Ionospheric anomalies during 26 December 2004 Sumatra Tsunami: observations from CHAMP and simulation

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Abstract

The low-orbiting CHAMP satellite observations of ionospheric anomalies, density and magnetic field fluctuations, during 26 December 2004 Sumatra tsunami is presented. Ionospheric anomalies near 400 km altitude are found to be present during 5:00-5:30 UT in the region where the main tsunami wave-front was sweeping the underlying Indian ocean at that time. These anomalies are found to have large amplitudes in the equatorial ionization anomaly region of the ionosphere. While these anomalies are found to be present on other days also, they were much stronger and more spreaded in the region during Sumatra tsunami.

The numerical modeling is carried out to explore the coupling mechanism via atmospheric wave that involve two-step process: the generation of Acoustic-Gravity-Wave (AGWs) by tsunami wave-front and the excitation of ionospheric anomalies by Acoustic-Gravity-Waves. The three-dimensional (altitude-latitude-longitude) fully-time dependent wave equation of the AGW is solved numerically for the modelled input tsunami wave-front during 5:00-5:30 UT. The ionospheric anomalies are simulated using the coupled atmosphere-ionosphere simulation model where the simultaneously simulated AGW acts as the driving source for the ionospheric current, density and magnetic field anomalies. The modeling result indicates the excitation of density and magnetic anomalies in the ionosphere attaining order of magnitude similar to the observed magnitudes and horizontal structure similar to the main tsunami wave-front.