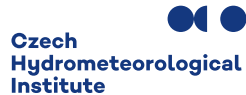


*Regional Cooperation for
Limited Area Modeling in Central Europe*



Overview of LACE DA activities

Antonín Bučánek & RC LACE DA teams



ARSO METEO
Slovenia

Operational DA systems in RC LACE

AROME

ALARO



Assimilation cycle: ■ 1h ■ 3h ■ 6h ■ 12h

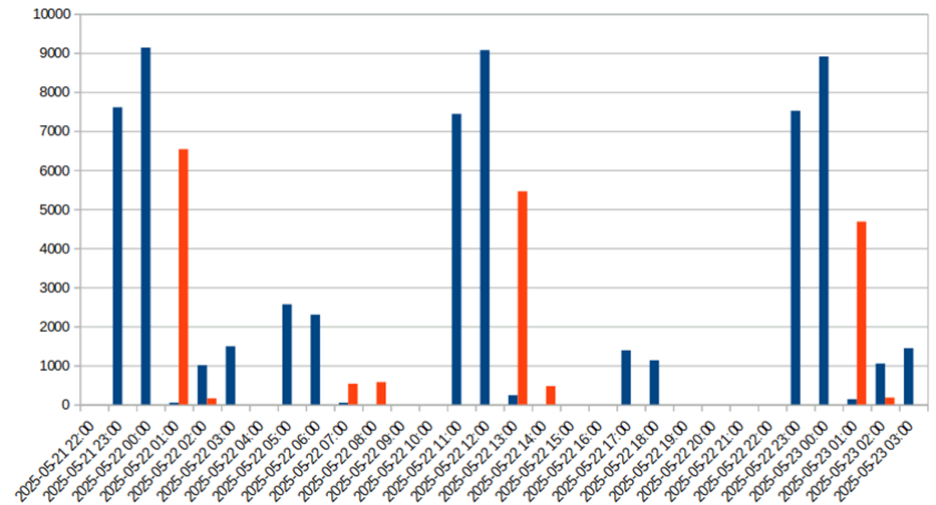
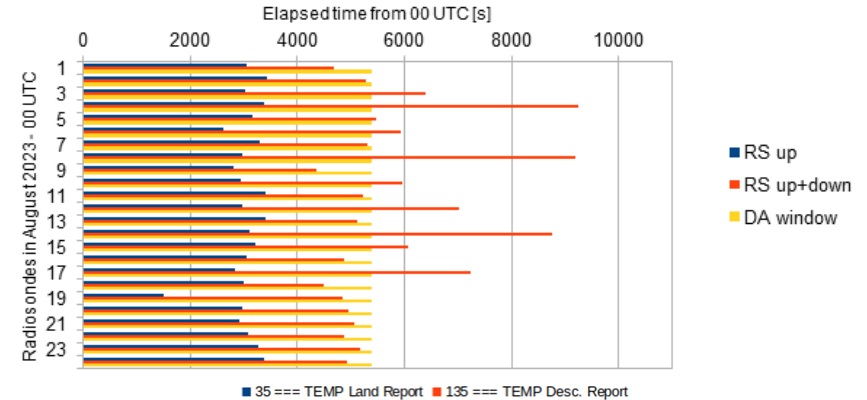
Recent activities and developments

- ▶ High resolution TEMP descend data
- ▶ Fast delivery MODE-S data
- ▶ Corrected SYNOP wind data
- ▶ Radar reflectivity assimilation
- ▶ All-sky assimilation
- ▶ Tuning of 3DEnVar in C-LAEF Alpe Adria

Radiosonde Experiments in AROME/HU

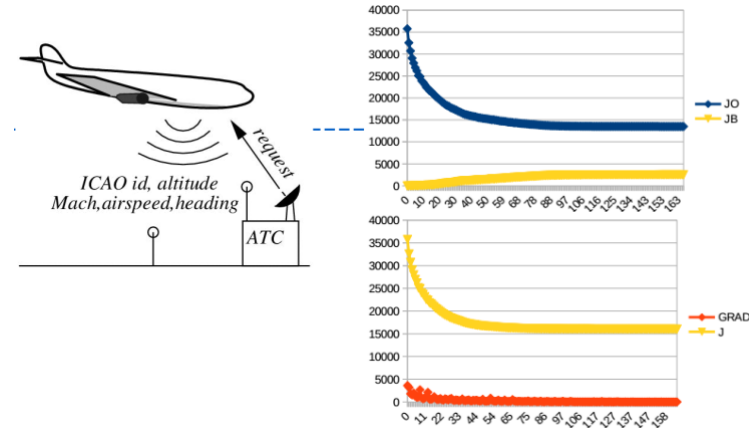
- ▶ Comparison Obsoul vs BUFR TEMP
 - ▶ No significant impact
- ▶ Descending data
 - ▶ Minor impact often in wrong direction
 - ▶ Possible reason – drift of radiosonde which was not followed
 - ▶ Often out of assimilation window (1-2h later than nominal time)
- ▶ **BUFR TEMP will be operational — no descent data**

Radiosonde measurement time lengths
August 2023 - with parachute



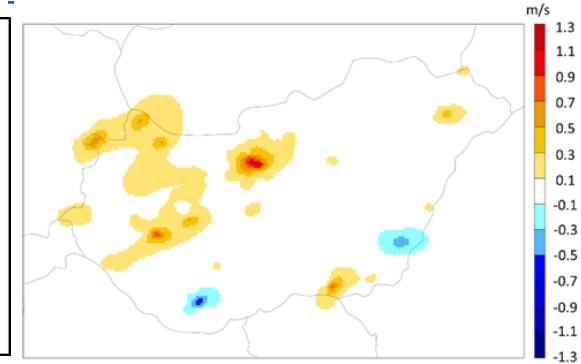
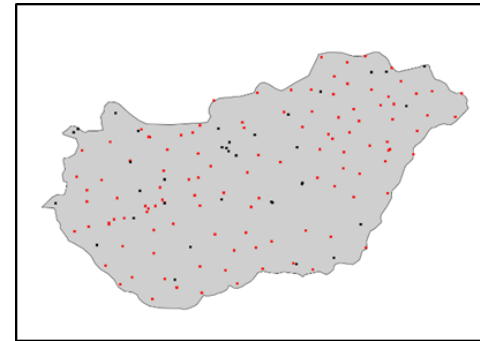
Fast delivery Mode-S EHS in AROME/HU

- ▶ **FAST observation data (5 min, EMADDC BURF)**
- ▶ Initial assimilation of **Mode-S EHS** data failed in **cy46t1_bf07**
 - ▶ **Bugfix** implemented during DAWW1 2025 (Uploaded GitHub)
- ▶ **AROME modifications for EHS:**
 - ▶ **Independent inflation** of Mode-S EHS observation error (separate from AMDAR)
 - ▶ Option to **include/exclude** Mode-S EHS **temperature data**, via LISTE_LOC
- **Experiments conducted:**
 - **1.3 km resolution:** 1–10 April 2025, **2.5 km resolution:** May 2025
 - Using **Siebrén's box thinning** -> EHS data still sufficient for **Desroziers method** due to its density
- **Next steps:**
 - Specify **optimal thinning distance**
 - **Evaluation in progress**



Corrected SYNOP wind data in AROME/HU

- ▶ **Not all HU stations measure wind at 10m**
- ▶ Corrected data available in OPLACE (GTS)
 - ▶ Logarithmic profile used
- ▶ Slight positive impact (12-16h) for wind gusts
- ▶ **No plan to use the corrected data**
 - ▶ only available in Hungary
 - ▶ Complicates the preprocessing
- ▶ 6 Work of Anikó Kardos-Várkonyi (HU)

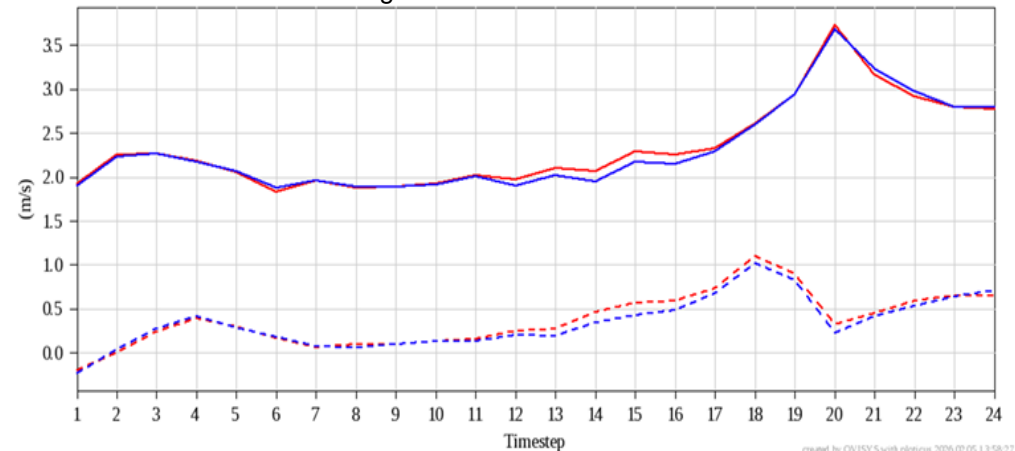


Top left: corrected (black) SYNOP wind measurements.

Top right: 10m wspd analysis difference between corrected and uncorrected SYNOP data at 0 UTC on 29 July 2025

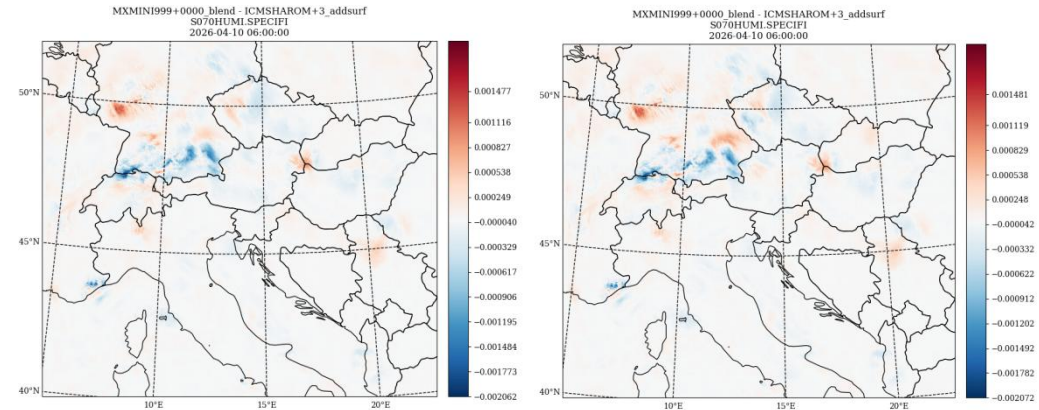
Bottom: Bias (dashed) and RMSE (solid) of **10m gust**. Period 29 July -- 4 August 2025. The verification was done against the original SYNOP data.

— AROME_uncorrected_wind/RMSE
- - AROME_uncorrected_wind/BIAS
— AROME_corrected_wind/RMSE
- - AROME_corrected_wind/BIAS



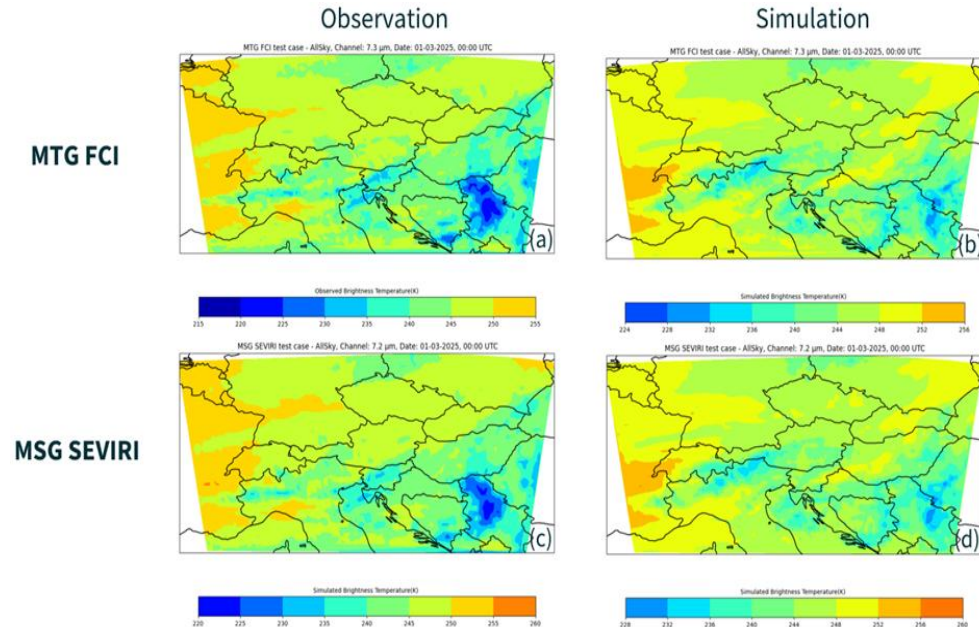
- ▶ **New radars added to AROME-RUC (AT):**
 - ▶ Hochficht (Meteopress), 3 German radars: deneu, denhb, dedrs, Croatian radar near Zagreb (restored after name update), Bolzano radar (bilateral exchange), Corsican radars (France)
 - ▶ Radar reflectivity assimilation planned in next **operational C-LAEF version**.
- ▶ Radar reflectivity **operational at Czechia (May 2025)**
 - ▶ Revised method to compute **Minimum Detectable Reflectivity Factor (MDRF)**:
 - ▶ Removes **lowest 1st percentile of DBZ values** at each distance step per elevation scan.
 - ▶ Neutral to slightly positive impact.
- ▶ Stay at CHMI on optimization of thinning, November 2025
 - ▶ Obstacle used to check observation error correlations (thresholded 0.2 used as indicator of not correlated observations)
 - ▶ 10-day sensitivity study was conducted using three different configurations
 - ▶ The results of this work are presented in **more detail in the ACCORD NL8 newsletter**

- ▶ **Direct assimilation of reflectivity was tested** in a case in C-LAEF Alpe Adria
- ▶ Reasonable hydrometeor and moisture increments
- ▶ Obs. perturbation could create RH observations above 100% or negative values
- ▶ Solution: obs_error used to perturb observations decreases linearly to 0 above 90% and below 10% of relative humidity



Q increments on 10.04.2026 06UTC by Bayesian approach (top), by direct assimilation (bottom). Bayes approach does not provide any hydrometeor update.

- ▶ The goal is to assimilate VIS and IR channels within a unified framework after technical development and testing is finished
- ▶ **All sky** assimilation of
 - ▶ **VIS channels** of MSG SEVIRI **established** (CY50).
 - ▶ **MTG FCI IR implemented** and technically tested in AROME-AT (3D-Var)
 - ▶ **IASI implement** as preparation for **MTG IRS**

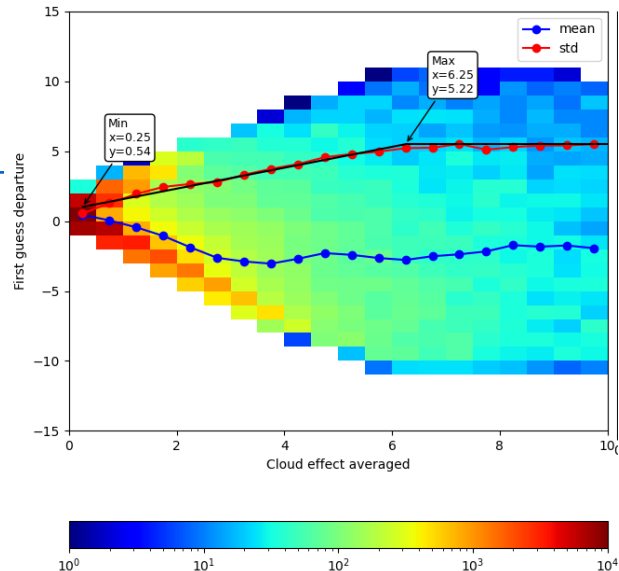


WV7.3 μm channel from MTG FCI(top) and MSG SEVIRI (bottom), (a & c) Observed brightness temperature, (b & d) All-Sky simulated brightness temperature.

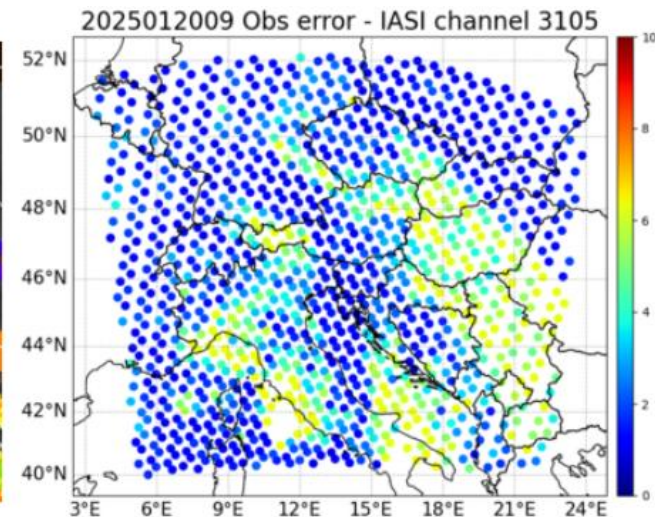
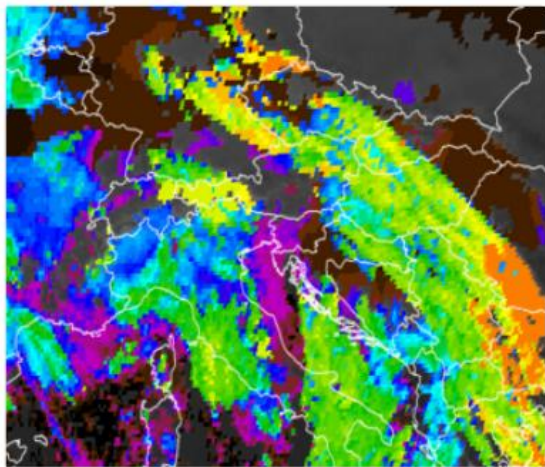
All-sky assimilation IASI

- ▶ Okamoto method in EnVar
- ▶ New **external namelist for cloud-dependent observation error modeling**
 - ▶ Dynamically assign observation errors based on the averaged cloud effect
 - ▶ Observation errors scale **linearly with cloud effect**, up to predefined maximum
- ▶ Cold start calibration cycle:
 - ▶ **15 Jan – 15 Feb 2025**,
 - ▶ IASI in **passive mode**.
 - ▶ first-guess departures used to fit error bounds for 4 channels

Histogram of first-guess departures vs. cloud effect, mean (blue), standard deviation (red), and linear fit (black) for observation error estimation (channel 2958)



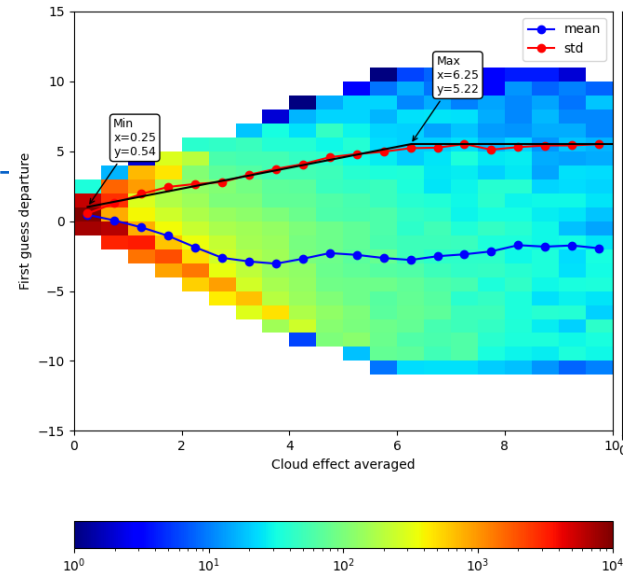
Case 20.01.2025.: EumetView Cloud top height product (b. left), modeled observation error values for IASI channel 3105 (b. right)



All-sky assimilation IASI

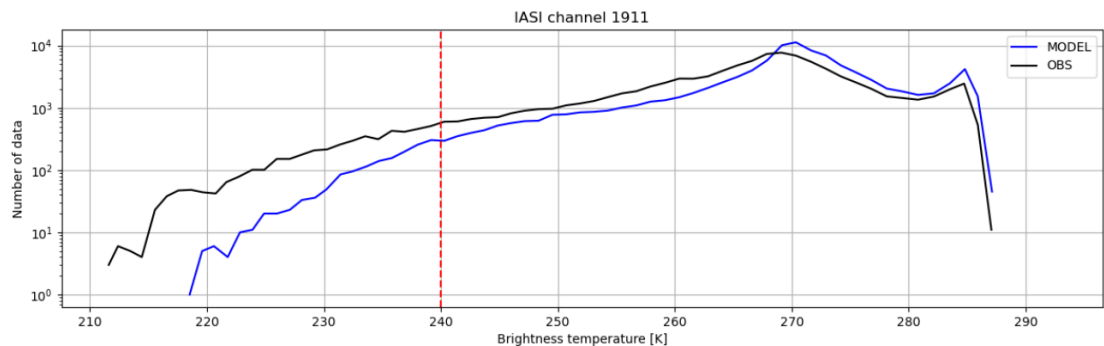
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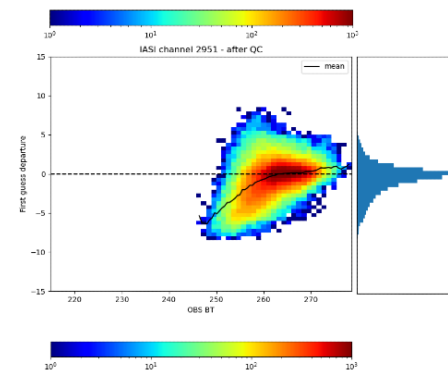
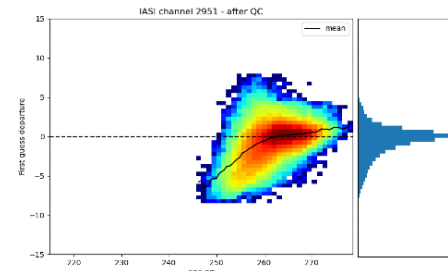
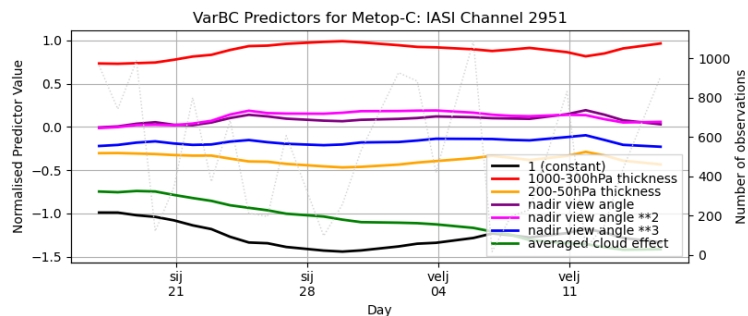
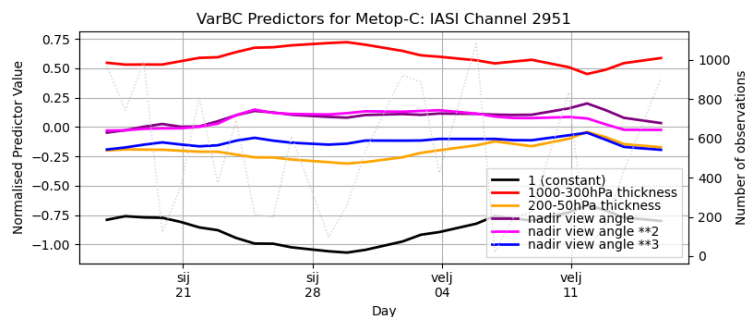
- ▶ Cold start calibration cycle:
 - ▶ **15 Jan – 15 Feb 2025,**
 - ▶ IASI in **passive mode.**
 - ▶ first-guess departures used to fit error bounds for 4 channels

- ▶ Model cloud tops **too warm**
=> **obs < 240K rejected**



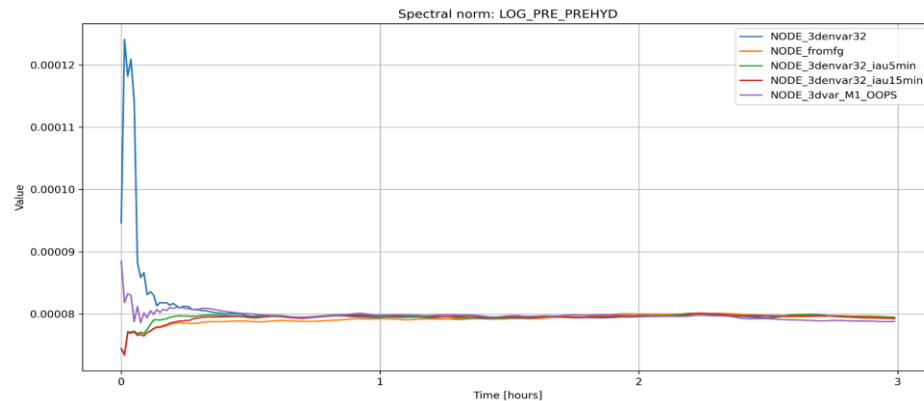
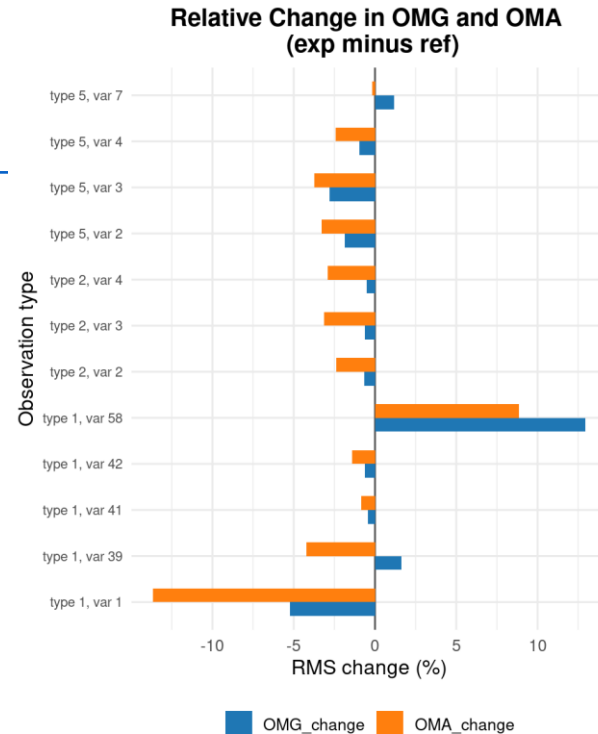
IASI channel 1911: number of data points as a function of brightness temperature for the observations (black line) and the model (blue line); Rejection threshold (red dashed line)

- ▶ **Cloud-aware VARBC predictor added**
 - ▶ still ongoing due to its long warm up period.
- ▶ Predictor remains unconverged after two months of cycling;
- ▶ However, it is already providing a stabilizing effect on the other VARBC predictors
- ▶ It also reduces the bias of clear-sky and near clear-sky observations
- ▶ See the report [Panežić \(2025\)](#)



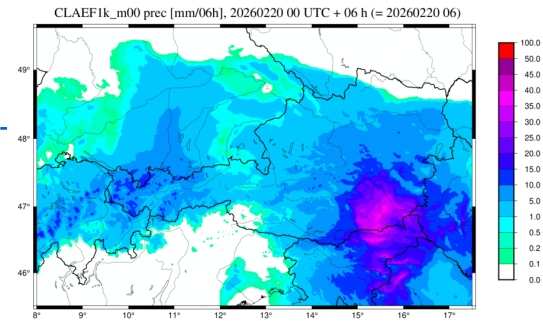
3DEnVar in C-LAEF AA

- ▶ **Tuning of EnVar member** in C-LAEF Alpe Adria (1km) is ongoing
- ▶ Recent updates and tests:
 - ▶ **Sub-Ensemble Scaling** in 3DEnVar technically implemented (e.g., current, lagged, LBC)
 - ▶ **Scale-Dependent Localization (SDL)** tested
 - ▶ Hor. length scales 150, 75, 15km for 3 spectral bands
 - ▶ **Smoother increments** than vertically depended localization
 - ▶ **But significantly more expensive** then vert. dep. localization
 - ▶ Mixed impact:
 - **Positive** for upper-air obs
 - **Negative** for **surface humidity**
 - ▶ **IAU (15 min)** applied to remove spin-up

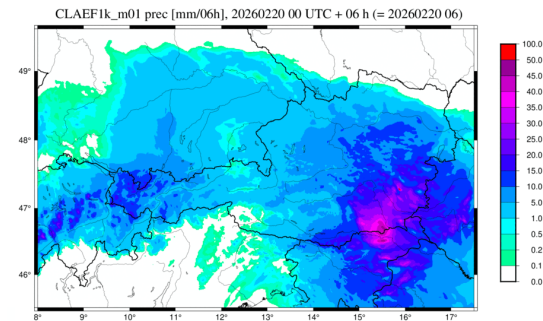


3D-EnVar vs 3D-Var performance

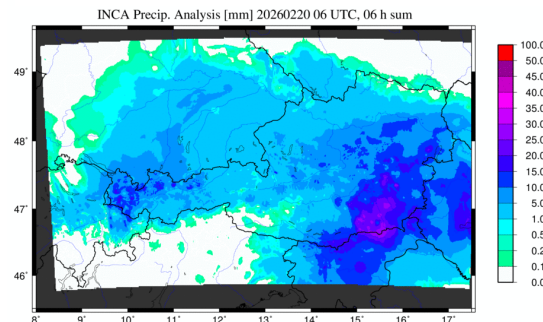
- ▶ 3D-EnVar performs comparably to 3D-Var with slightly **better precipitation structures**
 - ▶ Differences can be found up to 24h rarely beyond
 - ▶ Temperature & wind scores are **neutral to slightly positive**
- ▶ This winter **inner Alpine stratus** in valleys was often even more **underestimated in EnVar** compared to 3D-Var.
 - ▶ We assume that this might be related to rather short localization lengths.



3D-Var



EnVar



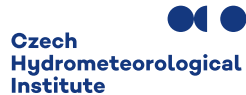
Inca

- ▶ HIGH resolution TEMP data going operational at HungaroMet without descent data
- ▶ Radars reflectivity – operational at CHMI, ongoing implementation
- ▶ All-sky assimilation unified framework ready, settings ongoing
- ▶ 3DEnVar with vertically dependent localization is used due to available resources

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Thank you for your attention.



ARSO METEO
Slovenia