



1854-2014: 160 years of far-field tsunami detection and warning

Emile Okal

Northwestern University, Geol. Sci., Evanston, United States (emile@earth.northwestern.edu)

The first scientific study of a tsunami as generated by a distant earthquake can be traced to Bache [1856] who correctly identified waves from the 1854 Nankai earthquake on California tidal gauges. We will review developments in the study of the relationship between earthquake source and far field tsunami, with their logical application to distant warning.

Among the principal milestones, we discuss Hochstetter's [1869] work on the 1868 Arica tsunami, Jagger's real-time, but ignored, warning of the 1923 Kamchatka tsunami in Hawaii, his much greater success with the 1933 Showa Sanriku event, the catastrophic 1946 Aleutian event, which led to the implementation of PTWC, the 1960 events in Hilo, and the 1964 Alaska tsunami, which led to the development of the A[~~now N~~]TWC.

From the scientific standpoint, we will review the evolution of our attempts to measure the seismic source (in practice its seismic moment), always faster, and at always lower frequencies, culminating in the W-phase inversion, heralded by Kanamori and co-workers in the wake of the Sumatra disaster. Specific problems arise from events violating scaling laws, such as the so-called "tsunami earthquakes", and we will review methodologies to recognize them in real time, such as energy-to-moment ratios. Finally, we will discuss briefly modern technologies aimed at directly detecting the tsunami independently of the seismic source.