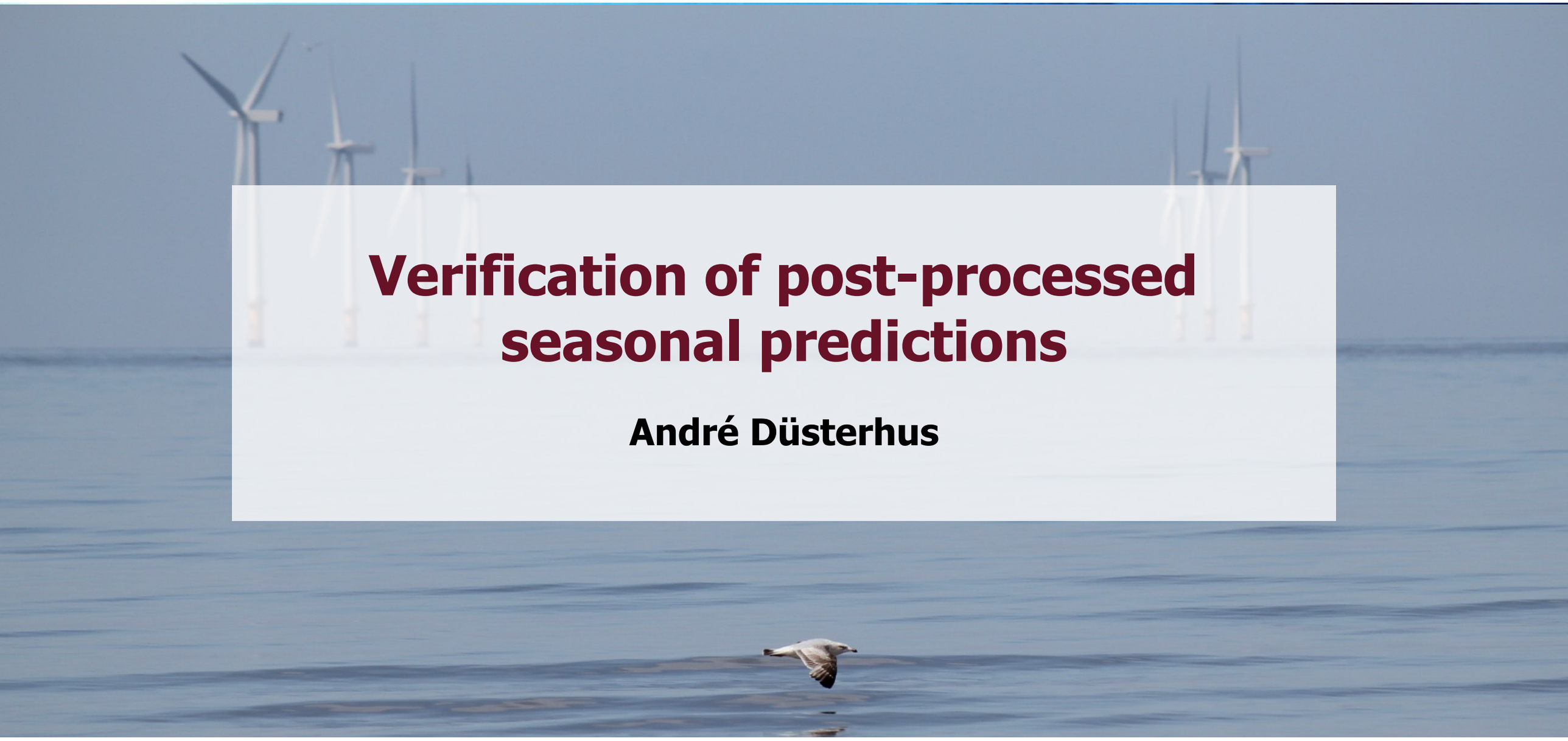

Verification of post-processed seasonal predictions

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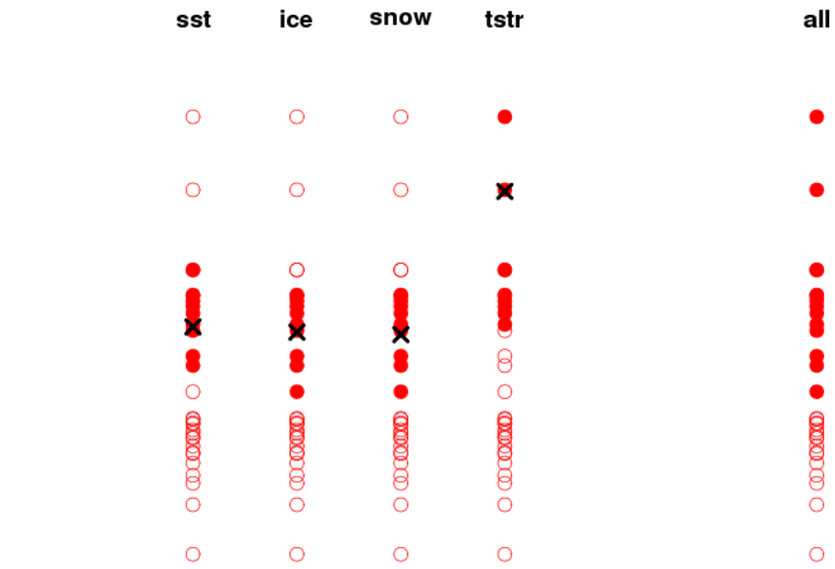
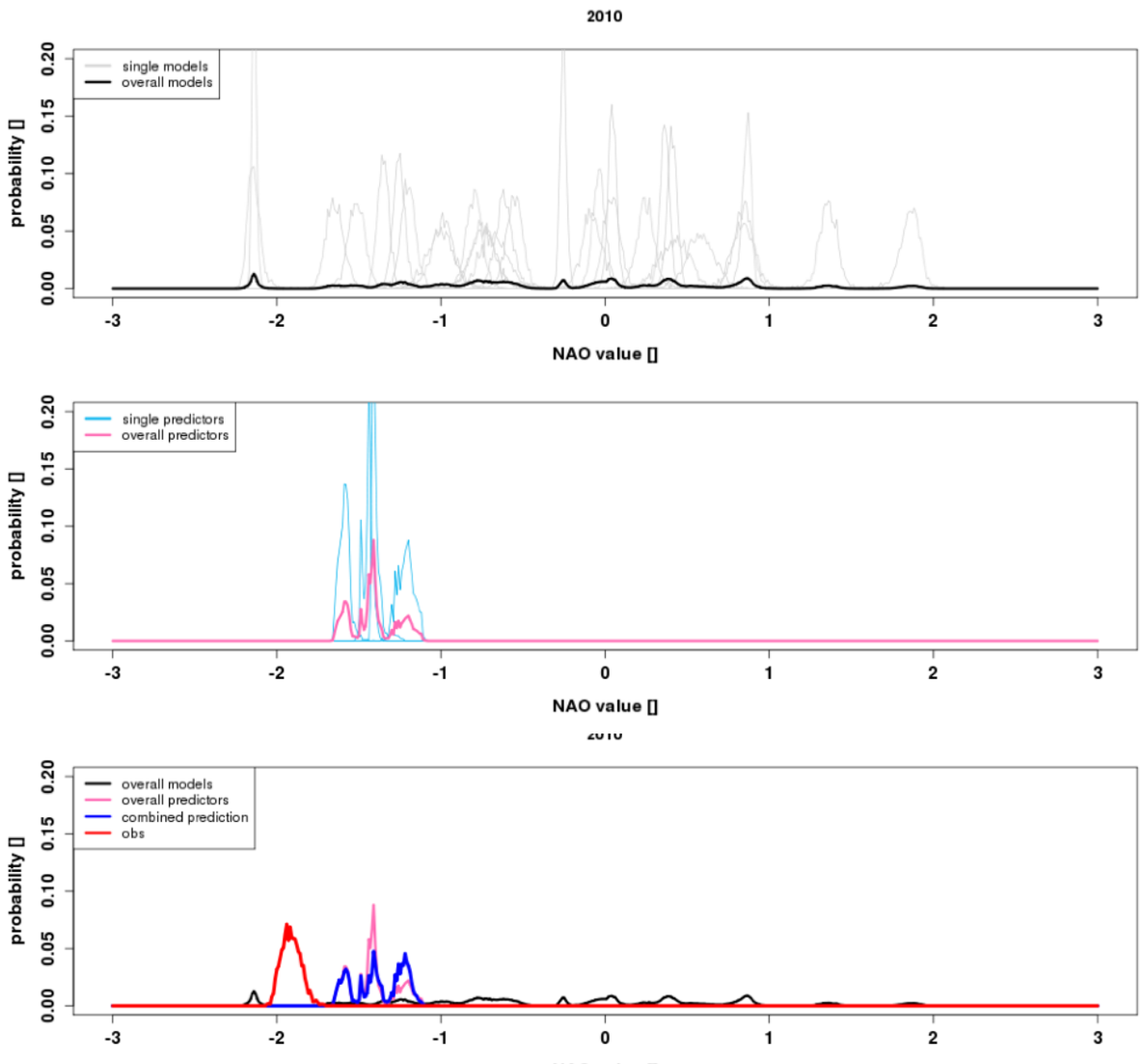
Combining dynamical & statistical model (sub-sampling) to gain better prediction skill for the winter North Atlantic Oscillation has been introduced by Dobrynin et al 2018.
In this study ensemble members are not selected, but seen as probability distributions and merged.
But how do we verify those predictions, when observations are also probability distributions?



Statistical predictors basing on variables before initialisation propose individually a NAO value. Those ensemble members closest to those preidctors are selected for this preidctor. For one year, all ensemble members selected by at least one predictor are chosen and create a new ensemble mean



Dynamical ensemble prediction

Statistical predictors

Combining dynamical & statistical model

Earth Mover's Distance (EMD) and Integrated Quadratic Distance (IQD) are two ways to compare probability distributions. By creating a score 1d-dimensional score q, comparing a predicting pdf (A) with the observational pdf (O) and the climatology (C) we are able to say, which prediction performs better.

$$q(\mathcal{A}, \mathcal{O}) = 1 - \frac{D(\mathcal{A}, \mathcal{O})}{D(\mathcal{C}, \mathcal{O})}$$

$$D_{EMD}(f, g) = \frac{1}{n_b} \sum_{i=1}^{n_b} |F(v_i) - G(v_i)| \qquad D_{IQD}(f, g) = \frac{1}{n_b} \sum_{i=1}^{n_b} (F(v_i) - G(v_i))^2$$

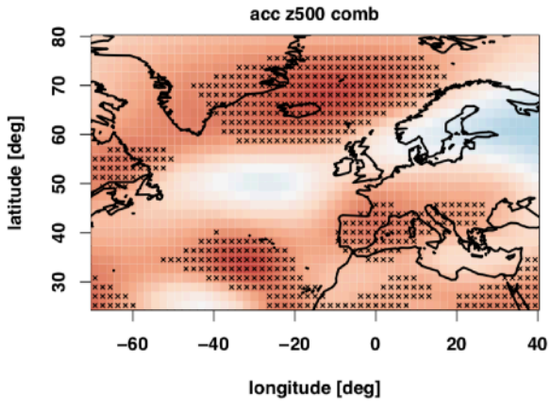
By ranking for each year the three models (statistical, dynamical and combined) it is possible to make a detailed analysis why one prediction is better than another

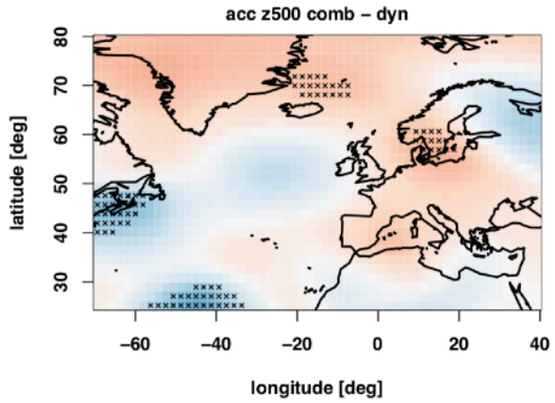
EMD	Dynamical Model	Statistical Model	Combined Model
1	5	17	14
2	5	10	21
3	26	9	1

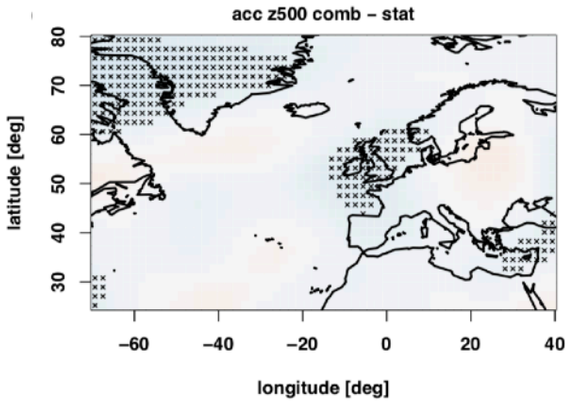
IQD	Dynamical Model	Statistical Model	Combined Model
1	13	16	7
2	7	12	17
3	16	8	12

EMD, punishing too unspecific predictions harder, shows that in case the combined prediction is not the best prediction it is at least a good compromise between dynamical and statistical model.
IQD confirms this, but also shows that the combined model is not necessary more correct with its sharp predictions.

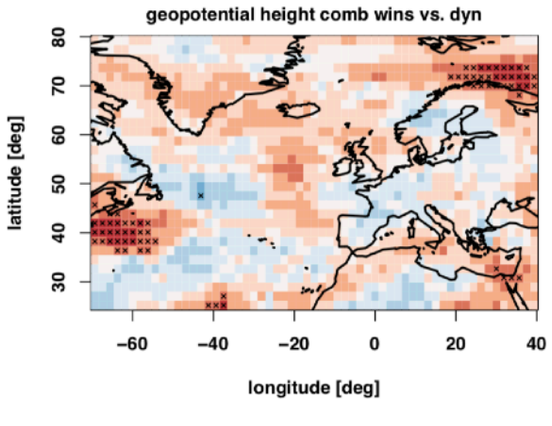
ACC

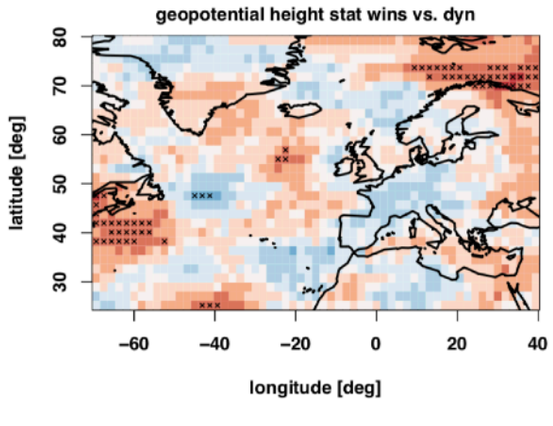


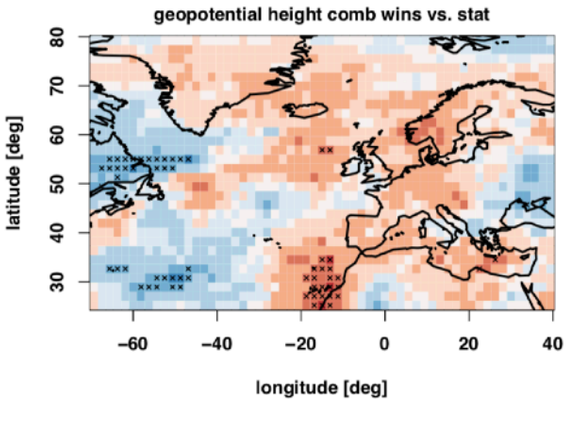




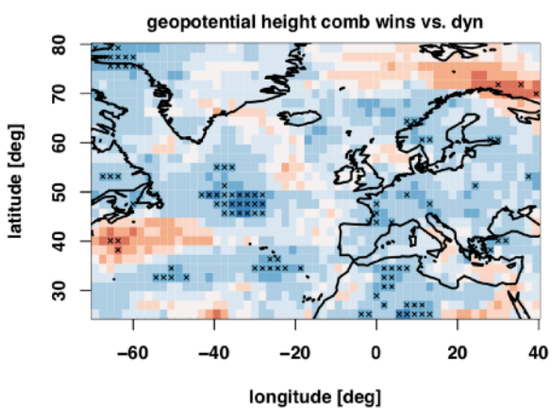
EMD

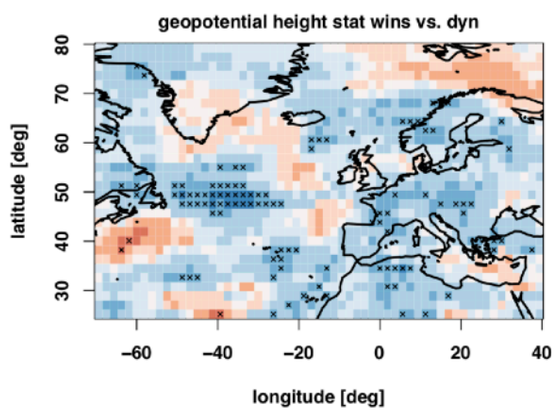


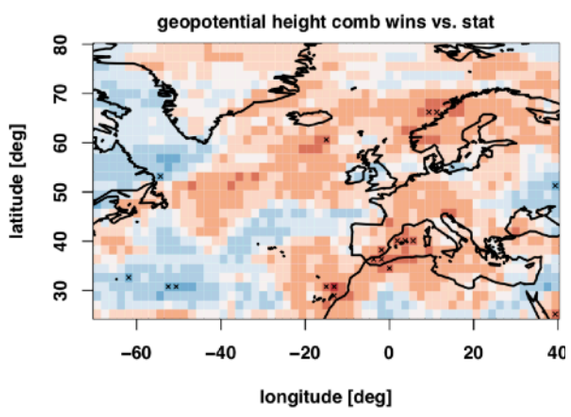




IQD







By applying the different analysis tools (the anomaly correlation (ACC), EMD and IQD) to the predictions of a variable field (z500) shows that these tools demonstrate different characteristics of skill.

One strength of EMD and IQD is that they evaluate every year individually and answer the question: **How sure can we be that a single prediction is better than another?**

Conclusion

The 1D-continuous-EMD and 1D-continuous-IQD show its ability to evaluate probabilistic predictions with probabilistic observations.

They answer the question:
How sure can we be that a single prediction is better than another?

Probabilistic post-processing by merging dynamical model results with statistical predictions can lead to more balanced predictions.

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