Quantifying Sampling Losses during Aerosol Measurements of Flare Generated Particulate Matter based on Effective Density

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Abstract

Global gas flaring is an important source of black carbon emissions and is believed to be the dominant source of black carbon deposition on snow and ice in the Arctic. With Canada's recent ratification of the Gothenburg protocol, flare generated black carbon is also a component of new international black carbon reporting protocols and potential reduction commitments. Despite an obvious need, we still lack basic, science-based data to develop emission factor models, create accurate pollutant inventories, and enable effective regulations. The FlareNet initiative is intended to fill this gap.

However, a key barrier to accurate measurements is a quantitative understanding of losses that inevitably occur during sampling of aerosol species. The objectives of this work were to develop and apply a model capable of quantifying sampling losses during aerosol measurements. Aerosol instruments are reliant on the sampling lines that feed them, where sampling lines with different attributes such as diameter and length can affect particle deposition within the lines and hence change the output of the instruments at the end of the line. Several loss mechanisms can affect measured results in sample extraction and transportation including thermophoretic deposition, turbulent inertial deposition, gravitational settling, diffusion, inertial deposition in bend and contraction losses. The importance of each of these mechanisms depends on the particle size distribution and density. Experimental measurements of soot particle effective-density taken at the Carleton University Flare Facility (CUFF) were used for calculations to better quantify actual loss mechanisms. This poster outlines the new FlareNet Particle Penetration Calculator (FPPC) which can quantify and account for sampling losses through each of these mechanisms. This important tool allows robust quantification of measurement uncertainties and is an essential component of developing scientifically defensible particulate matter emission factor data and models.