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Ammonia Eddy Flux Measurements by QC-TDLAS & Impacts on Aerosol Characteristics in Pollutant Plumes during TORCH-1

J.Whitehead(1) , J.Allan(1), H.Coe(1), M.Zahniser(2), M.Gallagher (1), I.Longley(1), K.Bower (1), M.Flynn (1), D.Fowler(3) , G.McFiggans(1)

(1). School of Earth, Atmospheric& Environmental Science (SEAES), University of Manchester, Sackville Street Building, Sackville Street, Manchester M60 1QD, UK. (2). Centre for Ecology & Hydrology, Edinburgh, UK. (3). Aerodyne Inc., Billerica, Boston, USA.

A novel quantum-cascade tuneable diode laser absorption spectrometer (QC-TDLAS) was deployed as part of the first Tropospheric Organic Chemistry Experiment (TORCH-1) to measure ambient ammonia and NO_2 concentrations. Ammonia is the most important atmospheric reducing species with many sources. In the UK 90% of ammonia emissions are produced by agriculture practices (animal waste and fertilisers) but contributions from urban and numerous related anthropogenic sources may also be increasing. As reduced nitrogen is the main contributor to total UK nitrogen deposition understanding its deposition and emission rate for terrestrial systems relies on accurate measurements of fluxes both from natural and urban sources. During TORCH-1 ambient concentration measurements were provided by a Peltier cooled QC-TDLAS system (Aerodyne Inc., Zahniser) operating at 967 cm^{-1} and 1606 cm^{-1} respectively for NH_3 and NO_2. In addition eddy flux measurements of the vertical exchange rate were also attempted with this system. TORCH-1 was a large UK field experiment designed to increase understanding of the role of primary and partially oxidised organic species in atmospheric gas phase photochemistry. This is being achieved by development of thermodynamic and microphysical models of organic aerosol behaviour which are being validated against field data from “near” and “far-field” plume data downwind of London. TORCH-1 was conducted at Writtle College in Essex a semi-rural location NE and immediately downwind of the London pollution plume. Measurements took place in July & August 2003. The TDLAS system was installed overlooking a large agricultural produce field with canopy height between 80-100 cm.

The field was harvested during the experiment after which the main body of ammonia flux measurements were subsequently obtained. Eddy flux measurement results will be presented and discussed and the performance of the system is analysed with respect to inlet loss effects for reactive trace gases and their subsequnt impacts on flux measurements. Inlet criteria are discussed absed on laboratory experiments. Finally the use of the TDLAS measurements to study equilibrium of ammonia gas-to-particle conversion states during TORCH-1 to assess the aerosol composition state in the London plume are also discussed in combination with high resolution measurements of aerosol composition by an Aerosol mass Spectrometer.