INPUT FOR 6/14/2006 SCIENCE ADVISORY WORKING GROUP MEETING

Charles Mader

All the tsunami modeling numerical techniques currently used by NOAA, Cornell, Universities of California, Washington, Alaska, and Hawaii, or WCATWC assume that the flow is described by the shallow water equations or a minor variation of them. While the model can approximately describe an initial tsunami wave propagation across deep ocean basins if the tsunami period is large (~ 15-30 min), the numerical techniques can not model tsunami inundation within a factor of 2. Realistic source models are not available and even if the source is known, the shallow water model can not model the tsunami wave generated by the source within a factor of 2 to 10. A calculation from source to run-up and flooding often has a factor of 10 errors.

The 1946 modeling results obtained by the UH study have large error bars similar to all the other similar studies in the technical literature including those of this writer as documented in the monograph *Numerical Modeling of Water Waves (NMWW), CRC Press 2004.* The UH team had to increase the source magnitude of the 1946 event from the observed 7.5 to 8.4 to obtain inundations similar to those observed for the 1946 event. This means that they had to have NINE 7.5 magnitude earthquakes to compensate for the many errors characteristic of all shallow water model calculations.

The many sources of errors are documented in *NMWW.* For example, Fig 3.12 and 3.15 show greater than factors of two errors are present for wave shoaling and for flow over underwater barriers or topography like reefs, shoreline roads, etc. The effects of bottom friction, trees, buildings introduces another factor of 2 to 10 uncertainty.
On the bottom of page 196 the following is concluded.

" One of the more important water wave problems is the determination of Civil Defense evacuation zones for tsunamis. As shown in this chapter the shallow water model is inadequate for the task"

The only scientifically valid method for determination of tsunami evacuation zones is to examine historical records such as those of the recent Indian Ocean tsunami. Hermann Fritz who studied the Indian Ocean tsunami and its effects on Somali which is about as far away from the source as Hawaii would be from a M9+ event along the Pacific Rim suggests the following criteria:

1. Evacuation should occur for all areas that are below 15 meters above sea level and within 0.25 mile of the shoreline or along rivers.
2. Evacuation should occur for all areas that are below 10 meters above sea level and within 1.0 mile of the shoreline or along rivers.
3. Evacuation should occur for all areas that are below 5 meters and within 3 miles of the shoreline or along rivers.

Or one can use the Hawaii historical data base where maximum run-up heights of over 16 meters (ie 1946, Waikolu Valley) has been observed at distances of up to a mile (ie 1946 Waipio Valley) to justify the original Doak Cox and George P.C. choice to evacuate areas less than 50 feet below sea level and near the shore line (where it made sense).