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Impact of Mode-S wind observations in the UK convective-scale model

Gareth Dow (1), Ed Stone (2), Zhihong Li (3), and David Walters (4)

(1) Met Office, R2O, Exeter, United Kingdom (gareth.dow@metoffice.gov.uk), (2) Met Office, Observations R&D, Exeter, United Kingdom (ed.stone@metoffice.gov.uk), (3) Met Office, Observations R&D, Reading, United Kingdom (zhihong.li@metoffice.gov.uk), (4) Met Office (david.walters@metoffice.gov.uk)

Since 2011 the Met Office has been investigating a new method of collecting low cost observations from aircraft. Navigational data broadcast from commercial aircraft for Air Traffic Control and other aircraft may be freely intercepted using equipment designed for and by aircraft enthusiasts. This information is defined by the Mode-Selective (Mode-S) Enhanced Surveillance (EHS) and Automatic Dependent Surveillance Broadcast (ADS-B) standards.

The Met Office has invested in its own network of small, relatively low-cost receivers to collect these data which contain information about the current state of the aircraft, including air movement and ground movement vectors. The difference between these two vectors is the wind acting on the aircraft. The Met Office network currently collects approximately 100 000 000 messages a day which after processing and quality control yields more than 5 000 000 useable upper air wind measurements per day, a 500-fold increase in the number of aircraft observations available for NWP over the UK.

Over a period of a few years the quality of these wind observations has been assessed in several ways including comparisons to AMDAR, research flight investigations using both inter-comparisons and synthesised observations, and routine comparisons with model forecast fields. O-B Mode-S RMS wind errors appear to be similar to those of AMDARS at around 2 to 3 m/s.

Because Mode-S observations are a particularly dense observation type, it is necessary to thin them in both space and time to reduce observation redundancy and correlated biases. Sensitivity studies were conducted in the hourly cycling 4D-Var data assimilation system of the 1.5km convective-scale UKV model to arrive at a suitable thinning strategy for the data.

After successful research trials to evaluate the impact on forecasts from the assimilation of Mode-S wind observations, this upgrade was introduced into our Parallel Suite 42 (PS42) which ran from late November 2018 to early March 2019. When assessed relative to the current operational UKV forecasting system (OS41) baseline, the principal benefit from Mode-S appears to be an improved fit to upper level winds up to 12 hours into the forecast which is most prominent around aircraft cruise levels and reflects the vertical distribution of Mode-S observations. There is also some evidence of benefit for the short-period forecast of precipitation. The results from follow on work to optimise the observation thinning will also be presented.