Air pollution dynamics

Getting to grips with urban ozone without models

Through previous studies it was found that a connection between various meteorological parameters and high urban ozone concentrations in Oklahoma City existed. It was generally deduced that hot sunny days, light winds, dry (low humidity) conditions and fewer clouds led to occurrences of high ozone days (maximum 8-hour is greater than 75ppb).

This study goes further to describe changes in ozone concentrations due to the foreseen variability of meteorological parameters due to a changing climate. The hypothesis is that increases in warm, dry and stagnant conditions, as is predicted by climate models to happen in the region, will also increase ozone concentrations.

To assess this theory, the authors analysed ten years of model climate data (2003-2012) and selected two cooler and wetter years (2004 and 2007) with two warmer and drier years (2011 and 2012). Cooler or warmer compared to the climatological average; with warmer years showing high solar radiation and dew point temperatures as well. These were seen to be representative of what could be possible in the future. Measured pollutant concentrations and meteorological parameters for the four years were retrieved from the city's three monitoring stations with highest monthly averaged ozone concentrations measured over the ten year period. The authors looked at changes in distribution of maximum and minimum ozone, number of exceedance days and duration of exceedance.

Results indicate that the warmer and drier years show three times as many ozone exceedance days than the cooler wet years, with a doubling of the duration of the high ozone season. Consecutive exceedance days also become more common. Minimum concentrations of ozone, something not commonly looked at, also showed increases during the warmer years.

This paper highlights the need for good quality monitoring data (air pollutant and meteorological) as a discovery or scoping tool to understanding urban ozone dynamics. Once the big questions are discovered, modelling may then be used to identify the mechanisms. Stations that monitor ozone should ideally monitor temperature, wind speed, wind direction, relative humidity, solar radiation and precipitation in addition to pollutant concentrations. It is also shown in this research that effects on air quality due to changes in climate can be assessed, at least initially, by using primarily retrospective measured data.

Ramsey, N.R., Klein, P.M. and Moore, B. (2013). The impact of meteorological parameters on urban air quality. Atmospheric Environment, 86 (2014). 58-67.