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Evaluation of compact water vapor DIAL technology in various climates

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Continuous water vapor profiling within the atmospheric boundary layer is a major unmet measurement requirement for improving weather analysis and prediction. Humidity profile information can be used in mesoscale numerical models for severe weather prediction, flash flood prediction, energy management, and other applications. This study presents results from recent and ongoing field campaigns using three compact Water Vapor Differential Absorption Lidar (DIAL) system prototypes designed to continuously report water vapor mixing ratio profiles in unattended all-weather operation. The purpose of the study is to assess the performance of the DIAL against several other measurement platforms under various atmospheric conditions. Observations include a field campaign at the U.S. Department of Energy's Atmospheric Radiation Measurement (ARM) Southern Great Plains (SGP) atmospheric observatory in Oklahoma from 15 May to 12 June 2017, representing humid convective summertime conditions in the Southern Great Plains area. Height-resolved mixing ratio measurements from the DIAL are compared to those of a Raman Lidar, an Atmospheric Emitted Radiance Interferometer (AERI), and radiosonde launches. The DIAL system operated unattended and failure-free throughout the campaign. The maximum height for valid DIAL measurements was found to be about 1200 m, based on 50 % data availability. Comparing the DIAL to all radiosondes over the height range of 0 m to 1500 m, the DIAL measurements were essentially unbiased with a standard deviation of 0.68 g kg-1. The comparison of the DIAL to Raman Lidar had a standard deviation of 0.97 g kg-1, and the comparison to AERI 1.19 g kg-1.

Two other measurement sites with ongoing work are the Environment and Climate Change Canada's (ECCC) Canadian Arctic Weather Science (CAWS) supersite in Iqaluit, Nunavut, representing Arctic conditions, and the Meteorological Observatory in Lindenberg by the German Weather Service (DWD), representing mid-latitude continental conditions. The two DIAL prototypes at these two sites include further developments of the prototype design and demonstrate unattended operational use over several seasons. The paper discussed preliminary results from these ongoing evaluations.