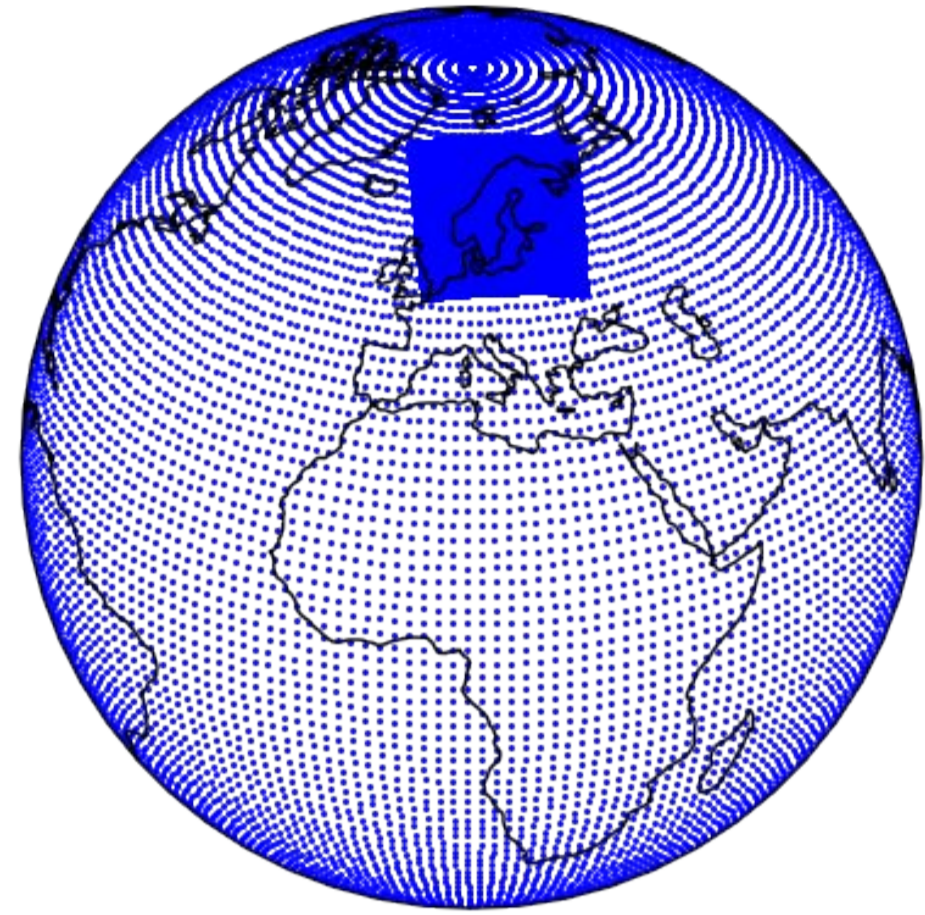
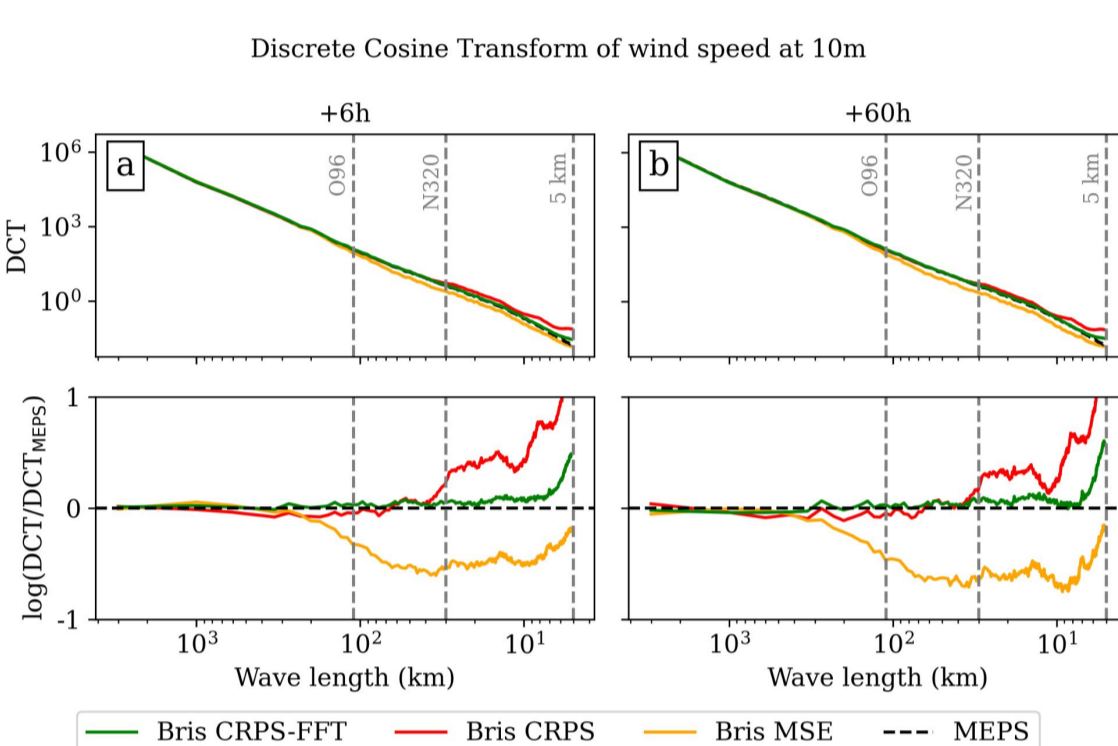
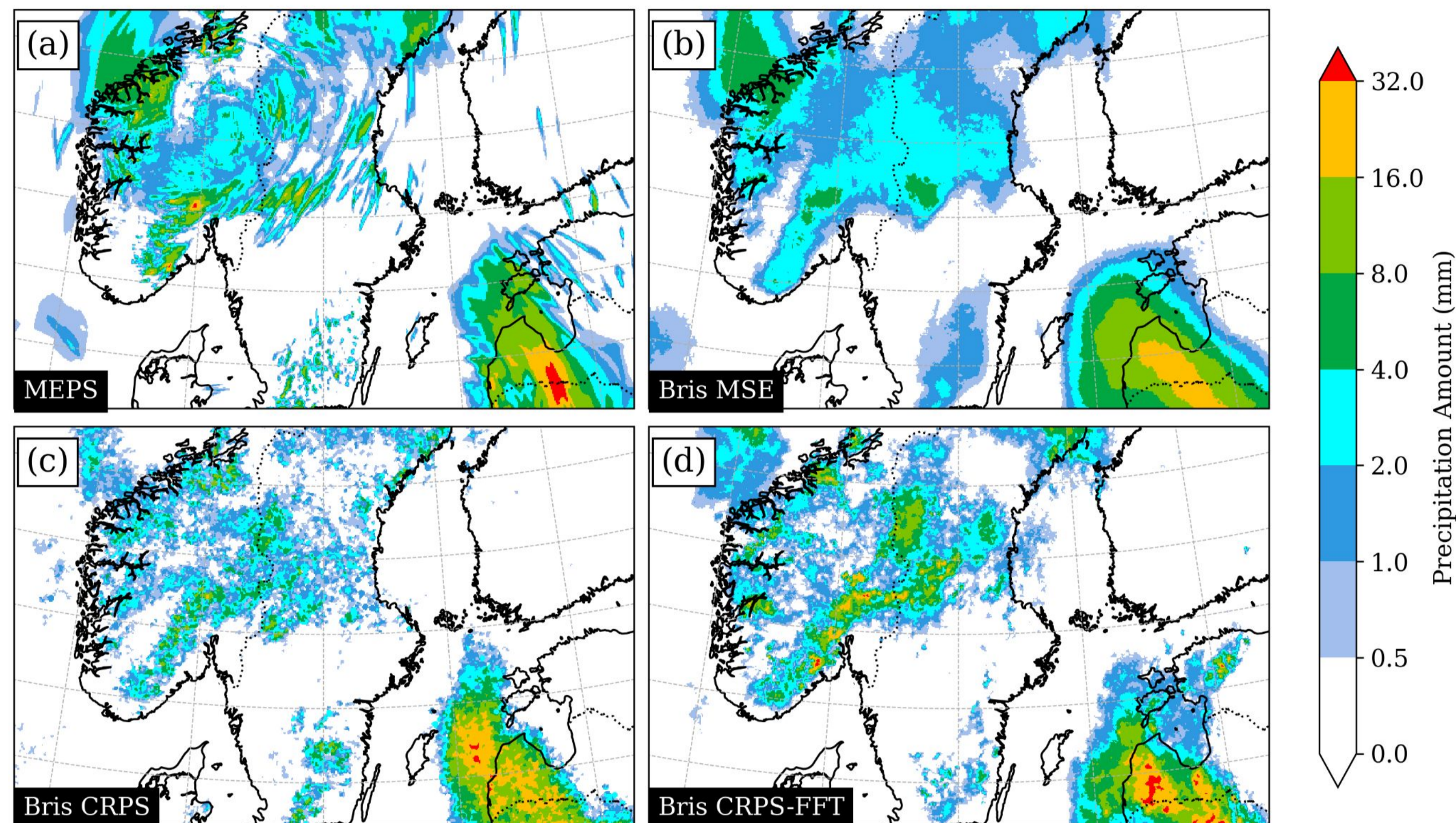


## Bris



6-hour Accumulated Precipitation, 2022-06-01T00Z (+18h)



Bris is a **probabilistic** data-driven weather forecasting model capable of providing an **ensemble** of high resolution realizations of 87 variables at arbitrary forecast length and ensemble size [1].

Bris uses the **Anemol** framework, with an encoder-processor-decoder and connections defined by a graph. This allows for a **stretched grid** that combines global low resolution data (**31km**) with regional high resolution data (**2.5km**) over the nordics. Weather flows seamlessly between the two domains. The model is **pre-trained** on **43 years** of ERA5, and fine-tuned on **3 years** of IFS + MEPS analysis.

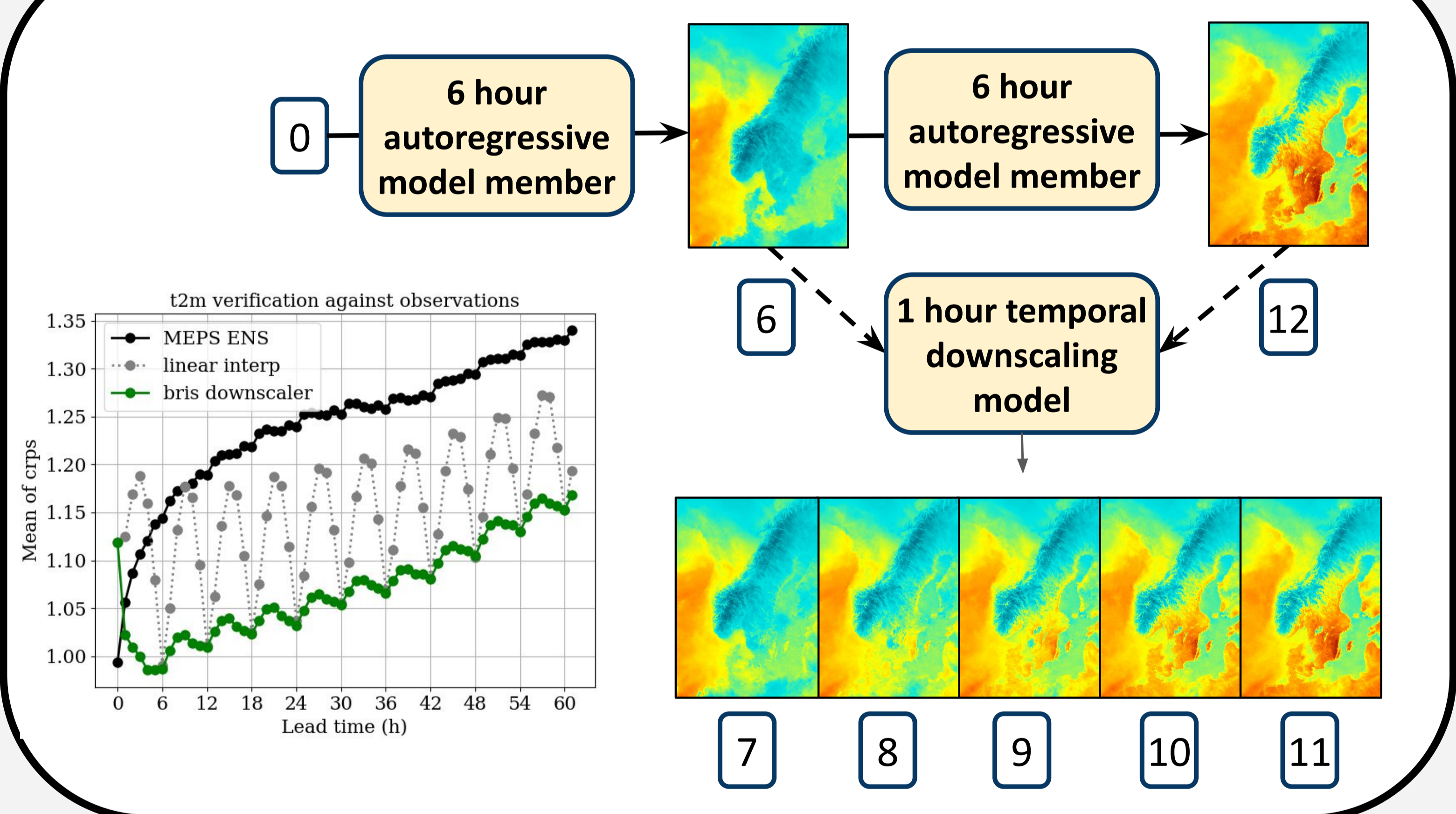
With a learned noise injector to produce ensemble members, bris is trained with **almost fair CRPS** as a loss objective. This is done both in **real** and **spectral** space. The spectral component is key to improve the spatial consistency of the fields at high resolution.

The Bris forecaster is **autoregressive** with a base time-step of 6 hours. The next step is to extend the ensemble of **6-hourly** forecasts to **1-hourly** temporal resolution. With **no hourly MEPS analysis**, an hourly forecaster is not an option. Instead, we train an emulator on nwp trajectories **bounded at 0 and +6 hours** to act as a temporal downscaler. The model uses a similar architecture to the forecaster, with a change in the decoder to output the intermediate hours **1-5 simultaneously**.

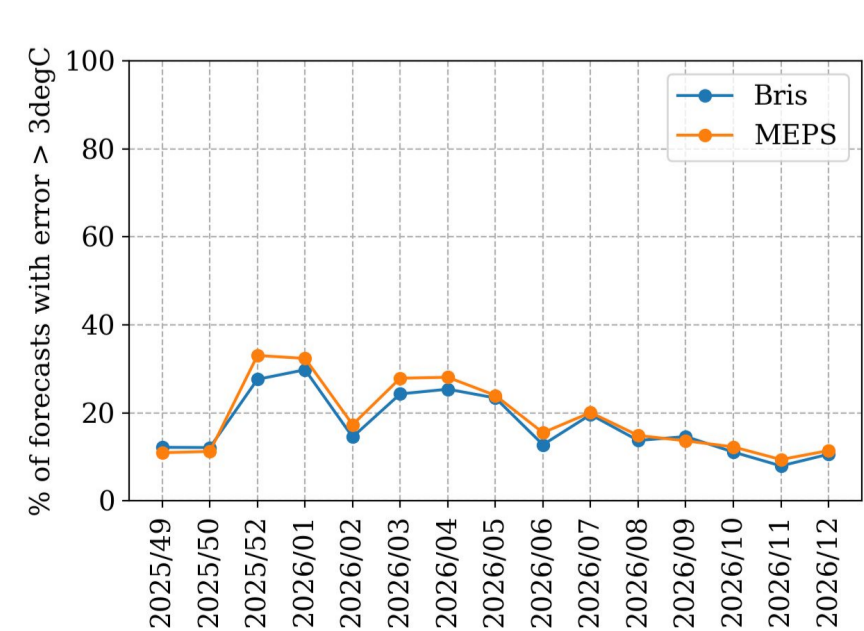
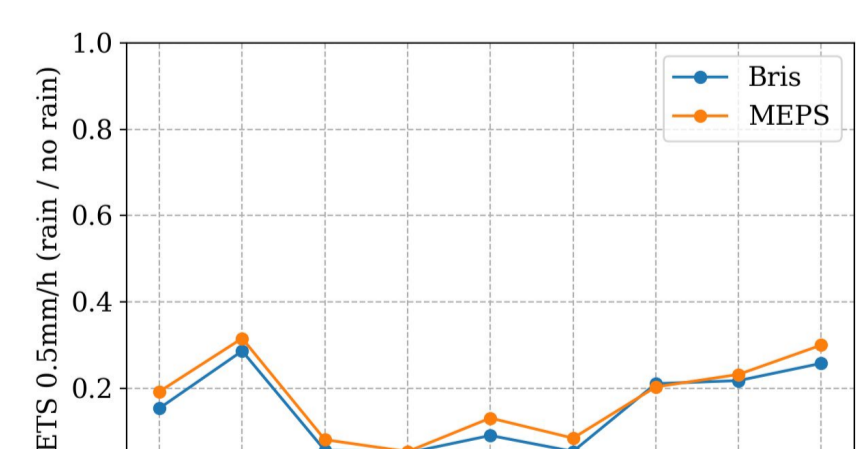
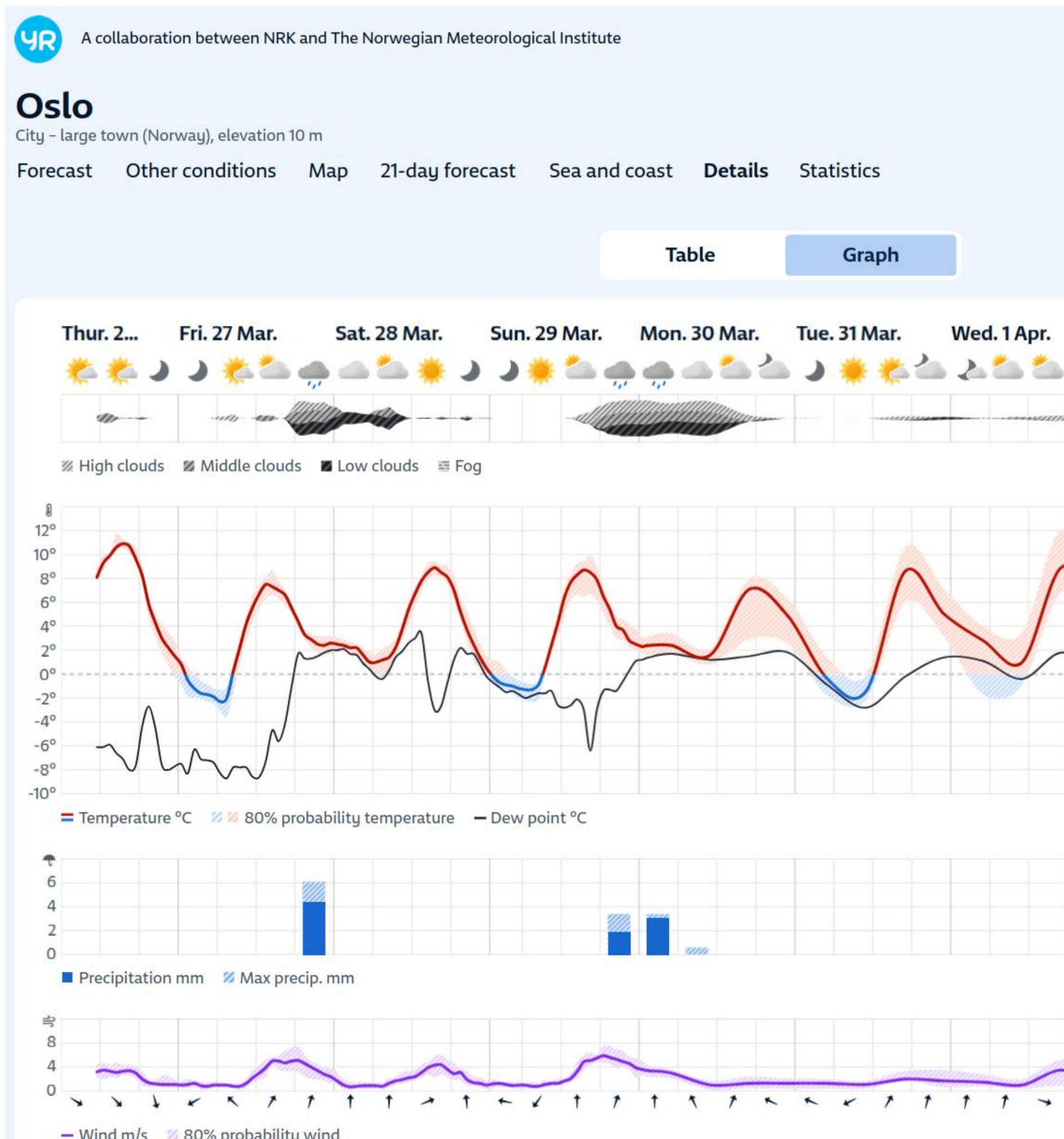
To produce **realistic scenarios**, the downscaler is also trained with a **probabilistic** objective with both real and spectral components. Additionally, calculating the loss on **time-aggregated** mean, min and max promotes **temporal consistency**.

In **inference**, the downscaler runs together with each member of the bris forecaster. It runs at **similar speed** to the forecaster, doubling the compute when going from 6-hourly to 1-hourly output.

## Temporal Downscaling



## Road to Operations



Bris is producing forecasts in **real time** in a pre-operational setup in-house at MetNorway

- 16 members
- 1 hour resolution out to 5 days
- 4 initializations per day (00, 06, 12, 18)
- Hardware: 2x NVIDIA H200
- Full pipeline runtime: 20 min

Connects to the **public user interface YR** - useful to evaluate the end product.

**Real time verification** compared with our NWP model MEPS

### Acknowledgement:

This work is supported by the ECMWF Machine Learning Pilot Project

### References:

1. Nordhagen E. M. et al. High-Resolution Probabilistic Data-Driven Weather Modeling with a Stretched-Grid. arXiv.2511.23043 (2025)