Continuous observations of temperature profiles by the 443 MHz wind profiling radar with RASS in Okinawa

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This study is devoted to the continuous monitoring of virtual temperature profiles by the 443 MHz wind profiling radar (443 MHz-WPR) with Radio Acoustic Sounding System (RASS) (443 MHz-WPR/RASS) at the Ogimi Wind profiler Facility of National Institute of Information and Communications Technology (NICT), Okinawa, where the severe weather phenomena with a short lifetime frequently strike. We have been collaborating with NICT on application of the RASS technique to the 443 MHz-WPR since 2006. The previous study designed a horn speaker system for RASS, and conducted a preliminary observation in November 2006, which successfully demonstrated capability of the 443 MHz-WPR with RASS (hereafter, called as 443 MHz-WPR/RASS) in obtaining temperature profiles with the temporal and height resolutions of four minutes and 300 m, respectively.

In the previous study, the 443 MHz-WPR/RASS observation was carried out only for a short period, only when someone attended and monitored manually the RASS observation at the Ogimi observatory. However, it is very important to continuously operate the RASS observation to monitor sporadic severe weather phenomena with a short lifetime which is often occurred in Okinawa subtropical region. In this study, we developed a remote control and monitoring system for 443 MHz-WPR/RASS observation to achieve the unpeopled continuous observation. The real-time processing system is also made to download the power spectral data and derive virtual temperature profiles within a latency of 2.5 hours.

A test observation started on May 23, 2007, and the continuous observation with the new system is operated at 0700-2000LT since February 4, 2008. The virtual temperature profiles agree very well with data from radiosonde launched at the Okinawa meteorological station of Japan Meteorological Agency (JMA). Considerable improvement of accuracy by a numerical weather prediction model of JMA is expected by assimilating the RASS results on a real-time basis.

Application of Frequency domain Interferometric Imaging (FII) technique to RASS (RASS-FII) was also studied to improve the vertical resolution of RASS observation. In the FII analysis for RASS echo, a model temperature profile is required to compensate for the Doppler shift bias due to the shape of range gate weighting. In order to remove this bias, an iteration algorithm was developed so that the temperature profile of the previous FII result can be used for the bias correction of the next FII step. The optimum parameters to minimize the vertical resolution are derived via the simulation study of RASS-FII. The simulation results predicts the vertical resolution of the MU radar/RASS-FII can be improved with the increase in the frequency swept ratio of an FM chirped acoustic wave. We carry out MU radar/RASS-FII observation on November 11-14, 2008 and verified the improvement of vertical resolution with the optimized observation parameters. Then, optimum observation parameters for RASS-FII with 443 MHz-WPR/RASS were proposed to improve the vertical resolution to 36 m.