Target Competition: Federal Funding Opportunity Number: NOAA-OAR-CPO-2010-2001720, Priority # 7 (RISA), Competition # 2142036

Project Title: Climate Adaptation Partnership for the Pacific (CAPP): Pacific RISA Phase II

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Budget Period: July 1, 2010 – June 30, 2015
Total Funds Requested: $3,487,558
Total Funds Requested Per Year: $699,739 in Year 1; $691,812 in Year 2; $696,219 in Year 3; $699,922 in Year 4; $699,866 in Year 5
ABSTRACT:
The proposed Climate Adaptation Partnership for the Pacific (CAPP): Pacific RISA Phase II program aims to support the integration of flexible processes for building adaptive capacity to climate variability and change in diverse island settings. We will support this goal through three interrelated research, assessment, and outreach objectives: (1) conduct place-based assessment of risk and vulnerabilities and development of adaptation strategies; (2) support the implementation of adaptation strategies for Pacific Island communities; (3) evaluate adaptation plans and policy making in the Pacific region. The proposed work builds on existing regional and local partnerships and responds to (1) needs expressed in stakeholder assessments; (2) recent climate science and service developments in the Pacific region; and (3) the recommendations of external evaluators of the first phase of the Pacific RISA program. The activities are designed to engage scientists, governments, businesses, and communities in Hawaii and the US-Affiliated Pacific Islands (American Samoa, Guam, Commonwealth of the Northern Mariana Islands, Federated States of Micronesia, Republic of the Marshall Islands, Republic of Palau) in collaboratively addressing the challenges posed by a changing climate. The proposed work underscores an ongoing commitment to the emergence of the Pacific Climate Information System, which facilitates the development and use of climate information to support decision making in the Pacific region.

The Pacific RISA Phase II program emphasizes integrated activities that address real-world problems with multiple methods. Our proposed work includes a component which will support the downscaling of climate projections for specific island locations. Unavailable to date, this is critical for island climate adaptation planning. A component utilizing these projections will assess the sustainability of ground water resources in island settings. Risk and vulnerability assessment will be supported in all the island jurisdictions and best practices shared; we will also assess the human dimensions of drought vulnerabilities in the region. Findings from all components will be integrated to support island adaptation planning. We plan to expand the Climate Information and Delivery Support System to Guam and CNMI and to evaluate the role of Pacific RISA in advancing adaptation efforts. Ongoing stakeholder outreach and education will build on the strong network of partners developed in Phase I and bridge the multiple activities.

To accomplish the proposed activities, the East-West Center is partnering with multiple institutions including: the University of Hawaii’s International Pacific Research Center, Water Resources Research Center, Social Science Research Institute, and Center for Island Climate Adaptation and Policy; Pacific ENSO Applications Center; National Weather Service; NOAA Integrated Data and Environmental Applications Center; Pacific Climate Information System; Hawaii Drought Council; Hawaii Climate Change Task Force; Office of Environmental and Emergency Management, Office of the President, Federated States of Micronesia; and the Office of Environmental Response and Coordination, Office of the President, Palau; National Drought Mitigation Center at the University of Nebraska; and Climate Assessment for the Southwest.
1. RESULTS FROM PRIOR WORK

Phase II of the Pacific RISA will build upon, be guided by, and contribute to the future development, integration, and assessment of previous work described below.

1.1. Engaging Stakeholders and Significant Advancement of Knowledge

1.1.1. Review of the Pacific ENSO Applications Center (PEAC). The review of the first 10 years of PEAC shaped the direction of the initial Pacific RISA program (also called Phase I within this proposal). The keys to PEAC’s successful first decade will critically shape Phase II Pacific RISA activities: early and sustained user engagement; partnership with other climate forecasting and research; commitment to ongoing public education and outreach; and a focused program of forecast interpretation tailored to meet user needs.

1.1.2. Climate and Society Needs Assessment Workshops. In 2005-2006, participatory workshops led by Eileen Shea and Cheryl Anderson elicited information requirements and research needs in the US-Affiliated Pacific Islands (USAPIs): American Samoa, Guam, Commonwealth of the Northern Marianas (CNMI), Republic of the Marshall Islands (RMI), Federated States of Micronesia (FSM), and Republic of Palau. An adaptation workshop was held in Majuro in 2009; and a Climate Leadership Summit was organized for the 2009 Hawaii Conservation Conference.

1.1.3. Focused Evaluation of the Pacific RISA Experience by NCAR. Susanne Moser (NCAR) was contracted to evaluate stakeholder engagement. Findings commended the Pacific RISA team on building a “strong foundation of committed leadership and extensive experience, good will, continued enthusiasm, and a growing recognition among agencies and researchers in the region of the importance of stakeholder engagement in providing useful climate services that actually improve decision-making and enhance the level of resilience…”. Recommendations included conducting an in-depth evaluation of the effectiveness of stakeholder-engagement.

1.1.4. Cross-RISA Collaboration: Scoping a Project on the Integration of Climate and Traditional/Local Ecological Knowledge. Three RISA programs (Pacific, Alaska, and the U.S. Southwest) are collaborating on integrating local knowledge in climate programs and increasing capacity among local and indigenous stakeholders. The project will help to assure that stakeholders in remote communities have increased access to climate products and services. Results will be disseminated through the RISA network and peer-reviewed publications.

1.1.5. Social and Cultural Impacts of Agricultural Drought. Led by Melissa Finucane, in-depth interviews with agricultural decision makers in Hawaii explored values and socio-demographic factors that influence agricultural drought experiences. Analyses of mental models suggested two drought-management approaches characterized respondents: one emphasizing business-management strategies and another emphasizing natural-human systems management. Many respondents tended to think in terms of “drought” or “no drought” and were uncertain about how to interpret the five levels of drought presented in the U.S. Drought Monitor.

1.2. Influencing Operations and Policy

1.2.1. PEAC as a Core Element of NWS Pacific Region. The results of the 2004 PEAC Review and Pacific RISA activities have provided a strategic plan or “roadmap” for the future of PEAC and, more generally, operational climate forecasting program in the Pacific.

1.2.2. Regional Climate Services: The Pacific Climate Information System (PaCIS). After the PEAC review and other events, the Pacific RISA team, NWS Pacific Region, and partners including NWS/CPC, NWS Pacific Region, University of Hawaii (UH), the EWC, and the Uni-
versity of Guam, began joint planning for the emergence of the PaCIS. The PaCIS goal is to use integrated, interdisciplinary methods to foster knowledge sharing among climate sciences and services in the Pacific region. The Pacific RISA program is a critical element in the PaCIS Action Plan for the PaCIS Research and Assessment Working Group.


1.2.4. Hawaii Multi-Hazard Mitigation Planning. Prepared by Cheryl Anderson, the plans (approved by FEMA and Hawaii State Governor/County Mayors) are based on hazard risk and vulnerability assessment methods using "best available data" criteria. Hazards were expanded from hurricane, flooding, drought, and wildfire in the 2003 county and 2004 state plans, to include threats from climate variability and change in 2007.

1.3. Decision-Support Tools

1.3.1. Pacific Region Integrated Climatology Information Products (PRICIP). Led by John Marra, this NOAA National Climatic Data Center (NCDC) Integrated Data and Environmental Applications (IDEA) Center project explores the three extreme event thematic areas: heavy rains, strong winds, and high seas. A suite of extreme event climatology-related data and information products are being developed. Such information is critical to risk assessment to support coastal land-use planning and resource management. Historical storm event anatomies include a summary of sector-specific socioeconomic impacts, as well as its historic context climatologically.

1.3.2. Structural Hazard Risk Assessment. Led by Cheryl Anderson, a team of researchers and structural engineers have modified HAZUS-MH (a software modeling tool originally developed by FEMA to assess disaster damage) to assess multi-hazard risks to structures from different hazard scenarios and to apply model results to inform hazard mitigation planning to reduce hazard risks.

1.3.3. Water Resource Estimations. Led by Aly El-Kadi, the Water Resource Research assessed water budgets and expected load reductions for nutrients and sediments for Kauai and Oahu. Stephen Gingerich (USGS) evaluated the sustainability of ground water resources in Pearl Harbor and Central Maui. These are the most heavily used aquifers in Hawaii and the Boards of Water Supply used this information to evaluate options for sustainable use of water.

1.4. Education and Outreach

1.4.1. Pacific Islands Training Institute on Climate and Extreme Events. Led by Eileen Shea, the Pacific RISA contributed significantly to a 2004 Pacific Islands Training Institute on Climate and Extreme Events. Learning objectives included understanding consequences of climate variability and change and enhanced awareness of climate forecasting tools and information. Participants were from multiple government, private, business, and media organizations.

1.4.2. Pacific RISA Website. The Pacific RISA website ([www.PacificRisa.org](http://www.PacificRisa.org)) includes a content-management system that enables stakeholders from multiple jurisdictions access to information on climate impacts and adaptation actions by sector and place and climate forecasts. The website also provides links to risk assessments, applications, decision-support tools, etc. The text and bibliographic references provide a resource for climate impact assessments.
2. STATEMENT OF PROPOSED WORK

2.1. Introduction

2.1.1. Goal
The overarching goal of the Climate Adaptation for the Pacific Partnership (CAPP): Pacific RISA Phase II program is to support the integration of flexible processes for building adaptive capacity to climate variability and change in diverse island settings.

2.1.2. Pacific Context
Climate variability and change pose unique challenges for small islands and local adaptation strategies must meet these challenges. Island vulnerability stems from limited size, proneness to natural hazards, physical isolation, low adaptive capacity for some, and high adaptation costs relative to gross domestic product. Disasters can have domino effects causing one vulnerable sector to influence others. In addition, the effects of less dramatic climatic events may accumulate over time and set in motion a chain of negative events.

Fresh water is critical for all islands. When supplies are affected by climatic events, food security, livelihoods, and public health are threatened. About half of the Federated States of Micronesia and 80% of the Marshall Islands are atolls, which peak at only a few feet above present sea level. Atoll water supply is particularly sensitive to changes in rainfall and fluctuation in the water table. Surface water is limited, if it exists at all. Aquifers are small and fragile—threatened by increasing demand as well as salt-water intrusion. Even on the “high” volcanic islands like Guam and Hawaii there are considerable demands on water resources due to tourism and the US military presence. It is of utmost importance to address the adequacy and long-term stability of water resources for Pacific Islanders.

Climate-related disasters have been extremely costly in the Pacific because of their frequency and magnitude. Frequent island climate-related disasters decrease island resilience because of limited recovery time between events. The strong ENSO signals in the Pacific result in many ENSO-related hazard events. In addition to the storms, floods, drought, and wildfires caused by the 1997-1998 event, Typhoon Chataan and Super Typhoon Pongsona occurred in 2002, an El Niño year. They resulted in damages exceeding $1.6 billion (2008 USD) in FSM, Guam, and CNMI. Drought in Oceania from 1990-2008 has resulted in more than $10.7 billion (USD) in damages; floods were estimated at $4.13 billion (USD). Hurricane Iniki that impacted Kauai, Hawaii in 1992 resulted in more than $1.8 billion (USD) in damages and took the economy more than ten years to recover. Based on severe drought experiences, FSM implemented a successful feeding assistance program in 2006. In December 2008, wave over wash contaminated crops and water resources and flooded homes. The event also impacted food and water resources in RMI, and left 400 tons of garbage on the island in Majuro Atoll. The relief-assistance costs were exceptionally high.

Current climate models show a vast array of possible outcomes for the tropical Pacific region in global warming scenarios (e.g., Fig. 10.16 of AR4). However, a substantial number of models forecast an increase in variability about a mean El Niño-like warming. Therefore, a logical starting point for adaptation planning in the Pacific is to address El Niño climate-variability impacts.

The strong 1997-98 El Niño event had significant impacts such as water rationing (water access was limited to 1 hour every 14 days in Majuro, RMI in February, 1998), crop losses, job losses, wildfires, dry stream beds, and coral bleaching. These impacts were mitigated by advanced seasonal-to-inter-annual forecast information provided by the Pacific ENSO Applications Climate...
(PEAC) Center coupled with a sustained program of outreach. The 1997-98 events reinforced the need for an integrated, multidisciplinary approach in the Pacific Islands.

2.1.3. Past Activities in Phase I

The Pacific RISA region covers Hawaii and the USAPIs (American Samoa, Guam, CNMI, RMI, FSM, and Palau). To address the vulnerabilities of small islands in this region, the initial Pacific Assessment called for an ongoing process of partnering to produce quality climate information for effective decision making. Phase I of the Pacific RISA program responded with activities targeting four objectives: (1) develop enhanced data that better address the consequences of current and future patterns of climate-related extreme events; (2) adapt and apply existing model-based decision-support tools in the context of integrated methods; (3) sustain and expand a focused, interactive dialogue with decision makers in climate-sensitive sectors to enhance understanding of vulnerability, response options, and information needs; and (4) enhance regional efforts to develop and apply forecasts and information products to meet decision-maker needs.

Phase I of the Pacific RISA program (2003-2006) was supported primarily by a grant (GC03-399) from NOAA; modest bridge funding (NA03OAR4310143) was received during 2007-2009 and was supplemented by more than $150,000 of in-kind and financial support from the EWC. Since 2003 we have sustained important partnerships with local, regional, and international organizations (see Table 1). We identified critical climate-information needs and facilitated regional efforts to develop products and services to meet these needs.

Since 2003, the Pacific region has seen several climate science and service developments that now form the context for the second phase of Pacific RISA:

1. Review of the first decade of operations of PEAC (led by the EWC);
2. Emergence of the Pacific Island Contributions to the Global Climate Observing System (PI-GCOS) and Global Ocean Observing System (PI-GOOS);
3. Establishing NOAA IDEA Center;
4. Training Institute on Climate and Extreme Events in the Pacific Islands conducted jointly by the EWC, New Zealand National Institute of Water and Atmospheric Research (NZ NIWA), University of the South Pacific (USP), and Pacific RISA.

Table 1: Sample of Pacific RISA Partners

<table>
<thead>
<tr>
<th>Institution</th>
<th>Existing/New Partnership</th>
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<tbody>
<tr>
<td>East-West Center (EWC)</td>
<td>Existing</td>
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<tr>
<td>Pacific ENSO Applications Center (PEAC)</td>
<td>Existing</td>
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<tr>
<td>University of Hawaii (UH):</td>
<td></td>
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<tr>
<td>International Pacific Research Center (IPRC)</td>
<td>Existing</td>
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<tr>
<td>Social Science Research Institute (SSRI)</td>
<td>Existing</td>
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<tr>
<td>Department of Geography</td>
<td>Existing</td>
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<tr>
<td>School of Ocean and Earth Science and Technology (SOEST)</td>
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<tr>
<td>Water Resources Research Center (WRRC)</td>
<td>New</td>
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<tr>
<td>Center for Island Climate Adaptation and Policy (ICAP)</td>
<td>New</td>
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<tr>
<td>Univ. of Guam Water and Environmental Research Institute (WERI)</td>
<td>Existing</td>
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<td>NOAA Climate Program Office (CPO)</td>
<td>Existing</td>
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<td>NOAA National Weather Service Pacific Region (NWS)</td>
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<td>NOAA Integrated Data and Environmental Applications (IDEA) Center</td>
<td>Existing</td>
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<td>Pacific Risk Management `Ohana (PRiMO)</td>
<td>Existing</td>
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<td>Pacific Climate Information System (PaCIS)</td>
<td>Existing</td>
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<td>Pacific Regional Environment Programme (SPREP)</td>
<td>Existing</td>
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<tr>
<td>Pacific Islands Applied Geoscience Commission (SOPAC)</td>
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<tr>
<td>National Center for Atmospheric Research (NCAR)</td>
<td>Existing</td>
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<tr>
<td>Pacific Disaster Center (PDC)</td>
<td>Existing</td>
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<tr>
<td>US Geological Survey (USGS)</td>
<td>New</td>
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<tr>
<td>US Fish and Wildlife Service (USFWS)</td>
<td>New</td>
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<tr>
<td>Local community groups throughout the region</td>
<td>Existing &amp; New</td>
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(A list of acronyms is provided also at www.eastwestcenter.org/risaproposal)
5. Regional discussions regarding the emergence of a Pacific Regional Climate Centre in the context of the World Meteorological Organization (WMO);
6. Two external evaluations of the first phase of the Pacific RISA program;\textsuperscript{9,10}
7. The development of the PaCIS as the programmatic framework to integrate ongoing climate observations, operation forecasting services and climate projections, research, data management, outreach, and education to address the needs of Hawaii and the USAPIs. The PaCIS also includes international partners from the Pacific region;
8. The creation of the University of Hawaii (UH) Sea Grant College Program's Center for Island Climate Adaptation and Policy (ICAP); and
9. Initial work on GCM downscaling suggesting that existing adverse changes are consistent with expectations of how global climate change will affect local climate.

2.1.4. New Work in Phase II

The new work proposed for phase two of the Pacific RISA benefits from improved regional capacity for data and product development, responds to the observations and recommendations of the external evaluations, and focuses on critical contributions to the PaCIS as called for in the Action Plan approved by the PaCIS Steering Committee.

The proposed project addresses both inter-annual variability and longer-term changes in climate in the Pacific region. Adaptation to the impacts of a changing climate on multiple timescales is vital because small-island states are already among the most vulnerable to climate-related anomalies.\textsuperscript{11} However, the resolution of global climate models (GCMs) is too course for the scale and complex topography of many small islands. Therefore this project will identify, implement, and evaluate adaptation strategies under these conditions of significant uncertainty.

Unraveling the mechanisms underlying vulnerability and resilience requires exploring complex interactions within and among coupled natural and human (CNH) systems and this poses one of the most difficult scientific problems facing society today. Complex-systems theory argues that CNH systems are complex adaptive systems that exhibit non-linear behavior.\textsuperscript{12} The stress of climate variability and change demands adaptation by human systems (households, communities, infrastructure, commerce, governance)—a complex process that involves diverse social and technological responses. Understanding the capacity of communities to absorb different kinds of shocks is key to promoting resilience and effective climate adaptation strategies. Several climate-change adaptation frameworks have been developed by international and regional organizations to aid in climate adaptation planning.\textsuperscript{1,13-15} To date, however, none of the islands in the Pacific RISA region have developed a comprehensive state or national adaption plan. It is essential to provide a place-based, stakeholder-driven approach to support adaptation in the Pacific. For communities to adapt effectively, policy makers need to set a risk-management agenda that integrates sound science with an understanding of how science is interpreted and translated into action in society.\textsuperscript{16}

During the spring/summer of 2009, equatorial Pacific Ocean conditions have transitioned from ENSO-neutral to El Niño which emphasizes the important and timely nature of this project. It is in this context of climate anomalies that we propose to advance a program of research, assessment, education, and outreach to support climate-adaptation efforts in Hawaii and the USAPIs.

2.2. Pacific RISA Phase II Program Structure

2.2.1. Objectives and Framework

The goal of Phase II of the Pacific RISA program focuses on integrating flexible processes for
building adaptive capacity to climate variability and change in diverse island settings. We will support this goal through three interrelated research, assessment, and outreach objectives:


2. Support the implementation of adaptation strategies for Pacific Island communities.

3. Evaluate adaptation plans and policy making in the Pacific region.

These objectives are grounded in the major cross-cutting issue of concern to Pacific Island stakeholders and decision makers: **How will climate variability and change, in combination with other population and environmental stressors, impact sustainable development in the Pacific region?** Our new initiatives are organized around the interrelated objectives summarized in Table 2 and detailed in Section 2.3.

<table>
<thead>
<tr>
<th>Table 2. Pacific RISA Phase II Objectives and Prototype Projects</th>
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<tbody>
<tr>
<td><strong>Objective Addressed</strong> (and investigator pair responsible for oversight of activities)</td>
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<tr>
<td>2. Support the implementation of adaptation strategies for Pacific Island communities. (Anderson/Marra)</td>
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<tr>
<td>3. Evaluate adaptation plans and policy making in the Pacific Region. (Burkett/Finucane)</td>
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To meet our goal, it is necessary to establish an adaptation framework that develops the process for integrating climate science, planning, policy implementation, and evaluation. To that end, we reference the six-step approach for assessing vulnerability and identifying and implementing climate-change adaptations (the V&A approach, Figure 1) established by US Agency for International Development (USAID) for climate adaptation planning. This approach is compatible with the dynamic and flexible nature of Pacific RISA work, allowing for response to current events and changing stakeholder needs. It also follows a developmental path that can be applied at a project or program level.

**2.2.2. Roadmap for Integrating, Transitioning, and Evolving Activities**

The relationships between the new initiatives are conceptualized in Figures 2 and 3. Stakeholder-driven needs motivate (1) biological and physical science that generates data about the impacts
of climate variability and change on natural systems and (2) social science that generates data about climate impacts on human systems. The multi-scale knowledge is integrated through partnerships between biophysical and social scientists and between scientists and information users to address real-world problems about sustainable development in the Pacific in the context of a changing climate. Local adaptation support generated by this interaction includes the production of knowledge relevant to decision makers in sector or multi-sector groups as well as the development of iterative, sustained processes to support communications and collaborations (e.g., workshops, newsletters, consultations, dialogues).

2.2.3. Project Prioritization

Pacific RISA project priorities are determined through the partnership between stakeholders and researchers. The shared knowledge and iterative, sustained processes of communication will produce a set of mutually-developed information needs and research questions. The prototype projects proposed in this application respond to stakeholder needs identified in several assessments already completed. Project priorities will be informed by ongoing feedback from stakeholders and agency partners, anticipation of or response to events such as El Niño episodes, public discourse, resource availability, and fit with NOAA and CCSP goals. A key goal underlying prioritization is to maximize payoffs for stakeholders in the Pacific region and for NOAA. Prioritization decisions (and subsequent resource allocations) will be made based on extensive exchange among the Pacific RISA team of investigators, the Core Of-
2.2.4. Interdisciplinary Team

A highly experienced team has been assembled to approach the scientific objectives. Dr. Melissa Finucane (EWC) brings to the project a strong background of research on risk perception, risk communication, and decision making about environmental and health risks. Dr. Cheryl Anderson (UH), political scientist and certified urban and regional planner, specializes in developing planning tools to reduce climate and disaster risks and engaging local and traditional communities in research processes. Dr. Kevin Hamilton (IPRC), meteorologist, will contribute expertise in downscaling of climate observations and modeling. Dr. Aly El-Kadi (WRRC) specializes in watershed modeling and analysis for Pacific Islands. Mr. James Weyman (NWS) will contribute his expertise on the analysis, preparation, and issuing of meteorological services and information. Dr. Maxine Burkett (ICAP) will provide legal analysis of existing and proposed laws and policies affecting climate adaptation plans. Dr. John Marra (NOAA IDEA Center) will contribute expertise on coastal hazards and climate extremes data products. Dr. Nancy Lewis (Director of Research, EWC) has 30 years of experience working in the Pacific region and will contribute expertise in the human geography of Pacific Island communities and climate impacts on health.

2.2.5. Program Organization

The project will be managed from a central Core Office by a full-time Project Manager who will recruit as soon as funding is awarded. This person will work with the PIs to develop an ongoing research and assessment agenda and to facilitate integration through the partnership activities outlined below. We will maintain flexibility to pursue projects through alternative funding sources, leveraging the Pacific RISA funding. A Post-Doctoral Fellowship is included in the budget to facilitate work on the prototype projects described below and to develop new projects as needs are identified. The Core Office will be located at the EWC, an institution that serves as a vigorous hub for cooperative research, education, and dialogue on critical issues of common concern to the Asia-Pacific region and the US. The EWC provides an environment with well-established information technology, management, and other resources that have led to the success of many large, collaborative projects. The EWC is also the institutional home of the Pacific Islands Development Program (PIDP)–the Secretariat of the Pacific Island Conference of Leaders. The Pacific RISA Executive Committee will include the PI, co-PIs, and the Project Manager. This committee will be responsible for developing mechanisms for and ensuring the integration of research and stakeholder activities. The committee will meet at least monthly unless more frequent meetings are needed to respond to problems and opportunities that arise. The Pacific RISA will be guided by an Advisory Board comprised of representatives of the scientific community, government, businesses, and local community groups. Confirmed members include Eileen Shea (PaCIS Chair and Director of the NOAA IDEA Center), Neil Fujii (Hawaii State Drought Coordinator), Taito Nakalevu (Secretariat of the Pacific Regional Environment Programme, SPREP), and Dr. Trisha Kehaulani Watson (Honua Consulting). The Advisory Board will meet as early as possible once funding is awarded. Semi-annual meetings are planned thereafter.

2.2.6. Plan for Integrating the Science and the Team

Integration of the Pacific RISA Phase II activities will occur by (1) focusing on the cross-cutting theme of climate adaptation planning in the Pacific; (2) intellectual cross-fertilization via linkages across projects and synergies across sectoral and disciplinary perspectives; and (3) partnerships with stakeholders who will contribute to the co-production of science and policy recommendations. A place-based approach will guide integration (e.g., several activities including cli-
climate downscaling, hydrological modeling, adaptation plan development, and evaluation will focus at first on the State of Hawaii). In addition to the various subsets of investigators working closely together on specific projects, we plan to write whitepapers focusing on climate-adaptation processes by Pacific Islanders. This will serve as an intellectual focal point for integration of knowledge and a way to scope future integrated activities. An interdisciplinary style of research will be facilitated by interacting in an open dialogue, with frequent “eyeball-to-eyeball” meetings among investigators and between investigators and stakeholders, an approach recommended in previous stakeholder assessments as critical for success in the Pacific region.

2.2.7. Plan for Linking with Broader, Regional Climate Services Efforts
The emergence of PaCIS following the success of PEAC has received attention recently as a regional prototype for a National Climate Service. PaCIS provides a programmatic framework for integrating climate observations, forecasting services, research, assessment, data management, outreach, and education. Participation by diverse stakeholders in PaCIS (regional organizations, meteorological offices, users of climate information in Pacific Island communities) has resulted in the evolution of a climate risk-management process integral to sustainable development in island communities. As underscored in the PaCIS Action Plan, the Pacific RISA program is a key priority of the PaCIS Research and Assessment Working Group. We will continue to serve as an integral part of PaCIS, building on PaCIS efforts to date and synergizing with the goals and processes of PaCIS partners. We will build on our existing partnerships with the NWS Pacific Region’s PEAC, IPRC, SPREP, the State Climatologist, Hawaii Drought Council, and the NOAA IDEA Center. New partnerships are being formed with the WRRC, ICAP, USGS, and USFWS. These close collaborations will help to ensure that regional organizations inform and are informed by Pacific RISA activities. In addition, several Pacific RISA team members are involved in research currently funded by the National Integrated Drought Information System (NIDIS), including SARP and Cross-RISA Coping with Drought projects. Other key partnerships include the Climate Prediction Center, National Climatic Data Center (NCDC), the Secretariat of the Pacific Community (SPC), and community groups throughout the region. Through these collaborations, the Pacific RISA will contribute significantly to a National Climate Service by establishing a regional base for climate impacts and adaptation expertise linked closely with PaCIS.

2.2.8. Broader Impacts
We expect that the uptake of our products will be rapid and meaningful because the work will be conducted (1) in conjunction with the end users of the products and (2) in the context of a unique array of partnerships among physical and social scientists, private and government organizations, and other RISA programs, spanning Hawaii and the USAPIs, and reflecting a variety of physical and social contexts. The EWC’s extensive information-dissemination resources will be used to inform larger audiences. We will also look for other funding that maximizes the potential for partnering with independent Pacific-Island countries, the French Pacific, Meteo France, NZ NIWA, the Australian Bureau of Meteorology, WMO Region 5, and SPREP and SOPAC.

2.3. Prototype Projects
We are proposing a 5-year program of research, assessment, outreach, and education activities to inform policy and build adaptive capacity to respond to changing climatic conditions. Prototype projects describe work primarily conducted in the early years (1-3) of the program with flexibility built into later years for prioritizing work according to stakeholder needs and current events.

2.3.1. Objective 1: Conduct Place-based Assessment of Risk and Vulnerabilities and De-
Our first objective is to assess vulnerabilities and develop adaptation strategies at the society-environment interface for specific locations via integration of downscaled climate models with hydrological models, socio-economic assessments, and cultural knowledge.

2.3.1.1. Climate Projections for Hawaii and Other Pacific Islands (Lead: Hamilton)

This research will provide new capacity for projecting climate impacts linked to adaptation planning capabilities at an island level. The current climate-change projections from global coupled atmosphere/ocean models, as summarized e.g. in the 2007 IPCC assessment report, have only very limited direct application to Hawaii and elsewhere in the Pacific, as most very long climate forecast integrations have been performed with atmospheric component models with effective horizontal grid spacings of ~200-300 km. Without further analysis, the predicted changes in climate variables from such models are not really useful as the basis for planning adaptation measures. As part of the present proposal, model-based studies will be conducted in an effort to produce the best guidance possible on long-term climate changes expected in Hawaii and in later years, if feasible, other islands in the region. The results will be disseminated to decision makers and to the general public through the stakeholder interactions and outreach efforts described elsewhere in this proposal. The results will also be used as input to a specific application research project concerning sustainability of island water resources described in the next section.

Global Models. The regional projections envisaged here will require input from global coupled ocean-atmosphere model projections. A large suite of 21st century climate projections for different emission scenarios and for about 20 different global climate models was made available as part of the process leading to the 2007 IPCC 4th Assessment Report (AR4). A similar effort (Coupled Model Intercomparison Project 5 or CMIP5) is starting now in preparation of the 5th IPCC Assessment. CMIP5 results should be available by late 2010 and will be notable for the application of more modern model versions and a greater focus on producing detailed projections for the 10-30 year time frame, as well as consideration of the longer-term forced climate response which has dominated earlier IPCC assessments. An assessment of the AR4 and CMIP5 model performance will be undertaken to determine the models that have the most credibility in representing the relevant climate processes in the tropical and subtropical Pacific region.

Statistical Downscaling. One approach to dealing with the small scales is to use statistical relationships between local variables such as rainfall and the regional-scale weather patterns. If the relationships determined from present-day climate observations can be assumed to hold for future climate conditions, then these relationships can be used to “downscale” climate projections produced by coarse-resolution global models. Based on work currently underway at IPRC using a simple linear statistical downscaling of seasonal-mean rainfall for the main Hawaiian Islands using seasonal-mean input from the IPCC AR4 global models, this work will be extended to consider nonlinear relationships between variables. Also, consistent and in collaboration with efforts underway as part of the PRICIP project, this work can be extended to consider the distribution of rainfall intensities associated with extreme events throughout the Pacific islands.

Limited-Area Model Simulations. Statistical approaches will be complemented by more direct high-resolution atmospheric numerical modeling at IPRC. An initial assessment will be made using results provided to IPRC from the Climate Research Department of the Japan Meteorological Research Institute (MRI) which has a horizontal grid spacing of about 20 km. The MRI high-resolution model results provide, for the first time, a global warming forecast with a model that has a somewhat realistic representation of the coastlines and topography of the main Hawai-
ian Islands. These data can be used to see how well statistical downscaling approaches work in predicting the model simulated changes over Hawaii (at least at ~20 km resolution).

Unfortunately, even the 20 km horizontal resolution is too coarse for representing climate elements for most applications in Hawaii. Based on previous work, IPRC will conduct numerical climate-change projection experiments using a nested regional atmospheric modeling system with high resolution over Hawaii. These experiments will consist of model integrations representing current conditions and then perturbed runs for conditions anticipated for a global warming climate at intervals through the 21st century.

For the proposed Hawaii climate-change projections this approach will be extended to allow very fine resolution over the individual islands, via application of multiply-nested grid models. We will develop a new nested modeling system based on the community-supported Weather Research and Forecasting (WRF) model. The plan is to use the basic dynamical core of WRF and replace the physical parameterizations associated with boundary layer processes, convection, clouds and precipitation by those used successfully in the IPRC regional atmospheric model in simulating tropical circulation and cloud climatology.

It is anticipated that the final integrations would be performed with ~30 km horizontal grid spacing in an outer domain of several thousands of km extent and then using triply or quadruply nested-grids go down to ~0.5-1 km grid spacing covering individual islands. Mapping of results to still smaller scales will be performed with simple statistical models including the effects of topographic height and local topographic slope. Notably a detailed mapping of surface temperature, surface wind and rainfall statistics for the island of Maui will be conducted to provide input to the hydrological model described below.

2.3.1.2. Assessing Sustainability of Ground Water Resources Under Future Climate Conditions (Lead: El-Kadi)

This project will use projections of climatic conditions together with stochastic hydrologic models to assess the sustainability of ground water resources. Previous hydrological assessments have identified reliable potable water resources as a critical need throughout the Pacific Islands. The reliability of water supplies on all islands will be challenged by reductions in rainfall and changes in its distribution owing to climate change. With advance planning, the consequences of climate change on water systems can be mitigated.

Ground water is the primary source of municipal water on most developed islands in the Pacific. Most aquifers occur as a freshwater lens-shaped body that floats upon denser salt water. The freshwater lens usually stands no more than a few meters above sea level. The freshwater lens is dynamic: ground water flows constantly from inland areas of recharge to be discharged at the coast. Because of the underlying seawater, ground water pumping must be carefully managed to prevent salt water intrusion. Changes in recharge and pumping can alter the flow of freshwater through the aquifer, and therefore change the salinity of the pumped water. Of particular concern with regard to climate change is the possibility that decreases in precipitation or increases in evapotranspiration may reduce the amount of fresh water recharge and thus affect the sustainability of fresh ground water resources.

Recharge Estimation. Recharge can be estimated from the water budget through assessing water volumes entering, leaving, and being stored within the plant-soil system. Recent studies by El-Kadi on Kauai and Oahu assessed the water budget and expected load reductions for nutrients and sediments, based on suggested remediation strategies. On the island of Maui, the USGS has
constructed a water budget that estimates the amount of ground water recharge for much of the island towards assessing resource sustainability.\textsuperscript{21}

Assessing Ground Water Sustainability. Ground water models are used in assessing ground water resources and defining appropriate management practices that set aquifer sustainable yield. Example model applications include studies by El-Kadi (WRRC)\textsuperscript{22} and Gingerich (USGS).\textsuperscript{23} However, available studies have not accounted for issues related to long-term recharge forecast or uncertainty. According to the State Water Code (State Legislature of Hawaii, Act 45, 1987; Hawaii Revised Statutes, chapter 174C), the sustainable yield is set by Hawaii Commission on Water Resource Management (CWRM) using the best available information and should be reviewed periodically. Due to difficulties involved in numerical modeling and an absence of detailed site-specific data, sustainable yield determination defaults to a simple analytical model. In addition, conventional approaches fail to account for uncertainties, especially related to recharge.

Proposed Approach. Working with Pacific RISA partners such as USGS, the WRRC will use forecast rainfall and other meteorological parameters generated by IPRC as input to models to calculate the water budget so that it reflects a range of future conditions. Uncertainties in climate predictions will be also considered as input to stochastic hydrological models. Recharge assessment will be done on two levels. The first is a simplified approach that develops regression equations relating rainfall and recharge. The second approach uses a more elaborate method based on completing a water budget of the system, including rainfall, surface runoff, evapotranspiration, infiltration, soil moisture storage, and fog drip. Once the model is calibrated, scenario runs are used to quantify recharge under various climate conditions, which will then be used as input to the ground water flow model under forecast conditions. The sustainability of water resources can be evaluated by seeing how the aquifer responds to both current and proposed rates and distributions of pumping. Wells that are forecast to pump water beyond an acceptable salinity (usually taken as a 250 ppm chloride concentration) will be judged not sustainable. It may also be possible to simulate where additional wells can be installed to mitigate any loss of capacity. We will focus first on the Iao-Waihee Aquifer, Maui, where water budgets have been developed in the absence of future climate projections. Other potential aquifers are located at North Kohala, Southern Lihue, and Pearl Harbor. An additional direction for future work, if demanded by stakeholders, is to examine how climate change will affect rainfall and water resources on USAPIs such as Pohnpei, a high island like Maui, but with much lower GDP and consequently more limited resources. Partners, such as the University of Guam Water and Environmental Research Institute working with USGS, have conducted hydro-meteorological research in Micronesia and would be able to adapt these methods in Years 3-5 of the Pacific RISA program.

Utilization of Results. The Hawaii CWRM currently assesses the sustainability of ground water resources using simplified models. The new water budget from USGS caused CWRM to revise its estimates of many aquifer sectors on Maui. The new research is expected to enhance decision processes by including climate uncertainty. The results will inform Pacific RISA education and outreach activities targeted towards water and other resource managers. Example management decisions include determining whether additional wells can be drilled in an area, estimating pumping rates, and redistributing pumpage.

2.3.1.3. Hazards and Climate Risk and Vulnerability Assessment (Lead: Anderson)

This project will help communities to incorporate Climate Risk Assessments into Multi-Hazard Risk Assessments. Hazard risk and vulnerability assessments (RVA), specifically for climate-related risks, have been established as an interdisciplinary methodology that underpins the de-
development of disaster risk-reduction plans. Because of the extensive risk from multiple types of climate-related disasters (e.g., droughts, wildland fires, hurricanes, floods, sea-level variation and rise with associated coastal inundation) and the wide variation among island communities and infrastructures (often on or very close to the coast), islands must employ a multi-hazard risk-reduction framework. For the US Flag Islands (Hawaii, American Samoa, CNMI, and Guam), the Federal Emergency Management Agency requires that plans be updated every three years. Of the four FEMA-approved plans, only Hawaii assesses risks from climate change and only Hawaii has implemented drought mitigation plans. In the USAPIs, multi-hazard mitigation plans were required in 2004 from the FSM and RMI, but they did not include risks from sea level variability (ENSO-related), sea level rise, or other effects of climate change.

**Review and Update Disaster Risk Reduction Plans.** One part of the proposed RVA involves reviewing existing disaster risk-reduction plans and assisting island governments in updating these multi-sectoral plans with the best available climate-related data for understanding hazard risks. This will involve integrating assessment data from collaborators, such as the localized effects of ENSO (PEAC), sea level rise (NOAA IDEA Center, UH Sea Level Center), water resources/hydrology and downscaled rainfall projections (USGS, NWS, IPRC, UOG), and ecosystem impacts (USDA NRCS). We will integrate the best available data in the climate hazards identification, risks, and vulnerability sections of the plan. The latest data will be incorporated into plans in stages coinciding with hazard mitigation planning cycles (Hawaii 2010 and 2013, American Samoa and Guam 2011 and 2014, and CNMI 2012 and 2015). We are already in discussions with Palau as they have begun their update. In FSM, the climate office has merged with the Office of Environmental and Emergency Management and they request similar assistance. RMI is also updating its hazard plans. Partners will include the Hawaii State Climate Change Task Force and the State Office of Planning; the Office of Environmental and Emergency Management in the FSM’s Office of the President; and the Office of Environmental Response and Coordination in the Office of the President in Palau.

**Assets and Capabilities Assessment.** Pursued simultaneously, a second component of the RVA involves identifying critical facilities, infrastructure and lifelines; economic infrastructure and employment characteristics; ecosystems that aid in protection (coral reefs, dunes, vegetated coastlines, native forests, etc.); and characteristics of local populations. We will also inventory adaptive capacities including: availability of resources, sustainable financing for projects, alternative livelihoods, ecosystem management, institutional frameworks, legal and regulatory instruments (integrating results from section 2.3.3.1), governance, policy implementation, and sector-specific, local, and indigenous knowledge systems.

We will explore the use of increasingly sophisticated geospatial tools to assist in both managing and analyzing the data and rendering it understandable for decision makers. The integration of socioeconomic data and hazard risk layers improves the understanding of community sensitivity and exposure to climate hazard risks and enables decision makers to understand ways that systems overlap to produce risk. Geographic information systems (GIS) can easily manage databases of information and can be integrated into models to consider spatial risks and vulnerability. Displaying a visual map can help communities better understand the underlying reasons for vulnerability. We will focus on using open source software tools that integrate remotely sensed data and other geographic characteristics to help understanding of vulnerability.

Activities related to RVA in years 3-5 will be guided by stakeholder input. We have experimented with using scenario-planning methods to improve adaptation planning. Following the
baseline characterization of community exposure and resilience, the information can be linked with different hazard risk scenarios that are based on different climate change projections. Scenario planning allows the exploration of a range of system interactions under conditions of uncertainty with a suite of options as well as the evaluation of the consequences of decisions. Participatory stakeholder engagement (through workshops and communication in understanding climate forecasts) has become a familiar method as a result of our work over the last decade and because of this, these scenario planning techniques will be appropriate, especially in cultures with strong oral traditions. Resources and interest permitting, we will explore also the gendered nature of disaster in the Pacific. The literature on climate change risks describes women as among the most vulnerable groups. Yet coping strategies have not been well-documented and there has not been sufficient research on ways that gendered knowledge may facilitate adaptation. Two Co-PI’s (Anderson and Lewis) organized an international conference on “Gender Equality and Disaster Risk Reduction” in Honolulu in 2004. At the 2009 Climate Adaptation Workshops in Micronesia, participants requested gender analysis that could be integrated into their adaptation planning. Methods will include co-production of knowledge with established women’s organizations and gender focal points in government. The deliverables include tools for gender analysis and peer-reviewed publication to ensure that gender perspectives from the Pacific are part of our global understanding of adaptation to climate change. The matrilineal communities of the Pacific Islands may offer insights not yet considered in other regions.

2.3.1.4. Human Dimensions of Drought on Pacific Islands (Lead: Finucane)

This research seeks to develop qualitative analyses of the social and cultural impacts of drought, societal adaptation to drought, characterization of water users, and factors affecting water-use decisions. Discussions during the initial Pacific Assessment and the 2005-2006 Climate and Society Needs Assessments Workshops highlighted the importance of understanding the role of human and institutional systems in water availability. We began to address this need recently through a pilot project on the social and cultural impacts of agricultural drought (May-July, 2009). We interviewed 25 farmers, ranchers, and agricultural service providers across the State of Hawaii. Consulting closely with members of the Hawaii Drought Council (HDC) and researchers from the National Drought Mitigation Center (NDMC) on study design, we used behavioral decision research methods (mental modeling) to explore agricultural drought experiences and responses. Preliminary qualitative analyses suggested that (1) alternative mental models of agricultural drought can be identified, (2) understandings of and responses to drought vary with demographics, values, and traditions, (3) hard-to-quantify drought impacts can be captured reliably with qualitative methods. When shown the US Drought Monitor, many respondents did not differentiate among the five drought levels (D0-D4), but tended to think only in terms of “drought” or “no drought.” The pilot project showed how we might begin to assess diverse expressions of vulnerability and risk responses to help stakeholders and policymakers think through and communicate about the multiple dimensions of drought impacts. However, the small scope of the project means that a wider range of experiences still needs to be assessed.

In a new study, we will pursue a more comprehensive assessment of drought vulnerabilities in the Pacific region to answer the question: How can island drought planning activities be informed by an understanding of the human dimensions of drought? Synergizing our efforts with those described in 2.3.1.2 (forecasting water availability), we will first focus on stakeholders on the island of Maui reliant on or making decisions about the Iao-Waihee Aquifer. We will expand recruitment efforts to include stakeholders from non-agricultural sectors, including water resources (e.g., owners and operators of public water systems, Hawaii CWRM), tourism (e.g., ho-
tel managers), public health and safety (e.g., Dept. of Health division chiefs, community practitioners, hazard evaluation/emergency responders). We will examine expectations about different types of drought impacts (agricultural, hydrological, meteorological) and responses under alternative climate projections and water availability scenarios. We will identify the extent to which people differentiate drought levels and what factors facilitate or impede the use of tools such as water budgets or the US Drought Monitor. Indigenous approaches to water management will be explored. Resources permitting, we will focus subsequently on multi-sectoral sampling in other drought-prone areas with different topographies, population densities/growth rates, water and food security challenges, and socio-cultural values (e.g., northern RMI atolls, Guam, CNMI).

Results of this work will provide information lacking in existing literature and will aid the development of drought plans and tools. For instance, drought plans may be seen as more relevant and useful by stakeholders if they address the qualitative dimensions of drought impacts (and thresholds) that motivate drought-management responses. Resources permitting, we will examine whether the information in water budgets and the US Drought Monitor is integrated more fully in decision processes when it is packaged in a way that corrects misconceptions (errors) and/or informs poorly differentiated conceptualizations of drought. We will evaluate the impact of alternative information frames on decision processes using behavioral decision analysis (e.g., policy capturing methods) and in-depth interviews about the value of alternative information framings for scenarios based on real-world problems (e.g., determining the distribution of wells in the Iao-Waihee Aquifer). We will also develop a structured questionnaire for each jurisdiction to support ongoing assessment of localized social and cultural impacts of drought. Summary reports of the findings, including impact type, severity, spatial extent, and location, will be provided to the NDMC’s Drought Impact Reporter (DIR) database for integration with climatic and geographic data. A detailed understanding of how people perceive and respond to drought will inform materials developed for education and outreach. Partners in this project include the HDC, NDMC, NIDIS, relevant government agencies, utilities, indigenous groups, and other community groups.

2.3.2. Objective 2: Support the Implementation of Adaptation Strategies for Pacific Island Communities

Our second objective is to support the implementation of climate-change adaptation strategies in the Pacific region through integration and delivery of climate information and ongoing outreach and education activities.

2.3.2.1. Portfolio-Based Climate Services for Hazards Communities (Lead: Anderson)

The purpose of this project is to build capacity in the development, analysis, and delivery of climate information tailored to the needs of disaster management communities. This project builds on a Cross-RISA Coping with Drought collaboration that begins in 2009 working with the Hawaii hazards community. The Climate Information Delivery and Decision Support System (CLIDDSS) serves as the technical platform for data portfolio management to support the distribution of information employing newsletters to multi-sector disaster managers concerning their climate-related disaster risks. The newsletter will provide data analysis and briefings to propose mitigation actions to reduce hazard risks in Hawaii. The project involves working with a well-defined community to develop a process for: determining the types of climate data sets that would be most useful; managing the data; formatting the data in visual displays most meaningful to the hazards community; and interpreting and linking potentials risks and decision making options. Lessons learned from Hawaii will shorten the timeline for implementation of the newsletters in other hazards communities. The intent is to expand this project to Guam and CNMI in
2011-12 since they have well-defined, multi-hazard disaster management communities and data available from the NWS Guam Forecast Office.

CLIDDSS helps information intermediaries (e.g., extension agents) and decision makers “connect the dots” among information products from diverse, distributed sources. CLIDDSS lets individuals or groups create and manage customized information portfolios and the production of commercial quality PDF reports containing both provider-controlled content (e.g., forecast images, descriptions, contact information) and intermediary-controlled value-added content (e.g., application-based interpretive comments). CLIDDSS also provides rich tracking of product use (e.g., which products users are linking) to inform both research and operational climate services.

2.3.2.2. Stakeholder Workshops on Adaptation to Climate Change (Lead: Lewis/Anderson)

The vast oceanic expanse served by the Pacific RISA in addition to differing levels of resource endowment, economic development, human resource capacity, and political status present special challenges in supporting climate-change adaptation in the Pacific. In Pacific RISA Phase I, and especially during the bridging period, we made use of advances in telecommunication technologies, notably PEACESAT and the updated RISA website, to maintain the Pacific RISA network. Individually we have also taken advantage of travel opportunities in the region to assure that the network was maintained. However, while communication and personal interaction are important everywhere, given cultural norms, they are particularly so in the Pacific. The small size of island jurisdictions also results in significant personnel shifts between and within sectors in island governments. During the first year of Phase II we anticipate convening a workshop of key stakeholders from Hawaii and the USAPI. The objectives of the workshop will be two-fold: (1) to bring together key stakeholders from across the region, share with them the directions and prototype projects that we have described in this proposal (the majority are based on stakeholder input), solicit their further input, and make corrections as needed; and (2) to ensure an understanding of climate risk reduction planning and establish mechanisms and protocols for engaging in the RVA process. In Years 3 and 5, we anticipate holding similar workshops with thematic foci appropriate to the stage of our work to review progress over the past two years and assure that future directions are responsive to stakeholder needs. One of these meetings will be held on Guam, a transportation hub for the Micronesian states. To evaluate the success of the educational component of the workshop, we will administer pre- and post-surveys that assess changes in knowledge and confidence in the applicability of information and products to local decisions.

2.3.2.3. Ongoing Stakeholder Outreach and Education (Lead: Marra/Weyman/Finucane)

As emphasized above, ongoing dialogue and responsiveness to stakeholders’ needs is integral to progressing with Pacific RISA activities. Thus, we plan to continue our ongoing stakeholder outreach and education activities, including climate information and products training (via on-site workshops, webinars, and videoconferencing). The cross-RISA dialogue on climate change, water impacts, and indigenous people has resulted in a request to hold quarterly issue-based video-teleconferences on climate change issues, with opportunities to discuss pressing needs for technical information and to share best practices across islands and sectors. Participants will include, for example, water managers, climate-change working group members, weather service officers, cultural practitioners, conservation officers, agricultural extension agents, and coastal managers.

We will also develop colorful, easy-to-understand one-page fact sheets. In the last two years, a number of organizations have placed a large amount of climate information on the internet. NOAA’s Climate Prediction Center, NOAA NWS Climate Services Division, the Pacific RISA, PEAC, and the emerging PaCIS portal are valuable data sources. As noted by participants in the
2009 meeting of the Pacific Risk Management 'Ohana in Guam, however, this information is not easy to hand out, discuss at public events, or take away for ready reference. There are also locations in the Pacific with slow internet capability where some websites cannot be accessed.

The fact sheets will cover a variety of climate topics, terms, sectors, locations and impacts. Some will present the latest information available about climate projections from IPRC and forecasts from PEAC, providing recommended planning actions for specific jurisdictions in the Pacific. Other fact sheets will provide details of specific climate terminology or methods (e.g., downscaling, adaptation planning) or the results of specific projects. The PRICIP climate extremes case studies will be used to support this effort. These so-called “event anatomies” include a summary of sector-specific socioeconomic impacts associated with a particular extreme event, as well as its historic context climatologically. We plan to develop new event anatomy/case study content with an emphasis on flash flooding and drought, events closely associated with El Niño and which impact both disaster risk and freshwater resource management. This task also affords an opportunity to build upon the work in this area being conducted through PEAC and in a larger sense support the establishment of PaCIS as a regional version of a National Climate Service. The pamphlets and fact sheets will be available online and in hard copy. Key audiences for these materials include the general public and government agencies who wish to educate their clients.

We will continue to maintain and expand the Pacific RISA website and will use the website as one of several mechanisms to distribute relevant climate information and to solicit user feedback. We will coordinate with and capitalize on the efforts of the PaCIS Outreach and Education Working Group to expand our stakeholder interactions.

2.3.3 Objective 3: Evaluate adaptation plans and policy making in the Pacific region.

Our third objective is to evaluate adaptation plans and policy making and Pacific RISA performance place-based legal analysis, decision analysis, and evaluation activities.

2.3.3.1. Evaluating Climate Adaptation Law and Policy Implications (Lead: Burkett)

This project will assist governments in preparing and adopting laws and policies that facilitate cost-effective, efficient, and equitable adaptation strategies. The Center for Island Climate Adaptation and Policy (ICAP), a new Center with support from both the UH Richardson School of Law and the UH Sea Grant College Program, focuses on the law and policy implications of climate change. The Center Director, law students, and participating law faculty translate scientific research on climate change into policy recommendations and model legislation. ICAP also recommends science-based implementation strategies for laws currently on the books.

The process for developing adaptation measures typically follows the same process as developing public policy. After identifying and analyzing the issues relevant to the topic area, community leaders and decision makers will need to prepare options for policies and actions. They must then introduce laws, codes or regulations that support implementation. ICAP will assist governments in preparing to adopt these laws, policies, and/or administrative rules to facilitate the cost-effective and efficient operation of the adaptation strategies recommended.

For example, with respect to water availability, ICAP will conduct legal analyses that survey the capacity and the quality of laws that control the allocation, supply, infrastructure, maintenance and monitoring of water use. Further, consistent with our core emphasis on indigenous environmental knowledge, ICAP affiliates from both the Law School and Hawaiian Studies (for Hawaii based projects) will conduct analysis of the extant laws and procedures with a particular mind to perceptions among water users of their legal as well as traditional access and use rights. While
the legal frameworks of the State of Hawaii and the USAPI differ and there are differences between the legal frameworks of the various USAPIs, considerable experience exists both at the University of Hawaii and the EWC Pacific Islands Development Program (PIDP) to facilitate such analyses with respect to both legal frameworks and also indigenous and local knowledge.

It is also important to determine if existing laws and policies support the adaptive measures recommended. Use of existing national, state and/or local laws and policies can help to avoid opposition and ensure successful integration of adaptive measures. As Pacific RISA partners address the challenges of implementing climate change adaptation strategies, ICAP will be a valuable resource for helping to develop/modify the legal architecture that will support these strategies.

2.3.3.2. Evaluating Pacific RISA Performance (Lead: Finucane)

This work will develop measurement tools and evaluate the role of Pacific RISA in advancing adaptation planning in the Pacific region and thus contribute to assessing the value of the Pacific RISA program overall. The aim of this work is to measure the progress of adaptation planning in Hawaii, improve Pacific RISA program performance, demonstrate successes to funding agencies, stakeholders, and the public, and contribute to the emerging field of evaluating participatory science programs. We plan a two-pronged, but not sequential evaluation effort. The first prong will comprise an external evaluation of the role of Pacific RISA in progressing adaptation planning in Hawaii and constitute a discrete project. We will focus on Hawaii in part for logistical and cost reasons but also because Hawaii is where much of our initial work on integrating biophysical and social science and indigenous/local knowledge will take place. In the second prong, we will develop self-evaluation criteria to be administered in each year of the program and use the findings to refine our goals and methods region-wide.

The regional RISA centers have received increasing attention as effective institutions for providing climate information and decision support services to diverse stakeholders. They have also been asked to demonstrate their impact, to learn about what integrative activities work and why, and to improve their efforts. An initial review of stakeholder engagement in the first phase of the Pacific RISA program by Moser provided key recommendations for the next phase, including: (1) identifying whether the “right” stakeholders are involved; (2) providing deeper insights on the circumstances under which participatory processes are useful; and (3) assessing the wider set of motivations that could be elevated to change behaviors, procedures, or policies and the obstacles that prevent the use of climate information and services. In addition, stakeholders have identified a need to build capacity for evaluation research within the region. To evolve the Pacific RISA program and develop this capacity, we will focus on evaluating stakeholder engagement in a specific activity, namely Pacific RISA support for integrating biophysical and social science information and traditional/local knowledge in climate-change adaptation plans in Hawaii.

We will contract with Moser to conduct an external evaluation towards the end of Year 3. The evaluation will examine whether the right stakeholders are involved in adaptation planning in Hawaii, identify how progress in adaptation planning can be operationalized, examine how adaptation plans have changed over time regarding climate-change risks, and attempt to establish causal process-outcome links where possible. The wider set of motivations and obstacles to integration of information in adaptation plans will also be assessed. Conducting the external evaluation towards the end of Year 3 will allow time for program activities to be well underway or completed (so that there is work to evaluate), yet permit the program to adjust course in response to the findings, if necessary. RISA-wide implications of the results and larger lessons for program evaluation research will be disseminated via written reports and in person presentations.
The second prong of our evaluation activities will develop methods for self-evaluation throughout the Pacific RISA program. Within the first six months of receiving funding, the Executive Committee and Advisory Board will convene to: assess how well Pacific RISA objectives lend themselves to quantitative metrics; identify three areas of research and assessment to evaluate quantitatively; recommend specific metrics for documenting progress and measuring and communicating performance; and discuss possible limitations of quantitative measures and identify complementary, qualitative approaches. Following closely the report of the National Research Council’s Committee on Metrics for Global Change Research, we expect that useful metrics will address the quality of program leadership, strategic planning (goal and priority setting), metric acceptability by stakeholders, and quality assessment by independent, transparent peer review. We will explore the extent these program-internal metrics can be augmented with outcome measures. The metrics will be used to guide strategic planning and foster future progress. We will use the metrics to evaluate several aspects of the Pacific RISA projects and program, including: processes (e.g., incorporating Pacific cultural practices such as “talk story” into setting of research strategies and priorities); inputs (e.g., taking advantage of existing PaCIS data and resources); outputs (e.g., high-resolution climate models for Hawaii and other Pacific islands for use in local decision-support tools); outcomes (e.g., assessments identify and support local institutions to address a range of Pacific climate issues); and impacts (e.g., changes in laws and policies in Pacific island jurisdictions supporting climate adaptation). We will consult with Moser within the first six months of being funded (and subsequently as needed), to aid the development of self evaluation criteria. We anticipate that self-evaluations can be both event-driven (e.g., a post-hoc analysis of PEAC’s regional communication strategy in response the current El Niño) and part of a normal review and planning process. Thus, we will plan for at least one in-depth self-evaluation each year via electronic and mailed surveys and interviews. Evaluation focus groups will be conducted also during workshops. We will submit the findings for review by the Advisory Board and the Executive Committee and adjust our approach as necessary.

From the combination of periodic self-evaluation and independent external evaluation we anticipate obtaining valuable feedback to improve Pacific RISA operations and topical foci. Moreover, we believe that an explicit focus on advancing such programmatic evaluation research will yield invaluable lessons to the RISA and other decision support programs (e.g., SARP and other federal, non-NOAA programs) at a time when the call for effective information and decision support services in the climate and adaptation context are ever increasing.

2.4. Timeline

Upon confirmation of funding, the Pacific RISA Executive Committee will begin meeting regularly, developing detailed plans for the first year. The Advisory Board will also meet as soon as possible in first year, to review the detailed plans for Year 1 and to provide guidance on planned activities for Years 2-5. Decision points (guided by interactions with the Advisory Board, stakeholders, and CPO RISA Program Manager) will occur semi-annually, providing an opportunity to reallocate the budget if necessary. Significant reallocation decisions will be made only after thorough consultation and opportunity-cost analysis of alternative project pathways.
and water management in Pacific Island jurisdictions

Initial definition of problems and needs with partners and stakeholders, including stakeholder workshop

Initial integration of climate and hazards risk and vulnerability assessments to support climate adaptation plan development

Develop (and begin meeting) criteria for interaction with stakeholders, self evaluation

Redefinition of problems and needs with partners and stakeholders

Update integration of climate and hazards risk and vulnerability assessments to support climate adaptation plan development

Refine and develop projects responsive to updated stakeholder-identified needs and assessment findings

Develop metrics for external evaluation and conduct evaluation

Event-driven and routine evaluations

Full integration of assessment, research, and outreach/education activities

Expansion to other sectors as needs are identified

2.5. Relevance to the Priorities of NOAA

This proposal responds directly to the national priorities of the NOAA RISA program by:

1. Fostering integrated, place-based research across a range of social and physical sciences to expand decision options for managing climate change and variability at the regional level;

2. Improving our understanding of the decision-making context and the constraints facing the managers of climate-sensitive resources;

3. Enhancing and evaluating stakeholder engagement in the process of refining scientific research agendas and enhancing institutional capabilities;

4. Bridging climatic, environmental, and societal interactions on different temporal and spatial scales and advancing understanding of coupled natural-human systems; and

5. Contributing to the development of useful climate information and decision-support tools and a regional climate information service.

The Pacific RISA program also addresses the goal and priorities of NOAA’s Climate Program, particularly the Service Development component, by contributing significantly to the development of a regional climate service and the development of regional adaptation strategies. Our work will improve understanding of climate-environment-society interactions with a specific geographic focus (Pacific Islands), sectoral focus (with freshwater resources as an initial priority), and attention to climate impacts on socioeconomic and cultural variables.

2.6. Leveraging

As indicated in the description of the proposed work and the attached letters of support, the Pacific RISA will continue to work closely with a wide range of existing and new partners in the Pacific region. Leveraged resources are significant. Nancy Lewis, EWC Research Director, has pledged in-kind and financial resources amounting to $387,430 (see cost-sharing budget at www.eastwestcenter.org/risaproposal), including 0.5 months/year of her own time and 2 mo/yr for Melissa Finucane. Other resources provided by the EWC include: support from personnel in the departments of Information Technology, Publications, and External Affairs and financial support for publications/communications. James Weyman, Director of PEAC, has pledged 2 mo/yr of in-kind support (personnel, data access, information and service delivery) for outreach
and educational activities and potential operational climate products and services. Eileen Shea, Director of the NOAA IDEA Center, has pledged in-kind support from John Marra who will provide coastal hazards expertise for risk assessment and adaptation plan development. Kevin Hamilton, Interim Director of IPRC, has pledged postdoctoral support for regional atmospheric model development and testing, access to the IPRC parallel computing facility, including a newly purchased 488 core Linux cluster, and support through the Asia-Pacific Data Research Center (http://apdrc.soest.hawaii.edu) for serving data sets to be accessible to the community. Stephen Anthony, Acting Director, USGS Pacific Islands Water Science Center, has pledged 0.20 FTE for Stephen Gingerich to advise on groundwater models. Key stakeholders from government agencies will be providing their time as in-kind contributions. In addition, there will be opportunities to leverage climate outreach programs conducted by NOAA and our other partners.

2.7. Conclusion

The significant and increasing challenges from climate variability and change, in concert with population and environmental pressures, mean that now more than ever before Pacific Island communities need to build adaptive capacity. In Phase II of Pacific RISA, we are well positioned to lead research, assessment, and outreach activities within the organizational framework of PaCIS, the developing regional climate service. Despite limited resources to date, Pacific RISA members and partners have and will continue to participate actively in each of the PaCIS Working Groups and other regional, federal, and state committees tasked with supporting climate adaptation through training, decision support tool development, and adaptation plan development and implementation. Our efforts will continue to support cross-RISA collaborations and be coordinated with the work of other NOAA entities. Continuing our tradition of place-based, stakeholder-driven activities, our new initiatives respond to expressed needs in the region. As such, we envision expanding stakeholder capacity for building sustainable island communities.

2.8. References

3. BUDGET JUSTIFICATION

3.1. Personnel
Funds are requested to cover the salary and benefits for investigators and Core Office staff:

- Dr. Melissa Finucane (3 mo/yr in Yrs 1-5, $227,741; cost-share 2 mo/yr in Yrs 1-5) will serve as the Lead Principal Investigator. She will oversee the integration of activities supporting the program goal and the integration of research and stakeholder activities. She will contribute her knowledge of human decision processes under conditions of uncertainty to the design of materials and methods for Pacific RISA Phase II research, assessment, and outreach activities. She will lead the work related to analysis of human dimensions of drought (2.3.1.4) and performance evaluation (2.3.3.2), and co-lead the outreach and education activities (2.3.2.2).
- Dr. Nancy Lewis (0.5 mo/yr in Yrs 1-5, $55,675; cost-share 0.5 mo/yr in Yrs 1-5), Co-PI, will contribute her expertise in the human geography of Pacific-Island communities and climate impacts to the design of research, assessment, outreach, and education activities. She will co-lead activities related to the stakeholder workshops on climate-change adaptation (2.3.2.2).
- Project Manager (12 mo/yr in Yrs 1-5, $467,361) will be responsible for managing the Core Office. The Project Manager will work with the PIs, partners, and stakeholders to develop an ongoing research, assessment, and outreach agenda and to facilitate integration of all program activities. As part of the Executive Committee, the Project Manager will help to develop mechanisms for integrating research and stakeholder activities. Other responsibilities will include assisting with the development and proper implementation of protocols; managing the operational budget; and overseeing the day-to-day administration of program activities.
- Graduate Research Assistant (6 mo/yr in Yrs 1-5, $157,904) will assist with research and assessment materials development, participant recruitment, mailings, and supervised field work and data collection/entry.
- Fiscal Officer (0.2 mo/yr in Yrs 1-5, $8,976) will support the Core Office by monitoring expenditures throughout the funding period, assuring compliance with relevant policies and procedures, developing award instruments such as subcontracts and consultant agreements, and preparing periodic financial reports for the PI which provides information such as status of funds and projected expenditures.
- Program Officer (0.5 mo/yr in Yrs 1, 3, and 5, $13,198) will support the Core Office with arranging and coordinating travel, lodging, meeting rooms, equipment, and other supplies needed for the Advisory Board meetings and the stakeholder workshops.
- Technical Support (0.5 mo/yr in Yrs 1-5, $22,785) will support the Core Office in accessing climate and other data for use in decision support tools and use video-telecommunications and other electronic equipment as needed.
- Secretary (0.5 mo/yr in yrs 1-5, $14,348) will support the Core Office with document preparation and coordination of Executive Committee meetings.

3.2. Travel
Funds are requested to cover travel ($151,690) including airfares, per diem (meals and lodging), and ground transportation for: six Advisory Board members to travel from the region to Honolulu to meet in person in Yrs 1, 3, and 5; two stakeholders from each of six jurisdictions (RMI, Palau, CNMI, Guam, Yap, American Samoa) to travel to Honolulu for a stakeholder assessment and training workshop in Yrs 1 and 5; four co-PIs to travel from Honolulu to Guam for a stakeholder workshop in Yr 3; the PI and a Graduate Research Assistant to travel to outer Hawaiian Islands for the human dimensions of drought interviews (2.3.1.4) in Yr 1; the PI to travel to RMI
for drought interviews (2.3.1.4) in Yr 2; the PI to Boulder, CO to meet with RISA program officials and colleagues, Yrs 1-5; two co-PIs to Washington, DC for scientific conferences, Yrs 1-5.

3.3. Supplies

Funds are requested to cover supplies ($9,500) including files, folders, etc. for Yrs 1-5, a laptop computer (to display websites, decision-support tools, and other focal stimuli to stakeholders) in Yr 1, and an audiorecorder and microphone (for drought and evaluation interviews) in Yr 1.

3.4. Contractual

Consultants in Yrs 1-5 include: Statistical Analyst to advise on theory and methods for multidimensional modeling of survey and other data ($30,000); an expert in program evaluation (Moser) to advise on criteria development and to conduct an external evaluation of Pacific RISA support for adaptation planning ($104,242); and translators to translate materials for adaptation planning, surveys, and outreach and education into languages used in the USAPIs ($36,000).

Subcontracts for Yrs 1-5 include hosting, maintenance, and development of the PacificRISA.org website ($37,500). The UH SSRI-HCE subcontract ($434,982) includes salaries and benefits for personnel (Anderson, assistant researchers in Hawaii and the USAPIs, and a graduate assistant researcher), supplies, telecommunication costs, and publication costs related to work conducted in Hawaii and the USAPIs to assess localized risks and vulnerabilities, integrate the best available physical and social science data in current plans, draft impact reports and analyses, engage state organizations to refine methods and develop plans. Anderson will lead the work on risk vulnerability assessment and plan development (2.3.1.3) and portfolio-based climate services (2.3.2.1) and co-lead the stakeholder workshops (2.3.2.2). The UH SSRI-HCE subcontract also includes travel for face-to-face engagements with government representatives in USAPIs to improve the assessment methods and increase local capacity. UH SSRI-HCE will also contract with UOG WERI, which has a strong regional reputation in Micronesia for research on water resources availability, to collaborate and integrate their ongoing research into the risk and vulnerability assessments for disaster risk management, and later for adaptation planning. The UH IPRC subcontract ($651,841) includes salaries and benefits for personnel (Hamilton, assistant researcher, and postdoctoral fellow) who will develop downscaled models and island climate projections (2.3.1.1) for use in models of future freshwater availability. The postdoctoral fellow will be co-hosted by IPRC, WRRC, and USGS. The UH WRRC subcontract ($212,443) includes salaries and benefits for personnel (El-Kadi, assistant researcher) and supplies needed to develop water budgets and ground water flow models (2.3.1.2) based on IPRC climate projections; travel to one scientific conference in California is included also. The UH ICAP subcontract ($360,000) includes salaries and benefits for personnel (Burkett, graduate research assistant), legal research support (Westlaw/Lexis), travel (to gather information about island laws and policies and attend scientific conferences), and publishing costs related to the legal analyses (2.3.3.1). Together, the subcontracts build on existing partnerships, expand collaborations, and provide resources for developing tools for climate adaptation planning in Hawaii and elsewhere in the Pacific region.

3.5. Other

Additional costs include printing and mailing of letters, surveys, and fact sheets ($20,000); coffee/working meals at Advisory Board meetings and stakeholder workshops ($5,564); photocopying ($2,500); equipment and room rental for meetings/workshops ($3,500); publications ($12,500); fax, phone, and courier communications ($8,500); transcriptions of audiorecordings ($12,000); DVD authoring and production for distribution of educational materials and decision-support tools ($12,500); and participant vouchers ($2,400).
4. ABBREVIATED VITAE FOR INVESTIGATORS
Expanded CVs for the Investigators (and Consultants) are provided at: www.eastwestcenter.org/risaproposal.

MELISSA FINUCANE

EDUCATION
Ph.D. (Psychology), University of Western Australia, 1998
M.Psych. (Clinical Psychology), University of Western Australia, 1998
B.Sc. Honors (Psychology), University of Western Australia, 1991

EMPLOYMENT
2007-present Senior Fellow, East-West Center, Honolulu HI
2006-present Affiliate Investigator, Center for Health Research Hawaii, Honolulu HI
2006-2007 Senior Research Investigator, Center for Health Research Hawaii, Honolulu HI
2001-2006 Research Investigator, Center for Health Research Hawaii, Honolulu HI
1997-2001 Research Scientist, Decision Research, Eugene, Oregon; Visiting Scholar, Institute for Cognitive & Decision Sciences, Univ. of Oregon

RELEVANT PUBLICATIONS

SELECTED SYNERGISTIC ACTIVITIES
2000-present Member of the Editorial Board of the Journal of Behavioral Decision Making
2007-present Member of the Navigators’ Council of the Pacific Risk Management ‘Ohana (PRiMO)
2007-present Member of the Pacific Climate Information System (PaCIS) Working Group 3 (Research and Assessment)
1996-present Member, Society for Judgment and Decision Making
CHERYL ANDERSON

EDUCATION
Ph.D. (Political Science), University of Hawaii at Manoa, Honolulu, HI, 2005
M.S. (Urban and Regional Planning), University of Hawaii at Manoa, Honolulu, HI, 1996
Graduate Ocean Policy Certificate, University of Hawaii at Manoa, Honolulu, HI, 1996
East-West Center Degree Fellow & Certificate, East-West Center, Honolulu, HI, 1996
B.A. (International Relations), Pomona College, Claremont, CA, 1990

EMPLOYMENT
2006-present Graduate Faculty, Dept. of Urban & Regional Planning, University of Hawaii
2004-present Director, University of Hawaii Social Science Research Institute-Hazards, Climate, and Environment Program
1993-1994 Hazard Mitigation Planner, Yap, Federated States of Micronesia

RELEVANT PUBLICATIONS

SYNERGISTIC ACTIVITIES
Member of the Navigators’ Council of the Pacific Risk Management ’Ohana (PRiMO) Chair, PRiMO Risk Assessment and Post Disaster Evaluation Hui (working group) Chair, Research & Assessment Group, Pacific Climate Information System (PaCIS) Vice-Chair, Earthquake Advisory Committee to Hawaii State Civil Defense Member, Hawaii State Hazard Mitigation Forum Member, American Institute of Certified Planners Member, American Planning Association Affiliate Member, American Society of Civil Engineers
KEVIN HAMILTON

EDUCATION

Ph.D. (Geophysical Fluid Dynamics) Princeton University, 1981
M.Sc. (Physics) McMaster University (Hamilton, Ontario, Canada), 1977
B.Sc. (Physics) Queen’s University (Kingston, Ontario, Canada), 1976

EMPLOYMENT

2008-present  Interim Director, International Pacific Research Center, University of Hawai’i Manoa
2004-2007  Chair, Department of Meteorology, University of Hawai’i Manoa
2000-present  Professor, Department of Meteorology and International Pacific Research Center, University of Hawai’i Manoa
1988-2000  Research Meteorologist at the NOAA Geophysical Fluid Dynamics Laboratory
1987-1988  Visiting Scientist, Atmospheric and Oceanic Sciences Program, Princeton Univ.
1985-1987  Assistant Professor, Department of Meteorology, McGill University
1982-1985  Research Fellow, Department of Oceanography, University of British Columbia
1981-1982  Postdoctoral Fellow, National Center for Atmospheric Research
1988-2000  Visiting Lecturer, Princeton University

RELEVANT PUBLICATIONS


SELECTED SYNERGISTIC ACTIVITIES

2004-present  Co-Chief Editor for Springer Publishing Atmospheric and Oceanic Sciences Library monograph series
2007-present  Editorial Advisory Board for The Open Atmospheric Science Journal (Bentham Publishers)
1993-2007:  Co-Chair of Committee on Gravity Wave Processes and Parameterization of the SPARC (Stratospheric Processes and their Role in Climate) Initiative of the World Climate Research Program
ALY EL-KADI

EDUCATION
Ph.D. (Groundwater Hydrology); School of Civil and Environmental Engineering, Cornell University, Ithaca, New York, 1983
M.S. (Surface Water Hydrology); Ain Shams University, Cairo, Egypt, 1976
B.S. (Fluid Mechanics and Hydraulics); Ain Shams University, Cairo, Egypt, 1971

EMPLOYMENT
1989-present  Professor/Associate Professor, Department of Geology and Geophysics
and Researcher/Associate Researcher and Assistant Director, Water Resources
Research Center, University of Hawaii, Honolulu, Hawaii
1983-1989  Associate Director for Research/Research Scientist and Hydrologist, Water Science
Program, Holcomb Research Institute, Butler University, Indianapolis, IN
1971-1978  Instructor, Ain Shams University, Cairo, Egypt

RELEVANT PUBLICATIONS
Resources Series, Vol 13, 432 pp, WIT Press, Southampton, UK.
El-Kadi, A.I. M. Mira, J. E.T. Moncur and R.S. Fujioka. 2008. Restoration and protection plan
2008. Coastal Watershed Management, (pp. 251-282), Progress in Water Resources Series,
WIT Press, UK.
Deb, S.K., and A.I. El-Kadi. 2009. Susceptibility assessment of shallow landslides on Oahu,
to asynchronous dual-tide propagation, Ground Water, 46(2):239-250.
aquifers using constant-rate and variable-rate aquifer tests, Jour. of the American Water Re-
sources Association, 43(2): 334-345.
El-Kadi, A.I. and E. Yamashita. 2007. Modeling streamflows and flood delineation of the 2004
flood disaster, Mānoa, O’ahu, Hawaii, Pacific Science, 61(2): 235-255.
Mair, A, A. Fares, and A. I. El-Kadi. 2007. Evaluation of the effect of groundwater extraction
and long-term weather patterns on the Makaha Valley's streamflow, Jour. of the American
El-Kadi, A.I. 2007. Parameter sensitivity and uncertainty of a hydrocarbon biodegrada-
El-Kadi, A.I. 2005. Validity of the generalized Richards equation for the analysis of
three-dimensional test data for a coarse-material aquifer. Vadose Zone Journal, 4: 196-
205.
JAMES WEYMAN

EDUCATION

Master of Business Administration, Boston University, Boston, Massachusetts
Master of Science, Meteorology, Texas A&M University, Texas
Bachelor of Science, Mathematics, Grove City College, Pennsylvania

EMPLOYMENT

1996 – present   Director, Central Pacific Hurricane Center
                 Meteorologist-in-Charge, Weather Forecast Office Honolulu
                 Area Manager, Hawaii, National Weather Service Pacific Region
1985 – 1990   Test Director for multi-agency (National Weather Service, Department of Defense, and the Federal Aviation Administration), 161-member, test team who tested, prior to acceptance, the current, widely used United States Doppler weather radar.

RELEVANT PAPERS

2006   Sixth International Workshop on Tropical Cyclones, Section 5.1 Societal Impacts of Tropical Cyclones Co-Rapporteur
2002   Fifth International Workshop on Tropical Cyclones, Section 5.1 Societal Impacts of Tropical Cyclones Co-Rapporteur
1993   Probabilistic Quantitative Precipitation Forecasts for River Basins Roman Krzysztofowicz, William J. Drzal, Theresa Rossi Drake, James C. Weyman, and Louis A. Giordano

SELECTED SYNERGISTIC ACTIVITIES

1996 – present   Director, Pacific ENSO Applications Climate (PEAC) Center
2003 – present   NWS Pacific Region Climate Service Program Manager
2005 – present   Executive Director, Pacific Climate Information System (PaCIS)
2008 – present   NOAA Regional Climate Focal Point, Pacific Region
2002 – present   Chairperson, World Meteorological Organization (WMO), Regional Association V (Pacific Ocean area), Working Group on Climate Related Matters
2001 – present   Vice-Chairperson, United Nations Economic and Social Commission for Asia and the Pacific (ESCAP)/WMO Typhoon Committee Advisory Working Group
1996 – present   Member, World Meteorological Organization (WMO), Regional Association V (Pacific Ocean area), Tropical Cyclone Committee
2002 – 2008   Member, Pacific Island Global Climate Observing System Steering Group
JOHN MARRA

EDUCATION
Ph.D. (Geology), University of Canterbury, Christchurch, NZ, 1986
M.S. (Geology), University of Canterbury, Christchurch, NZ, 1985
B.A. (Geology), University of Montana, Missoula, Montana, 1982

EMPLOYMENT
2006-present RTi Senior Scientist, NOAA Integrated Data and Environmental Applications (IDEA) Center, Honolulu, Hawai`i;
2006-present Adjunct Fellow, East-West Center, Honolulu, Hawai`i
2002-2006 PSGS Senior Coastal Hazards Specialist, NOAA Pacific Services Center, Hawaii
1993-2002 Principal, Shoreland Solutions, Newport, Oregon
1999-2001 Coastal Hazards Specialist, Oregon Coastal Management Program.
1990-1993 North Coast Field Representative, Oregon Department of Land Conservation and Development, Newport, Oregon
1987-1988 Coastal Investigations Inc., Christchurch, New Zealand

RELEVANT PAPERS

SELECTED SYNERGISTIC ACTIVITIES
2006 Affiliate Graduate Faculty. University of Hawai`i at Mānoa
2005 State of Hawaii Hurricane Advisory Committee
2004 State of Hawaii Hazard Mitigation Forum
2003-2008 Hawaii State Earthquake Advisory Committee
MAXINE BURKETT

EDUCATION
J.D., University of California, Berkeley School of Law, Berkeley, CA, 2002

EMPLOYMENT
2009-present  Associate Professor of Law, William S. Richardson School of Law, University of Hawaii, Manoa, Honolulu, HI
2009-present  Director, Center for Island Climate Adaptation and Policy, University of Hawaii Sea Grant College Program
2006-2008  Associate Professor of Law, University of Colorado Law School, Boulder, CO

RELEVANT PUBLICATIONS
Maxine Burkett, *Shoreline Impacts, Setback Policy and Sea Level Rise*, Project 41.A/AS-1, Center for Island Climate Adaptation and Policy, University of Hawai’i Sea Grant College Program, April 2009 (with Dennis Hwang).

SELECTED SYNERGISTIC ACTIVITIES
**State of Hawaii Climate Change Task Force.** One of 17 member taskforce convened to scope the current and potential impacts of global warming and climate change on the people, natural resources, and economy of the State. *Ongoing.*

**State of Hawaii Greenhouse Gas Emission Reduction Task Force.** One of 10 member task-force convened to develop and recommend a work plan for statewide wide greenhouse gas (GHG) emissions reduction program and strategies including regulatory mechanisms, and legislation proposals, to ensure the achievement of the statewide GHG emissions reductions limits at or below the 1990 emissions levels by January 2020, as established by Act 234. *Ongoing.*

NANCY DAVIS LEWIS

EDUCATION
Ph.D. (Geography), University of California, Berkeley, 1981
M.S. (Health and Medical Science), University of California, Berkeley, 1976
M.A. (Geography), University of California, Berkeley, 1974
B.A., Honors (Psychology), University of California, Berkeley, 1968

EMPLOYMENT
2001-present  Director, Research Program, East-West Center
2007-2009  Adjunct Professor, Department of Geography, University of Hawaii
2000-2001  Acting Dean, College of Social Sciences, University of Hawaii
1993-2000  Associate Dean, College of Social Sciences, Univ. of Hawaii
1981-2003  Assistant/Associate/Ful l Professor, Department of Geography, University of Hawaii; Affiliate Appointments in Pacific Island Studies, Public Health, Women’s Studies and Urban and Regional
1991-1992  Adjunct Research Associate, Environment and Policy Institute, East-West Center, Honolulu Hawaii
1981-1986  Research Associate, Social Science Research Institute, University of Hawaii

RELEVANT PUBLICATIONS
Wall, Diane and Rabbinge, Rudy with Gallopin, Gilberto, Khoday, Kishan, Lewis, Nancy, Lubchenco, Jane, Melillo, Jerry, Schmidt-Traub, Guido, Sombilla, Mercedes and Cimarrusti, Lina 2005 Chapter 19” Implications for Achieving the Millennium Development Goals”, Millenium Ecosystem Assessment, Responses Assessment.

SELECTED SYNERGISTIC ACTIVITIES
1995-2009 Chair, Pacific Science Congress Task Force on Human Resources for the Future
1999-2007 Secretary General, Pacific Science Association
2006-2010 Charter Board Member, International Association for Ecology and Health
2007-2011 Vice President, Pacific Science Association
1989-2008 Editorial Board Member, Contemporary Pacific
2003-present Editorial Board Member, Pacific Science
5. LETTERS OF SUPPORT

Demonstrating existing and potential partnerships and support for the Pacific RISA program, we have received letters of support from individuals representing federal, state and county government agencies and regional organizations involved in climate services and risk management. Below is a list of the letters received; eight example letters follow thereafter. All letters can be viewed in full at: www.eastwestcenter.org/risaproposal.

<table>
<thead>
<tr>
<th>Name</th>
<th>Position, Organization</th>
<th>Type of Organization</th>
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<tbody>
<tr>
<td>Sitiveni Halapua</td>
<td>Director, Pacific Islands Development Program</td>
<td>Regional</td>
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<tr>
<td>Taito Nakalevu</td>
<td>Climate Change Adaptation Officer, Secretariat of the Pacific Regional Environment Program (SPREP)</td>
<td>Regional</td>
</tr>
<tr>
<td>Sally Ziolkowski</td>
<td>Chair, Pacific Risk Management `Ohana (PRiMO)</td>
<td>Regional</td>
</tr>
<tr>
<td>James Weyman</td>
<td>Director, Pacific ENSO Applications Center; NOAA NWS, Pacific Region Meteorologist in Charge</td>
<td>Regional; Federal Government</td>
</tr>
<tr>
<td>Eileen Shea</td>
<td>Chair, Pacific Climate Information System (PaCIS); Director, NOAA Integrated Data and Environmental Applications (IDEA) Center;</td>
<td>Regional; Federal Government</td>
</tr>
<tr>
<td>Ed O’Lenic</td>
<td>Chief, Operations Branch, NOAA Climate Prediction Center</td>
<td>Federal Government</td>
</tr>
<tr>
<td>Stephen Anthony</td>
<td>Acting Center Director, Pacific Islands Water Science Center, US Geological Survey</td>
<td>Federal Government</td>
</tr>
<tr>
<td>David Wesley</td>
<td>Acting Regional Director, US Fish &amp; Wildlife Service</td>
<td>Federal Government</td>
</tr>
<tr>
<td>Neal Fujii</td>
<td>Hawaii State Drought and Water Conservation Coordinator, Dept of Land and Natural Resources</td>
<td>State Government</td>
</tr>
<tr>
<td>Abbey Seth Mayer</td>
<td>Director and Chair of the Climate Change Task Force, Hawaii State Office of Planning</td>
<td>State Government</td>
</tr>
<tr>
<td>Pao-Shin Chu</td>
<td>State Climatologist, University of Hawaii</td>
<td>State Government</td>
</tr>
<tr>
<td>Thomas Schroeder</td>
<td>Director, Joint Institute for Marine &amp; Atmospheric Research, School of Ocean &amp; Earth Science &amp; Technology, University of Hawaii</td>
<td>State Government</td>
</tr>
<tr>
<td>Michael Hayes</td>
<td>Director, National Drought Mitigation Center (NDMC), University of Nebraska</td>
<td>US National Research Center</td>
</tr>
<tr>
<td>Trisha Kehaulani</td>
<td>President, Honua Consulting</td>
<td>Private sector (cultural consulting)</td>
</tr>
<tr>
<td>Scott Power</td>
<td>Co-Chair, Pacific Climate Change Science Program, Australian Bureau of Meteorology</td>
<td>Australian Government</td>
</tr>
</tbody>
</table>
August 25, 2009

Melissa L. Finucane
Senior Fellow East-West Center 1601
East-West Road Honolulu HI 96848

RE: Pacific RISA Proposal

Dear Dr. Finucane,

I am writing in strong support of your proposal entitled “Climate Adaptation Partnership for the Pacific: Pacific RISA Phase II.” The planned work clearly builds upon the results of in-depth dialogues and assessments and strong relationships among Pacific region partners established over the last 5 years. Your focus on place-based vulnerability assessment and direct support for climate adaptation planning in the Pacific directly responds to statements of need from a variety of regional stakeholders and is consistent with discussions of priorities in the Research and Assessment Working Group of the Pacific Climate Information System (PaCIS).

The activities outlined in the Pacific RISA Phase II proposal are highly synergistic with our work at the NOAA Integrated Data and Environmental Applications (NOAA IDEA) Center. Working closely with the Pacific RISA program will help inform our work, but also provide an opportunity for the NOAA IDEA Center to support broader research efforts addressing climate challenges in the Pacific region. Conversely, I believe that the Pacific RISA program will benefit from the NOAA IDEA Center’s investments in developing data products, information services, and decision-support tools relevant to managing climate risks such as coastal inundation in the Pacific Region. In this context, I am happy to confirm John Marra’s participation in the project as an in-kind contribution from the IDEA Center. The enhanced data products and information services related to climate extremes including inundation being produced through the Pacific Region Integrated Climatology Information Products (PRICIP) program will contribute directly to the development of a portfolio of climate risk management decision support services as outlined in your proposal. John’s expertise will contribute directly to the development and review of related climate risk, resilience and adaptation education and outreach materials. In addition, I anticipate opportunities to leverage broad climate education, outreach and literacy programs that IDEA and other NOAA partners will be undertaking. More generally, our collaboration provides the Pacific RISA team with access to the scientific assets, data holdings and climate services programs of the National Climatic Data Center which is home to the NOAA IDEA Center.

I would also like to highlight two other areas of shared interest relevant to your proposal. The NOAA IDEA Center is providing support for the work of Kevin Hamilton (University of Hawaii’s International Pacific Research Center) and colleagues related to the downscaling of
global climate models. Assuming funding levels for the NOAA IDEA Center continue at their current levels, I plan to continue this support for regional climate modeling at UH/IPRC for the next few years and I believe that this regional modeling work will directly contribute to your plans for place-based assessments of vulnerability. I would also like to acknowledge the value of your planned expansion of activities related to the use of CLIDDS-related tools and techniques. As you know, the IDEA Center provided direct support for Holly Hartman’s CLIDDS team with an eye towards its application in the Pacific and I am pleased to see this planned investment in the context of Pacific RISA Phase II.

I am pleased to accept your invitation to serve as a member of the Advisory Board of the Pacific RISA program. My participation will provide continuity for the program since its inception and underscores the importance of coordinating efforts by different researchers simultaneously working on multiple aspects of improving climate information and services in the Pacific region.

I look forward to a sustained, collaborative partnership with the Pacific RISA team to improve the capacity of Pacific Islanders to respond effectively to the significant climate challenges facing this region. As you know, I believe a strong and effective Pacific RISA program will be an important component of the Pacific Climate Information System which the IDEA Center considers a high priority for the region.

Yours sincerely,

Eileen Shea
Director, NOAA Integrated Data and Environmental Applications (IDEA) Center and Chair, Pacific Climate Information System Steering Committee
August 21, 2009

Melissa L. Finucane  
Senior Fellow, East-West Center  
1601 East-West Road  
Honolulu HI 96848

Dear Dr. Finucane,

I am excited about this proposed Pacific RISA and express my strong support for collaborations between the Pacific RISA program and Pacific ENSO Applications Climate (PEAC) Center, Pacific Climate Information System (PaCIS), and the National Weather Service (NWS) Pacific Region.

The mission of the PEAC Center is to conduct research and develop information products specific to Hawaii, U.S. territories, and the U.S. Affiliated Pacific Islands (USAPI) on the ENSO climate cycle and its historical impacts. This research and development support planning and management activities in climate-sensitive sectors as water management, fisheries, agriculture, civil defense, public utilities, coastal zones, and other economic and environmental sectors. PEAC Center core members include the National Oceanic and Atmospheric Administration’s (NOAA) Climate Program Office, NOAA’s National Weather Service’s Pacific Region, the University of Hawaii, School of Ocean and Earth Science and Technology, and the University of Guam, Water and Environmental Research Institute.

The Pacific RISA, as a critical part of the regional PaCIS, will help the PEAC Center and the multifaceted, multinational PaCIS team to understand regional climate risks and needs, develop effective risk communication and decision support tools, and enhance planning and management activities. I believe Pacific RISA’s overarching goal to support the integration of flexible processes for building adaptive capacity to climate variability and change information in diverse island settings is vital to the development of a regional component of a national climate service. I eagerly await the future outreach and educational collaborations and the possibility of an integrated, experimental regional test bed for future operational climate products and services and pledge 2 months of in-kind support for these.

Together, the Pacific RISA program, working with the NWS Pacific Region, PEAC Center, and PaCIS, will provide a comprehensive approach for identifying and addressing critical climate risks in Hawaii, U.S. territories, and the USAPIs. I look forward to resuming our partnership and working closely with your team.

Yours sincerely,

James Weisman  
Meteorologist In Charge, NOAA NWS Weather Forecast Office Honolulu  
Director, Pacific ENSO Applications Climate Center
Ms. Melissa L. Finucane  
Senior Fellow  
East-West Center  
1601 East-West Road  
Honolulu HI 96848

Dear Ms. Finucane:

Pacific Regional Integrated Science and Assessment (RISA) Proposal

Thank you for inviting me to participate as a member of the Advisory Board of the Pacific RISA program. I am pleased to be integrally involved with the Pacific RISA program in this way, providing my perspective as State Drought and Water Conservation Coordinator on the climate information needs of agencies, organizations, and communities.

Members of the Pacific RISA team have made valuable contributions to activities of the Hawaii Drought Council in the past and we look forward to expanding this partnership in the future. The new research, assessment, and outreach activities outlined in the Proposal support recommendations of the Hawaii Drought Plan, including assessing drought risks and impacts, and improving localized climate monitoring.

The Proposal’s adaptive planning approach with respect to climate change and its impacts on water resources is an encouraging perspective, since water resource managers can no longer rely purely on climatology to ascertain future water availability. This is especially significant on an island setting, where we rely solely on rainfall to provide all of our fresh water and sea level changes can have critical impacts to our aquifers.

The Pacific RISA program provides an important bridge between scientists, policymakers, and resource managers and will be key in helping to reduce the effects of drought upon the people and natural resources of Hawaii. Best wishes for a successful outcome with your proposal.

Sincerely,

[Signature]

NEAL FUJII  
State Drought and Water Conservation Coordinator
August 24, 2009

Dr. Melissa L. Finucane  
Senior Fellow  
East-West Center  
1601 East-West Road  
Honolulu, Hawaii 96848

Dear Dr. Finucane:

Subject: Pacific RISA Phase II

The Office of Planning supports your proposed Climate Adaptation Partnership for the Pacific, through which the Pacific Regional Integrated Science and Assessment (Pacific RISA) research, assessment, and outreach activities will be conducted. Your team’s efforts to help individuals and organizations use climate information and services effectively are most timely and necessary. A strength of your proposal is the iterative approach to stakeholder engagement to inform and guide the program of work.

On July 16, 2009, the State Legislature met in Special Session and enacted Act 20 (Senate Bill No. 266, SD2, HD2, CD1) which establishes a Climate Change Task Force within the Office of Planning to assess the impacts of global climate change trends in the State of Hawaii. As the Climate Change Task Force assesses impacts in the State of Hawaii and makes recommendations for adaptation policies and actions, it will be beneficial to have the assistance of the Pacific RISA in identifying current research and best practices to consider. The proposed community-based adaptation project that builds on previous and ongoing efforts of the Hawaii Coastal Zone Management Program’s engagement with communities in coastal management will provide needed localized information about adaptation planning.

The Ocean Resource Management Plan Working Group, supported by our office as well, has formed a climate change caucus focused on adaptation planning. We understand that the efforts of the Pacific RISA will provide critical climate-related information for hazard mitigation and risk reduction that will play a large part of adaptation planning in Hawaii.

In this regard, we wholeheartedly support the proposed project, and strongly recommend favorable consideration of this project.

Sincerely,

[Signature]

Abbey Seth Mayer  
Director, and Chair of the Climate Change Task Force
August 21, 2009

Melissa L. Finucane
Senior Fellow
East-West Center
1601 East-West Road
Honolulu, HI 96848

Re: Climate Adaptation Partnership for the Pacific (CAPP), Pacific RISA Phase II

Dear Dr. Finucane,

As Director of the Joint Institute for Marine and Atmospheric Research (JIMAR) in the School of Ocean and Earth Science and Technology (SOEST) of the University of Hawaii at Manoa, I am pleased to express my strong support for your Pacific RISA proposal to NOAA. The research assessment and outreach activities will support climate adaptation in Pacific Island communities. The interdisciplinary and place-based approach that underlies the Pacific RISA work plan constitutes a unique program for this region. We welcome the opportunity to coordinate and integrate our technical expertise on Asia-Pacific climate and ENSO with the social science capabilities of your team to expand the use of climate information and services in the Pacific. JIMAR’s Pacific ENSO Applications Center (PEAC) pioneered such efforts in mitigation of seasonal-to-interannual climate variability. Our customers are now seeking assistance in adaptation. Our collaboration will help planning and management activities in diverse climate-sensitive sectors such as water management, fisheries, agriculture and emergency management.

I look forward to working closely with the Pacific RISA team to identify and address critical climate risks in Hawaii and the US-Affiliated Islands.

Sincerely,

Thomas A. Schroeder
Director
Dr. Melissa L. Finucane  
Senior Fellow  
East-West Center  
1601 East-West Road  
Honolulu, HI 96848-1601

August 19, 2009

Dear Dr. Finucane:

I value the opportunity to provide my perspective as Hawaii State Climatologist to help guide your proposed “Climate Adaptation for the Pacific Partnership (CAPP) – Pacific RISA Phase II” project. The Pacific RISA program is noteworthy in its unique plan to integrate science, assessment, and stakeholder education/outreach activities to improve climate adaptation planning throughout the Pacific region. Building resilience to climate risks is critical for the sustainability of Pacific Island communities.

I look forward to working with you and contributing my experience and knowledge on tropical climatology in the Pacific to your important endeavors.

Sincerely,

[Signature]

Pao-Shin Chu, Ph.D.  
Professor and Hawaii State Climatologist
August 25, 2009

Dear Members of the Review Panel,

I am very pleased to write a letter in strong support of the proposal, “Climate Adaptation Partnership for the Pacific (CAPP): Pacific RISA Phase II.” I serve as the Director of the Pacific Islands Development Program (PIDP) at the East West Center. PIDP serves as the Secretariat for the Pacific Island Conference of Leaders which brings together over twenty Pacific heads of government, including those of Hawaii, American Samoa, Guam, the Commonwealth of the Mariana Islands, the Federated States of Micronesia, the Republic of the Marshall Islands and the Republic of Palau. It is the only grouping of regional leaders that includes representation by all Pacific Island governments regardless of political status. Ten are members of the United Nations.

As you are well aware, the threat of global climate change is a critical issue for the islands of the Pacific, many of which are already experiencing the effects of a changing climate. These may be exacerbated by the developing El Niño. As the leaders deliberate on the challenges that they face, climate change is always close to the top of the list. Almost a decade ago, when serving as chair of the Pacific Island Conference of Leaders, Leo Falcain, then president of the Federate State of Micronesia, was quoted, “For Pacific Island states, climate change and its effects are our main security concern.” (Honolulu Advertiser 8/12/2001).

The first phase of Pacific RISA was an innovative project that helped the islands build the capacity to adapt to climate change. In addition to the activities of the RISA project, it also allowed Guam, American Samoa, the Commonwealth of the Northern Mariana Islands and the sovereign states of Micronesia in free association with the U.S. (the Federated States of Micronesia, the Republic of the Marshall Islands and the Republic of Palau) to benefit more fully from the more developed climate services available in Hawaii, e.g. the National Weather Service, the Pacific ENSO Application Center, and now the NOAA Idea Center and PaCIS. CAPP: Pacific RISA II promises to strengthen the network of scientists, policy makers and other stakeholders that has been established, provide valuable climate science at a scale that has utility for the island states, continue to assist the islands in risk and vulnerability assessment and help institutionalize climate adaptation planning and implementation.

Sincerely yours,

Sitiveni, Halapua, PhD.
Director
Pacific Islands Development Program

SH/Nildm

The EAST-WEST CENTER is an education and research organization established by the U.S. Congress in 1960 to strengthen relations and understanding among the peoples and nations of Asia, the Pacific, and the United States. The Center contributes to a peaceful, prosperous and just Asia-Pacific community by serving as a vigorous hub for cooperative research, education, and dialogue on critical issues of common concern to the Asia-Pacific region and the United States. Funding for the Center comes from the U.S. government, with additional support provided by private agencies, individuals, foundations, corporations, and the governments of the region.
United States Department of the Interior

U.S. GEOLOGICAL SURVEY
Pacific Islands Water Science Center
677 Ala Moana Blvd., Suite 415
Honolulu, Hawaii 96813
Phone: (808) 587-2400/Fax: (808) 587-2401

August 25, 2009

Dr. Melissa L. Finucane, PhD
Senior Fellow
East-West Center
1601 East-West Road
Honolulu, Hawaii 96922

Dear Dr. Finucane:

The U.S. Geological Survey (USGS) is pleased to cooperate with the East West Center to implement Phase II of the Pacific Regional Integrated Science Assessment (RISA), which proposes an integrated and multidisciplinary approach to climate adaptation in the Pacific region. The Pacific RISA will provide a valuable avenue to incorporate current and planned research by the USGS of the effects of climate change on the availability of groundwater on Pacific Islands. The many partners in the Pacific RISA provide an outstanding opportunity to use USGS science to inform policy and planning stakeholders that are evaluating various climate mitigation and adaptation strategies.

The technical aspects of our work will be coordinated with the University of Hawaii International Pacific Research Center and Water Resources Research Center. Information on how climate change affects groundwater resources will be presented in a way that can be used by researchers at the University of Hawaii Social Science Research Institute and Center for Island Climate Adaptation and Policy. A major guiding principal will be that if technical information is going to be used to guide management and policy evaluations, it must be passed between stakeholders in a user-friendly way. We believe that the vision of RISA provides a broad audience to ensure that climate change planning is based on the best available science, and feel that it is part of our mission to work collaborative to provide this information.

To uphold the USGS commitment to the Pacific RISA, we will dedicate 20 percent time of Dr. Stephen Gingerich, who is a research hydrologist with the USGS Pacific Islands Water Science Center. Dr. Gingerich has done extensive study and numerical modeling of groundwater resources on several Pacific Islands. For this effort, we will use a previously published water budget and groundwater flow model of Central Maui to evaluate how forecast climates affect the availability of groundwater resources. We believe that this is an important part of planning for climate change, and look forward to working in collaboration with the Pacific RISA on this effort.

Sincerely,

Stephen S. Anthony
Acting Center Director

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### 6. CURRENT AND PENDING SUPPORT

<table>
<thead>
<tr>
<th>Melissa Finucane</th>
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<tr>
<td><strong>CNH:</strong> Coupled Natural-Human Systems and Emerging Infectious Diseases; National Science Foundation (DEB-0909410); 2 Mo/Yr; $1,398,380; 8/1/09-7/31/12.</td>
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<tr>
<td>Pacific RISA Integrated Climate Program Support, NOAA; 2 Mo/Yr; $39,070; 09/01/09-08/31/10; pending.</td>
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<tr>
<th>Cheryl Anderson</th>
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<tr>
<td>Hawaii State Disaster Gap Analysis; Hawaii State Civil Defense, FEMA-1664-DR-2006; 3 Mo/Yr; $620,860; 6/18/07-10/31/10.</td>
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<tr>
<td>University of Hawaii System wide Multi-Hazard Mitigation Plan, FEMA, FEMA-PDM-HI-2005; 3 Mo/Yr; $360,000; 09/05-05/12-31/09.</td>
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<td>Hawaii Disaster Public Awareness Campaign; FEMA and Hawaii State Civil Defense, FEMA-1575-DR-2005; 2 Mo/Yr; $160,000; 09/15/08-12-31/10.</td>
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<td>Kauai County Multi-Hazard Mitigation Plan Update; Kauai County; 1 Mo/Yr. $100,000; 07/01/09-10/31/09.</td>
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<td>Developing a Local and Indigenous Climate Knowledge Network; NOAA; NA17RJ1230; 1 Mo/Yr; $39,432; 08/01/08-6/30/10.</td>
</tr>
<tr>
<td>Integrating Socioeconomic Assessments to Build Community Resilience in Mitigating Drought; NOAA SARP; OAR-CPO-2009-2001430; 2.5 Mo/Yr; $32,600; 09/01/09-08/31/11.</td>
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<tr>
<td>Pacific RISA Integrated Climate Program Support, NOAA, NA09OAR4320075; 1 Mo/Yr; $137,035; 09/01/09-08/31/11.</td>
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<th>Kevin Hamilton</th>
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<td>Precipitation Climatology Projections for Mid and Late 21st Century for the Main Hawaiian Islands; USGS Pacific Islands Ecosystem Center; 04HQAG0124, 4124HS0001; 0 Mo/Yr; $42,427; 06/09-12/11.</td>
</tr>
<tr>
<td>Effects of the Stratospheric Quasi-biennial Oscillation on Seasonal Predictability of Tropospheric Circulation in the Northern Hemisphere Extratropics; NOAA CLIVAR Program; NA17RJ1230; 0 Mo/Yr; $166,355; 06/06-05/10.</td>
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<tr>
<td>JAMSTEC Year 13; Japan Agency for Marine-Earth Science and Technology; $2,246,000; 04/09-03/10.</td>
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<tr>
<td>Enhancement of Data and Research Activities for Climate Studies at the International Pacific Research Center; NOAA/NESDIS; NA17RJ1230; 0 Mo/Yr; $1,218,000; 07/08-06/09.</td>
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<tr>
<td>Data-Intensive Research and Model Development at the International Pacific Research Center; NASA, NNX07AG53G. 0 Mo/Yr; $5,525,000; 03/07-02/12</td>
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<tr>
<td>Next generation aerosol-cloud microphysics for advanced high-resolution climate predictions; US Department of Energy; 0 Mo/Yr; $500,000; 09/09-08/11; pending.</td>
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<th>Aly El-Kadi</th>
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<td>Design and Evaluation of Precision Vegetative Buffer Strips as Sustainable Conservation Management Practice to Control Non-Point Source Pollution in Hawaiian Watersheds; USDA CSREES National Integrated Water Quality Program; 2008-51130-04836; 0.5 Mo/Yr; $475,000; 11/08-10/11.</td>
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<td>Application of Radar Imagery as Input to Rainfall-Runoff Model for the Kawela Watershed, Molokai, Hawaii; 08HQAG0142; 0.5 Mo/Yr; $50,000; DOI-US Geological Survey; 9/1/08-12/31/09.</td>
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<td>On-Site Sewage Disposal System Inspection Protocol Development; Hawaii-Dept of Health; ASO Log 08-153; 1 Mo/Yr; $73,833; 6/30/08-11/30/09.</td>
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<td>Source Water Assessment Program (SWAP), Maintenance 2008-11; Hawaii-Dept of Health; ASO Log #09-114; 1 Mo/Yr; $165,000; 7/1/09-12/31/11.</td>
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<td>Numerical simulation of the effects of deep borehole flow on measured vertical salinity profiles from deep monitor wells, United States Geological Survey, Department of the Interior; G09AC00316; 1 Mo/Yr; $45,000; 8/1/09-7/31/10.</td>
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<td>Congressionally-directed Grant, Dept. Education #p116Z090286; 0 Mo/Yr; $190,000; 06/01/09-05/31/10; pending.</td>
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<th>James Weyman, John Marra, Nancy Lewis</th>
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<td>No current or pending support to report.</td>
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