

ESA Heritage Space: How CCI can be involved

Mirko Albani, Roberto Biasutti (ESA-ESRIN)
CCI colocation & CMUG integration meeting
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What are Heritage Missions?

All no longer operational EO Missions for which ESA archives, manages, valorises and distributes data.

Data are covered by the **Heritage Space Programme** starting five years after end of satellite operations or agreement with the 3rd party operator

ESA's Heritage Space Programme

- Preserves, keeps accessible and curates
- 40+ years of Earth Observation heritage data
- 150+ ESA and Third Party heritage missions & ESA dedicated EO Campaigns data from mid 70's

Heritage data provide the capability to:

- Look back in time
- Understand changes affecting our planet
- Shape our actions and future



HERITAGE MISSIONS

TIMELINE



- Optical
- SAR
- SAR + Optical
- SAR + Optical + Atmospheric
- Gravity Field
- - - - - Ongoing



On some heritage missions only part of the dataset is available at ESA.

Heritage Data Consolidation (including media transcription) & Archiving

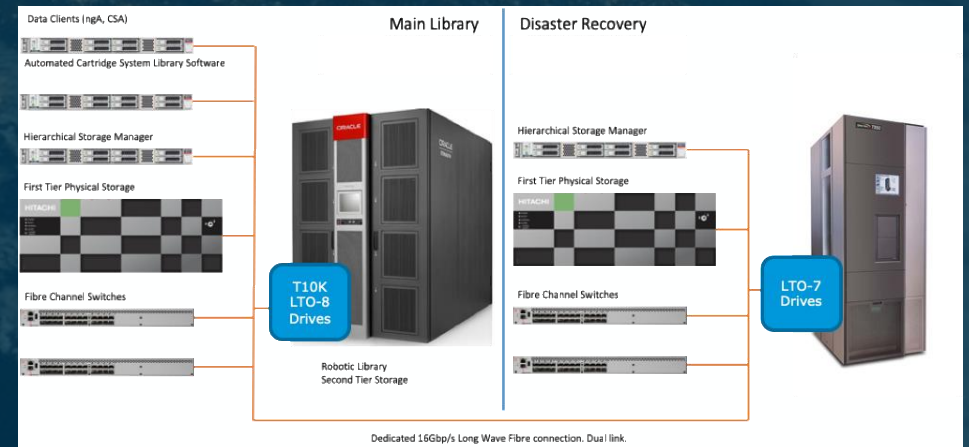
All EO heritage missions: data & information *consolidation, archiving/preservation to prevent loss*



ERS SAR Master consolidation overall results	2016	2022
Estimated completeness ERS-1 (data coverage vs recorded unavailabilities)	82%	95%
Estimated completeness ERS-2 (data coverage vs recorded unavailabilities)	88%	97%

Sensor / Type of product	Estimated completeness % (data coverage vs recorded unavailability's)
RA / ERAC	97.82%
MWR / EMWC	97.83%
SWM / EWAC	93.56%
WSC / EWIC	96.06%
ATSR-1 / RATSr	99.50%
Telemetry / EGH	96.69%

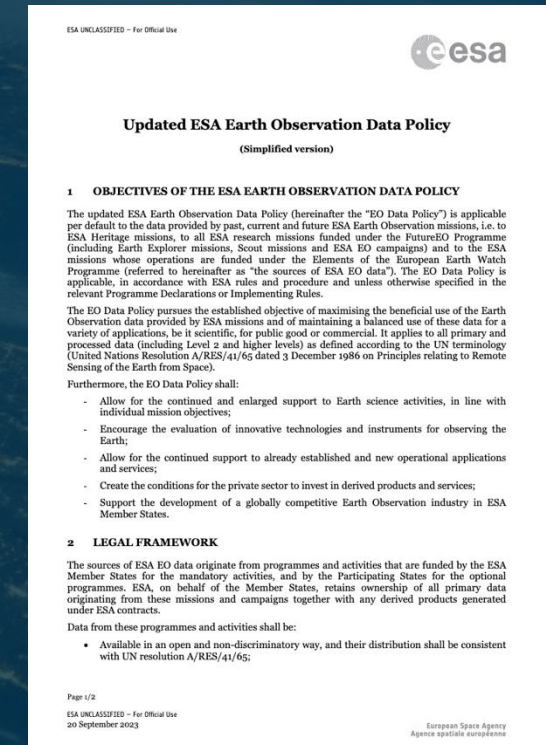
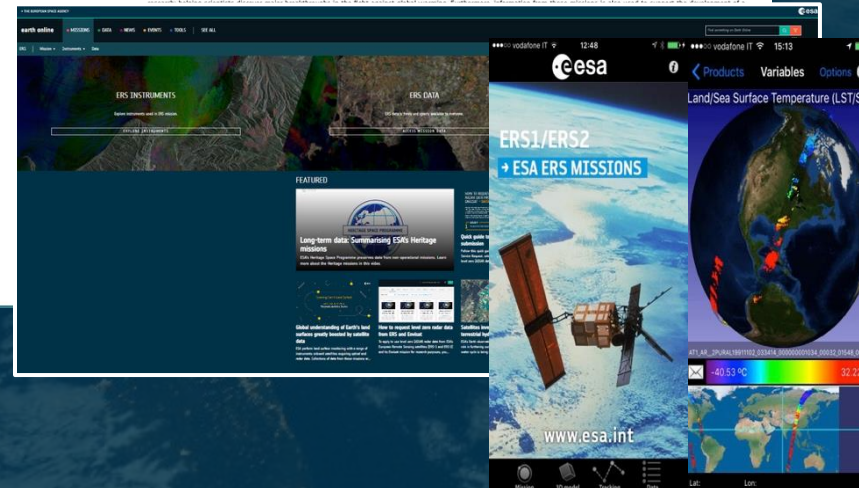
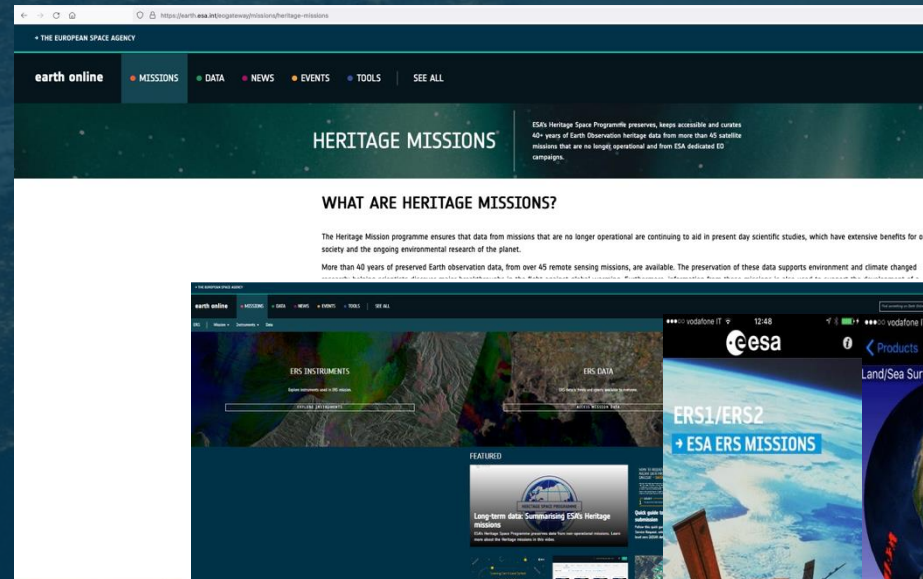
Sensor / Type of product	Estimated completeness % (data coverage vs recorded unavailability's)
RA / ERAC	96.53%
MWR / EMWC	97.56%
SWM / EWAC	84.62% (*)
WSC / EWIC	86.16% (*)
ATSR-2 / EATC-2	91.51%
GOME / EGOC	98.95%
Telemetry / EGH	82.74%



Heritage Data and Information Discovery and Access

All EO heritage missions: *Discoverability/accessibility* possibly with same performance as new missions

- Online access through ESA dissemination systems
- Open and free according to ESA EO Data Policy
- User Registration and acceptance of Terms and Conditions of use
- Restrained dataset access initiated via *Data Service Requests*
- Visualization and analysis tools



DATA ACCESS <https://earth.esa.int/eogateway/missions/heritage-missions>

High priority missions: *valorisation* activities to facilitate data exploitability & usability, and generation of *few Fundamental Data Records (FDRs)*

- Improve data quality (e.g. new algorithms, new auxiliary files)
- Align heritage missions datasets to new missions (e.g. Sentinels) using new IPFs / algorithms to generate long time data series
- Change data format to facilitate usability and better exploit modern technologies/tools (e.g. Data Cubes)
- Ensure compliance to CEOS Analysis Ready Data (ARD) specifications
- Generate new products

ESA Fundamental Data Records (FDR4*) projects



Fundamental Data Records (FDR) address valorisation of heritage assets (e.g. ERS-1/-2, Envisat, TPMs - Third Party Missions) - <https://earth.esa.int/eogateway/activities/fundamental-data-records-fdr>

Key aspects

- Exceed performance of individual mission datasets
- Pursue harmonization (Fiduceo-like approach) of different sensors
- Improve calibrations to reduce multi-mission bias
- Allow interoperability and continuity towards current & future projects
- Enhance traceability of satellite-derived EO data
- Improve uncertainty estimates based on EO Metrological guidelines
- Relevant for applications and ESA CCIs



Currently ESA are developing and updating 6 projects: 3 project have data available (see next slide for more details):

- for Altimetry (FDR4ALT) - <https://www.fdr4alt.org/>
- for Atmospheric Composition (FDR4ATMOS) - <https://atmos.eoc.dlr.de/FDR4ATMOS>
- from Optical data FDR4AVHRR - https://lps25.esa.int/lps25-presentations/presentations/1515/_1515.pdf



And for other 3 the data will be available in 2026/2027:

- for Land Dynamics (FDR4LDYN) – ERS scatterometer backscatter observables, yearly azimuthal correction terms and uncertainty interoperable with ASCAT and future METOP-SG SCA (data release foreseen in 2026)
- for Optical and NIR data (A)ATSR (FDR4(A)ATSR) – (A)ATSR ERS-1 and -2, Envisat Top of atmosphere (TOA) reflectance for three-views instruments
- FDR4VEG - Top of atmosphere (TOA) and bottom of atmosphere (BOA) reflectance from SPOT-VGT1, SPOT-VGT2 and PROBA-V satellites (data release foreseen end 2027)





FDR4ATMOS – ERS-2 GOME-1 and Envisat SCIAMACHY irradiance/reflectance for UV-VIS-NIR for O3, SO2 and NO2 from 1995 to 2012

FDR4ALT – ERS-1, ERS-2 and Envisat MW Top of atmosphere (TOA) Brightness Temperatures, altimetry waveforms, surface classification distance to coasts from 1991 to 2012 (similar to S3 products)



FDR4AVHRR – 1km all TIR and VNIR channels over Europe and additional selected world regions for the whole AVHRR series (1981-2020)

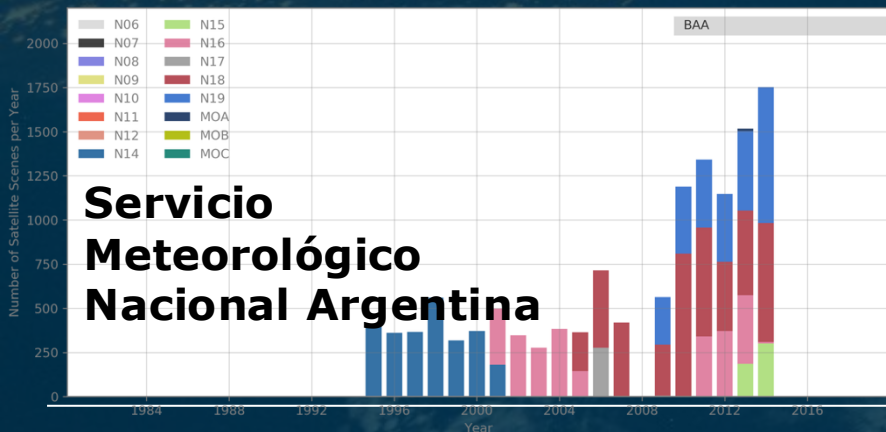
SCAN QR CODES TO ACCESS THE DATA WEB PAGES

AVHRR Data Outside Europe

- **ESA leading CEOS WGISS recovery project** to unfold and make accessible 1km data from regional archives
- **ESA transcribing unique data from old media and recovering data outside Europe from other organizations** (focus now on Africa / South America / Pacific - Hawaii, Asia and Australia)
- Objective to reprocess to Level-1b and 1c (same as Europe)
- New data releases on ESA dissemination systems during 2026-27



STAY TUNED !!!



CEOS-ARD ANALYSIS READY DATA

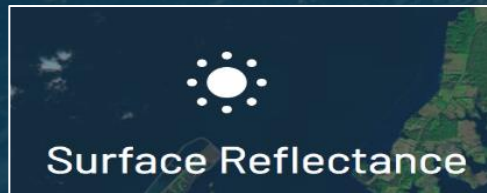
Analysis Ready Data are satellite data that have been processed to a minimum set of requirements and organized into a form that allows immediate analysis with a minimum of additional user effort and interoperability both through time and with other datasets: <https://ceos.org/ard/>



PROBA-V products



Other products available from 2027



Surface Reflectance

CEOS-ARD SR

Sentinel-2

Proba-V

Envisat MERIS

ERS/Envisat(A)ATSR

Land Surface Reflectance with solar, water vapour, atmospheric corrections and uncertainty estimate



Surface Temperature

CEOS-ARD ST

Sentinel-3

ERS/Envisat (A)ATSR

Land Surface Temperature with Corrections for Atmosphere and Emissivity and uncertainty estimate



Radar Backscatter

CEOS-ARD NRB

Sentinel-1

ERS/Envisat (A)SAR

CEOS-ARD Normalised Radar Backscatter [NRB] are provided in the Gamma-Nought (γ_T^0) backscatter convention, with Radiometric Terrain Correction (RTC), which mitigates the variations from diverse observation geometries and is recommended for most land applications

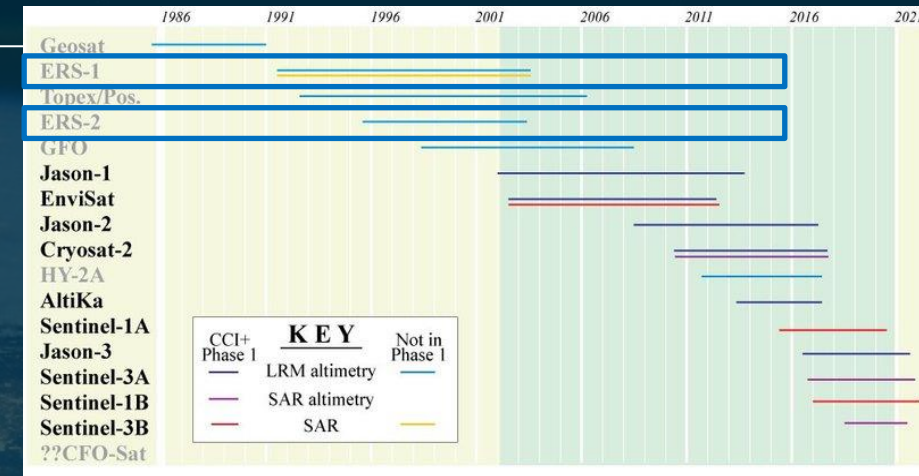
SAR Sea State from ERS mission - ERSAR

Project started in March 2026 to create ERS-1, ERS-2 SAR Sea State products from 1991 to 2011 applying new algorithms derived from Envisat and Sentinel-1A/1B L2 ocean products generated in the CCI [Sea State](#) project.

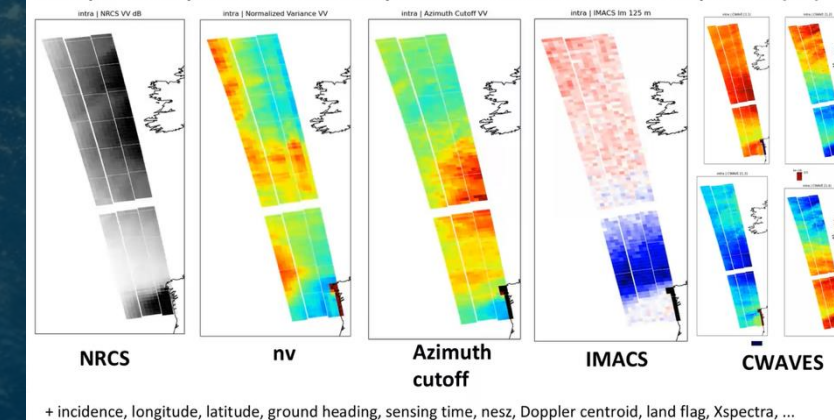
Machine learning (ML) algorithms, today successfully applied to Sentinel-1 and Envisat, enable the usage of ERS SAR archive. Moreover, the ERS SAR dataset can benefit of the concomitant ERS AMI scatterometer measurements to refine the algorithm sensitivities to local wind conditions.

Revisiting the ERS SAR imagette archive will allow to:

1. homogenise algorithms to produce a long-term analysis combining ERS data with Envisat and Sentinel-1 data to cover more than 30 years;
2. provide opportunities to improve the present-day state-of-the-art algorithms.



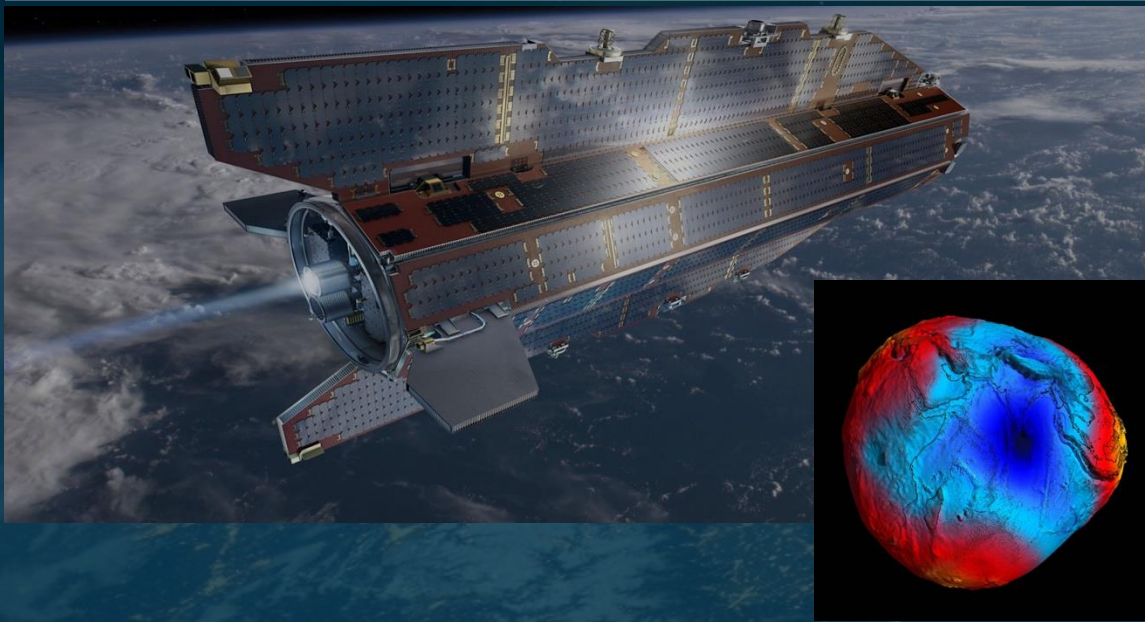
Example of L1B product content computed from one Sentinel-1 IW acquisition (VV)



+ incidence, longitude, latitude, ground heading, sensing time, nesz, Doppler centroid, land flag, Xspectra, ...

Sentinel-1 example

Data available in 2028



80+ Campaigns, living Collection

- *ground-based*
- *ship-borne*
- *balloon-borne*
- *airborne*

- *Best geoid ever*
- *Mission duration: Mar2009 – Oct2013*
- *Latest reprocessed Level 1b and Level 2 products available to users*



Online access upon registration through [ESA Earth Online](#)

HERITAGE THIRD PARTY MISSIONS (TPM)

- Landsat 1-7 Series (MSS, TM, ETM+)
- ALOS (AVNIR/PRISM/PALSAR)
- NOAA POES AVHRR
- MOS-1/1b
- IRS-1C/1D
- IRS-P3
- SPOT-1 to 5
- DMC 1st Generation
- IKONOS-2
- JERS-1 (SAR/Optical)
- Kompsat-1/2
- QuickBird-2
- SeaSat
- Nimbus-7 CZCS

Several projects ongoing to recover additional heritage TPM missions data, improve existing datasets available at ESA and to generate new products

ESA Heritage
Third Party Missions

Thematic Collections

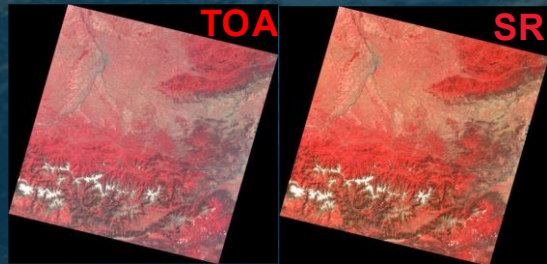
HERITAGE THIRD PARTY MISSIONS – FUTURE PRODUCTS



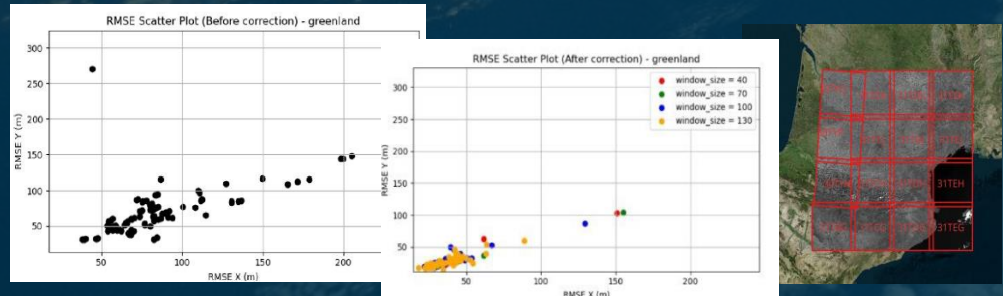
➤ Landsat MSS new Surface Reflectance ARD
Landsat 1 to 5 MSS CEOS Analysis Ready Data (ARD)
 1975-1993 specifications compliant product, considering updated radiances and improved geolocation -using as reference Sentinel 2 GRI data-, new atmospheric corrections (updated SMAC Look up tables), updated cloud mask and cloud shadow mask.

➤ MOS 1-1B new radiometric data and Surface Reflectance ARD products

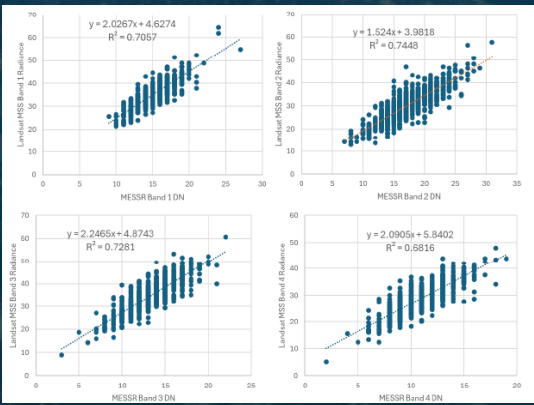
Data over Europe from 1987 to 1993 made up of MOS-1 and 1B, Japan's first marine observation satellites, new re-processed data calibrated against Landsat TM will be provided for the first time, together with CEOS ARD Surface Reflectance CEOS ARD



1975-07-16 MSS product corrected (before atm correction–left- and after –right)

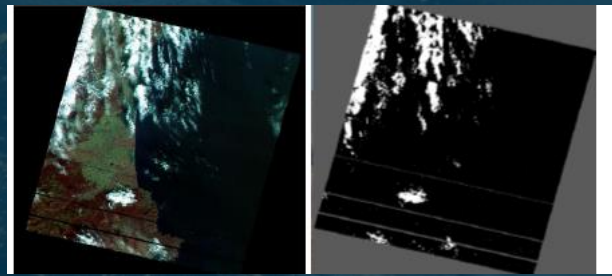


Geolocation correction (before and after over Toulouse dataset)



MESSR (MOS) DN and MSS (Landsat) radiances for calibration

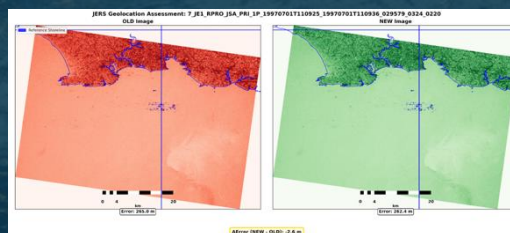
Cloud Mask over southern France



All data will be available by Q2 2027

➤ J-ERS SAR L-Band PRI and SLC geolocation improvement

JERS-1 mission data acquired at ESA spanning 1992-1998. L-band (HH polarisation) synthetic aperture radar generating SLC (Single Look Complex) and PRI (Precision Image) 18x18 m resolution products. Reprocessing using new orbit AUX files ongoing to improve geolocation.

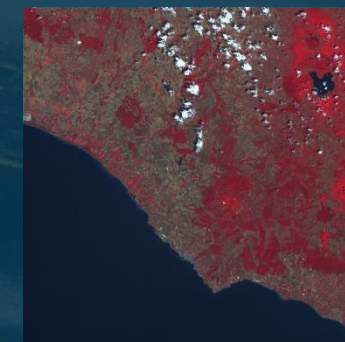


➤ SPOT 1-5 VNIR multispectral imager

Coordination with CNES to reprocess all ESA unique data holdings



Panchromatic (5 -1.5 m GSD)



Multispectral (20 - 5 m at nadir)

➤ IRS-1C/1D multispectral data (LISS-III, WiFS, PAN)

Project ongoing with GAF for media transcription and processing of the full archives from 1996 to 2005 and covering Europe and northern Africa.

➤ IRS-P3 MOS Multi-electronic Optical Scanner

Project ongoing with DLR to merge ESA and DLR full archives covering Europe and northern Africa and reprocess them to L1 and L2.

PLANNED TO BE RELEASED IN 2026/27 AND MORE TO COME....

- 1) Use Heritage Data in CCI related activities → unique capability to look back in time
- 2) Provide feedback and needs related to Heritage Missions:
 - What heritage data currently not accessible (in Europe or worldwide) are needed by CCI users and projects (e.g. commercial)?
 - What heritage data crucial for CCI activities are currently at preservation/access risk ?
 - What improvements on existing ESA heritage data would CCI need? Quality improvement? Reformatting? Alignment with newer missions? New data products?
- 3) Provide support in heritage data recovery/consolidation/reprocessing activities through expertise, tools, etc

Contacts: Mirko.Albani@esa.int, Roberto.Biasutti@esa.int