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Aerosol absorption coefficient measurements at the UV-vis-NIR using photoacoustic spectrometer

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Apart from the negative impact on human health and visibility, atmospheric aerosols also play a key role in the global climate system by its direct effects (scattering and absorption of the solar radiation) and indirect effects (modification of cloud properties and abundance) on climate. Among these factors, aerosol absorption is of particular importance for both direct and indirect aerosol effects. Unfortunately, aerosol absorption is one of the most uncertain parameters for the above-mentioned effects and one of the most difficult quantities to accurately measure. Photoacoustic spectroscopy (PAS) technique, which observes the aerosols on their natural suspended state (filter-free technique) and is insensitive to light scattering, is commonly recognized as one of the best candidates to measure the optical absorption coefficient (OAC) of aerosols. A multi-wavelength photoacoustic spectrometer (PAS) working at 405 nm, 532 nm and 780nm was developed for measurements of aerosol optical absorption coefficient (OAC) and a sensitivity of 1.3 Mm^{-1} was demonstrated. Using the established PAS, OAC measurements of the atmospheric aerosol at a suburban site of Hefei city (capital of Anhui Province, East China) were carried out. The temporal variations of the OAC are in line with that of the aerosol number concentration monitored by a condensation particle counter (CPC) and the aerosol absorption Angström exponent under clear day was found to be 2.04 which indicated a dominant organic carbon absorption (e.g. borwn carbon, BrC). Further more, a differential photoacousitc spectrometer was developed for OAC measurement at short wave infrared (SWIR, 1342 nm) wavelength with water vapor interference and the sensitivity was demonstrated to be $\sim$0.3 Mm^{-1}. Field environment rural aerosol measurements were carried out at West China and the measured OAC values were in good agreement with OAC values calculated by PcMondWin5 software (Ontar Corporation) which is the world standard Windows interface for MODTRAN5.