

EGU21-11448

<https://doi.org/10.5194/egusphere-egu21-11448>

EGU General Assembly 2021

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WeatherBench Probability: Medium-range weather forecasts with probabilistic machine learning methods.

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Because the atmosphere is inherently chaotic, probabilistic weather forecasts are crucial to provide reliable information. In this work, we present an extension to the WeatherBench, a benchmark dataset for medium-range, data-driven weather prediction, which was originally designed for deterministic forecasts. We add a set of commonly used probabilistic verification metrics: the spread-skill ratio, the continuous ranked probability score (CRPS) and rank histograms. Further, we compute baseline scores from the operational IFS ensemble forecast.

Then, we compare three different methods of creating probabilistic neural network forecasts: first, using Monte-Carlo dropout during inference with a range of dropout rates; second, parametric forecasts, which optimize for the CRPS; and third, categorical forecasts, in which the probability of occurrence for specific bins is predicted. We show that plain Monte-Carlo dropout does not provide enough spread. The parametric and categorical networks, on the other hand, provide reliable forecasts, with the categorical method being more versatile.