THE ANALYSES OF THUNDERSTORM ON 04 AUGUST 2006.

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I. INTRODUCTION

In this work, it is shown development of supercell in convective day during summer 2006 year. It is analysed the environmental condition for severe weather potential over Serbia. Supercell thunderstorm a type on 04. August 2006 in Serbia is determined.

A mesocyclone is an area vertically oriented atmospheric rotation (usually cyclonic) that is most often associated with a localized low-pressure region within a severe thunderstorm. Supercell is steady state rotating convective storms with mesocyclone forming in highly sheared environments. It is a long-lived persistent single cell thunderstorm, that is self-perpetuating and contains a rotating updraft The lifetime of supercell (from 1059 UTC to 1536 UTC) was 4,5 hours, and the cell to track more than 250km territory. The storm motion was about 15ms^{-1}. This supercell produced heavy rain (max 22 l/m^{2} in Belgrade), damaging wind (max 22ms^{-1} in Belgrade) and hail (max diameter of hail stone 3,5cm).

II. PRESENTATION OF RESEARCH

The data for analysis this supercell are: sinoptical chards, Belgrade sounding and hodograph, meteorological measurements from RHS, and radar images.

During two days before 04 August 2006 Serbia was under the influence of cold front passage. A warm front attached to the system was extending over middle Europe on 04. August. The centre of low pressure was in middle Adriatic see (Fig 1).Baroclinic boundary was favourable for supercell generation as had been seen in literatures (Markovski and Ramussen etc, 1997) It was environment conditions for severe weather. The initial cell gradually evolves into a small cyclonic supercell which strengthens after 2 hours. However, the vertical wind shear was strong relative to the cold pool circulation to promote sufficient lifting for repeated cell growth along the gust front. As was seen from radar (Gematronic) single cell developed in Bosnia (on the boundary with Serbia) and crossed into Serbia, where evolved into supercell.

The hodograph curvature was typical of a right-moving supercell and vertical wind shear in first 6km was found to be of strong intensity (24.7m/s; Fig 3). Boundary layer to 6 km shear relates to storm organization and mid-level rotation potential. Lifting Condensation Level (LCL) height (389 m) relates to increases low-level humidity and a reduction in the potential for low-level cold pooling. Convective Inhibition (CIN=110 Jkg^{-1}) and Level of Free Convection (LFC=737 m height) relate to the depth of a stable layer in the low-levels and weather the environment is near surface or significantly “elevated”. Storm Relative Helicity (SRH=167m^{2}s^{-2}) was moderate intensity. Convective Available Potential Energy (CAPE) values calculated from Belgrade sounding on 12 UTC (Fig 2) (CAPE= 610 Jkg^{-1}) together with Energy Helicity Index (EHI=0.64) and stability index (Lifted Index LI= -3.42 ºC , Total Totals index TT=50.2 ºC) showed moderate instability. The hodograph showed strong deep-layered wind shear supportive of rotating. CAPE is important because it defines how vigorous the updrafts within any particular storm-complex potentially are. Shear defines what happened to the updraft as it develops, and also governs the interaction between the storm downdraft and the storm inflow environment .SRH is a measure of the potential for cyclonic updraft rotation in right-moving supercell, and support supercell rotation. CAPE and wind-shear determined whether rotation will occur in thunderstorm, and what type of storm will occur. The storm environment characterized by strong, deep-layer shear and reduced CAPE, was conductive to mini supercell and mesocyclone development. The stability index from the sounding at 12 UTC did not good represent for environmental conditions that day, because it could not modify using winds, temperatures and dew points expect to occur, at the surface and upper level. Instability index was like as mini supercell and a modest CAPE value, may be misleading. The hodograph and storm relative winds from 9-11 km (≈ 17ms^{-1}) indicated that the classic supercell type was expected. The radars measurements were confirming these hypotheses.

Classic supercells usually develop inflow region, and rear flank downdraft (RFD). They may take an hour or more from several successive mesocyclones. They then dissipate and sometimes become part of multicell complex. The supercell developed on 04. August permitted track more than 250 km. The specific mesoscale features and dynamics probably contributed to this supercell´s longevity.

Classic supercell usually has some precipitation only in forward flank downdraft (FFD). FFD air was frictionally dragged down in cloud and evaporatively cooled air below cloud base, and formed gust front that spreaded outward.

Images from the radar station Samos near Belgrade showed typically supercell characteristics (Lemon and Doswel, 1979), such as WER (Weak Echo Region) as seen in Fig 4a , BWER (Bounded Weak Echo Region), hook echo and downwind with V-notch (Fig 4c). In Fig 4b can be seen (on the vertical cross-section at 1423 UTC) BWER with precipitation around updraft core thus producing a region of closed reflectivity around the updraft. A hook echo (Markovski, 2001) at the southern part of the cell could be noted at 1511 UTC (Fig 4c). Without Doppler Weather radar velocity images it was not possible identified the existence of mesocyclon. On the Fig 4c the reflectivity V-notch was still present. This was an identification of divergent flow around a powerful updraft. Classic supercell generate enough precipitation to be able to produce enough downdraft for a moderately strong outflow. Heavy precipitation (>50dBZ) within the hook can favour a severe RFD through precipitation loading and evaporation cooling.

III. RESULTS AND CONCLUSIONS

On 04 August 2006 classic supercell was developed and in addition to the supercell activity, heavy rain and hail up to 3.5 cm in diameter with damaging wind was reported during

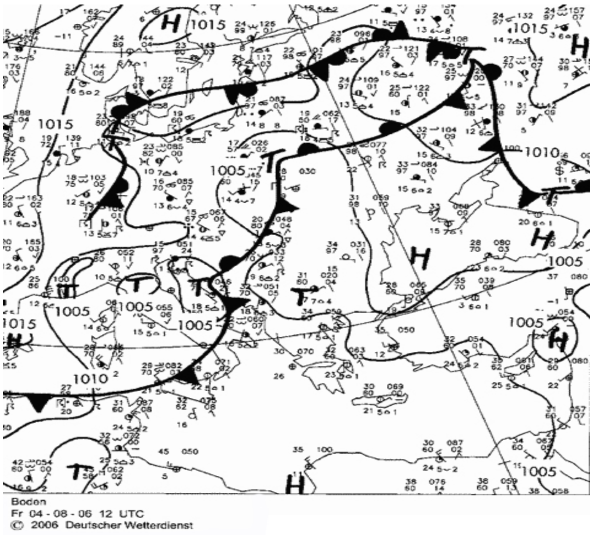

FIG. 1: Ground level synoptic chard on 04 August 2006 at 12 UTC

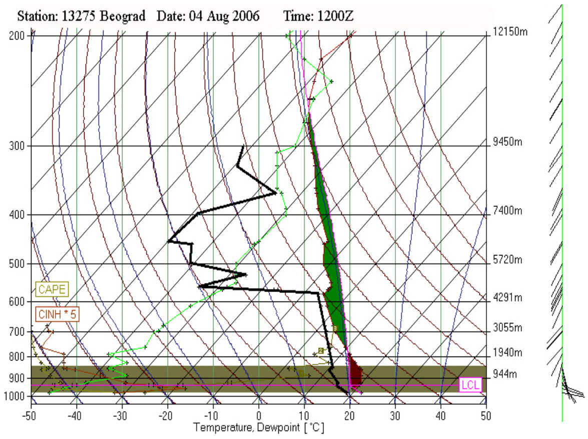

FIG. 2: Sounding for 12 UTC 04 August 2006 over Belgrade

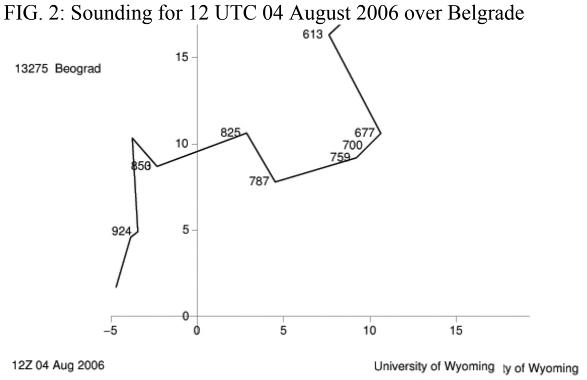

FIG. 3: Hodograph on 04 August 2006. 12 UTC. Belgrade sounding data.

this severe weather outbreak. It is very important to pay attention on environmental conditions (winds aloft and the shape of the hodograph), an evaluated assessment of potential supercell evolution can be accomplished. The radar meteorologist can focus his attention on the relevant portion of the storm looking for classic structures such as rotation aloft, hook echoes, WER, BWER. It is essential to determine the environments in which supercells developed in Southeast Europe and certainly to determine the parameter thresholds valid for those cases.

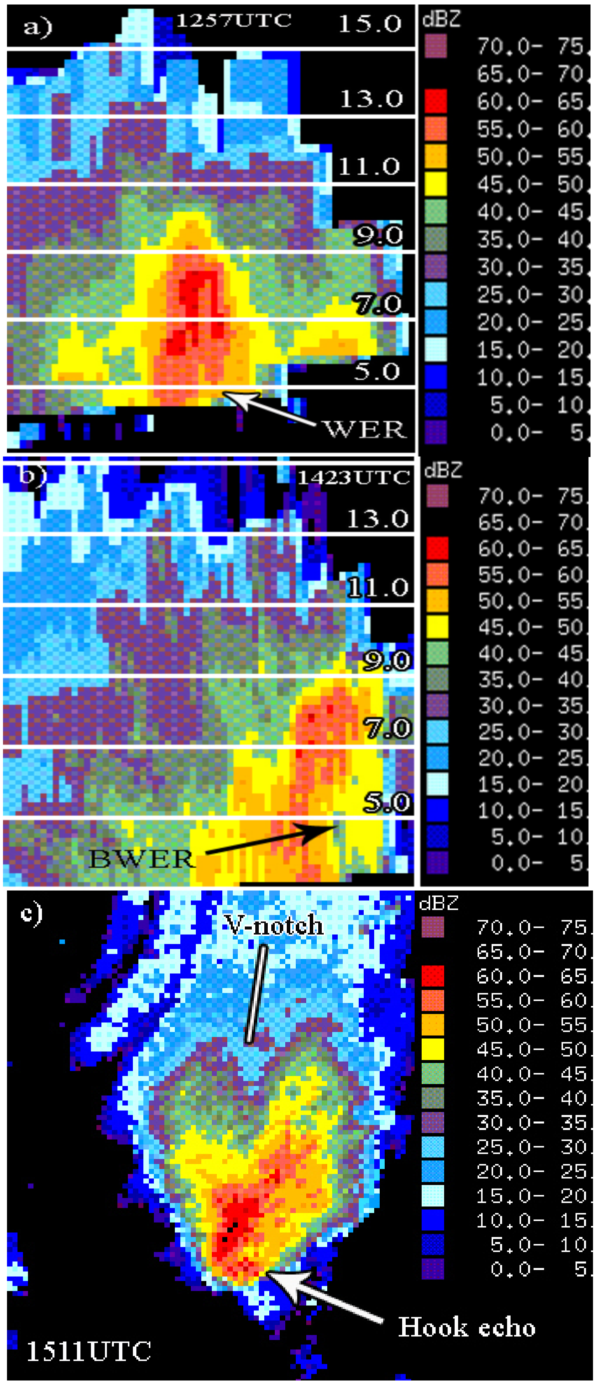

FIG. 4: RHI (a,b) and CAPPI (c) radar image cross-sections taken from radar centre Samos on 04 August 2006

V. REFERENCES

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