

## OPERATIONAL SETUP

Operational model configurations:

- ALADIN-HR40:  $\Delta x=4$  km; 480x432x73; CY43T2; HYD dyn.;  $t=150$  s; ALARO-1 phy.; IC: CANARI + 3DVar (3h-cycle, ENS B); 72h fcst.; LBC: IFS-3h (6-h lagged), 4 runs per day
- ALADIN-HR20:  $\Delta x=2$  km; 450x450x87; CY43T2; NH dyn.; DFI ini.;  $t=60$  s; ALARO-1 phy.; 72h fcst.; IC: ALADIN-HR40; LBC: IFS 1-h (6-h lagged); 4 runs per day
- HRAN: Analog-based method - a statistical post-processing method that finds analogous situations in the previous (training) period and using a similarity metric predicts values that are observed under a "very similar" forecast; predictor weight optimization and statistical correction for rare events are used

## DESTINATION EARTH (DESTINE)

- DestinE is an initiative of the European Commission to develop a digital model of the Earth on a global scale, and DHMZ is collaborator on several work packages (WPs).
- Within WP42, which is focused on post-processing, a benchmark method to generate ensemble of forecast and/or to provide uncertainty (Fig. 1) for the deterministic model is implemented.
  - The ensemble is generated from the multiple neighbouring model points to the location of interest and thus no additional NWP or training data is required. Neighbouring points can be filtered with respect to the orography or land-sea mask. Different shapes are also supported.

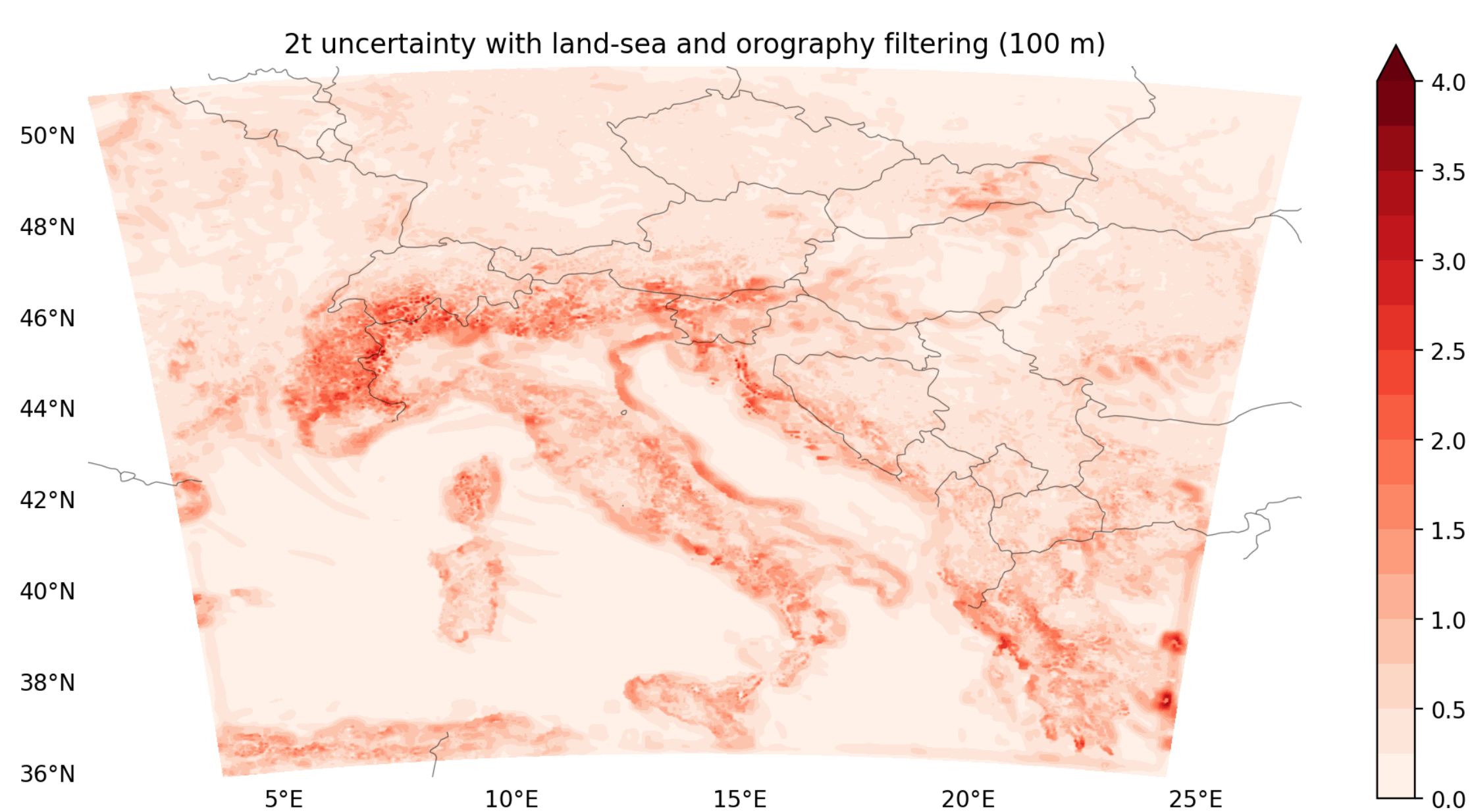


Fig.1: Deterministic model uncertainty from the neighbourhood ensemble

- Within WP44, using Universal Thermal Climate Index (UTCI) to determine temperature-related mortality is explored. Based on mortality data and measurements from 9 stations in Croatia we are determining the value of UTCI above/below which increased mortality is statistically significant in order to obtain thresholds for on-demand triggering.
- Within WP8 Renewable energy and health, several analog-based post-processing methods are utilized.
  - Analog based methods lead to improvements in wind speed forecasting for various meteorological stations (Fig. 2).
  - Varying ensemble sizes in the analog method combined with high-wind corrections are applied. New approaches exceed traditional analog method forecasts, especially for the high winds.

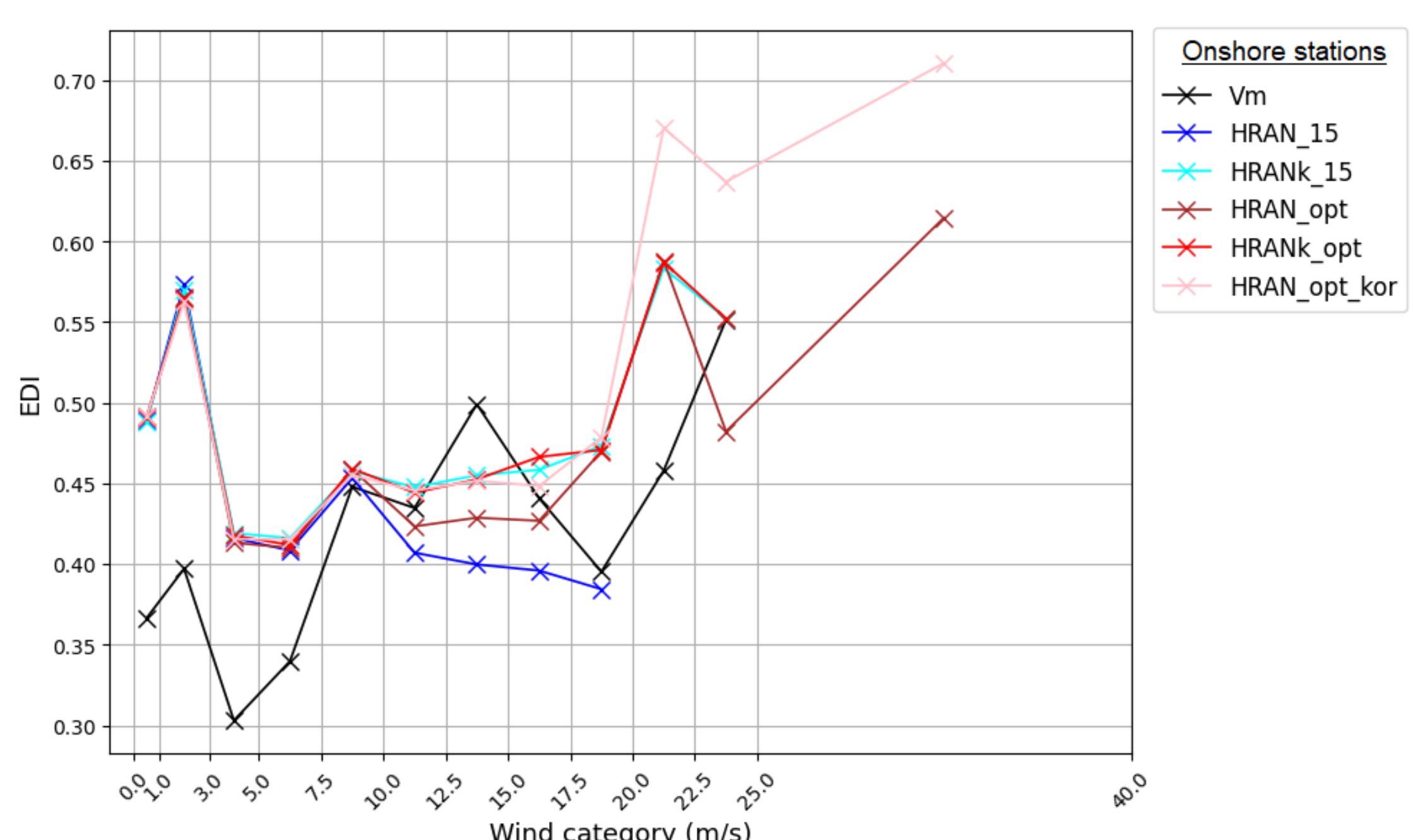


Fig.2: Extremal dependence index (EDI) for wind categories - analog based methods; Vm - HR20 conf., 15/opt - 15/optimized num. of ensemble memb., k - high wind speed correction

## VERIFICATION OF WIND SPEED

At the beginning of 2023., ALADIN-HRDA configuration was replaced by the ALADIN-HR20 configuration. A maximum of 10 m wind speed was calculated for the time period 2021-2022 from ALADIN-HR20 and ALADIN-HRDA configuration forecasts. Compared to ALADIN-HRDA, ALADIN-HR20 has very similar spatial distribution over continental Croatia but gives higher maximal wind speeds over coastal Croatia (Fig. 3). Storm and violent storm wind speed categories ALADIN-HR20 forecasts over a wider area under Velebit mountains. Strongest wind speed category ( $>32.7$  m/s) ALADIN-HR20 forecasts over a lot smaller area on a different location than ALADIN-HRDA and its location corresponds better to observations. Generally, both configurations show good agreement with observations.

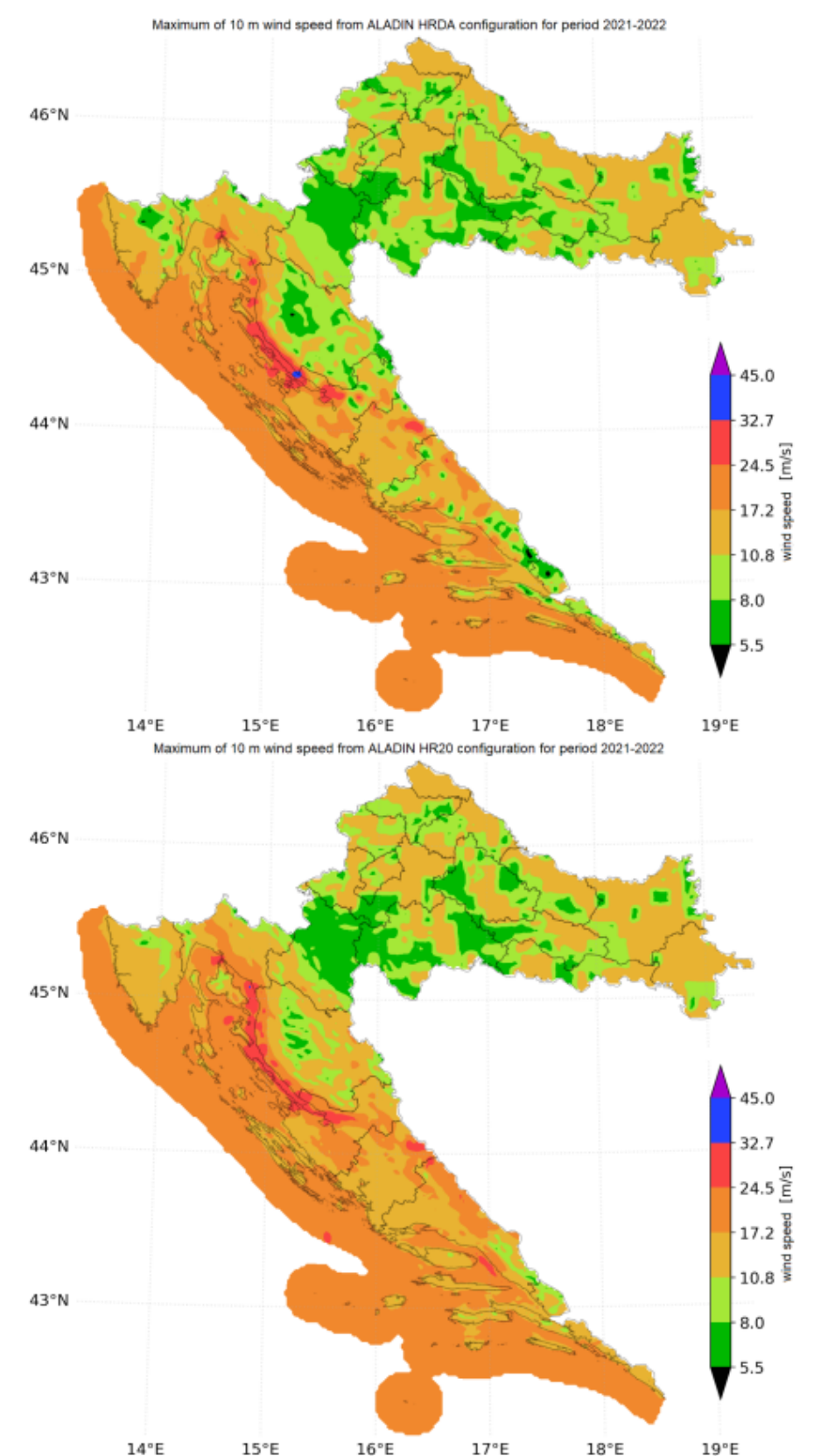


Fig.3: Spatial distribution of maximum 10 m wind speeds within Croatian borders for ALADIN-HRDA and ALADIN-HR20

## ASSIMILATION OF RADAR REFLECTIVITY

The purpose of the project "Modernisation of the National Weather Observation Network in Croatia - METMONIC" is the establishment of a modern and high-quality system of automatic surface meteorological stations, meteorological-oceanographic buoys and remote measurement systems, including six meteorological radars. New C-band dual-polarized radars were installed in locations: Gradište, Bilogora, Puntijarka, Goli, Debeljak, and Uljenje, now covering whole of Croatia (Fig. 4).

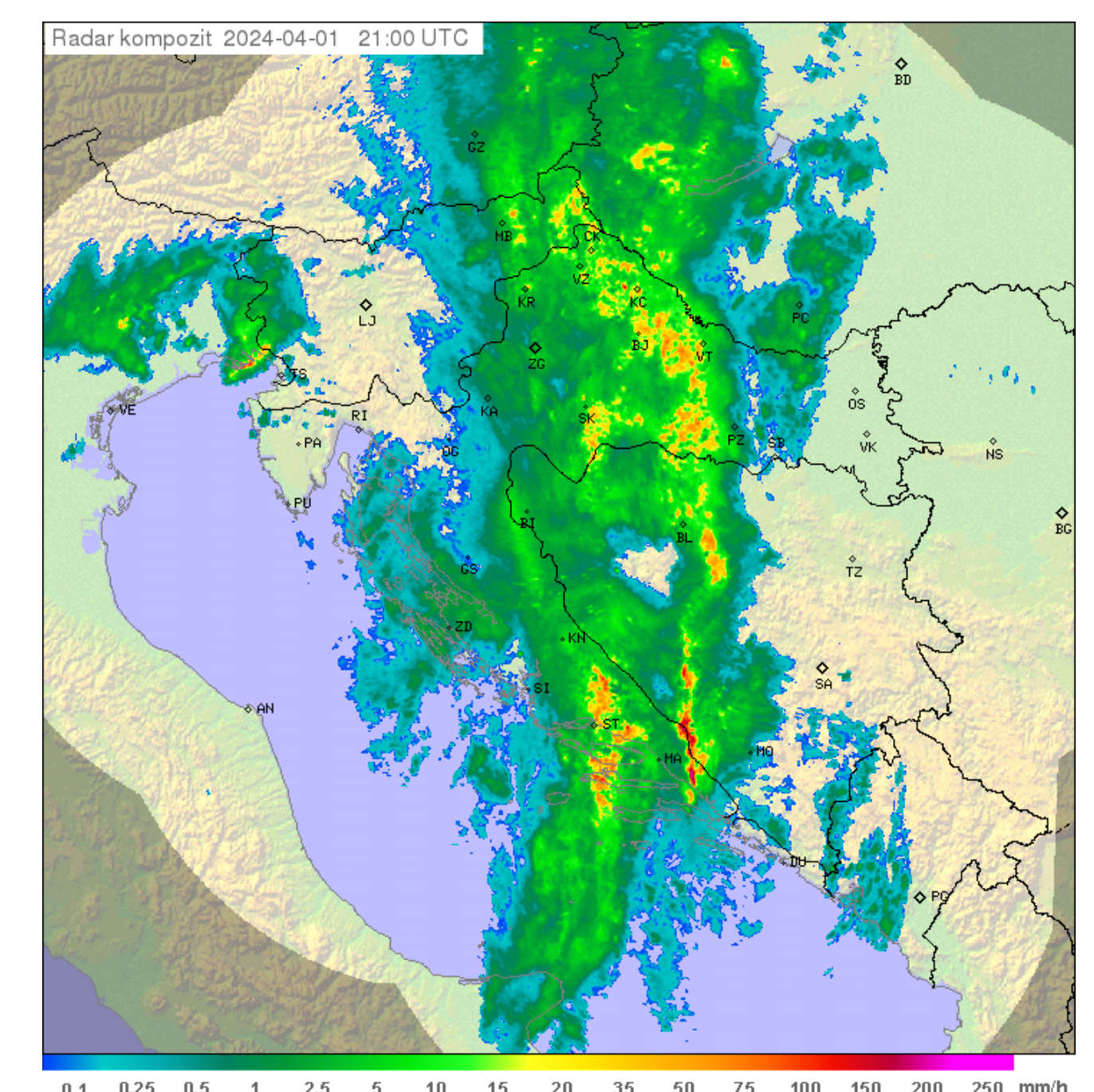


Fig.4: The six radar sites coverage

- Following the latest development of radar reflectivity data assimilation in ALARO CMC, rain threshold and observation error inflation of undetected data methods were tested for local implementation.
- Results showed that both methods reduced the "drying" effect in Bayesian inversion for reflectivity data. The combined method (marked with 2\_3 on plots) with the error inflation offset of 0.35 and the threshold of 0.0 performed the best, giving neutral scores (Fig. 5) when compared with the operational system (ALADIN-HR40) and improved 1h rain rates at the location of Croatian automatic stations (Fig. 6).

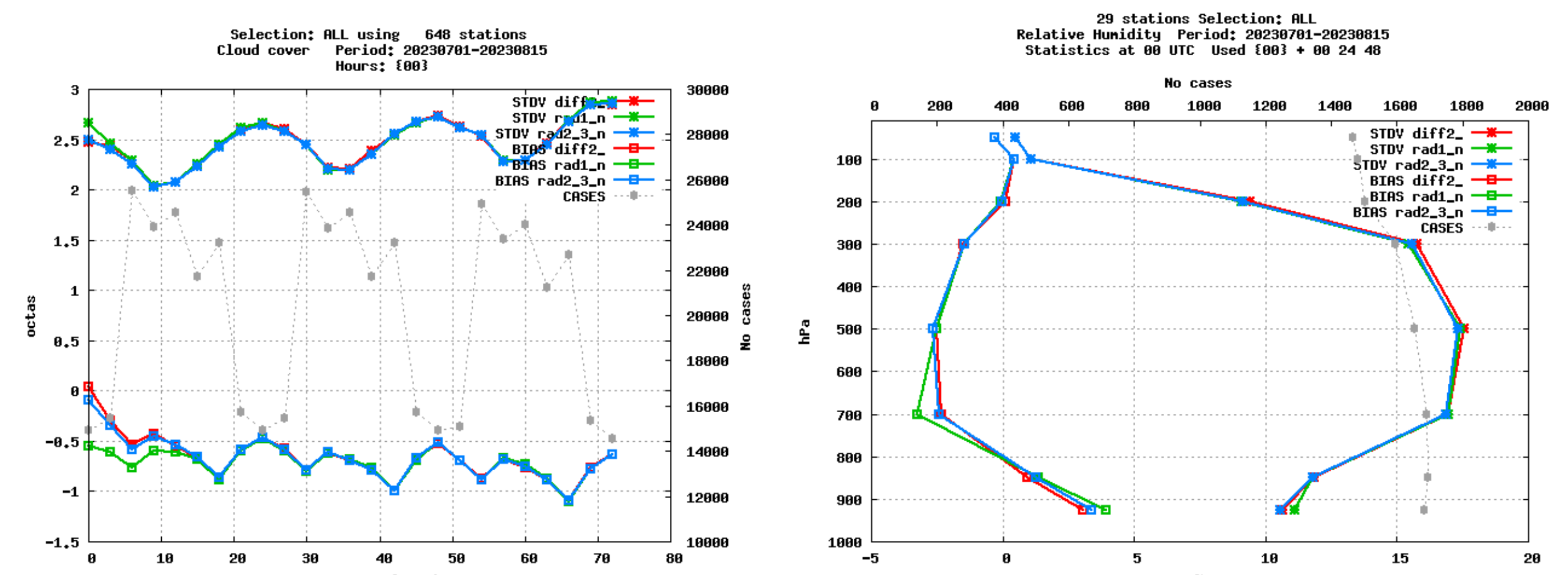


Fig.5: Bias and STDV for cloud cover and RH profile for summer period; Operational suite HR40 - no radar DA (red), AROME-MF setup (green), combined methods (blue)

Radar reflectivities from OPERA are successfully implemented in the Croatian operational chain from the end of 2023. Data from the NIMBUS production line showed comparable performance when compared with data from the ODYSSEY production line.

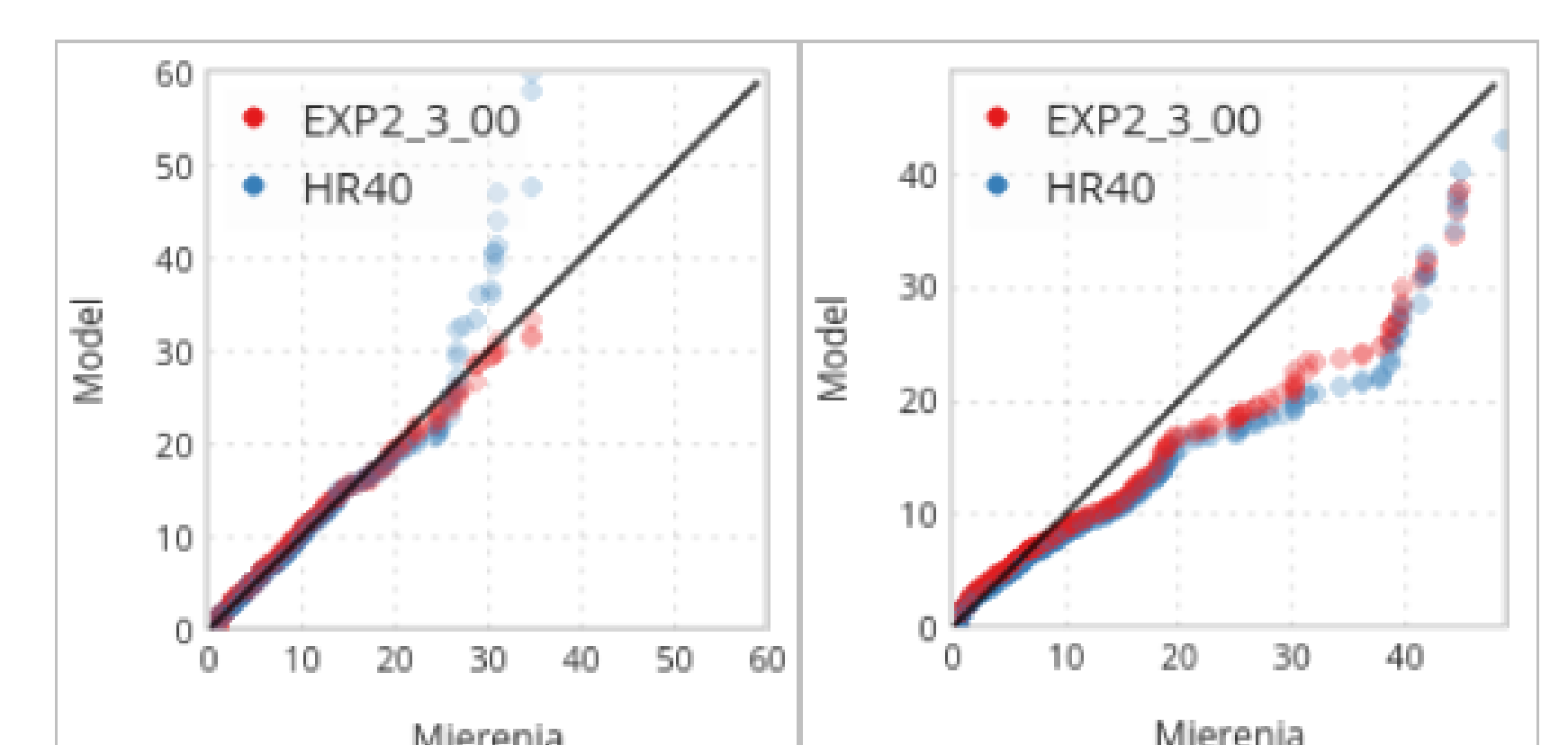


Fig.6: Q-Q plot of modeled and observed 1h rain rates; Continental (left) and coastal (right) stations