ALARO Physics Developments

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LACE area leader for physics

Operational applications of ALARO

- Benefits exist for resolutions at the upper limit and in the middle of the grey zone (9 km – 4 km)
- Be, Tr (4km) are already at the initial targetting resolution
- Tests at many scales are ongoing,

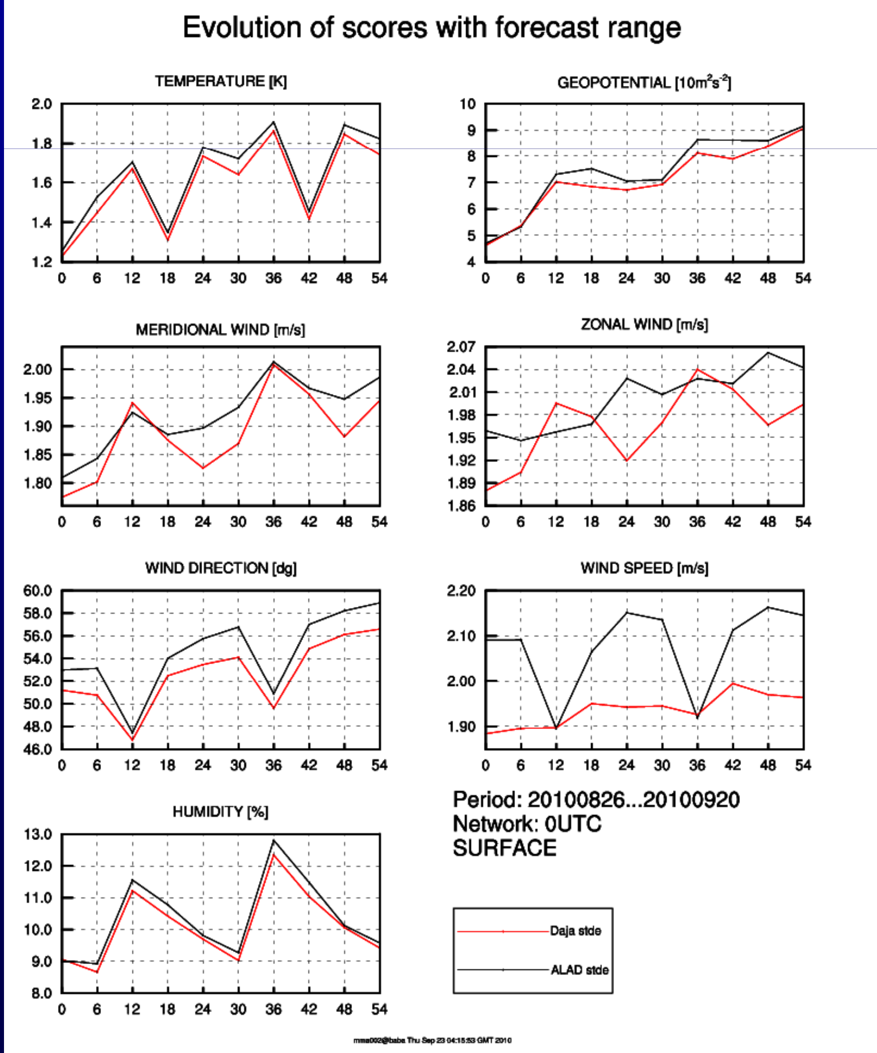
	ALARO-0 minus-3MT	Full ALARO-0
Cz	30/1/07	**4/6/08**
At	13/9/07	**7/4/09**
Sk	19/2/08	**19/8/08**
Hr	25/2/08	
Si	X	**16/6/08**
Be	X	**15/1/09**
Ro	**X**	**9/2/10**
Tr	**X**	**1/3/10**

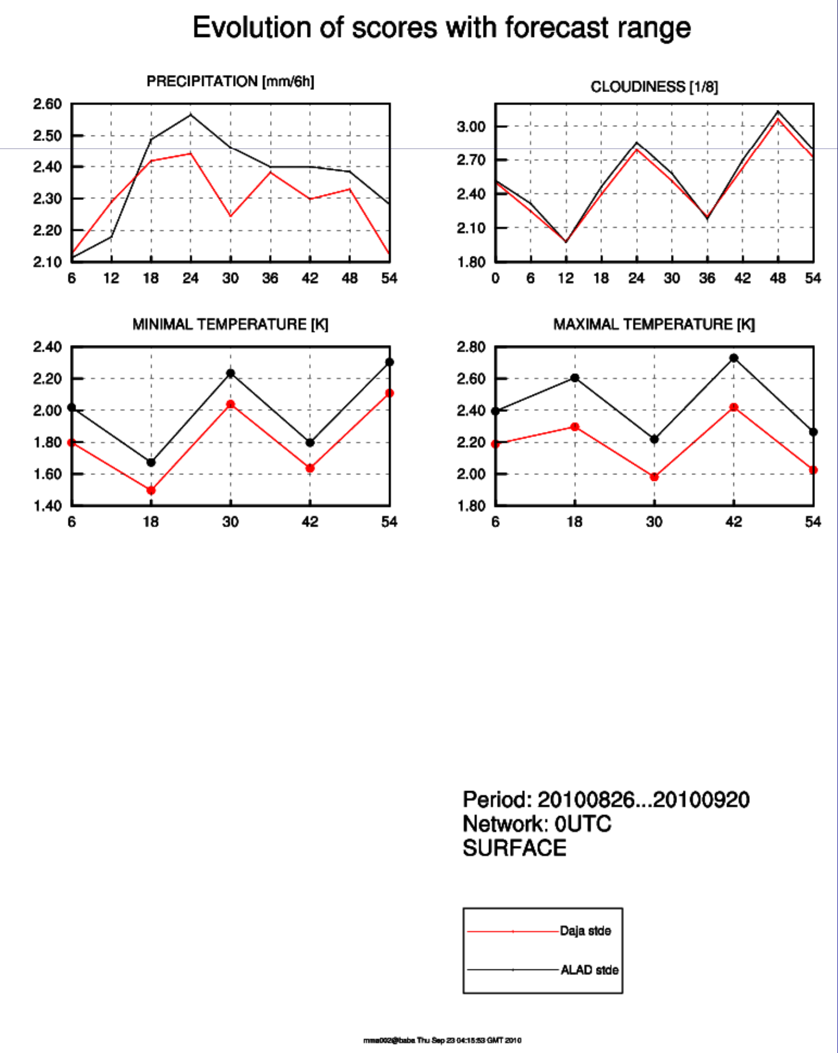
Operational ALARO configuration at scales around 5km mesh-size

- prepared and tested at CHMI
- 4.7 km, 87 vertical levels
- without NH dynamics,
- DFI blending settings
- quality of the model forecast fields is acceptable with current ALARO physics,
  - new aerosols, tuning linked to cloudiness
- start in October 2010

Cz – parallel suite results

Surface fields: better precipitations and wind; temperature neutral;

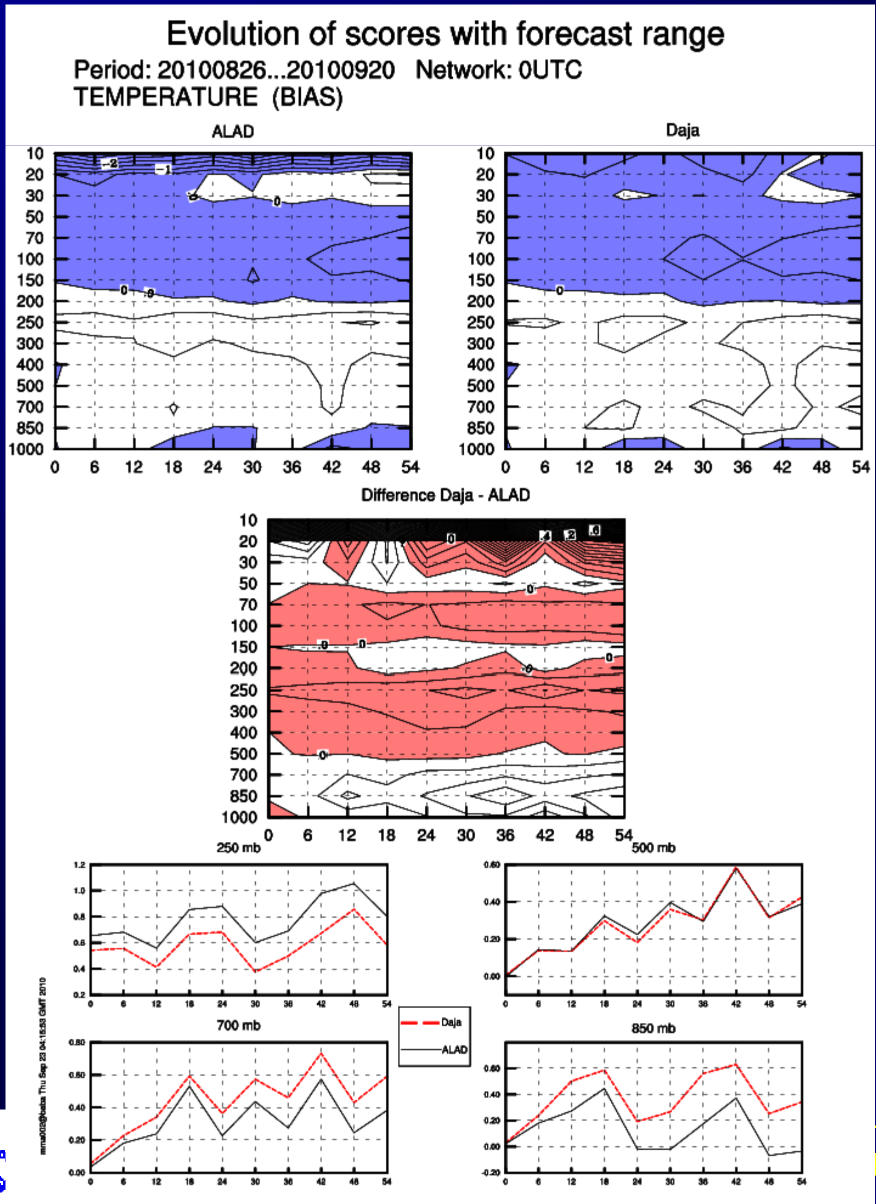


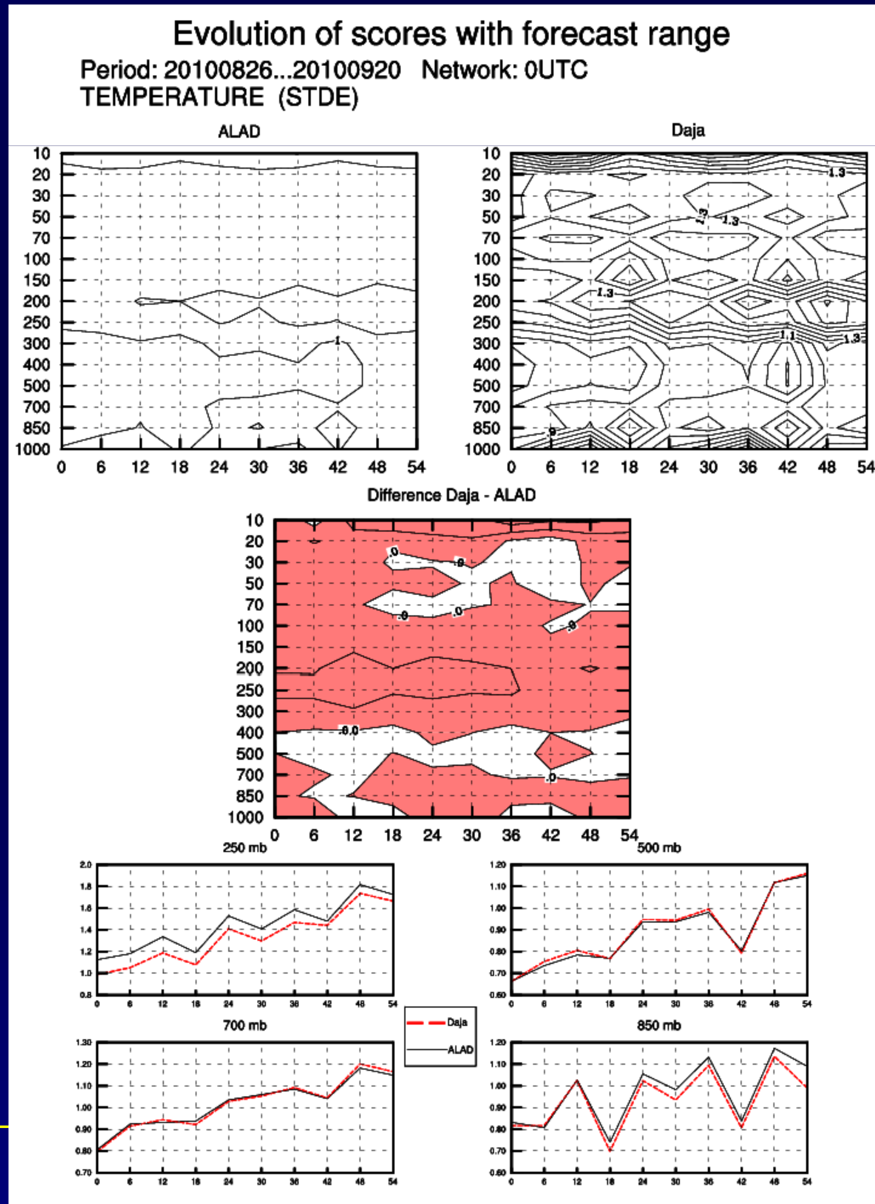


LACE nwp central europe

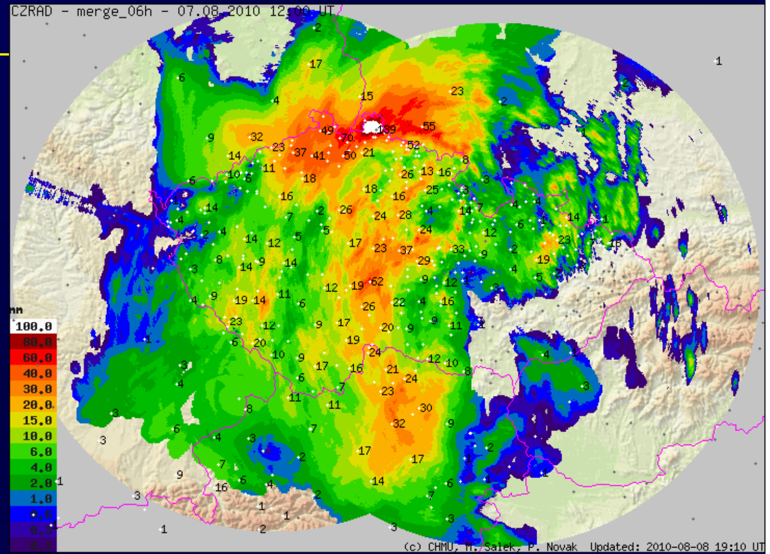
Cz – parallel suite results

Most problems with temperature bias





Cz – flood case 7 August 2010

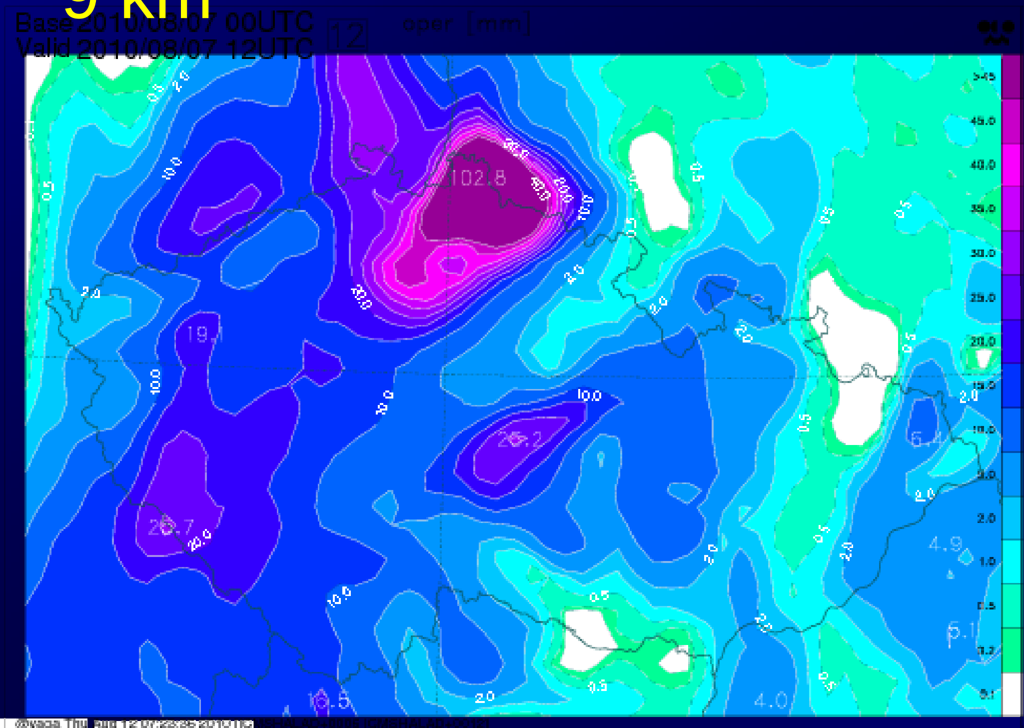


12h forecast

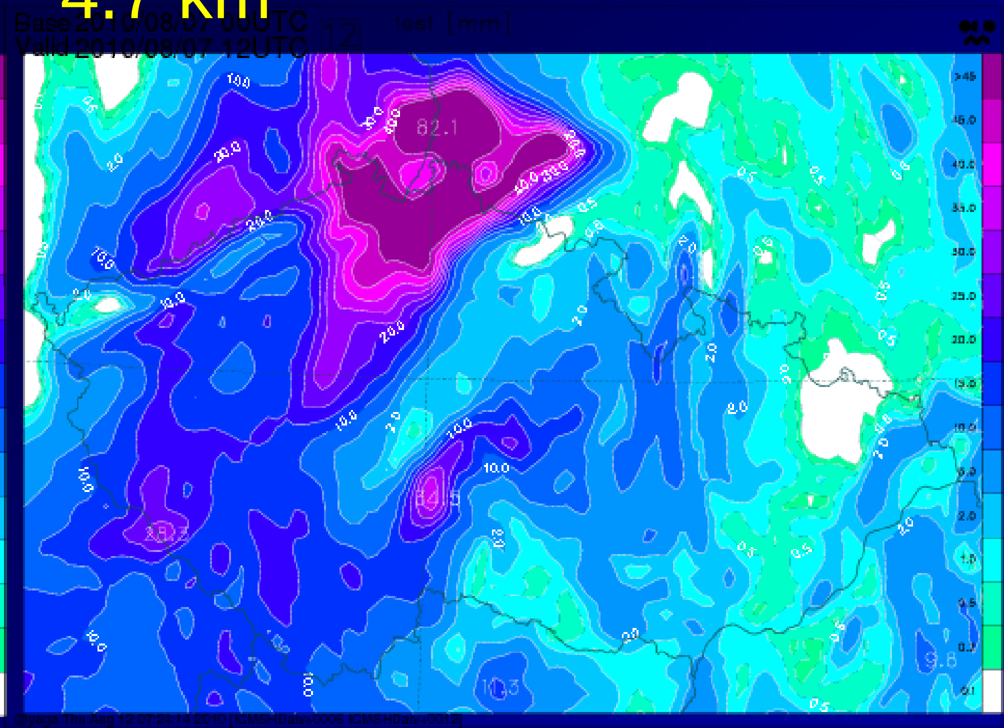
6h precipitation amount

Good location of intense precipitation

9 km



4.7 km

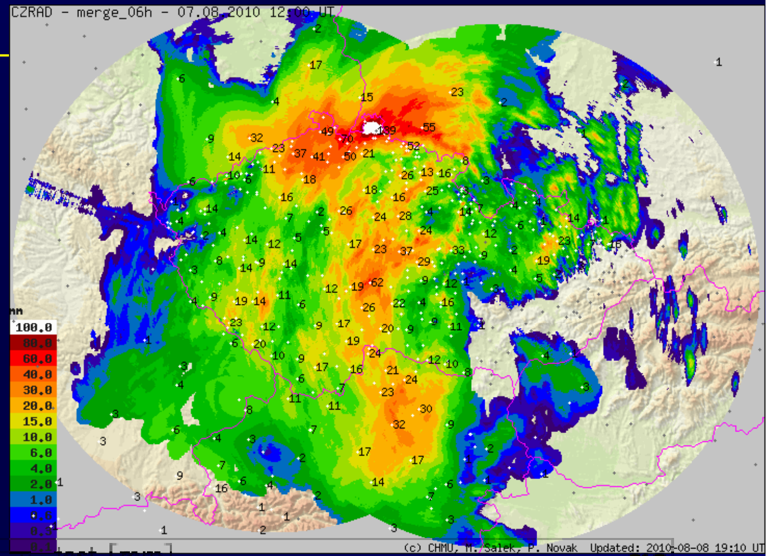


Cz – flood case 7 August 2010

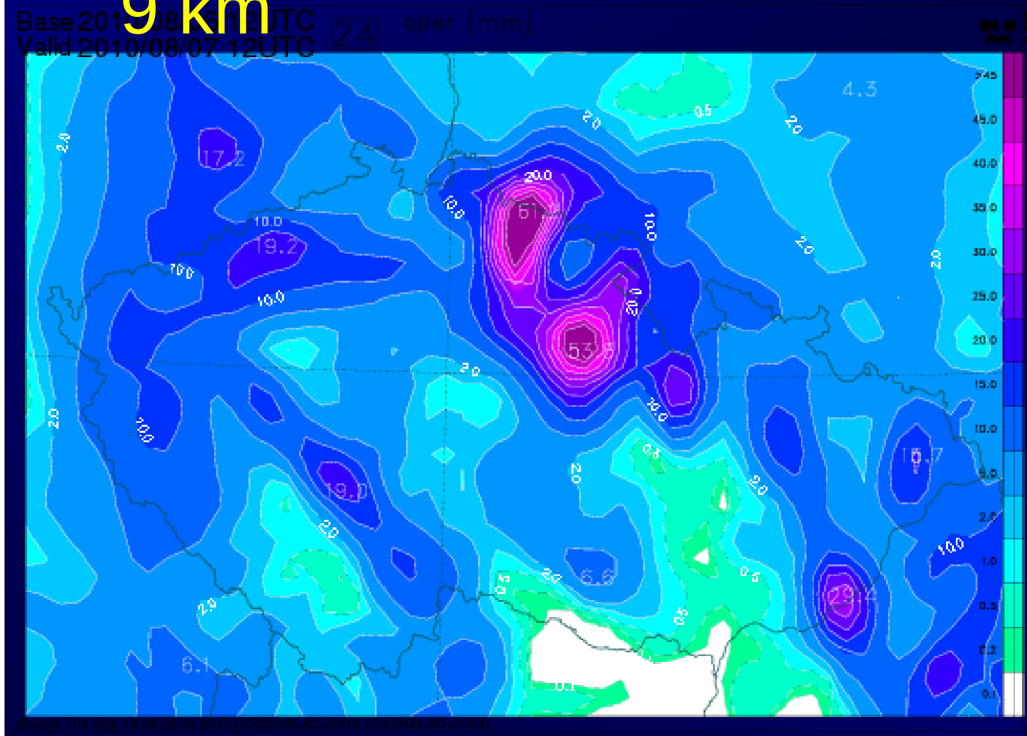
24h forecast

6h precipitation amount

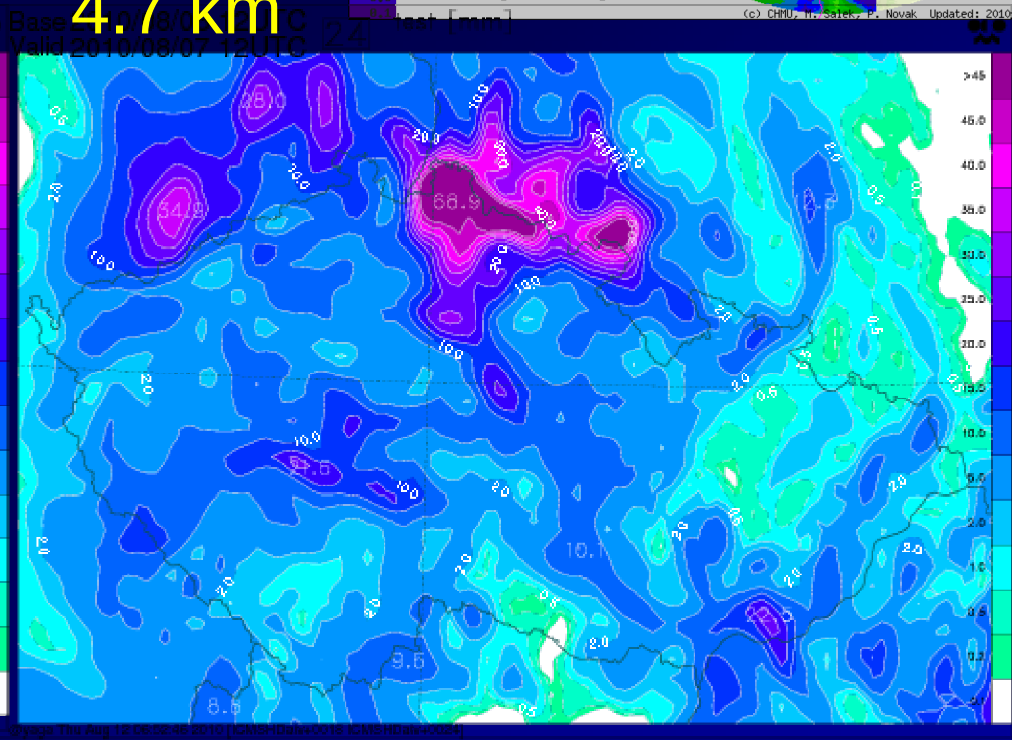
Already good location of intense precipitation, amounts smaller



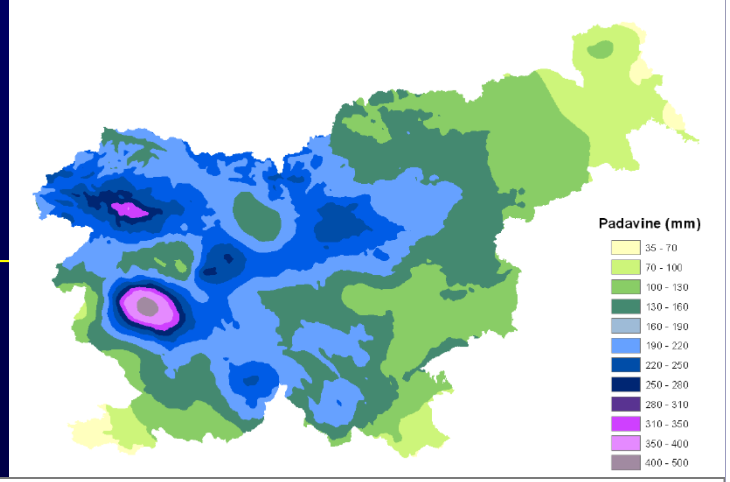
9 km



4.7 km



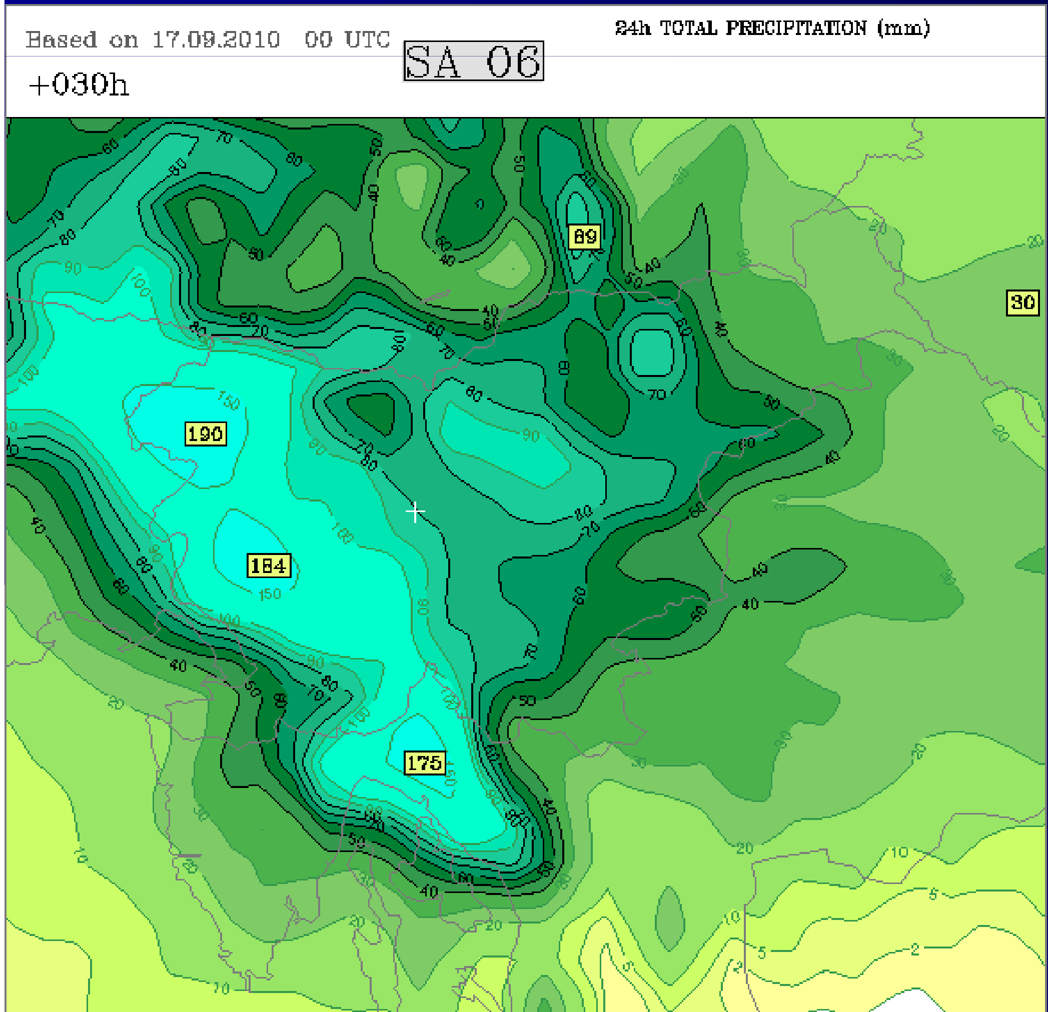
Si – flood case 18 Sep

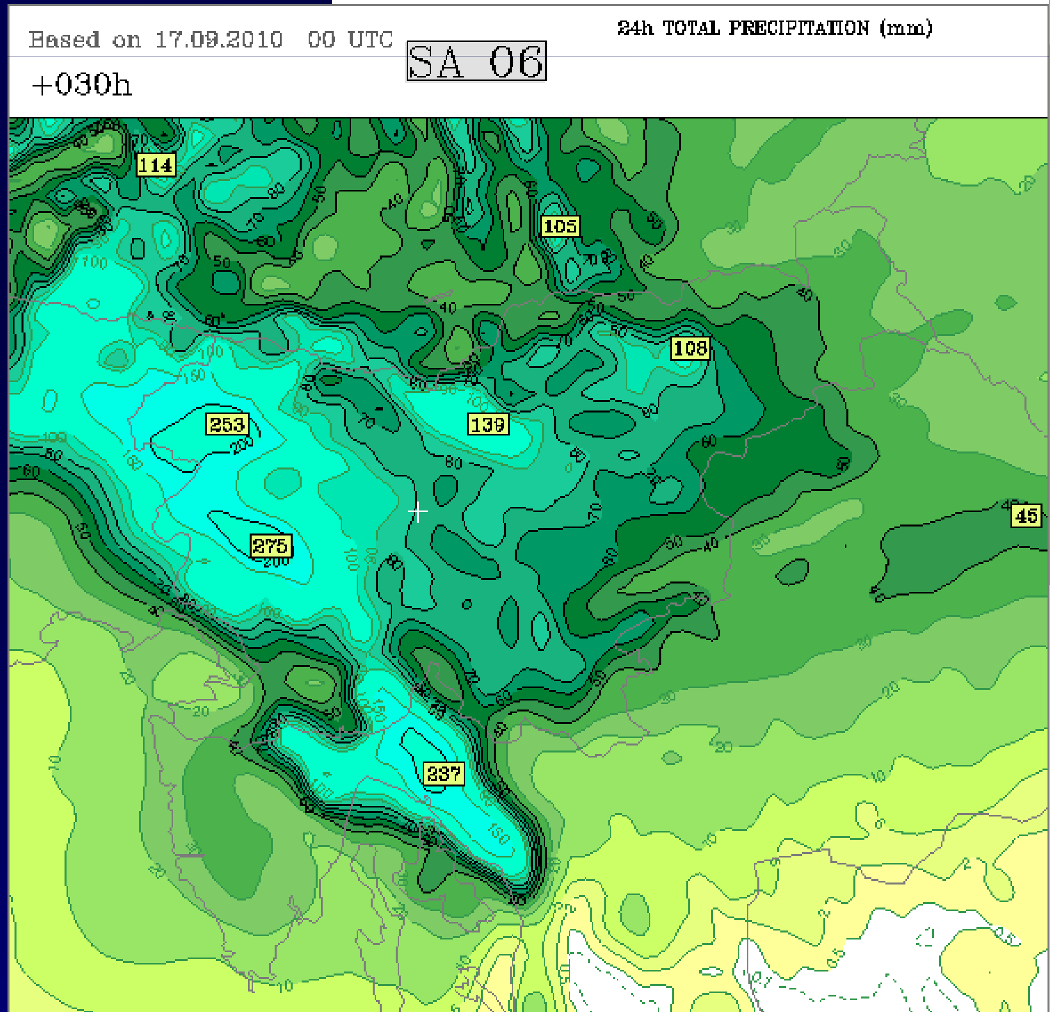


24h precipitation amount

9.6 km

4.4 km





Screen level diagnostic – T 2m

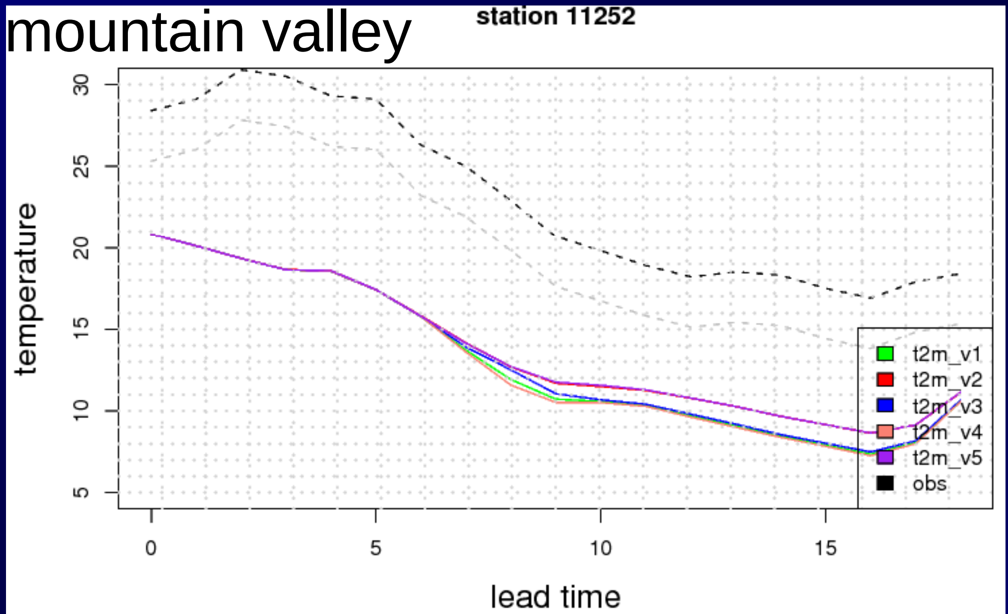
New development

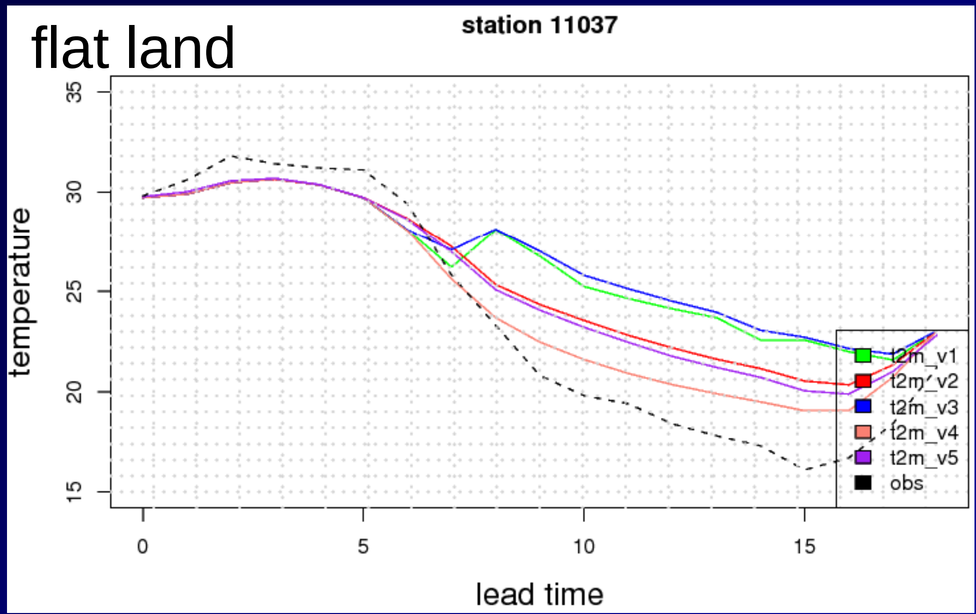
- coefficient (zah) is dependent on Richardson number
- based on in situ observations

Validation

- warm bias during night in flatland areas
- cold bias in mountainous areas, especially during nights (valleys, basins, etc)

v1: using zah=35
v2: using zah=f(Ri)
v3: using zah=15
v4: using old acntls
v5: zah=f(Ri) + modified heating capacities





Bias improves only a little bit.

Overview of developments

Contributions from

Doina Banciu, Ivan Bastak, Radmila Brozkova,

Luc Gerard, Jean-Francois Geleyn,

Filip Vana

The basic ideas, challenges

- **to go with 3MT concept until the kilometric scales** (precipitation convection can not be fully resolved with 2-3 km mesh-sizes)
- **Moist boundary layer parametrization with a single additional prognostic variable (TKE)**
- **a unique description of cloudiness (in all schemes radiation, turbulence, 3MT)**

ongoing developmnets

- TOUCANS turbulence scheme
- 3D turbulence
- Microphysics
  - include the option of ICE3 equations
- Convection
  - improving convergence of 3MT to CRM
- Radiation

TOUCANS Turbulence and diffusion

- replacement of pTKE
- anisotropy
- continuity for formulations in function of Ri (stable and unstable atmosphere)
- moist mixing length
- more to come

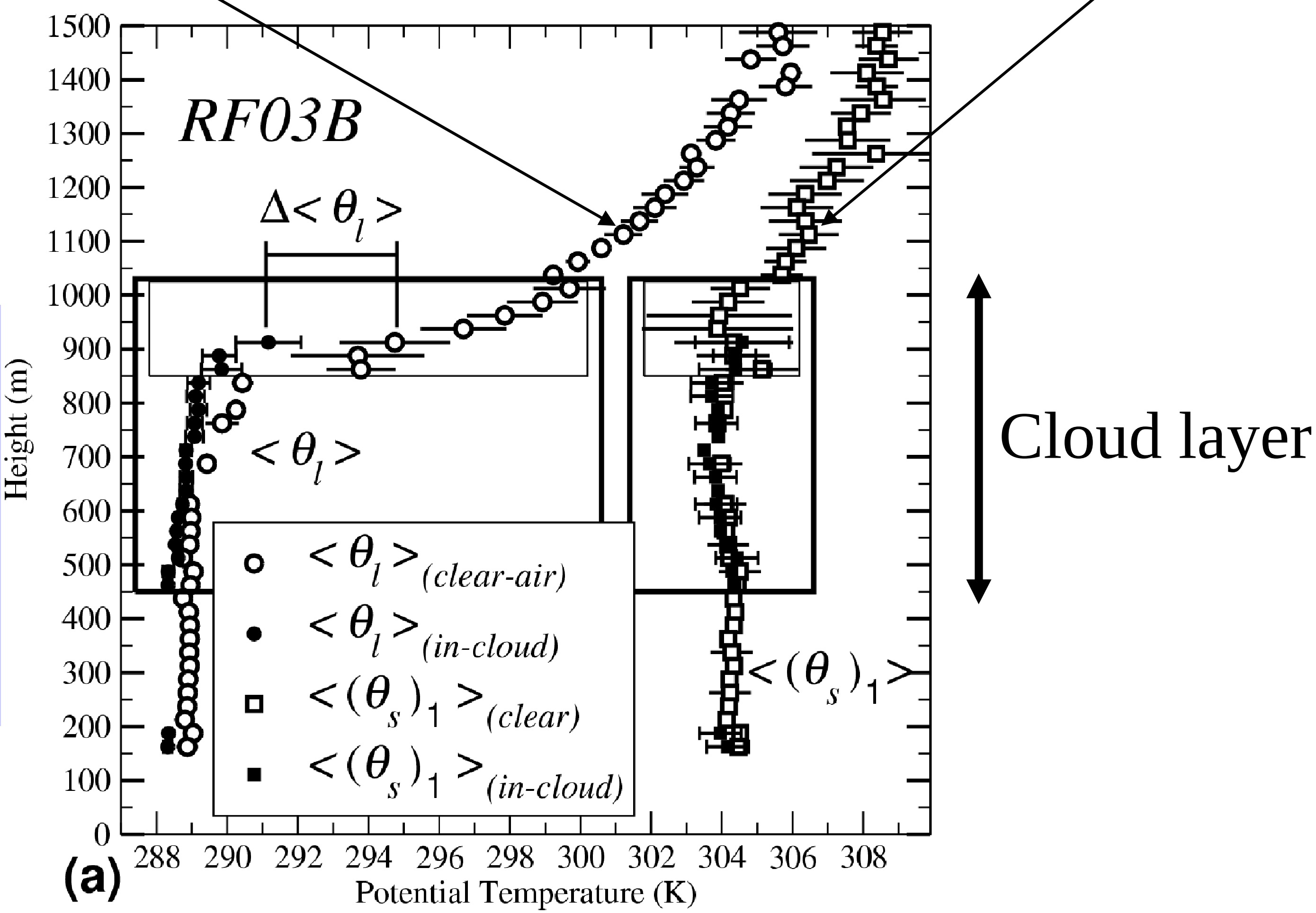
TOUCANS Turbulence and diffusion

- separation between turbulence computations and the ones associated with the thermodynamic adjustment
- use of the new multi-conservative potential temperature of Pascal Marquet.
- Shallow convection cloudiness
- introduction of TOMs effects parameterisation and its effect on PBL
- re-introduction of the diffusive transport of cloud liquid and ice water, but on the basis of the shallow convective formulation.

the ‘new’ moist potential temperature (Pascal Marquet)

Bett’s ‘moist conservative’ θ_l

New proposal $(\theta_s)_1$



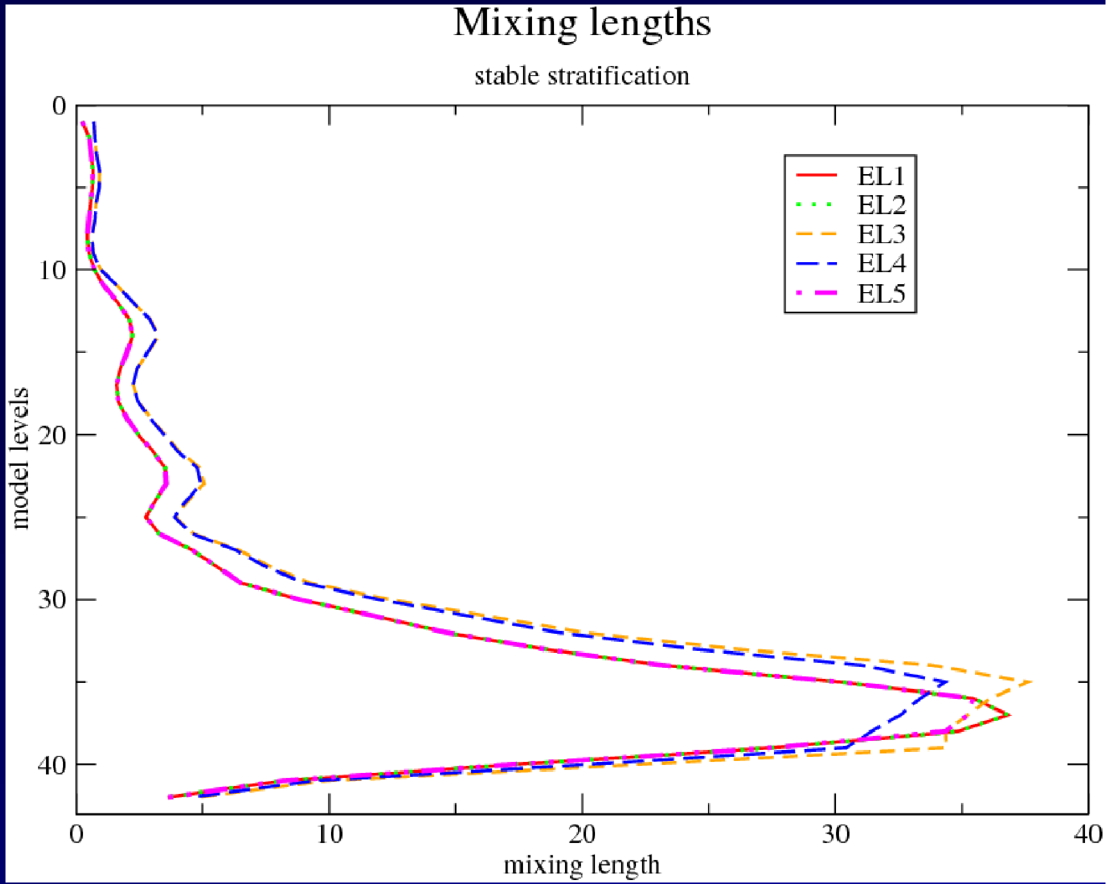
More homogeneity between cloudy and clear air parts in the new case

The ‘top of PBL discontinuity’ practically disappears when using the new quantity

TOUCANS – moist mixing lengths

Various formulation are coded and tested

- based on moist N and TKE
- computation improved
- cheaper
- consistent with the moist formulation



TOUCANS

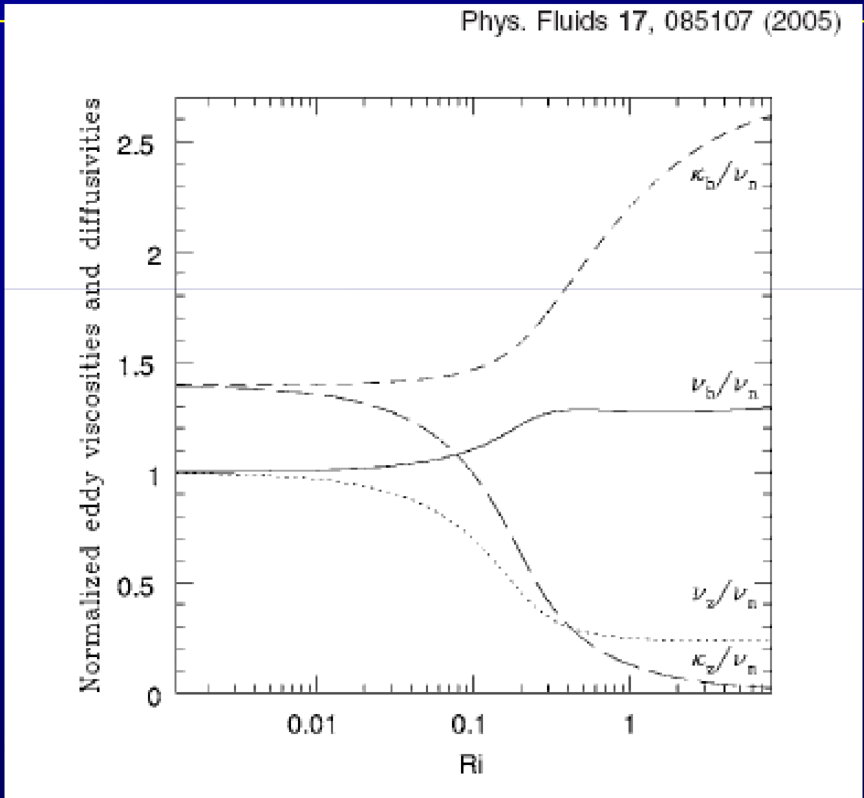
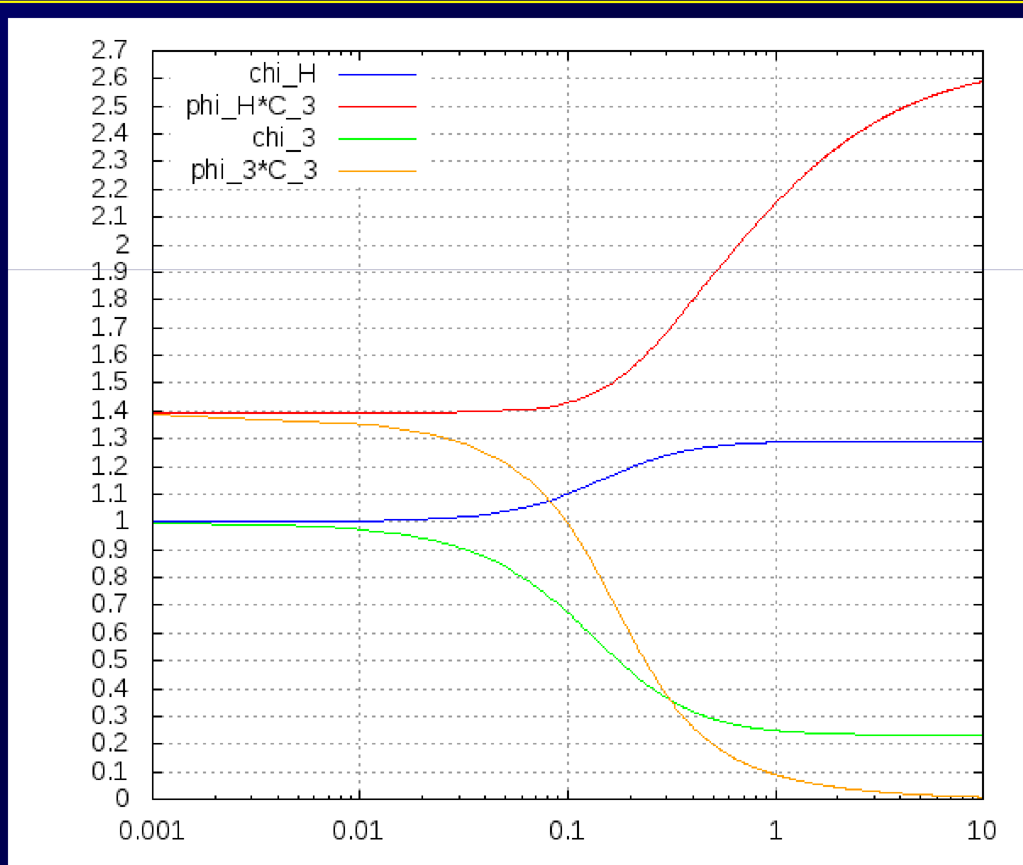


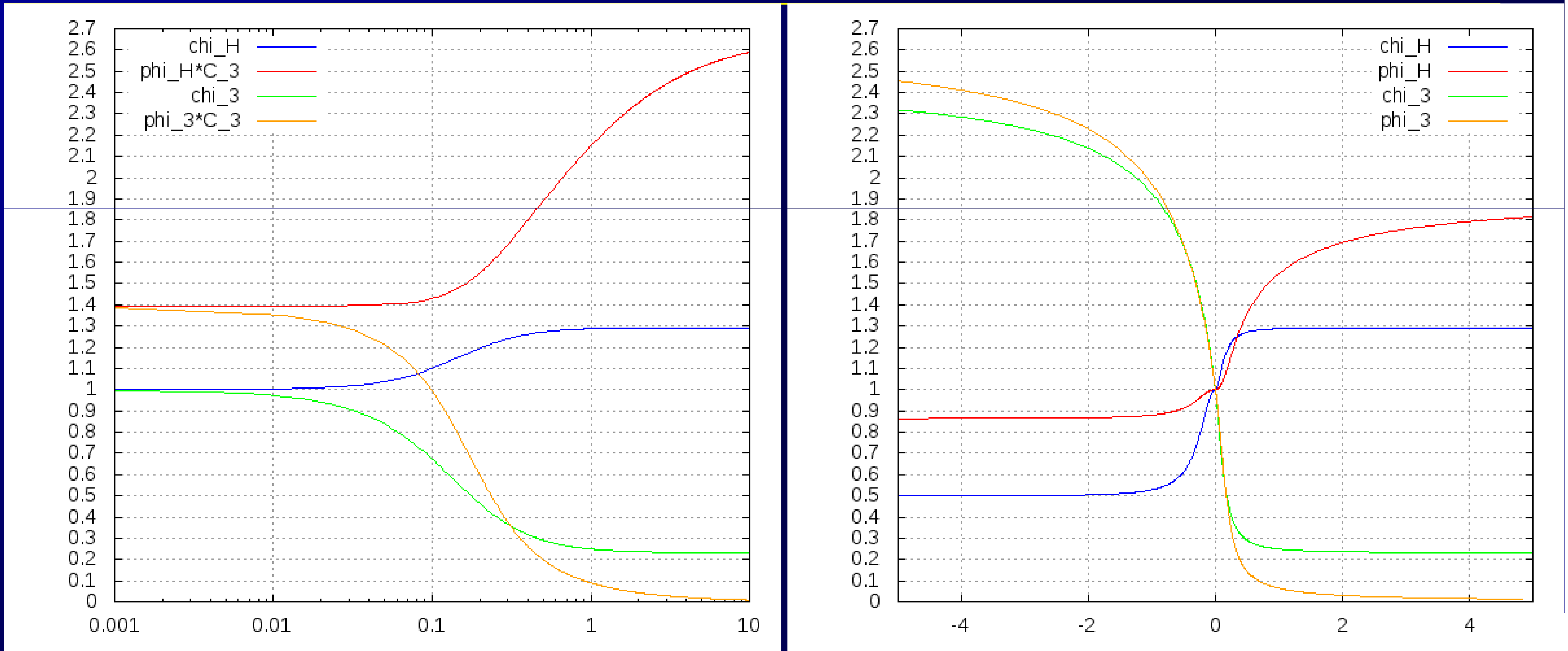
FIG. 8. Normalized eddy viscosities and diffusivities as functions of the gradient Richardson number Ri.



the horizontal QNSE fits for stable stratification

published computed

TOUCANS



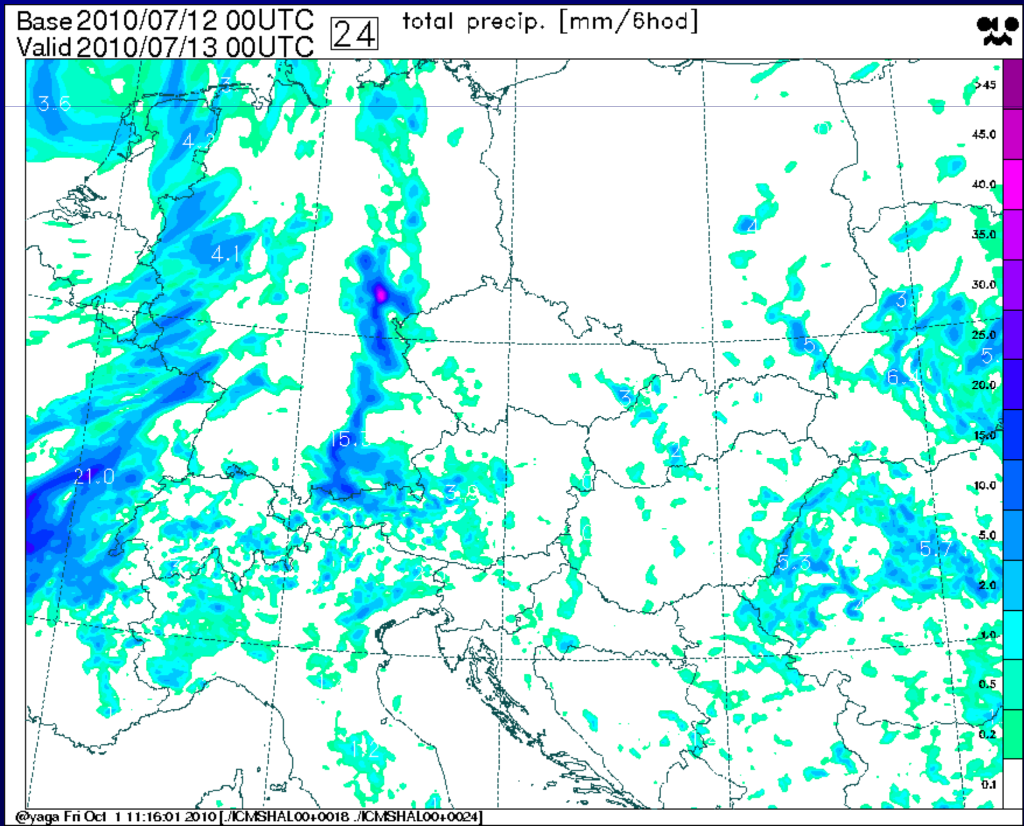
the horizontal QNSE fits (also for 3D turbulence)

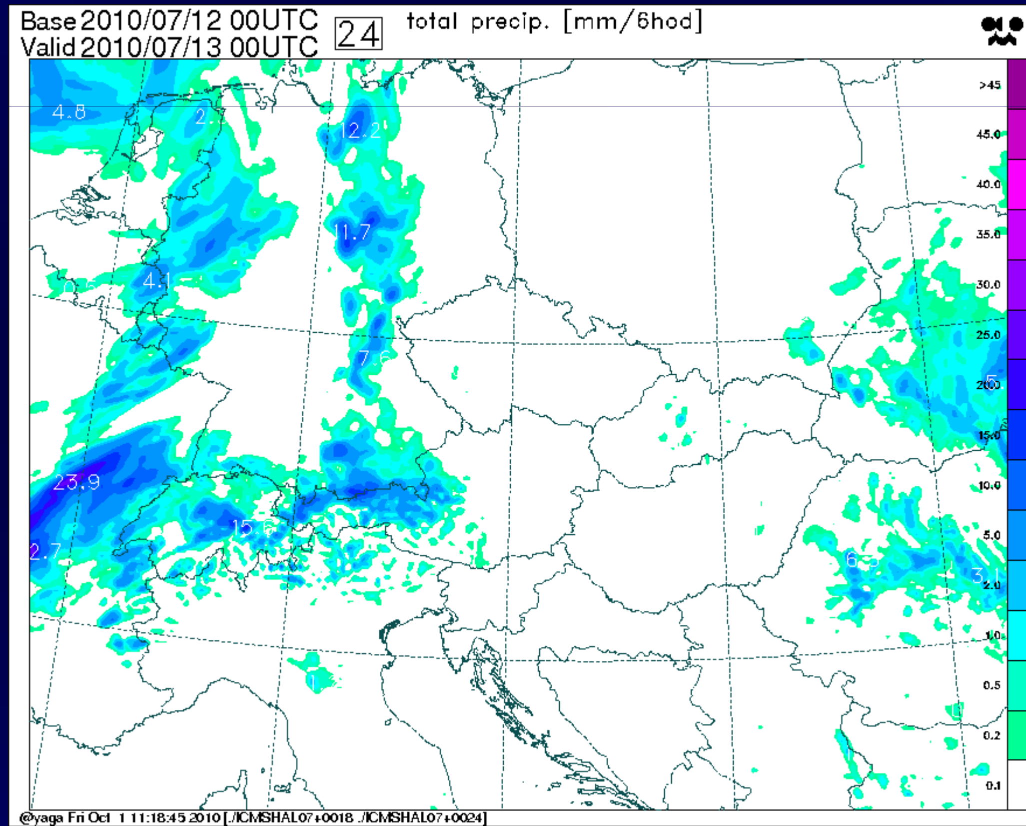
- for stable stratification (left)
- the extension to whole atmosphere (right)

TOUCANS scheme

test of two components:

the new stability functions and the new shallow convection treatment

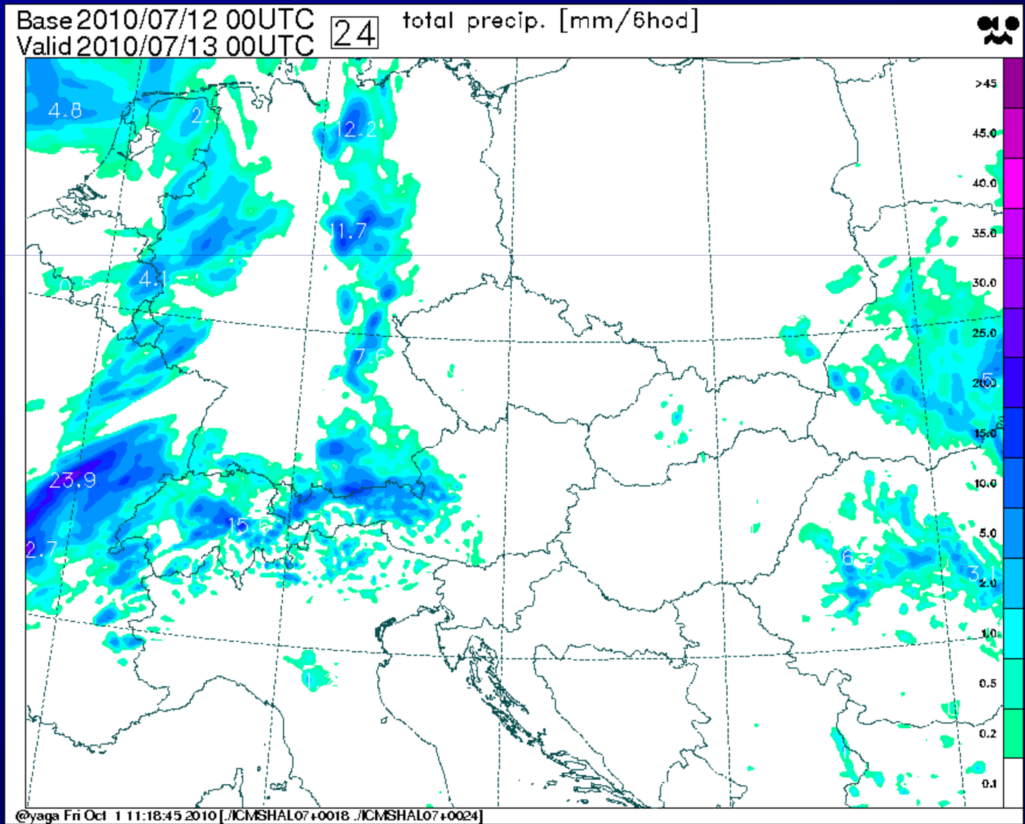


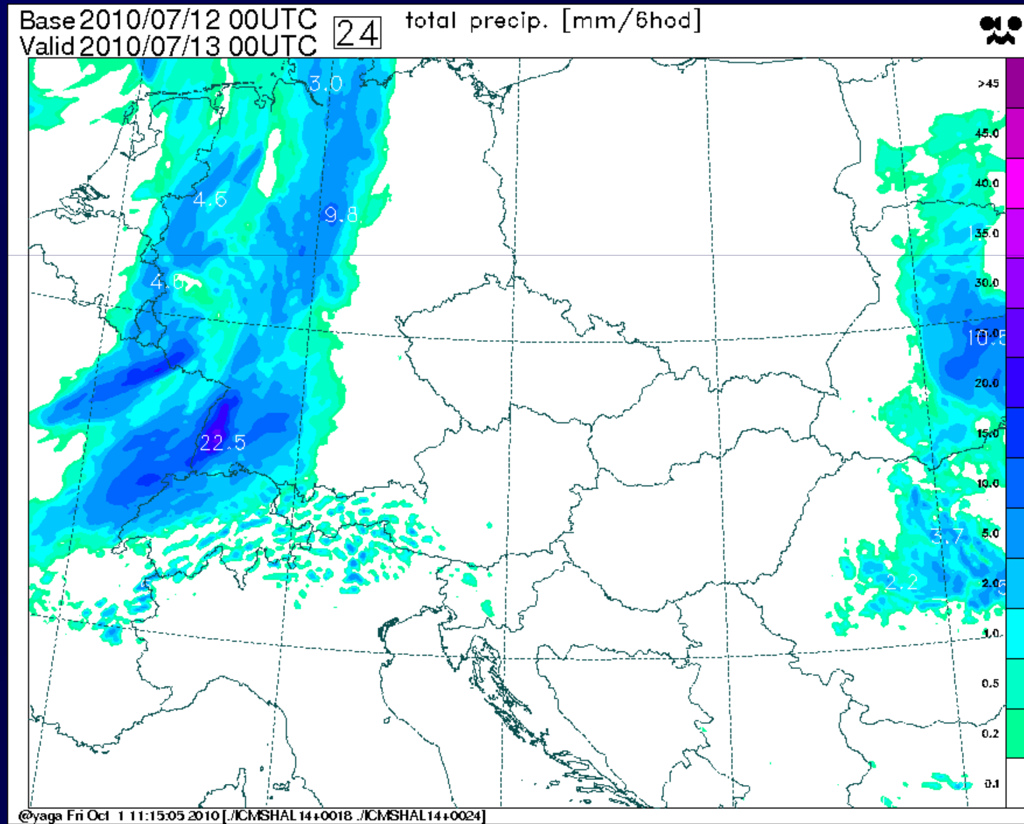


a reference forecast: pTKE scheme with old moist Richardson number, with moist AF turned on.

run with QNSE and new moist Ri derived from P. Marquet's potential temperature, with moist AF turned off.

TOUCANS scheme





run with QNSE and new moist Ri derived from P. Marquet's potential temperature, with moist AF turned off.

and moist mixing length (kind of BL89).

3D turbulence

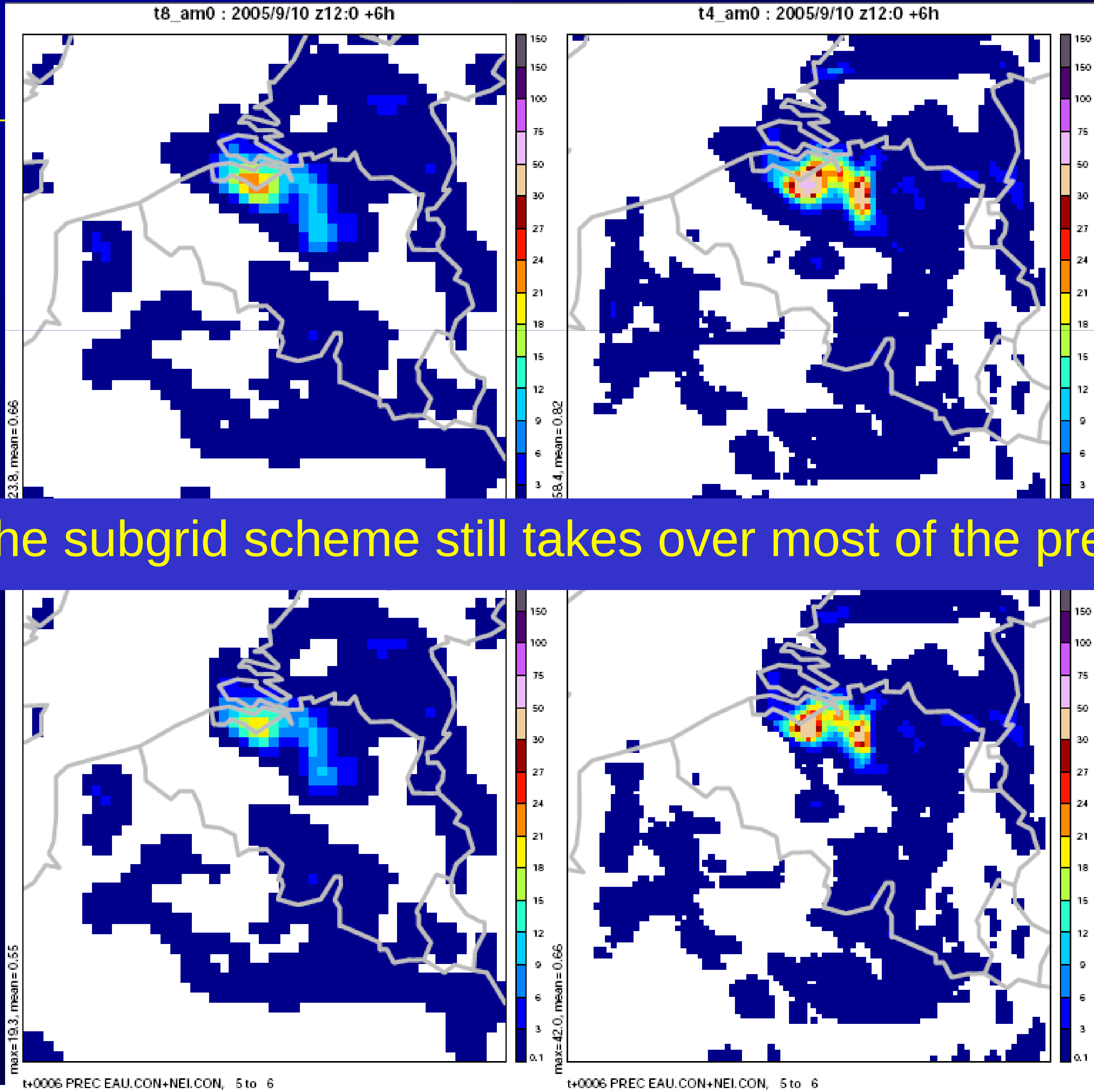
- consistent computations of vertical and horizontal exchange coefficients respect to existing constraints, mainly model spatial and temporal resolutions,
- based on TKE (with 3D shear term)
- numerical robustness and efficiency (<2% of CPU, 15% increase of memory)
- validation still needed

3MT convection

Convergence of the 3MT deep convection parameterization with the explicit convection at high resolution

- gradual rise/decay of the cloud
- sub-grid cloud
  - the virtual unresolved updraft, confined to the grid box
  - compensating downward motion (Bjeknes buoyancy reduction)
- mixed CAPE/MOCON closure

current scheme 9 km 4 km

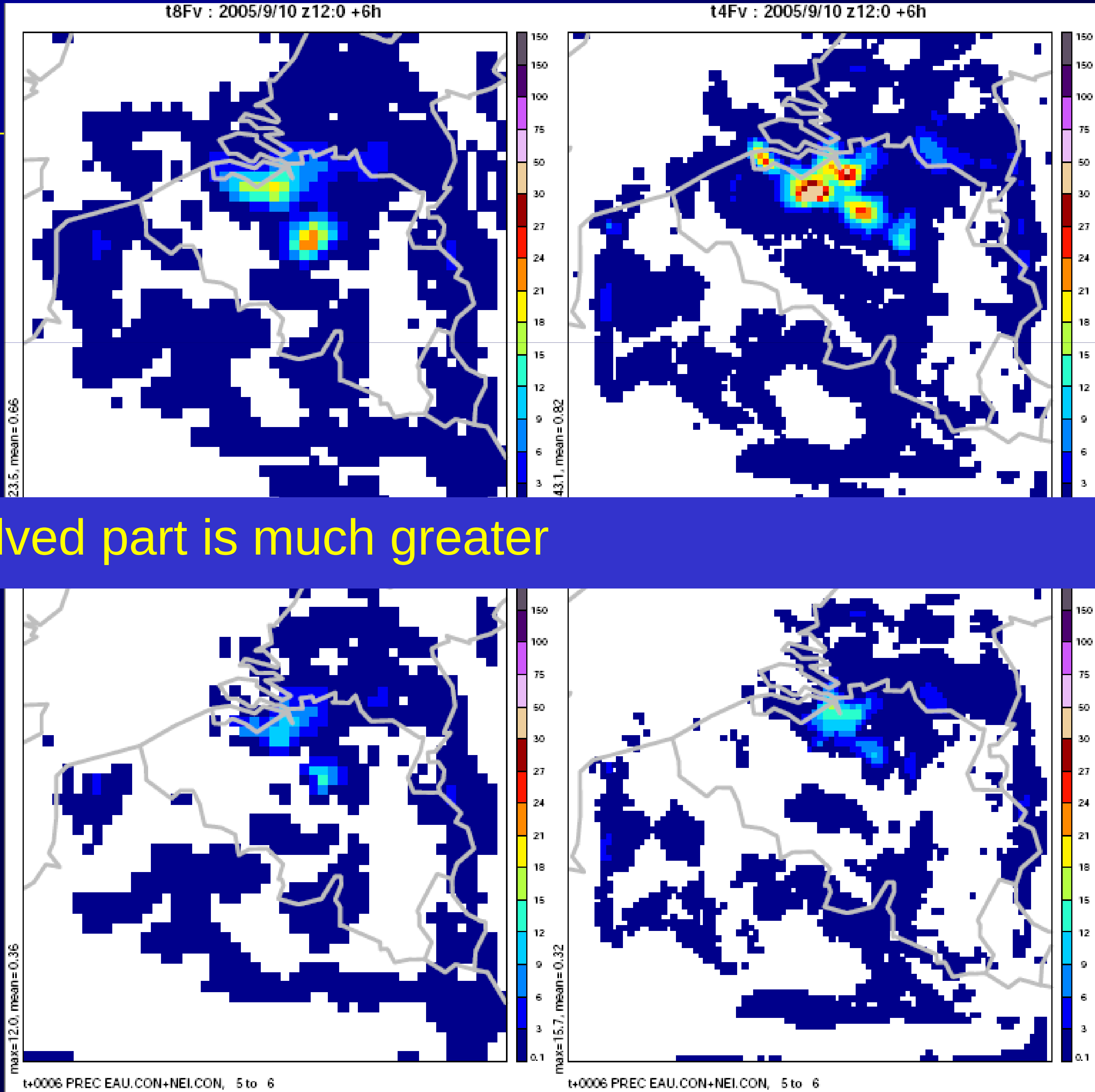


total prec.

at 4km the subgrid scheme still takes over most of the precipitation.

subgrid prec.

new scheme 9 km 4 km



total prec.

the resolved part is much greater

subgrid prec.

ALARO-1 Working days

Budapest, 16 – 19 February 2010

25 participants from 13 countries

overview of current developments

reports on ALARO-0 experience, local implementations and evaluation.

two exercise sessions

Outlook and plans

- further physics development:
  - Radiation, TOUCANS, 3D turbulence, convection
- validation
  - all developments to be tested together
  - a good diagnostics environment and validation tools (Cloud-Resolving-Model would be needed).
- more operational ALARO configuration at scales around 5 km mesh-size
- diagnostics of screen level fields
- tests at higher resolution