A Climate Study With the CWB Global Spectral Model

by

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Abstract

One would expect that improvements in numerical weather prediction will result from the integration of more "exact" models initialized with more "accurate" initial data. More accurate initial data can be obtained by better instrumentation, careful observations, data quality control and improved objective analysis and initialization. More exact models may be achieved by integrating a more correct set of equations, for dynamical as well as physical forcings (parameterization) formulations, and from the application of more accurate numerical methods to solve these equations.

When the integration of more "exact" models are used for the purpose of climate modeling, we need to test the individual decomposed modules of the model independently. This is to ensure that realistic climate produced by the model are not for the "wrong" reason. A good example of realistic flow for the wrong reason is given by McFarlane (1987) for the gravity wave drag parameterization. He discussed the realistic mid-latitude westerly flow produced by the low resolution model are due to the "error balance" of lacking enough poleward momentum trnasport and mesoscale mountain drag in the model. He then propose the gravity wave drag mechanisim in the high resolution model to cure the mid-latitude westerly bias. A good example of modules comparison is the Intercomparison of Radiation Codes for Climate Models (Fouquart et al. 1991).

Following the work of Held and Suares (1994), we perform a benchmark calculation for the dynamical core of the global model of Central Weather Bureau (CWB) in Taiwan. We studied the *no-mountain*, *no-physics* model climate with the CWB Global Spectral Model. The model is integrated with $T63$ and $L20$ resolution for 1200 days.

The statistics of the last 1000 days of the integration are evaluated. The model's temperature variables are forced to relax to a prescribed "radiative equilibrium temperature" in 40 days. The prescribed equilibrium temperature is a function of latitude and pressure, which is symmetric about the equator and has the maximum gradient in the mid-latitude lower atmosphere. The nonlinear evolution of the baroclinic waves are simulated. The simulated temperature variance $[T'^{*2}]$ is maximized around latitude 40 degree in the low level of the model atmosphere. The spectral response of $[U'^{*2}]$ between the latitude 30 degree and latitude 60 degree is mainly contained within the wave numbers 0 to 6. The results compare favorably with the model climate produced by the GFDL GCM and the NASA GCM. We will study the wave-mean flow interactions in the nonlinear baroclinic waves. In addition, the impact of the stratosphere to the model climate will be discussed.

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