Ocean Biogeochemistry and Climate Feedbacks
The Ocean is a key player in the climate system, buffering changes in the atmospheric composition. Changes in the ocean ... Our research line focuses on ocean biogeochemical processes and the effects on the climate system of their alteration.

Summary

Atmospheric levels of CO$_2$ and other greenhouse gases (CH$_4$ and N$_2$O) have increased substantially above preindustrial levels due to human activities. Carbon dioxide is continuously emitted to the atmosphere from natural and anthropogenic sources. The atmospheric concentration of CO$_2$ is currently at 409 ppm (pre-industrial level: 280 ppm). The ocean absorbs one-third of the atmospheric CO$_2$ via the ocean's physical and biological pump. Half of this uptake is immediately converted to carbonate (CO$_3^{2-}$) and bicarbonate (HCO$_3^-$) ions. The strength of the solubility pump depends globally on the strength of the MOC, the salinity gradient, and the atmosphere-ocean temperature difference. Carbonate chemistry impacts the uptake of atmospheric CO$_2$ and its alkalinity change. Note that the ocean's capacity to store CO$_2$ may be adversely affected by a changing climate due to changes in the ocean circulation, stratification, and temperature change. Changes in atmospheric CO$_2$ are feedbacks on the climate system.

Changes in CO$_2$ solubility:

CO$_2$ solubility is a function of the temperature, therefore as the ocean's temperature increases, the solubility of CO$_2$ decreases and consequently the uptake of the CO$_2$ is reduced.

Changes in the ocean stratification:

Increased sea surface temperatures (SST) and increased precipitation at high latitudes lead to an increase in the SST. This causes a shallower mixing layer and a reduction in the vertical exchange and transport of anthropogenic CO$_2$ to the deep ocean. This reduces the supply of DIC and nutrients, which are needed for biological activity.

Changes in the marine productivity:

Warming and other environmental changes (e.g. ocean acidification) can lead to further changes in marine productivity.

Changes in the ocean circulation:

On centennial time scales, the ocean carbon sink may also be affected by climate-driven changes in the ocean circulation such as the slowing down of the Thermohaline Circulation (THC), which plays an important role in the ocean's biogeochemical and climate processes. Reduced THC transport leads to reduced nutrient supply for the surface ocean biological productivity and changes the spatial distribution of CO$_2$ uptake and release. The THC and climate feedbacks research line is to study the response of the ocean in a changing climate and their feedbacks.

Objectives

To study the ocean biogeochemical impacts due to climate change and climate variability
To quantify feedbacks between ocean biogeochemistry in the climate system
To understand the impacts on the marine ecosystem due the changes of the main ocean biogeochemical cycles in a changing climate

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