Bistatic observations of large and small scale ULF waves in SPEAR-induced HF coherent backscatter

T. K. Yeoman[1], L. J. Baddeley[2], R. S. Dhillon[1], T. R. Robinson[1], and D. M. Wright[1]

[1]Dept. of Physics and Astronomy, University of Leicester, University Road, Leicester, LE1 7RH, UK (tim.yeoman@ion.le.ac.uk; rsd6@ion.le.ac.uk; txr@ion.le.ac.uk; darren.wright@ion.le.ac.uk)
[2]EISCAT Scientific Association, SE-98123 Kiruna, Sweden (lisa@eiscat.se)

Abstract - HF radar backscatter which has been artificially-induced by a high power RF facility has been demonstrated to provide ionospheric electric field data of unprecedented temporal resolution and accuracy. Here such data, induced by the SPEAR high power radar on Svalbard, are used to investigate ULF wave processes observed by the CUTLASS HF radars. Observations are presented of both waves with a large-scale nature, driven externally to the magnetosphere and those with small azimuthal scale lengths, driven by wave-particle interactions. For ULF wave events with large azimuthal scale lengths an excellent agreement in the observed wave polarisation ellipse is found between the radar observations and ground-based magnetometer data. In contrast, for the small scale events, no ground-based magnetic counterpart is observed. Indeed the data from the two CUTLASS radars seem inconsistent, and each radar must be interpreted separately, as the spatial resolution of the radars is sufficient to resolve the wave characteristics along the radar beams, but insufficient to resolve the wave characteristics across the beams. A high azimuthal wave number (m) wave with a period of 300 s and m~-60 is observed to occur over Svalbard at ~14:00 magnetic local time. This confirms the existence of waves driven by wave-particle interactions with trapped particle populations in the outer magnetosphere. A comparison of the observed wave characteristics with previous, lower latitude, observations suggests that these high latitude waves have a similar azimuthal scale size to those generated in the inner magnetosphere; the azimuthal wave number of -60 observed in the present study is comparable to previous values of -20– -50, but suggests an increase of m with latitude. A similar energy source in drifting proton populations is also suggested, but with lower characteristic proton energies of 10 keV implicated at high latitude, compared to the 20 – 60 keV energies invoked for previous lower latitude observations.