Significance of IMF B_y and Substorms on Ionospheric Electric Fields: New Results

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Abstract

The strong electrodynamic polar to equator coupling during geomagnetically disturbed times remains a subject of intense research. After decades of research, we understand the effects of IMF B_z on global ionosphere, perhaps up to a great extent. However, our understanding about the effects of the IMF B_y esp., up to the equatorial latitudes is still at a very nascent stage. Similarly, the impact of substorm on the Magnetosphere-Ionosphere system and their transmission to low latitudes remains poorly understood.

In the first part, using observations from multiple instruments from auroral to equatorial latitudes on a unique space weather event this work addresses the importance and impacts of IMF B_y on disturbed time ionospheric electric fields over equatorial latitudes. It is shown that large IMF B_y component under comparable southward IMF B_z conditions can substantially modify the electric field patterns from polar to equatorial latitudes resulting into unexpected modification of equatorial ionospheric electrodynamics. In the second part, the work will address the issue of polarity of substorm induced penetration electric field over low latitudes and how they compare with storm induced penetration electric field. Observations show that substorms can induce westward fields, contrary to recent claims that such substorms produce only eastward fields, and that their effects on low latitudes can compete with storm induced fields at times. These results strongly suggest a very crucial role of IMF B_y and substorms when evaluating storm-time effects on global Ionosphere-Thermosphere system.