

GAIM

Modeling The Regional Climatic Changes and Their Impacts on Water Resources and Ecosystems in Asian Region

A Proposal for GAIM Activities at The Regional Level

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1. Rationale

There has been an increase in the demand by the broader scientific community and policy makers for better projections of regional impacts of future greenhouse-gas-induced climatic changes. Clearly, this requires better projections of the regional climate of the regional climate and in greater detail than has been available thus far. For example, the changes of water resources in a region in response to the global warming depends largely on the regional climate changes. Because of the complexity and structure of terrestrial ecosystems, the studies on climate-terrestrial ecosystem interaction will have to be undertaken with a regional framework and higher spatial resolution.

However, the performance of present GCMs in reproducing regional climate has been rather poor, although they can simulate the main characteristics of general circulation reasonably well. There is significant regional diversity of climate in their response to the global forcing. Mesoscale features, such as topography, coastline, inland water bodies, vegetation characters and so on, are essential elements for proper modeling of the regional climate. The development of methodology to project the regional climate change has become one of the most interesting areas in the global change studies.

East Asia and Southeast Asia have to feed over 50 % of the world population. The impact of global change on the sustainable development of this region is crucial for a stabilized world. The unique monsoon driven ecosystem and natural landscapes make this region also very interesting in the study on the regional response to global warming.

2. Objectives

This proposed research project is aimed at making a better projection of regional climate change in response to the global warming and their impacts on the water resources and the coastal zone and the terrestrial ecosystems in the Asia monsoon region.

3. Main Research Themes

- (1) To develop a regional climate model for Asia monsoon region at higher resolution. Based on the existed climate version of meso-scale model, the model physics needs to be improved to represent the major characteristics of monsoon driven ecosystem and to take account of the major processes in the atmosphere-soil-vegetation interaction layer and the influence of strong ecological gradient.
- (2) To develop a data set for land cover over Asia in higher resolution based on satellite information as well as the ground observation, which will be used as the boundary condition for the regional climate model.
- (3) Testing the model capacity by simulating the surface climatology driven by observed global atmospheric information.
- (4) Development of nesting techniques to coupled the regional model with the GCMs.
- (5) There major simulations of nested regional climate model.
 - a) Validation of the model against present-day climate by comparing with the observed data as well as the GCM simulated present climate in the region;
 - b) Evaluation of the model ability to reproduce the past climate change over the region by comparing with the paleoclimate records in this region;
 - c) Simulating the regional climate changes under the climate forcing factors, such as the change of CO₂ concentration in the atmosphere etc.
- (6) As an alternative, the projection of the simulated large scale atmospheric circulation patterns from GCMs into the regional climate patterns by developing transfer functions which are based on

empirical studies of the relationship between large scale variables and local surface variables or the development of historical analogues for future climate based on historical and paleo-climate records.

(7) Simulation of impact of regional climate change on water resources in Asia monsoon region

The simulated regional climate would be used as the driving force for hydrological models for major river systems to project the changes of the components of water balance and to evaluate the water resource.

(8) Simulation of the response of major ecosystem, both natural ecosystem and agro-ecosystem, to the climate changes by using the simulated regional climate as the input for either static or dynamic vegetation models in replacing the coarser resolution GCM output.

(9) Simulation of the impact of regional climate change on the coastal ecosystem by developing the coastal zone system model.

4. Proposed Regional Activities

(1) A working group to evaluate the present status on modeling activities at regional level for Asia monsoon region.

(2) To develop a joint data set for land cover over the region with higher resolution to serve as the boundary condition of the regional climate model.

(3) To develop a data set of climate in Asian monsoon region based on the instrumental data and the paleo-records which need to go through the quality control and would serve for model validation.

(4) An International Workshop on Regional climate Change: Modeling and Observation.