Long-Short Term Memory (LSTM) Neural Network for Pre-earthquake Geomagnetic Anomaly Detection from Principal Component Time Series

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Pre-earthquake anomalous variations in Earth's ionosphere and lithosphere were examined in ~800 km radius for two major earthquake episodes in China – M6.0 in Arzak, occurred on 19th January 2020., and M6.3 occurred in Xizang on 22nd July 2020. The study has built on a previously conducted Empirical Orthogonal Function and Principal Component Analysis (EOF and PCA), utilizing ESA's satellite SWARM A, B, and C geomagnetic data. Eight observed significant PC time series were selected for modelling using a LSTM neural network architecture on a three-month and 1-year time scales, each of them is split into training and testing subsets. Strong departure from normal behaviour was noted on 9th January 2020 in Arzak region, and on 14th July 2020 in Xizang, corresponding to results previously obtained through EOF and PCA. Several additional anomalous events were observed in a period of two weeks and one month prior to the earthquake events, which further investigations are under way.