

## Project Proposals on Sustainable Use of Living Resources

### IMPACT OF GLOBAL CLIMATE CHANGE ON KEY MARINE AND COSTAL ECOSYSTEMS IN SUB-SAHARAN AFRICA

#### 1. IDENTIFIERS

<b>Project Number:</b>	RES-3
<b>Project Title:</b>	Impact of global climate change on key marine and costal ecosystems in sub-Saharan Africa
<b>Requesting Country (ies):</b>	Cote d'Ivoire, Gambia, Kenya, Mozambique, Nigeria, Senegal, Seychelles, South Africa
<b>Requesting National Organizations</b>	Cote d'Ivoire: Centre for Oceanographic Research, Abidjan (CRO), Ministry of Higher Education and Research Gambia: National Environment Agency -NEA, Organisation pour la Mise en Valeur de la Fleuve de la Gambie (OMVG) Kenya: Kenya Marine and Fisheries Research Institute (KMFRI) Mozambique: Ministry for the Co-ordination of Environmental Affairs Nigeria: Nigerian Institute of Oceanography and Marine Research (NIOMR) Senegal: Ministry of Environment Seychelles: Policy and Planning Division, Ministry of Environment South Africa: Department of Environmental Affairs & Tourism (DEAT)
<b>Executing Agencies:</b>	Cote d'Ivoire: Centre for Oceanographic Research, Department of Fisheries, Ministry of Agriculture Gambia: National Environment Agency -NEA, Organisation pour la Mise en Valeur de la Fleuve de la Gambie (OMVG), Department of Water Resources Kenya: Kenya Marine and Fisheries Research Institute (KMFRI) Mozambique: National Directorate of Environmental Management, National Directorate of Water, National Institute of Meteorology Nigeria: Nigerian Institute of Oceanography and Marine Research (NIOMR), Federal Department of Fisheries Senegal: Direction of Environment and Classified Establishments Seychelles: Seychelles Centre for Marine Research and Technology South Africa: Department of Environmental Affairs & Tourism (DEAT), Department of Agriculture and Land Affairs, Department of Water Affairs and Forestry (DWAF), Coastal Provincial Departments
<b>Possible Partners:</b>	Donors, National Government, Local Government, Private Industry, NGOs, CBOs
<b>Required National Partners:</b>	Cote d'Ivoire: DPA-PAA (Port Authority), National Environment Agency Gambia: Department of Agricultural Services, Department of Community Development Kenya: National Environment Management Authority; Kenya Wildlife Services; Meteorological Department; Fisheries Department. Mozambique: National Directorate of Forestry and Wildlife, Ministry of Fisheries, Universidade Eduardo Mondlane Nigeria: Nigerian Institute of Oceanography and Marine Research (NIOMR), Federal Department of Fisheries

Senegal: Department of Geology, LPA and Department of Biology, CSE  
Seychelles: Seychelles Centre for Marine Research and Technology, Seychelles  
Meteorological Office, Seychelles Fishing Authority, Marine Parks  
Authority, Seychelles Bureau of Standards, Ministry of Industries  
and International Business  
South Africa: Academic and Research Institutions

**Priority Issue Addressed:** GIWA issue(s): Modification / loss of ecosystems, Modification in streamflow,

**Regional Scope:** East Africa (Mozambique, Seychelles), West Africa (Gambia, Nigeria, Cote d'Ivoire, Senegal), South Africa

**Project Location:** Key marine and coastal areas and ecosystems in participating countries (to be identified in the project)

**Project Duration:** 3 years

**Working Group of the African Process** Sustainable Use of Living Resources

## 2. SUMMARY:

The enhanced greenhouse effect brought on as a result of the discharge of large volumes of greenhouse gases into the earth's atmosphere is raising concern over the current and future effects it may have on world climates. Certain changes are already evident, but these appear to be relatively minor. Future predicted changes in world climates and ocean circulation patterns are much more severe, however, and are likely to have a considerable impact on marine and coastal living resources in the future. These effects and the implications of this are only poorly understood at this stage, due to little research having been invested in this area, particularly in sub-Saharan Africa. Various climate models and scenarios have been developed to predict future trends in climate change, the most successful and widely favoured of these being the General Circulation Models. This project proposes to make use of these General Circulation Models to derive predictions on likely changes in key climate variables (e.g. air temperature, rainfall, wind field patterns) and to assess the effects of these changes on key habitats and key resources in sub-Saharan Africa (e.g. upwelling areas, estuaries, coral reefs). Results will be incorporated into existing management plans and will be used to anticipate future requirements under altered climatic regimes. Results will also contribute to a better understanding of the trends and future changes that are likely to affect the key priority issues on the marine and coastal environment including modification/loss of habitats, modification of streamflow, coastal erosion and overexploitation of living resources. The regional approach proposed for this project offers considerable added value over and above single country projects as it will allow for sharing of expertise in the region, regional capacity building and prediction of regional impacts and extrapolation of results to all major ecosystems on the sub-continent and from one country to another.

## 3. COSTS AND FINANCING (MILLION US \$)<sup>1</sup>

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### International & bilateral sources:

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	Financing by potential source:	USD1.296
	Subtotal international financing:	USD1.296
Co-financing:	Governments in cash & kind:	USD1.241
	Subtotal Co-financing:	USD1.241
Total Project Cost:		USD 2.537

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## 4. GOVERNMENT ENDORSEMENT(S)

Cote d'Ivoire: Ministry of Environment

Kenya: Director, Kenya Marine and Fisheries Research Institute (KMFRI)

Mozambique: Ministry for the Co-ordination of Environmental Affairs

Nigeria: Honourable Minister, Ministry of Environment

Senegal: Ministry of Environment

Seychelles: Principal Secretary, Ministry of Environment

South Africa: Honourable Minister, Department of Environmental Affairs & Tourism (DEAT)

## 5. GOVERNMENT FOCAL POINT(S)

Cote d'Ivoire: Environment Department, Centre of Oceanographic Research

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<sup>1</sup> This budget is preliminary and has not undergone a full consultation process with the respective countries. Therefore, it does not indicate the actual financial commitment that would be provided by participating countries once the project proposal and its components are finalised.

Kenya: Kenya Marine and Fisheries Research Institute and Meteorological Department  
Mozambique: Mrs Telma Manyate, Coastal Zone Mangement Department, DNGA, Ministry for the Co-ordination of Environmental Affairs  
Nigeria: Dr. A. Solarin, Nigerian Institute for Oceanography and Marine Research (NIOMR) Director, Federal Department of Fisheries  
Senegal: Fatimato Dia Tousi, Direction of Environment and Classified Establishments  
Seychelles: Mr R. Payet, Chairman National Climate Change Committee, Ministry of Environment  
South Africa: Director General, Department of Environmental affairs and Tourism (DEAT)

## **6. AFRICAN PROCESS WORKING GROUP FOCAL POINT(S)**

Country Co-ordinators on the Programme of Interventions of the Partnership Conference of the African Process:

Cote d'Ivoire: Dr Jaques Abe, Centre de Reserches Oceanologiques  
The Gambia: Dr Momodou Cham, National Environment Agency  
Kenya: Ali Mohamed; National Environment Secretariat  
Mozambique: Dr Evaristo Baquete, Ministry for Coordination of Environmental Affairs (MICOA)  
Nigeria: Dr Larry Awosika, Nigerian Institute for Oceanography and Marine Research  
Senegal: Mr BA Elimane, Direction de l'Environnement et des Etablissements Classés  
Seychelles: Mr Terry Jones, Ministry of Tourism and Transport  
South Africa: Mr Andre Share, Marine & Coastal Management, Department of Environmental Affairs & Tourism

Co-ordinator and experts of the Thematic Working Group on the Programme of Interventions of the Partnership Conference of the African Process

Co-ordinator: Dr Barry Clark, Zoology Department, University of Cape Town, South Africa  
Experts: Mr Jacob Ochiewo, Kenya Marine and Fisheries Research Institute, Kenya  
Dr Kwame Koranteng, Marine Fisheries Research Division, Ministry of Food and Agriculture, Ghana

## PROJECT DESCRIPTION

### 1. BACKGROUND & JUSTIFICATION

The greenhouse effect is a natural phenomenon that makes life on earth possible. Incoming solar radiation is trapped by certain gases in the atmosphere and acts to warm the earth's surface. The concentrations of these greenhouse gasses in the atmosphere have fluctuated in the geological past due to natural causes. However, since pre-industrial times (about 1750), greenhouse gases are thought to have increased dramatically due to human activities such as the burning of fossil fuels, intensive agriculture and industrial processes. It is estimated that Global CO<sub>2</sub> concentrations have been increasing at a rate of ~1.3 parts per million per year for the last 35 years, with a doubling of atmospheric CO<sub>2</sub> over the last 100 years. The result is the 'Enhanced Greenhouse Effect', which appears to be causing global atmospheric and sea temperatures to rise. Recent estimates suggest that annual global air surface temperatures have already warmed by 0.6°C over the period 1861-1997, and are likely to continue doing so (Jones *et al.* 1999<sup>2</sup>). The International Panel on Climate Change (IPCC) predict that air temperatures will have risen by 1.2°C by 2020, 2.1°C by 2050 and 3.2°C by 2080. It is predicted that sea surface temperatures will increase along with air temperature, although not as rapidly or to the same extent, owing to the greater thermal inertia of the ocean compared with the atmosphere.

Various climate models and scenarios have been developed to simulate past climate and predict future trends. The most successful and widely favoured of the methods use results from large-scale atmospheric models, known as General Circulation Models (GCMs). Preliminary work that has been undertaken in South Africa with General Circulation Models indicates that considerable changes in weather and circulation patterns can be expected, but it is not clear what the effects this may have on marine and coastal ecosystems. It is likely, for example, that changes in atmospheric circulation patterns will affect the upwelling regimes off the west coast of Africa. High primary productivity in upwelling areas around the world support large commercial fisheries, providing up to 20% of the world's marine fish catch. Upwelling relies on longshore winds and the effects of the earth's rotation to drive surface water offshore allowing nutrient rich subsurface waters to move up to the surface. There is a possibility that under the influence of global climate change these wind regimes may change, leading to the collapse of the upwelling systems and their associated high productivity. Another potentially important affect of global climate change are the effects on rainfall patterns. Rainfall patterns over southern Africa are expected to change by as much as 20% (mostly decreases) under a double CO<sub>2</sub> scenario (predicted to occur in about 2020). Reductions and modifications in streamflow are inevitable, and severe impacts to estuaries (among other things) are expected as a result. Estuaries are dependent on freshwater runoff, which ensures that their mouths remain open or at least open periodically to allow the ingress and egress of marine species. From an ecological point of view, estuaries are extremely important habitats, used by many commercially important fish and invertebrate species (such as prawns) as feeding and nursery grounds. Loss of estuarine habitats or reduction in estuarine functioning is likely to have a severely detrimental impact on estuarine associated fish and invertebrate species and on the associated commercial, artisanal and subsistence fisheries.

High populations densities exist in coastal areas in sub-Saharan African, with a correspondingly high proportion of people reliant on harvesting of marine living resources for their livelihoods. It is vitally important therefore for these countries to obtain some sort of advance warning regarding the likely effects of climate change and the implications these may have on marine living resources and peoples' livelihoods. Most climate change studies in Africa have dealt exclusively with impacts of sea level rise, and there has been little research into impacts of other aspects of climate change. As a result, few of the existing ICZM and/or development plans integrate likely future changes into their designs. Policy makers from government and industry are now demanding this kind of information in order to make more informed decisions and plans.

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<sup>2</sup> Jones, P.D., M. New, D.E. Parker, S. Martin & I.G. Rigor. 1999. Surface air temperature and its changes over the past 150 years. *Reviews of Geophysics* 37: 173-199.

## 2. OBJECTIVE & EXPECTED RESULTS

The overall objective of this project is to try and assess the likely impacts of climate change on key marine and coastal ecosystems in sub-Saharan Africa, using General Circulation Model (GCM) data. This project will build on the work that has been done to date, and will attempt to refine any existing prediction regarding the effect of climate change on living marine resources in sub-Saharan Africa. Information yielded by this project will be invaluable for future planning with regards to management of living marine resources.

The immediate objectives and expected results (outputs) are to:

1. Develop predictions regarding likely changes in key climate variables (e.g. air temperature, rainfall, wind fields) and their effects on key oceanographic and coastal variables and processes (e.g. SST, ocean currents, upwelling, stream flow) Expected output(s):

- Predictions regarding likely changes in key climate variable over southern Africa including air temperature, rainfall, wind fields Predictions regarding likely changes in key oceanographic and coastal variable and processes including sea surface temperature, ocean currents, upwelling and stream flow, affecting marine and coastal environments off participating countries Identify areas and regions along the coast that are likely to suffer the greatest impact as a result of changing climatic conditions and undertake detailed case studies in these areas

Expected output(s): Areas and regions of greatest biophysical change/impact identified Detailed case study assessments in identified key areas of potential changes to physical coastal and oceanographic processes and their effects on living resources and biodiversity Assess likely socio-economic impacts on human populations in the coastal zones of participating countries

Expected output(s): Predictions regarding socio-economic impacts of climate induced changes in marine resources and their availability in participating countries

4. Build capacity within relevant government departments and research organisations to monitor changes and address the implications thereof (i.e. planning)

Expected output(s): Enhanced capacity within government departments and research organisation in the region to monitor, predict and address long-term changes in biophysical and ecological oceanographic and coastal processes

- Likely climate induced changes accounted for in long-range management plans

5. To disseminate result of assessments as widely as possible, particularly to decision makers in sub-Saharan Africa, to raise awareness of potential implications of global climate change in the region

Expected output(s): Research reports, publications, presentations, web sites

## 3. PROJECT COMPONENTS/ACTIVITIES

To achieve the above objectives, the project will be carried out in the form of major components with corresponding activities:

1. Use global climate models to generate predictions on future changes in important climatic variables over sub-Saharan Africa including air temperature, wind fields and rainfall patterns
  - Researchers experienced in working with General Circulation Models to generate outputs on current and future predicted climate scenarios for participating countries from a variety of GCM models (e.g. Hadley Genesis, CSM Models)
  - Convene workshops to discuss and compare results obtained
2. Develop and/or adapt existing conceptual models to predicted effects of altered weather patterns on sea surface temperature, ocean currents, upwelling patterns and stream flow
  - Assess suitability of existing conceptual models to predict effects of altered weather patterns on key biophysical processes; identify, adapt and/or develop models suitable for the purpose
  - Develop predictions regarding likely effects of climate change on key coastal and oceanographic processes and variables

- Convene workshops to compare and discuss results for different countries
- 3. Develop predictions as to the likely effects of changes in key coastal and oceanic processes on marine living resources and biodiversity
  - Assess suitability of existing conceptual models to predict effects of changes in key biophysical processes; identify, adapt and/or develop models suitable for the purpose
  - Develop predictions regarding likely effects of climate change on marine living resources and biodiversity
  - Convene workshops to compare and discuss results for different countries
- 4. Assess socio-economic implications of climate induced changes to marine living resources and biodiversity
  - Researchers to assess likely impacts of climate induced changes to marine living resources and biodiversity on fishers, fisheries, coastal communities and national economies
- 5. Develop management recommendation to address resulting effects of climate change on ecosystem processes and resources
  - Develop management recommendations and assist national governments and regional agencies to develop policies and plans to cope with anticipated changes Disseminate results of the study as widely as possible within the region
  - Distribute research reports and publish research results, deliver presentations to key government departments, develop web site for reporting and communicating of research results
  - Run capacity building and training workshops as required to ensure adequate capacity in all countries and continued research activity in all countries

#### **4. LINKAGES TO OTHER NATIONAL OR REGIONAL ACTIVITIES / TRANSBOUNDARY ASPECTS**

A large amount of time and energy has been invested in researching likely impacts of climate change and in long-term monitoring of key environmental variables. Establishing links with as many of these programmes and projects as possible will reduce overlap and duplication of effort. As a minimum links will be established with the following existing programmes:

- Kenya 'Réhabilitation d'urgence d'infrastructures endommagées par les inondations de 1997 (El Nino) (AFD)
- Observation system for hydrological cycles in West Africa (FFEM)
- Regional pilot Project for the acquisition and dissemination of hydrological data (FFEM)
- Institutional co-operation in the field of Environmental Impact Assessment in Mozambique (NORAD)
- Reversing Land and Water Degradation Trends in the Niger River Basin (GEF)
- Land-Ocean Interactions in the Coastal Zone (LOICZ) Project of the International Geosphere-Biosphere Programme: A study of Global Change of the International Council of Scientific Unions ([ICSU](#))
- Benguela Current Large Marine Ecosystem (BCLME) project (GEF)
- Canary Current Large Marine Ecosystem (CCLME) project (GEF)
- Guinea Current Large Marine Ecosystem (GCLME) project (GEF)
- Protection of the Marine and Coastal Environment of the Western Indian Ocean (GEF)
- Management of the Senegal River project (FFEM)
- Global Ocean Observing System for Sustainable Integrated Management of the Marine and Coastal Environment and Resources in Africa (GOOS Africa) (IOC-UNESCO)
- Reversing Land and Water Degradation Trends in the Niger River Basin (GEF)
- Global Water Partnership
- Ocean Data and Information Network for Africa (ODINAFRICA) (IOC-UNESCO)

Links with these programmes will be established and maintained through activities such as: studying and reviewing the research of results from other projects and programmes (at the start of the project), regional SS Africa workshop to which leaders/specialists of all programmes will be invited to discuss their results and work.

#### **5. DEMONSTRATIVE VALUE & REPLICABILITY**

Assessments of the impacts of global climate change on coastal and oceanographic processes and variables, marine living resources, biodiversity, fisheries and coastal communities will be undertaken in 7 countries from east, west and southern Africa. This regional approach will allow for extrapolation of research results to all coastal countries in sub-Saharan Africa. Capacity and expertise developed in this project can be transferred to other countries in the region where similar assessments can be completed in the future.

## **6. RISKS AND SUSTAINABILITY**

A number of risks have been identified that could threaten the sustainability of this project. These include:

- Project executants unable to secure data from General Circulation Models
- Insufficient expertise available within participating countries to undertake necessary assessments
- National governments afford assessment of climate change impacts too low a priority
- National governments being unable to afford in-country contributions required to fund/sustain the project
- National governments unwilling/unable to adopt recommendations developed by the project
- Political instability

It is clear that implementation of this projects is not without risk. However, the level of risk associated with the proposed project is considered “acceptable” in the context of the clear need to identify and assess likely impacts of global climate change on marine and coastal resources and biodiversity. A number of measures have nevertheless been incorporated into project design to mitigate this risk where possible:

- Building capacity within national governments and other research institutions involved in climate and fisheries related research is considered an important component of this project. Exchange of information and expertise between countries within the region, as well as south-south collaboration between African and Southeast Asian and north-south collaboration between European and African countries will be given a high priority on this project.
- Links will have to be established with appropriate institutions in the USA and Europe to affect the necessary transfer of data, skills and expertise
- Significant cost saving will be incurred through simultaneous implementation of the project in several countries within the sub-Saharan African

To further assist in the assessment of risk for this project, potential risks are identified in the logical framework (see Annex 1).

## **7. STAKEHOLDER PARTICIPATION**

Many stakeholders stand to benefit from the information generated by this project, including governments, government departments, other decisions making agencies, fisheries management institutions, research institutes, private industry, coastal users, coastal communities, etc. Opportunities will be created to involve all of these stakeholders in the project whilst it is underway and to make it easy for them to gain access to the data and information generated by the programme. All reports, data and assessments generated by the programme will be available on the internet and the project itself will be given the widest exposure possible.

## **8. PROJECT MANAGEMENT & IMPLEMENTATION ARRANGEMENTS**

It is envisioned that this project will be implemented as a set of coordinated activities in each of the participating countries. Data and information requirements for each country are likely to be similar, as will requirements for capacity building and skills transfer. It makes sense therefore to have a regional coordinating committee that can oversee and direct activities within all countries. The committee will comprise experts from each of the participating countries that will be required to ensure that each of the participating countries have access to the necessary expertise, data and training at required intervals. National coordinators will ensure that activities proceed smoothly in each country and will also be required to report regularly to the regional coordinating body and funding organisations on progress within their countries. Institutions and individuals within each participating countries with the appropriate skills and expertise will be identified to undertake tasks necessary to complete the project.

## 9. PROJECT FINANCING & DURATION

The project is expected to last for a total of four years and is expected to cost \$1,333,000. A detailed breakdown of costs for all phases and activities is shown below. Costs to National governments will be in the form of in-kind contributions only.

Table 1. Component & Activity Financing

	External Source of Funds	National Government		Total
		Cash	In-kind	
	Source 1			
1. Generate predictions on future climate scenarios				
1.1 Capacity building and training workshops	180,000.00		\$180,000.00	\$360,000.00
1.2 Use GCMs to generate outputs on current and future predicted climate scenarios	\$120,000.00		\$120,000.00	\$240,000.00
1.3 Workshops to discuss and compare results	\$48,000.00		\$48,000.00	\$96,000.00
2. Model changes in climate variables on ocean and coastal processes				
2.1 Develop models to predict effects of altered weather patterns on key ocean and coastal processes, generate outputs	\$250,000.00		\$250,000.00	\$500,000.00
2.2 Convene workshops to compare and discuss results	\$48,000.00		\$48,000.00	\$96,000.00
3. Model effects of climate change on marine resources and biodiversity				
3.1 Develop models to predict effects of changes in key biophysical processes on resources, biodiversity, and socio-economic indicators, generate outputs	\$350,000.00		\$350,000.00	\$700,000.00
3.2 Convene workshops to compare and discuss results	\$40,000.00		\$40,000.00	\$80,000.00
4. Develop management recommendation				
4.1 Develop management recommendations, assist national governments to develop policies and plans to cope with anticipated changes	\$100,000.00		\$80,000.00	\$180,000.00
5. Disseminate results of the study				
5.1 Distribute research reports and publish research results	\$40,000.00		\$5,000.00	\$45,000.00
5.2 Capacity building and training workshops	\$120,000.00		\$120,000.00	\$240,000.00
<b>TOTAL</b>	<b>\$1,296,000.00</b>		<b>\$1,241,000.00</b>	<b>\$2,537,000.00</b>

Note: This budget is preliminary and has not undergone a full consultation process with the respective countries. Therefore, it does not indicate the actual financial commitment that would be provided by participating countries once the project proposal and its components are finalised.

## 10. MONITORING, EVALUATION & DISSEMINATION

Monitoring and evaluation will be coordinated through the regional coordinating team. This team will comprise the national coordinators from each of the participating countries as well as international experts on climate change and representative from the international partnering institutions and contributing donors. A detailed plan for the entire project and all national activities will be drawn up as part of a more detailed project proposal. It will be the responsibility of the national coordinators to ensure that in-country activities proceed according to the proposed schedule. Regular in-country and regional reporting sessions will be held for the purpose of monitoring progress, identifying areas in which additional assistance or input is required, for sharing information and exchanging ideas. Technical experts from the different countries will be

required to work particularly closely together in accessing and processing data from the General Circulation Models. Training programmes will be run at the start of the programme to ensure that all participating experts are familiar with the techniques and software required for accessing and analysing data for the project.

## 11. WORK PLAN AND TIMETABLE

Table 2 : Outline Work Plan and Timetable

1.1 Year	1				2				3			
1.2 Quarter	1	2	3	4	1	2	3	4	1	2	3	4
Establish regional coordinating committee, appoint national coordinators, identify national and international participating institutions, identify national and international team members												
Use Global Climate Models to generate predicted changes in key climate variable												
Develop and/or adapt conceptual models to predicted effects of altered weather patterns on wind fields, upwelling, SST, and stream flow												
Develop predictions on the likely effects of changes in key physical variable on marine, estuarine and coastal processes												
Develop management recommendation to mitigate resulting effects on ecosystem processes												
<b>Publicise results of the study</b>												

**ANNEX 1: LOGFRAME MATRIX**

	<b>OBJECTIVELY VERIFIABLE INDICATORS</b>	<b>MEANS OF VERIFICATION (MONITORING FOCUS)</b>	<b>CRITICAL ASSUMPTIONS AND RISKS</b>
<b>OVERALL GOAL</b>			
To assess the likely impacts of climate change on key marine and coastal ecosystems in sub-Saharan Africa	<ul style="list-style-type: none"> <li>Completed assessments for all participating countries</li> <li>Increased awareness of likely impacts and implications of climate change</li> <li>Inclusion of climate change in key policy documents</li> </ul>	<ul style="list-style-type: none"> <li>Peer review of assessment reports</li> <li>Public interviews and surveys</li> <li>Surveys of popular literature, newspapers, magazines etc.</li> </ul>	<ul style="list-style-type: none"> <li>Project is funded</li> <li>Continued political and financial support for sub-Saharan Africa</li> <li>National governments recognise importance of potential climate change impacts</li> <li>Sufficient capacity and expertise available within the region to undertake required assessments</li> <li>No major adverse changes in environmental, and economic conditions in the Region</li> </ul>
<b>PROJECT OBJECTIVES</b>			
1. To develop predictions regarding likely changes in key climate variables and their effects on key oceanographic and coastal variables and processes	<ul style="list-style-type: none"> <li>Data outputs from GCMs for sub-Saharan Africa</li> <li>Conceptual models developed to simulate effects of climate change on marine and coastal ecosystems</li> </ul>	<ul style="list-style-type: none"> <li>Peer review of data reports, predictions and models</li> <li>Workshop reports</li> </ul>	<ul style="list-style-type: none"> <li>Sufficient capacity and expertise available within the region to generate GCM data</li> <li>National governments commit required personnel and resources to project</li> </ul>
2. Identify areas and regions along the coast that are likely to suffer the greatest impact as a result of changing climatic conditions and undertake detailed case studies in these areas	<ul style="list-style-type: none"> <li>Completed assessments for all participating countries</li> <li>Case study reports</li> </ul>	<ul style="list-style-type: none"> <li>Peer review of assessments and case study reports</li> </ul>	<ul style="list-style-type: none"> <li>Sufficient funding available to complete case study assessments</li> </ul>
3. Assess likely socio-economic impacts on human populations	<ul style="list-style-type: none"> <li>Socio-economic assessment reports produced on schedule</li> </ul>	<ul style="list-style-type: none"> <li>Peer review of socio-economic impact assessment reports</li> </ul>	<ul style="list-style-type: none"> <li>Sufficient funding and expertise available to complete socio-economic assessments</li> </ul>
4. Build capacity within relevant government departments and research organisations	<ul style="list-style-type: none"> <li>Increase in research output</li> <li>Improved capacity to manage and monitor climate change and impacts thereof</li> </ul>	<ul style="list-style-type: none"> <li>Publications produced by academics and researchers in the region</li> <li>Interviews with private sector</li> </ul>	<ul style="list-style-type: none"> <li>National governments recognise importance of potential climate change impacts</li> <li>Continued financial support for the project</li> </ul>
<b>OUTPUTS</b>			
Predictions regarding likely changes in key climate variable over southern Africa	<ul style="list-style-type: none"> <li>Reports produced by each country</li> </ul>	<ul style="list-style-type: none"> <li>Peer review of status reports</li> </ul>	<ul style="list-style-type: none"> <li>Sufficient expertise available within each country</li> </ul>

	<b>OBJECTIVELY VERIFIABLE INDICATORS</b>	<b>MEANS OF VERIFICATION (MONITORING FOCUS)</b>	<b>CRITICAL ASSUMPTIONS AND RISKS</b>
Predictions regarding likely effects of climate change on key coastal and oceanographic processes and variables	<ul style="list-style-type: none"> <li>Assessment reports, workshop reports, climate change predictions</li> </ul>	<ul style="list-style-type: none"> <li>Peer review of assessment and workshop reports</li> </ul>	<ul style="list-style-type: none"> <li>National governments recognise importance of potential climate change impacts</li> <li>Sufficient expertise available within each country</li> <li>Continued support for the project</li> </ul>
Predictions regarding likely effects of climate change on marine and coastal resources and biodiversity	<ul style="list-style-type: none"> <li>Assessment reports, workshop reports, climate change predictions</li> </ul>	<ul style="list-style-type: none"> <li>Peer review of assessment and workshop reports</li> </ul>	<ul style="list-style-type: none"> <li>National governments recognise importance of potential climate change impacts</li> <li>Sufficient expertise available within each country</li> <li>Continued support for the project</li> </ul>
Predictions regarding likely socio-economic impacts of climate change	<ul style="list-style-type: none"> <li>Assessment reports, workshop reports, climate change predictions</li> </ul>	<ul style="list-style-type: none"> <li>Peer review of assessment and workshop reports</li> </ul>	<ul style="list-style-type: none"> <li>National governments recognise importance of potential climate change impacts</li> <li>Sufficient expertise available within each country</li> <li>Continued support for the project</li> </ul>
Enhanced capacity within government departments, research organisations, Enhanced capacity within relevant government departments, research organisations, & industry	<ul style="list-style-type: none"> <li>Training workshop reports</li> <li>Record of attendance at training workshops</li> <li>Increased capacity within government and industry to manage and study climate change</li> </ul>	<ul style="list-style-type: none"> <li>Interviews with government and industry personnel</li> </ul>	<ul style="list-style-type: none"> <li>Government commitment to investigating and dealing with likely impacts of global climate change</li> <li>Continued support for the project</li> </ul>
<b>PROJECT ACTIVITIES</b>			
Project initiation (Identify key roles player in each country, establish regional and national coordinating bodies, establish contact with key institutes, research centers and organizations, Run capacity building and training workshops)	<ul style="list-style-type: none"> <li>Reports from regional and national meetings</li> <li>Training workshop reports</li> <li>Record of attendance at training workshops</li> </ul>	<ul style="list-style-type: none"> <li>Peer review of meeting reports</li> <li>Interviews with participants at training workshops</li> </ul>	<ul style="list-style-type: none"> <li>Government commitment to investigating and dealing with likely impacts of global climate change</li> <li>Continued support for the project</li> </ul>
Use GCMs to develop predictions of likely changes in key climate variable over southern Africa	<ul style="list-style-type: none"> <li>Assessment reports, workshop reports, climate change predictions</li> </ul>	<ul style="list-style-type: none"> <li>Peer review of assessment and workshop reports, climate change impact reports</li> </ul>	<ul style="list-style-type: none"> <li>Sufficient expertise available within each country</li> <li>Continued support for the project</li> </ul>

	<b>OBJECTIVELY VERIFIABLE INDICATORS</b>	<b>MEANS OF VERIFICATION (MONITORING FOCUS)</b>	<b>CRITICAL ASSUMPTIONS AND RISKS</b>
Develop predictions regarding likely effects of climate change on marine and coastal resources and biodiversity	<ul style="list-style-type: none"> <li>Assessment reports, workshop reports, climate change predictions</li> </ul>	<ul style="list-style-type: none"> <li>Peer review of assessment and workshop reports, climate change impact reports</li> </ul>	<ul style="list-style-type: none"> <li>Sufficient expertise available within each country</li> <li>Continued support for the project</li> </ul>
Develop predictions regarding likely socio-economics impacts of climate change	<ul style="list-style-type: none"> <li>Assessment reports, workshop reports, climate change predictions</li> </ul>	<ul style="list-style-type: none"> <li>Peer review of assessment and workshop reports, climate change impact reports</li> </ul>	<ul style="list-style-type: none"> <li>Sufficient expertise available within each country</li> <li>Continued support for project</li> </ul>
Develop management recommendations and present to national government authorities for endorsement	<ul style="list-style-type: none"> <li>Management recommendation reports</li> <li>National policy documents published by relevant government agencies</li> </ul>	<ul style="list-style-type: none"> <li>Peer review of recommendations</li> <li>Review of national policy documents and legislation frameworks</li> </ul>	<ul style="list-style-type: none"> <li>Government willingness to modify existing policies and/or adopt new policies</li> <li>Continued support for project</li> </ul>
Publish and disseminate results of the project	<ul style="list-style-type: none"> <li>Presentations, research reports and publications</li> </ul>	<ul style="list-style-type: none"> <li>Enumeration of research reports and publications</li> <li>Interviews with researchers in government</li> </ul>	<ul style="list-style-type: none"> <li>Government commitment to project</li> <li>Continued support for project</li> </ul>