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First joint analysis of high-latitude SuperDARN data and mid-latitude Irkutsk Incoherent scatter radar observations during September 25-26, 1998 geomagnetic storm

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The Super Dual Auroral Radar Network (SuperDARN) is a very powerful tool for investigating the ionosphere and magnetosphere via the scattering of radiowaves, mostly at F-layer heights. A well-known drawback with SuperDARN, however, is the reduction in ionospheric backscatter experienced during very disturbed conditions, when the electron density is low enough and absorption is high enough to not observe F-layer scattering.

An example of one of such situation, the September 25-26 1998 geomagnetic storm, has been analysed and is the subject of the present paper. During this interval, much of the northern hemisphere SuperDARN network did not observe any F-layer scattering suitable for electric field calculations. Three radars, Þykkvybær(PYK), Stokkseyri (STO) and Hankasalmi (HAN), however did observe very high velocities of the order of 1000m/sec in the west-east direction at F-layer heights.

During the same geomagnetic storm a powerful scattered signal was observed by the mid-latitude Irkutsk incoherent scatter radar (IISR). The presence of this signal was caused by two-stream and gradient-drift instabilities in the ionospheric E-layer due to polar phenomena extending equatorward. A new technique, used at IISR, allows us to calculate the electric field indirectly, by scattered power profile inversion.

Joint analysis of the data obtained at IISR and at PYK, STO and HAN has shown the same velocities to the north from the Irkutsk ISR and in the SuperDARN radar fields-of-view. The analysis has shown that not only amplitudes, but time dependence, correlates well between these two sets of the data obtained with high temporal resolution (about 2 minutes) during almost 5 hours of observations. This suggests that we can use these joint observations to simultaneously monitor the electric field over a wide longitude area (about 120 degrees) in the F-layer by the SuperDARN network, and in the E-layer by Irkutsk ISR.

These results allow us to conclude that using data from mid-latitude radars together with high-latitude SuperDARN data during geomagnetically disturbed conditions is very important and allows us to investigate magnetospheric convection during these very important conditions more fully.

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