2nd ACCORD ASW Meeting, 4 – 8/04/2022, Ljubljana (hybrid)

METEO IMGW-PIB
meteo.imgw.pl

NWP in Poland

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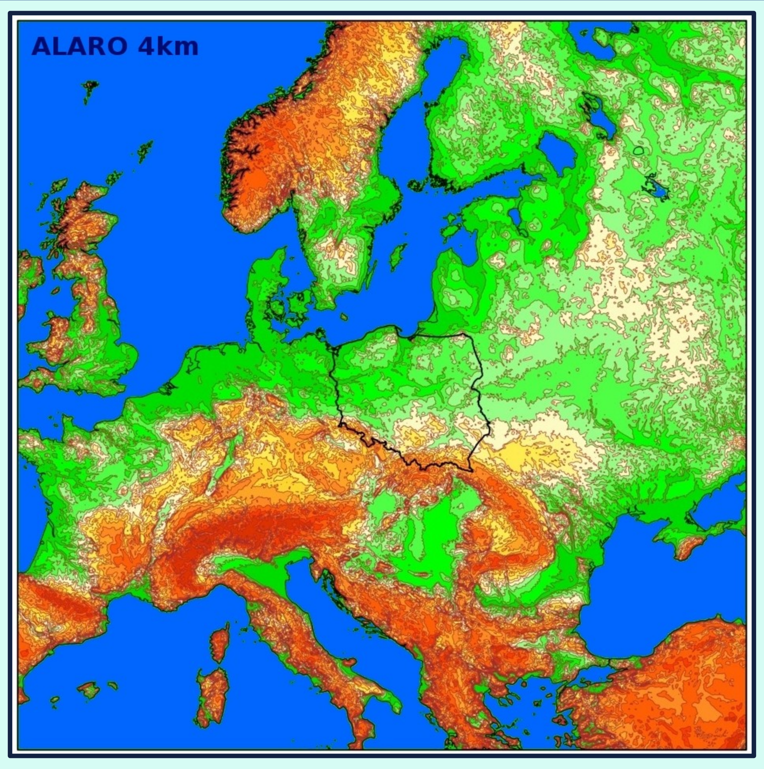
Operational

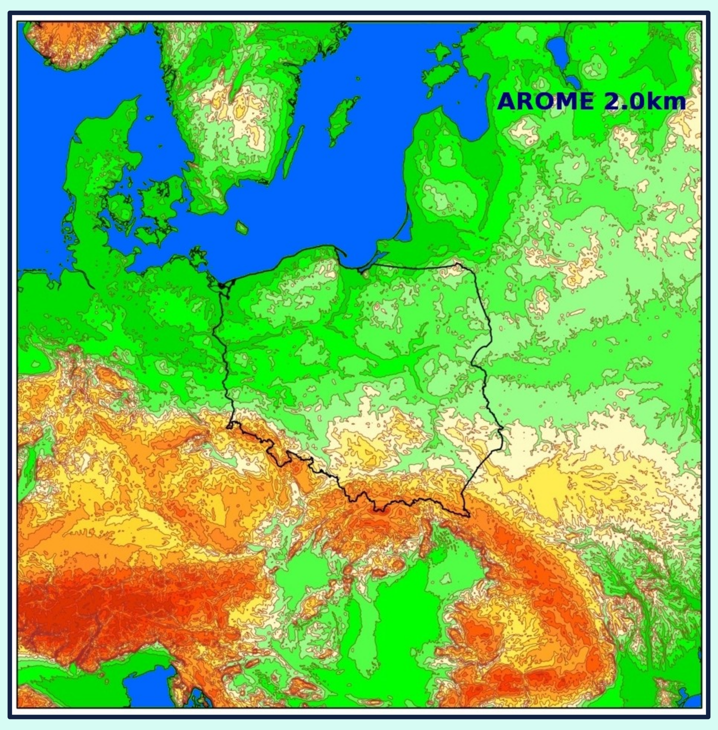
ALARO-v1B NH (CY43T2)

Operational Domain:

E040 domain:

4.0 km horizontal resolution, 789x789 grid points, 70 vertical model levels on a Lambert projection with 3h coupling frequency and 1h output, coupling zone with 16 points; Runs 4 times per day (00,06,12 and 18) with 72 hours forecast range; LBC from ARPEGE with 9.4km horizontal resolution; Time step 150s.





AROME (CY43T2)

Operational Domain:

P020 domain:

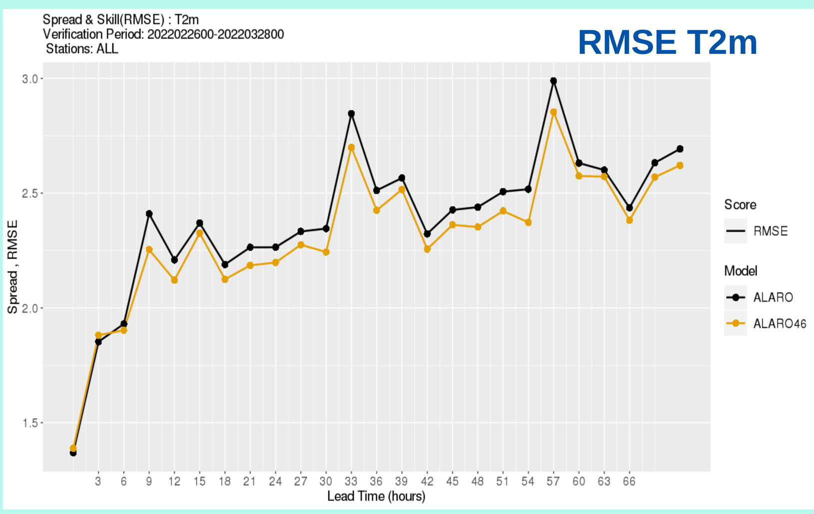
2.0km horizontal resolution, 799x799 grid points, 70 vertical model levels on a Lambert projection with 3h coupling frequency and 1 hour output 4 runs per day (00, 06, 12 and 18UTC) with 30 hours forecast range; Time step 50s; LBC from ALARO-1 4.0km; GRIB format, every 1h – for LEADS system; 10min output for INCA Nowcasting System.

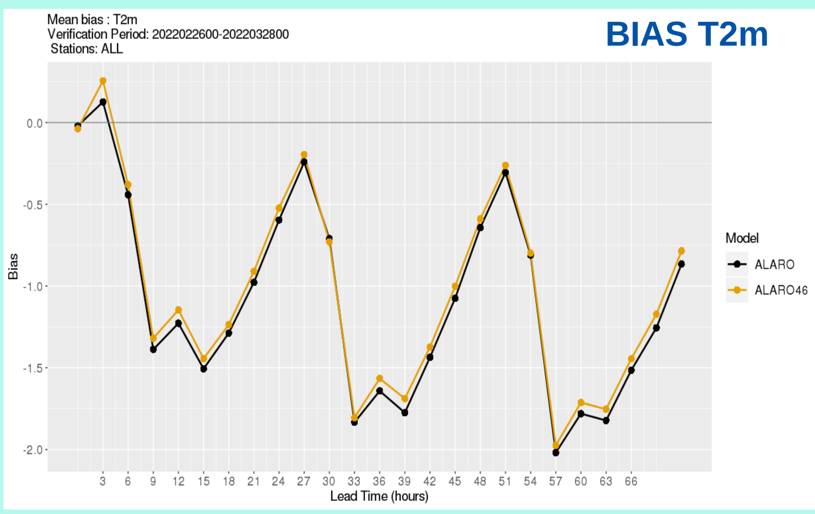
Operational machine characteristics

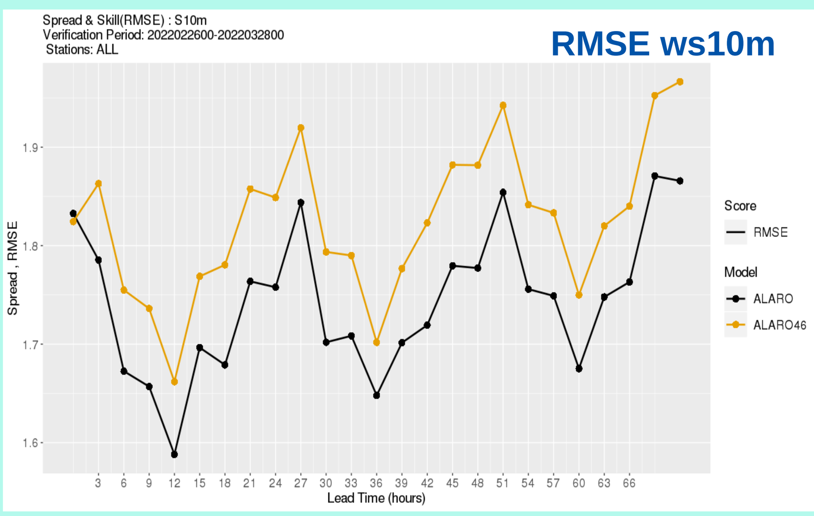
Cluster of HP BL460c_GEN8 servers connected with Infiniband network, OS Scientific Linux 6, Intel Xeon E5-2690 processors – with maximum 1552 cores (97 nodes with 16 cores each), each core RAM 128 GB, disc array – 64 TB.

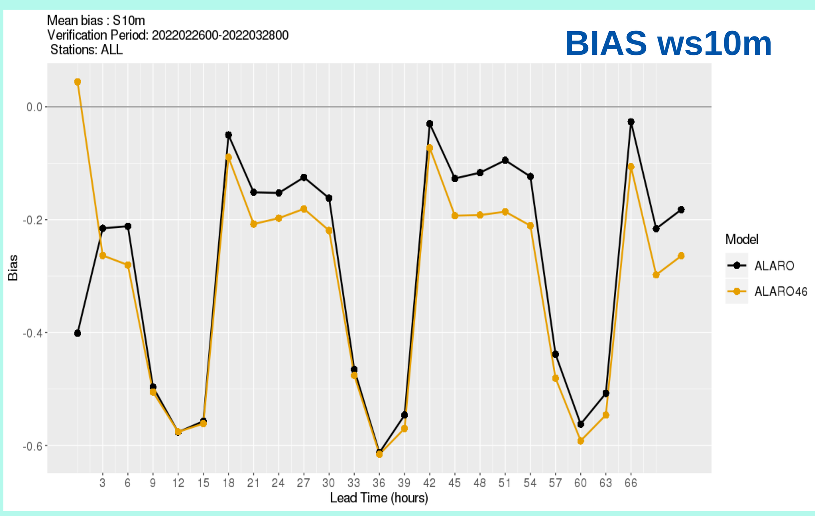
ALARO cy46t1

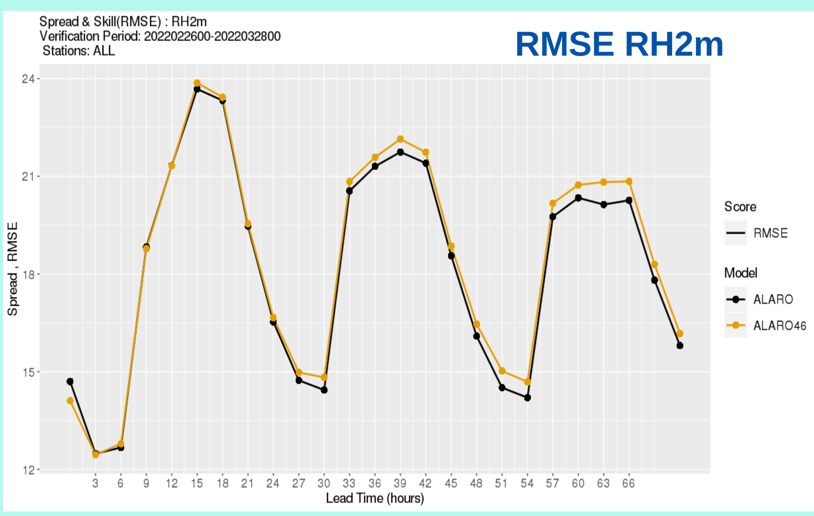
Preoperational tests with cy46t1 export version runs daily for ALARO CMC. One month (March 2022) of comparison with current operational version shows improvement for 2m temperature (T2m), degradation for 10m wind speed (ws10m) and no change for 2m relative humidity (RH2m).

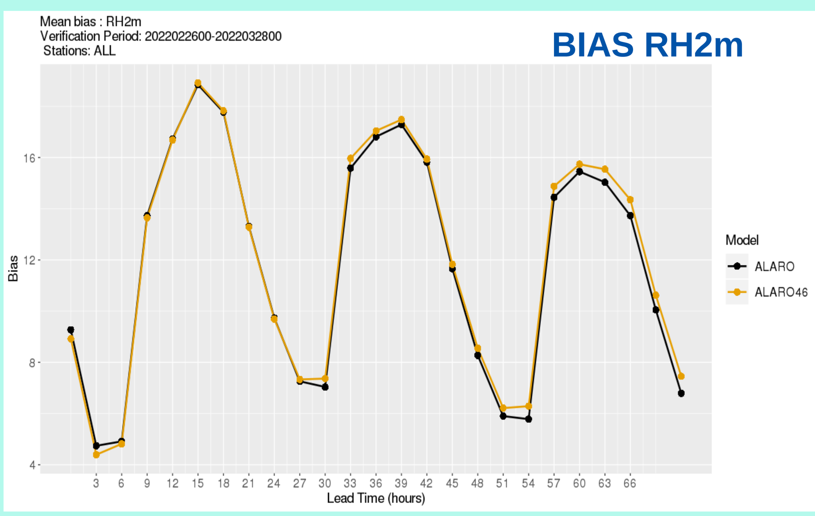












Improved analysis of CROCUS snow cover with INCA-PL2

CROCUS is a snowpack model run in an operational mode once a day just after the morning run (r00) of NWP models is complete. As it is coupled with AROME (+30 h), its forecast horizon is 24 hours. In our experiment, CROCUS forecast was recalculated using short-range forecast from INCA-PL2. INCA-PL2 is a nowcasting model with 8-hour forecast length and 1 km x 1 km spatial resolution run operational at IMWM. It provides more precise precipitation forecast. Only analysis were used in this experiment. During the experiment, the forecasts substituted AROME forecasts of snow- and rainfall, temperature, humidity and wind speed and Crocus was rerun.

Verification period spans the time from 1st to 28th December 2020 and considers only snow depth. Due to large spatial heterogeneity of this parameter, the produced analysis were evaluated pointwise against observations at 54 synoptic stations in Poland. On average, there is a slight improvement of MAE (2.87 vs 2.99). The improvement is the most distinct in northern Poland (stations most to the left at Fig.1), while in central part it is mainly neutral. However, at stations lying at the foothills of Carpathian Mountains, the difference is negative indicating that the forecasts are worse. In fact in a mountainous region there is an overestimation of snow as exemplified on Fig. 2 (station Hala Gąsienicowa, 1520 m a.s.l.)

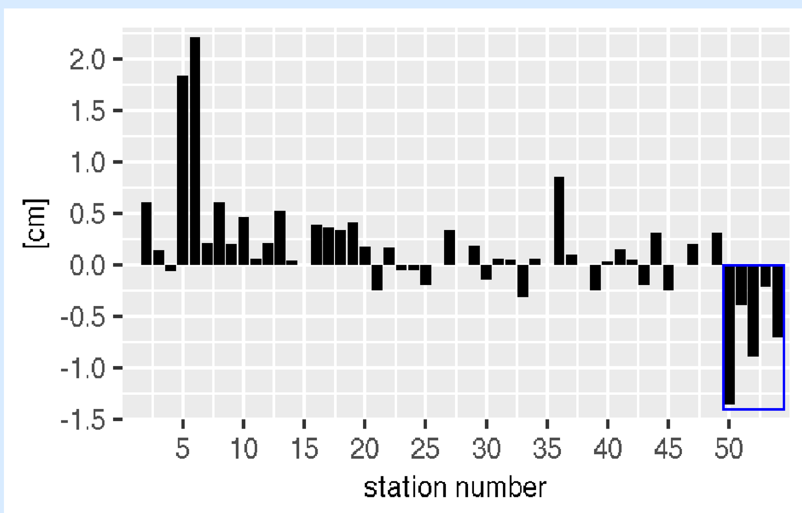


Fig. 1 Difference of MAE between the operational and the experimental forecast of CROCUS. Positive difference indicates improvement.

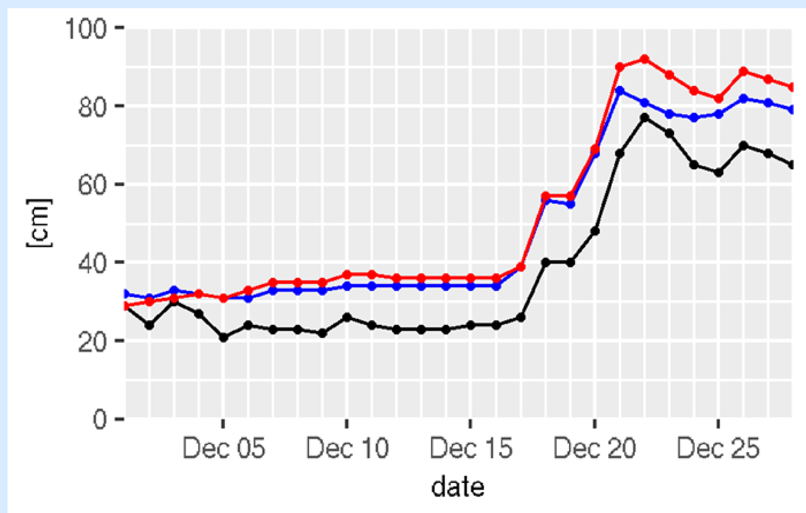
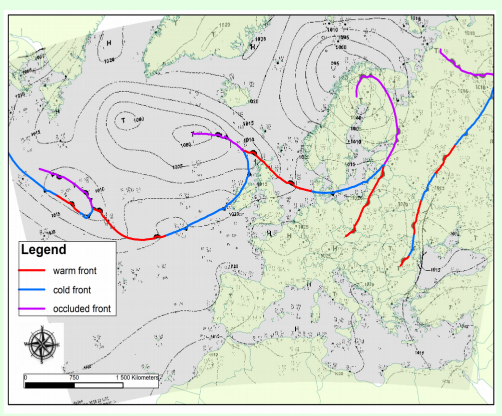


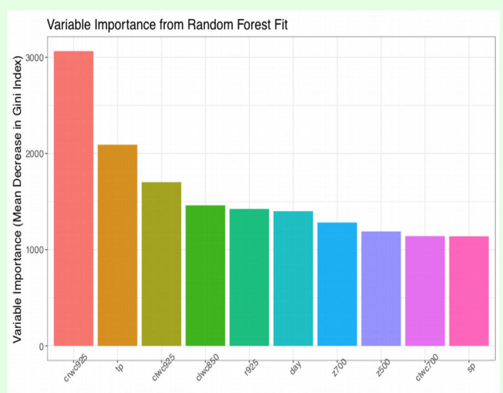
Fig. 2 Snow depth at Hala Gąsienicowa synoptic station (1520 m a.s.l.). Black points denote observations, blue – operational forecast, red – experimental forecast.

Machine Learning – based front detection

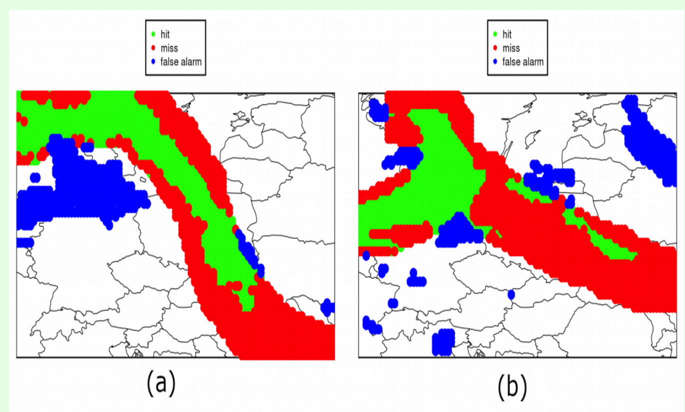
Extreme weather phenomena such as wind gusts, heavy precipitation, hail, thunderstorms, tornadoes, and many others usually occur when there is a change in air mass and the passing of a weather front over a certain region. The climatology of weather fronts is difficult, since they are usually drawn onto maps manually by forecasters; therefore, the data concerning them are limited and the process itself is very subjective in nature. In this article, we propose an objective method for determining the position of weather fronts based on the random forest machine learning technique, digitized fronts from the DWD database, and ERA5 meteorological reanalysis. Several aspects leading to the improvement of scores are presented, such as adding new fields or dates to the training database or using the gradients of fields.



Example of "digitalized" synoptic map



Random Forests's variable importance



Example of model evaluation

Bochenek, B.; Ustrnul, Z.; Wypych, A.; Kubacka, D. Machine Learning-Based Front Detection in Central Europe. *Atmosphere* **2021**, *12*, 1312. https://doi.org/10.3390/atmos12101312