

Times Standard

Not My Fault: You are an essential part of the end-to-end tsunami warning system

Lori Dengler for the Times-Standard

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This is a photo from the Manila beach segment of the 2005 Kinetic Grand Championship race. Duane Flatmo's Extreme Makeover kinetic sculpture has many eyes and a large mouth but no ears. It illustrates the diversity of our beach user group and the complexity of reaching everyone who might be in harm's way of a tsunami but may have difficulty in hearing alerts and knowing what to do.

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I spent the last week in Colorado at a meeting of the Tsunami Science and Technology Advisory Board (TSTAP). We are a small group tasked with providing recommendations to the NOAA administrator on how to improve the U.S. tsunami warning program. Colorado may seem like an odd place to meet to talk about tsunamis, but it's the hub of USGS seismic information gathering and where many essential NOAA data repositories are located.

I find many meetings too big, too noisy, and not focused enough on what I find interesting. But TSTAP is different. We are a tight-knit group with one purpose, to examine all aspects of the end-to-end U.S. tsunami warning system. It includes many parts, from understanding the hazard, to data acquisition and processing, assessing threat, communication, and getting everyone in harm's way to evacuate, and we didn't address everything in our three-day meeting. But we touched on many of them.

I've been connected to the U.S. tsunami program since 1994 when I participated in one of the workshops after the 1992 M7.2 earthquake to identify weaknesses in tsunami mitigation. The focus was near source events with only minutes between an earthquake and the arrival of

tsunami waves. Few people were aware of the Cascadia subduction zone in those days, and 'tsunami' hadn't yet gained its overwhelming disaster connotation, but the post 1992 workshops led to a small earmark in the federal budget and the National Tsunami Hazard Mitigation Program (NTHMP) was born.

So much has changed in the U.S. tsunami program since then. That small NTHMP earmark led to the first operational ocean bottom pressure sensors that we now call DART buoys, improvements in the earthquake data streams for the tsunami warning centers, first generation tsunami hazard maps for some areas on the West Coast, and fledgling outreach and education programs. More importantly, the NTHMP partnership between the Pacific States and NOAA became a springboard to gain permanence and funding after the 2004 Andaman – Sumatra earthquake elevated 'tsunami' to a household name.

Catastrophic tsunamis are relatively uncommon and only two events have caused more than 100 casualties on U.S. soil, both of which produced the somewhat cobbled together tsunami warning system we have today. The tsunami spawned by the 1946 April fool's day quake in the Aleutians killed 5 in Alaska, 158 in Hawaii, and 1 in California and led to the establishment of the first U.S. warning center (now PTWC) on Oahu in 1949. The Great Alaska earthquake of 1964 claimed 106 tsunami deaths in Alaska, 5 in Oregon, and 14 in California, and led to the 1967 establishment of a second tsunami warning center in Palmer, Alaska (now NTWC).

Warning center areas of responsibility and operating procedures changed over the years with technology and a growing understanding of the physics of tsunamis, and each developed different hardware and software. PTWC went down a UNIX track and NTWC chose Windows. The two centers were not in the same organizational unit: PTWC in NOAA's Pacific region and NTWC in Alaska. We were well aware of the structural impediments in the 1990s during the formation of the NTHMP, but it took nearly three decades to finally do something about it.

TSTAP was mandated as a result of the Tsunami Warning, Education, and Research Act of 2017. It was charged with providing independent oversight and advice on all aspects of the tsunami system and is statutorily required to provide annual reports and 4-year comprehensive reviews. The first quadrennial report was released in 2021 and included eight areas of recommendations. The top priority was to "Improve unification and capabilities of the Tsunami Forecast System." You can read this report and all TSTAP publications at <https://sab.noaa.gov/report-library/>.

The TSTAP recommendation was the push needed to put the two U.S. tsunami centers into the same administrative framework and unify systems so that each center could effectively backup the other. I joined TSTAP in 2022 and could hardly believe the official NOAA response to that recommendation: both centers would be put into the National Centers for Environmental Prediction where other overarching NWS operations like the National Hurricane Center are housed and a common analytic system (CAS) would be developed for both centers to use.

It's not a small task to develop a CAS and we are now in year 2 of this slow transformation. We spent much of last week's meeting getting an update. Unique tsunami forecast models developed by each center need to become one. The new system needs to adapt rapid technology changes as alerting needs and capabilities change. And bumps in political priorities, budget cutting, and reorganization pose additional challenges. CAS should become operational in the next few years.

Communication emerged as a big theme at the TSTAP meeting. It's not just the two tsunami centers that need to communicate, there are different branches within NOAA, separate U.S. agencies like the USGS, and disciplines like the social sciences that are all components of a complete warning system. One of the reasons for choosing Colorado as our meeting spot was the USGS National Earthquake Information Center in Golden where global earthquake information is collected and analyzed. While the tsunami centers currently receive much USGS information, there are areas of seismology research that could improve tsunami forecasting in the future such as detailed fault characterization or landslide triggering that could refine the areas that should be placed in warnings.

The biggest communication challenge is with the ultimate user – the person on the beach and they can be the most difficult to reach. In looking for an image for this column, I came across a kinetic sculpture race slide I used to illustrate the diverse users of our beaches. A closer look Duane Flatmo's Extreme Makeover sculpture shows multiple eyes and giant mouth but no ears, a perfect metaphor for many of the people I talk to after tsunami events. I get a litany of complaints about how no one told them about what the hazard was or what they should do. There was plenty of information out there but if you don't pay attention to it or listen beforehand, it is of little use.

Short attention spans, an expectation of instant information, misinformation, and unreliable sources blur the landscape. But enough with the excuses. If you live, work, or play in a tsunami area, it's up to you to learn more about the hazard before the ground is shaking or the water rises. It's easy to find out what areas are at risk and which ones are safe (<https://rctwg.humboldt.edu/tsunami-hazard-maps>). Drop by the Earthquake – Tsunami booth at the Humboldt County Fair today, or the NWS Office on Woodley Island at any time to pick up maps and flyers.

Note: the Indian Ocean tsunami warning system was tested on Friday following a M7.7 earthquake in Indonesia. The system was established after the 2004 Indian Ocean tsunami when it became tragically clear that Indian Ocean countries had no alerting mechanism. On Friday, alerts and evacuation orders were issued within five minutes of the earthquake and disseminated via texts and media broadcasts. A 3-foot tsunami was recorded on a tide gauge 34 miles away from the epicenter and many amateur videos show water receding and flooding beach areas. No damage or casualties have been reported at this time due to the tsunami but the earthquake shaking caused major damage on the island and 47 deaths have been reported. Casualty numbers will rise as the areas closest to the epicenter can be accessed.

Lori Dengler is an emeritus professor of geology at Cal Poly Humboldt, and an expert in tsunami and earthquake hazards. The opinions expressed are hers and not the Times--Standard's. All Not My Fault columns are archived online at <https://kamome.humboldt.edu/taxonomy/term/5> and may be reused for educational purposes. Leave a message at (707) 826-6019 or email Kamome@humboldt.edu for questions and comments about this column or to request copies of the preparedness magazine "Living on Shaky Ground."