

Abstract

Using the earthquake catalogues from China and ISC (International Seismological Centre), a uniform catalogue of Himalaya areas has been established for the seismic hazard analysis and seismic hazard map of Himalaya areas according to the following principles. 1) The earthquake parameters should be taken from China catalog if the events occurred in China. 2) The earthquake parameters should be taken from ISC catalog if the events occurred out of China. 3) The earthquake parameters should be checked if the events occurred on the China border areas based on the data of earthquake stations.

There are 17886 events with event magnitude 4.0 and greater in the catalogue, among them, there are 65 ones with magnitude 7 and greater. Based on the catalogue, the seismicity of the Himalaya and adjacent areas has been analyzed, and the following conclusions are made. 1) The epicenters generally follow a NW-NE trending band distribution along the Himalayan arc. At the eastern and western ends, that is, the structural knots of the Himalayas, the epicenter strips are respectively turned to the NE-trending. 2) Intermediate and deep source earthquake are distributed on both east and west ends of the Himalayan arc structure belt, that is, the Pamir at the west end and the Assam at the east end. In the Tibet Plateau and the front of the Himalaya arc, events are basically shallow earthquakes. 3) Earthquakes with magnitude greater than 4.0 are basically complete since 1960 A.D.. 4) The b-values of magnitude – frequency relationship for the study areas are between 0.9 and 1.0.

Introduction

For implementing the Science and Technology Consensus of China-Indian Symposium on Mitigation of Earthquake Disasters in 2013 and the spirit of First Joint China-India Committee Meeting in 2015, a program on Seismic Hazard Analysis for Himalayan Region had been planned by China Earthquake Administration. As the first step of the program, a uniform earthquake catalogue of Himalaya areas has been established. The events are within the region 68-100°E, 23.8-38.4°N and with magnitude 4.0 or greater. The earthquake data are from China and ISC (International Seismological Centre). The final uniform catalogue is given according to the following principles: 1) The earthquake parameters should be taken from China catalog if the events occurred in China. 2) The earthquake parameters should be taken from ISC catalog if the events occurred out of China. 3) The earthquake parameters should be checked if the events occurred on the China border areas based on the data of earthquake stations. Based on the catalogue, the followings are the study on the seismicity of Himalaya areas.

Spatial Characteristics of Earthquake Activities

Figure 1 is the epicenter distribution map of earthquakes in the study areas. There are 17886 events with event magnitude 4.0 and greater in the catalogue, among them, there are 65 ones with magnitude 7 and greater. It shows that the events mostly concentrated in three group of bands. The first group is NW-NE-trending Himalaya arc band, associated with the compression fractures caused by the collision between the India Plate and Eurasia Plate. The second group are the two Himalaya structural knots which are located at the eastern and western ends of Himalaya, the earthquake distributions are mainly NE-trending associated with the twisted tectonic activities caused by the collision of the Indian plate with the Eurasian plate. The third group is the NS-trending bands distributed in inner Tibet Plateau, associated with the tensile fracture caused by the collision of the Indian Plate with the Eurasian Plate in the Tibetan Plateau. It also shows that intermediate to deep source earthquake are distributed on both east and west ends of the Himalayan arc structure belt, that is, the Pamir at the west end and the Assam at the east end. Most of events are shallow earthquakes in the Tibet Plateau and the front of the Himalaya arc.

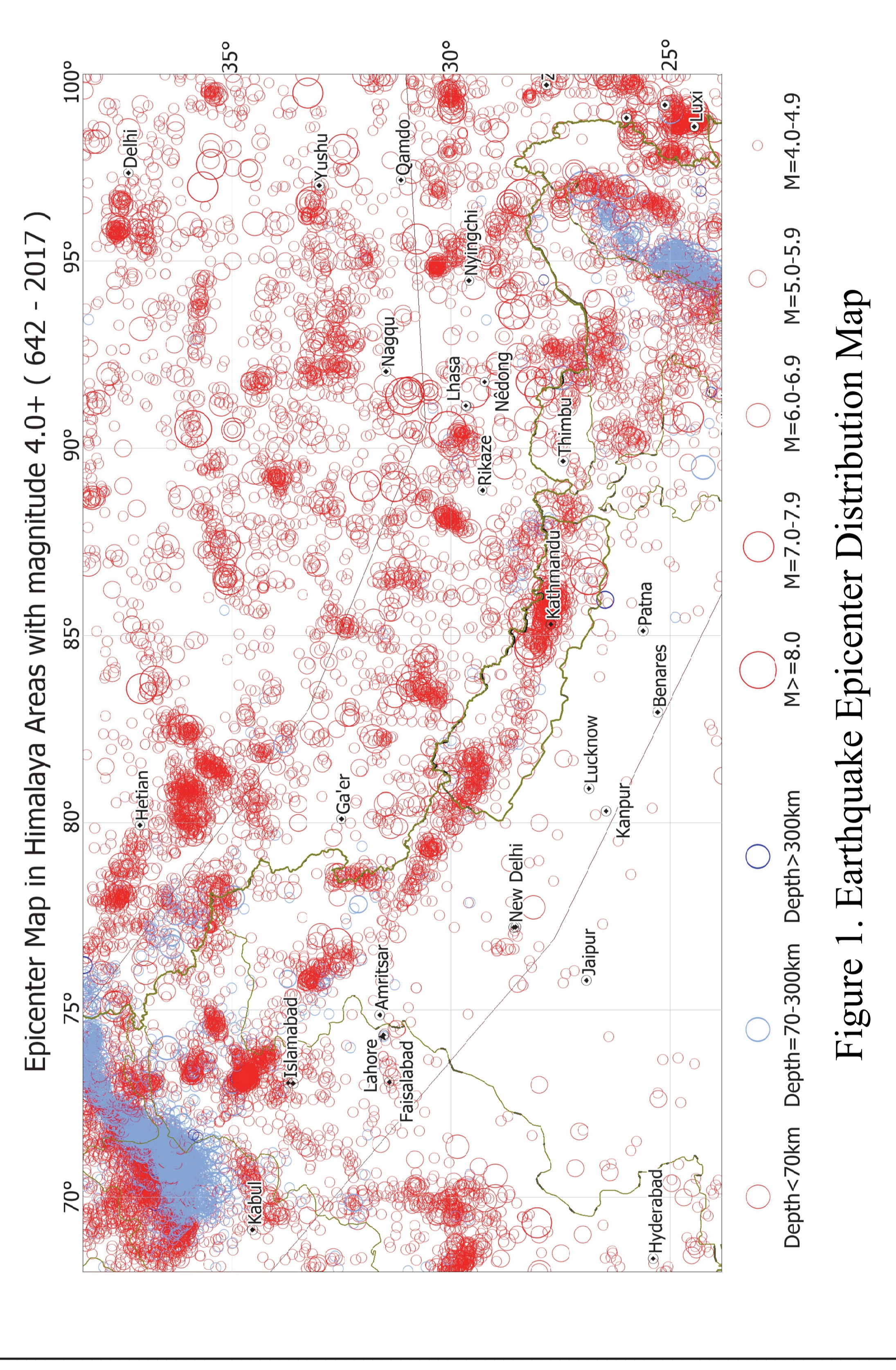


Figure 1. Earthquake Epicenter Distribution Map

Temporal Characteristics of Earthquake Activities

Figure 2 is the temporal distribution map (M-T map) of earthquakes in the study area. It shows that there are rare earthquakes recorded before 1900 A.D. This may be due to incomplete historical records. Since 1900 A.D., earthquakes with magnitude more than 6.0 are basically complete. It also shows that more and more events had been recorded since 1950 and earthquakes with magnitude more than 4.0 are basically complete.

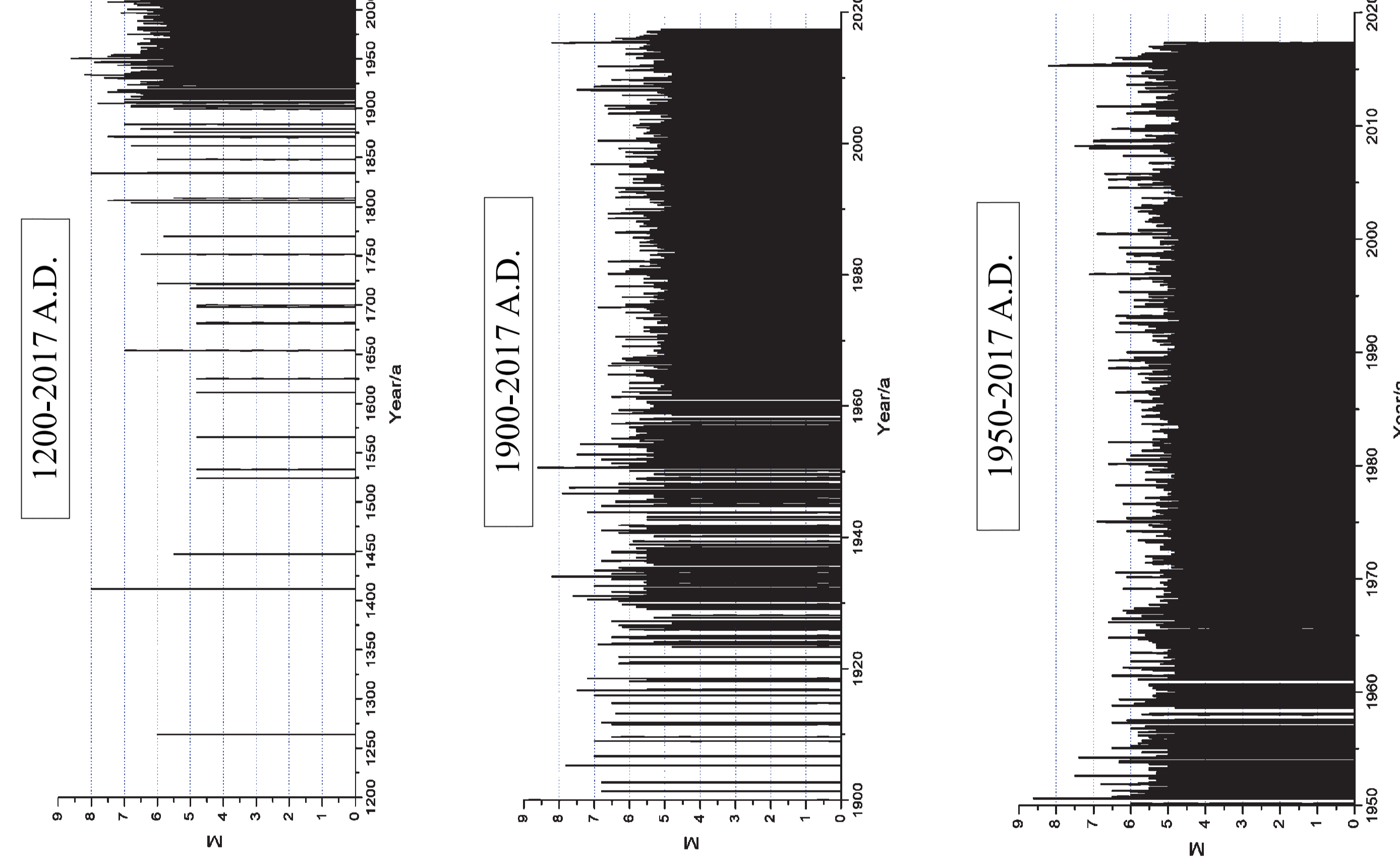


Figure 2. Earthquake Time Series Distribution map (M-T)

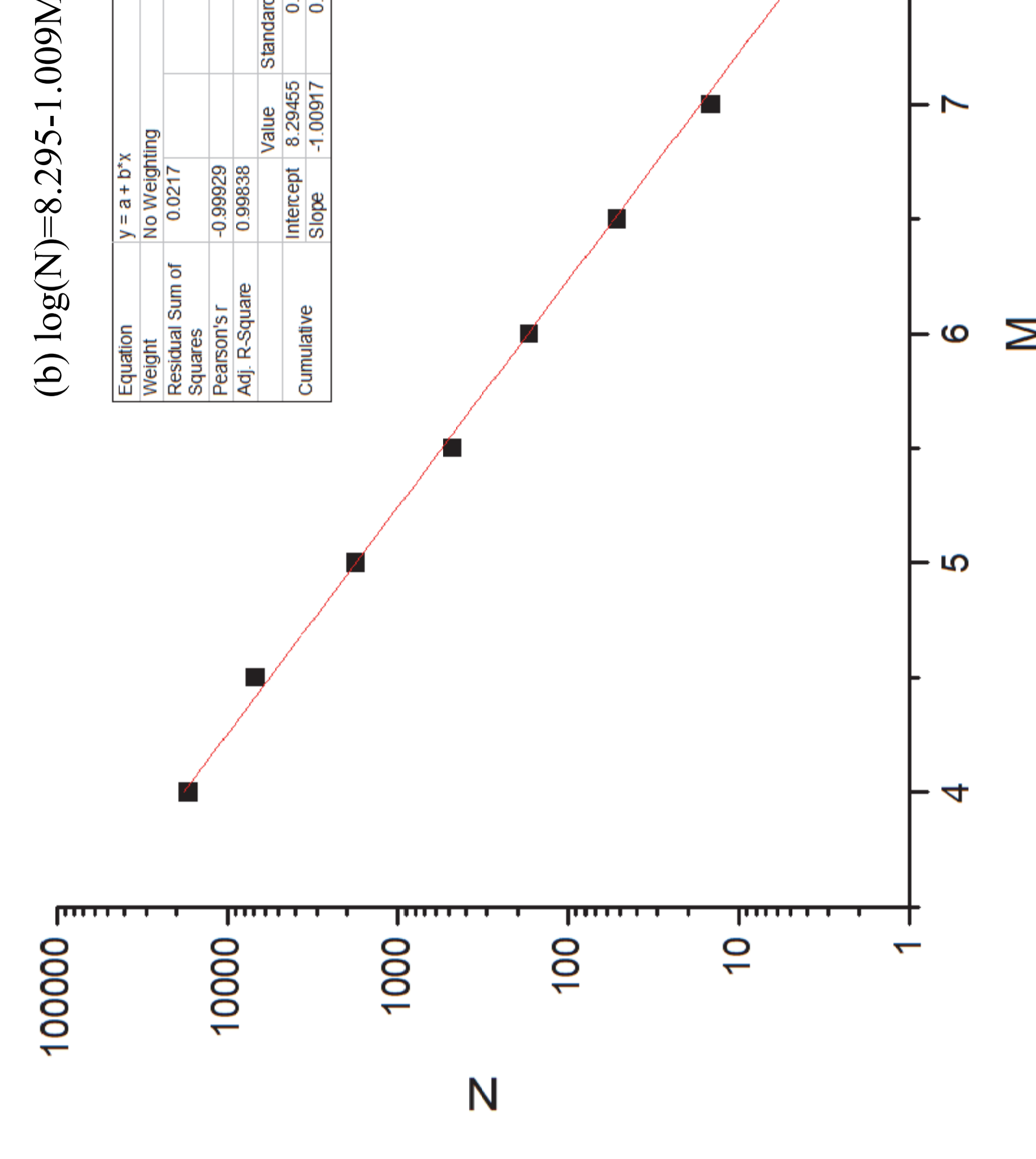
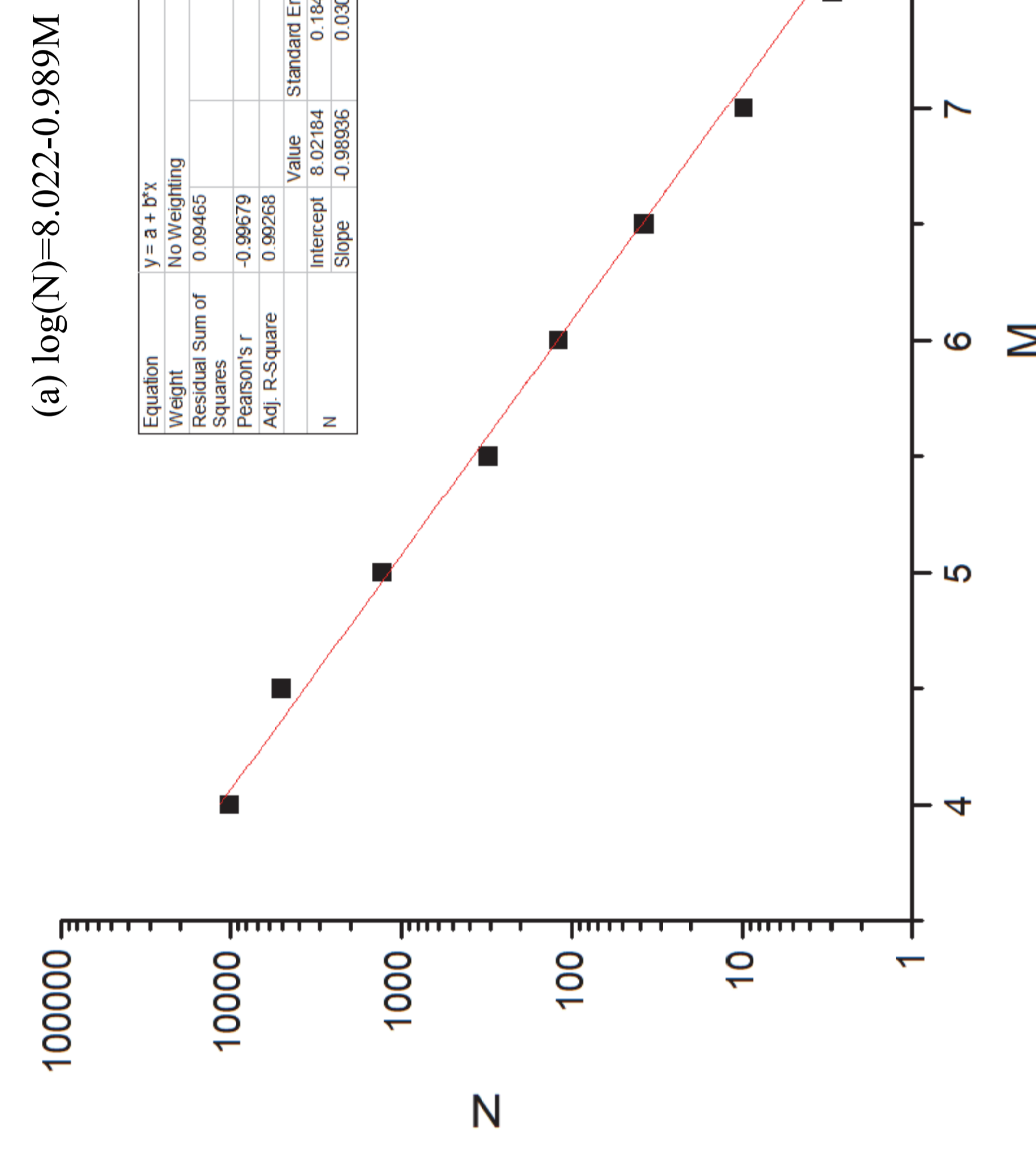


Figure 3. Log(N)-M Curves (1960-2017)

(a) Magnitude - Frequency Curve; (b) Cumulative Magnitude - Frequency Curve

Figure 3 shows the magnitude -frequency curve (a) and the cumulative magnitude -frequency curve (b) of the study areas from 1960 to 2017. Figure 4 shows the magnitude -frequency curve (a) and the cumulative magnitude -frequency curve (b) of the study areas from 1973 to 2017. The b-values of magnitude – frequency relationship for the study areas are between 0.9 and 1.0 inferred from the two figures and the average 1-year occurrence rate of earthquake with magnitude 4 or greater in the study areas is between 295 and 345.

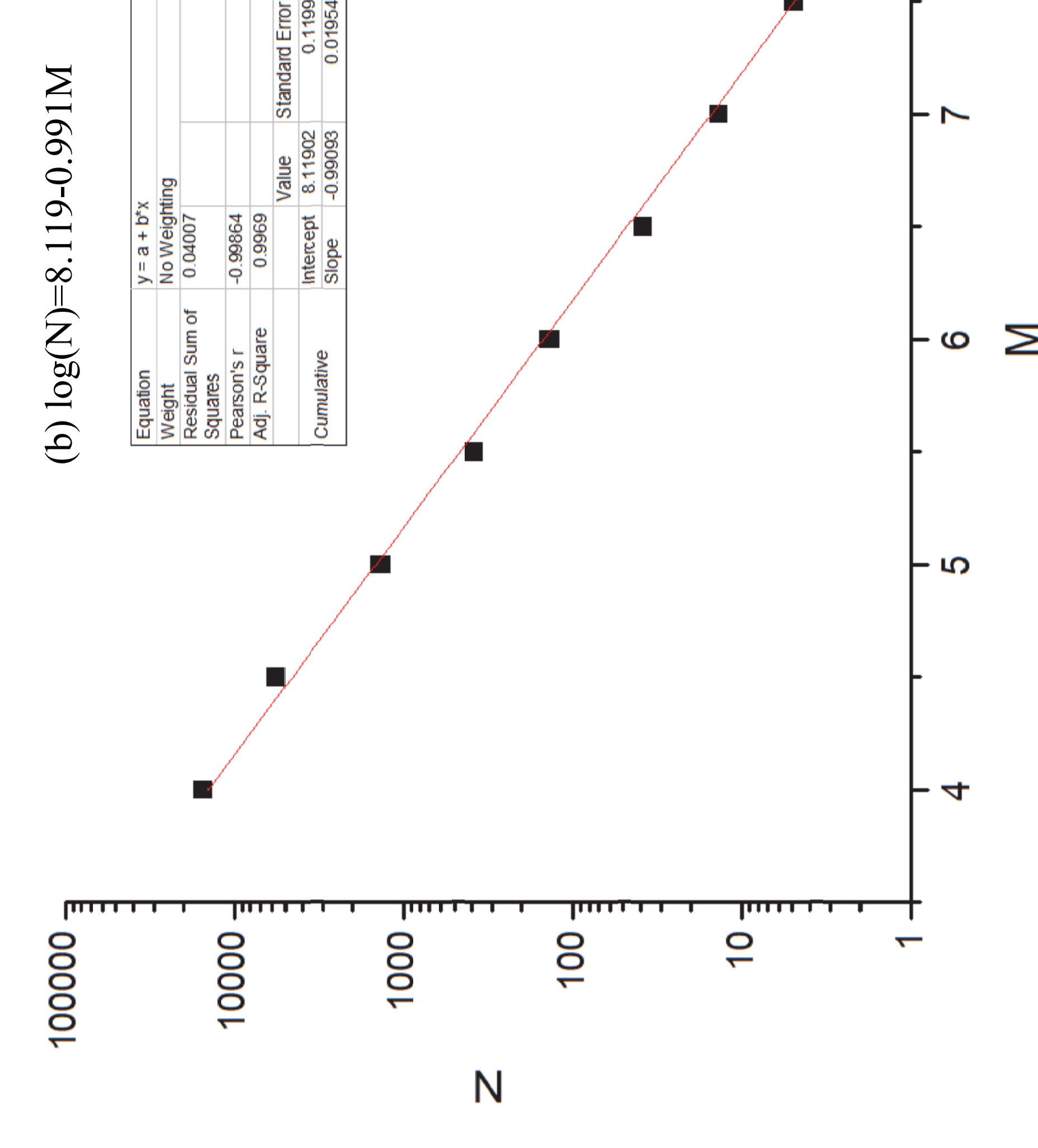
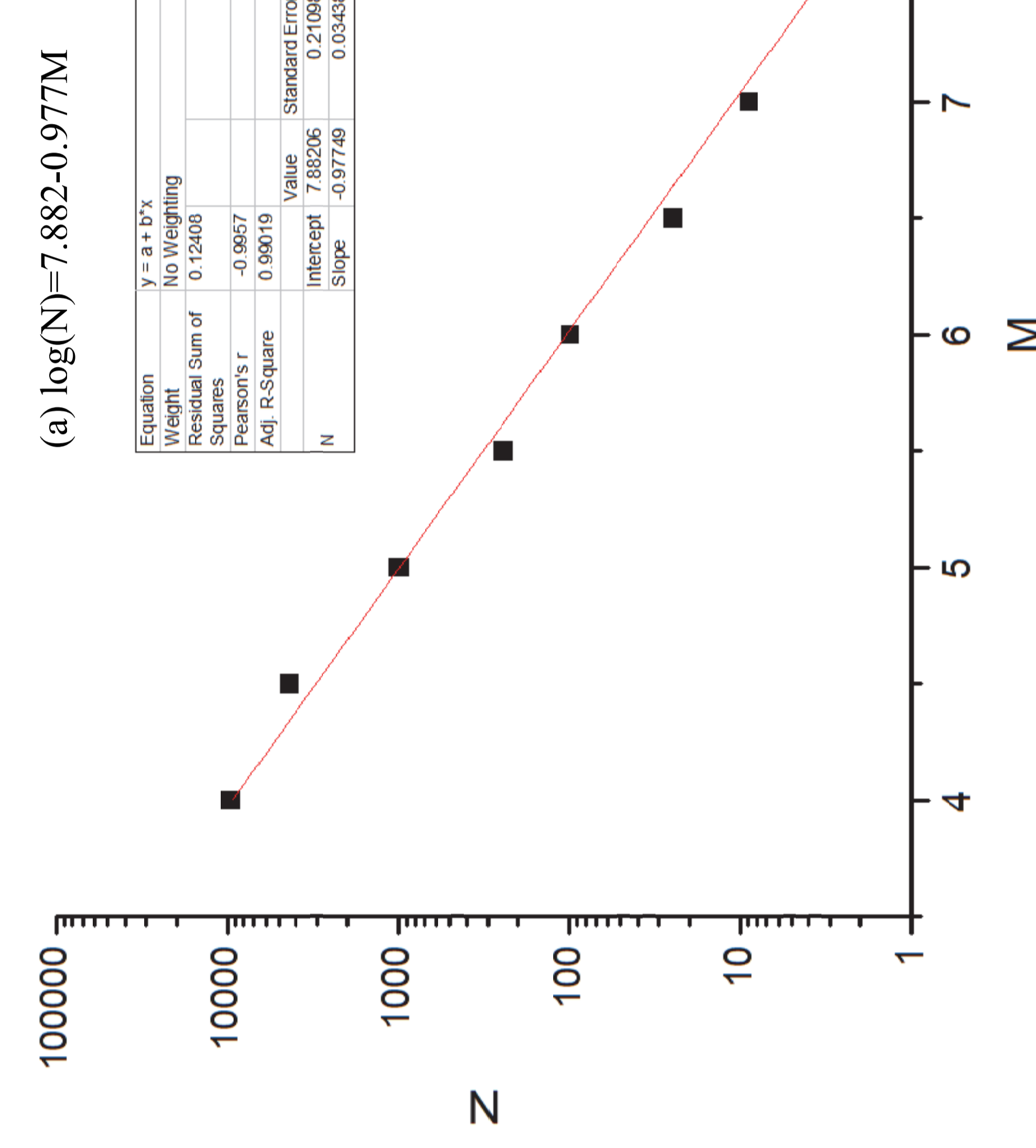


Figure 4. Log(N)-M Curves (1973-2017)

(a) Magnitude - Frequency Curve; (b) Cumulative Magnitude - Frequency Curve

Discussion

Using the earthquake catalogues from China and ISC (International Seismological Centre), a uniform catalogue of Himalaya areas has been established. Based on the catalogue, the seismicity of the Himalaya areas is analyzed preliminarily, and the conclusions as followings are made. 1) The Earthquakes mostly concentrated in three group of bands, NW-NE-trending Himalaya arc band, the two Himalaya structural knots located at the eastern and western ends of Himalaya, and the NS-trending bands distributed in inner Tibet Plateau. 2) Intermediate to deep source earthquake are distributed on both east and west ends of the Himalayan arc structure belt, the Pamir at the west end and the Assam at the east end. Most of events are shallow earthquakes in the Tibet Plateau and the front of the Himalaya arc. 3) The b-values of magnitude – frequency relationship for the study areas are between 0.9 and 1.0 and the average 1-year occurrence rate of earthquake with magnitude 4 or greater in the study areas is between 295 and 345.

Contact Information

Guangyin XU
Institute of Geophysics, China Earthquake Administration
No.5 Minzudaxue South Road, Beijing, 100081, China
Tel: +86-10-68729247
Email: xugy@cea-igp.ac.cn