Deutscher Wetterdienst

Role of COPS for improving model deficiencies from the view of the DWD

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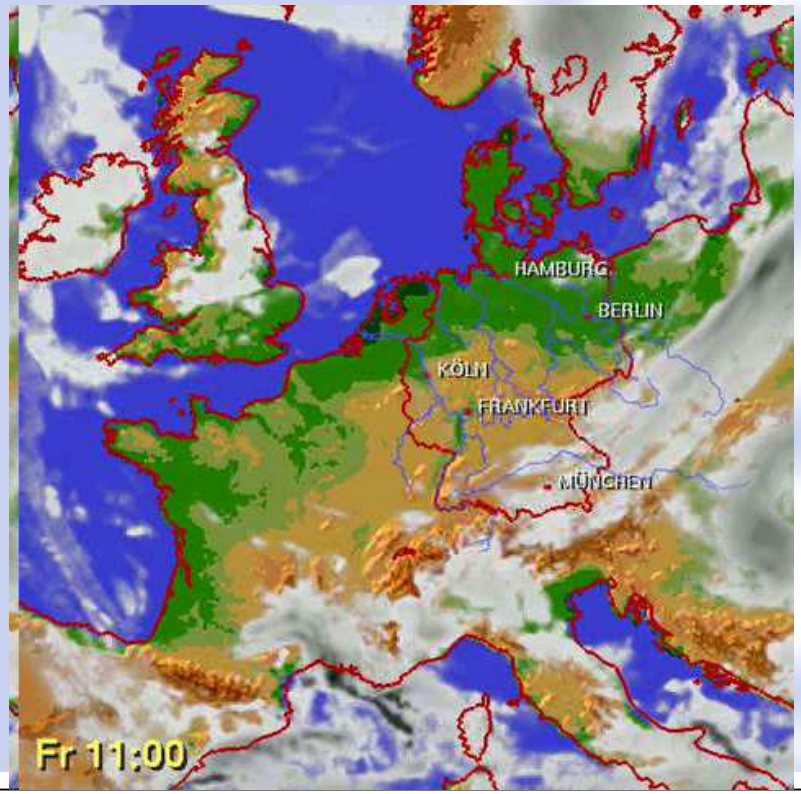
Local Model LM

nonhydrostatic (elastic) model
objective: direct simulation of deep convection



CONSORTIUM FOR SMALL SCALE MODELING
COSMO

www.cosmo-model.org

UGM, ARPA DWD, GeoInfoDBW

HNMS Meteo-Schweiz IMGW

Global model GME

grid size: 40 km

layers: 40

forecast time: 174 h from 00 and 12 UTC

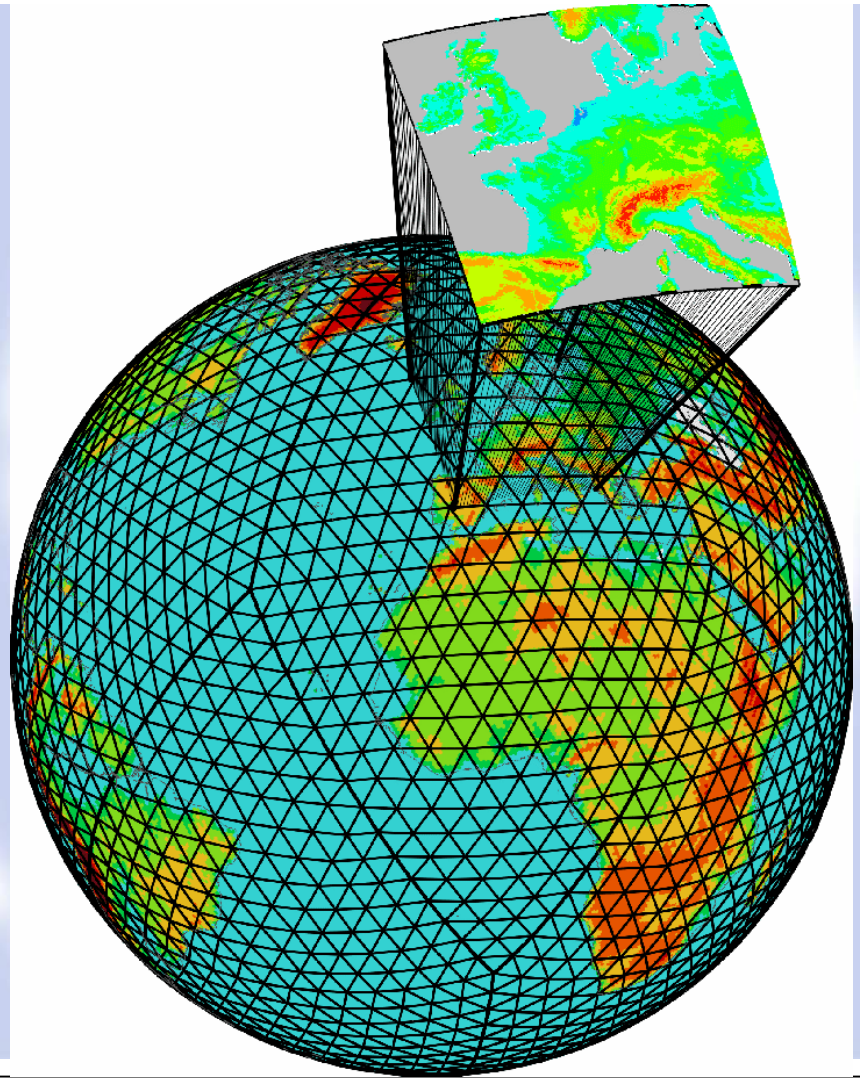
48 h from 18 UTC

1 grid element: 1384 km^2

data assimilation:

OI with 1d-VAR for radiances

2006: 3d-Var



Local model LM

grid size: 7 km

layers: 35

forecast time: 48 h

from 00, 12 and 18 UTC

1grid element: 49 km^2

September 2005: LME

data assimilation:

nudging, later 3d-Var

local model very short range „Kürzestfrist“ (LMK)

grid size 2,8 km

forecast time 18h

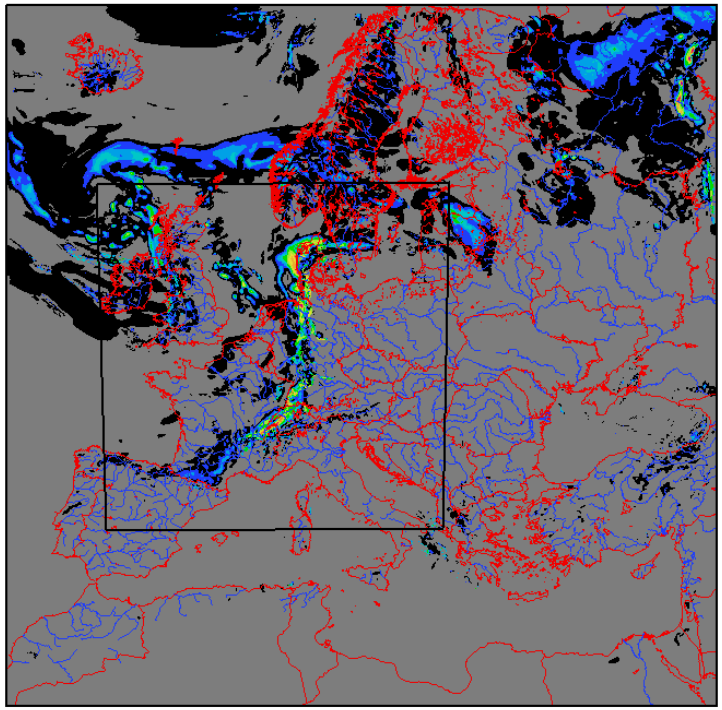
from 00, 03, 06,... 21 UTC

1 grid element: 8 km^2

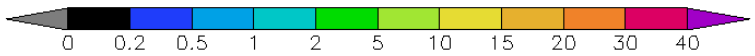
mid of 2006

LME 7km/L40 (exp.: 4624)
initial: 02 JUN 2005 12 UTC
valid: 04 JUN 2005 00 UTC

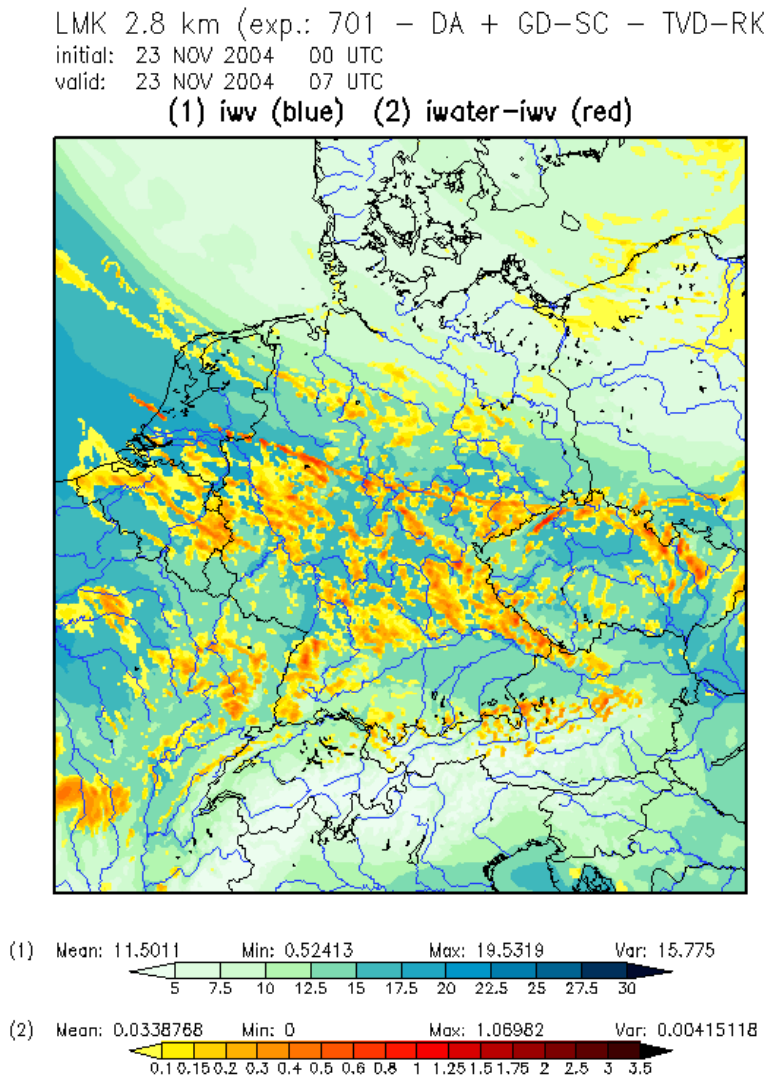
CURRENT TOTAL PRECIPITATION RATE [mm/h]



(T)	Mean: 0.0805386	Min: 0	Max: 68.9392	Var: 0.74678
(R)	Mean: 0.0802441	Min: 0	Max: 68.9392	Var: 0.746795
(S)	Mean: 0.000294539	Min: 0	Max: 1.35087	Var: 3.49812e-05



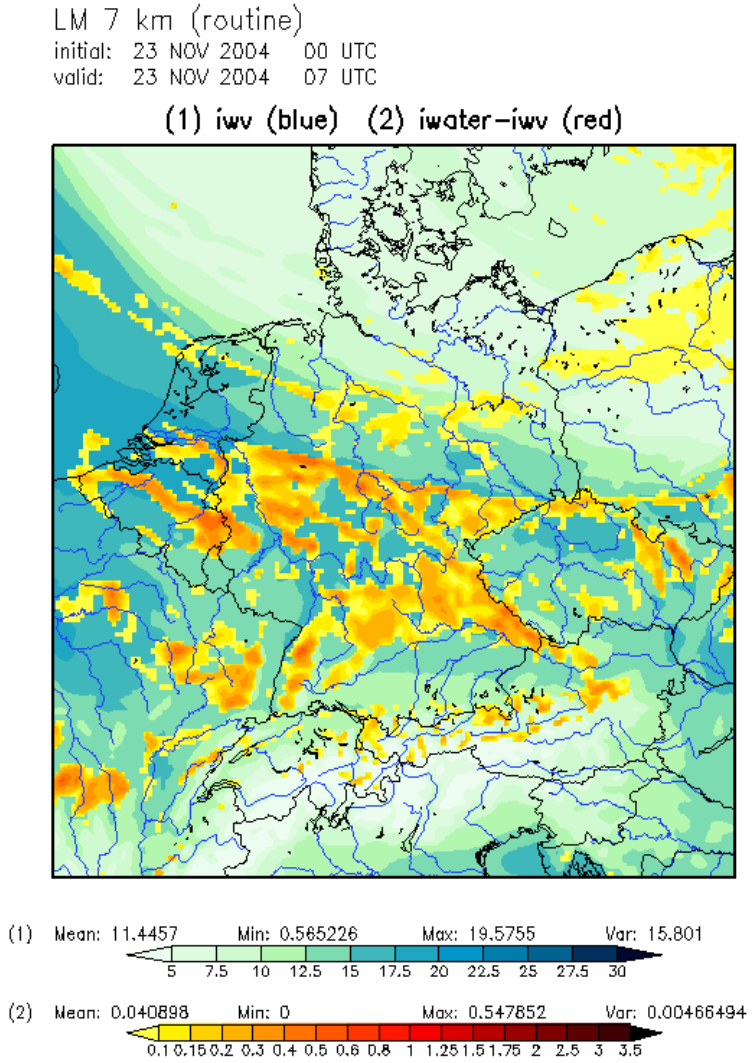
Model domain LME



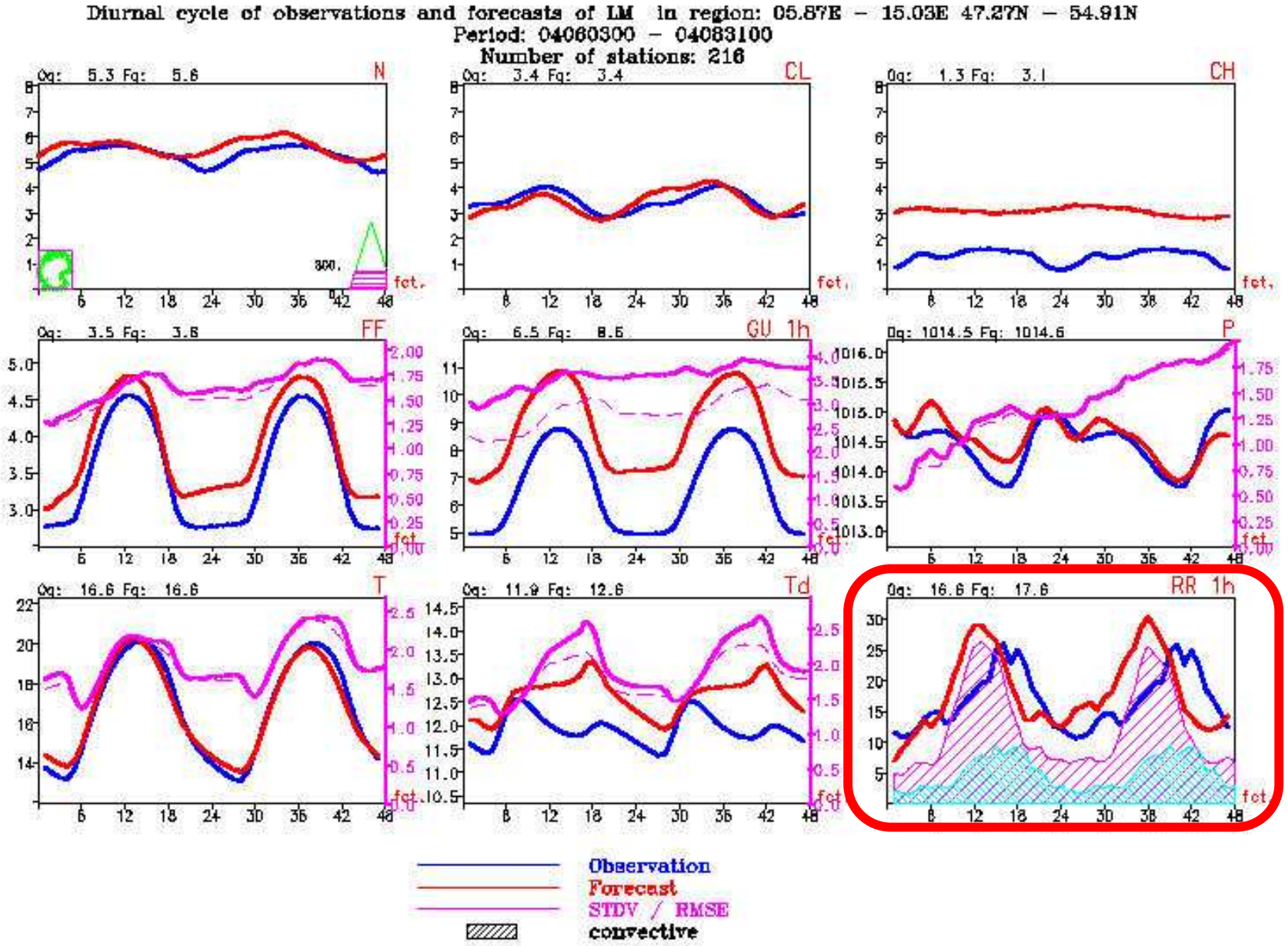
Model domain LMK

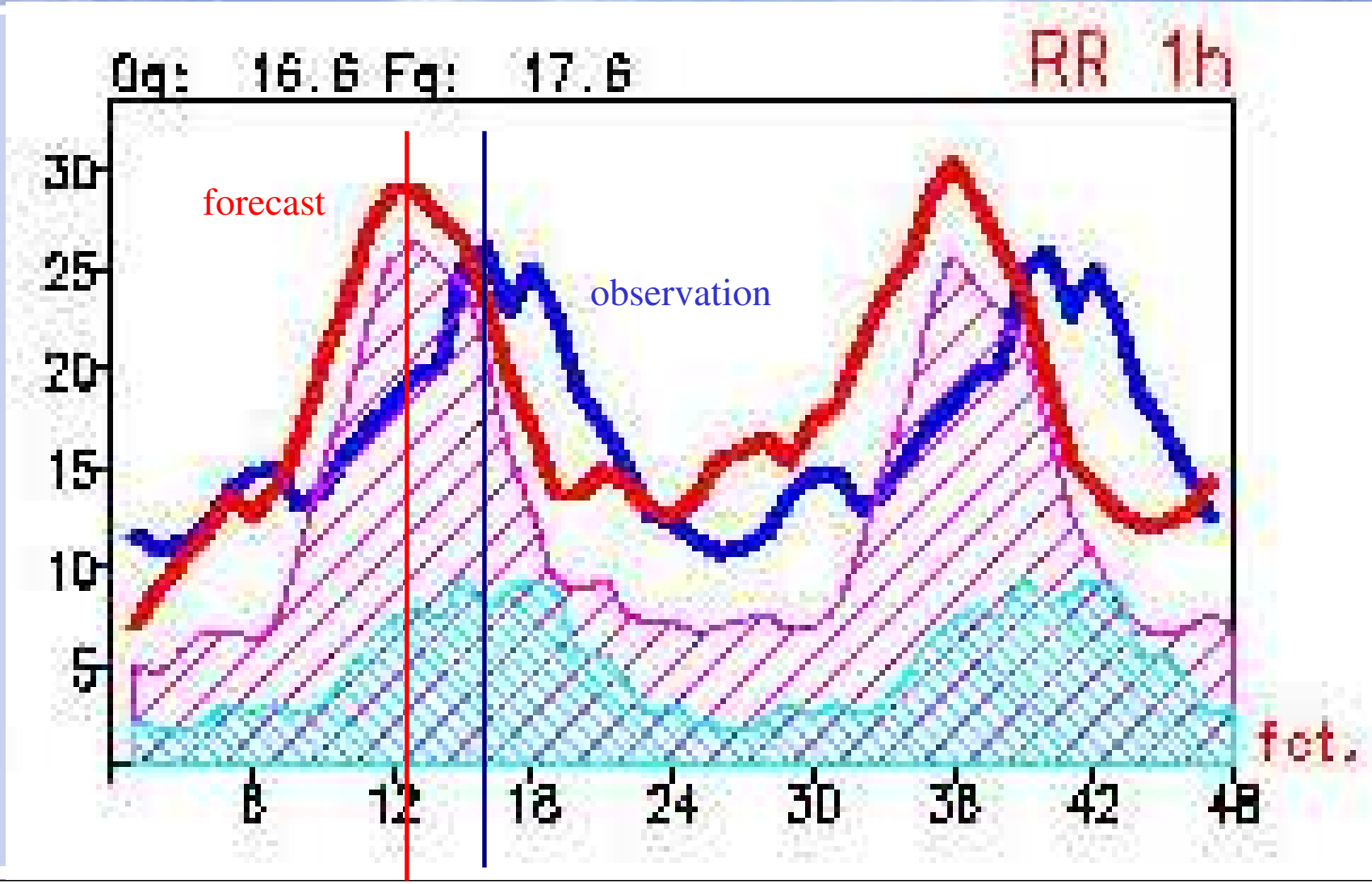
LMK:

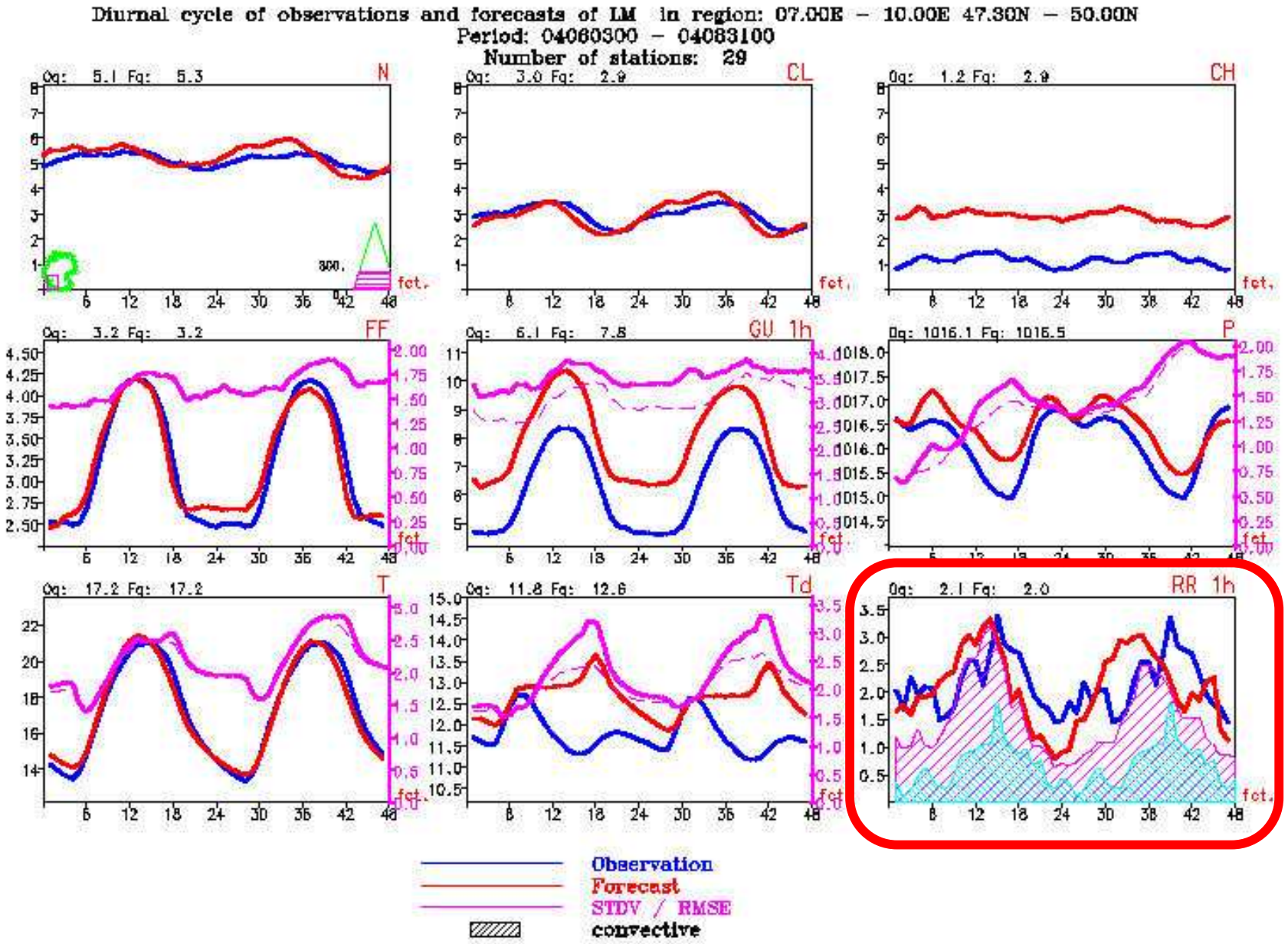
- $\Delta x = 2.8$ km
- 421 * 461 Gitterpunkte
- 50 Schichten
- $\Delta t = 30$ sec.
- $T_{ges} = 18$ h

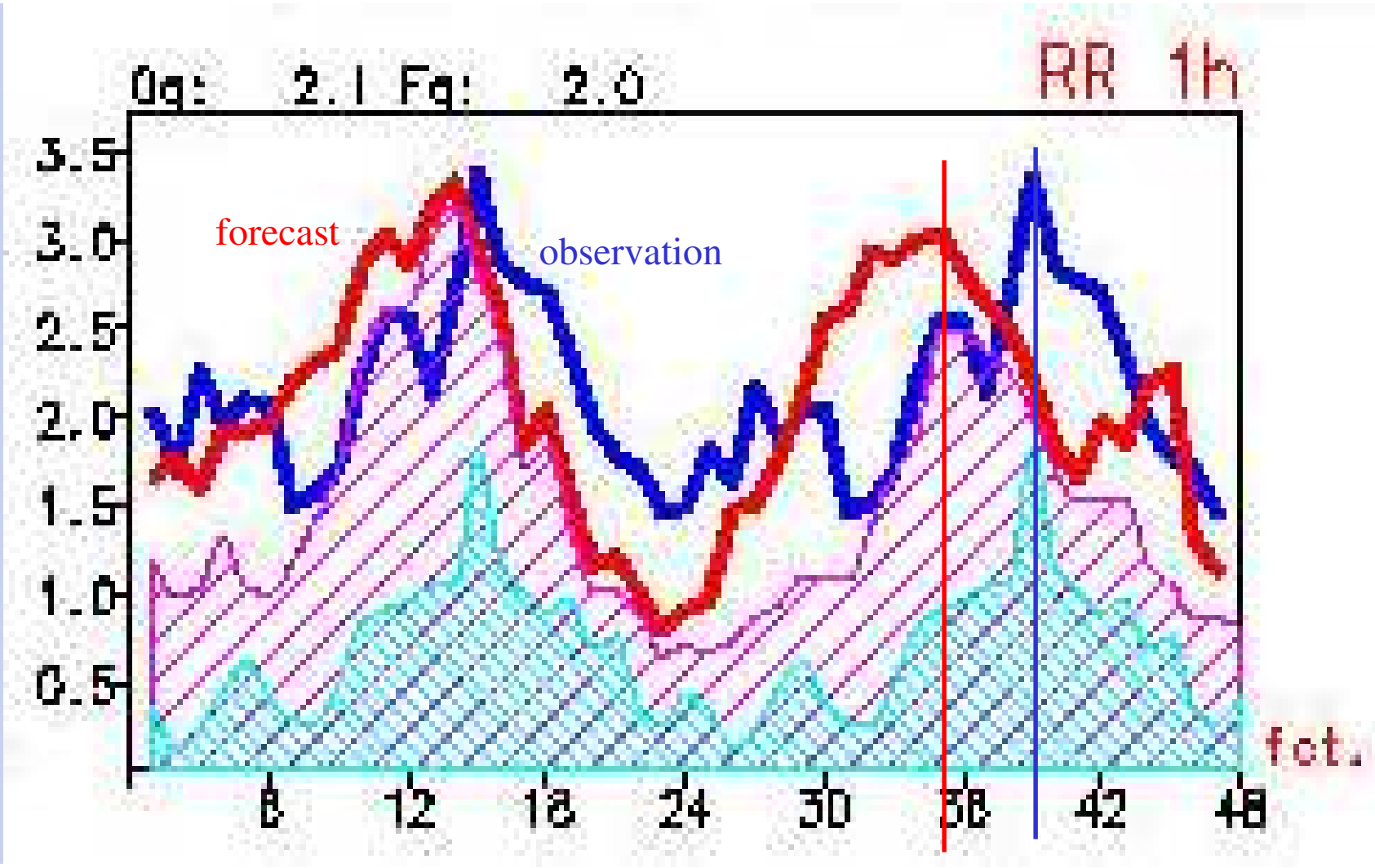


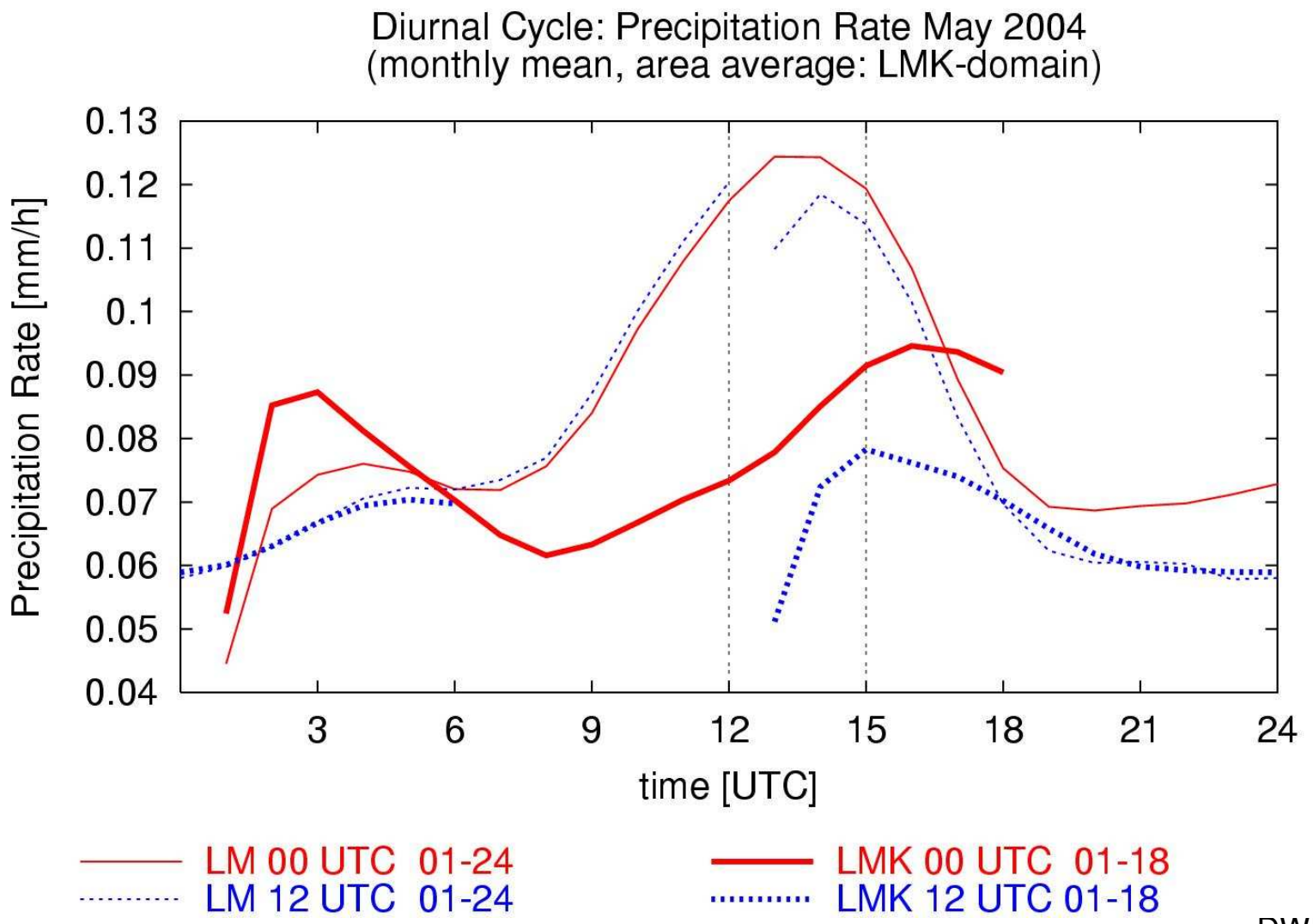
LM, 7 km grid size


Diurnal cycle of observations and forecasts of LM in region: 05.87E – 15.03E 47.27N – 54.91N
Period: 04060300 – 04083100
Number of stations: 216
Og: 5.3 Fg: 5.6
N
Og: 3.4 Fg: 3.4
CL
Og: 1.3 Fg: 3.1
CH
Og: 3.5 Fg: 3.8
FF
Og: 6.5 Fg: 8.6
GU 1h
Og: 1014.5 Fg: 1014.6
P
Og: 16.6 Fg: 16.6
T
Og: 11.9 Fg: 12.6
Td
Og: 16.6 Fg: 17.6
RR 1h
fct
Observation
Forecast
STDV / RMSE
convective


Og: 16.6 Fg: 17.6
RR 1h
forecast
observation
30
25
20
15
10
5
fct.
6
12
18
24
30
36
42
48

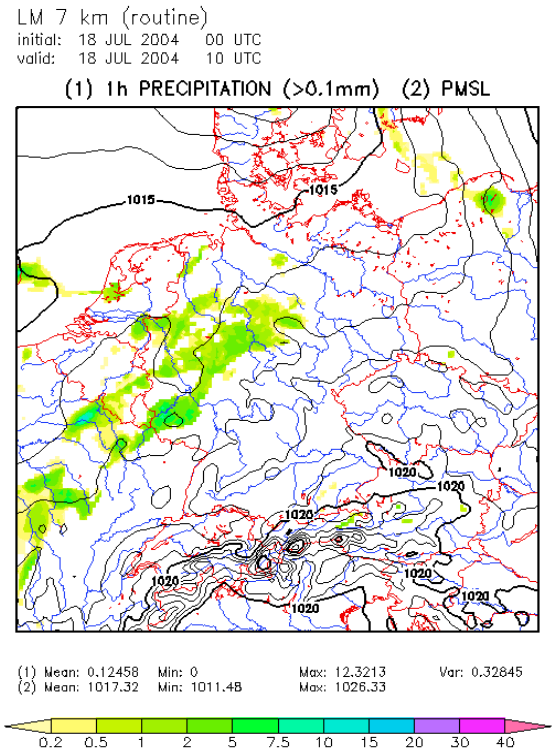

Diurnal cycle of observations and forecasts of LM in region: 07.00E – 10.00E 47.30N – 50.00N
Period: 04060300 – 04083100
Number of stations: 29
Og: 5.1 Fg: 5.3
N
Og: 3.0 Fg: 2.9
CL
Og: 1.2 Fg: 2.9
CH
Og: 3.2 Fg: 3.2
FF
Og: 6.1 Fg: 7.8
GU 1h
Og: 1016.1 Fg: 1016.5
P
Og: 17.2 Fg: 17.2
T
Og: 11.8 Fg: 12.6
Td
Og: 2.1 Fg: 2.0
RR 1h
fct.
Observation
Forecast
STDV / RMSE
convective


Og: 2.1 Fg: 2.0
RR 1h
forecast
observation
3.5
3.0
2.5
2.0
1.5
1.0
0.5
6
12
18
24
30
36
42
48
fct.

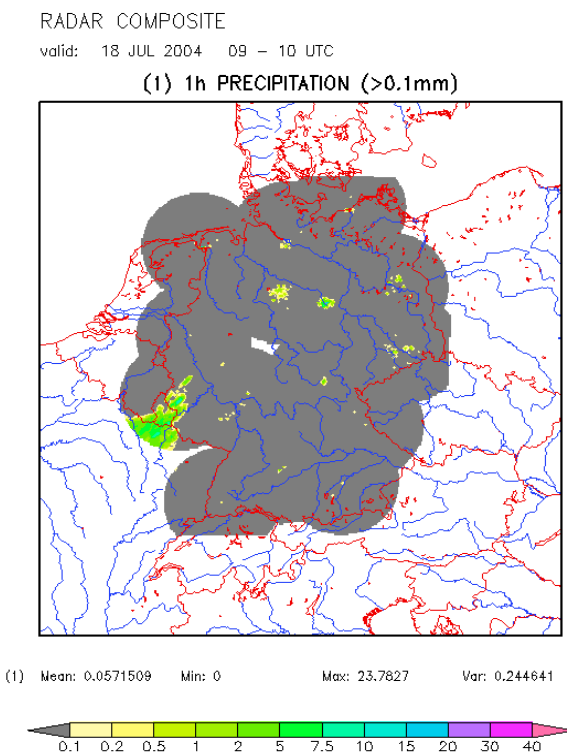

Diurnal Cycle: Precipitation Rate May 2004
(monthly mean, area average: LMK-domain)
Precipitation Rate [mm/h]
0.13
0.12
0.11
0.1
0.09
0.08
0.07
0.06
0.05
0.04
3
6
9
12
15
18
21
24
time [UTC]
LM 00 UTC 01-24
LM 12 UTC 01-24
LMK 00 UTC 01-18
LMK 12 UTC 01-18

Example: 18.07.2004, 00 UTC + 10 h

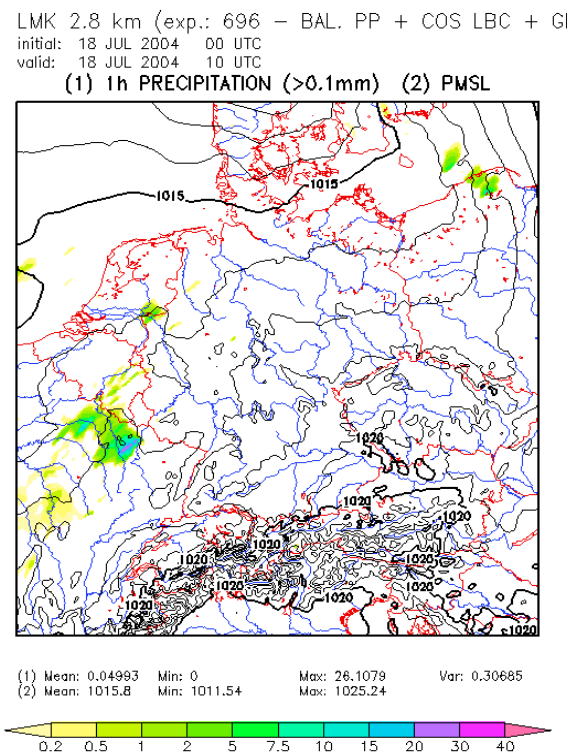
LM



Radar

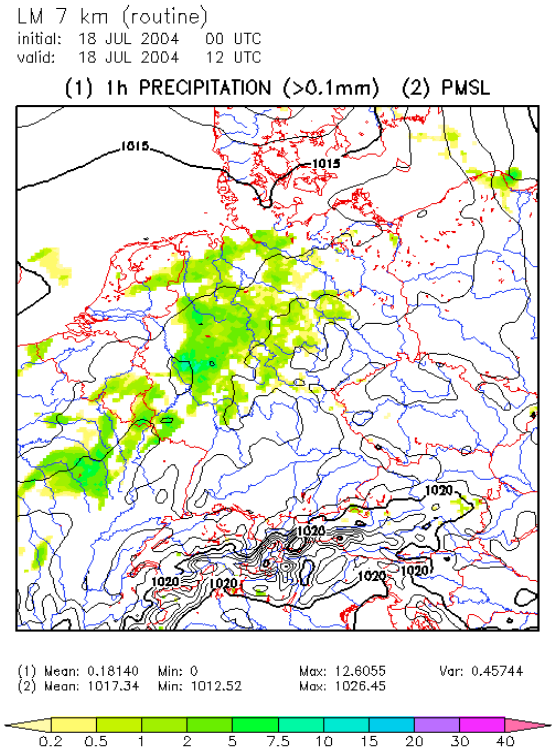


LMK

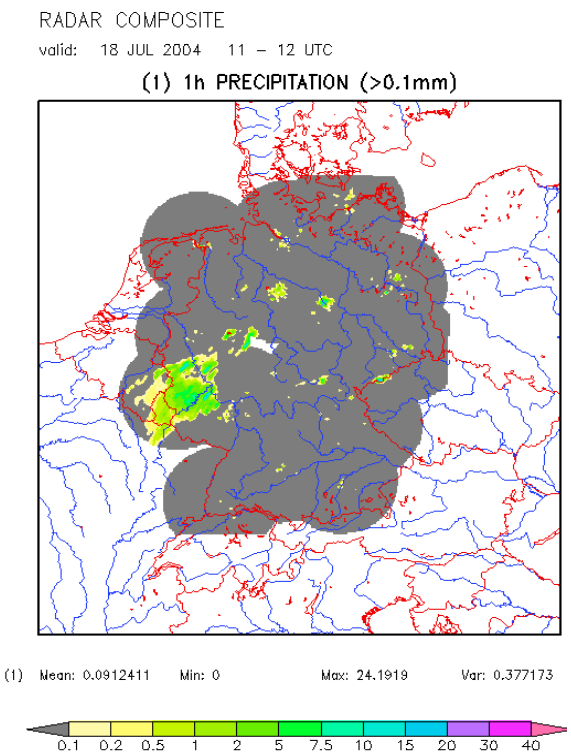


Example: 18.07.2004, 00 UTC + 12 h

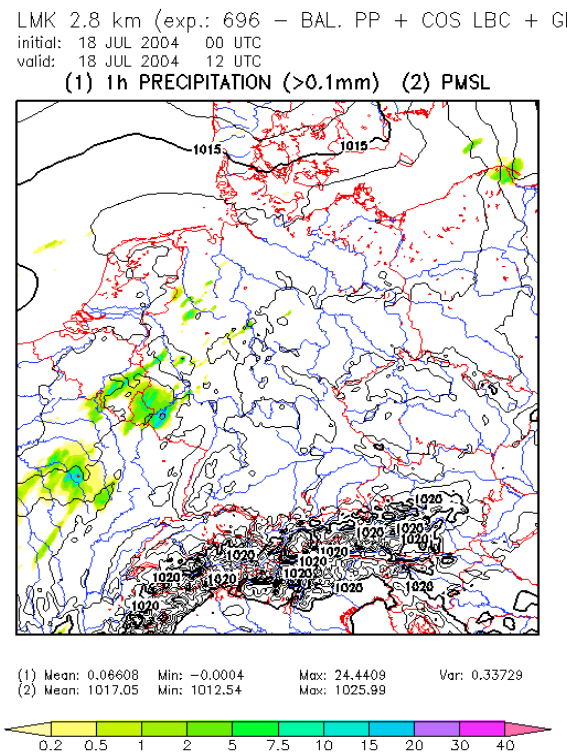
LM



Radar

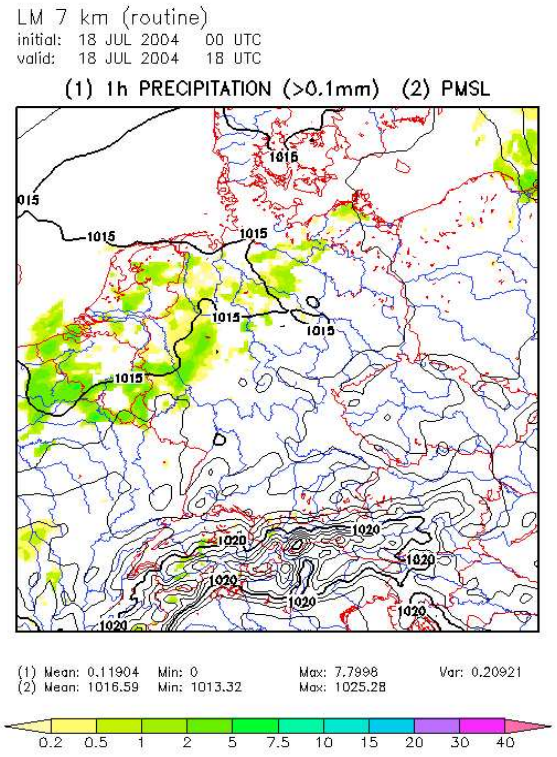


LMK

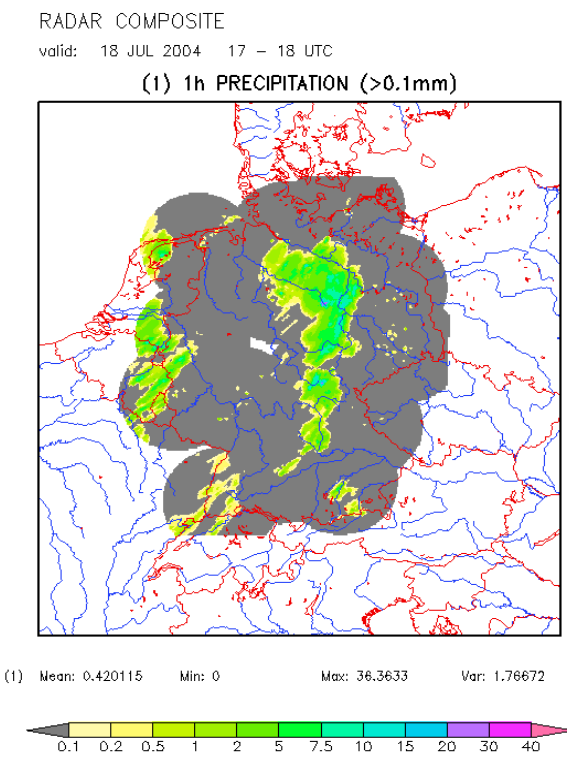


Example: 18.07.2004, 00 UTC + 18 h

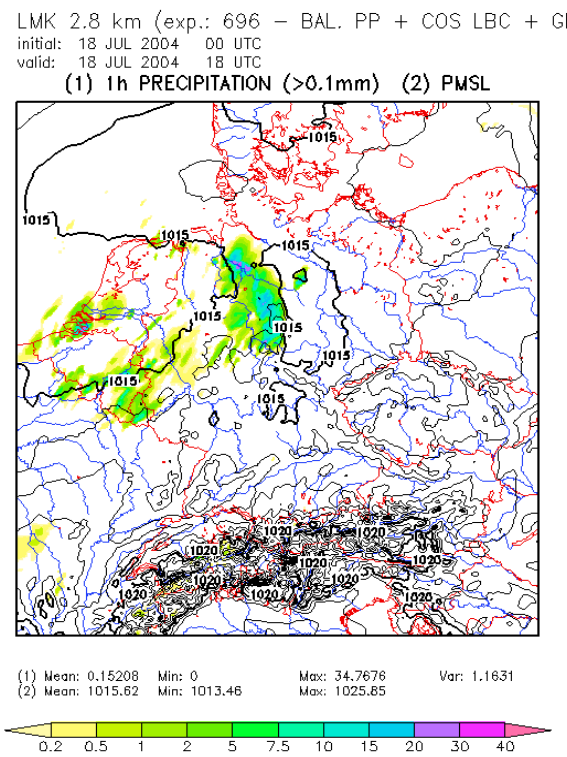
LM



Radar



LMK



Summary

- Daily cycle of precipitation is simulated poorly
  - causing often large forecast errors of the distribution of precipitation in space and time
- Increasing resolution (direct simulation of deep convection) may help,
  - which has been proven but has not been understood
  - which does not solve the problem in global circulation models (e.g. for medium range forecasts)
- WGNE (CAS, CCL) recommends to spend more research efforts to the problem of convection in weather forecast models and climate models

Role of COPS

- Questions to COPS
  - Which processes are responsible for the daily cycle for precipitation and deep convection?
  - Which processes determine the time scales of deep convection and precipitation, the phase shift relative to the forcing?
  - How can the effect of the relevant processes be quantified by observations?
- We need a experimental design to improve the understanding of the relevant processes from observations.