

Long-term visibility data in the UK – how does visibility vary with meteorological and pollutant parameters?

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Poor visibility can be an indicator of poor air quality. Moreover, degradation in visibility can be hazardous to human safety; for example, low visibility can lead to accidents particularly during winter when fogs are prevalent. The present quantitative analysis attempts to explain the influence of aerosol concentration and composition, and meteorology on long-term UK visibility. We use visibility data from eight UK meteorological stations which have been running since the 1950s. The site locations include urban, rural and marine environments.

Overall, most stations show a long term trend of visibility increase, which is indicative of reductions in aerosol pollution, especially in urban areas. Additionally, results at all sites show a very clear dependence on relative humidity, indicating the importance of aerosol hygroscopicity on the ability of aerosols to scatter radiation and hence impact upon visibility. The dependence of visibility on other meteorological parameters (e.g. relative humidity, air temperature, wind speed & direction) is also investigated.

To explain the long term visibility trends and their dependence on meteorological conditions, a light extinction model was constructed incorporating the concentrations and composition of historic aerosol. The lack of historic aerosol size distributions and aerosol composition data, which determine hygroscopicity and refractive index, leads to an under-constrained model. Aerosol measurements from the last 10 years are used to constrain these model parameters, and hence their historical variation can be estimated; sensitivity analyses are used to estimate errors for the time period before regular aerosol measurements are available. A good agreement is observed between modelled and measured visibility.

This work has generated a unique 60 year data set with which to understand how aerosol concentration and composition has varied over the UK. The model is applicable and easily transferrable to other data sets worldwide. Hence, different clean air legislation can be assessed for its effectiveness in reducing aerosol pollution. The implications for the UK will be discussed.