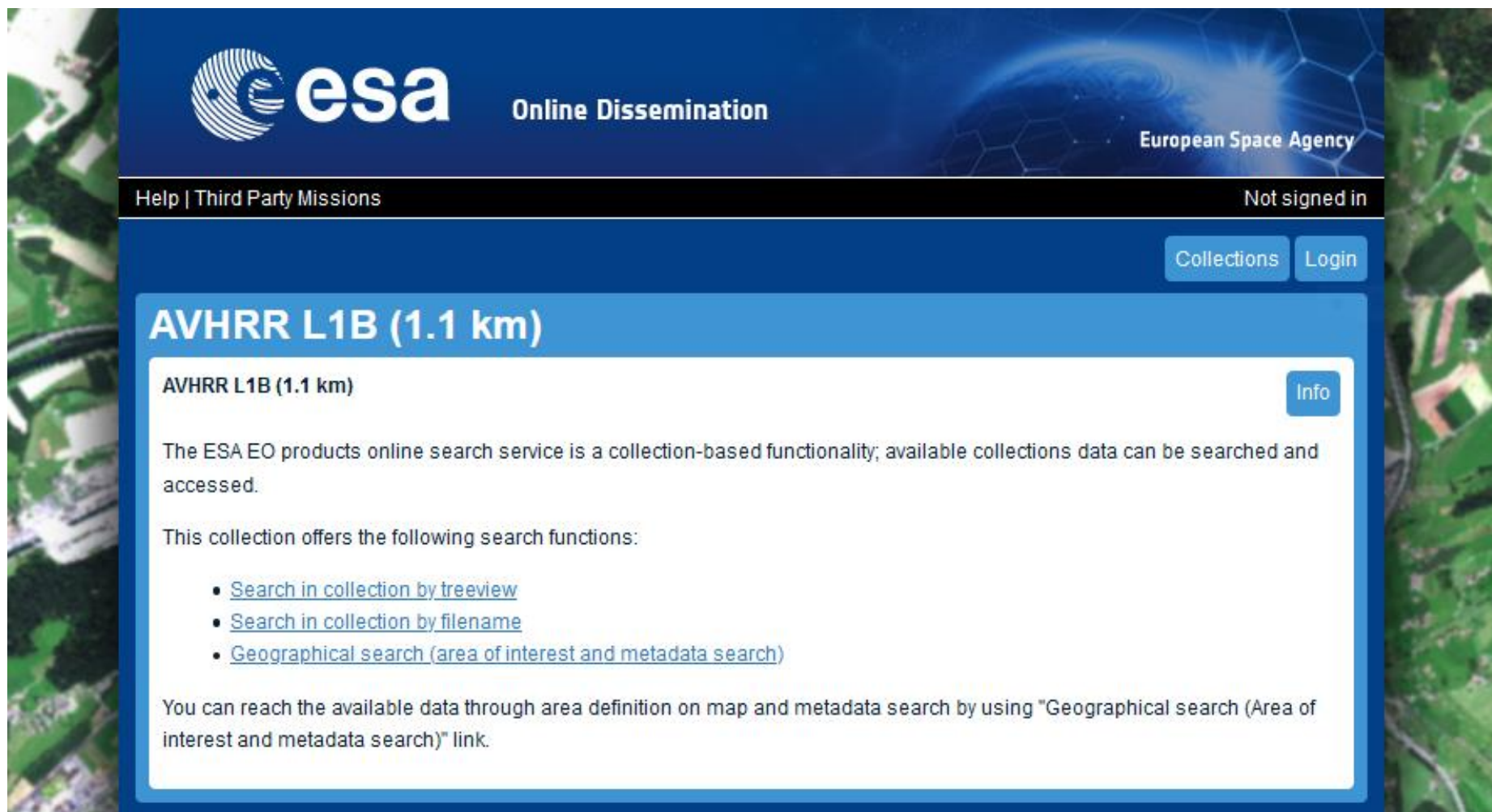
EO-SIP package (Earth Observation – Submission Information Package)

- > EO-SIP package structure, content and metadata attributes for the AVHRR products in scope, in line with the ESA Next Generation Multi-Mission PDGS Infrastructure, to be used for archiving and dissemination.



ESA Online Dissemination – AVHRR L1B data

https://tpm-ds.eo.esa.int/oads/access/collection/NOAA_AVHRR_L1B_LAC



The screenshot displays the ESA Online Dissemination interface. At the top left is the ESA logo and the text "Online Dissemination". To the right, it says "European Space Agency". Below this is a navigation bar with "Help | Third Party Missions" on the left and "Not signed in" on the right. There are two buttons: "Collections" and "Login". The main content area is titled "AVHRR L1B (1.1 km)" and includes an "Info" button. The text describes the search service and lists search functions: "Search in collection by treeview", "Search in collection by filename", and "Geographical search (area of interest and metadata search)". A final paragraph explains how to reach the data through a map and metadata search link.

esa Online Dissemination
European Space Agency

Help | Third Party Missions Not signed in

Collections Login

AVHRR L1B (1.1 km)

Info

AVHRR L1B (1.1 km)

The ESA EO products online search service is a collection-based functionality; available collections data can be searched and accessed.

This collection offers the following search functions:

- [Search in collection by treeview](#)
- [Search in collection by filename](#)
- [Geographical search \(area of interest and metadata search\)](#)

You can reach the available data through area definition on map and metadata search by using "Geographical search (Area of interest and metadata search)" link.

[Collections](#) [Login](#)

Tree view: year, month and day

AVHRR L1B (1.1 km)

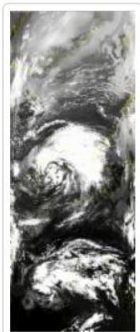
[Info](#)

[Collection](#) AVHRR L1B (1.1 km)
[Year](#) 1985
[Month](#) 05
[Day](#) 24

Available products (3)

N09_RPRO_AVH_L1B_1P_19850524T131432_19850524T132907_002301_v0100.ZIP

[Download Product](#) | [Product Info](#) | [Browse](#) | [Download Metadata File](#) | [Download Quality Report](#)



Start Date:	1985-05-24T13:14:32Z
Stop Date:	1985-05-24T13:29:07Z
Orbit:	2301
Orbit Direction:	ASCENDING
Product Type:	AVH_L1B_1P
Satellite:	NOAA 09

[Collections](#) [Login](#)

Tree view: year, month and day

AVHRR L1B (1.1 km)

[Info](#)

[Collection](#) AVHRR L1B (1.1 km)
[Year](#) 2020
[Month](#) 09
[Day](#) 19

Available products (10)

N19_RPRO_AVH_L1B_1P_20200919T174836_20200919T180150_059871_v0100.ZIP

[Download Product](#) | [Product Info](#) | [Browse](#) | [Download Metadata File](#) | [Download Quality Report](#)



Start Date:	2020-09-19T17:48:36Z
Stop Date:	2020-09-19T18:01:50Z
Orbit:	59871
Orbit Direction:	ASCENDING
Product Type:	AVH_L1B_1P
Satellite:	NOAA 19

Essential Climate Variables (GCOS / GOOS)



- Global Climate Observing System: established by the international science community to measure how the climate system is changing
- A set of Essential Climate Variables were defined, that should be monitored systematically
 - ★ Atmosphere
 - ★ Ocean
 - ★ Terrestrial
- Environmental satellites play a significant role in this effort



A few examples of the developments and operational services developed by University of Bern

Pre-processing of AVHRR
data; calibration and
geocoding/
orthorectification

Aerosol Optical Depth (AVHRR)

Probability Cloud Mask (PCM)

Albedo, Vegetation Dynamic, Fire

Lake Surface Water Temperature (AVHRR)

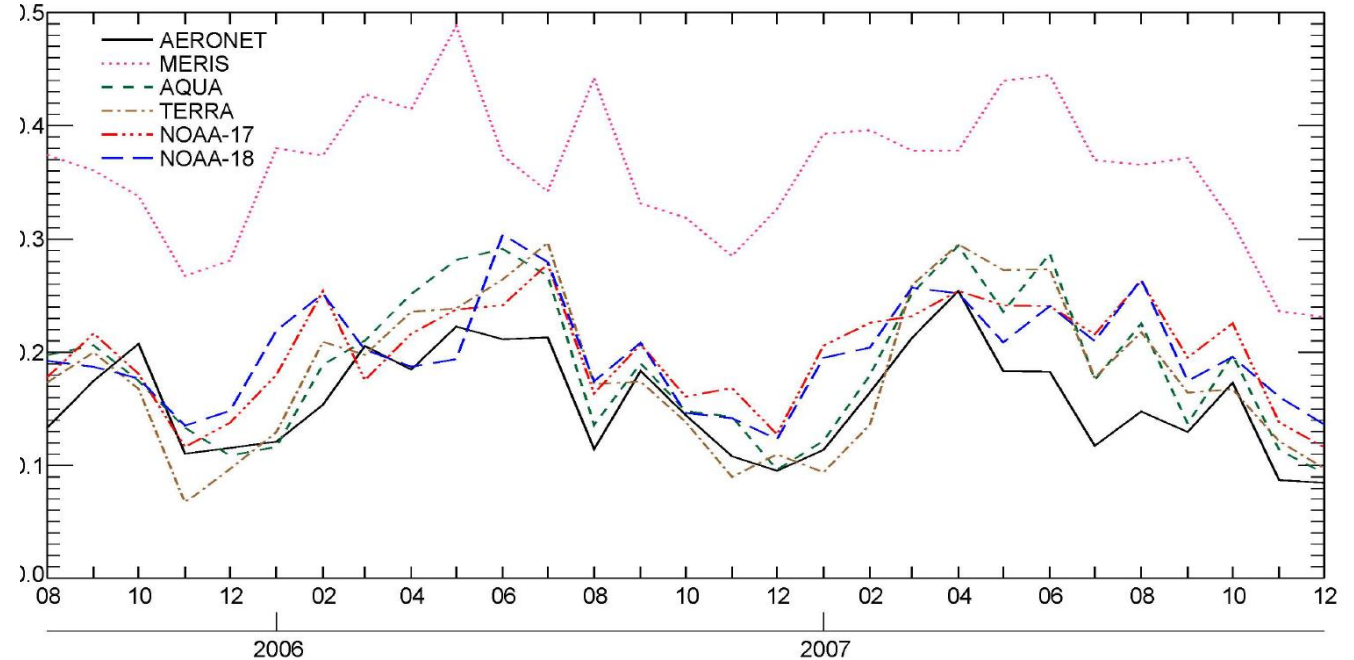
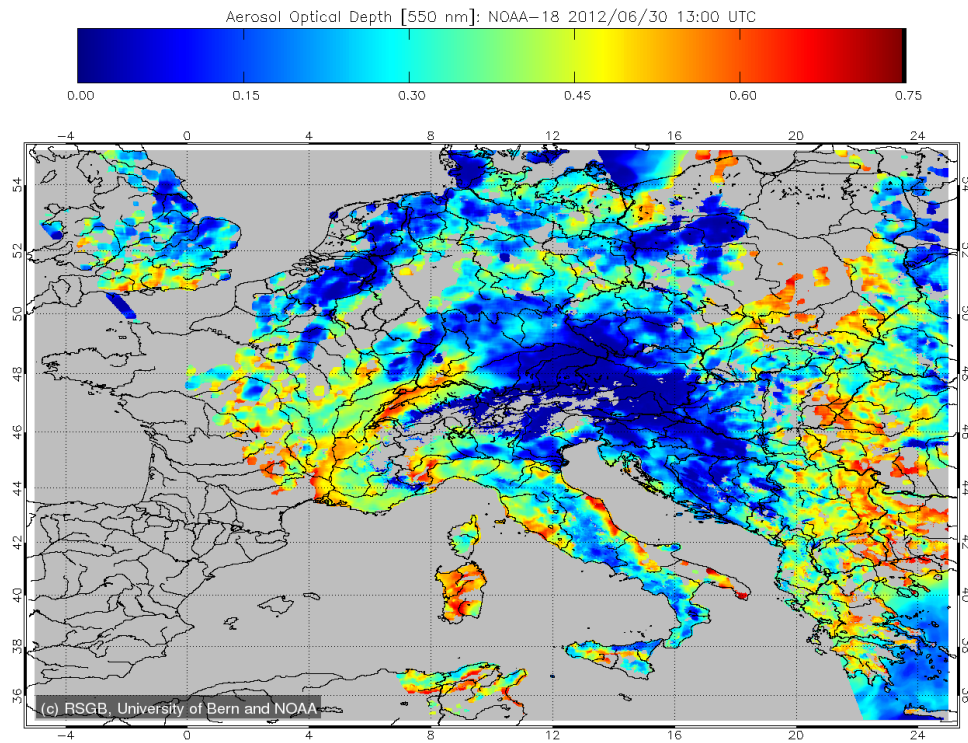
Snow Cover Fraction (AVHRR)

Atmosphere

Land



Aerosol Optical Depth (AOD) derived from AVHRR



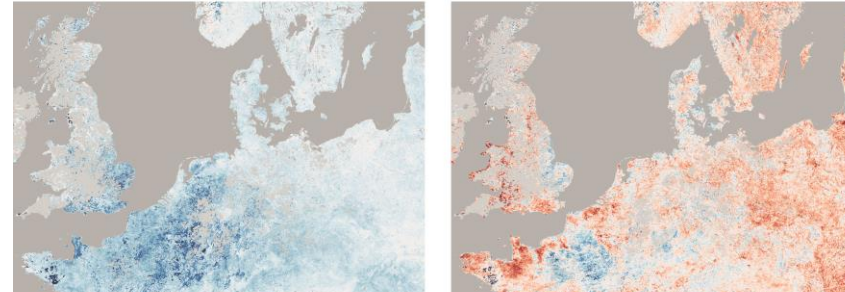
Riffler, Michael; Popp, Christoph; Hauser, Adrian; Fontana, Fabio; Wunderle, Stefan (2010). *Validation of a modified AVHRR aerosol optical depth retrieval algorithm over Central Europe*. Atmospheric Measurement Techniques (AMT), 3(5), pp. 1255-1270



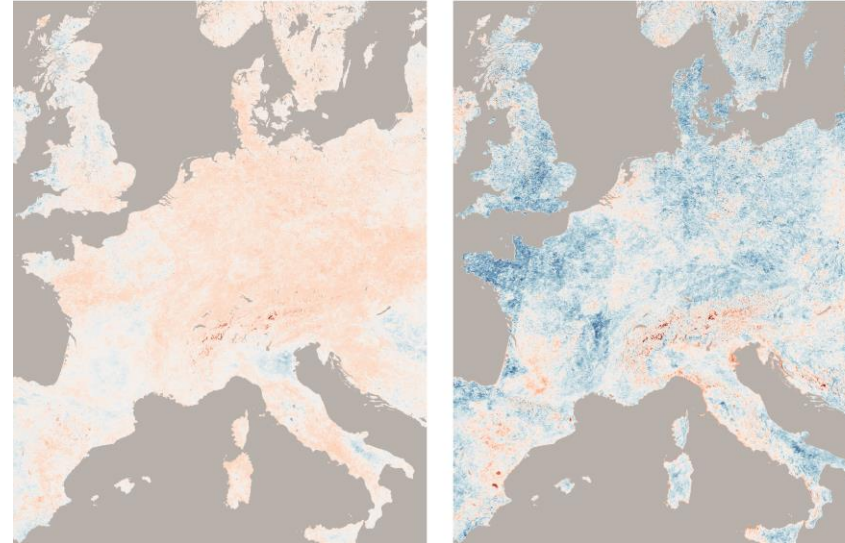
Albedo 1990 - 2014 annual August white-sky albedo anomalies VIS (left) and NIR (right)



1990

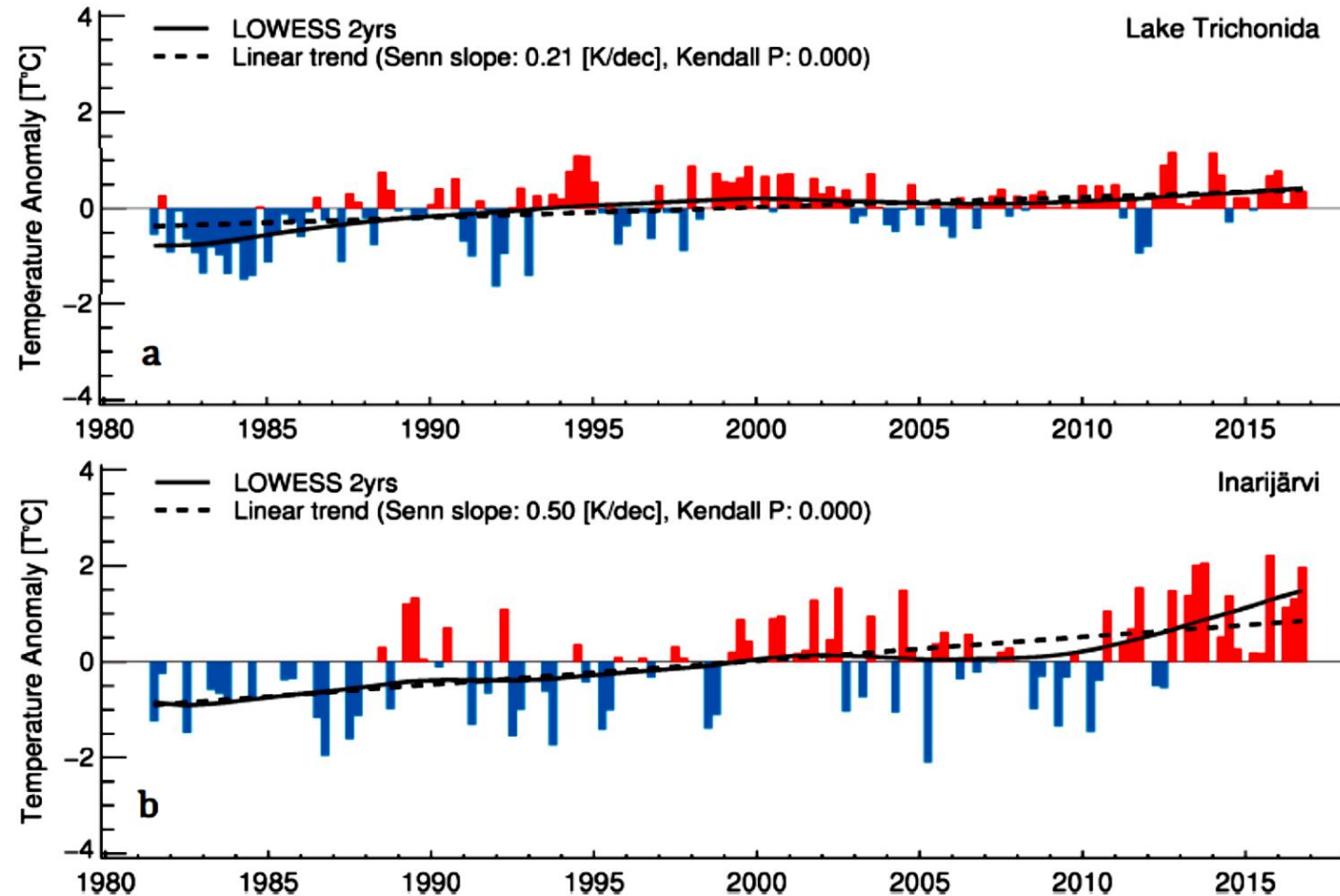
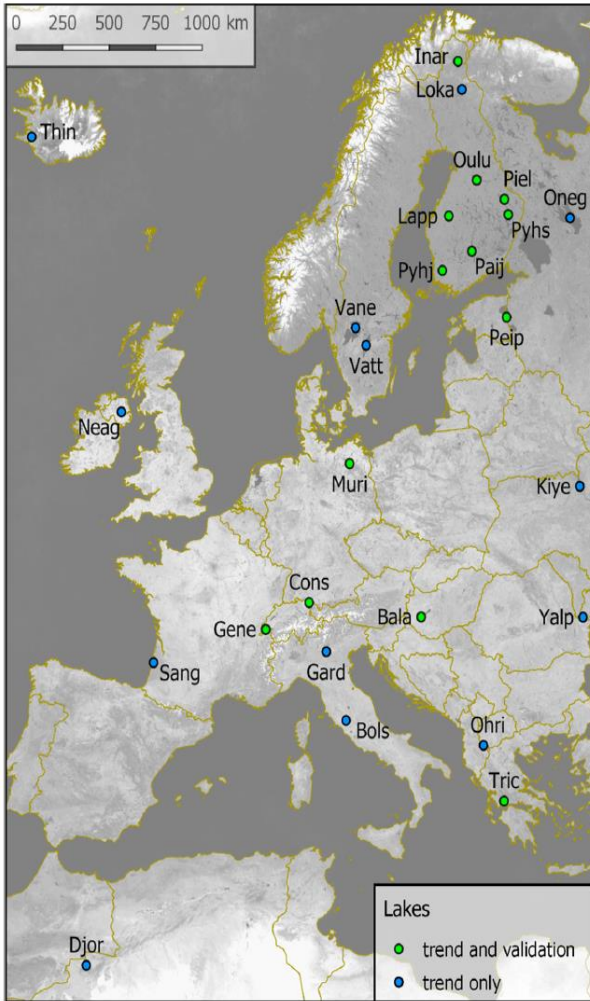


2012





Lake Surface Water Temperature LSWT derived from AVHRR

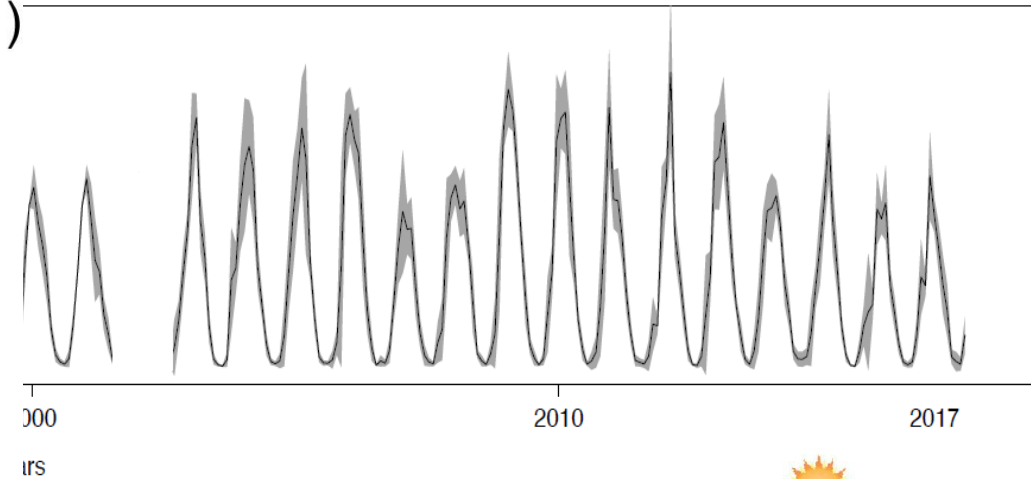
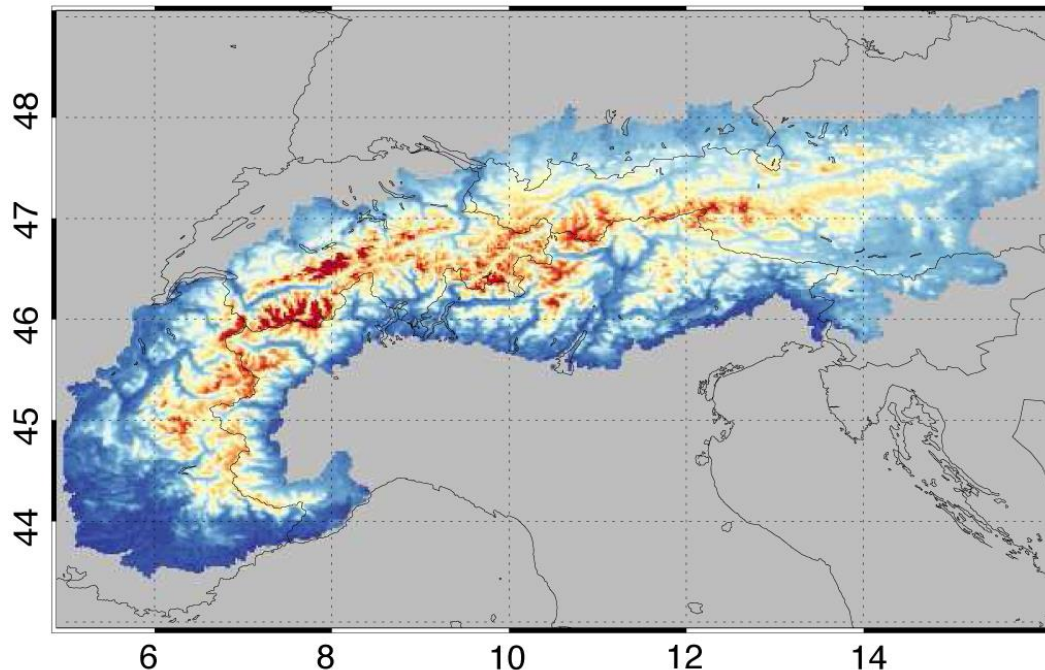
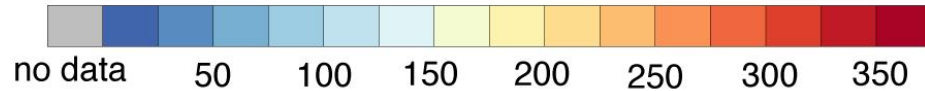




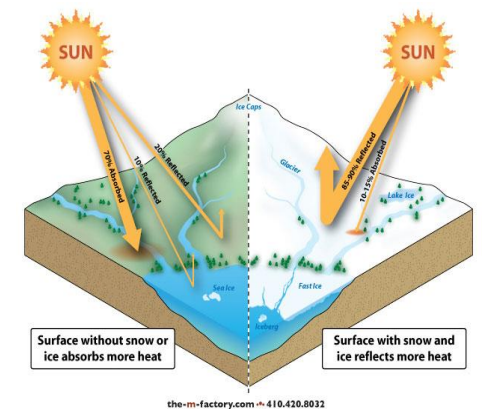
Snow covered Area (SCA) based on AVHRR LAC data (1982 – 2017)

Snow Covered Area (SCA) of the European Alps (1982 - 2017)

Mean snow cover duration in days (1991-2011)



Snow cover reflects approx. 80% of incoming solar radiation. High relevance for our climate



the-m-factory.com - 410.420.8032



SNOW
cci

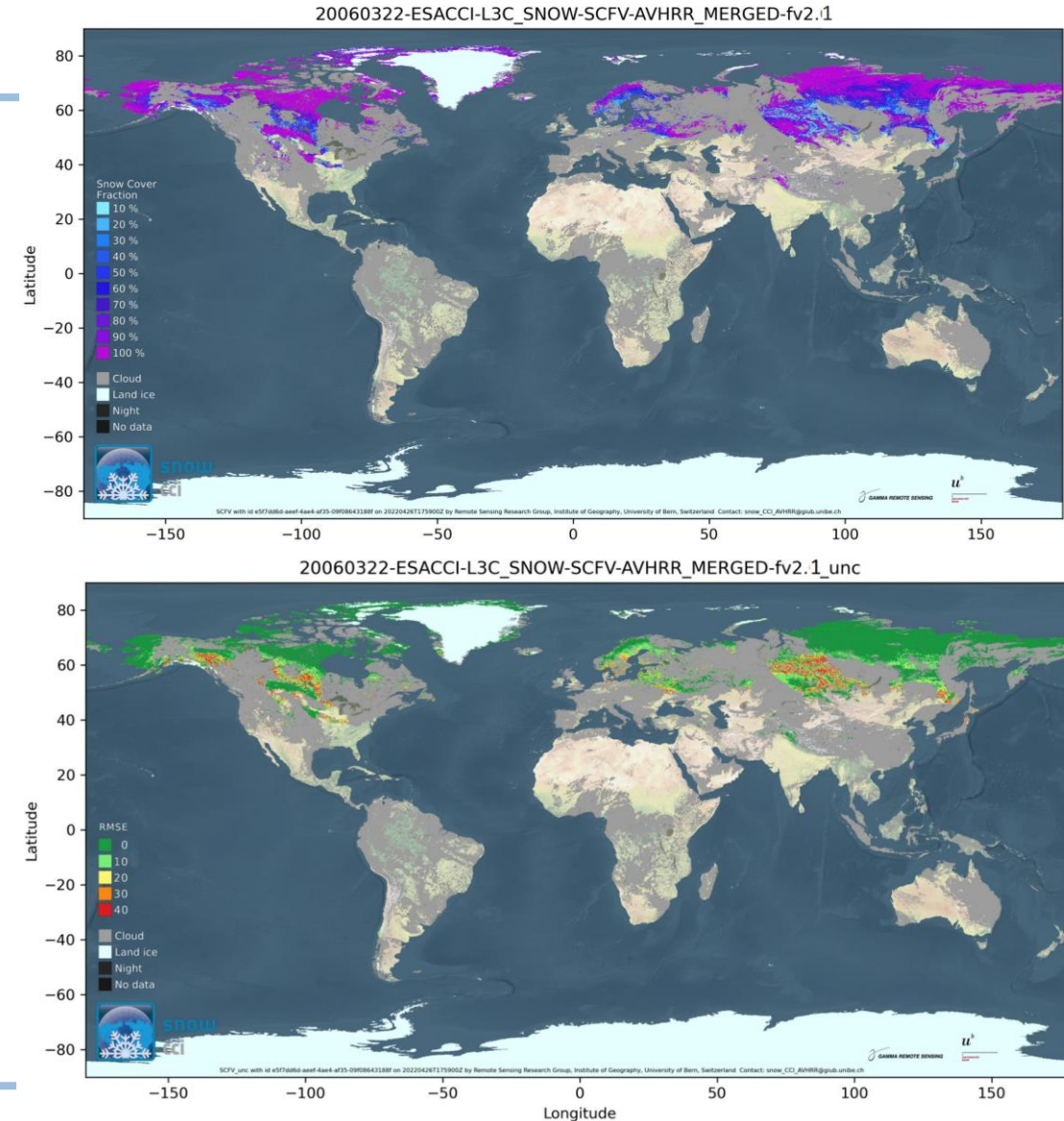
AVHRR Snow Cover Fraction (global) by University of Bern

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b
UNIVERSITÄT

- > Aim: consistent SCFV/SCFG (1978 – 2023)
- > Data source:
 - AVHRR GAC, reprocessed by EUMETSAT
 - Morning and afternoon passes
 - CLARA-A3 daily composites from CM SAF
- > Retrieval scheme:
 - NDSI, Scamod and tailored thresholds
 - spatial and temporal adapted transmissivity based on NDVI
 - Cloud probability based on CLARA-A3

Right: SCFV and uncertainty (20060322) based on AVHRR GAC



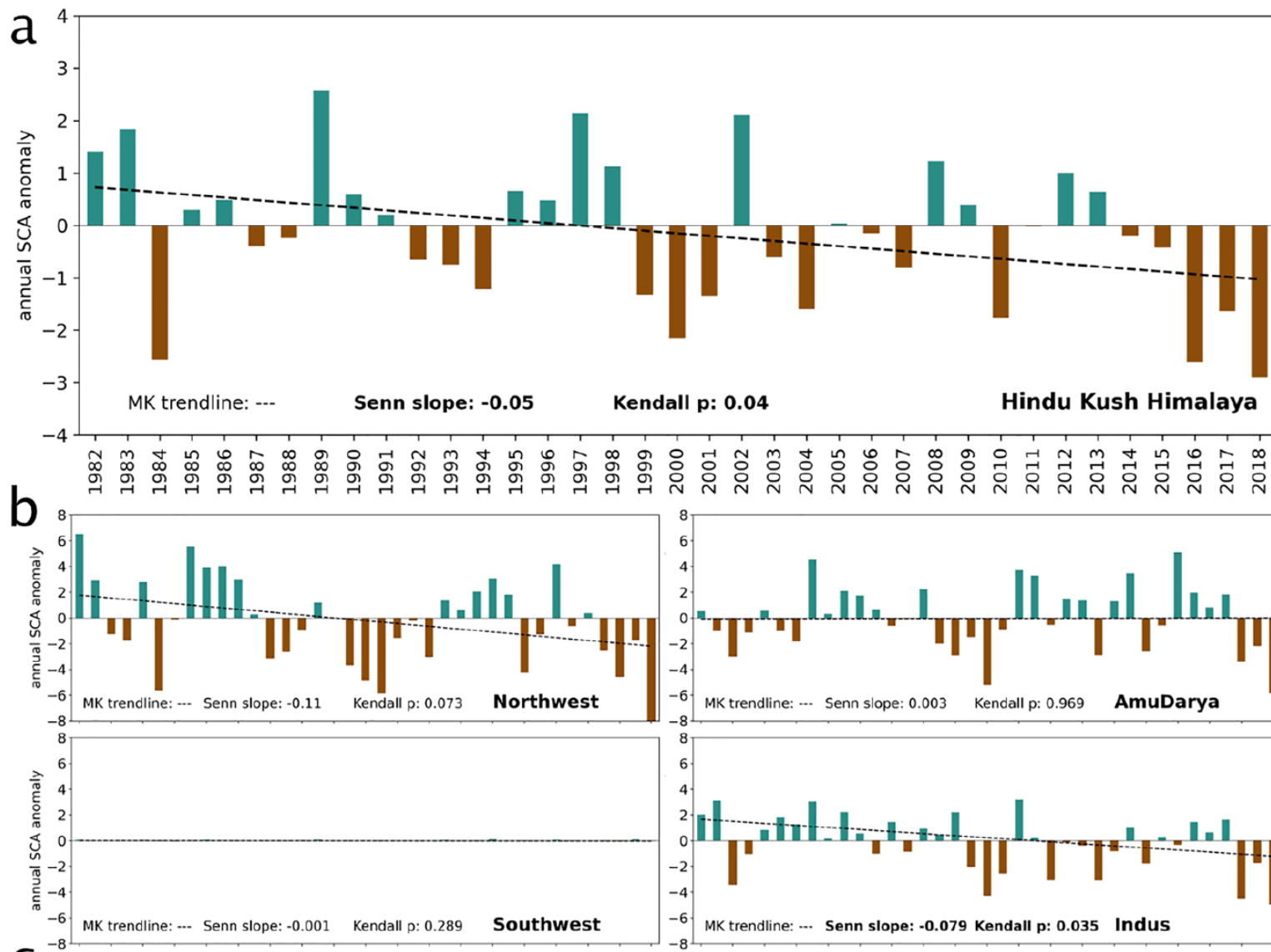
scientific reports

OPEN

Revealing four decades of snow cover dynamics in the Himalaya

K. Naegeli^{1,2}, J. Franke¹, C. Neuhaus¹, N.

Knowledge about the distribution and dynamics of snow cover is essential for climate studies, hydrology or hazards assessment in the Himalaya both in space and time. Previous studies have focused on the local hydrological system. Here, we use satellite-based time series of snow cover information to evaluate SSC dynamics for the entire HKH at a 0.05° spatial and daily temporal resolution. We find significantly decreasing SSC trends in the Himalaya, indicating a tendency from mid-spring to mid-fall, indicating a shift in the character of seasonal snow cover and its cross-downstream regions.



Summary and Outlook

> Summary

- A homogenous and consolidated AVHRR LAC time series (1981 – 2020) is now available via ESA dissemination service.
- More than 250.000 AVHRR data (level 1b) covering Europe are ready to be used
- Approx. 55.000 CEOS Sharp-1 segments were rescued, re-processed in a consistent way (EO-SIP) and are accessible via ESA dissemination service, too.
- Software and processing procedure developed at University of Bern is installed and tested at ESA facilities.
- Next step is the generation of Level 1c data (calibrated and geocoded, in NetCDF format) for a better service to support communities without the needed expertise in AVHRR processing.

Outlook

- > Filling of AVHRR level1b archive with LAC data until the end of AVHRR sensor (NOAA, MetOp) approx. 2027
- > **Integrate global AVHRR LAC data of the pre-MODIS era (e.g. 1992 – 1999; more than 30.000 data sets); start rescue activities for local archives around the world.**
- > On the way to a FCDR:
 - include Sentinel-3 and other medium resolution satellite data
 - Apply best practice for uncertainty characteristics (e.g. FIDUCEO)
- > Data Usage:
 - Open and free availability of AVHRR data will support any study
 - Provide Access-Ready-Data (ARD) for user, climate modelling community (CMUG)
 - Climate Observations and Monitoring for Policy Action Support from Space;