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Dynamic characteristics of atmospheric planetary waves during stratospheric warmings in winter 2008

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The wave mechanism of energy transfer is quite significant in transferring energy in the Earth's atmosphere. Atmospheric internal waves of different spatial and temporal scales (including 1-30-day planetary waves) transfer a great deal of kinetic energy from the troposphere and stratosphere to higher atmospheric layers. As deduced from experimental data, systems of strong zonal stratospheric winds prevent penetration of planetary waves from the troposphere to the upper atmosphere (mesosphere and thermosphere), but the part of their energy reaches the upper atmosphere. Planetary waves are in many respects associated with such interesting phenomena in the Earth's stratosphere as sudden winter stratospheric warmings (SSW), observed almost every winter and characterized by geographical nonuniformity. High concentration of stratospheric warming centers is typical of the Asian region of Russia.

We examined dynamic characteristics of atmospheric planetary waves observed in the Asian region of Russia in the longitudinal sector of ∼80-125°E during stratospheric warmings in winter 2008. Satellite data on vertical temperature distribution obtained by the Microwave Limb Sounder (MLS) aboard the spacecraft EOS Aura and Irkutsk digisonde DPS-4 data were used.

It has been established that pronounced wave-like temperature disturbances with characteristic periods of 10–14 days were observed in the Asian region of Russia in the sector of ∼80–125°E and 40–64°N over a height range of 20–90 km during development of the SSW in January–February 2008. Revealed here is a high correlation between temperature disturbances and the minimum frequency of reflection in the Irkutsk digisonde DPS-4 ionograms.

This paper offers a method for investigating characteristics of propagation of long-term temperature disturbances by a cross-correlation analysis. This method consists in determining delays between disturbances observed at different points and in deriving a system of linear equations for the full vector of disturbance velocity. The delay is considered to be the minimum phase shift providing the local maximum of correlation coefficient. This analysis method was used to obtain dynamic characteristics of planetary waves in the middle atmosphere observed in the Irkutsk region at heights of 20–40 and 60–80 km.

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