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Three-dimensional analysis of the initial stage of convective precipitation using an operational X-band polarimetric radar network

Abstract

Localized heavy rainfall is increasing in annual frequency due to climate change and is a cause of catastrophic disasters. Therefore, understanding and forecasting the initial stages of a localized convective storms is important but also challenging due to the difficulty of observing the rapidly developing convective system. To overcome this problem, this study developed a new method to construct 3D-CAPPI data – which is high-spatial-temporal resolution data (30 seconds and 0.1 degrees) – from two dual-polarized X-band radars with different scanning angles in the same time period. To construct the 3D-CAPPI composite map, this study applied the normalized cross-correlation (NCC) method combined with linear interpolation to reduce errors due to signal attenuation and obscuration by terrain. The 3D-CAPPI composite map describes the temporal changes and vertical structure of rapidly growing convective cells, clearly showing the formation process and providing quantitative information such as: cloud top height (ETmax), maximum response (Zmax), lifetime and updraft velocity of each cell. This study focused on the early stages of a convective rainfall system. Although it is beyond the scope of this study to investigate the entire evolution of the system, the team observed back–side-building during both the development and maturation stages of the system. New cells are continuously generated at the back and develop into stronger rainfall through this mechanism – which is different from the traditional back-building model. A detailed analysis of the maturation stage in this case will be a potential future research direction. In addition, it is important to study how cells form within a storm.

Keywords

3D-CAPPI, Advection vector

Reference

Kim, Y., Maki, M., Lee, D.-I., Jeong, J.-H., & You, C.-H. (2019). Three - dimensional analysis of the initial stage of convective precipitation using an operational X-band polarimetric radar network. *Atmospheric Research*, 225, 45–57.