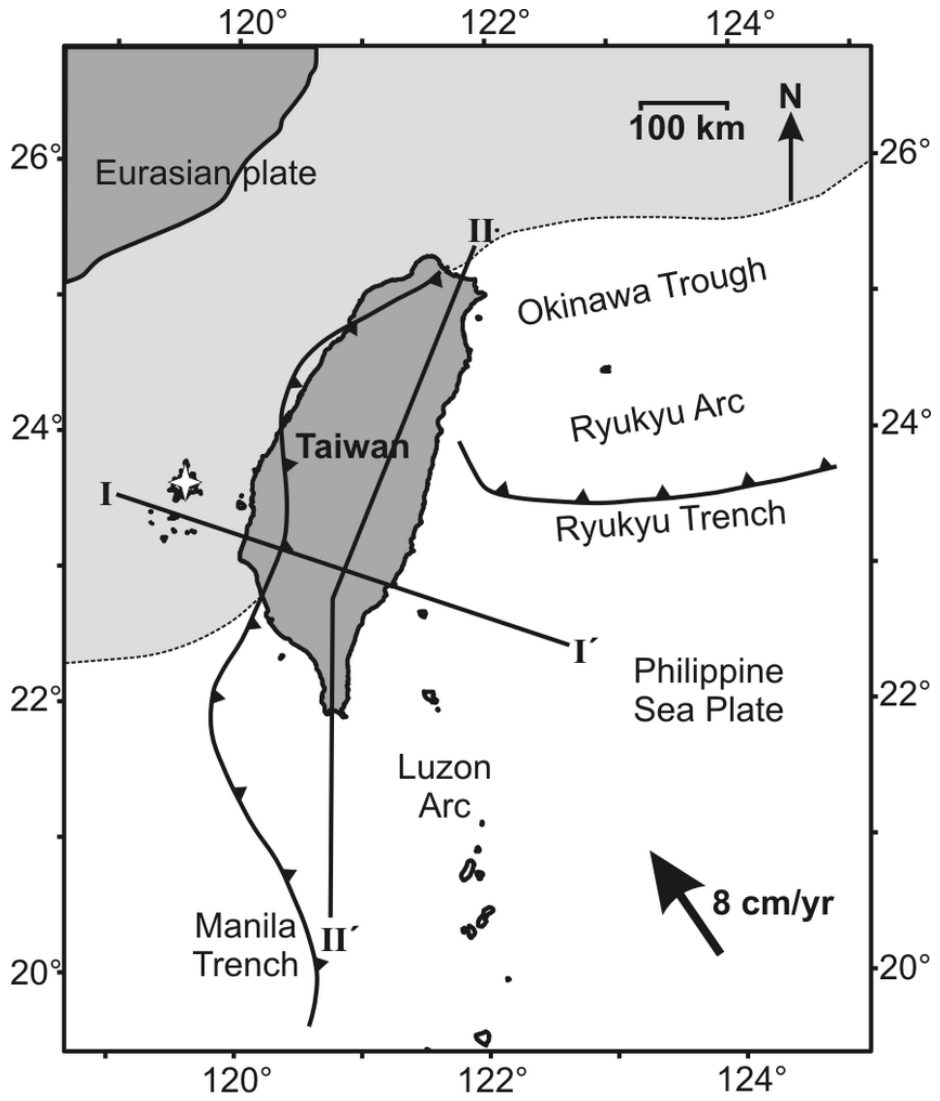
Application of Ground Motion Model Considering Rupture Directivity to Earthquake Early Warning System in Taiwan

Chin-Ting Weng, Chun-Hsiang Kuo, Hsin-Hua Huang, Shu-Hsien Chao

Where is Taiwan located?

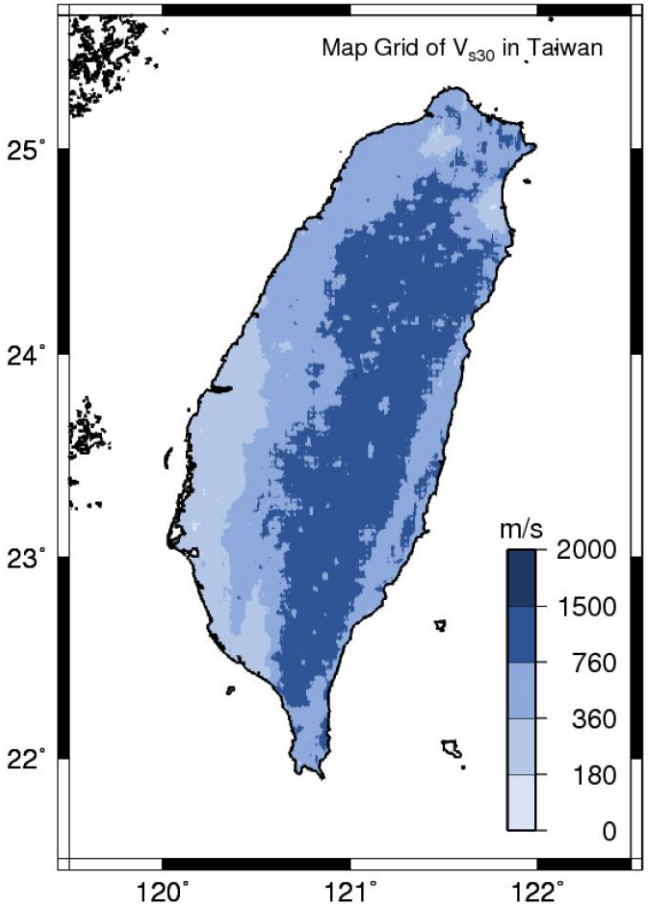


Reference:

1. Topographic characteristics of the Taiwan orogen. Fig1. L. A. Ramsey et al. (2006)
2. mapsoftworld.com：https://www.mapsofworld.com/taiwan/taiwan-location-map.html

Methodology

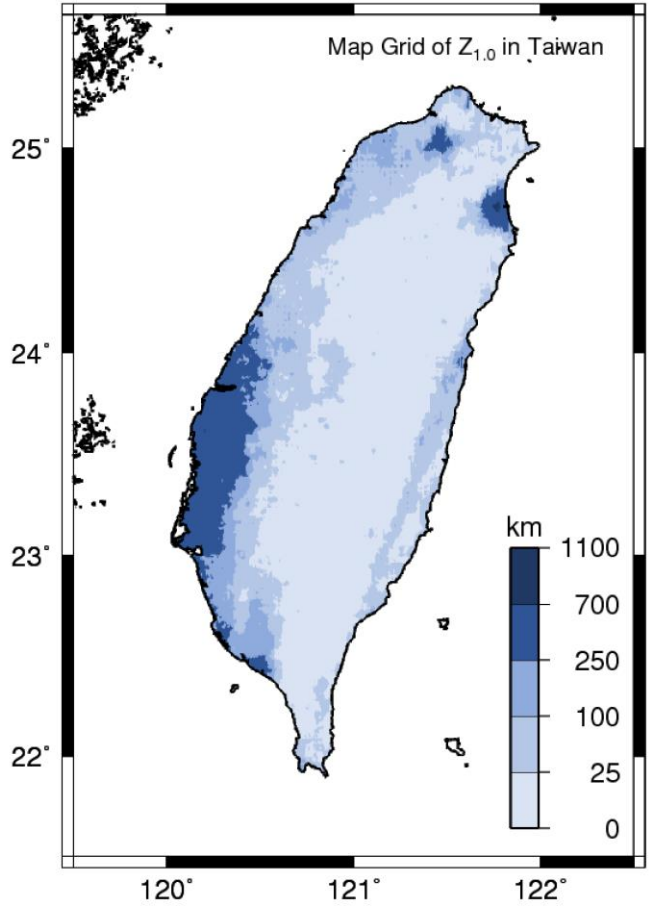
Methodology



◀ **Fig1.** V_{s30} grid map in Taiwan.

V_{s30} :
the average shear-wave velocity from the surface to a depth of 30m

$Z_{1.0}$:
the depth to the first occurrence of Vs=1km/s

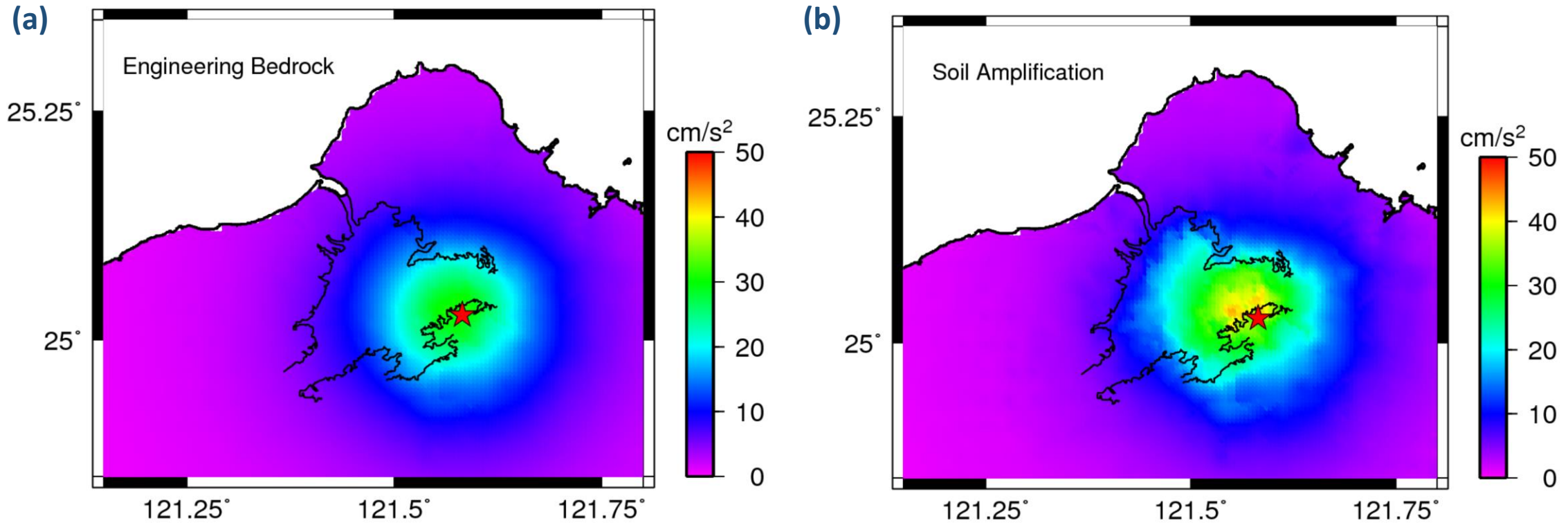


▶ **Fig3.** $Z_{1.0}$ grid map in Taiwan.

Methodology

Decay outward in concentric circles

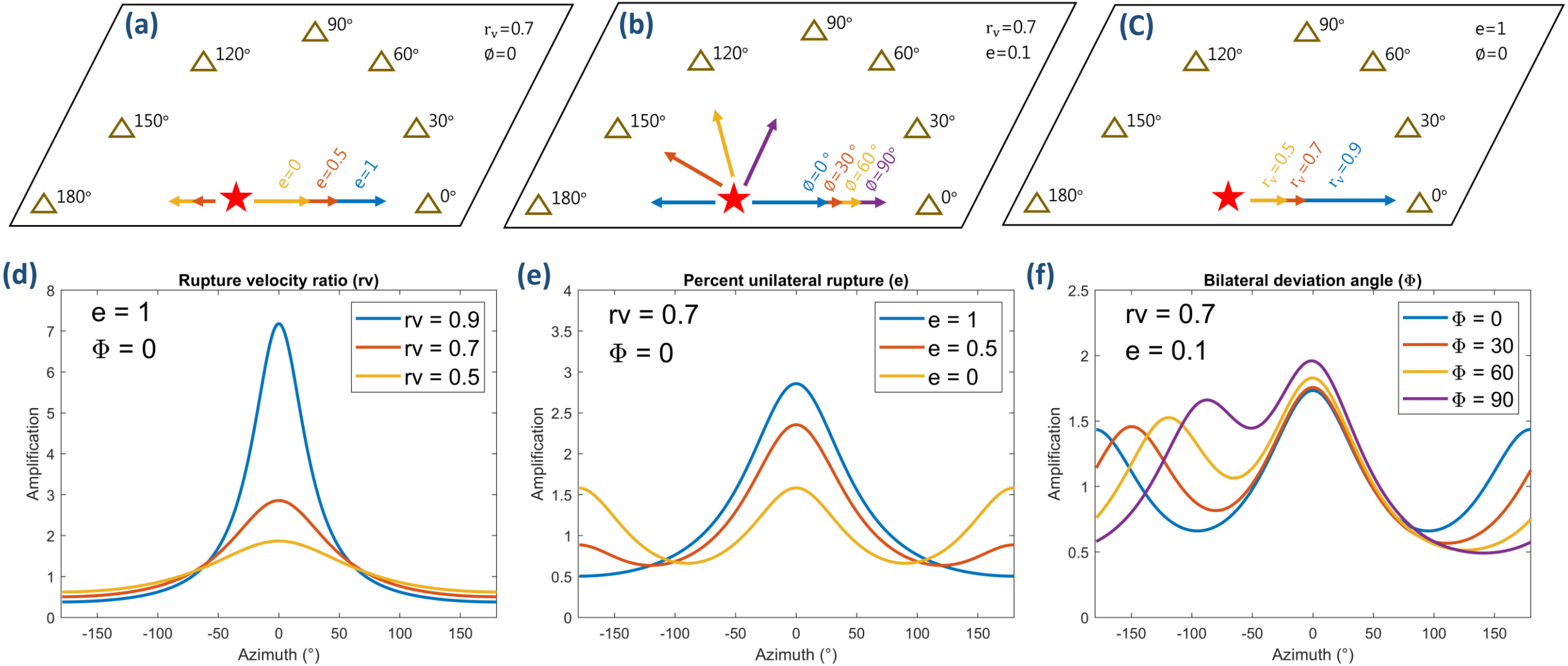
A significant amplification within Tapei basin



▲ **Fig 2.** The results are calculated by using GMM for a point source of M_w=3.5 outside the Tapei Basin. **(a)** The condition of engineering bedrock (V_{s30}=760m/s). **(b)** Considering different V_{s30} values in various regions.

Methodology

Fig 4. There are three scenarios about fault-receiver distribution and the modeling of peak ground values azimuthal variations. **(a, d)** Varying velocity ratio, r_V. **(b, e)** Varying coefficient of percent unilateral rupture, e. **(c, f)** Varying bilateral deviation angle.



Earthquake Events & Their Results

201306020543

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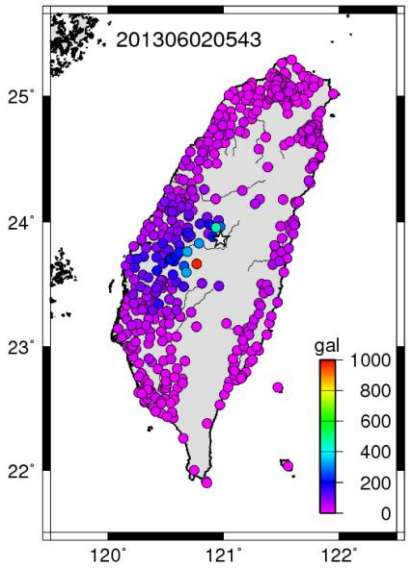

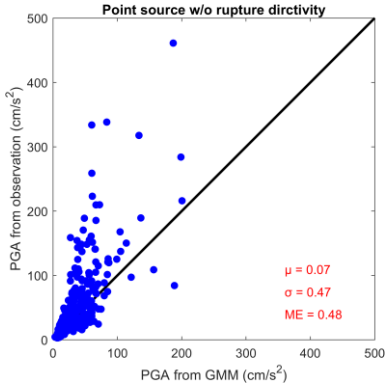

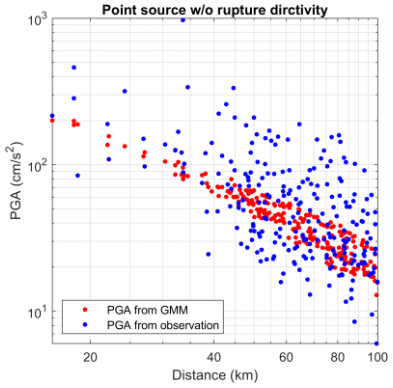

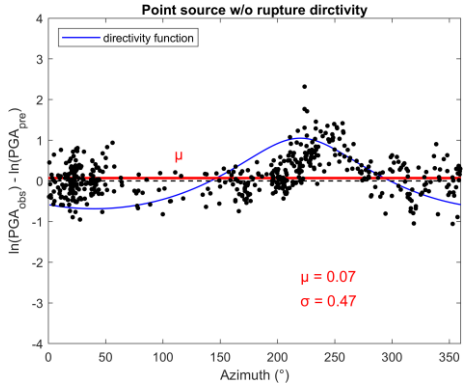

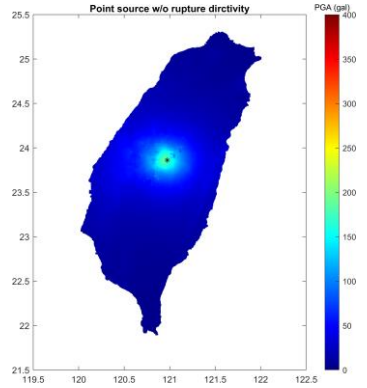

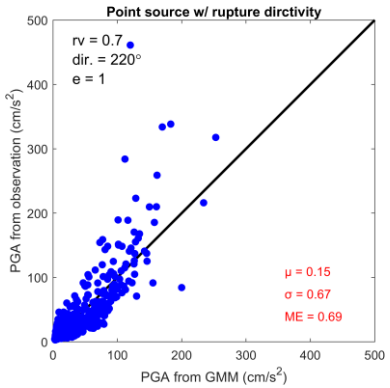

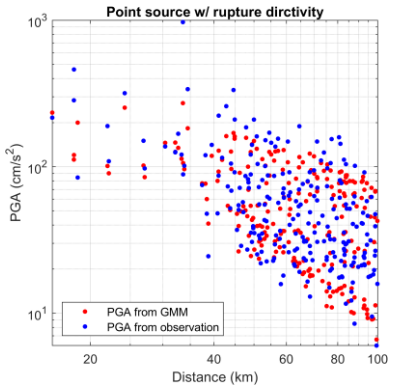

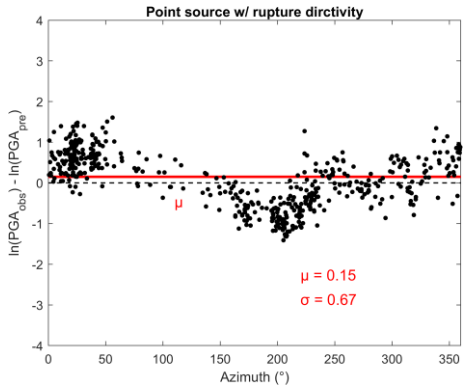

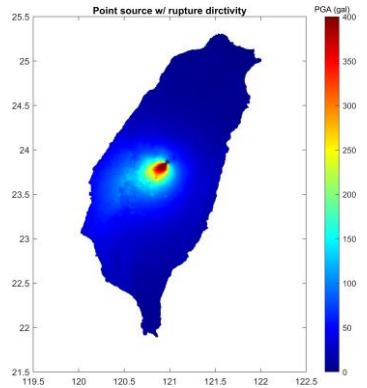

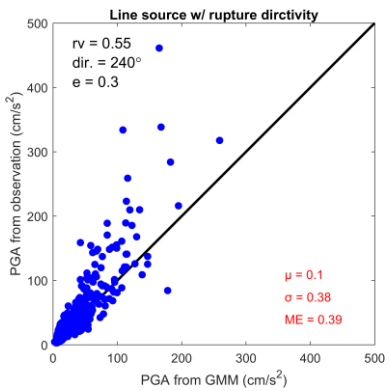

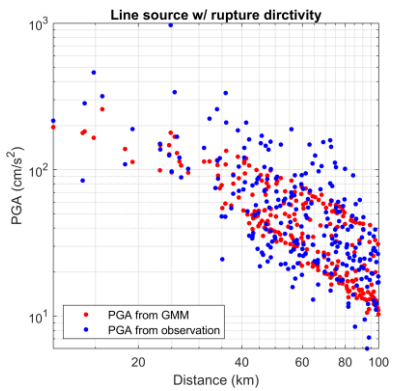

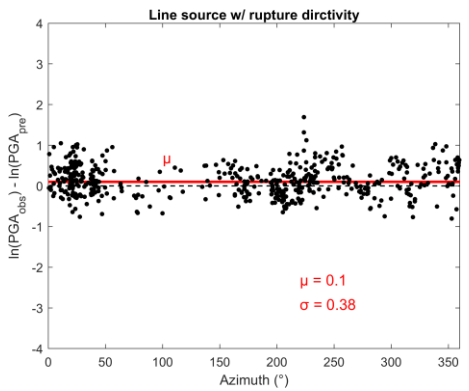

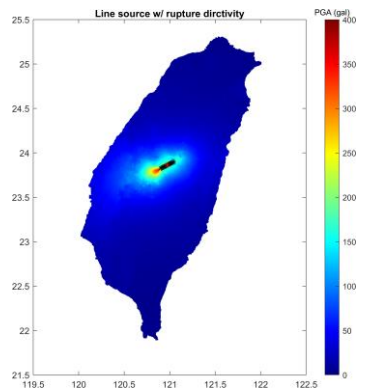

Point

Point+Dir

Line+Dir

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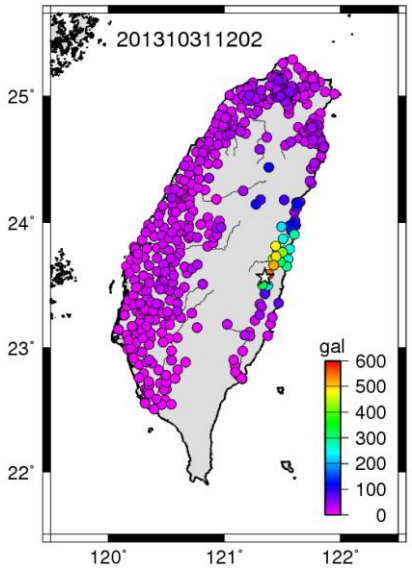

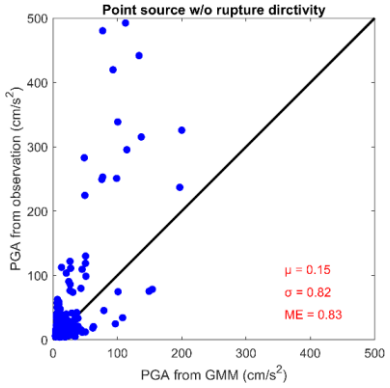

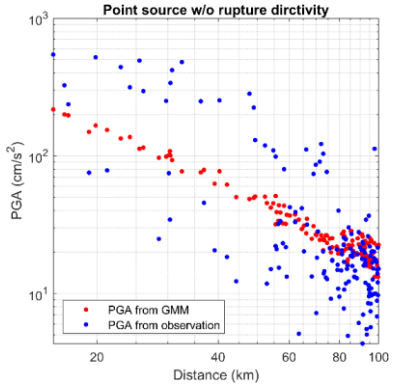

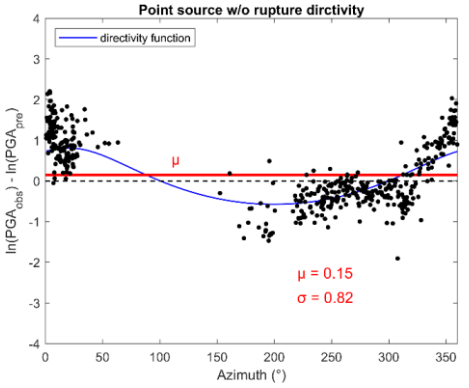

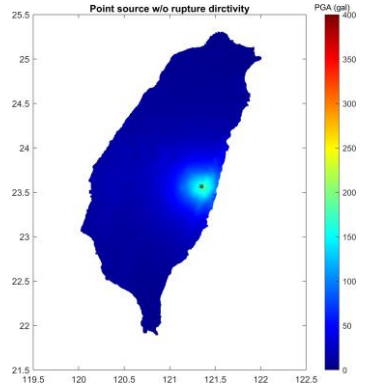

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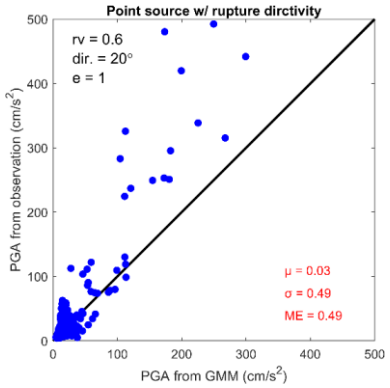

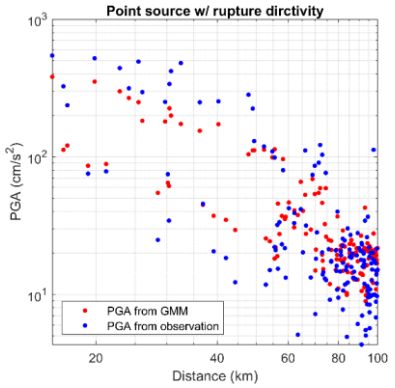

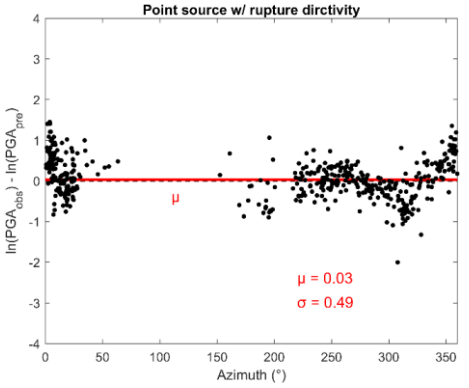

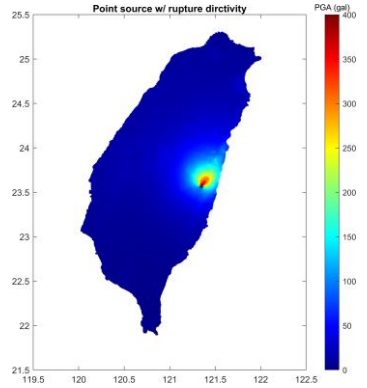

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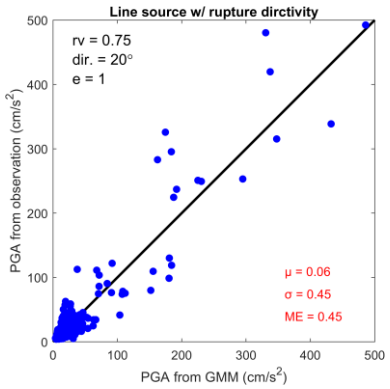

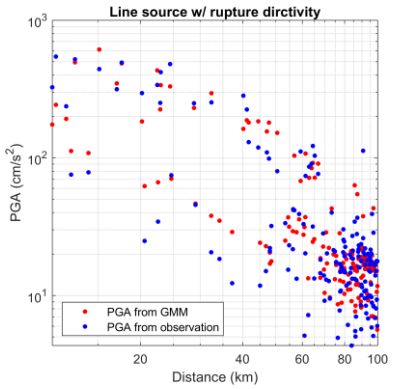

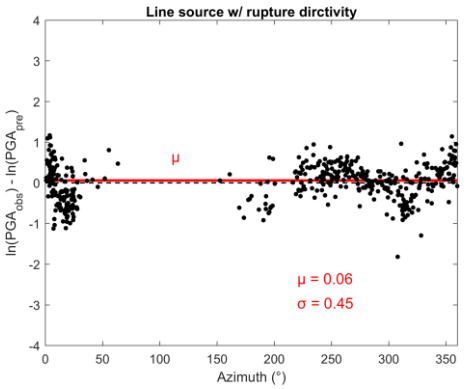

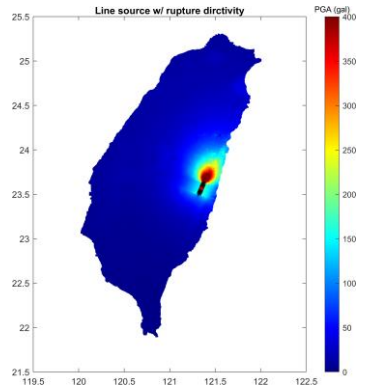

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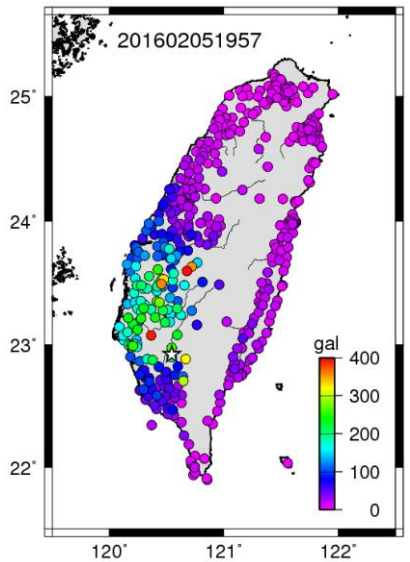

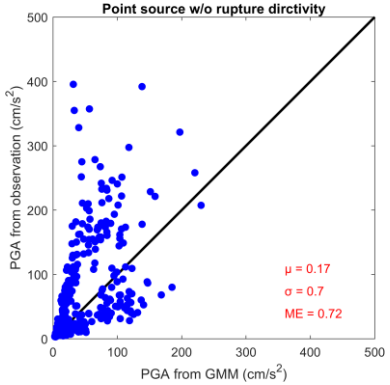

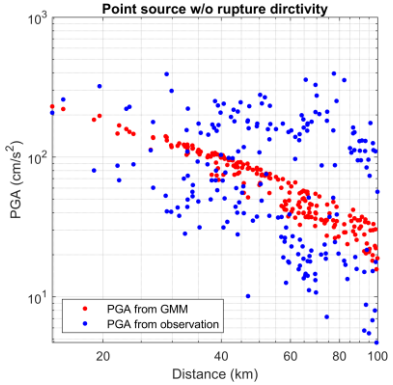

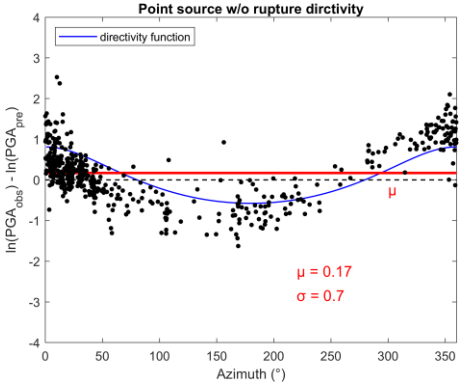

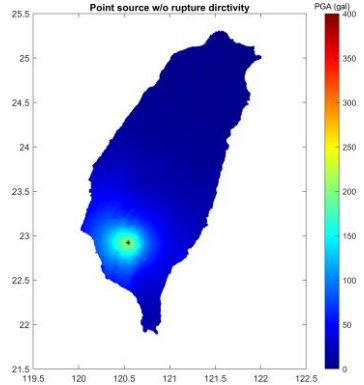

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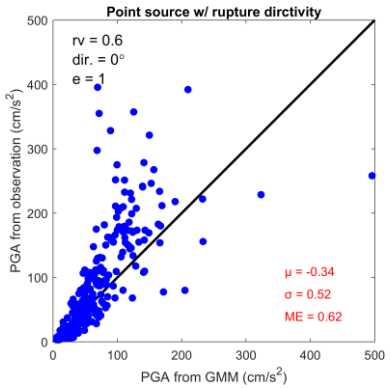

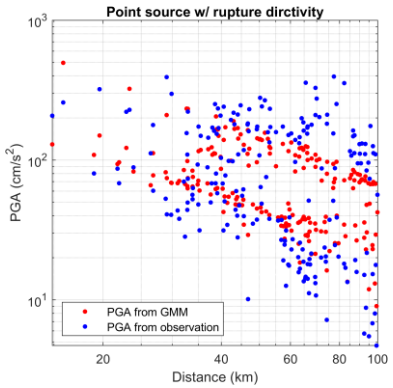

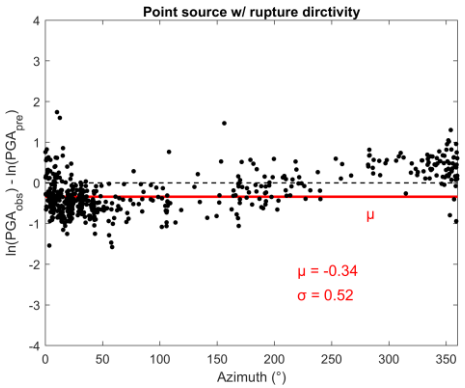

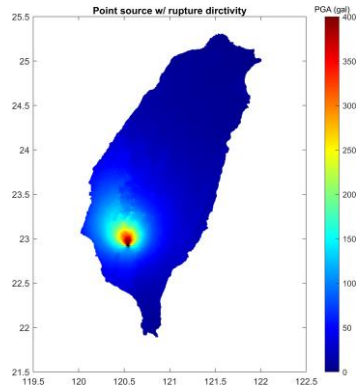

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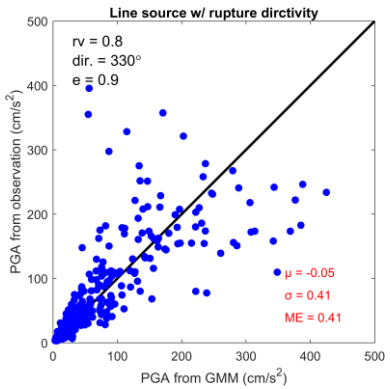

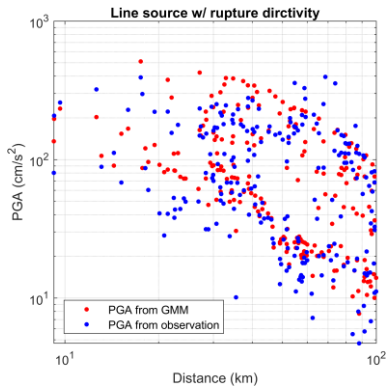

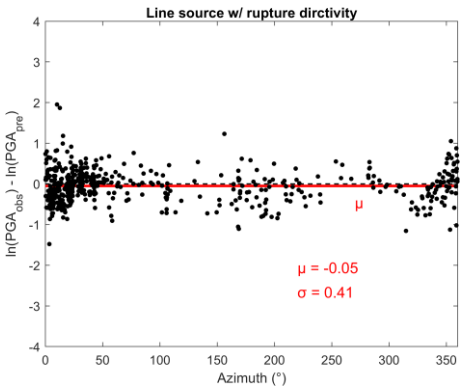

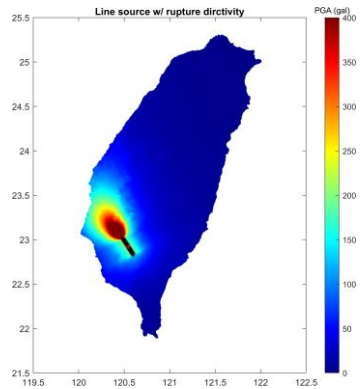

Line+Dir

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Lon	Lat	Depth	Mw
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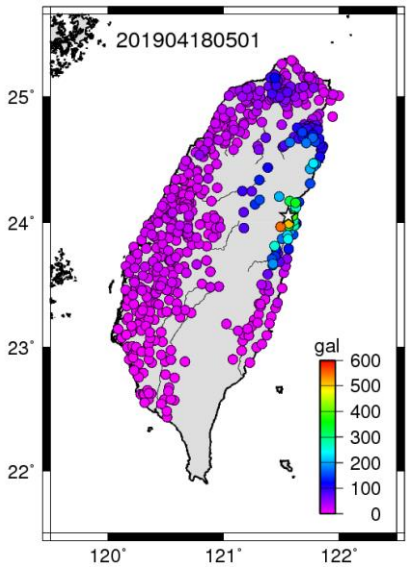

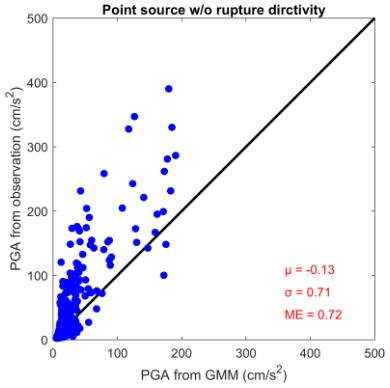

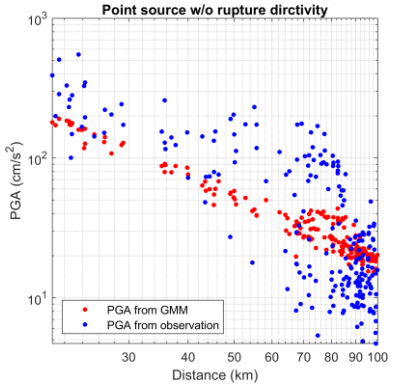

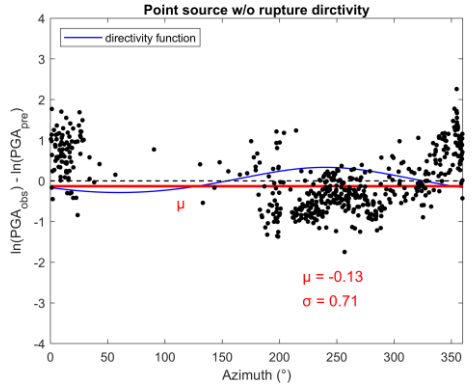

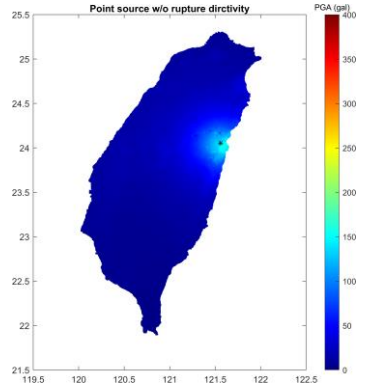

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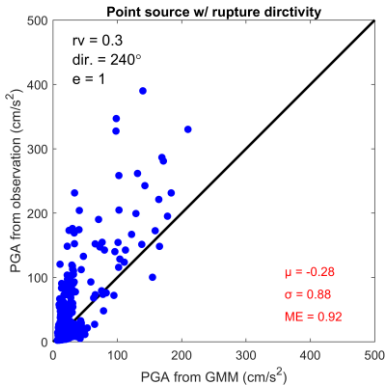
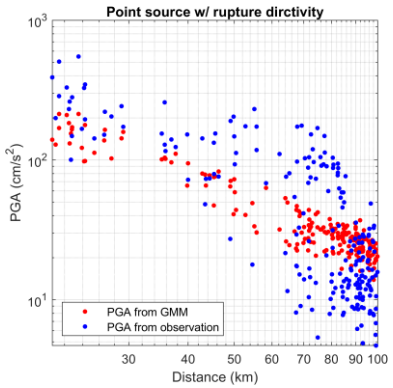
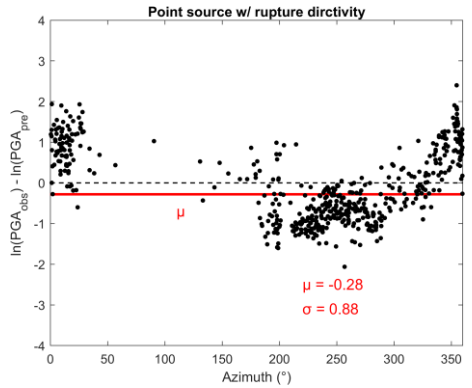
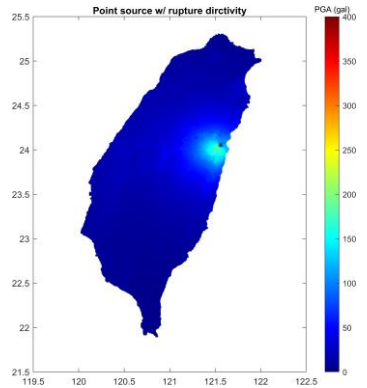
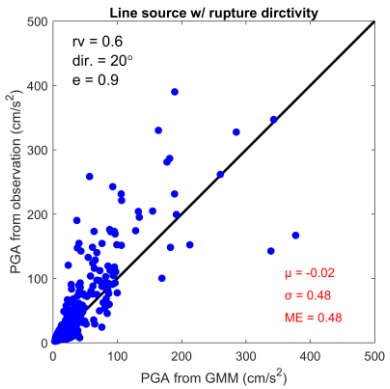


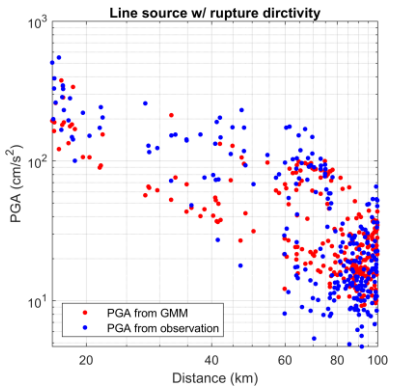


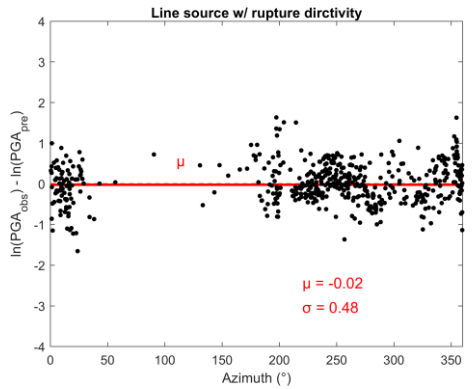


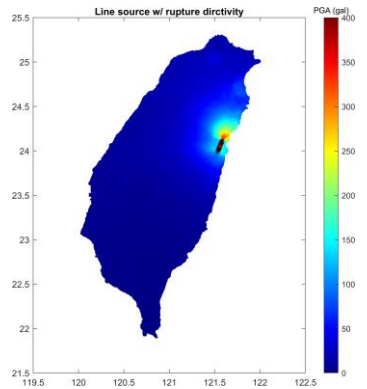


Point+Dir









Line+Dir

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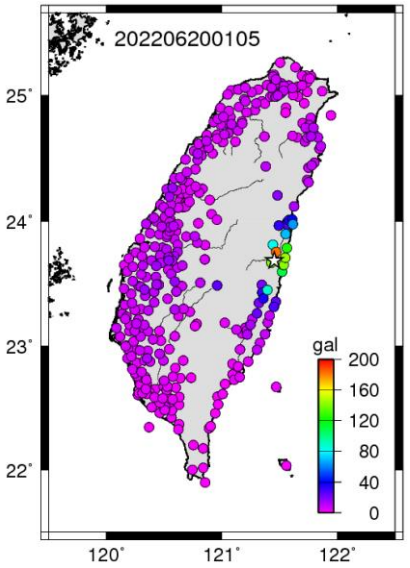

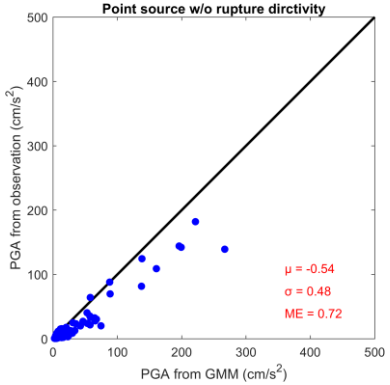

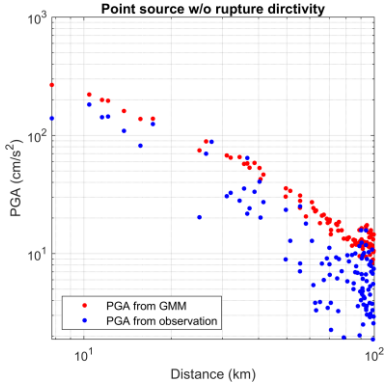

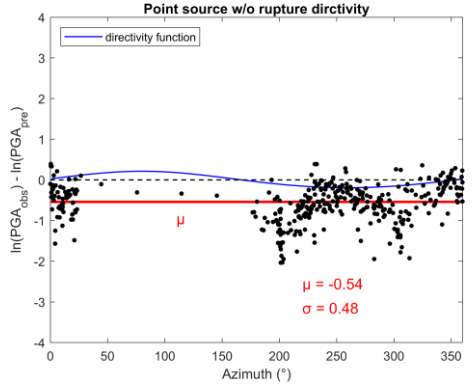

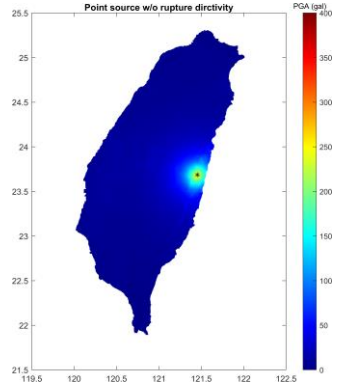

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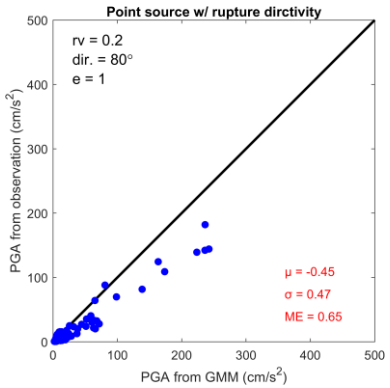
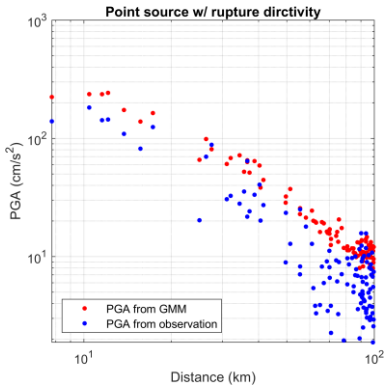
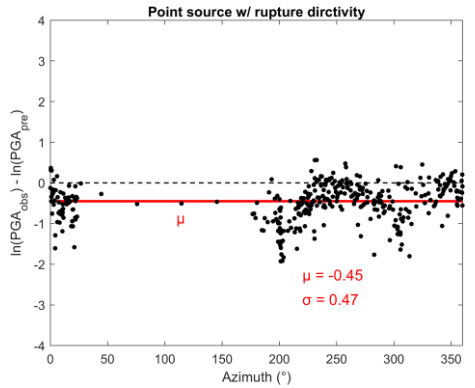
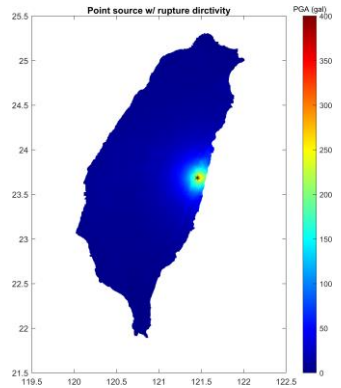
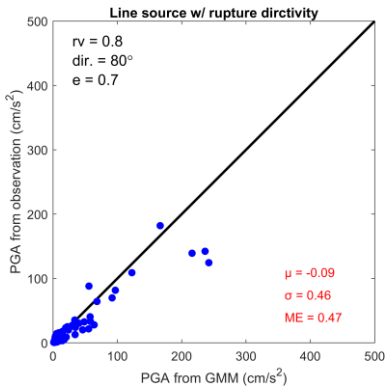


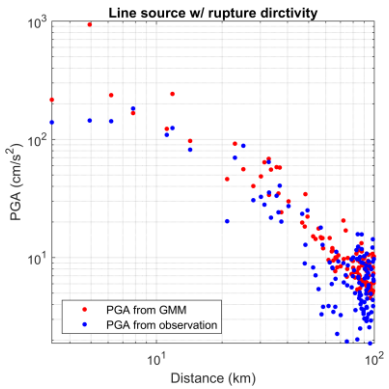


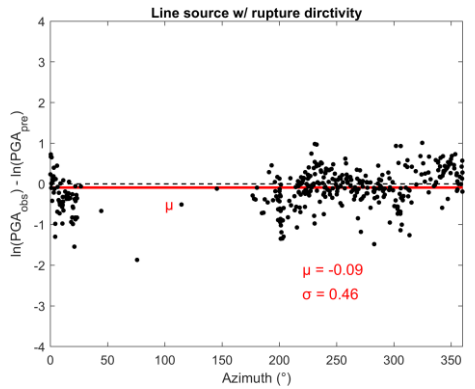


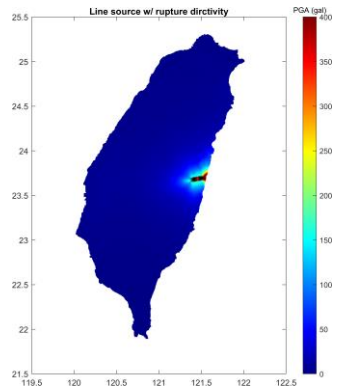


Point+Dir









Line+Dir

202209171341

Lon	Lat	Depth	Mw
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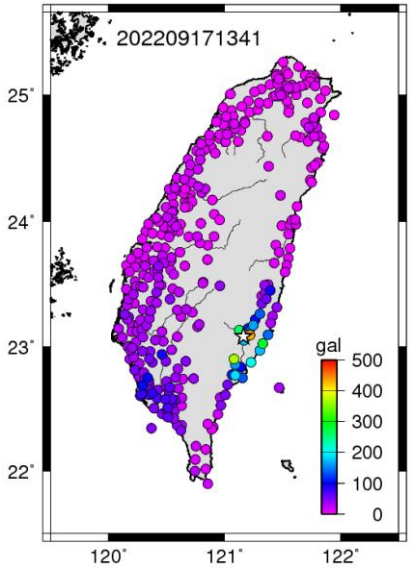

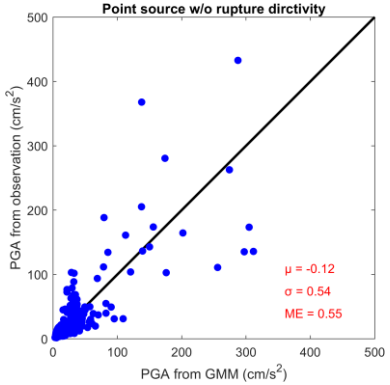

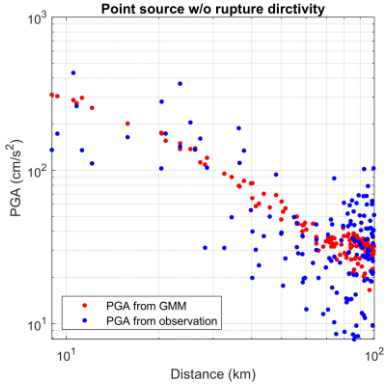

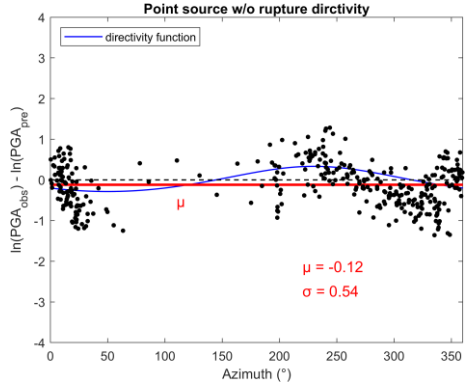

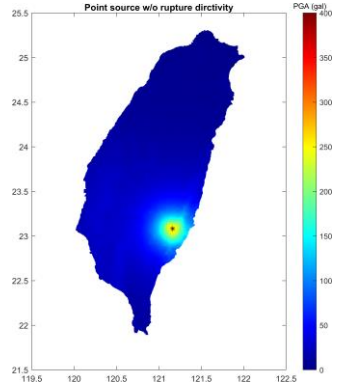

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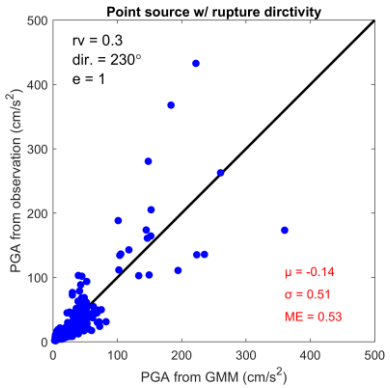
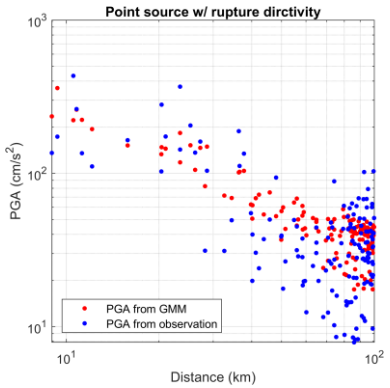
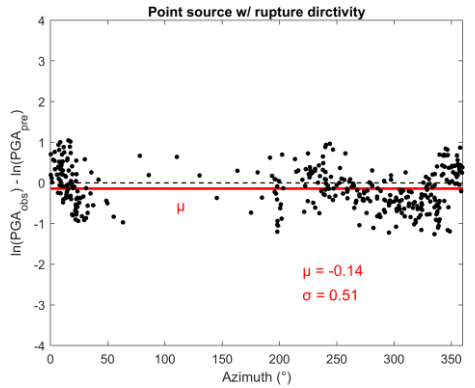
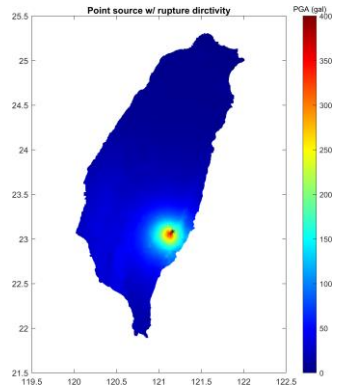
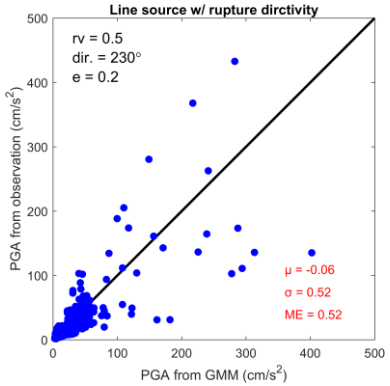


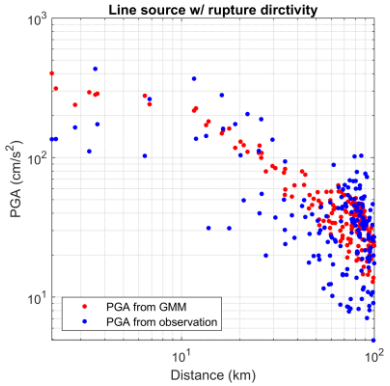


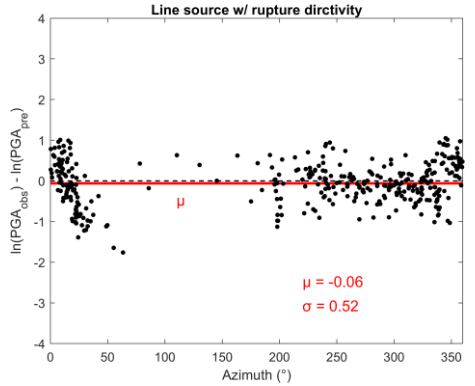


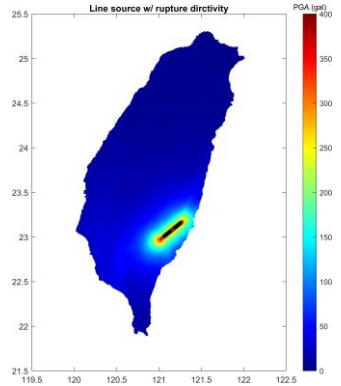


Point+Dir









Line+Dir

202209180644

Lon	Lat	Depth	Mw
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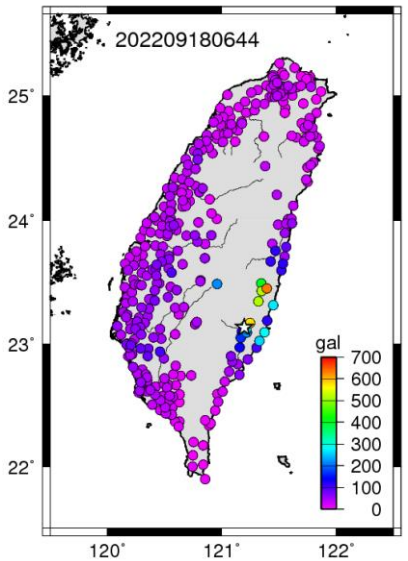
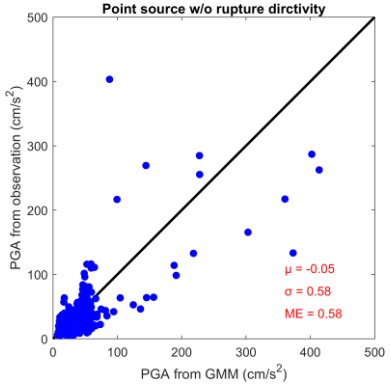
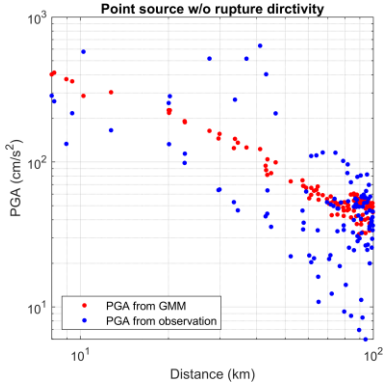
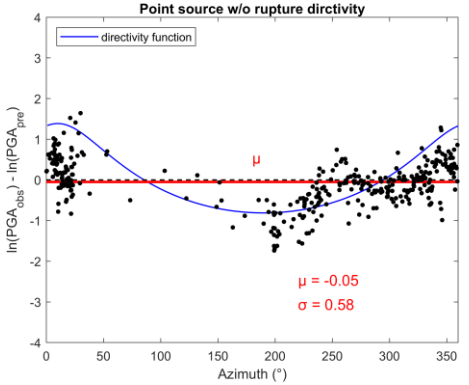
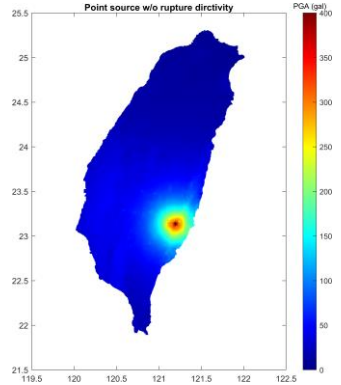


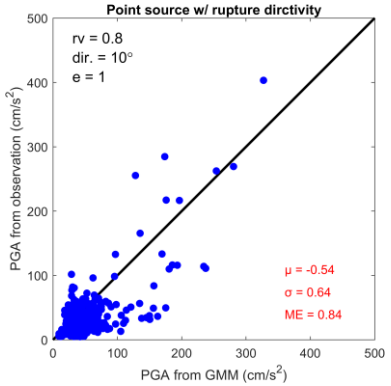


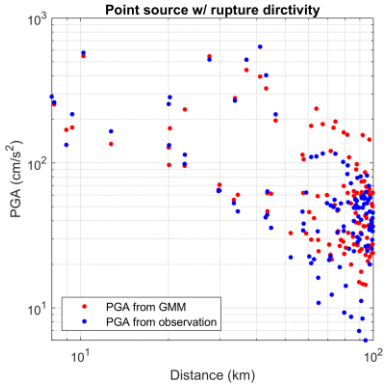


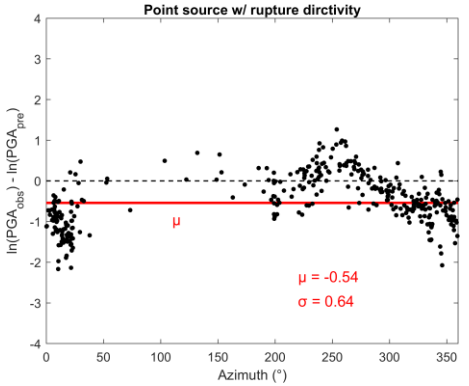


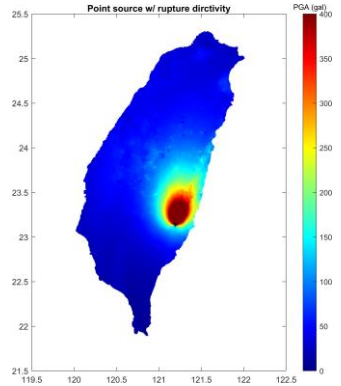


Point

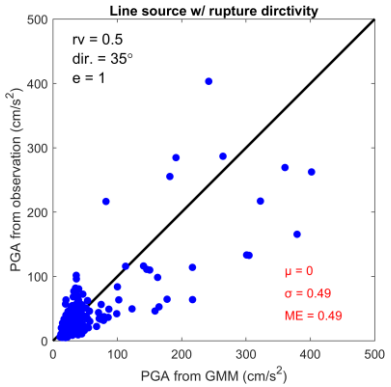


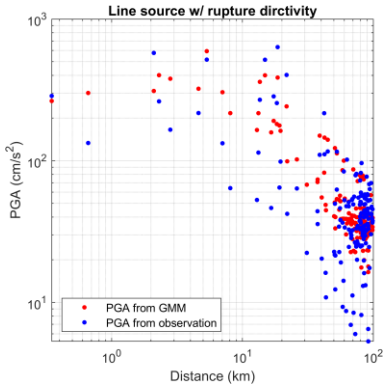


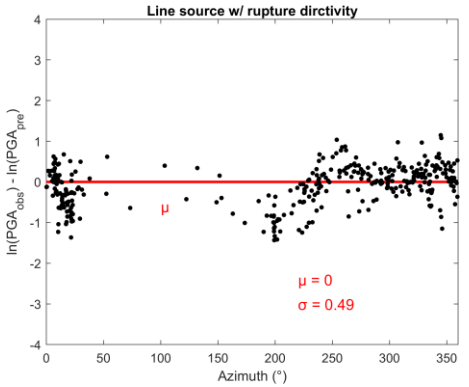


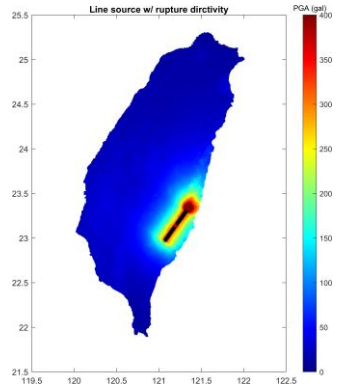


Point+Dir









Line+Dir

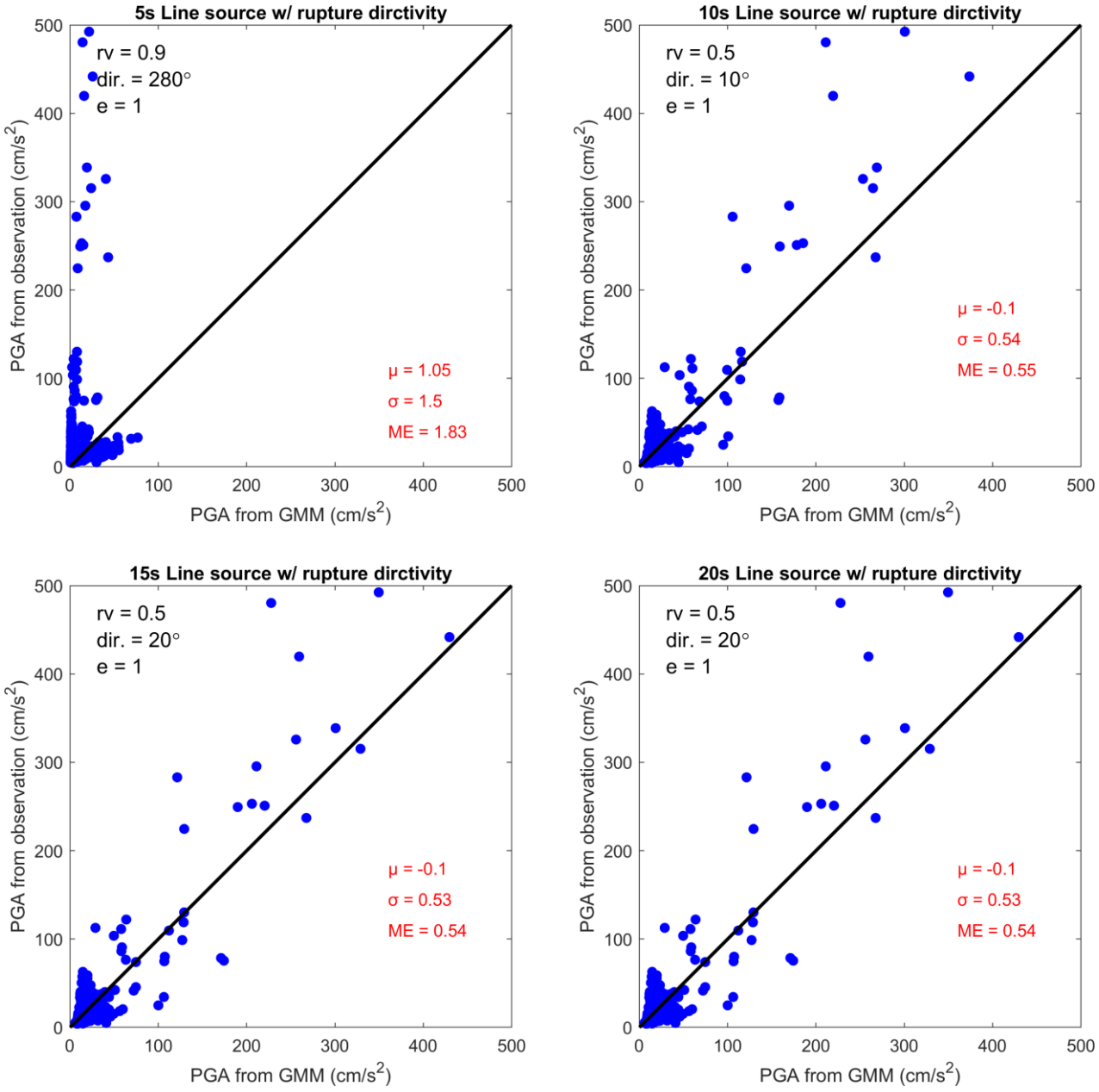


Fig 7. The ground motion prediction of line source considered with rupture directivity at different time points after t_0 for the Ruisui earthquake. **(a)** 5s. **(b)** 10s. **(c)** 15s. **(d)** 20s.

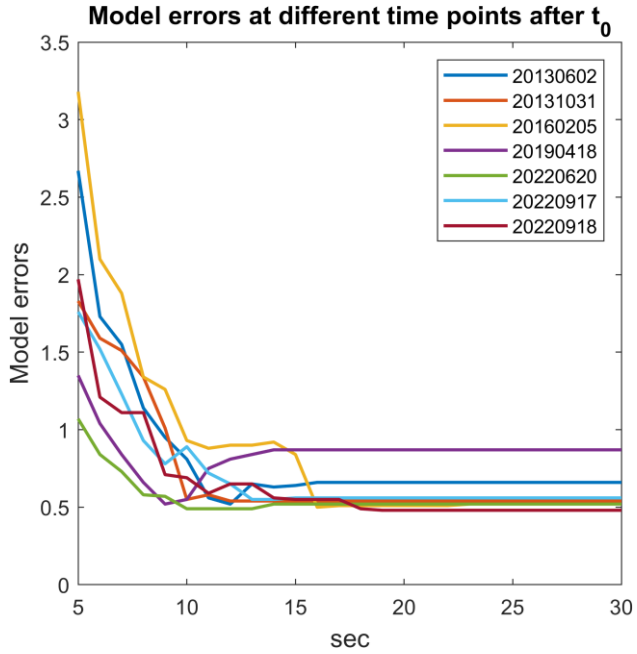
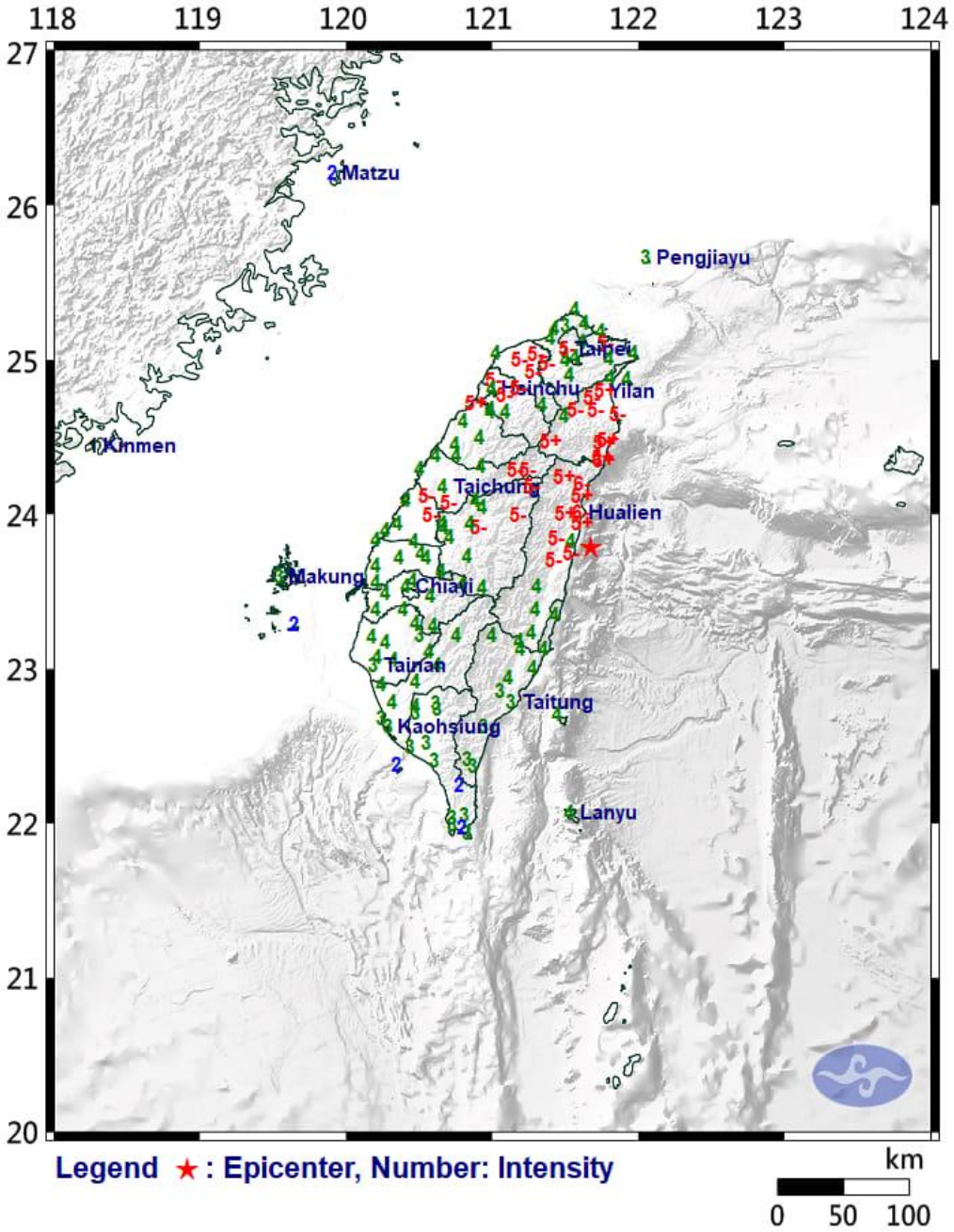


Fig 8. The model errors at different time points after t_0 for 7 earthquake events with M_w larger than 6. We can find that the model errors will reach stable states at 10s ~ 20s.

Another Case: 2024.04.02 11:58 (UTC)



CWA EARTHQUAKE REPORT

Earthquake No.: 113019

Origin time (Taiwan Standard Time: GMT+8):

4/ 3/2024 7:58: 9.9

Epicenter: 23.77°N, 121.67°E,

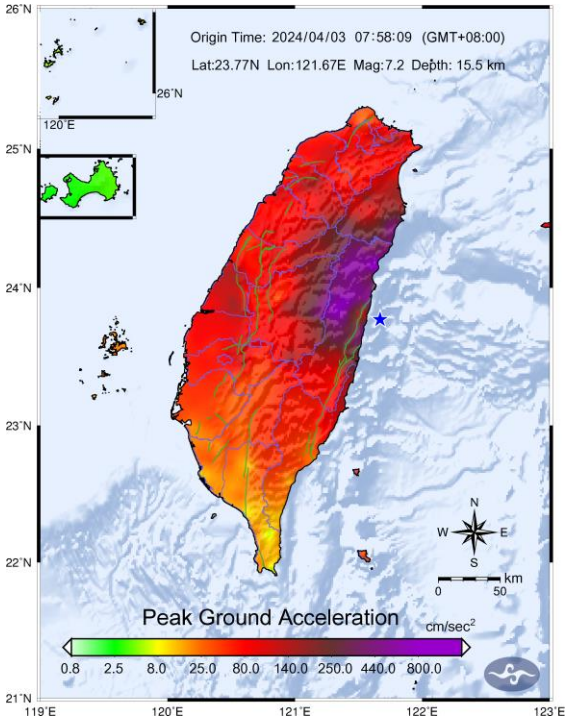
i.e. 25.0 km SSE of Hualien County Hall

Focal depth: 15.5 km

Magnitude (ML): 7.2

Local Largest Intensity:

Hualien County	6+	Hsinchu City	4
Yilan County	5+	Tainan City	4
Miaoli County	5+	Keelung City	4
Taichung City	5-	Pingtung County	4
Changhua County	5-	Penghu County	3
Hsinchu County	5-	Lienchiang County	2
Nantou County	5-	Kinmen County	1
Taoyuan City	5-		
New Taipei City	5-		
Taipei City	5-		
Taitung County	4		
Chiayi County	4		
Yunlin County	4		
Kaohsiung City	4		
Chiayi City	4		



Reference:

CWA earthquake report.

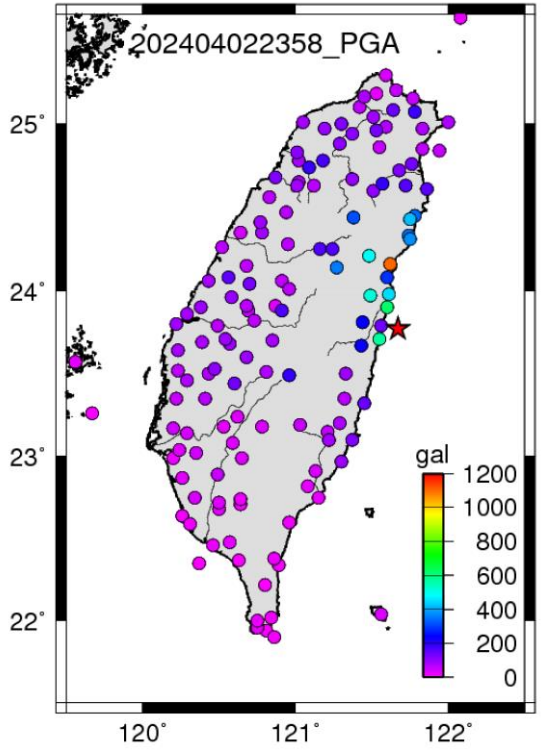
Multiple buildings collapsed or partially collapsed. And this earthquake caused at least 10 fatalities and over a thousand injuries.

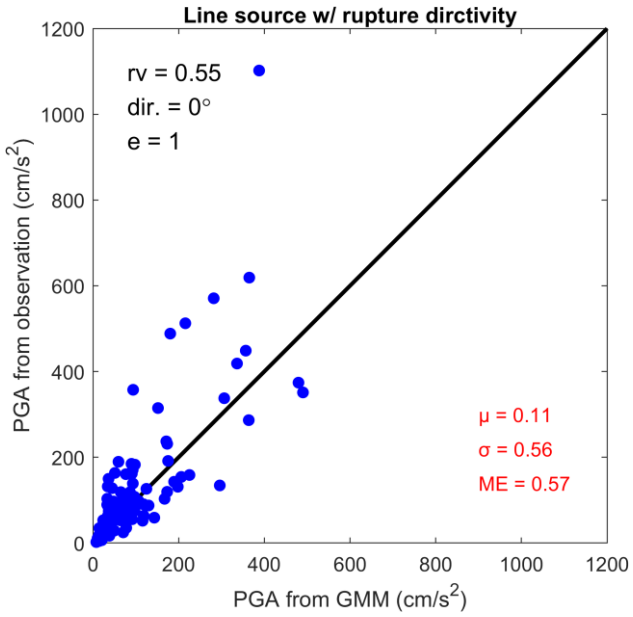
Reference:

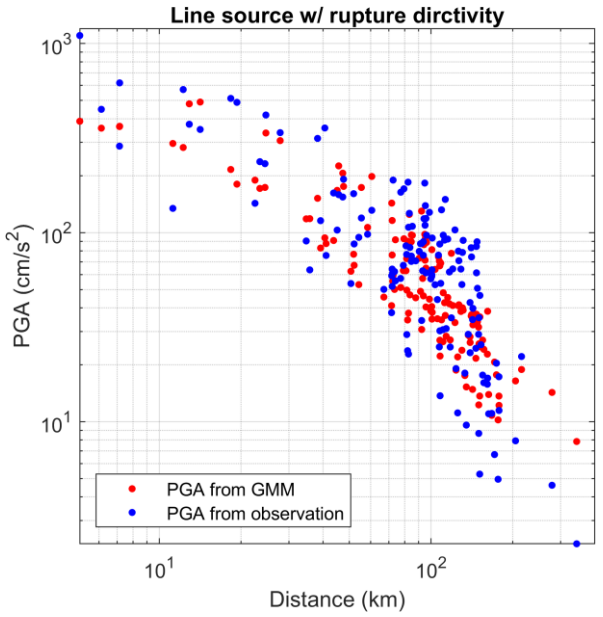
1. Earthquake damage in Huallien City, Shufu Liu, Office of the President, Taiwan
2. Pictures on the internet

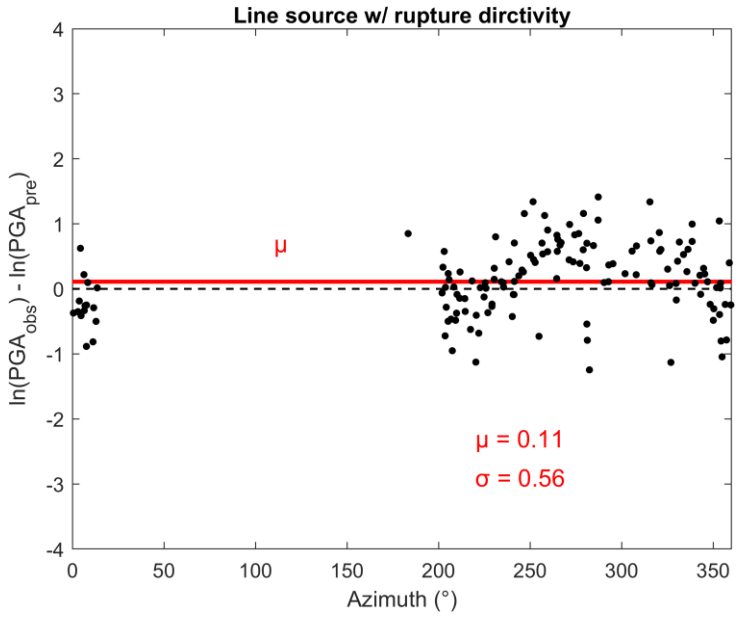
202404022358

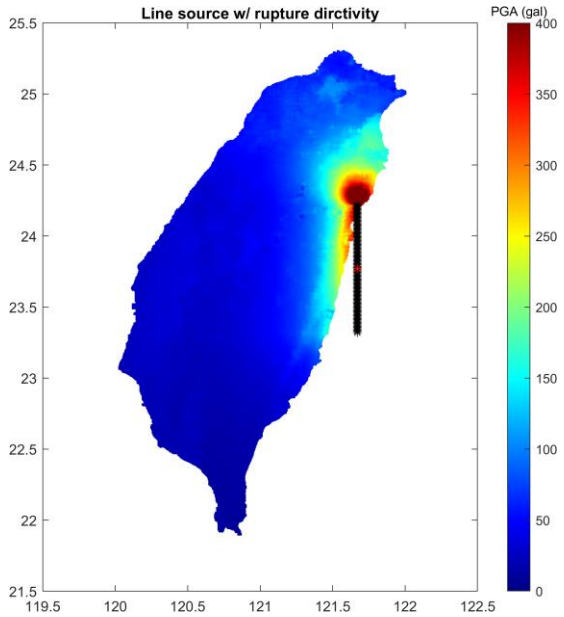
Lon	Lat	Depth	Mw
121.67	23.77	15.5	7.4











202404022358

Lon	Lat	Depth	Mw
121.67	23.77	15.5	7.4