



## Development of a small unmanned aerial vehicle for thermodynamic and trace gas concentration measurement

Samuel Illingworth (1), Grant Allen (1), Carl Percival (1), Martin Gallagher (1), Hugo Ricketts (1), Peter Hollingsworth (2), Harry Hayes (2), Gareth Roberts (2), Pawel Ladosz (2), and David Crawley (3)

(1) The University of Manchester, Manchester, United Kingdom (samuel.illingworth@manchester.ac.uk), (2) The School of Mechanical, Aerospace and Civil Engineering, The University of Manchester, Oxford Road, Manchester, M13 9PL, UK, (3) The School of Electrical and Electronic Engineering, The University of Manchester, Oxford Road, Manchester, M13 9PL, UK

This study will demonstrate novel measurements of in-situ trace gas concentrations and thermodynamics sampled on-board an instrumented Skywalker Unmanned Aerial Vehicle (UAV). Remotely piloted flights were conducted at in Manchester, UK, with the Skywalker equipped with an adapted Vaisala electrochemical cell ozonesonde measuring O<sub>3</sub> concentrations at 0.5 Hz, and a RS92-KE radiosonde measuring pressure, temperature and humidity.

Small local and temporal 3D gradients were observed corresponding to changes attributable to micrometeorology and local chemistry with changes to airmass background noted by back trajectory analysis. The ability to sample subtle variability over a localised 3D frame, such as enabled by the techniques demonstrated in this study, highlights the important and novel capabilities of UAVs to rapidly characterise local area micrometeorology and chemistry, as well as area-emissions, and fence-line inputs.

By comparing to ground-based in situ measurement, and taking into account local meteorological conditions, it was found that the UAV measured concentrations were a reliable indicator of background concentrations at the urban scale whilst revealing additional local variability important for air quality monitoring and related policy obligations.