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The sensitivity of the Atlantic Meridional Overturning Circulation to global warming: The role of model resolution and the hydrological cycle

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The response of the Meridional Overturning Circulation (MOC) to an increase in atmospheric greenhouse gas concentration is considerably different in various climate models. A number of idealized CMIP-type global warming experiments have been carried out using the coupled model ECHAM5/MPI-OM. In addition to experiments studying the sensitivity to changes in the parameterization of sub-grid scale processes (such as vertical and horizontal mixing), the role of ocean and atmosphere model resolution and the associated representation of physical processes is investigated. All model runs show a significant reduction of the strength of the overturning when the CO2 concentration is increased to two and four times the preindustrial level. The response depends only slightly on the choice of sub-grid-scale parameterizations. Considerable differences are found, however, in experiments with different resolutions in the atmosphere and the ocean model. The higher resolution runs show less reduction and quicker recovery of the MOC after stabilization. Differences are found in the representation of the hydrological cycle and the associated inter basin exchange of fresh water. The relation of these changes to the different representation of atmosphere-ocean processes, such as El Nino, is investigated.