5.015 First steps developing a tool to monitor city-wide air quality using Earth observations.

Early Career Scientist

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Abstract:

Air pollution has adverse effects on human health, but is challenging to routinely and effectively monitor in cities. Satellite observations of atmospheric composition provide complete coverage of cities, but are cumbersome and challenging to use. We present first steps to develop a tool that end users can use to monitor city-scale air quality with Earth observations. We use surface observations of NO_2 for 2011-2016 from six monitoring sites in Birmingham (UK), a post-industrial city undergoing urban renewal, to validate that tropospheric column NO_2 observations from the Ozone Monitoring Instrument (OMI) accurately represent temporal changes in NO_2. Surface concentrations of monthly mean NO_2 averaged around the satellite overpass (12h00-15h00 local time) decrease by 1.5-4.2% a^{-1} across the monitoring sites. Sites are spatially correlated ($R > 0.55$) and so are combined to obtain a representative city average decline in NO_2 of 3.1% a^{-1} (95% confidence interval (CI): -6.2 to +1.1% a^{-1}). Monthly mean NO_2 from OMI is temporally correlated with city average surface NO_2 ($R = 0.69$) and gives steeper decline in NO_2 of 4.1% a^{-1} (95% CI: -8.0 to +0.6% a^{-1}) for 2011-2016. All trends are not significant due to large temporal variability and a short period of overlap. Decline in OMI NO_2 becomes very significant (p-value < 0.001) over the long OMI record (2005-2017) and is 3.4% a^{-1} (95% CI: -4.3 to -2.5% a^{-1}), similar to the reported UK-wide decrease in NO_x emissions of 3.9% a^{-1}. In Birmingham, tropospheric column NO_2 equivalent to the EU standard and WHO guideline of 40 µg m^{-3} is 6.1 x 10^{15} molecules cm^{-2} and could be used to assess whether city-wide NO_2 concentrations exceed levels safe for human health.