Numerical Simulation of Regional climate models in a Subtropical Region of China

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Abstract

On the basis of using RegCM regional climate models and with the data of 10km horizontal resolution to perform numerical simulation in subtropical region of China for 20 years, the author makes a conclusion that: Compared with the global model, regional model provides a more detailed temperature and precipitation in the spatial distribution of information. There exists an apparent performance of the phenomenon of "Warm Nest "in the southern part of both Hunan and Jiangxi in the simulation process, reproducing the basic features of the climate of those regions.

Keywords: Regional Climate Models; Warm Nest; numerical simulation

1. Introduction

Regional climate model was put forward and developed in as early as the late 1980s by Giorgi and the others, it has a very wide range of applications in research on climate and climate changes. China is located in the monsoon region of East Asia, with the characteristics of a complex topography and land surface, often causing large deviations in the global model simulation of this region. Study shows that the deviation is mainly due to lack of resolution caused by global models, and regional climate model, yet can greatly reduce the bias. Regional climate model can not only better reproduce the climate of contemporary China, while, also make it show a greater difference of the terrain in which, gives the signal to future climate changes and global patterns due to more real force.

2. RegCM Model Description

Regional Climate Model version 4 (RegCM4) is developed from the first generation of regional climate model. The Abdus Salam International Center for Theoretic Physics which is run by Giorgi is in charge of its maintenance and development. RegCM series model is widely used in contemporary China.
regional climate modeling, vegetation change and climate effects of aerosol testing, and other forecasts of climate changes.

RegCM simulation system consists of four modules, including the terrain (Terrain), the initial / lateral boundary field (ICBC), the main program (Main) and post-treatment (Postproc) module. The entire technological process can be divided into pre-processing, simulation and post-processing. The pre-processing stage includes topographic parameters, parameters of the study area as well as the mode setting of the initial and boundary conditions for the setting. Terrain and ICBC are two parts in the pre-processing stage. Terrain and ICBC block the elevation, surface type, surface ocean temperature and global reanalysis data from the latitude and longitude grid on the level of the region into the high-resolution; the main module (Main) is the master control program in the model process; post-processing mode is to convert the output for the needs of the average type and data format after running.

3. RegCM simulation in a subtropical region of China

In the research of climate modeling, the regional climate model can be seen as the complement of global circulation model. Given under the condition of large-scale force, with its high resolution and dynamic, accurate, subtle characteristics of physical process, it is used in the research on the climate characteristics in a smaller range and how regional climate responses in the context of global climate change. The mean annual climate characteristics of the simulation can not only test patterns on simulation capabilities of the regional mean climate state, the simulation results of the diagnostic analysis can also reveal the formation mechanism of a particular climate, and sensibility of regional climate on physical processes of land surface.

The global reanalysis data NNRP1 is used in the initial field and lateral boundary value in this simulation. With the purpose to test RegCM’s simulate ability of regional climate characteristics in the region which is at the center longitude 112.5, the center latitude 25.5, step size 10km, and number of grid points for the 64x34's. RegCM parameters required to run can be read from the file, here the simulation parameters is in this table:

| Table 1 |
|---|
| **&dimparam** |
| iy = 34 (This is number of points in the N/S direction); | jx = 64 (This is number of points in the E/W direction); | kz = 18 (Number of vertical levels); | nsg = 1 (For subgridding, number of points to decompose); |
| **&geoparam** |
| iproj = 'LAMCON' (Domain cartographic) | ds = 10.0 (Grid point horizontal resolution in km); | clat = 27.5 Central latitude of model domain in degrees); | clon = 122.5 (Central longitude of model domain); |
| **&terrainparam** |
| domname = 'China' (Name of the domain); | ntypec = 5 (Resolution of the global terrain); | ntypec_s = 2 (Same as ntypec except for subgrid); |
### 4. Case Analysis

Usually during the simulation of mean climate characteristics, due to different research purposes, the lateral boundary conditions of regional climate model can have two sources, namely, reanalysis data and global circulation models of the simulation results. Reanalysis data contains a lot of new observation information, so in the given conditions of reasonable large-scale force, the results of regional climate simulation can explain the uneven surface of the impact on regional climate and the operating principle of the variety of physical processes that determine the development and evolution of regional climate. Driving the global circulation models and regional climate model experiments to test regional climate model can not only reproduce the ability of the average climate characteristics, but also to facilitate the two modes of simulation results compared to find the difference of two simulation capability at the regional scale, which provides some reference for the future short-term weather forecasts meanwhile. At present, the study have been carried out on the NNRP1 with points for 20 consecutive years, 6 hours a boundary value of the input and the output variables, including total precipitation, surface air temperature and the region in February and the ground surface temperature and maximum temperature, as shown in the following Figure Distribution:
Fig 1 total precipitation(mm/day)

Fig 2 ground temperature(degree)
By comparing the observed data in the region, the output of the simulated observations are consistent with the real, there exists an apparent performance of the phenomenon "Warm Nest" in the southern part of both Hunan and Jiangxi in the simulation process, reproducing the characteristics of climate of the period in those regions.

5. Conclusion

The present research area, is located in the subtropical region, rich in forest vegetation, the terrain is in the shape of "U", special feature of the terrain determines the climate change, which will have very
complicated impact on the forest vegetation in the region. Due to space restrictions, the present paper has no mention of the relationship between simulation results and vegetation distribution in the region, and neither regional climate on sensitivity to characteristics of land surface and physical processes. The simulation results should be analyzed further to expose the specific characteristics of China's eastern subtropical forest vegetation responding to climate change.

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