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ON THE INTERCONNECTION OF DYNAMIC PROCESSES IN THE LOWER THERMOSPHERE WITH METEOROLOGICAL PHENOMENA IN THE TROPOSTRATOSPHERE

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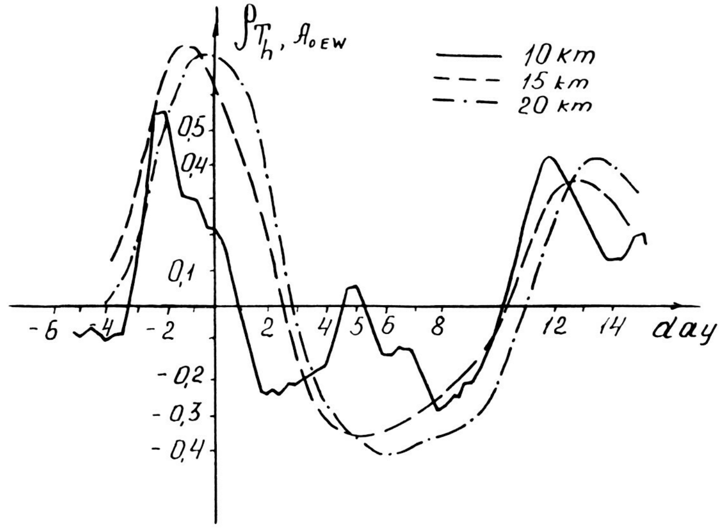
Nowadays the atmosphere is considered a single dynamic system governed by inner and outer factors, the separate layers of which (troposphere, strato-mesosphere, thermosphere) are in a state of interaction though they differ physically from one another in thermal stratification and energetic processes. There is now substantial acceptance of the point of view that disturbances of meteorological fields caused by baroclinicity and orography are transferred up from the troposphere to the stratosphere by the wave mechanism. This is substantiated not only theoretically, but also by the results of statistical studies of measured thermodynamic parameters.

This paper presents observational data of thermodynamic parameter connections in the troposphere-stratosphere-mesosphere-lower thermosphere height range. Data from radio and rocket atmosphere soundings over Heiss Island (80°3 N) and Volgograd (48°4 N) were used. Over Kazan (55°4 N), radiosonde data up to 30 km and meteor wind radar observations in the altitude range of 80-100 km carried out as part of the MAP/GLOBMET international program were analyzed. The trop-strato-mesosphere statistical characteristics obtained during the five year period at Heiss Island and Volgograd serve as a background for Kazan where observational results were used for analysis of the winter and summer period of 1984.

For all the above observation stations in winter and summer periods temperature field correlation coefficients pass through zero. As observed at the tropopause, this is a consequence of the antiphase nature of the thermodynamic field disturbances in the tropo- and stratospheres. In the stratosphere the correlations between the levels are higher and weaken more gradually as the distance between the levels increases.

In spring, the correlations obtained testify to the downward transmission of the reconstruction mechanism.

This report attempts to define the interconnection between the temperature field disturbances in the tropo-stratosphere and the dynamic regime in the lower thermosphere in winter and summer, as revealed by observations in Kazan. Characteristic analysis of prevailing wind influx in the meteor zone (on 10-31 of January and 8-16 of February, 24-29 of February, 1984) and the tropo-stratosphere temperature regime (on 1-8 of January, 24-29 of February, 1984) showed the presence of wave disturbances with time scales of 2-8 days. Reciprocal correlation analysis showed the presence of wind parameter disturbances in the meteor zone that propagated from the troposphere with a 1-6 day delay from altitudes of 30-10 km respectively. Curves of reciprocal correlation functions of temperature T, prevailing wind amplitude A_o, semidiurnal influx $A_2(\rho_T, A_o, \rho_T, A_2)$ are presented in Figs. 1 and 2.



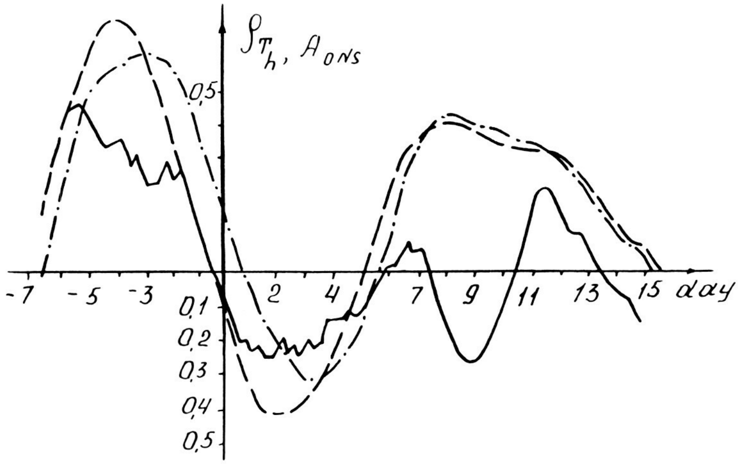


Fig. 1 Reciprocal correlation function of temperature T and amplitude of zonal A_{OEW} and meridional A_{ONS} prevailing wind component in the winter period.

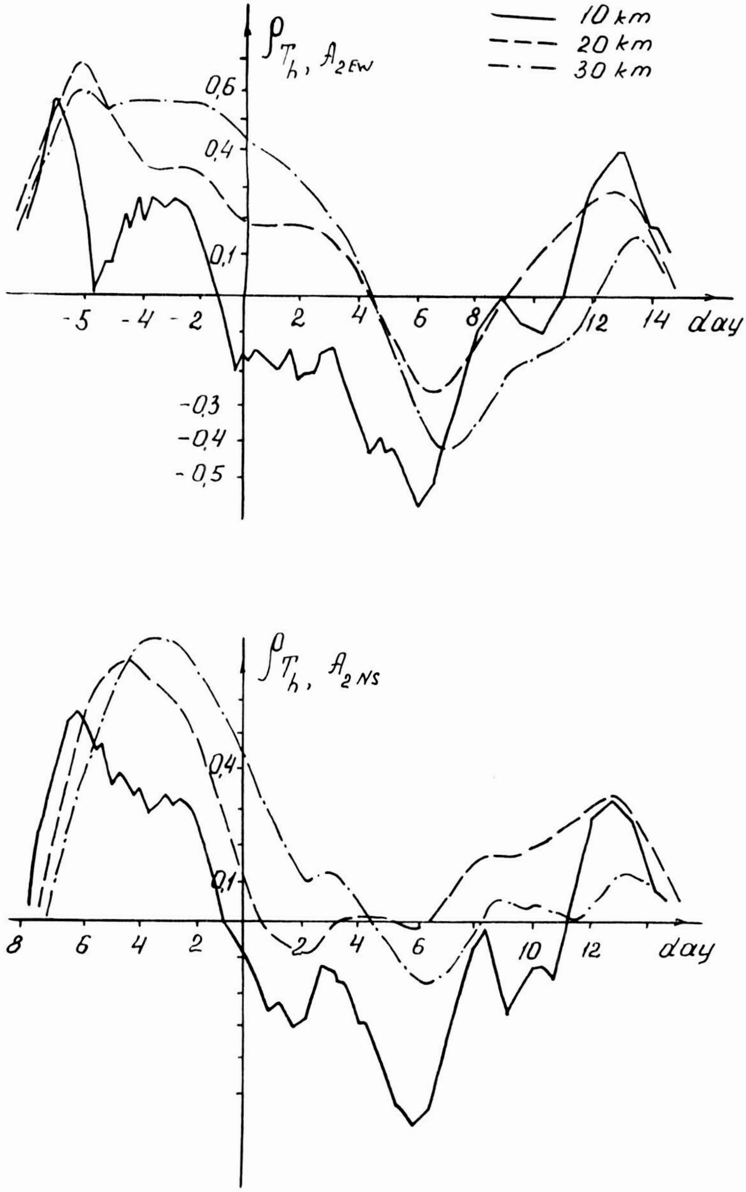


Fig. 2 Reciprocal correlation function of temperature T and amplitude of zonal A_{2EW}, meridional A_{2NS} semidiurnal influx component in the winter period.

A sharp reversal coinciding with the rise in temperature in the troposphere and the decreases of the prevailing wind vector on the stable wind position are more noticeable for the zonal component. The amplitude of the prevailing wind and the semidiurnal influx are modulated by a two-day wave.

In the summer period (July 16 - August 6, 1984) there were disturbances with time scales of about 2-8 days in the prevailing wind field, in the semidiurnal tide in meteor zone, and in the temperature field in the tropo-statosphere. Reciprocal correlation function curves for the summer period are shown in Fig. 3 and 4. No process of successive transmission of temperature field disturbances from the troposphere-stratosphere to the lower thermosphere was revealed in the summer period.

Nevertheless the reciprocal correlation analysis shows the presence of a quasi-two-day wave in the meteor zone in the semidiurnal tide with a delay of about 4 days relative to the lower troposphere. In the prevailing wind a 4-day wave is traced along with a 2-day wave which is revealed in the meteor zone in the zonal component with a delay of about 4 days relative to the troposphere level. The reciprocal correlation function curves in summer reveal a maximum correlation of semidiurnal tide and temperature with a delay of 5-6 days observed between the troposphere and the meteor zone. It should be noted that the disturbance of the temperature field T at altitudes of 15-20 km is in antiphase with the 1-10 km level. The wind parameter disturbance at meteor heights (80-100 km) is in phase with the disturbance T in the 1-10 km layer and in antiphase with the 15-20 km layer.

When the change in the prevailing wind vector amplitude is strong in the summer period, the direction of the prevailing wind is stable except for the short lived reversals during the day on July 24 and 30 and August 3, corresponding to the minimum values of wind amplitude.

These results testify to the interconnection of thermodynamic parameter disturbances in the middle atmosphere, which are most clearly revealed in the winter period.

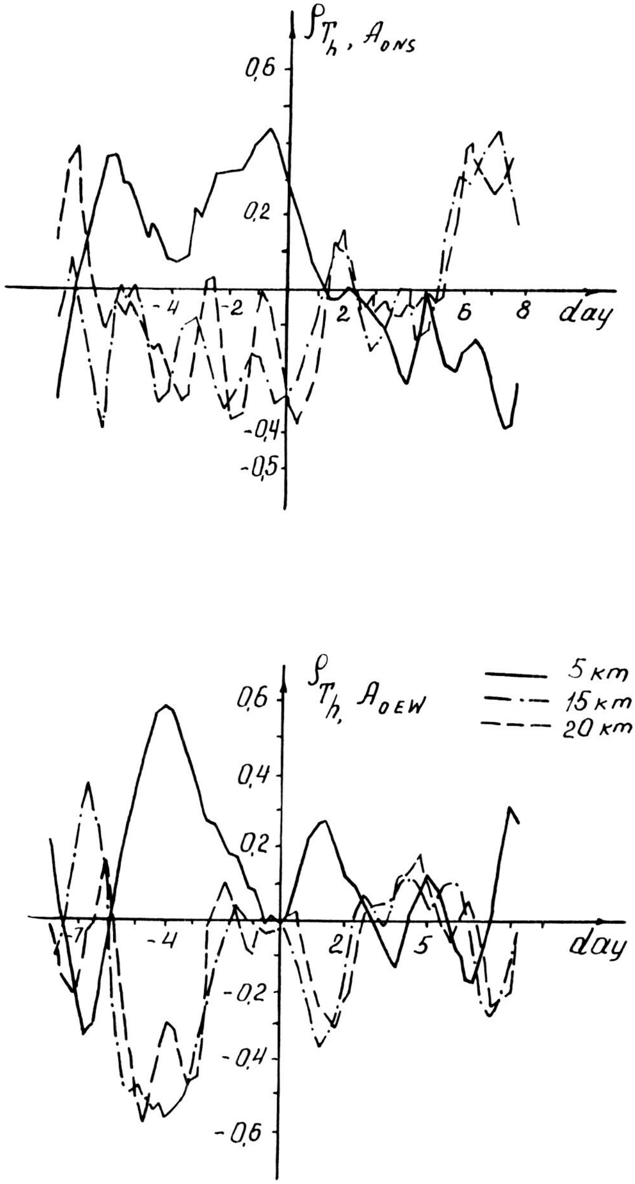


Fig. 3 Reciprocal correlation function of temperature T and amplitude of zonal A_{OEW} and meridional A_{ONS} prevailing wind component in the summer period.

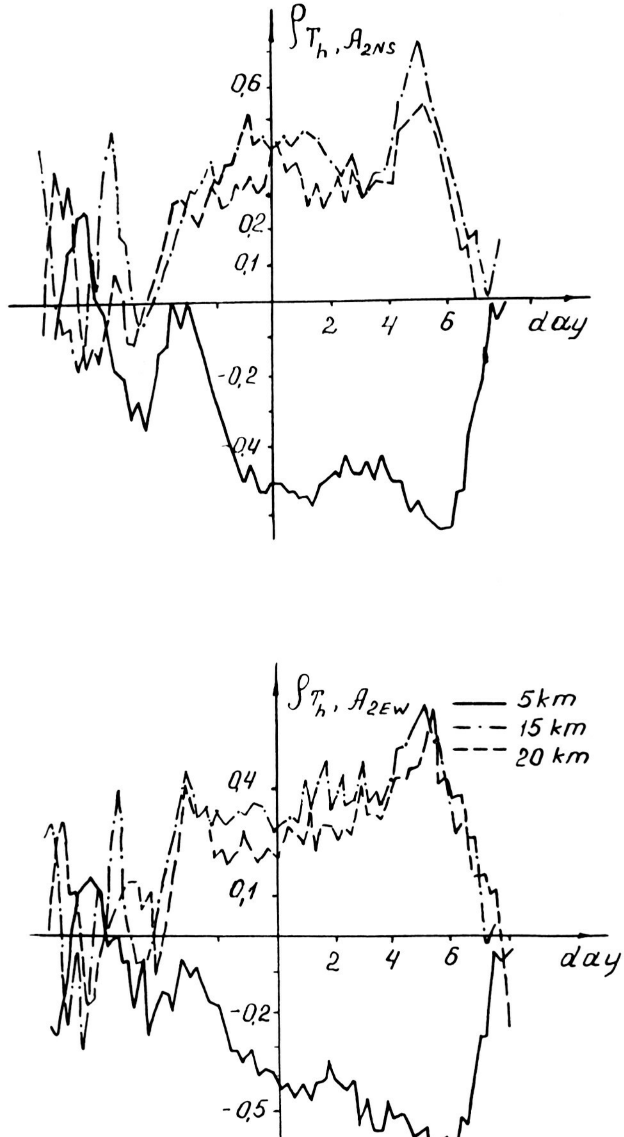


Fig. 4 Reciprocal correlation function of temperature T and amplitude of zonal A_{2EW} and meridional A_{2NS} semidurnal influx component in the summer period.

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