Predictability of 2019 stratospheric sudden warming in the Southern Hemisphere and its impact of surface weather

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This study analyzes observational features of displacement-type of minor sudden stratospheric warming (SSW) event that occurred in the Southern Hemisphere (SH) in September 2019 (SSW2019-SH). The predictability of SSW is also investigated examining the Japan Meteorological Agency operational 1-month and 6-month ensemble prediction data in comparison with the Japanese 55-year Reanalysis data. SSW events are rare in SH, with only two in recorded times - one in 2002 that is the first major (split-type) event and the other in 1988 classed as a minor warming. SSW2019-SH occurred under El Nino Modoki, westerly quasi-biennial oscillation together with solar minimum, positive Indian Ocean dipole, and phases 3-6 of the Madden-Julian oscillation. This SSW is characterized by the strongest Antarctic warming on record with a temperature increase of 70 K within 2 weeks, the strongest accumulated upward wave activity flux with zonal wavenumber 1 in July-August-September. The vertical profile of geopotential height anomalies averaged over the polar cap region illustrates the downward propagation of SH circulation anomalies from the stratosphere in September to the troposphere in late October. Months of October-December 2019 (the month of September) are marked by anomalously negative values (a positive value) of the southern annular mode (SAM) index. The negative SAM index is characterized by warm polar temperatures, high geopotential height over the polar cap, and weak circumpolar flow along 60˚S. Predictability of sea-level pressure anomalies averaged over 60-90S is usually about 10 days. However, this predictability is a little longer just after signals of such geopotential height anomalies or SAM index descend down from stratosphere to troposphere. Root-mean-square error, anomaly/pattern correlation coefficient between forecast and the reanalysis for diagnostics are investigated to measure the predictability skill of the model.

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