# Calibration and quantifying uncertainty of daily water quality forecasts for large lakes with a Bayesian joint probability modelling approach

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Correcting the systematic bias and quantifying uncertainty associated with the operational water quality forecasts are imperative works for risk-based environmental decision making. This work proposes a post-processing method for addressing both bias correction and total uncertainty quantification for daily forecasts of water quality parameters derived from dynamical lake models. The post-processing is implemented based on a Bayesian Joint Probability (BJP) modeling approach. The BJP model uses a log-sinh transformation to normalize the raw forecasts and corresponding observations, and uses a bivariate Gaussian distribution to characterize the dependence relationship. The posterior distribution of the transformation parameters is inferenced through Metropolis Monte Carlo Markov chain sampling; it generates unbiased probabilistic forecasts that account for uncertainties from all sources. The BJP is used to post-processing raw daily forecasts of dissolved oxygen (DO), ammonium nitrogen (NH), total phosphorus (TP) and total nitrogen (TN) concentrations of Lake Chaohu, the fifth largest lake in China with lead times from 0 to 5 days. Results suggest that an average 93.1% forecast bias has been removed by BJP. The root mean square error in probability skill scores range from 5.8% for NH to 68.2% for TP, and the nonparametric bootstrapping test suggests that 67.7% forecasts are significantly improved averaged across all sampling sites, water quality parameters and lead times. The probabilities of the calibrated forecasts are reasonably consistent with the observed relative frequencies, and have appropriate spread and thus correctly quantify forecast uncertainty. The BJP post-processing method used in this study can be a useful operational tool that help to better realize the potential of water quality forecasts derived from dynamical models.

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