CZECH HYDROMETEOROLOGICAL INSTITUTE

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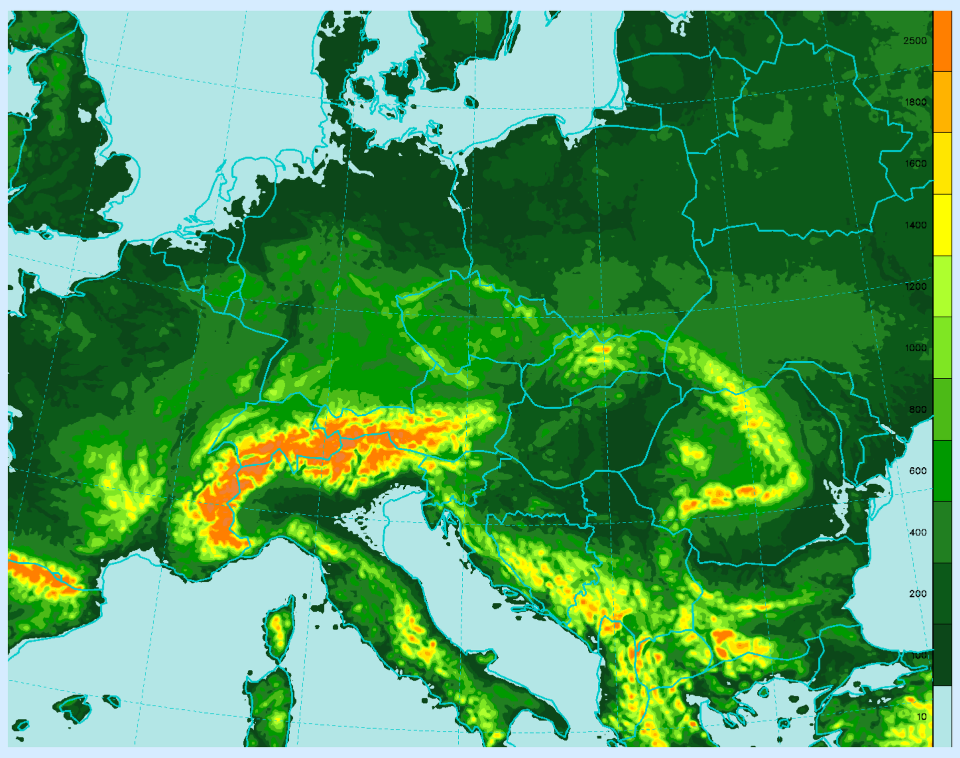
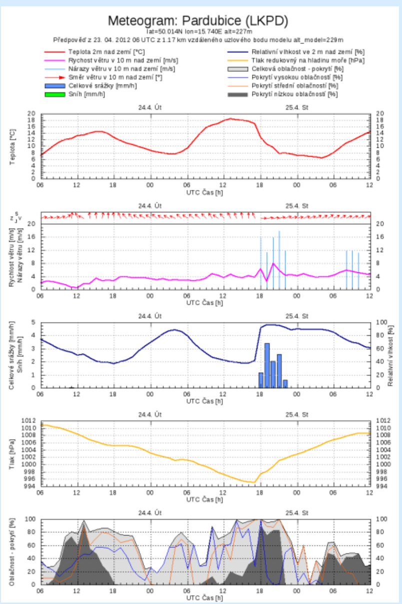
ALADIN/CE model set-up

- domain (529x421 grid points, linear truncation E269x215, Δx~4.7km)
- 87 vertical levels, mean orography
- time step 180 s
- OI surface analysis based on SYNOP (T2m, RH2m)
- digital filter spectral blending of the upper air fields, long cut-off cycle (6h cycle, filtering at truncation E87x69, no DFI in the next +6h guess integration)
- digital filter blending + incremental DFI initialization of short cut-off production analysis of the upper air fields
- 3h coupling interval



Orography of ALADIN/CE model domain



- ALADIN cycle 36t1_op4 (ALARO-0 with 3MT)
- OpenMP parallel execution
- 00, 06, 12 and 18 UTC forecast to +54h
- hourly fullpos
- hourly DIAGPACK analysis (SYNOP)
- verifpack on cycle 36t1
- **new meteogram products**

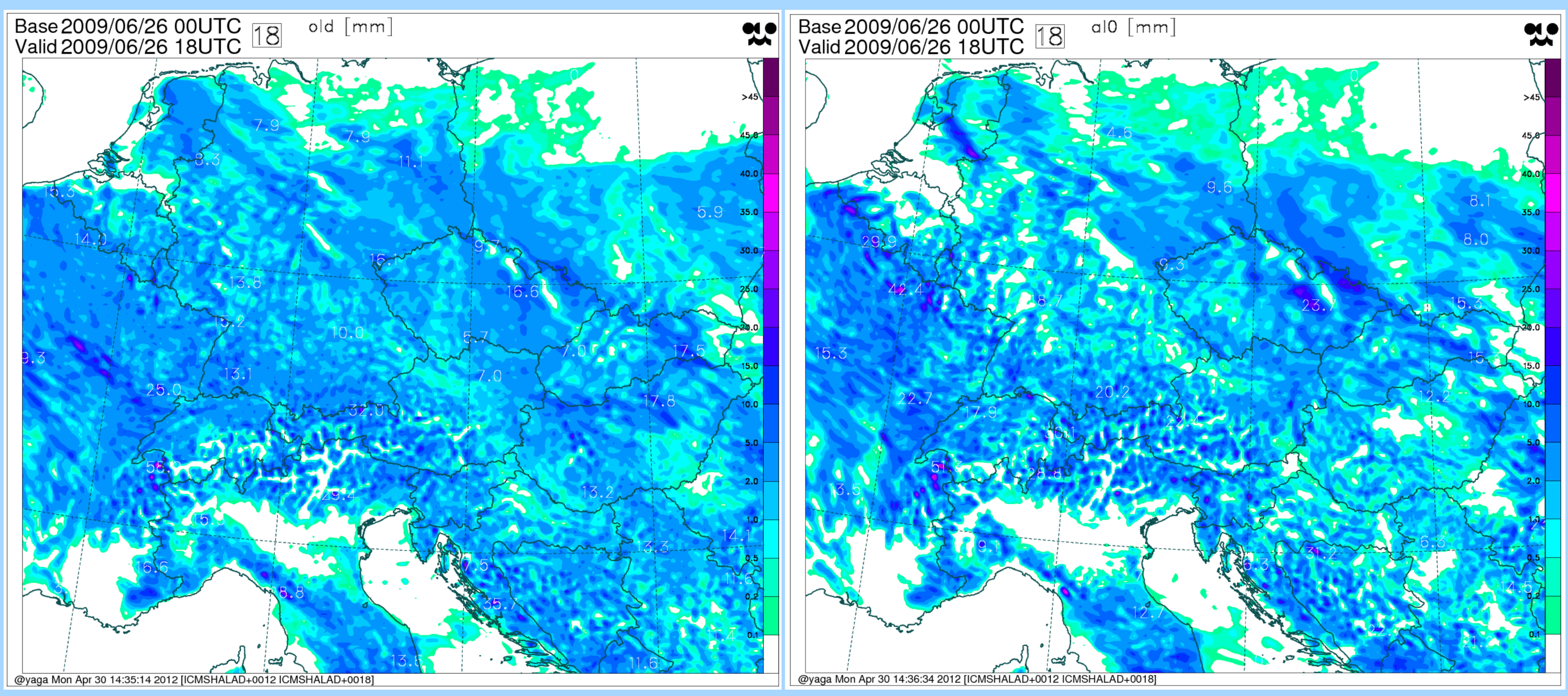
HPC system

- two full **NEC SX-9** nodes (1TB RAM and peak performance 1.6 TFLOPS provided by 16 vector CPUs each node)
- GFS with 118TB usable disk space
- operating system is SUPER-UX and NQSII scheduler
- two Linux **frontend servers** (4 Intel Xeon quad core CPUs, 2.93 GHz clock rate and 31 GB RAM each)

Tuning of moist physics

Radmila Brožková

New formulation and tuning of dependency of the relative critical humidity on horizontal resolution was found. It leads to better partition of resolved and convective condensation in 3MT scheme. Entrainment and downdraft efficiency were also retuned.



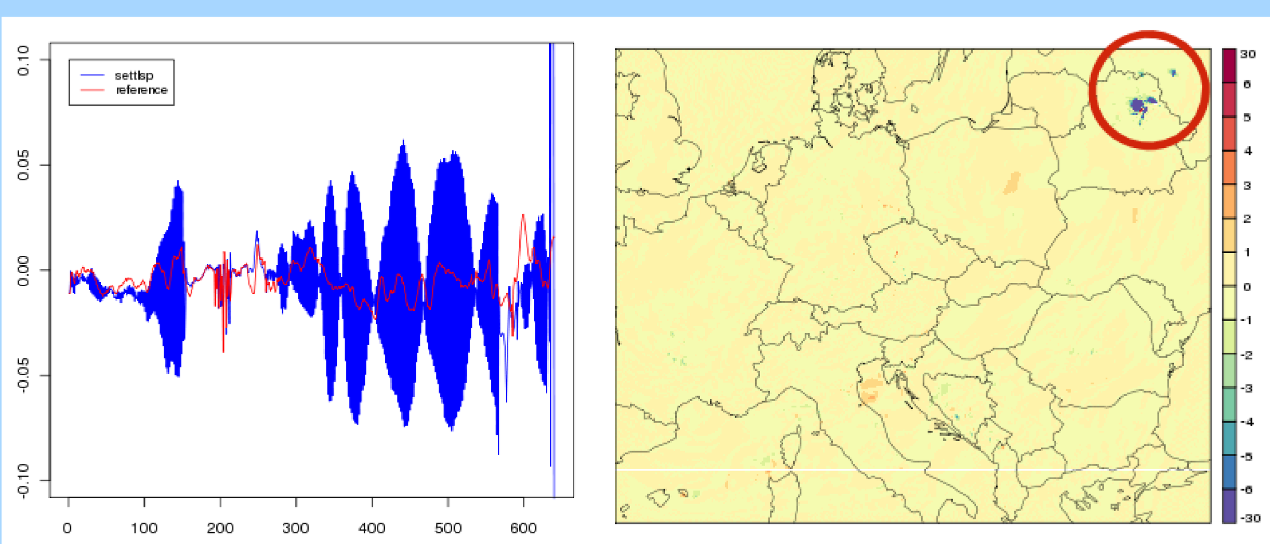
Figures show simulation of a strong convective situation on 26 June 2009 at 4.7km resolution, 6h afternoon precipitation sum: left panel – old tuning; right panel – new tuning with better structured precipitation.

Second order accurate time scheme for the physics-dynamics interface based on SETTLS technique

Petra Smolíková

The current explicit first order in time accurate coupling of physics to dynamics was extended to second order accuracy by using the SETTLS type technique. The theory in this case says that we will lose little bit on stability but gain on accuracy. However, the real case simulations with the settings used in the current operational version of the model Alaro for the Czech domain showed poor stability of this configuration. If the SETTLS type coupling is applied on all the advected variables (but the moisture is enough to produce this phenomena) significant time oscillations appear in the field of temperature mostly near the ground, but not exclusively restricted to this area. If applied only on prognostic GMV variables as temperature and the horizontal wind components, the stability is recovered but the expected enhanced accuracy was not detected in a one month validation (the forecast for 54 hours once per day).

Figures show the time evolution of *T* tendencies at 77th vertical level in a single point; red - the reference; blue - SETTLS on physical tendencies of GMV and *q,q_i,q_l,TKE* – left panel. Right panel shows *T* difference between the SETTLS and the reference at 87th level after 32 hours of integration



Major operational changes (May 2011 – Apr 2012)

25 May 2011	new model cycle 36t1 implemented operationally
19 Jul 2011	VFE applied and 2m diagnostics and cloudiness retuned
13 Feb 2012	sedimentation of cloud water and ice added
15 Mar 2012	Wegener-Bergeron-Findeisen process tuned
25 Apr 2012	cloudiness, convection and sedimentation schemes retuned

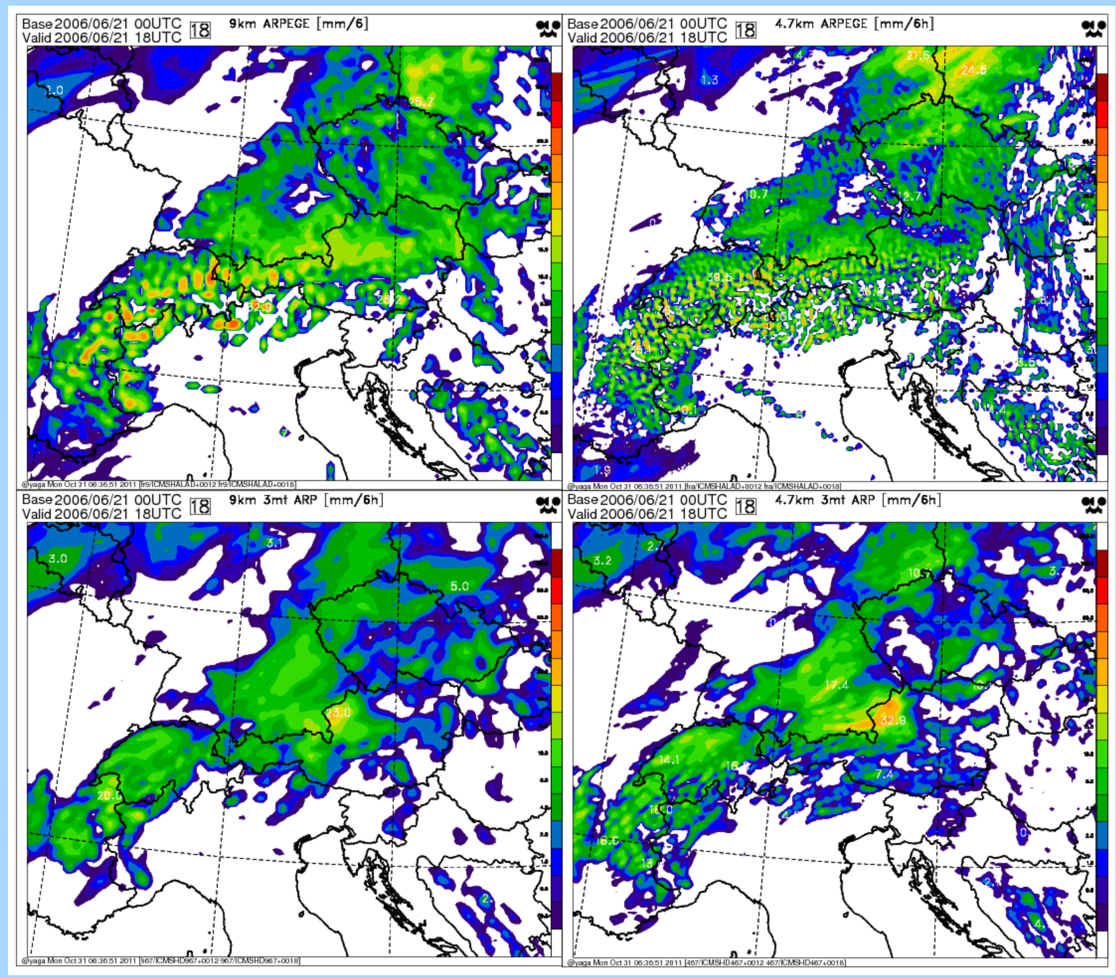
Development of the configuration “3MT in ARPEGE”

Radmila Brožková

The 3MT moist physics is associated with schemes used in ARPEGE: RRTM scheme for radiation, Smith type of thermodynamic adjustment, Lopez type of microphysics processes, CBR and KFB shallow convection, gravity wave drag. Cloud radiation interface relies on prognostic cloud water only – input from moist deep convection is counted within the 3MT cascade and input from shallow convection is added; cloud cover fraction is combined from Smith, moist deep convection and shallow convection schemes. Dynamics setup is kept like in ARPEGE (horizontal diffusion, SL interpolators).

3MT in ARPEGE was also tested in grey zone, yielding quite good results.

Figures show left column resolution of 9km and right column 4.7km resolution. Upper row ARPEGE native configuration of the model and lower row 3MT in ARPEGE configuration.



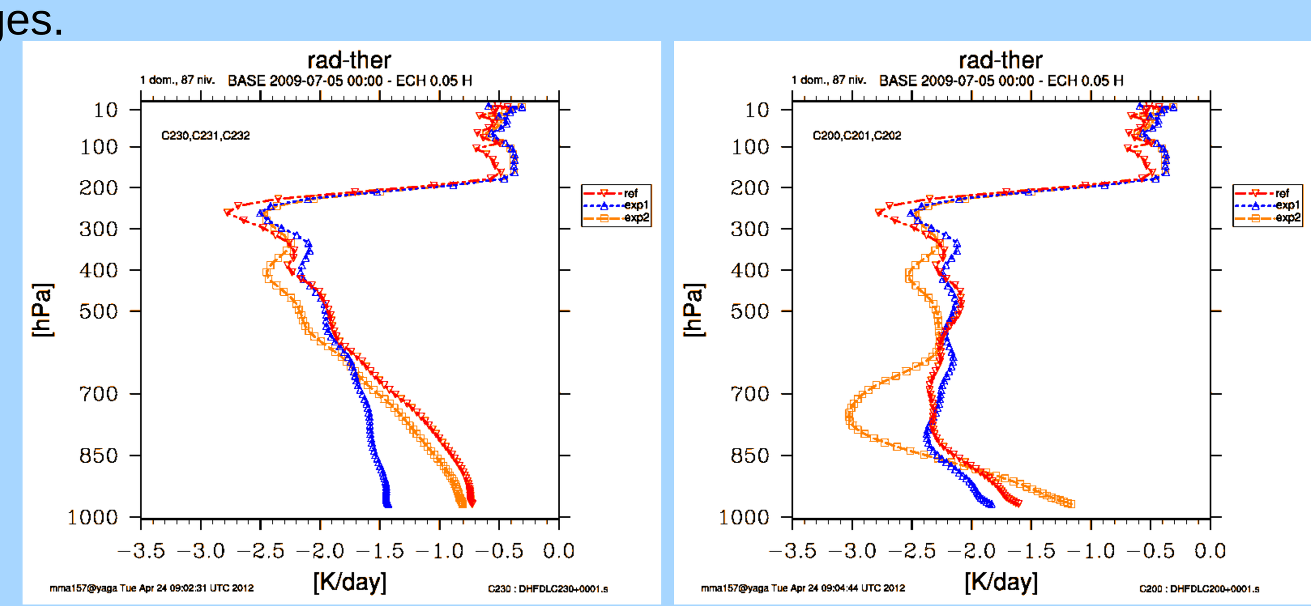
New developments in radiation scheme

Ján Mašek, Tomáš Král, Radmila Brožková

Revision of current radiation scheme ACRANEB is ongoing since March 2011. Main goal is to increase its accuracy to be comparable with RRTM/FMR schemes, but still keeping only two spectral bands and thus having lower computational cost. Key task was improvement of gaseous transmission functions, taking into account secondary saturation and non-random gaseous overlaps – phenomena typical for broad spectral intervals. The task was accomplished by changing functional form of gaseous transmissions. Old fits used 10-parametric Pade approximants, but they ignored secondary saturation in strong line limit. New fits replaced Pade approximants by simple 2-parametric rescaling of Malkmus type optical depth and they find dependency of optical depth on absorber amount, pressure and temperature in one go. As for gaseous overlaps, earlier work of T. Kral was revisited. New approach works in absorptivity space, eliminates explicit pressure/temperature dependency from fitting and introduces modulation factor which reduces 2D fits to 1D. For each gaseous pair, there are only 3 fitting parameters. It was also shown that triple overlaps are of minor importance and can be neglected, which makes all the procedure tractable.

New treatment of H_2O e-type continuum was developed, introducing H_4O_2 (i.e. H_2O dimer) as a separate gas with zero Malkmus core. It enables consistent treatment of nonhomogeneous optical paths by Curtis-Godson approximation. H_2O e-type continuum had to be refitted using MT_CKD data, since the old semi-empirical reference had wrong temperature dependency. Overlap of (H_2O, H_4O_2) pair turned to have key importance for getting correct broadband transmissions.

All new developments were coded into ACRANEB_TRANS (transmission part of modularized ACRANEB) and extensive testing was carried on. Even if new transmissions are superior to the old ones in idealized framework, severe problems are seen for thermal H_2O with e-type continuum included. It is still believed that there is some bug or hidden misconception, but all attempts to find it failed so far. Once localized, work should continue by retuning statistical NER model to be consistent with the new transmissions. New scheme will also differentiate between thermal weights for cooling to space term and remaining exchanges.



Figures show DDH cooling rates in thermal band for clear sky case. H_2O without e-type continuum (left) and H_2O with e-type continuum (right). RRTM reference in red, ACRANEB with old transmissions in blue and ACRANEB with new transmissions in yellow.