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Ice core records of organic aerosol tracers over the past 450 years

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Carbonaceous aerosols, which include a mix of light absorbing and light-scattering components, influence the global climate via direct and indirect effects on radiative balance. However, the natural variability and factors controlling the emissions, transport and role in the climate system of carbonaceous aerosols are highly uncertain both for the past and future. Here we analyzed organic molecule tracers in ice-cores collected from Greenland and Kamchatka Peninsula over the past 450 years. Newly generated and previously published organic tracer records (Kawamura et al., 1996, 2012) were derived from Greenland Site-J and the Kamchatka Ushkovsky ice-cores. Concentrations of specific organic tracers: soil bacteria derived long-chain dicarboxylic acids (hereafter di-acids), higher plant leaf-wax derived long-chain monocarboxylic acids (hereafter leaf-waxes), and biomass burning derived levoglucosan are applied to reconstruct changes in the deflation and transport of soil organic matter (di-acids and leaf-waxes) and biomass burning products (levoglucosan and leaf-waxes). The concentrations and composition of biomass burning-, soil bacterial- and plant wax -tracers in the two ice cores were found to correspond with Arctic and regional temperatures from the different parts of the world over solar modulated multi-decadal time-scales with order of magnitude decreases (increases) in abundance during the colder (warmer) phases of the Little Ice Age. Thus, our study suggests a strong link between Arctic climate and carbonaceous aerosol loading in the high latitude.

Keywords: ice core, Greenland, Kamchatka, organic aerosol, Little Ice Age, Arctic Oscillation