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SST forced Stratospheric warming over Southern-Hemisphere high latitudes

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Satellite observations show significant stratospheric warming trends over Southern-Hemisphere (SH) high latitudes and large portion of the Antarctic polar region in spring season since 1970s. To investigate the relationship between the observed stratospheric warming and sea surface temperature (SST) increases, we performed simulations with a coupled chemistry-climate model (WACCM) forced by observed time-varying global and tropical (30S-30N) SSTs. For global SST forcing, ensemble simulations generate significant warming trends in the SH high-latitude stratosphere and cooling in the mesosphere over the Antarctic. The maximum warming of about 7-8 K over 1979-2006 is located in the middle stratosphere. The warming trends mainly occur in austral winter, different from the timing of observed warming trends that are in austral spring (September and October). For tropical SST forcing, the timing and spatial patterns are similar to that of global SST forcing, but with weaker magnitudes, about half of the global SST forcing. EP flux analysis shows that the stratospheric warming is resulted from increasing wave activity from the troposphere to the stratosphere, which enhances the Brewer-Dobson Circulation (BDC), causing warming in the high-latitude stratosphere. Furthermore, there also exists an increase in ozone concentration with a maximum value of 40 DU in the SH high latitudes in winter and spring. These results suggest that SST warming, especially over the tropics, did contribute to the observed stratospheric warming since 1970s.