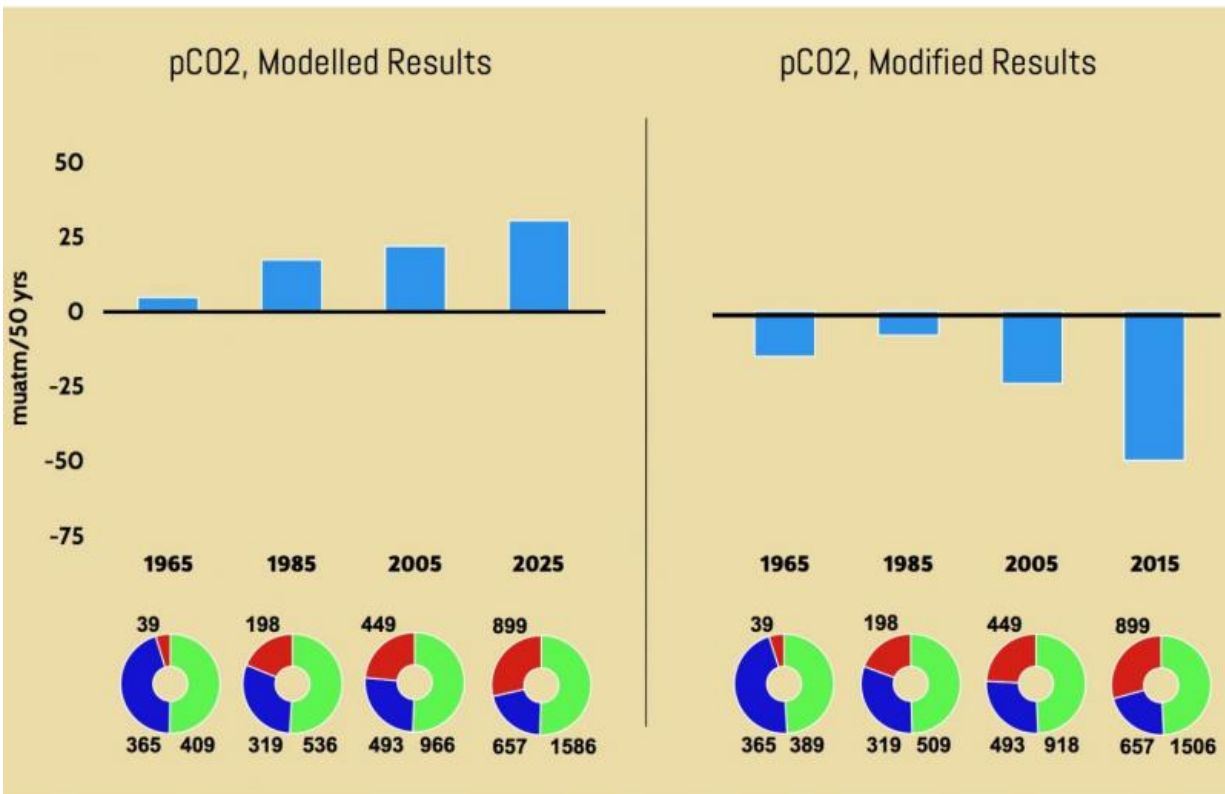


# Uncertain future carbon uptake in the North Atlantic

December 18 2015

## Driving forces of longterm CO<sub>2</sub> uptake changes



Light blue bars: climate induced change in the chemical contribution of oceanic pCO<sub>2</sub> for our simulated results (left panel) and for a modification of the results, where the values of the biological contribution are about 5% less (right panel).

Chart diagrams: origin of these changes: biological production (green), ocean circulation (blue) and CO<sub>2</sub> uptake (red). pCO<sub>2</sub>-changes can be calculated by subtracting contributions of both ocean circulation and CO<sub>2</sub> uptake from the biological contribution.

Driving forces of longterm CO<sub>2</sub> uptake changes. Credit: Infographics by Nadine Goris

Will carbon uptake increase or decrease due to global warming? A new model experiment shows that uncertainties in modelled biological production makes the answer unclear.

The world's oceans take up approximately 26 percent of our current CO<sub>2</sub> emissions, and are therefore moderating the increase of atmospheric CO<sub>2</sub> concentrations and mitigating [climate change](#). At the same time the warming climate is also effecting the CO<sub>2</sub> uptake of the oceans.

"Many researchers expect that this warming will attenuate the future CO<sub>2</sub> uptake of the oceans. In this case, the mitigating power of the ocean's will be reduced and we face an acceleration of climate change. Therefore, it is of high importance to understand and foresee the effects of climate change on the oceans uptake," Nadine Goris says, researcher at Uni Research and the Bjerknes Centre.

Together with colleagues in the SNACS project, she has conducted two experiments with the Earth System Model BCM-C (Bergen Climate Model with carbon cycling).

## **Sensitive CO<sub>2</sub> uptake**

The North Atlantic is one of the most important regions of the world's ocean when it comes to CO<sub>2</sub> uptake and storage. Yet, several studies associated to the report of the Intergovernmental Panel on Climate Change suggest that its CO<sub>2</sub> uptake is also most sensitive to climate change. The reasons for this sensitivity are still under debate. In order to

contribute to this ongoing discussion, Goris and her colleagues conducted the model experiments.

"In both experiments we first apply observed CO<sub>2</sub> emissions for the years 1850-2005 and secondly expected CO<sub>2</sub> emissions for the years 2006-2099. But in our first experiment, we omit the climate impact of CO<sub>2</sub>. In this way, we can isolate the effect of climate change on the oceans uptake of CO<sub>2</sub>, as the latter is simply represented by the difference between both experiments," Goris explains.

In the simulations, climate change leads to a slow down of the ocean circulation as well as less [biological production](#). Each of these processes affects the variables dissolved inorganic carbon and alkalinity, which again affect the partial pressure of CO<sub>2</sub> and thereby the CO<sub>2</sub> uptake.

## **A sequence of different processes**

Only the sum over the climate change effect on all individual processes explains the effect of climate change on CO<sub>2</sub>. In the model experiments, the sum over all relevant processes leads to an uptake reduction of about 45 billion tons CO<sub>2</sub>. Yet, the analysis of individual processes shows us clearly, that the contributions of individual processes are way larger (in both positive and negative direction, see Figure). That means that climate change would lead to an enhanced CO<sub>2</sub> uptake if, for example, the biological production was only about 5 percent smaller.

"Unfortunately, we only have a rudimental understanding of biological production and it is indeed very likely that the modelled biological production has an uncertainty of more than 5 percent," Goris says.

"Our analysis of both experiments shows that it is not possible to give a clear answer to the question if climate change is going to reduce the future CO<sub>2</sub> uptake of the North Atlantic. This uncertainty is due to the

fact that climate change triggers a sequence of different processes, which all interact with each other and the differences between their impacts are partly only small. For a better knowledge of the future CO<sub>2</sub> uptake of the worlds oceans we need to better represent some of these processes in our model, like biological production."

**More information:** Nadine Goris et al. Responses of carbon uptake and oceanic CO to climate change in the North Atlantic: A model study with the Bergen Earth System Model , *Global Biogeochemical Cycles* (2015). [DOI: 10.1002/2015GB005109](https://doi.org/10.1002/2015GB005109)

Provided by Uni Research

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