Developing Method to monitor Strong Wind Associated with Downburst and Gust-front Using Doppler Radar for Railways Operation

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For monitoring strong wind occur along railway lines, anemometers are installed at several or several tens km interval on average for Japanese railways. But there is potential risk to overlook that a train is exposed strong wind associated with downburst or gust-front, because these horizontal scales are only a few km or less, sometimes smaller than an interval of anemometers. So we're studying to develop a method of monitoring strong wind associated with downburst and gust-front for railways operation, by using Doppler weather radars to complement monitoring by anemometers.

We developed the method to detect radial divergence or convergence signature in radar data, in reference to previous research(Merrit, 1989, Hermes et al., 1993). Using observation data of AMeDAS anemometers located within 45km from X-band dual-polarization Doppler weather radars, we picked up 76 cases that strong wind exceeding 18m/s observed with a sharp rise in wind speed and a drop in temperature as target of this study. In most of these cases, radar echo with radial wind shear was observed above the anemometer when wind speed increased. We adjusted threshold of detection of wind shear in reference to these cases.

We're observing wind speed and direction using 5 anemometers installed linearly at several km interval at Fukuoka prefecture. At 17:00UTC on 9 July 2017, the gust-front passed along the arrangement of anemometers, strong wind exceeding 20m/s with a sharp rise in wind speed was observed. We detected radar echo with convergence signature passing above anemometers using our developed method. And we confirmed that our developed method can alert the sign of strong wind 5min before the strong wind reaches railway lines, which is enough time to stop a train.