REGION SPECIFIC MAXIMUM MAGNITUDE ESTIMATION CONSIDERING THE NEW CORRELATION BETWEEN RUPTURE LENGTH AND MOMENT MAGNITUDE

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The maximum possible earthquake magnitude (M_{max}) calculation is indispensable in many seismic/engineering applications. It is obligatory for earthquake engineering community, disaster management agencies and the insurance industry. However, there is no universally accepted practice for estimating the value of M_{max} (Kijko and Singh, 2011).The maximum magnitude is defined as the upper limit of earthquake magnitude for a given region and is synonymous with the magnitude of the largest credible. It assumes a sharp cutoff magnitude at M_{max} , so that, by definition, no earthquakes are to be expected with magnitude exceeding M_{max}. Presently, deterministic and probabilistic based approaches are being used for M_{max} estimation. These approaches are based on the frequency magnitude distribution, seismicity data and maximum observed magnitude (M_{max}^{obs}) of seismic study area (SSA) which have lots of uncertainty. These approaches are suitable for the regions having long seismicity data and high seismicity rate. Furthermore, these are inconsistent with the selection of radius of SSA and most of them would not account regional rupture phenomenon which depends upon the energy released during an earthquake event. In this study, an alternate approach has been proposed for estimating the largest possible magnitude considering the regional rupture character of the SSA. The source criterion which influenced the fault rupture is the density and shear wave velocity of the crustal rock at rupture. These parameters directly related the rupture rock strength.

The M_{max} is usually estimated for each seismic source considering the empirical relation presented by Wells and Coppersmith (1994) (WC94) between subsurface rupture length (RLD) and moment magnitude (M_w). This relation is quite old and many significant earthquakes were reported after 1994 and also the WC94 correlations haven't accounted down dip dimension (RW) precisely and earthquake events associated with subduction zone are excluded. It is renessary to update WC94 relation between RLD and M_w . In this study a new correlation between RLD and M_w has been derived considering the worldwide database of 221 reliable earthquakes from 1857 to 2013 consisting of 10 largest subduction zone earthquakes since 1990 along with 12 events having $M_w > 7$ which have occurred before 1994 and excluded by WC94 and 32 new events after 1994. The regression relation between RLD and M_w for all the data is shown in Figure 1 (a) and different fault types [strike slip (SS), reverse (R) and normal (N)] is shown in Figure 1 (b). The proposed related is different from WC 94 relation. Even though RLD versus M_w relation gives possible rupture length in the region.

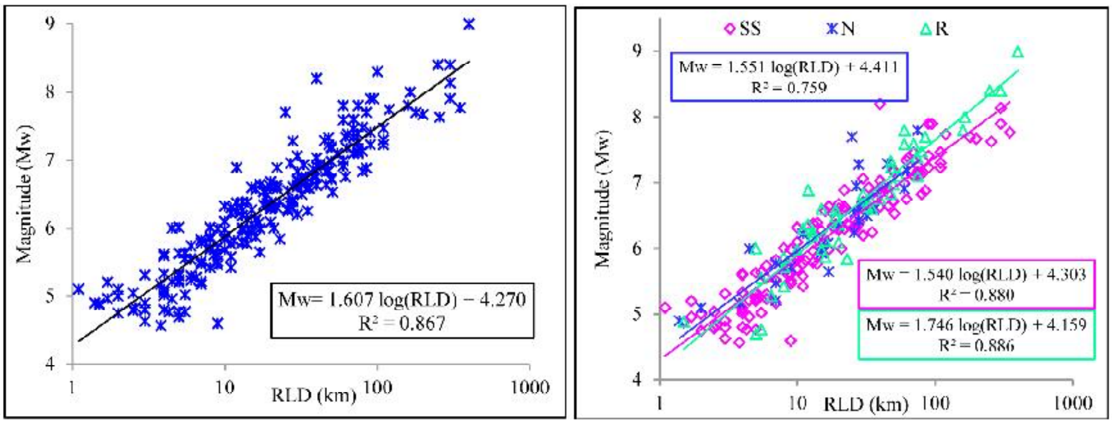

Figure 1. (a) Regressions of surface length and moment magnitude for all faults and (b) Regressions of surface length and magnitude for different types of faults

Because of worldwide data, still its directly applicability of specific region depends on rock present in the focal area. In order to account regional rupture phenomena Anbazhagan et al. (2014) established regional rupture character considering faults in the region, damaging earthquakes and relation between RLD and M_w relation. RLD values for the past earthquake is estimated using relation given in Figure 1a and which has been normalized by dividing RLD by the total length of source associated and plotted with total length of the source. The ratio of subsurface rupture length (RLD) to Total Fault Length (TFL) expressed in percentage is defined as Percentage Fault Rupture (PFR). It is observed that the normalized factor (PFR) follows a unique trend with total length and found to be similar in the region, which is called as the regional rupture character of the region. Based on the observed trend, the typical curve can be divided into three segments, considering the maximum percentage of fault rupture and total length of the fault. The rupture values of these segments can be considered as an average rupture of a region. The average/maximum rupture values can be increased based on structural type and can be used to estimate the maximum magnitude of a particular region. In this study, low to moderate seismicity region of Vishakhapatnam in Southern India has been selected to estimate maximum magnitude using this region specific approach. SSA has been generated by dividing the seismotectonic map into three radiuses of considerations viz. 150km, 300km and 500km. Regional rupture characteristic has been established considering 19 faults experienced M_w of 5 and above. This new approach gives the maximum magnitude as M_w 6.7, which is constant for three radii. The M_w for SSA is also estimated by conventional methods and compared with the newly proposed approach. The proposed method is more consistent as compared to the existing methods where seismic sources are well defined. The proposed method depends upon the seismic sources and magnitude of the seismic study area and follows the same trend irrespective of seismic study area radius. This method can be used as an alternate method to estimate the maximum magnitude for seismic hazard analysis. Presently the proposed method is applicable in the area where earthquakes are associated with the well defined fault. This method needs to be modified for the region with poor source details.

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