Lidar Approach for Global Atmospheric Column CO₂ Measurements

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Advanced knowledge in atmospheric CO₂ distributions is critical in predicting the Earth’s future climate. Large uncertainties in the prediction persist due to limited observations. This study focuses on the development and demonstration of the Intensity-Modulated Continuous-Wave (IM-CW) lidar for atmospheric CO₂ measurements. Simulations show that IM-CW lidar systems operating at 1.57 um will provide precise atmospheric column CO₂ measurements from space. Airborne systems have demonstrated the feasibility of the technology and instrumentation for space active atmospheric CO₂ missions.

In this presentation, the atmospheric CO₂ column measurements from airborne flight campaigns and lidar system simulations for space missions will be discussed. Data analysis shows that airborne lidar CO₂ column measurements over desert and vegetated surfaces agree well with in-situ measurements. A measurement precision of 0.08% or ~0.3 ppmv for a 10-s average over these surfaces has also been achieved. Generally, airborne flight campaigns have demonstrated that the column CO₂ measurements of the current IM-CW lidar systems meet the accuracy and precision requirements of atmospheric CO₂ measurements. Furthermore, analyses of space CO₂ measurements shows that the current IM-CW lidar technology and approach will enable space missions to achieve their science goals.