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Gas flaring and residential burning pollute the Arctic more than previously thought

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Gas flaring and residential combustion are significant sources of soot, or black carbon, pollution in the Arctic, but their role has been underestimated until now, according to a recent study. The research indicates that flaring from oil and gas developments is the largest source of this pollutant, responsible for 42% of black carbon pollution in the Arctic.

Pollution caused by the long-range transport of aerosols (fine particles in the atmosphere) across continents is visible as haze in the Arctic. One component of the haze is black carbon (BC), emitted from human and natural sources, such as the burning of fossil fuels and biomass. Because BC in the atmosphere absorbs the sun's radiation, it contributes to the warming of the Arctic. Furthermore, BC deposited onto snow and ice darkens the surface and reduces the albedo, or reflection, of sunlight back into space, contributing to snow and ice melt. Arctic haze is seasonal and is most intense in winter and early spring.

Studies that simulate the atmospheric transport and removal of BC by precipitation and deposition to the surface may not adequately capture these differences between seasons, nor do they include some significant sources of BC emissions. BC emissions are not constant throughout the year, and are higher, for example, in winter owing to increased use of residential heating. Emissions from flaring (burning) gas that cannot be stored or transported at oil and gas developments are also an important source of BC, as many oil and gas developments are found at high latitudes.

As part of the EU-funded project ECLIPSE[1], the researchers traced emissions of BC from the following major human and natural sources: residential combustion; gas flaring from the oil and gas sector; burning of agricultural waste; biomass burning in forests and grasslands; and from transport, industry, waste burning and the rest of the energy sector excluding flaring, grouped together by the study as 'other sources'.

Flaring was identified as the largest source of BC in the Arctic. Although results suggest that flaring accounts for about 3% of global BC emissions, flaring is responsible for 66% of all BC emissions north of the Arctic Circle. The transport modelling suggests that due to this large relative contribution to emissions at high latitudes, gas flaring accounts for 42% of the annual average surface concentrations of BC in the Arctic. In March each year, 52% of near-surface BC is attributable to flaring.

Surface concentrations of BC from residential combustion were also found to be 68% higher annually when calculated using daily emissions compared with calculations using annual emissions. Moreover, surface concentrations of BC are 150% higher in January when calculated on a daily basis, suggesting that daily estimations of BC emissions are better at capturing the seasonal variation of BC in the Arctic, than annual estimates.

The modelled results were compared with observations from six monitoring sites in the Arctic: Barrow, Alaska; Alert, Canada; Pallas, Finland; Zeppelin/Ny Ålesund, Spitsbergen, Norway; Station Nord, Greenland and Summit, Greenland, as well as with data from a ship campaign. These comparisons indicated that the inclusion of BC emissions from residential combustion calculated on a daily basis, as well as from gas flaring, improved the agreement between modelled BC emissions and the average concentration observations, and the seasonal effect of emissions at these stations.

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1. ECLIPSE (Evaluating the CLimate and Air Quality ImPacts of Short-livEd Pollutants) is supported by the European Commission under the Seventh Framework Programme. See: http://eclipse.nilu.no/