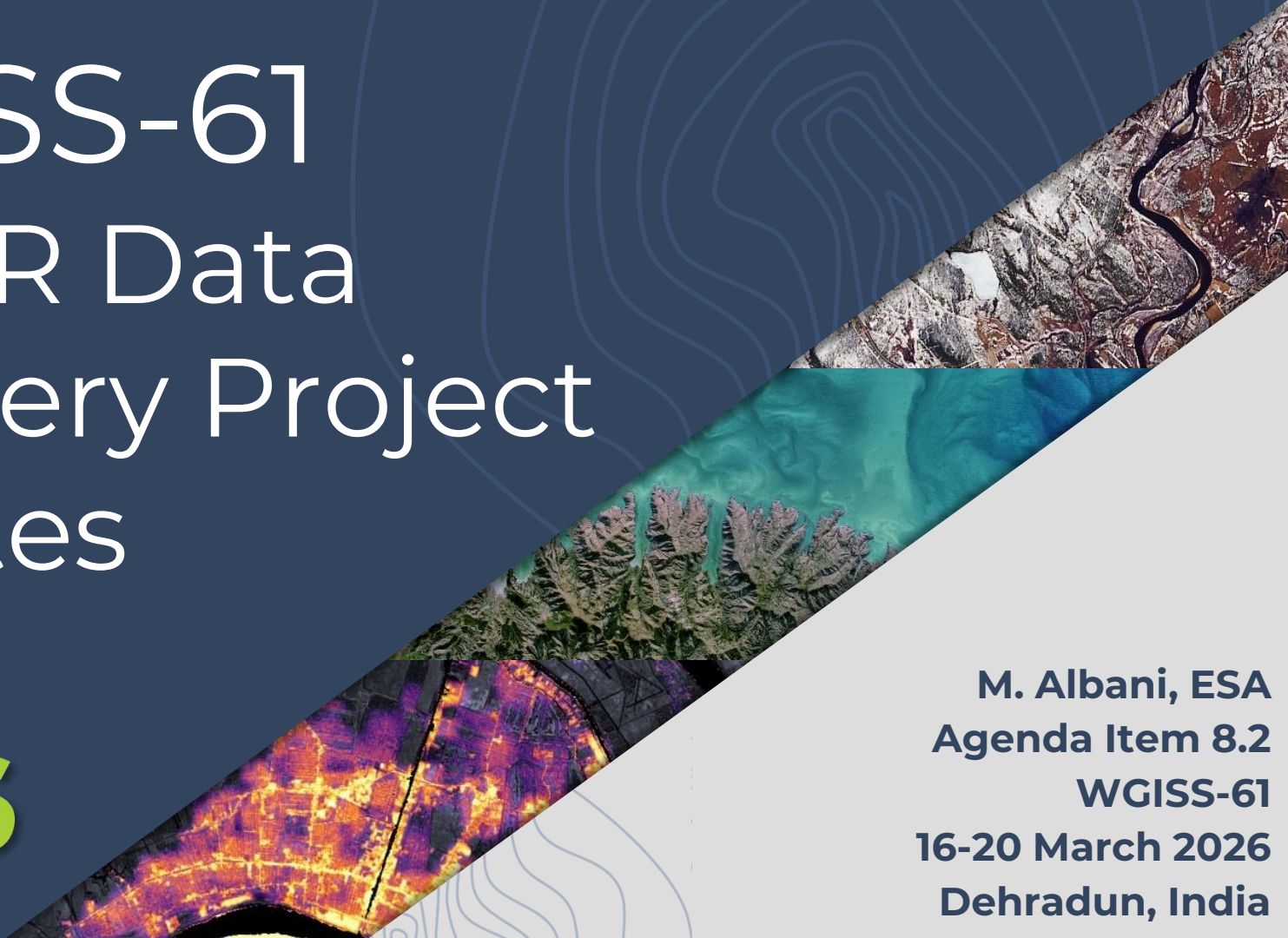
WGISS-61
AVHRR Data Recovery Project Updates



CEOS
Committee on
Earth Observation Satellites

M. Albani, ESA
Agenda Item 8.2
WGISS-61
16-20 March 2026
Dehradun, India

AVHRR a unique long time data series

AVHRR data available as GAC (4 km) or LAC (1km). 1-km AVHRR LAC data gives new insights on structural changes on land in comparison of coarse resolution AVHRR GAC data.

GAC DATASETS

- NOAA POES AVHRR GAC global archive: 1978 onwards

LAC DATASETS

- EUMETSAT MetOp AVHRR 1km FRAC global archive: March 2008 onwards
- Global Land 1-km AVHRR data set covering the period 1992-99 *“1Km project”*
- Many national / regional data archives of LAC data around the world covering a longer period with high value for the retrieval of ECVs. Some of them accessible to users, others not due to unknown accessibility, responsibility, data format and structure.

Cooperation Activities on AVHRR

Objective: Build a worldwide coverage AVHRR LAC data series from 1978 onwards

1. Unfolding and making accessible 1km AVHRR data from regional archives (possibly open and free);

1. Transcribing unique data from heritage media;

1. Identifying a common format for AVHRR Level-1b and Level-1c data and pursuing (re)processing from AVHRR data owners/holders and data accessibility;

1. Facilitating data discovery through the WGISS Connected Data Assets Infrastructure.

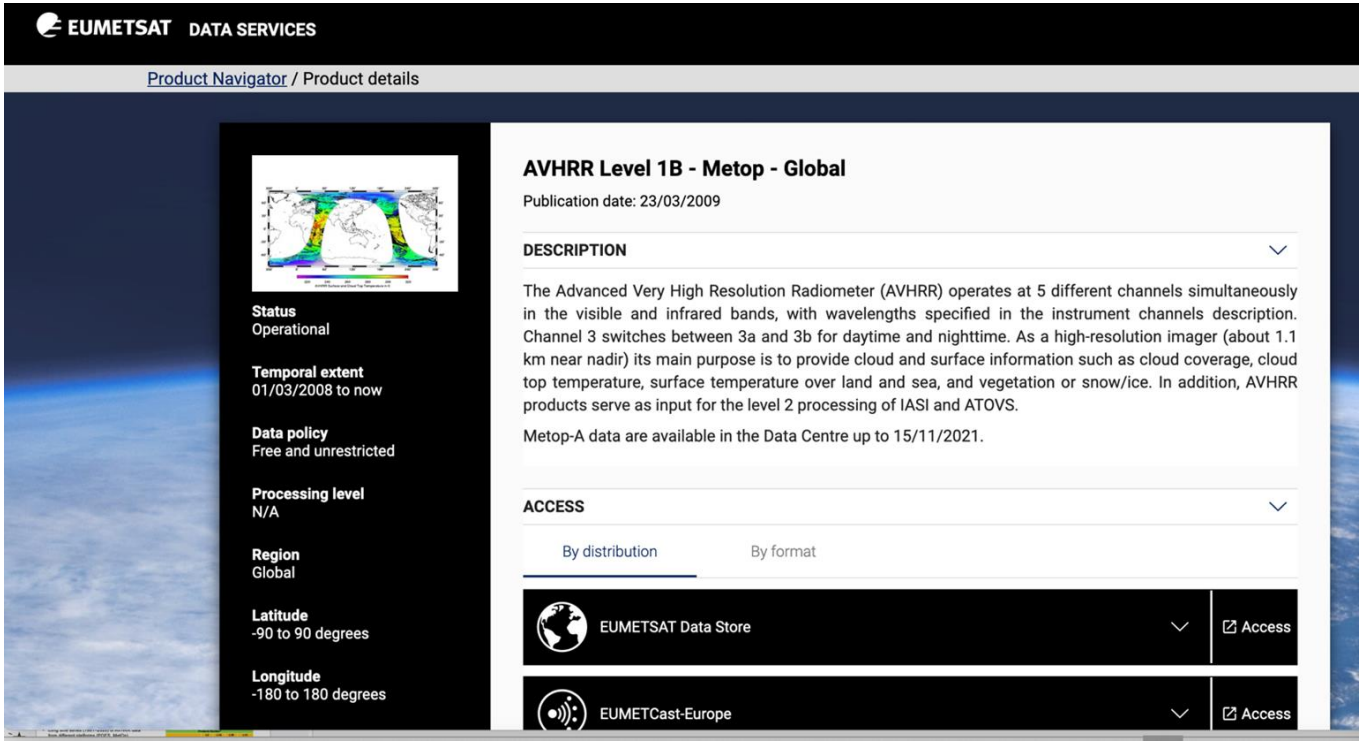
AVHRR 1 Km digital data archives (excerpt)

- **Europe**: ESA & University of Bern (Switzerland), STFC CEDA (UK, including Dundee Satellite Receiving Station), MeteoFrance (France), DLR (Germany), METoffice (UK), IGiK (Poland);
- **Americas**: NOAA and USGS (USA), NRCan/CCMEO (Canada), GiDyC-Servicio Meteorológico Nacional (Argentina), INPE (Brazil);
- **Africa**: SANSA (South Africa), ASI / University of Rome (Kenya);
- **Asia**: CMA (China), IRIM (Mongolia), GITSDA (Thailand), Jaxa & Chiba University (Japan), ISRO (India);
- **Australia**: CSIRO;
- Datasets from Meteorological Institutes, Universities and other organizations all over the globe.

Fundamental to ensure accessibility of 1-km LAC data from all available sources (in particular in the period before 2008)

AVHRR Global Land 1km Dataset

Global 1km AVHRR dataset 2008 - today



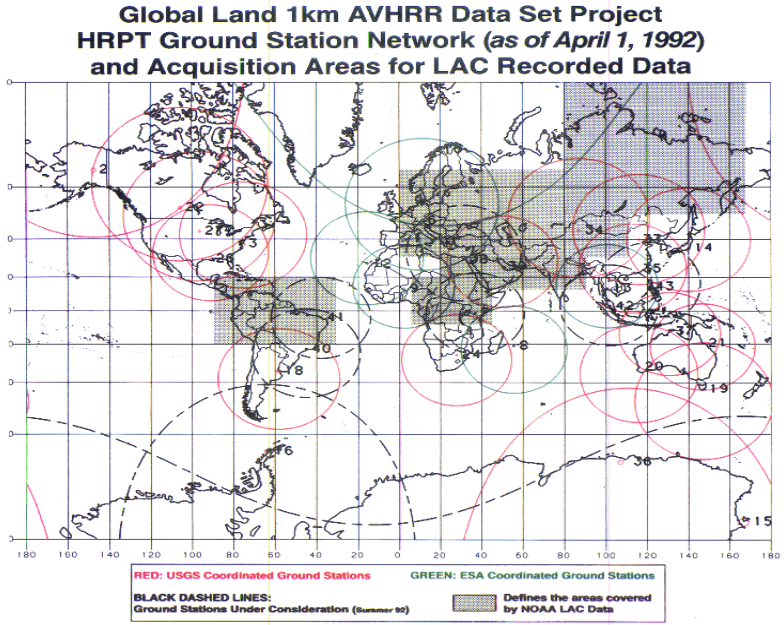
Metop satellites operated by EUMETSAT

Temporal extent: 01/03/2008 to today

Level-1b data

Open and Free

Global 1km AVHRR dataset 1992-1999



AVHRR receiving stations contributing to global land 1km AVHRR data set. (https://lta.cr.usgs.gov/1km/hrpt_image)

Products Number*				
	L0	L1A	L1B	L1C
1Km-Project (out of Europe)		3901	3901	2991

* No L0 available.

Two different global Land 1-km AVHRR datasets covering the period 1992-1999 are available at ESA :

1. **Data acquired at ESA network stations** (Terranova, Nairobi, Manila, etc..) processed up to L1C and accessible through ESA as dataset *Out-of-Europe*.

1. **Data in stitched format (.arch files) from USGS network stations** not accessible at USGS/NOAA but available at ESA in stitched format.

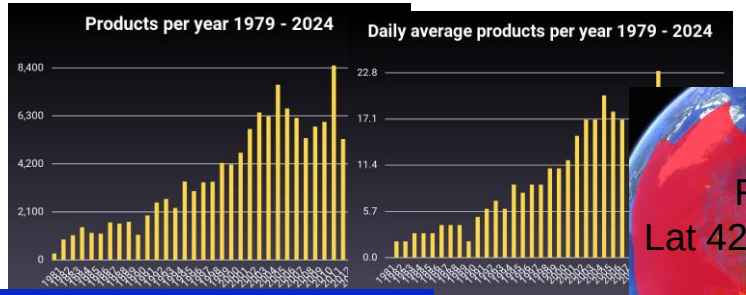
- **Unstitching, conversion, full processing into Level-1B and Level-1C completed at ESA.**
- Open access to users through ESA dissemination systems by **Q2/Q3 2026**.

AVHRR Regional LAC Archives

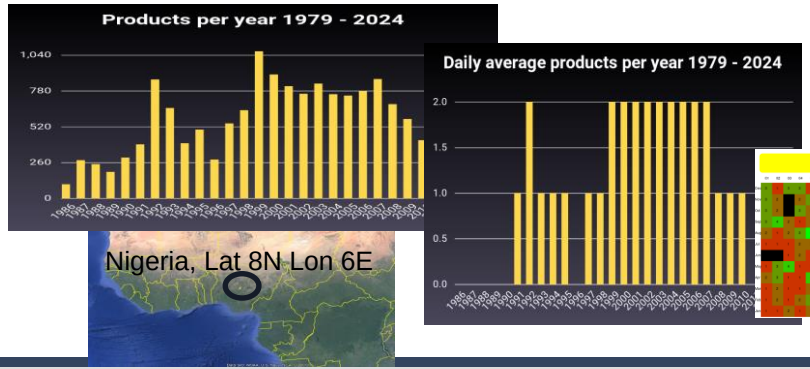
ESA AVHRR geoTool

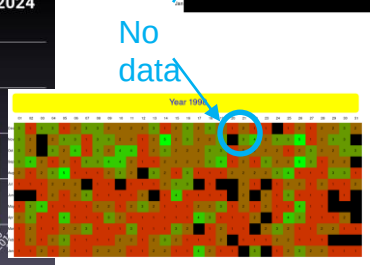
A **tool** was developed to **select AVHRR products** available at ESA over specific Earth **points** (lat, lon) and **time range**. The tool generates:

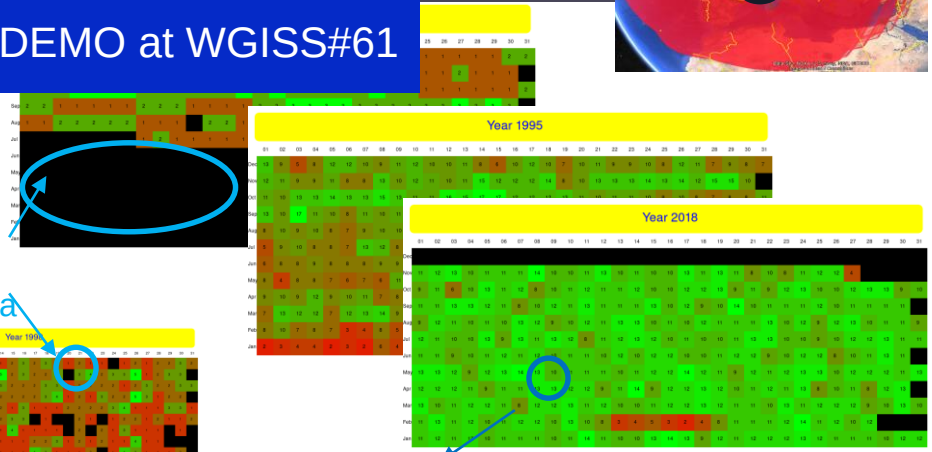
- KML files with available products frame coordinates
- Graphs with products per year and average daily products per year
- Heat charts per year to identify daily gaps and **trigger/support da**
- **Data gap analysis being extended to other CEOS agencies AVHRR datasets (global map)**



DEDICATED Presentation and DEMO at WGISS#61





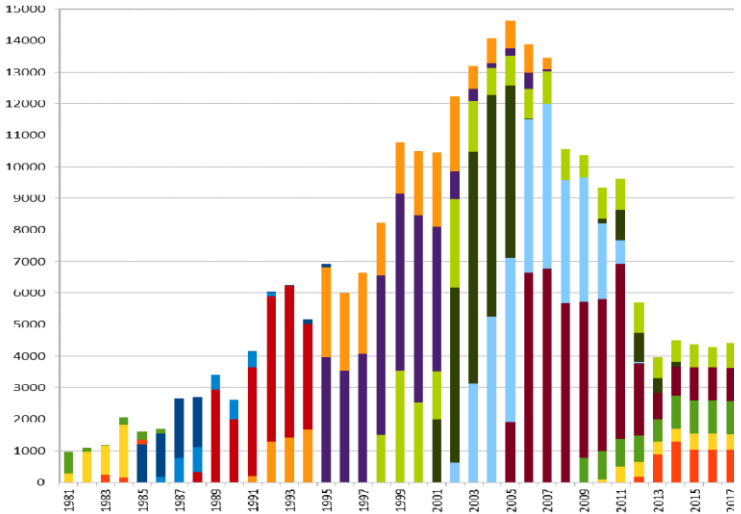


Europe – ESA & University of Bern

- Long time series (1981–2020) of AVHRR data from different platforms (POES, MetOp)
- Unique source to retrieve Essential Climate Variables (ECV) to investigate climate change over last 40 years.
- European dataset includes data from University of Bern, Dundee Station and ESA holdings: **260.000 products harmonized** and **consolidated** through a dedicated ESA project (Heritage Space Programme).
- **Processing to L1C completed.** All **data** safely archived at ESA and **accessible free** of charge via ESA since end 2024**.**

Products Number*				
	L0	L1A	L1B	L1C
Europe	145231	259747	260060	259164

*The L0, L1A and L1B input data are scattered.



https://earth.esa.int/eogateway/catalog/avhrr-level-1b-1c-local-area-coverage-imagery

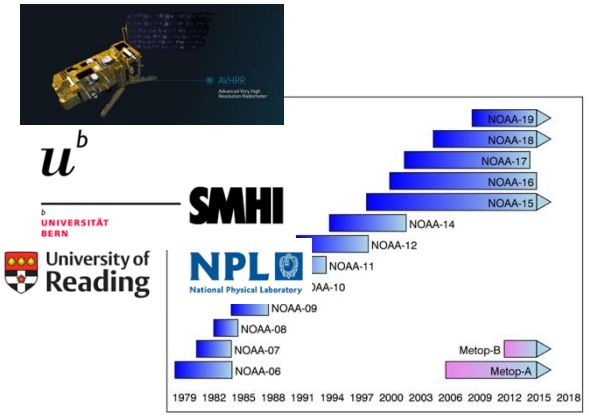
https://doi.org/10.5270/AVH-f1i8784

Presentation at WGISS#56

FDR for Advanced Very-High-Resolution Radiometer instrument (FDR4AVHRR)

New project started in **Q1 2024 at ESA:**

- Reprocessing of European AVHRR LAC products series (NOAA & MetOp missions) to generate a L1C Fundamental Data Record (FDR);
- Reprocessed dataset based on **new SW modules** for improved **geocoding / orthorectification, error propagation** and **accurate uncertainty estimates** in the calibration module;
- **FDRs for TIR and VNIR channels** over Europe, **cross-mission calibrated** AVHRR FDR 1 km dataset for all channels;
- Extending European Data Set with data:
    1. over Europe from **2020 to 2025;**
    2. over **Greenland** and northern areas;
    3. over selected regions across the world (**Argentina, Kenya, South Africa, 1-KM Project, Pacific/Atlantic/Africa**).
    4. Completion by mid 2026 and publication in the ESA system by **Q3 2026**.



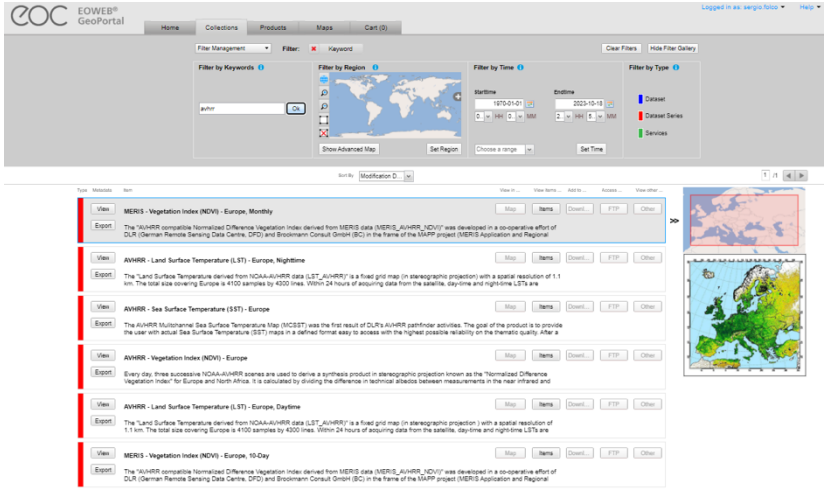
Presentation at WGISS#57 and #58

Europe – DLR

Four AVHRR datasets over Europe (N14,N16,N17,N18,N19) available in the DLR catalogue:

- AVHRR - Land Surface Temperature (LST) - Europe, Nighttime;
- AVHRR - Sea Surface Temperature (SST) - Europe;
- AVHRR - Vegetation Index (NDVI) - Europe;
- AVHRR - Land Surface Temperature (LST) - Europe, Daytime.

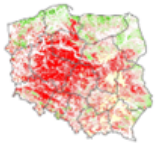
High redundancy with ESA dataset; not clear if L0 data available at DLR.



Presentation at WGISS#57

Europe – IGIK (Poland)

- The Polish Institute of Geodesy and Cartography dept of Remote Sensing holds NOAA satellites data since 1996 and used for agriculture studies
- The receiving station recorded data in HRPT, SeaWiFS (and other formats) from NOAA, Seastar, Metop and NPOESS polar-orbiting satellites.
- AVHRR data are not accessible from the web site.



Map of NDVI distribution as compared to previous year

The datasets have been downloaded and stored in the ESA tape archive.

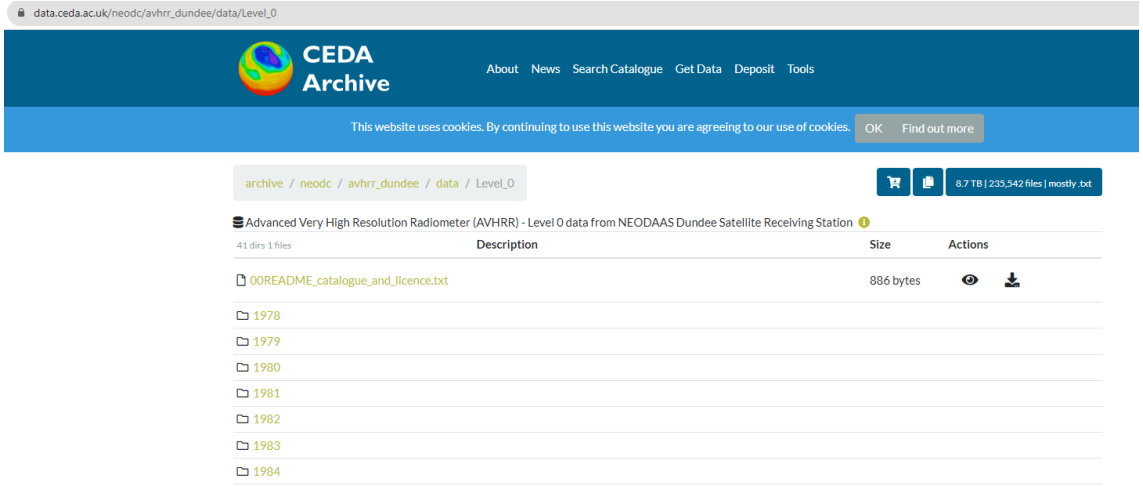
ESA received feedback from IGIK in Jan 2025. Two datasets available:

1. NOAA AVHRR Data from All Automatic Overpasses Over Poland Collected by the Dartcom System. Time range 2012-2018, volume 2.0 TB.
2. Dataset from NOAA-11 to NOAA-19 (1995-2014). Volume is 350 GB.
3. **Next Steps**: full processing into Level-1B and Level-1C, open access to users.

Europe – Dundee Station data archived at CEDA

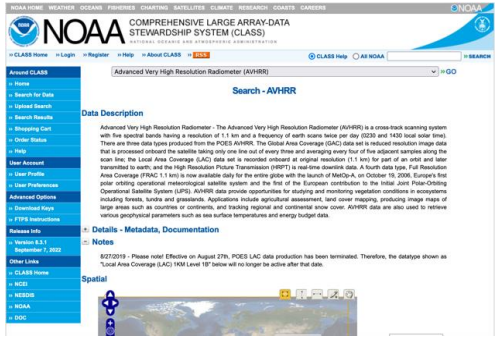
1978 – 2018 AVHRR L0 data available with free and open access through CEDA (UK).

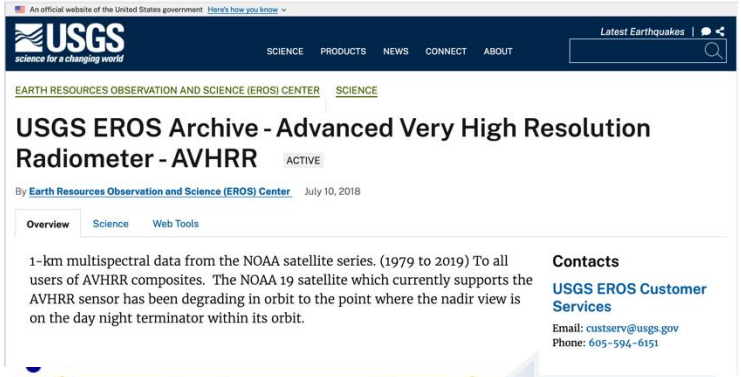
- ESA downloaded the full Dundee AVHRR L0 products (8.9TB, 235,541 L0 products).
- Some data were reprocessed and included in the European dataset. Remaining products are now integrated to extend geographical coverage towards **Greenland** and in time back to 1978 (FDR4AVHRR ESA project Open access to users via ESA systems **Q3 2026**).



Presentation at WGISS#56

North America – NOAA & USGS



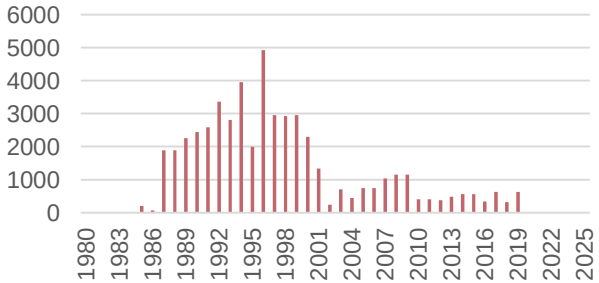


NOAA presentation at WGISS#55

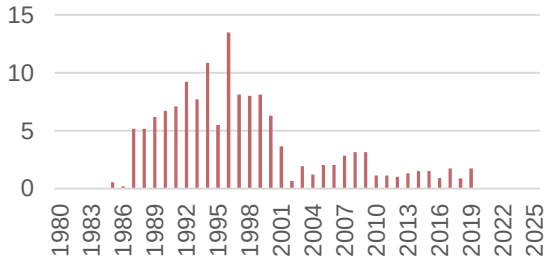
Analysis by ESA over North America

Receiving Station
- Cape Ferguson, Australia
- Dundee, Scotland, UK
- Ewa Beach, HI
- Ford Island, HI
- Gilmore Creek, AK
- Honolulu, HI
- Miami, FL
- McMurdo Antarctic Data Acquisition
- Monterey, CA
- Sioux Falls, SD
- NOAA Svalbard Antennae
- SOCC
- Svalbard
- Western Europe
- Wallops Island, VA

Products per year



Average daily products



USGS dedicated Presentation at WGISS#61

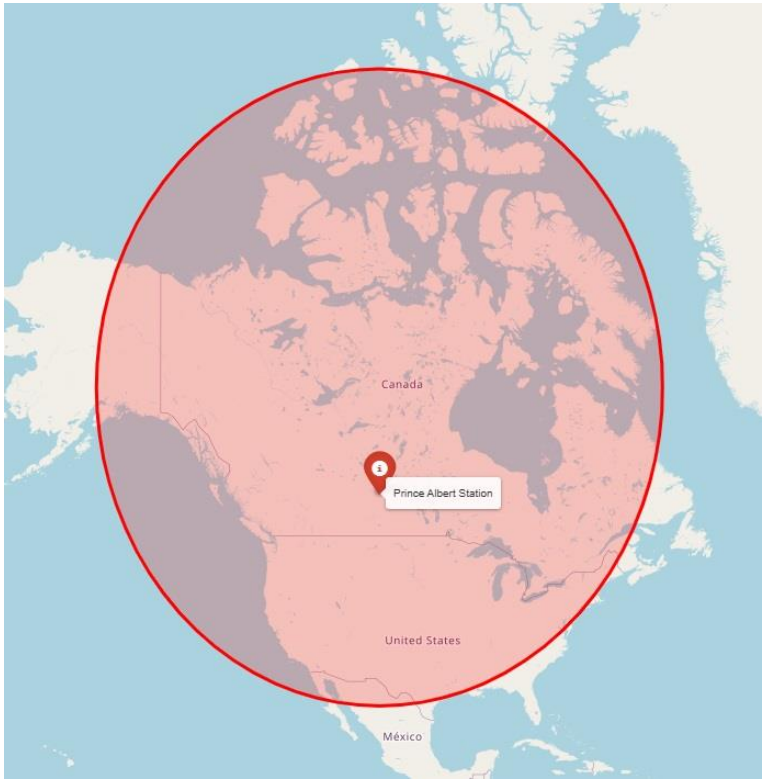
Canada – NRCan/CCMEO

Two AVHRR data collections available at CCMEO:

- L1 data products acquired from various stations in Canada from 2013 to today. 1667 products in NOAA L1B format.

- L0 HRPT data acquired at Prince Albert station from 1983 to 2014. 118388 products in NITAS format.

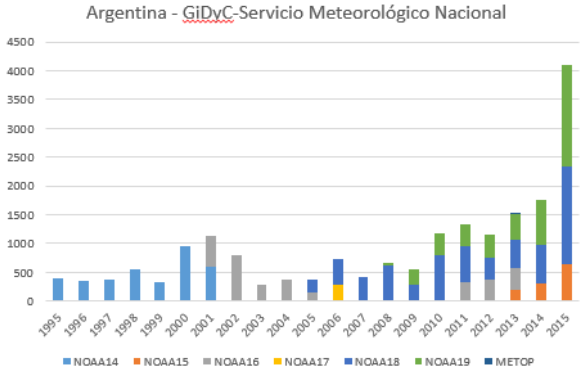
Exchange of information ongoing between ESA and NRCan/CCMEO.



Argentina - GiDyC-Servicio Meteorológico Nacional

Initial products Metadata

- Source: Jefa Departamento Teledetección Y Aplicaciones Ambientales, GiDyC-Servicio Meteorológico Nacional, Buenos Aires, Argentina
- Number of products: 19360
- Volume size: 740GB
- Satellites: N14, N15, N16, N17, N18, MetopA/B
- Time Period: 1995 – 2015
- Extent: roughly Lat=[-30,15] Lon=[-60,-15]
- Format: QUO (HRPT)



Downloaded products metadata:

- Number of products: **25504**
- Volume size: **1.02 TB**
- Time Period: **1995-2017**
- Format: **.rar, .quo, .WI**

- Data transfer to ESA and full processing into Level-1B and Level-1C completed (FDR4AVHRR ESA project).
- Open access to users via ESA systems **Q3 2026**

Brazil - INPE

- Satellites: METOP-A, METOP-B, N12, N14, N15, N16, N17, N18, N19,
- Number of L0/L1A : 287325
- Volume size < 18TB
- Time Period: 1998 - 2024
- Extent: Brazil
- Format: HRPT and others

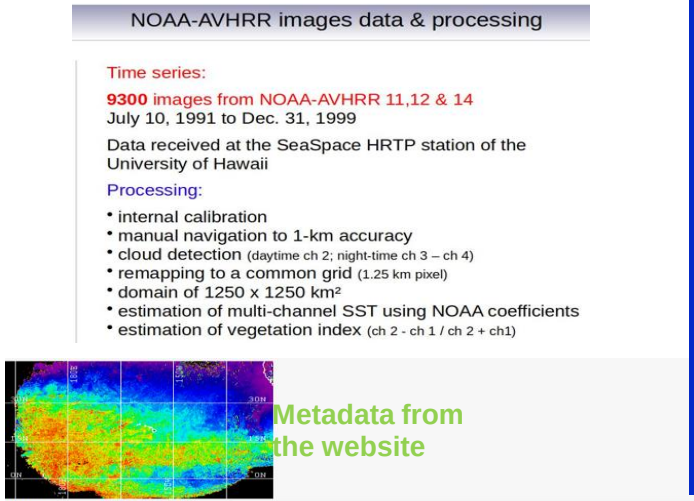
METOP-B	May 2013-Ma-2024	HRPT	29237
METOP-C	Dec 2019-Mar 2024	HRPT	7924
NOAA_12	Aug 1998-Aug 2007	HRPT	16333
NOAA_14	Aug 1998-Jun 2007	HRPT	10976
NOAA_15	Jul 2001-Aug 2019	HRPT	36816
NOAA_16	Aug 2001-Dec 2014	HRPT	20692
NOAA_17	Jan 2003 - Mar 2013	HRPT	24575
NOAA_18	May 2005 – Mar 2024	HRPT	52626
NOAA_19	Jan 2012 - Mar 2024	HRPT	39791
S1*	---	Unknown	48355

- Data transfer to ESA completed.
- **Next Steps**: full processing into Level-1B and Level-1C, open access to users via ESA systems (FDR4AVHRR ESA project).

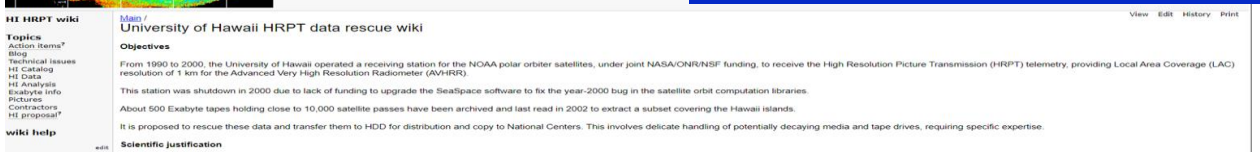
** The S1* files are under investigation because they could be single data/calibration for channel.*

Pacific Ocean – University of Hawaii

An AVHRR dataset was acquired at the Hawaii University between 1990 and 2000. Data are still on Exabyte tapes, some were extracted covering the islands but accessibility not clear.



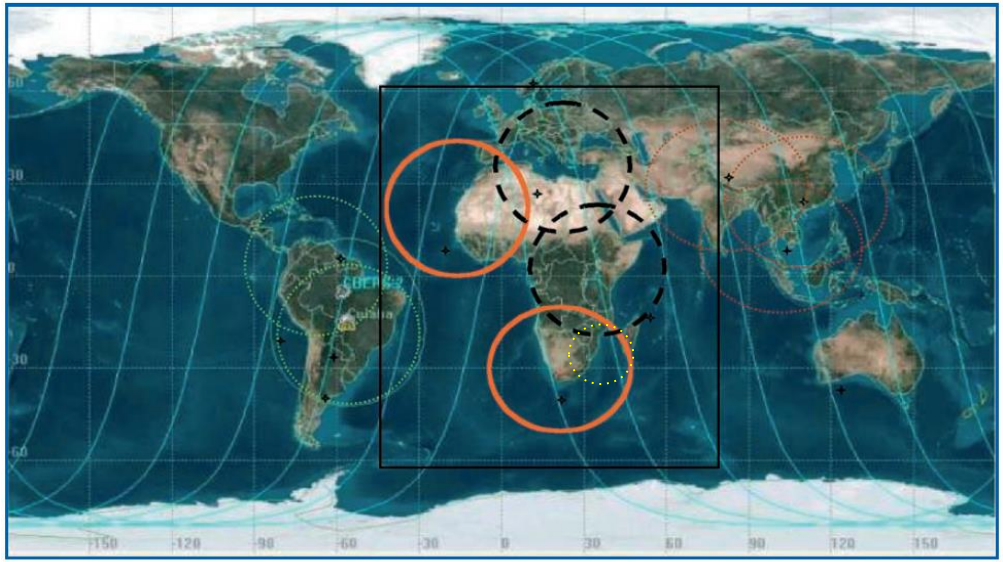
Metadata from the website



- Exabyte tapes and hardware were shipped to ESA/ESRIN and transcription chain is being assembled.
- The ESRIN laboratory has manufactured a special device to roll/unroll tapes at very slow speed and clean their surface from moisture before transcription. Test of this equipment is on-going.
- Content extracted successfully from one tape.
- **Next steps**: transcription of all tapes, full processing into Level-1B and Level-1C, open access to users via ESA systems.

African Coverage

The combination of AVHRR data acquired in Maspalomas (Spain), Matera (Italy), Cairo (Egypt), Niamey (Niger), Hartebeesthoek (South Africa) and Malindi/Nairobi (Kenya) can provide full coverage of Africa;



Running (Green for Brazil, red for China) and planed Ground Stations for Africa. The locations of the ground stations are Canary Islands (Spain), Hartebeesthoek (South Africa), Malindi (Kenya) and Matera (Italy).

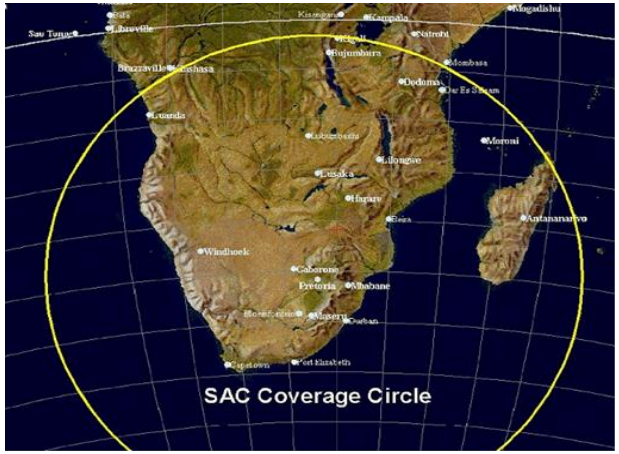
NOAA provides also access through CLASS to many data over Africa which were recorded onboard and downloaded on US stations.

South Africa – SANSA

1km NOAA AVHRR data received at Hartebeesthoek, South Africa (25°53' S 027°42’ E) and maintained by SAC/SANSA – South African National Space Agency

NOAA 9	1985-1987
NOAA 11	1989-1993
NOAA 14	1995-2001
NOAA 16	2001-2005
NOAA 17	2005-2010
NOAA 18	2005-2009

Number of products: 7684
Volume size: 464GB



- Data transfer to ESA and full processing into Level-1B and Level-1C completed (FDR4AVHRR ESA project).
- Open access to users via ESA systems **Q3 2026**

Central Africa (Kenya) - ASI/UniRoma

Data acquired at Malindi station in Kenya from **2001** to **2009** and stored on **44 DLT** tapes. NOAA AVHRR data (Apr 2001 - Apr 2009) received:

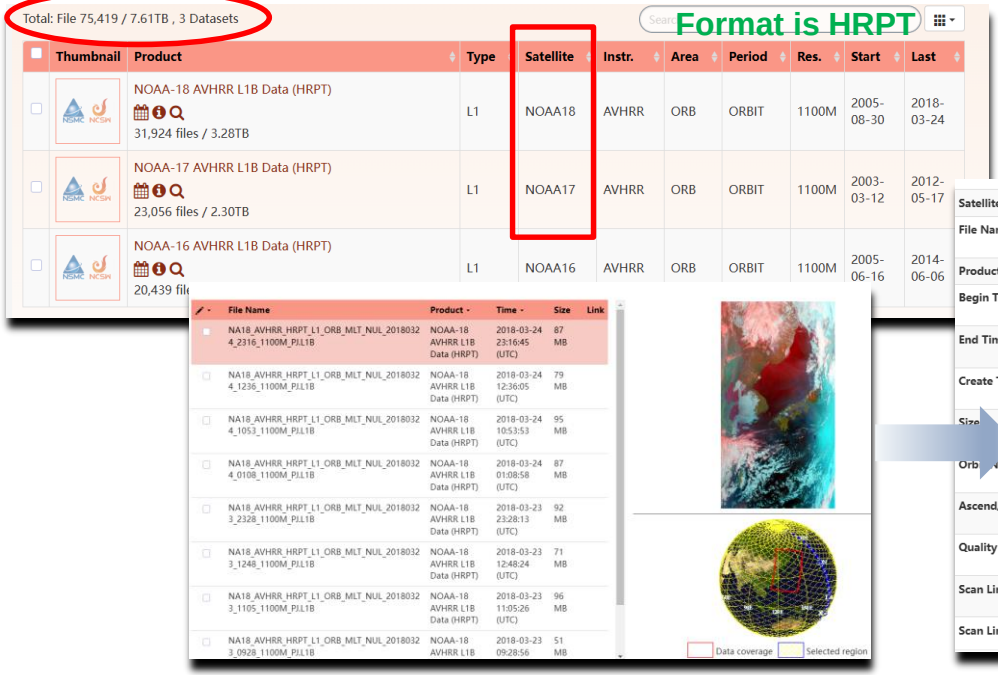
- At Malindi station, Agenzia Spaziali Italiana (2°56′18″S 40°12′45″E)

- ESA transcribed the DLTs content successfully.
- Full processing into Level-1B and Level-1C completed (FDR4AVHRR ESA project).
- Open access to users via ESA systems **Q3 2026**

Number of products: 8452
Volume size: 614 GB

China – CMA/NSMC

- AVHRR-receiving stations for global 1km land product (coordinated by USGS): Beijing, Urumqi, Guanzhou
- AVHRR 1-km data covering Himalaya-Hindukush of the period 1981 – 1992 would be of exceptional value
- Data after 2003 available at NSMC



http://satellite.nsmc.org.cn/DataPortal/en/data/dataset.html?dataCategoryCode=L1

Satellite	NOAA18
File Name	NA18_AVHRR_HRPT_L1_ORB_MLT_NUL_20180324_2316_1100M_PJL1B
Production Name	NOAA-18 AVHRR L1B Data (HRPT)
Begin Time	2018-03-24 23:16:45 (UTC)
End Time	2018-03-24 23:28:20 (UTC)
Create Time	2018-03-24 23:16:00 (UTC)
Size	91,740,672 Bytes
Orbit Number	0
Ascend/Descend	Descend
Quality Flag	0
Scan Line, Actual	4,166
Scan Line, Total	4,166
Northeast Latitude	52.1505°N
Northeast Longitude	160.9671°E
Southeast Latitude	15.2762°N
Southeast Longitude	139.229°E
Northwest Latitude	59.3153°N
Northwest Longitude	116.4395°E
Southwest Latitude	19.5257°N
Southwest Longitude	112.8192°E

- No products downloading possible via machine-2-machine interface.
- CMA/NSMC has been contacted and invited to present at WGISS-61.

India - ISRO

https://bhoonidhi.nrsc.gov.in/bhoonidhi/index.html

Presentation at WGISS#57

ISRO dedicated Presentation at WGISS-61

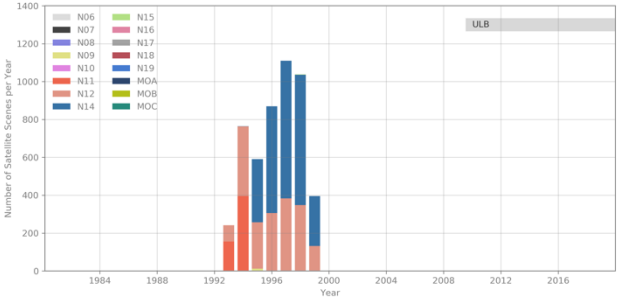
NOAA products are *open-data* and, after user registration, the products are downloadable.
No products number or volume can be extracted from the web site.

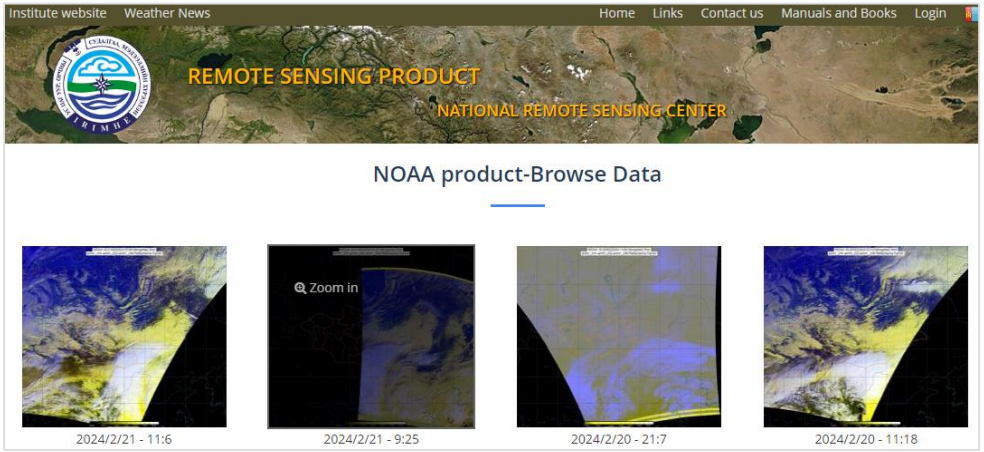
ISRO is processing AVHRR dataset holdings onto L1A products in house. L1B and L1C products will then be generated using the pyGAC software provided by ESA to ISRO.

Mongolia - Remote Sensing Department, Information and Research Institute of Meteorology, Hydrology and Environment

From UniBern

- AVHRR UBM data
- Source: Remote Sensing Department, Information and Research Institute of Meteorology, Hydrology and Environment, Ulaanbatar, Mongolia
- Number of Scenes: 5.016
- Satellites: N09, N11, N12, N14, N15
- Time Period: 1993 – 1999
- Extent: roughly Lat=[20,70] Lon=[80,120]
- Format: hmf (origin: dat, grid, lut)
- Further info:- UBMx station data were included in the Global Land 1km AVHRR Data Project





Browsing the NOAA data, the acquisitions are from 01/01/2017 up to now.
Downloadable data (raw,L1b,L1c) from 10/12/2023 (http://icc.mn/)

ESA established contacts with IRIMHE institute in Mar'25. NOAA-15, NOAA-17 and NOAA-18 HRPT data were transferred to ESA.
Next steps: transcription of all tapes, full processing into Level-1B and Level-1C, open access to users via ESA systems.

Australia – CSIRO

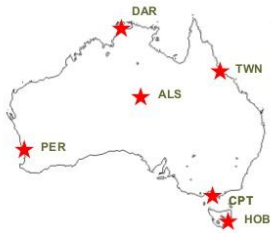
- AVHRR reception based on 6 stations for continuous 1-km data set. Since the early 1990s CSIRO has been merging these separate local data sets to produce a stitched archive with national coverage. The assembly and consolidation of this data set continues within CSIRO today.
- Data availability: 1981 (NOAA-7) onwards covering essentially the greater Australasian region and NZ.

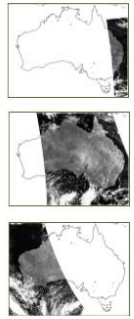
- CSIRO planning to reprocess all data into higher levels and provide access.
- Coordination and cooperation with ESA ongoing (exchange of info and SW) to facilitate reprocessing and harmonization of datasets.
- **Next steps**: CSIR will be invited to make a presentation at WGISS-62

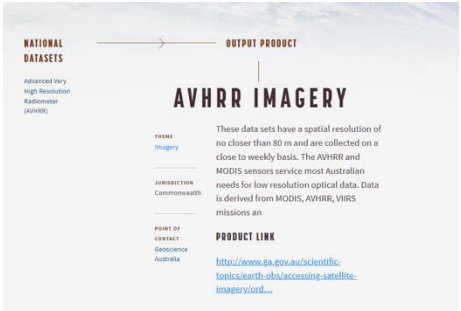
Presentations at WGISS#56/57/58

Reception

Ian Grant, Bureau of Meteorology, Australia



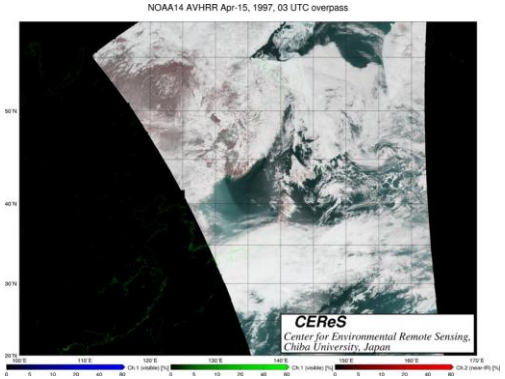




https://link.fsdf.org.au/dataset/avhrr-imagery

Chiba University - Japan

Center for Environmental Remote Sensing (CEReS) is a Remote Sensing Center which was established in 1995 at Chiba University (35°37′27″N 140°6′15″E), Japan.



Chiba dedicated presentation at WGISS-61

Exchange of information between ESA and Chiba University in 2025 (with JAXA support). Data transfer to ESA **COMPLETED**.
Next steps: full processing into Level-1B and Level-1C, open access to users via ESA systems.

Additional AVHRR data available at ESA

Three HD with potentially unique AVHRR data made available to ESA from Prof. P.Cornillon (University of Rhode Island).

Region/Acquisition Station	Products
Brazil	283891
East Pacific	7530
HRPT - Peru’	5055
HRPT – South Africa	9721
Wallops Island	109421
West Atlantic	21744
West Pacific	16809
Total	**454171**

- Data extraction from disks completed at ESA.
- **Next Steps**: full processing into Level-1B and Level-1C, open access to users via ESA systems (FDR4AVHRR ESA project).

Other organizations

- Inventory of existing national/regional HRPT and LAC data archives Version 3.2 has been produced in Q1 2026;
- List of Met offices and other organizations around the world who might have AVHRR LAC data being compiled at ESA;
- ESA will perform a worldwide AVHRR LAC data gap analysis extending the one done for Europe;
- ESA will contact additional organizations who might have AVHRR LAC data to investigate possibility to fill identified gaps.

AVHRR Media Transcription

AVHRR 1 Km data on media

Several hundred heritage media (optical disks, DLTs, Exabytes) with potentially unique AVHRR LAC data identified:

- ESA (Optical Disks) □ TRANSCRIPTION ONGOING
- University of Reading (Optical Disks) □ TRANSCRIPTION ONGOING
- University of Rome / ASI (DLTs) □ TRANSCRIPTION COMPLETED
- University of Hawaii (Exabytes) □ TRANSCRIPTION ONGOING

300 CLV DISKS

100 ATG GM-9001/5 DISKS

Exabyte tapes

LM 1200 optical Disk 2.4GB

AVHRR Data Processing and Access

Next Steps

1. WGISS members to continue ongoing transcription/reprocessing activities and projects

1. WGISS members to exchange information and SW to facilitate respective activities and pursue harmonization of respective datasets

1. ESA to contact additional organizations with potentially unique AVHRR LAC data

2. WGISS to check status of discoverability of AVHRR datasets worldwide and pursue common entry point through WGISS data discovery and access infrastructure

AVHRR Session follow-on will be held at WGISS#62