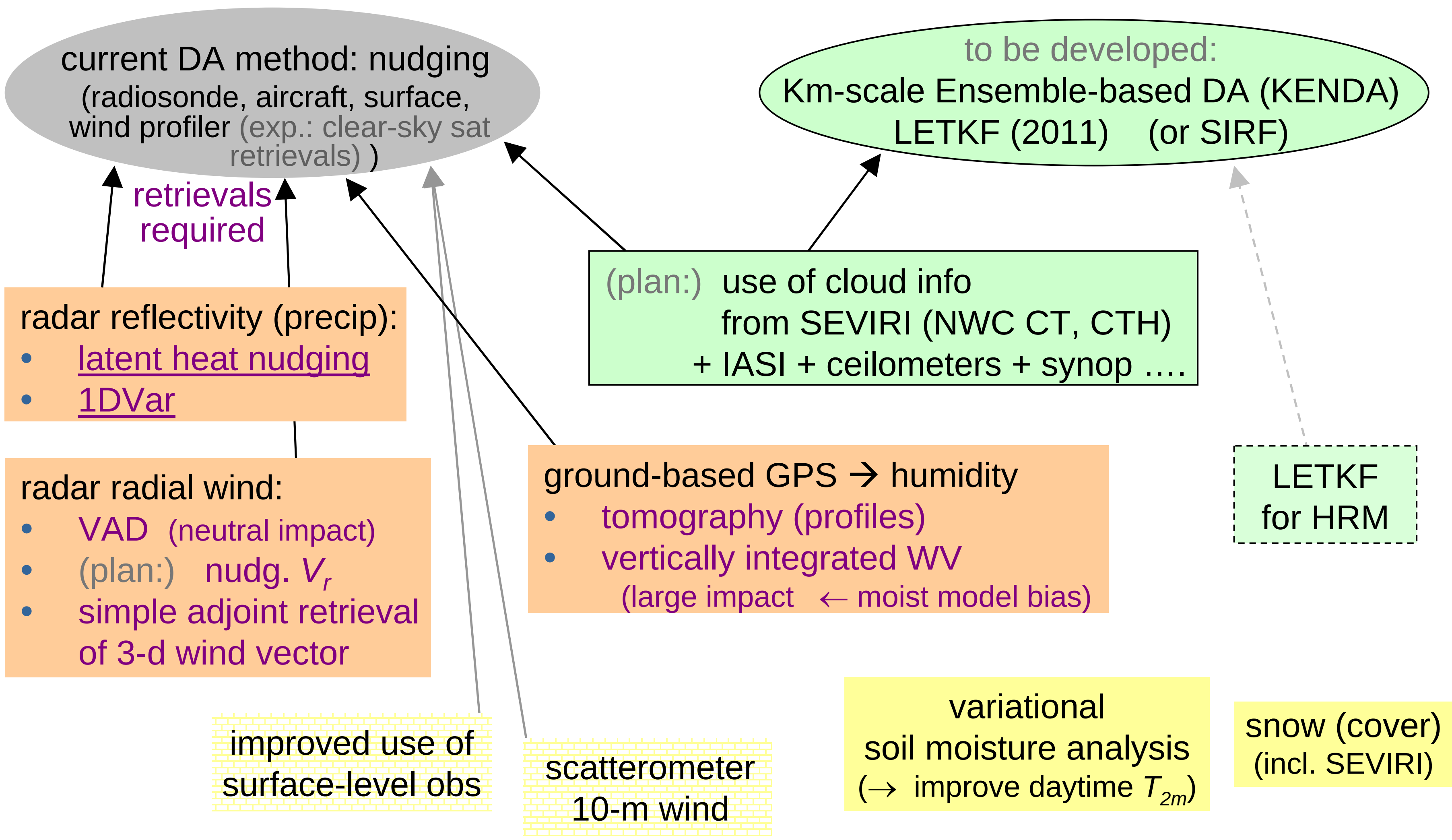
Status Overview in COSMO

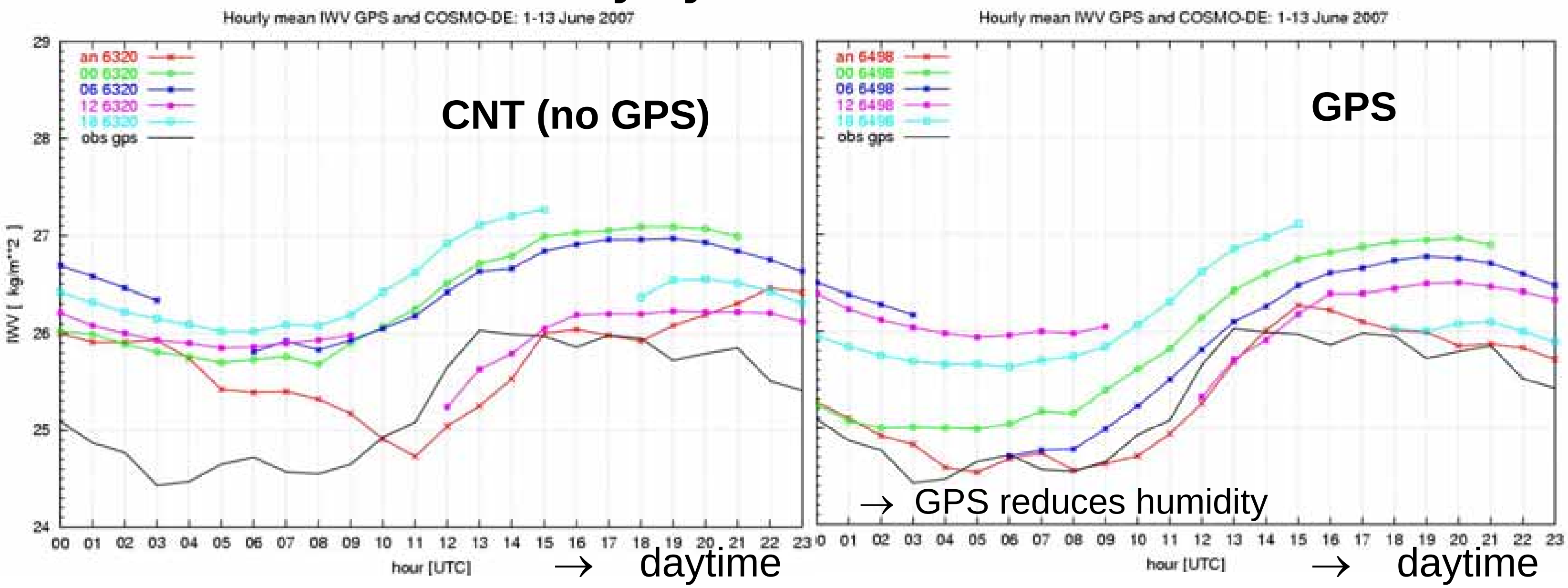
impact of latent heat nudging / fine-scale analysis

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))
retrievals required
to be developed:
Km-scale Ensemble-based DA (KENDA)
LETKF (2011) (or SIRF)
(plan:) use of cloud info from SEVIRI (NWC CT, CTH) + IASI + ceilometers + synop ….
radar reflectivity (precip):
• latent heat nudging
• 1DVar
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)

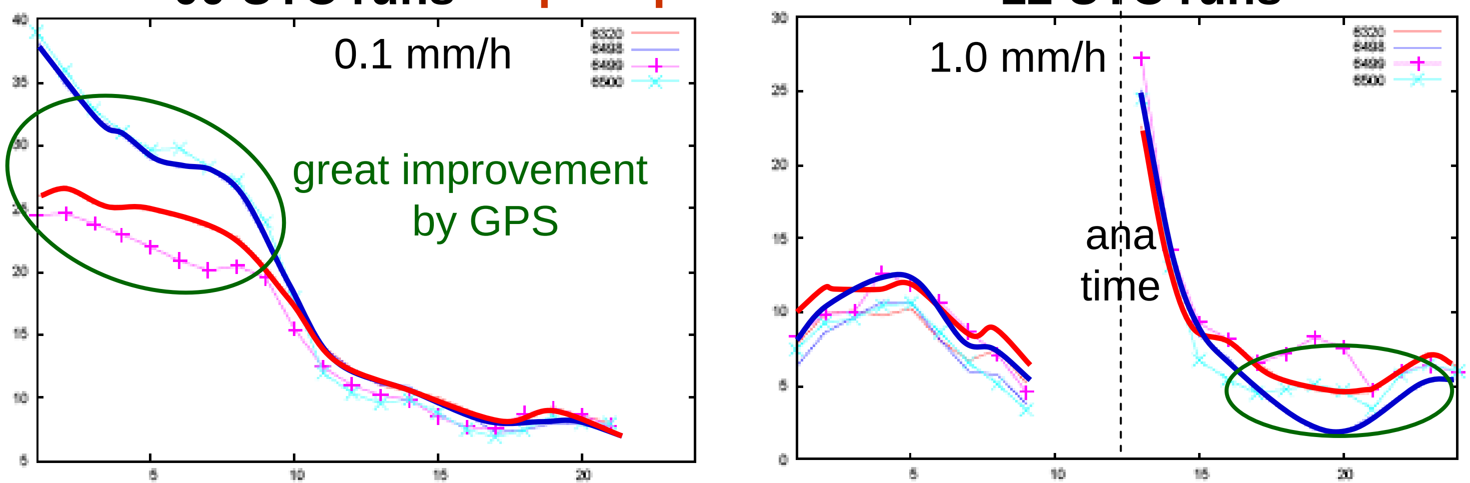
daily cycle of: IWV (1 – 13 June 2007, air-mass convection)



Δx = 2.8 km

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

00 UTC runs precipitation: ETS 12 UTC runs



- CNT
- GPS

degradation because too little strong precip. in early evening

Overview

current DA method: nudging
(radiosonde, aircraft, surface, wind profiler (exp.: clear-sky sat retrievals))

retrievals required

to be developed:
Km-scale Ensemble-based DA (KENDA)
LETKF (2011) (or SIRF)

(plan:) use of cloud info from SEVIRI (NWC CT, CTH) + IASI + ceilometers + synop ….

radar reflectivity (precip):
- latent heat nudging
- 1DVar

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

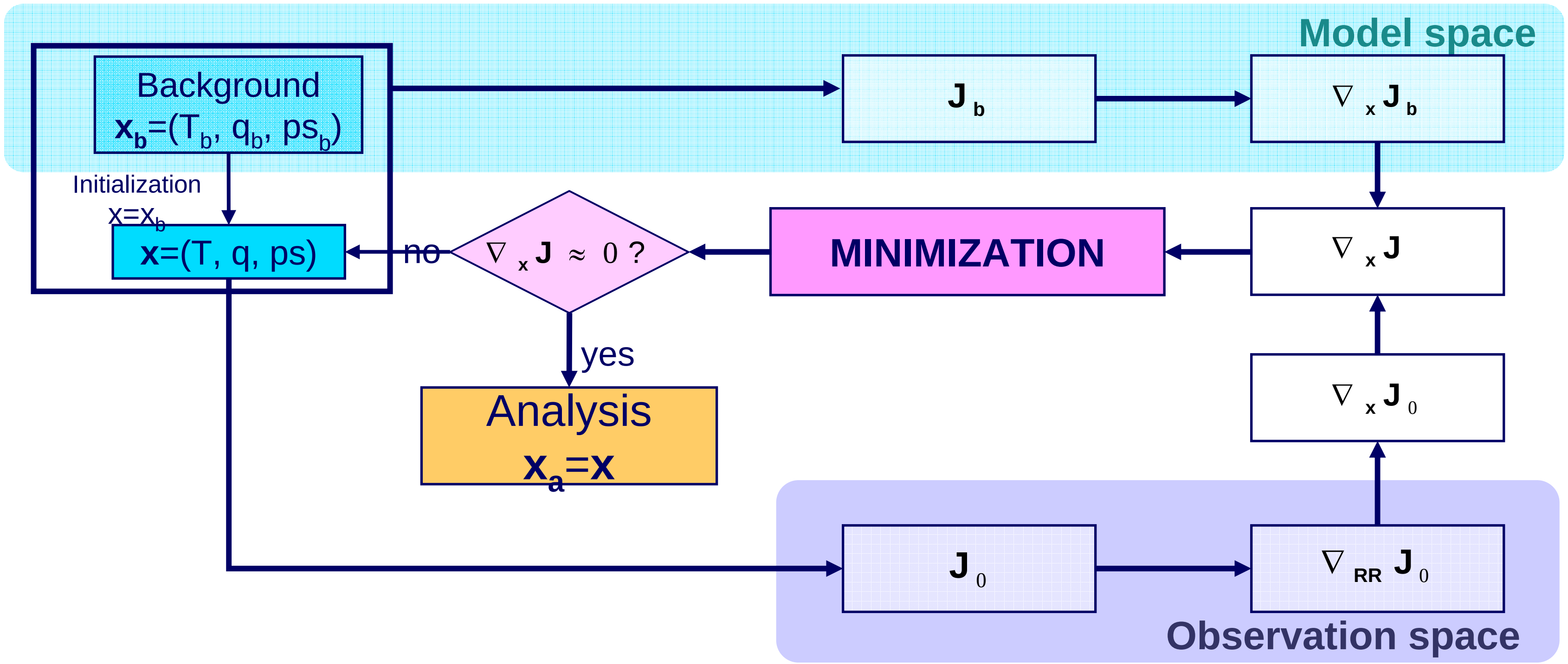
variational soil moisture analysis
(→ improve daytime T_{2m})

snow (cover) (incl. SEVIRI)

Use of radar-derived surface precipitation

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

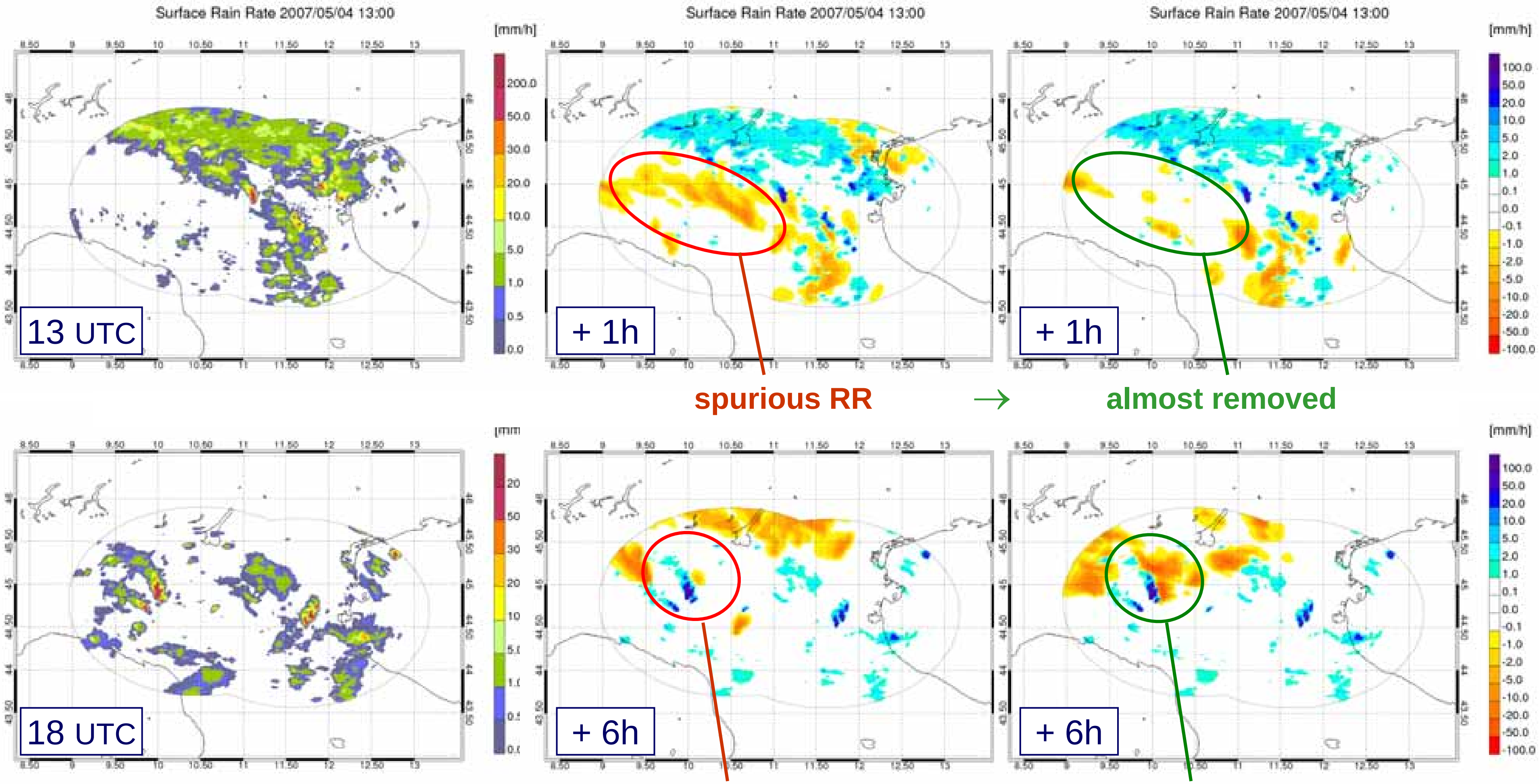
1DVAR to retrieve T, q –profiles from RR (using linearised parameterisations of large-scale condensation and convection)
then nudge T, q –profiles



Example of RR assimilation

encouraging results !

radar | radar – CTRL (no 1DVar) | radar – 1DVar-EXP



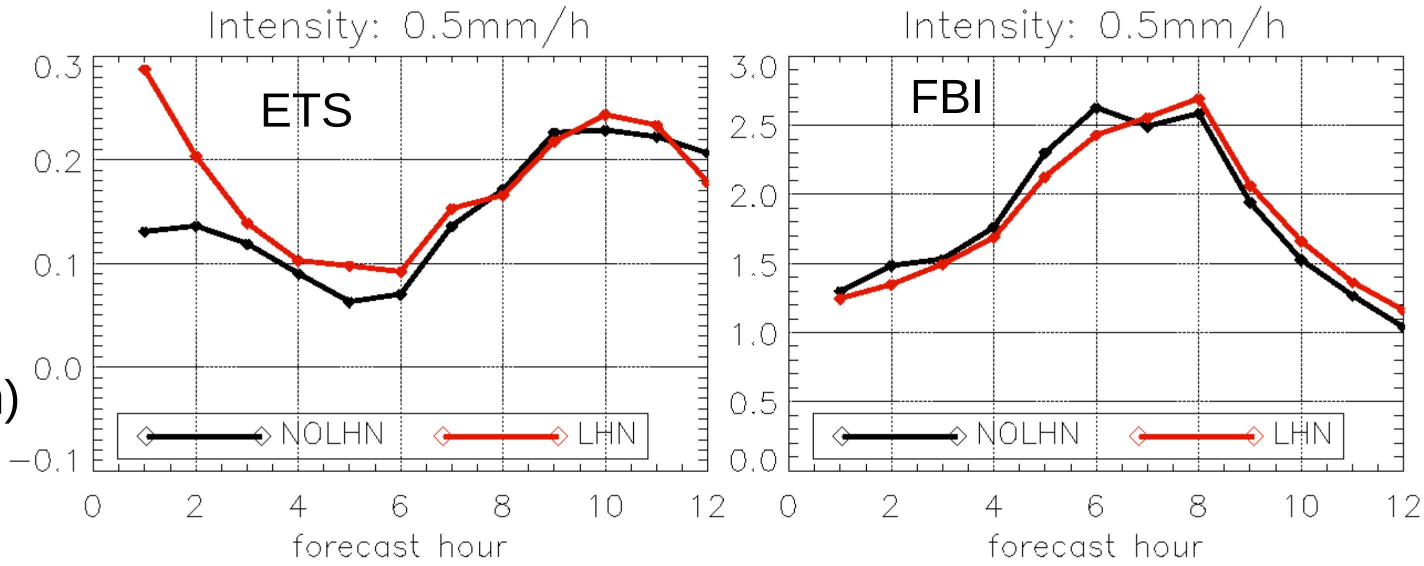
missed RR → introduced with small displacement

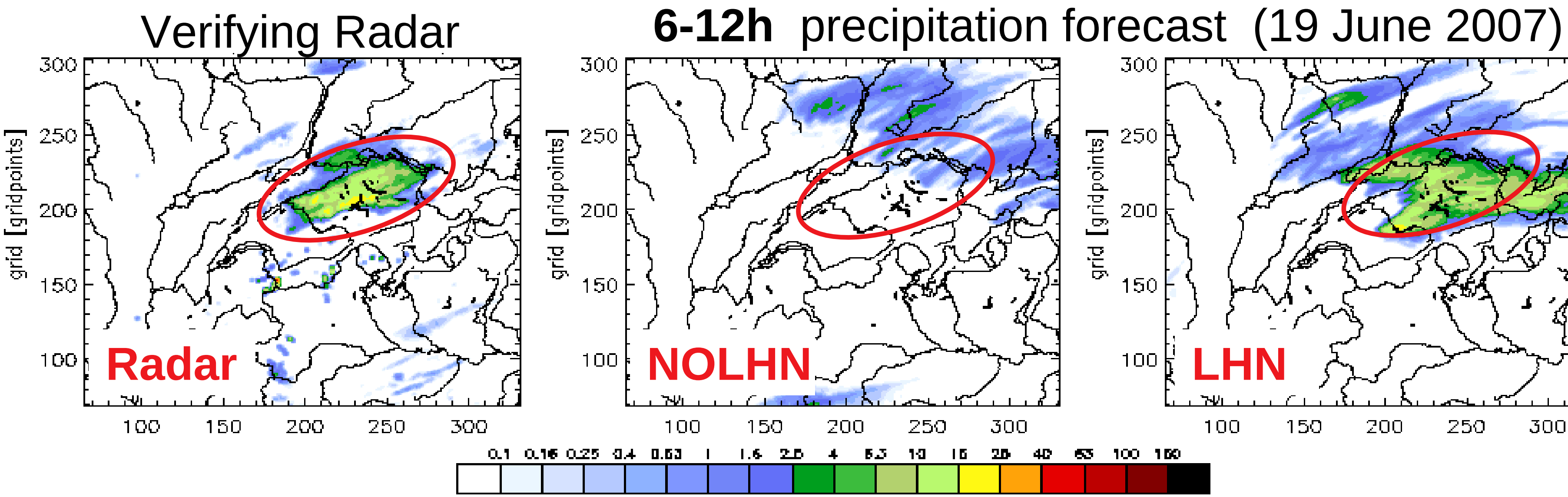
christoph.schraff@dwd.de

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 ?

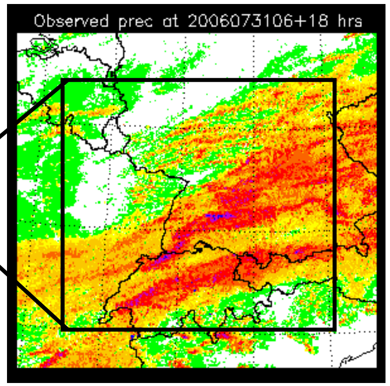
Daniel Leuenberger[1], Christian Keil[2] and George Craig[2]

[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

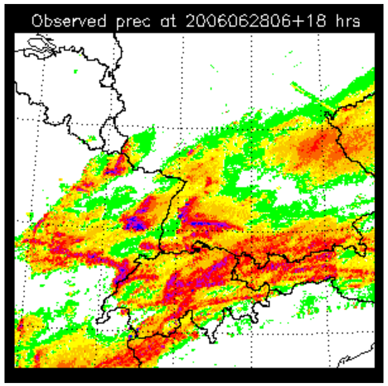
31 July 2006

verification area



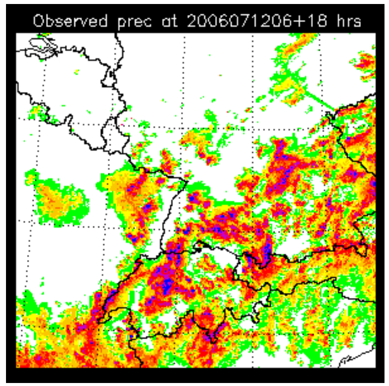
forced frontal

28 June 2006



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

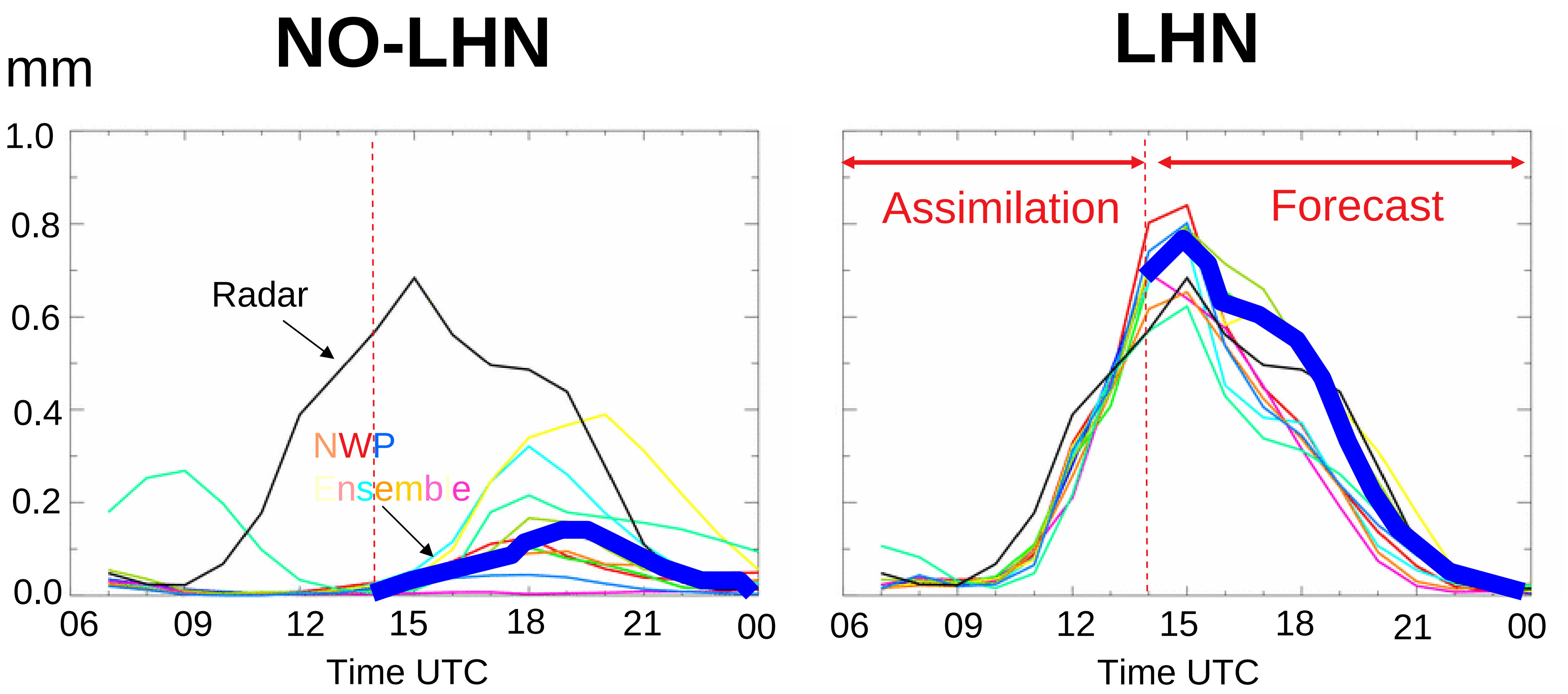
12 July 2006



air mass

Timelines of observed and simulated area-averaged surface rainfall

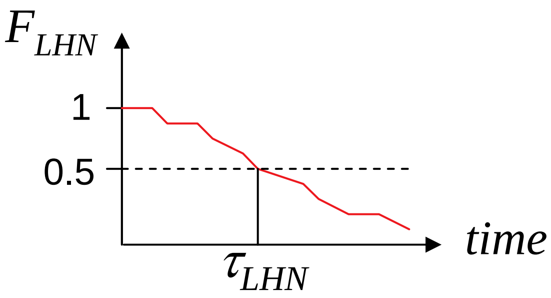
Example: Air mass convection case



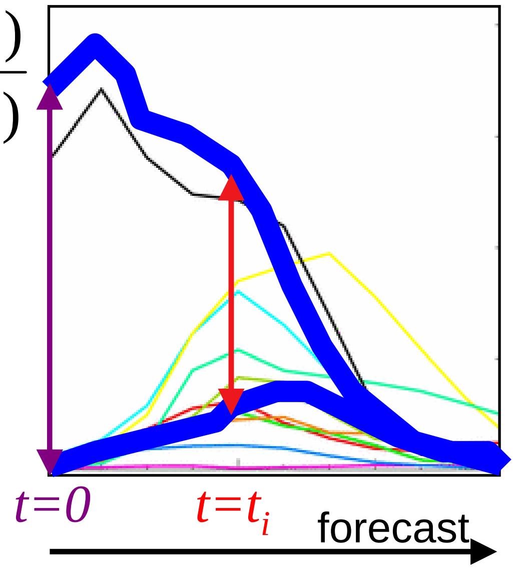
christoph.schraff@dwd.de

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



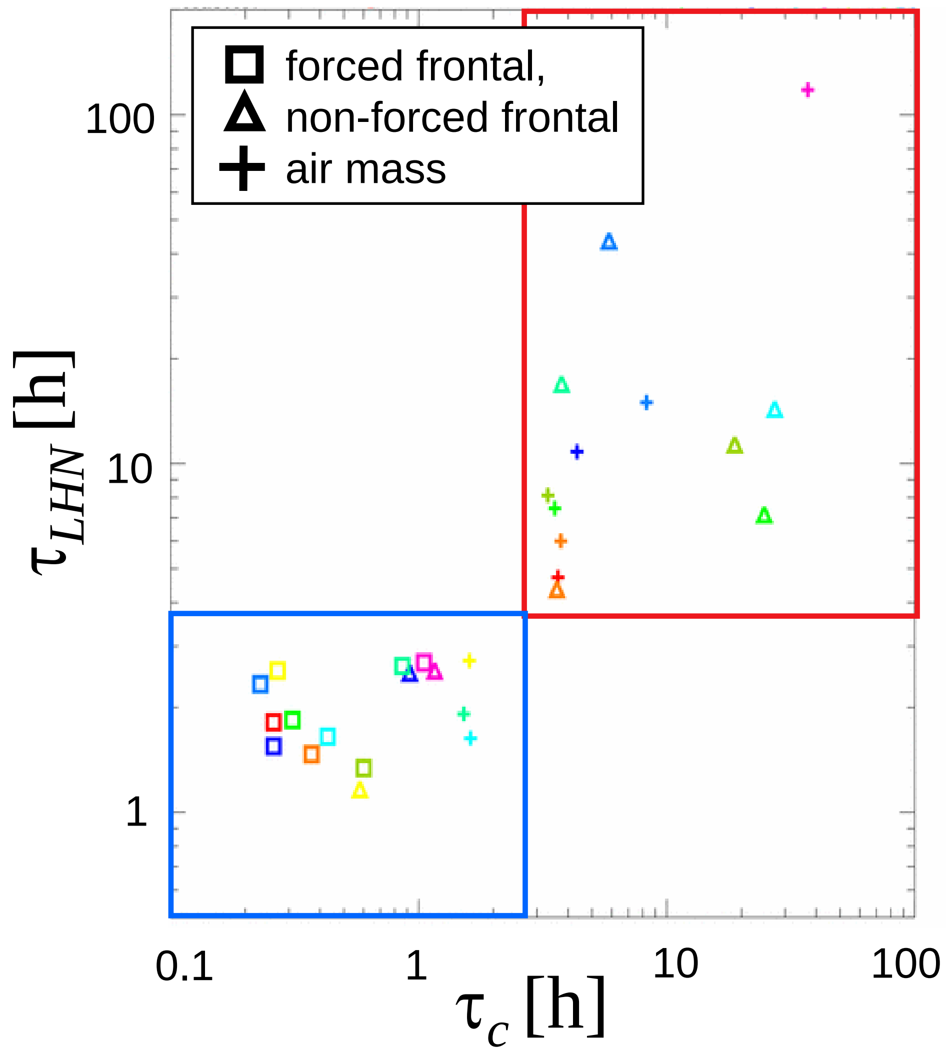
- LHN time scale τ_{LHN} $\quad F_{LHN}(\tau_{LHN}) = 0.5$

- 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 τ_c
  - precipitation only redistributed
  - short-lived impact of LHN
- non-equilibrium situation:
  - long τ_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

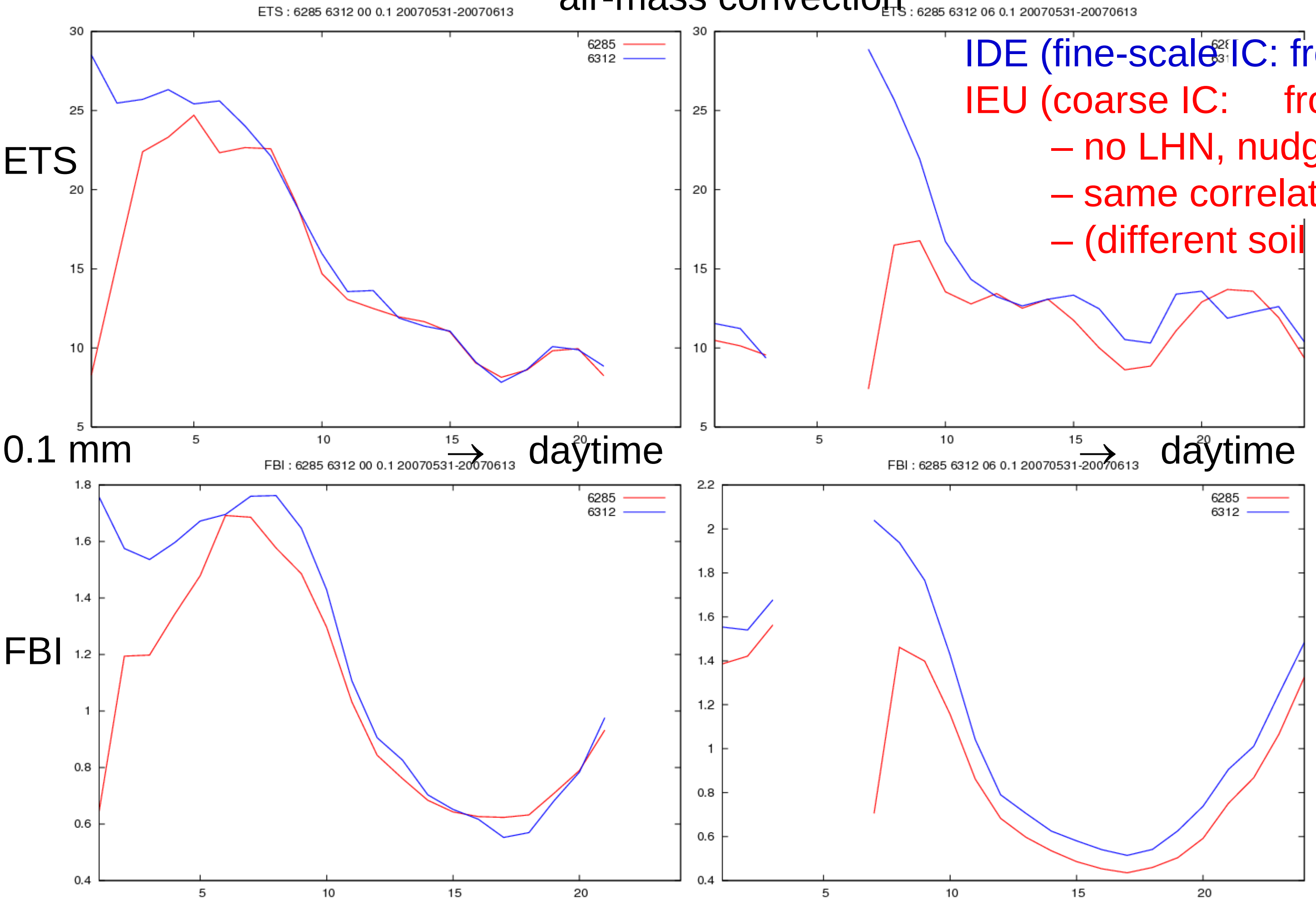
IDE (fine-scale IC: from 2.8 km ass. cycle)

IEU (coarse IC: from interpolated 7 km

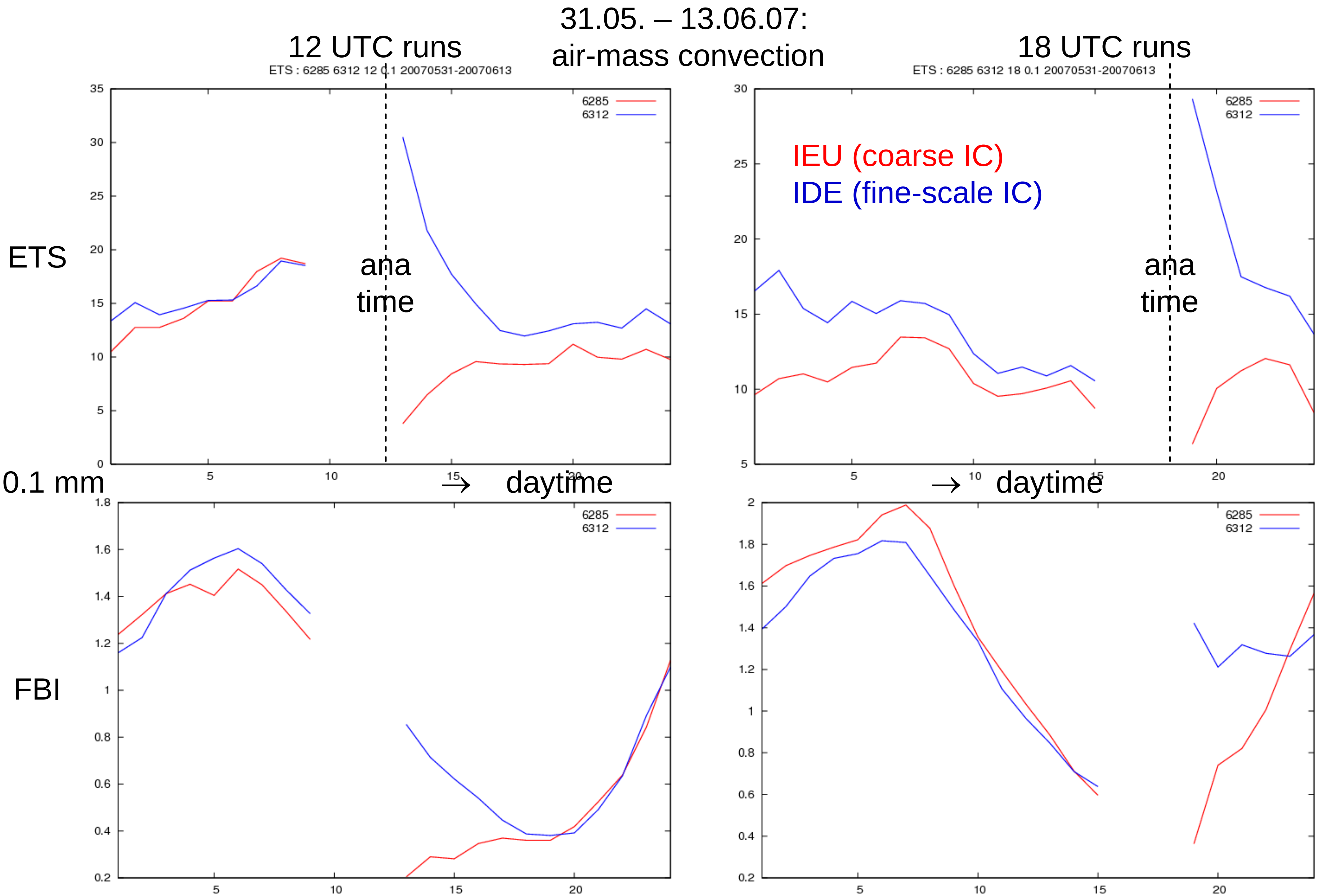
– no LHN, nudging on coarse scales

– same correlation scales in nudging

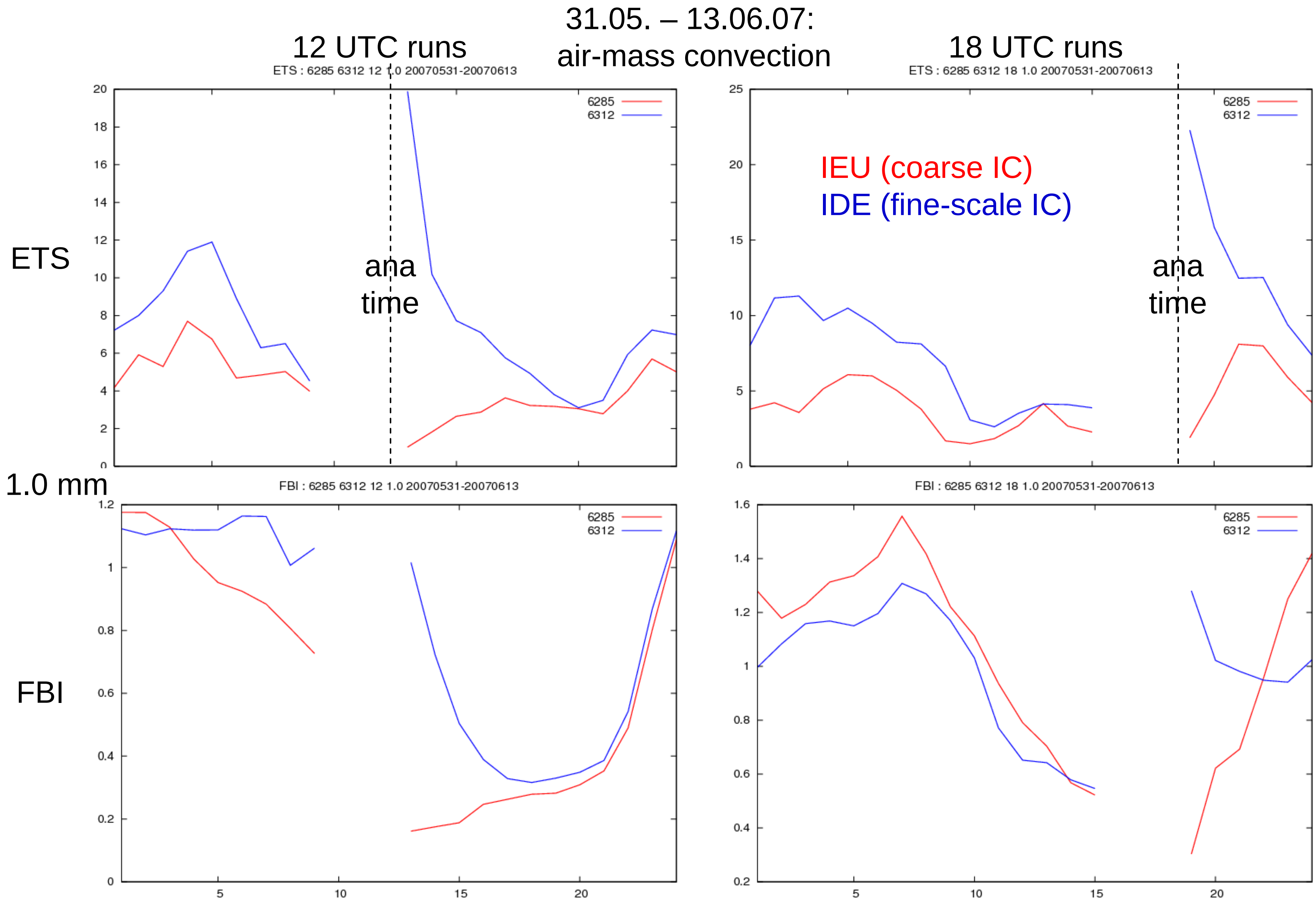
– (different soil moisture))

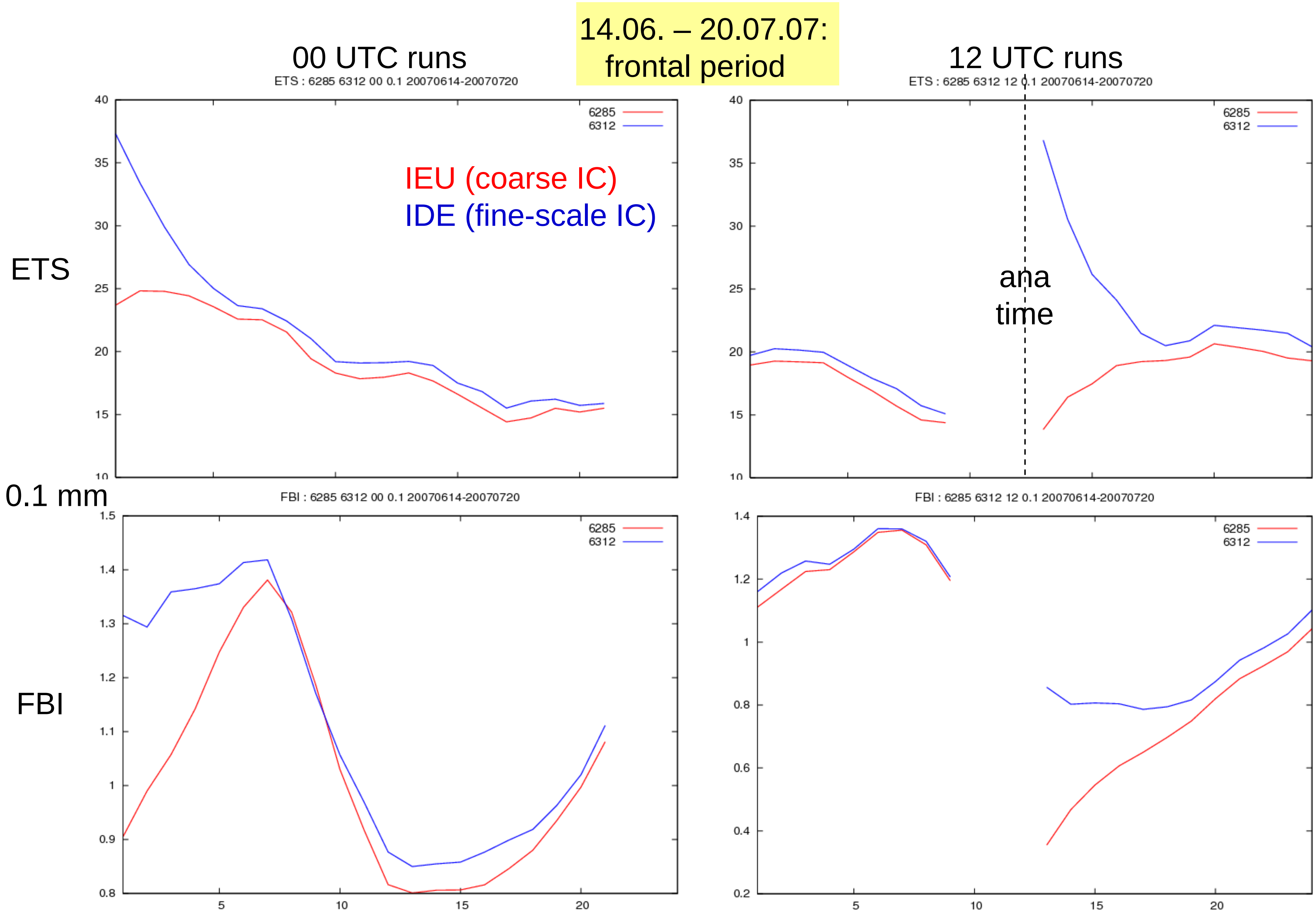


Status Overview of Data Assimilation in COSMO



Status Overview of Data Assimilation in COSMO




14.06. – 20.07.07:
frontal period
00 UTC runs
12 UTC runs
ETS : 6285 6312 00 0.1 20070614-20070720
ETS : 6285 6312 12 0.1 20070614-20070720
FBI : 6285 6312 00 0.1 20070614-20070720
FBI : 6285 6312 12 0.1 20070614-20070720
6285
6312
IEU (coarse IC)
IDE (fine-scale IC)
ETS
0.1 mm
FBI
ana
time

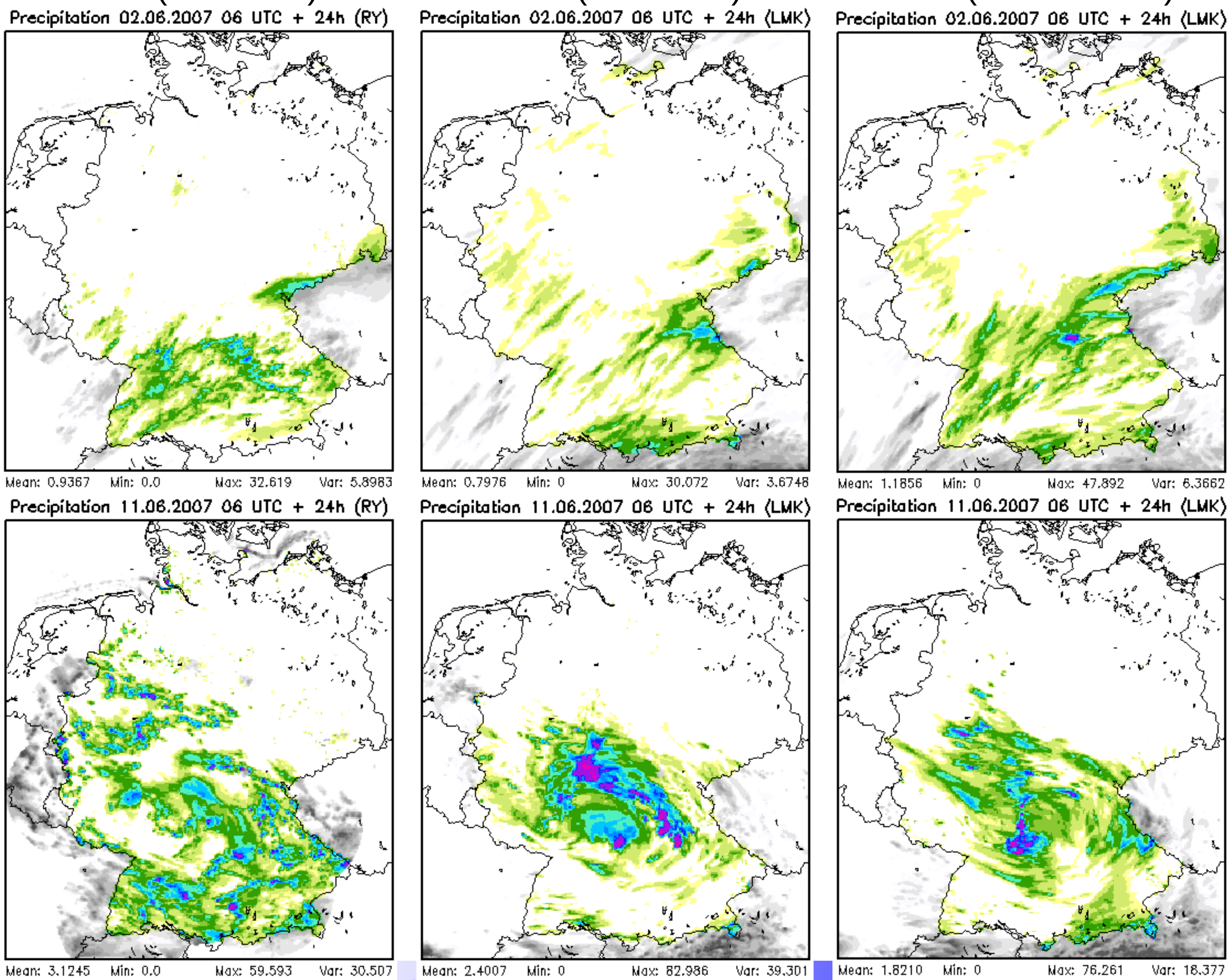
Status Overview of Data Assimilation in COSMO

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



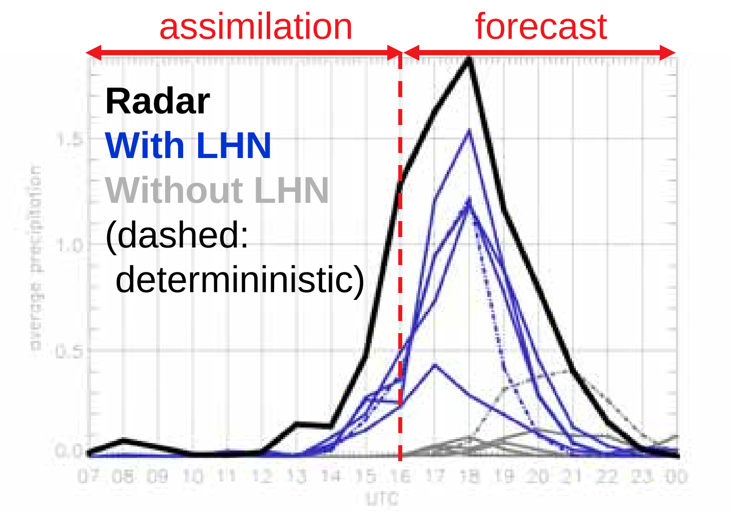
assess importance of km-scale details in analysis

benefit from fine-scale details in analysis:

- strongly depends on the case

  and on the convective environment

  (past experiments, Leuenberger)



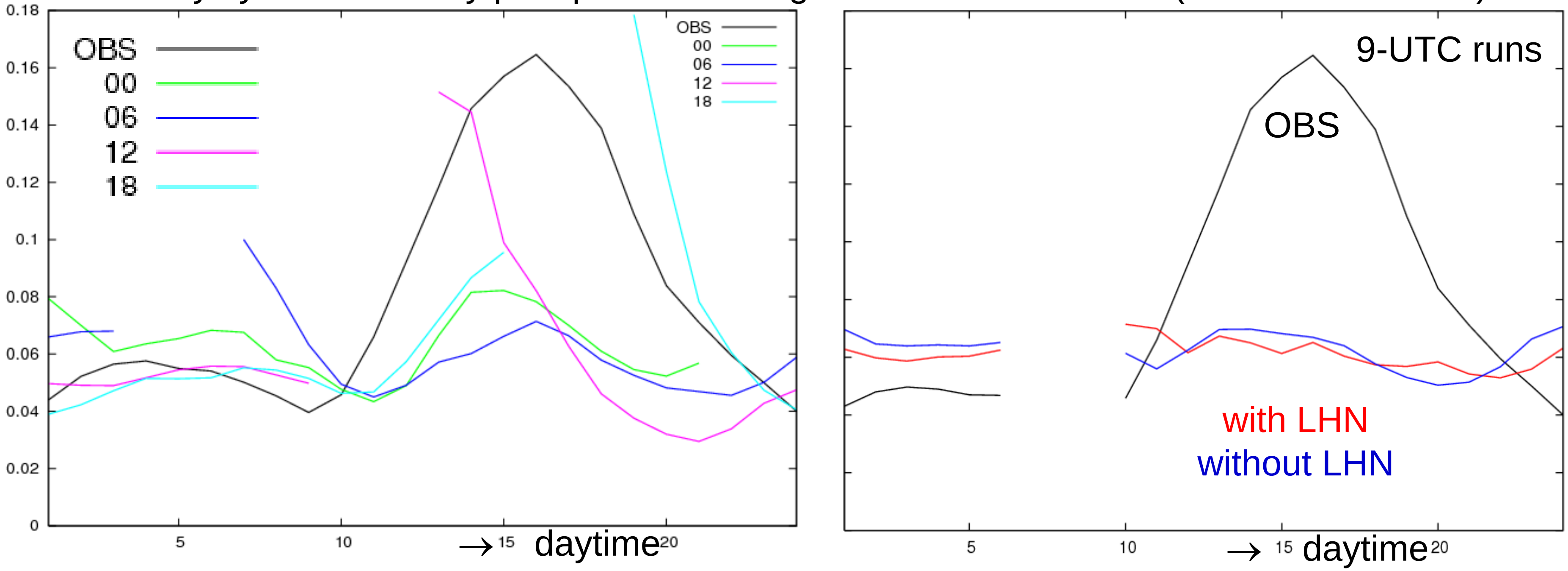
- depends on the initial time of the forecasts (in these experiment)

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)