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Quantification and radiocarbon source apportionment of black carbon in Northern European and South Asian atmospheres using the CTO375 and ECOC methods

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Atmospheric Black Carbon (BC) is forcing climate, affecting human respiratory health, and represent an important conduit in the global biogeochemical cycle of this poorly constrained carbon form. In fact, the accurate sampling and determination of pyrogenic carbon species in aerosols have been recognized as one of the most difficult challenges facing atmospheric chemists. The atmospheric field is dominated by commercially available thermal-optical (e.g., ECOC) and optical (e.g., aethelometer) techniques. In biogeochemical studies of soils and sediments, a technique determining BC with chemothermal oxidation at 375ºC in air (CTO375) is commonly applied.

Following up the initial results of the BC Ring-Trial, the ECOC and CTO375 methods were here further examined for their specific applicability toward atmospheric BC, using both positive and negative reference materials. The methods were also cross-examined in several atmospheric field campaigns. For the new NIST RM-8785, a good agreement was found between BC results of the CTO375 method (0.054 +/- 0.002 g/g) and the ECOC (STN-NIOSH) method (0.067 +/-0.008 g/g). In contrast, BC concentrations measured with the CTO375 method was a factor 8-10 lower than the ECOC results in a cold-season campaign in a Swedish background area and a factor 3-10 lower in an intermonsoon campaign in India and the Maldives. Underlying reasons for these substantial differences will be discussed.

Source apportionment of atmospheric BC between biomass and fossil fuel combustion is a key uncertainty in emission models. Therefore, natural abundance radiocarbon measurements were performed on BC isolated with both CTO375 and ECOC methods. The 14C data for CTO375-isolated BC suggests that biomass combustion sources contributes nearly 70-90% of cold-season BC to the Swedish background air and 55-70% to atmospheric BC during the South Asian dry season.