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Evaluation of the source area of rooftop scalar measurements in London, UK using wind tunnel and modelling approaches.

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The source area of an instrument is an estimate of the area of ground over which the measurement is generated. Quantification of the source area of a measurement site provides crucial context for analysis and interpretation of the data. A range of computational models exists to calculate the source area of an instrument, but these are usually based on assumptions which do not hold for instruments positioned very close to the surface, particularly those surrounded by heterogeneous terrain i.e. urban areas. Although positioning instrumentation at higher elevation (i.e. on masts) is ideal in urban areas, this can be costly in terms of installation and maintenance costs and logistically difficult to position instruments in the ideal geographical location. Therefore, in many studies, experimentalists turn to rooftops to position instrumentation. Experimental validations of source area models for these situations are very limited.

In this study, a controlled tracer gas experiment was conducted in a wind tunnel based on a 1:200 scale model of a measurement site used in previous experimental work in central London. The detector was set at the location of the rooftop site as the tracer was released at a range of locations within the surrounding streets and rooftops. Concentration measurements are presented for a range of wind angles, with the spread of concentration measurements indicative of the source area distribution. Clear evidence of wind channeling by streets is seen with the shape of the source area strongly influenced by buildings upwind of the measurement point.

The results of the wind tunnel study are compared to scalar concentration source areas generated by modelling approaches based on meteorological data from the central London experimental site and used in the interpretation of continuous carbon dioxide (CO_2) concentration data. Initial conclusions will be drawn as to how to apply scalar concentration source area models to rooftop measurement sites and suggestions for their improvement to incorporate effects such as channeling.