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Automatic Method for Monitoring the Lower Ionosphere and Lightning Location by Tweek-Atmospherics

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Abstract:

A new real-time technique is proposed for automatic identification of tweek atmospherics, distance finding to lightning and estimating the effective heights of the lower ionosphere for the fundamental and higher order modes of the Earth-ionosphere waveguide. Effectiveness of the technique is demonstrated with the experimental records of atmospherics. Application of a clustering algorithm allowed us to reveal different patterns of variations of the lower ionosphere effective height along different propagations paths. The distance finding accuracy of our tweek method had been roughly estimated by a comparison with independent data from the Blitzortung.org lightning location network to be less than 100 km with standard deviation less than 200 km in the range of distances from 500 to 1400 km.

Keywords: lightning location, lower ionosphere, ELF - VLF radio waves, tweek-atmospherics, Earth-ionosphere waveguide

I. Introduction

Lightning discharges represent a source of electromagnetic interference in a wide range from ultra-low frequencies to gamma-ray frequencies. In the ELF-VLF ranges, the radiation is recorded thousands to tens of thousands of kilometers from the source due to the waveguide propagation in the cavity formed by the conducting surface of the Earth and the lower boundary of the ionosphere. Therefore, the location of lightning and evaluation of the parameters of the propagation path is important in solving EMC problems for communication and control systems operating on the ELF-VLF.

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