The CCSRNIES CCM simulations for the variations of wave propagation and Antarctic polar vortex strength responded to the sea surface conditions

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The dynamical response of the southern hemisphere stratosphere to the ocean-surface conditions in 2002 and 2019, when exceptional sudden stratospheric warming (SSW) events occurred, were examined through the chemistry–climate model and experiments with 1,000 ensemble members using the sea-surface temperature (SST) and sea-ice conditions. Planetary waves propagating from the troposphere to the stratosphere in experiments using the ocean-surface conditions in 2002 and 2019 were markedly enhanced compared to those in experiments using climatological ocean conditions, owing to the zonal wavenumber-2 component in August 2002 and the wavenumber-1 component from August to November 2019. As a result, the distribution function from the ensemble members of the Antarctic polar-vortex intensity shifted to a weaker side in the 2002 and 2019 experiments relative to that of the climatological ocean conditions. In particular, the weakening of the Antarctic polar-vortex intensity in the 2019 experiment was more pronounced from October to December relative to the 2002 experiment, in accordance with the earlier final warming in 2019 compared to that in 2002. These results suggest that the SSWs in 2002 and 2019 are related to the ocean surface conditions in these years through wave propagation in the troposphere and stratosphere.

Keywords: chemistry–climate model (CCM), sudden stratospheric warming (SSW), Antarctic polar-vortex

