# Evaluation of forward modelled backscatter with an urban ceilometer network for a clear-sky period

Elliott Warren (1), Sue Grimmond (1), Simone Kotthaus (1), Cristina Charlton-Perez (2), Sue Ballard (2), and Humphrey Lean (2)

(1) Department of Meteorology, University of Reading, Reading, UK, (2) Met Office@Reading, University of Reading, Reading, UK

Due to their implications on health and visibility, it is critical to monitor and predict urban aerosols. High vertical and temporal resolution automatic lidars and ceilometers (ALC) are being increasingly deployed to observe aerosols, using measurements of vertical profiles of attenuated backscatter. Numerical Weather Prediction (NWP) models are beginning to explicitly represent aerosols at sub-km grid scales. Consequently, the need for evaluation and data assimilation (DA) using observations with appropriately high resolution are growing. A forward operator (FO) can be used to estimate the attenuated backscatter from model variables, which would allow for the inter-comparison with observations and the potential for DA.

Here, an FO is developed and used with Met Office NWP (UKV 1.5 km) data to estimate attenuated backscatter. It is tested against ceilometer observations. The FO uses profiles of a simple aerosol proxy (MURK) and relative humidity (RH) as inputs. Assumptions about the aerosol constituents are also made. Parameterisations initially produce estimates of bulk aerosol characteristics such as mean radius and number concentration, which are used to estimate optical properties. An extinction enhancement factor (f(RH)) is used to represent the change in optical properties due to aerosol swelling.

An initial test is undertaken for a cloud-free period (4 – 6 May 2016) in London. Qualitative, evaluation against Vaisala CL31 ALCs suggests that the vertical gradients of FO attenuated backscatter evolve similarly in time with respect to observed attenuated backscatter. This is further supported by point comparison to surface PM10 and RH observations to the near-surface FO inputs. Quantitative assessment identified disparities in morning boundary layer growth between FO attenuated backscatter and ceilometer observations. Further discrepancies were identified between older and newer generations of CL31s. A 'ringing' artefact was present in the older CL31s. This could have implications for DA, especially for the Met Office, as many of the ceilometers in their national network are of the older generation.