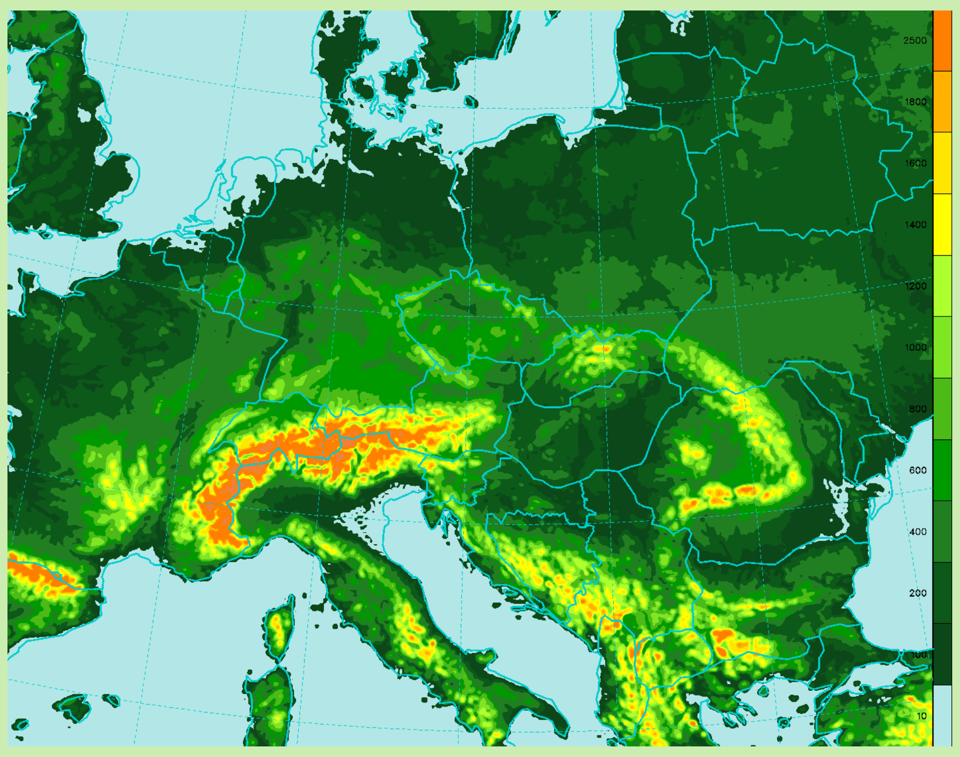
Czech Hydrometeorological Institute

ALADIN@CHMI

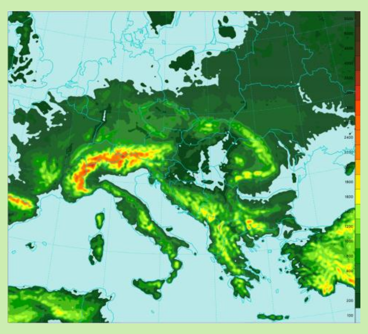
Model set-up


Orography of the new domain

- new 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
- ALADIN cycle 36t1ope (ALARO-0 with 3MT prognostic convection)
- OpenMP parallel execution
- 00, 06, 12 and 18 UTC forecast to +54h
- hourly off-line fullpos

- hourly DIAGPACK analysis (SYNOPs)
- verifpack on CY32T1
- monitoring of SYNOP and TEMP observation based on OI quality control


Orography of the old domain

HPC system used in operations

• two full **NEC SX-9** nodes.
Each node has 1 TB RAM and peak performance 1.6 teraflops provided by 16 vector CPUs.
Apart from local disk space separate for each node **both nodes are connected to global file system (GFS)** with 118TB usable space
Operating system is SUPER-UX
NQSII scheduler
• two Linux **frontend servers**.
Each has 4 Intel Xeon quad core CPUs, 2.93 GHz clock rate and 31 GB RAM.
Apart from local disk space **both frontends have access to global file system (GFS)**

Major operational changes (October 2010 – October 2011)

25 Oct 2010	Increase of the spatial resolution: 4.7km and 87 vertical levels
11 Jan 2011	Tuning of horizontal spectral diffusion, bugfix in the downdraft and advection of convective detrained fraction activated
15 Feb 2011	Retuning of horizontal spectral diffusion, correction of convective updraft transport and tunings, correction in microphysics
12 Mar 2011	Retuning of wind gust diagnostics
19 Jul 2011	Vertical Finite Element vertical discretization, retuning of convective cloudiness and screen level diagnostics.

Increase of spatial resolution

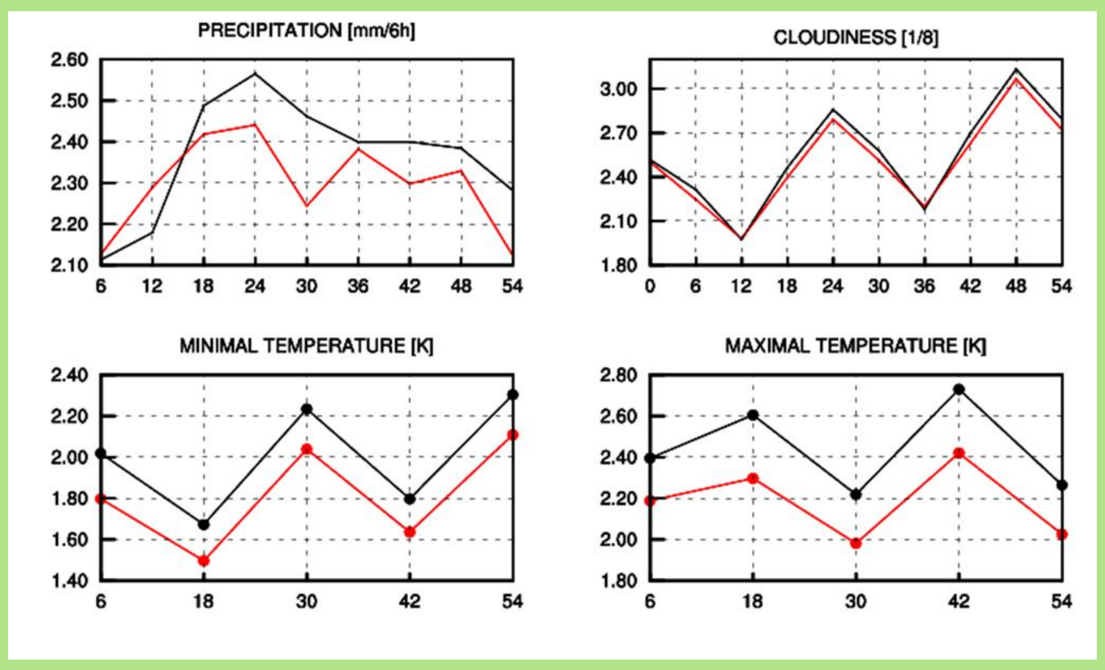
The resolution of the model was increased to 4.71 km in horizontal and to 87 vertical levels. The centre of the computational domain was moved to NorthWest while keeping the same projection plane of Lambert map (see orography of both domains on the left panel). Dynamics is using HPE set with the 2TL SI-SL scheme and 180s time step.

The "low" resolution for DFI blending was computed as geometrical average from ALADIN high forecast resolution (4.71 km), ARPEGE high forecast resolution (10.709 km in the centre of the computational domain) and the highest resolution of the ARPEGE 4DVAR assimilation inner loop (T323 non stretched, corresponding to 61.777 km). This gives the blending low resolution of 14.61 km and ratio of resolution between "high" and "low" one equal to 3.1, yielding low resolution truncations E87/E69.

The low and high resolution filters were updated. The high resolution incremental DFI span is set to 1 hour and a half and the low resolution DFI span was set to 3 hours and 45 minutes. The time-step length at low resolution to 600s (in proportion of the resolution ratio).

Due to higher vertical resolution it was necessary to treat the geometry problem of clouds. Weight for maximum overlap was retuned together with the coefficient of cloud condensation function. Also supportive diffusion coefficient was retuned.

New aerosols active in the solar band only were introduced to the radiation scheme (sea, land, soot, and desert) and two corrections were made in the prognostic downdraft computation.

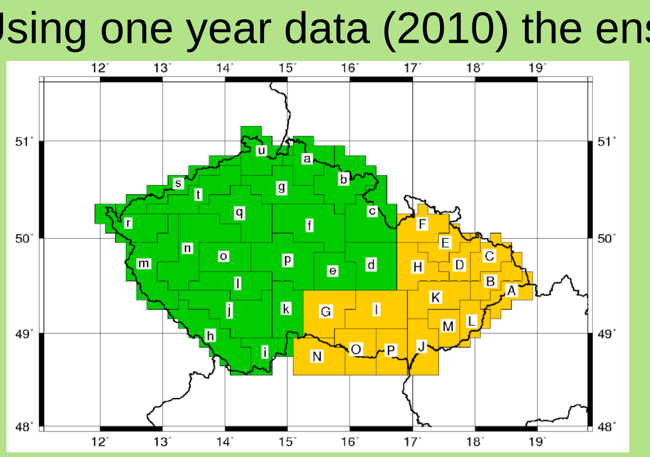


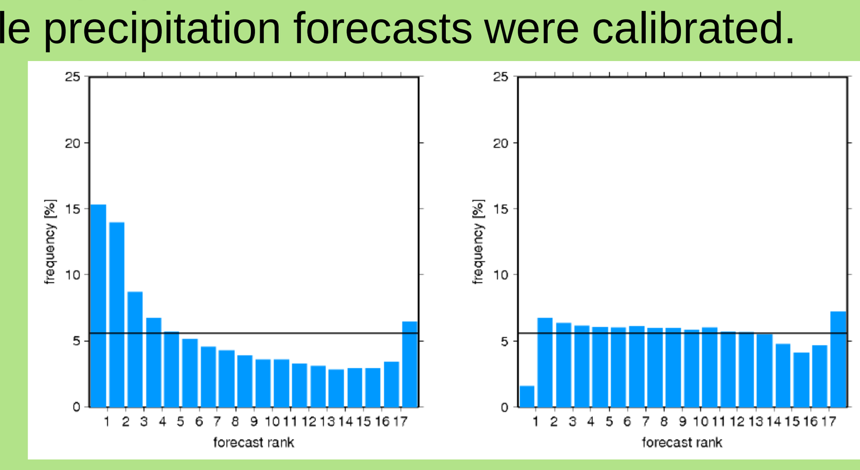
The standard deviation scores of some near surface parameters show an improvement for the testing period of Aug 26 – Sep 20 2010

Application of ALADIN/LAEF ensemble in hydrology

(J. Masek)

Application for hydrological ensembles was prepared based on ALADIN/LAEF of RC LACE. Using one year data (2010) the ensemble precipitation forecasts were calibrated.

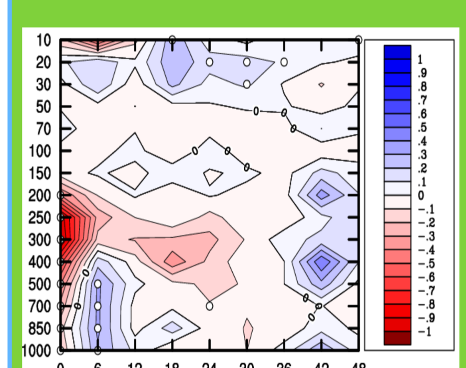

River catchment zones for which precipitations are computed from ensemble members.

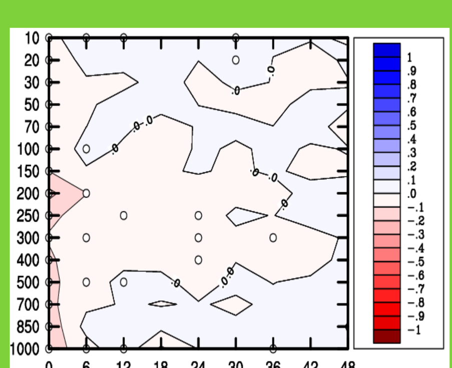

Rank histograms for 6h cumulated precipitation, for all zones. Before (left) and after calibration (right).

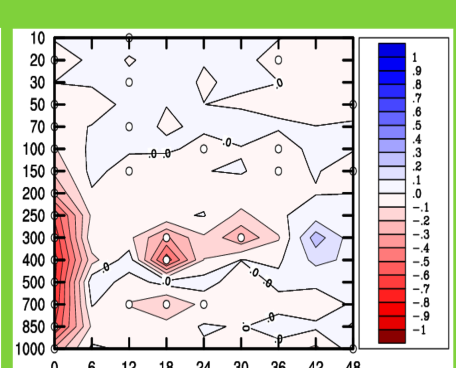
Data Assimilation Tests

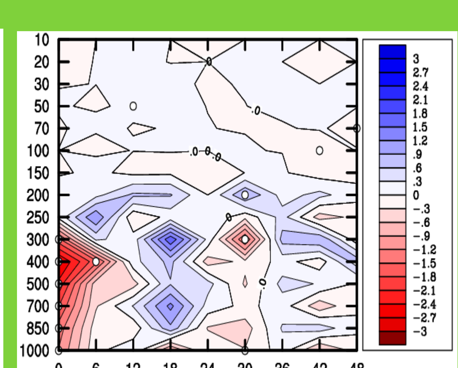
A. Trojáková

Latest results of conventional (SYNOP, TEMP and AMDAR) data assimilation test on 4.7km resolution with BlendVar scheme (3D-VAR analysis on the top of the digital filter blending). The objective scores against observation show small positive impact mainly for analysis of most of the variables. Noticeable is a degradation around 200hPa for the relative humidity and for the geopotential after +6H, whose source is under investigation. On the figures is displayed RMSE differences against observation for the first 2 weeks of July 2011. Red areas denote better performance of BlendVAR with respect to blending scheme. The white circles point that RMSE difference is better/worse with significance 95% two-side confidence interval.


Geopotential [m]


Temperature [K]


Wind speed [m/s]


Relative Humidity [%]

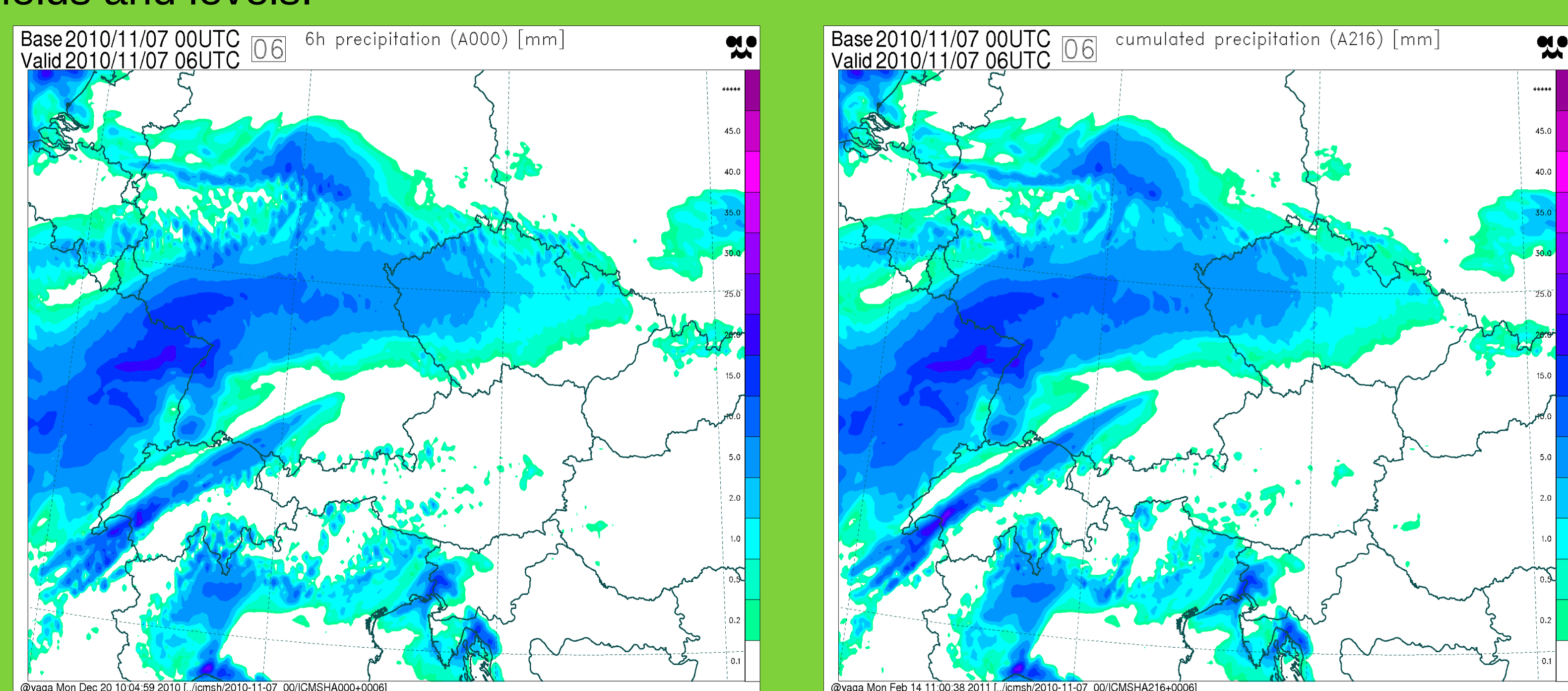
Removal of orographic noise due to spectral diffusion

(J. Masek, R. Brozkova, F. Vana)

From time to time, short scale noise in precipitation and cloudiness fields was produced by operational model ALADIN/CE (dx=4.7km, linear grid, 87 levels). Numerical experiments proved that noise was of orographic origin and could be reproduced in adiabatic run, looking at vertical velocity field. In some respects phenomenon resembled well known problem of orographic resonance in semi-Lagrangian scheme (it could be reduced by shortening the timestep), but it occurred for wind speeds well below numerical resonance. Further investigation showed that source of problem was **too strong spectral diffusion on horizontal divergence**.

Basic mechanism was understood in linearized 1D shallow water equations. Unnecessarily strong linear diffusion on divergence smoothes wind field too much and due to continuity equation flow is forced to copy orography more closely, which reverses sign of subresonant geopotential response and eventually amplifies its magnitude.

Proposed solution was to prevent spectral diffusion on all fields in troposphere (apart from weak supporting diffusion needed by SLHD scheme), where its role is taken by more physical nonlinear semi-Lagrangian diffusion (gridpoint part of SLHD). Above 100hPa level 2nd order spectral diffusion is still used to eliminate spurious reflections from model top. New tuning of spectral diffusions in SLHD scheme was tested in parallel suite, showing slightly positive impact on most model fields and levels.



The 6 hour precipitation with operational SLHD settings (left). Short scale noise clearly visible above parts of Germany and Czech Republic was significantly reduced with retuned spectral part of SLHD (right).