

THE EXAMPLE OF A RECONSTRUCTION OF HISTORICAL SEVERE CONVECTIVE STORMS FROM 25-26 MAY 1872

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Introduction

The severe convective storms are recently analysed with the help of NWP models. However, probably the most extreme convective storms in Czech territory in last two centuries occurred in May 1872, so the standard research of this event is not possible. Of course, both quantify and accessibility of meteorological data decrease toward the past, so the survey must be based not only on published measurements, but also on other historical sources.

Severe storms, intensive flash rain, hailstorm and some tornadoes affected on May 25-26, 1872 the several thousand km² large area westward from Prague. This event was one of the most catastrophic natural disasters in the Czech territory during last centuries; about 240 people died (*Koristka, Bernat 1872*). Following contribution summarizes existing results of the historical and meteorological survey of this extraordinary event.

Reconstruction of the synoptic situation

To describe the synoptic situation over Central Europe, yearbooks from 1872 were used, which are at disposal in the archive of Czech Hydrometeorological Institute. There are *Magnetische und meteorologische Beobachtungen 1872*, *Jahrbücher der K.k. Central-Anstalt 1872* and *Schweizerische meteorologische Beobachtungen 1872*. Unluckily, daily measurements only from the morning were published in the Austrian yearbook, so one synoptic map per day is possible to draw (Fig. 1). In the future, we would like to complete the maps with the data from Germany.

Only one Czech station (Prague – Klementinum) published its measurements in 1872. Some original reports of climatological stations luckily exist, which can be used for more detailed description of weather development in Czech territory (Fig. 2 and 3).

The synoptic situation over Central Europe on 25 May was characterized by a substantial, almost stationary front, which separated very cold air mass in the northwest and much warmer air in the southeast. On this front, a probably deepening cyclone was detected, whose centre was located somewhere in Bavaria or in Upper Austria in the morning (Fig. 1a).

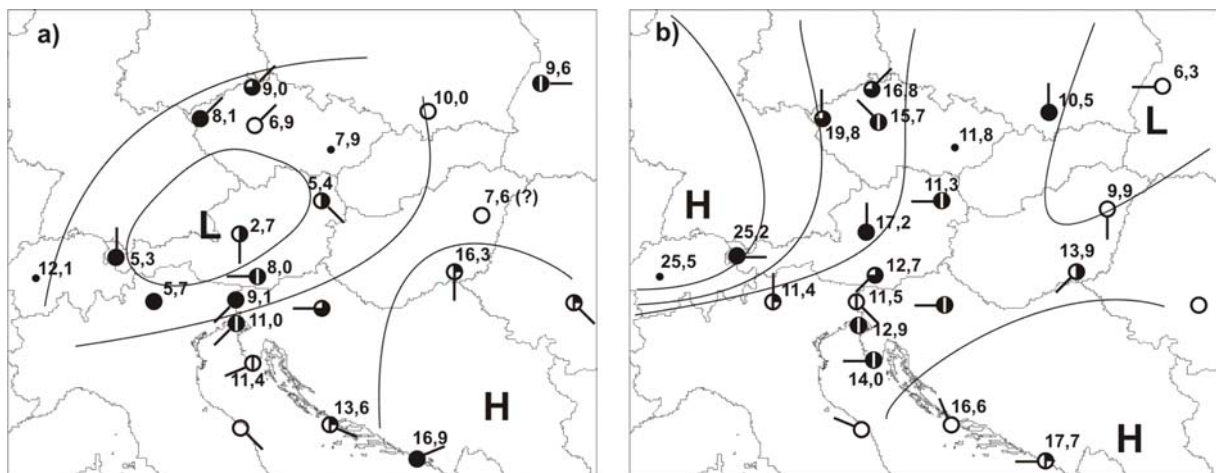


Fig. 1. Fragmentary synoptic map of Central Europe on 25 Mai (a) and 26 Mai (b) 1872 in the morning. The numbers denote atmospheric pressure values minus 1000 hPa, the wind direction is signed with short lines, the cloud amount with usual symbols.

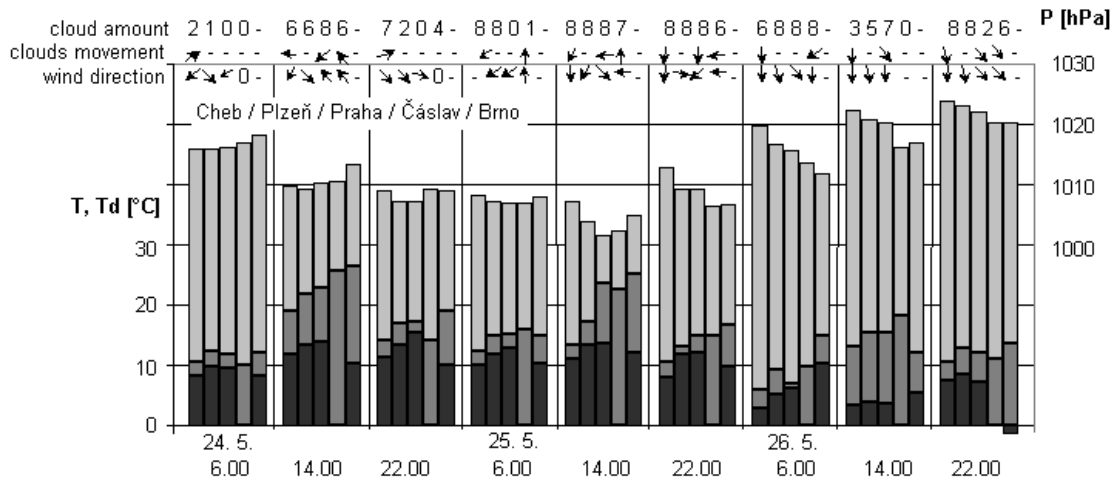


Fig. 2. Selected meteorological elements development on May 24–26, 1872 at five stations in the CR (approximately in the direction W-E): atmospheric pressure - all column height, air temperature - height of darker part of the column, dew point temperature - height of the darkest part of the column, cloud amount – in eighths of sky covering. Failing data are signed with a dash.

This cyclone moved over Bohemia before noon when the absolute pressure minimum was gauged in Prague (Fig. 2). There was a strong horizontal pressure gradient on sides of the depression and were significant temperature differences between the west and east part of Czech lands (Fig. 2 and 3). The substantial vertical change of the wind direction was detected in the area affected later by severe storms – cold wind from the northern quadrant blew at the ground, in higher levels the cloud motion from SW was observed (*Zhoubna povoden 1872*).

The movement of the cyclone to the northeast or east continued, so the atmospheric pressure was the lowest in the evening in east part of Czech lands (Fig. 2.). On 26 May, the partly filled depression was located far on the east while a significant high moved over Central Europe (Fig. 1b). Very cold and dry air came into Bohemia on the front side of this high (Fig. 2.).

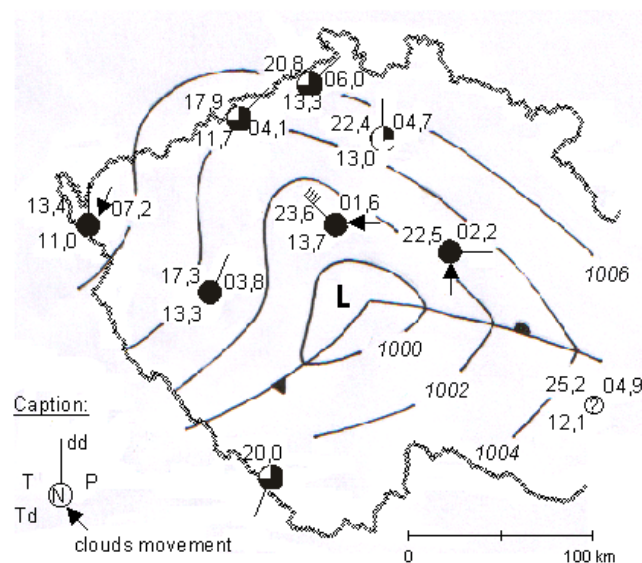


Fig. 3. Fragmentary synoptical map of Czech territory on May 25, 1872, at 2 p.m. with station circles (see the caption). The approximate location of the warm and cold fronts is marked in the map.

Reconstruction of the storms and flash rain

Only several climatological stations existed in 1872 in Bohemia. The dense rain gauge network was built up only several years later and the described event was one of the most important reasons for it. The reconstruction of storms development and flash rain had to be based also on other historical sources (books, chronicles, newspapers...). The territory attacked by severe storms (Fig. 4) such as occurrence of dangerous phenomena (Fig. 5) was studied with the help of those sources.

Formation of severe storms was stimulated on 25 May 1872 in the afternoon by the motion of upper described significant depression. That is the reason why storms affected large region in west and northeast Bohemia. The impacted area forms a disconnected band on the left side of the cyclone centre motion; it means, the storms occurred in the territory, where the cold air with mainly northern ground wind appeared, however, in the high levels remained warm air with inverse streaming (see upper). Nevertheless, storms and flash rain had only in a part of this band an extraordinary intensity (Fig. 4).

None of existing stations were located in this area of the strongest flash rains – the highest daily precipitation amount measured by a rain gauge on 25 May was 65 mm (Fig. 4). However, in some parts of the Berounka and Blanka river basins the rain was much stronger. Two unique precipitation amounts were detected in open vessels (*Kořistka, Bernat 1872*): in a village Mladotice (north of Plzen) fell 237 mm precipitation probably in 90 min (!) and in village Mcholupy by the town Zatec it was 289 mm in about 12 h. Anyway, the flash rain was distinguished by extreme short-term intensity, which was almost four times higher than the 100-year precipitation for corresponding duration (*Müller, Kakos 2004*).

Hailstorm affected many places; in a few cases also big hailstones and at least three tornadoes occurred (*Kořistka, Bernat 1872*). A significant asymmetry was found in the field of hailstorm (Fig. 5) when hailstorm was more frequent on the southeast (right) side of the moved convective system.

Recurred flash rain caused flash floods not only on small streams, but also on the Berounka river (a tributary of the Vltava river). At the time reached peak flow of Berounka was not exceeded till now, not even big floods in August 2002. Many land slides also occurred; the valley by village Mladotice was blocked and the Mladotické lake was created, which is the only one originated in this way during the historical period in Bohemia.

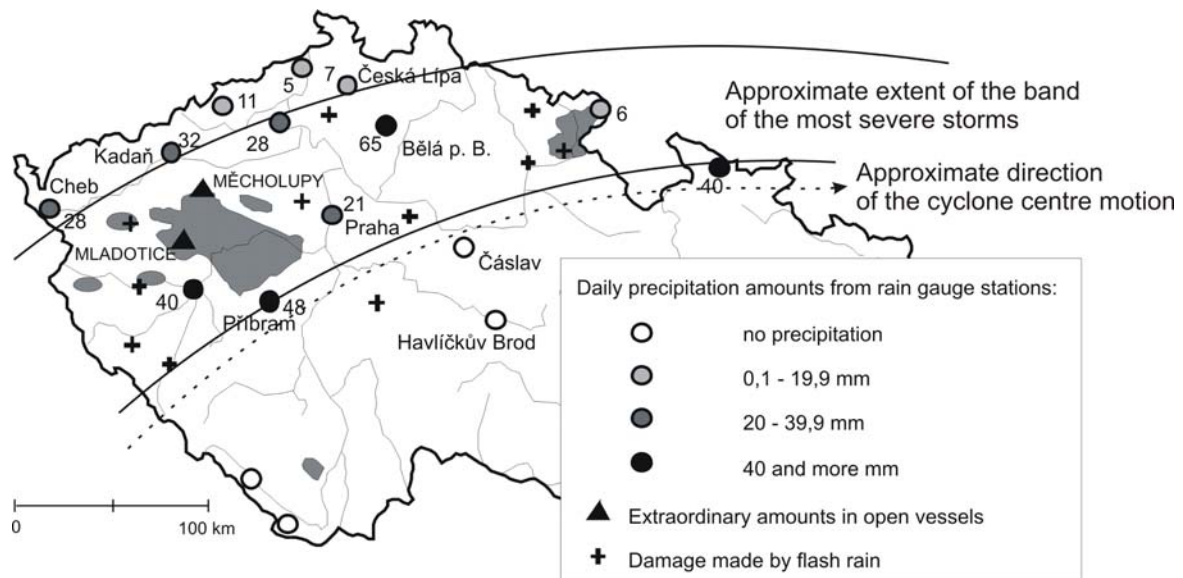


Fig. 4. Precipitation in Czech lands on Mai 25, 1872. The area of the strongest flash rains (according to Koristka 1872) is marked with the grey colour.

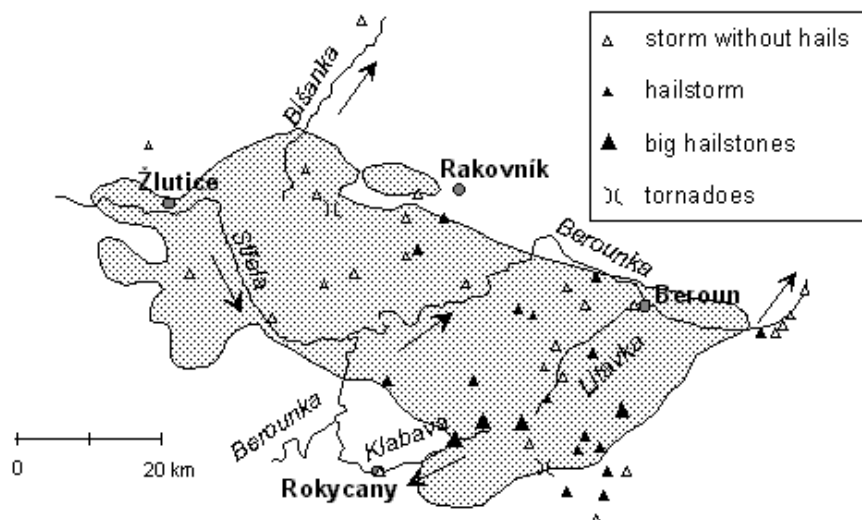


Fig. 5. Occurrence of storms, hails and tornadoes on Mai 25–26, 1872 (according to a popular book *Zhoubna povoden* 1872). The area of the strongest flash rain (according to Koristka 1872) is marked with the grey colour.

Conclusions

Severe convective storms on May 25-26, 1872 caused one of the most catastrophic natural disasters in the Czech territory during the historical period. The reconstruction of the synoptic situation demonstrated the motion of a significant depression across Bohemia to the northeast. The severe storms occurred on the left side of the depression centre trajectory, where the substantial vertical change of the wind direction was detected.

The severe storms were distinguished by unique short-term intensity of flash rain. They affected a large area (several thousand km²), mostly in the same river basin (Berounka river, a tributary of Vltava), and remained for an extraordinary long time (from the afternoon to the night). The resultant floods were the biggest known ones on Berounka and Blsanka rivers.

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