CASE STUDY OF THE 20 MAY 2008 TORNADIC STORM IN HUNGARY – REMOTE SENSING FEATURES AND NWP SIMULATION

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(Dated: 15 September 2009)

I. INTRODUCTION

On 20 May 2008 a severe convective system developed over Hungary causing heavy precipitation, strong winds and hail, above all in southern and eastern part of Hungary. Tornado, funnel clouds were reported. Flash floods occurred at some places.

II. SYNOPTIC SITUATION

The synoptic situation was favourable for severe storm development. The thunderstorms occurred in the vicinity of a frontal boundary and low-level line of convergence. The prefrontal southerly flow was moist and unstable with moderate low- and mid-level wind shear supporting generation of both streamwise and crosswise horizontal vorticity.

II. REMOTE SENSING REATURES

The evolution of the system can be followed on METEOSAT rapid scan (5-minute) imagery. The system was long-living; it was active during more than 10 hours. The animations show explosive growth and right moving cells. In radar images 'bow echo' and 'comma' features can be observed. Some of the thunderstorm cells show HP supercell characteristics, e.g. WER-echoes (Fig.1). The lightning activity of the system was extremely high.

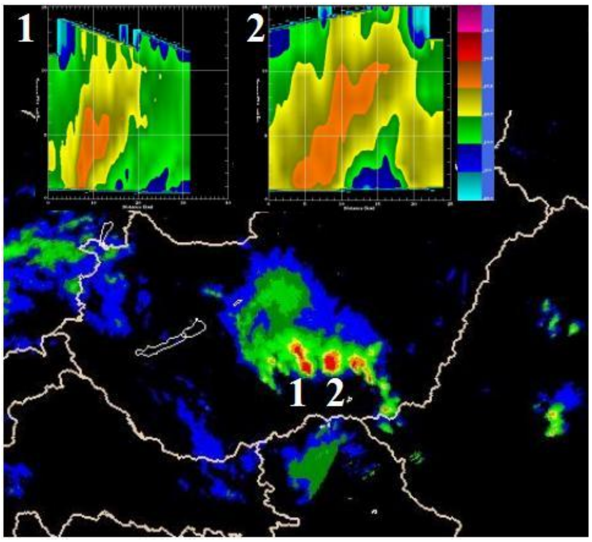

FIG. 1: Radar image from 20 May 2008 at 13:30 UTC. The smaller images above are SW-NE vertical cross-section of cell 1 (12:45 UTC) and W-E cross-section of tornadic cell 2 (13:15 UTC).

Several remote sensing features refer to the severe nature of the storm system. The first cell was a cold ring shape storm (Fig. 2), which developed very fast into a severe storm system also showing cold rings in its later stages.

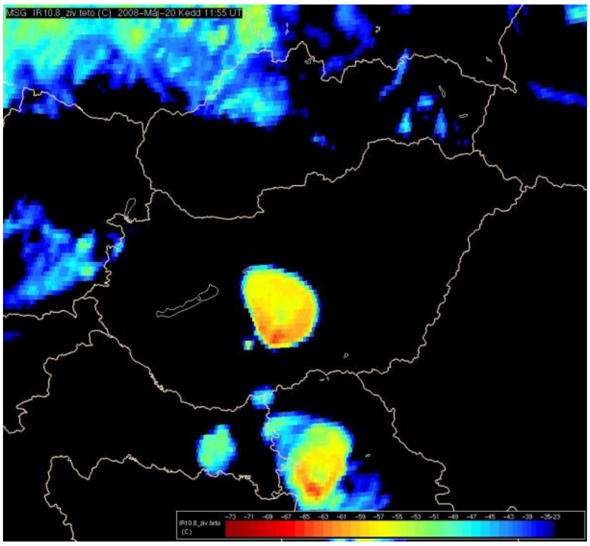

FIG. 2: Meteosat-9, IR10.8 image from 20 May 2008 at 11:55 UTC.

Well expressed overshooting tops, plumes, radial cirrus, gravity waves are present in several HRV images.

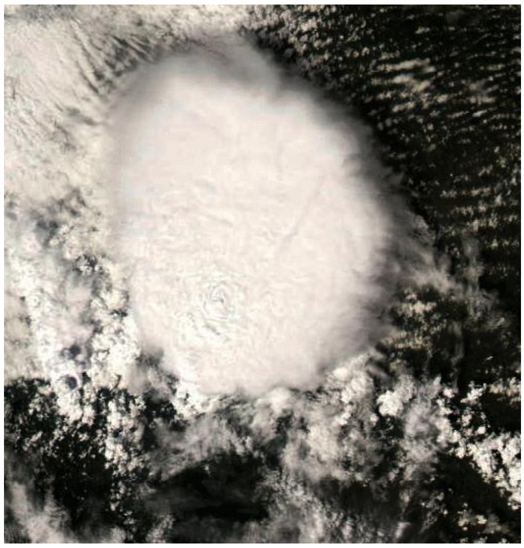

FIG. 3: AQUA/MODIS enhanced true-color RGB image from 20 May 2008 at 11:40 UTC.

The cloud top microphysics was investigated. Both the RGB imagery and the shape of the IR10.8 brightness temperature and effective cloud particle size scatter plot indicate high probability of strong updraft (Lensky and Rosenfeld, 2006).

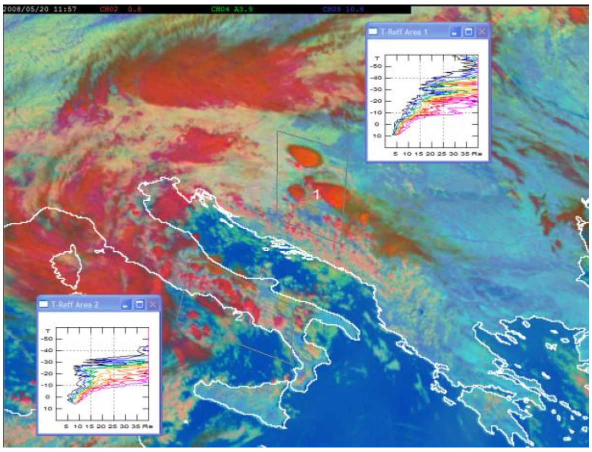

FIG. 4: Meteosat-8, day microphysical RGB image from 20.05.2008 at 11:55 UTC, with IR10.8 brightness temperature and effective radius scatterplot for two subregions.

III. NWP SIMULATION

The convective system was successfully simulated by the MM5 non-hydrostatic model (Dudhia, 1993) operationally used at HMS. The model forecasts at 2.8 km horizontal resolution show evolution of two deep and persistent mesocyclones within the system, which are associated with high vertical velocity and vorticity, both in low- and mid- tropospheric levels (Fig. 5). The simulated cells developed close to the area of the observed thunderstorms. The mesocyclone of the cell on the left side is deeper and at low levels it tends to evolve rather on the east flank of the cell in rain free area. The cell on the right side had a stronger updraft (15 m/s), the centres of the mid- and low level mesocyclones are closer to each other. Later the forecasted system moved eastwards with continuing development of intense thunderstorm cells.

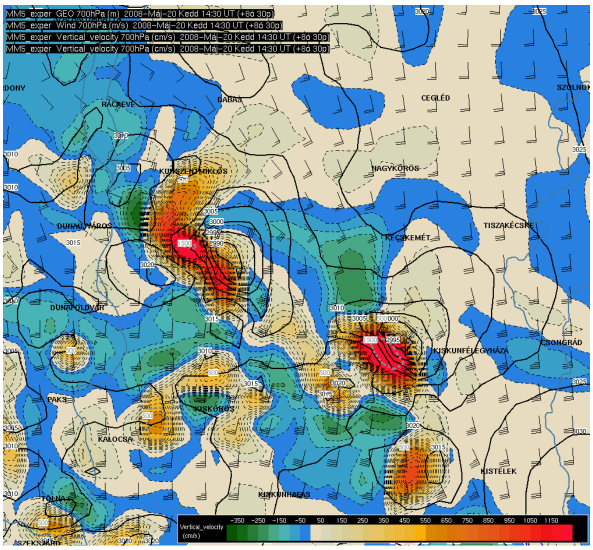

FIG. 5: Forecasts of 700 hPa vertical velocity (color, cm/s), geopotential (lines by 5 gpm) and wind based on 20 May 2008 06 UTC MM5 run, valid for 14:30 UTC.

IV. CONCLUSIONS

Large thunderstorm systems and squall lines propagating towards Hungary from west, southwest, are often associated with severe weather. RGB composites of MSG satellite provide information about the structure and microphysics of thunderstorm cloudiness. High resolution numerical model simulation show the possibility of low-level mesocyclogenesis despite of relatively moderate values of large scale convective indices. This knowledge can help the forecasters to decide for higher degree of weather warnings in similar situations. In the future, a higher resolution nested model run could help to better specify the area and the conditions for potential tornadogenesis.

V. ACKNOWLEDGEMENTS

The authors would like to thank to EUMETSAT for the beneficent training workshops on MSG applications on convection and to the lecturers on these workshops for their valuable instruction as well as to the authors of the MSG interpretation Guide.

VI. REFERENCES

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