

**Climate Change, Water Impacts and Indigenous People:  
Cross-Regional Dialogue with Alaska, Pacific Islands and Arizona**

Hosted by the Alaska Center for Climate Assessment and Policy (ACCAP), the Pacific Islands RISA, and the Climate Assessment for the Southwest (CLIMAS)

**Session 2: April 7, 2009**

**Water Concerns: Drought and other climate issues –  
Observations, research and information needs**

**SUMMARY**

**Introduction**

This is a summary of the second video conference initiated to establish a cross-regional dialogue about climate change impacts on water availability and quality, with specific focus on Native people and tribal water managers. This forum provides an opportunity to share experiences and learn from each other.

Climate change is already impacting Native people throughout the country and continued changes are expected. Changing water availability and quality impact household use, agriculture, river levels, and ecosystems that are crucial for subsistence fish, water fowl and game. People in Alaska, the Pacific Islands and the American Southwest are among the most dramatically impacted.

The goals for this dialogue are to:

- Establish a cross-regional network of Native leaders and resource managers.
- Share impacts and strategies for response among regions.
- Document impacts and strategies in a report for participants and federal agencies.
- Create a written document for federal and state agencies that outlines important insights and things to consider when working with Native people and Native Tribes on climate change and water related issues.

In this dialog, we had a brief overview of the first dialog that was held in November 2008, two speakers, and open discussion. Suggested topics for discussion were:

**Open Discussion – Strategies for Coping and Responding to Water Impacts**

*Possible discussion questions:*

- a) *What strategies have you used in your home village or region to address and respond to water related impacts? What has worked well and why? What has not worked well and why?*



- b) *What resources do you have available? Who do you talk to or work with in trying to develop strategies (i.e. what are your communication networks?)*
- c) *What actions do you have planned? How can people from other regions help?*
- d) *How can traditional knowledge help solve problems related to climate change, water availability and water quality?*

**Open Discussion - Where do we go from here?**

*Possible discussion questions:*

- a) *What information is needed to move forward? How can we get it?*
- b) *Who do we need to connect with or talk to in order to build coalitions and collaborations?*
- c) *What should non-Native scientists and decision-makers know in order to work effectively with Native communities?*
- d) *What are the next steps?*

**Participants**

**Tribal Governments and Resource Managers**

*Alaska:* Alaska Native Science Commission; Aleutian Pribilof Island Association; Environmental Projects Director, Association of Village Council Presidents; Environmental Program Office, Aleknagik Traditional Council; Director, Environmental Services, Bristol Bay Native Association; Planning Department, Northwest Arctic Borough; Subsistence Coordinator, Maniilaq Association; Tribal Environmental Manager, Maniilaq Association; Village Economic Development Director, NANA Regional Corporation

*Arizona:* Coordinator, Tribal Air Quality Program, Inter Tribal Council of Arizona, Inc; Department of Environmental Quality, Gila River Indian Community; Department of Natural Resources, Hualapai Indian Tribe; Department of Water Resources, Navajo Nation; Water Resources, Water Management Branch, Navajo Nation; Environmental Protection & Natural Resources, Salt River Pima-Maricopa Indian Community; Environmental Protection Office, Tohono O'odham Nation; Environmental Protection Program, Ak-Chin Indian Community

*Pacific Islands:* Conservation Ranger, Marshall Islands Conservation Society; Consultant, Marshall Islands; Executive Director, Marshall Islands Conservation Society; MPA and Sustainable Fisheries Coordinator, Marshall Islands Conservation Society; Solid Waste and Special Projects Coordinator, Marshall Islands Conservation Society

**Federal Agency Representatives**

Alaska Tribal Climate Change Coordinator, Environmental Protection Agency; Geologist, United States Geological Survey, Santa Cruz, CA; Environmental Coordinator, Indian General Assistance Program, Environmental Protection Agency, Buckland, AK; United States Geological Survey, Flagstaff AZ



### National Non-Profit Groups

National Congress of American Indians Policy Research Institute; Renewable Energy Organizer, Union of Concerned Scientists

### Private Consulting

Senior Consultant, ENTRIX; Seven Generations Consulting

### University Representatives

*Alaska:* Coordinator, Alaska Center for Climate Assessment & Policy, University of Alaska Fairbanks; Director, Chukchi Campus, University of Alaska Fairbanks; Graduate Student, University of Alaska Fairbanks; Outreach and Education Specialist, Alaska Center for Climate Assessment & Policy, University of Alaska Fairbanks; School of Education, University of Alaska Fairbanks

*Arizona:* American Indian Studies, University of Arizona; Deputy Director, Science Translation and Outreach, Institute for the Study of Planet Earth, University of Arizona; Northern Arizona University; Program Manager, Climate Assessment for the Southwest, University of Arizona

*Pacific Islands:* Hazards, Climate & Environment Program, University of Hawaii; Sea Grant Coordinator, College of the Marshall Islands; Senior Fellow, East-West Center

### Presentations

**Dan Ferguson**

***Program Manager, Climate Assessment of the Southwest  
Summary of November 2008 Dialog***

The goals of the cross-regional meetings are to get people talking to one another about climate change impacts in native communities throughout the three regions, and for people that work for NOAA to listen and send the resulting messages to NOAA so they can be a more responsive agency. In the last videoconference, one striking theme was how many environmental issues the three very different regions have in common. Most of the concerns discussed were surrounding issues of water quantity and quality. Larry Mercurieff inspired a good conversation about how to have better integrated information available that works better in native communities. For example, it is not useful to distinguish between drought and climate change impacts. All of these impacts are related to climate. There was also a strong consensus that this type of cross-regional networking is a very valuable resource and the discussions need to continue.

**Erik Stegman, Carry the Kettle First Nation (Assiniboine)**

***Program Manager, NCAI Policy Research Center,  
National Congress of American Indians (NCAI)***

**Climate Change Community of Practice: Building Knowledge, Guiding Research**



The NCAI Policy Research Center functions as a tribally-driven think tank that puts the needs and values of tribes into action and research.

The NCAI Policy Research Center's mission is to provide tribal leaders with the best available knowledge to make strategically proactive policy decisions in a framework of Native wisdom that positively impact the future of Native peoples.

NCAI launched the Policy Research Center because they realized they didn't have a way to think strategically about the future to support tribal leaders in making good policy decisions. The tribally-driven think tank was developed to try to forecast policy situations for tribal leaders and help identify credible information to be used for informed decision making. The Policy Research Center works in the areas of research support, assisting tribal communities through the research process, understanding the ways communities can regulate their own research, and also helping communities understand how they can be proactive developing research in their own communities. The NCAI Policy Research Center vision is to support Indian Country in shaping its own future. The website provides a clear overview of the work the Policy Research Center is engaged in: <http://www.ncaiprc.org>. The presentation today focuses on the Community of Practice Program (CoP).

The CoP offers organizational and communication support to diverse networks of stakeholders that are working on key issues in Indian Country in an effort to build knowledge and share resources. Currently, CoP programs are organized around tribal climate change, Indian child welfare, and tribal governance. An additional program has just been started to focus on good state-tribal agreements and to highlight areas where tribes and states are working together to better their communities. The purpose of all of the CoPs is to cast the net widely among all the stakeholders who are working on the issues in Indian country to help build knowledge.

This talk focuses on the Climate Change CoP. The goal of this CoP is to identify current resources, for example, the RISAs, and also to identify information gaps. It is centered on questions like what do we know and what do we want to know about climate change? The CoP hopes to realize the knowledge gaps and develop the resources from them.

The climate change CoP has been operating since 2008 and there are two major national working groups established from it. The first is a national advocacy working group whose primary purpose is to develop policy stances around issues of climate change. The second working group is aimed at adaptation and mitigation. It seeks to understand how tribal communities are adapting to climate change and how are they helping to fight climate change. These groups meet in person and through teleconferences with a goal of being as inclusive as possible.

There are several projects that have developed out of the Climate Change CoP. First is a pilot study to understand the impacts of climate change in Indian Country. A common theme that has resulted from climate change discussions with the NCAI and many native groups is that tribal leaders want some kind of study to show what the impacts of climate change are

on a couple of different levels. First, research often makes the case of why tribal communities are more disproportionately affected by issues of climate change and why they need resources and help to cope with and change the situation. Second, tribal communities want to know what the costs of climate change are: economically, environmentally, socially, and to traditional life ways. These needs have prompted the pilot study which will look at a single tribe or two tribes in a biome that have yet to be chosen. With research partners at the Center for Integrated Research at the University of Maryland, the Policy Research Center will be conducting the study and then coming back to all of the interested stakeholders and partners in the CoP to ask for guidance and input on the project. At the completion of the project, the stakeholders will again be asked how to measure the success and impact of the pilot study to ensure it is worthwhile and sensitive. From this process, 'lessons learned' will be created. Finally, the study will be nationalized to study tribes in all of the different biomes, both for policy making purposes and to assist tribal communities and resource managers in making the right decisions for their circumstances.

The next project is a legal paper that will examine tribal government participation in international climate change policy. This is a big issue currently, because Copenhagen is coming up [United Nations Climate Change Conference in December 2009 at Copenhagen, Denmark, <http://en.cop15.dk/>]. It is important for tribal governments to be involved in those upcoming meetings.

Finally, the third project is a resource sharing and information website for each CoP. There are lots of stakeholders conducting research and planning projects, but it is challenging to have an on-line site that is useful. The purpose of this is to determine what resources are needed on-line after meetings and interactions to keep the conversations going. The site will include a cutting-edge file exchange system, a national directory with individuals, groups, and projects. The site will also include a searchable discussion forum and a news and events area. This site is intended to be a central clearinghouse for users to share information on one another and projects related to climate change.

The NCAI Policy Research Center wants feedback:

What information do you need about climate change in tribal communities?

What tools and resources need to be developed?

What information do you think you can share/provide?

What is most important to your local region?

What other stakeholders need to be at the table to build knowledge about tribal climate change?

### **Presentation Discussion**

- Comment: A concern was raised about the short timeline of the pilot study. Also, there are many impacts that are hard to predict and quantify. If something specific like water resources isn't chosen to study, the two month timeline will be an obstacle to finishing the project.



- Response: The pilot project partners at the Center for Integrated Research at the University of Maryland have a lot of experience measuring impacts and the two month timeline is to get the project up and running, not to see it to completion in this timeframe. Advisory groups will be formed for valuable feedback just like this.
  
- Question: Regarding the development of web site, will opposing views all get a voice concerning the issues of climate change? What are the next steps for developing the web site?
  - Response: The development process is starting and the website will hopefully be up by mid-late May 2009. The site will be user registered to protect the information being shared. The forum will also be monitored in case there are concerns about the information being said or shared. Anyone who is interested can register to use the forum.
  
- Question: The World Wildlife Fund’s Arctic Program gave a good presentation on public television that discussed the impacts of climate change but also what people could do. Will the NCAI exchange information with the World Wildlife Fund’s Arctic Program?
  - Response: The Policy Research Center will look into this resource, and the question raises a good point. What do we do with the information? This is a critical step and useable tools need to be developed for tribal communities. There are some really innovative solutions available- especially those borne out of traditional native knowledge.
  
- Comment: It is always good to research, but on-the-ground adaptations need to take place too. The West is in a drought right now. Pipeline development, water storage and drilling new wells are options being considered. Associated with climate change are abnormal severe weather patterns that have caused tribes to modify their contingency plans to address heavy snowfall, freezing conditions, and other extremes. We need money to obtain these objectives.
  - Response: Yes, with one issue come many others. Part of what the Policy Research Center needs help with is translating information that is already available into useable resources. What do tribal environmental people need to implement program changes? One reason to generate the research is to get the money. On the national level there is a push to give tribes more resources. The research will help tribes be more competitive and prepared in obtaining money.

**Mark Stege (presenter), Terry Keju, Moriana Phillips, and Ingrid Ahlgren**  
**Climate Change and Water Resources: The Marshall Islands**

Mark is from the Ijirik Clan in the Marshall Islands, which is a matrilineal society. His family is from Maloelap Atoll. Mark interned with the Office of Environmental Policy and Planning Coordination (OEPPC) in the Marshall Islands and has been working as a pro-bono consultant with some of the projects he outlines in this talk.

**Climate Impacts in the Marshall Islands.** The 1200+ Marshall Islands cover 750,000 square miles and are all very small and low-lying. This increases their vulnerability to impacts from climate change.

The El Nino system occurs naturally every 10-15 years but appears to be occurring more frequently as climate change occurs. The highlighted sections of slide 4 show the El Nino periods which correspond with drought in the Marshall Islands. According to the Intergovernmental Panel on Climate Change (IPCC, <http://www.ipcc.ch/>), this results in lower water availability in the form of rain, and also a reduction in the size of the fresh water lens. This compounds the impact that El Nino has on the Marshall Islands.

An additional impact to water resources in the Marshall Islands is the impact that climate change has had on the Inter-Tropical Convergence Zone (ITCZ). Research conducted by Dr. Julian Sachs at the University of Washington indicates that the ITCZ rain band has been moving North since the little ice age ended in 1630AD. That movement north, at the rate of 1.5 kilometers per year, indicates a change in rainfall pattern that needs to be studied further in the Marshall and Gilbert Islands. This research will help identify changes in rain patterns in the coming decades and guide policy makers in allocating resources and potentially relocating residents.

Sea level rise pushes up freshwater lenses until they are eventually infiltrated by salt water. A *moderate* prediction of sea level rise was estimated in the Kiribati Adaptation Plan that was finalized in March 2009. The estimate was that sea level will rise by 16 inches or 39 centimeters in the next century. This would definitely impact the Marshall Islands, which are only a foot above sea level in some areas.

**Indigenous-based strategies** will be presented next, but the term should be broadened to include gender, youth, and socially-based strategies too. The following examples illustrate successful examples of these strategies.

**1) Student tree-planting to create salt-water spray barrier.** A report currently in the draft stages illustrates a partnership between the Marshall Islands Conservation Society and the Ministry of Education. Marshall Islands High School students were targeted to increase their awareness of climate change and adaptation actions they can take. Students were surveyed before they were involved in a large scale tree-planting effort to create a salt water spray barrier. The trees selected to be planted also have medicinal value. After the planting activities, students were surveyed again to see what level of education and awareness was raised by the activity. Results demonstrate that this student outreach work does get youth informed and mobilized to act on issues of climate change. This is an example of an indigenous-based adaptation strategy that involves youth.

**2) Adaptations in taro planting and farming.** The next example of an indigenous-based adaptation strategy occurred on the Chuuk Islands in Micronesia. A high tide in December 2008 inundated taro pits with salt water and impacted this traditional food resource. It can take 2-3

years to recover from an event like this. This problem was discussed in a similar videoconference discussion. Franco Materieti in the Marshall Islands shared ways to raise the taro pits over time by using soil and fallen vegetative matter. He discussed ways of planting taro, like effective depths, crop rotation and variety selection to optimize the crop and adapt to sea level rise. The full transcribed response is available with Cheryl Anderson of Pacific RISA [canderso@hawaii.edu, (808) 956-3908].

**3) Raising community awareness and sharing adaptation response in Woman’s Forum.** Next, the Women’s Forum on Climate Change was held on April 7, 2009 by a very active women’s group in the Marshall Islands. With the EPA and the women’s group, the issues of water and what women’s roles in water are were discussed. An example of a Cholera epidemic in an El Nino year in Ebeye highlighted the need for women in the Marshall Islands to organize around water resource issues. Because the women are responsible for the cooking, cleaning, and washing, women in Ebeye were particularly affected by the epidemic. This Women’s Forum is an example of getting communities involved in just discussing the issue as a strategy in and of itself. This is an example of raising the community awareness and moving forward with the types of suggestions and adaptation responses that can result from opening a dialogue.

**4) Education reform to include indigenous language and climate adaptation.** Last, in tandem with re-thinking the education process in the Marshall Islands, there has been a resurgence in improving literacy by “localizing” the education curriculum using Marshallese language and examples of culture and environment that students have grown up with and thus are easier to understand. This movement has been labeled “the re-thinking of education” or the “Marshallization or localization of education.” The successes of the people in the Marshall Islands to adapt to climate change may be proportional to the people’s ability to hold a job or communicate effectively with people from other countries in a generation or two. By some predictions the Marshall Islands will be uninhabitable. The education process is critical in adapting to climate change.

#### **Presentation Discussion**

- Question: Early in the presentation there was a slide about changes in rainfall patterns. The women who pick berries in Kotzebue have noticed a big change in rainfall patterns in the Arctic Circle. What are the Marshall Islands experiencing?
  - Response: The changes in the Marshall Islands have been in the form of drought. There is a song that comes out during every El Nino period: one speaks about what we will do when the wells run dry, and another was titled “El Nino.” In some of the most populated areas, there are changes in the fresh water lenses. There has been change in well use from drinking water to using the water just for plumbing or plant watering purposes. Population increases also impact the water resource.
- Comment: The Aleutians/Pribilof Island tribes are surrounded by ocean as well, and are a similar size. Regarding the NCAI and the new website development, please don’t forget the oceans. The effects of climate change and CO2 in the oceans is tremendous.



We have seen that the ocean is affected by rising temperatures, thermal expansion, rising sea levels, ocean acidification, harmful algal blooms, lack of sea ice coverage, and biological regime shifts that affect species composition and commercial/subsistence fisheries. For example in the Pribilof region, in Nelson Lagoon, a water line that was buried a few meters down washed out because of lack of sea ice in the fall. The wave action eroded the beaches. This can be seen throughout coastal Alaska.

- Response: A lot of the strategies the Marshall Islands are looking at are tied specifically into the ocean. One specific practice is the traditional activity of strategically planting trees. When it is coupled with modern knowledge of how to rehabilitate the land more quickly, the traditional knowledge can perhaps afford a few more decades of existence on the small, low lying atolls.
- Comment: The Marshalls recently went through a drought and began to run out of water and get into the emergency phase again. Drought forecasting would be very useful to get a head start on planning.
  - Also, developments need to be made in drought infrastructure. There is a lack of rainwater collection tanks in households. Targeted aid projects could focus on this so that people were better prepared for drought. Reverse osmosis machines are relied on heavily and shared between islands during droughts. The planning associated with the machines could be coordinated better so that communities could move more quickly when droughts start to happen. Disease and infant mortality increases during these periods.
  - It would be useful to identify water lenses on the atolls. The majority of people use rainwater, but the fall back is to return to the more traditional methods of using groundwater. Research to identify current lenses and assess their quality in terms of contaminants could be conducted so people know ahead of time where the quality resources are. If people could use their groundwater, the problem of drought wouldn't be so dire. Remediation measures need to be taken to reduce pollution and raise the water quality in fresh water lenses.
  - Beach profiles should be monitored in the Marshall Islands because residents are losing land rapidly to erosion, yet the rate is unknown. Quantifying the rate of erosion might prompt more people to participate in the issue.
- Comment: One of the ways people in Interior Alaska propose to deal with issues of contaminated water is to develop an Adopt-A-Stream program to monitor bacteria, chlorides, and other pollutants. There is more information on the US EPA website [<http://cfpub.epa.gov/npdes/stormwater/menuofbmps/index.cfm?action=browse&Rbutton=detail&bmp=20>] about starting a program. It is a good idea to start a water monitoring program, both for education and to provide chemistry data about the quality of your community's water.
- Comment: Hilo River Indian Community is one of the few tribes that have joined the Climate Registry [<http://www.theclimateregistry.org/>]. The cost of joining as a member is currently being waived for tribal organizations.

- Comment: The USGS Coastal Marine Geology Program is planning several sub-marine groundwater research projects in Hawaii and the Pacific and would like to follow up and learn about some of the specific needs in the Marshall Islands.

### **General Discussion**

- Comment: It seems that the people in the Marshall Islands will either have to move off the island or find a lot of money to live there. There will be many problems associated with staying there. No one can stop the sea from rising. Alaskans are on higher ground, so the impacts will be different. Unless the Army Corps of Engineers intervenes now to stabilize the islands and the water lenses, the people of the Marshall Islands will have to move.
  - Response: It might not be that simple. If coral reefs are healthy, they deposit sand back to the atolls. The problem is that reefs are impacted, so they don't produce as much sand. Reefs might be able to produce enough sand to keep islands growing on pace with sea level, but we don't know yet.
  - Response: Often times increased human population puts pressure on the fisheries and the ecosystem, including the coral reefs, suffer. These are complex questions and issues.
  - Comment: The Elders talk about how nature does not follow a linear progression curve. We can't predict what will happen in the future. Species may hit tipping points that cause major shifts to occur quickly. Scientists are just now beginning to affirm what Elders have been saying for a couple decades: that sea ice is going to melt faster than projected. Everything snowballs and things will happen a lot faster than expected. The point is that we should be careful how one relies on the science. The science has its limitations and we need to identify what those limitations are. In terms of climate change, the changes are happening on such a large scale, with so many new variables that computer models can't possibly keep up. According to many Elders, we need to begin to share the traditional *processes* for adaptation, not the specific strategy. That could be valuable to share at this time, but there is no vehicle for that yet.
  - Response: Elders around the country have shared that same sentiment. There is a lot of demand to share the processes. There is a lot of interest to record and share our Elder's observations about how the world has been changing and adapting. Please share any ideas on how to exchange that information with the group.
- Comment: It would also be valuable to share things that people are doing that are helpful to their communities. Across Alaska, for example, is the issue of dust. The drier summers have increased dust. One tribe is trying to mulch four-wheel vehicle trails with chips from beetle-killed trees. No one group, person, or organization will have all the solutions, so maybe we can all share the small things we do as we all work toward a larger solution in the bigger picture.

- Comment: One of the things the Hilo River Indian Tribe has focused on is how to respond to serious, and uncommon natural events and emergencies. President Bush implemented the National Incident Management System (NIMS) for emergency funding, but the funding depended upon whether grantees could comply with the training requirements. NIMS didn't work in Indian country. This may go back to the indigenous response to emergencies and Elders teaching the value sets that are different outside Indian communities. NCAI could look at how tribes respond to emergencies and how they can better respond to emergencies, taking into consideration the issues that Indian Country had with NIMS.
- Comment: Since the last video conference, the Tohono O'odham Nation has formed a working group of the different stakeholders on the Nation. The group is focused on what is being done to address climate change impacts and adaptation. The group is in the process of identifying more stakeholders and putting the plan together based on their concerns. Hopefully this cross-regional dialogue will continue and not just stop like some programs and working groups do, without an outcome. This has been a helpful discussion and prompted the Tohono O'odham Nation to form its own group.
- Comment: It would be helpful for groups to post a list of research needs and identify what the issues are on their websites. This would help students who need projects and funding find something that interests them to work on.
  - Response: The NCAI updates its tribally driven research agenda annually by topic. This is posted at [ncaiprc.org](http://ncaiprc.org).
- Comment: The Hilo River Indian Tribe is working on conducting research on cutting-edge renewable energy projects. In order to get stimulus money for renewable energy, groups are required to have some feasibility studies. The Hilo River Indian Tribe has offered to conduct the feasibility studies so that organizations and individuals can use them. One area that they are looking at is using algae oil for biodiesel. They would like to hear from anyone doing this type of work.
  - They are also involved in an annual bird count. There has been a significant decline in the number of birds. Any similar wildlife assessments would be good to know about. NCAI could handle the coordination of information.
  - They are also working on increasing air monitoring. The tribe finds it useful for many reasons. Other tribal entities may be able to use and share information and stay out of non-attainment.
  - Carol Browner was appointed the assistant to President Obama for climate change and energy. Apparently she is very interested in hearing from tribal leaders. If tribes got together and approached her, the feeling is that she would be very interested in understanding tribal issues.



- Comment: Hopefully NCAI will work with other tribal organizations across the country that have done a tremendous amount of work on climate change already. We need to get a good group discussion going.
  - Response: NCAI is partnering with many groups. Register with the CoP to participate in the large national teleconferences and stay abreast of the collaborative activities. If you see any groups that aren't participating, please refer them. [<http://climatechange.ncaiprc.org/>]
- Question: The World Wildlife Fund (WWF) has made available a Climate Witness Toolkit geared toward the South Pacific. Could we invite someone from the WWF to share their resources? They seem to have many relevant programs that we could learn from. It seems like the people in this discussion are informed about climate change. A good way to move forward with this discussion is to share very practical solutions to the issues. We need to get people to support the concepts that can solve the problem. There are things we can do, but sometimes we get stuck.
  - Response: We tried to get someone who worked on the WWF Toolkit in Fiji to present here today, but were not able to find someone who was available. This would be a good forum to share that kind of information and practical tools.  
[[http://www.panda.org/about\\_our\\_earth/all\\_publications/?162722/Climate-Witness-Community-Toolkit](http://www.panda.org/about_our_earth/all_publications/?162722/Climate-Witness-Community-Toolkit)]
- Comment: The cost of solar energy has come down. Tribes could invest in solar because the costs are so much less now. Coal fired plants are expensive, monetarily and environmentally.
- Comment: Regarding the issue of moving forward, it would be helpful to hear more about how to measure climate change. We have lots of information and language about stakeholders, strategies, etc, but if we are going to really understand it, we need hard numbers. We need to establish where we are at in this moment in time, so we can measure changes in the future.
  - Response: When we start thinking about measuring climate change we need to develop the right metrics of the biological impacts that are associated with the changes so we measure everything at once, not just one or two parameters.
  - Response: We have a lot of satellite and weather station data. There is a fairly new USGS program called the National Phenological Network [<http://www.usanpn.org/?q=content/participate>]. There are official and citizen monitoring efforts. It is a strong way to measure changes over a short amount of time.
- Comment: Is there an effort by this group to put together an atlas-type product that could highlight the top 10 or so impacts of climate change the group sees and fuse the



traditional knowledge into a document about each impact? Ears are open to the part of the story that includes traditional knowledge.

- Comment: There are a couple of ways to approach the discussion. There is a national level and local level at which we can share. Please stay in touch with each other so we can keep moving forward in the ways that make sense.
- Comment: In Bristol Bay, there are a number of tribes that want to document local observations but are unsure how to move forward. There is a potential pilot project in the Bristol Bay region that may take place with assistance from NOAA's Pacific Services Center [<http://www.csc.noaa.gov/psc/>] and specifically the PRiMO program [<http://www.csc.noaa.gov/psc/FHMPPI/>], looking at climate change and extreme events from an indigenous standpoint in terms of adaptation. There is an initial discussion in place.
- Comment: The PRiMO program has been a good resource for organizing around disasters and making sure we have communities that are talking to each other. The Pacific RISA is collaborating to link disaster information that is locally relevant. The focus is on adaptation and resilience strategies communities can engage in.
- Comment: In Kotzebue, communities want to know concrete information, like will the community be under water in 10 years? People want to know this information, but they are not attending meetings. We would like to hear more hard numbers so that people know they need to prepare and participate in the process.
- Comment: This is all very overwhelming. It is really important to get hard numbers. NOAA and US federal agencies have a good idea of what the Marshall Islands will experience in the next few decades, but the Marshallese don't seem to have any idea, other than the fact that we are seeing impacts already. It would be responsible of the US, if they have the information of what to expect, they should pass it on. The Marshallese have been the subjects of data manipulation for decades, in the form of nuclear testing. People are already scared and they need the numbers and figures to plan ahead and help people plan. This group would be ideally placed to help.
- Comment: There is a lot of information available, but learning how to access it is key. A useful thing universities could do is help communities find information. The EPA hosts an annual, national information meeting [Community Involvement Training Conference, <http://www.epa.gov/ciconference/>] that would be useful to attend.