SEVERE STORM PREDICTORS – CAPABILITIES OF REMOTE SENSING IN CENTRAL EUROPE

Michaela Valachová[1, 2], Patrik Benáček[1, 2], Hana Kyznarová[3]

1/ Central Forecasting Office, Czech Hydrometeorological Institute, Prague, Czech Republic
2/ Department of Atmospheric Physics, Faculty of Mathematics and Physics, Charles University, Prague
3/ Radar Department, Czech Hydrometeorological Institute, Prague, Czech Republic
michaela.valachova@chmi.cz

REASONS

Electrification, dynamics and microphysics of a cloud are connected → changes during the storm life-cycle are visible in all remote sensing data.

Is it possible to observe differences between ordinary and severe convective storms?

Are we able to reveal the potential of a severe storm already in the early stages of its development?

What data from remote sensing are the most important for determining the storm hazard?

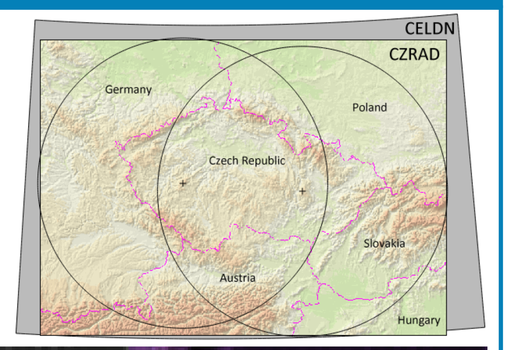
DATA

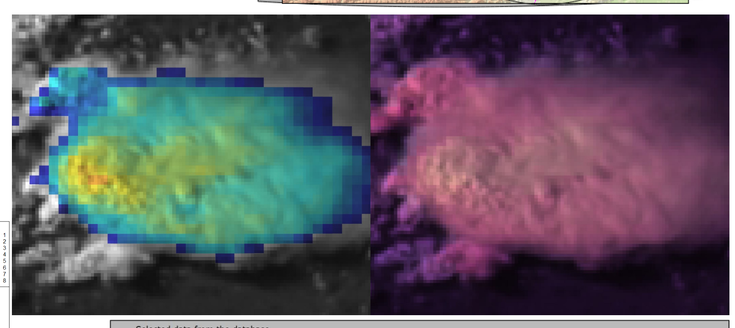
Isolated storm selection

- at least 5 strokes over the Czech Republic
- CELLTRACK algorithm (30 dBZ threshold)
- cases studied individually and manually

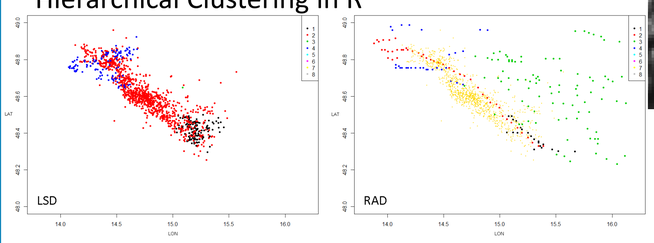
Remote sensing available every 5 min

- radars CZRAD
- lightning detection CELDN
- MSG satellite (Rapid Scan)
- processed in R and McIDAS-V



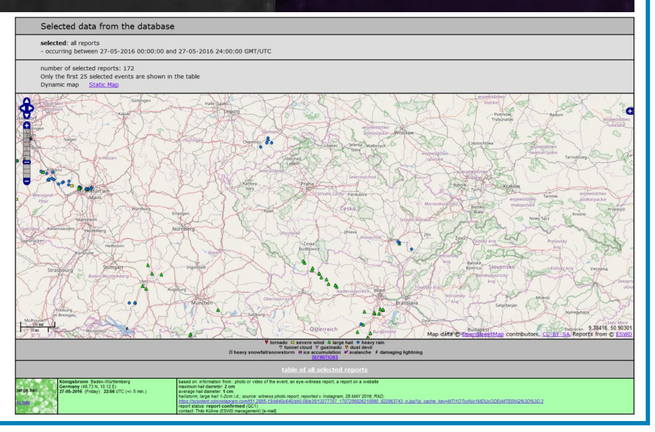


Hierarchical Clustering in R



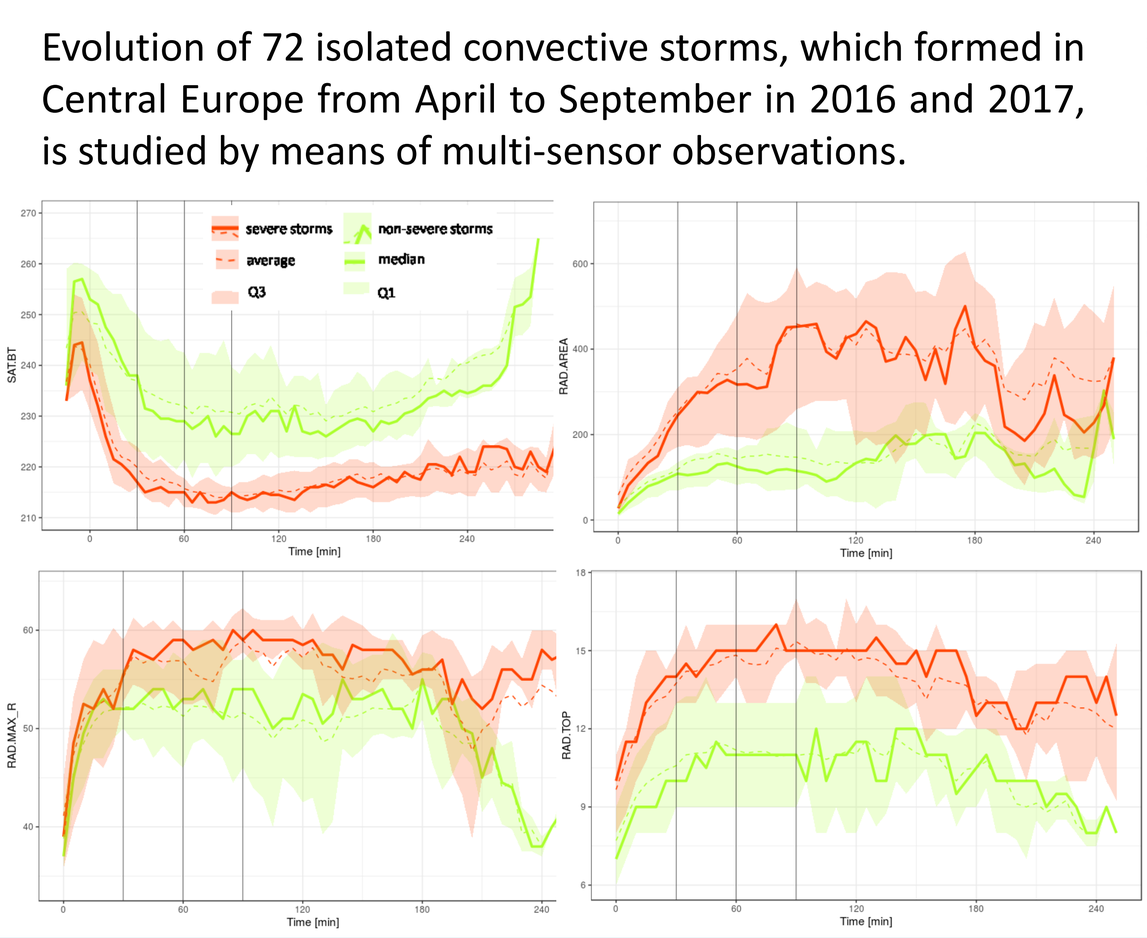
Severe weather reports

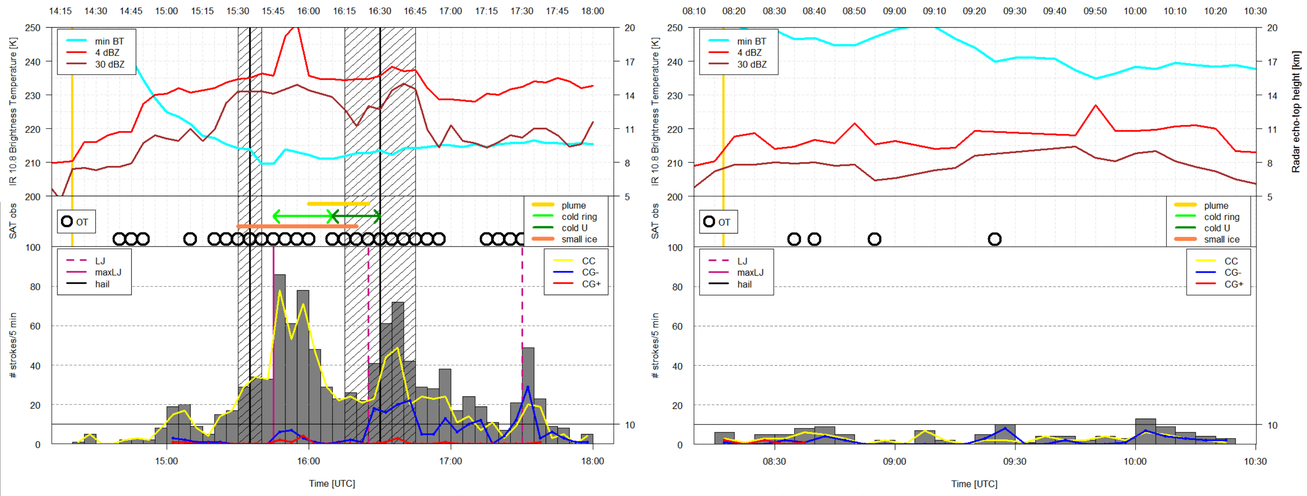
- ESWD operated by ESSL
- large hail, heavy rain, tornadoes
- quality control (QC0+, QC1, QC2)
- time uncertainty up to 15 min



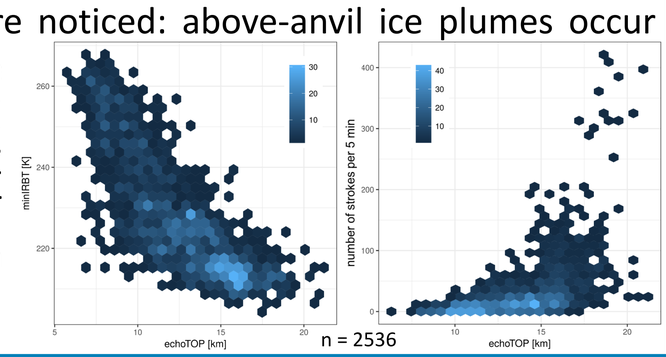
OBSERVATIONS

Evolution of 72 isolated convective storms, which formed in Central Europe from April to September in 2016 and 2017, is studied by means of multi-sensor observations.





Statistically significant differences essential for the storm nowcasting are observed between severe and non-severe storms. Each storm has its complex evolution, but some commonalities are noticed: above-anvil ice plumes occur close to the max stroke rate, the course of the stroke rate is usually well synchronized with the max 30dBZ height, radar echo-tops or IR10.8 BT cooling. Relations are confirmed also in every measurement from all cases.

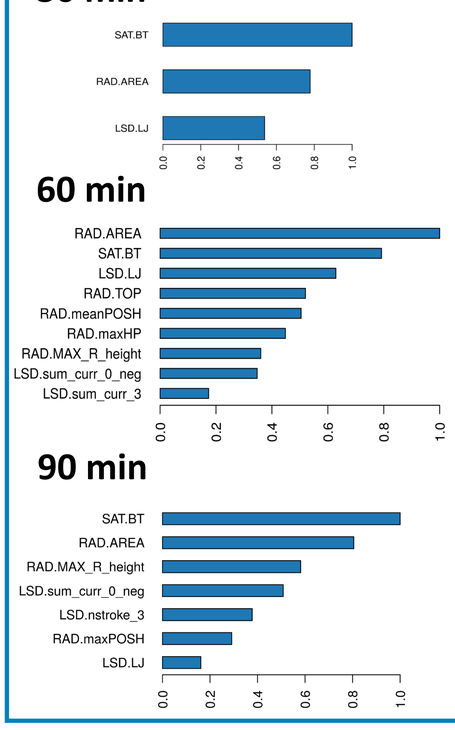


REGRESSION MODELS

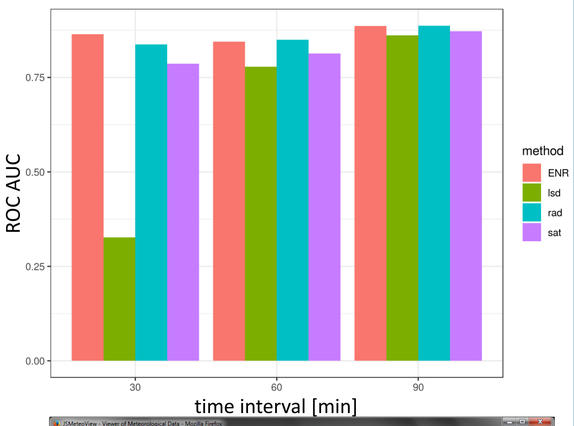
- in total 81 variables, 72 storm cases
- 3 logistic regressions (RAD, SAT, LSD) and Elastic Net (all variables together)
- 3 time periods: 30, 60 and 90 min

RESULTS

Variable Importance

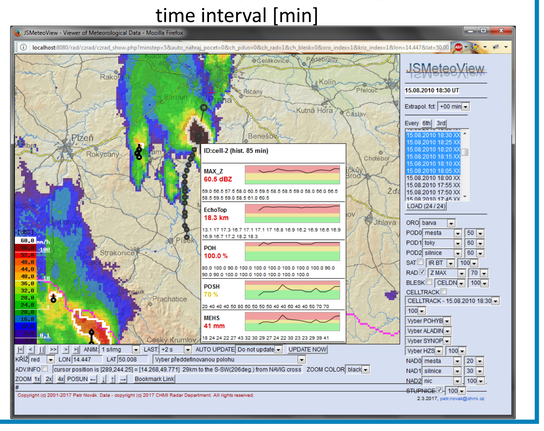


- machine learning classifiers → probability of the storm severity almost in real time
- high performance of models for our dataset
- crucial predictors:
  - IR 10.8 minimum Brightness Temp
  - area of the radar reflectivity core
  - number of lightning strokes in 5 min and its sudden increase



Future steps

- improve the lightning jump algorithm
- find relations for new data sources, thresholds
- adaptations for the operation



10th European Conference on Severe Storms, 4 – 8 November 2019, Kraków, Poland