Regional Cooperation for
Limited Area Modeling in Central Europe

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Status of data assimilation at CHMI

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Outline

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- Overview of the progress since June 2012
- Evaluation of DA scheme
- Questions
- Case study

Progress since June 2012

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- The study of the evolution of error dispersion spectra in successive steps of DFI Blending, 3DVAR, Blend-Var simulated by ensemble - Antonin's talk
- First test of water vapor regimes verification using SAL - Patrik's poster on ALADIN/HIRLAM workshop
- Radiance data assimilation - Patrik's talk
- Evaluation of DA scheme
  - background error statistics
  - observation and background errors diagnostics

Background error statistics

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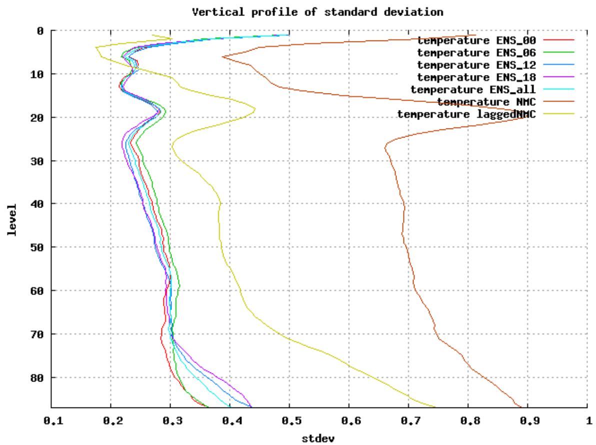
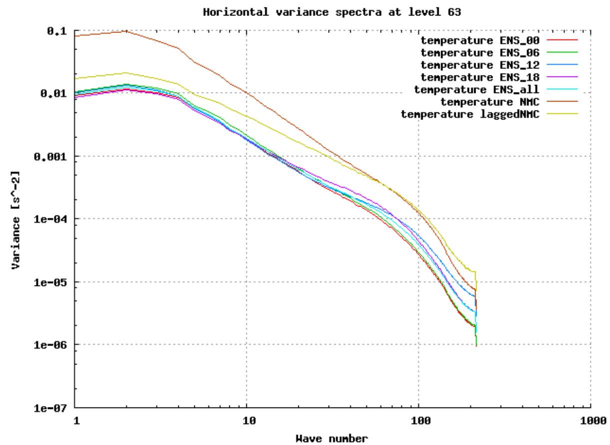
Background error statistics are essential component for the 3DVAR. There are several typical characteristics which are usually examined, e.g. standard deviations which correspond to the expected amplitude of background errors, correlations (or length-scales) which determines how local observation are spatially filtered and propagated to the neighborhood and cross-covariances between the different variables (divergence, vorticity, temperature, surface pressure and humidity) which usually reflect physical couplings between different variables, e.g. geostrophic balance.

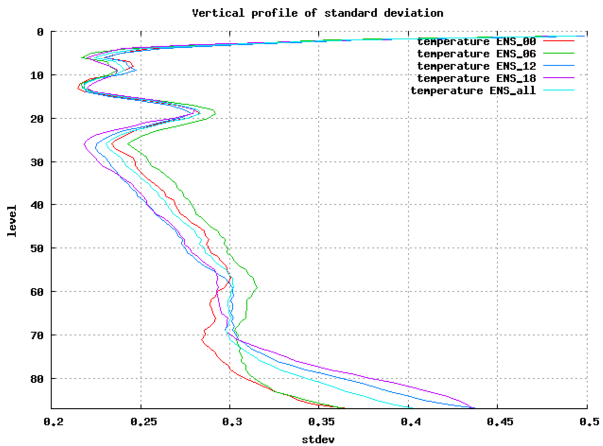
The NMC lagged statistics were compared with ensemble based, which should provide better representation of the initial errors and the analysis effects (Berre etal 2006)

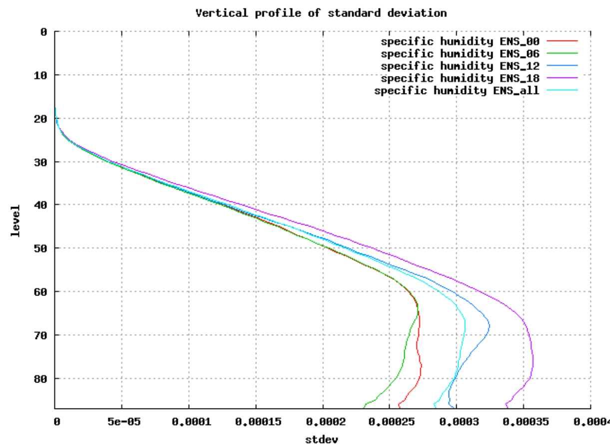


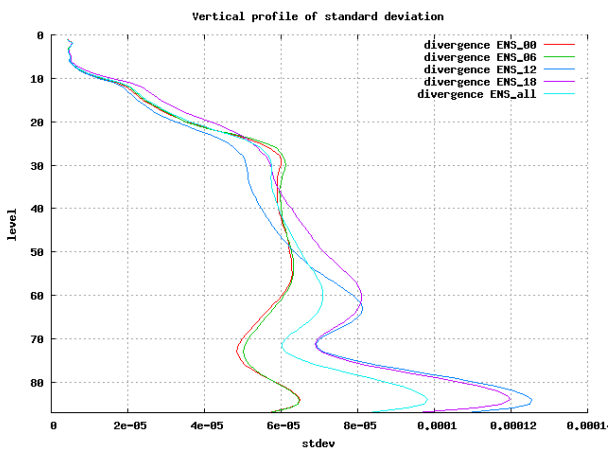


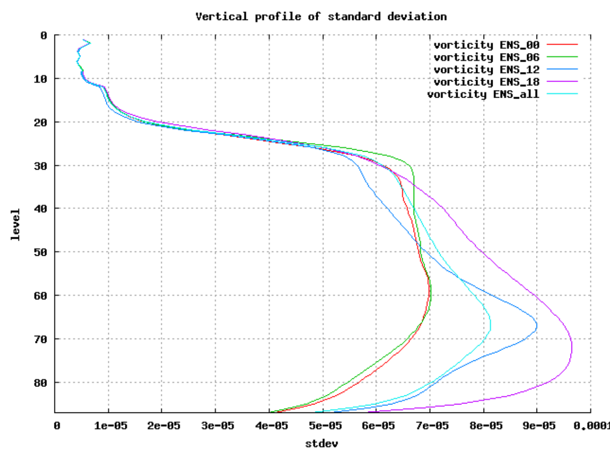
Background error statistics

The ensemble based statistics for 00,06,12,18UTC and all were examined.



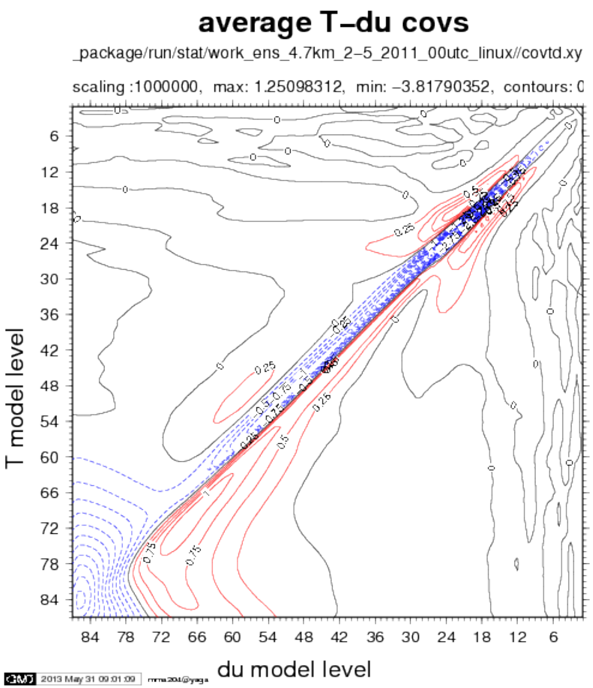


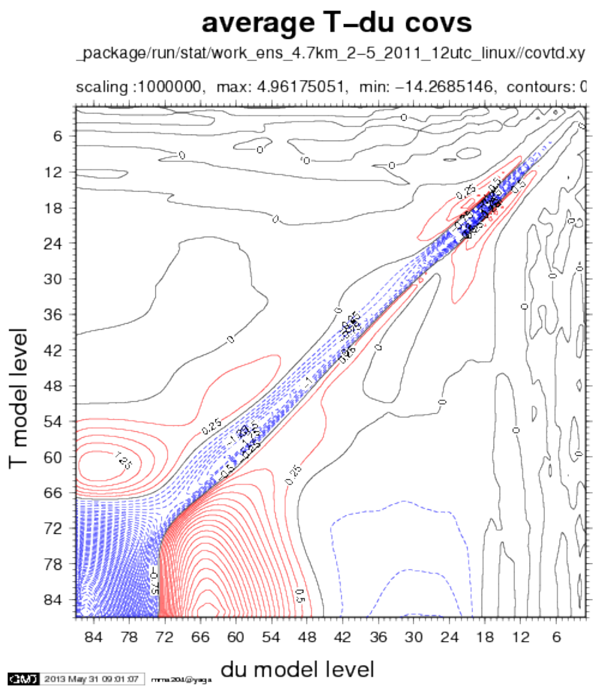




Background error statistics

The ensemble based statistics for 00,06,12,18UTC and all were examined.





Mostly quantitative differences have been found, (e.g. bigger standard deviations and cross-covariances for 12UTC and 18UTC), which complicated an inter-comparison and the impact study have been carried out.

Evaluation of DA scheme

The upper-air analysis scheme was of our main interest with aim to replace the operational DFI blending scheme by 3DVAR based technique which uses observation directly.

- 3DVAR schemes with different B matrix were tested in simplified framework, which consist of an experiment without assimilation cycling !
- aim is to quickly check performance of the analysis scheme and to get the best scores up to +6H forecast at least
- tested periods 1-14 February 2013 (and 1-14 July 2012)
- observation assimilated (data from OPLACE only)

  SYNOP (ϕ)

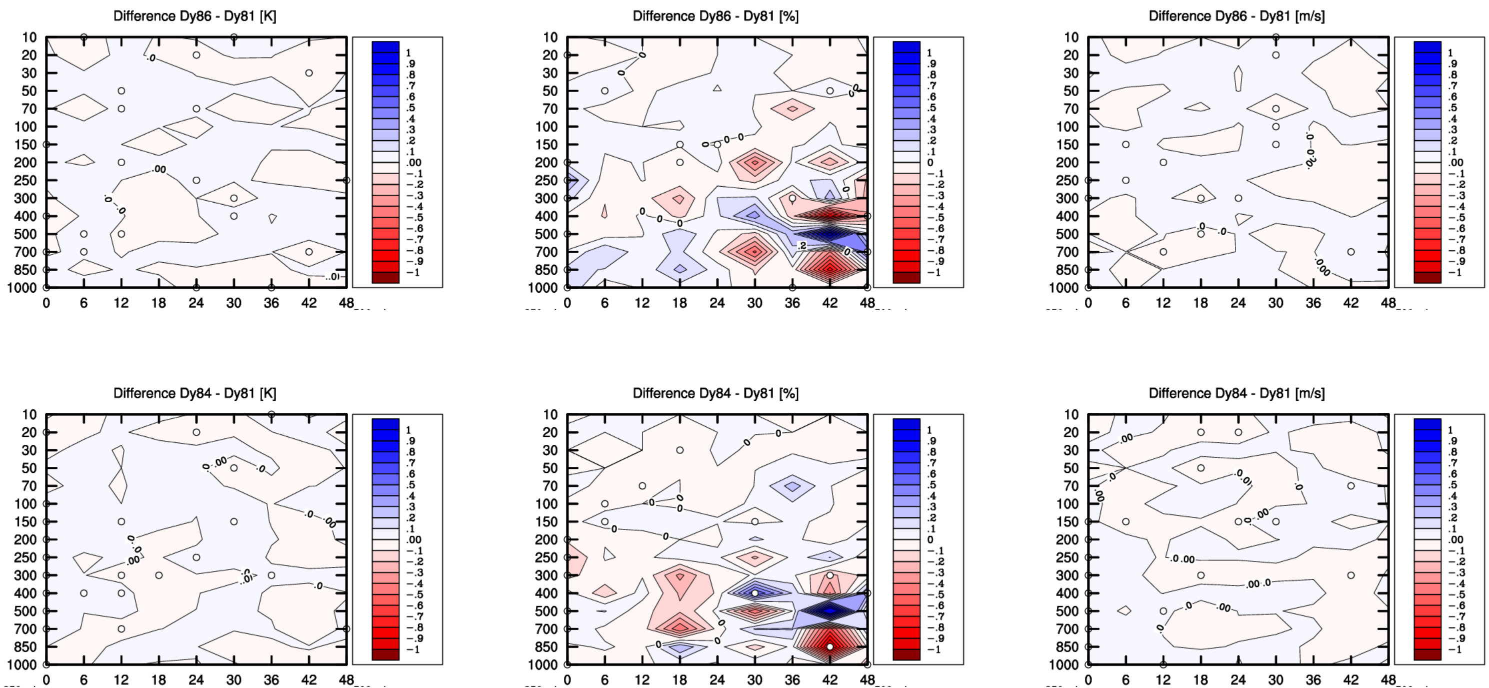
  TEMP ($T, q, wind$)
- verification method - scores against SYNOP&TEMP (VERAL)

The impact of the background errors was studied for ensemble based B (REDNMC=1) for production +48H forecasts starting from 00 and 12UTC

- Y86 - ensemble B sampled valid at 00UTC only (ENS_00)
- Y84 - ensemble B sampled valid at 12UTC only (ENS_12)
- Y81 - ensemble B sampled for all analysis times (ENS_all)

Impact of ensemble based B

RMSE differences of the scores against observations for 00UTC forecasts
red areas denote a positive impact of ENS_00 (top), ENS_12 (bottom)
with respect to ENS_all, white circles significance 95% two-side confidence int



T [K] RH [%] $wind$ [m/s]

Impact of ensemble based B

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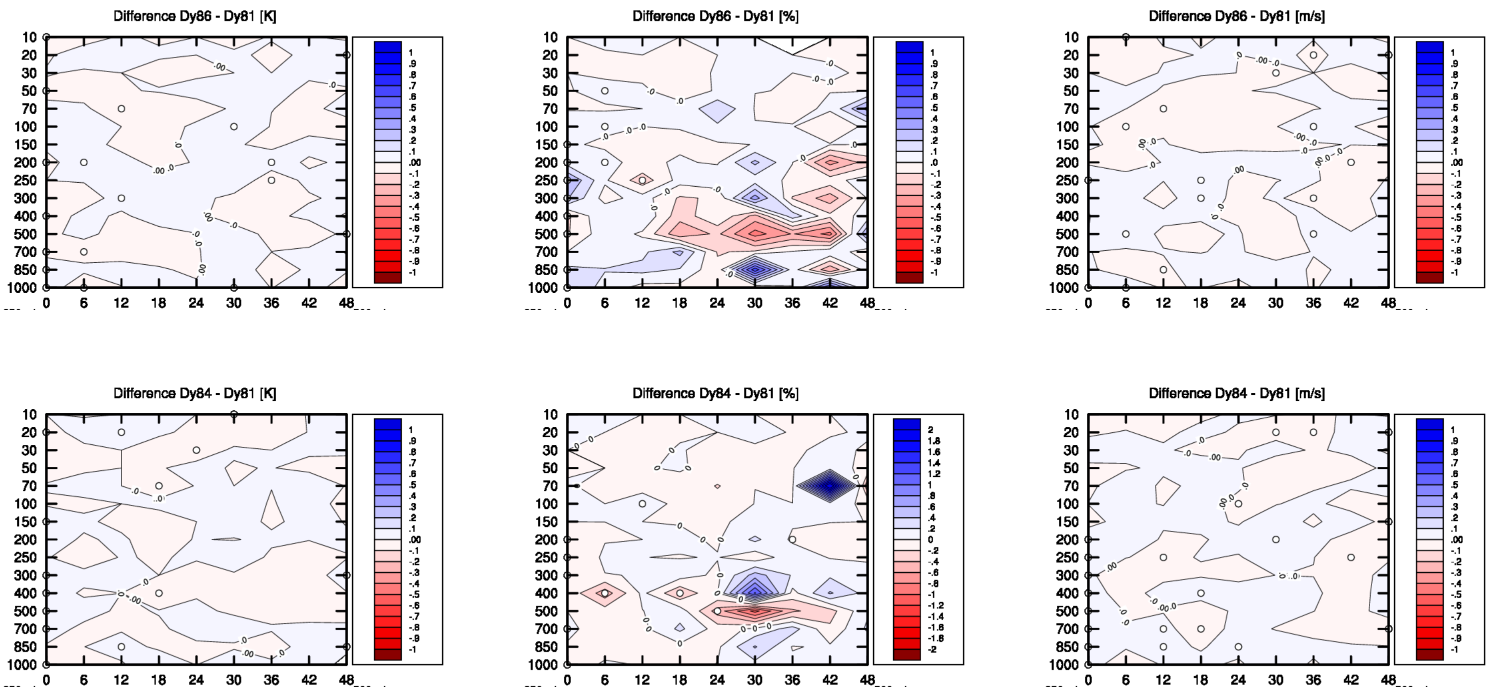
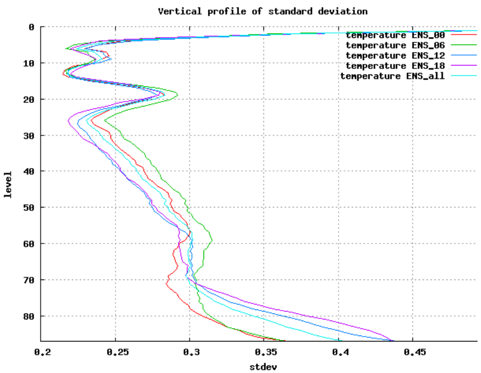
RMSE differences of the scores against observations for 12UTC forecasts
red areas denote a positive impact of ENS_00 (top), ENS_12 (bottom)
with respect to ENS_all, white circles significance 95% two-side confidence int

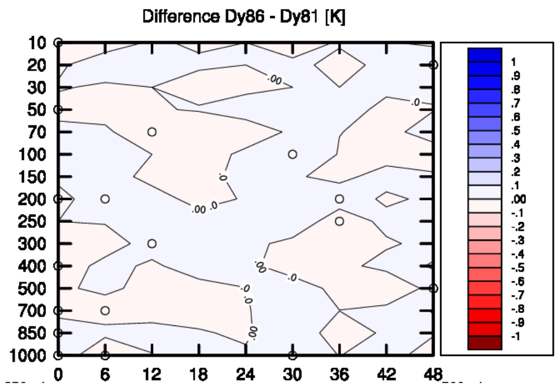


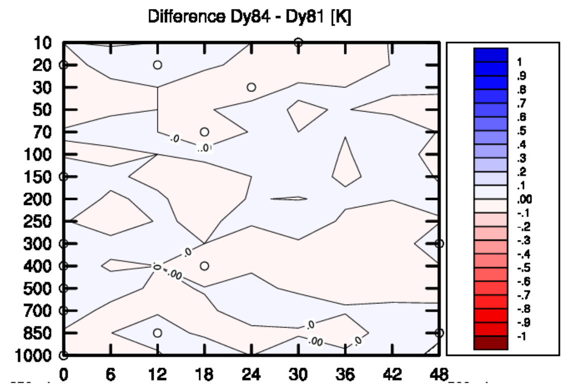
T [K] RH [%] $wind$ [m/s]

Impact of ensemble based B

- The impact studies showed rather small impact (although many times statistically significant).
- Impact of some parameters has correlation with the value of standard deviation, e.g. temperature (the higher errors the bigger positive impact)







It is difficult to make conclusions as

- the quantitative differences hamper a fair experimental evaluation (and at least appropriate tuning of the background standard deviations is needed)
- the design of the experiments (use of the simplified framework = test without assimilation cycling) might be questionable

Errors diagnostics

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A posteriori diagnostics of the observation and background errors proposed by Desroziers et al 2005 showed that the background errors are overestimated while observation ones are underestimated.

Exp	ENS_all		
Var	cases	r_o	r_b
q	10321	0.61941	1.21313
T	17424	0.84735	1.53390
Ek	17655	0.75862	0.78490
Mean	45400	0.76589	1.21538

Table 1: The ratios of diagnosed/predefined standard deviations for observations r_o and background r_b

The impact of the errors tuning was studied in the simplified framework for ensemble based ENS_all (ad-hoc selection!) for 1-14 February 2013 00UTC

Exp	Y88			Y89			Y90		
Var	cases	r_o	r_b	cases	r_o	r_b	cases	r_o	r_b
q	10327	0.67346	1.11380	10327	0.67063	0.94799	10327	0.64998	0.85763
T	17428	1.00326	1.62716	17429	1.06875	1.54322	17430	1.07456	1.45898
Ek	17657	0.88722	0.78246	17660	0.94684	0.70839	17660	0.95286	0.65623
Mean	45412	0.89190	1.23946	45416	0.94298	1.14605	45417	0.94459	1.07313

- **y81 - Dynamical adaptation + 3DVAR ENS_all**
- **y88 - REDNMC=1.2 and SIGMAO_COEF=0.8**
- **y89 - REDNMC=1.5 and SIGMAO_COEF=0.7**
- **y90 - REDNMC=1.7 and SIGMAO_COEF=0.67**

Impact of errors tuning

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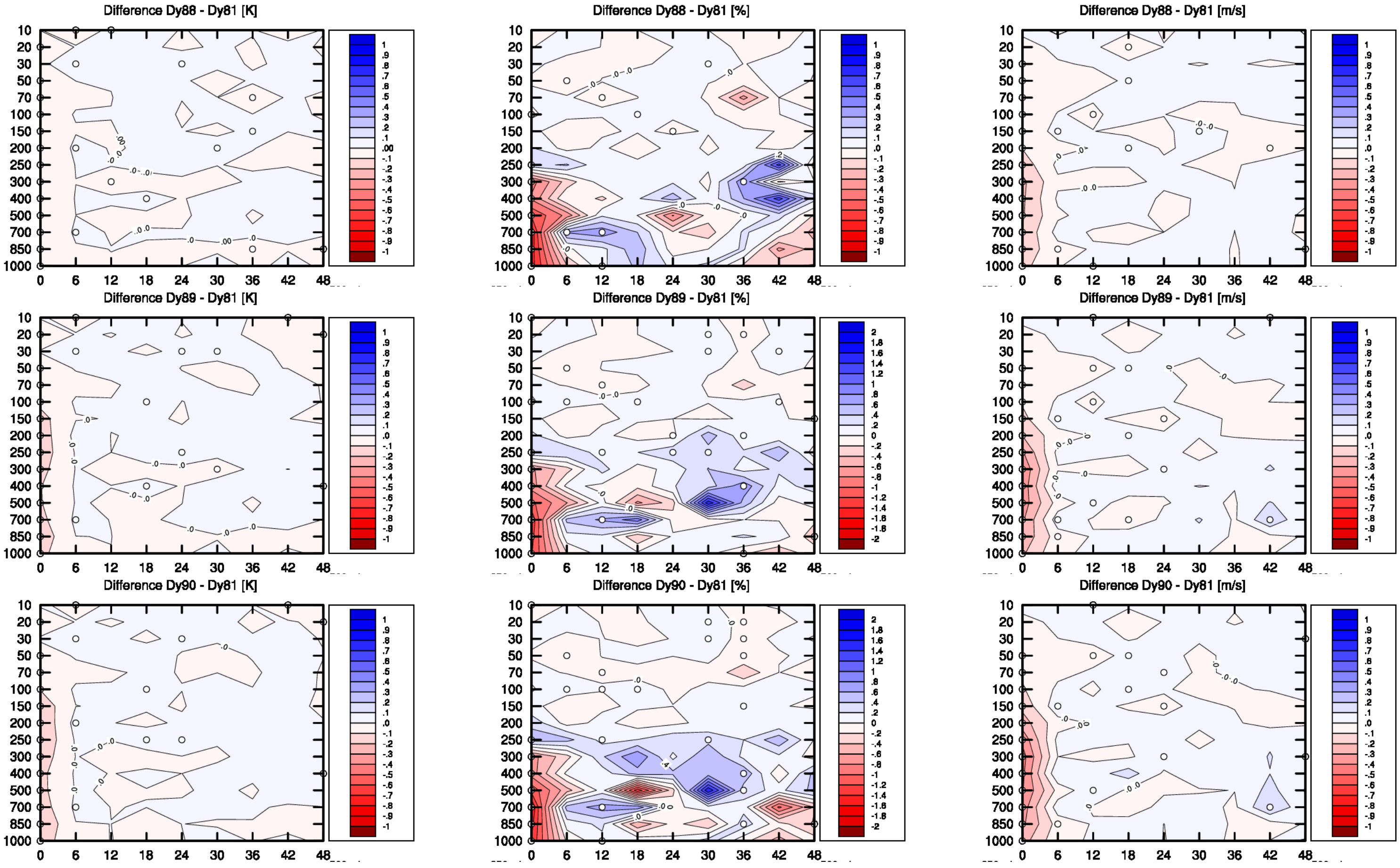
RMSE differences of the scores against observations for 00UTC forecasts



T [K] RH [%] $wind$ [m/s]

Summary

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The upper-air analysis scheme was of our main interest with aim to replace the operational DFI blending scheme by 3DVAR based technique which uses observation directly.

- only observation conventional data (SYNOP & TEMP) assimilated (data from OPLACE only)
- 3DVAR schemes with different B were tested in the simplified framework

  no clear guidance of the background errors sampling was obtained
- the observation and the background errors tuning was tested

  the observation and the background errors tuning showed potential to improve the analysis mostly

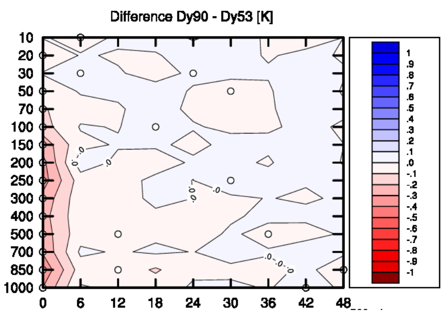
  Warning:
  1) SIGMA_COEF have to be set in BATOR, screening and minimization namelists !
  2) SIGMA_COEF is not applied to SYNOP and partially also TEMP observations (see bator_ecritures.F90 and bator_init.F90) in CY36T1!

Summary

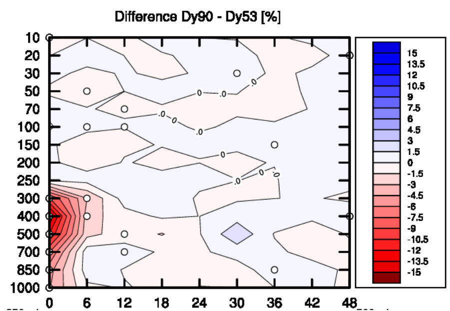
- the goal is to set-up a 3DVAR for further testing (with more observations and the full assimilation cycling)

  we have obtained quite encouraging results

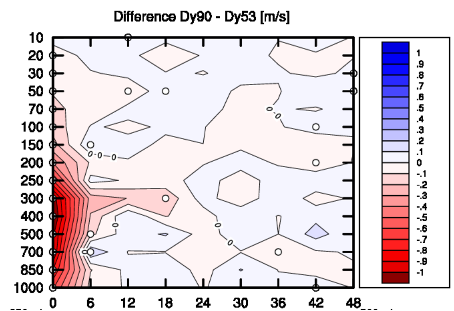
RMSE differences of the scores against observations for 00UTC forecasts
red areas denote a positive impact of the 3DVAR set-up
(ENS_all & REDNMC=1.7 & SIGMAO_COEF=0.67)
with respect to dynamical adaptation, white circles significance 95% two-side confidence interval



T [K]



RH [%]



$wind$ [m/s]

Questions

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- What background errors are used and why ?
- How did you evaluated the background errors ?
- What are your experiences or future plans regarding:
  - background error sampling strategies (seasonal, daily dependency) ?
  - observation and background error tuning ?
- What is an interaction of REDNMC and grid-point background errors (sigma_b) of the day (from ARPEGE ENS_DA) ?

Importance of data assimilation

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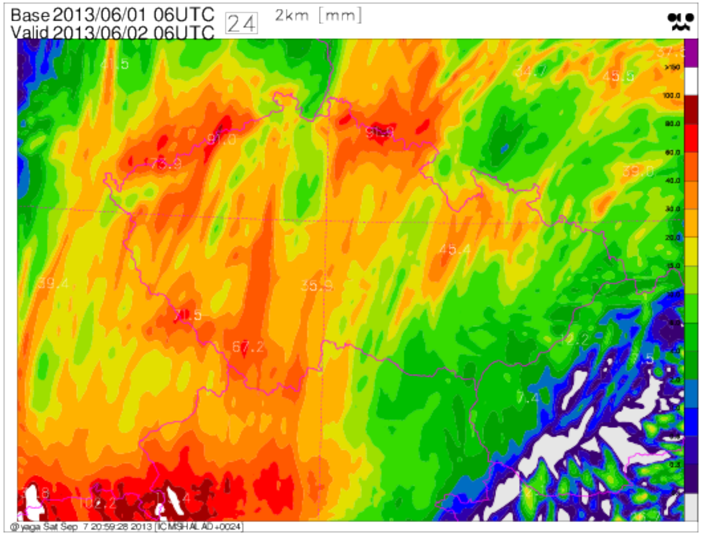
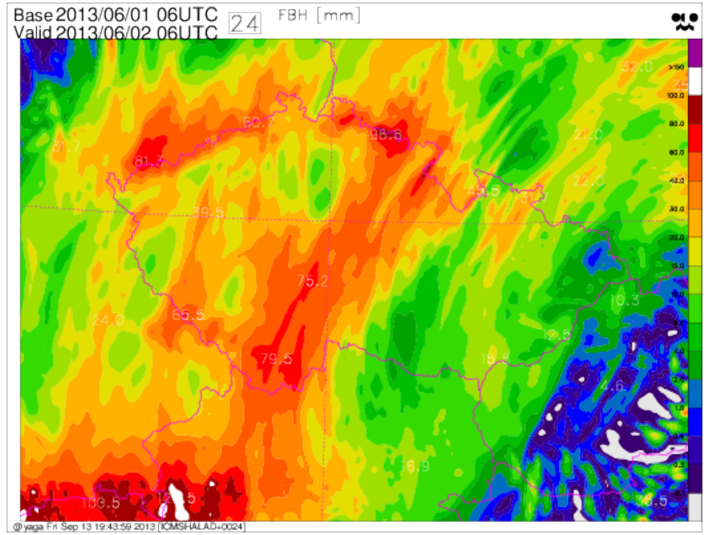
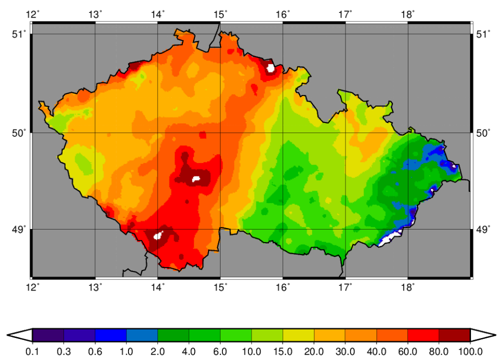
Case study in high resolution of 2.2km for the the flood event of 1st July 2013



interpolated ARPEGE



interpolated blending analysis from 4.7km



Thank You for Your attention !