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Measurements of Black Carbon and aerosol absorption during global circumnavigation and Arctic campaigns

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During two flight campaigns: around the world (2012) and over the Arctic (2013) we demonstrated the feasibility of scientific research and aerial measurements of aerosolized Black Carbon with ultra-light aircraft. Conducted measurements provided first ever information on Black Carbon concentrations and sources over such a large area at altitude.

Ground-level measurements of atmospheric aerosols are routinely performed around the world, but there exists very little data on their vertical and geographical distribution in the global atmosphere. These data is a crucial requirement for our understanding of the dispersion of pollutant species of anthropogenic origin, and their possible effects on radiative forcing, cloud condensation, and other phenomena which can contribute to adverse outcomes. Light absorbing carbonaceous aerosols and black carbon (BC) in particular are a unique tracer for combustion emissions, and can be detected rapidly and with great sensitivity by filter-based optical methods.

A single-seat ultra-light aircraft flew around the world and on a Arctic expedition. The flights covered all seven continents; crossed all major oceans; and operated at altitudes around 3000 m ASL and up to 8900 m ASL. The aircraft carried a specially-developed high-sensitivity miniaturized dual-wavelength Aethalometer, which recorded BC concentrations with very high temporal resolution and sensitivity [1, 2]. We present examples of data from flight tracks over remote oceans, uninhabited land masses, and densely populated areas. Measuring the dependence of the aerosol absorption on the wavelength, we show that aerosols produced during biomass combustion can be transported to high altitude in high concentrations and we estimate the underestimation of the direct forcing by models assuming a simple linear relationship between BC concentration and forcing in comparison to observations [3,4].

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