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High-resolution climate simulations using the Non-hydrostatic Icosahedral Atmospheric Model, NICAM

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We introduce a series of climate simulations using the Non-hydrostatic Icosahedral Atmospheric Model, NICAM. For weather simulations for the integration period between a week and a month, NICAM can been run with a mesh size of 3.5 km, while for climate simulations for the integration period over multi-decades, a relatively coarser mesh size is chosen because of limitation of computational resources and sustained integration time. In Kodama et al. (2015, J. Meteor. Soc. Japan), we have performed the AMIP-type 30-year simulations with a mesh size of 14 km under the present and future boundary conditions. Although we switch off cumulus parameterization scheme in order to keep physics schemes consistently across resolutions between 3.5 and 14 km, the simulated climatology is fairly good, competitive with other climate models. The advantage of a fine-mesh global climate simulation is that atmospheric multi-scale phenomena ranging from large-scale circulation to meso-scale features associated with convection, front, severe rainfall, atmospheric gravity waves are represented in a seamless manner. For example, we discuss statistics of detailed structure of multi-scale convective systems and extremes such as tropical cyclones (TC); Yamada et al. (2017, J. Climate) analyzed the NICAM AMIP-type results and show that horizontal scale of intense TCs will increase in future warmer climate. Now, targeting the CMIP6 HighResMIP, we perform further longer time integration experiments for 65 years or more. The simulations are initialized on 1st January 1950. Because multiple choice of resolution is required, we use mesh sizes of 14, 28, and 56 km. The model used here has been updated and tuned in terms of cloud microphysics (Roh and Satoh, 2014, J. Atmos. Sci.), aerosol, and land model to improve performance of the simulated climatology. Cumulus parameterization is switched off for all the simulations, while orographic gravity wave parameterization is introduced. Of particular interest here is genesis, development, track, and structure of tropical cyclones, and we will show some preliminary results including impact of the horizontal resolution on tropical cyclone statistics.