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GOOS – AFRICA:
Global Ocean
Observing System
for SICOM



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SUMMARY

Fifty eight Delegates to the PACSICOM, including representatives from seventeen coastal countries in Africa, attended the Technical Workshop on GOOS-Africa: *Data for Sustainable Integrated Coastal Management (SICOM) in Africa, Global Ocean Observing Systems for SICOM in Africa*. The discussions led to specific recommendations regarding marine data and information needs in Africa which were taken forward to the Ministerial Conference which formed the culmination of PACSICOM. The Workshop also laid the foundation for a supporting organizational framework for the Global Ocean Observing System in Africa (GOOS-AFRICA).

The overall objective of the Workshop was to improve and strengthen marine data acquisition, analysis and interpretation capabilities in support of SICOM in Africa. This recognized that marine data and information, especially the location of resources, trends in environmental change and forecasts of extreme events, are essential aids in decision making for coastal managers concerned with such basic human needs as the security of health, food, shelter, water and energy. They also contribute to improving opportunities for the creation of wealth through offshore and coastal industry, marine trade, mariculture and aquaculture, and tourism. Equally, the information will enable governments to monitor their own performance against targets set out in the major international Conventions and Agreements such as Agenda 21.

The Workshop recommended investment in the following top priority activities to provide a sound marine data base in support of SICOM in Africa:

- (i) Encourage the formation of an Africa-wide network of national ocean data centres that are properly equipped and staffed by trained personnel;
- (ii) Upgrade and expand the present African network of stations for the measurement of tides and sea-levels so as to provide warnings on potentially hazardous and costly changes in the local marine environment - such as sea-level rise;
- (iii) Create a network of specialists trained in the use of data acquired by remote sensing from space satellites so that coastal managers have ready access to the rapidly increasing wealth of spatial data on the coastal environment;
- (iv) Facilitate the further implementation of modern electronic communication systems such as Internet connections and data transfer mechanisms so as to promote effective communication and availability of information for coastal planning.

The participants in the Workshop took the view that what happens in coastal seas is commonly a function of ocean and atmospheric processes on regional and global scales. Thus there is potential for the Global Ocean Observing System to address the needs of SICOM in Africa. The second part of the Workshop was therefore concerned with the design of a supporting organizational framework, GOOS-AFRICA, with the following hierarchy of bodies and responsibilities:

- (i) National GOOS Co-ordinating Committees to articulate user needs, to develop plans for operational oceanography in respect of environmental processes and living resources at sea and along the coast, to facilitate data acquisition for the responsible national agencies, and to promote product application and dissemination;
- (ii) Regional GOOS bodies to bring together existing initiatives, to strengthen regional capabilities, to develop further regional pilot projects and to encourage capacity building;
- (iii) A Co-ordinating Committee for GOOS-AFRICA to oversee the development of GOOS in Africa through the implementation of a GOOS-AFRICA Strategic Plan, and to provide the necessary liaison with the international GOOS activities and other partners in GOOS.

The Workshop sets out these recommendations and structure for the attention of the scientific community, funding agencies, potential donors, appropriate regional bodies and national governments in Africa and for the United Nations bodies including UNESCO and its IOC.

RESUME

Cinquante-huit délégués présents à la PACSICOM, parmi lesquels les représentants de 17 pays côtiers d'Afrique, ont assisté à l'Atelier technique sur les données destinées à la gestion intégrée des zones côtières dans une perspective durable (SICOM) en Afrique, les systèmes mondiaux d'observation de l'océan au service de la SICOM en Afrique. A l'issue des débats, des recommandations spécifiques ont été faites concernant les besoins de l'Afrique en données et information marines; elles ont ensuite été soumises à la Conférence ministérielle qui constituait l'apogée de la PACSICOM. L'Atelier a également jeté les bases d'un cadre structurel à l'appui du Système mondial d'observation de l'océan en Afrique (GOOS-AFRIQUE).

L'Atelier avait pour objectif général d'améliorer et de renforcer l'acquisition des données marines, leur analyse et les capacités d'interprétation à l'appui de la SICOM en Afrique. Les participants ont reconnu que les données et informations marines, en particulier celles concernant la localisation des ressources, les tendances de l'évolution environnementale et les prévisions des événements extrêmes, étaient indispensables aux responsables de la gestion des zones côtières pour prendre en connaissance de cause des décisions concernant des besoins humains aussi fondamentaux que la sécurité sanitaire, l'alimentation, l'habitat, l'eau et l'énergie. Elles contribuent également à améliorer les possibilités de créer des richesses grâce aux industries offshore et côtières, au commerce maritime, à la mariculture, à l'aquaculture et au tourisme. Ces informations permettront également aux gouvernements de comparer leurs propres résultats aux objectifs définis dans les principaux Accords et Conventions internationaux, Action 21 par exemple.

L'Atelier a recommandé d'investir dans les activités absolument prioritaires ci-après afin de constituer une base solide de données marines à l'appui de la SICOM en Afrique :

- (i) encourager à l'échelle de l'Afrique tout entière, la formation d'un réseau de centres nationaux de données océanographiques bien équipés et dotés de personnel qualifié;
- (ii) améliorer et développer l'actuel réseau africain de stations de mesure des marées et du niveau de la mer, afin de pouvoir lancer des avis d'alerte en cas de changements potentiellement dangereux et coûteux de l'environnement marin local - comme par exemple l'élévation du niveau de la mer;
- (iii) créer un réseau de spécialistes formés à l'utilisation des données de télédétection fournies par satellites, de façon que les gestionnaires des zones côtières aient facilement accès aux riches collections de données spatiales relatives à l'environnement côtier, dont le nombre s'accroît rapidement;
- (iv) faciliter l'installation de systèmes modernes de communication électronique, comme les connexions à l'Internet et les mécanismes de transfert de données, afin d'améliorer l'efficacité des communications et la disponibilité de l'information en vue de l'aménagement des côtes.

Les participants à l'Atelier ont été d'avis que les phénomènes qui se produisent dans les mers bordières sont généralement fonction de processus océaniques et atmosphériques à l'échelle régionale et mondiale. Le système mondial d'observation de l'océan est donc virtuellement à même de répondre aux besoins de la SICOM en Afrique. La deuxième partie de l'Atelier a par conséquent porté sur la conception d'un cadre structurel d'appui, GOOS-AFRIQUE, qui serait doté, dans l'ordre hiérarchique suivant, des organismes et des responsabilités ci-après :

- (i) des comités nationaux de coordination du GOOS chargés d'explicitier les besoins des utilisateurs, d'élaborer des plans d'océanographie opérationnelle en ce qui concerne les processus environnementaux et les ressources vivantes en mer et le long des côtes, de faciliter l'acquisition de données aux organismes nationaux responsables et de promouvoir l'application et la diffusion des produits;
- (ii) des organismes régionaux du GOOS chargés de regrouper les initiatives existantes, de renforcer les capacités régionales, de poursuivre la mise en oeuvre des projets pilotes régionaux et d'encourager le renforcement des capacités;

- (iii) un Comité de coordination pour le GOOS-AFRIQUE chargé de surveiller la mise en place du Système en Afrique grâce à la mise en oeuvre d'un Plan stratégique pour le GOOS-AFRIQUE, et d'assurer les liaisons nécessaires avec les activités internationales du GOOS et d'autres partenaires de celui-ci.

L'Atelier présente ces recommandations et cette structure à la communauté internationale, aux organismes de financement, aux donateurs potentiels, aux organismes régionaux compétents et aux gouvernements nationaux d'Afrique, ainsi qu'aux organismes du système des Nations Unies, notamment l'UNESCO et sa Commission océanographique intergouvernementale.

RESUMEN

Cincuenta y ocho Delegados de PACSICOM, entre ellos representantes de 17 países costeros de Africa, asistieron al Taller Técnico sobre GOOS-Africa: *Datos para una Gestión Integrada y Sostenible de las Zonas Costeras (SICOM) en Africa, Sistemas Mundiales de Observación de los Océanos para la SICOM en Africa*. Los debates dieron lugar a recomendaciones concretas relativas a las necesidades de Africa en materia de información y datos oceanográficos, que se transmitieron a la Conferencia Ministerial con la que culminó PACSICOM. En el Taller también se sentaron las bases de un marco organizativo de apoyo para el Sistema Mundial de Observación de los Océanos en Africa (GOOS-AFRICA).

El objetivo general del Taller era mejorar y fortalecer las capacidades de adquisición, análisis e interpretación de datos oceanográficos a fin de respaldar la SICOM en Africa. Los participantes reconocieron que la información y los datos marinos, en especial la localización de los recursos, las tendencias observadas en los cambios ambientales y las previsiones de fenómenos extremos, son elementos esenciales para facilitar la adopción de decisiones a los administradores de zonas costeras con respecto a necesidades humanas básicas como la seguridad de la salud, la alimentación, la vivienda, el agua y la energía. También contribuyen a ampliar las posibilidades de generar ingresos mediante la industria mar adentro y costera, el comercio marítimo, la maricultura y la acuicultura y el turismo. Asimismo, la información permitirá a los gobiernos supervisar su propio desempeño en relación con los objetivos establecidos en los principales convenios y acuerdos internacionales, como el Programa 21.

Los participantes en el Taller recomendaron que se invirtiera en las siguientes actividades de máxima prioridad para proporcionar una base sólida de datos oceanográficos en apoyo de la SICOM en Africa:

- (i) alentar la constitución de una red africana de centros nacionales de datos oceánicos, adecuadamente equipados y dotados de personal calificado;
- (ii) mejorar y expandir la actual red africana de estaciones de medición de las mareas y el nivel del mar que puedan emitir alertas sobre cambios en el medio ambiente marino local, potencialmente peligrosos y de consecuencias costosas, como aumentos del nivel del mar;
- (iii) crear una red de especialistas en materia de utilización de datos adquiridos por teledetección desde satélites espaciales a fin de que los administradores de las costas tengan fácil acceso al volumen rápidamente creciente de datos espaciales sobre el medio ambiente costero;
- (iv) facilitar la expansión de los sistemas electrónicos modernos de comunicación como las conexiones a Internet y los mecanismos de transferencia de datos a fin de promover una comunicación eficaz y la disponibilidad de información para la planificación relativa a las costas.

Los participantes en el Taller estimaron que lo que sucede en los mares costeros es habitualmente el resultado de procesos oceánicos y atmosféricos de escala regional y mundial. Por esa razón, el Sistema Mundial de Observación de los Océanos puede responder a las necesidades de la SICOM en Africa. Por consiguiente, la segunda parte del Taller se dedicó a la elaboración de un marco organizativo de apoyo, GOOS-AFRICA, con la siguiente jerarquía de órganos y responsabilidades:

- (i) Comités Nacionales de Coordinación del GOOS encargados de definir las necesidades de los usuarios, elaborar planes para la oceanografía operacional con respecto a los procesos ambientales y los recursos biológicos en el mar y a lo largo de las costas, a fin de facilitar la adquisición de datos para los organismos nacionales responsables, y promover la aplicación y difusión de esos productos;
- (ii) órganos regionales del GOOS para agrupar las iniciativas existentes, fortalecer las capacidades regionales, elaborar nuevos proyectos piloto regionales y fomentar la capacitación;
- (iii) un Comité de Coordinación del GOOS-AFRICA encargado de supervisar el establecimiento del GOOS en Africa mediante la ejecución de un Plan Estratégico del GOOS-AFRICA y de constituir el enlace necesario con las actividades internacionales del GOOS y otros copartícipes.

Los participantes en el Taller señalan estas recomendaciones y la estructura propuesta a la atención de la comunidad científica, los organismos de financiación, los posibles donantes, los órganos regionales apropiados y los gobiernos nacionales de Africa, así como los organismos de las Naciones Unidas, comprendida la UNESCO y su COI.

ملخص

اشترك ثمانية وخمسون مندوبا من الموفدين الى مؤتمر عموم افريقيا بشأن الإدارة المتكاملة المستديمة للبيئة الساحلية (PACSICOM)، بمن فيهم ممثلو سبعة عشر بلدا ساحليا في افريقيا، في "حلقة العمل التقنية بشأن النظام العالمي لرصد المحيطات - افريقيا (GOOS-Africa): بيانات من أجل الادارة المتكاملة المستديمة للبيئة الساحلية (SICOM) في افريقيا، النظام العالمي لرصد المحيطات من أجل SICOM في افريقيا". وأسفرت المناقشات عن وضع توصيات محددة بشأن البيانات البحرية والاحتياجات في مجال المعلومات في افريقيا أحييت إلى المؤتمر الوزاري الذي يشكل الهيئة الرئيسية لـ PASICOM. كما أرست حلقة العمل حجر الأساس لإطار تنظيمي داعم للنظام العالمي لرصد المحيطات في افريقيا (GOOS-AFRICA).

وكان الهدف العام لحلقة العمل هو تحسين وتعزيز القدرات في مجال تحصيل البيانات وتحليلها وتفسيرها لدعم الإدارة المتكاملة المستديمة للبيئة الساحلية في افريقيا. وهذا في حد ذاته اعتراف بأهمية البيانات والمعلومات البحرية، وخاصة فيما يتعلق بمواقع الموارد، والاتجاهات في مجال التغيرات البيئية، والتنبؤ بالحالات القصوى، كمعينات أساسية في اتخاذ القرار بالنسبة للمسؤولين عن إدارة البيئة الساحلية المهتمين باحتياجات الإنسان الأساسية كالأمن في مجال الصحة والغذاء والمأوى والمياه والطاقة. وهي تسهم أيضا في زيادة فرص الكسب عن طريق الصناعات في البحار والسواحل، والتجارة البحرية، والزراعة البحرية والزراعة المائية، والسياحة. وبنفس الصورة، ستتمكن هذه المعلومات الحكومات من مراقبة مستوى أدائها بالنسبة للأهداف المحددة في الاتفاقيات الدولية الكبرى مثل جدول أعمال القرن ٢١.

وأوصت حلقة العمل بالعمل بالاهتمام بالأنشطة التالية باعتبارها في قمة الأولوية من أجل توفير قاعدة بيانات بحرية سليمة لدعم الإدارة المتكاملة المستديمة للبيئة الساحلية في افريقيا:

- (١) تشجيع إنشاء شبكة افريقية للمراكز الوطنية لبيانات المحيطات تكون مجهزة على النحو الملائم بالمعدات وبالموظفين المدربين؛
- (٢) تحسين وتوسيع نطاق الشبكة الافريقية الحالية لمحطات قياس المد والجزر ومستويات البحر من أجل التحسب لظواهر التغيرات الطبيعية في البيئة البحرية المحلية - مثل ارتفاع مستوى البحر - التي قد تترتب عليها آثار خطيرة ومكلفة؛
- (٣) إنشاء شبكة أخصائيين مدربين على استخدام البيانات التي يتم الحصول عليها عن طريق الاستشعار عن بعد بواسطة التتابع الفضائية بحيث يتسنى للمسؤولين عن إدارة البيئة الساحلية أن يستخدموا مباشرة البيانات الوفيرة عن البيئة البحرية المتاحة بفضل التتابع الفضائية؛
- (٤) تيسير الاستعانة بنظم الاتصال الإلكتروني الحديثة مثل الروابط مع شبكة انترنت وآليات نقل البيانات من أجل تعزيز الاتصال الفعال وتوافر المعلومات لتخطيط البيئة الساحلية.

ورأى المشتركون في حلقة العمل أن ما يحدث في البحار بقرب السواحل يكون عادة نتيجة اجتماع ظاهرات بحرية ومناخية منها ما هو إقليمي وما هو عالمي. ولذلك فإن بإمكان النظام العالمي لرصد المحيطات أن يعالج احتياجات الإدارة المتكاملة المستديمة للبيئة الساحلية في افريقيا. وانصب الجزء الثاني من حلقة العمل بالتالي، على تصميم إطار تنظيمي داعم "GOOS-AFRICA" يشتمل على الهيئات والمسؤوليات التالية:

(١) لجان تنسيق وطنية لـ GOOS تعنى بتلبية احتياجات المنتفعين بصورة منظمة، واستنباط خطط في مجال علم المحيطات التطبيقي بشأن العمليات البيئية والموارد الحية في البحر وعلى طول الشاطئ؛ وتيسير البيانات من قبل الوكالات الوطنية وتشجيع تطبيق تلك البيانات ونشرها؛

(٢) هيئات إقليمية لـ GOOS تعمل على الربط بين المبادرات الجارية، وتعزيز القدرات الإقليمية، واستحداث المزيد من المشروعات الرائدة الإقليمية، وتشجيع بناء القدرات؛

(٣) لجنة تنسيق لـ GOOS-AFRICA تُعنى بالإشراف على تطور GOOS في افريقيا من خلال تنفيذ خطة استراتيجية لـ GOOS-AFRICA، وتوفير الربط اللازم مع أنشطة GOOS الدولية ومع الشركاء الآخرين في إطار GOOS.

وتعرض حلقة العمل هذه التوصيات وهذه البنية التنظيمية على الأوساط العلمية ووكالات التمويل والمانحين المحتملين والهيئات الإقليمية المعنية والحكومات في افريقيا وعلى هيئات الأمم المتحدة بما فيها اليونسكو واللجنة الدولية لعلوم المحيطات التابعة لها.

RESUMO

Cinquenta e oito delegados junto do PACSICOM, entre os quais representantes de dezassete países litorâneos africanos, assistiram à Oficina Técnica referente ao GOOS-Africa: *Dados para a Administração Sustentável Integrada Litorânea (Sustainable Integrated Coastal Management - SICOM) em África, Sistemas Globais de Observação dos Oceanos para SICOM em África (GOOS-AFRICA)*. As discussões resultaram em recomendações específicas referentes a dados marítimos e a necessidades de informação em África, que foram levadas à Conferência Ministerial que constituiu o ponto alto do PACSICOM. A Oficina também lançou as bases para uma estrutura organizacional de apoio para o Sistema Global de Observação dos Oceanos em África.

O objectivo global da Oficina foi a melhoria e o reforço da recolha de dados marítimos, da análise e da capacidade de interpretação em apoio ao SICOM em África. Reconheceu que os dados marítimos e a informação, nomeadamente a identificação de recursos, tendências nas transformações ambientais e previsões de eventos extremos, são ajudas fundamentais no processo de tomada de decisões para os administradores costeiros afectados por necessidades humanas básicas como a segurança da saúde, a alimentação, o alojamento, o abastecimento em água e energia. Também contribui para a melhoria das oportunidades de criação de riquezas através da indústria costeira ou off-shore, do comércio marítimo, da mareocultura e da aquacultura, bem como do turismo. Da mesma forma, a informação permitirá que os governos controlem a sua própria actuação face aos objectivos fixados nas principais convenções e acordos internacionais, como a Agenda 21.

A Oficina recomendou que sejam efectuados investimentos nas seguintes actividades de prioridade absoluta, com a finalidade de prover uma base de dados marítimos sólida como suporte do SICOM em África:

- (i) Estimular a formação de uma rede em toda a África que englobe todos os centros que detenham dados relativos aos oceanos e que disponham de equipamento adequado e de pessoal treinado;
- (ii) Aperfeiçoar e melhorar a actual rede africana de estações dedicadas à avaliação de marés e de níveis marítimos, de maneira a poder suprir informações sobre mudanças nos litorais potencialmente perigosas no meio ambiente marinho local, tais como a elevação do nível do mar;
- (iii) Criar uma rede de especialistas formados para o uso de dados recolhidos através de captação remota por satélites espaciais, de maneira a permitir aos administradores costeiros pronto acesso à riqueza do acervo de dados, que não cessam de aumentar, referentes ao meio ambiente litorâneo;
- (iv) Facilitar uma melhor implementação dos sistemas modernos de comunicação electrónica como as conexões via Internet e os mecanismos de transferência de dados, de maneira a promover uma comunicação eficaz e a disponibilidade da informação para a planificação litorânea.

Os participantes desta Oficina expressaram a opinião de que o que ocorre nos mares costeiros está geralmente vinculado aos processos oceânicos e atmosféricos em escala regional e global. Por conseguinte, há um potencial para que o Sistema Global de Observação dos Oceanos possa satisfazer as necessidades da SICOM em África. A segunda parte da Oficina foi, consequentemente, dedicada à elaboração de uma estrutura organizacional de apoio, a GOOS-AFRICA, dotada da seguinte hierarquia de órgãos e responsabilidades:

- (i) Comitês Nacionais de Coordenação GOOS, que deverão articular as necessidades dos utentes, desenvolver planos para uma oceanografia operacional que respeite os processos ambientais, a fauna e a flora dos mares e ao longo das costas, facilitar a recolha de dados para as agências nacionais responsáveis e promover a aplicação e a disseminação de produtos;

- (ii) Órgãos regionais GOOS, os quais deverão reunir iniciativas existentes, fortalecer competências regionais, desenvolver projectos pilotos a nível regional e encorajar o aperfeiçoamento das competências;
- (iii) Um Comité de Coordenação para a GOOS-AFRICA, que deverá supervisionar o desenvolvimento dos GOOS em África, através da implementação de um Plano Estratégico GOOS-AFRICA, e fornecer o necessário vínculo com as actividades internacionais dos GOOS e outros parceiros em GOOS.

A Oficina formula essas recomendações e esta estrutura para a atenção da comunidade científica, das entidades de financiamento, dos doadores potenciais, dos órgãos regionais apropriados e dos governos nacionais em África e para os organismos da Nações Unidas, inclusivamente a UNESCO e o seu COI.

1. INTRODUCTION

The Pan-African Conference on Sustainable Integrated Coastal Management (PACSICOM) took place in Maputo, Mozambique, from July 18th to 24th, 1998.

The Conference was convened as part of region-wide efforts to give greater impetus to the management of seas and the coasts in Africa. It brought together Ministers and senior officials from all over Africa, as well as from international agencies, non-governmental organizations and bilateral financial institutions. The Conference offered a unique opportunity for discussing the state of the coastal and marine environment in Africa, with special focus on the need for concerted intergovernmental dialogue.

The main objectives of PACSICOM were:

- (i) to represent a major contribution by Africa to the observance of the United Nations *International Year of the Ocean* and *EXPO'98*;
- (ii) to assess and review the efforts and experiences in sustainable integrated coastal management (SICOM) in Africa over the last two decades;
- (iii) to help to strengthen sustainable development in coastal zones and areas otherwise affected by marine processes in Africa, to raise awareness about the urgent need for well-co-ordinated global actions, and to help establish a strategic and integrated plan of action for the coastal management of Africa;
- (iv) to initiate the PACSICOM Process, comprising (a) PACSICOM itself, whose main outputs include the Maputo Declaration, (b) a Pan-African Conference (Cape Town, South Africa, 30 November - 4 December 1998) to promote intra-African co-operation in the implementation of regional conventions, programmes and Action plans to protect, manage and develop Africa's marine and coastal environment, (c) a Partnership Conference to be held in 2001, in close co-operation with Africa's development partners, to consider a set of proposals for funding in addressing major priorities for actions identified by the PACSICOM and Cape Town Conferences. The emphasis and focus will be on funding.

The conference was organized in three parts: (i) the Technical Congress (18-20 July), consisting primarily of a set of workshops on different aspects of the theme of Sustainable Integrated Coastal Management (SICOM); (ii) a Cross-Cutting Workshop (21 and 22 July) to integrate the output from the Technical Congress; and (iii) a Ministerial Conference (23 and 24 July 1998) with high level decision makers (including Ministers) to review the output of the Technical Congress, to consider political implications and socio-economic factors, and to approve the "Maputo Declaration", "PACSICOM Statement", "PACSICOM Resolutions" on the principles of sustainable development for the coastal zones and areas of Africa related to marine influences.

This report describes the outcome of the workshop on Data for SICOM: Global Ocean Observing System for SICOM in Africa: GOOS-AFRICA. This workshop was included in the Technical Congress because the sustainable management of the marine environment in coastal seas everywhere requires information based on data obtained by national operational oceanographic and marine meteorological observing systems. The demand for this information has increased recently because of the increase in national jurisdiction over resources in Exclusive Economic Zones, and because of the pressures placed on coastal seas by growing populations and increased pollution from land. Marine data and information are particularly important to Africa, bounded as it is by the Atlantic and Indian Oceans and the Mediterranean and Red Seas.

The overall objective of the workshop was to outline a strategy and define an action plan to improve and strengthen the data acquisition, analysis and interpretation capabilities needed to support SICOM in Africa, recognizing that marine data and information, especially trends and forecasts, are essential aids in decision making for coastal managers concerned with such basic human needs as the security of health, food, shelter, water, and energy, as well as with improving opportunities for the creation of wealth through offshore and coastal industry, marine trade, fishing, mariculture and aquaculture, and tourism.

The workshop organizers took the view that what happens in coastal seas is commonly a function of ocean and atmospheric processes happening on regional or global scales. The workshop was therefore designed to assess the usefulness of the Global Ocean Observing System (GOOS) to SICOM in Africa, and an evaluation of the need to increase the involvement of African countries in GOOS through a GOOS-AFRICA

programme. Recognizing that processes on the adjacent land may also affect coastal seas, the workshop also evaluated the possible contribution of the Global Terrestrial Observing System (GTOS) to SICOM in Africa.

PACSICOM was sponsored by the Government of Mozambique, in partnership with the Government of Finland, the United Nations Educational, Scientific and Cultural Organization (UNESCO), the United Nations Environment Programme (UNEP), and the Food and Agricultural Organization of the United Nations (FAO). The African governments and institutions provided support and substantial assistance to the Conference. The workshop reported on here was sponsored by the Intergovernmental Oceanographic Commission (IOC) of UNESCO.

Following the opening of the Technical Congress, the GOOS-AFRICA workshop was opened at 19.00 on the evening of July 18th, continued from 11.00 to 20.00 on July 19th, and from 09.30 to 15.15 on July 20th. The workshop was opened by the conveners, Colin Summerhayes and Justin Ahanhanzo of the IOC, and chaired by Professor Geoff Brundrit of the University of Cape Town, with Professor Maria Snoussi (Morocco), and Larry Awosika (Nigeria) as Rapporteurs in French and English respectively. Simultaneous translation was provided in French and English. There were 45 participants, whose details appear in Annex II. Annex III indicates attendees who are also members of the GOOS-AFRICA Interim Co-ordinating Committee. The agenda for the workshop appears in Annex I.

Prior to the workshop, a series of background papers had been commissioned, so as to be available to inform the workshop discussions. These papers are presented in the separate volume (see UNESCO PACSICOM Technical Workshops proceedings).

Following the technical workshop, the Chairman, the Rapporteurs and the Conveners participated in the Cross-Cutting Workshop (July 21-22), to assist in integrating the results of all the technical workshops and to ensure that the most appropriate recommendations regarding marine and coastal data, and information needs were taken forward for presentation to the meeting of ministers.

2. DATA FOR SUSTAINABLE INTEGRATED COASTAL MANAGEMENT

2.1 OUTLINE OF THE FIRST SESSION

The first session of the Technical Workshop was concerned with the design of a strategy and an action plan to improve and strengthen the data acquisition, analysis and interpretation capabilities needed to support SICOM in Africa. The context for the discussions was set by:

(i) presentations:

- * on GOOS (by Colin Summerhayes, Director of the GOOS Project Office);
- * on the Coastal Module of GOOS (by Larry Awosika, a member of the Coastal GOOS Panel);
- * on GTOS (by Professor Chris Magadza, a member of the GTOS Steering Committee);
- * on Integrated Coastal Area Monitoring Systems (by Dale Kiefer, representing FAO).

(ii) background papers prepared on the needs as perceived from the point of view of different African sub-regions (see UNESCO PACSICOM Technical Workshops proceeding), including:

- * IOC, The Global Ocean Observing System (document also provided in French);
- * Magadza, C., Background review of the Global Terrestrial Observing System, GTOS in Africa;
- * Awosika, L., Marine data and information exchange in west Africa: an important element of GOOS;
- * Koranteng, K.A., Data for sustainable integrated coastal management in western Africa, Regional/Sub-regional Marine Data and Information Collecting and Processing Systems;
- * Snoussi, M., Regional/Sub-Regional Marine Data and Information Systems in Mediterranean/North West-Africa;
- * Purini, R., The management of northern Africa coastal areas: an integrated approach among local observations, satellite data and environmental modelling;
- * Halim, Y., State of data acquisition and information systems in the East Mediterranean and the Red Sea, and proposals for a strategy for GOOS-AFRICA;
- * Ragoonaden, S., The development of Global Ocean Observing System in the Indian Ocean: GOOS-AFRICA or GOOS-WIO;

- * Okemwa, E., and Odido, M., Capacity Building for the Global Ocean Observing System (GOOS): development needs and requirements for eastern Africa;
- * Brundrit, G., The development of a Global Ocean Observing System for Africa;
- * Ahanhanzo, Justin, The GOOS-AFRICA Concept.

The presentations were followed by a debate on the state of data and information systems in Africa, on what was required to provide the data and information needed by decision makers, planners and managers in the coastal zone, on the regional imperatives, on the benefits likely to be accrued, on the potential stakeholders, on possible funding sources and on the organization and priorities needed to take matters forward. The discussions led to the formulation of a list of specific recommendations for consideration by the scientific community, funding agencies, potential donors, appropriate regional bodies, non governmental organizations, national governments and the United Nations bodies including IOC, UNESCO, UNEP, FAO, UNIDO, UNDP, GEF, and the World Bank.

2.2 SUMMARY OF KEY POINTS FROM PRESENTATIONS AND BACKGROUND PAPERS

2.2.1 The Global Ocean Observing System (GOOS)

Colin Summerhayes described the basic characteristics of GOOS, (see the UNESCO PACSICOM Technical Workshops proceedings). He made the following key points: GOOS was called for by Agenda 21 to aid in sustainable management of seas and oceans. It is driven by user needs, and provides a unified global network to systematically acquire, integrate and distribute ocean observations, and to generate analyses, forecasts and other useful products designed for the benefit of a wide user community. It is analogous to the World Weather Watch (WWW) that underpins all weather forecasts, in relying on co-operation between neighbouring countries in the collection and exchange of pertinent data. The Tropical Atmosphere Ocean (TAO) array of buoys in the equatorial Pacific, which is used to collect the data underpinning forecasts of El Niño events, is an example of an operational ocean observing system that is part of GOOS. GOOS facilitates data collection; data and information management; data analysis, preparation and dissemination of products; numerical modelling and forecasting; and the training, technical assistance and technology transfer needed to build the capacity of all countries to both contribute to and benefit from GOOS.

The operational oceanographic and marine meteorological measurements made in GOOS by countries and by international organizations to which they subscribe should be systematic, routine, sustained for the long term, relevant to user's needs, high quality, cost-effective, and available in a timely manner. They are designed so as to provide (i) accurate descriptions of the present state of the sea and its contents, including contaminants and living resources; (ii) continuous forecasts of the future condition of the sea and its contents for as far ahead as possible; and (iii) long-term data sets showing trends and changes including the effect of the ocean on climate and of climate change on coastal seas. The manifold benefits of such a system are listed in section 2.3.5. In addition GOOS will provide the data required to enable governments to meet their obligations under major Conventions like those on Climate Change and Biodiversity, and Agreements like the Global Plan of Action for the Protection of the Marine Environment from Land-Based Activities (GPA).

GOOS is being designed through four main scientific and technical modules to meet the needs of user communities with interests in (i) coastal seas; (ii) living marine resources; (iii) the health of the ocean; and (iv) climate change. It is being implemented in five parallel phases: (1) planning; (2) pilot or demonstrator projects; (3) incorporation of existing systems, adapted as needed; (4) gradual operational implementation of the global scale system, e.g. by the addition of new activities and facilities; (5) continued assessment and improvement in individual aspects and in the entire system. Most activity to date has been focussed on phases 1, 2, and 3. There are major pilot projects in Europe (EuroGOOS), the north-east Asian Region (NEAR-GOOS), the USA, and the equatorial Atlantic (PIRATA - Pilot Research Array (of buoys) in the Tropical Atlantic); new regional programmes are being developed in the Mediterranean (MedGOOS), the western Indian Ocean (WIOMAP - Western Indian Ocean Marine Applications Project) and the Pacific islands (Pacific-GOOS). Existing observing systems have been pulled together to form the GOOS Initial Observing System (see UNESCO PACSICOM Technical Workshops Proceedings for details).

Africa has not been extensively involved with GOOS to date, but north African countries are involved in MedGOOS, and east African coastal and island countries are involved in WIOMAP. Several African countries are involved in one or other of the elements of the GOOS Initial Observing System, such as the Ship-Of-Opportunity Programme (SOOP) and the Global Sea Level Observing System (GLOSS), and in the IOC's International Ocean Data and Information Exchange programme (IODE), which is closely linked to GOOS. Dr Summerhayes explained that the PIRATA pilot project, led by a developing country, Brazil, will

study ocean-atmosphere interactions in the tropical Atlantic, as the basis for understanding and eventually forecasting climatic change. It will focus especially on: (i) the roughly 4-year El Niño cycle, which brings droughts to north-east Brazilian and southern Africa, and (ii) the roughly 12-year Atlantic sea surface temperature dipole cycle, which appears to affect rainfall in north-east Brazil and the African Sahel. There is potential for African countries to become more involved in ongoing pilot projects, such as PIRATA, to develop other regional GOOS pilot projects to demonstrate the value of the GOOS approach locally, and to learn how to contribute to and benefit from GOOS as it develops.

In his presentation, Professor Brundrit reminded participants that there was already a considerable amount of data being collected around Africa as the basis for operational forecasts of maritime weather and sea state as well as to warn of extreme events, for shipping, fishing, offshore industries and navies, and these data could provide a natural contribution to GOOS. While there is a coarse grid of subsurface open ocean information, supplemented by extensive surface information mainly from satellites, he pointed out that much more could be done to make these data more widely available and to fill gaps, like those in the Indian Ocean. He felt that further advance required improvements in making data available and would best be served through regional collaboration. GOOS-AFRICA could be an influential agent for lobbying governments, international donors and the private sector for the investment required to expand operational oceanography in such a way as to contribute to both SICOM and GOOS.

2.2.2 Coastal GOOS

Professor Halim noted that there is an increasing need for coastal data because of growing coastal urbanization and industrialization, expanding coastal engineering, and overfishing. In addition, there are serious problems in delta regions where extraction of water and oil from subsurface aquifers is leading to subsidence, causing relative rise in sea level and consequent intensification of coastal erosion. Furthermore, climate change seems to be increasing the frequency of abnormal climatic events like storms and flash floods.

Dr. Larry Awosika gave a presentation on plans and progress in the Coastal Module of GOOS (C-GOOS). As Costanza pointed out in *Nature* recently (1997, v.387, pp 253-260), classical economics fails to take into account the value of natural ecosystems, which may be worth some \$30 Trillion annually, \$11 Trillion being from the coastal zone. The effects of human activities on the ocean are greatest in the coastal zone, and may have profound and deleterious effects on these valuable ocean ecosystems. The aims of C-GOOS are: (i) to determine user needs in the coastal zone, and specify the data and products needed to meet those needs; (ii) to identify where current monitoring efforts are inadequate, and to formulate plans to fill those gaps; (iii) to identify inadequacies in the measurement programmes of current observation systems, and help to correct them; and (iv) to promote the development of regional to global networks to improve data gathering and forecasting of environmental change in the coastal zone. The initial focus is on four operational categories: (1) preserving healthy coastal environments; (2) promoting sustainable use of coastal resources; (3) mitigating coastal hazards; and (4) safe and efficient marine operations.

A broad regional (even global) approach is needed because everything is connected. The ocean knows no political boundaries and large scale forcing must be considered for predicting even local changes in coastal ecosystems. Effective mechanisms for predicting these changes require the development of regional to global networks linking observation and analysis in more effective and timely ways. These presently weak mechanisms can be strengthened by integrating the fragmented coastal research community, and developing stronger links between it and the user community. Applying the C-GOOS approach in the African context would help to improve SICOM in Africa for the benefit of a broad user community.

2.2.3 The Global Terrestrial Observing System (GTOS)

Chris Magadza explained the structure, aims and objectives of GTOS. It is designed to facilitate monitoring of the terrestrial ecosystem, and shares a natural interface with GOOS in the coastal zone. Both GOOS and GTOS have coastal working groups, and in future it will be necessary for them to work more closely together to develop a fully integrated observing system for the coastal zone. GOOS and GTOS are clustered together with GCOS (the Global Climate Observing System) under the umbrella of an Integrated Global Observing Strategy, and share more or less the same group of UN sponsors (UNESCO, IOC, WMO, FAO, and UNEP), along with ICSU. GTOS was generated in response to the call by Agenda 21 to provide policy makers, resource managers and researchers with access to the data needed to detect, quantify, locate, understand and warn of changes in terrestrial ecosystems, to support sustainable development. It is at an earlier stage of development than GOOS, having only adopted its implementation plan in June 1998. What is needed to exploit the synergy between GOOS and GTOS in the African coastal zone is: (i) greater

collaboration among coastal study groups; (ii) harmonization of data collection, archiving, retrieval and accessibility by researchers, so as to make more of present data; (iii) a mechanism for managing regional co-ordination and the linkage between GOOS and GTOS; (iv) capacity building; (v) networking; and (vi) improved exchange of data.

2.2.4 Monitoring System

In the presentation by Dale Kiefer (FAO) on Integrated Coastal Area Monitoring Systems, the following key points were made. Effective local monitoring of water quality is needed to provide information for coastal managers to use in resolving conflicts caused by competing uses of water (e.g. sewage disposal *versus* fishing *versus* recreation *versus* mariculture, etc.). Satellite data can be extremely useful in the detection of plumes of polluted water (e.g. using images from Synthetic Aperture Radar, SAR). A challenge for Africa is how to extract the maximum information from such data. Ideally, all available data (such as river runoff, pollutant load, ocean currents, river plumes, and ocean thermal and salinity structure, as well as socio-economic data on environmental use) should be integrated in a Geographical Information System (GIS) to produce products demonstrating how pollutant plumes change spatially and with time, as the basis for developing effective plans to deal with water quality problems. Kiefer used a lap-top computer to demonstrate the operation of a user-friendly Environmental Analysis System (EASY), developed with EC funding.

2.2.5 Regional approach to GOOS-AFRICA

2.2.5.1 East Atlantic/West Africa

Larry Awosika made the following key points. He noted that in West Africa there are many national and regional agencies and ocean programmes. However, although there is a lot of data, many data are only in manuscript form, scattered haphazardly, and difficult to access. There is a need for a data rescue programme. Each country should be collecting its data digitally in fully operational National Ocean Data Centres to make information widely available to coastal planners and decision makers.

Many laboratories are not well equipped, and spare parts for equipment are difficult to obtain. To facilitate development of operational oceanography in west Africa it would be useful to create a regional inventory of existing equipment and resources as the basis for developing a regional plan for adequately equipping the marine science community.

There is a serious shortfall in developing a modern electronic communication system linking researchers locally and through Internet. To address this, an examination should also be made of the needs for electronic communication between scientists and as the basis for exchanging data.

There is a need for investment in basic data collection. For instance, there is a basic network of tide gauges which is about to be extended with the installation of gauges provided by Sweden in Gambia and Côte d'Ivoire, but most of the gauges produce analog rather than digital data so their results are not easy to use.

To improve communication between scientists in the region, the IOC Regional Committee on the Central Eastern Atlantic (IOCEA) has planned a Regional Co-operation in Scientific Information Exchange project for the Central East Atlantic (RECOSCIX-CEA), headquartered in Abidjan, Côte d'Ivoire. This project is modelled on a successful initiative in the western Indian Ocean (see 2.2.5.3), but needs resources; it is expected to take off in 1999. Within the network the question of language needs serious attention, given that the region contains both French and English speaking countries.

Finally, to assist in developing GOOS in Africa a GOOS-AFRICA workshop should be held in 1999 as the basis for developing strategic and implementation plans.

Dr. Koranteng was unable to attend the meeting. Principal problem areas identified in his background paper include (i) inadequate management, dissemination and utilization of data; (ii) inadequate communication links hindering the dissemination and sharing of information between countries; (iii) lack of regional and sub-regional databases; (iv) lack of co-ordinated and sustained data collection; (v) lack of use of data already collected; (vi) lack of infrastructure for access to and use of satellite data; and (vii) ineffective linkage between marine scientists and decision makers. Solutions include: (a) making an inventory of existing relevant data; (b) formulating regional or sub-regional projects to enable countries to effectively participate in and benefit from GOOS; (c) creating sub-regional observatories and centres of excellence in marine research to focus investment; (d) linking marine scientists through effective networking.

2.2.5.2 Mediterranean and Red Sea

Professor Snoussi noted that in north-west Africa many data are held in universities and are the products of bilateral (North-South) projects; there is no East-West network for data collection. Most data are obtained within specific projects rather than as part of ongoing monitoring programmes.

Morocco, Tunisia and Algeria are involved in MEDPOL, which is the part of the UNEP Mediterranean Action Plan (MAP) for monitoring pollution in the region. Morocco and Tunisia are also involved in the EuroGOOS Mediterranean Forecasting System Pilot Project (MFSP). Although there is a desire to participate in MEDGLOSS, which is part of the GLOSS programme, no north African Maghreb country has an operational tide gauge at present. There is minimal north African participation in the IOC's IODE programme, with only Morocco having a NODC.

Morocco is involved in the development of MedGOOS, which is designed to enhance operational oceanographic and marine meteorological activities in the Mediterranean region. A MedGOOS workshop on costs and benefits of operational oceanography is being proposed for Morocco in early 1999, as the basis for pulling together information to convince politicians and funding agencies of the value to be gained from GOOS activities.

Recommendations include: (i) assistance for the development of NODCs; (ii) development of a sub-regional data and information network to link NODCs; (iii) development of operational tide gauges, leading to participation in MEDGLOSS; (iv) North-South partnerships for the training of professionals as part of capacity building in operational oceanography; (v) establishment of a National GOOS Committee; (vi) participation in and development of MedGOOS.

Roberto Purini, Director of the Instituto Talassografico in Trieste, described a proposal for a possible joint MedGOOS project between Italy and the countries of North Africa (See UNESCO PACSICOM Technical Workshops proceedings). The project involves integrating physical, chemical and biological data measured by ships, satellites and marine platforms; into coupled ocean, atmospheric and biological models; as the basis for forecasting water quality. It also involves capacity building and training through technology development, data processing and interpretation and modelling and forecasting. The idea is to develop a regional observing and forecasting system that can contribute both to SICOM and GOOS. One of the elements in the proposal concerns the development of fixed platforms, as opposed to buoys, for making key measurements, so as to be able to monitor even extreme events with confidence. The participants found Dr. Purini's presentation interesting and encouraged the idea of a follow-up meeting to enable the concept to be developed further.

Professor Halim noted that there is a wealth of data on the Red Sea, and somewhat less in the eastern Mediterranean, but that many of the data remain within projects not in data centres. There is a need for NODCs to be created, for a data rescue programme, and for the regional exchange of data between NODCs. Means of encouraging researchers to commit their data to NODCs need to be found urgently. There is also a need to agree on the variables to be measured, and on quality assurance procedures including inter-calibration exercises, as well as a need for training and capacity building. The recommendations of the IOC-PERSGA-ACOPS workshop in Jeddah, October 1995 (IOC Workshop Report No.126) on needs for integrated coastal management in the Red Sea should be taken forward. Arabic translation of the report by the IOC will help to spread its message. National and Regional GOOS co-ordinating committees are needed, as is a possible GOOS-AFRICA group along the lines of NEAR-GOOS.

2.2.5.3 Western Indian Ocean

Mika Odido made the following key points. Many data are held by individual scientists on disc or in report form, and are not being made generally available. Many scientists seem reluctant to release their data for a variety of reasons, in some cases because they lack the software to process and interpret their data or to assess its true quality. Few countries have institutional or national databases like National Ocean Data Centres (NODCs).

Many data are collected close to the coast from small boats, as there are few large vessels for ocean-going research. Thus the kinds of problems addressed tend to be small in scale, except in fisheries and meteorological operations, where the scales are significantly larger. There is little participation in either the Voluntary Observing Ship (VOS) programme of the WMO, or the IGOSS Ship-of-Opportunity (SOOP) programme, and little or none in the Data Buoy Co-ordination Programme (DBCP). Several countries maintain sea-level stations within the Global Sea Level Observing System (GLOSS) programme, but technicians need

appropriate training for them to maintain these stations properly. More stations are needed to provide comprehensive coverage. In the offshore islands, ORSTOM has established and manages from the Seychelles a system for measuring SST. UNEP is working with coastal states to collect coastal data into databases to underpin development of a coastal data atlas.

Through the IOC's Regional Committee for Co-operative Investigation in the North and Central Western Indian Ocean (IOCINCWIO), communication between scientists has been enhanced by creation of a regional data and information network developed through the IOC project on Regional Co-operation in Scientific Information Exchange in the Western Indian Ocean (RECOSCIX-WIO). It is intended that this network should now be expanded to include data exchange, by providing a regional structure linking NODCs, thereby ensuring access of regional scientists to data collected by different nations within the region. The network will also help scientists gain access to data sets not located in the region, including satellite data sets, and will develop and disseminate data products for the benefit of policy and decision makers in the region. The network needs to be properly resourced for it to achieve its objectives.

Dr. Ragoonaden made the following key points in his presentation. Based on a survey of user capabilities and requirements there is an urgent need for information on SST, sea state and weather over the area. This need cannot be met because routine operational data collection in the western Indian Ocean is rather limited. Many *ad hoc* observations are being made by research vessels of nations from outside the area, but is difficult to access these data which are held by university researchers in foreign countries. Attempts should be made, perhaps through the IOC, to encourage donation of these data to local centres. Assistance from IOC is needed to establish NODCs in the region. Semi-routine collections of data are being co-ordinated through ORSTOM from fishing boats. Following the ending of the TOGA project, funds are no longer available to maintain regional GLOSS sea-level stations, with the result that many are no longer operational; funds are needed for spare parts and consumables. Due to lack of skilled personnel and lack of information, most countries in the region do not manage to participate in the main research and operational oceanographic programmes (including SOOP, VOS, GLOSS, and DBCP). A proposal has been developed for an Array of Moored Buoys In the Tropical Indian Ocean Network (AMBITION). It would operate like the TAO array in the equatorial Pacific, and would underpin and improve weather and climate forecasting throughout the region. The Indian Ocean needs a permanent geostationary satellite.

He suggested that GOOS would be very beneficial to a number of users in the region, and recommended organizing a workshop on the benefits of GOOS in Africa. This workshop, or another, might also discuss a regional approach to improving contributions to the VOS, SOOP, DBCP and GLOSS programmes, as well as the proposed AMBITON project.

Michel Larue, Director of the ORSTOM laboratory in La Réunion, indicated that there was an ORSTOM comprehensive database from satellite measurements (SST, Ekman Pumping, Dynamic Topography) as well as a ship borne (GAO database), and fisheries data on the SW Indian Ocean. He further noted that the GREEN Consortium (IFREMER, ORSTOM, CIRAD and GOPA) support a regional environmental programme funded by the European Community in the Indian Ocean.

2.3 THE DEBATE

2.3.1 State of Data and Information Systems in Africa

As pointed out by Okemwa and Odido (see UNESCO PACSICOM Technical Workshops Proceedings), the need to develop capacity in the collection, analysis and distribution of data and information from oceans and seas to underpin sustainable development is one of the tenets of Chapter 17 of Agenda 21. It is also a requirement for the effective management of the Exclusive Economic Zones which all nations may now claim under the newly ratified United Nations Convention on the Law of the Sea. Such capacity can be built through strengthening national capabilities for data collection and analysis, creation of national databases, linking of databases to existing data and information services and mechanisms, and co-operation with a view to the exchange of information and its storage and archiving through global and regional data centres. This strategy is also that of the IOC's International Oceanographic Data and Information Exchange (IODE) programme.

There are three main potential sources of data and information on oceanography and marine meteorology. National agencies are the bodies primarily responsible for the provision of information for decision making. Educational agencies also collect considerable amounts of data, usually for specific research projects rather than as part of a monitoring exercise; nevertheless such data may be the only data available in

some areas or on some topics. Private industry is potentially a source of monitoring data, though usually over limited geographical areas.

The general consensus of the meeting was that in most African countries systems for data collection, storage, archiving, retrieval, analysis, interpretation and exchange are inadequate for the purpose of providing information useful for marine policy and decision makers, coastal managers and other end users.

There is an urgent need to enable the use of all potentially available data. In a great many instances data are kept in analog form in reports and files that remain the property of the scientist who collected them, which are scattered across each country, and which are not readily accessible to the wider community. To encourage researchers to part with past data requires the national launching and resourcing of a vigorous data rescue programme based on the Global Oceanographic Data Archaeology and Rescue (GODAR) project of the IOC's IODE programme. These data should be translated into standard formats and transmitted to National Ocean Data Centres (NODCs) from which they can readily be made available to the user community.

Three GODAR workshops have identified data holdings in African regions (IOC Workshop Reports No. 107, 110 and 136). Funding is now needed for NODC establishment, and development of the data management infrastructure, including appropriate training.

In some instances, researchers keep their data because they do not yet have the means to process them as the basis for analysis and interpretation. In these instances programmes should be devised to make the appropriate software available for such processing, on condition that the data will then be released to the NODC for national use.

To encourage researchers to share data they collect in the future it should be conditional on their receipt of research money from donor agencies that they must transmit their data to an NODC so as to increase its value nationally (and internationally) beyond that to the research project for which it was collected. Data so transmitted can be flagged so that they are not used in such a way as to prejudice the ability of the originator to make best initial use of them for their original purpose.

Where there is no NODC, every effort should be made to create one as an essential means of adding value to the original national investment made in collecting the data in the first place, and to underpin sustainable development and management of coastal seas. If it is not possible to create an NODC, then at the very least countries are encouraged to create a Designated National Agency (DNA) to start the process of making better use of the national investment in data collection. Currently there are seven NODCs and three DNAs in Africa: Egypt, Guinea, Kenya, Morocco, Mozambique, Nigeria and South Africa have NODCs, Ghana, Seychelles and Tanzania have DNAs.

NODCs will not only (i) store data; they will also (ii) check it for quality, rejecting bad data; (iii) communicate with potential users to let them know what data are available; (iv) use data and their interpretations to produce products useful to coastal managers and decision makers; and (v) make these products widely available. Requirements for the establishment and operation of NODCs and DNAs are described in the IOC Manuals & Guides Series No.5 (UNESCO, 1997) and are available from the IOC's IODE programme office in Paris. To assist countries in obtaining funds to support the establishment of an NODC, there is a template for the creation of a "typical" NODC.

Recognizing that the oceans know no political boundaries, and that national coastal zones may be affected through teleconnections by events far away, there is an urgent need for neighbouring countries to exchange data on their common coastal environment, so as to acquire the spatial coverage needed as the basis (i) for a full understanding of the processes affecting the coast and its climate, and (ii) for accurate forecasts of how conditions may change on a variety of time-scales (hourly, weekly, monthly, seasonally, inter-annually). Such regional understanding is as essential for ocean issues as it is for weather forecasting, where the principle of data exchange is very well established through the World Weather Watch (WWW) of the World Meteorological Organization (WMO).

The need to exchange data highlights an urgent need to enhance communication between scientists and managers, and of data from scientists to NODCs, by electronic means. Because of costs, the implementation of electronic networking in Africa is proceeding very slowly, making difficult the access to data that is potentially available locally and internationally via the Internet. Organizing data collection within a network of scientists should improve the use and availability of data once the communication infrastructure is in place. To facilitate the construction of such a network requires development of a Directory of marine

scientists, like the Western Indian Ocean Directory of Marine Scientists (WIODIR) developed for IOCINCWIO, which is available on CD-ROM, and which is included in the IOC's Global Directory of Marine (and freshwater) Professionals (GLODIR). A recent useful development is the ODINAFRICA network which focuses on the establishment of a data and information network for Africa, within the framework of IODE.

There is an urgent need for African coastal states to access more of the wealth of remotely-sensed data that is being produced by the rapidly growing number of ocean-observing satellites crossing Africa daily. This need can be met by training more specialists in the use and interpretation of such data; by increasing the access of such specialists to regional satellite receiving stations in Africa (like those in La Réunion and Las Palmas); and by linking these specialists together in a network.

African meteorological services already have access to data from NOAA polar orbiting satellites, however, more data may be available than is currently obtained, if the equipment can be provided to process information from these and other satellites. As a first step there is a need to make an inventory of what satellite receiving stations are available, what data they provide, and what data they could provide in addition if the right equipment was available.

More widespread access to and application of high resolution space satellite data for SICOM would come about if there were more satellite receiving stations in Africa. As establishing them could prove quite costly it would be best to do this on a regional rather than a national basis. Even without such stations there is considerable potential for the acquisition of coarse resolution data, and its manipulation using PC-based software. However, access to new satellite data, like that on ocean colour, requires new means of access. In any case it needs to be remembered that while satellite images are useful, they need to be validated by *in situ* data.

Acquisition of satellite data for the Indian Ocean would be greatly enhanced if there was a geostationary satellite positioned permanently overhead. At this time there is one, METEOSAT-V, moved temporarily from the Atlantic for the Indian Ocean Experiment, but it will only be available for 18 months. It has been suggested that either the Russian Federation or China might establish such a satellite, but no action has been taken as yet.

Recommendation:	it was recommended that efforts should be made to get a geostationary satellite over the Indian Ocean.
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Satellites are not the only means for rapidly obtaining large scale spatial data from the ocean surface. Aircraft using the CASI system (Compact Airborne Spectrographic Imaging) can provide an effective means of rapidly obtaining spatial data from coastal seas.

There is an urgent need to improve data collection. For instance the stations that monitor tides and the rise in sea level need to be properly maintained so that they do not fall into a state of disrepair, which in turn requires the provision of adequate spares as well as the training of the technical professionals manning the stations. In addition the network of sea-level stations needs to be expanded so as to provide denser regional coverage, and upgraded so as to provide higher quality information from which improved advice can be obtained. Equipping sea-level stations with GPS receivers will greatly improve their capabilities, as will make all stations digital. In addition, sea-level stations can be equipped to provide multiple data streams by monitoring additional ocean properties (like sea surface temperature - SST, and salinity), thereby increasing their usefulness.

There is an urgent need to make better use of the data that are being collected. For instance, the technical professionals manning sea-level stations need to be trained in the statistical and other methods for processing and interpreting the data produced by their gauges, and in converting their data and interpretations into products that are useful to managers and decision makers.

There is also a need to extend coastal sea surface temperature (SST) monitoring networks to create comprehensive coverage as the basis for accurate modelling and forecasting.

One way to improve data collection is to make manuals available with guidance for collection programmes. This has been done successfully for the sampling of coral reefs under the aegis of the International Coral Reef Initiative, ICRI).

Aside from the collection and storage of data there is the issue of data quality assurance. Quality standards can be maintained through the application of appropriate standards, backed by programmes of appropriate training and supported by inter-laboratory calibration. As in the case of other expensive facilities, like satellite receiving stations, it is sensible to think in terms of establishing national or regional laboratories in acknowledged centres of excellence.

2.3.2 Linkage of Data and Information Systems to Coastal Management

For SICOM to work effectively, a primary requirement which is not being met in many instances is that data should be collected in such a way as to meet the requirement of the coastal user community. This requires dialogue between scientists and the user community in advance to determine its needs, followed by the design of a sampling programme to produce data and information that will meet those needs. It is the products required by users that will determine the variables that need to be measured.

A survey of user capabilities and requirements has been made in the western Indian Ocean, to lay the groundwork for setting up the Western Indian Ocean Marine Applications project (WIOMAP), the first meeting of which was held in Mauritius in May 20-22, 1997 (copies of the report of this meeting are available from the GOOS Project Office in the IOC/UNESCO, Paris).

The most comprehensive surveys of user's needs have been carried out in Europe, by EuroGOOS. Copies of the EuroGOOS questionnaire, which can be adapted readily for similar surveys in Africa or elsewhere, are available electronically or in hard copy from the EuroGOOS Office at the Southampton Oceanography Centre in the UK.

A second requirement is that the sectoral approach to data collection should be made cross sectoral in three ways: (i) the user community should be encouraged to integrate its requirements; (ii) the scientific community should be encouraged to adopt a multi-disciplinary approach, recognizing that the solution to environmental problems is commonly some combination of physical, chemical, biological and even geological data; and (iii) land information (e.g. relating to river runoff and pollutant loads) should be integrated with offshore information, and *vice versa* (e.g. more effective use of offshore data in meteorological and climate forecasting for land operations and activities).

Mechanisms should be found to inform the user community of what is available and of who is doing what, for instance by publication of Directories of marine scientists, like WIODIR, and publication of newsletters targeted at particular user groups, for example building on the Western Indian Ocean Waters (WINDOW) newsletter developed in the IOCINCWIO region and now edited by WIOMSA (Western Indian Ocean Marine Sciences Association).

2.3.3 What kinds of Data and Information are needed for SICOM?

In order to detect and observe environmental changes in such a way as to use the information for forecasting requires developing national knowledge, understanding and predictive skill. Knowledge comes from observing oceanographic and marine meteorological phenomena, and implies the need for data acquisition systems. Understanding comes from studying the processes that cause these phenomena, and implies the existence of a skilled workforce. Prediction comes about by using knowledge and understanding to forecast outcomes, and implies access to appropriate computing and communication facilities and an appropriate skills base.

In designing observing systems what has to be remembered is that the only thing constant about the environment is change, which comes about either naturally or through the influence of man. We now know that there are major natural oscillations in the climate system, like (i) the El Niño-Southern Oscillation associated with El Niño events, that is centred in the equatorial Pacific and recurs about every four years, which affects Africa through modifications to the jet stream; and (ii) the equatorial Atlantic dipole, which is centred in the equatorial Atlantic, has a cycle of about 12 years, and affects rainfall in the Sahel through modifications to the position of the Inter-Tropical Convergence Zone (ITCZ). The Earth also seems to be warming, and as a result sea level is rising, as a consequence of man's activities. Gathering observations about these various changes so that their effects can be forecast is a primary tool in anticipating and dealing with their consequences, and demands the establishment of long-term measurement programmes spanning time frames commonly longer than the lives of individual governments, but usually within the life spans typical of major Government agencies (20 years plus).

In establishing measurement programmes it also needs to be remembered that the ocean knows no political boundaries. Single ocean current ecosystems, like those of the Benguela Current off South Africa, Namibia and Angola, cross several borders. The temporal and spatial scale of these connections leads to the recognition that regional programmes and networks of data collection and exchange are required.

At the regional scale VOS and SOOP observations of meteorological parameters, including wind speed and direction, air temperature and pressure, and precipitation, as well as SST and salinity from the surface and subsurface upper ocean are needed to underpin and improve weather and climate forecasting. The WWW is itself a source of information for coastal managers, and can be accessed through the WMO's Global Telecommunications System (GTS).

Data from fixed and drifting buoys in the Atlantic and Indian Oceans would also be useful for observing and forecasting climatic variability. The PIRATA array of buoys is already being emplaced in the equatorial Atlantic. Japan is proposing to place two fixed buoys in the eastern equatorial Indian Ocean as part of the TRITON programme. Plans for a complementary array of buoys in the central and western Indian Ocean have been developed by the IOC Regional Committee for the Indian Ocean (IOCINCWIO) in the proposal for a project labelled AMBITION (Array of Moored Buoys In The Indian Ocean Network). PIRATA would monitor the equatorial Atlantic dipole, which has an effect on coastal climates in West Africa; the Indian Ocean arrays would monitor the behaviour of the equivalent of El Niño in the Indian Ocean, which should provide early warning of Sahel rains, and of cyclic sea-level changes.

An improved network of sea-level stations is needed to monitor sea-level rise. Such a network has recently been emplaced in the Caribbean with GEF funding. Many organizations (e.g. coastal and offshore engineers and operators) need information about waves, which may be obtained from judiciously placed wave-rider buoys, from coastal HF radar sites, or (more crudely) from satellites.

An improved network of SST measuring sites is also required to provide fundamental data regarding water circulation in coastal seas and the adjacent ocean.

Numerical models can add substantial value to data by integrating them to produce fields and forecasts rich with information at relatively low cost. In coastal seas a great deal of useful information about the environment can be obtained from a relatively sparse network of observing stations that may be either fixed or moored, provided that these data are used within numerical models that convert the data into data fields and forecasts. A combination of models and provisional measuring stations (or previously measured data) can be used to ascertain the ideal and most cost effective spatial and temporal sampling pattern, and to eliminate excessive redundancy. In this kind of system it may be advisable not to site measuring stations too close to land where the effects of shoals and irregular coastlines distort the signal. A prerequisite in such modelling exercises is the provision of precise bathymetry, since much of the circulation of coastal seas is highly influenced by the shape of the seabed.

In some cases measurements of extreme events close to shore will be needed to improve the ability of models to predict the effects of such events. In these cases, observations from devices attached to jetties may have advantages over those from moorings.

Aside from measurements at point sources, measurements will be required along transects at selected locations, so as to monitor the changing ocean to coastal gradients in water properties at different times of year. Selected lines can be re-occupied by a single vessel on a seasonal basis.

Routine measurements of water quality are a prerequisite especially near known sites of potential runoff from land. Such measurements should include a spectrum of variables including: turbidity, nitrate, fluorescence (as a proxy for chlorophyll) and dissolved oxygen, as well as the basic water properties of temperature and salinity and current speed and direction. The oxygen will provide an immediate yardstick to the extent of eutrophication, and hence to potential damage to the marine ecosystem. Measurements and analysis of plankton are also recommended for the early detection of potentially toxic algal blooms that may threaten coastal sea food production and associated human health. Satellites (ocean colour and SAR) and aircraft (CASI) provide additional indirect sources of information about water quality (detection of slicks and plumes for example). Locally measurements of radioactivity may be required, for instance if there has been any dumping or leakage of radioactive materials. The same goes for hydrocarbons. Routine monitoring of selected water quality variables can also be achieved by using the approach of the international Mussel Watch programme. Statistics on the flow and constituent load of major rivers and other point sources should also be

collected as part of water quality monitoring. Rivers, for example, carry excess nutrients from farms in the hinterland, disturbing coastal ecosystems.

Following the theme of Agenda 21, efforts should be made to determine what combination of local indices can be used as sustainability indicators; examples might include measures of the community structure of marine organisms, or of indicator species. In addition there will be a need to monitor the character and health of living marine resource populations.

Ideally, measurements should be made through well-focussed projects that are supported by well argued cases, designed to solve problems, deliver useful products, meet user requirements, and have a finite end point followed by review as the basis for decisions about continuance or modification. Without such project proposals it is unlikely that funding will be forthcoming from national or international agencies.

2.3.4 How can GOOS help?

The participants took the view that what happens in coastal seas is commonly a function of ocean and atmospheric processes happening on regional or global scales, and that therefore the potential of the Global Ocean Observing System (GOOS) to address the needs of SICOM in Africa should be considered.

GOOS is already contributing to the solution of African coastal problems through application of data obtained in operational programmes like GLOSS, SOOP, VOS and DBCP, which are now parts of the GOOS Initial Observing System. GOOS is the umbrella for the PIRATA Pilot Project in the equatorial Atlantic. It is also the driving force behind the development of (i) MedGOOS, which will bring together the countries bordering the Mediterranean to devise strategies for operational oceanographic and marine meteorological activities to meet common needs, and (ii) WIOMAP, which will do the same for western Indian Ocean countries. In the Mediterranean, EuroGOOS has obtained funds from the EC for the development of the Mediterranean Forecasting System, a Pilot Project from which MedGOOS's African members will benefit.

In addition GOOS is now developing designs and implementation plans for monitoring programmes that can be applied in Coastal Seas, in the evaluation of Living Marine Resources, and in assessing the Health Of The Ocean. As soon as they are available they will be supplied to the African GOOS community for application. Some of the thinking behind the developing designs is already embedded in section 2.3.3, above.

GOOS will be implemented by national agencies operating singly in their own waters, or together in regional programmes (like MedGOOS and WIOMAP) and in international programmes (like VOS, SOOP, GLOSS and DBCP). The effectiveness with which GOOS works will therefore depend not only on international co-ordination, but also on the effectiveness of national institutional structures. To take GOOS forward requires strengthening of these structures. Ideally, National GOOS Co-ordinating Committees (NGCCs) should be created in which all of the key stakeholders are brought together (government departments, key industrial sectors, and educational institutions) to define user needs and find ways of meeting them.

In this context GOOS provides a powerful intellectual stimulus for change, because - like Integrated Coastal Management - it requires integration across different disciplines and between different stakeholders. In some countries there may already be an integrative and multi-disciplinary national structure which brings together the required group of stakeholders and crosses discipline boundaries. In those cases the appropriate pre-existing body may simply take on the duties of a NGCC, or adapt itself slightly to meet those responsibilities. However, in most countries the concept of both discipline and stakeholder integration which is at the heart of both GOOS and SICOM is new and runs counter to traditionally sectoral organization. In those cases a NGCC will have to be created as an entirely new body. National Oceanographic Committees commonly contain the right mix of disciplines, but tend not to contain the full range of stakeholders needed for the establishment of an NGCC. They may either adapt to do so, or perhaps form a subcommittee along the appropriate lines.

It will be the task of the National GOOS Co-ordinating Committees to develop and strengthen the effectiveness of the national institutional infrastructure in support of operational oceanography and marine meteorology for all purposes, including SICOM. The NGCCs will be expected to:

- (i) Determine user needs and specify the data and products required to satisfy those needs;
- (ii) Identify and work to improve existing national capabilities, including human skills and available technology;

- (iii) Identify gaps in those capabilities, including inadequacies in present observing and data management systems, and work to correct them, focussing (a) on training and practical assistance related to meeting users' needs in the coastal zone, and (b) on formulating plans to fill gaps;
- (iv) Pay special attention to exploiting the opportunities offered by the increasing number and variety of observations of the coastal zone from space satellites;
- (v) Promote communication between marine scientists and coastal managers through the development of national, regional and global electronic networking;
- (vi) Promote the design and implementation of regionally co-ordinated strategies for data acquisition, integration, synthesis and dissemination of products to improve coastal zone assessment, and the forecasting and prediction of environmental change;
- (vii) Develop regional pilot projects to demonstrate the usefulness of the GOOS system in the coastal zones of Africa, and encourage African participation in ongoing GOOS pilot projects;
- (viii) Evaluate costs and benefits as the basis for persuading governments, donor agencies and the private sector to support a data acquisition programme and associated capacity building;

2.3.5 Benefits of an effective Data and Information System

An improved data and information system will lead to economically and socially beneficial improvements in:

- (a) warnings of extreme events like storms, high waves and surges;
- (b) management of ports and harbours;
- (c) optimising offshore design and operations (oil and gas industry);
- (d) ship-routing;
- (e) marine recreation;
- (f) detection of poor water quality;
- (g) managing fisheries and mariculture;
- (h) climate forecasts for agriculture, energy and water supplies and increased preparedness against climate-induced epidemics of diseases (like malaria).

Equally, the information will enable governments to monitor their performance against targets set out in the major international Conventions and Agreements like those on Climate Change, Biodiversity, Dumping at Sea, the Global Plan of Action for the Protection of the Marine Environment from Land Based Activities, Highly Migratory and Straddling Stocks, and Agenda 21.

Ultimately the main beneficiaries will be national economies, through improved performance based on efficient use of data and information in indicating where resources may occur and in forecasting droughts, floods, cyclones, sea-level rise and other kinds of change, including those in living resources and water quality.

2.3.6 Capacity Building

Capacity building in support of SICOM must take place in the context of a plan for SICOM and GOOS. The plan should be developed by the NGCC or some similar body, whose task is to identify the needs for operational oceanography and marine meteorology, and to translate those needs into a programme calling for specific numbers and kinds of specialists, identifying the training required, specifying the amount and type of equipment, and determining the nature and extent of the underpinning infrastructure.

While capacity building plans should be based ultimately on national need, the regional nature of ocean science means that capacity building is commonly delivered on a regional basis. This in turn demands consideration of national needs by some appropriate regional body which may well be made up of representatives of the NGCCs in the region. This preserves the link to the user community that is missing in many of the presently existing regional bodies.

Possible sources of funding are manifold and include: (i) the national governments themselves (through national agencies); (ii) the IOC, through its various programmes including TEMA; (iii) various international aid agencies such as the Global Environmental Facility (GEF) of the World Bank; and (iv) the overseas aid programmes of various developed countries. In addition use should be made of programmes like the UNESCO Chairs (one in marine science is planned for Maputo), the FAO visiting researchers programme, and the IGBP's START programme.

2.4 THE RECOMMENDATIONS

Data for sustainable Integrated Coastal Management

- (i) For GOOS to meet coastal needs in Africa requires as a first urgent step organizing National GOOS Co-ordinating Committees to improve the effectiveness of the national institutional infrastructure in support of operational oceanography and marine meteorology. The national committees would be expected to carry out the tasks listed in section 2.3.4.
- (ii) The second urgent step requires investment in the following top priority activities to support sustainable integrated coastal management in Africa:
 - (a) To form an Africa-wide network of National Ocean Data Centres that are properly equipped and staffed by trained personnel, whose first responsibility will be the rescue in digital form of the presently widely-scattered and more or less unavailable observational data on African coastal seas, so as to provide a sound information base for local and regional coastal planning;
 - (b) To upgrade and expand the present African network of sea-level stations for the measurement of tides and sea levels, and to train the technical professionals manning those stations in the analysis and interpretation of the data, so as to enable the production of advice for decision makers on potentially hazardous and costly changes in the local marine environment - such as sea-level rise;
 - (c) To encourage formation of a network of specialists trained in the use of remotely-sensed ocean data from space satellites, and to ensure the increased access to regional satellite receiving stations in Africa, so as to ensure that coastal managers have ready access to the rapidly increasing wealth of spatial data on the coastal environment;
 - (d) To facilitate the further implementation of modern electronic communication systems such as Internet connections and data transfer mechanisms, so as to promote effective communication and to make data and information more readily available for coastal planning.

3. GOOS-AFRICA CONCEPT

3.1 OUTLINE OF THE SECOND SESSION

Justin Ahanhanzo introduced the GOOS-AFRICA Concept. In his presentation, he explained the GOOS-AFRICA Concept (its philosophy), why GOOS-AFRICA is needed, and how to implement the GOOS-AFRICA programme. He demonstrated that there is a considerable potential in Africa to develop a GOOS programme based on users' needs and on the ongoing GOOS related activities in the region. He stressed in particular, that in a world society where information is the dominant resource, vigorous and relevant efforts for suitable environmental information and data acquisition, analysis, processing and interpretation with a view to sustainable management of natural resources can - as some societies have already demonstrated - validate the theorem that 'the poor nations' with immense environmental resources can get rich by developing national Marine and Coastal Science and Technology Strategy through the exercise of strong political will. Defining the GOOS-AFRICA scientific basis, he listed the existing subregional and international marine programmes at the level of the continent as a whole. He proposed for GOOS-AFRICA a functional structure that might link policy makers and scientists as well as various stakeholders and groups of conflictual interests. GOOS-AFRICA management, he underlined, should take root at local to national level, as well as at national to subregional level and at the continental level. To make GOOS-AFRICA successful, the regional organizations should be

strongly involved in developing GOOS related activities in the region. He stressed the need for GOOS-AFRICA to establish a co-operative link with the GOOS Family world-wide. He then suggested that the concept could be taken forward through a GOOS-AFRICA Conference to be held before the next millennium. The main objective of this Conference, with both scientific and political segments, would be to bring together policy makers, and scientists with a wide range of users and stakeholders including the private sector.

The presentations were followed by a debate on what is required to implement GOOS in Africa, on the regional operational imperatives, on the potential stakeholders, on the need for capacity building, on possible sources of funding, and on a tentative organizational framework.

Following the debate, recommendations were made concerning:

- Recommendations:**
- (i) the establishment of national GOOS committees, along with their responsibilities and membership;
 - (ii) the establishment of regional GOOS bodies, along with their responsibilities and
 - (iii) the establishment of an interim co-ordinating committee for GOOS-AFRICA, along with its responsibilities and membership.

3.2 THE DEBATE

3.2.1 National GOOS Co-ordinating Committees

Participants indicated a strong interest in forming National GOOS Co-ordinating Committees along the lines described in section 2.3.4, with membership from national agencies, users in both government and private sectors, and educational institutions. The government agencies are responsible for the long-term collection and storage of data, the educational agencies for adding value through training, modelling, and improving understanding of the underlying process, and the users for defining the real needs of society at large.

An indication of the intention to establish NGCCs came from certain of the countries who had played a vigorous role in the debate: Egypt, Morocco, Ghana, Côte d'Ivoire, Nigeria, South Africa, Mauritius, and Kenya. Morocco is already well along the road to forming a NGCC, and plans to link its development to the MedGOOS workshop on benefits that has been proposed for Morocco in 1999. Mauritius does not have an NGCC as such but brings marine interests together in its National Committee on Climate Change, which has a Sub-committee on sea-level rise. In due course it may be appropriate to convert one or other of these groups into a NGCC. South Africa has an ideal structure in the Southern Africa Data Centre for Oceanography (SADCO), which serves both Namibia and South Africa. It might take on the NGCC role in the future. In Nigeria the Environmental Protection Agency has the responsibility for bringing together all groups with a stake in the environment, including NGOs, and might be able to develop a NGCC.

It was noted that there are a number of initiatives to form National Oceanographic Committees, and that it might be wise to use these as NGCCs rather than creating two new bodies. In this case it would be necessary for the newly formed (or forming) National Oceanographic Committees to take on board the GOOS concept and strive to involve a full range of stakeholders. In some cases, where the pool of expertise is limited, regional groups of experts might provide more comprehensive technical advice than NGCCs, for instance on such broad issues as ocean dynamics and climate.

It was recognized that the formation of NGCCs would give governments an institutional structure for dealing with the implications and obligations of Conventions and Treaties. In some cases one or other of the four GOOS modules might represent a springboard to use to convince national governments of the wisdom of investment in the GOOS approach. However it would be important to educate policy makers about the links between the open ocean and coastal seas to avoid decisions being made that fragmented the integrative aspect of the GOOS approach.

Participants felt that the development of regional programmes and pilot projects offered the most suitable vehicle for the development of GOOS in the African context, and would stimulate the development of national capabilities. In some instances members felt that regional initiatives might lead national initiatives and

the formation of NGCCs, because without products from regional projects policy makers might not have enough conviction to form NGCCs.

It was agreed that to meet the needs of SICOM, national committees should recognize land-based systems and inputs, and that to enable this a link with GTOS would be advisable.

It was agreed that national committees should take the responsibility for capacity building. However, there are good grounds for recommending that regional initiatives are used to encourage capacity building. The committee recognized that even though data is currently being produced, without people on the ground to analyze the data and produce products, GOOS will not succeed in Africa. To make capacity building more effective, training programmes should focus on training the trainers, and on the provision of distance learning materials that permitted multiple re-use and simultaneous use in many places.

As far as funding is concerned, the WMO voluntary country programme provided a useful model to follow (individual nations submit their requirements to WMO, which acts as broker in circulating them to possible donor countries and agencies to seek support).

3.2.2 Regional GOOS bodies

It was agreed that given the geography and oceanography of Africa it made sense to consider developing GOOS in Africa on a regional basis, while recognizing that parts of GOOS were fully international (VOS, SOOP, DBCP, GLOSS etc). The MedGOOS model, developed at the GOOS Capacity Building Workshop for the Mediterranean Region, November 26-29, 1997, in Valletta, Malta (IOC Workshop Report No. 140. UNESCO, 1998) was used as a template for possible regional GOOS programmes in Africa.

Regional GOOS bodies will promote implementation of GOOS in Africa through:

- * development of pilot projects (to develop and demonstrate the value of certain aspects of operational oceanography);
- * adaptation of existing observing systems and their integration into a common system;
- * surveying users to determine their needs and interests;
- * encouraging development of the end-to-end (production line) approach which connects initial observation, through data processing and modelling, to final product;
- * encouraging communication about GOOS;
- * encouraging the development of capacity building.

Regional GOOS bodies will promote the development of national GOOS committees to:

- * increase awareness at national levels;
- * foster support for regional and sub-regional pilot projects;
- * identify agencies interested in participating in regional GOOS activities;
- * circulate information about GOOS and its regional activities in Africa;
- * communicate and interact with other GOOS bodies;
- * conduct surveys on needs, requirements, costs and benefits;
- * identify capacity building needs and strive to meet them with assistance as appropriate.

Membership of regional GOOS bodies should be from:

- (a) national GOOS Co-ordinating Committees in the region;
- (b) existing regional or sub-regional science programmes contributing to the various modules of GOOS (LMEs, WIOMAP, etc);
- (c) new regional pilot projects;
- (d) existing regional bodies (IOC regional Committees, UNEP Regional Seas programmes, etc);
- (e) regional capacity building networks.

Each regional body should develop links with other appropriate regional bodies, for instance the Global Coral Reef Monitoring Network, and the Indian Ocean Commission. It should also aim to stimulate effective co-ordination on marine issues between all UN bodies operating in the region.

Expected regional GOOS bodies, with detail of existing and proposed projects, would be:

- (a) MedGOOS (includes Mediterranean Forecasting Project as a Pilot Project);
- (b) Red Sea GOOS;
- (c) Western Indian Ocean GOOS (includes WIOMAP as a Pilot Project);
- (d) West African (or Eastern Atlantic) GOOS (which could include PIRATA as a Pilot Project shared with Brazil).

Given that some countries sit at the boundaries of two oceans or seas, it would seem sensible for them to belong to two regional groups: Morocco to both MedGOOS and West African (or eastern Atlantic) GOOS; South Africa to both West African and Western Indian Ocean GOOS; and Egypt to both MedGOOS and Red Sea GOOS.

Other projects that could be considered as a starting point for developing regional programmes include:

- (i) the various Large Marine Ecosystem (LME) projects (mostly in proposal stage);
- (ii) BENEFIT: Benguela-Environment-Fish-Interaction-Training;
- (iii) the POEM Project: Physical Oceanography of the Eastern Mediterranean.;
- (iv) Indian Ocean Commission activities;
- (v) CLIVAR-AFRICA projects;
- (vi) Mediterranean Data Acquisition project.

In response to the question of how to create and co-ordinate new regional bodies, it was agreed that new committees are not needed if present structures can be adapted to bring in all stakeholders. It is this characteristic of inclusion that differentiates GOOS from most other pre-existing bodies, including IOC regional committees. Considering the way forward would be one of the tasks of the GOOS-AFRICA committee (see below). In setting up these bodies it has to be clear what they are going to do and what benefits would be expected to accrue from their activities. The process might start with an invitation to regional policy makers and other stakeholders to attend a meeting to learn about the benefits of a regional GOOS programme. In Europe, the EuroGOOS Conference in The Hague in 1996 provided an effective vehicle for capturing the attention and interest of a broad community. Something similar might be tried in Africa. The Mediterranean benefits meeting in Morocco in 1999 may provide an example.

Regional issues that will need to be considered by regional bodies include the establishment and networking of NODCs, communication, sources of satellite data, determination of variables to be measured, and their means of measurement, the growing requirement for biological data and its integration with physical data, and many of the other issues raised in section 2 as in need of improvement or development.

Surveying existing systems against GOOS yardsticks would be an important initial activity, leading to the identification of gaps that need to be filled. Adapting existing systems would be an important regional activity, as would the identification of new pilot projects. Efforts should be made to ensure the provision (and continuance) of long time series.

Regional bodies should also consider the need for regional facilities and services, especially where expensive technologies are concerned. Examples of possible regional initiatives might be: (a) regional satellite receiving stations; (b) oceanographic research vessel; (c) regional centres of excellence for training in such technologies as GIS and others, and so on.

Regional bodies should also consider the potential for developing ocean partnerships in Africa and between Africa and other nations.

Identifying sources of funding, and lobbying for support would also be a key activity of regional groups, with help where appropriate from the GOOS sponsors (IOC, WMO, and UNEP) and from the GOOS Project Office (GPO).

3.2.3 An Interim Co-ordinating Committee for GOOS-AFRICA

Participants agreed that in order to stimulate the development of appropriate regional and national GOOS committees, and to take GOOS forward in the African context, an Interim GOOS-AFRICA Co-ordinating Committee was required. The following responsibilities form the basis for its Terms of Reference:

- (a) Develop GOOS-AFRICA strategy and action plans;

- (b) Link various modules of GOOS into regional and national GOOS Committees;
- (c) Create a GOOS-AFRICA network as the basis for communication about GOOS;
- (d) Establish communication with appropriate GOOS and related bodies (e.g. IOCEA, IOCINCWIO, Indian Ocean Commission, CLIVAR-AFRICA, etc.);
- (e) Develop a biennial work programme and budget;
- (f) Through lobbying and by other means promote development and funding of GOOS activities in Africa.

Its initial tasks will be:

- (i) to oversee production of the report of the present workshop, which should be published in French and English and should have summaries in Arabic, Portuguese and Spanish;
- (ii) to plan workshops to develop regional GOOS programmes in the western Indian Ocean and eastern Atlantic.

The Committee is expected to work mainly by electronic mail. But there is the potential to hold a follow up meeting in association with the Coastal GOOS meeting in West Africa in the spring of 1999, assuming funds could be made available and if that seemed useful.

The Committee will be an interim body for a period of 3 years at which time the necessity for continuance of its role would be reviewed, along with its membership.

Initial membership was agreed as follows, and is based on the African representation on international GOOS bodies, on representation of key regional bodies, and on African representative from GTOS:

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3.3 THE RECOMMENDATIONS

GOOS-AFRICA

- (i) Form National GOOS Co-ordinating Committees to articulate user needs, to develop plans for operational oceanography (including living resources and non living resources and coastal monitoring) and marine meteorology, to facilitate data acquisition by the responsible national agencies, and to promote product application and dissemination.
- (ii) Form Regional GOOS Bodies to strengthen regional capabilities and develop regional pilot projects.
- (iii) Form an Interim Co-ordinating Committee for GOOS-AFRICA to oversee the development of GOOS in Africa.

ANNEX I

AGENDA

Saturday, 18 July 1998

- 18.50 Opening of the workshop
 Welcoming from the conveners
 Introducing participants
 Adoption of the agenda
 Working arrangements
- 19.10 Review of GOOS and other Global related Programmes (C. Summerhayes)
- 19.40 Review of Coastal GOOS (C-GOOS) (L. Awosika)
- 20.00 Review of Global Terrestrial Observing System in Africa, GTOS (C. Magadza)
- 20.20 Integrated Coastal Area Monitoring systems (D. Kiefer)
- 20.50 Discussion
- 21.00 Dinner

Sunday, 19 July 1998

11.00 First Workshop Session: what is needed for SICOM in Africa?

The State of Data & Information Systems in Africa:

- (i) Data Acquisition, Information, Data Exchange and Public Awareness (National and Regional Data Bank) :
- Infrastructure, Scientific Data Transmission Satellites
 - Human Resources and Training
- (ii) The needs for SICOM:
- Description and definition of the linkage between Data issues and Sustainable Integrated Coastal Management (SICOM)
 - Infrastructure, Scientific Data Transmission Satellites
 - Human Resources
 - Funding : budget for GOOS-AFRICA implementation: from where and whom?
 - Conceptual framework for involving decision-makers and donors
- (iii) What can be achieved ?
- Review of possible options: definitions of opportunities and limits (list of constraints to action) : personnel, capital equipment, travel & logistics, consumables)
- (iv) What are the benefits?
 (e.g. improved food security, prediction of extreme weather events, others).

13.00 Lunch

14.00 Second Workshop Session: design GOOS-AFRICA programme

Discussion of suggested Model for Geographical Subdivision of GOOS-AFRICA

- (i) Co-ordination of GOOS-AFRICA implementation activities:
- Subregional Committees based on the Geographical Subdivision Model

- GOOS-AFRICA Committee (GOOS-AFRICA Committee should consist of up to 10 scientists, 2 from each regional committee plus some international scientists and representatives of funding agencies)
- (ii) Recommendations:
 - Recommendations concerning policies and options for (SICOM) in relation to: local, sub-regional, regional and Global Ocean Observing Systems in Africa
 - Recommendations concerning Capacity Building towards (SICOM)

15.55 Coffee Break

16.05 Drafting GOOS-AFRICA Programme with Follow up Activities:

- GOOS-AFRICA first Meetings:
- TAO implementation Panel Meeting with PIRATA, Abidjan, Nov 1998
- MedGOOS workshop early 1999

18.05 Review & finalization of draft programme

19.35 Adoption of Workshop Report & Draft Programme for follow up activities

20.00 Closure and submission of (completed) SICOM report (2 pages)

Monday, 20 July 1998

09.30 Further development of the GOOS-AFRICA concept and exploration of possibilities of developing regional programmes and specific pilot projects

1510 Videos

1520 Closure and submission of (completed draft) report

ANNEX II

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ANNEX IV

THE PACSICOM STATEMENT

1.1 PREAMBLE AND GENERAL PRINCIPLES

1. We, the Governments of African countries represented by our Ministers and Senior Officials responsible for the environment, in mutual consultations with representatives of non-governmental organizations, intergovernmental organizations and the region's development co-operation partners, meeting in Maputo, Mozambique, from 18 to 24 July 1998, fully recognize the crucial role which the seas and coasts play in our continent's sustainable development efforts. Our Conference was organized in three stages, namely, technical workshops from 18 to 20 July at the Pan-African Conference on Sustainable Integrated Coastal Management (PACSICOM), a workshop on cross-cutting issues on 21 and 22 July; and a Ministerial Conference on 23 and 24 July.

2. We have been actively participating in the programmes for the conservation of the coastal and marine environment. This has been done within the framework of action plans specifically formulated to cater for Africa's needs in the protection, management and development of the marine and coastal living and non-living resources. The West and Central African, the Eastern African, the Red Sea and the Gulf of Aden and the Mediterranean Action Plans encompass the African continent. They were developed to mitigate against the degradation of our unique and fragile ecosystems and habitats, which threatens the life support resources, human health and general well-being of our peoples.

3. In December 1985, our countries convened the first session of the African Ministerial Conference on the Environment (AMCEN) in Cairo, Egypt and, *inter alia*, established committees, respectively, on seas and on island ecosystems. The objectives of these committees are to support the implementation of regional seas action plans and to strengthen the co-operation between African States, the activities of their national institutions and experts involved in the implementation of the plans.

4. We also recall that the environment and natural resource management ministers of a number of countries met in 1993 in Arusha, United Republic of Tanzania, to address these problems at a regional level. The ministers considered and endorsed a resolution containing various recommendations dealing with the coastal zones of their countries (the Arusha Resolution on Integrated Coastal Zone Management in Eastern Africa including Island States). Integrated coastal zone management (ICZM) was once again recognized as the best tool to address the multiplicity of issues involving the coastal zones.

5. We are aware that, in the years since Arusha, there have been a number of initiatives, both regionally and at the national level, to try to achieve improved management of the coastal environment and resources. For example, the Experts and Practitioners Workshop on Integrated Coastal Area Management in Eastern Africa and the Island States, in Tanga, United Republic of Tanzania, in August 1996, provided an opportunity to share experiences and learn from ongoing activities. At the Second Policy Conference on Integrated Coastal Zone Management in Eastern Africa and Island States, which was held in Seychelles from 23 to 25 October 1996, policy makers from the region assessed successes and failures in ICZM since Arusha, and discussed and agreed on actions needed to improve the situation.

6. We are aware that the region has over 50 significant international river basins, more than any other continent. Nearly all our countries are part of at least one river basin. For 14 of our countries, practically their entire national territory falls within international river basins. Yet for most of our continent's international rivers there are no international agreements. In this we fully recognize the urgent need to promote regional international conservation of shared water resources.

7. We welcome the Accra Declaration on the Environmentally Sustainable Development of the Large Marine Ecosystem of the Gulf of Guinea. It was adopted at the first meeting of the Ministerial Committee of the Gulf of Guinea, which took place in Accra, Ghana, on 9 and 10 July 1998, attended by ministers of the environment from Benin, Cameroon, Côte d'Ivoire, Ghana and Togo, as well as the Director General/Chief Executive of the Federal Environmental Protection Agency of Nigeria. The meeting considered, *inter alia*, the Large Marine Ecosystem Project of the Gulf of Guinea.

8. Our countries also welcome the United Nations System-wide Special Initiative on Africa, which was launched in 1996, by the United Nations Secretary-General. The choice of Africa as the centrepiece of a comprehensive United Nations follow-up initiative to the United Nations Conference of Environment and Development underscores the international community's recognition that Africa represents the foremost challenge of global development and is a test case for international co-operation.

9. We further welcome the substantial contributions made by bilateral and United Nations agencies, including the UNEP regional seas programme, the programmes of IOC, the UNESCO Project on Environment and Development in Coastal Regions and in Small Islands, as well as the International Hydrological Programme (IHP) of UNESCO and related initiatives by the Food and Agriculture Organization of the United Nations (FAO), such as the code of conduct of responsible fisheries, to promote actions for the protection and development of the African marine environment.

10. In the preparations for PACSICOM, we have benefited from the recommendations and directions contained in the Lagos Plan of Action (1980), the Programme of the African Ministerial Conference on the Environment (1985), the Treaty Establishing the African Economic Community (1991), the regional seas programme for Africa, notably the conventions, action plans, protocols for Western and Central Africa, Eastern Africa, the Red Sea and Gulf of Aden, as well as the Mediterranean. The regional processes leading to the above-mentioned Arusha and Seychelles conferences also provided useful experiences.

11. We are fully aware that PACSICOM is taking place during the International Year of the Ocean, declared by the United Nations General Assembly to draw attention to the decisive role played by the oceans in shaping the life of the planet. Accordingly, the African States, together with the rest of the world, are drawing up plans to ensure that seas and coastal issues are accorded top priority in the decision-making agenda of all countries. PACSICOM will therefore, help raise awareness and the visibility of a range of marine and coastal issues of common concern.

12. Our countries are aware that the ocean covers almost three quarters of the surface of our planet. It links and unites the continents, rather than separates them. The world ocean is our common heritage. We therefore recognize that protecting and managing Africa's seas and coasts represent our contribution to the shared responsibility of safeguarding that global heritage.

13. In the same context, we recognize the emergence of a new order for the seas and oceans. The process of ratification of the United Nations Convention on the Law of the Sea has seen its entry into force on 16 November 1994. Most of its institutions have been put in place. The International Sea-bed Authority has been established in Jamaica, the International Tribunal for the Law of the Sea has been set up in Germany and several countries, across the world, have enacted laws and established institutions for the management of ocean space under their jurisdiction. They are initiating programmes for the sustainable development of their coastal zones.

14. Our countries are fully aware that the United Nations Convention on the Law of the Sea marks a breakthrough in the history of international law on the sea. The United Nations Convention on the Law of the Sea is the beginning of a process of transformation, continued and developed through the United Nations Conference on Environment and Development and its follow-up conventions, agreements and programmes. This process is pointing towards a new political, social and economic world order for the twenty-first century. PACSICOM and its follow-up actions will provide opportunities for encouraging effective participation of our region in these developments.

15. We are aware of the provision in the Convention on the Law the Sea which gives our land-locked States the right to participate, on an equitable basis, in the exploitation of an appropriate part of the surplus of the living resources of the exclusive economic zones of our coastal states.

16. We therefore fully recognize the need for bilateral agreements between our land-locked and coastal States of the same region, so as to enhance the creation of joint ventures in fisheries and shipping, as well as to strengthen co-operation and economic integration.

1.2 STATE OF AFRICA'S SEAS AND COASTS: KEY ISSUES

17. Our coastal environment contains diverse and valuable ecosystems of high productivity and biodiversity, and offers unique habitats for many species. These ecosystems contribute significantly to the livelihood of our coastal communities and the economy of our countries. They have intrinsic values,

including shoreline stability, beach enrichment, nutrient generation, recycling and moderation of pollution. This environment is, however, being threatened by pollution, destructive fishing methods and over-exploitation. Its ecosystems require urgent protection from pollution from land based sources, oil spillages, industrial and municipal waste and coastal erosion. The issue of coastal erosion is increasingly becoming a major social, economic and environmental concern to a large number of coastal States in our region. Reversing and halting this threat to our development effort requires comprehensive measures and strategies.

18. The information presented at PACSICOM further confirms that Africa's coastlines are suffering from demographic pressures. Already millions of our peoples live along coastlines. Owing to poorly planned construction and other development activities, as well as over-exploitation of resources, the physical and ecological degradation of coastal areas is accelerating in our region.

19. The often irreversible alteration of natural coastal systems and extensive coastal pollution are caused by the concentration of industrial development, accompanied by inadequate environmental policies and sectoral development. The situation in some of our small island States, which largely depend on the development and use of their coastal zones, is of particular concern.

20. Recent events, such as the El Niño phenomenon, as well as assessments carried out by organizations such as WMO, show that the expected impacts of climate change, sea-level rise in particular, will exacerbate the present problems and could, *inter alia*, impair future development and use of low-lying areas and coastal zones and cause setbacks in our efforts to achieve sustainable development. We therefore fully recognize the need to accord these issues greater attention in national policies and intergovernmental programmes.

21. Competition for the use of scarce resources is a key problem of economic development. This is particularly evident in some of our coastal zones because of the lack of clearly defined ownership of rights to the use of common property resources. This competition for resources creates conflicts of interest between the public and private users.

22. We realize that our coastal zones are still not fully considered as a finite economic asset which can be used on a sustainable basis only by prudent and rational exploitation. This intrinsic economic value of the coastal natural resources and amenities should be accorded a higher degree of importance in our national policies on the marine environment.

23. Declining catches in some of the continent's fishing grounds clearly demonstrate that increased fishing effort and investment as well as unmanaged small-scale fisheries can bring about the total dissipation of the value of fisheries.

24. This situation is adversely affecting our peoples' livelihood and diminishing the contribution of coastal resources to the gross national product (GNP).

25. Over the last two decades:

- (a) Our countries have been parties to intergovernmental agreements and arrangements which have now provided the legally binding basis for action on the marine and coastal environment in Africa. These include the Abidjan, Nairobi, Jeddah and Barcelona Conventions and their respective protocols;
- (b) Within these frameworks, our countries have adopted number of intergovernmental programmes and are partners in similar initiatives, which constitute the substantive basis for action in the continent;
- (c) Our countries have also set up structures, such as the regional co-ordinating units respectively for the Abidjan, Nairobi, Jeddah and Barcelona Conventions, which give us the institutional basis for our actions.

1.3 PACSICOM PORTFOLIO OF ACTION PROPOSALS AND SPECIFIC RECOMMENDATIONS FROM THE WORKSHOPS

26. In the course of our discussions at PACSICOM, and as reflected below, we have identified issues which require renewed intergovernmental and international dialogue. We have also agreed on areas requiring political commitment and policy actions to be addressed within our existing regional conventions,

intergovernmental programmes and institutional mechanisms for co-operation and co-ordination. The relevant bilateral and multilateral organizations are called upon to support these efforts through their programmes in Africa.

27. First and foremost, we recognize the need for more effective actions as well as better co-ordination. For that reason, we resolve and commit our countries to the following processes and call upon United Nations agencies, as well as development co-operation partners, to give full support to our efforts in that regard:

- (a) Designing of innovative and comprehensive strategies for sustainable integrated coastal environment management in the Africa region, taking fully into account the cultural and social dimensions of development and bearing in mind the interface processes between the physical environment, the cultural heritage and people;
- (b) Regular review of the state of Africa's marine and coastal environment as well as the performance of our intergovernmental agreements, including programmes;
- (c) Enhancement of the efficiency of our institutions responsible for management of coastal and marine environments, along four axes, namely, through better co-ordination, through making them more cross-sectoral, through the involvement of relevant stakeholders, and through providing appropriate national funding arrangements.

28. The findings of the assessment on the integrated coastal management projects in Africa, carried out in preparation for PACSICOM (commissioned by UNEP and financed by the Government of Finland), show that, in spite of successful initiatives, there seems to be a lack of a learning process or effective mechanisms by which information on successes and failures can be shared at the national, subregional and Africa-wide levels. Regional dialogue and co-operation will be necessary in effected applying the lessons learnt.

29. We therefore recognize the need to inculcate the culture of learning regional and sharing of experience and we agree to institute an Africa-wide mechanism for periodic reviews and assessments of integrated coastal management (ICM) initiatives based on proven methodologies. We call upon UNEP, in collaboration with other United Nations bodies and bilateral and multilateral agencies, to assist African States in co-ordinating these assessments as their contributions to the above review and assessment process. The results of these periodic assessments should be fed into the PACSICOM process. In order to enhance the ownership and accountability of ICM initiatives by African States, we agree to integrate ICM initiatives in our national development plans and accept them as contributing towards the national development process.

30. In recognition of the analysis made by, first, the workshop on cross-cutting issues and, second the technical workshops, as contained in the annexed document "Joint Report of the Technical Workshops", and associated high-level technical recommendations and actions to be developed into programmes dealing with land-ocean interactions and sustainable integrated coastal management in Africa. We also agree with and endorse the priorities for action reflected, respectively, in sections 5 and 6. We undertake to carry out measures in furtherance of the recommended goals and call upon the relevant United Nations agencies, as well as partners, to extend the necessary support.

31. We recommend that some of the priorities for action be developed into programme briefs for the consideration of the Partnership Conference to be held in 1999, in which our Governments and our development co-operation partners will take part.

1.4 PACSICOM PROCESS

32. Our countries resolve to deal respectively with the challenge confronting us in the implementation of our regional conventions and intergovernmental programmes. In this regard, and in the spirit of global interdependence, we recognize the importance of international co-operation in tackling the constraints and problems that we face in the implementation of the above agreements and programmes.

33. We are committed to maintaining the momentum generated by PACSICOM and will count on the continuous support of the international community and, in particular, the PACSICOM co-sponsors, namely, the Governments of Mozambique and Finland, UNESCO and UNEP. We commend FAO for playing a supportive role in the convening of the technical workshops. We welcome the assistance and the willingness

of the Advisory Committee on the Protection of the Seas (ACOPS) to assist in the process of reinforcing existing partnerships for the sustainable management of the marine and coastal environment in Africa, as is evident in its readiness to support the PACSICOM process.

34. We call upon all relevant African institutions, including regional and subregional organizations, to participate fully in the PACSICOM process.

35. We also call upon our development co-operation partners, including United Nations bodies, as well as bilateral and multilateral agencies, to take the necessary measures to enhance co-ordination with regard to project formulation, implementation and monitoring. This can be achieved, *inter alia*, through periodic reviews involving our Governments and our development co-operation partners.

36. In order to see through and reinforce the PACSICOM process, we have resolved to participate in the following mutually reinforcing pan-African conferences:

- (a) First, a Pan-African conference to promote intra-African co-operation in the implementation of our regional Conventions, programmes and action plans to protect, manage and develop Africa's marine and coastal environment. The Conference will be held in Cape Town, South Africa, from 30 November to 4 December 1998, to be hosted by the Government of South Africa and with the assistance of ACOPS and UNEP. The Cape Town Conference will essentially review the existing regional conventions, agreements, action plans, protocols and multilateral programmes for the protection, management and development of the marine and coastal environment. Stock will be taken of the achievements as well as shortcomings and gaps, with a view to addressing them through existing African intergovernmental programme;
- (b) Second, a partnership conference to be held in mid-1999, which will consider a set of proposals for funding in addressing major priorities for action identified by the Maputo and Cape Town Conferences;
- (c) Third, a special pan-African conference to review the progress made in the implementation of the measures emanating from PACSICOM. This special review session will be held in the year 2003.

37. Our countries recognize that it is on the basis of systematic, collective and constructive review, through processes such as PACSICOM, that Africa's countries will take full responsibility for the protection, management and sustainable development of our continent's seas and coasts. It is also on this basis that we can organize Africa's effective participation in international efforts and initiatives to protect the global marine environment.

38. PACSICOM has provided a forum for discussions and exchange of views on key issues of concern. As a demonstration of our individual and collective resolve to address these issues, we have considered endorsed and adopted the following conference outcomes:

- (a) PACSICOM Statement (section 2.1);
- (b) Resolution on the conclusions of PACSICOM (section 3.1);
- (c) Resolution on Africa's participation in the observance of the International Year of the Ocean (section 3.2);
- (d) Maputo Declaration (section 4);
- (e) Portfolio of Action Proposals by the Workshop on Cross-Cutting Issues (section 5);
- (f) Summary Statement and Specific Recommendations of the Technical Workshops (section 6).

39. In adopting these important documents, we fully recognize that the recommended actions constitute a challenge:

- (a) First, to ourselves to take action on the measures identified at PACSICOM;
- (b) Second, to the international community and relevant international agencies and bodies to contribute to the achievement of the goals we have set at PACSICOM and throughout the PACSICOM process;
- (c) Third, to our countries and peoples to utilize the 1998 International Year of the Ocean as a unique opportunity to promote national and regional activities for the protection of the marine environment.

ANNEX V

THE PACSICOM RESOLUTIONS

We, the African countries, having participated in the Pan-African Conference on Sustainable Integrated Coastal Management (PACSICOM) held in Maputo, Mozambique, from 18 to 24 July 1998:

1.1 RESOLUTION ON THE CONCLUSIONS OF PACSICOM

Expressing our appreciation and thanks to the Government of Mozambique for initiating the idea of PACSICOM and for hosting it, and also congratulating the African countries for fully supporting PACSICOM and its process,

Also expressing our gratitude to the Governments of Mozambique and the Finland, UNESCO and UNEP for co-sponsoring PACSICOM and commending FAO for co-sponsoring some of the arrangements for the Technical Workshops,

Further expressing our appreciation of the assistance provided by the Advisory Committee on the Protection of the Sea in promoting the implementation of our regional conventions, intergovernmental agreements and programmes on the coastal and marine environment in Africa,

Congratulating the members of the PACSICOM Co-ordinating Committee for facilitating and co-ordinating the preparations for PACSICOM,

Recalling the conventions, protocols, action plans and intergovernmental programmes put in place to protect, manage and sustainably develop Africa's seas and coasts,

Further recalling the policy and programme measures we have taken under the aegis of the African Ministerial Conference on the Environment to promote regional co-operation on the African environment,

Bearing in mind the hopes and aspirations we embodied in the African Common Position on Environment and Development submitted by the Organization of African Unity to the 1992 Rio Earth Summit, in which we specified the basis for action on the management of the marine and coastal environment in Africa,

Aware of the goals of the United Nations System-wide Special Initiative on Africa;

Further aware of the objective of United Nations General Assembly resolution 49/131, adopted on 19 December 1994, declaring 1998 as the International Year of the Ocean, and determined to take full part in its observance,

Aware also of the initiatives under way within the framework of international co-operation in support of our efforts to protect, and to manage in a sustainable manner Africa's seas and coasts,

Call on African countries to take necessary actions on the outcome of PACSICOM, notably:

- (a) The PACSICOM Statement;
- (b) The resolution on the conclusions of PACSICOM;
- (c) The resolution on Africa's participation in the observance of the International Year of the Ocean;
- (d) The Maputo Declaration;
- (e) The Portfolio of Action Proposals by the Workshop on Cross-Cutting Issues;
- (f) The Summary Statement and Specific Recommendations by the Technical Workshops.

1.2 RESOLUTION ON AFRICA'S PARTICIPATION IN THE OBSERVANCE OF THE INTERNATIONAL YEAR OF THE OCEAN

Conscious of the relevance of the goals of the International Year of the Ocean to the efforts of African countries to protect, manage and sustainably develop the region's marine and coastal environment,

Aware of the goals of the water components of the United Nations System-wide Special Initiative on Africa,

Recognizing the unique opportunities for heightening awareness on the of importance of ocean governance in Africa through observance of the International Year of the Ocean,

Urge all African countries to participate actively, at the national, subregional and global levels, in activities relating to the observance of the International Year of the Ocean;

Request the African Ministerial Conference on the Environment to promote the observance of the International Year of the Ocean in Africa;

Also request Mozambique, in its capacity as host of PACSICOM, to convey the outcome and recommendations of PACSICOM, which represents, *inter alia*, a significant contribution of African countries to the observance of the International Year of the Ocean to the following persons and bodies:

- (a) Secretary-General of the Organization of African Unity, for the attention of the heads of State and Government at their next summit;
- (b) Governing bodies of African subregional and regional organizations;
- (c) Secretary-General of the United Nations;
- (d) Governing bodies of the respective United Nations agencies;
- (e) Bureaux and secretariats of the contracting parties of;
 - (i) Regional conventions, notably those dealing with issues relevant to the coastal and marine environment; and
 - (ii) Relevant global conventions;
- (f) Executive Secretary of the United Nations Economic Commission for Africa;
- (g) Co-Chairs of the Steering Committee of the United Nations System-wide Special Initiative on Africa (the United Nations Administrative Committee on Co-ordination);

Further request the Government of Mozambique, in its capacity as the host of PACSICOM, to convey the same message to the organizers of EXPO '98.

Maputo, Mozambique, 24 July 1998

ANNEX VI

THE MAPUTO DECLARATION

We, the Governments represented by our ministers and senior officials responsible for the environment, meeting in Maputo from 18 to 24 July 1998, as part of the process of reinforcing and renewing our common resolve to effectively protect, manage and sustainably develop Africa's marine and coastal environment,

Noting with concern the continued deterioration of our coastal and marine environment and the threat that it poses to the well-being of present and future generations;

Recognizing the need to move towards more integrated policies and the practice of sustainable integrated coastal management to improve the quality of life for our peoples,

Also recognizing the increased impact of sedimentation and wastes on the environment due mainly to inappropriate agricultural activities upstream and inadequate waste management strategies,

Further recognizing the need for the protection, management and sustainable development of Africa's more than fifty significant international river basins,

Fully aware that Africa's environmental and economic problems are compounded by frequent occurrences of natural disasters, such as drought, floods and the El Niño phenomenon,

1. Affirm our commitment:

- (a) To review our respective national policies and programmes with a view to incorporating the goals of chapter 17 of Agenda 21 of the United Nations Conference on Environment and Development, on sustainable integrated coastal areas management;
- (b) To conduct periodic reviews of the legislative, substantive and institutional basis for action on the coastal and marine environment in Africa;
- (c) To promote systematic intergovernmental dialogue on the priority issues identified at the Pan-African Conference on Sustainable Integrated Coastal Management, relating to sustainable integrated coastal management;
- (d) To address issues identified in Statement of the Pan-African Conference on Sustainable Integrated Coastal Management, using existing regional conventions, protocols, action plans and intergovernmental programmes on the marine and coastal environment, as well as appropriate new initiatives;
- (e) To update our existing regional agreements on Africa's marine and coastal environment in the light of recent developments, including the United Nations Conference on Environment and Development, the adoption of the Treaty Establishing the African Economic Community, the entry into force of the United Nations Convention on the Law of the Sea and the adoption of numerous regional and global conventions on the environment;
- (f) To take stock of the potential hot pots in our region and to identify our continent's stakes in global ocean security debates considering, first, the crucial role of environmental security in our region's development efforts; second, the growing attention to ocean security issues; and, third, that international waters are increasingly becoming flashpoints for future conflicts;
- (g) To promote concerted efforts, at the regional level, to monitor the impacts caused by climate change and to encourage regional and international co-operation to address the impacts;
- (h) To take measures essential to the establishment and strengthening, at the regional level, of forecasting and early warning capabilities to deal with natural disasters;

- (i) To ensure that effective intergovernmental agreements for the protection, management and development of shared water resources are put in place;
 - (j) To promote soil conservation measures to address the increasing impact of sedimentation.
2. Request the Organization of African Unity and the African Ministerial Conference on the Environment and other relevant United Nations agencies, in furtherance of the objectives of the Pan-African Conference on Sustainable Integrated Coastal Management, to consider the possibility of convening, in 1999, a regional summit of heads of State and Government to heighten awareness and to focus attention on the hot pots in Africa's aquatic environment, both marine and freshwater;
 3. Affirm our commitment to the PACSICOM process.

Maputo, Mozambique, 24 July 1998

ANNEX VII

**PORTFOLIO OF ACTION PROPOSALS BY THE PACSICOM WORKSHOP
ON CROSS-CUTTING ISSUES**

(Maputo, Mozambique, 21 - 22 July 1998)

Following two days of deliberations on cross-cutting issues and inter-linkages in the management of Africa's coastal and marine environment, including river basins and catchment areas, participants at the Workshop on Cross-cutting Issues identified priorities for action in the region within the framework of existing national, regional and international institutions and made the following recommendations:

1. TO STRENGTHEN THE EXISTING INSTITUTIONAL AND LEGAL FRAMEWORK FOR INTEGRATED MANAGEMENT OF COASTAL AREAS, BY:
 - (a) Integrating marine and coastal related issues in national development policies plans to guide the sustainable management of the coastal areas;
 - (b) Empowering national institutional structures with:
 - (i) Strong mandates for effective actions in dealing with the multidisciplinary and complex challenges of the management of coastal areas;
 - (ii) Responsibilities for promoting multisectoral approaches in the management of coastal areas;
 - (iii) Adequate authority to regulate and facilitate the enforcement of environmental policy, as well as to influence national development strategies on which invariably, the protection of the marine and coastal environment depends;
 - (iv) Responsibilities for accelerating the ratification of all relevant subregional, regional and international environmental agreements, conventions, and protocols;
 - (v) Relevant national legislation and ensuring its conformity with corresponding subregional, regional and international environmental agreements, conventions and protocols;
2. TO ENSURE THE ACCEPTABILITY AND SUSTAINABILITY OF PROGRAMMES AND PROJECTS, BY INVOLVING ALL RELEVANT STAKEHOLDERS, THROUGH:
 - (a) Realistic participation of local communities in the formulation, implementation and monitoring and evaluation of policies, plans, projects, and programmes;
 - (b) Effective involvement of non-governmental organizations, to facilitate the management processes of coastal areas;
 - (c) Involvement of the private sector as partners in the development and conservation initiatives of coastal areas;
 - (d) Ensuring an effective gender balance;
3. TO BUILD AND STRENGTHEN INDIGENOUS CAPABILITIES TO COPE WITH THE FULL COMPLEXITY OF THE PROBLEMS FACING AFRICA'S MARINE AND COASTAL ENVIRONMENT, BY:
 - (a) Building human and technical capacities in natural and social sciences relevant to the needs of the region;
 - (b) Expanding curricula to include coastal and marine environment issues at all levels of education;
4. TO STRENGTHEN THE COLLECTION AND DISSEMINATION OF SCIENTIFIC INFORMATION AS A BASIS FOR EFFECTIVE MANAGEMENT OF COASTAL AREAS, THROUGH:
 - (a) Enhancement of management-driven marine scientific research;
 - (b) Collection, use and protection of indigenous knowledge;

- (c) Supporting sustained routine and long-term measurements and monitoring of environmental variables as the basis for forecasting change;
 - (d) Use of appropriate information delivery mechanisms;
 - (e) Sharing of information, data and experience on integrated coastal management programmes and projects;
 - (f) Identification of common methodologies and harmonizing activities in information collection;
 - (g) Periodic assessments and evaluation of integrated coastal management initiatives to propagate learning and exchange of experiences;
5. TO IMPROVE CO-OPERATION AT SUBREGIONAL, REGIONAL AND INTERNATIONAL LEVELS, IN ORDER TO COPE WITH NEW CHALLENGES FACING AFRICA'S COASTAL AND MARINE ENVIRONMENT, BY:
- (a) Reviewing and updating the existing subregional and regional conventions, protocols and action plans;
 - (b) Co-ordinating and harmonizing projects and programmes to avoid duplication and competition and to ensure cost saving;
 - (c) Using indigenous capacities in the implementation of subregional and regional initiatives;
6. TO BUILD CONFIDENCE AND TRUST AND TO ENSURE THE SUCCESSFUL IMPLEMENTATION OF INTEGRATED COASTAL ZONE MANAGEMENT, THROUGH:
- (a) Establishment of more demonstration projects and programmes in the region for sustainable integrated coastal management (SICOM), in addition to such successful existing projects as the Tanga Integrated Coastal Management Programme. United Republic of Tanzania; the Large Marine Ecosystem-Gulf of Guinea Project, West Africa; the protection of coastal areas and wetlands of Hammamet Gulf, Tunisia, and others;
 - (b) Identification and safeguarding of cultural and spiritual sites, as well as biologically diverse areas;
 - (c) Mitigation of negative environmental impacts;
7. TO INSTITUTE FINANCING MECHANISMS, WHEREBY:
- (a) Governments prioritize SICOM programmes and make adequate budgetary allocation for their implementation;
 - (b) Governments honour their funding commitments to ratified conventions and protocols;
 - (c) Governments provide incentives to the private sector to encourage their financial contribution to the implementation of SICOM programmes and projects;
 - (d) Bilateral and multilateral donor agencies provide support for programmes and projects based on national, subregional and regional priorities;
 - (e) GEF support for the Africa region is equitably expanded;
8. TO SUSTAIN THE MANAGEMENT PROCESS OF THE MARINE AND COASTAL ENVIRONMENT WHICH HAS BEEN INITIATED AT PACSICOM, THROUGH:
- (a) Active participation of all African countries in the PACSICOM follow-up process, in particular, the Cape Town Conference and the Partnership Conference to be held, in 1998 and 1999, respectively, as well as initiating a subregional PACSICOM process;
 - (b) The support of OAU, the Economic Commission for Africa, the African intergovernmental bodies and regional and subregional environmental organizations, United Nations agencies and other multilateral and bilateral organizations in the outcome of PACSICOM and the activities envisaged in the follow-up process.

ANNEX VIII

SUMMARY STATEMENT AND SPECIFIC RECOMMENDATIONS BY THE TECHNICAL WORKSHOPS
(Maputo, Mozambique, 18 - 20 July 1998)

First: Sustainable integrated coastal management (SICOM) is a process that needs gradual and continuous implementation. It requires compliance with the following principles, which were particularly emphasized during the technical workshops:

1. Intra- and inter-generational equity, which includes both the sustainable management of natural resources and the conservation of the cultural and natural heritage;
2. Community participation based on communication at all levels and stages of decision-making;
3. Recognition and application of knowledge of indigenous people and respect of their property rights;
4. Development of sound technical understanding, based on the integration of scientific, social and economic variables, the monitoring of social, economic and natural conditions and the forecasting of changes;
5. Co-ordination among formal and informal institutions for decision-making in resource allocation and development;
6. Legislation to amend institutional mandates, the modification of user rights and the introduction of mechanisms to regulate activities and resolve conflicts;
7. Consensus-building as a basis for good management and the prevention of conflicts;
8. A holistic and transdisciplinary approach in both formal and informal education;
9. Effective use of the media in both formal and informal means of communication;
10. Training of professionals to ensure that all the above principles become effective.

We strongly commend these principles as a basis for the implementation of SICOM in Africa. The ministers endorsed these principles, as clearly reflected in the PACSICOM Statement.

Second: The detailed recommendations of the technical workshops are given in the joint report. These represent our collective view on the future actions needed to achieve SICOM in Africa. We seek the support and endorsement of the ministers for these recommendations.

Third: We wish to highlight the following specific recommendations of the technical workshops. The details may be found in the joint report of the technical workshops.

1. It is essential to build a strong constituency for sustainable integrated management. Commitment by States is required to establish the appropriate institutional and legal mechanisms that shape sectoral roles and interactions between central, provincial and local governments and civil society and private sector institutions. Regional and international solidarity and partnerships are important to reconcile local needs with global interests and concerns.
2. Provision of a sound information base for local and regional planning requires:
 - (a) Formation of an Africa-wide network of national ocean data centres;
 - (b) Upgrading and expanding the present African network of stations for monitoring sea-level rise;
 - (c) Creating a network of specialists trained in the use of data acquired by remote sensing from space satellites;
 - (d) Facilitating the further implementation of modern electronic communication systems such as Internet connections and data transfer mechanisms.

3. Capacity-building embraces the essential elements of human resources, infrastructure, adequate funding and supportive national policies. The priorities for SICOM are:
 - (a) Training and education in marine science and technology;
 - (b) Institutional strengthening;
 - (c) Sustainable funding; and
 - (d) Integration of coastal management in the national developmental and environmental plans.
4. In order to enhance the integration and sustainability of programmes and projects, it is essential:
 - (a) To establish an inter-ministerial steering committee for SICOM, dealing with matters including communication and information, to co-ordinate and ensure the effective participation of institutions among themselves and with the concerned communities;
 - (b) To enhance the quality and quantity of information transfer between the Government's institutions, their agents, international bodies and non governmental organizations interested in project implementation, through the use of information and communication technologies; and
 - (c) To set up participatory analysis, monitoring and evaluation mechanisms.
5. Environmental education for SICOM is important and it is essential that Governments should:
 - (a) Improve and develop this educational approach at all levels of formal and non-formal education; and
 - (b) Involve all relevant United Nations agencies, non-governmental organizations and the private sector, in order to ensure an integrated and interdisciplinary approach of interest to SICOM.
6. An evaluation of the potential of earth resources in coastal areas is needed and efforts must be made to ensure their future exploitation in an environmentally sound manner, involving capacity-building of the participating geoscientists. Funds for geoscientific research projects and training facilities may be provided from national and international institutions.
7. River basin management and coastal area management should be closely integrated. At the planning level, proper co-ordination and linkages should be established between water resources management plans and land-use and urban development plans. International river basin organizations should be strengthened to ensure the proper management, protection and development of international waters, through local and national actions and regional co-operation. A new, intensive relationship between policy-making and the scientific community should be encouraged, to create a wider knowledge base through education and research.

We urge the African States, in collaboration with the PACSICOM conveners and other technical and development partners, to give particular attention to the timely and effective implementation of these actions.

ANNEX IX

LIST OF ACRONYMS

ACOPS	Advisory Committee on Protection of the Sea
AMBITION	Array of Moored Buoys in the Tropical Indian Ocean Network
CASI	Compact Airborne Spectrographic Imaging
CD-ROM	Compact Disk with a read-Only Memory
CEOS	Committee on Earth Observation Satellites
CMM	Commission for Marine Meteorology (WMO)
DBCP	Data Buoy Co-operation Panel (WMO-IOC)
DNA	Designated National Agency
EASY	Environmental Analysis SYstem
ENSO	El Niño and the Southern Oscillation
EuroGOOS	European Global Ocean Observing System
GCOS	Global Climate Observing System
GEF	Global Environment Facility (World Bank-UNEP-UNDP)
GESAMP	Group of Experts on the Scientific Aspects of Marine Environmental Protection
GIS	Geographical Information System
GLODIR	Global Directory of Marine (and Freshwater) Scientists
GLOSS	Global Sea Level Observing System
GODAR	Global Oceanographic Data Archaeology and Rescue Project
GOOS	Global Ocean Observing System
GOOS-AFRICA	African Global Ocean Observing System (Data & GOOS for SICOM in Africa)
GPA	Global Plan of Action for the Protection of the Marine Environment from the Land-Based
GPO	Global Ocean Observing System Project Office
GSC	Global Ocean Observing System Steering Committee
GTOS	Global Terrestrial Observing System
GTS	Global Telecommunication System
GTSP	Global Temperature-Salinity Project
HOTO	Health of the Oceans
I-GOOS	Committee for the Global Ocean Observing System
ICRI	International Coral Reef Initiative
ICSU	International Council of Scientific Unions
IGOSS	Integrated Global Ocean Services System
IOC	Intergovernmental Oceanographic Commission of UNESCO
IODE	International Oceanographic Data and Information Exchange (IOC)
IPCC	Intergovernmental Panel on Climate Change
LMR	Living Marine Resources
MAP	Mediterranean Action Plan
MedGOOS	Mediterranean Global Ocean Observing System
NEAR-GOOS	North East-Asian Region Global Ocean Observing System
NOAA	National Oceanic and Atmospheric Administration (USA)
NODC	National Ocean Data Centres
OOSDP	Ocean Observing System Development Panel
Pacific GOOS	Pacific Island Global Ocean Observing System
PACSICOM	Pan-African Conference on Sustainable Integrated Coastal Management
PERSGA	Regional Organization for the Conservation of the Environment of the Red Sea and Gulf of Aden
PIRATA	Pilot Research Array of buoys in the Tropical Atlantic
POEM	Physical Oceanography of the Eastern Mediterranean
RECOSCIX	Regional Co-operation in Scientific Information Exchange
SAR	Synthetic Aperture Radar
SICOM	Sustainable Integrated Coastal Management
SOOP	Ship Of Opportunity Programme
SST	Sea Surface Temperature
TAO	Tropical Atmosphere Ocean array of buoys in the Equatorial Pacific
TEMA	IOC Committee for Training, Education and Mutual Assistance in Marine Sciences
TOGA	Tropical Ocean and Global Atmosphere
UNCED	United Nations Conference on Environment and Development
UNCLOS	United Nations Convention on the Law of the Sea

UNEP	United Nations Environment Programme
VOS	Voluntary Observing Ship
WCRP	World Climate Research Programme
WESTPAC	IOC Sub-Commission for the Western Pacific
WIOMAP	The Western Indian Ocean Marine Application Project
WMO	World Meteorological Organization
WOCE	World Ocean Circulation Experiment

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