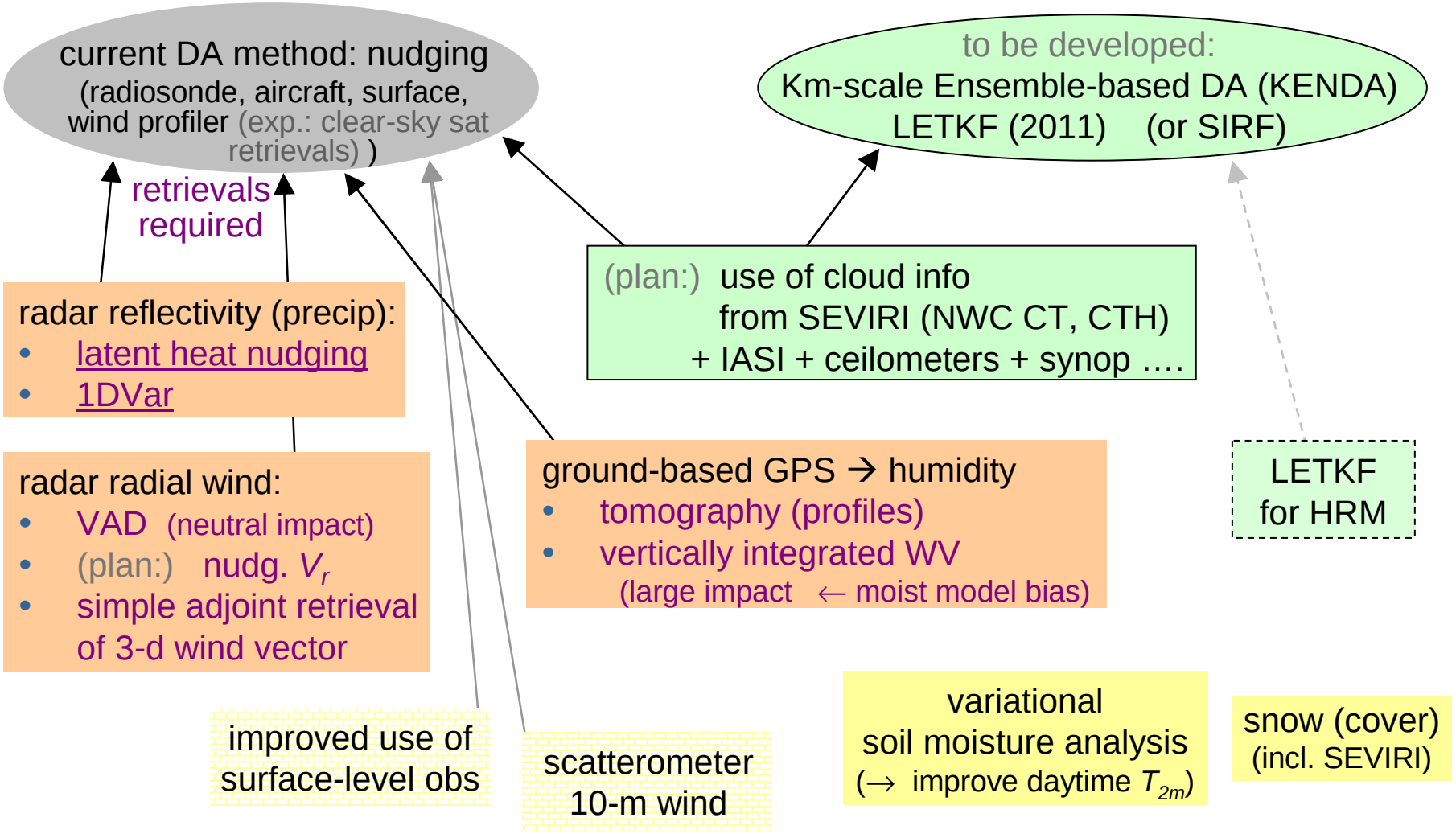
# Status Overview in COSMO

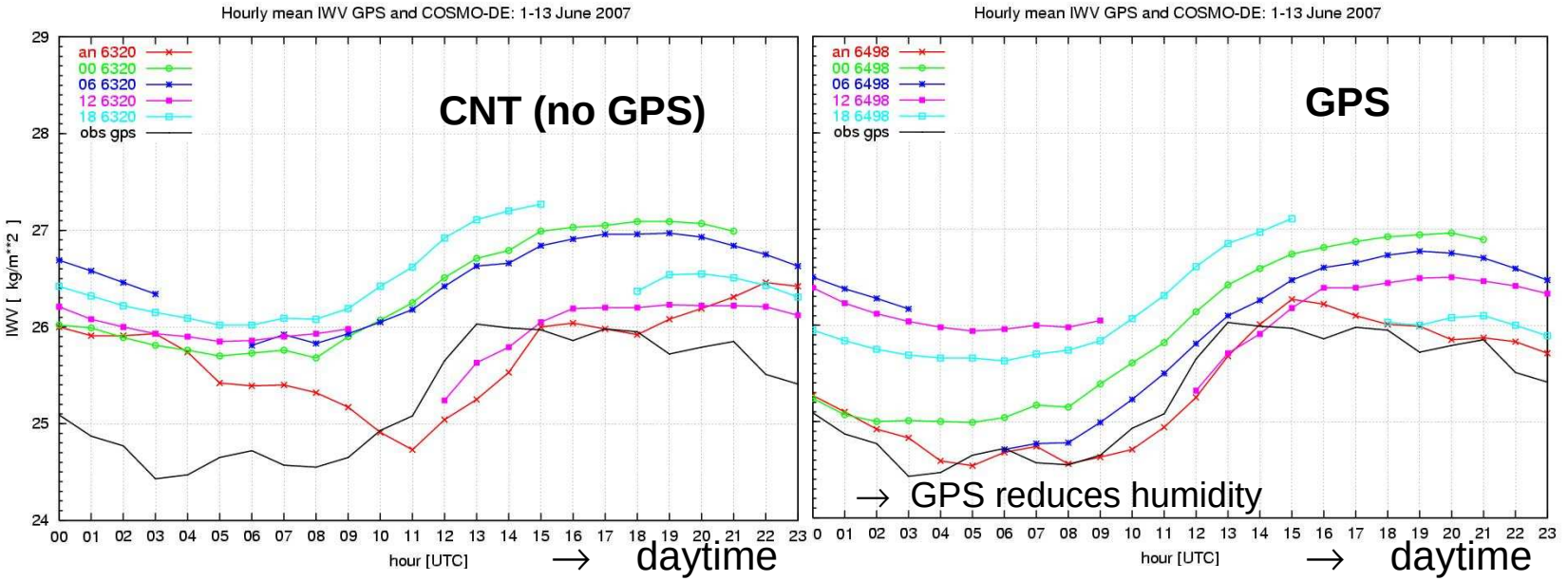
## impact of latent heat nudging / fine-scale analysis

christoph.schraff@dwd.de
Deutscher Wetterdienst, D-63067 Offenbach, Germany

# Overview


current DA method: nudging
(radiosonde, aircraft, surface, wind profiler (exp.: clear-sky sat retrievals) )
to be developed:
Km-scale Ensemble-based DA (KENDA)
LETKF (2011) (or SIRF)
retrievals required
radar reflectivity (precip):
• latent heat nudging
• 1DVar
(plan:) use of cloud info from SEVIRI (NWC CT, CTH) + IASI + ceilometers + synop ….
radar radial wind:
• VAD (neutral impact)
• (plan:) nudg. $V_r$
• simple adjoint retrieval of 3-d wind vector
ground-based GPS → humidity
• tomography (profiles)
• vertically integrated WV
(large impact ← moist model bias)
LETKF for HRM
improved use of surface-level obs
scatterometer 10-m wind
variational soil moisture analysis
(→ improve daytime $T_{2m}$)
snow (cover) (incl. SEVIRI)

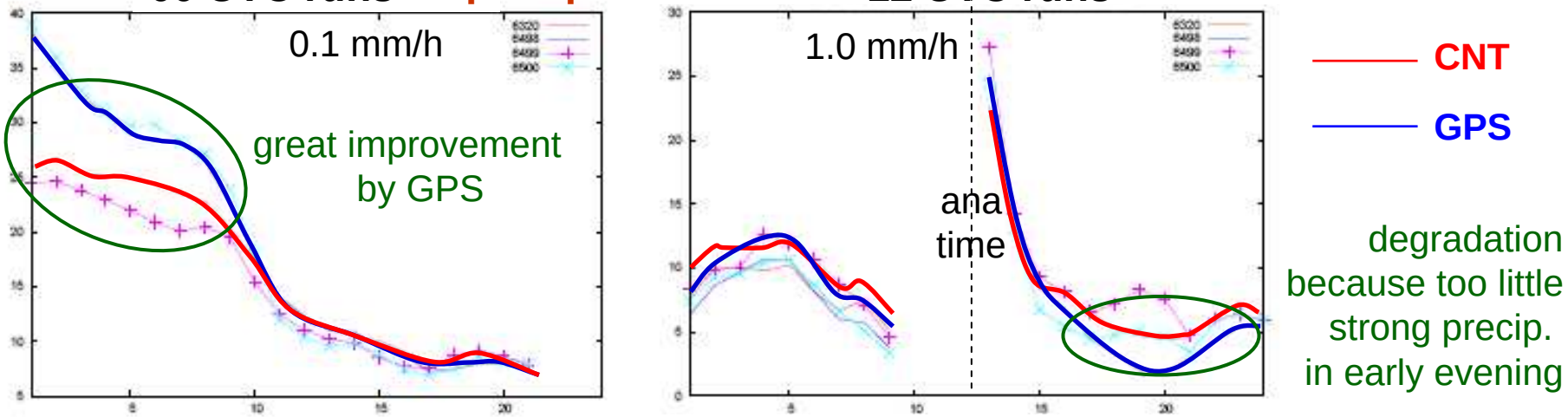
## daily cycle of: IWV (1 – 13 June 2007, air-mass convection)




Δx = 2.8 km

- Analysis
- 00 UTC
- 06 UTC
- 12 UTC
- 18 UTC
- Obs

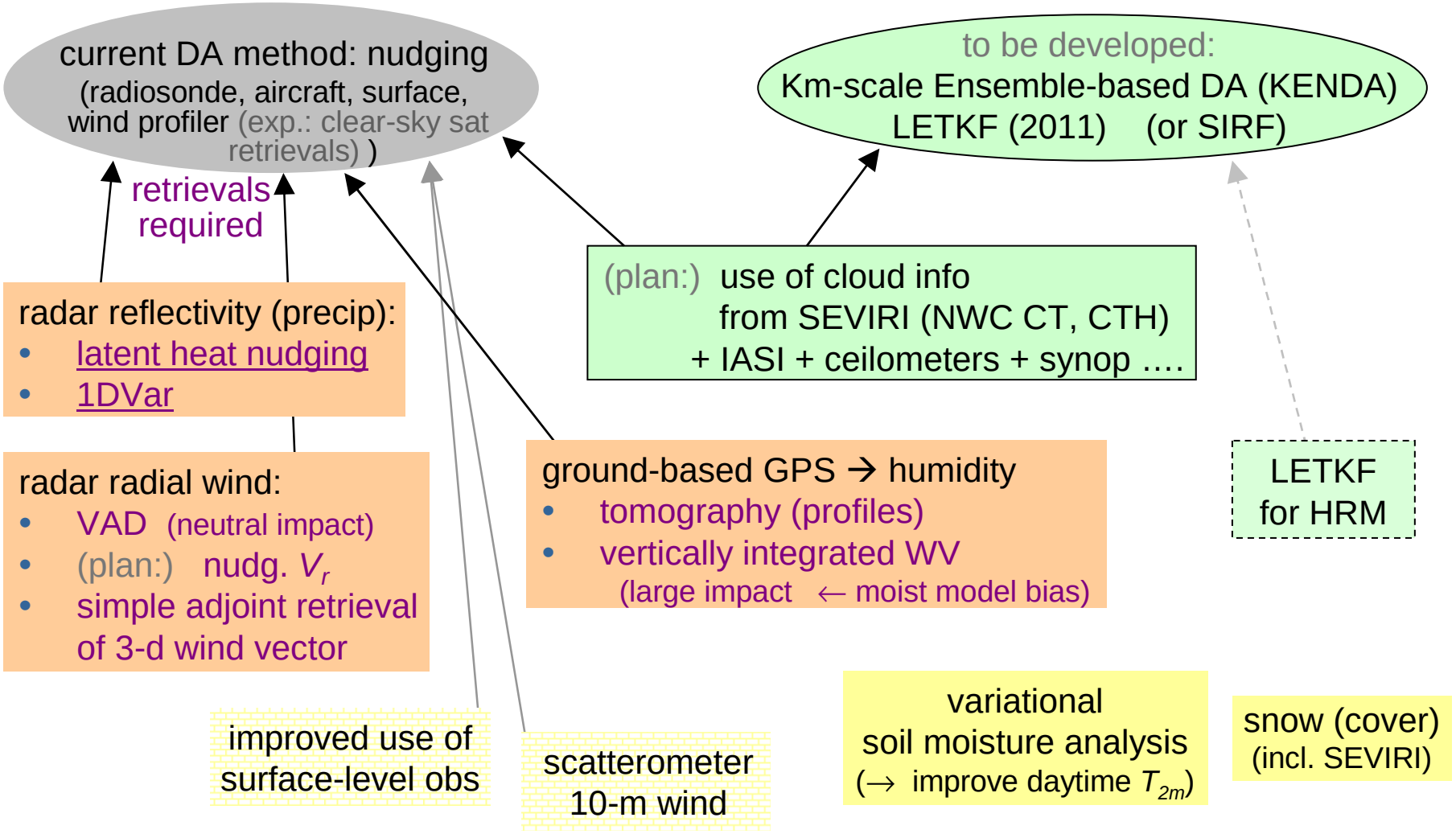
## precipitation: ETS




- CNT
- GPS

degradation because too little strong precip. in early evening

# Overview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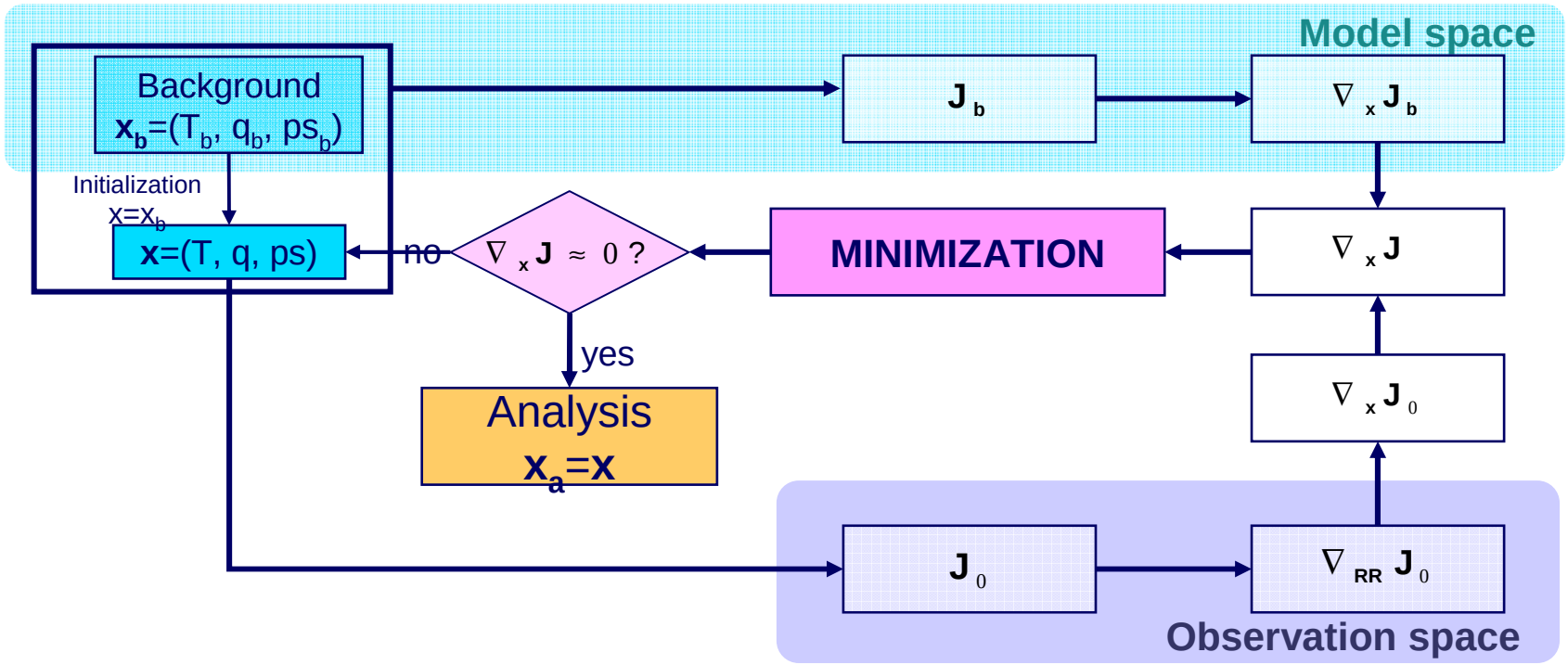
(→ improve daytime $T_{2m}$)
snow (cover) (incl. SEVIRI)

# Use of radar-derived surface precipitation

Virginia Poli, Francesca di Giuseppe (ARPA-SIM, Bologna)

**1DVAR** to retrieve T, q –profiles from RR (using linearised parameterisations of large-scale condensation and convection)
then nudge T, q –profiles



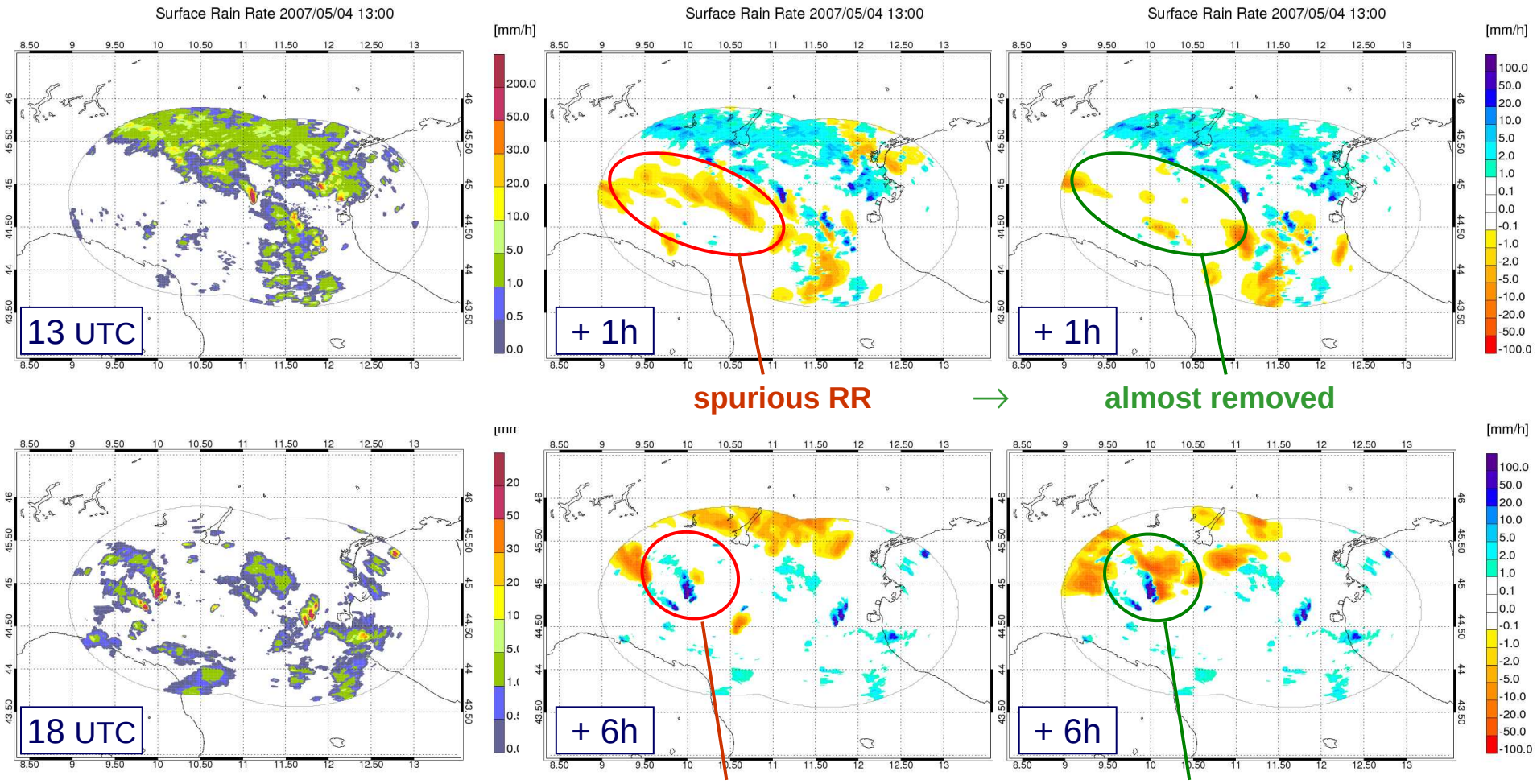
# Example of RR assimilation

**encouraging results !**

radar

radar – CTRL (no 1DVar)

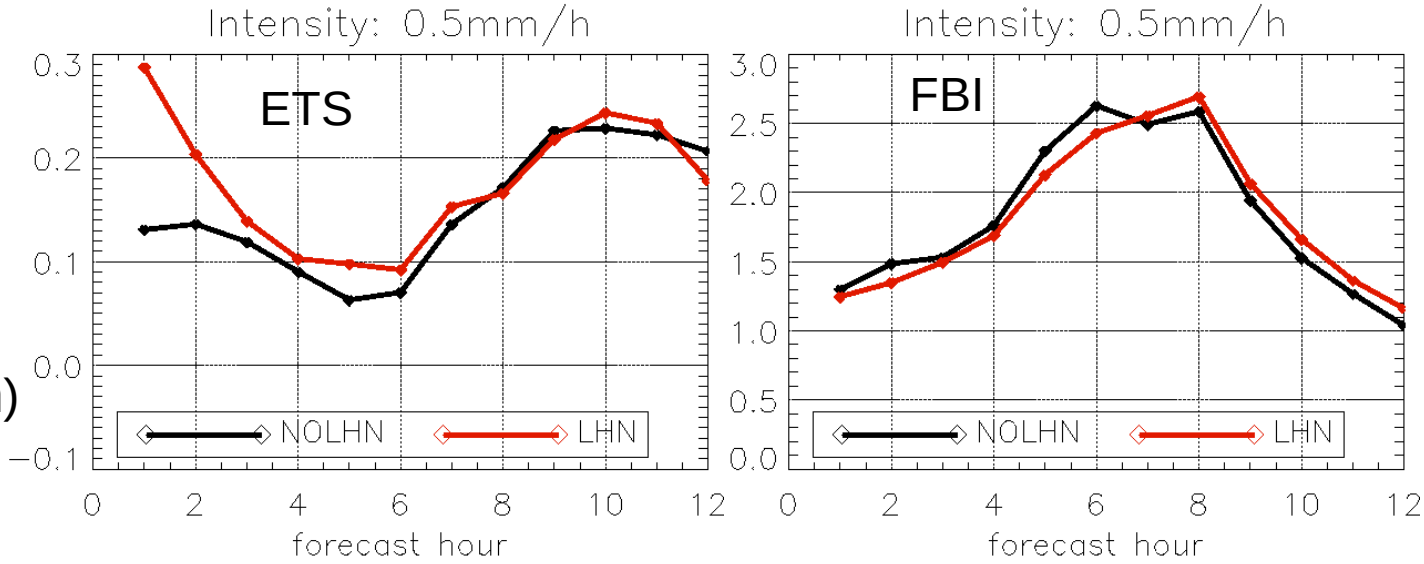
radar – 1DVar-EXP

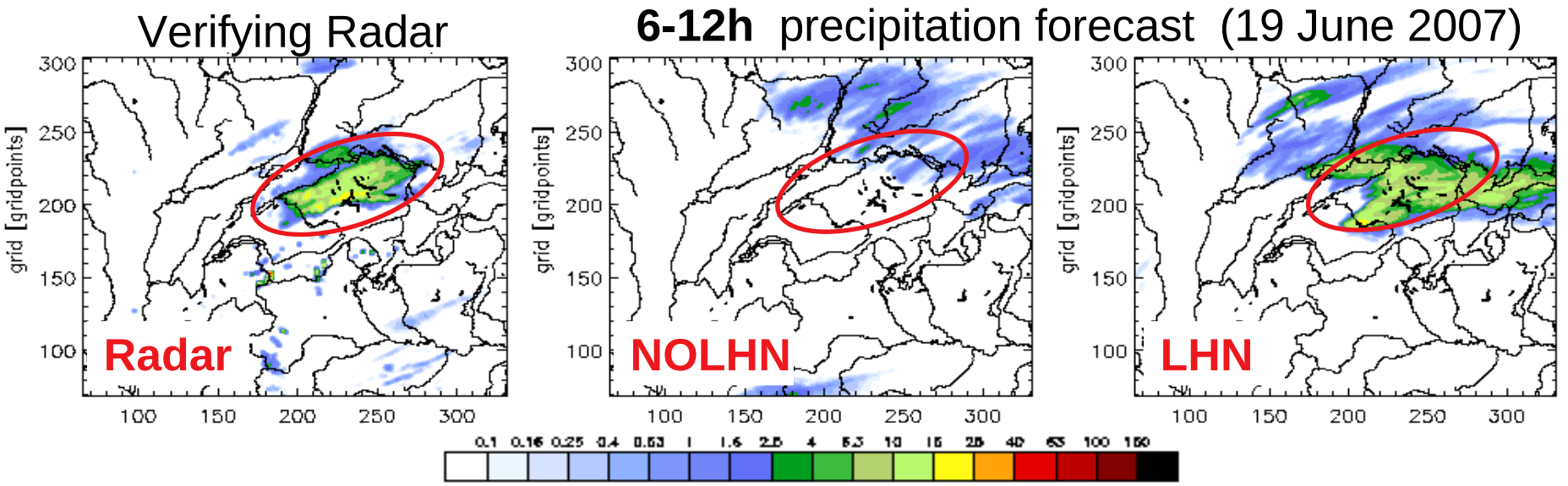


# Latent Heat Nudging operational also at MeteoSwiss

verification of hourly precipitation against radar

11 – 19 June 2007 (air mass convection)



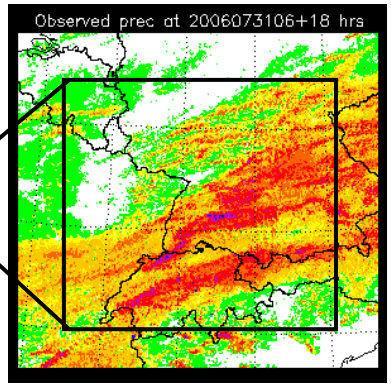
# What determines the impact of LHN ?

Daniel Leuenberger[1], Christian Keil[2] and George Craig[2]

[1] MeteoSwiss, Zurich, Switzerland
[2] DLR, Oberpfaffenhofen, Germany

- use high-resolution NWP ensemble (2.8km mesh size)
  - driven by regional COSMO-LEPS ensemble
  - 10 members with LHN, 10 members without
  - different mesoscale environment in each member
- 3 differently forced convection cases

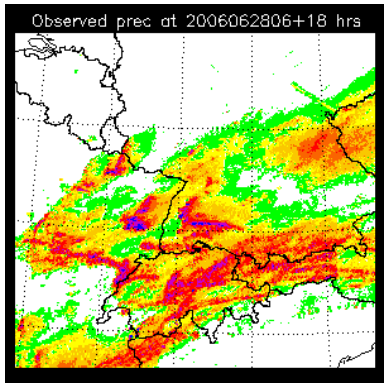
31 July 2006




verification area

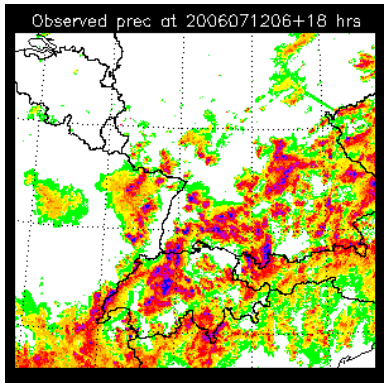
forced frontal

28 June 2006




non-forced frontal
(with upper-level trough, no distinct surface front)

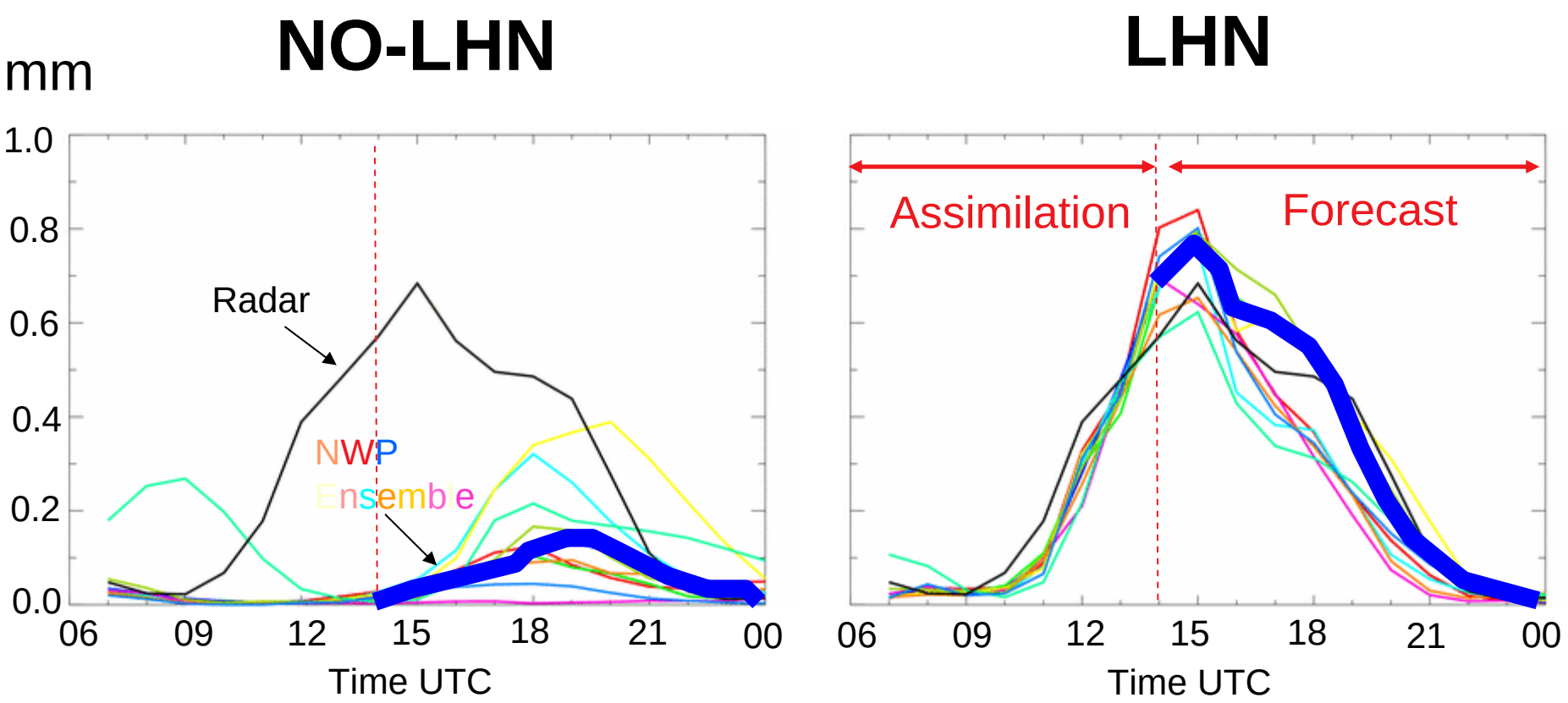
12 July 2006




air mass

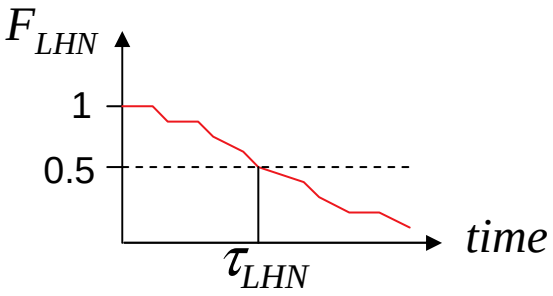
Timelines of observed and simulated area-averaged surface rainfall

## Example: Air mass convection case

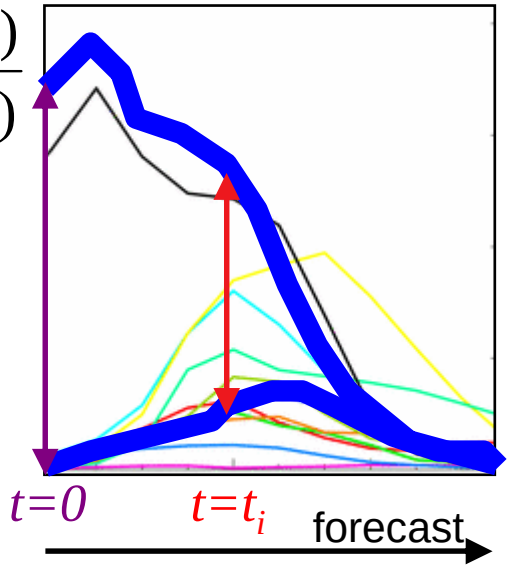


# Definition of Time Scales

- LHN impact factor $F_{LHN}(t_i) \sim \dfrac{P_{LHN} - P_{NOLHN}(t = t_i)}{P_{LHN} - P_{NOLHN}(t = 0)}$




$P$ : rainfall amount in verif. area

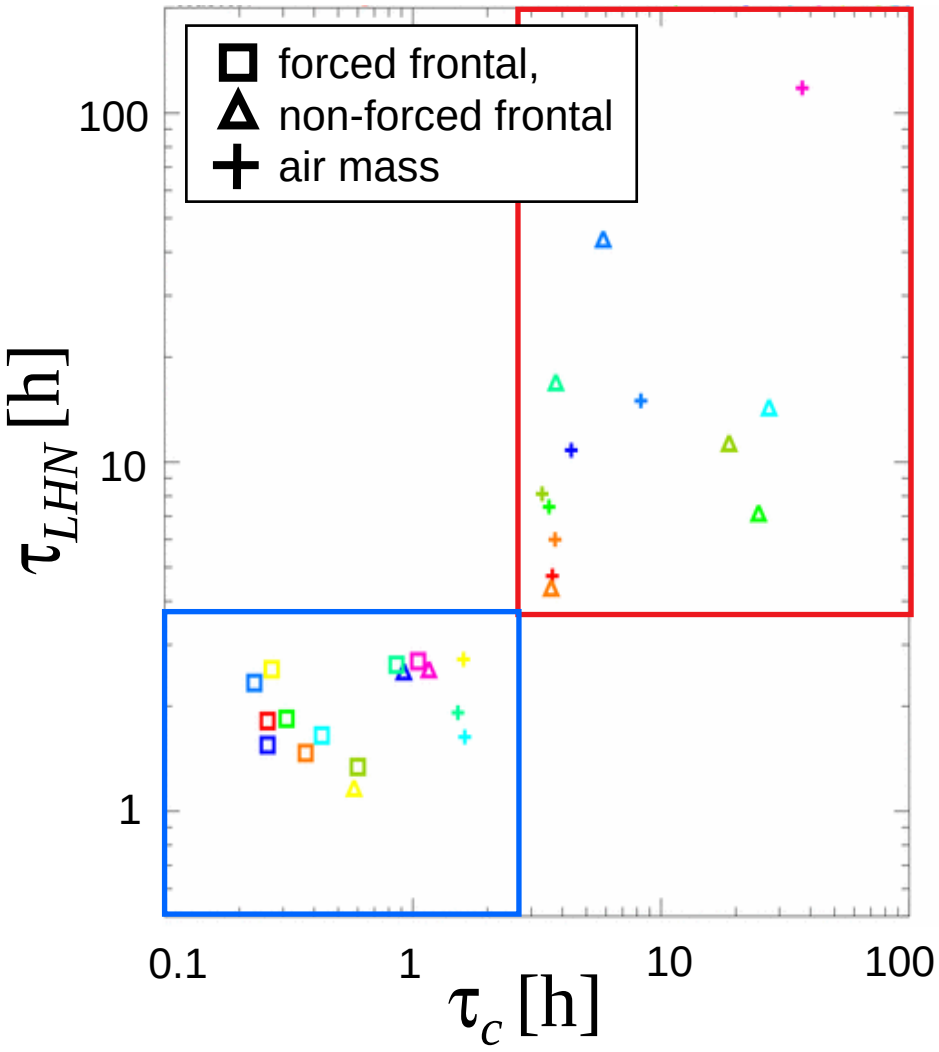



- LHN time scale $\tau_{LHN}$ $\quad F_{LHN}(\tau_{LHN}) = 0.5$
- Convective time scale $\quad \tau_c \sim \dfrac{CAPE}{d(CAPE)/dt}$
  - Done et al. (QJ 2006)

## Stratification of Simulations

results suggest 2 different regimes:

- equilibrium situation:
  - short $\tau_c$
  - precipitation only redistributed
  - short-lived impact of LHN
- non-equilibrium situation:
  - long $\tau_c$
  - LHN triggers convection
  - long lasting impact of LHN




Impact of LHN on QPF dependent on
- precipitation forcing (equilibrium vs. non-equilibrium)
- mesoscale environment of convection (e.g. stability)
- life time of precipitation system
- extent of NWP model domain and radar data coverage

do we have to analyse the small scales, or is it sufficient to analyse the large scales ?

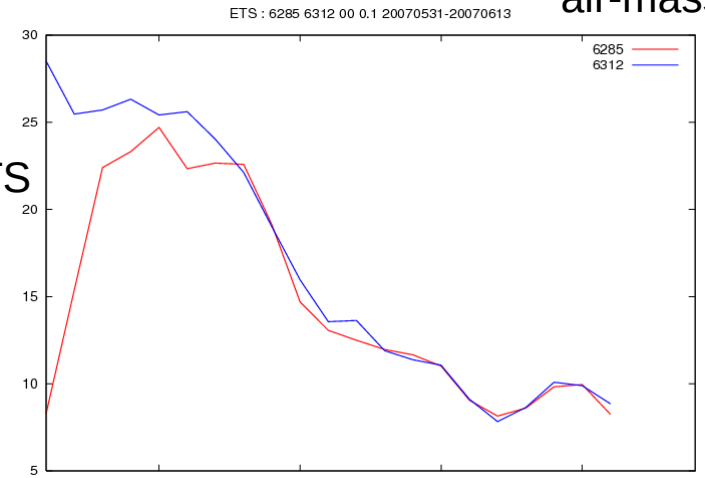
Klaus Stephan, Christoph Schraff (DWD)

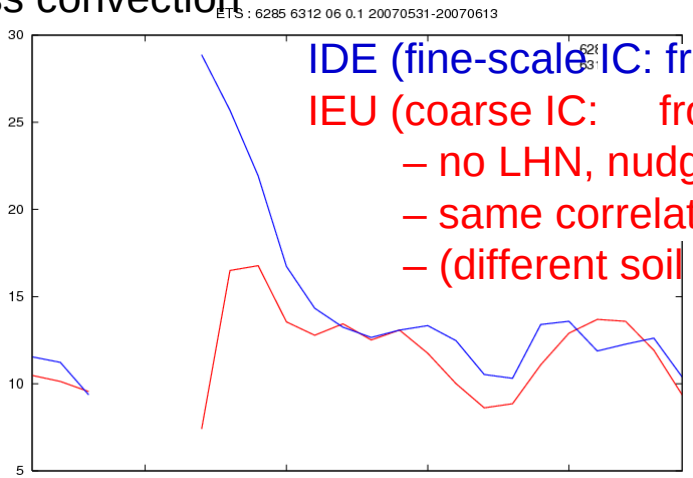
31.05. – 13.06.07:
air-mass convection

00 UTC runs

06 UTC runs

ETS

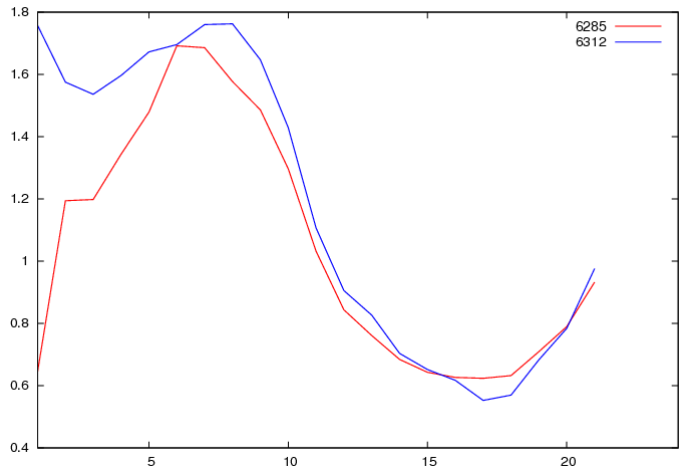


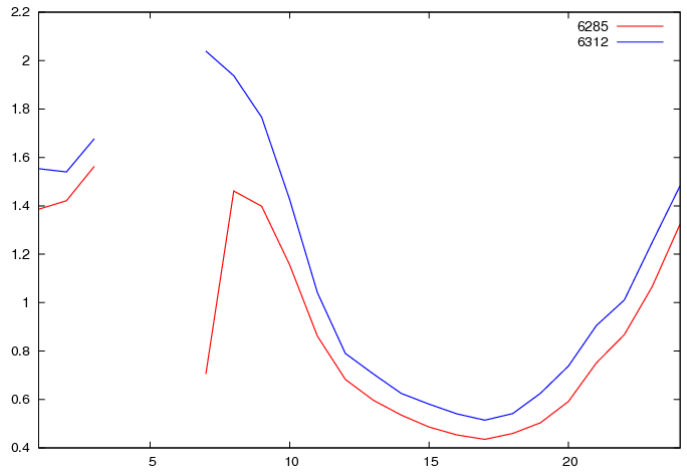




IDE (fine-scale IC: from 2.8 km ass. cycle)
IEU (coarse IC: from interpolated 7 km
– no LHN, nudging on coarse scales
– same correlation scales in nudging
– (different soil moisture) )

0.1 mm → daytime → daytime

FBI



31.05. – 13.06.07:
air-mass convection

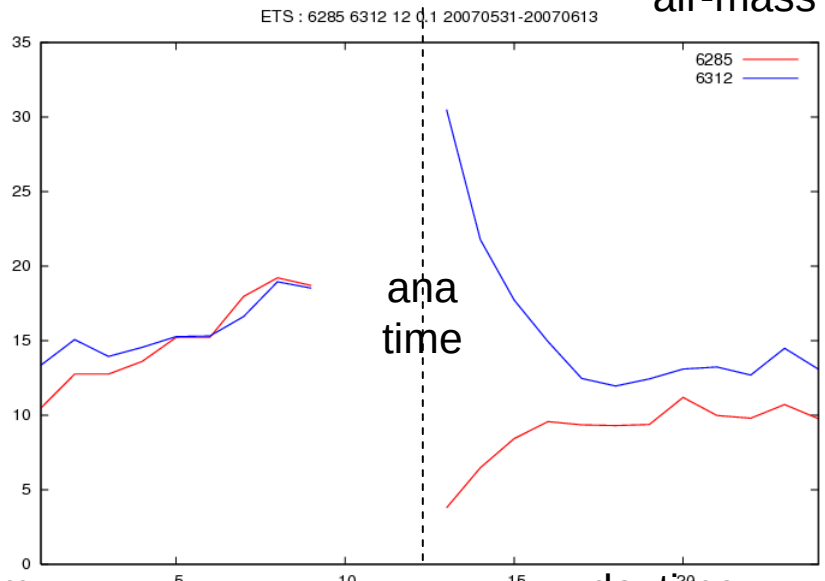
12 UTC runs

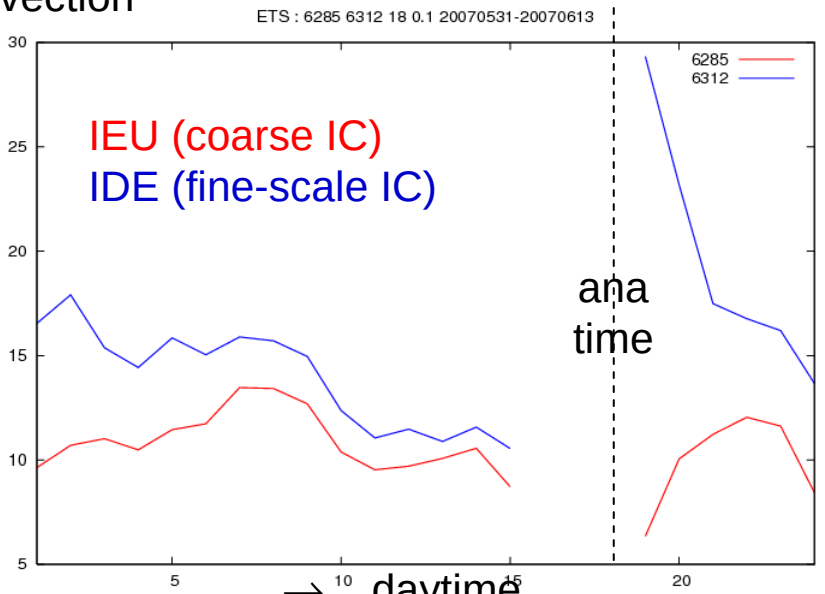
18 UTC runs

ETS

0.1 mm

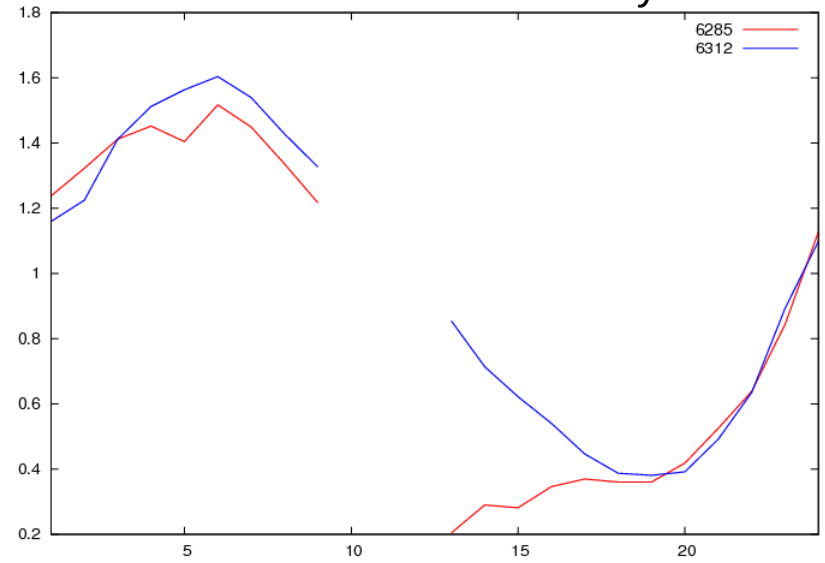
FBI

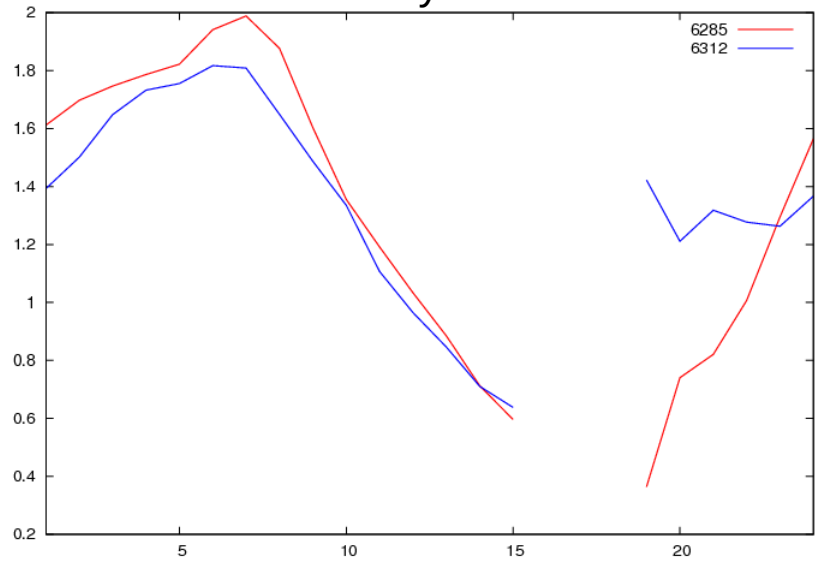



→ daytime

→ daytime



# Status Overview of Data Assimilation in COSMO

31.05. – 13.06.07:
air-mass convection

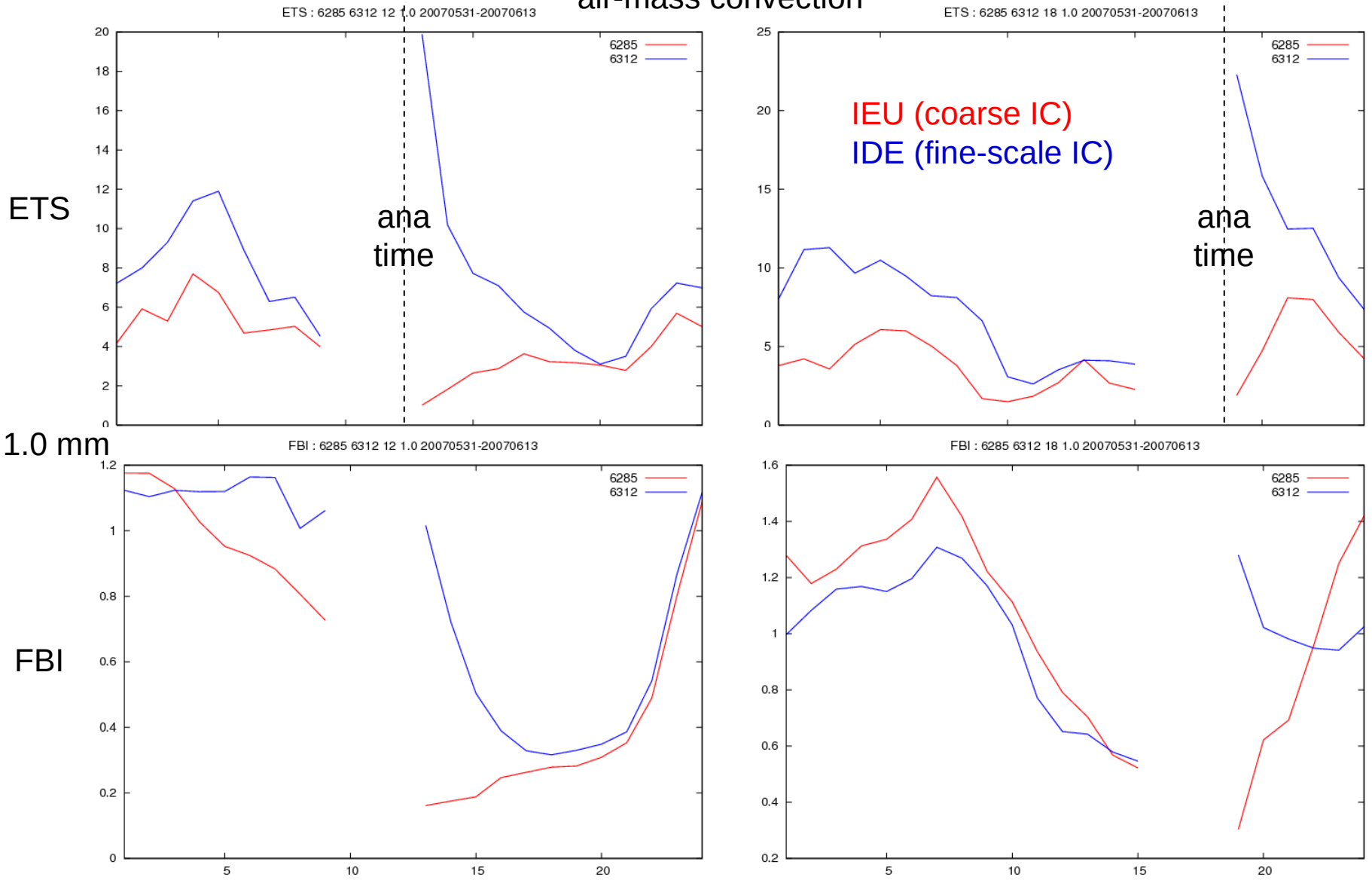
12 UTC runs

18 UTC runs

ETS

1.0 mm

FBI



14.06. – 20.07.07:
frontal period

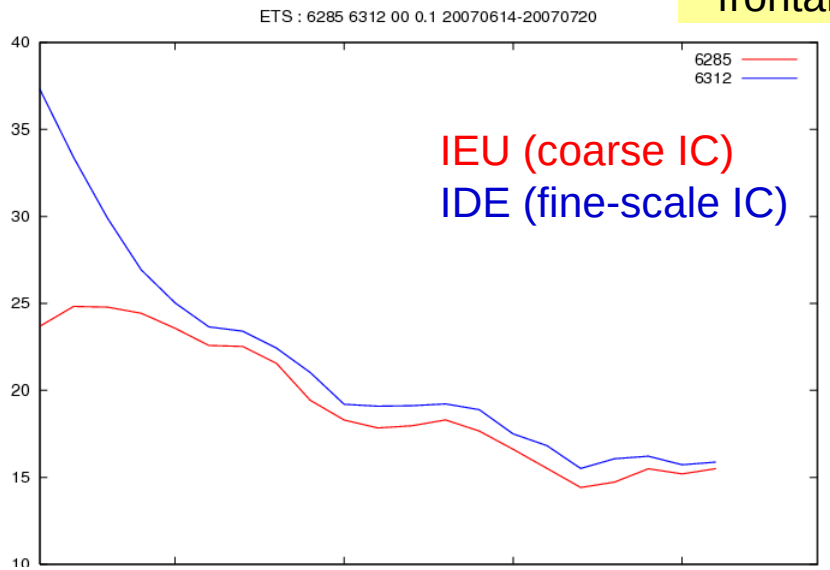
00 UTC runs

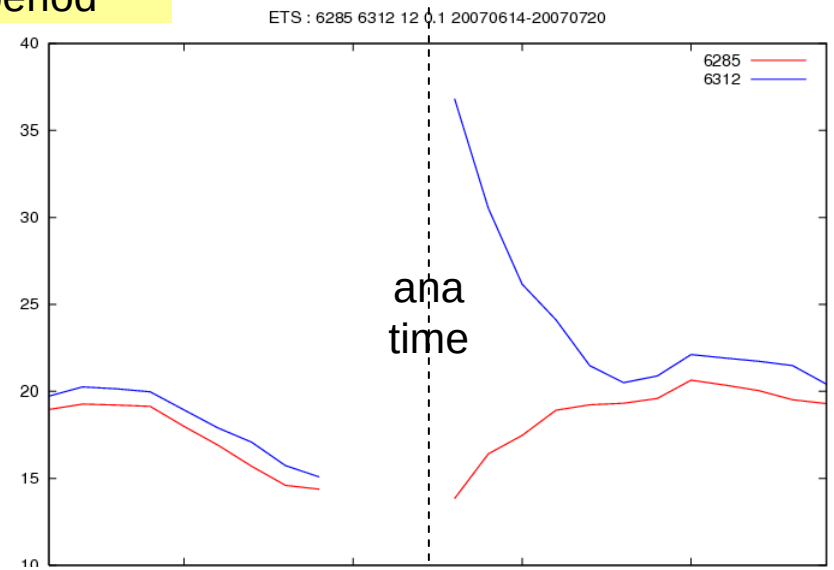
12 UTC runs

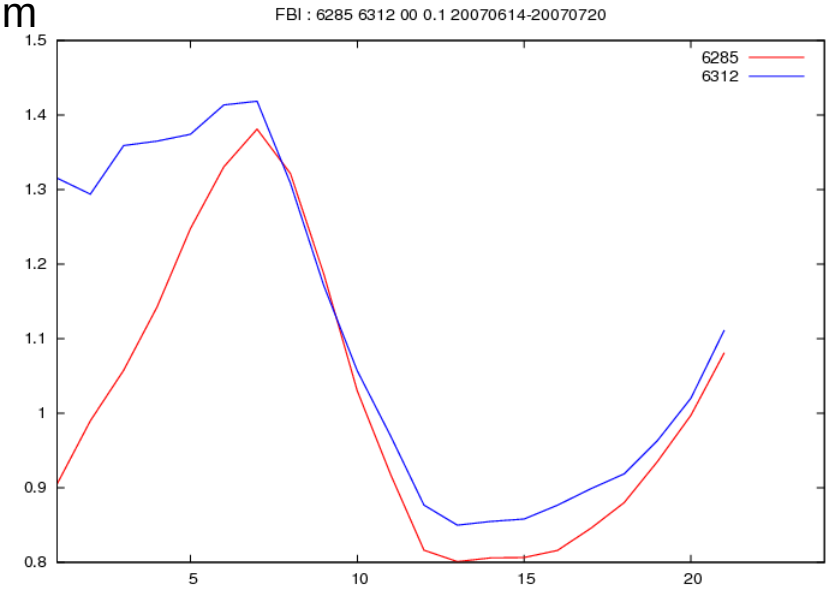
ETS

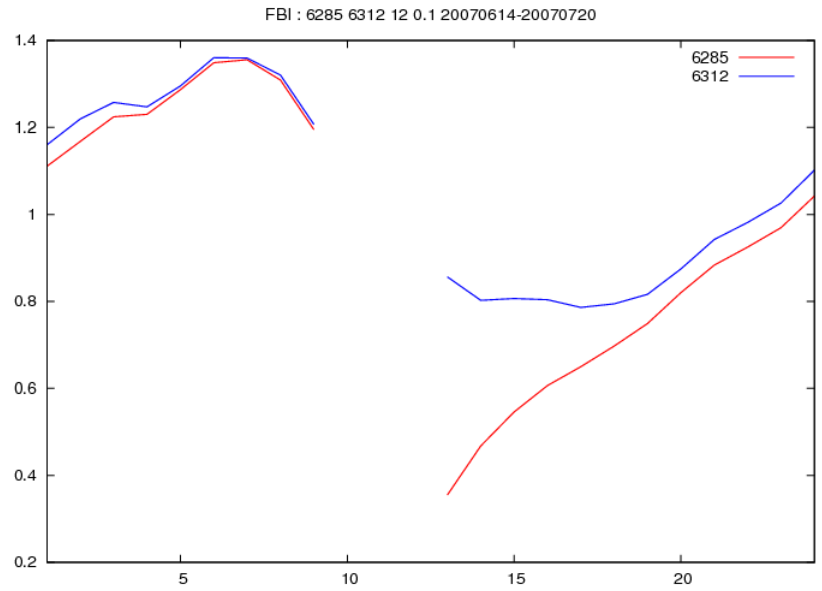
0.1 mm

FBI



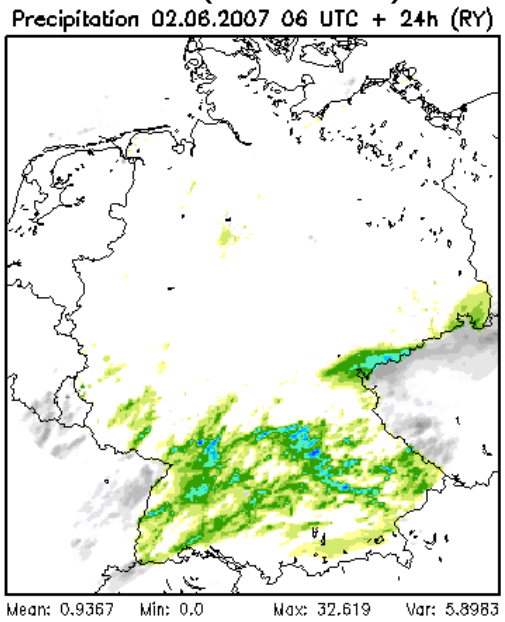
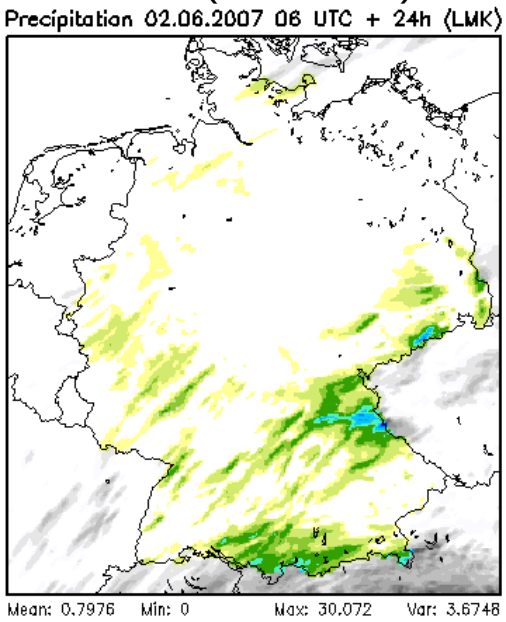
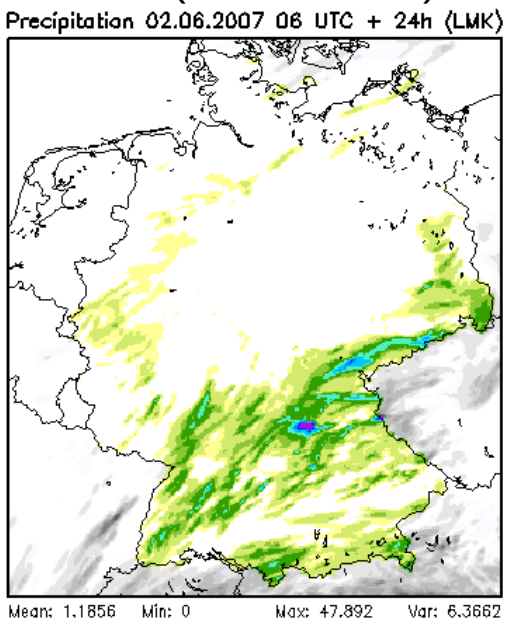
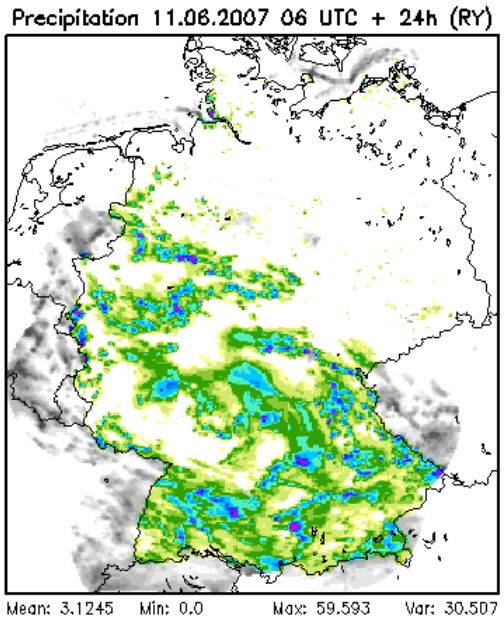
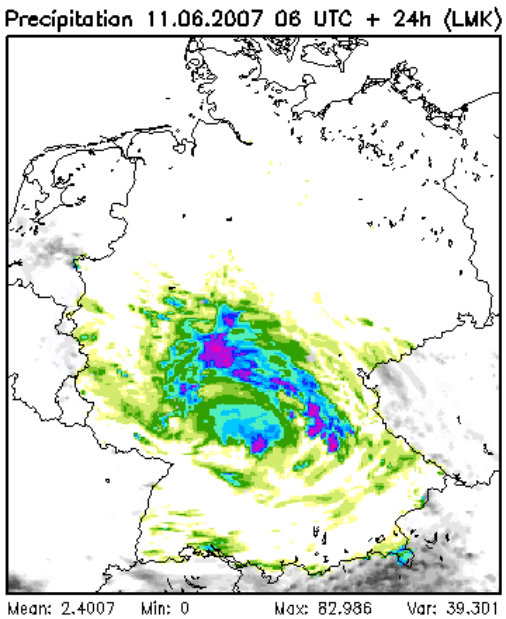
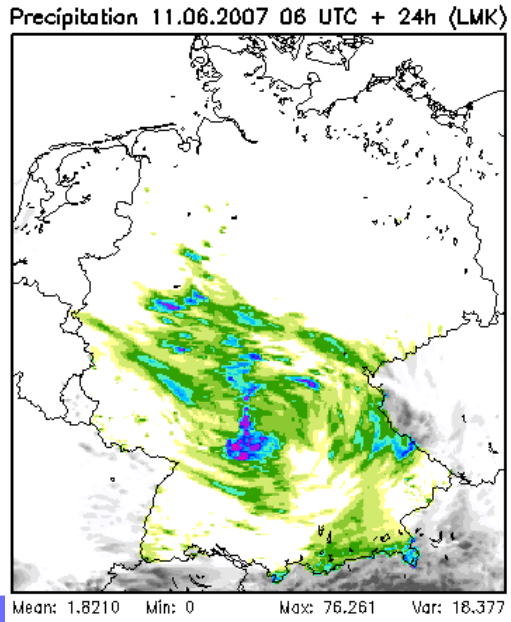



# Status Overview of Data Assimilation in COSMO

model:
2 x
6 – 18 h fcst
=
24-h sum of precipitation

| | radar (24-h sum) | IEU (coarse IC) | IDE (fine-scale IC) |
|---|---|---|---|
| 2 – 3 June 07 |   |   |   |
| 11 – 12 June 07 |   |   |   |

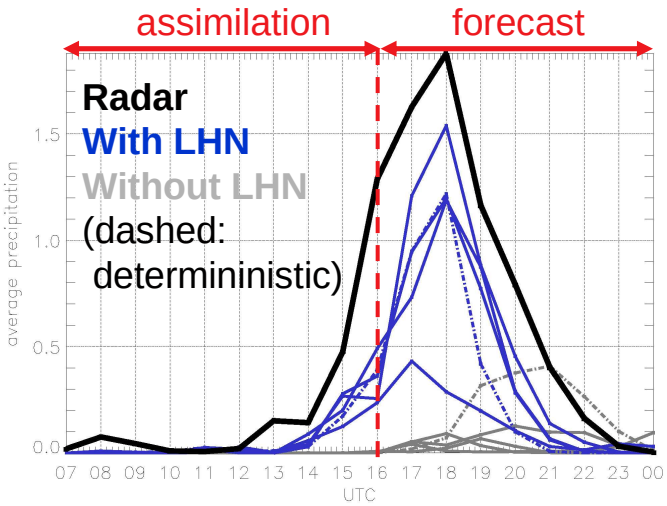
# assess importance of km-scale details in analysis

benefit from fine-scale details in analysis:

- strongly depends on the case

  and on the convective environment

  (past experiments, Leuenberger)



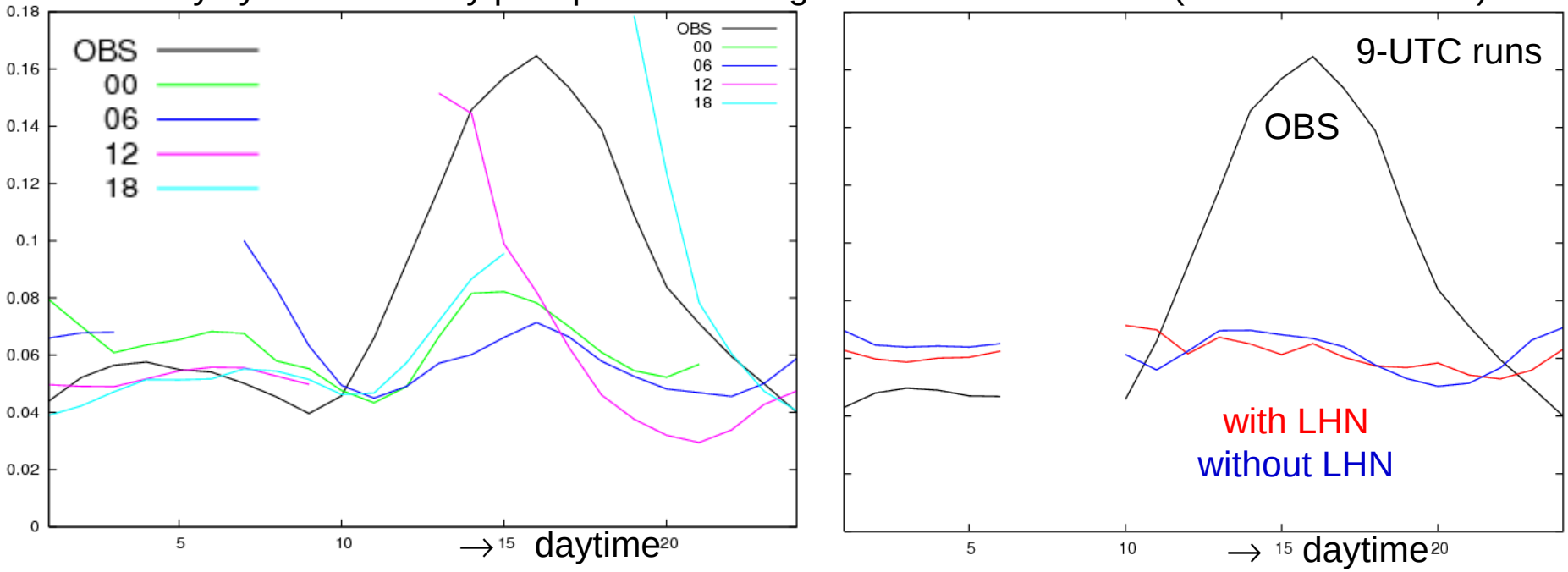

- depends on the initial time of the forecasts (in these experiment)

**Thank you for your attention**

many experiments: – different initial conditions (IDE, IEU, no LHN, no RS-q,…)
– different lateral boundary cond. (opr (delayed), actual, analysis)

→ largest impact on daily cycle of precip. from variation of initial time of forecast !

daily cycle of 1-hourly precipitation averaged over radar domain (31. 05. – 13.06.07)




– the closer the initial time is to 9 UTC, the less (increase of) convection in afternoon
– not significantly affected by LHN, little affected by RS-humidity

→ model climate differs from 'climate' introduced by observations (nudging)

→ experiments: – without ass of upper-air $T$, ($q$)
– without ass of $p_s$ (incl. $T$-correction)