

# The Changing Sea

The sea is on the front-line of climate change— if we can understand what is happening now can we predict future change?

## The Heat is On

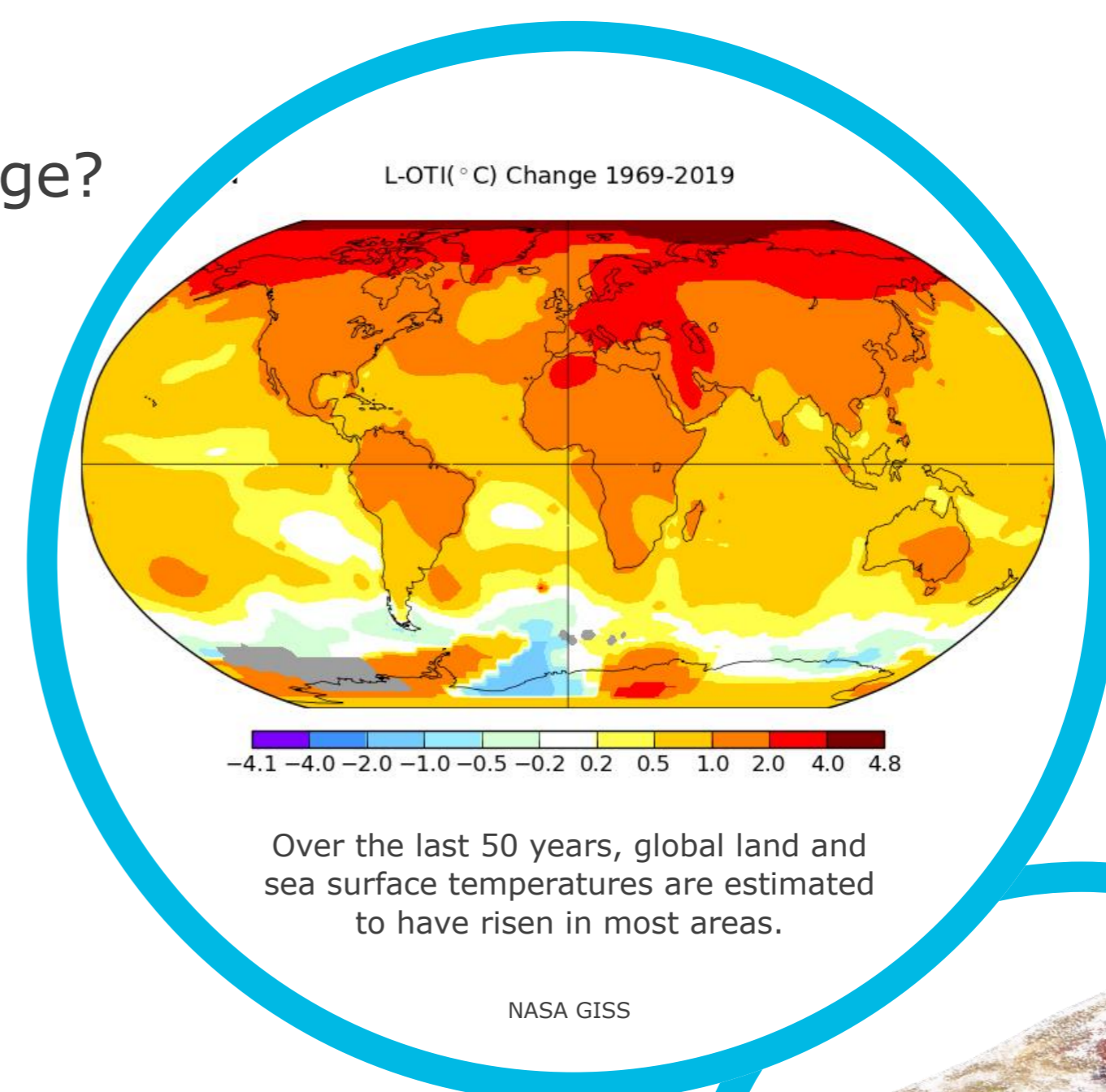
The oceans act as a heat sink: around 90% of the excess heat produced by human activity over the past 50 years has been absorbed by the world's seas.

Studies show that the seas around Britain have warmed four times faster than the global average over the last 40 years. The temperature of the North Sea has risen by 2°C. This is unlike anything seen in the last 20,000 years and is having noticeable effects on marine habitats.

## Ocean Currents

Ocean circulation is important in regulating climate and supporting marine life by transporting heat, carbon, oxygen, and nutrients throughout the world's seas. Excess heat and carbon are captured in the deep ocean.

Scientific models show that the flow is declining and that global warming will further weaken it, for example, by adding fresh water from melting Polar ice. This could severely impact the whole marine ecosystem.



**CO<sub>2</sub> absorbed from the atmosphere**

$$\text{CO}_2 + \text{H}_2\text{O} \rightleftharpoons \text{H}_2\text{CO}_3 \rightleftharpoons \text{HCO}_3^- + \text{H}^+$$

**Removal of carbonate**

$$\text{CO}_2 + \text{H}_2\text{O} + \text{CO}_3^{2-} \rightleftharpoons 2\text{HCO}_3^-$$

Increased CO<sub>2</sub> dissolved in water leads to lower pH and reduced carbonate ions—essential for shell and coral formation.

Marine Scotland

**Hurricanes, typhoons and cyclones extract heat from the surface and sub-surface of the ocean, which acts as a source of energy making them stronger and last longer.**

Copernicus Marine Service  
2019



## Water Chemistry

Warmer water holds less oxygen, needed for fish to grow and develop. This is already affecting fish in warmer waters such as the Mediterranean.

In addition, the seas have absorbed over a third of the excess carbon-dioxide produced since the industrial revolution. This means that the oceans are becoming more acidic at a faster rate than at any time in the last 300 million years.

## Stormy Weather

Increased energy in the atmosphere is already causing more extreme weather and storms. This can cause more severe coastal erosion, washing silt and chemicals into the sea. Together with rising sea levels, it also affects users of the sea.

