Regional Cooperation for
Limited Area Modeling in Central Europe

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Status of data assimilation at CHMI

DAWD 30. 9.–2. 10. 2015

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DHMZ SHMU OMSZ ZAMG ROMANIA ANM

Operational Setup

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- **ALARO-1, CY38T1_op3**
- **$\triangle x$ ∼4.7km, 529x421 grid points, linear truncation E269x215,**
- **87 vertical levels, mean orography,**
- **6h cycling without initialization, time step 180s, 3h coupling interval,**
- **NEW scheme - BlendVar:**
  - **surface CANARI**
  - **DF Blending (filtering truncation E87x69)**
  - **3D-Var**
- **production 4 times a day (00 06 12 18 UTC) up to +54h**
- **see Bučánek et al. [2015]**

Progress since January 2015

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- **BlendVar scheme is operational from 20th August 2015**

  Our main efforts were dedicated to an operational implementation of the BlendVar. Practical developments comprised a preparation of new tasks and an overall optimization of our operational suite.

- **Mode-S data assimilation at CHMI - Alena's talk**
- **Satellite bias correction - Patrik's talk**
- **Ensemble B matrix with static coupling**
- **Preparatory work for SYNOP and TEMP BUFR data handling**

  Alena: GTS SYNOP and TEMP BUFR data processing has not progressed much. Preliminary tests pointed a need of careful handling of GTS BUFR bulletins, especially "BBB" (addition/amendment/correction) messages, otherwise ODB may contain wrong or multiple values of given observation. A development of a special tool to decode/encode such BUFR bulletins started. BATOR (CY38T1) seems to be able to handle BUFR data, but more detailed validations are needed.

BlendVar Setup

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- The idea behind BlendVar is to analyse long waves first by DF Blending and subsequently shorter part of the spectra by 3D-Var.

- We use ensemble based B matrix [Berre et al., 2006] computed over the 3-month period of February – May 2011.

- According to posteriori diagnostics SIGMAO_COEF=0.67 and REDNMC=1.7 [Trojáková, 2013]

- Observations (3h assimilation window)
  - SYNOP (MSLP)
  - TEMP (T, RH, U, V)
  - AMDAR (T, U, V)
  - Meteosat-10 (channels 2, 3, 4, 6, 7),
  - AMV

BlendVar Setup - Varbc and IDFI

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Bias correction:

- 24-hour cycling
- Initialized from AROME
  - Warmed-up in passive assimilation mode for 1.5 month
  - Namelist parameter NBG_MSG_HR increased to 20000 (default 5000) to control the slow adaptation of bias parameters that is important for statistically meaningful estimates.
- Default NBG_MSG_HR is kept in active assimilation

IDFI setup and Coupling [Benáček, 2015]:

- IDFI was re-tuned to allow shorter waves in initial conditions
- Namelist parameter TAUS was reduced from 5400s to 1800s
- Space consistency coupling - improves short range forecast up to +6 h

BlendVar Setup - CANARI bugfix

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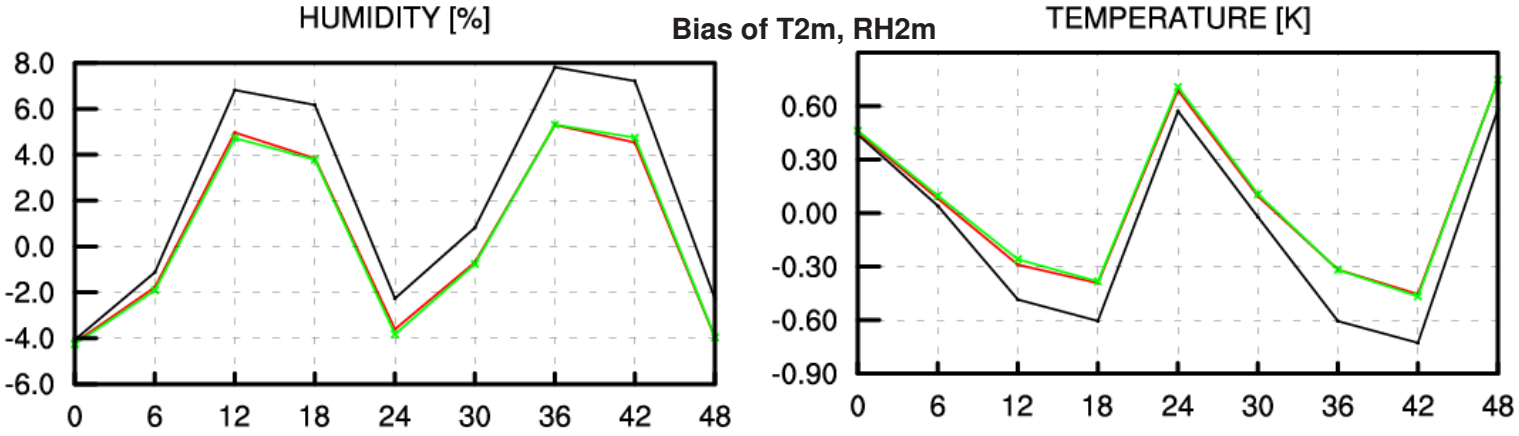
- Missing TOUCAN interface for screen level observations, wrong physics namelist for ALARO-1
- Missing instantaneous and cumulative fluxes in guess [Belluš, 2013] - impact on temperature and humidity bias
- Increments are modulated (mostly decreased) depending on fluxes like prec, w10m, cloud, ice.
- Surf moisture increments are set to zero, if surface evaporation is bigger than evapotranspiration or both fluxes are missing in the guess.

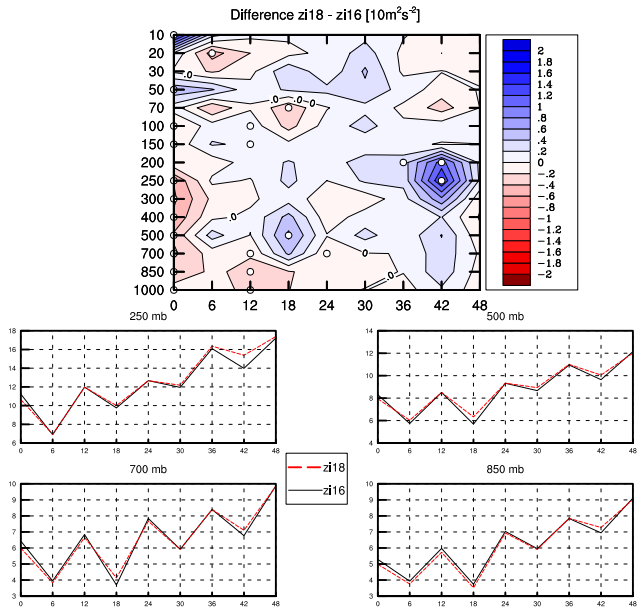
Red =no fluxes, Green =fluxes + modif. modulation, Black = fluxes + default modulation



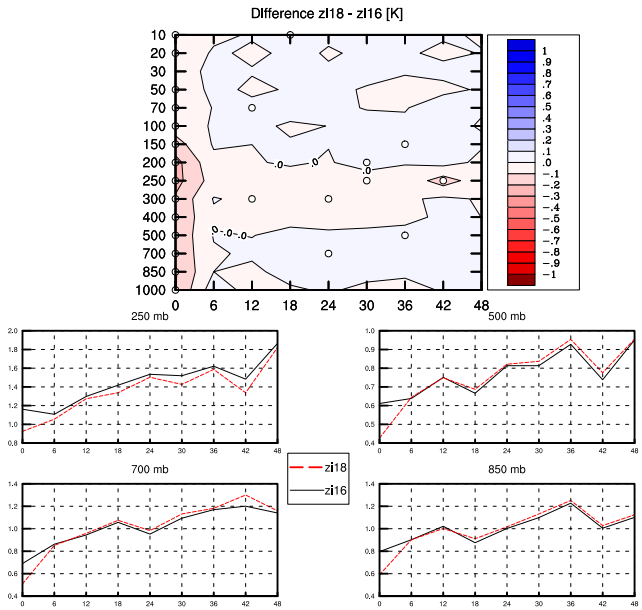
BlendVar flood case study 1

- **Period 26. 5. – 10. 6. 2013, Meteosat-10 not used, cy36_op8**
- **Improved initial conditions**

(a) Geopotential



(b) Temperature

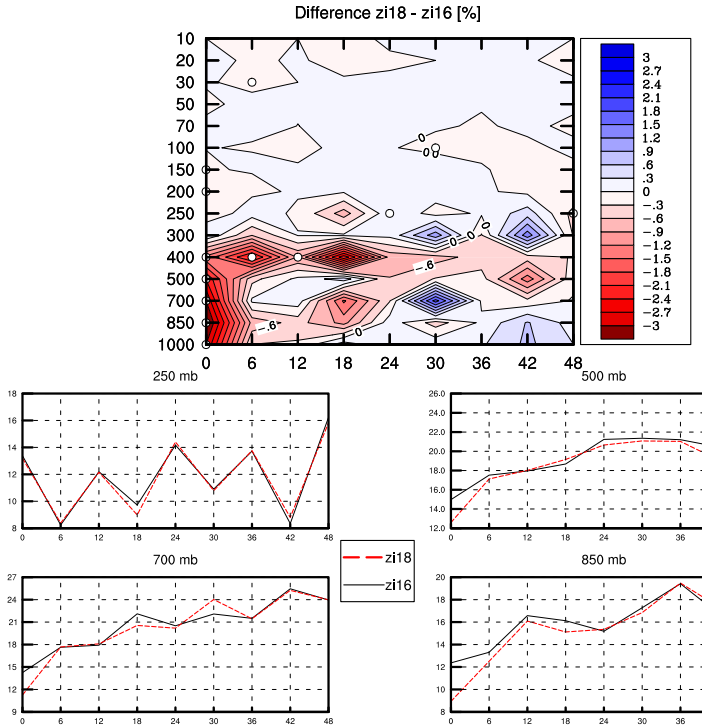


RMSE of BlendVar (zi18) compared to operational setup Blend (zi16), 00UTC runs. Verification was done against TEMP observations. Small circles show statistically significant difference. RED denotes better score for BlendVar.

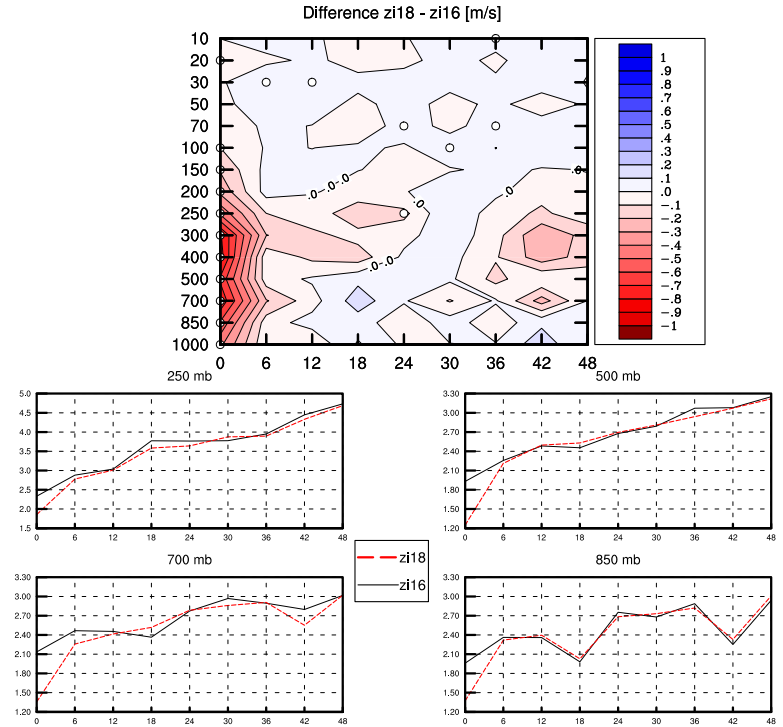
BlendVar flood case study 2

- **RMSE of relative humidity from 00 UTC runs has the best score**

(a) Relative humidity



(b) Wind speed



RMSE of BlendVar (zi18) compared to operational setup Blend (zi16), 00UTC runs. Verification was done against TEMP observations. Small circles show statistically significant difference. RED denotes better score for BlendVar.

BlendVar flood case study 3

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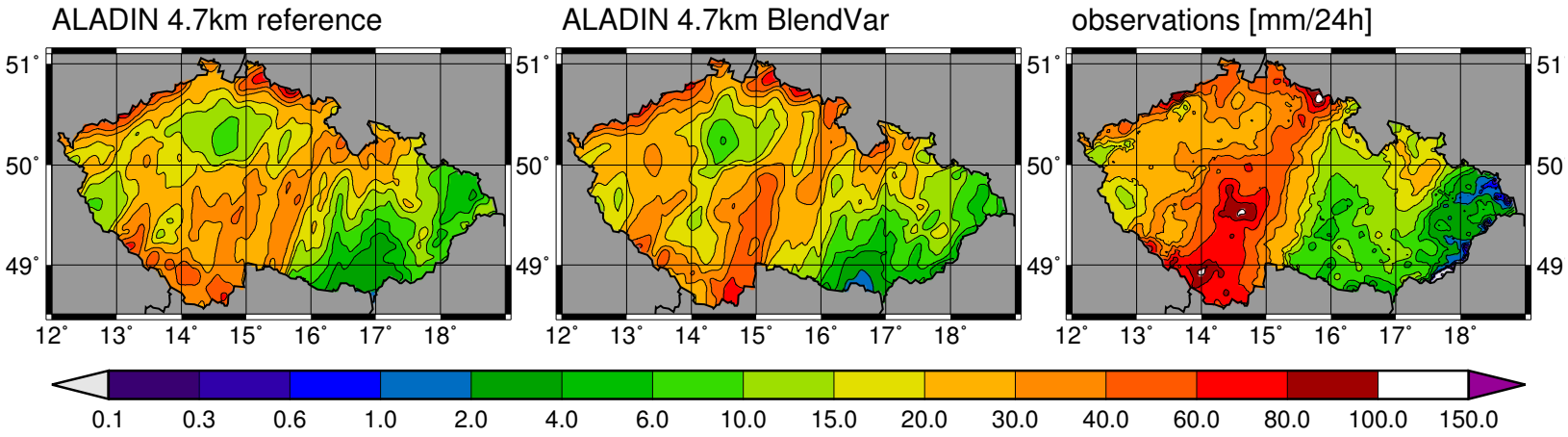
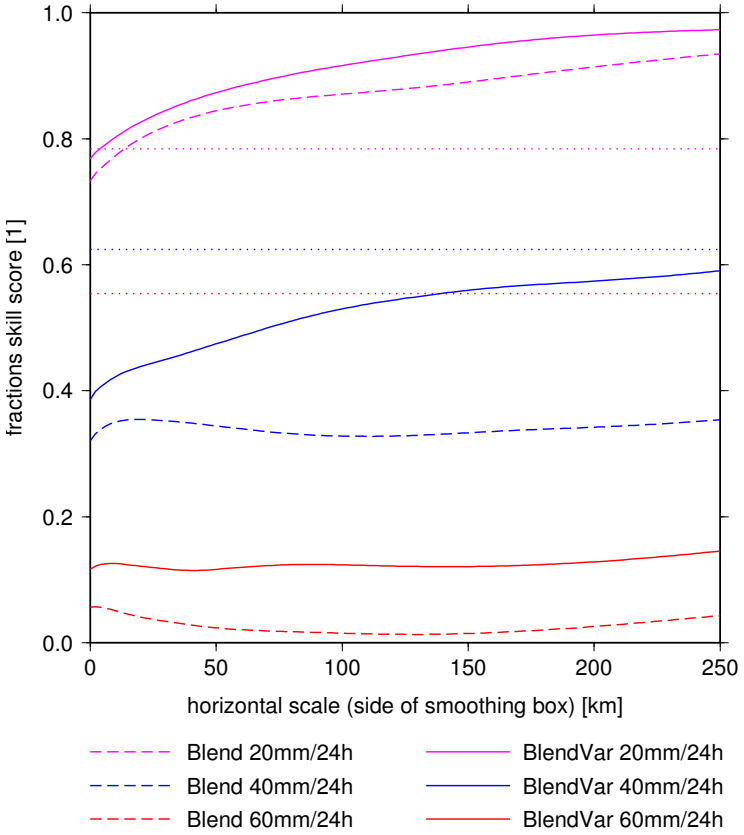


- **The most heavy precipitations was falling 1–3 June 2013**
- **The 24h rainfall totals exceeded locally 100mm (accumulated from 6 UTC 1 June 2013)**
- **BlendVar assimilation improves precipitation pattern**

BlendVar flood case study 4

- FSS [Roberts and Lean, 2008] of BlendVar and reference for three thresholds (20, 40, 60 mm/24h). Forecast started at 06:00 UTC 1. 6. 2013.
- BlendVar is better of all tested thresholds



BlendVar X 3D-Var, flood case study 1

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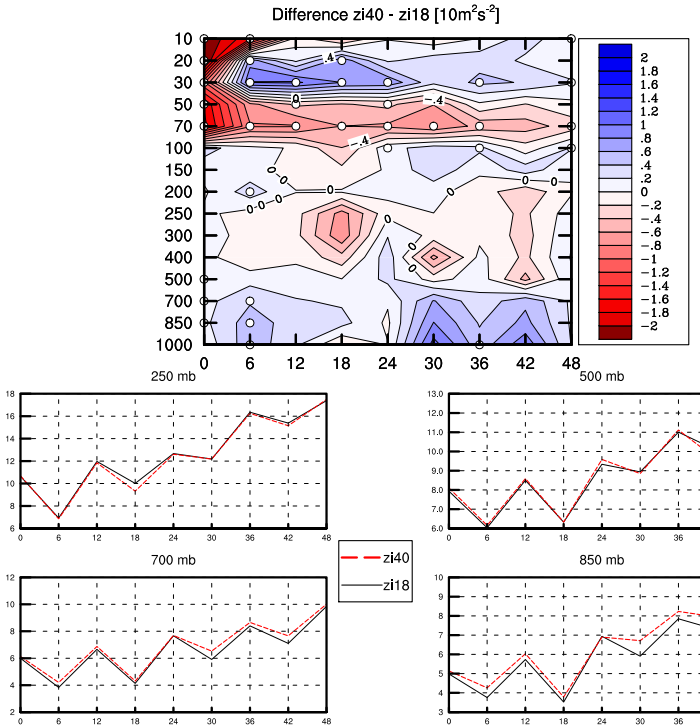
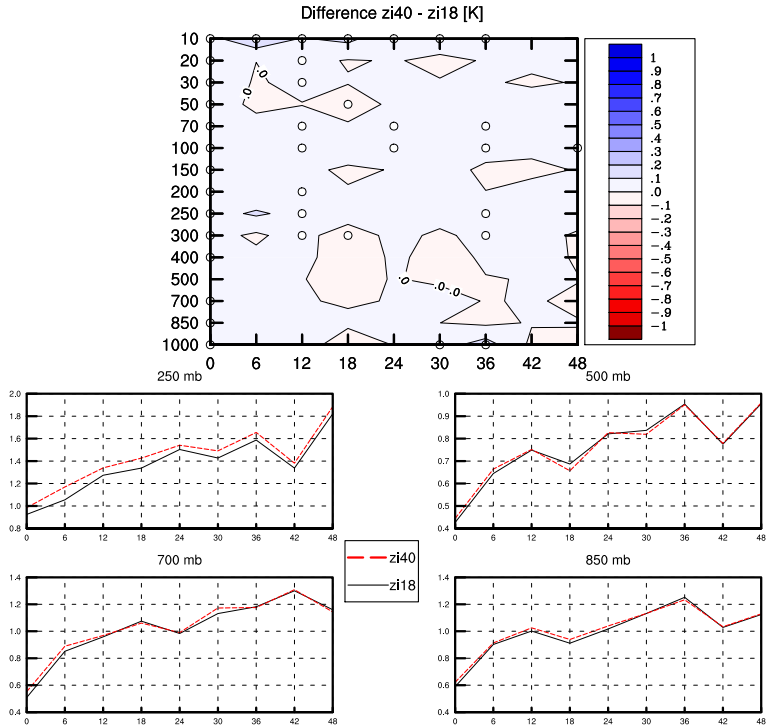
- **RMSE**

(a) Geopotential



(b) Temperature



RMSE of 3D-Var (zi40) compared to BlendVar (zi18), 00UTC runs. Verification was done against TEMP observations. Small circles show statistically significant difference. **Blue** denotes better score for BlendVar.

BlendVar X 3D-Var, flood case study 2

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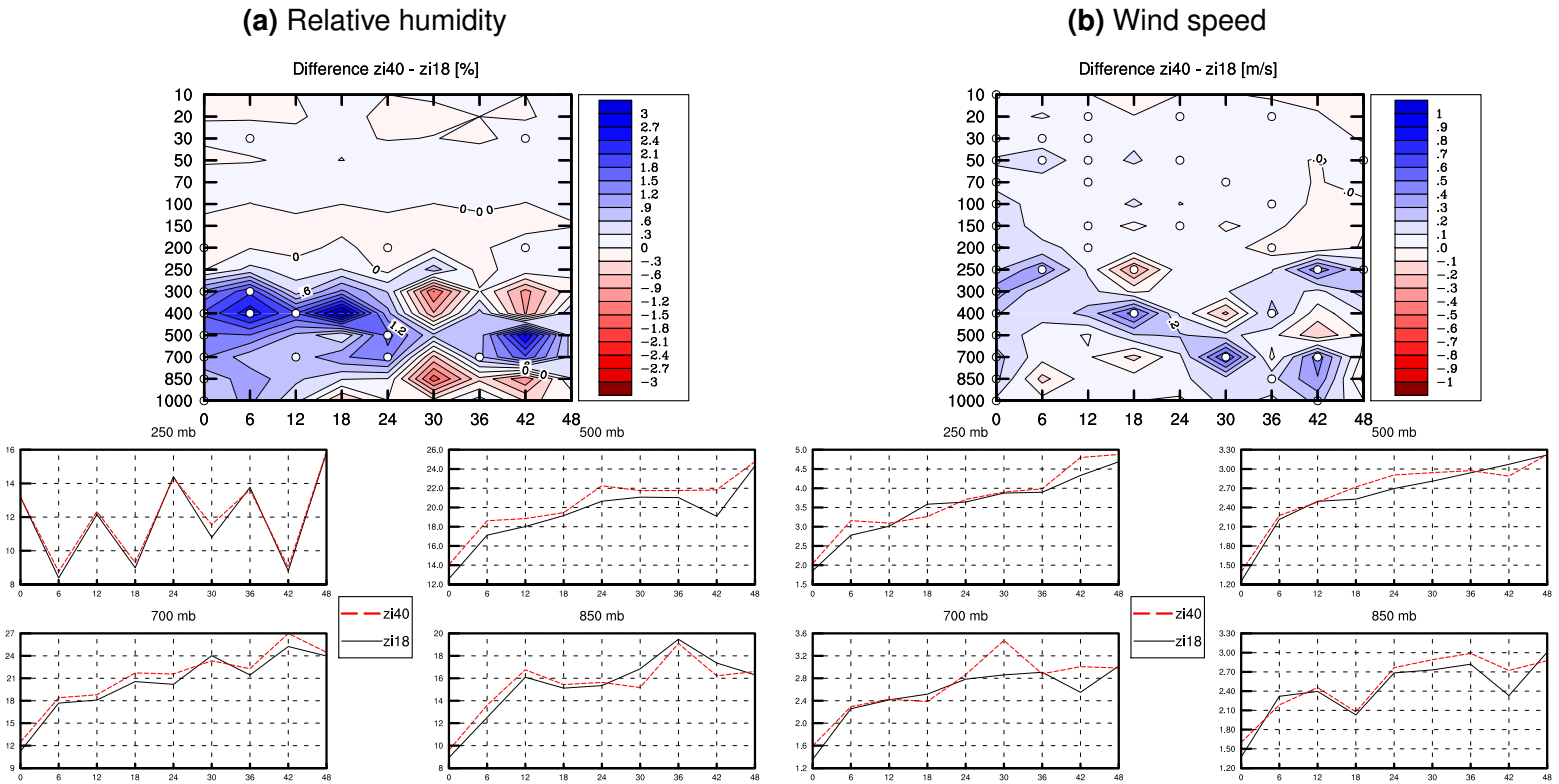
- **RMSE**



RMSE of 3D-Var (zi40) compared to BlendVar (zi18), 00UTC runs. Verification was done against TEMP observations. Small circles show statistically significant difference. **Blue** denotes better score for BlendVar.

BlendVar X 3D-Var, flood case study 3

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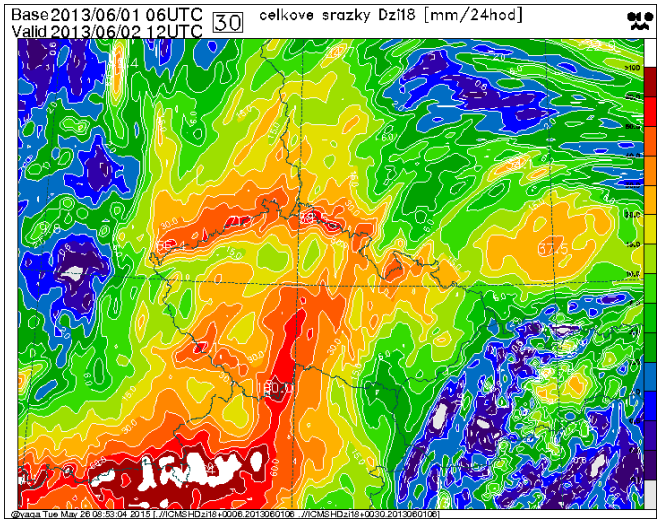
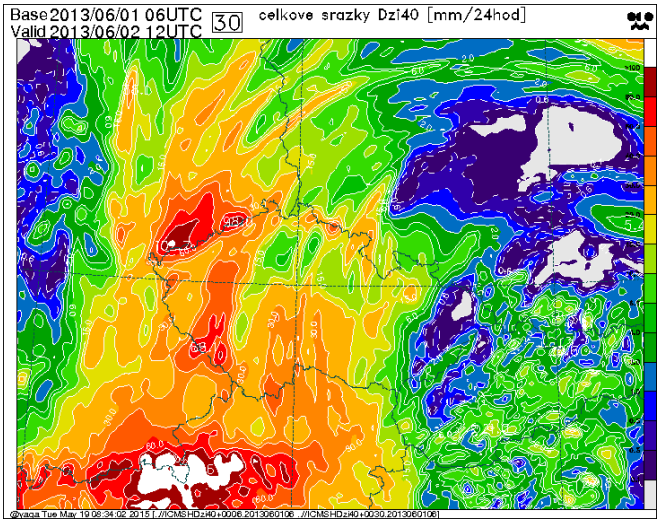
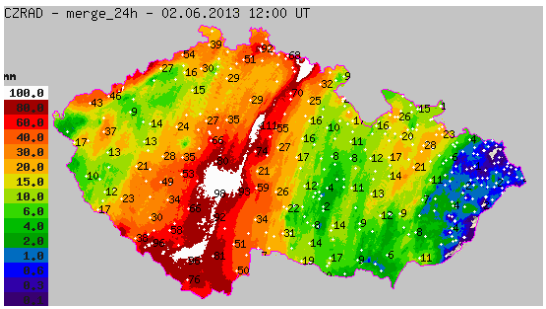
(a) BlendVar



(b) 3D-Var



(c) Radar



- **3D-Var itself was not able to locate precipitation band correctly**

BlendVar performance 1

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- BlendVar tested in parallel suite AKC over the period 25. 6. – 20. 8. 2015.
- BlendVar showed significant improvement in fit of analyses to assimilated observations. Impact on forecasts was smaller, but mostly positive.
- Subjective comparison of precipitations over the Czech Republic favor the BlendVar configuration although the differences against reference were very small during the examined period. Setup of parallel suite AKC became operational on 20. 8. 2015 at 12 UTC.

BlendVar performance 2

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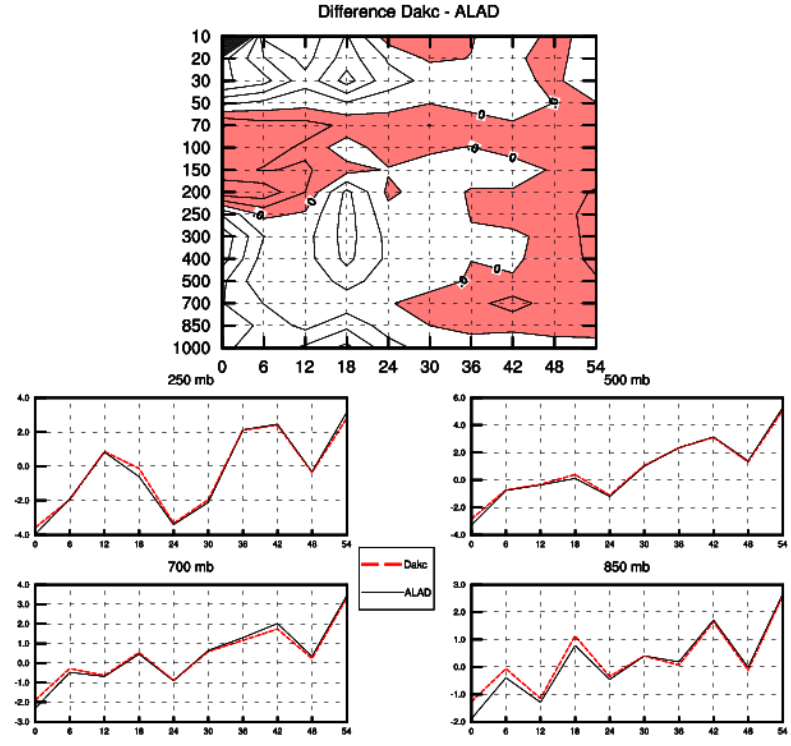
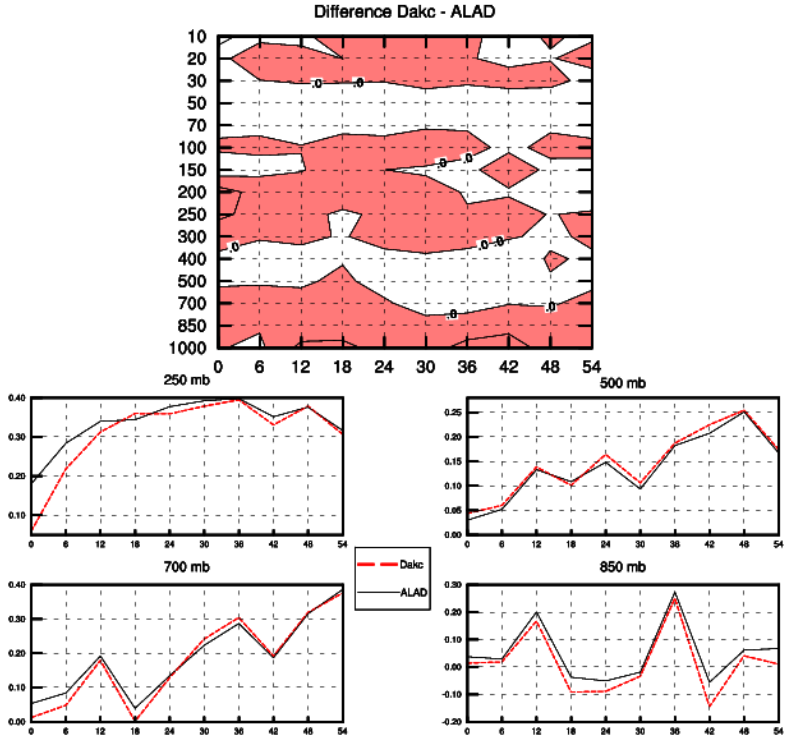
BIAS

(a) Geopotencial $[m^2/s^2]$



(b) Temperature [K]



BlendVar (Dakc) - Reference (former operational setup, ALAD), 00UTC runs

BlendVar performance 3

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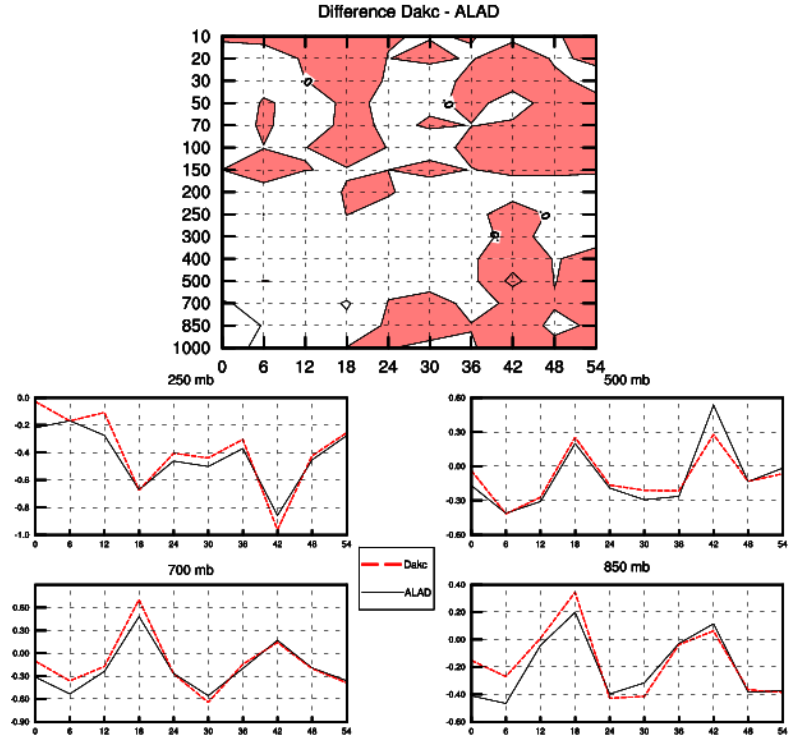
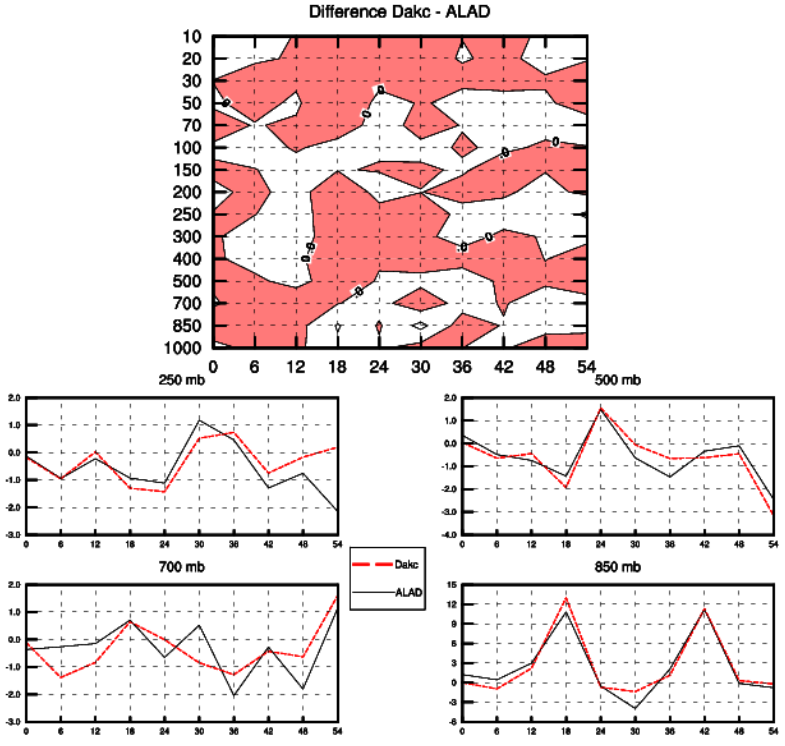
BIAS

(a) Wind speed [m/s]



(b) Wind direction [°]



BlendVar (Dakc) - Reference (former operational setup, ALAD), 00UTC runs

BlendVar performance 4

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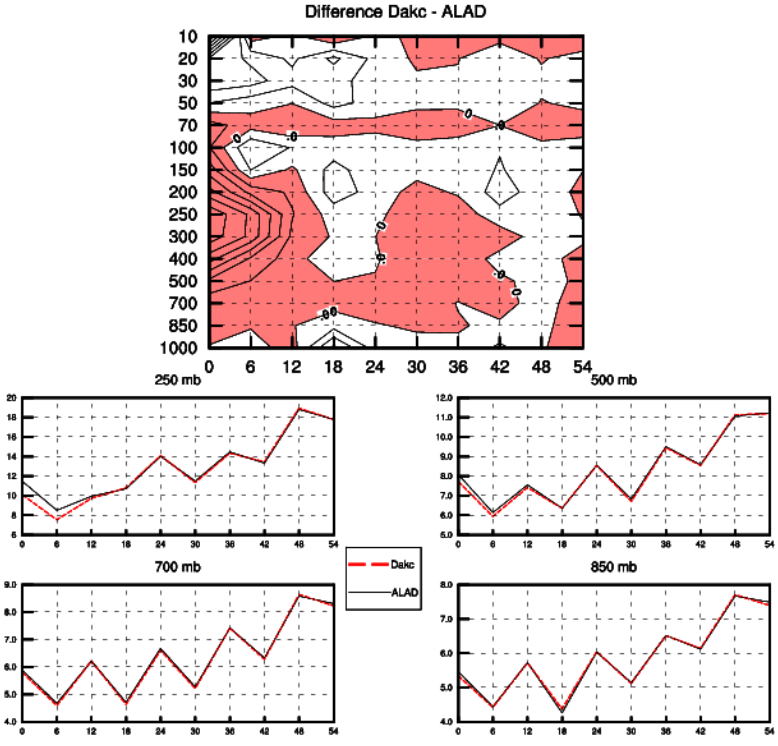
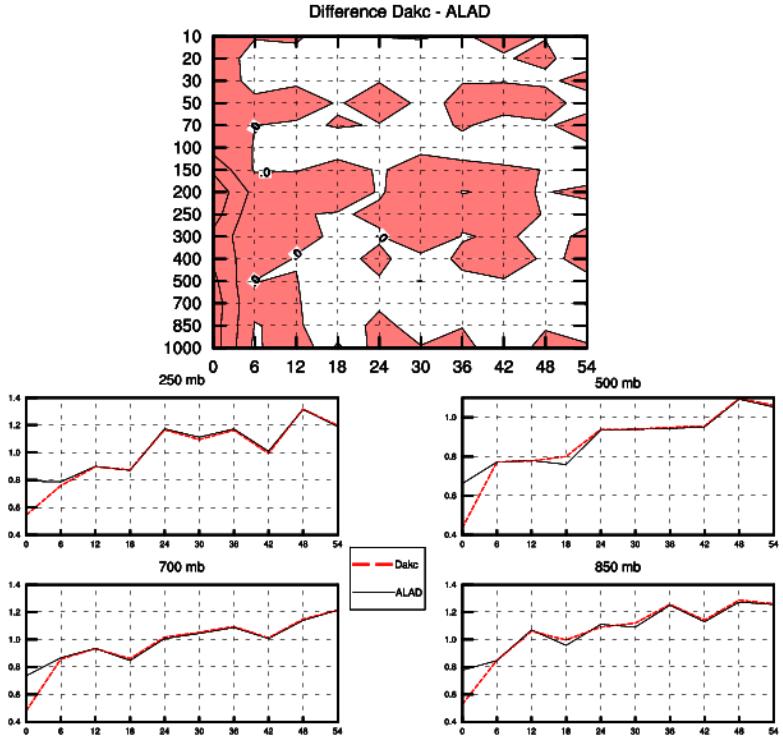
RMSE

(a) Geopotencial $[m^2/s^2]$



(b) Temperature [K]



BlendVar (Dakc) - Reference (former operational setup, ALAD), 00UTC runs

BlendVar performance 5

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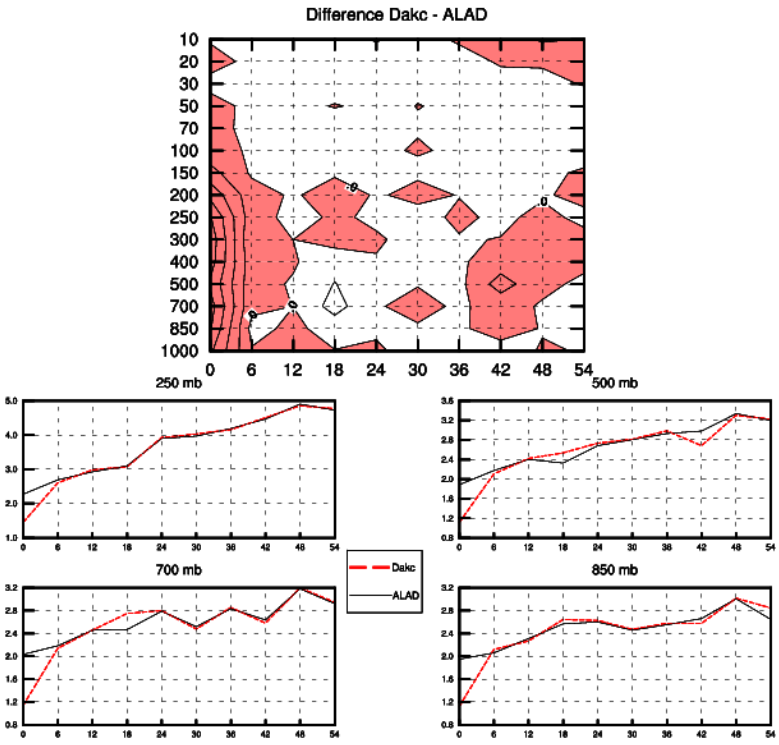
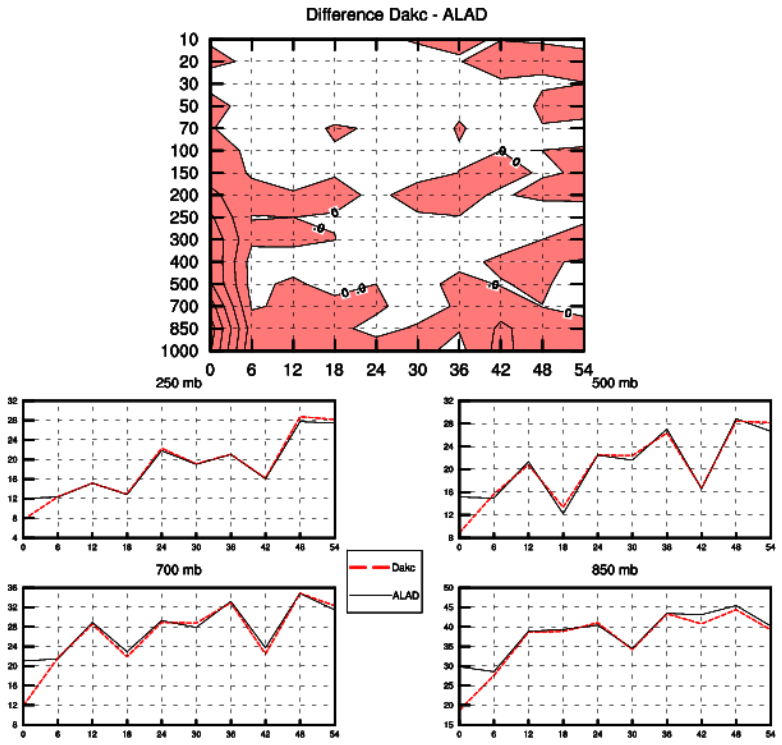
RMSE

(a) Wind speed [m/s]



(b) Wind direction [°]



BlendVar (Dakc) - Reference (former operational setup, ALAD), 00UTC runs

Mate's questionnaire

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- **What is(are) the main purpose(s) of doing DA at your institute?**
  To improve the initial conditions and ensuing high resolution forecast.
  To get the high resolution analysis for the purposes of nowcasting, for example, or other (validations).

- **What will be the main goal(s) regarding DA(or even NWP through DA) at your institute in the next few year?**
  We have now the BlendVAR system operational. We could demonstrate that BlendVAR is superior to Blending and also to 3DVAR alone. We wish to further improve this system by a more adapted B matrix.
  We would like to include more observations – for example MODE-S, more satellite data, windprofilers, perhaps GNSS, and to profit from their temporal density via a combination of a more frequent updates with BlendVAR.

- **Doing research or doing operational DA activities has higher priority in your institute?**
  It has the same priority like model developments to maintain the balance, since it goes together.

- **Where do You think LACE collaboration can help your local DA work most efficiently?**
  Clearly by working together on research topics, let us name the work on MODE-S data.
  OPLACE is also an essential part of the system.

Thank You for Your attention !

References

M. Belluš. Time consistent versus space consistent coupling and the revision of the ensemble of surface data assimilations by canari in aladin/laef. Technical report, stay at ZAMG, 2013. http://www.rclace.eu/File/Predictability/2013/Report_ZAMG_2013_mbell.pdf.

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Nigel M Roberts and Humphrey W Lean. Scale-selective verification of rainfall accumulations from high-resolution forecasts of convective events. *Monthly Weather Review*, 136(1):78–97, 2008.

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