**Vertical distribution of black carbon (BC)**

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*Introduction*

Black Carbon (BC) is one of the leading contributors affecting our climate system.[1] Absorbing at all visible wavelengths results in a warmer environment [2] and thus has been considered the second most important contributor to global warming after carbon dioxide. The primary sources of BC aerosol are the incomplete combustion of fossil fuels and biomass burning. However, the composition of atmospheric aerosols varies with the height above the Earth's surface. Recent studies have shown significant uncertainties (about 25%) in model simulations of the vertical BC distribution, both on the regional and global levels.[3] BC's vertical transport is suggested to be one area where the models still differ significantly,[4,5] highlighting further investigation.

*Methods*

In the present study, we used an unmanned aerial vehicle (UAV)—Hexarotor UAV, M600, in cooperation with Czech Globe—Global Change Research Institute CAS. Compared to other land-based approaches or other aerial methods, it is found to be a versatile method for measurements. Micro-Aethalometer (AE51, AethLabs, San Francisco, CA), a portable handheld instrument, was used to measure eBC (equivalent black carbon) mass concentration. Measurements were performed on the flow rate of 150 ml/min with a time resolution of 1 sec. During the sampling campaign, eBC was simultaneously monitored every 1 min at 4 m above the ground with a multi-wavelength aethalometer (AE33, Magee Scientific, Berkeley, CA, USA). We measured the eBC using two mounting methods: 1- Inlets were mounted on the top of the drone. 2- Hanging the instruments below the drone using a 2.5 mm string. The measurements were found stable when inlets were mounted on the drone. The descent flights were not found reliable because of the downwash effect from drone wings.

*Results and Discussion*

The measured concentration from AE-33 was found to be lower at ground level (4 m) than the concentration measured by AE51 at 50 m. The measurements were taken during the daytime and strong vertical mixing inside the planetary boundary layer (PBL) led to aerosol particles being rapidly transported to the upper level. The eBC concentration did not vary much up to 70-180 m and showed a sudden high increase above 180 m. Such behavior can be due to lower noon-time PBL height because of the presence of cloud, as cloud suppresses the evolution of PBL. Further investigation and measurement campaigns can reveal more about the vertical behavior of the eBC concentration with PBL.

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