Satellite Application for Felt Earthquake Events in Sabah, Malaysia

A. Sali, D. Zainal, N. H. Tauhid Ahmad, and M. F. Omar

***Abstract*—The recent earthquake in Ranau, Sabah on 5 June 2015, which killed 18 people,has opened up the reality of impending earthquakes in Malaysia since the country had never experience any major earthquake before. To monitor the earthquake events, the Malaysian Meteorological Department (MetMalaysia) has the system implemented a real-time and remote earthquake monitoring all over Malaysia since 2004. The system helps in extracting the data for development of a possible Earthquake Warning System (EWS). From data obtained from the system, this paper analyses relation between felt earthquake events and seismic parameters such as intensity, distance to epicentre, foundation and elevation of seismic stations. The events under study occurred in Sabah, Malaysia, from 2004 to 2014. In particular, displacement (D), accelerated velocity (V) and acceleration (A) from 2004 to 2014 are analysed and discussed. The feasibility of modelling two outstanding felt earthquake events is assessed using Gaussian distribution with reasonable RMSE values.**

***Index Terms*—Earthquake warning system, Sabah, Malaysia.**

I. Introduction

Earthquake occurrence is one of the significant events in nature that causes both irretrievable financial and physical harm. Apparently the monitoring of earthquake is essential in developing Early Warning System (EWS) for disaster management is proposed. The geological and seismotectonic information of the South East Asia region showed that Malaysia do face certain degree of threats from major earthquakes originating from the surrounding regions as well as from local earth tremors [1]. These potential threats are in the form of tsunami and ground shaking. In [2], the earthquake epicenter data of past 80 years of the Southeast and East Asian region is shown.

From [2], several epicenters are shown in the Straits of Malacca, however the magnitude is small, less than 4 Mb. The intermediate depth earthquakes of adjacent to Sumatera with magnitudes in excess of 6 could possibly produce moderate ground shaking in Peninsular Malaysia may be hazardous to high-rise buildings [2]. For East Malaysia region, two earthquakes in the Sulawesi area with magnitude more than 7 caused ground shaking in Sabah, specifically at Tawau and Kota Kinabalu [2]. From [1], seismotectonic map of active fault is scattered in area of Sabah. Data from Minerals and Geoscience Department (JMG) reported Ranau region of central Sabah, has strong topographic relief and even moderate magnitude earthquakes are likely to induce large-scale mass movements (landslides) [2].

This paper proposes an analysis on seismic data and seismic station parameters in Sabah, Malaysia. By using Gaussion distribution to model displacement, velocity and acceleration, the least RMSE is used to correlate with the earthquake event parameters. Part II explains felt earthquake events in Sabah, and the earthquake monitoring system in use. Part III presents the analysis of these earthquake events, emphasising on intensity, distance, foundation and elevation of the station. The paper is finally concluded in Part IV.

II. Earthquakes in Sabah, Malaysia

A. Seismology Stations

Malaysia Meteorological Department, known as MetMalaysia, has developed seismic station network with the objective to monitor earthquake activity since 1976. Currently, 20 seismic stations has been operated all across Peninsular and East Malaysia comprising of 8 weak motion stations and the remaining 12 are strong motion stations. For remote stations, seismic wave data received at each stations are being recorded in real time which is then transmitted using VSAT satellite communication system to MetMalaysia Head Quarters data centre [3]-[5].

B. Remote Earthquake Monitoring System

Geostationary satellite system is being utilised for the seismic data transmission from the station to the head quarter data centre due to seismic limited access and unavailability of terrestrial communication infrastructure at every remote location seismic station. Very Small Aperture Terminal (VSAT) robust system will provide continuous communication solution for the early warning system that requires very high availability even during exceptional circumstances [6]. The solar panels will power the batteries and indoor communications unit (IDU) of VSAT system for the real-time seismic data transmission from station to the satellite network operation centre. The setup and configuration for a remote earthquake monitoring using geostationary satellite network is shown in Fig. 1.

The seismic station will be put in a quite area to minimize ground vibrations and other type of noise, which would degrade the seismic signal. The seismic equipment, data acquisition system, indoor communication unit (IDU) is housed inside a small building. A fence will be erected at the entire site around the station. Seismometer and accelerometer is the key instrument at the station. It detects and measures earth ground motion. Both instruments will be placed on a

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concrete pad which directly contact with the bedrock. The signals are converted to digital records and stored in a data storage unit. The seismometer is extremely sensitive and can pick up a broad spectrum of motions.

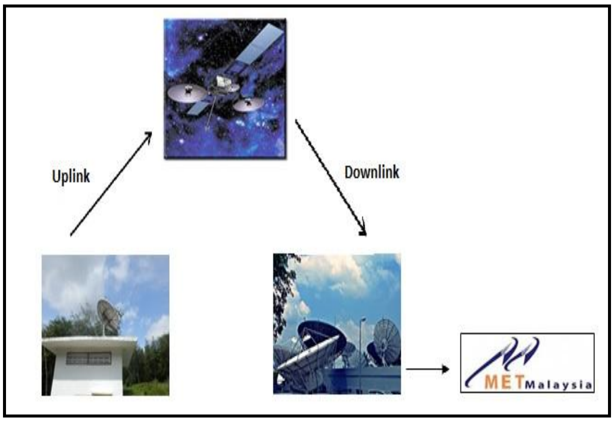

Fig. 1. Satellite signal transmission configuration for a remote seismic station.

Three directions of motions can be measured by the seismometer and accelerometer consist of North-South, East-West and Up-and-Down (Vertical). It provides seismic data – Displacement (D), Accelerated velocity (V) and Acceleration (A). The field station components are shown in Fig. 2.

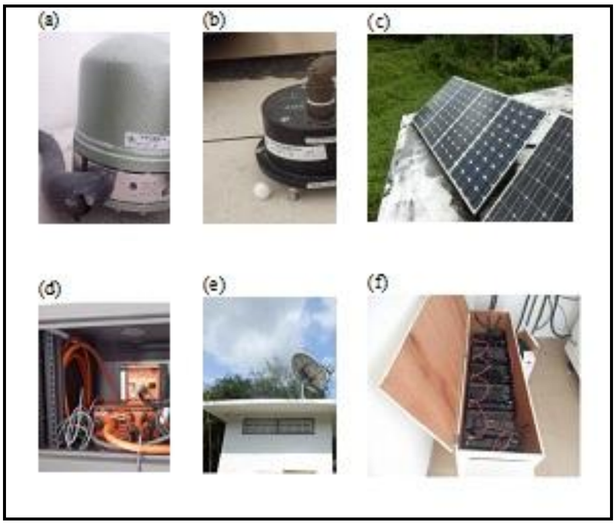

Fig. 2. The field station components.

TABLE I: SATELLITE TRANSMISSION PARAMETERS

Parameter	Variable	Value
Operating frequency	f	6 GHz (uplink) / 4GHz (downlink)
Satellite	S	Measat3a
Satellite position	S_y	91.5°E
EIRP	P_{Rx}	57 dBW
Antenna diameter	d_{ant}	1.8m

The real-time transmission of seismic data is relayed from remote seismology stations back to the control and processing centre over the satellite network. The parameters in the satellite transmission are presented in Table I. The backhaul network configuration for the satellite transmission is shown in Fig. 3. Block diagram for the setup and configuration of the seismic sensors and the communication unit is presented in Fig. 4.

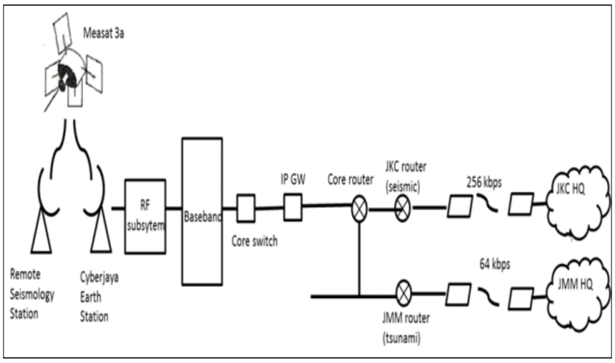

Fig. 3. Backhaul network configuration for satellite transmission.

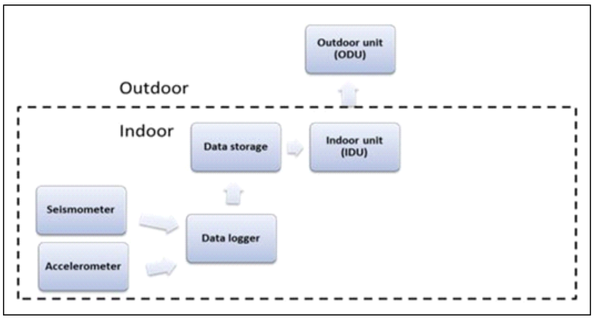

Fig. 4. Block diagram for the setup and configuration of the seismic sensors and the communication unit.

III. Analysis of Felt Earthquake Events in Sabah

A. *Felt Earthquake Event*

In this paper, Sabah had been chosen as the area of study since felt earthquake recorded by the Malaysia Metrological Department (MMD) seismic system are significant which showed 28 earthquake felt event occurrence across the state of Sabah for the past 10 years.Gaussian distribution was used to model the events. From this model, RMSE is calculated. The lowest RMSE recorded for a particular event is used to indicate a level of accuracy in the model. A lower RMSE reflects a better model and vice versa. The RMSE values for respective events are shown in Tables A, B and C in the Appendix.

B. *Intensity*

The effect of an earthquake on the Earth's surface is called the intensity [7]. The Modified Mercalli Intensity Scale is one of intensity scales have been developed to evaluate the effects of earthquakes. Modified Mercalli (MM) Intensity Scale was developed in 1931 by the American seismologists Harry Wood and Frank Neumann in United States. This scale, composed of increasing levels of intensity that range from imperceptible shaking to catastrophic destruction and designated by Roman numerals. Fig. 5 [2], [8] shows zones of ground shaking intensity in Malaysia in terms of the Modified Mercalli Intensity scale according to the Malaysian Meteorological Department. The MMI VII of very strong ground shaking in Sabah was produced by earthquakes with epicentres located within the state. Fig.6 illustrates the relationship between RMSE and MM Intensity by intensity level. It is found and observed that the values of RMSE are highly correlated to the intensity level. The higher intensity more lower the RMSE.

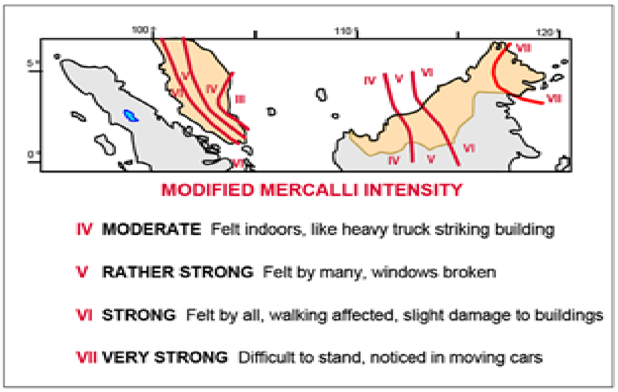

Fig. 5. Ground Shaking Intensity in Malaysia as per MMI scale [1].

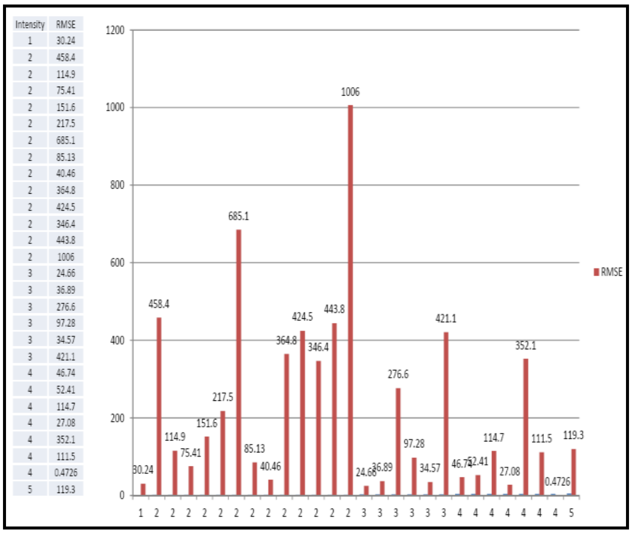
Fig. 6. Relationship between RMSE and MM Intensity by intensity level.

C. Distance

According to the three seismic parameters analyse, as per smallest RMSE value for Acceleration (A), Velocity (V) and Displacement (D), it is found and observed that lower values of Distance, Velocity and Acceleration are highly correlated to smaller value in distance-to-epicentre. In Fig. 7 the Gaussian distributions for the seismic Distance (D) parameters has resulted RMSE value 6.004, the distance to the epicentre is 868.696km. With RMSE value at 19.22 for the Velocity (V) parameter, the distance is 1037.099 km as in Fig.8 and with RMSE value at 0.4726, the distance in 336.375 km to the epicentre as is shown in Fig. 9. It can be observed from the analysis, the lowest RMSE for acceleration, velocity and distance parameter has recorded the lowest distance value in kilometre from the epicentre of the earthquake event.

D. Foundation

The seismology stations in Malaysia had been built in a quite area to minimize ground vibrations and other type of noise, which would degrade the seismic signal. In Sabah, most of the foundation for seismology stations are sandstone as shown in the Table II as below:

The data from 2004 – 2014 had been study to understand the correlation between seismology foundation and lowest RMSE value in Gaussian distribution. Lowest RMSE value for each seismology station foundation was analysed and Table III shows 79.3% of earthquake events in Sabah had impacted sandstone foundation station.

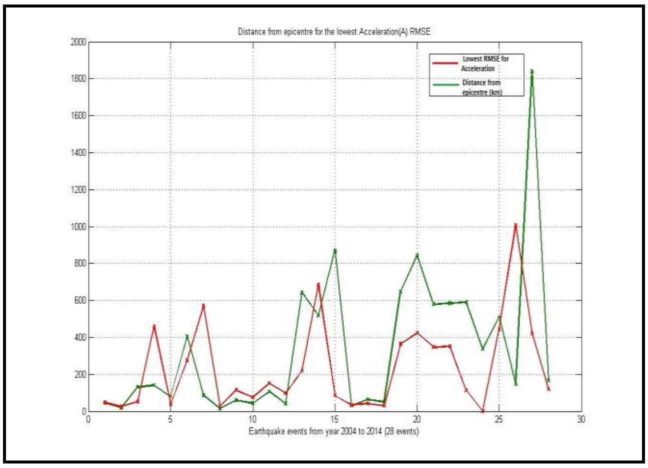
Fig. 7. Parameter for distance (in km) to the lowest RMSE acceleration.

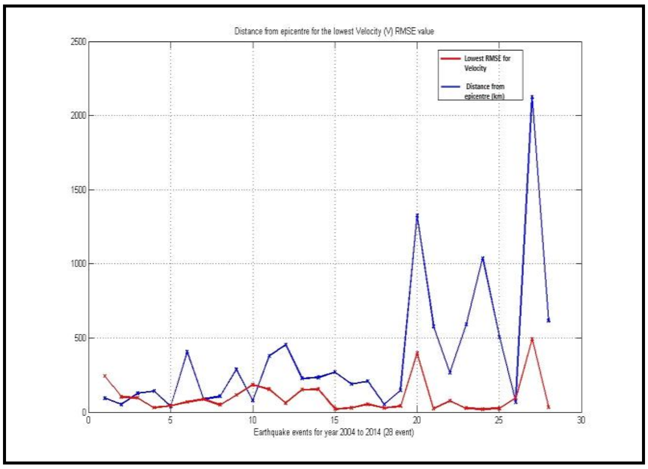
Fig. 8. Parameter for distance (in km) to the lowest RMSE velocity.

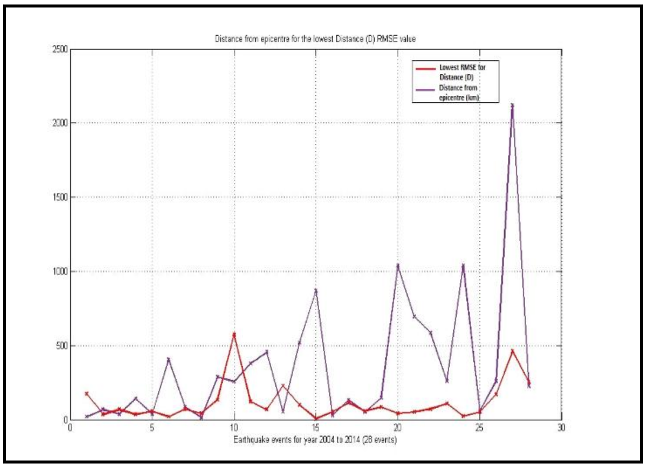
Fig. 9. Parameter for distance (in km) to the lowest RMSE displacement.

The relation between D, V and A parameters and lowest RMSE value for each impacted station foundation shown in the Fig. 10, Fig.11 and Fig.12. From the analysis, significant trend between lower RMSE value and sandstone station could indicated stronger felt earthquake event.

E. Elevation

Elevation of the seismology stations is one of the information recorded in the seismic data analysis for earthquake monitoring in Sabah. Table IV shows the seismology stations, their respective identification (id) and the foundations of the stations.

TABLE II: FOUNDATION OF SEISMOLOGY STATION IMPACTED BY EARTHQUAKE IN SABAH

Seismology Station			Foundation
Station Name	**Latitude**	**Longitude**	
KDM (Kudat)	6.91670	116.83330	Granite
KKM (Kota Kinabalu)	6.04430	116.21470	Sandstone
RNSM (Ranau)	5.95481	116.68159	Rocky
SDM (Sandakan)	5.64090	117.19500	Sandstone
SPM (Sapulut)	4.70830	116.46500	Sandstone
BTM (Bintulu)	3.20000	113.08330	Sandstone
LDM (LahadDatu)	5.17770	118.49800	Sandstone
TSM (Tawau)	4.29360	117.87250	Granite
BNM (Bakun)	2.77670	114.03500	Sandstone
SBM (Sibu)	2.45290	112.21400	Sandstone

TABLE III: LOWEST RMSE AT SEISMOLOGY STATION FOUNDATION

Foundation	Occurrence of earthquake
Sandstone	23
Rocky	1
Granite	4

From these stations, a record of seismic data is analysed. Gaussian distribution model is used and the station which recorded the lowest root mean square error (RMSE) is considered as an event [9]. From this list of stations with the lowest RMSE for each felt earthquake event, a histogram is plotted to observe which stations shows the lowest RMSE, as in Fig. 13.

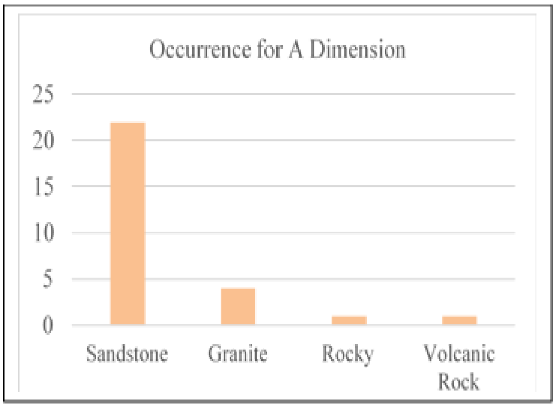

Fig. 10. Occurrence of earthquake events at lowest RMSE value for A dimension.

In Fig. 13, the histogram of felt earthquake events in Sabah is shown, as a function of elevation (in metre) of the seismology stations. It can be seen that Kota Kinabalu station (marked as seismology station id 'KKM'), which 813m in elevation, recorded the highest number of earthquake events. It is also noted that the foundation of this station is sandstone, similar to most other stations (refer Table IV). From this observation, it is noticed that Kota Kinabalu stations observe the lowest RMSE from the Gaussian model. For example, although an earthquake happened in Ranau, but Ranau seismology station recorded higher RMSE compared to Kota Kinabalu station, which is 100km away from the earthquake event. This is an interesting observation, as it could indicate that sandstone foundation with higher elevation is more sensitive to detecting an earthquake event.

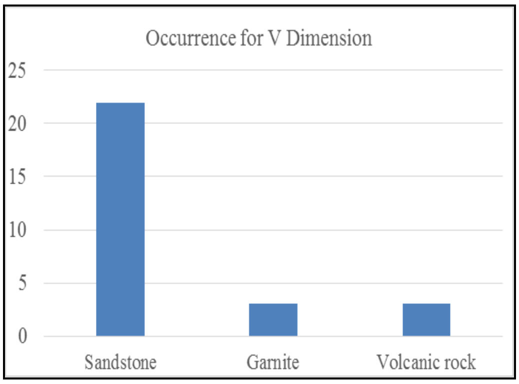

Fig. 11. Occurrence of earthquake events at lowest RMSE value for V dimension.

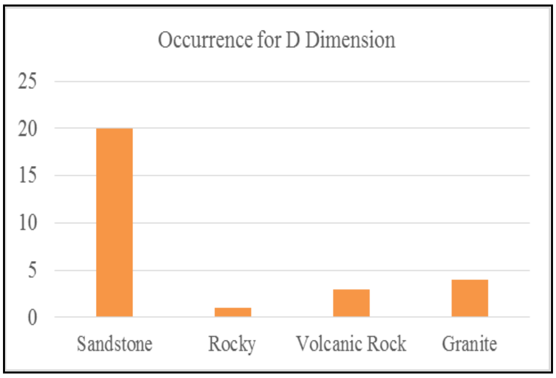

Fig. 12. Occurrence of earthquake events at lowest RMSE value for D dimension.

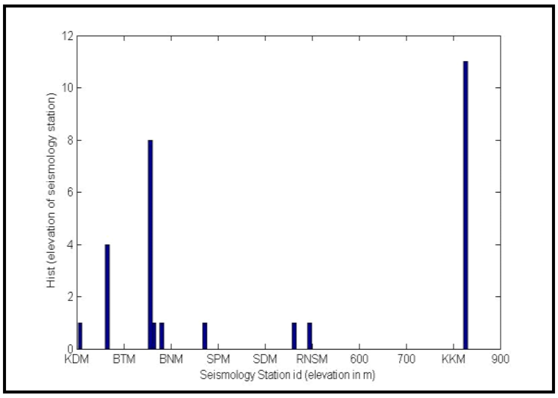

Fig. 13. Histogram of felt earthquake events in Sabah with respect to seismology stations (and respective elevation in m).

TABLE IV: SEISMOLOGY STATIONS AND FOUNDATIONS

Seismology Station Id	Seismology Station	Foundation
KKM	Kota Kinabalu	Sandstone
RSNM	Ranau	Rocky
BTM	Bintulu	Sandstone
KDM	Kudat	Granite
TSM	Tawau	Sandstone
SDM	Sandakan	Sandstone
SPM	Sapulut	Sandstone
BNM	Bakun	Sandstone
TSM	Tawau	Sandstone

IV. Conclusion

Early Warning Systems (EWS) are a major element of disaster risk reduction for global and local hazards by taking decisions in the proper time[10]. Objectives of EWS is to be better prepared to face challenges of the risk of long term or sudden disasters by avoiding and reducing damages and loss, saving human lives, health, economic development and cultural heritage. Due to remote location of seismic sensors, satellite systems can offer coverage and reliability of in transmitting the seismic data.

This paper analyses felt earthquake events for 10 years data, from 2004 to 2014 in Sabah. The study shows significant relation between felt earthquake events and seismic parameters such as intensity, distance to epicentre, foundation and elevation of seismic stations. Analysis result observed that, smallest RMSE value for Acceleration (A), Velocity (V) and Distance (D) parameters are highly correlated to smaller value in distance-to-epicentre. Sandstone foundation with higher elevation is more sensitive to detecting an earthquake event and the similar RMSE trend is observed for higher intensity. Future work includes developing system model which contribute to estimate the nature of felt earth quake event and how this can relate to triggering alert for the local people on the impending impact of the felt earthquake event.

Appendix

Station	Foundation	Elevation	Latitude	Longitude	Distance to epicentre (km)	Direction	Lowest RMSE	Intensity
KKM	Sandstone	830	6.04430	116.21470	44.158	A_Z	46.74	II
RNSM	Rocky	499	5.95481	116.68159	17.004	A_Z	24.66	II
KKM	Sandstone	830	6.04430	116.21470	130.587	A_N	52.41	II
KKM	Sandstone	830	6.04430	116.21470	140.295	A_N	458.4	III
KKM	Sandstone	830	6.04430	116.21470	80.644	A_N	36.89	III
BTM	Sandstone	156	3.20000	113.08330	406.115	A_N	276.6	IV
SPM	Sandstone	275	4.70830	116.46500	82.481	A_E	114.7	IV
KDM	Granite	3	6.91670	116.83330	13.444	A_Z	27.08	IV
TSM	Granite	62	4.29360	117.87250	59.275	A_N	114.9	II
TSM	Granite	62	4.29360	117.87250	43.467	A_N	75.41	III
LDM	Sandstone	177	5.17770	118.49800	106.697	A_E	151.6	II
KKM	Sandstone	830	6.04430	116.21470	40.857	A_E	97.28	IV
SBM	Sandstone	237	2.45290	112.21400	641.618	A_Z	217.5	II
BTM	Sandstone	156	3.20000	113.08330	516.841	A_Z	685.1	IV
KSM	Volcanic Rock	66	1.47330	110.30830	868.696	A_E	85.13	I
TSM	Granite	62	4.29360	117.87250	29.206	A_Z	34.57	II
KKM	Sandstone	830	6.04430	116.21470	63.363	A_N	40.46	III
KKM	Sandstone	830	6.04430	116.21470	50.443	A_E	30.24	IV
BTM	Sandstone	156	3.20000	113.08330	648.69	A_N	364.8	III
KKM	Sandstone	830	6.04430	116.21470	844.23	A_E	424.5	II
BTM	Sandstone	156	3.20000	113.08330	578.069	A_N	346.4	II
BTM	Sandstone	156	3.20000	113.08330	584.604	A_N	352.1	II
BTM	Sandstone	156	3.20000	113.08330	589.519	A_N	111.5	IV
KKM	Sandstone	830	6.04430	116.21470	336.375	A_N	0.4726	III
KKM	Sandstone	830	3.20000	113.08330	507.697	A_N	443.8	IV
SDM	Sandstone	463	5.64090	117.19500	9	A_Z	1006	II
KKM	Sandstone	830	6.04430	116.21470	1841.347	A_N	421.1	II
KKM	Sandstone	830	6.04430	116.21470	166.696	A_E	119.3	II

Graph 1. Lowest RMSE for acceleration parameter for 28 felt earthquake events in Sabah, Malaysia.

Station	Foundation	Elevation	Latitude	Longitude	Distance to epicentre (km)	Direction	Lowest RMSE	Intensity
KDM	Granite	6.118	6.91670	116.83330	92.292	V_N	241.7	II
SDM	Sandstone	5.855	5.64090	117.19500	49.975	V_E	101.6	II
SDM	Sandstone	6.773	5.64090	117.19500	126.065	V_N	95.1	II
KKM	Sandstone	6.885	6.04430	116.21470	140.295	V_N	28.66	III
SDM	Sandstone	5.731	5.64090	117.19500	37.129	V_E	41.93	III
BTM	Sandstone	5.312	3.20000	113.08330	406.115	V_N	66.39	IV
KKM	Sandstone	5.302	6.04430	116.21470	85.36	V_N	85.89	IV
KKM	Sandstone	6.803	6.04430	116.21470	105.798	V_Z	49.1	IV
KKM	Sandstone	4.559	6.04430	116.21470	287.209	V_E	114.9	II
LDM	Sandstone	4.645	5.17770	118.49800	77.732	V_N	184.5	III
KKM	Sandstone	4.888	6.04430	116.21470	377.067	V_N	153	II
BNM	Sandstone	5.99	2.77670	114.03500	455.401	V_Z	59.89	IV
LDM	Sandstone	6.12	5.17770	118.49800	226.891	V_Z	149.8	II
TSM	Granite	6.07	4.29360	117.87250	233.456	V_E	153.2	IV
KKM	Sandstone	4.113	6.04430	116.21470	268.459	V_E	20.66	I
SPM	Sandstone	4.353	4.70830	116.46500	188.693	V_N	27.84	II
LDM	Sandstone	5.864	5.17770	118.49800	207.215	V_N	52.3	III
KKM	Sandstone	6.084	6.04430	116.21470	50.443	V_E	26.09	IV
SDM	Sandstone	5.4	5.64090	117.19500	146.945	V_E	39.91	III
KSM	Volcanic Rock	1.41	1.47330	110.30830	1326.758	V_E	396.3	II
BTM	Sandstone	4.6	3.20000	113.08330	578.069	V_E	22.54	II
KKM	Sandstone	4.64	6.04430	116.21470	265.203	V_E	75.59	II
BTM	Sandstone	4.73	3.20000	113.08330	589.519	V_E	25.69	IV
KSM	Volcanic Rock	4.86	1.47330	110.30830	1037.099	V_Z	19.92	III
BTM	Sandstone	6	3.20000	113.08330	507.697	V_E	24.45	IV
TSM	Granite	4.8	4.29360	117.87250	67.017	V_N	93.4	II
KSM	Volcanic Rock	-5.5	1.47330	110.30830	2123.253	V_N	493.6	II
BTM	Sandstone	6.3	3.20000	113.08330	617.024	V_E	34.3	II

Graph 2. Lowest RMSE for acceleration parameter for 28 felt earthquake events in Sabah, Malaysia.

Station	Foundation	Elevation	Latitude	Longitude	Distance to epicentre (km)	Direction	Lowest RMSE	Intensity
RNM	Rocky	499	5.95481	116.68159	19.939	D_Z	172.5	II
KKM	Sandstone	830	6.04430	116.21470	67.879	D_Z	35.23	II
KDM	Granite	3	6.91670	116.83330	37.553	D_E	67.56	II
KKM	Sandstone	830	6.04430	116.21470	140.295	D_N	35.36	III
SDM	Sandstone	463	5.64090	117.19500	37.129	D_N	56.16	III
BTM	Sandstone	156	3.20000	113.08330	406.115	D_Z	19.81	IV
KKM	Sandstone	830	6.04430	116.21470	85.36	D_Z	69.02	IV
KDM	Granite	3	6.91670	116.83330	13.444	D_N	40.85	IV
KKM	Sandstone	830	6.04430	116.21470	287.209	D_E	133.1	II
KKM	Sandstone	830	6.04430	116.21470	255.47	D_N	573.5	III
KKM	Sandstone	830	6.04430	116.21470	377.067	D_N	122.4	II
BNM	Sandstone	166			455.401	D_Z	68.08	IV
KKM	Sandstone	830	6.04430	116.21470	52.148	D_Z	227.1	II
BTM	Sandstone	156	3.20000	113.08330	516.841	D_E	99.91	IV
KSM	Volcanic Rock	66	1.47330	110.30830	868.696	D_E	6.004	I
TSM	Granite	62	4.29360	117.87250	29.206	D_E	50.13	II
SPM	Sandstone	275	4.70830	116.46500	132.581	D_Z	113.4	III
KKM	Sandstone	830	6.04430	116.21470	50.443	D_N	57.89	IV
SDM	Sandstone	463	5.64090	117.19500	146.945	D_N	84.91	III
BTM	Sandstone	156	3.20000	113.08330	1036.925	D_E	40.47	II
SBM	Sandstone	237	2.45290	112.21400	695.696	D_E	51.88	II
BTM	Sandstone	156	3.20000	113.08330	584.604	D_E	71.24	II
KKM	Sandstone	830	6.04430	116.21470	261.253	D_Z	107.3	IV
KSM	Volcanic Rock	66	1.47330	110.30830	1037.099	D_E	21.57	III
KKM	Sandstone	830	6.04430	116.21470	53.908	D_N	50.19	IV
KKM	Sandstone	830	6.04430	116.21470	259.772	D_E	170.2	II
KSM	Volcanic Rock	66	1.47330	110.30830	2123.253	D_N	462.8	II
TSM	Granite	62	4.29360	117.87250	223.988	D_Z	252.5	II

Graph 3. Lowest RMSE for displacement parameter for 28 felt earthquake events in Sabah, Malaysia.

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REFERENCES

[1] *Study on the Seismic and Tsunami Hazards and Risks in Malaysia*, 2008.
[2] *Assessment of the Seismic Threats to Malaysia from Major.*
[3] *Earthquakes in the Southeast Asian Region*, 2008.
[4] *Assessment of the Seismic Threats to Malaysia from Major Earthquakes in the Southeast Asian Region*, 2008
[5] *Ninth Malaysian Plan, Projek Geobencana Negari Sabah, Geological Terrain Mapping of Ranau Area*, Sabah, JMG, SBH(GBN), 2010
[6] R. M. Allen, "The status of earthquake early warning around the world: An introductory overview," *Seismological Research Letters*, vol. 5, no. 5, Sept./Oct. 2009.
[7] *Chinese Journal of Geophysics* vol. 55, no. 2, 2012, pp. 150–165.
[8] *Study on the Seismic and Tsunami Hazards and Risks in Malaysia*, 2008.
[9] R. G. D. Steel and J. H. Torrie, *Principles and Procedures of Statistics with Special Reference to the Biological Sciences*, McGraw Hill, 1960, p. 288.
[10] Y. Nakamura, J. Saita, and T. Sato, "On an earthquake early warning sytem (EEW) and it applications," *Soil Dynamic and Earthquake Engineering*, vol. 31, 2011.

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