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# Gravity wave - planetary wave interaction simulated by gravity wave ray-tracing

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Gravity waves are the main driver of the global circulation in the mesosphere. They are also known to be the most prominent feature driving the quasi biennial oscillation. Further, they are responsible for almost 50 percent of the climate trend of the Brewer Dobson circulation.

There are many open questions in the interaction of gravity waves (GW) and planetary waves (PW). For instance, both GWs and PWs are filtered by the background wind, but how does the presence of PWs modify the interaction with the zonal mean? Does the presence of PWs modify the amount of GW momentum flux entering the middle atmosphere, and does the presence of PWs modify the altitude where this momentum flux is deposited? Do GWs induce, amplify or suppress PWs? And, how are these interaction processes altered when GWs are considered to propagate only vertically (as normally assumed in GCMs) instead of oblique (as in nature)? Therefore, we investigated the propagation of GWs and their momentum flux deposition by use of the Gravity wave Regional Or Global RAy Tracer (GROGRAT).Trajectories for GWs have been calculated for northern hemisphere winter stratosphere and mesosphere for 2008 NOGAPS-ALPHA (Navy Operational Global Atmospheric Prediction System – Advanced Level Physics – High Altitude) and 2003/04 ECMWF data. Our calculations show, that the GW drag deposition is dominant in the winter mesosphere, which is known to be the main breaking zone of GWs. Additionally, the drag nearly vanishes at the equinoxes. In general, its zonal component is much more dominant compared to the meridional over the whole year. On the other hand, the momentum flux calculated by GROGRAT shows a clear correspondence to the presence of PWs. There is also a clear phase relationship between PWs and the GW distribution, which is consistent in stratosphere and mesosphere. Furthermore, we present whole latitude time series for 2003/04 and 2008, which show strong seasonal dependencies between the wave like part of the background and the GW momentum flux deposition as well as the GW drag deposition. For this reason, we derived an interaction quantity to estimate the coupling effect between PWs and GW drag. This quantity shows a clear seasonal and latitudinal behavior for the zonal and the meridional direction. So, the interaction of northern hemisphere GWs and PWs is strongest during winter time, but weakens in summer.