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Reply to L. M. Leslie and A. F. Bennett

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We appreciate the clarification of prior work of Leslie and Bennett, provided by the authors in their comments on our article. If our references to their work led to misinterpretation, we apologize for being too brief in our discussion. Reviewing the format of their work on systematic error correction is a useful contribution to research in this area.

Leslie and Bennett's 2nd comment is indeed significant. We welcome this opportunity to discuss it, with reference to our continuing work on the problem they highlight. Some of the differences in their results may be attributed to the use of a different NWP model and data assimilation algorithm (for a region and pressure level not specified in their comments). However, the greatest differences are undoubtedly due to the fact that they have not used "regime change detection" in conjunction with model correction (personal communication). We did; and it *is* critical to the outcome.

With our continuing work on techniques for efficient and effective model output correction, we are testing alternative regime change detectors. In the research mode of reported work, we compare the sign of the forecast-minus-analysis increment with the sign of the estimated correction. When they differ, no correction is made. However, each new increment is used in calculating the corrections to be applied in future. (Recall that these are tapered averages of past differences between forecast and observed values of the field variable.) Use of this technique in operations requires a proxy regime change indicator, to signal those situations where subtraction of the tapered average increment from the recent past would make a "correction" of the wrong sign.

The objective is to find change points in the series of forecasts; namely, those points at which the sign of the increment between the forecast and true value of the field changes. Clearly, these are the points at which subtracting a tapered average difference of past increments will worsen agreement, rather than improving it. If there has been a consistently positive discrepancy between uncorrected forecast and signal, and the current discrepancy is to be negative, then we refer to this as a "regime change". Of the candidates available for detection, we have 3 in the testing process. 2 of these use differences between forecast and current climatological values; and the 3rd uses differences between forecast values and tapered averages of prior forecast values. Specifically, the change indicators for these 3 candidates are as follows.

(1) the sign of

$$(F_{t+1} - C_{t+1}) \times \left(\sum_k w_k (F_k - C_k) \right),$$

where the forecast and climatological values are the spectral coefficients;

(2) the same as (1) except using full field values of forecast and climatological variables;

(3) the sign of $(F_{t+1} - \bar{F}_t) \times (F_t - \bar{F}_{t-1})$, where the overbar indicates a tapered average of the most recent past forecast values.

We welcome additional suggestions and insights. This is clearly a topic which offers significant return, in units of forecast accuracy.