Information about CCCma SCM4

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Model Name and History

Long Name :
Canadian Centre for Modelling and Analysis Single Column Model Version 4
Acronym:
CCCma SCM4
Short/conversational name :
SCM4
Generic predecessor :
Canadian Centre for Modelling and Analysis Single Column Model Version 3, CCCma SCM3
Model Type : 1D

Numerical Domain :

SCM4 uses 35 eta levels in the vertical which have layer thicknesses that increase from 100 m at the surface to approximately 3 km near the model top (approximately 1 hPa) (von Salzen et al., 2005). The timestep used in the model is 1200 seconds. For experiment 3 the number of vertical layers was increased to 50 and the timestep reduced to 200 sec. SCM4 was been developed from GCM4 which is a spectral model that uses T47 truncation of a spherical harmonic expansion.

Since SCM4 is derived from GCM4 detailed information about the dynamics and physical parameterizations can be found in von Salzen et al. (2005) and references therein. Below are very brief descriptions of the model to avoid repetition with the information provided in von Salzen et al. (2005).

Numerical Technique

Numerical Method : Spectral, , leapfrog time integration
Advection Scheme : Spectral transport algorithm of hybrid variables.
Dynamical equations :
Numerical diffusion :
Lateral boundary conditions : N/A
Upper boundary condition : Sponge layer
Translation velocity of the reference frame : N/A

Physical Parameterization

Surface flux parameterization : Land surface scheme, Canadian LAnd Surface Scheme (CLASS) (Verseghy et al., 1993).
Longwave radiation parameterization : Correlated-k distribution model (Li and Barker, 2005) coupled with the radiative transfer solver of Li (2002); Li and Barker (2002). The radiation is typically called once every hour but for these simulations the radiation is called every dynamical timestep. This was to increase the samples of radiative fluxes and heating rates available for time-averaging.
Shortwave radiation parameterization : Correlated-k distribution model (Li and Barker, 2005) coupled with the radiative transfer solver of Li et al. (2005). The radiation is typically called once every hour but for these simulations the radiation is called every dynamical timestep. This was to increase the samples of radiative fluxes and heating rates available for time-averaging.
Radiative fluxes above computational domain : Radiative fluxes above the computational domain are simulated using a single layer with constant properties (using information from upper-most computational layer).
Cloud/Convective parameterization : Stratiform cloud is modelled using an extended version of the microphysical scheme of Lohmann and Roeckner (1996) in combination with a statistical cloud scheme (Chaboureau and Bechtold, 2002). Deep convection is simulated using the parameterization of Zhang and McFarlane (1995) and shallow convection is simulated using the parameterization of von Salzen and McFarlane (2002). An interactive sulphur cycle is simulated in the model allowing effects of aerosols on stratiform clouds and radiation.
Turbulence scheme : Turbulent transfer of momentum, heat, moisture and prognostic tracer constituents are performed using diffusivities which are functions of vertical wind shear and local gradient Richardson number (von Salzen et al., 2005; McFarlane et al., 1992). A non-local mixing scheme is applied to simulate boundary layer mixing.

Remarks

Rather than use the provided aerosol information, climatological values, as computed in a previous GCM simulation, were used. To force the SCM to use the prescribed latent and sensible heat fluxes and surface temperature calculations made by the CLASS land surface scheme were ignored and the prescribed values were used.

For experiments 1 and 2 in period B we noticed that there are oscillations in the specific humidity and temperature below 700 hPa. Reducing the timestep reduces the magnitude of these oscillations. However, we submitted results that use the standard SCM timestep of 1200 seconds so that the results are consistent with how the physics are called in the GCM.

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