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Sampling, filtering and analyzing procedures for thermal-optical OCEC analysis to determine black carbon, organic carbon and total carbon concentrations in Arctic snow, ice and water samples

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Seemingly small amounts of black carbon (BC) in snow, of the order of 10–100 parts per billion by mass (ppb), have been shown to decrease its albedo by 1–5 %. Due to the albedo-feedback mechanism, surface darkening accelerates snow and ice melt and contributes to Arctic warming.

Here we present the most recent procedures we use for sampling, filtering and analysis of Arctic snow, ice and water samples, to determine their black carbon (BC), organic carbon (OC) and total carbon (TC) contents. For the purpose, we apply the OCEC analyzer of the Finnish Meteorological Institute's aerosol laboratory, Helsinki, Finland (60°12 N). Particles are collected on a quarz-fiber filter and subjected to different temperature ramps following the protocols (NIOSH-870, EUSAAR2, or IMPROVE). Pyrolysis correction is by laser transmittance. Light transmittance through the filter is monitored during the collection phase to quantify BC. The OCEC thermal-optical method is the current European standard method for determination of atmospheric BC.

Our Arctic samples include surface snow and snow profile samples collected north of the Arctic Circle at the Finnish Meteorological Institute Arctic Space Center in Sodankylä, Finland (67□37 N, 26□63 E), which is also a World Meteorological Institute's Global Atmospheric Watch station (WMO GAW). In addition, samples from H2020 EU-Interact stations of Faroes FINI, Iceland Sudurnes and UK Cairngorms, and elsewhere from Iceland and Finland, including Helsinki Kumpula SMEAR-III station (60°12 N, 24°57 E, Station for Measuring Ecosystem-Atmosphere Relations, https://www.atm.helsinki.fi/SMEAR/index.php/smear-iii) and the most northern research catchment area of Pallas (68°N, about 130 km north from the Arctic Circle, https://blogs.egu.eu/divisions/hs/2019/06/19/featured-catchment-series-pallas/), have been sampled and analyzed. The BC concentrations have been detected to vary according to the origin of the air masses and as a result of the seasonal snow melt process.

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