4.161 Development of global high-resolution climate model and its application to the chemistry-climate study.

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Abstract:

We introduce the current status of the development of Non-hydrostatic Icosahedral Atmospheric Model (NICAM, Satoh et al., 2014) and a series of chemistry-climate simulations using NICAM. The uncertainty of convection and cloud process is a critical issue not only for the climate studies but also for the air quality studies. Vertical transport by the convective motion is essential for the long-range transport of aerosols and trace gases. Rain-out and wash-out processes are also critical but have large uncertainty in the global chemistry-climate models. One of the effective ways to reduce these uncertainties is a high-resolution simulation. The NICAM simulations with 14km-3.5km horizontal mesh, without using convection parameterization have shown good results, especially in the tropical weather predictions. Recently, aerosol simulations using NICAM revealed the importance of horizontal resolution and the simulation without parameterizations for the coarse grid spacing. Sato et al. (2016) showed strong resolution dependency of polar-ward transport of black carbon. Three-years simulation with 14km horizontal mesh showed a fairly good agreement with the observation at ground stations (Goto et al., 2017). For the aerosol effects on cloud water, the NICAM simulated observed results well, which is contrary to the result of traditional global climate models (Sato et al., 2018). The development efforts in computational aspects play an important role in the global high-resolution simulations. The high-resolution simulations require a huge amount of computational resources and the effective use of state-of-the-art supercomputers is

necessary. The code optimization and refactoring improved computational performance and scalability of NICAM (Yashiro et al., 2017). NICAM has been selected as one of proxy application for the evaluation of Japanese next flagship supercomputer, post-K. We will show the recent efforts of NICAM and NICAM-Chem development toward expanding the capability of global cloud-resolving chemistry-climate model simulation.