Newly developed impact diagnostics for cross-validating the consistent use of different observation types

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Abstract

New cross-validation diagnostics have been derived by partitioning the established impact diagnostic originally introduced by Langland and Baker (2004). They give rise to consistency relations, the most prominent of which indicates whether the first guess departures of a given observation type pull the model state into the direction of the verifying data (when processed with the employed model error covariances). This is a fundamental condition for getting a beneficial impact from these observations. As verifying data we use well established observations as, e.g., radiosonde measurements, and the new diagnostic relationship is exploited to quantify the consistency of other observation types with these data in different locations (e.g., at different latitudes or altitudes) or under some otherwise specified conditions. To obtain a sensitive statistical tool, a normalization is provided which renders results largely independent from the total number of observations and the closeness of their collocation and, also, an indicator of statistical significance. While the model error covariances employed in this work are estimated from the DWD's localized transform ensemble Kalman filter, we expect results to be highly relevant also for our hybrid EnVar system which also makes use of the ensemble estimated covariances.

As the quality of the assessment strongly depends on the suitability of the ensemble covariances, in a first step the method is applied to the cross-validation of two well established types of in situ observations whose results give some indication of the quality (and some limitations) of these covariances and can be taken as a benchmark when applying the method to more complex observations (like, e.g., satellite radiances).

Keywords: observation cross, validation, forecast impact, ensemble covariances, data quality

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