

1. **Award Title: Climate Adaptation Partnership for the Pacific (CAPP): Pacific RISA Phase II**
2. **Performance Period: April 30, 2011 – April 30, 2012**
3. **Who are your Team Members?**

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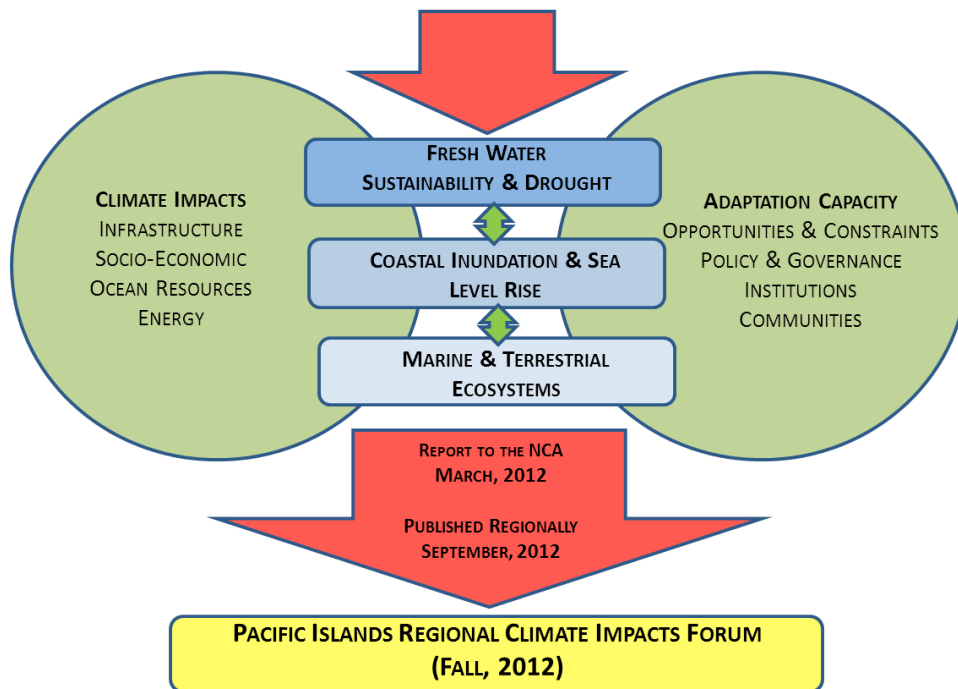
4. What are your **new areas of focus or partnerships** that have begun this past year?

Research activities during this reporting period have pursued more in-depth collaborations and projects with stakeholder groups that were identified in previous research and outreach. While a great deal of time was devoted by the Pacific RISA Core Office and collaborators to producing a report in support of the 2013 National Climate Assessment (NCA), many relationships with regional stakeholders and collaborators were more thoroughly cemented through the NCA process, and new partnerships were created throughout the region via travel and workshops. As PIRCA activities have lessened considerably since March 1, Pacific RISA expects to devote the

majority of the remaining Year 2 time integrating our research activities around assessing the impact of future climate at an island-scale on water resource planning for the island of Maui.

- Pacific Islands Regional Climate Assessment (PIRCA).** The PIRCA is a Pacific region-wide collaboration of over 100 experts in Hawai'i and the US-Affiliated Pacific Islands formed to support the regional contribution to the 2013 National Climate Assessment. Through a series of technical workshops centered on three focus areas (Figure 1); (1) preserving fresh water resources and minimizing impacts of drought; (2) fostering community resilience to the impacts of sea level rise, coastal inundation, and extreme weather; and (3) sustaining aquatic and terrestrial ecosystems, the PIRCA generated a truly collaborative and regionally comprehensive report assessing the most current climate impacts and knowledge. Through the Core Team of 19 interdisciplinary academic and government researchers, PIRCA will be the mechanism by which the regional NCA processes are sustained. The Core Team is actively generating publications and subsidiary products from the report, which will be released throughout 2012.

REGIONAL CLIMATE PROGNOSES: (1) WESTERN NORTH PACIFIC (2) CENTRAL NORTH PACIFIC (3) CENTRAL SOUTH PACIFIC

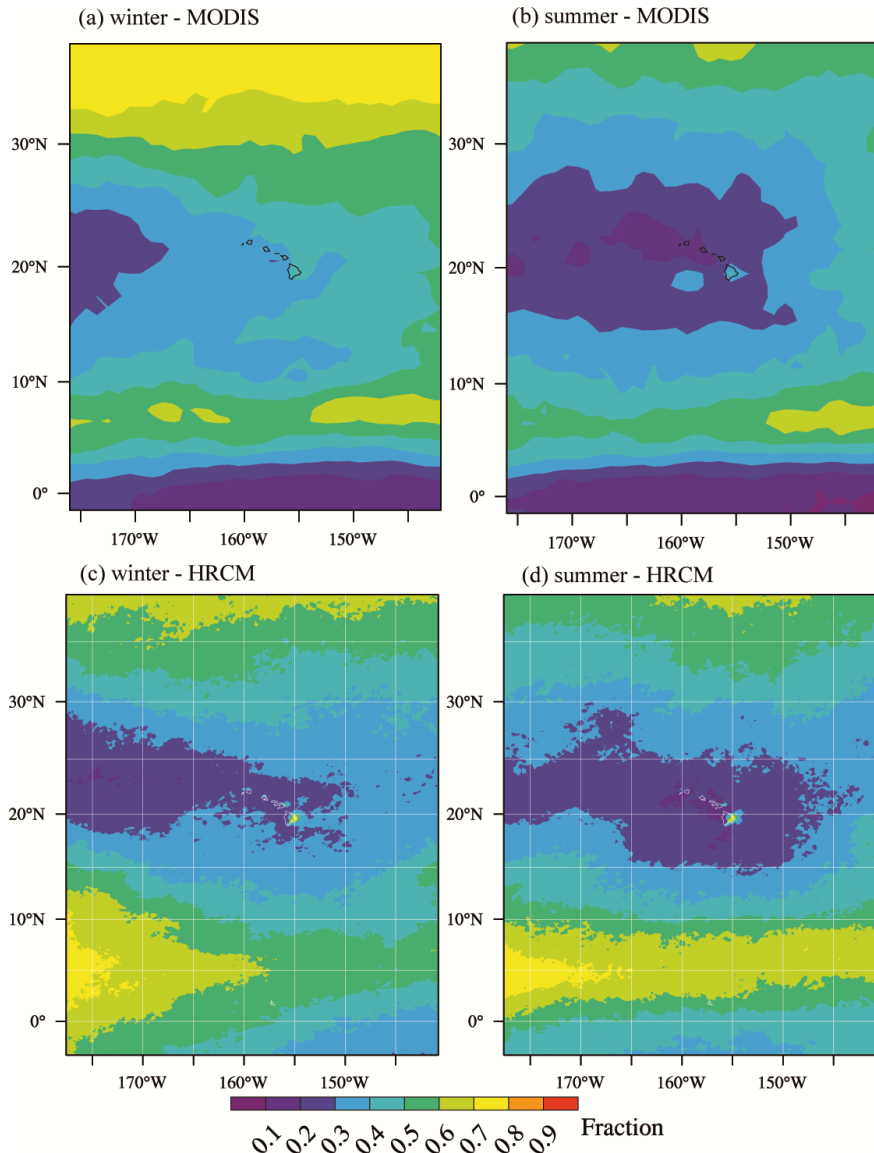


**Figure 1. The three technical PIRCA focus areas are considered under the overarching themes of elucidating climate impacts and adaptive capacity of communities and countries in the Pacific Islands region.**

- DOI Pacific Islands Climate Science Center (PI-CSC).** In October, 2011, the DOI announced the placement of a regional Climate Science Center in Honolulu, led by researchers at the University of Hawai'i. The Pacific RISA, through its relationships to the East-West Center and the University of Hawai'i, has been involved with determining research priorities for the new center and maintaining clear lines of communication between PI-CSC administration and other regional climate research groups. The PI-CSC will be a strong collaborator in the coming years, as their focus on specific areas of climate science will allow Pacific RISA to pursue more in-depth research in stakeholder-driven high priority sectors.

- ***Ocean Resources Management Plan (ORMP); Hawai'i State Office of Planning; Integrated Planning and Education/Outreach Working Groups.*** The Hawai'i Office of Planning has stepped forward as a state-governmental leader in the integration of climate knowledge and adaptation plans into statewide policy. In January of 2012, the ORMP introduced a Climate Adaptation and Planning Bill to the legislature to modify the Hawai'i State Planning Act. Pacific RISA was a participant, consultant, and reviewer to the bill. As a follow-up, Drs. Finucane and Keener now serve on the ORMP Integrated Planning and Education and Outreach working groups.
  - ***USDA Forest Service; Pacific Southwest Research Station; Institute of Pacific Islands Forestry.*** Through the PIRCA process, RISA researchers established collaboration with the Forest Service in Hilo, Hawai'i Island. Researchers there are looking at potential scenarios of future precipitation amounts on modeled distributions of invasive flora and stream flows through a previously parameterized DHSVM model. Pacific RISA is leveraging researcher time and expertise (Keener) to assist with time-series and statistical analyses. Through this collaboration, we hope to gain larger stakeholder networks on Hawai'i Island and create opportunities for future RISA research into ecosystem function under climate change projections.
  - ***Maui County Department of Water Supply.*** Through our Year 2 focus on integration of research efforts to a single place-based water resource issue, we are focusing heavily on the island of Maui in Hawai'i, and specifically the `Iao-Waihe`e watershed in central and west Maui. In this context, in addition to working with a wide variety of stakeholders, we are specifically going to work with planners at the Department of Water Supply to apply future downscaled climate projections to their current planning scenarios.
5. Please provide a list of 1 - 5 **research findings** (e.g. dust-on-snow reduces Colorado River runoff by 5%)
- ICAP researchers have analyzed Hawai'i's law and policy framework to identify ways of enhancing climate adaptation for Hawai'i's water resources. From reviewing recent case studies and peer-reviewed literature on adaptive governance, ICAP found that, in broad terms, four characteristics define the "adaptive capacity" of such laws and policies: (i) Forward-looking—focused on crisis avoidance over crisis mitigation; (ii) Flexible—able to adjust to changing needs and conditions; (iii) Integrated—able to address climate-related impacts that cut across political and geographical boundaries; and (iv) Iterative—utilizing a continuous loop of monitoring, feedback, and reevaluation. ICAP's recent white paper identifies those four characteristics embedded within Hawai'i's existing water law and policy regime. ICAP's analysis revealed that Hawai'i's legal and policy framework for managing water resources displays those adaptive characteristics at every level, from top-tier constitutional provisions that require the protection and conservation of water and the state's public trust over all water resources, to a single integrated Hawai'i Water Plan through which all water management should be coordinated. Additionally, ICAP has

proposed twelve tools to improve climate adaptation for the benefit of Hawai'i's water resources. The findings and adaptive tools are explained in the white paper, *Water Resources and Climate Change Adaptation in Hawai'i: Adaptive Tools in the Current Law and Policy Framework* (<http://icap.seagrant.soest.hawaii.edu/icap-publications>).



- Results of the Hawai'i Regional Climate Model (HRCM) simulations show that a reasonably good representation of time-mean rainfall on relatively small scales in Hawai'i can be obtained with a high-resolution regional atmospheric model. To some extent the observed synoptic time-scale variations of the island-averaged rainfall can also be captured with significant skill in the model simulation. The HRCM results also show that more realistic representation of the small-scale structure of land surface properties leads to an overall improvement in aspects of high-resolution simulations for the islands (notably for the surface temperatures and surface winds).

**Figure 2. Data from MODIS satellite imaging and model simulated total cloud fraction over Hawai'i for winter (a, c) and summer (b, d). (From Zhang et al., 2012)**

- Comparisons of various techniques to estimate cloud top heights and trade-wind-inversion height show generally good agreement around Hawai'i (Figure 2). However, the estimates of cloud base height by CALIPSO lidar and ground-based ceilometers, while positively correlated, display some significant scatter and systematic biases. The estimated cloud thicknesses were found to be significantly correlated with rainfall rates, with thick clouds corresponding to higher rainfall rates on average.
- In the Hawai'i-based assessment of climate information for freshwater sustainability project, interviews, workshops, and survey results revealed that stakeholders are mostly

male, highly educated, and reflect diverse ethnicities. Their climate-sensitive decisions focus largely on: What fresh water will be available in the long-term (amount, when, for how long, where)? Participants highlighted the need to disentangle natural variability from long-term climate change. They were interested in receiving information about the *most probable* and *worst-case* scenarios. Their climate literacy is high, but there are some surprising findings (e.g., that 28% of the sample think there is a lot of disagreement among climate scientists about whether or not climate change is happening; and that 23% think aerosol spray cans are a major source of climate change).

- The US Pacific Island states and territories are required by FEMA to develop hazard mitigation plans to receive funds for post-disaster recovery. There is an opportunity to improve risk reduction by increasing the consideration of climate risk reduction throughout the hazard mitigation planning process in the US Pacific Islands. There are considerable opportunities to leverage resources by engaging in joint planning activities for hazard mitigation and climate adaptation. However, methods for projecting losses rely heavily on historic damage and economic losses. These records are not consistent for the climate-related hazards. Magnitude of loss based on economic data does not help to prioritize actions, because the losses are not comparable. Qualitative values of impacts and projected socio-cultural losses need to be improved and used in hazard mitigation and climate adaptation planning.
6. \*\*Please provide a summary of 1 - 5 **ACCOMPLISHMENTS** from your research activities and stakeholder collaborations. In your summary, please include PIs, partners including stakeholders, abstract, findings, leveraged funding sources. Where possible, please include a relevant high-resolution graphic or figure.\*\* (You can include an accomplishment recently submitted to the RISA program annual report, but we encourage you then to come up with at least one more accomplishment with a relevant graphic.)
- A series of three short educational outreach videos were written, produced and directed with Melissa Finucane with assistance from Victoria Keener, to portray personal narratives about why climate and climate information is important for various sectors in Hawai'i . Each video is approximately three minutes long, and features interviews from a single stakeholder in important and varied sectors: a representative from the hotel and tourism industry in Waikiki, Oahu, an independent rancher in the Ka'u district of Hawai'i Island, and the administrator of a construction landfill in Waianae, Oahu. Leveraged resources included seed funds (Finucane), and time (Finucane & Keener). Although a 4<sup>th</sup> interview was conducted with the Meteorologist-In-Charge of the National Weather Service in Honolulu, post-production funds were not available to edit the film into a finished form. Funding for video production and editing was provided by EWC seed funds (Finucane), while RISA funding leveraged FTE (Keener & Finucane) and travel. Videos are freely available on Vimeo and the Pacific RISA homepage ([www.PacificRISA.org](http://www.PacificRISA.org)). As of 4/17/2012, the Documentments have been loaded more than 1,500 times and played 288 times in 26 different countries. The still images below are the opening scenes from each video, featuring a quote by each stakeholder about why climate matters to them personally or professionally.

Additionally, Dr. Wendy-Lin Bartels from the SECC RISA visited the Pacific RISA last year, and took back the idea of the Climate Documents to the southeast. In partnership with CPO and Climate Watch, she ended up assisting with the creation of two more videos focusing on climate impacts in her RISA's region.



*"Climate Matters for Island Environments."* Climate Matters Documents. Writ. and Exec. Prod. Melissa Finucane, 2011. Available at: [http://www.pacificrisa.org/cms/index.php?option=com\\_content&view=article&id=267](http://www.pacificrisa.org/cms/index.php?option=com_content&view=article&id=267)

*"Climate Matters for Waikiki Beach."* Climate Matters Documents. Writ. and Exec. Prod. Melissa Finucane, 2011. Available at: [http://www.pacificrisa.org/cms/index.php?option=com\\_content&view=article&id=268](http://www.pacificrisa.org/cms/index.php?option=com_content&view=article&id=268)



*Climate Matters for Ranchers in Hawai'i.* Climate Matters Documents. Writ. and Exec. Prod. Melissa Finucane, 2011. Available at: [http://www.pacificrisa.org/cms/index.php?option=com\\_content&view=article&id=269](http://www.pacificrisa.org/cms/index.php?option=com_content&view=article&id=269)



- In the process of writing the PIRCA report, the Core Team (including RISA PI's and collaborators Melissa Finucane, Victoria Keener, John Marra, and Deanna Spooner), created numerous original figures and tables that aimed to better communicate specific aspects of climate knowledge in the Pacific Islands to varied stakeholders. An original product to come out of PIRCA was the "*Indicators of Climate Change in the Pacific Islands*" graphic (Figure 4). Designed using Pacific RISA funding, the image serves to make a global issue regionally specific, using facts discussed in the report and images that stakeholders can immediately relate to. We have received very positive feedback from stakeholders that have seen the graphic at this point, and will try to highlight it through our research and outreach programs.

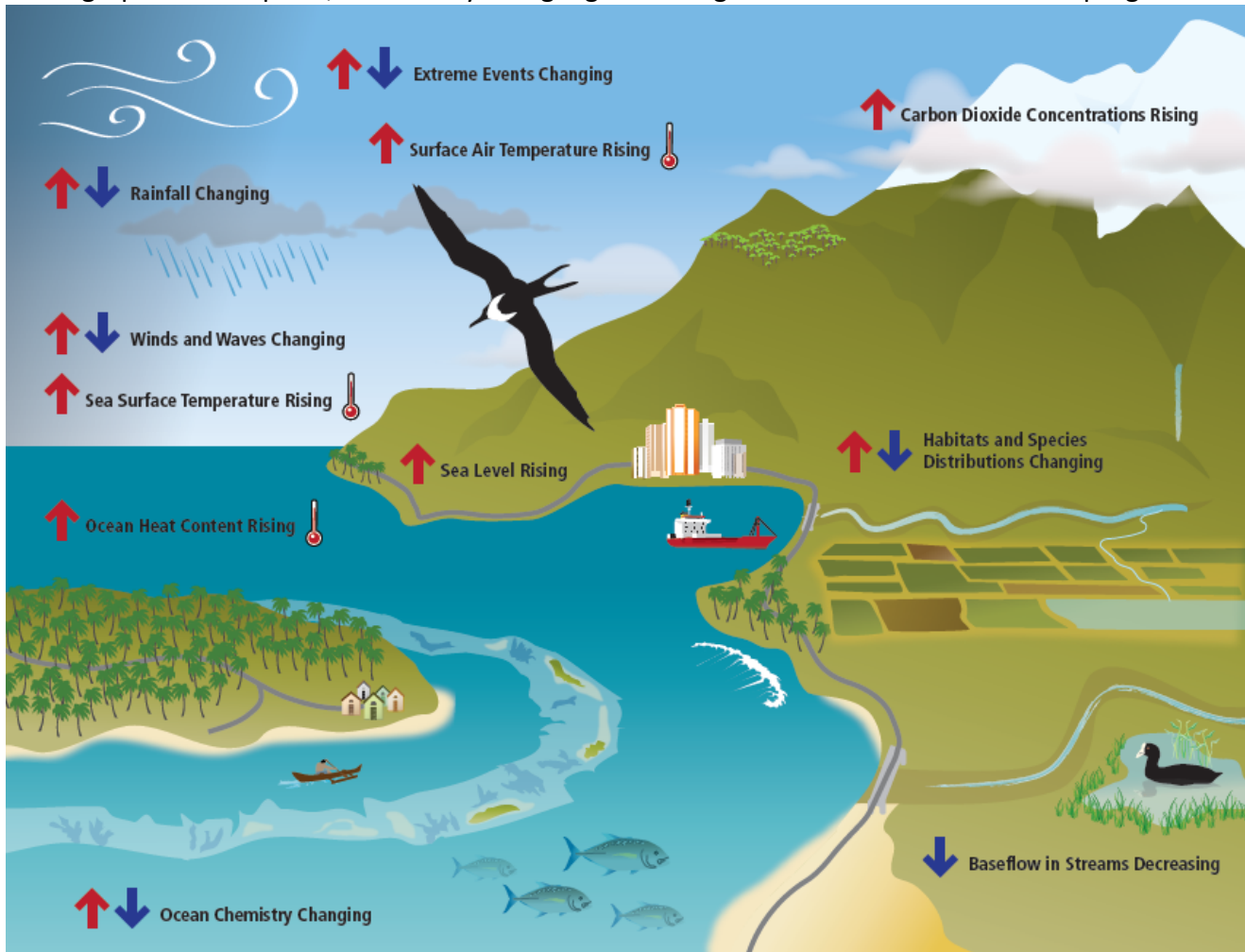


Figure 4. Indicators of Climate Change in the Pacific Islands. (Adapted from "Ten indicators of a Warming World" by NOAA NCDC, 2009 State of the Climate Report)

7. List of **completed publications, white papers, or reports (with internet links if possible)** from the past year. These can be either non-peer reviewed or peer-reviewed. For peer-review publications, please list either **published** or in **press**, but **not** "in review". Please \* the ones where any of the information has been communicated to decision makers and stakeholders (please identify to whom the information has been communicated).



Anderson, C.L. 2012. **Analysis of integrating disaster risk reduction and climate change adaptation in the US Pacific Islands and Freely Associated States.** University of Hawai'i, Social Science Research Institute, Technical report #201105.

Hagedorn, K.B., Mair, A. and El-Kadi, A.I. 2011. **Inventory of research, tools, and information to support decision making about the Pearl Harbor Aquifer under a changing climate.** Univ. of Hawai'i, Water Resources Research Center, Honolulu, HI.

\*Finucane, M.L., Marra, J.J., Keener, V.W., Smith, M.H. (2012) **Pacific Islands Region Overview.** In *Climate change and Pacific islands: Indicators and impacts*. Report for the 2012 Pacific Islands Regional Climate Assessment (PIRCA). Honolulu, Hawai'i, USA.

\* Australian-American Leadership Dialog, Subject Matter Expert Exchange, Honolulu, Hawai'i (October 2-6. 2011)

\*Keener, V.W., and S.K. Izuka. 2012. **Fresh water and drought on Pacific islands.** In *Climate change and Pacific islands: Indicators and impacts*. Report for the 2012 Pacific Islands Regional Climate Assessment (PIRCA). Honolulu, Hawai'i, USA.

\*U.S. Air Force and Royal Malaysian Air Force – Subject Matter Expert Exchange (April, 2012)

\* *Climate Change Here and Now: Impacts on Pacific Islands, Coastlines, and Ocean* Climate Change Teacher Professional Development Day. Waikiki Aquarium, Honolulu, HI, Saturday, April 28, 2012, 8 am - 12 noon

\*Marra, J.J., V.W. Keener, M.L. Finucane, D. Spooner, and M.H. Smith, eds. 2012. **Climate change and Pacific islands: Indicators and impacts.** Report for the 2012 Pacific Islands Regional Climate Assessment (PIRCA). Honolulu: Pacific RISA.

\*U.S. Air Force and Royal Malaysian Air Force – Subject Matter Expert Exchange (April, 2012)

\* "Rising to the Occasion: Reporting Changes in Sea level Law." *The Conversation* on Hawai'i Public Radio. January 23, 2012. ICAP's Director, Maxine Burkett, was interviewed on a weekday morning radio show on Hawai'i Public Radio.

\* "Insights – Climate Change." *Insights on PBS Hawai'i*. December 15, 2011. A weekly television program on *PBS Hawai'i* featured Pacific RISA PI's and collaborators ICAP Director, Maxine Burkett, PICCC Director, Deanna Spooner, and NOAA RCSD, John Marra on a panel of experts to discuss climate change and the impacts on Hawai'i and Pacific Island communities.

\*Wallsgrave, R. and Penn, D. (2012) **Water Resources and Climate Change Adaptation in Hawai'i : Adaptive Tools in the Current Law and Policy Framework,** (Center for Island Climate Adaptation and Policy, Honolulu, Hawai'i ), *available at* <http://icap.seagrant.soest.hawaii.edu/icap-publications> *and* [www.islandclimate.org](http://www.islandclimate.org).

\*Wallsgrave, R. and Penn, D. (2012) **Executive Summary of Adaptive Tools From Water Resources and Climate Change Adaptation in Hawai'i : Adaptive Tools in the Current Law and**

**Policy Framework**, (Center for Island Climate Adaptation and Policy, Honolulu, Hawai'i , 2012), available at <http://icap.seagrant.soest.hawaii.edu/icap-publications> and [www.islandclimate.org](http://www.islandclimate.org).

\* "Water Resources and Climate Change Adaptation in Hawai'i: Adaptive Tools in the Current Law and Policy Framework", A Presentation and Discussion. The first of many sharing and listening sessions with policy and decision makers around the state (April 20, 2012).

\*July 8 and July 15, 2011, Pacific RISA Workshops: Climate Change Impacts on Fresh Water Resources in Hawai'i Workshops, Honolulu, HI. ICAP's Senior Attorney, Richard Wallsgrove, presented preliminary findings of ICAP's legal and policy analysis of freshwater resource management in Hawai'i with respect the ability to adapt to climate change.

\*November 14, 2011, Water Resource Sustainability Issues on Tropical Islands Conference, Honoulu, HI. ICAP's Senior Attorney, Richard Wallsgrove, gave a presentation that focused on strategies for using Hawai'i 's law and policy framework to address climate-related findings such as those presented by scientists at the conference.

\*January 11, 2012, Hawai'i Water Law Conference, Honolulu, HI. This presentation, delivered by Richard Wallsgrove, focused on the implications of ICAP's recommended twelve tools, for two distinct groups in attendance: (1) attorneys in private practice, whose clients are likely to be affected by climate impacts on water resources, and by adaptive responses to those impacts; and (2) government agency attorneys and water managers, whose role will be to ensure that water management strategies appropriately protect Hawai'i 's water resources from climate impacts, as mandated by the Hawai'i constitution and other laws.

C. Zhang, Y. Wang, A. Lauer, K. Hamilton (2012). **Configuration and Evaluation of the WRF model for the study of Hawaiian regional climate**. *Monthly Weather Review*, accepted.

C. Zhang, Y. Wang, K. Hamilton (2011). **Improved representation of boundary layer clouds over the Southeast Pacific in WRF-ARW using a modified Tiedtke cumulus parameterization scheme**. *Monthly Weather Review*, **139**, 3489-3513.

8. Please provide one specific example of how your team has linked this past year with a **NOAA entity and/or NOAA regional partners** (eg. Regional Climate Service Directors, RCCs, Sea Grant extension, etc...) to exemplify regional climate services.

Through the PIRCA coordination and writing process throughout the last year, the Pacific RISA has linked with many different NOAA offices. The largest NOAA partnership that Pacific RISA has been involved with in the past year has been with our RCSD, John Marra. In the PIRCA process, the Lead Editors included two Pacific RISA representatives (Finucane & Keener), the PICCC Coordinator (Deanna Spooner), and the NOAA RCSD (Marra). In this context, we worked together extensively to organize three supporting technical workshops, manage large teams of people and timelines, and write and edit contributions. We also interact with John regularly through his work as the Director of the Pacific Climate Information System (PaCIS), and are

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represented on the Freshwater and Forum Planning working groups. Finally, Pacific RISA and John/PaCIS are in constant collaboration on outreach activities to the community, policy makers, and other stakeholders, providing support for each other's research and organizations, and filling gaps as needed.

9. Please explain how much of a priority NCA activities will be (and in what form the NCA activities will take) for your RISA team after June 1, 2012, compared to the rest of your RISA activities.

After June 1, 2012, we will have submitted the final independently reviewed PIRCA report for printing. Soon after that point, we hope to focus media attention on the rollout of the report to the public. In conjunction with our RCSD and our PICCC collaborators, we will promote and distribute the report to stakeholders such as regional policy makers, interested academics, and natural resource managers. In part, the reason that this particular NCA report-generating process was so time consuming was that previously, the NCA process has not been sustained. With the new emphasis on a "sustained assessment", we intend to retain the PIRCA name and Core Group activities so that future reports will be better led, organized, and accepted in the Pacific Islands region. Additionally, the PIRCA report will form a solid basis for the region-wide (Hawai'i, USAPI, and international) climate impacts "forum" being planned in conjunction with PaCIS and PICCC for late 2012. With the technical chapters well-covered in the report, we intend to invite non-specialist stakeholders to participate and contribute to adaptation and impacts sections to round out the regional assessment process. In-person relationships are of crucial importance in the Pacific region, and the forum will be an ideal start to better representing and integrating many outer island nations in regional climate planning processes.

Finally, Pacific RISA intends to create subsidiary products from the PIRCA report, such as short fact-sheets, policy briefs, and natural resource manager guides for a lay-person audience. Pacific RISA will also maintain and update an active regional and technical area-based reference list, including contact information for academics and professionals who are willing to address climate-related questions from policy makers or community members. In relation to the rest of our Year 2 research activities, we estimate NCA activities to take about 15% of our time.

10. Please fill out the attached table and indicate which team projects are RISA-led\* (RISA-led means RISA investigator is leading the effort and/or RISA funding is primary source) and which ones your team or a RISA PI contributes to (where RISA funding and/or RISA-funded investigator time contributes to the project but is not the main component of the project)\*\*.