THE CHORUS ASSOCIATED WITH MAGNETIC STORMS AND SUBSTORMS, AS OBSERVED BY AN *L*=4 GROUND STATION - A STATISTICAL STUDY

A.J. Smith (1) **and R.B. Horne** (3)

(1)British Antarctic Survey, High Cross, Madingley Road, Cambridge, CB3 0ET, U. K. E-mail: A.J.Smith@bas.ac.uk

(2) As (1) above, but E-mail: R.Horne@bas.ac.uk

ABSTRACT

It is well known that whistler mode waves, predominantly in the form of ELF/VLF chorus, are generated by electrons injected into the magnetosphere during geomagnetic storms and substorms, e.g. [1]. Recently evidence has been found suggesting that this chorus may play a role in the poorly understood acceleration process which produces electron fluxes in the relativistic energy range (~MeV), sometimes known as "killer electrons" which can damage space systems in space weather events, e.g. [2,3]. In order to investigate this hypothesis further, it is necessary to have good quantitative information about the intensity of chorus, and its spatial distribution and time evolution before, during, and after such events. While such data can be and has been successfully gathered by satellite-borne wave receivers, ground wave data provide an alternative and complementary view of magnetospheric chorus activity. Space-borne receivers record the waves at a point in space generally moving in *L* and latitude along the satellite orbit. In contrast, a ground VLF station can detect waves from a large volume of the magnetosphere (typically a few *L* by 1-2 h in local time) at a fixed latitude and longitude for extended time intervals, and usually with higher time resolution and more continuously than is possible in space. A further difference is that whistler mode waves such as chorus which are observed in space will normally be non-ducted, whereas chorus from the same source regions seen on the ground will have propagated mainly in ducted mode. A disadvantage of ground observations is that a model of propagation through and under the ionosphere is needed to infer magnetospheric wave properties from the data.

In this paper we characterise the magnetospheric whistler-mode wave activity at Halley station, Antarctica (76S 27W, *L*=4.3) using a 10-year nearly continuous data set from the VELOX instrument [1]. Almost continuous (>95%) measurements of absolute ELF/VLF wave power, arrival azimuth, polarisation and peak-mean-minimum ratios, in eight frequency band from 500 Hz to 10 kHz have been made with 1 s resolution since January 1992. The results reported here are based upon 1-minute means of the wave power data in three of the VELOX channels in which chorus is most frequently seen, namely 1.0, 2.0, and 3.0 kHz. Power spectra produced by Fourier transforming sections of the data show the expected frequencies representing annual and diurnal variations, i.e. 1/(365 d), 1/(24 h) and their harmonics. In addition we expect a solar cycle variation. The periodic part of the signal representing these frequencies, which is composed of both source and propagation contributions, is modelled by curve fitting, and then subtracted from the original time series to give the sporadic (or non-periodic part) of the signal. This includes substorm- and storm-related chorus events as well as other minor contributions such as from auroral hiss, whistlers, and occasional local interference. An analysis of the storm effect is presented, and conclusions are drawn regarding how the results relate to the proposed role of magnetospheric chorus in electron acceleration.

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