NWP at Croatian Meteorological and Hydrological Service, 2021

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Operational suite

4 configurations:

Operational configuration settings include:

- 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; cy38T1
- ALADIN-HR2: Δx = 2km, 87 vert. lev., 72 fcst. hours, LBCs: ALADIN-HR4, non-hydrostatic; INIT: A-LAEF unperturbed member; 4 runs per day;ALARO-1 phys. package; cy43
- 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

Post-processing

Neighborhood post-processing (NPP)

- Model grid size ≠ model resolution
- Rapid predictability loss at small scales

→ Equiprobability between neighboring model grid points

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

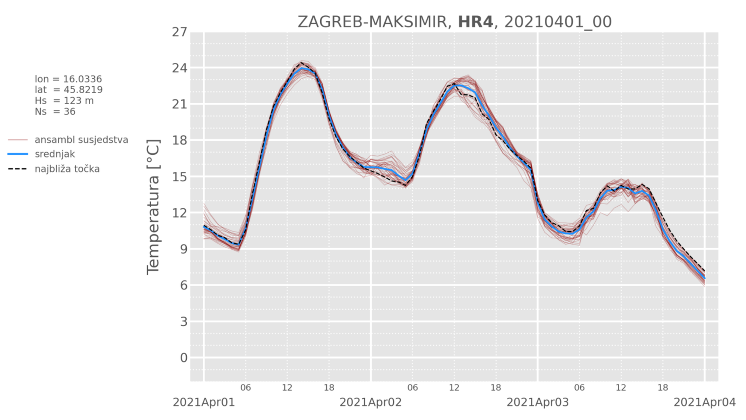

Fig. 1. ALADIN-HR4 2 m temperature forecast with lead time with NPP ensemble as plumes (red). Dashed black line denotes raw nearest point deterministic forecast and ensemble mean is shown in solid blue.

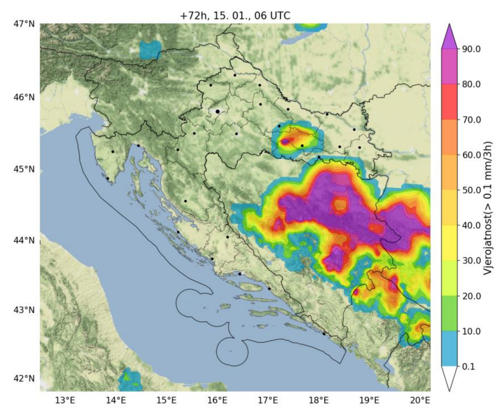

Fig. 2. The ALADIN-HR4 precipitation probability forecast (> 0.1 mm/3h) derived from the NPP ensemble.

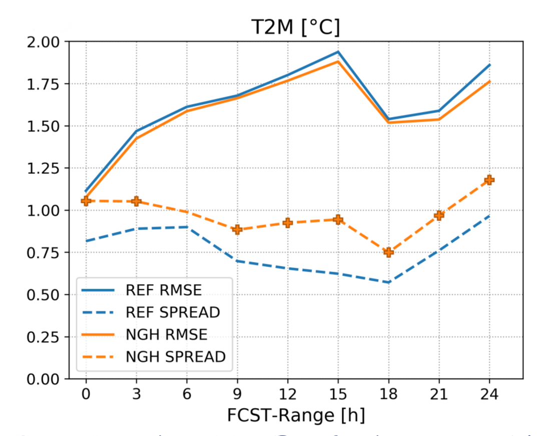

Fig. 3. The RMSE of the ensemble mean (solid) and spread (dashed) of reference experiment (blue) and NPP (orange) for 2-m temperature averaged over 62 days. Forecast ranges with statistically significant difference are highlighted using markers.

- Verification: NPP ensemble mean has about 10% (15%) lower RMSE for wind speed (gusts).
- Specific percentile (~ 55th-60th) of a NPP 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).

A-LAEF (ALARO - Limited Area Ensemble Forecasting)

- A meso-scale ensemble system A-LAEF, developed in the frame of RC LACE consortium, is focused on short range probabilistic forecasts and profits from the advanced multi-scale ALARO physics.
- Its main purpose is to provide a probabilistic forecast for the national weather services of RC LACE partners which could not achieve that with their own HPC resources.
- We have created an entirely new website (Fig. 4) to provide A-LAEF products. It is designed to provide an interactive user experience. For example, values are shown on mouse hover, features shown in legend can be turned on or off, etc.
- Products include meteograms, probability plots (Fig. 5) for various thresholds and 2-D plots of ensemble mean and spread.
- We receive a positive feedback and will thus continue to use this format and, possibly, include other ALADIN products as well.

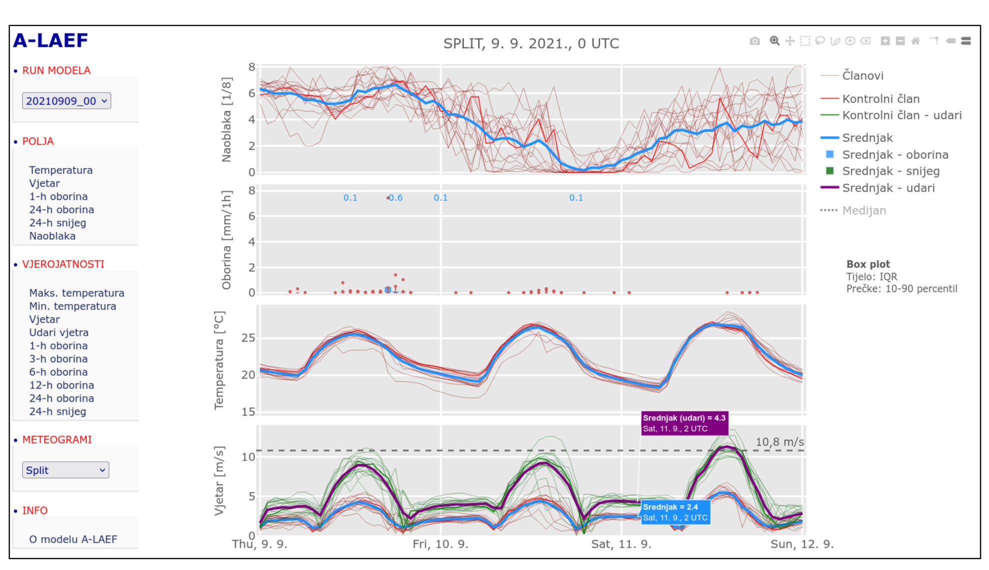

Fig. 4. The A-LAEF homepage and meteogram.

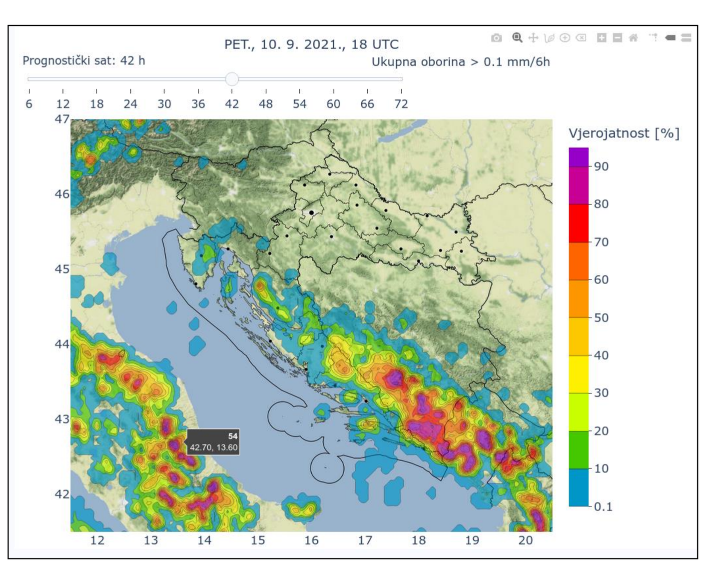

Fig. 5. The probability of 6-h precipitation exceeding 0.1 mm.

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 (Fig. 6), while case study analysis suggests more consistent prediction of heavy rainfall.

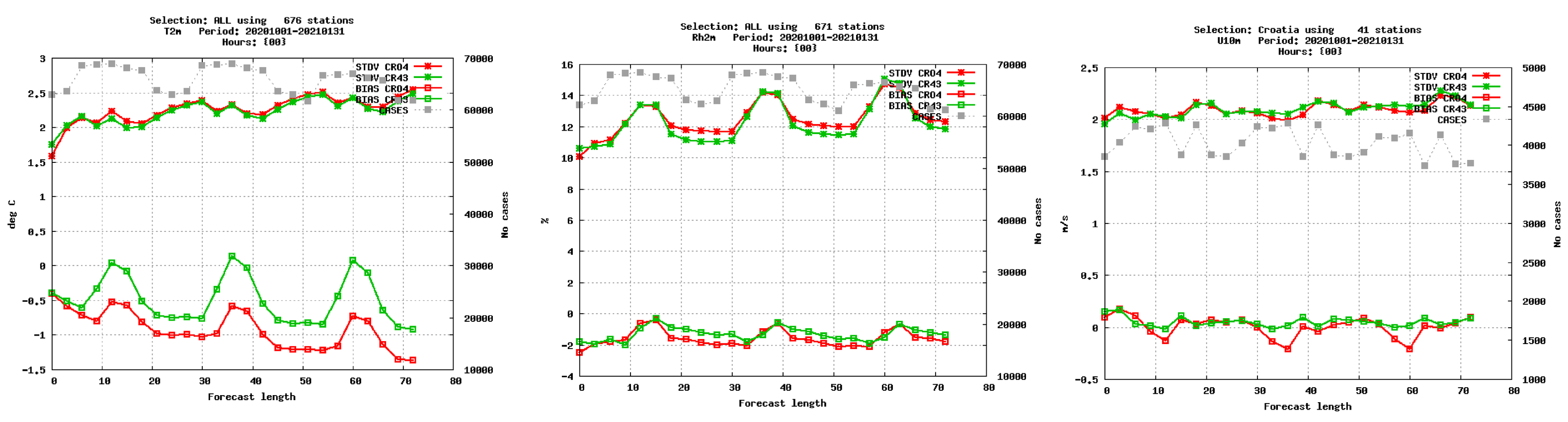

Fig. 6. BIAS and STDEV for temperature (left), relative humidity at 2m (middle) and wind speed at 10 m (right; Croatian stations).

- 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 (Fig. 7, left). In agreement with forecasters original 16 precipitation types were merged to 8 types (Fig. 7, middle).

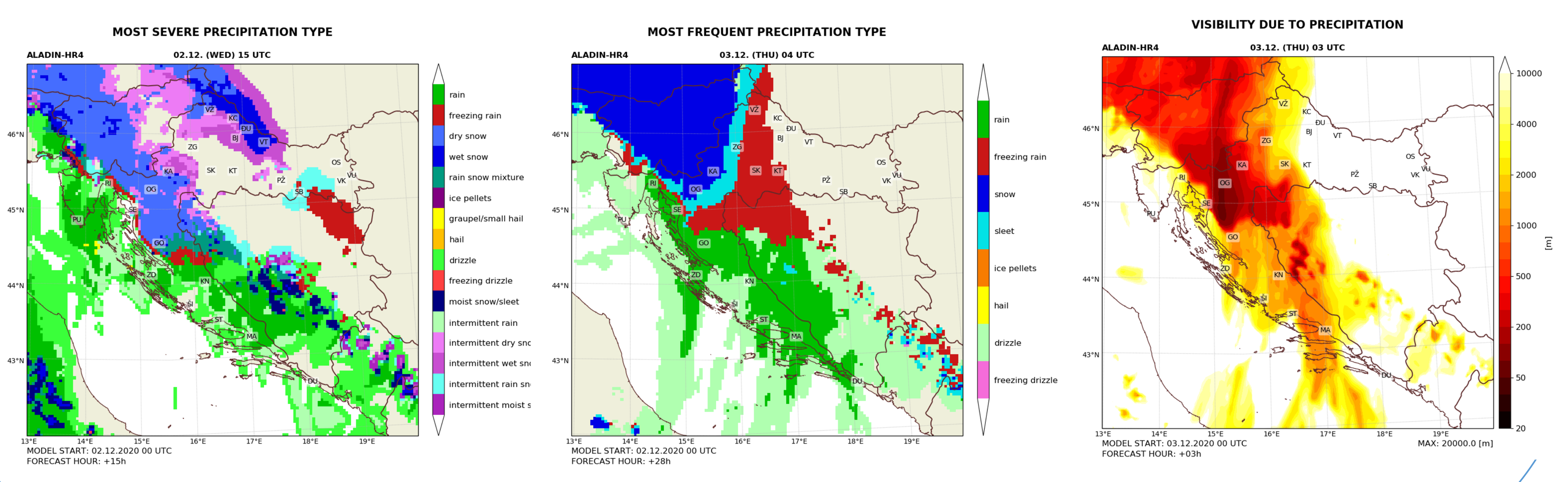

Fig. 7. The most severe (left), the most frequent (middle) precipitation type and visibility due to precipitation. (right).

SEE-MHEWS-A

WMO project: South-East European Multi Hazard Early Warning Advisory Warning System

- Main role of our team is the verification of 24-h precipitation NWPs for 18 SEE countries. NWP models include ECMWF, ALADIN, COSMO, ICON and NMM-B (WRF) and verification period is 22/09/2020-22/11/2020.
- Country-specific reports are completed and include continuous (e.g., Fig. 8), categorical (e.g., Fig. 9) and neighborhood approches (e.g., Fig. 10)

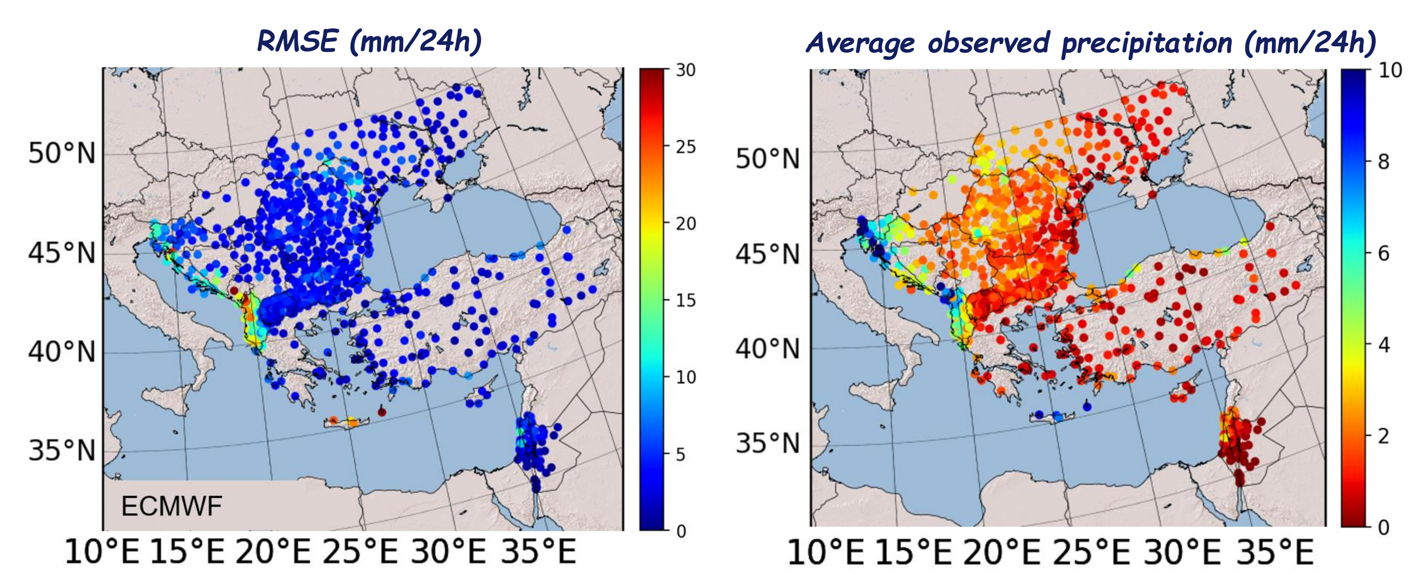

Fig. 8. The RMSE for ECMWF NWPs (left) and corresponding average observed cumulative 24-h precipitation per station (right) in the observing period.

- Dispersion error is predominant, whereas systematic sources of error are smaller. Bias and RMSE error increase with terrain complexity and near the coastlines.
- The accuracy is higher for more common events, and it improves with the spatial scale in majority of cases

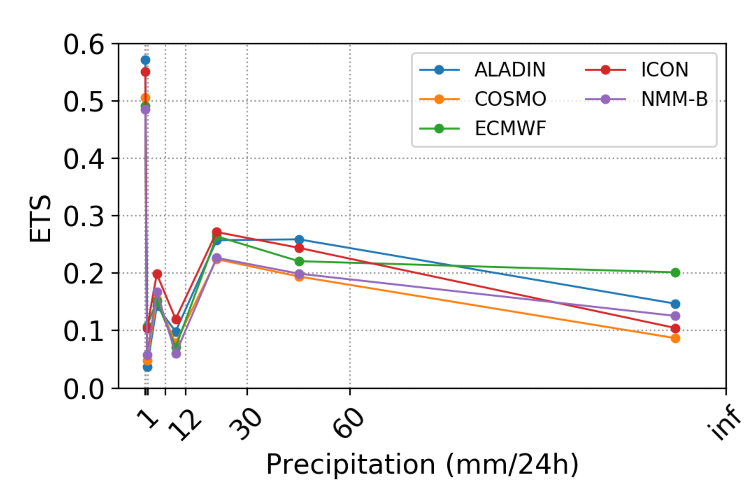

Fig. 9. The equitable threat score of different models' forecasts in the observing period at 33 stations in Croatia.

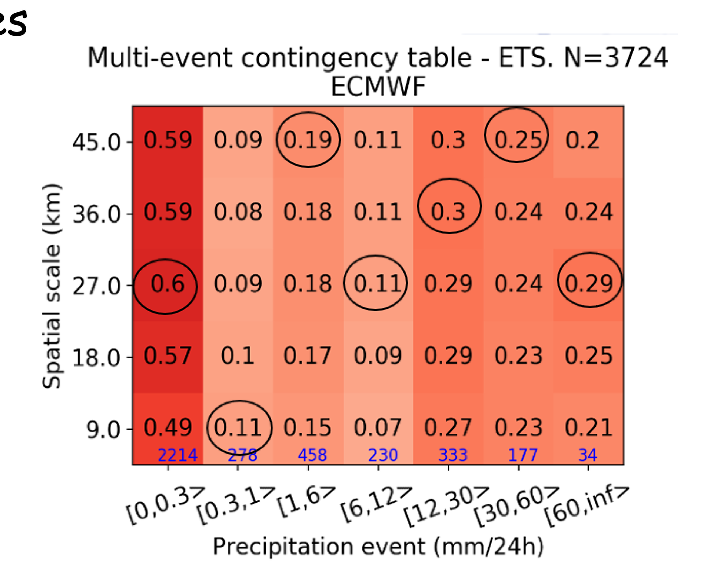

Fig. 10. The neighborhood verification result for ECMWF forecasts in the observing period at 33 stations in Croatia.