
Magnetic storms

By J. Lemaire

A magnetic storm manifests itself at the Earth's surface by a temporary decrease of the horizontal component of the magnetic field of the Earth in the equatorial zone.

K. Störmer already connected this characteristic variation of the magnetic field with the increase of a ring-shaped electric current flowing around the Earth in the equatorial plane at more than 3 Earth radii.

This ring current is composed of magnetospheric electrons, protons and ions of more than 10 keV, trapped in the geomagnetic field. It is generated by the azimuth drifts to the East for the electrons and to the West for the ions. The horizontal component of the magnetic field in the equatorial plane may diminish by as much as 1% (300nT) when the ring current is strongly enhanced.

A magnetic storm can last 1 or 2 days; the population of energetic ions that form this current is reduced by pitch angle scattering and precipitating of the trapped electrons and ions in the atmosphere of the Earth.

Other magnetic disturbances exist, more localised in the auroral zones. For example the more frequent magnetic substorms due to the injections of a cloud of protons and electrons coming from the magnetotail in the region of the magnetosphere, which are connected to the auroral zones. These magnetic substorms last only a few hours, but can come in series and cause significant and catastrophic disturbances in the global structure of the magnetosphere and induce electric currents into the ionosphere as well as in electric power systems at the surface of the Earth.

