

Rates of occurrence of TIGER HF radar echo parameters sorted according season, the K_p index, and the interplanetary magnetic field at sunspot maximum

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The recently commissioned Tasman International Geospace Environment Radar (TIGER) is located on Bruny Island, Tasmania (147.2°E, 43.4°S geographic). Knowledge of the basic occurrence statistics for TIGER HF echoes will facilitate the design of numerous experiments, and the subsequent interpretation of results. The occurrence statistics are different to those found for other radars in the SuperDARN network because of TIGER's unusual mid-latitude location. Yet the tilt of the Earth's dipole field toward Tasmania still results in the default range gate (180 to 3555 km) covering an interval of high geomagnetic latitude (57°S to 88°S). In this study we present the statistics of FITACF parameters derived from all the normal scan beam 4 observations made since the radar commenced routine soundings in December 1999. These sunspot maximum results were sorted according to season, the K_p index, and the IMF vector separated into the four basic quadrants of the B_y - B_z plane.

During summer it was found that 65% of the echoes detected by TIGER were first-hop "ground" echoes from the Southern Ocean, with a peak occurrence rate >80% near to 19 h LT. Of the remaining echoes flagged as "ionospheric," the majority were 1/2- and 1 1/2-hop backscatter from decameter scale irregularities in the nightside auroral oval. Although the zero angle-of-arrival found for 3% of TIGER echoes may be erroneous, their values imply a small population of surface-wave sea echoes (ranges < 500 km), and direct line-of-sight ionospheric echoes. The peak occurrence rate of F -region ionospheric echoes was ~70% near 0130 MLT and 71°S (magnetic latitudes hereafter) for all K_p values, with this peak moving equatorward with increasing K_p . However, the total number of echoes detected decreased dramatically with K_p , thereby demonstrating the sensitivity of the experiment to enhanced absorption. Moreover, there was nearly always a distinct minimum occurrence just past local solar noon, consistent with the normal diurnal variation of D -region absorption at mid-latitudes. Lastly, numerous meteor echoes were identified, mostly between midnight and noon and the first 600 km of range, but peaking at 5 h MLT and ranges 300–400 km.

The statistical average line-of-sight F -region velocities showed clear evidence for the dawn and dusk convection cells, and the cross polar cap jet. The latter was least developed for B_y negative and B_z positive, and most developed for B_y positive and B_z negative, consistent with the prediction of statistical convection models. The location of the greater cusp/cleft was obvious from the maximum spectral widths observed in the pre-noon sector near 78°S magnetic. Another particularly interesting feature was a sharp decrease in cross polar cap velocity and spectral width on the nightside at ~67°S, tentatively associated with equatorward limit of magnetospheric convection. The feature formed the poleward wall of a "trough" in spectral widths (~80 m s⁻¹) found between ~62°S and 67°S, and lasting from ~1930 to 0300 MLT. A region of enhanced spectral widths (150 to > 250 m s⁻¹) found between ~60°S and 64°S then occurred during ~0300 to 0600 MLT (not meteor scatter). Hence the sharp decrease in spectral width at ~67°S is tentatively associated with the poleward wall of the main ionospheric trough and the trough in spectral widths with the overall extent of the trough. The region of enhanced spectral widths during ~0300 to 0600 MLT is associated with F -region irregularities forming high in the pre-sunrise trough when the electron densities are lowest, and is the subject of further investigation.

Summary < 100 Words

The Tasman International Geospace Environment Radar (TIGER) is geographically the most equatorward (43.4°S, 147.2°E) of any of the radars in the SuperDARN network, yet its default range gate still covers an interval of high geomagnetic latitude (57°S to 88°S). Basic occurrence statistics of TIGER echo parameters are sorted according to season, the K_p index, and the interplanetary magnetic field. The statistics are used to investigate the relationship between various spectral width features, the location of the open/closed field-line boundary in the nightside auroral oval, the location of the main ionospheric trough, and field-aligned irregularity production in the pre-sunrise trough.