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Development of a Ground-Based Differential Absorption Lidar for High Accurate Measurements of Vertical CO2 Concentration Profiles

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High-accurate vertical carbon dioxide (CO2) profiles are highly desirable in the inverse method to improve quantification and understanding of the global sink and source of CO2, and also global climate change. We have developed a ground based 1.6μm differential absorption lidar (DIAL) to achieve high accurate measurements of vertical CO2 profiles in the atmosphere. The DIAL system is constructed from the optical parametric oscillation(OPO) transmitter and the direct detection receiving system that included a near-infrared photomultiplier tube operating at photon counting mode. The primitive DIAL measurement was achieved successfully the vertical CO2 profile up to 7 km altitude with an error less than 1.0 % by integration time of 50 minutes and vertical resolution of 150m.

We are developing the next generation 1.6 μm DIAL that can measure simultaneously the vertical CO2 concentration, temperature and pressure profiles in the atmosphere. The output laser of the OPO is 20mJ at a 500 Hz repetition rate and a 600mm diameter telescope is employed for this measurement. A very narrow interference filter (0.5nm FWHM) is used for daytime measurement.

As the spectra of absorption lines of any molecules are influenced basically by the temperature and pressure in the atmosphere, it is important to measure them simultaneously so that the better accuracy of the DIAL measurement may be realized. Moreover, the value of the retrieved CO2 concentration will be improved remarkably by processing the iteration assignment of CO2 concentration, temperature and pressure, which measured by DIAL techniques.

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Reference

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