THE NWP ACTIVITIES AT CROATIAN METEOROLOGICAL AND HYDROLOGICAL SERVICE IN SPRING 2021

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OPERATIONAL SETUP AND PLANS

The operational model version used is AL38T1 with ALARO0 physics for 4 and 2 km resolution forecasts.

Operational configuration settings:

- ALADIN-HR4: Δx = 4 km, 73 vert. lev.; CANARI+3DVar with 3h cycle (no DFI); 72h fcst. (with DFI), LBCs: IFS (lagged mode), 4 runs per day (00, 06, 12 and 18 UTC); hydrostatic
- ALADIN-HR2: Δx = 2km, 37 vert. lev., SSDFI, 48h fcst. hours, LBCs: ALADIN-HR4, 1 run per day (+06 hrs forecast of the ALADIN-HR4 00 UTC run); non-hydrostatic
- ALADIN-HRDA: Δx = 2km, 32 vert. lev., 72h fcst., LBCs: ALADIN-HR4, dynamical adaptation mode; 4 runs per day (00, 06, 12 and 18 UTC); hydrostatic

Ongoing work: validation and tuning of CY43T2_bf10 based e-suite at Δx = 4 km, as well as new high resolution configuration aimed to replace ALADIN-HR2 and ALADIN-HRDA at Δx = 2 km, operational implementation of neighbourhood post-processing, testing new climate files with improved clay and sand fields, preparation for migration to the new HPC.

POST-PROCESSING

Neighbourhood post-processing

- model grid size $\neq$ model resolution
- rapid predictability loss at smaller scale

$\Rightarrow$ equiprobability between neighbouring grid points

Solution: Neighbourhood post-processing (time/space) at point of interest (POI). Treat neighbouring points as members of an ensemble valid at POI. Several operational products were developed as shown on Figs. 1 and 2.

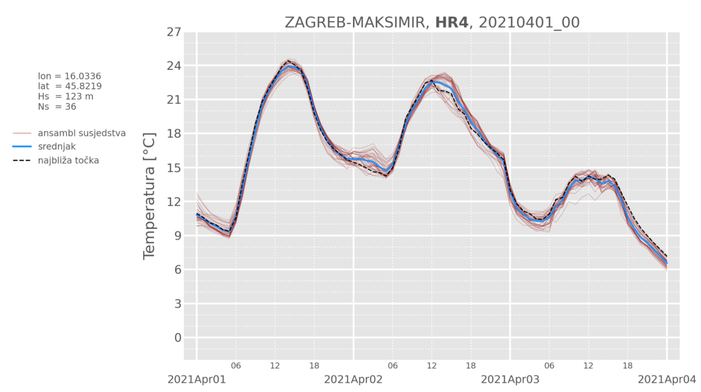

Figure 1: ALADIN-HR4 2 m temperature forecast with lead time with neighbourhood ensemble as plumes (solid red). Dashed black line denotes standard nearest point deterministic forecast and ensemble mean is shown in solid blue.

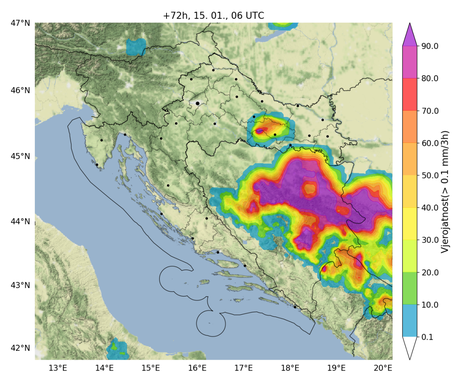

Figure 2: ALADIN-HR4 precipitation probability forecast (above 0.1 mm/3h) derived from the neighbourhood ensemble.

Verification: Neighbourhood ensemble mean has about 10-15 % lower RMSE for wind speed (gusts). Specific percentile (usually 55th-60th) of a neighbourhood ensemble gives significantly more accurate precipitation forecast (more hits, less false alarms) than simply using the closest model grid point. Combination with an EPS: spread is significantly increased (Fig. 3).

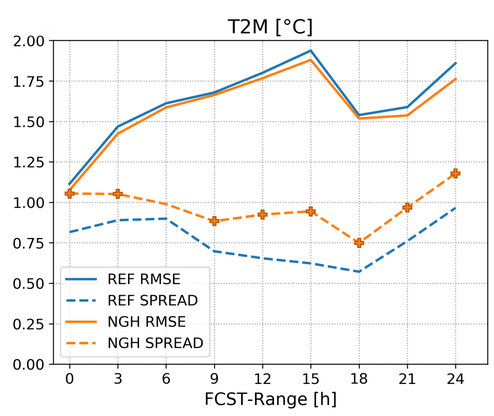

Figure 3: RMSE of the ensemble mean (solid) and spread (dashed) of reference experiment (blue) and neighbourhood (orange) for 2 m temperature averaged over period of 62 days. Forecast ranges with statistically significant difference are marked with bullets (RMSE) and crosses (spread).

Analog-based post-processing:

i) optimizing the algorithms for the operational use (e.g., parallel computing), ii) additional quality control of the training data (suspicious measurements are noticed) and iii) preparation of the algorithms to determine the best deterministic forecast regarding high-wind speed.

THE NEW CLIMATE FILES

European Soil Database Derived data (ESDAC Dataset) have been used in order to acquire the high resolution soil fields in climatological files (Figure 4). The clay and sand percentage data have been interpolated to the Croatian ALADIN-HR4 domain and added in step 5 of the e923 configuration. Their influence on the analysis and forecast is being tested.

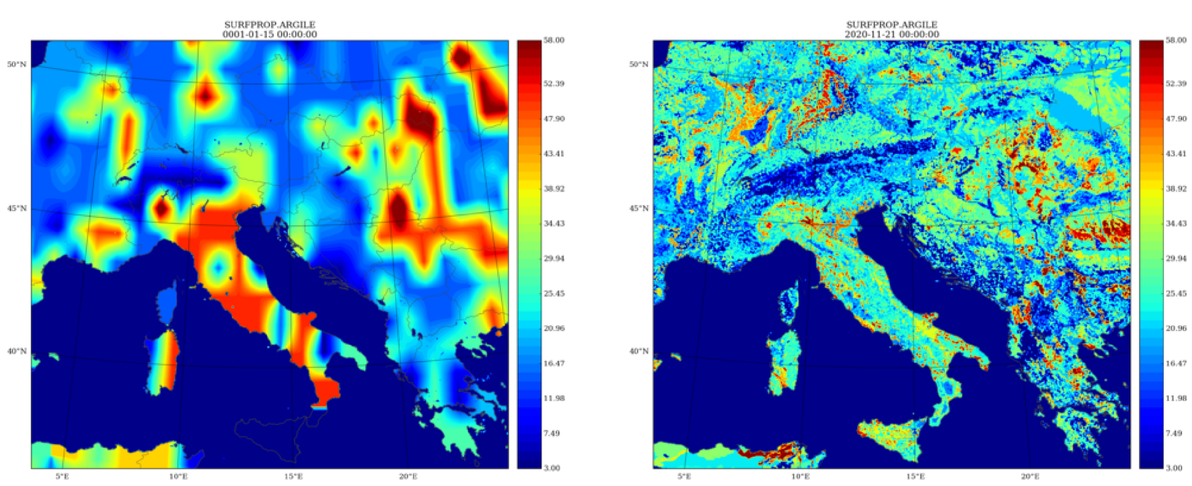

Figure 4: Old field of clay percentage in soil (left); new high resolution field of clay percentage in soil (right).

CY43T2-BF10 BASED E-SUITE

The main changes/characteristics introduced with the CY43T2-bf10 are: ALARO-1vB physics package, ensemble based B-matrix, relaxation towards the climatology in surface data assimilation (DA), wider optimal interpolation radius of influence, corrected diagnostics of near-surface winds and minimal/maximal temperature, precipitation type/visibility diagnostics. Compared to the old CY38, CY43 has better scores for screen level temperature (less biased) and relative humidity (Figure 5), while case study analysis suggests more consistent prediction of heavy rainfall.

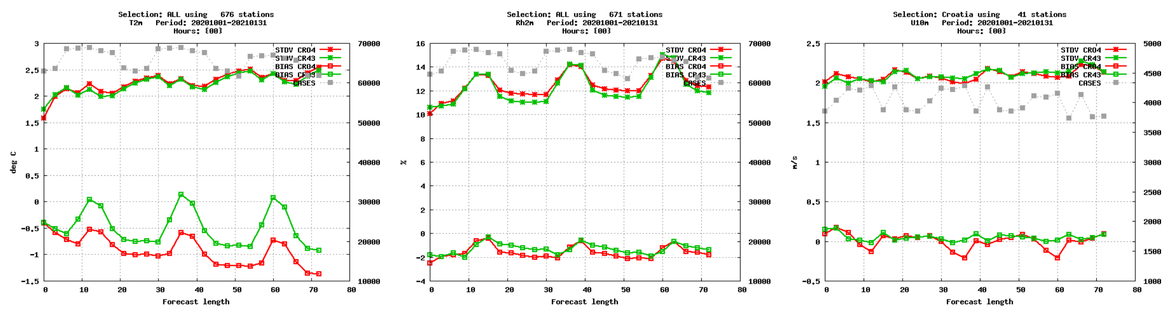

Figure 5. BIAS and STDEV for temperature (left) and relative humidity at 2m (middle) and wind speed at 10 m (right; Croatian stations).

Precipitation type diagnostic (adapted for ALARO at CHMI in Prague) was phased to bf10 and tested on several cases. On the 2nd of December, freezing rain has been reported near Slavonski Brod, which was nicely captured by the new CY43 (Figure 6, left). In agreement with forecasters original 16 precipitation types (Figure 6, left) were merged to 8 types (Figure 6, middle).

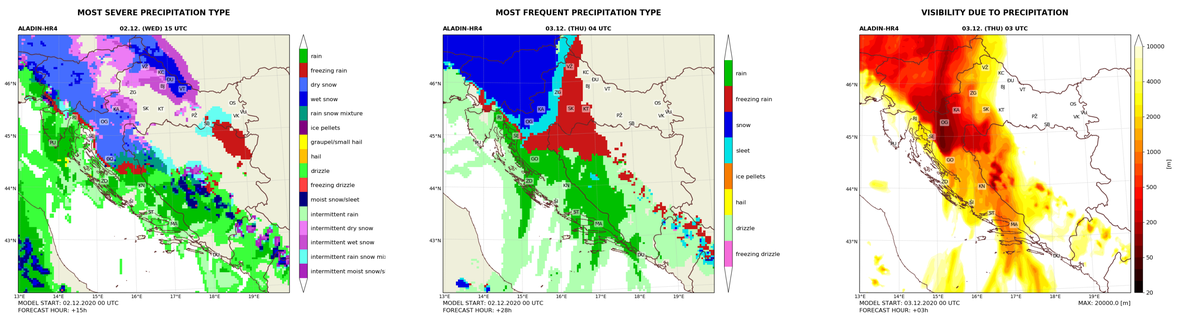

Figure 6. The most severe, the most frequent precipitation type and visibility due to precipitation.

Cycling of 12 GFL fields was added to the DA suite used for initialization of the 72h forecast during the period from November 23rd to December 10th 2020. During that period, cases of severe fog, freezing rain and intensive cyclone occurred. Verification scores (Figure 7) were better for the new setup for 2m relative humidity, cloud cover, and most of the upper air fields, mainly during the first 20 hours of the forecast. Additionally, on top of this new setup, Jk method was tested. Verification results indicate a positive effect on the forecast for upper-air fields.

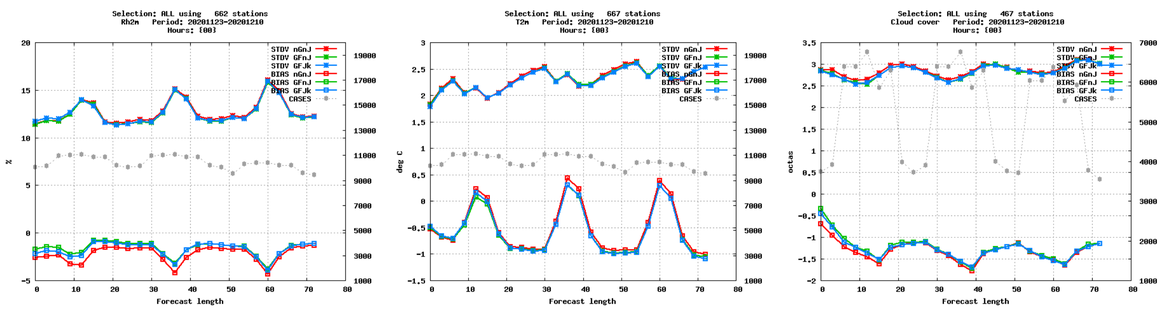

Figure 7. BIAS and STDEV for screen level relative (left), specific (middle) humidity and cloud cover (right).

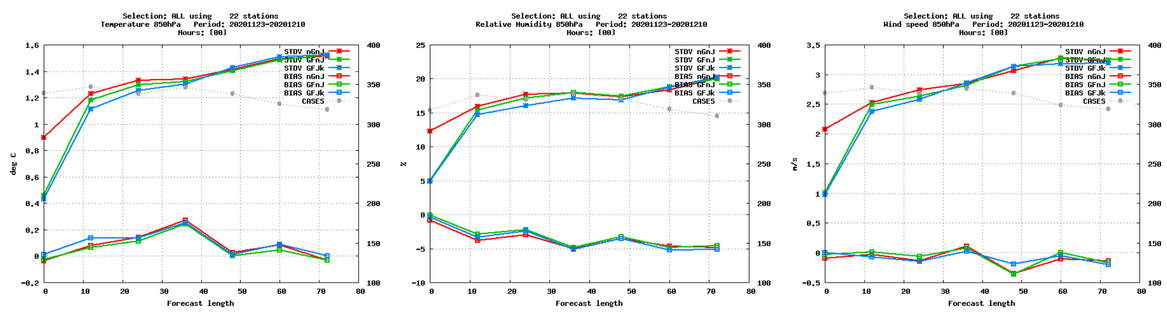

Figure 8. BIAS and STDEV for 850 hPa temperature (left), relative humidity (middle) and wind speed (right). Red line represents reference, green line GFL experiment and blue line GFL and Jk experiment.

TESTS OF ALADIN-HRDA vs ALADIN-HR2-CY43

With the aim to replace ALADIN-HRDA, the new ALADIN-HR2-CY43 was set up: non-hydrostatic, Δx = 2km, 87 vert. lev., 72h fcst. hours, LBCs: ALADIN-HR4. Verification was focused on wind speed and gusts (Figure 9). The scores were better for ALADIN-HR2-CY43 for wind gusts and rather neutral for 10m wind speed. For upper-air wind fields, clearly better results were obtained with the ALADIN-HR2-CY43.

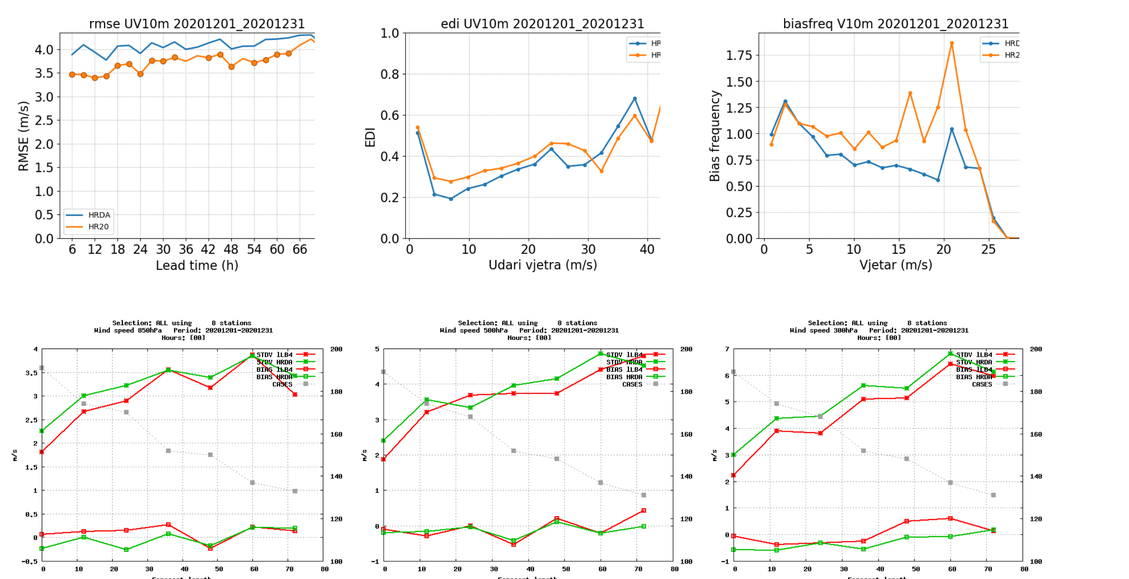

Figure 9. RMSE and EDI for wind gusts (upper left and middle) and frequency bias for wind speed (upper right). BIAS and STDEV for 850 (lower left), 500 (lower middle) and 300 (lower right) hPa wind speed.