Description of SAM

We used the System for Atmospheric Modeling (SAM) [Khairoutdinov and Randall, 2003], coupled with a two moment microphysical scheme that predicts mixing ratios and number concentrations of five hydrometeors: cloud droplet, ice, rain, snow, and graupel [Morrison et al. 2005; Morrison et al., 2009]. For details about cloud microphysical processes, please refer to the listed references.

SAM is a CRM with the dynamical framework of a large-eddy simulation (LES) model and the detailed model description is given in Khairoutdinov and Randall [2003]. Here some highlights are presented. SAM solves the equations of motion using the anelastic approximation. The finite difference representation of the model equations uses the Arakawa C staggering, with stretched vertical and uniform horizontal grids. The advection and diffusion of momentum are of second-order accuracy. Time integration of momentum equations is done using the third-order Adams-Bashforth scheme with variable time stepping to maintain linear stability. The subgrid-scale (SGS) fluxes have been parameterized with the options of a Smagorinsky-type closure and 1.5-order SGS closure based on prognostic SGS turbulent kinetic energy. Advection of all scalar prognostic variables is done using a monotonic and positive-definite advection scheme [Smolarkiewicz and Grabowski, 1990]. A damping layer is implemented in the upper third of the domain to reduce gravity wave reflection and buildup [Khairoutdinov and Randall, 2003].

Simulations were run on a 3-dimensional (3-D) computational domain comprised of 192 x 192 horizontal grid points and 77 vertical grid points with a horizontal resolution of 1 km, respectively. Stretched vertical coordinates were used with the resolution increasing from the bottom (100 m) to top (400 m). The model top was about 24 km. Periodic lateral boundary conditions were used. The dynamic time step was 6 s. The long-wave and shortwave radiation schemes from the National Center for Atmospheric Research (NCAR) Community Atmospheric Model (CAM3.0; Kiehl et al. [1998]) were called every 5 min during the simulation.

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