# American Samoa Seismic Hazard Deaggregations

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The deaggregations of seismic hazard at sites in Samoa and neighboring islands using the latest probabilistic seismic-hazard model of the National Seismic Hazard Mapping Project (NSHMP) may be performed at URL (to be supplied). The seismic hazard model post-dates the model presented in Petersen and others (2012). Some deaggregation results at a site in Pago Pago are included in this folder. We consider peak ground acceleration (PGA), and 0.2-s and 1.0-s spectral accelerations.

Deaggregation of seismic hazard partitions the earthquake sources into bins. Within each bin, the range of important parameters, such as distance, magnitude, azimuth, or epsilon (parameter on ground-motion uncertainty), is kept small. The results are often presented as tables and as graphs. Two main kinds of deaggregations are routinely performed, although others have been considered. The first kind is in magnitude, distance, and epsilon (e.g., Harmsen and others, 1999). The second kind is in azimuth, distance, and magnitude (Bazurro and Cornell, 1999; Harmsen and Frankel, 2001). Azimuth is the site-to-source azimuth.

This folder shows graphs of these two types of deaggregations at a site at Pago Pago, Tutuila, and at sites in Suva City, Fiji, and Nuku`alofa, Tonga, using the latest NSHMP PSHA model. These graphs are four dimensional, with X,Y, Z (height), and color representing these dimensions. Height is always a measure of the contribution of this bin's sources to the total hazard at the ground-motion level being considered. The tallest columns correspond to the most likely, or modal, events that contribute to the hazard (associated with the given binning scheme). The modal event is often considered a suitable choice when computing scenario events for subsequent ground-motion design studies. Other columns represent contributions from other sources.

In the magnitude, distance, epsilon graphs, epsilon0 is assigned a color. Hot colors are associated with *low* values of epsilon0. Here, epsilon0 is the value of epsilon that occurs at the specified ground motion, for the graphs at this folder, the ground motion that is associated with the 2% in 50 year probability of exceedance. Because PSHA is concerned with the exceedance of a given ground motion, the distribution of epsilon above epsilon 0 is also important. The front face of the graph shows the binned values of epsilon in one-sigma intervals. Further detail on these contributions by epsilon is found in the corresponding tables. The rationale for associating hot colors with low epsilon0 is that if one is designing to the probabilistic motion, and if the event with the specified magnitude and distance occurs, its motion will more likely be above the median value than below. If the probabilistic motion is below the median, i.e., if epsilon0 is less than zero, the design will be more challenged by the vibrations than if the design motion had been above the median. Whence, hot or "caution" colors are associated with low epsilon0. In general, consideration of more probable ground accelerations, those with a relatively large probability of exceedance, yield more and more pink, red and brown bins in the deaggregation graph. More distant and smaller earthquakes of course have cooler colors associated with them than closer and larger earthquakes. Such events tend to be less challenging to seismic resistant design.

In the distance, azimuth, magnitude graphs, average magnitude is assigned a color, following Harmsen and Frankel (2001). That is, magnitudes of all sources in each of the distance, azimuth bins are averaged, each proportional to its contribution to the hazard in that bin, and a color is assigned to the resulting average magnitude. Hot colors are associated with large magnitudes. At Pago Pago, the largest magnitude earthquake that might affect the hazard is **M**8.5 or **M**9. Such events are megathrust earthquakes in the Tonga Trench (Petersen and others, 2012). These megathrust events are important contributors to intermediate- to long-period spectral acceleration, but are of lesser importance to short-period hazard at Pago Pago. In order to present maps in 4 dimensions, we position ourselves above the Earth surface and view the map to the North (Y-dimension). The view angle is 35° above the horizon. The gray column on the left side of the map is a scale for hazard contribution, but is not an actual source. The distance scale is correct in the East-West direction, but distance is foreshortened in other directions.

Among more recently explored methods for displaying the hazardous sources is one proposed by Smith and Harmsen (2011). This method emphasizes ground motion (or return time, with probabilistic ground motion proportional to return time) and relative contributions of various sources or source categories at each of those return times. At American Samoa, the principal seismic source categories are shallow local sources, shallow outer-rise sources, Tonga-Kermedec subduction sources, and deep intraplate or Benioff sources. Such an approach helps planners and designers better understand how the different source categories are dynamically linked to return time. Our new approach to displaying the hazard should not be thought of as a replacement for more traditional deaggregations, but as a complementary approach.

Figure 1 below is a plot of hazard contributions versus return time. The left side corresponds to 1.0-s spectral acceleration at Pago Pago, American Samoa. The right side of fig. 1 corresponds to 0.2-s spectral acceleration. This figure shows the importance of local seismicity, whose relative contribution falls between the red and green curves, at all return times from 10 years to 100,000 years. Local seismicity is not as well understood at Pago Pago as we would like. In particular, no seismic networks exist in American Samoa and our understanding of local seismicity is based on regional catalogs and on smoothing techniques. Furthermore, no study of active faults on the island of Tutuila was performed for this investigation. The subduction source tends to be important at relatively short return times, and its peak contribution occurs at about 100 year return time for the 1-s period. Deep sources, because of their large distance from Pago Pago, tend to be of vanishingly low importance. The deep-source contribution is found in the band between the X-axis and the turquoise curve in fig. 1.

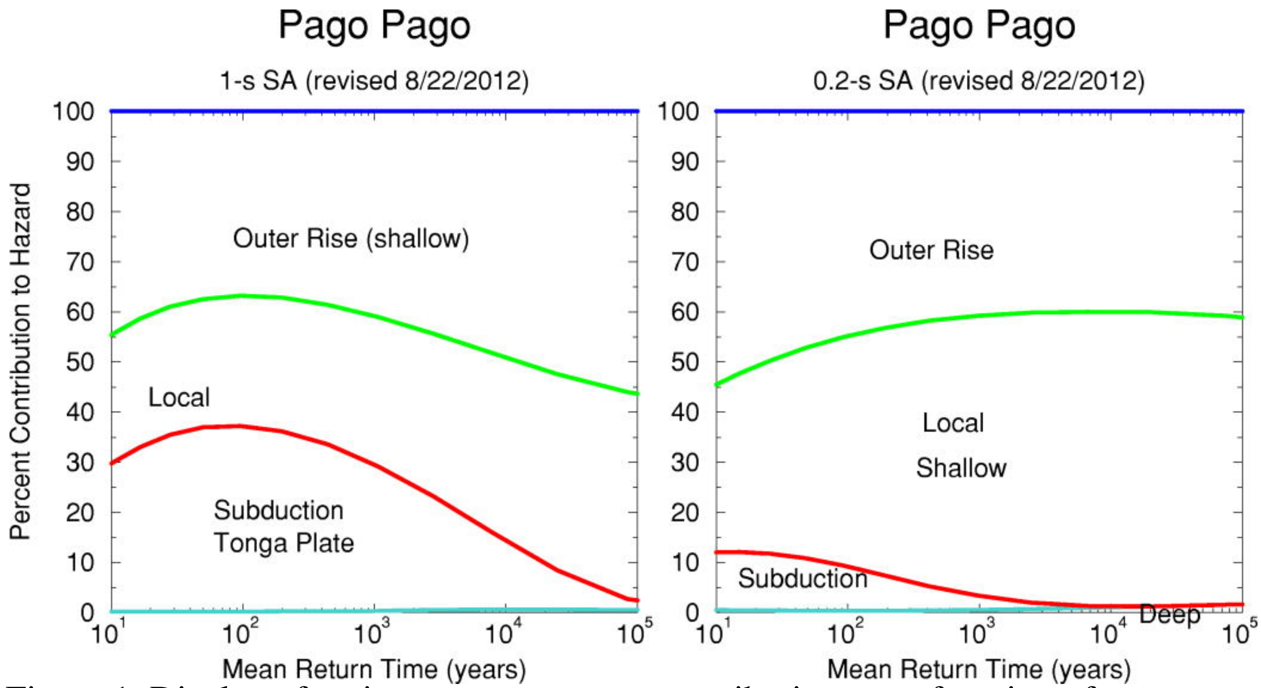


Figure 1. Display of major source category contributions as a function of mean return time. The 2% in 50 year motion has a mean return time of 2475 years.

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