

Meeting Report of the Third SPREP Meeting on Climate Change and Sea Level Rise in the Pacific

**Noumea, New Caledonia
18—22 August, 1997**

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Chairpersons Summary of Findings and Future Needs

The chairpersons for the meeting were the government representatives and administrators of American Samoa, Cook Islands, Kiribati, Samoa and Vanuatu.

The science of climate change has been summarised periodically for some twenty years. Some findings were well accepted whereas others were more widely debated. The increasing levels of greenhouse gases (GHGs) (e.g 0.4 percent per year for Carbon Dioxide-CO₂) and their effect on enhancing the heating of the earth (2.5 W/m²) are well established. A doubling of carbon dioxide (CO₂) concentration would directly increase global temperatures by 1.20C. When feedback mechanisms are considered a total heating of 1.5-4.50C has been agreed to over the last 20 years. It is also agreed that the world has heated 0.3-0.60C since 1860 but there is debate whether this can be attributed to an enhanced Greenhouse (GH) effect. The Intergovernmental Panel on Climate Change (IPCC) Second Assessment Report, in a major change from its 1990 Report, stated that it is unlikely that the heating is entirely natural. There is now a discernible effect of human activity. But how much the earth will warm and how much sea level will rise in the future depends on many factors. By the year 2100 the temperature is expected to increase by 1-40C (1.70C middle scenario) and global sea level by 13-94cm (49cm middle scenario). At present, little can be said with any certainty about regional scale changes, particularly in the Pacific.

A review of scientific information and understanding in the Pacific about Climate Change and Sea Level Rise (CC and SLR) draws on information from a number of sources. They show temperatures have been increasing by 0.10C per decade in the region and sea levels by 2mm per year. There is also evidence, climate phenomena such as EL Nino and Southern Oscillation (ENSO) will have major influences on the impact of CC and SLR. It is also understood the Pacific region plays an important role in understanding global climate change.

Modeling, scenario development and vulnerability assessments will play key roles in helping the Pacific respond to CC&SLR. Models currently suggest a doubling of CO₂ concentration will increase sea-surface temperatures by 10C and increase rainfall intensity in

the central equatorial Pacific. Although the second assessment of the Intergovernmental Panel On Climate Change (IPCC) did not produce a consensus regarding tropical cyclones in a changed climate regime, recent research has indicated a possible intensity increase of 10-20 percent with a doubling of CO₂. Vulnerability assessments have shown PIC's to be highly vulnerable to CC&SLR with a low capacity to respond.

This response capability needs to be strengthened through regional and international cooperation and education, training and awareness raising. Countries also need to be encouraged to perform integrated impact assessments in addition to sectoral ones.

The National Tidal Facility (NTF), established by Australia at Flinders University in 1989 as a service to Australia and the region, operates eleven sea level monitoring sites in the South Pacific. In its five years of operation the data has provided information on sea level changes during cyclones and tsunamis as well as for modeling tidal information. Interestingly, most station show accelerated SLR, and increases of up to 25mm per year. This is more than ten times the trend this century. The findings have been validated by satellite data showing 20-30mm per year rises in a region from Papua New Guinea southeast to Fiji. The cause and duration of this change is unknown, but is probably related to ENSO.

The New Zealand Meteorological Service has supported a number of PIC meteorological services since around 1940. Analysed data shows that since 1920, temperature has risen 0.6-0.70C in Noumea (New Caledonia) and Rarotonga (Cook Is), much greater than average increases worldwide. This is based on data at 34 stations throughout the Pacific, located from about 160 degrees east, but mainly south of the equator. Research shows surface air temperatures have increased by 0.30C to 0.80C this century, with the greatest increase in the zone south-west of the South Pacific Convergence Zone (SPCZ). This is well in excess of global rates of warming. The records also indicate rainfall had increased in the north-east, and decreased in the south-west of the Pacific. Interannual variations in temperature and rainfall were found to be associated with the Southern Oscillation Index (SIO) and the research also

found an eastward movement of the SPCZ had taken place. The changes observed in the twentieth century were considered to be consistent with anthropogenic activity.

Research results such as those reported here are highly dependent on the continued support of Pacific meteorological services. Long-term, high quality data with consistent standards are required to study climate change, both in the region as it affects global processes. To ensure the maintenance of quality data, Pacific Island governments need to ensure that financial support for national meteorological services is maintained, that there is ongoing training, capacity building, and the appropriate technologies are used for the purpose.

A great deal of international effort has enabled the identification of seasonal, and interannual trends in oceanic conditions, but scientists are not yet in a position to identify long term trends in temperature and salinity. More oceanographic observational work is needed to achieve understanding of the mechanisms that govern climate in the region.

C02 exchanges between the ocean and atmosphere in the equatorial zone east of the international dateline, have resulted in 1000 million tonnes of carbon being exported to the atmosphere as a result of upwelling. This figure would be even higher, except for biological processes, which reuse carbon brought to the surface by upwelling in the eastern Pacific. Results from ORSTOM Research Institute in Noumea, New Caledonia, indicate that during El Nino events atmospheric C02 concentrations tended to increase less rapidly, and during La Nina C02 measurements indicated a more rapid increase in atmospheric concentration. While C02 fluxes can be monitored there are physical dimensions of the process which are not well understood, such as seasonal differences.

Recent data and modeling suggest we are moving into a significant El Nino event with a multivariate ENSO index showing the current event is occurring with greater rapidity than any of the six previous events for which data is available. The Pacific ENSO Applications Center in Hawaii (USA) provides information to a number of PICs regarding ENSO. Experimental climate forecasting is presently being carried out. It is felt climate forecasts will be of considerable assistance in planning agricultural production, fisheries, human health, and civil defense activities. While in some locations, and for certain seasons a high degree of skill

can be obtained in forecasting ENSO related climate conditions, in other areas predictions are more difficult.

Communications in the Pacific region are badly in need of significant improvement for a better Tropical Cyclone (TC) warning system. Although Meteorological Services are doing their best, the error in predicting the locality to be hit by a TC is quite high. For example if a warning is given 12 hours ahead, the error is 122km. Due to this high error, it's likely an unprepared area may be hit by a TC. Media-reports on TCs are not as accurate as desired. Such reports were criticised.

According to statistics from 1940-1994, the average number of TCs per year is seven. Although the general TC season is between October and May, most TCs occur between January to March each year. Changes in frequency, area of occurrence, time, mean intensity and maximum intensity of the TC, cannot be predicted by present numerical models. Based on the present records, no two TCs are the same. However, TCs usually take place between latitudes 80S and 200S and longitude 1450E and 1250W. Probability of occurrence is maximum near 80S and decreases with increasing latitude. During ENSO a TC has more than a 40 percent chance of being severe.

Climate change and its impact on human health is a new area of research. One of the problems is that we do not know enough about what might happen in the future, therefore highlighting the importance of integrated assessment models (IAM) for assessing the climate change impacts on human health. Currently there are significant numbers of health related disasters in the developing world. Many areas of the world suffer from tidal waves. But there is little knowledge of how this phenomenon might be affected in the future by climate change. There is a threat posed by infectious and vector-borne diseases such as malaria and cholera in the developing world. Cholera incidence is on the rise and there have been reports of malaria incidence in areas which previously did not have malaria - eg in the highlands of Papua New Guinea. Future work included:

- (i) identification of vulnerable population to health risk;
- (ii) develop indicator species of vectors, and response strategies, and
- (iii) to establish early warning system such as ENSO.

This work is particularly relevant for PICs. Regional, national and international communities should focus on adapting to present natural variability and prepare for extreme events. The National Oceanic and Atmospheric Administration (NOAA) and the Secretariat of the South Pacific Community (SPC), are in the process of collaborating on work related to health indicators and ENSO related extreme events.

The impacts of climate oscillation on tuna fisheries in the Pacific Ocean have been studied by the SPC. Some seventy percent of tuna catches come from the Pacific Ocean. Tuna activities have expanded considerably. The catch is mostly skipjack and yellow fin tuna, with the majority coming from the western equatorial Pacific. The tuna resource is closely linked to position of warm pool, an area of low primary production. The result is surprising as tuna need to consume ten percent of their body weight each day. One reason may be the convergence zone along the eastern boundary of warm pool. This may provide a possible mechanism for replenishing productivity in warm pool. Hence research is being made into the presence of the convergence zone and the presence of tuna. Results from a 1988 - 95 study show a large interannual variation and high spatial variability. Conclusions based on simulation studies indicate that secondary production (upwelling) enables the concentration of tuna in otherwise 'poor' productivity areas as a result of convergence zones. The impact of ENSO is clearly established: Zonal movements include east-west movement of primary production and tuna levels.

The IPCC assessment of the social and economic dimensions of climate change makes little reference to Pacific island countries. The focus is mitigation. The IPCC report uses models designed mainly for developed economies. All islands are treated as if they are the same. For the world as a whole the IPCC estimates a net loss for 2 x CO₂ of about 1.5-2.0 percent of global Gross National Product (GNP). Developing countries are estimated to have net loss of 2-9 percent GNP.

The social and economic dimension of global climate change has a number of implications to Pacific countries such as:

- (a) PICs make a small or negligible contribution to GHG;
- (b) they are among the countries which are most impacted; and

- (c) knowledge of relevant parameters is very low.

Thus Pacific island countries should take precautionary approaches, acquire more understanding and knowledge about the causes than effects, and more about migration than adaptations. Understanding effects and adaptation is essential in the political arena and thus public awareness is important to the Pacific region.

Most Pacific island governments are aware of climate change, but want to know how to address the problem. The cultural dimension involves the environmental impact on both people and culture. For example, the larger islands with more resources would influence class structure and culture of communities living in them. Traditional knowledge has governed activities and survival of people in the region both in the past and present. The socio-economic dimension has indicated a change from subsistence to dual economy. Issues that need to be addressed include population density, location infrastructure, food security, culture and activities.

The response options that exist, include migration, resettlement and decentralisation. All these need planning as they have policy implications. The future direction will have to be researched so that some response strategies will be planned and recommended for future adaptations.

Papers presented during the meeting, and subsequent discussions, identified the need for:

1. At the National Level

- Implementation of locally-based "coping/sensitivity" studies. These take into account socio-economic consequences of such phenomena as droughts, food security, tropical cyclones, high abnormal tides and storm surges, coastal erosion, outbreaks of cholera and failure of food supplies.
- Development, validation and application of integrated (i.e. multi-sector), national-level impact assessment models (e.g CLIMFACTS) which meet the requirements and challenges of producing meaningful results for Pacific island countries.
- Development and validation of seasonal forecasts of key national indicators, including rainfall anomalies, wind anomalies, tropical cyclone frequency and intensity, and sea level variations and change.

- In country assessments of local adaptation and mitigation strategies, including assessing technical and economic effectiveness, cultural and social acceptability and links with traditional methods.
- Public awareness raising, including such activities as translation of technical information into local languages, songs, plays etc. Briefing of decision-makers and policy-makers, information exchange, and education, including curriculum development and preparation of relevant resource materials such as case studies and practical projects. Current examples are the South Pacific Sea Level and Climate Monitoring, US Atmospheric Radiation Measurement project (ARM), and School of the Pacific Rainfall Climate Experiment (SPARCE) program.
- Non-targeted (i.e. generic), in-country training to empower decision makers, planners and community organisations in such skills as consensus building, priority setting and conflict resolution.
- Targeted, in-country training to equip key individuals with technical skills to use locally and internationally derived information (e.g. Pacific Islands Climate Change Assistance Programme (PICCAP) in-country training activities).
- Capacity building, including strengthening of national meteorological services and port authorities.

2. At the Regional Level

- Regional assessments of likely environmental changes, including production of high resolution scenarios leading ultimately to predictions, and assessing economic, social, cultural and environmental consequences.
- Development and dissemination of guidelines for coastal protection, including assessment of technical, economic and cultural (e.g. compatibility with traditional practices) options.
- Development and dissemination of guidelines for coastal management, including features such as set-back “rules.”
- Development and dissemination of technical guidelines on procedures like storm surge calculations.
- Regional assessments of mitigation and adaptation strategies, including assessments of their technical effectiveness, economic effectiveness and cultural and social acceptability, including compatibility with traditional methods.

- Preparation of materials for raising public awareness, such as translation of technical information into local languages, songs, plays etc, for briefing of regional decision-makers, information exchange, and education, plus curriculum development and resource materials of regional relevance (e.g. case studies of practical projects).
- Non-targeted (i.e. generic) “training of trainers” for empowering decision makers, planners and leaders of community organisations (e.g. the Australian/SPREP Atoll Project).
- Targeted, “training of trainers” for equipping key individuals with technical skills to use locally and internationally derived information (e.g. Regional training initiatives under PICCAP and The South Pacific Sea Level and Climate Monitoring Project).
- Capacity building, including regional activities to strengthen national environmental agencies and meteorological services.

3. At the Sub-Regional Level

- This involves similar activities as those undertaken on a region-wide basis, but with sub-regional focus, bringing together those island countries with common needs, settings and backgrounds. Activities might relate to such themes as adaptation strategies for high islands, coastal protection for low islands, forest management, water catchment management, “natural” catchments (e.g. rivers) and “artificial” catchments (e.g. roofs).

4. At the International Level

- Technical support to Alliance of Small Islands States (AOSIS) and PIC negotiators, by establishing a Technical Support Network (e.g. AOSIS-TSN).
- Input to IPCC activities, including responsibilities of Pacific islanders as lead authors, and contributors to reports.
- Sector-based, regional studies of consequences of environmental changes such as those related to tuna fisheries and energy supplies.
- Technical support for sustainable development of small island states, including reference to human dimensions as well as biophysical aspects.
- Raising global awareness raising through such activities as a Pacific island countries’ Home Page on the Internet. This would help counteract inappropriate lobbying by industry and would help spread the AOSIS/PIC messages.

Opening Remarks

by Tamari'i Tutangata, Director of SPREP

It is with a deep feeling of pride that I join the Director of ORSTOM for New Caledonia, Dr Françoise Jarige, in bidding you all a warm welcome to the third Meeting on Climate Change and Sea Level Rise in the Pacific.

Your Excellency, Mr Dominique Bur, Delegate of the French Government and High Commissioner to New Caledonia. Thank you for officially opening this Meeting. I should also like, to thank the Government of France, through Your Excellency, for being the main sponsors of one of the most significant regional meetings that we, in SPREP, will be involved in organising this year.

Representatives of the Territorial Government of New Caledonia, it is just over ten years since I was last here in your fascinating islands; islands which provided a home for me for almost seven years, until I left in 1987. Arriving here yesterday, I see that your islands are still as captivating as ever. Coming from the airport and around the coast from town to Anse Vata, I was quickly reminded as to how captivating Noumea can be when our lady driver at one point told all the men to look towards the land and not to look at the beach. Needless to say, all the men nearly tipped the bus over to the right in their rush to witness the forbidden sight. Thank you to the Government and people of New Caledonia for your open arms of welcome to all of us.

Allow me at this time to recognise Dr Jacques Merle, Regional Director of ORSTOM for the Pacific. As you know, ORSTOM, is jointly organising with us in the SPREP Secretariat, led by Dr Chalapan Kaluwin. Allow me also to extend the heartfelt appreciation of the SPREP member governments and Secretariat to you, Dr Jarrige and to your staff in ORSTOM, New Caledonia for hosting this meeting.

Some of you may remember that at the second Meeting held five years ago in 1992 in these premises, the SPREP Secretariat, although having already been relocated from Noumea to Samoa earlier that year, was still technically operating under the umbrella of the South Pacific Commission. The ratification of the 1993 SPREP Agreement in 1995 completed the formal separation of SPREP from the SPC as a legally constituted, autonomous organisation. SPREP had been nurtured by the SPC since it was conceived in 1982. For that reason,

I should now like to recognise Dr Bob Dun, Secretary General of the South Pacific Commission and to thank him for providing the services of his interpreters for this meeting.

Distinguished Delegates from SPREP Member Governments, I spoke at the outset about the pride that I feel in welcoming you all here. That feeling of pride is related not only to your presence here, but is also due to the fact that the convening of this meeting is in response to the continuing deep concern by our leaders in government and by an ever-growing number of people in our region over climate change issues and their link to sea level rise.

Since 1992, member government representatives at the annual SPREP Meetings, SPREP's governing body, have continued to urge us, in the Secretariat, to accord the highest priority to the subject matters of this meeting and of the need for member governments to be continually updated on these crucial issues. In pursuing this objective, the SPREP Secretariat and our member countries have been most fortunate :

- in the continuing extra-budgetary assistance provided by the Australian, French and New Zealand governments;
- in the recently launched Pacific Islands Climate Change Assistance Programme known as PICCAP and funded by the Global Environment Facility at the World Bank through UNDP, Apia and its sister Climate Change Training project known as CC: TRAIN funded by UNITAR , through the same UNDP office; and
- the support of:
 - Australia's National Tidal Facility in Flinders University;
 - government agencies of Denmark, France, Japan, Netherlands, and the United States;
 - the Forum Secretariat's Cyclone Warning Upgrade project funded by the European Union;
 - WMO; and
 - others.

In addition, the support accorded for this meeting by so many institutions and agencies provides further impetus and inspiration to our joint efforts on behalf of the people of our region. I have already referred to the French Government being the main sponsor of this meeting through the provision of the necessary funds to enable island government representatives and the Secretariat to be here. The United States and UNESCO/IOC has also provided assistance towards this end.

It is also pleasing to note the willingness of the Governments of Australia, France, Japan, New Zealand and the United States as well as the University of Waikato in supporting the participation of resource scientists to this meeting.

Distinguished Delegates will know that our government leaders, primarily through their annual South Pacific Forum sessions, continue to call for concerted global action for the mitigation of the negative and adverse effects of climatic change and sea level rise on our islands. As expected, the agenda for the 1997 Forum session to be held in Rarotonga, Cook islands next month, calls for an update by SPREP on the issues before this meeting.

Some of you will recall that the second meeting in this series of Climate Change and Sea Level Rise meetings, was held just one month before that momentous occasion when the United Nations Framework Convention for Climate Change was finally adopted. This was followed just a month later by the all-important Rio Earth Summit

Global responses to this vital area of climate change since then have progressed rapidly, relative to other global issues. In the course of this meeting, we will be updated on progress by the Ad Hoc Group on the Berlin Mandate. We will be briefed on the recent statement by the Chairman of the International Panel on Climate Change in relation to the reduction of greenhouse gas emissions that:

“...the adoption of a global strategy needs to be given serious consideration now; the implementation needs to begin in the course of the first decades of the 21st Century and a more precise time table needs to be agreed by the Parties of the Convention.”

We will also be briefed on the significant inroads made by the AOSIS group in having the major concerns of small island states reflected in the document submitted

to the June 1997 Special Session of the General Assembly of the United Nations and the resoluteness of that same group on behalf of small island states at the recently concluded session of the Ad Hoc Group on the Berlin Mandate. It is worth noting here, that Ambassador Neroni Slade of Samoa was recently elected to Chair the AOSIS Group. There will be other status reports on other related developments.

Distinguished delegates, Ladies and Gentlemen; you will have seen from our Provisional Agenda, we are most fortunate to have the participation of several of the most respected scientists in the area of climate change and sea level rise present at this meeting to provide you and I, and through you, to your respective governments and people of our region, with the latest available information on these issues. Aside from representatives of governmental and inter-governmental agencies we also welcome into our midst those from our regional institutions as well as those from non-government organisations such as GreenPeace.

We will all have noted that over the next five days we will have access to the widest array of information available on the vital issues before this meeting. We also know that as rapid as the developments over these issues have been in global terms, Leaders of Pacific Island Countries will be impatient to see positive moves towards meeting their stated goals; goals that they had formulated over ten years ago and further refined over recent years.

You will also be aware Distinguished Delegates that the issues that we are facing this week are amongst the most sensitive issues facing, not just our region, but the global community as a whole. These issues therefore require sensitive treatment.

We, in the SPREP Secretariat, seek guidance from all in this meeting in reviewing developments to date especially in relation to our efforts to meet the stated objectives of the island governments and administrations that SPREP is mandated to serve; and to provide us with the necessary directions for our efforts on your behalf.

I am, very much, looking forward to meeting and sharing with each one of you over this week. It is also the earnest hope of your Secretariat that the progress that we make at this meeting will allow us all to taste some of the culinary and other delights that New Caledonia has to offer.

Introduction

Pacific island countries (PICs) are particularly vulnerable to climate change, climate variability and sea level rise, due to their physiographic, ecological, socio-economic and cultural characteristics. In recognising these issues, PICs in 1987, with assistance from the United Nations Environment Programme (UNEP) Ocean and Coastal Areas Programme, the governments of Australia, United States of America, Denmark, Japan and the Commonwealth Secretariat, the regions scientists mandated the South Pacific Regional Environment Programme (SPREP) as the organisation to coordinate climate change activities in the region. Since then, numerous projects and activities have been implemented. Amongst these activities, SPREP organised the last two Intergovernmental Meetings on Climate Change and Sea Level Rise in the Pacific (Majuro, Marshall Island, July 1989 and Noumea, New Caledonia, February 1992). A regional climate change programme was developed in 1991 and is being implemented by SPREP. The objective of SPREP's climate change programme is to understand and respond to climate change, particularly through integrated coastal management.

A third Climate Change and Sea Level Rise Meeting was organised by SPREP in collaboration with L'Institut Francais de Recherche Scientifique pour le D'veloppement en Cooperation (ORSTOM) based in New Caledonia for the following important reasons:

- To involve decision makers, senior governmental and planning officials from all SPREP member government administrators and media, plus NGO representatives from around the region.
- To allow the of exchange ideas and information, and to foster working relationships between scientists and governments of the region.
- Review the results of the latest scientific developments in particular, reports of the IPCC Working Groups and their implication for the region, as well as opportunities to advance our understanding of climate change.
- Review the results of climate change activities relevant to the Pacific region, such as:

- (a) Tropical Ocean and Global Atmosphere (TOGA)-Coupled Ocean-Atmosphere Response Experiment (COARE), South Pacific Sea Level and Climate Monitoring Project, Atmospheric Radiation Measurement (ARM) program, Intergovernmental Oceanographic Commission (IOC)/UNESCO, JGOFS programme and other regional scientific research and activities.
- (b) Meteorological Programmes including the South Pacific Meteorological Project, WMO/CLICOM activities.
- (c) SPREP reports and studies.

- Update participants on the ongoing United Nations Framework Convention on Climate Change (UNFCCC) negotiations.
- Identify the needs of PICs and to raise awareness and understanding on climate change to facilitate policy development.
- Strengthen and enhance cooperation between international organisations, such as the Intergovernmental Oceanographic Commission (IOC)/UNESCO, World Meteorological Organization (WMO) and the United Nations Environment Programme (UNEP) with SPREP member countries.

The Major Sponsors: The Government of France, ORSTOM and SPREP.

Other Sponsors: Governments of: Australia, Mauritius, New Zealand, Italy, Japan, USA; International Organisations: United Nations Education Scientific and Cultural Organization (UNESCO), Intergovernmental Oceanographic Commission (IOC), GreenPeace, World Meteorological Organization (WMO), United Nations Development Programme (UNDP), Global Environment Facility (GEF), and the European Union (EU).

The organising Committee for the meeting were: Dr Jacques Merle (Regional Director, ORSTOM), Ms Jacqueline Thomas (Scientific Information Officer, ORSTOM), Mr Penehuro Lefale (Climatologist/Meteorology Officer, SPREP), Dr Graham Sem

(Scientific Adviser, Pacific Islands Climate Change Assistance Programme (PICCAP, SPREP), Mr Wayne King (PICCAP Project Manager, SPREP), Prof. John Hay (Director of Environmental Science, University of Auckland, New Zealand), Mr James Aston (Coastal Management Officer, SPREP), and Dr Chalapan Kaluwin (Climate Change Officer, SPREP).

The agenda for the meeting is attached in Annex 1 and the list of participants appears as Annex 2. This report is a brief summary of the presentations, discussions and recommendations of the meeting. Its completeness is a

true of the enormous efforts of the following people: Prof. John Hay, Ms Louise Rose, Mr Mohammed Ali, Prof. Bill Aalbersberg, Dr Graham Sem, Dr Simon Saulei, Dr Mahendra Kumar, and Dr Than Aung.

A summary of the meeting report highlighting the findings and future needs of the region is on pages iii to vi of this document.

The working papers for the meeting will be published in full. They are now available from SPREP.

Conference Sessions

OPENING SESSION

The meeting participants were welcomed to ORSTOM by Dr. Francois Jarrige, the Director of ORSTOM (Noumea). He thanked delegates for responding to the call to attend the meeting. ORSTOM has personnel and facilities to help develop the science of climate change in the region, especially by working with other groups in the Pacific.

A prayer was delivered by the American Samoa delegate, Mr Akapo Akapo.

The meeting was officially opened by the High Commissioner of New Caledonia, M. Dominique Bur. He congratulated ORSTOM for hosting the meeting and welcomed the role of French scientists working in New Caledonia cooperating with other regional bodies to assist national governments. He reminded delegates of the importance of their advice from this meeting to national governments in the region. A better understanding of the environment is important for development in the Pacific.

The Director of SPREP, Tamari'i Tutangata, presented his opening remarks. He said Climate Change and Sea Level Rise (CC/SLR) was one of the most complex programme areas in SPREP. Pacific Island Countries (PICs) governments, through the South Pacific Forum, have given this topic their highest priority. He referred to the various CC/SLR programmes implemented by SPREP and also to the excellent support for this meeting. He was grateful for the attendance of the scientific community to help provide the latest scientific thoughts on CC/SLR, to guide this meeting in its advice to Pacific governments.

The keynote address was given by Dr. Bill Erb of the International Oceanographic Commission (IOC). He stated that the conflicting information concerning climate change currently being published could only be overcome by increased basic science research. IOC, via its WESTPAC programme, has worked for some time in the Pacific with South Pacific Applied Geoscience Commission (SOPAC). An MOU with SPREP is in preparation. He hoped these two agencies will provide the lead in setting up a Global Ocean Observation System (GOOS) in the South Pacific. IOC also has begun a study of the status of the marine

environment and of the El Nino effect that is so important for the Pacific. He noted that 1998 has been declared the International Year of the Oceans: Our Common Heritage.

SESSION A: Science of Climate Change

1. *Global Perspective*

Richard Warrick, University of Waikato, presented a global overview of the science of climate change. He reminded participants that the science of climate change had been summarised periodically for some twenty years. Some findings were well accepted whereas others were more widely debated. The increasing levels of GHGs (e.g 0.4 percent per year for CO₂) and their effect on enhancing the heating of the earth (2.5 W/m²) were well established. A doubling of CO₂ concentration would directly increase global temperatures by 1.20C. When feedback mechanisms are considered a total heating of 1.5-4.50C has been agreed to over the last 20 years. It is also agreed that the world has heated 0.3-0.60C since 1860, but there is debate whether this can be attributed to an enhanced Greenhouse (GH) effect.

The Intergovernmental Panel on Climate Change (IPCC) Second Assessment Report (SAR), in a major shift from its 1990 report, stated it is unlikely that the heating is entirely natural and that there has been a discernable effect by human activity. But how much the earth will warm, sea levels will rise depends on many factors. By the year 2100, the temperature is expected to increase by 10-40C (1.70C middle scenario) and global sea level by 13-94cm (49cm middle scenario). Unfortunately at present, little can be said with any accuracy about regional scale changes, especially in the Pacific.

Paul Llanso presented information on the WMO Climate Information and Prediction Services (CLIPS). This is a programme initiated in 1995, to help provide up to date information on climate science to the National Meteorological Service (NMS). And to help them make better use of this information. This is achieved through training, demonstration/pilot projects, liaison with research programmes and networking.

2. South Pacific Perspectives

Prof. John Hay provided an overview of scientific information and understanding in the Pacific regarding CC/SLR. There is evidence, from a range of sources, that temperatures have been increasing by 0.10C/decade in the region and sea levels by 2mm per year. There is also evidence that climate phenomena such ENSO will have major influences in the impacts of CC/SLR. It is also recognised, the Pacific region plays an important role in understanding global climate change.

Models, scenario development and vulnerability assessment will play key roles in helping the Pacific respond to CC/SLR. Models currently suggest that a doubling of CO₂ concentration will increase sea-surface temperatures by 10C and increase rainfall intensity in the central equatorial Pacific. Although the second assessment of IPCC did not reveal a consensus regarding tropical cyclones in a changed climate regime, recent research has indicated possible intensity increase of 10-20 percent with a doubling of CO₂. Vulnerability assessments have shown that PICs are highly vulnerable to CC/SLR, with a low capacity to respond. This response capability needs to be strengthened through regional and international cooperation and education, training and awareness raising. Countries also need to be encouraged to perform integrated impact assessments in addition to sectoral ones.

There was a question on the meaning of the data that showed portions of the coast of Betio island, in Kiribati, eroding and partly accreting. The answer was that coastlines are highly dynamic and that interannual variability in climate regimes can cause localised effects.

Bill Mitchell (National Tidal Facility) discussed the South Pacific Sea Level and Climate Monitoring Project. The NTF was set up at Flinders University, in 1989, as a service to Australia and the region, now manages eleven facilities in the South Pacific. In its five years of operation the data collected provided information on sea level changes during cyclones and tsunamis as well as for modelling tidal information. Especially interesting, most stations are showing accelerated SLR with increases of up to 25 mm/year, which is more than 10 times the trend this century. The findings have been validated by satellite data showing 20-30 mm/yr rises in a region from Papua New Guinea southeast to Fiji. The specific cause and duration of this variation is unknown, but is likely to be related to El Nino Southern Oscillation (ENSO).

Jim Salinger (NIWA, NZ) spoke on New Zealand's meteorological and climate monitoring activities. The New Zealand Meteorological Service has supported a number of PIC meteorological services since the 1940s. Data available from this program provide important information for the study of CC/SLR. The National Institute of Water and Atmospheric Research (NIWA) of New Zealand, maintains the South Pacific Climate database and studies the trends and variability in climate as well as tropical cyclones and ENSO events. Analysed data show that in Noumea and Rarotonga temperature has risen 0.6-0.70C since 1920, which is greater than average worldwide increases.

Bob Brook (Bureau of Meteorology, Australia) spoke on meteorological information available in the Pacific region. He emphasised the importance for long-term high quality data with consistent standards if they are to be used to study climate change, both in the region and as they affect global processes. To ensure maintenance of quality data, Pacific island governments need to ensure, financial support for national meteorological services is maintained, and there is ongoing training with appropriate technologies being used.

3. Global and Regional Programmes

Michel Gauthier (Euro-GOOS, UK) informed the meeting of the objectives and activities of the European Global Ocean Observing System. A major task confronting Euro-GOOS is the rationalisation of the huge number of ocean management, resource use and monitoring or measuring systems in their region, especially relating to the North Sea. GOOS activities cover a variety of marine issues including living marine resources, health of the ocean, coastal zone management, climate monitoring, forecasting and prediction.

Christian Henin (ORSTOM, New Caledonia) outlined the various ocean monitoring activities carried out in the region since 1969. He indicated that a great deal of international effort had enabled the identification of seasonal and interannual trends but they were not yet in a position to identify long term trends in temperature and salinity. He concluded that more oceanographic observational work was needed to achieve understanding of the mechanisms that govern climate in the region.

Bill Erb, Inter-governmental Oceanographic Commission (IOC) detailed the structure and major

activities of the IOC. Three main types of programmes exist, including Ocean Science Programmes, TEMA, and regional activities and ocean services programmes. The sub-commission for the Western Pacific (Westpac) covers the region in which most Pacific Island countries are located. He pointed out the Pacific region was one where regional co-operation was very important given the small size of many countries. In conclusion he drew attention to 1998, the UN International Year of the Ocean. The purpose of this was to build awareness of the ocean and coastal environment and enhance political visibility for ocean related issues, including their socio-economic dimensions.

Ian Goodwin (SCAR, Australia) canvassed issues relating to Antarctic Contributions to Global Sea Level Changes. He informed the meeting that scenarios of a rapid sea-level rise, caused by a West Antarctic Ice Sheet (WAIS) collapse was unrealistic on the basis of present knowledge, although research was continuing. Moreover, current research suggests, on the basis of various scenarios of global warming, accumulation of grounded ice in the Antarctic will contribute to a lowering of sea level of around 10 mm/decade by 2050. At present uncertainties in these figures are +/- 10 to 20 per cent, although improvements are expected in the next five years by using satellite altimetry.

Robert Le Borgne (ORSTOM, New Caledonia) outlined the role of carbon flux and climate in the Equatorial Pacific. He showed that CO₂ exchanges between the ocean and atmosphere in the equatorial zone east of the international dateline, resulted in 109 tonnes of carbon being exported to the atmosphere, as a result of upwelling. This figure would be considerably higher were it not for biological processes which reuse carbon brought to the surface by upwelling in the eastern Pacific. His research also indicated that during El Niño events atmospheric CO₂ concentrations tended to increase less rapidly and during La Niña CO₂ measurements indicated a more rapid increase in atmospheric concentration. While CO₂ fluxes can be monitored there are physical dimensions of the process which are not well understood, such as seasonal differences.

Jim Salinger (NIWA, New Zealand) updated recent research on observed climate change and variability in the South Pacific. The results are based on data from 34 stations throughout the Pacific from about 160° E and mostly south of the equator. The research showed

surface air temperatures had increased by 0.3°C to 0.8°C this century, with the greatest increase in the zone south-west of the SPCZ. This is well in excess of global rates of warming.

The records also indicate that rainfall had increased in the north-east and decreased in the south-west of the Pacific area studied. Interannual variations in temperature and rainfall were found to be associated with the Southern Oscillation Index (SOI) and the research also found an eastward movement of the South Pacific Convergence Zone (SPCZ). The changes observed in the twentieth century were considered to be consistent with anthropogenic activity. Jim Salinger made the point that the research was highly dependent on the continued support of Pacific meteorological services and he thanked representatives from Pacific Island countries for their contribution.

Allan Hilton (NOAA, Hawaii) discussed emerging programmes for applications of ENSO predictions and monitoring for the benefit of affected sectors in the Pacific Islands region. Recent data indicate that we are proceeding into a significant El Niño event with a multivariate ENSO index showing the current event was occurring with greater rapidity than any of the six previous events for which data was available. The Pacific ENSO Applications Center (PEAC) provides information to a number of PICs regarding ENSO. Currently experimental climate forecasting is being carried out. It is considered that climate forecasts will be of considerable assistance in planning agricultural production, fisheries, human health and civil defence activities. While some locations, and for certain seasons, a high degree of skill can be obtained in forecasting ENSO-related climate conditions. In other areas prediction is more difficult.

J Recy (ORSTOM, France) discussed a study of cold anomalies in a recent holocene sea surface temperature time series, sourced from coral records in the South West Pacific. The chemical composition (specifically the Sr/Ca ratio) of coral can, be shown to be a reliable indicator of past sea surface temperatures (SST). The accuracy is better than 10C. The coral records show the tropical ocean was 60C cooler than the present mean of 27.50C. The warming of surface water seems to have started 14,000 years ago. It is believed the method developed in the study may be used to identify the effect of recent climate change, including influences on the intensity of ENSO. The influence of ENSO, on the change of SST, was found to be significant.

Progress and achievements of the Pacific Meteorological Services Project were reviewed by D Thistlewaite. The project is funded by the Australian Agency for international Development (AUSAID). It is one of the major projects in the Pacific region developed as an Australian response to concerns raised by PICs over the potential impacts of climate change. Nine PICs are involved in the project, which was initially designed for 3 years (1993-1996). The project was a success and extended a further year (until end of 1997). The 3 major components of the project are assessment of observing sites, supply of new and upgraded equipment, maintenance requirements and training. Wind (speed and direction), temperature (maximum and minimum) and rainfall are the major parameters observed. In the region 120 stations have been upgraded, as well as new stations established during the project period. A meeting participant complimented the improved quality of stations compared with the NIWA stations.

N.Koop (EU-FORSEC) presented an overview of the Tropical Cyclone (TC) Warning Project in the Pacific. Death and damage resulting from tropical cyclones were highlighted, starting from 1900 to date. Death and damage are believed to be inversely related to each other. If the death toll was high, the cost of damage was low. Meteorological service communication, coordination and public response are three major components of the TC warning project. Communication in the Pacific region is badly in need of significant improvement for a better TC warning system. Although Meteorological Services are doing their best, the error in predicting the locality to be hit by a TC is quite high. For example, if a warning is given 12 hours ahead, the error is 122 km. Due to this high error, it is likely that an unprepared area may be hit by a TC. Media reports on TCs are not as accurate as desired. Such reports were criticised.

Analysis of tropical cyclones data for the South Pacific was described by Jim Salinger (NIWA, NZ). Tropical cyclone (TC) definitions and classifications of TC were provided, based on wind speed and atmospheric pressure. Major requirements for a TC to form are: sea surface temperature must be higher than 27°C; and there must be upward atmospheric motion. These requirements may vary, based upon the conditions of ENSO. According to the recorded number of TC between 1940 and 1994, the average number of TC's per year was seven. Although the general TC season is between Oct and May, most TC's occur between

January to March. Changes in frequency, area of occurrence, time of occurrence, mean intensity and the maximum intensity of the TC cannot be predicted by present numerical models. Based on the present records, no two TC's are the same. However, TC's usually take place between latitudes 80S and 200S and longitude 1450E and 1250W. Probability of occurrence decreases with increasing latitude. During ENSO a TC has more than a 40 percent chance of being severe.

P Riley (Australian Bureau of Meteorology, Melbourne) provided information on GCOS, GOOS and GTOS, as examples of international cooperation for monitoring global change. Their international status, Australia's role and regional cooperation in the South Pacific region were broadly discussed for each of the above systems. The establishment of the programmes and their structure were presented along with the scientific plans for observing both the atmospheric climate and oceans. Opportunities for, and advantages of, regional programs in the South Pacific were also highlighted.

The Atmospheric Radiation Measurement (ARM) programme in the Tropical Western Pacific was discussed by W. Clements (University of Mexico). The ARM Program was created in 1989 as part of the U.S. Global Change Research Program. The objective is to improve the parameterization of cloud cover properties and atmospheric radiation in the computer models used to predict climate change. Parameters observed include surface radiation balance, air temperatures, cloud properties, aerosol optical, depth and precipitable water. The vertical structure of the atmosphere is also observed at ARM stations. There will be five stations in total in the Pacific region, with three stations along the equator, and one north of the equator and one south of the equator. So far, the Papua New Guinea station at Manus Island has been operating since October 1996. The next station, in Nauru, will be established in April 1998. The last station on the equator may be Christmas Island, Kiribati. Installation depends on the availability of funding. Each locale has an education program associated with its measurement program.

An ultra-violet (UV) monitoring network in Fiji was discussed by M.Kumar (University of the South Pacific, Fiji). Ozone depletion, UV measurement and a regional network (Fiji school's network and USP-NASA Project) were briefly explained. Ozone depletion takes place both in the northern and southern hemispheres. It affects human health, land plants and marine ecosystems. There are many parts of the world where no

UV measurements are being made. To help fill the gaps, five simple UV monitoring stations were set up in Fiji schools about 10 months ago. Senior science students look after the system. At the same time, the Chemistry Department of the University of South Pacific (USP) also started measuring the vertical profile of the ozone layer above the USP campus. Educational awareness exercises were also conducted in the schools before they began UV measurement. A considerable amount of funding is necessary to expand the UV Monitoring network in the Pacific region.

N. Quinn (Asia-Pacific Network for Global Change Research) APN talked about APN and System for Analysis, Research, and Training (START) and their activities relating to the Pacific Region.

START provides a framework of regional networks for training and research on global environmental change and its human causes and effects. START has established regional networks in Mediterranean, North Africa, Southern Africa, South East Asia There is interest in establishing a START Oceania regional arrangement.

Involvement in START and APN activities is one way to participate in global programmes while retaining a regional focus. Regarding climate issues, START and APN are concerned with global change issues in general - including biodiversity, land use, land cover and land form changes, damage to ecosystems by pollution and atmospheric changes. There is interest in exploring how PICs can take part in START and benefit from its activities.

The School of the Pacific Rainfall Climate Experiment (SPARCE) was described by S.Postawko. Since 1991, the SPARCE programme has been working with schools in the Pacific to enhance science research. Initially the intention was to try to validate rainfall estimates from satellites using surface data, but there were big validation problems. It was decided to use surface measurements. These were only available for the main island as the small atolls do not have a lot of data.

Thirteen schools were contacted using Pan Pacific Education and Communication Experiments by Satellite (PEACESAT). Rain gauges, videos and books about weather were given to the schools. The Meteorological Services were also active in recruiting schools, especially in areas that did not have much rainfall data.

In total, 120 schools are involved in making rainfall measurements across Melanesia, Polynesia and Micronesia. Students are encouraged to look at the data in the local context. The range of instruments have been expanded. Interestingly the program works best in areas that are least developed. Data are being used for inter-comparison of precipitation, including looking at which algorithm best estimates rainfall amounts at the surface. The analysis includes both student and conventional meteorological data.

Under the Tropical Western Pacific ARM programme, funding has been provided for automated weather stations. These are used at upper high school levels. Work is in progress to perfect the instrument packages. Automated instrumentation allows study of interrelationships of relative temperature and wind. Teachers give feedback on where the program needs to be enhanced. Once a month a newsletter is circulated, including pictures of students. Once a month PEASAT sessions are held to discuss questions and problems.

A study of equatorial waves and sea level rise by satellite altimetry in the Pacific was described by T. Delcroix (ORSTOM). The focus of the presentation was on sea level changes in the tropical Pacific during El Nino. Model derived satellite altimetry showed that sea level variations in the 0 to 250 mm layer accounts for 90 percent sea level change in the Pacific. The accuracy was 2 cm on a monthly time scale. Over 250 000 temperature profiles were taken between 1979 and 1996. These were irregularly distributed in time and space so the data was processed using time filtering to calculate inter annual variability and compare with the SOI.

Sea level variation showed geostrophic and oceanic variations of 50 cm. There are two types of variation of about 10 cm amplitude. The seasonal signal was filtered using dynamic height data. When matched with time and the Southern Oscillation Index (SOI) there was a reduction of sea level of about 15 cm, a rise in eastern part of Pacific basin and a zonal see saw event at each side of the Pacific depending on whether an El Nino or La Nina event was occurring. The amplitude was compared east and west from 1980 to 1995. The amplitude was close to 30 cm and associated with El Nino. There was also a phase and time lag between west and east which represents the time taken for the ocean to adjust to winds. A second important see saw event is the inter annual signal which is a year behind SOI and involves a transfer of water mass between south

and north of the equator. It is concluded that there are strong ENSO related sea level variations with peak to peak variation in the order of 30cm. The sea level mechanisms imply a conservation of mass. To indicate a change in the total mass of water volume as a result of global warming twenty years of data was not enough. The long term trends therefore are not known.

Implementation of Topex/ Poseidon (T/P) Altimetry Technology in the South Pacific Sea Level and Climate Monitoring Project was described by G. Musiela (NTF - Australia).

The Topex Poseidon Altimetry technology was used to measure regional and global circulation. The technology is a joint initiative of NASA and CNES (France). SPREP, in collaboration with AusAID, established 11 monitoring stations to carry out a geodetic programme, to measure the movement of the earth's crust. This served to raise awareness of climate change in the region. Phase I was to retrieve and correct the data. Phase II was to interpolate and filter data, to calculate depth and bathymetric pressure. Phase III was to convert the ASCII data to CDF format. Phase IV involved mathematical operations and filtering of gridded files.

T/P topography data was used to calculate trends, and compare the intervariability of tide gauges. There is a long way to go before it will be possible to create reliable and useful information. Using technology proved efficient and flexible and good for visualisation. A large volume of T/P data was processed using generic mapping tools. At present the resolution of the data is 1 degree by 1 degree but a finer resolution of 0.1 to 0.1 degree is proposed. The project benefited from the modularity of software and data retrieval from custom databases and complimented the traditional methods of sea level measurement.

A review and update on tide gauge technology, and its application at global and regional levels, especially addressing sea level rise measurements in the Pacific region, was presented by W. Scherer, of the National Oceanic and Atmospheric Administration, (NOAA) USA. There used to be manual reading of tide gauges. Some of the tide gauges date back to the middle ages and consisted of a float device to filter high frequency data. They developed subtle problems with density stratifications. In some cases, fouling impeded inflow and outflow of water. The current generation of water level measurement instruments has real time

capabilities. These instruments are not a water level device but a complete system of data down link, and data management. They are based on micro processor technology. Sampling is carried out at one sample per second. The data is stored on board and transmitted by satellite.

Two hundred systems have been installed around the coastline of US, Alaska and the Great Lakes region. The system has application for tsunami measurements, storm surges, and environmental monitoring using ancillary sensors. The cost was around US\$1 million for the 200 stations. Annual maintenance also costs about US\$1m. The development costs were US\$6m.

The data has application for time series trends of mm/year sea level rise. However, the signal to noise ratio is high (eg from 2 mm to 20 mm.) Seasonal variations in sea level were highlighted. They can change our view of long term change. The signature of El Nino events disturbs the signal and the statistical regression can skew the results.

Assuming stable land, the long term sea level trends for the US show a 1.5 to 2 mm per year best estimate for global sea level rise. However, the seasonal, inter annual, decadal, multi-decadal cycles plus 60 - 70 year cycles are complex to unravel.

Wolfgang Scherer went on to describe the GLOSS Network. There are 300 stations with all types of gauges. Over 260 are in operation. The two global systems attempt to answer questions related to tropical ocean variability, gyres, chokepoints, western boundary currents, accelerated sea level rise and altimetry calculation. The reports will be published at the year end by NOAA.

There is a need to continue using insitu data. Initially only 10 stations were needed to maintain calibration of the satellite data. Now the risks are too high to rely solely on satellite information. There is also a long geophysical data record compared to the satellite data.

In discussion it was pointed out that before finding a solution you need to ask the right question. In regard to tide gauges, it is not possible to tell if there is sea level rise or not. The longer the time series the less accurate the reference. The earth has changed and oceanographic circulation changes in relation to the centre of earth. This may change the position of the tide gauges. Therefore

there is a need to collect uncorrelated data and find a consistent solution.

During the discussion there was a plea for better observations and also a need to improve the models. Oceanographers in Melbourne have developed a good model of sequestering of trace gases in the southern ocean. This reduces the thermal expansion of sea level rise by 25 percent (approximate only). There is a huge time lag as most expansion comes from deeper water.

4. *Climate Change: Science Needs in the Pacific Region*

In a needs analysis related to climate change science Prof. John Hay (University of Auckland) chaired this session and asked the PIC governments and the conference to contribute here and where he would then summarise the points discussed here. He started off by saying that not only is an understanding of science needed, but also set of needs people most affected the changes scientists are investigating can relate to. There is a need to ask relevant scientific questions articulate questions to the countries and communities in PICs. The challenge, is how to frame questions that translate from international science based needs to regional, national and local science based needs.

The following PIC governments contributed to the discussions.

Mr Samani (Tonga) identified two problems: (1) gaining political will for issues of climate change; and (2) lack of trained human resources. The meeting had so far focused on high order science. Few presentations were about low order science. There is an opportunity to tailor research on problems in the Pacific island countries. Projects such as SPARCE are needed to raise awareness.

Mr Lui (Samoa) said there is a need to highlight and translate, in simple form, the information affecting small islands in terms of climate change and sea level rise. More focus should be on education and information needs. National meteorological officers should be involved (eg attachments to universities to give them an idea of what is going on). Capacity building and institutional strengthening are lacking. There is a need to respond to sea level rise by producing urban and rural development criteria, designs for building of physical infrastructure and natural disaster preparedness. There

is still much uncertainty, but it is important to be well prepared.

Mr Hadley (Federated States of Micronesia) noted that climate change is a big concern to FSM. Vulnerability of sites to landslides is a big issue in FSM. They are now starting to look at how this is related to climate change.

Ms Abete (Kiribati) indicated that the need in Kiribati is for modelling of climate change. Several people should be trained in case one leaves. Funding is needed for disaster preparedness. Resources to maintain or fix public assets destroyed in disasters are limited. Another need is public awareness. Requirement is for low level science material, translated into local languages.

Ms Court (French Polynesia) asked who is responsible for global warming and changes in the El Nino phenomena? She agreed that it was the industrialised countries and hence these countries should do something. As a result of the El Nino phenomenon, it appears that French Polynesia will be hit by cyclones. She asked when they will hit French Polynesia, and sought clarification from NOAA.

Mr Sokomanu (Vanuatu) thanked the National Tidal Facility for the attachment courses, especially in awareness and education programmes. He urged that training be carried out amongst the Pacific countries. There should be practical exercises in problem areas such as coastal locations where there is heavy mining.

Dr Simon Saulei (University of Papua New Guinea) said islands have different needs. Since resources are owned by local people, the results of research should be made available for people to use and take steps to minimise effects of climate change. He stressed the need for two way communication. The way the research needs are driven affects the process. There is a need to get these issues into the political arena. Capacity building is a further area of need.

Ms Gravelle (Fiji) noted that Fiji is a member of AOSIS and is concerned with mitigating climate change. Greenhouse gas emissions of PICs is not significant. Vulnerability assessment is important to communication plans. Many countries do not have financial and technical assistance to achieve these tasks. There is also a need to make projects reliant on financial assistance, a top priority.

Mr Lui (Samoa) stressed the need for networking within the region in addition to that addressed by the Pacific Islands Climate Change Assistance Programme (PICCAP). Translation of technical material into the local languages was difficult. Developing planning standards that account for sea level rise and strategies for adaptation should be high priority.

Pene Lefale (SPREP) indicated that PICs are having an effect on international communities. The outcomes of the recent ad hoc group on the Berlin Mandate Meeting and SBSTTA and AOSIS may be relevant. He reported that:

1. AOSIS gives full support to climate change programs.
2. IPCC Third Assessment Report noted regional emphasis on report. Experts from PICs should be involved in drafting the report.
3. Agreement was reached on the following issues:
 - Narrowing uncertainties;
 - Narrow scales to make them meaningful and applicable;
 - More efforts of IPCC on assessments of regional impacts and responses including adaptation;
 - Further improve understanding of oceans and regional weather patterns;
 - Concern about high order science dominating; need a low order science Effort should be made to synthesise and understand matters of relevance to local people.

SESSION B: Climate Change Impacts and Response Options

1. Global Perspectives

The chairwoman, Ms Tererei Abete (Kiribati) introduced the session and called Prof. McLean to begin his presentation.

Prof. Roger McLean (ADFA-UNSW) discussed the historical development of the IPCC assessment process.

He emphasised the process and procedures of making assessments are fairly complex and involve many people at international level. He noted that the Second Assessment report (SAR) (IPCC 1995) mainly focused on:

- assessment of scientific information about climate change;
- evaluation of environmental and socio-economic impacts and;
- formulation of response options and strategies for adaptation to climate change and sea level rise.

He also noted the important inputs from IPCC Working groups WGI, WGII and WGIII. He concentrated on some of the issues pertaining to the development and application of the IPCC common methodology, particularly on vulnerability and adaptations assessment. Enormous contributions to the chapter on coastal zones and small islands by expert groups over a number of years prior to SAR was acknowledged. Some of the response options centred on the principles of retreat, accommodate and protect. The special case of small island states (SIS) was highlighted in relation to integrated coastal zone management (ICZM) both at regional and local scale. The presentation drew comment from Mr Nakibae Teuatabo (Kiribati) who said that with respect to adaptation to, and mitigation responses of, climate change and sea level rise the Third Assessment Report (TAR) must include cultural systems particularly from small low-lying island states.

The second presentation and discussion centred on the links between climate change and human health. Erwin Jackson (Greenpeace-Australia) said climate change and its impact on human health is a new research area. One of the problems is that we do not know enough about what may happen in the future. This highlights the importance of integrated assessment models (IAM) for assessing the climate change impacts on human health. He added that at present there are a significant number of health related disasters in the developing world. Many areas of the world suffer from tidal waves at present and there is little knowledge of how this phenomenon might be affected in the future by climate change. He noted the threat posed by infectious and vector-borne diseases, such as malaria and cholera in the developing world. Cholera incidence is on the rise and there have been reports of malaria outbreaks in areas which previously did not have malaria - eg in the

highlands of Papua New Guinea. Erwin also suggested a number of future work activities, including:

- identification of vulnerable populations vulnerable to health risk;
- develop indicator species of vectors, and response strategies; and
- establish early warning system for such events as ENSO.

He stressed that the work is particularly relevant for PICs and urged the regional, national and international communities, to focus on adapting present natural variability, and prepare for extreme events.

It was pointed out by Alan Hilton (ENSO Center Hawaii) that NOAA and the South Pacific Commission (SPC) are collaborating on work related to health indicators and ENSO related extreme events. The work is in progress. A representative from Mauritius (S.Ragoonaden) shared his experience of undertaking vulnerability and adaptation assessment under the United States Country Studies Program (USCSP). The vulnerability and adaptation assessment (V and A) was focused on agriculture, water resources and coastal zone. The Vand A concluded that Marutitius (S.Ragoonaden) is already sensitive to current climatic conditions and management and that as much as 70-80 percent of beach would be flooded if there was a 1m rise in sea level.

The second half of the morning session was devoted to Integrated Assessment Models (IAMs). Prof. Warrick (University of Waikato) discussed the role of IAMs and their robustness and flexibility as tools for assessing vulnerability and adaptation to climate change and sea level rise.

G. Kenny (University of Waikato) discussed the importance of critical thresholds in vulnerability and adaptation assessment. He pointed out that, under the requirements of the United Nations Framework Convention on Climate Change (UNFCCC) there is a focus on climate changes that may potentially be 'dangerous', or have serious consequences on the environment. It is not feasible, scientifically, to identify changes that might be dangerous. However, it is possible to identify thresholds of change that might be critical. A threshold is defined as a 'point of entry'. Therefore a critical threshold is a 'point of entry' beyond which there may be major consequences. Identification

of critical thresholds requires information about: threshold responses of particular exposure units, possible rates of change and possible magnitudes of change.

An integrated modelling approach, such as CLIMFACTS, enables rapid simulation of multiple scenarios of climate change, for specified exposure units. Importantly, the particular scenario approach that is used allows consideration of changes over both time and space. This allows for a rapid appraisal of environmental sensitivities, which can assist in identification of thresholds that may be critical, both in terms of magnitudes and rates of change. There is a need for more biophysical information, so system sensitivities can be considered alongside knowledge of adaptive capacity, to determine at a local, or national level, global climate changes that might well be critical i.e those that have long-term, significant consequences.

Barrie Pittock of the Commonwealth Scientific and Industrial Research Organisation (CSIRO-DAR), described the OZCLIM model for assessing hydrological impacts. He used an example, from the MacQuarie river basin in northern NSW.

The CEARS group (University of Waikato) - R.A Warrick, Gavin Kenny, Graham Sims and Graham Sem (now of SPREP) jointly presented and demonstrated a VANDACLIM model. The model was developed out of CLIMFACTS as a training package for CC:TRAIN (UNITAR). Its application in vulnerability and adaptation assessment was highlighted and demonstration of its applications in vulnerability and adaptation assessment for various sectors - health, water resources, agriculture and coastal zone were presented. VANDACLIM has a high potential for adaption and application in the Pacific Island countries.

2. Regional and National Perspectives

Prof. Mimura (Ibaraki University, Japan) described the Japanese/SPREP vulnerability and resilience studies in the Pacific region. These have been carried out in countries; Tonga, Fiji, Samoa and Tuvalu. The IPCC common methodology was used for the Tonga study while the Fiji and subsequent studies used semi empirical methods, ie: use of questionnaire type survey requiring close interaction with village communities to ascertain extent of erosion. The studies in all cases evaluated the procedures employed eg air photos for Tonga, GIS, etc, and looked at the implications of

different sea level changes. The studies highlighted importance of local knowledge, the resilience of existing natural systems and the need for better databases.

The Australia/SPREP vulnerability initiative for Atoll Island States was described by L. Rose (Environment Australia). The goals of this project included:

- enhancing capability of PICs in assessment of, and response to, climate change; and
- improve communication between countries, SPREP and Environment Australia

This study highlighted the importance, vulnerability and fragility of the atoll environment. There is a need for integrated management which involves, understanding the linkages within atolls and also local understanding. The shortage of data, appropriate analytical techniques, expertise and the need for proper building standards, water resource management and training were stressed. During discussion and in reference to construction of a sea wall around Majuro, there is need for expertise to demonstrate how to construct sea wall. The SOPAC representative responded by saying that this has also been the recommendation from other workshops, ie the need for a manual including guidelines for the construction of sea walls

Joseph Huang (USCSP-USA) described the US Country Studies Programmes in the Pacific. The objective of the programmes was to support the implementations of the UNFCCC. Features of the initiative were:

- cooperative programme (financial);
- provide technical support - ie: help countries organise programme according to own needs;
- enhancing capabilities;
- developing and implementing national policies and measures
- assistance to countries in securing support for projects and programmes
- supporting requirements towards the fulfilment of UNFCCC protocols

The Interagency and International Donor Cooperation programmes were described. Many in-country training

programmes and workshops have been conducted. Study results have been widely distributed. The importance of developing a one to one relationship with an advanced country was stressed. There is a need for more motivation.

Assessing the vulnerability of the island states to climate change by ways of improved scenarios of climate change was discussed by B.Pittock (CSIRO-DAR). The importance of getting the General Circulation Model (GCM) right was addressed in terms of:

- skill;
- slab ocean vs coupled modelling results; nested models at 125km and 60km spacing for coupled models; and
- the use of smaller grid boxes with the capability to produce more realistic results.

There is a need to involve locals and regional people in modelling in order to ask the right questions and communicate the correct answers.

P. Lehodey (ORSTOM) considered the impacts of climate oscillation on tuna fisheries in the Pacific Ocean. He pointed out that 70 percent of tuna catches come from Pacific Ocean and that tuna activities have expanded considerably. These catch is mostly skipjack and yellow fin tuna, with the majority coming from the western equatorial Pacific. The tuna resource is closely linked to the position of warm pool, which is an area of low primary production. The result is surprising as tuna need to consume 10 percent of their body weight each day. The reason for this may be the convergence zone along the eastern boundary of warm pool. This may provide a possible mechanism for replenishing productivity in warm pool. Hence research is being made into the presence of the convergence zone and the presence of tuna. Results from a 1988 - 95 study show a large interannual variation and high spatial variability. Conclusions based on simulation studies indicate that secondary production (upwelling) enables the concentration of tuna in otherwise 'poor' productivity areas as a result of convergence zones. The impact of ENSO is therefore clearly established: Zonal movements include east west movement of primary production and tuna levels.

P. Fairbairn (FORSEC) provided details on an energy conservation project implemented as a pilot phase of

activities implemented jointly. This is a pilot project in the Forum countries. He described two projects under the AIJ.

- air conditioning in Solomons (with Solomon Islands government and Electricity Authority); and
- grid connected photovoltaics in Fiji (in conjunction with BP Solar).

The main considerations are to reduce CO₂ emissions, duplicate findings in other PICs, and enhance economic, social, environmental cost and benefits. The projects were described and some preliminary results from the air conditioning project were presented. The implications in respect of the reduced carbon dioxide that will accrue as a result of lower fossil fuel usage were highlighted.

A pilot project proposal in Papua New Guinea on greenhouse gas mitigation was described by S. Saulei (UPNG). It relates to an initiative of biodiversity conservation and forestry management. A significant issue is the importance of CO₂ offset due to a modification in use of traditional energy sources. This leads to the need for improved forestry management, conservation, improved efficiency of wood use, reforestation and sustainable use of the resources. The opportunities for AIJ in this sector were pointed out. The responses from Australia and NZ regarding JI and AIJ activities were slow, but some US companies have shown interest.

B. Aalbersberg raised issues related to the ways that climate change impacts on biodiversity in the region. The USP discussed possible adaptation options in Fiji. Initially, he described projects completed at the USP, utilising student resources on campus and at centres. This involved “low intensity science” and required community involvement. The importance of applied research, like that carried out at USP, was stressed. The need for pragmatic approaches to coastal problems was highlighted. The vulnerability of PICs in terms of their limited biodiversity was stressed. Hence the need for sensible approaches to planning, mitigation and adaptation.

G. Sem (SPREP) described vulnerability and resilience studies. He focused on the Tuvalu case study conducted jointly with EA (Japan). He described the detailed methodologies used, the salient features of the island

and the assessment of vulnerability presented. The important conclusions were:

- Tuvalu is vulnerable but this is offset by intrinsic resilience systems, and;
- there is intense pressure on the limited resources.

Regarding the future, the following comments were made: (i) National, regional and international efforts are needed to integrate global environmental issues; (ii) Political will, ownership and country specific information were needed; (iii) National development priorities need to be established; (iv) Cost of adaptation burden need to be assessed, and; (v) Future research and assistance towards enhancing capabilities need to be realised.

An analysis of climate change and sea level vulnerability was described by D.Forbes (SOPAC), using the Suva peninsula and vicinity, Vitilevu, Fiji and Betio, South Tarawa, Republic of Kiribati as examples. This was a project carried out under the US Country Studies Programme.

The detailed techniques used, characteristics of the sites surveyed and other salient features were highlighted. The need to adapt procedures to the PIC situation was stressed. For the Suva study, a vulnerability index for the greater Suva area was developed. The Betio study demonstrated the close relationship, between wind and sediment transportation in Tarawa. And the twin affects of erosion and accretion in the different parts of the area.

At the end of the session, discussion stressed on the importance of local (cultural) knowledge in undertaking such a study was stressed. Important local background information, for example as it related to the Tarawa atoll, helps put the studies in the correct perspective. There is also a need for a proven storm surge and wave run up model for use in the region. It was also pointed out, there are two apparent paradoxes arising out of discussions and presentations:

- The use of ‘beach shelves’ as indicators of erosion as well as providing a natural structure to act as a barrier for erosion; and,
- Use of Bruun’s rule for the estimation of changing coastlines, provides useful first order

estimates, yet it is not reliable as a scientific technique. However, it continues to illustrate major coastal degradation, and responses to sea level rise. It is useful to those lobbying the need to address sea level rise. There is also no other adequate coastal /level change model appropriate to the regions.

Nakibae Teuatabo (Kiribati) presented a paper on coastal erosion in Kiribati with respect to individuals' observations. He gave two definitions of coastal erosion, one from perspectives of the consultants and one from the people of Kiribati. The Kiribati definition involves more than the natural coastal processes, population pressures, climate change, sea level rise. He stressed that changes have taken place with the disappearances of landmarks. These have been noted by the people who have over the years accumulated information and knowledge about such environmental changes. This information and knowledge should be used by consultants in their work on climate change and sea level rise.

Mohammed Ali (Maldives) also emphasised the importance of local knowledge and information, when presenting a paper on island morphodynamics, and their significance in accessing the impacts and response to sea level rise. He went further by stressing the need for countries and people within the region to know factual data and time as to when the sea level will rise. The changes taking place on the islands need to be understood, especially in relation to seasonal climates in the region. Such changes have been observed to be quite variable amongst the islands. Concern was raised in regard to current modelling of climate change and sea level rise which appears to be quite abstract and not addressing the immediate needs of the islands for their mitigation and adaptation responses. Information and awareness were seen as problem areas identified with the region. Technical scientific information need to be translated so they can be easily read and understood by local people in the region. Information about climate change, sea level rise and its effect on morphodynamism of islands, was seen as another constraint to further understanding the dynamic processes occurring on the islands. There is a need to address both short and long term changes and implications for island ecosystems.

James Aston's (SPREP) presentation on adaptation/mitigation response option-Integrated Coastal Management (ICM) plans gave an overview of what SPREP has achieved. SPREP's approach requires

integration at different levels: National, local and regional communities should participate, as they own the resources. SPREP needs resources, such as funds and time, to implement ICM and assist member countries to manage their plans. Institutions within the region need to improve their capabilities and improve their scientific and information bases. Education, training and extension would assist in enhancing this ICM. SPREP would take a precautionary approach to dissemination of information and implementing ICM.

The policy response to climate change in New Zealand was described by H.Plume (Ministry of Environment, NZ). She highlighted a number of interventions NZ has taken. NZ financed the 1990 country study on GHG inventory and is continuing its research activities. The 1990 study identified a number of sectors from which Greenhouse gas (GHG) is being produced; agriculture (59 percent), industries (4 percent), energy (32 percent) and waste (4 percent). Policy measures taken so far include voluntary agreement with industries, legislative and regulatory reform in energy sector, subsidy for removal of nitrous oxides, increase research, investment, and waste management.

SESSION C: Socio-economic Dimensions of Climate Change

1. Global Perspectives

John Campbell (University of Waikato) presented the social and economic dimensions as identified by the IPCC Working Group 3. This had little reference to Pacific island countries. The report focussed on mitigation and provided models mainly of developed economies and treated all islands the same. On the whole IPCC reported a net loss for 2 x CO₂ of 1.5-2.0 percent global GNP for developed countries.

The social and economic dimensions of global climate change have a number of implications for Pacific countries including:

- (a) PIC make small contribution to GHG emissions
- (b) they are the most affected, and
- (c) Knowledge of key parameters is very low

Thus PICs should take precautionary approaches. PICs have more knowledge about the causes than effects and more knowledge of migration than adaptations. The understanding of effects and adaptation is essential in the political arena. Thus public awareness is important to Pacific region.

2. Regional Perspectives

Taiamoni Tongamoa's (SPREP) presentation on social and economic dimensions of climate change in the Pacific region indicated most island governments are aware of climate change, but they need to know what to do. The cultural dimension involves the environmental influence on both people and culture. Depending on the size of the island there is also an influence on class structure and culture. Traditional knowledge has governed activities and survival of people in the region. The socio-economic dimension has indicated a change from subsistence to dual economies.

Issues that need to be addressed include population concentration and location infrastructure, activities, food security and culture.

The response options will continue in the areas of migration, resettlement and decentralisation but these need planning and many have policy implications. The future direction will have to be researched so that appropriate proper strategies will be planned and recommended for the future.

3. Needs Analysis on Impacts, and Socio-economic Dimensions of Climate Change

In chairing this session, Prof. Roger McLean (UNSW-ADFA) provided an overview on this area and in his assessment indicated two levels ('hard and soft') of the sciences which he suggested to be taken into account and thus understood. They must go hand in hand in addressing climate change and sea level rise. Tererei Abete (Kiribati) commented that time and financial resources are required by participating communities and member countries. Training should be in-country. Public awareness of climate change and sea level rise needs to be fostered. SPREP should take the lead. Kiribati wants to be involved in Integrated Coastal Zone Management research. Similarly, it wishes involvement in freshwater assessment, fisheries, wildlife and other areas such as greenhouse gas inventory, identifying

appropriate energy sources, different landuses, mangroves and data systems. Pene Lefale responded that SPREP would help in public awareness through press releases.

Pati Liu (Samoa) outlined Samoa's plans for climate change, which includes policy and response frameworks. A number of comments were made in regard to societal changes and their unpredictable impacts on the environment. Local communities are not aware of climate change and sea level rise. There is a lack of information for public awareness. SPREP was asked to conduct research on coastal erosion, salt water intrusion, protection of ground and coastal water on islands. Recommendations were made for sharing and exchanging of experiences and information amongst islanders.

SESSION D: United Nations Framework Convention on Climate Change (UNFCCC)

The session was chaired by Pati Lui representing the Samoa Government. Five topics were set for discussion, covering aspects and flow of events towards the conference of Parties (COP3) of the UNFCCC at Kyoto Japan in December 1997.

Pene Lefale (SPREP), briefed the participants on the background, fundamental objectives of the Climate Convention (CC) and the status of ratification by governments, adding that 12 Pacific Countries were party to the convention.

He, then specified the Articles of the Convention that are of specific concern for the Small Islands Developing States (SIDS), and drew attention to Articles 2, 4, 6, 11 & 12, in particular.

Some of the striking features of the convention were:

- the commitment by member countries
- the recognition of industrialized countries commitments
- the acknowledgment of developed countries responsibility for the global climate change, and;

- the developed countries, financial and technical communities to assist developing countries, to adapt to climate change

Lefale, told the meeting only three countries were recognised to have met their commitments regarding emissions. However, Denmark was the only country, that had met the standards required.

The long and lengthy discussions and negotiations from AGBM to COP3 were detailed. The AGBM called on member states to negotiate a POALI to strengthen commitments of Annex I countries post 2000. However, the POALI, contained all contentious issues involving legal instruments relating to policies, measures and reporting. With the Quantified Emission Limitations and Reductions (QELROS), one of the issues being debated by COP3 was the question of gases to be specified. What gases are to be included in a basket of gases, individual gas minerals, or all gases? On this issue, AOSIS was trying to get a reduction of 20 percent reduction at CO₂. AOSIS was also hoping that IPCC would define “dangerous levels” with regards to emissions.

The question of time-frame, with regards to limiting emissions was discussed. Flexibility of parties after acceptance of emission standards was also raised. The impact of a reduction in emissions, e.g through the introduction of a ‘carbon’ or ‘energy’ tax would adversely burden the developing countries, in particular the PIC’s. Lefale, warned such a tax will be pushed on the consumer. Given the transport costs involved, PIC’s will be severely affected. As PIC’s depend heavily on fossil fuel, price increases will have significant social and economic impacts in the region. The “domino effect” of such increases in fuel prices for the region have not yet been addressed. In this regard, alternative energy strategies for the PIC’s need to be given high priority in the near future.

On an international front, new techniques and approaches at emission reduction by Annex I countries were outlined. Some approaches include “burden sharing”, “joint implementation”, borrowing and banking and ‘emission trading’. These techniques are very deceiving and require very careful interpretations and analysis, by the developing countries and in particular PICs. With all the legal, technical, and political considerations being negotiated, the text before the COP3 remained open. The PICs were urged to participate fully in the negotiations at government levels,

and in particular lend support to the position of AOSIS in the negotiations. Support of the member countries regarding technical or legal issues for AOSIS was crucial.

Prof. Roger McLean addressed the question of IPCC’s view on setting targets of ‘dangerous levels’ in emissions. He indicated that IPCC considers this a political decision and therefore could not decide on it.

Prof. Nobuo Mimura made some personal observations on the UNFCCC and its development since COPI. He suggested the main agenda item for COP3 was the adoption of a Protocol or other legal instrument to fulfill the Berlin Mandate (1995). The issue of utmost concern, politically for Small Island Developing States (SIDS) was the stronger influence of OPEC countries within the G-77 and China group. For this reason, the AOSIS require a stronger voice to influence the group to favor the SIDS, during negotiations. He outlined the preparations and what was required for the COP3 at organisational level. It was noted that a ministerial meeting will be held from 8-10 December and the provisional agenda will be finalised by mid-October.

Information and contacts for the Kyoto (COP3) meeting was given by Prof. Mimura.

Mr Ian Fry (Greenpeace Australia) commented on the key political discussions with regards to UNFCCC in the past 12 months. He highlighted the crucial issues that need to be taken into account and the real/political concern for the plight of PIC’s. Some of the negotiations of interest were covered.

At the CSD5 meeting, Australia was seen to be “globalising” the problem; suggesting that the developing countries have their responsibility too, towards reducing their emissions. EU was proposing to reduce emissions by 15 percent by 2010, but AOSIS was insisting on 20 percent under 1990 levels by 2005. In contrast some OPEC countries did not want any targets. He mentioned the new tactics the US was adopting too.

The G7 and Russia (Denver) meeting, issuing the Denver G-8 statement, accepted the scientific aspects, like global warming and climate change issues and even called for developed countries to take the lead and stabilize emissions to “acceptable” levels. This “acceptable level” presented the problem according to Mr Fry. The statement also called for setting up

mechanisms for monitoring the status and compliance by parties.

At the UNGASS in June 1997, the president of FSM stated that some atolls of FSM have been abandoned already. The interesting development at UNGASS was the divergence of US political views between the White House and the Congress.

Both appear to be adamant and it is expected that the intransience will continue. The lobby in the US appears to be quite strong, despite Clinton's drive to move forward. Saudi Arabia and Australia's stand on targets were made clear, a position that does not favor SIDS.

The expectations of specific targets from developing countries came out again at the seventh subsidiary body meeting. The developments at the meeting does not favor SIDS, either. He said the stand of the G-77 and China group was weakened by the split within the group, when the African group took a more pro- OPEC stand.

The split will make it difficult for the G-77 and China Group to force developed countries to set targets and reduce emission rate of GHG. He, therefore urged AOSIS to be a stronger voice and while being sensitive, they need to be assertive also.

Dr Joseph Huang (USCSP) outlined the philosophy behind the programme, the objectives and the next phase of the project. The main purpose of this project was to assist individual countries in preparing climate change action plans, and to exchange information and expertise in support of the UNFCCC. Eighteen countries were receiving support, and he noted the importance of integrating NGO's and local communities into the project. Greenhouse gas inventories, and vulnerability assessment were highlighted in these studies. He displayed an emission scenario where the amount of GHG emission from developing countries by the year 2100 will be three times more than developed countries, whose emissions will stabilize at a much lower rate.

Greenpeace responded by saying this was just one scenario and such misleading information has been used to play one country against another to cause controversy.

In responding to the UNFCCC obligations, the Pacific countries have started on national communications with funding assistance from the Global Environment Facility (GEF). Wayne King (SPREP) outlined the

Pacific Islands Climate Change Assistance Programme (PICCAP) and CC/TRAIN projects underway. With the concerns of the PIC's, including assessing and understanding information, addressing government concerns, PICCAP has taken these considerations into the project.

Since, this is an enabling project, the primary goal implementing the UNFCCC, by strengthening and enhancing the national capacity of individual countries. Ten countries are participating in the project, that will cost is \$3million over three years.

GreenHouse Gas (GHG) inventorizing, vulnerability assessments, adaptation strategies, and national implementation are some of the activities that will be carried out under the project. Consideration for local needs and in particular the training and the stress on regional expertise input, are some of the strong points of this project.

1. UNFCCC Discussions.

Pene Lefale (SPREP) led the discussion session, following from earlier presentations in the afternoon. In his introductory remark, he informed the participants of the means of getting information regarding the Climate Change convention. With regards to the preparation for COP3, it was pointed out that member countries need to provide guidance to SPREP in preparation for COP3. On this aspect, the Director of SPREP said the FORUM will be discussing these issues and will have endorsed government views on the issues concerned.

At this point, Prof. Hay clarified the issue of GHG emission scenario that was raised by Dr. Joseph Huang earlier in the US Country Studies Programme. Prof. Hay suggested a possible safe level of GHG. In his scenario he made it clear developed countries need to reduce their emissions drastically, while allowing for some increases in emissions by developing countries. However, it is still a political decision.

Lefale indicated on the question of 'net' and 'Gross' luminous, that these are again very complicated issues and such terms can often be manipulated by countries to suit their own policies, without achieving a real reduction in emissions. Such technical evaluations are at times beyond the capabilities of SPREP, and often the individual representing the organisation. He urged member countries to provide technical support on such

matters, so as to understand the manipulations and jargon, being introduced, by some countries, into the debate. To this effect Prof. Hay proposed a SPREP Task Group (SPREP-TG) which can be formed to provide the required technical assistance in such negotiations. This can be achieved by establishing a network of scientists from around the region.

SESSION E: Information and Awareness Raising

1. Global Perspectives

This session was chaired by Mr Martin Sokonamu (Vanuatu) who spoke briefly about information and data diffusing into the PICs. He said the information flow was quite slow. Later he introduced The World Meteorological Organization (WMO) representative Mr Paul Lanso. He described the history of WMO involvement in climate change activities from 1974 to the present. These include press releases, speeches, newsletters, technical reports and brochures, workshops and expert meetings, World Meteorological Day, education and training materials and a world wide web site.

Dr Bill Erb and Cecile Grignon-Logerot (IOC/ UNESCO) presented their plans for the International Year of the Ocean (IYO) in 1998 and described the types of activities. The IOC has agreed to help coordinate the IYO. The theme is "Our Common Heritage". Activities include an ocean charter, education, production and dissemination of public information and promotional material, ocean awards, cruises, conferences and publications. There will be press kits available in six official languages. Information was provided on the Summit of the Seas planned for September 1997, and the preparation of a voluntary Ocean Charter for governments and individuals. The IOC has also just published a guide for integrated coastal zone management, prepared by an interdisciplinary team of French scientists. This will be distributed to workshop participants as soon as it is available in English.

2. Pacific Perspectives

Dr Fairley Barnes (Atmospheric Radiation Measurements (ARM)-Tropical Western Pacific Education Program) described their educational programme in the Pacific. The ARM Program

recognises that response to climate change requires both expertise and implementation at a range of levels. It provides a case study in the development of a proactive role for international science in public education and awareness. The ARM Program has a component in several locations, including mid continental USA, the Tropical Western Pacific in Alaska. Currently it is developing an education component for each site. It has the advantage of constant funding over 10 years. Tropical Western Pacific sites will include Manus Island in Papua New Guinea, Nauru and Kiribati Island (Kiribati). Activities commenced in Manus, PNG in 1992/93 and include development and implementation of an education plan and technical training for on-site technicians and observers. These activities are focussed at local, rather than national level. At regional level the program is developing training activities in collaboration with SPREP and the National Tidal Facility of Flinders University, Australia.

During question time, the PNG and Tonga made several comments and queries. Mr Kevin Luana (PNG) expressed their appreciation to the ARM Program for their commitment to the technical program and contribution to the local community.

Mr Ulilou Samani (Tonga) asked what was the ARM approach to training attachments. Dr Barnes replied that training occurs with each visit and the National Weather Service is invited to the US. Observers from Nauru will also go to Fiji for training.

Dr Than Aung made a lively presentation on the information and training component of the South Pacific Sea Level and Climate Monitoring Project. This project has two phases from 1991 -1995 and from 1995 to 2000, involving project management, data management and interpretation, regional information and training, site work design, installation and commissioning. It uses state of the art technology and continuous measurements of a range of parameters. There are eleven countries participating. Education and training is the most visible component of phase two. The project is using a wide range of techniques for disseminating information. The training component includes awareness raising workshops, study tours, short term attachments and development of an educational curriculum module. There is a great deal of interest and some pressure to provide sea level trends. The ability to provide meaningful trends is restricted by the short time frame to analyse data from the project. The project is providing information on the local tidal character, tidal

predictions, local meteorological data, storm surge and tropical cyclone warning and the status of El Nino.

3. **Regional Needs**

The chair of the meeting requested if Prof John Hay could provide a summary of the meeting needs for the conference to view and discuss. Professor Hay divided his summary of the meeting outcomes into four interlinking components - national, regional, sub-regional and international. He stressed the recognition given by the meeting to the importance of the peoples agenda, a grassroots focus and the need to shift from a biophysical assessment to one of socio-economic analysis, leading to recognition and management of consequences.

At the national level the need for alternatives to the established vulnerability assessments was emphasised. Identified alternatives included:

- locally based coping and sensitivity studies
- integrated (multi sector) impact assessment models
- seasonal forecasts of key national indicators
- in-country assessments of local adaptation
- public awareness raising
- briefing of decision makers
- education
- non targeted local training emphasising empowerment, the development of generic skills in consensus building, priority setting and conflict resolution.
- targeted local training to equip key individuals with technical skills

Priorities for regional level include:

- assessments of probable environmental changes and of mitigation (limitation) strategies
- development of guidelines for coastal protection, coastal management, and technical issues

- preparation of materials for public awareness raising
- briefing regional decision makers
- non-targeted - “training of trainers” eg as per Australia/SPREP Atoll Initiative
- targeted training for equipping key individuals, eg: through PICCAP

At sub-regional level priorities were similar to regional level but should take a specific approach with a spatial and/or sector based orientation eg for high islands, low islands, forest management, catchment management (both natural and constructed).

At international level there is a strong requirement for:

- a technical support network for AOSIS and for PIC negotiators (AOSIS -TSN)
- emphasis on input to the IPCC by local authors and PIC contributors
- sector based regional studies of the consequences of environmental change eg for tuna fisheries and energy supplies
- global awareness raising

SESSION F: Identifying Potential Sources of Funding for Climate Change Activities in the Region

Mr Sokonamu introduced the session and commented on the current programmes/activities being implemented in the region. He stressed the need for international partners to work with the PICs governments and their regional organisations to address a rather complex issue. And in order to increase and improve their understanding on the subject matter.

The Global Environment Facility (GEF) representative, Dr Avani Vaish briefly described the GEF financial operations and support for the region. He explained how governments could access the funds from them.

The implementing arrangements for the GEF were also explained. The focus is four fold: climate change,

biodiversity, international waters and atmospheric ozone. Despite substantial financial commitments from donors, its interim role as a financial mechanism for the Convention on Biodiversity, and the FCCC imposes limits on the capacity to obtain donor commitments.

The GEF emphasises country driven projects and is guided by the Convention and the COP in setting priorities for its climate change portfolio. Its funding pattern includes agreed full costs for enabling activities, incremental costs for other projects and project preparation support if needed. Access to GEF resources is through UNDP, UNEP or the World Bank. Countries are eligible, providing they qualify, or are a signatory to the for financial assistance from the UNFCCC, or are eligible to borrow from the World Bank.

In recognition of the urgency surrounding development of national communications projects, sums less than US\$350,000 may go through an expedited approval process. Others, however, go through the full process. Seventy two enabling projects have been approved, a further 12 are in the final stages of approval. These projects cover 113 countries and 84 national communications.

Dr Michel Gauthier described the European Union (EU) Global Oceanic Observing Systems (GOOS). Its aim is to become a global mechanism, both geographically and in terms of interest. Each GOOS module covers operational mechanisms. The aim is to integrate national GOOS subsystems with regional and international systems. The Pacific is a very significant region for GOOS, particularly as a result of its huge maritime surface, future development opportunities and prospects from marine resources, deep water potential and importance as a warm water source. There are related GOOS interests in SE Asia to the South Pacific. There is an impending seminar on establishment of GOOS for the South Pacific.

Mr Seali'i Sesega representing UNDP in Samoa, provided the UNDP perspective on climate change and sea level rise. He emphasised on the importance of action programmes (using scientific information) and felt the needs of PICs have been expressed in a number of Forum meetings. This has led to the development of PICCAP and CC:Train.

The UNDP has a range of resources including :

- country programmes

- inter-country programmes
- cost sharing with various other donors
- GEF

It is important that donor agencies make the most of SPREP in pooling and making the most of resources for the region.

Dr. Roger Hill of the European Union (EU) based in Noumea, provided a summary of environmental programmes carried out in the Pacific. The EU and its member countries have ratified the convention and are supporting the adoption of a 15 percent reduction of basket of gases on 1990 levels. The EU has a long term interest in the environment, and supported a range of projects in the developing world. The EU is committed to jointly approved checklists, and EIA for its project proposal. All projects are to be evaluated on the basis of environmental effects. A percentage of the funding is reserved for emergency aid. The remainder is available for national and regional programs. A nationally indicative program forms the framework for implementation. This has been agreed for the next five years for PICs. Discussion on a regionally indicative program is nearing completion. There is potential to establish medium term projects because of the five year funding cycle. This does, however restrict flexibility in allowing for new concerns, or changed circumstances.

Prof Mimuro discussed the range of Japanese programmes in the Pacific. These included the Asia Pacific Network for Global Change Research, the Green Initiative, Asia Pacific Seminars on Climate Change, the Global Environmental Research Programme and SPREP/Japan cooperation. The Asia-Pacific Network is an intergovernmental network aiming to support regional cooperation, collection and management of data, scientific and technical capability and public awareness raising. The Green Initiative has been proposed by PM Hashimoto and includes the development and diffusion of green technology and forest conservation. The funding mechanism is Green Aid. The Asia-Pacific Seminars on Climate Change encourage the exchange of information and regional cooperation. The Global Environmental Research Program included integrated coastal vulnerability assessment in Asia and the Pacific. It involves 11 institutions and 30 researchers. It also assists in the development of test models on coastal changes and will input results of vulnerability assessments into the next

stage of IPCC reporting. SPREP/Japan cooperation has involved collaboration in vulnerability assessments and pilot study of adaptive options.

Mr Navarra (Italy) discussed the Italy proposal in the conference with a view of getting support from the Pacific governments. The Italian Environment Ministry is interested in establishing cooperative activities in the region. Areas of research in Italy of relevance to the Pacific, include global circulation modelling, seasonal to interannual variability, experimental seasonal prediction systems, ocean data simulation systems, ecosystem modelling, local and regional mesoscale prediction systems. Mr Navarra gave an overview of some of the research being done in Italy.

1. Discussions.

After the donors presentation, questions and discussions focused on how to access funds and ways for donors to implement climate change programmes in the region.

Prof. McLean stressed the importance of scientific support for SPREP and IPCC reporting at regional level. The need to recognise information exchange as a two way process was raised and highlighted. To often the research agenda is donor driven. Research and tertiary training priorities need to be identified from within the region to moderate purely donor driven activities. There needs to be more emphasis on translation into PICs languages.

Dr Saulei (PNG) representative asked that the importance of local participation be stressed in the meeting summary. PIC national capacity to absorb and implement GEF programs is an issue requiring attention. There is a need to emphasise national capacity within

island countries. There has been too great a reliance on outside expertise from and inadequate use of local expertise.

Mr Samani (Tonga) highlighted the projects with SOPAC and the opportunity provided for postgraduate student training as a productive approach to training attachments. In addition, he commented on the importance of National Meteorological Services and the need to lobby for their retention.

SPREP requested some clarification of questions from the GEF including:

- the regions focal point
- bottlenecks in releasing funds
- the interim status of the Global Environment Facility (GEF).

There are three implementing agencies (UNDP, UNEP and World Bank).

Which agency to work with is a countrys own choice. The time taken for approval and release of funds involved a brief approval by GEF Council, then fleshed out by governments, returned to Council, before a final proposal returned back for final governments. This can result in delays for regional projects as was the case with PICCAP which took two years for funding to be released. GEF is still an interim mechanism. The decision to change this is the responsibility of the COP. GEF hoped that the review process would be finalised at Kyoto, but this now appears unlikely. Continuation as an interim mechanism could lead to hesitation by some donors to commit funds.

Conclusion and Close of Conference

The Director of ORSTOM gave his apologies for the final closing ceremony as he was giving a television interview. He had been able to give numerous television, radio and newspaper interviews promoting the meeting. He passed on his thanks to both organisers and participants, the representatives of PICs and traditional donors in the region. He thanked SPREP, the organisational team and the excellent team of interpreters provided by the SPC. He thanked the SPC for their contributions to tea breaks, the IOC contributors and the ORSTOM team with a special thank you to Jacqueline Thomas and bravo to Chalapan!

The Director of SPREP thanked all the sponsors. He highlighted the sensitivity of the issue for politicians, bureaucrats and administrators across the globe. He emphasised that SPREP is established to serve the PICs assisted by donor member governments. He endorsed the summary provided by Professor Hay which reflected the approach SPREP aims to take, particularly in

emphasising the human element in all SPREPs activities. He suggested that with the pace of research and the range of issues to be addressed that the meeting needed to be held more frequently. He recommends three yearly rather than five yearly meetings. He emphasised the need to obtain more regional media coverage. Climate change and sea level rise continues to be a major emphasis for the South Pacific Forum and SPREP. SPREP is very conscious of the issues of countries absorptive capacity in development and implementation of programs. SPREP is investigating the establishment of a biodiversity trust fund. This will be developed further at a meeting in Pohnpei in September 1997. As Director, he is conscious of ensuring activities in the SPREP Secretariat are integrated and hopes to promote this approach further nationally, regionally and internationally. He again thanked all participants, donors and the organisational team and presented gifts and flowers to the organisational team and interpreters.

