Statistical analysis of pre-seismic ionospheric electron density anomalies using ionosonde data, over Japan

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Earthquake activity gives a great impact on human life. Even now in the 21st century, the damage caused by the earthquake has occurred unchanged, especially the damage caused by the 2011 off the Pacific coast of Tohoku Earthquake and the accompanying tsunami is remembered. In order to mitigate such large-scale disaster, a short-term forecast of seismic activity is important. Recently, various electromagnetic phenomena preceding the seismic activity have been reported. Among of them, the research focusing on ionospheric disturbances related to seismic activity has been active in recent years. One method to observe earthquake-related ionospheric disturbance is to detect the disturbance of the ionosphere by the Ionosonde and GPS - TEC (Total Electron Contents) data. In particular, Ionospheric observation using Ionosonde has been performed for a longer time, so long-term data can be obtained, and more detailed statistical analysis and case analysis are possible. Therefore, in this study, we performed to use statistical analysis of ionospheric anomalies preceding large earthquakes over 60 years of 1958 ~ 2017 using Ionosonde data. In this research, from the Ionosonde data observed at Kokubunji, Japan by the National Institute of Information and Communication Technology (NICT). The studied parameters are NmF2, which is the maximum electron density of the F2 layer, hmF2, which shows the NmF2 altitude, h'F which indicates the apparent altitude of the F2 layer, and foEs which is the critical frequency of the Es layer. The period for the statistical analysis was from 1958 to 2017, and the selected earthquakes were magnitude >= 6 with depth <= 40 km. We perform the Superposed Epoch Analysis (SEA) to evaluate statistical significance. We also investigate the magnitude dependence. The results show that there was a significant positive anomalies in NmF2 6-10 days before each condition. For parameters related to altitudes such as hmF2 and h'F, there is no clear correlation with the earthquake. As for foEs, we need more detailed investigation. Regarding the dependence of magnitude, looking at the maximum probability of anomalies occurrence in each result, the probability increases with increasing magnitude. Therefore, it can be considered that there is a magnitude dependence. Also, we are now investigating the assessment of effectiveness for short-term forecast of earthquakes using Molchan's Error Diagram. The results will be present in the poster.

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