



## Assimilation of Radar-Derived Precipitation by Latent Heat Nudging

- **Required:** relation: precipitation rate  $\leftrightarrow$  model variables  
(observed) (info required by nudging)  
precipitation  $\leftrightarrow$  condensation  $\leftrightarrow$  release of latent heat

→ **Assumption:** vertically integrated latent heat release  $\propto$  precipitation rate

- **Approach:** modify latent heating rates such that the model responds by producing the observed precipitation rates  
→ Latent Heat Nudging (LHN)

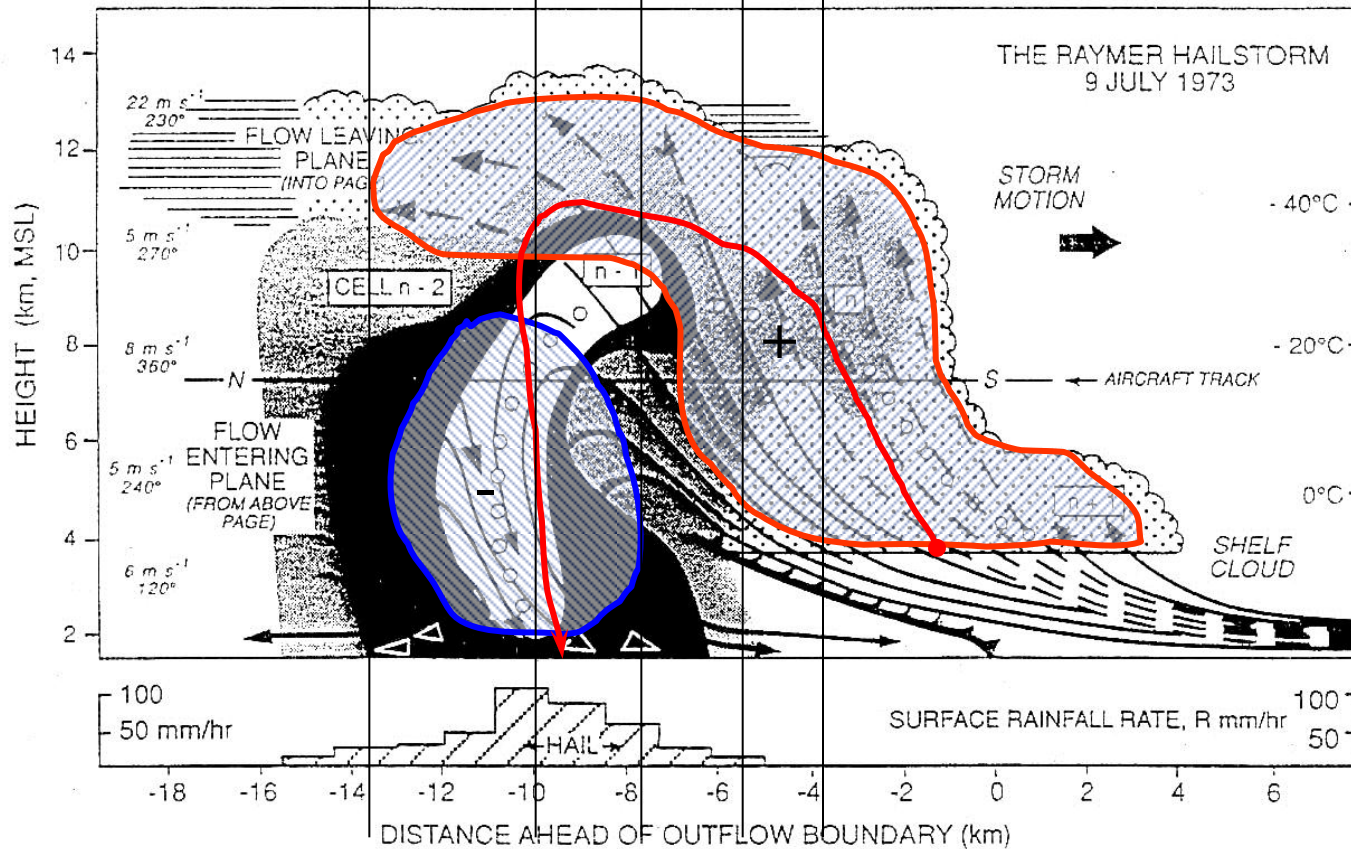
$$\frac{\partial T}{\partial t} = F(T) + \left( \frac{\partial T}{\partial t} \right)_{nudging} + \left( \frac{\partial T}{\partial t} \right)_{LHN}$$
$$\Delta T_{LHN} = (\alpha - 1) \cdot \Delta T_{LH} \quad \text{with} \quad \alpha = \frac{RR_{obs}}{RR_{ref}}$$

+ adjustment of specific humidity to maintain relative humidity





Correlation:            0        <0        low    max    low        0



(R. A. Houze, Jr.: Cloud Dynamics, International Geophysics Series Vol. 53)





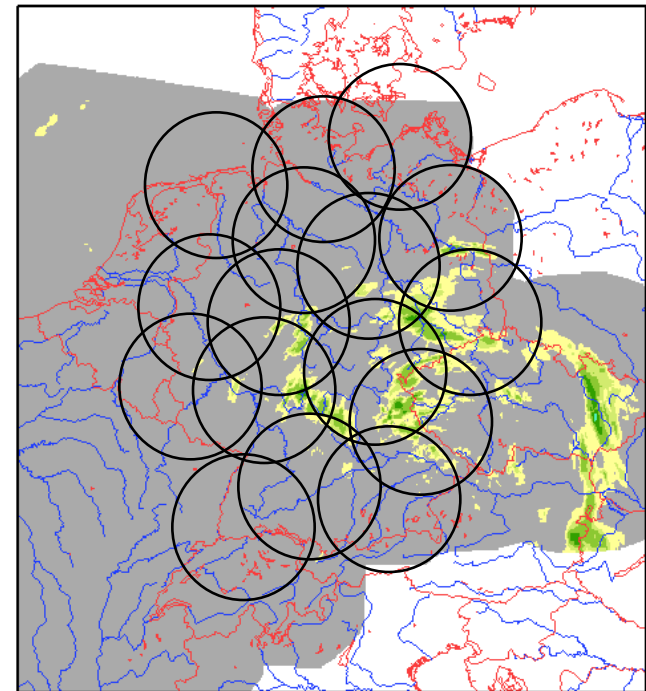
## Radar data coverage

- Currently
  - 17 German Doppler radar stations
  - 18 European Doppler radar stations:
    - 2 Dutch stations
    - 2 Belgian stations
    - 9 France stations
    - 3 Swiss stations
    - 2 Czech station

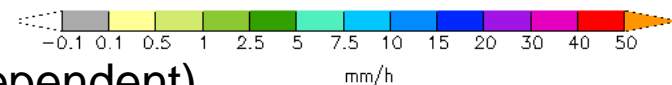
RADAR COMPOSITE

valid: 26 APR 2011 12 - 13 UTC

1h PRECIPITATION



Mean: 0.0580894 Min: 0 Max: 6.53501



R is derived using a 4 class z-R relation (storm dependent)



# Reflectivity → LHN



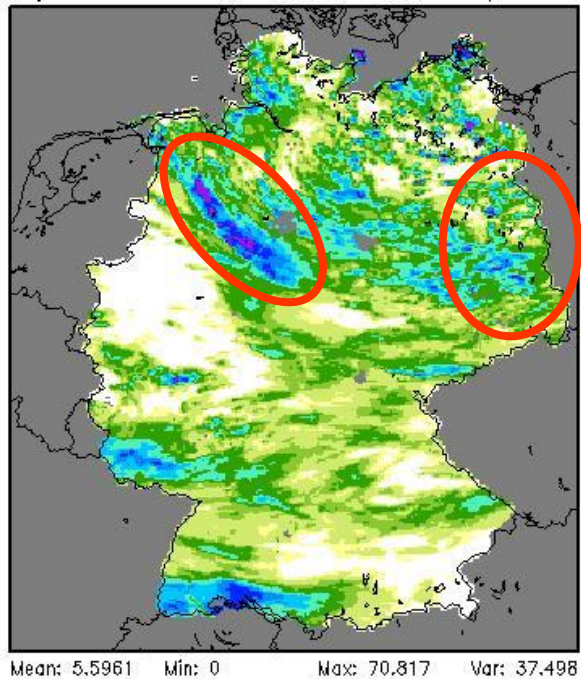
Deutscher Wetterdienst  
Wetter und Klima aus einer Hand



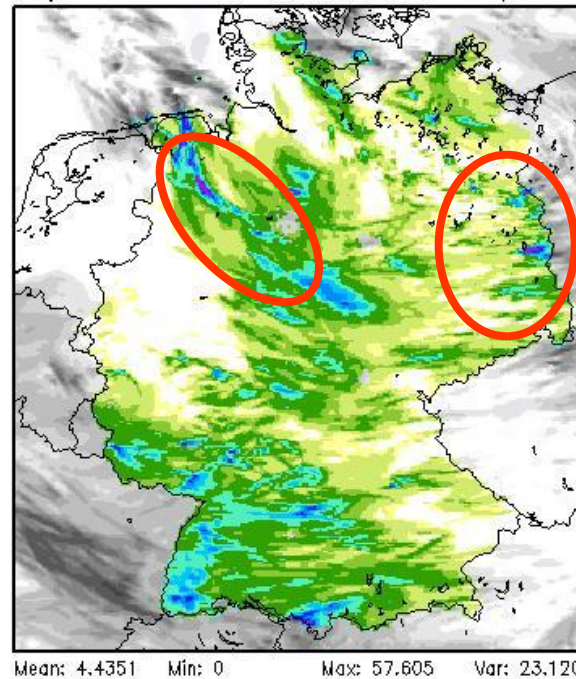
24H precipitation sum: 26.08.2006 (6 UTC – 6 UTC)

Assimilation of German Radar sites

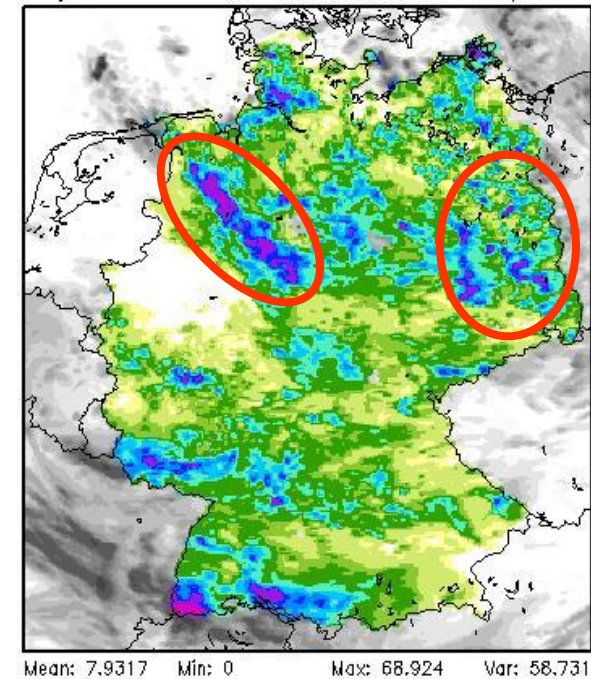
Radar-OBS



No LHN



LHN



# Reflectivity → LHN



Deutscher Wetterdienst  
Wetter und Klima aus einer Hand



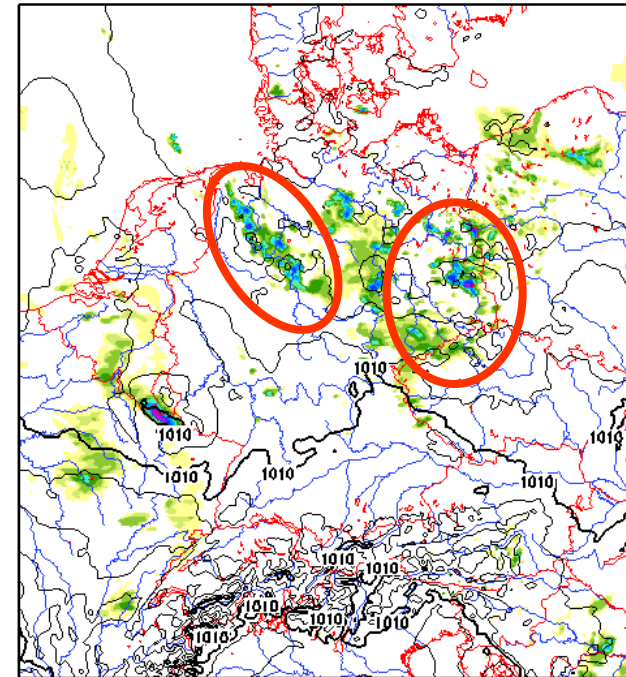
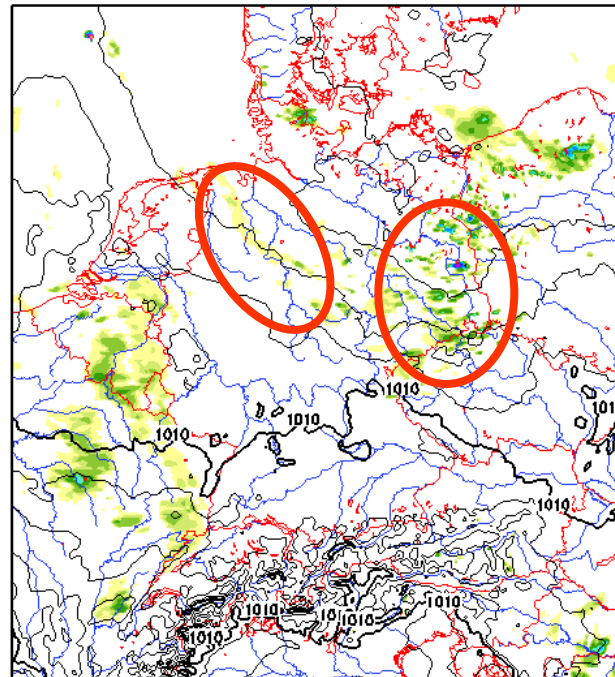
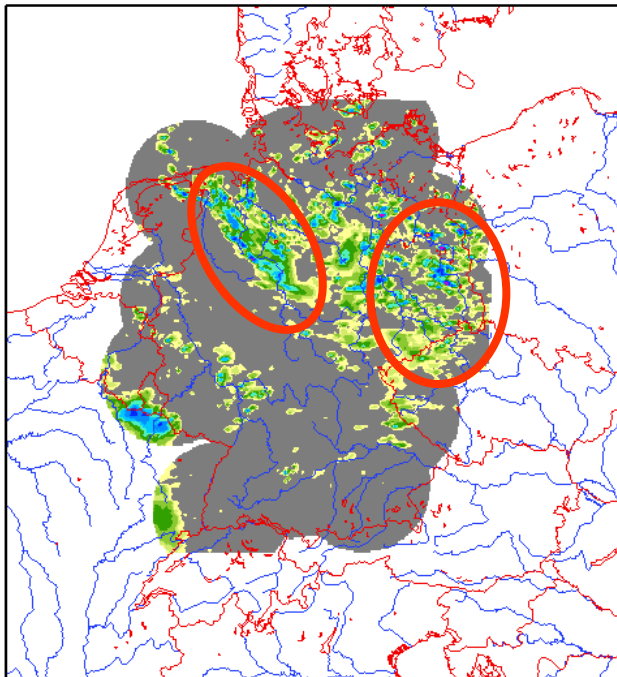
Animation of 1H precipitation sum 26. August 2006

Free Forecast 12 UTC + 1 H  
(Assimilation till 12:30 UTC)

Radar-OBS

No LHN

LHN



# Reflectivity → LHN



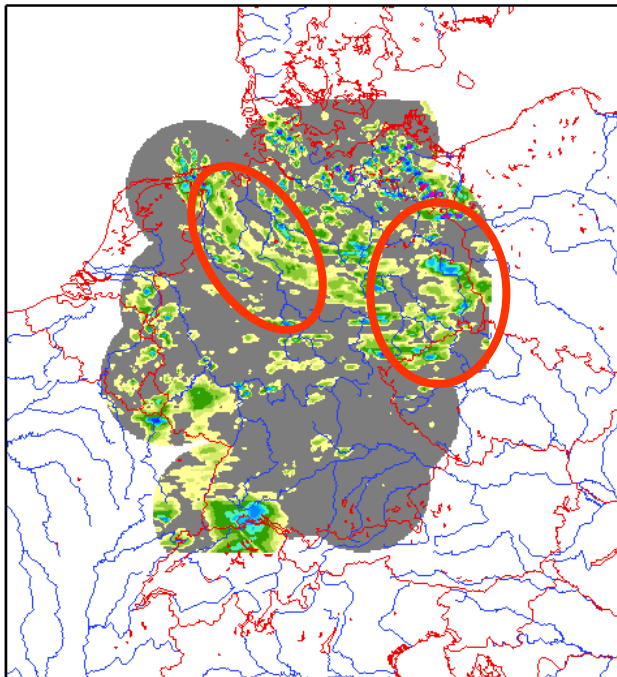
Deutscher Wetterdienst  
Wetter und Klima aus einer Hand



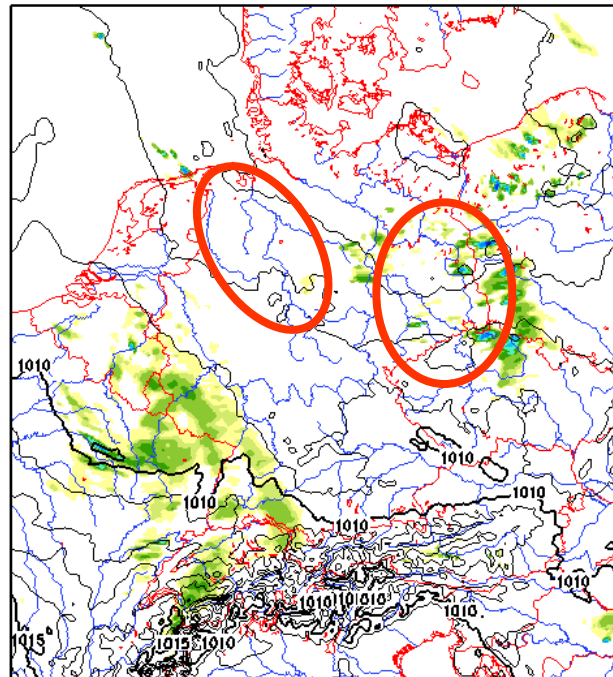
Animation of 1H precipitation sum 26. August 2006

Free Forecast 12 UTC + 4 H

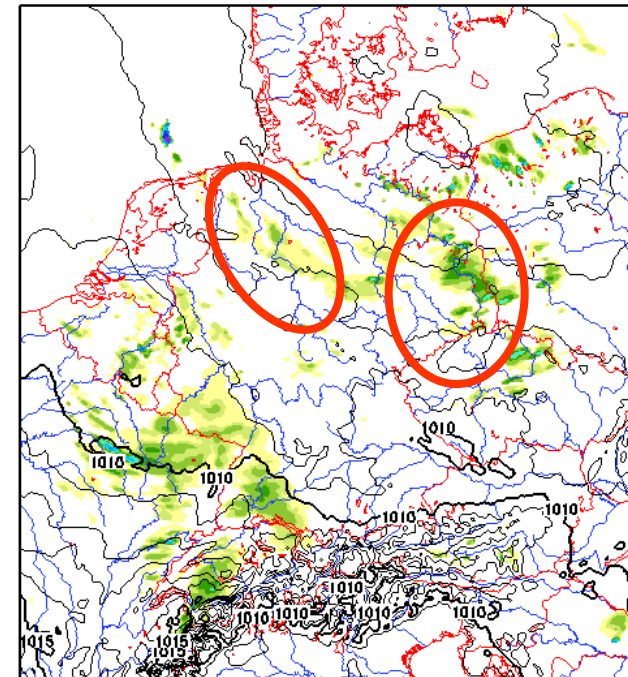
Radar-OBS



No LHN



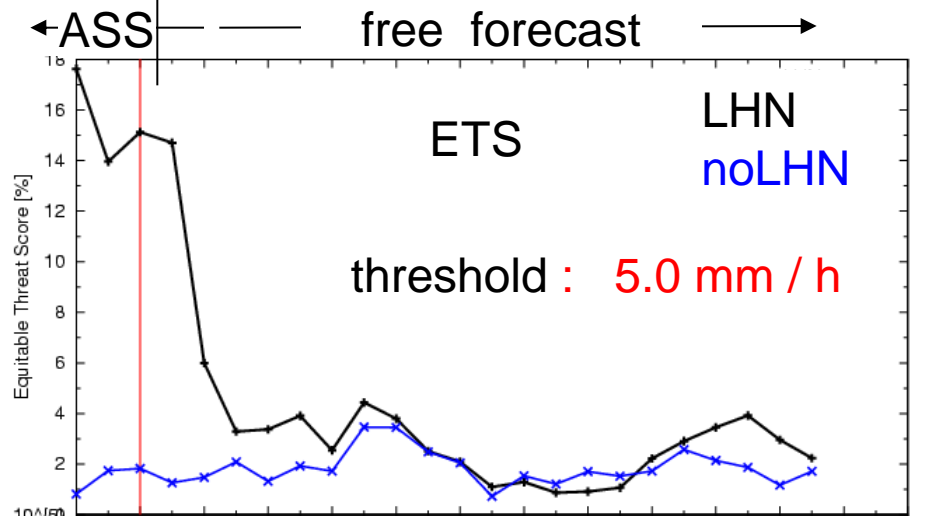
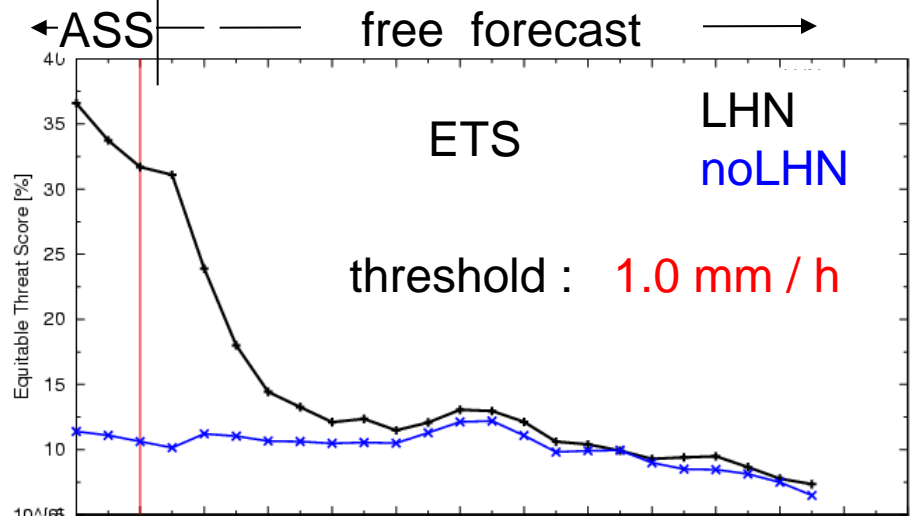
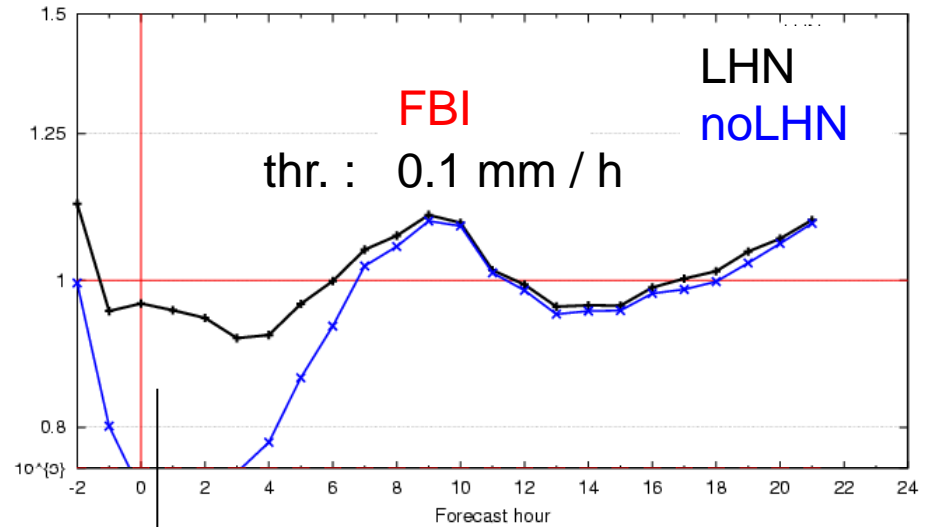
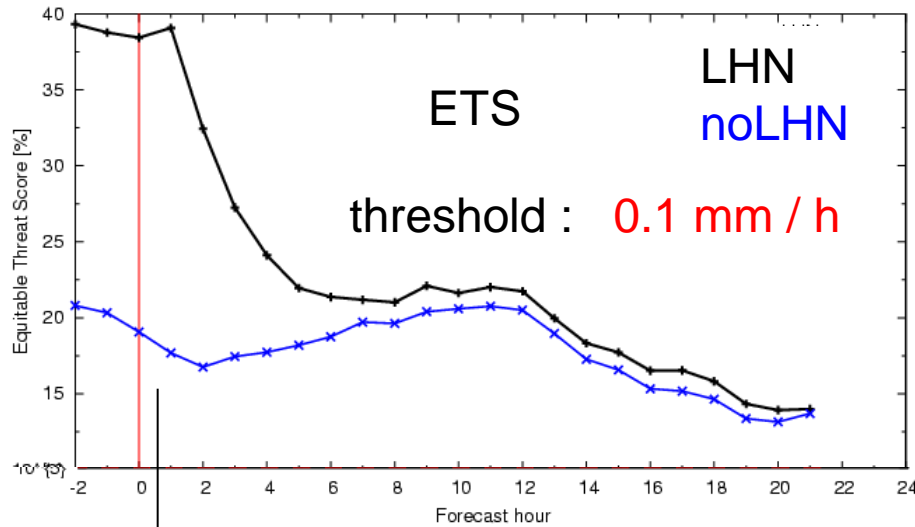
LHN





# Reflectivity → LHN

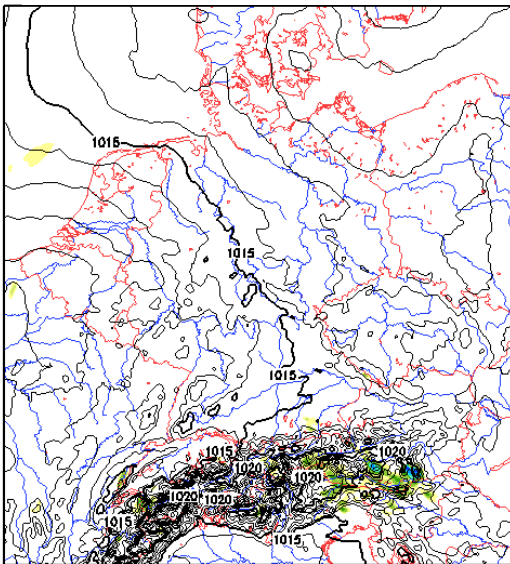
15 – 30 August 2006, 00 and 12 UTC runs (32 forecasts); threshold : 0.1 mm / h



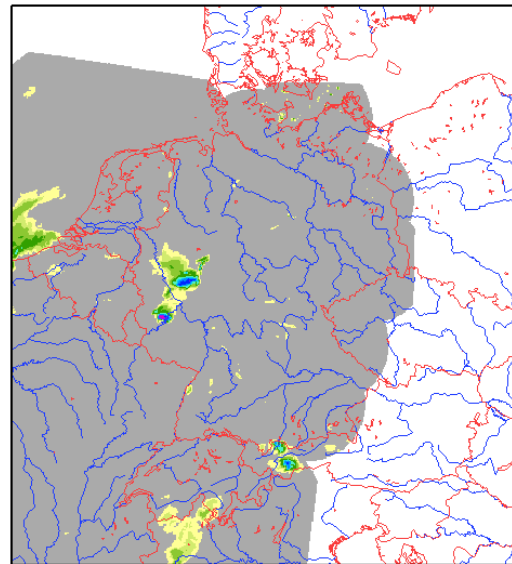


# Impact of extended data: Hourly Precipitation on 25.05.2009 12 UTC +5h

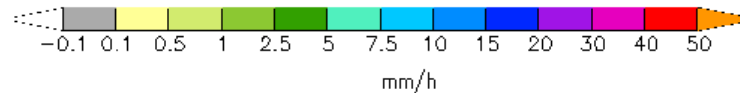
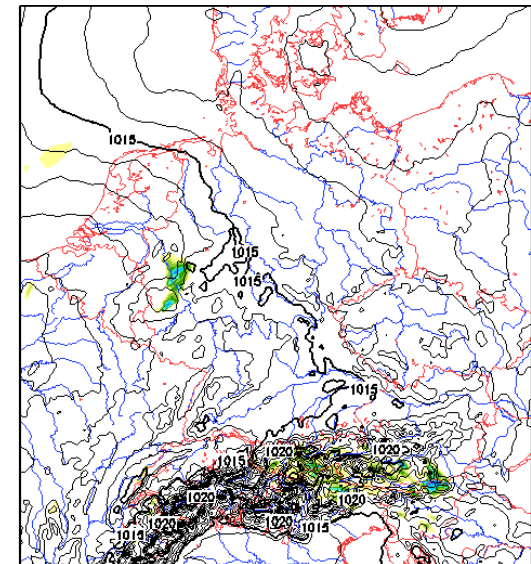
Forecast on LHN-  
Anal. of German data



New Radar Composite



Forecast on LHN-  
Anal. of European data



Forecast is improved by extension to European data base

