Regional Cooperation for
Limited Area Modeling in Central Europe

LACE
nwp central europe

LACE verification activities

Doina-Simona Tașcu with contributions of LACE partners

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

Implementation of Panelification tool in HARP @Austria

Setting up environment

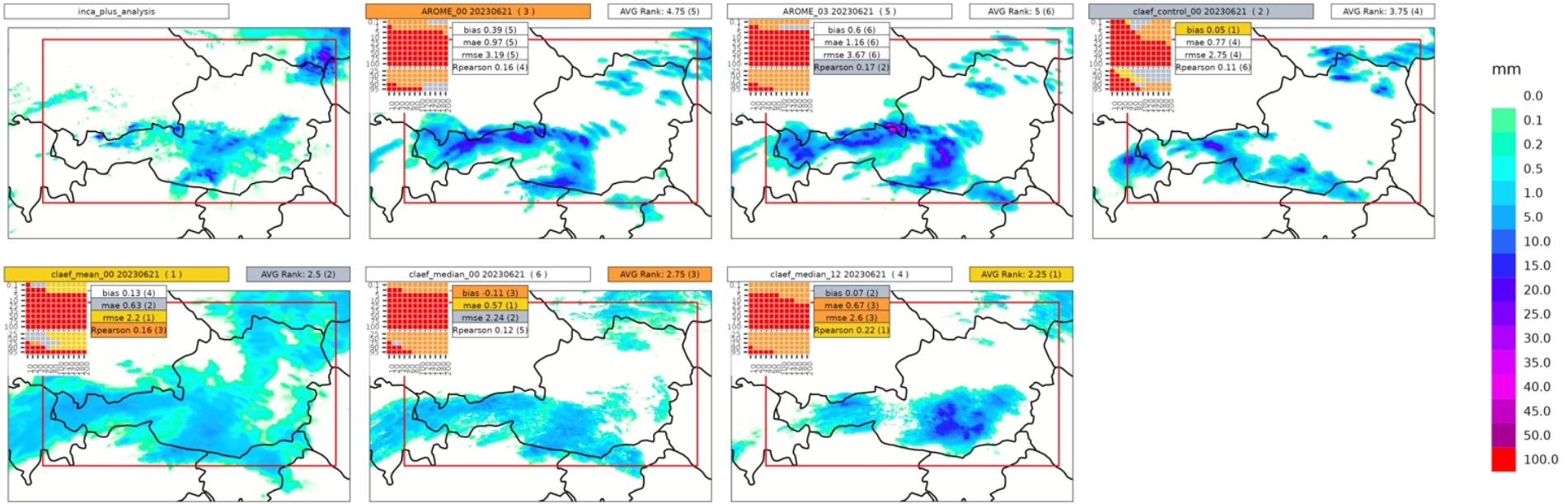
- conda (mainly for R version on virtual machine)
- renv (for R packages installed within R)

harpSpatial

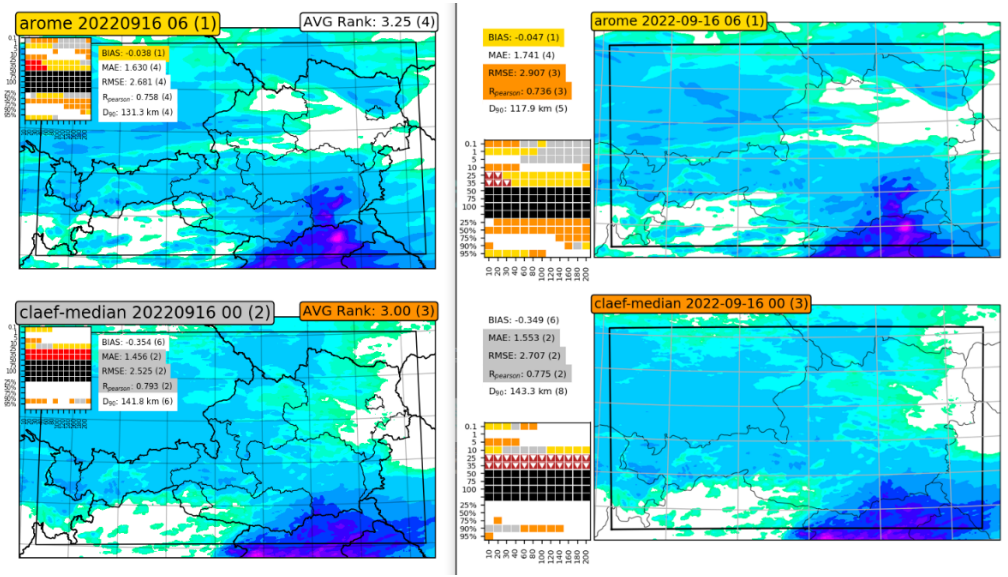
- Added scores rmse, RPearson, FSS percentiles to local harpSpatial
- **Distinguish** between regridding domain and verification domain
- Allow returning of regridded precipitation fields & verification domain
- Add **unit_factor** to assure same units of the fields

Panelification with HARP spatial @Austria

AccPrec1h: 21/ 06/ 2023 17 UTC

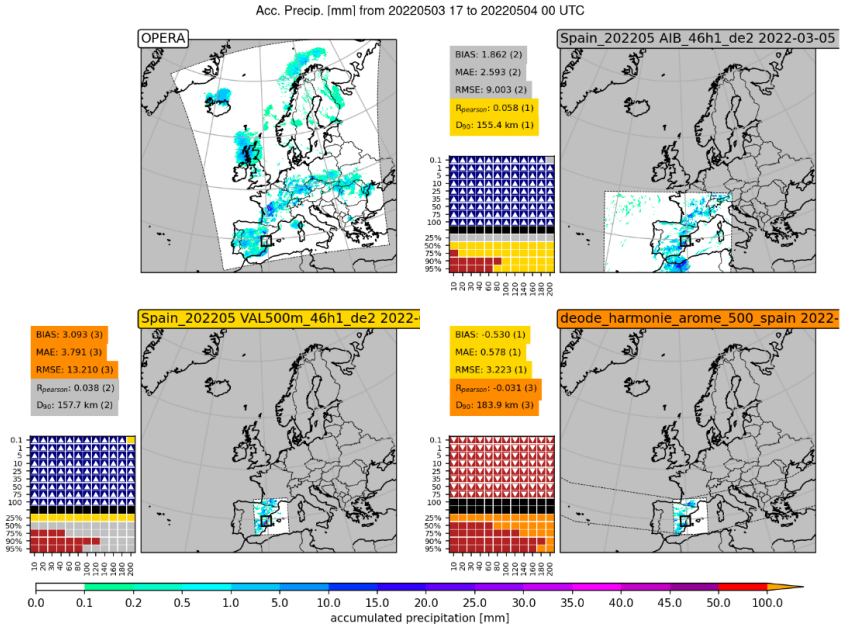


Updates to Panelification @Austria



- the scores are now shown outside of the map to not cover any part of the precipitation field
- the FSS ranking plots now also include information on whether the model is over or underestimating the precipitation for the given window and threshold
- comparison between the old (left) and updated (right) panels
- the slight change in the shape of the verification domain is due to the updated and more general method

Updates to Panelification @Austria



- the technical work on Panelification was mostly related to DE330
- New features were implemented as follow:
  - to improve and complete the panelification web mask
  - to add ECFS capability in order to use input files stored on ECFS
  - to add MARS capability for retrieving data from MARS and use data in Panelification
  - to add the possibility to verify the Destination Earth Digital Twin from ECMWF
- It was started the collaboration with AEMET (Spain) and RMI (Belgium) to work on verification outside of Austria

Scientific upgrades:

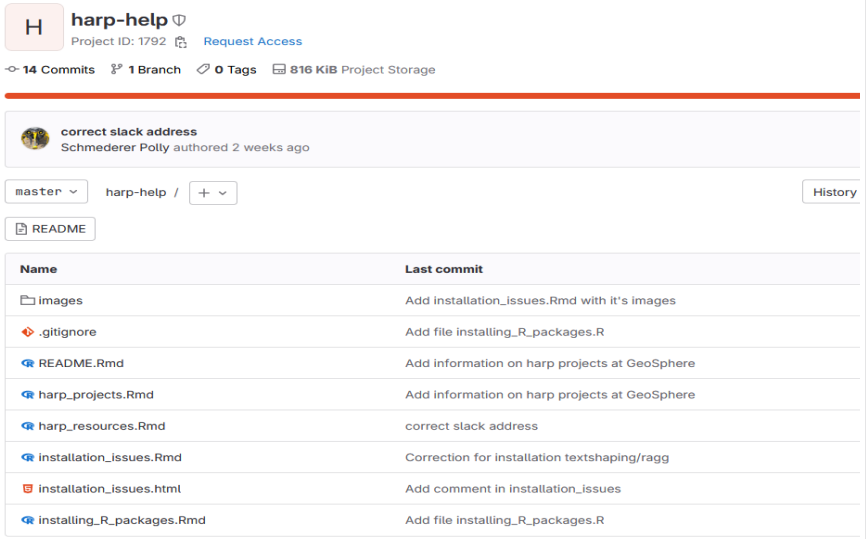
- verification subdomains - based on a 1-km grid on a stereographic projection
- observations and model are always interpolated to this new grid
  - ==> This solves a previous problem, where meridian convergence and the projection of the observation grid could cause the verification domain to deviate from the desired rectangular shape

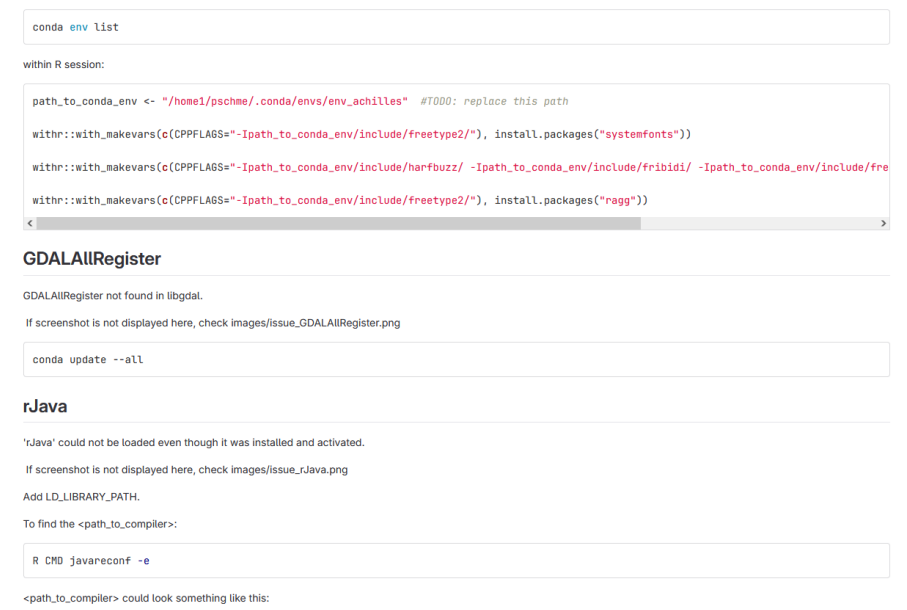
Updates to Panelification @Austria

- in the Framework of the DEODE Project, the code was partially refactored to accomodate a wider range of regions and simulations
- it was made significantly easier **to add new regions and verification subdomains**
- the map generation was improved, it does not require individual border files for each country but will generate any borders and coastlines worldwide automatically
- the panels are now checked for their aspect ratio and the paneling is adjusted accordingly

HARP @Austria

- installation of HARP releases on GeoSphere verification servers
- migration work of operational verification scripts to new HARP releases
- migration of harp-panelification to HARP 2.0
- setup of an internal Help and Documentation gitlab-site for operational and development duties collecting all kinds of harp-related information: installation instructions, known issues, links to projects using harp





HARP linked to OPLACE database @Slovakia

Martin Petras in collaboration with Alena Trojáková

For this purpose, the verification was performed by using

- HARP version: *remotes: install_github("meteorolog90/harp-develop", "develop")*
- VERAL - point verification and elementary spatial analysis

Two formats of observation data:

- obsoul from OPLACE
- vobs from ECMWF observation database

HARP linked to OPLACE database @Slovakia

harp_params.R

Variable names and corresponding numbers (varno) in obsoul files

varno	name	harp name
1	mean sea level pressure	Pmsl
39	2m temperature	T2m
58	relative humidity	RH2m
7	specific humidity 2m	q2m
41	wind speed&direction	S10m,D10m
91	cloudiness	CCtot

varno	name	harp name
79	1h precipitation accumulation	AccPcp1h
80	6h precipitation accumulation	AccPcp6h
81	minimum temperature	Tmin
82	maximum temperature	Tmax
92	snow depth	Snow

Added new variables with corresponding numbers

HARP linked to OPLACE database @Slovakia

- to read and perform T2m correction from FA files
- the surface geopotential name was replaced in **get_fa_param_info.R** from *SURFGEOPOTENTIEL* into *SPECSURFGEOPOTEN*
- *the* SHIP was removed - in order to avoid the duplication obstype number (SYNOP and SHIP have the same obstype number) when the merge of the GTS and national obsouls data is done

HARP linked to OPLACE database @Slovakia

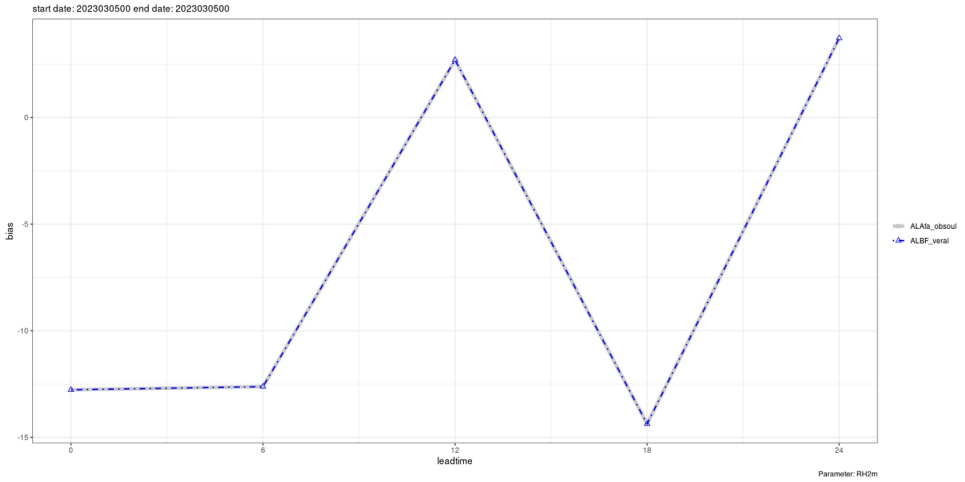
- Comparison of HARP and VERAL scores:
  - one station Praha-Ruzyne
  - for one day: 05.03.2023
  - for 00 UTC

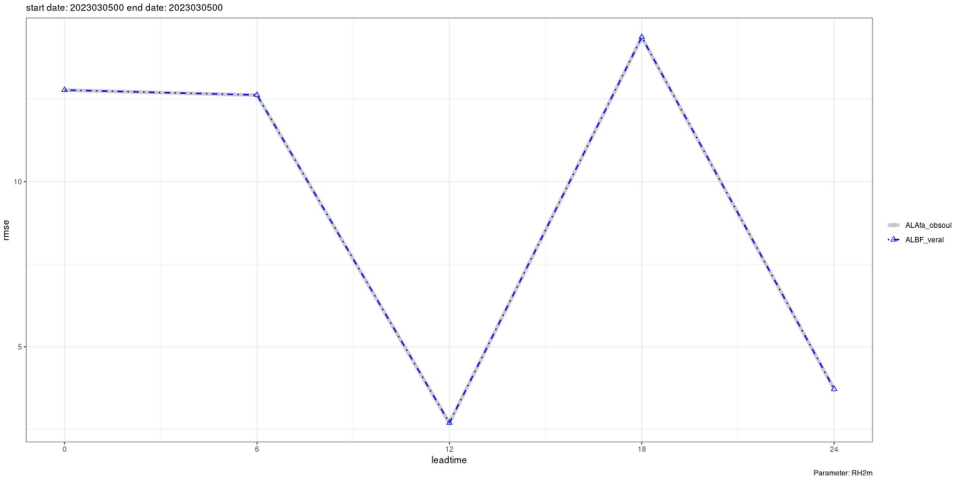
  - the validation was performed for several parameters: T2m (without height correction), RH2m, WS10m, D10m, CCtot

HARP linked to OPLACE database @Slovakia

- This comparison helped to identify several issues:
  - Harp counts only four precipitation fluxes (SURFPREC.EAU.CON, SURFPREC.EAU.GEC, SURFPREC.NEI.CON, SURFPREC.NEI.GEC)
  - while VERAL consider five of them, in addition, there is SURFPREC.GRA.GEC - the precipitation flux of new prognostic graupel
  - overall the scores from both tools are fairly similar

HARP linked to OPLACE database @Slovakia





BIAS (left) and RMSE (right) for RH2m using Harp (gray) and VERAL (blue dotted)

HARP linked to OPLACE database @Slovakia

Obsoul implementation is now part of the official version of Harp and the source code can be found here:

- https://github.com/harphub/harpIO/tree/master

An example of reading/writing an obsoul file:

```
obs <- read_obs(
seq_dttm(2023030100,
file_path = "/work/mma266/obs",
by = "1h",
file_template = "{YYYY}/{MM}/obsoul_1_all_{
output_format_opts = obstable_opts ( path =
"/work/mma266/obsoul/test-26-
return_data = TRUE
)
```

- Also, in Slovakia the work continued with HARP implementation for RUC, RUC 1 and ALA1 suites.

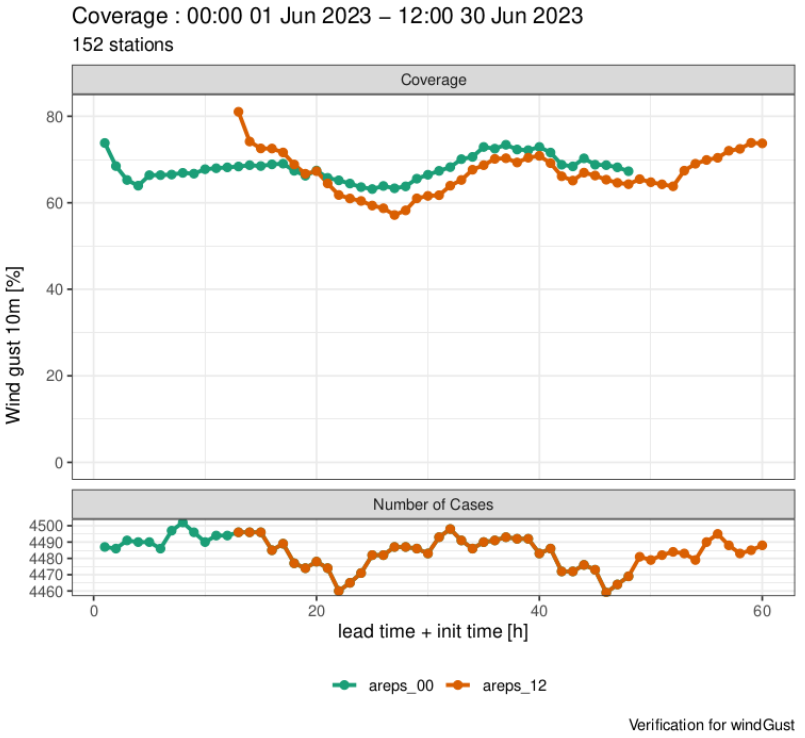
Using HARP for verification of AROME-EPS @Hungary

- already **done** the prepared scripts to verify all relevant surface and upper air parameters, for a pointwise comparison with OMSZ surface stations and available radiosonde measurements
- forecasts and measurements are available in NetCDF and GRIB format
- **local** reading routine for the special NetCDF files
- GRIB files are handled with the built-in function of HARP, wind and precipitation components are treated separately

Using HARP for verification of AROME-EPS @Hungary

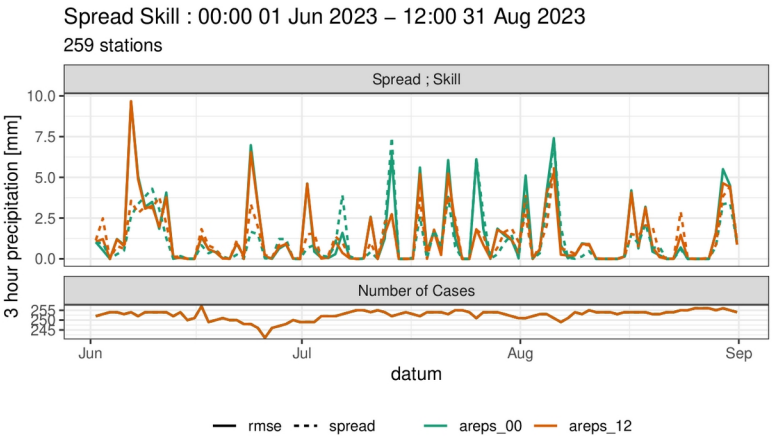
- A series of plots were produced and put into PDF report using:
  - R library
  - Markdown editor

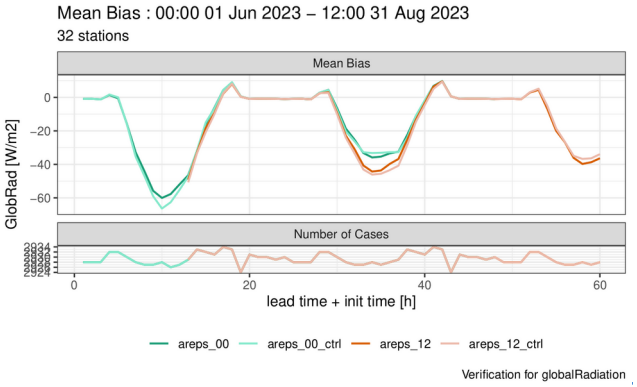
- AROME-EPS verification for June 2023
- for **00 UTC** and **12 UTC** runs
- ensemble coverage [%] for 10 m wind gust as function of lead time (shifted by forecast initialization time)



Using HARP for verification of AROME-EPS @Hungary

- **preparing for the operational verification with HARP**
- radiosonde measurements from NetCDF files converted from BUFR format produced by OPLACE were used
- in HARP, bias and RMSE of the control member to EPS were added to the score table, to compare EPS mean and single forecast runs
- the saving data for interactive visualization with Shiny was included
- seasonal verification was tested
- harpIO 0.9186 and harpPoint 0.9105 were used





Verification of AROME with new cloud parameterization @Hungary

- in order to investigate the impact on convection - running in parallel for summer period (end of June 2023 until mid-September)

  AROME-TEST [LOSIGMAS=T, VSIGQSAT=0.02]

  AROME/HU [LOSIGMAS=F]

- objective and subjective evaluations were carried out, including also the forecasters

Verification of AROME with new cloud parameterization @Hungary

- summer 2023, differed significantly from the dry summers of the last 2 years
- more than average precipitation fell - in the form of showers and thunderstorms
- precipitation structure was more discrete and isolated
- the number of precipitation objects became more accurate in the AROME-TEST based on the SAL
- according to the forecasters, in many cases this was closer to measurements, but sometimes led to overestimation or false precipitation objects

Verification of AROME with new cloud parameterization @Hungary

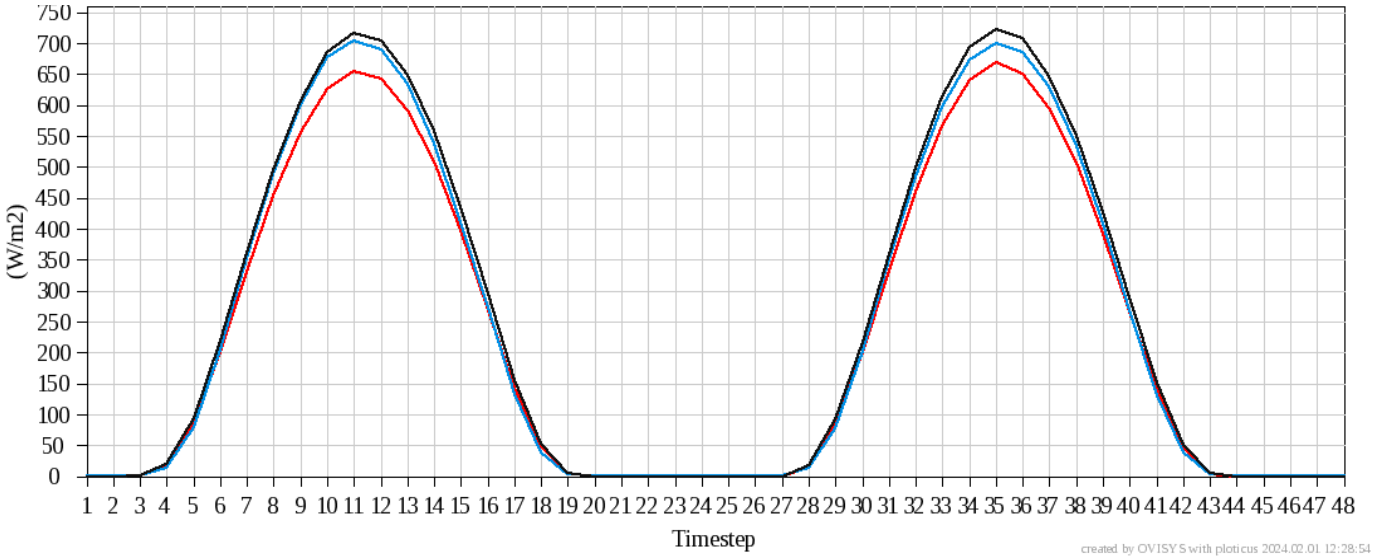
1-hour global radiation

00 UTC between 26 June and 15 September 2023

AROME/HU

AROME-TEST

observations



Verification of AROME with new cloud parameterization @Hungary

12-hour maximum temperature

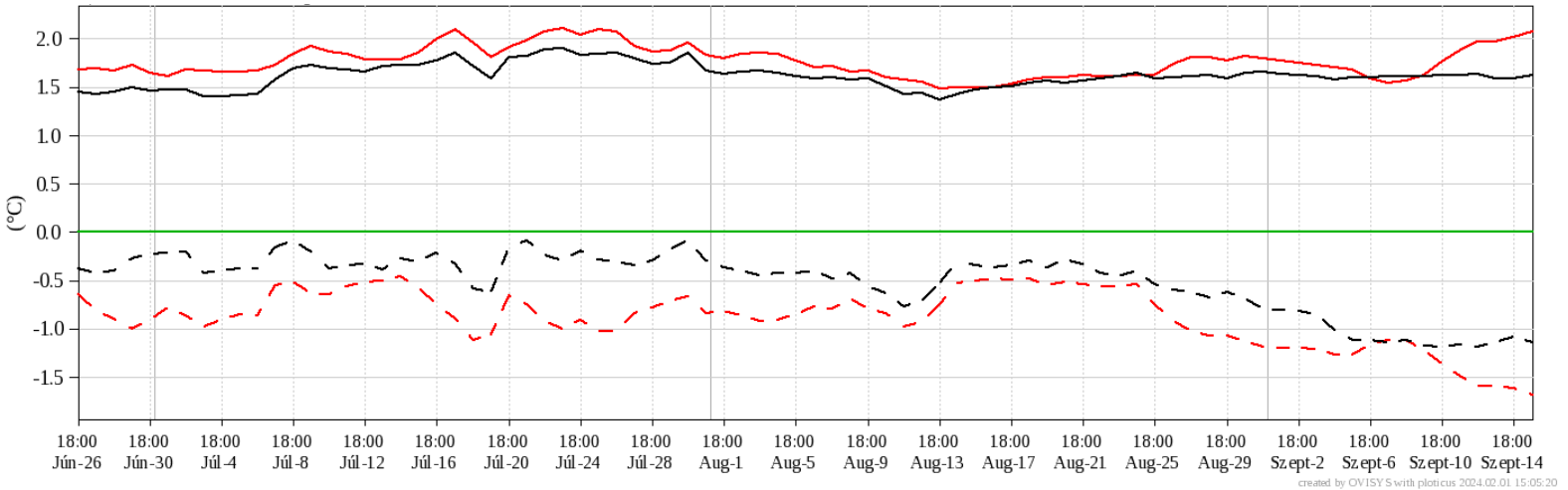
00 UTC + 18h between 26 June and 15 September 2023

AROME/HU

AROME-TEST

RMSE (solid lines)

BIAS (dashed lines)

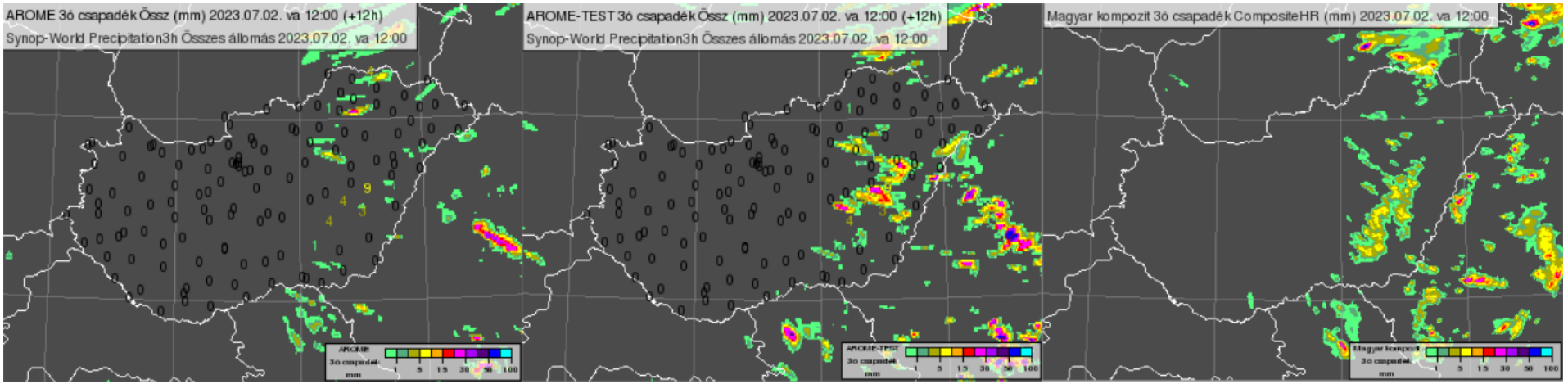


Verification of AROME with new cloud parameterization @Hungary

3-hour precipitation sum (in mm) based on 00 UTC + 12h-forecasts, on 2 July 2023.

AROME (left) and AROME-TEST (middle)

Hungarian radar measurements (right) and SYNOP observations (marked with numbers in the first two panels)



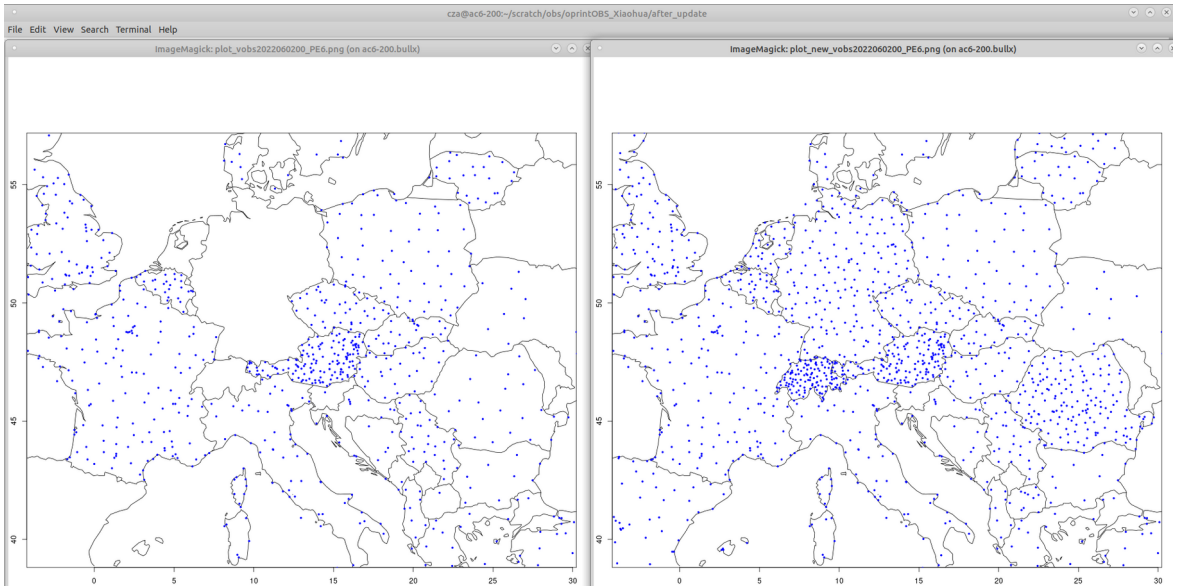
- operational implementation of [LOSIGMAS=T, VSIGQSAT=0.02] on **November 2023**

Verification of the DE-330 53 use cases @Czech Republic

- preparation of historical observation dataset for verification of the DE-330 53 use cases
- it was noticed that vobs files currently used for verifications have gaps mainly in precipitation data
- the bufr2obs tool was extended to extract precipitation from:
  - *totalPrecipitationPastXXHours*
  - and *totalPrecipitationOrTotalWaterEquivalent*
    - together with specified the accumulation period

Verification of the DE-330 53 use cases @Czech Republic

- left panel: the coverage of 6h precip recomputed (ec:/hirlam/oprint/OBS)
- right panel: the new modifications including data from Germany and Swiss



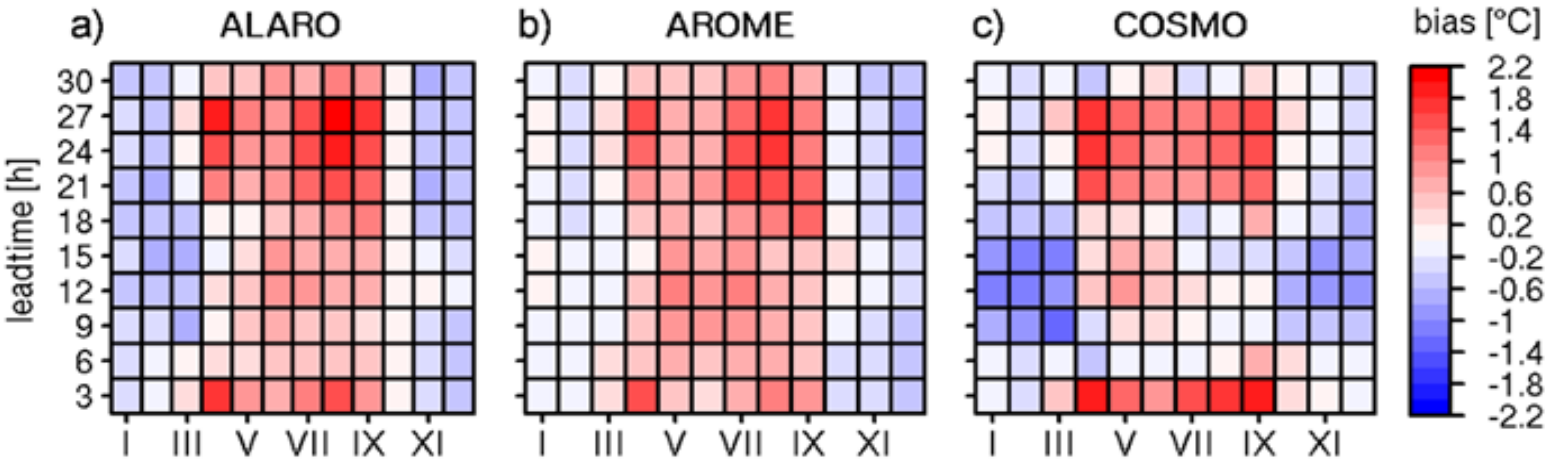
Forecast accuracy of the models @Poland

A comparison of verification scores of air temperature forecasts produced by NWP models:

- AROME 2.5 km
- ALARO 4 km
- COSMO 7 km

Forecast accuracy of the models @Poland

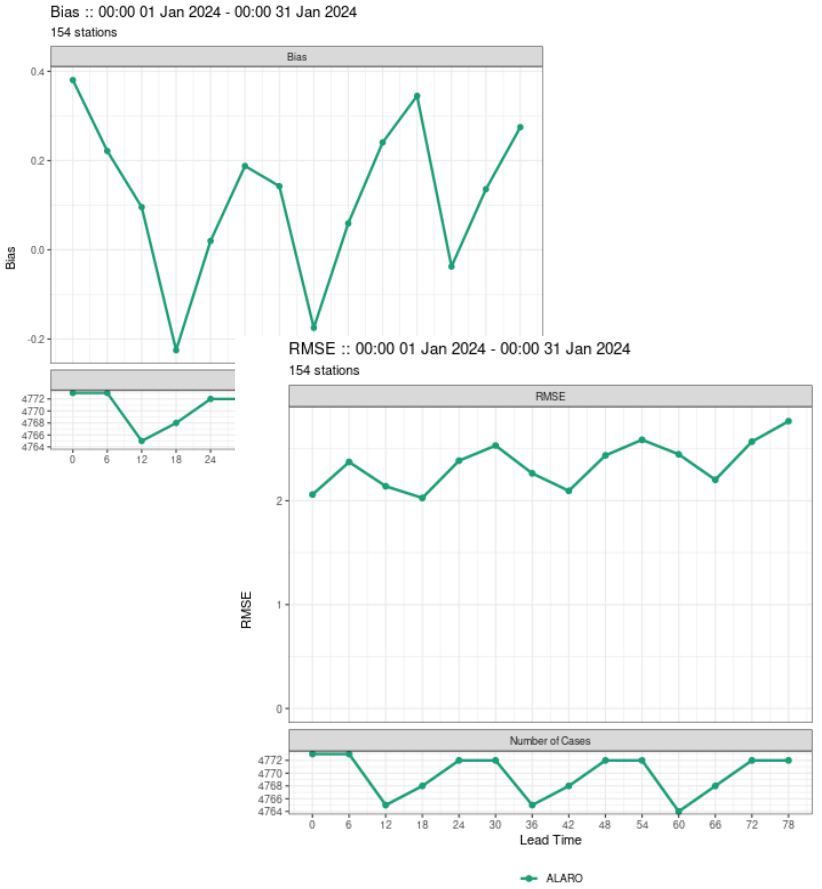
Temporal variability of bias in the NWP models.



- all of the models tend to overestimate air temperature especially at nights and in the mornings during warm months (from April until September)
- in case of ALARO and AROME, warm bias persists also during daytime, but it is smaller than at nights

HARP @Romania

- verification test for the operational ALARO version at 4 km
- 154 stations
- January 2024
- 2m temperature
- some issues regarding our operational table and the default shortName recognized by HARP



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Thank you for your attention.

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