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Sources of water-soluble Brown Carbon at a South-Eastern European Site

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Atmospheric brown carbon (BrC) is a highly uncertain, but potentially important contributor to light absorption in the atmosphere. Laboratory and field studies have shown that BrC can be produced from multiple sources, including primary emissions from fossil fuel combustion and biomass burning (BB), as well as secondary formation through a number of reaction pathways. It is currently thought that the dominant source of atmospheric BrC is primary emissions from BB, but relatively few studies demonstrate this in environments with complex source profiles.

A field campaign was conducted during a month-long wintertime period in 2020 on the campus of the University of Peloponnese in the southwest of Patras, Greece which represents an urban site. During this time, ambient filter samples (a total of 35 filters) were collected from which the water-soluble BrC was determined using a semi-automated system similar to Hecobian et al. (2010), where absorption was measured over a 1 m path length. To measure the BrC, a UV-Vis Spectrophotometer was coupled to a Liquid Waveguide Capillary Cell and the light absorption intensity was recorded at 365 and 700 nm. The latter was used as a reference wavelength. We found that the average BrC absorption in Patras at a wavelength of 365 nm was 8.5 ± 3.9 Mm^{-1} suggesting that there was significant BrC in the organic aerosol during this period. Attribution of sources of BrC was done using simultaneous chemical composition data observations (primarily organic carbon, black carbon, and nitrate) combined with Positive Matrix Factorization analysis. This analysis showed that in addition to the important role of biomass burning (a contribution of about 20%) and other combustion emissions (also close to 20%), oxidized organic aerosol (approximately 40%) is also a significant contributor to BrC in the study area.

Reference

Hecobian, A., Zhang, X., Zheng, M., Frank, N., Edgerton, E.S., Weber, R.J., 2010. Water-soluble organic aerosol material and the light-absorption characteristics of aqueous extracts measured over the Southeastern United States. Atmos. Chem. Phys. 10, 5965–5977. https://doi.org/10.5194/acp-10-5965-2010