Statistical Postprocessing of Week-1 and Week-2 Precipitation Forecasts Over Taiwan

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abstract

The predictability of precipitation is hindered by finer-scale processes not captured explicitly in global numerical models, such as convective interactions, cloud microphysics, and boundary layer dynamics. However, there is growing demand across various sectors for medium- (3–10-day) and extended-range (10–30-day) quantitative precipitation forecasts (QPFs) and probabilistic QPFs (PQPFs). This study uses a novel statistical postprocessing technique, APPM, that combines analog postprocessing (AP) with probability matching (PM) to produce week-1 and week-2 accumulated precipitation forecasts over Taiwan. AP searches for historical predictions that closely resemble the current forecast and create an AP ensemble using the observed high-resolution precipitation patterns corresponding to these forecast analogs. Frequency counting and PM are then separately applied to the AP ensemble to produce calibrated and downscaled PQPFs and bias-reduced QPFs, respectively.

Evaluation over a 22-year (1999-2020) period shows that raw ensemble forecasts from the GEFS of NOAA/NWS/Environmental Modeling Center, collected for the Sub-seasonal Experiment, are under-dispersive with a wet bias. In contrast, the AP ensemble spread well represents forecast uncertainty, leading to substantially more reliable and skillful probabilistic forecasts. Furthermore, the AP-based PQPF demonstrates superior discrimination ability and yields notably greater economic benefits for a wider range of users, with the maximum economic value increasing by 30% to 50% for the week-2 forecast. Compared to the raw ensemble mean forecast, the calibrated QPF exhibits lower mean absolute error and explains 3–8 times more variance in observations. Overall, the APPM technique significantly improves week-1 and week-2 QPFs and PQPFs over Taiwan.