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ORIGINAL STUDY

A combined approach using b-value and ionospheric GPS-TEC for large earthquake precursor detection: a case study for the Colima earthquake of 7.7 M_w, Mexico

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Abstract
Possible ionospheric TEC precursor and crustal stress (b-value) precursor related to the M_w 7.7 Colima earthquake of September 19, 2022, were analyzed in the present study. b-value analysis was conducted using the Gutenberg-Richter law. Results indicate a decrease in the b-value towards the western part of Colima Rift and Michoacan Block due to an increase in the effective stress level before major earthquakes. Further, the Poisson probability was also computed from the derived data that indicates the probability of 82% occurrence for a 7.7 M_w earthquake. In addition, several negative anomalies in TEC (Total Electron Content) before the 7.7 M_w Colima earthquake were observed by GPS data. A distinct anomaly was observed on 22 August and 6 September, 2022, 28 and 13 days before the earthquake. The study also found that TEC values were significantly low in areas with lower b-values, indicating a higher probability of larger earthquakes. Additionally, a low TEC zone was detected near the epicenter before the earthquake using TEC data from a dense network of 57 GPS sites in Mexico.

Keywords Total electron content (TEC) · vTEC · LAIC · b-value · NNI · Colima earthquake

1 Introduction

The process of generating earthquakes is a complicated phenomenon that encompasses various scales of the Earth's crust, ranging from tectonic plates to microscopic processes such as friction, electric charge generation, and chemical reactions. Earthquakes are closely related to the dynamics of the Earth's crust and are a natural occurrence that can result in immense damage to life, property, the environment, and the ecosystem. Therefore, it

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