SEVERE STORM IN BAVARIA, THE CZECH REPUBLIC AND POLAND ON 12-13 JULY 1984

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I. INTRODUCTION

One of the best-known historical European severe storms is the event from July 1984. In Germany it is known as "Münchner Hagelunwetter" (Munich hailstorm) and was studied in detail by Kurz (1986). In the Czech Republic, the storm got its own name "Markéta" (Munzar et al., 1990). The storm crossed Central Europe from Switzerland to Poland on 12 July and during the following night. It affected hundreds km long strip of land by hails (up to 10 cm in diameter), flash rain (tens of mm) and wind gusts (more than 30 m.s^{-1}). Only in Germany, the storm caused damage of 1.5 billion German marks.

Kurz (1986) mentioned that the most intense convective cell had showed the characteristic behaviour of a supercell storm. As confirmed in this study, the development of the storm resulted from a specific combination of macro- and meso-scale processes. The aim of the presented case study is to describe the synoptic and sub-synoptic meteorological conditions before and during this historical event by means of the re-analyses of meteorological fields and NWP model outputs.

II. RECONTRUCTION OF THE EVENT IN SYNOPTIC AND SUB-SYNOPTIC SCALES

The synoptic-scale conditions before and during the event are analysed in terms of the extremeness of specific thermo-dynamic quantities (see an example in Fig. 1). In order to evaluate the extremeness, we used the database of ECMWF re-analyses ERA-40 for the summer months (June – August) from the period of 1958 – 2002. The area of interest covers a large part of Europe and northern Atlantic (30°W – 40°E, 30° – 70°N) with the horizontal resolution of 2.5°.

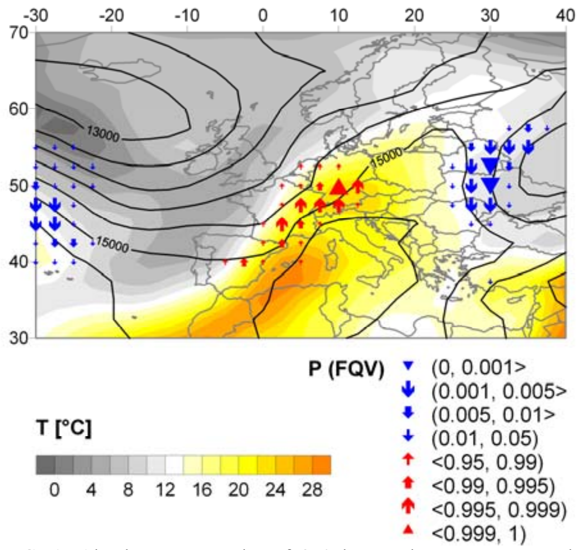

FIG. 1: Absolute topography of 850 hPa and temperature at the same level on 11 July 1984 at 12UTC; extremeness of the daily mean of the meridional flux of moisture (FQV) at AT850 expressed by the parameter *P*.

The extremeness of a value *xi* of the quantity *X* in a grid point is described by the probability *P* of not exceeding the value (Müller and Kašpar, 2006):

$$P=i/(N+1),$$

where *i* is the number of values which are equal or less than *xi* and *N*=4140 is the total number of the values.

The spatial and temporal analyses of sub-synoptic characteristics are carried out employing the numerical simulation of the event by non-hydrostatic limited area NWP model LM COSMO (Doms and Schättler, 1999). The configuration of the model run consists of two parts. Firstly, a driving model is integrated over a large part of Europe with the horizontal resolution of 11 km (see an example in Fig. 2). In the second step, a nested model with the domain of interest runs with the horizontal resolution of 2.8 km (Řezáčová and Sokol, 2003).

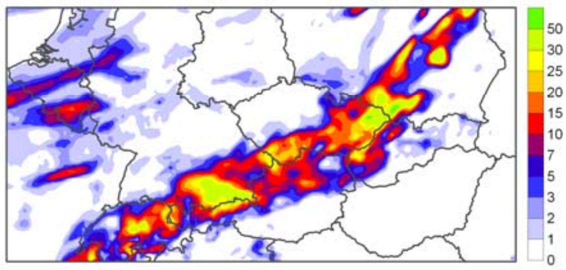

FIG. 2: Daily precipitation totals [mm] over Central Europe on 12 July 1984 simulated by the LM COSMO run with the horizontal resolution of 11 km.

The measured and simulated precipitation amounts are used to verify the LM COSMO forecast (Řezáčová et al., 2007). Furthermore, where available, the radar data are compared with simulated radar reflectivity by the Radar Simulation Model applied on the LM COSMO outputs (Haase and Crewell, 2000). The thermo-dynamic properties of convection environment and the impact of interactions between downdraft outflows and convection environment on lifetime of the system are investigated by the model for the Objective Analysis of Gust Fronts (Kašpar and Müller, 2007a). The model calculates the position of most significant gust fronts, assesses the heights of gust front heads and the speed of propagation. In addition, the model contains a decision algorithm which quantifies the potential of objective gust fronts to initiate convection using the objective analysis of vertical shear, stability and humidity conditions (Kašpar and Müller, 2007b).

III. RESULTS AND CONCLUSIONS

Synoptic settings were characterized by a stationary frontal zone separating air masses with quite different thermo-dynamic properties: cold air above eastern Atlantic and a tongue of extremely warm air accompanying by an extra strong meridional flux of moisture (FQV) from western

Mediterranean over Central Europe (Fig. 1). The severe storm studied was related to a frontal wave at this boundary.

The analysis of the extremeness of synoptic-scale thermo-dynamic fields demonstrated that some thermo-dynamic quantities may reach extreme values not only during large-scale precipitation events, as it was in July 1997 and August 2002 (Řezáčová et al., 2005), but also during a case of severe convection. In contrast to large-scale floods in 1997 and 2002, the FQV was reversely oriented from the south to the north in July 1984. It may be assumed that the extremity of synoptic-scale thermo-dynamic characteristics contributed to the extremity of the mesosynoptic convective phenomena.

The LM COSMO run with horizontal resolution of 11 km properly simulated precipitation in terms of totals as well as spatio-temporal distribution (Fig. 2). We suppose that it was due to the relation between the MCS and the synoptic conditions. Employing the LM COSMO run with horizontal resolution of 2.8 km and the model for the Objective Analysis of Gust Fronts, a more detailed analysis of the event will be also presented.

IV. AKNOWLEDGMENTS

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