Regional Cooperation for
Limited Area Modeling in Central Europe

LACE
nwp central europe

ALADIN

HIRLAM

ALARO status overview

with contributions by
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DHMZ SHMU ARSO METEO Slovenia OMSZ ZAMG ROMANIA ANM

Talk outline

- ALARO current status
- Convective case: sensitivity study to horizontal resolution and deep convection parameterization
- Enhancement of deep convection parameterization
- Outlook

ALARO status

- In the operational use in ALADIN countries
  - **ALARO-0: at, hr, ro,**
  - **ALARO-1vA|B: be, cz, hu, po, sk, si, tr**
    model resolution between 8 km – 4 km, 1.3 km

National posters

- In EPS systems
  - **ALADIN-LAEF, GLAMEPS, EPS at HMS,RMI**
  - **HarmonEPS convection-permitting ensemble system**

- In climatological simulations
  - **be, cz, se**

ALARO-1 versions

- ALARO-1vA (February 2015)
  - TOUCANS, ACRANEB2, 3MT

+ modified interpolation to screen level (T2m, RH2m) in stable situations (May 2016)

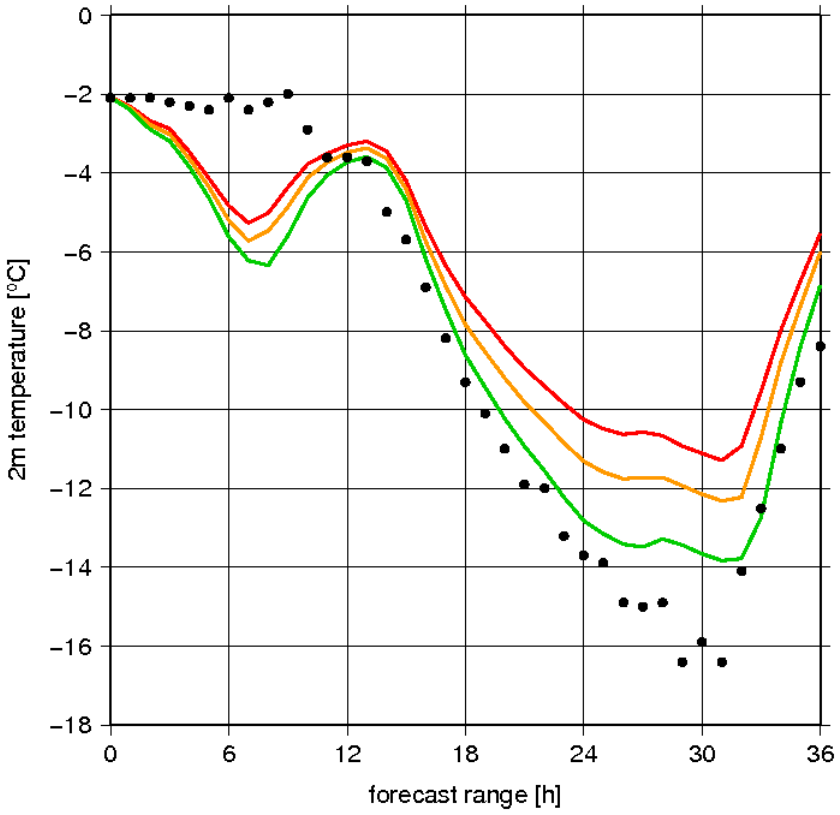
- ALARO-1vB (January 2017)
  - Shallow convection closure, exponential-random cloud overlaps in radiation and cloud diagnostics, improved sunshine duration and direct solar flux at surface

ALARO-1 versions

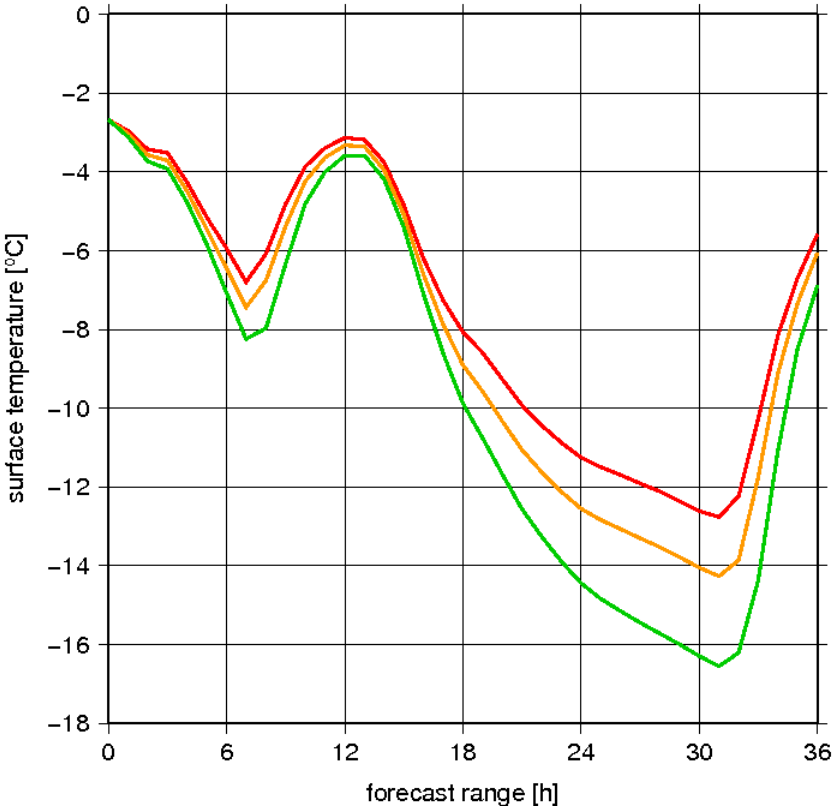
- Recently studied „problems“
  - **minimum 2m temperature** in stable anticyclonic situations **with snow cover** not low enough
    - heat exchange with the deep soil in the presence of snow is to large

T 2m – snow model in ISBA scheme

2 m temperature



surface temperature



10 Jan 2017 00run +36
Prague

Operational settings
extreme (NCHSP=1) soft (NCHSP=2)

ALARO-1 versions

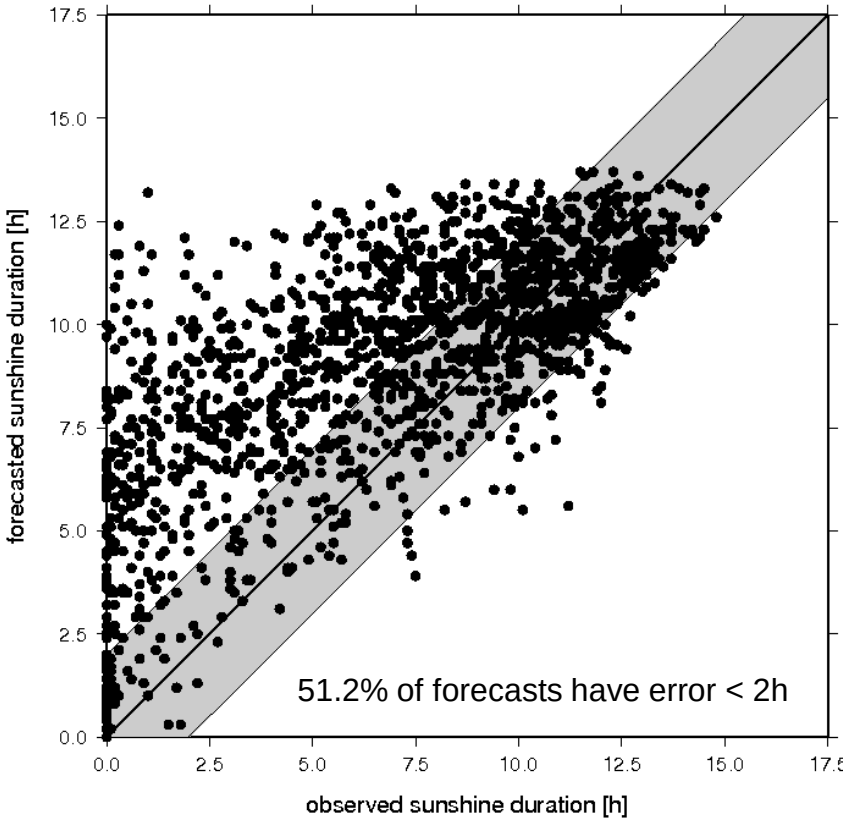
- Recently studied „problems“
  - **minimum 2m temperature** in stable anticyclonic situations **with snow cover** not low enough
    - heat exchange with the deep soil in the presence of snow is to large
    - 2-layer ISBA is insufficient in such case,
    - usage of SURFEX with more advanced snow scheme

ALARO-1 versions

- Recently studied „problems“
  - **minimum 2m temperature** in stable anticyclonic situations **with snow cover** not low enough
  - **diagnostics of sunshine duration** overestimation in cases with partial cloud cover
  - **low cloudiness** in stable winter conditions

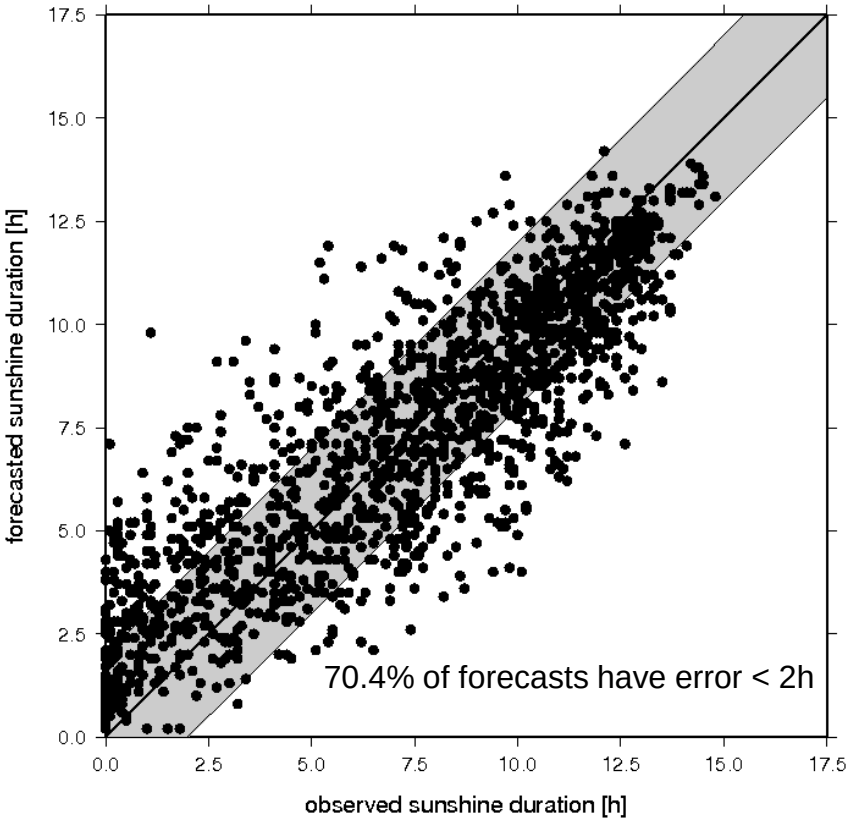
Sunshine duration

Period: 30 Jun – 26 Sep 2016
19 Czech stations



CHMI ALARO-1vA
00+24 hour forecasts

Daily sunshine duration



CHMI ALARO-1vB
00+24 hour forecasts

Sunshine duration

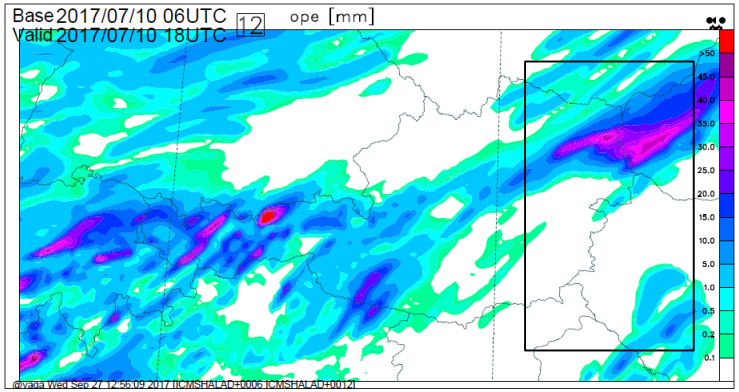
- Improvements are coming from
  - taking into account subgrid variability of surface direct solar flux
  - the exponential-random cloud overlap (instead of maximum-random one),
  - from related retuning in the cloud scheme.

- Overestimation of global radiation and sunshine duration remain during winter due to insufficient low inversion clouds.

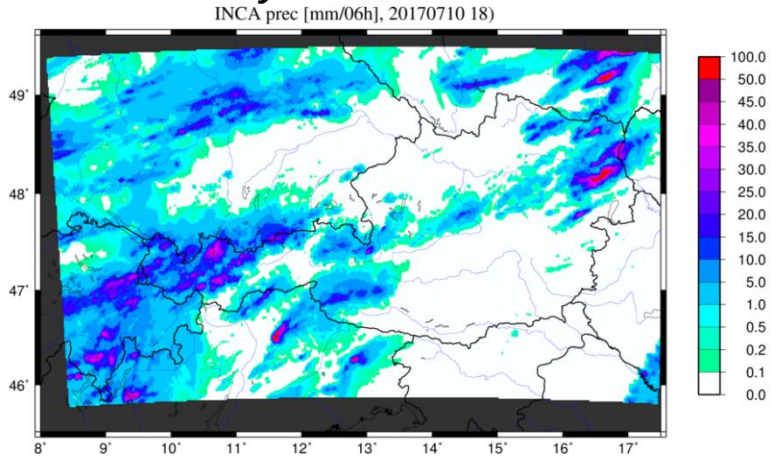
Strong convection case with tornado

ALARO-1vB (CZ oper, 4.7km, BlendVar, cpl ARPEGE)

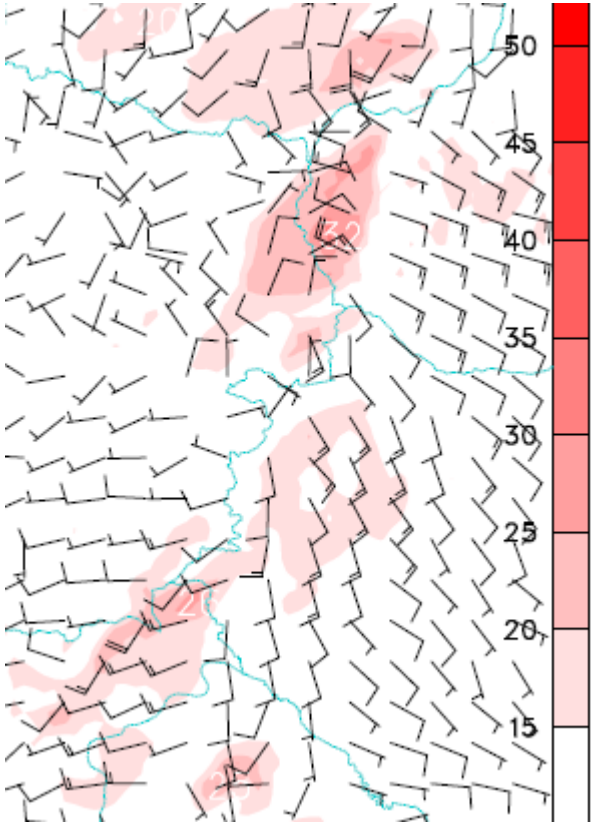
6h precip (06 run+12h)



INCA analysis



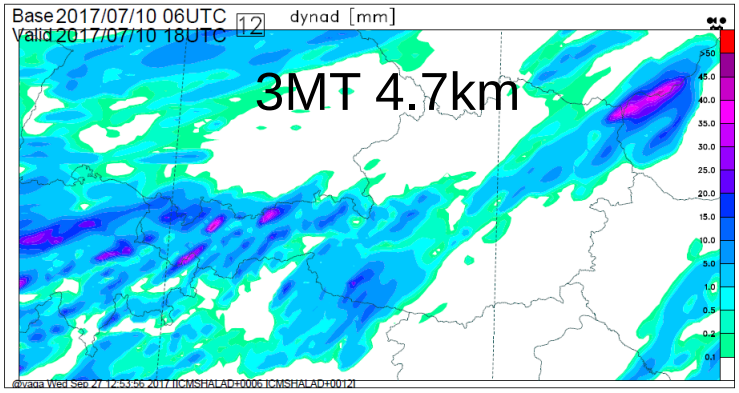
Strong gusts on the front line, at 16h UTC (06 run+10h)

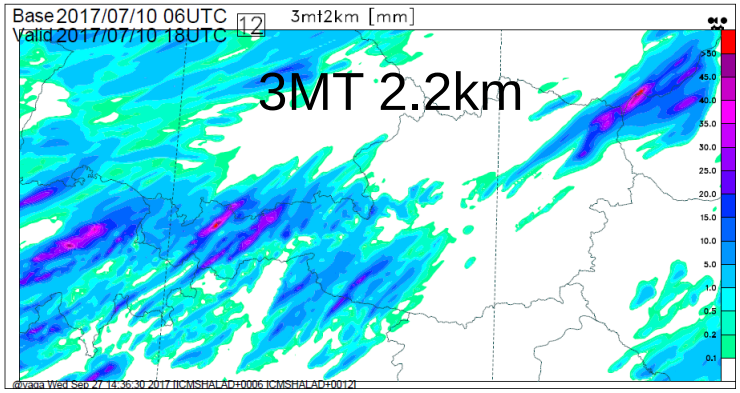


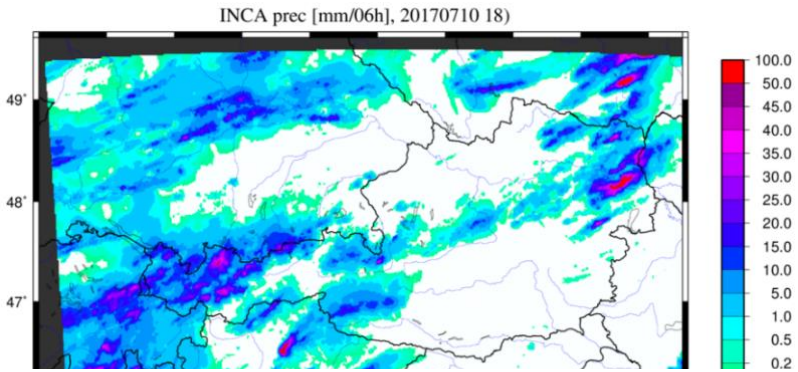
Sensitivity to resolution and deep convection parameterization: **precipitation**

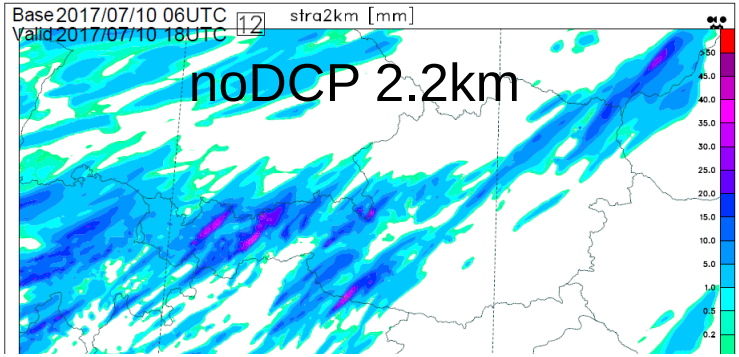
with dynamical adaptation (no DA)

6h precip (06 run+12h)



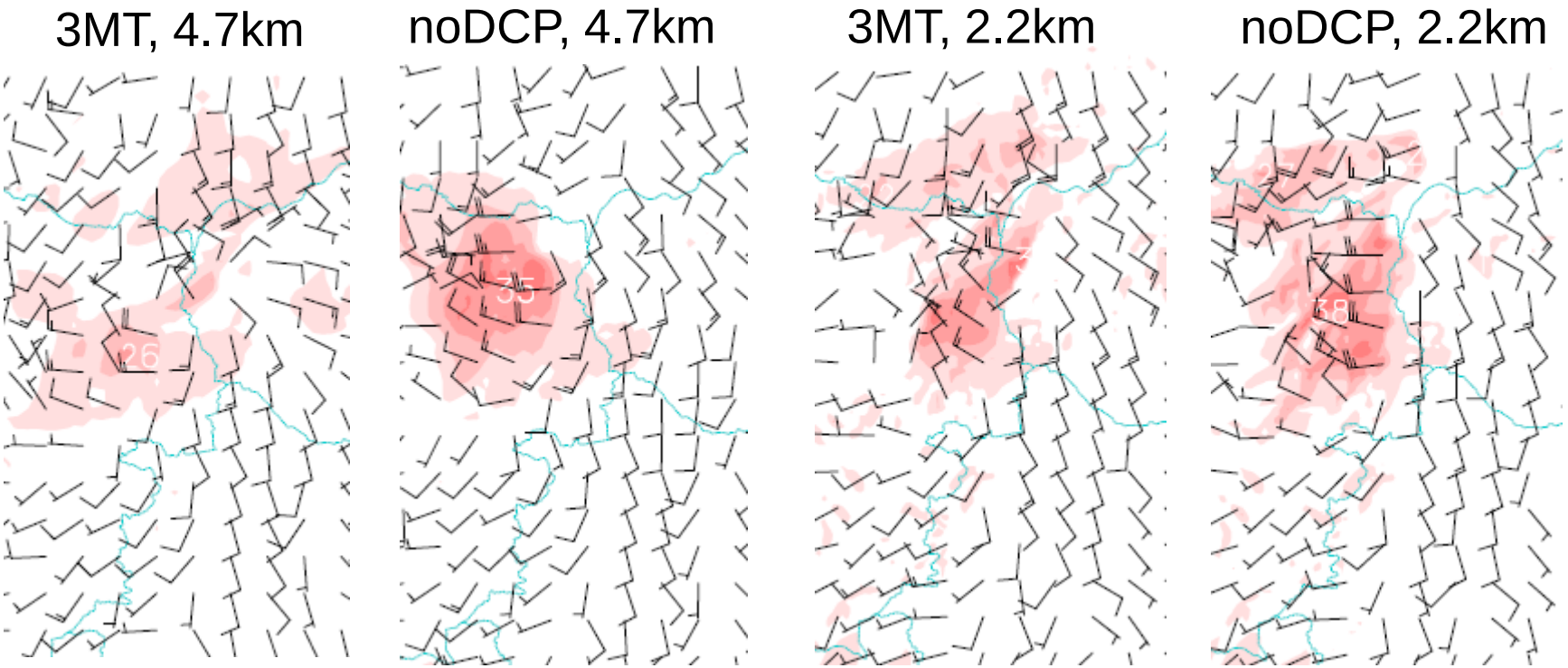






The most active area in the plane is moved to the North in case without DA.
Higher resolution brings finer structures.
Not enough strong precipitation in the plane in case without parameterization.

Sensitivity to resolution and deep convection parameterization: **wind gusts**



Higher resolution brings **sharper surface wind convergence** limit.
Absence of the moist deep parameterization leads systematically to even stronger surface wind at both resolutions since the dynamics tries to compensate.

Deep convection

October 2015

Bulk Mass-Flux Perturbation Formulation for a Unified Approach of Deep Convection at High Resolution

LUC GERARD

Royal Meteorological Institute of Belgium, Brussels, Belgium

(Manuscript received 20 January 2015, in final form 25 June 2015)

Complementary Subgrid Draft produces a gradual transition to explicit convection

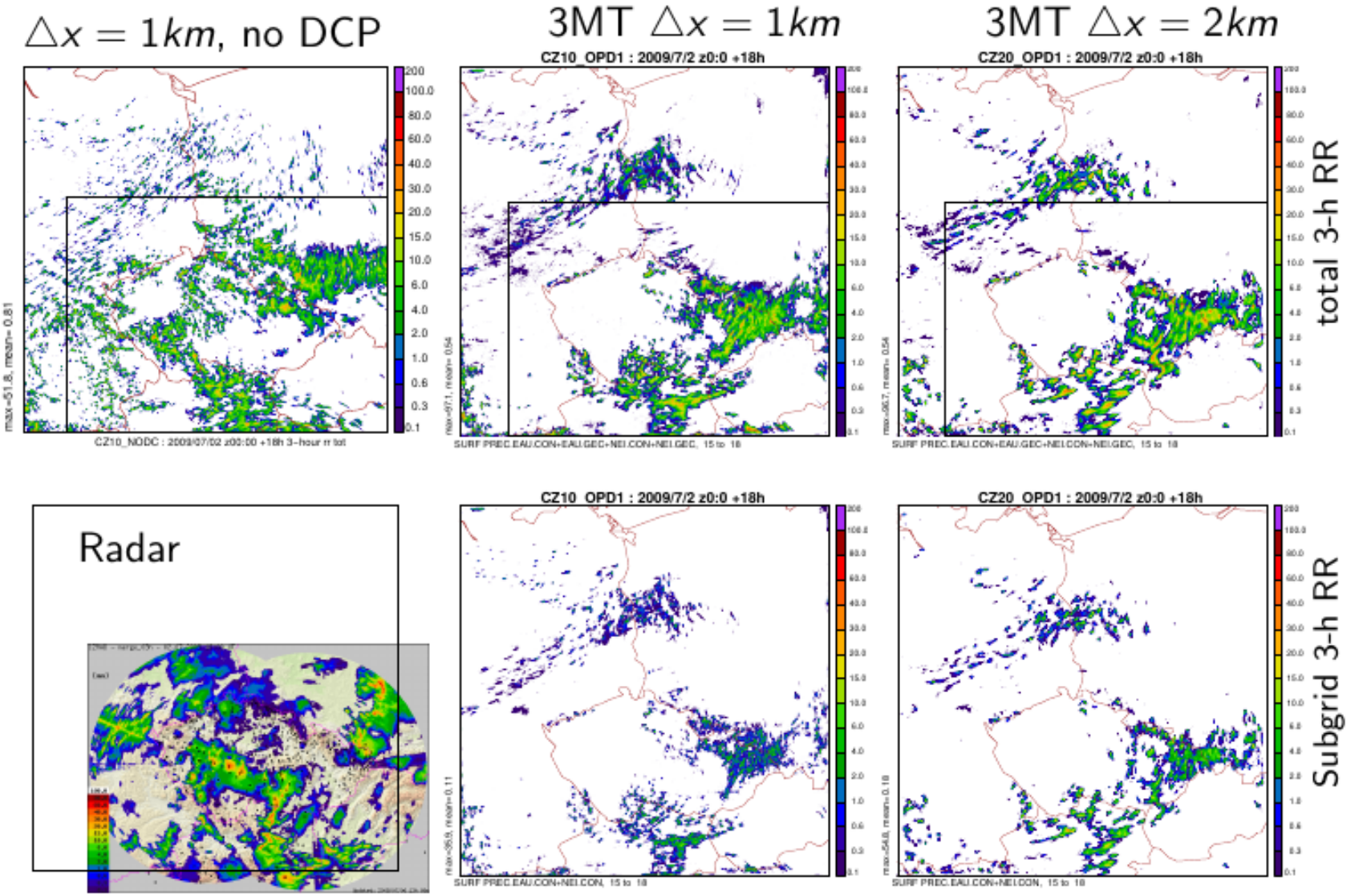
Essential features:

- sequential physics with feed-backs, e.g. convective area protection, downdraft.
- **plume model for perturbation-updraft**
- **specific closure formulation**
- **adapted/specific triggering formulation**
- prognostic updraft evolution (velocity, mesh fraction, rising cloud top).
- single prognostic microphysics

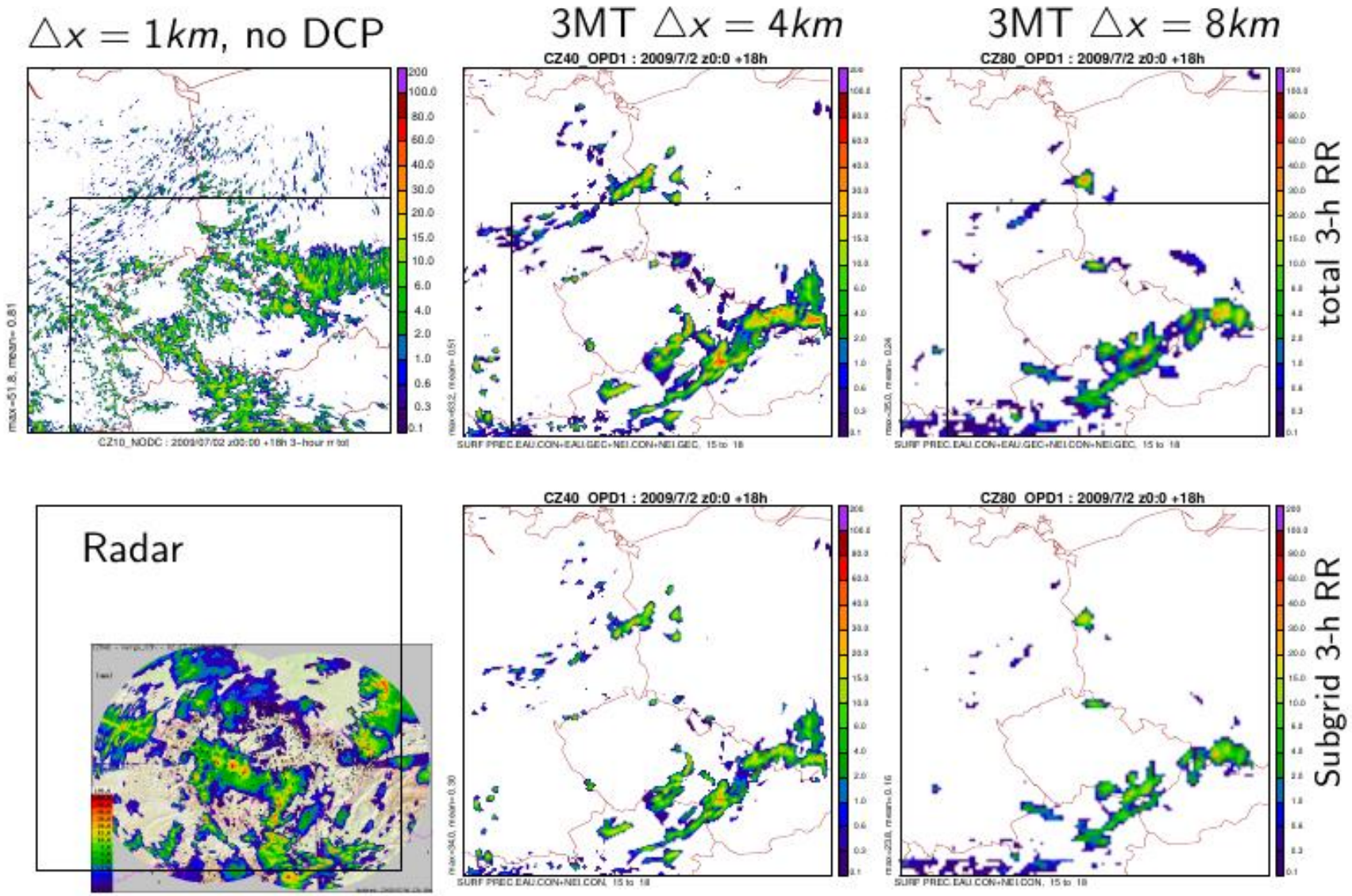
Recent developments:

- the criterion for determining cloud top
- reviewed critical humidity profile in the cloud scheme

Example CSD vs 3MT behaviour across resolutions



Example CSD vs 3MT behaviour across resolutions

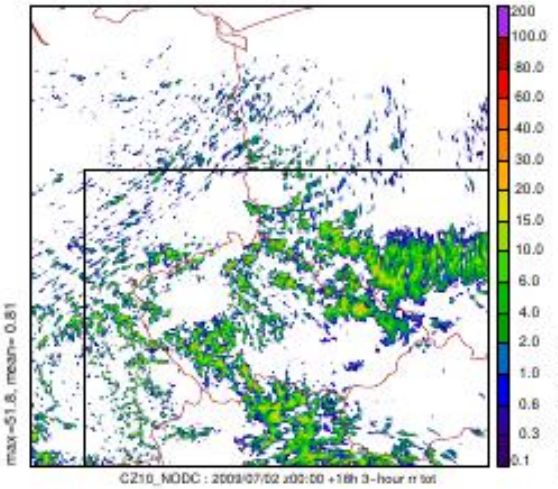


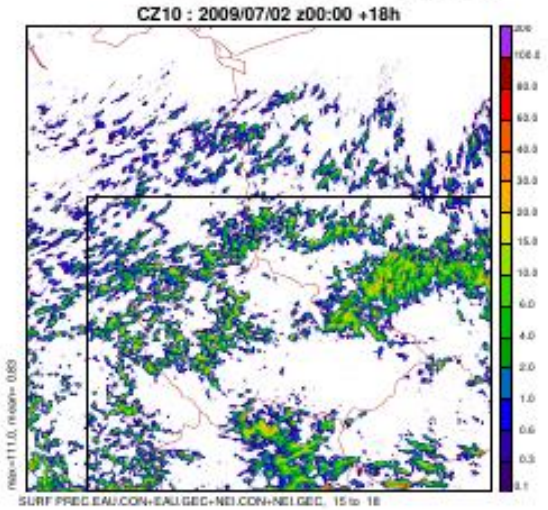
Example CSD vs 3MT behaviour across resolutions

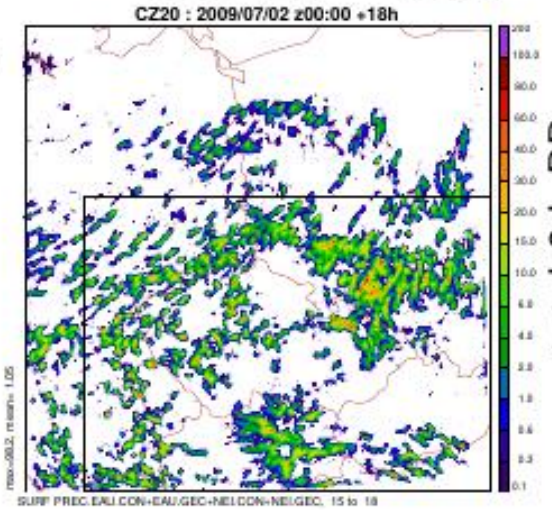
$\triangle x = 1km$, no DCP

CSD $\triangle x = 1km$

CSD $\triangle x = 2km$

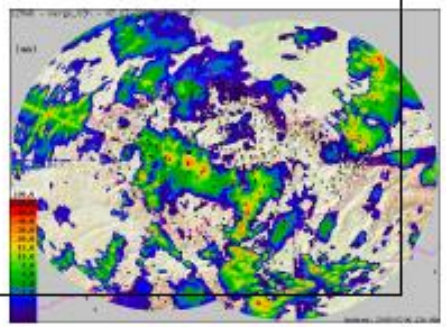


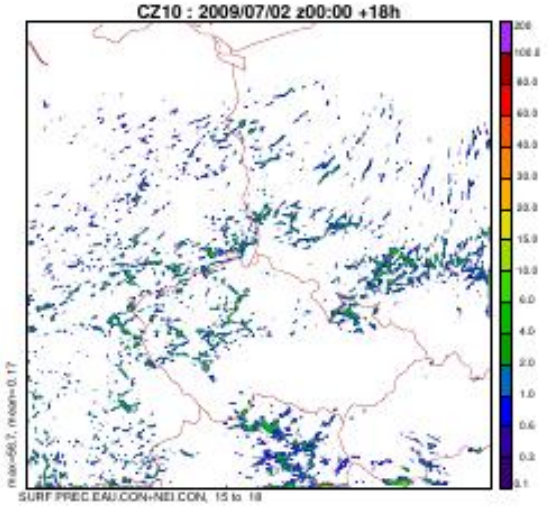


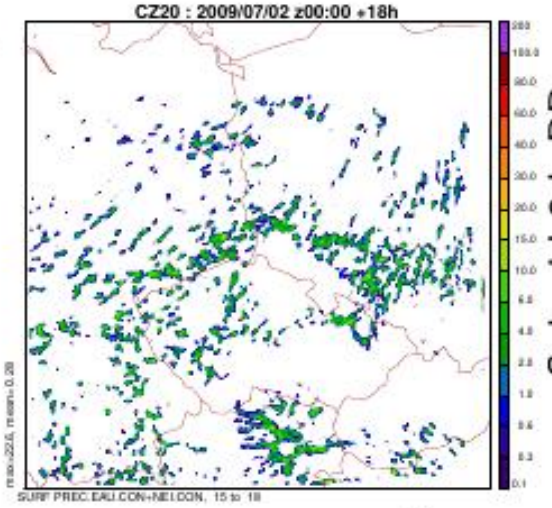


total 3-h RR

Radar







Subgrid 3-h RR

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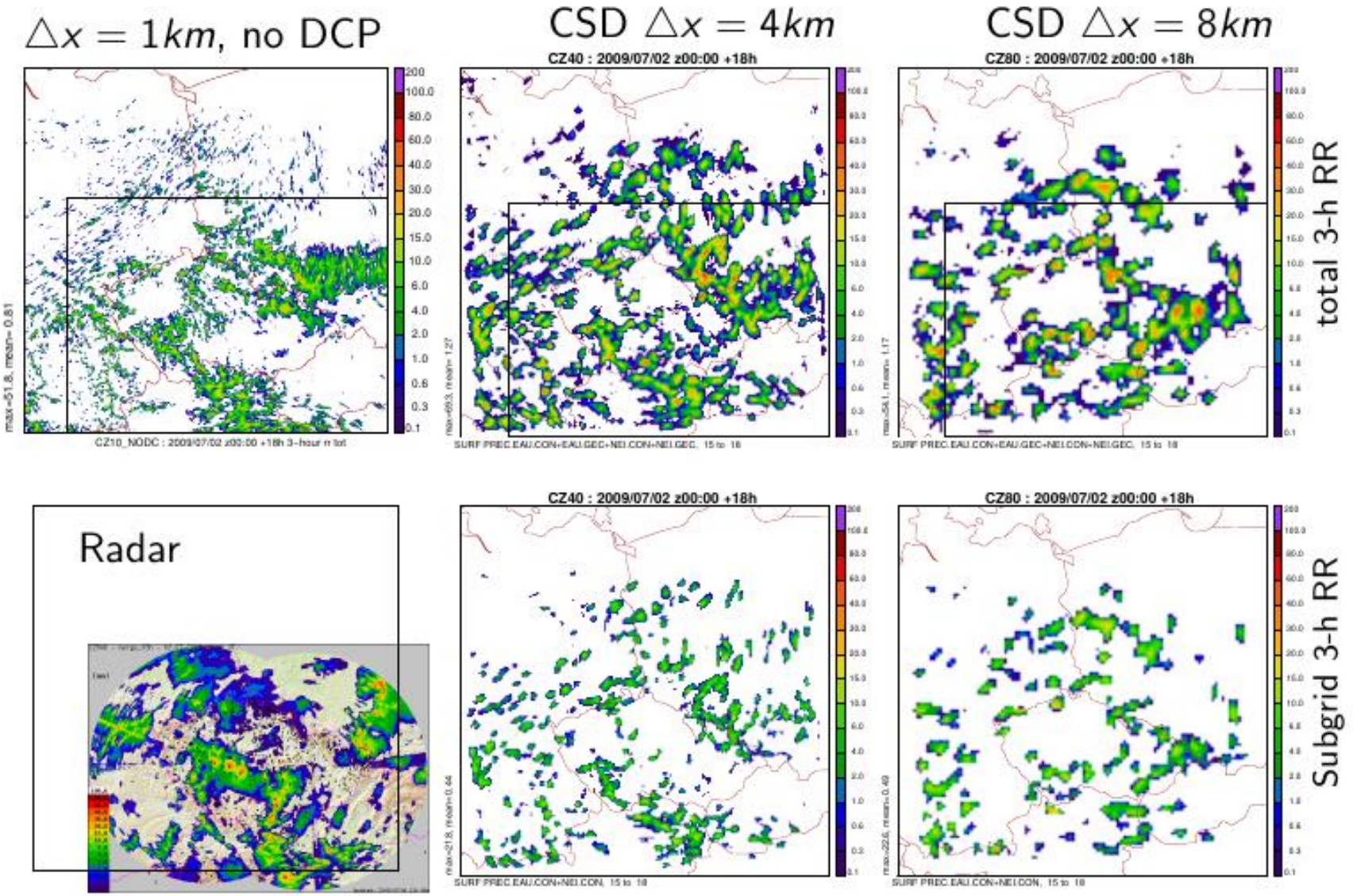
Example CSD vs 3MT behaviour across resolutions



Outlook

- Enhancement of the 3MT downdraft parameterization towards **non-saturated downdraft** option
- Adding aspects of **Complementary Sub-grid Drafts** to radiation, turbulence and microphysics
- Further enhancements of the **Third Order Moments** and **mixing length scale** parameterization in TOUCANS
- Further steps towards **the unification of cloudiness**
- Linking with the **SURFEX** scheme

Thank you!