Exchange of Water Soluble Organic Compounds (WSOC) between aerosol and snow layers: investigation for new climate change markers

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Abstract

The organic fraction of aerosol contains Water Soluble Organic Compounds (WSOCs), which include several species of organic acids, amines, carboxylic compounds and amino acids. WSOCs are a substantial component of Arctic aerosol and they may have a great relevance as molecular tracers to investigate the effect of climate change. Levoglucosan is now considered a specific marker for biomass burning in the aerosol and ice samples (Zennaro et al., 2014; Zangrando et al., 2016) while amino acids could be suitable tracers for marine primary production (Barbaro et al., 2015).

During the Arctic campaign 2010 (NyAlesund, Svalbard), aerosol samples were collected weekly and we investigated WSOC present in size-segregated airborne particulate matter to better understand their distributions and transport processes of aerosol towards the Arctic.

Biomass burning produced molecules including levoglucosan (0.004 to 0.682 ng m−3) and phenolic compounds (<0.49μm, mean atmospheric concentration 6 pg m−3) were present in the sampled aerosols. Levoglucosan, an unambiguous cellulose combustion tracer, was mainly distributed in the fine fraction: the fractions <1.5 μm represented 98% of total collected levoglucosan. Phenolic compounds levels in the Ny-Alesund atmosphere in different size fractions reflected both long-range transport linked to biomass burning and a terrigenous local source (Zangrando et al., 2013; Turetta et al., 2016).

We also determined free amino acid is these sample with the aim to identify potential emission sources and the relative contributions of region a land local sources. Our results suggested the contribution of two sources of amino acids in Arctic aerosols: (1) regional and long-range transport from marine areas and (2) the influence of local sources such as marine primary production. Arctic Ocean is a significant source of bioderived aerosol and amino acids can be used as tracer of this aerosol (Scalabrin et al., 2012).

While there are data available for WSOCs in aerosol, no measurements are present in surface and sub-surface snow. During the 2015 campaign, a 5-meters ice core (4 year coverage) was sampled in Holtedahlfonna glacier (Svalbard Islands). We determined the concentration of free amino acids in the entire core with particular attention to their seasonal signal and the results have been compared with satellite measurements of chlorophyll A in the Greenland sea to quantify the year average primary production. This preliminary study firstly proposed to combine aerosol and snow

measurements to identify new environmental tracer to better assess the effect of climate changes in the Arctic areas.

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