Vertical structure and diurnal variation of atmospheric environments for convective cloud development around the Central mountains in Japan during warm seasons

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Convective clouds often develop in the afternoon on fair-weather summer days around the Central mountains in Japan. Vertical structure and diurnal variation of the dynamic and thermodynamic environments of the convective clouds have not been well understood because of scarce observation data. In this study, vertical structure and diurnal variation of the environments for both active and non-active convection cases were statistically investigated using the data from a ground-based microwave radiometer (MWR), surface weather observation system, a wind profiler, and radiosonde during July and August from 2012 to 2014.
Firstly, typical cases were extracted and classified into active and non-active convection cases. From the results of surface and wind profiler observations, no significant difference between active and non-active cases was found in vertical structure and diurnal variation of thermally-induced local circulations in term of ability to trigger the convective clouds. Vertical profiles of atmospheric temperature and water vapor were retrieved by a one-dimensional variational (1DVAR) technique combining the MWR observation data and the results of JMA Non-Hydrostatic Model (NHM) simulations. It was confirmed that these profiles were more reliable than NHM-simulated profiles by comparison with radiosonde data, surface weather data, and cloud base temperature obtained from an infrared radiometer. Statistical analysis based on the 1DVAR-derived thermodynamic profiles revealed that the LCL increased and the LFC decreased during daytime for both active and non-active cases. In addition, stability indices had similar diurnal characteristics for both active and non-active cases, although they showed that atmospheric stratification was more unstable for active cases than for non-active cases. It's found that the traditional method based on radiosonde observations at 09 JST (00 UTC) is of benefit for the diagnosis of the afternoon convective activity around the Central mountains in Japan, even if considering the effect of diurnal variations of the dynamic and thermodynamic environments.

Keywords: convective cloud, diurnal variation, ground-based microwave radiometer

