



Co-funded by the
Erasmus+ Programme
of the European Union



Reliable oceanographic data sources: Ocean Remote Sensing: Data source, downloading and software (SNAP)

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OUTLINE

Introduction

Data sources for the blue ocean (SST, sea level, waves, etc.)

Data sources for the green ocean (chlorophyll-a concentration)

First steps with Sentinel Data Hub for data downloading

Sentinel-hub EO-Browser

**First steps with Sentinel Application Platform (SNAP)
(practical lesson)**



Introduction

Cambridge Dictionary | Diccionario | Traductor | Gramática | Sinónimos | +Plus | f | @ | t | Iniciar sesión / Registrarse | Español | Buscar

reliable | x | inglés | Q | inglés-español | español-inglés | inglés-catalán

reliable

adjective

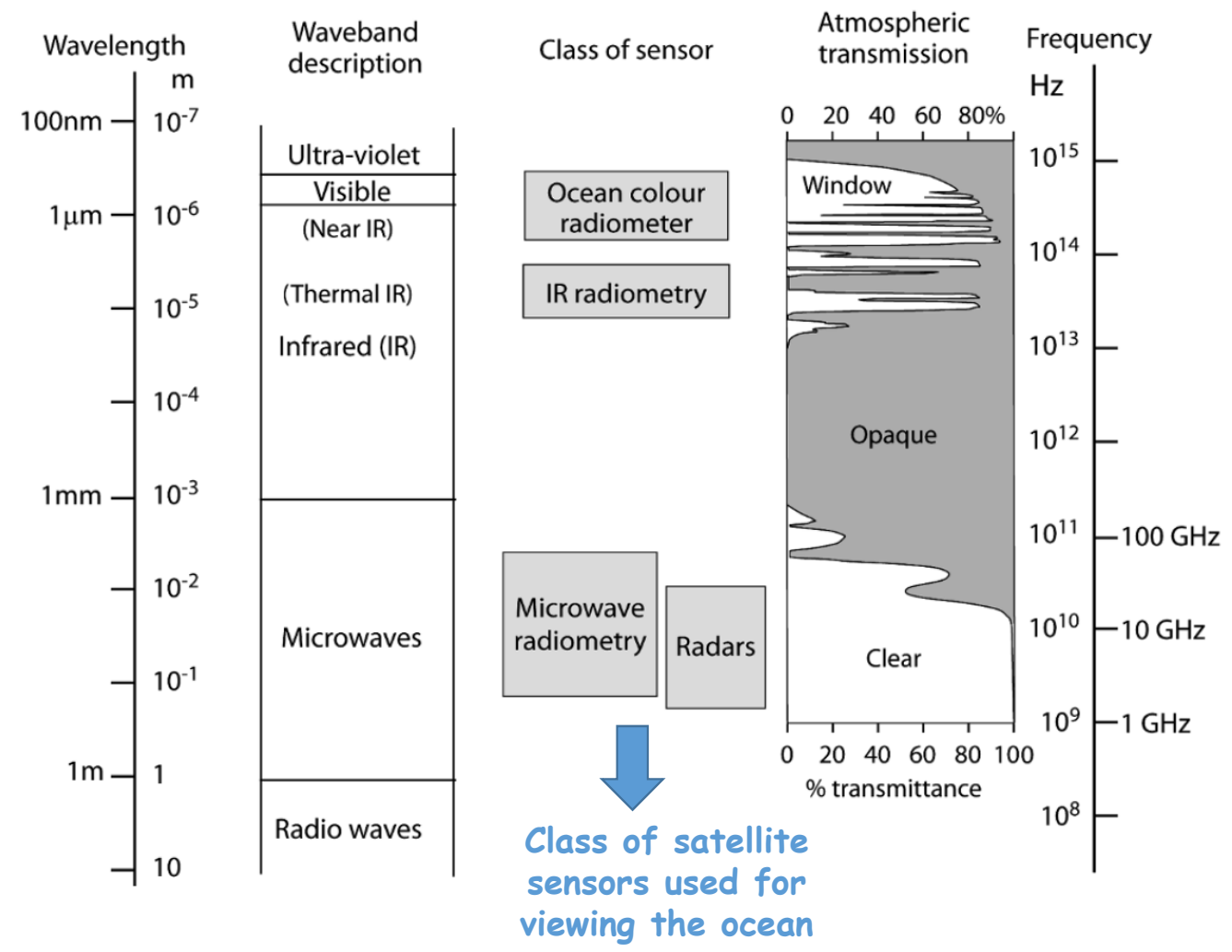
UK /rɪˈlaɪ.ə.bəl/ | US /rɪˈlaɪ.ə.bəl/



B1

Someone or something that is **reliable** can be trusted or believed because he, she, or it works or behaves well in the way you expect:

Introduction

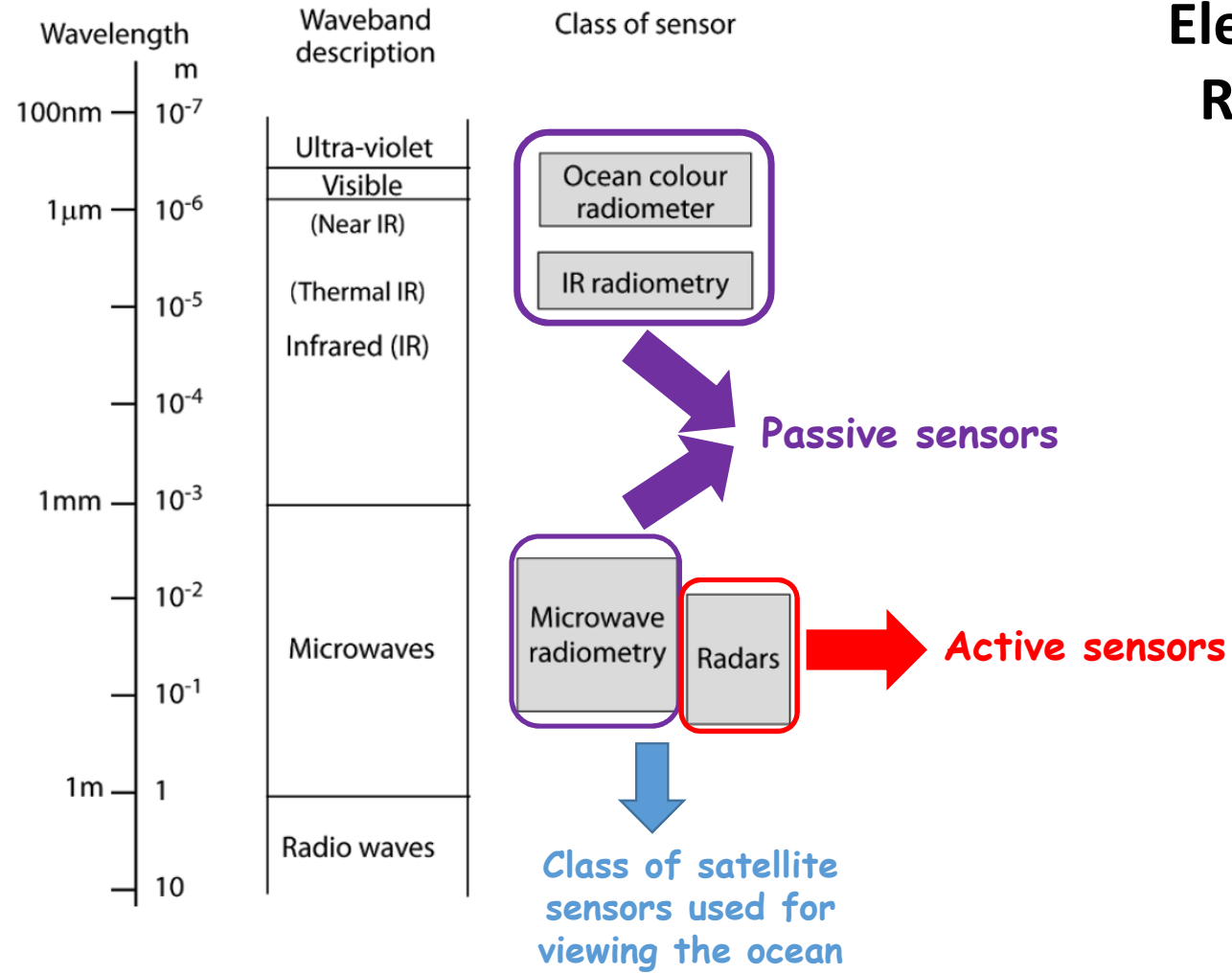


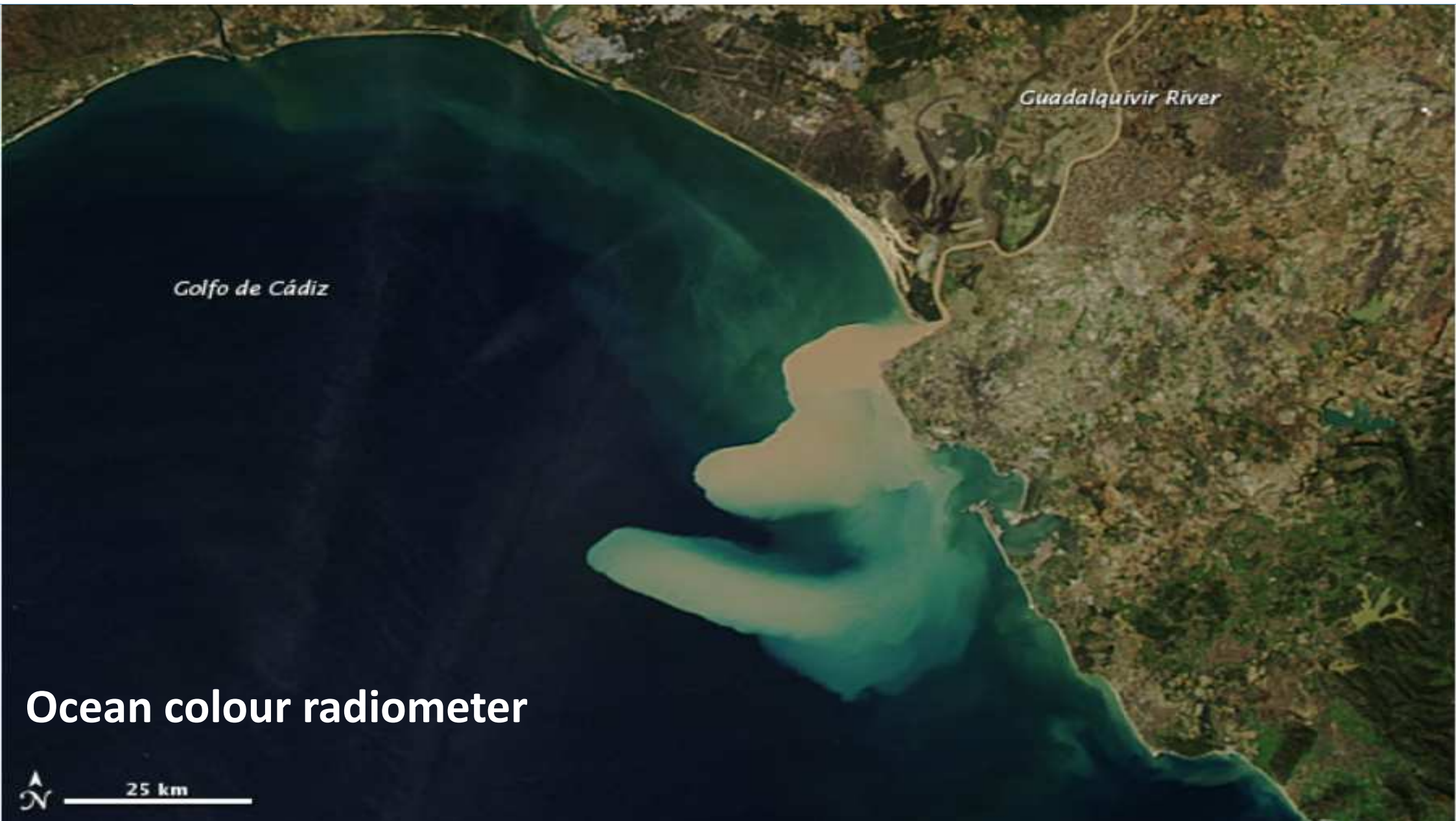
Electromagnetic Radiation (EM)

Atmospheric windows

Introduction

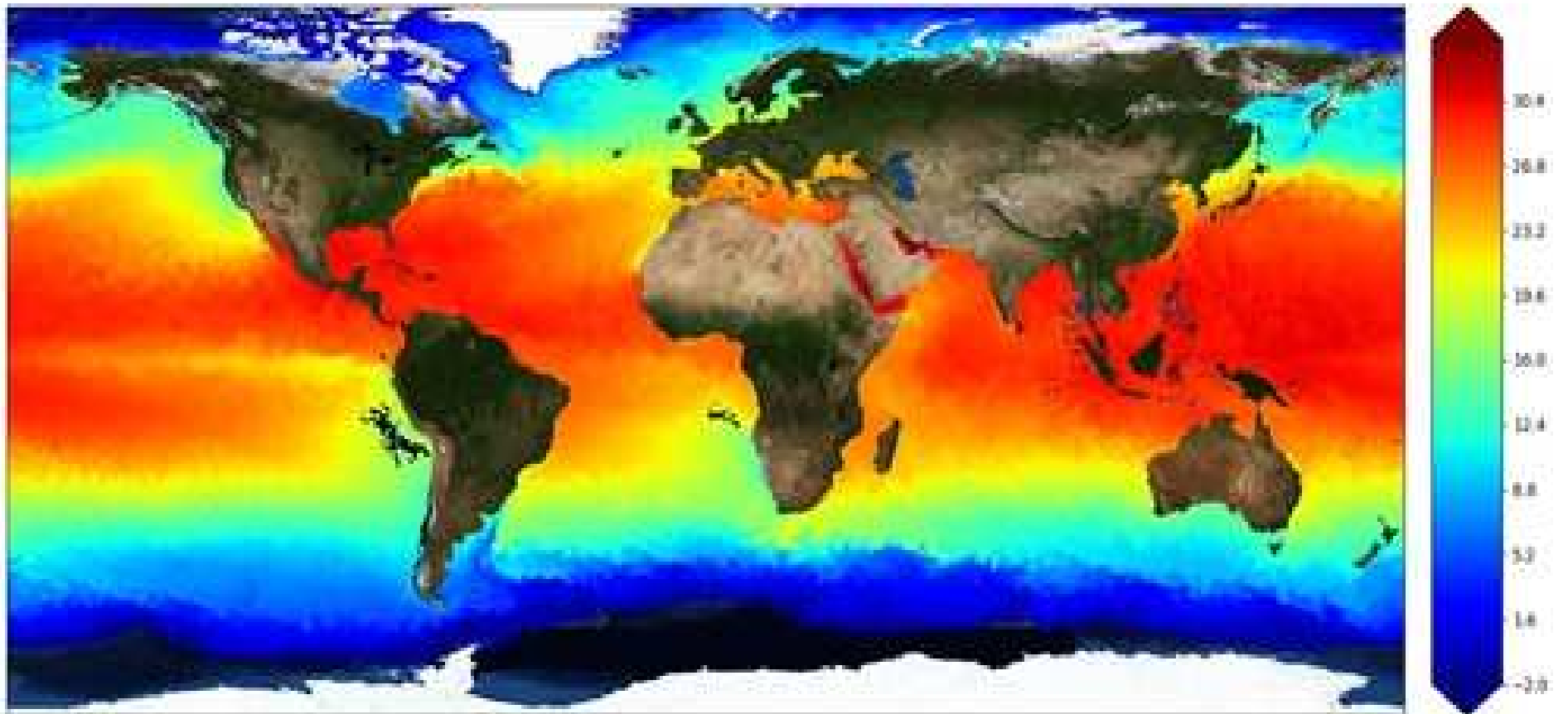
Electromagnetic Radiation (EM)

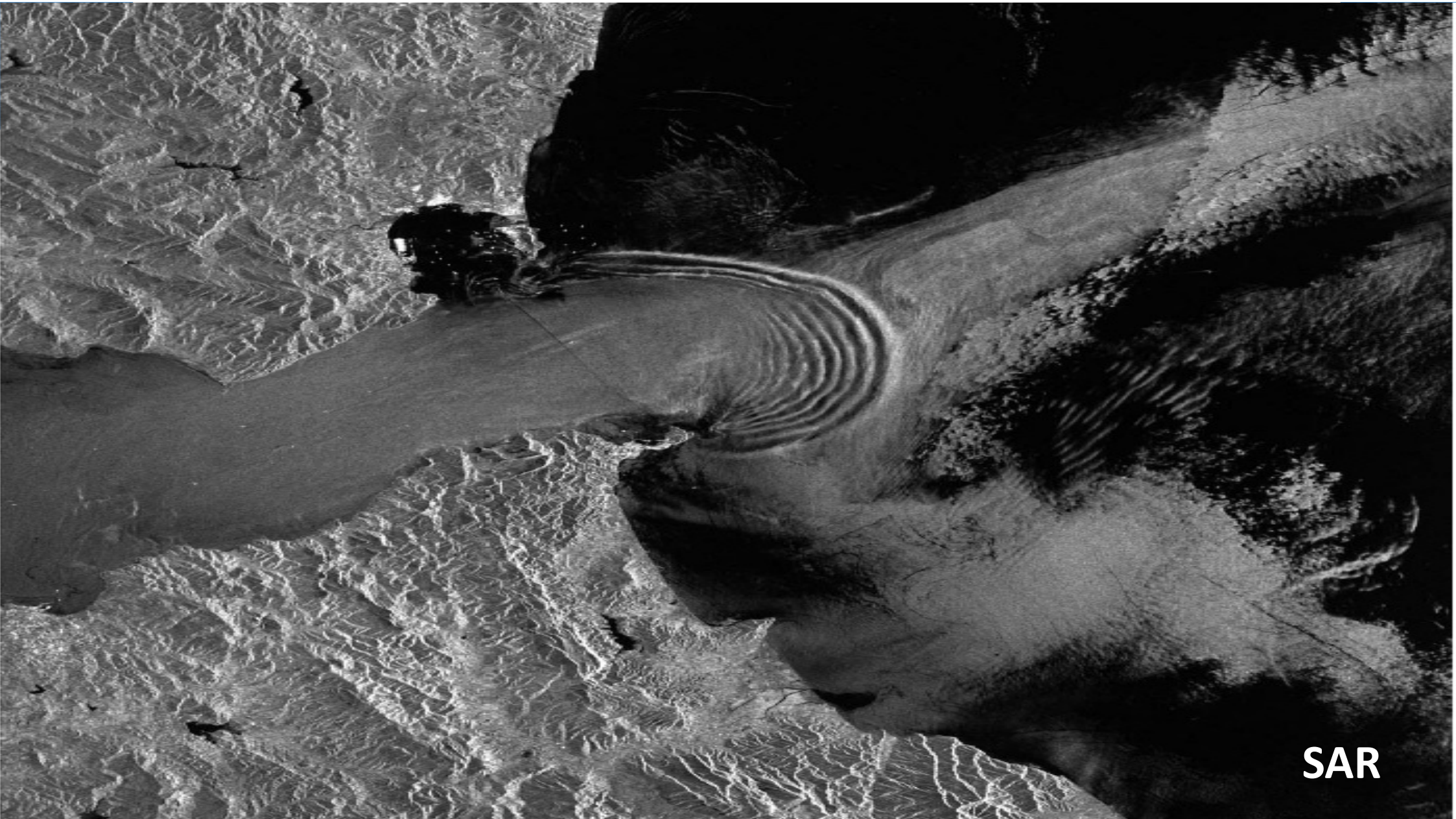




Sentinel 3A SLSTR sea surface temperature (S3A_SL_2_WST) - September 2016

IR radiometry

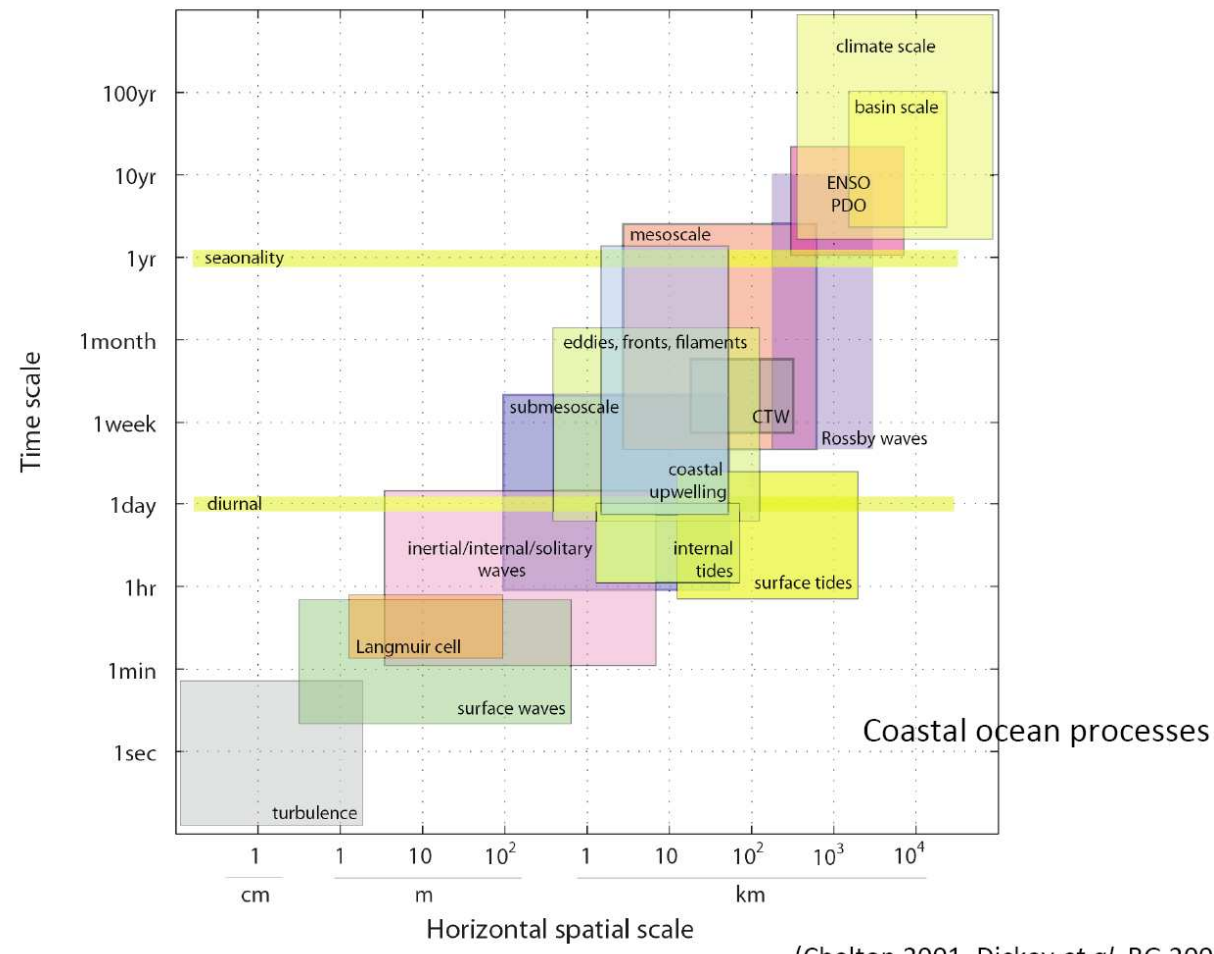




SAR

Introduction

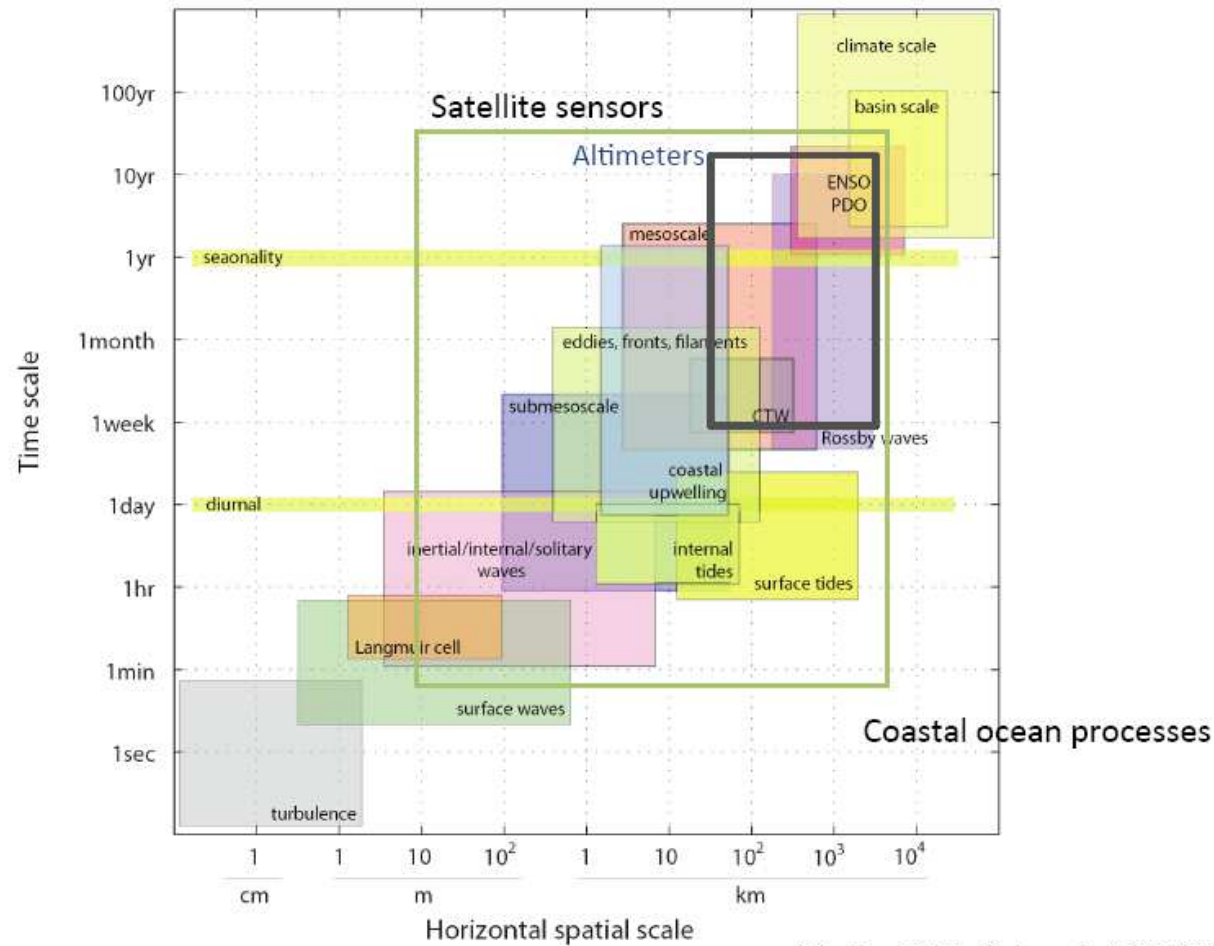
Oceanic processes in time and spatial scales



(Chelton 2001, Dickey *et al*, RG 2006)

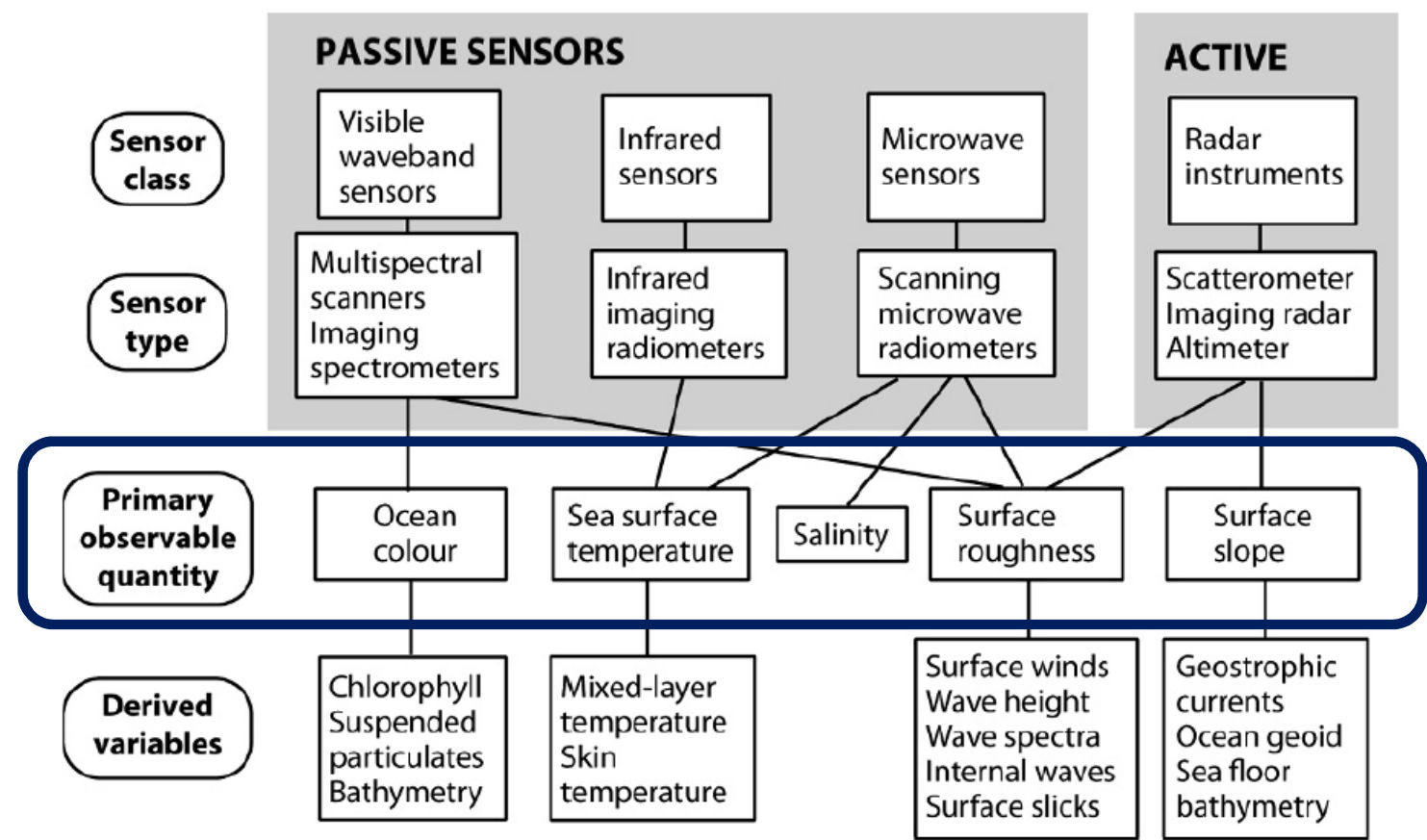
Introduction

Oceanic processes in time and spatial scales



(Chelton 2001, Dickey *et al*, RG 2006)

Introduction



Schematic illustrating the different RS methods and classes of sensors used in satellite oceanography, along with their applications (I. S. Robinson, 2004)



Users (you!) should ask themselves some basic questions to find the right satellite-derived dataset for their application:

- What spatial and temporal resolutions do I need?
- Do I need a skin or foundation (bulk) temperature (T^a at about 10 m)?
- Do I need regularly gridded data with no data gaps?
- What temporal range do I need?
- Do I need near real time or non-critical time data?
- Do I need level 2 ungridded data that contains ancillary data fields as well as complete error characteristics for each pixel?

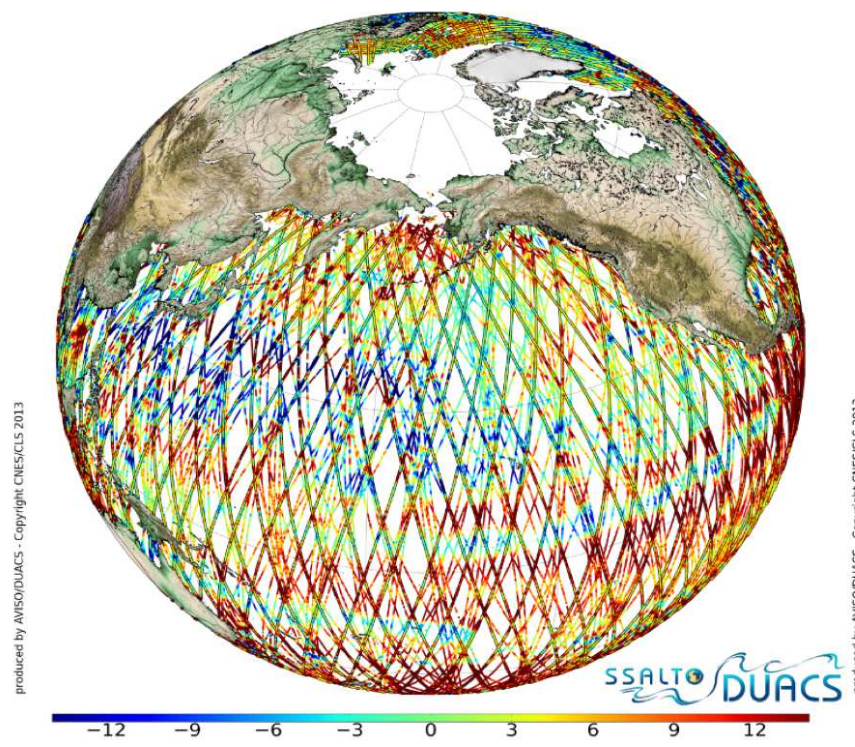
Satellite data processing levels for users

Level 0, Level 1 and some also Level 1b → 'Raw data'

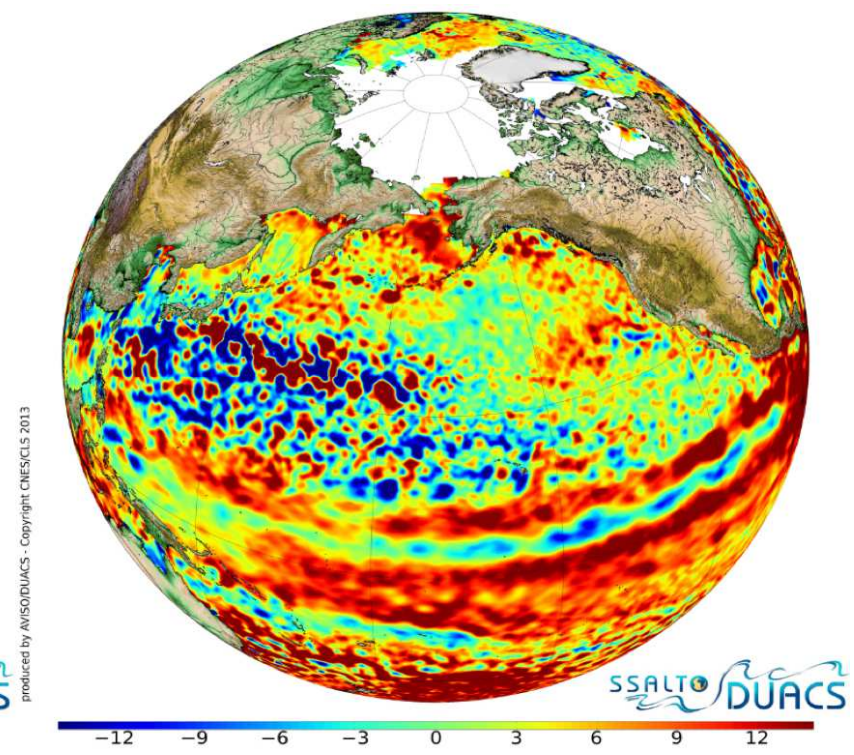
- Level 2** → Derived geophysical variables at the same resolution and location as Level 1 source data
- Level 3** → Variables mapped on uniform space-time grid scales, usually with some completeness and consistency (quality controlled)
- Level 4** → Modeled output or variables derived from multiple measurements

Satellite data processing levels for users

Level 2



Level 3





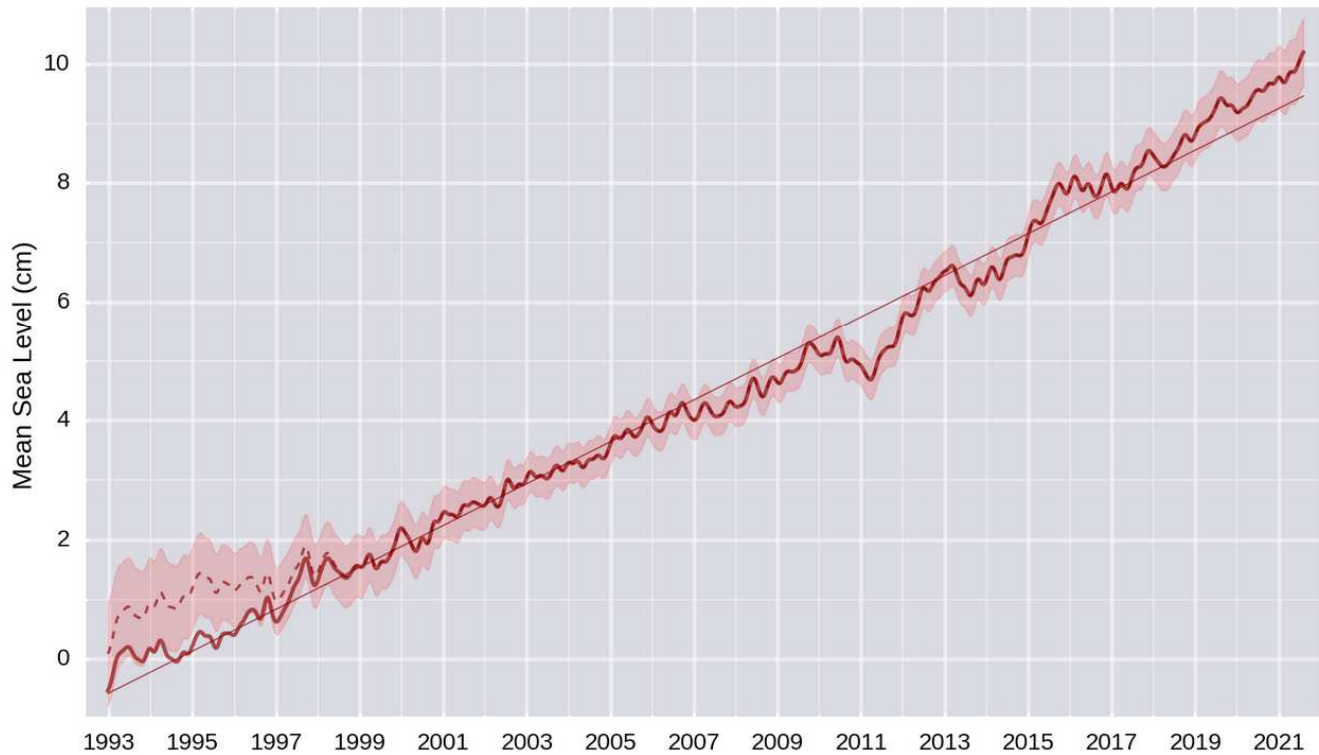
Introduction

Satellite data processing levels for users **Level 4**

Latest MSL Measurement
17 August, 2021

+3.51 mm/yr

Reference GMSL - corrected for GIA

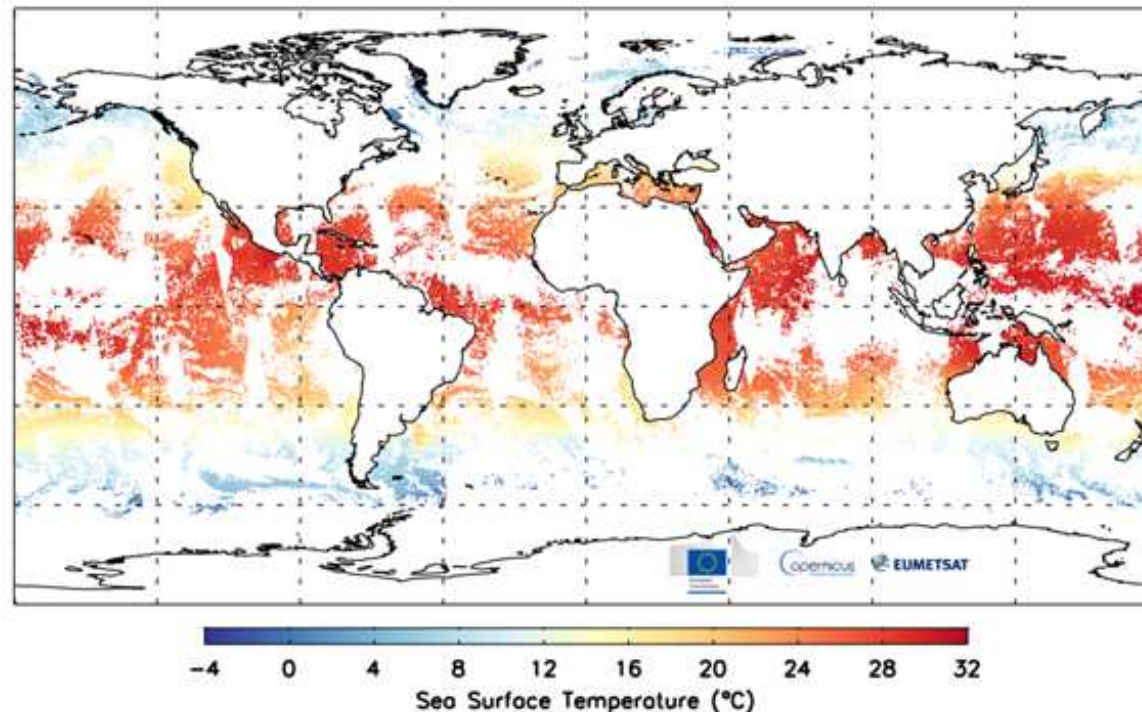


Temporal resolution of the products

- Level 2** → 'Instantaneous' or delayed data from the sensor
- Level 3** → Daily, monthly, yearly... reprocessed products
- Level 4** → Daily, monthly, yearly... reprocessed products

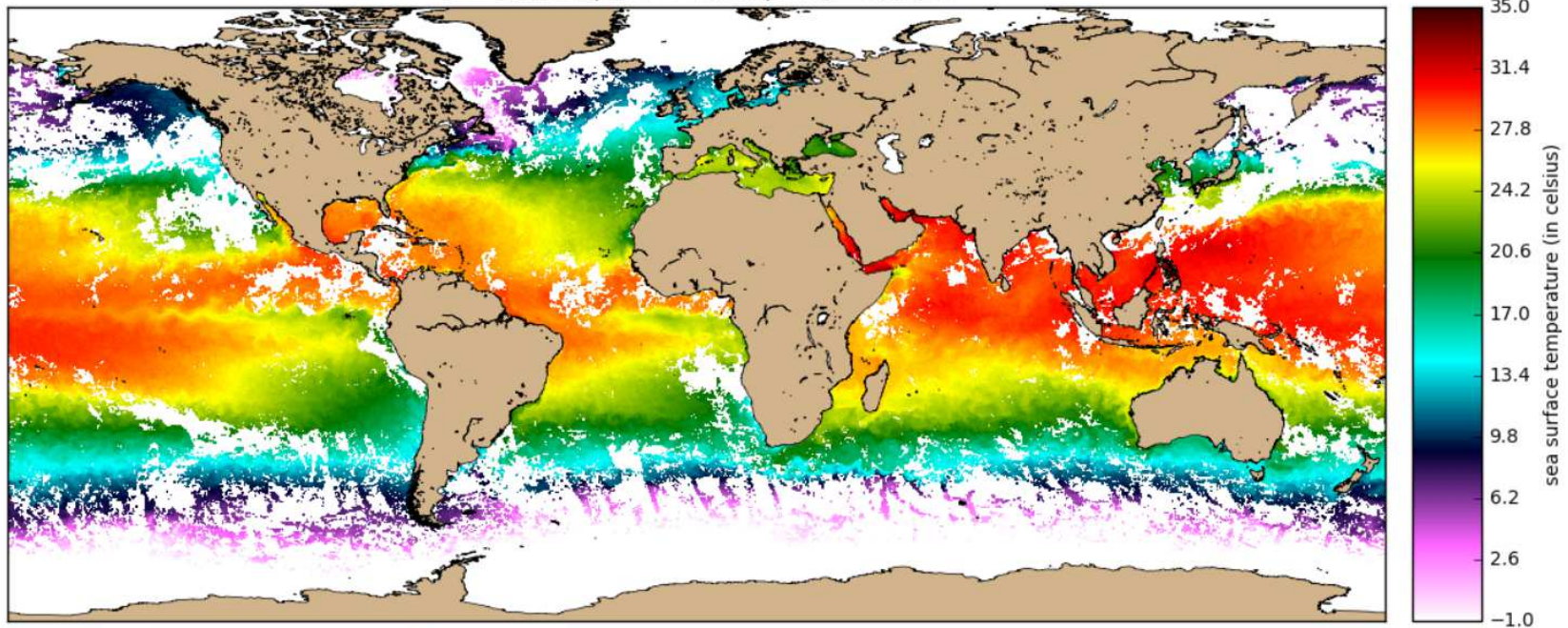
Temporal resolution of the products

Copernicus Sentinel-3 SLSTR SST 20181106



SLSTR Sea Surface Temperature from both Sentinel-3A and Sentinel-3B combined globally over one day for 6 November 2018

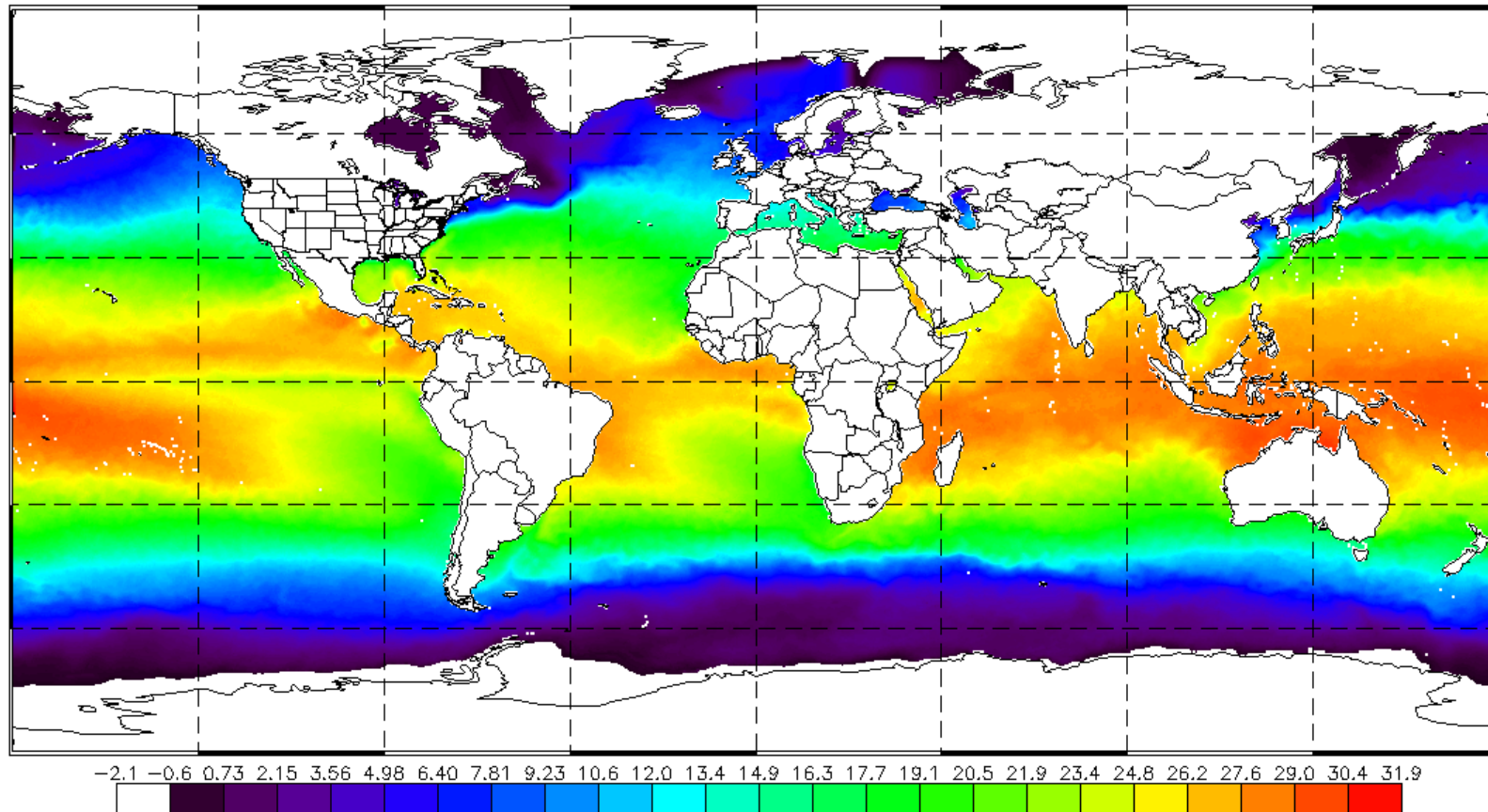
sea surface skin temperature
15-19 Jun 2017 composite - Sentinel-3A / SLSTR WST NR [PB2.16]-
N = 1427346, min = -1.99 C, max = 36.71 C



 EUMETSAT  Copernicus

Sentinel-3 SLSTR Sea Surface Temperature Level-2 Ensemble Mean,
15-19 June 2017. Composite product.

Monthly Mean Satellite-only Nighttime SST for January, 1994



Near Real-Time (NRT) vs. Non-Time Critical (NTC or delayed products)

If latency is your primary concern



NRT: Level 1b and Level 2 products at $T < 8$ hours (even less) of satellite observation. Low level of processing. Operational needs.

If not...



NTC: science quality data products; internally consistent, well-calibrated products. They are created using the best available ancillary, calibration and ephemeris information.

Spatial resolution of the products

Optical imagery



Triple Sat Constellation
80 cm spatial resolution

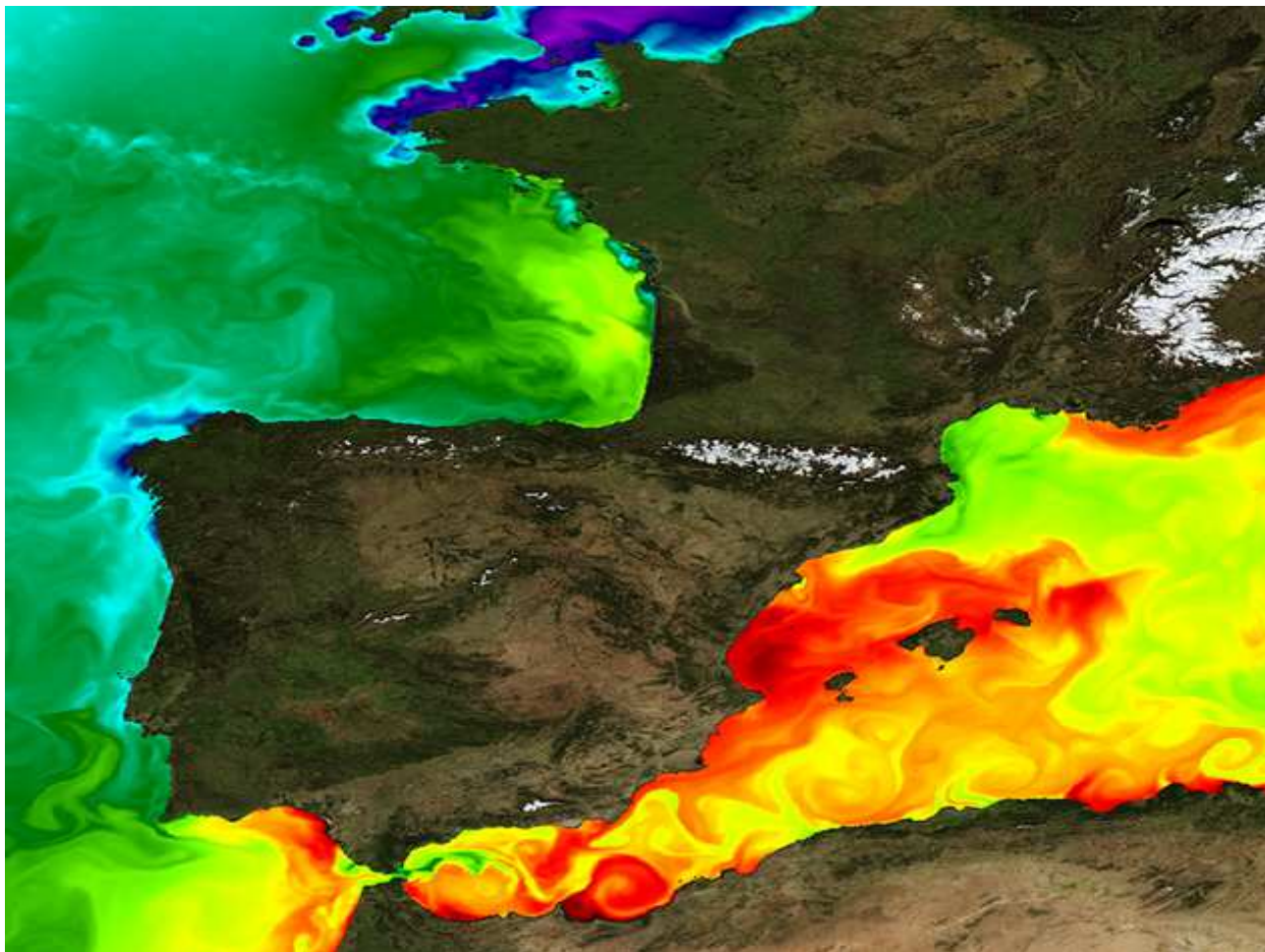


Landsat-8 image
15 m spatial resolution



Data sources for the blue ocean (SST, sea level, waves, etc.)

Data sources for the blue ocean (SST, sea level, waves, etc.)



SST
**Infrared and
MW sensors**



Data sources for the blue ocean (SST, sea level, waves, etc.)



Infrared imaging radiometers:

- Passive radiometers operating in the thermal-infrared wavelengths.
- The observable variable is the Sea Surface Temperature (SST).
- In the thermal infrared and microwave parts of the spectrum most observed radiation will have been thermally emitted by the sea surface.
- In this way infrared and microwave radiometers can be used directly to measure the radiation temperature of surfaces.
- Given knowledge about the emissivity of the sea surface this can be used to estimate the physical temperature of the water.
- For infrared measurements there is a close relationship between emitted infrared radiation and SST.



Data sources for the blue ocean (SST, sea level, waves, etc.)



Microwave sensors:


- Passive radiometers operating in the microwave (MW) wavelengths.
- One sensor type: Scanning microwave radiometers.
- The observable variables are SST, salinity and surface roughness.
- The amount of energy emitted by the surface in the MW part of the EM is much smaller than in the IR.
- For that reason, the spatial resolution of MW sensors is less finer than IRs.



Data sources for the blue ocean (SST, sea level, waves, etc.)

<https://www.ospo.noaa.gov/Products/ocean/sst.html>

» OSPO Home » DOC » NOAA » NESDIS » OSPO



NOAA OFFICE OF SATELLITE AND PRODUCT OPERATIONS
NATIONAL ENVIRONMENTAL SATELLITE, DATA, AND INFORMATION SERVICE

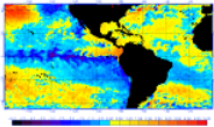
Please Note:
To view imagery from the operational GOES East (GOES-16) and GOES West (GOES-17) satellites, users may visit <https://www.star.nesdis.noaa.gov/goes/>.

ORGANIZATION SERVICES PRODUCTS OPERATIONS

Sea Surface Temperature (SST)

(SST is defined as the skin temperature of the ocean surface water.)

Operational Products

SST Anomaly Charts	This global 5km Sea Surface Temperature (SST) Anomaly product , displays the difference between today's SST and the long-term average. The scale goes from -5 to +5 °C. Positive numbers mean the temperature is warmer than average; negative means cooler than average.
	The SST anomaly field (degrees C) is the difference between the 50 km nighttime-only SST and the nighttime-only monthly mean SST climatology. The climatology is based on nighttime observations from 1984-1993, with SST observations from the years 1991 and 1992 omitted due to aerosol contamination from the eruption Mt. Pinatubo in June of 1991. Monthly Mean SST Anomaly Charts (1984-1998)
POES & GOES	Resolution: 5 Km Frequency: Daily

POES & GOES
Polar & Geostacionary Operational
Environmental Satellites
(weather satellites)
IR bands



Data sources for the blue ocean (SST, sea level, waves, etc.)

<https://podaac.jpl.nasa.gov/SeaSurfaceTemperature>

NASA EARTHDATA Other DAACs

NASA Jet Propulsion Laboratory California Institute of Technology

podaac
Physical Oceanography Distributed Active Archive Center

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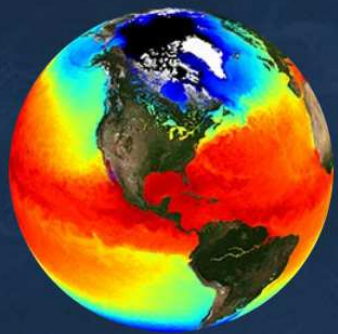
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Ocean Temperature

Science Disciplines



Ocean Temperature is a measure of the energy in the ocean due to the motion of molecules. Depending on the sensor, spaceborne measurements give us an unprecedented global measurement of ocean temperatures from approximately 10 μm below the surface to 1 mm depths using radiometers.

FIND DATA

Related Missions

- AQUA
- GHRSSST
- MEaSURES-MUR
- S-NPP
- Saildrone
- TERRA

IR and MW bands



Data sources for the blue ocean (SST, sea level, waves, etc.)

<https://catalogue.ceda.ac.uk/uuid/62c0f97b1eac4e0197a674870afe1ee6>



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Dataset



ESA Sea Surface Temperature Climate Change Initiative (SST_cci): Level 4 Analysis Climate Data Record, version 2.1

[Open Access](#) [Download](#) [See Related Documents](#)

Update Frequency:	Not Planned
Status:	Completed
Online Status:	ONLINE
Publication State:	Citable
Publication Date:	2019-08-02
DOI Publication Date:	2019-08-22
Download Stats:	last 12 months

Abstract

This v2.1 SST_cci Level 4 Analysis Climate Data Record (CDR) provides a globally-complete daily analysis of sea surface temperature (SST) on a 0.05 degree regular latitude - longitude grid. It combines data from both the Advanced Very High Resolution Radiometer (AVHRR) and Along Track Scanning Radiometer (ATSR) SST_cci Climate Data Records, using a data assimilation method to provide SSTs where there were no measurements. These data cover the period between 09/1981 and 12/2016.

The dataset has been produced as part of the European Space Agency (ESA) Climate Change Initiative Sea Surface Temperature project (ESA SST_cci). The data products from SST_cci accurately map the surface tem

Coverage

Temporal Range	
Start time:	1981-08-31T23:00:00
End time:	2016-12-31T23:59:59

IR bands

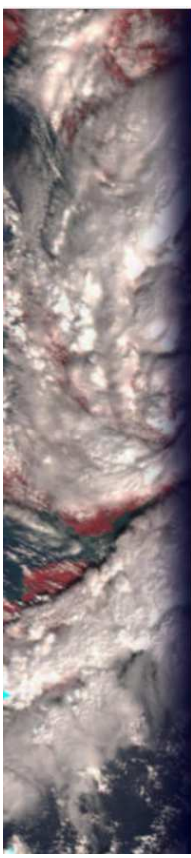




Data sources for the blue ocean (SST, sea level, waves, etc.)

Sea and Land Surface Temperature (SLSTR) Sentinel-3

<https://scihub.copernicus.eu/>



Copernicus Open Access Hub

esa European Commission

Welcome to the Copernicus Open Access Hub


The Copernicus Open Access Hub (previously known as Sentinels Scientific Data Hub) provides complete, free and open access to Sentinel-1, Sentinel-2, Sentinel-3 and Sentinel-5P user products, starting from the In-Orbit Commissioning Review (IOCR).


Sentinel Data are also available via the Copernicus Data and Information Access Services (DIAS) through several platforms .


 Please visit our [User Guide](#) for getting started with the Data Hub Interface. Discover how to use the APIs and create scripts for automatic search and download of Sentinels' data, with synchronous access to the latest data and asynchronous access to historic data via the API and GUI.

For further details or requests of support please send an e-mail to eosupport@copernicus.esa.int


Reports & Stats
Data updated hourly

 **38,892**
prod. published in the last 24h

 **338,550**
downloads in the last 24h

 **Reports**

Resources

 **DHUS Open Source Portal**

 **Copernicus Portal**

Open Hub **API Hub** **S-5P Pre-Ops** **POD Hub**



Data sources for the blue ocean (SST, sea level, waves, etc.)

<https://psl.noaa.gov/map/clim/sst.shtml>



Home » Map Room » SST

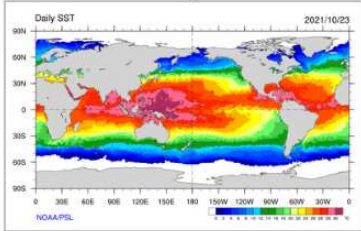
PSL Map Room - Sea Surface Temperature (SST)

Plots created from [daily](#), [weekly](#), and [monthly](#) NOAA Optimum Interpolation (OI) Version 2 SST data.

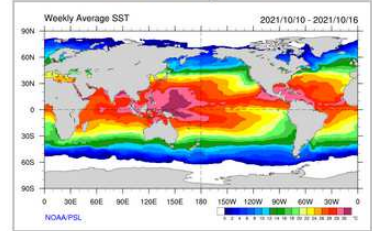
These graphical products are not guaranteed to be updated on a regular basis. They are intended to serve as examples of our ongoing work. You are free to use and distribute these images, but we request that you acknowledge PSL when you do use them. Please read the [disclaimer](#) page for additional information, including how to cite this work.

Totals (Updated: Oct 24 10:10 MDT)

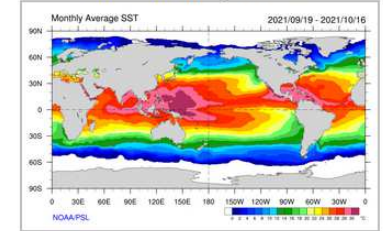
Latest Daily Product



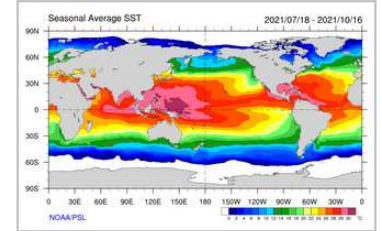
Latest Weekly Product



Latest Monthly Product



Latest Seasonal Product



Animations: [Weekly](#) [Seasonal](#) [Annual](#)



Data sources for the blue ocean (SST, sea level, waves, etc.)

<https://marine.copernicus.eu/>

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Providing free and open marine data and services to enable marine policy implementation, support Blue growth and scientific innovation.

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DATA

OCEAN PRODUCTS

A robust ocean data catalogue, to download or visualise data including hindcasts, nowcasts and forecasts.

EXPERTISE

OCEAN STATE REPORT

Extensive annual analysis on the state of the ocean over nearly 20 years and severe/notable annual events.

TRENDS

OCEAN MONITORING INDICATORS

Essential variables monitoring the health of the ocean over the past quarter of a century.

EXPLORATION

OCEAN VISUALISATION

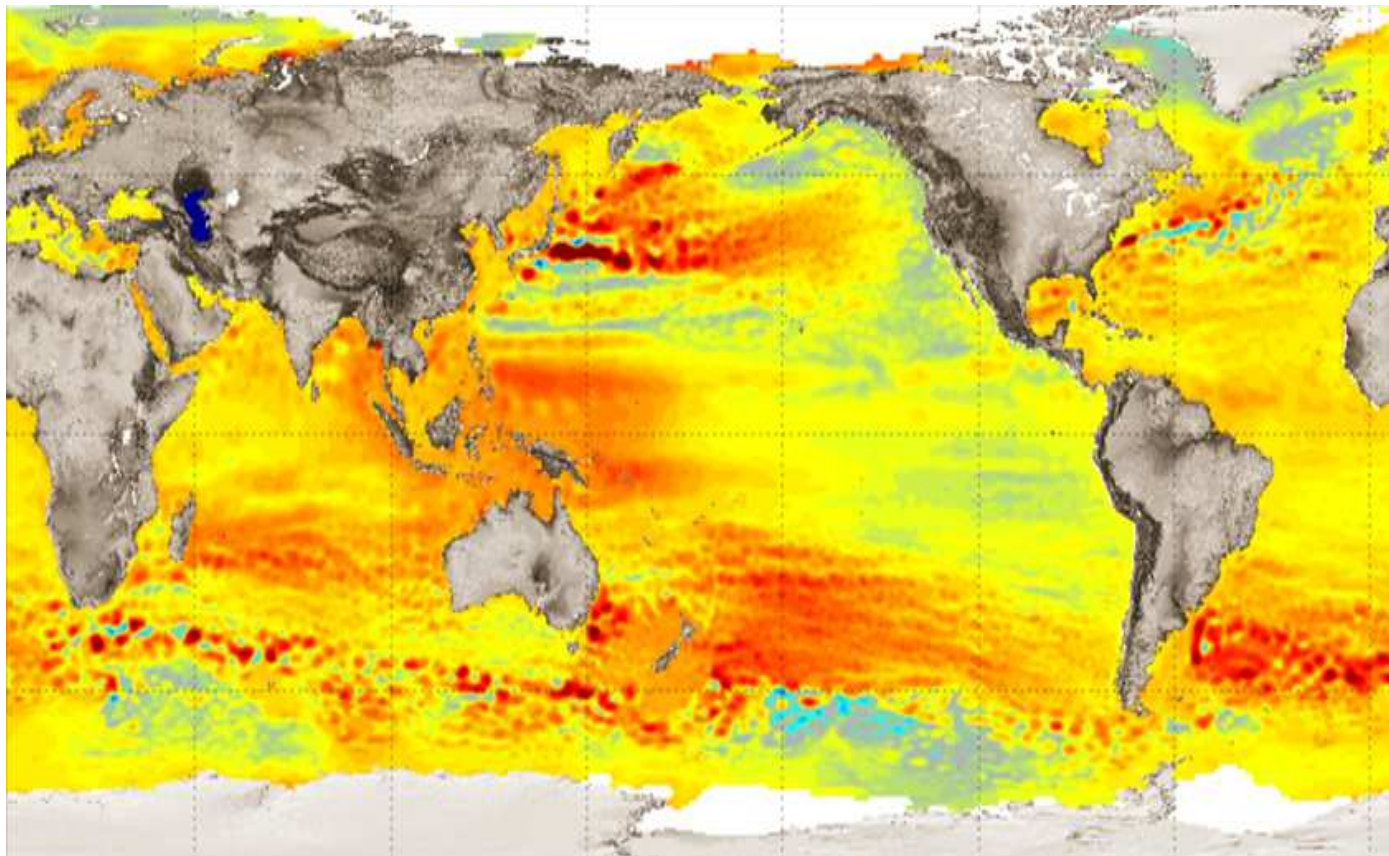
Dive into our 4D digital oceans through our 3 visualisation tools for beginner, intermediate and advanced users

The Copernicus Marine Service is a nutshell





Data sources for the blue ocean (SST, sea level, waves, etc.)



**Sea level,
waves and
winds
Radar
altimeters**



Data sources for the blue ocean (SST, sea level, waves, etc.)



- The altimeter is a radar at vertical incidence (nadir instrument).
- The signal returning to the satellite is from quasi-specular reflection.
- Measure distance between satellite's centre of mass and sea (called 'Range') by measuring the travel time of the emitted signal.
- Determine position of satellite (precise orbit).
- Hence determine height of sea surface.
- Give three parameters: sea level, significant wave height and wind speed at sea Surface (10 m).
- Give information along the satellite track (along-track product). Using more than 2 satellites it is possible to obtain gridded products.



Data sources for the blue ocean (SST, sea level, waves, etc.)

<https://marine.copernicus.eu/>

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Data sources for the blue ocean (SST, sea level, waves, etc.)

<http://rads.tudelft.nl/rads/rads.shtml>

Radar Altimeter Database System



The Radar Altimeter Database System (RADS) is DEOS' effort in establishing a harmonised, validated and cross-calibrated sea level data base from satellite altimeter data. It operates within the framework of the Netherlands Earth Observation NETWORK **NEONET**, an internet facility, funded by the Dutch government (BCRS and SRON), for exploitation of remote-sensing expertise and data. The RADS data base aims at users at both expert level like geoscientists and entry level, like advisory councils, water management authorities, teachers, and students.

For more details check out the [literature](#) section.

In case of any questions or problems, do not hesitate to contact e.n.doornbos@tudelft.nl.

Contents

- Data acquisition**
For obtaining data out of the RADS data base
- Status**
Current status of RADS
- Literature**
List of references and on-line literature
- Results**
Some results obtained with the RADS data base
- Software**
Useful software for altimeter data processing
- Experts**
Access to the RADS manual and mailing list for RADS expert users

[Data](#) | [Status](#) | [Literature](#) | [Results](#) | [Software](#) | [Experts](#) | [RADS Home](#) | [DEOS Home](#)

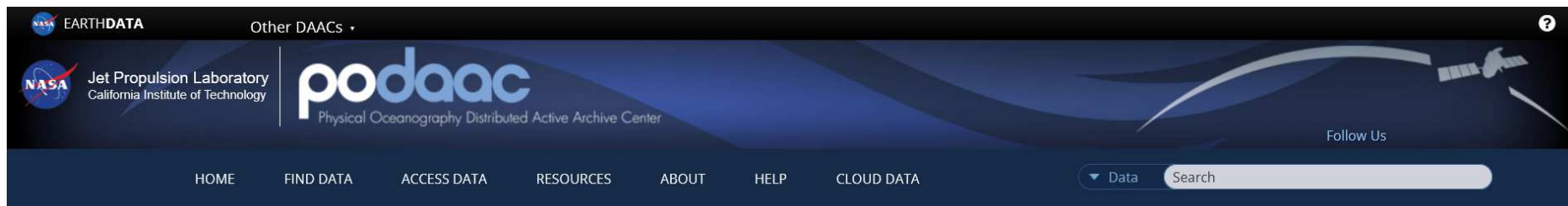
This page is maintained by
Marc Naeije, m.c.naeije@tudelft.nl





Data sources for the blue ocean (SST, sea level, waves, etc.)

https://podaac.jpl.nasa.gov/Altimetric_Data_Information



[Home](#)

NASA and NOAA Altimetric and Ocean Surface Topography Data Information

Intro	Missions	Data Centers	Data Access	Coastal	Hydrological	Climatology	Sea Level	SAR
Waves	Glossary	Related Links						

The purpose of this page is to provide information on what satellite altimetric data are available for scientific research, especially from NASA's PO.DAAC and NOAA's NODC. While this page does not contain any data, it provides succinct descriptions and pointers to the data via dataset information pages or online tools. The information is broken up into multiple sections:

- **Missions** – This contains a chronological listing of past, present and future satellite altimetric missions.
- **Data Centers** – Provides information on mission mandated and non-mandated data centers that archive and distribute data.
- **Data Access** – How to access data from PO.DAAC and NODC and a listing of datasets available from each center.
- **Coastal Altimetry** – Descriptions of the various projects that provide coastal altimetric data.
- **Hydrological Altimetry** – Descriptions of the various projects that provide hydrological altimetric data.



Data sources for the blue ocean (SST, sea level, waves, etc.)

<https://www.avis0.altimetry.fr/en/home.html>

AVISO+
Satellite Altimetry Data

Mobile version

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Release of the extension of the ARCTIC OCEAN GRIDDED SEA LEVEL HEIGHTS
Monomission and multimission products have been extended until June 2020

AVISO+ releases updated Mean Sea Level (MSL) Ocean Indicator products
These climate key indicators are now based on the 2021 reprocessed L2P along-track AVISO+ products V03_00

Release of ANTARCTIC OCEAN GRIDDED SEA LEVEL HEIGHTS AND GEOSTROPHIC CURRENTS
The Aviso+ Team is pleased to announce the publication of the ANTARCTIC OCEAN GRIDDED SEA LEVEL HEIGHTS AND GEOSTROPHIC CURRENT

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Mean Sea Level (cm)
2021-10-12
These climate key indicators are now based on the 2021 reprocessed L2P along-track AVISO+ products V03_00
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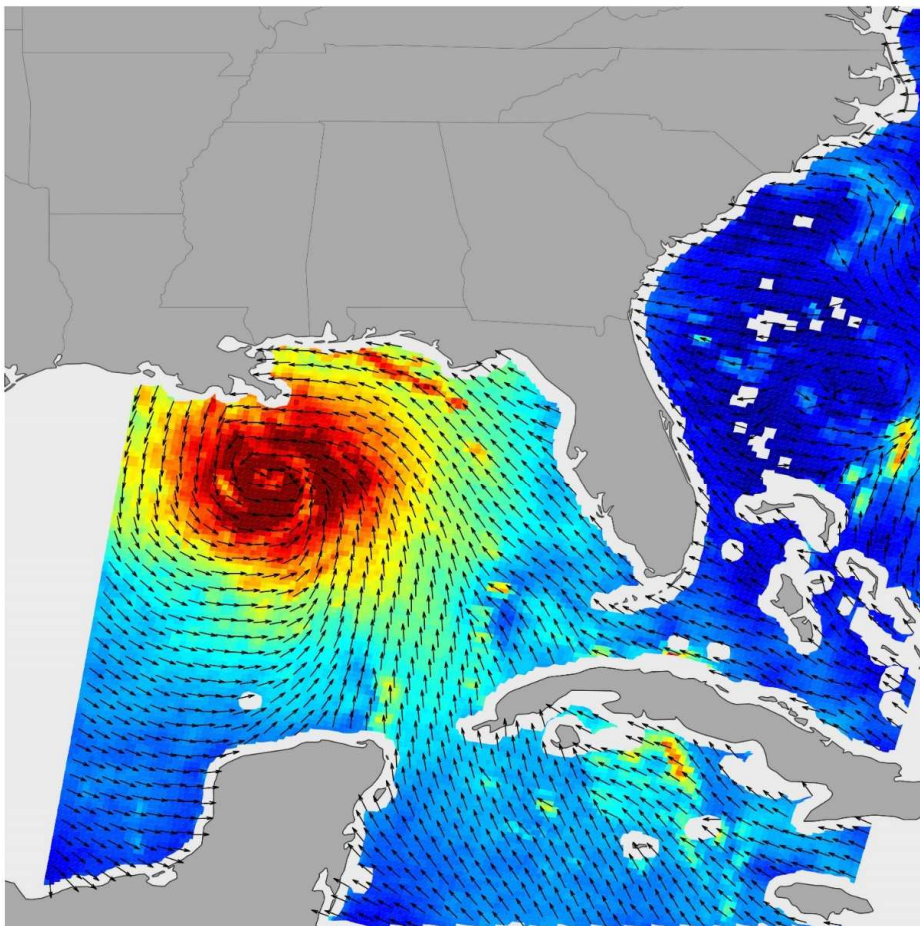
Products guide

Multi-mission product

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Data sources for the blue ocean (SST, sea level, waves, etc.)

Hurricane Katrina August 28, 2005



Wind Speed (miles per hour)
0 20 40 60

Winds
Radar
scatterometers



Data sources for the blue ocean (SST, sea level, waves, etc.)

<https://manati.star.nesdis.noaa.gov/datasets/ASCATData.php>

NOAA | NESDIS | STAR | SOCD

OSWT Home | Product Description | Data Products | Research | Contact US

STAR Center for Satellite Applications and Research
National Environmental Satellite, Data, and Information Service (NESDIS)

Ocean Surface Winds Team

Additional Products: NOAA wind vectors 10x15 (25) | Year: 2021 | Month: 10 | Day: 25 | Global(80N80S-180E180W) |

Ascending Pass

ASCAT-A 25KM NOAA Winds Oct 25 16:07 UTC 2021 ascending

0 5 10 15 20 25 30 35 40 45 >50 knota

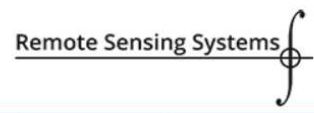
Enter search term(s)

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Data sources for the blue ocean (SST, sea level, waves, etc.)

<https://www.remss.com/>



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> **33+ Year - Climate Data Record (CDR) - Merged Microwave - Air-Sea Essential Climate Variables (AS-ECV)**

MISSIONS



MEASUREMENTS



RESEARCH



STORM WATCH





Data sources for the blue ocean (SST, sea level, waves, etc.)

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OCEAN VISUALISATION

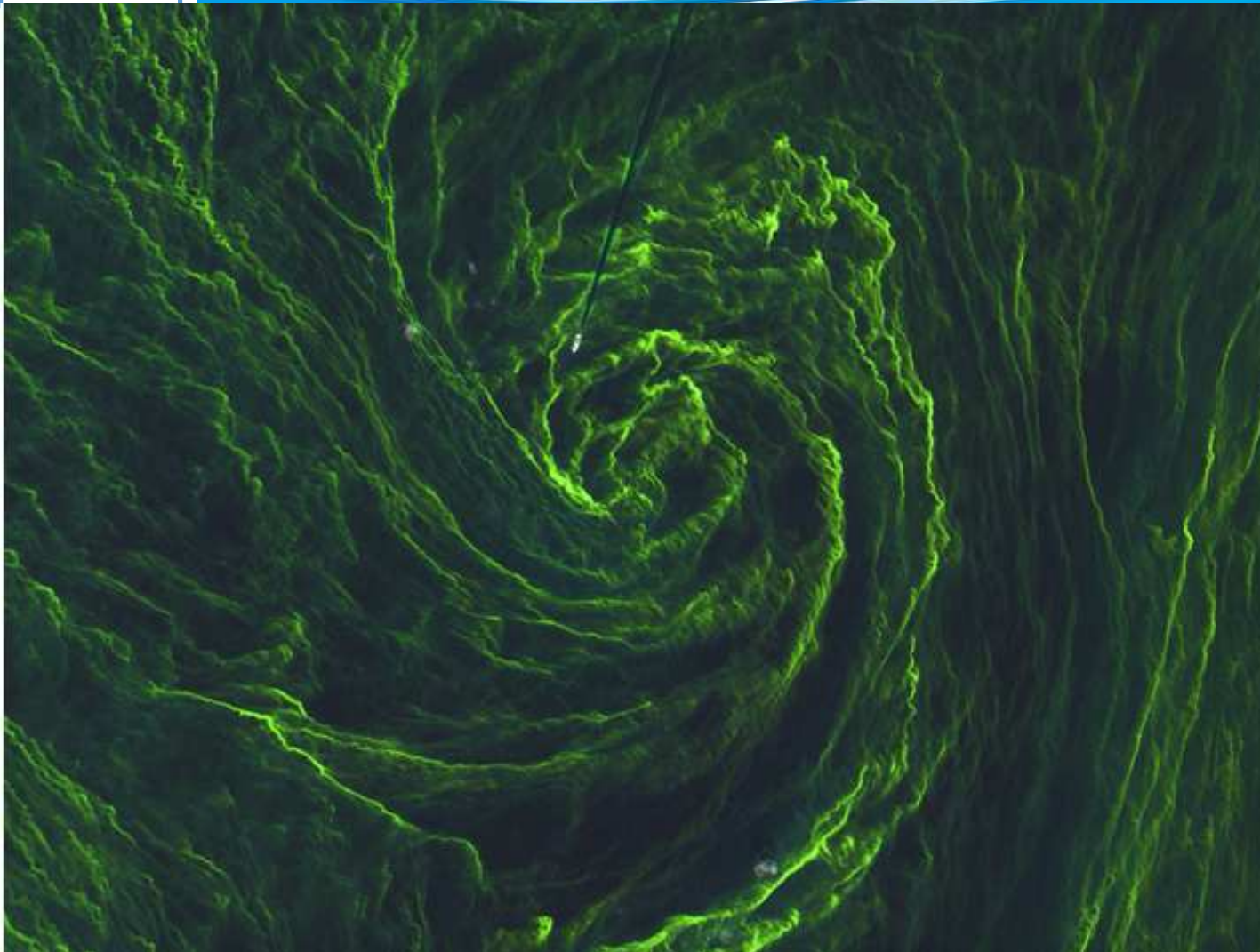
Dive into our 4D digital oceans through our 3 visualisation tools for beginner, intermediate and advanced users

The Copernicus Marine Service is a nutshell





Data sources for the green ocean (chlorophyll-a concentration)



Chl-a
Optical sensors



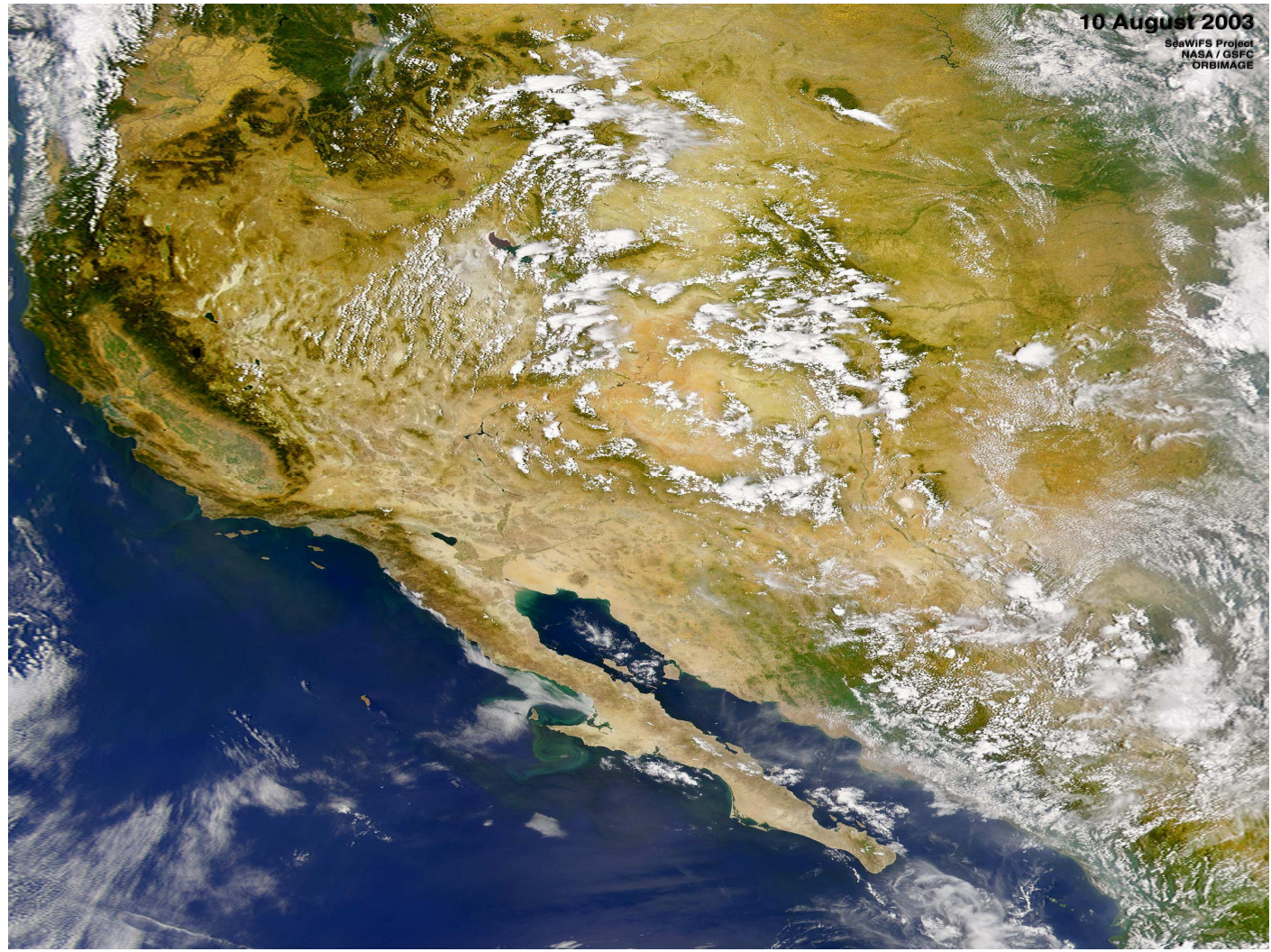
Data sources for the green ocean (chlorophyll-a concentration)



- Passive radiometers operating in the visible and near-infrared (IR) wavelengths.
- They are commonly known as Ocean Colour Remote Sensing (Multispectral scanners and Imaging spectrometers).
- It was historically one of the first techniques used to study the ocean from space.
- **IMPORTANT:** is the only technique which penetrates beneath the surface skin of the ocean and "sees" directly into the surface layers down to a depth of several meters or more.
- We are dealing here with the reflected EM signal in the water photic column (and under some conditions, the EM signal reflected by the sea floor).
- Sensors receive (measure) this energy (radiance arriving to the top-of-atmosphere).
- From the relative magnitude of the water-leaving radiance detected by the different spectral channels of a radiometer, methods have been developed to estimate the concentration of those water constituents which give the sea its color.

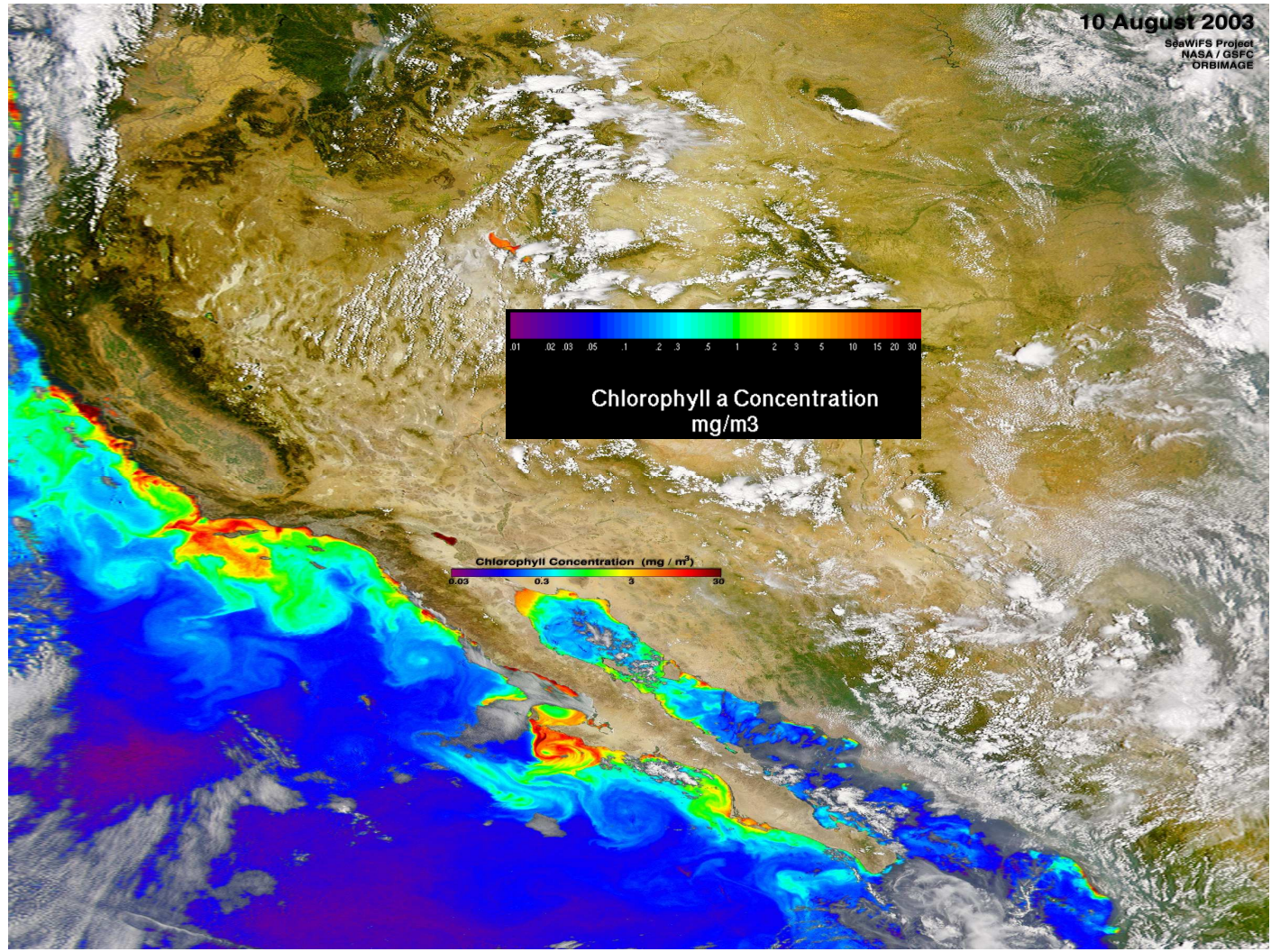


Data sources for the green ocean (chlorophyll-a concentration)





Data sources for the green ocean (chlorophyll-a concentration)





Data sources for the green ocean (chlorophyll-a concentration)

<https://oceancolor.gsfc.nasa.gov/>

NASA EARTHDATA Other DAACs

OceanColor WEB

ABOUT MISSIONS DATA DOCS SOFTWARE & TOOLS SERVICES GALLERY FORUM

Degraded Ocean Color Data: We are experiencing an issue with ozone ancillary data used in ocean color data processing. [Read more >](#)

OCEAN BIOLOGY
DISTRIBUTED ACTIVE ARCHIVE CENTER

NASA's OceanColor Web is supported by the Ocean Biology Processing Group (OBPG) at NASA's Goddard Space Flight Center. As a Science Investigator-led Processing System (SIPS), our responsibilities include the collection, processing, calibration, validation of ocean-related products from a large number of operational, satellite-based remote-sensing missions providing ocean color, sea surface temperature and sea surface salinity data to the international research community since 1996.

As a Distributed Active Archive Center (DAAC), known as the Ocean Biology DAAC (OB.DAAC), we are responsible for the archive and distribution of satellite ocean biology data produced or collected under NASA EOSDIS, including those from historical missions and partner space organizations.

Ocean Color Feature

SeaHawk/HawkEye Begins Routine Operations



Data sources for the green ocean (chlorophyll-a concentration)



<https://marine.copernicus.eu/>

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Copernicus Marine Service

Providing free and open marine data and services to enable marine policy implementation, support Blue growth and scientific innovation.

[Access Data](#) >

DATA

OCEAN PRODUCTS

A robust ocean data catalogue, to download or visualise data including hindcasts, nowcasts and forecasts.

EXPERTISE

OCEAN STATE REPORT

Extensive annual analysis on the state of the ocean over nearly 20 years and severe/notable annual events.

TRENDS

OCEAN MONITORING INDICATORS

Essential variables monitoring the health of the ocean over the past quarter of a century.

EXPLORATION

OCEAN VISUALISATION

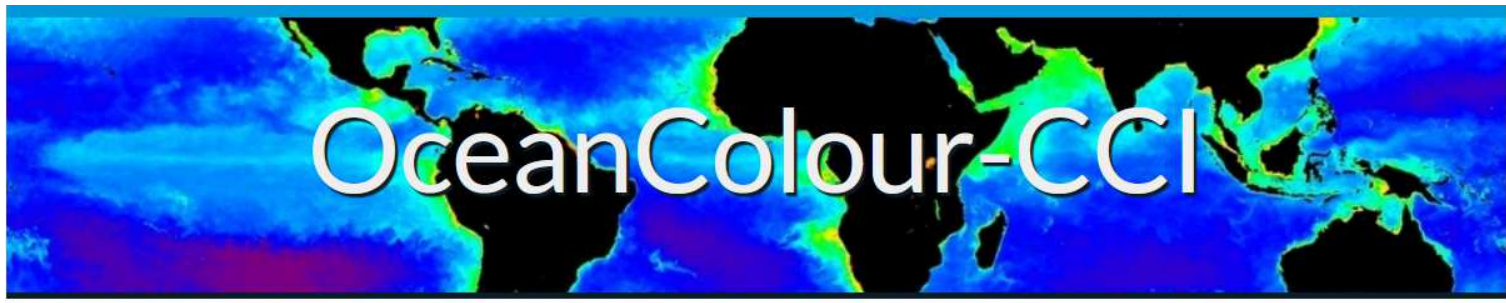
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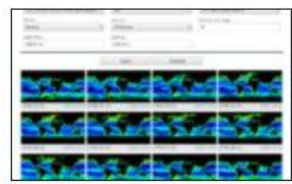
Data sources for the green ocean (chlorophyll-a concentration)



<https://www.oceancolour.org/>

References & Citation Information

For complete details of relevant references, DOIs, and citation information please see the [Ocean Colour](#) section of the [ESA Climate website](#)



Composite Browser
Access a range of products composited in different periods. Data can be searched by time ranges, periods, products & wavelengths.



OPeNDAP
A freely available framework that simplifies all aspects of scientific data networking, making local data available to remote locations regardless of storage format.



Web GIS Portal
View, manipulate & analyse data.

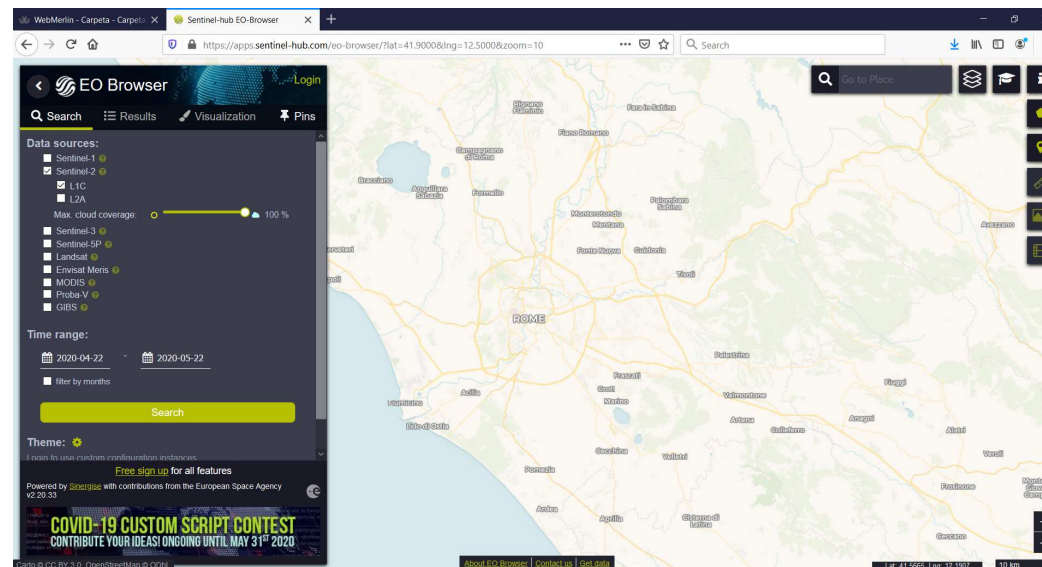


FTP
Download large sets of data easily. Version 5.0 datasets available now.



Sentinel-hub EO-Browser

<https://apps.sentinel-hub.com/eo-browser/>





First steps with Sentinel Application Platform (SNAP) (practical lesson)