

September 29, 2009 Mw 8.0 Samoa Earthquake – Preliminary Tsunami Wave Height Modeling Results

By Hong Kie Thio and Paul Somerville, URS, October 2, 2009 (updated Oct 7).

The September 29, 2009 earthquake was caused by normal (tensional) faulting of the Pacific Plate in the outer rise, east of the subduction zone between the Pacific and Australian plates, where the subducting plate bends as it starts to subduct (Figure 1). The earthquake source parameters (from Jascha Polet, personal communication), are: $M_w = 8.0$, $M_0 = 1.17 \times 10^{21}$ Nm; Strike = 138.7° , Dip = 40° , Rake = -90° , Fault length = 125 km; Fault width = 40 km; Centroid depth = 15 km; and Average fault slip = 10 m.

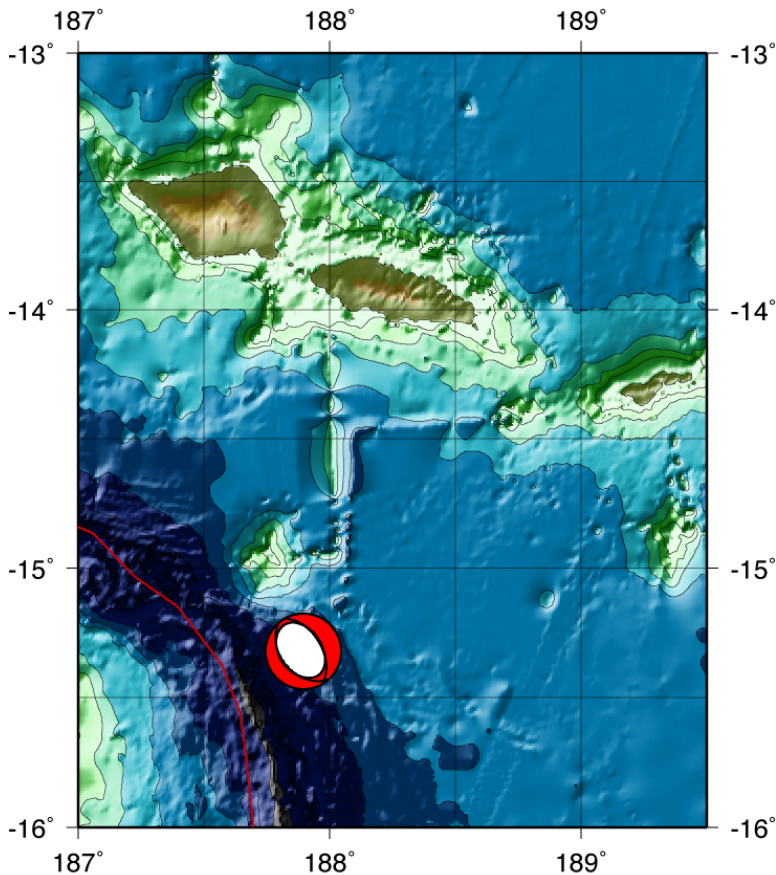


Figure 1. Map of the plate boundary region between the Pacific and Australian plates, showing the location and mechanism (J.Polet, pers. comm.) of the 29 September 2009 earthquake and the Samoan Islands.

These fault parameters were used to calculate the tsunami wave field throughout the region. The maximum wave heights for the Samoan Islands are shown in Figures 2 through 7. The bottom part of Figure 8 shows a comparison between the tide gauge recording at Pago Pago and Apia with the tsunami waveform calculated using the earthquake source model, showing good agreement. We are waiting for more data on measured tsunami wave heights in the Samoan Islands to make a more extensive comparison between calculated and recorded wave heights. Meanwhile, Figures 2 through 7 provide a guide for emergency response and reconnaissance teams in the Samoan Islands.

Samoa tsunami simulation (max waveheight - first 2 hours)

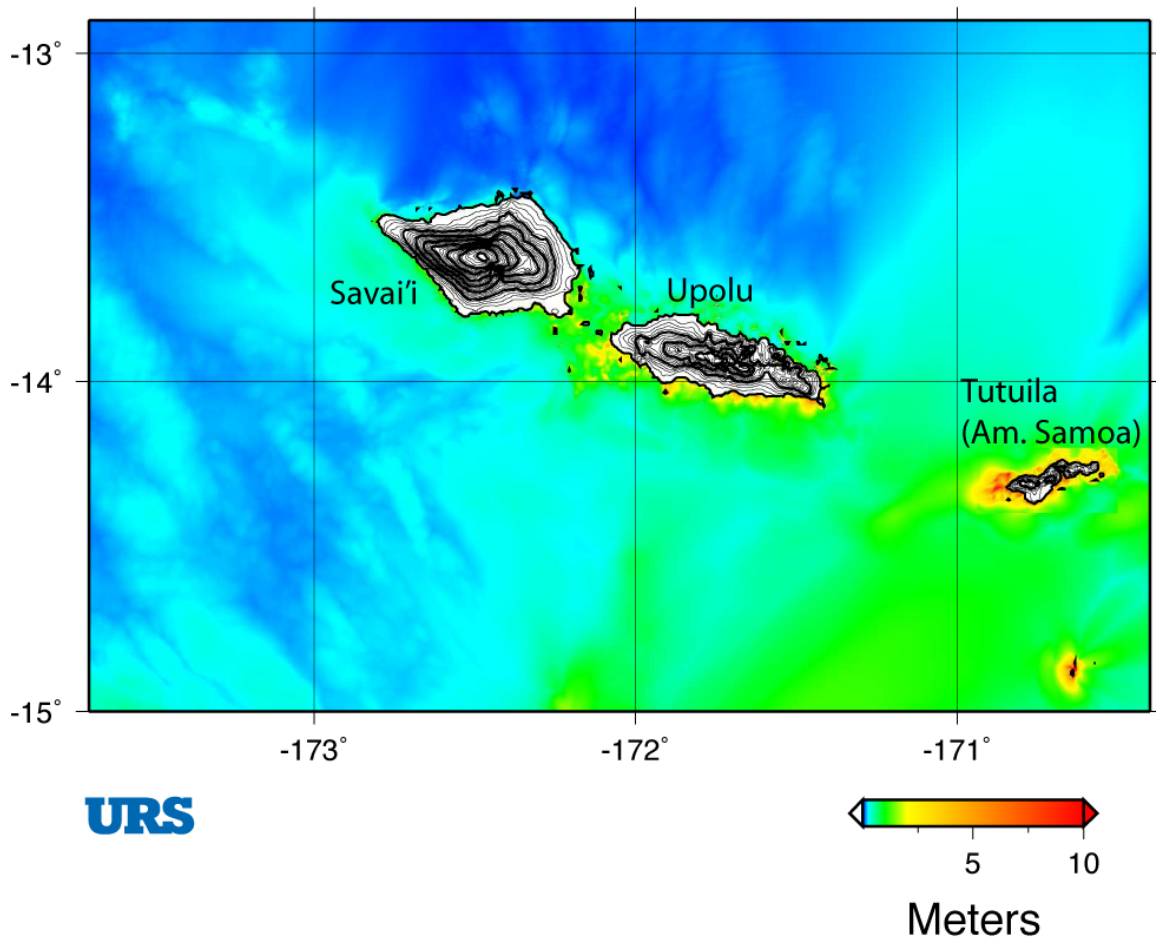


Figure 2. Maximum waveheights in Samoa and American Samoa.

Samoa tsunami simulation (max waveheight - first 2 hours)

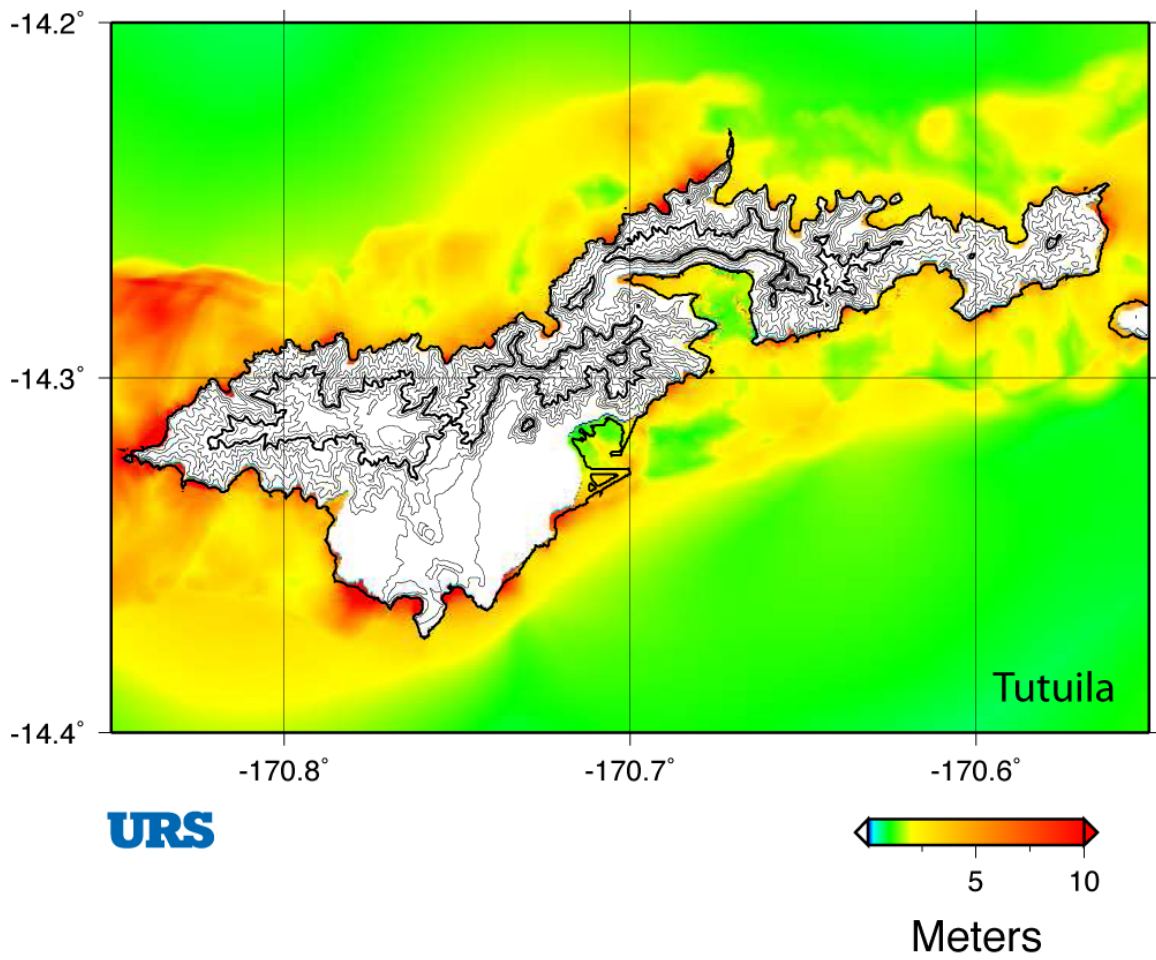


Figure 3. Detailed map of American Samoa (Tutuila).

Samoa tsunami simulation (max waveheight - first 2 hours)

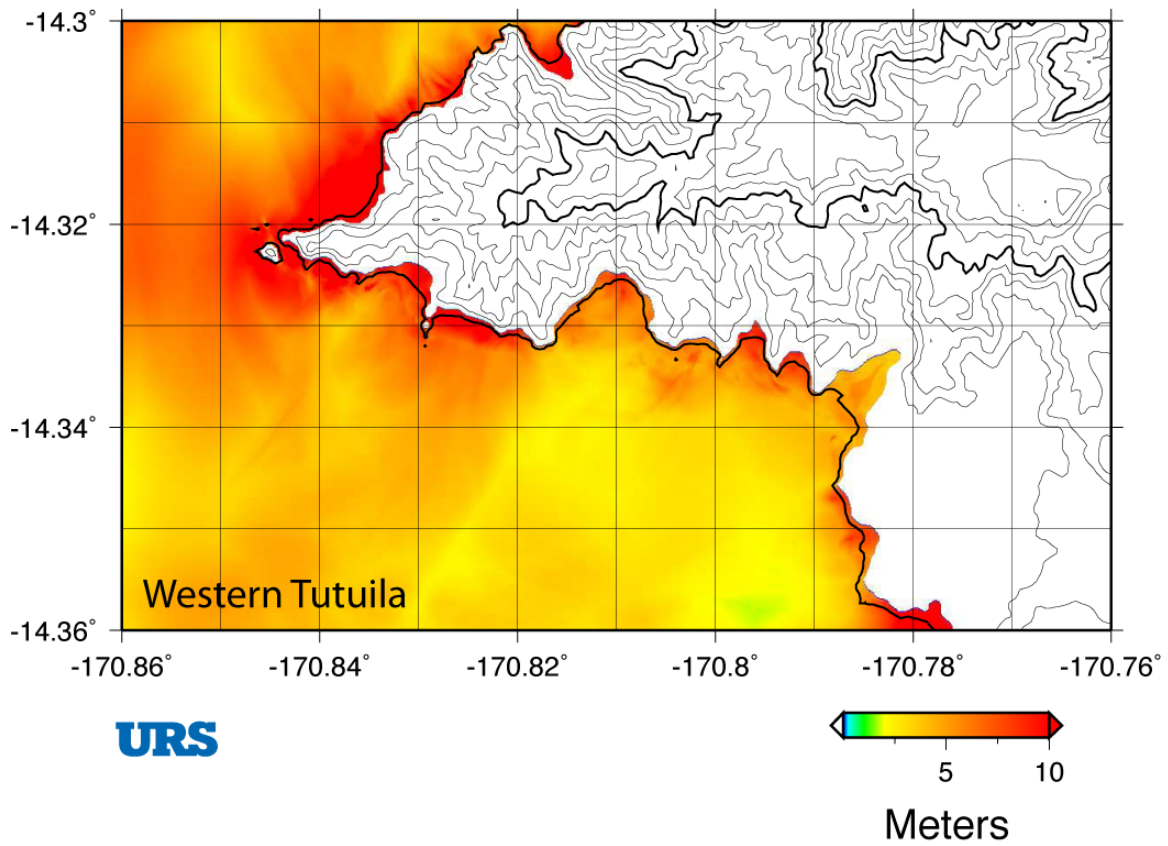


Figure 4. Detailed map of the maximum waveheights in western Tutuila.

Samoa tsunami simulation
(max waveheight - first 2 hours)

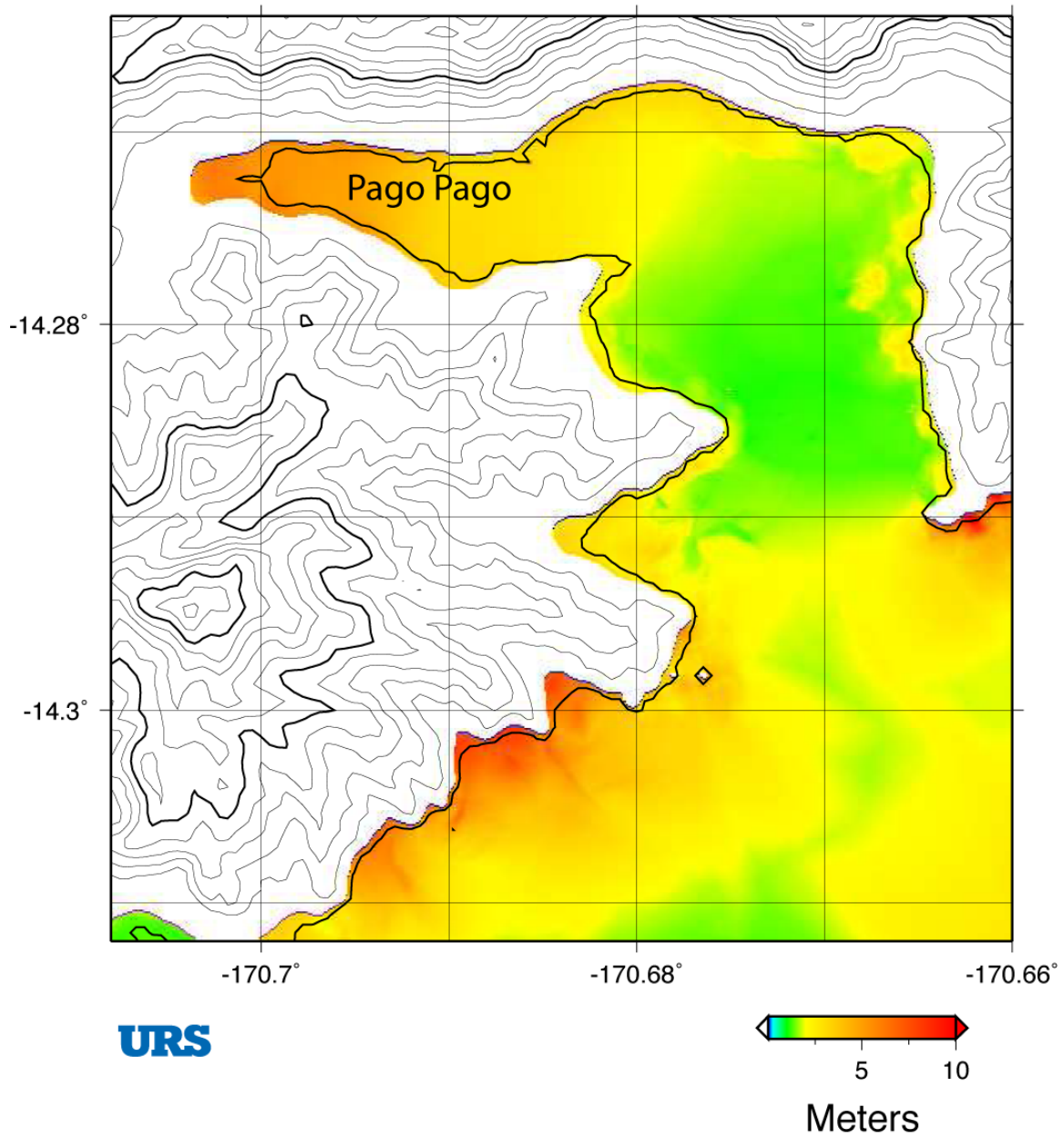


Figure 5. Detailed map of maximum waveheights around Pago Pago.

Samoa tsunami simulation (max waveheight - first 2 hours)

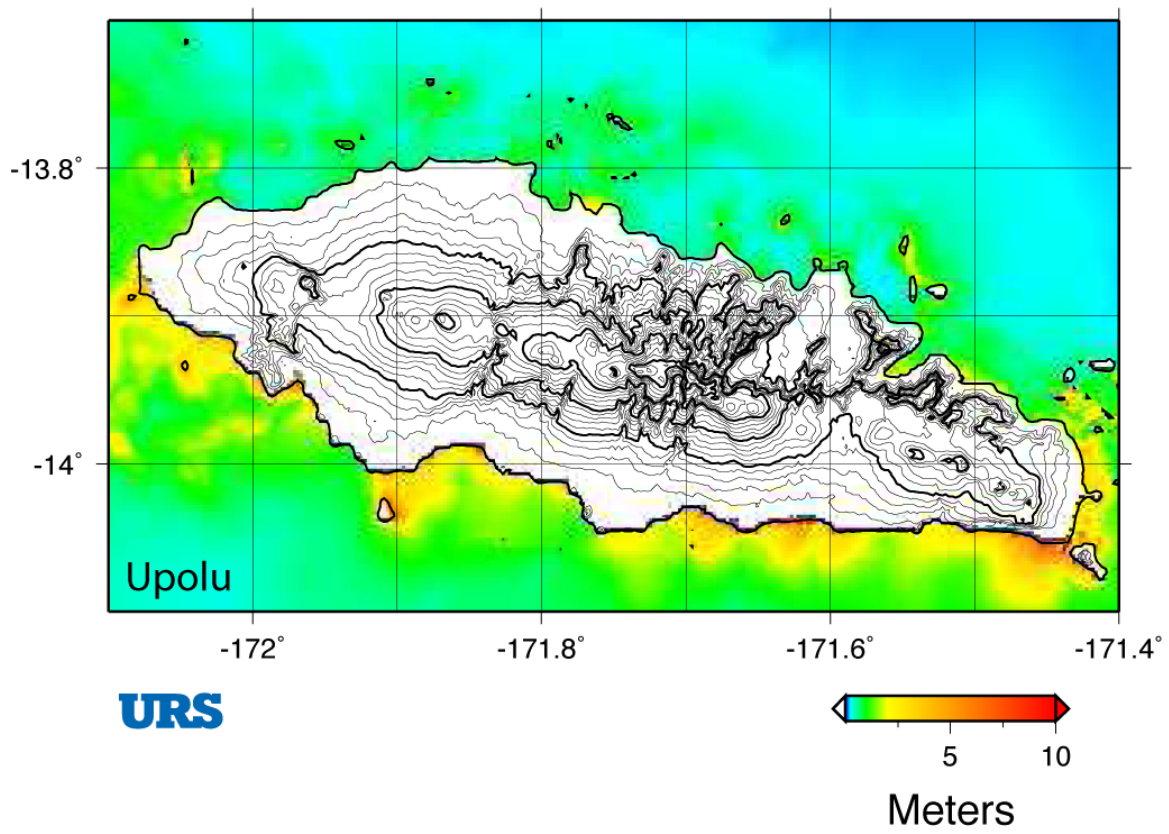


Figure 6. Detailed map of Samoa, Upolu Island.

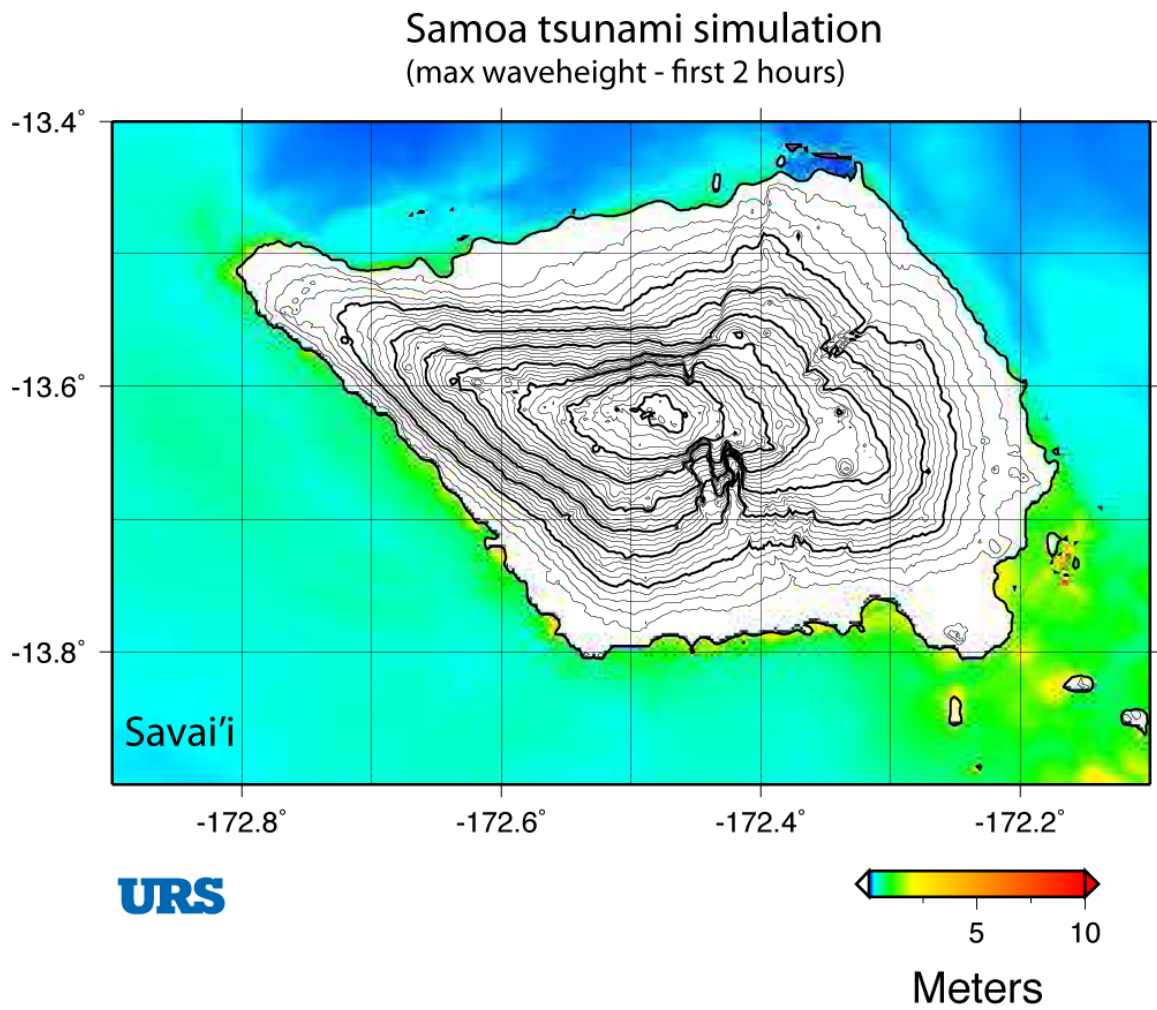


Figure 7. Detailed map of Samoa, Savai'i island.

20090929 Samoa tsunami - tide gauge records (red - observed, black - model)

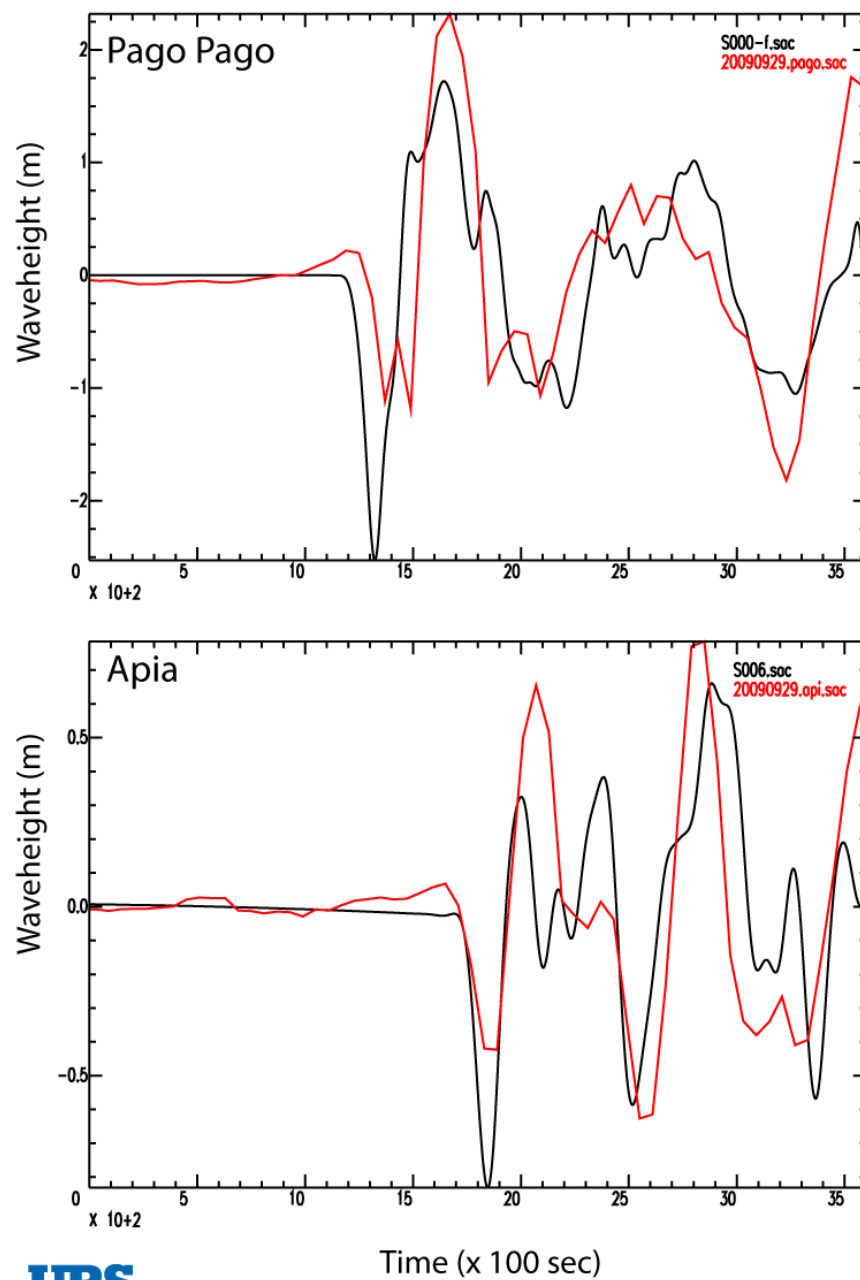


Figure 8. Tide gauge recordings (red) and model simulations (black) at Pago Pago (American Samoa), top, and Apia, Upolu Island, Samoa, bottom. The data have been low-pass filtered to remove the tidal component. The Apia data have been shifted in time by 4 minutes.

Technical details:

Tsunami modeled using nested staggered grid non-linear finite difference algorithm.

Bathymetry merged from two data sets: SRTM30+ global digital elevation model and 1/3 arcsec (~10 m) grid of American Samoa from the NOAA Tsunami Inundation Gridding Project.

Grid spacing:

Samoa: 8 arcsec (~250 m)

American Samoa: 1.6 arcsec (~50m)

W Tutuila and Pago Pago: .32 arcsec (~10m)

Source mechanism, centroid and moment information from Dr. Jascha Polet (Cal Poly Pomona):

M_w	Lat	Lon	Dep	Str/Dip/Slip
8.0	-15.321	-172.104	15.0 (30.)	-30.2/50/-82