8. Results

8.1 100-Year Tsunami Map

Using the methods described above, Fig. 29 and Plate 1b show the tsunami wave heights, including tides, that are met or exceeded at an annual probability of $P = 0.01$. For brevity, we will call this the 100-year tsunami map. A common feature in all the maps is an increase in the offshore wave height as the water depth decreases toward the outer coast. This is a direct effect of shoaling of the long waves. Inside the estuary, the hydrodynamics are more complex. For the 100-year tsunami map, there is little inundation of the developed areas in the study region. The region of coastal dunes south of the estuary mouth (that is, along the Promenade) are high enough in elevation to block most of the far-field tsunamis. Although a few of the far-field earthquake scenarios resulted in significant areas of inundation (for example, Source 3, Table 6, where the 1964 Alaska earthquake occurred), the 100-year tsunami map shows little inundation because the average inter-event times for these earthquakes are substantially longer than 100 years.

As a sensitivity test to see what effect our choice of segmentation models for Aleutian-Alaska Subduction Zone earthquakes has on the 100-year tsunami map, we compare the results in Fig. 29 with a similar map in which only Segmentation Model 1, which includes the 1964 source region (Fig. 13), is used (Fig. 30b). (Correspondingly, the weight for Segmentation Model 1 was changed from 0.5 to 1.0.) Figure 30a is the 100-year map shown in Fig. 29. Although there is a slight increase in the wave heights using just Model 1 for Aleutian-Alaska earthquakes, there is no significant increase in regions that are inundated by the tsunamis.

8.2 500-Year Tsunami Map

In a similar manner, the 500-year tsunami map was constructed and represents wave heights that are met or exceeded at an annual probability of $P = 0.002$ (Fig. 31, Plate 1c). In stark contrast to the 100-year tsunami map, the 500-year tsunami map shows large regions of inundation with significant wave heights throughout Seaside. The 500-year tsunami map is dominated by the tsunami generated by a local Cascadia Subduction Zone earthquake. For reference, the region of inundation indicated by the 500-year tsunami map includes most of the localities where tsunami deposits from the 1700 Cascadia tsunami were found (Fig. 10).

Because the 500-year tsunami map is dominated by local Cascadia tsunamis, uncertainties in the corresponding earthquakes are likely to have a

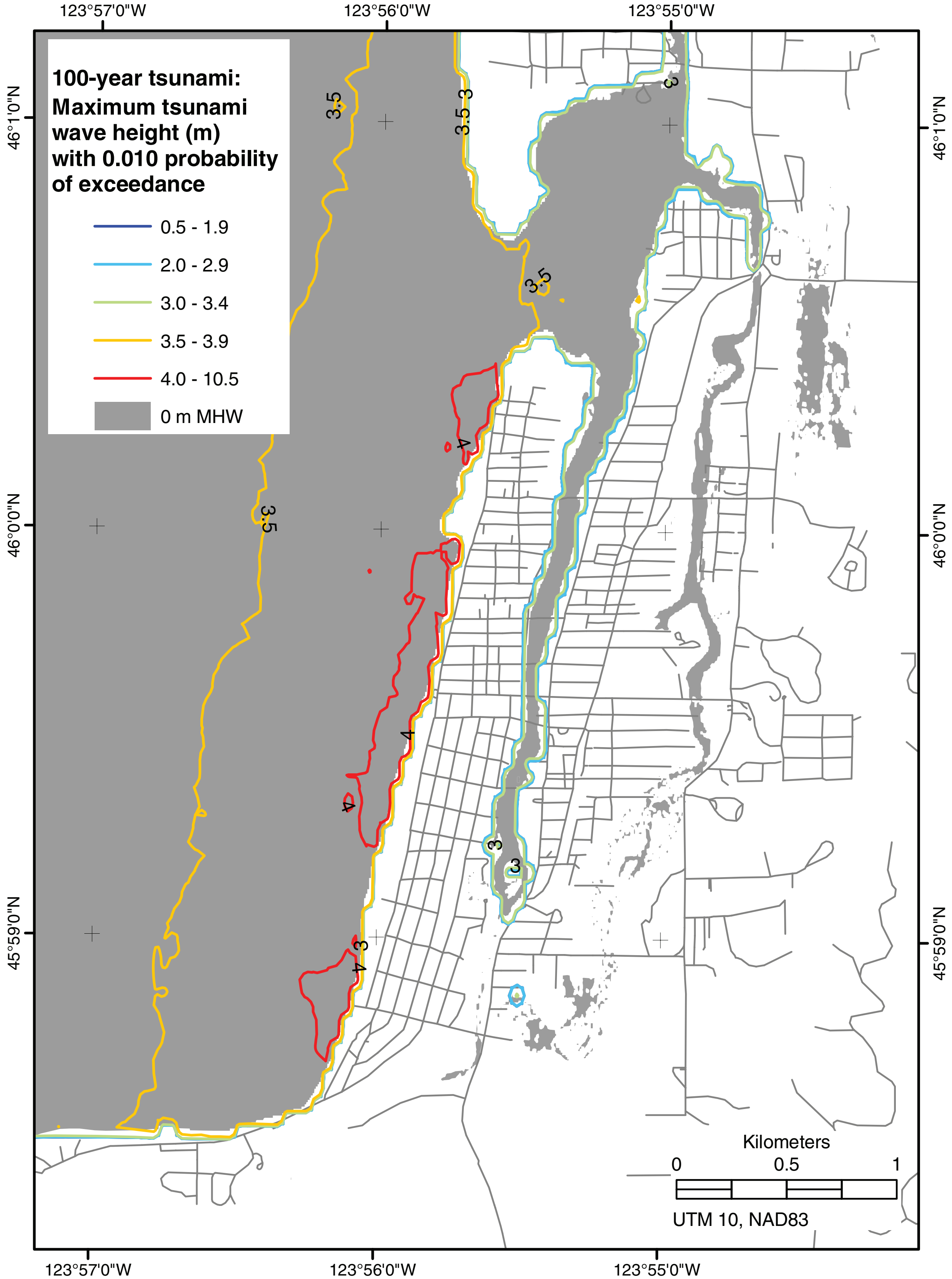

Figure 29: Tsunami wave heights (m) with a 1% annual probability of exceedance. Wave heights include the effects of tides.

large influence. Some of the epistemic uncertainties associated with these earthquakes are discussed in Geist (2005) and in the section below. In Fig. 32, we explore how uncertainty in the mean inter-event time for these earthquakes affects the 500-year tsunami map. Figure 32a is the 500-year map shown in Fig. 31. Two other estimates for mean inter-event times, 477 years and 610 years, that fit the paleoseismic observations (Fig. 17) are shown in Fig. 32b and 32c, respectively. The shorter mean inter-event time (477 years, Fig. 32b) results in significant changes in the 500-year tsunami map because it crosses the threshold of the exceedance probabilities being mapped (500 years). In contrast, increasing the mean inter-event time to 610 years (Fig. 32c) results in little change in the 500-year tsunami map. It is evident that it will be important to gather more accurate age dates of Cascadia Subduction Zone earthquakes to constrain the mean inter-event times shown in Fig. 17.

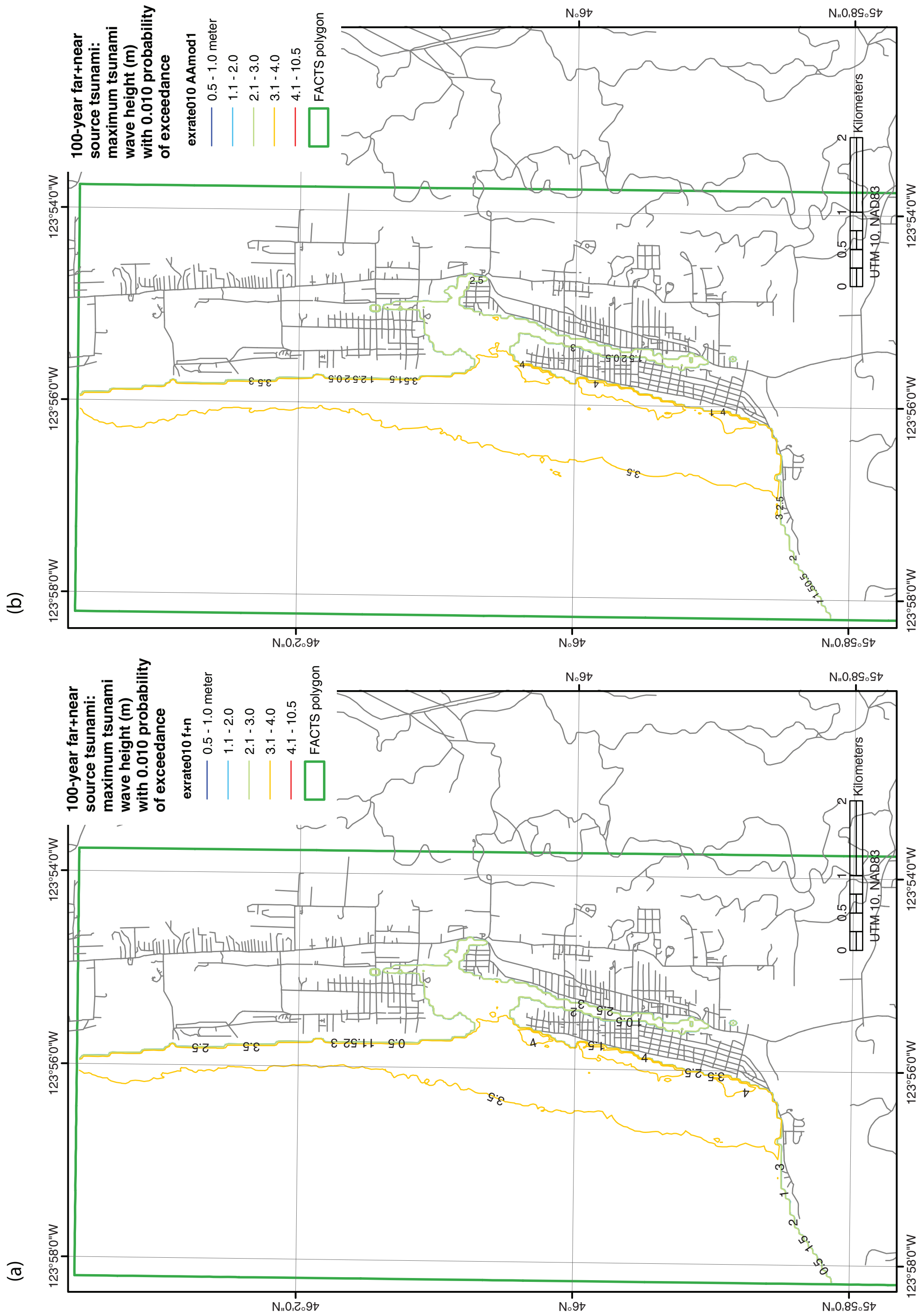

Figure 30: Comparison of (a) the 100-year tsunami map shown in Fig. 29 with (b) a similar map in which only Model 1 for Aleutian-Alaska earthquakes is used.

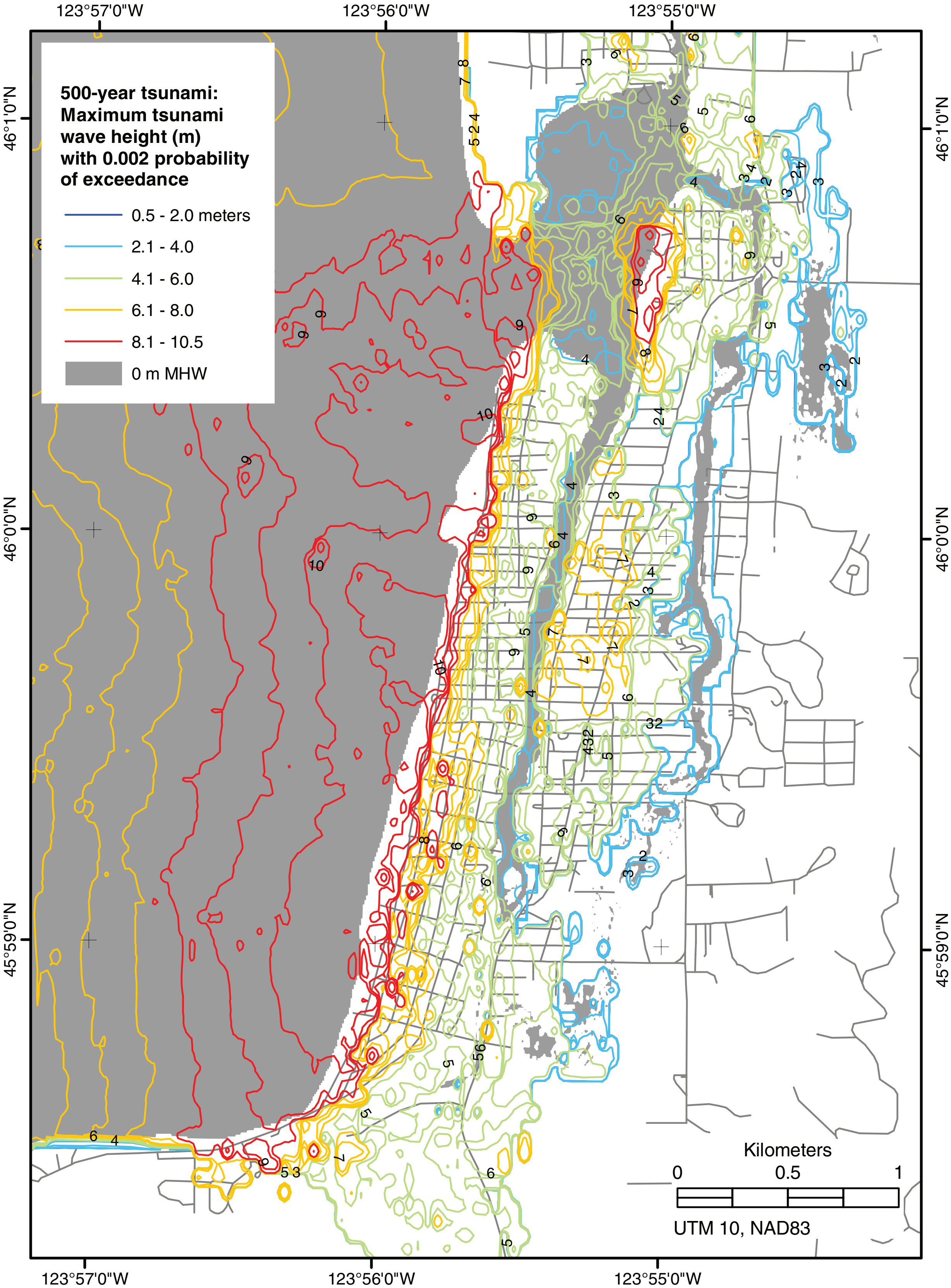

Figure 31: Tsunami wave heights (m) with a 0.2% annual probability of exceedance. Wave heights include the effects of tides.

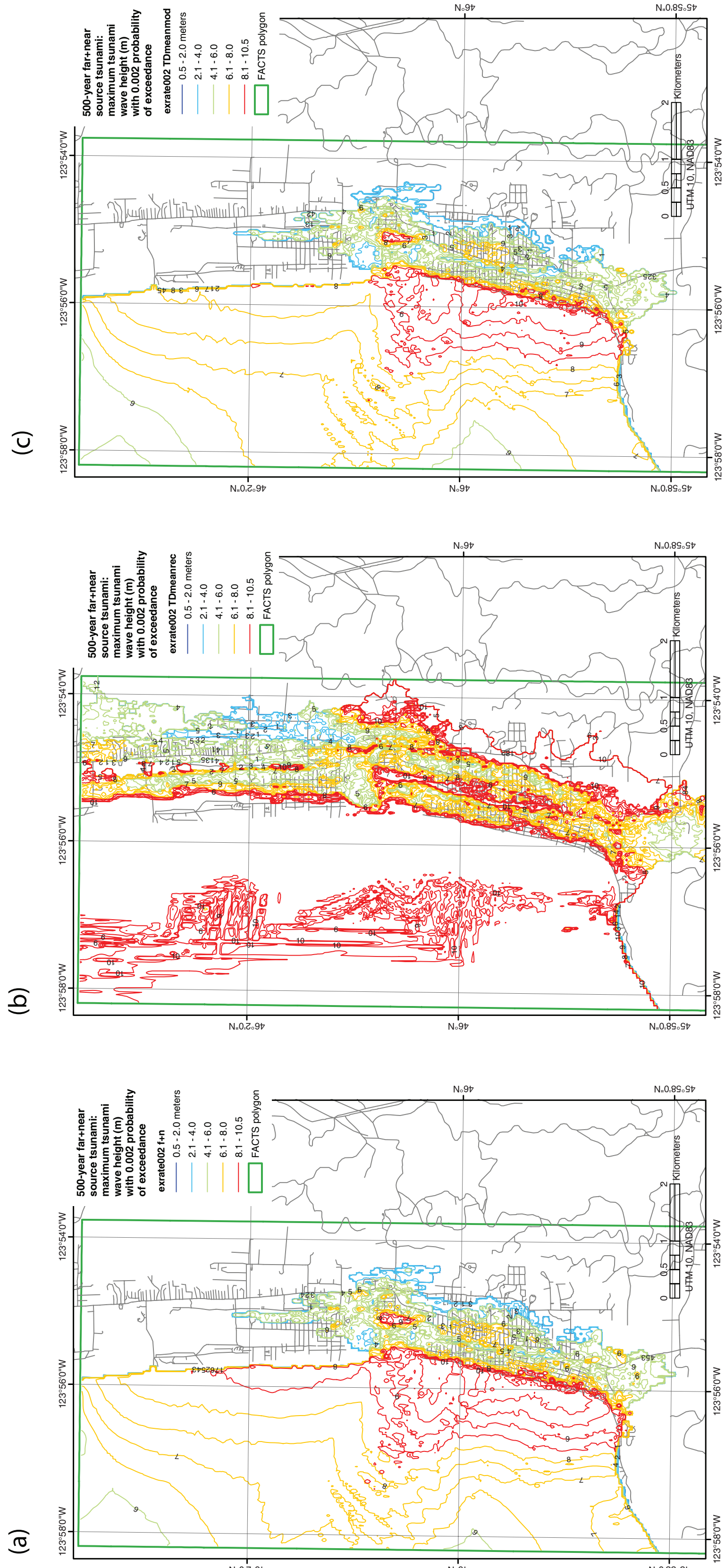

Figure 32: Effect of mean inter-event time for Cascadia Subduction Zone earthquakes on 500-year tsunami map. (a) Map shown in Fig. 31. (b) Map using a mean inter-event time less than 500 years (477 years). (c) Map using a mean inter-event time of 610 years (see Fig. 17).

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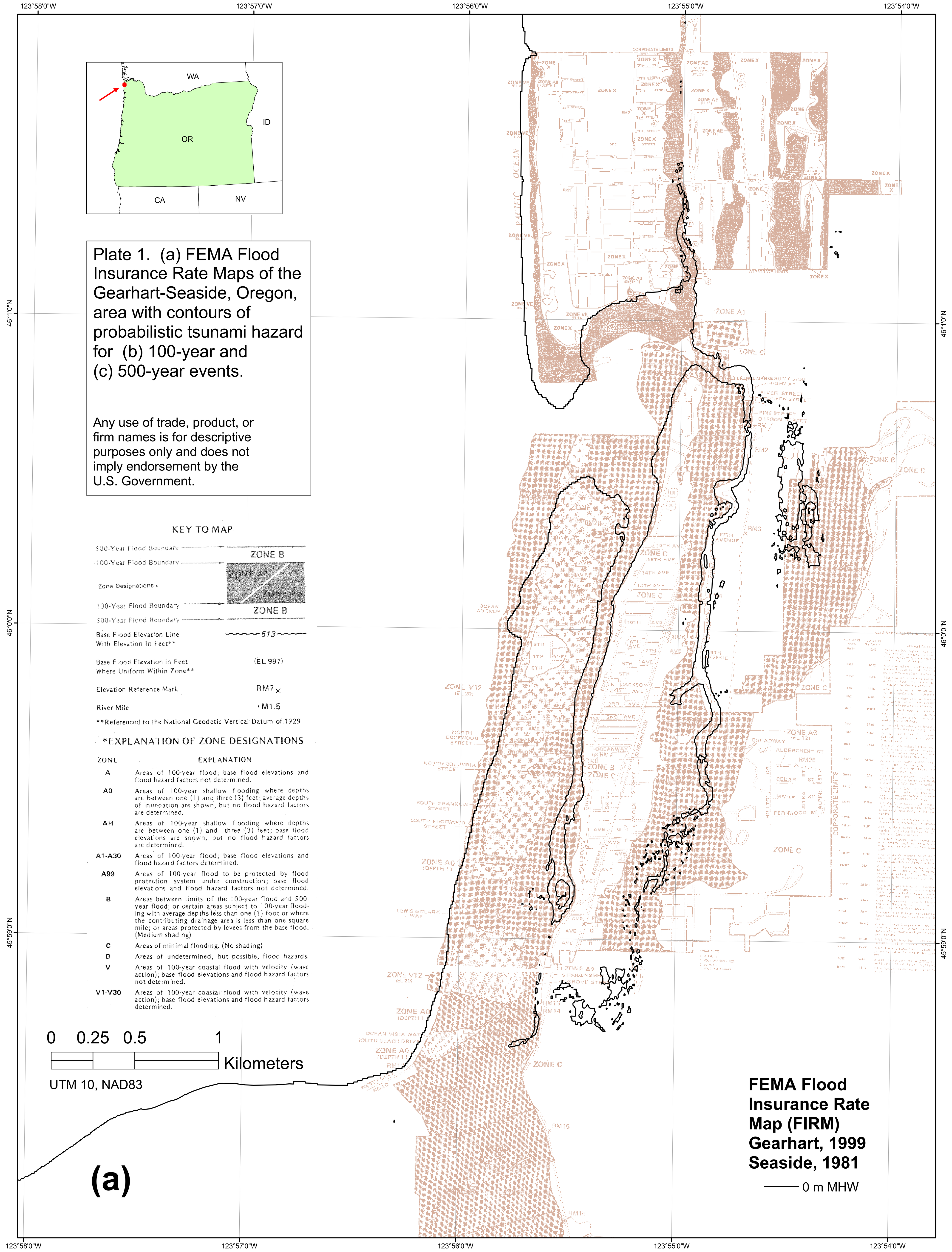
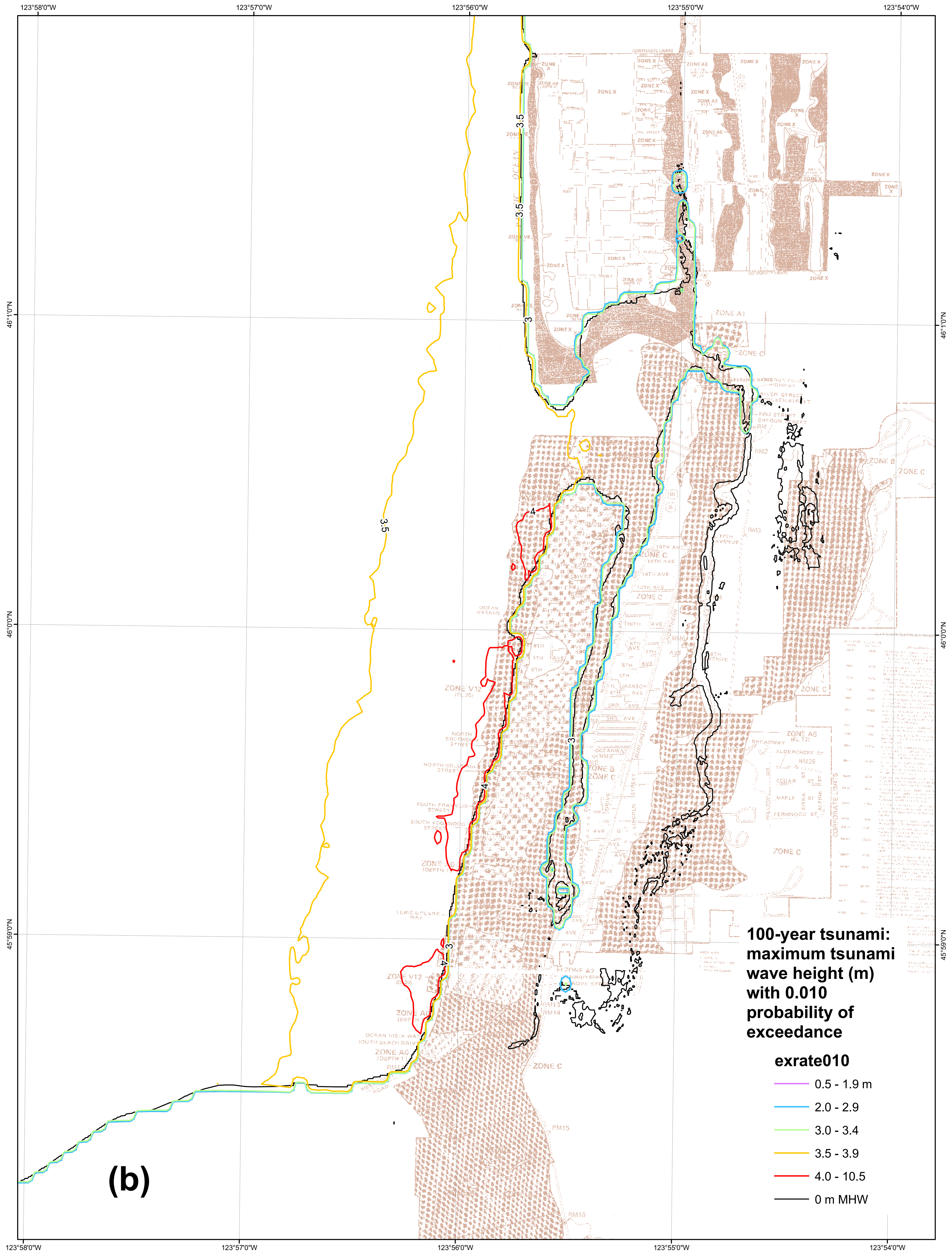
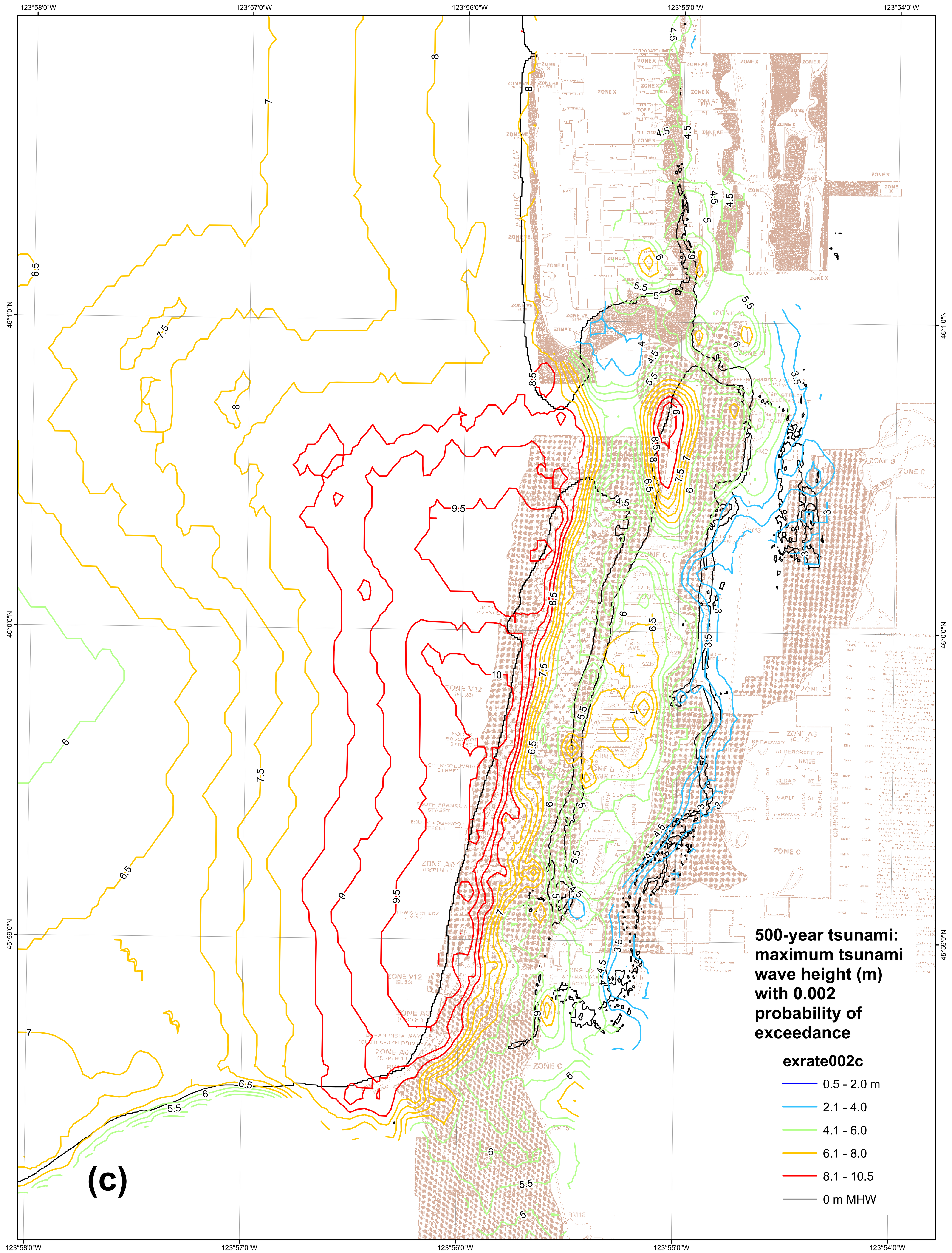
Plate 1.

Plate 1. (a) FEMA Flood Insurance Rate Maps of the Gearhart-Seaside, Oregon, area with contours of probabilistic tsunami hazard for (b) 100-year and (c) 500-year events.







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