

Analysis of Tornadoic Storm in Southern Moravia on 24th June 2021 Based on Polarimetric Doppler Weather Radar and Lightning Detection Data



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I. Tornado ground track and basic facts

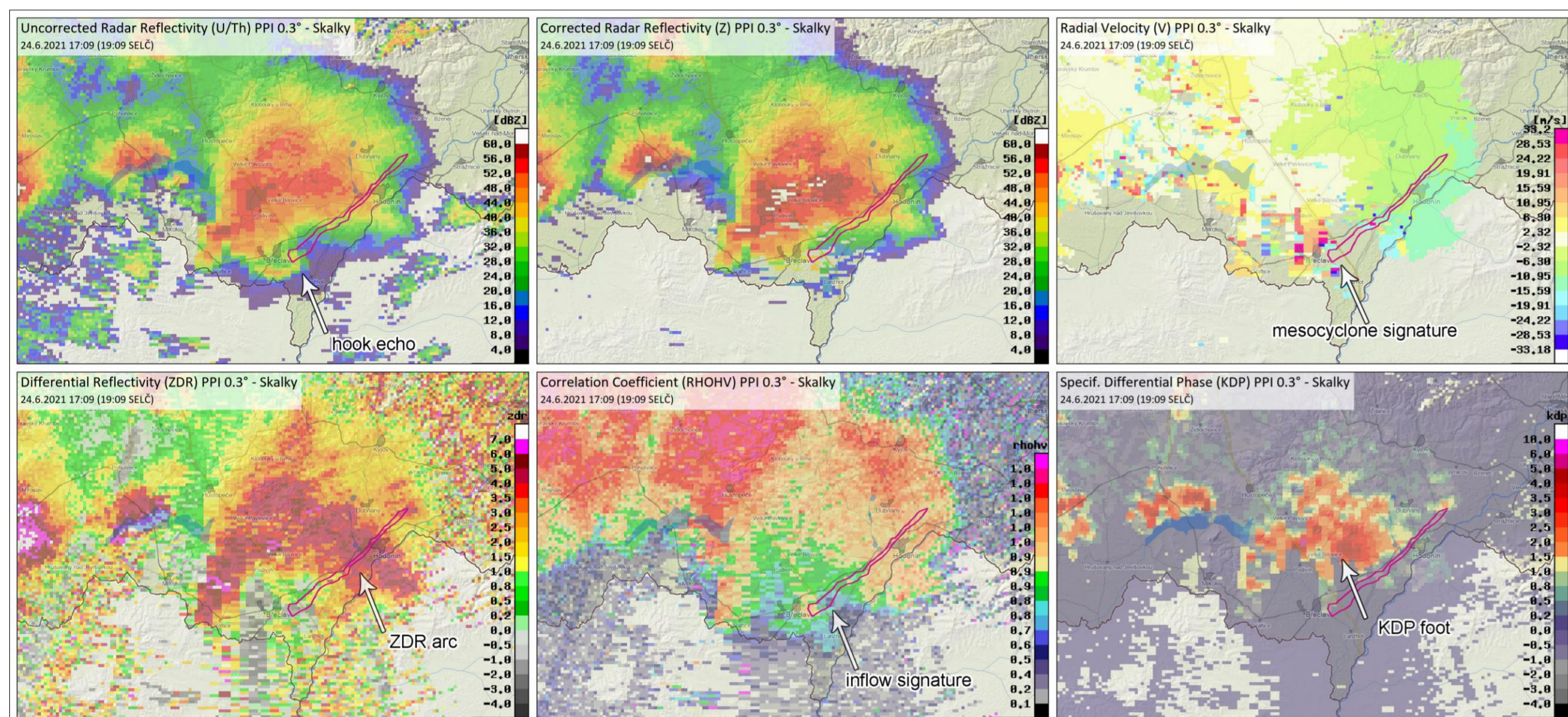
- ✓ Tornado duration: ≈ 17:14 – 17:53 UTC
- ✓ Maximum intensity: F4 (IF4)
- ✓ Damage swath length: ≈ 27 km
- ✓ Damage swath width: up to ≈ 2.5 – 3.5 km
- ✓ A total of 6 people died, and about 250 were injured (directly by the tornado)
- ✓ A total of ≈ 200 houses or buildings out of about 1200 were damaged by the tornado and had to be torn down
- ✓ Total damage is estimated to be 600 Million €, the tornado is the thirdmost devastating weather-related event in the history of Czech Rep., right after the 2002 and 1997 floods
- ✓ Supercell produced giant hail up to ≈ 9 – 12 cm in diameter



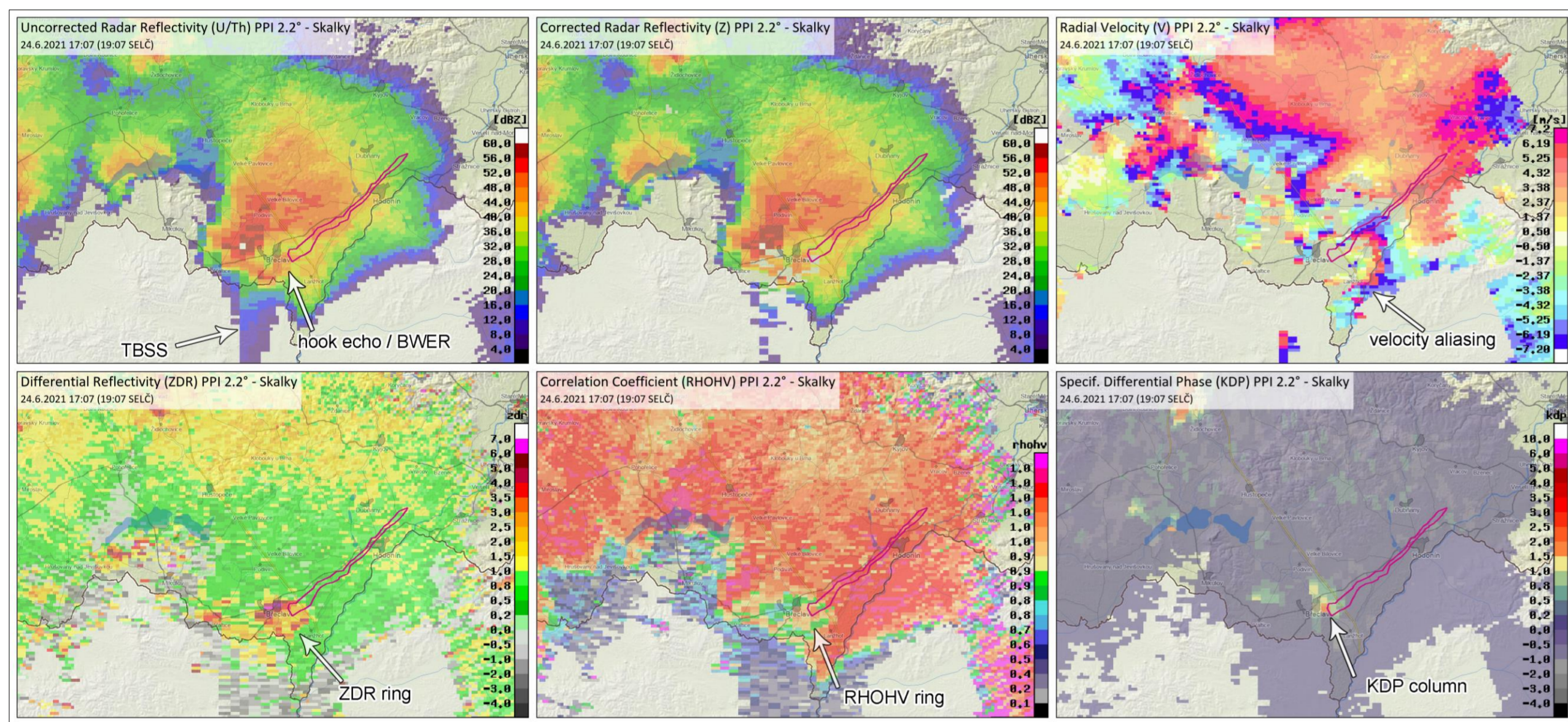
Photo of the tornado

III. Dual polarization radar signatures

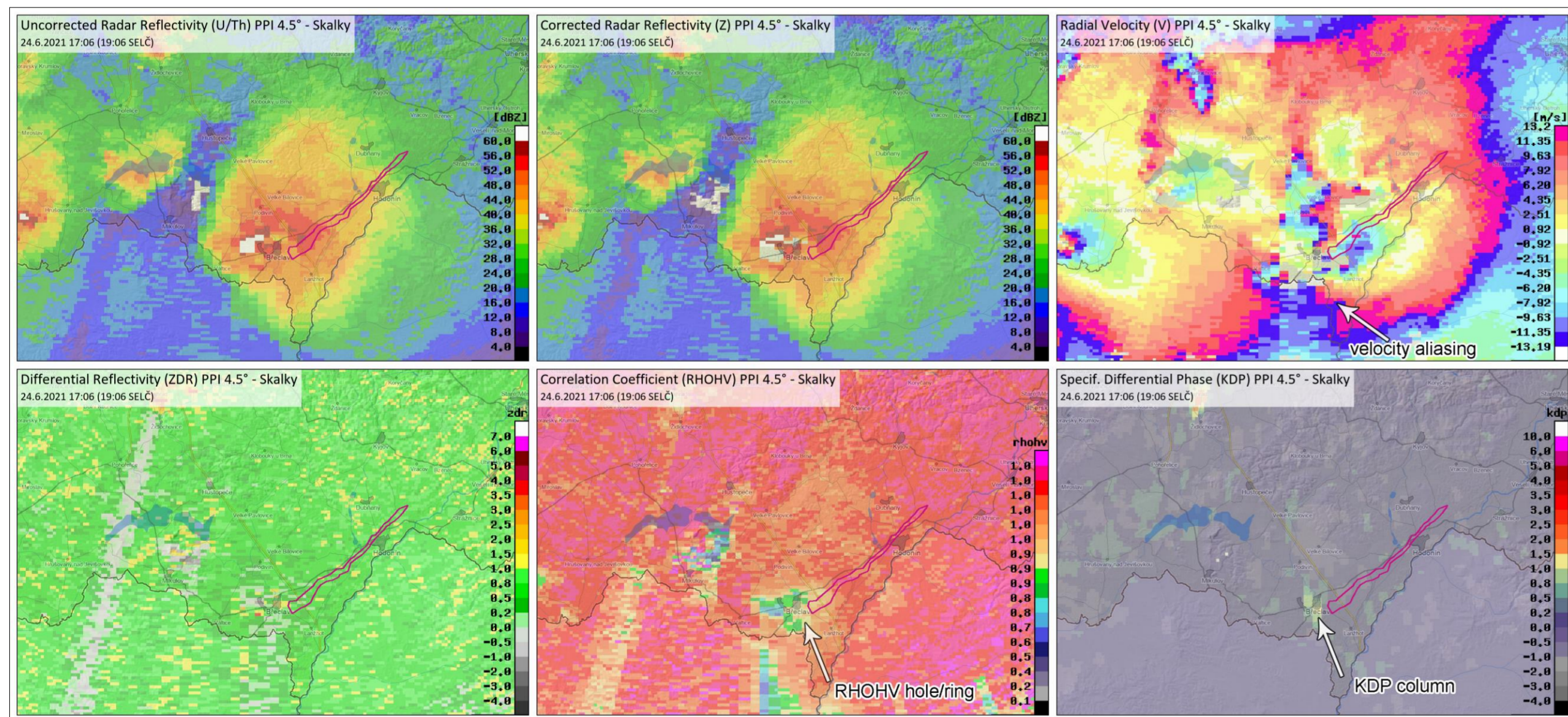
- ✓ PPI 0,3° - low levels ≈ 1.5 km a.s.l.



- ✓ PPI 2,2° - mid levels ≈ 4.25 km a.s.l. (≈ 0°C isotherm)

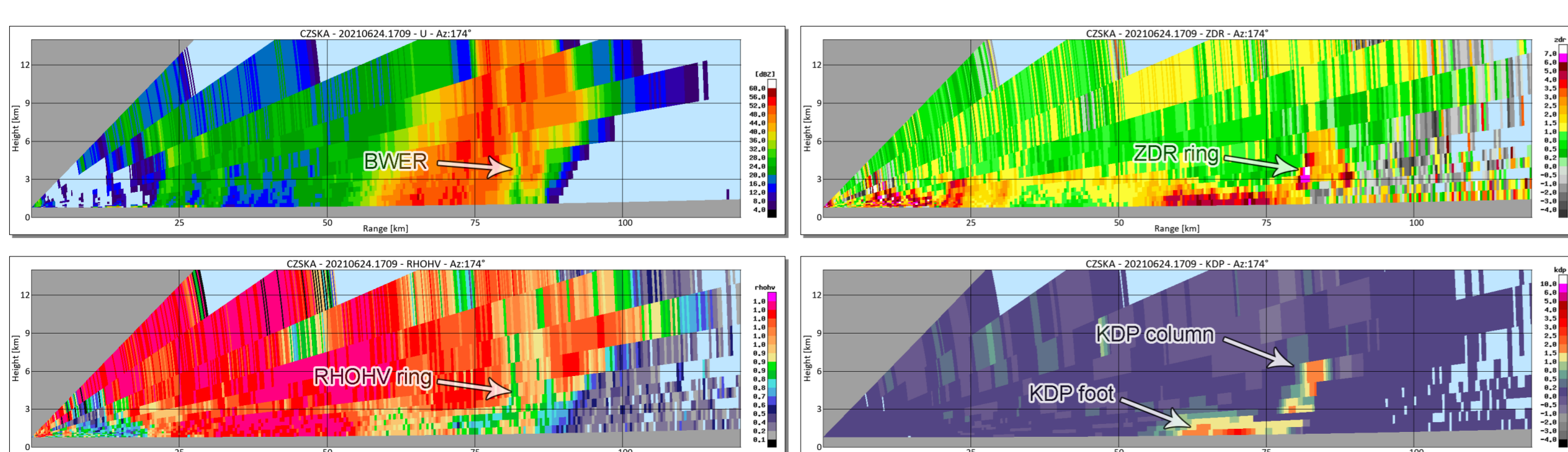


- ✓ PPI 4,5° - upper levels ≈ 7.5 km a.s.l.



PPI displays of selected radar moments (uncorrected reflectivity U, corrected radar reflectivity Z, radial velocity V, differential reflectivity ZDR, correlation coefficient RHOHV, specific differential phase KDP) at 3 different elevations from 24.6.2001 17:06 -17:09 UTC. Magenta line shows the area of ground damage.

- ✓ Vertical cuts



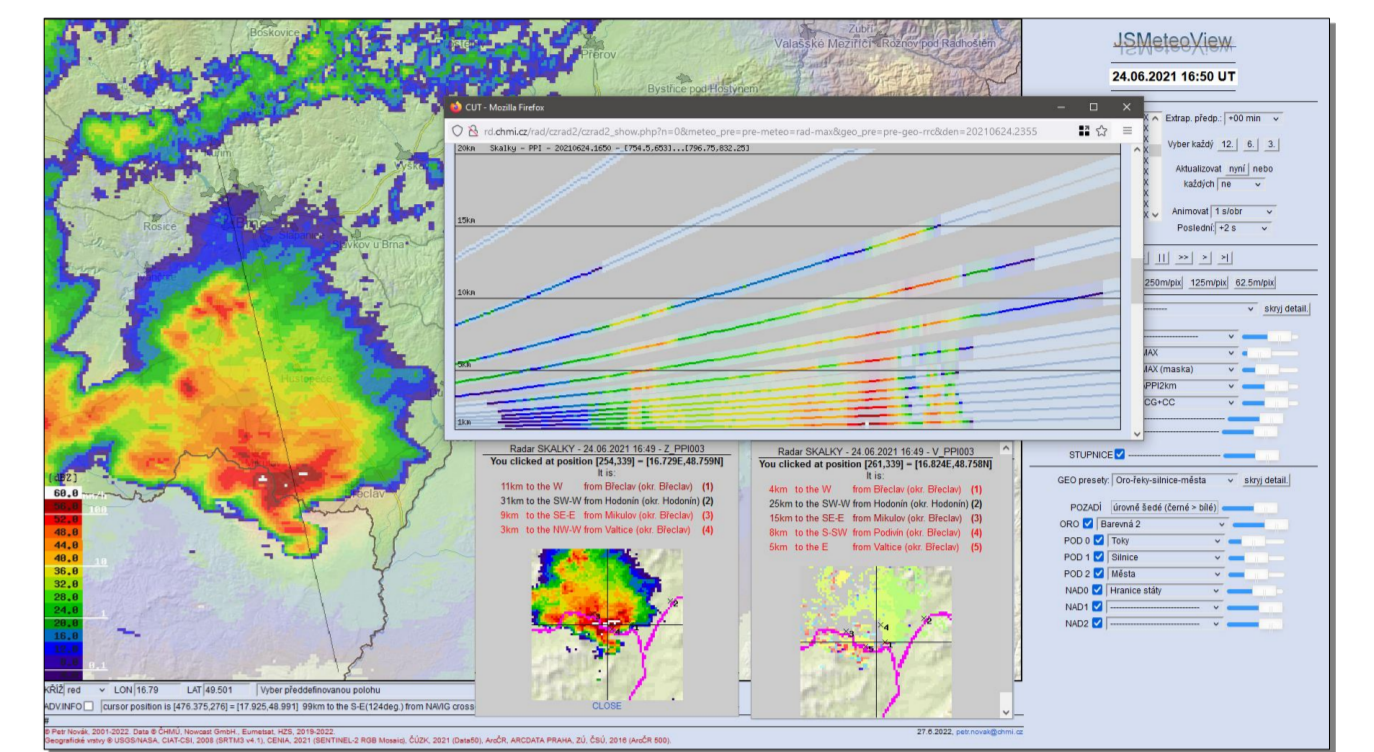
Vertical cuts through the storm mesocyclone. Vertical cuts generated from main volume scan: uncorrected reflectivity U (upper left), differential reflectivity ZDR (upper right), correlation coefficient RHOHV (lower left) and specific differential phase KDP (lower right) from 24.6.2001 17:05 -17:09 UTC.

II. Radar and lightning data

- ✓ CZRAD - two dual polarization Doppler weather radars Vaisala WRM-200 operated by the Czech Hydrometeorological Institute (CHMI). Skalky radar approx. 80km to the North from the tornado occurrence.
- ✓ LINET – lightning detection network operated by Nowcast GmbH. Data from Czech Republic and close surrounding area are available in the CHMI on the basis of a commercial contract.

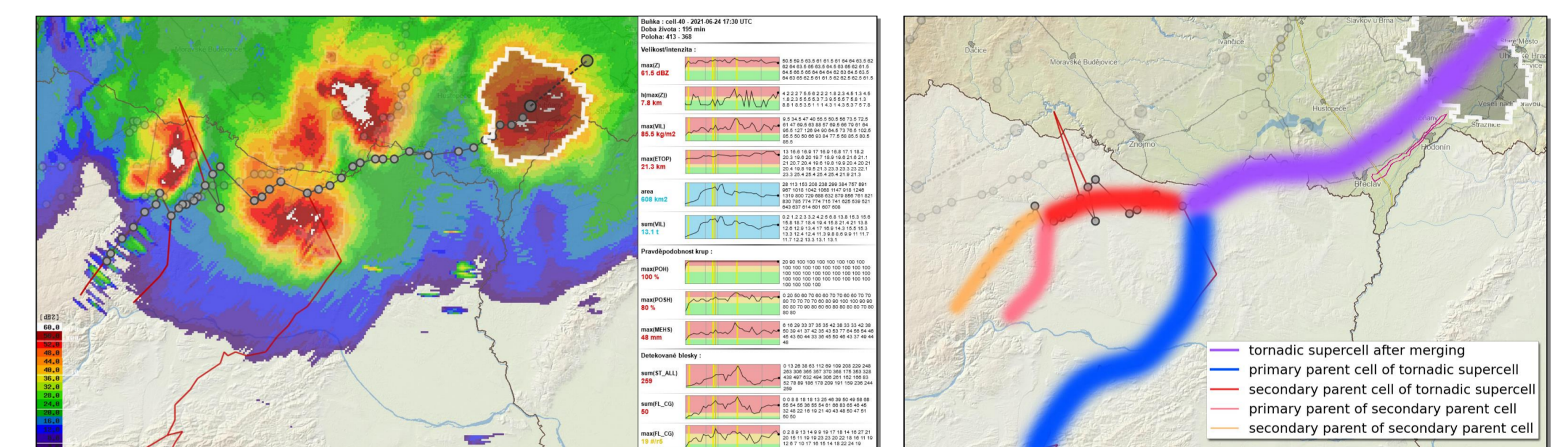


Tornado damage



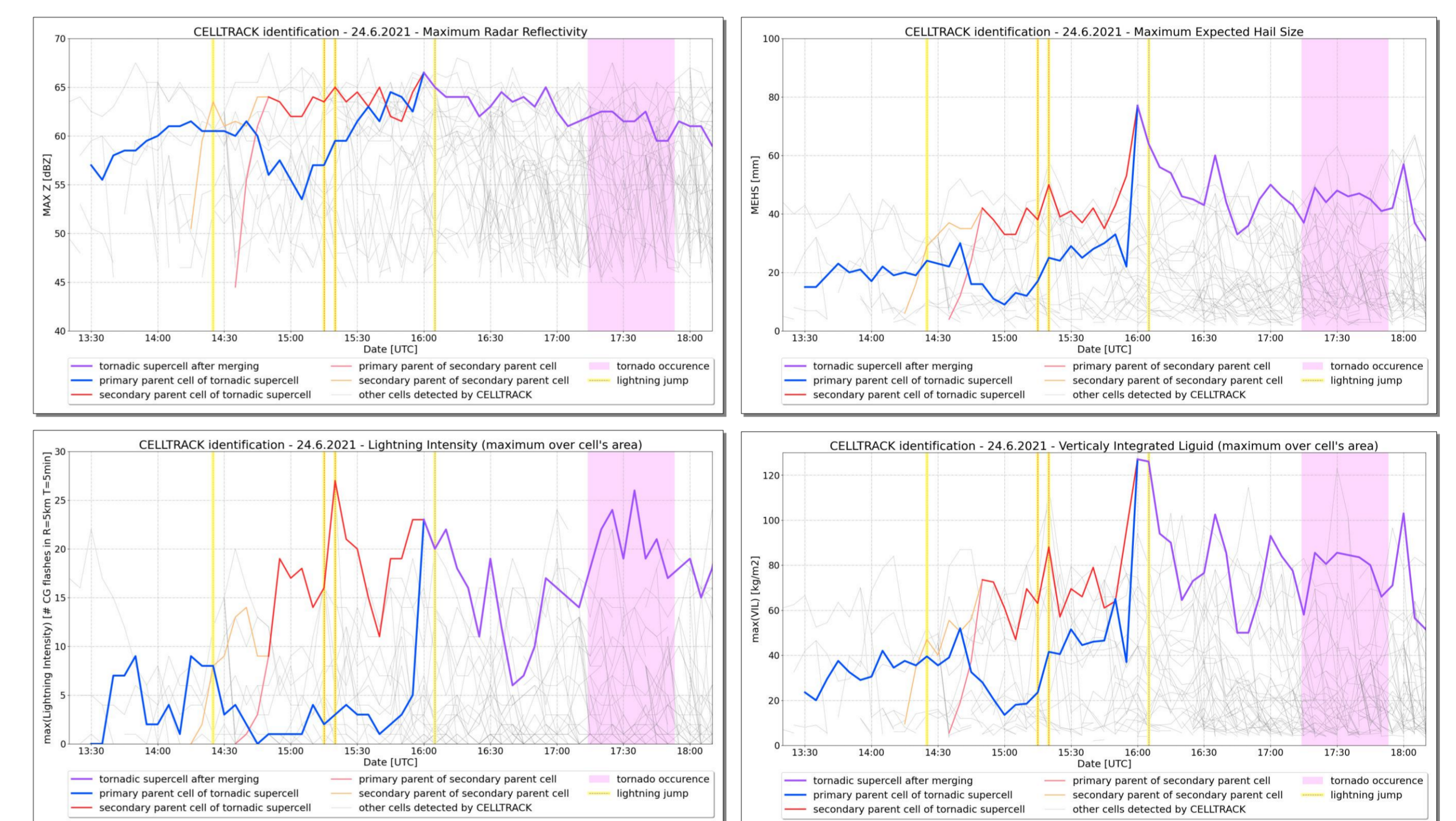
Operational radar data display

IV. CELLTRACK – convective storms detection and tracking



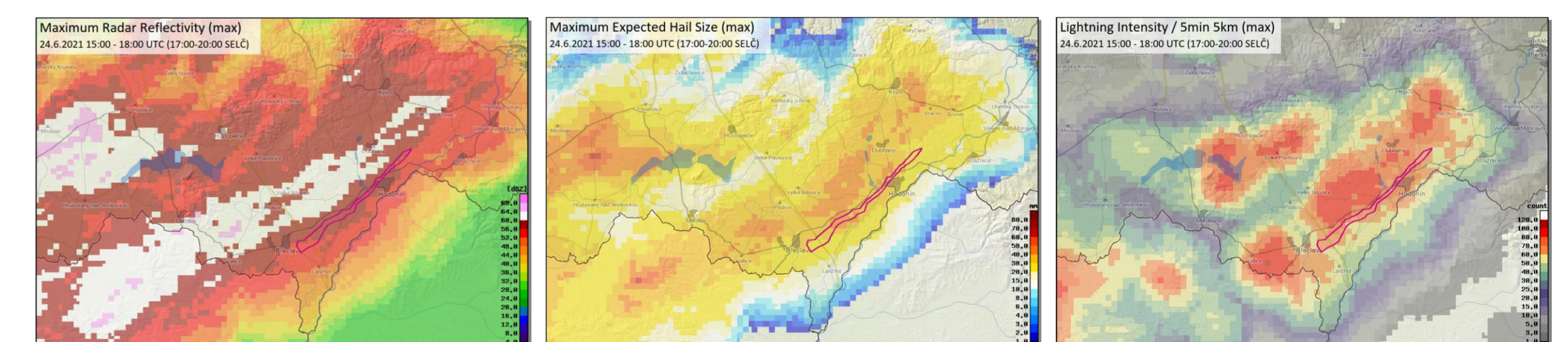
Example of operational CELLTRACK display

Schematics of tornadoic storm evolution



Evolution of selected radar and lightning parameters of tornadoic storm and all other identified CELLTRACK cells.

V. Aggregations



Radar and lightning data aggregations – magenta line shows the area of ground damage.

Summary

- ✓ Modern dual polarization Doppler weather radars of the CZRAD network enable measurements of various radar quantities in addition to horizontal radar reflectivity. Quality of most of these quantities is reasonably good.
- ✓ Dual polarization radar data together with nowcasting tool CELLTRACK and advanced visualization tools enable detailed analysis of severe convective storms.
- ✓ Main radar scan, focused on quality of reflectivity data, measures radial velocity data with a rather low maximum unambiguous velocity. A specialized Doppler velocity scan is performed every 10 minutes. More high quality Doppler velocity data would be appreciated by the forecasters but this is in conflict with other users' requirements. A study is planned on how to improve Doppler velocity data of the main scan while maintaining extent and quality of reflectivity data.
- ✓ Lightning data provide useful additional information. Derived lightning jump product has been evaluated only qualitatively. More thorough evaluation is needed.