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The influence of resolved gravity waves in the stratosphere for subseasonal hindcasts of the troposphere during SSW events

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Sudden stratospheric warmings (SSW) are major weather events in the stratosphere with a long-lasting impact on tropospheric weather conditions and, thus, offer a great potential to extend the predictability of surface weather on subseasonal time scales. However, underestimating the warming signal in the stratosphere itself hinders prediction systems to exploit this source of tropospheric predictability. In this study, hindcast experiments with the ECMWF IFS model reveal sensitivity to vertical resolution both for the amplitude and the persistence of the stratospheric warming signal and the prediction skill of surface variables. A potential mechanism for the extended and strengthened warming in the stratosphere with higher vertical resolution are better resolved gravity waves that break in the proximity of the zero-wind line in the upper stratosphere. The enhanced gravity wave drag with higher vertical resolution increases positive temperature anomalies in the middle stratosphere, consistent with anomalous subsidence over the polar cap during the SSWs. Nudging experiments confirm that the enhanced gravity wave drag results directly from increased vertical resolution, as opposed to the modified background state, and that increased surface skill and longer predictable lead times are of stratospheric origin.