**Interactive comment on** “Probability assessment on the recurring Meishan earthquake in central Taiwan with a new non-stationary analysis” by J. P. Wang and X. Yun

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Interactive Discussion

Fig. 1 Schematic diagram for the time-predictable model: a) best-estimate relationship between cumulative co-seismic slips and time, and b) the earthquake-time prediction facilitated with a failure state and a constant stress increment.

(a) Cumulative co-seismic slip vs. Time

(b) Failure state vs. Stress

Co-seismic slip of the recent event

Interactive Comment

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Discussion Paper
Fig. 2 Schematic diagram showing the essential of the Brownian model; within the two imaginary stress states, the model considers the stress-time series should be random and could be modeled by a long-term stress increment and a Brownian motion as

\[ X(t) = \lambda t + \sigma W(t) \]

where \( X(t) \) is the stress at time \( t \), \( \lambda \) is the long-term stress increment rate, \( \sigma \) is the magnitude of a Brownian motion \( W(t) \).
Fig. 3 Schematic diagram illustrating the negative binomial model; between the two stress states, many “stress routes” can be present, and the probability of each route can be estimated with the model, then developing the probability distribution for the interval between two consecutive events.
Fig. 4 Schematic diagram illustrating Mohr-Coulomb failure criterion; Circle A represents the initial state after a thrust-fault earthquake or at $t_0$, Circle B denotes stress states at $t^*$ after $t_0$, and Circle C is the stress state corresponding to the failure state.

Shear stress
cohesion
friction angle
Circle A
Circle B
Circle C

 Failure envelope
Principle stress

$\sigma_{1\text{ failure}}$
$\sigma_{3\text{ failure}}$
$\sigma_{3\text{ initial}}$

C3873
Fig. 5 The Mohr circles for evaluating the non-stationary earthquake probability for strike-slip earthquakes.
The probability distribution
Earthquake probability
within time $t^*$ after $t_0$

Fig. 6. The essentials of the new non-stationary model: Developing the probability distribution of the major principal stress at time $t^*$ (i.e., $1_\ast t\sigma$) after the last event or after $t_0$. 

Major principal stress at failure state

Major principal stress at time $t^*$ after $t_0$
Fig. 7 The location of the Meishan fault in central Taiwan.
Fig. 8. The earthquake probability associated with the Meishan fault in three 10-year periods subject to the best-estimate return period of 162 ± 50 years (other input data are summarized in Table 1).

- **New non-stationary model**
- **Stationary Poissonian calculation**

<table>
<thead>
<tr>
<th>Time</th>
<th>Probability</th>
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<tbody>
<tr>
<td>2015~2025</td>
<td>0.06</td>
</tr>
<tr>
<td>2025~2035</td>
<td>0.08</td>
</tr>
<tr>
<td>2035~2045</td>
<td>0.08</td>
</tr>
</tbody>
</table>
Fig. 9. The earthquake probability associated with the Meishan fault in three 10-year periods subject to the best-estimate return period of 162 ± 100 years (other input data are summarized in Table 1).
Fig. 10. A schematic graph explaining the average earthquake probability for the model application is decreased with a bigger range of return period, owing to the non-linear relationship between earthquake probability and return period.
Fig. 11 The Mohr circles for evaluating the non-stationary earthquake probability for normal-fault earthquakes.

- Shear stress
- Cohesion $c$
- Friction angle
- Circle A
- Principle stress
- Circle B
- Circle C
- ABC

C = $\sigma_{3\text{\_failure}}$, B = $\sigma_{3\text{\_t}}$, A = $\sigma_{3\text{\_initial}}$, $\sigma_{1\text{\_failure}}$

Failure envelope

Principle stress
Fig. 12 The Mohr circles for evaluating the non-stationary earthquake probability subject to an oblique tectonic compression.
Fig. 13. Schematic diagram illustrating the stationary process after combining many non-stationary processes; taking $T = t_0$ and $T = t_1$ for example, the sum of that many non-stationary probabilities will be close to each other, although the probability is very low for Fault D at $T = t_0$, and it is very low for Fault A at $T = t_1$. 