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Tsunami Safety in Alaska

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**Testimony before the Senate Committee on Commerce, Science, and Transportation
US Senate**

Mr. Chairman and Members of the Committee, thank you very much for inviting me to testify. My joint appointment as the State Seismologist for Alaska and as a Research Professor at the Geophysical Institute of the University of Alaska Fairbanks (UAF) places me in a unique and advantageous position to partner in a tsunami hazard mitigation program for Alaska bringing together operational monitoring, education, and research activities. I have been involved in the National Tsunami Hazard Mitigation Program (NTHMP) since its inception as a co-author of the Implementation Plan nearly 10 years ago, and continuing to this day as a strong facilitator and member of the NTHMP Steering committee representing Alaska. My unique position also serves to manage the Alaska Earthquake Information Center which operates and maintains the over 400 station Alaska Seismic Network for regional monitoring of earthquakes and volcanos in Alaska. Our decades long collaboration and partnership with the Alaska Tsunami Warning Center for seismic data exchange has been recently strengthened by our involvement in the NTHMP and the related Tsunami Warning and Environmental Observatory for Alaska (TWEAK) programs. TWEAK has funded the creation of a virtual center at UAF, called the Alaska Tsunami Center and Observatory, that combines the strengths of the Geophysical Institute, the Institute of Marine Sciences, and the Alaska Regional Supercomputer Center into one organization in partnership with our federal and state agencies.

Tsunami Safety in Alaska comes from a strong partnership between several state and federal agencies. The NTHMP was created with the understanding that the best way to address the hazards posed by tsunamis was through a State/Federal partnership that leveraged an improved “coordination and exchange of information to better utilize existing resources.” Through participation in the NOAA National Tsunami Hazard Mitigation Program (NTHMP), this partnership provides improved levels of warning guidance, hazard assessment, and mitigation; allowing an integrated response in Alaska to a potentially tsunamigenic earthquake.

It is important to recognize that tsunami warning systems require a sophisticated infrastructure that goes well beyond just the ability to detect a tsunami and send a warning message. This infrastructure must include a continuing partnership between the state and federal agencies and the local communities at risk to assess the hazard and provide levels of mitigation to minimize the risk to life and property. Nowhere in the U.S. is such a partnership more important than in Alaska. Much of Alaska is remote, with little built infrastructure for communications, harsh winters, and communities that are located in one of the most seismically active regions of the world. Our primary hazard comes from the “local” tsunami generated by nearby large earthquakes in or near the coast of Alaska, rather than from the “distant” tsunami that travels across the open ocean. In this

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case, the deep ocean buoys, or “tsunameters”, while a part of the larger warning system designed for US Pacific-wide tsunamis, are secondary indicators for Alaska warnings, because a locally generated tsunami wave will hit the Alaska coast long before it reaches the deep ocean buoys. We must rely on the rapid warnings issued from the detection of the earthquake; and even more so on education, hazard assessment, and mitigation as to how to respond to the potential of a tsunami.

The U.S. Tsunami Warning System consists of two warning centers: the Pacific Tsunami Warning Center (PTWC) in Ewa Beach, Hawaii and (important to Alaska) the West Coast/Alaska Tsunami Warning Center (WC/ATWC) in Palmer, Alaska. These centers work in cooperation with other NOAA units to perform their mission. In Alaska, state agencies such as the Alaska Department of Homeland Security and Emergency Management (ADHS&EM) and the Alaska Division of Geological and Geophysical Surveys (ADGGS), and the Alaska Tsunami Center and Observatory at the University of Alaska Fairbanks (UAF), are strong partners in the tsunami warning mission.

Warning Guidance

First and foremost, we must be able to detect events that can trigger tsunamis. The current tsunami warning systems are triggered by information from earthquake seismic networks. Typically, earthquake magnitudes above certain levels cause tsunami warnings to be issued. In Alaska the WC/ATWC has the responsibility for issuing all tsunami warning, watch, advisory, and information messages to emergency management officials. As earthquakes trigger most tsunamis, the WC/ATWC monitors data from seismic networks throughout Alaska and worldwide. While the WC/ATWC maintains a backbone network of 11 seismic stations in Alaska, in order to monitor for large coastal earthquakes they receive a subset of about 40 stations from the 400-station combined seismic network of the Alaska Earthquake Information Center (AEIC) and Alaska Volcano Observatory (AVO). The data are processed in near-real-time and initial warnings for tsunamis from large earthquakes are based solely on seismic data. This is the reason that it is so critical to have modern instrumentation for application to modern techniques for rapid determination of earthquake magnitude. Sea level data (both tide gauges and deep ocean buoys) are also monitored to verify the existence of and danger posed by tsunamis. Bulletins are issued through standard NWS channels, such as the NOAA Weather Radio and the NOAA Weather Wire as well as the FAA NADIN2 system, FEMA’s National Warning System, State Emergency channels, and other means. (All Alaska earthquakes are then re-processed by AEIC utilizing the entire combined Alaska Seismic Network and included in the authoritative catalog at AEIC). The NTHMP funded upgrades to ~55 seismic stations in regional networks throughout the western US. This leveraged NTHMP resources with the already substantial investments in seismic networks in order to provide high quality data to the tsunami warning centers. AEIC was tasked through NTHMP to develop 18 of these stations for Alaska for delivery to the warning centers. At the request of ATWC, the TWEAK program has now substantially increased the number of modern stations AEIC can provide to augment this sparse improvement. Yet many vast areas of Alaska (and in particular the Aleutian Islands) still remain underpopulated with modern seismic stations.

Hazard Assessment

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Well recognized in the NTHMP, a second part of the tsunami warning and safety procedure requires an understanding of hazards and risks associated with tsunamis in Alaska. Without a clear understanding of what areas are at risk and which areas are unlikely to be flooded, it is impossible to develop effective emergency response plans and education programs. To ensure reliable tsunami early detection and hazard assessment capabilities, it is essential to create a numerical model to forecast future tsunami impact and flooding limits in specific coastal areas. The NTHMP made it a priority to develop the expertise within each state for providing tsunami flood maps for the states communities at risk. In Alaska we are evaluating the risk by constructing inundation maps for at-risk communities through modelling of the tsunami water waves from scenario earthquakes and landslides. This effort for Alaska is being led by the UAF Alaska Tsunami Center and Observatory in close collaboration with ADHS&EM, ADGGS, the UAF SuperComputer Center, and other state and federal partners. As inundation maps for communities are completed, they are presented to both state and local emergency managers who then use the information for planning and exercising evacuation routes and safe zones for the communities visitors, tourists, and local residents. Maps for several communities on Kodiak Island, Homer, Seldovia, and Seward have been or are nearly completed, and we now wait for needed information on bathymetry for the many other at-risk communities for which maps will be made. The earlier example of the remoteness of Alaska again affects our productivity in map generation. Many regions along the shallow waters off the coast of Alaska have not been mapped in many years. Some areas not since before the 1964 Prince William Sound M9.2 earthquake. Reliable modelling results require that we have accurate bathymetry to a resolution that is not generally available except in lower 48 states, and at a very few communities in Alaska. Collection of improved bathymetry should be a top priority for enhanced funding of any tsunami program. In addition, it is important to stabilize the infrastructure necessary to create the numerical models within Alaska.

Mitigation and Response

Arguably the most important aspect of tsunami warning systems is the existence of a mechanism for disseminating warning information to the people and businesses on the shorelines. It has been recognized that tsunami hazard mitigation requires a long-term sustained effort. Tsunami mitigation needs to be an institutionalized part of continuing public education, emergency management and responsible planning decisions in Alaska's coastal communities. Tsunami education materials, inundation maps, community evacuation maps and signs, warning sirens, and numerous other mitigation-related products are being developed as part of the NTHMP program. These materials are brought to communities by a team of scientists and Statewide emergency planners on a routine schedule to establish the infrastructure for education and outreach with respect to tsunami hazards and warnings. This infrastructure of communication between UAF, WC/ATWC, emergency management officials, ADGGS, and local communities is what allows warnings to be disseminated and acted upon in an efficient manner throughout the Alaska Communities. The TWEAK program is assisting this through an active education and outreach program, as well as partnering with ATWC and ADHS&EM to purchase and install tsunami warning sirens in at risk communities. Discussions with the emergency management community and the

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Director of the Alaska Tsunami Warning Center both concluded that the most useful improvement to be made to the warning system in Alaska is to improve the warning and communication infrastructure at the local level for both emergency managers and the public. Again, increased funding for tsunami programs for Alaska should also include as a top priority resources for expanding the warning dissemination infrastructure and mitigation activities.

What is needed for the future

While Alaska has created an infrastructure for efficient tsunami warning and safety procedures, our efforts are only beginning. As mentioned earlier, the weak link of information and communication must include not only improvements to infrastructure and data collection and processing, but also include a continuing state/federal partnership for education and outreach.

Important to tsunami safety for Alaska, the TWEAK program between UAF and the Alaska regional level of the NOAA Weather Service, is a program in support of the NTHMP that provides direct assistance to the issues most critical to tsunami safety in Alaska. The TWEAK program has brought the federal, state, and university partners within Alaska into a mature organization of tsunami activities described above. A virtual center, called the Alaska Tsunami Center and Observatory, has combined the strengths of the Geophysical Institute, the Institute of Marine Sciences, and the Alaska Regional Supercomputer Center in one organization in partnership with our federal and state agencies. This Center will continue to support the goals of the National Tsunami Hazard Mitigation Program that are unique to the difficult setting of Alaska through improvements and enhancements in monitoring, modeling, and education and outreach.

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