RISK ANALYSIS OF EARTHQUAKES IN TURKEY

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Risk

Risk, different to hazard, takes into account the consequences of an event as well as the probability of occurrence. In this case the consequence was determined from the local population in that area. So a rural area with a high hazard may have a lower risk than a city with a low hazard.

Hazard

The hazard relates purely the probability of an event occurrence. Areas with high hazard are more likely to experience a large magnitude event. In this case the hazard is determined by predicting the magnitude of event for a given return period. Where a return period is the average time between two earthquake events that exceed a set magnitude threshold.

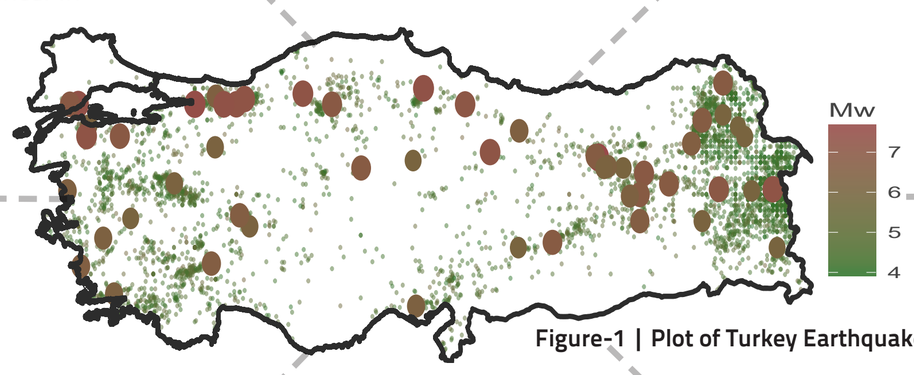

Figure-1 | Plot of Turkey Earthquakes

The risk map is produced from the hazard map but with an additonal factor for the population density in that area. Proportionally, areas with higher risk equate to more lives lost and a higher economic damage. It is estimated that globally over 300,000 people lost their lives to earthquakes between 1980-2008 and c.$350 billion USD worth of economic damage occured in the same period.

A number of distributions were suggested in the literature to describe earthquake occurrences. They were tested on the Turkey dataset and results compared. In sparser, more local datasets, some distributions were very inaccurate and so discarded from further testing. A number of distributions performed well and so a superior distribution could not be determined.

Risk Map and Implications

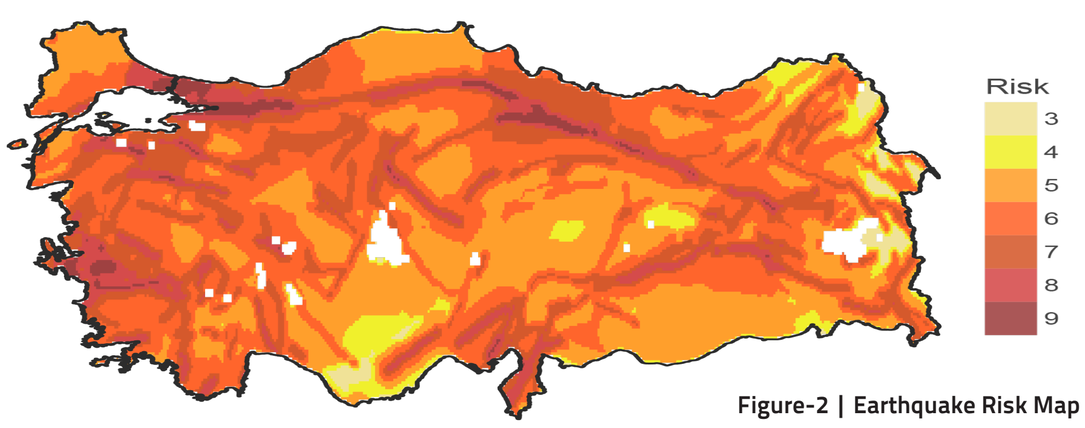

Figure-2 | Earthquake Risk Map

The risk map highlights the areas with greatest need for investment and infrastructure to mitigate earthquake occurrances. Correct government planning, with respect to number of hospitals, aid locations etc. can be better informed. An area of high-risk is the major city of Istanbul, with the highest population of c.14 million this is a region that will require substantial aid and financial support if a major event was to occur.

Hazard Map and Implications

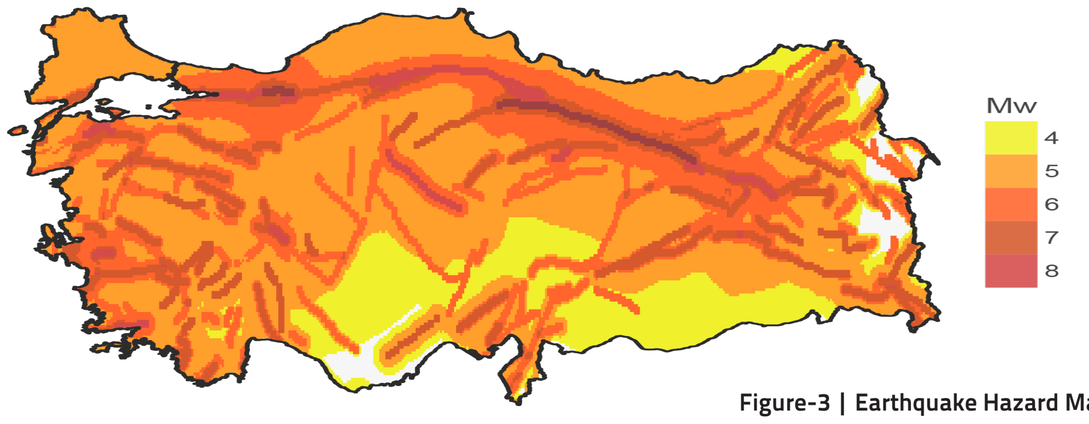

Figure-3 | Earthquake Hazard Map

Significant industry should be constructed away from the zones of high-hazard to ensure little damage occurs to the economy from an event. Major cities, such as Istanbul are unable to re-locate, and only mitigation schemes are possible, such as purchasing insurance and improving building standards. However, emerging industries have greater manoeuvrability with regards to location as does planned infrastructure and should be planned accordingly.

Risk Sensitivity

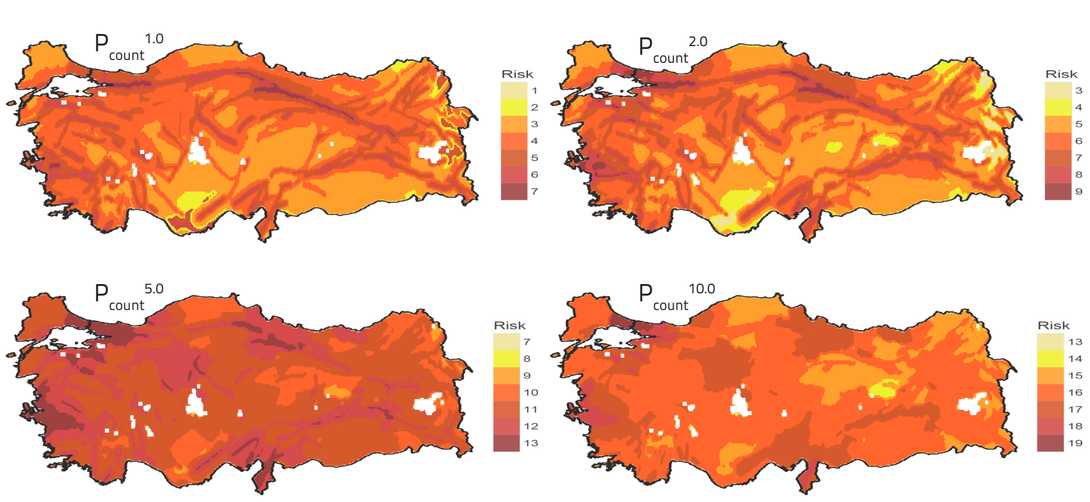

Figure-4 | Risk Sensitivity Analysis

The risk map is subject to the proportion of consequence vs. hazard. This map is solely based on population density, an area of further study that would beneficial is relating the population density to the number of human casualties. In this case P^{1}_{count} has a low population proportion and P^{10}_{count} a high one compared to predicted hazard. This, however, is regional as local building codes and resident occupations will determine the consequences of an event in an area.

Hazard Sensitivity

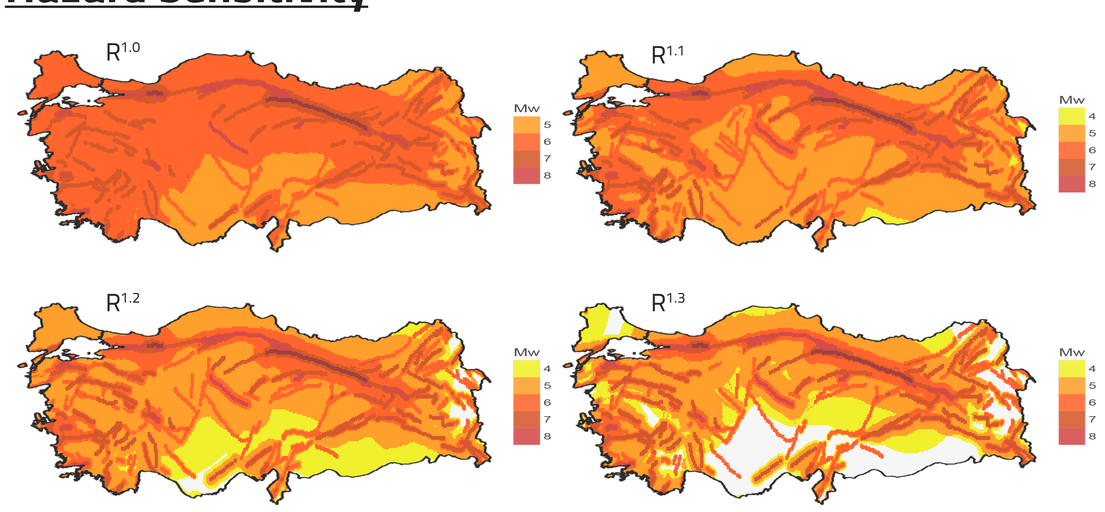

Figure-5 | Dissipation Sensitivity Analysis

From the sensitivity analysis, there are a number of factors that affect the hazard map creation. The most prevalent is an estimation of topographical earthquake attenuation, in the above figure the slowest energy dissipation is $R^{1.0}$ and the fastest $R^{1.3}$. This varies on a regional basis dependent on the local landscape. Further research and improved regional estimation is required to reduce uncertainty in the hazard map.