Ensemble Calibration and Uncertainty Quantification of Precipitation Forecasts for a Risk-based UAS Navigation

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Abstract

Uncertainty on precipitation forecasts results in major high cancellation rate in Unmanned Aircraft Systems operations and reduces the benefits of BVLOS operations in terms of risk-based contingency planning. Hence, quantifying and reducing the uncertainty on precipitation forecasts will reduce mission uncertainties, avoid accidents and make the integration of UAS into the National Airspace System more efficient and reliable. To achieve this goal, the Member-ByMember post-processing technique is used to calibrate a probabilistic forecast composed of 20 members of precipitation rate over South Florida during summer period. The Continuous Ranked Probability Score (CRPS) of the ensemble is minimised to achieve the optimal regression between ensemble members without any assumption on the forecasted parameter. The radar data from the Multi-Radar/Multi-Sensor (MRMS) is used to correct ensemble spread every 10 min and reduce forecasting uncertainty. A multi-physics ensemble was used to generate high-resolution, convection resolving/allowing 48-hours forecasts. The calibration was obtained over a learning process over the 48-h simulated period over 3 years. The comparison between the raw and calibrated ensemble from unseen data is presented in terms of bias correction and ensemble reliability. The calibration was able to correct the bias found in raw probabilistic forecasts relative to MRMS data. The comparison with precipitation data from tipping buckets over four airports over South Florida revealed that the calibrated ensemble tends to overestimate the precipitation rates mainly because of the particles evaporation that is taking place under radar beam.