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ACTIVITY REPORT

Section 1. Propagation of Atmospherics and ELF Radio Noise

Measurements of Schumann resonance frequency have been made at Tottori Observatory by a frequency tracker. Using data obtained, averaged diurnal variations of the resonance frequency at particular intervals were examined relative to the solar ionizing radiation, solar zenith angle and the geomagnetic activity.

A real time lightning discharge locator for single station observations was developed using the dispersive characteristics of VLF and ELF propagation. A remarkable merit of this apparatus is the real time locations of atmospherics, with distinction between ground discharges and cloud discharges. How the ratios of ground discharges to cloud discharges change with latitude would be clarified by the use of this apparatus. Although further improvements are necessary and not much data have been obtained at the present time, it is indicated that few ground discharges occur on the sea in the daytime. In connection with this study, because the fundamental studies on the refraction of long wave propagation to great distances are needed, measurements of bearings and polarizations of c. w. signals radiated from a transmitter have been initiated by a Master Course student who joined our research group last spring.

Since we have three kinds of locating equipment including Atmospherics Analyser developed by German scientists, simultaneous observations by those three methods are considered to be very important in improving their accuracy. Merits and weak points of these three kinds of apparatus were compared in a paper presented at the Waldorf Conference on 'Long-Range Geographic Estimate of Lightning Sources' held in September 1972.

Solar zenith angle dependency of the attenuation coefficients for slow tail propagation was examined by simultaneous observations at Tottori and Moshiri Observatories to obtain more precise values of attenuation for daytime. By the use of the Fourier transformation ratio method, which is effective for the waveforms superimposed onto noise, the attenuation coefficients were obtained against frequency at zenith angles of 51° and 74° . It is necessary to collect more data at other angles during different seasons.

As it is important to theoretically investigate the effect of the ionospheric conditions

on wave guide mode propagation, studies were conducted to compare reflections from homogeneous and inhomogeneous ionospheres. A term including the derivative of the refractive index of the ionosphere was introduced to the wave equation derived from Maxwell's Equation in the case of TM wave radiated from a vertical dipole. It was found that the existence of the term involved in the gradient of the refractive index becomes important, particularly at ELF.

Two rocket experiments to measure the electromagnetic field strength were carried out. One was made on September 25, 1971 by a rocket called S-210 launched at Syowa station in the Antarctica. The objective was to examine the VLF hiss in auroral arcs. While the rocket was at an altitude of 95–110 km, both the electric and the magnetic fields of the waves on 7.5 kHz increased. This result will give an important clue to the generation mechanism for some of the auroral hiss events. Another experiment was made by a rocket K-9M launched on February 22, 1972 at Kagoshima Space Center in Japan. The aim of this experiment was to examine both the change of antenna impedance and that of field strength of waves in the ionospheric plasma, and interesting events were observed. These events are now being analysed.

Satellite experiment to measure VLF radio noise in the magnetosphere was carried out from August 19, 1972 to August 22, 1972 at Kagoshima Space Center by REXS Satellite. The data are also being analysed.

Theoretical works on the wave phenomena in the space plasma have been devoted to the excitation mechanism of electrostatic waves by a line dipole immersed in an anisotropic plasma and to the excitation and growth mechanism of plasma turbulences and plasma waves by a moving bodies. Some experiments about the nonlinear wave-wave interaction of plasma waves were carried out by a space plasma chamber at the Institute of Space and Aeronautical Science, University of Tokyo.

Further observations of the arrival direction and the occurrence frequency of atmospheric at Syowa station in the Antarctica were continued from February 1970 to February 1971 by the members of Japanese Antarctic Research Expedition using our instruments. The activity of thunderstorm areas distributed along the equatorial zone was analyzed from these results obtained.

Newly designed field meters for atmospheric at frequencies of 10, 21 and 27 kHz are constructed and the observations are being carried out at Sakushima Observatory together with the observations of intensity and phase of radio waves transmitted from VLF stations at frequencies of 22.3 and 40 kHz. These data are to be transmitted by microwave telemeter system to Toyokawa now. At present, the field strength of the 7 GHz carrier wave is recorded to obtain the data on microwave propagation.

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