



## **Study of local manifestations of strong geomagnetic storms at middle latitude with using geomagnetic and TEC data**

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Local manifestation of the strong geomagnetic storms at middle latitudes using in situ geomagnetic and TEC data is considered in this work. A case study analysis of the strong geomagnetic storm Halloween running from 29 to 31 October, 2003 was carried out. We used the data from three geomagnetic observatories (GOs) Ebro EBR (Spain), Surlary SUA (Romania) and Beijing Ming Tombs BMT (China) and from nearby IGS GNSS sites EBRE, BUCU, SOFI, and BJFS. The datasets include minute values of the geomagnetic field H-component for GOs from the INTERMAGNET network (<http://www.intermagnet.org/>), RINEX files for GNSS sites from IGS services (<http://www.igs.org/>), and hourly values of the Dst index from the World Data Center for Geomagnetism in the Kyoto University (<http://wdc.kugi.kyoto-u.ac.jp/>). A study of the temporal variations of the planetary geomagnetic index Dst, the H-component of the geomagnetic field recorded at three GOs, and the VTEC values obtained from the GNSS observations during the three-day storm was conducted. The wavelet transform analysis of the geomagnetic DS-index reveals local peculiarities in time-frequency decomposition of the signal for each GOs. The differences in the H-component's variation along the geographical longitude are associated with the ring current asymmetry. The co-comparison between the VTEC and the DS-index reveals some similarities in their timing variability. Throughout the storm's duration, a change in the electron concentration gradient between SOFI and BUCU GNSS sites has been detected that could be associated with 2D-solitary nonlinear IGW, as well as TID of the electron density excited by them. Based on the obtained results, it is concluded that wavelet transform is a useful tool for studying the local manifestation of strong geomagnetic storms in the time-frequency domain.

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