Geophysical Research Abstracts,
Vol. 11, EGU2009-7461-3, 2009
EGU General Assembly 2009

Latitudinal skewness in global EQ distributions

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The results of statistical analysis of worldwide seismic catalogs (ISC and NEIC), which was carried out in frame of two projects are presented. In both cases we extracted the evens occurred in the Pacific region from 1964 with Mb>=4.0. The aftershocks were canceled from the list. All events were divided into following magnitude ranges (MR): 4<=Mb<4.5; 4.5<=Mb<5; 5<=Mb<5.5; 5.5<=Mb<6.0; 6<=Mb. Further analysis was performed separately for each MR.

In frame of the first project [Levin, Sasorova, 2009] the whole Pacific region was divided in 18 latitudinal intervals (size of every interval was 10 deg). The number of events in each latitudinal interval was normalized two times. The first one number of events was divided on common number of events in given MR. It was calculated relative number of events in each latitudinal interval for given MR. Then normalization was produced with respect to the length of lithosphere plate boundaries situated in given latitude zone. The approach gives the characteristic of seismicity for lithosphere plate boundary, i.e. seismic event number which was generated at unit of length of plate boundary. An analysis of the Pacific earthquake latitude distribution showed that the empirical distribution is described by a bimodal function with two maxima in middle latitudes (40-50 deg N and 20-30 deg S), local minimum near equator (10-20 deg N), and zero values in polar zones. Thus the bimodal latitudinal EQ distribution shows clear expressed skewness (in direction to the Northern Hemisphere). The stability of distributions from the observation interval size was demonstrated on the data independence analysis for several ten-year intervals. Then it was carried out the analysis about statistically valid regularity of the EQ distribution over depth and over latitudinal belts for different magnitude ranges (MR). It was shown, that for the high latitudes up to 90% of the EQ sources are located on the depth H<=20 km. The part of EQ with 20<H<=60 km increases step-by-step for middle latitudes. And the essential part of EQ sources in latitudinal belts near equator (30 deg S -30 deg N) are located on the depths 100<H<=240 km and H>=500 km (deep EQ). In this case clear expressed peak of deep EQ belongs on latitudinal belt 30-20 deg S

In frame of the second project [Levin, Sasorova, 2005; Sasorova, Levin, Emelyanova, 2006] statistical verification of hypothesis about existence non-random component in time distribution of the EQs between the Northern and Southern part of the Pacific was carried out. The distribution-free test (run test with significant level 1%) was used for existence proof of nonrandom component into time sequences. The time sequences of the EQ switching between the Northern and Southern parts of the Pacific region contain statistically significant nonrandom component for the events with 4.0<=Mb<6.0. Then data in each magnitude range was subdivided in two groups: the deep earthquakes (H>70km) and the shallow earthquakes (H<=70km). It was found that nonrandom component does not exist for deep earthquakes. On the contrary it is clearly manifested in time distribution of the shallow events. The digital model (superposition of random and periodic processes) was proposed. It was shown that the manifestation of non-random component depends on magnitude of studied events and on the duration of the observation period. The stability of distributions from the observation interval size was demonstrated on the data independence analysis for several eight -year intervals.