

Gravity waves sources in the southern polar night jet inferred by ray tracing from analysis fields of the ECMWF NWP model system

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Satellite and ground-based observations display a band of enhanced gravity wave (GW) momentum flux in the southern mid- to high-latitudes in connection with the winter polar night jet. This structure is reproduced in the analysis data of the ECMWF Integrated Forecast System (IFS) in location and magnitude. Which particular processes are contributing to the generation of gravity waves in this region, however, is an open question. A better understanding of the GW source spectrum could provide important directions for the parametrisation of the sub-scale gravity wave processes for numerical weather prediction and climate models. We present a case study of GW source identification for a particular atmospheric situation on 1 August 2014. This pattern was located above the Pacific Ocean several 100 km east of the southern island of New Zealand. In the data, a large pattern of gravity waves is found spanning from approximately 50°S to 65°S and 170°E to 205°E and displaying temperature amplitudes larger than 3 K. Spatial and temporal windows of the wave structure have been captured by lidar measurements in the scope of the DEEPWAVE campaign and by AIRS satellite observations supporting the extent. To investigate the origin of the waves, we analyse data from the ECMWF IFS analysis fields using the GROGRAT ray-tracer in combination with a wave identification algorithm. Gravity wave vectors are fitted using a sinusoidal wave fit at 25 km altitude in the observation region and subsequently used to initialize GROGRAT. Stepping backwards in time, the GROGRAT model allows us to follow the propagation back to the most likely source of the fitted wave. Our results indicate that the gravity waves found in the structure east of New Zealand are not simply generated by the orography of the Southern Alps. The ray paths calculated point to additional sources from spontaneous adjustment further west than New Zealand. These findings support the conclusion that especially stratospheric gravity wave structures in this area have various processes contributing to their source spectrum.