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Monitoring geospace disturbances through coordinated space-borne and ground-based magnetometer observations

Georgios Balasis

National Observatory of Athens, Institute for Astronomy, Astrophysics, Space Applications and Remote Sensing, Penteli, Greece (gbalasis@noa.gr, +302106138343)

Recently automated methods of deriving the characteristics of ultra low frequency (ULF) waves in the magnetosphere have been developed (Balasis et al., 2012, 2013), which can be effectively applied to the huge datasets from the new ESA Swarm mission, in order to retrieve, on an operational basis, new information about the near-Earth electromagnetic environment. Processing Swarm measurements with these methods will help to elucidate the processes influencing the generation and propagation of ULF waves, which in turn play a crucial role in magnetospheric dynamics. Moreover, a useful platform based on a combination of wavelet transforms and artificial neural networks has been developed to monitor the wave evolution from the outer boundaries of Earth's magnetosphere through the topside ionosphere down to the surface. Data from a Low Earth Orbit (LEO) satellite (CHAMP) and two magnetospheric missions (Cluster and Geotail) along with three ground-based magnetic networks (CARISMA, GIMA and IMAGE), during the Halloween 2003 magnetic superstorm when the Cluster and CHAMP spacecraft were in good local time (LT) conjunction, are used to demonstrate the potential of the analysis technique in studying wave evolution in detail.