



Report

of the Member of the Dissertation Council Dr. Chen Wen on the dissertation by Popov Andrey Alekseevich “Seasonal and interannual variability of the activity of internal gravity waves according to nightglow observations in the mesopause region”, submitted for the degree of Candidate of Physical and Mathematical Sciences in the specialty 1.6.18. Atmospheric and climate sciences.

The dissertation by Popov A. A. is devoted to study mesoscale waves in the mesosphere and lower thermosphere (MLT) region. This problem is actual, especially, in view of dynamical interactions between different atmospheric layers. Atmospheric waves are able to propagate to the upper layers of the atmosphere and carry energy and momentum, affecting the formation of climate change. Various turbulent and meteorological processes in the lower atmosphere can generate waves. Propagating upwards, the waves dissipate in the mesosphere and thermosphere regions, transferring energy to the environment.

Measuring variations of characteristics of nightglows is widely used to monitor the thermodynamic regime and composition of the upper atmosphere. The study by Popov A. A. deals with seasonal and interannual variations of mesoscale disturbances in hydroxyl (OH) nightglow and their relationship with internal gravity waves (IGWs) propagating from the lower atmosphere to the MLT region. The actuality of these studies is confirmed by their inclusion in all recent international research programs on the dynamics and climate of the middle and upper atmosphere.

In the thesis, the author developed methods for the analysis of long-term data on variations in the OH nightglow in the mesopause region in order to obtain information about atmospheric IGWs. Seasonal and interannual changes in mesoscale OH nightglow disturbances and IGW characteristics observed on the network of ground-based stations were studied. Numerical simulation of IGW propagation in the background temperature and wind fields corresponding to optical observation stations in order to interpret observations of wave variations of the OH nightglow was performed.

Some important aspects of the study have scientific novelty. The method of digital difference filters with stable transmission functions was first adapted and applied to the analysis of mesoscale disturbances of nightglows. For the first time, a statistical procedure has been developed and applied to evaluate and exclude uncorrelated noise of instrumental and atmospheric nature from experimental standard deviations of OH rotational temperature. Big amount of optical observation data on the OH nightglow emission in the MLT region was analyzed and new data on seasonal and interannual changes in mesoscale disturbances and IGW characteristics at various observation

stations were obtained. An improved numerical model of the propagation of the spectrum of IGW modes was first used to calculate wave noise on a network of nightglow observation stations. New data on the influence of background wind and temperature profiles on the wave disturbance in the MLT region in various geographical locations have been obtained. These results can be used to improve models of climate and atmospheric dynamics. The developed methods of data analysis and numerical modeling can be used to study data on wave variations on a wide international network of observations of nightglows in MLT region. The main results of the work have been published in 13 scientific papers and were reported at 6 Russian and international symposiums and conferences.

Among disadvantages, I can mention some misprints and grammar mistakes in the English version of the dissertation. However, this does not change positive impression from the dissertation.

I confirm that dissertation of Popov Andrey Alekseevich on the topic: "Seasonal and interannual variability of the activity of internal gravity waves according to nightglow observations in the mesopause region" meets the basic requirements established by Order No. 11181/1 of 19.11.2021 "On the procedure for awarding academic degrees at St. Petersburg State University", therefore Popov Andrey Alekseevich deserves the award of the degree of Candidate of Physical and Mathematical Sciences in specialty 1.6.18 – Atmospheric and climate sciences. Violations of paragraphs 9 and 11 of mentioned Order were not found in the dissertation.



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