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Sudden stratospheric warming variability in EC-EARTH and its modulation by ENSO and the PDO

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The European Consortium EC-EARTH climate model is used to assess the importance of a well-resolved stratosphere regarding sudden stratospheric warming (SSW) occurrence. Two coupled simulations of 100 years, one with top at 0.01hPa (L91, High-Top) and other with top at 5hPa (L62, Low-Top), are analysed to detect SSWs from November to March. Results show a marked difference in the SSW frequency along the seasonal cycle: while High-Top yields larger SSW occurrence in mid-winter, which is similar to observations, Low-Top peaks in late-winter; despite both have a similar SSW decadal variability (i.e. around 8 events per decade). Further analysis reveals that there is no significant difference in the fraction of explained variance of the tropospheric precursors between mid-winter and late-winter, neither on the strength of the polar vortex. The key dynamical feature appears to be the climatological injection of wave activity into the stratosphere, which is stronger in Low-Top as compared to High-Top for March. The spatial distribution of the climatological zonal-eddy heat flux (v*T* at 100hPa) points at Eurasia as main source of discrepancy between the two simulations, and to small-scale waves (wavenumbers 3-5) as responsible for it.

The impact of El Niño-Southern Oscillation (ENSO) and the Pacific Decadal Oscillation (PDO) on the seasonal cycle of SSWs is assessed with EC-EARTH at its High-Top configuration (L91, 0.01hPa). ENSO and the PDO can modulate the occurrence of SSWs since both are associated with anomalous wavetrain propagation in the North Pacific that can interfere with the climatological wave pattern over the Aleutian Low region and Alaska-Canada, and affect the wave injection into the stratosphere. To this aim, several 50-member atmosphere-only simulations have been performed: a control simulation with climatological SSTs, a prescribed El Niño/La Niña SST pattern in the tropical Pacific with climatology elsewhere, a prescribed PDO+/- SST pattern in the North Pacific with climatology elsewhere, and a 3-times PDO+/- SST pattern (amplified).