

Development and Adjustment of Water Vapor Lidar (DIAL) and Field Observations in Nagasaki

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We have been developing a compact diode-laser-based differential absorption lidar (DIAL) to observe the vertical profiles of water vapor up to altitudes of 3-4 km throughout the day and night. This objective is to improve the forecast skill of localized torrential rainfall associated with stationary linear mesoscale convective systems (SLMCSs), which are called "Senjo-Kousuitai" in Japan.

We have focused on improving the transmittance of the receiving spectrometer, increasing and stabilizing the transmitted laser power, and improving the adjustment processes of the DIAL. In order to adjust and evaluate the DIAL, experimental observations were conducted from May to July 2025 at the Meteorological Research Institute (MRI) in Tsukuba. The vertical profiles of water vapor concentration observed with the DIAL corresponded closely with the radiosonde observations at Tatenos, and the JMA Meso-scale Analysis values over the MRI also matched the DIAL observations.

After the experimental observations, a field observation campaign was conducted in Nagasaki from July 21 to October 27, 2025. Nagasaki is an optimal location for the observation of the vertical profiles of water vapor inflowing from the East China Sea, which has the potential to trigger SLMCS. For approximately three months during the summer, the DIAL operated almost stably. Multiple SLMCSs occurred in Kyushu from August to September 2025. Although there were some adjustment issues of the DIAL, the vertical profiles of water vapor during that period were observed. We will present the details of the observation results in Nagasaki and recent functional improvements to the DIAL.

Keywords: Water vapor lidar, DIAL, Stationary linear mesoscale convective systems