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Ray paths of VLF/LF transmitter radio signals in the seismic Adriatic regions

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We analyze the radio wave propagations of VLF/LF transmitter signals along subionospheric paths using two different reception systems localized in the Graz seismo-electromagnetic facility (15.43E,47.06N). Those systems allow the simultaneous detection of more than fifteen transmitter signals emitting in the northern (i.e. France, Germany and United Kingdom) and southern (i.e. Italy and Turkey) parts of Europe. In this work, we investigate the transmitter radio wave propagations associated with two earthquakes (EQs) which occurred, at two occasions, in nearly the same Croatian regions (Geo. Long.=16°E; Geo. Lat.=45°N). The first and second EQs happened, respectively, on March 22 and December 29, 2020, with magnitudes M_w equal to 5.4 and 6.4. The use of two complementary reception systems, i.e. INFREP (Biagi et al., *Open Journal of Earthquake Research*, 8, 2019) and UltraMSK (Schwingenschuh et al., *Nat. Hazards Earth Syst. Sci.*, 11, 2011), and the proximity to the epicenters lead us to characterize the behavior of the transmitter signal amplitudes particularly above the Croatian seismic regions. We analyze the amplitude variation for a given transmitter frequency starting few weeks before the earthquakes occurrences. We discuss the observed anomalies in the transmitter signals which may be considered as precursors due to the ionospheric disturbances of the transmitter ray paths above the earthquakes preparation zones.