LACE
nwp central europe

Highlights of latest LACE data assimilation activities

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DHMZ SHMU OMSZ ZAMG ROMANIA ANM

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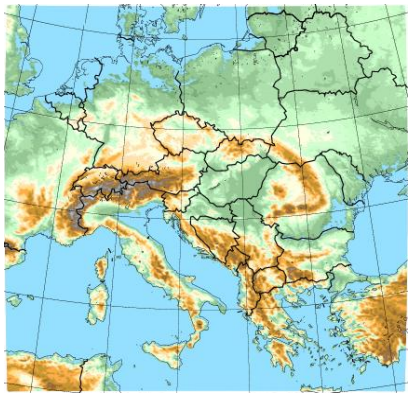
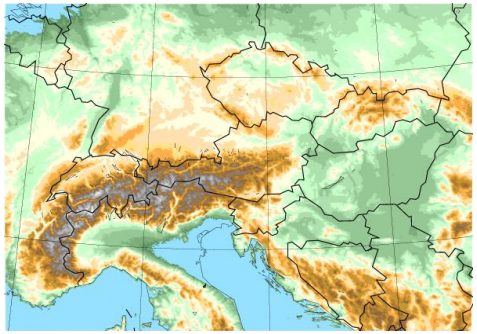
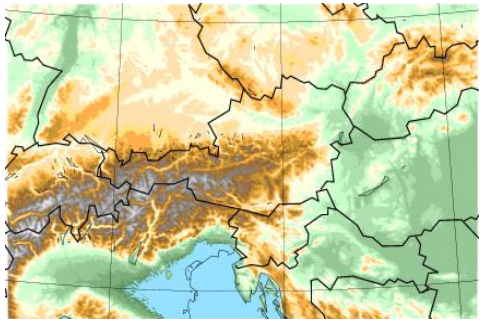
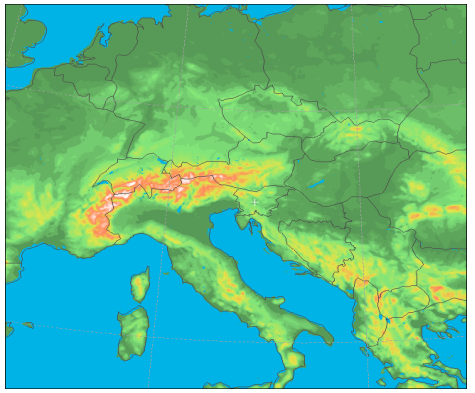
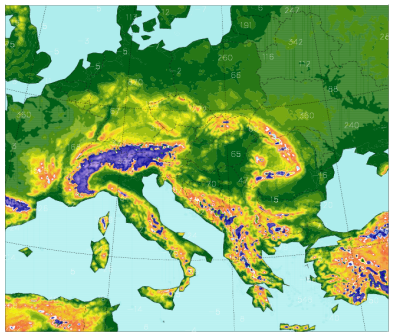
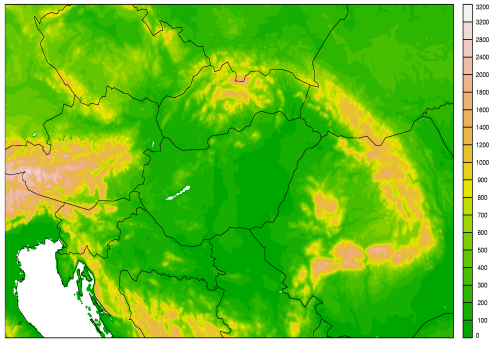
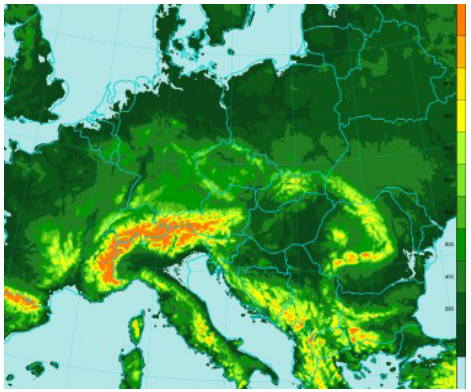
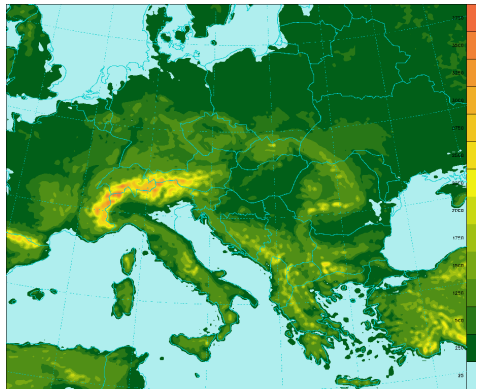
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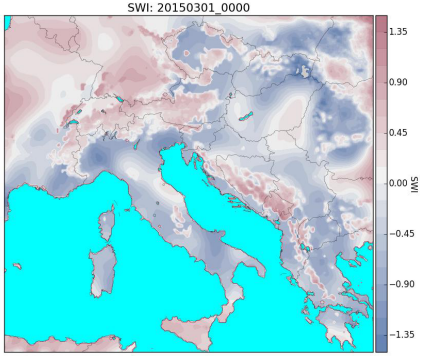

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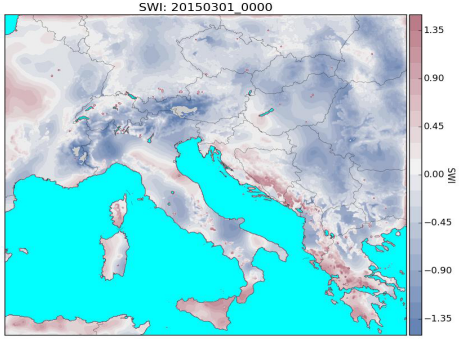

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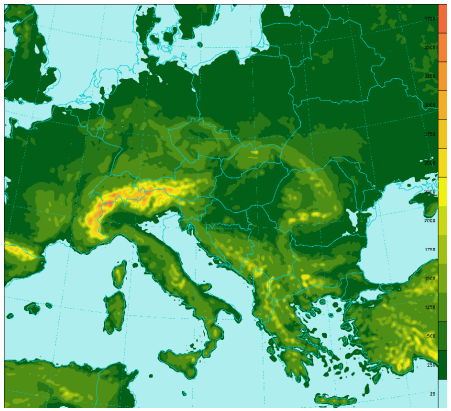
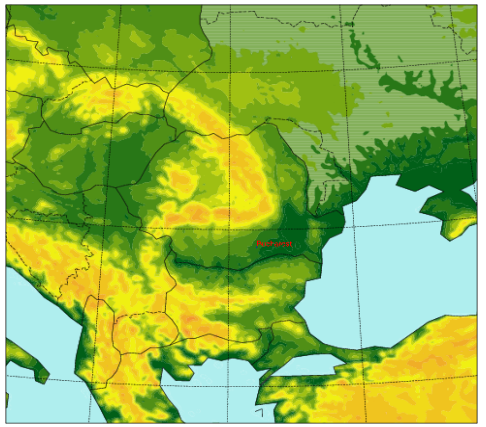
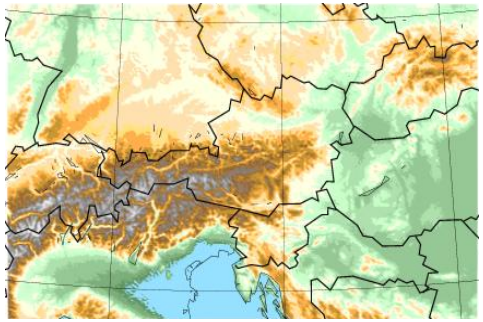



7 LACE countries (Austria, Croatia, Czech Republic, Hungary, Romania, Slovenia, Slovakia)

~11 operational systems (+3 pre-operational ones)

Status



AROME nowcasting Austria

- 3DVAR **1 hourly** non-cycled
- RADAR reflectivity and radial wind

For more information
check Florian's presentations

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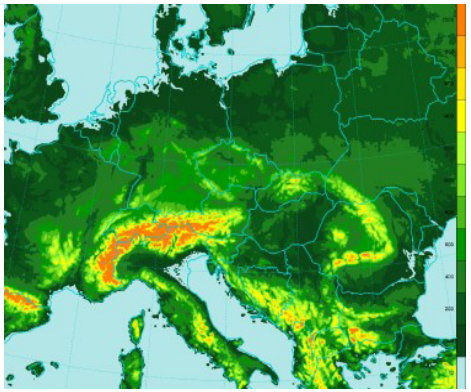
Status

ALARO BlendVAR Czech Rep.

- OI → **DF Blending** → 3DVAR
- Operational since 20/08/2015

For more information
see Czech national poster



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Outline

- Introduction: Oper and pre-operational systems
- Surface assimilation with EKF
- Extended Mode-S network
- GNSS ZTD assimilation
- Radiance observations
- AMDAR humidity
- OOPS toy models
- OPLACE

Surface assimilation using extended Kalman Filter approach

- Optimal interpolation for surface analysis is widely used in LACE, however, it has several limitations
- Extended Kalman Filter approach is under development to replace OI approach in LACE and also to consider non-conventional observations for surface analyses.
- Control vector of an operational EKF system would consist the same set of parameters as it is in OI (TG1, TG2, WG1, WG2). (**More about the latest efforts in Hungarian national poster!**)
- From a EU-FP7 Imagines project, the EKF was proven to be beneficial using various satellite surface products to be assimilated. (**More details in Helga's presentation!**)

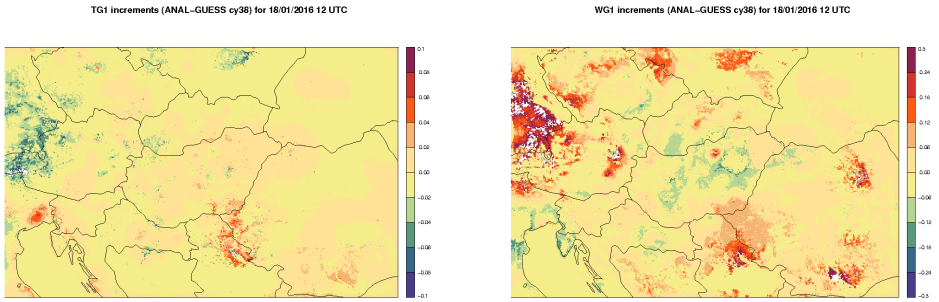
$$x_t^a = x_t^b + \mathrm{K}(y_t^o - H(x_0^b))$$

$$\mathrm{K} = \mathrm{B}\mathrm{H}^T(\mathrm{H}\mathrm{B}\mathrm{H}^T + \mathrm{R})^{-1}$$

$$\mathrm{A} = (\mathrm{I} - \mathrm{K}\mathrm{H})\mathrm{B}$$

$$\mathrm{H} = \frac{\partial \mathrm{y_t}}{\partial \mathrm{x_0}}$$

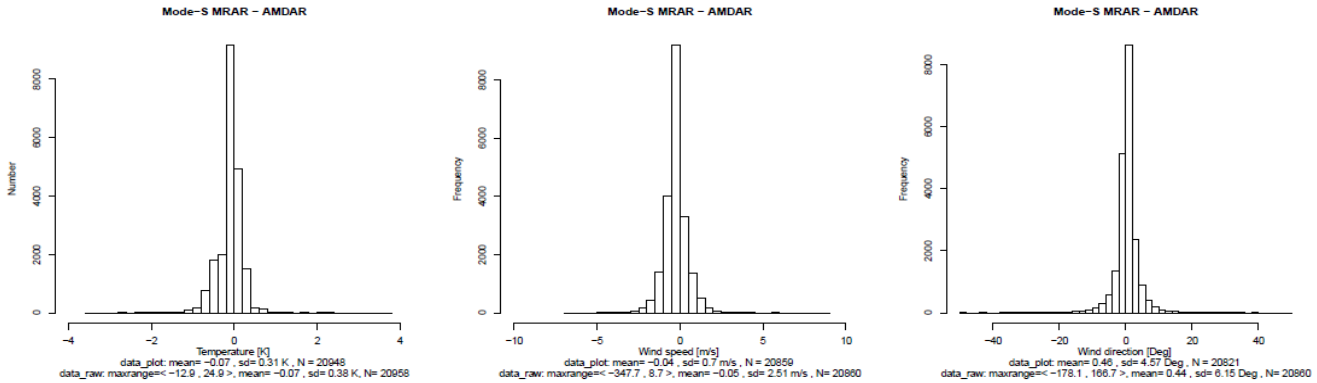
$$H_{ij} = \frac{\partial y_i}{\partial x_j} \approx \frac{y_i(x + \delta x_j) - y_i(x)}{\delta x_j}$$



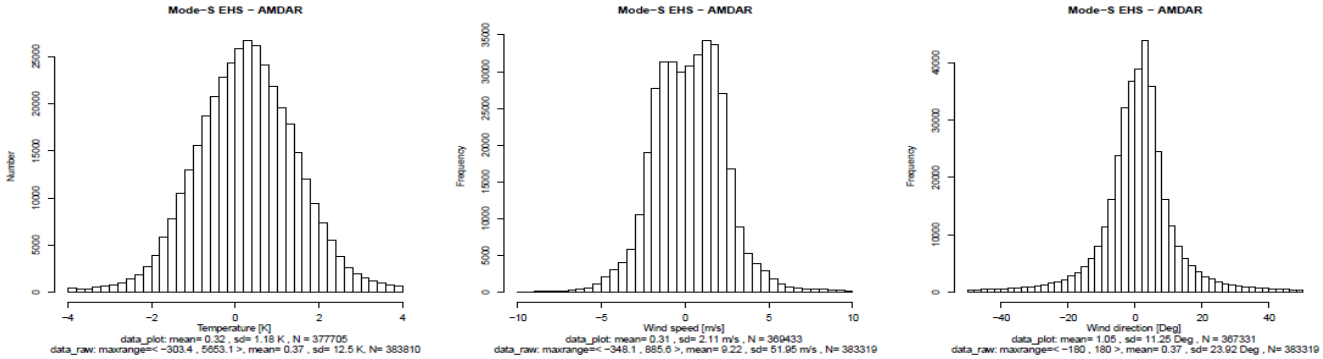
TG1 and WG1 analysis increments using cy38t1 and Surfex v7.2

Extended Mode-S network in LACE

- Mode-S (both EHS and MRAR) recognized as important high resolution conventional observation in mesoscale DA systems.
- In LACE Mode-S observations have been collected and studied from 2 Slovenian, 3 Czech, 1 German, 1 Slovak and 1 Austrian radars so far
- During the Czech Mode-S study both EHS and MRAR observations have been investigated which gave the opportunity to compare the different types of Mode-S in quality.
- Validation of Mode-S observations was carried out with Mode-S AMDAR collocation and with NWP as reference.

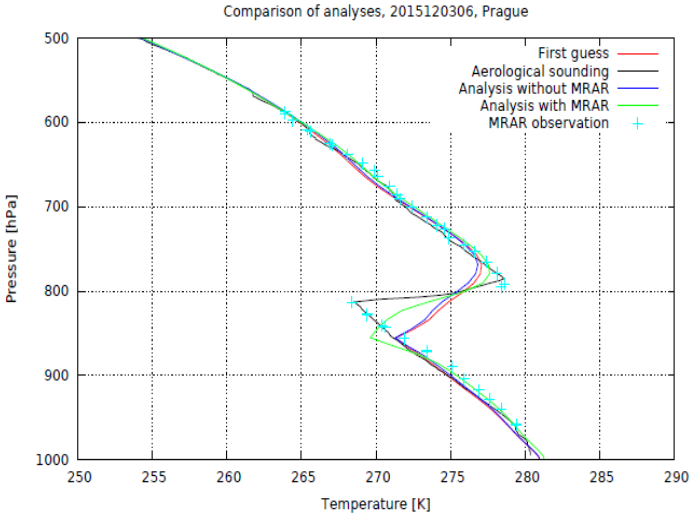


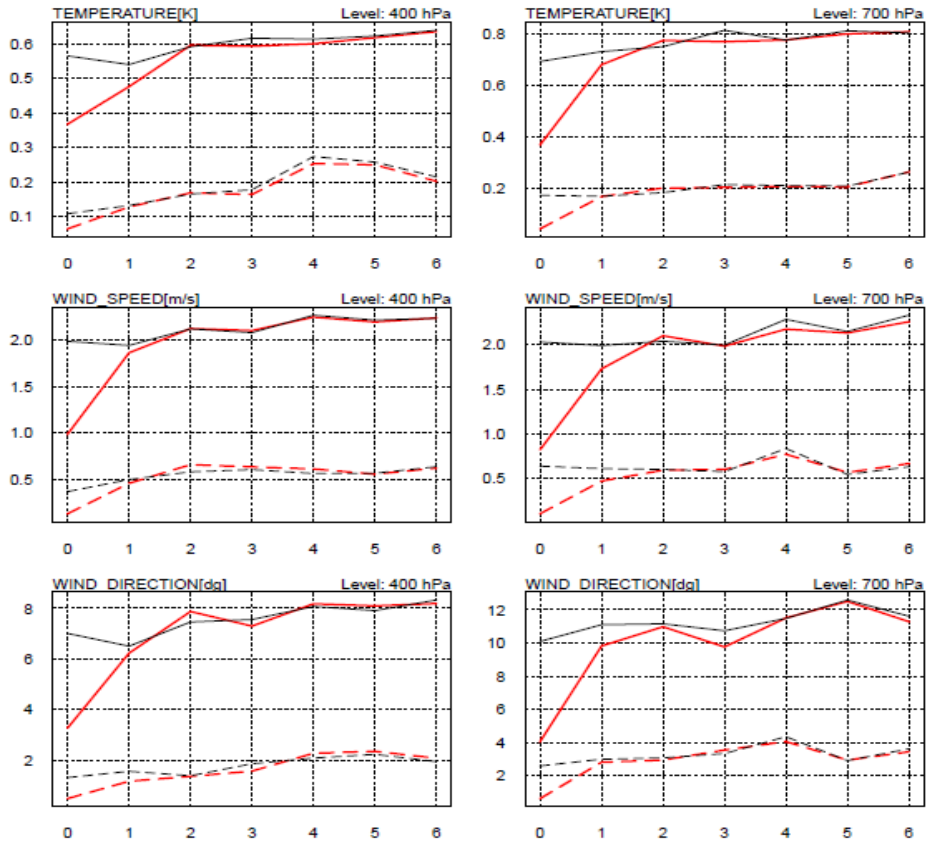
Histograms of Mode-S MRAR and EHS differences wrt AMDAR for T, WS, WD



Extended Mode-S network in LACE

- After quality investigations, assimilation impact study has been done with Mode-S MRAR observations in ALARO/CHMI.
- Verification against independent Mode-S observations showed positive impact of the assimilated Mode-S MRAR for temperature and wind forecasts.
- In conclusion the Mode-S observations can extend nicely the conventional dataset with high resolution and good quality observations which is very important in mesoscale very short-range forecasts.



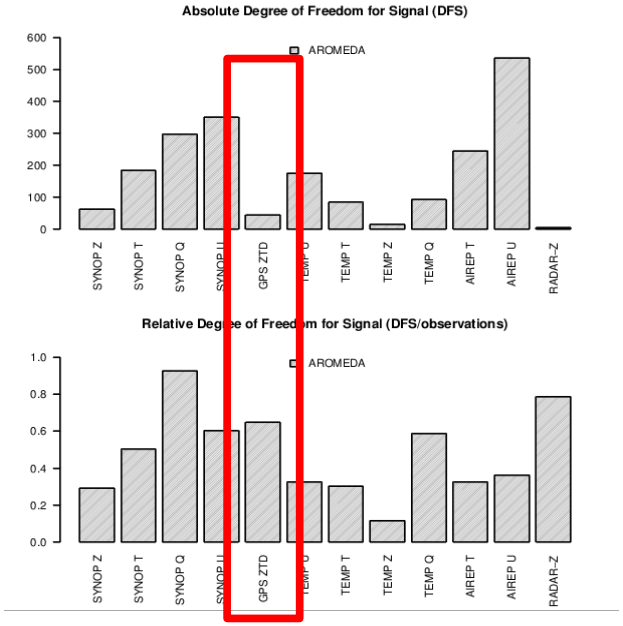


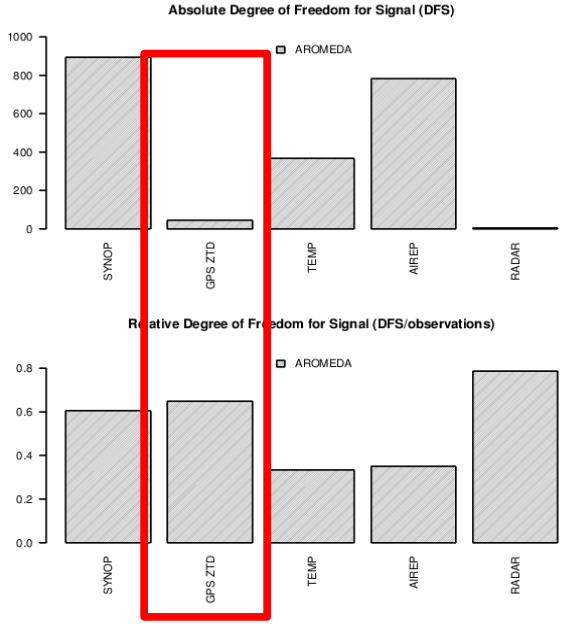
For more information

- **Take a look on Czech Mode-S poster!**

The use of GNSS ZTD in LACE

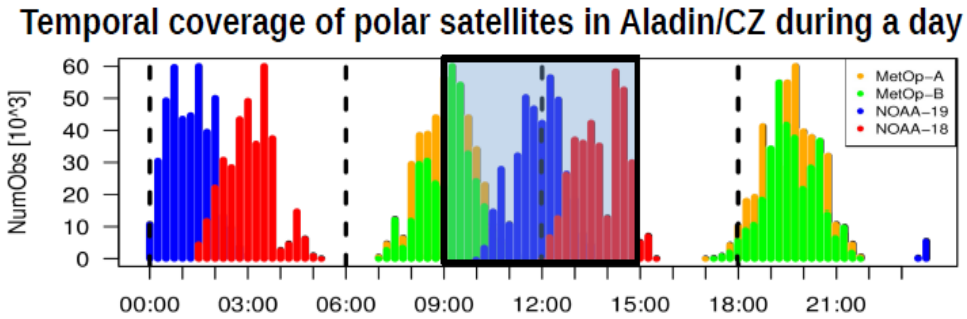
- More and more LACE countries (namely Austria, Hungary and Slovenia) have experiences with GNSS ZTD assimilation.
- Relying on mulitvariate link with the lack of humidity observations or using univariate q analysis is not optimal (mostly summer period in mesoscale models), therefore the use of more humidity observations is a better choise.
- GNSS products are recognised as an important contributor to atmospheric humidity analyses.

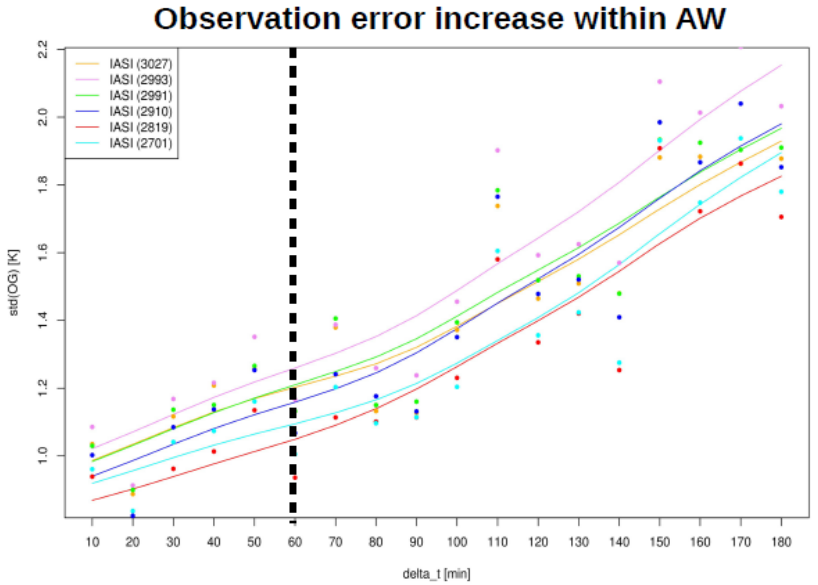




Radiance observations

- In OPLACE radiance observations are available and new ones are being introduced (ATMS, CrIS, SSMI) soon.
- However the efficient use of these observations requires careful assimilation studies regarding bias correction, thinning, channel selection and blacklisting.
- Furthermore default settings of radiance data assimilation is usually fit to global model characteristics.
- In 3DVAR the length of the assimilation window should also revised in LAM DA system to not use radiance observations with increased time-delay bias.





Courtesy of Patrik Benacek, CHMI

Radiance observations

- Regarding VARBC the adaptivity of bias parameters is also not optimal for LAM models.
- Due to smaller observation numbers, the detected bias is more affected by first-guess and data pre-processing errors.
- In order to avoid oscillations and flow-dependent bias from time evolution of bias parameters, observation number dependent adaptivity parameter is proposed.
- With the new adaptivity parameter the changes of bias correction are controlled in each cycle

$$J(x,\beta) = J_b + (\beta_b - \beta)^T B_\beta^{-1}(\beta_b - \beta) + [y - h(x,\beta)]^T R^{-1}[y - h(x,\beta)] \quad (1)$$

$$h(x,\beta) = h(x) + \sum_{i=0}^{N} \beta_i P_i \quad (2)$$

$$B_\beta = diag(\sigma_{\beta_1}, \cdots, \sigma_{\beta_n}) \quad ; \quad \sigma_\beta^2 = \sigma_o^2 / N_{bg} \quad (3)$$

Old

$$\sigma_\beta^2 = \frac{\sigma_{obs}^2}{N_{bg}^{df}} = \frac{\sigma_{obs}^2}{5000}$$

New

$$^*\sigma_\beta^2 = \frac{\sigma_{obs}^2}{[C \cdot log(\frac{N}{N_{min}}) + NBG_{min}]} \quad \text{where } N > N_{min} \quad (4)$$

$$^*\sigma_\beta^2 = \frac{\sigma_{obs}^2}{NBG_{min}} \quad \text{where } N < N_{min} \quad (5)$$

- Courtesy of Patrik Benacek, CHMI

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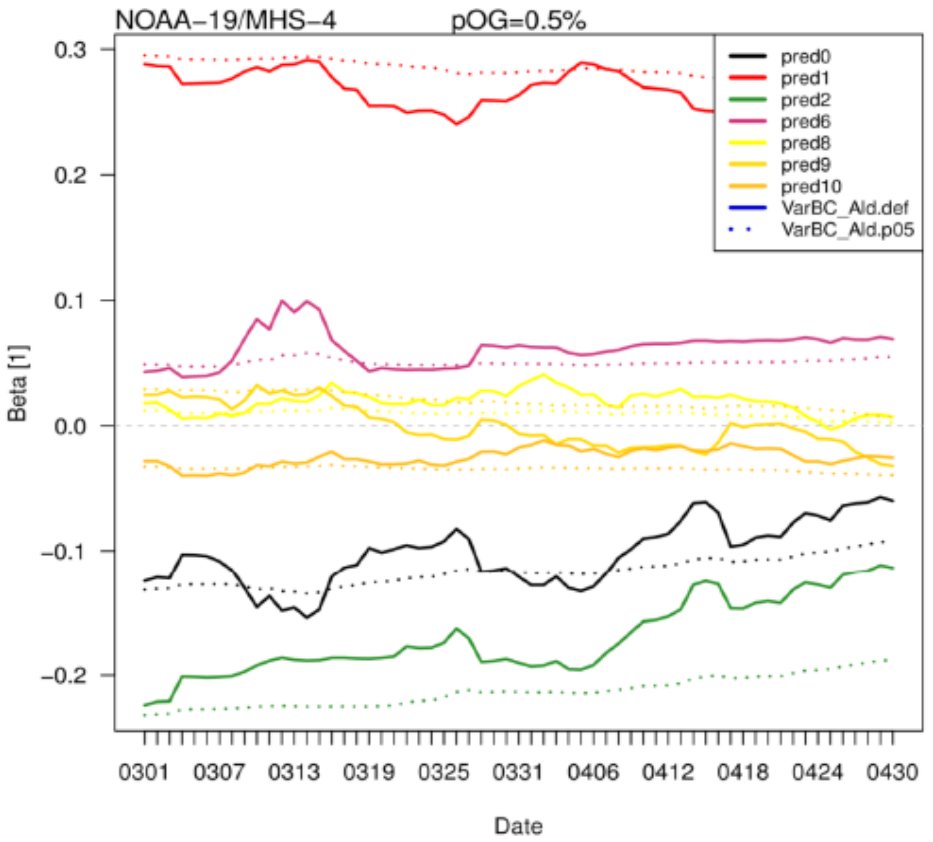
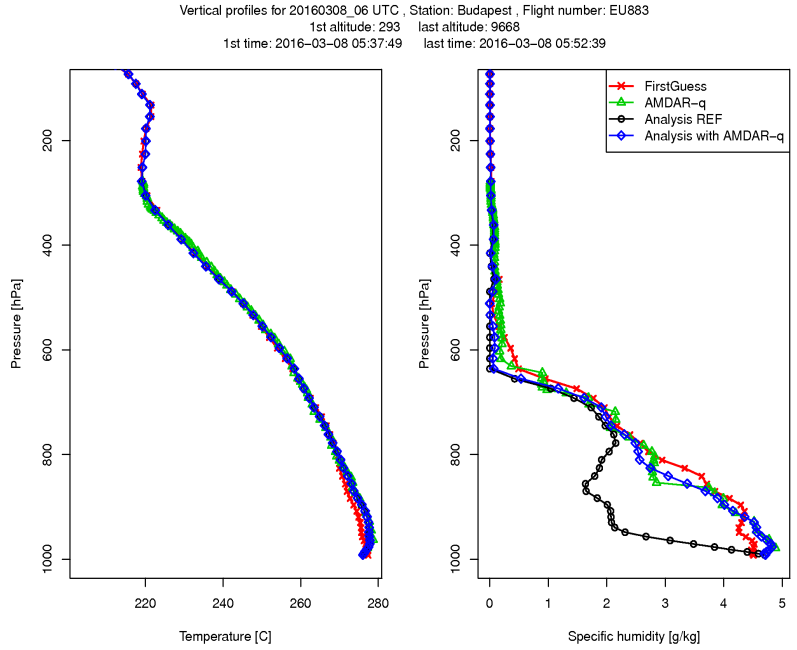
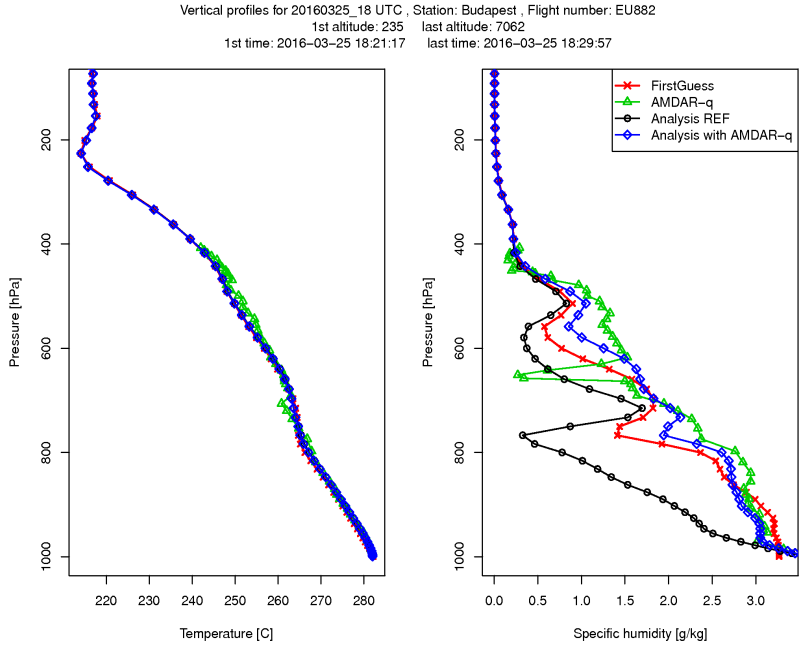


Courtesy of Patrik Benacek, CHMI

AMDAR humidity

- Recently beside temperature and wind measurements of commercial aircrafts, humidity data is also included for few aircrafts operating mainly over North America and with some reports over Europe.
- Aircrafts (over Europe) equipped with humidity sensor on board measuring water vapour mixing ratio (WVSS-II).
- Very preliminary study shows good agreement between aircraft humidity and radiosonde measurement for selected cases.
- Furthermore assimilating AMDAR humidity converted to specific humidity showed reasonable correction in vertical profiles of 3DVAR analyses.



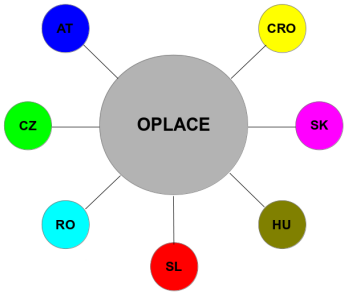


From Viktoria Homonnai, OMSZ

OOPS toy models in LACE

- First prototype release of OOPS LAM 3DVAR (OOVAR) and HOP driver have been kindly provided by Meteo-France, ECMWF and HIRLAM colleagues.
- Despite limited manpower resources in LACE, minor contributions as local validation exercises, installations have been started with OOPS toy models.
- Local installation of OOVAR on the Hungarian platform and HOP driver in HARMONIE scripting system were done and the validation is ongoing.
- Besides LAM observations mainly used by LACE (MSG-HR, refractivity index) are going to be implemented in OOPS frameworks as well.

OPLACE News



- Migration from TAC to TDCF is still not finished in OPLACE due to discrepancies in TEMP and in the use of BUFR format in BATOR.
- Due to this, the pre-processing chain of OPLACE still consists decoding, local databases and OULAN before BATOR which complicates the system, but helps to not lose any observations for DA systems
- New observations are gradually added to OPLACE pre-processing (last time HRW and soon ATMS, CrIS, SSMIS)
- Non-LACE countries showed interest to access OPLACE observations, therefore Tunisia became the first non-LACE user making agreement with LACE.

From Alena Trojakova, LACE DM

Thank You for your attention!

Thank You for colleagues who contributed!

Questions?