Regional Cooperation for
Limited Area Modeling in Central Europe

LACE
nwp central europe

Data assimilation activities CHMI

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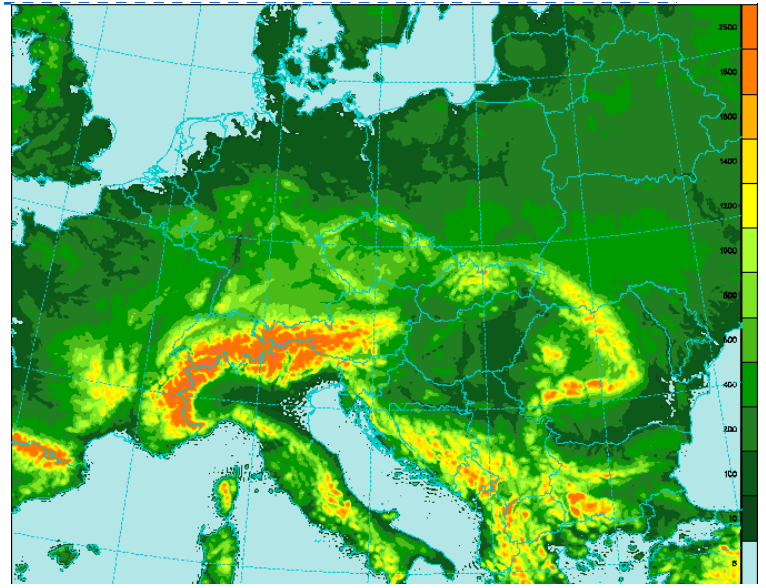
GeoSphere Austria · DHMZ · Czech Hydrometeorological Institute · IMGW · HungaroMet Hungarian Meteorological Service · METEO ROMANIA · SHMU · ARSO METEO Slovenia

Operational Setup at CHMI



- **ALARO NH-v1B cy46t1mp_op3**:
  - domain: Δx 2.3km, 1069x853GP, time step 90s
  - 87 vertical levels, mean orography
  - 1h 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
  - **3h assim cycle**, no IDFI in the next +3h 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

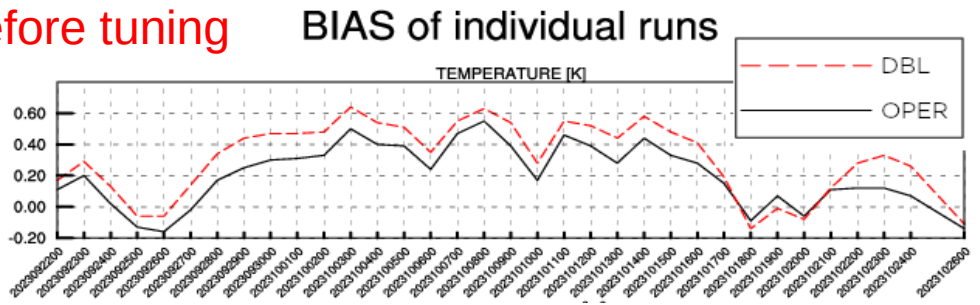
Progress summary since last DAWD

- Increase of long cut-off assimilation frequency to 3h & new setting of surface assimilation and snow roughness (Feb 2024)
- Snow analysis for ALARO (using ISBA)
  - mostly technical validation & familiarization - master thesis of Jáchym Ševčík
- SEVIRI data assimilation (Sep 2024)
- Assimilation of OPERA radar data
  - Technical validation of NIMBUS - stay of Michal Neštiak
  - Further evaluation of reflectivity DA, optimization/vectorization
  - Radial wind DA - stay of Martin Petrovič

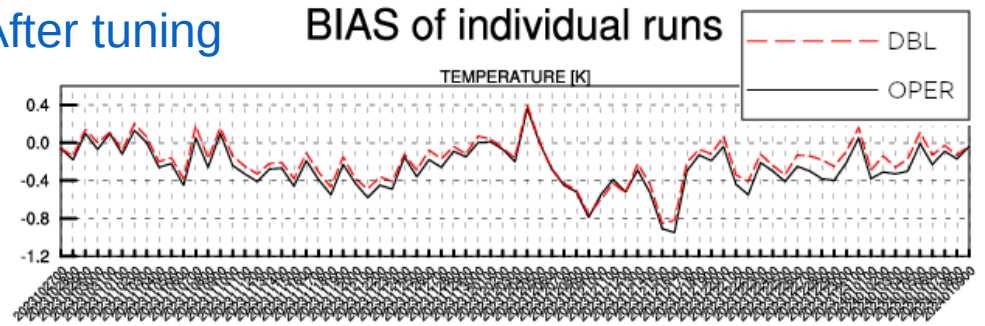
Tuning of soil analysis activity in OI

- 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, RCLIMCA=0.0225,
  - no relaxation to snow climatology, RCLIMSN=0.,
  - Averaging of soil moisture increments, LISSEW=T, NLISSEW=7 (3h-cycling)
  - Sun declination function, SMU0=-1., FPDMAX=0.5, FPDMIN=0.125,
  - SPRECIP=0.15
- Launched in operations in February 2024
- Unfortunately not in common code yet, modset can be provided on request.

Before tuning



After tuning



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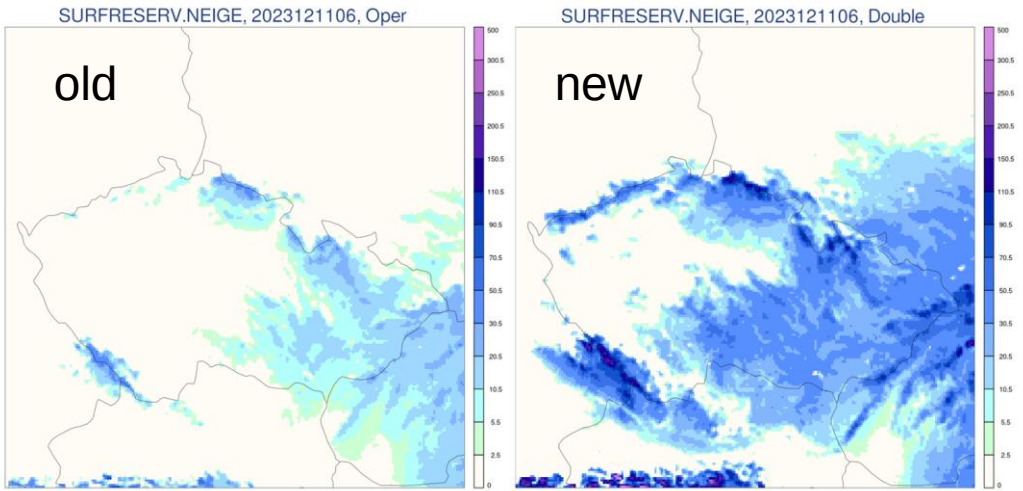
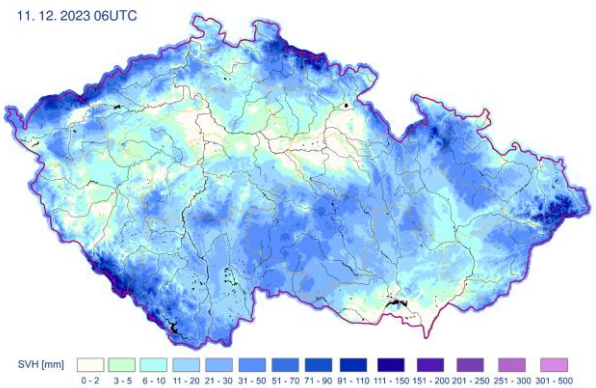
New snow treatment (within 3h cycling)

- When switching to a 3-hour cycle the relaxation to the climatology was halved (RCLIMCA=0.0225) for soil params & switched off for snow to get more realistic snow amount
- New treatment of the roughness of the vegetation covered by snow (LZ0SNOWH=T, RZ0_TO_HEIGHT=0.1) was introduced (available since CY49T1)



observed



Snow data assimilation (ALARO+ISBA)

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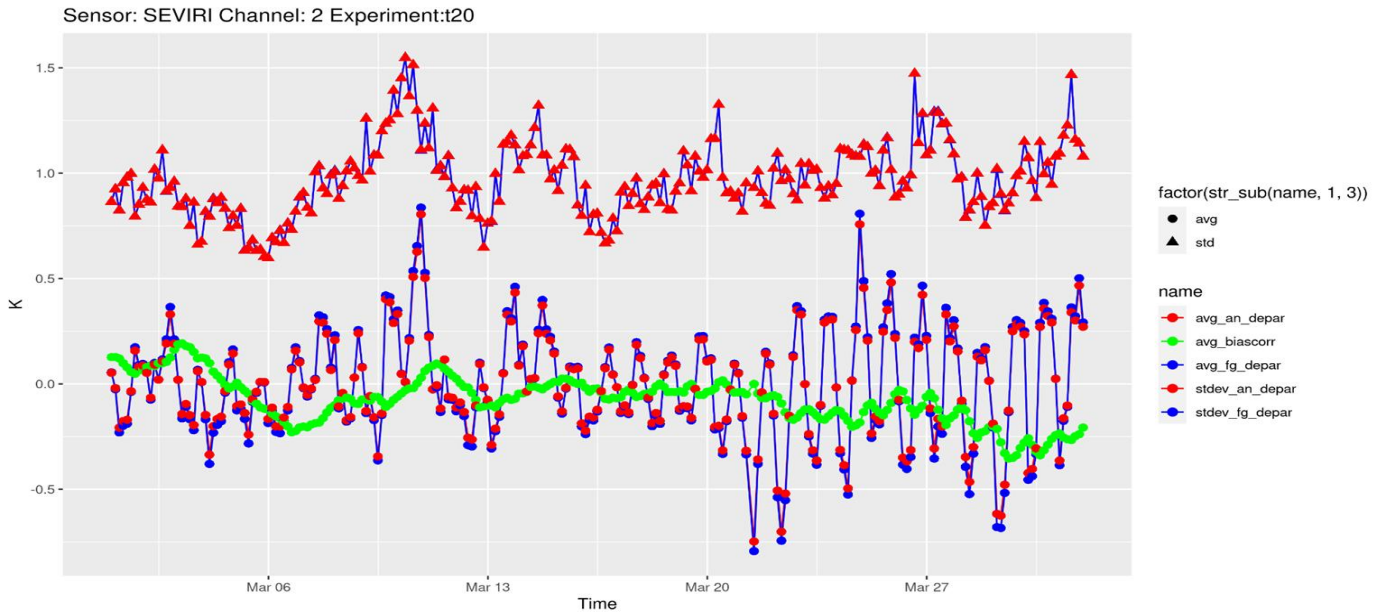
- CANARI technical validation & code familiarization (master thesis of Jáchym Ševčík)
  - snow analysis currently coded only for SURFEX -> enabled for ISBA
  - bf for CANARI analysis flag (datum_anflag.*@body) (MF oper branch) NFLCAN replaced by individual codes NCUT2M,NCUH2M,NCUSN,...
  - Ongoing test of flexible rejection limit for snow QC over mountains (LAOROFLEXREJSN kindly provided by Florian Meier)

SEVIRI data assimilation

- SEVIRI withdrawn after exchange of Meteosat-10 and Meteosat-11 in March 2023 (due to significant bias (~1K) with unusually large diurnal variations)
- various VARBC warm-up strategies tested, finally cold start with increased adaptivity was considered



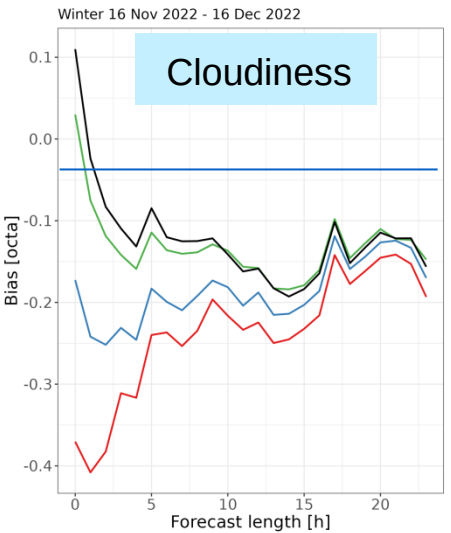
Impact of radar reflectivity in 3D-Var

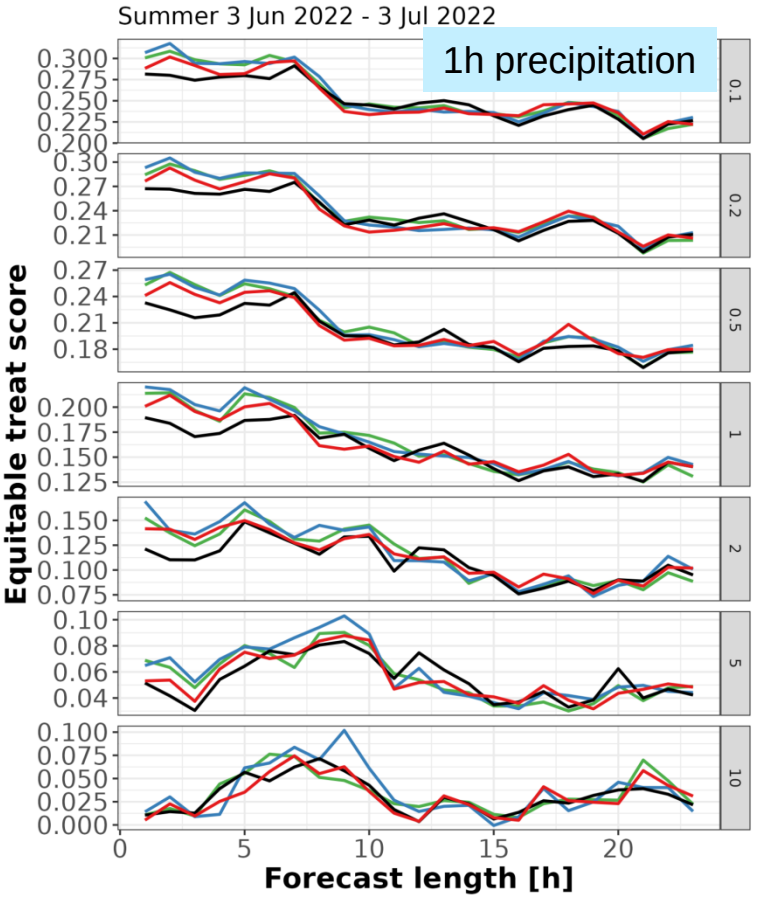
Proposals to suppress drying effect in Bayesian inversion

- 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)





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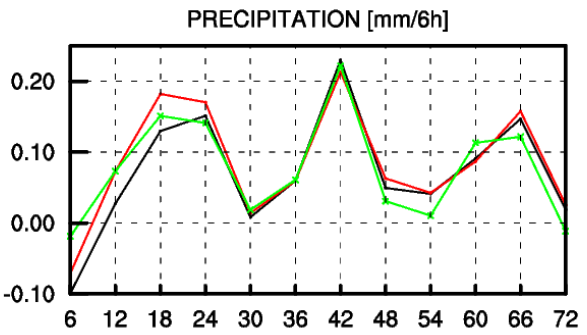
Radar reflectivity assimilation extension & fixes.

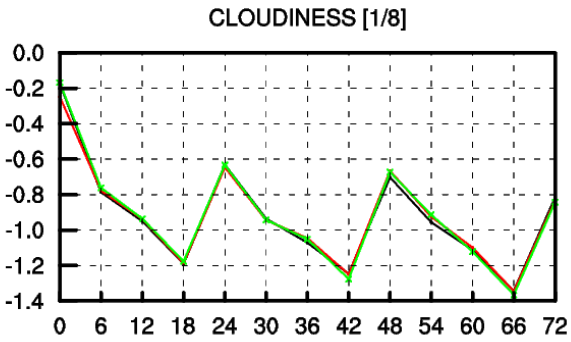
- LRADAR_DENSITYFIX - T to fix density in reflsim_2dop.F90 (default F)
- LRADAR_STORE_REAL_FG - T to store real values of FG in odb [no rewriting of FG refl in inv_refl1dstat.F90] (default F)
- LRADAR_RAINTHR - remove model profiles that have no significant rain (DBZ) in obs or model
- RRADAR_DIST - distance for searching model profile is put to namelist instead of hard coded value (radar_prof.F90).
- LRADAR_NMBDO - T to Not Moisten By Dry Observation the model (flgdyn==0)
- LRADAR_PROFCHECK - T check profiles /= RMDI before averaging (default F)
- LRADAR_SIGMA3CHECK - T profiles which are too far from obs removed from averaging (default F)
- LRADAR_CDOF - Check Dry Obs Flip of sign [only works when LRADAR_STORE_REAL_FG=.T.] (default F)
- LRADAR_MAXHEIGHT - Use limitation of height for reflectivity assimilation (default F)
- Report on RCLACE, Bučánek(2023)

Promising setup of reflectivity assimilation

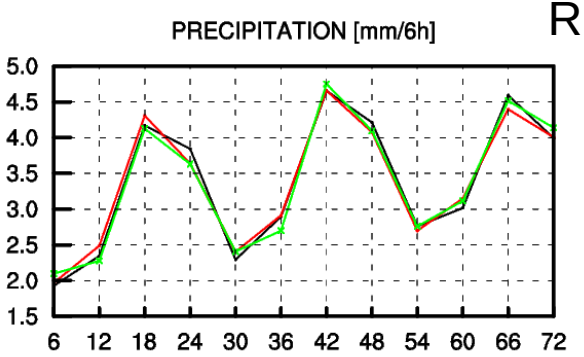
- Optimization and vectorization of screening of NEC Aurora machine (10min before, 2min after)
- Combination of Threshold method and obs. Error inflation method LRADAR_RAINTHR=0, ZRADARXSIG=0.2, RRADAR_DIST=200000,
- Bator RRADAR_OFFSET_DOE =0.35

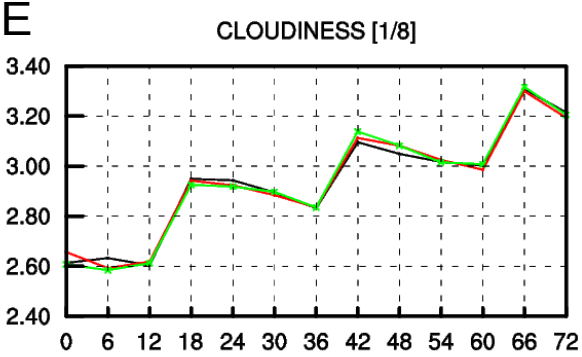
Bias





RMSE





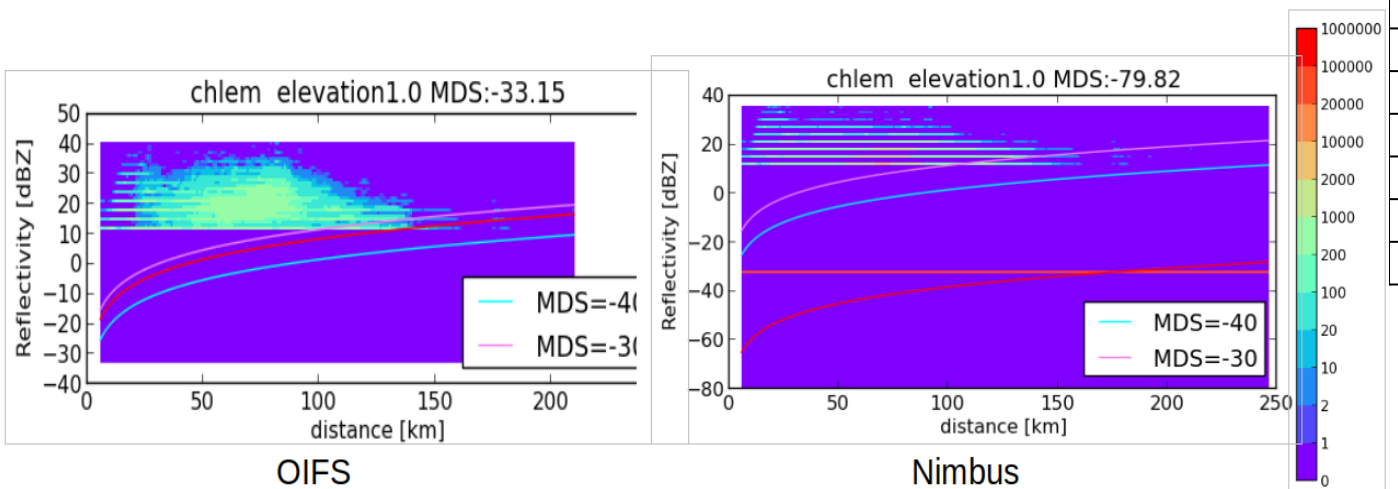
OPER, RADAR EXP, RADAR EXP + ALARO obs operator

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

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Thank you for your attention.

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IMGW
HungaroMet Hungarian Meteorological Service
METEO ROMANIA
SHMU
ARSO METEO Slovenia