

Analysis of Geomagnetic Disturbances for Earthquake Precursor Detection

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Presentation Outline



Background

Motivation

Workflow

Results

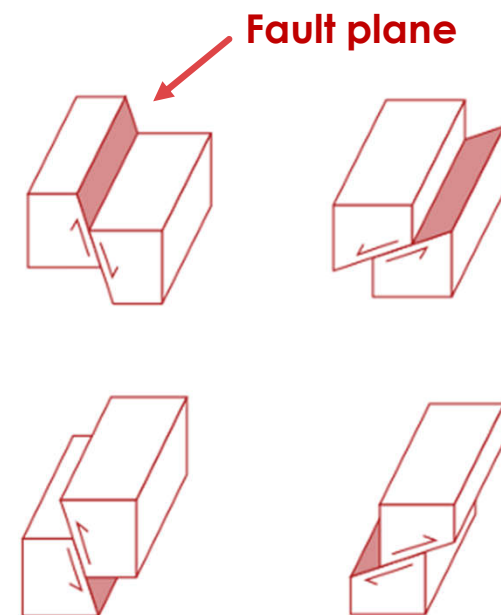
Discussion

Conclusion

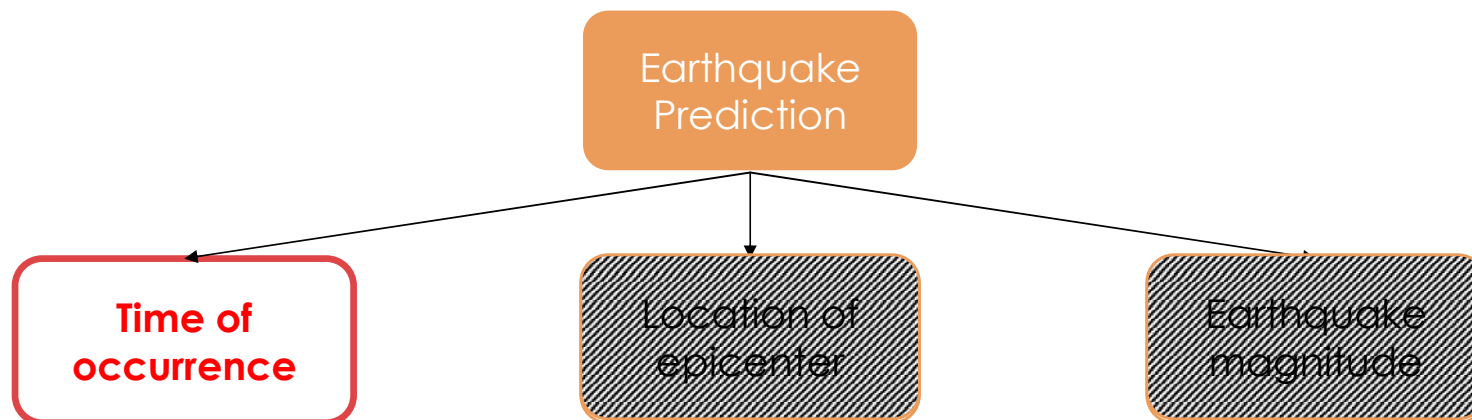
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Earthquake happens when two blocks of the earth slide past another.

The phenomena before the earthquake event is called earthquake preparation process. The ground magnetic field could be affected by the phenomena within that particular area.



The challenge in understanding the relationship between the earthquake and the regional geomagnetic changes.



(Uyeda, 2013)



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Approach: Diurnal variation range ratio (DVRR) method

- Only necessitates 1-min sampling period
- Could extend to other non-seismological area
- Provide the predicted period range of the earthquake occurrence

Inconsistencies in the application of the DVR method

Objective: To determine the most efficient approach for the analysis of the magnetic response prior to the earthquakes.

I) DVR Method 1: Anomalies Based on Threshold Values

II) DVR Method 2: Anomalies Based on 1-year Background Comparison



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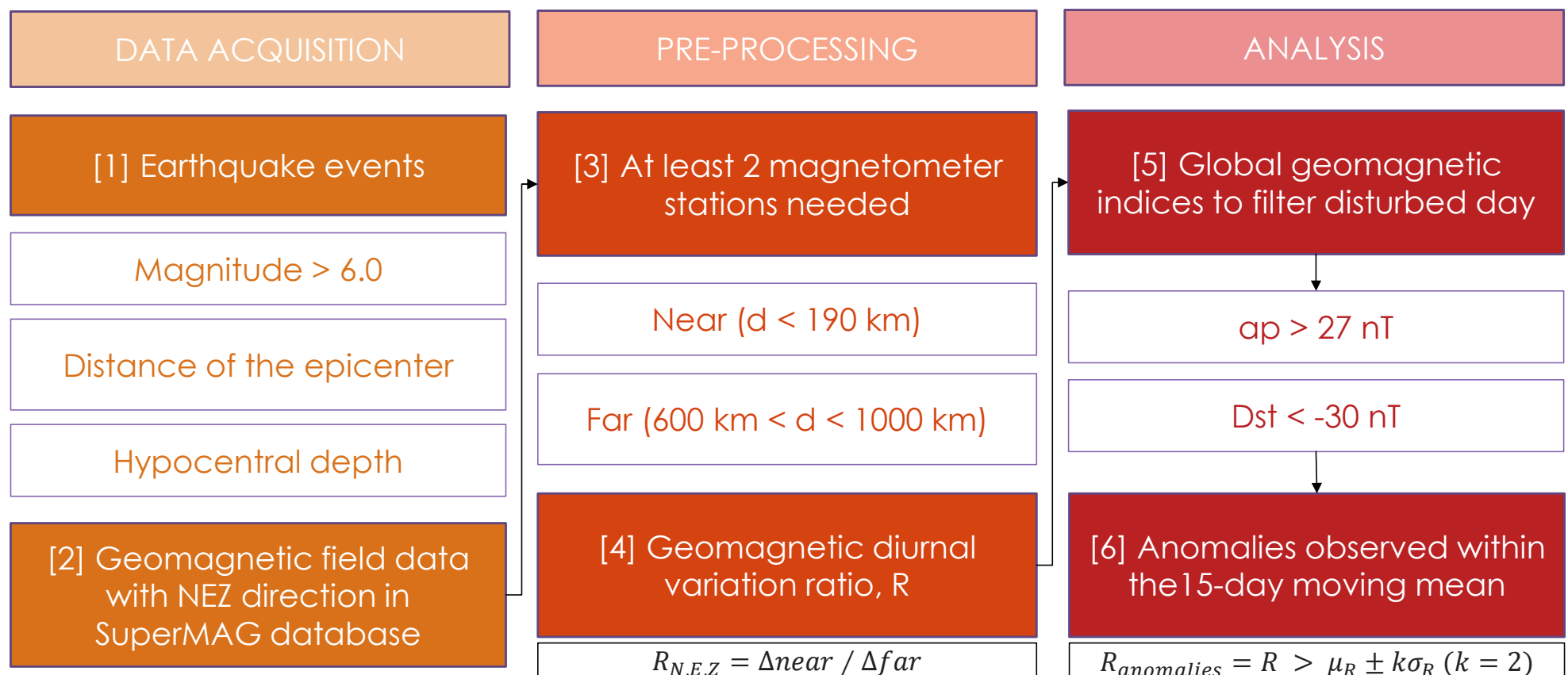
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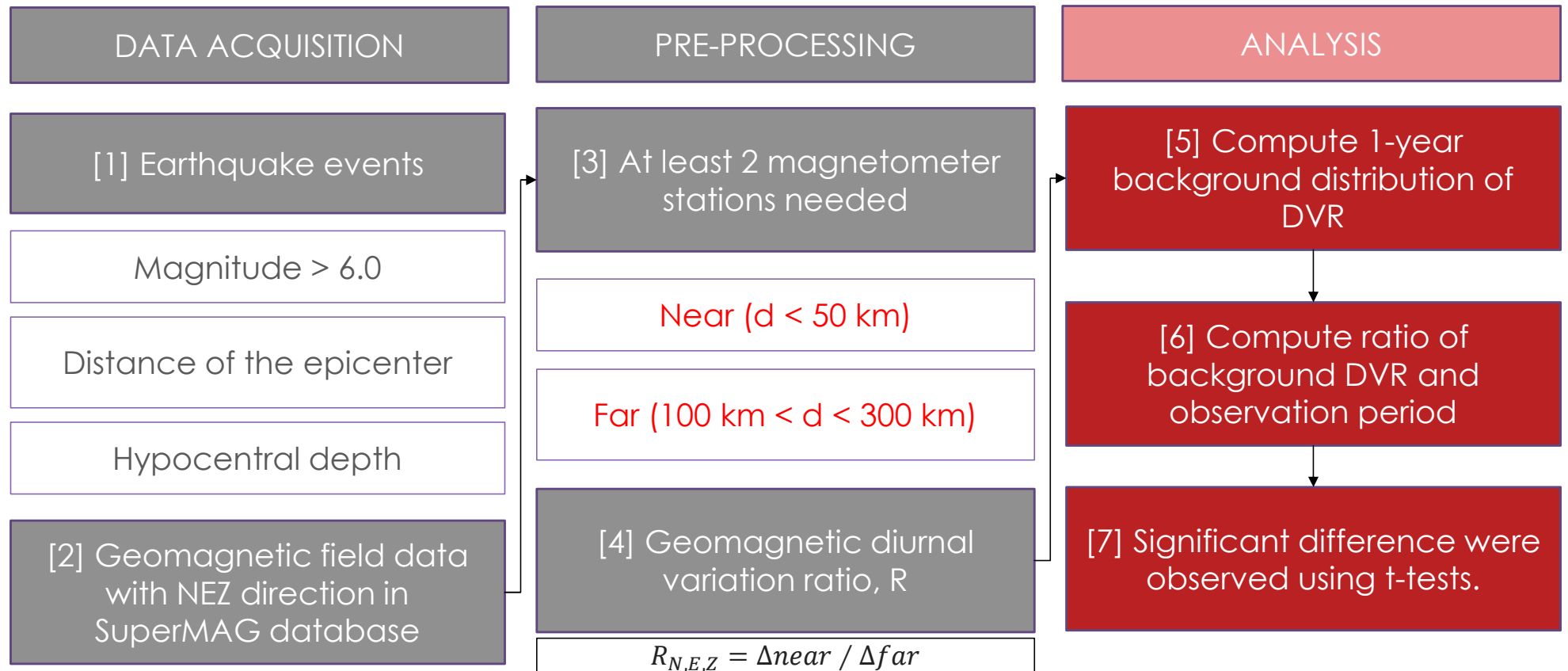
Conclusion

Workflow (DVR Method 1: Anomalies Based on Threshold Values)



(Yusof et al., 2021)

Workflow (DVR Method 2: Anomalies Based on 1-year Background Comparison)



(Modified from Liu et al., 2006)

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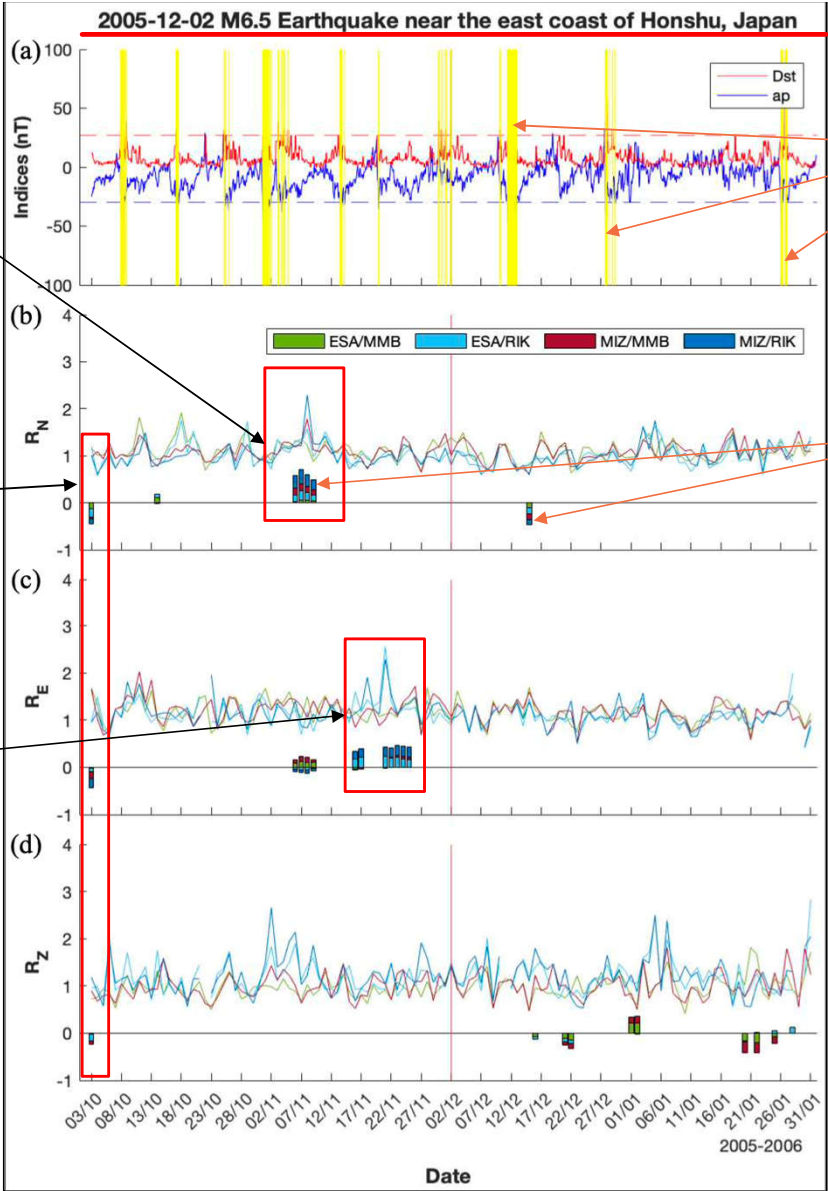
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DVR Method 1: Anomalies Based on Threshold Values

23 days before earthquake

60 days before earthquake

7 days before earthquake



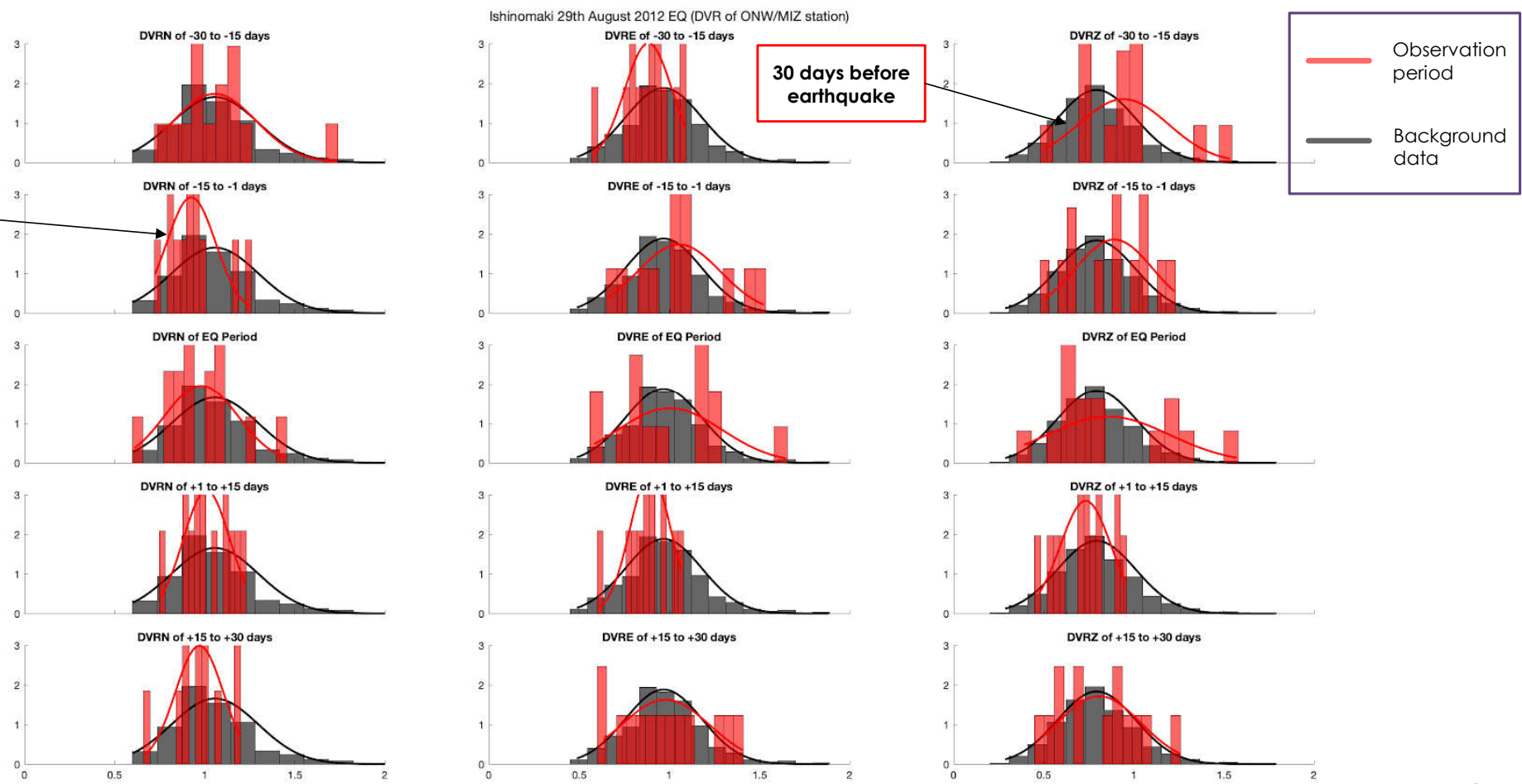
Yellow shaded region = the occurrence of the geomagnetic storm

The anomalous period were indicated by the bar graph of the 15-day moving mean in each component

The observation period was conducted 60 days before and after the earthquakes

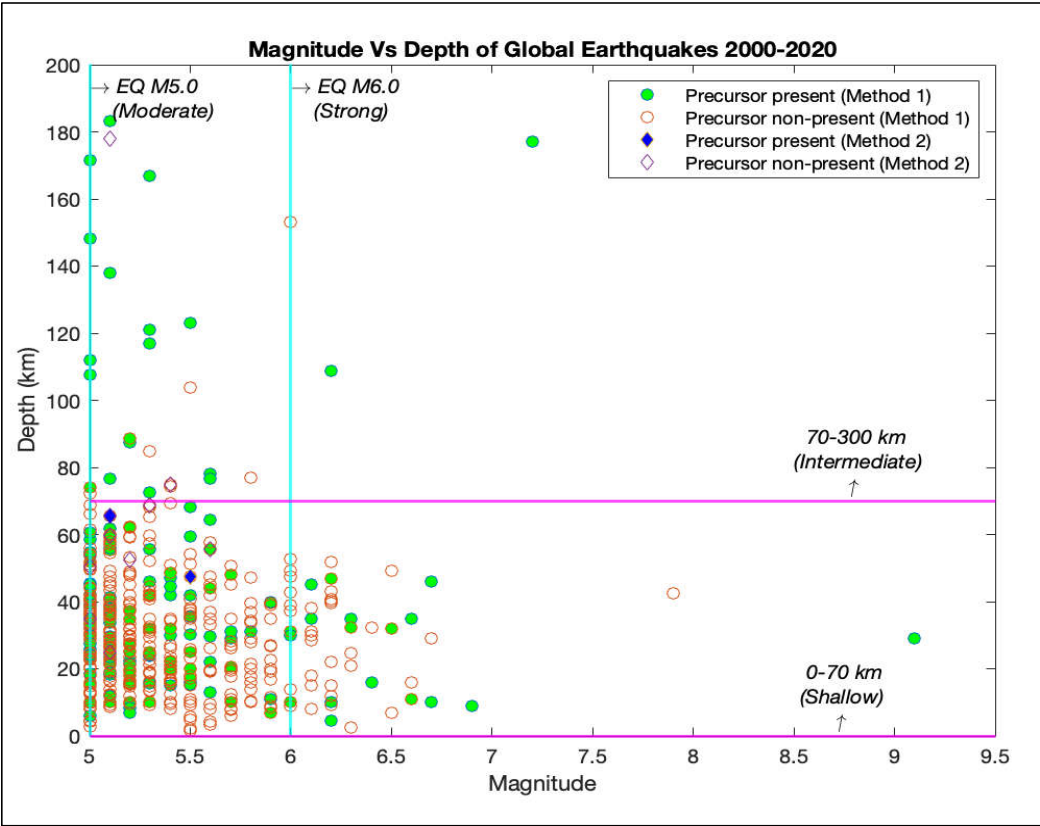
DVR using anomalies threshold during 2nd December 2015 EQ, near the east coast of Honshu, Japan.

DVR Method 1: Anomalies Based on 1-year Background Comparison



DVR using 1-year Background Geomagnetic Data for Onagawa (ONW) and Mizusawa (MIZ) during 29th August 2012 EQ, 44 km E of Ishinomaki, Japan.

Results



Shallow-focus EQ
Method 1: 25%
 Method 2: 17%

Mid-focus EQ
Method 1: 76%
 Method 2: -

Moderate EQ
Method 1: 26.34%
 Method 2: 15%

Strong EQ
Method 1: 41.25%
 Method 2: -



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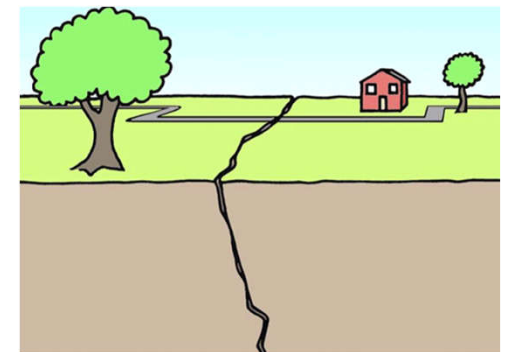
How the anomalies generated?

I. Conductivity structure changes during the earthquake preparation.

II. Caused by: (Chen et al., 2013)

‡ Momentary existence of earthquake-related high conductivity materials.

‡ Movement of electric current along faults.



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- The two DVR variants implemented by previous studies were compared and analysed to determine the efficiency of both techniques.
- One of the more significant findings to emerge from this study is that **Method 1: Anomalies Based on Threshold Values, yields more significant results** as compared to Method 2: Anomalies Based on 1-year Background Comparison.
- The anomalies appeared as early as **60 days before EQ event for Method 1** while **Method 2 revealed the anomalies as early as 30 days** in all components.
- The evidence from this study suggests that **Method 1 could produce more significant results** in detecting the earthquake precursor prior to the earthquake events.

**Thank you for your attention.
We appreciate for any feedbacks
and comments.**