# Seasonal and Diurnal Variation of Equivalent Black Carbon in Dublin, Ireland

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Air pollution in the city of Dublin has been a well-documented issue in the 20th century. Since the introduction of a ban on bituminous coal in 1990, a steady decline in air pollution has been observed in the city, greatly benefitting the health of the population (Clancy et al. 2002). In recent years however, solid fuel burning has once again become a prominent issue in the city (Lin et al., 2018).

Using an aethalometer (model AE-33, Magee Scientific), in addition to an Aerosol Chemical Speciation Monitor (Aerodyne), a two-year measurement campaign was conducted on the campus of University College Dublin (UCD) (53.309, -6.2242). The site, designated as urban background, was located ~500 m from the nearest road and ~750 m from the nearest residential properties, and with an elevation of ~20 m.

The Equivalent Black Carbon (eBC) mass concentration was calculated from the wavelength-dependent absorption coefficient, $b_{abs}$, and the mass absorption cross-section (MAC) according to the equation:

$$eBC = \frac{b_{abs}(\lambda)}{MAC(\lambda)}$$

The mass concentration was then split into two source-related components, $eBC_{Tr}$ for traffic and $eBC_{SF}$ for solid fuel burning, using the methods detailed by Zotter et al. (2017). Given that a number of different solid fuels are used in Ireland, it is more appropriate to change the commonly used wood burning label ($eBC_{WB}$) to solid fuel, encompassing wood, peat, turf and coal. The absorption Angström exponents (α) used during this study to separate the traffic and solid fuel burning contributions to eBC were $\alpha_{Tr}$ = 0.9 and $\alpha_{SF}$ = 1.68 (Zotter et al., 2017). Seasonal averages for eBC are presented in Table 1.

Table 1. Seasonal variation of eBC at an urban background location in Dublin, 2016-2018.

| Season | $eBC_{Tr}$ (μg/m$^3$) | $eBC_{SF}$ (μg/m$^3$) | % $eBC_{SF}$ contribution |
|---|---|---|---|
| Winter | 0.40 | 0.52 | 57 |
| Spring | 0.26 | 0.21 | 44 |
| Summer | 0.24 | 0.06 | 20 |
| Autumn | 0.37 | 0.15 | 29 |

The eBC levels during winter (December, January and February) were three times higher than during the summer (June, July and August). This large increase is mainly attributed to solid fuel burning, which contributes 57% of the measured eBC in winter. In the summer, when $eBC_{Tr}$ is the main contributor (80%), the total eBC value is significantly lower than the $eBC_{SF}$ contribution alone in winter. The importance of solid fuel burning as the major source of pollution during winter is reinforced by the diurnal variation of eBC, Figure 1, which shows a significant increase in the evening hours. In some instances, the carbonaceous content of $PM_1$ rose as high as 89% (Lin et al. 2018). The results from this monitoring campaign will be used to inform policy changes in Ireland as part of the new Clean Air Strategy announced by the Irish Government.

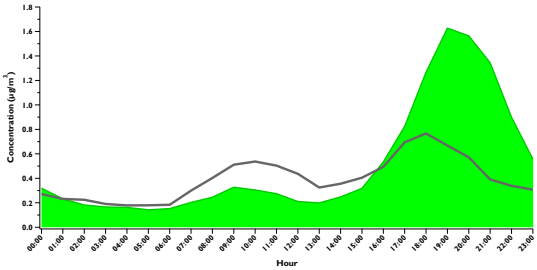


Figure 1. Winter diurnal profile of $eBC_{Tr}$ (grey line) and $eBC_{SF}$ (solid green).

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