Proceedings of the Research Institute of Atmospherics,
Nagoya University, vol. 22 (1975)

ACTIVITY REPORT

Section 1. Propagation of Atmospherics and VLF, ELF Radio Noise

On the basis of the theoretical considerations concerning the polarization error in atmospheric direction finding, an experimental study of direction finding through the use of the ELF component of atmospherics(slow tail) has been initiated in the frequency range between 200 and 500 Hz. Results have been encouraging, although it was necessary to design a new crossed loop aerial for ELF use, interesting facts have been found already. For instance, in the comparison measurements of simultaneous ELF and VLF(10 kHz) DF's, there are some cases in which only ELF directional traces appear on the CRT without those of VLF in a particular sector of azimuthal angle.

For the study of Schumann resonance, the resonant frequency for the non-uniformity of the ionospheric conductivity along the whole propagation path of the cavity has been investigated. The diurnal variation of resonant frequency has been calculated against the local time at the assumed origin by introducing ionospheric conditions represented by the amount of wave impedance at equally spaced segments along the path. The diurnal variation of resonant frequency thus calculated is an intrinsic one for a particular propagation path, and, as a result of it, the diurnal variation of resonant frequency for 1st and 2nd orders has been found to show approximately semi- diurnal variations.

To obtain the propagation constant for a particular propagation path, simultaneous observations of waveforms at two stations are normally required. As the atmospheric waveforms are contaminated by independent radio noise superimposed at every station, the likelihood of correctly estimating the propagation constant has been studied assuming Gaussian noise. By this method, the attenuation factor for ELF relative to frequency has been derived employing the slow-tail waveforms measured simultaneously at two stations with respect to the solar zenith angle $\chi = 52°$.

Further improvements for LSS(locator by single station) have been

devoted to the additional circuits to reduce rather scattered locations of atmospherics. As it is necessary to know the precise locations in order to check the function of the apparatus, the results obtained by LSS have been compared with records of thunderstorms occurring in the People's Republic of China being supplied by a scientist belonging to the Academy of China.

Another interesting investigation is the measurement of wave impedance of 250 Hz atmospherics. The phase term of the ratio of the electric field to magnetic field is represented in terms of both the conductivity and the reflection height of the ionosphere, and is independent of the field intensity of a received atmospherics. The function of the apparatus for wave impedance measurement is designed so that the averaged value of every E/H ratio can be recorded continuously. Tentative observations have been made with successive improvements of circuits.

The S-210JA-19 rocket experiment for auroral hiss investigations was carried out July 15, 1973 at Syowa station in Antarctica. The payloads consisted of two hiss receivers with a loop and with a whip antenna, a tuned radio-frequency receiver for 30 kHz, an impedance meter for antennas and a Langmuir probe. The rocket and instruments worked successfully, and useful data were obtained.

In order to study the geophysical property of the lower ionosphere, the phase-height measurement is being carried out simultaneously at Toyokawa for 22.3 kHz and at Syowa station for 17.4 kHz. Moreover, the preliminary observation of phase-height measurement for OMEGA signals is also being carried out at Toyokawa since May 1974 for 10.2 and 13.6 kHz.

For the provision of EXOS-B satellite experiment which is planned to launch in 1978 and to investigate the wave-particle interaction phenomena in the magetospheric plasma, theoretical works on the wave phenomena have been devoted to the radiation of electrostatic waves from an antenna.

November 12, 1974

— Kazuo SAO ——

— Tetsuo KAMADA —

Publications (1973 – 1974)

Sao, K., M. Yamashita, S. Tanahashi, H. Jindoh and K. Ohta: Experimental investigations on Schumann resonance frequencies. Trans. IECE of Japan 56-B, 6, 252(1973), in Japanese.

Kamada, T., A. Iwata and H. Ishikawa: Methods of measurements and some results of lower ionosphere by using VLF and LF radio waves. Bulletin of COSPAR 16th Plenary Meeting. (1973)

Kurahashi, K. and T. Kamada: Radiation of electrostatic ion waves by linear antenna in anisotropic plasma. Trans. IECE of Japan. A.P. 73-3(1973), in Japanese.

Sao, K. and H. Jindoh: Real time location of atmospherics by single station techniques and preliminary results. J. Atmos. Terr.Phys. 36, 261(1974).

Yamashita, M. and K.Sao: Some considerations of the polarization error in direction finding of atmospherics - I. Effect of the Earth's magnetic field. J. Atmos. Terr. Phys. 36, 1623(1974).

Yamashita, M. and K. Sao: Some considerations of the polarization error in direction finding of atmospherics - II. Effect of the inclined electric dipole. J. Atmos. Terr. Phys. 36, 1633(1974).

Tanahashi, S.: Maximum likelihood estimation of propagation constants and its application to the terrestrial ELF band. Trans. IECE of Japan, in press.

Kurahashi, K.: Radiation of electron cyclotron harmonic waves by a short dipole antenna located in an anisotropic plasma. Trans. IECE of Japan. 57-B, 11, 697-704(1974), in Japanese.

Kurahashi, K. and T. Kamada: Electron acoustic wave perturbed by a strong ion cyclotron harmonic wave. to be submitted to J.G.G..

Kurahashi, K. and T. Kamada: Lower hybrid resonance wave radiated by a short dipole antenna. Planet Space Sci., in press .

Kurahashi, K.: Radiation of ion cyclotron harmonic waves by a short dipole antenna. to be submitted to J. Plasma Phys..

Kurahashi, K.: Radiation of electrostatic waves by a short dipole antenna - analysis taking the weak Landau damping into consideration. Trans. IECE of Japan, in press, in Japanese .