# Are Seismic Hazard Predictions Effective?

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***Introduction:*** The **G**lobal **S**eismic **H**azard **A**ssessment **P**rogram began at the request of the U.N. in 1992 and was completed in 1999. The goal was to standardize the methods by which hazard was quantified internationally with the end result of a gridded global map of seismic hazard based on a 10% chance of exceedance in 50 years for Peak Ground Acceleration (pga). This project seeks to determine the accuracy with which GSHAP has predicted major, damaging earthquakes.

***Methods:*** Locations, dates and magnitudes of major earthquakes (earthquakes of Magnitude 7 or greater) since December 2004 were compiled from the USGS Catalog of past earthquakes and plotted over GSHAP data[1]. These earthquakes were sorted according to predicted pga. A cutoff point of pga less than 2.4 $m/s^2$ was used to define areas at significant hazard. Damage reports for each earthquake were compiled from the Emergency Database (EMDAT)[2]. I then looked into Seismic Gap Prediction to find how it could supplement the data given by GSHAP.

*Fig. 1: Large (mag>7) earthquakes of the past 5 years over GSHAP Grid*

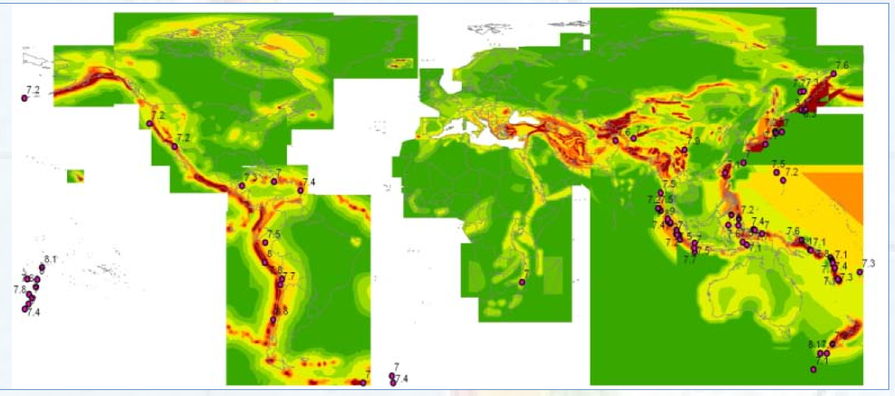
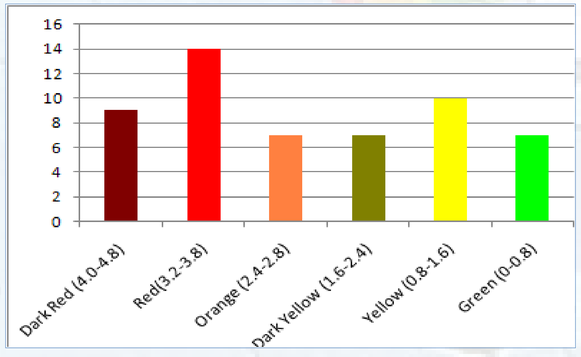


*Fig. 2: Where earthquakes occurred by predicted pga*




[1]Giardini, D., Grünthal, G., Shedlock, K. M., and Zhang, P.: 1999, The GSHAP global seismic hazardmap, Ann. Geofis. 42(6), 1225–1230.

*Fig. 3: The largest earthquakes do not occur in areas at the highest predicted risk*

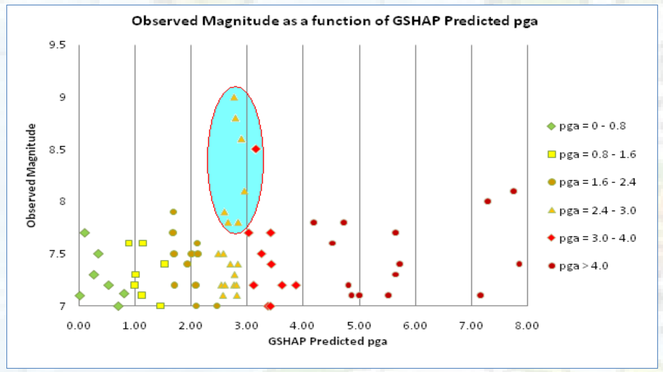



*Fig. 4: Unpredicted quakes have caused more total deaths since December 2004*

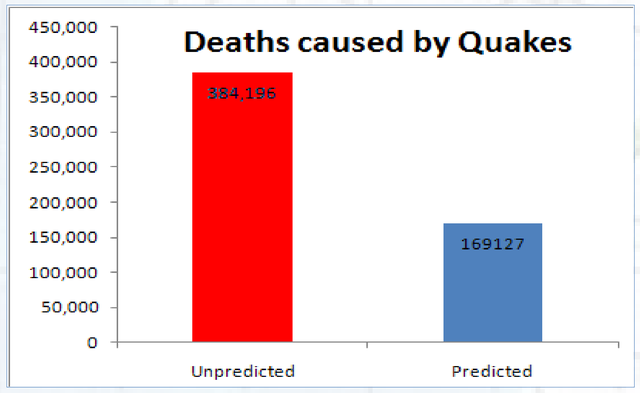
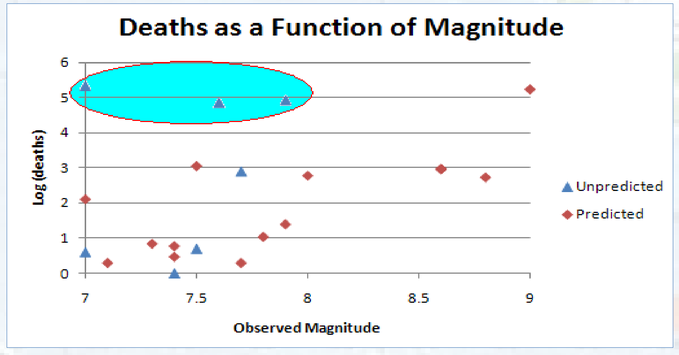



*Fig 5: While GSHAP predicted pga accurately forecast the four largest earthquakes, it missed three of the four earthquakes that killed the most people.*




[2] EM-DAT: The OFDA/CRED International Disaster Database – www.emdat.net – Université catholique de Louvain – Brussels – Belgium.

*Fig 6; McCann et al,. (1979)[4] identified a gap at the location of the 1/12/2010 Haiti earthquake, but did not accurately constrain the timescale of the earthquakes. This was a region not predicted to be at risk by GSHAP.*

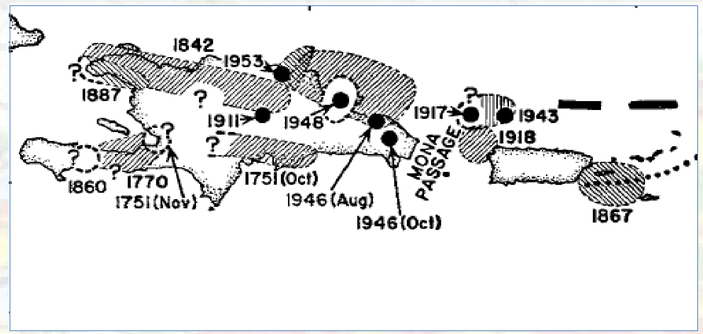
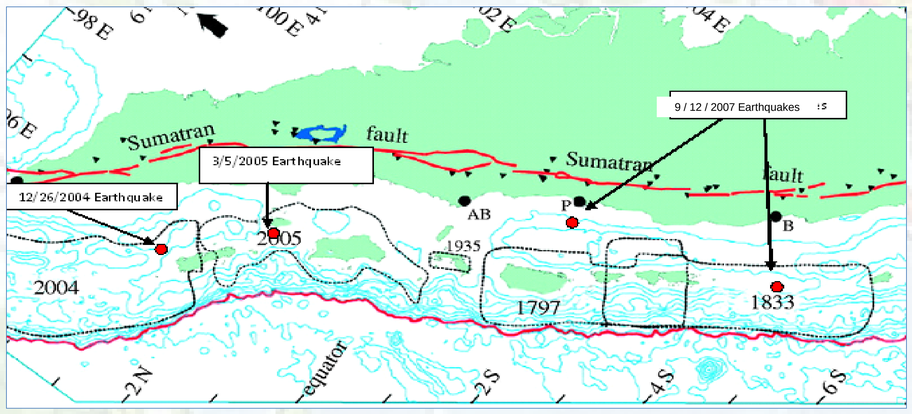



*Fig. 7: Sieh (2006)[3] accurately predicted the locations of the 9/12/2007 Earthquakes. These were in a region predicted to be at moderate risk.*




***Conclusion:*** Because of how GSHAP data was created, it is unable to predict earthquakes that have a large recurrence time. 44% of the major earthquakes in the past 5 years did not occur in places designated as at risk. While the GSHAP advanced hazard analysis, its methods alone are not sufficient to prepare for hazard. Sieh's analysis of Indonesia's seismic history provides a template for the work that should be done in other regions that have been historically known to be at risk, such as Haiti and the Himalayan front, even though there are no records of recent, recorded seismicity.

[3]Sieh K *2006.* Sumatran megathrust earthquakes—from science to saving lives. Phil. Trans. R. Soc. A. 364, 1947–1963.

[4] McCann et al., 1979. W.R. McCann, S.P. Nishenko, L.R. Sykes and J. Krause , Seismic gaps and plate tectonics: seismic potential for major boundaries. *PAGEOPH* **117** (1979), pp. 1082–1147.