Regional Cooperation for
Limited Area Modeling in Central Europe

LACE
nwp central europe

ALADIN

HIRLAM

ALARO physics developments

Neva Pristov
contributions from LACE and Belgium teams

EWGLAM and SRNWP meetings

DHMZ SHMU OMSZ ZAMG ROMANIA ANM

Talk outline

- ALARO current status
- New developments
  - **shallow convection inside TOUCANS**
  - **novelties in radiation scheme**
  - **cloud overlap treatment**
  - **interpolation to screen level**
  - ***enhancement of deep convection***
- Outlook

ALARO status

- In the operational use in ALADIN countries
  - **ALARO-0: at, be, hr, ro, sk, si**
  - **ALARO-1vA: cz, hu, po, tr** (e-suite be,sk)
    model resolution between 8 km – 4 km, 2km

National posters

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

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

First version of ALARO-1

- is a multi-scale, able to run at various horizontal resolution, across the gray zone of convection, down to 1 km
- source code and documentation available in February 2015
- modified interpolation to screen level (T2m, RH2m) in stable situations in May 2016
- novelties (presented in next slides) in the e-suite at CHMI

TOUCANS

- Shallow convection closure in turbulence scheme (non-precipitating)

Moist (in presence of condensation) buoyancy is parameterized from a simple mass flux-type model with simplified entrainment profiles

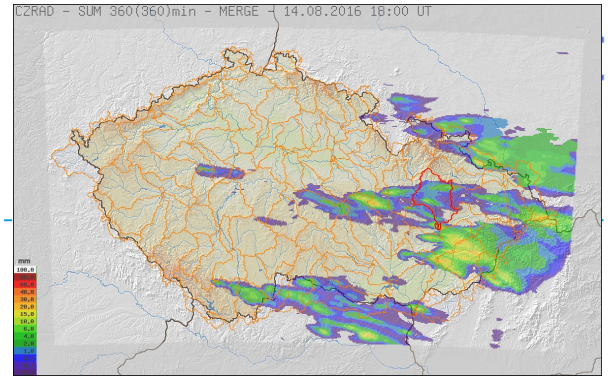
Validation:

- amount of cloudiness is increased in general – retuning is needed in radiation scheme, diagnostic cloudiness
- highest impact in summer season

Results:

- BIAS of precipitation, T2m, RH2m is smaller
- precipitation structure improved
- reduction of weak precipitation
- can help that precipitating convection start at the right place

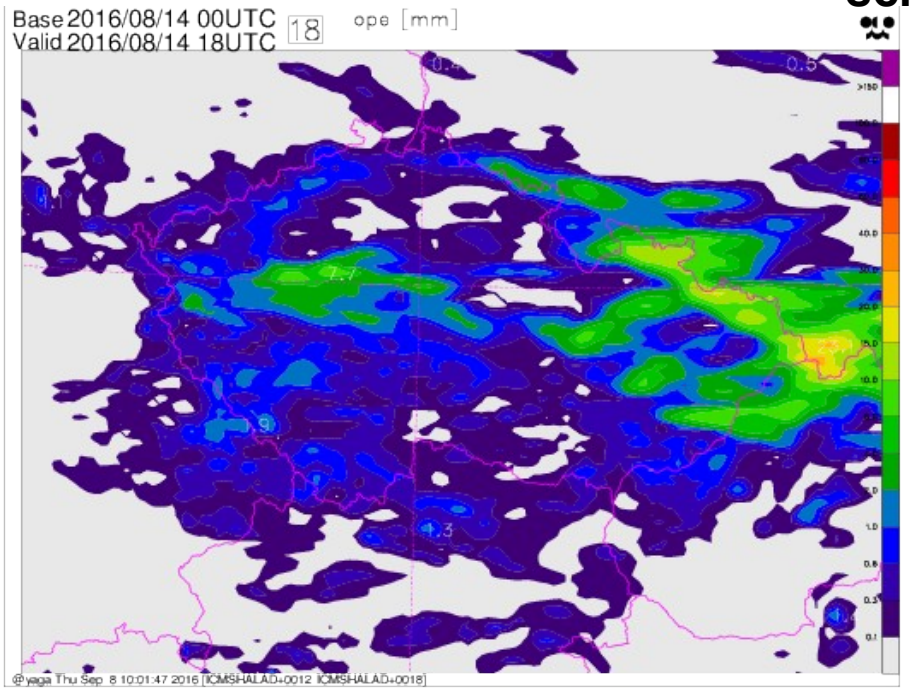
6h precipitation amounts based on radar
14.08.2016 12-18h

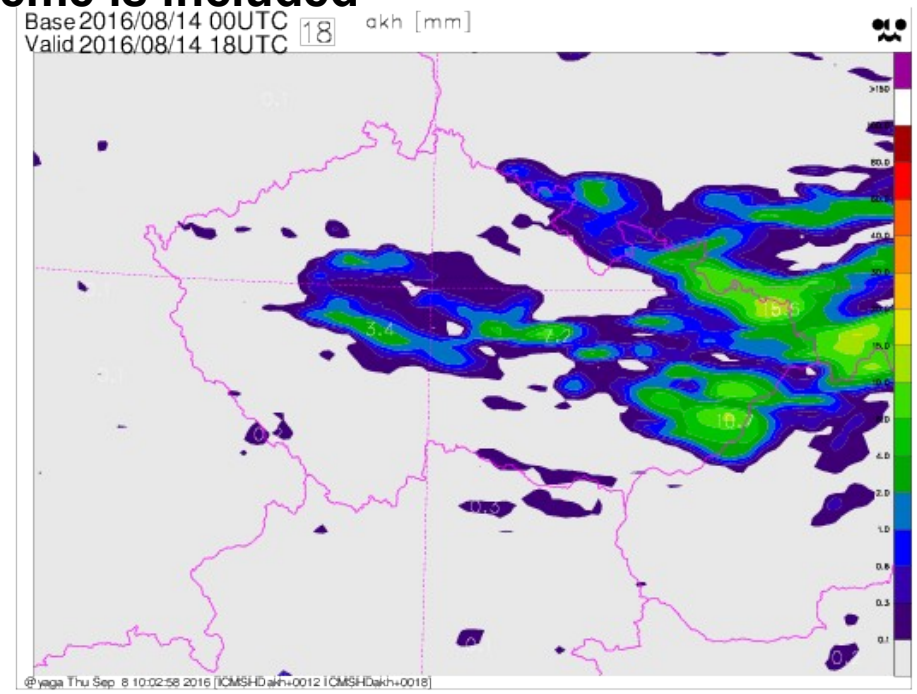


TOUCANS

- Shallow convection closure

oper **e-suite new shallow convection scheme is included**



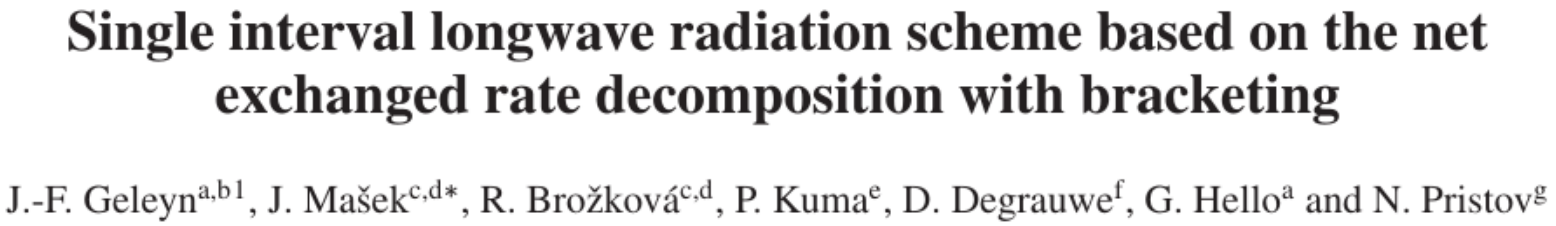


6h precipitation amounts
14.08.2016 00+18h

Radiation

SW part
October 2015

- paper describing LW part submited to QJRMS

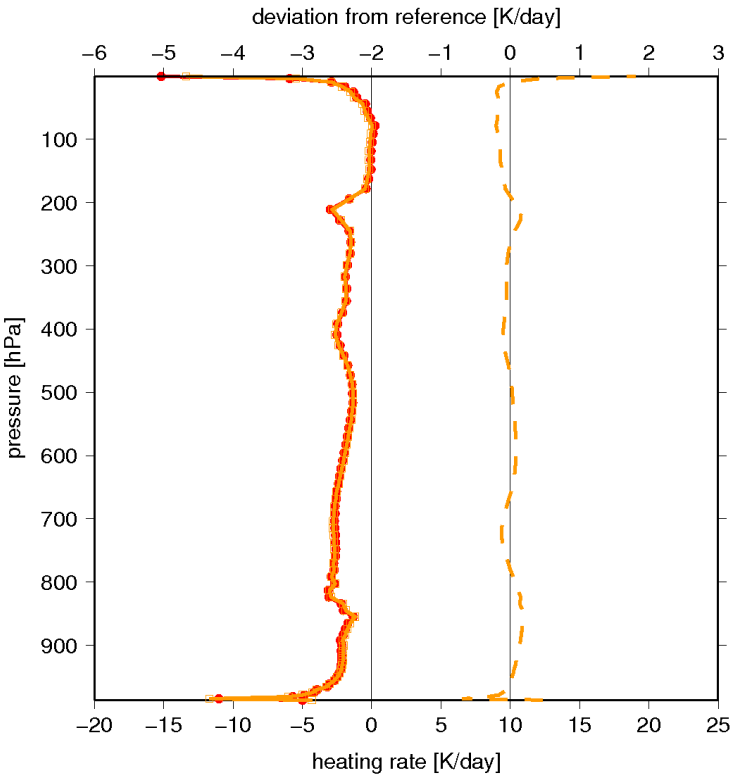


- writing the papers helped to significant improvement of ACRANEB2 scheme
  - verification against SW and LW narrowband references helped to identify the weak points,
    some of them are cured already

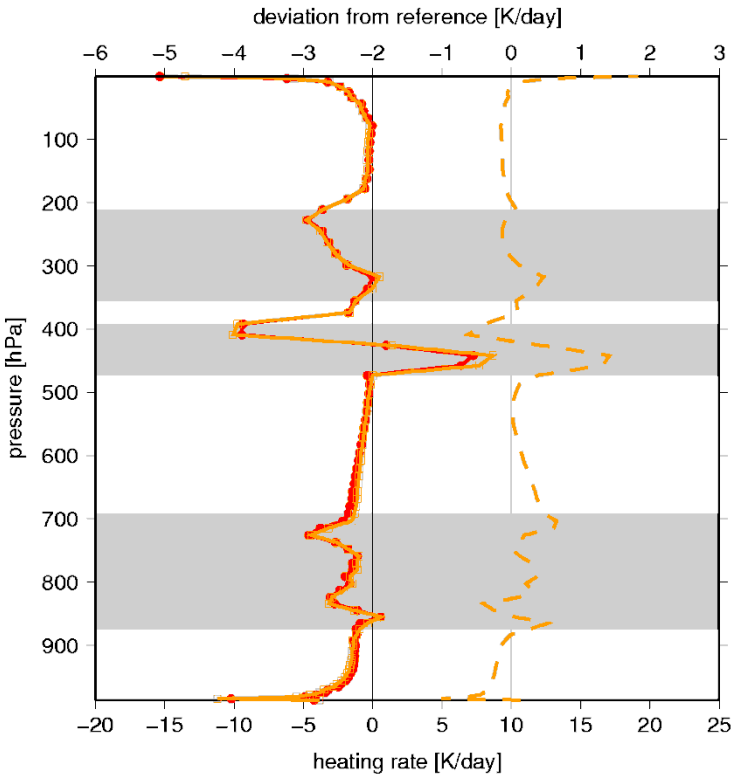
ACRANEB2 verification against narrowband reference

LACE nwp central europe

clear sky case



cloudy case

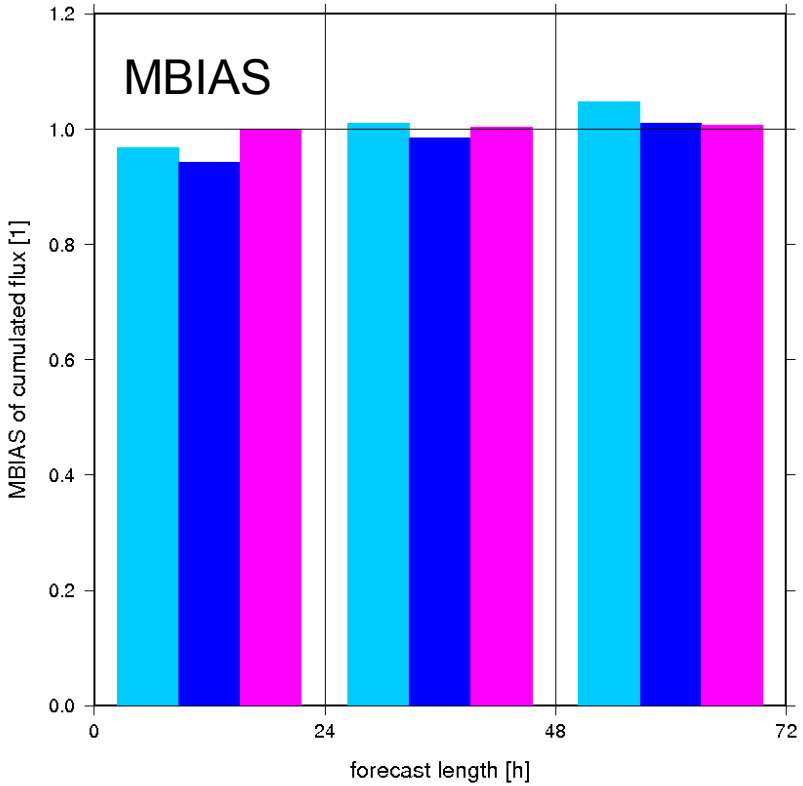


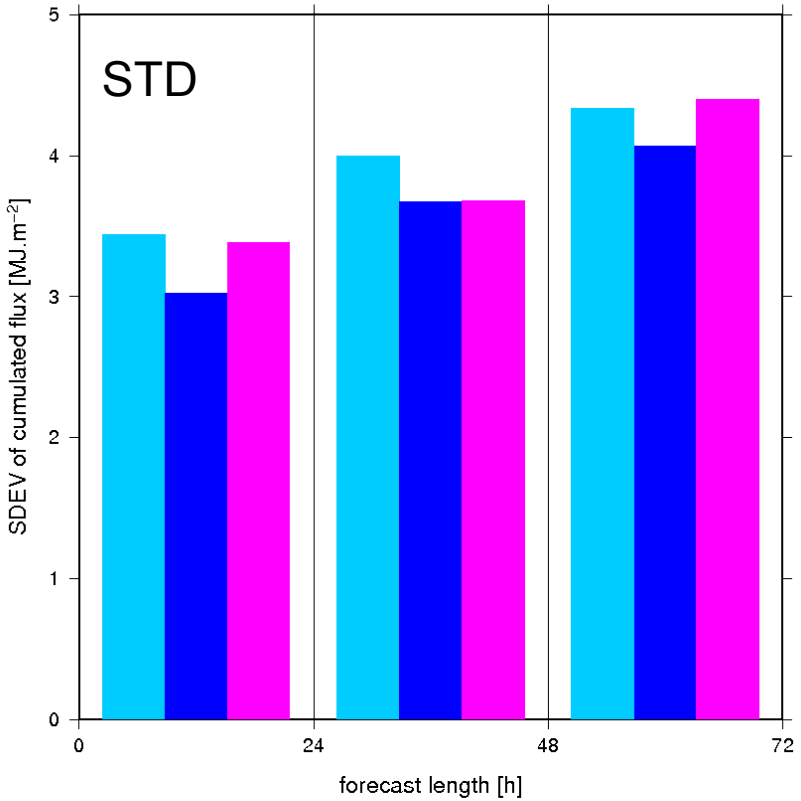
Longwave heating rates: red - NBM reference(432 LW bands),
yellow – ACRANEB2 (1 LW band)

Dashed line: difference (upper scale); grey shading – cloud layers

Direct solar flux at surface

Daily totals





Period: 30 Jun – 26 Sep 2016
6 Czech stations

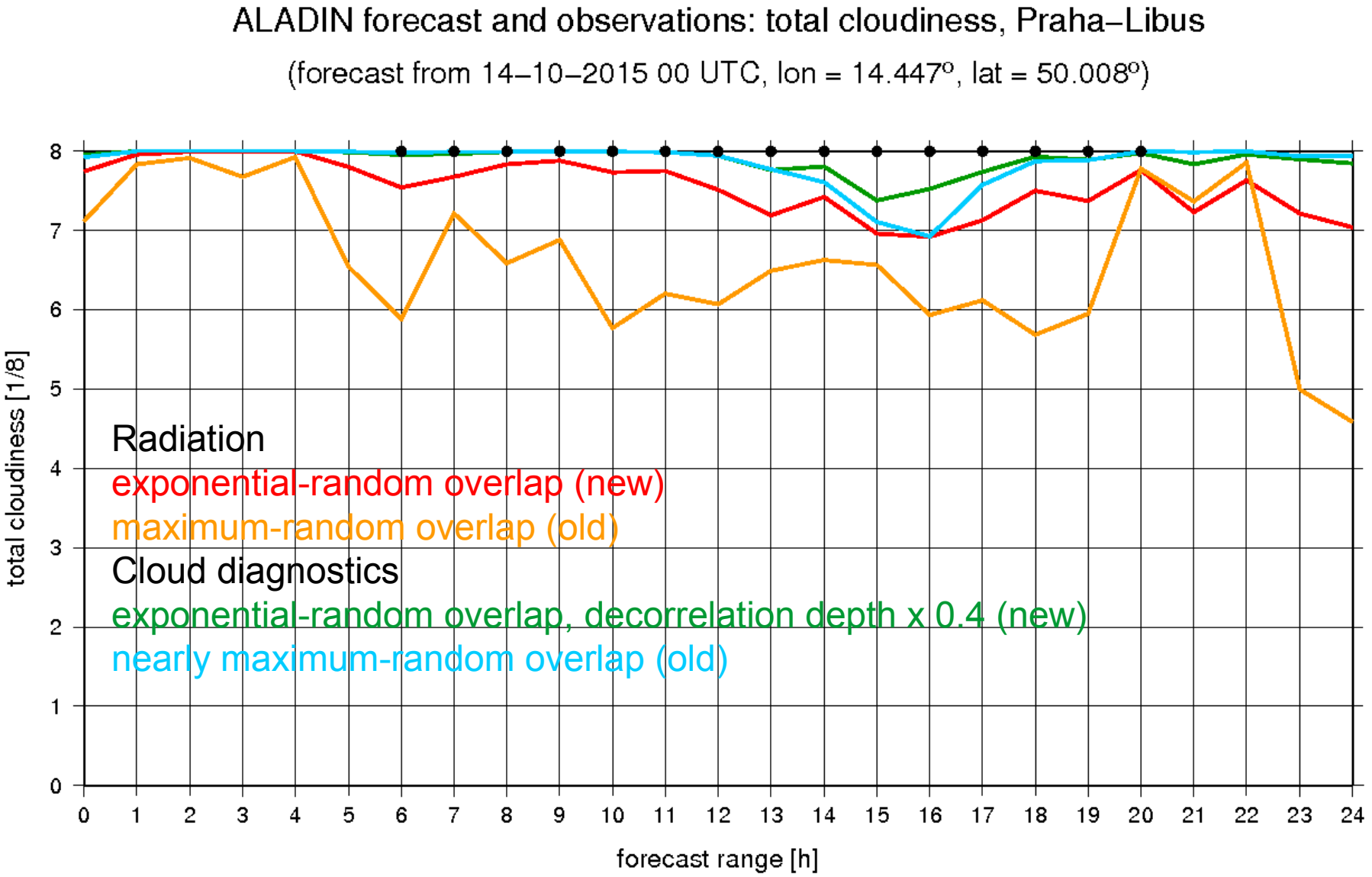
CHMI oper
CHMI e-suite (all novelties)
ECMWF

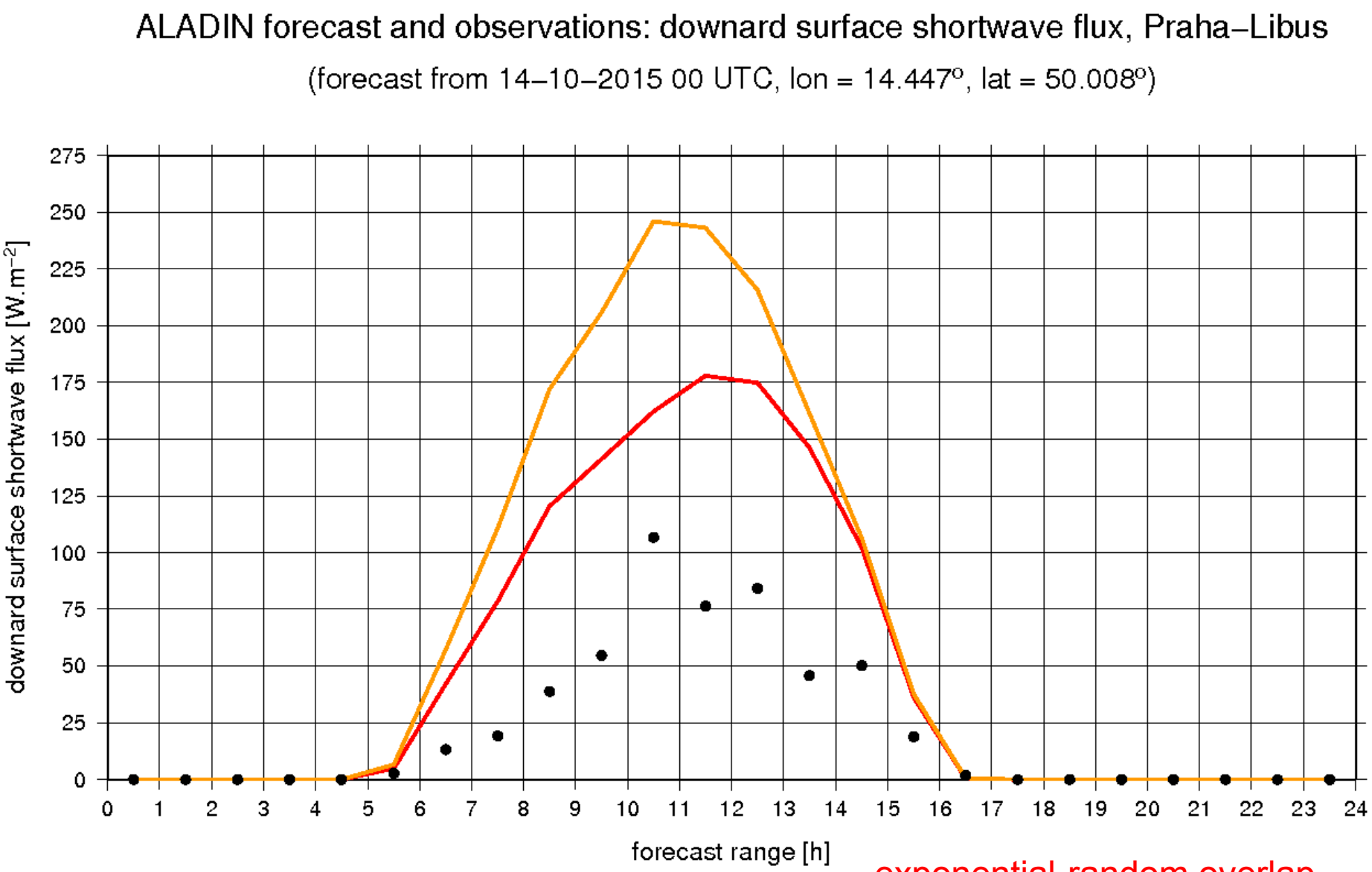
Cloud overlap treatment

- Case: 14-Oct-2015 at, cz, … overcast with rain
  - diagnostic total cloudiness was almost correct
  - ALARO-1 forecast with ACRANEB2 scheme overestimated SW global radiation more than twice

- Main reason: different cloud overlap hypothesis in radiation and diagnostics

- Solution:
  - cloud cover in radiation is increased by replacement of maximum-random cloud overlap with exponential-random


ALADIN forecast and observations: total cloudiness, Praha–Libus
(forecast from 14–10–2015 00 UTC, lon = 14.447°, lat = 50.008°)
total cloudiness [1/8]
forecast range [h]
Radiation
exponential-random overlap (new)
maximum-random overlap (old)
Cloud diagnostics
exponential-random overlap, decorrelation depth x 0.4 (new)
nearly maximum-random overlap (old)



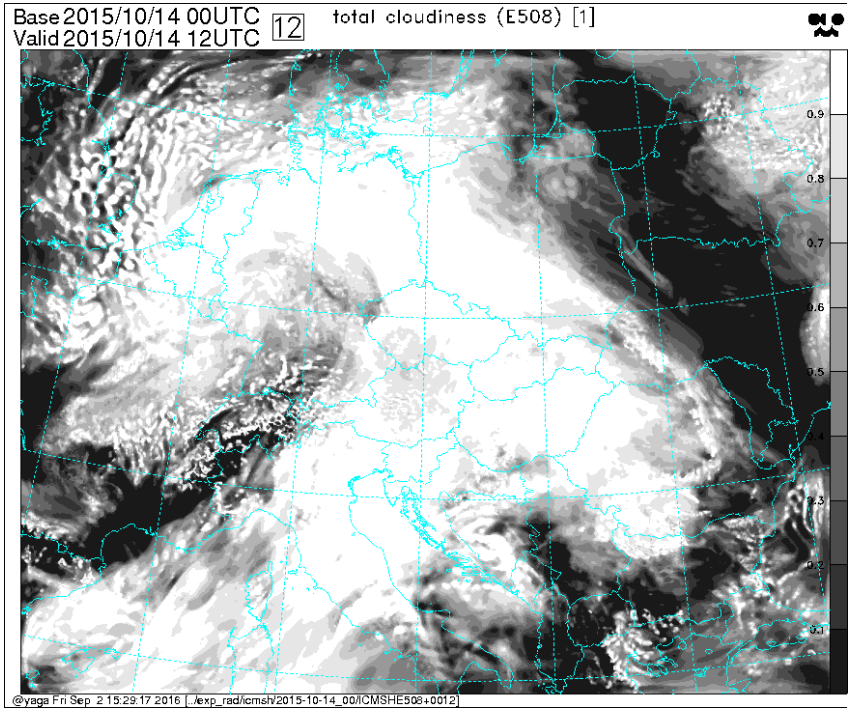
exponential-random overlap

maximum-random overlap

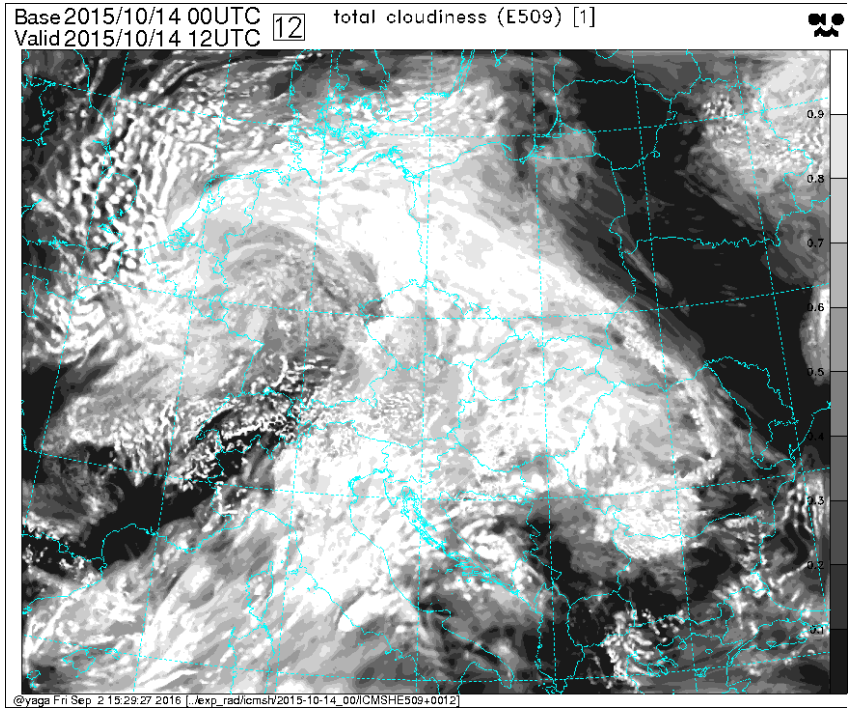
New cloud overlaps partially reduce difference

Cloud cover inside radiation scheme

Total cloud cover
14.10.2015 00+12h



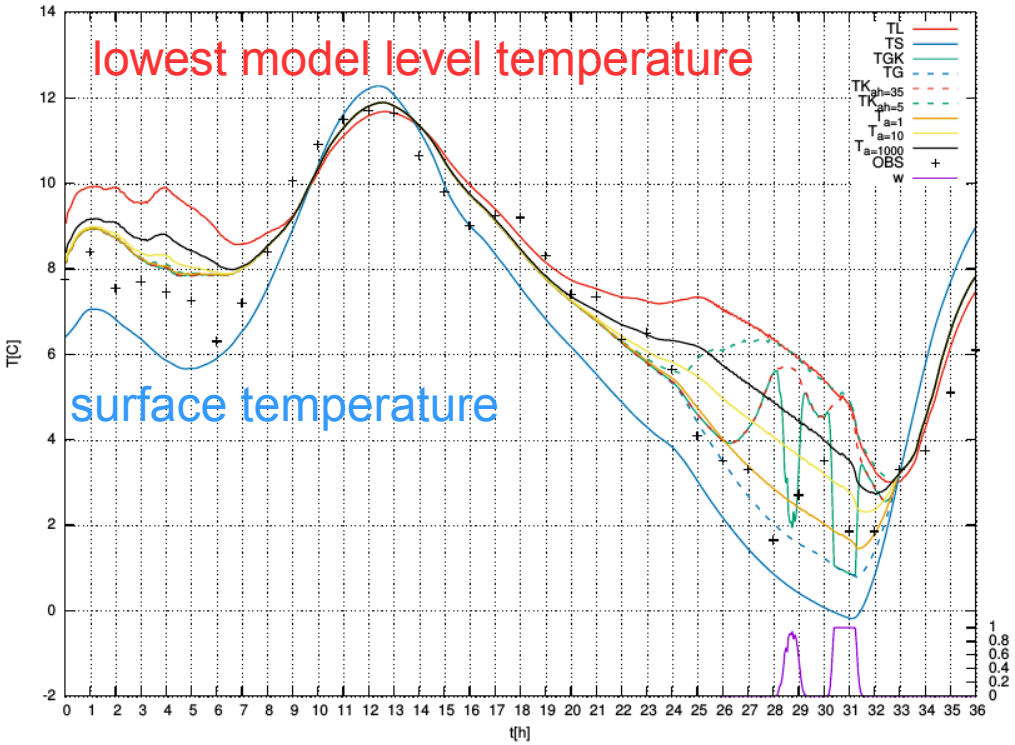
Exponential-random overlap



Maximum-random overlap

Interpolation to screen level (T2m, RH2m) in stable situations

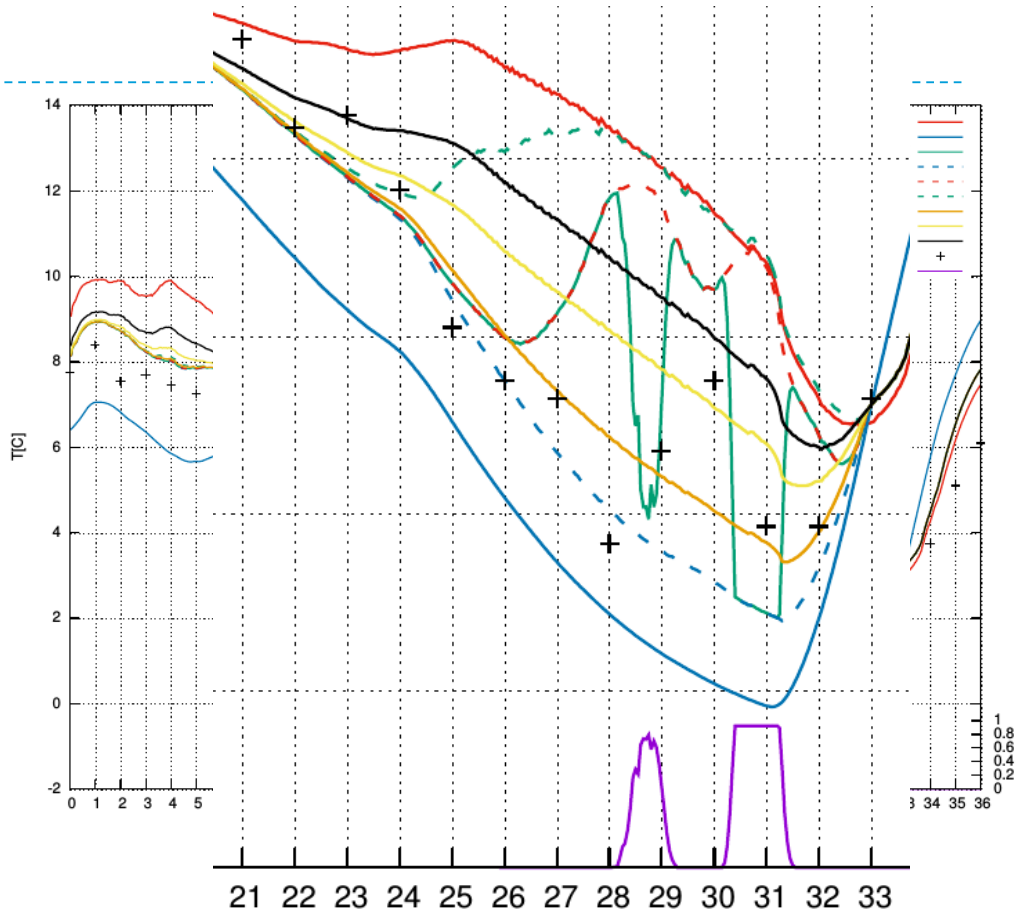
- modified interpolation
  - Mixture of Geleyn 1988 and Kullmann 2009 method has oscillations



mixture of Geleyn and Kullman
dashed Geleyn 1988
dashed Kullman 2009
new recomended

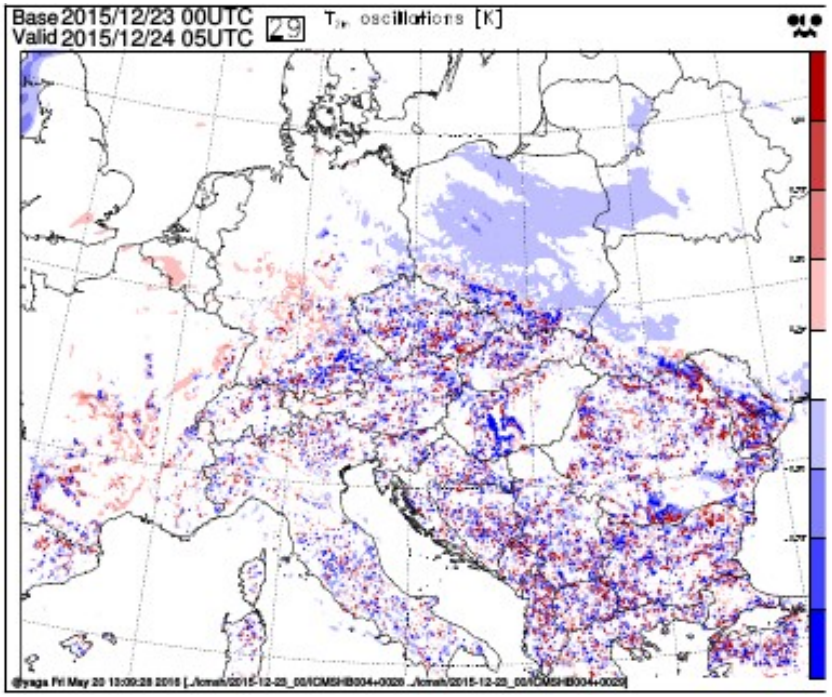
Interpolation to screen level (T2m, RH2m) in stable situations

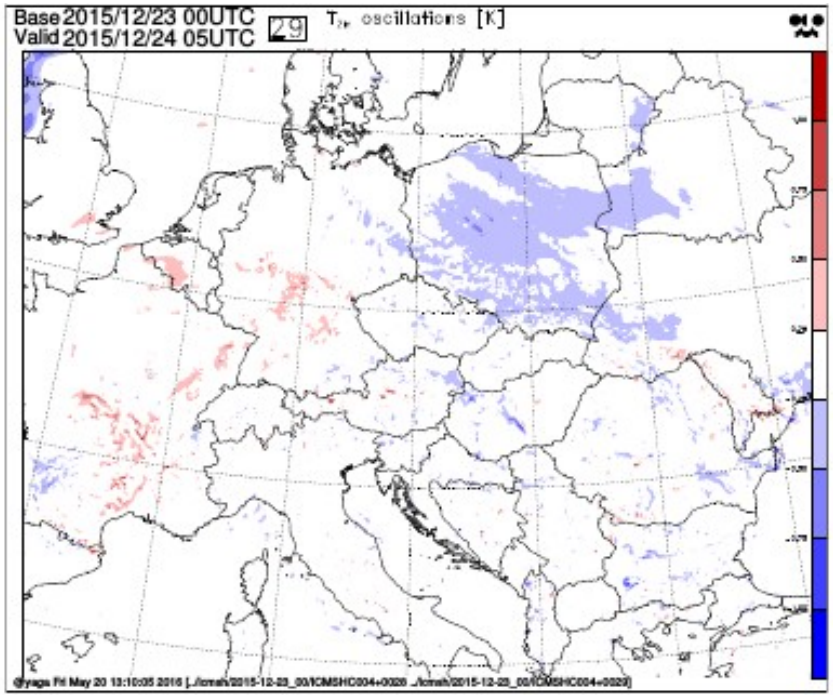
- modified interpolation
  - Mixture of Geleyn 1988 and Kullmann 2009 method has oscillations
  - Shape of stability functions (used in Kullmann method) is modified
  - one tuning parameter (recomended to be between 1 and 3)



mixture of Geleyn and Kullman
dashed Geleyn 1988
dashed Kullman 2009
new recomended

interpolation to screen level (T2m, RH2m) in stable situations





Old

1h 2 m temperature difference
23.12.2015 00+29h

New

First version of ALARO-1

Novelties (inside e-suite) - summary

- modified **interpolation to screen level** (T2m, RH2m) in stable situations
- new parameterization of **shallow convection** on the turbulence side
- **re-tuning of radiation cloudiness** (due shallow convection moisture transport)
- **exponential-random cloud overlap** with same decorrelation depth in microphysics and radiation; in diagnostics scaled by factor 0.4
- **diagnostics of surface direct solar flux** applying delta-scaling in clearsky part of gridbox
- **diagnostics of sunshine duration** taking into account subgrid variability of surface direct solar flux
- correct **diagnostics of 10m wind** when lowest model level falls below measurement height

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

Meso-scale organization not always well rendered at high resolution:

- tuning of turbulent diffusion has a big impact
- stochastic components (cellular automata)
- subgrid cold pools parameterization

Outlook

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

Thank you!