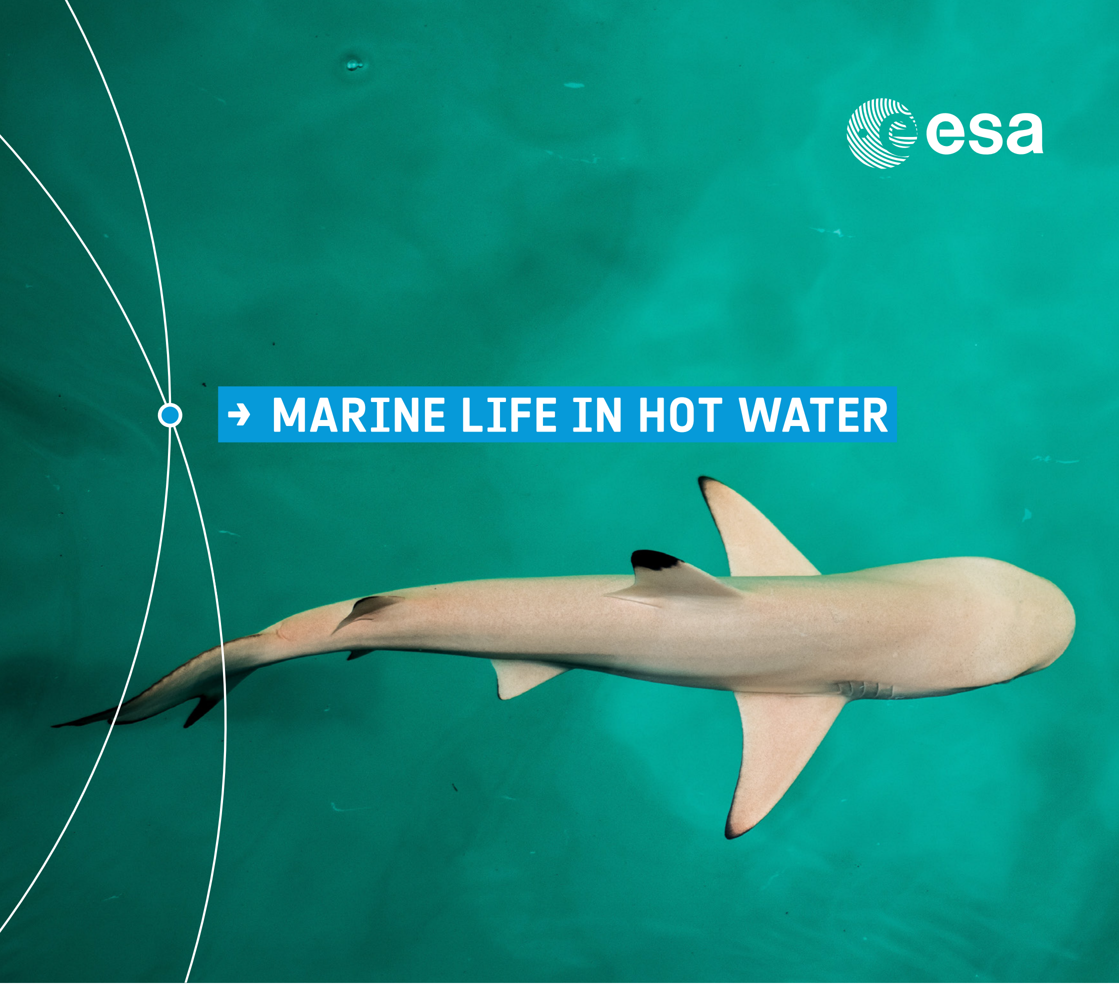
→ MARINE LIFE IN HOT WATER



Heatwaves are not confined to land – ocean temperatures are breaking records too. Off the California coast near San Diego, scientists measured an all time high for seawater temperature in August 2018.

Phases of extreme heat can damage kelp forests and coral reefs as well as harm marine life, and slow the growth of plankton, an essential food source for many marine creatures.

Text source: The Guardian, 15 August 2018
Photo by Ali Abdul Rahman on Unsplash

The oceanic food chain

Single-cell algae called phytoplankton are important for life on Earth as they are responsible for producing around half of the oxygen in the atmosphere and are the base of the oceans' food chain. Their name is derived from the Greek words for 'plant' (phyto) and 'wandering' (planktos), and they can be found across all the world's oceans.

Like any plant, phytoplankton need sunlight, carbon dioxide and nutrients to grow. Their growth is mainly limited by a lack of nutrients, so when they are brought to the surface by the upwelling of the ocean circulation, phytoplankton growth occurs. And as they grow, they absorb carbon dioxide from the atmosphere removing this dangerous greenhouse gas. Where phytoplankton grows on such a huge scale, you can see it from space.

Sea Surface Temperature

Upwelling regions of the oceans are commonly found along coastlines due to wind-driven surface waters moving away from the coast, to be replaced by water from deeper currents. When compared with sea surface temperature data you can see these nutrient-rich waters that support the growth of phytoplankton are colder than the surrounding ocean.

Nutrients and therefore phytoplankton are also abundant near river outlets such as the Amazon and the Congo rivers. The most productive fishing areas are generally near river outlets, and where upwelling occurs.

➔ Go to Ocean Colour ➔ Chlorophyll-a concentration globe

Satellites can measure changes in colour, produced by the chlorophyll in phytoplankton. The lighter colours in the animation show high concentrations of Chlorophyll-a and indicate the movement of ocean currents.

➔ Next, in the bottom right of the screen click Compare and select Sea Surface Temperature

Compare the Sea Surface Temperature animation which shows colder areas where upwelling happens – these correspond with areas of high levels of Chlorophyll-a shown in Ocean Colour data.

→ WHAT COULD CAUSE SEA LEVEL TO DROP?

We're told that sea levels around the world are rising, but in 2011 satellite measurements showed there was an unexpected drop.

Scientists looked at each of the different contributors to sea level rise to see why the change had occurred. All seemed normal with glaciers and ice sheets melting at an increasing but regular pace, and the thermal expansion of the warming oceans happening at a consistent rate. However, looking at rainfall and soil moisture data, researchers realised that the heavy rain that fell over Australia in 2010-2011 could account for the drop. The downpours fell in areas where the water didn't have a direct route back to the sea, taking about a year to make its way to the ocean. Could that year's strong La Niña have made the difference?

Text source: Scientific American, 20 August 2013
Photo by Peter Fogden on Unsplash

El Niño southern oscillation

El Niño and La Niña are the warm and cool phases of a recurring climate pattern across the tropical Pacific – the El Niño-Southern Oscillation, or ENSO. The pattern switches between the phases every two to seven years, each triggering predictable disruptions of temperature, precipitation, and winds. These changes disturb the usual patterns of large-scale air movements, leading to a cascade of global side effects.

El Niño

A warming of the ocean surface, or above-average sea surface temperatures (SST), in the central and eastern tropical Pacific Ocean. Rainfall is reduced over Indonesia, but increases over the tropical Pacific Ocean. Low-level surface winds, which normally blow from east to west along the equator – easterly winds – weaken or can sometimes start blowing the other direction from west to east – westerly winds.

La Niña

A cooling of the ocean surface, or below-average SST, in the central and eastern tropical Pacific Ocean. Rainfall over Indonesia tends to increase, while it decreases over the central tropical Pacific Ocean. The normal easterly winds along the equator become even stronger.

Climate from Space

iPad / Android app

→ Go to Sea Surface Temperature → sst anomaly globe

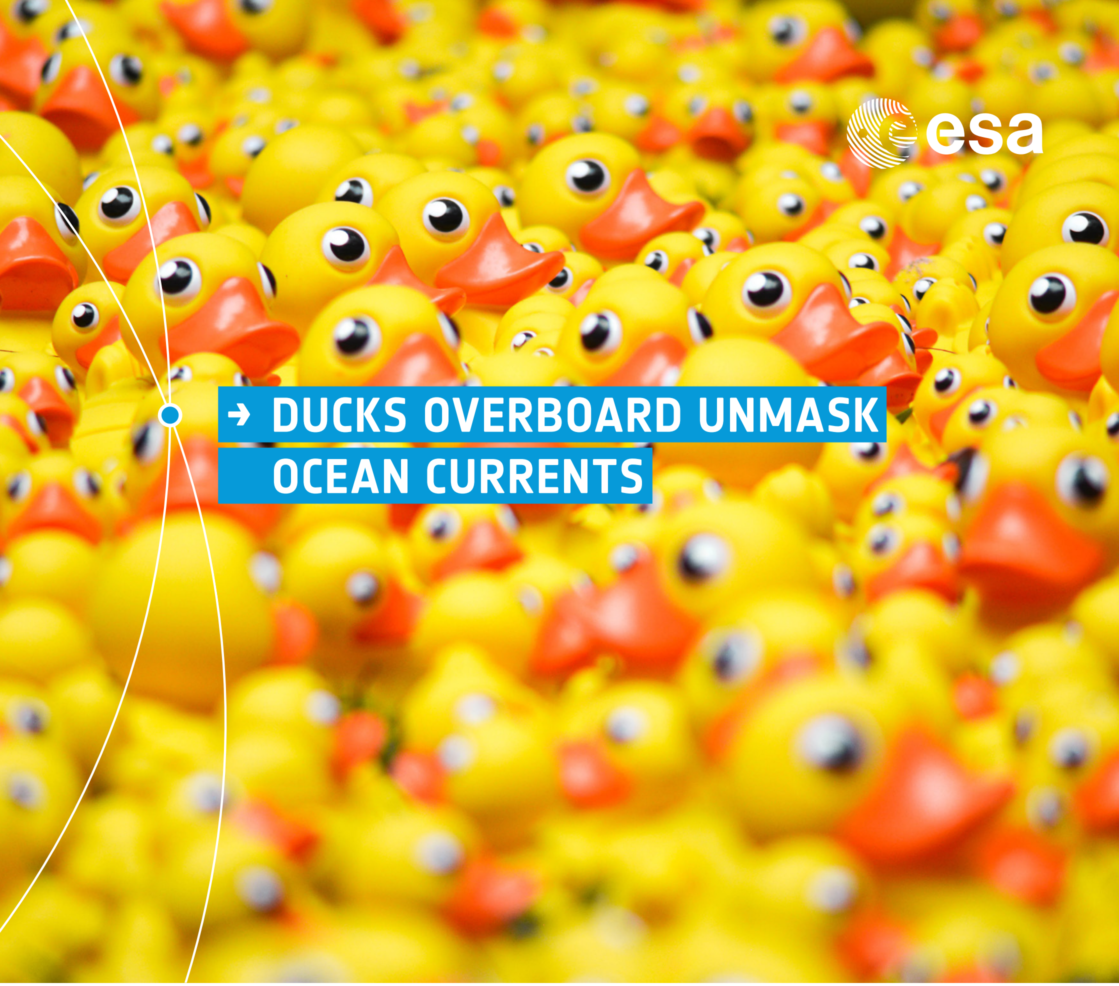
Rotate the animation to focus on the Pacific Ocean and watch how the warm areas (red) across the equator increase at the end of 1997, indicating the beginning of a large El Niño event.

Follow the animation through to the end of 2010 to see colder areas appear as a La Niña phase arrives – the cause of the 2011 sea level anomaly.

→ Next, in the bottom right of the screen click Compare and select Sea Level Anomaly

Compare the Sea Level anomaly with Sea Surface Temperature anomaly – higher sea levels correspond with higher SST during an El Niño phase, and lower and cooler during La Niña.

→ DUCKS OVERBOARD UNMASK OCEAN CURRENTS



A shipping container lost in the Pacific Ocean left a trail of 28,000 rubber ducks in its wake in 1992. Years later, the 'friendly floatees' had been spotted across the globe, from Alaska to South America, stuck in Arctic ice and as far afield as Scotland. Through mapping the journeys of the little yellow ducks, researchers now have a better idea of how ocean currents behave, and that it takes three full years to complete the global current circulation.

The ducks also helped to identify the currents circulating North Pacific Gyre, highlighting the huge patch of rubbish that has formed there. They still pop up occasionally on far flung beaches!

Text source: Port Technology, 26 May, 2015
Photo by Andrew Wulf on Unsplash

Ocean currents

Water is circulated around the world's oceans by major currents that travel horizontally and vertically, transporting both surface and deep water. These currents are critical in transporting heat and energy around the globe.

These huge circular currents, or gyres, move in a clockwise direction in the Northern Hemisphere and anti-clockwise in the Southern Hemisphere, but due to the rotation of the Earth, they are always strongest along the west coast. These 'western boundary currents' can clearly be seen in the Sea surface temperature data, transporting warmer water to the poles.

Climate from Space

iPad / Android app

→ Go to Sea Surface Temperature → sea surface temperature globe

Watch how the colours change during each year – orange indicates high sea surface temperatures (SST), blue indicates lower. The annual cycle shows the how the western boundary currents behave: the Gulf Stream along the north-west Atlantic is clearly visible, along with the Kurushio current off Japan and the Agulhas current off South Africa.

Curls of smaller currents are also evident, particularly across the equator in the Pacific Ocean.

→ Next, in the bottom right of the screen click Compare and select Sea Level Anomaly

Explore the height differences in the eddies within the currents – red indicates higher than usual sea level, blue indicates lower. These eddies are an important means of bringing nutrient-rich deep waters to the surface to supply the food chain.

→ WET WINTERS MEAN MORE WILDFIRES

Wildfires need dry conditions to start, but they also need fuel to keep going. So when you get a wet winter or spring this leads to abundant growth of grasses and shrubs that dry out in the summer, creating more fuel that can easily burn.

Forest trees, weakened by previous scorching summers, can also provide additional fuel once they fall to the forest floor. Effective forest management is, therefore, crucial in keeping fuel to a minimum, reducing the frequency and intensity of the fires and ultimately reducing the spread and impact of forest fires.

Text source: News Deeply, 19 June 2017
Photo by Mari Pa on Unsplash

Land cover and fire

South of the Sahara Desert, is the semi-arid zone of grass and scattered shrubby vegetation known as the Sahel. Further south, the Sahel turns into more thickly vegetated savanna.

For thousands of years, African farmers and herders have set fires in this region to clear brush, to stimulate new growth of pasture grasses, or to drive game. The burning area shifts from north to south over the course of the year, in step with the change of Africa's rainy and dry seasons.

Comparing the areas of vegetative growth from the high resolution land cover data with information from the fire dataset, you can see where the burned areas correspond with the type of vegetation most prone to wildfires.

Although fires are a part of the natural cycle in Africa, in the fragile Sahel, for example, land degradation through overuse of fire or overgrazing can create pockets of desert. The massive amount of burning that occurs in Africa each year creates carbon dioxide and aerosol particles, both of which play a role in the global climate. In addition, the smoke and accompanying gases and particles create a public health hazard.

→ Go to Land Cover → land cover type globe

Investigate the wide range of land cover types across Africa, from desert to forest.

→ Next, in the bottom right of the screen click Compare and select Fire burned area

As the animation runs, you can see the variation in burned areas between the hemispheres and through the different times of year.

Compare the Burned area with Land cover type – which sort of land cover is most likely to burn?

→ URBAN TREES CAN STORE ALMOST AS MUCH CARBON DIOXIDE AS RAINFORESTS

Trees are an essential part of towns and cities, providing shade, removing air pollution and helping to prevent floods. Trees are also removing and storing carbon dioxide [CO_2] from the air. This means that in cities they are absorbing this critical greenhouse gas very close to the source of fossil fuel emissions from transport and industry, stopping it from going into the atmosphere.

Combining data measured from the air and from the ground, researchers found that mature trees in some parts of London can absorb almost as much carbon dioxide as temperate and tropical rainforests.

Text source: The Conversation, 26 June 2018

Vegetation and Carbon dioxide

Trees and plants take up CO_2 as they grow. In particular, deciduous trees use a lot more carbon dioxide during photosynthesis as they regrow leaves in the spring. However, during autumn, these trees drop their leaves, which decompose releasing CO_2, producing a rise and fall in CO_2 levels during the year. Of course, while it's spring in the Northern Hemisphere, it's autumn in the Southern Hemisphere, which logically should mean they cancel each other out.

Sadly not. As there is a more land in the Northern Hemisphere, that has larger forested areas in Siberia. As a result, CO_2 levels around the world peak in May each year, as it's built up over the Northern Hemisphere winter, before the growing season kicks-in. This seasonal cycle drives changes in carbon dioxide on monthly to yearly timescales, but it is human activities that are changing the long-term trends of carbon dioxide.

➔ Go to Greenhouse Gases ➔ carbon dioxide globe

Carbon dioxide levels are concentrated over land where the emissions largely occur – the animation shows how CO_2 levels vary over the course of a year, moving from north to south with the seasons.

The alarming increase in CO_2 levels is also evident, as the blue colours indicating lower levels of CO_2 give way to mostly red, indicating high levels.

➔ Next, in the bottom right of the screen click Compare and select Vegetation Index

Run the animation to see how vegetation changes month by month across the different continents and hemispheres.

Compare the vegetation variability with carbon dioxide levels to see the correlation between growing seasons and changes in CO_2 levels.