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Role of parametrized orographic gravity waves in the lower stratosphere

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Cohen et al. (2014) recently highlighted that there is a remarkable degree of compensation between gravity wave (GW) and resolved wave driving (i.e. compensation mechanism). Of special interest for research of sudden stratospheric warmings (SSWs) is the compensation mechanism connected with GW perturbations outside of the surf zone (Albers and Birner, 2014). In our study, we investigate the so far unexplored short-term impact of events with localised strong and intermittent orographic GW drag (OGWD).
The analysis has been based on the nudged chemistry-climate model CMAM30 (Shepherd et al, 2014). The model climatology was evaluated against the novel dataset GRACILE (Ern et al, 2018) in terms of absolute gravity wave momentum flux and shows that the parametrization of orographic GWs (OGWs) overestimates the OGWD in the northern hemisphere. CMAM30 overestimates the net GWD from reanalyses (JRA55, MERRA2) by about a factor two from 30 to 70°N - i.e. at latitudes in the lower stratosphere (LS), where OGWD dominates the total GWD. This facilitated the motivation of our study to investigate the dynamical and transport processes connected with the excessive OGWD in the LS. Compositing the strong and intermittent OGW events within three selected orographic hotspots in the LS, we found that especially the Himalayan hotspot reveals features suggesting a connection to SSWs. Resolved wave activity and the residual circulation are amplified in polar regions, while there are warming and ozone enrichment in the polar latitudes of the lower stratosphere. Our results propose that the compensation mechanism is more complex than considered by Cohen et al. (2014), involving e.g. influence on GW propagation and breaking (preconditioning of the hotspots).