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# Ka バンドおよび X バンドレーダによって観測された積乱雲の発達過程に関する数値実験
# Numerical Simulation on Development Process of a Cb in the Early Developing Stage observed by Ka-band and X-band radars

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Millimeter-wavelength radar is a useful tool for observing the initiation and early developing stage (DS) of cumulonimbi because it has higher sensitivity and higher spatial resolution than those of conventional weather radars (S-, C-, and X-band radars; centimeter-wavelength radars). The National Research Institute for Earth Science and Disaster Prevention (NIED) of Japan has a Ka-band Doppler radar (KaDR) with mobile capability (Iwanami et al., 2001) and performed intensive observation of cumulonimbi with the KaDR and an X-band polarimetric Doppler radar (MP-X) in the western Kanto region, Japan during the summer of 2011-2013. Sakurai et al. (2012) successfully observed a cloud from initiation to the DS using the KaDR and from the DS to the dissipation stage using the MP-X on 18 August 2011, and revealed that the echo top height which developed stepwise corresponded to the height of three stable layers in the atmosphere. It is considered that the following convective activity broke through the stable layers in the DS, and echo top height finally reached 12 km ASL.

To clarify the development mechanism of the cumulonimbi, we performed numerical simulations using a CReSS, which is a 3D non- hydrostatic model developed by the Hydrospheric Atmospheric Research Center (HyARC) of Nagoya University, Japan (Tsuboki and Sakakibara, 2002). We used sounding data at Tateno at 09 JST (JST = UTC + 9 hr) on 18 August 2011 for the initial and lateral boundary conditions. we ran an experiment that positive perturbation (about 2 K) was added intermittently with an interval of 15 minutes as a buoyancy forcing at a height of 500 m around initiation region of the convection observed by the KaDR. The numerical simulation successfully reproduced the stepwise development of the cumulonimbus. In the beginning of the DS, convection was shallow for about an hour and the convection developed gradually. The development of the convection was suppressed around stable layers. The latter convection developed deeper than the former one, which was also consistent with observational result. From the investigation on temporal variation of RH profiles in the numerical simulation, preceding convection could not break through the low-level stable layers, however it moistened the lower troposphere. It is considered that the following convection could break through the stable layers because it could possess positive buoyancy enough to break through the stable layers due to low entrainment rate in the moistened lower troposphere.

キーワード: 積乱雲, 数値実験, Ka バンドレーダー
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