ABSTRACTS (MASTER THESIS)

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

**(Graduate School of Informatics,
Laboratory of Atmospheric Sensing and Diagnosis, RISH, Kyoto University)**

Takuma UESUGI

It is projected that localized extreme weather events could increase due to the effects of global warming, resulting in severe weather disasters. 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 laser at a wavelength of 266 nm. This wavelength is in the ultraviolet 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 used for measuring the light separated into an elastic backscatter signal and vibrational Raman signals of oxygen, nitrogen and water vapor at wavelengths of 266, 277, 284, and 295 nm, respectively. This system can be used for continuous water vapor measurements in the lower troposphere.

We have demonstrated the potential of the 266nm Raman lidar at the middle and upper (MU) radar observatory in October 30-31, 2014. The mean values of standard deviation, which is differences of water vapor mixing ratio between the lidar and radiosonde, increased with height from 0.28 g/kg (up to 300 m) to 0.74 g/Kg (up to 600 m). The large values of the standard deviation at higher altitudes might be caused by the broken clouds which were observed above 400 m. We found a good agreement of the temporal variations of the water vapor mixing ratio near the ground between lidar and surface in-situ observations during experiment including the daytime.

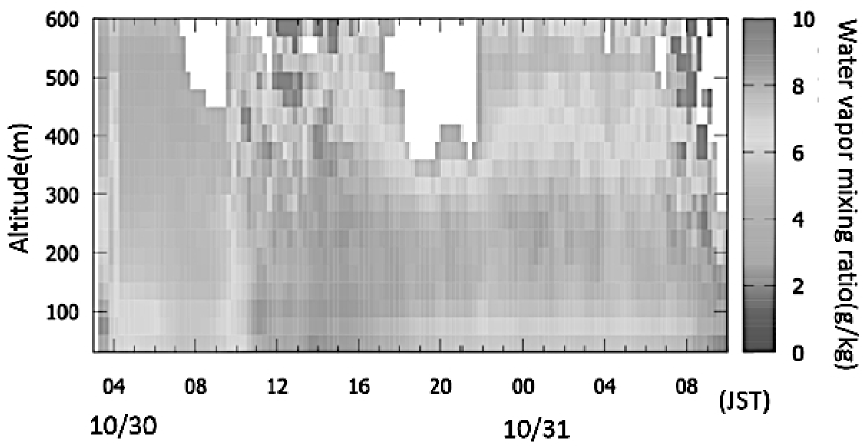

Figure 1. Temporal variation of vertical profiles of water vapor mixing ratio measured with the 266 nm Raman lidar at a middle and upper atmosphere (MU) radar site (34.9°N, 136.1°E, 385 m a.s.l.), Shigaraki, Japan, on October 30–31, 2014.