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TI: **Ocean Heat Uptake in Transient Climate Change: Mechanisms and Uncertainty due to Subgrid-Scale Eddy Mixing**

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AB: The ocean heat uptake (OHU) is studied using the MIT ocean general circulation model (OGCM) with idealized ocean geometry. The OGCM is coupled with a statistical-dynamical atmospheric model. The simulation of OHU in our coupled model is consistent with other coupled ocean atmosphere GCM in a transient climate change when concentration increases at 1\% per year. The global average surface air temperature increases by 1.7\deg C at the time of concentration doubling (year 70). The ocean temperature increases by about 1.0\deg C near the surface, 0.1\deg C at 1000 m in the Pacific and 0.3\deg C in the Atlantic. The maximum overturning circulation (MOTC) in the Atlantic at 1350 m decreases by about 4.5 Sv. The center of MOTC drifts upward about 300 m, and therefore a large OTC anomaly (14 Sv) is found at 2700 m. The MOTC recovers gradually, but the OTC anomaly at 2700 m does not seem to recover after concentration is kept constant during 400 year simulation period. The diagnosis of heat flux convergence anomaly indicates that the warming in the lower latitudes of the Atlantic is associated with large scale advection. But, the warming in the higher latitudes is associated with the heat brought down from the surface by convection and eddy mixing. In global average, the treatments of convection and eddy mixing are the two main factors affecting the OHU. The uncertainty of OHU due to subgrid-scale eddy mixing is studied. In the MIT OGCM this mixing is a combination of Gent-McWilliams bolus advection and Redi isopycnal diffusion (GMR), with a single diffusivity being used to calculate the isopycnal and thickness diffusion. Experiments are carried out with values of the diffusivity of 500, 1000, and 2000 cm^{2}s^{-1}. The total OHU is insensitive to these changes. The insensitivity is mainly due to the changes in the vertical heat flux by GMR mixing being compensated by changes in the other vertical heat flux components. In the Atlantic when the diffusivity is reduced from 1000 to 500 cm^{2}s^{-1}, the surface warming can penetrate deeper. Therefore, the warming decreases by about 0.15\deg C above 2000 m, but increases by about 0.15\deg C below 2500 m. Similarly when the diffusivity is increased from 1000 to 2000 cm$^

{2}$s^{-1}, the surface warming becomes shallower; the warming increases by about 0.2\deg C above 1000 m but decreases by about 0.2\deg C below 1000 m. These changes in the vertical distribution of the OHU also contribute to the insensitivity of the total OHU to changes in the GMR mixing. The analysis of heat flux convergence indicates that the difference of OHU seems to be associated with the MOTC circulation.

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