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# Adaptive Tuning of Innovation Weight Parameters: Formulation and Results with NAVDAS-AR/NAVGEM

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## Abstract

This work investigates new applications of the observation sensitivity tools for improving the performance of the Naval Research Laboratory Atmospheric Variational Data Assimilation System-Accelerated Representer (NAVDAS-AR) and the U.S. Navy's Global Environmental Model (NAVGEM). Adaptive tuning of innovation-weight parameters is used for adjusting a suboptimal analysis increment and alleviate issues related with radiance bias correction. Our work relies on a validation state produced by ECMWF to evaluate the observation sensitivity of an initial-condition (analysis) error aspect, here measured in a dry total energy norm, and avoids the increased uncertainty associated with a nonlinear model forecast. A training stage is set for April 1-14 of 2018 when information derived from adjoint-based observation sensitivity and innovations is used to adaptively tune the weight parameters. Validation is performed for April 15 – May 31 of 2018 when the performance of the tuned NAVDAS-AR/NAVGEM system is investigated in terms of the reduction in the analysis errors and the 24-hour forecast errors. The validation results show that in average, as compared with the control run and verified against the ECMWF analyses, the tuning procedure provides 10%-20% reduction of the analysis errors and 2%-5% reduction of the 24-hour forecast errors. A comparative assessment of the observation impact on reducing the initial-condition and forecast errors is provided. The analysis of the time series of the errors in the temperature fields shows a significantly improved performance in the first half of the validation period, indicating that systematic updates of the innovation weights are necessary to maintain the performance of the tuned system.

**Keywords:** observation sensitivity, parameter tuning, forecast error, validation

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