Towards Further Development of Regional Climate Model (RCM) and Application for Asia (APN 99005)

Project Leader:

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APN Funding
US$ 100,000

List of participating countries
China, Denmark, India, Italy, Japan, N. Korea, S. Korea, Mongolia, U.S.A.

Introduction/Background
As pointed out in the latest IPCC report, "An important long-term goal is the accurate projection of regional climate change, so that potential impact can be adequately assessed." The key research challenge for the next decade is the regional-scale estimate, analysis and impact assessment of global change. The TEACOM/START-APN project "Regional Climate Model (RCM) Development and Application for Asia" directly addresses such a challenge to provide scientific base for policy makers to properly adopt the mitigation strategy of regional climatic change. The primary purposes of this project are to integrally analyse the characteristics of climatic and environmental change in Asia monsoon region, and to make better projection of climate change in Asia under regional anthropogenic forcing factors, based on developing a coupled climate /biosphere /hydrology /chemical /aerosol regional model for Asia.

The project has mainly three components:
- Development of a coupled climate /biosphere /hydrology /chemical /aerosol regional model for Asia;
- Application of this model to project RCM change in Asia in next 20-50 years;
- Capacity building of research network.

The project received three years of continuous support from APN and is implemented in conjunction with several national projects of the TEACOM region. The Chinese Academy of Sciences provides the major research funding for the project implementation in START TEA RC.

The progress of this project in the past three years has laid a solid foundation for the further development of this project.
- Developed a concept of "General Monsoon System" which serves as the theoretical framework of the project;
- Developed two major components of RCM: climate-vegetation coupling and climate-aerosol coupling, and a new version of RCM for Asia, i.e., the Regional Integrated Environmental Modeling System for Asia (RIEMS);
- Developed a database and data-information-computation system for RCM research;
- Established an international steering committee and a network for RCM research;
- Enhanced human resources capacity through START fellowships and an training course on the application of regional climate modeling for Asia held in November, 1998 in Beijing.

The objective of this project for the fiscal year 1999-2000 focuses on analysing the research results in the past years and developing a web-based platform. We will try to evaluate the statistical behaviors of RIEMS in their capacity of simulating regional climate and its response

to anthropogenic forcing factors, including CO2, sulphate aerosols and land use/cover change. We will also try to transfer these scenarios into policy-relevant information for policy makers to improve impact assessment and adopt mitigation strategy regarding regional climatic change.

Outline of activities conducted

According to our proposal to APN, we conducted a series of activities in the following aspects:

1) Researches:

In 1999, the following research activities have taken place:

- The START TEA RC has made a 10-year run of RIEMS for East Asia to evaluate the statistical performance of RCM regarding its capacity of simulating regional climate and climate variability of East Asia.
- The START TEA RC is making nest of RCM with GCM to examine the regional climate change under the forcing of both CO2 and sulphate aerosol.
- One case study for the Yellow River in China was conducted for policy relevant application of the RIEMS. By using RIEMS to simulate the moisture condition (precipitation, evaporation, surface run-off, etc.) at three sketches of Yellow River and comparing with the observed parameters of moisture, we concluded that the cut-off of Yellow River discharge is partly due to natural reasons, such as the decline of precipitation and the enhancement of evaporation.

2) Development of web-based platform and data, information and computation system for the RIEMS:

- The Web-based platform for RIEMS was developed at START TEA RC which consists of six major parts: a).Introduction and registration; b). Domain definition; c).Initial fields; d). Model run; e). Output; f). Display. The platform has been open for use since 1999. The website of the platform is: http://ultra2-3d.tea.ac.cn. Users can login in this platform through the Internet and use the available data to run the model for their own countries and regions. Up to now, about 30 scientists from at least 13 countries have used this platform including China (including Taiwan), Korea, Japan, Mongolia, Russia, Fiji, Malaysia, U.S.A., India, Thailand, Kenya, South Africa, Austria. The total amount of transferred data is over 300MB.
- With the support of START, APN and CAS, more capacious hard disk and related software were installed. The total storage capacity has increased to 282GB and the available capacity reached 232GB. One network laser printer, one data projector, one video presenter, two tape drivers and other facilities were also installed. These facilities set up a powerful computation environment to meet the requirements for the implementation of this project.
- Services for the operation of the platform were also provided, such as platform demos and training, online data transmission, delivery of datasets and RIEMS source code, preparation of RIEMS documentation, etc.

3) Fellowships

In the second half year of 1999, the START TEA RC hosted two scientists Dr. RYU Gi-Ryol and Mr. JANG Hyon Chol from D.P.R. Korea for one month and one scientist Mr. GOMBOLUUDEV Purevjav from Mongolia for three months. They came to learn and conduct cooperative research about regional climate modeling and the application of the RIEMS. Through a series of training classes, they felt they had a primary understanding of

regional climate modeling and were prepared to undertake further study in order to apply it to their own countries.

4) Workshop and training courses

- The TEACOM RCM SSC workshop for the TEACOM/START-APN RCM project was held at International Center for Theoretical Physics (ICTP), Trieste, Italy, under co-sponsorship of ICTP and APN. SSC members and several invited guests and observers attended the workshop. The progresses of RCM project were reviewed and the future activities were discussed, with a focus on a renewal proposal of the project on inter-comparison study of RCMs for Asia (RMIP for Asia). Seven RCM research groups focussing on this region would take part in this study.
- Under the joint support of APN and ICTP, four young scientists from China, Dr. Yun Qian, Dr. Ming Chen, Dr. Zhuguo Ma and Dr. Yu Liu, attended the training courses concurrently held in ICTP during June 5-27, 1999 for young scientists on regional climate change analysis and modeling.

Outcomes/Products

Fu, C.B. and G. Wen, 1999: Variation of ecosystems over East Asia in association with seasonal, interannual and decadal monsoon climate variability. *Climatic change, 43, 477-494.*

Fu, C.B., H.F. Diaz, D.F. Dong, and J.O. Fletcher, 1999: Changes in atmospheric circulation over northern hemisphere oceans associated with the rapid warming of the 1920s. *International Journal of Climatology, 19, 581-606.*

Giorgi, Filippo, Y. Huang, K. Nishizawa and C. Fu, 1999: A seasonal cycle simulation over eastern Asia and its sensitivity to radiative transfer and surface processes, *J.G.R. vol. 104, 6403-6424*

Wei, H.L, C.B. Fu and W.C. Wang, 1998: The effect of lateral boundary treatment of regional climate model on the East Asian summer monsoon rainfall simulation. *Chinese Journal of Atmospheric Sciences. Vol.22, No.3, 231-243*

Fu, C.B. and L. Xie, 1998: Global oceanic climate anomalies in 1980's. *Advances in Atmospheric Sciences. Vol.15, No.2, 167-178*

Fu, C.B. and D.Z. Ye, 1998: Towards predictive understanding of the environmental change in China on decadal to centennial scales. *Global Environmental Research, Vol.1, No.1&2, 83-93.*

Qian, Y. and F. Giorgi, 1999: Interactive coupling of regional climate and sulfate aerosol models over eastern Asia. *Journal of Geophysical Research, Vol.104, No.D6, 6477-6499.*

Wei, H.L. and C.B. Fu, 1998: Study of the sensitivity of a regional model in response to land cover change over northern China. *Hydrological Processes, 12, 2249-2265.*

Fu, C.B., H.L. Wei, M. Chen, B.K. Su, M. Zhao and W.Z. Zheng, 1998: Simulation of the evolution of summer monsoon rainbelts over Eastern China from regional climate model. *Scientia Atmospherica Sinica. Vol.22, No.4, 522-534.*

Qian, Y., H.Q. Wang, C.B. Fu and Z.F. Wang, 1998: The temporal and special distribution of the radiative effects of the antrhopogenic sulfate aerosols over East Asia. *Advances in Atmospheric Sciences. Vol.15, No.3.*

Fu, C.B., H.L. Wei, Y. Qian and M. Chen: Documentation on Regional Integrated Environmental Modeling System (RIEMS). Version 1, 1999.

Wang, L.Z., H.L. Wei: A User's Guide to on-line RIEMS. 1999.

Future directions/follow-up work

The future work of this project in 2000 is focused on Regional Climate Model

Inter-comparison to further improve the RCMs for Asia and to provide better projection of regional climate change in Asia and assessment of impact on Asia. We will try to combine the work of seven research groups working on the RCM application for Asia through examining their statistical behaviours in a 10-year continuous run; their capacity of reproducing extreme climate events, such as flush floods and persistent severe droughts; and their sensitivities to the parameterisation of physical processes, lateral boundary schemes, initial field and land cover characteristics.

The main activities in 2000 is to have an 18-month run of RCMs for the period from March 1997 to September 1998 during which a complete annual cycle and two extreme climate events occurred in East Asia, including a hot and drought summer in 1997 and a severe flood disaster in 1998. In 2001, we will have a 10-year run experiment from 1979 to 1998 to compare with the AMIP run for the same period.

The implementation of these activities partially depends on our proposed project for APN 2000-2001: Regional Climate Model Intercomparison for Asia.

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