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An anaysis of different bias-correction algorithms in a synthetic environment

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The estimation and correction of systematic errors is an accepted way of improving the performance of numerical weather forecasts. A range of methods has been proposed and tested on various forecast and corresponding verification data sets. Most forecast data sets, however, are relatively small. Some studies used simple models to investigate bias-correction algorithms with larger training data sets. Another possibility, followed in this study, is the use of synthetically generated observations and forecasts for testing the performance of various bias-correction algorithms.

The synthetic observations were generated using an ARMA process with statistics estimated from a series of actual numerical analysis. Synthetic forecasts were then produced by adding (a) random forecast errors of various magnitude (to reflect the skill or lead time of the forecasts), and (b) a time independent error of different magnitude (to represent systematic error) to the synthetic analyses, where the statistics of the synthetic errors matches that of actual numerical forecasts. Two bias estimation methods were then compared. The first method uses the traditional bias estimate of the time mean difference between past observations and forecasts. The second method, motivated by the Bayesian theory, estimates the bias as the time mean difference between the forecasts and the expected (and not actual) value of the observations, given the forecast value.

It was found that the second, Bayesian method outperforms the first, traditional method in terms of time mean error (by a large margin), and continuous ranked probability skill score (to a smaller degree). No improvement, however, was found in the mean squared error. With the second method it was also found that when the training sample size is increased from one season (100 days) to a 50-year hind-cast climatol-

ogy (5000 days), the reduction in systematic error is only around around 5% of the total root mean square error. Similar reductions are observed in operational forecasts in a period of 2-3 years, due to continuous improvements. This suggests that the use of large hind-cast datasets generated by frozen systems may be problematic.