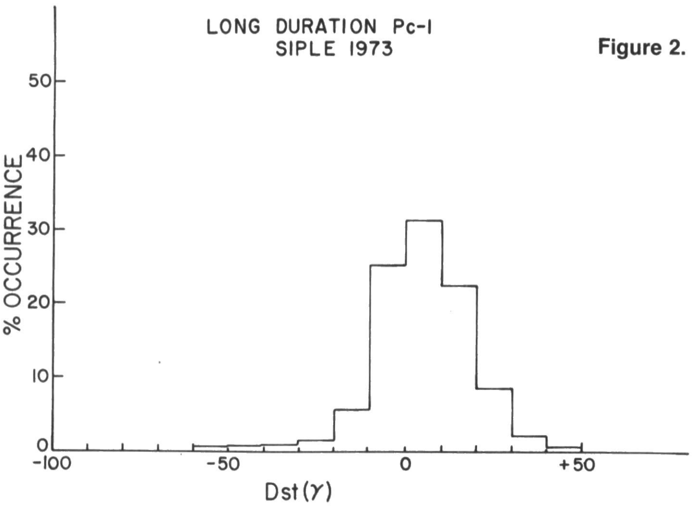

Figure 2.

at the plasmapause. As a next step, the above results will be compared with Siple very low frequency (VLF) determinations of equatorial density profiles.

Long-lasting Pc-1 events have been found in the Siple data. A spectrogram of an interesting long event is shown in figure 1. The event has a sudden beginning and then divides into two frequency bands, later coalescing back into one. An analysis of the dispersion of the two frequency bands suggests very different paths of propagation for the two branches. Long events often consist of pulsating signals such as those seen in the upper branch of the one in figure 1. Since the Pc-1 peaks theoretically are amplified by a resonant interaction with energetic protons, and because the pulsations seen in the long events are comparable to proton drift periods, an attempt is under way to correlate Explorer-45 proton measurements with such events. In the few cases studied, trapped proton pitch angle distributions after the commencement of an event show a marked change from near isotropy to rounded, peaking at 90°. This correlation suggests that the particles are indeed supplying energy to the waves in resonant interaction.

About 35 long events were found in the 1973 data. A statistical study of these events in correlation with Dst is shown in figure 2. The long duration events clearly do not occur during times of ring current inflation; in fact, they appear to favor times of +Dst, when the solar wind is apparently compressing the magnetosphere.

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F-layer duct propagation of hydromagnetic waves in the polar cap ionosphere

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Operation of the three-component induction magnetometer and associated data recording systems at Vostok Station (Soviet Union) continued in cooperation with Soviet scientists of the Arctic and Antarctic Scientific Research Institute, Leningrad.

It is well established that some type Pc-1 hydromagnetic wave events propagate horizontally in the F-layer duct (e.g., Manchester and Fraser, 1970). Some theoretical features of duct propagation have been determined (Greifinger and Greifinger, 1968; P. Greifinger, 1972; Greifinger and Greifinger, 1973). Fraser and Summers (1972) find that Pc-1 signals propagating in the duct are approximately linearly polarized in the horizontal plane in the direction of wave propagation, consistent with the prediction of Greifinger and Greifinger (1968).

Greifinger and Greifinger (1968) also predict the existence of a low-frequency cutoff in the neighborhood of 0.1 to 0.4 hertz for waves propagating in the duct. It is difficult to test that prediction by using Pc-1 data because the source mechanism, the proton cyclotron resonance instability, imposes a natural low frequency cutoff that is generally in the range 0.2 to 2 hertz, depending on the L value and plasma parameters at the source location. However, to this end the broadband magnetic noise designated type Pi may be used. Our archives of pulsation data recorded at College, Alaska, clearly indicate that when College is on the Pi source lines, as evidenced by large amplitudes and correlated particle precipitation effects, the Pi frequencies extend well below 0.1 hertz with more integrated power below 0.1 hertz than above.

Pulsation recordings taken at the polar sites Vostok and Thule disclosed many Pi events with an apparent low frequency cutoff, generally 0.1 to 0.3 hertz (e.g., figure 1). To identify this frequency as a true low frequency cutoff for duct propagation of Pi waves is difficult because we cannot confirm that the observed event was propagated to the polar sites from simultaneous Pi activity observed at auroral oval sites. In structured Pc-1 events, similar features of structure permit one to identify Pc-1 signals that propagate from a common source region to two or more observing sites. Despite lack of similar verification for Pi events, we feel that the evidence strongly supports existence of a low frequency cutoff for events like the one in the figure: that is, under some ionospheric conditions Pi signals originating at auroral oval latitudes propagate to the poles and suffer a low frequency cutoff in agreement with the prediction of Greifinger and Greifinger (1968). Preliminary evidence suggests that poleward propagation of Pi signals is more common than equatorward propagation. The gradients associated with walls of the main ionospheric trough probably are a significant factor in inhibiting equatorward propagation.

The banded continous missions of Tepley and Amundsen (1965) were probably instances of Pi energy propagating in the horizontal duct to low latitudes. Some band-limited Pi-1 events of McPherron *et al.* (1968) may have been cases where short-distance propagation was involved, which resulted in some attenuation of frequencies below 0.1 hertz.

Wave polarizations in the H-D plane for events like that shown in the figure were examined. A large scatter in the alinements of the major axes for any given event greater than 45° was observed, though approximately linear polarization with constant alinement was observed for some wave packets. If this scatter indicates scatter in arrival direction for the Pi-1 waves (Fraser and Summers, 1972), then the observed Pi-1 signals probably originated over a significant local time sector of the auroral oval field lines.

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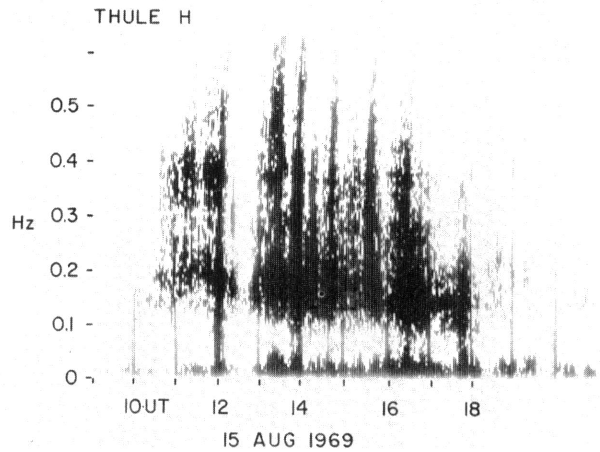

Example of type Pi-1 activity with a low frequency cutoff near 0.1 to 0.15 hertz. The low-frequency cutoff decreases with time in this example. The presence of the cutoff may indicate propagation of the Pi-1 noise in the F-layer duct.

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Whistler-mode VLF propagation measurements at Siple Station

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For about 10 years the Physics and Engineering Laboratory, N.Z. Department of Scientific and Industrial Research, has been carrying out a study of very low frequency (VLF) radio signal propagation