

Pacific ENSO (El Niño-Southern Oscillation) Applications Center

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Mission

Recent scientific advances in climate prediction and the study of the ENSO (El Niño-Southern Oscillation) cycle have enabled scientists to generate ENSO "forecasts" at significant skill levels, with lead times up to several seasons in advance. Impacts of ENSO related climate variability on regional weather patterns, and their social and economic consequences, can therefore be anticipated. The mission of the Pacific ENSO Applications Center is to conduct applied regional climate research and provide regional climate forecasts and information for use in management and planning undertaken in the USAPI (United States-Affiliated Pacific Islands) in such climate-sensitive sectors as water resource management, fisheries management, agriculture, civil defense, power utilities, coastal zone management, etc.

Organization

PEAC is a collaborative effort between the US federal government (NOAA-NWS), academic research institutions with regional expertise (University of Hawai'i and University of Guam), and a regional association of Pacific island jurisdictions (Pacific Basin Development Council which includes the governments of Hawai'i, Guam, American Samoa, and CNMI with strong ties to the Republic of the Marshall Islands, Palau, and the Federated States of Micronesia).



Core Institutions

- NOAA National Weather Service – Pacific Region
- University of Hawai'i JIMAR – Joint Institute for Marine and Atmospheric Research
- SSRI – Social Science Research Institute
- UOG/WERI University of Guam – Water and Energy Research Institute
- PBDC Pacific Basin Development Council

US Affiliated Pacific Islands

- Territory of Guam
- Territory of American Samoa
- Commonwealth of Northern Mariana Islands (CNMI)
- Federated States of Micronesia (FSM)
- Republic of Marshall Islands (RMI)
- Republic of Palau
- State of Hawai'i

Case Study: PEAC and the 1997-1998 El Niño

The following is a brief summary of PEAC's response to the 1997-1998 El Niño condensed from *Preparing for a Changing Climate* (Shea et al.) and *The Pacific ENSO Applications Center: Lessons learned for regional climate forecasting* (Hamnett et al.). Due to space constraints, this example focuses primarily on El Niño related changes in rainfall that led to severe drought conditions in the United States-Affiliated Pacific Islands (USAPI). This is by no means a complete picture of the impacts of the El Niño on the USAPI. Public health, fire management, fisheries, and agriculture were among the many areas impacted by the 1997-1998 El Niño. A more complete summary of the events can be found in the aforementioned sources.



In May of 1997, climate modelers in the US and other parts of the world agreed an El Niño was developing and that it could be a strong event. Through the *Pacific ENSO Update*, PEAC notified its clients that an El Niño was developing quickly. PEAC told national and territorial governments that this event could be as strong as the 1982-1983 El Niño, which caused severe droughts in the PEAC service area. By August, there was little doubt that this event would be a very strong El Niño and that severe droughts were likely to develop beginning in December 1997. In September and October 1997, PEAC staff briefed government officials in Guam, Commonwealth of the Northern Mariana Islands (CNMI), the Marshall Islands (RMI), the Federated States of Micronesia (FSM), and Palau on the ENSO events and the strong likelihood of severe droughts.

Following PEAC briefings, all jurisdictions in the US-Affiliated Pacific Islands in the North Pacific established drought response committees, developed aggressive drought response

References

- Shea, Eileen, et al. 2001. *Preparing for a Changing Climate: The Consequences of Climate Variability and Change for Pacific Islands*. Honolulu: East-West Center
- Hamnett, M.P., and C.L. Anderson, 2000. *Impact of ENSO events on tuna fisheries in the U.S. affiliated Pacific Islands*. SOEST Publication 00-03, JIMAR Contribution 00-330, 27 pp.
- Hamnett, M.P., C.L. Anderson, C. Guard and T.A. Schroeder, 2000. *The Pacific ENSO Applications Center: Lessons learned for regional climate forecasting (revised report)*. Pacific ENSO Applications Center, University of Hawai'i Honolulu, HI
- He, Y., A.G. Barnston and A.C. Hilton, 1998. *NCEP/Climate Prediction Center Atlas No. 5: A Precipitation Climatology for Stations in the Tropical Pacific Basin; Effects of ENSO*. U.S. Dept. of Commerce, NOAA, 280pp.
- Lewis, N., M. Hamnett, U. Prasad, L. Tran, A. Hilton, 1998. *Climate and Health in the Pacific: Research in Progress*. *Pacific Health Dialog* 5(1): 187-190.
- Yu, C. P. Chu and T. Schroeder, 1997. *Predictive Skills of Seasonal to Annual Rainfall Variations in the U.S. Affiliated Pacific Islands: Canonical Correlation Analysis and Multivariate Principal Component Regression Approaches*. *J. Climate* 10: 2586-2599
- Glantz, M. 2003. "Problem Climates or Problem Societies?" Keynote Address delivered at the 20th Pacific Science Congress, March 19, 2003, Bangkok, Thailand.

Outreach

Newsletter

The *Pacific ENSO Update* provides tailored climate forecasts for the United States-Affiliated Pacific Islands (USAPI). The newsletter provides a "user-friendly" climate summary of expected local climate variability for each island area. In addition, the newsletter introduces new climate research and information of interest to the USAPI communities. The *Pacific ENSO Update* is produced quarterly, with additional special reports on important changes in ENSO conditions as may be required from time to time.

Website

<http://lumahai.soest.hawaii.edu/Enso/index.html>

The PEAC website provides climate information for the Pacific region. The website includes an electronic version of the *Pacific ENSO Update*, current climate research, climatology of the USAPI, and links to related climate information websites.

On island meetings and workshops

During workshops, PEAC members from NOAA-NWS, WERI, and University of Hawai'i interact with government and industry officials in various climate sensitive sectors. Users are educated on the ENSO cycle, its impacts, and the application of ENSO based climate forecasts at various lead times. These workshops provide a forum to discuss climate related issues such as water management (quantity and quality), typhoon preparedness, health issues and hydrology in the region.



Research

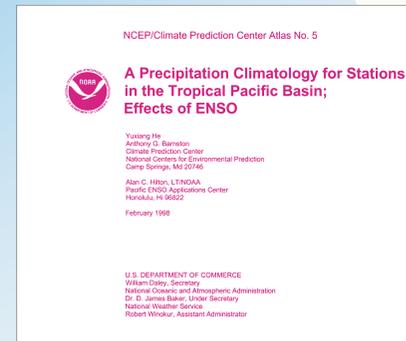
Sea level variability and predictability

Currently, PEAC is studying the correlation between ENSO indices and sea level variability (Figures 1 and 2). Based on these correlations, it is anticipated that an outlook for seasonal sea level variability in the USAPI will be developed.

Rainfall forecast modeling

Research in rainfall forecast modeling led to the development of the PEAC Canonical Correlation Analysis Forecast Model (Yu et al.). This statistical model uses sea surface temperatures (SSTs) in the Pacific Ocean as predictors to forecast the seasonal rainfall variation in the ten major USAPI island stations (Anderson AFB/Guam, Guam Weather Service Office, Kwajalein, Koror, Majuro, Pago Pago, Pohnpei, Truk/Chuuk, Yap and Wake).

FIGURE 2. Correlation between the sea level and the sea surface temperature (SST) for July-September at Yap, FSM for station #008, 09-31N, 138-08E (i.e., strong link [lag 0] with tropical Pacific SST – a clear relation to ENSO). Dr. Rashed Chowdhury, PEAC, data source: NOAA-CIRES Climate Diagnostics Center



Fisheries

Anecdotal evidence indicates that ENSO events have an impact on economic fish distribution in the US-Affiliated Pacific Islands. Preliminary research conducted by PEAC members indicates that there is a correlation between ENSO events and the migration and species mix of economic fish (Hamnett and Anderson). Research continues in this area.

Cyclone research

The location of tropical cyclone activity is strongly affected by the ENSO state (Figure 3). A comprehensive report on the effects of ENSO of hurricane distribution, sea level and rainfall for each US affiliated island group is being completed by PEAC members at WERI.

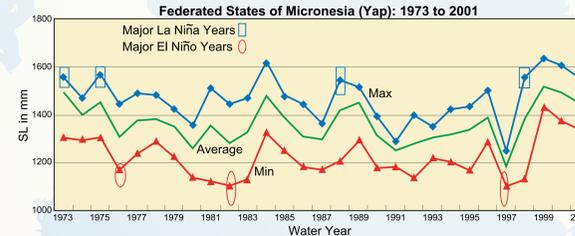


FIGURE 1. Changes in values of annual maximum, minimum, and average water level during the major ENSO years for Yap, FSM. Dr. Rashed Chowdhury, PEAC, data source: UH-Sea Level Center

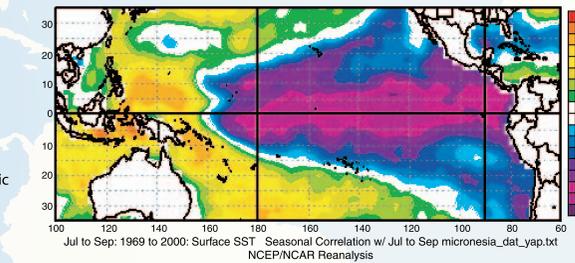


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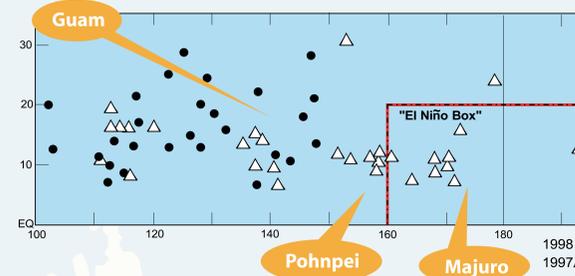
Rainfall atlas

A regional atlas on seasonal rainfall climatology and ENSO-related variability for 66 locations in the tropical Pacific region was published in cooperation with NCEP/CPC. This atlas contains histograms, plots and tables detailing various aspects of the rainfalls and their relationship with the ENSO state.

Health

Members of PEAC continue to work in conjunction with faculty and staff from the University of Hawai'i, the East-West Center and regional institutions on health related issues in the Pacific Islands. To date, studies have been conducted in the Pacific region studying the relationship between dengue fever, diarrheal disease, cholera, leptospirosis, influenza, fish poisoning and ENSO indices (Southern Oscillation Index, Sea Surface Temperature, rainfall and air temperature). Collaborative studies are continuing in this area.

FIGURE 3. Tropical Cyclone Formation in the Western North Pacific: 1997 versus 1998. Note the eastward shift of tropical cyclone genesis during the strong 1997 El Niño. By the 1998 tropical cyclone season, the El Niño began to dissipate and the tropical cyclone genesis migrated westward. Dr. Mark Landers, UOG/WERI



PEAC Review

A comprehensive review of the PEAC program is being conducted by the East-West Center with support from the NOAA Office of Global Programs. The objectives of the review are to:

- Assess the effectiveness of PEAC's approach to establishing and sustaining an interactive process of dialogue among scientists, forecasters and users
- Identify critical information gaps and areas where future climate research should be conducted

Currently the review includes written surveys, interviews, small-group discussions and a June 2004 regional workshop. The Workshop brought together PEAC users, scientists, and forecasters in Honolulu, HI to address issues related to the Review objectives described above. Results from this review will help direct future research and outreach programs.

Although work on the PEAC review is still underway, a few key "lessons learned" about climate forecasting and services are emerging:

- Use a **problem-focused (vs. forecast focused) approach**: climate forecasts must be set in the context of the problem being addressed and the timing, content and language of forecasts must be appropriate to that problem and the decision makers addressing it
- Early and continuous partnership and collaboration with users is essential**: utilize a collaborative, participatory process involving both users and providers of climate information and services
- Building trust and credibility is a long-term endeavor** that requires sustained "eyeball-to-eyeball" contact and an active program of education, outreach and dialogue
- Build on existing and trusted information brokers**: recognize the importance of local and traditional knowledge and practices; engage non-governmental players as well as local weather service offices
- Strive for a climate information system addressing multiple timescales rather than solely an "event-based" early warning system**: many decision makers are interested in climate information on a continuum of timescales from extreme events through seasonal and interannual variability to long term change on timescales of decades and longer
- Early experience points to a number of scientific, technical and institutional constraints** in some places and sectors including:
 - communications systems;
 - language barriers
 - differential forecast skill (season, place & parameter)
 - limitations in observations and data availability
 - computational constraints
 - limited understanding of consequences and vulnerability at local scales and
 - political and institutional boundaries that limit both the production of forecasts and the options for managing risks
- Recognize the need for an integrated program** of observations, monitoring, forecasting, assessment, education, dialogue and applications that *addresses the integrated climate-society system* (Glantz, 2003)
- Facilitate proactive decision-making** through information and services that support iterative, reflective, flexible and adaptive management approaches

Climate risk management - and the climate information systems that support it - should be set in a sustainable development context which enables communities, businesses and governments to respond to today's variability, adapt to long-term change and mainstream the use of climate information to support community development and economic planning.



Mahalo

- Dr. Rashed Chowdhury and Rebecca Schneider (PEAC)
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- Dr. Thomas Schroeder (JIMAR/SOEST, University of Hawai'i)
- Dr. Nancy Lewis (East-West Center)
- Jim Weyman and Charles "Chip" Guard (NOAA-NWS)
- Dr. Mark Landers (WERI, University of Guam)