A multiple receiver - multiple transmitter VLF high-order differential analysis evaluation network for near real-time detection and discrimination of seismic-ionospheric precursor phenomena

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This study provides an evaluation of the application of high-order differential analysis on VLF signals on a multiple-receiver multiple-transmitter network. This application provides a method for near-real-time detection of disturbances that can be attributed to seismic-ionospheric precursor phenomena and can discriminate disturbances that could be classified as false positives and thus should be attributed to other geomagnetic influences.

VLF data acquired in Thessaloniki, Greece (40.59N, 22,78E) Herakleion, Greece (35.31N, 25.10E), Nicosia, Cyprus (35.17N, 33.35E), Italy (42.42N, 13.08E) and transmitted by the VLF station in Tavolara, Italy (ICV station 40.923N, 9.731E) and the station in Keflavik, Iceland (ICE 64.02N, 22.57W) from January 2015 to January 2016 were used for the purpose of this paper.

The receivers have been developed by Elettronika Srl and are part of the International Network for Frontier Research on Earthquake Precursors (INFREP).

The process applied for this study has been further developed and is based on differential analysis. The signals undergo transformation using an enhanced version of the Hilbert Huang Transform, and relevant spectra are produced. On the product of this process, differential analysis is applied. Finally, the method produces the correlation coefficient of signals that are on the same path over an earthquake epicenter in order to highlight disturbances, and on the opposite can make comparisons with unrelated transmitted signals of different paths to eliminate disturbances that are not localized to the area of interest. This improvement provides a simple method of noise cancellation to signals that would otherwise be considered as false positives.

A further evaluation of the method is provided with the presentation and discussion of sample results. The method seems to be a robust tool of analysis of VLF signals and also an automatic detection tool with built-in noise cancellation of outside disturbances.