ICYESS2013-71-1
Interdisciplinary Conference of Young Earth System Scientists
Hamburg, Germany, 22 – 25 September 2013

Towards More Realistic Future Ocean Projections

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Ocean modelling has come to a stage where mesoscale processes are explicitly resolved even in global Ocean General Circulation Models. It has been shown that a large amount of kinetic energy is contained at length scales of 10 to 500 km. This length scale is associated with oceanic eddies that contribute to the fidelity of large scale current field. In particular the North Atlantic Ocean has been extensively studied and the pathways, strengths and spatial distributions of the currents are far more realistic when the horizontal resolution is increased. However, a lot of computational effort is necessary to perform such experiments. Until now climate models cannot be run with eddy resolving resolution. Consequently the fidelity of the oceanic component in climate models is less realistic than for state of the art Ocean General Circulation Models. In summary: coarse resolution leads to unrealistic ocean current field which in turn influences the realism of the whole climate model and makes future climate projections with such models less reliable.

A way out of this dilemma would be to reduce the complexity of the atmospheric model and transfer computing power towards the ocean component. Several promising approaches with simplified atmospheric models need to be tested regarding the ability to investigate the earth system for possible future climate scenarios.

So why is it useful to put more weight on the oceanic component than on the atmospheric component? Of course the atmosphere adopts faster to an external forcing like an CO_2 increase, but however the ocean due to its high heat capacity and high overturning time scales will not equilibrate fast under external forcing. It has been shown that ocean is a main sink for anthropogenic CO_2 but this behaviour might change when the ocean circulation changes. So it seems to be important to investigate the ocean circulation under future climate scenarios.

One of the largest sources of uncertainty is the choice of the simplified atmospheric component. So it is crucial to investigate the impacts of different simplifications of the atmospheric component on exchange rates of energy between the ocean and atmospheric (turbulent surface fluxes). Besides this many other assumptions are made to run climate models and each contributes to uncertainty of the final results.