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Measurement study on stratospheric turbulence generation by wave-wave interaction

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During a joint campaign of the research programmes METROSI and GW-LCYCLE 2 (Northern Scandinavia, January 2016), an extraordinary case of turbulence generation by wave-wave interaction has been observed. To describe this turbulence, we will focus on the energy dissipation rate. The most feasible way to measure dissipation is to resolve the inner scale of turbulence. This is done by our balloon-borne instrument LITOS (Leibniz-Institute Turbulence Observations in the Stratosphere) that combines a precise turbulence measurement method with the capability of being launched from every radiosonde station. For the flight in discussion further information on the meteorological background is obtained by a radiosonde. Due to the fact that the balloon drifts horizontally during ascent, measurements of vertical and horizontal wave parameters are ambiguous. Hence further understanding of the wave field is aided by 3d-simulations using WRF and ECMWF.

Concentrating on one out of six LITOS launches during that campaign, we see some turbulent activity across the whole flightpath as on most other LITOS measurements. Nevertheless, we find pronounced maxima in the middle stratosphere (24 - 32 km). They coincide with a distinct phase of a mountain wave. As seen from WRF and ECMWF wind fields, this mountain wave interacts with another larger scale gravity wave. That is, the second wave influences the propagation of the smaller scale mountain wave. With LITOS we see the strongest dissipation rates in areas where the phase direction of the smaller wave changes due to wave-wave interaction. Therefore, these measurements provide an opportunity for further investigation into breakdown processes of internal gravity waves.