SEVERE SQALL LINES IN HUNGARY. IT IS VIABLE TO USE A SIMPLE CONVECTIVE CHECK-LIST BASED ON HYDROSTATIC NWP IN OPERATIONAL FORECASTING?

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I. INTRODUCTION

A high percentage of severe linear mesoscale convective systems produce hail, damaging winds, flash floods and other dangerous weather events. Considering the risk these organized thunderstorms pose to human lives and property, their assessment for better forecasting is crucial to properly forecast their temporal and spatial evolution and the related hazards. Following the steps of Kuchera and Parker (2006), Parker and Jonson (2000), Cohen et al. (2007), the authors wish to examine whether it is possible to create a simple and effective decision process based on convective parameters and other relevant fields derived from hydrostatic NWP output.

II. DATA AND METHODOLOGY

In the present research, a large number of cases involving linear mesoscale systems that appeared over Hungary were examined. These cases were selected manually, considering storm structure and severe events via radar reflectivity, rain gauge and wind gust measurements (cases with wind gusts above 90 km/h were preferred). The dataset consists of NWP fields (ECMWF, 2005-2011), radar data, precipitation and wind gust measurements, and a radar-ellipse database calculated by the TITAN algorithm. Examinations were performed both manually and in an automated manner.

Manual examinations were done through the visualization software (HAWK-3) of the Hungarian Meteorological Service, applying a set of hydrostatic NWP fields divided into convective parameter and synoptic (trigger) based checklists for the selected cases.

For this dataset, a highly customizable search algorithm was created to be able to separate certain types of cases based on convective parameter criteria. This algorithm is a useful tool for a quick access to NWP climatology and to check whether a certain setup of convective parameters occurred in the past, which makes it useful for operational forecasting as well. The algorithm pairs radar ellipse data with grid point data activated by the given conditions. Using this algorithm, thunderstorm environments supporting linear MSC-s were also examined in an automated way.

The goal of this research is to create a checklist consisting of relevant parameters that indicate important processes for linear MCS development, such as wind shear, buoyancy, moisture, high level storm relative winds or more recent parameters like DMGWIND, connected to damaging surface events. Several fields were added to highlight the synoptic approach for a better understanding of these systems.

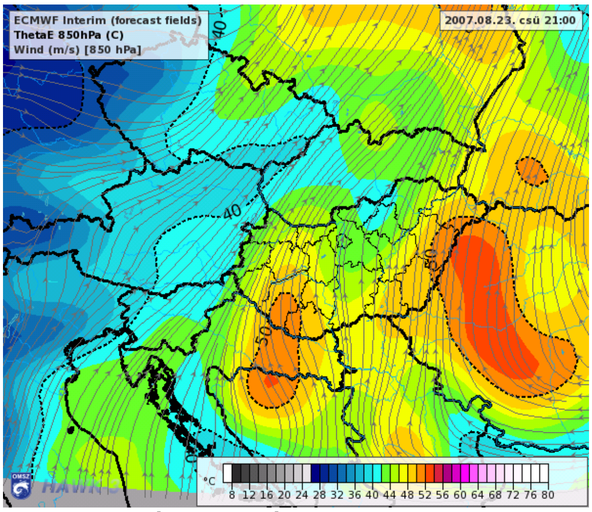

FIG. 1: Equivalent potential temperature map at 21 UTC, 20070823. Note the band of warm and moist air stretching from Bosnia-Hercegovina to Lake Balaton (warm conveyor belt (WCB)).

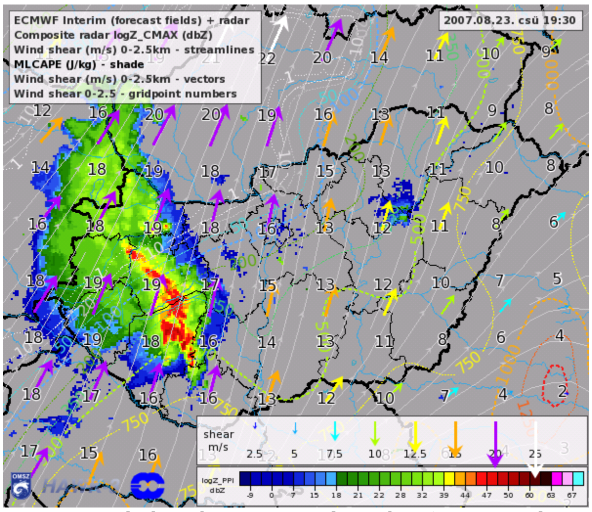

FIG. 2: Wind shear between 0 and 2.5 km (arrows, gridpoint numbers and streamlines) and MLCAPE (dashed) at 21 UTC, 20070823. The squall line was subsequently evolving on the strong shear zone (exceeding 18-20 m/s) and the WCB (FIG.1).

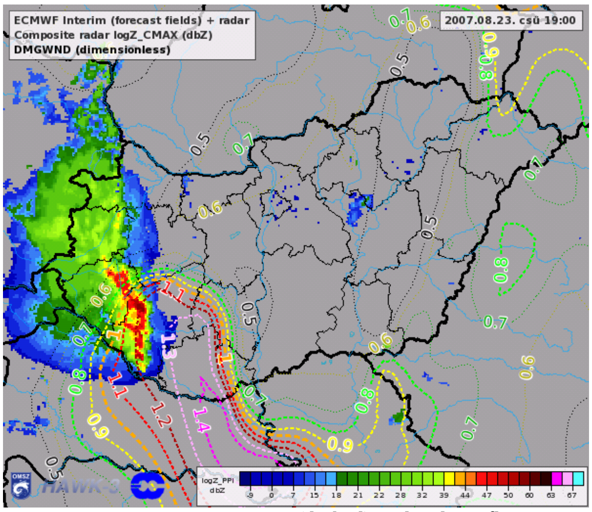

FIG. 3: DMGWIND at 18 UTC (dashed) and radar reflectivity at 1900 UTC, 20070823.

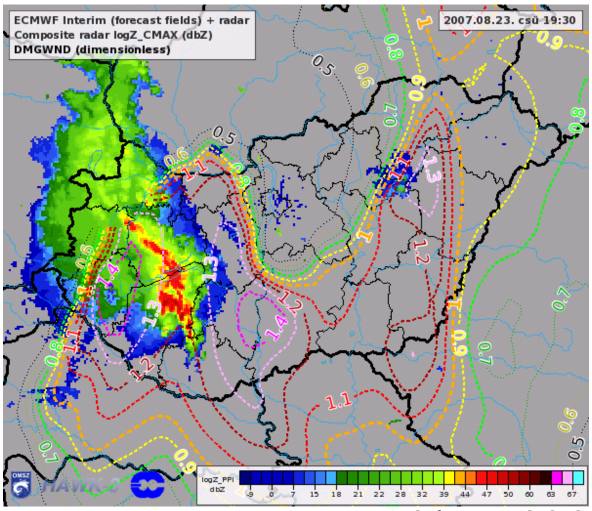

FIG. 4: DMGWIND at 21 UTC, 20070823 (+9h forecast) (dashed) and radar reflectivity at 1930 UTC. Wind gusts exceeded 100 km/h throughout the Trans-Danubian part of Hungary, where DMGWIND maxima (1-1.5) overlap high reflectivity values.

III. RESULTS

Preliminary results show the importance of parameters connected to wind shear – the proper analysis of wind shear magnitude and direction in different levels has high forecasting value. DMGWIND also shows good forecast potential for damaging wind gust.

As for the synoptic point of view, proper analysis of air masses, conveyor belts, stream patterns and triggers were also found to be crucial. Equivalent potential temperature and mid-level vorticity maps are shown to be important in detecting moisture and buoyancy maxima, as well as trigger sources and the orientation of organized thunderstorm development. Along with convergence fields on lower (and divergence on higher) levels, these fields prove to possess promising forecast value.

IV. ACKNOWLEDGMENTS

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V. REFERENCES

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