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Superposed epoch analysis of coupling mechanisms captured by meteor radars during sudden stratospheric warmings

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Previous studies that analysed the mesosphere and lower thermosphere (MLT) dynamics during sudden stratospheric warmings (SSWs) were limited only to particular SSWs or focused on a particular station representative only for some regions. Here we describe a comprehensive study of the average meteorological conditions during SSWs with a special focus on the general contribution of planetary (PW) and gravity (GW) waves as primary coupling mechanisms between lower and upper atmosphere. The average meteorological conditions in the MLT during SSWs were analyzed using a superposed epoch analysis (Denton et al., 2019) of meteor radar measurements for stations in the northern (NH: Collm, Kiruna, Sodankyla, CMOR) and the southern hemisphere (SH: Rio Grande, Davis, Rothera) for the altitude range of 80–100 km Using the adaptive spectral filtering method (Stober et al., 2021), we study in detail PW and GW characteristics in addition to measured zonal and meridional wind components in a time period from 2000 to 2020.

In the NH the zonal wind is typically decreasing from around two weeks before the SSW onset, corresponding to an increased PW activity. Around the SSW onset, latitudinal differences in the zonal wind component as well as the PW activity can be seen. In the weeks before the SSW onset, the stations in the NH also show an increased level of GW kinetic energy. The meridional wind at the NH stations fluctuates with a periodicity of about 10 days before and around the onset. In contrast to previous studies (e.g. Yasui et al., 2016), the measurements in the SH are consistent with the inter-

hemispheric coupling hypothesis. The expected downward shift of GW drag (Körnich and Becker, 2010) was reproduced by a downward travelling layer of enhanced GW activity at Davis and Rio Grande. Finally, the role of the terdiurnal tide in the GW energy composite is considered.