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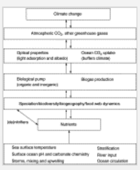
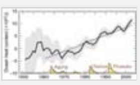
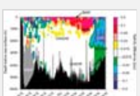
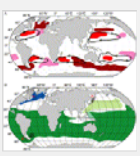
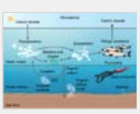
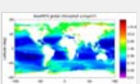
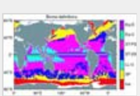

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Chapter 1 Impacts of the Oceans on Climate Change

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Abstract

The oceans play a key role in climate regulation especially in part buffering (neutralising) the effects of increasing levels of greenhouse gases in the atmosphere and rising global temperatures. This chapter examines how the regulatory processes performed by the oceans alter as a response to climate change and assesses the extent to which positive feedbacks from the ocean may exacerbate climate change. There is clear evidence for rapid change in the oceans. As the main heat store for the world there has been an accelerating change in sea temperatures over the last few decades, which has contributed to rising sea-level. The oceans are also the main store of carbon dioxide (CO_2), and are estimated to have taken up ~40% of anthropogenic-sourced CO_2 from the atmosphere since the beginning of the industrial revolution. A proportion of the carbon uptake is exported via the four ocean 'carbon pumps' (Solubility, Biological, Continental Shelf and Carbonate Counter) to the deep ocean reservoir. Increases in sea temperature and changing planktonic systems and ocean currents may lead to a reduction in the uptake of CO_2 by the ocean; some evidence suggests a suppression of parts of the marine carbon sink is already underway. While the oceans have buffered climate change through the uptake of CO_2 produced by fossil fuel burning this has already had an impact on ocean chemistry through ocean acidification and will continue to do so. Feedbacks to climate change from acidification may result from expected impacts on marine organisms (especially corals and calcareous plankton), ecosystems and biogeochemical cycles. The polar regions of the world are showing the most rapid responses to climate change. As a result of a strong ice–ocean influence, small changes in temperature, salinity and ice cover may trigger large and sudden changes in regional climate with potential downstream feedbacks to the climate of the rest of the world. A warming Arctic Ocean may lead to further releases of the potent greenhouse gas methane from hydrates and permafrost. The Southern Ocean plays a critical role in driving, modifying and regulating global climate change via the carbon cycle and through its impact on adjacent Antarctica. The Antarctic Peninsula has shown some of the most rapid rises in atmospheric and oceanic temperature in the world, with an associated retreat of the majority of glaciers. Parts of the West Antarctic ice sheet are deflating rapidly, very likely due to a change in the flux of oceanic heat to the undersides of the floating ice shelves. The final section on modelling feedbacks from the ocean to climate change identifies limitations and priorities for model development and associated observations. Considering the importance of the oceans to climate change and our limited understanding of climate-related ocean processes, our ability to measure the changes that are taking place are conspicuously inadequate. The chapter highlights the need for a comprehensive, adequately funded and globally extensive ocean observing system to be implemented and sustained as a high priority. Unless feedbacks from the oceans to climate change are adequately included in climate change models, it is possible that the mitigation actions needed to stabilise CO_2 and limit temperature rise over the next century will be underestimated.

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