Characteristics of major sudden stratospheric warmings in Northern winter seasonal hindcasts

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This study investigates characteristics of major sudden stratospheric sudden warmings (MSSWs) in Northern winter seasonal hindcasts of six systems from 1993/1994 to 2016/2017, archived at the Copernicus Climate Change Service database. It compares the hindcast (HC) data to the JRA-55 reanalysis data. A focus is placed on the sequence of variability around and frequency of the MSSWs in both climatological and teleconnection aspects, the latter of which deals with El Niño/Southern Oscillation (ENSO) and Quasi-Biennial Oscillation (QBO) as external factors.
Regarding the climatological aspect of the MSSWs for the entire period, the HC data generally well reproduce the weakening of the stratospheric polar vortex, precursory increase in the poleward eddy heat flux (i.e., wave activity) in the lower stratosphere, and anomalous geopotential height patterns in the troposphere intensifying planetary waves. Differences of the HC data from the JRA-55 data are seen in magnitude of the increased heat flux, and relative contributions from the wave 1 and wave 2 components for a few systems. The MSSW frequency of the six systems is distributed around the JRA-55 counterpart: MSSWs in a few systems are more frequent than in the JRA-55 data, whereas those in other systems are less frequent. The frequency differences among the systems are correlated with those in the mean vortex strength, and also in the frequency of notable heat flux events.
As for the teleconnection aspect, ENSO-related signals in the HC data show consistent changes characterized by weaker mean polar vortex, increased MSSW frequency, and stronger wave activity for El Niño than for La Niña. This contrasts with the JRA-55 counterpart, where such consistent changes of the mean vortex strength and MSSW frequency are relatively unclear. QBO-related signals in the extratropical atmosphere in the HC data are less conspicuous, in contrast to the familiar observed signal of weaker vortex and more frequent MSSWs during the QBO easterly phase.

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