RECENT RESEARCH ACTIVITIES

Forecast of Localized Heavy Rain by Combining Coherent Doppler LIDAR and Numerical Model

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Recent study, the impact of coherent Doppler LIDAR (CDL) radial velocity on the forecast of localized heavy rain was examined. For simulating localized heavy rain case, which occurred in Tokyo on 24 Jul. 2015, I used the four-dimensional vibrational data assimilation (4D-VAR) and three-dimensional vibrational (3D-VAR) system for use with a high-resolution numeral model, Weather Research and Forecasting Model - Advanced Research (WRF-ARW).

This is because clouds which occurs rain are generated by updraft with convective instability, and the exact location of convection initiation is essentially determined by the location of updrafts. So, I observed wind condition in detail at boundary layer by using CDL, and get convergence. Assimilating the wind velocity of the boundary layer to WRF helps to improve precision of localized heavy rain forecasts. I had observed the radial wind velocity of the boundary layer at Nihombashi, Tokyo from May 2015 to May 2016 by using CDL whose observation range was from 100m to 4km and resolution was 100m. First, I examined the impact of 3D-VAR, and had an impact on lower wind condition near the place of CDL. However, WRF-ARW was not able to strengthen convergence. 3D-VAR examination realized the shortage of observation range.

Second, I examined the impact of 4D-VAR by which 5 data of radial wind velocity every 6 minutes assimilated to WRF-ARW, and strengthened a convergence line, approximately 30km long, on the boundary layer around the spot of CDL. However, the convection was not able to rain on the WRF-ARW because of observation range. In the sensitivity experiment to assimilate artificial wind, precipitation was calculated when assimilating strong lower wind convergence. Therefore, to predict localized heavy rain in advance, it is one of the effective way to assimilate the observation data of lower wind.

In the future, we complete our developing coherent Doppler Lidar and will examine the impact of assimilating observational data of multiple CDLs with expanded observation range into WRF-ARW and further discuss the assimilation method by 4D-VAR to LES (Large Eddy Simulation).

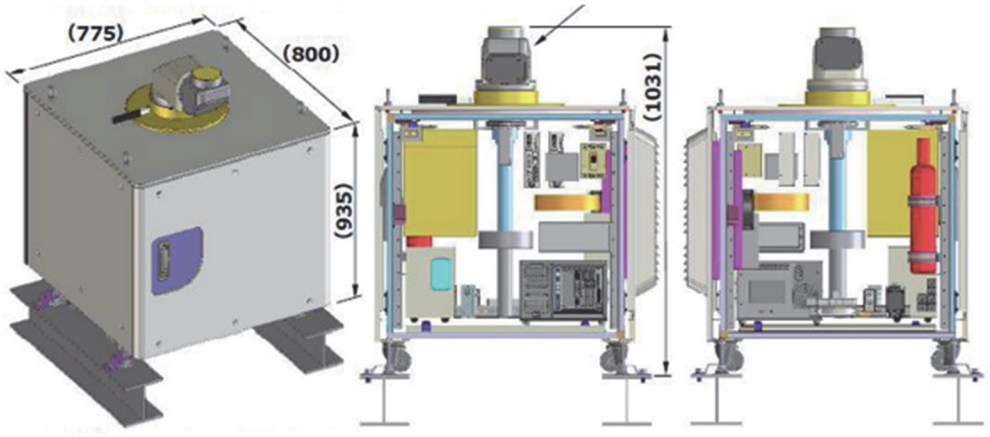

Fig. 1. Coherent Doppler Lidar under development in our laboratory