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OCEAN WARMING

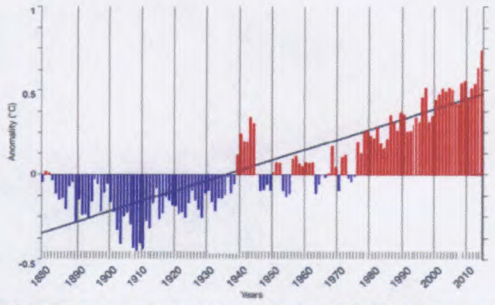
NOVEMBER 2017

- The ocean absorbs most of the excess heat from greenhouse gas emissions, leading to **rising ocean temperatures**.
- Increasing ocean temperatures **affect marine species and ecosystems**. Rising temperatures cause coral bleaching and the loss of breeding grounds for marine fishes and mammals.
- Rising ocean temperatures also affect the benefits humans derive from the ocean – **threatening food security, increasing the prevalence of diseases and causing more extreme weather events and the loss of coastal protection.**
- Achieving the mitigation targets set by the Paris Agreement on climate change and **limiting the global average temperature increase to well below 2°C above pre-industrial levels** is crucial to prevent the massive, irreversible impacts of ocean warming on marine ecosystems and their services.
- **Establishing marine protected areas** and **putting in place adaptive measures,** such as precautionary catch limits to prevent overfishing, can protect ocean ecosystems and shield humans from the effects of ocean warming.

What is the issue?

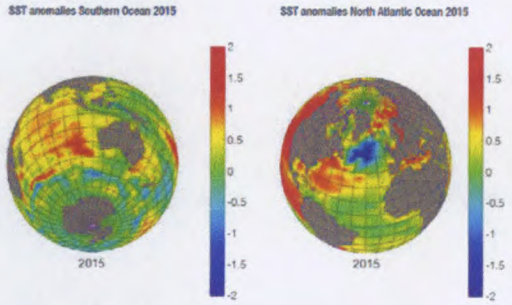
The ocean absorbs vast quantities of heat as a result of increased concentrations of greenhouse gases in the atmosphere, mainly from fossil fuel consumption. The Fifth Assessment Report published by the Intergovernmental Panel on Climate Change (IPCC) in 2013 revealed that the ocean had absorbed more than 93% of the excess heat from greenhouse gas emissions since the 1970s. This is causing ocean temperatures to rise.

Data from the US National Oceanic and Atmospheric Administration (NOAA) shows that the average global sea surface temperature – the temperature of the upper few metres of the ocean – has increased by approximately 0.13°C per decade over the past 100 years. A 2012 paper published in the journal *Geophysical Research Letters* revealed that the deep ocean is also affected, with one third of the excess heat absorbed 700 m below the sea surface. Modelling studies published in IPCC's 2013 Report predict that there is likely to be an increase in mean global ocean temperature of 1-4°C by 2100.



Annual global sea surface temperature anomalies from 1880 to 2015 with superimposed linear trend (Base period 1951–1980), red positive, blue negative. From: http://www.ncdc.noaa.gov/cag/time-series/global/globe/ocean/ytd/12/1880-2016

The distribution of excess heat in the ocean is not uniform, with the greatest ocean warming occurring in the Southern Hemisphere and contributing to the subsurface melting of Antarctic ice shelves.



Maps of sea surface temperature anomalies for 2015 with a southern hemisphere polar and northern hemisphere semi-polar view. Figure produced by Pierre Hélaouët, SAHFOS based on GISS data http://data.giss.nasa.gov/gistemp.

The ocean's ability to absorb excess heat has shielded humans from even more rapid changes in climate. Without this oceanic buffer, global temperatures would have risen much more than they have done to date. IPCC's Fourth Assessment Report published in 2007 estimated that the Earth had experienced a warming of 0.55°C since the 1970s. According to an analysis by the Grantham Institute, if the same amount of heat that has gone into the top 2,000 m of the ocean between 1955 and 2010 had gone into the lower 10 km of the atmosphere, the Earth would have seen a warming of 36°C.

Why is this important?

Ocean warming leads to deoxygenation – a reduction in the amount of oxygen dissolved in the ocean – and sea-level rise – resulting from the thermal expansion of sea water and continental ice melting. The rising

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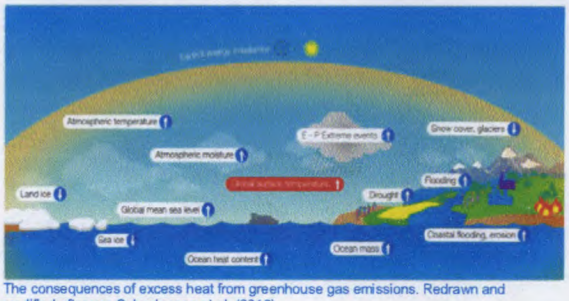
temperatures, coupled with ocean acidification (the decrease in pH of the ocean due to its uptake of CO_2), affect marine species and ecosystems and, consequently, the fundamental benefits humans derive from the ocean.



The consequences of excess heat from greenhouse gas emissions. Redrawn and modified after von Schuckmann et al. (2016).

Impact on marine species and ecosystems
Marine fishes, seabirds and marine mammals all face very high risks from increasing temperatures, including high levels of mortalities, loss of breeding grounds and mass movements as species search for favourable environmental conditions. Coral reefs are also affected by increasing temperatures which cause coral bleaching and increase their risk of mortality.

Impact on humans
A 2012 report by the Food and Agriculture Organization of the United Nations estimates that marine and freshwater capture fisheries and aquaculture provide 4.3 billion people with about 15% of their animal protein. Fisheries and aquaculture are also a source of income for millions of people worldwide. By altering distributions of fish stocks and increasing the vulnerability of fish species to diseases, ocean warming is a serious risk to food security and people's livelihoods globally. Economic losses related to ocean warming are likely to run from tens to hundreds of millions of dollars.

Rising temperatures also affect vegetation and reef-building species such as corals and mangroves, which protect coastlines from erosion and sea-level rise. Rising sea levels and erosion will particularly affect low-lying island countries in the Pacific Ocean, destroying housing and infrastructure and forcing people to relocate.

The rise in sea surface temperatures is causing more severe hurricanes and the intensification of El Niño events bringing droughts and floods. This can have significant socio-economic and health effects in some regions of the world.

Warming ocean temperatures are linked to the increase and spread of diseases in marine species. Humans risk direct transmission of these diseases when consuming marine species, or from infections of wounds exposed in marine environments.

What can be done?

Limiting greenhouse gas emissions
There is an urgent need to achieve the mitigation targets set by the Paris Agreement on climate change and hold the increase in the global average temperature to well below 2°C above pre-industrial levels. This will help prevent the massive and irreversible impacts of growing temperatures on ocean ecosystems and their services.

Protecting marine and coastal ecosystems
Well-managed protected areas can help conserve and protect ecologically and biologically significant marine habitats. This will regulate human activities in these habitats and prevent environmental degradation.

Restoring marine and coastal ecosystems
Elements of ecosystems that have already experienced damage can be restored. This can include building artificial structures such as rock pools that act as surrogate habitats for organisms, or boosting the resilience of species to warmer temperatures through assisted breeding techniques.

Improving human adaptation
Governments can introduce policies to keep fisheries production within sustainable limits, for example by setting precautionary catch limits and eliminating subsidies to prevent overfishing. Coastal setback zones which prohibit all or certain types of development along the shoreline can minimise the damage from coastal flooding and erosion. New monitoring tools can be developed to forecast and control marine disease outbreaks.

Strengthening scientific research
Governments can increase investments in scientific research to measure and monitor ocean warming and its effects. This will provide more precise data on the scale, nature and impacts of ocean warming, making it possible to design and implement adequate and appropriate mitigation and adaptation strategies.

Where can I get more information?

IUCN Global Marine and Polar Programme
iucn.org/marine

IUCN's work on Climate Change
iucn.org/climate

Laffoley, D. and Baxter, J.M. (eds.) (2016). *Explaining ocean warming: Causes, scale, effects and consequences.* Full report. Gland, Switzerland: IUCN.

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