A19

Size Distributions of Precipitation Systems during the Jakarta Flood Event in 2007 Simulated by JMA-NHM

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1. Introduction

In the tropics, convective systems are dominant in precipitation. In the numerical models, reproducibility of cumulus convections depends on model resolution, cumulus parameterization, and so on. The scale of convective systems is one of the parameters to measure the reproducibility. However, the size distributions of convective systems in the models are not well documented in the literature. The purpose of this study is to understand differences of the size distributions of convective systems among numerical simulations with difference horizontal resolutions and cumulus parameterizations.

2. Model setup and analysis method

The time-lagged ensemble downscaling experiment on the Jakarta Flood event in 2007 was performed with Japan Meteorological Agency Nonhydrostatic model with horizontal resolutions of 2, 4, 5, and 20 km (Trilaksono et al., 2011, 2012). Only the 5- and 20-km runs use the Kain-Fritsch cumulus parameterization. The 20-km run covers the two months from 1 January to 1 March, and other runs cover the five days from 31 January to 4 February. The computational domain for the 2-km run is used for the analysis. Consecutive areas that exceed thresholds of black body temperature or surface rain rate are detected as the systems.

3. Results

Figure 1 shows the size distributions of cloud shield, in which the models generally agree with the MTSAT IR observations. The distributions in Fig. 1 show a power low with kinks for lower clouds and lower rain rates, and lognormal distributions for higher clouds and higher rain rates for all the experiments. The lognormal distribution is consistent with previous works. Differences between the resolutions are larger at the both ends of the distributions. The 4-km run shows higher frequencies around 10^3 km^2, whereas the 20-km run shows higher frequencies at the right ends of the distributions. The size distributions for the 20-km experiment are modulated during the simulated two months (not shown).

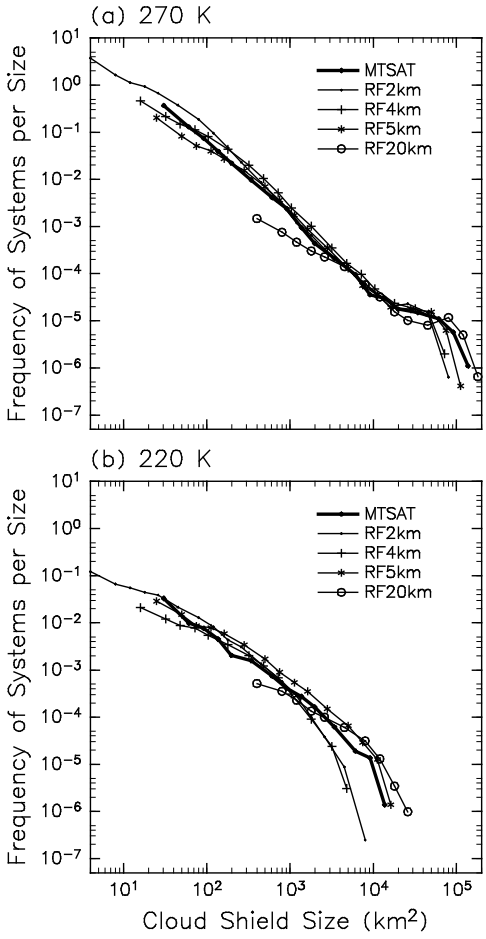

Figure 1. Frequency distributions of cloud shield size with threshold values of (a) 270 K and (b) 220 K.