



Multi-diagnostic Radio Observations During Ionospheric Disturbances

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Multi-diagnostic observations, covering a significant area of northwest Europe, were made during the magnetic storm interval (April 28-29 2001) that occurred during the High Rate SolarMax IGS/GPS-campaign supported by COST 271 activities. HF radio observations were made with vertical sounders (St. Petersburg and Sodankyla), oblique incidence sounders, on paths from Murmansk to St. Petersburg, 1050 km, and Inskip to Leicester, 170 km, Doppler sounders, on paths from Cyprus to St. Petersburg, 2800 km, and Murmansk to St. Petersburg, and a coherent scatter radar (CUTLASS, Hankasalmi, Finland). These, together with total electron content (TEC) measurements made at GPS stations from the Euref network in northwest Europe, are presented in this paper. A broad comparison of radio propagation data with ionospheric data at high and mid latitudes, under quiet and disturbed conditions, was undertaken. This analysis, together with a geophysical interpretation, allow us to better understand the nature of the ionospheric processes which occur during geomagnetic storms. The main results of the investigations are the following. A narrow trough is formed some 10 h after the storm onset in the TEC which is most likely a result of enhanced ionospheric convection. The so-called main ionospheric effect during a substorm was observed at mid and high latitudes. Ionospheric irregularities observed by CUTLASS were clearly related to the gradient in TEC associated with the trough. The oblique sounder and Doppler observations also demonstrate differences between the mid latitude and high latitude paths during this particular storm. These results could be useful in Space Weather, for radio communications and for ionospheric forecasting.