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## Development and Evaluation of a High sensitivity DIAL System for Profiling Atmospheric CO<sub>2</sub>

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A ground-based 2-micron Differential Absorption Lidar (DIAL) CO<sub>2</sub> profiling system for atmospheric boundary layer studies and validation of space-based CO<sub>2</sub> sensors is being developed and tested at NASA Langley Research Center as part of the NASA Instrument Incubator Program. To capture the variability of CO<sub>2</sub> in the lower troposphere a precision of 1-2 ppm of CO<sub>2</sub> (<0.5%) with 0.5 to 1 km vertical resolution from near surface to free troposphere (4-5 km) is one of the goals of this program. In addition, a 1% (3 ppm) absolute accuracy with a 1 km resolution over 0.5 km to free troposphere (4-5 km) is also a goal of the program. This DIAL system leverages 2-micron laser technology developed under NASA's Laser Risk Reduction Program (LRRP) and other NASA programs to develop new solid-state laser technology that provides high pulse energy, tunable, wavelength-stabilized, and double-pulsed lasers that are operable over pre-selected temperature insensitive strong CO<sub>2</sub> absorption lines suitable for profiling of lower tropospheric CO<sub>2</sub>. It also incorporates new high quantum efficiency, high gain, and relatively low noise phototransistors, and a new receiver/signal processor system to achieve high precision DIAL measurements. This presentation describes the capabilities of this system for atmospheric CO<sub>2</sub> and aerosol profiling. Examples of atmospheric measurements in the lidar and DIAL mode will be presented.