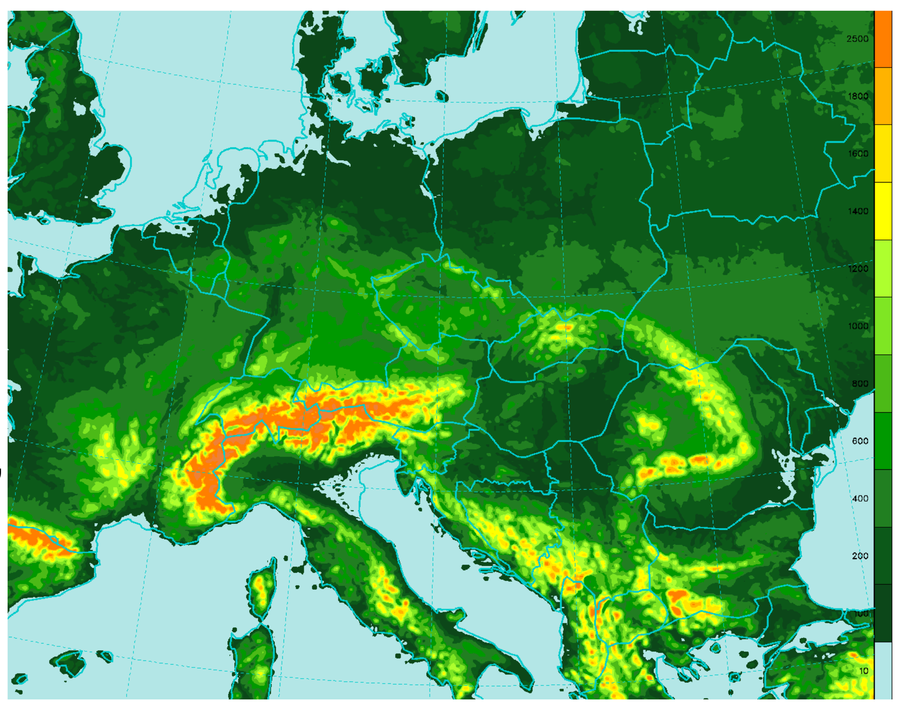
Numerical Weather Prediction

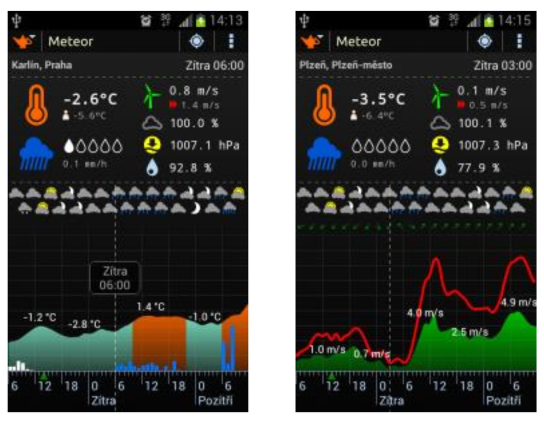
Czech Hydrometeorological Institute

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 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_op8 (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 products for mobile phones**

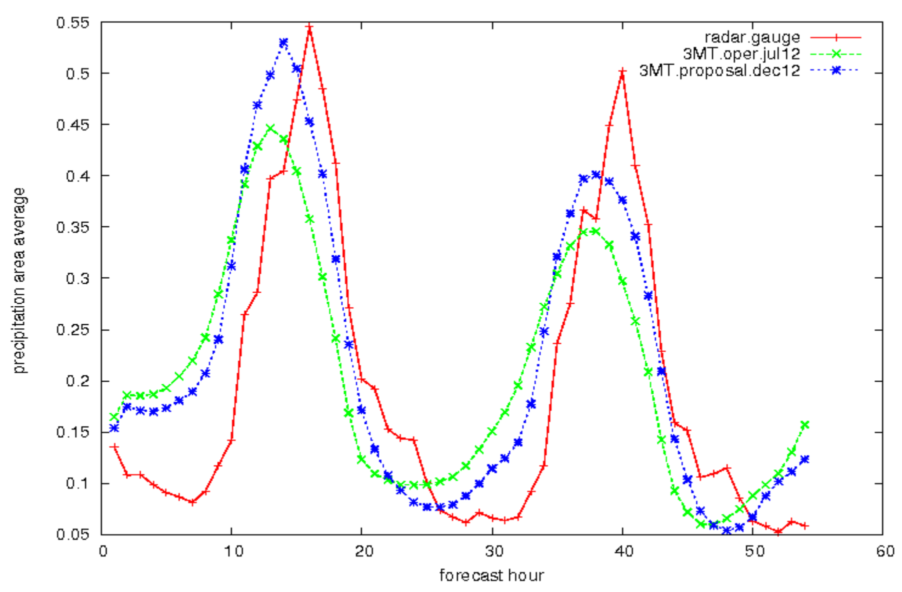
HPC system

- 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)

Diurnal cycle problem of parameterized moist deep convection

Radmila Brožková

A known problem of the parameterized moist deep convection: too early onset. Three modifications to improve the diurnal cycle were introduced in the 3MT scheme: (i) mixed CAPE-type & moisture convergence closure; (ii) relative humidity modulation of entrainment; (iii) evaporation-memory-linked adaptive detrainment. Especially on the second day, rain intensity and particularly the diurnal cycle shape are improved, with a delay of maxima towards the observed time, even if the onset is still too rapid.

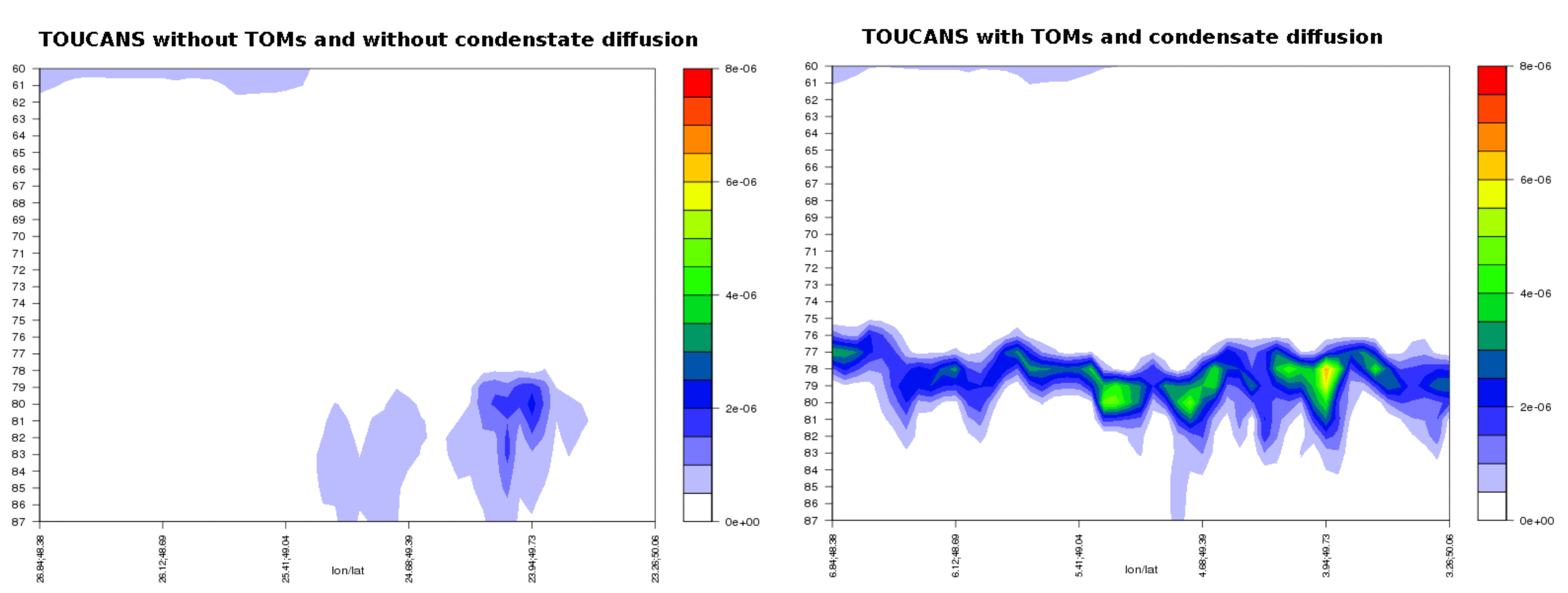


Situation of 24 June to 04 July 2009: this period corresponds to exceptional quasi-tropical diurnal convective conditions over Central Europe. Diagram = precipitation average over Czech Republic measured by radar and rain-gauges (red) is compared to model simulations (11 times 54h forecast) before (green) and after novelties (blue).

TOUCANS turbulent scheme

Ivan Bašták-Ďurán, Jean-François Geleyn

Third Order Moments (TOMs) parametrisation and vertical turbulent diffusion of condensates (with "Upstream ↑↓ discretisation") in TOUCANS turbulent scheme leads to accumulation of condensate in the region of (shallow convection) cloud.



Major operational changes (Sep 2012 – Sep 2013)

12 Dec 2012 **ALARO-0 baseline**: dependency of entrainment on the environment relative humidity, modulation of closure, dependency of adaptive detrainment on evaporation rate, precipitation fluxes due to downdraft evaporation within sedimentation corrected, new expression for dependency of critical relative humidity on mesh size introduced, cloudiness, autoconversion, updraft and downdraft detrainment associated with the introduced novelties retuned, ventilation index as an instantaneous flux introduced

6 Aug 2013 Retuning of low vegetation thermic coefficient in order to improve diurnal cycle of T2m, especially to reduce warm bias in summer

Update of ACRANEB radiative transfer scheme

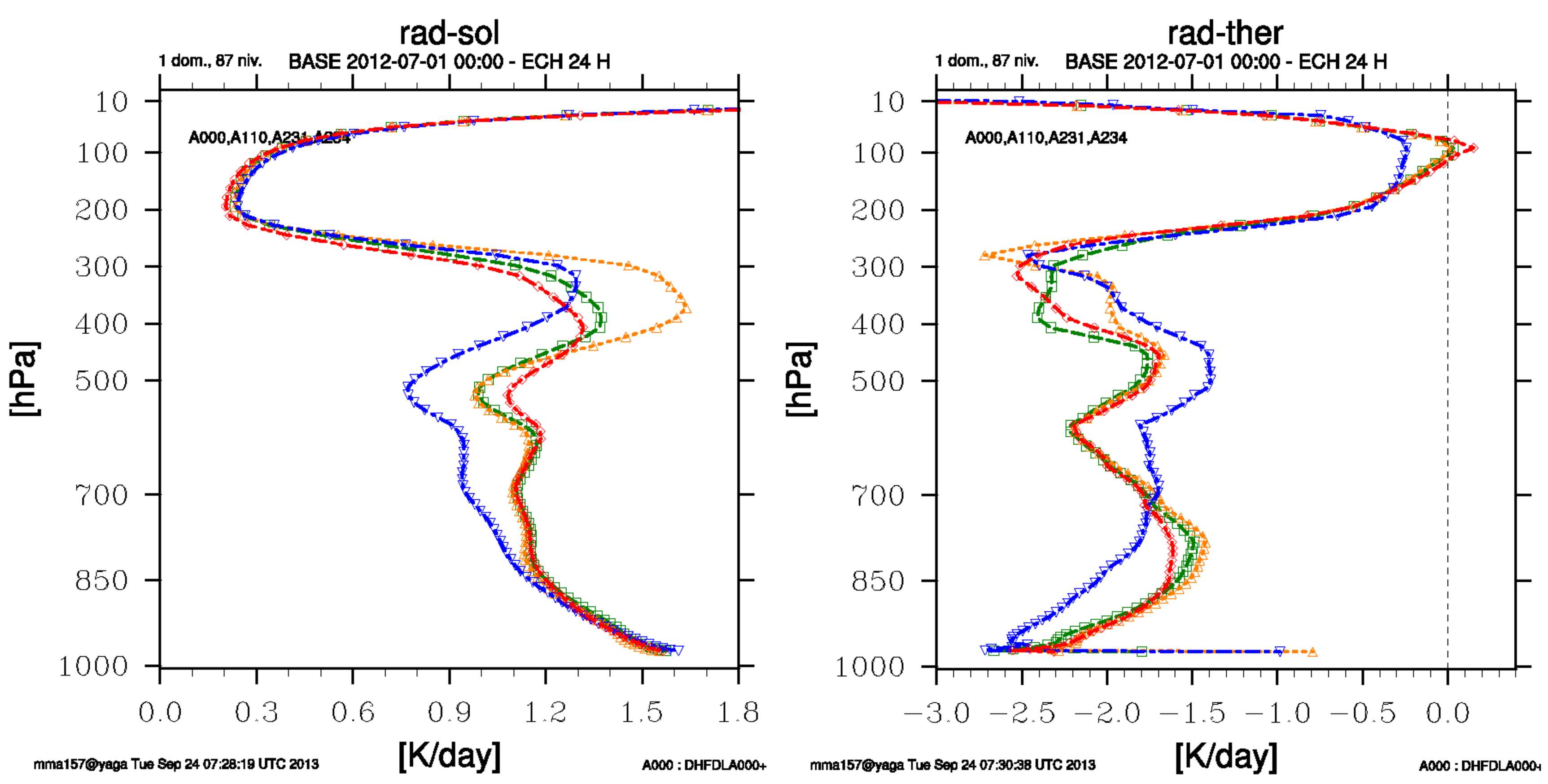
J. Masek, J.-F.Geleyn, H. Okodel Achom, O. Giot, P. Kuma

Work on updating ACRANEB scheme continued in 2013. Main issue was improvement of gaseous transmissions, which was finalized in summer. It includes new gaseous fits based on HITRAN 2008 line data complemented by Serdyuchenko 2009 data for continuum solar ozone absorption. Water vapor self continuum is taken from version 2.5.2 of AER continuum model MT_CKD (thermal band only). Broadband approach requires also parameterization of non-random gaseuos spectral overlaps and of secondary saturation. Another fundamental problem concerned temperature used in Planck weights, which was originally set to temperature of the layer T_loc, while it should be temperature of emitting body T_e instead. Fortunately, there is a way how to apply T_e correction consistently with net exchanged rate formalism used in thermal computations.

Another novelty is intermittent computation of thermal gaseous transmissions, which is important for scheme efficiency. Gaseous composition of atmosphere evolves only slowly, so it is fully sufficient to update gaseous transmissions every hour, while realistic feedback with cloudiness requires update of cloud optical properties in every timestep.

New scheme was assembled and tested both in idealized and real cases. Tests in cloudy environment revealed several problems. Ice clouds based on Rockel et al. 1991 data were absorbing too strongly in both solar and thermal bands. Situation improved greatly after ice cloud optical properties had been refitted against more realistic Edwards et al. 2007 data. Another problem concerns bracketing hypothesis used for exchanges between layers, which must take into account influence of clouds. It still has to be solved - current emergency solution does not enable to use statistical model and requires more expensive exact computation of bracketing weights. Very recently problem with solar surface budget was discovered and it seems to be caused by insufficient Rayleigh scattering whose broadband treatment will have to be revised.

In clearsky environment, new broadband approach gives typical tropospheric heating rate error ~0.1K/day with respect to narrowband fitting reference. In cloudy environment, deviation from FMR/RRTM reference stays usually within ~0.2K/day. For 1h intermittency CPU cost of the new ACRANEB scheme is comparable to FMR/RRTM. There is slight overhead which can be attributed to timely update of cloud optical properties present in ACRANEB, but missing in FMR/RRTM.



The plots show domain averages of heating rate profiles in solar (left) and thermal (right) bands obtained from 24 hour integrations (summer case with front passage):

red - FMR/RRTM reference
blue - old ACRANEB
yellow - new ACRANEB
green - new ACRANEB with updated ice clouds