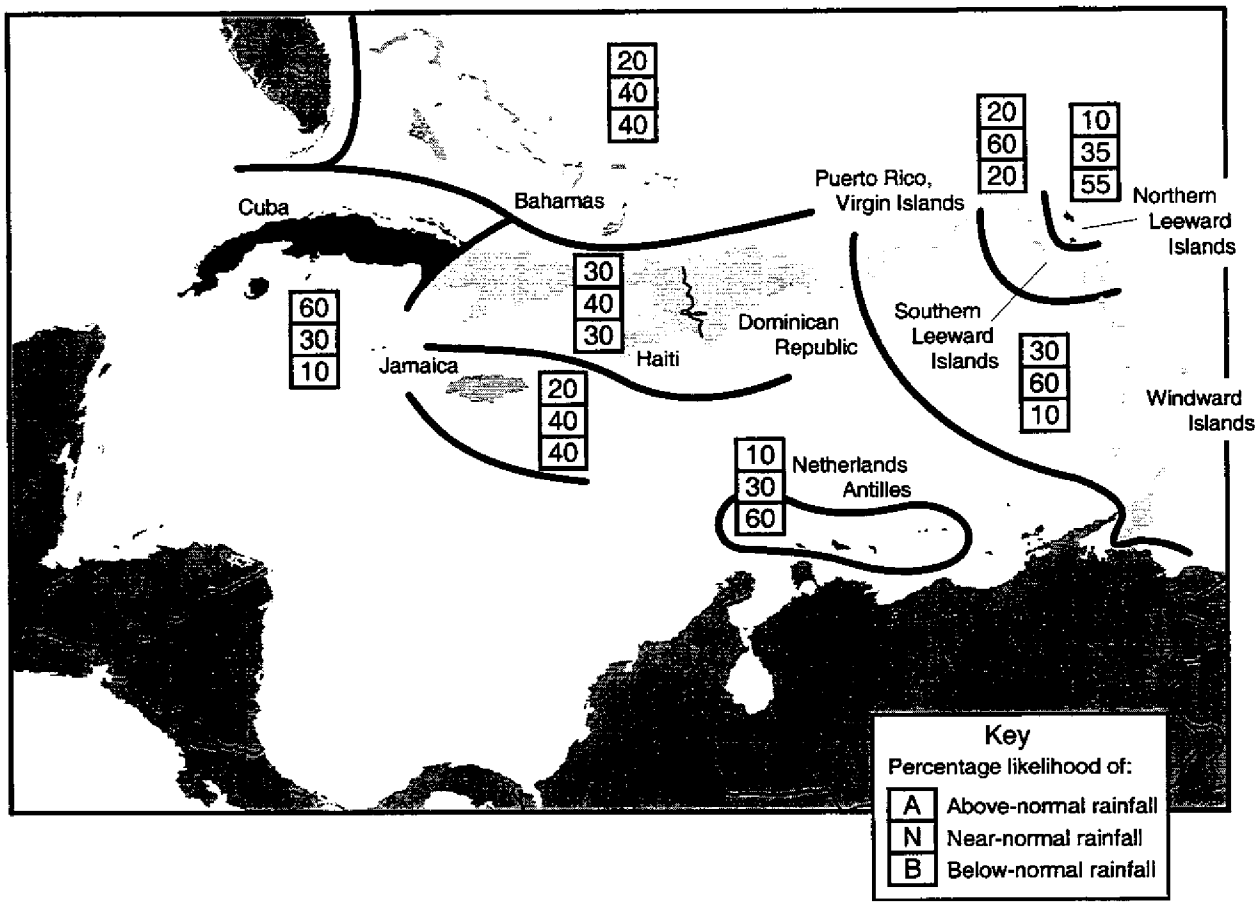
Consensus Climate Guidance

Caribbean Regional Climate Outlook Forum

21-22 May 1998 *Kingston, Jamaica*

(for list of participants and explanatory text see associated discussion)

June - August 1998



IRI INTERNATIONAL RESEARCH INSTITUTE FOR CLIMATE PREDICTION
EXPERIMENTAL CLIMATE FORECAST DIVISION

IRI is a cooperative agreement between NOAA Office of Global Programs, Lamont-Doherty Earth Observatory of Columbia University and Scripps Institution of Oceanography/University of California, San Diego.

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Latin America and Caribbean Survey Results

To evaluate the Outlook Fora and determine how the forecast information produced at them was used, NOAA-OGP sponsored a survey of participants in the Outlook Fora, Applications Workshops and Conferences. Survey results were compiled at the International Institute for Applied Global Change Research (GAIA), Ensenada, Mexico. Of 286 total participants in the Latin America and Caribbean events, 119 responded to the survey. Of the 119 respondents, 50% were from academic research centers and National Meteorological and Hydrological Services, about 30% were from agricultural, fisheries, water resources, disaster mitigation, and health sectors, and the remainder were from various public agencies.

Approximately 60 respondents were directly involved in creating the consensus Outlooks, and 25% of this group indicated they had previous experience in generating climate forecasts. This statistic highlights the need for training in the methods of climate forecasting in Latin America and the Caribbean. Despite the relatively small number of experienced forecasters, the majority of respondents to the survey (60%) indicated the Outlooks were generally representative of precipitation amounts during the forecast period (15% indicated the Outlooks were not representative of rainfall conditions and 25% had no opinion). Respondents indicated that the climate forecast information from the Outlook Fora was used to:

- Develop risk maps for river basin flooding;
- Inform the agricultural sector in various countries of the potential for droughts and floods;
- Advise the agricultural sectors in certain regions to alter timing and type of crops to be planted;
- Inform government representatives and ministries of agriculture, water resources, and health of drought and flood potential;
- Define rainfall probabilities for river flow models, which in turn served as a basis for flooding alerts;
- Create a system to regulate water reserves for energy production; and
- Support requests for emergency funding in certain regions.

The vast majority of respondents indicated that consensus forecasting activities similar to the Outlook Fora should continue, indicating the success of these events in facilitating forecast applications, and the potential for forecasting networks to develop in Latin America and the Caribbean in the future. To more fully achieve the original objectives of the Outlook Fora (identifying gaps in information and technical ability, improving information exchange and coordination within the forecasting community, and discussing issues related to Outlook development and use), it was suggested that more time be allotted to each Outlook Forum for

participants to address these issues. Intra-country meetings following regional Outlook Fora that include potential forecast users at the local level (as opposed to regional or national) would further encourage the use of forecast information. Although over 70% of survey respondents indicated the format of the Outlooks was usable, several offered suggestions for improvement:

- Include a more thorough explanation of probabilities and the limitations of available forecast products;
- Include information on rainfall distribution within the season and probability of extreme events;
- Provide numerical rainfall values to accompany the terciles;
- Enhance Outlook spatial resolution and present probabilities in greater detail than terciles (i.e. dividing the forecast into four or more categories);
- Offer additional forecast products, such as thermocline depth, transpiration rates, humidity levels, soil moisture, and minimum-maximum temperatures on land; and
- Standardize the methods for producing and evaluating individual forecast contributions to the consensus product, and an approach for evaluating the consensus forecast itself.

SOUTHEAST ASIA OUTLOOK FORUM - February 1998

As the 1997-98 El Niño developed, the Asian Disaster Preparedness Center (ADPC) and NOAA-OGP took the initiative to host an "Asian Regional Meeting on El Niño Related Crises." The event, sponsored by USAID-OFDA was held in Bangkok, Thailand, February 1998. The primary foci of the meeting were 1) to discuss enhancement of capability in short-term forecasting of El Niño-generated weather patterns, 2) discuss application of forecasts both regionally and internationally, and 3) to generate a consensus precipitation forecast for the Southeast Asia region for February to April 1998. Other topical issues included the role of forecasts in early warning and impacts assessment, and the need for public education, information dissemination, and contingency planning. The Outlook Map, description, and a map of observed precipitation amounts for the forecast period, expressed in terms of percentage of normal rainfall, follow in the next few pages.

The Southeast Asia meeting attracted 130 delegates from 21 countries including those of the Asia and Pacific regions, and received worldwide media coverage. It brought together national policy and decision-makers (from various sectors including: public health and population welfare; industry and economy; natural resources and environment; and industry and economy), regional and international climate scientist and organizations, disaster managers from countries in the region, representatives from the international humanitarian assistance community, bilateral and multilateral donors, the Asian Development Bank, non-governmental organizations and regional media representatives. The meeting also provided a crucial interface between meteorologists and national agencies charged with responding to crises that significant disruptions, such as El Niño, cause in expected climatic cycles.

This event facilitated an exchange of information and experiences between professionals and helped elucidate the potential and limitations of forecasting such events. It indicated that the correlation between ENSO events and changes in the normal climate cycle varies significantly among countries in the region. It further highlighted the need for additional study on the impact that temperature fluctuations in the Indian Ocean may have on the weather patterns and rainfall for south and southeast Asia.

Participants at the Southeast Asia Outlook Forum focused on the importance of long-lead forecasts in alleviating social and economic costs related to climate variations, and the need for

political and financial support to establish an integrated regional climate information system. It was emphasized that these climatic events tend to magnify human mistakes and absence of planning. A number of follow-up actions are being envisaged including: 1) facilitation of a Regional Climate Forum and establishment of a Regional Strategic Planning Committee; 2) establishment of a Pilot Regional Information Clearing House at ADPC as an operational instrument of the above two Fora; and 3) development of a long-term multi-institutional program on "Regional Capacity Building for Climate Forecasting and Applications".

Outlook Evaluation[38]

Many Southeast Asian nations experienced drier than normal conditions from February to April, 1998. For most of the Philippines, rainfall amounts were less than half normal levels, consistent with the Climate Outlook of 70% likelihood for below-normal precipitation. Sri Lanka and islands in south-central Indonesia were forecast at 50% probability for below-normal precipitation, also in general agreement with observations. Indonesia and New Guinea were forecast to have near-to below-normal rainfall, which they did, except for western New Guinea. Much of Vietnam, Thailand, and Cambodia experienced drier than normal conditions, matching the forecast for increased likelihood of below-normal rainfall in these areas.

[38]For a description of the qualitative method used to evaluate the Outlook, see Comparison of Climate Outlooks and Observations in the Methodology section.

Climate Outlook - Rainfall

Statement from the Southeastern Asia Regional Climate Outlook Forum
2 February, 1998, Bangkok, Thailand

SUMMARY

Below normal rainfall conditions will continue to prevail in most parts of the region during the period February through April 1998. Indications for below average rainfall are strongest in the Philippines, northeastern Kalimantan, the northern Sulawesi and the region around the Bay of Bengal, including Sri Lanka and around the South China Sea. Above average precipitation is expected only in western Sumatra and southeastern China. These conditions are consistent with precipitation patterns usually associated with the mature phase of a major El Niño, such as occurred in previous events (e.g 1982-83) and the current event (e.g. 1997-98).

THE CLIMATE OUTLOOK FORUM

A Regional Climate Outlook Forum convened in Bangkok on Feb. 2, 1998 to formulate consensus guidance for the February-April 1998 season in Southeastern Asia. The Bangkok Forum reviewed the state of the global climate system and its implications for Southeastern Asia. One of the principal factors taken into account is the major El Niño event on-going in the tropical Pacific Ocean; anomalously warm sea surface temperatures over the Indian Ocean were also considered. Recent El Niño occurrences such as in 1982-83, 1986-87 (although with somewhat different patterns), 1991-92 and 1994-95 resulted in below-average rainfall across much of Southeastern Asia and disrupted climate patterns around the globe.

METHODOLOGY

The regional climate assessment began with consensus agreement that the current El Niño will remain over the forecast period (February-April 1998). This and other factors affecting Southeastern Asia's climate were assessed using coupled ocean-atmosphere models, physically-based statistical models and expert interpretation The current status of seasonal to inter-annual forecasting allows prediction of spatial and temporal averages, and does not fully account for all factors that influence regional and national climate variability. This Outlook is relevant only to seasonal time scales and relatively large areas, and local variations will occur. Users are strongly advised to contact their National Meteorological Service for interpretation of this Outlook and for additional guidance.

OUTLOOK

February through April covers much of the dry season in most parts of the Asian tropical monsoon region, with April being the transitional month of the commencement of the summer monsoon. The region from the Philippines, northeastern Kalimantan, northern Sulawesi, most parts of Indochina, Thailand, Myanmar, Bangladesh and Sri Lanka are expected to continue to have below-average precipitation, except for southeastern China and the western part of Sumatra where there is an expectation of above average rainfall.

The precipitation outlook described above is consistent with conditions in Southeastern Asia and the Indonesian maritime continent usually associated with the mature phase of a major El Niño episode.

PARTICIPANTS

Participants at the Forum included representatives of fifteen Meteorological Services (Australia, Bangladesh, Kingdom of Cambodia, China, Fiji, Indonesia, Republic of Korea, Lao PDR, Macau, Malaysia, Union Myanmar, Philippines, Sri Lanka, Thailand and Socialist Republic of Vietnam) and climate scientists and other experts from national, regional and international institutes (ADPC, IRI, the University of Colorado, NOAA, and USAID).

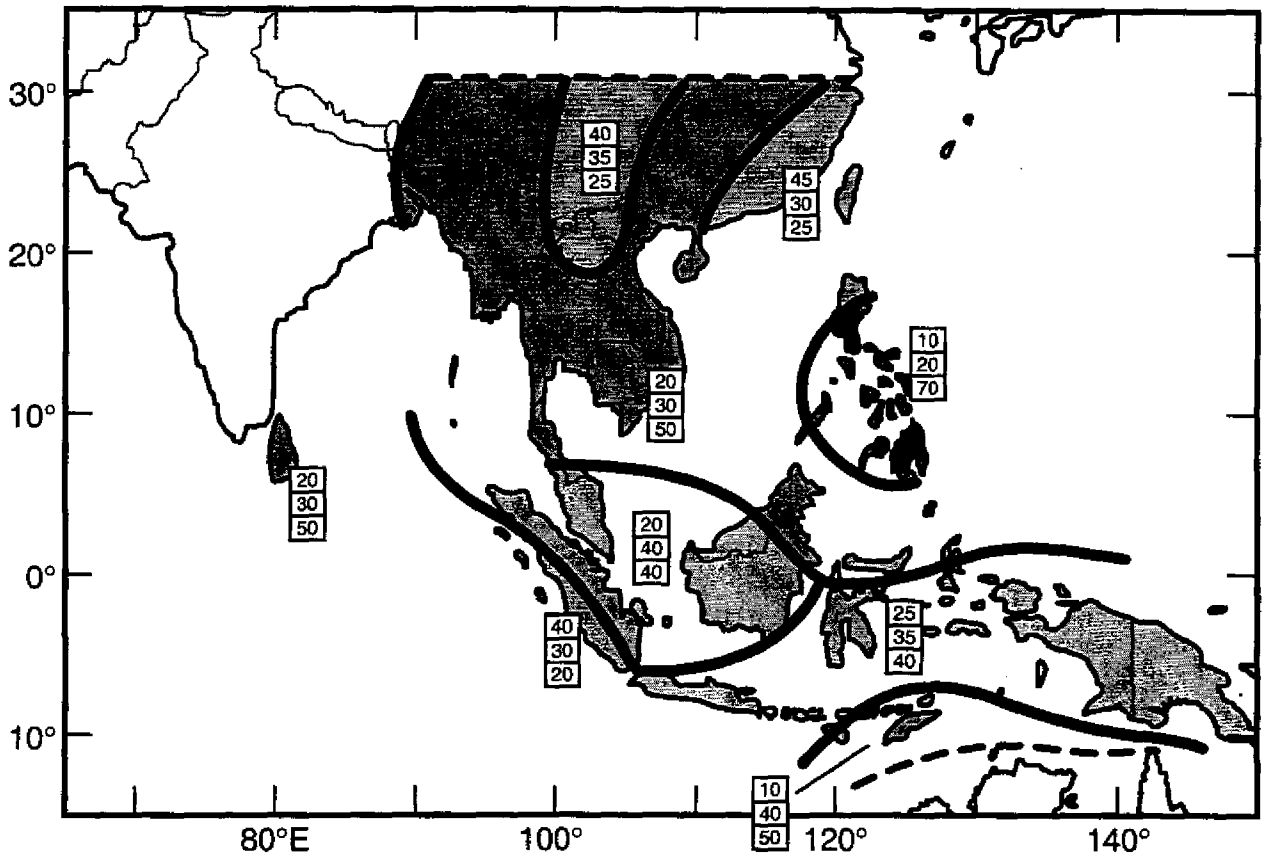
Consensus Climate Guidance

Southeastern Asia Regional Climate Outlook Forum

2 February 1998 *Bangkok, Thailand*

(for list of participants and explanatory text see associated discussion)

February - April 1998



Feb. 2, 1998

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IRI International Research Institute
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Experimental Climate Forecast Division

RECOMMENDATIONS

The Outlook Fora were largely successful in achieving the objectives of 1) developing and communicating consensus seasonal Climate Outlooks, 2) facilitating research cooperation and data exchange within and between regions; 3) improving coordination within the climate forecasting community; and 4) developing a regular dialogue between producers and users of the climate information. In fact, several of the regions where the Outlook Fora occurred have already conducted or plan to conduct consensus climate forecast activities in 1998-99. These activities will further advance collaboration between climate forecasting entities and decision makers in climate-sensitive sectors.

Participants in the Outlook Fora and associated meetings identified priority activities for developing climate forecasting and applications techniques and closing the gap between user needs and forecasting capabilities, including:

- Improved forecast accuracy, detail, and tailoring for decision-makers in specific sectors;
- Forecast training programs and educational opportunities that cross political and sectoral boundaries;
- Establishment of uniform criteria for forecast skill and validation techniques;
- Continued updates (ideally consensus forecasts) of the state of the climate for the upcoming season;
- Continued interaction between forecast users and producers to create the best and most applicable forecasts for given sectors; and
- Pilot demonstration projects designed to establish a framework for responding to climate forecast information in the areas of agriculture and food security, water resource management, public health and forestry;

Many of these activities are currently underway or being developed by NOAA-OGP and its national and international partners that helped organize and fund Climate Outlook Fora in 1997-98.

Forecast accuracy and detail

While many of the forecasts for El Niño-related precipitation deficits or excesses were quite reliable and promising in their utility, they were by no means perfect. Further application of seasonal to interannual forecasts will be aided by improvements in their accuracy and detail. This will be achieved through continued physical climate system research into the dynamics of ENSO and other ocean-atmosphere interactions outside of the equatorial Pacific that have a significant

influence on regional to global-scale climate patterns. Forecast detail will improve as computer models more accurately capture key climate system mechanisms and as computing power increases. In certain regions, forecasts based on historical data can be improved through compiling more complete and longer data sets of precipitation and temperature. Tailoring of forecast products to specific needs will also increase utility. For example, a forecast product describing the likelihood of extreme rainfall events may be more useful to a disaster manager than general seasonal precipitation trends.

Outlook Fora Methodology

Training

In some cases, lack of familiarity with seasonal climate forecasting or lack of capacity limited the contributions of participants to the Outlook Forum process. To support the development of climate forecasting and applications in the region, additional training and educational opportunities will be necessary. One possible model for training of forecast producers is the "Regional Training Course on Practical Application of Seasonal-to-Interannual Climate Prediction to Decision-Making in Agriculture and Water Resources Management in Africa". The course, which was jointly sponsored by the IRI, the African Centre of Meteorological Applications for Development (ACMAD), and the WMO, occurred in Niamey, Niger during the summer of 1997. Following the model of this course, a similar training session was organized by ACMAD, also in Niger, prior to the PRESAO meeting in Abidjan, Ivory Coast, May 1998. The primary purpose of each was to expose a group of professionals from African countries who were familiar with seasonal and interannual climate variations and ENSO-related impacts, to state-of-the-art climate monitoring and predictions.

The first portion of the training courses focused on background of climate prediction, current models, data requirements, communications, model output interpretation, amalgamation of different data sources and regional problems associated with ENSO events. Participants learned how to use the software CLIMLAB, a statistical and graphical software package designed to analyze climate information, and to make statistical climate forecasts of past conditions (i.e., hindcasts) for their individual countries. Participants then used observational data from their country/region to validate the hindcast results. As a result of this training, national meteorological

service participants at the West Africa Outlook Forum were better prepared to actively engage in the creation of the Climate Outlook. Also, the measured skill of their individual forecasts permitted a more objective blending of forecasts into a consensus.

Training courses such at those that occurred at ACMAD are an essential component in building regional capacity to utilize climate forecast information. Training and educational opportunities are also necessary for the user community to enhance understanding of the capabilities and limitations of forecast information. The IRI, WMO, World Bank, IAI, START, ACMAD, and other institutions, both public and private, have expressed their enthusiasm for participating in and contributing to the creation of cross-sectoral training and educational opportunities related to climate forecasting.

Forecast Criteria

The potential usefulness of climate forecasts depends upon their accuracy. It is therefore essential that common criteria be established for the creation and evaluation of forecasts. For the Outlook Fora, forecasters in various regions used a multiplicity of verification methods for their individual forecasts which were often difficult to compare. Ideally, all forecasts should be verified in terms of a standard set of criteria to provide a common measurement base that can be used to inform future development of techniques.

The following set of draft criteria are under consideration by the Southern Africa Climate Outlook Forum. Participants at SARCOF generally agreed that a set of objective criteria are necessary to govern the inclusion of individual forecasts which serve as inputs to consensus Outlooks. Criteria are necessary because it takes many years to prove if, and at what level, a forecast system demonstrates skill. If adopted, each forecast contributor would be required to submit a summary of their forecasting system, including methods and estimates of skill levels expected in real-time.

For empirical methods:

- Predictors should be physically plausible and based on current scientific understanding;
- Assessing the skill in real-time is controversial, but some estimate of skill independent of model training is needed;
- Satellite records are generally considered too short to be used in empirical models;

- A data set of 30-40 years is considered necessary to derive reliable skill estimates; and
- A number of methods for testing skill levels are available, including cross-validation and retroactive real-time validation.

For dynamical models:

- In many cases validation cannot be performed due to an insufficient number of model experiments, but the general ability of a model to simulate atmospheric responses to sea surface temperatures contributes to confidence in the model's forecasts;
- Some estimate of skill is required;
- Ten years of past forecasts are preferred; and
- Each model should be treated on its own merits.

Establishment of a skill verification system will help prospective users of climate information determine which forecast products best suit their requirements. The need to provide common verification methodologies across differing forecast systems has been recognized by the World Meteorological Organization Commission for Atmospheric Sciences Working Group (WMO-CAS), and an internationally-accepted standardized verification system (SVS) is being devised cooperatively by the WMO-CAS, the WMO Commission for Basic Systems (CBS), and the WMO Commission for Climatology (CCl). A training workshop linked to the Outlook Fora would be an ideal venue for exploring the practicality of using a common verification and validation methodology based on a common data set.

In addition to the issue of validating individual forecasts, the skill of the consensus forecasts created at the Climate Outlook Fora also need to be evaluated. One example of quantitative Outlook evaluation is the method employed by SARCOF participants.[39] Although this method does not fully address the probabilities associated with terciles, it is the type of quantitative and objective procedure necessary to avoid potential biases in qualitative evaluations. A major challenge to climate forecasters and users is to develop a validation technique for consensus forecasts that 1) more fully accounts for their probabilistic nature, and 2) provides a measure of skill that users of the forecast information can understand.

[39]See SARCOF Preseason Outlook evaluation section.

Outlook Communication and Dissemination

Terciles

The use of terciles and the term "normal" could be altered to provide the user with more detailed and clearer information. Although "normal" in the tercile scheme is defined as the middle third of the historical record, to a potential forecast user, "normal" is a subjective term that could result in expectations for climate conditions different than those originally forecast. One way to address this issue would be to provide forecasts in terms of probability that rainfall will exceed a given amount (e.g., there is a 70% chance that rainfall will exceed 20 centimeters over the next 3 months) or in terms of the likelihood of extreme rainfall events. Using rainfall amounts would provide more information to the user while simultaneously avoiding subjectivity associated with the terms below-, near-, and above-normal. Alternatively, regional maps of threshold rainfall values for each tercile would also encourage users to think in terms of rainfall amounts as opposed to what is "normal". Such maps were handed out by the IRI at the Greater Horn of Africa Forum and the PRESAO. The maps were received favorably by NMHS representatives, but were difficult for users to interpret. Also, the multi-colored and intricate nature of the maps made them difficult to reproduce in many regions.

Communication Links

Communications and connectivity, particularly with regards to e-mail and the internet, were recurring themes at the Outlook Fora that will have to be addressed in order to realize climate forecasting and applications goals. Communications capabilities differ greatly within regions among both the producers and users of climate forecast information. Vital communication links are supported by a range of technologies, from state-of-the-art internet connections to unreliable telephone and radio links. Collaboration between local, regional, and international entities will be vital to the development of improved communications links which will enhance the flow of information between forecast users and producers at a number of levels and across a myriad of sectors.

Systematic Forecast Creation and Distribution

The Climate Outlook Fora and associated meetings prior to and during the 1997-98 El Niño event demonstrate clearly the need and potential for a long-term strategy for the regular generation, dissemination, and application of forecast information. To meet this challenge, NOAA-OGP is working in Africa, Latin America, the Caribbean, and Southeast Asia, with a group of domestic and international partners, to develop regional forecast production and application capabilities. In Latin America and the Caribbean, for example, NOAA-OGP is working with USAID-OFDA, WMO, IRI, and several international and national level organizations to establish the Pan-American Climate Information System (PACIS). An agreement signed by the governments of Chile and the United States at the Summit of the Americas in Santiago (April, 1998) formally recognized the intent to establish PACIS. It is envisioned that such a system will be capable of monitoring, modeling and predicting climate and then interpreting and applying climate predictions for mitigation and response policy- and decision-making. This comprehensive approach will serve to build on and coordinate a range of activities currently being carried out in the region.

Creating systematic mechanisms and activities for climate forecast creation and dissemination will build on existing regional institutions and capacity, therefore enhancing the potential for the system to be maintained and further sustained with regional resources. The intended result will likely be a regular, ongoing series of climate updates, distributed to sectoral specialists and the public through National Meteorological and Hydrological Services and by other media, that would improve decision-making in the context of climate variability. Sector-specific activities would be undertaken to mitigate the impacts of predicted extreme climate conditions on vulnerable populations, as well as to enhance sectoral performance under benign or beneficial conditions.[40]

Forecast Value

The identification and monitoring of user activities in response to forecast information products and an estimation of the benefits obtained by selected users is an essential component of forecast applications. Through successful application of climate projections, users will be more

[40]Please contact NOAA-OGP for further information on activities related to the evolving climate forecast networks in Latin America and the Caribbean, Southeast Asia, and Africa.

inclined to incorporate forecasts into their decision-making processes. Many of the participants of the Outlook Fora were surveyed to determine the value of the climate forecasts. Value, like the term normal, is a subjective one, and therefore difficult to measure. Evidence is often anecdotal, and determining what would have happened in certain instances had a forecast not been utilized is problematic. Nonetheless, survey results from climate forecast users in southern Africa, Latin America, and the Caribbean indicate the Outlooks, although not perfect, were useful to many individuals in planning for and responding to climate variability associated with the 1997-98 El Niño.