The role of EBC measurements in Zeppelin Station for identifying source areas of transported carbonaceous aerosol from lower latitudes

V. Stathopoulos[1], S. Vratolis[1], N. Evangeliou[2], A. Stohl[2], K. Eleftheriadis[1]

[1]Institute of Nuclear Technology and Radiation Protection, Environmental Radioactivity Laboratory, National Centre of Scientific Research "Demokritos", 15310 Ag. Paraskevi, Attiki, Greece
[2]NILU – Norwegian Institute for Air Research, Kjeller, Norway
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Climate change and a warming of Arctic regions are research topics of current interest. Equivalent Black (EBC) aerosols, amongst other atmospheric trace constituents, are considered to be of importance in this respect. The magnitude of the aerosol forcing of black carbon (EBC) on snow and ice is 0.04 (0.02 to 0.09) W m^{-2} (IPCC, 2013).

In order to determine a high-resolution, long-term aerosol EBC climatology for the European Arctic, results from ongoing measurements at the GAW Ny-Ålesund Zeppelin station (474 m asl; 78°54'N, 11°53'E) with an AE-31 model (7-wavelength) are reported here.

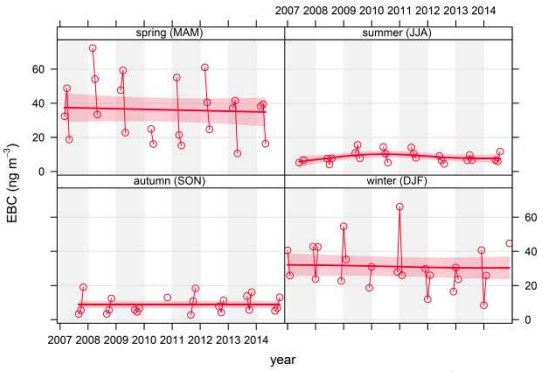

Figure 1. BC time-series at Zeppelin, Ny-Ålesund, Svalbard from 2007 to 2014 for 4 seasons. Dots are monthly averages of EBC.

A trendline with 95% confidence intervals for spring (March, April, May), summer (June, July, August), autumn (September, October, November) and winter (December, January, February) is also depicted. A decreasing trend is observed, mainly in spring. The winter-spring months exhibit frequent episodes of high BC concentration (monthly averages ~ 40 ng m^{-3}). In comparison, summer-autumn BC concentrations were generally < 20 ng m^{-3} with occasional episodic BC events. The annual average (median) EBC concentration for 2007 to 2014 is 22 (11) ng m^{-3}. In the long term a significant decrease is found compared to the 1998-2007 annual average (median) at 39 (27) ng m^{-3}.

The Lagrangian particle dispersion model FLEXPART (Stohl et al., 2013) with a 1^o x 1^o resolution was used to track EBC transport history for the period 2007 to 2014. Twenty-day backward simulation was performed, using hourly releases of 40,000 particles per release, in daily runs covering the aforementioned period.

A Potential Source Contribution Function (PSCF) model based on FLEXPART footprints was subsequently applied (Eleftheriadis *et al*., 2009).

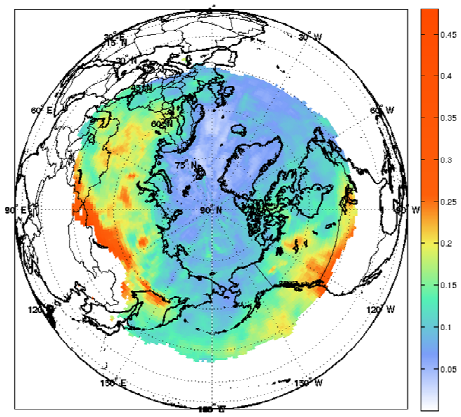

Figure 2. FLEXPART Air Tracer PSCF for the 10% highest EBC values (2010-2011). Cells with very low values (below the 65th percentile) at the footprint of peak concentrations are removed.

Sources affecting Ny Alesund indicated for the period 2010-2011 are Norilsk, Yakutsk and Volga industrial regions attributed to gas-flaring emissions (Stohl et al., 2013). The areas west of the Kamchatka and north Canada lakes are probably due to forest fires. There is also evidence of influence from Mongolia and North China, despite that the distance is large. Influence from the North of the United States can be also observed.

Vertical distribution patterns of aerosols have shown that aerosols originating from Asia are mixed throughout the entire troposphere within a few days (Stohl et al., 2002). This might explain why influence from Northern China and Mongolia was recorded in Zeppelin despite that the distance of these sources is much more than 5000 km.

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