Standoff Measurements of CO_2 and H_2O in Boulder using DIAL And IPDA Techniques

D. Plusquellic, G.A. Wagner, and K. Briggman

National Institute of Standards and Technology (NIST), Physical Measurement Laboratory, Quantum Electromagnetics Division, Boulder, CO 80305; 303-497-6089, E-mail: david.plusquellic@nist.gov

Integrated path differential absorption (IPDA), light detection and ranging, and differential absorption LIDAR (DIAL) systems have been developed to monitor and detect sources of CO_2 in the spectral region of ≈ 1602.2 nm. The strategy of both approaches is to rapidly scan through a narrow spectral window that contains both CO_2 and H_2O absorption lines and to fit the observed line shapes to obtain CO_2 dry-air mixing ratios. The IPDA system is based on an electro-optic (EO) modulated continuous-wave (CW) laser to produce >100 frequencies at a scan repetition frequency (SRF) of 10 kHz. The DIAL system consists of an optical parametric oscillator (OPO) operating at a pulse repetition frequency of 100 Hz. The OPO is sequentially injection-seeded with 10 frequencies from an EO-modulated CW laser at a SRF of 10 Hz. We compare the dry-air mixing ratio results with those of a calibrated cavity ringdown point sensor for several nighttime periods.

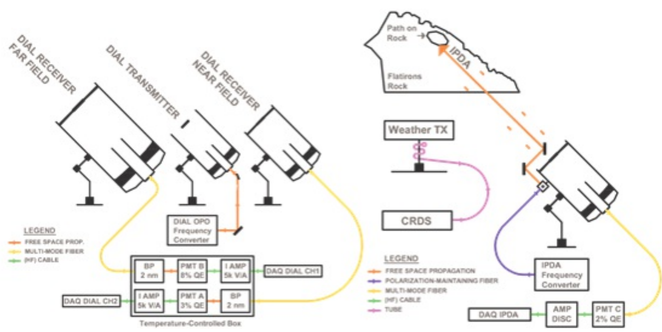

Figure 1. Multifrequency DIAL system consisting of a near- and far-field receiver and hybrid photon current/count detection system (left panel) and natural target IPDA system consisting of a coaxial transmitter and photon counting detection system (right panel).

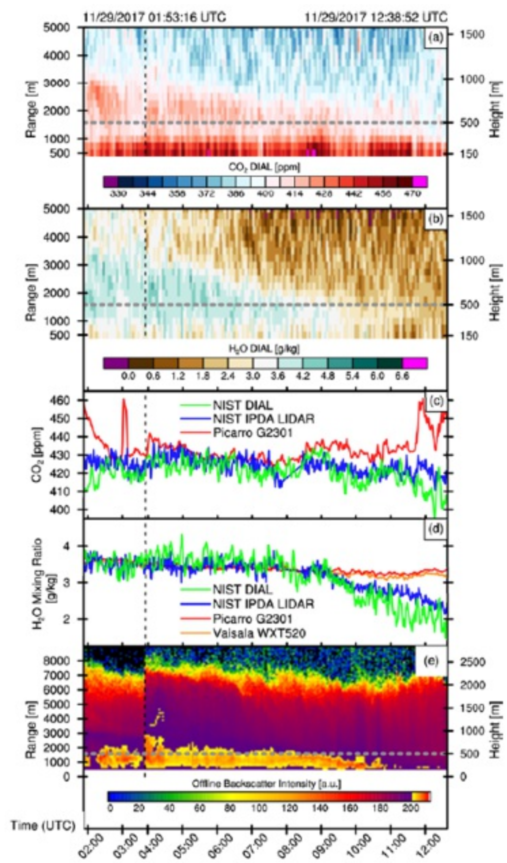

Figure 2. DIAL measurements on 11/29/2017 consisting of the (a) range resolved CO_2, (b) range resolved H_2O dry-air mixing ratios, and (e) range and background corrected offline backscatter signals. Comparisons of the IPDA LIDAR and point sensor data (Picarro G2301 and Vaisala WXT520) are made with the column-averaged DIAL data (0.5 km to 1.75 km) for (c) CO_2 and (d) H_2O, respectively. DIAL surfaces are shown for an effective time resolution of 10 min and for increasing range bin size (see text for details). Dashed vertical line indicates a small gap in data. Time on abscissa is UTC (local time −7 hrs).