

A Catalog of Nepal Himalaya Earthquakes from 1255 to 2012

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1 Introduction

A complete earthquake catalog is desirable for the purpose of quantification of seismic hazard and understanding risk. A seismic risk assessment done without a complete catalog is always susceptible to questionable conclusions. The past seismicity not only indicates where destructive earthquakes occurred but it also gives a statistical basis to analyze the prediction of future ground motions probabilistically. An attempt has been made to compile all available earthquake events (historical and instrumental) in the Nepal Himalaya in order to produce a complete catalog of earthquakes in context to contribute for the seismic hazard studies of Nepal.

The earthquake events from available published sources for the area between 20° to 35° N and 78° to 92° E is taken for the preparation of a catalog. For completeness of earthquake data from different sources, the earthquake catalog is divided into: Historic catalog (1255-1910) and Instrumental catalog (1911-2012). Historical catalog consists of historical earthquakes taken from different reports and literatures. In this catalog, magnitude is estimated from different reported intensities using appropriate empirical relations. Instrumental catalog used in this work consists of earthquakes reported by International Seismological Centre (ISC).

The collected earthquake data consists of different magnitude scales and intensities which are finally converted into moment magnitude in order to keep uniformity in completeness by using the empirical relationships given by Johnston, A.C. (1996b) and E.M. Scordilis (2006). As the available earthquake data consists of shock, main shock and aftershock, it is difficult to separate main shock from background event. Hence, after converting reported magnitude (M_s or M_b) and intensity into moment magnitude (M_w), all the dependent events (shock and after-shock) were removed by the windowing procedure based on Gardner and Knopoff's algorithm (1974).

The residual catalog obtained after declustering the dependent events, containing independent earthquakes was finally prepared. The earthquake distribution map of complete catalog is shown in figure 1. The earthquake catalog is prepared neglecting magnitude less than 4 because earthquakes with magnitude less than 4 contributes very less in seismic hazard assessment. In this work a total of 2275 main shocks are presented for the period of 1255 to 2012 A. D.

It is examined that the prepared earthquake catalog follows Poissonian distributions as depicted in Figure 2. In this figure the horizontal axis represents number of earthquakes per year as obtained by dividing the catalog completion duration into nearly 100 intervals in a duration of 1911 to 2012 A. D. The vertical axis represents the cumulative frequency of exceedance of number of earthquakes.

2 Completeness of Catalog

Nepal is located in one of the seismically sensitive parts of the world. There is lack of earthquake data especially for the earthquakes which occurred many years ago. For this work, we considered historical earthquakes before 1910; these earthquakes are reported in past works. Hence the earthquake data before 1910 is not expected to be complete. The ISC's instrumental record was found to be incomplete for the events before 1964; however, the catalog is complete after 1964, especially for the magnitudes of 4 or greater than 4.

As in the previous studies, the seismicity pattern was found to follow a concentrated narrow strip extending from east to west of Nepal. In this work, it is Fig. 1 Earthquake distribution map for complete earthquake catalog

observed that seismicity rate is high in northern part of Nepal.

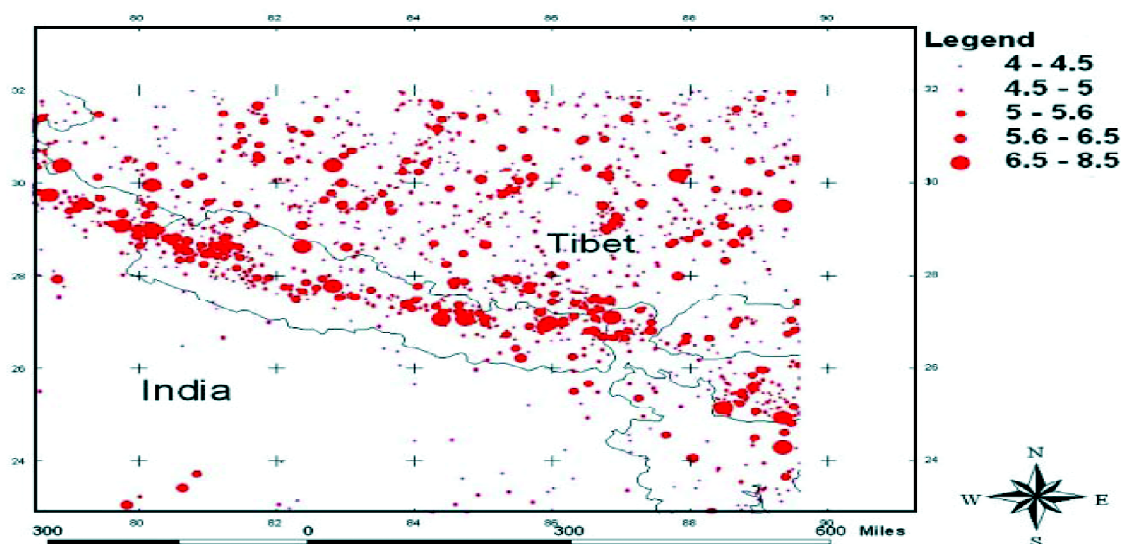


Fig1. Earthquake distribution for complete catalog consisting of different magnitudes

The earthquake occurrence data since 1964 indicates that, on an average, 48 earthquakes, with magnitude 4 or more occur per year in the study area. This can be assumed as the indicator of seismic risk of this part of the world.

3 Concluding Remarks

A catalog of Nepal Himalayan earthquakes from 1255 to 2012 is prepared. Spatially and temporally dependent events are removed by windowing procedure based on Gardner

and Knopoff's algorithm (1974). Residual catalog containing independent events is examined to follow Poissonian distributions. Finally, the earthquake distribution map is prepared and its earthquake distribution with respect to time is observed. However, the completeness of earthquake catalog before 1964 may not be shown properly due to unavailability of sufficient earthquake data, the catalog is complete for later period.

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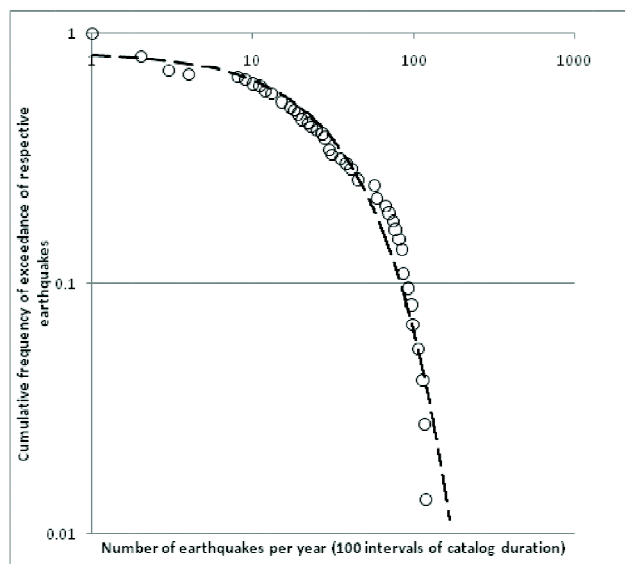


Fig 2. Cumulative frequency of earthquakes considered for the given number of earthquakes per year (dots represent the observed value and dashed lines represent the approximate exponential function; Poisson distribution)