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The Four-Wavelength Photoacoustic Aerosol Absorption Spectrometer PAAS-4λ

Martin Schnaiter[1,2], Claudia Linke[1], Eija Asmi[3], Henri Servomaa[3], Antti-Pekka Hyvärinen[3], Sho Ohata[4,5], Yutaka Kondo[6], and Emma Järvinen[1]

[1]Institute of Meteorology and Climate Research, Karlsruhe Institute of Technology, Karlsruhe, Germany
[2]schnaiTEC GmbH, Bruchsal, Germany
[3]Finnish Meteorological Institute, Helsinki, Finland
[4]Institute for Space–Earth Environmental Research, Nagoya University, Nagoya, Japan
[5]Institute for Advanced Research, Nagoya University, Nagoya, Japan
[6]National Institute of Polar Research, Tokyo, Japan

Light absorbing particulate emissions, known as black carbon (BC) or brown carbon (BrC), are major contributors to the atmospheric aerosol and have a significant impact on climate forcing. The spectral light absorption coefficient of these particles, which is essential for understanding their impact on the climate, can vary greatly depending on the combustion process and atmospheric aging, particularly in the Arctic where concentrations of BC and BrC are low but the climate is sensitive to changes in the atmospheric aerosol. Traditional filter-based methods for characterizing light absorbing aerosol can be prone to errors in environments where the relationship between particle light scattering and absorption is high due to cross-sensitivity to co-deposited light scattering particles. The photoacoustic absorption spectroscopy (PAS) method is less sensitive to particle light scattering and has a high measurement precision and accuracy, but is not widely used for long-term monitoring due to ist assumed lack of sensitivity and robustness.

The Photoacoustic Aerosol Absorption Spectrometer PAAS-4λ has been developed for use in unattended air quality monitoring stations and utilizes four wavelengths coupled to a single acoustic resonator in a compact and robust design. It has a low detection limit of below 0.1 Mm^{-1} and has been calibrated in the laboratory using NO2/air mixtures and Nigrosin aerosol. The PAAS-4λ has been validated at an air quality monitoring station in the European Arctic and its performance during 12 months of deployment is presented. Comparisons with filter-based photometers demonstrate the capabilities and value of the PAAS-4λ for both long-term monitoring and the validation of filter-based instruments.