

Development of the broad band radar using pulse compression technique

Tomoo Ushio[1]; Tsuyoshi Yamamoto[2]; Tomoaki Mega[3]; Takeshi Morimoto[1]; Zen Kawasaki[4]

[1] Osaka Univ.; [2] Eng., Osaka Univ.; [3] Dept. Aerospace Eng., Osaka Pref. Univ.; [4] Dept. of EEI. Eng. Osaka Univ.

Rainfall observations using weather radar have a great advantage that it is possible to observe precipitation widely in a short time. However, the rain rate obtained by the weather radar does not necessarily correspond to that observed by the ground-based observation like rain gauge. One of the causes of this disagreement is the non-uniformity distribution of rain drops in a rain scattering volume. The another cause is that the most radar cannot obtain the rain echo in low altitude, because the radar beam overshoots a few km in height due to the earth's curvature or in vertical pointing mode it turns off the receiver during transmitting the pulse. Therefore, in order to know how the reflectivity profile changes near ground and to estimate the cause of the reflectivity measurement error precisely, the radar capable of observing the reflectivity from near ground with high resolution and high precision is needed. In addition, the interest in the fine structure of bright band which is important for the algorithm of space born microwave radiometer motivated us to develop the high resolution radar.

In this study, we have developed the Broad Band Radar(BBR), and an initial experiment was conducted in Osaka, Japan for the purpose of studying the small scale variability in low altitude. The BBR use the low power (100 mW) 80 MHz broad band signal for transmitting with arbitrary modulation and digital pulse compression technique for the detection of the targets. The radar system can observe the back scattered signal from rain volume with high resolution from the near ground. The range resolution was on the order of 4 meter with 1 second temporal resolution. A calibration has successfully been done within 1.7 dBz using the DSD measured by the JWD disdrometer, and the correlation coefficient between the Ze observed at 40 m above ground and calculated from the DSD shows 0.98.

Two case studies were presented here, demonstrating the BBR performances. In the first case, a fine scale measurement by the BBR was shown in contrast the conventional radar system for a convective type event, and the enhancement feature in reflectivity near ground was verified. In the second case, stratiform type rain event was analyzed. The rain streaks were clearly observed by the BBR system, and a classical estimation of rain fall velocity using the slope of the rain streak shows a good agreement with a doppler spectrum estimation. Double peak bright band feature was observed and analyzed.

In these case studies, the radar was operated in the vertically pointing mode, but the system has the rotating capability and is capable of 3 dimensional observation. The inhomogeneity observation in rain will be an important research topic using this radar.