SST at EUMETSAT: Selecting appropriate products

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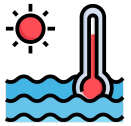
EUMETSAT series of short courses: Warming oceans: using satellite to monitor sea surface temperature, ocean heat content and marine heatwaves; 07.2023

Summary



Sea Surface Temperature

- *Surface temperature*

What SST products are out there and why/when should you use them ?

1. Satellite missions operated by EUMETSAT
2. Satellite Data Level
3. SST product portfolio
   a. EUMETSAT OSI SAF
   b. EUMETSAT Copernicus Marine
4. What data for which usage ?
5. Data Access and distribution means

Current EUMETSAT satellites

OPTIONAL AND THIRD-PARTY PROGRAMMES (INCLUDING COPERNICUS)

SENTINEL-3A & -3B (98.7° incl.)
Low Earth, sun-synchronous orbit

Copernicus satellites delivering marine data services from 814 km altitude

JASON-3 (63° incl.)
Low Earth, non-synchronous orbit

Copernicus ocean surface topography mission (shared with CNES, NOAA, NASA and Copernicus)

Sentinel-6 Michael Freilich (66° incl.)
Low Earth, non-synchronous orbit

Copernicus ocean surface topography mission (shared with NASA, NOAA, ESA and Copernicus with support from CNES)

MANDATORY PROGRAMMES

METEOSAT-10, -11
Geostationary orbit

Meteosat Second Generation

Two-satellite system
Full disc imagery mission (15 mins) (Meteosat-11 (0°))
Rapid scan service over Europe (5 mins) (Meteosat-10 (9.5° E))

METEOSAT-9 (45.5° E)
Geostationary orbit

Meteosat Second Generation providing Indian Ocean data coverage

METOP-B & -C (98.7° incl.)
Low Earth, sun-synchronous orbit

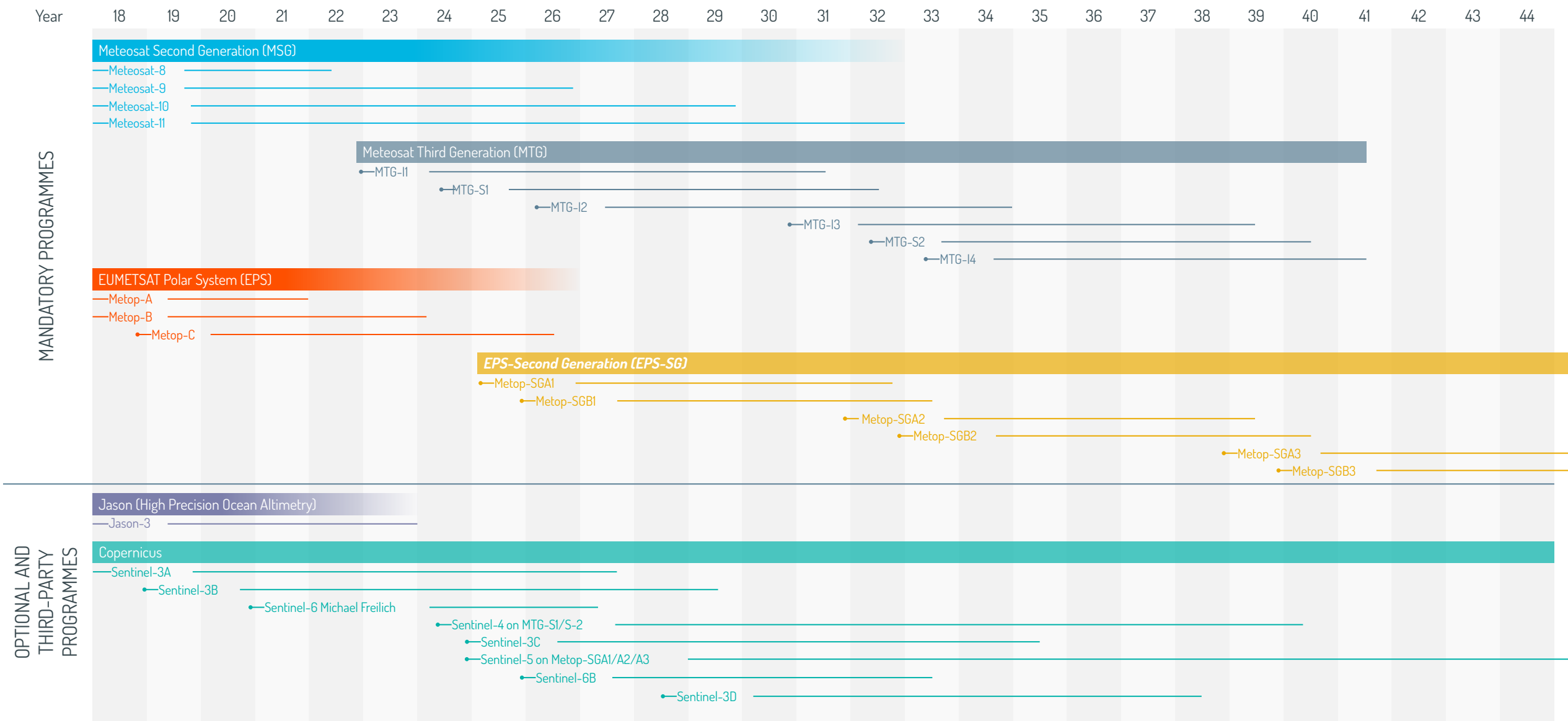
EUMETSAT Polar System (EPS)/ Initial Joint Polar System

MTG-I1
Geostationary orbit

Meteosat Third Generation imaging mission, currently in commissioning phase

EUMETSAT mission planning

www.eumetsat.int



Data Processing Levels

General

Data Level	Description
Level 0	**Reconstructed, unprocessed instrument and payload data at full resolution**, with any and all communications artifacts (e.g., synchronization frames, communications headers, duplicate data) removed.
Level 1B	**Reconstructed, Processed instrument data at full resolution**, time-referenced, and annotated with ancillary information, including radiometric and geometric calibration coefficients and georeferencing parameters.
Level 2	**Derived geophysical variables** at the same resolution and location as L1B source data.
Level 3	**Variables mapped on uniform space-time grid scales**, usually with some completeness and consistency.
Level 4	Model output or results from analyses of lower-level data (e.g., **variables derived from multiple measurements**).

GHRSST

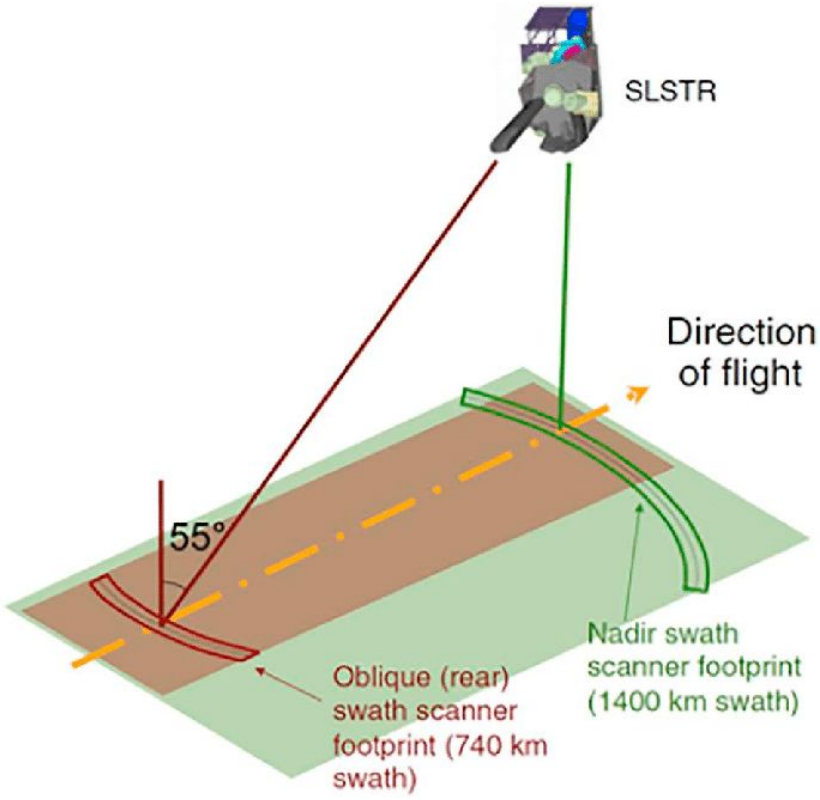
Data Level	Description
Level 2P	L2P data products provide **satellite SST observations together with a measure of uncertainty for each observation in a common GHRSST netCDF format**. Auxiliary fields are also provided for each pixel as dynamic flags.
Level 3U	**Gridding a single L2P file produces an "uncollated" L3 file** (L3U).
Level 3C	Multiple **L2P files are gridded to produce a "collated" L3 file (L3C) from a single sensor**
Level 3S	Multiple **L2P files are gridded to produce a "super-collated" L3 file from multiple sensors (L3S)**
Level 4	L4 gridded products are generated by combining complementary satellite and in situ observations within Optimal Interpolation systems.

EUMETSAT Copernicus marine SST processing

EUMETSAT operates the Copernicus Sentinel-3 satellite and provides data from the SLSTR sensor at Level-1B and Level-2

- SLSTR provides
  - day-time and night-time skin temperature
  - with global coverage at 1 km resolution every 1-2 days.
- Highly accurate calibration and low detector noise
- "Dual view" geometry allows for improved atmospheric characterisation and more accurate SST retrievals.

>>> **SLSTR is a climate quality reference sensor. Adopted as the reference sensor by CMEMS and much of the wider community.**



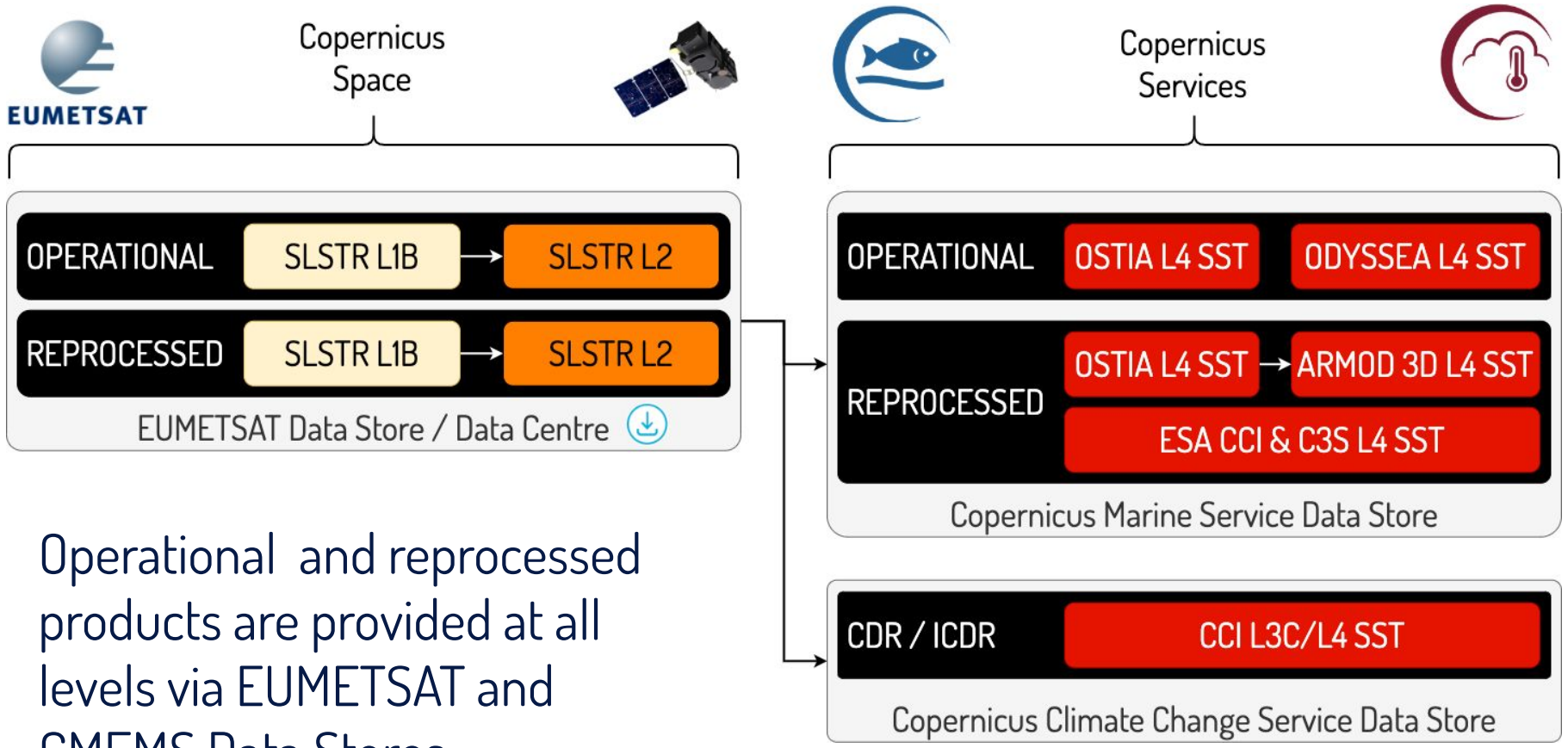
4 different products/algorithms for SST retrieval:

- Night time dual view 3-channel (D3)
- Night time nadir view 3-channel (N3; D3 > N3 quality)
- Day time dual view 2-channel (D2)
- Day time nadir view 2-channel (N2; D2 > N2 quality)

Highest quality algorithm used in final SST product

EUMETSAT Copernicus marine SST products

SLSTR products are incorporated into downstream Copernicus service products.



- Operational and reprocessed products are provided at all levels via EUMETSAT and CMEMS Data Stores.

- Climate data records (CDR) are provided at Level-4 via C3S

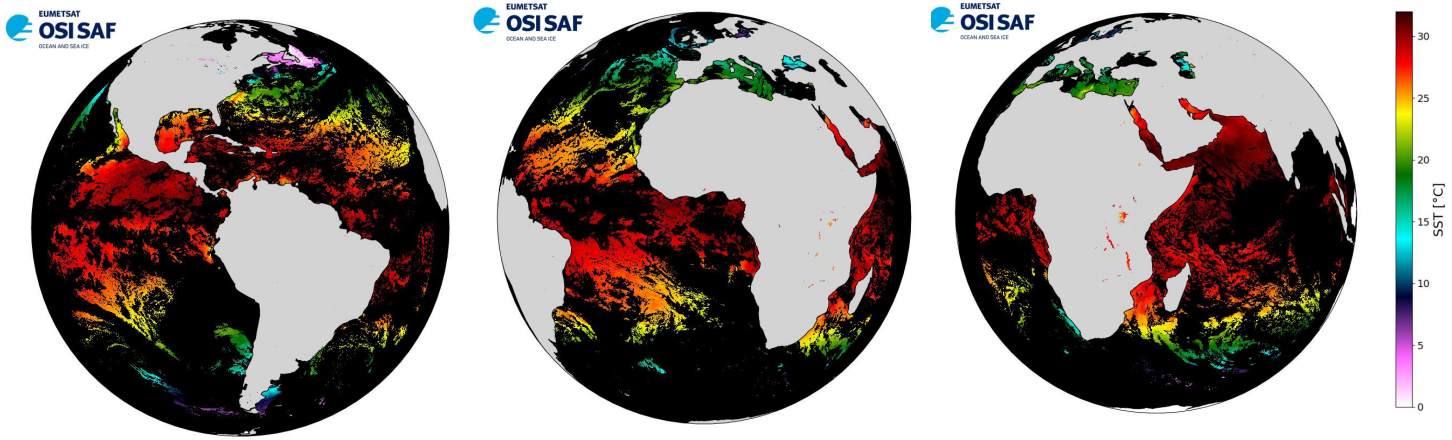
EUMETSAT OSI SAF SST processing

EUMETSAT OSI SAF
OCEAN AND SEA ICE

The OSI SAF (Ocean and Sea Ice Satellite Application Facility) is the dedicated EUMETSAT centre for processing satellite data at the ocean-atmosphere interface.

Operational and quality controlled products

Geostationary : GOES-East (ABI), MSG-0°, MSG-IO (SEVIRI)

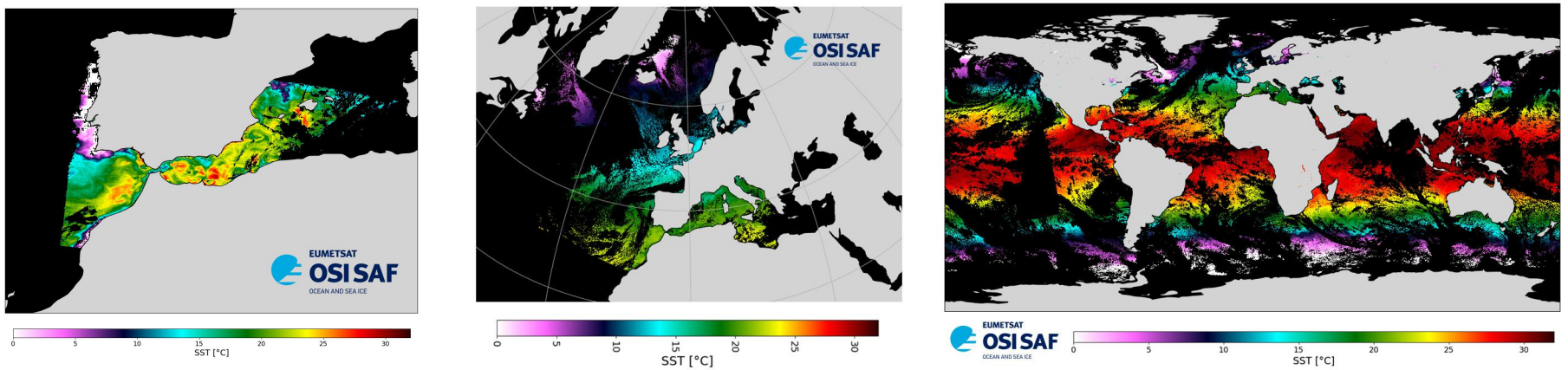


Temporal & Spatial Resolution

- Geo : Hourly / 0.05°
- Global : 2 times daily / 0.05°
- L2 : 3' granules / 1 km

https://osi-saf.eumetsat.int/products/sea-surface-temperature-products

Polar orbiting satellites : Metop (AVHRR & IASI), NOAA (AVHRR & VIIRS), Suomi-NPP (VIIRS)



OSI SAF SST Products

- L2 products
- L3 Regional Products
- L3 Global Products

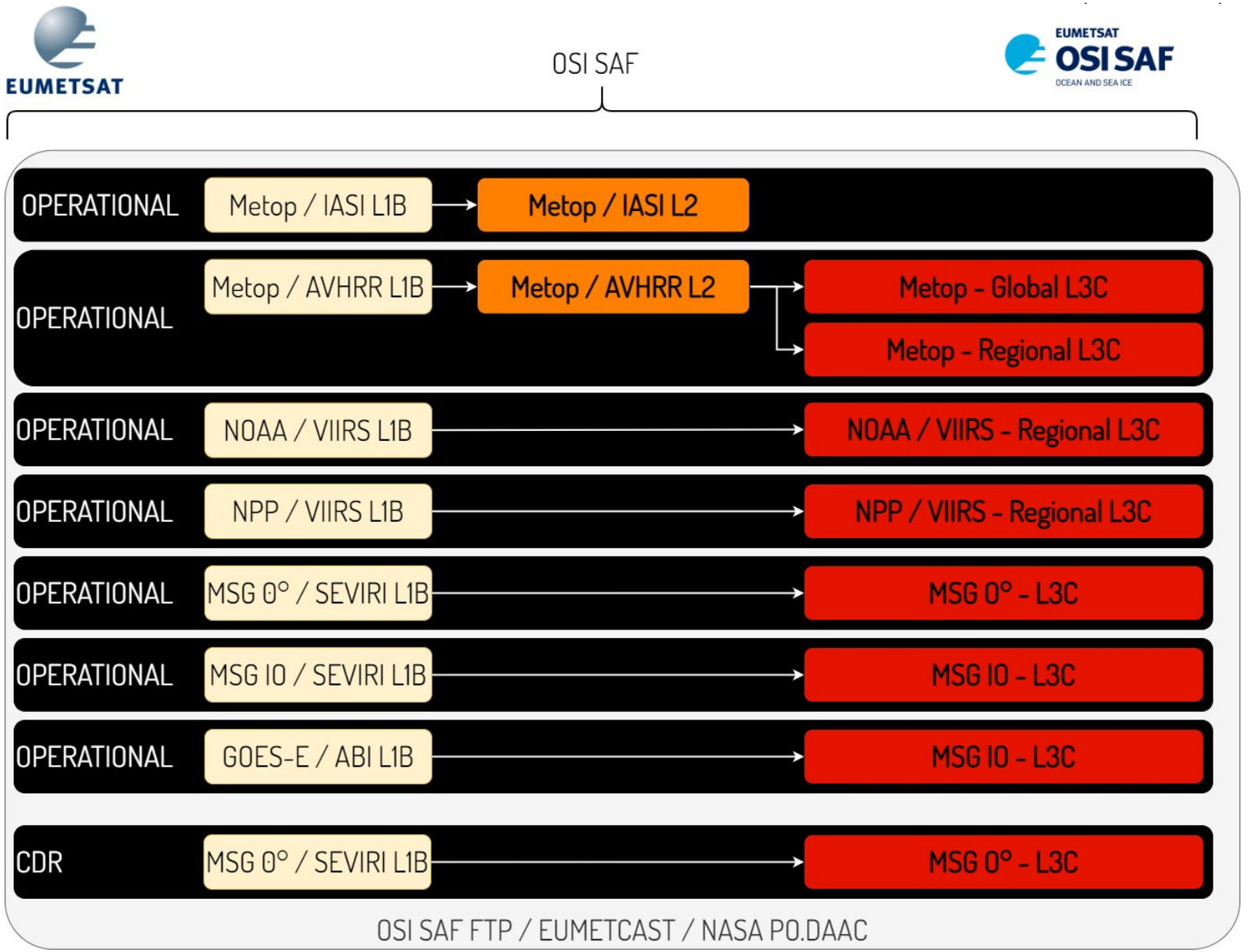
EUMETSAT OSI SAF SST products

Access OSI SAF data, stay informed :
Register on https://osi-saf.eumetsat.int

Products
- NetCDF format

Access means
- FTP access
- EUMETCast / EUMETSAT Data Centre and Store
- Thredds

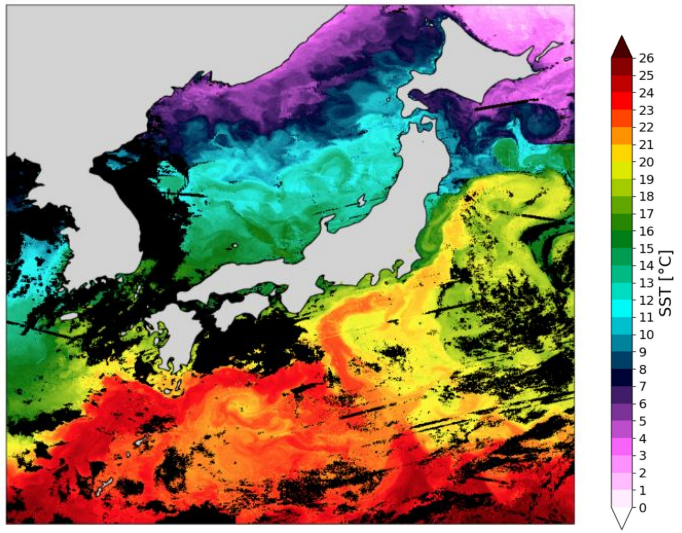
Redistribution
- Copernicus
  - Marine and Climate Change Service
- NASA PODAAC



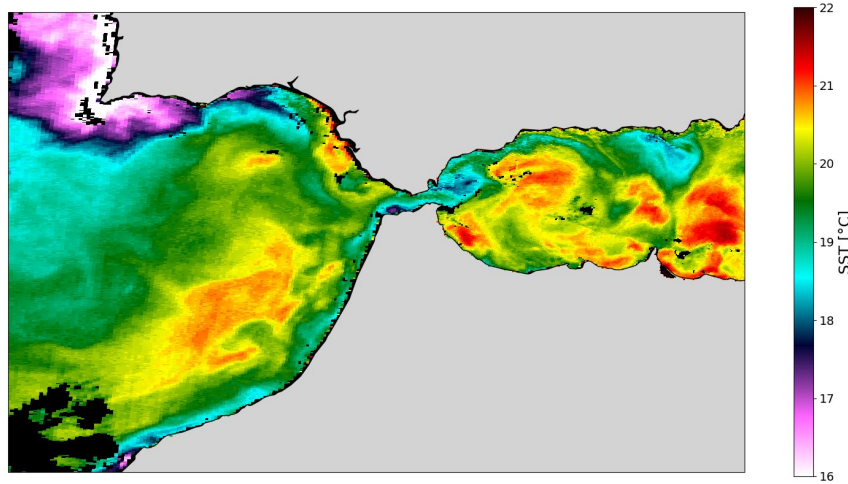
Why / when should you use SST data?

What is the use of knowing the sea surface temperature?

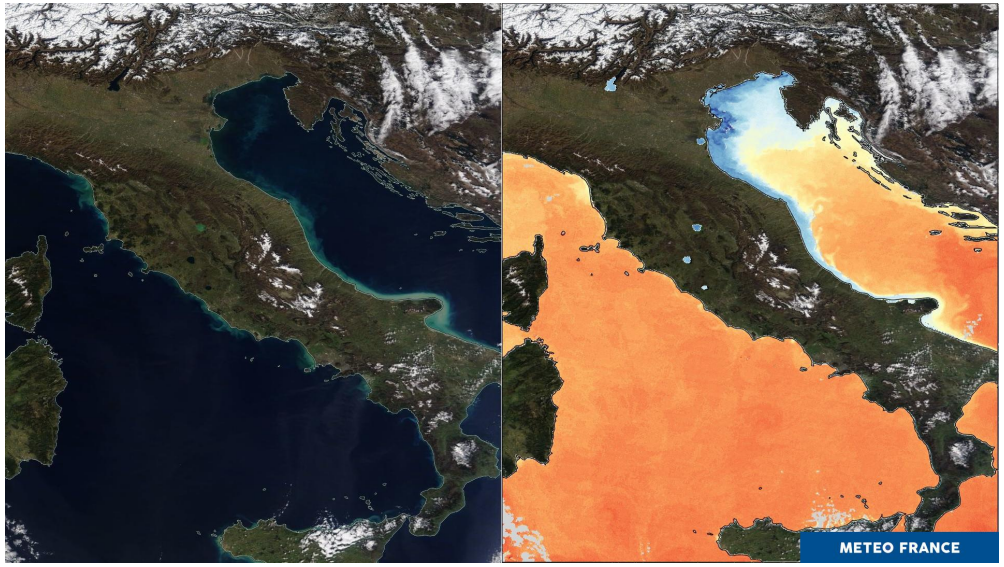
- Input for weather forecasting
  - L2 data / Operational forecasting
- Ocean/atmosphere exchanges
  - L2 data / Diurnal exchanges
- Ocean circulation indicator and water mass marker
  - L2 / L3 / L4
- Climate change indicator
  - L3 / L4
- Bio-geochemical activity control parameter
  - L3 / L4



Sea Surface Temperature Metop-C - 14/05/2023



Sea Surface Temperature Metop-B - 02/05/2023



TERRA TrueColor & Metop-B SST - 23/02/2022

Diurnal cycles

Satellites

Geostationary :

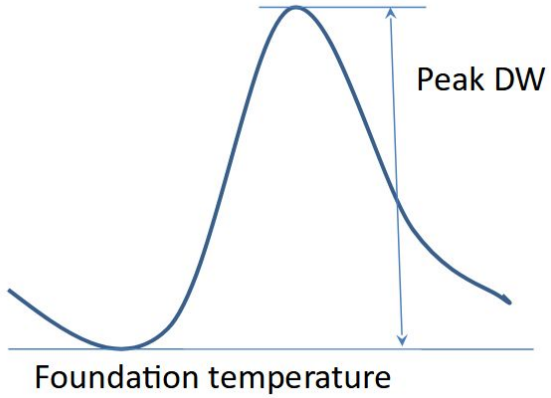
- GOES-East (ABI),
- MSG-0°,
- MSG-10 (SEVIRI)

Temporal & Spatial

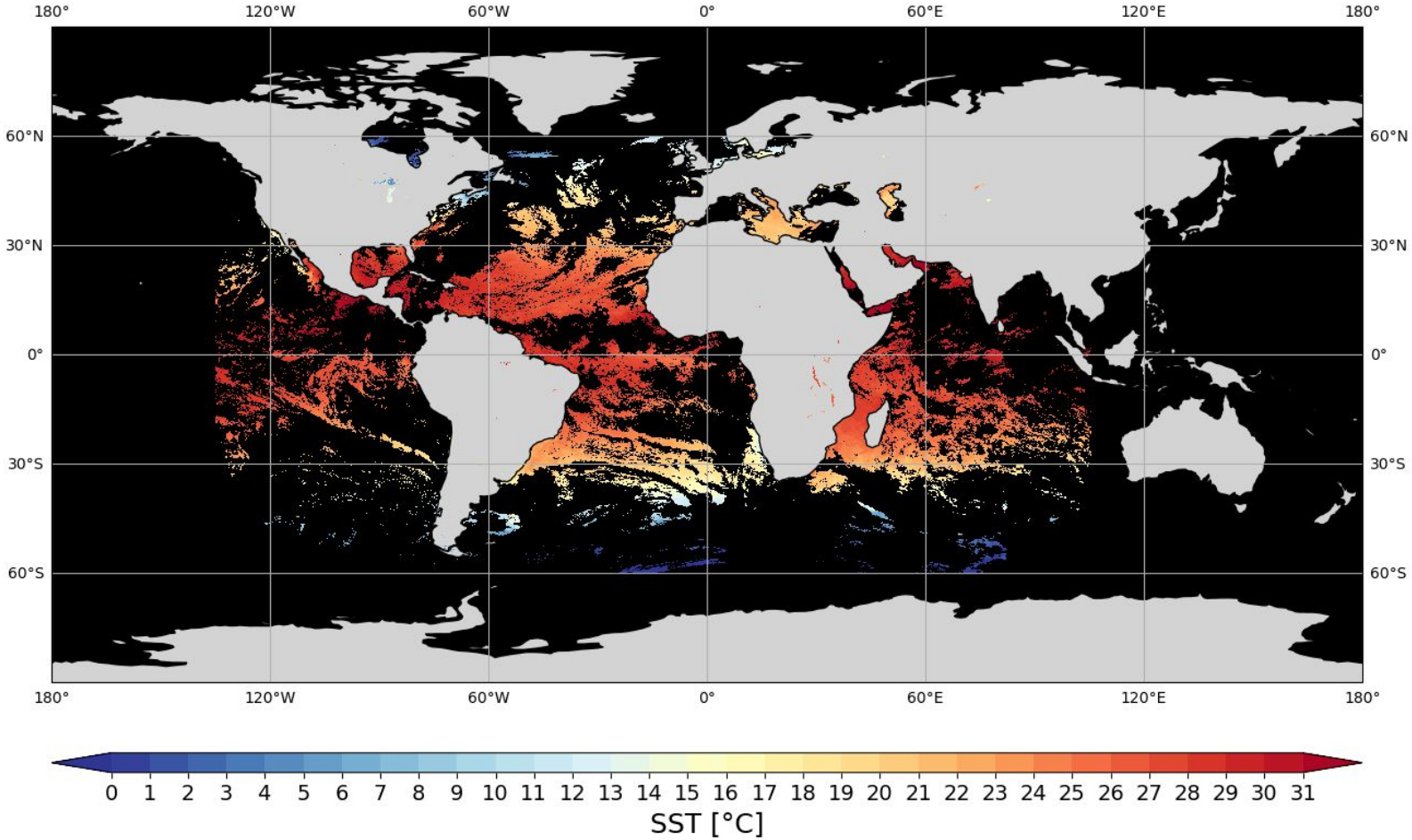
- Hourly / 0.05°

Diurnal Warming (DW) Methods

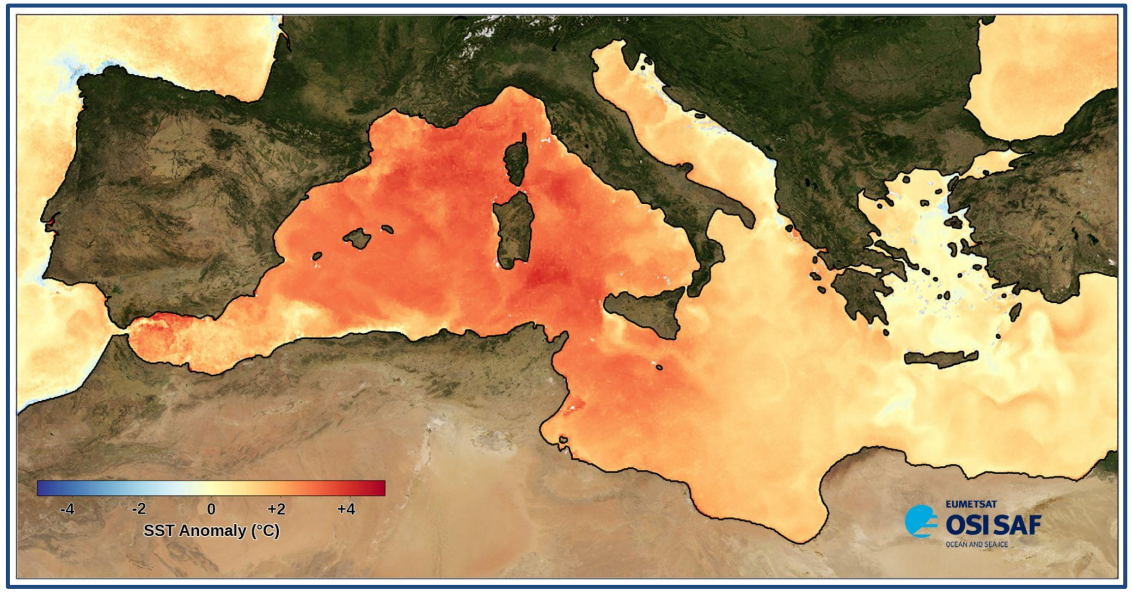
Idealized SST Diurnal Cycle



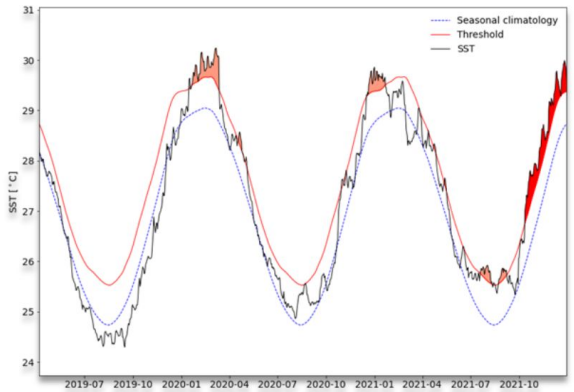
OSI SAF – Hourly data from the geostationary orbit

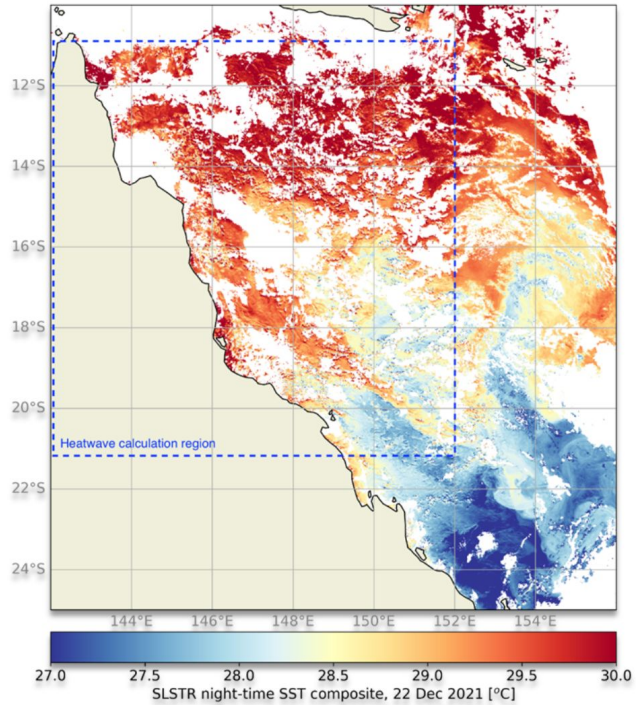


SST Anomalies & Marine Heatwaves



Mean SST Anomaly - Metop-B - August 2022

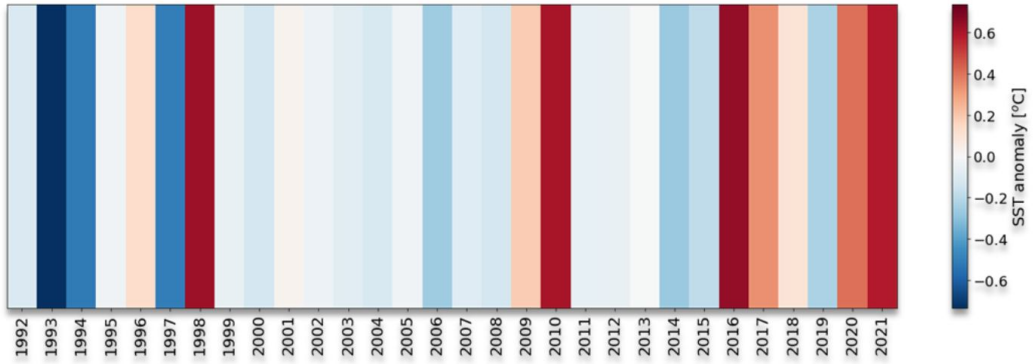




https://www.eumetsat.int/marine-heatwave-intensification-threatens-coral-reef-health

- Need to identify and monitor events relative to historical baselines.
- Impacts on ecosystems and dependent industries.

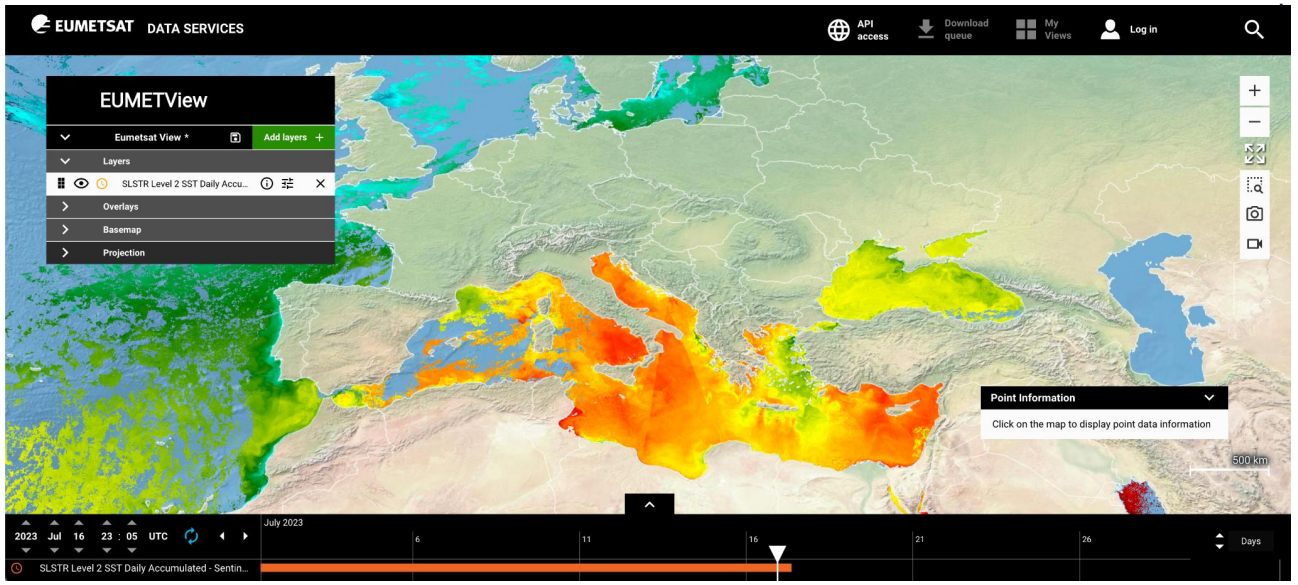
- Notebook shows how to access NRT data, as well as longer reprocessed series and conduct analysis.

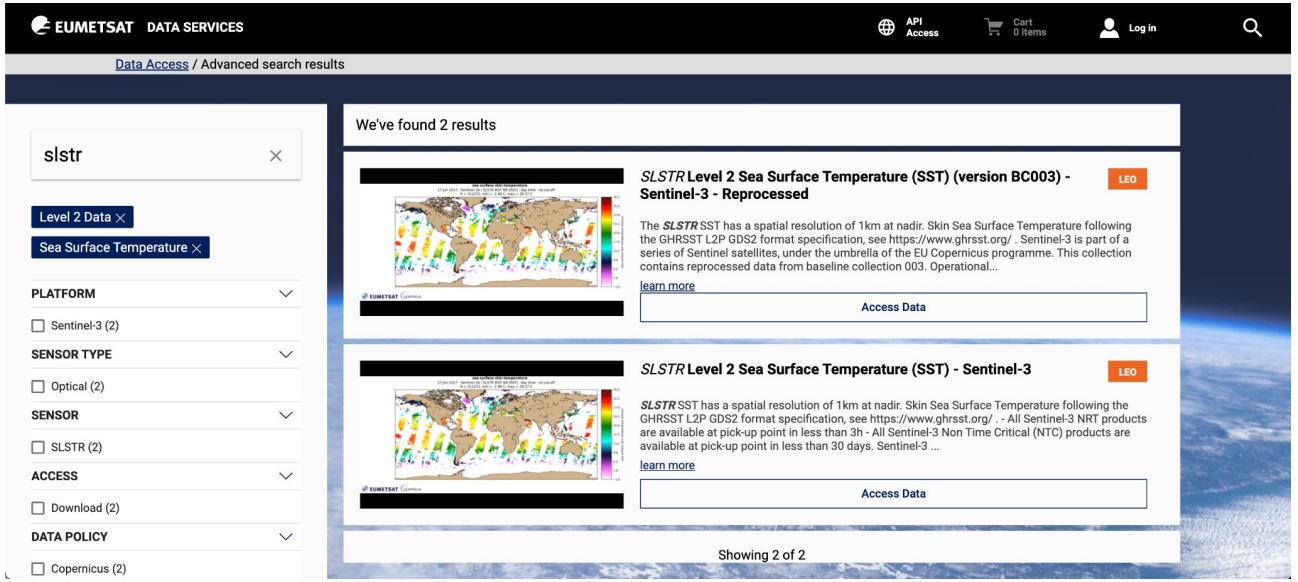


Carefully select night time data to compare to SST foundation climatologies.

Data Access and Distribution Means: EUMETSAT Copernicus data

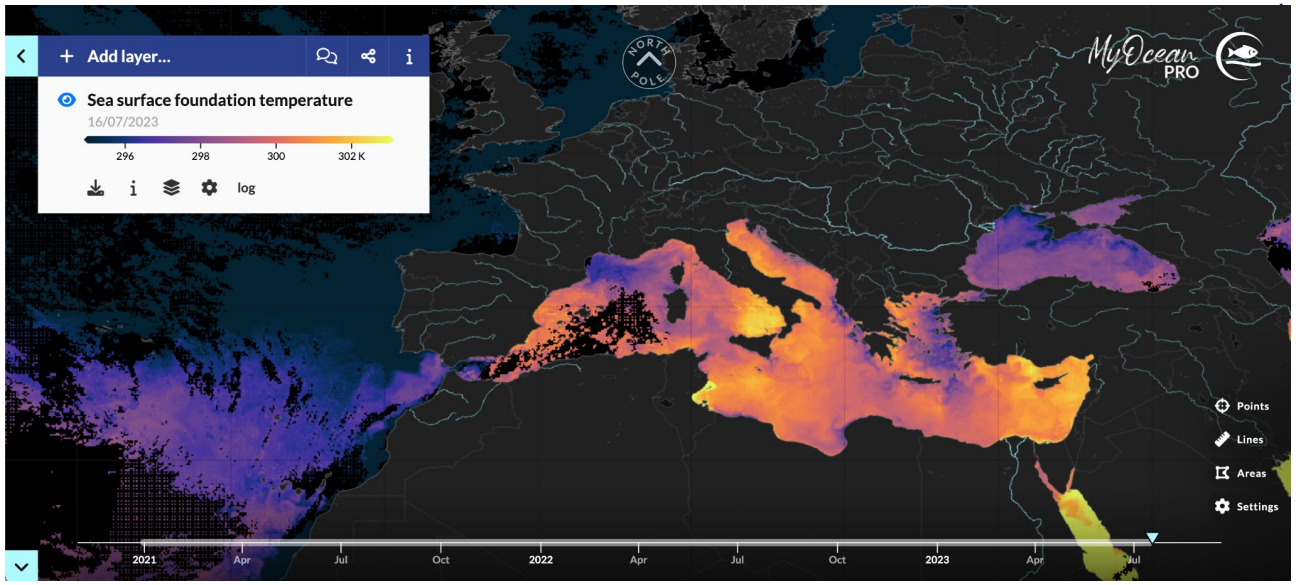
- The EUMETView WMS service provides “quick view” access to see NRT SLSTR SST products.
  - https://view.eumetsat.int
- SLSTR Level-1B/2 data, both operational and reprocessed, be accessed through the EUMETSAT Data Store.
  - https://data.eumetsat.int
- The Data Store provides API access for automated/routine searching, filtering and downloading of data. For examples see:
  - https://gitlab.eumetsat.int/eumetlab/oceans/ocean-training/sensors/learn-slstr
- Data are provided in “SAFE” format netCDF and in GHRSST L2P specification.

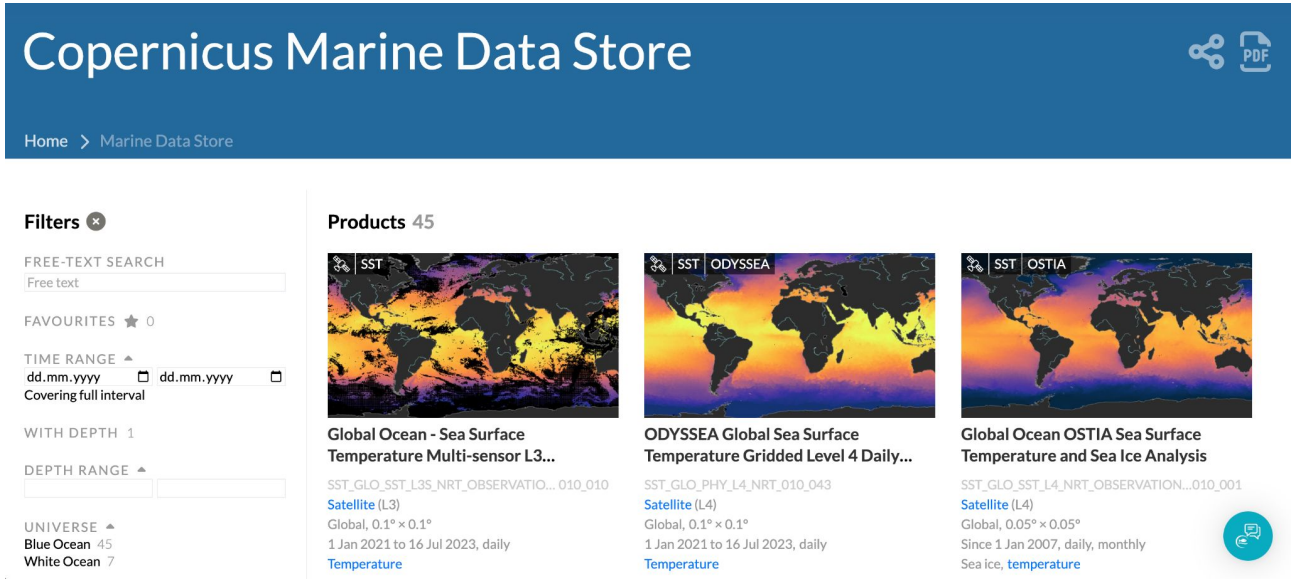




Data Access and Distribution Means: Copernicus service data

- The CMEMS MyOcean Pro service provides “quick view” access to see NRT SLSTR SST products.
  - https://data.marine.copernicus.eu/viewer/expert
- SST data at Level-3 and Level-4 can be sourced from the CMEMS Data Store.
  - https://data.marine.copernicus.eu/products
- The CMEMS Data Store provides API & openDAP access for searching, streaming and downloading of data. For examples see:
  - UPDATE WITH OCEAN CASE STUDIES
- Data are typically provided as netCDF.
- Climate data records for SST available though C3S
  - https://cds.climate.copernicus.eu/





Other datasets of interest

Beyond what is available through EUMETSAT, OSI SAF and the Copernicus Services there are other data sets that may be of interest in your applications;

- Coral Reef Watch use their own L4 SST dataset called CoralTemp. This is a daily global, 5km, night-time SST product, available from 1985 to present with high internal consistency (Skirving et al., 2020)

- NOAA also make extensive use of the NOAA Geo Polar Blended SST dataset (Maturi et al., 2017). This product aims to incorporate SLSTR in the future.

Thank you ! Questions ?

Thank you for attending !

Any questions ?

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