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Aerosol classification using sun photometer and lidar data within a machine learning algorithm-a possible nowcasting application

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The Met Office operates a ground based operational network of nine polarisation Raman lidars (aerosol profiling instruments) and sun photometers (column integrated information). An aerosol classification scheme using supervised machine learning has been developed. The concept of Mahalanobis (~normalized) distance to identify the aerosol type from individual Aerosol Robotic Network (AERONET) measurements including Extinction Angstrom Exponent, Absorption Angstrom Exponent, Single Scattering Albedo and Index of refraction is used for a subset of AERONET stations around the globe of known main aerosol types (training set). The aerosol types include maritime, urban industrial, biomass burning and dust. We build a predictive model from this training set using K nearest neighbour machine learning algorithms. The relation of particle polarisation ratio and lidar ratio from the Raman lidar is used as a sanity check. We apply the model to 3- 4 years of AERONET and profiling data across the UK, with instruments evenly distributed across the country, from Camborne in Cornwall to Lerwick in the Shetland Islands. We are showing more detailed data of a dust event in May 2016, dust/biomass burning aerosol mix from October 2017 (hurricane Ophelia) and more recent aerosol transported from the Canadian wild fires in September 2020. AERONET Level 2.0 data is compared to level 1.5 in order to determine the implications for the aerosol classification. Level 1.5 data are cloud-screened, but not quality assured and may not have the final calibration applied. Level 2.0 data have pre- and post-field calibration applied, are cloud-screened, and quality-assured data. As level 2.0 data is usually only available after 1-2 years (after a new calibration has been performed), it is important to understand the usefulness of more readily available level 1.5 (cloud screened) data.

The aim is to build a real time aerosol classification application that can be used in Nowcasting.