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KEYNOTE

EXTENDED ABSTRACT ONLY

Processing numerical weather prediction (NWP) outputs to enhance precipitation forecasting for Australia

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Abstract: Statistical processing of raw forecasts from NWP models aims to produce forecasts that are unbiased, reliable in ensemble spread, as skillful as possible and consistent with seasonally varying climatology. However, many processing models are inadequate in representing the seasonality of precipitation, resulting in unrealistic forecasts especially for regions with strong seasonality. This problem is often caused by the availability of only short archives of NWP data for establishing statistical calibration models. In this study, we implement the newly developed seasonally coherent calibration (SCC) model and the Schaake shuffle technique to improve precipitation forecasts across Australia.

The SCC model has been developed to resolve three key issues: (1) constructing a calibration model that is sophisticated enough to allow for seasonal variation in the statistical characteristics of raw forecasts and observations, (2) bringing climatology that is representative of long-term statistics into the calibration model, and (3) reducing the number of model parameters through sensible re-parameterisation to make the model workable with short NWP datasets.

In our implementation, we process the precipitation forecasts produced by the Australian Community Climate and Earth-System Simulator (ACCESS-G2) model. As an operational model of the Australian Government Bureau of Meteorology, ACCESS-G2 provides weather forecasts for 10 days ahead. We process raw precipitation forecasts in reference to the Australian Water Availability Project (AWAP) precipitation data during April 2016-March 2018. Specifically, we first apply the SCC model to individual grid cells (with a spatial resolution of 5km) and lead-times to generate calibrated ensemble forecasts across Australia. The Schaake shuffle technique is then applied to link ensemble members of the calibrated forecasts across grid cells and over lead-times, so that the forecast ensemble members are coherent in spatial and temporal patterns.

The quality of the calibrated forecasts is assessed by evaluating bias, accuracy, reliability in ensemble spread, and percentage of wet days. The spatial and temporal patterns instilled by the Schaake shuffle are assessed by evaluating reliability in ensemble spread when aggregated to coarser spatial and temporal scales. The SCC calibrated forecasts are found to produce significant improvements over raw forecasts. The shuffled ensemble forecasts are shown to be reliable at various spatial and temporal scales, indicating that the forecast ensemble members have realistic spatial and temporal patterns.

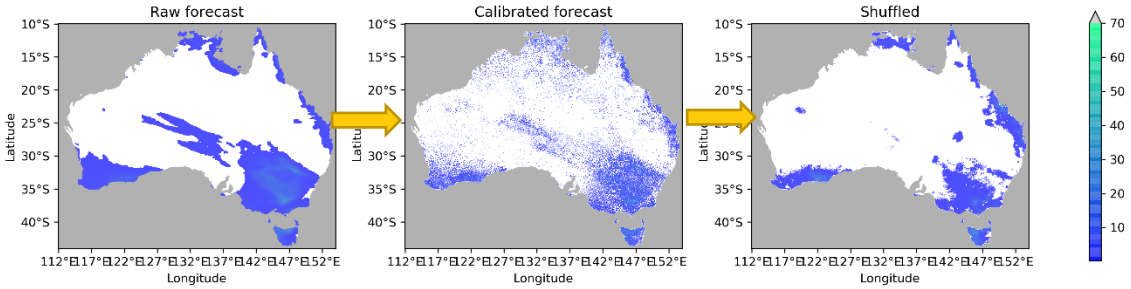

Figure 1. Precipitation processing with SCC and Schaake shuffle

The processing methods can be easily adapted for applications to future operational NWP models. The methodology will also be applicable to other NWP variables, such as temperature, wind, vapor pressure, solar radiation, and reference crop evapotranspiration, which are also of interests to many forecast users. The processing will benefit a broad range of forecast users by providing well-calibrated ensemble forecasts in high-resolution across Australia.

Keywords: *Statistical calibration, ensemble weather forecasts, climatology, seasonality, Schaake shuffle*