

Precipitation attenuation retrieval method with Phased Array Radar network

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Remote sensing technology is effective in precipitation observation, including severe phenomena such as heavy rain and tornadoes. Most of conventional weather radars have parabolic antennas, which radiate electromagnetic wave with beam width of around 1 degree. In elevation and azimuth directions, the scanning mode of the radar is mechanical. It takes about 1~5 minutes to observe at low altitude and 5~10 minutes for three-dimensional observation. Besides conventional radars have range resolution of 500 meters. However, severe phenomena regionally occur during several minutes at low altitude, so it is not sufficient for conventional radars to detect these phenomena. Additionally in the most observable area, conventional radar can not detect anything in the lowest altitudes due to earth's curvature. On the other hand, X-band Phased Array Radar(PAR), located at Suita campus of Osaka University and Nishi Ward, Kobe city, can observe severe phenomena because of it's high resolution and scanning mode. PAR has range resolution of 100 meters and temporal resolution of 30 seconds. Additionally PAR scans electronically at elevation direction and mechanically at the azimuth direction. The coverage is not affected by earth's curvature so much. These advantages enable PAR to observe within a range of 60 km in 30 seconds. However, X-band wave can be attenuated more seriously than waves at lower frequency bands. Precipitation attenuation is a critical and inherent problem for most precipitation radars since it often yields a large negative bias error which makes us underestimate reflectivity factor of precipitation. A radar network observation is a strategy to deal with this problem. The reason is that when one radar can not observe precipitation because of large precipitation attenuation, the other can complementarily observe it. There is also another problem. Hitchfeld-Bordan(HB) method, a precipitation attenuation retrieval method, is one of attenuation retrieval method which is occasionally used in low frequency band radars such as S-,C-band because attenuation is very slight. However, if we apply HB method to X-band radar, divergence of correction value happens at times. In this study, a new integration method to correct the reflectivity factor of two PARs is proposed and has been used in the overlapped area at the radar network.

Keywords: phased array radar, precipitation attenuation, precipitation attenuation retrieval, radar network