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LED-CE-DOAS measurements of NO_2: intercomparison with CaRDS

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The combination of cavity enhanced absorption spectroscopy (CEAS) with Light Emitting Diode (LED) light sources lends itself to the application of the well established Differential Optical Absorption Spectroscopy (DOAS) technique (LED-CE-DOAS). In contrast to other broad band CEAS (BB-CEAS) techniques, CE-DOAS relies only on the measurement of relative intensity changes, i.e., does not require knowledge of the light intensity in the absence of trace gases (I_0). With CE-DOAS there is no necessity for sampling lines to supply air samples into a cavity, or filters to remove aerosols from the airstream, as measurements are possible in a cavity that can be open to the atmosphere.

A novel LED-CE-DOAS instrument was built at CU Boulder for the sensitive and selective detection of nitrogen dioxide (NO_2), glyoxal (CHOCHO), iodine oxide (IO), water, and oxygen dimers (O_4). CU Boulder's LED-CE-DOAS instrument was collocated to NOAA's NO_2 Cavity Ring Down (CaRDS) instrument to test different CE-DOAS data retrieval algorithms for NO_2 and O_4. Both instruments were collocated to sample known NO_2 concentrations from the same gas manifold, and to sample atmospheric air in a parking lot. This contribution focuses on the instrument components, challenges and means to retrieve quantitative concentrations of NO_2 by LED-CE-DOAS, i.e., the distortion of NO_2 and O_4 absorption features due to different effective path lengths induced by (1) changes in the mirror reflectivity with wavelength, and (2) changes in light extinction across the absorption bands due to differential trace gas absorption features. We demonstrate that simultaneous measurements of O_4 and NO_2 enable to characterize the effective pathlength in the absence and presence of NO_2 and perform absolute measurements based only on relative intensity measurements. To our knowledge these are the first CEAS measurements that rely solely on relative intensity measurements.