Nat. Hazards Earth Syst. Sci. Discuss., 2, C642–C647, 2014
www.nat-hazards-earth-syst-sci-discuss.net/2/C642/2014/

Natural Hazards and Earth System Sciences
Discussions
Open Access

Interactive comment on "Brief Communication: Correlation of global earthquake rates with temperature and sunspot cycle" *by* R. Rajesh and R. K. Tiwari

R. Rajesh and R. K. Tiwari

rekapalli@gmail.com

Received and published: 15 May 2014

Reply to Interactive comment on "Brief Communication: Correlation of global earthquake rates with temperature and sunspot cycle" by J.J.Love

Thanks for your interest in our paper entitled "Brief Communication: Correlation of global earthquake rates with temperature and sunspot cycle".

1. We fully agree with concern that the accurate counting of the earthquakes over the globe started only during the recent decades, therefore, keeping the above fact in view, we have analyzed the data from the year 1975 onwards only and this largely

justifies the procedure of our data selection. Secondly our sole purpose in this study is to correlate ensemble average earthquake rate (number of occurrences /year) with the solar activities. We, however, are not intended to correlate individual earthquake of high magnitude only with solar activity as has been done by Dr Love and Thomson 2013 and claim for the cause and effect relationships. Love and Thomson (2013) have analyzed data from 1900 onwards with a cutoff magnitude 7.5 ignoring many smaller and bigger genuine events (at least during the past three to four decades), which the authors themselves have stated.

2. Our main results are drawn from the comparison of Eigen modes using Singular Spectral Analysis (SSA). Prior to decompose the data into the eigen values and eigen vector components, we have appropriately performed the boot-strap test to rule-out/ provide estimates on the possibility of randomness or outliers (Fig.1). The correlation analysis is simply an additional analysis for check.(answer for comment 2 and 4)

3. The separation of the eigen components and reconstruction of the eigen modes of specific components allow us to separate the random components. Thus there is no means of randomness present in the data to produce the accidental correlation. In case of the normalized temperature data and raw earthquake number data, the trend between them is clearly matching along with the cyclic pattern . Hence suspecting for accidental correlation between solar activities and earthquakes occurrence rate is ruled out here.

We have performed null hypothesis test on the earthquake rate data. The test rejected the null hypothesis at the 5% significance level with p= 2.5 Ëč 10-10 for the process to be random. Further, we have calculated correlation coefficients between the temperature data and the global earthquake rates (histogram of Fig.2) from 1000 bootstrap samples. Similarly Fig.3 shows the correlation coefficient between SSA reconstructed earthquake rate (only from the significant principal components, 2 and 3) and sunspot number data. The bootstrap estimates indicate that the correlation coefficients obtained in our analyses are statistically significant and are not due to statistical accident.

4. Our approaches of data selection and analysis are different as mentioned above. Furthermore, we are not totally dependent on linear correlation analysis. Here our attempt is to identify the nonlinear dynamical aspects of the earthquake rate employing the matching nonlinear SSA, which is appropriate. Accordingly we have quantified the contribution of each of the components of the physical processes in terms of eigen percentile in which second and third eigen components together correspond to the out of phase relationship with sunspot numbers.

As far as the physical relation is concerned between the two phenomena, it is worth mentioning that earthquake is nonlinear and “critical phenomena” and at the time of “critical state stress”, even small variation of some associated phenomena (need not to be the sole cause here) would destabilize/trigger the earthquake and will be reflected in the observation.

Interactive comment on Nat. Hazards Earth Syst. Sci. Discuss., 2, 2851, 2014.

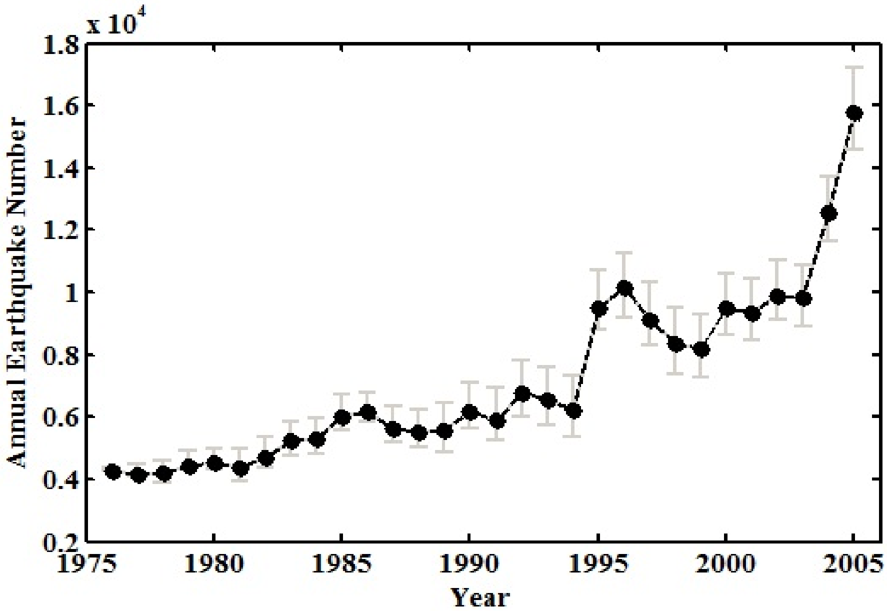

Fig. 1. Bootstrap confidence bounds of standard deviation of the global earthquake rate data using 1000 bootstrap samples.

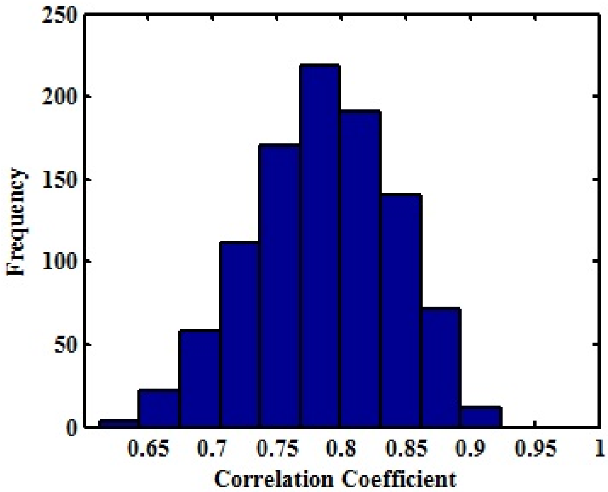

Fig. 2. Histogram of bootstrap correlation coefficient estimates between global earthquake rate data and temperature data series using 1000 bootstrap samples.

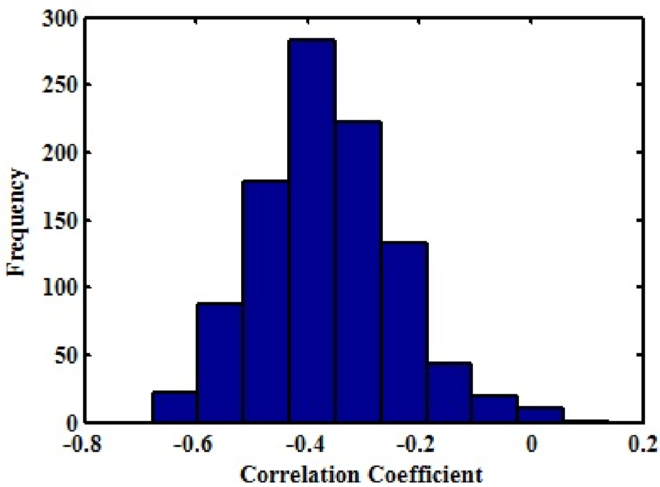

Fig. 3. Histogram of bootstrap correlation coefficient estimates between SSA reconstructed global earthquake rate data from (Principal component 2) PC2 and PC3 and sunspot number data serieses using 1000 boot