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Section 4. Whistlers and Related Phenomena

From the comparison between atmospheric intensities around the geomagnetic conjugate zone of ground-based whistler stations and expecte intensities of whistlers escaping from the ionosphere to the ground, an enhancement of whistler activity in the late afternoon (14-17h LT) in winter at low-latitude stations(Sakushima(geomag. lat. 24°) and Kagoshima(20°)) is interpreted in terms of a joint influence of the following factors : 1) electromagnetic energies radiated from whistler-producing strokes in which the total electromagnetic energy is about ten times as great as that in the average lightning return stroke. 2) a high activity of thunderstorms around the geomagnetic conjugate zone(Northern Australia) of our stations. 3) incidence of the radiated energy on to the ionosphere from below at small angles from the upward vertical. 4) the non-loss propagation along a magnetospheric path closely associated with the equatorial anomaly, to the receiver.

The coordinated goniometric direction finding experiments were carried out in 1978-79 at multiple stations. As a result, the exits of daytime whistlers through the ionosphere are located in the high latitude region of the equatorial anomaly. If non-attenuated trapping of whistler energies is theoretically established into enhanced small-dimensional field-aligned ducts existing in the tail of the equatorial anomaly, the above observational result can be understood as the consequence of ducted propagation. On the other hand, nighttime whistlers at low latitudes can be interpreted by ducted propagation mode, which is also evidenced by the coordinated goniometric direction finding experiments.

A newly developed whistler direction finder combined with a field-analysis direction finder and a goniometric one has been equipped at Moshiri(geomag. lat. 34.5°) since 1978. The observed results lead us to conclude that medium-latitude daytime whistlers are attributed to the propagation in an isolated duct and that nighttime whistlers whose polarization is less circular and incident angles are distributed are interpreted in terms of the presence of multiple ducts.

Computer-aided analyses are developed to measure whistler dispersions more accurately than by the real-time whistler analyzer based on the cross-correlation method. The improved whistler analyzer is realized on the basis of the templet matching method, and it can measure, with the measuring accuracy $\pm 2\ sec^{1/2}$, the dispersions of not only pure and discrete whistlers but also of multi-flash and diffused ones immersed in atmospherics and artificial noises such as local noises and power-line harmonics. It is still required to reduce the present calculating time of less than two seconds spent for the estimation of the dispersion of a whistler.

The second year's project of the cooperative research with Chulalongkorn University of Thailand was carried out from August 24 to October 3, 1980, in order to improve the fixing accuracy of atmospheric sources in South-East Asia along the baselines of the triangulation direction finding stations in Japan. The 1979-80 research programme was executed by use of measurements of the propagation time difference of ELF atmospherics between Japan and Thailand, the direction finding network at 7.3 kHz in Japan, and of measurements of the arrival time difference between ELF and VLF. Additionally, the direction finder was equipped at Bangkok, Thailand during the 1980 campaign. As a consequence, it is confirmed that the measurement of the propagation time difference between Bangkok and Toyokawa is useful for fixing accurately atmospheric sources in South-East Asia.

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