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Impact of modeling the stratosphere on ENSO tropospheric teleconnections

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There is growing evidence that the stratosphere significantly influences the troposphere. In this work, we study the ENSO signal from the troposphere to the stratosphere, reported as a polar warming and polar vortex weakening, and from the stratosphere to the surface, to analyse if ENSO-induced anomalies in mean meteorological fields, have an impact on the surface climate. In particular, we investigate the possible influence of the stratosphere on the tropospheric extratropical response to ENSO and the impact of the stratosphere, as represented in atmospheric general circulation models, on the extratropical Northern Hemisphere response to ENSO in late winter/early spring at the surface. We compare numerical experiments performed with two configurations of the ECHAM5 General Circulation Model: the first one, including a full representation of the stratosphere (high-top simulations) and the second one, with only a partial representation of the stratosphere (low-top simulations). Our results show that: 1. The ENSO signal in the lower stratosphere in late winter is found in both the simulations, because the forcing comes from the troposphere, but it is stronger for the simulations including a well-resolved stratosphere, consistently with a more annular structure in geopotential height anomalies and more Sudden Stratospheric Warmings. 2. The stratospheric ENSO signal propagates downward from the lower stratosphere into the troposphere only in the simulations inlcuding a well resolved stratosphere. 3. Concerning the ENSO signal at the surface, the strongest difference between the high-top and low-top simulations is found in the North Atlantic - European sector in late winter early spring where the high-top model signal resembles the negative phase

of the NAO and is consistent with the expected canonical El-Nino signal over Europe studied with observations. Our results point out the importance of including the representation of a well resolved stratosphere in climate modeling and especially in seasonal climate prediction in the North Atlantic - European region.