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Multi-dimensional bin-microphysics model coupled with JMANHM

HASHIMOTO, Akihiro[1*]

[1]Meteorological Research Institute, Japan Meteorological Agency

The progresses of computer technology enable us to perform a simulation of cloud system using more and more sophisticated numerical model. A high-end model gets to have more diversity of the physicochemical properties of aerosols and hydrometeors, and of the interaction processes between them. Development of a bin-microphysics model started in 1970's and application to the studies on aerosol, cloud, and precipitation increased for decades. Today, this type of model comes to represent the spectra of shape and density as well as mass of hydrometeors. (Chen and Lamb, 1994, Misumi et al. 2010, Hashino and Tripoli, 2011). Multi-dimensional bin-microphysics model (Misumi et al. 2010) has been implemented into Japan Meteorological Agency Non-Hydrostatic Model (JMA-NHM) in order to simulate the microphysical processes of cloud system in detail. Program optimization for the K computer has been done. Overview of the model and the optimization will be presented.

The multi-dimensional bin-microphysics model has been developed by a domestic community of microphysics researchers in order to simulate cloud microphysical processes in detail. The model has three and five independent variables for representing physicochemical properties of liquid and solid hydrometeors, respectively. Each variable is discretized into a finite number of bins. All the discretized variables form multi-dimensional bin spaces. The properties of droplets are expressed as the spectra of mass values of pure water and two types of aerosol in the bin space. For solid hydrometeors, aspect ratio and volume are also considered as constituent parameters of bin space.

Program optimization has been done in terms of the process parallelization in the bin space in order to reduce the memory requirements for a process, since the single node memory is 16 GB in the K computer and the total memory requirement of the model easily exceeds the limit. In addition, the program has been modified for loop blocking and dimension reduction of work array to improve memory utilization. Performance investigation is going on for large-scale parallel computation with the model.

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References

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