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Section 5. Atmospheric Radio Noise and Thunderstorms

A routine observation of the atmospheric radio noise in ELF-VLF bands have been made at the Sakushima Observatory since July this year for the purpose of measuring the long-term variation of the statistical frequency spectrum (SFS). Four different field strength values of $V_{0.1}$ are simultaneously measured, each of which is exceeded with 0.1 percent by the noise envelope at respective output of the four different receivers with a common vertical antenna, their tuned frequencies being 2.5,3.5, 5 and 8 kHz. A SFS curve is obtainable on a graph using a set of $V_{0.1}$ values at four different ferquencies,which are measured for a 100 seconds time interval as each 10 minutes elapses. Based upon automatically repeated measurements at intervals of 10 (or 2) minutes, the diurnal variation of SFS is planned to be obtainable day by day throughout four seasons of the year. Data are transmitted on real time by the microwave telemetry from the Sakushima Observatory to Toyokawa, where these are printed on a roll-paper in a digital form.

By considering that any individual SFS can be determined by both the source statistics and the wave attenuation subjected to at different frequencies as it propagates, the following situations may be worthwhile to be investigated for each datum of SFS. When the nearest thunderstorms approach the measuring site, the obtainable SFS must approximate the source statistics, i.e., the magnitude of the field strength in ELF-VLF bands at the source. When the nearest thunderstorms locate very distantly from the measuring site, individual SFS's must give the wave attenuation at respective frequency subjected to as it propagate over a given distance Then, individual data of SFS may be correlatable to an ionospheric condition, which is expressible by the electron density profile and the electron collisional frequency profile.

An outstanding feature of SFS shape was observed in this summer on a day, when the thunderstorms approached the Meiji-Mura in Aichi-prefecture in the distance of about 70 km from the measuring site. The corresponding time interval, some 20 minutes lasting, was characterized by heavy rains, much accelerated lightning discharges and thunders compared with the other time intervals preceding and following it. The field strength of $V_{0.1}$ is the highest at 2.5 kHz and decreasing with increasing frequency, which is very clearly distinguishable from its various shapes observed for the lower discharging rates.

Based upon the mode theory in ELF-VLF bands, the SFS has been theoretically calculated as a function of the source distance under a given condition of the ionosphere, which is expressible by the electron density profile and the electron collisional frequency profile. The fit problem on the SFS-curve-shape between the theory and experiment will be examined in further study.

During the winter of 1975/76 we observed thunderstorms at Unoke and Fukui in the Hokuriku area. These storms are remarkable in their electrical characteristics because the ground strokes lower positive charge, as opposed to strokes in the more intensively studied summer thunderstorms which lower negative charge to earth. The existence of the reversed polarity strokes was confirmed not only at Unoke but also at Fukui. One discharge recorded by a video camera was a cloud to ground flash initiated by an upward moving streamer. Although previous studies have shown the existence of upward moving streamers originating from tall objects and towers, this streamer which initiated a return stroke originated from an object whose height was less than 15 m. This observation throws a new light on the importance of upward moving streamers in considerations of lightning protection for power transmission lines, and should be given further study.

This winter, in a Japan-U.S. cooperative study, thunderstorms were again observed at Unoke in cooperation with Prof. Brook and Dr. Raymond of the New Mexico Institute of Mining and Technology, Socorro, N.M., U.S.A. The object of the study was to further clarify the electrical nature of the winter thunderstorms, and to this end observation were made of following: 1) Lightning channel characteristics with two video cameras, 2) the 3-dimentional structure of the thundercloud with a 5-cm wavelength radar, 3) the electrical discharge mechanism and development with electric field-change meters at four stations located over an area of 50 km^2, 4) thundercloud charge distribution with three electric field mills, and 5) the location and orientation of the lightning channels by sound ranging with a four microphone network. At an observation site close to ours, Prof. Magono and Dr. Endoh of Hokkaido University, measured charge on precipitation, electric field, and snow crystal shape both at the surface and in cloud with balloons. Their results will be correlated with ours.

Meteorological conditions in the Arctic circle in Sweden are different from those in the temperate zone, so that some characteristics of lightning discharges occurring in this region might be different from those observed in lower latitudes. For the above reason we observed thunderstorms in the summer of 1976 at Kiruna located in the Arctic circle in Sweden. Additional observations were made at Uppsala near Stockholm in the same season to compare the results with those obtained Kiruna. The data obtained at both sites are now being analysed.

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