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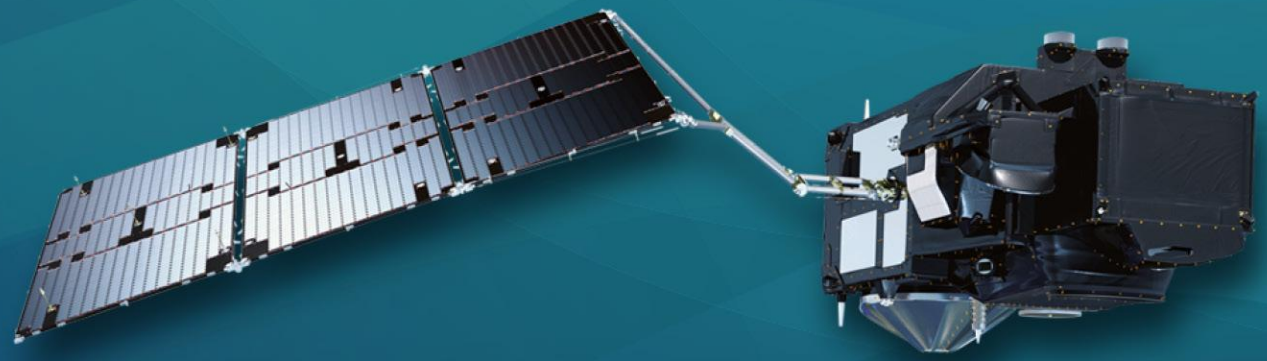

9th Sentinel-3 Validation Team meeting 2026

30 March–01 April 2026 | ESA–ESRIN | Frascati (Rome), Italy

Science for Marine Surface Temperature (Sci4MaST) service: Presentation of the Sea and sea-ice Surface Temperature activities

C. Ribere[1], C. Bearzotti[4], E. Bodéré[3], B. Delaveau[1], D. Briand[3], S. Eastwood[6], M. El Hajj[1], O. Embury[5], P. Englyst[4], G. Dybkjær[4], V. Henningsen[4], E. Hayashi[4], J. L. Høyer[4], I. Karagali[4], A. Kettle[2], A. Zafiamy[1], N. McCarroll[5], C. Merchant[5], J-F. Piollé[3], I. Robles Garcia, J. Sarrau[1], S. Saux Picart[2], J. Sarrau[1], N. Lalloué[1], G. Corlett[7], A. Reed[7], I. Tomazic[7]

1. NOVELTIS – 2. Météo France – 3. Ifremer – 4. The Danish Meteorological Institute – 5. University of Reading – 6. Norwegian Meteorological Institute – 7. EUMETSAT

Sci4MAST – Summary of activities

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Service Management

NOVELTIS

GHRSST

Activity 1:

Improving the Sentinel-3 SLSTR SST and IST product quality

- Consistency of SST products and steps towards harmonization
- Validation of pre-operational Collection 4 SLSTr sea-IST products
- Evolution of Coefficient Generation Tool including preparation for SLSTR-C and D and algorithm and retrieval developments

NOVELTIS | University of Reading | The Danish Meteorological Institute | METEO FRANCE | Norwegian Meteorological Institute

Activity 2:

Evolution of EUMETSAT SST and IST Cal/Val tools and implementation of GHRSST Data Discovery and Catalog

- Multi-Mission Match-Up Database (felyx evolution)
- GHRSST Central Data Discovery and Cataloguing Service (incl. GDS)
- EUMETSAT Marine Surface Temperature Cal/Val tools (METIS evolution)

NOVELTIS | Ifremer

Activity 3:

Coordinating, organising and administrating the GHRSST Project Office, including the web-site and web service

- GHRSST website update
- Management of GHRSST Science Team
- Annual Science Team meeting
- Capacity Building
- GHRSST Documentation

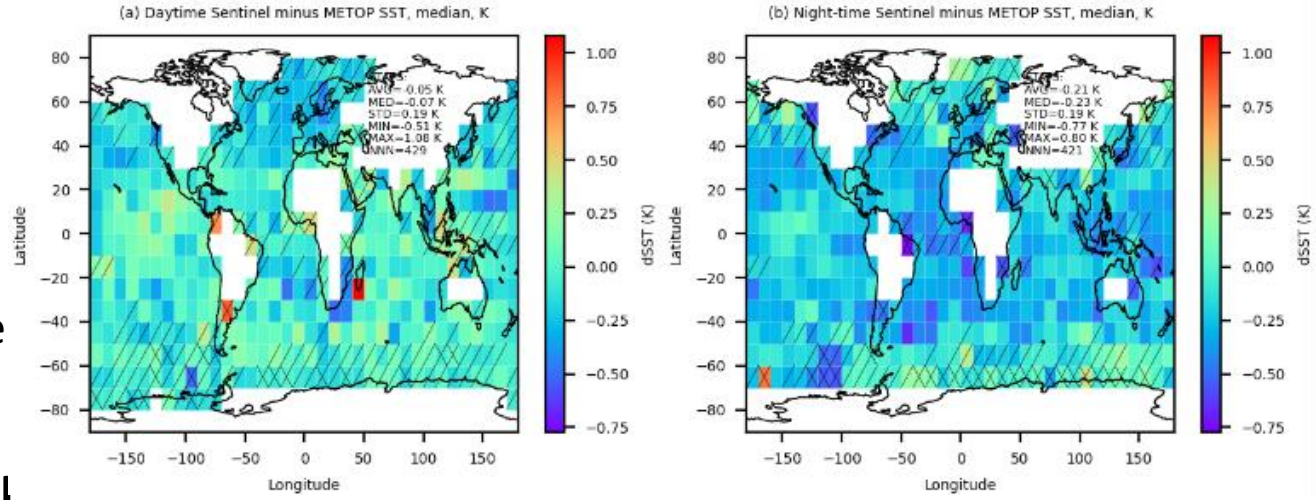
NOVELTIS | The Danish Meteorological Institute

Activity 1 – Improving the Sentinel-3 SLSTR SST and IST product quality

1.1 Consistency of SST products and steps towards harmonization

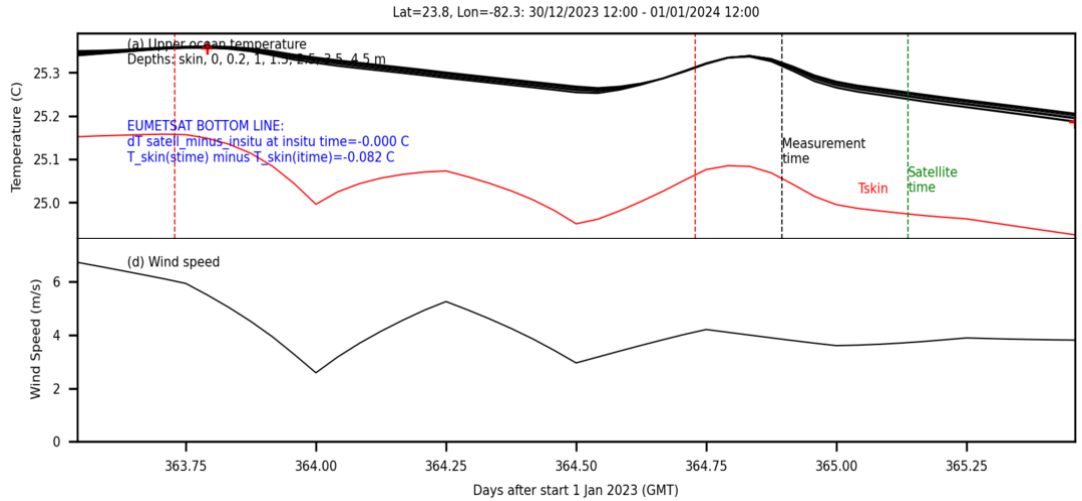
Comparison of Sentinel-3a/SLSTR and Metop-B/AVHRR

- Collocate Sentinel-3a/SLSTR (skin SST) and Metop-B/AVHRR (sub-skin SST) granules within a 1 hour time window.
- Cool skin and warm layer are visible at large scales on the Sentinel-3a/SLSTR minus Metop-B/AVHRR SST difference due to different definition of SST.



Development of cool skin and warm layer model

- Technical developments on existing version of Kantha and Clayson (1994), and Fairall et al. (1996).
- Use to compute ΔSST in time and depth to allow comparison of different measurements (in-situ vs satellite or satellite vs satellite).



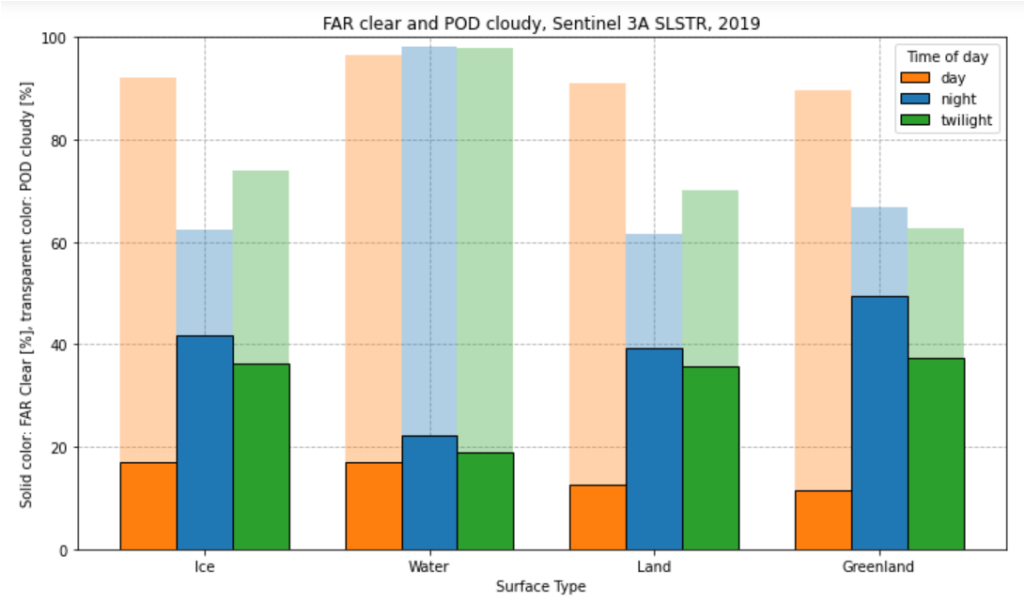
Poster: Modelling the 'cool skin' and 'warm layer' effect for improving satellite sea surface temperature products.

Activity 1 – Improving the Sentinel-3 SLSTR SST and IST product quality

1.2 Validation of pre-operational Collection 4 SLSTr sea-IST products

Validation of cloud mask used in SLSTR IST product

- Cloud mask from EUMETSAT Nowcasting SAF, PPS v2021, is used for cloud masking in the SLSTR IST processor.
- The PPS v2021 processor provides classical threshold-based cloud mask and a naive bayesian cloud probability, which are combined with the cloud masking for the SLSTR IST processor.
- Validation is done by comparing the cloud mask with cloud observations from the Calipso/Caliop lidar.
- Preliminary validation of the cloud mask shows that the cloud mask performs well, except over sea ice during night time. Polar conditions during night time are very challenging for cloud masking.



Above : Validation scores (PoD_cloud and FAR_clear) for PPS cloud mask for SLSTR-A nadir view data at northern hemisphere during 2019.

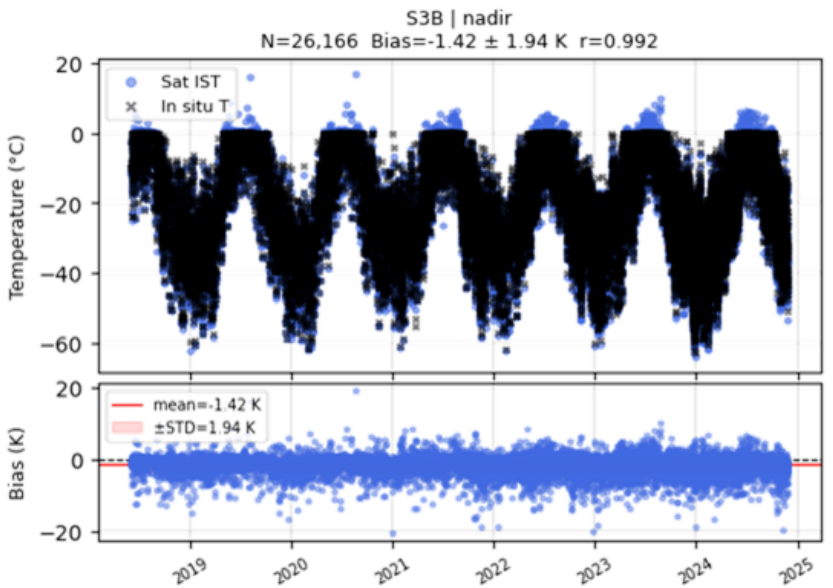
Activity 1 – Improving the Sentinel-3 SLSTR SST and IST product quality

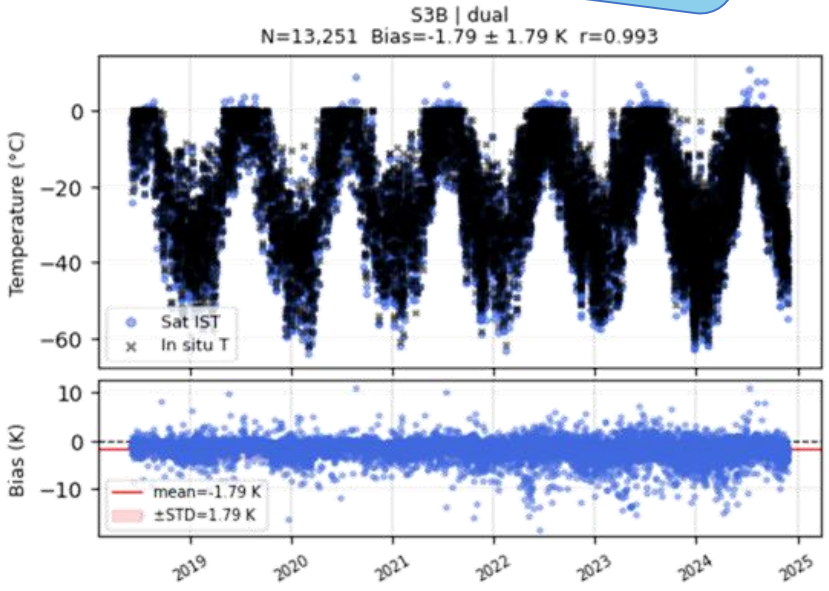
1.2 Validation of pre-operational Collection 4 SLSTr sea-IST products

Validation of the EUMETSAT S3-SLSTR, Collection-4 IST data

- IST data: Satellite-derived surface temperature from Sentinel-3 SLSTR-A and SLSTR-B, represented by the Nadir View algorithm (NV) and the Dual View algorithm (DV).
- 4 IST data sets evaluated: NV-S3A, NV-S3B, DV-S3A and DV-S3B.
- Valid for data Quality Level 4+5, observations within 1 km and 15 minutes

See previous presentation by Gorm!
"Evaluation of the Collection-4 of the Sentinel-3 SLSTR IST retrieval algorithms"



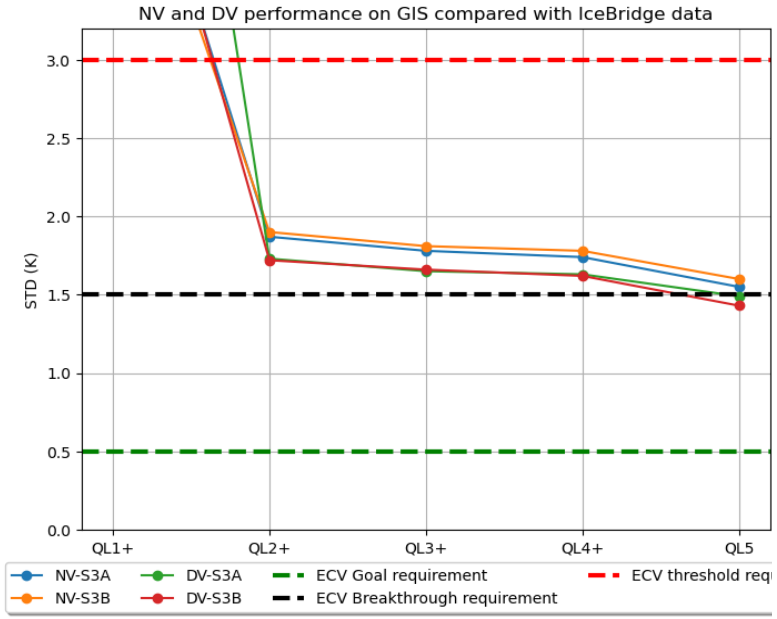


Activity 1 – Improving the Sentinel-3 SLSTR SST and IST product quality

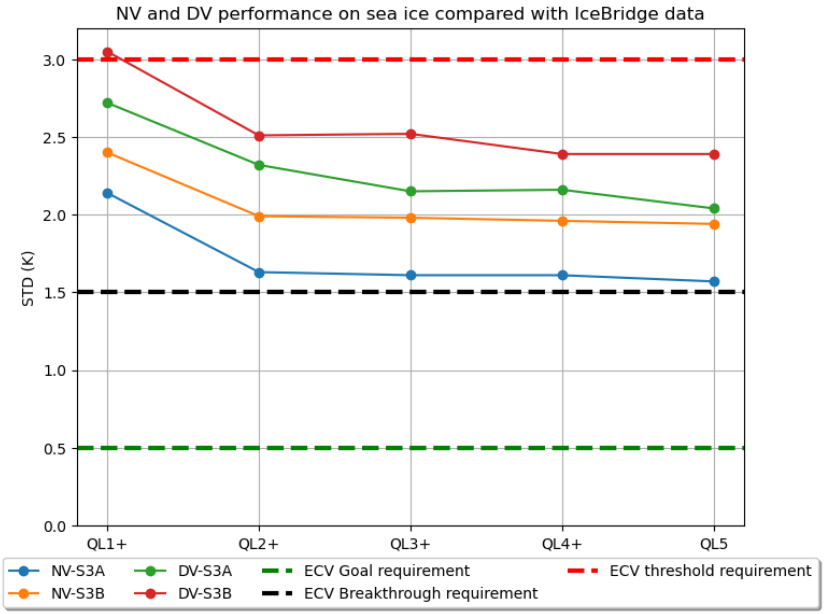
1.2 Validation of pre-operational Collection 4 SLSTr sea-IST products

Validation of the EUMETSAT S3-SLSTR, Collection-4 IST data

- Comparison with Operation-IceBridge data for skin temperature evaluation over the GIS (left) and over sea ice (right).
- General performance against PROMICE on the GIS is around GCOS ECV breakthrough requirement of 1.5 K (1 sigma)
- Only S3S-NV algorithm against ICEBRIDGE reference data over sea ice performs equally good as all algorithms against PROMICE. To be investigated…



Above: S3A/B NV and DV algorithms over the GIS. Reference temperatures are IceBridge.



Above: S3A/B NV and DV algorithms over sea ice. Reference temperatures are IceBridge for sea ice concentrations > 95%.

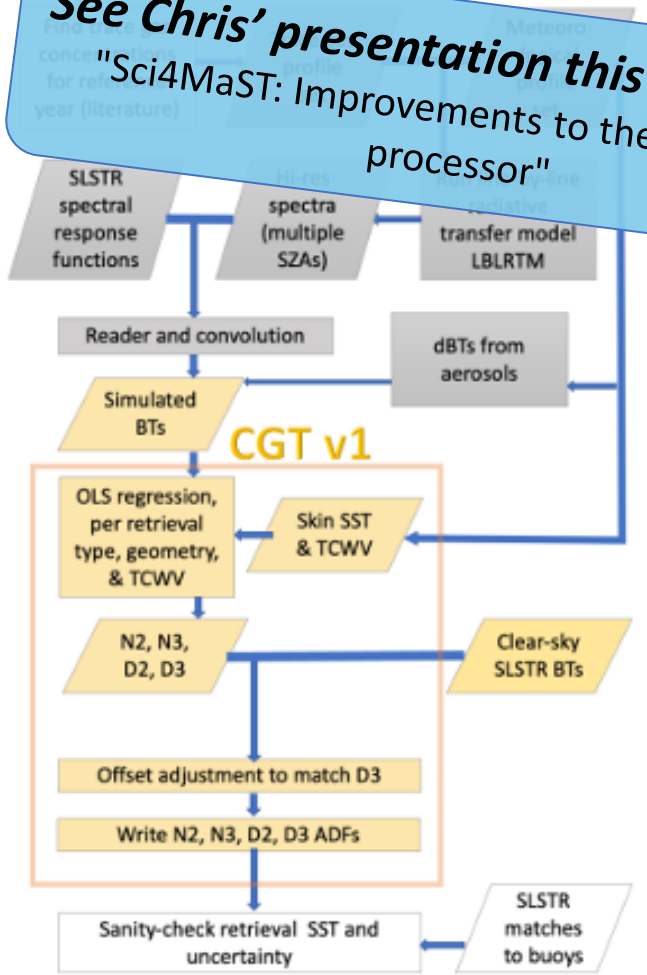
Activity 1 – Improving the Sentinel-3 SLSTR SST and IST product quality

1.3 Evolution of Coefficient Generation Tool including preparation for SLSTR-C and D and alg. and retrieval developments

SST Coefficient Generation Tool

- SLSTR uses coefficient-based SST retrieval
  - Highly accurate, aerosol-robust
  - Physically based using line-by-line radiative transfer simulations
  - Maximum independence from in-situ measurements
  - Includes correlated and uncorrelated uncertainty estimates
- Method developed for ATSR Reprocessing for Climate (ARC) and ESA Climate Change Initiative
- Developed V2:
  - Includes updated trace gas profile
  - Combines with instrument spectral response functions (SRFs)

See Chris' presentation this afternoon!
"Sci4MaST: Improvements to the SLSTR SST processor"

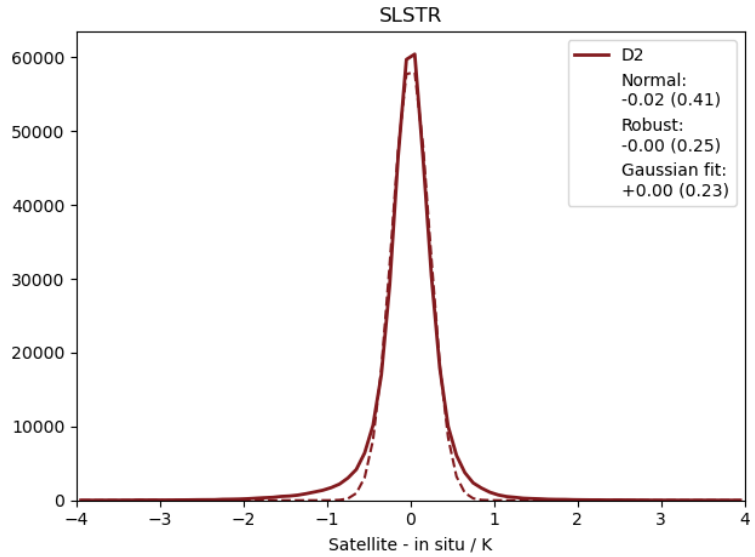


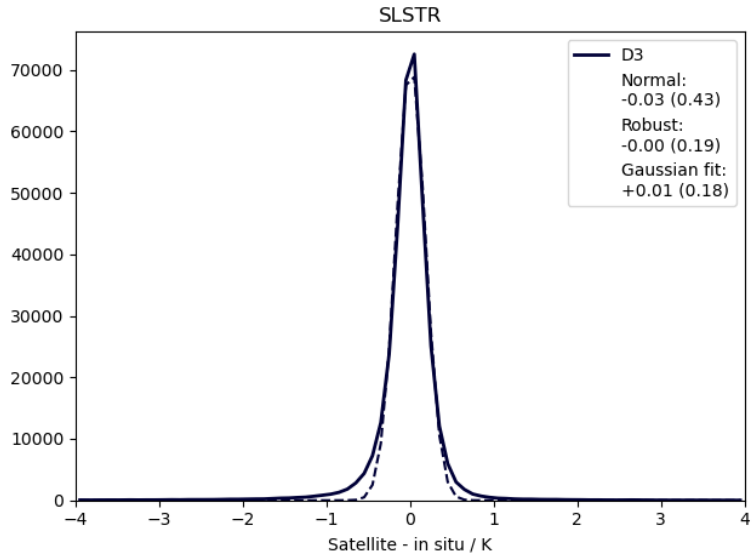
Activity 1 – Improving the Sentinel-3 SLSTR SST and IST product quality

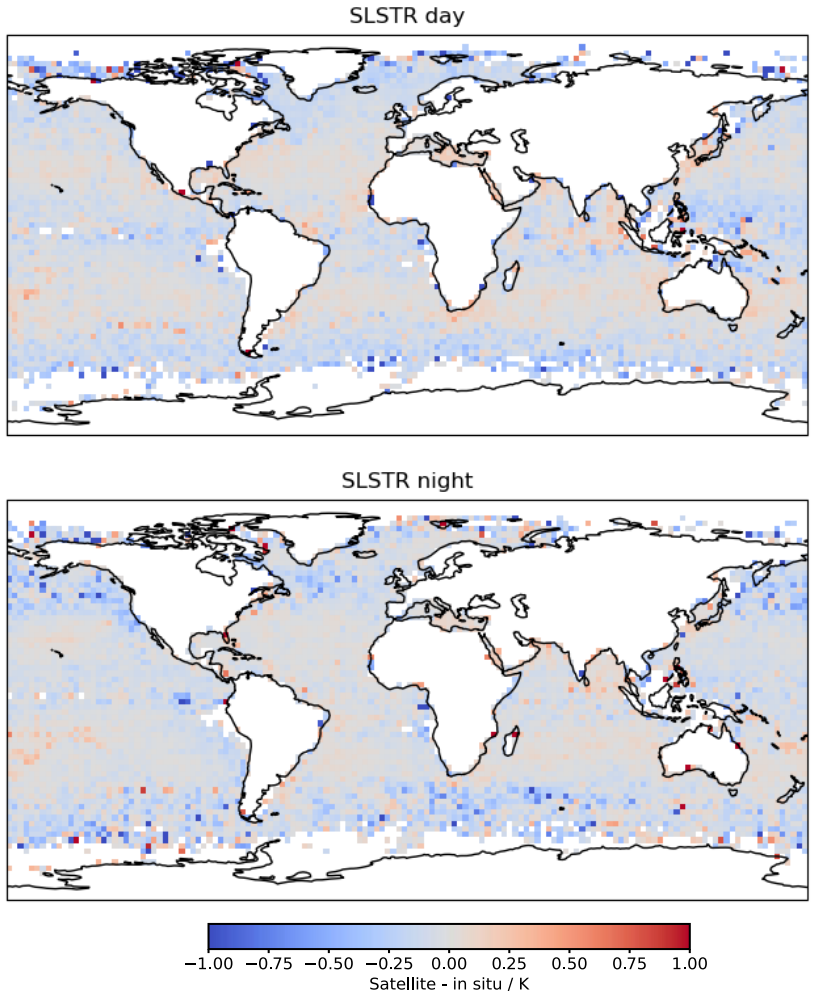
1.3 Evolution of Coefficient Generation Tool including preparation for SLSTR-C and D and alg. and retrieval developments

SST Prototype Processor

- Prototype Processor based on ESA SST CCI software
  - Dual-view Bayesian cloud detection
  - Support for external diurnal variability model
  - Fully compatible with CCI v3 processor







Activity 2 – Improving the SST and IST monitoring and Cal/Val tools

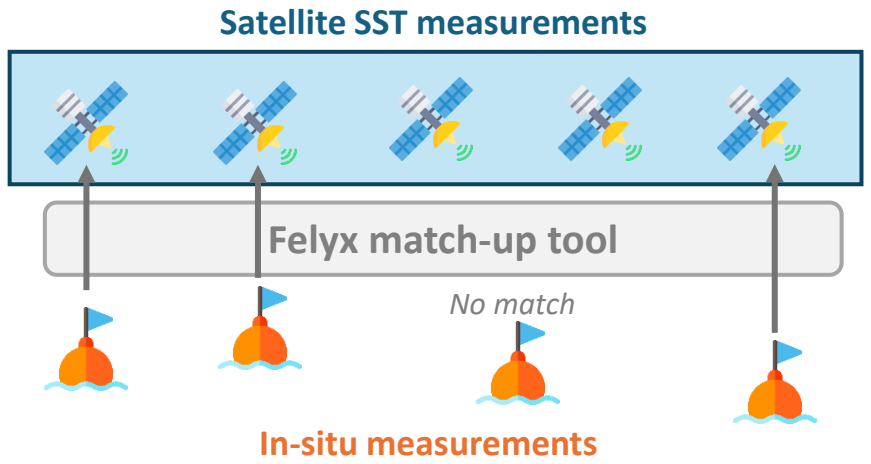
2.1 Multi-Mission Match-Up Database

Evolution of a matchup and subset MMDB/felyx production system

- Configurable and scalable open source matchup and data subsets tool
- Objective is to generate, routinely or in backlog mode, satellite to in-situ match-ups:

```
MMDatasets:
  S3A_SL__OPE_NRT__cmems_drifter:
    site_collection_id: cmems_drifter
    eo_datasets:
      S3A_SL_2_WST__OPE_NRT:
        reference: True
        subset_size: 21
        matching_criteria:
          time_window: 120
          search_radius: 5.
    output: # (optionnel, utile à la commande assemble matchup)
      # the temporal extent of each created match-up file
      frequency: '1d'
      # history of in situ data to include with the matched measurement, as a
      # duration in minutes before and after the matching time
      history: 360
      # output file pattern (ignored if subproducts are defined)
      # default time units default time units in CF convention style (default is
      # 'seconds since 1950-01-01')
      default_time_units: seconds since 1980-01-01

      products:
        S3A_SL__OPE_NRT__cmems_drifter:
          # output file pattern for the subproduct
          filenaming: '%Y/%j/%Y%m%d%H%M%S_S3A_SL__OPE_NRT__cmems_drifter.nc'
          # tailor the content of the assembled files
          content:
            S3A_SL_2_WST__OPE_NRT:
              # [Optional] list of variables to include in the assembled files (all
              # of them by default)
              variables: [.*]
```



- Distributed processing framework (jobard – dask based job scheduling system) implemented for different platforms (PC, cloud, HPC)
- Data downloader with extended connectors to collect data files from various data provider interfaces
- Reporting and alerting capabilities

Activity 2 – Improving the SST and IST monitoring and Cal/Val tools

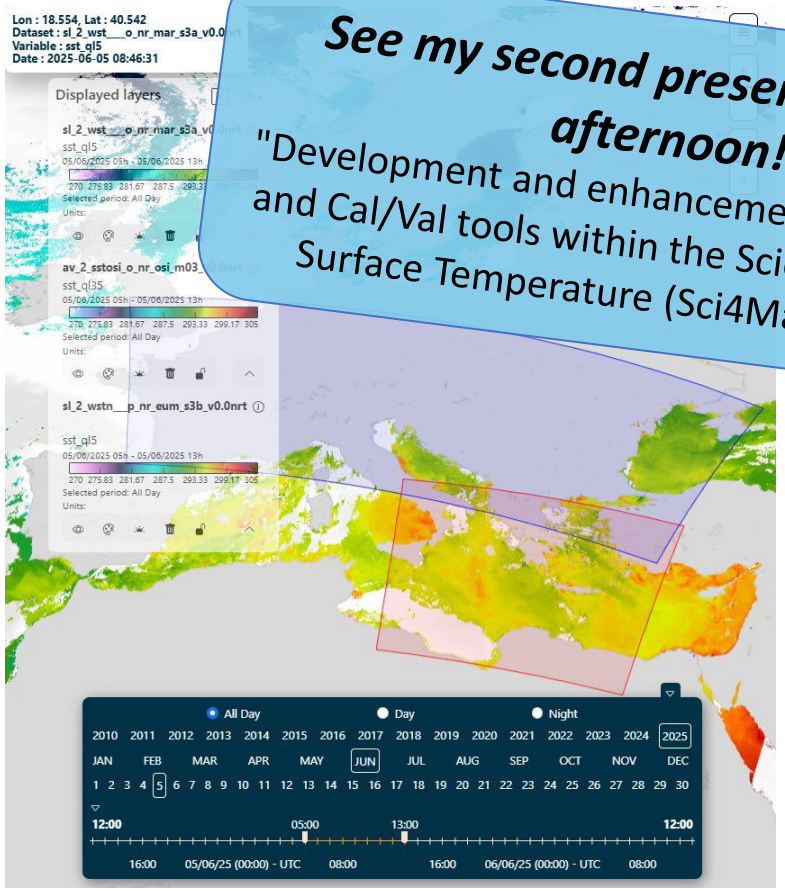
2.2 EUMETSAT Marine Surface Temperature Cal/Val tools

Evolution of the EUMETSAT marine Surface Temperature Cal/Val tools to enable multi-level, mission and parameter inter-comparisons

- Interactive and user configurable mapping and graphing tool
- Supports L1/L2/L3/L4 + in-situ/matchups + model data
- Monitoring, analysis and products intercomparison

Interactive mapping tool

- ✓ Zoom in/out, panning, layers, opacity
- ✓ Configurable/dynamic colormaps and data ranges
- ✓ Global/polar (NH/SH) projections
- ✓ Configurable and shareable view (permalink)
- ✓ Product/granule (L1/L2/…) info + point values
- ✓ Ingestion of external dataset

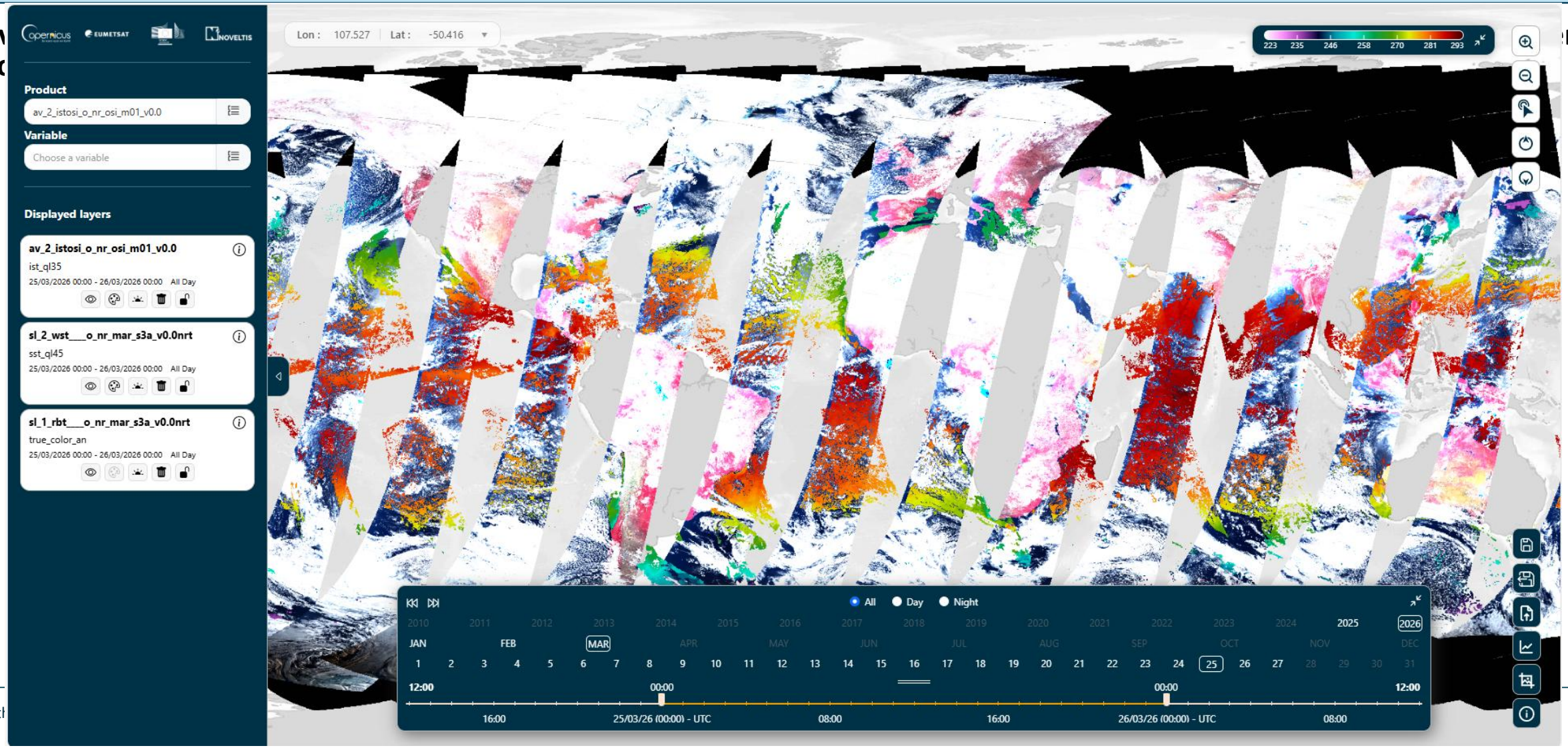


See my second presentation this afternoon!

"Development and enhancement of monitoring and Cal/Val tools within the Science for Marine Surface Temperature (Sci4MaST) project"

Activity 2 – Improving the SST and IST monitoring and Cal/Val tools

2.2 EUMETSAT Marine Surface Temperature Cal/Val tools



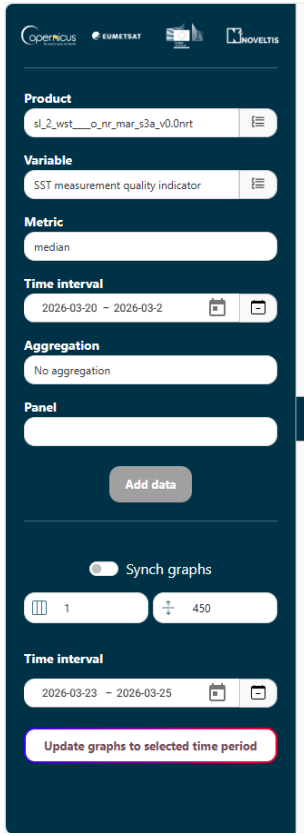
Activity 2 – Improving the SST and IST monitoring and Cal/Val tools

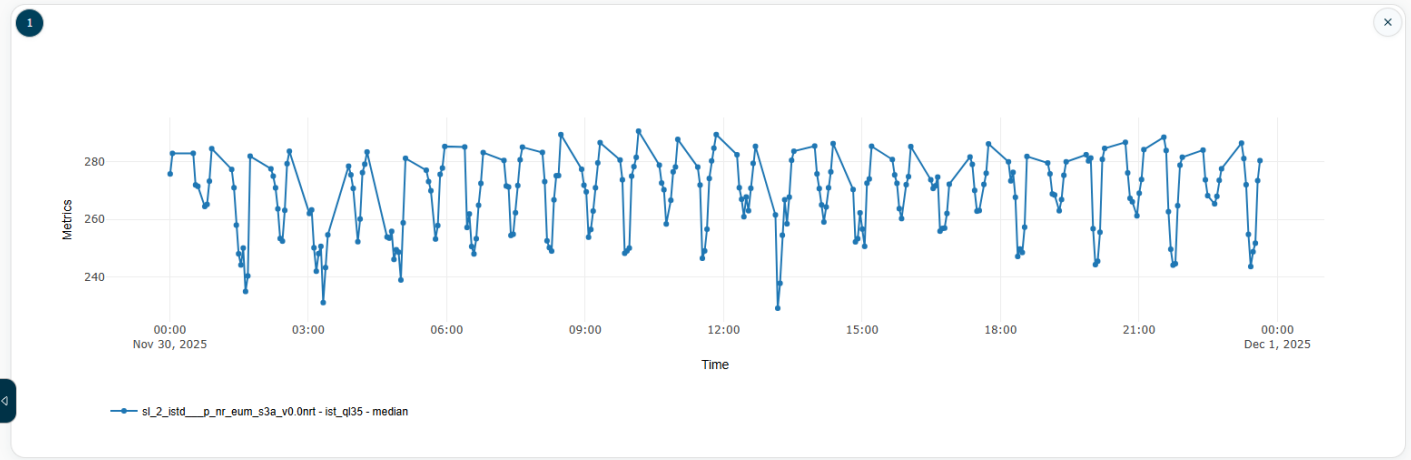
2.2 EUMETSAT Marine Surface Temperature Cal/Val tools

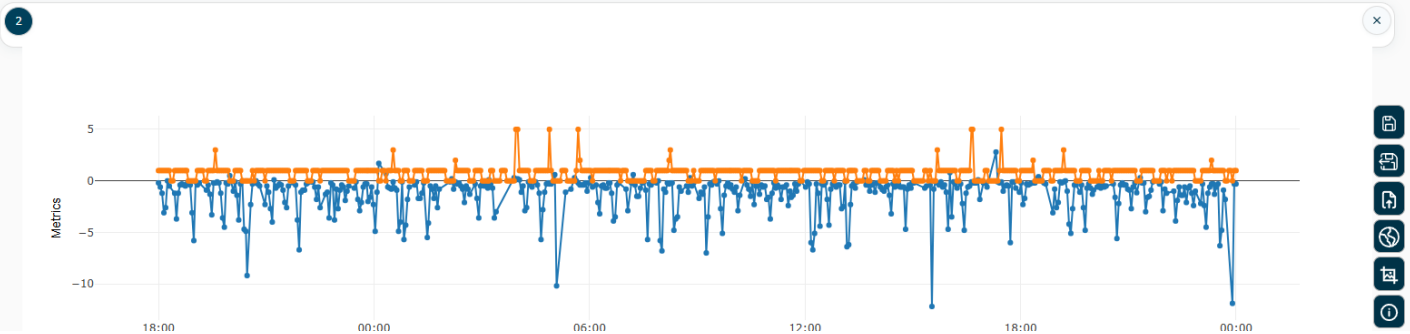
Evolution of the EUMETSAT marine Surface Temperature Cal/Val monitoring tools (METIS evolution) to enable multi-level, mission and parameter inter-comparisons

Interactive graphing/time series tool

- Zoom in/out, metrics, custom time intervals
- Multiple panels/graphs, synchronization, annotation
- Configuration/permalinks
- Ingestion of external dataset







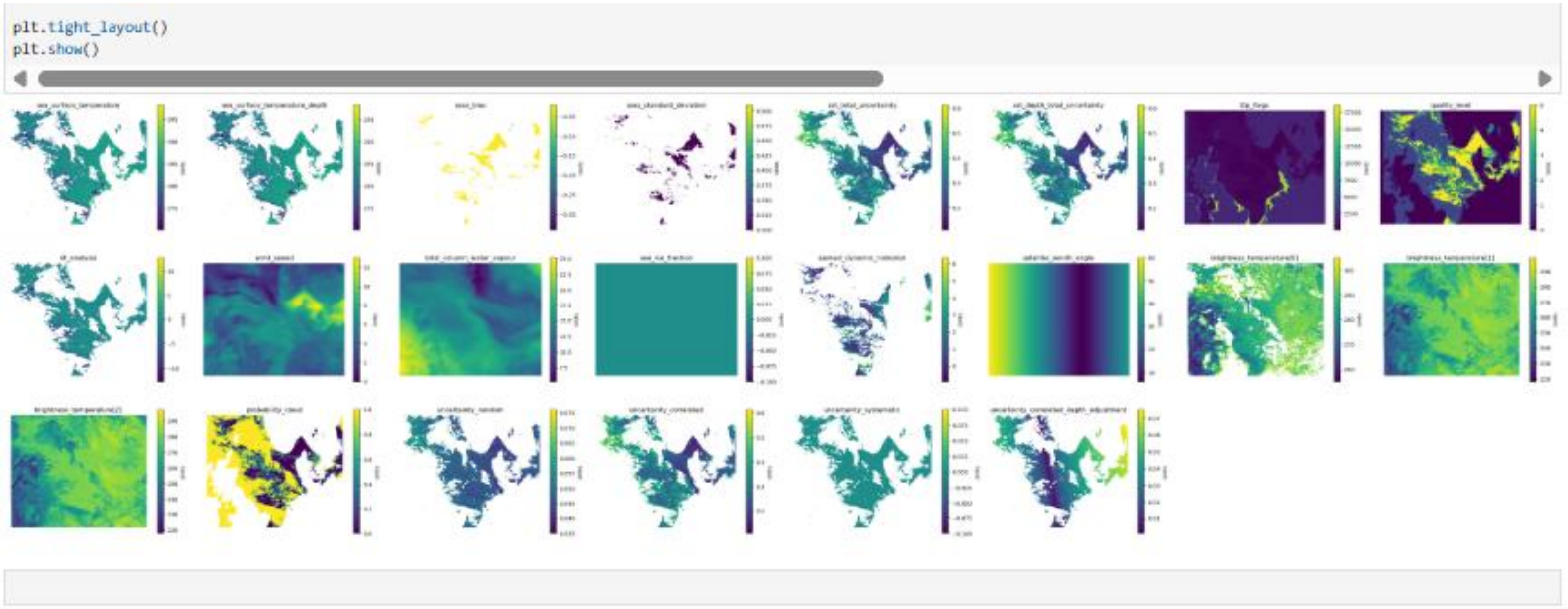
Activity 2 – Improving the SST and IST monitoring and Cal/Val tools

2.2 EUMETSAT Marine Surface Temperature Cal/Val tools

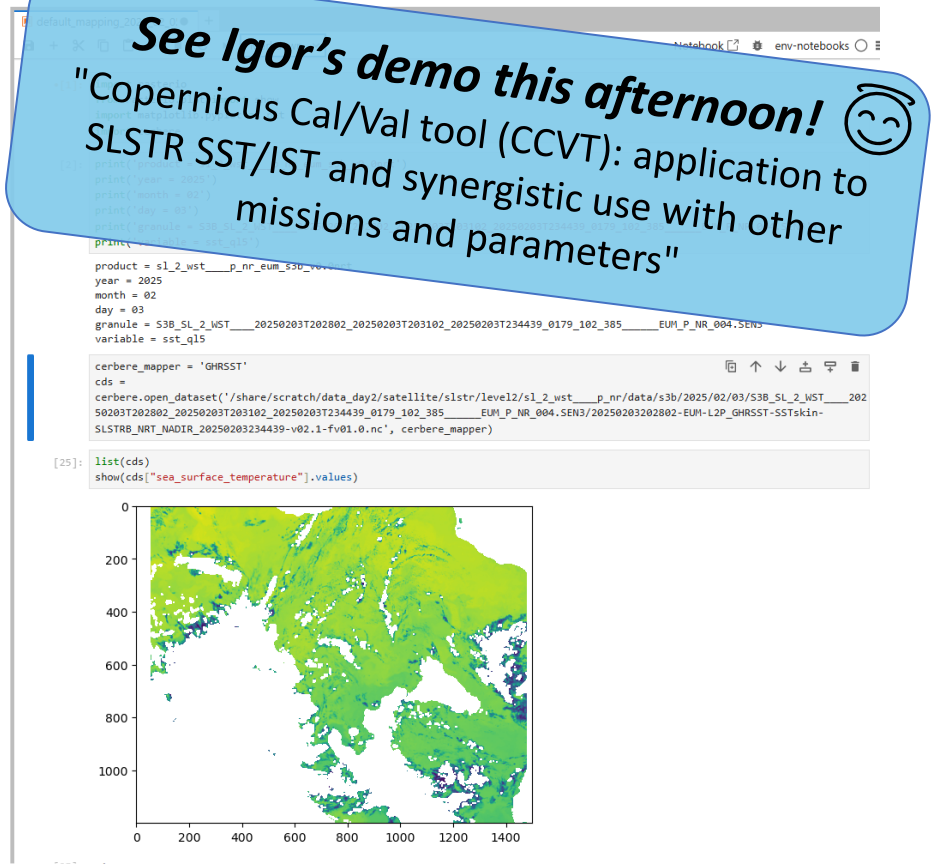
Evolution of the EUMETSAT marine Surface Temperature Cal/Val monitoring tools (METIS evolution) to enable multi-level, mission and parameter inter-comparisons

Interactive computing tool

- Customized Jupyter Notebook templates (for mapping and time series)



See Igor's demo this afternoon!
"Copernicus Cal/Val tool (CCVT): application to SLSTR SST/IST and synergistic use with other missions and parameters"

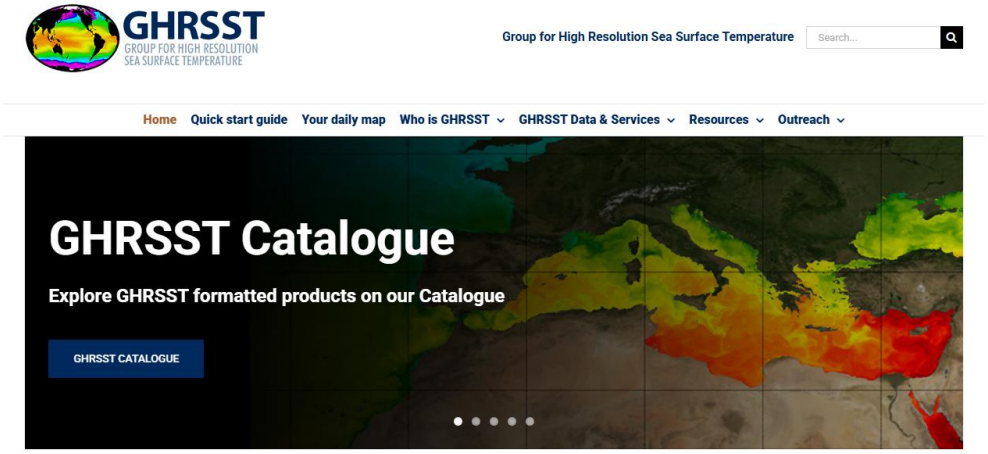


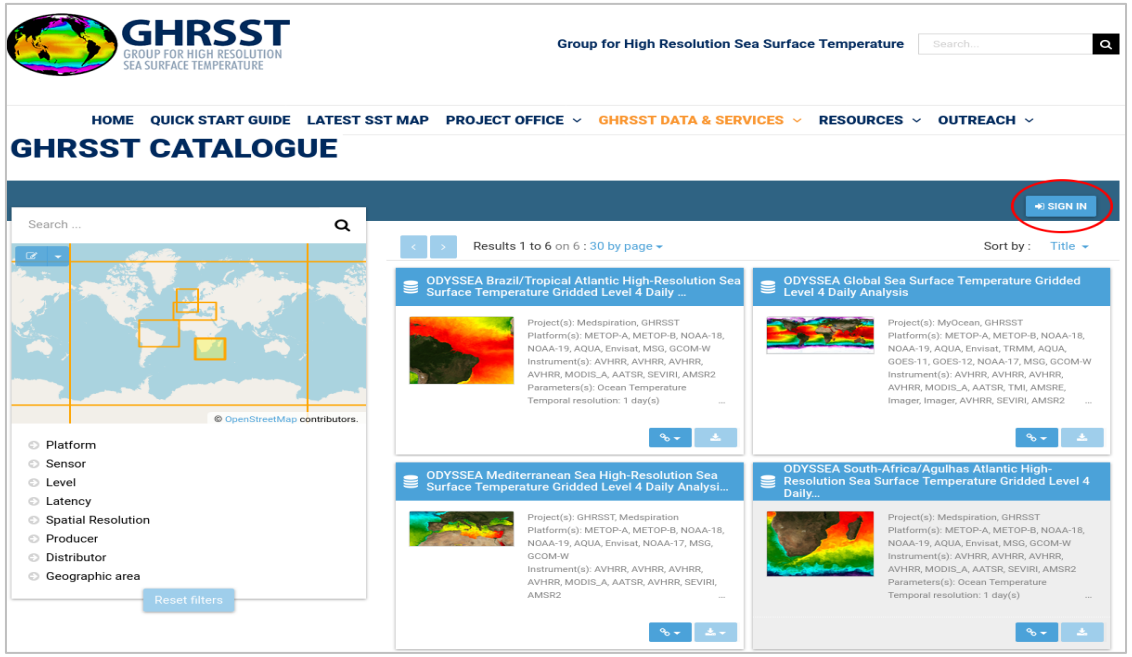
Activity 2 – Improving the SST and IST monitoring and Cal/Val tools

2.3 GHRSST Central Data Discovery and Cataloguing Service (incl. GDS)

GHRSST Catalogue

- GHRSST -> The Group for High Resolution Sea Surface Temperature
- Data catalogue presenting products from diverse sources, unique format
- Access at: https://www.ghrsst.org/ghrsst-data-services/for-sst-data-producers/ghrsst-catalogue/



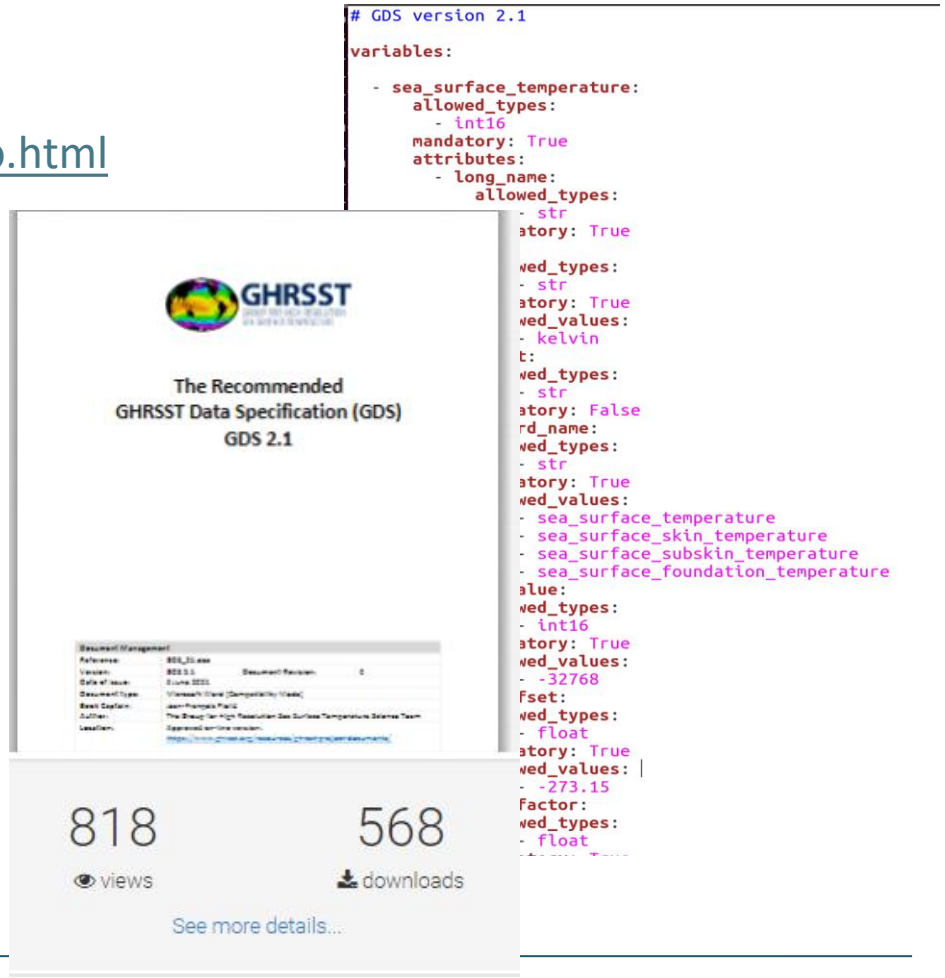


Activity 2 – Improving the SST and IST monitoring and Cal/Val tools

2.3 GHRSST Central Data Discovery and Cataloguing Service (incl. GDS)

GDS

- Format guidelines specified in GHRSST Data Specifications
- New 2.2 version based on Jupyter book: https://ghrsst.github.io/GDS/intro.html
- Work in progress on v3, focused on:
  - Uncertainty specifications
  - Cloud-optimised formats
  - Very high resolution products
  - Addition of ice temperature



Format checker

- L2P, L3U/L3C/L3S, L4 format verification
- Light, portable, easily installable (pip) python checker
- Now published: https://github.com/GHRSST/GDS-checker
- Based on YAML description of each product level

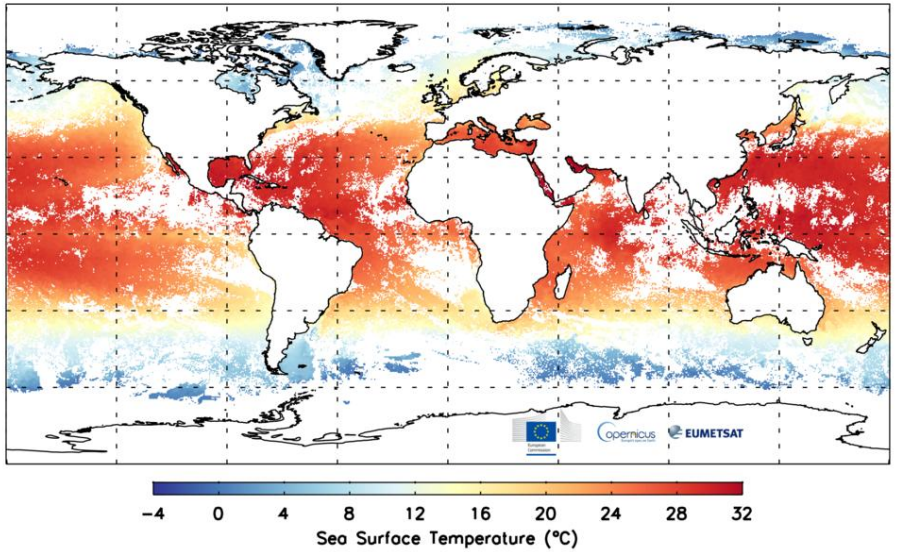
Activity 3 – Coordinating, organising and administrating the GPO

3. GHRSST Project Office, including the web-site and web service

GHRSST's mission

- To provide operational users and the science community with the SST measured by the satellite constellation
- Open international science group
- Framework for SST knowledge and data
- Best practices for processing & uncertainties
- Includes a forum for scientific dialogue:
  - Provision of SSTs for operational weather and ocean forecasting, climate studies?
  - Provision of SSTs to the operational users and scientific researchers?

GHRSST http://www.ghrsst.org



Copernicus Sentinel-3 SLSTR-A and SLSTR-B SST on 13 & 14 September 2025

Activity 3 – Coordinating, organising and administrating the GPO

3. GHRSST Project Office, including the web-site and web service

GPO activities

- Provides support to Science Teams (ST) and ST Chair
- Supports Task Team activities (9 TTs)
- Organises GHRSST annual meetings
- Maintains GHRSST documentation
- Maintains GHRSST website http://www.ghrsst.org
- Maintains GHRSST social media accounts
- Organises capacity-building activities

@ghrsst.bsky.social

GHRSST

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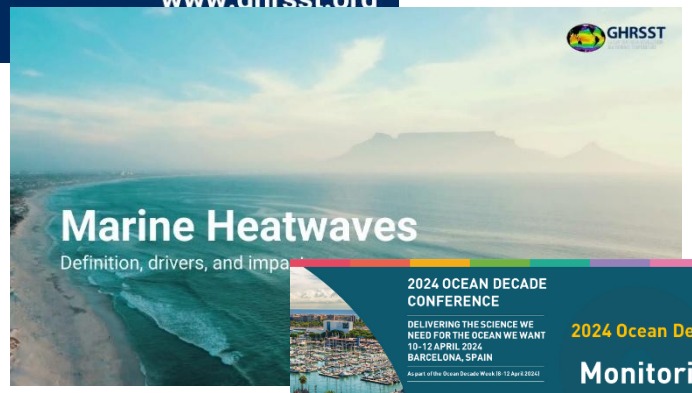
LinkedIn GHRSST

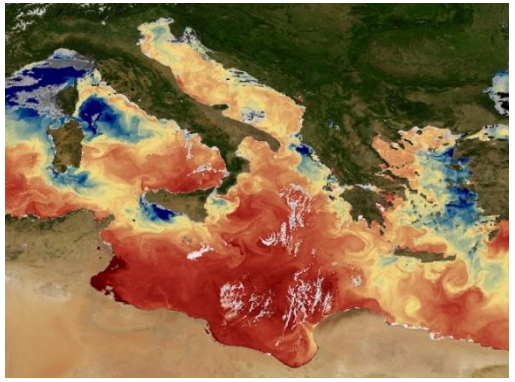
Activity 3 – Coordinating, organising and administrating the GPO

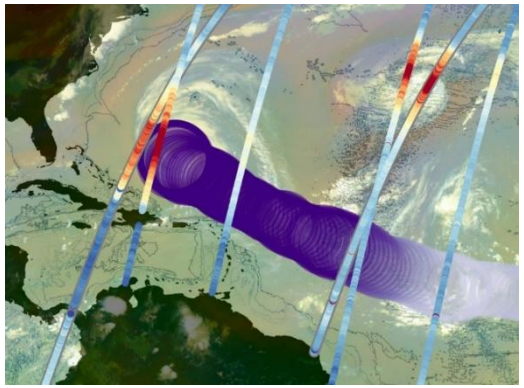
3. GHRSST Project Office, including the web-site and web service

Capacity-building activities

- Publishing web stories on the GHRSST website
  - Marine Heatwaves
  - Behind the Scenes: Monitoring the Ocean with Satellites
  - "My 21-Year GHRSST Journey", Reflections from Helen Beggs
- GHRSST activities at events, conferences and workshops
- GHRSST blog





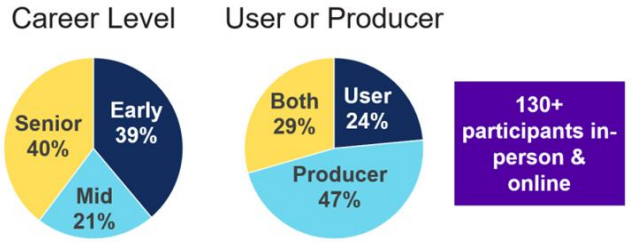


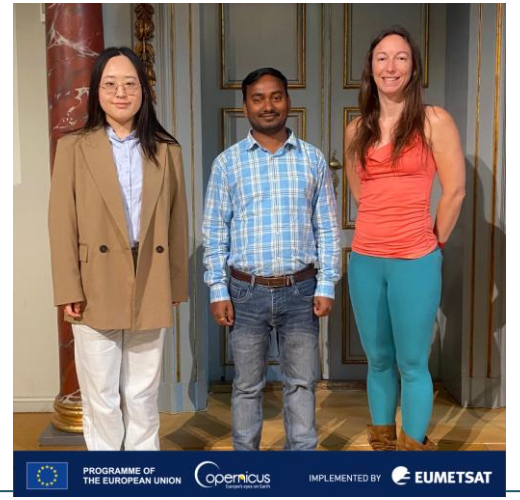
Activity 3 – Coordinating, organising and administrating the GPO

3. GHRSST Project Office, including the web-site and web service

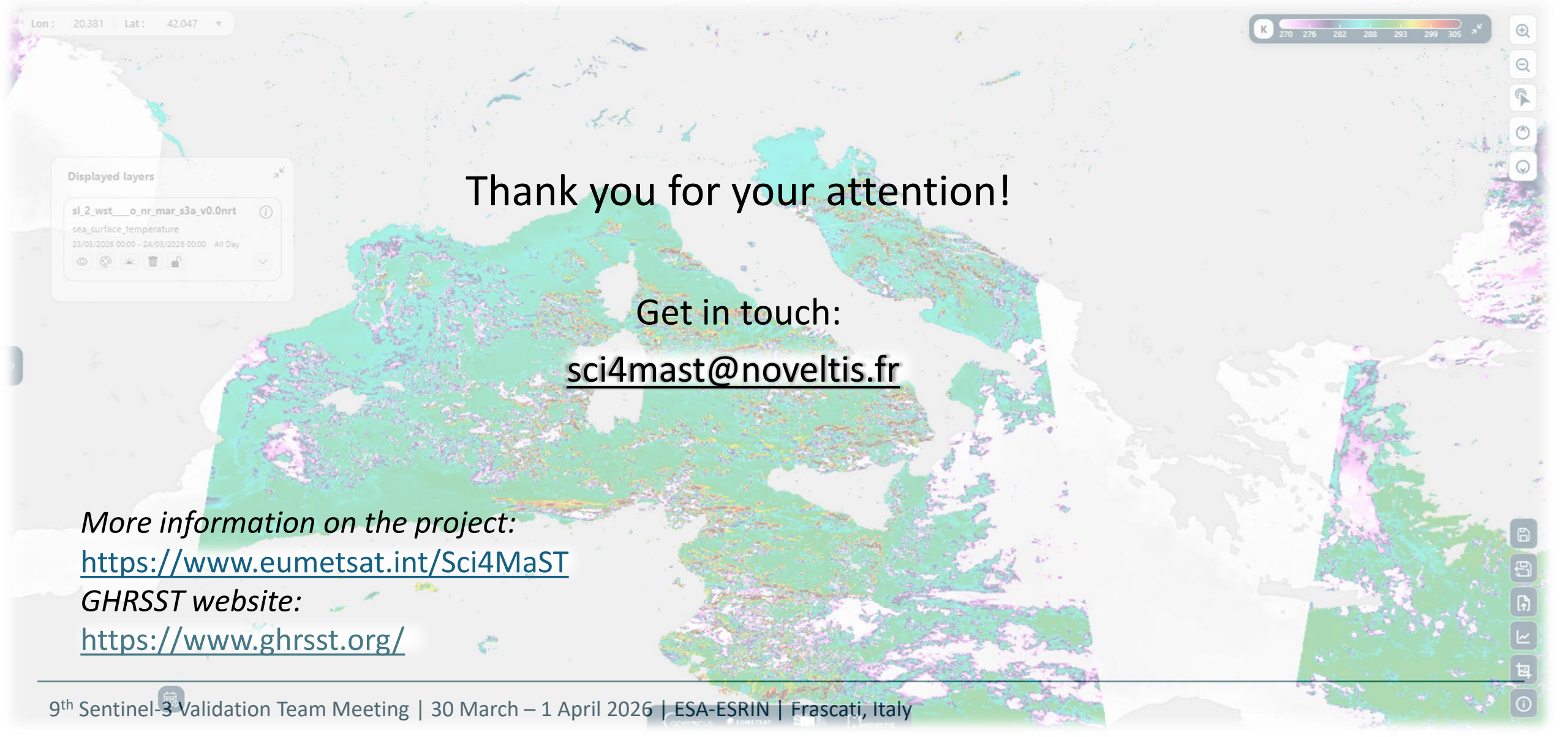
Capacity-building activities

- GHRSST Training Plan
  - 2023, in-person training in Ahmedabad, India
  - 2025, GHRSST Training plan published, including the implementation plan for four training modules to be delivered in the 2025-2027 period
- GHRSST Talks
- Involvement of early-career researchers and scientists at GHRSST Science Team Meetings and SST User Symposia





Conclusions



Thank you for your attention!

Get in touch:

sci4mast@noveltis.fr

More information on the project:
https://www.eumetsat.int/Sci4MaST
GHRSST website:
https://www.ghrsst.org/