Power Spectral Analyses of the Ionospheric ULF Micropulsation Data

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Power spectral analyses of perturbations in the geoelectric and geomagnetic fields are reported. The electric field data were obtained by balloon payloads launched in the Antarctic during the 1980-1981 Siple Rocket-Balloon Campaign (L=4) and 1985-1986 South Pole Balloon Campaign (L=14). The magnetic field data were obtained from 3-axis fluxgate magnetometers on the ground. This analysis was performed using a 6x6 cross-spectral matrix computed from 15 s averages of the three components of each field. For the Siple data, dynamic power spectra were computed using data from the 3 longest balloon flights comprising a total of 47 hours. The spectral matrices were averaged into bins determined by magnetic activity level and magnetic local time. For the South Pole data comprising a total of 468 hours from eight balloon flights, the spectral matrices were averaged into bins determined by various IMF and solar wind parameters as well as the geomagnetic parameters. The range of frequencies studied was from 0.07 mHz to 66.7 mHz. It was found from Siple power spectral analyses that the overall shapes of the power spectra for the horizontal components of both fields appear to be in agreement with those of ULF waves published in the literatures. The shapes and amplitudes of power spectra of both horizontal components of the electric field were very similar, whereas the amplitudes of the spectra of the magnetic field components differ by an order of magnitude. The power level of the magnetic field was largest in the H component and lowest in the Z component. The power spectra of each component averaged over Kp and MLT revealed the similar results previously published. From the South Pole power spectral analyses, it was observed that the variation of the amount of magnetic field fluctuation power in the Pc 3-5 frequency band was found to agree with previously published results obtained at both mid-latitude and South Pole. The variation of the amount of electric field fluctuation power, especially in the poleward component, showed different

results. For both data bases, the apparent Hall admittance of the ionosphere was investigated as a function of frequency. The low average value of the B/E ratio as compared to model expectations indicates the presence of a significant amount of electrostatic or short scale size turbulence. The amplitude, time variation and frequency structure of this ratio are the available data for determining the amount of background turbulence, if waves are observed, and, if so, which mode(s). We infer that the observed perturbations have either an electrostatic character or a short horizontal scale size in the frequencies near 3 mHz.