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Southern Hemisphere circulation in an era of ozone recovery

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Stratospheric ozone depletion has significantly influenced the tropospheric circulation and climate of the Southern Hemisphere (SH) over recent decades, the largest trends being detected in summer. These circulation changes include strengthened westerly winds and lowered Antarctic sea level pressure. Ozone changes will continue to influence climate during the 21st century when ozone recovery is expected. Therefore, in order to obtain reliable projections of SH climate, it is important to have reliable estimates of future ozone changes. Future ozone estimates may be obtained from chemistry-climate models (CCMs) which include interactions between stratospheric ozone chemistry and greenhouse-gas-induced climate change but usually do not include an ocean component, employing prescribed sea surface temperatures instead. This constrains the surface climate response to changes in ozone and other forcings in these models. Here we use future ozone projections from two CCMs to force 21st century simulations of the HadGEM1 coupled ocean-atmosphere model, along with A1B GHG concentrations, and study the simulated response in the SH circulation. Both CCMs simulate observed ozone climatology and trends reasonably well but future ozone recovery trends in one of them are about twice as large as those in the other. When forced by the larger ozone recovery trends, HadGEM1 simulates significant negative zonal mean zonal wind trends near the tropopause in summer in the period of 2000-2049 but the trends near the surface are not significant. In the simulations with the smaller ozone recovery trends the zonal mean zonal wind trends are not significant throughout the troposphere. The HadGEM1-simulated zonal wind trends are considerably smaller then the trends simulated by the CCMs, both in the stratosphere and in the troposphere, despite the fact that the zonal mean ozone trends are the same between these simulations.