Machine learning for postprocessing ensemble forecasts of wind gusts with a focus on European winter storms

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NP 5.1: Advances in statistical post-processing, blending and verification of deterministic and ensemble forecasts

Agenda

1. Machine learning methods for postprocessing ensemble forecasts of wind gusts

2. Postprocessing in European winter storms

Setting

Goal: Find best postprocessing method for ensemble forecasts of wind gusts.

⇒ Review and comparison of existing postprocessing approaches

Basic methods:

Only wind gust ensemble

- EMOS
- MBM
- IDR

Separate model for each station!

ML benchmark:

Use additional predictors

- EMOS-GB
- QRF

Separate model for each station!

Neural networks:

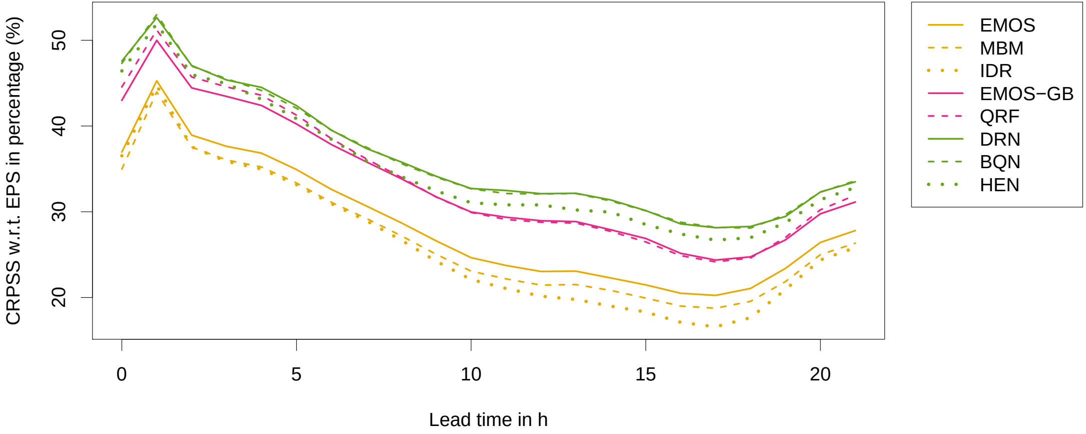
Locally adaptive

- DRN
- BQN
- HEN

Joint model for **all** stations!

Schulz, B. and Lerch, S. (2022): **Machine learning methods for postprocessing ensemble forecasts of wind gusts: A systematic comparison**, *Monthly Weather Review*, **150**, 235–257.

CRPSS over Lead Time



CRPS skill of the postprocessing methods w.r.t. the ensemble dependent on the lead time. Each method is applied for each lead time separately. **Higher means better.**

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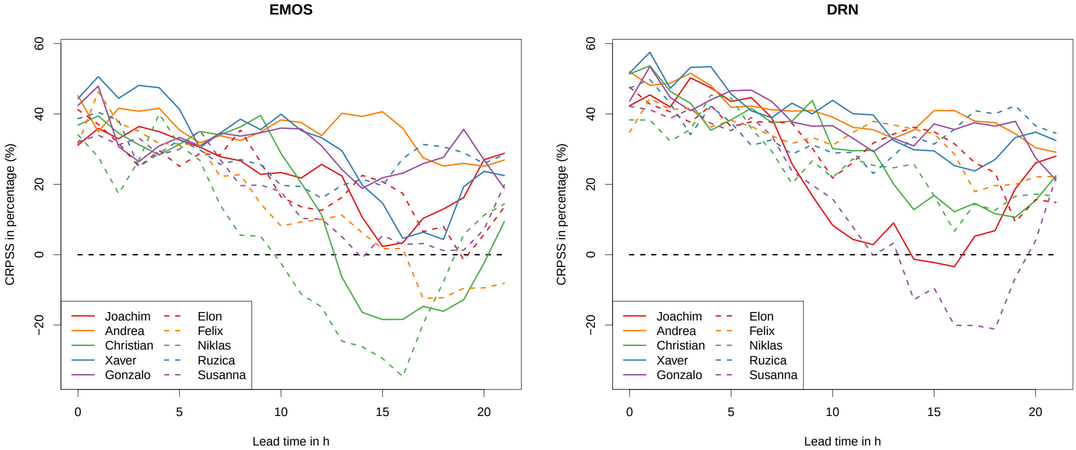
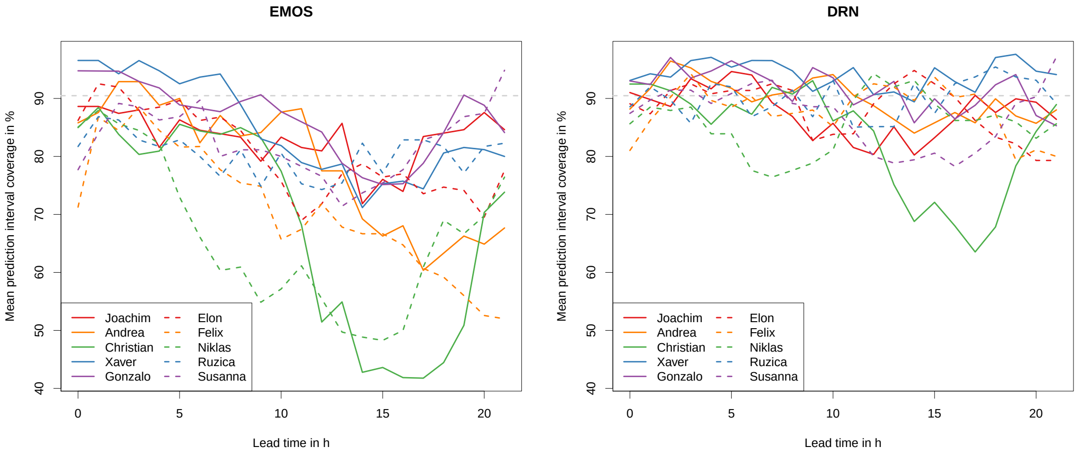
Skill in Winter Storms



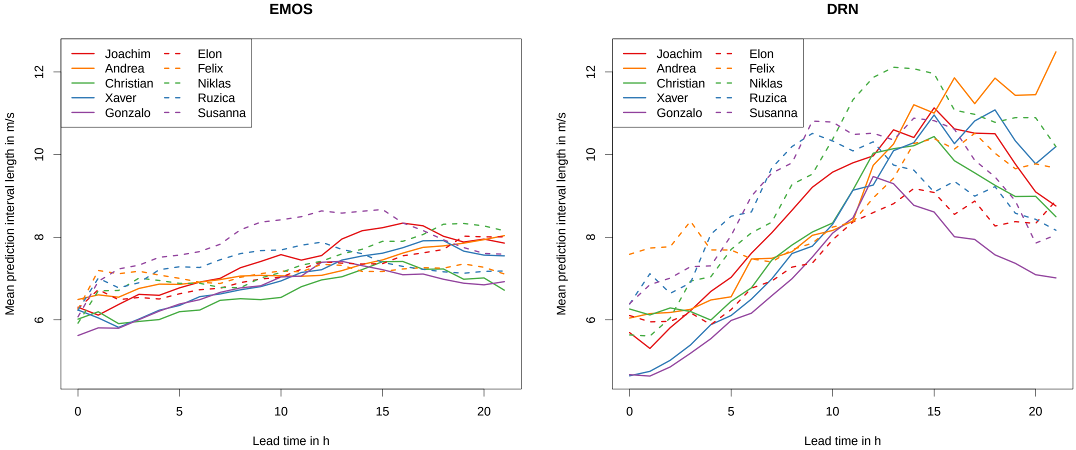
CRPS skill of EMOS (left) and DRN (right) w.r.t. the ensemble dependent on the lead time. Each method is applied for each lead time separately. **Higher means better.**

Reliability in Winter Storms



Prediction interval coverage of EMOS (left) and DRN (right) dependent on the lead time. Each method is applied for each lead time separately.

Forecast Uncertainty in Winter Storms



Prediction interval length of EMOS (left) and DRN (right) dependent on the lead time.
Each method is applied for each lead time separately.

Conclusions and Outlook

Systematic comparison:

- Neural networks significantly outperform state-of-the-art benchmark methods.
- The neural networks learn **physically consistent** relations (not shown).

Winter storms:

- Neural networks outperform postprocessing benchmark also within winter storms.
- Neural networks are **more reliable** and better represent the forecast uncertainty.
- Neural networks are still subject to a **forecast bust**.

Outlook:

- Investigate **effect of predictors** on neural networks within winter storms.
- **Feature-dependent** forecast error analysis and postprocessing.