

# Observing the ocean from space

12. June 2024







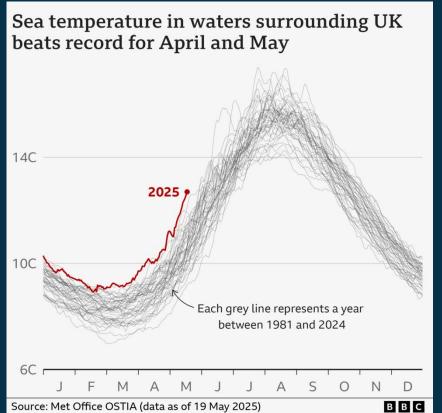


Susanne Mecklenburg

ESA



## Sea around the UK much warmer than usual Sea surface temperature on 20 May 2025, compared with 1982-2011 average for that day Colder Warmer oc +2C -2C >+4C <-4C North Sea Atlantic Ocean **FRANCE** 200km 200 miles в в с Source: Met Office OSTIA, ESA CCI





Temperatures in the seas around the UK and Ireland have soared in the past week with some areas now 4C warmer than normal, with potential implications for marine life and recreational sports @ BBC 22 May 2025

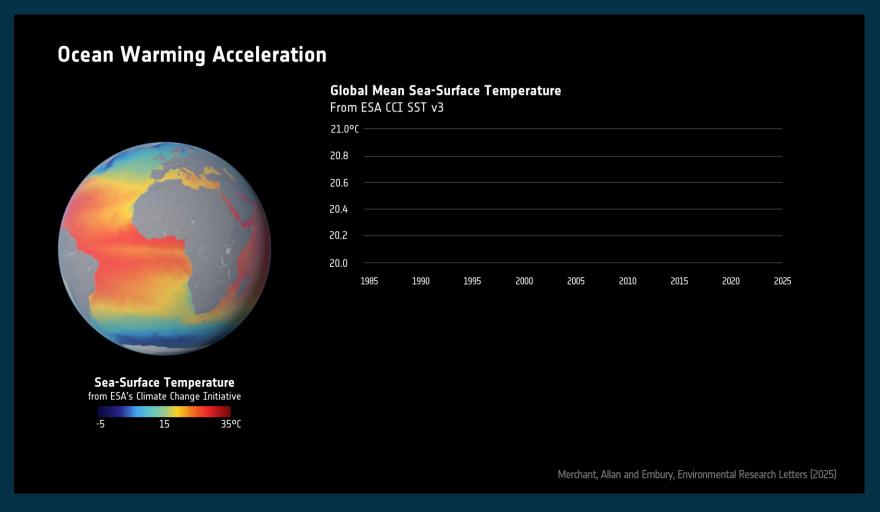
**BBC 22 May 2025** 



# The beauty of space data – Sea Surface Temperature



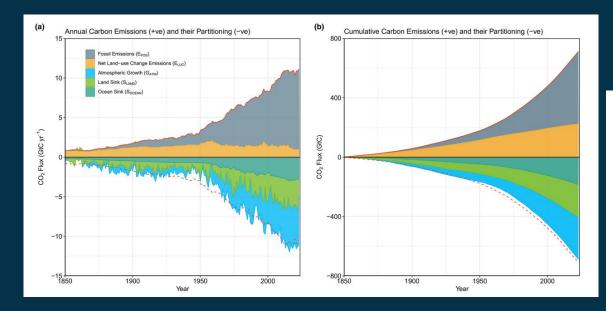
## long-term | continuous | timely | global | collocated



- Satellite data show four-fold acceleration in sea surface temperature (SST) rise
- SST increased from 0.06K (1985–1989) to 0.27K (2019–2023)
- Warming trend is linked to an increasing Earth Energy Imbalance
- Short-term factors (e.g. El Niño, volcanoes, solar shifts) do not change the long-term trend
- Authors warn warming may outpace past 40-year linear trends within 20 years (so observations are critical!)

# Why we need to monitor the oceans





P. Friedlingstein et al.: Global Carbon Budget 2024

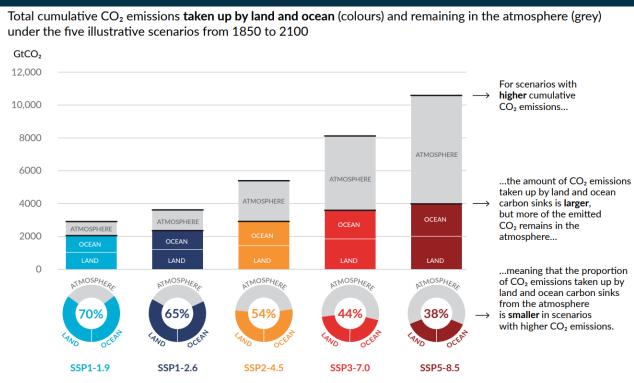


Figure SPM.7 | Cumulative anthropogenic CO₂ emissions taken up by land and ocean sinks by 2100 under the five illustrative scenarios

**IPCC AR6 WG I SPM** 

# Tipping Points: Sensitivity to global warming

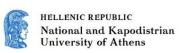










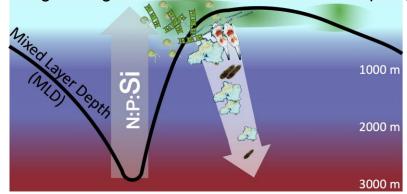




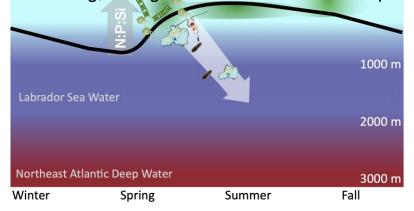
### Tipping points and abrupt changes In the Marine Ecosystem (TIME)

#### **North Atlantic Subpolar Gyre**

Strong forcing, weak stratification → efficient pump

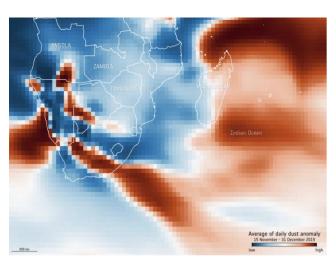


Weak forcing, strong stratification → inefficient pump



The North Atlantic Subpolar Gyre plays an important role in carbon cycling – **Hypothesis**: Shutdown of deep convection in the North Atlantic subpolar gyre will drastically reduce the efficiency of the biological carbon pump.

#### **Phenology**





JOURNAL ARTICLE

An exceptional phytoplankton bloom in the southeast Madagascar Sea driven by African dust deposition 3

John A Gittings , Giorgio Dall'Olmo , Weiyi Tang , Joan Llort , Fatma Jebri , Eleni Livanou , Francesco Nencioli , Sofia Darmaraki , Iason Theodorou , Robert J W Brewin , Meric Srokosz , Nicolas Cassar 

, Dionysios E Raitsos 

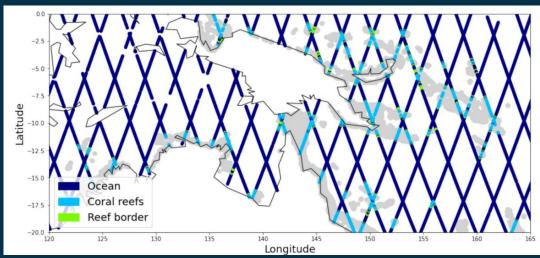
Author Notes

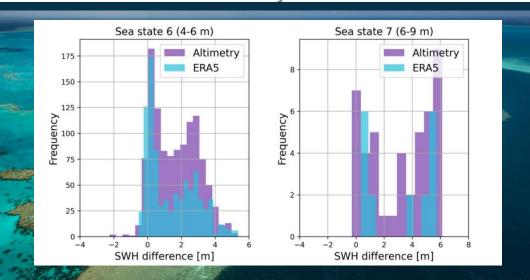
In late 2019, southeast Madagascar waters experienced one of the largest phytoplankton blooms over the last two decades. T2 will attempt to search for similar events across the global oceans.

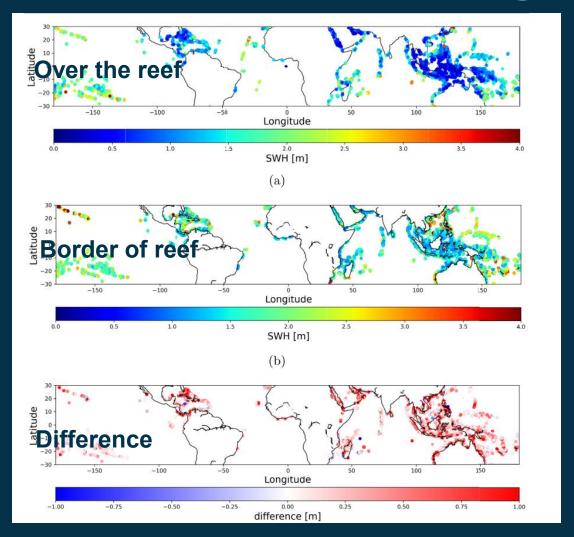
# Adaptation: Effect of Coral Reefs on Wave Height



#### Using satellite altimetry to measure SWH







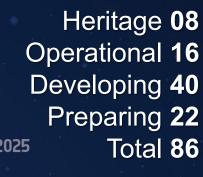
M.Usoltseva et al 2025 https://doi.org/10.1007/s41976-025-00228-1

# **ESA's Earth Observation Missions**

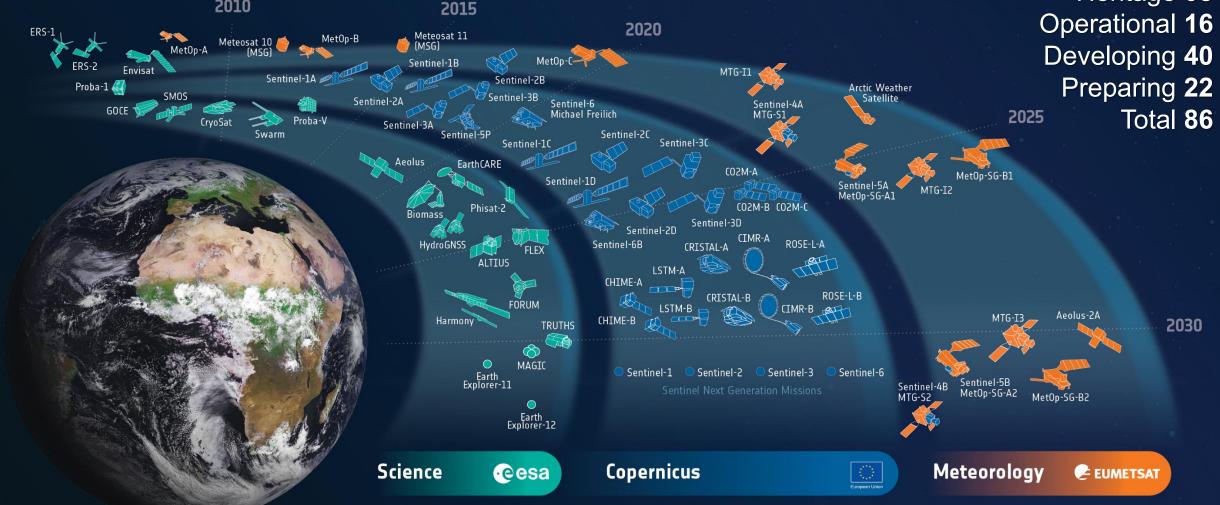
2010

eesa

World-class Earth Observation systems developed with European and global partners to address scientific & societal challenges



**Satellites** 



# **Copernicus Space Evolution**



**ROSE-L** 

L-band Radar

**Observing System** 

co-funded with





soil properties crop health raw materials biodiversity water quality

geohazards polar ice forest management food security maritime surveillance



**LSTM** Land Surface Temperature Monitoring

Carbon dioxide and methane from human activity

water resources management sustainable adjiculture

Copernicus Imaging Microwave Radiometer

CO2M

Copernicus Anthropogenic Carbon Dioxide Monitoring Combatting

Strengthening Copernicus **Space Component with** Copernicus Sentinel **Expansion Missions** 

ice sheets and glaciers sea-ice thickness

Sed lie Concentration



CRISTAL

Copernicus Polar Ice and Snow Topography Altimeter

# Take home messages



Space-based data provide essential information about the state of the oceans through being longterm, continuous, timely, global and collocated

The European cooperation on Copernicus provides a large portfolio of ocean data (and related services), with a continuous expansion and enhancement of the space infrastructure

ESA covers the entire supply chain of observations over ocean: from satellite to CDR, providing R&D and pre-operational development to operational climate services

New space infrastructure in Copernicus will support a multitude of new ocean focussed applications.



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