The analog-based method implementation in the Croatian operational forecasting system

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Introduction

- State-of-the-art mesoscale models exhibit noteworthy errors, especially in complex terrain.
- The need to improve NWP forecast via post-processing where measurements are available is becoming more and more evident
- Is analog-based method – a way to go?

Tested for deterministic forecasts: [Odak Plenković et al., 2018]
https://doi.org/10.1175/JAMC-D-17-0151.1

The properties of the ensembles tested: [Odak Plenković et al., 2020]
https://doi.org/10.1002/qj.3769

The answer is … YES!

1. Photo: RP Global
2. Photo: PIXSELL,/Danas
3. Photo: Dino Stanin / PIXSELL

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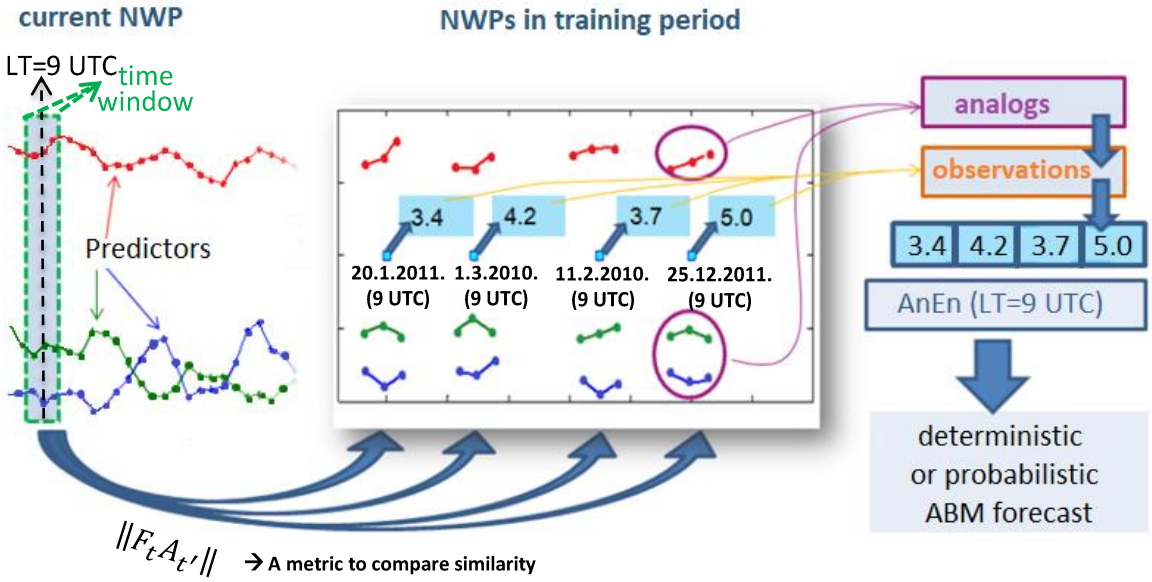
What is an analog-based method (ABM)?

It is a point-based post-processing approach composed of finding the most similar past numerical weather predictions (NWP), called analogs, to the current NWP over several variables (predictors) and forming an analog ensemble (AnEn) out of the corresponding observations.



What is the setup?

- Data includes the measurements (temperature, wind speed, and gusts) and operational ALADIN-HR4 NWP forecasts at approximately 50 stations
- The training period is 2 years, consisting of past NWPs and corresponding observations.
- The temperature analog forecasting is very easily over-fitted so only 4 predictors are used, while 10 predictors are used for the wind forecasting.

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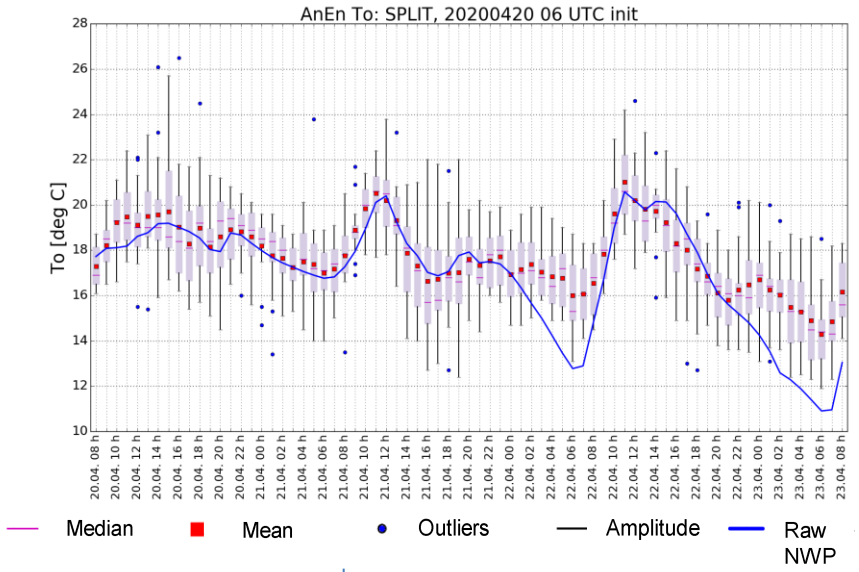
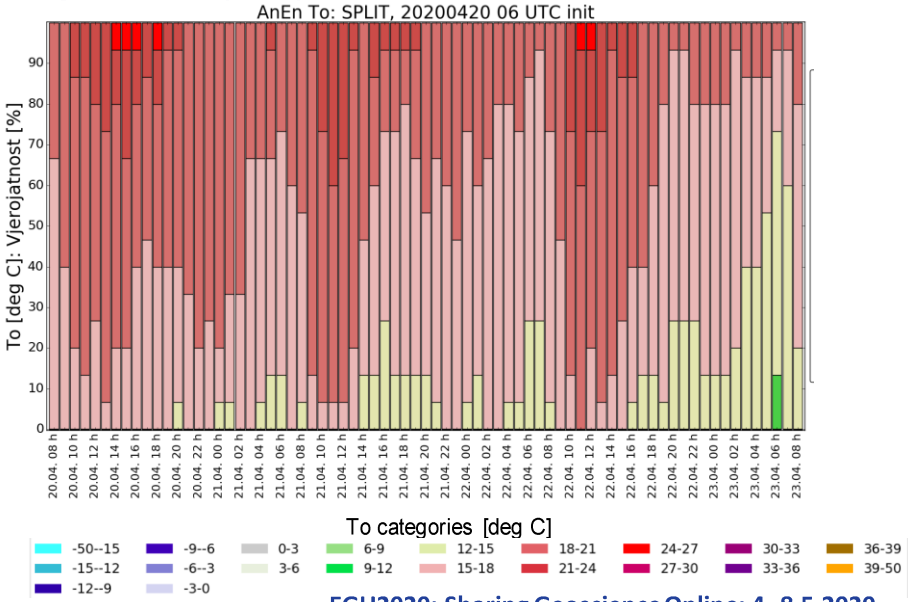
So, how does it look in the test operational mode?

ABM setup includes 15 members wind speed, wind gusts and temperature ensemble predictions with the hourly resolution, up to 72 h ahead. The ABM forecast is run four times per day. The ABM is implemented as a part of the forecasting system in operational test mode from August 2019.

The example for the ABM temperature (2 m) forecast





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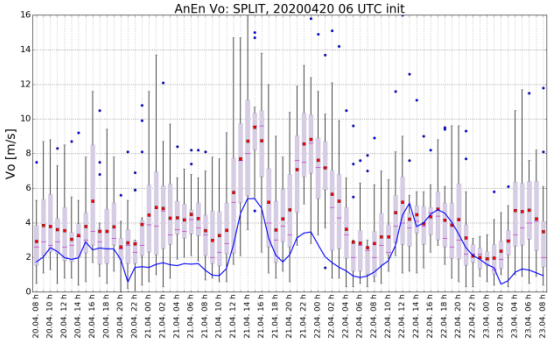
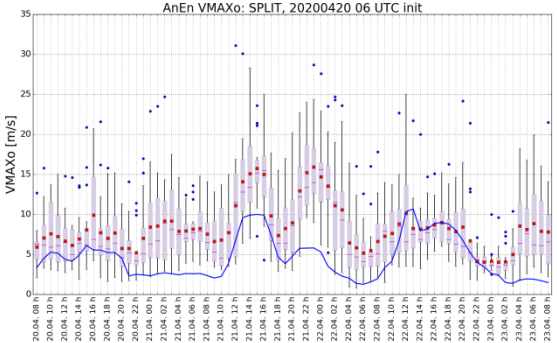
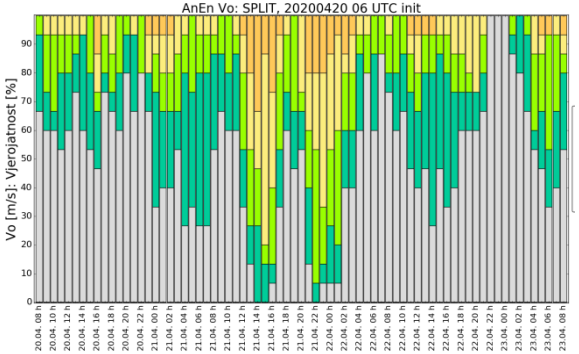
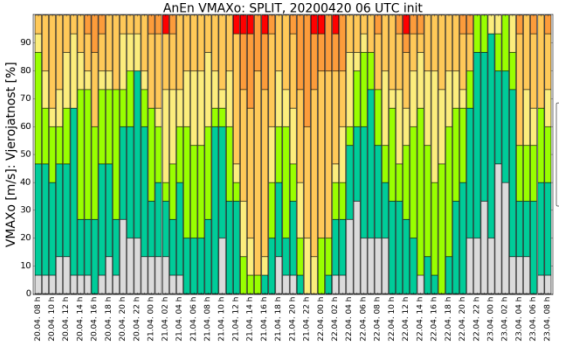
The example for the ABM wind speed Vo and gusts VMAXo (10 m) forecast









AnEn → ensemble forecasts

Median Mean Outliers Amplitude Raw

- The ensembles are shown as the box-plot diagrams.
- The mean/median value can be used as new and improved deterministic forecast.
- The higher the box or the amplitude shown by whiskers the more uncertain the AnEn forecast..

AnEn → probabilistic forecasts

Wind speed categories [m/s] 0-3.4 3.4-5.5 5.5-8 8-10.8 10.8-17.2 17.2-24.5 24.5-32.7 32.7-45 45-100

- Forecasted probabilities for the event are represented via (stacked) bar-plots.
- The color of each bar represents the category
- The height represents the forecasted probability for the event to occur.
- Only the categories with more than 0 % chance are shown.

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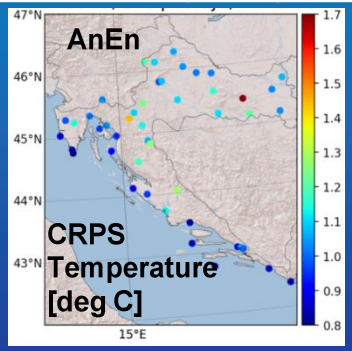
Preliminary results (yr. 2018):

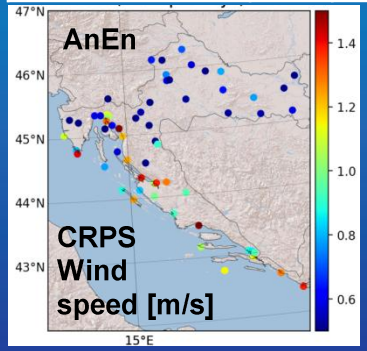
Temperature	AnEn	raw
Bias [°C]	0.13	-0.35
Corr	0.98	0.97
RMSE [°C]	1.93	2.20
Spread [°C]	2.29	x
BSS za T>20 °C	0.80	x
CRPS	1.06	x

Wind speed	AnEn	raw
Bias [m/s]	-0.06	0.29
Corr. Coeff.	0.79	0.69
RMSE [m/s]	1.71	2.16
Spread [m/s]	1.72	x
BSS for V>10 m/s	0.46	x
CRPS	0.77	x

Wind gusts	AnEn	raw
Bias [m/s]	-0.11	0.08
Corr	0.81	0.71
RMSE [m/s]	3.01	3.84
Spread [m/s]	3.05	x
BSS za V>10 m/s	0.49	x
CRPS	1.40	x

- The error measured by RMSE and bias are reduced by ABM, while the correlation is increased.
- The ensembles seem properly dispersed (spread vs. RMSE) and skillful (measured by the Brier skill score BSS or Continuous rank probability score CRPS)





- The best results for the temperature forecast are at coastal maritime region, while the mountain complex area seems to be the least predictable one, resulting in the lowest CRPS (left panel)
- For both wind speed and gusts analog-based forecast is more accurate at nearly-flat continental terrain situated more inland than at coastal and mountain complex area, as expected (right panel).

Thank you!!!

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