Master´ s thesis defense by Søren Borg Nielsen

Title: On Arctic Temperature Bias in a Climate Model and its cause.

Abstract: A temperature bias in the Arctic Ocean in the coarse resolution Community Climate System Model version 4 (CCSM4) is documented and the cause is analyzed. The bias is attributed to a too warm ocean inflow from the Nordic Seas and it is shown that the inflow temperature bias is connected to the parameterized mesoscale eddy mixing of temperature in the Norwegian Current. A series of model setups are created with different parameterization settings, forcings and resolution and run for 300 years. It is shown that by reducing either horizontal or thickness diffusivities, or both, the Arctic temperature bias is reduced. Side effects of reduced diffusivities include deepening of the upper Atlantic water, improving the depth in the Canadian basin but not in the Eurasian basin, as well as an improved circulation around the Canadian basin slope when reducing thickness diffusivity. It is further shown that the cause of the temperature bias in the Nordic Seas is a spurious, vertical 2-core structure of the Norwegian Current, shielding the lower branch from the atmosphere and the associated heat loss related to poleward advection. Reducing the diffusivities causes the separation of the Norwegian Current to be weaker, and ultimately it loses more heat to the atmosphere and reduces the temperature bias of the inflowing water to the Arctic. One caveat is that it cannot be determined if the cause of the 2-core structure is excessive eddy diffusion, or if the eddy diffusion in the Nordic Seas is caused by the formation of the 2-core Norwegian Current, but the results clearly call for more sophisticated eddy tracer mixing parameterizations.