Regional Cooperation for
Limited Area Modeling in Central Europe

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Data assimilation activities at CHMI

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Progress summary since last DAWD

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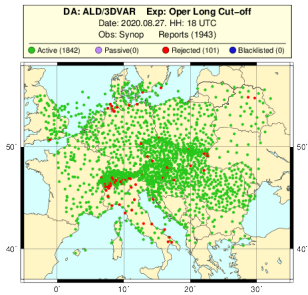
- **Background error covariances recomputed with Ensemble Data Assimilation method with perturbed observations in collaboration with Wafa Khalfaoui (2019)**

  - **The structure functions length scales were retuned and representative LACE national SYNOP data from (Central Europe: AT, CR, CZ, HU, PL, RO, SI, SK) were implemented in surface analysis (CANARI).**



- **Use of existing observations was extended by:**
  - **wind profiler data: selected sites added based on quality assessment,**
  - **High-resolution AMV (HR-AMV) replaced standard AMV product,**
  - **ocean winds (ASCAT) added to active DA.**

- **Assimilation of OPERA radar data was investigated:**
  - **ALARO test of radar observation operator - Alena's talk**
  - **processing of radar reflectivities in screening - Antonin's talk**
  - **first trials with radial wind data assimilation - Katarina's talk**

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Operational Setup at CHMI

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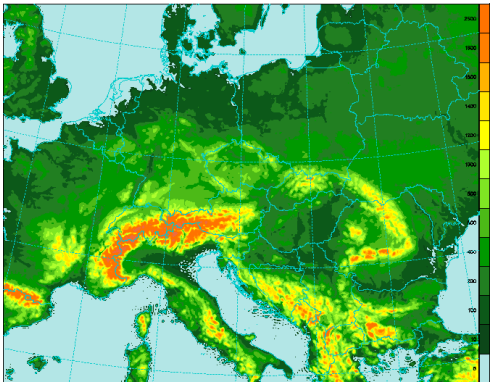

- ALARO NH-v1B cy43t2pt_op1:
  - domain: △x 2.3km, 1069x853GP, time step 90s
  - 87 vertical levels, mean orography
  - 3h space consistency coupling ARPEGE synchronous
  - forecasts up to +72/+54h at 00, 06, 12 and 18 UTC
  - weak IDFI of short cut-off production analysis
- Upper air analysis – BlendVar scheme
  - BlendVar = DF Blending (filter. at trunc. E102x81) followed by 3D-Var
  - 6h assim cycle, no IDFI in the next +6h assim guess
  - REDNMC=0.5, Ensemble Data Assimilation B matrix based on AEARP
  - ±1.5h assim window, VARBC 24h cycling
  - Assimilated observations: SYNOP (Ps), TEMP (t, q, u, v), AMDAR (t, u, v), SEVIRI (channels: 2, 3), Mode-S MRAR CZ / Mode-S EHS from KNMI (t, u, v) HR-AMV, wind profiler (u,v), ASCAT
  - SIGMAO_COEF=.67, SIGMAO_COEF(AMDAR)=2.8, SIGMAO_COEF(RADIANCE)=1.15
- Surface analysis – OI based on GTS SYNOP + national SYNOP (T2m, RH2m)
  - REF_A_(H2/T2)=40km

Background error covariances

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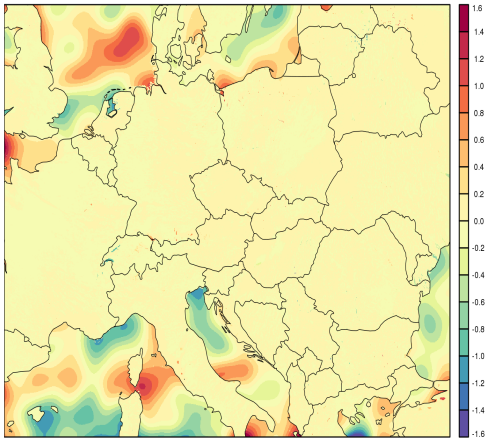
- in collaboration with Wafa Khalfaoui (2019)
- B matrix recomputed with Ensemble Data Assimilation approach Berre et al. (2006), similarly to Brousseau et al. (2011)
  - 2 periods: winter 10-24 Feb 2016 & summer 6-20 July 2016
  - 6 independent 3D-Var assimilation cycles with perturbed observations
  - all members started from the same guess
    but each member is coupled with one member of AEARP
- investigation of SST perturbation
  - almost one third of the domain covered by sea
  - suggested by Y. Michel (pertsurf.F90 43t2_op2)
  - idea is to generate random 2D white noise,
    apply smoothing by digital filter and normalization
  - perturbation radius should be adapted to $\triangle x$
    AROME EDA $\triangle x$=3.2km: radius=14km
    ALARO/CHMI $\triangle x$=2.3km: radius=10km



SST perturbation mem=5

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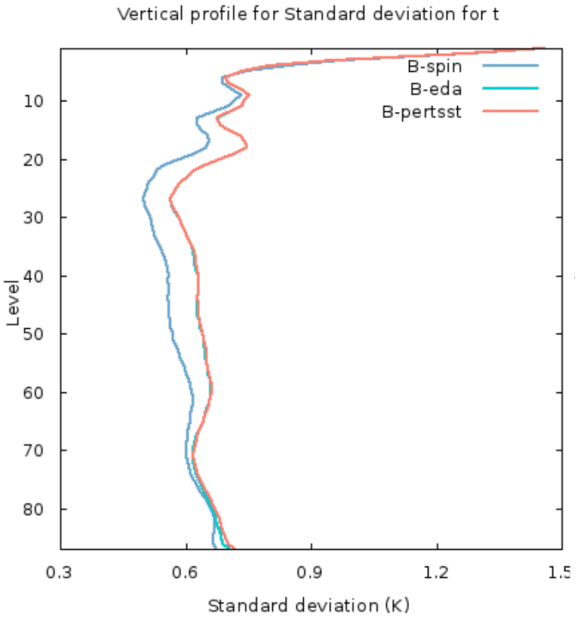
Background error covariances

- **Diagnostics of B_EDA versus B_spin**
  - similar lengthscales
  - same shape of standard deviations vert. profiles
  - larger standard deviations for B_EDA (except q)
  - horizontal variance spectra larger for B_EDA
- **Diagnostics of B_EDA versus B_EDA_SST**
  - no significant difference except small increase of T & q standard deviations near the surface



- **Impact study using B_EDA**
  - test period of 10-24 Sep 2019
  - reference (operational setup with B_spin)
  - small improvement at some levels of q and T at analysis time, neutral otherwise
- **Impact study using B_EDA_SST**
  - almost no differences between B_EDA_SST w.r.t. B_EDA on forecast scores
  - tuning of pert. radius to be considered
- **B_EDA implemented operationally in April 2020**

CANARI tuning for LACE national data

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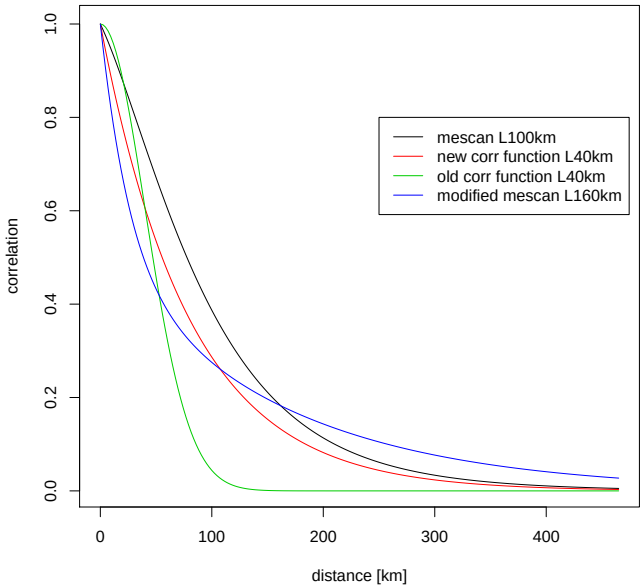
- representative LACE national SYNOP data from Central Europe selected for surface analysis via blacklist;
  - CANARI correlation functions
    - old function
    - new function
    - Mescan function
    - modified Mescan function
  - Artificial experiment designed for testing of correlation functions & different length scales
    - 6H forecast stands for ”true”
    - synthetic obs generated from ”true”
    - 12H forecast used as guess
    - CANARI analysis for 2 weeks (not cycled)

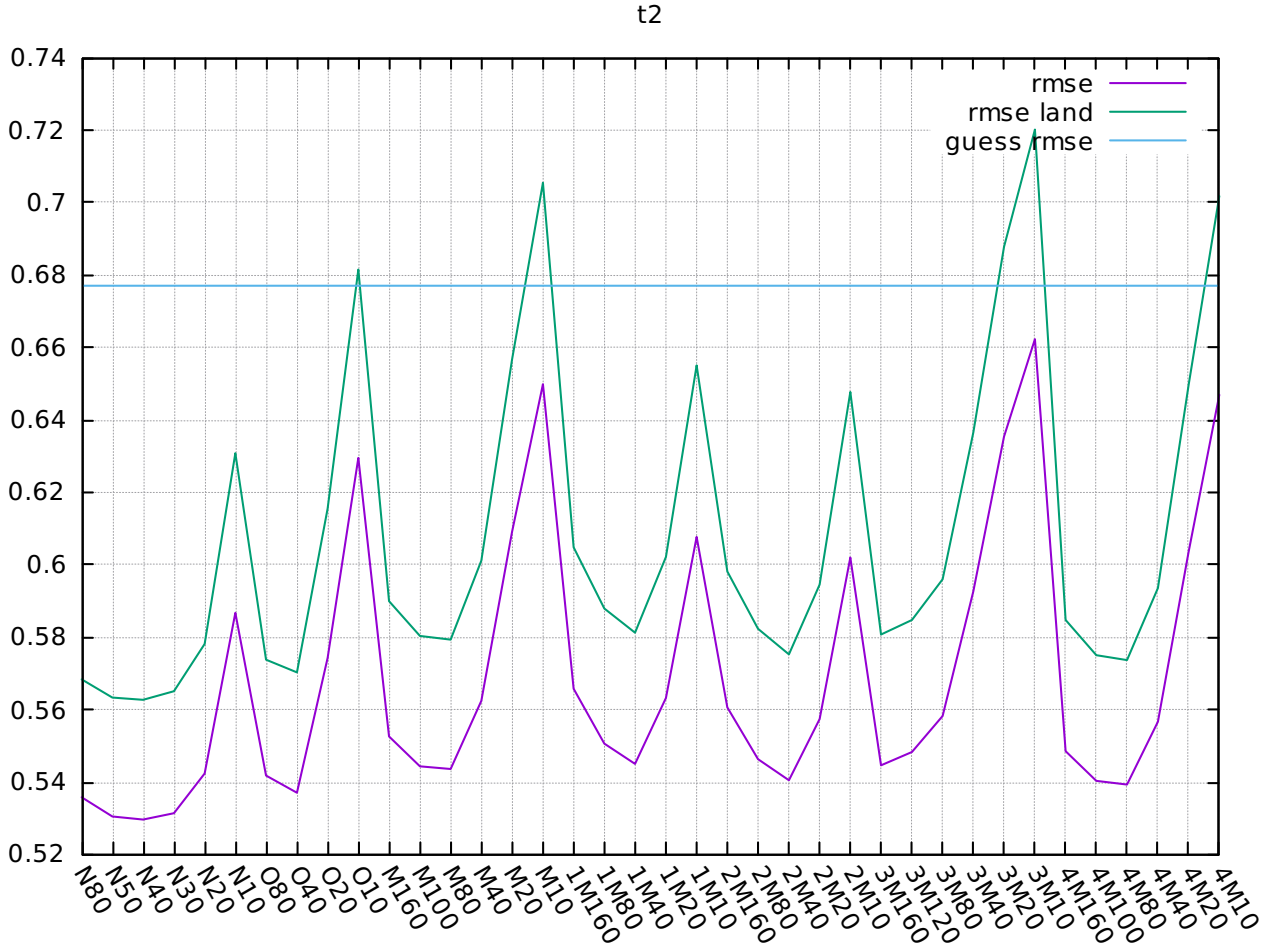
      1-14 May 2019



CANARI correlation functions

CANARI tuning for LACE national data

- **RMSE between ”truth” and T2m analysis for different correlation functions and length scales used as meassure of quality**



CANARI tuning for LACE national data

- three new setups selected for full assimilation cycle exp of 1 month (Sep 2019)
- CANARI correlation functions
  - new function with 40km [N40]
  - Mescan function with 100km [M100]
  - modified Mescan function with 100km [4M100]

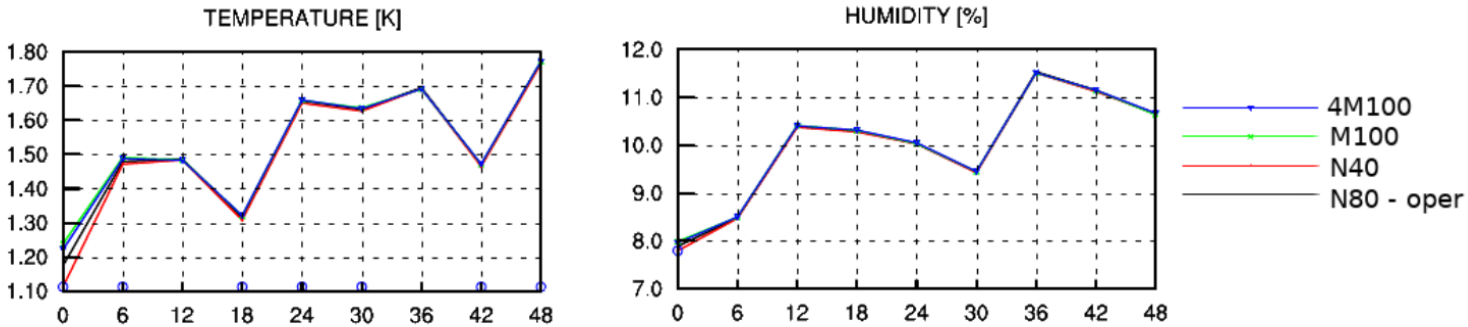


Fig 4: RMSE of T2m, RH2m for forecast up to 48h verified against GTS synop observation. The period is one month September 2019, runs from 0UTC.

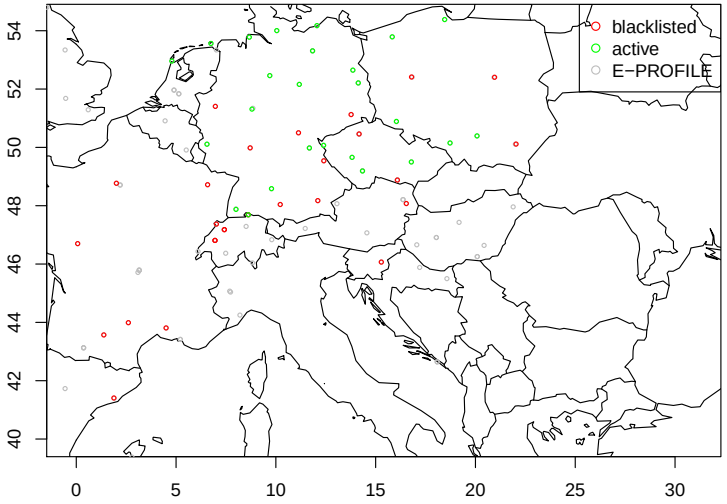
- new correlation function with length scale of 40km [N40] became operational

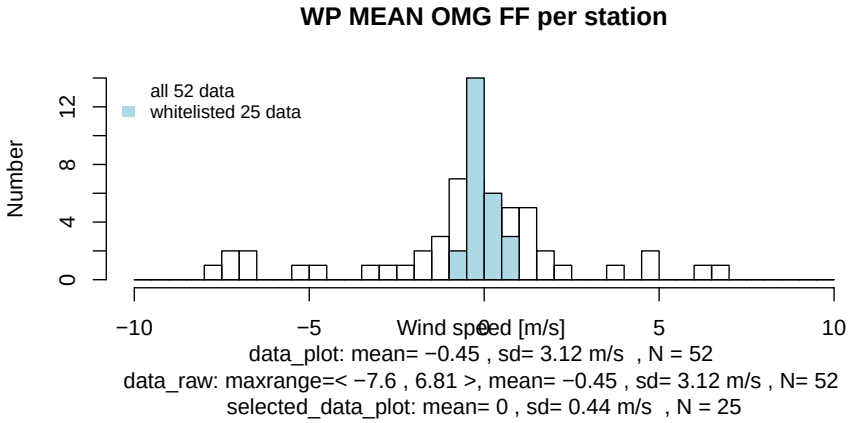
Wind profiler data

- **good measurements were selected based on 3 months statistics (March-June 2019) with respect to ALARO/CZ NWP model**
- **TEMP considered as independent observational reference for wind profiler data**

	MEAN	STDE
Wind speed	$\geq$1 m/s	$\geq$3.5 m/s
Wind direction	$\geq$2 deg	$\geq$35 deg

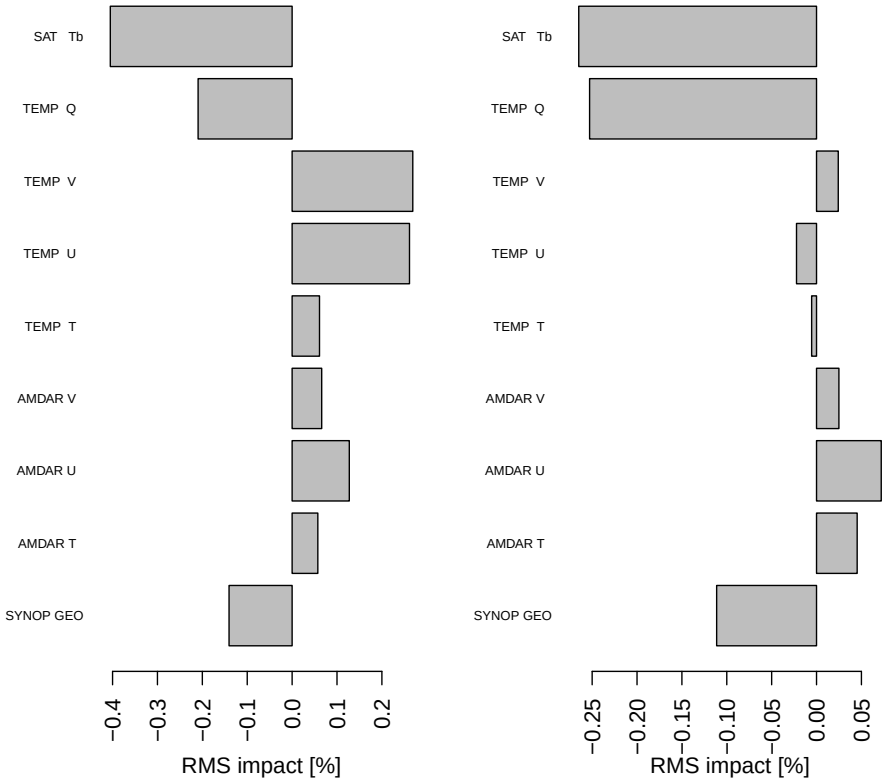
Table 1: Criteria used to blacklist wind profiler stations.





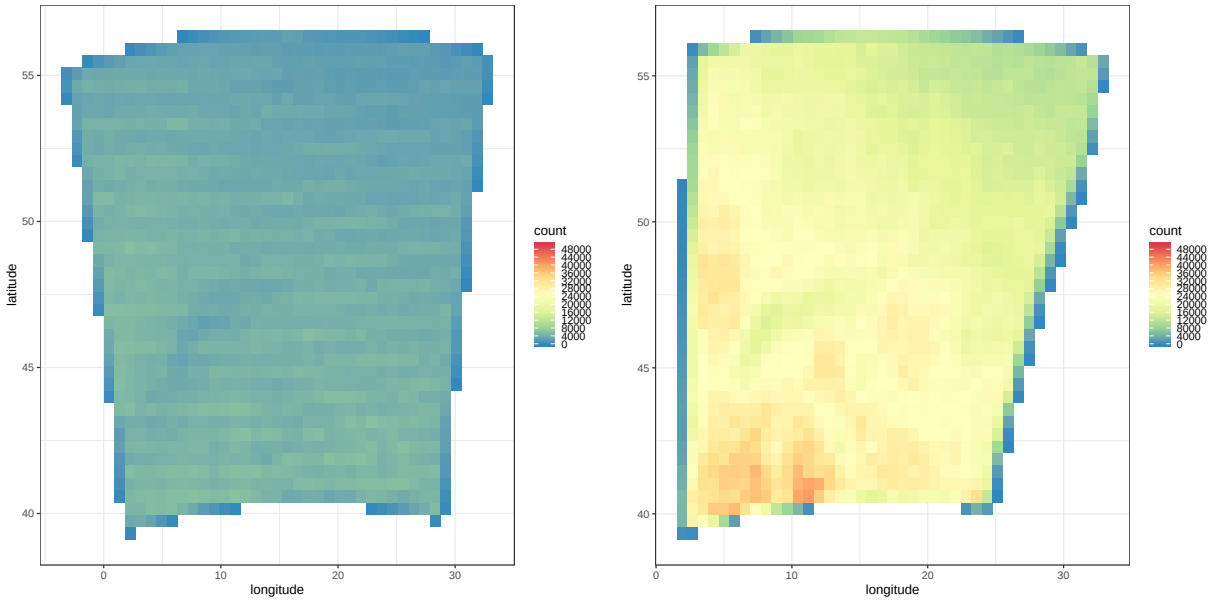
Wind profiler data

- impact study of 1 month (August 2019) showed neutral scores w.r.t. TEMP
- relative changes of RMS of OMA (left) and OMG (right) due to assimilated wind profilers



HR-AMV data

- two types of AMV derived from MSG satellite available in OPLACE.
- ”standard” AMV and ”high-resolution” AMV (HR-AMV) generated by NWC SAF at HMS



- analysis of OMG showed a larger number & better quality of HR-AMV
- impact study of 1 month (August 2019) showed neutral scores w.r.t. TEMP

ASCAT data

- due to lack of observation reference only the impact study was performed
- impact study of 1 month (August 2019) showed neutral scores
- Assimilated observations were extended by:
  - wind profiler data: selected sites added based on quality assessment,
  - High-resolution AMV (HR-AMV) replaced standard AMV product,
  - ocean winds (ASCAT) added to active DA.

Future Plans

- **Increase BlendVar cycling frequency from 6h to 3h**
- **Extend use of existing observations:**
  - **radar data**
  - **radiances from polar satellites, eventually GNSS data.**

End

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Thank you for your attention !

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References

L. Berre, E. S. Ştefănescu, and M. B. Pereira. The representation of the analysis effect in three error simulation techniques. *Tellus A*, 58(2):196–209, 2006.

Pierre Brousseau, Loïk Berre, François Bouttier, and Gérald Desroziers. Background-error covariances for a convective-scale data-assimilation system: AROME–France 3D-Var. *Quarterly Journal of the Royal Meteorological Society*, 137(655):409–422, 2011. doi: 10.1002/qj.750. URL `https://rmets.onlinelibrary.wiley.com/doi/abs/10.1002/qj.750`.

Wafa Khalfaoui. Optimization of blendvar at 2.3km. Technical report, CHMI, 2019. `http://www.rclace.eu/File/Data_Assimilation/2019/WafaKhalfaoui_2019.pdf`.