Regional Cooperation for
Limited Area Modeling in Central Europe

LACE
nwp central europe

Overview of LACE DA activities

Antonín Bučánek & RC LACE DA teams

GeoSphere Austria · DHMZ · Czech Hydrometeorological Institute · IMGW · HungaroMet Hungarian Meteorological Service · METEO ROMANIA · SHMÚ · ARSO METEO Slovenia

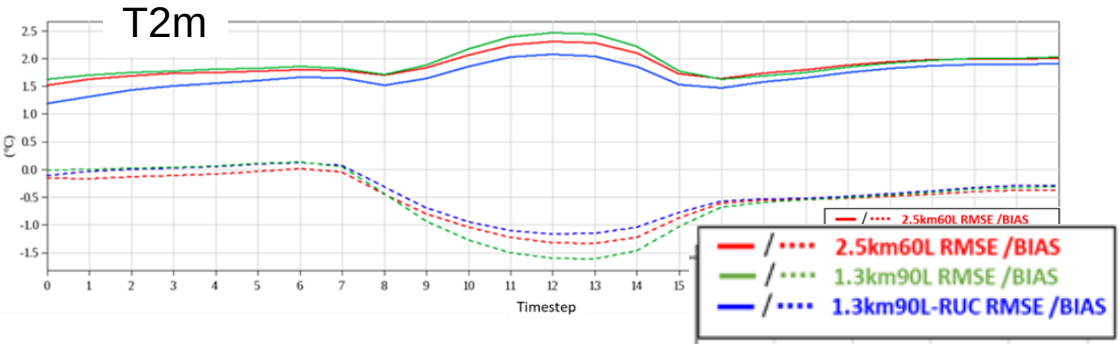
Operational DA systems in RC LACE

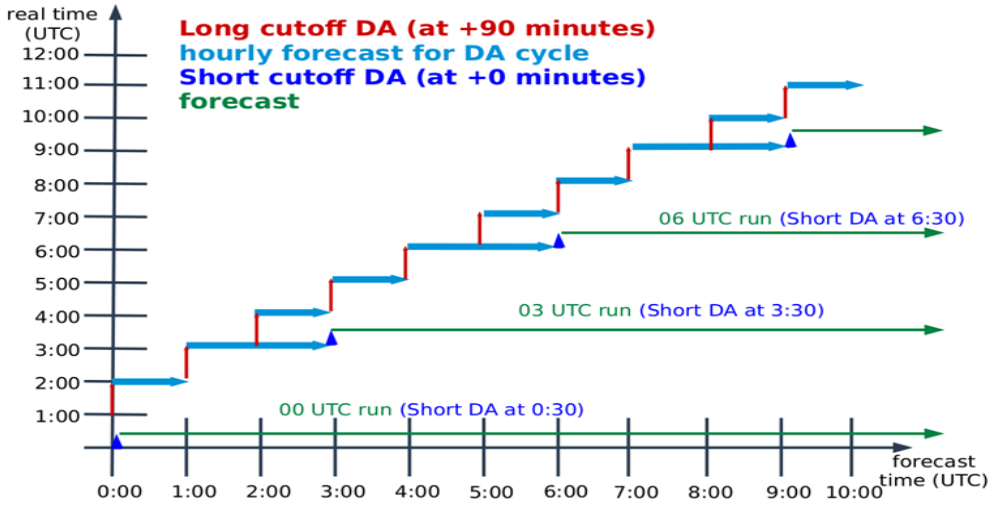
Recent activities and developments

- Upper-air DA assimilation
  - RUC, cycling strategy, initialization
  - Radar reflectivity assimilation
  - Nimbus (OPERA) validation
  - SEVIRI in All-sky conditions (talk A. NEDUNCHERAN)
  - Recent progress with GNSS derived data
  - Monitoring of observations
- Surface data assimilation
  - Superficial soil moisture
  - Assimilation of Snow
  - Tuning of soil analysis activity in OI

Assimilation cycling strategy for RUC

- **Clear benefit of AROME-HU RUC for precipitation in summer and T2m in winter**
- Tests with 3-h cycle in surface DA (HU)
  - Small improvement in winter while strong bias in summer
  - For simplicity 1-h cycling selected
- **Test suite 1-h AROME RUC (HU)**
  - 1.3L90, 3D-Var + SEKF; 120min long cutoff
  - 7xFC +12h per day, 30min short cutoff
  - guess from assimilation cycle (long cutoff) FC+2h used for short cutoff DA in productions
- **Testing 1-h ALARO RUC (SK)**
  - 1.0L63, 3D-Var, 30min cutoff
  - Optimal cycling strategy investigated





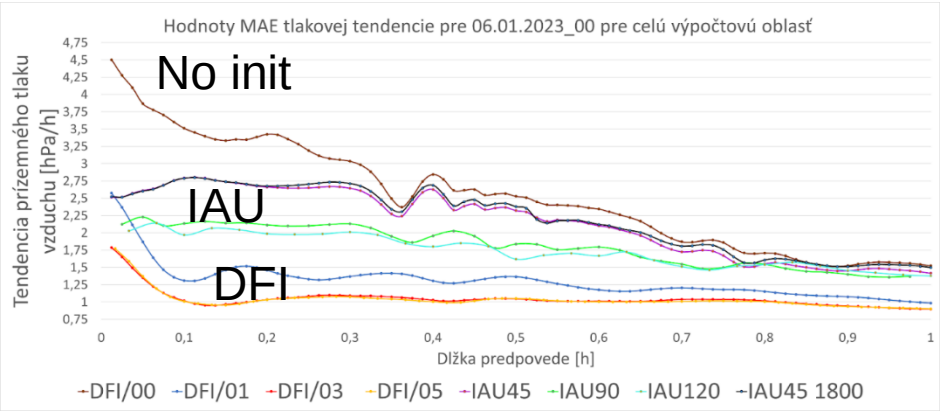
D. Lancz, A. Varkonyi, M. Nestiak

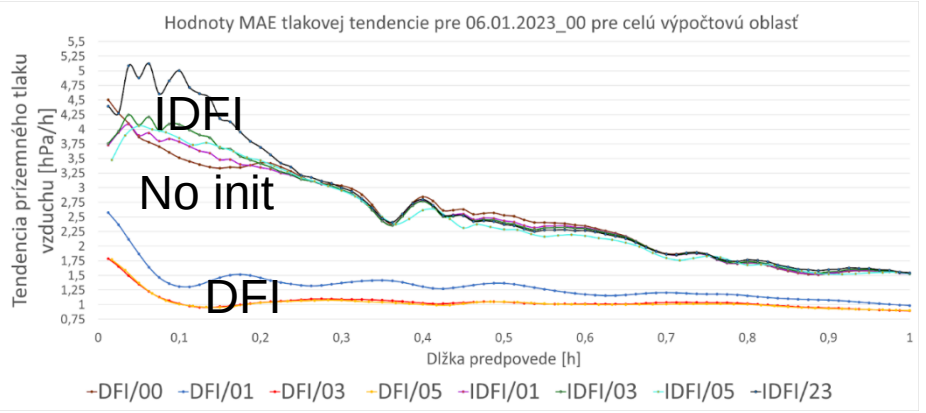
Initialization in RUC

Diploma thesis of Martin Petrovic: spin up in the experimental RUC setup (1km) of ALARO-SK

- Tested: DFI, IDFI, IAU
- Level of noise studied by ECHKEVO
- The DFI smoothed local meteorological structure too strongly.
- The IDFI filtering was mostly insufficient (or needs further tuning).
- The un-centered IAU has been evaluated as the best technique, to be further used at SHMU.

M. Petrovic, M. Derkova





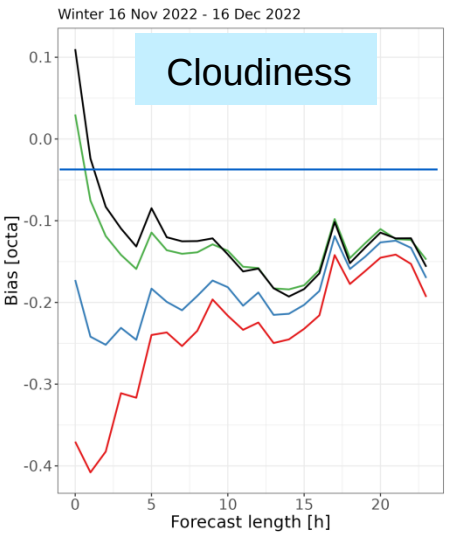
Impact of radar reflectivity in 3D-Var

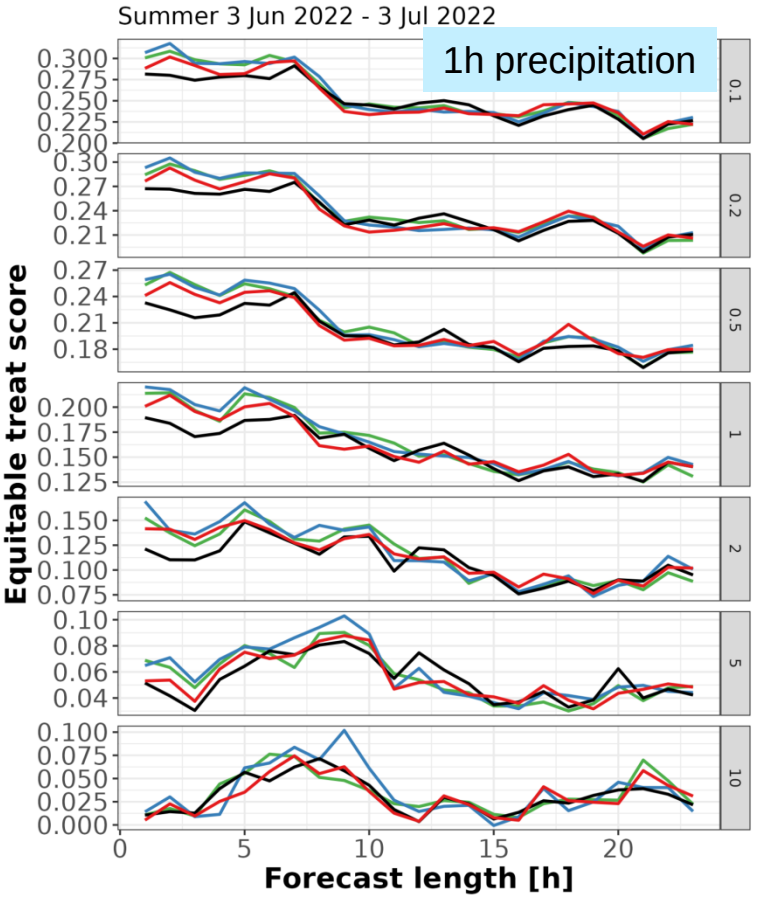
Proposals to suppress drying effect in Bayesian inversion

- Obs. error inflation: for undetect (“dry”) observations by a fixed offset
- Threshold approach: apply assimilation only when at least one RFL gate in observation column or in first guess is above threshold (we use 12 dBZ)
- **Ported to CY49T1**

Impact exp. in ALARO-CZ:

- Reference (no radar DA)
- Default inversion setup (AROME-FR)
- Increased observation error for dry cases
- Assimilate cases with reflectivity above rain threshold (12 dBZ)





A. Bučánek, S. Panežić, B. Strajnar, A. Trojáková

Impact of radar reflectivity in 3D-Var

- Croatia assimilates radar reflectivity operationally
- “Undetected/dry” observations have inflated error by 0.35
- Assimilation active only if reflectivity in model or observation is above rain threshold of 0.0dBZ
- 1h rain rates improved

S. Panežić and A. Zajec

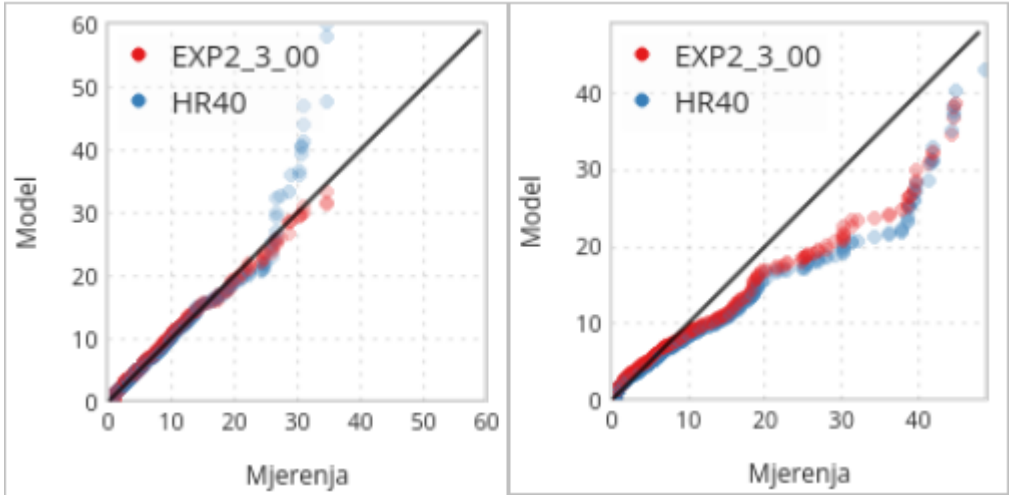


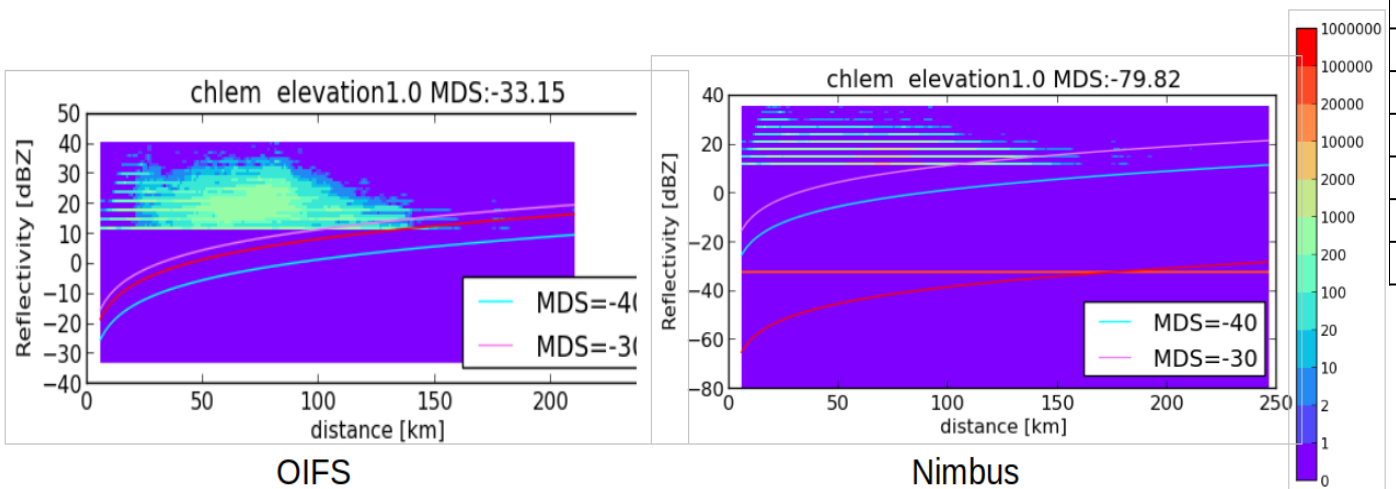
Figure: Comparison of 1h rain rates from the model and observations at the location of Croatian automatic stations; period 1.7.2023.-15.08.2023.; continental stations (left) and coastal stations (right); operational system (HR40) and radar DA (EXP2_3_00)

OPERA Nimbus validation

- Most of Nimbus radar sites had availability larger than 95%
- A few radars has lower availability in Nimbus
- Swiss and British radars have discrepancies between nodata and undetect attributes
- A parallel DA cycle with Nimbus refl. data was tested over period 7.12.2023.-4.1.2024 by Croatia with neutral impact.

Tab 1: The radar stations with the lowest number of available files from Nimbus vs OIFS production line over period 3.-10. 3. 2024 at CHMI.

RadarStation	OIFS avail. [%]	Nimbus avail. [%]
iedub	99	0
robob	1	0
rsfrg	100	0
plpas	99	1
romed	16	13
grand	55	15
rotim	48	44
grlar	100	54
esbad	59	56
norsa	64	59
plgda	99	67



OIFS Nimbus

CZ, SK, CR, SI, AT colleagues

Recent progres with GNSS-derived data

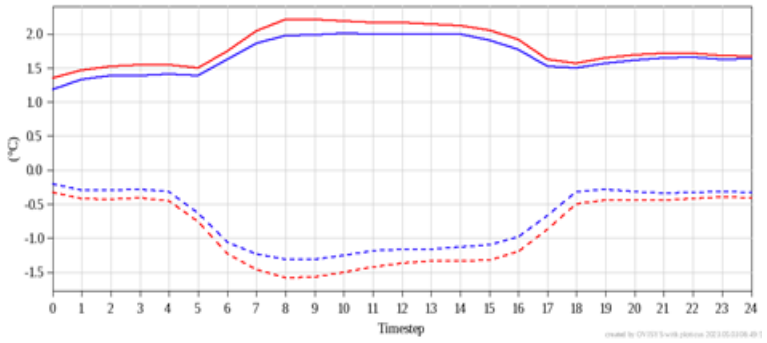
1) Switch of data provider in Hungary (Budapest University of Technology and Economics) due to bad quality of SGO1 (H. Toth)

2) ZTD trains in Austria: additional tests to mimic possible operational application (using subsets of data due to delayed provision), static bias cor. (F. Weidle)

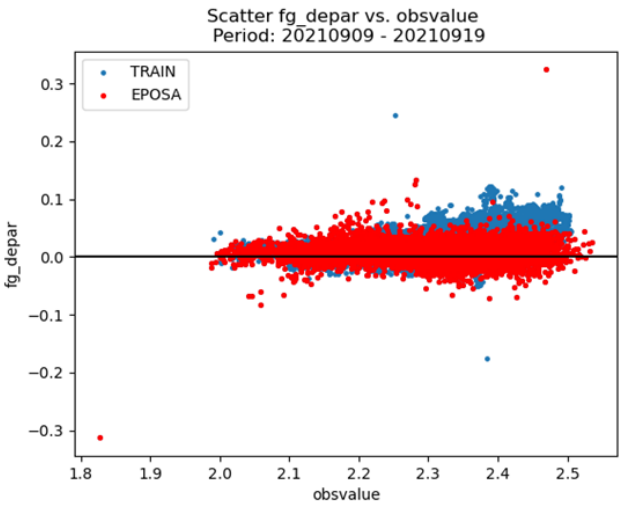
3) Finished phasing of slant total delays from CY48T1 to CY49T1 as a branch on the ACCORD IAL GitHub. (M. Imrišek)

4) InSAR Sentinel-1 delay assimilation with STD slant delay operator (de Haan and Imrišek) in cy43t2 3D-Var. Ongoing work on bias correction based on FG departure statistics. (F. Meier)

T2m verification using ZTD networks SGO1 and BMEG.

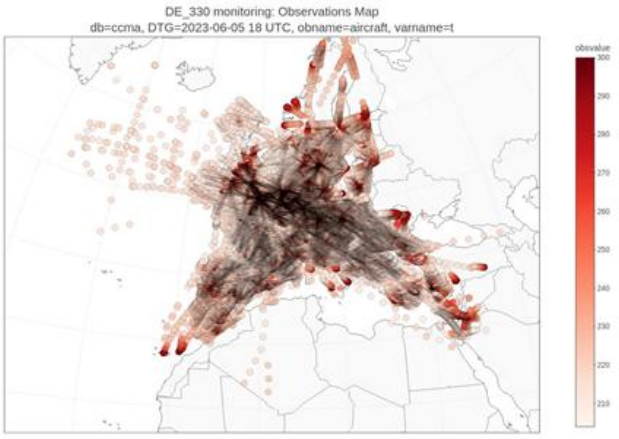


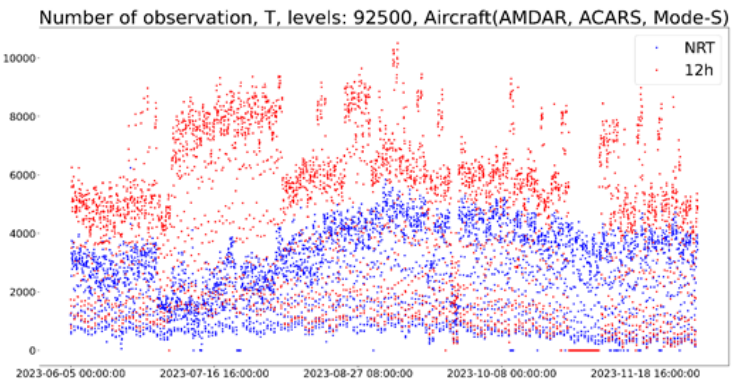
Comparison of ZTD from moving trains and permanent GNSS stations in Austria.



Monitoring, availability of observations

- DE_330: monitoring of observations on the European domain
- Main sources: ECMWF (dedicated SAPP extraction for members) and OPLACE
- Comparison of short cut-off (30 min) and delayed (12h) availability
- **Within first 30 minutes:**
  - **Almost all surface stations**
  - **75 % of aircraft observations**
  - **30-50 % of radiosondes (depending on observation time)**
- Dissemination speed cannot be augmented, given that the update times of the OPLACE and ECMWF extraction for member states align with the operational requirements of the existing LAM DA suites.





B. Strajnar, N. Kastelec

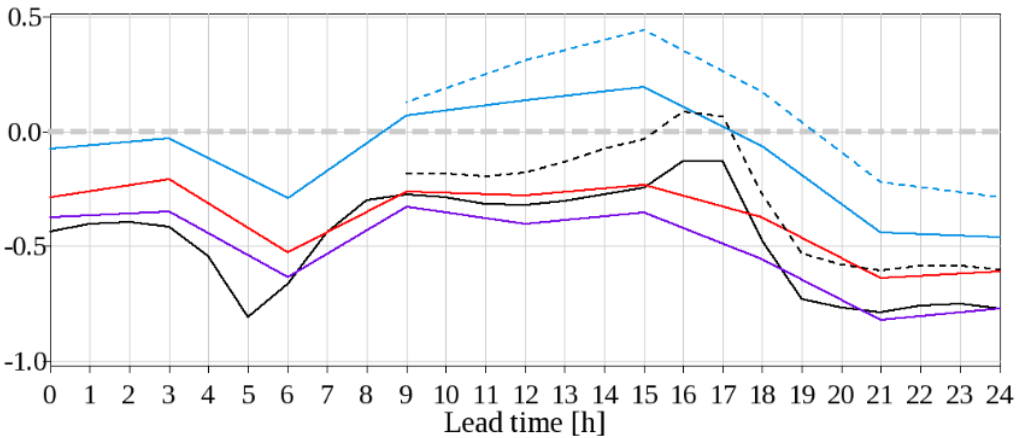
Assimilation of superficial soil moisture

- Inline DA of satellite based superficial soil moisture (SSM) observations with SURFEX through SODA/SEKF.
- Observations: H08–SM-OBS-2 (H08) by EUMETSAT, based on ASCAT, 2 x day ~ 9, 19UTC
- Scaling and processing of raw data (25 km) to 1 km at GeoSphere
- CDF matching technique used to calibrate the observations (remove bias)
- Near-real time product, feasible for operations

- 2m dewpoint underestimated
- Night temperature is overestimated by all runs

Experiments	REF	ECM	JFM	HYB
Surface observations	SYNOP T2M, HU2M	ASCAT SM	ASCAT SM	SYNOP T2M, HU2M ASCAT SM
Control variables	WG1, WG2, TG1, TG2	WG1, WG2	WG1, WG2	SYNOP: WG1, WG2, TG1, TG2 ASCAT: WG1, WG2
Observation errors	1 K, 7 %	0.05 m^3/m^3	0.06 m^3/m^3	SYNOP: 1K, 7 % ASCAT: 0.05 m^3/m^3
Model errors	0.1 m^3/m^3, 0.15 m^3/m^3, 2 K, 2 K	0.01 m^3/m^3, 0.01 m^3/m^3	0.06 m^3/m^3, 0.03 m^3/m^3	SYNOP: 0.1 m^3/m^3, 0.15 m^3/m^3, 2 K, 2 K ASCAT: 0.01 m^3/m^3
Surface analysis [UTC]	0, 3, 6, 9, 12, 15, 18, 21	9, 18, 21	9, 18, 21	SYNOP: 0, 3, 6, 12, 15 ASCAT: 9, 18, 21
Reference	-	de Rosnay et al., 2013 DOI:10.1002/qj.2023	Mahfouf, 2010 DOI:10.1002/qj.602	-

2-metre dewpoint bias [°C], May 2023, 0 UTC (full line) and 9 UTC (dashed) runs



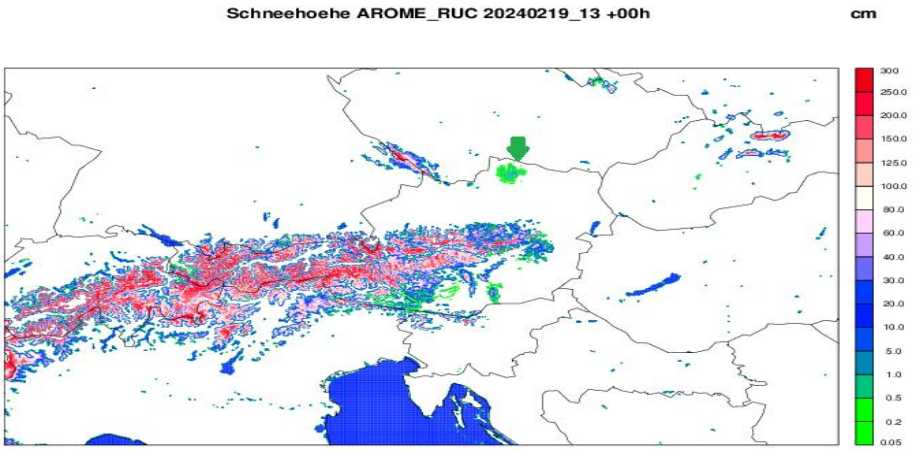
M. Ličar, H.Toth, S. Schneider

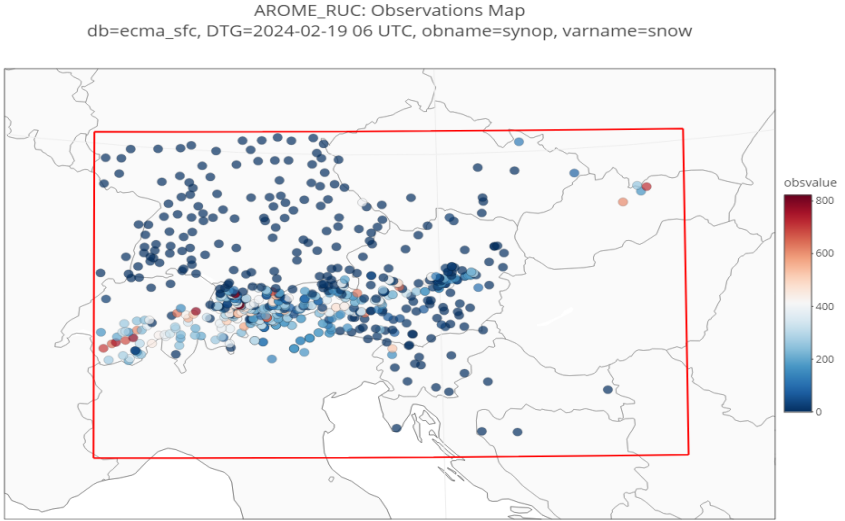
Assimilation of Synop snow

- Synop snow height in CANARI is independent of station height and therefore mountain peak station data often get rejected due to higher total snow amounts
- rejection limit made dependent on height in Austria

In Hungary

- all snow measurements have to be checked by human
- Significant delays in availability
- New uncontrolled data will be available soon
- First test with assimilation on cy43 indicates problems plan to test on cy46

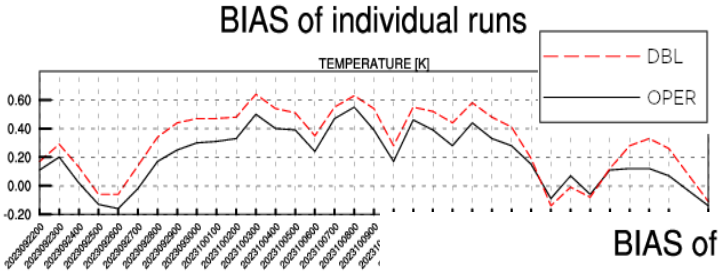




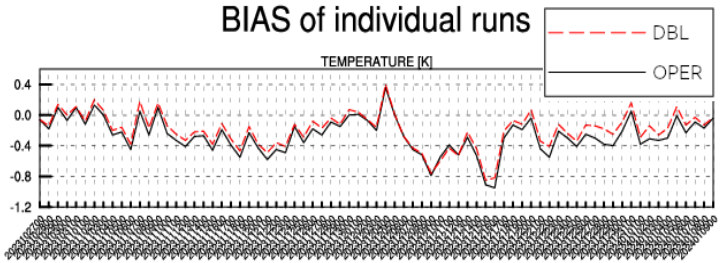
F. Meier, B. Szintai

Tuning of soil analysis activity in OI

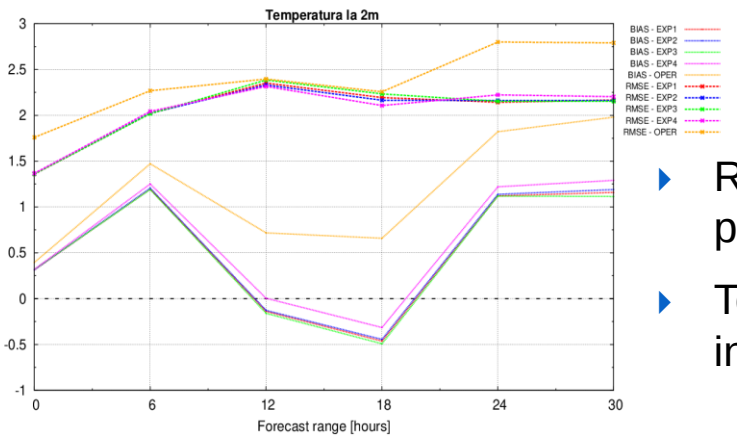
- CANARI at CZ had to be retuned in 3-h cycling due to bias in T2m
- DBL tuning of 3-h cycle:
  - relaxation to clim. but with half the coefficients of the 6-h cycle,
  - no relaxation to snow climatology
  - LISSEW=T, NLISSEW=7
  - sun declination function
- Launched in operations in February 2024



Before tuning



After tuning



- Romania, OI improves screen level parameters compered to dynamical adaptation
- Testing sensitivity on different polynomes ISBA in CANARI

A. Bučánek, R. Brožková, A. Dumitru

Summary

- RUC – optimal cycling
- Reflectivity
  - Fine-tuning of Bayesian inversion
  - Nimbus validation
- Feasibility studies with several non-conventional observation types (GNSS, microLinks)
- Observation monitoring
- Surface assimilation:
  - SEKF applied SSM
  - Synop snow assimilation
  - Diagnosis and refinements of OI, in context of short assim. cycles

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Thank you for your attention.

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ARSO METEO Slovenia