

INSIGHTS AND SUGGESTIONS REGARDING CHANGES TO HAWAIIAN TSUNAMI MESSAGING

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Project Overview

Recent scientific study reveals a new level of tsunami hazard in Hawai'i that requires changes to current tsunami safety instructions and procedures. The changes may result in two sets of instructions, with actions that differ depending on which tsunami occurs.

How can emergency managers ensure that the new messages are clear and that the changes do not reduce trust nor undercut existing training and awareness? This question has immediate importance to Hawai'i's tsunami readiness and long-term significance to all who communicate changes in scientific understanding.

As part of efforts to answer this question, co-author Richards sought advice from numerous experts, including some outside his usual circles of advisors. At Richards' request, co-author Perry assembled colleagues with a wide range of expertise in the social and behavioral sciences, public health, design and communication. Via conference calls and email exchanges, they shared experience gained in other areas and other hazards. They made general observations and suggestions that Hawaiian experts can tailor to fit Hawai'i's situation.

This paper identifies the project participants, the information they were given, and the insights and recommendations they shared. Appendix A summarizes the group members' backgrounds. From time to time, the conversation included discussion of larger issues, only tangentially relevant to the current changes in tsunami messaging. Appendix B summarizes that part of the discussion.

Project Participants

- **Kevin Richards**, *Earthquake and Tsunami Planner*, State of Hawai'i Civil Defense
- **Julie Greenly**, *Project Coordinator*, Pacific Disaster Center
- **Sue Perry**, *Disaster Scientist*, Science Application for Risk Reduction, U.S. Geological Survey
- **David Eisenman**, *Director*, Center for Public Health and Disasters, U. California, Los Angeles
- **Malcolm Williams**, *Health Policy Researcher*, Rand Corporation
- **Christina Zarcadoolas**, *Professor*, City University of New York School of Public Health at Hunter College
- **Wendy Vaughn**, *PhD student*, City University of New York School of Public Health at Hunter College
- **Elisa Ruffino**, *Director*, Designmatters, Art Center College of Design
- **Sherry Hoffman**, *Faculty*, Designmatters, Art Center College of Design
- **David H. Krantz**, *Co-Director*, Center for Research on Environmental Decisions (CRED), Earth Institute, Columbia University
- **Ben Orlove**, *Co-Director*, CRED, Earth Institute, Columbia University
- **Katherine Thompson**, *PhD candidate*, CRED, Earth Institute, Columbia University

- **Courtney St. John**, *Associate Director of Outreach*, CRED, Earth Institute, Columbia University

An Initial Briefing

Project participants were first briefed about Hawai'i's tsunami risk and readiness. This is what they were told.

Tsunami Risk, Readiness and Challenges

Hawai'i is in the path of damaging tsunamis from all sides of the Pacific Ocean and tsunami disasters are more familiar to Hawai'i than to most other places. The State of Hawai'i Civil Defense (HI-CD) has put a lot of resources into developing tsunami inundation maps that use the best scientific understanding, and into public education that make residents and visitors knowledgeable about when to evacuate and how far inland and uphill to go. The messages seek to avoid "over-evacuation" which clogs roads and causes various public safety headaches.

The education effort is not perfect or complete - confusion persists about where the safe zones are, and what the difference is between an evacuation zone and an inundation zone. However, over the years, many people have been educated and much trust has been established between HI-CD and the local governments, businesses, and communities. In Hawai'i, tsunamis that require response from government or the public occur about once per year. Overall, evacuations have gone well, because locals are familiar with the current level of threat and the procedures.

Recently, with insights from Japan's 2011 Tohoku earthquake, scientists have determined that if a particular large earthquake occurs in the Aleutian Islands, it could cause a level of inundation in Hawai'i that far exceeds inundation by the more typical tsunamis which Hawai'i faces from year to year. The inundation specifics vary from island to island. On O'ahu, which has the most people and infrastructure, substantially larger numbers of people would need to move high up on the island - to evacuate in the way they have been instructed *not* to do in other events. For this event, getting to safe ground is no longer a matter of walking a few blocks inland. People may now need to travel several miles, because of steep terrain, limited roads, and roads that hug the coast within inundation zones.

With the Aleutian event, traffic jams become a major concern. Already, the locals are very aware that a tsunami can disrupt port deliveries of food and supplies to Hawai'i. Tsunamis lead to traffic snarls as people do last minute shopping to stock up on supplies and gas before evacuating. In general, HI-CD seeks to get more people to walk during evacuations; to get people to make their emergency purchases ahead of time; and to know their evacuation zones ahead of time.

Overall, HI-CD wants to get people aware of and ready for this Aleutian tsunami event, but fears that the change in message could cause confusion and undercut

the training and awareness about what to do in other tsunamis. They seek advice about how to approach this situation, to maximize buy-in and avoid confusion.

For more information:

Butler, R., Bai, Y, Burney, D. Cheung, and K, Yamazaki, Y, 2013, "Evidence for a Great aleutian Paleotsunami on Kaua'i", abstract, American Geophysical Meeting, San Francisco, 12/13/2013.

Butler, R., 2012, "Re-examination of the Potential for Great Earthquakes along the Aleutian Island Arc with Implications for Tsunamis in Hawai'i", Seismological Research Letters, vol. 83, no. 1, Jan/Feb 2012.

Current Tsunami Awareness Tactics

In Hawai'i, a siren signals a public emergency. The basic public education principle is *find out what the siren means*. The locals turn on radio or TV when they hear a siren. For many impending events, the siren is not a surprise. For example, people know for days when a hurricane is approaching, and when the siren goes off, they understand *it's time to take action*. When a siren goes off unexpectedly, many locals assume the event must be a tsunami and they prepare to move to higher ground.

When the siren sounds, television comes to interview HI-CD. Radio receives standardized messages that try to give enough but not too much information: *a tsunami is on the way, it will arrive in X hours but do not wait to evacuate*. Locals are told to go to their known safe zone - a temporary refuge site. Visitors are told to get to higher ground.

Educating tourists is always more difficult. HI-CD has recently published a guide for maritime and boaters and has in development a visitors' guide safety book that seeks to communicate *even paradise has some things to watch out for, including riptide, jellyfish, pounding surf, tsunamis*. The hospitality industry is an essential public safety partner with specific needs when it comes to publicizing risks, and has begun to collaborate with HI-CD.

HI-CD has a new campaign, HHARP (Hawai'i Hazard Awareness and Resilience Program), to reach out to communities including local tourist industry workers - the cab drivers, rent-a-car workers, lifeguards, jetski renters - who have daily interactions with tourists. HHARP seeks to establish a sense of empowerment, emergency plans (*ex. if there is a tsunami warning, re-route this bus to pick up people and take them away from the beach*), and a sense of personal responsibility for visitor safety.

Under development is a guide targeted for visitors and for those who work in the tourist industry. The guide lays out what HI-CD *wants* to happen during a tsunami as well as numerous other hazards. (Tsunamis are covered in pages 21-25 of the guide in progress: <http://www.nxtbook.com/nxtbooks/hvcb/travelsafetytips/#/22>.)

The next step is for HI-CD to conduct study to understand what actually does happen now. For example, the ideal is for a bus driver to drive his load of tourists to a safe area. It is unknown how many bus drivers currently do this.

Maps on the internet (<http://tsunami.csc.noaa.gov/map.html>) and in telephone books show *tsunami evacuation zones* - areas that must be evacuated. To each island, HI-CD provides maps of *tsunami inundation zones* - areas that could get wet in a tsunami. Each island then develops its own evacuation zones, based on the State inundation zones and on local landmarks and roads. Currently, the public sees maps of evacuation zones but not of inundation zones.

Underway now is an effort to develop a standard process to identify buildings that would be safe for *vertical evacuation* - that is, when someone goes high up in a building rather than heading for higher ground.

Each of the four island Counties has its own issues, concerns and preparations.

- Kaua'i has signs that mark evacuation routes and that announce "entering tsunami zone" and "leaving tsunami zone".
- The Big Island (Hawai'i) has signs that announce "entering tsunami zone" and "leaving tsunami zone".
- Maui has no signs.
- O'ahu is conducting a study that will post signs like Kaua'i has, and that will create evacuation route maps for the police (showing which ways to turn traffic, for example).
- O'ahu has some of the worst traffic in the U.S. and a large and growing number of suburbs in evacuation zones, where many young families live. On any day, these residents spend 2-3 hours commuting fewer than 10 miles in traffic.
- O'ahu plans to create two evacuation lines, one for the Aleutian tsunami and one for all other tsunamis. It is already building this plan into its new signage system.
- Kaua'i thinks that it will use only one evacuation line, based on the larger, Aleutian event.
- Hawai'i and Maui have not yet planned for the Aleutian event.

Current Tsunami Safety Measures When A Tsunami is Forecast

On all four islands:

- A siren sounds when the Pacific Tsunami Warning Center issues a tsunami warning. The timing of the first siren depends on many variables, but at a minimum, a siren will sound when a forecast tsunami is 3 hours away. In that 3-hour case, the siren sounds again at 2 hours, 1 hour, and 1/2 hour away. At 1/2 hour, all emergency responders pull back to safety.
- There are *safe zones* - temporary refuge sites where people wait to see if a forecast tsunami in fact arrives and is dangerous.
- There are *shelters* - longer-term sites which open if the tsunami causes damage.

- TV and radio inform that a tsunami may be on the way, that those in evacuation zones should get to known refuge points or higher ground, and that evacuation zone maps can be found in phone books and the internet.
- Police and fire departments patrol the evacuation zones and man roadblocks at major entrances to evacuation zones.

Proposed Changes to Tsunami Safety Measures

- A second evacuation line?
- A single evacuation line (that will be unnecessarily high for all but one event)?
- Explanation/justification for the new evacuation zones?
- Restrict car evacuations to those who really need them?

Insights, Recommendations, and Shared Experience

Messaging changes can potentially have negative impacts.

Your concern is justified. Without suitable care, the changes can confuse the public and discredit the experts. To limit confusion and maximize acceptance:

- phase in use of a second evacuation line, and emphasize that there is a small risk of this low-probability tsunami;
- in every aspect of messaging, clearly distinguish between the large "Aleutian" and more commonplace tsunamis;
- have a unified terminology and consistent public procedures across all four Counties.

Consistent messaging from multiple sources is extremely important.

If each island does things differently, confusion is sure to increase on all islands.

If only one island wants to use a single evacuation line, it would be better for that island to have two evacuation lines that are identical, than to have a single line when the other islands have two lines.

To avoid confusion, locals and tourists who move between islands need a unified general plan and terminology that is consistent from island to island.

Use of the right names can boost public understanding.

If you have two evacuation zones and distinguish them by colors, numbers, or letters (orange zone vs. yellow zone, zone 1 vs. zone 2, zone A vs. zone B), it will be difficult for people to understand or remember the distinction. Names are better.

Hawai'i has new evidence of past tsunamis that were as large as the newly-discovered, Aleutians-generated tsunami. Are there names for these past tsunamis that have meaning for the locals - such as Hawaiian place names? Or perhaps key words from local survivor stories? If the name of the "Aleutian" tsunami and the names of the two new evacuation zones can make use of

Hawaiian names, that would tie local history to the latest science and could increase public acceptance. Hawai'i might adapt southern California's popular earthquake nickname, *the Big One*, for this new tsunami threat.

You may create confusion if you call the new event "the Aleutian" or "the Alaskan" tsunami, because future scientific study may uncover evidence that large, rare tsunamis can also come from other locations. In addition, physical distance can increase psychological distance, which discourages action. Calling it "the Aleutian tsunami" may increase the psychological distance.

Avoid referring to the events as the "99.1%" tsunami vs. the "0.1%" tsunami. Although this does a good job capturing the *sense* of typical vs. atypical tsunamis, it could cause confusion because these are not the actual scientific probabilities, which scientists may discuss from time to time. More generally, very few people understand probabilities, so avoid their use whenever possible.

To increase understanding, reduce the amount and complexity of terminology. It is very good that in Hawai'i the public does not have to hear both *inundation zone* and *evacuation zone*. There is other terminology that can be clarified.

Experts frequently use variations in terminology synonymously. But a non-expert does not understand that the variations are synonyms and instead hears each term as a separate concept, which quickly gets overwhelming. For example, expect all of these terms to be interpreted as having different meanings:

- evacuation zone
- tsunami evacuation zone
- evacuation area
- tsunami evacuation area.

It will aid public understanding to choose a single term and stick with it. In casual speech it is common for experts to interchange terms like these, which, again, will seem distinct and confusing to the public:

- refuge point
- refuge site
- refuge zone
- safe point
- safe area.

The term *evacuation zone* is ambiguous. Some people think it means "the zone to leave because it is unsafe". Others think it means "the zone to go to because it is safe". Simpler terminology would be to distinguish *tsunami safety zones* from *tsunami danger zones*.

The distinction between *refuge* and *shelter* is a difficult one to grasp. It might help to always call them *short-term refuges* vs. *long-term shelters*. Or even more simply, *short-term shelters* vs. *long-term shelters*.

To increase safe behavior in future events, minimize the public's perception of false alarms and near misses.

These can make people less willing to take action the next time.

If people evacuate and then no damaging tsunami occurs - or the tsunami doesn't affect them - they assume experts were wrong, when in fact there can be many other reasons they have been spared. A public "post-mortem" after each event could, over time, increase public understanding of this.

Using a single evacuation zone that is unnecessarily high except for one event is wasteful and may come to be discredited or ignored.

It will increase the perception of false alarms if, for garden-variety tsunamis, people are told to leave areas that are only at risk in the largest, rarest tsunami.

Stress how the improvement in scientific understanding benefits the public.

To maximize public buy-in, it will be important to acknowledge that the residents have lived with tsunamis - as have their parents, and their grandparents - and now, here is how things have changed.

Our new scientific information has resulted in improved understanding and increased public safety. To the public, this will be a compelling and convincing story.

The current siren system works very well.

Auditory cues can be powerful aids to communication and memory.

Consider a second kind of siren to signal the larger event. As always, when people hear a siren they will need to seek information about what it means.

Use of two sirens allows for more nuanced messages. However, when the crisis occurs:

- when people are under pressure or face high risk they can most easily absorb three points in short sentences that are about 10 seconds or 30 words total;
- the most important points should go in sentences 1 and 3;
- messages should be repeated;
- visual aids are very helpful.

Public participation in the process of making changes will improve the content, improve up-take of the information, and increase buy-in.

Hawai'i already reaches out to its residents of many different groups and they can be powerful allies in this new effort, particularly when they are engaged in the development of the changes.

Consider involving target communities - including historically vulnerable and underserved populations - before you finalize decisions. For example, you could:

- get community input about what to name the two evacuation lines, and which terminology is clear;
- involve communities to help you evaluate and compare the effectiveness of your top options for a new message;
- engage communities in exercises where they make use of new messages;
- involve residents in the design of evacuation routes, as they know effective routes in their own communities.

Community involvement can help to make the messages appropriate and relevant to different kinds of communities.

If you develop a process that makes target communities crucial from the outset, that process could be applied successfully to many other awareness efforts.

Your changes should be tested.

Expert plans are usually missing important pieces - no experts are immune from this, including this group! The way to ensure that your changes work will be to try them before finalizing them. Focus groups, computer simulations, and small-scale, live drills all have roles to serve in this process.

Appendix A. Participants' Background & Experience

Sue Perry, U.S. Geological Survey, assembled a group of partners with a wide range of expertise in the social and behavioral sciences, public health, design and communication. What the group has in common is an approach to public safety that combines academic research with time spent working closely with communities to apply the research and learn what else is needed. Below are extracts of their experience most relevant to this effort. Upon request, each of these participants will be happy to provide citations to their pertinent, scholarly publications. The references cited here are general audience publications that instead summarize research results.

In New York

1) **The Center for Research on Environmental Decisions (CRED)**, Earth Institute, Columbia University. CRED studies how people make environmental decisions under conditions of uncertainty. They have studied evacuation decisions as hurricanes, wildfires, or debris flows approach, and the effectiveness of scientific hazard maps. CRED currently conducts over fifty lab and field experiments, which engage groups and communities in Africa, Europe, the Asian Pacific, South and North America, and the Caribbean. CRED published a popular climate change communication guide that has been translated into several other languages and distributed to more than 26,000 people. CRED has recently begun work on a hazard communication guide.

Colleagues from CRED:

- **David H. Krantz**, psychologist, CRED founding co-director.
- **Ben Orlove**, anthropologist, CRED co-director.
- **Courtney St. John**, urban planner, CRED outreach director.
- **Katherine Thompson**, psychologist, CRED PhD candidate.

For more information:

Center for Research on Environmental Decisions, 2009, "The Psychology of Climate Change Communication: A guide for Scientists, Journalists, Educators, Political Aides, and the Interested Public", New York, 48pp. Available from: <http://cred.columbia.edu/guide/>

2) **Christina Zarcadoolas**, socio-linguist, City University of New York School of Public Health at Hunter College. Chris' research focuses on how experts and officials communicate complex emergencies to various segments of the public; how public safety is compromised by misunderstanding of maps, terminology, and instructions; how understanding varies in different segments of the public, and the influence of changes in communication technologies and mobile devices. Among her current projects Chris is working with a coastal community in New York City to co-develop more understandable and engaging preparedness and response information.

3) **Wendy Vaughn**, student, The Graduate Center, City University of New York. Wendy is a graduate student in public health communications, who has worked with Chris for many years as Research Manager and co-author on a range of qualitative and ethnographic research. Wendy is originally from Maui.

For more information:

Zarcadoolas, C., Pleasant, A., and Greer, D., 2006, "Advancing Health Literacy: A Framework for Understanding and Action", 396 pp.

In Los Angeles

4) **David Eisenman**, physician and director, University of California, Los Angeles, Center for Public Health and Disasters. David's work focuses on developing and evaluating public health emergency and disaster programs particularly with 'hidden' and vulnerable populations. He is the preparedness science officer for the Los Angeles County department of public health.

5) **Malcolm Williams**, policy researcher, RAND Corporation. Malcolm's background is in health services research, including community resilience to disasters, disaster vulnerability, and racial and ethnic disparities in quality and access to care.

David and Malcolm are leaders in the **Los Angeles County Community Disaster Resilience Project** (LACCCR), a collaborative pilot effort to build disaster resilience at the community level. LACCCR engages community-based

organizations, helps to develop local leadership and partnership, and provides resources as communities prioritize hazards, identify assets, and recognize vulnerable populations.

For more information:

Ringel, J. S. Chandra, A., Williams, M., Ricci, K.A. Felton, A., Adamson, D.M., Weden, M.M., and Huang, M., 2009, "Enhancing Public Health Emergency Preparedness for Special Needs Populations, A Toolkit for State and Local Planning and Response," 117 pp.

http://www.rand.org/pubs/technical_reports/TR681.html

6) **Elisa Ruffino**, director, **Designmatters**, Art Center College of Design. Elisa is the project development liaison between Art Center creative teams and Designmatters' collaborators. These collaborations have yielded multiple award-winning awareness campaigns, publications, and documentary films.

7) **Sherry Hoffman**, faculty, **Designmatters**, Art Center College of Design. Sherry teaches *branding strategies* and has a background in advertising and entertainment marketing. Sherry participated in brainstorming sessions among USGS, earthquake science, social science, and emergency managers in development of information products for earthquake early warning and forecasting.

The **Designmatters** department at Art Center College of Design oversees all art and design for social innovation programming at the college and applies the principles of design and marketing to social causes. Designmatters has a long list of international collaborations in government, academia, NGOs, nonprofits, and more. For the USGS, Designmatters developed branding, public service announcements, and web site for the first ShakeOut Drill and led high level strategy workshops for the ARkStorm scenario. For the SAFRR Tsunami Scenario, Designmatters students developed a prototype of a public education campaign; and the first in a trio of 1-minute movies intended to raise tsunami awareness among 18-34 year olds.

For more information:

Tsunami preparedness campaign prototype:

<http://www.designmattersatartcenter.org/proj/the-next-wave/>

Public Service Announcement, "The First Sue Nami":

<http://www.youtube.com/watch?v=4cWaMU12tyg>

Video summarizing scientific study, "Preparedness Now":

<http://www.youtube.com/watch?v=opXZY1zZ8xk>

8) **Sue Perry**, disaster scientist, **Science Application for Risk Reduction (SAFRR)**, USGS. Sue specializes in finding new and more effective ways of communicating science to non-scientists. She was a member of the steering committee that planned the first ShakeOut Drill. She routinely assists emergency

managers and local planners to develop exercises and works with communities as they identify and prioritize their natural hazards. **SAFRR** has a mission to innovate the application of hazard science for the safety, security, and economic well-being of the nation.

For more information:

Perry, S., Cox, D., and Jones, L., "The ShakeOut Earthquake Scenario - A Story That Southern Californians Are Writing", 2008, 24 pp.

<http://pubs.usgs.gov/circ/1324/>

Appendix B. Other Important Discussion Points

Sometimes this group's conversation moved into areas that are important, but only tangentially related to the immediate changes in messaging.

Understanding Science and other Technical Information

Low levels of science literacy will impede understanding of new as well as current warnings. National Science Foundation surveys over the last 30 years estimate that 20% of the public is science literate. When we talk with people about changing science and improvements in knowledge, we don't convince them. Instead the reactions are *Why are they changing their minds?* or *Scientists just like to argue.*

Most adults in the U.S. read poorly - at an 8th grade level or lower. Just as many adults have low or inadequate levels of "health literacy" and struggle to use safety information. Reading and health literacy levels create barriers that must be understood and planned for in order to successfully communicate public safety information.

The changes in tsunami procedures provide an opportunity to talk about the improvements in technology and forecasting that drive these new procedures. They also provide an enormous opportunity to visualize and demystify scientific information. Such an effort could be most effective combined with historical information, which would make the science more relevant and compelling.

This is also an opportunity for science education. Discussion of this rare Aleutian event could help people understand a little bit about plate tectonics and how earthquakes generate tsunamis. This is curriculum that should be in elementary school and repeated again in high school.

Individual and Community Empowerment

In spreading the word about the new messages and procedures, community-based organizations, cultural organizations, and other social service organizations have more reach into a community than the emergency management department or public health community. Hawai'i's existing efforts with community groups will be important here and could be expanded.

Coordination is the missing element in much hazard planning. Many levels are needed: coordination among households and throughout organizations, as well as cross-level coordination, in which individuals are aware of organizational plans and organizations will survey and understand individual plans. The HI-CD survey of bus drivers' current practices is one good example of cross-level coordination.

Inundation from this new tsunami could be a truly horrible disaster in O'ahu. The prospects of such a tsunami's inundation might promote otherwise unpopular measures to ease snarled transportation on O'ahu. To accomplish such changes, tsunami planning must be broadened out of a silo of experts.

The Participants Can Learn From Hawai'i

As Hawai'i develops and rolls out its new tsunami messaging, that experience will provide valuable lessons to those working with other hazards in other locations. Thus, several in this group of participants would be interested in seeking funding to study - to observe and evaluate - the Hawaiian experience. They would need several months advance notice to pursue project funding.

Participants Will Remain Available As Needed

Participants in this project seek to apply their knowledge and research to improve public safety and thus appreciate the opportunity to engage in these discussions. Whenever feasible, they will be happy to remain available for additional questions and discussion about Hawai'i's tsunami messaging.