Atmospheric Gravity Waves in ADM-Aeolus Wind Lidar Observations

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As the first Doppler wind lidar in space, ADM-Aeolus provides us with a unique opportunity to study the propagation of gravity waves (GWs) from the surface to the tropopause and UTLS. Existing space-based measurements of GWs in this altitude range are spatially limited and, where available, use temperature as a proxy for wind perturbations. Thus, space-borne wind lidars such as Aeolus have the potential to transform our understanding of these critically-important dynamical processes. Here, we present the first observations of GWs in Aeolus data. We analyse a case study of a large orographic GW over the Southern Andes in July 2019 which is clearly visible in the horizontal wind. This example demonstrates the capability of Aeolus to measure the phase structure of GWs from near the surface up into the stratosphere. We validate these results against temperature-based observations from the AIRS nadir sounder and CORAL lidar, and also against ERA5 wind and temperature. There is close agreement in phase structure between Aeolus and the validation datasets, and with a near-identical observed vertical wavelength and spatial location. This case study suggests that data from Aeolus, and similar next-generation space-borne wind lidars, could play a critical role in constraining future model GW parameterisations, with the potential to significantly broaden our understanding of atmospheric dynamics.