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Sub-ionospheric VLF/LF waveguide anomalies over Europe

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Extended Abstract

Ground based long-term sub-ionospheric VLF/LF amplitude and phase measurements of propagation paths along spatially far away distributed transmitter and receiver facilities provide a powerful tool to characterize waveguide parameters and their variations under various endo- and exogenic dynamics. This monitoring service is usually one component of multi-parameter seismo-electromagnetic investigations. Figure 1 shows the dense web-like structure of the radio links with a focus on Europe, details and performance of the receiving facilities are given in [1, 2].

The VLF/LF waveguide extends from the Earth's surface up to the D/E-region (day/night) of the ionosphere with a variety of natural and man-made electromagnetic sources in the lithosphere, atmosphere, and ionosphere. Our primary objective are soundings of waveguide modifications related to seismic activity determined via regular VLF/LF amplitude and phase measurements at the receiver stations. We show results from earthquakes with magnitude $M_w \geq 5.5$ where VLF/LF radio link crossings are available (observations over Southern Europe during the last years) and we explore coupling mechanism within the waveguide boundaries, among them acoustic waves and atmospheric gravity waves. In general, numerous amplitude and phase anomalies with a suitable S/N ratio are available, but it is mandatory to probe the full power of combined links in the network in order to disentangle the sources. The study also explore the impact and potential of complementary investigations from ground and space.

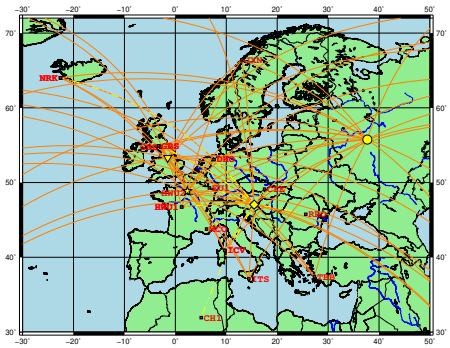

Figure 1. Map of the European part of the VLF/LF receiver network (three operational stations, one planned; symbols in yellow) showing the great circle paths (orange lines) to the transmitters (red squares) in the northern hemisphere. Additional receivers which further intensify the net – mainly in Southern Europe, the INFREP system [2] – are not shown, except the Graz station with paths to ten transmitters (yellow dot-dot-dash lines).

References

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