

REPLY

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We would like to thank Dr. Errico for his interest in our paper (Langland and Baker, 2004, LB04 hereafter) and his finding that we have correctly derived our adjoint-based expression (A10 in LB04) for the impact of observation data on short-range forecast error. Dr. Errico has shown that our procedure provides higher-than-first order accuracy, and it does so by combining information from sensitivity gradients on *two* trajectories, those of the background and the analysis. We agree that alternative notation might be preferable in eqs. (A11) and (A12) of LB04. However, eq. (A10) is the basis for our calculations, and Dr. Errico agrees this equation is correctly written.

Dr. Errico mentions a possible ambiguity regarding the interpretation of impact for subsets of observations, due to the non-linearity of the calculation. While such an ambiguity is possible, we have not seen this as a significant limitation in our evaluation of results. The LB04 procedure has, for example, identified data quality problems associated with individual radiosonde profiles,

ship observation data, specific satellite observation channels, and feature-track wind products. These identifications of data quality problems have been verified by independent information from observation data-providers and quality control personnel at operational forecast centers. We believe that the LB04 procedure is a useful diagnostic method for data quality control and assessment of the data assimilation procedure. Our method efficiently provides quantitative information about the beneficial or non-beneficial impact of each assimilated observation data, whereas it is not computationally feasible to obtain similar information using conventional data denial experiments.

Reference

Langland, R. H. and Baker, N. L. 2004. Estimation of observation impact using the NRL atmospheric variational data assimilation adjoint system. *Tellus* **56A**, 189–201.

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