Multi-Frequency Differential Absorption LIDAR System for Simultaneous Aerosol and Cloud Retrievals of Greenhouse Gasses

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A multifrequency differential absorption LIDAR system operating in the near-infrared region is demonstrated to detect range-resolved concentrations of CO_2, CH_4 and H_2O (DIAL) while simultaneously retrieving integrated path concentrations (IPDA) from cloud targets over ranges of up to 25 km. The DIAL frequency converter consists of an optical parametric oscillator that is switched at a 100 Hz repetition rate over 10 to 20 colors using a microwave-driven electro-optic phase modulator and filter cavity with high spectral purity (> 30 dB). Near and far-field detection systems are based on hybrid photon counting modules that extend the linear dynamic range for retrievals by more than 6 orders of magnitude. The high signal-to-noise IPDA concentrations from clouds are compared with the column averaged range-resolved retrievals for calibration and validation of the dry-air concentrations of CO_2 and CH_4. Strategies are also discussed to obtain range-resolved temperature and pressure profiles by expanding the frequency coverage of the systems.

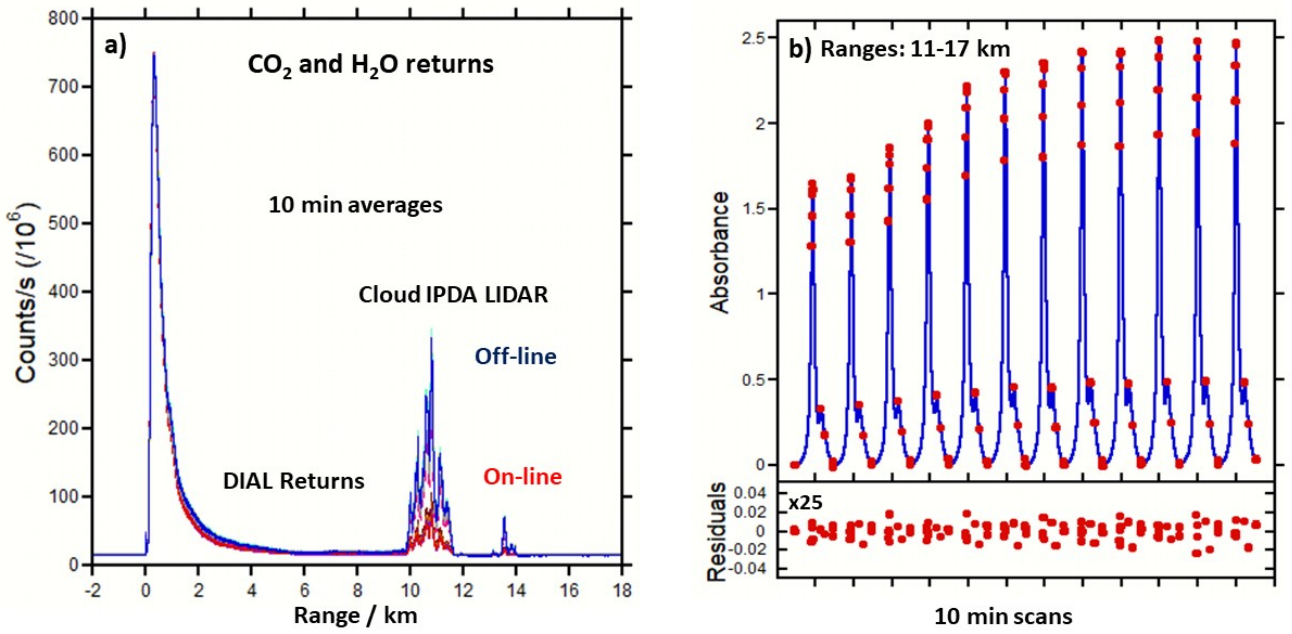

Figure 1. a) 10 color DIAL returns for a 10 min interval illustrating the range-resolved signals out to 10 km after which signals increase significantly over a 3 km range from cloud backscatter. b) Integrated path measurements to clouds (red) are shown over consecutive 10 min intervals for ranges from 11 km to 17 km together the best fit line shapes of CO_2 and H_2O (blue). Fit residuals (x25) are shown below each interval.