GEOMAGNETIC DATA AS A PRECURSOR OF THE SEPTEMBER 5, 2018 EARTHQUAKE IN JAPAN (MW= 6.6)

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Magnetic anomalies have been discussed long ago as an earthquake precursor. Any parameter that changes before the occurrence of the earthquake, so that a precise investigation of these changes could predict the earthquake, is called a precursor. In this study, the characteristic curves are obtained by frequent over plotting of magnetic data in a 24-hour time frame, for three geomagnetic stations and in Japan (MMB, KAK, KNY). All three components (Z, Y, X) or (Z, D, H) were processed in a period of one year. In order to increase the intensity and distinction of the anomalies observed before the earthquake in comparison with the original data, we tried to eliminate the effect of daily variation of the magnetic field by this method.

The changes in the magnetic field associated with the change in stresses were first observed by Stacey (1963) and Nagata (1969). Nagata introduced tectonomagnetism for the first time. Tectonomagnetism involves the variation of the magnetic field associated with the occurrence of the earthquake. Reiki Taki (1976) and Melon et al. (1998) studied the geomagnetic effect of earthquakes. Comparison of simultaneous data of a geomagnetic network of seismic magnetic effects is quite evident (Liu et al., 2006).

The data are from the INTERMAGNET site and the station's distances are less than 500 kilometers (Figure 1 left). Among the various magnetic components, the X components are usually more suitable for the proposed process. The characteristic curve can be seen in (Figure 1 right), the middle solid line which is surrounded by dash lines which show its uncertainty. After removing daily changes from each of the components, we can observe anomalies related to the earthquakes more distinctly in Figure 2. In this figure, the raw record is presented at left. The processed record at right

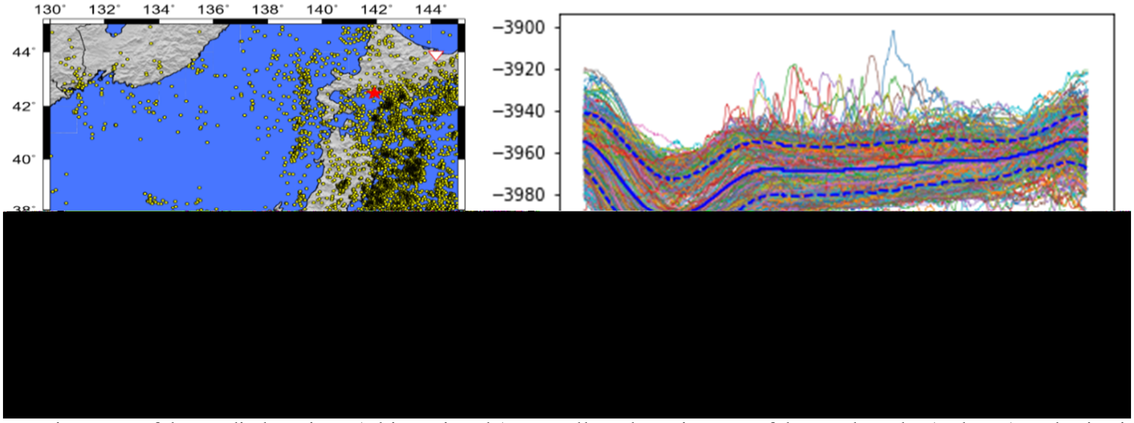

Figure 1. Left: Location map of the studied stations (white triangle), as well as the epicenter of the earthquake (red star) and seismicity of the region from 1900 to 2014 (yellow dots). Right: The characteristic curve (the solid line) in one of the stations plotted for the X component of the magnetic field. Dashed lines are confidence limits based on 1σ calculation. The horizontal axis represents the time (min) and the vertical axis represents the magnetic field amplitude (nT).

shows more distinct anomaly prior to the earthquake.

There is an anomaly on 2018/08/26, due to the earthquake occurring about 10 days after later. This anomaly can be described as a precursor for Japan's 6.6 magnitude earthquake 2018/09/05. Also, with a similar method, a second anomaly on 2018/09/11 was observed, which could be probably related to the 4.8 magnitude earthquakes occurred on 2018/09/16 in the same area but the time window between the observation of the anomaly and occurrence of the earthquake (5 days) is less than what is expected, considering the other case studies which show it should be generally more than 7-8 days.

After complete processing on geomagnetic data, more information was obtained for further investigation and consideration of other aspects that may create anomalous magnetic data, such as magnetic storms (from the USGS website). The collected data shows that two magnetic storms have been reported on the same dates (2018/08/26 and 2018/09/11). Thus the relevance of the magnetic storm and the observed anomalies need more accurate studies on the nature of geomagnetic precursors.

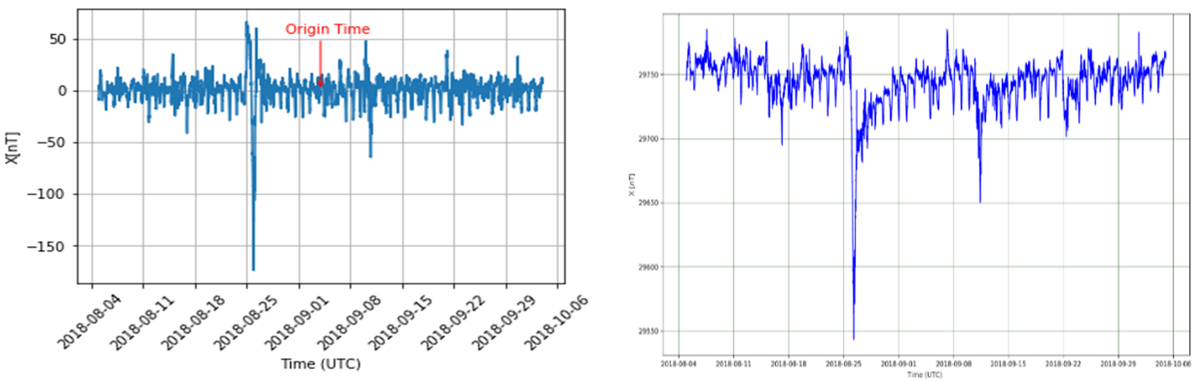

Figure 2. The raw (left) and the processed data (right) within a week before and after the origin time of the Earthquake for one of the stations (X component).

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