A Statistical Analysis of Q-burst Observations at Arrival Heights, Antarctica

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Large amplitude ELF sferics, specifically "ELF transients" or "Q-bursts" (e.g., Ogawa et al., *J. Geomag. Geoelec.*, 19, 377-384, 1967), are important physical events generated by lightning and detectable in the Schumann resonance band. According to past experimental observations, Q-bursts occur moderately infrequently (approximately once per minute, globally) and are related to sprite occurrence or gigantic jet occurrence, although they do not have a one-to-one correspondence. They are strongly correlated with positive cloud-to-ground lightning (85%) and are observed to propagate multiple times around the globe. Although Q-bursts are essentially thought to be equivalent to strong ELF sferics that are directly associated with the continuing currents in lightning, important issues remain to be clarified. To date, no comprehensive ELF survey has been performed to characterize the nature of the Q-burst. The ELF receiver at Arrival Heights, Antarctica, is ideally situated to perform global observations of Q-burst activity. ELF observations have been conducted nearly continuously at Arrival Heights since the 1980's, although the vast majority of the data is inconveniently stored on magnetic tape. Recent hardware upgrades to the ELF receiver and recording system at Arrival Heights have resulted in significant improvements to the background noise levels, enabling much more sensitive detection of Q-burst activity. The digitization technique now provides ready access to all ELF data sets starting in January 2010. In this paper, we report our initial efforts to statistically characterize the occurrence rate of and Schumann mode excitation by Q-bursts as observed at Arrival Heights, Antarctica. The results will be useful in the develoment of numerical and analytical ELF propagation models that can readily account for day/night assymmetry, the effect of the Earths magnetic field, and the variation of the ground and ionospheric conductivity as a function of space.