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The spatial structure of simulated ocean heat uptake in the CMIP3 and CMIP5 climate models

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In simulations of climates with increased greenhouse gas concentrations, sea level change is predominantly thermosteric in large parts of the ocean. Therefore it is relevant to study the simulated ocean heat uptake. This is done here firstly by comparing the climate models of the CMIP3 and CMIP5 projects with respect to aggregate measures of their ocean heat uptake, namely their ocean heat uptake efficiency and their expansion efficiency of heat. The ocean heat uptake efficiencies of the CMIP3 and the CMIP5 models appear to be not systematically different. Second, the hypothesis is tested that differences in the vertical distribution of initial temperature and of heat uptake influence the models' ocean heat uptake efficiency and expansion efficiency of heat. Furthermore, an analysis of the CMIP3 models (SRES A1B) reveals that the models agree well on the location of heat uptake in the upper layer (above 700m), the maxima of which are in the Southern Ocean and the North Atlantic. But the models also agree on a significant deep ocean heat uptake (below 2000m) in the Southern Ocean, in some regions south of 40S. The heat uptake there can amount to 40% of the column total, however the imprint on thermosteric sea level rise is less than for the upper-ocean heat uptake.