

ABSTRACTS (MASTER THESIS)

Study of UV/Visible Raman Lidar Systems for Profiling of Water Vapor and Aerosols

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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. Meanwhile, the interaction of atmospheric aerosol particles with water vapor is related to cloud condensation nuclei activity. A demand is increasing for development of a continuous observation system of the atmospheric water vapor and aerosols in the lower troposphere. We study in this thesis a Raman lidar which can obtain an accurate height profile of these parameters. We operated a Raman lidar for visible bands under different weather conditions, then, we have newly developed a UV (ultra-violet) Raman lidar.

We carried out observations with the visible Raman lidar at Shigaraki MU observatory located in a forest region. We found that the particle scattering associated with the water vapor content increased in autumn and summer. The results suggest that measurement of the aerosol particle size is required with a lidar system on multi-wavelength in order to know aerosol hygroscopic properties quantitatively.

We have developed a UV Raman lidar that can be operated even in urban areas, where human eye safety must be ensured. The nominal ocular hazard distance of this UV laser is about 130 m, which is one order of magnitude smaller than that for a visible laser. We conducted observations with this UV Raman lidar at Uji in July 2011. The vertical resolution of the water vapor profile is 116m and 26m at an altitude of 1.0 km with an integration time of 300 s and 900 s, respectively, which is estimated from the statistical uncertainty resulting from signal noise. We found, however, some optical detection components of the lidar system are sensitive to ambient temperature, and the detected signals fluctuated periodically because of room temperature variations. Therefore, we smeared out the periodic variations, which degraded the time resolution to 1800 s from the implicit resolution. Employing both UV and visible Raman lidars, we studied aerosol hygroscopic processes and clarified particle growth with the increase in water vapor content.

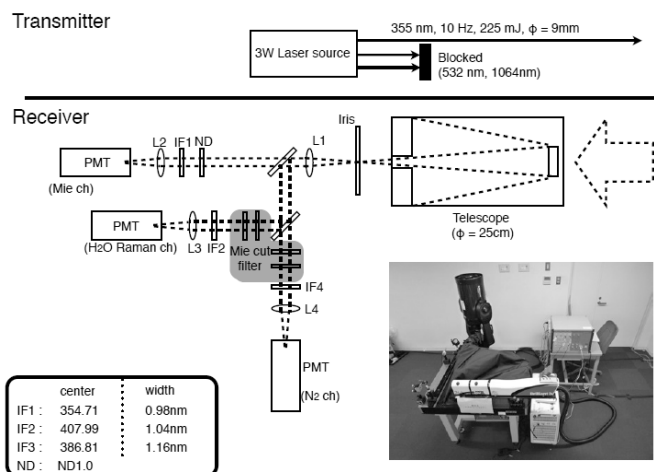


Figure 1. A schematic of the developed UV Raman Lidar system

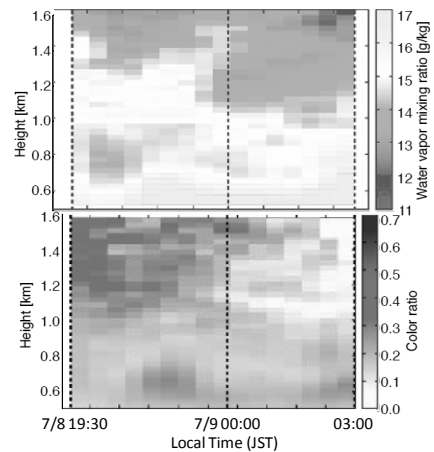


Figure 2. Water vapor mixing ratio (top) and aerosol color ratio (bottom) from the UV Raman Lidar at Uji, Kyoto, for July 8-9, 2011. The color ratio, which here is the ratio of backscatter coefficients at wavelength of 532 and 355 nm, gives a measure of effective particle radius.