CZECH HYDROMETEOROLOGICAL INSTITUTE

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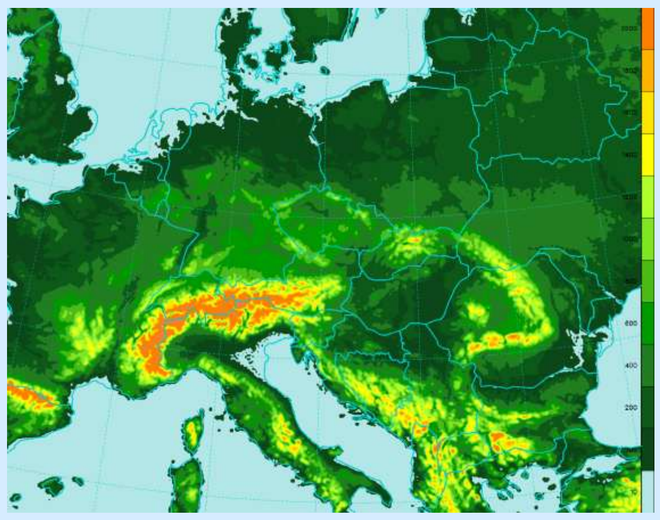
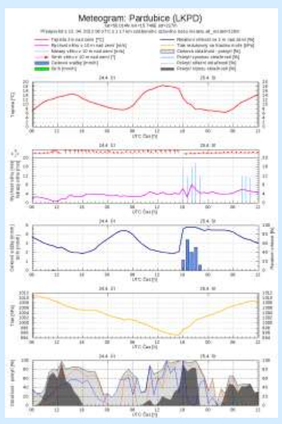
ALADIN/CE model set-up

- 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_op5 (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**

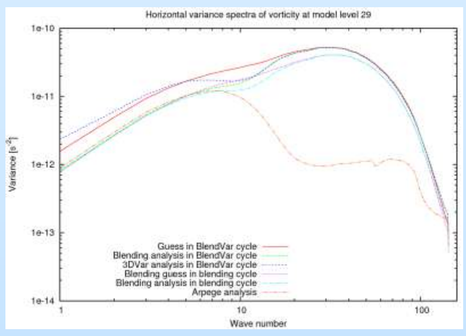
HPC system

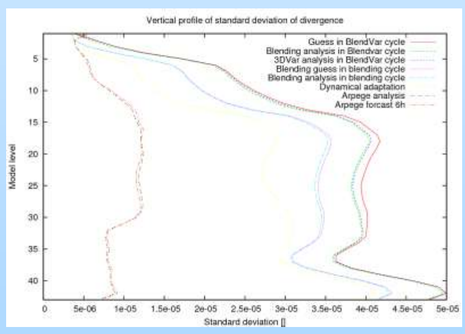
- two full **NEC SX-9** nodes (1TB RAM and peak performance 1.6 TFLOPS provided by 16 vector CPUs each node)
- GFS with 118TB usable disk space
- operating system is SUPER-UX and NQSII scheduler
- two Linux **frontend servers** (4 Intel Xeon quad core CPUs, 2.93 GHz clock rate and 31 GB RAM each)

Evolution of dispersion spectra in blending and BlendVar cycles

Antonín Bučánek

Dispersion is studied by variance spectra and standard deviation profiles of differences between 2 members of ensemble which are driven by AEARP (Assimilation Ensemble ARPege). Experiments are run with ALADIN model, linear truncation E159x143, Δx~9km, 43 vertical levels.





Blending: The idea is to combine AEARP analysis with information from scales which are not resolved by AEARP but by ALADIN. Digital filter spectral blending of the upper air fields is used to insert additional information from 6h ALADIN guess to analysis. Filtering is done at truncation E29x26 which is almost ALADIN equivalent of AEARP native resolution. No digital filter initialization in the next +6h integration is used.

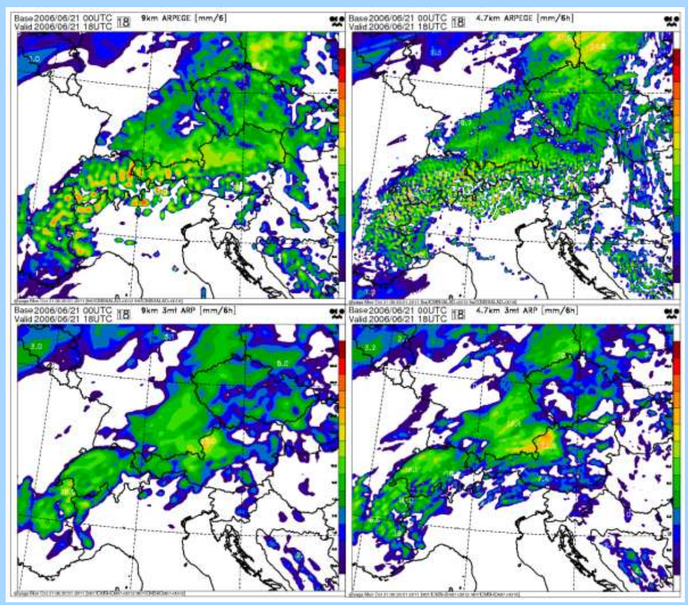
BlendVar: Digital spectral blending followed by 3DVar analysis of perturbed observations (SYNOP, TEMP). Perturbations are constructed as normally distributed random numbers with variance equal to assumed observation error variance.

On the standard deviation profile could be seen increase of stde in Blending cycle and even more in BlendVar cycle, analysis always reduces stde as expected. The variance spectra shows that blending works as described, small scales are from guess and large scales are from AEARP analysis. Guess files has maxima of variance in scales which are not fully resolved by AEARP analysis. BlendVar cycle increases overall variance but 3DVar analysis has impact only in large scales.

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 Left column: resolution of 9km, right column: resolution of 4.7km. Upper row: ARPEGE native configuration, lower row: 3MT in ARPEGE.

Major operational changes (Jul 2011 – Sep 2012)

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
31 May 2012	2 new products (convective inhibition, convective temperature)
22 Aug 2012	tuning to increase day amplitude of T2M (e-suite)

New gaseous transmissions

Ján Mašek

Work on new gaseous transmission functions is ongoing since March 2011. Target is to have radiative transfer scheme using single solar and thermal bands, with CPU cost proportional to number of levels and accuracy comparable to RRTM. During year 2011 new functional form of broadband transmissions was proposed and fitted against SPLIDACO reference (set of narrowband Malkmus coefficients based on line by line computations done in early 1990s). It employs Malkmus formula with additional rescaling of optical depth, taking into account broadband saturation visible as reduced log(delta)-log(u) slope in strong line limit (delta - optical depth; u - absorber amount). Issue of non-random gaseous overlaps, crucial for broadband approach, was addressed as well. In 2012 new gaseous transmissions were implemented in ACRANEB scheme of model ALADIN. Validation in clear sky case brought several bad surprises in thermal band:

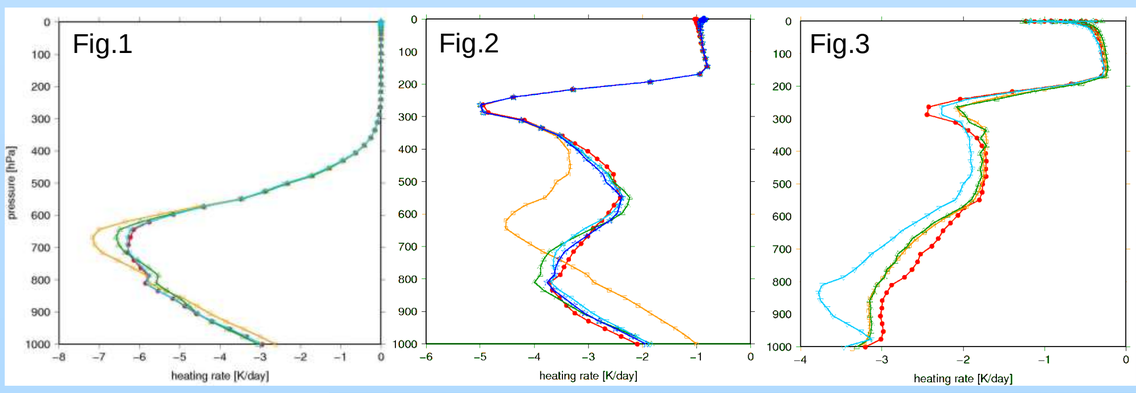
1) Even if for homogeneous optical paths new transmissions are clearly superior to the old ones, their accuracy turned to be insufficient when heating rates were evaluated. In order to get realistic heating rates, cost function used in nonlinear fitting procedure had to be reformulated, together with introduction of secondary corrective fits (figure 1).

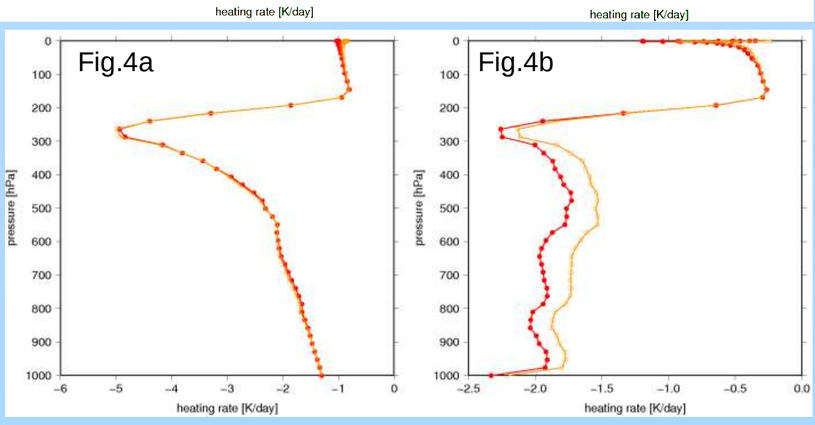
2) Parameterization of broadband gaseous overlaps can be source of significant heating rate error. It can be partially reduced by using more costly fitting function tuned against reference heating rate profiles instead of homogeneous optical depths (figure 2).

3) Consistent treatment of H2O e-type continuum was achieved by introduction of pseudo-gas H4O2 (formally treated as water dimer). It turned out that SPLIDACO e-type continuum is strongly overestimated and had to be replaced by more reliable MT_CKD data. Even with this change, H2O heating rates with e-type continuum included differ significantly from published reference (figure 3).

4) 1D tests revealed that there is fundamental problem with broadband thermal transmissions. They should depend on both layer temperature (entering via line strengths and half widths) and temperature of emitting body (entering via Planck weights). However, in SPLIDACO reference as well as in NER (Net Exchanged Rate) method used by ACRANEB, the two temperatures are merged. This is source of significant error as soon as nonisothermal profile is used (figure 4). While it is not a problem to introduce double temperature dependency in SPLIDACO reference and its fits, accommodating it in NER scheme requires major design change.

Points 1) and 2) were solved at the expense of increased cost. Point 3) is mostly technical question - it requires handling of some well established line by line model (e.g. LBLRTM), computing new reference transmissions and redoing all the fits. Point 4) is the most uncertain one, being still under investigation. For the moment it is not clear what will be the cost of the new scheme when finalized.





Figures: Heating rates in thermal band computed for ICRCCM midlatitude summer case (sometimes using isothermal profile with T=281.7K). SPLIDACO reference already accommodates double temperature dependency of broad-band transmissions.

Fig. 1: H2O e-type continuum, isothermal profile. Red is SPLIDACO reference, remaining curves are new ACRANEB: yellow – temperature independent corrective fits; green – temperature dependent corrective fits; cyan – temperature dependent corrective fits with reformulated cost function.

Fig. 2: H2O including e-type continuum, isothermal profile. Red is SPLIDACO reference, remaining curves are new ACRANEB: yellow – random gaseous overlaps; green – non-random overlaps fitted with original cost function; cyan – non-random overlaps fitted with reformulated cost function; blue – non-random overlaps fitted against heating rate profile.

Fig. 3: H2O including e-type continuum. Comparison of SPLIDACO reference (cyan) with various line by line models: red – LBLRTM; green – GLA; yellow – GFDL.

Fig. 4: H2O excluding e-type continuum. Comparison of SPLIDACO reference (red) with new ACRANEB (yellow): **a)** isothermal profile; **b)** nonisothermal profile.