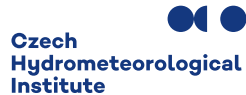


*Regional Cooperation for
Limited Area Modeling in Central Europe*



Overview of LACE DA activities

Antonín Bučánek & RC LACE DA teams

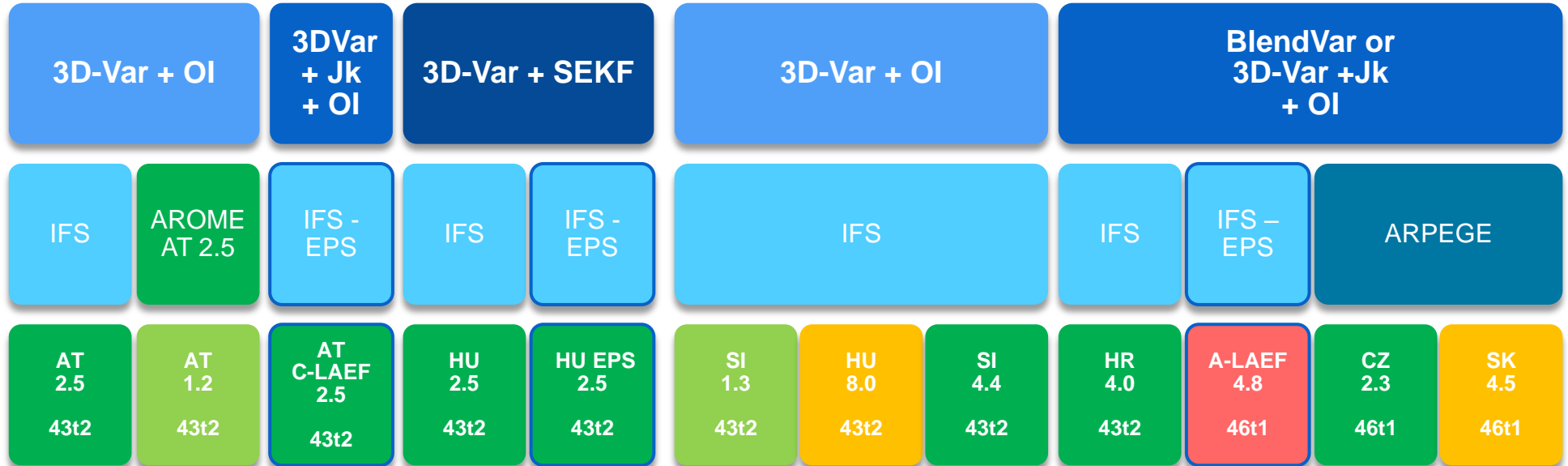


ARSO METEO
Slovenia

Operational DA systems in RC LACE

AROME

ALARO



Assimilation cycle: 1h 3h 6h 12h

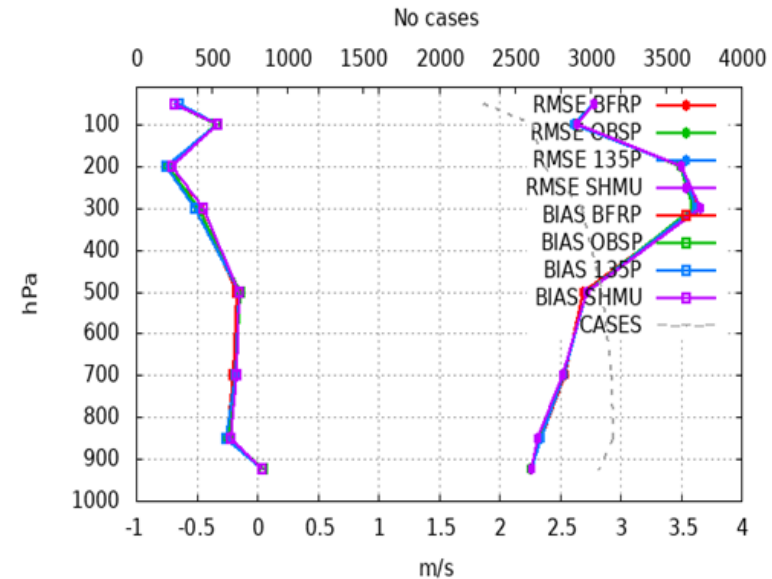
Recent activities and developments

- ▶ Upper-air DA assimilation
 - ▶ High resolution TEMP descend data
 - ▶ Fast delivery MODE-S data
 - ▶ Radar assimilation
 - ▶ Recent progress with GNSS derived data
 - ▶ Assimilation of Sentinel-1 delays into AROME (talk of F. Meier)
 - ▶ All-sky assimilation
 - ▶ AllSky VIS/IR assimilation activities at GeoSphere Austria (talk of A. Neduncheran)
 - ▶ First Experience with 3DEnVar in Routine Runs of the Claf1k Ensemble (talk of B. Strajnar, F. Meier)
- ▶ Surface data assimilation
 - ▶ Assimilation of Snow

TEMP descend data

- ▶ High resolution BUFR TEMP observations (Stay of D. Lancz (HU))
 - ▶ TEMP BUFR was implemented and technically tested in Slovakia (CY46)
 - ▶ Ascend & Descend data (codetype 135)
- ▶ Experimental period 15-31 October 2024
 - ▶ Only station which provide both Obsoul and Bufr data were used
 - ▶ No significant improvement but more data assimilated so the plan is to replace Obsoul data

61 stations Selection: ALL
Wind speed Period: 20241015-20241031
Used {00} + 12 24 36 48



TEMP (green), BUFR TEMP (red),
BUFR TEMP with data from descending
radiosondes (blue), operational ALARO
(purple)

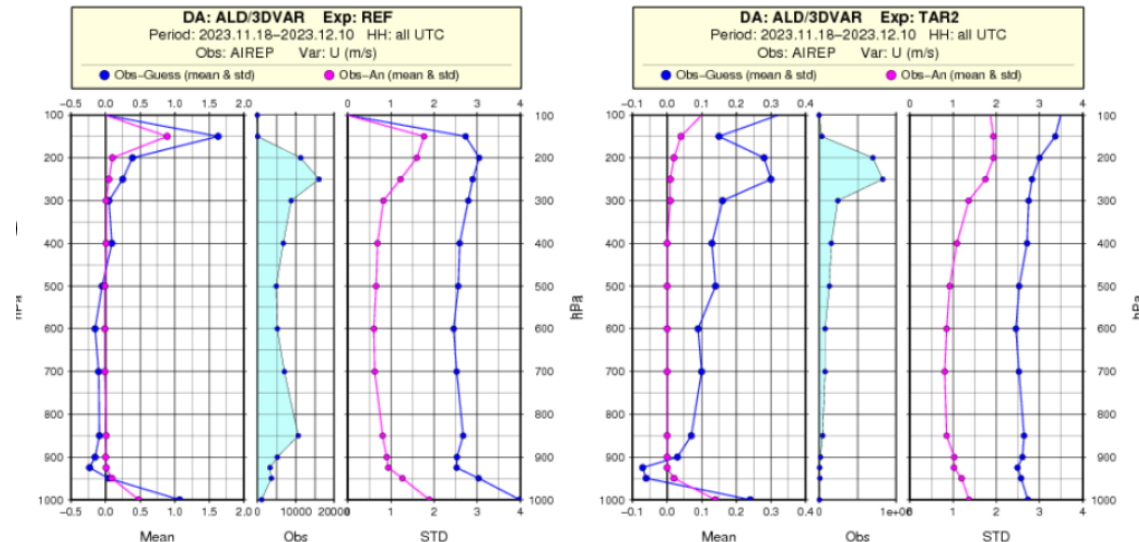
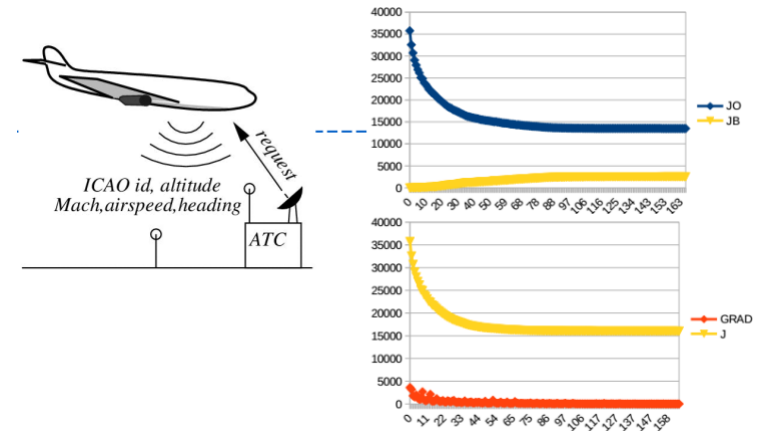
- ▶ 4 Work of D. Lancz(HU), P. Strban, M. Derkova, M. Nestiak (SK)

Fast delivery MODE-S data

- ▶ EMADDC v2.2 data from OPLACE in BUFR
- ▶ **FAST observation data (5 min)**
- ▶ experiments in winter and summer periods
- ▶ pre-thinning python script from Siebren de Haan

(boxthinning: --box_heights 300,300,600,1000 --box_width 40)

- ▶ SIGMAO_COEF(2)=2.8 (0.9)
- ▶ NITER=200 (60)
- ▶ NSIMU=210 (70)
- ▶ **Neutral verification vs. TEMP**



- ▶ Stay M. Nestiak (SK) November 2024
 - ▶ Transfer and validation of CHMI radar modset to Slovakia (cy46t1)
 - ▶ Test of **LRADAR_SIGMA3CHECK=T**, model profiles which has average distance less than $3 \times x\sigma$ from observation are not used
 - ▶ Unfortunately model minima are around -300DBZ while observation -40DBZ that's why we lose most of the observation close to the radar
 - ▶ **Do not use the key!**



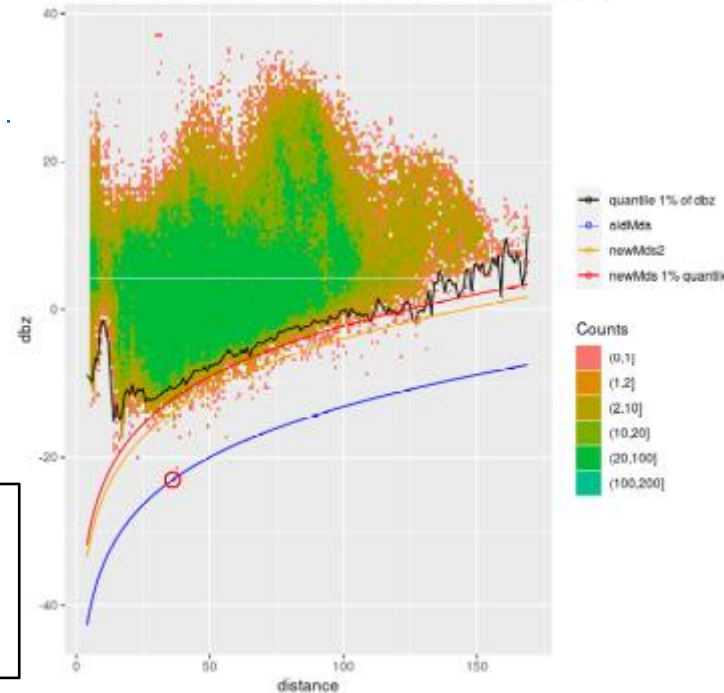
Red squares denote original setting ($x\sigma=0.2$ and LRADAR_SIGMA3CHECK=F), Green plus signs denote LRADAR_SIGMA3CHECK=T and Blue x signs denote setting $x\sigma=1$ and LRADAR_SIGMA3CHECK=T.

Radar reflectivity

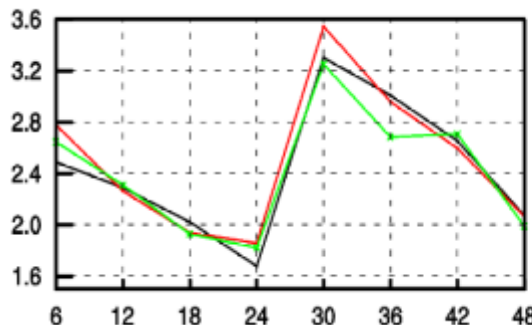
- ▶ Screening optimization/vectorization for NEC Aurora
 - ▶ Not yet in common code
- ▶ New way of computation of minimum detectable reflectivity factor
 - ▶ One percentile of data is cut out
 - ▶ Protects against excessive drying by undetected obs.
 - ▶ Impact neutral to slightly positive

Black Oper. run
Red radar assim
Green New MDRF

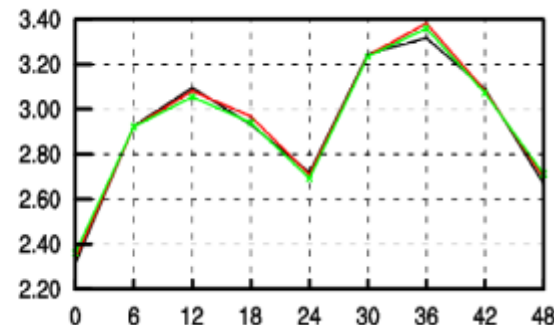
DBZ statistics, newMds=-43.87 oldMds=-54.77 newMds2=-45.59



PRECIPITATION [mm/6h]

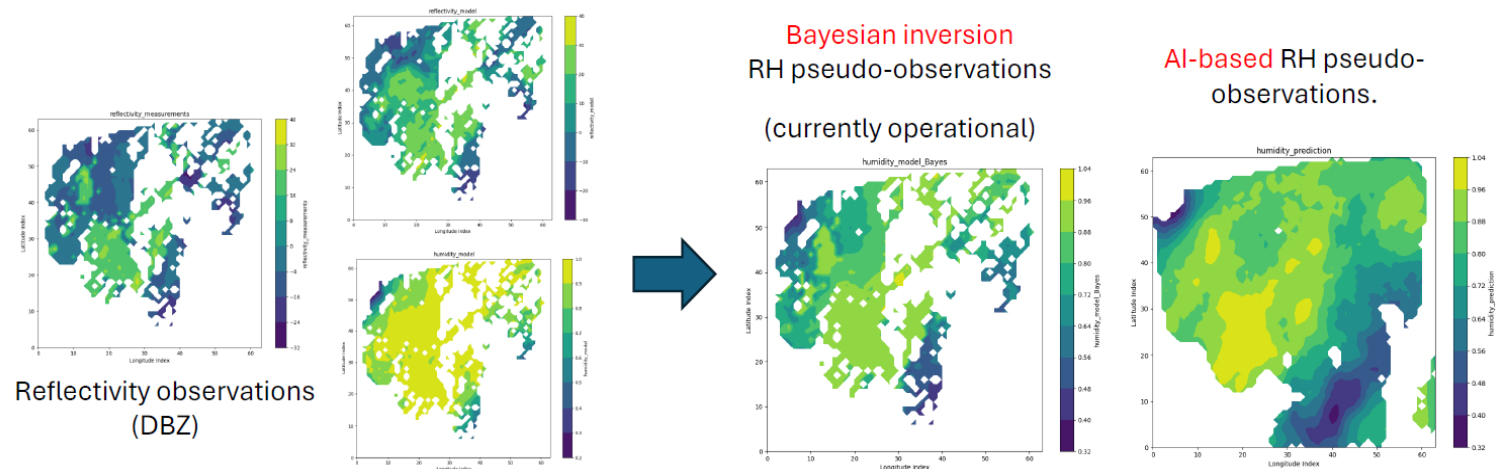


CLOUDINESS [1/8]



AI/ML for Radar assimilation

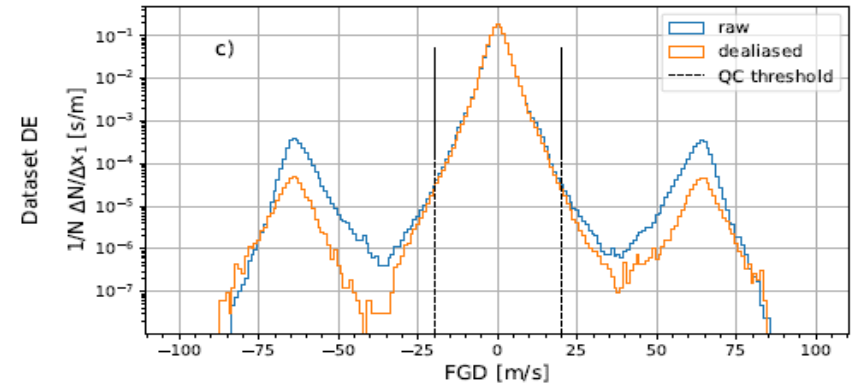
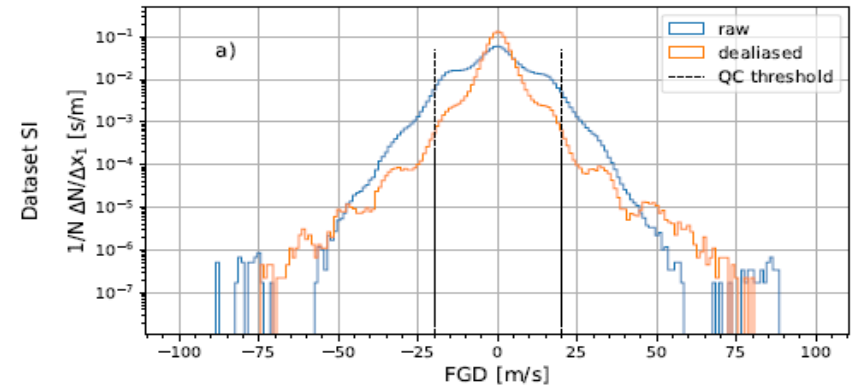
- ▶ Project to replace Bayesian inversion in radar reflectivity assimilation by **AI**
- ▶ Large dataset prepared for 2023
 - ▶ Radar obs, First guesses RH and REFL
 - ▶ Selected cases for training where observed and model reflectivity was in good agreement
- ▶ A goal is to train a neural network to construct good pseudo-observed relative humidity



Main advantage of the AI-based method: spatial consistency. Challenge: incorporate into the Fortran DA flow

Radar wind data

- ▶ F. Meier (AT) read NI for each elevation separately in Bator (modification) instead one number per file
- ▶ P. Smerkol, V. Svagelj, B. Strajnar (SI) refined torus mapping dealiasing in HOOF
 - ▶ part of the peer-review process
 - ▶ correctly dealias more than 90% of radial winds
 - ▶ reasonable quality for data assimilation after the additional QC step of DA

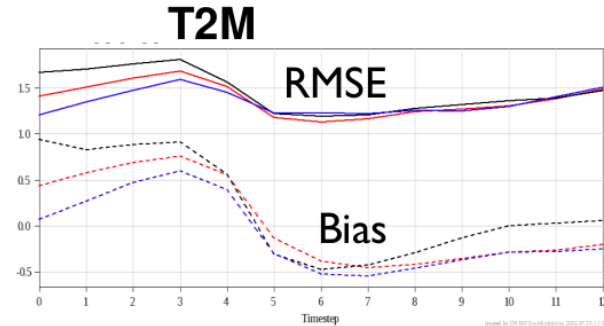


First guess departure distribution of radial winds over one year. The comparison is between raw and dealias datasets for SI (upper panel) and DE (lower panel). The side peaks in all distributions represent aliased measurements and should be diminished in favor of the main peak. The vertical dashed line represents QC interval in DA.

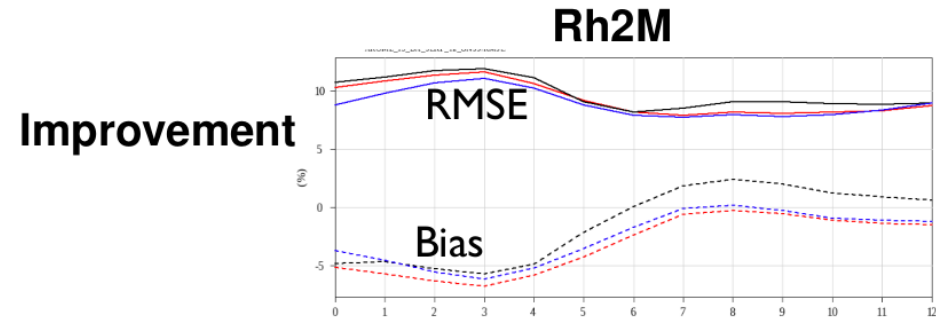
GNSS ZTD in high resolution

- ▶ Arome RUC 1.3km (HU)
 - ▶ **Bugfix PREGPSSOL**, 1-hourly cycling added
 - ▶ The BMEG, GF1R, ASI, WUEL and GOP1 networks are included
 - ▶ New whitelist
- ▶ C-LAEF1k (AT) GNSS-ZTD assimilated
 - ▶ **Bugfix** - allocation of already allocated arrays in `varbc_setup.F90` in `cy46t1` which caused crashes of VARBC for GNSS ZTD in C-LAEF1k (AROME) system
 - ▶ NDREMOVE and LCLEANTABLE switches in NAMVARBC to get rid of corrupted old VARBC entries without restarting VARBC of C-LAEF1k
 - ▶ New whitelist

Experiment 1-15 May 2024



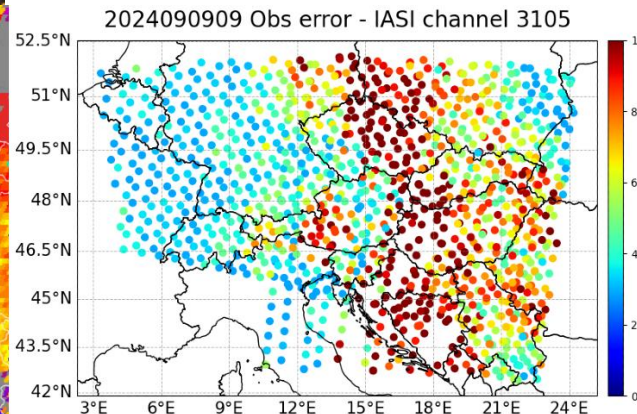
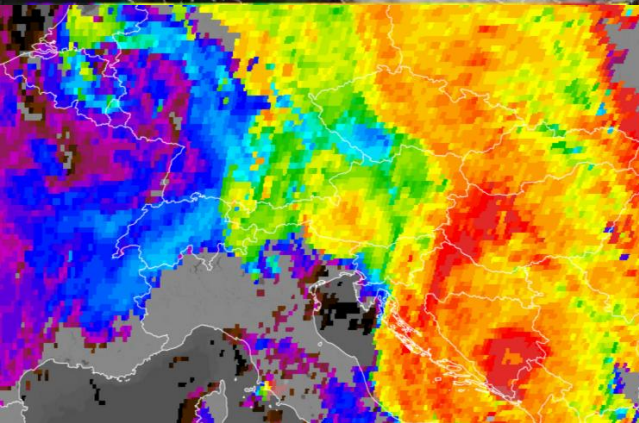
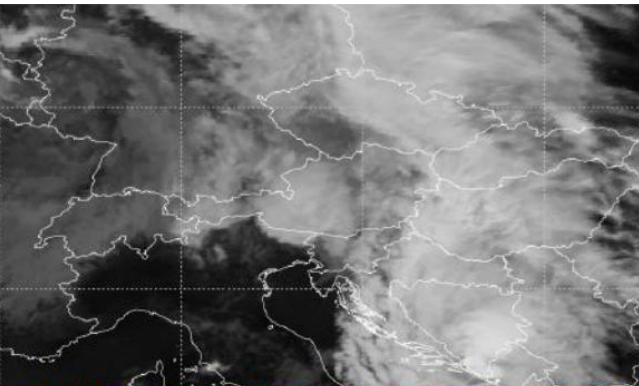
- AROME-OPER 2.5
- **AROME-RUC 1.3**
- **AROME-RUC 1.3 km with using new whitelist.**



All-sky IR assimilation

- ▶ All sky assimilation of IR channels of IASI within OOPS (cy48t3_bf3) EnVar.
- ▶ Preparation for the new MTG IRS (expected in summer 2025)
 - ▶ Code adaptation to activate all-sky in RTTOV for IR
 - ▶ Observation error linearly increases with the average cloud effect
$$C_A = \frac{|B - B_{CLR}| + |O - B_{CLR}|}{2}$$
 - ▶ Additional QC is implemented to reject data with large average cloud effect.

[S. Panežić \(HR\)](#), [B. Strajnar \(SI\)](#)



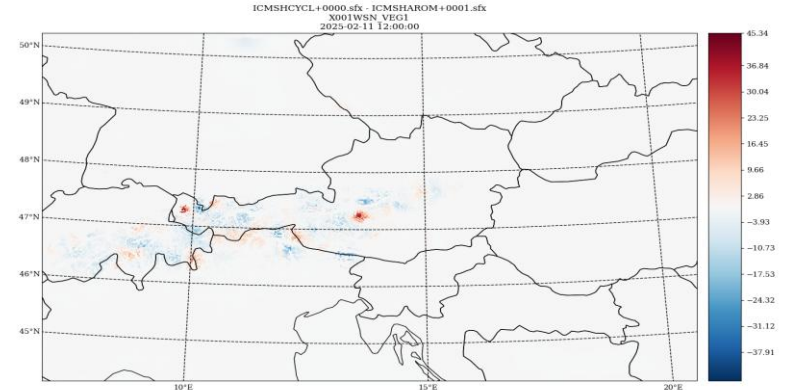
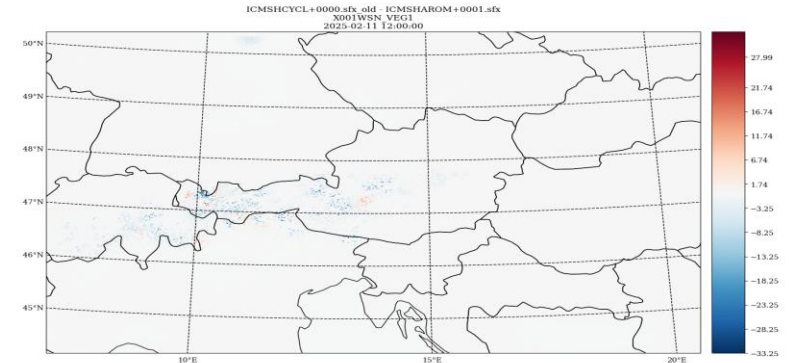
Case 09.09.2024. at 09 UTC:

- SEVIRI IR10.8 μm (upper picture),
- Cloud top product (lower left picture),
- High observation error values are assigned to the high and thick clouds with very low brightness temperatures (lower right picture; IASI channel 3105)

Snow DA in AROME

- ▶ Snowgrid model partially change FG snow field (before 100%, now only 10%)
- ▶ Snow analysis on in C-LAEF1k setting as in RUC system
- ▶ Quality checks, FG check and modification of LMESCANSN correlation function were tested
 - ▶ linear decrease with altitude down to 0. (not 0.5 like in T2m/RH2m)
 - ▶ RTCORSN(2)=0.002; REF_A_SN 12km->18km
- ▶ Improved snow monitoring tool

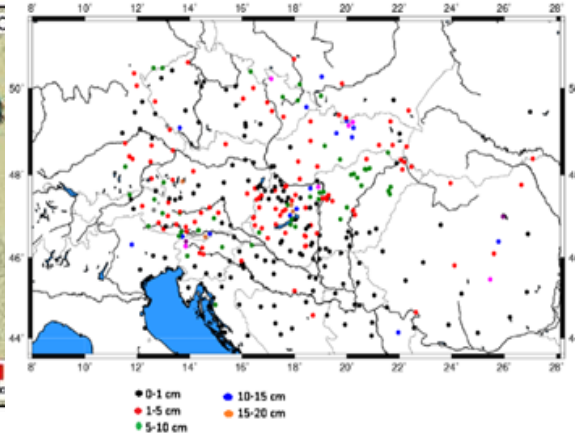
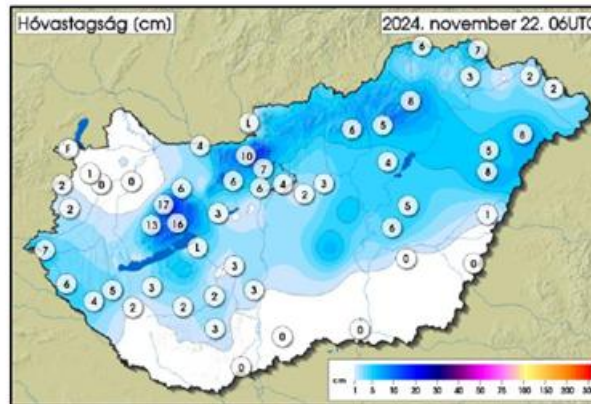
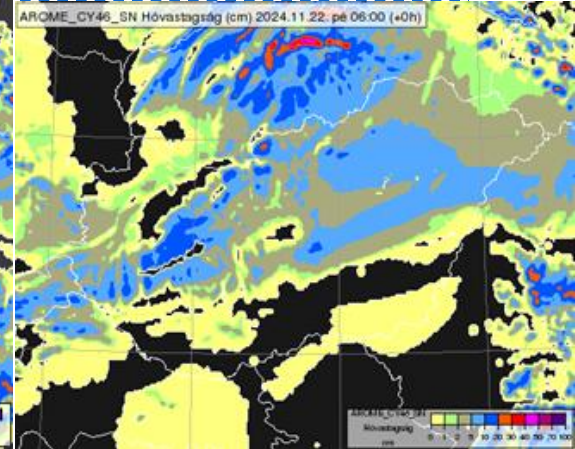
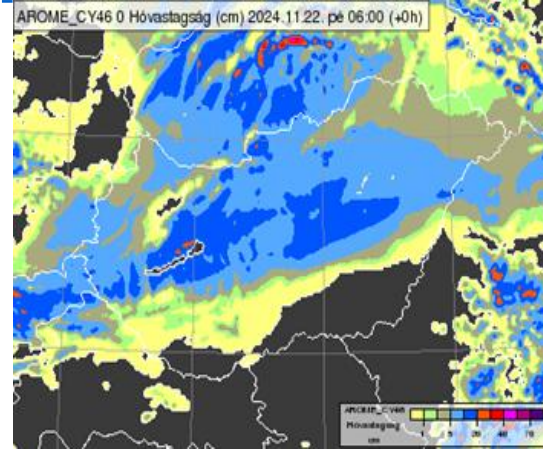
F. Meier, N. Kurshid (AT)



Snow increments from CANARI snow assimilation using the current setting (top) and MESCAN like correlation function (bottom) with linear decrease with altitude down to 0. (not 0.5 like in T2m/RH2m).

SYNOP snow depth assimilation in AROME/HU

- ▶ Uncontrolled snow depth data now immediately enter the database
 - ▶ Now provided also by oplace
- ▶ 1-layer (D95) snow scheme
 - ▶ Prognostic snow-water equivalent, snow density and snow albedo
 - ▶ LAESNM = T (active snow assimilation)
 - ▶ REF_S_SN = 5 kg/m² (background error standard deviation)
 - ▶ ECTERO(1,1,92,1) = 4 kg/m² (observation error standard deviation)



Helga Kolláthné Tóth (HU)

Snow depth analyses in AROME without (top left) and with (top right) assimilation of snow water equivalent, Hungarian SYNOP observations (bottom left) and observations in CANARI OI-MAIN (bottom right) at 6 UTC on 22 November 2024.

Upper air assimilation:

- ▶ TEMP descent data neutral impact
- ▶ Radars
 - ▶ New MDS calculation,
 - ▶ AI/ML inversion or reflectivity
 - ▶ Updated torus dealiasing
- ▶ GNSS – more stations and bugfixing
- ▶ All-sky assimilation – first runs are made

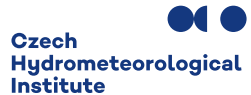
Surface assimilation:

- ▶ Snow analysis improvements

*Regional Cooperation for
Limited Area Modeling in Central Europe*



Thank you for your attention.



ARSO METEO
Slovenia