



Asymmetries in the thermal and carbon response in climate projections for the North Atlantic Ocean due to the dynamic redistribution of heat and carbon

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The ocean is providing an important role in climate change by sequestering extra carbon and heat supplied to the climate system from carbon emissions and the resulting increase in radiative forcing. The anthropogenic warming and carbon uptake in the upper ocean of the North Atlantic differs regionally in an idealised slab atmosphere and ocean model, and in climate projections from a suite of 6 Earth system models, both forced by an annual rise in atmospheric CO₂. Differences in the thermal and carbon response are explained in terms of a dynamical effect from the redistribution of the pre-industrial temperature and carbon distributions. The pre-industrial heat and carbon distributions oppose each other: surface, subtropical waters are warm with low carbon content, while deep and high-latitude waters are cool with high carbon content. Consequently, the dynamic response to a changing circulation leads to opposing contributions for heat and carbon, a weakening of the overturning acting to reduce the upper ocean warming and instead enhance the upper ocean carbon inventory in the subpolar North Atlantic.