

Development of a 266 nm Raman lidar for profiling atmospheric water vapor

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It is projected that localized extreme weather events could increase due to the effects of global warming, resulting in severe weather disasters, such as a torrential rain, floods, and so on. Understanding water vapor's behavior in the atmosphere is essential to understand a fundamental mechanism of these weather events. Therefore, continuous monitoring system to measure the atmospheric water vapor with good spatio-temporal resolution is required. We have developed several water vapor Raman lidar systems employing the laser wavelengths of 355 and 532 nm. However, the signal-to-noise ratio of the Raman lidar strongly depends on the sky background because of the detection of the weak inelastic scattering of light by molecules. Therefore, these systems were mainly used during nighttime.

Hence, we have newly developed a water vapor Raman lidar using a quadrupled Nd:YAG laser at a wavelength of 266 nm. This wavelength is in the ultraviolet (UV) range below 300 nm known as the "solar-blind" region, because practically all radiation at these wavelengths is absorbed by the ozone layer in the stratosphere. It has the advantage of having no daytime solar background radiation in the system. The lidar is equipped with a 25 cm receiving telescope and is used for measuring the light separated into an elastic backscatter signal and vibrational Raman signals of nitrogen and water vapor at wavelengths of 266.1, 283.6, and 294.6 nm, respectively. This system can be used for continuous water vapor measurements in the lower troposphere. This study introduces the design of the UV lidar system and shows the preliminary results of water vapor profiles.