

A statistical analysis of ionospheric anomalies before 736 M \geq 6.0 earthquakes

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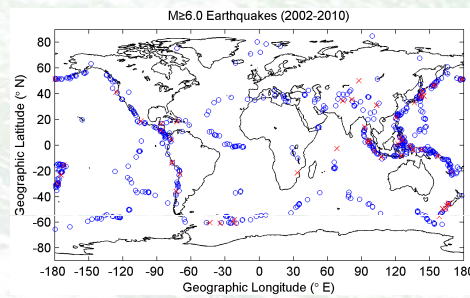
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1. Objectives

To check what extent are ionospheric anomalies before the earthquakes related to the incoming earthquake, we carry out a statistical analysis by investigating the TEC anomalies some days before more than 700 earthquakes with magnitude $M \geq 6.0$ during 2002-2010 in the Global area.

2. Ionospheric Data and Earthquakes Selected

Date source: GIM/TEC data from CODE



	Depth \leq 20	Depth \leq 30	Depth \leq 40
M \geq 6.0	490	602	736
M \geq 6.1	372	468	573
M \geq 6.2	293	369	454
M \geq 6.3	226	292	362
M \geq 6.4	167	221	273
M \geq 6.5	132	177	221
M \geq 6.6	103	139	176
M \geq 6.7	70	99	130
M \geq 6.8	57	78	104
M \geq 6.9	43	60	79
M \geq 7.0	36	48	66
M \geq 7.1	29	39	53

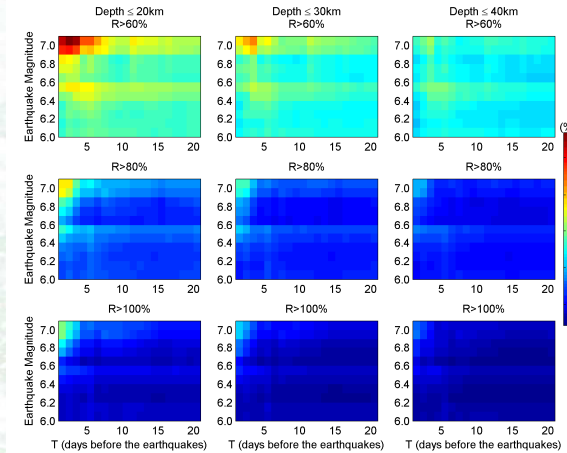
3. Statistic Method

1. Find the abnormal days (more than six abnormal points (6 hours) in a day and the largest deviation $> R$ (such as 60%, 80%, or 100%).
2. Calculate the number of abnormal days with deviation level R within T days before an earthquake, which is noted as $N_{R,T}$.
3. The days related with the magnetic disturbed activity are excluded ($Dst < -40nT$), ΔS .
4. Calculate the occurrence rate of abnormal day (P_E) for the earthquakes satisfied some certain conditions (e.g. $M \geq 6.5$ and depth $D \leq 20km$).
5. Calculate the occurrence rate of abnormal day (P_N) during background days (the 61-300 days before the earthquake)

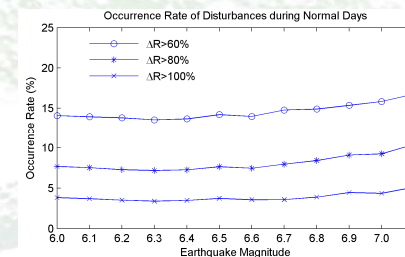
$$P_N = \frac{\sum_{n=1}^K N_{R,T}^n}{K \times 240 - \Delta W} \times 100\% \quad P_E = \frac{1}{K} \sum_{n=1}^K \frac{N_{R,T}^n}{T - \Delta S_n} \times 100\%$$

4. Results

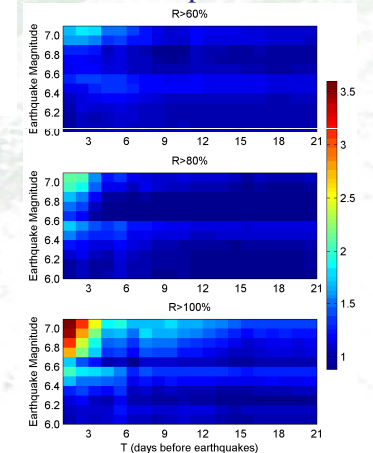
Occurrence Rate of anomalies for the different earthquakes (P_E)



Occurrence rate of anomalies in background days (P_N)



P_E/P_N for the earthquakes with Depth $< 20km$



5. Conclusions

1. The values of P_E are related with the earthquake magnitude, the earthquake source depth, and the length of days prior to the earthquake.
2. The occurrence rate of anomaly within several days before the earthquakes is overall larger than that during the background days, especially for the large magnitude and low depth earthquakes.
3. These results indicate that those anomalous behavior of TEC within just few days before the earthquakes are related with the forthcoming earthquakes in high probability.