Poorly-Characterized Black Carbon Sources

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EXTENDED ABSTRACT

Black Carbon (BC) has received attention due to its detrimental effects on climate and human health. Nevertheless, emissions of BC are highly uncertain, relative to emissions of other pollution which harms air quality or climate. This is particularly true for global inventories. Due to a lack of regulations specifically addressing BC emissions, or mandated BC inventory activity, inventories are currently quite coarse. As a result, some sectors which are relatively small in global inventories but quite important regionally or locally have received little attention. Furthermore, unlike long-lived greenhouse gas emissions, the location of black carbon emissions is a critical factor in the climate impact of those emissions, particularly if emissions are near the Arctic or other snow- or ice-covered regions.

This presentation will focus on BC emissions from sectors which are less well studied than other sectors considered in this session. These poorly quantified sectors include industrial sources such as brick kilns, coke ovens, and flaring. These can be very significant point sources, which need to be characterized and considered for targeted mitigation. They also include sources such as marine shipping, domestic heating stoves, and agricultural fires. Globally, these sectors are accounted for in inventories, yet there are significant uncertainties in emissions factors and activity data that produce the inventories. Further, near-Arctic emissions of BC from these sources may have particularly strong climate impacts.

While work to characterize emissions factors from the industrial sectors is currently quite limited, some efforts are underway and will be described. For coke ovens and brick kilns, inventories of technologies and associated activity exist to some degree, but emissions factors are lacking. For flaring, measurements are underway to obtain emissions factors, which could greatly improve inventories for this source. Access to needed data on the quantity and composition of gas flared, and the conditions of flaring, will remain a challenge.

Emissions inventories indicate that stoves for domestic heating are a particularly important source of BC in Arctic nations. Emissions factors for these stoves need better characterization, as emissions may vary widely with type of stove, fuel, and operation of the stove. Work is underway to improve our understanding of emissions from this sector.

Source attribution studies on the Arctic snow and air indicate that biomass burning is a predominant source of BC in the Arctic. This biomass burning includes some combustion of wood in heating stoves in and near the Arctic, but there is also evidence that open burning of forests and agricultural lands are large sources. While organic carbon (OC) particulate co-emitted with BC from biomass burning significantly offsets the direct warming effects of BC emitted from these sources on a global basis, in the Arctic the cooling effects of OC are reduced and the warming effects of BC are magnified. As a result, emissions of OC and BC from open fires which reach the Arctic are warming.

Back trajectory and measurement work indicates that Central Asia and Russia are critical source regions for BC from biomass burning which reaches the Arctic. Current efforts are underway to improve understanding of the locations, times, and meteorological conditions most favorable for transport to the Arctic. These efforts, designed to help with the planning of agricultural fires and controlled burns of forests, will also aid inventory efforts and quantification of Arctic impacts from these sources. Work to improve satellite-based inventories of emissions from open fires in northern Eurasia will also be described.

International efforts to identify approaches to reduce BC emissions and impacts within the Arctic Council and the UN Economic Commission for Europe Convention on Long Range Transboundary Air Pollution have motivated much of this work and will be described.

KEY WORDS

Black Carbon, Emissions, Biomass Burning