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LOW-TROSPOSPHERIC JET STREAMS IN THE WESTERN CARPATHIANS ON MAY--ETC(U)
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by

E. Budziszewska and M. Morawska-Horawska

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LOW-TROPOSPHERIC JET STREAMS IN THE WESTERN CARPATHIANS ON MAY 6, 1968

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A synoptic and aerological analysis of a low-tropospheric jet stream occurring at a height of 2-2.5 km during a foehn in the Tatras on May 6, 1968.

Strong winds in the Carpathians are not rare phenomena, and as a result of their action, more or less broad forested areas are ruined every year, among other things. However, the damage that the winds in the Tatras, Podhale, and the Western Beskids caused on the evening of May 6, 1968 was exceptionally great. From preliminary observations, it appears that the air flows which caused the catastrophe mentioned passed mainly through the valleys and along the northwestern slopes.

An analysis of the spatial distribution of atmospheric pressure and air temperature on May 4-7, particularly between 6 PM and midnight on May 6, has permitted the statement that winds of high velocity were caused by the simultaneous action of three factors:

- a characteristics pressure development, which caused a foehn to be established as early as May 4;

- an increase in the pressure gradient in the evening of May 6;

- the effect of the barrier of mountains.

The increase in the pressure gradient was caused by an intensification of the secondary system of the low troposphere, initially in the surface layer, and then, as the synoptic situation developed, in the low and intermediate troposphere. This system swept through the edge of a high-pressure block from above southeastern Europe, consistent with the main direction of confluence at an isobaric surface of 500 mb. The high-pressure system was extended toward the upper limit of the troposphere, as a result of which the intensified secondary low could not shift it toward the east and only caused an increase in the pressure gradient in the lower troposphere at the edge of the high-pressure system. The isotachs at isobaric surfaces of 850 and 700 mb indicate the existence of a branching stream of strong winds at these levels. This stream is connected through the troposphere with the southern branch of the upper tropospheric jet stream, whose core was lowered on that day. The two branches of this low jet stream could also be distinguished on maps of the isobaric 850 and 700 mb surfaces on May 7 at midnight. The shorter northern branch was directly connected with the very active secondary low mentioned above, which existed above the southern Baltic. It was found at that time above the northern part of Poland, above lowland terrain, and therefore did not cause any direct effects at the earth's surface. On the other hand, the second branch, observed at an altitude of 2000-2500 m, above the Carpathians, caused destruction in the mountain regions.

In the period in May analyzed, a double salience was noted in the lower troposphere of these low streams with high velocities, about 15-20 m/sec. They had a width of about 200-300 km, and length of 1500-1000 km, and a thickness of about 1 km and lasted from 24 to 26 hours, moving along with the secondary, low-pressure system and associated with the stream flow in the upper troposphere. They arose during the creation of secondary, very active lows at the edge of the high-pressure blocking system, in a region of great thermal contrasts. It must be assumed that the main reason for such high wind velocities at the earth's surface was a jet stream at a level of about 760 mb. On vertical cross-sections through this stream over the region of the Carpathians, there can be distinctly seen, on May 7 at midnight, below the jet stream in the upper troposphere and occurring at a height of about 340 mb, a second, considerably weaker maximum in wind speeds at a height of about 760 mb. From measurements, it appears that the wind velocity at this height in the free atmosphere above the Poprad station in Czechoslovakia was 38 m/sec. Similar to this value were the velocities also measured at Kasprowy Wierch during a maximum wind force amounting to 50 m/sec. The wind directions were also consistent (about 240° at the core of the stream) both over Poprad and at Kasprowy Wierch, although a certain deviation in their direction may be expected in the free atmosphere due to the orographic effect of the Tatra Mountains.

The air settling along the northern slopes of the Tatras was displaced to the north. For a more precise definition of the the range of the foehn's effect, the dewpoint temperature distribution was analyzed, treating it as an invariable characteristic of the air mass in the process of its horizontal transport. The maximum value of dewpoint temperature in the area where the foehn was in force was 8.2°C at Zakopane. Taking on the curvature of the limiting value at 9.0°C, the path of this isodrosotherm is marked on the map and treated as the boundary of the foehn's range. The range of this air, which extended beyond 12 hours on May 6, and then 48 hours later with the foehn in Zakopane, only a little beyond Podhale, twelve hours later reached the geographic latitude of Plosk.

The analysis presented has produced the following conclusions:

1) the existence is established of a stream of strong winds at an altitude of 2000-2500 m, which the authors called low-tropospheric jet streams. They appear with a locally and areally increasing pressure gradient. They appear in the region of a mountain barrier, during the system characteristic of a foehn in the Carpathians, which causes high wind velocities;

2) it is established that a low-tropospheric jet stream occurs under thermobaric conditions other than low-level jet;

3) it is established that the effect of the foehn may reach along the Warsaw Trough;

40 it is observed that the stability of large-scale pressure systems contribute to the development of such a situation in the case analyzed. It seems that strong, highly extended blocking systems play an essential role in the origin of this development. They hinder the movement of secondary low systems and thereby cause the occurrence of large pressure and temperature gradients.