

Development of flat-file and selection of GMPEs (TEM PSHA2025, draft)

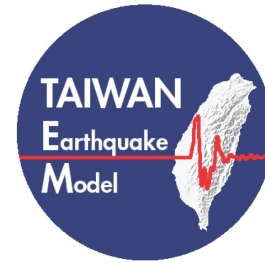
Data (flat-file)

- Data processing
(manual and automatic filtering)

GMPE Ranking method

- LLH
- EDR
- SP

Ranking result



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Central University, Taiwan

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and The TEM Working group.

Data (flat-file)

Ground motions and intensity

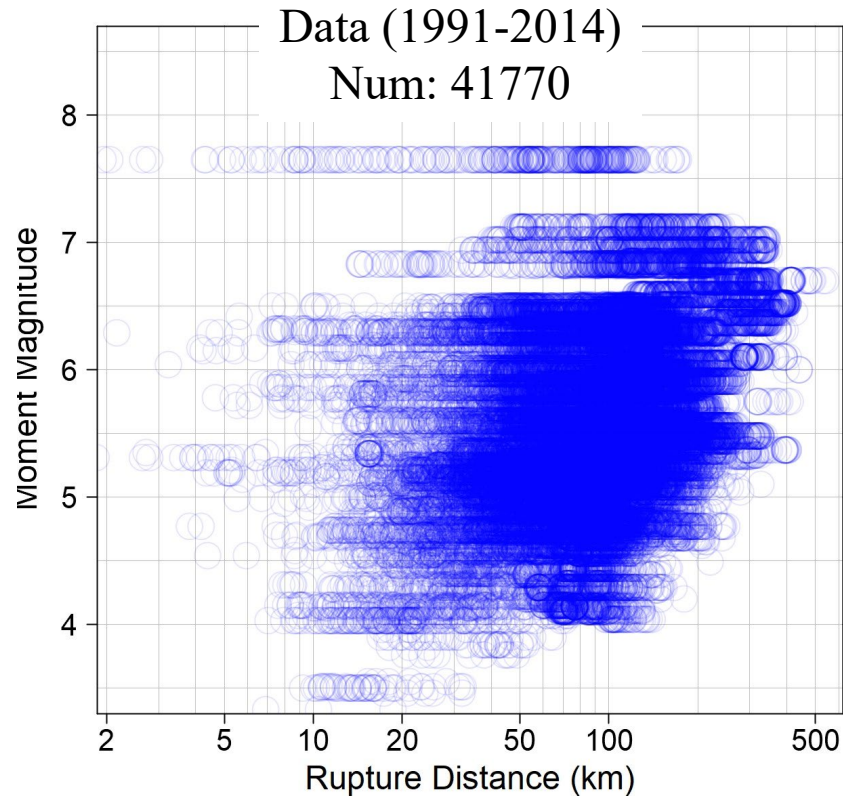
- **Data processing**
- Computation of ground-motion parameters

Source metadata

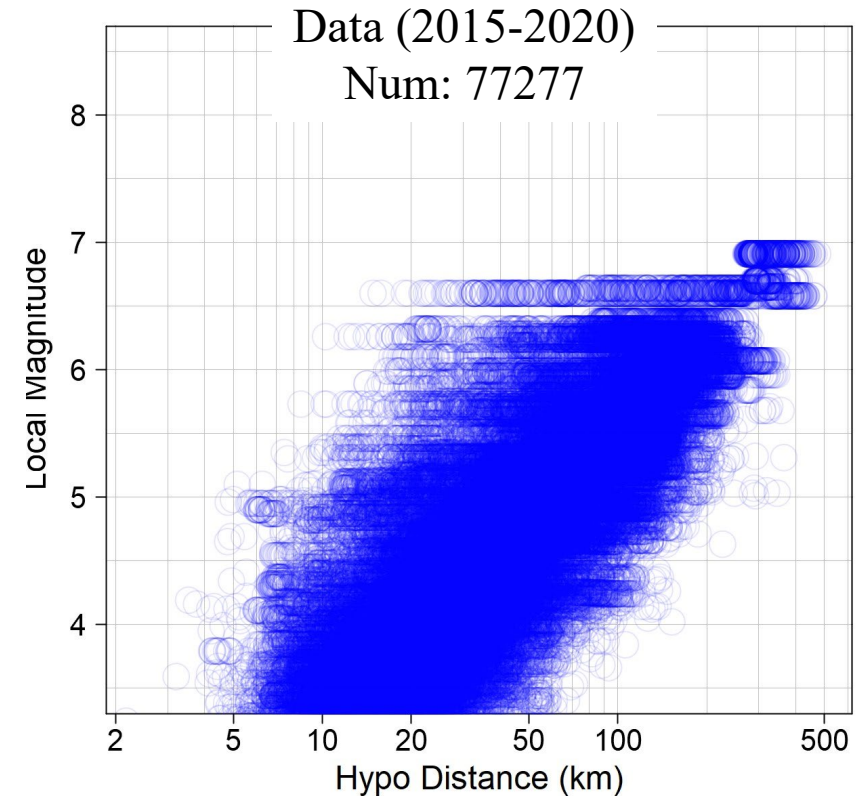
Path metadata

Site condition parameters

Current dataset

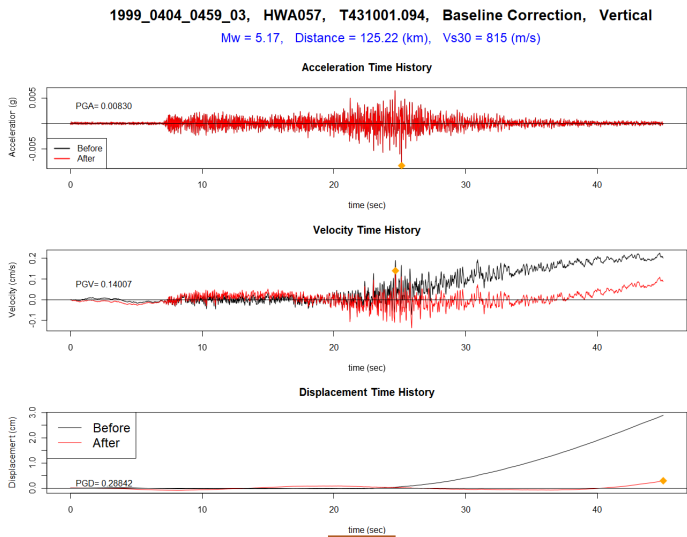


Target set

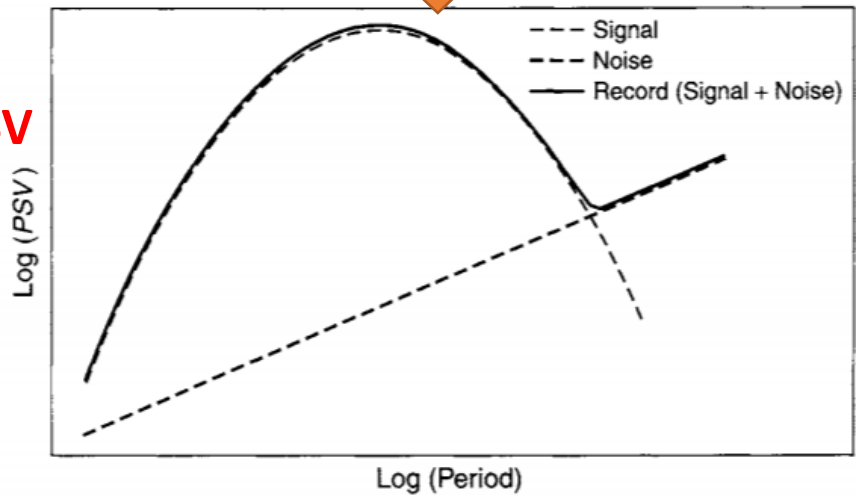


Manual Filtering

Baseline Correction (BC)

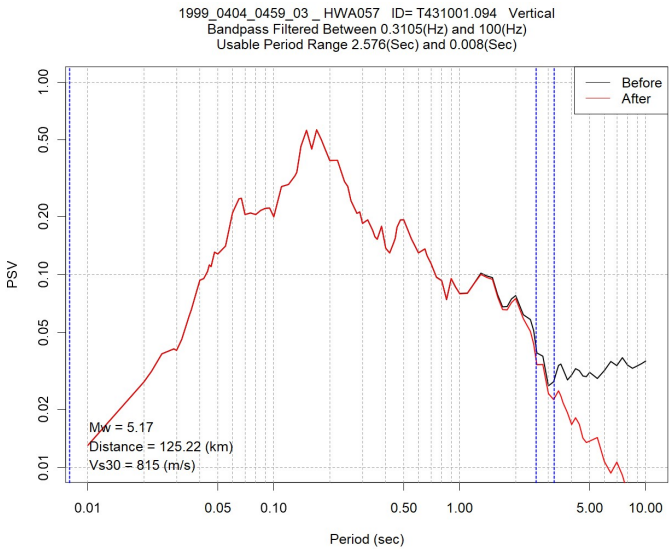


PSV

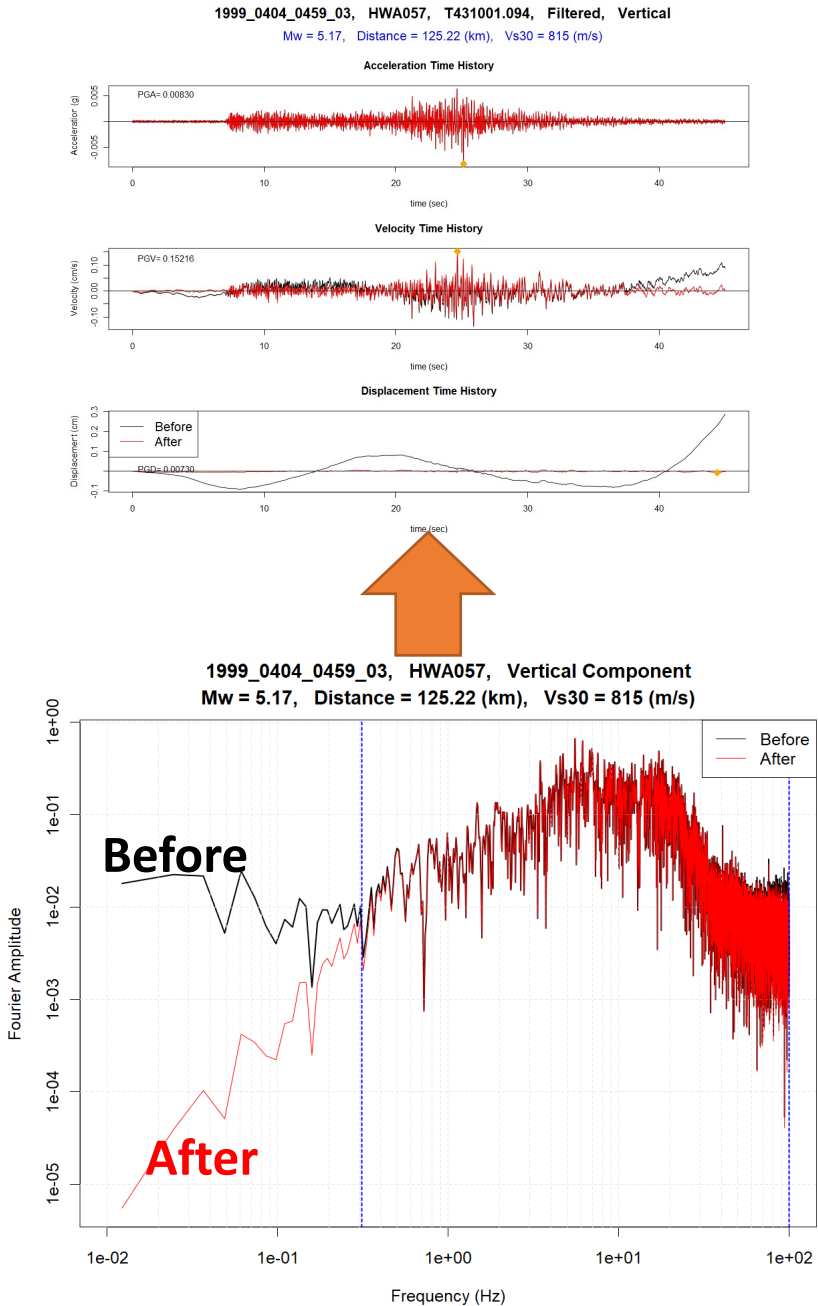


Shakal et al. (2004)

- Each component



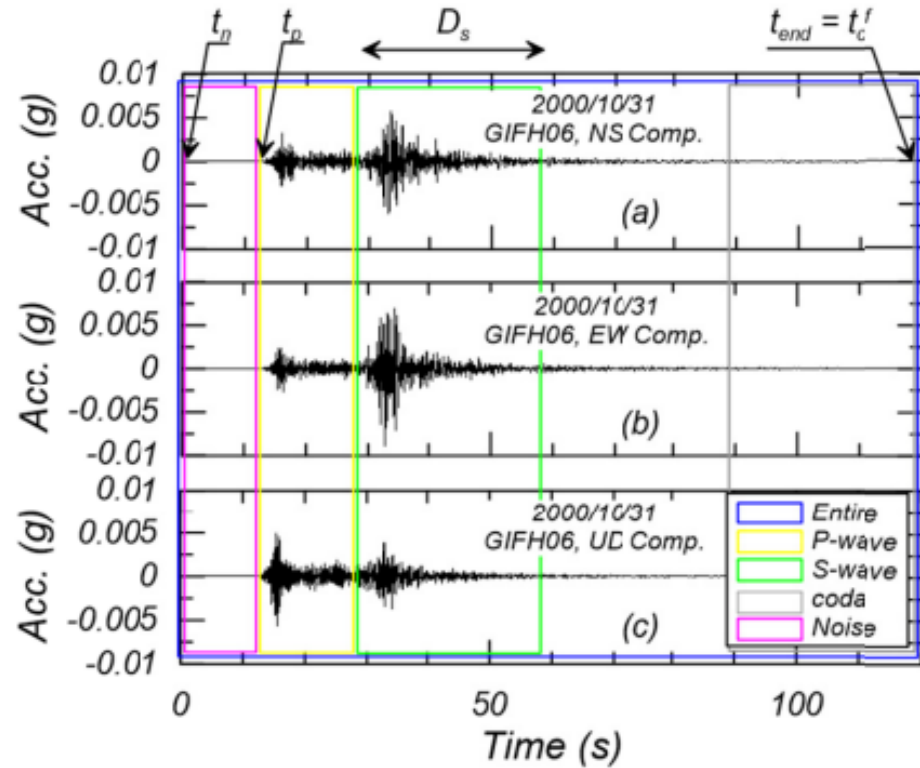
BC + Filtering



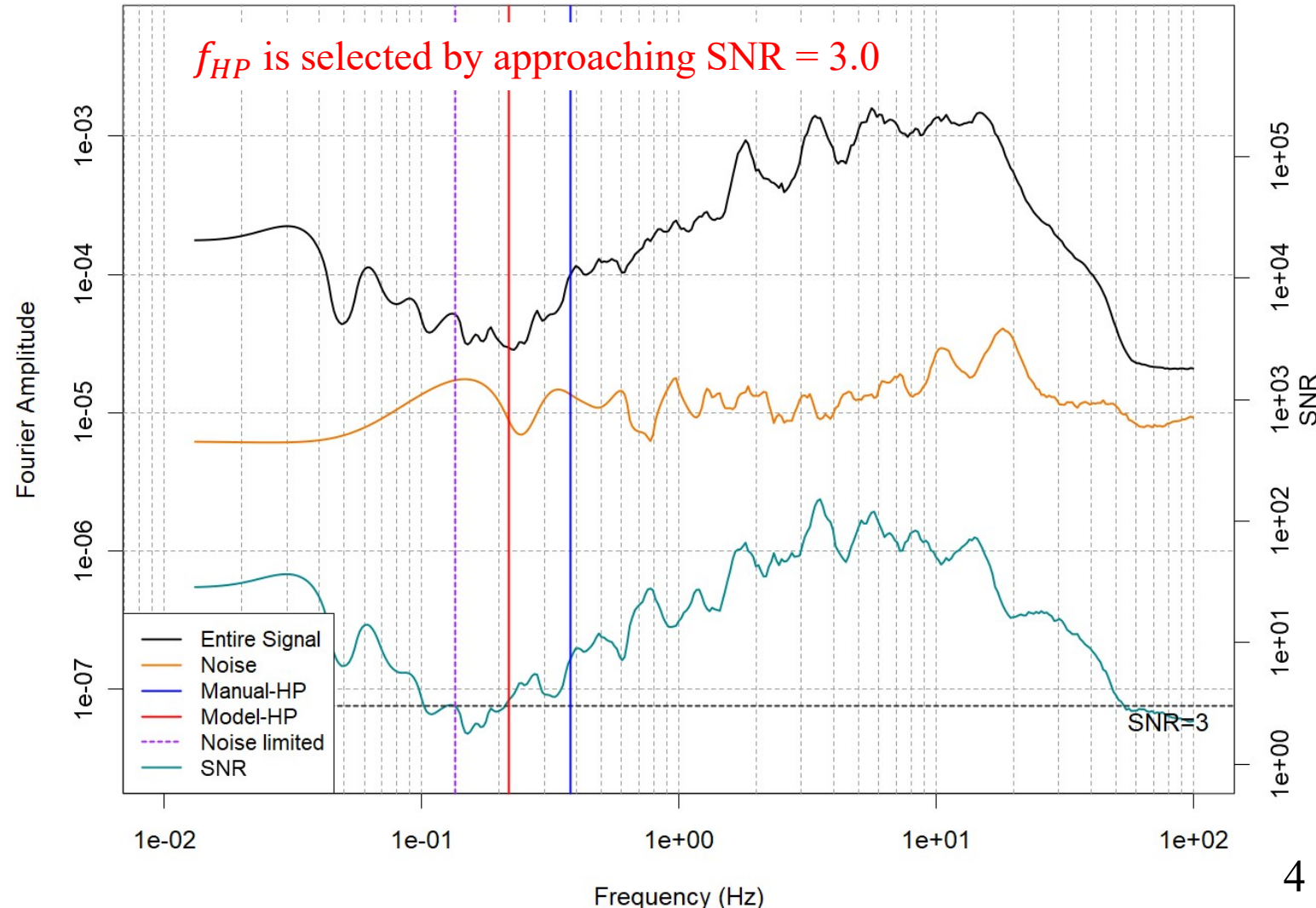
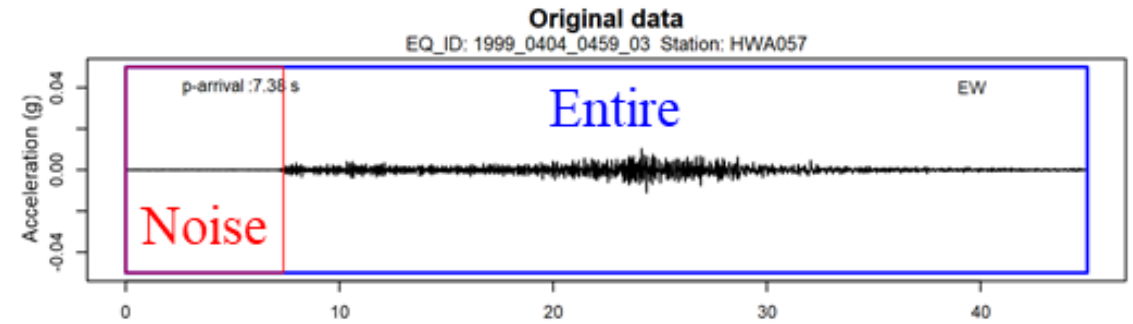
Automatic Filtering

Determine noise window of time series

SNR(signal-to-noise ratio)

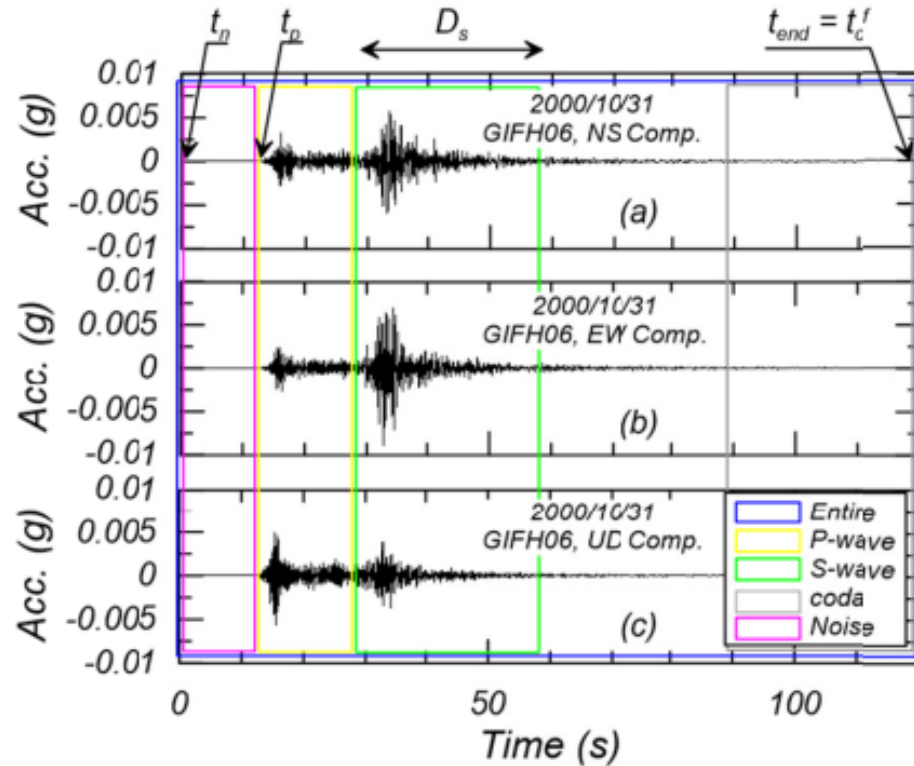


Schematic drawing of different time windows
(PEER report 2020/02)



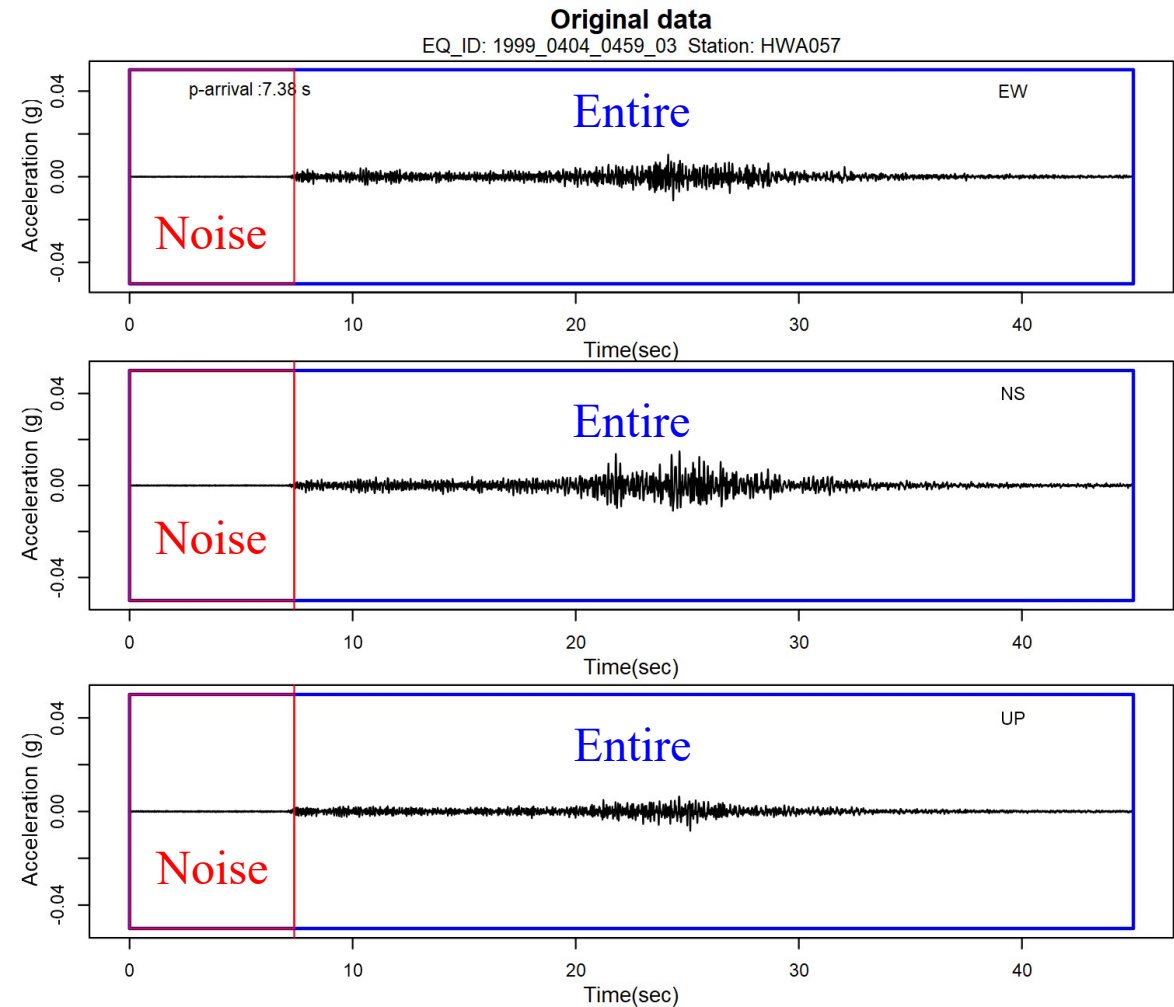
Automatic Filtering

Determine noise window of time series



Schematic drawing of different time windows (PEER report 2020/02)

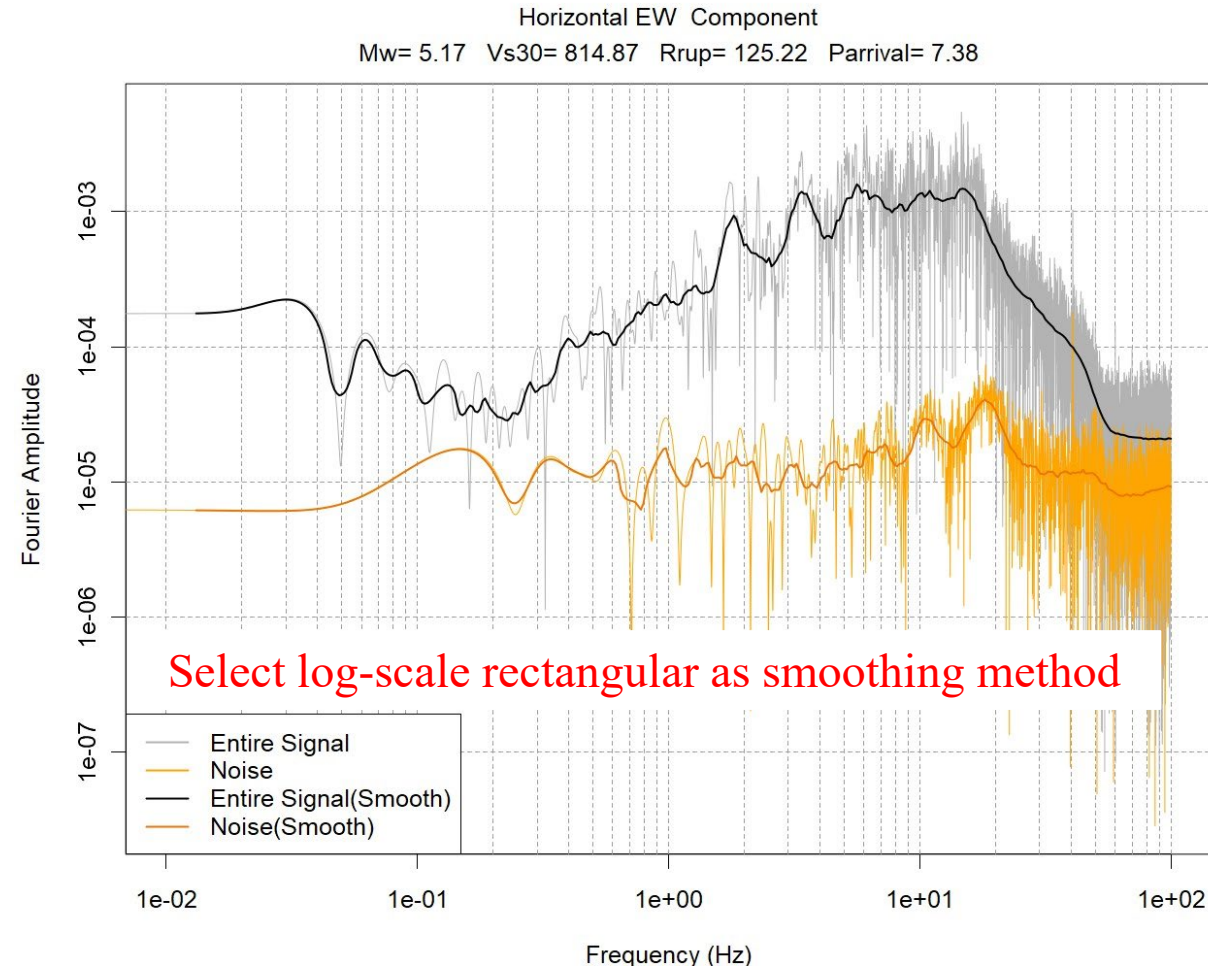
Determining the P-wave arrival time (Akazawa, 2004). This technique picks up the onset times, employing full power of the AR-AIC algorithm and the STA/LTA ratio. we can locate the noise window for each time series.



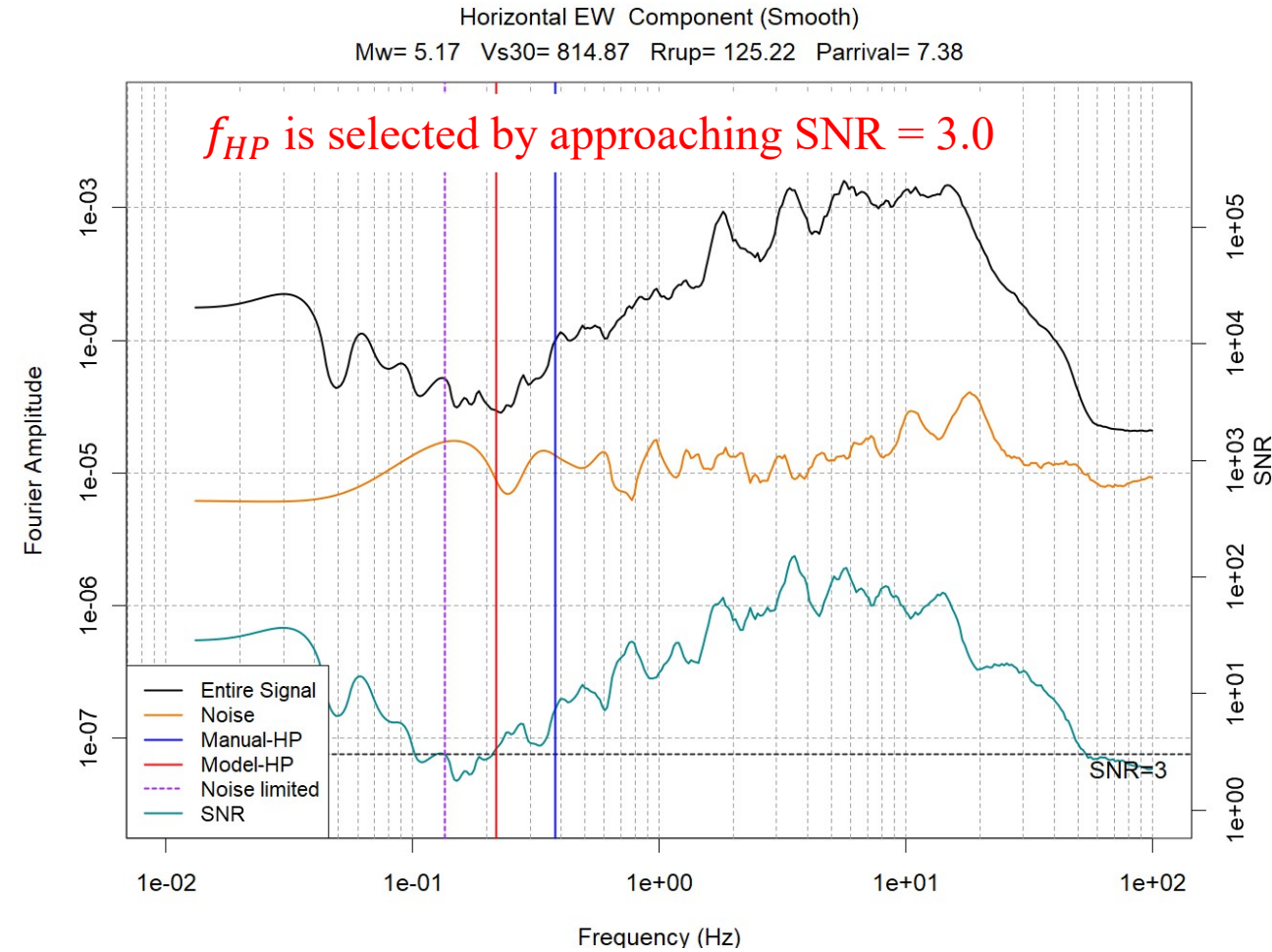
Noise window: 0 to P wave arrival time

Automatic Filtering

Compute FAS and Smoothing



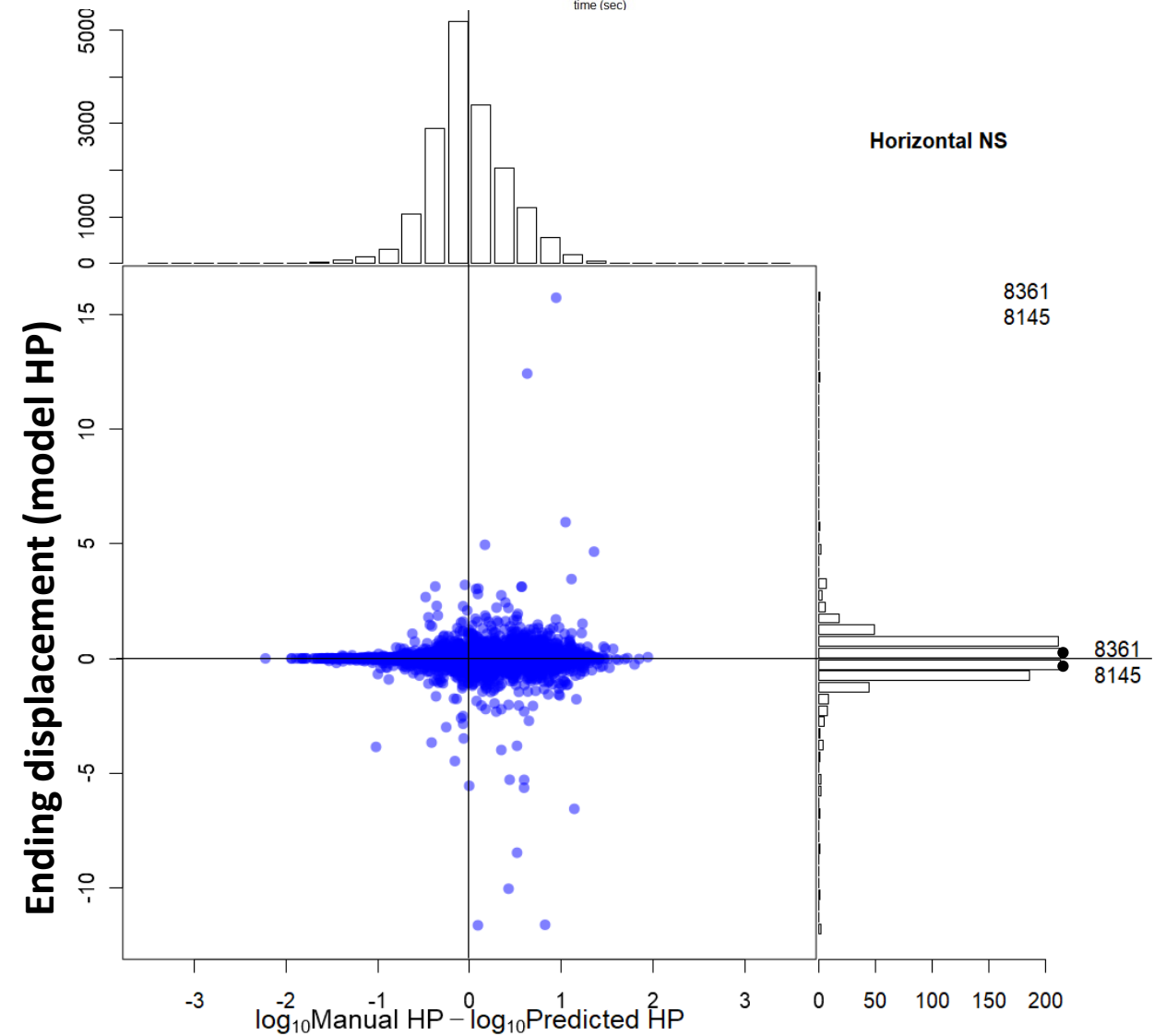
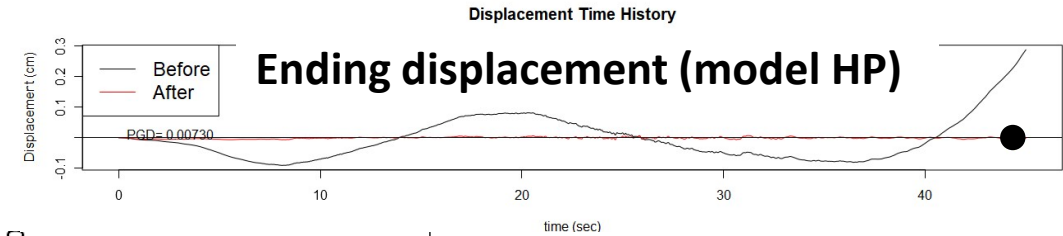
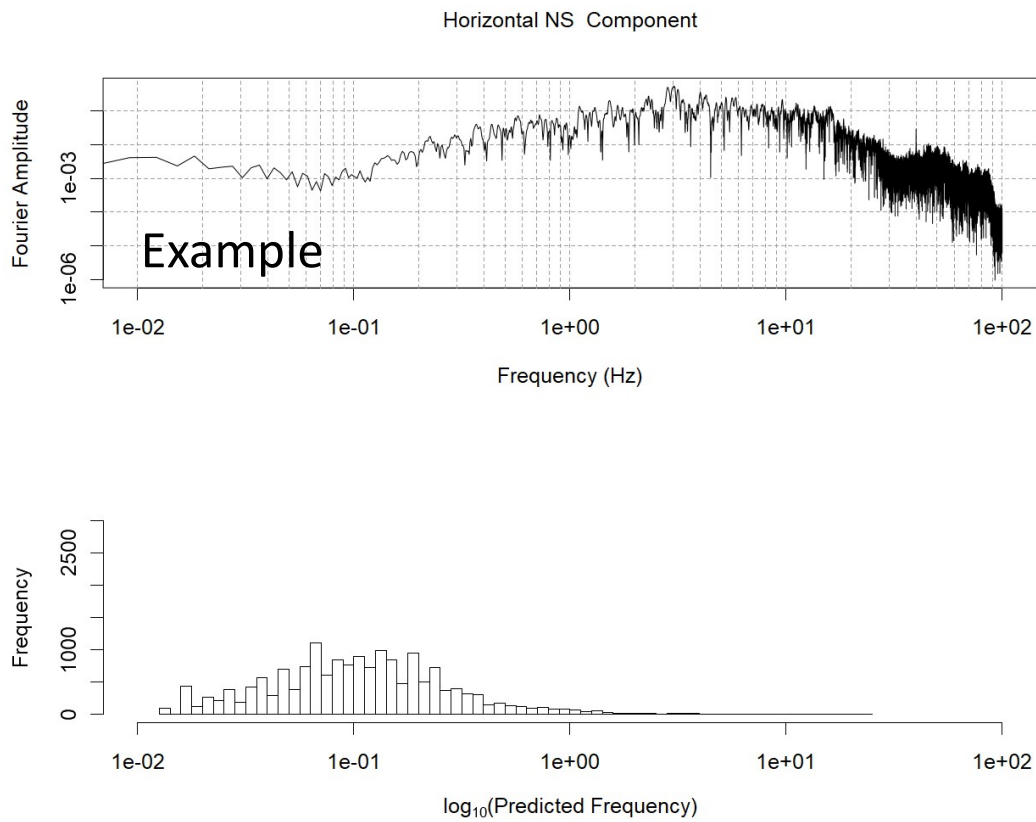
SNR(signal-to-noise ratio)



Konno and Ohmachi (1998), Boore (2020), PEER (2020)

Automatic Filtering

Model HP Distribution



GMPE Ranking method

- LLH (Scherbaum et al., 2009)**

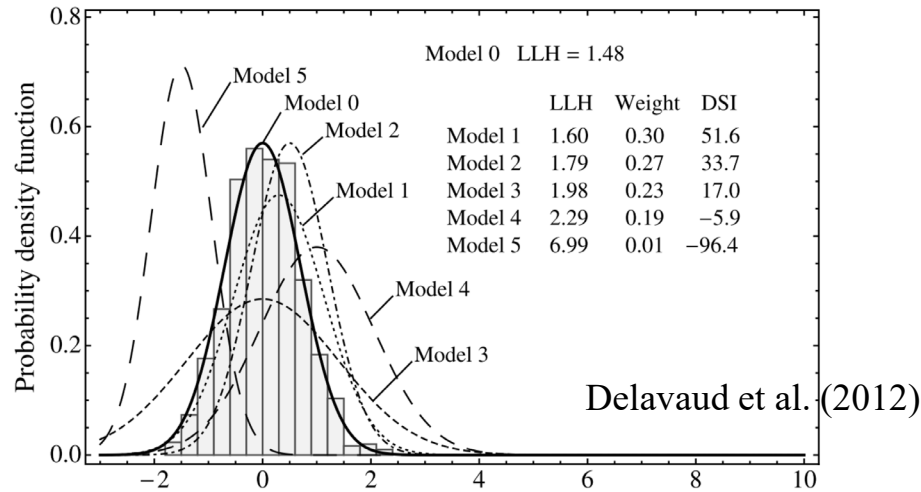
The probability of occurrence of observed samples by the consideration of the probability distribution of the GMPEs.

Formula:

$$LLH(g,x) = -\frac{1}{N} \sum_{i=1}^N \log_2(g(x_i))$$

$g()$: probability density function of model

x_i : observations



- EDR (Kale and Akkar, 2012)**

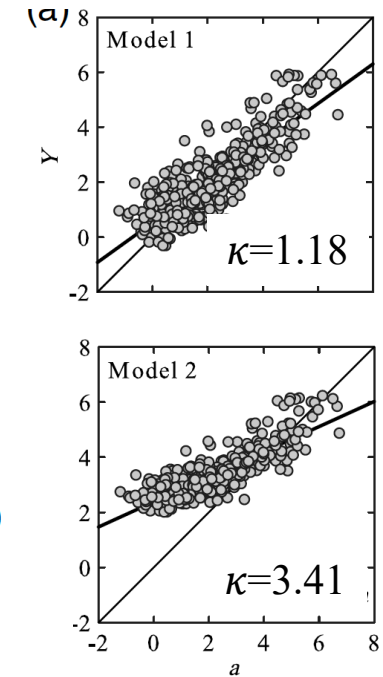
Both consider the aleatory uncertainty of GMPEs and the bias between the observation and the prediction.

Formula:

$$EDR^2 = \kappa \times \frac{1}{N} \times \sum_{i=1}^N MDE_i^2$$

$$\kappa = \frac{DE_{original}}{DE_{corrected}}$$

$$MDE_d = \sum_{j=1}^n |d_j| \Pr(|D| < |d_j|)$$



κ : the ratio of original and corrected Euclidean distances

MDE : total occurrence probability for a set of $|d_j|$

Instance & Weighting method

- **LLH**

Farhadi, A., Pezeshk, S., & Khoshnevis, N. (2018)

- **EDR**

Mahendra, R., Rohadi, S., & Rudyanto, A. (2017)

- **LLH & EDR**

Fallah Tafti, M., et al. (2017)

Farhadi, A., Farajpour, Z., & Pezeshk, S. (2019)

Kowsari, M., et al. (2017)

Nizamani, Z. A., & Park, D. (2021)

Ogwen, L. P., & Cramer, C. H. (2014)

Sotiriadis, D., & Margaris, B. (2023)

- Most studies have not taken into account the full response spectrum.
- LLH and EDR each have their own advantages and disadvantages.

- **LLH weighting (Scherbaum et al., 2009)**

The proportion of the LLH value of the specified model among all models.

Formula:

$$w_l = \frac{b^{-\langle \log_b(\mathcal{L}(g_l|\mathbf{x})) \rangle}}{\sum_{k=1}^K b^{-\langle \log_b(\mathcal{L}(g_k|\mathbf{x})) \rangle}}$$

LLH value

b : 2 for calculation

K : number of GMPEs

- **SP (SALIC, Radmila, et al., 2017)**

Formula:

$$SP_j = \sum_{i=1}^{NQNT} (EDR_i \times LLH_i)$$

$$w_j = \frac{\left(\frac{\max SP}{SP_j} \right)}{\sum_{j=1}^{NGMPE} \left(\frac{\max SP}{SP_j} \right)}$$

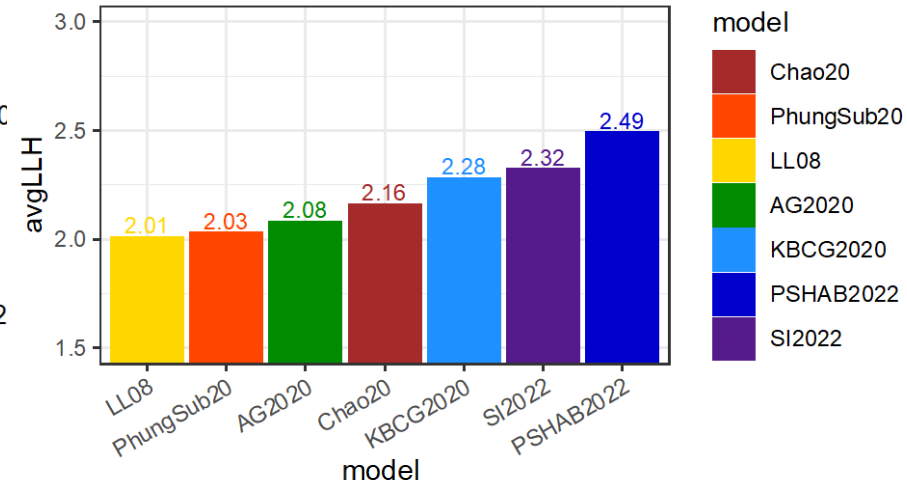
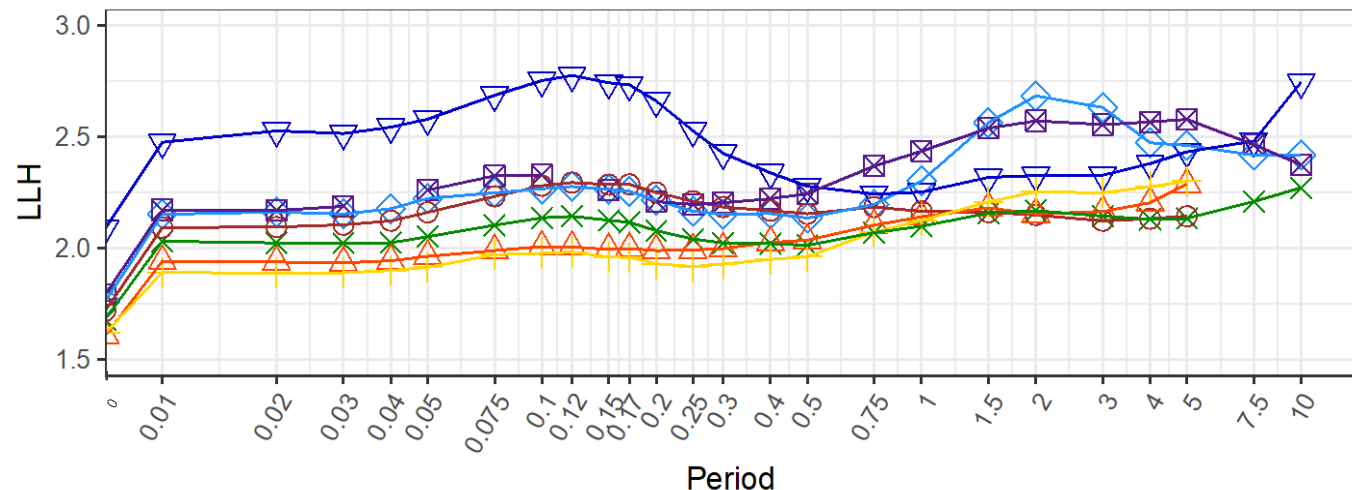
NQNT : the number of hazard parameters

NGMPE : number of GMPEs

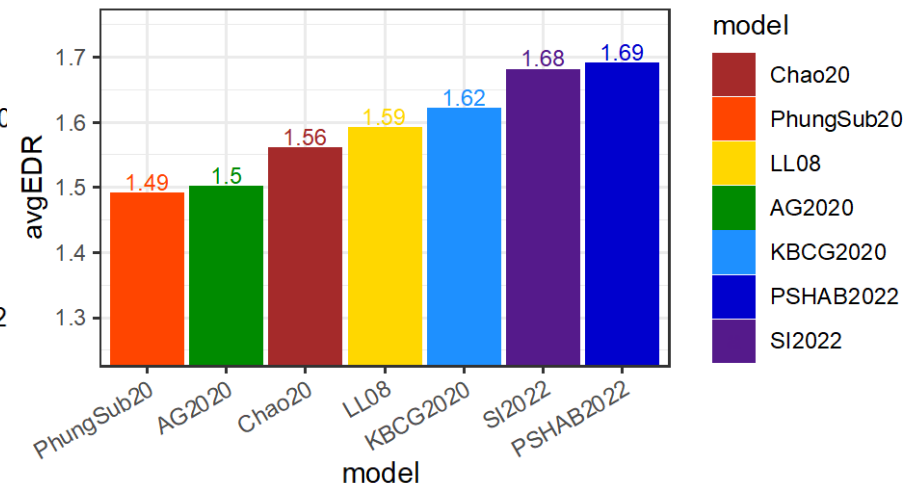
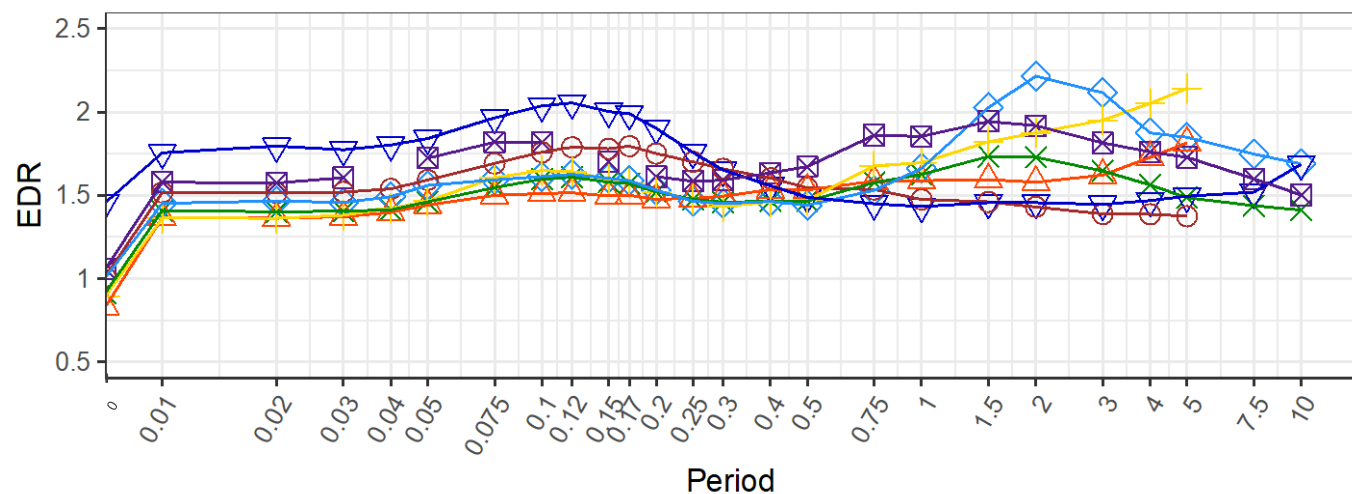
much more in favor of EDR than LLH scoring scheme

Ranking result – LLH & EDR

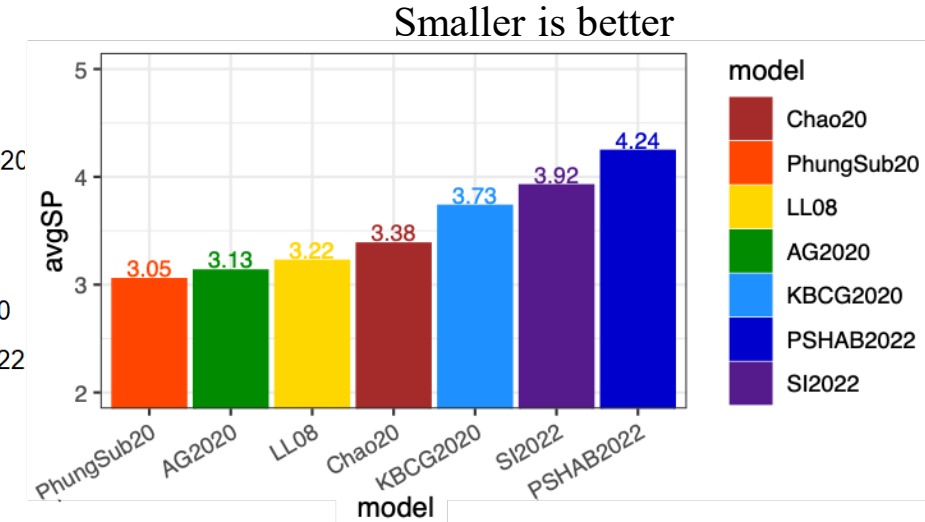
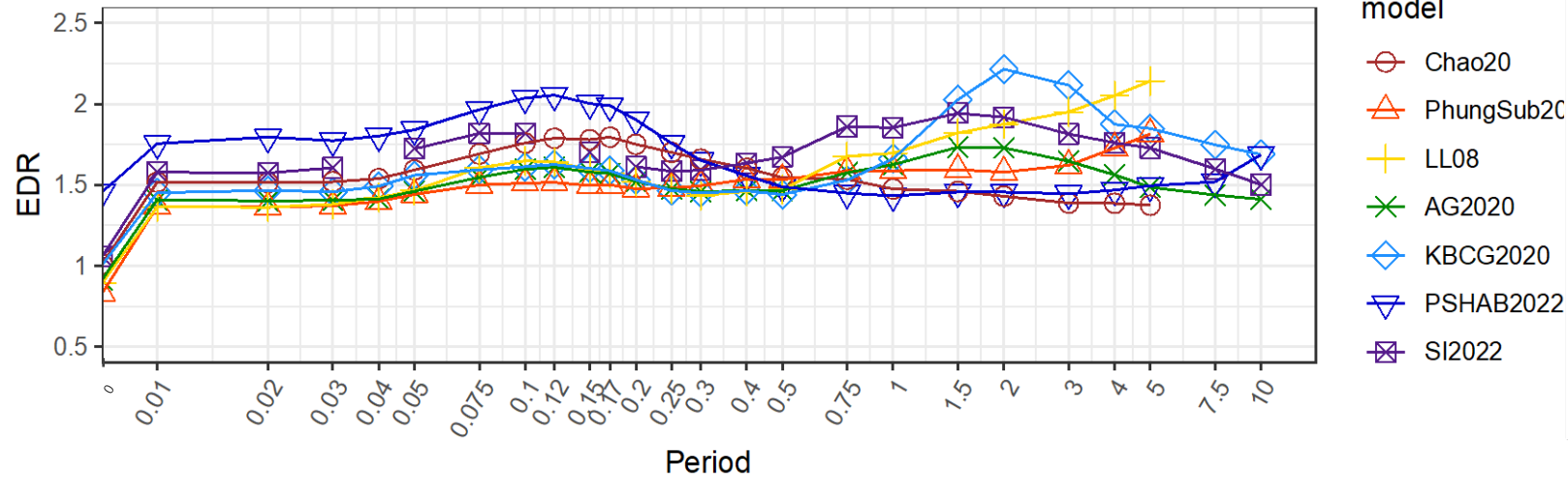
Smaller is better



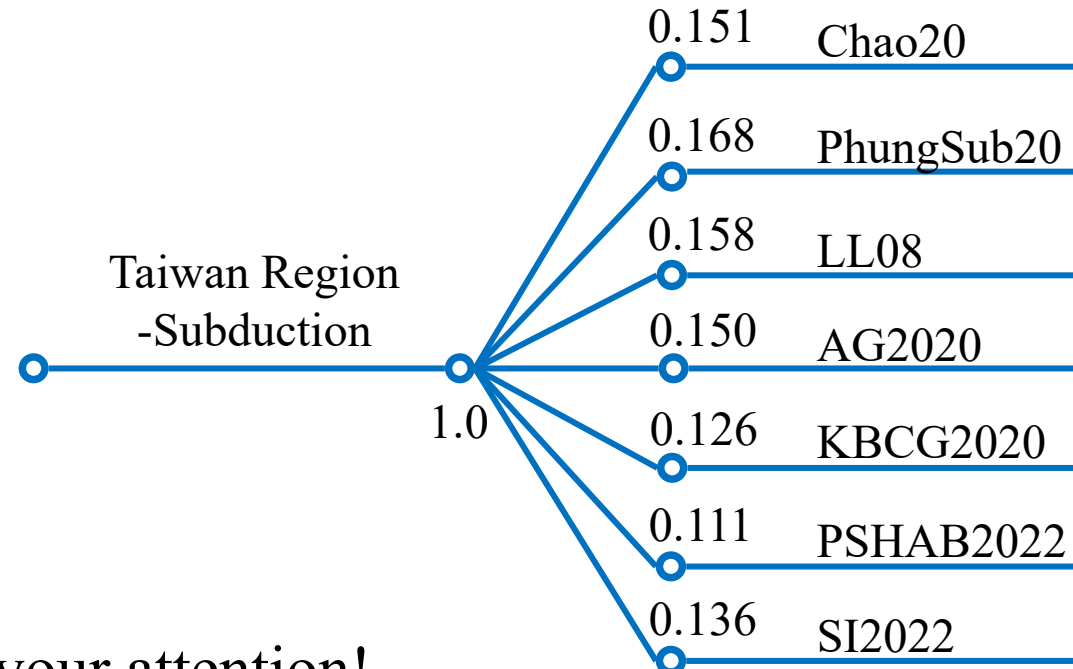
Smaller is better



Ranking result - SP



subduction model	LLH mean weighting	SP weighting
Chao20	0.144	0.151
PhungSub20	0.154	0.168
LL08	0.155	0.158
AG2020	0.150	0.150
KBCG2020	0.137	0.126
PSHAB2022	0.125	0.111
SI2022	0.134	0.136



Thanks for your attention!

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Thanks for TEM working group's help!

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