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IRI

Preparing for El Niño: Advancing Regional Plans and Interregional Communication

Workshop Proceedings

Palisades, New York, USA
April 29 - May 2, 2002

COLUMBIA UNIVERSITY

Participating Organizations

ASEAN Specialised Meteorological Centre (ASMC)
Asian Disaster Preparedness Center (ADPC)
Bangladesh Academy of Sciences (BAS), National Science & Technology Museum
Central Weather Bureau, Taiwan
Centro de Previsão de Tempo e Estudos Climáticos, Instituto Nacional de Pesquisas Espaciais (CPTEC/INPE), Brazil
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"Can we recycle as Nature does?" is an **enso** (or Zen circle) used with permission of the artist, Kazuaki Tanahashi, who lives in Berkeley, California. More information on Kazuaki Tanahashi can be found on his website (www.brushmind.com).

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This workshop was organized with assistance from the NOAA Office of Global Programs.

This report and additional materials from the workshop may be found at http://iri.columbia.edu.

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Preface

A workshop on Preparing for El Niño: Advancing Regional Plans and Interregional Communication was hosted by the International Research Institute for Climate Prediction (IRI) on April 29 - May 01, 2002 in Palisades, New York. The workshop was organized to bring together leading regional representatives of the seasonal forecasting and applications community to advance regional preparedness by informing planning processes and developing communications networks, and to draft action plans to confront an El Niño event in 2002-2003.

Participants were invited from 12 regions that are characterized by significant historical El Niño impacts or that otherwise manifest societal vulnerability to climate variations. Many have been involved in the development of regional climate information and applications networks, while others were recommended as strong candidates for network development. Representatives from regional, national, and international organizations (World Meteorological Organization, World Bank, US Agency for International Development, NOAA's Office of Global Programs, US Climate Prediction Center and Dialogue on Water and Climate) also participated in the discussions and planning.

The specific objectives of the workshop were to:

- Evaluate the current state of the global and regional climate system and regional forecasts
- Evaluate regional preparedness and potential El Niño impacts
- Share experiences inter-regionally
- Develop a global strategy for regional preparedness
- Refine mechanisms for interregional knowledge exchange.

This document provides a summary of the workshop outcomes and next steps as defined by the meeting participants. The wealth of knowledge and experience shared among participants was far beyond what can be expressed in these pages, although, a synthesis of major themes is attempted.

This workshop was prepared on short notice, to advance preparedness for an emerging El Niño in 2002. To paraphrase one participant, "its long-term goal is to effectively build resilience in societies, and thereby reduce the vulnerability to El Niño related regional climate effects." In preparing for the next El Niño and in building systems for the future, much work remains to be done. We hope that this workshop constitutes one small step towards assisting affected regions to cope with this El Niño, and strengthens regional systems in the long run for managing climate variability and change.

Workshop Steering Committee, June 2002

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Welcome Letter

Palisades, NY - April 29, 2002

Dear Participant,

Let me extend a warm welcome to this workshop on El Niño/Southern Oscillation (ENSO) preparedness and inter-regional communication. As of this writing, an El Niño event during 2002-2003 is more likely than not. We cannot know with certainty what the effects of El Niño on regional climates will be, nor the impacts of potential climate anomalies on society. What we do know, however, is that El Niño affects regional climates and that these effects are to some extent predictable.

The International Research Institute for Climate Prediction (IRI) has organized and sponsored this workshop to bring together experts on climate and its impacts from regions affected by El Niño around the globe. Together we will review the El Niño forecast, its potential impacts in affected regions and the state of regional preparedness. Based on this information we will identify measures that can be taken within the context of emerging regional climate information and applications networks and globally to prepare for El Niño.

Whether or not an El Niño materializes this year, we also know that El Niño and its counterpart, La Niña, continually reoccur. Therefore we must continually strive to improve society's understanding and management of the climatic shifts that accompany them. As we move into the future, where climatic patterns are potentially even more uncertain, it is vital that we strengthen capacity at all levels – national, regional and global – to adapt human activities within the context of the climate system.

In support of this endeavor the IRI will work with the international community toward the establishment of mechanisms to facilitate inter-regional communication to improve management of climate variability. These include the development of a network of regional climate correspondents and a web-based climate information and applications system developers' toolbox. Input and insight from you, the workshop participants, will be essential to refine these correspondent and toolbox concepts. Your input at the workshop and your continued efforts will be vital to meet the needs elaborated over the next few days.

Thank you for coming and I look forward to working with you during the workshop and beyond. If you need anything during the meeting please do not hesitate to ask me or any member of the IRI staff. Again, welcome!

Sincerely,

Antonio Divino Moura
Director General

Summary of Outcomes and Next Steps

Overall Patterns in Regional Preparedness

The workshop on which the following report is based was designed to promote regional preparedness for an El Niño event this year, as well as to contribute towards strengthening of regional climate networks for managing climate variability and change in years to come. Summaries on the state of preparedness in El Niño/Southern Oscillation (ENSO) affected regions below from the developers and implementors of a dozen such networks illustrate that progress has been made since the El Niño of 1997/98 in understanding, anticipating, and preparing for El Niño impacts. The following comments are generalizations about the overall state of regional preparedness, based on a review of the regional summaries that appear later in this report. Preparedness varies across regions, so further detail should be sought on a region-by-region basis from the regional preparedness summaries and their authors.

Advances in regional preparedness since the previous event of 1997/98 are clearly evident in many areas. In many regions, a great deal has been learned about the effect of ENSO on regional climate. Impacts of regional climate variations are increasingly well documented and understood. As important, there is an emerging ability to characterize uncertainty with respect to ENSO's effects on climate and their impacts. Progress has been made in the ability of national meteorological centers and research institutions to forecast seasonal climate. Progress has also been made in developing and issuing consensus climate outlook guidance at the regional level in advance of key seasons when climate impacts on society are expected to be greatest.

Many of the Regional Status Reports below document involvement by potential and actual climate information users in interpreting and applying climate information in decision-making contexts. This involvement is leading to an increasing recognition of the importance of social and economic vulnerability in determining the impacts of climate. Progress has also been made in identifying specific vulnerability factors in climate-affected sectors.

An ongoing dialogue that has taken place between climate information producers and users since 1997 has contributed to the establishment of mechanisms for applying climate information. These include sectoral committees, formalized planning sessions and contingency planning. An on-going process of integration between international, regional and national-level efforts to manage climate variability appears to be underway.

Much remains to be done, however. In general, the improved ability to anticipate climate conditions has not translated as well into the ability to anticipate climate impacts. This is partly due to the diverse nature of potential impacts, which makes forecasting impacts a more complex endeavor than forecasting one or two climate variables. Anticipating impacts requires systematic monitoring of vulnerability characteristics of sectors or populations affected by particular climatic hazards or shocks. Earlier and more accurate warning of climate impacts will depend on the continued involvement of experts who can precisely characterize the vulnerability of climate-affected socio-economic systems.

Similarly, knowledge about decision-making frameworks and options that can employ climate information is still sketchy compared to knowledge of the climate system and its workings. This translates into an uneven ability to effectively channel tailored climate information to decision makers in support of specific types of decisions.

Two additional areas that deserve further attention are (1) more effective use of the media to communicate climate information to the public at large, and (2) systematic documentation and evaluation of climate forecast use.

Given the advances in capabilities since 1997, and the predicted weak to moderate strength of the developing El Niño, the next 12 months offer the opportunity to evaluate and improve some of the preparedness measures which have been initiated. The developing El Niño provides an opportunity to strengthen regions' and countries' abilities to manage predictable climate shocks. Some key needs were identified:

- the need to foster relationships among organizations to strengthen regional climate information and applications networks, and to strengthen these networks as primary sources of information in coping with El Niño and climate variability
- the need for sufficient human and financial resources to be able to meet increased demand for information under El Niño conditions, and

• the need for involvement of sectoral and other experts to aid in forecasting and managing impacts and guiding design of tailored products to support decision-making.

Finally, educating users to develop flexible coping strategies given the probabilistic nature of climate forecasts remains a major challenge. Experience has shown that forecasts are perceived as deterministic by users and the public. As all forecasts are probabilistic, however, the only certainty is that sometimes the least expected outcomes will occur. This cloud has two silver linings. First, unexpected outcomes reinforce the need for developing appropriate and effective risk management strategies that take into account the real uncertainties inherent in probabilistic predictions. Second, regions where there is predictive skill have demonstrated that confidence-shaking experiences can eventually be overcome because, in the long run, the probabilities favor greater benefits from using climate forecast information over simply guessing. Nonetheless, it is recognized that improvements in forecast skill are necessary, and much research is focused on this goal.

ENSO Update and Current Conditions

This workshop was prepared quickly in response to the predicted development of El Niño in 2002/2003. In March, the IRI estimated a 70% chance of El Niño developing (30% represents the uncertainty). (Box 1 presents the IRI ENSO Quick Look updated as of July 2002.) The likelihood of a basin-wide El Niño persisting through the calendar year is now 90%, although the magnitude of the event is likely to be weak or moderate. The implications of El Niño for regional climates are complex, and for climate related impacts even more so. However, a number of regions already facing climate and/or economic stresses have increased vulnerability to potentially adverse climate conditions associated with El Niño in the coming months.

Common Elements of the Planning Process

Planning sessions were held to develop a vision and elements of an action plan for each region, building on ongoing programs and emphasizing what can be accomplished immediately with available resources. To address short-term preparedness, regional groups (1) defined plans for clarifying the message on the current El Niño event, including mechanisms for updating information, and (2) identified ways to capitalize on the current demand for information about El Niño to highlight areas for long-term improvement in the use of seasonal climate forecast information in decision-making. In the latter context the groups considered how to improve on existing networks for communicating climate information. WMO has a long term plan to work with global forecast centers and regional climate centers (RCCs) to ensure accepted standards for seasonal and interannual climate information.

The plans highlight critical needs and actions, some of which may require additional resources to implement, particularly in the long-term. The regional participants may further develop elements of the regional plans and communicate with funding agencies regarding those elements requiring additional resources.

A number of important messages are recurrent in the regional planning reports:

• It is important to emphasize climate anomalies and their potential impacts rather than the characteristics of El Niño itself.

• This El Niño event will result in regional impacts but those impacts will vary from place to place within countries and regions. The impacts will not be the same as those experienced in the previous event of 1997/98 because both climate and socio-economic circumstances are different.

• Nonetheless, there is a great deal of information available through regional and national climate centers and their networks that can be used to anticipate and manage El Niño-related climate anomalies, as modified by other local and regional influences. Regional climate networks and centers are stepping up their efforts to supply this information in light of El Niño.

• Inherent uncertainties about El Niño's effect on regional and local climates, and the impacts of climate anomalies on affected locations and sectors, require appropriate and informed risk management approaches. Decisions should incorporate "no regrets" strategies to take into account the possibilities of unexpected outcomes.

• The current El Niño also highlights the continued need to strengthen regional, national and global climate networks and centers. This includes growing involvement of sectoral experts who can act as intermediaries for the communication of climate and impacts information among the various scientific and user constituencies. These networks and centers are the building blocks for sustainable systems to anticipate and manage climate variability and change in the future.

Summary of Two Mechanisms for Inter-regional Communication: The Affiliates Network and Climate Information System Developers' Toolbox

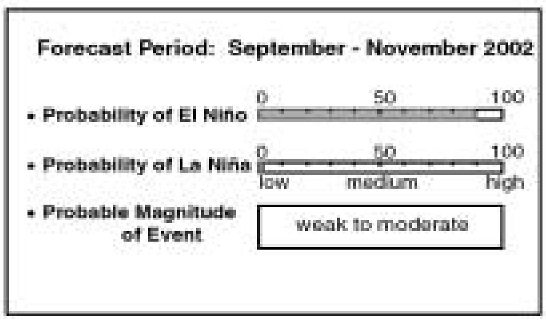
Two mechanisms were proposed by the IRI at the workshop for facilitating inter-regional communication on climate related issues. Such communication assists with documenting and managing climate impacts and with the development of sustainable climate information and applications systems. One was an inter-regional network of affiliates. The affiliates in the network would be regional experts, able to interpret climate

ENSO *QUICK LOOK* July 17 2002

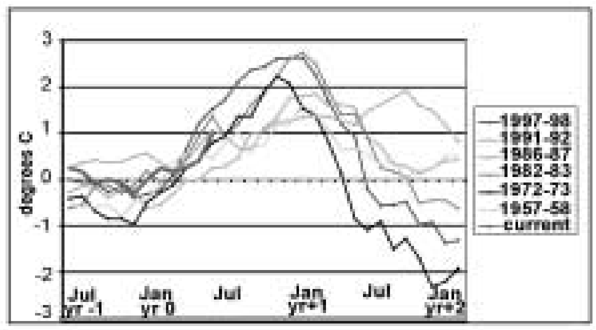
A monthly summary of the status of El Niño, La Niña and the Southern Oscillation , or "ENSO"

Ocean conditions in the tropical Pacific have currently reached the minimum level required to represent the onset phase of El Niño. These conditions are sufficient to initiate generation of climate-related impacts in some regions. The IRI's assessment is that there is a 90% probability that these conditions will persist for the next 6-9 months, indicating a high likelihood for a fully developed El Niño for the remainder of 2002 continuing into early 2003. The forecast sea temperatures in the tropical Pacific are significantly less than those associated with the 1997-98 El Niño. Climate impacts are anticipated to be generally weaker than those associated with the 1997-98 but may be substantial in some regions.

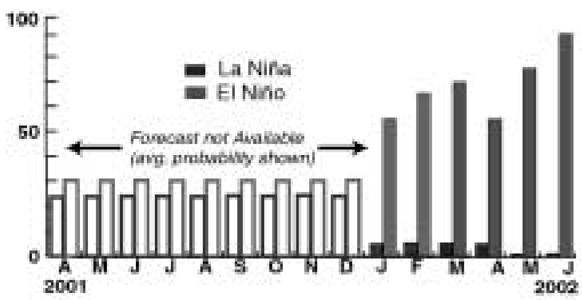
Current ENSO Forecast Summary *



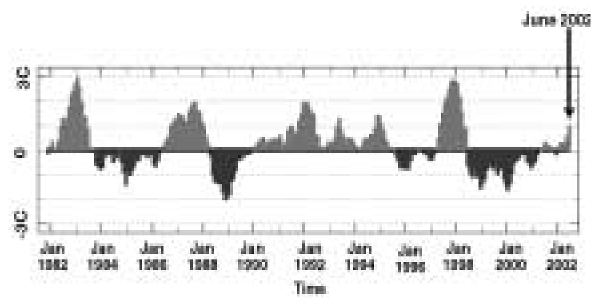
Current Conditions vs. Past El Niño**



ENSO Probabilities over the past year



Historical Sea Surface Temperature Index**



Historically Speaking

El Niño and La Niña events tend to develop during the period Apr-Jun and they:

- *Tend to reach their maximum strength during Dec-Feb*
- *Typically persist for 9-12 months, though occasionally persisting for up to 2 years*
- *Typically recur every 2 to 7 years*

* Probability of an El Niño refers to the likelihood of a sustained (that is, over several seasons) warming across a broad region of the eastern and central tropical Pacific, not just along coastal South America.

** Based on sea surface temperature departures from the long-term average over the "NINO 3.4" region (120-170W, 5S-5N).

Box 1. IRI ENSO Quick Look (http://iri.columbia.edu/climate/ENSO/currentinfo/QuickLook.html).

forecasts and document their uses in specific contexts. The affiliates would facilitate and/or perform:

1. High quality analyses of climate impacts in sensitive sectors throughout their respective regions
2. Documentation of climate impacts
3. Interpretation to improve understanding of these impacts.

Moreover, systematic communication about impacts and the use of forecasts will provide insights for improving management of social and economic stresses related to climate variability. This will be helpful not only within each region but also across regions, as experiences are systematically shared inter-regionally.

Following discussion at the workshop on how such a network could be formulated to promote intra- and inter-regional knowledge exchange, next steps identified included identification of the means of formalizing the network, development of information formats and methods, and identification of information-sharing mechanisms. The IRI agreed to coordinate this process and act as a clearinghouse for region-specific proposals.

Since the April meeting, nine proposals for regional affiliates activities have been developed by regional participants and submitted to the IRI. The proposed activities include (1) those which emphasize climate related impacts analysis and reporting to a broad community, that can be initiated in preparation for the potential El Niño this year and (2) those which emphasize building regional networks through meetings and workshops to enable (1) above in the future. The IRI encourages efforts in both regional network building and climate related impacts analysis and reporting. After careful consideration of the present needs of the community, and in light of the developing El Niño, a decision has been made to support pilot projects which can immediately begin to assess and report on climate related impacts and communicate such information regionally and internationally.

Elements of proposed affiliates activities which meet immediate needs and provide a pilot phase for generating knowledge regarding climate related impacts will be posted on the workshop web site (http://iri.columbia.edu/outreach/meeting/ENSOWS2002/). Such regional activities include:

- National or regional monitoring of climate impacts in important sectors during 2002/2003
- Documenting the use of seasonal forecasts within affected sectors and decisions made
- Providing information sharing via website for use by regional organizations, updated monthly during 2002/2003.

The other mechanism proposed at the workshop was a web-based climate information system developers' toolbox. The toolbox would provide a portal into regional climate information network activities, and a vehicle for sharing selected information, tools and techniques across regions. Its purpose is to assist regional climate information system developers in promoting more effective use of climate information. In addition to information provided by the affiliates network, toolbox content could include links to regional climate information system web pages, training course curricula and modules, project design aids, pilot project results, and a link to a database on climate information applications being developed by the IRI.

Following presentation of a prototype demo developed jointly by the IRI, NOAA/OGP and the World Bank and discussion by workshop participants, next steps were identified. These included a review of the toolbox demo site based on discussion at the workshop, further identification of regional collaborators, and organization of the process of managing and presenting content and of obtaining and incorporating feedback. IRI and NOAA/OGP agreed to coordinate follow-up on the toolbox, building upon work already ongoing in many regions along these lines to date.

Next Steps

The April meeting contributed to regional preparedness planning in response to the developing El Niño. At this writing, preparations continue with some urgency as the likelihood of the event increases. For more information regarding ongoing efforts in particular countries, regional participant contact information is provided at the end of this document. The IRI, as part of a broader effort by the Earth Institute at Columbia University, is making special efforts to support El Niño affected regions through ongoing and new programs in the coming year.

El Niño Preparedness

Key Topics for the Planning Process

The following summarizes workshop discussions on key cross-cutting topics related to planning for El Niño events and climate anomalies.

Part I: User Needs and Linkages

This discussion explored regional efforts and experiences in developing communication networks, identifying intermediaries, clarifying message content which is appropriate and responsive to user needs, and mechanisms for the above.

Regional Networks

Regional networks are structures through which information on climate and its impacts is exchanged to inform national and local decision-making. They involve those who have common information interests and needs. For example, a network in East Africa includes food security specialists as well as climatologists. Agricultural networks are fairly well developed in many regions and disaster management networks are increasingly being linked in. In all cases, from the perspective of users the climate event is not the issue; the issue is the climate impact. The long-term socio-economic benefits of these growing networks will depend on a better understanding of climate impacts and on the involvement of both public and private sectors.

Intermediaries

Intermediaries are important in climate information networks because they understand both social systems and climate science. They link information providers with users and help to tailor general information for particular uses. Climate services in many regions have been working with civil society and disaster management organizations, agricultural ministries, private agricultural organizations and water resource managers to identify intermediaries and forge working relationships. In some regions intermediaries have been identified by mass mailings, in others by classifying users and determining key players in each area, and finally by making individual contacts and developing partnerships. Mechanisms for interaction between the climate and intermediary/user communities include monthly representation at sub-regional user meetings and participatory user workshops. Some sectors are paying for workshops and information which defrays costs. Communication requires learning from all participants, and should be seen as a long-term building process.

The media are important intermediaries. Misleading information disseminated by the media, however, can lead to unwanted consequences, often due to poor communication between the climate community and journalists. Such consequences can be ameliorated by developing relationships with individual journalists to improve their understanding, holding media training workshops and getting journalistic input on writing media releases. Greater emphasis should be placed on potential climate anomalies and their impacts and less emphasis on ENSO, which can be a distraction from more pressing considerations.

Virtual Conferencing

Virtual conferencing technology might become part of an overall strategy help to strengthen communication networks in a cost effective way and its use is being explored in some regions, notably Central America. Effective use of virtual conferencing, however, requires strategic identification of its role within a larger package of information dissemination and communication activities. The most powerful elements of society have better access to information, while those with little power often have little access. Thus, groups who are most vulnerable and in greatest need of information are not always those who have access to it. Virtual conferencing does little to balance such inequities, unless it is used to inform more powerful governmental and NGO decision-makers, who can forward information on to larger audiences. Virtual technology can potentially be used to reach high-level decision-makers who are more likely to have time constraints which might prevent them from attending briefings. Intermediaries who can reach specific constituencies should be selected for attendance at virtual conferences when possible. Used in this way, virtual conferencing technology can extend the reach and scope of a climate network beyond what is possible through the use of exclusive and expensive face-to-face international meetings. It may also help reduce the costs of providing and using climate information, a contribution to sustainability.

Part II: Decision-making Under Uncertainty and Contingency Planning

Uncertain information on climate conditions and potential impacts can be assimilated through scenario building and contingency planning. These methods are beginning to be employed by intermediaries and user networks and can help to strike a balance in message formulation between uncertainty and useful information. Such methods also guard against using any single past event deterministically as a template for the future.

There is a need to identify win-win response strategies, and convey to users an accurate sense of the reliability of the forecast information. One way to do this involves constructing a range of projections and possible consequences and outcomes. This would include a range of climate scenarios, ranges of associated impacts, and collaborative identification of the decisions that will be "win-win" or "least regrets", and that make the system more resilient over the long term.

Antecedent climatic and socio-economic conditions can play a critical role in informing decision-making, particularly in the case of systems that are already stressed. Thus, there is significant value in evaluating the current conditions with decision-makers and discussing with them the potential impacts of probable future climate conditions. This places more emphasis on the development of response strategies rather than the climate forecasts themselves. Decisions will depend as much on the decision-maker's knowledge of the context in which the decision will be made as on the content of the forecast. Scenarios of potential impacts in specific sectors are one tool for translating potential climate shocks into potential impacts as a means for exploring response options.

Regional Planning Reports

The following section provides context, a vision and elements of as action plan for each region. These were developed based on regional status reports (next section, below), discussion of key planning topics and a review of the global climate situation.

South America

While scientific and technical capacity is relatively strong in South America, the national meteorological services vary considerably in both research and operational capacity. In some countries, climate related research activities are primarily undertaken at universities. Thus, the dissemination channels for climate information and feedback on it may be less clearly defined than in regions where regional climate centers exist and where national meteorological centers are strongly tied in. Few in the South American climate community have background or skills in communications, which is needed to improve network building in the region.

There is a need to motivate and guarantee more participation of Universities and Research Centers in COF meetings (participation has dropped in the last two years basically for lack of coordination and resources). In addition, there is a need to evaluate the potential impact in decision-making of the availability of climate forecast information over the past several years. Case studies can help to identify changes in decision-making, evaluate the outcome and detect possible benefits.

Short-term priorities in the region include formulating and communicating the appropriate message about climate conditions and impacts, reducing the dramatization of El Niño, and capitalizing on the current interest in El Niño to educate and inform. Developing an appropriate message involves a number of elements. First, El Niño is not the only source of climate variability for South America; it must be made clear that the Atlantic Ocean plays a significant role in determining seasonal climate variations in many parts of the region. Second, the uncertainties with respect to ENSO teleconnections and impacts must be clarified so that users understand that each event is different. Further, the message should include that seasonal forecasts should be used regularly – not only during an El Niño event. The current attention on El Niño is an opportunity to improve awareness of climate related issues and to promote resilient systems (urban, agricultural, etc). The highest priority activities should be those that increase resilience in these systems to climate shocks. The utilization of climate forecasts in management decisions involving significant risk will be more effective within the context of more resilient systems.

Long-term priorities are (1) improved exchange of information (both meteorological and sector specific) between countries in the region and (2) activities designed to improve the communication of seasonal forecast information to users at all levels.

IRI's participation is needed in the short-term (1) to assist regions in documenting past experiences and undertaking case studies, and (2) to play a more active role in the regional climate outlook forum process. IRI assistance is needed in the long-term (1) to establish downscaling projects, which are needed for sector specific forecasts, and (2) to improve monitoring of both climate and impacts, to provide a more complete context for decision-making. Finally IRI experience is needed for training in seasonal forecast generation at the local/regional level.

Africa

Although capacity in the user, intermediary and climate communities has been steadily increasing, there is a need for more capacity at major African climate centers which serve the national meteorological services and user groups. There is also a need for better understanding of drivers of regional climate variability (not only ENSO) and impacts in parts of Africa where few studies have been done.

In the short-term, clarifying the message on El Niño will involve the distribution of climate information via websites, dissemination of outlook bulletins, and conducting workshops for media, disaster preparedness and livestock groups. The priority is to get seasonal forecast information to the national meteorological services, which add local contextual information and disseminate forecast information broadly. RANET, a radio internet communication link is being implemented in some rural and remote areas throughout Africa to complement existing radio and other mass media.

To meet demand for information generated by the current interest in ENSO, additional resources will be sought for workshops and training programs to involve users and policy-makers in integrating climate information into planning. User training will increase understanding about influences other than ENSO, e.g. the Indian and Atlantic Oceans that have important regional seasonal climate effects. Existing information, e.g., *Coping with the Climate: A Way Forward* (IRI, 2001) and *Lessons Learned from the 1997-98 El Niño: Once Burned Twice Shy*? (Glantz, 2000) will be widely distributed.

Longer-term strategies for improving communications networks include continued emphasis on traditional means of communication (e.g., churches, mosques, respected local authorities, successful farmers, etc.), updating forecasts throughout the season, and continuing the outlook forum process, which contributes to information exchange and learning.

Radio is a mechanism for dissemination of information about climate and possible impacts to the most remote areas, but has advantages and disadvantages as a communication medium. While radio has potential to reach remote areas, there are difficulties in developing a clear verbal message regarding the probabilistic nature of forecast information. Experience from Central America showed that knowledge of each region and use of geographic terms must be consistent and commonplace for messages to be understood.

South and Southeast Asia

Over the next five years greater attention is needed on climate variability, in order to anticipate impacts and to respond appropriately. This will require strengthening or establishing local institutions within affected countries to generate and apply climate forecast information. Regional and global preparation is less of a priority because impacts occur locally, although regional and global support for national and local efforts remains critical.

Elements of a regional action plan include:

- Strengthening national climate information providers and user networks
- Building capacity through training and workshops for translating global climate forecasts into local weather variables
- Undertaking pilot projects to demonstrate the feasibility of end-to-end processes at the local level, and
- Creating web-based climate information and application resources.

These activities will require expansion of the ongoing activities which include pilot projects in Vietnam, Indonesia and the Philippines, training workshops in 10 ASEAN countries collaboratively conducted by ADPC, ASMC and IRI, and ongoing Indian agrometeorology center activities.

The messages regarding the current El Niño will be targeted to the more sensitive areas first, with target zones identified according to ENSO sensitivity. The construction and emphasis of messages should be according to vulnerability to ENSO (which varies within a country). Any notion of generalized impacts of ENSO for an entire country or region should be dispelled.

Increased capacity is needed, particularly in downscaling forecasts at the national level, but also in developing intermediary institutions to translate and communicate locally useable information. It is important to advocate "no regrets" options. Existing regional networks should be utilized and enhanced to achieve continuous monitoring. Forecast demand centers, e.g. agricultural input suppliers, community boards, etc. must be identified, keeping in mind that equity is maintained and that disadvantaged groups receive equal attention.

Asia-Pacific

In order to clarify the message on the developing El Niño, current operations at PEAC and NIWA will be expanded to generate an Island Climate Update, a Pacific ENSO Update and a monthly teleconference with additional responses to public inquiries. There is a critical need to improve the speed of information flow among the islands. Fax and e-mail will be utilized wherever possible, as mail services often take two weeks.

East-West Center workshops will be conducted to build capacity, raise awareness and advance planning efforts in the coming months. Climate information needs will be identified, with an emphasis on preparing for extreme events, and funding resources will be identified.

To improve preparedness in the long-term, current regional capacity of Pacific climate centers must be maintained and enhanced. It was requested that IRI sponsor and assist in training for the media. There is a need to further the ongoing work in climate applications, particularly with regard to disasters. Retention of national capacity is essential in the region, in order to locally produce and analyze climate information for users. There is potential to create a virtual climate center at the University of Hawaii.

Central America and Caribbean

Maintaining existing networks is the most important and most challenging task for long-term preparedness in the region. While climate information networks have been developing in Central America since Hurricane Mitch in 1998, the island nations in the Caribbean are in earlier stages of utilizing climate information proactively.

Local messages regarding ENSO should emphasize the potential climate anomalies that are expected to accompany the El Niño rather than characteristics of the event itself. It is important to tailor the message to suit the needs of the audience and it should include response strategies, which suggest the path of "least regret". In addition, messages should be timed appropriately for various sectors and applications. The situation should be continuously monitored and timely updates useful to users provided at intervals. Regional centers should update information from the IRI and pass it to intermediaries who can process it as needed and relay a complete package of information to sectoral users. Information flow should be encouraged through intermediaries who link between the climate community and user sectors and geographic areas. High-level contacts within political organizations should be informed because governments respond to hazards and can mobilize needed resources. Media briefings are also needed but must be done by someone competent in communication as well as versed in El Niño, its climate effects and their impacts.

To capitalize on the current interest in El Niño, national and regional planning based on seasonal forecasts should be promoted. Documenting and publicizing potential impacts of the coming event would raise the level of awareness of decision-makers and might improve regional cooperation. Funding sources will be identified for impact studies at regional and national levels. This opportunity will be used to sensitize decision-makers to the importance of slow onset events and their impacts (e.g. drought).

Better climate impacts analysis would help highlight the need for information and networks. Financial institutions must be engaged to support climate information systems in the region.

Regional Status Reports

ENSO Preparedness in Central America

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Central America is a 500,000 Km^2 strip of land with a population of 30 million, located in the middle of the Americas. Bounded by the Caribbean Sea at the East and the Pacific Ocean at the West, the region enjoys a diversity of physical and biological, as well as social systems.

The seven countries sharing the isthmus represent a range of different sizes, populations and socio-economic conditions.

ENSO's Effects in Central America's Climate

Central America's climate is defined by its latitude position in the fringe of the Intertropical Convergence Zone (ITCZ), and within the Trade Winds belt, and its complex orography. A mountainous range, running Northwest-Southeast, with elevations over 4000m in some parts, it is divided into two watersheds, the Pacific and the Caribbean. The interaction between the Trade Winds and this mountain range defines two different rainfall regimes. In the Pacific watershed, the rainy season spans from May to November, with a relative minimum in July and August and a maximum in September to October; the dry season extends from December to April. On the Caribbean side there is not a defined dry season and only two relative rainfall minimums in March and October.

The ENSO effect in Central America is mainly irregular distribution of the rain during one or two rainy seasons. Irregularity is shown in space and time. Usually during summer months, particularly in July and August, there is a deficit of rain in the Pacific Watershed and excess in the Caribbean.

In the Pacific Basin, the number of rainy days during the wet season is less than normal. The decrease in the number of tropical disturbances in the Caribbean during those periods diminishes the number of "temporales" induced by indirect effect of this phenomena.

On the Pacific side, particularly in the interior valleys and plateaus, and in the plains located leeside of the predominant easterly winds, rainfall reduction between May and October can range between 20% and 60% of the mean. Rain tends to occur more in isolated showers, shorter but more intense than in non-ENSO years and the rainy season tends to be shorter.

Excessive rain on the Caribbean side could reach 100% of the mean in July and August but in win-

COUNTRY	AREA (km^2)	Population (millions)	Literacy Rate (%)	Life Expectancy (Years)	Income per Capita (US$)
Belize	22,965	.211	93	68	2,450
Costa Rica	51,100	3.011	93	76	2,150
El Salvador	20,749	5.384	78	68	1,320
Guatemala	108,889	10.322	60	65	1,100
Honduras	112,088	5.770	73	68	600
Nicaragua	130,700	4.401	74	66	340
Panama	75,517	2.563	88	73	2,600

Table 1. Central America Basic Figures.

ter months (December, January and February), during ENSO mature phase, rainfall also tends to decrease.

In the Pacific side, temperatures 1° to 1.5° C higher than normal are observed in the drier areas.

ENSO Impacts in Central America

In the Pacific watershed, summer and the shorter wet season reduces planting season. Annual crops, mainly rice, maize and beans, cannot develop properly. Little re-growth of pastures reduces cattle productivity and increases calves' mortality. Rainfall deficits reduce water availability for domestic supply, electricity generation, irrigation and aquaculture. Longer and drier dry seasons increase the risk of forest fires; extended fires during ENSO years have severe impacts on wild life and forest resources. Migration and mortality of marine species due to warmer sea temperatures in the marine areas in the Pacific coast, significantly reduce captures, causing severe losses to fishery industry.

In the Caribbean Basin, excessive rain observed in July and August in most of the coastal areas causes damage in road infrastructure, reduction in banana exportation due to bad weather and increases the risk of outbreaks of vector-borne diseases as dengue and malaria.

Climate variability is a menace to Central America. In the last 50 years, nine ENSO events, spanning between 12 and 36 months have caused Central America severe losses (1993-94 as an example causes losses of US$160 million in grain production alone). The last event in 1997-98 greatly impacted the region, in different magnitudes in the different countries, however. In spite of information available in international, and in some cases, national sources, Central American society was unable to adopt early measures to cope with its possible impacts due to insufficient understanding about the event or measures to be taken.

In Hurricane Mitch, 1998, extreme rains affected 3.5 million of Central Americans (10.9% of total population) and caused losses in the order of 6 billion US$.

Two years later, in 2001, Central America again experienced rainfall deficits that triggered drought conditions in a significant part of the area. Population affected by this climate anomaly is estimated at 23.6 million, equivalent to 70% of the drought prone area population. 60,000 were directly affected in the agriculture sector. Besides that, water rationing indirectly affected many people; in Honduras alone it is estimated at 1.8 million people (ECLAC, 2002). Twenty-three million experienced electricity cuts or paid higher prices as a consequence of the reduction of hydroelectricity generation due to reduced dam water levels.

2001 drought impacts were exacerbated by the crisis in coffee production due to international product price reductions. Lack of employment in coffee plantations made more people dependent on seasonal grain production that failed afterward because of drought. 2001 left the region with increased vulnerability that is likely to exacerbate impacts in the case of ENSO 2002 developing.

2002 ENSO Awareness

Due to previous bad experiences in 1972-73, 1976-77, 1982-83, or 1986-87, 1991-1993, and 1997-98, awareness of ENSO induced climate anomalies and its economic impact is high among authorities, media and the general public. Recognition that, with timely and appropriate climate information, many of these activities may be subject to changes or adaptation for risk reduction is higher due particularly to the differences in damages experienced by the different countries in the traumatic events of 1997-1998, and the result of some regional cooperation projects developed after Mitch, which included awareness about the value of climate information and the adoption of prevention measures in their objectives.

1998 Hurricane Mitch

- **3.5 millions affected (53% Children less than 5 yrs)**
- **US$ 6,018 M. damages**

Damages equivalent to:

13% of NGP
41% of Region's Exports
34% of Region's external debt
66 % of Region's gross investment

2001 rainfall reduction

Anomalies between 20% and 60 % of the mean

Damages

Major part of grain crops lost.

1.4 million without enough food supply

Water availability for the following dry season compromised

Figure 1. 1998 Hurricane Mitch and 2001 Drought Impacts.

Region's Capacities for ENSO Preparedness

With US NOAA support, Regional COFs started to be organized in 1998. In the last two years under the auspices of the Regional Committee for Hydraulic Resources, an agency of the Central American Integration System responsible for climate and water, seasonal COFs were being held regularly and climate perspectives were being disseminated using electronic media to an ample group of decision-makers in emergency management, agriculture, water, health, environment, transportation, tourism trade and policy making.

All countries in the Region have analyzed ENSO's climate anomalies and impacts under the auspices of the IDB/Japan project "Improving Regional Capacity for Climate Variability Impacts in Central America" (TC 97-09-46-3 IDB-CRRH-CEPREDENAC). All have also prepared proposals for Early Alert Systems, that contain actions to be taken following an ENSO alert. These plans will be the platform for actions to be undertaken after the announcement of a probable evolution of an ENSO event in 2002.

On April 24th, the Regional Climate Outlook for May-July 2002 (first part of the rainy season), was issued by the I Regional 2002 Climate Forum, and presented to a group of 120 decision-makers from different economic sectors. The report signaled the areas likely to experience less rain than normal in the period.

Actions immediately taken included:

- Agencies under the Central American Integration System (SICA) in water, agriculture, health, disaster prevention, and food security, immediately initiate coordination for the integration of resources, technical capacities and collaborative programs regionally and sectorally
- Dissemination of the Outlook to a group of stakeholders in each country
- Regional Agencies (Agriculture, Health, Contingencies Prevention and Preparedness, Disasters Management) having coordination meetings for planning ENSO Mitigation and Preparedness Plans
- A workshop to discuss action for food security under a drought scenario for 2002
- In some countries, immediate review of agriculture and hydroelectricity generation annual plans
- At national levels some countries' scenarios of rain deficits for weak, moderate or strong El Niño, prepared by climatologists, are being used to support decisions for the 2002 agricultural campaign.

References

Comision Economica para America Latina (CEPAL/ECLAC). Evaluacion del Impacto de la Sequia 2001 en Centroamerica. Febrero 2002.

Ramírez P y Brenes, A. La Sequia 2001. Informe Especial, CRRH/SICA. Diciembre 2001.

Roman Ana V. Alimentacion y Nutricion en Centroamerica en Condiciones de Sequia. Informe del Instituto de Nutricion de Centroamerica y Panama (INCAP). Febrero 2002.

BID-CEPREDENAC-CRRH. Proyecto para el mejoramiento de la Capacidad técnica para Mitigar los Efectos de la Variabilidad Climática (El Niño). Informe de los estudios por país. 2002.

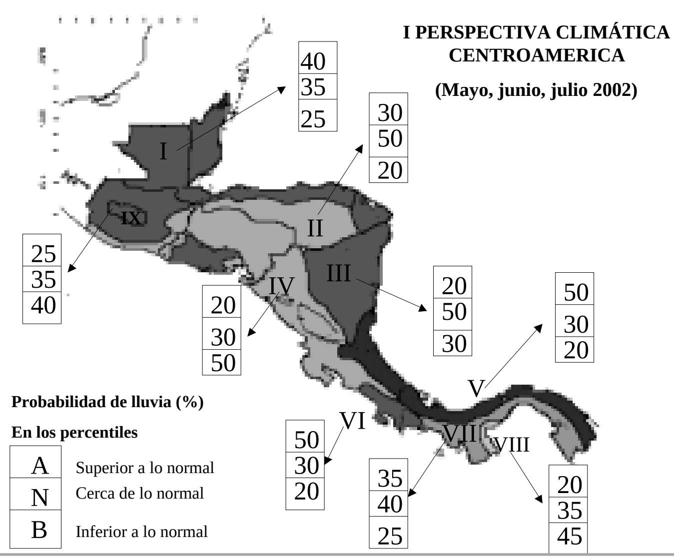

Figure 2. Central America Forecast MJJ 2002.

Overview of the Status and Prospects of Regional Preparedness for an El Niño Event in the Caribbean

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In preparing this overview, the authors have chosen to address directly the four topics suggested by IRI. There are several reasons for this, including economy of time.

1. What happened last time?

Were climate anomalies observed over the region during the recent El Niño and La Niña events (1997-2001) anticipated?

To an extent, in the El Niño year of 1997, the climate anomalies over the region were anticipated. Jamaica's climatology can be divided into a dry season (December to March), an early wet season (April to July), an intervening dry spell (July and August) and the late wet season (September to November). Drier than normal conditions were expected in the period July to December based on previous research (Hastenrath 1976,1978), (Ropelewski and Halpert 1986, 1987, 1989, 1996). Subsequent research supports this and shows that, in addition, the dry season is also affected by El Niño (Stephenson and Chen 2002, Spence and Taylor 2002).

Figure 1 shows the areas (negative values) where drier than normal conditions are expected in November-December-January based on single value decomposition analysis of precipitation and sea surface temperature data. The drier conditions would occur in Northern Venezuela and Columbia.

Figure 2 shows the areas (positive values) where drier than normal conditions are expected in August, September and October based on single value decomposition analysis of precipitation and sea surface temperature data. The drier conditions would occur in Northern Columbia/Venezuela and in Puerto Rico and the Lesser Antilles.

In the dry period of 1996/97, Jamaica experi-

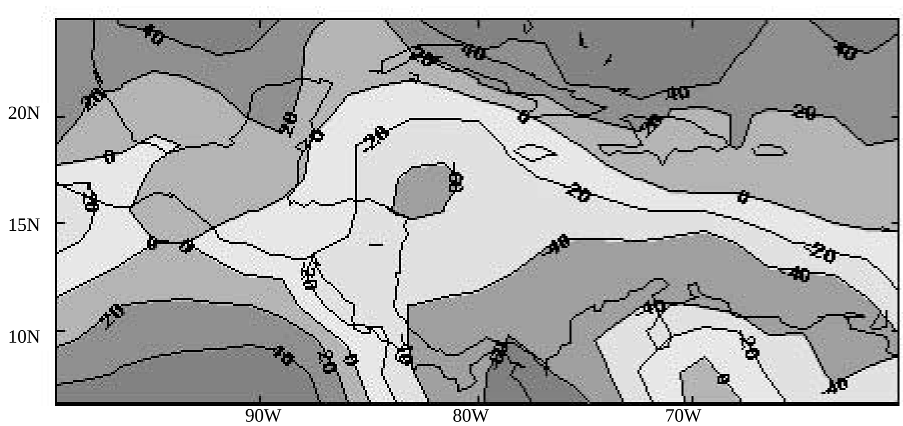

Figure 1. Single value decomposition analysis of precipitation and sea surface temperature data (NDJ).

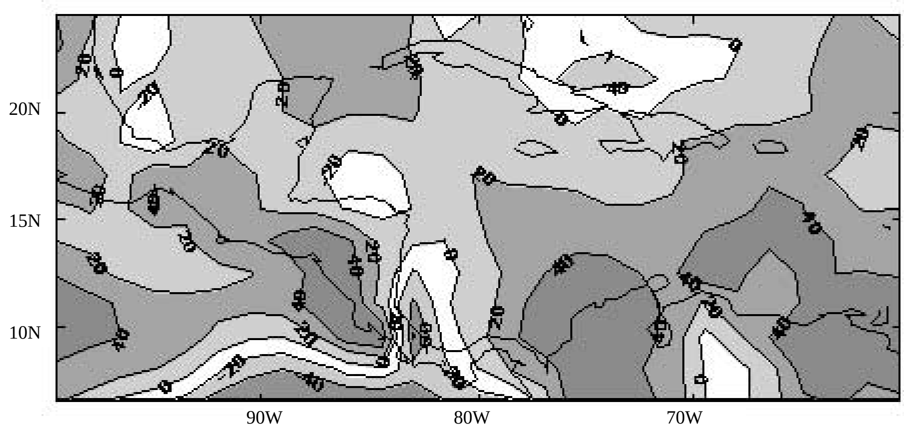

Figure 2. Single value decomposition analysis of precipitation and sea surface temperature data (ASO).

enced extreme and severe droughts in six of 14 parishes of Jamaica from December 1996 to January 1997, with five other parishes also experiencing drought conditions. In April to May, eight parishes experienced severe or extreme droughts. Drought was experienced in many parishes throughout the year (Table 1).

Climate anomalies were anticipated in the La Niña year of 2001. Chen and Taylor (2002) demonstrated that if the Caribbean sea-surface temperatures (SSTs) were in phase with those of the Pacific, as in 2001, then drier than normal conditions were expected in the early rainfall season (AMJJ). Figure 3 show the areas (darker) most expected to be dry based on Empirical Orthogonal Function (EOF) analysis.

Thus precipitation in the Caribbean basin between 10° and 20°N was expected to be below normal. Figure 4 shows the areas of Jamaica that were affected. All the light areas experienced rainfall of less than 60% of normal.

What were the impacts of recent and/or El Niño related climate variability on socio-economic sectors?

Because of the limited time given to prepare this presentation details are provided only for Jamaica. The data presented here is taken from Drought Review 1997, prepared by the Mitigation Planning and Research Division, Office of Disaster Preparedness and Emergency Management (ODPEM).

Agriculture

The agricultural sector was the first to be affected because of its heavy dependence on soil stored water. Some of the effects of the drought on agriculture were extended to 1998 so that loss of production in some sectors in 1998 was greater than in 1997. For example, the volume of sugar cane milled from October to December 1998 was 37,998 tons compared with 81,341 tons in the corresponding period of 1997. Also, banana export volumes were 25.9% below the corresponding quarter of 1997.

Overall the PIOJ's (Planning Institute of Jamaica) agricultural index showed a decline in produc-

	Dec-Jan	Jan-Feb	Feb-Mar	Mar-Apr	Apr-May	May-Jun	Jun-Jul	Jul-Aug	Aug-Sep	Sep-Oct	Oct-Nov	Nov-Dec	Dec-Jan
Han													
Wes													
St.E													
Man													
Cla													
St.C													
Tre													
St.J													
St.A													
St.M													
Por													
St.T													
KSA													

Table 1. Droughts experienced by Jamaica parishes from December 1996-January 1997 through December 1997 - January 1998.

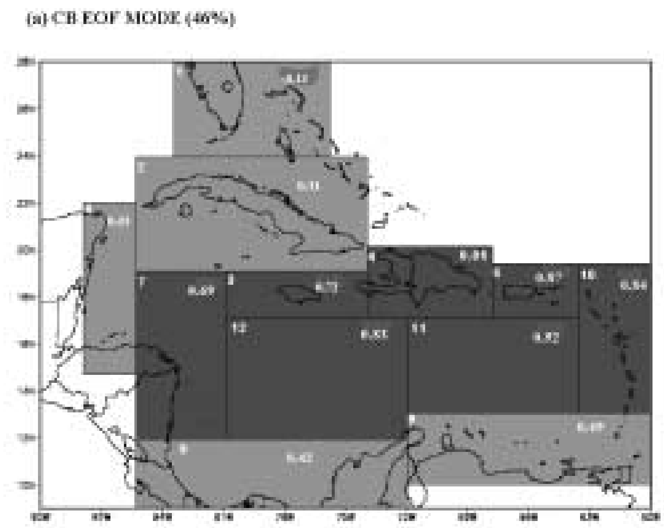

Figure 3. Areas (darker) most expected to be dry based on EOF analysis.

tion of 16.6% in 1997 and a 1.1% decline in 1998. The direct financial losses island wide for 1997/98 stood at J$331,686,580 (US$ =J$47 approx.). These losses were due to:

- Damage to crop quality
- Income loss for farmers due to reduced crop yield
- Plant disease
- Increased cost of irrigation.

In the livestock sector losses were due to reduced milk production, the high cost of feed and water for livestock.

Water supply

Due to low levels of water in reservoirs, water-lock-offs were instituted. In other cases water sources such as rivers or wells were completely dried up. It was necessary to supply water by trucking. The cost of this exercise was J$20,336,635.

Environment

While losses likely included damages to plant and animal species, wildlife habitat, air and water quality, and damages due to forest and range fires, the only quantifiable is an estimation of the number of forest fires increasing by 71% for the drought period.

Health

The Ministry of Health indicated that the lack of

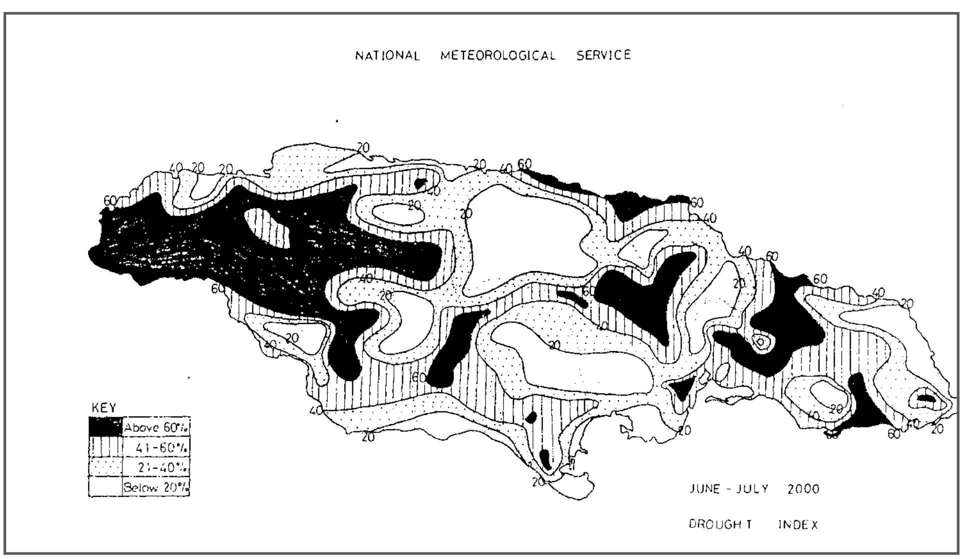

Figure 4. Areas of Jamaica that were affected by below normal precipitation.

water created problems in the proper disposal of sewage and in personal hygiene standards. There was the possibility of increase in diarrhea diseases and typhoid especially in endemic areas in Western Jamaica, but this did not materialize. The Ministry initiated a Public Awareness and Education Program at an expense of $6,846,555.

Schools

Many schools were not equipped with storage water tanks or drums and were greatly affected by the drought. The effect on bathroom facilities was of concern and there is a possibility that some schools may have been closed because of lack of water.

If anomalous climate was accurately foretold during the 1997/98 El Niño event (and/or 1998-2000 La Niña), were impacts anticipated?

No accurate predictions for 1997/98 come to mind. The Climate Studies Group at the University of the West Indies accurately predicted the 2001 La Niña drought. The prediction was circulated. However, it did not appear to have been employed in any meaningful way, perhaps mainly because no impacts were included in the forecast. ODPEM's report on the impacts of this drought has not yet been completed.

Were mechanisms (networks of communication and action) in place to deal with anticipated impacts prior to 1997/98 El Niño?

Although no special mechanism to deal with El Niño impacts was in place, the National Disaster Management Agencies were in place since 1980.

What lessons were learned from previous El Niño event: public perception of actions taken; institutional perception of actions taken; specific actions that were or were not effective?

There was some media publicity about the 1997/98 El Niño, so there was a degree of awareness. However this publicity was probably of little use to the man on the street since no real effort was made to simplify the concept of El Niño and its effects on the Caribbean. A Caribbean Climate Outlook Forum was held in May of 1998 under the sponsorship of USAID, NOAA/OGP and WMO. The media publicity, which was to have been arranged by USAID, did not materialize.

2. Assessment of current climate situation and socio-economic status (e.g.vulnerabilities).

Have recent climate patterns increased vulnerability (e.g., recent drought may have left resources depleted)?

Most disasters increase Jamaica's vulnerability since recovery is slow due to the poor state of the economy. For example, providing trucked water always puts a strain on the parish and national budgets by diverting resources from other areas. Environmentally speaking, bush fires that denuded hillsides, eventually led to erosion and slope instability.

There would also have had been some effects on agriculture since there was loss of cattle and crops. Subsistence farmers would find the situation extremely difficult to recover. Earlier this year some parishes experienced drought (non-El Niño?), and so they will be hard pressed if the drought is further aggravated by El Niño.

What other factors such as political instability have influenced the current socio-economic status of the region, particularly for sectors perceived as vulnerable to impending climate variability?

Factors affecting current socio-economic situation were:

- Riots in Western Kingston in July 2001 arising from alleged police brutality and political allegiance
- September 11th attack on the World Trade Center, leading to less tourist arrivals
- Floods in the parish of Portland in November 2001 in the wake of Hurricane Mitch.

As a result, the Government of Jamaica had to seek a loan from World Bank to support the economy, including Tourism and Agriculture.

3. Evaluate institutional readiness and capacity to cope with El Niño-related extreme events and uncertainties this year and next.

After the last El Niño, training in bush fire management was carried out in association with the National Resources Conservation Authority with funding from USAID. Firemen and Jamaica Defense Force soldiers as well as some community groups were trained. This has increased response capability in fighting bush fires.

The effects of the El Niño event of 1997/98 proved so devastating to the island that the Government of Jamaica, through the OPDEM, formulated a drought plan and activated a drought response team. The drought plan addresses domestic, agricultural and industrial water needs throughout Jamaica, utilizing the multiple agencies approach to drought management. The plan calls for the activation of the response team during the period identified as a meteorological drought by the Meteorological Office, and is divided into sections according to the disaster cycle under the headings of preparedness, mitigation, emergency response rehabilitation and development. For drought preparedness activities, the Climate Studies Group Mona, in the Physics Department at the University of the West Indies (Mona campus), was assigned the task of issuing advisories of impending drought to the OPDEM and the Meteorological Office of Jamaica (Met Office) when appropriate. The Met Office, which maintains the water and climatological station network in Jamaica and which monitors meteorological drought indices, was assigned the role of issuing warnings and alerts to OPDEM and other agencies, including the Ministry of Agriculture and the Rural Agricultural Development Agencies (RADA).

For the English speaking Caribbean, the Caribbean Disaster Emergency Response Agency (CDERA) located in Barbados does what OPDEM does for Jamaica. The Caribbean Institute of Meteorology and Hydrology (CIMH) also provides seasonal precipitation forecasts every 2 or 3 months. In Cuba, the Instituto de Meteorologia provides seasonal climate forecasts.

What mechanisms for coordination and information dissemination (such as the climate outlook fora) have developed since 1997 in response to anticipated impacts?

Three Climate Outlook Fora have been held in 1998, 1999 and 2000. At the last climate outlook forum, a steering committee was selected to plan for a climate prediction and application network. The steering committee's proposal is being submitted for funding, and a climate outlook forum may be organized for early next year.

Based on anticipated risks or potential impacts which institutions are likely to be key players in the response to ENSO?

Key Players (Ja):
Office for Disaster Preparedness and Emergency Management
National Meteorological Service
Water Resources Authority
National Water Commission
Parish Councils
Climate Studies Group Mona, University of the West Indies (UWI)
Ministry of Agriculture
Ministry of Health
Ministry of Education.

For the Caribbean:
CDERA, CIMH, Instituto de Meteorologia.

What communication pathways need to be in place?

In Jamaica, the OPDEM has already activated the National Drought Committee. This has largely been in response to the early season drought on 2002, already mentioned.

What are the main challenges to effective coordination of efforts in your region?

There are several challenges in terms of constraints. First is the financial constraint. There have been severe budget cuts, so that even rapid response truck units that would respond to drought will be hampered by lack of finances. Secondly, given the financial constraints, all planned activities must be as efficient as possible. This will call into question the accuracy of climate predictions and the impacts expected. UWI and National Meteorological Services (NMSs) need to be in close touch with institutions like the IRI.

4. Highlight areas for potential responses.

Given realistic time and resource constraints how might activities be prioritized?

Priorities, given constraints, are prevention mainly for fires, early warnings so that water conservation can be effective, public information and education. Preparations for possible trucking of water also need to be in place. We also need better capture of data, especially meteorological, so that the drought situation can be monitored and responses evaluated. Perhaps the best approach would be pooling expertise of UWI and NMS.

As previously mentioned the National Drought Committee has already been activated.

References

Hastenrath, S., 1976: Variations in the low-latitude circulation and extreme climatic events in the tropical Americas. J. Atmos. Sci., 33, 202-215.

-----, 1978: On modes of tropical circulation and climate anomalies. J. Atmos. Sci., 35, 2222-2231.

Office for Disaster Preparedness and Emergency Management, Drought Review 1997, Prepared by Mitigation Planning and Research Division, May 1999.

Ropelewski, C. F., and M.S. Halpert, 1986: North American precipitation and temperature patterns associated with the El Niño/Southern Oscillation. Mon. Wea.Rev., 114, 2352-2362.

-----, 1987: Global and regional scale precipitation patterns associated with the El Niño/Southern Oscillation. Mon. Wea. Rev. 115, 1606-1626.

-----, 1989: Precipitation patterns associated with the high index phase of the southern oscillation. J. Climate, 2, 268-284.

-----, 1996: Quantifying southern oscillation - precipitation relationships. J. Climate, 9,1043-1059.

Spence, J. and M. Taylor, Effect of Concurrent SST Anomalies on Caribbean Climate, Paper presented at 13th Symposium on Global Climate Change Studies, AMS, Orlando, Florida, January 2002.

Stephenson, T. and A. Chen, Analyzing and Understanding Climate Variability in the Caribbean Islands, Paper presented at 13th Symposium on Global Climate Change Studies, AMS, Orlando, Florida, January 2002.

Northern South American Region

Recent ENSO-related Impacts over Colombia

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The report is presented following the four main topics suggested by the IRI.

1. What happened last time?

The 1991-1992 ENSO had a significant socio-economic impact on the region. There were electricity blackouts for a year all over Colombia, and the agricultural sector suffered the consequences of a long and intense drought. After the 1991-1992 ENSO the region decided to take measures to anticipate and be prepared for future ENSO events. It is important to know than once an ENSO starts to occur in the Pacific Ocean the effects over the region are lagged three months on the average. The region then anticipated the occurrence of the 1997-1998 ENSO. The Colombian Institute of Hydrology, Meteorology and Environmental Studies (IDEAM), through the forecasts of international and American agencies anticipated the occurrence of the 1997-1998 ENSO. The region does not have the capacity to predict ENSO. ENSO forecasts in the region are done using the information of international agencies.

ENSO has a diverse impact over the region. In most of Colombian territory the conditions are of a severe drought. Ecuador will have above average precipitation and runoff, and the Orinoco and Amazon basin conditions will be about normal.

In Colombia, during the 1997-1998 ENSO, extreme drought conditions were present in about 10% of the municipalities, severe drought conditions in about 75% of the municipalities, mild drought conditions in 6% of the municipalities and normal or above normal conditions in 9% of the municipalities. The main impacts were:

- Reduction in agricultural production (down 5% in main products, down 12% in some important products such as rice, corn and others)
- Reduction in milk production (down 4%)
- Fishery reduction (down 50% in the Pacific Ocean and 9% in the Atlantic Ocean)
- Loss of crops
- Reductions in stream flows between 15 and 35% in most rivers and in some cases reductions of 80%
- Scarcity of water for human consumption
- Forest fires (12,000 forest fires were reported)
- Economic losses
- Unemployment in rural areas
- Increase of displaced population into the main cities
- Sea level and temperature increases in the Pacific Ocean
- River transportation reduced about 25%
- Increase in health problems (6% increase of malaria cases, increase in dengue and other endemic sicknesses).

The 1997-1998 ENSO was the strongest one in the last century. It produced the highest climatic anomalies in the region ever. Some sectors were well prepared for the occurrence of 1997-1998 ENSO. There were no electricity blackouts and the Colombian electric sector did not suffer any economic losses. Other sectors, such as agricultural and health, were not as well prepared and suffered important impacts as shown above, with economic losses for the country. Mechanisms to deal with the 1997-1998 ENSO were in place only in some sectors.

Aspect	ENSO impact
Water availability	⇩
Sea surface temperature	⇧
Sea level	⇧
Precipitation	⇩
River stream flows	⇩
Forest fires	⇧
Agricultural production	⇩
Water availability	⇩
Sea surface temperature	⇧
Sea level	⇧
Precipitation	⇩
River stream flows	⇩
Forest fires	⇧
Agricultural production	⇩

Table 1. ENSO Impacts.

The main lessons learned from the 1997-1998 ENSO occurrence were:

- Economic sectors that had mechanisms ready to cope with ENSO did all right.
- Agricultural and health sectors can be better prepared to cope with ENSO occurrence. Some mechanisms were designed.
- Mechanisms to deal with ENSO occurrence are of great variety, covering economic, social, educational, technical and research measures.
- Research to analyze ENSO possible impacts and the measures to deal with it is needed.
- There is a need to adequately inform the general public about the occurrence of ENSO and its possible consequences.

2. Current climate situation and socioeconomic status

Recent climatic patterns in the region have been about normal or even in some cases above normal. Water availability and storage are above expected levels. The Colombian electric sector regulator has already taken measures to guarantee appropriate reservoirs levels for the start of next summer season (June-July). Several government agencies are already informing and instructing the general public about the ENSO impacts and possible measures to mitigate those impacts.

The sociopolitical situation in Colombia (almost a civil war) increases the vulnerability of the country to ENSO occurrences, especially in the rural areas and the electric sector. Colombian guerrillas have intensified its actions in the last months, blowing up electricity transmission towers all over the country and blocking government aid to the agricultural sector.

3. Institutional readiness and capacity to cope with ENSO related extreme events and uncertainties this year and next

Several committees and institutions have been working on preparedness for the upcoming ENSO. The Ministry of Energy and Mines created an inter-institutional committee for the tracking of ENSO, to analyze possible impacts, and to recommend measures to deal with those impacts. The electric sector regulator has taken measures to deal with ENSO. The Ministry of Agriculture has already taken measures to deal with ENSO, and has a website with information about the expected impacts of ENSO over the agricultural sector, and the measures that can be implemented to mitigate those impacts. The Colombian Government is supporting research to evaluate ENSO impacts on socioeconomic aspects and the measures that can be implemented. Colombian Government, through the Agricultural Bank, is offering a special favorable loan for preparedness and alleviation of ENSO impacts.

The Ministry of Agriculture suggested that 16 million cows could be affected with the next ENSO. It suggested measures such as: create animal food deposits, reduce taxes and create a machinery Bank.

IDEAM offers periodic updates about the evolution of the ENSO in the Pacific Ocean, based on the reports of international climatic agencies. The academic sector (universities) is proposing to create a hydrologic and climatic prediction center that could be financed by the Colombian government. This center could have its own models and cooperation arrangements with several

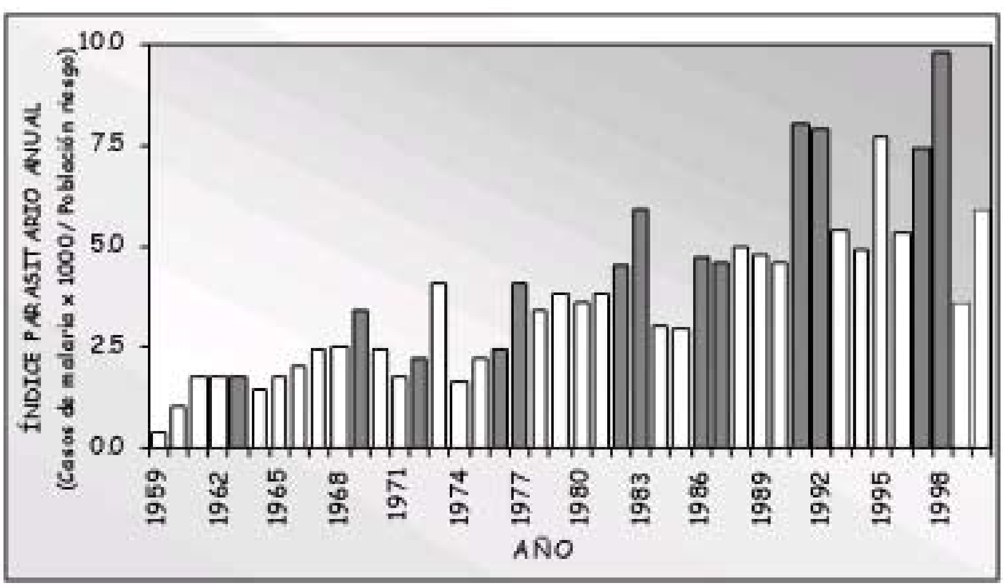

Figure 1. Cases of Malaria in Colombia.

international climatic agencies and other universities. The region does not have any ENSO predictability capacity.

About twice a week the main Colombian newspapers publish some information about the occurrence, impacts and measures related to the incoming ENSO. Some sectors have scheduled training courses on measures to cope with ENSO, specially the Ministry of Agriculture.

The region is much better prepared for the upcoming ENSO than it was for the 1997-1998 ENSO. Even so, resources in the country are not enough to cope with ENSO. There is some lack of coordination, the total money needed to adequately cope with ENSO is not available, and information about ENSO is not reaching all of the general public. The Colombian social situation, with almost a civil war in progress, makes the country more vulnerable to ENSO impacts.

The key players in the response to ENSO are:

- IDEAM
- Ministry of Agriculture
- Ministry of Energy and Mines
- Ministry of Health
- Ministry of Internal Affairs.

The communication between these institutions to coordinate response to ENSO impacts is through work committees and IDEAM. An intersectorial network for monitoring and evaluation of ENSO is being created.

Several subregions have been identified with high or moderate degrees of vulnerability to ENSO. The central and northern regions are affected by severe drought conditions. The southern and Pacific Ocean regions are exposed to an increase in precipitation and stream flows. The preparedness for ENSO is then different depending on the region being considered.

Several strategies are being developed to cope with the upcoming ENSO:

- Institutional

i. Create an intersectorial network for ENSO
ii. Permanently inform the general public about the occurrence, impacts and measures to cope with ENSO
iii. Implement recommendations to cope with ENSO
iv. Develop institutional and economic capability to support affected areas and sectors.

- Technical

i. Identify vulnerabilities
ii. Develop a system of ENSO impact indicators
iii. Propose a system of recommendations
iv. Monitoring and evaluation.

- Financial

i. Financial support for preparedness
ii. Implement a system of economical incentives
iii. Financial support to alleviate ENSO impacts.

4. Areas of potential response

The main actions to cope with ENSO are:

Before ENSO

- Identify vulnerable regions
- Identify and evaluate possible impacts
- Make recommendations on how to deal with impacts
- Inform the general public
- Identify and evaluate institutional capabilities
- Increase preparedness
- Create intersectorial network
- Training
- Develop an ENSO related information system
- Propose contingency measures
- Monitoring
- Coordination.

During ENSO

- Apply recommendations
- Monitoring and evaluation
- Support requirements of technical and economical needs
- Coordination.

After ENSO

- Evaluation of impacts
- Reports
- Monitoring
- Research
- Support requirements of economical needs.

The main areas are then:

- Public information
- Training on possible measures to cope with ENSO
- Inter-institutional coordination
- Evaluation of impacts
- Economic and financial support
- Monitoring
- Research.

Northern South American Region

Recent ENSO-related Impacts over Brazil

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1. What happened last time?

The 1997/98 ENSO:

The rainfall pattern observed over Brazil during the 1997/98 ENSO was correctly forecast and actions were taken in various sectors of society to cope with the increased rainfall forecast over southern Brazil and deficient rains over the Nordeste. The forecast was verified, and the actions taken represented savings of property and to the economy. Some examples of the use of the seasonal climate forecasts for supporting decision-making in the states of Rio Grande do Sul, Paraná, Santa Catarina and Ceará are described below.

In late 1997, in Rio Grande do Sul, rice farmers were advised that wetter than normal January/February 1998 was expected due to the, then current, ENSO. Based on that forecast, they postponed the planting of rice and cotton until late September, to avoid the deleterious effect of excess rainfall during the period of blossoming of those crops. Rio Grande do Sul produces over 90% of a type of rice very popular in Brazil (rice “agulhinha”).

In Santa Catarina, the State Bureau of Meteorology took a very pro-active approach when the prediction of the 1997/98 ENSO materialized. It:

- Elaborated flyers targeted to the population, elucidating the risks associated to the elevated rainfall totals forecast for the coming months due to ENSO.
- Worked side by side with Civil Defense in the Municipalities, increasing the number of Municipal Civil Defenses personnel from approximately 30 to over 200.
- The Civil Defenses then organized and promoted voluntary work groups in the communities to remove sediments from creeks and drainage channels in the cities. As a result, there was an estimated reduction of 30% of the number of cases of municipal flooding in the State during the wet period of the 1998 ENSO.
- Farmers also have taken precautionary actions to minimize the effects of wetter conditions. An evaluation of the impacts of such measures has not been done as yet.

More recently, Brazil has experienced a period of severe shortage of electric energy due to the depletion of water on the country’s largest hydroelectric power plants’ reservoirs. Over 90% of Brazil’s electric energy is generated by large hydroelectric power plants. Even though the rainfall distribution over the drainage basins of the major hydroelectric dams in Brazil was only approximately 20% below normal for the total rainfall observed during the last five years, the level of the reservoirs was being lowered year after year to generate the extra demand of electricity occurred during the period. With water levels near critical values in mid 2000, the reduction of seasonal rains, which climatologically is expected to occur by the end the year, resulted in the collapse of electricity production in some plants, while others had to operate with less turbines to save water. This situation culminated in a mandatory reduction of electric consumption by both residential and commercial consumers in the whole country during most of the year 2001.

At the same time, the Federal Government assembled an extraordinary ministry for dealing with the electricity crisis in the country. Among other measures, a task force was formed within CPTEC, with the attribution to monitor and predict the weather and climate on a daily basis, with special emphasis over the drainage basins of interest. Daily and weekly reports were sent to the ministry, keeping the Government informed about any changes in future availability of accumulated water in the hydroelectric reservoirs. When the rainy period over the SE began during September 2001, the restrictions of electricity consumption were gradually relaxed.

Concurrent with the Federal Government awareness of the need for accurate information on climate variability over the country as an element of economic stability, a new upgrade of CPTEC’s supercomputing system was approved; the value of such was approximately US$25 million. The previous upgrade of CPTEC’s supercomputing system occurred during the 1997/98 ENSO event.

2. Assess current climate situation and socio-economic status (e.g. vulnerabilities).

Although 1998 was the last severe drought that occurred over the Nordeste region (there are indications that 2002 will be characterized by below average rainfall over northern Nordeste and the region's rainy season is still underway), the 1999-2000 La Niña conditions have not brought generalized above-average rainfall over the region. In fact, due to the below-average rainfall totals observed so far over most of the northern part of Nordeste during 2002, the region became more vulnerable, from the economic and social perspective, to the occurrence of a possible dry season during February-May 2003.

A drought during 2002/03 over Nordeste also has the potential to affect politics in the region and in the country, as state and presidential elections will take place during the second semester of 2002 in Brazil. Under the effect of below average rainfall this year (2002) and an announced ENSO in 2003, which in people's mind is generally linked to droughts over the Nordeste, it is not unlikely that a state of "emergency" in which the Nordeste enters during periods of severe droughts contributes to shaping the final outcome of the national elections. The recent economic stability prevailing in the country is still fragile, and if a populist candidate is eventually elected, due in part to the effects of the current and "announced" drought over the region, this could have a deleterious effect on the Nordeste region's and Brazil's economy, with possible effects in neighboring countries during the coming years.

3. Evaluate institutional readiness and capacity to cope with El Niño-related extreme events and uncertainties this year and next.

The last electrical energy crisis in Brazil has served the purpose to demonstrate that during times of hardship, government bodies and large fractions of the population can work together in Brazil with the common objective to overcome the difficult times. This has been demonstrated to be the case in other parts of the world as well. Along with other long-term initiatives taken by the Federal and State Governments in Brazil, the strategy assembled to monitor and predict rainfall variability during the 2000/01 electricity crisis is an excellent framework to couple, from the atmospheric point of view, with an occurrence of ENSO during this year and the next. The Ministry of Science and Technology of Brazil has developed a program with most of Brazilian states towards monitoring and predicting weather, climate, and water resources in the states. In addition to promoting the use of state of the art methodology and equipment by the participating states, this program, whose acronym is PMTCRH, is promoting monthly workshops to discuss the prevailing and future climate conditions over the country. One such discussion occurs at CPTEC in Cachoeira Paulista, SP, and one meeting occurs in one of the participating states every month. These mini-workshops have demonstrated to be an excellent form of dissemination of climate information to different classes of

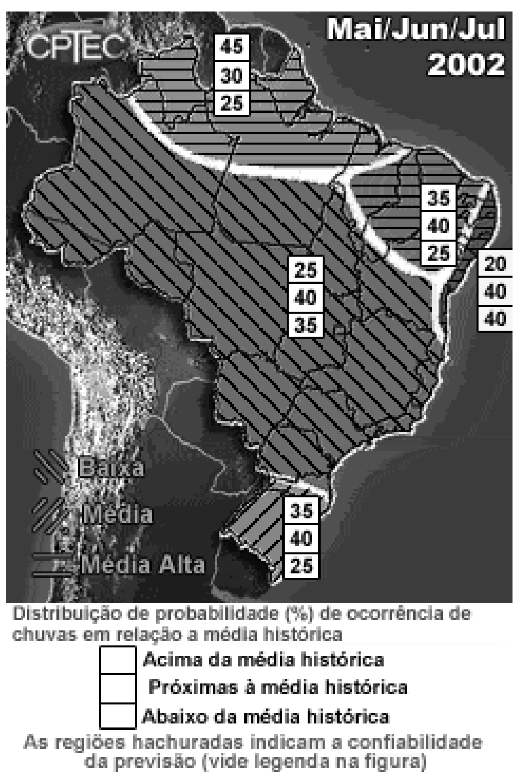

Figure 1. CPTEC'S Seasonal Climate Forecast Map.

users. This is so not only because they occur in the region where the users live and work, but also fundamentally because of the existence of an "interpreter" of the climate forecast information to the local user. The mini-workshops in the states also have served as an opportunity for continued training of meteorologists of the state bureaus on the meanings and limitations of the climate forecasts generated at CPTEC and other centers in the world.

Another example is that followed by FUNCEME, in Ceará State, which has both invested in developing dynamical downscaling of seasonal climate forecasts over Nordeste, and has promoted workshops with agricultural extensionists from the State Secretary of Agriculture and cooperatives to explain the meaning of the information provided by FUNCEME. These technicians then became interpreters of the seasonal forecasts to small farmers in the countryside.

Based on the anticipated risks of the occurrence of an ENSO during this and the coming year, institutions that are likely to be key players in response to ENSO in Brazil are CPTEC, the state bureaus of Meteorology and Water Resources, in particular those of the states of Ceará and Pernambuco in the Nordeste, and Paraná and Santa Catatina in the South. The other states' bureaus are likely to participate in the process of information dissemination in their respective states. Other institutions that will participate are the Civil Defense, the Secretaries of Agriculture, and the recently created National Water Agency (ANA). One important aspect of ensuring that climate information can be used to support decision-making is trust. The clear understanding of the climate indicators used, their limitations, and degree of confidence, as well as their timelines, are crucial for trust building in the user's community. In this way, although most of the information presently generated in the world climate centers is freely available electronically via the web, accessibility to the products themselves, not to mention their actual practical use, is hindered by the lack of web access to a large fraction in the rural areas of Brazil, particularly in the Nordeste. Here, again, when approaching the question of communication, effectiveness can only be measured when the target population is defined and the needs evaluated.

Also, it is necessary that each meteorological center in the states have full and unlimited access to all the climate information made available in Brazil and in the world. This means providing hardware, software and people necessary to retrieve, process, and understand the diverse products available from different sources. It is necessary that innovative ways be brought to the table to ensure that the information will be available at the meteorologist, hydrologist, economist, agriculturist, civil defense, the Governor, Mayor, and Secretary, and the user's desks when they need it.

4. Highlight areas for potential responses.

Given realistic time and resource constraints, activities should be prioritized to make climate information pertinent to the locality/activity available to the user. This can be reached through:

- Cooperation among international centers to share their products, methods, and resources toward the common goal of producing state-of-the-art predictions over selected regions (those where present day models have demonstrated prediction skill)
- Partnership with regional centers that could increase the degree of detail of the global forecasts over their regions through dynamical or other method of downscaling
- Promotion of monthly meetings in the region, which in Nordeste today would require traveling to the meeting place, since videoconferencing capabilities are still not available there
- Conception of a detailed package of climate information, with a few but well understood parameters and their graphical display utilized to monitor and forecast the climate state over the regions of choice.

Andean South American Region

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Excluding Southern South America countries, Andean South America includes Bolivia, Perú, Ecuador, Colombia and Venezuela, though the Venezuelan andean sector is restricted to less than 10% of its territory.

The region is highly heterogeneous in terms of climate, ecosystems, human population distribution, cultural traditions and economic activities. This complexity makes the task of assessing the impacts of El Niño / La Niña upon the differing regions and socio-economic sectors difficult.

Two contrasting case studies are considered in this report: Perú, where El Niño can be taken as one of the most important components of its climate. Perú is situated in the western central part of South America, between 0º 01' and 18º 21' South and between 69º and 81º W, with a coastline extending 3,080 Km along the Pacific Ocean. El Niño impacts are not so severe in Venezuela, but the availability of water resources for hydro-electricity generation, irrigation and supply to the population are affected. Venezuela is situated between 0º and 12º North and between 60º and 73º W, with a coastline of 2,720 Km along the Caribbean Sea and the Atlantic Ocean.

1. What happened during the recent El Niño / La Niña (1997-2001) events?

Were climate anomalies observed over the region anticipated?

In the case of Perú, the climate anomalies observed during the period were partly anticipated. Teleconnections associated with ENSO were very much correlated with the climatology. Heavy downpours over the northern coast had the magnitude related with a very strong event, although the southern andean drought was not as bad as anticipated given the previous very strong events. During La Niña years (La Niña impacts are not very well understood in Peru), above average rainfall was once again registered in the northern coast, a feature noted previously only in 1989 S.H. summer. Some northern coast rivers had flows even greater than previous very strong ENSO events. Since 1998 every rain season in the northern Peruvian coast has been abundant. Short-lived droughts also were experienced in the Andean region during 1999-2002.

It is important to notice that SST Warming related rainfall in northern Peru seems to be shifting to the highest areas in the coast from lower ones. Ratios relating rainfall amount vs. altitude in the coast are showing clearly that rainfall tends to be heavier in the hills and weaker along the seashores. As a result of that, the Piura river has registered flows above 1,000 M^3/Sec in the last 5 consecutive years, a feature that has not been registered since 1925 when systematic data collection was first introduced by local authorities.

The 1997 rainy season, in most of Venezuela, showed a relative delay as compared with average years. Generally El Niño effects in Venezuela coincide with the dry season (November-April). As a result of this, an intensification of the dry conditions occurred, accompanied with higher temperatures, increase in evaporation rates and delay in the start of the rainy season. For January 1998, the rainfall deficits ranged from 10 to 120% (CAF, 2000). Maximum and minimum temperature increases between less than 1º and 4ºC (Urbina, 1998) were also recorded.

Streamflow behavior of the Orinoco and Caroní rivers was normal through the first half of 1997. Later there was an important decrease in the river discharges that lasted until January 1998, when both rivers reached near historically low records. The impacts of the 1997-98 El Niño event were somehow anticipated by EDELCA for the Caroni basin, since 72% of the electricity used in Venezuela is generated there.

What were the impacts of recent El Niño climate variability on socio-economic sectors?

The impacts of the 1997-98 El Niño related climate variability on socio-economic sectors in Perú were massive. The damages have been set at 3.5 billion US$ (46% direct cost, 31% production losses, 12% in extra-budgetary expenses and 11% in over-costs to local economy). More than 150 weather-related casualties were reported. The recent rainy season in the northern coast (2002) also produced damage to fishing and agriculture, although official numbers have not been disclosed. It is anticipated to be more than 100 million dollars.

In Venezuela the impacts were much less and mainly affected the power generation sector (hydro-electricity). Damages were estimated at 20 million US$ for 1998. Other sectors affected include fluvial transportation, agriculture, water supply for the population, and health. The Vargas disaster (exceptional rains that occurred in the northern-central coastline region in December 1999) caused more than 12,000 deaths and an estimate of 10,000 US$ in physical damages. This type of event seems to be associated with the occurrence of La Niña, but with a particular combination of SST patterns in the Pacific and Atlantic oceans and atmospheric circulation features over the Caribbean and Northern South America (Pulwarty and Andressen, 2002).

If anomalous climate was accurately foretold during the 1997-98 El Niño event (and/or 1998-2000 La Niña), were impacts anticipated?

Anomalous 1997-1998 climatic conditions (El Niño) and 1998-2000 (La Niña) were accurately foretold and impacts were better anticipated for Perú than for Venezuela.

Were mechanisms (networks of communication and action) in place to deal with anticipated impacts prior to 1997-98 El Niño?

Mechanisms of communication and actions to deal with El Niño 1997-98 in Perú were created when ENSO forecasts were disclosed and these mechanisms were dismantled after the emergency. Very little was done on this respect in Venezuela. Occasional press releases and lectures by public institutions (meteorological services) and universities were provided.

What lessons were learned from previous El Niño event: public perception of actions taken; institutional perception of actions taken; specific actions that were or were not effective?

In the first place, ENSO conditions can be forecasted and its adverse impacts minimized. Now both decision-makers and the general population know that cyclic ENSO events are going to be experienced. Although some actions – especially the ones to protect infrastructure – may be futile, the business sector looks for ENSO forecasts to plan their future actions and government institutions have made some contingency plans because of the 1997-98 experience. An important aspect is that the public and the decision-makers in Perú are more aware of El Niño and its impacts than in Venezuela. After the Vargas disaster (December 1999) in Venezuela, for which the national meteorological services did not issue an early warning, information on ENSO has been included in the regular bulletins and web sites.

Cuadro III.2.1-2 Venezuela. Daños directos e indirectos por sectores de afectación, causados por El Niño 1997-98

Sector afectado	Monto del daño. Millones de dólares	Porcentaje del total
Sectores productivos	38,5	54%
Servicios	27,8	39%
Incendios forestales	2,6	4%
Transporte fluvial	2,3	3%

Fuente: estimaciones CAF con base en cifras suministradas por las instituciones públicas.

Figure 1. Sectoral effects of 1997-98 El Niño.

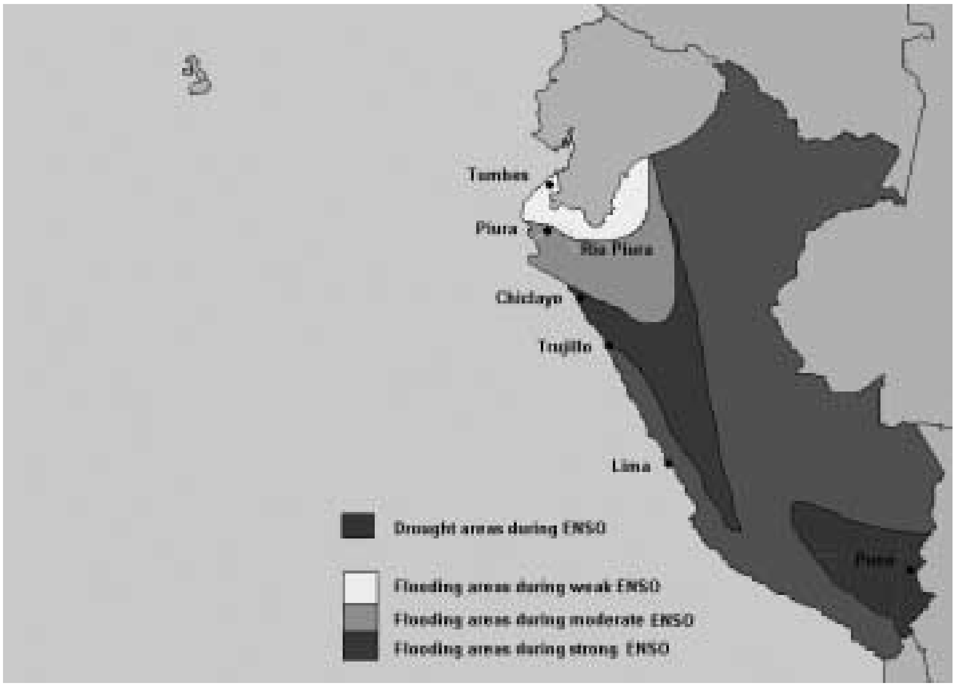

Figure 2. Areas affected by droughts and floods during ENSO.

2. Current climate situation and socio-economic status (vulnerabilities).

Have recent climate patterns increased vulnerability?

There are several cases in Perú where vulnerabilities have persisted since 1997-98. The fishery industry is still dealing with irregular catches since then. The sector, which is under heavy debt because it did not operate for almost a year during then, may have pressed the resources over its maximum sustainable yield (MSY). Catches have not met IMARPE´s estimates for the last several months. Tropical deceases enhanced during the last ENSO have produced persistent isolated focuses and health authorities still have problems dealing with them.

According to reports from the Ministry of the Environment (MARN, 2001, 2002), rainfall amounts and distribution for 2000 and 2001 have showed some differences from normal years. Particularly in 2001, general rainfall amounts were lower than long-term averages for most of Venezuela. Dry regions were seriously impacted, as well as the Guayana region, affecting therefore the hydro-electricity generation capacity. An increase in some tropical diseases has also been reported.

What other factors, such as political instability, have influenced the current socio-economic status of region?

This is a very important aspect for the region. In Perú, recent political unrest had produced three governments in two years. A significant number of local authorities familiar with ENSO conditions and its impact on local and regional communities, and moreover possessing the knowledge to deal with them, have been replaced by new bureaucrats politically related with the new government that lack the experience that 1997-98 gave. Drastic political changes have been undertaken In Venezuela, since 1998, which have produced serious social and economic unrest. Also, directors and heads of important institutions, such as the Ministry for the Environment, Civil Protection Agency and others have been replaced several times in three years, affecting the implementation of plans and actions.

3. Institutional readiness and capacity to cope with El Niño-related extreme events and uncertainties this year and next.

What mechanisms for coordination and information dissemination have developed since 1997 in response to anticipated impacts?

Based on anticipated risks or potential impacts which institutions are likely to be the key players in the response to ENSO?

What communication pathways need to be in place?

What are the main challenges to effective coordination of efforts in your region?

In Perú, Estudio Nacional del Fenómeno del Niño (ENFEN) was created. It gathers all scientific and civil defense authorities together with the purpose of making regular forecasts on ENSO conditions and addressing national authorities on potential impacts.

Unfortunately, the concept surrounding ENFEN is to produce a single forecast that everyone has to endorse. The current eastern tropical Pacific warming was underestimated by IMARPE, although SENAMHI´s opinion was much more in line with what happened. The IMARPE point of view was adopted and as a result of that the government did not take preemptive action when time was appropriate. The IMARPE has conspicuous fishery industry executives on its board of directors which presumably are much more concerned on their economic activity than other national issues. IMARPE´s president has been seriously criticized for its conservative forecast since rain damage proved to be much greater than expected. This attitude of IMARPE was also seen in the onset of the 1997-8 event, although ENFEN was not in place then, and independent opinions forced them to recognize the severity of the impending El Niño.

Now it is very well understood what to do and what not to do in terms of planning, both at private and public sectors if an ENSO event is forecasted. The challenge is to give every level of decision-makers the capacity to switch to an emergency environment to quickly put in place contingency measures that cannot be taken because of complex legislation and a centralist government. A project to elect local authorities late in 2002 as a strategic plan to decentralize government will provide a good opportunity to put that idea in place.

In Venezuela, the Warning Center for Floods and Droughts (Centro de Alerta de Inundaciones y Sequías) at the Ministry for the Environment is the institution responsible for procuring information on ENSO forecasts and issuing early warnings for the different sectors. Electricidad del Caroní (EDELCA) operates a regional scheme for the Guayana region (Caroni river basin) to ensure adequate electrical power generation. For coordination purposes, the National Meteorological and Hydrological Committee (CNMeH, which is supported by the Ministry for Science and Technology) can play an important role for implementing the distribution of tasks and actions and for disseminating information. Another aspect to be taken into consideration is the VENEHMET Project (a project for the modernization of the meteorological and hydrological services in Venezuela), for which implementation has been very slow since it was launched in 1995.

4. Areas for potential responses

Given realistic time and resource constraints how might activities be prioritized?

In Perú, the 1997/98 mitigation effort was directly managed by the office of the president. Political reasons were presumably behind that concept. The result was a massive national effort to mitigate infrastructure and production damage that, although it produced good results, did not translate into a follow-up recovery effort after the demise of the event.

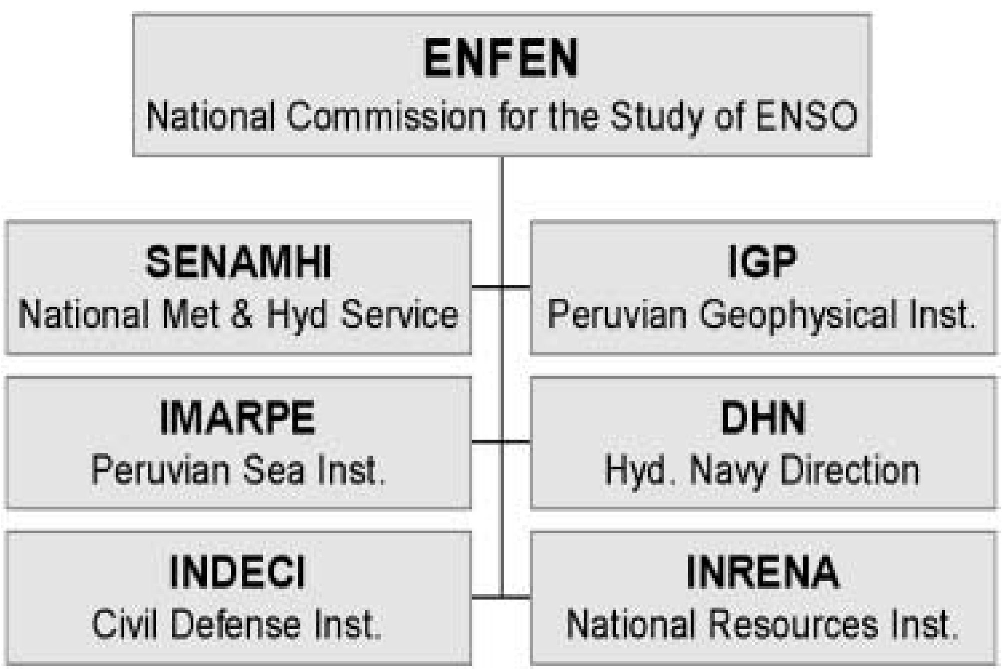

Figure 3. Institutional Framework of ENFEN.

It may be a good idea to reproduce some of the measures that were taken then. Although the eventual strength of the event may be weaker than 1997-98, which may not require the economic and public effort that was needed before the rain season started in late 1997, the national government should be given the responsibility to carry them out. Local authorities are still experiencing the same conditions as in 1997 so not very much can be expected from them.

Early warning weather related information is still very poor in Peru. An effort between the scientific community and the media may help a lot in terms of mitigation of loss of property and lives.

In Venezuela, a previous interesting successful experience was the institutional organization to deal with climate change and climatic change impacts assessment, during the period 1990-1996. An inter-agency national committee was appointed that included many scientists from universities. A similar type of an inter-agency committee with active participation of universities should be appointed, by the CNMeH, to handle matters related to ENSO, instead of scattered efforts that are, at the present time, made in only two or three government institutions that mainly deal with operational meteorology and hydrology. This ENSO committee should design a plan of actions to face the forthcoming event, in order to mitigate adverse effects.

References

Acevedo, M., McGregor, K., Andressen, R., Ramírez, H. and Ablán, M. 1999. 'Relations of Climate Variability in Venezuela to Tropical Pacific SST Anomalies'. Dallas, Texas: 10th Symposium on Global Change Studies. American Meteorological Society. Preprints, p. 81 - 84.

Corporación Andina de Fomento (CAF). 2000. Las Lecciones de El Niño. Venezuela. Memorias del Fenómeno El Niño 1997-1998. Retos y Propuestas para la Región Andina. Caracas: Ex Libris, 248 p.

Corporación Andina de Fomento (CAF). 2000. Las Lecciones de El Niño. Perú. Memorias del Fenómeno El Niño 1997-1998. Retos y Propuestas para la Región Andina. Caracas: Ex Libris.

Marticorena, B. (Editor). 1999. Perú: Vulnerabilidad frente al Cambio Climático. Aproximaciones a la Experiencia con el Fenómeno El Niño. Lima. Consejo Nacional del Ambiente. 209 p.

Ministry for the Environment (MARN). 2001. Comportamiento de la Temporada Lluviosa en Venezuela del Año 2000. Caracas: Dirección de Hidrología, Meteorología y Oceanología. Reporte Interno por Carlos Urbina, 10 p.

Ministry for the Environment (MARN). 2002. Comportamiento de la Precipitación de Venezuela en el Año 2001. Caracas: Dirección de Hidrología, Meteorología y Oceanología. Reporte Interno por Carlos Urbina, 30 p.

Pulwarty, R. and Andressen, R. 2002. 'The Vargas Tragedy Caused by Exceptional Rains in Venezuela. December 1999'. In preparation.

Torres L., A., Díaz, M., Andressen, R., Ramírez, H., Lugo, L., Carrero, C. y Cedeño, L. 2001. ´Natural Hazards Assessments and Management in Caribbean Pine Plantations of Eastern Venezuela´. The Economics of Natural Hazards in Forestry. Solsona, Spain: 7 - 10, June. CTFC-EFI. Padua University Press, p. 21 - 30.

Urbina, C. 1998. Comportamiento Térmico de las Regiones Planas de Venezuela entre Agosto 1997 y Mayo 1998. Caracas: Ministerio del Ambiente, Departamento de Agrometeorología. Informe Interno, 5 p.

Acronyms

CNMeH: Comisión Nacional de Meteorología e Hidrología
EDELCA: Electricidad del Caroní
ENFEN: Estudio Nacional del Fenómeno del Niño
IMARPE: Instituto del Mar del Perú
SENAMHI: Servicio Nacional de Meteorología e Hidrología
VENEHMET: Venezuelan Hydrological and Meteorological Project

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Responses to topics suggested by the IRI:

1. What happened last time?

Were climate anomalies observed over the region during the recent El Niño and La Niña events (1997-2001) anticipated?

Comparison of the results of the Regional Climate Outlook Fora (RCOF) for Southeast South America and the observed rainfall in October-November-December:

1997/98: (First RCOF for Southeast South America)

RCOF Most likely tercile:	High
Observed tercile:	High

1998/99:

RCOF Most likely tercile:	Central - Low
Observed tercile:	Central - High

1999/2000:

RCOF Most likely tercile:	Central - High
Observed tercile:	Low (very)

What were the impacts of recent and/or El Niño related climate variability on socio-economic sectors?

1997/98: Severe floods in Argentina, Paraguay and Uruguay
Summer crops: good yields

1998/98: Some areas with water excess in Buenos Aires
No major anomalies or impacts

1999/2000: Severe drought
Very low yields of summer crops

If anomalous climate was accurately foretold during the 1997/98 El Niño event (and/or 1998-2000 La Niña), were impacts anticipated?

Possible impacts of both, El Niño 1997/98 and La Niña 1999/2000 were anticipated by the research organizations (INIA-IFDC projects), and communicated via mass media.

Were mechanisms (networks of communication and action) in place to deal with anticipated impacts prior to 1997/98 El Niño?

The entities below were crucial for reacting to the effects of the extreme events (floods and droughts). No anticipatory measures were taken.

- National Emergency Systems
- Drought Commission
- Information and Decision Support System (INIA-IFDC).

What lessons were learned from previous El Niño event: public perception of actions taken; institutional perception of actions taken; specific actions that were or were not effective?

The typical actions were reactions to the extreme events (flood or drought). The main improvement from previous events, were in the monitoring systems, and in the methods used for prioritizing aid (using INIA-IFDC's Information and Decision Support System). Not much was achieved with respect to risk management or preparedness largely due to difficulties in interpreting and/or using climate outlooks.

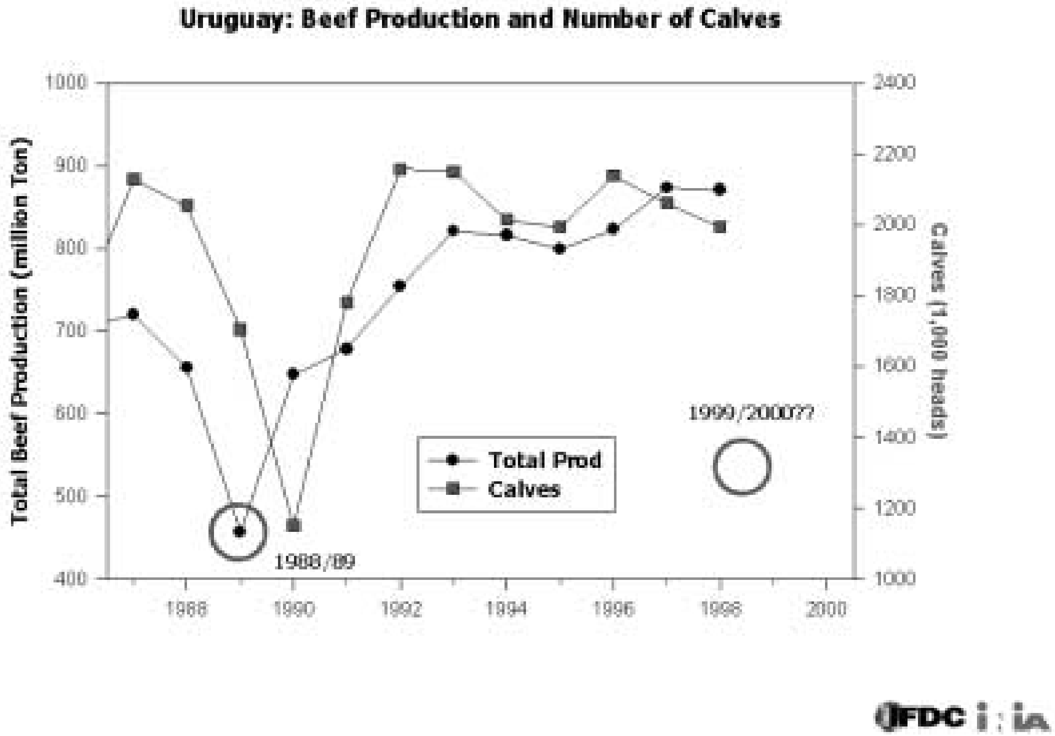

Figure 1. Uruguay Beef Production and Number of Calves.

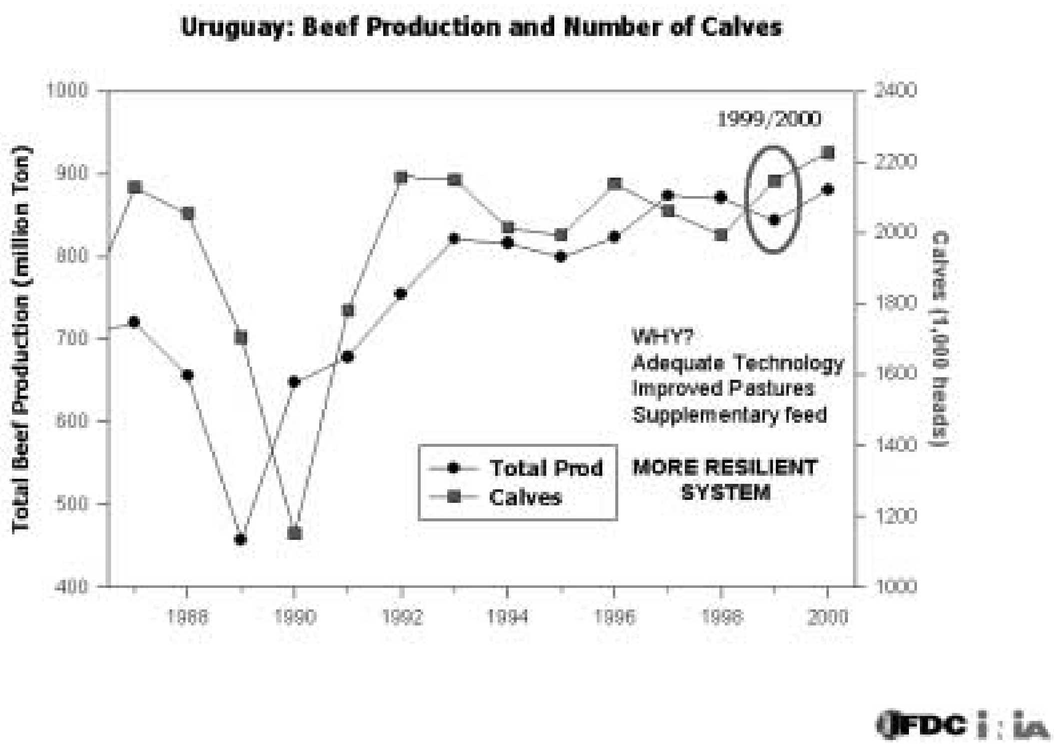

Figure 2. Uruguay Beef Production and Number of Calves, 1999/2000.

2) Assess current climate situation and socio-economic status (e.g. vulnerabilities).

Have recent climate patterns increased vulnerability (e.g., recent drought may have left resources depleted)?

October-December 2001: Excess rainfall resulted in very poor winter crop harvest

March-April 2002: Excess rainfall is resulting in serious floods in Uruguay.

What other factors such as political instability have influenced the current socio-economic status of region, particularly for sectors perceived as vulnerable to impending climate variability?

Beef production is a key economic activity in the region. In 2001, foot-and-mouth disease was detected in Argentina and Uruguay. Losses in Uruguay were approximately US $200 million.

Instability and uncertainty in the monetary policy of Argentina (December 2001) brought general instability in the regional economies.

Changes in the monetary policy in Brazil (1999) and in Argentina (2001-2002) also resulted in disadvantages for the price/cost ratios of agricultural products in Uruguay.

3. Evaluate institutional readiness and capacity to cope with El Niño-related extreme events and uncertainties this year and next.

Institutional capacity is adequate in the region: climate and application research systems, National Emergency Systems, Drought Commissions, National Weather Services, are all in place and operational. There is a lack of adequate communication between these organizations.

Readiness is less clear: there are still difficulties in applying the climate forecasts to take preparatory measures due to: (a) difficulties for defining actions in accordance to the probabilistic nature of the forecasts, and (b) the probability shifts in the forecasts are often too small to make changes (e.g., from 33% to 45% or 50%, which means that the other two scenarios are at least equally likely).

What mechanisms for coordination and information dissemination (such as the climate outlook fora) have developed since 1997 in response to anticipated impacts?

Since early 1990's:

National Emergency Systems, National Drought Commission.

Since 1997:

(a) Climate Outlook Fora, uninterruptedly every three months since December 1997

(b) Some new research projects on Seasonal Climate Prediction (Universities) and on Applications of Climate Forecasts in Agriculture (e.g., INIA, INTA, IFDC).

Since 2000:

INIA/IFDC project that brings together: climate and applications researchers with National Weather Service and a Technical Agricultural Working Group (agribusiness, farmer associations, NGOs, governmental planning agency, National Weather Service).

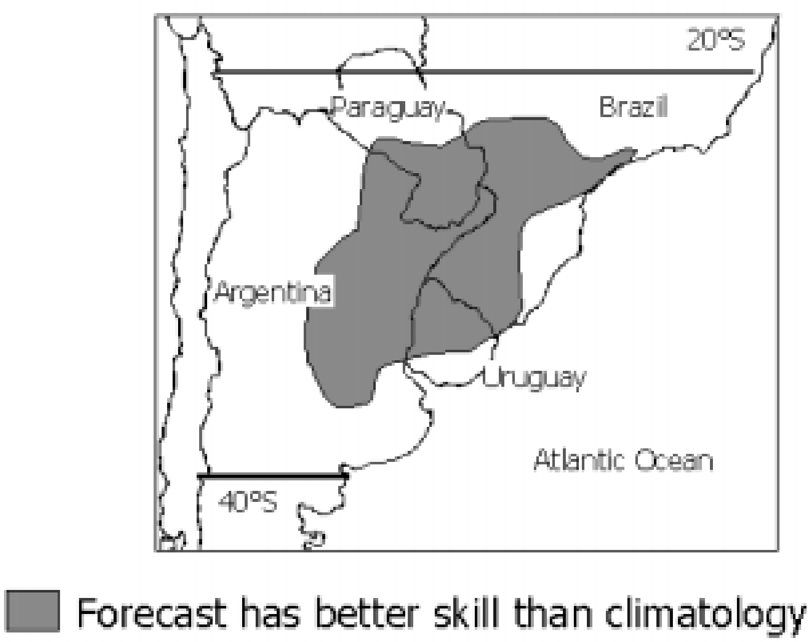

Figure 3. Validation of 12 Climate Forums of SE South America.

Based on anticipated risks or potential impacts which institutions are likely to be key players in the response to ENSO?

- National Emergency Systems
- Drought Commission
- Information and Decision Support System (INIA-IFDC)
- National Weather Services
- Media.

What communication pathways need to be in place?

1. Climate research system
- National Weather Service

2. Climate research system
- "Applications" Research System

3. Climate research system
- Emergency systems/Drought Commissions

4. National Weather Service
- Media

5. "Applications" research system
- Governmental planning agencies
- Emergency systems
- Farmers' Associations
- Media

What are the main challenges to effective coordination of efforts in your region?

Most stakeholders (public and private sector) still do not understand and/or do not know how to modify decisions using probabilistic forecasts (needs "education"). Scientific climate community is often too concerned with making public the results of their research. There is often aversion to talk to the media, and consequently media get information from "unqualified" sources. There is a clear need for "intermediary" actors who understand enough of the science behind climate forecasts and who can communicate with stakeholders and the media.

4. Highlight areas for potential responses.

Given realistic time and resource constraints how might activities be prioritized?

For the Immediate term:

- Ensure / facilitate communication pathways
- Explain climate outlooks (probabilistic nature)
- "Screen" climate outlooks that reach government, planning agencies, emergency systems (avoid confusion).

For the Intermediate term (Regionally)

- Improve Seasonal Climate Forecasts (larger probability shifts)
- Expand Research programs on Applications (regionally coordinated).

Pacific Islands Summary

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The Pacific Islands – twenty-five countries and territories, including New Zealand, Australia, and Hawaii (US) with varied geographic, climatological, political, and socio-economic characteristic – experience clear El Niño and La Niña signals. The impacts of ENSO in the Pacific can be as varied as the islands, including wetter than normal or dryer than normal seasons and extreme climate events including floods, droughts and changes in tropical cyclone patterns. This report attempts to summarize the range of capabilities and needs of Pacific Island agencies and organizations to deal with the impending El Niño.

1997-1998 El Niño event and Lessons Learned

Many of the regional organizations and meteorological services anticipated the 1997-1998 El Niño but Pacific Island governments were not as prepared as they could have been for the droughts and other climate impacts that occurred with it. The degree of anticipation varied, based on skill of models for specific islands, understanding of what the local impacts would be, and dissemination of climate forecast information.

Prior to the onset of the 1997-1998 El Niño event, several organizations in the Pacific had begun public awareness and educational programs. The Pacific ENSO Applications Center (PEAC) had provided seasonal to inter-annual climate forecasts and applications information to the US-affiliated Pacific Islands since 1994. The newsletter, the Pacific ENSO Update, was sent throughout most of the Pacific Islands and regional organizations.

Most ocean-atmospheric observations and predictive models indicated that an El Niño was developing in May 1997. By June 1997, PEAC alerted the governments it serves that the event appeared to be strong, and the impacts may be similar to the 1982-83 event. In September 1997, PEAC issued its first quantitative rainfall forecast that severe droughts would be likely beginning in December 1997. The US-affiliated islands (Palau, Marshall Islands, American Samoa, Federated States of Micronesia) organized ENSO Task Forces, multi-agency and organization efforts, to prepare for the impending droughts, to reduce the impacts of the drought, and to increase public awareness.

Through most of the period from July 1997 through June 1998, a strong El Niño event dominated Australia's weather. This event was already well-established by July, and strengthened further in the spring months, ultimately equalling the infamous 1982/83 event in terms of deviations from normal of most atmospheric and oceanic indicators. Fortunately, its influence on Australian rainfall was far less severe than in the earlier event or even the moderate 1994 event. July was generally dry, but in the second half of August, significant rain developed over Western and South Australia, extending across most of the country in September, as a series of low-pressure systems tracked across southern Australia. In the agricultural districts of South Australia, September 1997 was one of the wettest on record.

Drought severely affected the islands of Fiji, Papua New Guinea, the Solomon Islands, Tonga, the Marquesas, the Federated States of Micronesia (FSM), the Marshall Islands, Guam, and Palau. These islands experienced both meteorological and agricultural drought. All of the islands experienced rainfall deficits, and they all imposed water hours for conservation. In June 1998, the Fiji Government declared drought, which empowered the relevant departments to divert resources to the drought-stricken areas issuing supplementary food rations to 28,000 households and water to 48,000 households. By October 1998, 54,000 families were receiving food supplies and 400,000 people, half the population, were receiving water deliveries. At the worst, during April and May 1998, the Marshall Islands water utility operated once every fourteen days for seven hours to supply water. Other islands maintained a conservative, but daily supply of water, especially to critical facilities such as the hospitals. Many atoll islands and remote locations on several islands required water distribution via ship or truck, an unbudgeted expense costing thousands of dollars. Commercial and subsistence crops were lost in many islands. Some islands required relief food. Disaster management offices used PEAC and the US National Weather Service forecasts to plan food relief and agriculture replanting programs for the droughts in the Marshalls and FSM.

Wildfires occurred in most drought-ridden islands. Guam had over 1,600 fires between January and April and the cost of fighting fires for March, the worst month, was over US$600,000. In Australia, drier than normal conditions, combined with unseasonable warmth in November/December, caused an early onset to the bushfire season. Fires raged for several weeks, stretching resources to their limits, and causing loss of life and much damage to property. In Victoria, dry conditions and extreme heat and strong winds led to many dangerous fire days; these conditions persisted into late March. Tasmania also experienced serious fires in January, but fortunately property damage was confined to a few houses. It was believed that increased fire awareness and preparations (including increased consultation between the Bureau of Meteorology and fire authorities) compared with earlier seasons (e.g., 1982/83), greatly reduced losses in Victoria and Tasmania.

As early as November 1997, PEAC staff became concerned about the increased risk of waterborne diseases from the impending drought in the US affiliated Pacific Islands. Initially, PEAC sought assistance from the US Center for Disease Control, the US Federal Emergency Management Agency, and the US Department of the Interior to deal with this risk. Local public awareness campaigns emphasized the need to boil water, and these efforts reduced the incidence of waterborne diseases. In Fiji, there was an increase in reports of incidence of infectious diseases such as diarrhea. Air quality problems from the wildfires increased respiratory illnesses in many islands.

Fisheries, one of the most important economic resources in the Pacific Islands, were impacted by the 1997-98 El Niño. From interviews and catch data, it is clear that there was a general shift of the catch to the east followed by a general shift to the west. Beginning about April 1997, there was a significant decline in the catch in FSM, Papua New Guinea, and the Solomon Islands, and an increase in catch in the Line and Phoenix Islands and areas east of Samoa. There was, however, an overall decline in the catch and the species mix was very unusual. US purse seiners landed a much higher proportion of yellow fin, and, late in 1997, vessels landed skipjack weighing up to 35 pounds.

Extreme tides in Yap and Palau resulted in saltwater intrusion into low-lying areas and damage to crops. Coral bleaching was reported initially with the warm event in 1998, but occurred also during exposure and low tides as the water level changed with the change in ocean temperature. Reef fish in the outer islands were lost because of extreme tides and higher water temperatures on reef flats. Parts of eastern Australia and Papua New Guinea experienced damaging frosts. Many islands experienced severe flooding after the droughts because soils would not absorb the water once the rain returned. Western parts of Fiji experienced severe flooding in January 1999. Some islands experienced wetter than normal conditions in late 1997 through the first half of 1998, including Kiribati.

Eastern regions of New Zealand were badly affected by drought due to 1997/98 El Niño event. There were significant losses in agriculture, especially pasture, grains, fruits and trees (native and plantations) and loss of water reserves. The cost to agriculture alone was estimated at $425,000,000 (Basher, 1998).

Current Climate Situation and Socio-Economic Status in the Pacific

The current socio-economic status in many of the Pacific Islands has made them more vulnerable to the impacts of the next extreme climate event than in the past. Many islands depend on tourism and even prior to September 11, tourism arrivals from Japan and elsewhere were significantly lower than “normal”. Most islands recovered after the ENSO events and disasters associated with them in the 1990s, but each subsequent event has further impaired the resiliency of the Pacific Island nations. Several island nations have also experienced political instability, such as Fiji and the Solomon Islands, which further challenge recovery efforts.

In Hawaii, the islands of Maui, Hawaii and Molokai have had almost four years of drought. Molokai has not yet recovered. One of Palau’s reservoirs has been depleted this year, and they are currently rationing water supplies for the most populated island of Koror. Typhoon Mitag hit Chuuk and Yap States in the Federated States of Micronesia in early March 2002, and the damage assessments are still being conducted. Several islands completely lost their gardens and land-based food supplies from storm surge and saltwater intrusion. These islands typically experience drought, even in milder El Niño events, and the ability to recover from tropical storm damage will be seriously threatened by the impending El Niño.

Institutional Readiness and Capabilities

PEAC began discussions with the South Pacific Regional Environment Programme (SPREP) in 1995 and 1996 about the feasibility of establishing a climate information service for the non-US-affiliated Pacific Islands. Given the limited staff capacity in most of the meteorological services in the Pacific, building climate forecasting capability within several of the met services in the South Pacific with technical support from SPREP made sense. PEAC offered to provide training and technical assistance to help develop such a system.

The Island Climate Update (ICU) is a monthly regional bulletin produced by National Institute of Water & Atmospheric Research Ltd (NIWA) in collaboration with Bureau of Meteorology (BoM), Fiji Meteorological Service (FMS), Meteo-France (New Caledonia and Tahiti). This bulletin is a product of a 1996 feasibility study under South Pacific Regional Environmental Programme (SPREP), where an urgent need to disseminate climate information and forecast in the South Pacific was identified by the Pacific Island Countries (PICs). There was no mechanism in place at that time to disseminate regional seasonal guidance through Pacific. Due to constraints in their annual budgets and unavailability of expertise, Pacific Island Meteorological Services lack resources and cannot produce such climate information bulletin. The information from ICU is used to create public awareness using local media and to issue monthly climate guidance (in country).

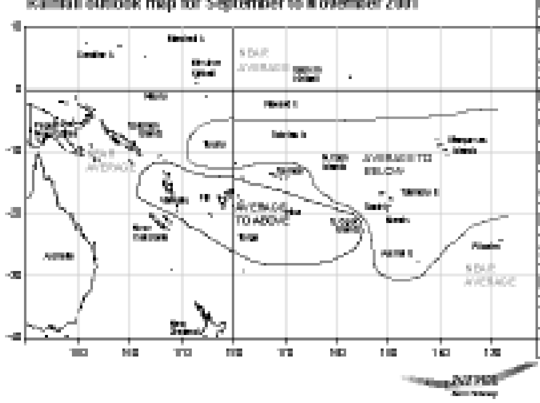
Goal of the Island Climate Update:

- Dissemination of South Pacific information easily and quickly to regional users – hard copy and world wide web.
- Imperative that ICU is bought by the local communities – Regional Ownership.
- Meetings. Forecast process is enhanced by the regional input. Regions will be encouraged to perform these process themselves in future.
- Seasonal climate forecasts and information used in the real world to mitigate the impacts of climate.
- Monthly teleconference between BoM, NIWA, FMS, Meteo-France (New Caledonia and Tahiti) which leads

NIWA
Taihoro Nukurangi

Sep ICU: Seasonal Rainfall Outlook

Rainfall outlook map for September to November 2001



TROPICAL PACIFIC RAINFALL OUTLOOK TABLE (SEPTEMBER – NOVEMBER 2001)

Island Group	Rainfall Outlook	Low: Mid: Top	Confidence
Vanuatu	Average to above	20:35:45	Moderate
Fiji	Average to above	20:35:45	Moderate
Tonga	Average to above	30:30:40	Low
Niue	Average to above	20:40:40	Low
Southern Cook Islands	Average to above	20:40:40	Low
Papua New Guinea	Average	30:40:30	Low
Solomon Islands	Average	30:40:30	Low
New Caledonia	Average	30:40:30	Low
Western Kiribati	Average	30:40:30	Low
Samoa	Average	30:40:30	Low
Eastern Kiribati	Average	30:40:30	Low
Wallis & Futuna	Average	30:40:30	Low
Pitcairn Island	Average	30:40:30	Low
Austral Islands	Average to below	40:40:20	Low
Northern Cook Islands	Average to below	40:40:20	Low
Society & Tuamotu Islands	Average to below	40:40:20	Low
Marquesas	Average to below	40:40:20	Low
Tuvalu	Average to below	45:35:20	Moderate
Tokelau	Average to below	45:35:20	Moderate

Figure 1. Seasonal Rainfall Outlook, September-November 2001.

to consensus on seasonal forecasts for the region. Validation of the forecasts also key element of this project.

PEAC also began working with what is now the Disaster Management Unit of the South Pacific Applied Geoscience Commission (SOPAC) on development of methods to assess the impact of the 1997-1998 El Niño and develop drought mitigation plans for the South Pacific. PEAC staff provided SOPAC with an impact assessment protocol that was used in Fiji and assisted with the design and facilitation of an impact assessment and mitigation planning workshop held in July 1999. PEAC also worked with SOPAC to plan and facilitate a regional workshop on Fiji and other countries in the South Pacific on the use of disaster impacts assessment information, climate analysis and climate forecasting for disaster response and mitigation planning held in October 1999 in Fiji. The regional workshop involved met service staff, disaster managers, and water system managers from the Pacific Islands region. It clearly demonstrated that there is climate forecasting capacity in the region and that close collaboration among met services, disaster management organizations, and water management agencies can result in more robust disaster response and mitigation plans.

Based on anticipated risks and potential impacts of the impending event in the Pacific Islands, the key players in response to ENSO include collaboration and participation of regional and local organizations. The following regional organizations are important: the South Pacific Regional Environment Programme (SPREP), the South Pacific Applied Geoscience Commission (SOPAC), the Secretariat of the Pacific Community (SPC), the Pacific ENSO Applications Center, National Institute of Water & Atmospheric Research (NIWA) Ltd (NZ) and Bureau of Meteorology (BoM Aust). At the local level, the following organizations are essential for dealing with ENSO impacts: the meteorological service, disaster management office, water resource managers, agriculture, public health, government leaders and decision-makers.

The communication links that need to be in place are both inter- and intra-agency communication at the local and regional levels. Participants in several col-

Country	Needs Identified
American Samoa	More accurate, greater lead time seasonal/interannual predictions Quarterly updates of ENSO events Awareness, Education of users of climate information
Cook Islands	Seasonal/interannual predictions for agriculture
Fiji	Seasonal/interannual predictions – the provision of products, information and advice to seasonal and interannual variations of climate to the public and industry (disaster management, agriculture, water resources, forestry, fisheries) Other climate applications
French Polynesia	Seasonal/interannual prediction – the provision of products, information and advice related to season and interannual variations of climate to the public and industry
Guam	Public awareness and education through the media on droughts, climate variability, climate change etc Increase use of internet for weather information
Kiribati	Improved climate information including seasonal/interannual predictions Improved interpretation of information by Met personnel
Marshall Islands	More accurate, greater lead-time seasonal/interannual prediction for agriculture Climate variability expressed in simple terms 1-5 day forecast for agriculture
Federated States of Micronesia	More and easily accessible weather information and forecasts including seasonal/interannual prediction Better designed weather products and educational programs for end users
Nauru	Establishment of a National Meteorological Service
New Caledonia	Seasonal/interannual prediction – provision of products, information and advice related to seasonal and interannual variations of climate to the public and industry Other climate applications
Niue	Seasonal/interannual prediction for agriculture, disaster management etc
Northern Mariana Islands	Increased access to improved seasonal/interannual predictions Public awareness and education on seasonal predictions Research on impact of climate variability on local weather, sea level and on critical coastal and marine resources Greater involvement of users and partners in the review of progress and development of shared solutions
Palau	Increased access to improved seasonal/interannual predictions Public awareness and education on seasonal predictions Research on impact of climate variability on local weather, sea level, rainfall patterns and on critical coastal and marine resources Greater involvement of users and partners in the review of progress and development of shared solutions
Papua New Guinea	Improved seasonal/interannual predictions (including droughts) – for agriculture, forestry, water resources, power, disaster management Development of specific climate applications to meet PNG needs e.g. in agriculture
Samoa	Seasonal/interannual prediction Awareness and education on use of predictions Interpretation and use by industry, government, disaster managers
Solomon Islands	Seasonal/interannual prediction Awareness and education on use of predictions Interpretation and use by industry, government, disaster managers
Tokelau	Disaster management
Tonga	Seasonal/interannual prediction
Tuvalu	Seasonal/interannual prediction Improved climate data and information
Vanuatu	Seasonal/interannual prediction – provision of products, information and advice related to seasonal/interannual variations of climate to public and industry
Wallis and Futuna	Seasonal/interannual prediction – provision of products, information and advice

Table 1. Experience in Pacific, according to an assessment conducted by SPREP.

laborative workshops indicated that agencies need better mechanisms for communicating and explaining climate information so that it can be useful for the needs of different agencies.

Complications for communicating and for response to climate variability include the remoteness of the islands from each other and from the world, expense in supplying resources to remote islands, the lack of natural resources and dependency on imported goods and services, and economic dependency on tourism and fisheries, which can be affected by climate variability.

Potential Areas for Response

Pacific meteorological services tend to lack expertise in some aspects of their operations due to limitations of resources. Pacific services tend to rely on some financial and technical assistance from Australia, New Zealand, and the United States. Over the years, there has been greater focus on weather forecasting with limited importance given to development of climate services or climate forecasting until recently. The El Niño 1997-98 played major role in recognition of climate services in national meteorological services in Pacific.

Improvements that are required in the region based on experience in Pacific, according to an assessment conducted by SPREP (See Table 1. Adapted from South Pacific Regional Environment Programme (SPREP), 2000, A Needs Analysis for the Strengthening of Pacific Island Meteorological Services):

- Increased communication links and improved internet services in-country will definitely improve information dissemination between developed and developing world
- Understanding local climate patterns and mechanisms that affect it
- Specialized seasonal/interannual prediction scheme (rainfall)
- Interpretation of seasonal/interannual predictions – provision of products, information and advice related to seasonal/interannual variations of climate to public and industry.

The lessons learned from the experience of the Pacific ENSO Applications Center and the focus of current efforts include the following:

1. Local climatology and local forecasts are essential
2. Understanding of the climate variability and local effects by clients and climate information needs by forecasters or translators are very important
3. Climate information users want simple quantitative local forecasts
4. Lead-time on a major ENSO event
5. A better understanding of the effect of ENSO events of different magnitudes and of La Niña events need to be developed
6. A better understanding of the impacts of multi-year droughts is also needed.

West Africa Summary

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West Africa shelters about 200 million people. More than 95% of this population is rainfed cereal (millet, sorghum, maize, riz) dependent. Diseases, food shortages and water scarcities are very common in the region. In terms of SST, there are 2 sub-regions: Guinean gulf countries, more related to Atlantic oscillations, and the Sahel region, more likely related to Pacific oscillations and where ENSO events has an effect. Recently, the 1997/1998 El Niño had variable impacts on crop production, disease incidence as well as disasters (inundations).

The vulnerability of West Africa to climate variability and ENSO is actually documented. 1997 was very dry in Sahel. The consequence was food shortage, low farmer income and severe subsequent poverty. In 1998, the amount of rainfall doubled in certain sahelian countries. The increase of the local flood (i.e. August-September) of Niger river at Niamey station clearly shows the importance of the phenomenon. In addition, there is an increase in terms of vegetation index (NDVI) and crop production. Furthermore this very wet rainy season has increased the rate of severe malaria prevalence, which was very low the previous year (1997).

Institutional setup and readiness

There is a seasonal forecast at the regional-scale level mainly within the framework of the WA COF but in terms of ENSO events there is a little experience and no information on the time and space distribution or down-

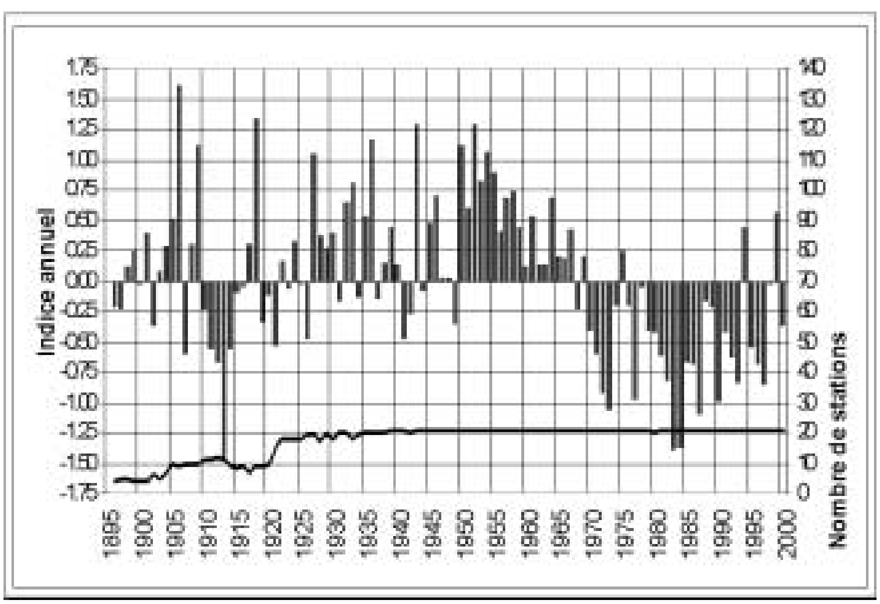

Figure 1. Annual Rainfall indices for West African Sahel (after L'Hote, 2000).

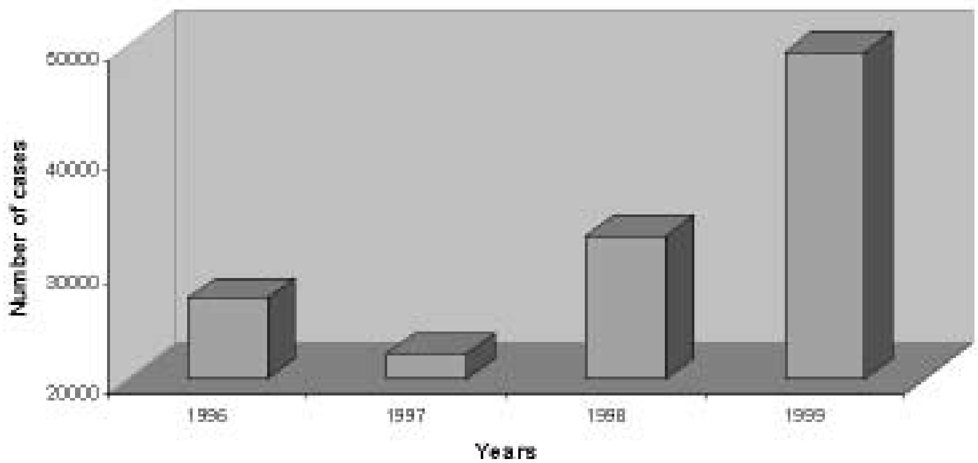

Figure 2. Severe malaria incidence rates for Niger.

scaling issues. Nonetheless there are key technical institutions in the response to ENSO:

- At the continental level, the African Center for Meteorology Application for Development (ACMAD), which deals with capacity building and training, links with Global Centers as well as coordination of WACOF (PRESAO)
- At the regional level AGHRYMET Regional Center (ARC), the formal partner of PRESAO, is also dealing with capacity building, training, and information exchange in the Sahel countries of CILSS
- At the national level, hydrology and meteorology services, agricultural research services, early warning system.

These key institutions don't have a very clear relationship. However, a global coordination mechanism exists through a permanent working group of AGRHYMET (data and products in agriculture, meteorology, hydrology, crop disease protection, prediction and evaluation of agricultural production) and national institutions (inter-ministerial working group). Despite this great potential of information dissemination there are many weaknesses such as a lack of reliable interface for information flow between ARC and member states because of the bureaucratic constraints. In addition, at the national level, there is a lack of on field working facilities because of the high dependence on political decision.

Main Challenges in West Africa

- Make available to end users information generated by regional and sub-regional centers; lack of appropriate extension services
- Increase the interest of decision-makers in climate information (not only during emergency situations)
- Extend EWS and disaster management concepts to take into account impacts of climate variability and extremes.

Areas for potential responses

- The Mali experience:

Since 1982, Mali has implemented an operational climate information gathering and dissemination system at National, Provincial and Producer levels based upon implementation of rural radio programs and involvement of political leaders (election criteria). There is a need to find ways to learn from this experience (and others) for the whole sub-region, to contribute to rainfed agricultural production.

- Ways and activities to improve preparedness to ENSO

- Set up an information exchange network for key stakeholders

- Find ways of arriving at extension services able to integrate climate information into advice to end users

- Develop communication facilities based upon RANET (RAdio and interNET)

- Consider climate information and its availability as an essential part of the sustainable development process.

Preparing for the Impending Extreme Regional Climate Events in East Africa Including Those Associated with El Niño

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General Summary

Extreme climate events such as droughts and floods are very common in the Intergovernmental Authority on Development (IGAD) region. Notable examples of the potential hazards of such events have been demonstrated by the impacts of the 1997/98 El Niño related floods and the La Niña related drought of mid 1998-2001. The effects of the two alternating extremes will linger on for a long time. The 1997/98 El Niño related floods led to loss of life and property, destruction of infrastructure and large losses to the economy. The floods were immediately followed by one of the longest and severest droughts in the history of the region. The 1998-2001 drought had harsh negative impacts on agriculture, livestock, wildlife, tourism, water resources and hydroelectric power generation. Low water levels in the dams led to severe power rationing in some countries, which resulted into large losses in their economies. Water supply for industrial and domestic consumption was not spared by the drought. There were serious water shortages both in urban and the rural areas. Lack of water and pasture led to severe conflicts between wildlife and pastoral communities. The impacts of the 1997/98 El Niño related floods and 1998-2001 La Niña associated drought were so severe that they could not be accommodated within the limited national resources. The governments of some of the IGAD member states had to seek support from international communities to address the impacts. It should be noted that the impacts of extreme climate events affect the welfare of the communities and tend to enhance poverty, especially in this region where rain-fed agriculture and hydroelectric power form major sources of food and energy respectively. The destruction of crops resulting from floods and low yields resulting from drought reduce the economic status of most of the population of the rural communities, especially women, who form a majority of the population. Similarly, lack of adequate power, as was experienced in year 2000-2001, due to prolonged drought, resulted in loss of employment and reduction of economic status of the people.

The severe impacts associated with extreme climate events can be reduced through good understanding of the climate patterns of the previous events, enhanced monitoring, early warning, and effective and timely disseminated early warnings as well as improved awareness of the usefulness of climate information and prediction products in decision-making.

Since its establishment in 1989, the Drought Monitoring Centre in Nairobi (DMCN) has played an important and useful role in providing the sub-region with weather and climate advisories including prediction and early warnings on severe climate events such as floods and droughts. DMCN's other major activity has been the building the capacity of the member countries to optimize the use of the available climate prediction technology and applications for socio-economic development.

For instance, the Centre provided timely climate outlook for the extreme anomalous rainfall that characterized the Greater Horn of Africa (GHA) during 1991-93, 1994-96, 1997-98 and 1998-2001. Some of these extreme anomalies were associated with the extreme global events like the El Niño and La Niña episodes. From the predictions, the various governments have been able to put measures in place and mitigate some of the adverse impacts. Good examples were in the energy and food security sectors. The governments of Kenya and Tanzania implemented rationing of power in time and made provision for buying generators. Similarly the governments of the GHA countries appealed for food assistance in time to alleviate the impacts of the food shortages associated with the drought that ended in year 2001. Consequently, although the 1998-2001 drought was most severe from historical records at several locations, the impacts were relatively less due to the use of the DMCN information for timely interventions. Due to the significant contribution that the DMCN has made to the region, the governments of the region have adopted a resolution to absorb the Centre as a specialized institution of IGAD. A strategic plan for its adoption into the IGAD system is currently being finalized.

It should be noted that in the GHA sub-region, not all extreme climate events are associated with ENSO, and there is no year that the whole region is devoid of

drought or floods. Neither can any particular drought or flood cover the whole of the GHA sub region. This is mainly due to the complex regional features that include existence of large water bodies as well as complex topographical features.

The DMCN mission has been "enhanced regional climate monitoring, prediction, early warning and applications for sustainable development in GHA". IRI as well as National Oceanic and Atmospheric Administration (NOAA)/National Weather Service (NWS)/National Centers for Environmental Prediction (NCEP)/Climate Prediction Center (CPC)/ African Desk have been DMCN's major international partners in development. Most of DMCN's activities have been supported by World Meteorological Organization (WMO), United Nations Development Program (UNDP), NOAA's Office of Global Programs (NOAA/OGP), US Agency for International Development Office of US Foreign Disaster Assistance (OFDA) and Regional Economic Development Services (REDSO).

Regarding the evolving ENSO event, DMCN would treat it in the same way as the case of 1997/98 and 1999-2001 ENSO events by providing timely regional 10-day, monthly and seasonal outlooks. DMCN will also continue to enhance capacity building of the GHA NMHSs and the users. It will also continue with the basic research to understand processes and the associated socio-economic impacts.

DMCN would like to use lessons that have been learned from the mistakes and successes to ensure that credible and timely regional information is availed to GHA NMHSs and sectoral users. In this regard, a new GHA Climate Watch template has been established at the DMCN to provide not only the latest information on the evolving ENSO, but more so the state of regional climate. DMCN's climate watch information is sent to all NMHSs and the users in the region.

In GHA, the impacts of a strong ENSO are often observed from June to December of the ENSO onset year up to the end of the specific ENSO cycle. The intensity and sign of the regional climate anomalies not only vary from location to location and from one season

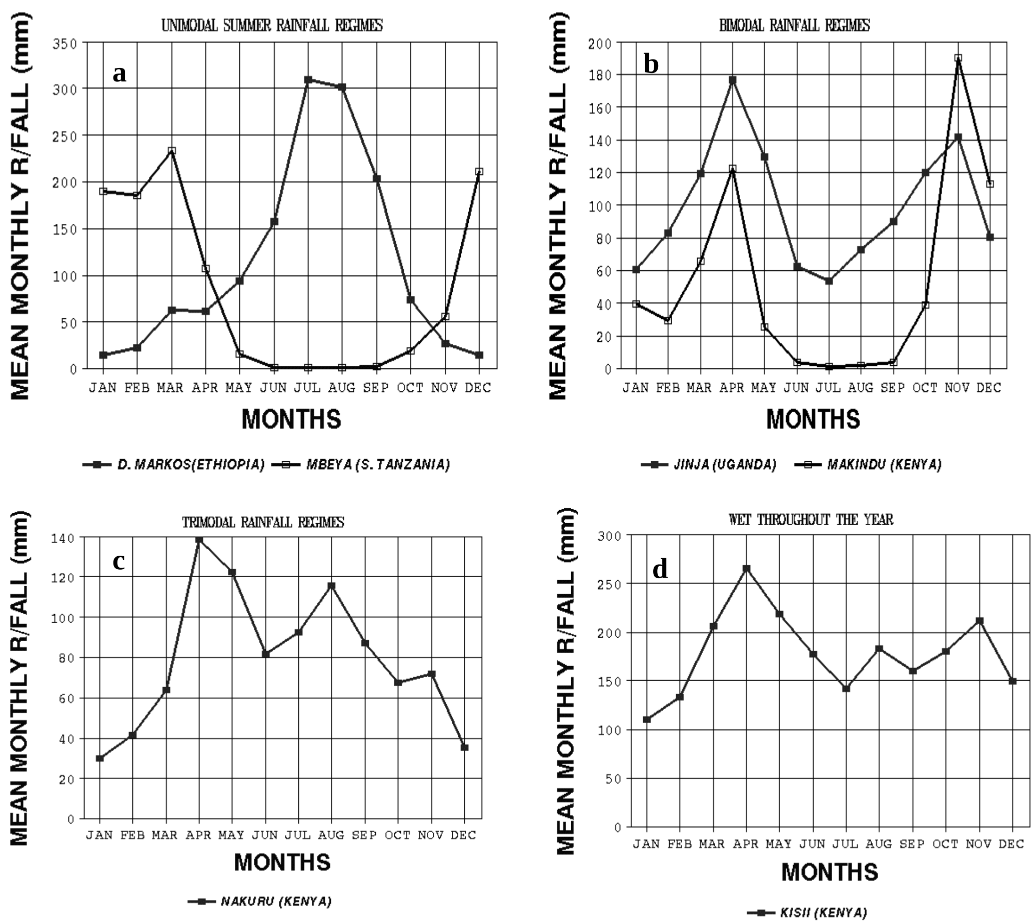

Figure 1. Annual rainfall over Eastern Africa.

to another, but also depend on the evolution phase of ENSO namely the onset, peak and withdrawal phases. The ENSO-related regional climate anomalies over the GHA are occasionally modulated by Sea Surface Temperature anomaly evolutions over the Indian and Atlantic Oceans. A number of capacity building workshops are being planned for the users at both regional and national levels. For example, a two week workshop is ongoing at DMCN to provide June-September regional climate outlook for GHA. Another one is also planned for August to precede the tenth Climate Outlook Forum (COF10). Regarding the users, it is hoped that a one week workshop for livestock users and also one on river flow forecasting will be held a week before COF10. It should also be noted that the theme for this year's COF10 users workshop is 'the use of climate information and prediction services in disaster management' in anticipation of possible maturity of the evolving ENSO phenomenon. Availability of resources however remains the major handicap to DMCN plans to optimally address challenges that may be associated with the evolving ENSO event.

Climate Anomalies Over Eastern Africa (GHA)

The climate of the GHA is complex both in space and time. Some areas exhibit an unimodal type of rainfall distribution (Figure 1a), others exhibit bimodal characteristics (Figure 1b) while others exhibit trimodal character (Figure 1c). There are also areas, which are wet throughout the year with all the months having mean rainfall greater than 50 mm (Figure 1d). Superimposed on these complex climatic characteristics are anomalies which have been linked to anomalies in the global atmospheric winds and ocean currents that are often referred to as the general circulation. The complex regional features that include complex topography, Indian and Atlantic oceans as well as the large inland lakes significantly modify the general circulation such that there is no year and season that the whole region receives normal rainfall and is void of extreme anomalies such as floods and droughts. In addition, large temporal and spatial variability of rainfall is observed. Anomalies that have been linked to occurrence of extreme events in the region include the El Niño /Southern Oscillation (ENSO) phenomena, tropical cyclone activities, and anomalies in monsoon wind systems, Inter-tropical Convergence Zone (ITCZ), among many others. ENSO events have strong influence on rainfall anomalies in the region during all seasons especially when conditions in the Indian and Atlantic Oceans are favorable. It is therefore apparent that El Niño conditions over the Pacific may not mean much to Eastern Africa if sea surface temperature

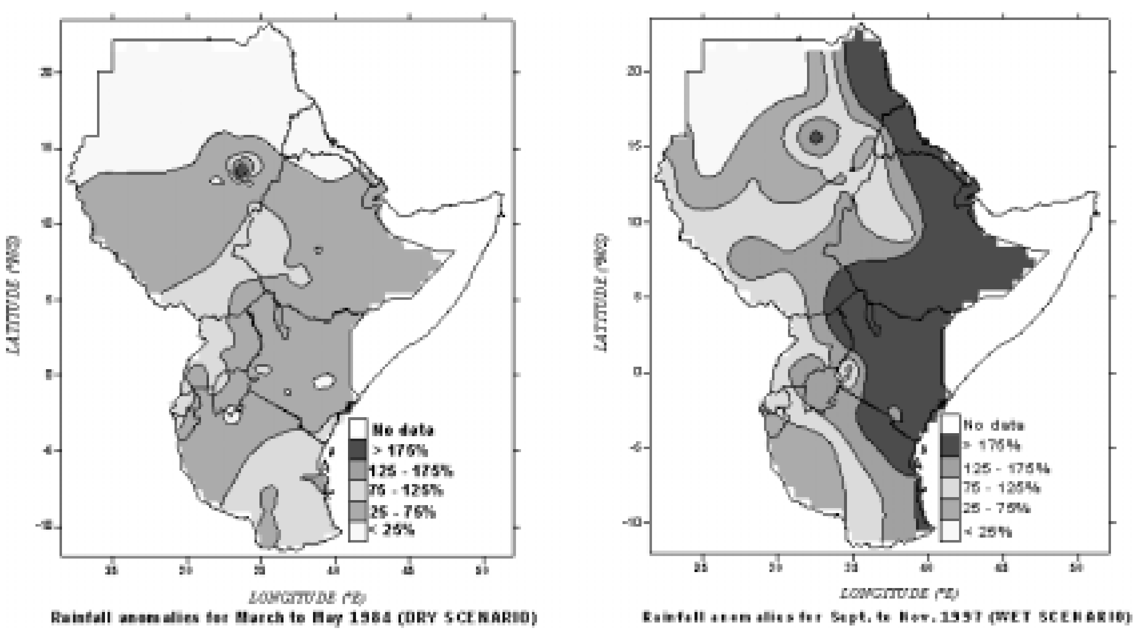

Figure 2. Rainfall anomalies over the GHA for (a) a dry scenario in March to May 1984 and (b) a wet scenario in Sept. to Nov. 1997.

anomalies (SSTAs) over Indian and Atlantic oceans as well as the atmospheric circulation over the African continent do not respond.

Anomalies and Impacts During the Period 1997-2001

During the 1997/98 El Niño period, the subregion was characterized by one of the worst floods ever experienced in the last 50 years. Some locations experienced the wettest conditions in the history of the available records. Figure 2(a) shows the spatial patterns of rainfall anomalies for September to November 1997, which indicates that the wet areas (anomalies > 175%) covered most of the eastern parts of the sub region. From mid 1998 to 2001, La Niña conditions characterized the sub-region resulting into one of the longest and severest droughts ever experienced in the last 50 years. Some locations experienced the driest conditions in the history of the available records. Figure 2(b) shows the spatial patterns of the rainfall anomalies in March to May 1984, which was one of the driest years in the sub region.

The 1997-98 El Niño related floods led to loss of life and property, destruction of infrastructure and large losses to the economy. On the other hand, the 1998-2001 drought had harsh negative impacts on agriculture, livestock, wildlife, tourism, water resources and hydropower generation. The low water levels in the dams led to intense power rationing, which in turn led to large losses to the economy. There were serious water shortages both in the urban and rural areas. Lack of water and pasture led to severe conflicts between wildlife and human beings as well as conflicts among communities.

Anomalies are part of the climate system variability and therefore recurring in nature. Given that another severe drought had occurred in the region in 1983/84, the impacts of a drought of similar magnitude were therefore anticipated. With early warnings from the DMCN and NMHSs, appropriate mechanisms were put in place, which greatly reduced the impacts. As such, the impacts of the 1998-2001 drought were not as severe as those of 1983/84 drought. Figures 3a - 3c are cumulative monthly total rainfall curves for selected stations in the subregion depicting that the drought of year 2000 was more severe than the one of 1983/84. Taking the lessons learned from the experiences of El Niño/La Niña events, communities are becoming more and more aware of the events and associated impacts. Several steps have been taken in the Africa region to put mechanisms to help mitigate impacts of extreme climate anomalies in place.

These include for example, the establishment of:

- The AGRHYMET Centre in Niamey, Niger
- The African Centre of Meteorological Applications

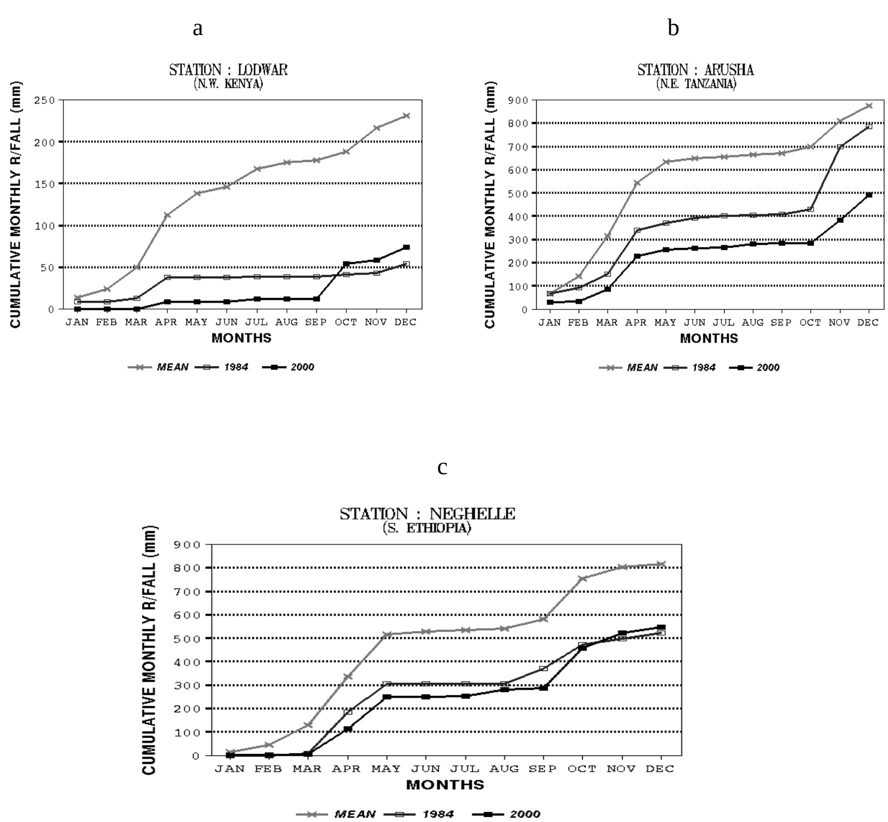

Figure 3. Cumulative rainfall performance.

for Development (ACMAD)
• The Drought Monitoring Centres (DMCs) in Nairobi and Harare.

Vulnerability of Eastern Africa to Impacts of El Niño/La Niña climate related extremes

It has been noted in recent times that the frequency and intensity of extreme climate events has increased. The result has been that the region has become more vulnerable to impacts of these climate events. The 1997-98 El Niño related floods and 1998-2001 La Niña associated drought were very severe and could not be accommodated within the limited national resources. Many governments had to get support from international communities to address the impacts.

Despite the fact that many countries have made considerable efforts to build capacity for early warning and monitoring as well as formulating national disaster preparedness and prevention strategies, serious capacity, policy and institutional gaps remain part of meaningful strategy development processes.

Capacities and Institutional Readiness to Deal with El Niño Related Extremes and Uncertainties

Much of the region's experience is in the area of drought/flood early warning systems. Undoubtedly, drought/flood early warning systems are an important element of risk assessment and management. However, concrete decisions require a varied and broader set of tools and capacities. Early warning systems involve detecting and forecasting impending risks/hazards and issuing warnings. Effective risk reduction would require information beyond early warning. The early warning information needs to be complemented by information on the consequences of risk, estimate of the extent of damage, and appropriate strategies to mitigate the loss and damage that would arise. The information also needs to be communicated to vulnerable groups in a way that facilitates their own decisions and enable them to take timely actions.

The Drought Monitoring Centre-Nairobi (DMCN) is charged with the responsibility of providing on a regular basis, reliable and more accurate climate information forecasts and advisories with particular emphasis on early warnings on droughts, floods and other adverse weather conditions. The products produced by the Centre and disseminated to users include:
• Ten-day rainfall distribution, drought severity (Figure 4a), agrometeorological conditions, general impacts and weather outlook
• Monthly and seasonal climatological summaries, drought severity, dominant synoptic systems, weather outlook (Figure 4b) and socio-economic conditions as well as their impacts.

Other activities of the Centre include:
• Enhancement of the use of climate information: The Centre organizes climate outlook fora in collaboration

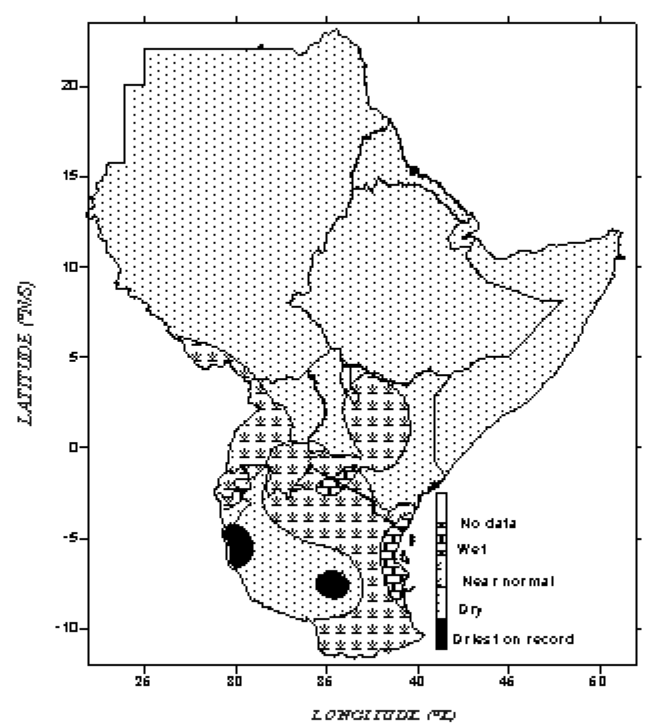

Figure 4a. Drought severity index for dekad 6 (21-28 February) 2002.

with other advanced climate prediction centres. To date, nine forums have successfully been held in eastern Africa since February 1998. The forums have proved beyond doubt that pre-disaster mitigation strategies through optimum use of climate information and prediction products can contribute enormously to sustainability in the region in terms of food security among others.

- Demonstration of the value of climate information: The Centre is also implementing several pilot application projects geared towards demonstrating the value of climate information in socio-economic development.

There is therefore a clear recognition that DMCN has contributed to improved disaster management by availing information as well as articulating strategies. There are however, still many challenges that inhibit optimum production, processing, dissemination, and use of climate information. The major challenges include fast declining observational network, inadequate skilled human resources for climate and sectoral users of climate products, institutional capacity, lack of well integrated national and regional policies, networking and data/information exchange at national, regional and international levels as well as lack of awareness and education among the public, sectoral users of climate products, and policy makers among others.

Areas of Potential Response

- A thorough understanding of the mechanisms governing the Indian and Atlantic Oceans circulation as well as the regional climate processes and their interaction with the global climate systems
- Data problems need to be addressed seriously especially the West Indian Ocean, which is more disadvantaged
- An efficient and effective network is required to ensure timely availability of early warning products
- Capacity building of the existing early warning systems including NMHSs
- Users' interface problems.

Summary and Conclusions

- There are several institutions in the region providing vital climate information including El Niño advisories. These include the NMHSs and the DMCN. They are working closely with several advanced international climate centers.
- Seasonal rainfall in the region is dependent on the Indian and Atlantic Oceans for moisture and as such overall impact of El Niño conditions over the Pacific depend on the modulations by the two oceans.
- Due to limited disaster preparedness and prevention capacity, many countries in Eastern Africa find themselves extremely vulnerable to impacts of the extreme events.
- There is need for resources to be availed to international, regional and local institutions to optimally address the evolving ENSO challenges.

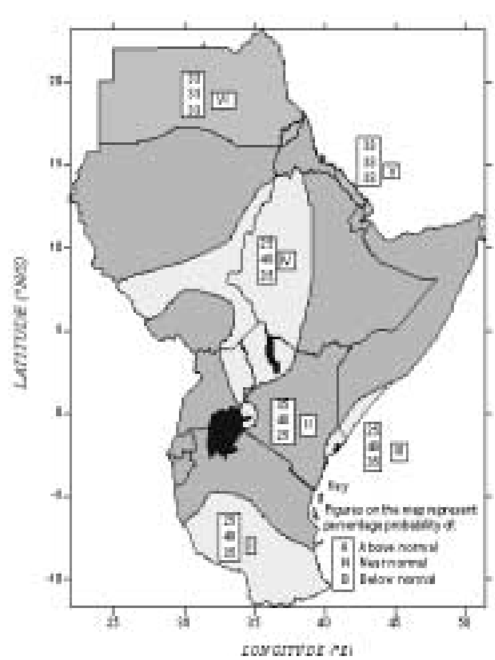

Figure 4b. Seasonal Outlook for March - May 2002.

The North African Region Case

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Foreword

In the last issue about the current state of ENSO, the International Research Institute for Climate Prediction (IRI), indicated that current observations suggest that a shift away from neutral conditions may be occurring. Some indications show the same behavior observed prior to the onset of many past El Niño events.

The analysis concluded that if an El Niño does develop, which would be more apparent in the middle of 2002, it would persist for at least the remainder of the year and likely through March of 2003.

Thus, taking into account the potential development, and the lessons from the past (Once burned, twice shy!), it is important at this stage, while continuing the monitoring, for the scientific community to advise and make preparedness plan to cope with it.

This paper, through the presentation of the Algerian case, is a preliminary contribution to this effort over the North Africa region. It tentatively gives rough information available regarding the impacts of El Niño and related climatic events in the region in regards to:

- What happened during the previous extreme climate events
- The current climate and socio economic situation
- The institutional readiness to cope with the next event
- The potential response.

El Niño and its Teleconnections

Very little interest has been focused on the potential impacts of El Niño over the Mediterranean area of North Africa.

1. Thus, when the question from decision-makers comes to the Meteorological Office in Algeria on the potential impacts of the 97/98 El Niño, just after the release of the press information by World Meteorological Organization "the very strong ENSO episode was a major factor that contributed to record high global temperatures in 1997," we faced of situation of lack of information to respond. However, contacts made with most of international climate analysis centers ended up with the following answer from Dr. Vern Kousky (CPC) in February 1998, "the impacts of El Niño over the Mediterranean region are not very consistent from one episode to another. However, there is a weak indication that region becomes wetter than normal on average during the winter and early spring of El Niño years."

2. Later in a report on El Niño and its teleconnections in Africa and Mediterranean published in the Regional Research Network on Global Environmental Change in the Mediterranean Basin and Subtropical Africa (MEDIAS) newsletter (December 2000) it was stated, "with the current acknowledgement of ENSO influence on global climate, the low signal in Africa and Europe may be interpreted with much more confidence. Nevertheless, the impacts on these regions is low and the correlation between the various parameters are not significant as a rule. …in conclusion, the increased correlation between ENSO and Europe in the second half of the XXth century could not be due to an intensification of ENSO as suggested by Moron and Ward (1988), but could be considered as an expression of global change as it has just been suggested by Rodo et al (1977)".

3. The seven strongest El Niños and rainfall in Algeria

Using these known seven strongest El Niño events since 1950 and looking to the covariation (Figure 1) with yearly rainfall anomalies over Algeria, no relation appears in such a simple exercise. However, more elements such as nature and strength of the event (severity and extent of drought, flooding, heat and cold waves), time of the year, area of extent, severity, frequency, duration, on one hand and ENSO characteristics on the other hand, should be taken into account before concluding.

What Happened Last Time?

a) About the anticipation of climate anomalies observed over the region during the recent El Niño and La Niña events (1997-2001): With reference to the climate analysis issued by the CPC/Washington and published by WMO, several climate anomalies have been observed during the last El Niño 97/98.

b) The low level of awareness, lack of local scientific capacities for regional and local climate analysis and prediction, no operational system of routine exploitation of information available through international centers (difficulties of access as Internet not available within meteorological service until end of 1998) could not really lead to effective anticipation about the impacts of El Niño and climate related events.

Nevertheless, the region is known to be very sensitive to climate variability and most of sectors are directly affected (see evaluation below). Thus at the beginning of 1998, national measures had been taken, such as:

- Emergency plan for water distribution as Algeria was experiencing drought situation
- Setting up a fund for agricultural insurance.

On the communication side, we noticed that the statement made in 1997 by international bodies such as WMO and the Kyoto process has brought the media system (newspaper, radio, TV, etc.) to diffuse at large scale information about climatic extremes.

The meteorological office has taken part in this popularization action by distributing copies of the WMO pamphlets.

However, no mechanism has clearly been set up to deal with El Niño phenomena and one may notice that during the occurrence of El Niño, the social activity was dominated political elections (1997/1998).

c) Evaluation of impacts of recent climate variability on socio-economic activities:

To illustrate the value of the use of the weather and climate information in the socio-economic activities, the meteorological office has recently conducted an analysis of the impacts of extreme events on these activities.

This analysis of impacts, show clearly that socio-economic activities are affected to a large extent such that investment on climate prediction and analysis and their integration as a project value in the decision scheme would largely be beneficial to the nation.

Analyzing the socio-economic impacts of climate vulnerability:

Since 1987, the meteorological office is collecting through its station network and in coordination with local representative from specific sectors (Civilian protection, Agriculture, Forest, Health) yearly information related to impacts (in terms of damages and losses) of extreme events.

The extreme events considered are: heavy rains (flooding or not), solid precipitation (snow, hail, etc.) drought, heat or cold waves, and high winds.

The damage are structured in levels of 10 of a given weight:

1- Limited perturbations	10
2- Limited economic loss	20
3- Economic loss important	30
4- Important loss in limited area	40
5- Important loss for large area	50
6- Limited damage to population	60
7- Important damage to population	70
8- Loss of lives	80 -120

Certainly the analysis presents some discrepancies in regard to the direct or indirect impacts data.

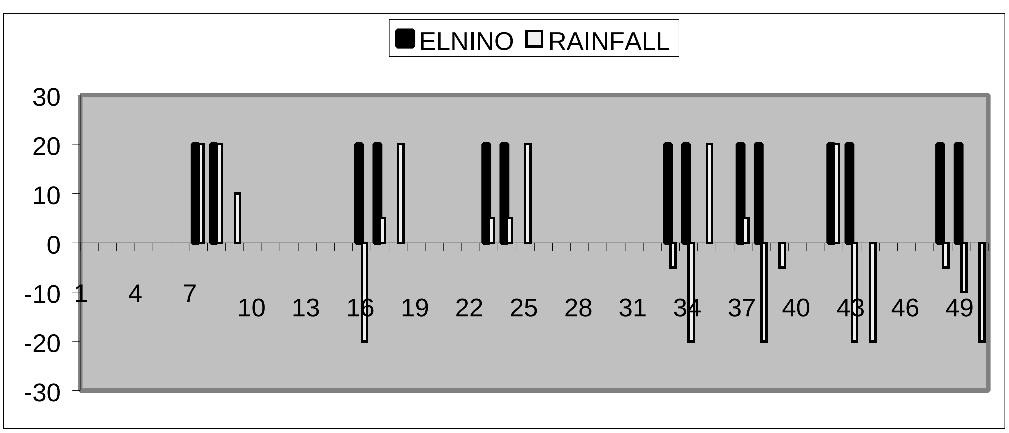

Figure 1. The seven strongest (56/57, 65/66, 72/73, 82/83, 86/87,91/92, 97/98) El Niño events and anomalies of rainfall over Algeria.

Summary of the Current Climate Situation and Socio-economic Status

Currently Algeria (and most North African countries) are experiencing one of the most severe drought situations after 4 to 5 successive years of below normal precipitation in some areas. In this region where precipitation is a preeminent factor to many sectors and the population is facing a big stress as the dry season is just ahead.

Actions, some drastic measures, are undertaken by national authorities to cope with this particular situation such as for Algeria:

- water distribution to users (1/3 days)
- repair of all distribution and drainage pipe systems
- search of other underground water resources
- desalinization of sea water.

Looking to other factors that might have strengthened the socio-economic status and while noting that the current socio-economic situation in Algeria is getting back to normal, the last decade (1990 's) of instability have created other stresses such as:

- pressure on urban area from rural populations
- difficulties in investing and developing
- growth of population and its new needs of development and welfare
- the debt: real pressure on social development as for many developing countries.

Institutional Readiness and Capacity to Cope with El Niño-related Extreme Events and Uncertainties this year and next

What are the potential impacts?

We are aware that in this region, natural climate variability or that induced by human activities leads to land degradation, water shortage (drought), sanitary (health) problems, decrease in agricultural yield, increase forest fires, etc.

What coordination system can be mentioned?

Coping with this event, expect a land use planning system. The following coordination since 1997:

1. Regional coordinating committee for climate change (for Maghrebian countries)
2. National coordinating committee on desertification
3. Seasonal forecast "elmasifa project"
4. National water committee since January 2002
5. PRESANOR (seasonal forecast for North Africa) initiative of ACMAD successfully started in Algiers in April 2002.

What key institutions to respond:

1. Meteorological department
2. Water resources department
3. Agriculture and forest department
4. Health department
5. Media

What are the suggested mechanisms for coordination and information dissemination communication pathways?

1. Today, the meteorological services are or have upgraded their meteorological telecommunication system and have more skills in communicating meteorological information to the public through different media and especially the TV.

Thus the mechanisms for coordination (to be defined) could rely on the following available means of communication:

International (regional) level: the WMO telecommunications system, access to internet and availability of information on different web sites, satellite (use of RANET), fax sheet, mailing

National level: TV, radio and newspapers, specific national fora.

The coordination mechanism:

1. Should imply through IRI (WMO and ACMAD) National Meteorological Services as a main coordinating structure
2. Coordinating structure for Africa: ACMAD
3. Regional correspondents to link with IRI and ACMAD (for Africa)
4. National correspondents.

Setting up the regional team (regional correspondent and national correspondents) could be, for North Africa, a reinforcement of the PRESANOR initiative (enhancement of its activities and climate products). These activities could serve as a demonstration project for the planned WMO Regional Climate Centre in this sub-region?

The main challenges to effective coordination could be seen at this stage as follows:

a. institutional: setting up a network of key persons

b. production of information

1. access to available information on global and regional projects (which, where, how)

2. interpretation and adaptation to sectors (to what extent users could rely on information produced).

c. follow up of dissemination of information, gathering information on actions taken, analyzing results.

Thus, prioritizing activities seems as follows, though it needs to be analyzed further to fit the goals of the field actions of the preparedness plan.

1. Setting up of the coordination and the follow up mechanisms

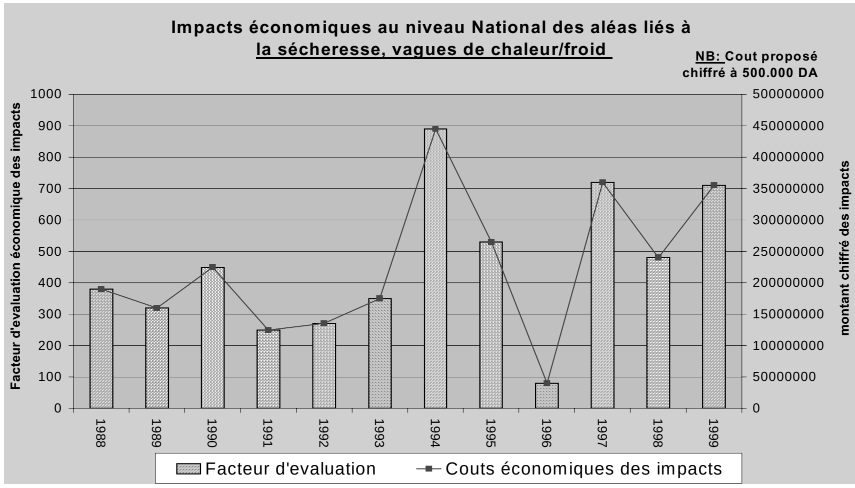

Figure 2. Economical losses from damages caused by drought, heat and cold waves in Algeria for the period 1990-2000.

2. Dissemination of the available information, including state of art (multiple paths)
3. Reinforcement of the PRESANOR initiative

Conclusion

This important initiative would certainly be appreciated by users (sectors vulnerable to climate variability) in the North African area, as they would receive information that they could use as a project value in their planned operations of resources management. Such support from the meteorological community to the users, a step forward in the usefulness of the climate monitoring, analysis and prediction system, will enhance the relationship.

El Niño-Southern Oscillation and Indian Monsoon

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Introduction

The El Niño-Southern Oscillation (ENSO) causes the strongest year-to-year fluctuation in global climate system with the main seat of activity in the tropical Pacific. Just west of the Pacific, over the Indian Ocean, another fascinating climatic phenomenon takes place, known as the Indian monsoon, the strongest monsoon of the world. The inter-relationship between these two major climate systems was noted as early as in the 1920's by Sir Gilbert Walker, who was searching for world-wide precursors of monsoons. Walker discovered the Southern Oscillation, which was later linked to the oceanic events in the East and Central Pacific. According to present understanding, the ENSO and Indian monsoon are intimately linked, but the relationship is not perfect.

ENSO-Monsoon Relationship

That the El Niño affects the monsoon rainfall has been noted since early 1980's. Some of the recent El Niño years, 1911, 1918, 1939, 1941, 1965, 1972, 1982, and 1987 have experienced about -15, -25, -9, -13, -18, -24, -15 and -19% departure of rainfall from normal. Likewise, the La Niña years of 1916, 1942, 1964, 1970, 1973, 1975, 1978, 1983, and 1988 have experienced 13, 14, 10, 12, 8, 15, 9, 13, and 19% departures from normal rainfall. But the relationship is not one-to-one as shown in 1979, one of the most deficient years(-19%), was not an El Niño year and the year 1961 with +22% excess rainfall was not a La Niña year. We note that there may be some variation in identifying the year as El Niño or La Niña years depending on the definition. This will however, not greatly alter the results.

It is noteworthy that the recent El Niño of 1997 witnessed +20% departure of rainfall from normal and the La Niña year of 1999, 2000 and 2001 witnessed -4, -8 and -9% of rainfall departures respectively. During 1997, the rainfall departure was initially negative up to July, but became slightly positive thereafter. This is somewhat surprising as the El Niño tend to peak in the latter part of calendar year. Also, the four year long sequence of El Niño episodes (1991-94) experienced rainfall departures of -9, -7, -0, and +10% respectively. The forecast of the forthcoming severe El Niño was therefore ignored by the Indian meteorologists.

It may be noted in passing that a limited number of studies conducted have shown that the El Niño years (or negative SOI) result in a more southerly track of Tropical cyclones in the post monsoon season.

Food Production and Monsoon Drought

The total food production in India has witnessed a fourfold increase from 50.8 mT in 1950-51 to 210 mT (projected) in 2001-2002. Increase in area sown, increase in irrigated area, introduction of high yielding varieties after the green revolution, better crop management and increasing use of fertilizer have been the main cause of this increase. This has enabled India to become not only self-sufficient in food production but to turn from a food importer to food exporter. About 8 mT of cereals have been exported during the year 2001. The buffer stock has also grown over these years and stands at about 60 mT today. The total food grain consists of 34% wheat, 42% rice, 7%, pulses and 17% other cereals.

The variations of weather (monsoon), however, continue to affect the food production in a significant way, though some resilience seems to have been developed. The major jump in food production (from the previous year) occurred in 1967-68 (28%), 1975-76 (21%), 1988-89 (21%), 1958-59 (20%) and 1980-81 (18%) all representing recovery from the drought in past years. There was no major rise in production in 1961, the year of maximum excess monsoon year, as this was following a non-drought year and was in the period prior to the Green Revolution.

In general the fall in food production is comparatively less. The highest fall in food production occurred in 1965-66 (17.7%), 1979-80 (18.7%), 1976-77 (8%), 1957-58 (8%) and 1950-51 (7%). Out of these the rainfall anomalies were positive in 1976 (+2.3%), and 1950 (+8.3%). The fall in food production was 4.6% in 1997-98 and 6.1% in 2000-2001, the latter was a La Niña year.

Long Range Forecasting of Rainfall

The long-range forecasts of monsoon rainfall are being issued in India for more than 100 years. Blanford in 1884 suggested linkage of Himalayan snowfall during winter and spring with the performance of monsoon rainfall and the first operational forecast based on this relationship was issued on 4th July, 1886. G.T. Walker made a worldwide search of antecedent parameters for foreshadowing monsoon rainfall. While searching the parameters, he discovered Southern Oscillation and since then the relationship between monsoon rains and S.O. have been identified from time to time. He employed the technique of multiple regression in the early 1920's. The intensive search of suitable parameters has continued since then and many parameters have been tested during the last two decades. A number of techniques have also been introduced. During the 1980's, the techniques of dynamic stochastic transfer, parametric model and power regression were introduced for prediction of all India rainfall. The parametric model has forecasted the correct category of all India monsoon rainfall successfully by using 16 parameters during past 14 years (1988-2001). It is, however, important to note that these years have witnessed normal rainfall. The same parameters have been used in a power regression model to produce quantitative forecasts, with model error of ~4 % but the absolute mean error has come to 7% during years 1991-99. Extensive studies of secular variations of the relationship between these predictors and monsoon rainfall carried out by various authors have revealed the change in strength or even sign of these relationships. Four of the 16 parameters used in the operational model, until 1999:

(i) 500 hPa ridge position in April across 70 E
(ii) North India minimum temperature in March
(iii) 10 hPa zonal wind (January)
(iv) Darwin pressure (Spring).

have lost the significance of the relationship and have since been replaced by –

(i) SST anomalies over South Indian Ocean (150-300 S,700 E-1100) February and March
(ii) SST anomalies over NW Arabian Sea (150 N - 25 0N, 500 E - 1000 E)
(iii) Darwin pressure difference between April and January
(iv) Pressure gradient over Europe in January.

The equations based on new parameters have provided forecasts with absolute mean error of 3.2% over the same period (1991-99). Each set of these 16 parameters, old or new, have contained 4 parameters related to ENSO. Recently, the operational forecasts have once again begun to be produced for smaller regions, north-west India, and peninsular India. Some studies have also shown the possibility of predicting rainfall on even shorter (sub-divisional) spatial scale over west-central India with some skill. Recent studies have also employed the techniques of principal component analysis, artificial neural network, canonical correlation analysis and power transfer models for predicting monsoon rainfall.

Monitoring and Management of Drought

Several institutional mechanisms exist for monitoring initiation and progression of monsoon drought (and crop production) and for taking ameliorative measures. The Ministry of Agriculture has constituted a Crop Weather Watch Group, which monitors the past weather, crop conditions (area, sown, water stress), soil conditions and even availability of water in the dams and reservoirs. The Medium Range Weather Forecasts are also discussed in the meeting of this group held every week. This group then recommends strategies of combating drought. Such crop weather groups also exist in different states for detailed local analysis. Biweekly bulletins on aridity conditions are issued on drought in kharif (monsoon) crop season for the 250 districts in South Peninsula and Northern India. The remotely sensed data, particularly the vegetation index as measured through Indian Remote Sensing satellites are used to monitor crop state, possible crop yield, area under severe moisture stress, floods etc. Contingency action plans in respect of seed availability, fodder and food supply, power, water use, cattle management are suggested or put to action if a serious fall in agricultural output is expected.

The Socio-Economic Aspects

Several steps are taken in the modern times for increasing food production, ensuring food (nutritional) security and rural development. For example, some of these are:

(i) Fixing of minimum support prices of food grain and procurement by state agency
(ii) Empowering the village level communities to receive and utilize the funds according to local needs
(iii) Promotion of watershed development schemes through involvement of non-government. organizations and self help groups
(iv) Employment generation schemes, food for work programs, food campaigns
(v) Relief funds
(vi) Public distribution system, fair price shops, and distribution of food grain at highly reduced (even free) prices
(vii) Rural bank credits and subsidies
(viii) Social security scheme (pension, home loan)

(ix) Buffer stocks for food and fodder
(x) Crop insurance.

The media publicity has been playing an important role in creating awareness and dissemination of relevant information, and mobilization of people participation. Even public interest petitions about food security/ drought keep pressure on the government and other agencies.

El Niño and its Impacts in Southeast Asia

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Introduction

Among the environmental issues threatening economic growth in the Asia/Pacific region is year-to-year incidence of droughts, floods and marine storms, which create substantial disruption and severe economic dislocation. Such impacts associated with El Niño have ranged in the billions of US dollars for the region, and have profound implications for the region's ecosystems, economies and human populations. Extended periods of drought and heat can increase the susceptibility of urban settlements and forestlands to fire, can disrupt food production and water supplies, and in developing regions, can occasionally lead to massive human migrations. Prolonged and excessive periods of precipitation can cause flooding, delay planting, contaminate water resources, and temporarily disrupt patterns of production and trade.

The 1997-1998 El Niño event, possibly the most significant climate event of the century, has brought into focus the urgent need to better understand the climate phenomena and their /impacts on different sectors of society. Under this context, this paper presents a broad overview of the impacts of El Niño events and the need for making the best use of climate forecast information for risk management in the Southeast Asian region.

What happened last time?

Characteristics of 1997-1998 El-Niño

- In late 1996, certain hints began to appear that a warm event in the Pacific was starting to develop.
- Three major prediction centers issued forecasts early in 1997 warning of the impending El Niño.
- By May 1997, it became obvious that one of the largest El Niños of the century was occurring.
- Some of the usual signatures associated with the El Niño were apparent: drought in Southeast Asia, Africa and Indonesia; floods along the coast of the Americas. But Indian summer rainfall was normal and Australia rainfall was mostly not deficient.
- However, with this El Niño we have more observational platforms in place than ever before so that an exhaustive post-analysis can be undertaken.
- Besides being among the strongest events on record, the event was forecast more accurately and with the largest lead-time on record.

Forecast and Early Warning of the 1997-1998 El Niño Event

In early 1998, climate scientists observed two peculiarities in the current El Niño events: first, that it was developing with considerable force and speed compared to previous El Niños; and second, that the surface temperature of the Pacific Ocean off South America, in June 1997, had risen by more than 5^0 centigrade which was significantly higher than in most previous El Niños. This abnormally high temperature continued thereafter until the end of December 1997. The geographic location of the anomalous warming has also been slightly unusual, being particularly close to South America.

The El Niño 1997 forecasts were made available as early as Jan 1997, providing six months lead time to enable the planners to undertake suitable measures to minimize the negative impacts of El Niño and at the same time capitalize on the possible positive effects.

There was thus a great scope for the countries of the region to refine their assessment tools to take advantage of lead time provided by early predictions of El Niño 1997. Refined impact assessment methods would also enable the Southeast Asian countries to design appropriate public awareness campaign measures to inform all stakeholders about the impending El Niño impacts. The affected countries were in a better position to evolve an appropriate framework to meet the impacts arising from the El Niño 1997.

El Niño Impacts in Southeast Asia

Weather Anomalies, Droughts and Water Resources

In the Southeast Asian region, the primary El Niño related impacts generally include lower than normal rainfall. This is adequately illustrated by annual rainfall data from different countries of the region. For instance, in the Philippines, Indonesia and Singapore, the time-series annual rainfall data shows a sharp reduction of rainfall during the El Niño years. Despite being a high rainfall region in the normal years, the Southeast Asian region demonstrates a high correlation between El Niño events and occurrence of drought. In most cases, lower rainfall in the El Niño years leads to moderate to severe drought conditions. For example, in Indonesia, over 93% of the monsoon droughts have been associated with El Niño during the period 1944-1983. Over in Java, Indonesia, the relationship between El Niño and droughts has been so strong that the advent of an El Niño event can be safely used as a prognostic indicator of subsequent drought.

In the Philippines, reports indicated that there was reduction of rainfall in various regions during Southwest monsoon periods ending October 1997. There was less than normal storage of water in major reservoirs like Angat dam (-23%) and Pantabangan dam (-22%).

Impact on the Agriculture Sector

Despite rapid industrialization in the past two decades, agriculture remains the dominant sector engaging more than half of the economically active population in Southeast Asian region. The drought conditions arising from a severe El Niño event seriously affect the agricultural sector in the region. In the past El Niño years, this impact has been clearly reflected in the decrease of crop area and crop production, water levels of the multipurpose dams and its cumulative inflow.

The analysis of rice yield data reveals that the region, despite intensive agriculture system irrigation and improved agronomic practices, is impacted by El Niño either by reduction of rice production or retarded annual growths. The following Table 1 presents the time series rice yield data for selected Southeast Asian countries for normal and El Niño years.

In some cases, the agriculture sector adjusts the cropping pattern by reallocation of crop areas to different crops. For example, in the Philippines, during the drought years of 1987 and 1989, the corn hectarage increased by 2.25 to 3.5%, respectively. This increase was also due to the fact that vast areas of dried up marshlands could be brought under corn cultivation. Similarly, in Indonesia, during the 1982-1983 El Niño, though the rice production decreased in certain areas, corn production increased by 56%.

While agriculture related activity recovers fairly quickly on return of normal monsoon conditions, the impact on natural resources mostly causes irreparable damage to the fragile ecosystem.

Broader Economic Impacts

In most countries of the Southeast Asian region, the El Niño related climatic variation and the ensuing droughts often affect agricultural production, resulting in food security threats. The adverse effects on the agriculture sector often lead to local food shortages (and in some cases even national food shortages), disruption of drinking water supply, loss of cattle and outbreak of epidemics. For example, throughout Indonesia, the crop failure of 1982-1983 resulted in more than 300 deaths. In addition, in many Southeast Asian countries, agriculture makes substantial contribution to foreign exchange reserves. The import of food grain in substantial quantities during El Niño years leads to export-import imbalances, strained economies and food shortages in some countries.

According to the Indonesian Tourism, Post and Telecommunications, the forest fires in Kalimantan and Sumatra in 1997/1998 have caused a drop in tourism by about 15% as many travelers and tour groups from European and Asian nations have cancelled their trips to Indonesia.

Environmental Impacts

During the El Niño years, the impact of the dry spell on the forest and other natural resources has also been severe. For example, in the 1982-1983 El Niño year, forest fires in East Kalimantan in Indonesia were extremely serious. The dry spell in 1982-1983 El Niño caused normally evergreen trees to lose their leaves, which resulted in a build-up of dry forage on the forest floor. Fires possibly triggered by agricultural burning for land clearance spread rapidly through the forage. Forest

El Niño Impact on Rice Yields (Tons per hectare)

Year	Indonesia	Malaysia	Philippines	Thailand	Vietnam
1971	2.41	2.47	1.60	1.99	2.23
1972*	2.43	2.40	1.44	1.83	2.19
1973	2.56	2.63	1.66	1.92	2.21
1981	3.59	2.99	2.36	1.95	2.20
1982*	3.32	2.75	2.39	1.89	2.52
1983	2.83	2.71	2.50	2.04	2.63

Table 1. Rice Yield for Selected Southeast Asian Countries for Normal and El Niño Years.
**El Niño Year, Source: FAO Rice Production Data, 1990.*

containing areas of logging suffered badly because organic debris from the logging was left on the forest floor. More than 3.5 million hectares in East Kalimantan, and 1 million hectares in Malaysian Sabah were destroyed. Fires raged for almost three months and were described as one of the worst environmental disasters of the century. In 1997-1998, about 10 million hectares were destroyed in Indonesia.

Lessons Learned

One major lesson learned from the recent El Niño episode was that weather, climate, smoke and haze do not recognize national boundaries. The forest fires in 1997/1998 were exacerbated by the El Niño related drought in the region that provided favorable conditions for large-scale fire. Another major lesson was that the meteorological services played a critical role in the response and management of the regional and national smoke and haze problem. They contributed in valuable ways through:

(1) traditional activities related to meteorological monitoring and forecasting

(2) monitoring and surveillance functions, including hot spot identification using satellite imageries, haze trajectory modeling, compiling monthly and seasonal climate prediction information, and activities related to air quality monitoring, and

(3) effective and prompt dissemination of information to environmental and other agencies engaged in fire and smoke and haze response and management, and the general public through the Internet and press releases.

An operational ASEAN Specialised Meteorological Centre's (ASMC) Intranet has been established to provide the relevant weather, climate and environmental information and forecast products to ASEAN NMSs, national environmental agencies and various relevant national organizations. Some details on the ASMC Intranet are given in Appendix 1.

While the fires of 1997/1998 were severe, they were not rare. Records in the region have shown that there have been at least nine episodes of widespread smoke and haze since the 1970s, and that they occurred most frequently during El Niño events. Based on this trend, it is highly possible that such fires and widespread smoke and haze episodes will occur again, as present land use plans in the region necessitate continued large scale land conversion. Thus there is a pressing need for the region to maintain its vigilance, and to further develop and implement haze-related action plans. For this purpose, there is a need to further strengthen the capacities of the meteorological services to better provide the timely warnings and forecasts required to anticipate risks of widespread fires and resultant smoke and haze episodes, and assist decision-makers in managing smoke and haze episodes.

Besides enhancing the meteorological capacities to better address the regional smoke haze episodes, there is a need to help mitigate the negative impacts and aspects of El Niño. This could be done through public education about El Niño to improve societal response and how best to cope with it, undertake studies on the impacts of El Niño and development of capacities at regional, national and local levels. While timely warnings can be made easily available to the public, people require education and training to interpret and use such warnings. Such expertise and awareness are required prior to the onset of a potentially disastrous El Niño event to enable effective integrated preparedness and mitigation response.

APPENDIX 1

Operational ASEAN Institutional Framework for the Detection and Monitoring of Smoke Haze in Southeast Asia

The ASEAN Specialised Meteorological Centre (ASMC), co-located with the Meteorological Service Singapore, was officially established in January 1993 as a regional collaboration program among the National Meteorological Services (NMS) of ASEAN countries to enhance benefit from the advances made in meteorological science and technology, and to strengthen support provided to important weather-sensitive segments of their economies.

One of the roles of ASMC is the provision of relevant weather information and forecast products to

Figure 1. ASMC Intranet.

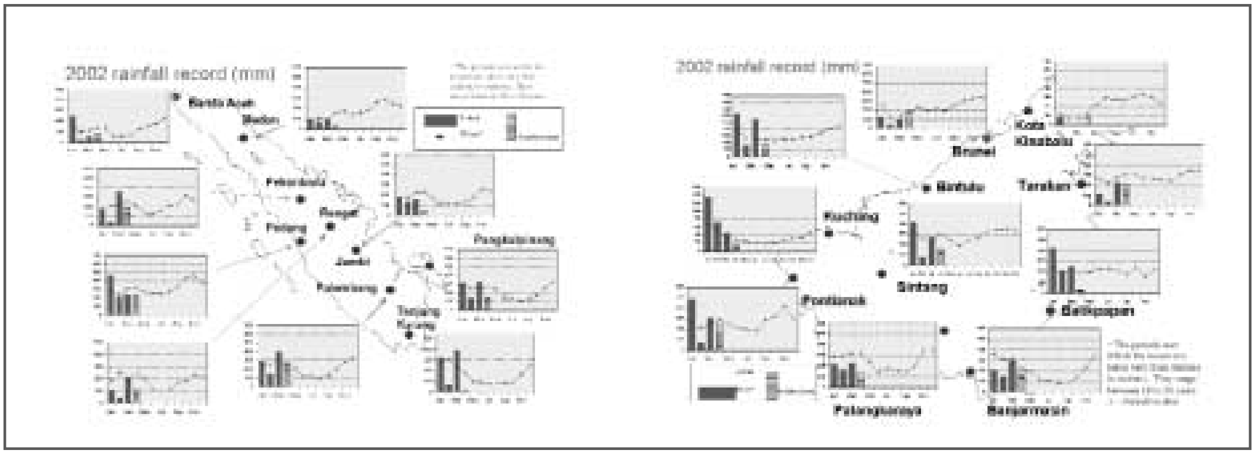

Figure 2. Assessment of Current Climatic Situations.

ASEAN NMSs to serve as an early warning service for tropical storms and climate-related events such as smoke haze over the ASEAN region. The individual NMSs and the relevant national authorities shall remain the sole authorities of issuing hazardous weather and environmental conditions to their populace.

An operational ASMC Intranet has been established to provide the relevant weather, climate and environmental information and forecast products to ASEAN NMSs, national environmental agencies and various relevant national organizations. The ASMC Intranet provides a comprehensive set of customized weather, climate and environmental products as shown below:

General

In the past few months, the rainfall as recorded in the ASEAN countries has been below average for most parts. Meanwhile, increased convective activity has been observed from Papua New Guinea eastward to the date line. Continued warming of SST has also been observed over most parts of tropical Eastern Pacific with as much as 2-3^{0}C above average seen near the coast of Ecuador and Peru. These conditions are likely manifestation of a developing El Niño in its early stage. Figure 4

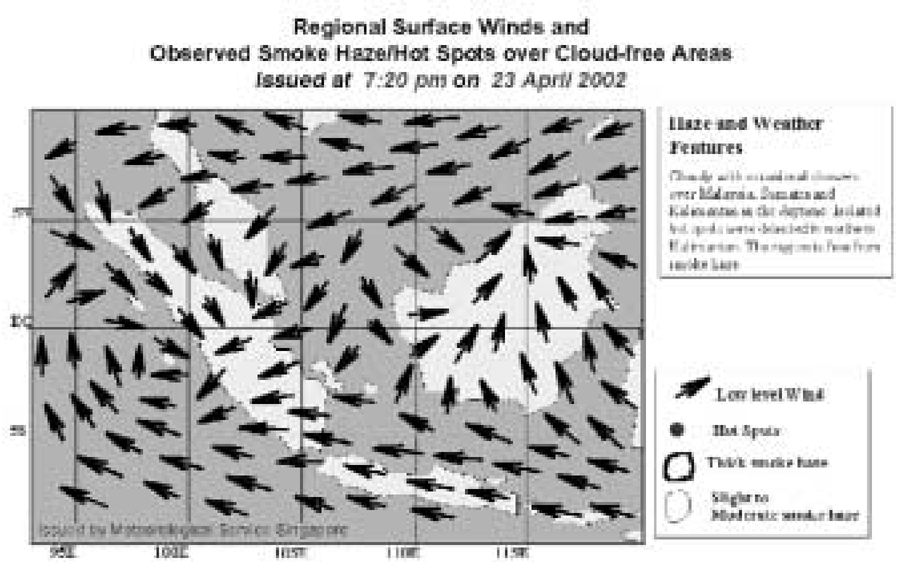

Figure 3. Regional Haze Map.

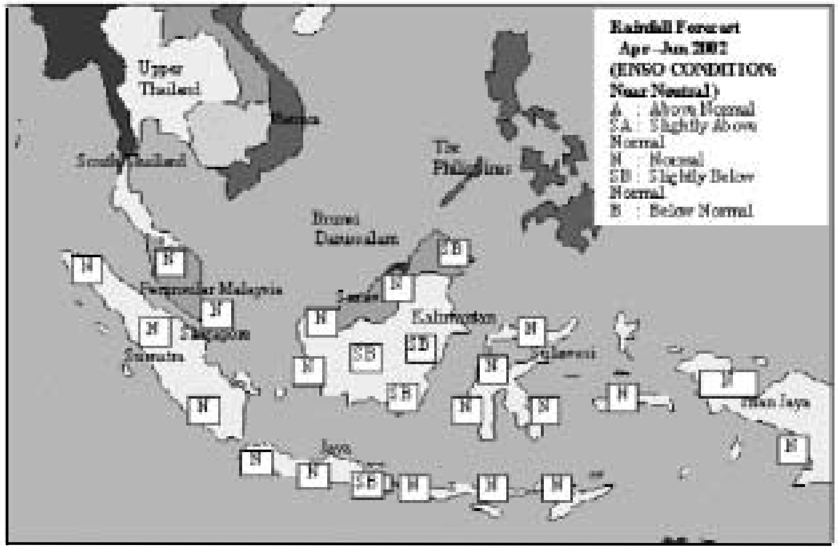

Figure 4. Rainfall Prediction for the ASEAN Region, April to June 2002.

is a summary of regional rainfall predictions made during the 6th Sub-Regional Climate Review Meeting held in Singapore (1 April 2002).

Impacts of ENSO on Taiwan

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Impacts of ENSO on Taiwan vary from one case to another, because Taiwan is so small in spatial size and located in the subtropics, not the tropics. When the strength of ENSO is not very strong, Taiwan normally doesn't feel a clear impact of ENSO. Instead, the regional anomalous climate change may impose great impacts on Taiwan. For example, Taiwan is in a very dry condition right now. It is because during the past winter and spring synoptic transient waves in the Asian-western Pacific region were weak and shifted northward, resulting in deficient winter and spring rainfall in Taiwan. The government has issued a level-1 drought alert to limit water use, which prohibits the use of water for swimming pools, car washing, and so on. Also, the rice planting in spring was also abandoned in the northern Taiwan in order to save water resources. However, if the Mei-Yu in May doesn't bring in sufficient rainfall, the government plans to issue a level-2 drought alert in middle May, which will cut 10% of water supply for regular family use in daytime and provide no water supply from midnight to the next morning. The current outlook for the coming Mei-Yu is normal to below normal. We are eager to learn from the IRI about the forecast of the coming Mei-Yu in May.

Network Development

Affiliates Network

One of two mechanisms for facilitating inter-regional communication on climate related issues proposed and discussed at the workshop was an inter-regional network for information collection and exchange. The network would be comprised of regional experts, or affiliates, able to interpret climate forecasts and document their usage in specific contexts. The affiliates would provide high quality analyses of climate impacts in sensitive sectors throughout their respective regions, documenting and improving understanding of these impacts. Systematic communication on impacts, and the use of forecasts to manage them, would provide insights for improving management of climate variability. These insights would be useful not only within each region but also across regions, as experiences are shared inter-regionally.

Purpose

Managing climate through the use of seasonal climate forecasts is a relatively new undertaking, with many lessons yet to be learned. It requires in-depth knowledge of the impacts of climate on society. Part of the process of acquiring this knowledge is on-going monitoring and documenting of climate impacts. Knowledge of impacts in turn assists in improving society's ability to manage them.

Currently, a great deal of knowledge and information exists at the national and regional levels on climate and its impacts. This information is not always being systematically collected and shared, however.

An affiliates network provides a means of systematically building up a knowledge base on climate impacts and their management both within and across regions. Within regions, this information can serve as a real-time aid to decision-making. Over time, patterns of impacts will emerge that will assist in seeking long-term solutions to climate-related problems, and in identifying emerging ones. When communicated across regions, the accumulated experiences and lessons learned constitute a substantial expansion of the knowledge base available to any one region. Regions can learn from each other's experiences, and a global picture of climate impacts and experiences in managing them will emerge.

Implementation

Ingredients required for the implementation of the network include identification of affiliates, coordination of methods for assessing climate impacts and impact-management efforts, systemization of methods for documenting impacts, and establishment of knowledge-sharing mechanisms. A substantial infrastructure already exists in many regions on which such a network could be built. In some regions, however, additional human or other resources would be required.

Next steps include identifying the means of formalizing the network, developing information formats and methods and determining information-sharing mechanisms. The IRI agreed to coordinate this process and act as a clearinghouse for region-specific proposals.

Climate Information and Applications System Developers’

The second mechanism for promoting inter-regional knowledge exchange was a web-based climate information system developers’ toolbox. The toolbox would provide a portal into regional climate information network activities and a vehicle for sharing selected information, tools and techniques across regions. The toolbox would assist climate information system developers in promoting more effective use of climate information with and across regions. In addition to information provided by the affiliates network, toolbox content could include links to regional climate information system web pages, training course curricula and modules, project design aids, pilot project results, and a link to a database of information resources on climate information applications being developed by the IRI. Toolbox information would also be distributed via CDs, hardcopy reports and other means in addition to the internet.

Purpose

Advances in the use of climate information for managing climate variability are occurring around the world, thanks in part to the efforts of committed groups of climate information system developers who have established networks for managing climate variability in affected regions. The toolbox would provide a dedicated means of exchanging tools, techniques and experiences in developing these systems. Regions would be able to learn from each others’ experiences and adapt each others’ methods to systematically promote the development of these regional networks. Moreover, the toolbox would highlight the progress being made across the regions in climate variability management by increasing access to regional products and results.

Implementation

Many regional climate information systems already have websites containing forecasts and information on climate-related regional activities. These websites provide a foundation on which to build. In other regions, support is needed to compile initial content. As access to the worldwide web is not universal, non-web-based means of information dissemination of toolbox content would also be desirable.

Regional affiliates would be needed to identify materials – products, tools, methods, and documents – that would be of interest and value in other regions and to make those materials available for broader distribution. These affiliates could also serve as an oversight committee regarding the management of the content and its presentation for dissemination. The required resources and incentives would vary by region, suggesting that a useful starting point would be a modest effort to make initial content more widely available from among existing information resources.

Next steps include:

- a review of existing regional websites
- a review of the toolbox demo site based on discussion at the workshop
- identification of interested regional collaborators
- organization of the process of managing content and its presentation and of obtaining and incorporating feedback.

IRI and NOAA/OGP agreed to coordinate follow-up on the toolbox.

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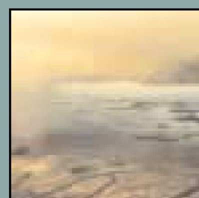

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