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Poster
Atmospheric carbon dioxide (CO_2) is the primary anthropogenic driver of climate change, accounting for more than half of the total effective radiative forcing (ERF). The accurate monitoring of carbon dioxide is essential to study the global carbon cycle and radiation budget on Earth. The Aerosol and Carbon Detection Lidar (ACDL) instrument, as the first space-borne integrated path differential absorption (IPDA) light detection and ranging (Lidar), was successfully launched in April 2022 onboard the DaQi-1 (DQ-1) satellite. ACDL enables observations to be taken at all latitudes and all times of year owing to their illumination, which allows a new perspective to quantify the global spatial distribution of atmospheric CO_2. Although the active techniques have some significant benefits, evaluating and attributing the measurement error is necessary for a rigorous error budget to ensure a high-quality CO_2 measurement. In this paper, the performance of the IPDA lidar was evaluated to meet the global weighted column-averaged dry air mixing ratio of carbon dioxide (XCO_2) measurement requirements of less than 1 ppm. The random errors resulting from the noise associated with the detection of the lidar signals were assessed. The simulations of ACDL lidar were conducted. Results showed that the random error was distributed in the range of 0-1.5 parts per million (ppm) with 50 km averaging over land surfaces and 50 km averaging over oceans. In addition, the systematic errors arising from the laser pulse energy, spectral purity, doppler shift, and atmospheric factors, transmitter, and receiver were also analyzed. The uncertainties of surface pressure were found to be the major source of error, followed by the Doppler shift. This study can help to improve the understanding of the measurement uncertainties and provide a reference for CO_2 retrievals and validation.
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