



Ionospheric TEC studies with GNSS system and corresponding variation of soil radon in some pre-seismic days of 24th Solar Cycle

Arpita Guha Bose ^{(1)*}, Aditi Das ⁽¹⁾, Saheli Chowdhury ⁽²⁾, Argha Deb ⁽²⁾

(1) Dept of Physics, Asutosh College, 92, S.P. Mukherjee Road, Kolkata-700026

(2) Dept. of Physics, Jadavpur University, Kolkata-700032

*Corresponding author email: arpitabose163@gmail.com

Total Electron Content (TEC) has been considered as an important earthquake precursor in ionospheric studies. Data from Global Positioning System (GPS) satellites of Global Navigation Satellite System (GNSS) are now used extensively in seismic precursor studies. This study was mainly dealt with the cases of moderate to large scale earthquakes ($M_w > 5.0$) occurring in the Indian subcontinent, situated near the northern crest of equatorial anomaly in 24th solar cycle period (2008-2019). The ionospheric TEC prior to earthquakes was already studied by many researchers all over the globe for long time [1,2,3,4,5]. In this paper, a few studies in some pre-earthquake scenarios related to ionosphere as well as lithosphere have been presented for some large earthquakes occurring over the 24th Solar cycle. The study focuses on researches on two earthquake precursors – ionospheric TEC and soil radon concentration. For the first part, the present authors analysed freely available online GPS/GNSS data (UNAVCO) and also data taken from Institute of Radio Physics and Electronics, University of Calcutta, Kolkata, India in different earthquake periods occurring in 24th solar cycle. Results of these data had shown anomalies in ionospheric electron density distribution during pre-seismic days where the sunspot number is high and low (during 2014-15 and 2018-19 period). Prominent anomalies were observed in the TEC values 1-15 days before the earthquake day. It was interesting to observe how solar and geomagnetic variations would affect these TEC variations in the days before earthquakes. On or around the days of TEC anomalies, soil radon anomalies were also observed. Soil gas radon concentration was monitored continuously with solid state nuclear track detector (SSNTD) at Jadavpur University, India. A number of pre-seismic soil radon anomalies were observed during 2014-15 and 2018-19 which corresponded more or less with the ionospheric TEC variations detected during the same period of time.

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