Ozone hole and Southern Hemisphere climate change

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The role of the Antarctic ozone hole in the Southern Hemisphere climate change is reviewed and updated using a set of climate model output archived for the WCRP/CMIP3 and the SPARC/CCMVal-2. Consistent with previous findings, stratospheric ozone is found to play a crucial role in driving Southern Hemisphere circulation change from the polar regions to the subtropics and from the stratosphere to the surface. For instance, stronger ozone depletion in late spring generally leads to greater poleward displacement and intensification of the westerly jet, and greater expansion of the Hadley cell during the austral summer in a quasi-linear manner. These changes significantly affect surface climate and hydrology which likely modify stratification and vertical circulation of the Southern Ocean. Model projections further show that the anticipated ozone recovery, resulting from the implementation of the Montreal Protocol, will likely decelerate future climate change resulting from increased greenhouse gases, although it might accelerate surface warming over Antarctica. Possible mechanisms how stratospheric ozone influences the tropospheric circulations and surface climate are discussed by re-visiting the mechanisms proposed in the literature. Model biases, persistence characteristics and the spread in sensitivity to stratospheric ozone forcing are also discussed.