HISTORICAL TSUNAMIS IN THE PACIFIC BASIN

PATRICIA A. LOCKRIDGE

National Geophysical Data Center NOAA/NESDIS, 325 Broadway, Boulder, CO 80303, U.S.A.

Abstract. The Pacific Basin was divided into ten regions, and historical data were compiled for each region. As the Japanese word "tsunami" suggests, the Japan area situated near a collision zone for two crustal plates has generated the most tsunamis (247), and most of the damage has been confined to that area. Across the Pacific to the southeast lies the South American coast, another zone of plate collision, that has spawned many tsunamis (91). The records of the area report 13 events that were devastating not only locally, but as far away as Hawaii and Japan. Further, magnitude 7.5 earthquakes are more likely to generate tsunamis along the coast of South America. The North Pacific area has generated events with far-reaching effects. Five of the nine tsunamis that were damaging outside their source regions in the last 100 years were generated in the arc stretching from the Kuril Islands and Kamchatka across the Aleutians to the Gulf of Alaska. Hawaii is the area most often damaged by tsunamis generated elsewhere in the Pacific Ocean basin. But the west coast of North America, although frequently the site of earthquakes, has generated only seven damaging tsunamis.

1. Introduction

Our purpose is to discuss historical tsunami data available at the National Geophysical Data Center (NGDC) and to compare the potential for future damaging tsunamis as defined by the historical records. We will begin by defining "tsunami," a Japanese word meaning "harbor wave," as a series of waves generated in the ocean or a small, connected body of water by an impulsive disturbance. The definition includes water waves generated by ocean-bottom displacement owing to earthquakes, submarine landslides, or volcanoes. NGDC's effort in compiling tsunami data is complemented by the efforts of two other governmental agencies within the National Oceanic and Atmospheric Administration: the Pacific Marine Environmental Laboratory, a research institution, and the National Weather Service that operates the Pacific Tsunami Warning Center. World Data Center-A for Tsunamis is collocated with NGDC.

1.1. Types of Data and Terms

We have divided the Pacific Basin into ten geographic regions (see Figure 1) to facilitate the study and comparison of historical tsunamis affecting each region. A further breakdown of geographic regions into tectonic areas is planned. Each event will be identified by (a) geographic region, (b) tectonic area, and (c) event year, month and day. Tsunamis occurring outside the Pacific Basin are identified in the same way. (Our data base at NGDC contains information about 389 such events outside the Pacific Basin.) The following tsunami parameters are included in our data base: (1) information about the source, including date of generation, type of source (e.g. volcanic, earthquake, landslide), location of source, depth and magnitude of earthquake where appropriate, and (2) information about the tsunami including maximum runup height (maximum water height above mean sea level for event), tsunami magnitude ($m = \log_2 \cdot H$ where H is the maximum runup height, according to Cox and others) or intensity, ($I = \log_2\sqrt{2} \cdot H$, according to Soloviev and Go) and local runup (maximum water height

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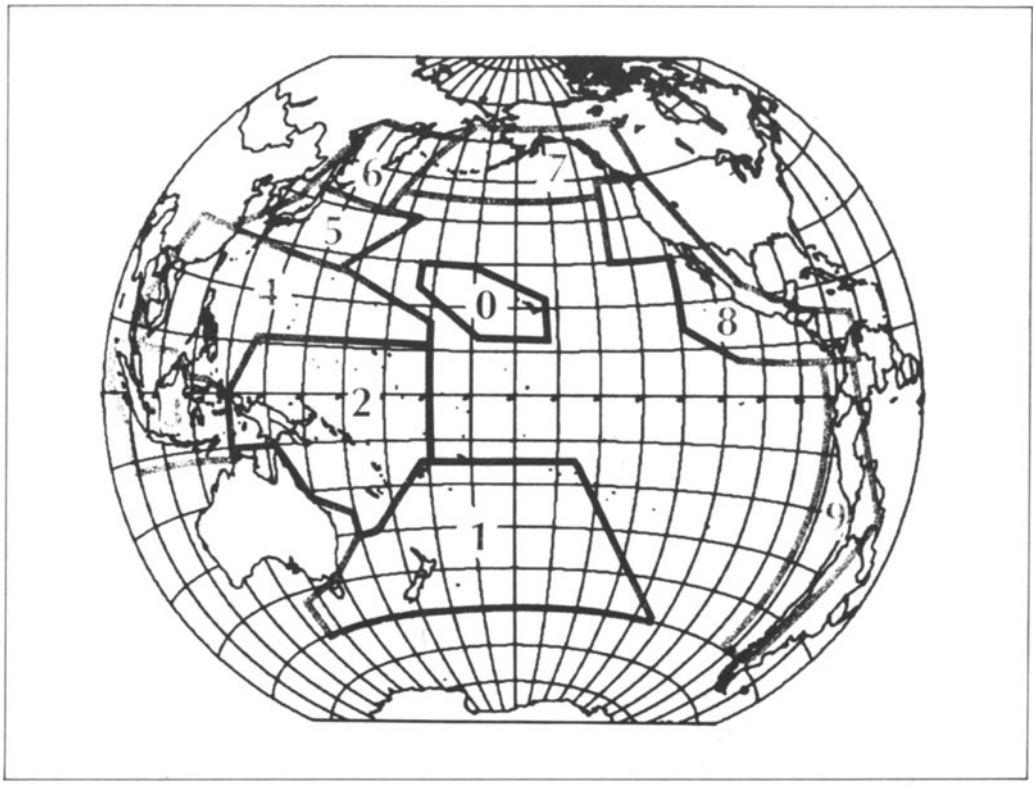

Fig. 1. Pacific tsunami region boundaries: 0 = Hawaii, 1 = S. Pacific/New Zealand, 2 = New Guinea/ Solomon Is., 3 = Indonesia, 4 = Philippines, 5 = Japan, 6 = Kamchatka/Kuril Is., 7 = Alaska/Aleutians, 8 = W. Coast N. and Central America, 9 = W. Coast S. America.

above mean sea level at given location), damage, deaths, arrival time, and travel time for each location experiencing the tsunami. Although we have information on 4500 locations that have experienced tsunamis, our still-incomplete data are constantly being updated and revised. A validity code from 0 (erroneous report) to 4 (definite tsunami) is assigned to each event. The validity code is necessary to prevent erroneous entries (i.e. storm surges, erroneous dates) from being reentered in the data base. The only events discussed in this paper are those having a validity = 2 (questionable tsunami) or higher.

The types of data available for each of the ten regions vary, as does the completeness of the tsunami historical record. Table I gives the extent of record for each of the ten regions, but does not indicate the completeness of the record. For example, some sparsely settled areas may have recorded an especially devastating event centuries ago, but have experienced only sporadic tsunamis in the intervening years. Also given are the number of known tsunamigenic events in each region since earliest times. These numbers were compiled from historical accounts and are dependent not only on the number of actual events in a region, but also on the accuracy of the recordkeeping for the region.