Combining rate-based earthquake forecasting models with precursory information and with non-normalized models

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Non-normalized models

Alarm function

\[ A(x,t) = \frac{\sum_{i=1}^{n} \omega(x_i,t_i)}{\sum_{i=1}^{n} \omega(x_i,t_i)} \]

Rate-based models

Poisson rate of expected earthquakes

\[ \lambda(x,M,t) \]

the expected rate of earthquake should be:

- \( g(A) > 1 \) - increased
- \( g(A) < 1 \) - decreased
- \( g(A) = 1 \) - unchanged

\[ \lambda_{combined}(x,M,t) = g(A(x,t)) \lambda(x,M,t) = A(x,t) \otimes \lambda(x,M,t) \]

Example 1:

Combining alarm-based model with rate-based model

EAST \rightarrow EAST

Example 2:

Combining alarm-based model with rate-based model

EAST \otimes EEPAS

Bibliography

Shebalin P., C. Narteau, J. Zechar, M. Holschneider, P. Shebalin (1,2), C. Narteau (2), J. Zechar (3), and M. Holschneider (4). Combining rate-based earthquake forecasting models with precursory information and with non-normalized models. doi:10.1007/s10403-014-0412-0.

Differential probability gain (DPG):

\[ g(\lambda) = \frac{\delta(\lambda)}{\delta T(\lambda)} \]

Why to combine:

EAST and EEPAS relative RI are informative.

To inform about the precursory information

Conservation rule

\[ \lambda_{combined} = \sum_{i=1}^{n} \lambda_i \otimes \sum_{j=1}^{m} \omega_j \otimes \sum_{k=1}^{l} \nu_k \]

Testing period July 2009 to December 2012

Comparison with convex EAST\(\otimes\)EEPAS model