ON CONNECTION BETWEEN EVOLUTION OF TROPOSPHERE FRONTS AND CHANGES OF CIRCULATION REGIME IN METEOR ZONE

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This report considers the interactions between the thermobaric fields at heights from 5 to 95 km at the beginning of a winter period, based on experimental radar measurements of meteor drifts obtained in Frunze in November-December, 1983. During this period the high atmosphere readily responds to even slight changes in the thermal regime of the stratosphere. The interdiurnal variations of average daily values of wind u, v, U, and azimuth ϕ are shown in Fig. 1.

Of particular interest here is the following - three of four days after a wind reversal from west to east in the meteor zone a powerful cold north-west intrusion took place in troposphere. The period considered witnessed five such intrusions, with a reversal of wind direction occurring in four cases. For example, intensive cold intrusions with transfer of arctic air were observed in the troposphere on November 18 and 26 and December 4. The main frontal division over Kirghizia at the time shifted from west to east. The temperature in the frontal division fell from +15°C to -3°C. The analysis of these tropospheric fronts were carried out using ground level weather maps for 3 to 4 days before their intrusion. The synoptic situation for all the three periods was similar: a cyclone existed over Europe, and an anticyclone over Middle Asia and Kazakhstan. The front was directed from north to south and stretched from the southern Urals to the south of Middle Asia and Turkmenistan.

The velocity of intrusion of these fronts was 55-60 km per hour and they advanced at a speed of 1,300 km a day. The ground weather maps for November 14 and 23, 1983, are given in Fig. 2. The maps of the 500 mb surface placed the frontal division practically parallel to that of the ground level weather maps. There was a hardly discernible trough above middle Volga and a ridge above northern Kazakhstan.

Most interesting here is the analysis of the pressure maps of the stratosphere at the 10 mb level for this period. The maps for November 14 and 23 are presented in Fig. 2. The stratospheric South-Asian anticlyclone with its northern boundary reaching to 48-50°N developed in the middle latitudes on November 14-15 and 22-23. Similar intrusion of subtropical anticyclone created a contrast in the temperature field of the cyclone with thermal overfall in the frontal zone ranging from -(61 to 63)°C to -48°C.

The frontal division in the stratospheric temperature field occupied the area from Sverdlovsk to the south-west and further to the Caspian Sea parallel to the frontal division in the troposphere. It led to the formation of a high frontal zone in the upper atmosphere in the same direction. The intensification of stratospheric anticyclones gives rise to local warmings near the stratopause and to intensification of planetary

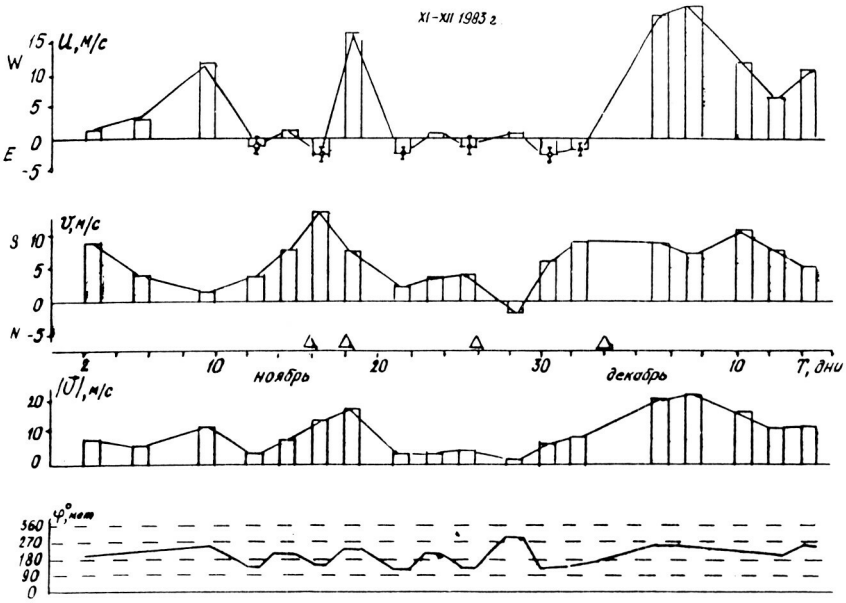

Fig. 1 Variation of zonal u, meridional v, and vector $|U|$, ϕ wind at 95 km over Frunze from November 2 to December 18, 1983.

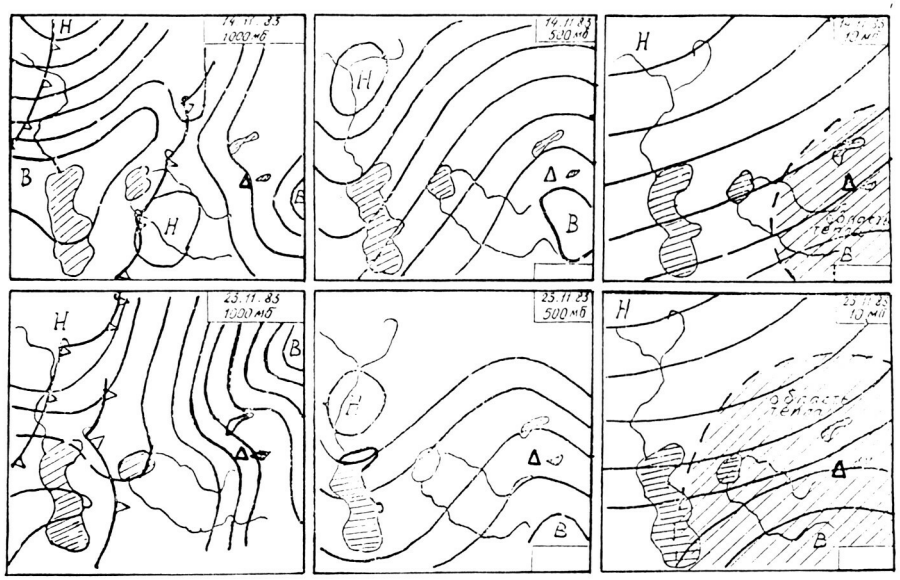

Fig. 2 1000, 500 and 10 mb maps over Central Asia (Frunze Δ) for November 14 and 23, 1983.

waves spreading from the troposphere to higher layers. The amplitudes of the planetary waves intensify owing to the blocking of western streams by anticyclones.

The waves spread upwards and upon reaching meteor heights cause reversal of the wind at 93 km above Middle Asia. The blocking processes in the tropospheric zonal wind stream during periods of local warming and the inverse reaction of higher layers produce intensification of frontal activity at ground level. Two and a half or three days after the anomalous wind reversal at the height of 93 km the troposphere over Kirghizia underwent a powerful intrusion from the north-west.

It is clear that the development in the stratosphere of the South Asian anticyclone leads to displacement of warm area to higher latitudes, from the center of the anticyclone to the north, bringing about a thermal reconstruction of the wind field at greater heights and even a reversal of wind direction at the height of 93 km.

The ridge that forms in the troposphere blocks the main western stream, a trough naturally appearing ahead of it. The frontal part of the trough serves as the frontal division and its projection on the ground forms the frontal line. The above front moved at a speed of 700-900 km a day and it took it 2.5-3 days to reach Kirghizia. These results would indicate, at least for the northern latitudes from which our observations were made, that the passage of a front at ground level is often preceded, by some 2.5 to 3 days, by a wind reversal at 93 kilometers.