Regional Cooperation for
Limited Area Modeling in Central Europe

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Status of data assimilation at CHMI

DAWD 21.–23. 9. 2016

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DHMZ SHMU OMSZ ZAMG ROMANIA ANM

Operational Setup

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- **ALARO-1, CY38T1_op5**
- **$\triangle x$ ~4.7km, 529x421 grid points, linear truncation E269x215,**
- **87 vertical levels, mean orography, time step 180s, 3h coupling interval,**
- **surface analysis based on OI of SYNOP (T2m, RH2m)**
- **BlendVar for upper air fields (DF Blending E87x69 followed by 3D-Var)**
  - **space consistent coupling**
  - **no DFI for long cut-off 6h cycle**
  - **incremental DFI init. for short cut-off production analysis**
- **production 4 times a day (00 06 12 18 UTC) up to +72h/54h**
- **see Bučánek et al. [2015]**

Progress since last DAWD

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- **Preparatory work for SYNOP and TEMP BUFR data handling**

  Alena worked on GTS SYNOP BUFR data processing. A draft of the ”BBB” (addition/amendment/correction) messages handling was prepared and a detailed validation of BATOR BUFR data handling is in progress. It is a big change of the obs processing chain, which requires detailed validations and further developments, e.g. Tmin/Tmax are not yet supported by the BATOR and they are required by CHMI applications.

- **Assimilation of Mode-S observations in ALADIN/CHMI Trojáková et al. [2015]**

  MRAR - direct obs of wind, temp; quality similar to AMDAR; slight positive impact against independent MRAR observation

  EHS - indirect obs; more biased, RMS 4 times larger than MRAR; not tested in assimilation

- **DA-system tuning for satellite and aircraft data - Patrik’s talk**

  optimal data thinning distance for AMSU-A, MHS, SEVIRI, AMDAR and MRAR and observation error setting

Progress since last DAWD 2

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- New hourly analysis tool VarCanPack replacing Diagpack (operational).
- Updated Veral CY38
- LDIRCLSMOD - update, introducing v10m from guess
- LNEIGE - proper humidity setting
- LSPRT == FALSE for 3D-Var !!!

VarCanPack 1

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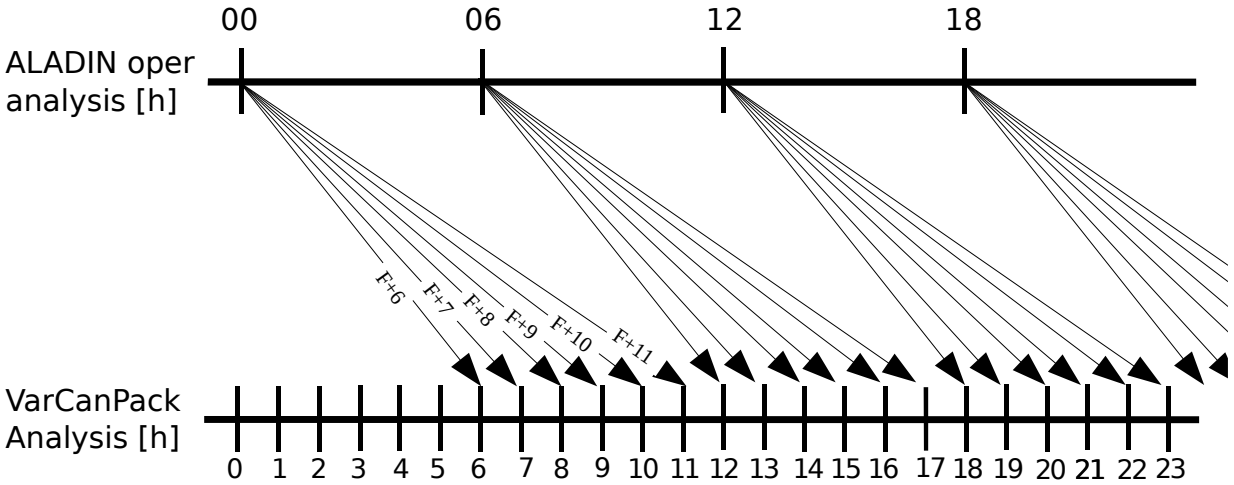
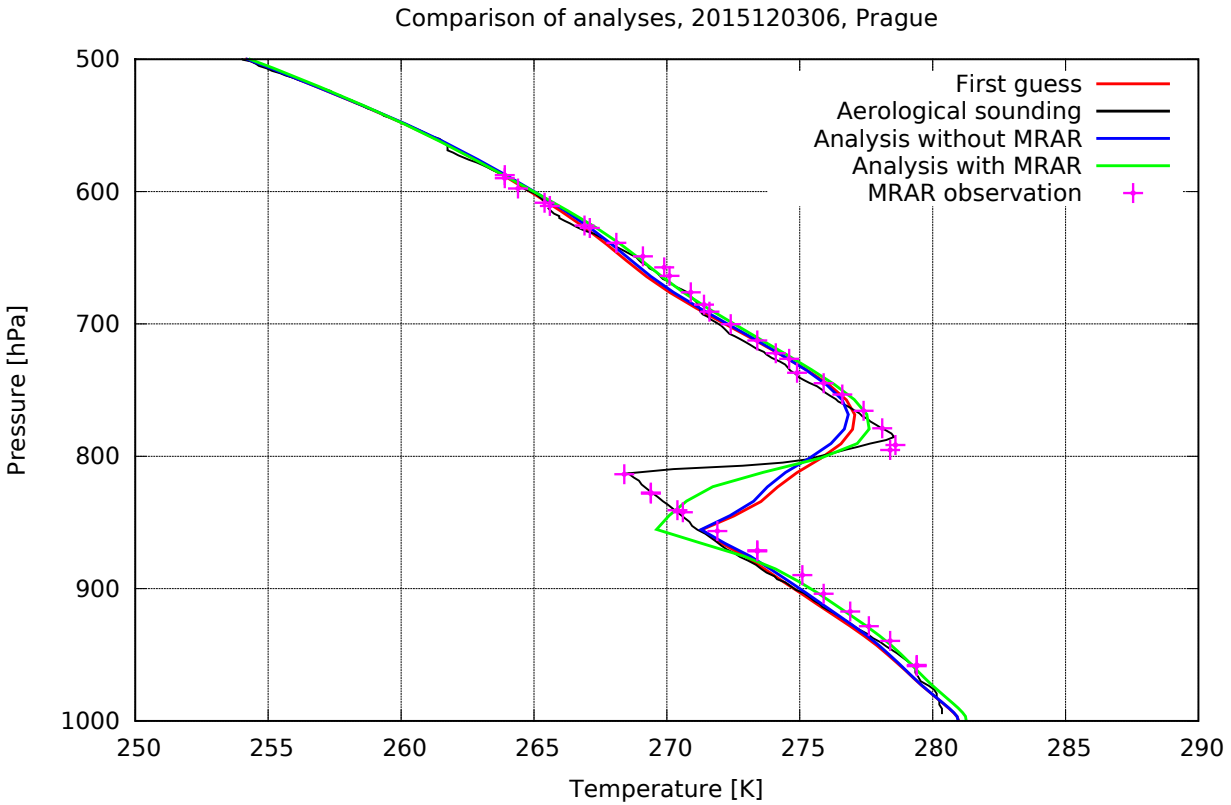
- **VarCanPack consists of 3D-Var for upper-air and Canari for screen level.**
  In our configuration they run serially (3D-Var then Canari) but it could run in parallel since they do not depend on each other
- **3D-Var setup is exactly the same as in production**
- **Canari is analyzing T2m, Rh2m, W10m. Setup is very close to diagpack. Guess fields of T2m, Rh2m and W10m are used and not diagnosed! (LDIRCLSMOD==TRUE)**
- **Starts at 18th minute every hour**
  The aim is to have analysis not more than 30 minutes after its validity time and to preserve all the functionality of Diagpack.
- **Observations (Synop, Temp, Amdar, MRAR, AMV, Seviri)**
- **Diagnostics of wind gust and mocon moved from morgane (1st) to full-pos in order to save time**
  code modification were necessary

VarCanPack 2

- **The diagnostic analyses are using as first guess the operational forecast of the ALADIN/CHMI model for different lead times, this is denoted by F+n hour forecast in the figure.**



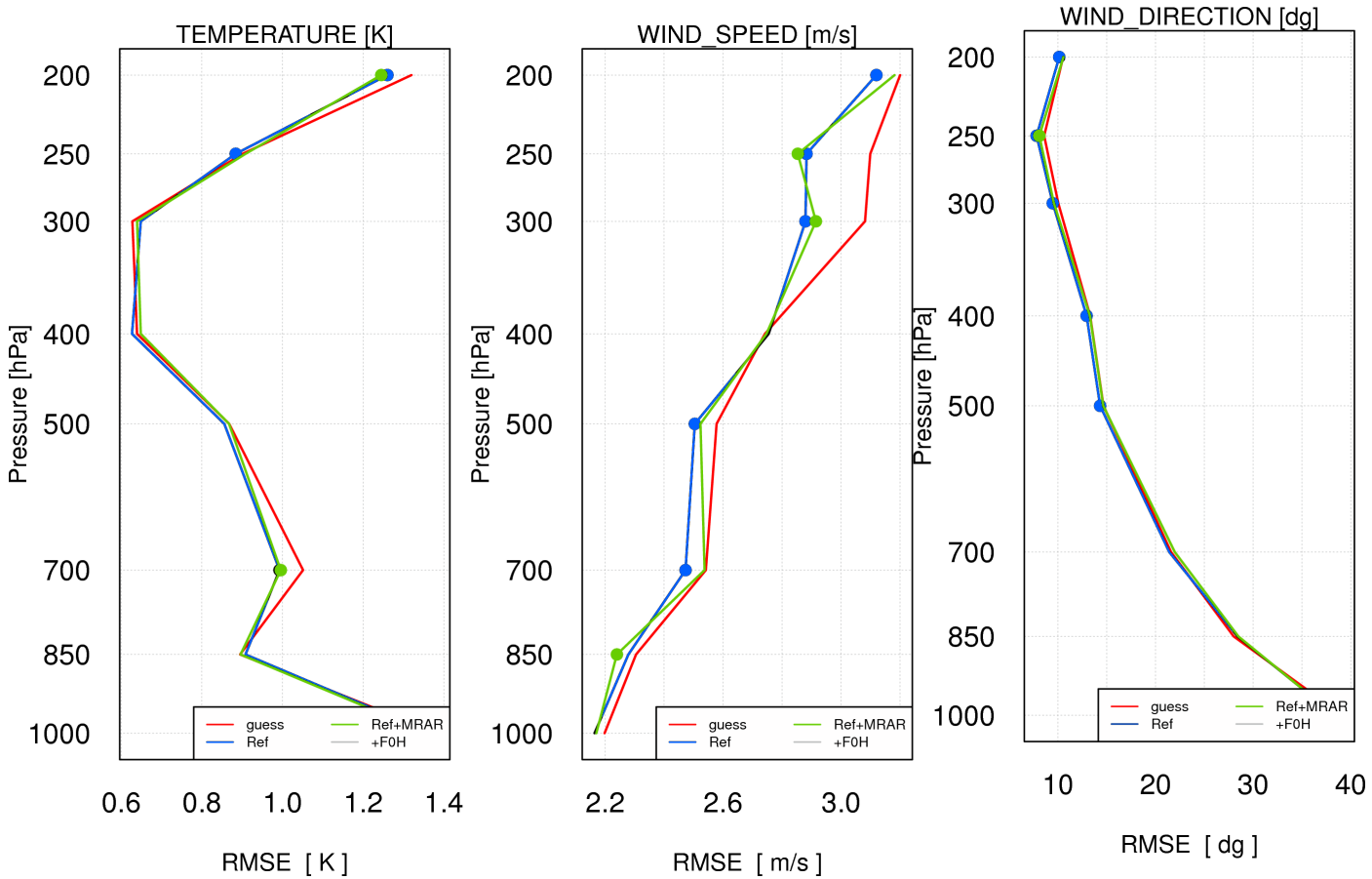
VarCanPack 3 - Results



A temperature inversion was observed over Prague on 3 December 2015 at 06 UTC. Aerological sounding is not available when analysis production starts and sounding data are used as reference. Only other source of vertically dense observations are aircraft measurements. The first guess (red line) captured the inversion already quite well, whereas the analysis already assimilating AMDAR observations did not improve description of the inversion (blue line), the analysis assimilating MRAR observations (green line) is much closer to the aerological sounding (black line) and MRAR observations (pink crosses)

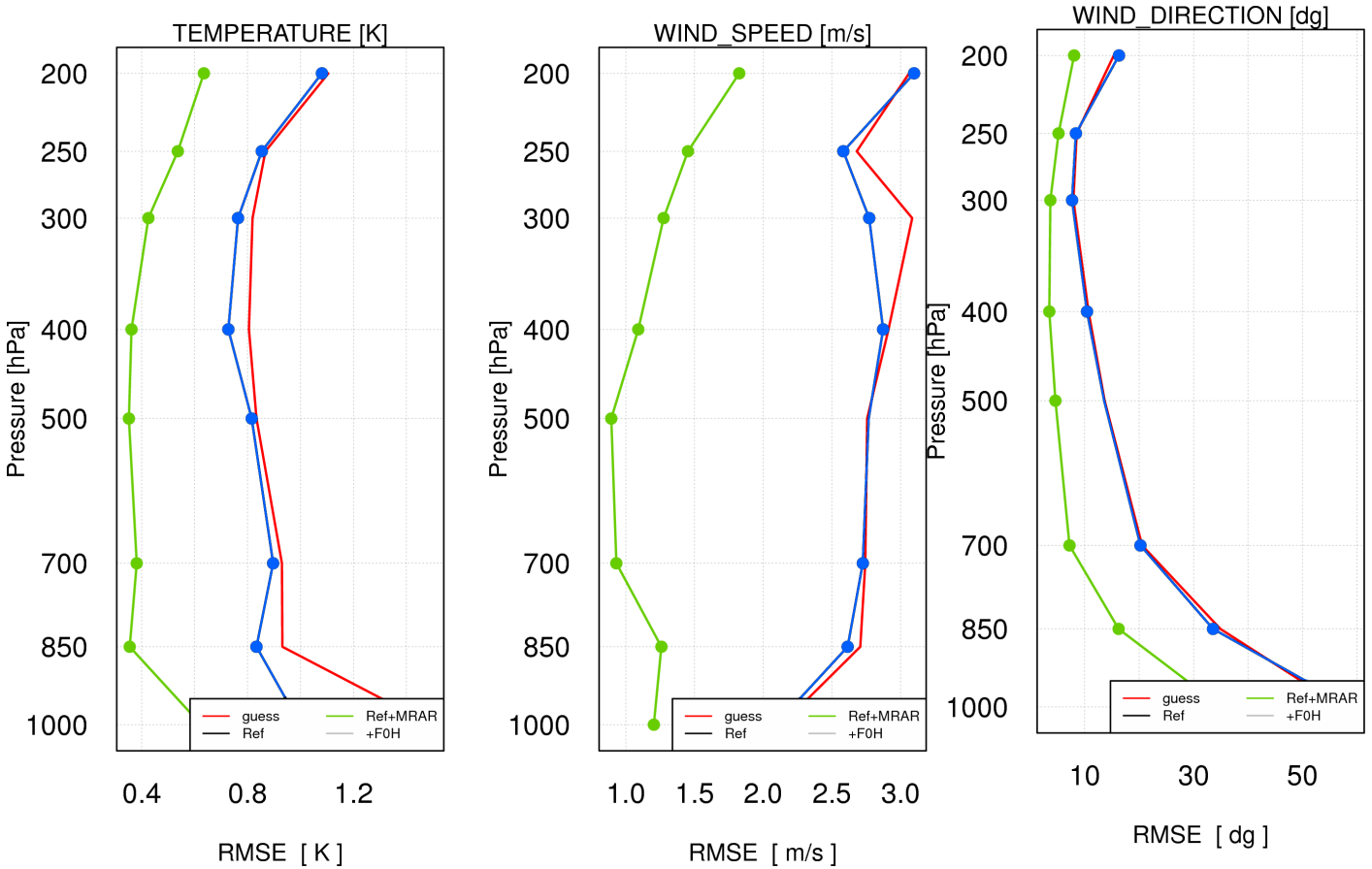
VarCanPack 4 - Results

- **RMSE against TEMP, guess (red), VarCanPack without MRAR (blue), VarCanPack with MRAR (green)**



VarCanPack 5 - Results

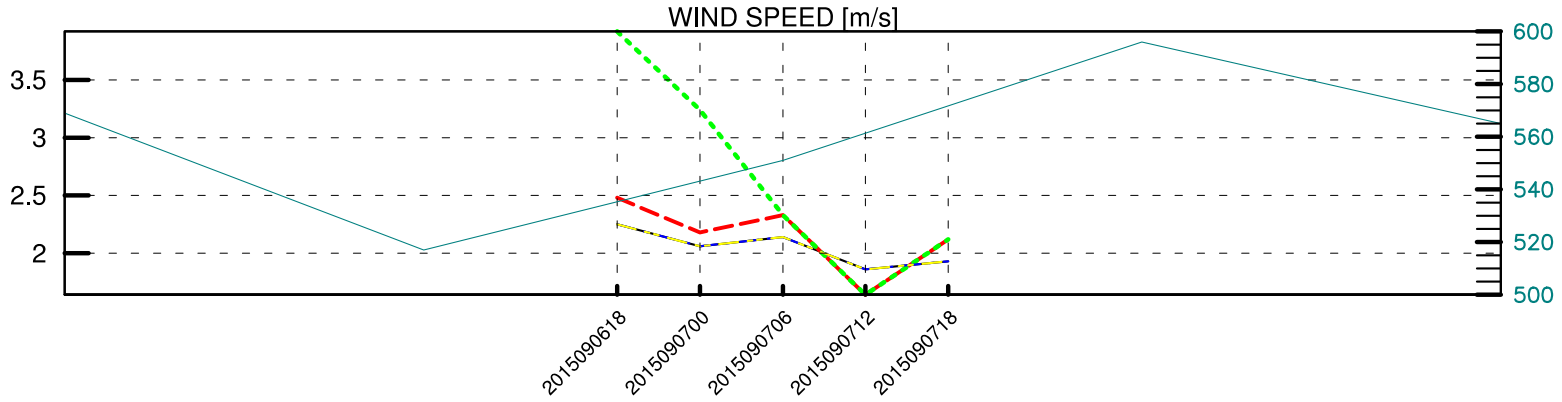
- **RMSE against MRAR, guess (red), VarCanPack without MRAR (blue), VarCanPack with MRAR (green)**



Veral cy38

- **All screen level parameters are read from guess (T2m, Rh2m, W10m) which allows for verification of new diagnostic schemes**

  green= v38 new diag., red= v38 old diag., yellow/blue = v36 new/old diag.



- **Due to dissemination of BUFR and stop of SYNOP we miss more and more observations, Germany is missed completely in CHMI databases**
- **Oplace observations are covering our needs only partly (missing min/max temperatures and precipitation)**

LDIRCLSMOD

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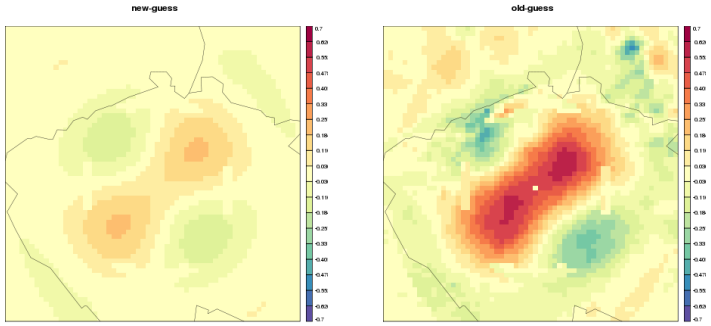
- We were expecting that also u10m, v10m are read from the guess when LDIRCLSMOD=T but they are diagnosed by ACHMT routine in analysis step.
- Instead of verifying u10m and v10m we were verifying last model level processed by diagnostics
- During modification two problems were spotted:
  - Vectorization in cacova.F90 for our platform = zero increments in observation location when obs sits on model grid.
  - Misbehaving of obs operator for v10m $=>$ too large increments in points where last model level is less than 10m (Not fixed, not a problem when LDIRCLSMOD=T)

LDIRCLSMOD 2

- **Zoom of zonal wind increments, left analysis increments of the new code, right analysis increments of operational version**

- **Zoom of meridional wind increments, left analysis increments of the new code, right analysis increments of operational version**



LDIRCLSMOD 3

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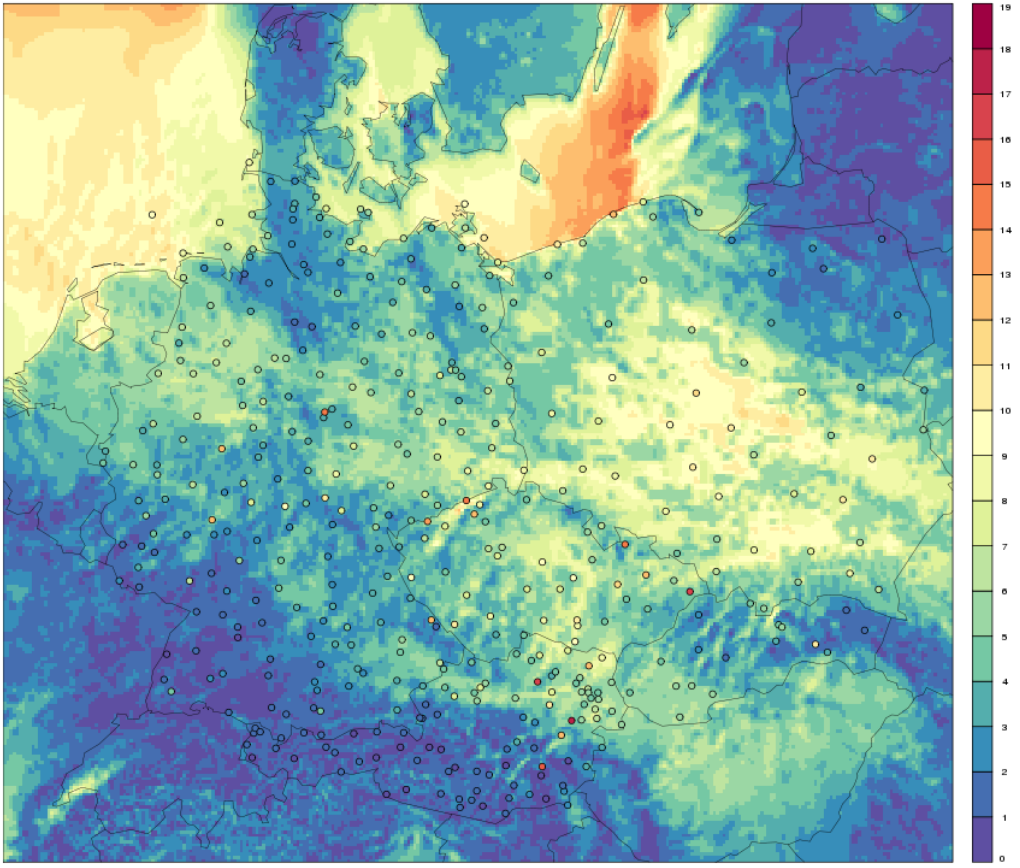
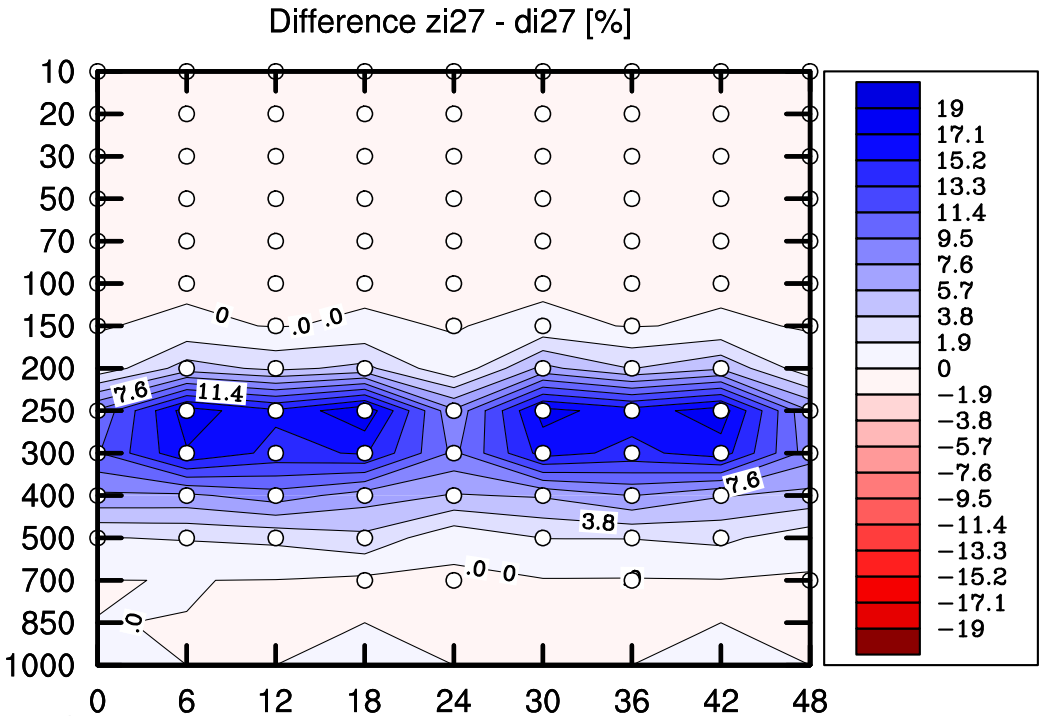
- **Wind speed, left – guess overlaid by colored circles of odb reproduced first guess values from old exe, right – guess overlaid by colored circles of odb reproduced first guess values new exe**



LNEIGE

- When LNEIGE=.F. saturation against water is expected only
- The formula using saturation against water is similar to one WMO proposes for measuring humidity by radiosondes
- RMSE when LNEIGE=T/F, Blue color indicates improvement.



LSPRT

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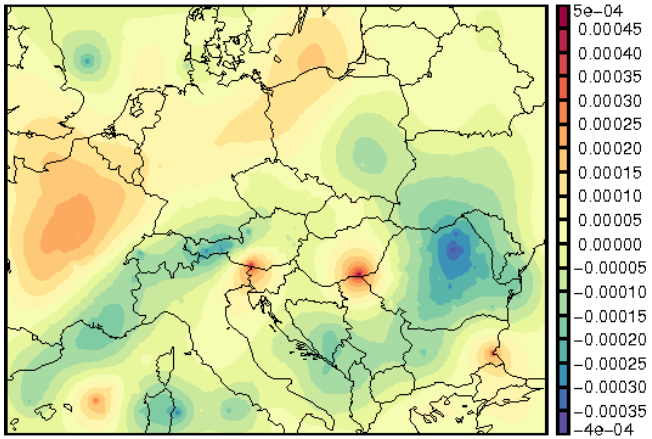
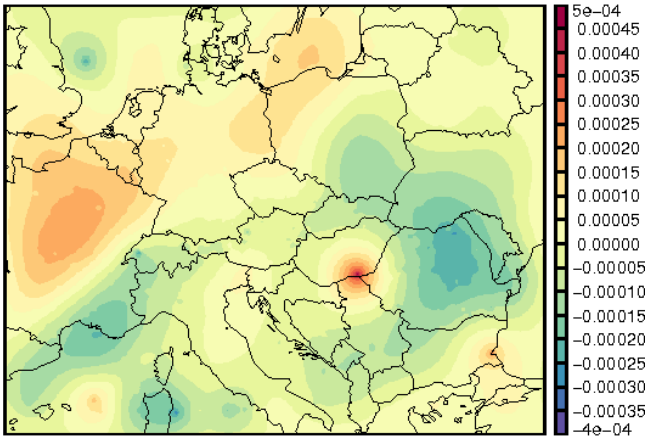
- LSPRT=T option seems to be bugged for ALADIN/ALARO configurations (using spectral humidity) and it is suggested to set LSPRT=F in the 3DVAR configurations.
- in B matrix derivation forecast differences with LSPRT=F should be used so that temperature differences (instead of Tv differences) are written in intermediate files and the covariance of T are computed!
- LSPRT switch is important for precise computation of pressure gradient term also in presence of cloud and falling precipitation species and it's impact for assimilation configuration is probably negligible (Radmila)

Analysis increment LSPRT=T
S074HUMI.SPECIFI
2015/09/01 z00:00 Uninitialized



Analysis increment LSPRT=F
S074HUMI.SPECIFI
2015/09/01 z00:00 Uninitialized



LSPRT 2

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- **For AROME Pierre Brousseau mentioned: "We use LSPRT=.T. in AROME 3D-Var but the control variable is T and not Tv, this is why we need to estimate covariance of T using LSPRT=.F. in femars.**

- **The problem with LSPRT=.T. in the 3D-Var is that at the beginning of the run, T is read from the background and changed in Tv= R.T in the model state. Then the model state (T) is transformed into the control variable (T) : this changes are done with R estimated using qv, ql, qi ,qr, qc, qs (all AROME hydrometeors). At the end of the run, when the control variable is converted to the model state, T is converted to Tv, and when the field is written in the analysis file, Tv is converted again in T. For this second to last change, in the incremental data flow, only the qv is available to estimate the air constant R used to transform T into Tv and then this transformation is not the bijection of the first ones : the main impact is that the precipitation fields have an effect on the analysis increment : you can guess the precipitation pattern in the T increment of a single observation for instance.**

- **To avoid this problem in the AROME 3D-Var we do not read the hydrometeors (NREQUIN=0 in NAMGFL) in the minimization step."**

Thank You for Your attention !

References

A. Bučánek, A. Trojáková, and P. Benáček. Operational implementation of blendvar scheme at chmi. Technical report, CHMI, 2015. http://www.rclace.eu/File/Data_Assimilation/reports/Bucanek_BlendVar_implementation_2015.pdf.

A. Trojáková, P. Benáček, R. Brožková, and A. Bučánek. Assimilation of mode-s observations in aladin/chmi. Technical report, CHMI, 2015. http://www.rclace.eu/File/Data_Assimilation/2015/rep_Mode_S_201512.pdf.