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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 biogeochemical processes and the effects on the climate system of their alteration are of great concern. 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 entering the ocean by means of the physical pump and the biological pump. These two pumps maintain a vertical gradient in CO$_2$ regulating the exchange of CO$_2$ between the atmosphere and the ocean. The strength of the solubility pump depends globally on the strength of the MOC, while the biological pump is associated with the productivity of marine ecosystems.

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 stratification of the ocean. This causes a shallower mixing layer and a reduction in the vertical exchange and transport of anthropogenic CO$_2$ to the deep ocean. The stratification 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.

Using state of the art earth system model (EC-Earth) and the experience on climate prediction gained in the Climate Prediction 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 to the changes of the main ocean biogeochemical cycles in a changing climate.