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New calibrated daily rainfall probability guidance

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The most important general weather forecasts for the public and forecasters alike are consistently found to be for rainfall. Calibrated, combined and downscaled (i.e. post-processed) guidance from Numerical Weather Prediction (NWP) is found, on average, to out-perform raw NWP for medium-range weather forecasting.

A new daily ensemble rainfall probability guidance post-processing system is presented and its output is compared with NWP and official forecasts.

Both “Poor Man’s Ensembles” (PME) of local and international deterministic guidance, and the native European Centre for Medium Range Weather Forecasting (ECMWF) global weather forecast ensemble (ECEPS) are used as inputs. The inputs are combined in probability space in a process analogous to quantile mapping.

The ECEPS and PME forecast rainfall amounts and probabilities are averaged with relative weights determined by the number of members in each ensemble and some optimisation from re-forecast verification. Probabilities from the combined forecast are produced both by using the uncalibrated ’voting’ probabilities from ensemble member counting and fitting calibrated Bayesian probability density functions to the ensemble mean. The calibration maximises skill in re-forecasts over a year. Calibration categories are used which take into account the reliability of rain / no rain guidance and rainfall amount guidance for like locations; this provides a degree of localisation of calibration while expanding the training data available for any given location.

The principal ’truth’ data for calibration are Australian Water Availability Project analyses at 0.25 degree resolution close to rain gauges, and the rainfall probabilities reflect that spatial scale. However, probabilities supplied for weather forecasting purposes are required to be reliable at rain gauge scale. Hence a simple but effective approach is used to ’rescale’ areal probabilities to points utilising rain gauge data. The forecast service does not treat ’dew’ as ’rain’, so an innovative approach is used to approximate exclusion of dew in forecast probabilities for chance of any rain (0.2mm or more).

These approaches have increased daily rainfall probability skill by the equivalent of at least 36h lead time over the last 2 years. The most recent guidance, not yet routinely available to forecasters, has become more skilful than the majority of official forecasts on average as measured by Brier skill score at rain gauges, although important caveats apply to that result. Business process changes are extending the skill improvement in official forecasts by another 12 to 24 hours lead time. Upcoming developments are discussed.