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Precursors Signatures of Few Major Earthquakes in Italy Using Very Low Frequency Signal of 45.9kHz

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Abstract : Earthquakes still exist as a threating disaster. Being able to predict earthquakes will certainly help prevent substantial loss of life and property. Perhaps, Very Low Frequency/Low Frequency (VLF/LF) signal band (3-30 kHz), which is effectively reflected from D-layer of ionosphere, can be established as a tool to predict earthquake. On May 20 and May 29, 2012, earthquakes of magnitude 6.1 and 5.8 respectively struck Emilia-Romagna of Italy. A year back, on August 24, 2016, an earthquake of magnitude 6.2 struck Central Italy (42.7060 N and 13.2230 E) at 1:36 UT. We present the results obtained from the US Navy VLF Transmitter's NSY signal of 45.9 kHz transmitted from Niscemi, in the province of Sicily, Italy and received at the Kiel Longwave Monitor, Germany for 2012 and 2016. We analyzed the terminator times, their individual differences and nighttime fluctuation counts. We also analyzed trends, dispersion and nighttime fluctuation which gave us a possible precursors to these earthquakes. Since perturbations in VLF amplitude could also be due to various other factors like lightning, geomagnetic activities (storms, auroras etc.) and solar activities (flares, UV flux, etc.), we filtered the possible perturbations due to these agents to guarantee that the perturbations seen in VLF/LF amplitudes were as a precursor to Earthquakes. As our TRGCP path is North-south, the sunrise and sunset time in transmitter and receiver places matches making pathway for VLF/LF smoother and therefore hoping to obtain more natural data. To our surprise, we found many clear anomalies (as precursors) in terminator times 5 days to 16 days before the earthquakes. Moreover, using night time fluctuation method, we found clear anomalies 5 days to 13 days prior to main earthquakes. This exactly correlates with the findings of previous authors that ionospheric perturbations are seen few days to one month before the seismic activity. In addition to this, we were amazed to observe unexpected decrease of dispersion on certain anomalies where it was supposed to increase, thereby not supporting our finding to some extent. To resolve this problem, we devised a new parameter called dispersion nighttime (dispersion). On analyzing, this parameter decreases significantly on days of nighttime anomalies thereby supporting our precursors to much extent.

Keywords : D-layer, TRGCP (Transmitter Receiver Great Circle Path), terminator times, VLF/LF
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