

Climate change and ocean acidification: similar but not the same

Climate change and ocean acidification are often thought of together, with a common misconception that ocean acidification is a climate change effect. While linked by their primary cause (CO₂ emissions), the processes that lead to changes in the state of the ocean are sufficiently different that they should be considered distinct.

Climate change is the change in global or regional prevailing weather and oceanographic conditions. These changes can be due to natural causes (for example, variations in incident solar radiation), but since the mid-19th century, human activities have been the main reason for the observed changes in climate. Human-induced climate change is due to increased concentrations of greenhouse gases in the Earth's atmosphere. This is primarily from the burning of fossil fuels, but also due to changes in land use and deforestation (such as farming livestock and cutting down forests). Within the UN Framework Convention for Climate Change, seven major greenhouse gases (or groups of) are recognised as drivers of human-induced climate change: CO₂, CH₄, N₂O, SF₆, PFC, CFC and NF₃ (United Nations, 1998).

All of these additional greenhouse gases have led to more of the Earth's back radiation being trapped inside the atmosphere (the "Greenhouse Effect"), although CO₂ emissions have contributed most. This additional energy has led to global warming, with impacts for terrestrial environments and the ocean. In the ocean, this has caused warming, decreasing oxygen concentrations and rising sea-level, with many further related impacts across marine ecosystems and the services they provide to mankind. More details of the importance of climate change to the OSPAR Maritime Area are included in the Climate Change Thematic Assessment <hyperlink>.

The ocean has absorbed 20 – 30% of the CO₂ added to the atmosphere by human activity since the 1980s (IPCC, 2019). Without this oceanic uptake, current atmospheric CO₂ levels would be even higher and global warming and other climate change impacts more pronounced. However, the uptake of excess CO₂ by the surface oceans has also caused a change in the ocean's carbon chemistry. When dissolved in seawater, CO₂ and water react to form carbonic acid. This subsequently breaks down into a bicarbonate ion and hydrogen ion. The result of this is an increase in acidity (increased amounts of hydrogen ions which is measured as lower pH). This is called ocean acidification and is a change in the prevailing chemical environment marine organisms are exposed to, with direct and indirect consequences for marine ecosystems. More information on ocean acidification in the OSPAR Maritime Area can be found in the Ocean Acidification Assessment <hyperlink>.

Although both climate change and ocean acidification share their primary driver, they will at times need individual consideration in policy making. To address climate change and ocean acidification, many measures aimed at reduced CO₂ emissions to the atmosphere will mitigate climate change and directly alleviate ocean acidification. On the other hand, some measures to mitigate climate change may focus on other greenhouse gas emissions, and will therefore not contribute to combating ocean acidification. Within policy responses, most care will be needed where potential measures to address climate change could exacerbate ocean acidification. Examples of this are the capture and storage of CO₂ emissions in deep ocean water masses or approaches that aim to increase ocean uptake of atmospheric CO₂. Finally, when considering adaptation to climate change and resilience, responses will also need to consider the cumulative impact of climate change and ocean acidification that may cause synergistic stress in marine organisms.

References

United Nations (1998). Kyoto Protocol to the United Nations Framework Convention on Climate Change. https://unfccc.int/kyoto_protocol

IPCC (2019) IPCC Special Report on the Ocean and Cryosphere in a Changing Climate [H.-O. Pörtner, D.C. Roberts, V. Masson-Delmotte, P. Zhai, M. Tignor, E. Poloczanska, K. Mintenbeck, A. Alegría, M. Nicolai, A. Okem, J. Petzold, B. Rama, N.M. Weyer (eds.)]. In press.