Quantifying gravity waves and turbulence in the stratosphere using satellite measurements of stellar scintillation

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Stellar scintillations observed through the Earth atmosphere are caused by air density irregularities generated mainly by internal gravity waves (GW) and turbulence. The strength of scintillation measurements is that they cover the transition between the saturated part of the gravity wave spectrum and isotropic turbulence. This allows visualization of gravity wave breaking and of resulting turbulence. We analyzed the scintillation measurements by GOMOS fast photometers on board the Envisat satellite in order to quantify GW and turbulence activity in the stratosphere.

The analysis is based on reconstruction of GW and turbulence spectra parameters by fitting the modeled scintillation spectra to the measured ones. We use a two-component spectral model of air density irregularities: the first component corresponds to the gravity wave spectrum, while the second one describes locally isotropic turbulence resulting from GW breaking and other instabilities. The retrieval of GW and turbulence spectra parameters - structure characteristics, inner and outer scales of the GW component - is based on the maximum likelihood method.

In this presentation, we show global distributions, seasonal and interannual variations of the GW and turbulence spectra parameters retrieved from GOMOS data in 2002-2005, for altitudes 30-50 km. In addition, we show global distributions of GW potential energy per unit mass and of turbulent structure characteristic C_T^2. In our presentation, we pay special attention to gravity wave breaking. Since other measurements at such small scales are very scarce in this altitude range, the obtained global distributions provide unique and complementary information about small-scale air density irregularities in the stratosphere.