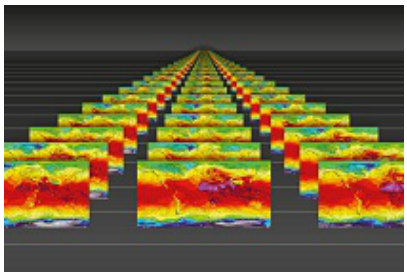

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Comparison of mean data assimilation increments from different centers using TIGGE

Data assimilation assumes unbiased observations and an unbiased forecast model and, hence, is expected to produce a zero-analysis increment on average. However, in practice, numerical weather prediction (NWP) and observations are all biased, resulting in non-zero average analysis increment. To the extent that variational observation bias correction successfully removes bias from the observations, the structure of these mean increments can shed light on the systematic errors of the forecast model. Comparing mean analysis increments from different centers allows one to distinguish between features that are common to many systems and features which are peculiar to specific systems. It is possible that such distinctions may help the Numerical Weather Prediction better understand why significant mean increment features are present and what can be done to remove them.

Here, we compare the structure of average analysis increments for four NWP centers: European Center for Medium Range Weather Prediction (ECMWF), United Kingdom Meteorological Office (UKMO), National Center for Environmental Prediction (NCEP), and the U.S. Naval Research Lab (NRL). For ECWMF, UKMO, and NCEP, we compute analysis increments from publically available TIGGE archive. The NRL data are obtained from an internal archive.

The analysis of the increment fields reveals that all centers share common modes of model error. Specifically, all models show (1) trade winds that are generally too strong, (2) the upper level zonally averaged meridional wind associated with the Hadley cell is too strong, and (3) persistent biases in the strength of the Jet Stream and in the location of Jet entrance and exit regions, specifically the North Atlantic storm track region. Each model also had unique patterns of model error that could be diagnosed and lead to improvements. For example, NCEP model circa 2015 had a persistent problem with representing outflow of cold air from the Antarctic. Our study suggests average analysis increments can be a useful statistics routinely produced by TIGGE that can lead to improved diagnostics and gradual reduction of model errors in the leading NWP models.

Primary authors: BISHOP, Craig (The University of Melbourne); FROLOV, Sergey (Naval Research Laboratory); BONAVITA, Massimo (ECMWF); CRAWFORD, W (Naval Research Laboratory); LALOYAUX, Patrick (ECMWF)

Presenter: BISHOP, Craig (The University of Melbourne)

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