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Sensitivity of Model Estimates of Contemporary Global and Regional Sea-Level Changes to Geothermal Flow

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An ocean general circulation model in a global configuration, constrained to observations over the period 1993–2010 as part of the ECCO (Estimating the Circulation and Climate of the Ocean) project, has been used to to infer the influence of geothermal flow on estimates of contemporary sea level changes. Two distinct simulations are compared, which differ only with regard to whether they apply geothermal flow as a bottom boundary condition. Geothermal flow forcing increases the global mean sea level trend over 1993–2010 by 0.11 mm yr^{-1} in the perturbation simulation relative to the control simulation with no geothermal forcing, mostly due to increased net thermal expansion in the deep ocean (below 2000 m). The Southern Ocean is particularly sensitive to geothermal flow, with differences between regional sea level trends from the perturbation and control simulations up to ± 1 mm yr^{-1} in some places. More generally, it is suggested that ocean heat transports redistribute the geothermal input along constant pressure surfaces and constant surfaces of temperature or salinity. This redistribution of heat results in stronger (weaker) steric height trend differences between the two solutions over deeper (shallower) areas, and effects anomalous redistribution of ocean mass from deeper to shallower areas in the perturbation solution relative to the control solution. Given the sparsity of heat flow measurements, ocean state estimation could (in principle) be a means to the end of constraining solid Earth heat flow estimates over the global ocean.