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Section 4. Whistlers and Related Phenomena

Our recent activities for whistler studies are made in the following subjects.

1. Real time identification of occurrence and dispersion of whistlers.
2. Direction finding(DF) of whistlers developed the field-analysis-method, being independent of polarization and elevation angle.
3. Electronic goniometer DF for low-latitude whistlers simultaneously observed at multi-stations.
4. Characteristics of low-latitude whistlers and their interpretations.

The real time whistler analyzers have been in operation at Kagoshima (L=1.216) and Sakushima(L=1.284) stations since 1976. As a result, it is found that the analyzer is useful enough to measure the occurrence frequency and dispersion of isolated pure tone whistlers whose S/N ratio is more than 6dB and frequency component continues from 6 to 2.5kHz. The exact measurement of the dispersion of multi-flash type whistlers is rather difficult, being due to the restriction of frequency-time resolution of the dispersion-sensitive-detector. In this case, only the occurrence is recorded. Whistlers observed at Moshiri(L=1.594) are more diffused than the ones at lower latitude stations of Sakushima and Kagoshima. It has been experimentally found in our recent observation at Moshiri that the analyzer is capable of identifying such whistlers that have, in most cases, the diffuseness of less than about several tens msec. Therefore the real time identification of whistlers has been made at Moshiri since December 1977 by using the analyzer improved to count the occurrence of multi-flash whistlers.

A DF system developed the field-analysis-method will be in operation at Moshiri before long. The system is devised to find any direction and polarization by making use of the functions of a goniometer DF and the measurement of the polarization ellipse of horizontal magnetic field in addition to the function of the field-analysis-method. And the DF data converted into eight bit digital signals are stored in magnetic tapes.

In order to detect the ionospheric exit points of low-latitude whistlers, goniometer DF is in preparation. The temporal observations will be simultaneously made at Kagoshima and a station situating at a higher latitude about 300km apart from Kagoshima, for one month from around 20th this month.

As for the propagation characteristics of low-latitude whistlers, which have been reviewed in detail by Hayakawa and Tanaka, it is most important to make clear that the propagation mode of ground-based whistlers is the ducted or non-ducted one. A reasonable solution should be given by DF experiments and another is tried to be presented in a theoretical approach such as ray tracing of ducted and non-ducted VLF wave propagation in the realistic inner magnetosphere models.

Secular variations of low-latitude whistlers have been investigated in the occurrence and dispersion during sunspot cycle No.19 and 20. And it is found that the dispersion decreases with decreasing solar activity but the occurrence shows an opposite trend.
And the late afternoon peak in the occurrence being usually observed in Japanese stations, may be remarkable in a longitudinal sector including Japan. An interpretation is being given from a comprehensive view-point on the source activity, the earth-ionosphere waveguide loss, the ionospheric absorption and the magnetospheric ducting.

As for the atmospheric source fixing at VLF by the triangulation DF networks, a couple of improvements made in connection with the installation of an enhanced computer system at Toyokawa in 1977 are the followings.

1. Storing the DF data in a digital magnetic recorder, instead of on paper tapes.
2. Adopting an automatic repeat request system(ARQ) connecting a minicomputer system in HF radio link for DF data transmission between Kagoshima-Toyokawa and Moshiri-Toyokawa.
3. The digital measurement of angles have been made at Sakushima mainly from a view-point of maintenance of the equipment. The digital measurement including uni-directional detection of bearing angles, will be successively made at Kagoshima and Moshiri.

The DF system at Moshiri was destructively struck by a strongest lightning on 18 October 1977 and it is now in repairs.

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Publications

Hayakawa M. and Y.Tanaka ; On the propagation of low-latitude whistlers, Rev.Geophys.Space Phys.,in press, May 1978

Hayakawa M. and S.Shimakura ; On the mechanism of reflection of ELF-LF radio waves from the lower ionosphere, Trans.Inst.Elect.Comm.Engrs. (IECE) Japan , 61-E,15(1978)

Iwai A.,T.Okada and M.Hayakawa ; Measurement of wave normal directions of low-latitude whistlers in the ionosphere,IECE,59-B,181(1976)

Iwai A.,M.Nishino,M.Kashiwagi and M.Satoh ; A locator system of lightning discharges using the triangulation of direction finders for atmospherics, J.Inst.Elect.Engrs.Japan,in press, 1978

Okada T. and A.Iwai ; A design of dispersion sensitive detector, IECE,59-B,70(1976)

Okada T.,A.Iwai and M.Hayakawa ; The measurement of incident and azimuthal angles and the polarization of whistlers at low latitudes, Planet.Space Sci.,25,233(1977)

Okada T.,A.Iwai,J.Ohtsu and M.Satoh ; A real time whistler analyzer, Proc.Res.Inst.Atmos.Nagoya Univ.,24,1(1977)

Nishino M. and M.Kashiwagi ; The characteristics of the distribution of atmospherics sources and the consideration of the fixing error, Proc.Res.Inst.Atmos.Nagoya Univ.,23,1(1976)

Nishino M. and A.Iwai ; A design of the atmospherics direction finder using the principle of the phase difference measurement,IECE,59-B, 444(1976)

Nishino M. and M.Kashiwagi ; Distribution of the sources of atmospherics noises in the east area of Asia.IECE,60-B,79(1977)