Observation of water vapor distribution in the lower troposphere in the sub-tropical region of Okinawa by a portable Raman lidar

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Water vapor effects on various atmospheric phenomena significantly through transportation of latent heat, cloud formation, precipitation etc.. Therefore, it is important to observe spatial and temporal variation of water vapor with a high time and spatial resolution in order to reveal its characteristics. A Raman lidar is an active remote sensing technique of profiling atmospheric parameters, including water vapor mixing ratio. We have developed portable Raman lidars for profiling water vapor at various observation sites. In this study, we have build up a stable automatic and remote observation system of small Raman lidar to be used in Okinawa, the sub-tropical region. The observation in Okinawa was initiated in April 2006, and profiles of water vapor mixing ratio and back scatter ratio up to about 3–4 km have been continuously observed with 0.5–1 hour resolution and 60–480 m height resolution, dependent on altitude (Figure 1). The observed data are automatically processed and stored in the database, which is open through web page. Comparison of the lidar observation with routine radiosonde observation at Naha, Okinawa showed that the spatial variety of water vapor at about 70 km horizontal distance was correlated with the temporal variability during the night by lidar observation especially around winter (September to March), when advection of water vapor due to synoptic scale motion. We further compared water vapor profile observed by the lidar with those derived from GPS occultation measurement, COSMIC. We have compared 11 profiles within 100 km distance, and found that observed difference of water vapor between the two technique at 1.0–2.3 km altitude did not show significant bias, when compared with the spatial difference estimated by the lidar observation. We also stress that in order to observe local distribution of water vapor which cannot be obtained by satellite, stable and automatic ground based observation such as Raman lidar is a useful technique.

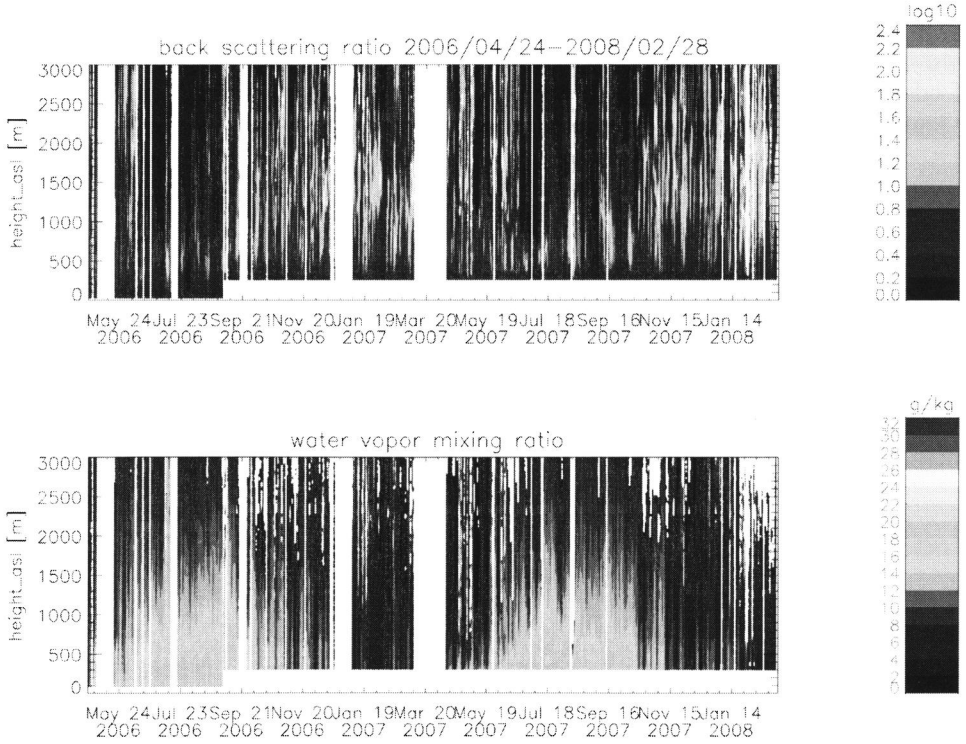

Figure 1. Backscatter ratio (clouds/aerosol content) (top) and water vapor mixing ratio (bottom) observed in Okinawa between April 24, 2006 and February 28, 2008. Nightly average is plotted. Observation sites before and after September 2, 2006 were Onna(26.5N, 127.8E, 8m ASL), and Ogimi(26.7N, 128.1E, 225m ASL), respectively.