PROGRAMME OF THE EUROPEAN UNION

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EUMETSAT

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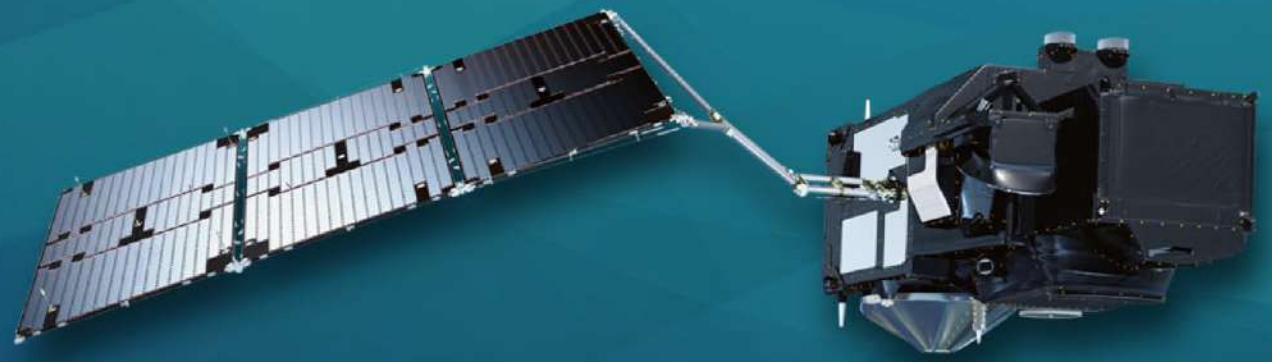

9th Sentinel-3 Validation Team meeting 2026

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

Copernicus Cal/Val Tool (CCVT): Application to SST/IST and Synergistic Use with Complementary Parameters

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CS group

C. Ribere
NOVELTIS

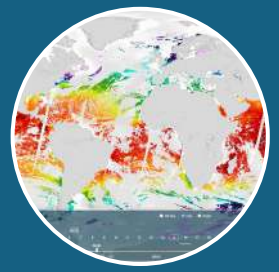
Acknowledgments
NOVELTIS team
J.F. Piolle, Ifremer

Motivation

- **Cal/Val activities:** Require routine mapping and time-series analysis to monitor and assess satellite data quality across missions and parameters
  → Essential for pixel level analysis (e.g. SLSTR SST reference mission)
- **No single tool** integrates interactive mapping, time-series analysis, and notebook-based investigation for generic 1D/2D data (including internal datasets)
  → Evolution of METIS (static maps + interactive time series) and S3MQ (configurable interactive time series – internal tool)
- **Multi-mission/parameter challenge:** Heterogenous data formats and metadata conventions across products

- **Goal:** Provide an integrated, configurable, web-based platform combining geospatial visualization, statistical time-series monitoring, and advanced analytics in a single tool → applicable to any EO parameter, not just SST/IST.

What is CCVT?

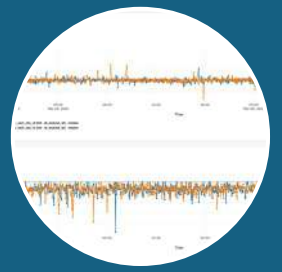


Interactive Maps

Multi-layer geospatial visualization with multiple projections (global, Arctic, Antarctic), configurable colormaps and data ranges, and granule inspection

Jupyter Notebooks

One-click notebook generation from any granule or graph, pre-configured scientific Python environment

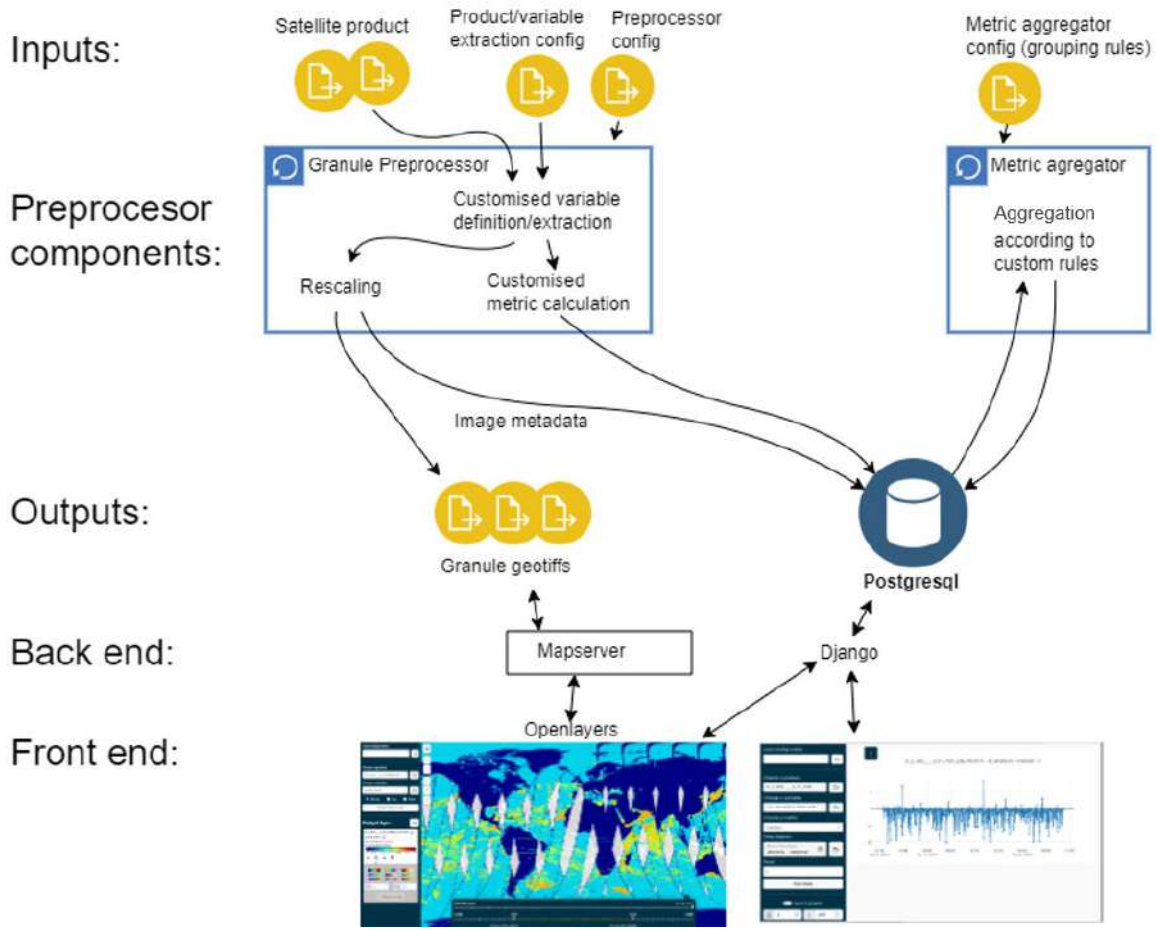


Interactive Time Series

Multi-panel statistical dashboard with metrics (mean, median, std, min/max) over configurable date ranges

- Developed within Copernicus Sci4MaST project by NOVELTIS, in accordance with EUMETSAT requirements
- Supports satellite Level-1/2/3/4, in situ, matchup data, model data, … (any 1D or 2D variable)
- User configurable backend, extendable with plugins
- Designed for SST/IST Cal/Val, applicable to any EO parameter
- Open source (GPLv3.0), containerised, scalable processing

Architecture



Fully containerized: Docker compose with 15+ services
Single ***docker compose up*** deployment

- Front end
  - Angular, OpenLayers, Plotly, Nginx
- Backend
  - Django, PostgreSQL, Redis, JupyterHub
- Data processing
  - Preprocessor (python + cerbere), MapServer (WMS), MapCache, Jobard + HTCondor/Swarm/k8s/PBS/Slurm (batch processing)
- Monitoring and alerting
  - Grafana
- User roles
  - Currently single user
  - Viewer, power user, admin

Data Ingestion Workflow

- **Product/granule access**
  Filesystem + access to EUMETSAT DataStore (eumdac) + ...
- **Data Reading**
  Multi-format support via cerbere mappers (NetCDF, S3 SAFE, HDF5, ...)
- **Metrics Extraction**
  Per-variable statistics: min, max, mean, median, std, count, (extendable through plugins)
- **GeoTIFF Generation**
  Cloud Optimized GeoTIFFs (COG) for WMS serving
- **Database Cataloging**
  Granule metadata, metrics, and file paths stored in PostgreSQL

YAML-driven configuration

Each product is defined by a YAML file specifying: variables (raw + custom computed), metrics, colormaps, valid ranges, and geotiff settings.

No code changes needed to add analyse new products (if product reader exists) — only configuration.

Multiple projections:
Global – WGS84 (EPSG:4326)
Arctic polar (EPSG:6931)
Antarctic polar (EPSG:6932)

Supported products 1/2

Parameter	Cerbere readers	Description
NetCDF	Xarray	Generic netcdf reader
SST	GHRSST, S3SLWST, S3SLWSTColl4	GHRSST SST L2/L3/L4 format reader: SLSTR, AVHRR, …
IST	S3SLIST, …	Sentinel-3 SL2 IST
SL1	S3SLRBTIR, S3SLRBTA/B	Sentinel-3 SL1 IR/A/B reader

New/updated S3 readers:

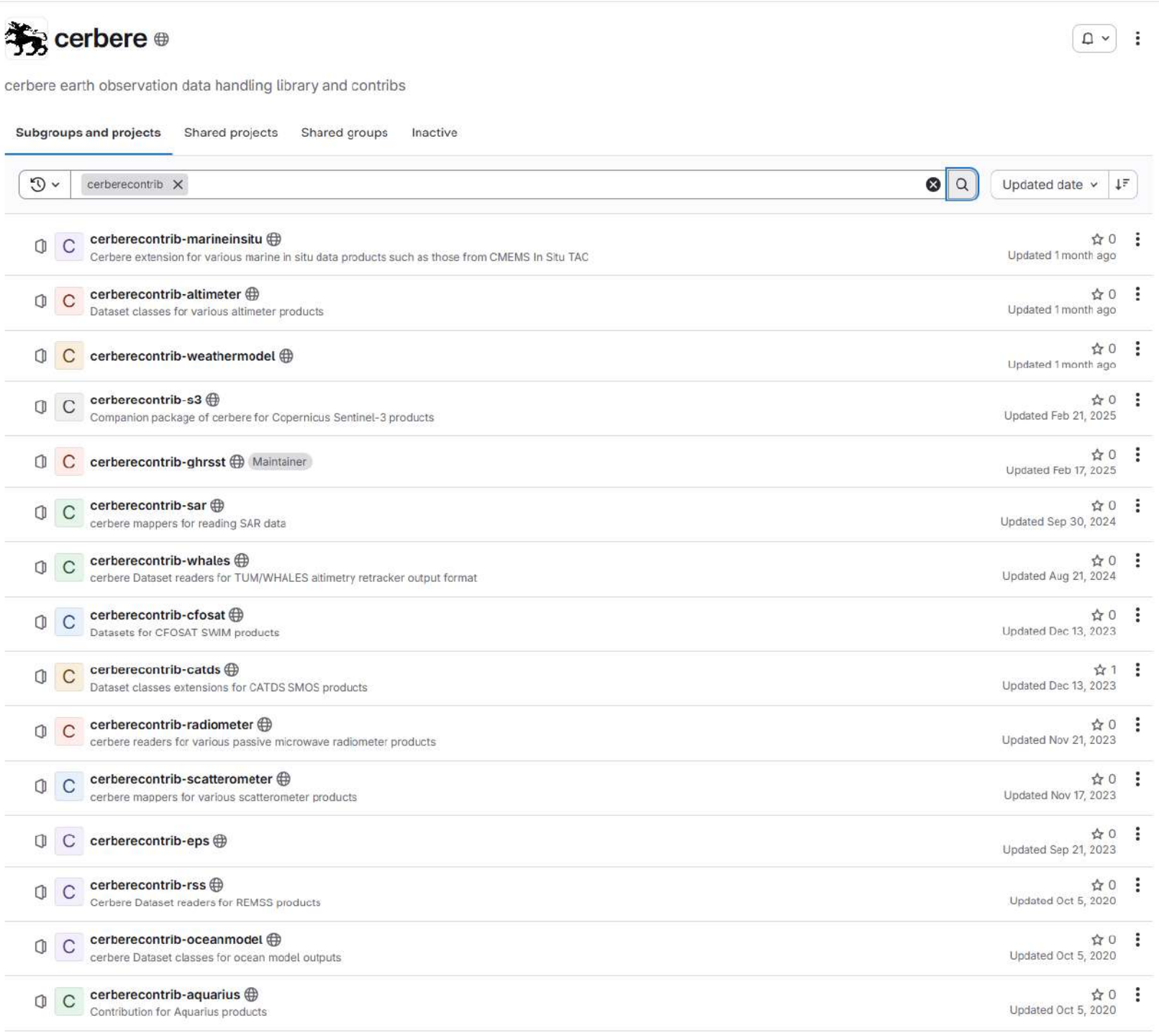
- OLCI L1 (EFR/ERR), OLCI Ocean Color (WFR/WRR), Altimetry WAT (SSH, SWH, Wind, …),
- Aerosol AOD, SLSTR L2 LST

In preparation: FRP, TCWV, …

Extensible: Adding a new product for cal/val requires creating reader (for the new product format), and creating YAML configuration file with defined variables, metrics, colormaps, and valid ranges.

Supported products 2/2

- Other readers available on Ifremer gitlab:
- https://gitlab.ifremer.fr/cerbere/?filter=cerberecontrib
- Cerber library: open source (GPL v3)
  - → Ifremer/J.F. Piolle



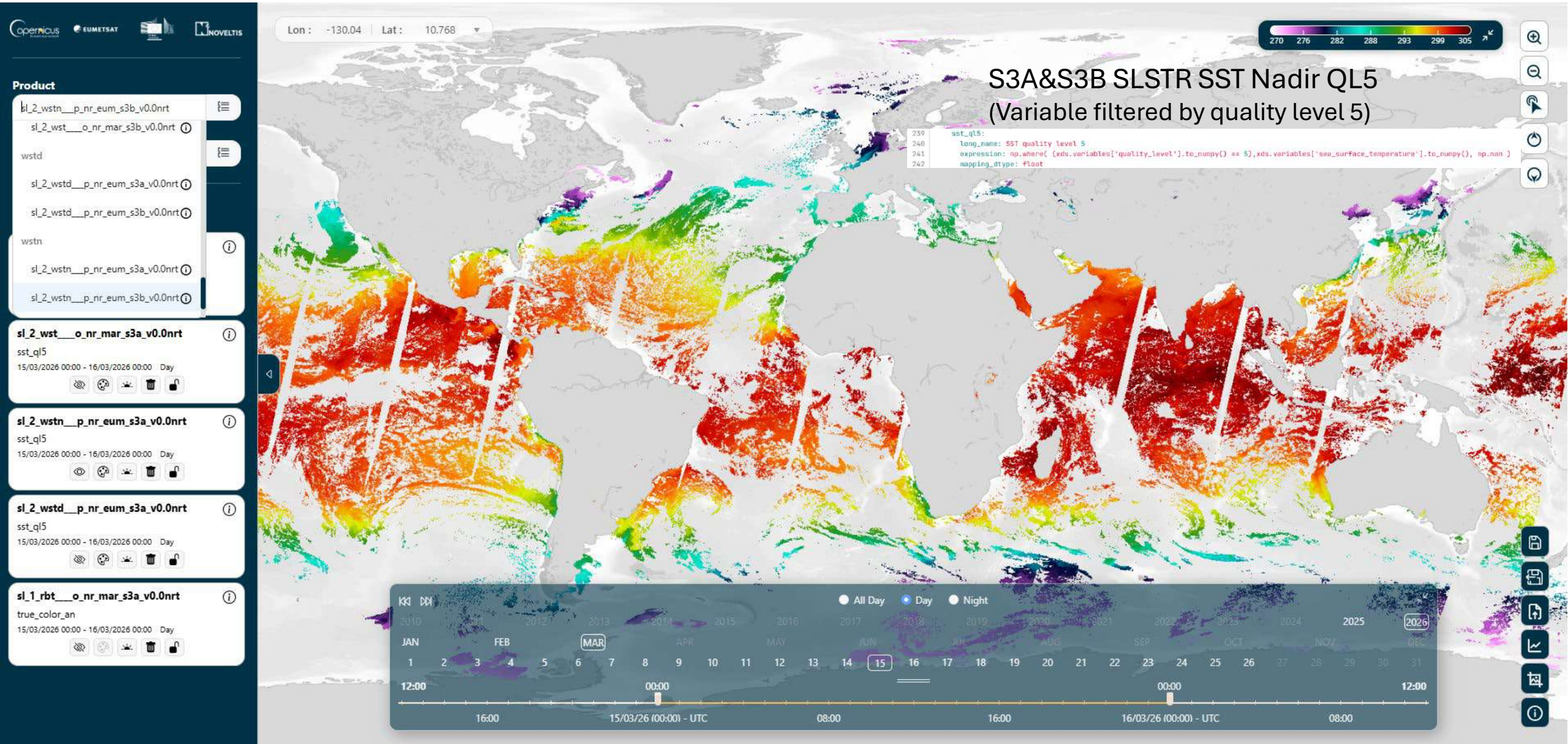
Key functionality

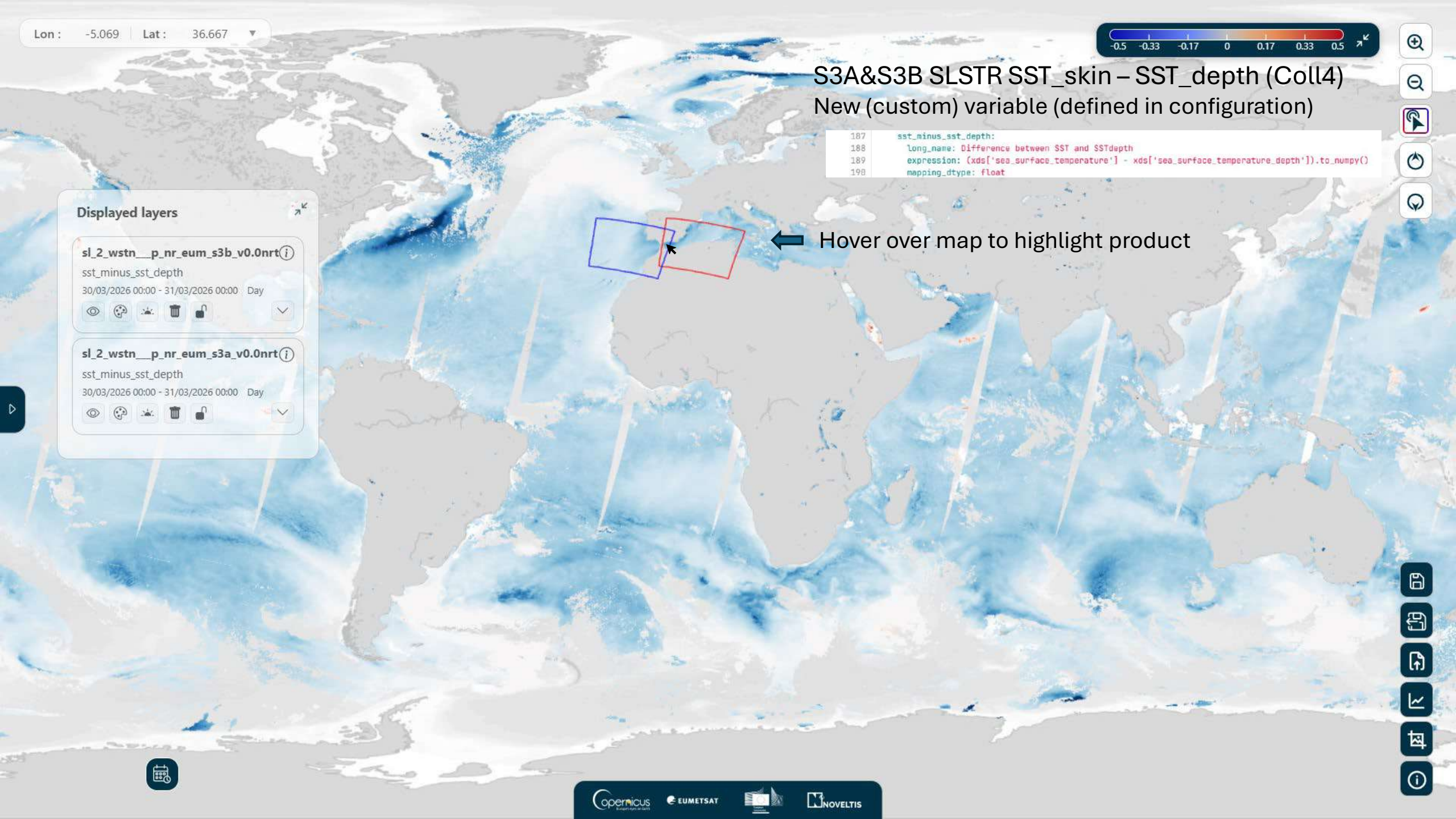
- **Multi-projection maps**
  Global (WGS84), Arctic and Antarctic polar views
- **Layer management**
  Multi-layer overlay, drag-reorder, opacity, time lock/unlock, hide/show, remove
- **Colormap customization**
  Multiple/customized palettes with adjustable min/max scaling
- **Temporal navigation**
  Interactive time slider, date picker, period presets
- **Granule inspection**
  Click to view metadata, quality attributes
  Click to jump to time series with focused selected granule
- **Multi-panel time series**
  Dashboard with synchronized graphs, multiple metrics
- **One-click Jupyter**
  Auto-generated prepared notebooks from any product or graph point
- **Configuration & permalink**
  Permalink (share exact view), configuration (load same layers/time series with new data)
- **Custom (3rd party) data upload**
  NetCDF and GeoTIFF file overlay on maps and CSV in time series
- **Custom variables**
  Computed on-the-fly (e.g., quality level or flag-filtered) based on the information in the product (python one-liner) or extended through plugins

Current implementation

- Two instances currently running in WEkEO
- Validation of S3 SLSTR Coll4 SST/IST
- Datasets: S3 SLSTR-A/B L2 SST Coll3, S3 SLSTR-A/B L2 SST Coll4 dual/nadir, S3 SLSTR-A/B L2 IST Coll4 dual/nadir, S3 SLSTR-A/B L1 RBT, MetOp-B AVHRR SST, MTG FCI SST 1h, OSI-SAF SIC 408 L3, OSTIA SST L4, …
- + experimentally testing: S3 OL1 True color, S3 OL2 CHL, S3 SLSTR L2 AOD, S3 SRAL ALT
- 8 cores/56 GB + HTCondor cluster (shared across different activities)

SST: Mapping interface




Lon : -5.069
Lat : 36.667
-0.5 -0.33 -0.17 0 0.17 0.33 0.5
S3A&S3B SLSTR SST_skin – SST_depth (Coll4)
New (custom) variable (defined in configuration)
sst_minus_sst_depth:
long_name: Difference between SST and SSTdepth
expression: (xds['sea_surface_temperature'] - xds['sea_surface_temperature_depth']).to_numpy()
mapping_dtype: float
Hover over map to highlight product
Displayed layers
sl_2_wstn___p_nr_eum_s3b_v0.0nrt
sst_minus_sst_depth
30/03/2026 00:00 - 31/03/2026 00:00 Day
sl_2_wstn___p_nr_eum_s3a_v0.0nrt
sst_minus_sst_depth
30/03/2026 00:00 - 31/03/2026 00:00 Day
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Lon : -4.569 Lat : 36.333

sl_2_wstn___p_nr_eum_s3b_v0.0nrt
sst_minus_sst_depth
2026-03-30 11:03 UTC : -0.22

sl_2_wstn___p_nr_eum_s3a_v0.0nrt
sst_minus_sst_depth
2026-03-30 10:01 UTC : -0.21

Hover over map to get per pixel values across all layers/products

-0.5 -0.33 -0.17 0 0.17 0.33 0.5

S3A&S3B SLSTR SST_skin – SST_depth (Coll4)

New (custom) variable (defined in configuration)

```
187     sst_minus_sst_depth:
188       long_name: Difference between SST and SSTdepth
189       expression: (xds['sea_surface_temperature'] - xds['sea_surface_temperature_depth']).to_numpy()
190       mapping_dtype: float
```

Displayed layers

sl_2_wstn___p_nr_eum_s3b_v0.0nrt
sst_minus_sst_depth
30/03/2026 00:00 - 31/03/2026 00:00 Day

sl_2_wstn___p_nr_eum_s3a_v0.0nrt
sst_minus_sst_depth
30/03/2026 00:00 - 31/03/2026 00:00 Day

S3B_SL_2_WST___20260330T110342_20260330T1...
2026-03-30 11:03:42 UTC

Product ID: sl_2_wstn___p_nr_eum_s3b_v0.0nrt
Variable: sst_minus_sst_depth
Coordinates: -4.57, 36.33
Value: -0.22

count_valid np.count_nonzero(~np.isnan(arr))

Graph | Jupyter notebook

Click to select product(s) and option to switch to 1) time series of defined metrics (with indicated selected product) or 2) detailed analysis in Jupyter notebook with prepopulated product info


```
import rasterio
from rasterio.plot import show
import cerbere

print('product = sl_2_wstn___p_nr_eum_s3b_v0.0nrt')
print('year = 2026')
print('month = 03')
print('day = 30')
print('granule = S3B_SL_2_WST___20260330T110342_20260330T110642_20260330T133938_0179_118_208_2340_EUM_P_NR_004.SEN3')
print('variable = sst_minus_sst_depth')

cerbere_mapper = 'GHRSST'
cds = cerbere.open_dataset('/share/scratch/data_day2/satellite/slstr/level2/sl_2_wst___p_nr/data/s3b/2026/03/30/S3B_SL_2_WST___20260330T110342_20260

from cvmap_library import plot_cds_variables
plot_cds_variables(cds, ns6 )
```

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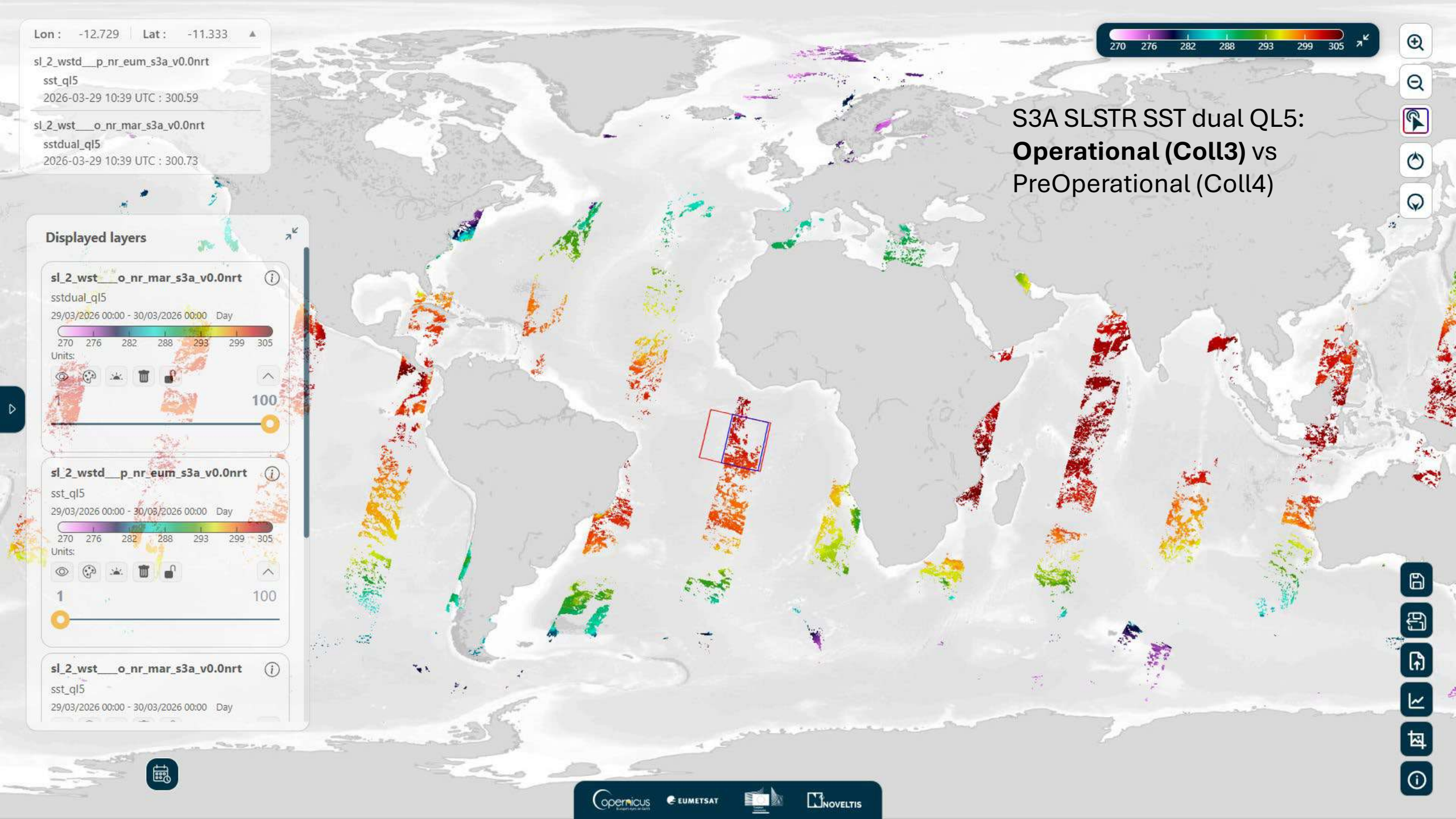
Lon : -12.729 Lat : -11.333
sl_2_wstd___p_nr_eum_s3a_v0.0nrt
sst_ql5
2026-03-29 10:39 UTC : 300.59
sl_2_wst___o_nr_mar_s3a_v0.0nrt
sstdual_ql5
2026-03-29 10:39 UTC : 300.73
270 276 282 288 293 299 305
S3A SLSTR SST dual QL5:
Operational (Coll3) vs
PreOperational (Coll4)
Displayed layers
sl_2_wst___o_nr_mar_s3a_v0.0nrt
sstdual_ql5
29/03/2026 00:00 - 30/03/2026 00:00 Day
270 276 282 288 293 299 305
Units:
1
100
sl_2_wstd___p_nr_eum_s3a_v0.0nrt
sst_ql5
29/03/2026 00:00 - 30/03/2026 00:00 Day
270 276 282 288 293 299 305
Units:
1
100
sl_2_wst___o_nr_mar_s3a_v0.0nrt
sst_ql5
29/03/2026 00:00 - 30/03/2026 00:00 Day
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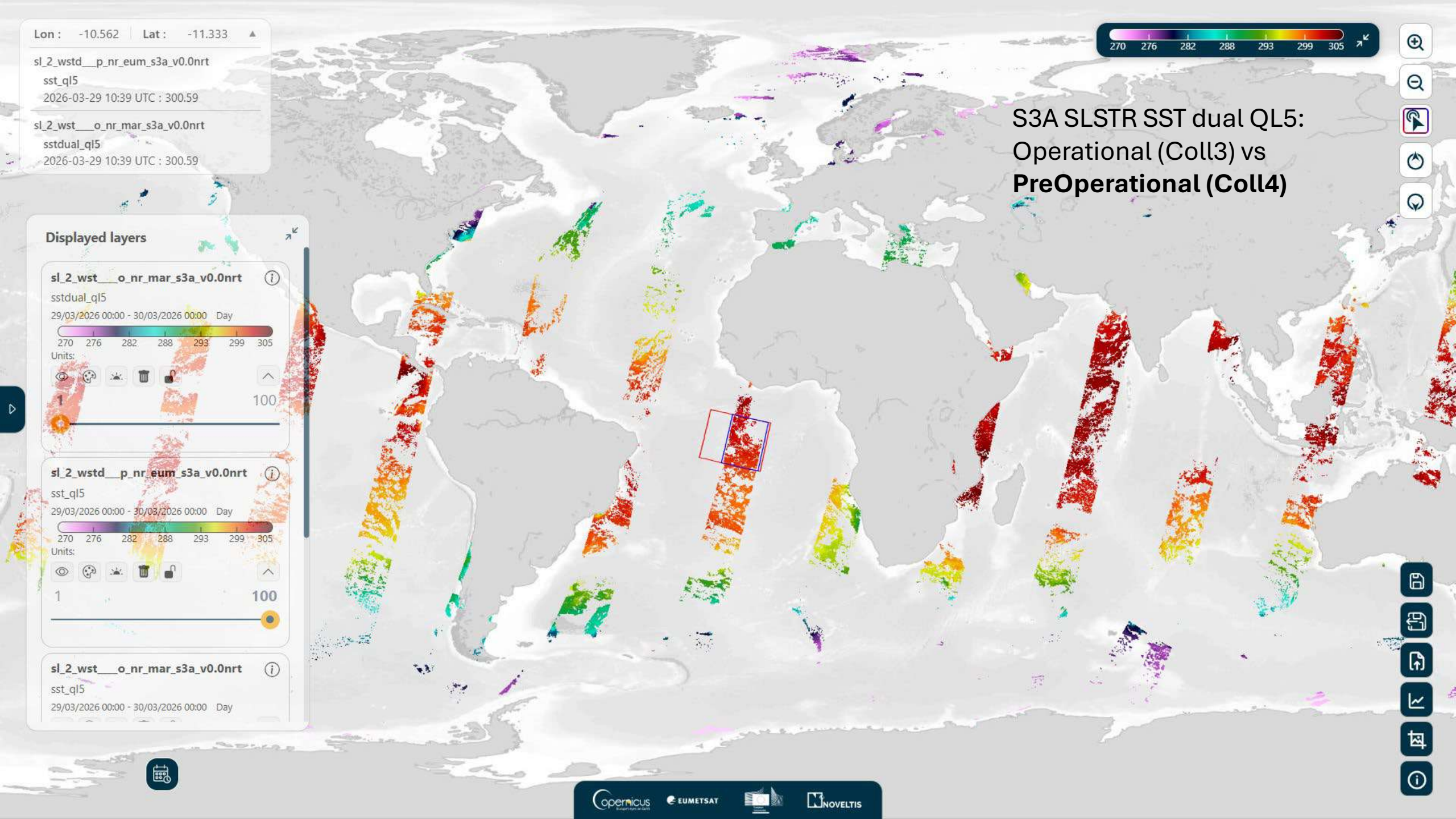
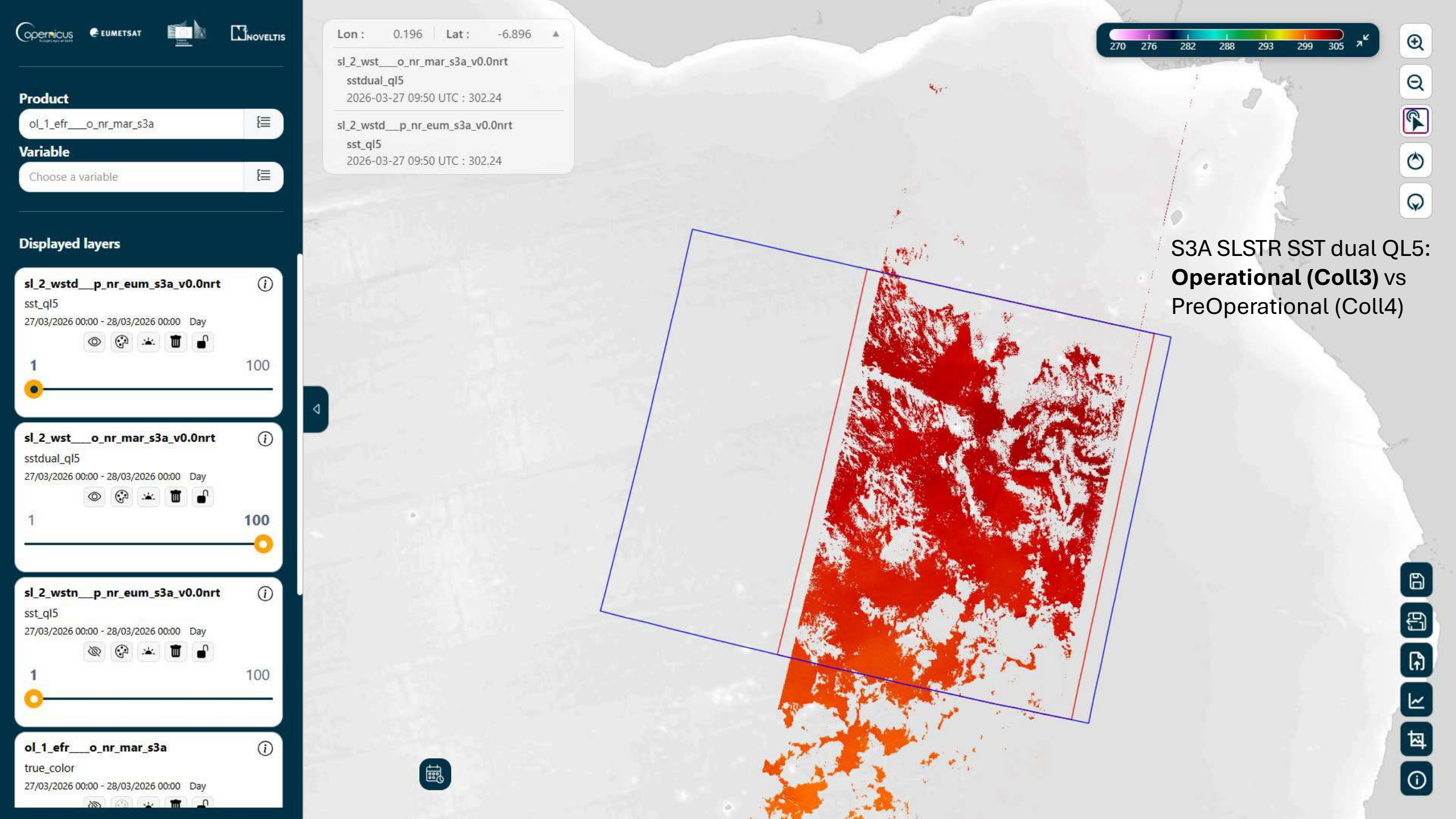
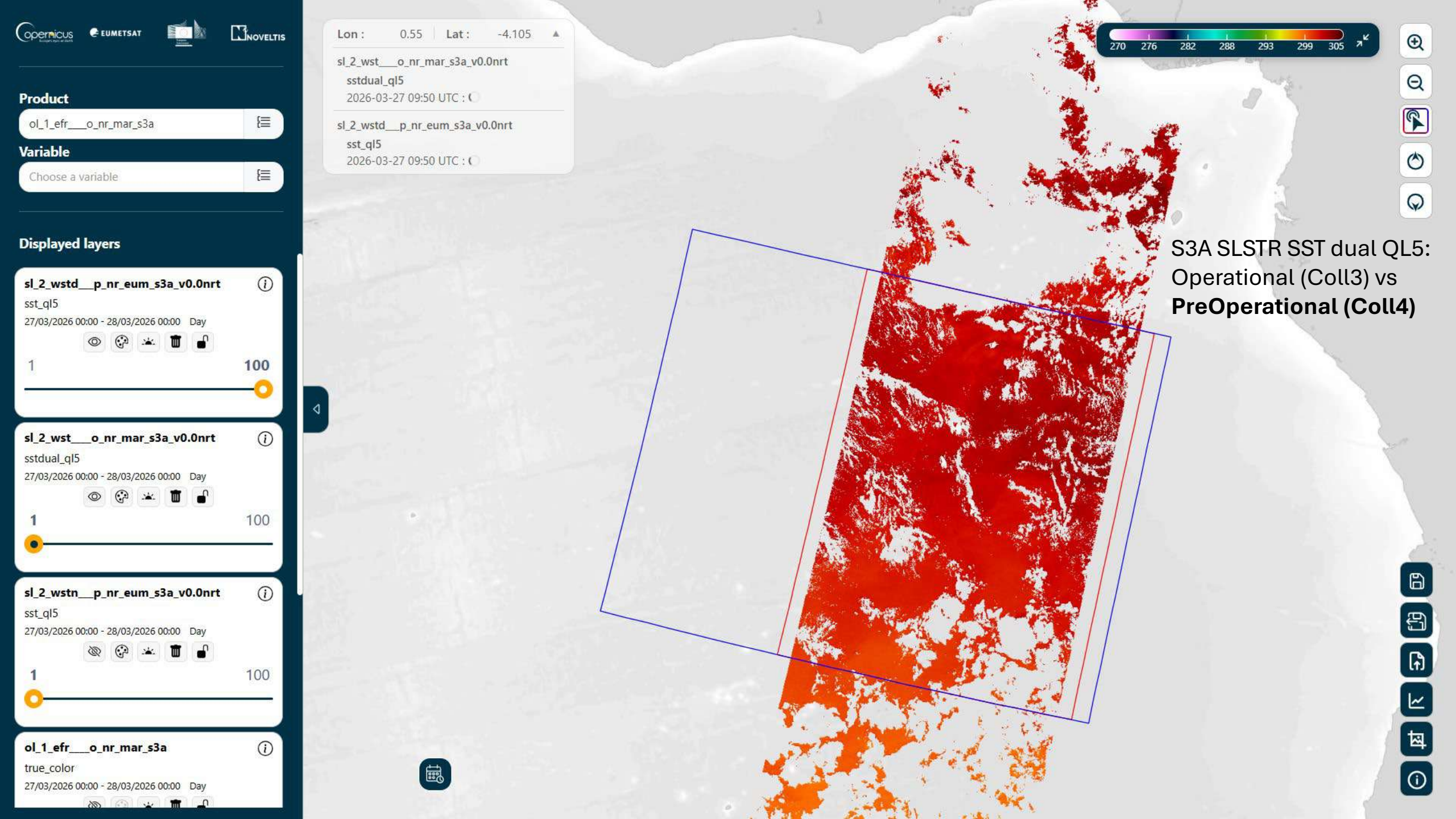
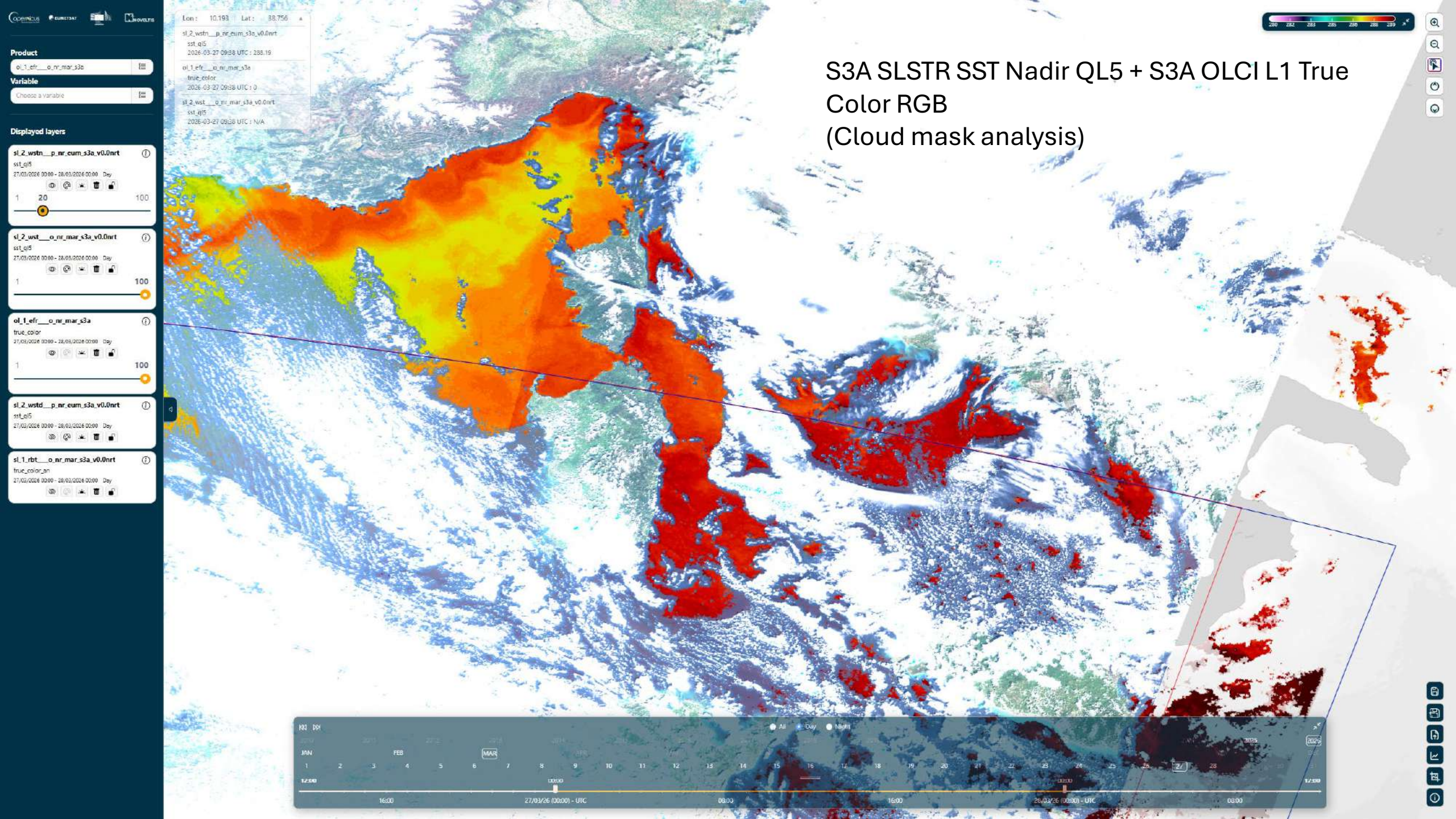
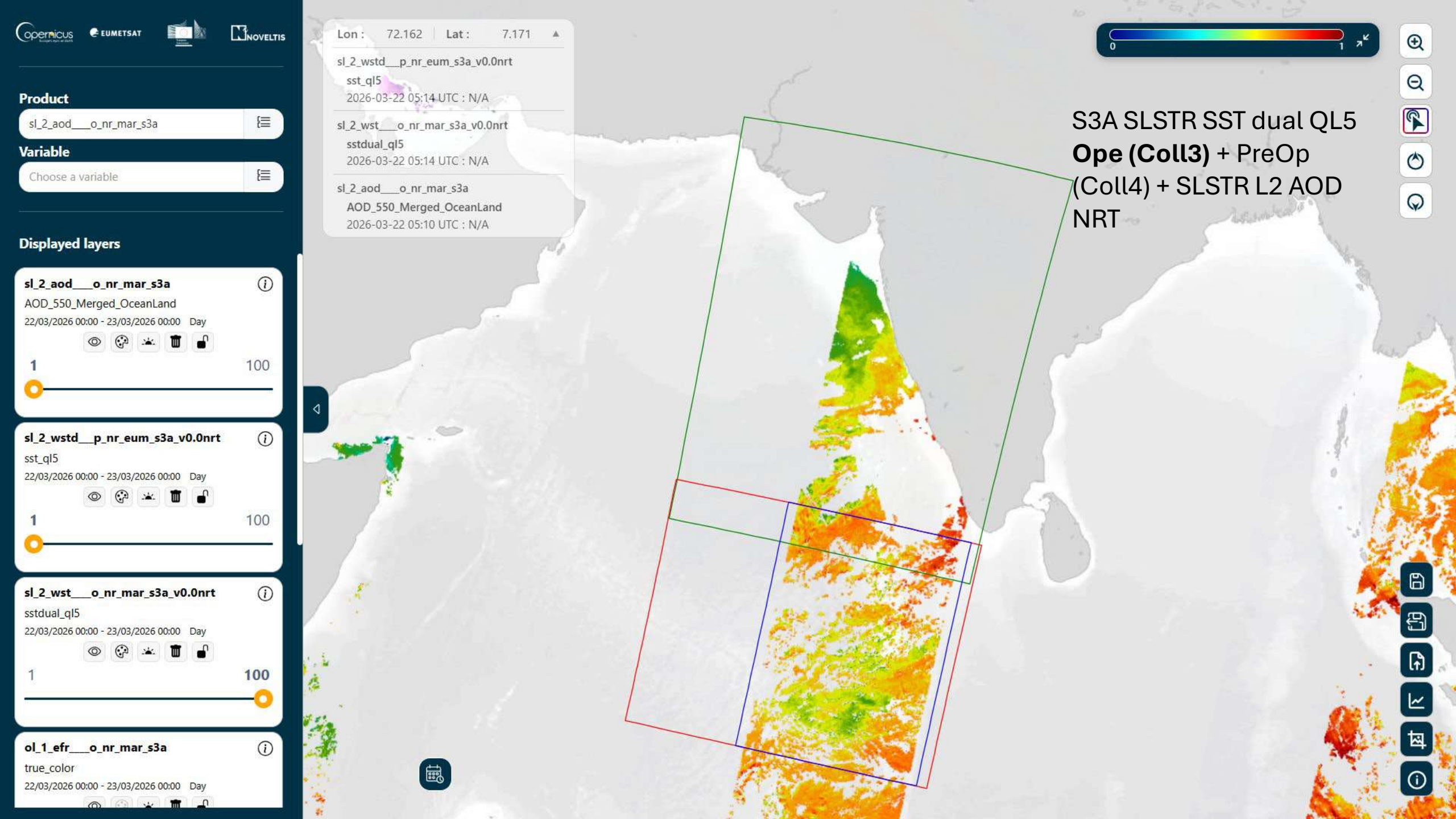
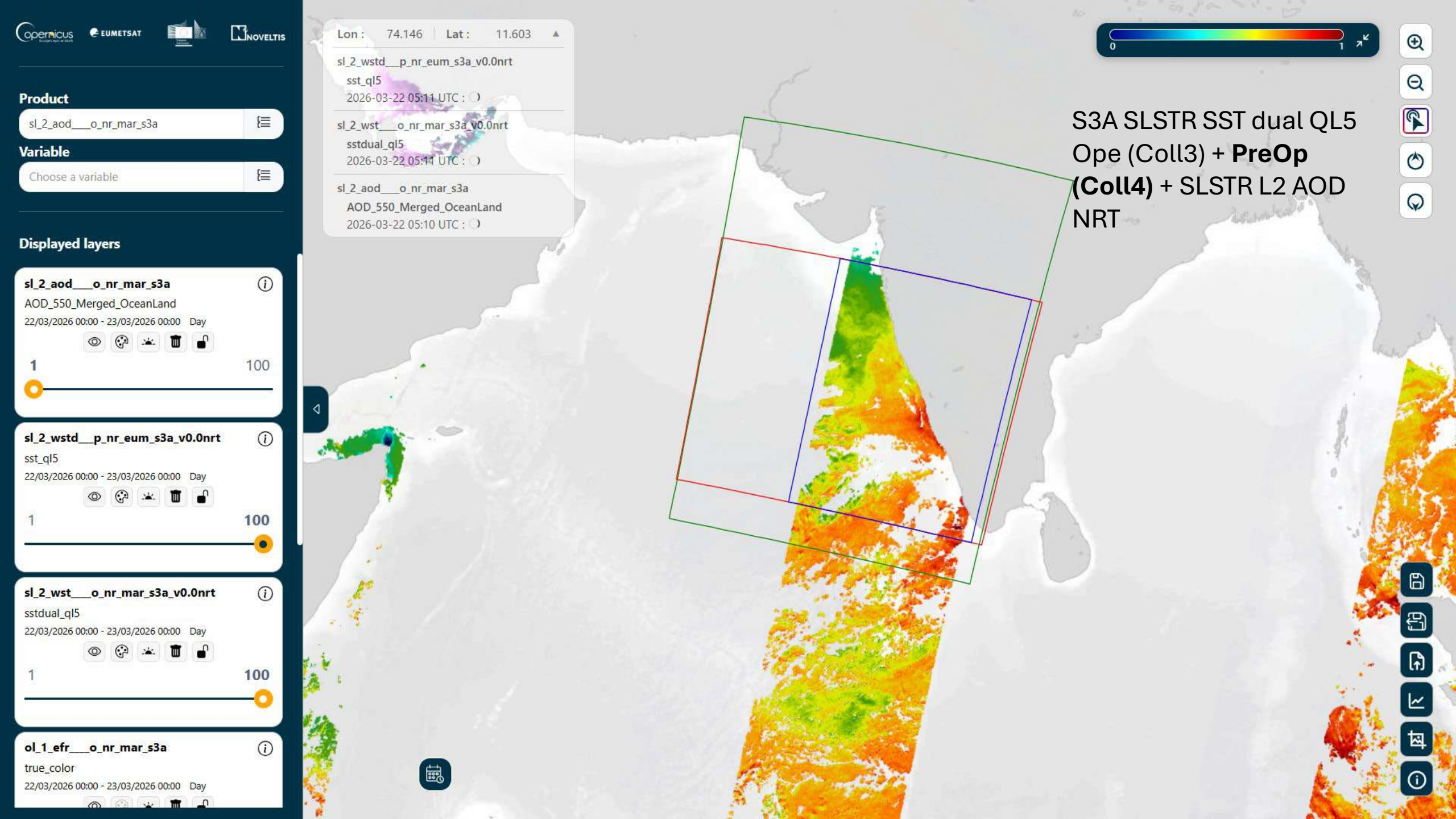

Lon : -10.562 Lat : -11.333
sl_2_wstd___p_nr_eum_s3a_v0.0nrt
sst_ql5
2026-03-29 10:39 UTC : 300.59
sl_2_wst___o_nr_mar_s3a_v0.0nrt
sstdual_ql5
2026-03-29 10:39 UTC : 300.59
270 276 282 288 293 299 305
S3A SLSTR SST dual QL5:
Operational (Coll3) vs
PreOperational (Coll4)
Displayed layers
sl_2_wst___o_nr_mar_s3a_v0.0nrt
sstdual_ql5
29/03/2026 00:00 - 30/03/2026 00:00 Day
270 276 282 288 293 299 305
Units:
1
100
sl_2_wstd___p_nr_eum_s3a_v0.0nrt
sst_ql5
29/03/2026 00:00 - 30/03/2026 00:00 Day
270 276 282 288 293 299 305
Units:
1
100
sl_2_wst___o_nr_mar_s3a_v0.0nrt
sst_ql5
29/03/2026 00:00 - 30/03/2026 00:00 Day
Copernicus
EUMETSAT
NOVELTIS

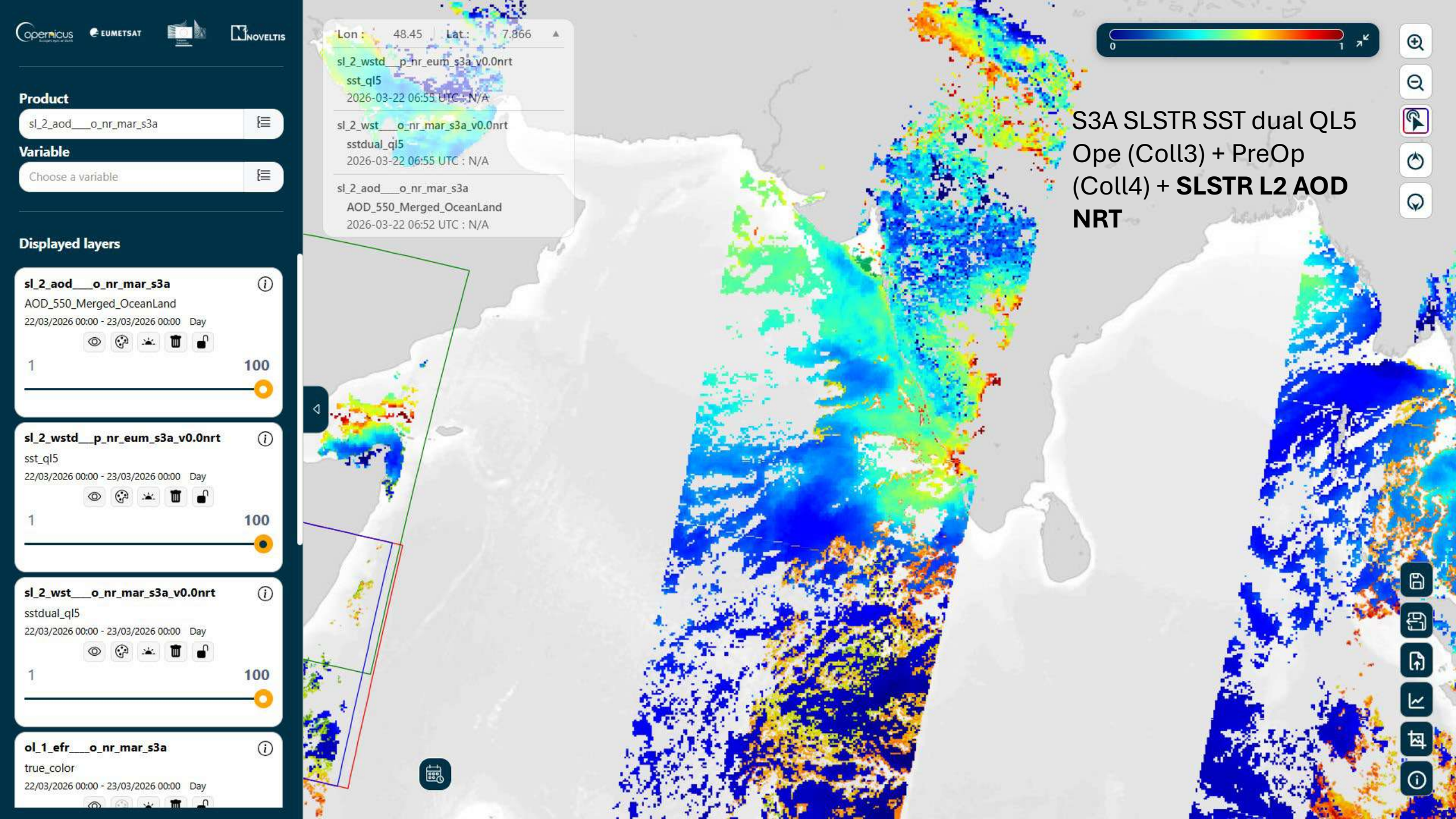

Lon : 0.196 Lat : -6.896
sl_2_wst___o_nr_mar_s3a_v0.0nrt
sstdual_ql5
2026-03-27 09:50 UTC : 302.24
sl_2_wstd___p_nr_eum_s3a_v0.0nrt
sst_ql5
2026-03-27 09:50 UTC : 302.24
270 276 282 288 293 299 305
Product
ol_1_efr___o_nr_mar_s3a
Variable
Choose a variable
Displayed layers
sl_2_wstd___p_nr_eum_s3a_v0.0nrt
sst_ql5
27/03/2026 00:00 - 28/03/2026 00:00 Day
1 100
sl_2_wst___o_nr_mar_s3a_v0.0nrt
sstdual_ql5
27/03/2026 00:00 - 28/03/2026 00:00 Day
1 100
sl_2_wstn___p_nr_eum_s3a_v0.0nrt
sst_ql5
27/03/2026 00:00 - 28/03/2026 00:00 Day
1 100
ol_1_efr___o_nr_mar_s3a
true_color
27/03/2026 00:00 - 28/03/2026 00:00 Day
S3A SLSTR SST dual QL5:
Operational (Coll3) vs
PreOperational (Coll4)

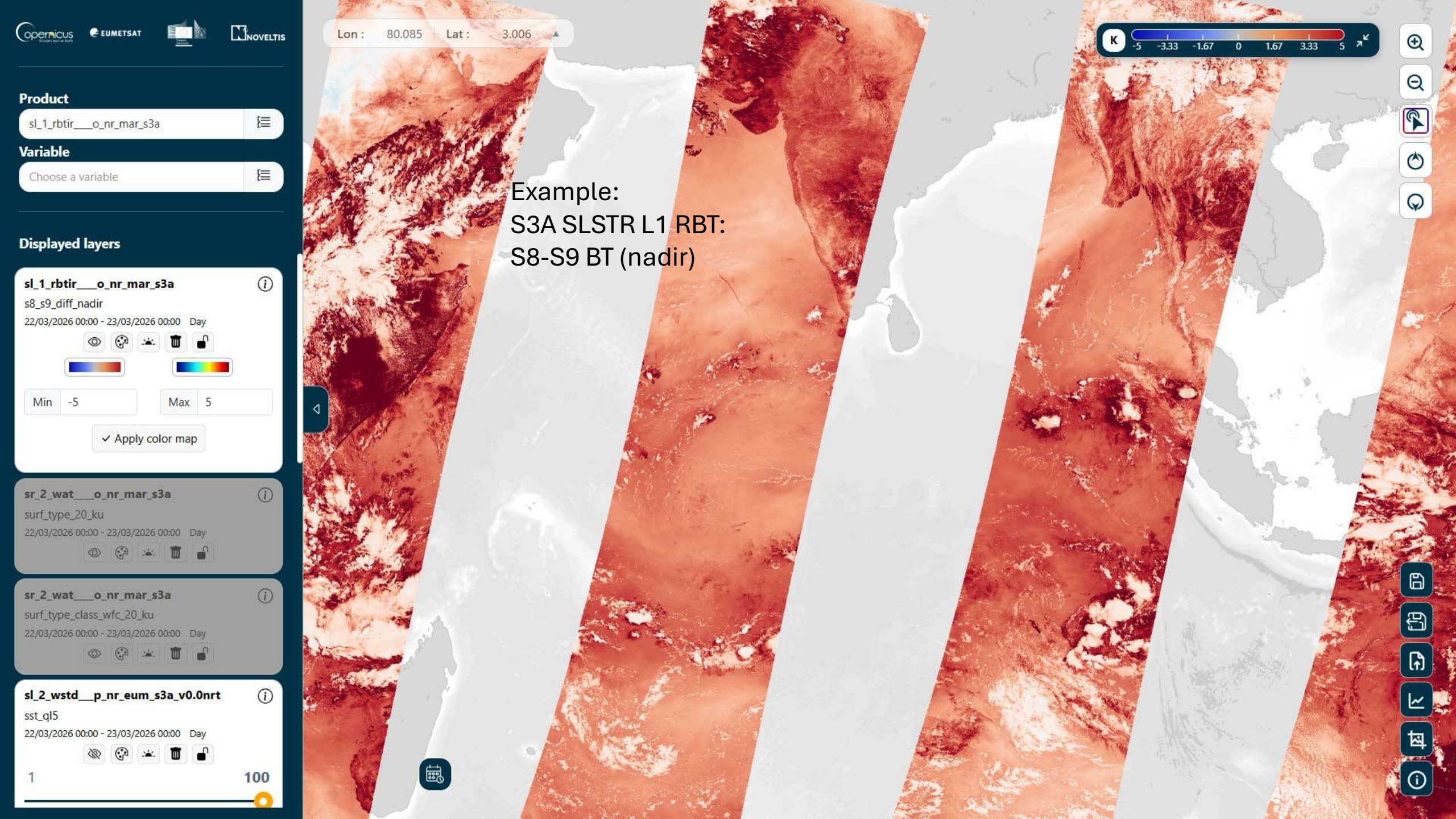

Lon : 0.55 Lat : -4.105
sl_2_wst___o_nr_mar_s3a_v0.0nrt
sstdual_ql5
2026-03-27 09:50 UTC :
sl_2_wstd___p_nr_eum_s3a_v0.0nrt
sst_ql5
2026-03-27 09:50 UTC :
270 276 282 288 293 299 305
Product
ol_1_efr___o_nr_mar_s3a
Variable
Choose a variable
Displayed layers
sl_2_wstd___p_nr_eum_s3a_v0.0nrt
sst_ql5
27/03/2026 00:00 - 28/03/2026 00:00 Day
1 100
sl_2_wst___o_nr_mar_s3a_v0.0nrt
sstdual_ql5
27/03/2026 00:00 - 28/03/2026 00:00 Day
1 100
sl_2_wstn___p_nr_eum_s3a_v0.0nrt
sst_ql5
27/03/2026 00:00 - 28/03/2026 00:00 Day
1 100
ol_1_efr___o_nr_mar_s3a
true_color
27/03/2026 00:00 - 28/03/2026 00:00 Day
S3A SLSTR SST dual QL5:
Operational (Coll3) vs
PreOperational (Coll4)

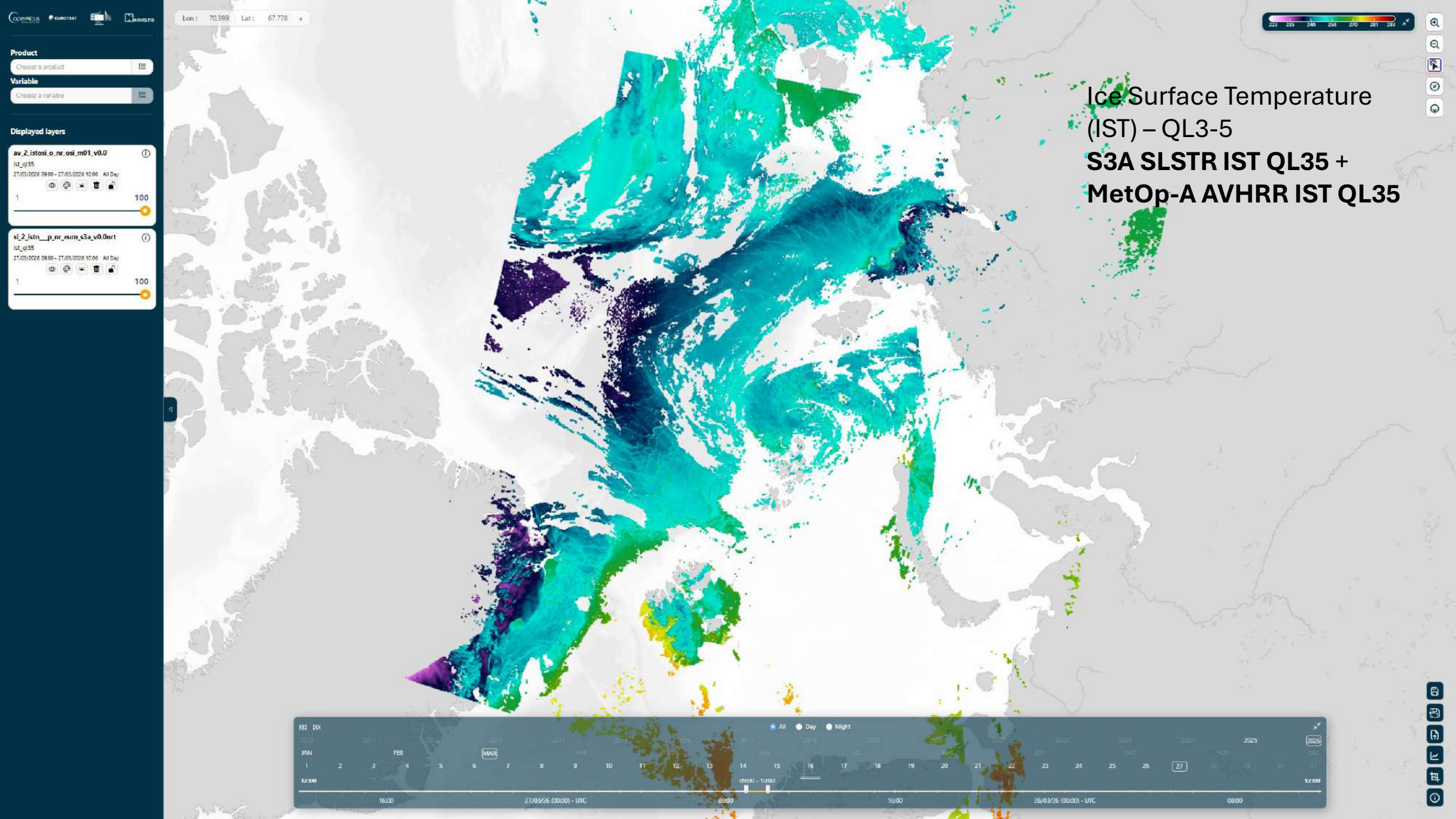

S3A SLSTR SST Nadir QL5 + S3A OLCI L1 True Color RGB
(Cloud mask analysis)


Lon : 72.162 Lat : 7.171
sl_2_wstd___p_nr_eum_s3a_v0.0nrt
sst_ql5
2026-03-22 05:14 UTC : N/A
sl_2_wst___o_nr_mar_s3a_v0.0nrt
sstdual_ql5
2026-03-22 05:14 UTC : N/A
sl_2_aod___o_nr_mar_s3a
AOD_550_Merged_OceanLand
2026-03-22 05:10 UTC : N/A
0
1
S3A SLSTR SST dual QL5 **Ope (Coll3)** + PreOp (Coll4) + SLSTR L2 AOD NRT
Product
sl_2_aod___o_nr_mar_s3a
Variable
Choose a variable
Displayed layers
sl_2_aod___o_nr_mar_s3a
AOD_550_Merged_OceanLand
22/03/2026 00:00 - 23/03/2026 00:00 Day
1
100
sl_2_wstd___p_nr_eum_s3a_v0.0nrt
sst_ql5
22/03/2026 00:00 - 23/03/2026 00:00 Day
1
100
sl_2_wst___o_nr_mar_s3a_v0.0nrt
sstdual_ql5
22/03/2026 00:00 - 23/03/2026 00:00 Day
1
100
ol_1_efr___o_nr_mar_s3a
true_color
22/03/2026 00:00 - 23/03/2026 00:00 Day


Product
sl_2_aod___o_nr_mar_s3a
Variable
Choose a variable
Displayed layers
sl_2_aod___o_nr_mar_s3a
AOD_550_Merged_OceanLand
22/03/2026 00:00 - 23/03/2026 00:00 Day
1
100
sl_2_wstd___p_nr_eum_s3a_v0.0nrt
sst_ql5
22/03/2026 00:00 - 23/03/2026 00:00 Day
1
100
sl_2_wst___o_nr_mar_s3a_v0.0nrt
sstdual_ql5
22/03/2026 00:00 - 23/03/2026 00:00 Day
1
100
ol_1_efr___o_nr_mar_s3a
true_color
22/03/2026 00:00 - 23/03/2026 00:00 Day
Lon : 74.146 Lat : 11.603
sl_2_wstd___p_nr_eum_s3a_v0.0nrt
sst_ql5
2026-03-22 05:11 UTC :
sl_2_wst___o_nr_mar_s3a_v0.0nrt
sstdual_ql5
2026-03-22 05:11 UTC :
sl_2_aod___o_nr_mar_s3a
AOD_550_Merged_OceanLand
2026-03-22 05:10 UTC :
0
1
S3A SLSTR SST dual QL5 Ope (Coll3) + **PreOp (Coll4)** + SLSTR L2 AOD NRT

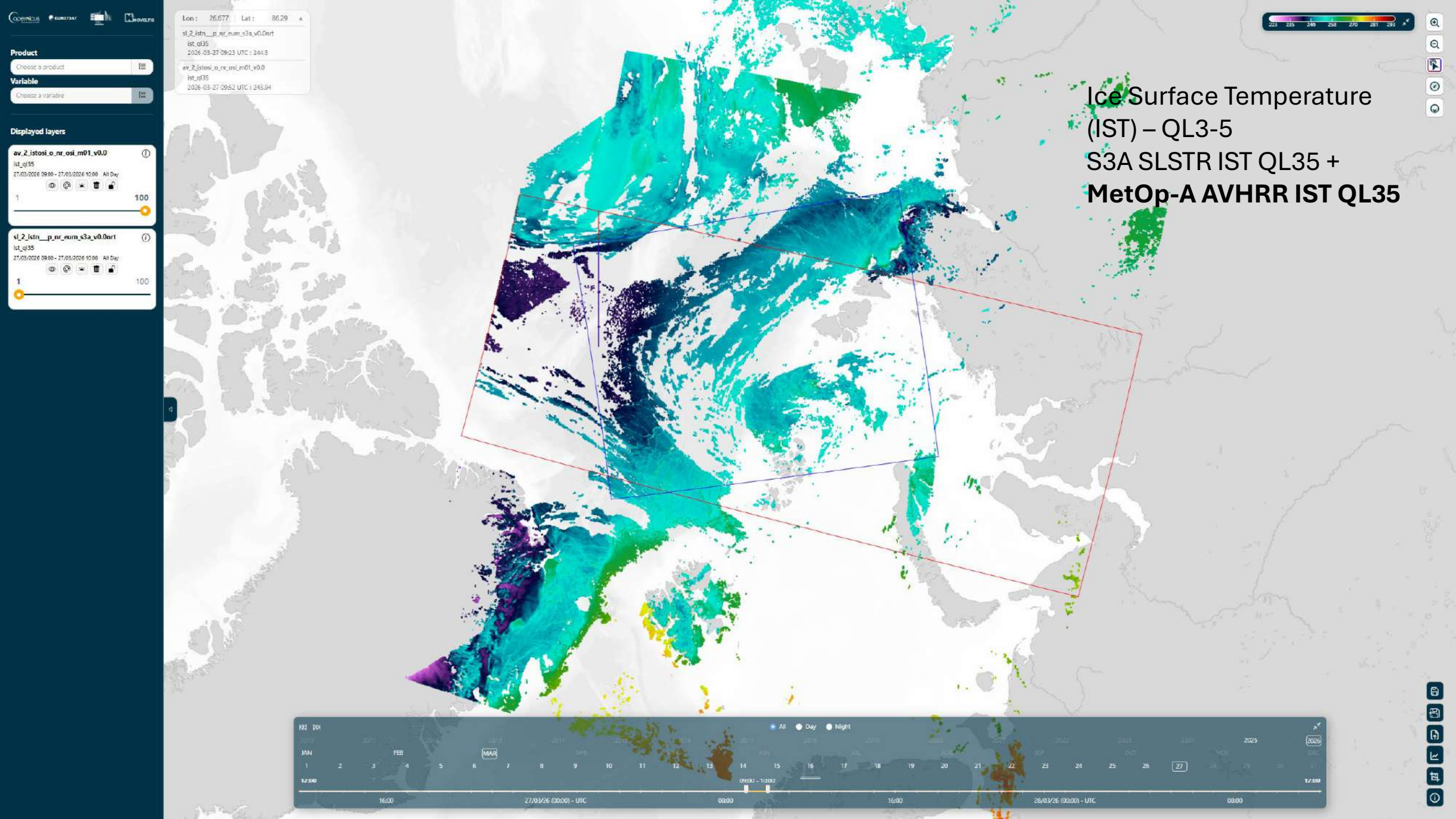

Lon : 48.45 Lat : 7.866
sl_2_wstd___p_nr_eum_s3a_v0.0nrt
sst_ql5
2026-03-22 06:55 UTC : N/A
sl_2_wst___o_nr_mar_s3a_v0.0nrt
sstdual_ql5
2026-03-22 06:55 UTC : N/A
sl_2_aod___o_nr_mar_s3a
AOD_550_Merged_OceanLand
2026-03-22 06:52 UTC : N/A
0
1
S3A SLSTR SST dual QL5 Ope (Coll3) + PreOp (Coll4) + SLSTR L2 AOD NRT
Product
sl_2_aod___o_nr_mar_s3a
Variable
Choose a variable
Displayed layers
sl_2_aod___o_nr_mar_s3a
AOD_550_Merged_OceanLand
22/03/2026 00:00 - 23/03/2026 00:00 Day
1
100
sl_2_wstd___p_nr_eum_s3a_v0.0nrt
sst_ql5
22/03/2026 00:00 - 23/03/2026 00:00 Day
1
100
sl_2_wst___o_nr_mar_s3a_v0.0nrt
sstdual_ql5
22/03/2026 00:00 - 23/03/2026 00:00 Day
1
100
ol_1_efr___o_nr_mar_s3a
true_color
22/03/2026 00:00 - 23/03/2026 00:00 Day


Lon : 80.085 Lat : 3.006
K
-5 -3.33 -1.67 0 1.67 3.33 5
Example:
S3A SLSTR L1 RBT:
S8-S9 BT (nadir)
Product
sl_1_rbtir___o_nr_mar_s3a
Variable
Choose a variable
Displayed layers
sl_1_rbtir___o_nr_mar_s3a
s8_s9_diff_nadir
22/03/2026 00:00 - 23/03/2026 00:00 Day
Min -5
Max 5
✓ Apply color map
sr_2_wat___o_nr_mar_s3a
surf_type_20_ku
22/03/2026 00:00 - 23/03/2026 00:00 Day
sr_2_wat___o_nr_mar_s3a
surf_type_class_wfc_20_ku
22/03/2026 00:00 - 23/03/2026 00:00 Day
sl_2_wstd___p_nr_eum_s3a_v0.0nrt
sst_ql5
22/03/2026 00:00 - 23/03/2026 00:00 Day
1
100



Ice Surface Temperature (IST) – QL3-5

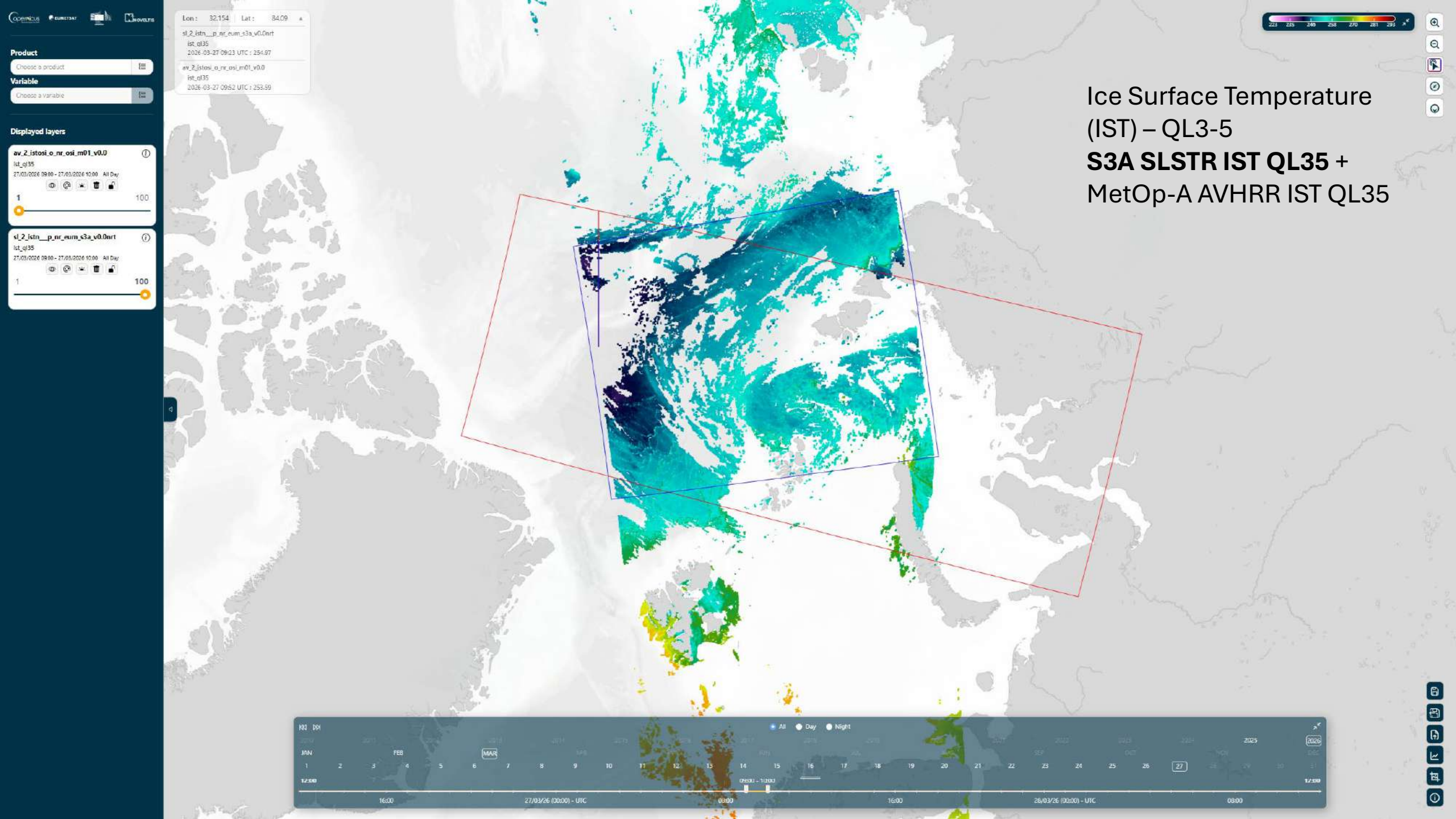
S3A SLSTR IST QL35 + MetOp-A AVHRR IST QL35

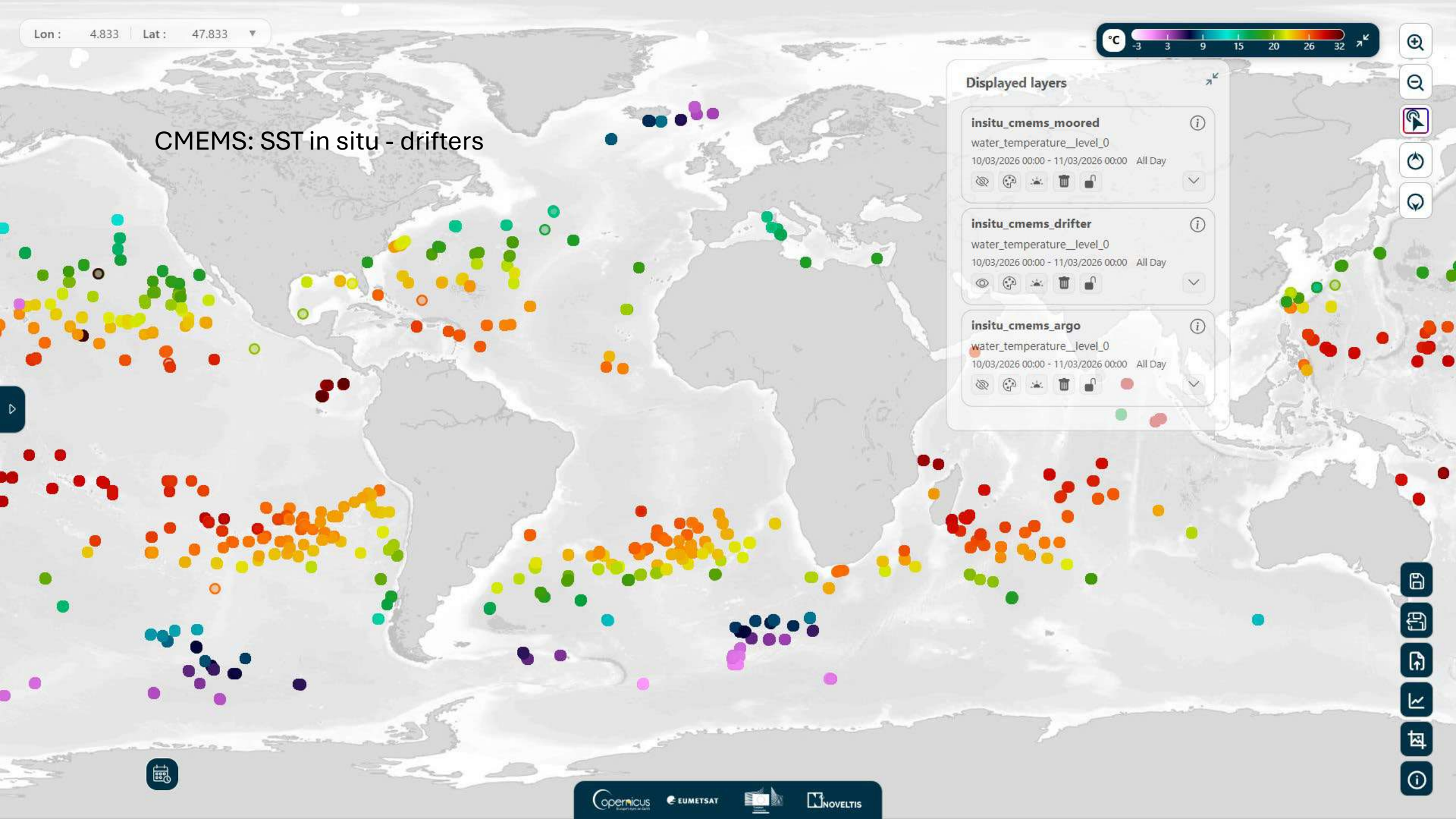


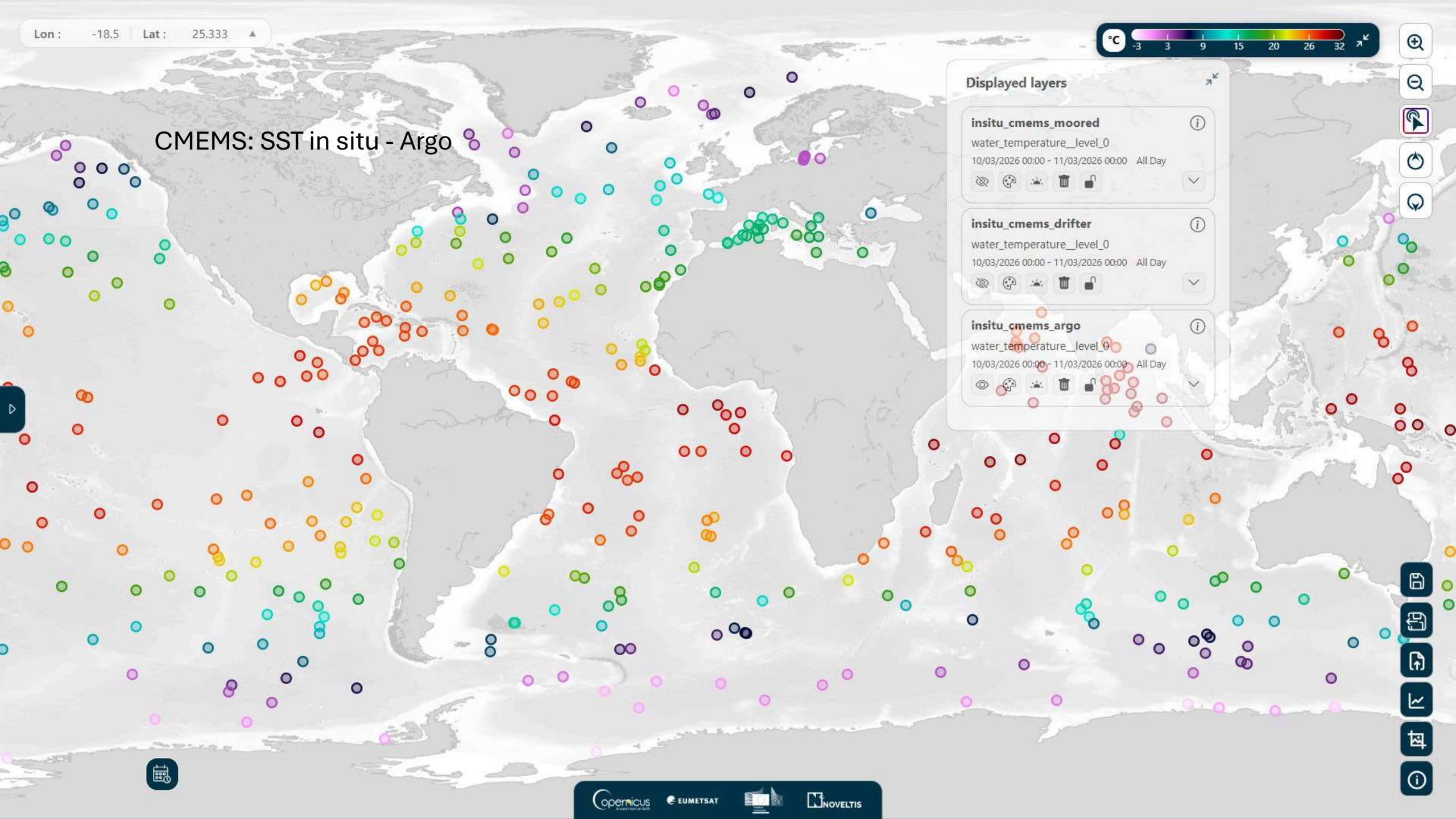
Ice Surface Temperature (IST) – QL3-5

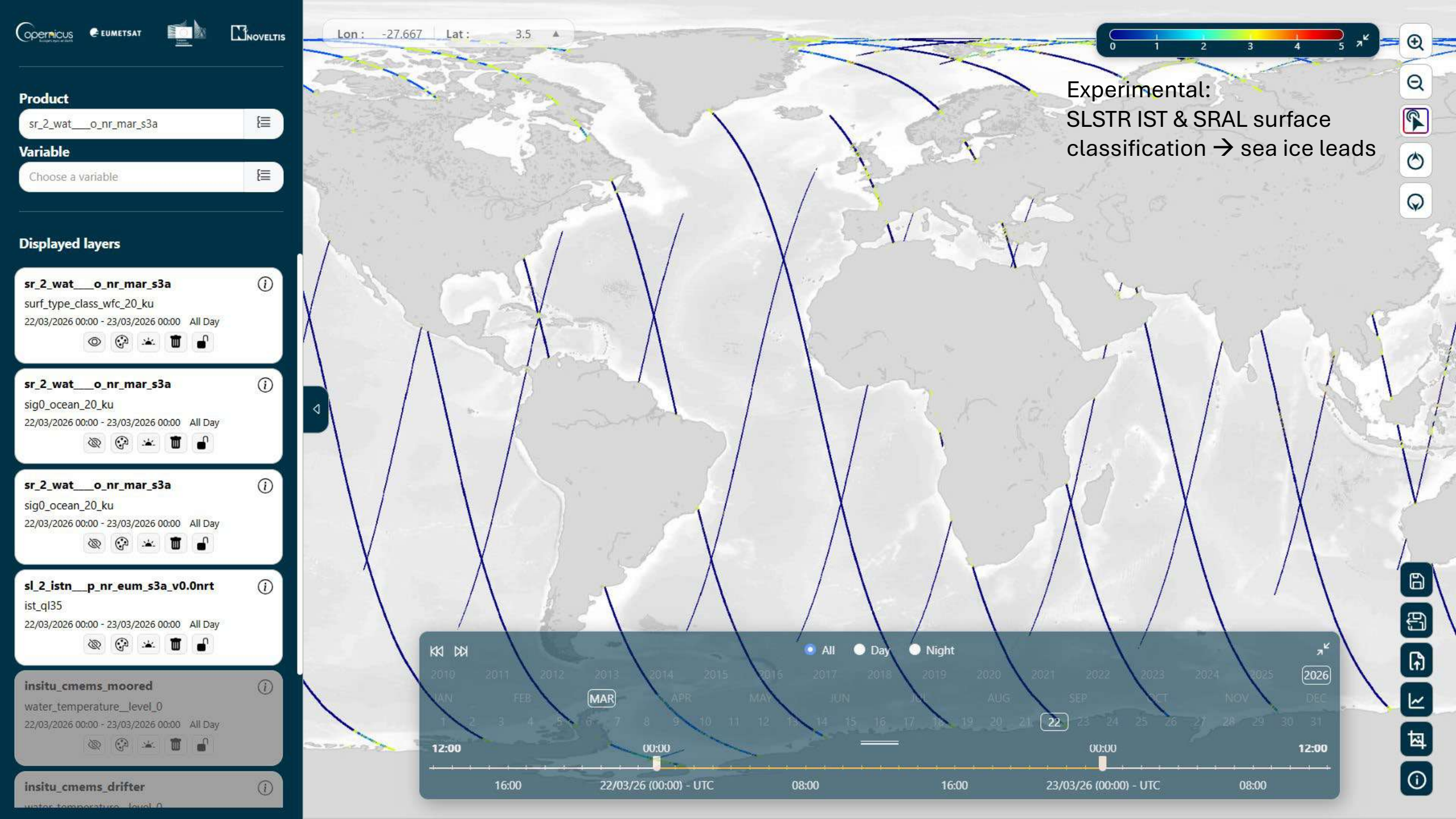
S3A SLSTR IST QL35 +

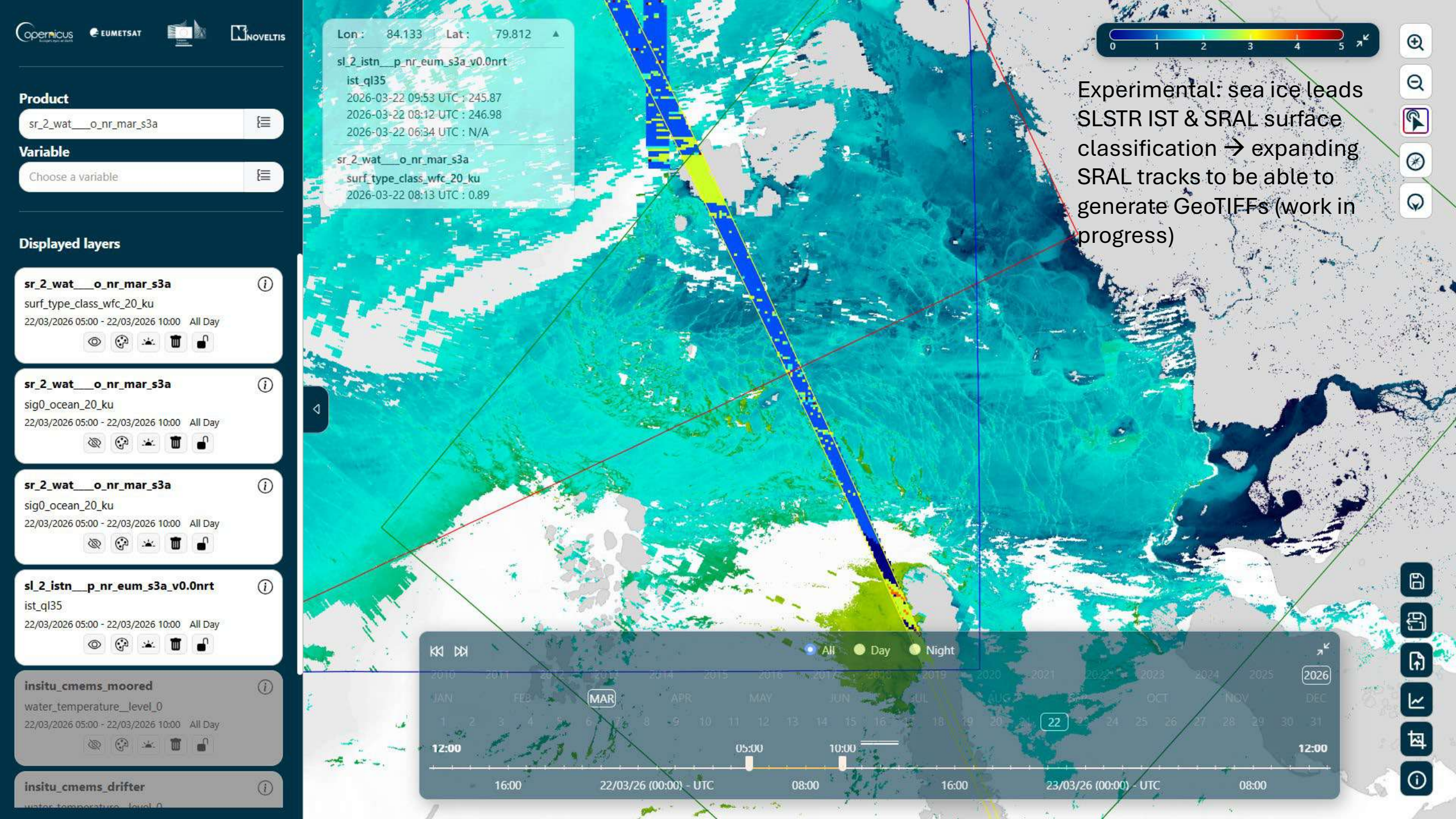
MetOp-A AVHRR IST QL35


Product
Choose a product
Variable
Choose a variable
Displayed layers
av_2_istosi_o_nr_osi_m01_v0.0
ist_ql35
sl_2_istn__p_nr_eum_s3a_v0.0nrt
ist_ql35
Ice Surface Temperature (IST) – QL3-5
S3A SLSTR IST QL35 +
MetOp-A AVHRR IST QL35


Lon : 4.833
Lat : 47.833
°C
-3 3 9 15 20 26 32
Displayed layers
insitu_cmems_moored
water_temperature__level_0
10/03/2026 00:00 - 11/03/2026 00:00 All Day
insitu_cmems_drifter
water_temperature__level_0
10/03/2026 00:00 - 11/03/2026 00:00 All Day
insitu_cmems_argo
water_temperature__level_0
10/03/2026 00:00 - 11/03/2026 00:00 All Day
CMEMS: SST in situ - drifters
Copernicus
EUMETSAT
NOVELTIS


Lon : -18.5
Lat : 25.333
°C
-3 3 9 15 20 26 32
Displayed layers
insitu_cmems_moored
water_temperature__level_0
10/03/2026 00:00 - 11/03/2026 00:00 All Day
insitu_cmems_drifter
water_temperature__level_0
10/03/2026 00:00 - 11/03/2026 00:00 All Day
insitu_cmems_argo
water_temperature__level_0
10/03/2026 00:00 - 11/03/2026 00:00 All Day
CMEMS: SST in situ - Argo
Copernicus
EUMETSAT
NOVELTIS


Lon : -27.667
Lat : 3.5
0 1 2 3 4 5
Experimental:
SLSTR IST & SRAL surface classification → sea ice leads
Product
sr_2_wat___o_nr_mar_s3a
Variable
Choose a variable
Displayed layers
sr_2_wat___o_nr_mar_s3a
surf_type_class_wfc_20_ku
22/03/2026 00:00 - 23/03/2026 00:00 All Day
sr_2_wat___o_nr_mar_s3a
sig0_ocean_20_ku
22/03/2026 00:00 - 23/03/2026 00:00 All Day
sr_2_wat___o_nr_mar_s3a
sig0_ocean_20_ku
22/03/2026 00:00 - 23/03/2026 00:00 All Day
sl_2_istn___p_nr_eum_s3a_v0.0nrt
ist_ql35
22/03/2026 00:00 - 23/03/2026 00:00 All Day
insitu_cmems_moored
water_temperature_level_0
22/03/2026 00:00 - 23/03/2026 00:00 All Day
insitu_cmems_drifter
All Day Night
2026
MAR
22
12:00 00:00 00:00 12:00
16:00 22/03/26 (00:00) - UTC 08:00 16:00 23/03/26 (00:00) - UTC 08:00


Lon : 84.133 Lat : 79.812
sl_2_istn___p_nr_eum_s3a_v0.0nrt
ist_ql35
2026-03-22 09:53 UTC : 245.87
2026-03-22 08:12 UTC : 246.98
2026-03-22 06:34 UTC : N/A
sr_2_wat___o_nr_mar_s3a
surf_type_class_wfc_20_ku
2026-03-22 08:13 UTC : 0.89
0 1 2 3 4 5
Experimental: sea ice leads SLSTR IST & SRAL surface classification → expanding SRAL tracks to be able to generate GeoTIFFs (work in progress)
Product
sr_2_wat___o_nr_mar_s3a
Variable
Choose a variable
Displayed layers
sr_2_wat___o_nr_mar_s3a
surf_type_class_wfc_20_ku
22/03/2026 05:00 - 22/03/2026 10:00 All Day
sr_2_wat___o_nr_mar_s3a
sig0_ocean_20_ku
22/03/2026 05:00 - 22/03/2026 10:00 All Day
sr_2_wat___o_nr_mar_s3a
sig0_ocean_20_ku
22/03/2026 05:00 - 22/03/2026 10:00 All Day
sl_2_istn___p_nr_eum_s3a_v0.0nrt
ist_ql35
22/03/2026 05:00 - 22/03/2026 10:00 All Day
insitu_cmems_moored
water_temperature_level_0
22/03/2026 05:00 - 22/03/2026 10:00 All Day
insitu_cmems_drifter
All Day Night
2026
MAR
22
12:00 05:00 10:00 12:00
16:00 22/03/26 (00:00) - UTC 08:00 16:00 23/03/26 (00:00) - UTC 08:00


Lon : 2.333
Lat : 27.667
200 222 243 265 287 308 330
Example of combining all surface temperatures: SLSTR SST, IST and LST
Copernicus
EUMETSAT
NOVELTIS

Time series interface

Product
sl_2_wstn___p_nr_eum_s3a_v0.0nrt

Variable
Difference between SST and SSTdepth

Metric
mean

Time interval
2026-03-24 – 2026-03-26

Aggregation
No aggregation

Panel

Add data

Synch graphs

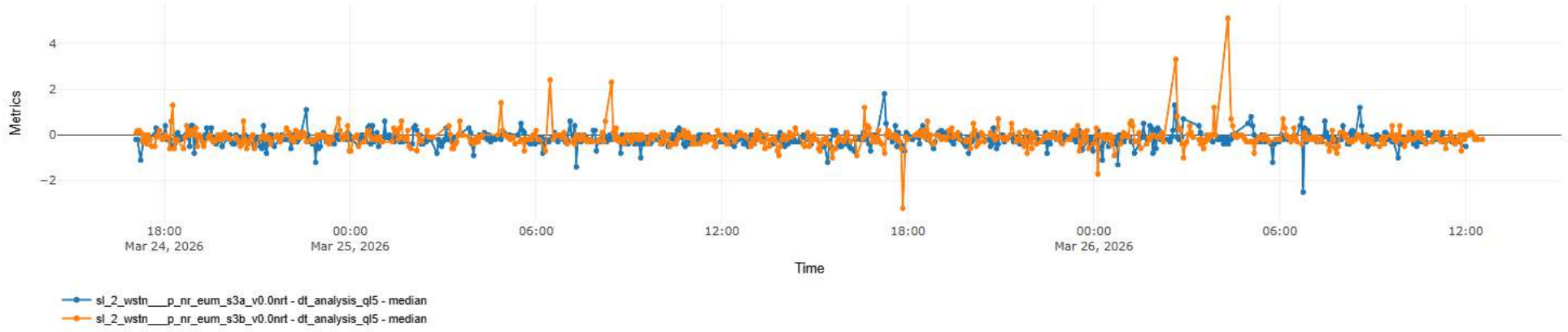
1 | 450

Time interval
2026-03-24 – 2026-03-26

Update graphs to selected time period

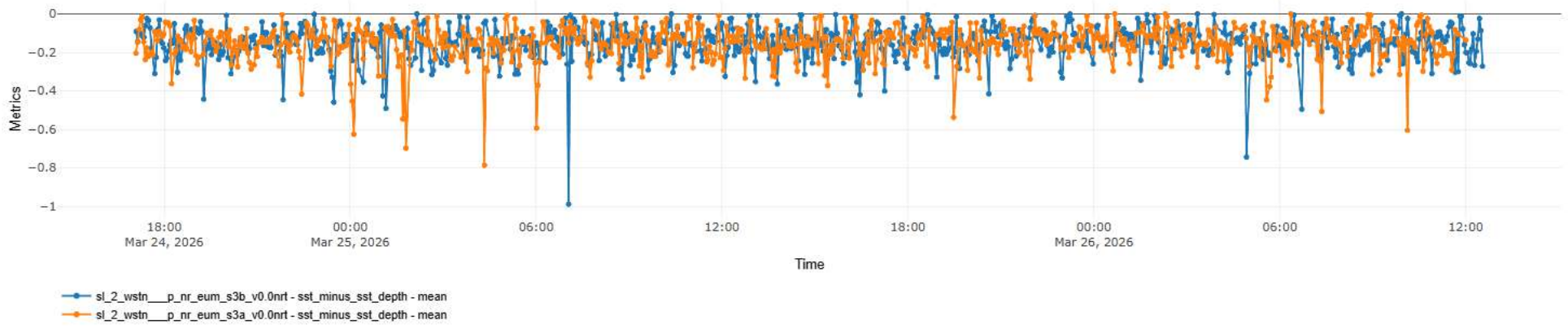
1

Example of time series of S3A and S3B SLSTR WST PreOp (Coll4) nadir dt_analysis variable (L2P) filtered by QL5 and applied median metrics (each point represents product)



2

Example of time series of S3A and S3B SLSTR WST PreOp (Coll4) nadir differences between SST_skin and SST_depth variables (L2P) filtered by QL5 and applied mean metrics (each point represents product)



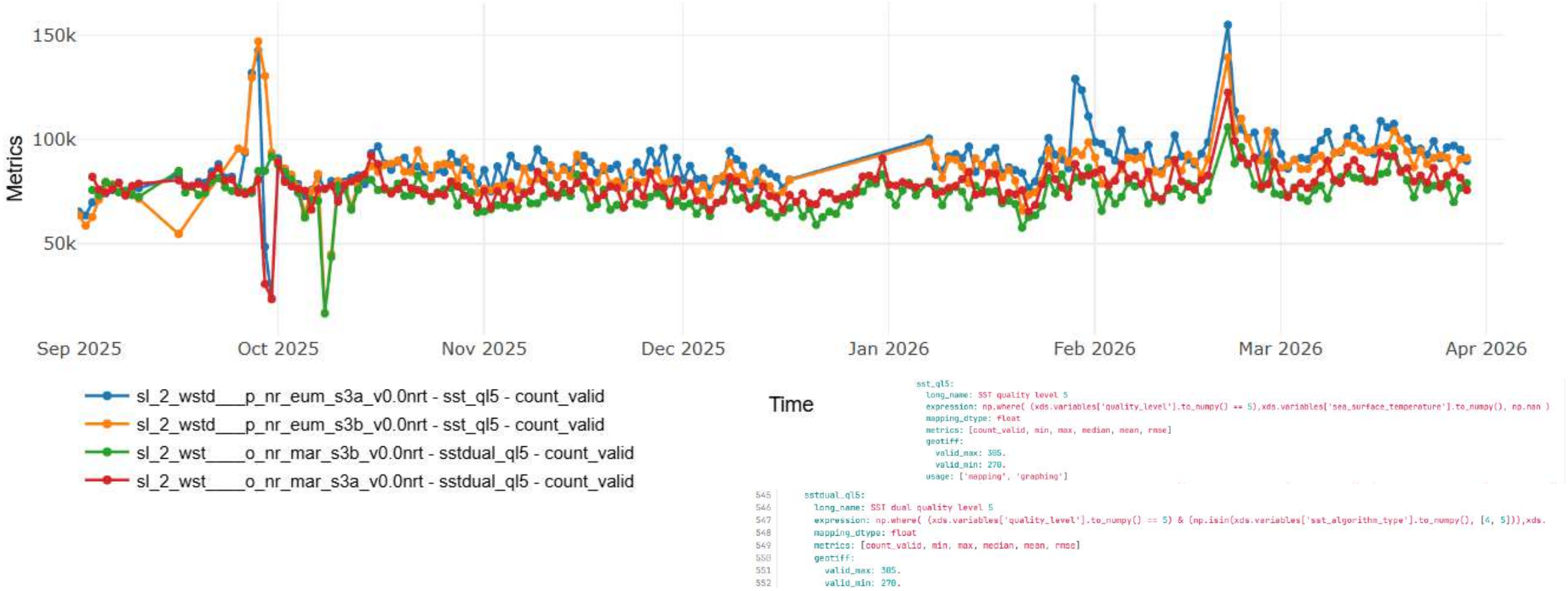
Time series interface

1

Example of time series of S3A and S3B SLSTR WST:

- PreOp (Coll4) dual SST variable (L2P) filtered by QL5 and applied count metrics
- Op (Coll3) SST variable filtered by QL5 and dual view algorithm types (4,5) and applied count metrics

→ Shows increased number of valid dual view QL5 pixels in PreOp




```
sst_ql5:
  long_name: SST quality level 5
  expression: np.where( (xds.variables['quality_level'].to_numpy() == 5),xds.variables['sea_surface_temperature'].to_numpy(), np.nan )
  mapping_dtype: float
  metrics: [count_valid, min, max, median, mean, rmse]
  geotiff:
    valid_max: 385.
    valid_min: 270.
  usage: ['mapping', 'graphing']
```

```
545  sstdual_ql5:
546    long_name: SST dual quality level 5
547    expression: np.where( (xds.variables['quality_level'].to_numpy() == 5) & (np.isin(xds.variables['sst_algorithm_type'].to_numpy(), [4, 5])),xds.
548    mapping_dtype: float
549    metrics: [count_valid, min, max, median, mean, rmse]
550    geotiff:
551      valid_max: 385.
552      valid_min: 270.
```

Configurations (preprocessor)

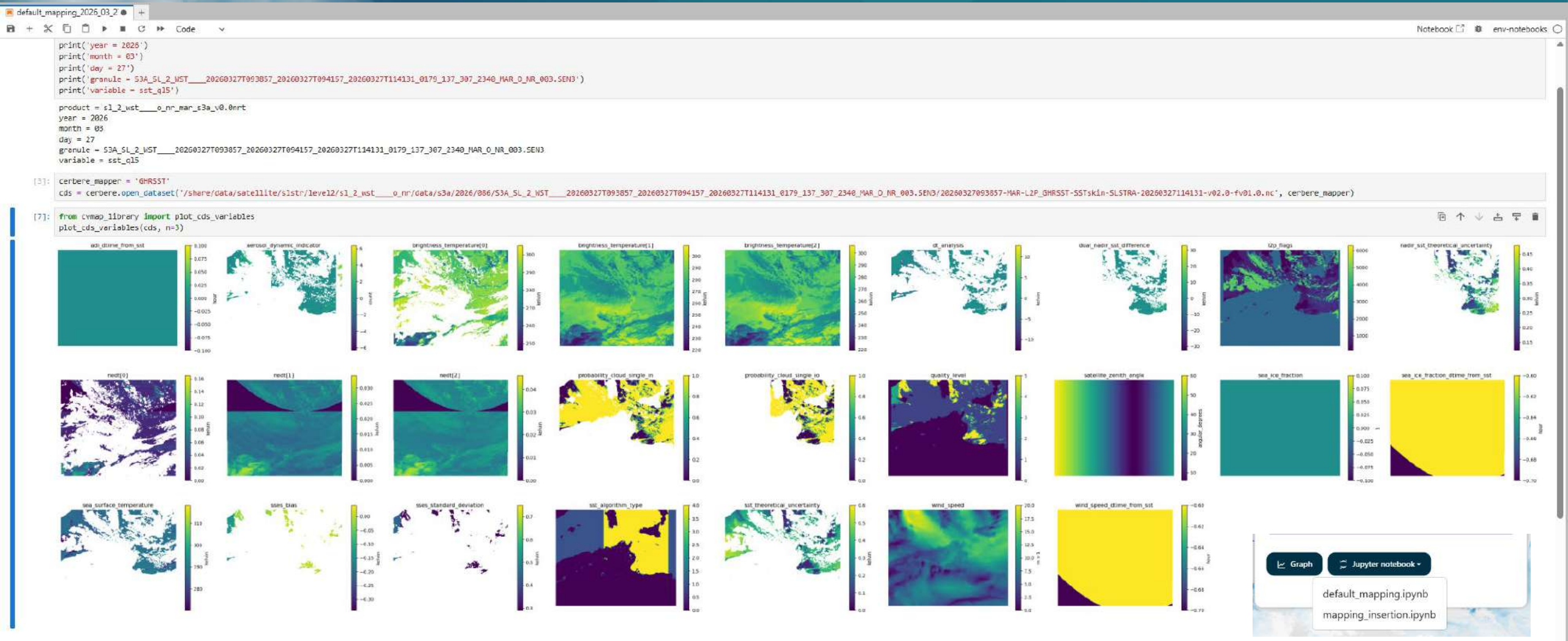
- Example of
  - raw variable
  - custom variable
  - Comparison with different dataset (e.g. OSTIA SST L4)

```
raw:
  dt_analysis:
    long_name: SST deviation from last analysis field
    mapping_dtype: float
    units: kelvin
    metrics: ['count_valid', 'min', 'max', 'median', 'mean', 'std']
    geotiff:
      valid_max: 2.
      valid_min: -2.
    show_decimal_values_colorbar: true
    usage: ['mapping', 'graphing']
    colormaps: ['{"name": "RdBu", "definition": [], "alt_name": "RdBu_r"}', '{"name": "greys", "definition": []}']

  sea_surface_temperature:
    long_name: sea surface skin temperature
    mapping_dtype: float
    units: kelvin
    metrics: ['count_valid', 'min', 'max', 'median', 'mean', 'std']
    geotiff:
      valid_max: 305.
      valid_min: 270.
    usage: ['mapping', 'graphing']
    colormaps: ['{"name" : "medspiration", "definition": [{"index": 0.0, "rgb": [255, 255, 255]}, {"index": 0.091, "rgb": [255, 145, 255]}, {"index"
```

```
custom:
  dt_analysis_ql5:
    long_name: Dt analysis QL5
    expression: np.where( (xds.variables['quality_level'].to_numpy() == 5),
                          xds.variables['dt_analysis'].to_numpy(),
                          np.nan )
    mapping_dtype: float
    metrics: [count_valid, min, max, median, mean, rmse]
    geotiff:
      valid_max: 2.
      valid_min: -2.
    usage: ['mapping', 'graphing']
    colormaps: ['{"name": "RdBu", "definition": [], "alt_name": "RdBu_r"}', '{"name": "picnic", "definition": []}']
  sst_minus_sst_depth:
    long_name: Difference between SST and SSTdepth
    expression: (xds['sea_surface_temperature'] - xds['sea_surface_temperature_depth']).to_numpy()
    mapping_dtype: float
    metrics: ['count_valid', 'min', 'max', 'median', 'mean', 'std']
    geotiff:
      valid_max: 0.5
      valid_min: -0.5
    show_decimal_values_colorbar: true
    usage: ['mapping', 'graphing']
    colormaps: ['{"name": "RdBu", "definition": [], "alt_name": "RdBu_r"}', '{"name": "greys", "definition": []}']
```

```
comparison:

  d_sst:
    long_name: Sea surface temperature difference L2-L4
    current_product:
      variable_name: sea_surface_temperature
    auxiliary_product:
      file system organisation:
        dir: f"{data_root}/aux/s3/sl_2_sstaax_met_o_nn_d/s3_/%Y/%j/"
        granule_regex: '^.*\.SEN3$'
        glob_path: f"{granule_path_aux}/*.nc"
      ingestion:
        method: xarray
      variable_name: analysed_sst
    mapping_dtype: float
    units: kelvin
    metrics: ['count_valid', 'min', 'max', 'median', 'mean', 'std']
    geotiff:
      valid_max: 10.
      valid_min: -10.
    usage: ['mapping', 'graphing']
    colormaps: ['{"name": "RdBu", "definition": [], "alt_name": "RdBu_r"}', '{"name": "greys", "defin
```

Jupyter Notebook interface



Example of a notebook automatically generated from a template and based on the product selected in mapping interface. This enables quick visualization of all variables within the selected product.
Additional notebook templates can be easily configured and extended.

DEMO

- SST:
  - Mapping: compare SLSTR SST operational vs preoperational (nadir and dual), add SL1 RGB to cross compare, change range, share view, change transparency
  - Time series: switch to graphing, increased number of dual view preop quality 5 pixels compared to operational dual view only, FCI SST decontamination – dt analysis (switch between time series and mapping), create multi-panel dashboard, add time series, synchronise, change time window, configuration
  - Jupyter notebook: Inspect one granule, open mapping notebook and plot all fields
- IST:
  - Mapping: compare SLSTR IST preoperational (nadir and dual) with AVHRR IST, zoom to specific time range (hours), add SL1 RGB to cross compare, use movable time window

Summary

- Integrated cal/val tool combining maps, time series, and Jupyter notebooks
- Multi-mission & multi-parameter by design, configurable (yaml)
- Open source (GPLv3.0), fully containerized (fairly easy to deploy)
  - scalable (jobard + HTCondor/swarm/k8s/pbs/…)
- Implementation in progress for SST/IST
  - Already proven extremely useful
  - Access shared within Sci4MaST project
- Testing just started for other EO parameters (OC, AOD, ALT, …)
  - Extensible to any EO parameter → create new cerbere reader
- Next:
  - Public code release planned 2026 Q3 (TBC)
  - Public access (SST/IST) planned in 2026 Q3/4 (TBC)

Thank you!

Questions/Comments

igor.tomazic@eumetsat.int