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“From Frogs to a National Network”

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Summary

Techniques for measuring the electric and magnetic (EM) fields produced by thunderstorms and lightning will be reviewed, with particular emphasis on the fields that propagate to large distances or are “radiated.” We will start with methods that were used to detect electrical storms in the 18th and early 19th centuries (Franklin, Lomonosov, Beccaria, Galvani, etc.). Later, as electrical science improved (Faraday, Henry, Maxwell, Hertz, etc.) and more quantitative detectors became available (Kelvin, Hughes, Lodge, Branly, etc.), wireless telegraphy and telephone systems were developed (Edison, Marconi, Popov, etc.) which increased the need to understand better the sources and characteristics of natural EM interference, which was termed “static,” “strays,” “atmospherics” or simply “sferics” by the operators. In the early 20th century, multiple-station networks of directional receivers were able to verify that (a) lightning is indeed the dominant source of sferics; (b) Earth has an ionosphere that reflects EM pulses and affects their propagation; and (c) the locations of sferics sources can be useful for weather analysis and forecasting (Appleton, Kennelly, Heaviside, Eckersley, Richardson, Bjerknes, etc.). Later, more sophisticated sensors equipped with cathode ray tubes enabled sferics waveforms to be measured with better time-resolution and their sources located; this information also enabled many properties of lightning to be quantified (Braun, Watson-Watt, Schonland, Norinder, Pierce, etc.).

We will conclude this brief review by describing the development and application of gated, wideband EM sensing techniques that now (a) measure the arrival times, waveforms, and other characteristics of lightning impulses; (b) use the wave shapes to infer the type of discharge process that produced the radiation, i.e. whether the impulse was due to a return stroke in a cloud-to-ground flash, a cloud discharge, or some other process; and (c) transmit this information to a central station where propagation corrections can be applied, an optimum source location computed, and the accuracy of that location quantified. Once the source location is known, a more accurate pulse onset time, polarity, and range-normalized amplitude can then be computed, displayed, and archived. These techniques are now the foundation of the U.S. National Lightning Detection Network (NLDN) and similar networks worldwide. Hopefully, the information derived from such systems, and that will be presented at the 2014 ILDC/ILMC, will lead

to improvements in the sensing technology and enhance lightning warnings as well as increase the scientific understanding of lightning phenomena.

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