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Intensification and poleward shift of subtropical western boundary currents under global warming

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Dynamic changes of subtropical western boundary currents (WBCs) are investigated based on three types of independent data sets. These include reconstructed and reanalysis products, satellite/blended observations and climate models output from the fifth phase of the Climate Model Intercomparison Project (CMIP5). Consistent increasing of sea surface temperature (SST) and ocean surface heat loss are found over the mid-latitude expansions of WBCs. Furthermore, the upper 100 m ocean water velocity are increasing in the same direction as the background WBCs, demonstrating that WBCs are strengthening. In addition, the positions of WBCs induced sharp SST fronts and intensive ocean heat loss are migrating towards the poles, suggesting that the routes of WBCs are shifting poleward. According to the ensemble projections from the CMIP5 models, the WBCs (except the Gulf Stream) will continue strengthening and shifting poleward if carbon dioxide levels keep rising in this century. The significant dynamic changes of WBCs are affected by an intensified and poleward shift of near-surface ocean zonal winds, which are attributed to positive annular modes-like trends, particularly over the Southern Hemisphere.