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Oceanic uptake of CO2 from an Earth system model

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The quantification of the present and future uptake of anthropogenic carbon by the ocean under increased CO_2 forcing is an open issue in current climate research. Measurement based estimates vary considerably depending on the method employed. Here an independent modelling approach is made by use of a highly complex Earth system model consisting of state of the art models of the terrestrial biosphere (JSBACH), the ocean (MPI-OM/HAMOCC5) and the atmosphere (ECHAM5), forced by SRES A2 CO_2 emissions according to the C4MIP protocol. With this model configuration which provides a closed carbon cycle, the computation of 'anthropogenic CO_2' in the ocean is straightforward. Time series of the globally integrated oceanic uptake will be shown together with the four-dimensional intrusion of anthropogenic CO_2 in the ocean. The main results can be summarised as follows: (i) The main storage of anthropogenic CO_2 occurs in the subtropical gyres above the thermocline, not in the deep ocean, even though column-integrated concentrations which are highest in the North Atlantic might suggest otherwise to the eye. (ii) North Atlantic uptake weakens after 2050, accompanied by a slowdown of the MOC while South Ocean uptake remains stable until 2100. (iii) Estimated total oceanic uptake from 1860 until year 2000 is 124 GtC (1994: 110.7 GtC) and until 2100 524 GtC.