ANNALS OF GEOPHYSICS, 68, 6, S688, 2025; doi:10.4401/ag-9381
OPEN ACCESS

Stress Transfer and Aftershock Distribution of The Strong Earthquakes in The Thailand-Laos-Myanmar Border

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Article history: received May 26, 2025; accepted November 5, 2025

Abstract

This study analyzed the stress transfer and the aftershock distribution in the Thailand-Laos-Myanmar border. The fault parameters of the three strong earthquakes with $M \geq 6.0$ that occurred during 2010-2022 in the Thailand-Laos-Myanmar border were used to calculate the Coulomb stress change with the numerical modeling techniques resolved on the receiver fault with (i) focal mechanism same as the focal mechanism of the mainshock, (ii) strike-slip, (iii) thrust, and (iv) normal faulting, respectively. The earthquake events were declustered spatially and temporally to identify the aftershocks in the area. Then, the stress transfer and aftershock distribution were analyzed to investigate the relationship. The results indicated that the type of receiver fault was the important factor that influenced the pattern of stress transfer on the Thailand-Laos-Myanmar border. The M6.1 earthquake in 2014 in Thailand generated most aftershocks in the areas of increased stress with stress change levels of more than 0.8 bar. The M6.9 earthquake in 2011 in Myanmar caused the stress to transfer into Thailand with increased stress levels smaller than 0.3 bar, and there was no aftershock generated in this area of Thailand. Meanwhile, the M6.2 earthquake in 2019 in Laos induced stress transferred into Thailand with levels of increased stress up to 0.8 bar, and there was one aftershock generated around this area of Thailand. The results are likely to be the characteristic of stress transfer and aftershock distribution, especially with increased stress levels above 0.8 bar, which can be used to identify the areas of aftershocks after the strong earthquake occurred in the Thailand-Laos-Myanmar border.

Keywords: Stress transfer; Coulomb stress; Strong earthquake; Aftershock; Thailand-Laos-Myanmar border

1. Introduction

The collision of the Indo-Australian plate and the Eurasian plate causes tectonic setting in the areas of the Thailand-Laos-Myanmar border and also creates seismogenic faults in the areas. As a result, a large number of earthquakes were generated continuously, including the strong earthquakes of M6.1, M6.2., and M6.9 in Thailand, Laos, and Myanmar, respectively (Fig. 1). These earthquakes damaged many buildings, and the ground shaking can be felt in several areas, especially in Thailand. Furthermore, they generated a lot of aftershocks with magnitudes up to 5. Generally, aftershocks with a magnitude of 4.0 or greater are capable of causing additional structural damage, particularly to buildings that were already weakened by the mainshock. Although most aftershocks are relatively small, the frequent occurrence of felt events can heighten public concern and awareness regarding the potential hazards associated with subsequent aftershock activity. Therefore, in addition to strong earthquakes, aftershocks are also important that should be studied, particularly in the areas of the Thailand-Laos-Myanmar border.

To clarify aftershock activities in the seismic sources, the characteristics of aftershocks were spatially investigated. For instance, Raju et al. (2008) studied aftershocks generated by a mainshock of M5.3 in the Himalaya that related to the stress change in the areas. They found that most aftershocks were distributed in the areas of increased stress of about 0.01-0.02 bar. This implied that a moderate earthquake that caused small stress changes could trigger aftershocks, especially in the areas of increased stress. Asayesh et al. (2020) investigated stress change of M6.6 earthquake related to the aftershock generating in Iran. They found that the changes of stress in the areas caused a lot of aftershocks generating, especially in the areas of increased stress. The stress changes induced by the mainshock were transferred to nearby faults, causing stress to increase in certain sections. This increased stress makes it possible to trigger a new mainshock earthquake in the near future. Wang et al. (2024) studied an earthquake of M5.0 that occurred south of the Red River fault. The results indicated that it was triggered by co-seismic and post-seismic stress increases of 1.447 bar and 0.241 bar, respectively, in the area. This stress generated from the strong earthquakes occurred in the past. They also found that the pattern of aftershocks triggered by the M5.0 earthquake represented the change of stress obviously in the area. Shao et al. (2024) studied the M7.8 earthquake that occurred around the Altai mountains in 1931. The results indicated that this earthquake imparted positive stress in the surrounding area around 0.015-0.134 bar. Then, the M7.2 earthquake occurred in the area that was possibly triggered by stress transfer from the preceding mainshock. They also found that a lot of earthquakes in this area occurred in the zones of increased stress. Furthermore, Sukrungsri et al. (2024) investigated co-seismic stress and aftershock distribution in the Sumatra-Andaman Subduction Zone (SASZ). They found that the relationship between aftershock distribution and stress change depends on the focal mechanism of the mainshock and the type of receiver fault in the area. For a major earthquake with thrust faulting in SASZ, the stress change calculated on the receiver fault with the focal mechanism same as the focal mechanism of the mainshock revealed that a majority of aftershocks

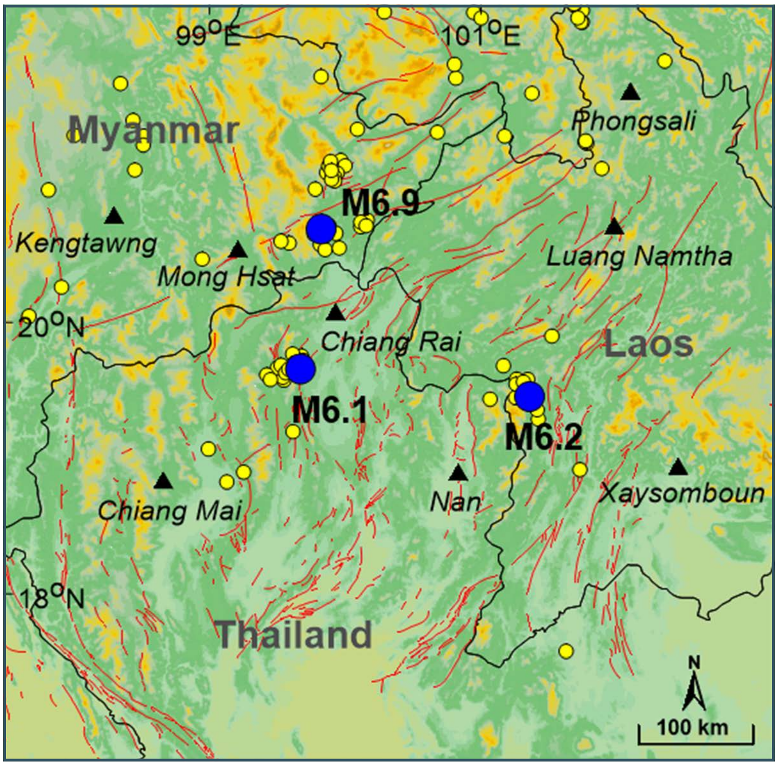

Figure 1. Map of the Thailand-Laos-Myanmar border illustrated the active faults (red lines) proposed by Pailoplee et al. (2009) and the earthquakes events (yellow dots) during 2010-2022 reported by the NEIC, including the strong earthquakes with M ≥ 6.0 (blue circles) used in this study.

will be triggered in the areas of increased stress. According to the related research as mentioned above, the stress change can be used effectively for forecasting of aftershock in the areas. Therefore, this study aimed to investigate stress transfer and aftershock distribution in the Thailand-Laos-Myanmar border. The results will be useful to specify the prospective areas of the aftershocks and further triggered mainshocks in the Thailand-Laos-Myanmar border.

2. Coulomb stress

Theoretically, an earthquake can change the shear and normal stresses on the nearby faults and also cause the seismicity rate change in the areas including mainshocks and aftershocks. At present, there are several methods that can be used to analyze the stress transfer and the conditions of failure in rocks. One of the most effective criteria is the Coulomb failure criterion (Raju et al., 2008; Asayesh et al., 2020; Shao et al., 2024; Sukrungsri et al., 2024; Wang et al., 2024). According to the Coulomb criterion, when the Coulomb stress exceeds a certain value, the failure will occur on a fault plane, resulting in an earthquake occurring in the area. These studies can be divided into two categories. First, the study of the relationship between a mainshock and the subsequent aftershocks. Second, the study of fault interaction between different mainshocks. This study focused on the first category. The changes of Coulomb failure stress (ΔCFS) induced by the mainshock were resolved onto the fault plane using the earthquake parameters, i.e., location of earthquake, length and width of rupture plane, amount of slip, strike direction, dip angle, and rake angle for calculating the stress change in the area. ΔCFS is defined as given in Eq. (1);

$$\Delta CFS = \Delta\tau_s + \mu'\Delta\sigma \quad (1)$$

where $\Delta\tau_s$ is the shear stress change on the receiver fault (set positive for the direction of the fault slip), $\Delta\sigma$ is the change in the normal stress on the target fault (set positive for unclamping), and μ' is the effective coefficient of friction (Harris, 1998; Stein, 1999; Toda, 2008). The parameter of μ' is generally called the apparent coefficient of friction and includes the effects of pore pressure changes as well as the material properties of the fault zone (Harris, 1998). A positive ΔCFS represents that the plane of interest was brought closer to failure, while a negative ΔCFS means the plane of interest moved away from failure. Both increased shear and unclamping of faults encourage failure (Harris and Simpson, 1998; Parsons, 2005; Aron and Hardebeck, 2009).

In this study, the stress transfer of the strong earthquakes in the Thailand-Laos-Myanmar border was analyzed using the Coulomb 3.3 software (Lin and Stein, 2004; Toda et al., 2005), assuming earth as a homogeneous elastic half-space and faults inferred as rectangular dislocations embedded in it. Based on these assumptions, the Young's modulus, shear modulus, Poisson ratio, and coefficient of friction were defined as 8×10^5 bars, 3.2×10^5 bars, 0.25, and 0.4, respectively.

3. Earthquake data

3.1 Aftershock sequence in the Thailand-Laos-Myanmar border

According to the earthquake catalog of NEIC, 100 earthquake events in the areas of the Thailand-Laos-Myanmar border during 2010-2022 (data available at https://www.earthquake.usgs.gov/earthquakes) including mainshocks and aftershocks, were utilized in this study. Theoretically, any earthquake event classified as an aftershock should be consistent with three conditions. First, the magnitude of the subsequent aftershock must be smaller than the magnitude of the mainshock. Second, the aftershocks will be generated within a certain time window depending on the magnitude of the mainshock. Third, the aftershocks will occur within the specific area around the mainshock epicenter or in the same fault system.

Based on previous research, there were several models to be used for declustering earthquake events and identifying aftershocks. For example, the algorithms of Gardner and Knopoff (1974) and Resenberg (1985). For the earthquakes in the areas of the Thailand-Laos-Myanmar border, the Gardner and Knopoff (1974) algorithm is one of the models that is used for declustering earthquakes effectively (Pailoplee et al., 2013; Puangjaktha and Pailoplee, 2018). Thus, the Gardner and Knopoff (1974) algorithm was used in this study, as expressed in Eq. (2)

and (3), to classify the mainshocks and aftershock sequences in the Thailand-Laos-Myanmar border. In the equations, the parameters of S and T are the maximum distance (km) and time duration (d) from the mainshock epicenter and occurrence time, respectively, depending on the magnitude of the mainshock (M). The earthquakes located within the distance S and the time duration of T will be identified as aftershock events.

$$S = 10^{0.1238M + 0.983} \tag{2}$$

$$T = 10^{0.032M + 2.7389} \tag{3}$$

With regards to the three strong earthquakes (M ≥ 6.0) used in this study (Table 1 and blue circles in Fig. 1), there were 36 earthquake events identified as aftershocks using the algorithm of Gardner and Knopoff (1974) as shown in Fig. 2. For strong earthquakes of 6.0 ≤ M ≤ 6.9, the aftershock sequence will be generated within 70 km from the mainshock epicenter, and the time window of these aftershocks is no more than 2.5 y after the occurrence of mainshock. As a result, the M6.9 earthquake in 2011 in Myanmar generated 10 aftershock events within 35.9 km from the mainshock epicenter. These aftershocks occurred in the time duration of 2.1 y after the origin time of the mainshock. Meanwhile, 20 aftershocks of the M6.1 earthquake in 2014 in Thailand were distributed within 26.3 km from the mainshock epicenter, and they occurred within 0.3 y after the origin time of the mainshock. Furthermore, the M6.2 earthquake in 2019 in Laos generated 6 aftershock events located within 32.2 km from the mainshock epicenter with the time duration of 1.6 y after the occurrence of mainshock.

Table 1. Earthquake parameters of the three strong mainshock events with a moment magnitude (M) ≥ 6.0 that were utilized in this Coulomb analysis.

Date	Lat (°N)	Lon (°E)	Dept (km)	M	M_0 (10^{18} Nm)	Strike (°)	Dip (°)	Rake (°)	Length (km)	Width (km)	Slip (m)
24/03/2011	20.687	99.822	8	6.9	28.51	71	86	13	32.09	24.07	0.77
05/05/2014	19.656	99.670	6	6.1	1.80	158	70	−171	12.54	9.40	0.32
20/11/2019	19.453	101.356	10	6.2	2.54	67	68	−28	14.10	10.57	0.36

3.2 Focal mechanism

The faulting of the earthquake source is regarded as the important factor that causes the stress transfer in the areas. It's called a focal mechanism. The focal mechanism of an earthquake also influences the pattern and the direction of stress transfer in the areas. In this study, the focal mechanisms of the three strong earthquakes (M ≥ 6.0) in the areas of the Thailand-Laos-Myanmar border (Fig. 2a) were obtained from the earthquake catalog of NEIC (data available at https://www.earthquake.usgs.gov/earthquakes). The rupture area of the earthquake, including length and width, was calculated using the magnitude of the earthquake based on Wells and Coppersmith (1994). The amount of slip of the fault rupture was calculated using the rupture area and the seismic moment of the earthquake (Aki, 1966). The details of earthquake parameters mentioned above were shown in Table 1.

Generally, the focal mechanism of the earthquakes in the Thailand-Laos-Myanmar border is a strike-slip faulting. However, the tectonic setting is complex. The focal mechanism is possible to be the other types of faulting, i.e., normal, reverse, and oblique faultings. In this study, the strike direction of the focal mechanism corresponding to the orientation of earthquake sources in the Thailand-Laos-Myanmar border (Fig. 2a) was used to consider a suitable solution of the focal mechanism of each earthquake event. For the three strong earthquakes of M6.9, M6.1, and M6.2 used in this study, the focal mechanisms were left-lateral strike-slip, right-lateral strike-slip, and normal left-lateral oblique, respectively (Fig. 2b). The M6.9 earthquake in 2011 in Myanmar had a focal mechanism

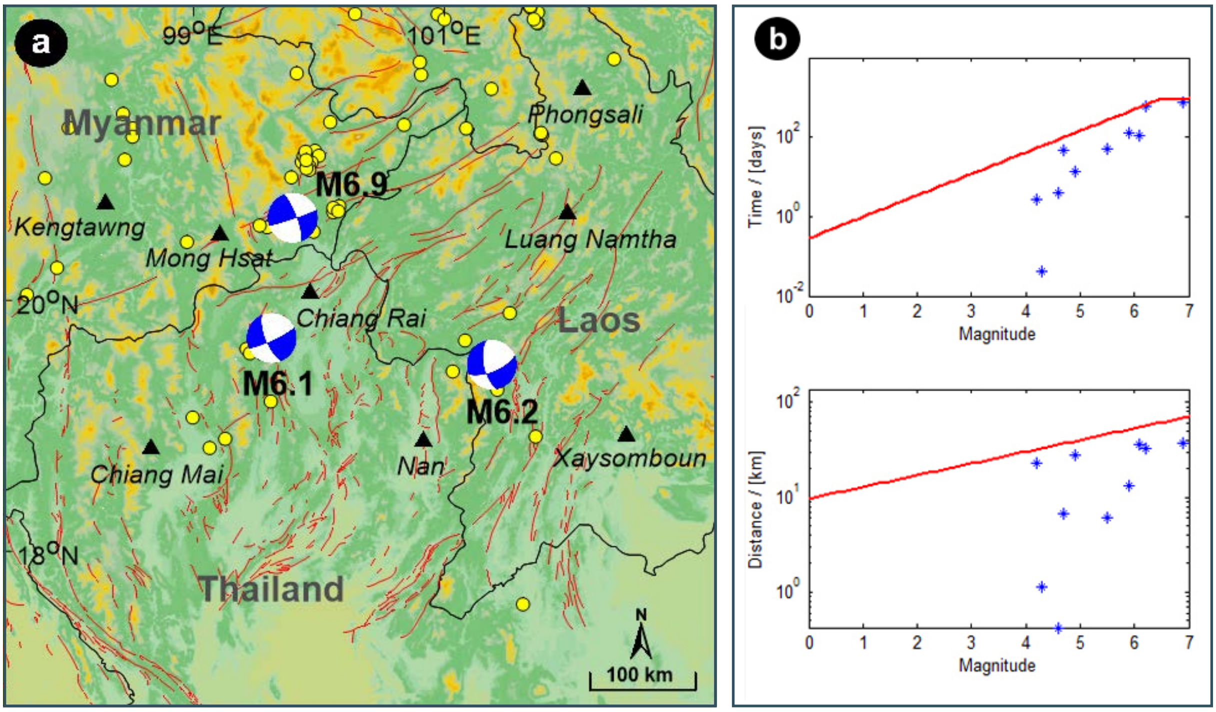

Figure 2. Analysis of the earthquake data used in this study. (a) Map showing beach balls (blue circles) as the focal mechanisms of the three strong earthquakes in the areas. (b) Diagram showing the earthquake declustering (blue dots) using both temporal (top) and spatial (bottom) analysis for identifying the aftershocks according to Gardner and Knopoff's algorithm (red line).

of a strike direction of 71°, a dip angle of 86°, and a rake angle of 13°, which demonstrates strike-slip faulting in almost E-W direction. The M6.1 earthquake in Thailand also had a focal mechanism of strike-slip faulting with a strike direction of 158°, a dip angle of 70°, and a rake angle of –171°. The M6.2 earthquake in 2019 in Laos had a focal mechanism of a strike direction of 67°, a dip angle of 68°, and a rake angle of –28°. The rupture occurred with both strike-slip and normal faultings.

4. Results

In this study, the earthquake parameters of the focal mechanism, the rupture area of the fault plane, and the slip of the earthquake were used to analyze the stress transfer with the numerical modeling techniques of Coulomb stress change (Toda et al., 2005). The focal mechanism illustrated the direction of fault rupture (strike, dip, and rake angles), representing the type of earthquake faulting, such as strike-slip, normal, or reverse faulting. The focal mechanism also implied the areas that are compressed or dilated by the earthquake, resulting in the stress transfer in the areas. Regarding the geometry and the slip of the fault plane, the rupture area (width and length) of the earthquake can be calculated from the magnitude of the earthquake according to Wells and Coppersmith (1994), while the amount of slip can be calculated using the rupture area and the seismic moment of the earthquake (Aki, 1966). These parameters influenced the pattern and the level of the stress transfer in the areas after the earthquake occurred. In this study, the Coulomb 3.3 software (Toda et al., 2005) was utilized to simulate the stress transfer from the earthquake using the input parameters of the earthquake as mentioned above. The stress transfer was analyzed spatially at the depth of the main shock event (Table 1) with the grid spacing of 0.01 degree on the receiver fault, or the faults that received stress from the mainshock. The type of receiver fault is one of the important factors that influenced the pattern of stress transfer in the areas. Therefore, in this study, all possible types of receiver fault, i.e., strike-slip fault, thrust fault, normal fault, and specified fault that has a focal mechanism same as the focal mechanism of the mainshock, were used to investigate the stress transfer from the strong earthquakes in the Thailand-Laos-Myanmar border as shown in Figs. 3-5.

4.1 M6.9 earthquake in 2011 in Myanmar

The stress transfer of the M6.9 earthquake in 2011 in Myanmar caused the stress change in the surrounding areas of the earthquake epicenter as shown in Fig. 3. The stress increased obviously in the NE-SW direction in Myanmar, including some areas in Thailand (Fig. 3 in red zones), while there were several areas that have decreased stress, especially in Myanmar and Laos (Fig. 3 in blue zones). For the stress change computed on the receiver fault with the focal mechanism same as the focal mechanism of the mainshock (Fig. 3a) and the strike-slip faulting (Fig. 3b), the patterns of stress transfer are not different. The stress decreased in both NE-SW and NW-SE directions from the earthquake epicenter. However, the stress change computed on the receiver fault with thrust and normal faultings (Figs. 3c and 3d, respectively). They had the different patterns, especially in the lobes of decreased stress. Regarding the aftershocks of this event, the cluster of aftershocks generated adjacent to the mainshock epicenter. However, there were some events of aftershock that scattered away from the mainshock in a NE-SW direction. Although there were some aftershocks generated in the areas of decreased stress (Fig. 3 in blue zones), the pattern of most aftershocks generated along the line of increased stress transfer for all types of receiver faults, especially

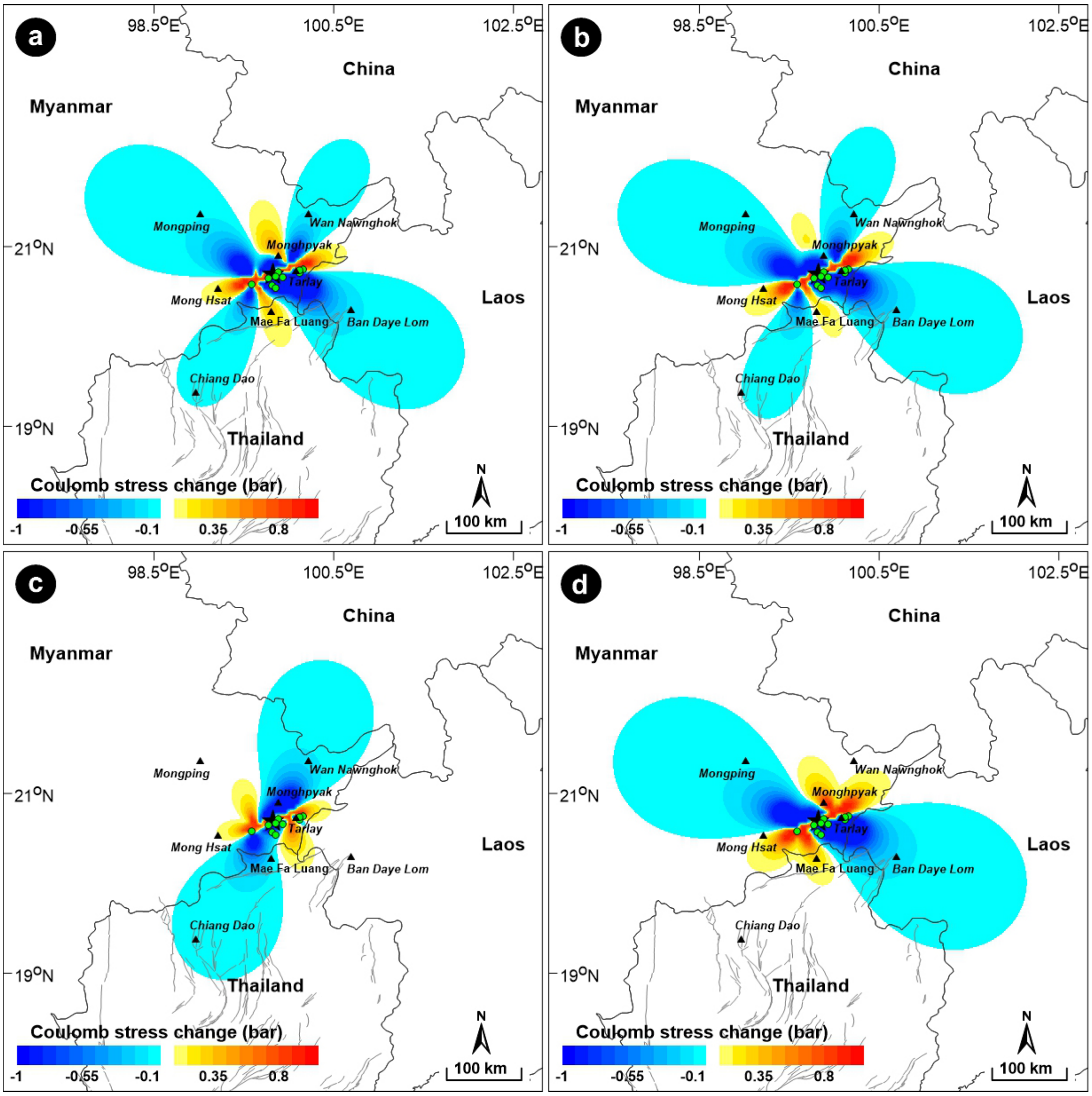

Figure 3. Coulomb stress change caused by the M6.9 earthquake in 2011 in Myanmar was calculated on the (a) specific receiver fault with a strike direction of 71°, dip angle of 86°, and rake angle of 13°; and the optimally oriented (b) strike-slip faulting, (c) thrust faulting, and (d) normal faulting. The green dots are the epicenters of aftershocks generated by the M6.9 mainshock.

in the areas of stress increased above 0.8 bar. In this study, there were some areas in Thailand with the increased stress from this event, the change of stress was in the scale of low levels (smaller than 0.3 bar). Thus, for the M6.9 earthquake in 2011 in Myanmar, it was very unlikely that aftershocks of this event scattered to the area of Thailand.

4.2 M6.1 earthquake in 2014 in Thailand

The M6.1 earthquake in 2014 in Thailand caused the stress change in the areas with both increased and decreased stress surrounding the earthquake epicenter, as illustrated in Fig. 4. This stress transferred in several directions, especially NW-SE, with the large lobes of decreased stress while the increased stress was transferred in smaller areas in both NW-SE and NE-SW directions. For the stress change calculated on the receiver fault with the focal mechanism same as the focal mechanism of the mainshock (Fig. 4a) and the strike-slip faulting (Fig. 4b), they had the same patterns of stress change. Meanwhile, the stress changes calculated on the receiver fault with thrust and normal faultings (Figs. 4c and 4d, respectively), the lobes of decreased stress aligned in the different directions.

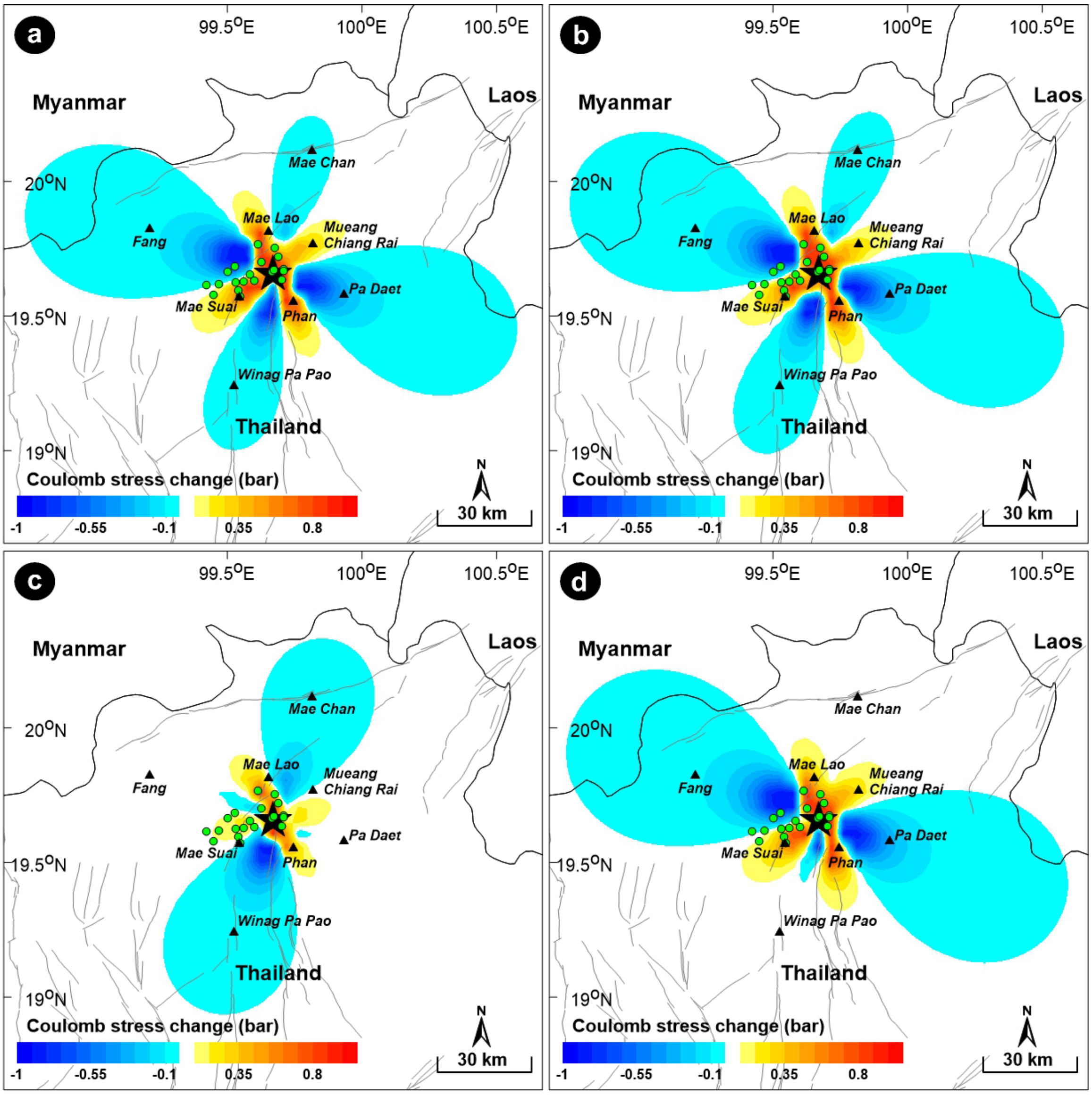

Figure 4. Coulomb stress change caused by the M6.1 earthquake in 2014 in Thailand was calculated on the (a) specific receiver fault with a strike direction of 158°, dip angle of 70°, and rake angle of −171°; and the optimally oriented (b) strike-slip faulting, (c) thrust faulting, and (d) normal faulting. The green dots are the epicenters of aftershocks generated by the M6.1 mainshock.

According to the aftershocks of this event, most aftershocks scattered in the two directions of NW-SE and NE-SW along the lines of increased stress transfer (Fig. 4 in red zones) for all types of receiver faults, especially in the areas of increased stress above 0.8 bar. The positive stress changes also transferred to the south adjacent to the nearby active fault (Fig. 4 in gray lines). Although the increased stress was likely to cover some parts of the nearby active fault, the stress change had low values (smaller than 0.3 bar). Thus, for the M6.1 earthquake in 2014 in Thailand, it was very unlikely that the increased stress triggered a new mainshock earthquake in the area of northern Thailand.

4.3 M6.2 earthquake in 2019 in Laos

The stress transfer due to the M6.2 earthquake in 2019 in Laos caused the stress change in the areas of the Thailand-Laos border as shown in Fig. 5. This stress spread surrounding the earthquake epicenter, especially in the NW-SE direction, with the lobes of decreased stress (Fig. 5 in blue zones). The stress change also transferred into the areas of Thailand that both increased and decreased stress. For the stress change computed on the receiver

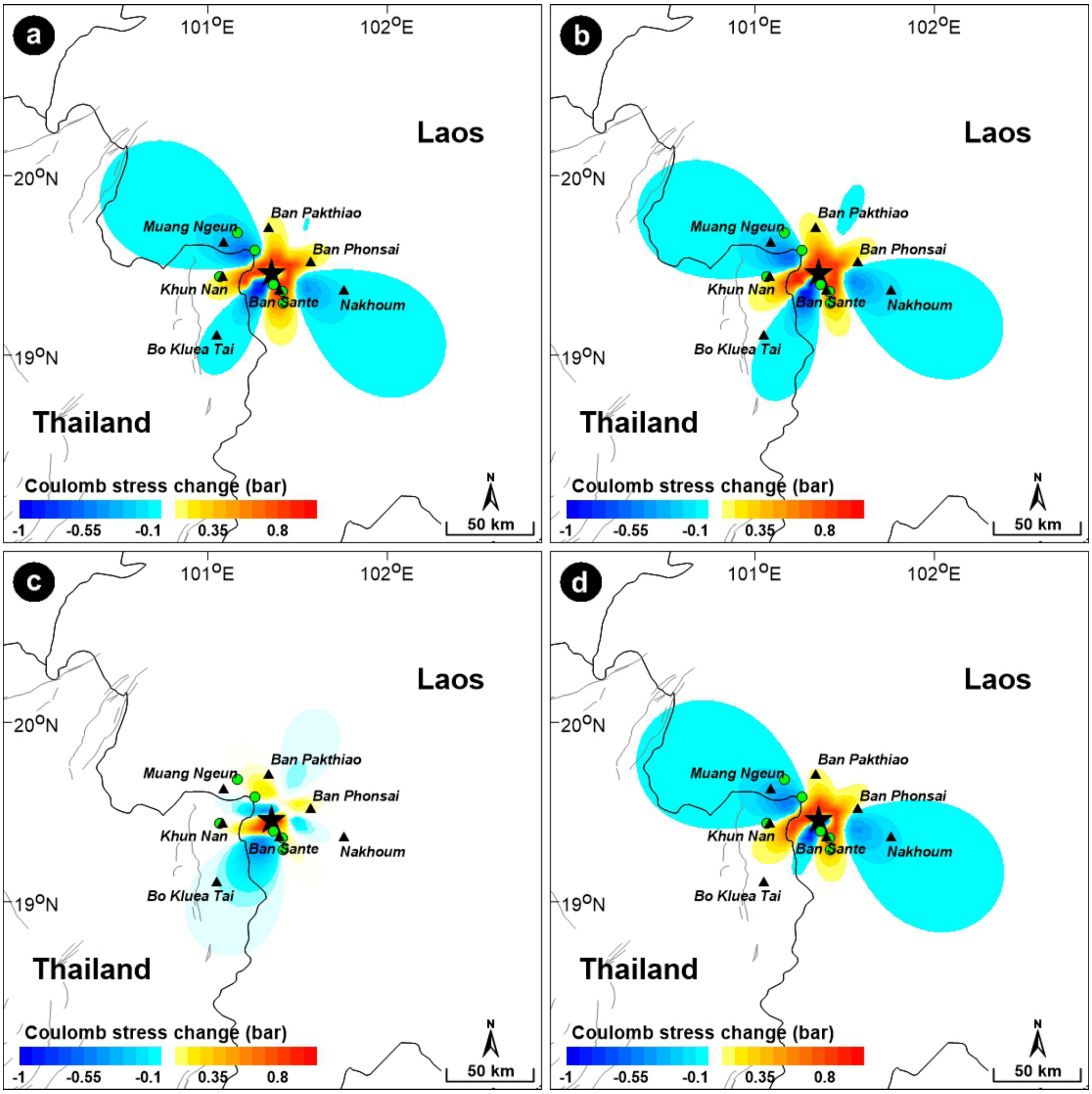

Figure 5. Coulomb stress change caused by the M6.2 earthquake in 2019 in Laos was calculated on the (a) specific receiver fault with a strike direction of 67°, dip angle of 68°, and rake angle of −28°; and the optimally oriented (b) strike-slip faulting, (c) thrust faulting, and (d) normal faulting. The green dots are the epicenters of aftershocks generated by the M6.2 mainshock.

fault with the focal mechanism same as the focal mechanism of the mainshock (Fig. 5a), strike-slip faulting (Fig. 5b), and normal faulting (Fig. 5d), the patterns of the stress changes are not different significantly. Meanwhile, the stress change computed on the receiver fault with trust faulting (Fig. 5c). The pattern of stress change was not clear, which the stress mainly seemed to be at very low levels. Regarding the aftershocks of this event, these aftershocks scattered in the NW-SE direction. The aftershocks were mainly triggered in the areas of increased stress, especially near the mainshock epicenter, with the stress increased more than 0.8 bar. The increased stress also transferred into some areas of Thailand, and there was one aftershock generated in Thailand near the area of stress increased up to 0.8 bar (Fig. 5a and 5b). Therefore, it is possible that this aftershock in Thailand was likely triggered by the increased stress of the M6.2 earthquake in Laos. However, the increased stress transfer did not reach the nearby active fault in Thailand (Fig. 5 in gray lines). So, it was very unlikely that increased stress from the M6.2 earthquake in Laos in 2019 triggered a new mainshock earthquake in the area of Thailand.

5. Discussion

According to the uncertainties in Coulomb stress change calculation, the slip and fault geometry are derived from empirical relations in this study. The rupture area (width and length) of the earthquake can be calculated from the magnitude of the earthquake according to Wells and Coppersmith (1994), while the amount of slip can be calculated using the rupture area and the seismic moment of the earthquake (Aki, 1966). Moreover, the receiver fault types in the study area are complex and significantly influence the spatial pattern of stress transfer. Thus, in this study, all possible types of receiver fault, were used for calculation. According to the uncertainties in aftershock location, there were 36 earthquake events identified as aftershocks using the algorithm of Gardner and Knopoff (1974) that the strong earthquakes in this study, the aftershock sequence will be generated within 70 km from the mainshock epicenter, and the time window of these aftershocks is no more than 2.5 y after the occurrence of mainshock based on the earthquake catalog of NEIC. Therefore, both the uncertainties in Coulomb stress change calculation and aftershock distribution, there is possible that the aftershocks are located both in the areas of increased and decreased stress. However, in this study, the patterns of the stress transfer and aftershock distribution can reveal the relationship of aftershock generation, especially in areas with stress changes exceeding 0.8 bar, which may be used to predict the aftershock hazard area when a strong earthquake occurs in the Thailand-Laos-Myanmar border.

6. Conclusions

In this study, the three strong earthquakes with magnitudes of $M \geq 6.0$ that occurred in the Thailand-Laos-Myanmar border during 2010-2022 were analyzed to investigate stress transfer and aftershock distribution in the areas. The results indicate that the type of receiver fault is the important factor that influence the pattern of the stress change in the Thailand-Laos-Myanmar border. The M6.1 earthquake in 2014 in Thailand generated most aftershocks in the areas of increased stress, especially in the levels of stress change above 0.8 bar. The M6.9 earthquake in 2011 in Myanmar caused the stress to transfer into Thailand with the low level of stress change (less than 0.3 bar), and there was no aftershock generated in this area of Thailand. Meanwhile, the M6.2 earthquake in 2019 in Laos induced the stress transferred to Thailand with the level of stress change up to 0.8 bar, which there was one aftershock event generated in this area of Thailand. The results are likely to be the characteristics of stress transfer and aftershock distribution, especially in the areas of stress increased above 0.8 bar, which can be used to identify the prospective areas of aftershocks after the strong earthquake occurred in the Thailand-Laos-Myanmar border.

Data availability statement. The earthquake data and the focal mechanisms for this study are provided by the NEIC earthquake catalog (data available at https://www.earthquake.usgs.gov/earthquakes).

Acknowledgements. The scholarship from the Graduate School, Chulalongkorn University, to commemorate the 72nd anniversary of His Majesty King Bhumibol Aduladej is gratefully acknowledged. This Research is funded by Thailand Science Research and Innovation Fund Chulalongkorn University (SOC_FF_69_045_2300_013). The thoughtful comments and suggestions by the editors and anonymous reviewers that enhanced the quality of this manuscript significantly are acknowledged.

References

Aki, K. (1966). Generation and propagation of G waves from the Niigata earthquake of June 14, 1964. Part 2. Estimation of earthquake moment released energy and stress-strain drop from G wave spectrum, Bull. Earthq. Res. Inst., 44, 73-88.

Aron, A. and J. Hardebeck (2009). Seismicity rate changes along the central California coast due to stress changes from the 2003 M 6.5 San Simeon and 2004 M 6.0 Parkfield earthquakes, Bull. Seismol. Soc. Am., 99, 2280-2292.

Asayesh, B. M., H. Zafarani and M. Tatar (2020). Coulomb stress changes and secondary stress triggering during the 2003 (Mw 6.6) Bam (Iran) earthquake, Tectonophysics, 775, 228304.

Gardner, J. K. and L. Knopoff (1974). Is the sequence of earthquakes in southern California, with aftershocks removed, Poissonian?, Bull. Seismol. Soc. Am., 64, 363-367.

Harris, R. A. (1998). Introduction to special action: stress triggers, stress shadows, and implications for seismic hazard, J. Geophys. Res., 103, 347-358.

Harris, R. A. and R. W. Simpson (1998). Suppression of large earthquakes by stress shadows: a comparison of Coulomb and rate-and-state failure, J. Geophys. Res.: Solid Earth, 103, 24439-24451.

Lin, J. and R. S. Stein (2004). Stress triggering in thrust and subduction earthquakes and stress interaction between the southern San Andreas and nearby thrust and strike-slip faults, J. Geophys. Res. Solid Earth, 109, B02303.

Pailoplee, S., P. Channarong and V. Chutakositkanon (2013). Earthquake activities in the Thailand-Laos-Myanmar border region: A statistical approach, Terr. Atmos. Ocean, 24, 721-730.

Pailoplee, S., Y. Sugiyama and P. Charusiri (2009). Deterministic and probabilistic seismic hazard analyses in Thailand and adjacent areas using active fault data, Earth Planets Space, 61, 1313-1325.

Parsons, T. (2005). Significance of stress transfer in time-dependent earthquake probability calculations, J. Geophys. Res.: Solid Earth, 110, B05S02.

Puangjaktha, P. and S. Pailoplee (2018). Application of the region-time-length algorithm to study of earthquake precursors in the Thailand-Laos-Myanmar border, J. Earth Syst. Sci., 127, doi:10.1007/s12040-018-0939-y.

Raju, P. S., V. K. Gahalaut and M. R. Kumar (2024). Phodong (Sikkim) earthquake of 14 February 2006 and its aftershocks – Coulomb stress analysis, J. Geodyn., 46, 63-67.

Resenberg, P. (1985). Second-order moment of central California seismicity, J. Geophys. Res. Atmos., 90, 5479-5495.

Shao, Y., J. He, X. Wang and Y. Zhao (2024). Viscoelastic stress change from the 1931 Mw7.8 Fuyun earthquake and its impacts on seismic activity around the Altai mountains, Geod. Geodyn., 15, 326-337.

Stein, R. S. (1999). The role of stress transfer in earthquake occurrence, Nature, 402, 605-609.

Sukrungsri, S., S. Khamsiri and S. Pailoplee (2024). Investigation of co-seismic stress and aftershock distribution along the Sumatra-Andaman subduction zone, Geosci.Lett., 11, doi:10.1186/s40562-024-00366-2.

Toda, S. (2008). Coulomb stresses imparted by the 25 March 2007 Mw = 6.6 Noto-Hanto, Japan, earthquake explain it's 'butterfly' distribution of aftershocks and suggest a heightened seismic hazard, Earth Planets Space, 60, 1041-1046.

Toda, S., R. S. Stein, K. Richards-Dinger and S. B. Bozkurt (2005). Forecasting the evolution of seismicity in southern California: animations built on earthquake stress transfer, J. Geophys. Res.: Solid Earth, 110, B05S16.

Wang, M., Z. Liu and R. Luo (2024). Stress triggering effect on the 2022 Honghe Ms5.0 earthquake with historical strong earthquakes, Geod. Geodyn., 15, 107-113.

Wells, D. L. and K. J. Coppersmith (1994). Updated empirical relationships among magnitude, rupture length, rupture area, and surface displacement, Bull. Seismol. Soc. Am., 84, 974-1002.

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