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The Terminator Time in subionospheric VLF/LF diurnal variation as recorded by the Romanian VLF/LF radio monitoring system related to earthquake occurrence and volcano erruptions

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The Romanian VLF/LF monitoring system consisting in a radio receiver and the infrastructure that is necessary to record and transmit the collected data is part of the European international network named INFREP.
Information on electromagnetic fields' intensities created by transmitters at a receiving site are indicating the quality of the propagation along the paths between the receivers and transmitters. Studying the ionosphere's influences on the electromagnetic waves' propagation along a certain path is a method to put into evidence possible modifications of its lower structure and composition as earthquakes' precursors.
The VLF/LF receiver installed in Romania was put into operation in February 2009 and has already 3 years of testing, functioning and proving its utility in the forecast of some earthquakes or volcanic eruptions. Simultaneously we monitor, in the same site with the VLF/LF receiver, the vertical atmospheric electric field and different other meteorological parameters as: temperature, pressure or rainfall. The global magnetic conditions are emphasized with the help of Daily Geomagnetic Index Kp. At a basic level, the adopted analysis consists in a simple statistical evaluation of the signals by comparing the instantaneous values to the trend of the signal.
In this paper we pay attention to the terminator times in subionospheric VLF/LF diurnal variation, which are defined as the times of minimum in amplitude (or phase) around sunrise and sunset. These terminator times are found to shift significantly just around the earthquake. In the case of Kobe earthquake, there were found significant shifts in both morning and evening terminator times and these authors interpreted the shift in terminator time in terms of the lowering of lower ionosphere by using the full-wave mode theory.
A LabVIEW application which accesses the VLF/LF receiver through internet was developed. This program opens the receiver's web-page and automatically retrieves the list of data files to synchronize the user-side data with the receiver's data. Missing zipped files are also automatically downloaded. The application appends daily files into monthly and anual files and performs 3D colour-coded maps with graphic representations of VLF and LF signals' intensities versus the minute-of-the-day and the day-of-the-month, facilitating a near real-time observation of VLF and LF electromagnetic waves' propagation. This type of representation, highlights the modification of the terminator time versus the length of the solar-day, improves the user's capability to detect possible propagation anomalies due to ionosphere conditions and allows a quick visual inspection of unexpected behaviors of transmission channels at different frequencies and paths. A very special result, was observed on the recordings made on the propagation path to Iceland (NRK, 37.5kHz). Recordings are made once a minute, for a period of 303 days. Icelandic channel propagation anomalies present in the range of 40-90 days are considered to be precursory phenomena associated with Eyjafjallajokull - Iceland, volcanic eruption occurred in April-May 2010.