Can we improve substantially weather forecasts without cheating?

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ABSTRACT

Proactive Quality Control (PQC) is a fully-flow dependent QC based on Ensemble Forecast Sensitivity to Observations (EFSO). Past studies showed that GFS forecasts can be improved by rejecting observations identified as detrimental by EFSO. However, the impact of cycling PQC in a sequential data assimilation has so far only been examined using the simple Lorenz'96 model. Here we use a low-resolution spectral GFS model that assimilates PrepBUFR (no radiances) observations with the Local Ensemble Transform Kalman Filter (LETKF), so that this study is a bridge between a simple model and the complex implementation into operations. We demonstrate the major benefit of cycling PQC in sequential data assimilation framework through the accumulation of improvements from previous PQC-updates. Such accumulated past PQC improvements is much larger than the "current" PQC improvement that would be obtained at each analysis cycle using "future" observations. As a result, it is unnecessary to use "future" information, which would be "cheating", and allows the operational implementation of cycling PQC. The results are excellent: the analyses and forecasts are improved the most by rejecting all of the observations estimated to be detrimental by EFSO, but major improvements also come from rejecting just the most detrimental. The forecast improvements brought by PQC are observed throughout the 10 days of integration and provide a substantial forecast lead-time gain (more than 12 hours). We found that PQC reduces substantially not only the forecast RMS errors, but also the forecast biases, especially in the tropics and the SH.