

QUANTIFYING GRAVITY WAVES AND TURBULENCE IN THE STRATOSPHERE USING STELLAR SCINTILLATION MEASUREMENTS

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Stellar scintillations observed through the Earth atmosphere are caused by air density irregularities generated mainly by internal gravity waves (IGW) 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 IGW and turbulence activity in the stratosphere.

The analysis is based on reconstruction of IGW 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 IGW breaking and other instabilities. The retrieval of IGW and turbulence spectra parameters - structure characteristics, inner and outer scales of the IGW component - is based on the maximum likelihood method. In this presentation, we show several spatio-temporal distributions obtained using this method.

In particular, we show the global distribution and seasonal variations of the turbulent structure characteristic CT^2 in 2003, for altitudes 30-50 km. Strong turbulence in the polar winter stratosphere at altitudes above 40-45 km is observed. The turbulent structure characteristic can reach values of $0.003 \text{ K}^2 \text{ m}^{(-2/3)}$, which are comparable with that in the boundary layer. The transition of scintillation spectra toward small scales with altitude and the latitudinal pattern with a maximum at ~ 70 deg indicate breaking of gravity waves in the polar night jet. This breaking seems to start in the upper stratosphere, a predicted, but not confirmed by observations before, feature. Weaker turbulent enhancements in tropics are also observed; they might be related to tropical deep convection.