Proceedings of the Research Institute of Atmospherics,
Nagoya University, vol. 26 (1979) - Activity Report -

Section 4. Whistlers and Related Phenomena

Our recent activity is devoted to the understanding of the propagation characteristics of whistlers at low latitudes and to the study of plasma in the inner plasmasphere. Hayakawa and Tanaka have comprehensively reviewed the recent observations and theories on low-latitude whistlers and suggested what should be done experimentally as well as theoretically to make clear the unsolved problems.

The powerful experimental technique for the study is the direction finding. We use two different systems; field-analysis-method and goniometer method. The field-analysis-method was carried out at Moshiri last winter, and yielded the high probability of ducted propagation and the longitudinal movement of ionospheric exit points. The goniometric measurement was also made at Kagoshima, Ohgata in Shikoku and Sakushima last winter, which has provided us with much information on the low-latitude whistler propagation. A more coordinated goniometric experiment will be done in February, this year at the four stations of Sakushima, Tokushima in Shikoku, Kagoshima and Amami-Ohshima. Concerning the accuracy of direction finding, we have calculated the effect of the Earth-ionosphere waveguide propagation on the measurement of polarization and arrival angles of whistlers, which are then compared with the experimental data. The real time whistler analyser which is able to monitor the detailed temporal variation of occurrence rate is found to be useful in studying the formation and decay processes of ducts. The secular variation of the occurrence rate and dispersion during solar cycles 19 and 20 was studied.

Theoretically we have studied the propagation characteristics of whistlers at low latitudes. The conditions of duct trapping at low latitudes were studied, which have yielded that very thin ($\sim$10 km) and highly enhanced ducts are suitable for trapping at low latitudes in combination with ionospheric gradients. The possibility of relevance of non-ducted propagation to the ground whistlers was investigated. The equatorial anomaly during daytime is found to act as a one-sided duct for whistlers, and this guiding mechanism may be

relevant to the daytime whistlers observed at Sakushima and Kagoshima. Another interesting finding is that the horizontal ionospheric gradient associated with the equatorial anomaly can support the pro-longitudinal mode of propagation at the latitude around Moshiri. However, it is found that there is a very low possibility of ground reception of non-ducted whistlers at night.

As for the direction finding network for atmospherics, the apparata installed at the three stations have been reconstructed with the newly developed systems. Routine observations using this new network have been carried out since the beginning of this year.

Aiming at the practical use of atmospheircs, the development of a new locating network for the atmospheric sources within 200 km has been started since last summer.

The cooperative research program with Chularongkon University of Thailand has been planned to study the propagation characteristics of atmospherics. This program will begin from this summer.

Dr. Tanaka is now staying in CRPE (CNRS) at Orleans, France to study the propagation of whistler-mode signals with Dr. L. R. O. Storey on the basis of the FR-1 Satellite data.

February 26, 1979

- Masashi HAYAKAWA -
- Akira IWAI -

Publications

Hasegawa M., M. Hayakawa and J. Ohtsu; On the conditions of duct trapping of whistlers at low latitudes, Ann. Geophys., 34, No.4, 1978

Hayakawa M. and M. Hasegawa ; Ducted and non-ducted propagation of whistlers at low latitudes, Summaries of Papers, 1978 Int'l Symp. Antenna and Propagation, 29-31 Aug. Sendai, 1978

Hayakawa M. and Y. Tanaka ; On the propagation of low-latitude whistlers, Rev. Geophys. Space Phys., 16, 763, 1978

Hayakawa M., Y. Tanaka, T. Okada and A. Iwai ; Goniometric measurement of ionospheric exit points of low-latitude whistlers at two stations, presented at URSI Helsinki meeting, 1-8 Aug., 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., J. Ohtsu, Y. Tanaka, M. Kashiwagi, M. Hayakawa and T. Okada, Simultaneous direction finding experiments of VLF radio emissions in europe and Japan,Int'l Magnetosphere Study Symp.,pp 34-43, July,Tokyo,1978

Iwai A., M. Nishino and M. Kashiwagi ; A locator system of lightning discharges using the triangulation of direction finders for atmospherics, Trans. Inst. Elect. Eng. Japan, 98-C, No.2, 1978

Iwai A., M. Nishino and M. Kashiwagi ; Triangulation direction finding network in Japan for fixing the sources of atmospherics, presented at URSI Helshinki meeting, 1-8 Aug., 1978

Iwai A., M. Kashiwagi, M. Nishino and M. Satoh ; Triangulation direction finding network for fixing the sources of atmospherics, Proc. Res. Inst. Atmos., Nagoya Univ., this volume, 1979

Moriyama S.,T. Okada, M. Hayakawa and A. Iwai; The effect of the Earth-ionosphere waveguide propagation on the polarization and arrival angles of whistlers, Proc. Res. Inst. Atmos., Nagoya Univ., this volume, 1979

Nishino M. and M. Kashiwagi ; Distribution of the sources of atmospherics noises in the east area of Asia, Trans. Inst. Elect. Comm. Engrs. (IECE) Japan, 61-B, 79, 1977

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

Okada T. and A. Iwal ; The measurement of incident and azimuthal angles and the polarization of low-latitude whistlers, presented at URSI Helsinki meeting, 1-8 Aug., 1978

Okada T., S. Moriyama and A. Iwai ; Development of a two-frequency direction finder for whistlers, Trans. Inst. Elect. Comm. Engrs. (IECE) Japan, 61-B, 993, 1978

Okada T. and A. Iwai, The measurement of arrival direction and the polarization of whistlers at low latitudes,Summaries of papers, 1978 Int'l Symp. Antenna and Propagation,29-31 Aug.,Sendai,1978

Okada T.,A. Iwai,J. Ohtsu,and M. Hayakawa, Coordinate measurement of whistlers by using the Real Time Whistler Analyser, Int'l Magnetosphere Study Symp.,pp69-81,July,Tokyo,1978

Tanaka Y.,M. Hayakawa, J. Ohtsu and A. Iwai ; Secular variation of occurrence rate and dispersion of low-latitude whistlers during the solar cycle Nos. 19 and 20,submitted for publication in the Solar Terrestrial Prediction Proceedings, 1978