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A global cloud-resolving simulation on an aqua planet

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Current atmospheric general circulation models (AGCMs) are required to employ a cumulus parameterization. However, the cumulus parameterization is one of the most uncertain components of current climate modeling. In order to avoid this ambiguity, our group has been developing a next generation global circulation model, with an intension to study climate by explicitly resolving clouds on the global domain. For this purpose, we have developed a new nonhydrostatic scheme that guarantees the conservation of total mass and energy, and choose an icosahedral grid system to obtain high computer performance on massively parallel computers such as the Earth Simulator. The new model is called Nonhydrostatic ICosahedral Atmospheric Model (NICAM). At present, first version of the model is almost completed, and the model is evaluated by several test cases. Our approach can treat explicitly the multi-scale and multi-physical interactions.

We have performed global cloud-resolving simulations with super-high resolutions on an aqua planet setup using NICAM. We studied the resolution dependency of the results and found that the simulations with grid intervals of 7 km and 3.5 km well capture many realistic features in the tropics; hierarchical structure of clouds, intraseasonal oscillation including the Madden-Julian Oscillation (MJO) -like signal, and diurnal cycle of precipitation. These successful results suggest that the global cloud-resolving simulation becomes one of promising approaches in the climate research field in the near future.