PROBABILISTIC SEISMIC HAZARD (PSHA): AN INVESTIGATION INTO A GPS BASED ALTERNATIVE

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The concepts of Probabilistic Seismic Hazard Analysis (PSHA) were developed in the late 1960's and computer implementation was done in the 1970's. While still an important tool in hazard computations it is now also accompanied by other tools. The use of satellite based data is increasingly important in all sciences, and this includes also solid earth sciences and specifically seismology. In recognition of the limitations of traditional Probabilistic Seismic Hazard Analysis (PSHA) we have explored the use of strain data, derived from GPS measurements and earthquake focal mechanisms, for constraining earthquake recurrence of large earthquakes within and along the western Himalaya arc. We have applied the Kostrov formulas for transforming strain to Seismic Moment and slip on presumed major rupture areas simulating the main Himalayan faults. Our preliminary results apply a number of assumptions in addition to a simple interpretation of the newly available strain data, in which all accumulated strains must be released in coseismic slip. The results indicate for some segments along the Himalaya arc a reasonable correlation with historical earthquake activity, while other segments seem characterized by a significant amount of yet unreleased earthquake slip, i.e. a situation that can be interpreted as predicting a great potential for large future earthquakes on these segments.

Earthquake hazard estimation was started by engineers, and for good reasons. It reflected the practical need for a sound design basis, and as such PSHA should be recognized as a practical engineering tool needed by the society. However, in a situation where the earthquake catalogues do not fulfil the requirements of the applied statistical methods the question arises if there are alternative data sources that can be exploited toward the same goal: Groundmotion estimation at given probabilities. More specific: Which other data can be used to constrain earthquake activity rates in a given smaller region? "Smaller", because nearly always in practical applications the large scale regional or global maps fail their goal of adequate precision needed in a design phase.

The use of fault structures is evident, but only few faults reach the surface (most are blind faults), and of the surface structures only few can be well quantified in terms of earthquake recurrence. Finally, for faults breaking the surface the recurrence quantification remains highly uncertain (see e.g. Atakan et al., 2000). The alternative now comes through the steadily increasing data flow from remote sensing: in our case GPS monitoring.

The permanent and time-limited GPS measurements yield precise information of long term, short term, regional and local deformations on the surface. With given assumptions and proper data processing these velocity vectors can also be translated into crustal strain values, and strain maps are now developed on global and regional scales, however, until now mainly in tectonically active regions. The possibly first Global Strain Rate Map (GSRM) was compiled by Kreemer et al., (2003), which was later used by Bird et al., (2010) for compiling a global long-term earthquake forecast model. Recently, Corné Kreemer and colleagues have established an updated Global Strain Rate Map under the GEM auspices (http://www.globalquakemodel.org/what/seismic-hazard/strain-rate-model/). This model is now available interactively for active plate margins and the results for India and southeastern Eurasia is shown in Figure 1.

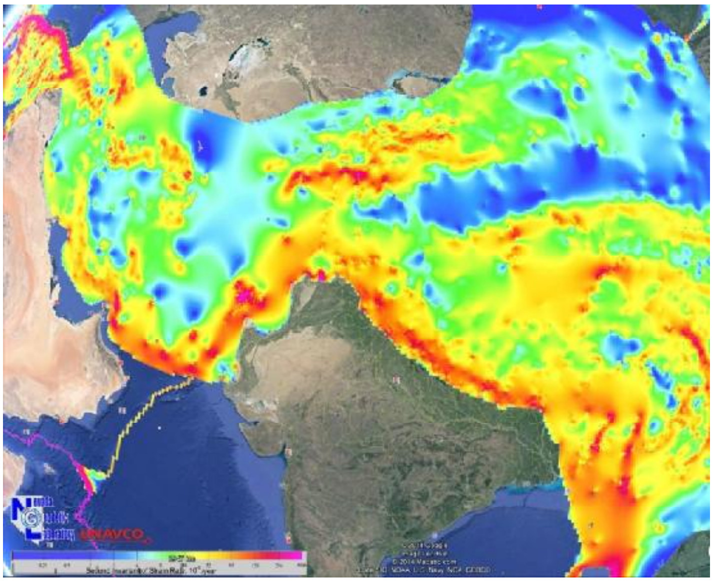

Figure 1. GSRM strain rate for SE Asia (http://gsrm2.unavco.org/model/model.html) developed under a GEM joint project by C. Kreemer

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