EGU22-920
https://doi.org/10.5194/egusphere-egu22-920
EGU General Assembly 2022

Convolutional neural networks for skillful global probabilistic predictions of temperature and precipitation on sub-seasonal time-scales

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Reliable sub-seasonal forecasts for precipitation and temperature are crucial to many sectors including agriculture, public health and renewable energy production. Since the forecast skill of numerical weather forecasts for lead times beyond two weeks is limited, the World Meteorological Organization launched a *Challenge to improve Sub-seasonal to Seasonal Predictions using Artificial Intelligence*, which was held from June to October 2021. Within the framework of this challenge, we have developed a hybrid forecasting model based on a convolutional neural network (CNN) that combines post-processing ideas with meteorological process understanding to improve sub-seasonal forecasts from the European Centre for Medium-Range Weather Forecasts (ECMWF).

Here, we present a refined version of our model that predicts tercile probabilities for biweekly averaged temperature and accumulated precipitation for weeks 3 – 4 and 5 – 6. Our model is trained on limited-area patches that are sampled from global predictor fields. It uses anomalies of large-scale predictors and features derived from the target variable forecasts as inputs. Spatial probabilistic forecasts are obtained by estimating coefficient values for local, spatially smooth basis functions as outputs of the CNN. Our CNN model provides calibrated and skillful probabilistic predictions, and clearly improves over climatology and the respective ECMWF baseline forecast in terms of the ranked probability score for weeks 3 – 4 and 5 - 6.