Ionosphere Precursor Phenomena associated with large earthquakes

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Abstract

We stress that precursor effects of large earthquakes (EQ) surely exist in the ionosphere, and the phenomena, which appear in the ionosphere, is explained as due to the electric field, associated with earthquake (Liu et al., 2008;Hsiao et al., 2008). Our result which comes out from the data analysis of Japanese satellite 2HINOTORI" (Oyama et al., 2008a) first provided a clear fact of electron temperature reduction in the topside ionosphere. This feature is also explained by electric filed. The problem now is "how and where the electric field is generated? ", and "how the electric field can influence on the ionosphere? ". Some scientists propose another mechanism on global circuit. Impedance of the lower atmosphere becomes lower, which leads to the change of electric filed in the ionosphere. Contrary to the change of electric field, the following is our scenario for the electric field generation. The seed of electric field originally starts from troposphere, where atmospheric temperature rises from two reasons, one is latent heat flux due to the water cluster ions, which are originally produced by radon emanation, and finally forms cloud. Another heat source might be ejection of extremely hot material from the ground. Increase of atmospheric temperature caused by the above channels might cause the internal gravity wave in the troposphere, and the wave propagates to the height region of 100km, which we call Dynamo region. It is well accepted that Dynamo electric filed is generated by neutral wind under the existence of earth magnetic field. Electric field in the dynamo region is modified by the waves propagating from troposphere. Once the effect reaches at Dynamo region, and the electric field, which is modified, propagates to topside ionosphere along the magnetic line of force.

According to the scenarios, which we proposed, as the second step following HINOTORI satellite, we started examining DE-2 satellite data to find more example of ionosphere modified in advance by earthquake. We found that depending on the location of epicenter, the parameters of the modified ionosphere such as NmF2, and TEC varies. The cause of the modification is most probably, due to electric field, because the effects some times appear in the magnetic conjugate points. It is also noted; all most all ionosphere phenomena, which have been reported, can be explained. As the next step, we tried to find the variation of atmosphere temperature prior to earthquake for two recent earthquakes, Sechuan earthquake and Pington earthquake. Our tentative analysis shows that there is surely the peculiar temperature increase prior to these two large earthquakes. The change of

temperature seems to propagate to 1000 km as wave. Our result will be submitted soon to the refereed Journal.

Our study is the beginning of the research on the lithosphere-atmosphere-ionosphere coupling. Apart from ionosphere precursor phenomena, infrared anomaly form the space, and VLF emission have been reported .As the precursor effects covers the wide scientific areas, we need collaboration between the scientist from various field such as seismologists, meteorologist, and ionosphere scientists.

However before going into the collaboration, we strongly encourage ionosphere scientists in Japan to start research by using data which are currently available from ground as well as satellite, and presents a clear evidence of ionosphere disturbance due to earthquake to the public. At some stage of the research, satellite constellation is needed to understand the physics and confirm the mechanism, which will be presented after the data analysis (Oyama et al., 2008b). The study on lithosphere-atmosphere -ionosphere coupling surely opens a new filed in the near future.

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