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Composition and Sources of Atmospheric Aerosols in a Residential Area of Ireland using Single Particle Mass Spectrometry

Paul Buckley, Eoin McGillicuddy, Jovanna Arndt, Ian O'Connor, Robert Healy, Dean Venables, John Sodeau, and John Wenger

Department of Chemistry and Environmental Research Institute, University College Cork, Ireland (j.wenger@ucc.ie)

The size-resolved chemical composition of single particles is often sufficiently unique to enable association with a particular source. Single particle mass spectra collected using instruments such as the Aerosol Time-Of-Flight Mass Spectrometer (ATOFMS) can be used to identify specific sources of particulate matter, both natural and anthropogenic. In this work, an ATOFMS was deployed in a residential area of Killarney, Ireland, during November-December 2014 to investigate the impact of the various sources of particulate matter upon local air quality. Over 500,000 single particle mass spectra were collected in the sampling period and subsequently grouped into distinct "classes" using a K-means clustering procedure. Based on the presence of key marker species in the mass spectra, the particle classes were then attributed to specific sources. The results indicate that particles generated from solid fuel burning accounted for the vast majority (>75%) of those measured during the sampling period, with similar temporal profiles observed for the three main locally available fuel types - coal, peat and wood. Moreover, these particle classes showed a very strong 24-hour cycle with a significant increase during evening and night-time hours, consistent with the use of fires for residential heating. Further scaling of the ATOFMS data was performed to convert particle number to mass concentration thus enabling the relative contributions of each fuel type to ambient PM2.5 levels to be determined. This information is very useful in assessing the impact of different fuel types on local air quality and is essential for the development of effective strategies for reducing particulate emissions.