



TITLE:

Development of a scanning Raman lidar for observing the spatio-temporal distribution of water vapor

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CITATION:

Matsuda, Makoto. Development of a scanning Raman lidar for observing the spatio-temporal distribution of water vapor. Sustainable humanosphere : bulletin of Research Institute for Sustainable Humanosphere Kyoto University 2013, 9: 42-42

ISSUE DATE:

2013-10-31

URL:

<http://hdl.handle.net/2433/185648>

RIGHT:

ABSTRACTS (MASTER THESIS)

**Development of a scanning Raman lidar for observing
the spatio-temporal distribution of water vapor****(Graduate School of Informatics,
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Water vapor and aerosol particles are important atmospheric constituents that play a key role in the atmospheric processes such as thermodynamics, radiative forcing, cloud physics, and chemistry. Atmospheric constituents near the surface are highly variable spatially and temporally, because of the complex turbulent flow over the surface. It is required to innovative techniques for observing the distributions of atmospheric constituents with good spatio-temporal resolution. We have newly developed a scanning Raman lidar to measure the spatio-temporal distributions of the water vapor and aerosol particles near the surface, which is useful to study the detailed behavior of meteorological phenomena as well as interactions of aerosol particles with water vapor.

Considering the eye-safe operation in urban districts, we employed the UV laser of 355 nm. We developed a scanning mirror system which comprises with highly reflective mirrors and a rotational stage. By use of the program-controlled rotational stage, vertical scan into any zenith direction can be operated with a maximum speed of $1.8^\circ/\text{s}$. Differences between the temporal variations of water vapor mixing ratio by the scanning Raman lidar and those by the conventional lidar for observing a vertical point are less than 2.5 %. It is indicated that the developed system can measure water vapor correctly though the scanning system is attached.

We have demonstrated the potential of the scanning Raman lidar in the forest region at the Shigaraki MU observatory in August and October, 2012. We performed a vertical scan in a zenith sector of 48° with a constant step width of 1.5° . The temporal resolution of each pointing direction was 30 s. We found that water vapor mixing ratio within the surface boundary layer varied in a range of 13.5 - 16.5 g/kg. It is suggested that the spatial variations are highly sensitive under the different topography. This system can also apply to the study of the cloud microstructures as well as understanding the spatial variations of atmospheric boundary layer height.

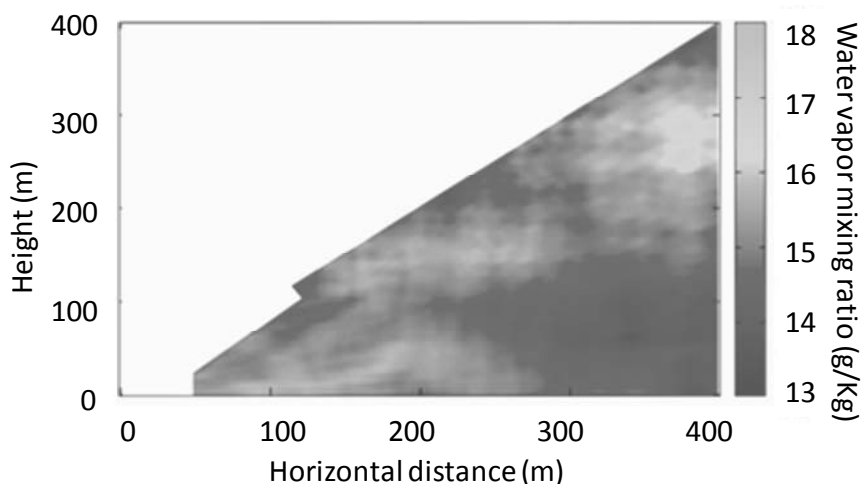


Figure 1. Distribution of water vapor mixing ratio in a vertical plane over Shigaraki at 22:17 JST on August 28, 2012.