Some considerations on VHR modelling of precipitation

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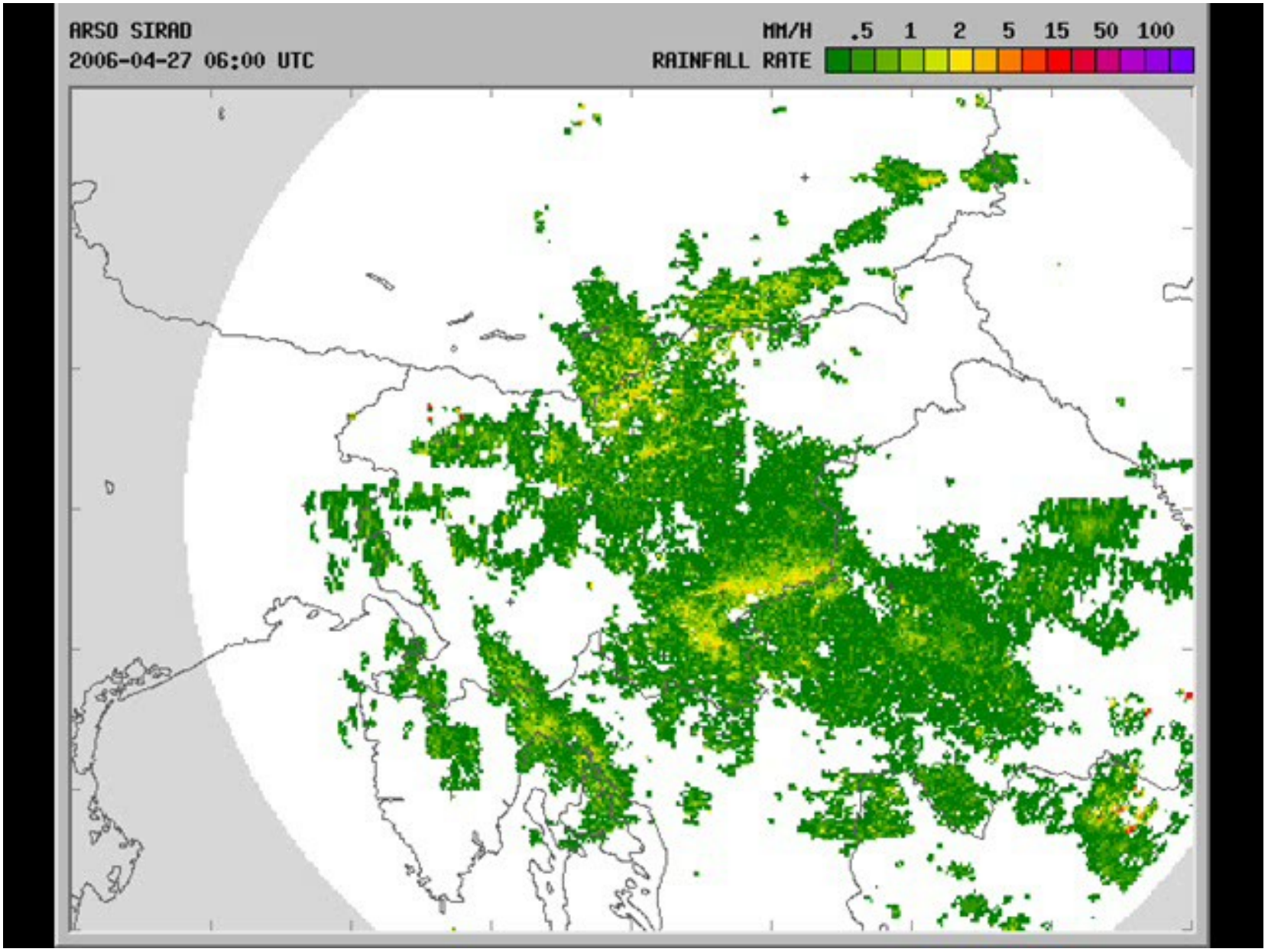
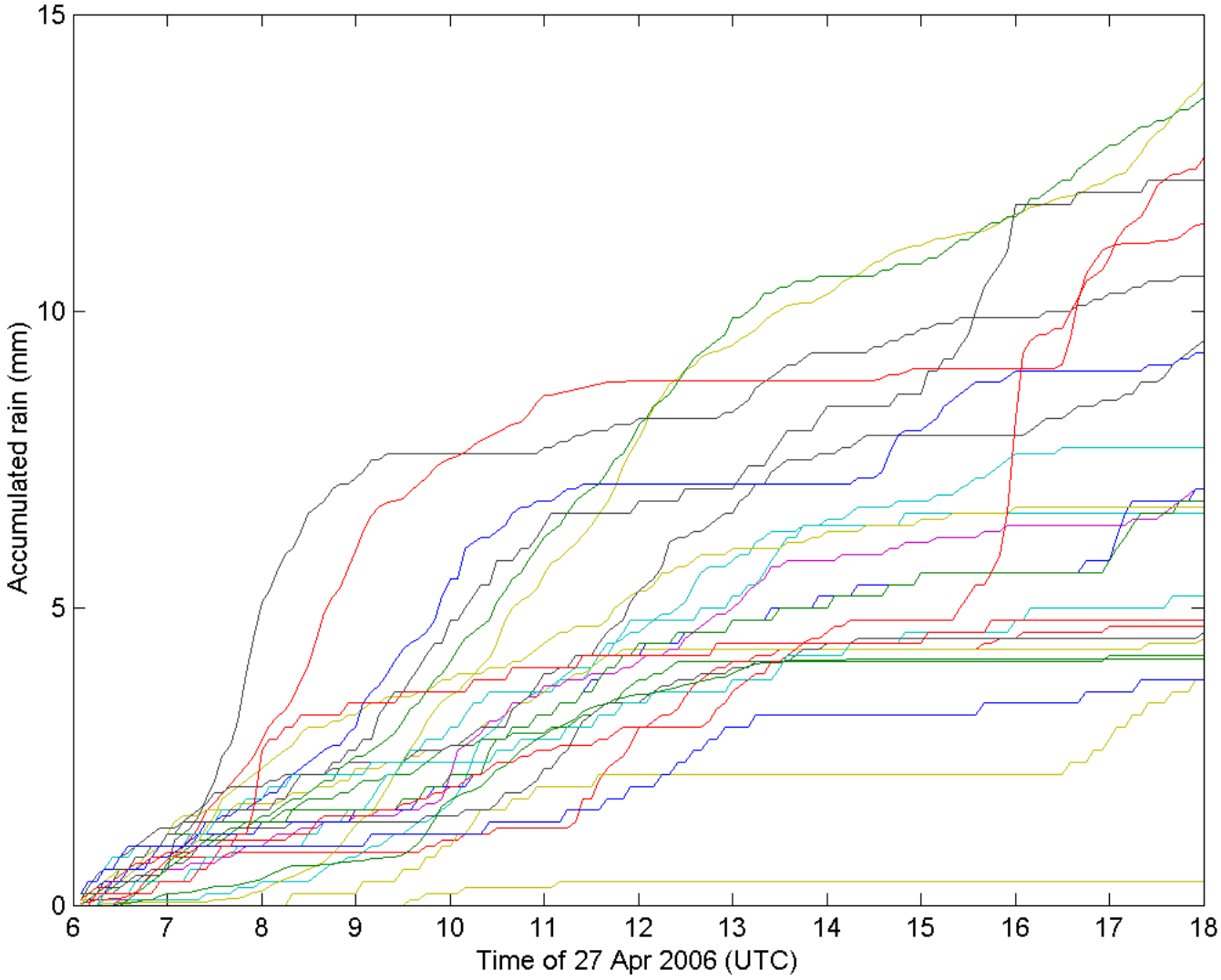
OUTLINE

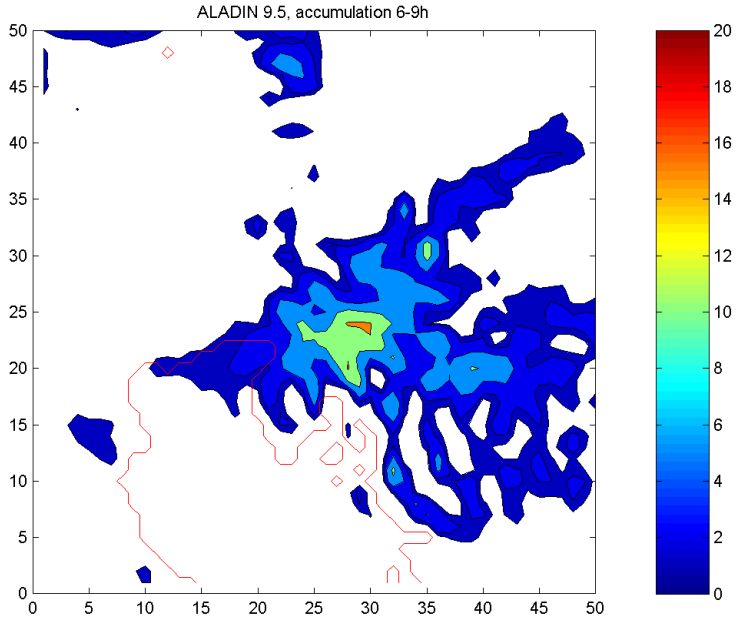
- A precipitation case Modelled in ALADIN 9.5 km
- Expectations from increased resolution
- Problems in- and suggestions for meeting them
- AROME 2.5 km simulation
- Demonstration of some possibilities

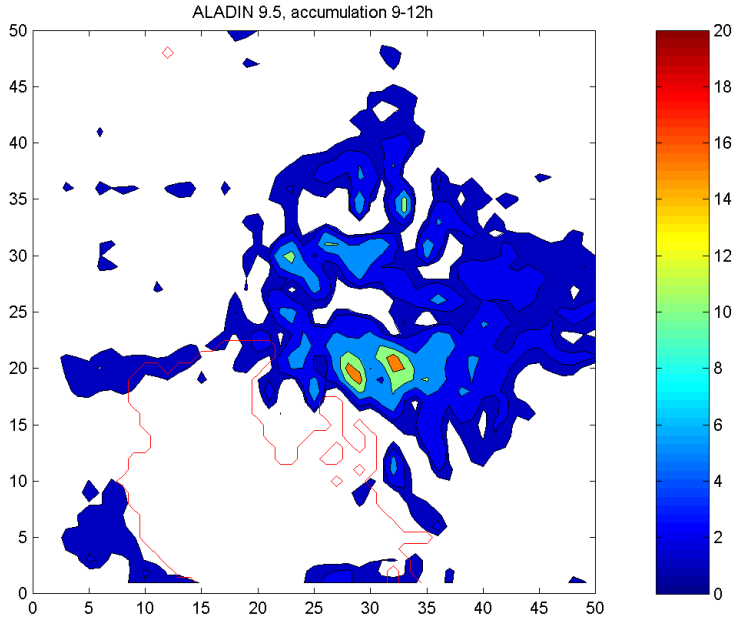
Low intensity, high variability



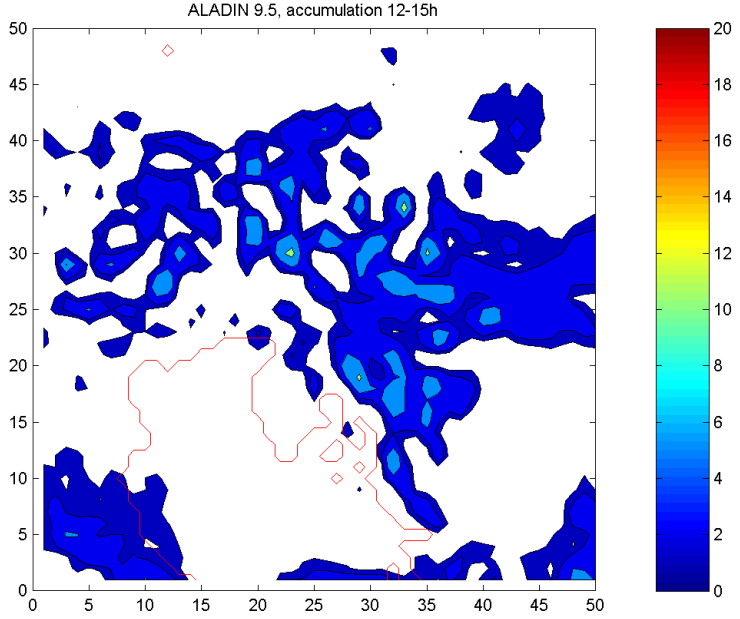
OBSERVATIONS

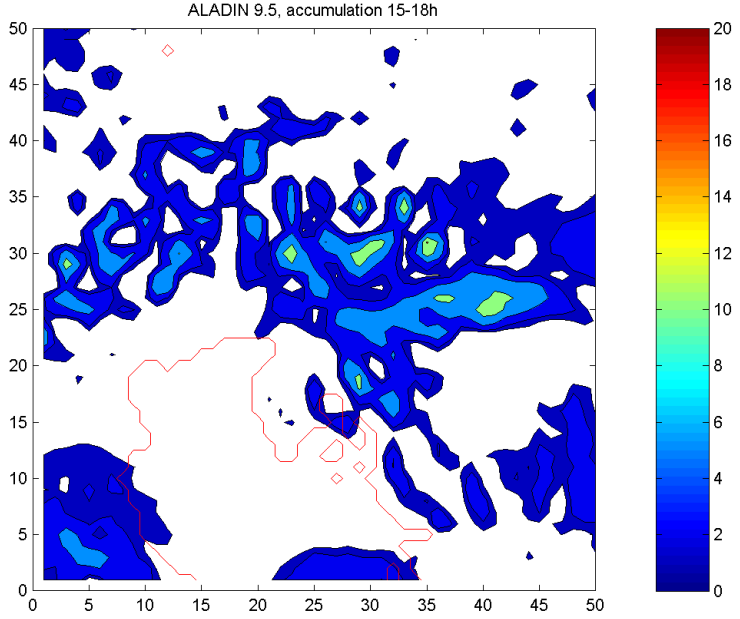



ALADIN 9.5, accumulation 6-9h

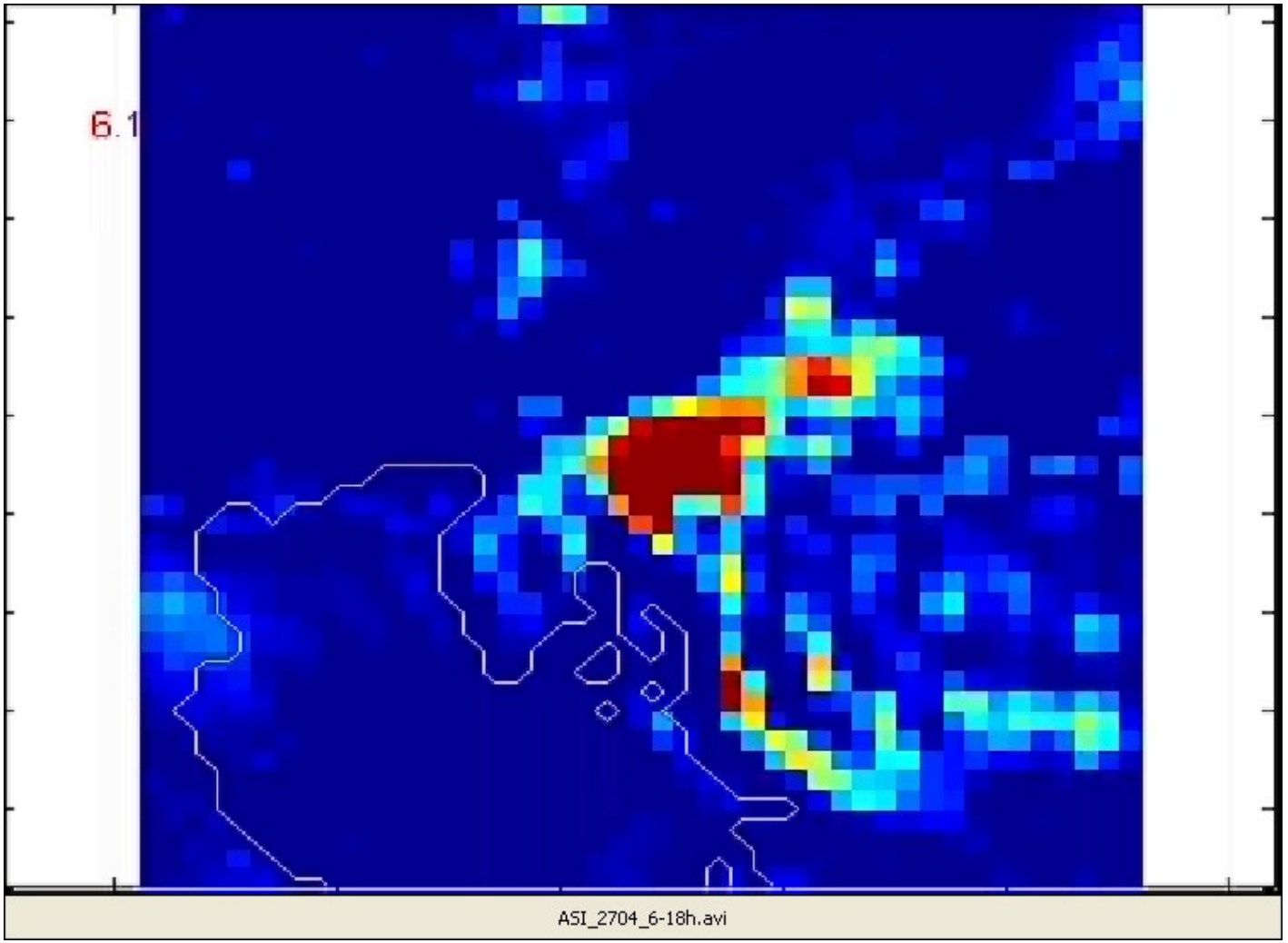

ALADIN 9.5, accumulation 9-12h

ALADIN 9.5


ALADIN 9.5, accumulation 12-15h


ALADIN 9.5, accumulation 15-18h

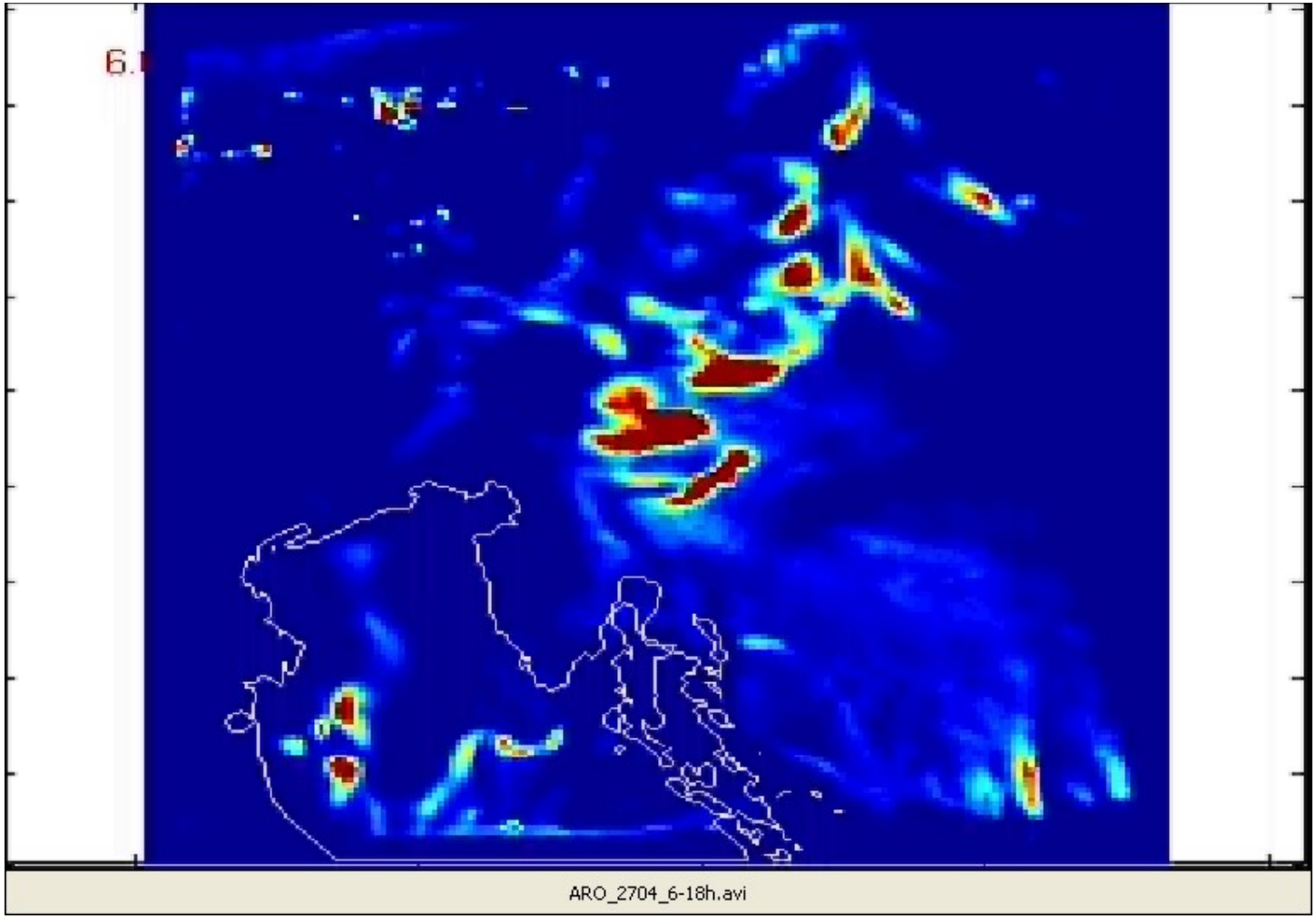
ALADIN 9.5



Going to VHR(1)

- What do forecasters (and we) expect:
  - Improvements of prediction at nowadays´ scales
    - upscaling
      - traditional parameters
      - added-value parameters
  - More true-to-nature appearance at very small scales
    - more sophisticated treatment of model results
    - different measures for comparing with observations

AROME 2.5



Going to VHR(2)

- Influence of high resolution to:
  - accumulations (12,6,3,1h)
  - sub-LSgrid variability
    - orography induced
    - precipitation-type induced
- Verification against
  - RADAR
  - rain gauges
    - 5 minute data

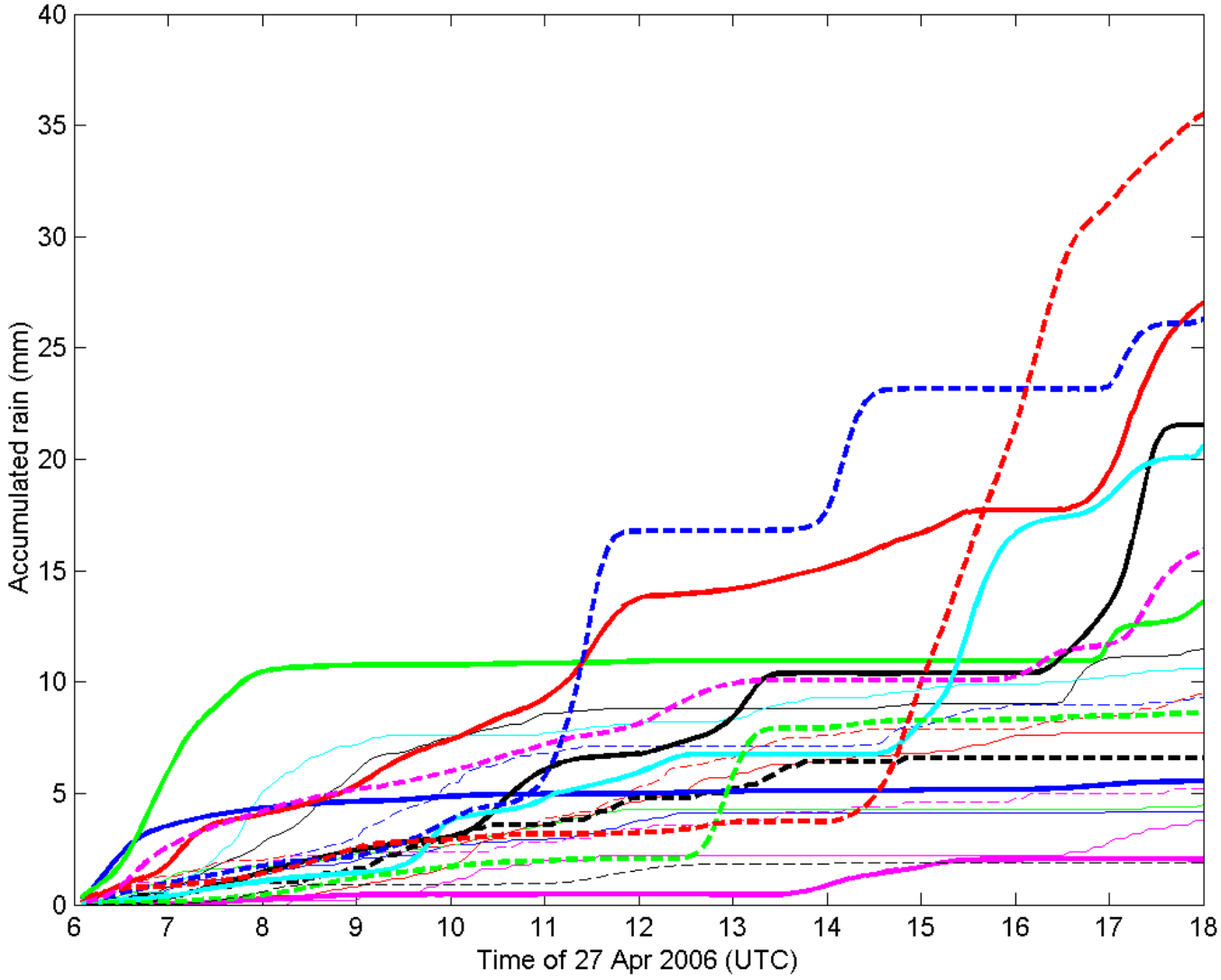
Orography-induced

- stationary pattern
- usually quite reliably simulated
- problem if not occurring in reality but only in a model => leading to huuuuuuuuuuge overestimation

Precipitation-type induced

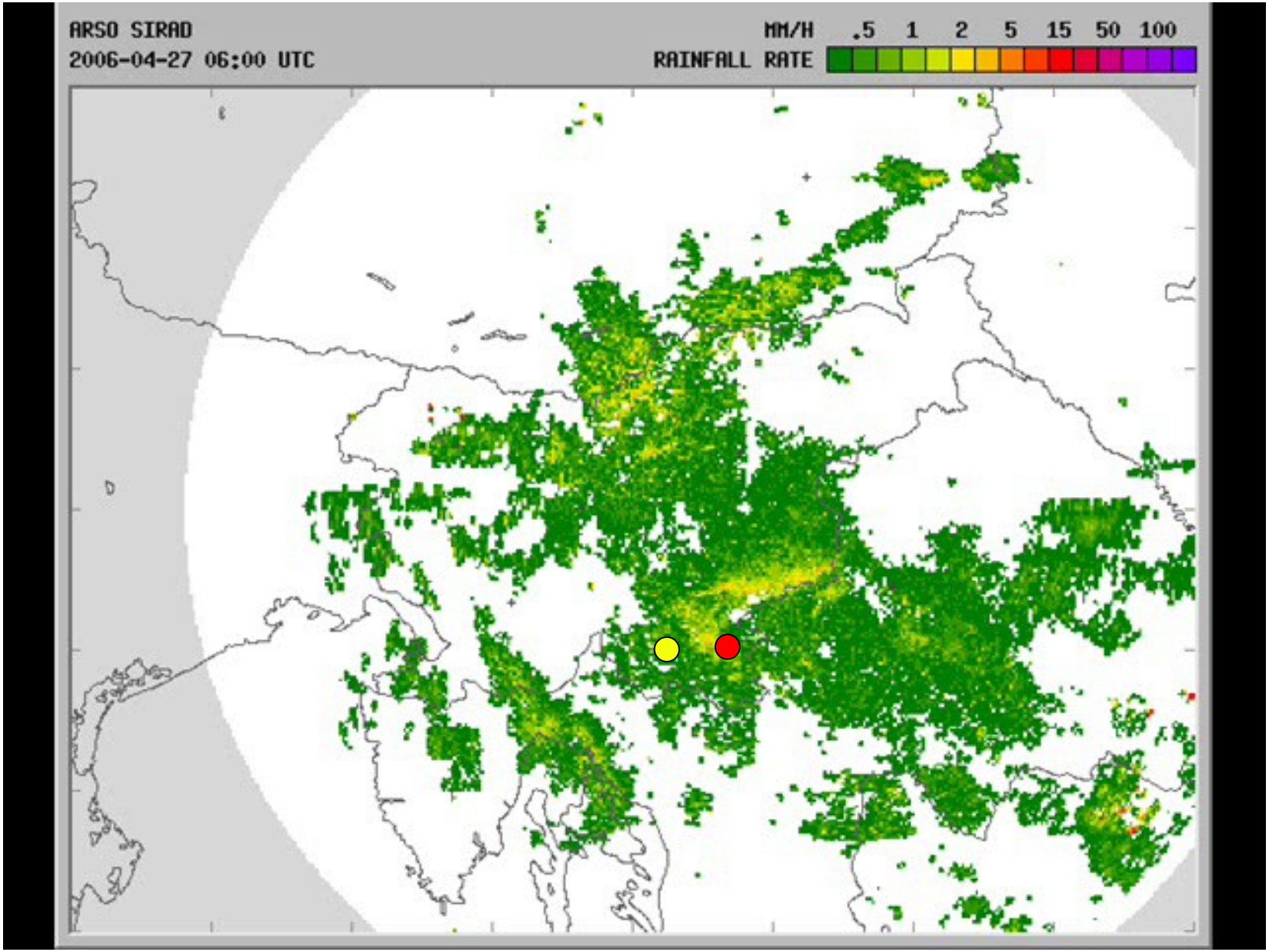
- showers – typical
- parameterized part?
- space vs. time
  - frozen showers (Taylor)?
  - potentially verifiable

OBSERVATIONS + AROME 2.5

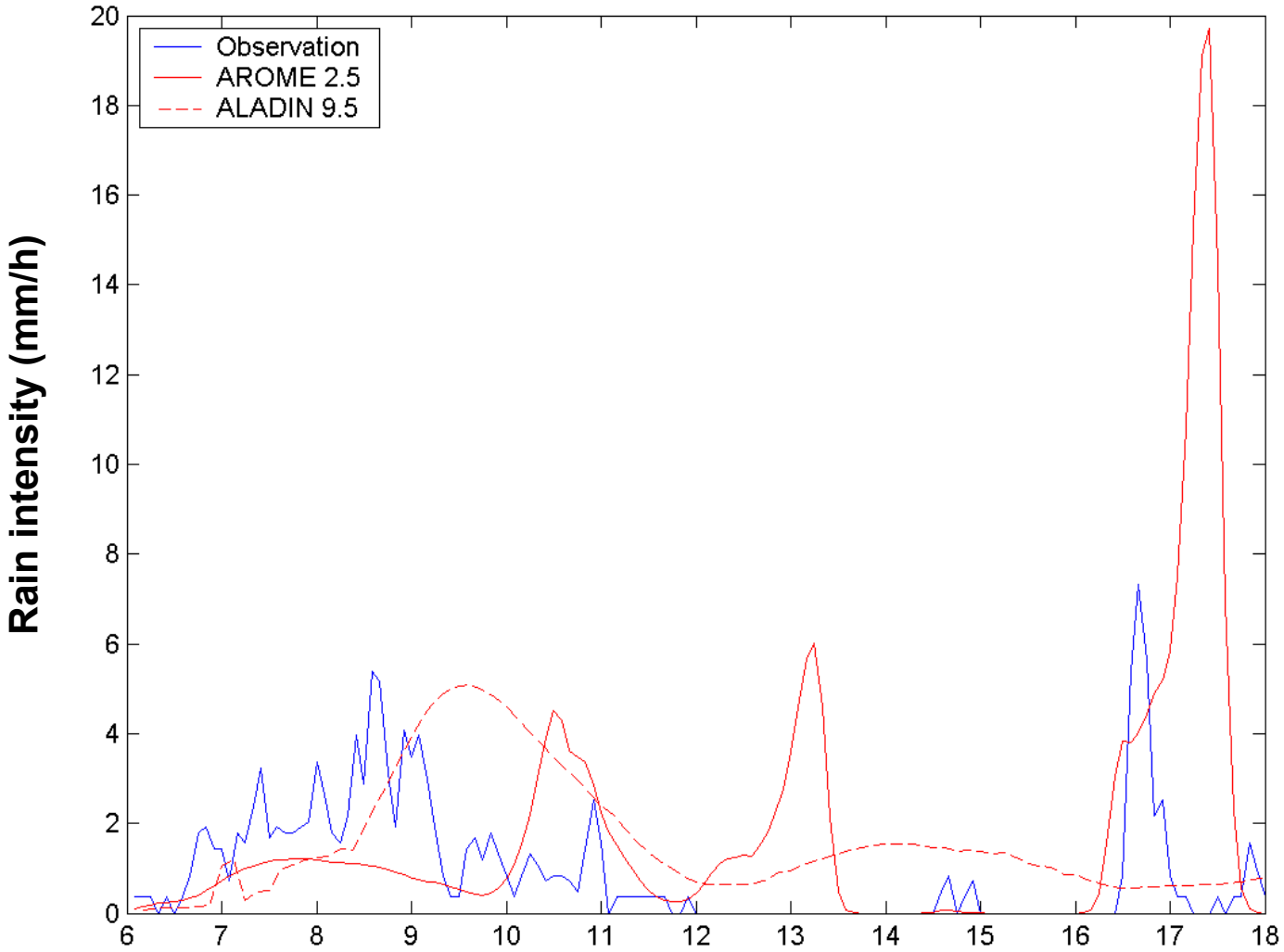


OBS.

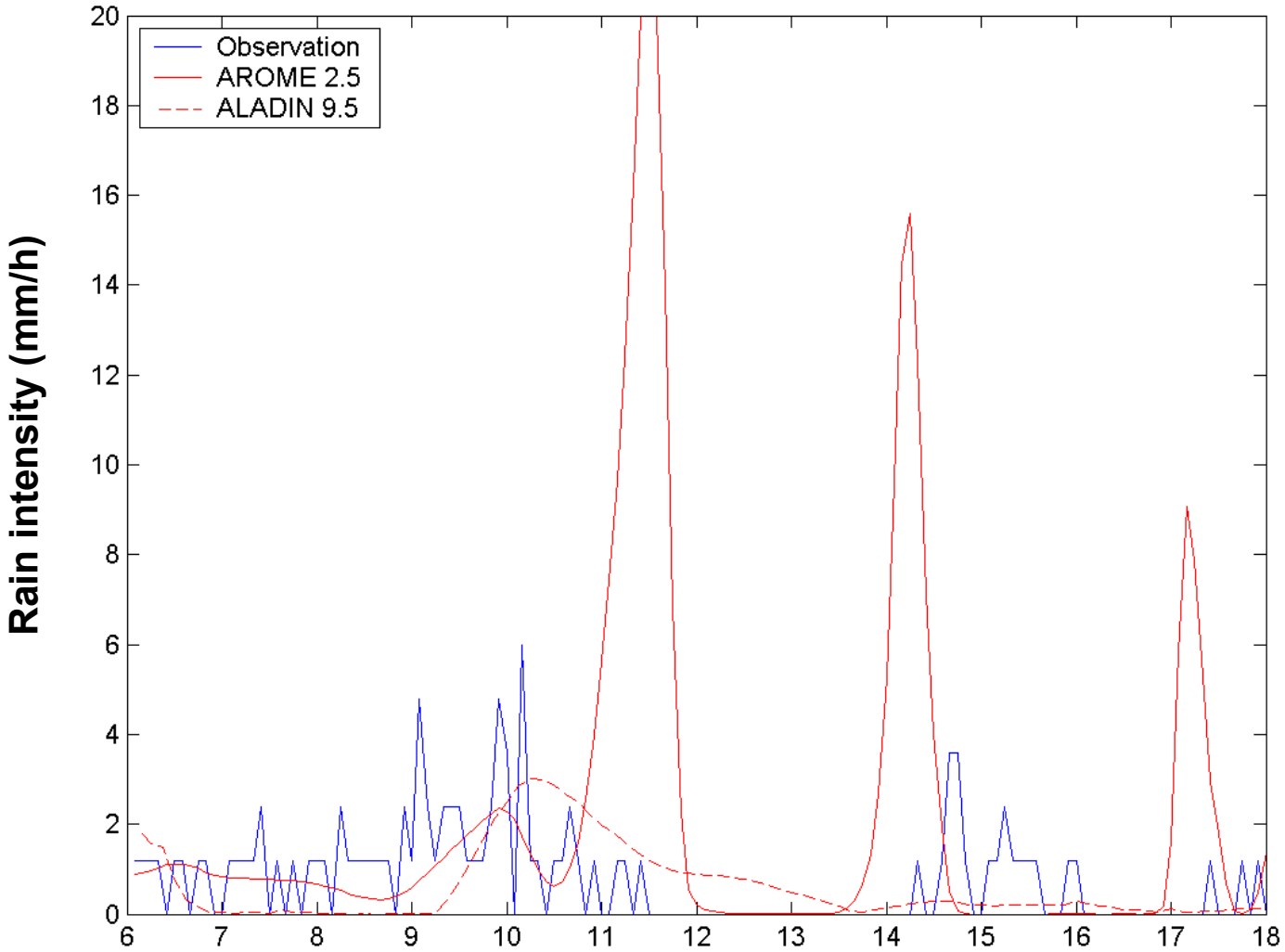
Model


ARSO SIRAD
2006-04-27 06:00 UTC
MM/H .5 1 2 5 15 50 100
RAINFALL RATE

Location


Observation
AROME 2.5
ALADIN 9.5
Rain intensity (mm/h)
0
2
4
6
8
10
12
14
16
18
20
6
7
8
9
10
11
12
13
14
15
16
17
18

Location


Observation
AROME 2.5
ALADIN 9.5
Rain intensity (mm/h)
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20
6
7
8
9
10
11
12
13
14
15
16
17
18

VARIABILITY(1)

(does the simulated rainfall resembles the real one?)

- Temporal
  - visualize in High Resolution
  - e.g. standard deviation:

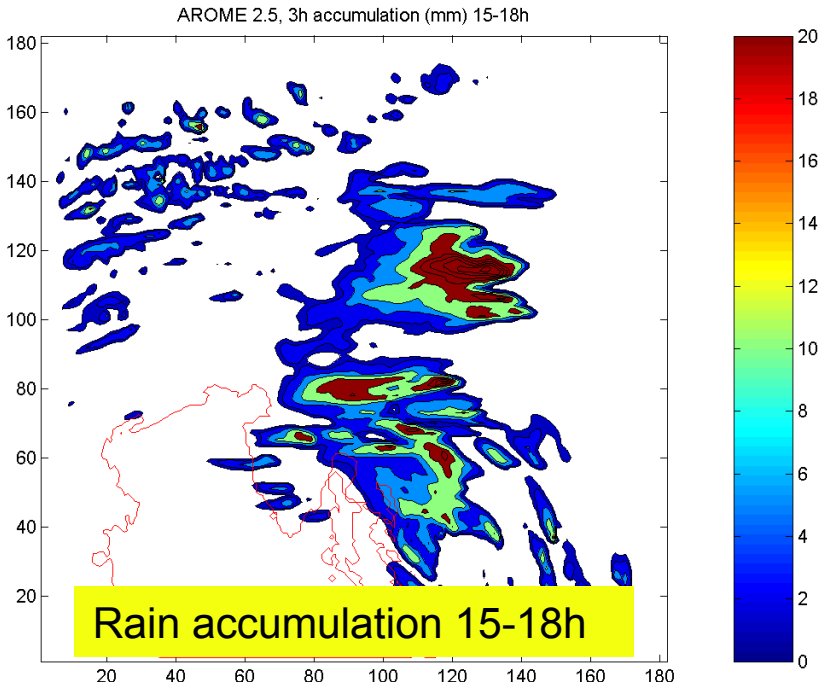
$$\sigma_t = \sqrt{\frac{\sum (p - \bar{p})^2}{n}}$$

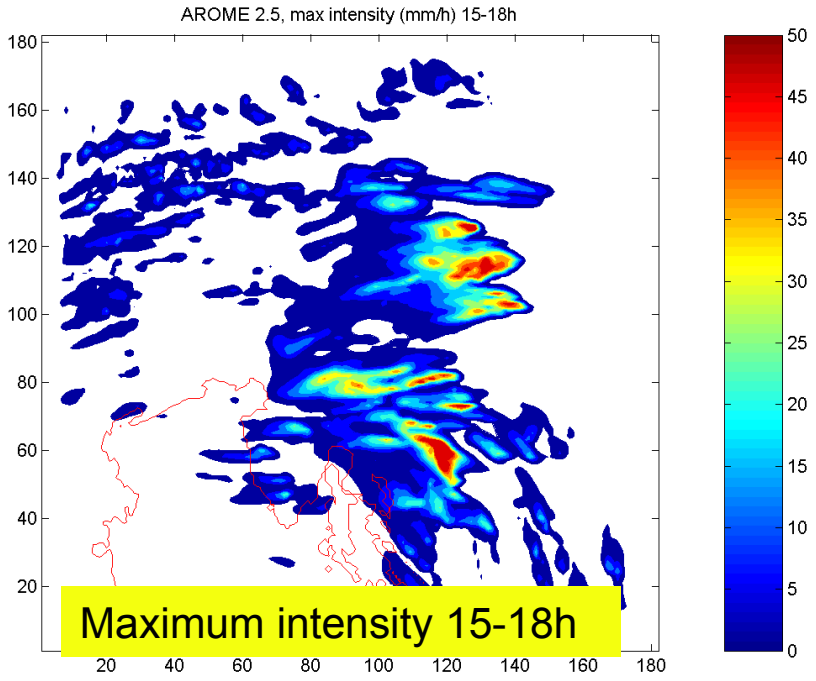
p - rain in 1, 5, … min.

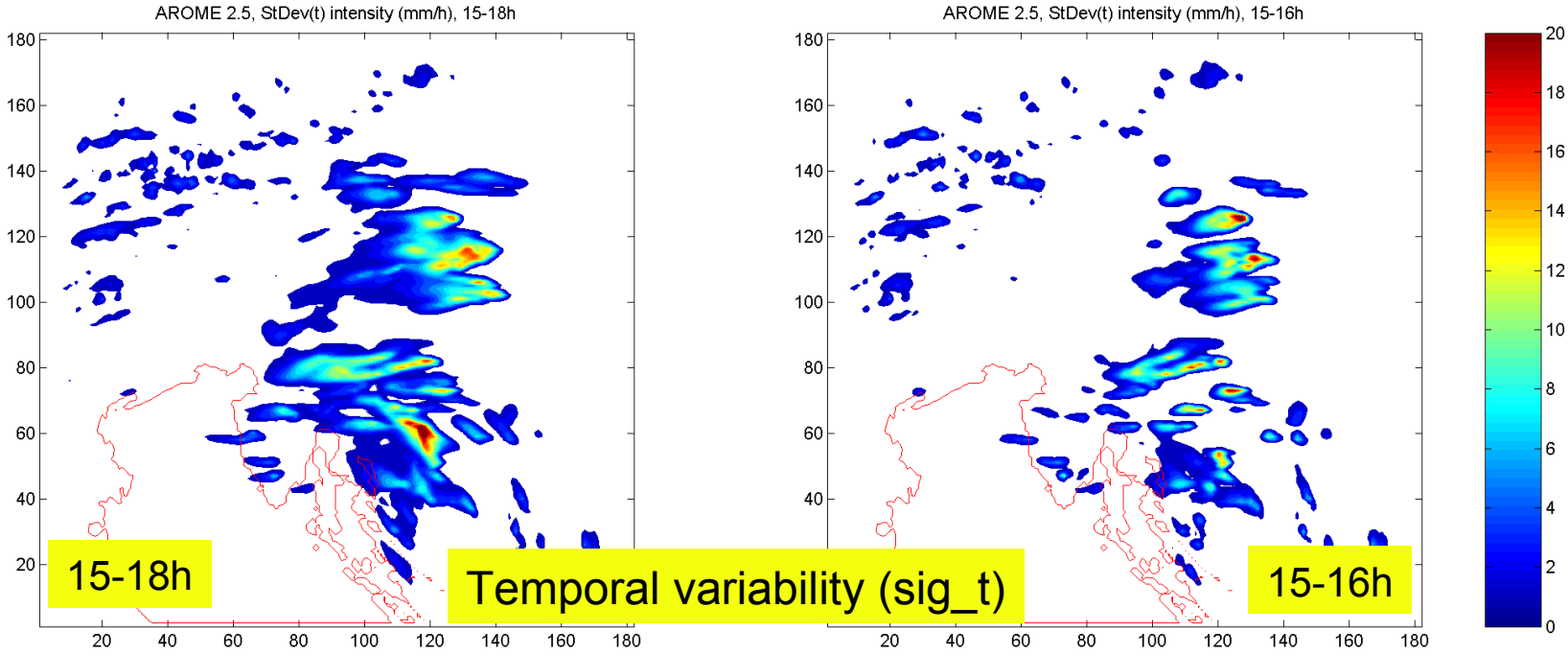
$\bar{p}$ - interval mean (1h, 3h, …)

n - number of *p* in interval

  - other measures


AROME 2.5, 3h accumulation (mm) 15-18h
Rain accumulation 15-18h


AROME 2.5, max intensity (mm/h) 15-18h
Maximum intensity 15-18h

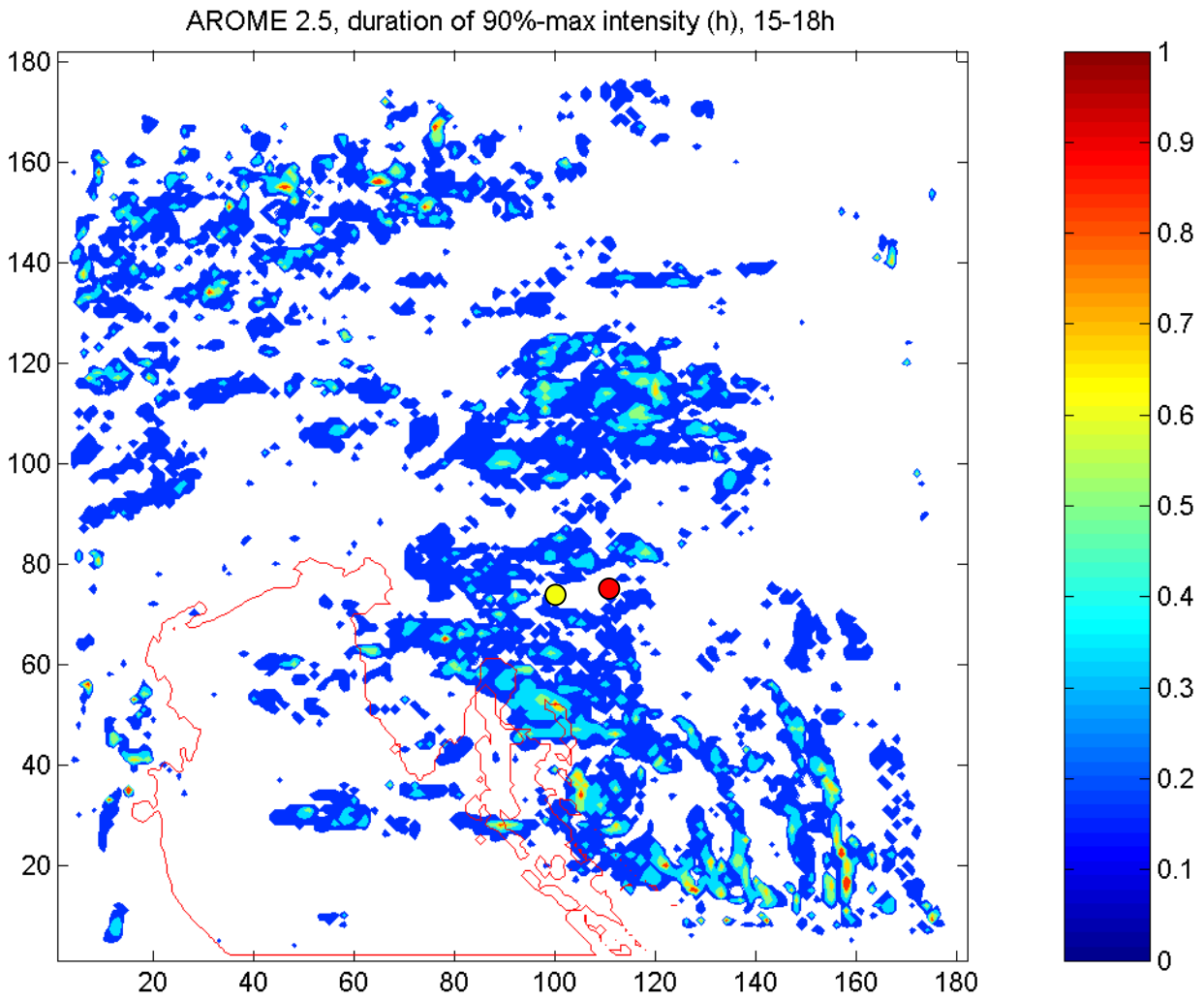

AROME 2.5, StDev(t) intensity (mm/h), 15-18h
AROME 2.5, StDev(t) intensity (mm/h), 15-16h
15-18h
Temporal variability (sig_t)
15-16h

Duration of over 90% max. intensity

15-18UTC

observ.
- 0.08h
- 0.08h

AROME
- 0.17h
- 0.08h



Duration of over 25% max. intensity

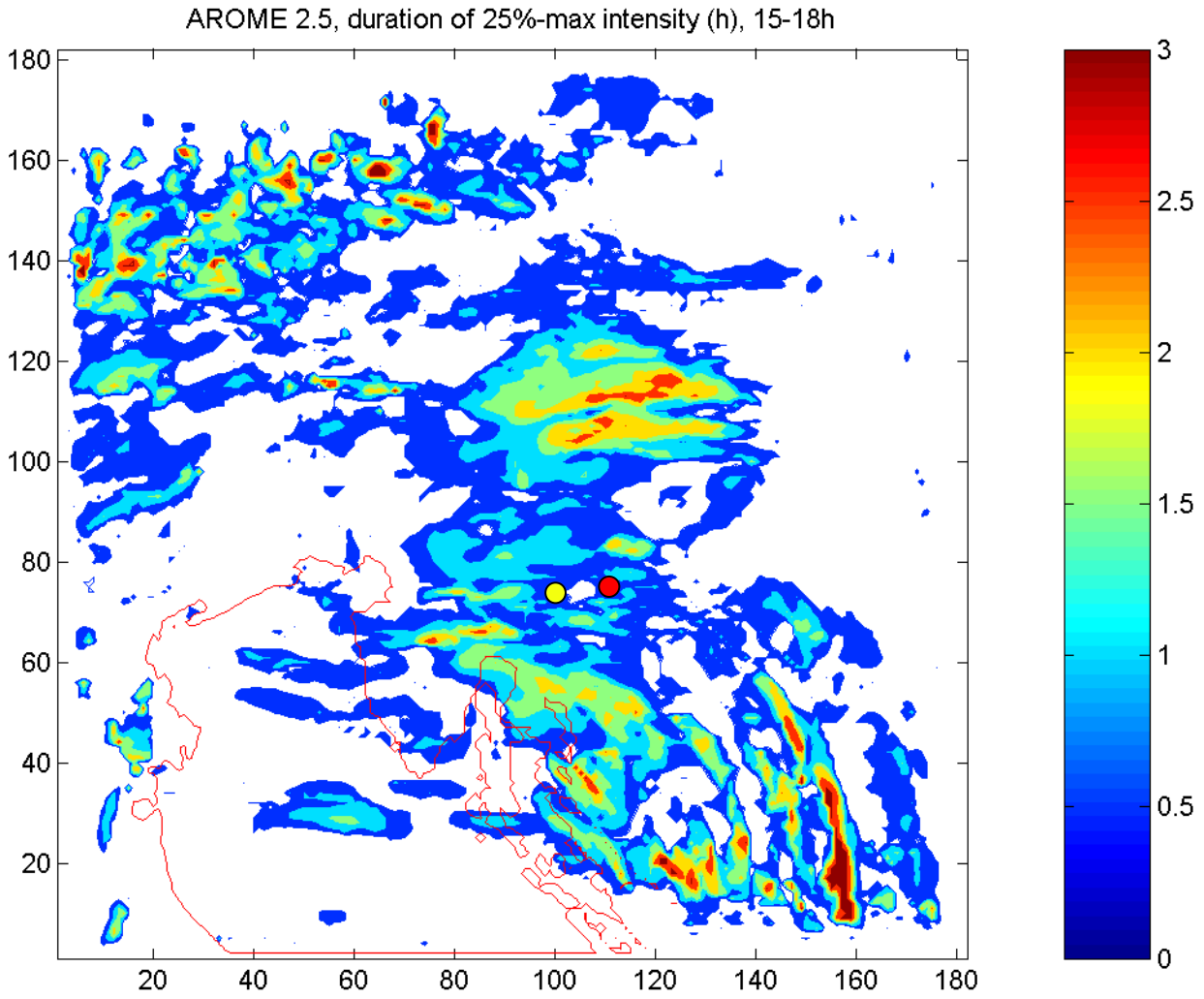
15-18UTC

observ.

- 0.4h
- 1.0h

AROME

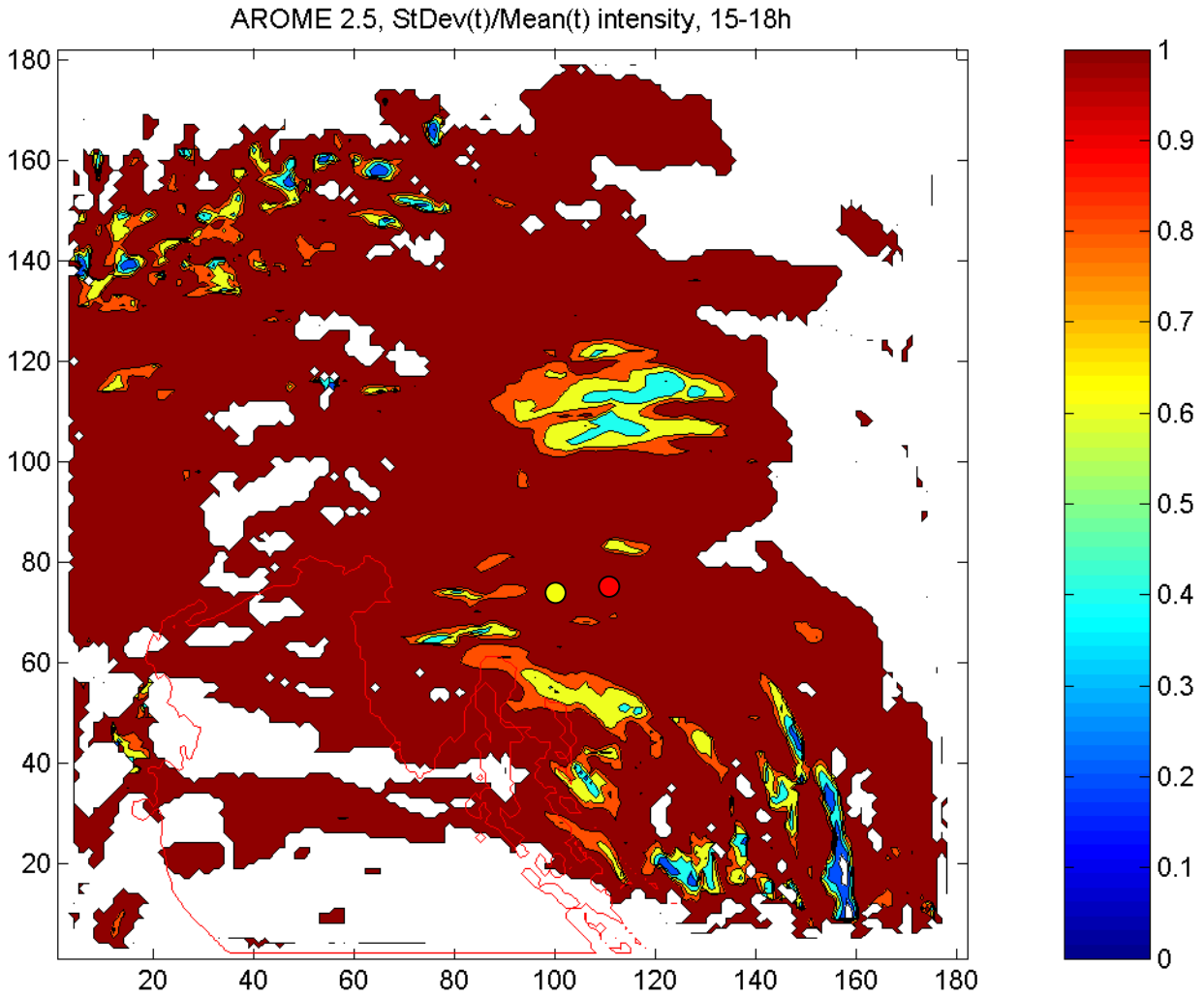
- 0.75h
- 0.4h



Variability normalized with mean intensity

observ.
2.18
1.53

AROME
1.50
2.21



Variability normalized with max. intensity

observ.

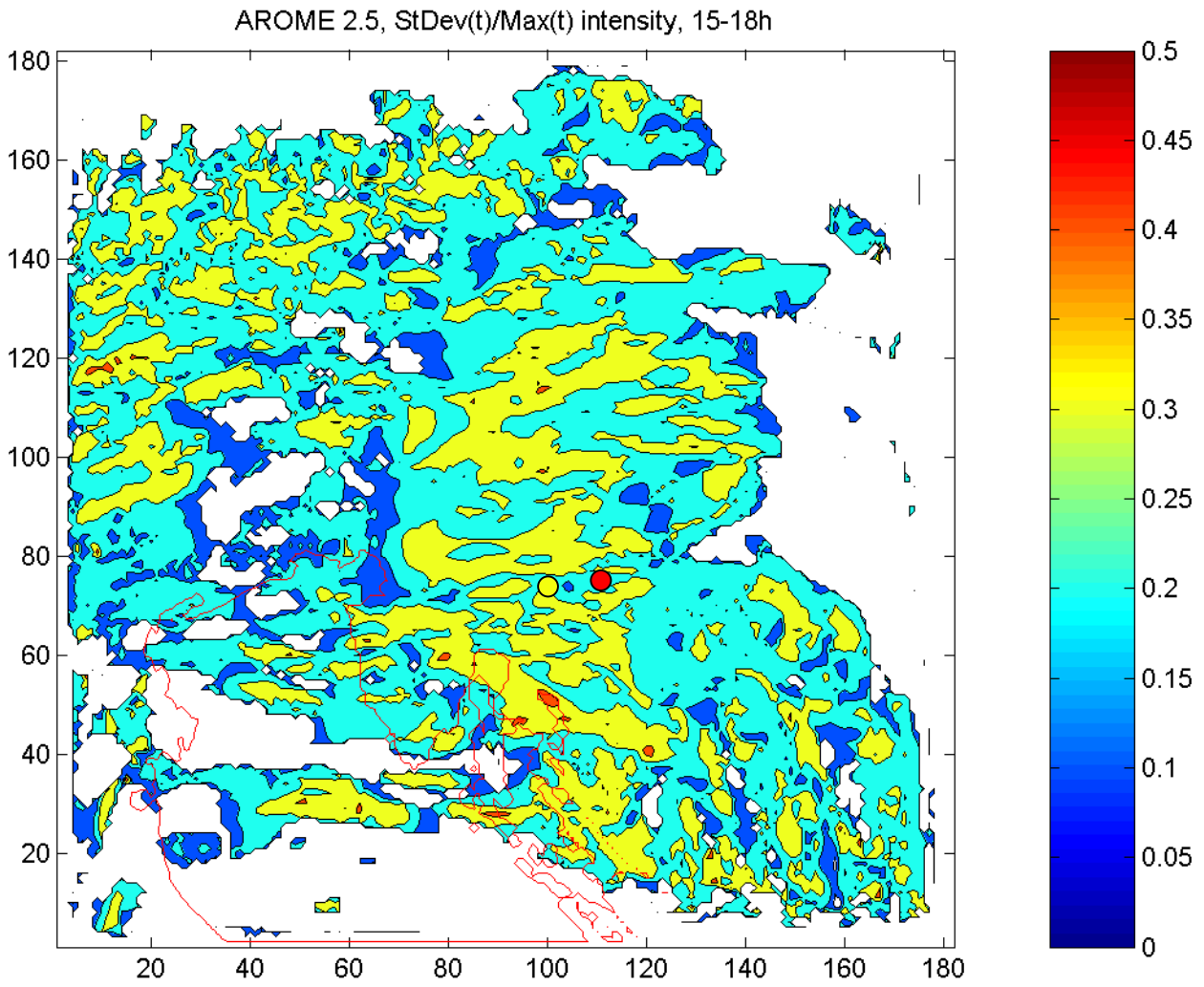
0.24

0.27

AROME

0.28

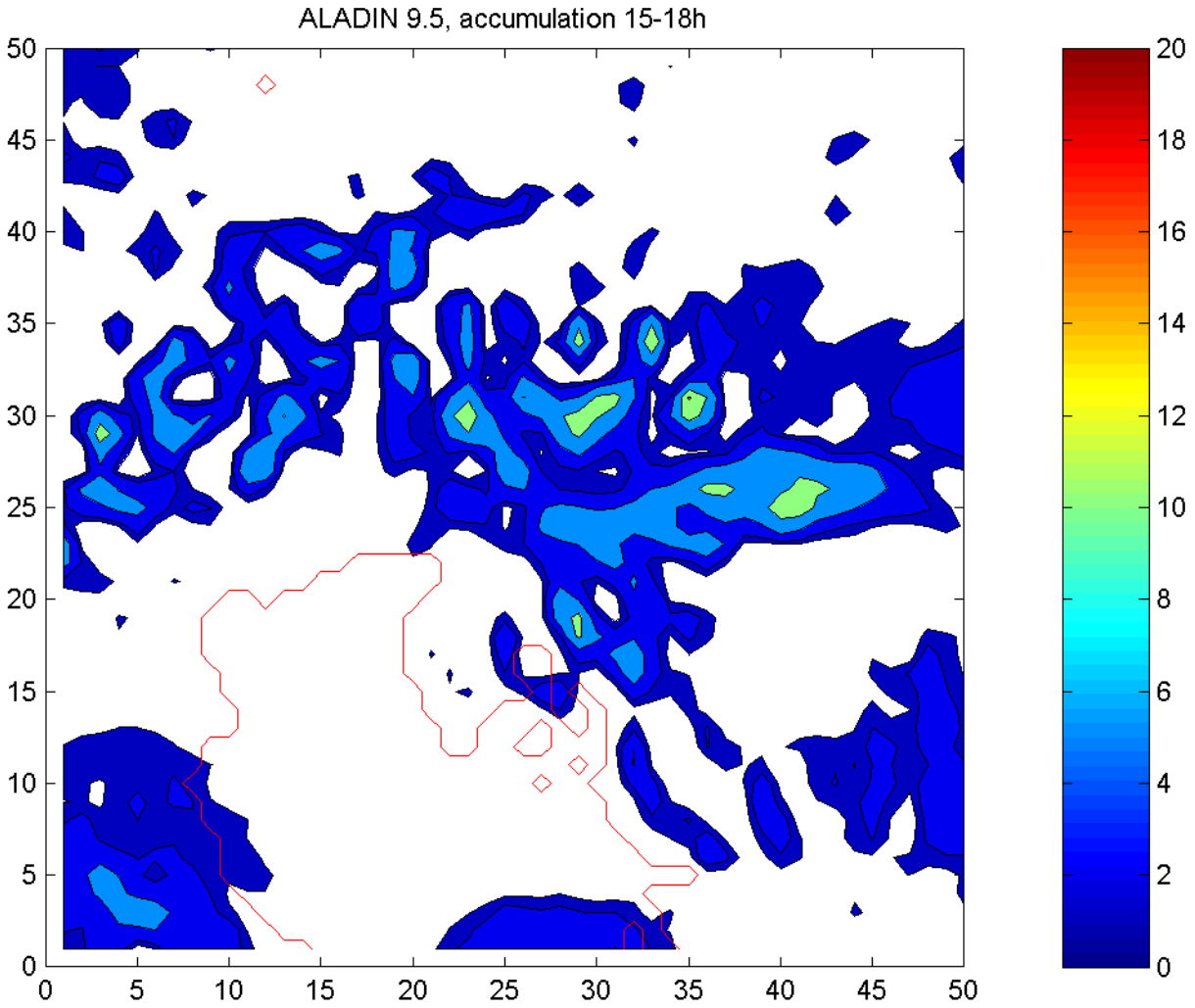
0.25



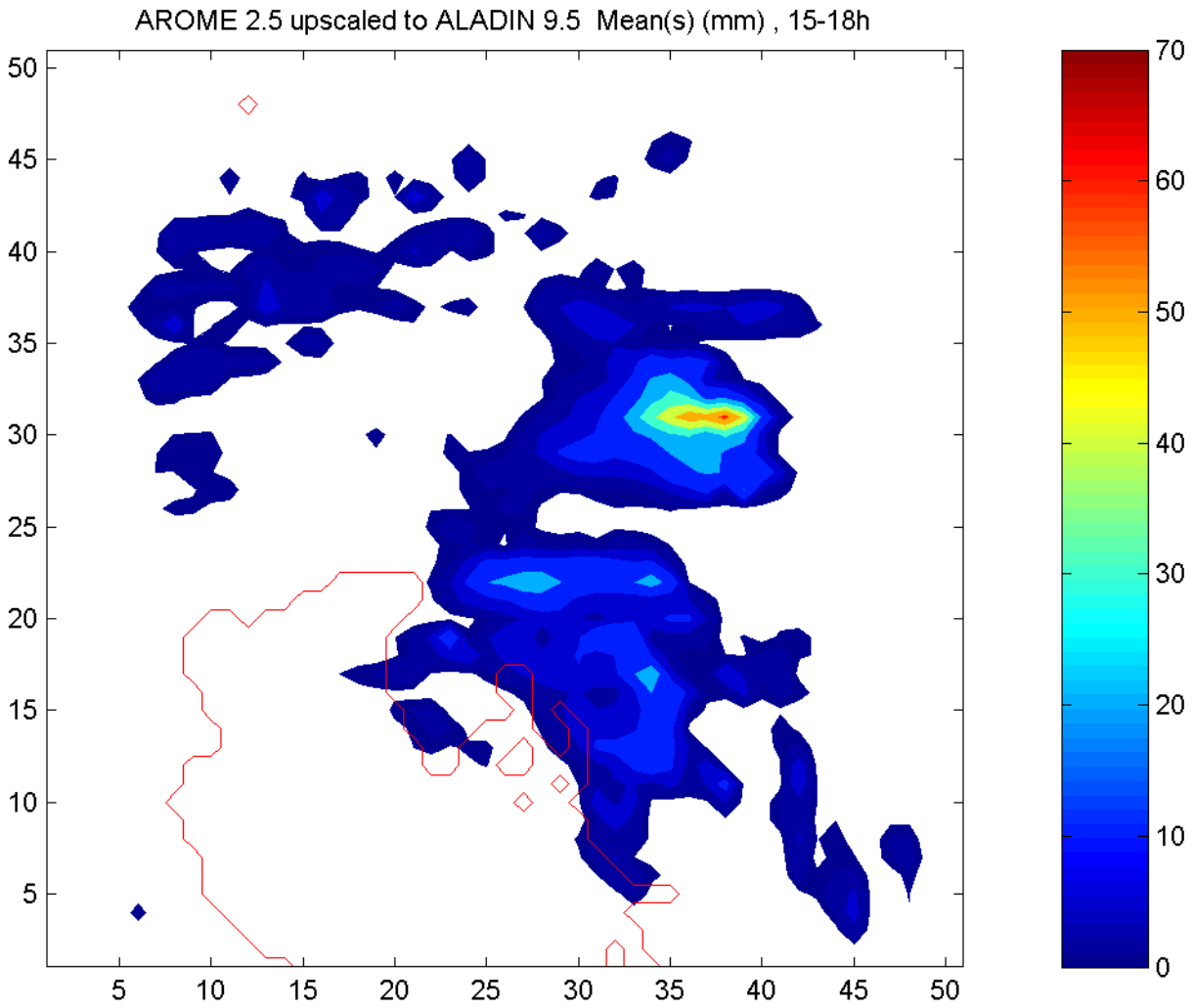
VARIABILITY (2)

- Spatial
  - upscale to lowest meaningful resolution
    - another model's grid
    - geographical regions (forecast information region)

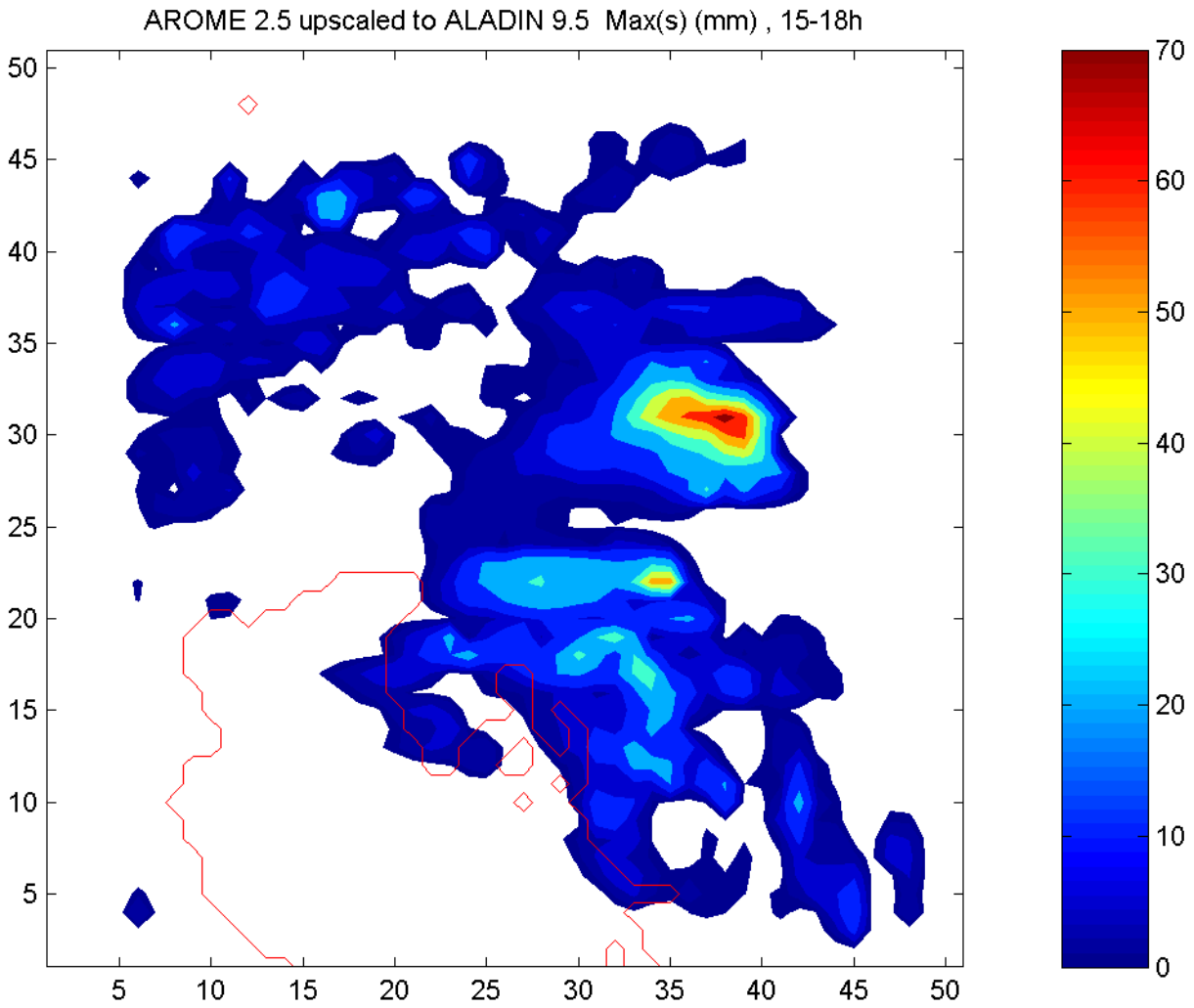
ALADIN 9.5 reminder



MEAN inside ∀ LS grid-box



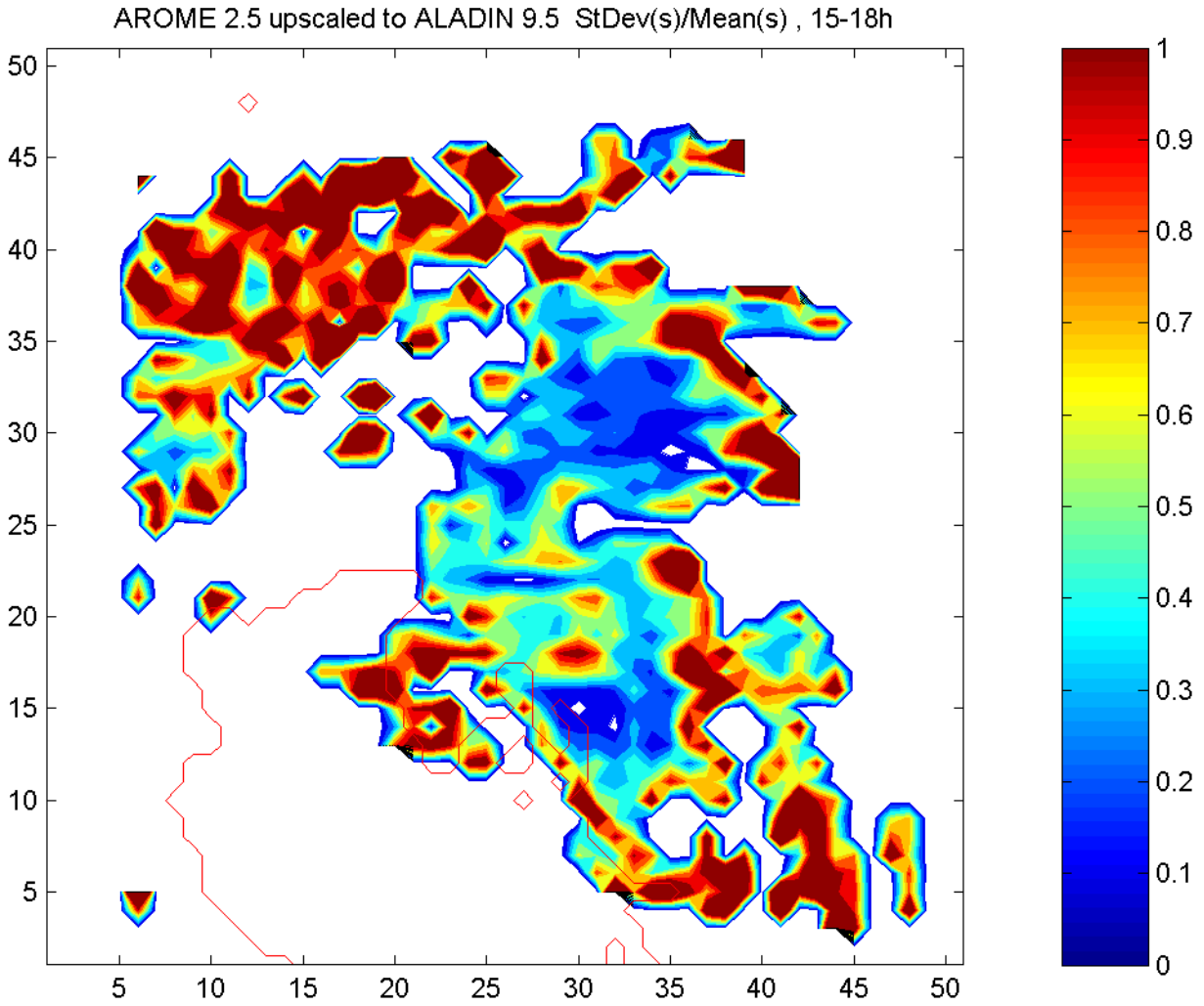
MAX inside ∀ LS grid-box



VARIABILITY inside ∀ LS grid-box

Large =
small showers

Small=
LS-rain



OTHER MEASURES for upscaling

Pre-requisite: VHR in time output (every time-step)

or

on-line computation of statistics

- Number of peaks in space at certain time
- Number of peaks in time
- Area that the peaks cover
- Combinations with topography
  - altitude
  - slope
  - …

$\forall\infty$

ONGOING WORK

- Ideas
- New measures
- Communication to users
- Model verification