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Internal gravity waves near the mesopause from observations of nocturnal hydroxyl emissions at Zvenigorod.

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The method of digital difference filters was applied to the analysis of spectral observations of the rotational temperature of vibrationally excited hydroxyl OH(6-2) at altitudes of 85-90 km at the Zvenigorod research station of IAP RAS (56°N, 37°E) in the period from 2000-2023. Seasonal changes in the monthly mean values of the rotational temperature and variance dispersions with periods of 0.7-11 h, which may be associated with internal gravitational waves in the mesopause region, were investigated.

Currently, much attention is paid to the study of internal gravity waves (IGWs) in the middle and upper atmosphere. Their sources are mainly located in the lower atmosphere. Propagating upward, IGWs are able to transfer energy and momentum to the middle and upper atmosphere, thus affecting thermodynamic processes at all heights of the atmosphere. Measurement of the intensity and rotational temperature of the nightglow is one of the ways to monitor the thermodynamic regime and composition of the upper atmosphere. For estimations in the present work, we used data from measurements of the hydroxyl rotational temperature at the Zvenigorod research station of the Institute of Atmospheric Physics of the Russian Academy of Sciences (56°N, 37°E) obtained using a spectrograph SP-50 with digital recording of the spectrum in the region of 800 - 1000 nm [1]. The field of view of the spectral instrumentation is 9° with a zenith angle of the instrument's central axis inclination of 53° in the northern direction. The measurements are carried out on cloudless nights. To obtain the required signal-to-noise ratio, the accumulation time for one spectrum recording is 10 min. The hydroxyl emission spectrum is a set of infrared vibrational-rotational bands, which allow us to determine the rotational temperature of OH molecules.

The method of difference digital frequency filtering [2,3] was used to extract mesoscale variations of night glow characteristics. As initial data, we take registrations of night glow characteristics at time moments t_i, which are averaged by the instrument for the accumulation time δt. To estimate the monthly standard deviations δf of mesoscale variations, numerical filtering is used by determining the differences between the recorded values that are separated by time intervals Δt.

One of the causes of nightglow mesoscale variations can be the IGW propagating in the luminous layer of the upper atmosphere. The polarization relations of the atmospheric IGWs theory [4] allow us to obtain the relation of the amplitudes of wave variations of the horizontal velocity U and potential wave energy E_p with the mesoscale dispersion and mean temperature value.

Refferences

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