Deutscher Wetterdienst
Wetter und Klima aus einer Hand

Assimilation of 3D Radar Data and Derived Objects on the Convective Scale with an Ensemble-based Data Assimilation System

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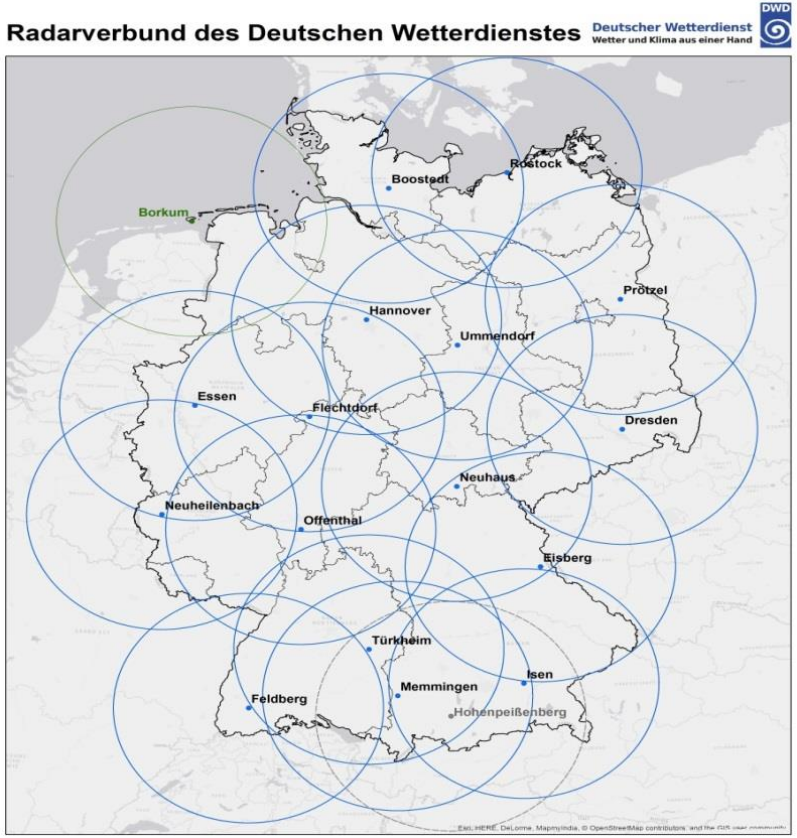
Seamless INtegrated FOrecastiNg sYstem

- Pilot project to integrate numerical weather prediction (NWP) and Nowcasting techniques into a new ensemble-based forecasting system
- Focus on severe summertime convective events
- Forecast range up to 12 hours

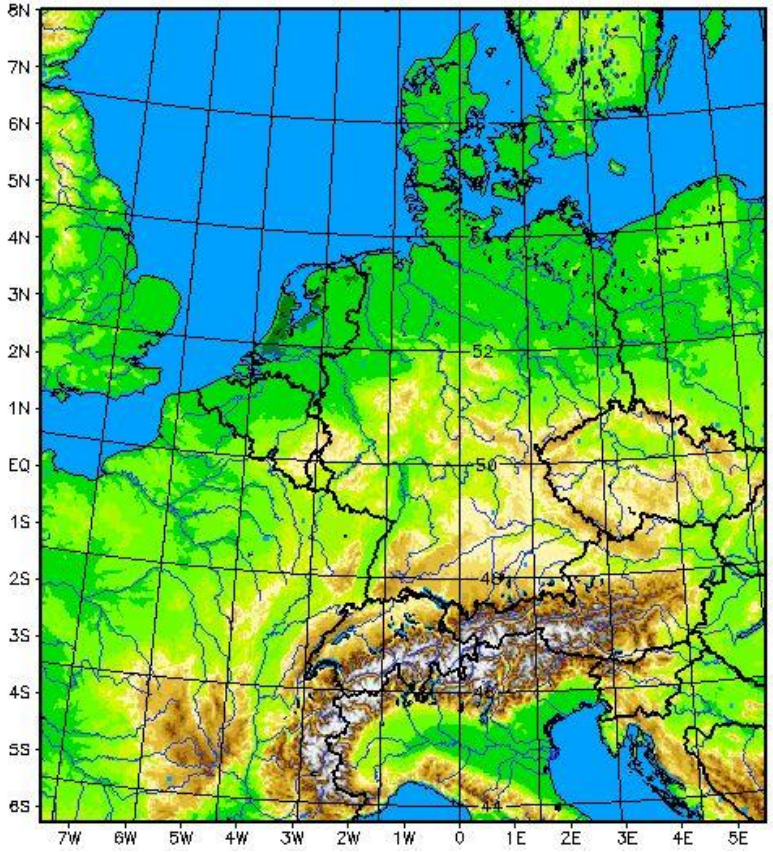
Julia Keller → Improving the prediction of flash floods
Alberto de Lozar → Storm-scale simulations with different microphysical schemes
Markus Schultze → Development of a probabilistic precipitation-nowcasting approach
Martin Rempel → Combining ensembles of NWP and nowcasting
Rober Feger → ***Generation of an object-based nowcasting ensemble***
Rafael Posada → ***Combination of object-based NWP and nowcasting***
Michael Hoff → ***Object-based verification of radar reflectivities***
Ulrich Blahak → being our boss

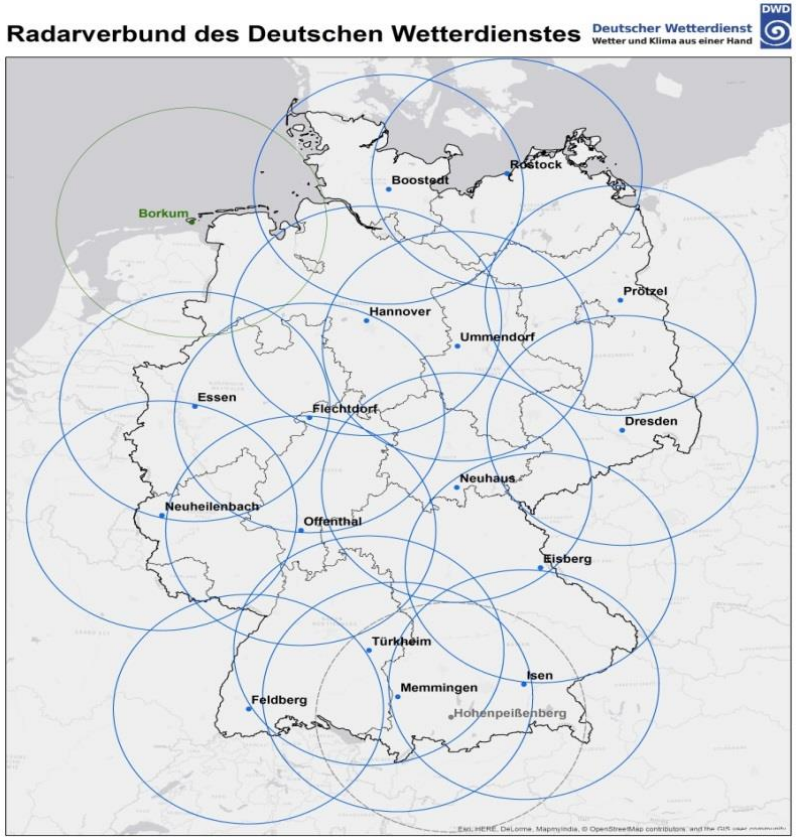
Radar Network & Model domain

- **Systems:**
  17 Doppler C-Band
- **Observables:**
  Reflectivity, radial wind,
  polarimetric moments
- **Temporal resolution:**
  Volume scan + terrain-following
  precipitation-scan every 5 min.
- **Spatial resolution:**
  1° azimuthal angular
  10 elevations (0.5° to 25°)
  1 km radial (up to 180 km)



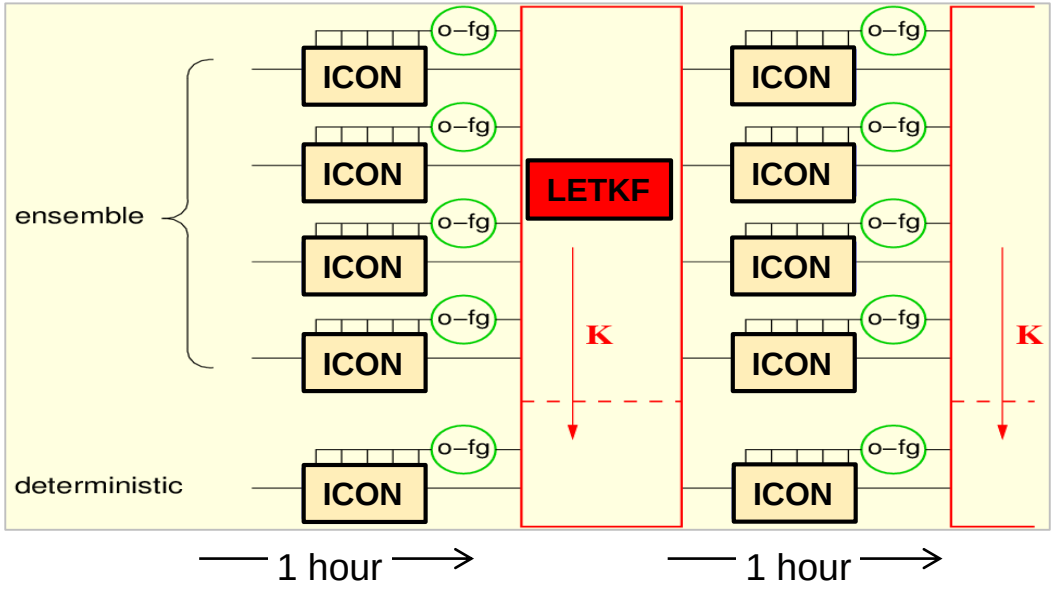
Radar Network & Model domain





DA-System: KENDA

KENDA: 4D-LETKF (conventional data* + **3D radar data / derived objects**)



x(t): state vector in model space

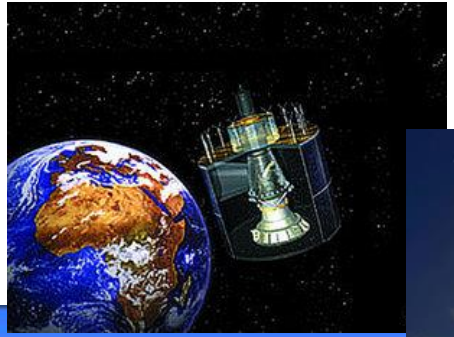
Forward operator

***H*(x,t): model equivalent in observation space**

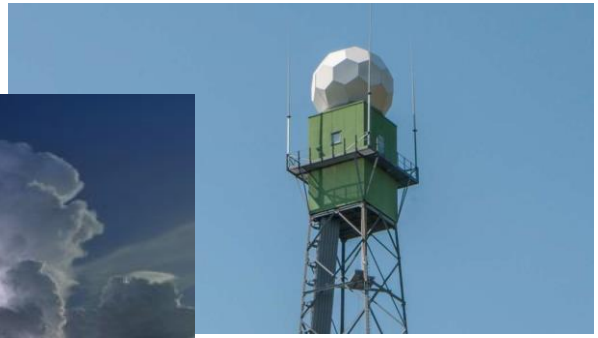
K: Kalman gain for ensemble mean

* airep, wind profiler, radiosondes, synoptic stations,…

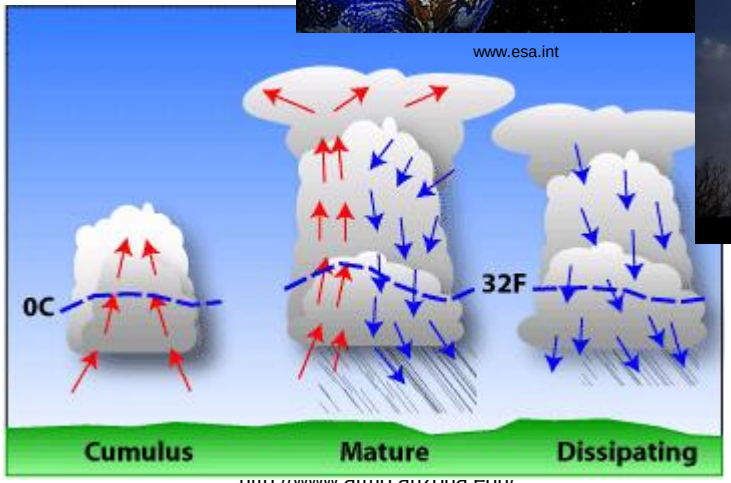
Why considering (convective) objects?



www.esa.int



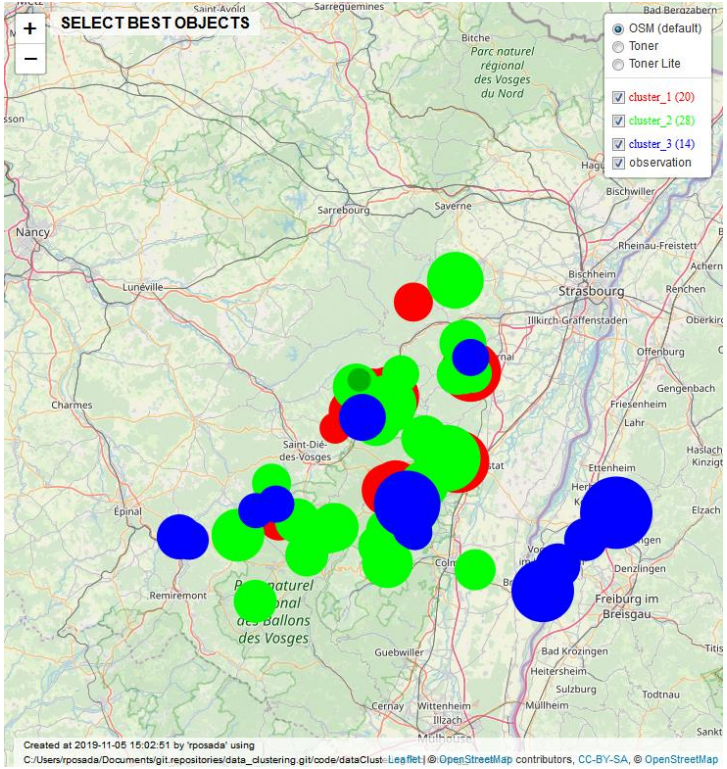
www.wlz-online.de



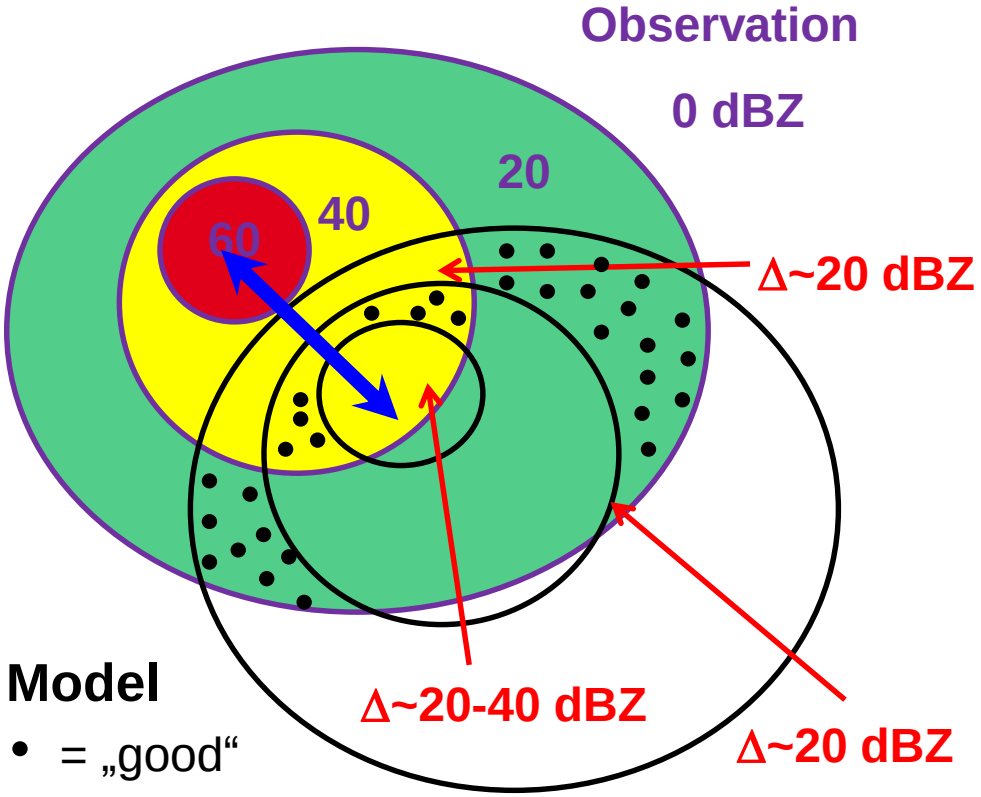
http://www.atmo.arizona.edu/

https://www.ubimet.com

Why considering (convective) objects?



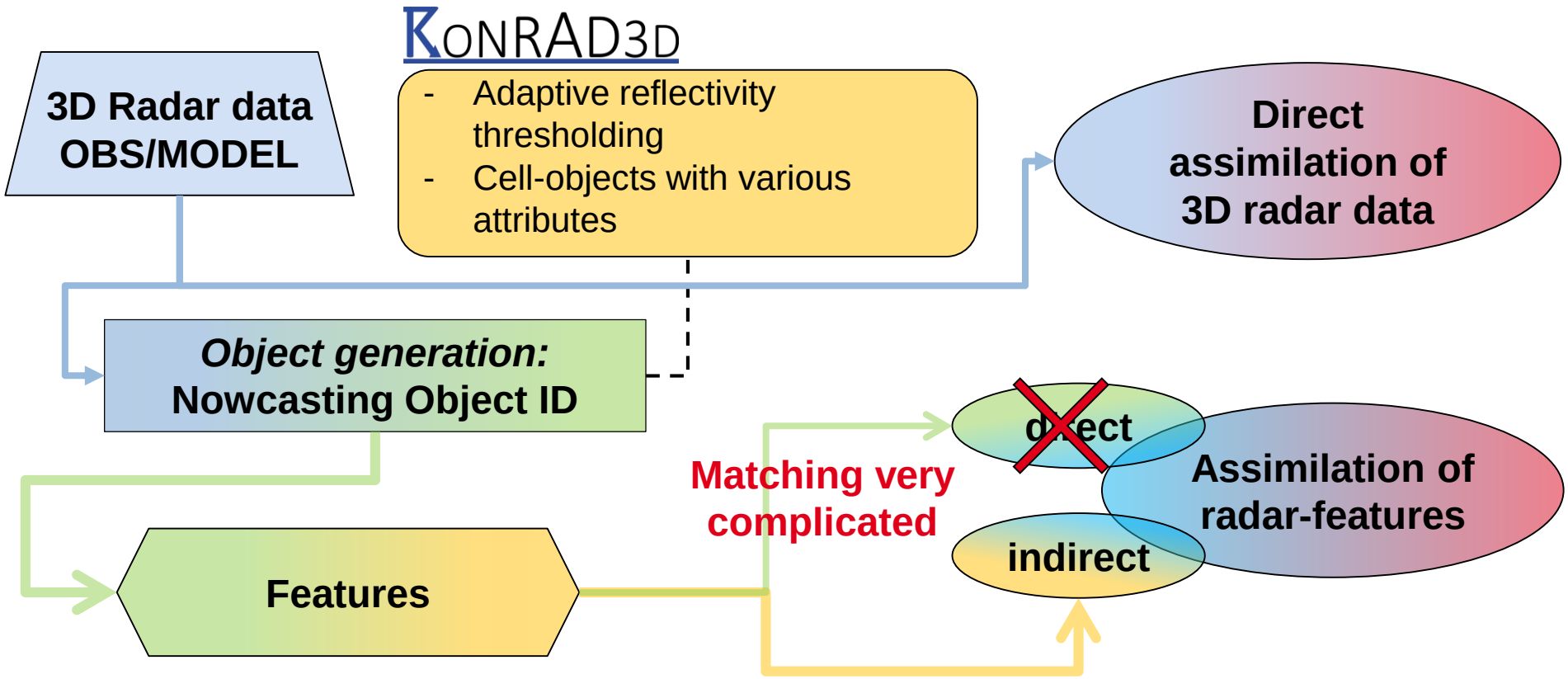
Talk by Rafael Posada (*object-based products*)



Model

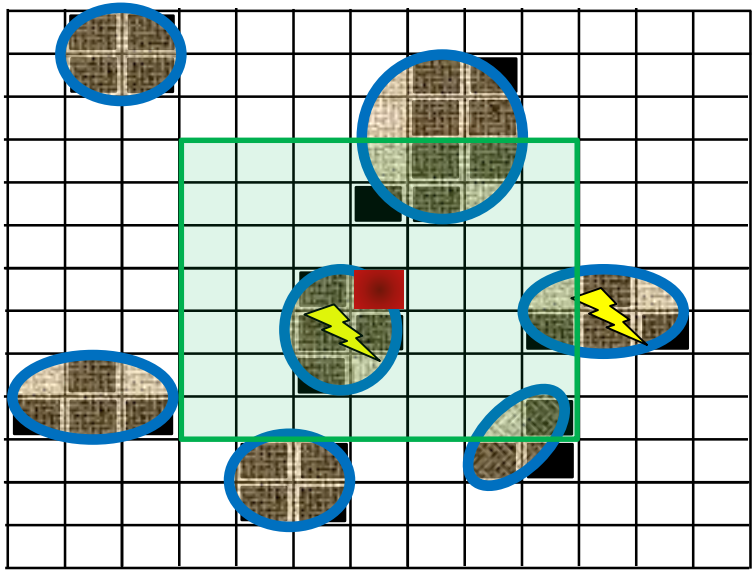
- = „good“

Overview: Assimilation of Features

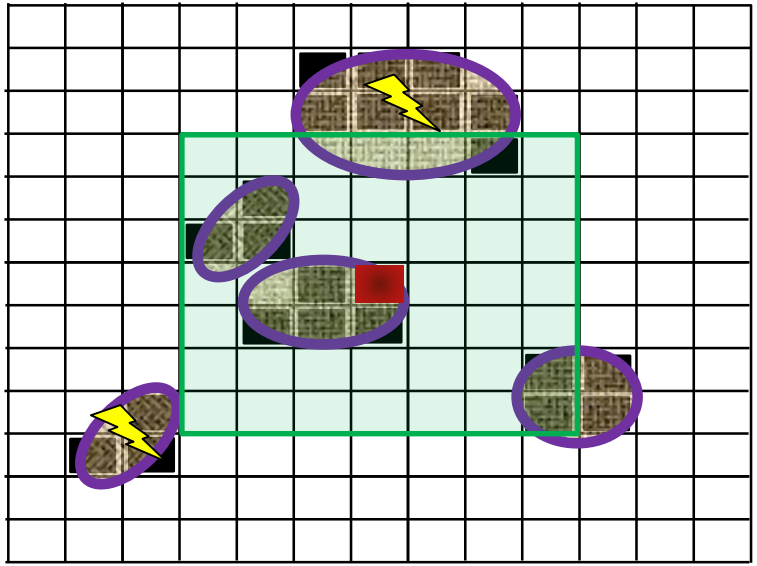


Feature Assimilation - Idea

Counts (observation)



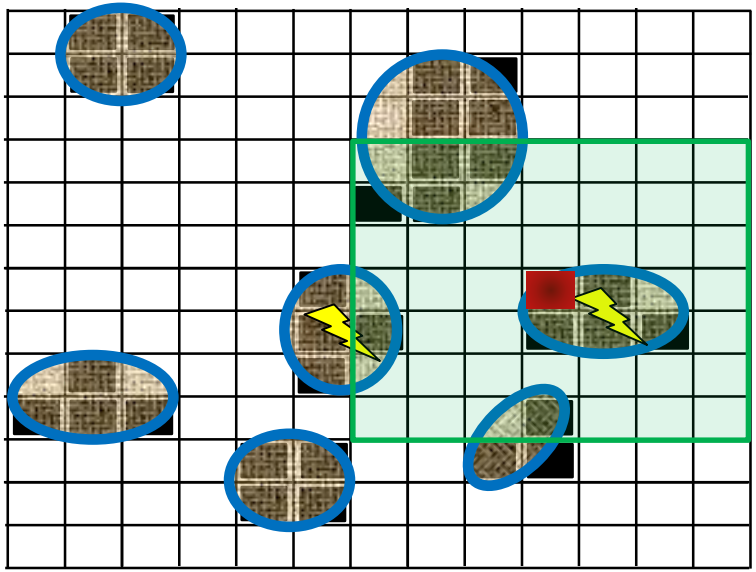
Counts (model equivalent)



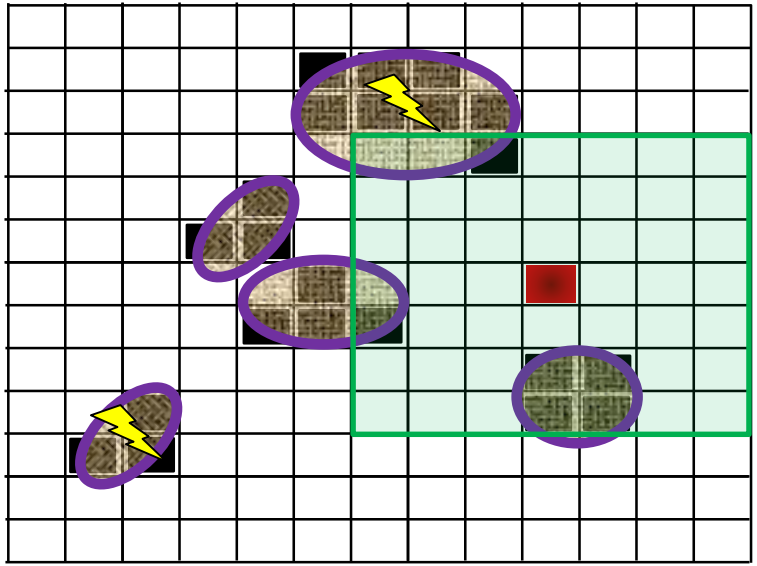
= identified objects (with collective attributes)

Feature Assimilation - Idea

Counts (observation)



Counts (model equivalent)



= identified objects (with collective attributes)

Case study

- **3rd of June 2019**
- **Calculate analyses at 18 UTC using:**
  - ❖ 40 Ensemble Member
  - ❖ Conventional observation always
  - ❖ Features if indicated by
    - ➢ Count of cells in area
    - ➢ Total (summed) vertically integrated liquid in area
  - ❖ 3D radar if indicated (reflectivity + radial velocity)
- **Calculate 1h forecast (first guess) starting from these analyses and compare in reflectivity space**
- **Shown:**
  - ➢ 1.5° composite (background)
  - ➢ polygons of cells as detected from Konrad3D (full 3D radar data)

Case study – 2019/06/03 18 UTC

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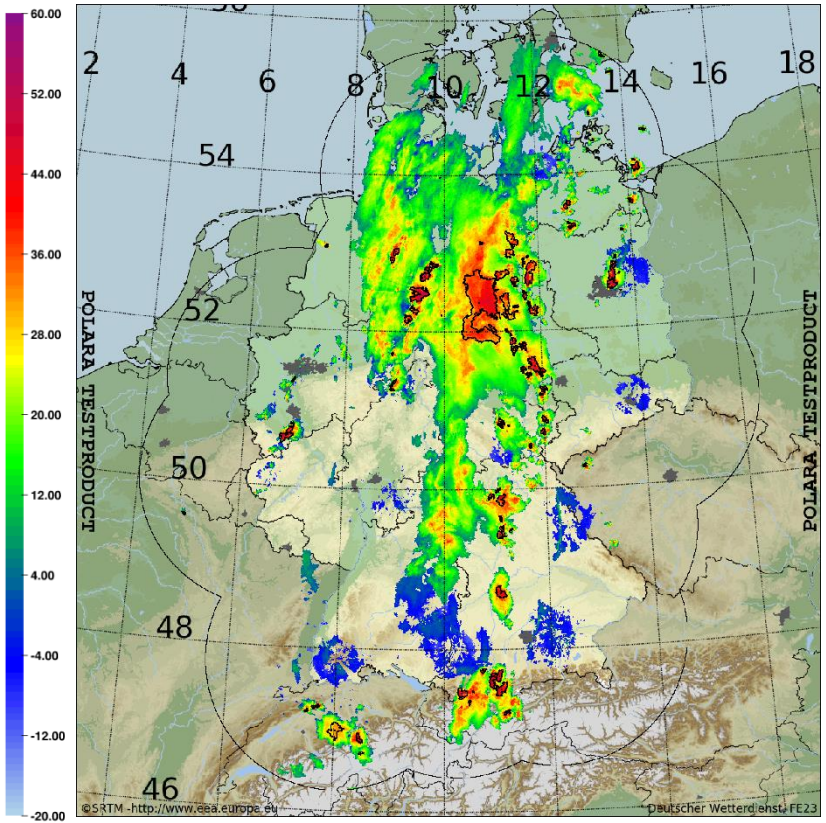
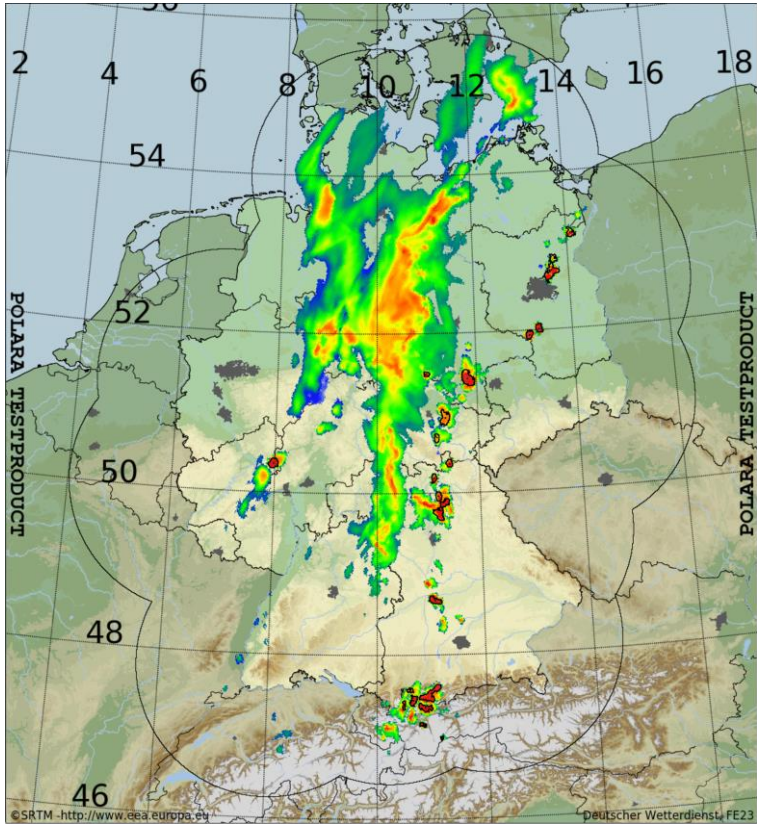
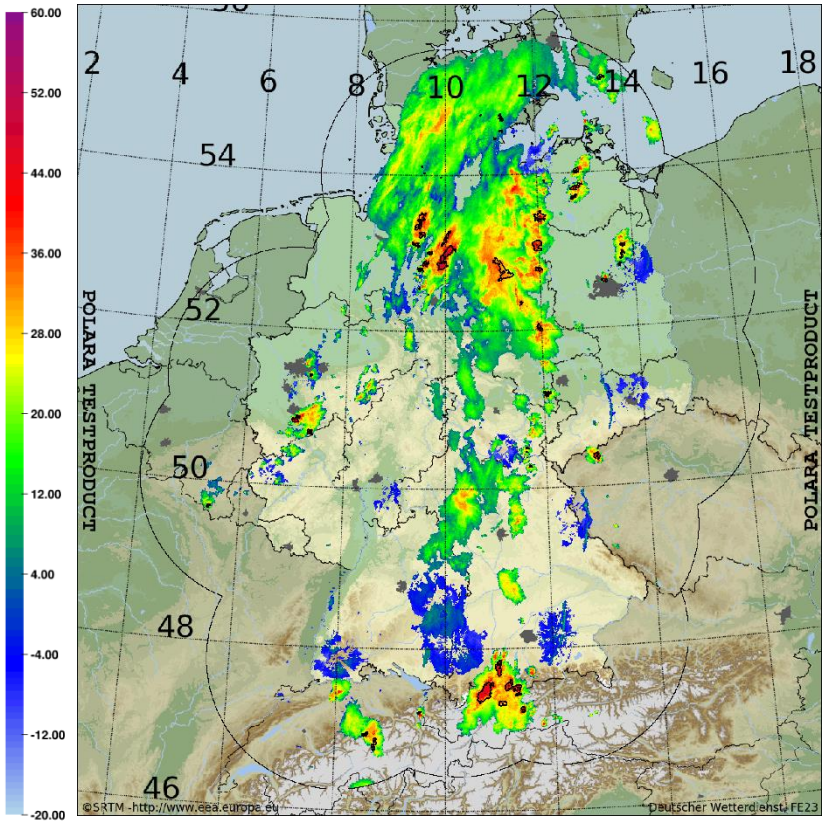


Obs ←

First guess →

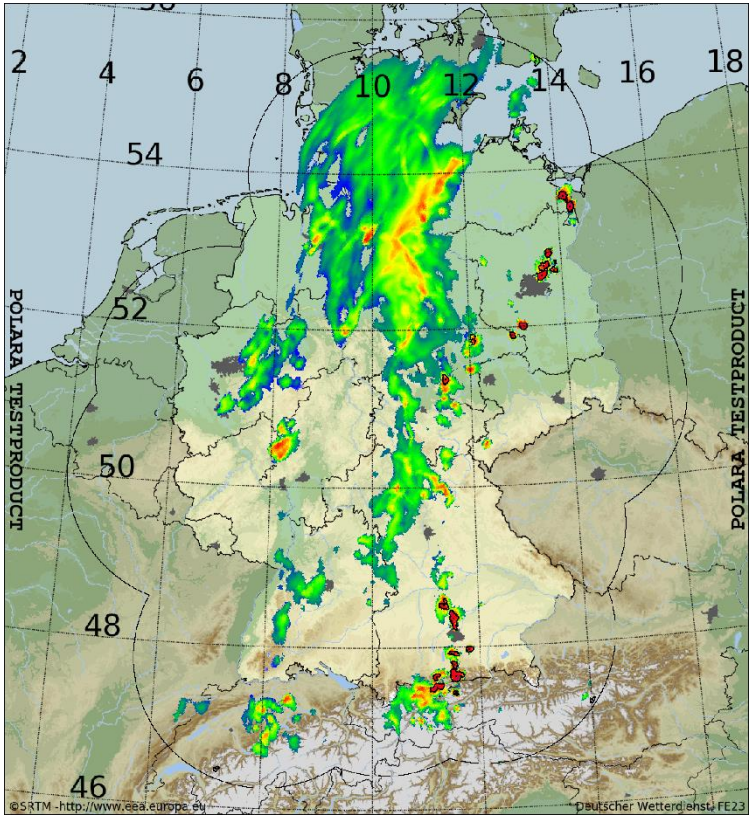


Case study – 2019/06/03 18 UTC + 1h

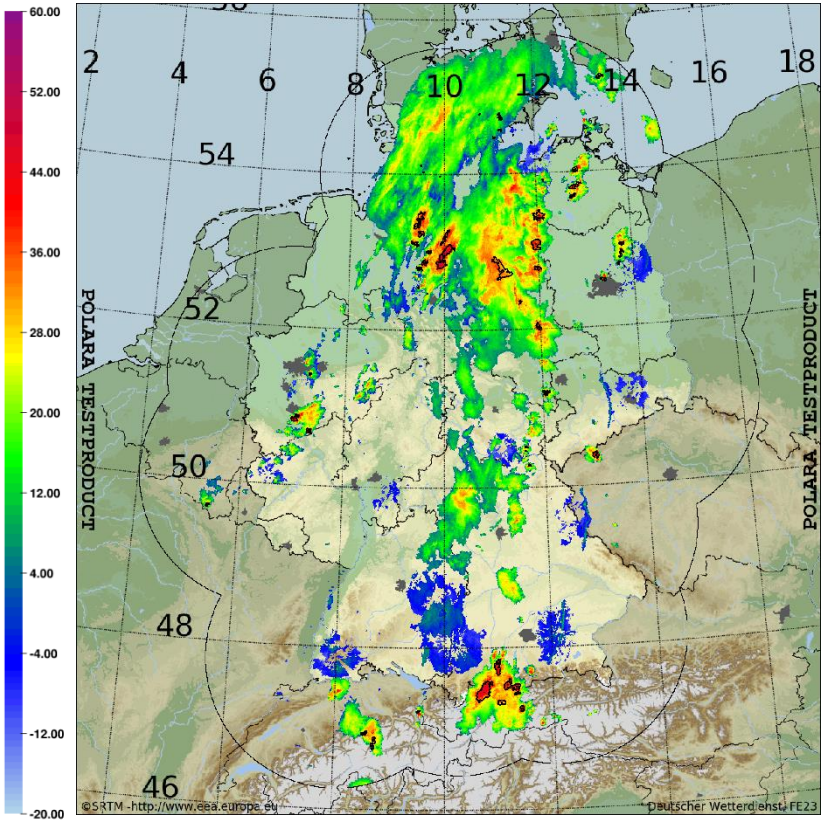


Obs ←

Det. → (No radar DA)

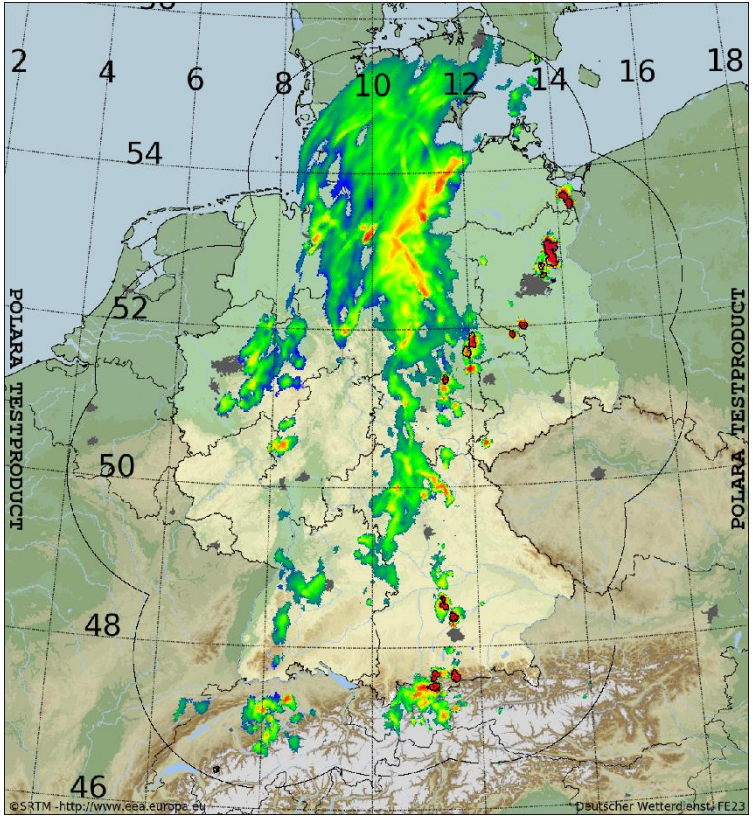


Case study – 2019/06/03 18 UTC + 1h

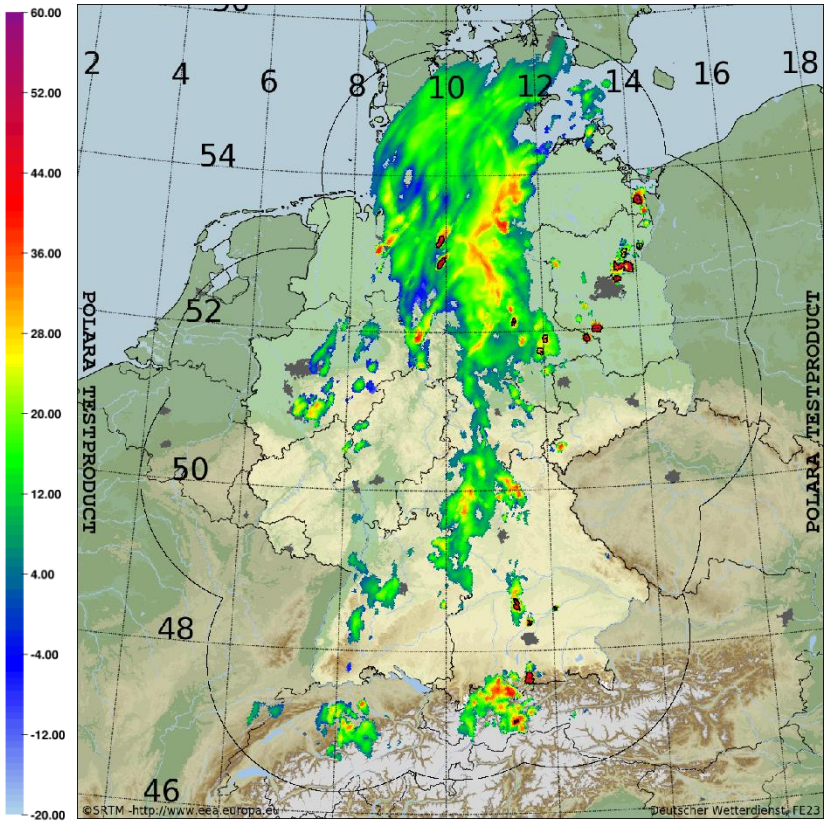


Obs ←

Det. → (Feature DA)

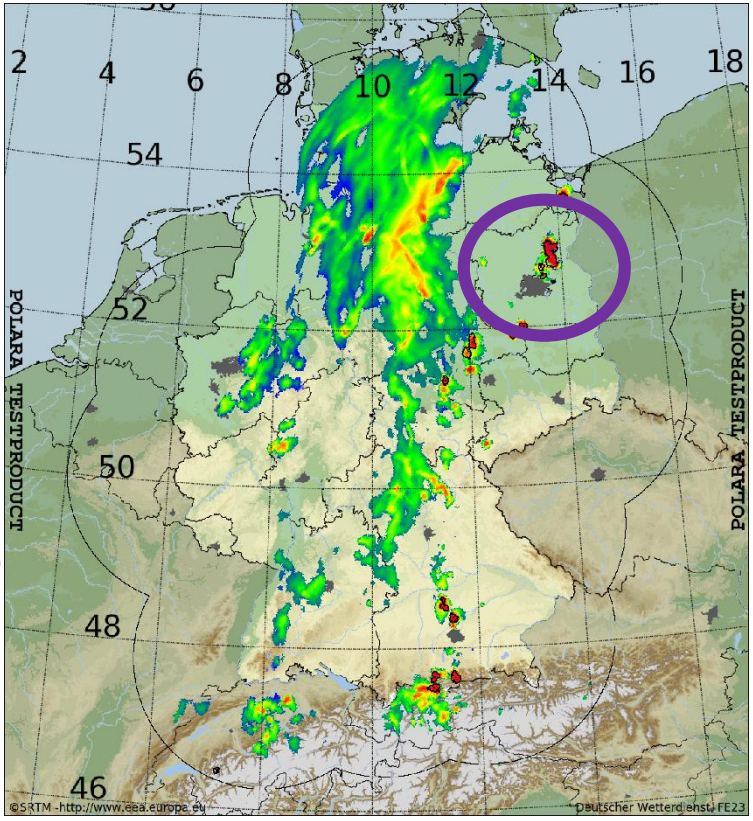


Case study – 2019/06/03 18 UTC + 1h



Det. (radar DA) ←

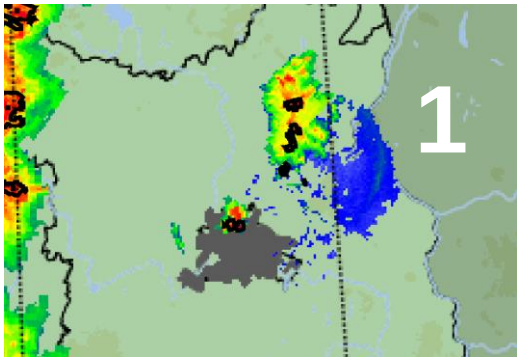
Det. → (Feature DA)

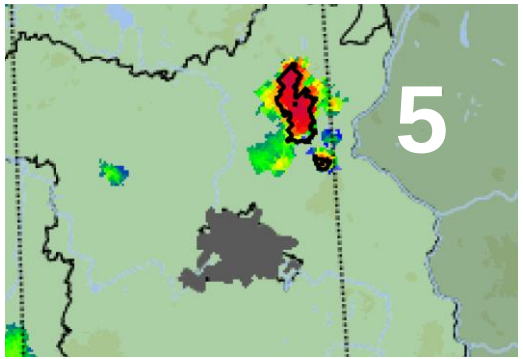


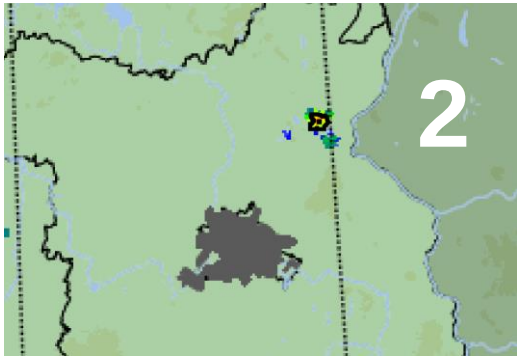
Case study – 2019/06/03 18 UTC + 1h

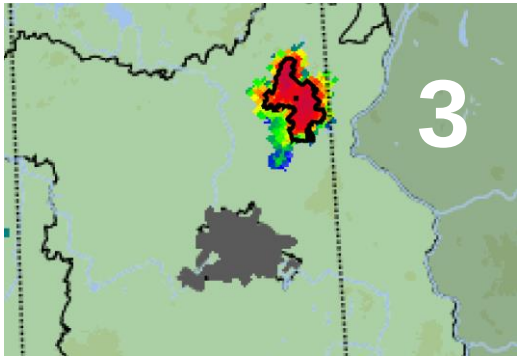
1: Observation
2: *No radar DA*
3: Feature DA
4: Radar DA
5: Feature & Radar DA

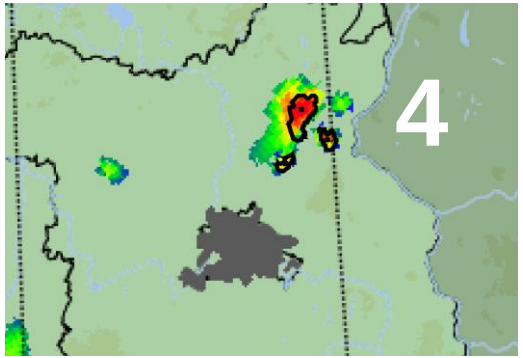
(2-5: Ensemble member)











Conclusion:

- Direct assimilation of 3D Radar Data is (still) a challenge
- The assimilation of features and attributes thereof in a gridded manner is an alternative (complementary) approach
- The approach has several advantages (reduced data, “less” double penalty) but also disadvantages (processing time, ID depends on model physics)

Outlook:

- Investigations and adjustments in data assimilation framework
- Verification with object-based scores (→ object-based products)
- “Bad hair model day”: environmental conditions plus warm bubbles?

Thank you for your attention

Dziękuję za uwagę

Gracias por tu atención

Obrigado pela sua atenção

Bedankt voor uw aandacht

Takk for din oppmerksomhet

Grazie per l'attenzione

Kiitos huomiostasi

Merci de votre attention

شكرا لاهتمامكم

谢谢你的关注

Danke für Ihre Aufmerksamkeit

Спасибо за внимание

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