Measurement of diesel combustion-related air pollution downwind of an experimental unconventional natural gas operations site

ABSTRACT

Background & aim: Unconventional natural gas (UNG) extraction activities have considerable potential to affect air quality. However, there are few published quantitative observations of the magnitude of such impacts. To provide context, we compared measured exposures to diesel engine exhaust close to industrial fracking equipment at an UNG training simulation site in Łowicz, Poland to pedestrian exposures to traffic-related air pollution in the city centre of Glasgow, UK. Methods: We made mobile and static measurements at varying distances from sources in both of the above locations with a portable aethalometer (Aethlabs AE51) for black carbon (BC) and portable monitors (Aeroqual Series-500) for nitrogen dioxide (NO_2) and ozone (O_3). Duplicate BC measurements were compared with NO_2 observations, after correction of the NO_2 sensor response for O_3 interference effects. Results: Duplicate BC instruments provided similar real-time measurements (r = 0.92), which in turn were relatively highly correlated with NO_2 observations at 5-min temporal resolution at the UNG experimental site (r = 0.75) and on the walking route in Glasgow city centre (r = 0.64) suggesting common diesel sources for NO_2 and BC in both locations. Average BC and NO_2 concentrations measured approximately 10 m downwind of diesel fracking pumps were 11 and 113 $\mu g/m^3$ respectively. These concentrations were approximately 37 times and 4 times higher than upwind background BC and NO_2 concentrations at the site; and approximately 3 times higher than average BC and NO_2 concentrations measured in traffic influenced areas in Glasgow. Conclusions: Marked elevations of BC and NO_2 concentrations were observed in downwind proximity to industrial fracking equipment and traffic sources. This suggests that exposure to diesel engine exhaust emissions from fracking equipment may present a significant risk to people working on UNG sites over extended time periods. The short time resolution of the portable instruments used enabled identification of likely sources of occupational and environmental exposure to combustion-related air pollutants.

Keyword : Unconventional natural gas (UNG); Air monitoring; Black carbon (BC); Nitrogen dioxide (NO2); Ozone (O3); AE51 aethalomete