EXPLORING THE FINE STRUCTURE OF THE STRATOSPHERE BY MEANS OF STELLAR OCCULTATION DATA

A. S. Gurvich*(1)

(1) A.M.Oboukhov Institute of Atmospheric Physics, Moscow, Russian Federation

This paper is addressed to the study of the fine structure of relative fluctuations of air density at the altitudes of 25-65 km based on observations of stellar scintillation from the "Mir" orbital scientific station in 1996-1999. The spatial resolution was equal to a few decimeters, which allowed us to obtain experimental estimates of the Kolmogorov and buoyancy scales together with the structure characteristics of isotropic and anisotropic components of the spectra of air density inhomogeneities. The observations of stars located in different positions with respect to the orbit plane allowed us to study each of the components separately. It is likely that the spatial structure of such small-scale density fluctuations at these altitudes has been studied for the first time.

We described the structure of stratospheric inhomogeneities by using the 3D spectral density. In order to restore it on the basis of the observations of scintillations we presented 3D spectrum as a sum of two components: isotropic and anisotropic. We used an analog of the Oboukhov model for the first component. We parameterized the second component assuming that it is generated by the superposition of random saturated internal gravity waves. Each component is described by two fitting parameters: dissipative scale and structure characteristic. Modern theory of scintillations allows us to connect measured scintillation spectra with the spatial spectra of air density. Model studies showed that the observation could give sufficient information to restore these four parameters. We used the maximum likelihood method to find the sought parameters. We processed the data obtained in 14 series of observations of stellar occultations. These observations are related to the latitudinal band between 40° S and 50° N.

The altitude functions of dissipative scales and of the structure characteristics are shown for altitudes between 27 and 65 km. We estimated the altitude dependence of the kinetic energy dissipation rate by using the parameters found for the isotropic component of 3D spectra. Obtained results are compared with existing models and with results of the different experiments.