Marine Data Literacy Course
Data Harvesting and Data Harnessing

Online Data Portals

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University of Malta

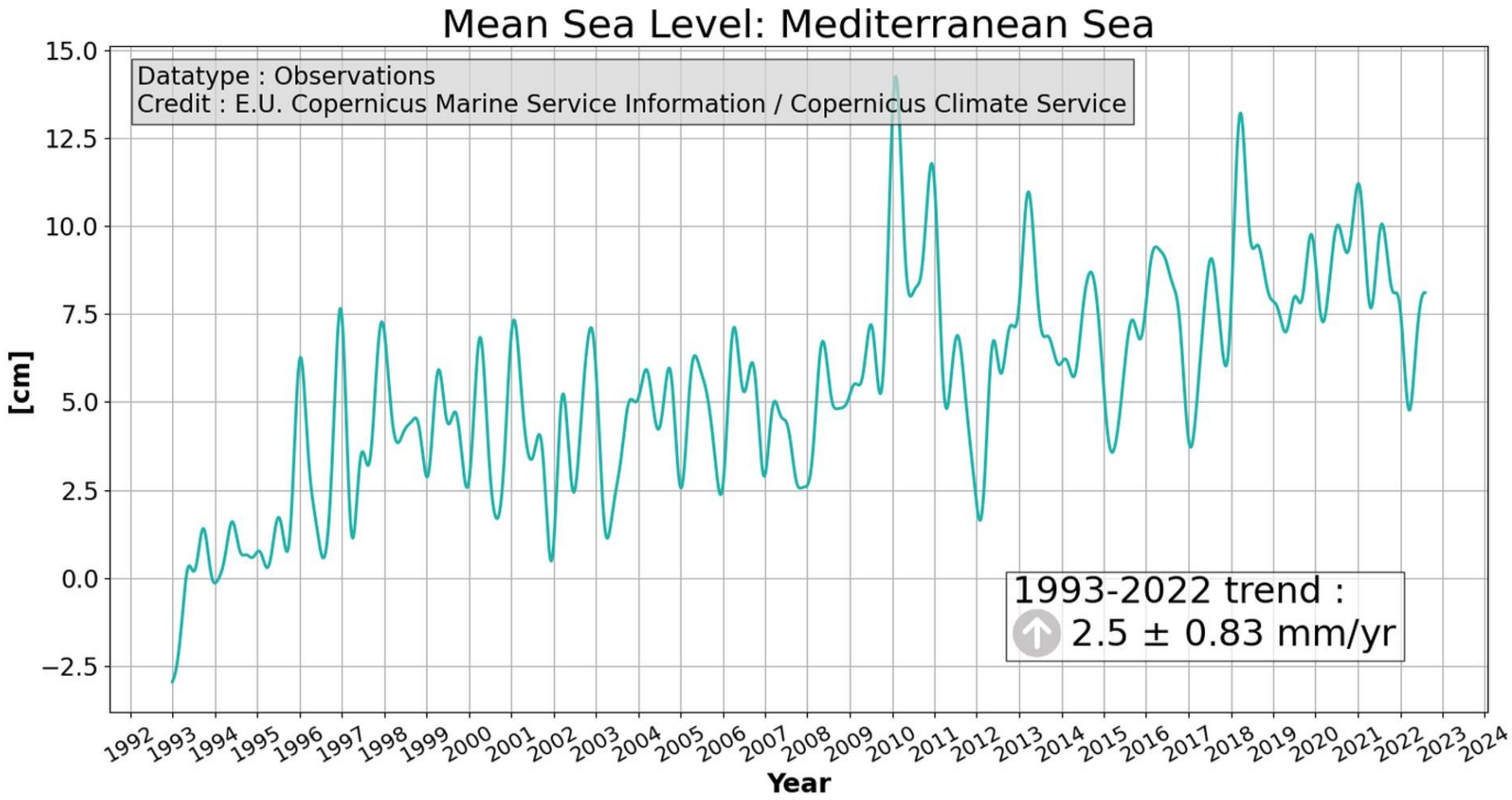
> Data is acquired and prepared once to be used by many.

> You can't manage what you can't measure.

Mean Sea Level

in Med Sea in the last 30 years

increased | decreased | remained the same



Copernicus Marine Service

Climate Change Service
climate.copernicus.eu

European Commission

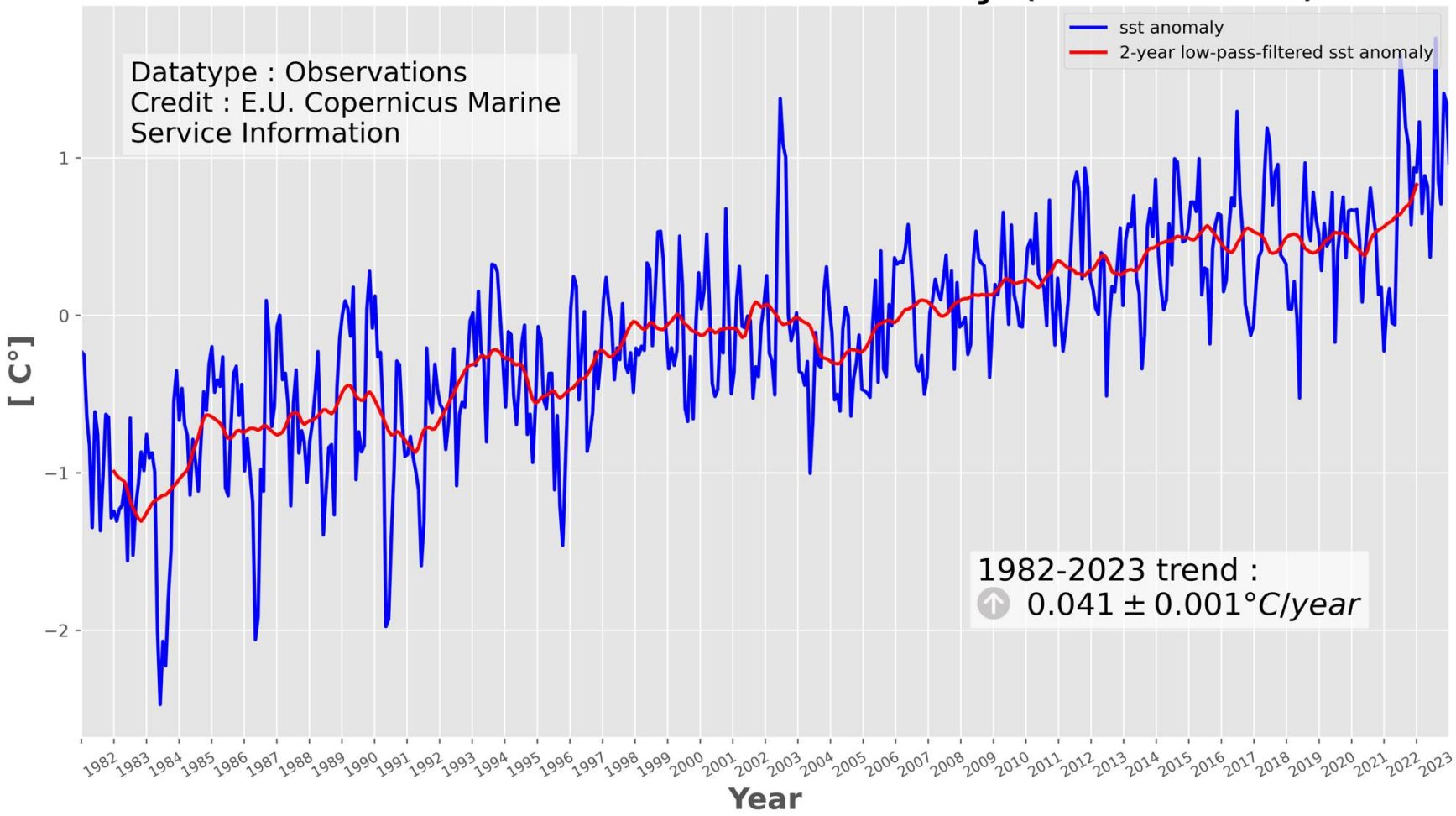
Copernicus
Europe's eyes on Earth

implemented by
MERCATOR OCEAN INTERNATIONAL

Sea Surface Temperature
in Med Sea in the last 30 years

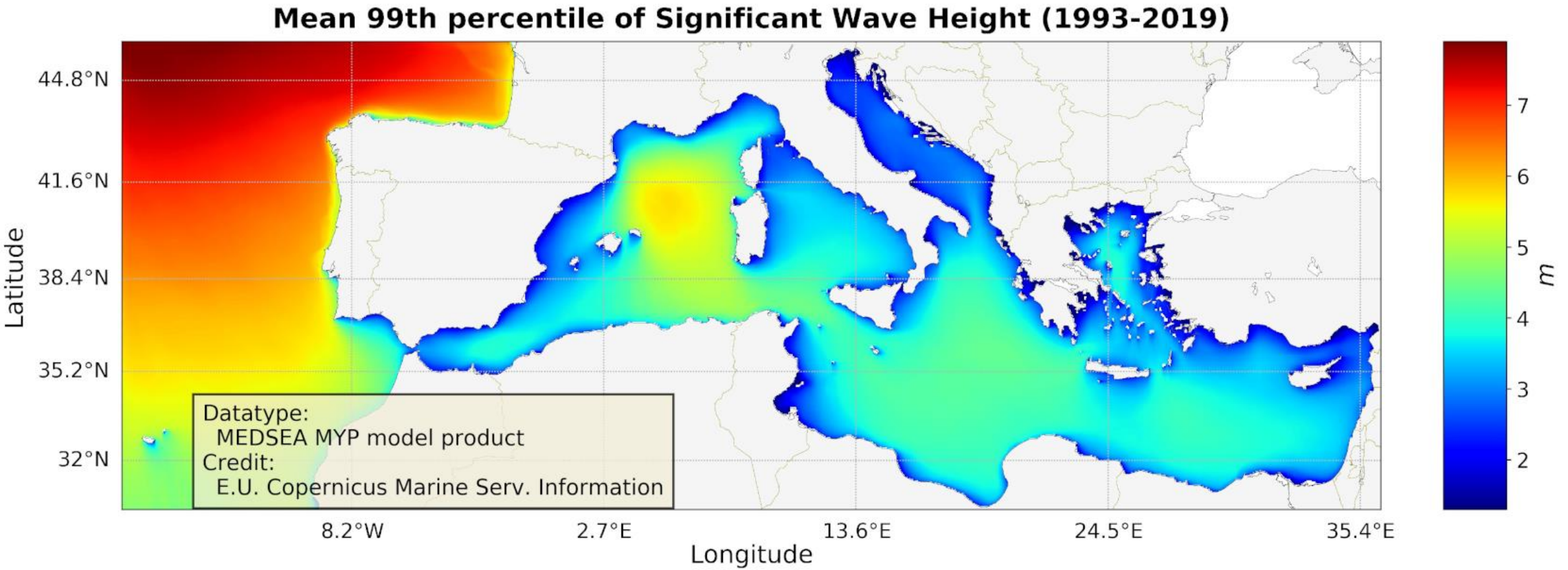
increased | decreased | remained the same

Mediterranean Sea SST Anomaly (1982-2023)



Highest Waves
in Mediterranean Sea

west | central | east

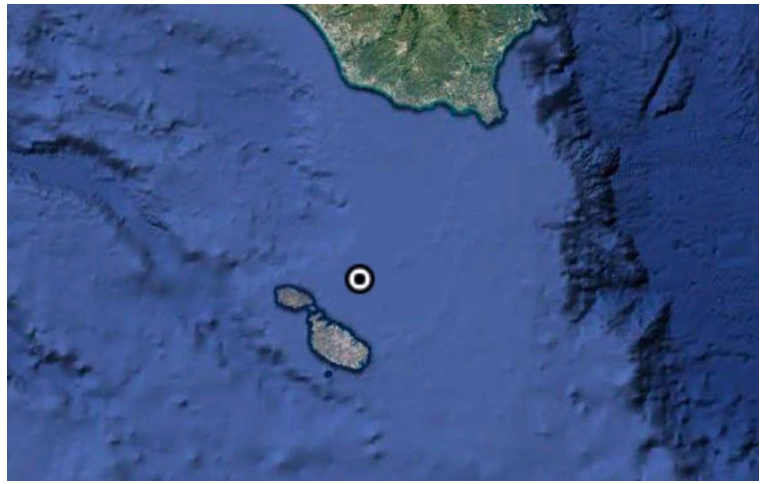
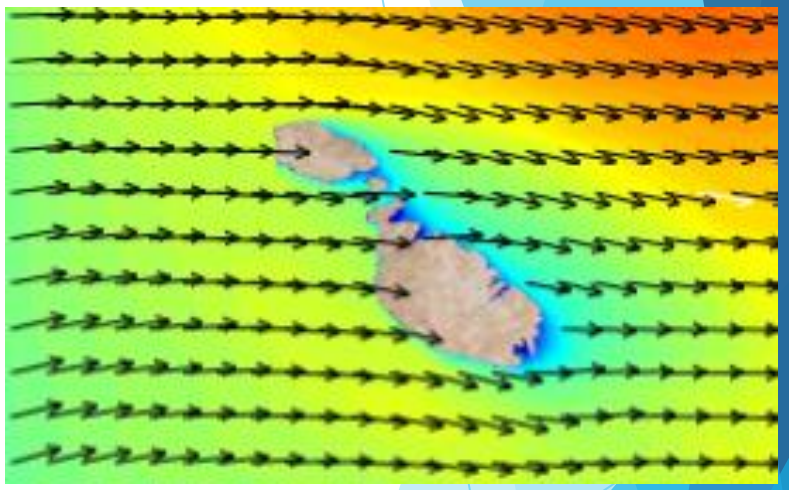

Mean 99th percentile of Significant Wave Height (1993-2019)
44.8°N
41.6°N
38.4°N
35.2°N
32°N
Latitude
8.2°W
2.7°E
13.6°E
24.5°E
35.4°E
Longitude
Datatype:
MEDSEA MYP model product
Credit:
E.U. Copernicus Marine Serv. Information
7
6
5
4
3
2
m

DATA

Outline

- **COPERNICUS Marine Data Portal**
  - NetCDF
  - PANOPLY
  - Matlab scripts
- **EMODnet**
  - EMODnet Bathymetry / Human-Activities / Physics / Ingestion
  - QGIS
- **The European Space Agency (ESA) Data Hub**
  - Sentinel Application Platform (SNAP)
  - Oil spill detection
  - CHL / TSM
- **World Ocean Database**
  - Ocean Data View (ODV)

Data

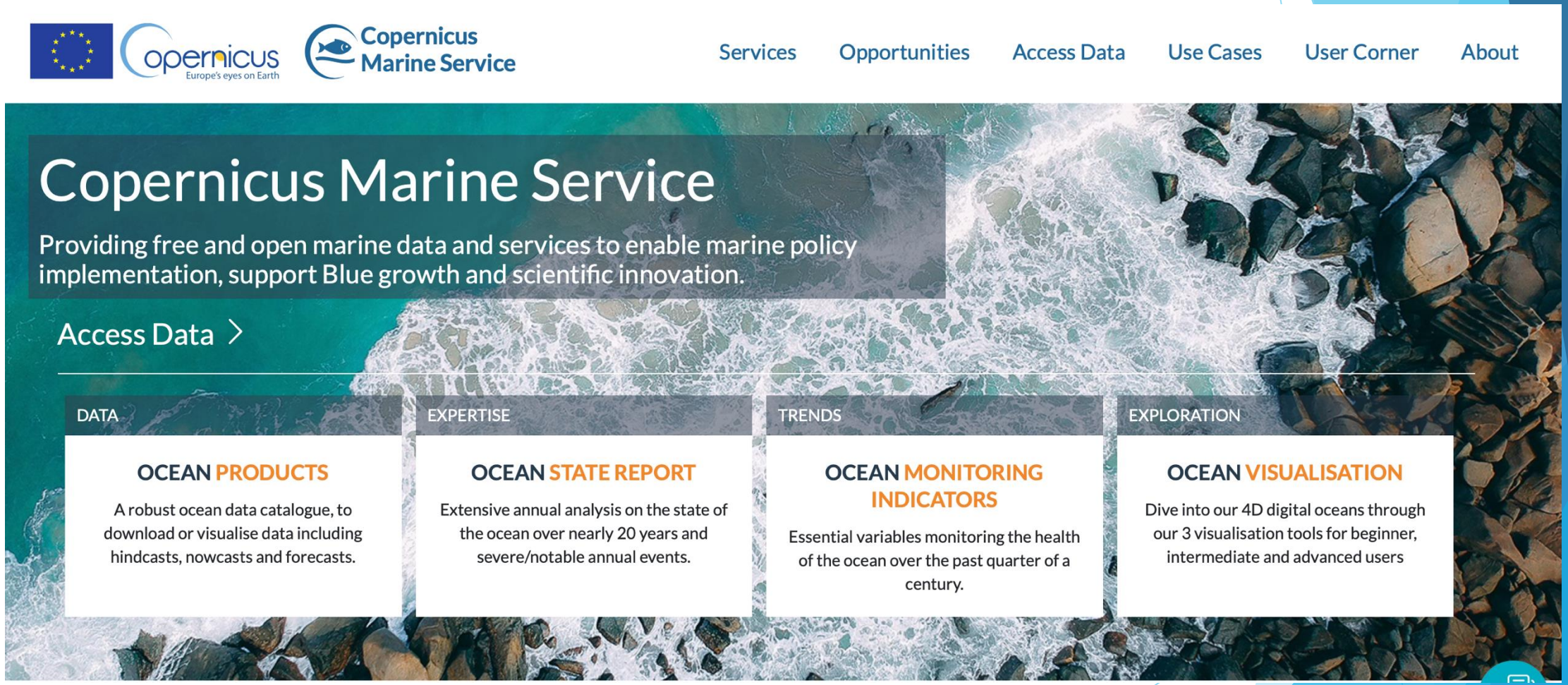
In-Situ	Remote Sensing	Models
		

Copernicus

Copernicus Marine Environment Monitoring Service (CMEMS)

- Integrated Service
- Open and Free
- Single Catalogue of Products
- Reliable
- Sustainable

Copernicus



marine.copernicus.eu

PROGRAMME OF
THE EUROPEAN UNION

Copernicus

Copernicus
Marine Service

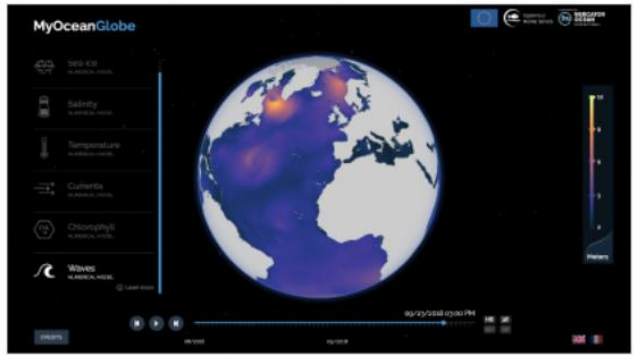
implemented by

MERCATOR
OCEAN
INTERNATIONAL

Copernicus [Data Visualising Tools]

MYOCEAN LEARN

(BEGINNER) GLOBE

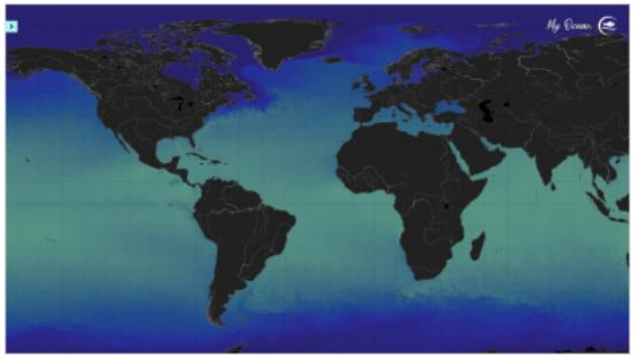


Understand key variables

Explore MyOcean Learn

MYOCEAN LIGHT

(INTERMEDIATE) PLANISPHERE

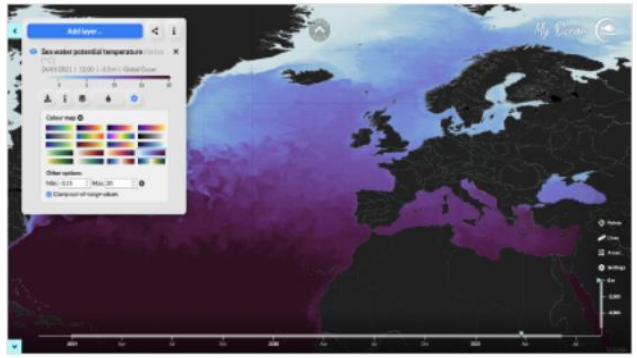


Access key variables

Explore MyOcean Light

MYOCEAN PRO

(EXPERT) PLANISPHERE



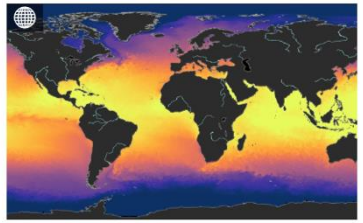
Access full catalogue

Explore MyOcean Pro

Copernicus [Ocean Products]

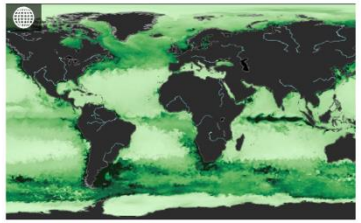
Products 303

MOST POPULAR



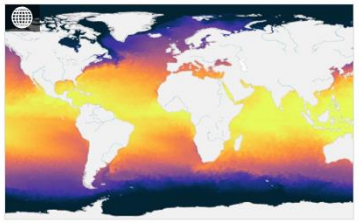
Global Ocean Physics Analysis and Forecast

GLOBAL_ANALYSISFORECAST_P... 001_024
Models
Global, 0.083° × 0.083° × 50 levels
1 Nov 2020 to 26 Mar 2025, hourly, daily,...
Temperature, salinity, sea surface height, velocity, mixed layer thickness, wave, sea ice...



Global Ocean Biogeochemistry Analysis and Forecast

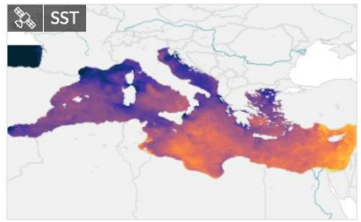
GLOBAL_ANALYSISFORECAST_B... 001_028
Models
Global, 0.25° × 0.25° × 50 levels
1 Oct 2021 to 21 Mar 2025, daily, monthly
Plankton, nutrients, oxygen, carbonate system, optics



Global Ocean Physics Reanalysis

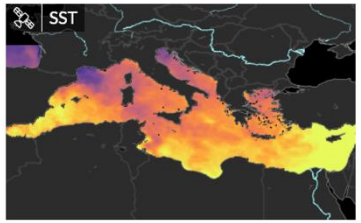
GLOBAL_MULTIYEAR_PHY_001_030
Models
Global, 0.083° × 0.083° × 50 levels
1 Jan 1993 to 25 Feb 2025, daily, monthly
Temperature, salinity, sea surface height, velocity, mixed layer thickness, sea ice

RECENTLY VIEWED



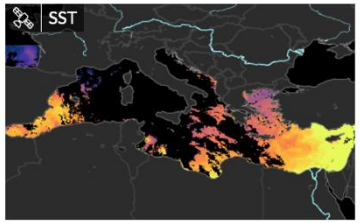
Mediterranean Sea - High Resolution L4 Sea Surface...

SST_MED_SST_L4_REP_OBSERVA... 010_021
Satellite (L4)
Med Sea, 0.05° × 0.05°
1 Jan 1982 to 14 Feb 2025, daily
Temperature



Mediterranean Sea High Resolution and Ultra High...

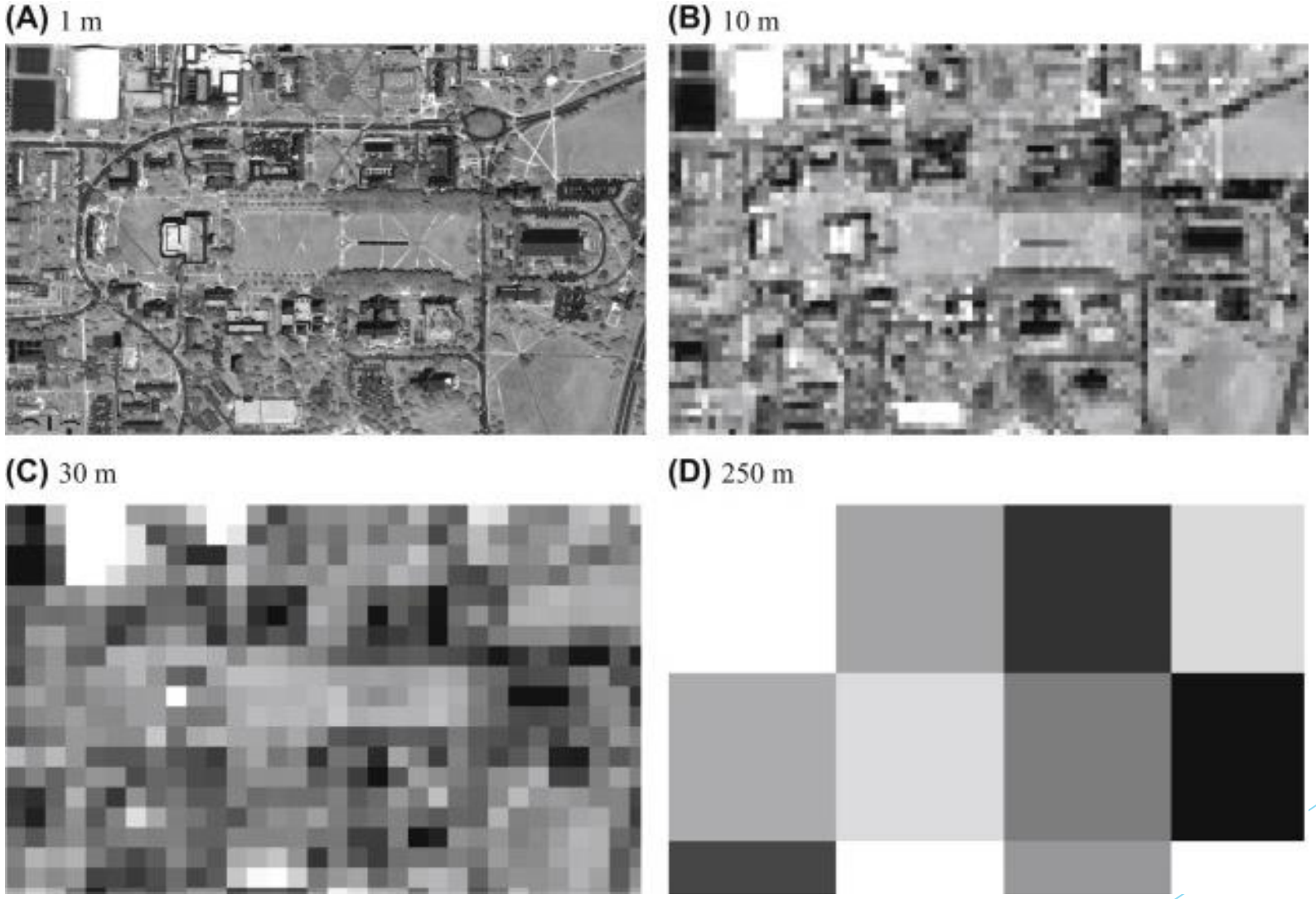
SST_MED_SST_L4_NRT_OBSERVA... 010_004
Satellite (L4)
Med Sea, 0.01° × 0.01°
1 Jan 2008 to 16 Mar 2025, daily
Temperature



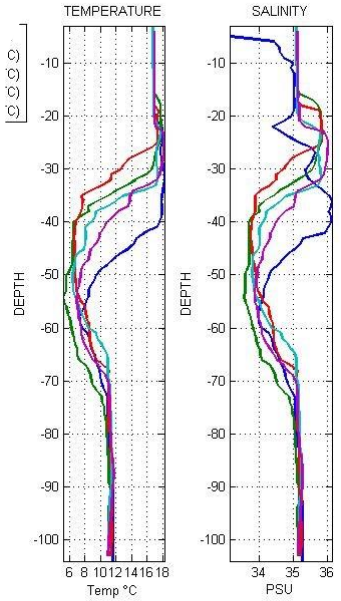
Mediterranean Sea - High Resolution and Ultra High...

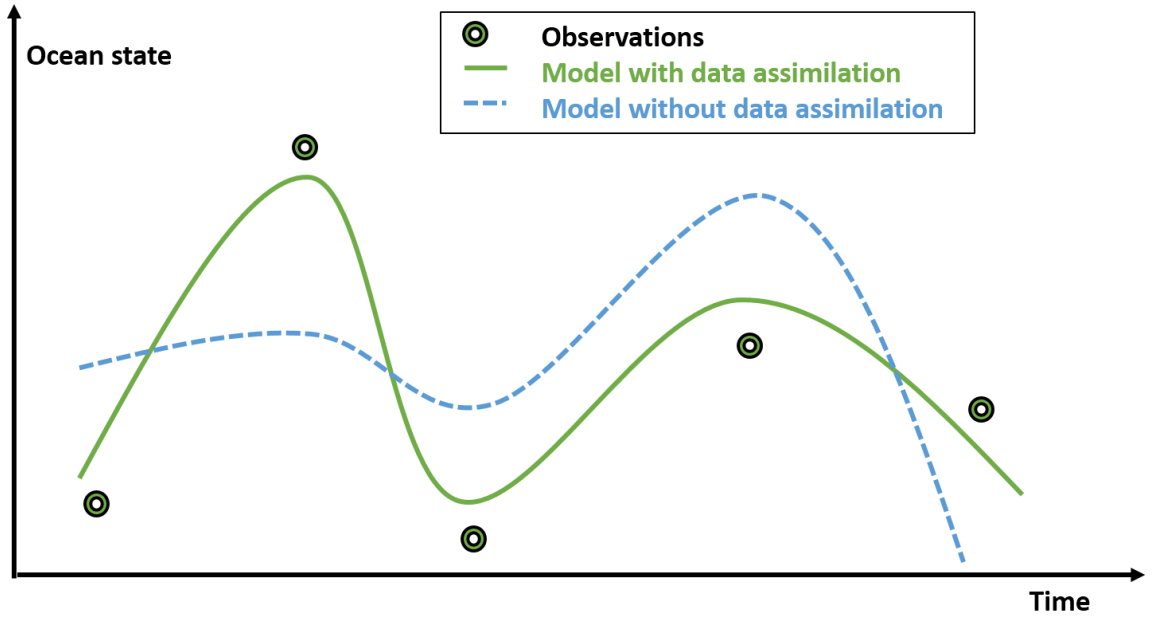
SST_MED_SST_L3S_NRT_OBSERV... 010_012
Satellite (L3)
Med Sea, 0.01° × 0.01°
1 Jan 2008 to 16 Mar 2025, daily
Temperature

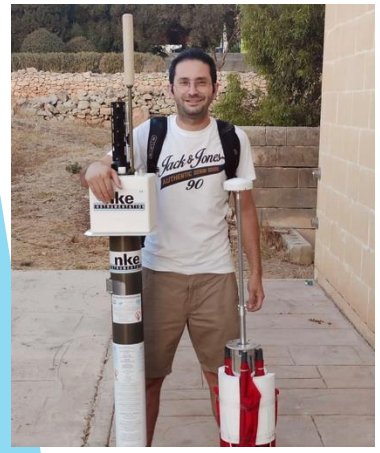
Copernicus [Spatial Resolution]

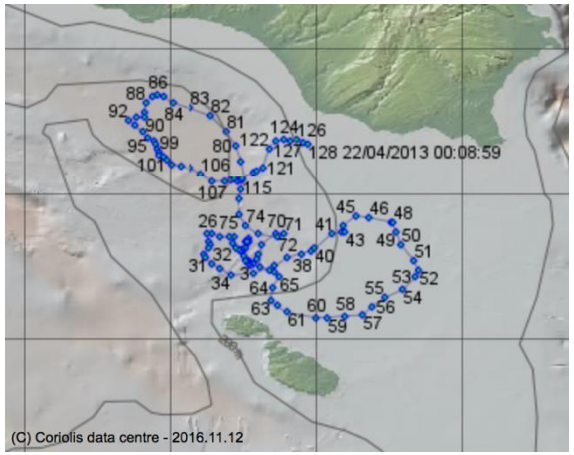


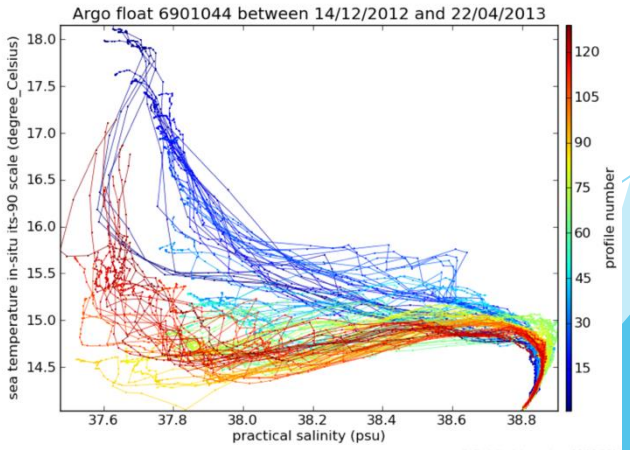
Copernicus [Data Assimilation]



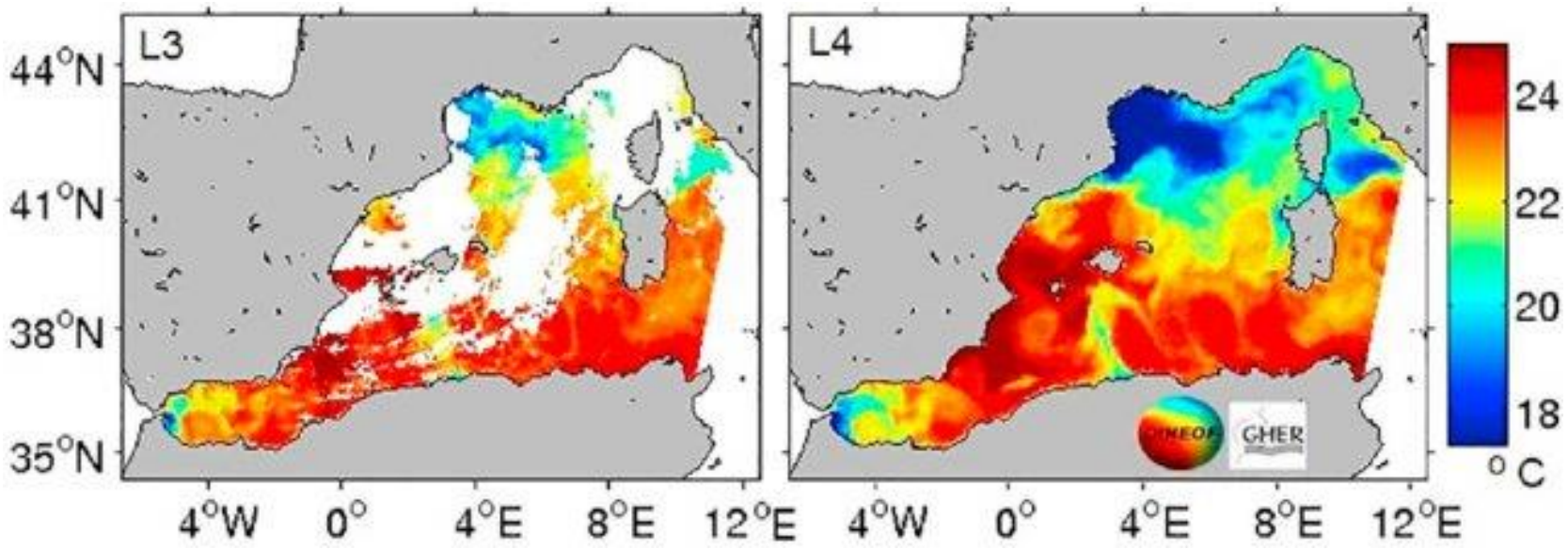








Copernicus [Satellite Data Levels]



Source: Minnett, P.J., et al., 2019. Half a century of satellite remote sensing of sea-surface temperature. *Remote Sensing of Environment*, *233*, p.111366.

Copernicus [Example]

- **Mediterranean Sea Physics Reanalysis**
  MEDSEA_MULTIYEAR_PHY_006_004

- **Mediterranean Sea High Resolution and Ultra High Resolution Sea Surface Temperature Analysis**
  SST_MED_SST_L4_NRT_OBSERVATIONS_010_004

Copernicus [Example]

Data access

MEDSEA_ANALYSISFORECAST_PHY_006_013

Mediterranean Sea Physics Analysis and Forecast

Dataset selected: med-cmcc-tem-an-fc-h

Geographical area

N: 40

W: 10

E: 18

S: 33

Reset geographical selection

Time range

(Default = Last date available)

☐ Select all dates

Start date: 2021-10-20 00:30:00

End date: 2021-10-22 23:30:00

Depth

(Default = Surface depth)

☐ Select all depths

Start depth: 1.0182

End depth: 1005.1355

Variables

(Default = All variables)

☑	Name	Description	Standard name	Units
☑	bottomT	sea floor potential temperature	sea_water_potential_temperature_at_sea_floor	degrees_C
☑	thetao	potential temperature	sea_water_potential_temperature	degrees_C

Copernicus [Example]

Data access

SST_MED_SST_L4_NRT_OBSERVATIONS_010_004

Mediterranean Sea High Resolution and Ultra High Resolution Sea Surface Temperature Analysis

Dataset selected

SST_MED_SST_L4_NRT_OBSERVATIONS_010_004_c_V2

Geographical area

N 40

W 10

E 18

S 33

Reset geographical selection

Time range

(Default = Last date available)

☐ Select all dates

Start date 2021-10-20 00:00:00

End date 2021-10-22 00:00:00

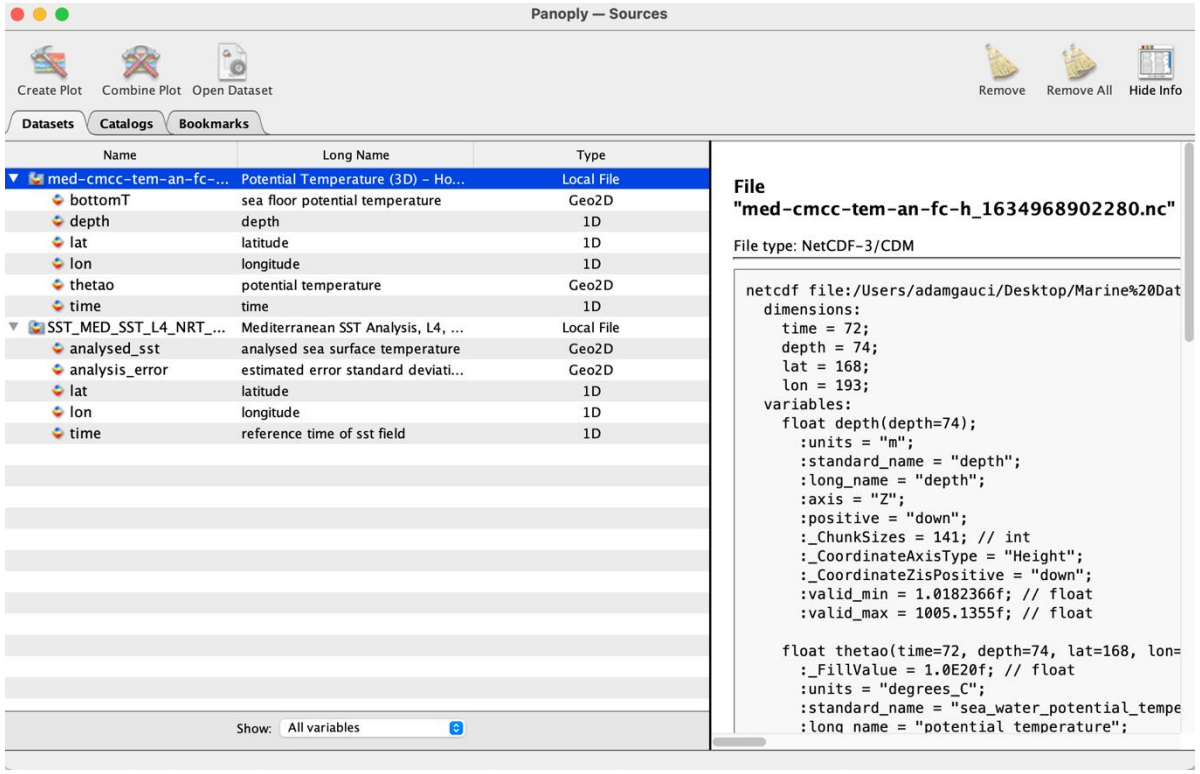
Variables

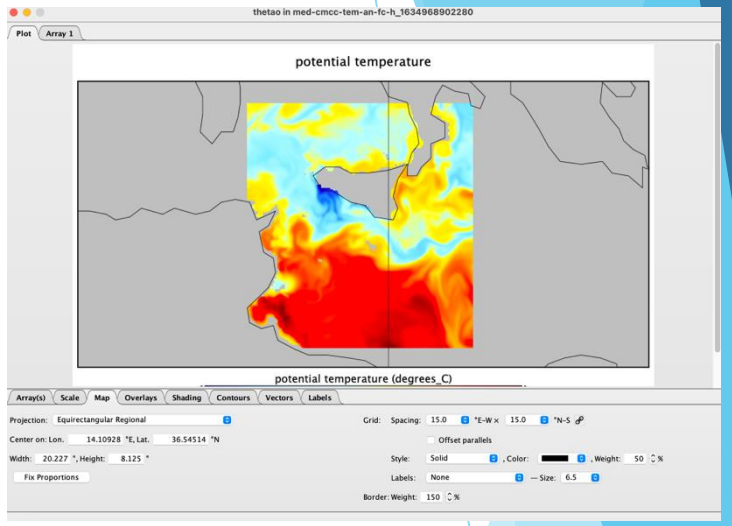
(Default = All variables)

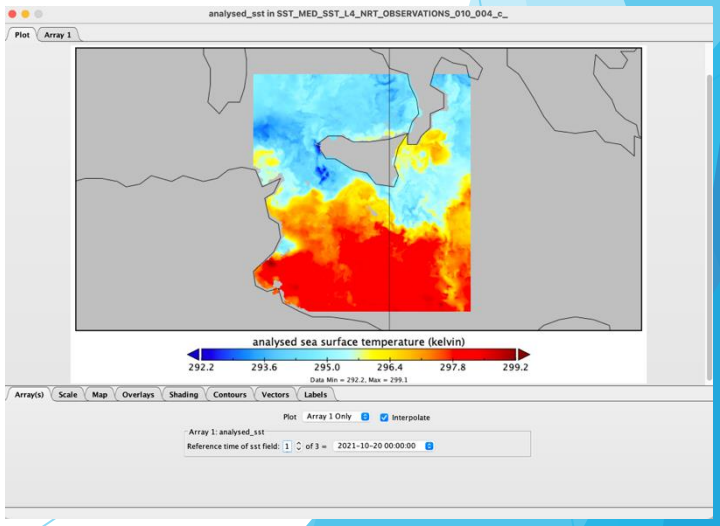
☑	Name	Description	Standard name	Units
☑	analysed_sst	analysed sea surface temperature	sea_surface_temperature	kelvin
☑	analysis_error	estimated error standard deviation of analysed_sst		kelvin

Panoply

https://www.giss.nasa.gov/tools/panoply/download/







Matlab

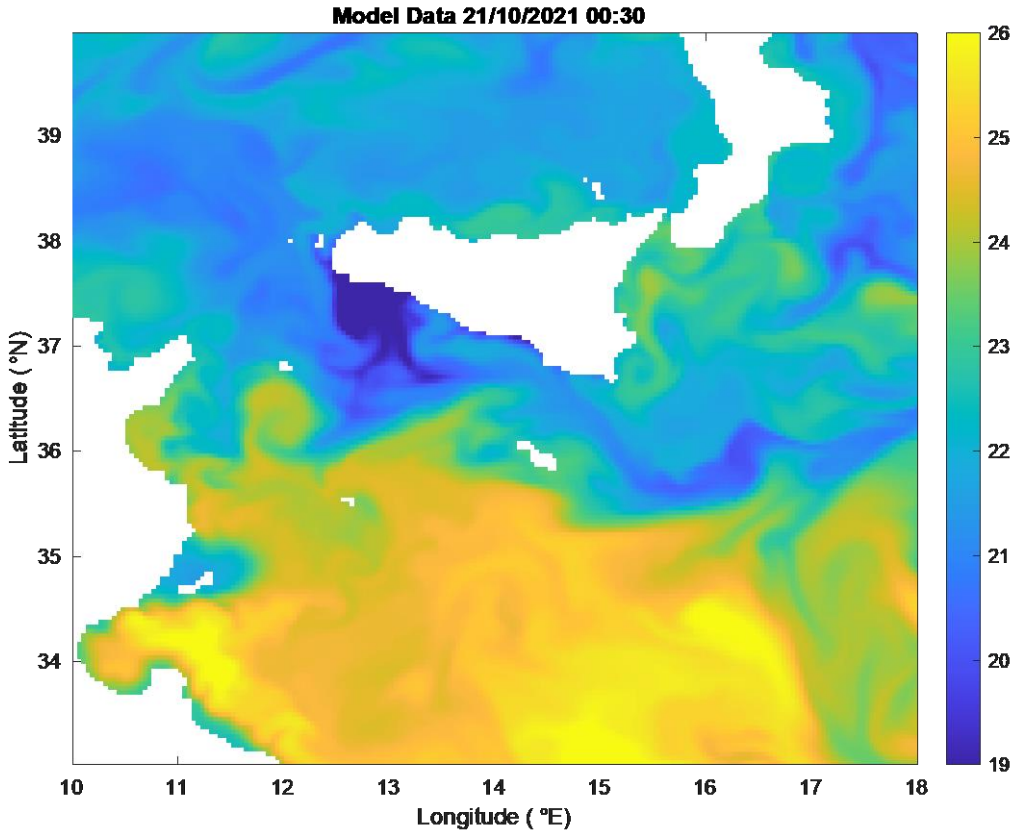
```
%reading model data
model_filename = 'med-cmcc-tem-an-fc-h_1634968902280.nc';
model_lon = ncread(model_filename, 'lon');
model_lat = ncread(model_filename, 'lat');
model_depth = ncread(model_filename, 'depth');
model_time= ncread(model_filename, 'time');
model_data = ncread(model_filename, 'thetao');

%extracting the first depth level
%for all frames
figure
for h = 1:1:size(model_data, 4)
    model_data_temp = model_data(:,:,1, h);
    pcolor(model_lon, model_lat, model_data_temp');
    box on;
    shading flat;
    title(['Hour = ', num2str(h)]);
    xlabel('Longitude (\circE)');
    ylabel('Latitude (\circN)');
    caxis([19 26]);
    colorbar;
    pause (0.1);
    drawnow;
end
```

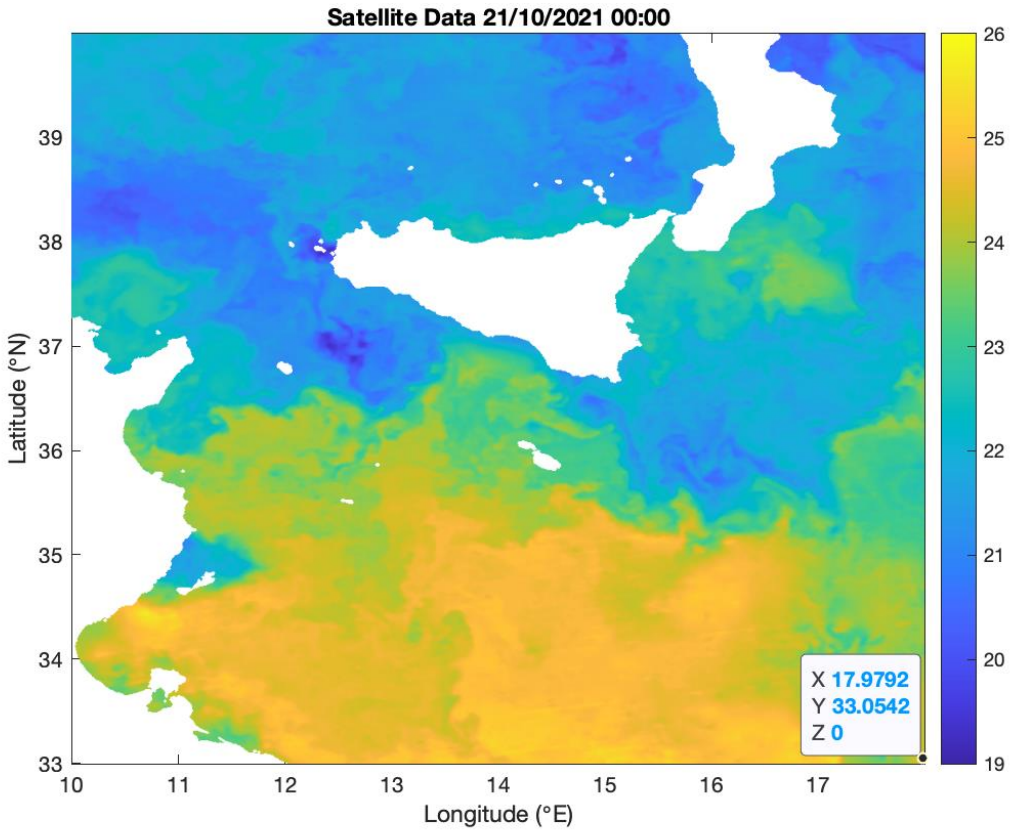
```
%extracting all depth levels
%for the first time frame
figure
for d = 1:1:size(model_data, 3)
    model_data_temp = model_data(:,:, d, 1);
    pcolor(model_lon, model_lat, model_data_temp');
    box on;
    shading flat;
    title(['Depth = ', num2str(model_depth(d)), 'm']);
    xlabel('Longitude (\circE)');
    ylabel('Latitude (\circN)');
    colorbar;
    pause (0.1);
    drawnow;
end

%------------

%extracting surface corresponidng to 21/10/2021 at 00:30
model_data_temp = model_data(:, :, 1, 25);
figure;
pcolor(model_lon, model_lat, model_data_temp');
box on;
shading flat;
title(['Model Data 21/10/2021 00:30']);
xlabel('Longitude (\circE)');
ylabel('Latitude (\circN)');
caxis([19 26]);
colorbar;
```

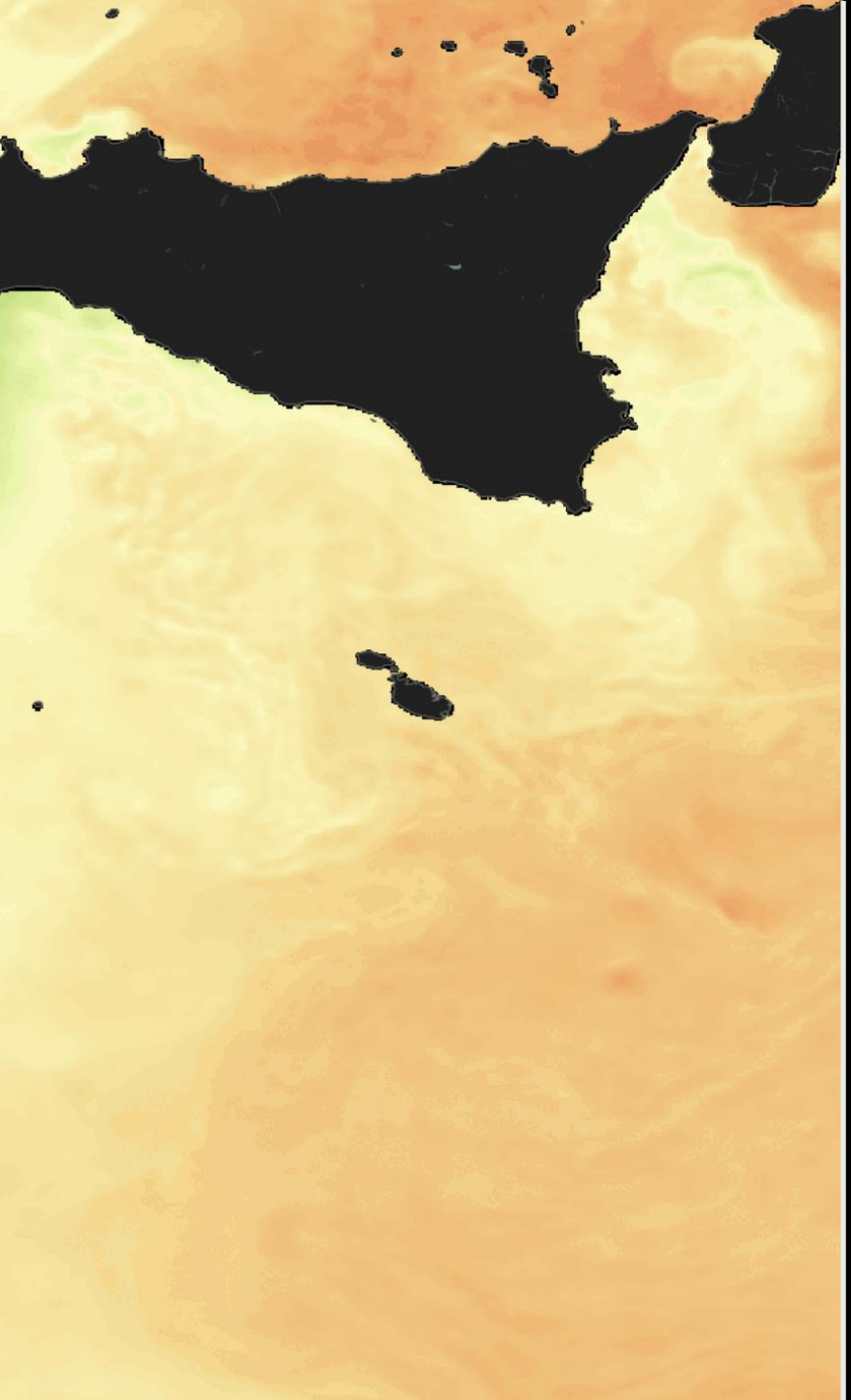
Matlab

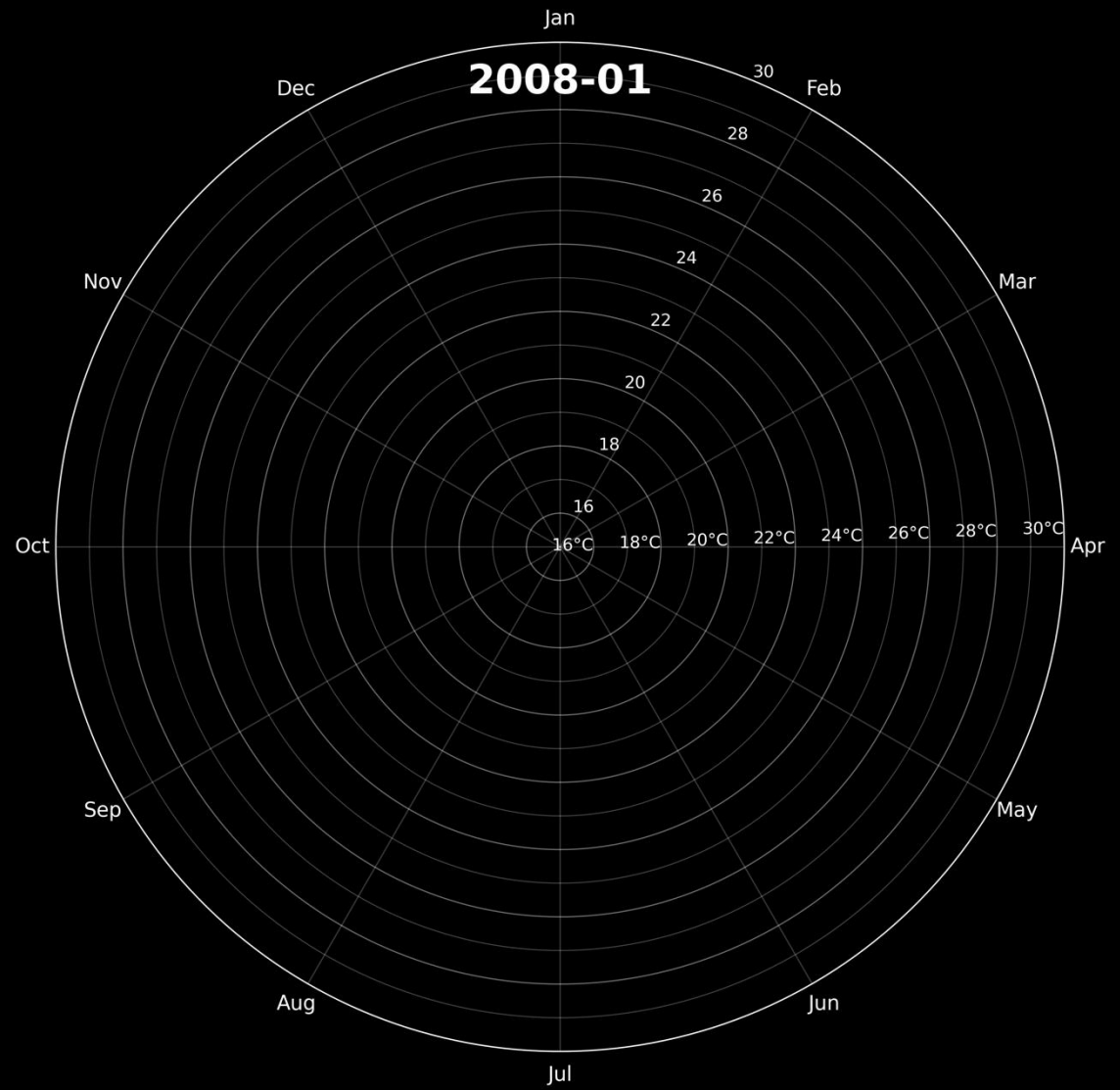
```
reading satellite file
sat_filename = 'SST_MED_SST_L4_NRT_OBSERVATIONS_010_004_c_V2_1634969733519.nc';
sat_lon = ncread(sat_filename, 'lon');
sat_lat = ncread(sat_filename, 'lat');
sat_time = ncread(sat_filename, 'time');
sat_data = ncread(sat_filename, 'analysed_sst');
sat_data = sat_data(:,:,2) - 273.15;
figure;
pcolor(sat_lon, sat_lat, sat_data');
box on;
shading flat;
title(['Satellite Data 21/10/2021 00:00']);
xlabel('Longitude (\circE)');
ylabel('Latitude (\circN)');
caxis([19 26]);
colorbar;

%------------

%mapping satellite data onto grid model
sat_data_interp = CommonGrid(model_lon, model_lat, model_data_temp, sat_lon,
sat_lat, sat_data);
plot(model_data_temp(:), sat_data_interp(:), '.');
axis equal;
axis tight;
xlabel('Model Data');
ylabel('Satellite Data');
axis([20 26 20 26]);
```

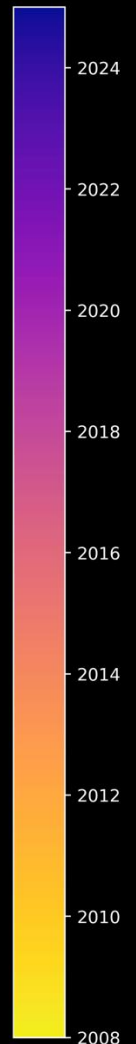
Matlab


Model Data 21/10/2021 00:30
Latitude (°N)
Longitude (°E)
39
38
37
36
35
34
10
11
12
13
14
15
16
17
18
26
25
24
23
22
21
20
19

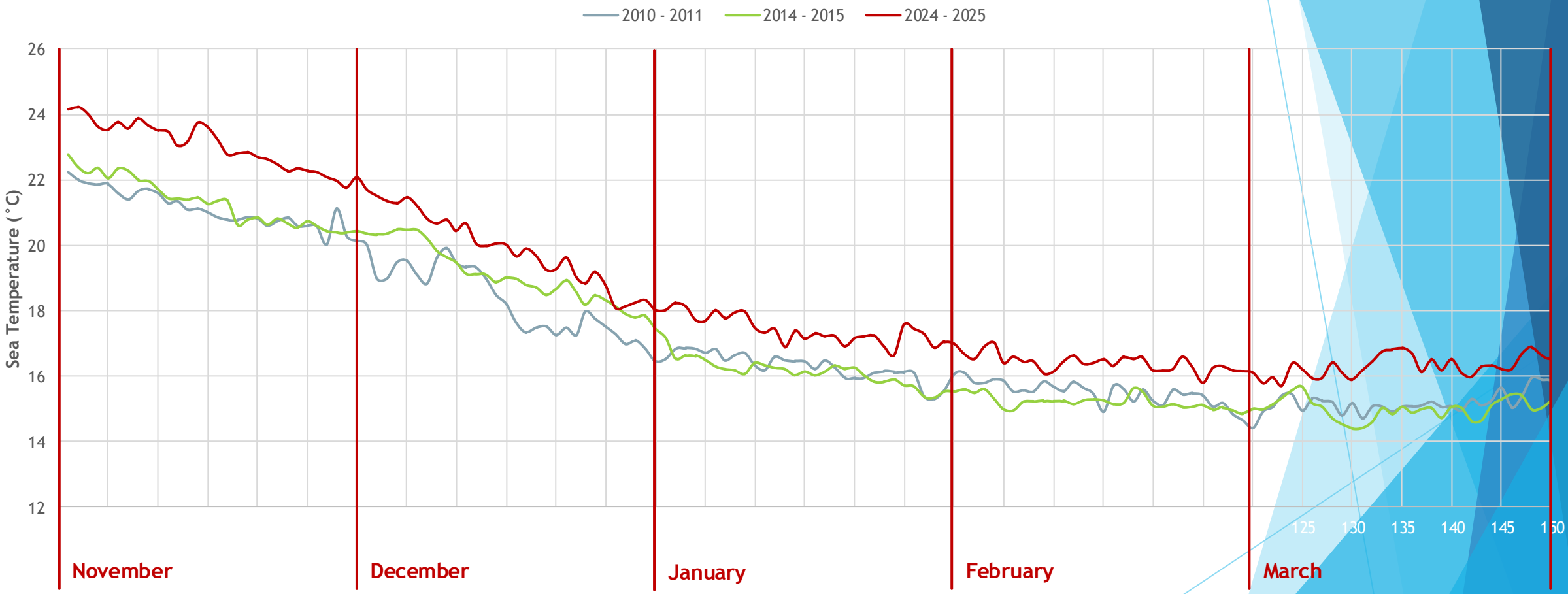

Satellite Data 21/10/2021 00:00
Latitude (°N)
Longitude (°E)
39
38
37
36
35
34
33
10
11
12
13
14
15
16
17
26
25
24
23
22
21
20
19
X 17.9792
Y 33.0542
Z 0



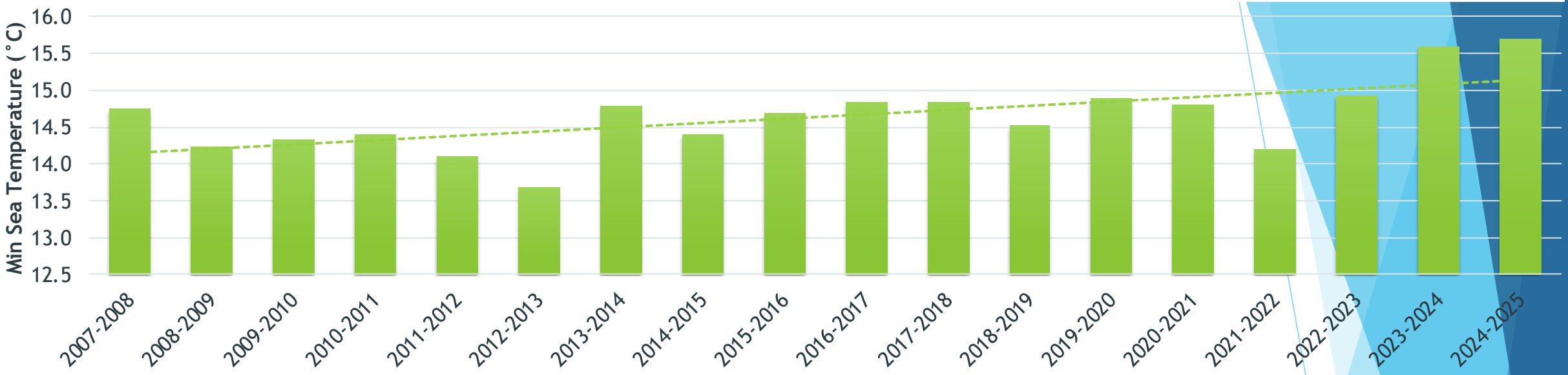

2008-01
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
16
18
20
22
24
26
28
30
16°C
18°C
20°C
22°C
24°C
26°C
28°C
30°C


2024
2022
2020
2018
2016
2014
2012
2010
2008

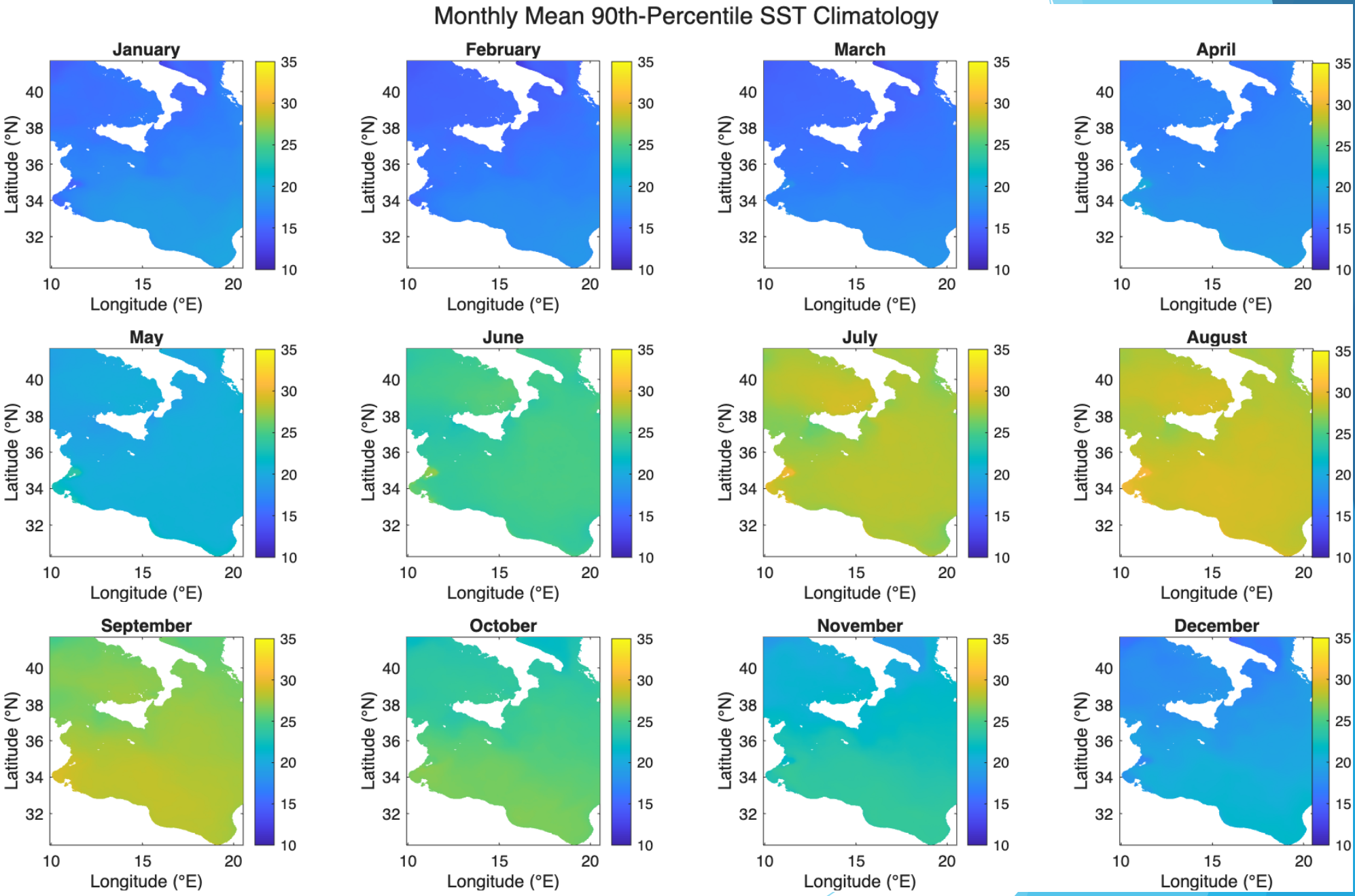
Daily Sea Surface Temperature
November to May



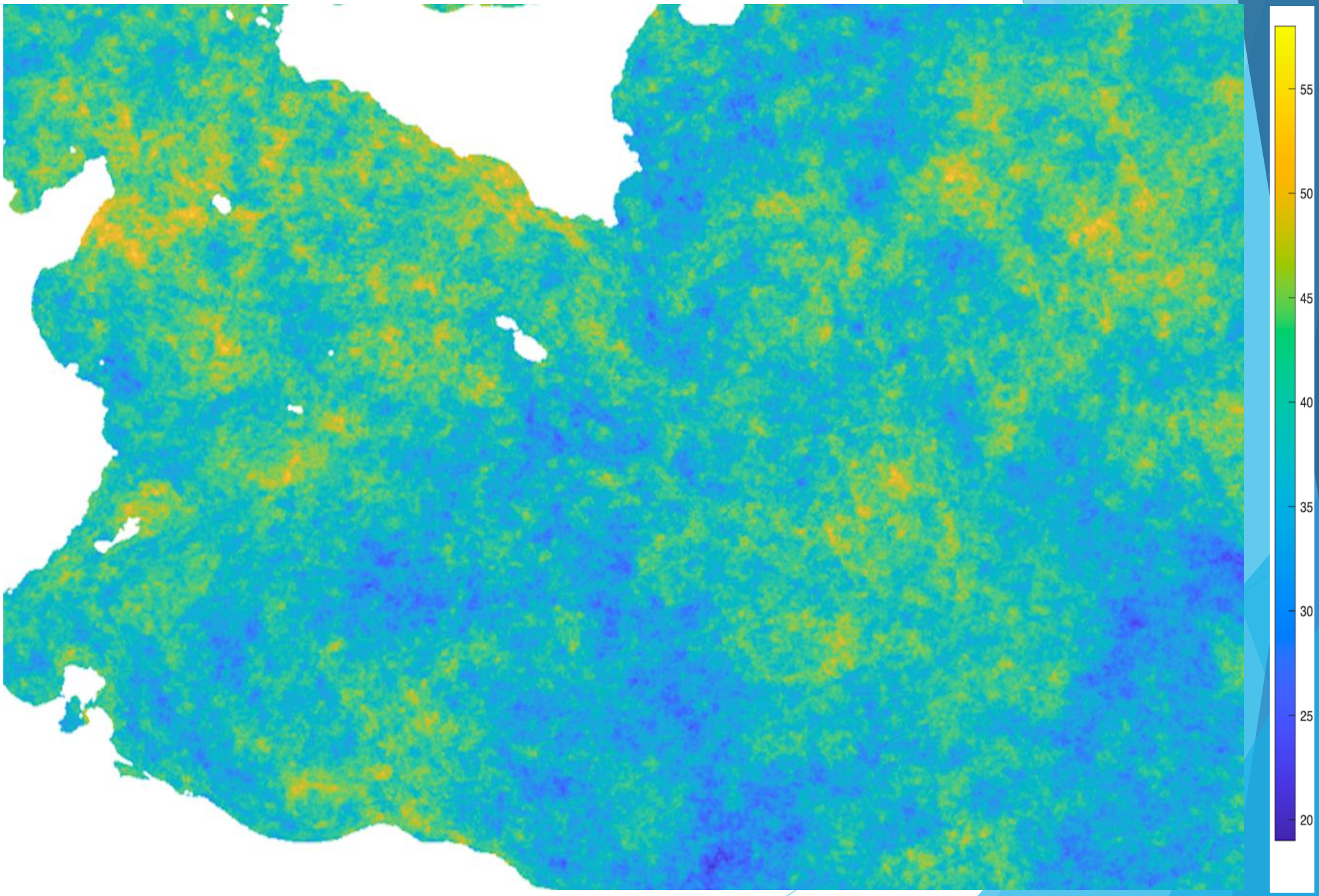
Winter Months (November - February)

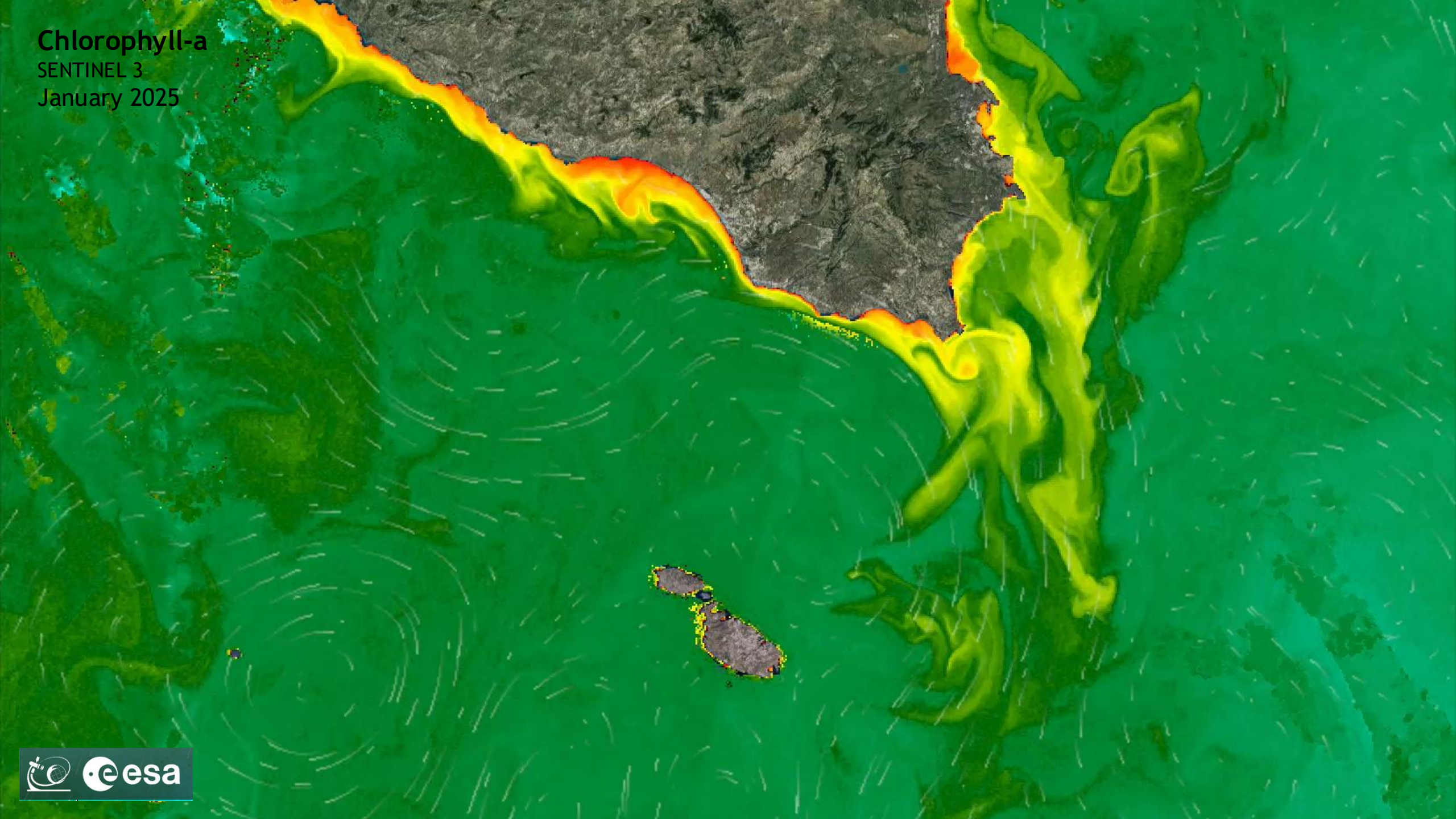


Climatology
90th Percentiles



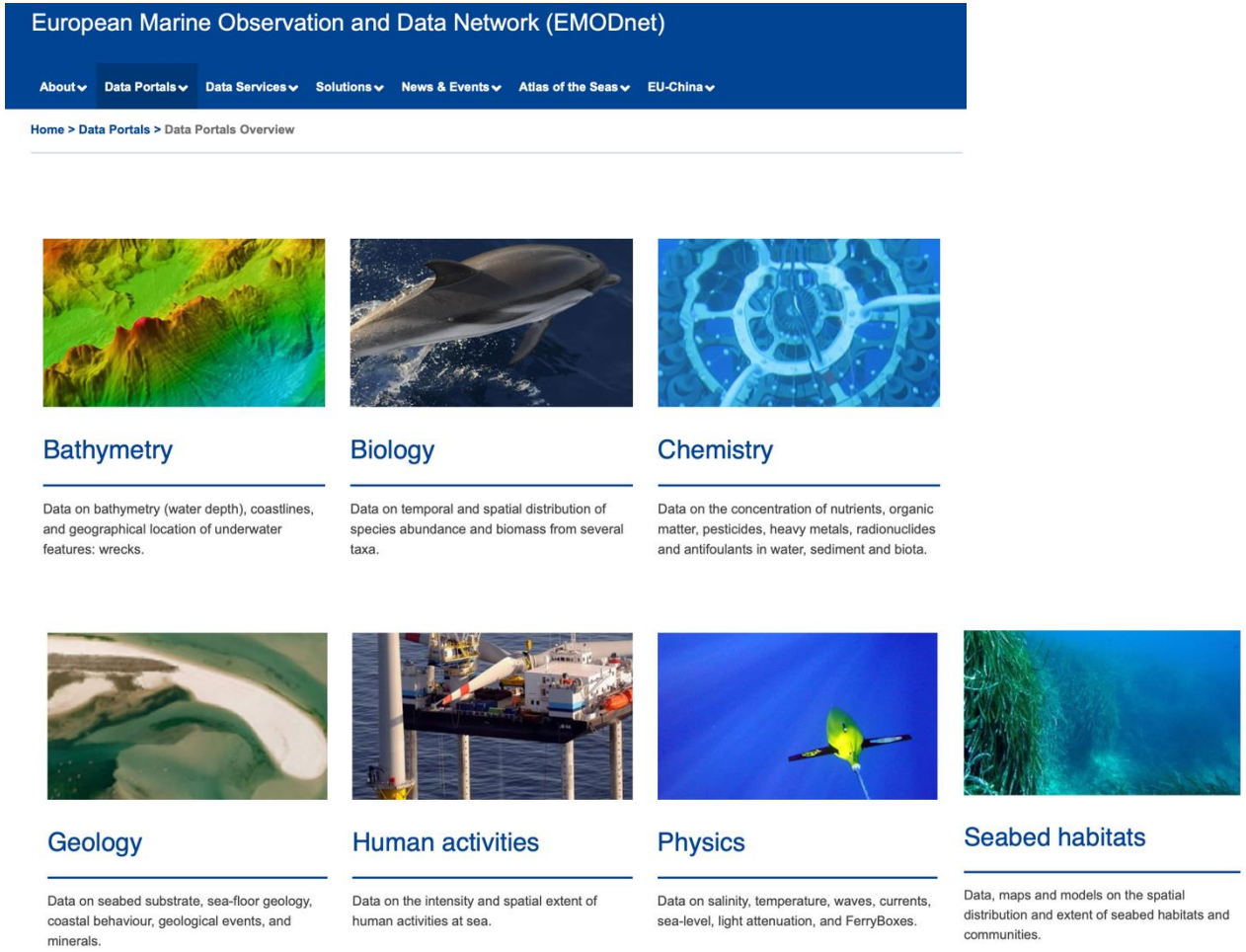
Detected Marine Heatwaves



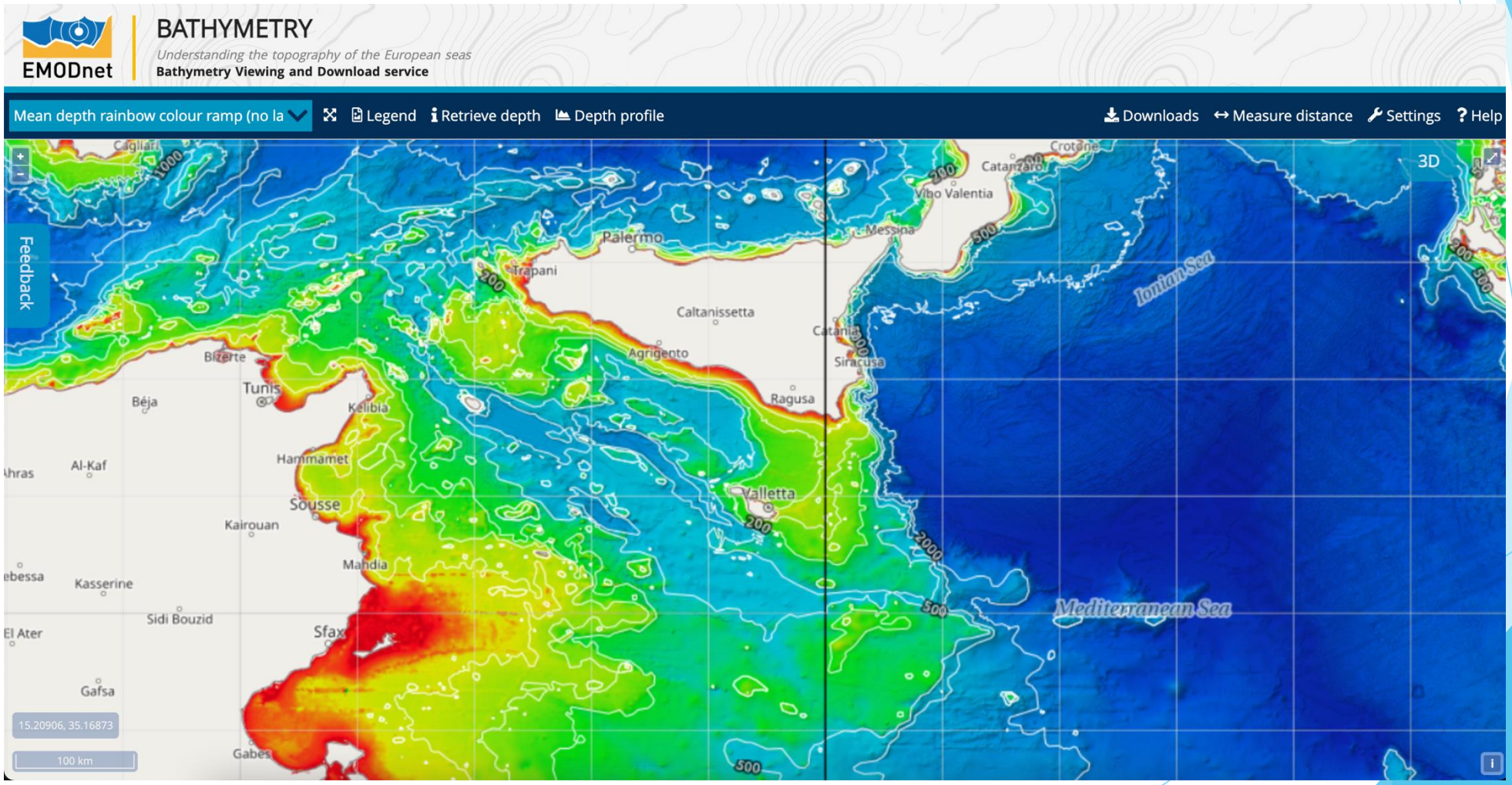

Chlorophyll-a
SENTINEL 3
January 2025
esa

EMODnet

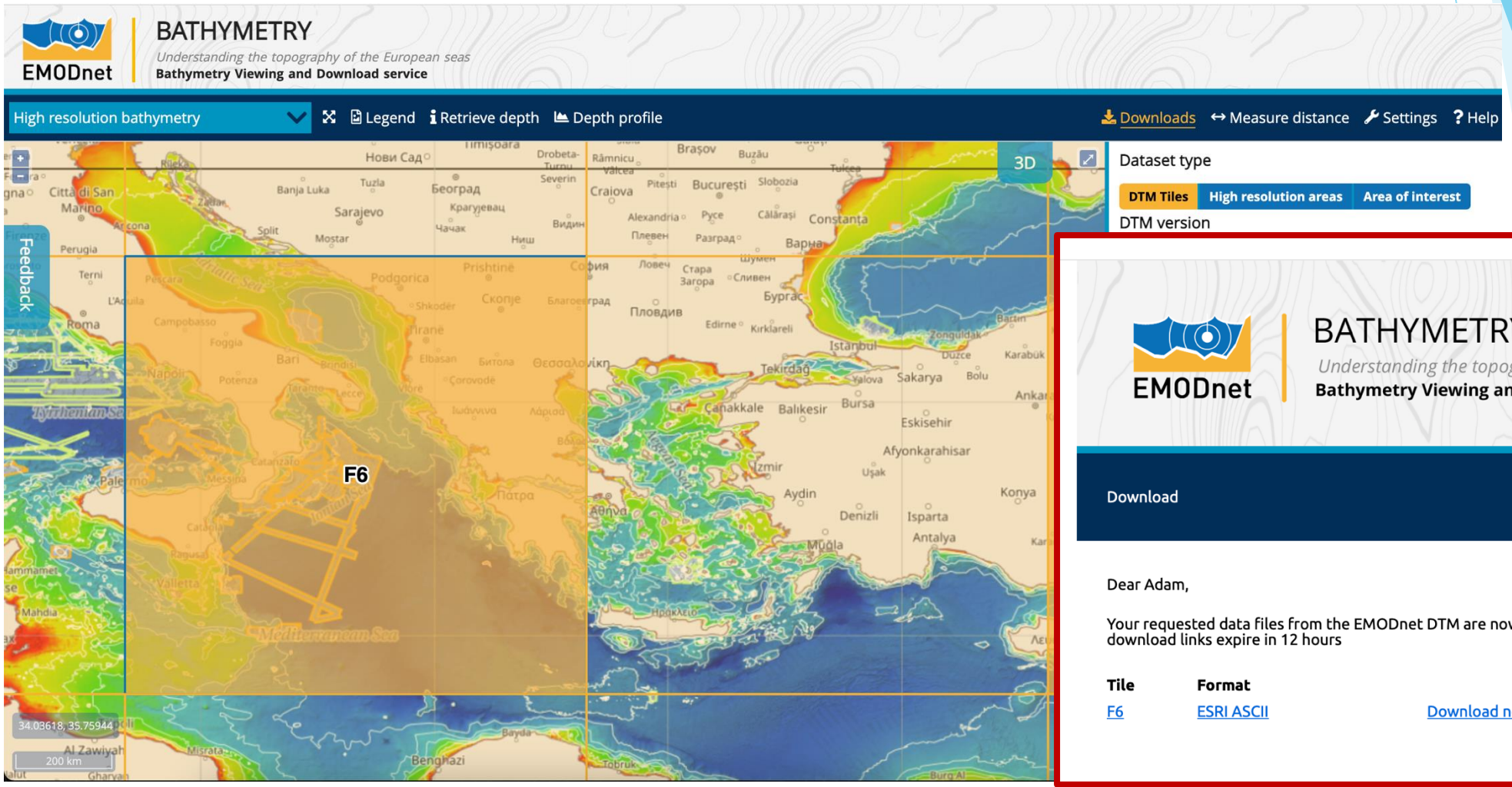
https://emodnet.ec.europa.eu/geoviewer/



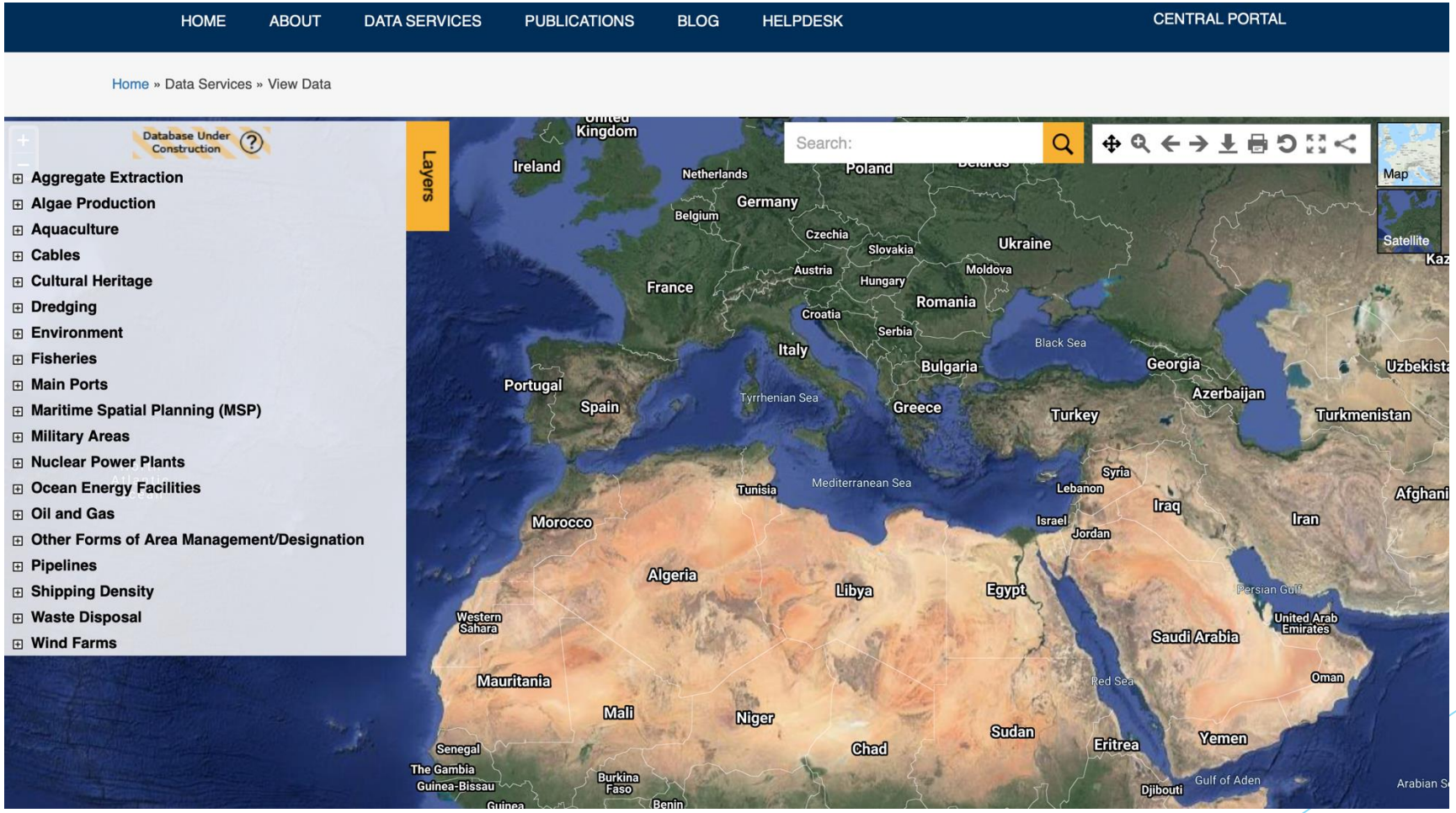
EMODnet [Bathymetry]



EMODnet [Bathymetry Download]



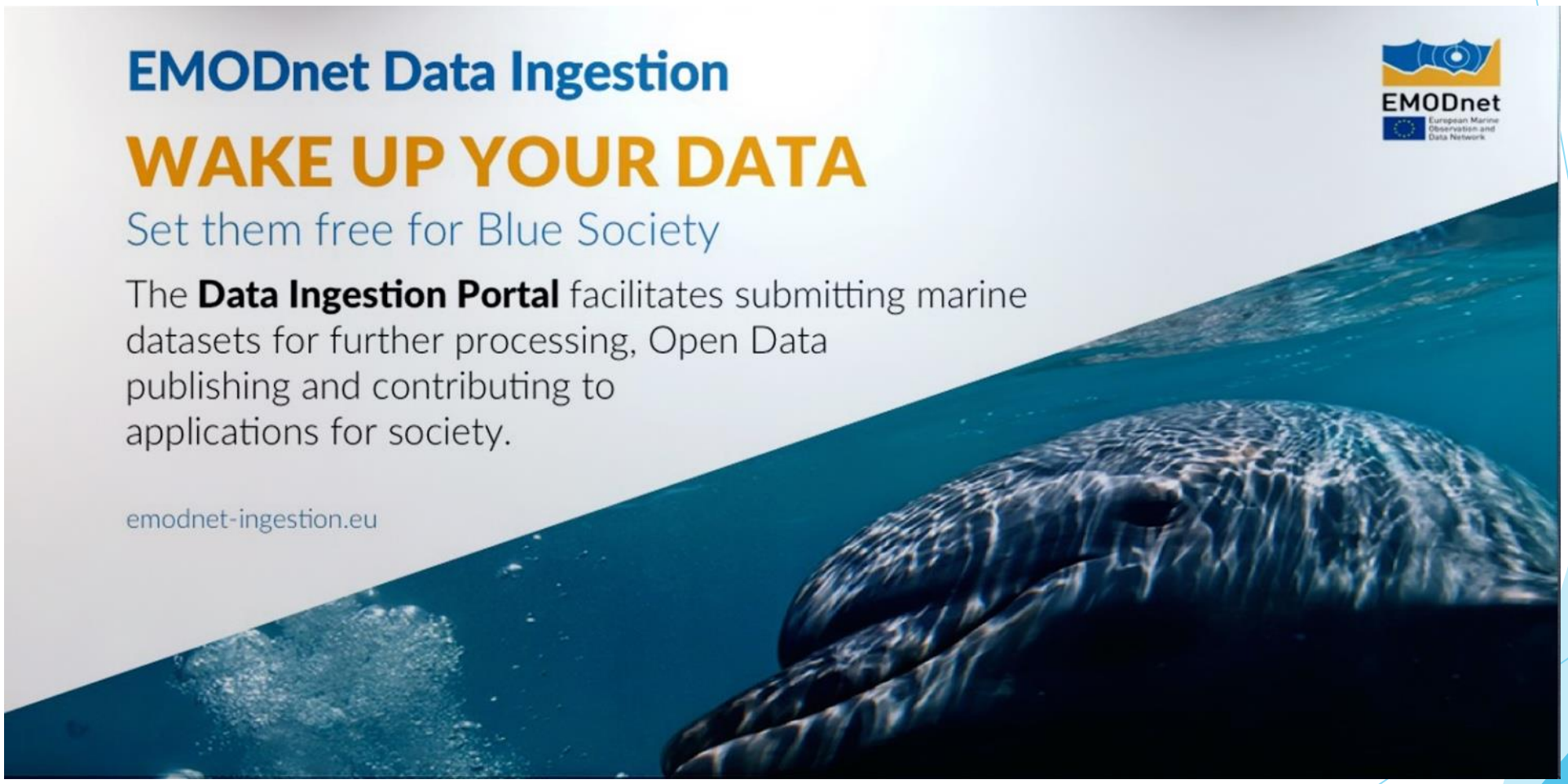
EMODnet [Human Activities]



EMODnet [Human Activities - Vessel Density]

- All - All types
- 00 - Other
- 01 - Fishing
- 02 - Service
- 03 - Dredging or underwater ops
- 04 - Sailing
- 05 - Pleasure Craft
- 06 - High speed craft
- 07 - Tug and towing
- 08 - Passenger
- 09 - Cargo
- 10 - Tanker
- 11 - Military and Law Enforcement
- 12 - Unknown

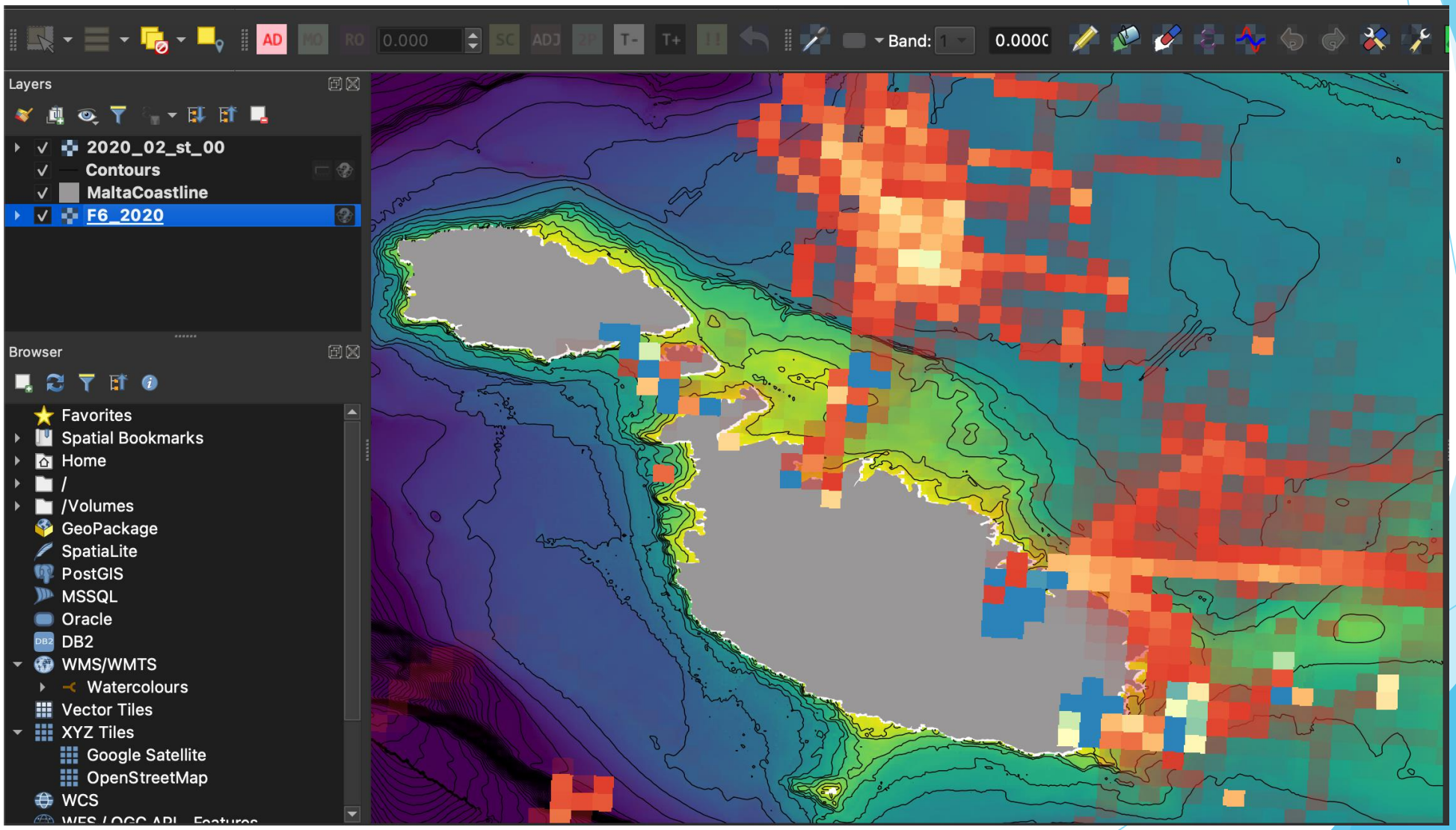
EMODnet [Ingestion]



QGIS

https://qgis.org/en/site/

QGIS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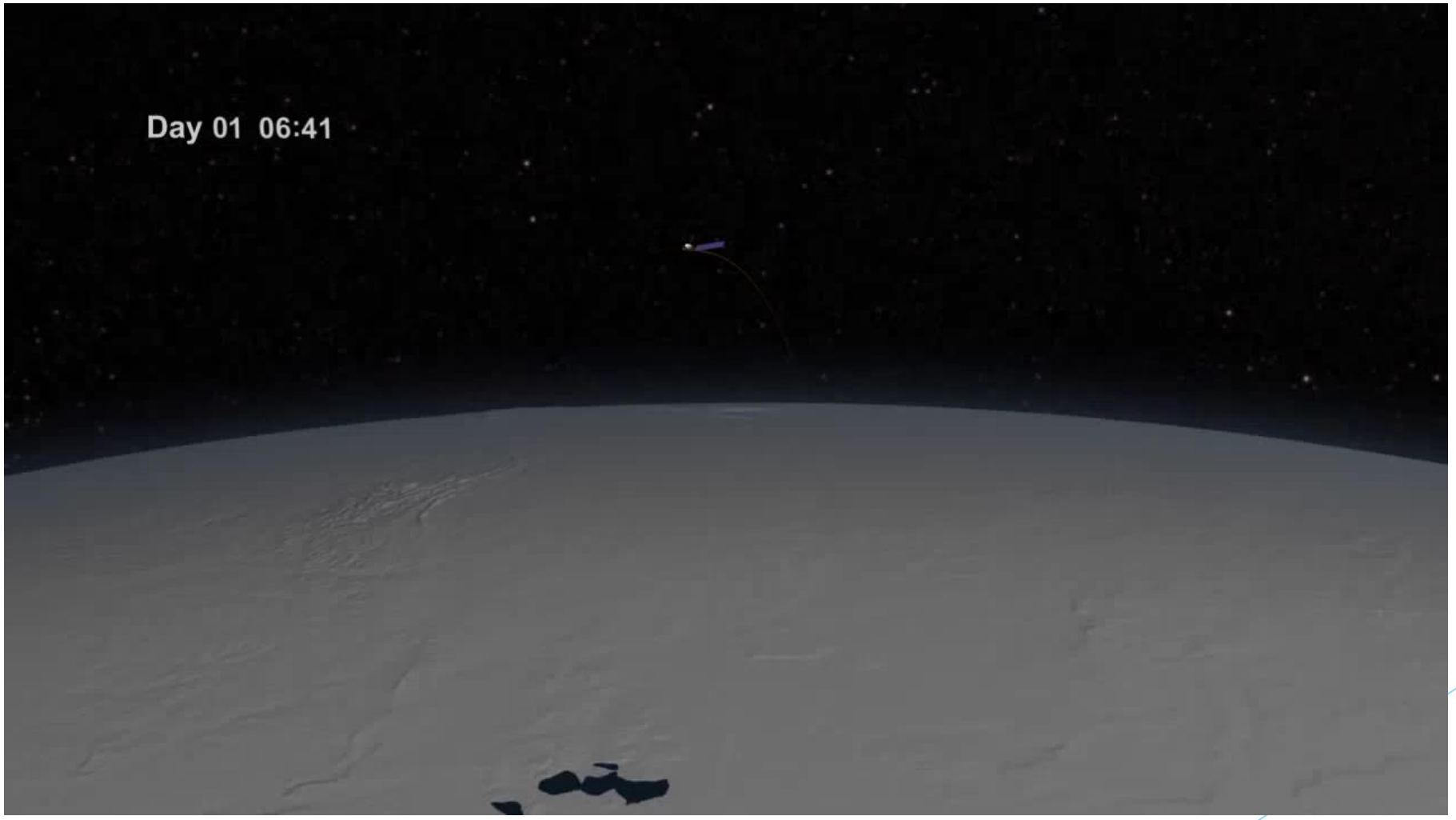
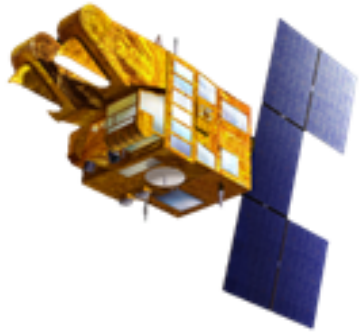
Contours
MaltaCoastline
F6_2020
Browser
Favorites
Spatial Bookmarks
Home
/
/Volumes
GeoPackage
SpatiaLite
PostGIS
MSSQL
Oracle
DB2
WMS/WMTS
Watercolours
Vector Tiles
XYZ Tiles
Google Satellite
OpenStreetMap
WCS

Sentinel Family



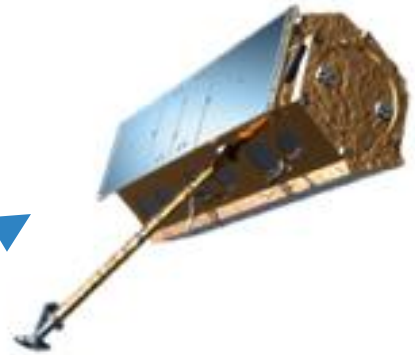
Sentinel Family

Sentinel Family



OPTICAL

RADAR



The optical satellite measures the visible part of the spectrum.

The energy scattered off the leaf is dependent on the greenness of the leaf as a function of the amount of chlorophyll, which absorbs the energy that is needed for photosynthesis

The radar satellite will measure the microwave part of the spectrum.

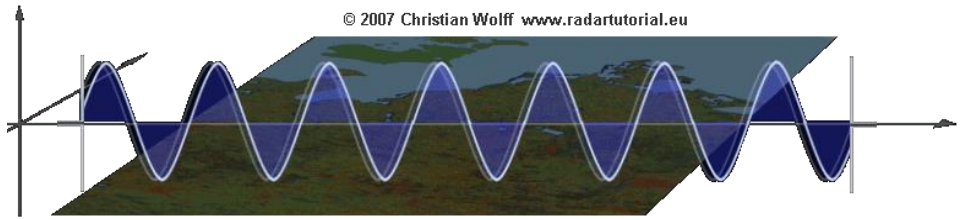
The energy scattered off the leaf is dependent on the size, shape, orientation and dielectric properties.

Sentinel Family [Optical]

- **SENTINEL-1 has a single C-band SAR instrument operating at a centre frequency of 5.405 GHz.**

Sentinel-2 Bands	Central Wavelength (µm)	Resolution (m)
Band 1 - Coastal aerosol	0.443	60
Band 2 - Blue	0.490	10
Band 3 - Green	0.560	10
Band 4 - Red	0.665	10
Band 5 - Vegetation Red Edge	0.705	20
Band 6 - Vegetation Red Edge	0.740	20
Band 7 - Vegetation Red Edge	0.783	20
Band 8 - NIR	0.842	10
Band 8A - Vegetation Red Edge	0.865	20
Band 9 - Water vapour	0.945	60
Band 10 - SWIR - Cirrus	1.375	60
Band 11 - SWIR	1.610	20
Band 12 - SWIR	2.190	20

Sentinel Family [SAR]

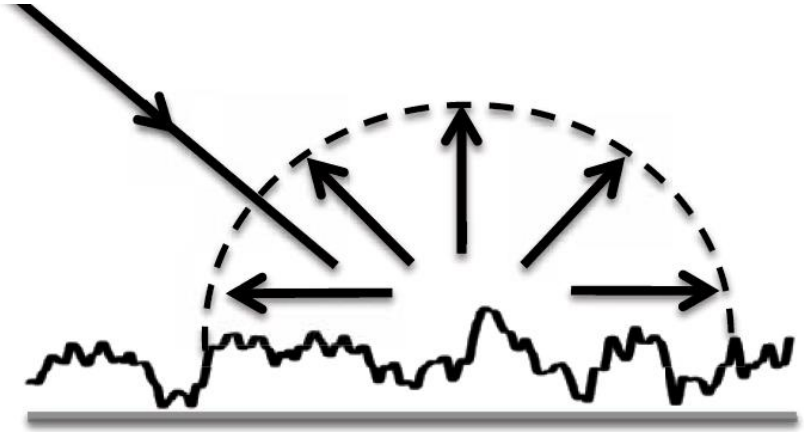


Single-polarimetric SAR mode	
VV	HH

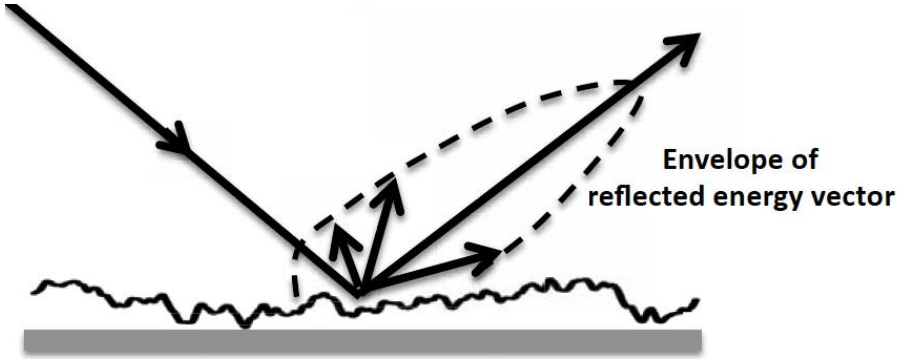
Dual-polarimetric coherent mode	
HH - HV	VV - VH

Full-polarimetric mode			
VV	VH	HV	HH

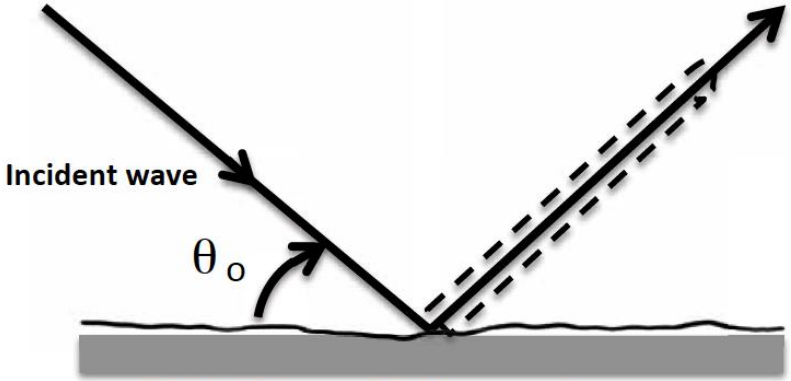
Sentinel Family [SAR]



Oil Sheen or no oil present

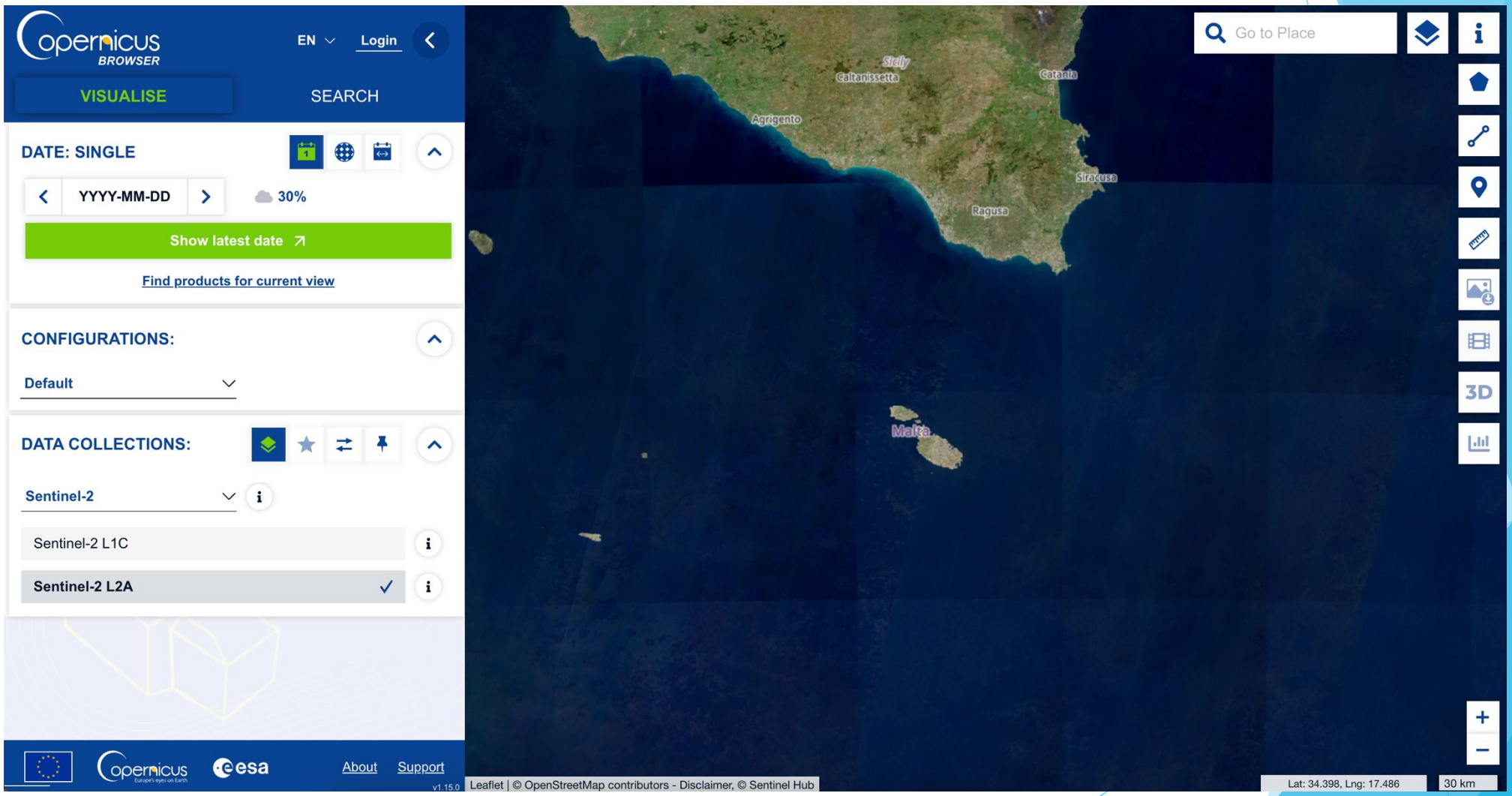


Thin layer of oil or surfactant



Thick layer of oil or surfactant

ESA Data Hub

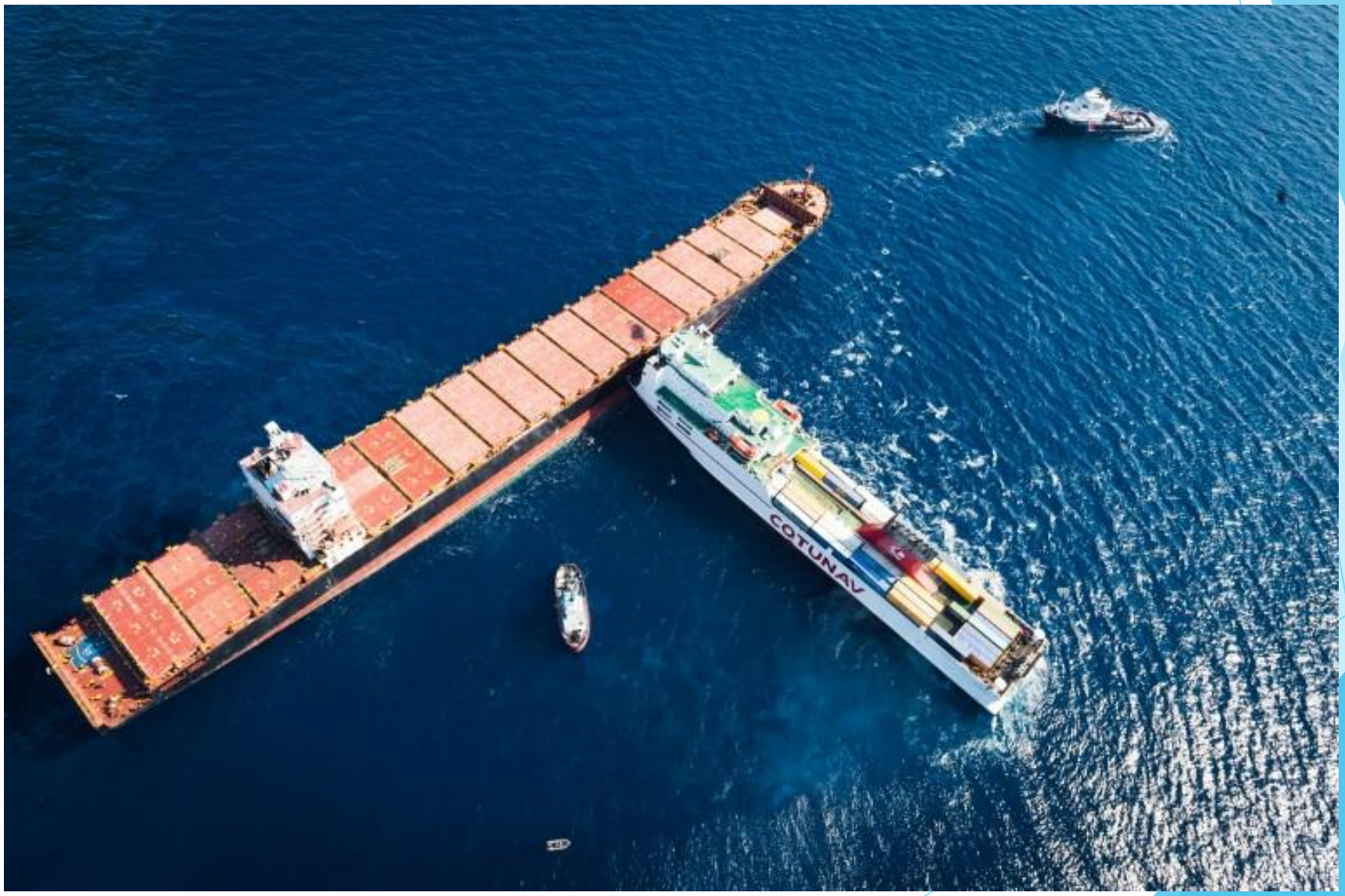


https://browser.dataspace.copernicus.eu/

SNAP [Oil Spill Exercise 1]

- Tunisian tanker carrying trucks rammed into an anchored Cypriot container ship north of Corsica in the morning on Sunday 7th October 2018.
- Huge hole in the hull of one of the ships caused the fuel spill into the marine reserve created just two years ago.
- Spill created a trail of pollution 12 miles long and several hundred meters wide, heading away from Corsica towards the French and Italian mainland. The spill was pushed by the wind and started to break up.
- An estimated 40 to 200 cubic metres of oil leaked.
- Not clear why crash in clear conditions happened but most likely cause was human error. No-one was injured in the collision.
- Inflatable booms were deployed to stop the spread of a slick.

SNAP [Oil Spill Exercise 1]



SNAP [Oil Spill Exercise 1]

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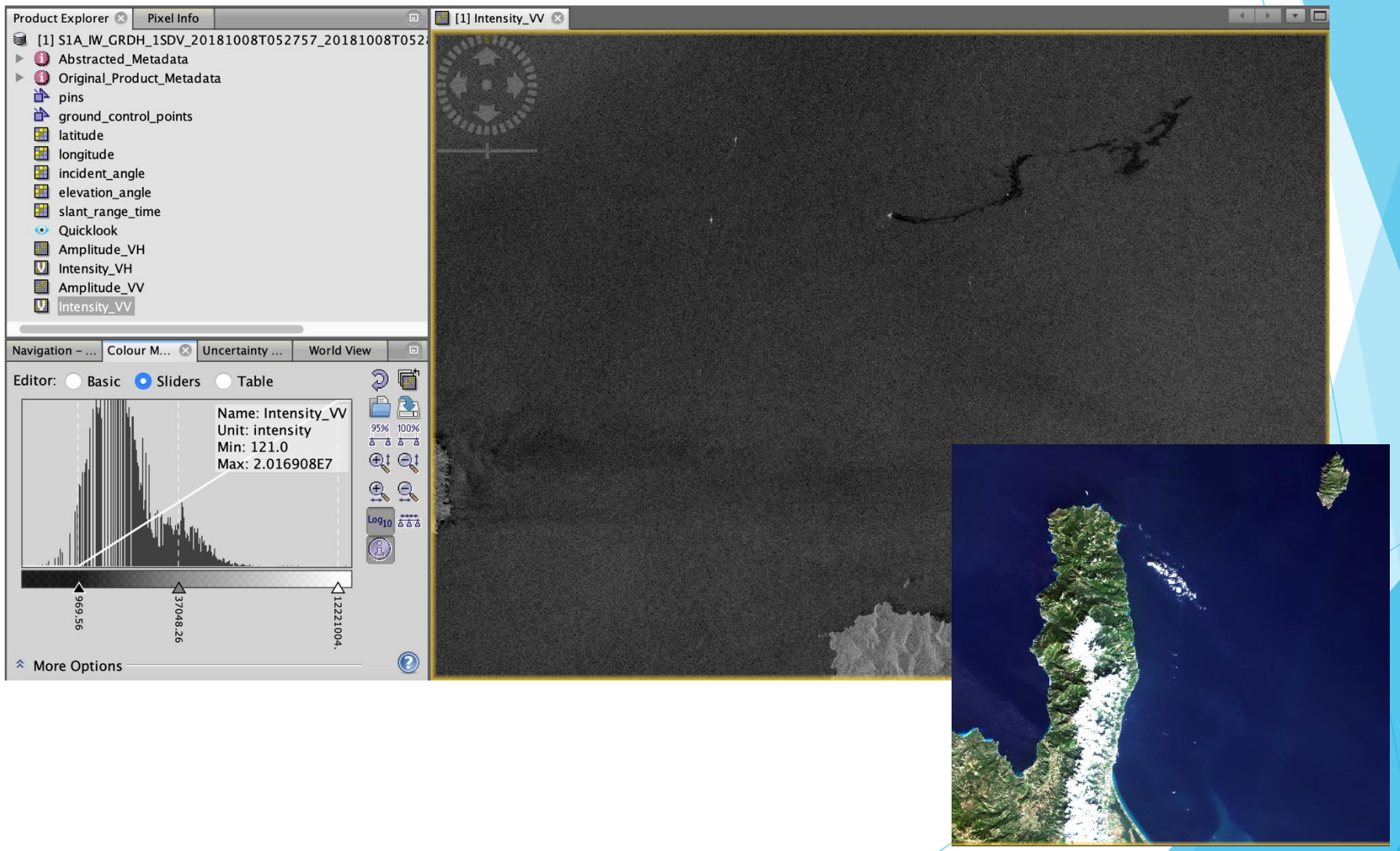
SNAP [Oil Spill Exercise 1]