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SSS01-12 Room:419 Time:May 2 17:15-17:30

Global distribution of the earthquake-induced Schumann resonance anomalies

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Schumann resonance (SR) is a global electromagnetic resonance phenomenon. Recently, SR anomalies before some earthquakes (EQs), which are considered to be concerned with the irregular disturbance of the lower ionosphere above the epicenters, are discovered. Although the examples are limited, we can see that the SR anomalies are usually different for different EQs. This paper concerns with the distinctions of SR anomalies observed at different locations for the same EQ, with the 2011 Magnitude 9.0 Tohoku-Oki EQ in Japan, before which significant SR anomalies have been observed in China, as an example.

Zhou et al. (2013) have found an anomalous SR affect observed at YS and AJ stations of China, associated with the Tohoku-Oki EQ. The anomalies were characterized by an increase in the intensity at frequencies from the first mode to the fourth mode in both magnetic field components, and the abnormal behaviors of the north-south magnetic field component primarily appeared at 0000-0900 UT 3 days prior to the main shock, about 2 h ahead of east-west magnetic field component. The above phenomena are shown in Figures 1 and 2. Figure 1 shows the deviations of the magnetic field amplitudes from the monthly averaged values observed at YS and QJ stations from 1 to 11 March 2011. Figure 2 shows the comparison of the amplitude differences of both magnetic fields on 8 March observed at YS station with 2 standard deviations which is calculated by the spectra over $\mp$15 days around 8 March, and the areas where the amplitudes are stronger than 2 standard deviations are marked with white. After the comparative analysis of the disturbed phenomena produced by the selected 10 sites shown in Figure 3 by numerical method with a locally EQ-induced disturbance model of the atmospheric conductivity in the day-night asymmetric Earth-ionosphere cavity, it is concluded that the SR anomalous phenomena before the Tohoku-Oki EQ have much to do with the excited sources located at South America and Asia marked with red circles in Figure 3.

Another 2 observing sites, with Sites 1 and 2 located at (N35^o, E137^o) and (N0^o, E110^o) respectively, are selected besides YS in order to compare the abnormal variations of SR magnetic fields observed at different locations under the same disturbance situation. The same simulation model and method as those in Zhou et al. (2013) are used, and the abnormal variations of both magnetic field spectra of SR observed at 3 sites are shown in Figures 4 and 5, with the source located at SA2 and AS4 as shown in Figure 3 respectively. It is obvious that the differences of the abnormal variations observed at different sites are distinct.

Further, Figures 6 and 7 show the global distributions of the anomalies for the first 3 modes of both SR magnetic field components under the excitation of the source SA2 and AS4 respectively. The color codes stand for the ratio of disturbed amplitude to the regular one, and the regions with green color represent the disturbed ratio lower than 1 and also include the possible nodal points which are the results of the simple model of point sources, while white to dark red colors represent the appearance of SR anomalies. It can be seen that the distribution of SR anomalies is very complicated, and is related to the relative locations of EQ epicenter, lightning currents and the observatories, and of course the EQ-induced disturbance of atmospheric conductivities.

The present simulations are done under the simple models of lightning and disturbed conductivity, which will be improved in the next studies.

Keywords: Schumann resonance, Tohoku-Oki earthquake, earthquake-induced Schumann resonance anomalies, day-night asymmetric Earth-ionosphere cavity

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