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The detection of seismo-ionospheric anomalies using the deep neural network

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Total Electron Content (TEC) measured by the Global Positioning System (GPS) is useful to register the pre-earthquake ionospheric anomalies appearing before a large earthquake. In this paper, the TEC value was predicted using the deep neural network. Also, the anomaly is detected utilizing this predicted value and the definition of the threshold value, leading to the use of the anomaly as a precursor. In neural networks, Convolutional Neural Network (ConvNets or CNNs) is one of the main categories to do images recognition, image classifications, object detections, facial recognition, etc. In this study, the CNNs has been applied to the ionospheric TEC of the Global Ionosphere Maps (GIM) data on a powerful earthquake in Chile on the 1st of April in 2014. In this method, a two-hour TEC observation is converted into a time series for this region for several consecutive days before and after the occurrence of an earthquake. The prediction of the non-linear time series is formulated as a method for specific pattern recognition in the input data using ConvNets. Results indicate that under suitable conditions the TEC values can be estimated properly in the aforementioned days and hours by ConvNets. In order to show the efficiency of this method in predicting the time series, the results obtained from this research were compared with those from other researches.