Occurence of supercells in Slovakia in 2000 - 2012

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Using the Doppler radar network of Slovak Hydrometeorological Institute, we investigated the occurrence of supercells in Slovakia in the period between 2000 and 2012. To detect supercells, we used both direct (mesocyclone detection) and indirect methods, which involve interrogation of typical radar features associated with supercells, such as WER, BWER, hook-echoes, overhang, splitting or typical movement. On average four days per year with supercells were found for the investigated period. Unfortunately, radar data is not completed (mainly in the first 6 years), thus statistics likely underestimate the actual number of supercells in Slovakia. Occurrence of supercells is strongly inhomogeneous over Slovakia, with eastern part exhibiting more cases than the rest of the country, as well as higher frequency of conditions favourable for supercells. We looked at the synoptic-scale conditions that are associated with development of supercells over Slovakia, too. Only a few cases have been documented as they occured multiple years before this research even started.

Typical synoptic conditions

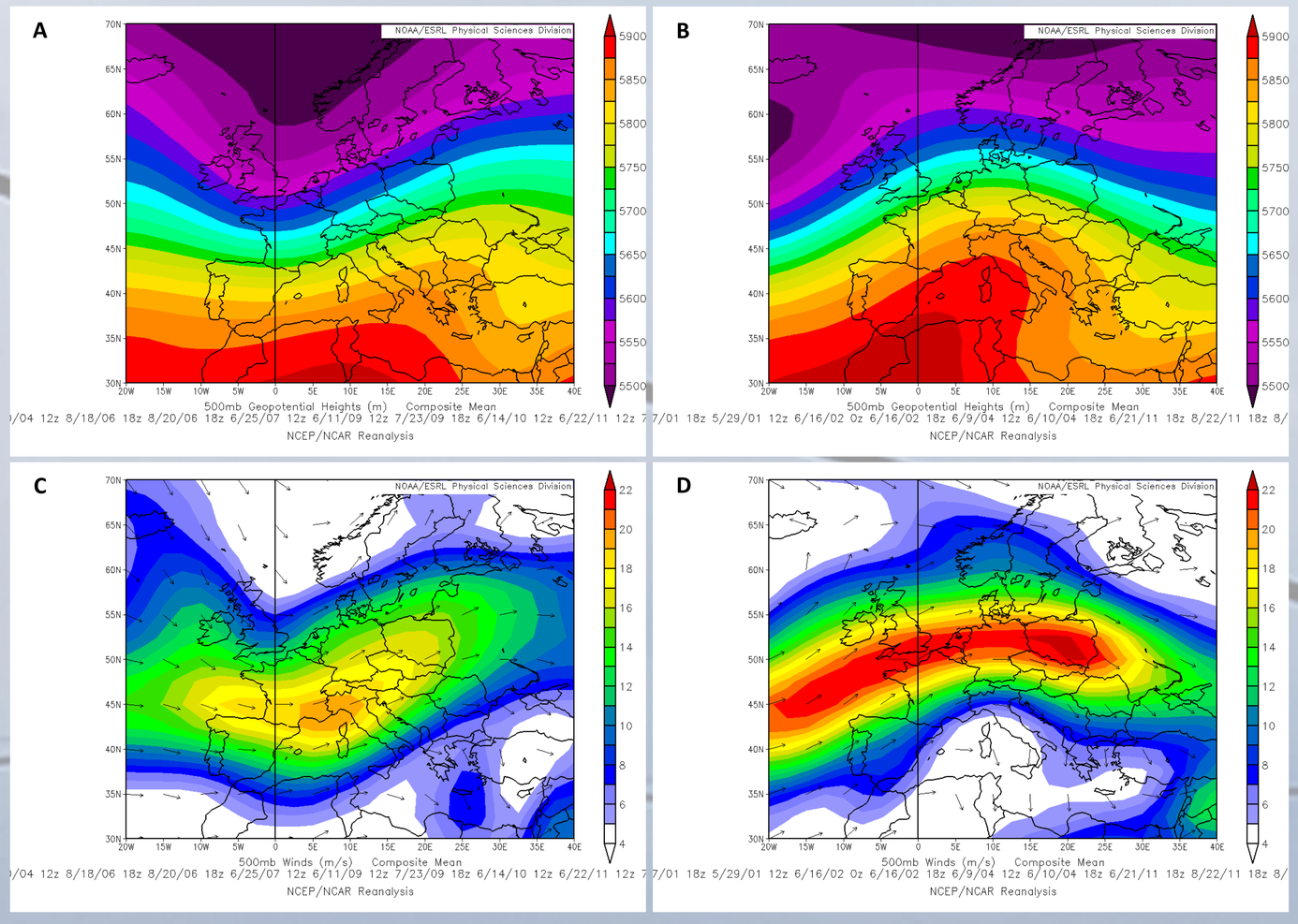


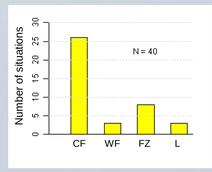
Fig. 1 – Typical synoptic-scale patterns associated with development of supercells over Slovakia. The front of upper level trough with southwesterly flow over Slovakia (A, C); and northern-northeastern edge of upper level ridge (B, D).

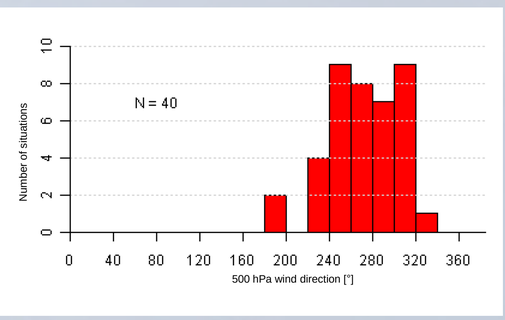
Statistics

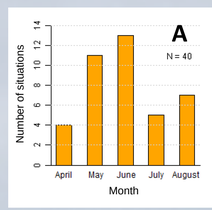
Fig. 2 (right) – Wind direction at 500 hPa for the supercell situations. None of them was found in easterly flow.

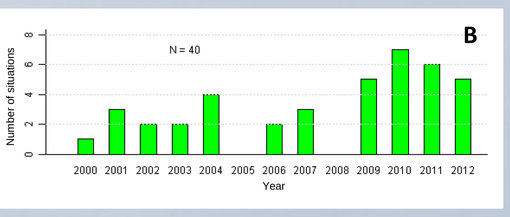
Fig. 3 (right) – Most supercells developed near a cold front (CF), fewer cases were associated near warm front (WF). Some cases were not associated with a front – upper-level frontal zone (FZ) and upper level low (L).

Fig. 4 (right) – Annual an monthly occurence of supercells. Typically, only 3-4 days with a supercell per year were found. Most of situations were found in May and June.









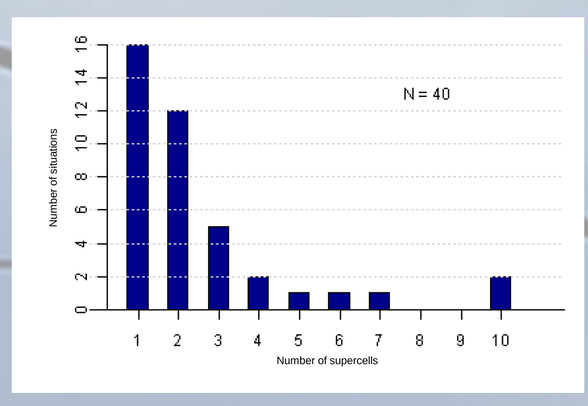


Fig. 5 – Number of supercells detected in one day. Usually, only one to two supercells occur on a given day.

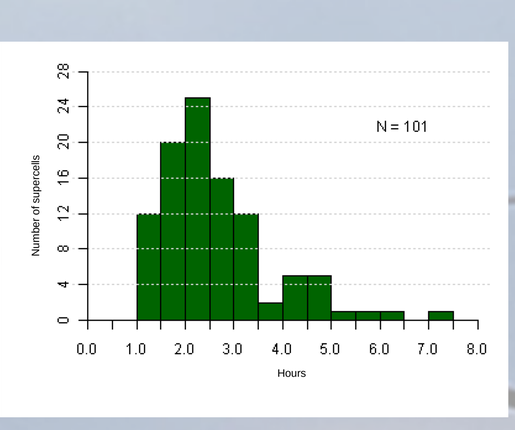


Fig. 6 – Typical lifespan of supercells is 2-2.5 h.

Regional differences

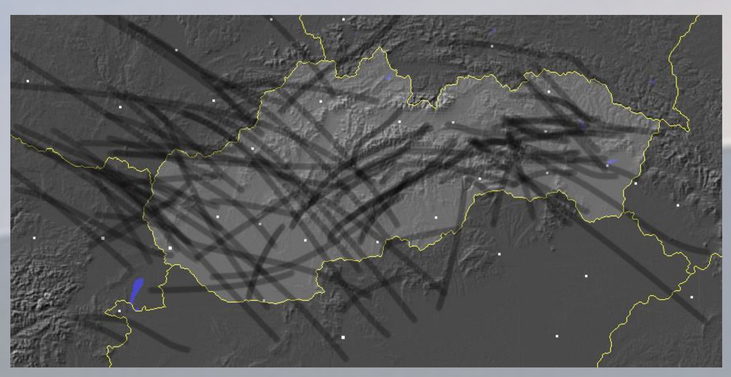


Fig. 7 (left) – Trajectories of supercells (only right-movers). Most supercells occur in eastern Slovakia.

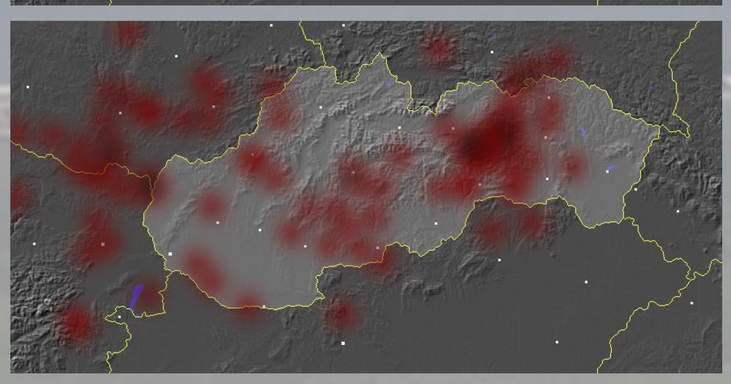


Fig. 8 (left) – Location of origin of supercells, mostly in eastern Slovakia in basin Hornádska kotlina and mountains Branisko and Volovské vrchy.

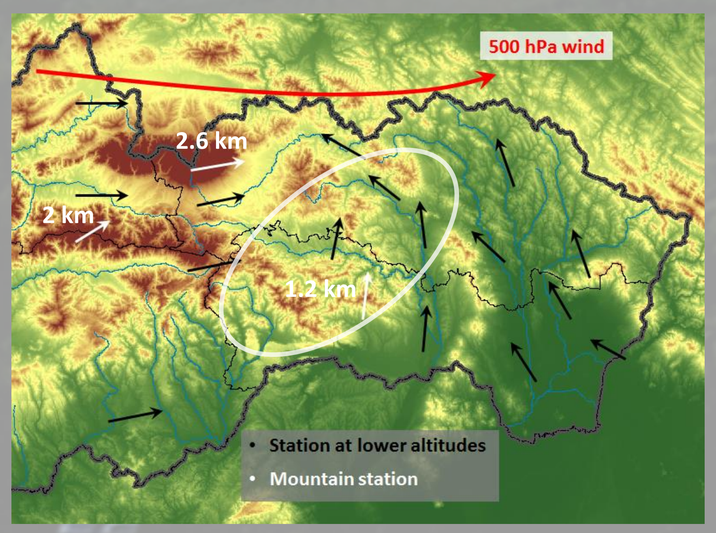


Fig. 9 (right) – 10 m wind direction associated with supercell development over eastern Slovakia.

Change of lower tropospheric flow frequently occurs ahead of the approaching front due to the orography, increasing the deep-layer shear in this region.

Extreme season 2017

Statistics

- 25 days with a supercell
  - Most of them in June and July
- More than 50 supercells
- Agreement with other statistics above

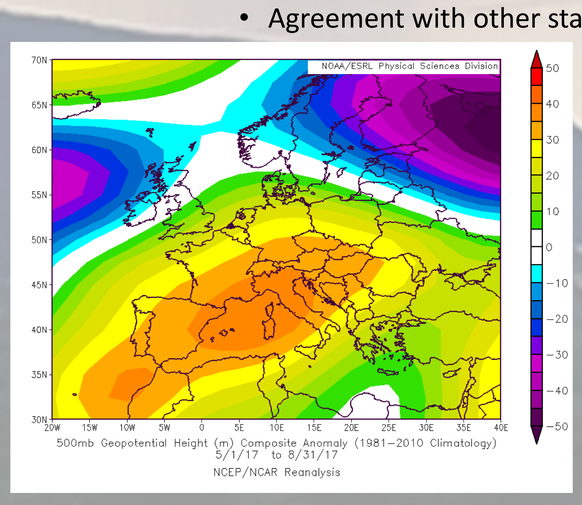


Fig. 10 – 500 hPa anomaly, may – august 2017.

Severity

- At least 75 % severe cases
  - 50 % with heavy rain
  - 33 % with large hail (bigger than 2 cm)
  - 33 % with severe wind damage

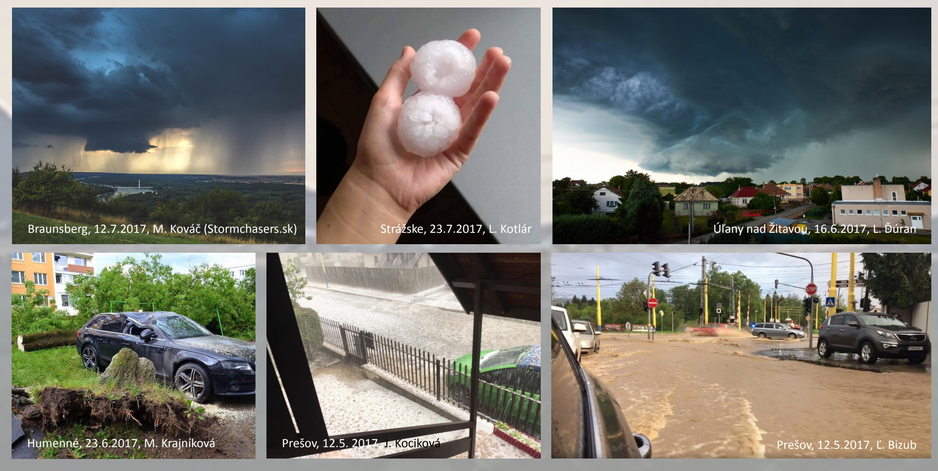


Fig. 11 - Severe weather and clouds associated with supercells in season 2017.

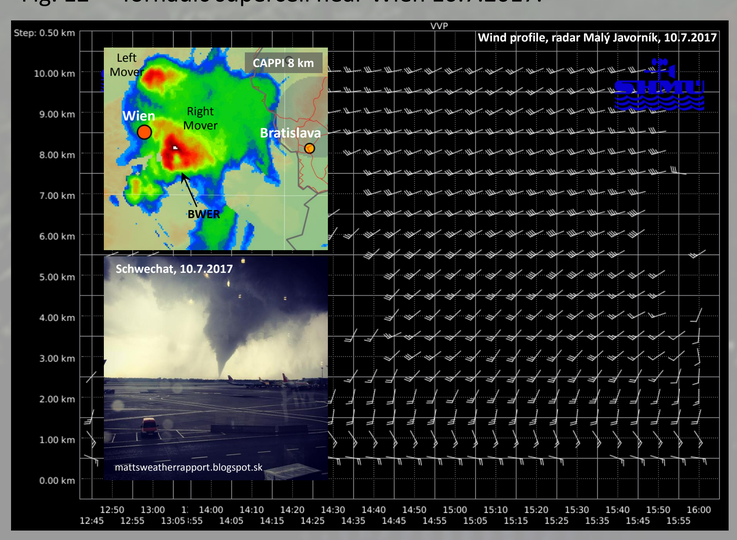


Fig. 12 – Tornadic supercell near Wien 10.7.2017.

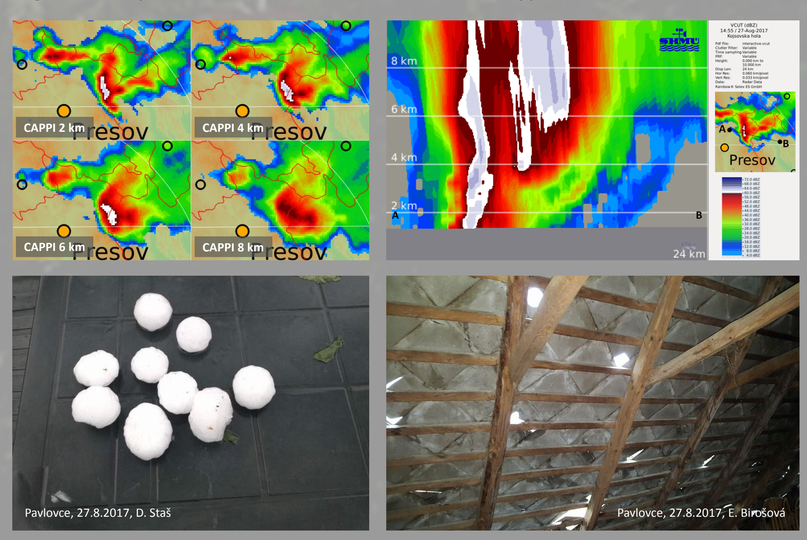


Fig. 13 – Supercell near Prešov 27.8.2017 with typical radar features.