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Spatial variability of sea level rise in Twenty-First century projections

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A set of state-of-the-science climate models are used to investigate global sea level rise (SLR) patterns induced by ocean dynamics in twenty-first-century climate projections. The identified robust features include bipolar and bihemisphere seesaws in the basin-wide SLR, dipole patterns in the North Atlantic and North Pacific, and a beltlike pattern in the Southern Ocean. The physical and dynamical mechanisms that cause these patterns are investigated in detail using the GFDL 2.1 climate model. Under the SRES A1B scenario, the steric sea level changes relative to the global mean (the local part) in different ocean basins are attributed to differential heating and salinity changes of various ocean layers and associated physical processes. As a result of these changes, water mass tends to move from the ocean interior to continental shelves. In the North Atlantic, sea level rises north of the Gulf Stream but falls to the south. The dipole pattern is induced by a weakening of the meridional overturning circulation. An opposite dipole occurs in the North Pacific. The dynamic SLR east of Japan is linked to a strong steric effect in the upper ocean and a poleward expansion of the subtropical gyre. In the Southern Ocean, the beltlike pattern is dominated by the baroclinic process during the twenty-first century, while the barotropic response of sea level to wind stress anomalies is significantly delayed.