

## **Modulations of MLT turbulence by waves observed during the WADIS sounding rocket project.**

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The WADIS project (WAVE propagation and DISSipation in the middle atmosphere) aimed at studying waves, their dissipation, and effects on trace constituents. Among other things, it addressed the question of the variability of MLT turbulence, both in time and space. A unique feature of the WADIS project was multi-point turbulence sounding applying different measurement techniques including rocket-borne ionization gauges, VHF MAARSY radar, and VHF EISCAT radar in Tromsø. The project comprised two sounding rocket campaigns conducted at the Andøya Space Center (69 °N, 16 °E). One sounding rocket was launched in summer 2013 and one in winter 2015.

The joint in-situ and ground-based observations showed horizontal variability of the turbulence field in the MLT at scales from a few to 100 km. We found that the turbulence dissipation rate varied in space in a wave-like manner both horizontally and in the vertical direction. This wave-like modulation reveals the same vertical wavelengths as those seen in gravity waves. We also found that vertical mean value of radar turbulence observations reveals wave-like modulation in time domain. This time variability results in up to two orders of magnitude change of the energy dissipation values with periods of 24 h. It also shows 12 h and shorter (~hours) modulations resulting in one decade variation.

In this paper we present recent measurement results of turbulence-mean flow interaction and discuss possible reasons of the observed modulations.