Proceedings of the Research Institute of Atmospherics,
Nagoya University, vol. 18 (1971)

Section 4. Whistlers and VLF Emissions

At the observatories, Moshiri and Sakushima, routine observations of whistlers and VLF emissions have been continued as usual, but at Kagoshima Observatory these observations were stopped in June, 1970, because of the expenditure.

Recent analysis of the data on auroral hiss observed at Syowa Base in Antarctica, indicates that auroral hiss arrives at the ground in the mode of right-handed and nearly circular polarization, having a comparatively small angle of incidence. It is becoming clear that most of the energy of auroral hiss propagates downward roughly within the geomagnetic meridian plane and auroral hiss received on the ground consists of many waves of various angles of incidence and random phases. From these results, it may be concluded that auroral hiss can not propagate to the lower latitudes, because the down coming auroral hiss is reflected at the ground and again enters the ionosphere. Therefore, low-latitude hiss is different from auroral hiss.

The observation of MF band radio-wave propagation with a mother-daughter type sounding rocket, K-9M-29, was made on Jan. 27, 1970, but it failed for lack of radiation power from the transmitter installed on the daughter rocket. The flight of satellite REXS, expected in the summer of 1971, has been postponed until 1972 because of the failure of satellite No. 1.

Data from simultaneous hiss observations (3.2 KHz—8.0 KHz) at ground stations (Moshiri and European network) and the UK-3 satellite during magnetic storms from May to November, 1967 are being analysed. From this study, the following is becoming clear: storm time hiss occurs over the pre-midnight to near noon (magnetic local time) and then they move eastward toward the evening side with a velocity nearly equal to the earth's rotational speed. This storm-time movement of hiss location is closely correlated with the drift motion of a few keV electrons in the storm-time ring current formed in the magnetosphere lower than about 3.5 L. Emission generation by electron cyclotron instability is not adequate for these few keV electrons at such a low altitude as $L=3.5$. The Cerenkov instability caused by an electron beam is being investigated as one of the generation mechanisms for the storm-time hiss as well as the middle-latitude VLF hiss.

From dispersion characteristics of whistlers, the solar-cycle variation of magnetospheric electron density at $L \simeq 1.50$ was investigated, and it was found to have a

good correlation with solar activity. Also, the seasonal variation of dispersion was deduced, being quite different from high-latitude characteristics. Solar-cycle variation of occurrence rate was studied in terms of ionospheric absorption and duct formation. Theoretical calculation of reflection of VLF radio waves from the model lower ionosphere was made. For the bilinear model, conspicuous changes in reflection coefficient arised, being composed of the reduction in reflection coefficient at all frequencies, and components which oscillate with frequency.

Routine observation with the direction finding network has been repeated every one or two weeks each month since last year.

Site error observations, at each station of the direction finding network, were carried out from Feb. to March at Kagoshima and from Oct. to Nov. at Sakushima, in order to establish an accurate correction curve at each station. Around the regular stations, an additional mobile direction finder was used to compare coincident measurements of arrival directions of individual atmospherics between the two direction finders. These observations are now being analysed.

Another direction finding network using an Adcock antenna was constructed in 1969, but sufficient results were not obtained because of unbalanced element antennas and interfering disturbances. Recently, these troubles were solved by improving the antenna coupling method and the pre-amplifier. The observation of this system will begin soon.

A new spaced-loop system direction finder using five crossed-loop antennas in LF band was developed for locating the atmospherics occurring within 2–3 hundred kilometers and was used to observe, experimentally, nearby thunderstorms this summer. As this direction finder showed almost sufficient results, another apparatus used for the triangulation method is now under construction.

December 1, 1970
—— Akira IWAI ——

Publications (1970–1971)

Hayakawa, M., J. Ohtsu and A. Iwai: Rocket Observation of Very Low Frequency Radio Waves in the Ionosphere, Rep. Ionos. Space Res. Japan, **24**, 13 (1970).

Hayakawa, M., J. Ohtsu and A. Iwai: Determination of Electron Density Profile of the Ionosphere by Means of Whistlers Observed on the Rockets, Trans. Inst. Elect. Comm. Engrs. Japan, **53-B**, 477 (1970).

Hayakawa, M., J. Ohtsu and A. Iwai: Plasma-induced Radio Frequency Interferences from Space Vehicle, Proc. Res. Inst. Atmospherics, Nagoya Univ., **17**, 99 (1970).

Hayakawa, M., J. Ohtsu and A. Iwai: Rocket Observation of VLF Radio Waves in the Ionosphere, Proc. Res. Inst. Atmospherics, Nagoya Univ., **17**, 33 (1970).

Kashiwagi, M., J. Ohtsu and A. Iwai: Observation of Tweeks, Proc. Res. Inst. Atmospherics, Nagoya Univ., **17** 125 (1970).

Kashiwagi, M.: Distribution of Atmospheric Sources around Japan for a few days in summer 1969., Proc. Res. Inst. Atmospherics, Nagoya Univ., this volume.

Tanaka, Y., M. Nishino and A. Iwai: VLF Hiss at Syowa Station, Antarctica, Proc. Res. Inst. Atmospherics, Nagoya Univ., **17**, 43 (1970).