

## **AIACC PROGRESS Report (july 2003)**

### **Assessing Global and Regional climate change scenarios for West Africa Project Number : AF20**

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#### **A/ SUMMARY**

The main goal of the AIACC AF20 project is to assess climate change scenarios from global and regional climate model simulations for use in impact studies in West Africa. The project seeks to develop and strengthen capacities in global and regional climate change scenario assessment. Since the computing facilities and infrastructures have been set up during the first year at Laboratory of Atmospheric Physics (LPA), Cheikh Anta Diop University of Senegal, GCM data have been collected from AF07 and NCAR (CCSM and CCM3). We have performed an assessment of the simulations of climate changed over West Africa using NCAR CCM3 and CCSM models. During this last period we have undertaken collaborative actions with Howard University, Penn State University and ICTP through the START/PACOM proposal. The proposal will address issues of climate variability, climate change and land-use change in West Africa. The goal is to produce a special journal volume of book with contribution from participants of a workshop hosted in Dakar (Senegal). We have also been involved in the process of West African Regional Dialogue on Water, climate and desertification. Stakeholders from the region (River basin organisations, NGOs, civil society representatives,...), climate change focal points, experts from ministries in charge of water management, Universities, regional development centres, have contributed.

#### **B/ STATUS OF TASKS PERFORMED**

- **B-1/ Travel activities**

1- Akintayo Adedoyin has attended the 8<sup>th</sup> annual community climate system model (CCSM) workshop held in June 24-26 2003 at Breckenridge, Colorado(USA). He found that our approach to the understanding African climate variability is also the focus of the international community. Climate effects of the middle atmosphere require model studies that extend from the surface to, at least, the tropopause.

2- Abdoulaye Sarr have attended the ICTP workshop on "The theory and use of Regional Climate Models" from 26 May to 06 June 2003 at Trieste (Italy). A travel support have been provided by AIACC Project AF20.

This was a very rich and exciting workshop due to the high level of expertise of invited speakers and the amount of work done on a short time period by the participants.

The first week was dedicated to presentations on the theory of regional climate modeling and presentation of the recent progress and results on various aspect of regional climate modeling in many areas of the world. A quick tutorial on the use of the new version of RegCM (RegCM3) from the setup to the post processing was also done during the last two days of first week.

Then participants were split on groups of three with the same region of interest to work on project group on an aspect interesting there region using simulations with RegCM3. The total number of groups was 17 with 5 focusing on Africa. The title of his work was "Impact of land use change on the climatology of West Africa using RegCM3".

As we know, land use change is an issue in West Africa where a long drought have affected the Sahel since late 1960's. So the aim was to try to use a dynamical model coupled with a land surface model (LSM) to investigate the impacts of land use change in the climatology of West Africa. A sensitivity test using three different configuration of land use was carried out. A control land use which is the native one generated by the LSM BATS, a modified land use which is the corrected one using the observed vegetation type from USGS over West Africa, and the third one which is a pessimistic scenario (desert covering 75% of the region and 25% savanna).

The simulations have shown that the circulation over west Africa is sensitive to the land use change and this has impact on the precipitation and temperature within the region.

He presented the results of the work available at ICTP web page in a plenary session on group presentations.

Interesting work have been done by all groups and the organizers. The representative of IPCC which supported the workshop, mentioned and insisted on the necessity to continue the work back home.

A regional climate network (RegCMNET) is created and work plan with a time frame for each region is put in place. The results should contribute to next IPCC fourth assessment report.

Another important action at a shorter time scale is the article summarizing the results of the workshop that will be submitted to the Bulletin of American Meteorological Society (BAMS).

3- Amadou Gaye (PI) have attended 2 workshops (April at Bamako, Mali and July at Niamey, Niger) on the West African Regional Dialogue "Water, climate change and desertification". Stakeholders from the region (River basin organisations, NGOs, civil society representatives,...), climate change focal points, experts from ministries in charge of water management, Universities, regional development centres, have contributed. AIACC have been considered by the Dialogue as an important contribution on the capacity building in the region. The Regional Strategy of Adaptation have been validated and the Dialogue have recommended the set-up of a Regional Network on "Water, climate change and variability and desertification". Inputs are expected from AIACC projects.

- **B-2/ Scientific production**

1- An analysis is done of observed and simulated circulation, mean sea level pressure, temperature and precipitation over West Africa. Inter-comparison of the National Center for Atmospheric Research (NCAR) Community Climate Model version 3 (CCM3) and the Coupled Climate System Model (CCSM) simulations as well as comparisons with observed climate are shown for the period 1981-2000. The models exhibit systematic cooling bias (1-4°C) over North West Africa in the last two decades of the 20th century. Broad regional warming is appreciable over North West Africa mostly in the range of 2 to 7°C for the period 2081-2100. CCM3 and CCSM capture qualitatively well the broad patterns of rainfall distribution in space with significant dry bias (2-8 mm/day) over regions with steep topography within the Inter Tropical Convergence Zone (ITCZ). The coupled model (CCSM) shows a better quantitative simulation of rainfall in the African branch of the ITCZ. The

improvements are more appreciable over mountainous regions probably because land-atmosphere interactions are better represented in the coupled model. The upper troposphere easterly winds are better simulated by CCM3. The continental branch of the mean troposphere winds (AEJ) represented in CCSM are closer to the observed climatology. The meridional temperature gradient between southern Atlantic ocean and land surface of West Africa related to the development of AEJ is probably better represented in the coupled model's land-atmosphere-ocean interactions schemes. Overall, some differences are noteworthy in the capabilities of CCM and CCSM, however the two models simulations are usually qualitatively similar. It is suggested that land-ocean-atmosphere interactions may have a critical contribution in modulating the intensity of climate events. Models deficiencies and impacts on the projected climate change signals for the 21<sup>st</sup> century have been also discussed.

2- With a presumed understanding of tropical Africa tropospheric dynamics, a mesoscale model of convective systems is being developed in University of Botswana in order to more realistically quantify the momentum, moisture and energy transfers into the upper troposphere and lower stratosphere during convective activities. The Uppsala University MIUU model will be adopted and adapted to the southern African region and results from numerical experiments are envisaged to improve the parameterization procedures in regional climate models. Adedoyin propose to invite a post-doctoral candidate, who is just finishing in Sweden, to join the team in the implementation of this programme. He has also two postgraduate students whose research thrust will be the mapping of vertical, horizontal and temporal distributions of aerosols over southern Africa . RegCM has aerosol components and then focusing experiments on Concentration gradient of aerosols, Lateral distribution of aerosols, and seasonal change of aerosols will enhance GCM simulations, which are geared towards improvement of parameterization of tropical events.

## **C/ DIFFICULTIES ENCOUNTERED AND LESSONS LEARNED**

### 1- GCM data availability

We still facing the lack of GCM outputs at daily, 12 and 6 hour intervals. Hopefully Gregory Jenkins should be with us in the coming months and could bring the necessary data from the NCAR Community Climate System Model (CCSM) at those timeframes. We will increase the storage capacity at LPA for efficient use of those data is important.

### 2- Meeting of team members

Before the next AIACC Regional workshop, we will organize a meeting of team members.

## **D/ TASKS TO BE PERFORMED IN NEXT 8-MONTH PERIOD**

- Interaction with other teams for collaboration and assistance
- Acquire observation data
- Complete GCM outputs for analysis of monthly, daily data
- RCM analysis
- Ongoing training students and new student enrollment;
- Preparation of end-year 2 progress report and financial reports

- Submission of end-year 2 end progress report and financial reports