Tsunami Early Warning - Interdisciplinary Collaboration to Save Lives

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Timely tsunami warning depends on the rapid detection and accurate assessment of dangerous tsunamis. 81% of tsunamis are generated by subduction zone earthquakes, making real-time source characterization a tsunami warning center (TWC) priority. Since the 1990s, the IRIS GSN has been the backbone for global seismic monitoring, supplemented by denser national networks for local monitoring. Earthquake Early Warning in Japan, and being tested in USA, now provides locations in seconds so critical facilities are shut down to avoid catastrophe. Currently, W-phase CMT solutions in 20 minutes establishes the tsunami source enabling coastal wave forecasts.

With more, high-quality seismic data, and faster characterization methods, the PTWC's response time in 2017 has been ~7 minutes, compared to 45 minutes in 1995. Ground-truth data from the 2004 Indian Ocean, 2009 Samoa, 2010 Chile, and 2011 Japan tsunamis, together with high-performance computing, have led to more accurate forecasts in minutes. Coupled with faster-reporting, denser tsunami monitoring networks, TWCs are now able to cancel warnings sooner when there is a non-destructive tsunami, thus avoiding economically-costly evacuations. Engineering field data has led to new tsunami structural provisions to the 2018 International Building Code. Modeling of currents is driving vessel evacuation planning in ports and harbors.

New data and technologies offer promise for inter-disciplinary collaborations to develop operational tools for multi-scale, timely tsunami threat assessment. GNSS networks can directly measure deformation in minutes, long before CMT solutions from seismic surface waves. Ionospheric tsunami detection from the total electron content has been demonstrated (2013 Canada, 2015 Chile). Offshore GPS surface buoys confirmed the approaching tsunami off Tohoku in 2011. Geophysical and oceanographic sensors on fiber-optic submarine cables now monitor Japan seismicity and tsunamis, and ITU-IOC-WMO SMART cables seek to use commercial telecommunication cables as trans-oceanic dense linear sensor arrays.