3rd International Conference on Earth System Modelling
Vol. , 3ICESM-88-1, 2012
3rd International Conference on Earth System Modelling

The Earth System Model FGOALS-s2: Coupling a DGVM with the climate system model

J. Wang (1), Q. Bao (1), N. Zeng (2), Y.M. Liu (1), G.X. Wu (1), and D.Y. Ji (3)

(1) Institute of Atmospheric Physics, Chinese Academy of Sciences, China (wangjun@lasg.iap.ac.cn), (2) Department of Atmospheric and Oceanic Science and Earth System Science Interdisciplinary Center, University of Maryland, College Park, Maryland, USA, (3) College of Global Change and Earth System Science, Beijing Normal University, Beijing 100875, China

The Earth System Model (ESM) is a fundamental tool to understand the climate change and the carbon cycle feedback. The development team of FGOALS aims to build up the ESM version of FGOALS-s2. This paper describes the coupling processes and relevant coupled results between the dynamic vegetation model (Vegetation-Global-Atmosphere-Soil version 2, in short 'VEGAS') and the climate system model (CSM) version of FGOALS-s2.

To quickly reach a state of equilibrium in the fully coupled integration, two spin-up methods have been adopted. Firstly, the offline VEGAS was forced with climatology of CSM version of FGOALS-s2 to reach the equilibrium state; after that, VEGAS was coupled with FGOALS-s2 to make the continue run. Totally, it took more than 700 years for ESM version of FGOALS-s2 to reach the state of equilibrium. The performances of equilibrium state with ESM version of FGOALS-s2 were comprehensively presented.

In climatology, the simulated global total gross primary production (GPP) is about 120 GtC/a and net primary production (NPP) is some 50 GtC/a. The entire terrestrial carbon pools have about 2000 GtC comprising 600 GtC in the vegetation and 1400 GtC in the soil. Spatially, the annual averaged GPP peaks in the tropics and decreases along with the latitude. Seasonal alteration of the NPP in the tropics excluding the desert regions exhibits a dipole mode across the equator due to migration of the monsoon rainy belt, while the seasonal alteration of the Leaf Area Index (LAI) is relatively unclear. In the Asian monsoon region, the seasonal cycle is obvious due to the changes of the temperature and precipitation from the boreal winter to the boreal summer. Yet, due to the low soil moisture, there are few simulated needleleaf trees in the northern mid-high latitude, and it induces to the weak the seasonal alteration in these regions. The further analysis suggested the bias of the needleleaf trees would lead to an unrealistic spatial distribution of the total terrestrial carbon pools.

In the interannual timescale, the sensitivity of the terrestrial ecosystem to the ENSO is robust. The correlation between the global total net ecosystem production (NEP) and Nino3.4 sea surface temperature anomaly (SSTA) can reach -0.6 to the maximum when the Nino3.4 SSTA precedes NEP for about 1-2 months. However, compared to the previous observational studies, the lag of NEP is a little shorter due to the weak capacity of the land model in storing the soil water.

Finally, the mechanisms of the shortcomings of the model have been proposed, and the possible solutions to these shortcomings have also been discussed.