Development and Observation of Water Vapor Raman Lidars for Localized Torrential Rainfall Prediction

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In recent years, the way of rain has been localized and concentrated, and disasters caused by localized torrential rain are increasing accordingly. One of the causes of these rains is thought to be the continuous supply of water vapor rich air through the lower atmosphere to the area where the rainfall is occurring. Therefore, it is very important to continuously observe the vertical distribution of water vaper in the lower atmosphere on the windward side to predict the localized torrential rainfalls. Water vapor Raman lidars are developed and observations are carried out in the Tokyo metropolitan area during summer time in 2017 and 2018. The lidars are carefully designed to potentiate the measurement of the water vapor near the ground as well as to have the capability on the daytime measurement. One of the lidars has the mobility so that we could make measurement at three observational sites in the seashore of the Tokyo metropolitan area that are located on the windward side of prospective area of the heavy rain in the Tokyo metropolitan area. Feasibility study of the impact of the water vapor mixing ratio profiles taken by the lidars on the numerical experiment for the precipitation prediction was carried out. We conducted water vapor assimilation experiment with use of the water vapor mixing ratio measured with the lidars. The assimilation results indicate that water vapor distribution in the analysis field was greatly changed by water vapor assimilation in the downwind side of the lidar observation site. Furthermore, a new research project has been just started to improve quantitative precipitation forecast for heavy rains in Kyushu island of Japan by means of data assimilation of water vapor lidars.

Keywords: water vapor, lidar, heavy rain, data assimilation , weather prediction