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Effects of different closures for thickness diffusivity

C. Eden (1), M. Jochum (2) and G. Danabasoglu (2)
(1) IFM-GEOMAR, Kiel, Germany (2) NCAR, Boulder, US

The effect of lateral and vertical structure in the thickness diffusivity (K) appropriate to the parameterisation of Gent and McWilliams (1990) on watermasses and ventilation is assessed in a coarse resolution global ocean general circulation model (CCSM). Simulations using three different closures yielding lateral and/or vertical variations in K are compared with a simulation using a constant value. Although the effect of changing K is in general small and all simulations remain biased, we find systematic local sensitivities of the simulated circulation and water masses on K.

The subpolar and subtropical gyre transports and ventilation rates in the North Atlantic increase by increasing K locally, the depth of the equatorial thermocline lifts by increasing K locally in the near surface tropical ocean and the strength of the Antarctic Circumpolar Current decreases by increasing K in the Southern Ocean. We also found that the lateral and vertical structure of K given by a recently proposed closure reduces the negative temperature biases in the western North Atlantic by adjusting the pathways of the Gulf Stream and the North Atlantic Current to a more realistic position.