



Geomagnetically Induced Currents over Kazakhstan during Large Geomagnetic Storms

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The paper shows that during very large magnetic storms (VLMS), the energy systems of Kazakhstan are exposed to geomagnetically induced currents for quite a long time (from tens of minutes to several hours). The minute values of the magnetic field vector B or its components B_x , B_y , B_z during four very large geomagnetic storms with a local geomagnetic activity K -index ≥ 7 were used to calculate the values of geomagnetically induced currents:

- September 26-28, 2011, VLMS, Sc, duration 54 h 00 min, K -index =7;
- June 22-25, 2015, VLMS, Sc, duration 78 h 30 min, K -index =8;
- October 24-28, 2016, VLMS, duration 93 h 00 min, K -index =7;
- May 12-17, 2021, VLMS, Sc, duration 17 h 25 min, K -index =7.

Sc – a sudden commencement of strong storms.

The data of four magnetic observatories of the INTERMAGNET network, whose geomagnetic latitudes are close to the geomagnetic latitudes of the southern and northern borders of Kazakhstan were considered: Alma-Ata Observatory, Kazakhstan (code AAA, 43.25°N, 76.92°E); Novosibirsk Observatory, Russia (code NVS, 54.85N, 83.23E); Irkutsk Observatory, Russia (code IRT, 52.17°N, 104.45°E) and the Beijing Ming Tombs Observatory, Beijing, China (code BMT, 40.3°N, 116.2°E).

Variations of the B_x component of the geomagnetic field during the four considered very large magnetic storms according to the observatories AAA, NVS, IRT, BMT showed variability from 50 nT to 150 nT for several hours.

Also, based on measurements of geomagnetic observatories AAA, NVS, IRT, BMT, the analysis of variations of the horizontal component H of the magnetic field vector and its time derivative (dH/dt) was carried out. Histograms of the distribution dH/dt and histograms of the distribution of the directions H and dH/dt are constructed.

It is shown that the energy systems of Kazakhstan are exposed to geomagnetically induced currents when dH/dt varies from 17 nT/min and more. The geomagnetic-induced current is

estimated based on the calculation that the electromotive force of self-induction is proportional to the rate of change in the magnetic field strength. According to preliminary calculations, the values of geomagnetic-induced currents are fractions of mA. For more accurate calculations, it is necessary to take into account the topology of the electrical system, the composition of the underlying surface and other factors that determine the degree of susceptibility of individual elements of the power system.

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