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Forecasting UK site level air quality with a Kalman filtering approach

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Despite efforts to reduce pollutant emissions in the UK, between 28,000 and 36,000 deaths a year are attributable to poor air quality and ambient air pollution is considered the UK's biggest environmental threat to health. Characterising, quantifying and understanding air quality variability and the importance of different drivers is essential to guide policies to address the issue and its risks, for both the short and long term. Here we investigate a statistical modelling approach to characterise air quality variability and its key drivers, using Kalman filters. Kalman filters are a commonly used tool in air quality modelling but are seldom used in a statistic framework that accounts for uncertainty in a principled way. Kalman filtering allows us to take data which is noisy or partially recorded, such as air quality data, and help reveal the true underlying trends and dynamics of the data. This allows us to combine measurement information with the statistical model to obtain an air quality forecast, using the measurement information to reduce the statistical model errors and improve model results. We explore this approach using air quality monitoring data from the UK Automatic Urban and Rural Network (AURN), which consists of 150 sites focussed mainly in populated areas, leaving large areas unmonitored. AURN is primarily used for compliance reporting against national and European air quality standards and targets. Eventually, our aim is to provide short-term forecasts of pollutant levels from AURN, comparing this against process model forecasts and ultimately providing an optimised combination of process model, statistical model and measurement.