The Impact of the Temporal Spacing of Observations on Analysis Errors

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This poster presents a theoretical study of the impact of the temporal spacing of observations on average analysis errors in a simple system analogous to a numerical weather prediction data assimilation system. The results are relevant to questions concerning the optimal distribution of polar-orbiting satellites, and particularly to the question of how available satellite assets might be deployed in the three orbital planes recommended by the World Meteorological Organisation in its "Vision for the Global Observing System in 2025".

The results of this study show that the sensitivity of analysis error to observation spacing depends on the metric used. The mean analysis error variance is sensitive to observation spacing, but the mean analysis "accuracy" (defined here as the inverse of error variance) is not sensitive in the limit of zero model error. Moreover, although the sensitivity of mean analysis error variance is small when forecast error variances double at their average rate (~12 hours), it is much greater when doubling times are shorter (6 or 3 hours), as might be expected in some high-impact weather events. The results support the case for deploying satellites in orbits that are approximately equally spaced where possible.

In initial experiments, it is assumed that observations from satellites deployed in different orbits have equal information content. In subsequent experiments, information content is simulated for a range of systems corresponding to present and future satellite observing systems. In addition to satellites operational in the period 2010-2011, the potential has been assessed of data from the satellites Suomi-NPP, Metop-B and FY-3C, and also from proposed future systems – hyperspectral infra-red sounders on a ring of geostationary satellites, and an enhanced constellation of radio occultation instruments. In each case, the impact of these observations on mean analysis error variance is assessed.