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## VLF radio remote sensing of ionospheric disturbances in Southern Europe

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We report in our study on intense earthquakes which occurred in Southern Europe in the period from 2009 to 2017. We have selected events characterized by a magnitude of more than 5.5 and a depth of less than 10 km. Those earthquakes occurred in central Italy (4 events), and in Crete and Ionian Islands in Greece (5 events). Previous studies have shown a drop of VLF amplitude signals several days before the earthquake occurrence (Hayakawa, 2015). This is associated to lithospheric physical processes which disturb the lower ionosphere above the seismic preparation zone. Such ionospheric disturbances perturb and alter the 'regular' VLF radio wave propagation. We use in this analysis the VLF transmitter signals recorded by the seismo-electromagnetic station in Graz, Austria (Schwingenschuh et al., 2011). Particular interests are given to transmitters situated in Southern Europe, e.g. ITS (Sicily, Italy) and ICV (Tavolara Island, Italy) transmitters, which lead to remote the ionospheric disturbances before earthquake occurrence. A quantitative method is applied to characterize the VLF daily reception signal. We discuss the efficiency of this method and the way to distinguish the effect of seismicity from non-seismic sources.

Reference:

Hayakawa, M., Earthquake Prediction with Radio Techniques, Ed. John Wiley & Sons, 2015. Schwingenschuh et al., The Graz seismo-electromagnetic VLF facility, Nat. Hazards Earth Syst. Sci., 11, 2011