My comments on the manuscript, entitled 'Beyond Static Forecasts: A Dynamic Stress Gradient Framework for High-Resolution Aftershock Prediction and Mitigation' (egusphere-2025-3348 (NPG)) authored by Boi-Yee Liao

The author constructed a framework by integrating the rate-and-state friction law, a KPP-type reaction-diffusion equation, and the Banach fixed-point theorem. He applied this framework to study the evolution of Coulomb stress following a large earthquake from numerical simulations of the dynamic redistribution of stress in space and time.

Although the study is interesting and significant, I cannot correctly evaluate whether manuscript may be accepted for publication in its current form or not due to the following basic reasons in 'Problems for Sciences.' These reasons make me unable to judge whether the numerical results made by the author are significant for the generation of aftershocks after the 2018 Hualien earthquake in Taiwan or not. Hence, I suggest that the author should answer the questions. This manuscript should be substantially revised and then reviewed again.

Major Problems with Sciences:

(1)In the author's framework, the rate-and-state friction law, the KPP-type reaction-diffusion equation, and the Banach fixed-point theorem are all one-dimensional. However, his simulations are made on a two-dimensional rectangle. The author should describe the two-dimensional model because the values of model parameters are often distinct in the different axes.

(2)The author wrote: 'To ensure numerical convergence and model reliability, we adopt spatial grid resolutions of Δx=1320 m and Δy=2600 m, yielding an effective length scale of Δ =2900.' In numerical simulations, the grid sizes can remarkably influence numerical convergence and stability. The selection of grid sizes for numerical simulations is important. How did the author select the two values: from a theoretical analysis or from numerical tests?

(3)For the study area represented by a rectangle in Figures 5–7, the differences in degrees are 0.5^o (or 55 km) along the longitude and 1^o (or 110 km) along the latitude. The grid size selected by the author is Δx=1320 m=1.32 km along the longitude and Δy=2600 m=2.6 km along the latitude. The uncertainty of earthquake location is about 2 km inland and about 3 km offshore. The values of Δx and Δy are both shorter than the location uncertainty. Can the simulated results based on the two values be applied to interpret the temporal variation and spatial distribution of aftershocks of the 2018 Hualien earthquake?

(4)For the 2D rectangle, its western part is on land, while its eastern part is offshore. The western part is below high mountains, while the eastern part is underwater. Hence, the vertical loading on the 2D rectangle is higher in the western part than in the eastern part. Hsu et al. (2025) showed that in southwestern Taiwan the excess seismicity rate is positively correlated with reduced NW-SE compression and/or decreasing vertical loading. This indicates the influence caused by vertical loading on seismicity. In the manuscript, the author wrote: 'The Hualien M_w6.4 mainshock occurred in the complex convergence boundary of the Philippine Sea Plate and Eurasian Plate.' This means that the geological structures and the values of physical parameters should be different in the two tectonic regimes. This would produce the difference in the stress diffusion between the two parts. Could the author clearly describe such differences due to different vertical loading.

[Reference]

Hsu, Y.J., R. Bürgmann, Z. Jiang, C.H. Tang, C.W. Johson, D.Y. Chen, H.H. Huang, M. Tang, and X. Yang (2025). Hydrologically-induced crustal stress changes and their association with seismicity rates in Taiwan, Earth Planet. Sci. Letts., 651, https://doi.org/ 10.1016/j.epsl.2024.119181.

(5)The mainshock showed thrust faulting and fault-to-fault jumping ruptures (Lee et al., 2019). Can the focal mechanism and rupture processes of the mainshock influence the spatial distribution of stresses and the evolution of stress diffusion?

[Reference]

Lee, S.J., T.C. Lin, T.Y. Liu, and T.P. Wong (2019). Fault-to-Fault jumping rupture of the 2018 M_w 6.4 Hualien earthquake in Eastern Taiwan. Seism. Res. Letts., 90(1). 30-39. https://doi.org/10.1785/0220180182

(6)Figure 1 displays that the number of aftershocks was larger in the eastern part (offshore) than in the western part (inland). This might indicate that the number of faults, sub-surface geological structures, and the values of physical parameters are different in the two parts. However, it does not seem able to apply the spatial distributions of stress changes at three depths (i.e., Figures 5–7) to explain the occurrence of aftershocks.

(7)As mentioned by the author, there are three faults in the study area. In fact, the number of faults is larger than three. Kuo-Chen et al. (2019) addressed a remarkable correlation between spatial distribution of aftershocks and the main fault along which the mainshock ruptured. Do the existence of those faults, particularly the main fault, which is not a straight line on the ground surface (cf. Lee et al., 2019; Kuo-Chen et al., 2019), influence the evolution of stress diffusion?

[Reference]

Kuo-Chen H., Z.K. Guan, W.F. Sun, P.Y. Jhong, and D. Brown (2019). Aftershock sequence of the 2018 M_w 6.4 Hualien earthquake in Eastern Taiwan from a dense seismic array data set. Seism. Res. Letts., 90 (1), 60-67. https://doi.org/10.1785/ 0220180233

(8)There are remarkable differences in sub-surface geological structures inferred from 3D tomography between the western part and eastern one (e.g., Rau and Wu, 1995; Ma *et al*., 1996; Kim *et al*., 2005; Wu *et al*., 2007; Kuo-Chen *et al*., 2012). Can such differences influence the evolution of Coulomb stress?

[References]

Rau, R.J. and F.T. Wu (1995). Tomographic imaging of lithospheric structures under Taiwan. Earth Planet. Sci. Lett., 133, 517-532, Doi:10.1016/0012-821X(95)00076-O.

Ma K.F., J.H. Wang, and D. Zhao (1996). Three-dimensional seismic velocity structure of the crustal and uppermost mantle beneath Taiwan. J. Phys. Earth, 44, 85-105.

Wu, Y.M., C.H. Chang, L. Zhao, J.B.H. Shyu, Y.G. Chen, K. Shieh, and J.-P. Avouac (2007). Seismic tomography of Taiwan: Improved constraints from a dense network of strong-motion stations. J. Geophys. Res., 112, B08312,

doi:10.1029/2007JB004983.
Kim, K.H., Chiu, J.M., Pujo, J., K.C. Chen, B.S. Huang, Y.H. Yeh, P. Shen (2005). Three-dimensional V_p and V_s structural models associated with the active subduction and collision tectonics in the Taiwan region. Geophys. J. Intern., 162, 204-220.

(9)In Section 3, the author described the reasons how to select the values of model parameters for numerical simulations of the evolution of Coulomb stress after the 2018 Hualien earthquake in Taiwan. The main reason is for preventing the model from converging. Although this is an acceptable reason, the author should explain whether the values of model parameters can meet regional geological and seismological structures.

Minor Problems
Compared with the above-mentioned problems, the followings are minor.

Problems with Figures:
(1)The quality of figures is not good enough for readers. For example, Figures 5–7 are not good for readers.

Problems with References:
(1)The format of cited references should follow the Journal's rules.

(2)the author should cite two important articles shown below for regional tectonics.
[References]
Tsai, Y.B., T.L. Teng, J.M. Chiu, and H.L. Liu (1977). Tectonic implications of the seismicity in the Taiwan region. Mem. Geol. Soc. China, 2, 13-41.
Wu, F.T. (1978). Recent tectonics of Taiwan. J. Phys. Earth, 2 (Suppl.), S265-S299.

(3)Few cited references, e.g., Zavyalov et al. (2024), are not listed in the Section of References.

(4)The KPP (or Fisher-KPP) equation is a very important nonlinear physical equation and has been widely applied in biology, ecology, and combustion theory. It is better to add cited references on Line 73 where the equation appeared at first in the text. The author may cite one of the following two articles or others:
Kolmogorov, A., I. Petrovskii, and N. Piskunov (1991). A study of the diffusion equation with increase in the amount of substance, and its application to a biological problem. In V.M. Tikhomirov, editor, Selected Works of A.N. Kolmogorov I, 248-270. Kluwer 1991, ISBN 90-277-2796-1. Translated by V.M. Volosov from Bull. Moscow Univ., Math. Mech. 1, 1-25.
El-Hachem M., S.W. McCue, W. Jin, Y. Du, and M.J. Simpson (2019). Revisiting the Fisher-Kolmogorov-Petrovsky-Piskunov equation to interpret the spreading–extinction dichotomy. Proc. R. Soc. A, 475:20190378. http://dx.doi.org/10.1098/rspa.2019.0378.

Problems with English Writing:
(1)The English writing is good. Nevertheless, there are some typo errors.

(2)The abstract is not concise.

(3)‘The Central Weather Bureau’ has been renamed ’the Central Weather Administration’ for a few years.