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A hybrid method for diagnostics of the mid-latitude ionospheric trough using GPS and DEMETER observations

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The middle-latitude ionospheric trough is the main and dominant scale structure, which is identified in F region of the ionosphere. The spatial structure of the trough presents as the latitudinal narrow and longitudinal extended depletion in the electron distribution. The physical mechanisms of the trough formation include complex interconnected physical processes in the mid and high latitude ionosphere. The trough dominates in winter conditions and is regularly detected in the evening and night hours. The occurrence of the trough depends on latitude, longitude and the geomagnetic activity. Latitudinal location of the trough can essentially differ at different longitudinal sectors. Currently GNSS techniques have provided a very good chance to study the ionospheric effects. GPS permanent networks, such as IGS and EPN, provide regular monitoring of the ionosphere on a global scale. The very dense GPS network in Europe (about 150 stations) allows for deriving TEC maps with high spatial and temporal resolution. Recently, TEC maps have been produced with 5 min intervals and with spatial resolution of 150 - 200 km. This high spatial and temporal resolution allows to detect all local and regional features of TEC distribution.The TEC is very sensitive to the changes in foF2-derived electron density. It is useful for identifying

the spatial locations of the main ionospheric trough. In situ satellite measurements can provide comprehensive coverage of the ionosphere effects in both time and geomagnetic location. For these purposes the data gathered on board of the currently operated DEMETER satellite seem to be excellent tool to analyse the signature of the mid-latitude ionospheric trough phenomena. In this paper, simultaneously detection of the signature of the main ionospheric trough by GNSS and in situ wave measurements during both quiet periods and strong geomagnetic disturbances between October 2007 and February 2008 is presented.