

A 12-month UK air quality aircraft campaign and model evaluation

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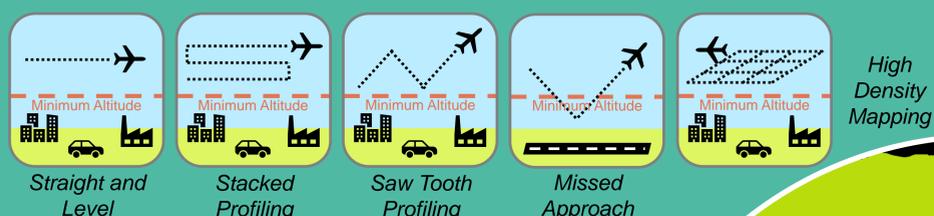
Overview

Ground based measurements from across the UK are used to evaluate the Met Office air quality model which is used to produce the UK national air quality forecast. There is, however, limited data available on the vertical distribution of key pollutants in the UK boundary layer which restricts modellers from evaluating the vertical structure in their models.

The SPF Clean Air project is addressing this knowledge gap by collecting 12 months of regular airborne observations over the southern UK using the Met Office Civil Contingencies Aircraft (MOCCA), which has been instrumented to allow measurements of gaseous and aerosol pollutants. These observations, along with the existing ground site measurements, will allow a more detailed evaluation to be performed of the 3-dimensional atmospheric composition simulated by the air quality forecast model.

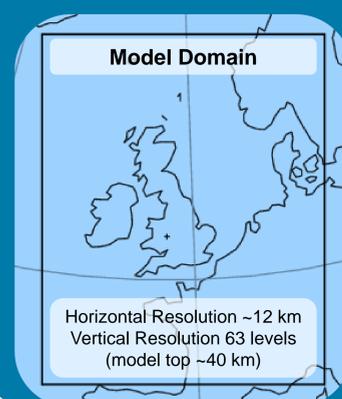
Flight Planning

Air quality forecasts are used in the flight planning process to identify any areas of interest. A number of different flight pattern techniques are used to collect measurements throughout the boundary layer. This range of observations allows the model performance at the different vertical levels to be investigated.



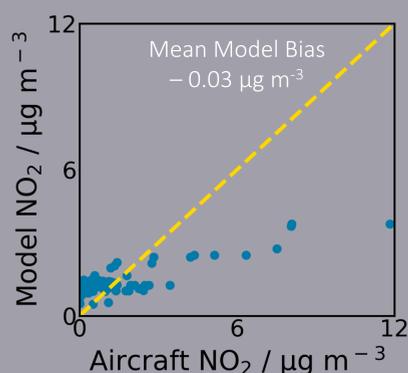
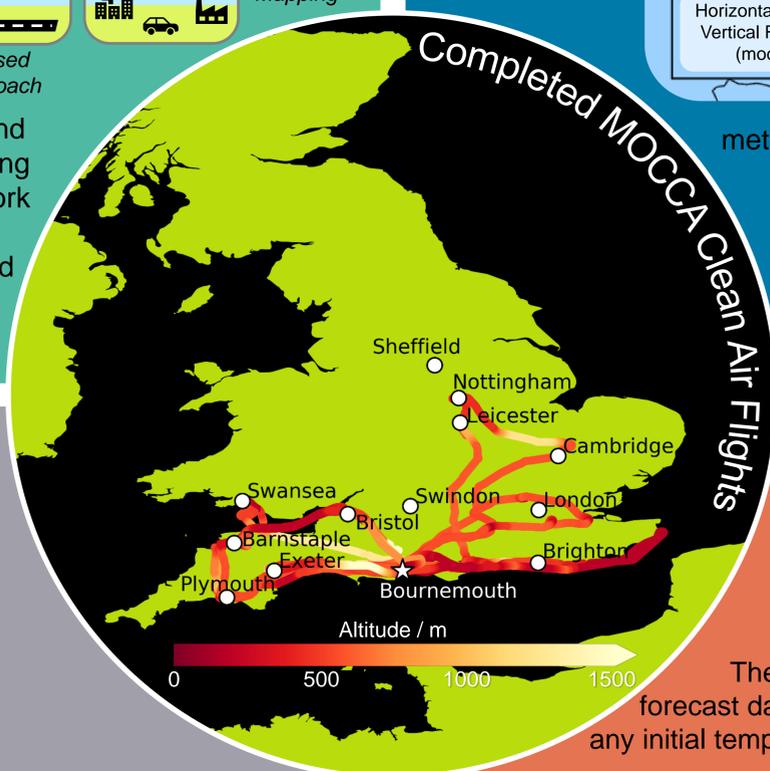
Pre-planned sorties cover the southern UK and include overpasses of ground based monitoring sites in the Automatic Urban and Rural Network (AURN). The flight sorties are also flexible, providing the opportunity to respond to specific air quality episodes when they arise.

Model Simulations



Air quality forecast simulations are re-run for each of the flight days using the Met Office Air Quality in the Unified Model (AQUUM). 3-dimensional data is output on a 5 minute timestep for the full model domain.

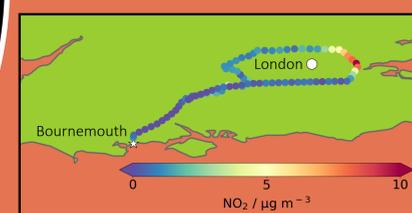
This data is then linearly interpolated to extract meteorological and pollutant information along the flight track of the aircraft. This enables direct comparisons to be made between the aircraft observations and the model forecast data.



Statistical properties, including the model bias, are calculated to quantify the agreement between the model data and aircraft observations. These statistics are used to explore any patterns in model uncertainty and support future development of the forecast model.

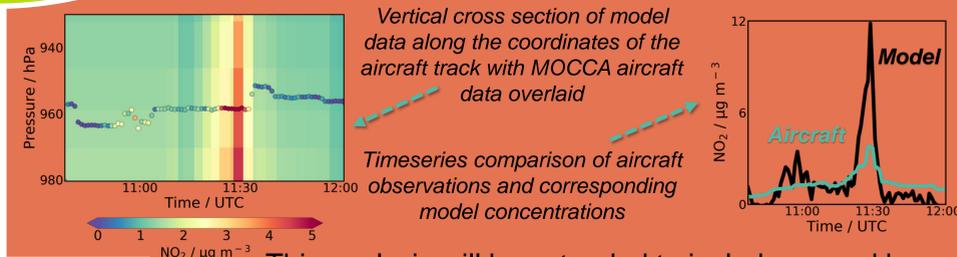
Analysis of the data from the different sorties and flight techniques is used to guide decisions about the priorities of upcoming research flights.

Model Evaluation



Plots show data from flight M251 on Tuesday 3rd September 2019.

The aircraft observations and corresponding model forecast data, are visualised in a variety of ways to identify any initial temporal and spatial patterns and trends in the data.



This analysis will be extended to include ground based measurement data as well as information from satellites.

Data Visualisation

Outcomes

- ❖ The aircraft measurements will be used alongside ground based observations to evaluate the national air quality forecasts and investigate model performance throughout the boundary layer.
- ❖ The emerging dataset will be used to improve our model simulations and will form a valuable resource for other modellers.
- ❖ The MOCCA Clean Air dataset and analysis software will be made publicly available for use by other groups wishing to make use of this unique new dataset of long term atmospheric boundary layer composition measurements.