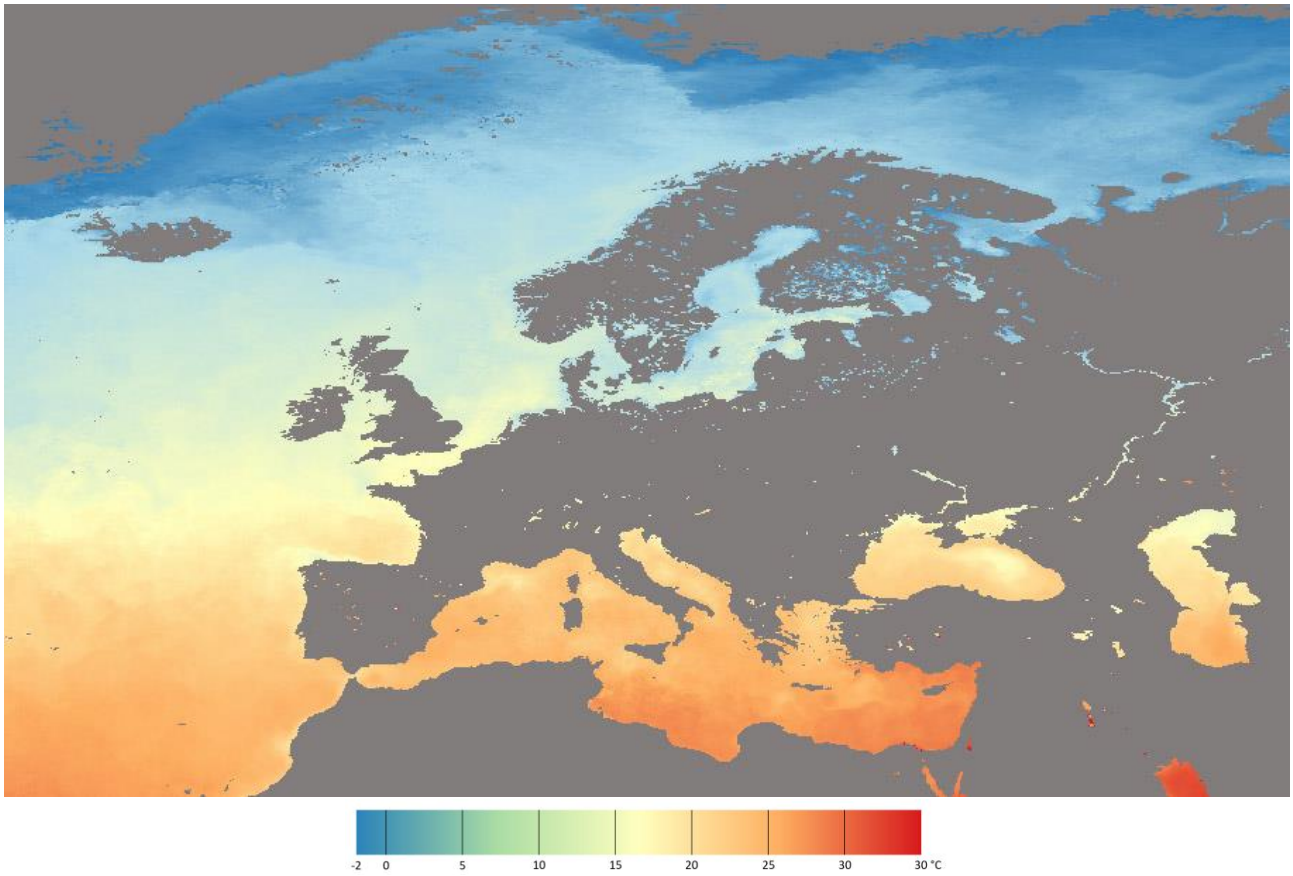
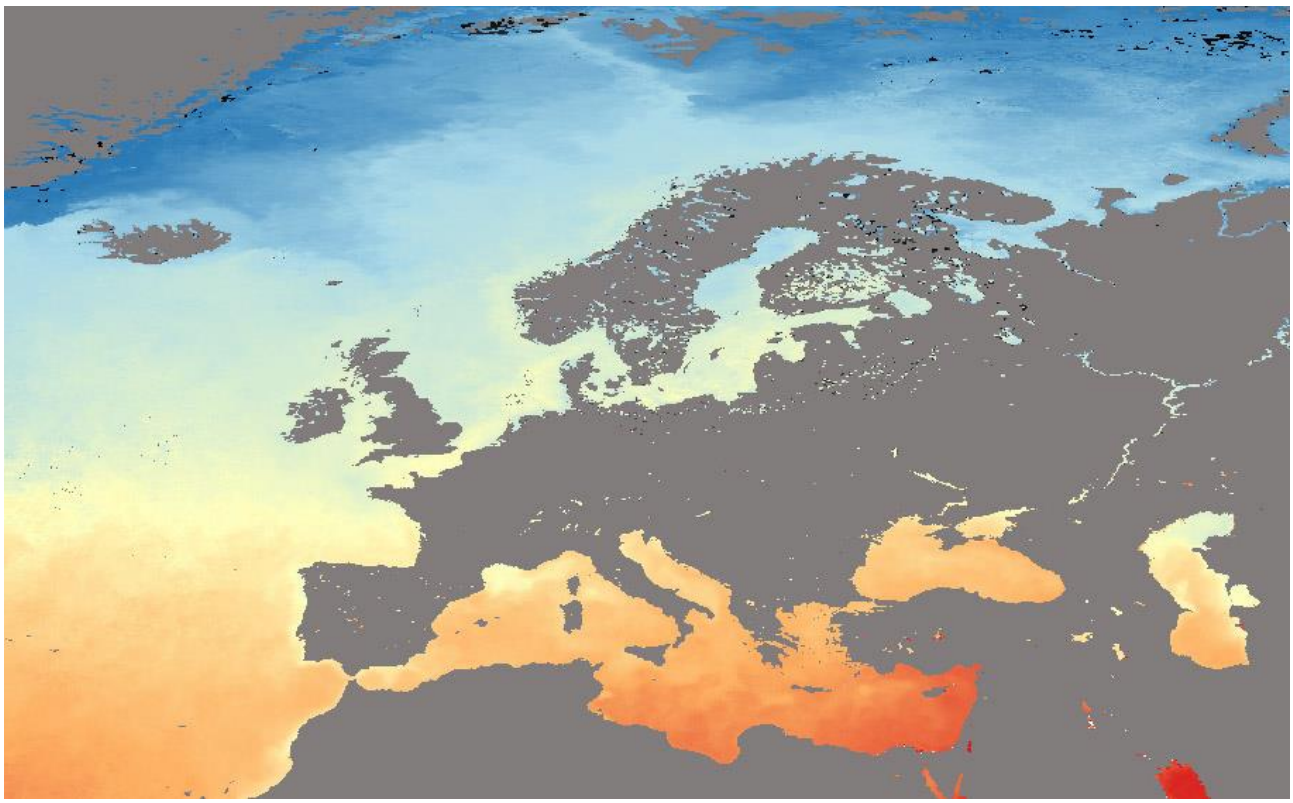
Sea Surface Temperature – Europe



Sea surface temperature around Europe, October 2009 (monthly average; Data: Sentinel-3).



Sea surface temperature around Europe, October 2021 (monthly average; Data: Sentinel-3).

Sea Surface Temperature around Europe

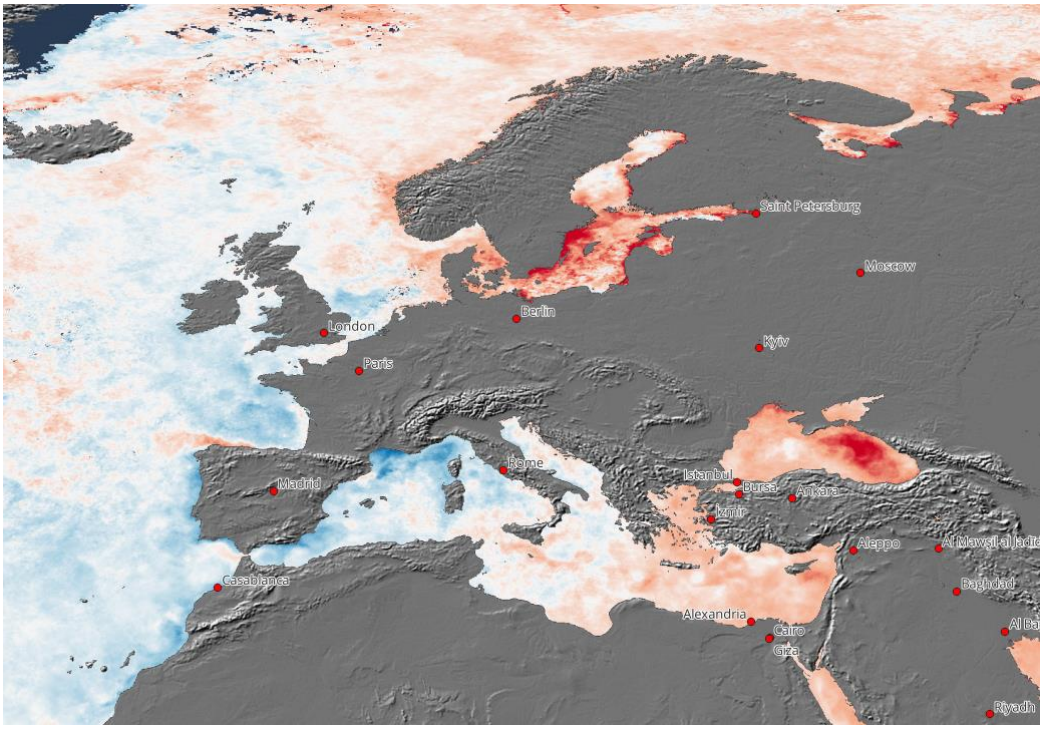
The seas surrounding Europe—including the North Atlantic, the North Sea, the Baltic Sea, and the Mediterranean—are critical components of the continent's climate system. The sea surface temperatures (SSTs) influence weather patterns, ocean circulation, marine ecosystems, and coastal economies. Over the past decades, advances in satellite technology have revolutionized the observation of SST, allowing to track changes with high accuracy. The observations provide clear evidence of a long-term warming trend, closely tied to global climate change.

Traditionally, SST was measured from ships and buoys. These observations were limited in both space and time. Since the 1970s, satellites equipped with infrared and microwave sensors have allowed for near-global daily coverage of SST. Agencies such as the European Space Agency (ESA), NASA, and EUMETSAT provide long-term data records.

Long-Term Trends in European Seas: Satellite data show that the seas around Europe have warmed significantly since the 1980s. The Mediterranean Sea stands out as one of the fastest-warming seas in the world, with SST increases of up to 0.4 °C per decade in some parts. The North Sea and the Baltic Sea also show pronounced warming, with average SST increases of around 0.3 °C per decade. By contrast, the North Atlantic shows more complex patterns. While the region south of Greenland has experienced periods of cooling, the waters west of Europe and around the Iberian Peninsula show sustained warming. This regional variability is partly explained by ocean circulation, such as changes in the Atlantic Meridional Overturning Circulation (AMOC), which redistributes heat across the basin.

Warming trends are **not uniform** across the seasons. Satellite data reveal that summer SSTs have increased more strongly than winter temperatures, especially in the Baltic and Mediterranean Seas. In shallow shelf seas like the North Sea, SST responds quickly to changes in atmospheric conditions, amplifying short-term warming episodes. Conversely, deeper basins such as the eastern Mediterranean show more gradual, but persistent, increases. This is reflected also by the satellite maps presented here for the month of October.

Another finding is the occurrence of **marine heatwaves**—periods of extremely high SST lasting days to weeks. These events have become more frequent and intense in European seas, particularly in the Mediterranean, where extreme warming in the summers of 2003, 2017, and 2022 caused increased mortality in marine species.



Sea surface temperature changes between October 2009 and October 2021 (Data: Sentinel-3).

Exercises

- Look at the Sea surface temperature maps from 2009 and 2021 and compare.
- Try to identify regions where the SST has increased and where it has decreased.
- Discuss why it might be difficult to assess changes with this data. Think about the expected extent of changes (several °C) compared with the temperature differences between north and south (up to 30°C) – what will be easier to see?
- Have a look to the SST Difference map showing the SST changes between October 2009 and October 2021. Is it easier to see changes now? Where do you see an increase, where a decrease in the SST?
- Why don't we see increasing SST everywhere? Think about the influence of weather, e.g. cooler atmospheric currents masking overall trends.

Links and Sources

- More about ESA's activities concerning Sea Surface Temperature measurements: https://www.esa.int/Applications/Observing_the_Earth/Space_for_our_climate/Sea_Surface_Temperature
- The ESA Climate Office's project on Sea Surface Temperatures: https://climate.esa.int/en/projects/sea-surface-temperature/