

Model for generation of geomagnetic variation due to tsunami

Yaschenko A.K., Sorokin V.M.

Pushkov Institute of Terrestrial Magnetism, Ionosphere and Radio Wave Propagation Russian Academy of Sciences, Moscow, Russia

e-mail: alex@izmiran.ru

We study the mechanism for geomagnetic field perturbation associated with tsunami wave propagation. The source of perturbation is assumed to be electric currents in the sea medium and the ionosphere. The electric current in the sea medium is due to the tsunami-produced wave motion of the seawater immersed in the geomagnetic field while the ionospheric current is due to acoustic-gravity wave (AGW) propagating from the atmosphere into the ionosphere. The AGW radiates into the atmosphere due to vertical displacements of seawater surface during tsunami wave propagation. Although the ionospheric conductivity is much smaller than seawater conductivity, the current in the ionosphere can be greater than that in the seawater due to an exponential increase in the amplitude of the upward propagating AGW. We deduce a spatial distribution of the geomagnetic perturbations generated by the electric current flowing in the seawater and ionosphere and take into account their mutual induction. The electric current in the ionosphere may greatly affect the geomagnetic field perturbations resulted from tsunami wave propagation. With the increase in the horizontal scale of tsunami wave and in the sea medium depth, the AGW-induced ionospheric current can enhance the perturbation amplitude observed on the ground by the factor of several units. Taking the dayside ionospheric parameters, the amplitude of geomagnetic perturbations caused by tsunami wave is estimated to be about 1 – 10 nT. In the nighttime conditions a height-integrated conductivity of the ionospheric plasma decreases by an order of magnitude that declines significantly a role played by the ionospheric currents. In our model, the ionospheric electric current due to AGW is completed through the conjugate ionosphere by virtue of field-align currents, which makes for excitation of transversal components of magnetic and electric fields at altitudes of the upper ionosphere and magnetosphere. The amplitude of magnetic and electric fields as well as the field-align current in the ionosphere can reach values of the order of 10 nT, 10 mV/m and 10^{-8} A/m², correspondingly. We can conclude that these estimates provide a possibility for monitoring of tsunami wave by virtue of cosmic techniques.