





# Lagrangian diagnostics of convective cells using combined satellite, lightning and radar observations

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Natural color composite and lightning, 2011-06-22 12:00:00



### **Objectives**

part of the project <u>Object-based</u> <u>Analysis</u> and <u>SE</u>amless prediction (OASE)



Better understanding, characterization and quantification of process structure and life cycles of severe weather events



Steps towards seamless prediction of convective events









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### Data / method

 radar-based cell track detection KONRAD: cells with > 9km<sup>2</sup> with > 46 dBz

**Tropospheric Research** 

- April-September 2011
- 1700 cells (long living, daytime)
- MSG:
  - effective radius Reff
  - optical thickness COT
  - (liquid and ice water path)
- LINET lightning detection network:
  - lightning rate per 5 min TL
  - tendency of lightning rate
- KONRAD-cell attributes:
  - size
  - hail warning flag















### Lightning tendency vs intense reflectivity

- two hail warning categories:
  - $> 1 \text{ km}^2 > 55 \text{ dBZ}$

 $> 13 \text{ km}^2 > 55 \text{ dBZ or} > 1 \text{ km}^2 > 60 \text{ dBZ}$ 

 more frequent hail warnings level 2 with increasing lightning tendency













### Intense reflectivity relative to max lightning tendency

more frequent hail warnings after • maximum 5min-tendencyof lightning rate





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### Life cycle









### Life cycle







Time relative to max(R<sub>eff</sub>)



total lightning positively correlated with

COT both before and after max(Re)





#### Hans-Ertel-Zentrum für Wetterforschung Deutscher Wetterdienst



- correlation between total lightning and Re strongly negative after max(Re)!
  - descent of large particles induces electrification



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### Lightning vs COT and Reff



 total lightning positively correlated with COT both before and after max(Re)



- correlation between total lightning and Re strongly negative after max(Re)!
- descent of large particles induces electrification











Investigate mechanisms based on radar-based descriptors for updraft, differential sedimentation and hydrometeor classification







## Example track near radar



2011-06-05, 11-16 UTC, Track: 550





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Distance [km]



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### **Hydrometeor** classification

(Ryzhkov and Zrnic, 2005)

+ LINET strokes

Figure: By courtesy of Raquel Evaristo.







Zhfil 2011-06-05 13:59

Strong <u>lightning tendency</u>: precursor of intensifying reflectivity <u>Effective radius</u>: precursor of intensifying thunderstorm and lightning activity Supported by (updraft and) hydrometeor estimates of polarimetric radar

→ better understanding of life cycle of deep convection

➔ support for nowcasting of such events





### More information

- Wapler, Trömel, Bick, Deneke, Diederich, Horvath, Senf, Simmer, Simon: The OASE project: Object-based Analysis and Seamless prediction, **Poster 134**.
- Wapler: High-resolution climatology of lightning characteristics within Central Europe, **Session 8**.
- Wapler and Frank: Analysis of lightning flash characteristics in Central Europe, Poster 92.
- Senf, Deneke and Wapler: Synthetic NWC-SAF products for regional NWP forecasts of summer convection over Central Europe, **Poster 153**.
- Dietzsch, Senf and Deneke: Validation of satellite-based CI detection of convective storms via backward trajectories, Poster 164.
- Simon and Diederich: Applying Mean-Shift Clustering for 3D object detection in remote sensing data, Poster 175.

