# A study on a UV-C Raman lidar for profiling the water vapor

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Water vapor is an important role in atmospheric processes such as the atmospheric energy budget, atmospheric chemistry, and localized extreme weather events associated with severe weather disasters. Accurate observations of water vapor in the atmospheric boundary layer are essential for improving weather forecasting. We have developed a water vapor Raman lidar using a laser operating in the ultraviolet C (UV-C) region. The UV-C region is known as the "solar-blind" region and has the advantage of having no daytime solar background radiation in the system. However, it is necessary correction for ozone absorption while estimating the atmospheric water vapor because of the strong ozone absorption in the UV-C region. In this study, we estimated the errors in the retrieved water vapor mixing ratio (WVMR) caused by the atmospheric conditions and validated the calibration methods of the lidar system.

The UV-C water vapor Raman lidar used a 35 cm telescope to collect the vibrational Raman of water vapor (294.6 nm), nitrogen (283.6 nm), and oxygen (277.5 nm) for a laser operating at a wavelength of 266 nm. We simulated the WVMR estimation errors using the theoretical Raman signals based on the radiosonde data, assuming several ozone profiles. When the surface ozone concentrations were 60 and 0 ppb, the maximum altitudes for which the WVMR estimation errors were within 10% were 1750 m and 2150 m, respectively. Two calibration methods were investigated to convert the WVMR from the lidar signals: 1) comparison of lidar signals with WVMR profiles of radiosonde; 2) calibration of the detector efficiencies of each Raman channel by the standard calibration lamp technique. While the estimation errors of the calibration factor using the radiosonde data were 1.21 % below the surface ozone concentrations of 60 ppb, those by the standard calibration lamp techniques for the Deuterium lamp and tungsten lamp was 1.07% and 6.91%, respectively.

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