

Airborne lidar measurements of water-vapor profiles

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Measurements of water vapor profiles are very important in studies of the atmospheric dynamics, aerosol growth effect and the earth's radiation effects. Water vapor is the predominant greenhouse gas and its vertical distributions are important parameters in model simulation of the global climate system. Passive remote sensing techniques from space provide global coverage of water vapor distribution but do not provide good vertical resolution, while lidar remote sensing techniques can provide high resolution measurements of water vapor distributions.

For future spaceborne water vapor DIAL systems, we developed a high power diode-pumped Nd:YLF laser and Ti:sapphire laser for water vapor DIAL. A Ti:sapphire laser is pumped by the SHG of the Nd:YLF laser. Tuning of the Ti:sapphire laser to a strong absorption line (ON1), a weak absorption line (ON2) of water vapor and an off line (OFF) is made by an injection seeder which consists of two single longitudinal mode laser diode modules. Two on-line laser diodes are locked to water vapor absorption lines using an absorption cell or a photo-acoustic cell. These three laser lines (ON1, OFF and ON2) are transmitted into the atmosphere with a triple pulse technique for measurements of water vapor profiles from the ground up to 10 km. The laser spectral width of the on line was 0.045 pm with a stability of 0.06 pm. The output energy of each laser line is more than 45 mJ. We have demonstrated airborne measurements of water vapor profile using this laser system.

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