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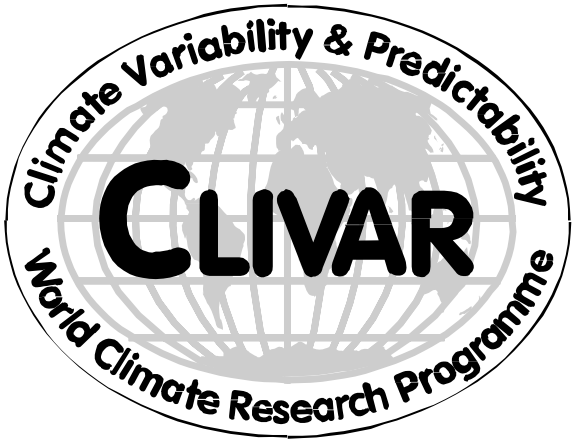

REPORT OF THE FIRST MEETING OF THE CLIVAR PANEL ON THE VARIABILITY OF THE AFRICAN CLIMATE SYSTEM (VACS)

NAIROBI 29-31 JANUARY 2001

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REPORT FOR FIRST VACS MEETING HELD IN NAIROBI 29-31 JANUARY 2001

Present at meeting:

VACS panel members:
A. Amani
K. Cook
I. Kgakatsi
T. Lebel
J. Lutjeharms
L. Ogallo (Co-chair)
J. Omotosho
G. Philander
C. Thorncroft (Co-chair)
N. Ward

Invited attendees:
M. Harrison (CLIPS)
D. Olago (PAGES/START)
F. Semazzi (ex-ICPO)

Introduction

The first meeting of the VACS panel was held at the Drought Monitoring Centre (DMC) in Nairobi between 29-31 January 2001. After initial welcome greetings from the host and co-chair Laban Ogallo, the meeting was officially opened by Dr. Mukabana, the PR of the Kenyan meteorological service. Dr Mukabana reminded the panel of the often very severe impacts of African climate variability on society and encouraged the panel to promote research which would help us improve our understanding of the climate variability and its impacts. The particpants of the meeting included VACS panel members, Mike Harrison from the WMO CLIPS office, Daniel Ogalo from PAGES, and local scientists from the DMC.

The meeting was arranged around 9 sessions. Most time was devoted to the four projects identified in the CLIVAR Africa Implementation Plan (IP): Annual Cycle, Interannual Variability, Intraseasonal Variability and Decadal Variability. Sessions were also included on current related activity taking place in other CLIVAR panels, Observational Issues, Users and Applications, Awareness and Funding Issues and Capacity Building. There were also presentations from Laban Ogallo on DMC activities and Daniel Ogalo on PAGES activities.

1 CLIVAR Issues

1.1 VACS Terms of Reference

C. Thorncroft briefly mentioned the events that lead to the establishment of the VACS panel, including the production of the Clivar Africa Report (1999) by the first working group and the Clivar Africa Implementation Plan (2000) by the Clivar Africa Task Team. The Terms of Reference for VACS were reviewed. The meeting was basically happy with the terms of reference except for a few points that need to be addressed.

(i) Nowhere in the TOR does it say what the main objective for VACS is.

Subsequent to the meeting it was agreed that there should be some additional words in the TOR which states the following: "To improve our understanding of the nature and causes of African Climate Variability and its linkages with the global climate."

ACTION: Thorncroft/ICPO

(ii) Consideration of TOR 2 lead to some discussion. TOR 2 relates to the requirements for limited-period and sustained observations in support of the CLIVAR Programme and the establishments of links with major climate observation programmes (e.g. GCOS, WWW, GOOS etc). The panel would like to have some clarification of how VACS can communicate with these programmes including contact points and procedures etc.

ACTION : C. Thorncroft

It was suggested that it would be beneficial to VACS if a co-chair attended GOOS meetings in order to promote VACS needs. This possibility will be investigated.

ACTION: Co-chairs

1.2 Action Items from the SSG

The action items proposed for the VACS Panel by the SSG at the meeting in Hawaii 2000 were presented and discussed. The actions and responses at this time are given here.

(i) **ACTION:** A first task will be the compilation (with the ICPO) of an inventory of data sources relevant to achieving CLIVAR's objectives with regard to Africa.

RESPONSE: Amos Makarau, unable to be present at the meeting, is responsible for compiling the data sources. Through interaction with the project leaders for P1-P4 the data inventory will be developed during the coming months. The CLIVAR Data Task Team has made contact with the panel and will be kept informed of progress.

(ii) **ACTION:** The panel should seek to identify a single topic of relevance throughout the continent (e.g. identifying the nature and causes of decadal climate variability).

RESPONSE: The VACS panel does not agree with the SSG in this matter. It sees no benefit at this time in identifying a single topic of relevance throughout the continent. Also, when we consider that Africa is a huge continent including many contrasting climates it makes little scientific sense to do so. Also, as discussed in the implementation plan, the panel considers the decadal variability project to have a lower priority than the other projects.

(iii) **ACTION:** The panel should explore with WGSIP the possibility of a joint case study of the Mozambique floods to determine if there might be predictability; similarly WGCM and VACS might investigate decadal variability in Sahel rainfall.

RESPONSE: The sub-project which is being promoted within the Interannual Variability project has been expanded to include consideration of the Mozambique floods. VACS has made preliminary contacts with WGSIP but active collaboration is not envisaged for at least another year when we have a better idea of the analysis of observations.

WGCM still needs to be contacted (see comments in P4 description below).

1.3 Links with other CLIVAR Panels

(i) VAMOS

In recent correspondence with R. Mechoso several topics were discussed which were presented at the meeting. On the topic of *stratocumulus*, he agreed that a comparative analysis of cloud properties and soundings in the coast of California, Peru/Chile and the south-east Atlantic should help to clarify many issues. VACS should also ensure links with VAMOS in the area of future projects on Atlantic tropical cyclones. VACS can also benefit from the experiences that VAMOS has gained in the area of capacity building. R. Mechoso has expressed a wish to attend the next VACS meeting which should encourage collaboration on issues such as these.

(ii) Asia-Australian Monsoon

B. Lau and S. Godfrey communicated the following: "the major planned activity in the AA monsoon panel in the next few years is coordinated field campaigns in the Bay of Bengal, the South China Sea and the western Pacific, together with an enhanced monsoon observation system, consisting among other things, of a series of moorings in the Indian Ocean (sub-surface current meters)." Many of the features and scientific issues of interest in the Indian Ocean are important for both the AA monsoon panel and VACS. It is clearly important that VACS should liase with the AA monsoon panel on many of these issues.

ACTION: co-chairs

(iii) Atlantic

VACS provided input to the Atlantic Panel meeting of 1-2 December 2000. The input consisted of the recommendations regarding Atlantic observations made in the Implementation Plan.

M. Visbeck has provided VACS with a response to this. He was pessimistic about the possibility of extending the PIRATA array towards Africa due to lack of funding. A request was made for VACS to provide the Atlantic panel with a list of ongoing efforts in African countries in the region.

ACTION: J. Lutjeharms

VACS has also been invited to make a presentation at the CLIVAR Tropical Atlantic workshop to be held in Paris 3-7 September. This could be a good venue for discussing Africa-Atlantic issues. C. Thorncroft hopes to attend this meeting.

ACTION: C. Thorncroft

2. Annual Cycle (P1)

Project Leader: Kerry Cook

The three aims of this project are:

(1) To analyse the annual cycle of the African climate and its relationship with the global climate.
(2) To evaluate the ability of dynamical models to simulate the various phases and dynamical aspects of the annual cycle of African climate and its relationship with the global climate.
(3) To identify and investigate the deficiencies in the dynamical models used to simulate the annual cycle of the African climate.

Initial efforts will be concerned with the first of these aims. As noted in the CLIVAR Africa Implementation Plan (June 2000), it is of fundamental importance to document and understand the annual cycle of climate over Africa, and to evaluate the degree to which climate models can capture this cycle. The annual cycle is relatively well observed, and this provides an opportunity to evaluate and improve models for variability studies and prediction.

I. Characterization of the Annual Cycle
The panel recognized a need for a coherent description of the annual cycle over Africa. A documentation of the climatological seasonal cycle of the continent and the surrounding oceans will serve two purposes that are central to the aims of VACS. First, it will serve as a target for model simulations, encouraging and improving the quality of comparisons between modeled and observed climatologies over Africa. Second, it will provide a base for studies that seek to improve our fundamental understanding of the annual cycle over Africa.
In accordance with the structure of modeling and, to some extent, observing systems currently in use, the characterization of the annual cycle will be approached on two spatial scales. The "global view" will emphasize the role of Africa and the two-way interactions with the global climate, and will characterize the annual cycle over the continent and surrounding oceans on large space scales. The "regional view" will emphasize climate processes on smaller scales and will include consideration of weather systems and local processes. Each of these projects is discussed below, including action items and time lines for accomplishing the characterization of Africa's annual cycle.

A. The Global View
The documentation of the large-scale, annual cycle over Africa will be accomplished by the creation of An Atlas of African Climate: The Annual Cycle. The creation of the Atlas will provide an opportunity to evaluate the relationship between the forcing of the annual cycle and its expression in the climate. In addition, the Atlas will provide a data set against which GCM climatologies can be tested, documenting the basic features of the African annual cycle.

Forcing of the Annual Cycle. Variations in insolation provide the fundamental forcing for the annual cycle, of course, but this forcing, to a great extent, comes into the atmosphere through the surface. Thus, in addition to documenting insolation distributions, the surface heat budget over the continent and adjacent oceans, and diabatic heating within the atmosphere, need to be evaluated to correctly specify the forcing functions of the annual cycle. With our current observation and reanalysis systems, a complete specification of the forcing of the annual cycle will be impossible. The Atlas will provide a compilation of the highest-quality information available, along with an evaluation of what observations are needed for improvement.

Features of the Annual Cycle. Following the documentation of variables that quantify the forcing of the annual cycle, the Atlas will display monthly climatologies of climatological variables. Standard variables that are relatively well-observed will be included, as well as less standard variables that we believe are especially

revealing of important processes over Africa. To support and encourage studies to evaluate the role of ocean processes, we will also include a documentation of SSTs and currents for the surrounding oceans.

Relationship with Global Climate. The Atlas will include a section that describes the role of Africa in the global climate. For example, northern Africa is one of the most important heat sources for the Hadley circulation during boreal summer and, thereby, can influence climate globally. Northern Africa is also an important global-scale source of atmospheric aerosols, and a better documentation of the seasonality of low-level winds directions and speed over Africa is crucial to an improved understanding of this global phenomenon. The regional circulations are also important for their influence on tropical cyclone activity.

B. The Regional View

The rapidly increasing quality of regional modeling studies motivates a similar effort to document the forcing and features of the annual cycle on smaller scales which includes consideration of the weather systems themselves (e.g. easterly waves and mesoscale convective systems) and interactions with local topography. As for the global-scale project, the purpose is to support and encourage studies of the fundamental mechanisms of the annual cycle, and to provide a target for the validation of modeling studies. However, it is not practical to consider such an effort on the continental scale. Rather than providing a comprehensive evaluation of the annual cycle on regional space scales for the entire continent, certain areas will be emphasized by relying on the expertise and perspectives of the African climate centers.

Actions:

1. Identify sources of funding for this effort (Cook, Thorncroft) – 6 months
2. A sub-group should be formed to discuss and provide guidance on what important fields and diagnostics should be included in the Atlas and to assess to what extent these are observable now (Cook, Thorncroft) – 6-12 months
3. Coordinate the initiation of the Atlas for the annual cycle, global scale view through proposal writing where appropriate, by linkages with ACMAD, Nairobi DMC and Harari DMC and the establishment of VACS web pages. – (Cook, Thorncroft) 12 months
4. Alongside the work on the Atlas initial evaluations of the ability of GCMs and regional models to simulate the annual cycle over Africa will be made. – (Cook, Thorncroft) 12 months +.
5. We recommend that as work progresses that we must evaluate the ability of current observations and observing systems to provide the information needed to improve our understanding of the annual cycle over Africa
   - evaluate the impact on prediction capabilities for Africa, and globally
   - recommend observing strategies for future development

   - (Cook, Thorncroft) 12 months +

II. Eastern Atlantic Stratocumulus

The CLIVAR Africa Implementation Plan emphasizes the stratocumulus problem over the eastern Atlantic, and mentions opportunities for pursuing collaboration with other CLIVAR panels to better understand atmospheric/ocean interactions that occur through the formation of these clouds.

Action:

6. Invite an expert on stratocumulus to our next meeting to discussion a possible collaboration on this topic, possibly from the VAMOS panel. (Cook) – 12 months

3. Interannual Variability (P2)

Project Leader: Neil Ward

The discussion began by reviewing the three aims of the project

1) To analyse the inter-annual variability of the African climate system and its relationship with the global climate
2) To evaluate the ability of dynamical models to simulate the inter-annual variability of African climate and its relationship with the global climate
3) To identify and investigate the deficiencies in the dynamical models used to simulate the interannual variability of the African cliamte

Some of the current scientific issues were raised that will be engaged in attempts to achieve these aims.

1. To analyse the inter-annual variability of the African climate system and its relationship with the global climate

To be achieved through diagnostic work with observations, reanalysis and GCM simulations.

Diagnose ENSO and regional teleconnection structures leading to regional African climate variability

Be aware of possible decadal modulation of those teleconnection processes and associated structures.

Consider the phase locking with the annual cycle of teleconnection modes, and in particular, the importing of ENSO signals into the African climate system and surrounding ocean basins.

Diagnose the relation of extreme weather events / several days of extreme weather with reagional scale circulation structures, which themselves are modulated by ocean-atmosphere modes, ENSO and regional ocean basins.

2. To evaluate the ability of dynamical models to simulate the inter-annual variability of African climate and its relationship with the global climate

There are examples of state of the science GCMs that vary enormously in their ability to reproduce observed interannual climate variability given SST forcing, but the results are not well documented. The documentation that exists has generally been end targeted (e.g. focusing on performance of vulnerable rainy seasons) rather than considering the variability in the climate system as a whole, which includes the strong convection area over Equatorial Africa.

Models need to be evaluated in terms of the realism of the ensemble spread that they generate – some models may be oversensitive to SST leading to unrealistic small spread.

Models equally need to be evaluated in terms of their ability to reproduce interannual variations in intraseasonal variability, including rainfall onset.

Models also need to be evaluated in terms of their systematic reproduction of small spatial scale anomalies (possibly bringing predictability to rainfall anomaly gradients over sub-regional scales) and also interaction with land surface to possibly generate in this way strong gradients of rainfall anomaly. Both the above may be better simulated in high resolution models.

3. To identify and investigate the deficiencies in the dynamical models use to simulate the interannual variability of the African climate

Model deficiencies can be documented, but it is more difficult to isolate the root causes. Some may be related to deficiencies in the annual cycle, which can result in displacement of anomalous diabatic heating anomalies for forcing anomalies internal to the African climate system. But this is very difficult to isolate. Comparison of models with contrasting abilities to simulate the annual cycle may shed some light.

The land surface is a potential source of error in terms of (i) its general interactive representation through the GCM runs and (ii) its potential role as a forcer of climate variations – specification of observered land surface conditions at the onset of a season of interest.

Sensitivity experiments to model parameterizations are a potential route to better understanding model deficiencies, especially once the ground work had been completed in 2. above to gain a better picture of the current range of model performances over Africa.

Two action areas were identified, one general and one specific to initiate the sub-project in P2.

1. Initial analysis of observations and intercomparison of the ability of models to simulate the interannual variability

2. Sub-project (1): Study of the climate system processes giving rise to the anomalous evolution of the annual cycle over eastern, southern and West Africa 1997-2000, evaluating the way in which ENSO influences were communicated into the region, and their interaction with processes over Africa and the surrounding ocean basins.

Actions under each area are now presented:

1. Initial analysis of observations and intercomparison of the ability of models to simulate the interannual variability

1. A sub-group should be formed to:
Consider which large-scale features of the circulation over Africa would efficiently convey the ability of a numerical model (atmospheric GCM forced with observed SST, regional climate model, or fully coupled global model) to simulate interannual variability of Africa climate. The group should also consider selected fields to be added to the annual cycle atlas.

Consider the higher order features of the climate simulated by the models. These considerations should interact with atlas thinking for generation of statistics of these features.

Consider which diagnostics would efficiently describe interaction of African climate system with global climate system, especially ENSO and surrounding ocean basins.

Actions:
1) Form sub-group. (Ward, Thorncroft) – 6 months
2) To have identified fields for inclusion in the atlas. (Ward) – 6-12 months
3) To have some examples of model performance in the above three categories for further discussion at the next panel meeting. (Ward) – 12 months

2. Sub-project (1). Study of the climate system processes giving rise to the anomalous evolution of the annual cycle over eastern, southern and West Africa 1997-2000, evaluating the way in which ENSO influences were communicated into the region, and their interaction with processes over Africa and the surrounding ocean basins.

In response to the SSG, the period of consideration for the sub-project has been extended to include the period of the Mozambique floods. A whole range of studies can be envisaged as contributing to this sub-project. It can act as a major focus for studies of the processes generating interannual variability in African climate. Some initial activities can be identified and the aim is to generate results that would stimulate a broad interest in the community to participate, including oceanographers and land surface specialists.

With the persistent La Nina 1998-2000, phasing issues can also be addressed, e.g. are processes different in the early onset phase of La Nina, compare to year 2 of La Nina – some of this could relate to persistent land surface modification resulting from the persistent large scale La Nina forcing.

The issue of regional modeling can also be explored in the context of this period of climate evolution. Requests could be particularly made to large scale model groups (e.g. ECMWF, IRI) to keep the necessary fields for regional model experiments for this period.

For the Indian Ocean 97/98 – need to engage and build on existing studies – Goddard & Graham, Latif & co workers, work in Japan, etc.

Utilize a range of model experiments to study SST impact through teleconnection processes (AMIP-type simulations, Individual ocean basin simulations). Performance of forecast models.

Taking the diabatic heating anomalies over Eastern Africa in OND 1997, what is the wind response over the Indian Ocean. What are the consequences for the Indian Ocean?

How well do regional models capture smaller scale features? Especially interaction with land surface. Opportunity to benefit from CATCH observations and theoretical developments. Can we get estimates of land surface conditions for contrasting years to evaluate land surface forcing in a predictability sense, versus the role of land surface atmosphere interaction as an amplifier of the chaotic component of climate variability.

These results are viewed as laying hypotheses to engage specialists on possible role of African climate in Indian Ocean (and Atlantic Ocean) evolution, and role of land surface in African climate evolution.

Actions:

1) Provide examples of the large scale atmospheric response to SSTs for these years using a GCM. (Ward) – 12 months
2) Provide regional model results for these years. This will be combined with analysis of observations of finer resolution (spatial, temporal) of observed climate and will be done in collaboration with the regional centres. (Ward) – 12 months
3) Provide the large scale reanalysis representation for the period of the case-study – and an assessment of the extent to which reanalysis captures the finer scales. (Ward) – 12 months
4) Contact ECMWF to make them aware of the project and propose that if they are considering saving a few years of daily data from DEMETER to force regional models, they include the sub-project years in their archive. (Ward) – 6-12

4. Intraseasonal Variability (P3)

Project Leader: Chris Thorncroft

The Aims identified in the Implementation Plan are:

(1) To assess the intraseasonal variability of the African climate and its relationship with the global climate.
(2) To evaluate the ability of dynamical models to simulate the intraseasonal variability of African climate and its relationship with the global climate.
(3) To identify and investigate the deficiencies in the dynamical models used to simulate intraseasonal variability of the African climate.

This project has strong links with P1 and P2 and also with applications. Hence we are interested in increasing our understanding of the relationship that intraseasonal variability has with the annual cycle and interannual variability.

The initial activity that will be promoted during the first year of VACS is concerned principally with the first aim above, the assessment of the intraseasonal variability and its relationship with the global climate. Analysis of rainfall and satellite data should be coordinated to assess the nature of the intraseasonal variability. Special emphasis should be given to the analysis of (a) wet/dry periods, (b) extreme events, (c) MJO, (d) synoptic and mesoscale systems and (e) tropical cyclones. Where appropriate this analysis should be combined with reanalysis data and available observations to assess if the intraseasonal variability is associated with coherent structures.

This analysis should be coordinated with the production of the atlas described above and again with the regional African centres. For the atlas it will be important to agree what type of analysis will be needed. This will be discussed by the panel and agreed in the first 6 months of the coming year. As an aid in prioritising the phenomena and timescales to be analysed in the different regions it was agreed that the regional centres be contacted and asked to provide written summaries of the regional climatologies of intraseasonal activity.

Clearly there will be a need to analyse observational data on daily timescales. By involving African scientists through the regional centres there will be an opportunity to document the daily data that exists and to encourage the archiving of this data for its future use. ICPO should be involved in this activity.

ACTIONS:

1 Working group should be formed which will prioritise phenomena to be examined and to make recommendations for the type of analysis and diagnostics that are required. This group should liase with work on Atlas in P1 and P2. (Thorncroft) – 6-months

2 Regional summaries of intraseasonal variability based on local knowledge should be sought via the regional centres. (Thorncroft) – 6-12 months

3 Analysis should be organised in collaboration with regional centres and potentially with climate forums. ACMAD should be contacted regarding this activity. (Thorncroft) – 6-12 months

4 There was also some discussion on the possibility of promoting a new sub-project on the variability of tropical cyclones in the Atlantic and Indian Oceans. Since this will link strongly with the VAMOS and Asia-Australian monsoon panels it was decided that these ideas should be discussed with these panels during the next year. The issue of Atlantic tropical cyclone activity could also be discussed at the planned tropical Atlantic workshop in Paris later this year. (Thorncroft) – 6-12 months

5. Decadal Variability (P4)

Project Leader: Laban Ogallo

The aim of this project is:

(1) To improve our understanding of the mechanisms involved in determining decadal variability of African climate and its impact on global climate.

The panel agreed that in comparison with seasonal and inter-annual climate variability, the understanding of the dynamics and the limits of predictability over decadal and longer time scales is much less advanced. The obvious reason is of course that at these time scales, it becomes very difficult to make observations that cover the full cycle of variability and that the information from past observations is usually not sufficient, both in coverage and to some extent in quantitative accuracy.

The aim of P4 is therefore, to improve our understanding of the mechanisms involved in determining decadal variability of the African climate and its impact on global climate. It was noted that though P4 (decadal variability) may not be a priority at the moment, it is very important for modelling purposes and learning of past climate within the scope of CLIVAR-VACS component. Some literature does exist for the region and these should form the starting point of such studies. In this context, the VACS panel meeting recommended the following actions.

ACTIONS:

1) Provide a review of previous work on observations of decadal variability. (Ogallo)- 12 months
2) Compile observational and reanalysis data, where appropriate, in a format that can be compared with the outputs of GCMs and included in an Atlas. (Ogallo) – 12 months
3) Produce decadal maps and analysis from GCMs in order to assess whether the models are able to simulate the observed behaviour of the African climate system on these timescales. Use should be made of pre-existing model runs based on SSTs from 1950 to present and where possible groups already producing these datasets should be encouraged to provide the analysis. (Ogallo,Thorncroft) – 12 months
4) If the GCMs considered in the first year show some skill in simulating the observed decadal variability the datasets from these models may be useful for improving our understanding of the mechanisms involved. Future work should consider the decadal variations in the influence of ENSO, the Atlantic and Indian Oceans and the NAO in determining decadal variability of African climate. (Ogallo) – 12 months +

6. Observational Issues

Lead by: Thierry Lebel, Johan Lutjeharms, George Philander

(i) Continental Observations
Thierry Lebel provided a report for the meeting (Appendix A). This was presented and discussed at the meeting. The panel was mostly in agreement with the document. No specific actions were agreed at the meeting. Thierry Lebel should provide a strategy document with proposed specific action items by the end of June.

ACTION: Lebel

With the obvious problems surrounding the sparsity of the operational network over the land it was agreed that there could be an increasingly important role for remotely sensed data in VACS activity. It was agreed that VACS needs to develop a strategy to encompass this. It was agreed that a review of available remotely sensed data should be provided to the VACS panel during the next 12 months. This should include a review of future satellites and their relevance for VACS. An author or authors will be contacted to provide such a review.

ACTION: Thorncroft

(ii) Oceanic Observations
It was agreed that the scientific case needs to be made for more observations and so the text in the IP should be updated with the following:

Sea surface temperature (SST) is the oceanic parameter that most affects the atmosphere, its weather and climate. The processes that determine SST depend on the time-scale of interest and involve mainly the upper ocean (to a depth of a few hundred metres) for seasonal and interannual variability, but involve the deep ocean too (to depths of thousands of metres) for decadal and longer-term variability. At present, a detailed 'real-time' description of the upper ocean, necessary information for predictions of changes in SST etc), is available for the tropical Pacific. For that region, a realistic General Circulation Model of the ocean, forced with observed winds, assimilates measurements from the TOGA array. A similar operational oceanographic activity needs to be implemented for the Atlantic and Indian Oceans. The measurements in support of such operations could include:

(a) An XBT program involving ships of opportunity.
(b) Arrays of moored thermistor chains at locations to be determined.
(c) Arrays of moorings instrumented with current metres in a few selected locations.
(d) Argos drifters that sample the ocean to depth of 2000m.

More discussions are required regarding specific actions, outside the meeting and should take place together with other CLIVAR panels including the two monsoon panels and the Atlantic panel.

ACTION: Lutjeharms

(iii) Data Inventory
Amos Makarau will be responsible for this and will be liasing with people during the coming months. This links with the work going on in P1-P3 in particular and the creation of the atlas and VACS web pages.

ACTION: Amos Makarau

7. Users and Applications

A presentation was made by Abou Amani on the work taking place at AGHRYMET.

Two recommendations were made in the IP. The first was to ensure a VACS presence at the regional climate forums and the second was to ensure good links with IRI and CLIPS. Good links with the IRI have been ensured by the membership of Neil Ward on the VACS panel. Good links with CLIPS have been ensured at this meeting by the presence of Mike Harrison. Regarding the former, the VACS co-chairs should ensure that VACS is represented at future regional climate forums.

ACTION: co-chairs

8. Awareness and Funding Issues

Funding
It was agreed that there exist several sources of funding which could be used for supporting VACS activity. As well as the standard national funding agencies other sources include, START (see section 10 below), WMO,

ACMAD's FIRMA program, GEF/GCOS, VCPR. It was recognised though that funding was often available just for short term projects.

A list of funding opportunities with contact details should be created and made available to the VACS panel and put on the VACS webpages.

ACTION: Chris/ICPO

Awareness
It was agreed that a glossy pamphlet should be created for promotion of VACS activities and for increasing the awareness of potential funding providers (e.g. USAID, World Bank, National funding agencies Thierry suggested that he may be able to provide some financial support for this. Included in such promotional literature should be relevant international quotes relevant to Africa. This includes a statement made by the Secretary-General of the United Nations included in the UN Millenium Conference report from 2000 where priorities stated included: "Developed countries in particular are urged to make special provision for the needs of Africa, and to fully support Africans in their struggle to overcome the continent's problems. Specifically, experts and foundations are urged to tackle the problem of low agricultural productivity in Africa."

It should also be made clear that the scientific questions addressed by VACS are directly relevant to the other tropical panels.

ACTION: Chris/Thierry/ICPO

9. Capacity Building

A discussion document was provided to the meeting by Ben Mohamed (Appendix B). This was considered by the meeting. Discussion at the meeting covered many aspects and the resulting outcomes are summarised here.

Promoting our science
It was suggested and agreed that future VACS meetings should include an extra half day or a whole day after the meeting where we can introduce and promote the scientific problems in our field to local scientists. We should include physicists and mathematicians in this meeting in order to encourage new scientists to work in our field.

ACTION: VACS Panel

Journal donation
It was suggested that since there is already considerable international financial funding of VACS meetings we should consider whether a little more funding could be made available which could help the host institution in a capacity building sense. We could encourage the donation of a journal subscription to the host of future VACS panel meetings in Africa. CLIVAR and WMO should be contacted for their opinion on this and the availability of funds.

ACTION: Thorncroft/Harrison

Publications list and VACS web pages
It was agreed that lack of access to current literature is a severe handicap for many scientists working in Africa. It was suggested that one step which could help this would be to at least provide scientists with access to a list of papers published in the area of VACS research each year. With this available it may be possible to contact individual authors for copies. Such a list should be included on the VACS website and should be constructed in collaboration with ICPO. The VACS web page is also a good vehicle for promoting VACS initiatives and encouraging linkages. It should also have links to the data inventory.

ACTION: Chris/ICPO

Promoting stronger links between scientists in Europe, US and Africa
Funding for short-term visits is often more readily available than funding for long-term projects (see section 8 above). This should be taken advantage of where appropriate and possible.

Workshop on African Climate Variability

The possibility of a workshop on African Climate Variability was discussed. This would have a capacity building component to it in terms of scientific training and should include oceanographic as well as atmospheric components. The possibility of this workshop will be considered further outside the meeting.

ACTION: Philander/Mohammed

10. PAN-AFRICAN START SECRETARIAT (PASS)/PAGES-Africa and VACS

A presentation was made at the meeting by Daniel Olago. A summary of his presentation has been provided by him here.

START is a world-wide network co-sponsored by the International Geosphere-Biosphere Programme (IGBP), the International Human Dimensions of Global Change Programme (IHDP) and the World Climate Research Programme (WCRP). The long-term management structure for START operations in the Pan African region was addressed at the 10th START-SSC meeting in Washington DC in September 1996, and this lead to the establishment of the Pan-African START Secretariat (PASS) in the Department of Geology, University of Nairobi in January 1997.

START has focused on the development of regional networks in the developing countries because of their role in, and sensitivity to, global change as well as their capacity building needs, both at national and regional levels. START also seeks to mobilise the resources necessary to augment existing scientific capabilities and infrastructures in developing countries, using regional networks as a basic framework. Consistent with its mission, the START network helps build indigenous capacity of the developing regions of the world to undertake global change research programmes and to conduct research of global significance and regional relevance.

Sub-Saharan Africa is one of the most sensitive regions, with respect to global climate and environmental changes. The region is experiencing a rapid rise in population and extensive changes in land-use. It is an area of considerable inter-annual climatic variability, and is known to be extremely sensitive to such variations, as witnessed by a series of recent El-Nino floods and droughts that has caused considerable human suffering. It is, therefore, of particularly high priority in terms of an improved understanding of regional impacts and response to global change.

START regional research effort in Africa is coordinated by PASS, and focuses on programmatic themes related to sustainable development of the region:

- Regional climate variability and change, including its prediction and impacts
- Changes in composition of the atmosphere and its impacts
- Land-use/cover-change and its impacts, including land degradation, deforestation and desertification
- Impacts of global change on terrestrial ecosystems and biodiversity
- Global change and coastal zones, land-ocean interactions and impacts on national and international waters

Several projects are currently running in the region, and these include, for example: The Miombo Network; The Kalahari Transect (KT) Project; IDEAL Project; Global Change and Subsistence Rangelands in Southern Africa, etc. PASS currently has a database with over 800 African global change scientists. PASS provides formal international linkages among these scientists through various research and training programmes and workshops. PASS is developing a modern, efficient and inter-operable data and information system (through the SEARCH project) that includes a seamless web of electronic communications network, computers, databases and a GIS system to provide the global change community, in Africa in particular, with *'information at user's fingertips'*. The electronic communications system is currently mirroring data from the World Data Center for Paleoclimatology and MEDIAS-France. The African global change scientists database is also hosted at PASS.

START runs a fellowship/award scheme which is aimed at increasing indigenous capacity in global change research, and enhancing international networks and research programmes dealing with global change issues.

1. START Young Scientist Award Programme.
To recognize the achievements of outstanding young scientists from developing countries in Africa, Asia and Oceania, the International START Secretariat set up an award programme which includes an honorarium. Award decisions are based on a journal article published by the young scientist (preferably in English). In keeping with START's mission of conducting research on regional aspects of global change, the article should focus on some aspect of global change research that is being conducted on a regional level or has a strong regional focus. Applicants for the START Young Scientist Awards must be 40 years of age or younger. In the case of multi-

authored articles, the applicant should be the lead author of the article. The article should have been published within the last two years.

2. START Fellowship Program.
This Program is designed to increase the number of developing country scientist who serve as active partners in global change research in START regional networks and in the Core Projects of IGBP, WCRP and IHDP. Through this effort, these scientists will be able to contribute to related aspects of sustainable development for their respective countries and regions. START Fellowships are offered at the dissertation and post-dissertation levels. The fellowships allow young scientists from Africa and Asia to work under senior mentors in leading laboratories or institutions in any part of the world, where research is conducted on relevant regional aspects of global change. START fellows are able to learn and use new techniques and approaches not prevalent in their own countries. Long-term collaboration between the individuals and institution involved is one important outcome of the programme. The duration of these fellowships is ordinarily one or two semesters.

3. START Visiting Scientist Award.
The START Visiting Scientist Awards, allows more senior scientists from developing countries the opportunity to undertake short-term visits to major international laboratories to become acquainted with recent advances in research and possible policy applications. The intended outcome is the development of long-term programmatic linkages between the individuals and institutions involved.

4. START Guest Lecturer Program.
The objective of the START Guest Lectureship Program is to provide scientists and institutions in the START regional networks with the opportunity to establish long- term links with leaders in global change research. During their visit, lecturers are based at START Regional Centres or research sites. There, they interact closely with the staff at the host institution and within the region by providing lectures, tutorials, and advice. The aim is to strengthen existing global change activities and also assist in establishing new lines of policy-related global change research. Priority is given to scientists willing to develop long-term links between their own and the Host institution. START Visiting Lecturers must also be willing to commit to an extended relationship with the host institution.

PASS/PAGES-Africa and VACS Linkages

The primary functions of the PAGES-Africa regional site are to provide formal international linkages among palaeo-scientists interested in (amongst other research programmes) the following: PAGES PEP III Transect; IDEAL Project; historical perspective of Miombo ecosystems; crater lakes and extreme or abrupt events; glacial variations on Mount Kenya; and fluvial and aeolian records of climate in sub-Saharan Africa. PAGES in conjunction with PASS is also developing data and information systems and institutional infrastructure in order to build a "centre of excellence" for palaeo-research, training and information exchange for sub-Saharan Africa.

One of the high priority research areas for PAGES is to tie high resolution climatological records obtained from sediment proxies spanning the last two millennia to the instrumental records obtained by modern climatologists in order to better understand aspects of climate evolution, variability and dynamics, and to improve climate forecasts and modelling parameters. PAGES and VACS can interact in this area by building capacity, networking and developing joint research programmes partly through the provisions of START/PASS as indicated above.

Further details on the activities of PASS can be obtained from:
Professor Eric O. Odada or Dr. Daniel O. Olago
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Websites: http;//wdc.uonbi.ac.ke; http://geology@uonbi.ac.ke

11. Project Management

The activity promoted by VACS is summarised here along with the leader of that activity.

Projects:

Code	Project	Leader(s)
P0:	Project Management	Chris Thorncroft / Laban Ogallo
P1:	Annual Cycle	Kerry Cook
P2:	Interannual variability	Neil Ward
P3:	Intraseasonal variability	Chris Thorncroft
P4:	Decadal Variability	Laban Ogallo

Other activity:

Code	Activity	Leader(s)
A1	Observations Issues	Thierry Lebel / Johann Lutjeharms
A2	Data Inventory	Amos Makarau
A3	Capacity building	Ben Mohamed

Reports should be provided to the co-chairs every 6 months. Reports should include a summary of the current status of the project and can be brief. They should include information about whether the aims for that 6 months have been met and an updated summary of the aims for the following 6 months. A one-page or less summary will be adequate. A more detailed report will be made only for the annual meeting.

Reports will be due just after the VACS meeting in January and 6 months after that. This means that the next report will be due before the end of June 2001.

A summary of the action items for P1-P4 activities is included here:

P1: Annual Cycle
Project Leader : Kerry Cook

Actions for completion within first 6 months ending June 30 2001:
1. Identify sources of funding for this effort (Cook, Thorncroft) – 6 months
2. A sub-group should be formed to discuss and provide guidance on what important fields and diagnostics should be included in the Atlas and to assess to what extent these are observable now (Cook, Thorncroft) – 6-12 months
3. Provide written report on progress for VACS panel (Cook) – 6 months

Actions for completion by next VACS meeting in January 2002:
4. Coordinate the initiation of the Atlas for the annual cycle, global scale view through proposal writing where appropriate, by linkages with ACMAD, Nairobi DMC and Harari DMC and the establishment of VACS web pages. – (Cook, Thorncroft) 12 months
5. Invite an expert on stratocumulus to our next meeting to discussion a possible collaboration on this topic, possibly from the VAMOS panel. (Cook) – 12 months
6. Provide written report on progress for VACS meeting. (Cook) – 12 months

Current ambitions for 2002:
7. Alongside the work on the Atlas initial evaluations of the ability of GCMs and regional models to simulate the annual cycle over Africa will be made. – (Cook, Thorncroft) 12 months +.
8. We recommend that as work progresses that we must evaluate the ability of current observations and observing systems to provide the information needed to improve our understanding of the annual cycle over Africa and to make recommendations for improving them where appropriate. (Cook, Thorncroft) 12 months +

P2: Interannual Variability
Project Leader: Neil Ward

Actions for completion within first 6 months ending June 30 2001:
1. Form sub-group for promoting analysis of work to be included in the Atlas. (Ward, Thorncroft) – 6 months
2. To have identified fields for inclusion in the atlas. (Ward) – 6-12 months
3. Provide written report on progress for VACS panel (Ward) – 6 months

Actions for completion by next VACS meeting in January 2002:

4. To have some examples of model performance for further discussion at the next panel meeting. (Ward) – 12 months
5. Provide examples of the large scale atmospheric response to SSTs for these years using a GCM. (Ward) – 12 months
6. Provide regional model results for these years. This will be combined with analysis of observations of finer resolution (spatial, temporal) of observed climate and will be done in collaboration with the regional centres. (Ward) – 12 months
7. Provide the large scale reanalysis representation for the period of the case-study – and an assessment of the extent to which reanalysis captures the finer scales. (Ward) – 12 months
8. Contact ECMWF to make them aware of the project and propose that if they are considering saving a few years of daily data to force regional models, they focus on the sub-project years for their archive. (Ward) – 12
9. Provide written report on progress for VACS meeting. (Ward) – 12 months

Current ambitions for 2002:

To be completed (see VACS webpages for updates)

P3: Intraseasonal Variability
Project Leader: Chris Thorncroft

Actions for completion within first 6 months ending June 30 2001:

1. Working group should be formed which will prioritise phenomena to be examined and to make recommendations for the type of analysis and diagnostics that are required. This group should liase with work on Atlas in P1 and P2. (Thorncroft) – 6-months
2. Provide written report on progress for VACS panel (Ward) – 6 months

Actions for completion by next VACS meeting in January 2002:

3. Regional summaries of intraseasonal variability based on local knowledge should be sought via the regional centres. (Thorncroft) – 6-12 months
4. Analysis should be organised in collaboration with regional centres and potentially with climate forums. ACMAD should be contacted regarding this activity. (Thorncroft) – 6-12 months
5. There was also some discussion on the possibility of promoting a new sub-project on the variability of tropical cyclones in the Atlantic and Indian Oceans. Since this will link strongly with the VAMOS and Asia-Australian monsoon panels it was decided that these ideas should be discussed with these panels during the next year. The issue of Atlantic tropical cyclone activity could also be discussed at the planned tropical Atlantic workshop in Paris later this year. (Thorncroft) – 6-12 months
6. Provide written report on progress for VACS meeting. (Thorncroft) – 12 months

Current ambitions for 2002:

7. Future work should start to assess the ability of GCMs and regional models to simulate the observed intraseasonal variability. (Thorncroft) – 12+ months

P4: Decadal Variability
Project Leader: Laban Ogallo

Actions for completion within first 6 months ending June 30 2001:

1. Invite an author or authors to provide a review of previous work on observations of decadal variability of African climate. (Ogallo) – 6 months
2. Provide written report on progress for VACS panel (Ogallo) – 6 months

Actions for completion by next VACS meeting in January 2002:

3. Ensure that the review of previous work on observations of decadal variability is provided to the panel. (Ogallo)- 12 months
4. Compile observational and reanalysis data, where appropriate, in a format that can be compared with the outputs of GCMs and included in an Atlas. (Ogallo) – 12 months

5. Produce decadal maps and analysis from GCMs in order to assess whether the models are able to simulate the observed behaviour of the African climate system on these timescales. Use should be made of pre-existing model runs based on SSTs from 1950 to present and where possible groups already producing these datasets should be encouraged to provide the analysis. (Ogallo,Thorncroft) – 12 months
6. Provide written report on progress for VACS meeting. (Ogallo) – 12 months

Current ambitions for 2002:

7. If the GCMs considered in the first year show some skill in simulating the observed decadal variability the datasets from these models may be useful for improving our understanding of the mechanisms involved. Future work should consider the decadal variations in the influence of ENSO, the Atlantic and Indian Oceans and the NAO in determining decadal variability of African climate. (Ogallo) – 12 months +

12. Any Other Business

Paleoclimate

The panel recognized that Africa is at the centre of much of the exciting paleoclimate research that is currently underway to better understand the stability of tropical and, therefore, global climate systems.

The possibility of increasing the level of expertise in African paleoclimate on the VACS panel should be considered through the addition of a panel member. (1 year).

ACTION: Thorncroft/ICPO

13 Next VACS meeting

The next meeting will be held at the beginning of January 2002. A venue for this meeting still needs to be agreed.

ACTION: VACS/ICPO

Appendix A

Report from Thierry Lebel

Observations and data issues
The observation and data issue in CLIVAR-Africa, some preliminary elements
T. Lebel

- ***Data are needed in CLIVAR for***:

- Documenting the climate variability at the scales of interest, that is intraseasonal to decadal. This is required to analyse the stationarity of this variability and to detect possible periods of "anomalous" behaviour and, of course, possible trends (even though this is not the priority of the moment in Africa-Clivar, given the need of a long term perspective in order for statistical analysis to be meaningful on such a question).
- Documenting changes and variability in variable/processes acting as boundary conditions of the climate system, whether interacting with climate (SST's, land cover, soil humidity, …) or being forced by climate (water resources, vegetation growth).
- Carrying out diagnostic studies that seek to understand the links existing between the various scales of variability of climate variables, rainfall being the first to consider.
- Validating models, from GCM's to LAM's and coupled atmospheric/hydrologic models.

- ***Which kind of data ?***

Rainfall is undoubtedly a key observation, for the following reasons:

- Rain is the climate parameter whose variability is the most damaging to people;
- It is a key link between the tropical atmosphere and the continental surface;
- It's variability is larger at any scale than that of any of the other major atmospheric variables
- Recent studies have shown that by looking closely at the organisation of rainfields, interesting questions are raised on the behaviour of the tropical atmosphere.

A paradox in rainfall measurements is that it is the easiest parameter to measure accurately at a point while at the same time it is felt that appropriate rainfall data are missing to carry out the research that would advance our knowledge of the African climate.

Other atmospheric and hydrologic data are also very important for Clivar but at different resolution or sampling frequency depending on their spectrum of variability. The availability of these data and the current state of measurement networks will be discussed below.

- ***Data collection***

Data collection requires money, a chain of qualified people, well organised and sustained institutions. Measurement networks are threatened every where in the world but nowhere more than in Africa. There is thus a tendency to promote remote measurements as a substitute for direct in situ measurements. While remote sensing constitutes a valuable and in some cases irreplaceable complement to in situ measurements, it cannot be a substitute to them. This is for two reasons :
i) remote sensing data require in situ observations for calibration/validation;
ii) channelling funding to remote sensing exclusively would mean depriving African countries of the possibility of participating to the monitoring of their own environment.

Given the various implications of observations and data availability, Clivar cannot act alone in this area. It must build join projects with other programs at WMO and elsewhere (GEWEX, WHYCOS, FRIEND). These projects should aim at:

- Inventorying and rescuing existing data
- Defining the needs for an appropriate monitoring of climate variability
- Developing a coherent strategy of in situ and remote sensing observations
- Funding regional monitoring systems, with free access to data for the scientific community.

Setting up regional monitoring systems, such as the one currently developed in West Africa, require a close co-operation between various institutions from African and non African countries where climate research is the most advanced. Regarding funding, the support of the Global Environment Facilities should be seeked. The GEF (http://www.gefweb.org/) was set up following the Kyoto conference. One outcome of this conference was to promote international programs for research and systematic observation of the climatic variability. The article 10d of the Kyoto convention stipulates that " *toutes les parties signataires de la convention coopèrent aux*

travaux de recherche technique et scientifique et encouragent l'exploitation et le développement de systèmes d'observation systématique et la constitution d'archives de données afin de réduire les incertitudes concernant le système climatique ..... et s'emploient à promouvoir la mise en place et le renforcement de capacités et moyens endogènes de participation aux efforts des programmes et réseaux internationaux et intergouvernementaux concernant la recherche et l'observation systématique ".

Observations and data issues
Operational in situ continental observations
T. Lebel

WARNING. *This is a preliminary report aimed at introducing a discussion to be held at the first meeting of the VACS panel. Only partial information was collected at this early stage of our work and the report is far from presenting a comprehensive overview of the observation and data issues that should be addressed by the VACS panel.*

Five categories of data have to be considered. Rainfall, for the reasons enunciated above, is the first. Then come the atmospheric observations at ground level, obtained either from synoptic or climatologic stations operated by national met. services. Then we have upper air soundings. And finally two categories of land surface observations : water cycle (river flows, aquifer levels, soil humidity, …) and vegetation cover. All these variables may be monitored remotely as well, but direct in situ measurements remain a necessity. In this preliminary report we will analyse in more details the situation prevailing for rainfall observations, taking example from West Africa, which is the region best known to the author of the report. Complementary information for the other regions of Africa should be added in the future.

♦ ***Rainfall***

Tropical rainfall is extremely variable in space. An illustration is given in the table below, obtained from the EPSAT-Niger observing system (Sahelian climate). From a study carried out by Lebel and Amani, (*J. Appl. Meteo*., **38**, 555-568) it was shown that an average density of 10 gauges per 10,000 km_ allows for an accuracy of 15% in the estimation of the areal rainfall over a 1°∗1° box at the event scale. At the monthly scale, the accuracy is in the order of 10% for a density of 4 gauges per 10,000 km_. Now, if **only one station** is available to estimate the average rainfall over the entire EPSAT-Niger area (16,000 km_) then the average monthly estimation error would be between 20% and 30%, depending on the month considered.

Atmospheric models are not doing well in reproducing this variability at space scales that are relevant for impact studies. For instance, GCM's are not able to reproduce correctly the seasonal cycle of rain over West Africa, even though it is a basic and fundamental characteristic of the regional climate.

While the density of daily raingauge networks is acceptable in many regions of Africa, the Global Precipitation Climatology Centre (GPCC), which may be viewed as an official institution set up in support of WCRP for rain data collection, has great difficulties in obtaining monthly totals in a number of countries. From the table given herewith, it is seen that in certain countries monthly totals are not even available for synoptic stations. At the same time, there is a risk that data get lost, when they are not archived in a centre which has the mission and the adequate means for such a task. For instance, following a disk crash at DMN, the data base of Mali was recently rescued thanks to its storage at AGRHYMET. For the last decade, rainfall data of some West African countries are not accessible and it is not even known whether they are stored on some electronic support.

Another problem is that rain data for time steps smaller than one day are rare and of poor quality. It should not be too difficult to replace existing paper recording raingauges by electronic memory gauges.

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	Average
Seasonal Total											
minimum	292	341	389	314	492	323	374	273	402	416	361,6
Maximum	659	725	782	621	856	636	597	565	1044	794	727,9
Average	419	522	513	463	663	495	503	417	659	563	521,7
(M-m)/m	1,257	1,126	1,01	0,978	0,74	0,969	0,596	1,07	**1,597**	0,909	**1,0251**
(M-m)/A	0,876	0,736	0,766	0,663	0,549	0,632	0,443	0,7	0,974	0,671	0,7011
August Total											
minimum	39,6	120,5	150,7	109,5	181,4	150	132,1	45,8	127,8	131,4	118,88
Maximum	212,5	270,9	400,7	330,5	415,5	341	295,2	143,3	342,5	291,6	304,37
Average	90,9	179,9	221,1	177,3	275,7	253,3	218,5	83,23	209,9	195	190,47
(M-m)/m	**4,366**	1,248	1,659	2,018	1,291	1,273	1,235	2,129	1,68	1,219	**1,8118**
(M-m)/A	1,902	0,836	1,131	1,247	0,849	0,754	0,746	1,171	1,023	0,822	1,0481

Statistics (mm) obtained from a network of 30 gauges evenly distributed over a flat 16,000 km_ area.

♦ ***Other atmospheric observations***

Necessity to rescue ground network data (temperature, wind, radiation, pressure).
Radio-soundings in insufficient number and of unequal quality. Transmission via GTS not always done.

♦ ***Other continental observations***

For river flows and aquifer tables, direct in situ measurements are required since no satisfying remote sensing measurements exist. Soil moisture is a difficult issue (great variability in space and time; remote sensing not accurate and not at the proper resolution). Long term monitoring systems are needed.
Land cover changes may be observed from space. Data bases published by NASA. However detailed local studies show difficulty in assessing precisely from space-born sensors the pattern of vegetation.

♦ ***A few actions***

Following are a few actions that CLIVAR should promote:

- Inventory and rescue of existing data
- Promotion of regional data centres
- Analysis of variability from data of the past
- Training
- Establishment of regional monitoring systems, with free access to data for scientists.

Appendix B

Report from Ben Mohammed

Input for discussions on Capacity Building in VACS

1. Promote VACS science amongst groups who have not traditionally been concerned with climate
There is a sufficiently large number of young scientists in atmospheric physics in African Universities (as can be seen from participation in FIRMA projects) and in Met. Departments to focus on, that there is no need to include maths and physics department particularly. My feeling is that VACS science should also be promoted amongst groups dealing with application of Climate Variability to solve climate dependant socio-economic problems, e.g. in relation with Environmental Conventions; I am talking about people working in the area of Environment (public, NGO's) who are decision makers with small or even no background on climate and it's variability .
We can achieve this for universities and met services scientists through the ACMAD's FIRMA program, by means of VACS oriented research grants, and also participation in graduate courses in African Universities. For the second category, they can only be recipients, which means promote VACS Science through participation in capacity building workshops organized at the main subregional institutions like DMC's.

2. Improve data access to scientists interested in VACS science.
The question of data access is delicate because of ownership problem. I think that it is essential to restrict it to research purposes in cooperation with projects, and also to consider it within the issue of a central depository of selected African surface and upper air data.

3. Promote stronger links between scientists in Europe, the US and Africa. Collaborative projects
There are two aspects to consider. The first is involvement of African scientists in projects defined by US or Europe to be executed in Africa, the second is definition of collaborative projects. Up to now and for a while I think that it is more realistic to consider the first aspect. In order to promote stronger links, identified African scientific teams should be associated with project definition in order to ensure local impacts in terms of capacity building, and possibilities of local applications via improvement of contribution of met extension services for food security, water resources and health; especially when measuring or estimation of rainfall are concerned.

4. Enhancement of modeling capability
We must know first what are the main expectations from use of modeling today in Africa? Primarily this is related to seasonal forecast and its applications. It should also focus on regional models. Since experience of Africa in running RCM is very limited, I think that the best solution should be through development of partnerships with big modeling centers and use of high speed connections to run models from African Centers. This is also an area for urgent capacity building (downscaling, adaptation, validation, etc).

5. Promoting an e-mail discussion group for anyone interested in African climate variability
The simplest way to do things is to have a web site like www.clivar.org, and develop specific pages for the African program, with links to relevant African institutions and key partners' web sites.

6. Promote the funding of projects in Africa
I think that probably one of the most realistic way to ensure funding of projects in Africa is have "climate windows" within development aid funds, i.e. use climate variability related research as a lever for solving development problems of Africa's highly climate sensitive economies.