Field Testing of a Diode-Laser-Based Micropulse Differential Absorption Lidar System to Measure Atmospheric Thermodynamic Variables

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Abstract

Traditionally, quantitative lidar techniques like differential absorption lidar (DIAL) and high spectral resolution lidar (HSRL) utilize high power-aperture product designs, which partially compensates for a need to take discrete derivatives of noisy data in post-processing (for number density for DIAL and extinction for HSRL) and provides for high performance measurements, i.e. higher resolution, accuracy, or precision. Conversely, low power-aperture product lidar designs are easier to make eye-safe, reliable, and cost-effective, important attributes for networkable field deployment. The science community has expressed the need for high-quality, quantitative, robust, network deployable, and cost effective sensors for a variety of applications such as improved numerical weather forecasting, in essence requiring the best of both worlds without the accompanying drawbacks. In response to this need, the National Center for Atmospheric Research (NCAR) and Montana State University (MSU) have been developing the MicroPulse DIAL (MPD) architecture to address the needs of the science community for thermodynamic profiling in the lower atmosphere. The MPD architecture takes advantage of the benefits of low-power, low-cost laser diodes and fiber optics to achieve quantitative profiling leveraging narrowband filtering and efficient elastic scattering. MPD instruments have demonstrated water vapor number density profiling (using WV DIAL), quantitative aerosol profiles (using HSRL), and temperature profiling (leveraging both O_2 DIAL and HSRL). A field-deployable MPD instrument capable of humidity, quantitative aerosol, and temperature profiling has recently been developed. This presentation will describe the current status of this MPD thermodynamic profiler and initial results from a recent field deployment. Emphasis will be given to the analysis of the temperature data including comparisons to co-located radiosondes to describe current performance.