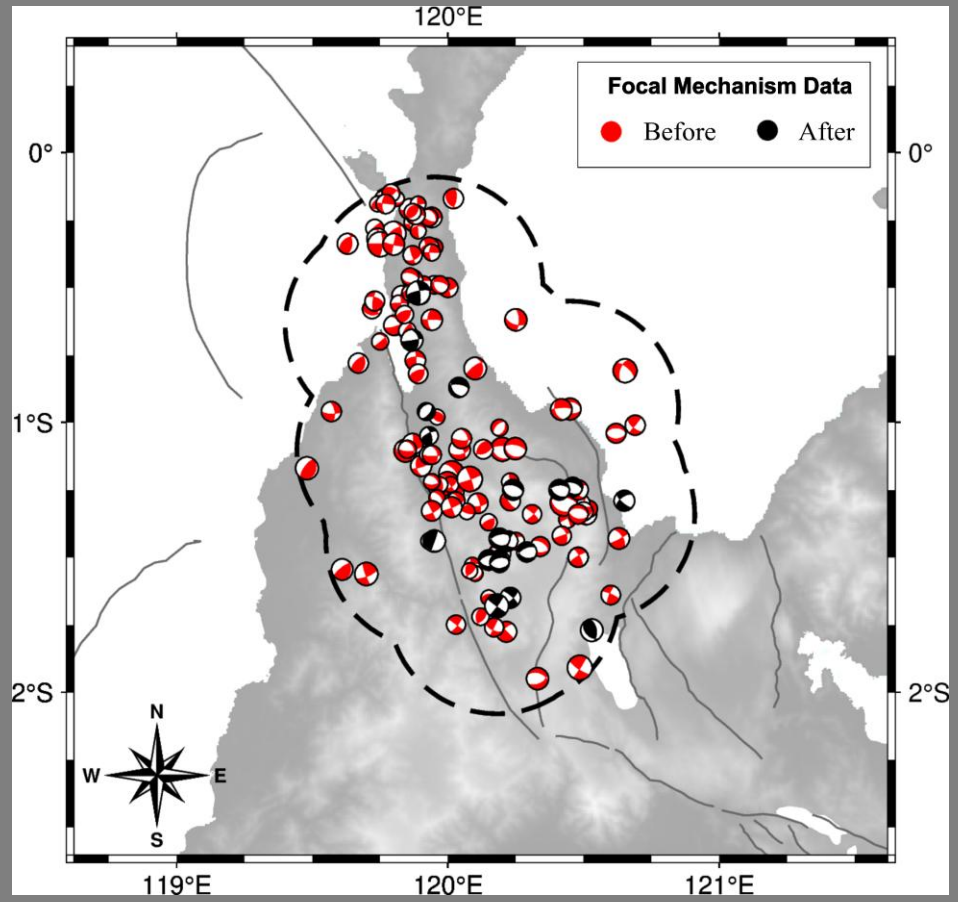
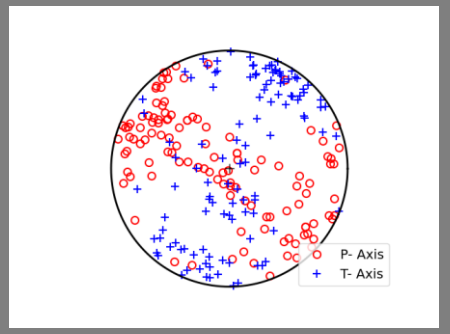
Stress Orientation Rotation of the 2018 Mw 7.5 Palu Earthquake

Focal Mechanisms Data

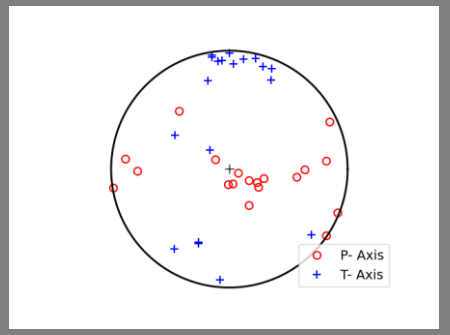


Before 2018 Mw7.5 Palu



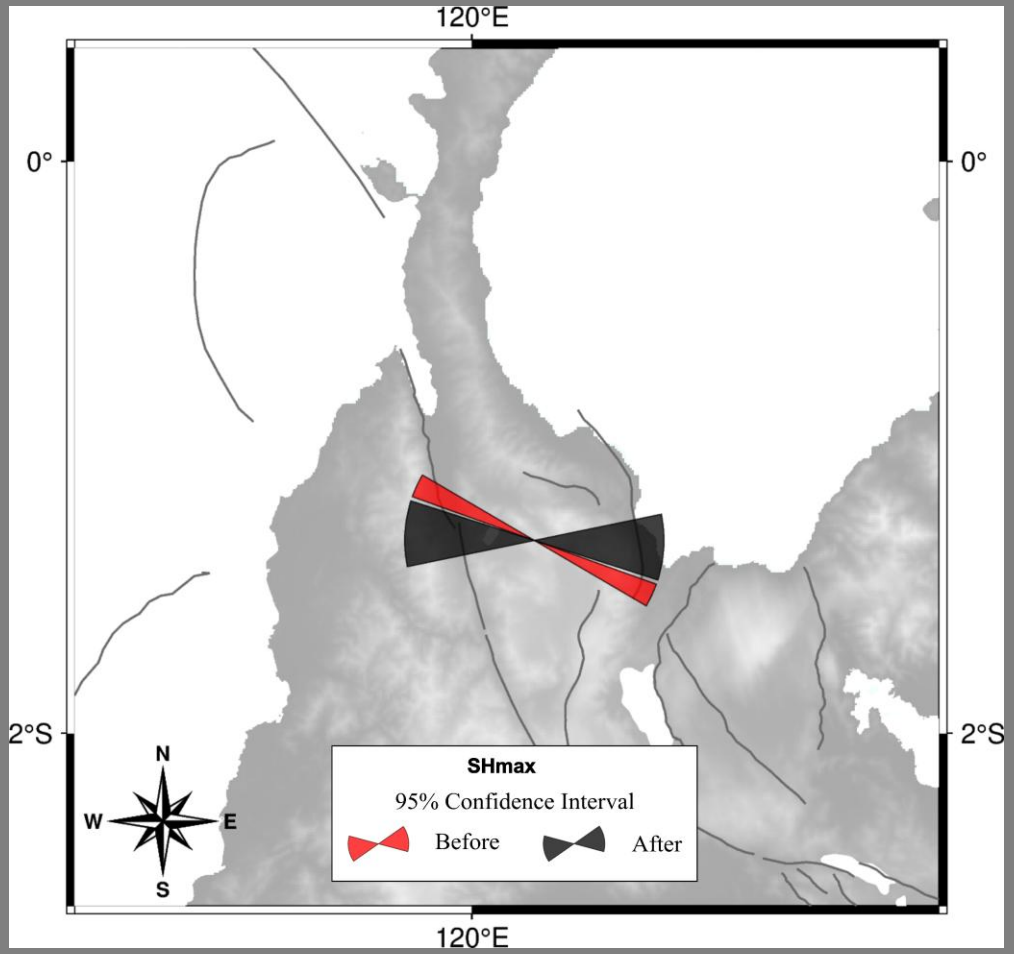
118 events
May 1977 – Sep 2018

After 2018 Mw7.5 Palu

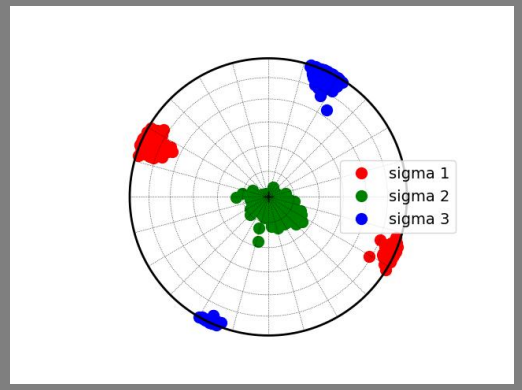


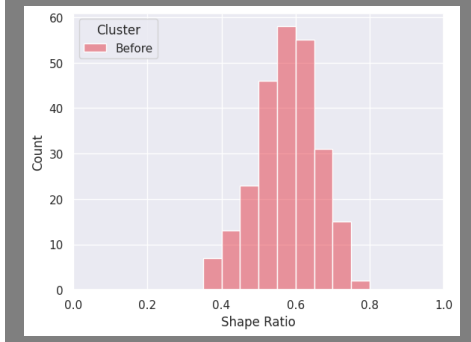
19 events
Sep 2018 – Nov 2021

Stress Inversion Result

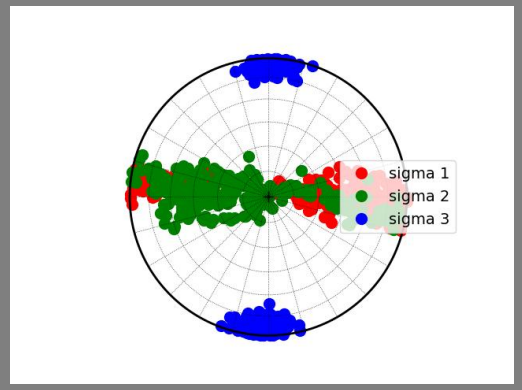


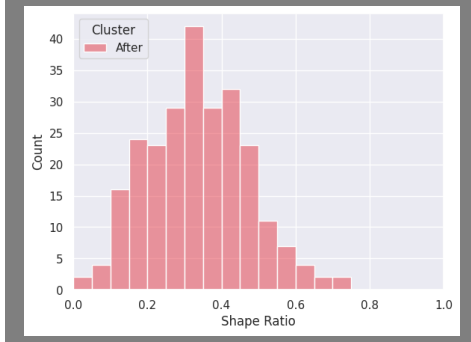
Before 2018 Mw7.5 Palu





After 2018 Mw7.5 Palu





	$\sigma 1$ *Azimuth*	$\sigma 1$ *Plunge*	$\sigma 2$ *Azimuth*	$\sigma 2$ *Plunge*	$\sigma 3$ *Azimuth*	$\sigma 3$ *Plunge*	SHmax
Before	115.0 ± 5.2	9.0 ± 8.7	78.2 ± 86.0	79.4 ± 8.6	25.3 ± 5.2	6.2 ± 6.1	115.1 ± 5.3
After	89.3 ± 35.1	42.1 ± 39.9	87.3 ± 48.4	45.0 ± 40.0	4.1 ± 12.3	8.1 ± 7.8	90.3 ± 15.0
Δ	-26.2 ± 33.9	35.3 ± 41.7	7.6 ± 106.3	-35.9 ± 42.6	-21.2 ± 13.4	0.5 ± 10.8	-24.2 ± 15.3

Stress Drop Ratio $\left(\frac{\Delta\tau}{\tau}\right)$ Calculation

To calculate the stress drop ratio, we use equation (4) in Hardebeck 2001

$$\Delta\theta = \tan^{-1}\left(\frac{1-\frac{\Delta\tau}{\tau}\sin 2\theta - \sqrt{\left(\frac{\Delta\tau}{\tau}\right)^2 + 1 - 2\frac{\Delta\tau}{\tau}\sin 2\theta}}{\frac{\Delta\tau}{\tau}\cos 2\theta}\right) \longrightarrow \frac{\Delta\tau}{\tau} = -\frac{\sin(2\Delta\theta)}{\cos(2\theta + 2\Delta\theta)}$$

Calculation of θ and $\Delta\theta$

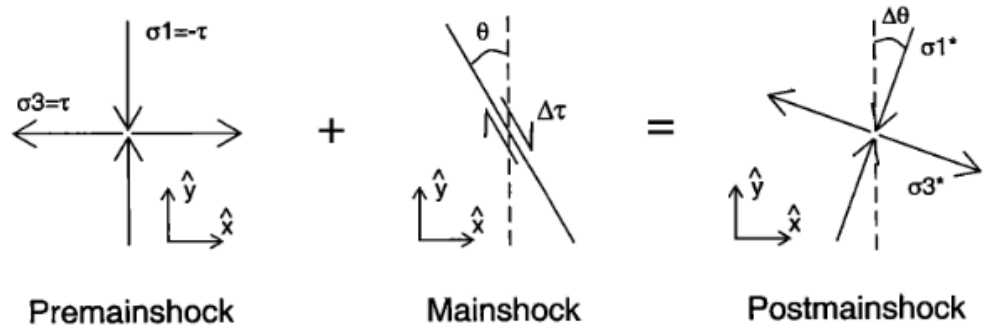


Figure 8. Assumed geometry of a stress rotation due to slip on a fault. The postmainshock stress state is equal to the premainshock stress state plus the stress change due to the earthquake. The problem is assumed to be two-dimensional, so it can be represented entirely in the σ_1-σ_3 plane. θ is the angle from the fault trend to the σ_1 axis, clockwise positive. $\Delta\theta$ is the rotation of the st[illegible]d, clockwise positive. The mainshock stress drop, $\Delta\tau$, is taken to be positive for the se[illegible]hown and negative for the opposite sense of slip.

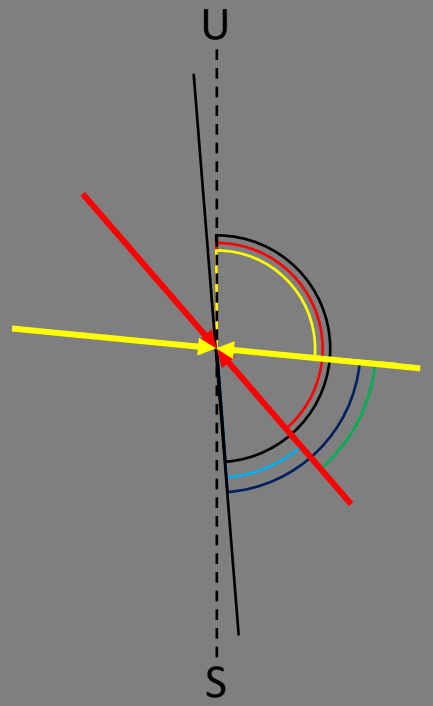
Hardebeck & Hauksson 2001 say that θ and $\Delta\theta$ are calculated on the $\sigma1-\sigma3$ plane. Since the mechanism of the 2018 Mw7.5 Palu earthquake is strike-slip, the $\sigma1-\sigma3$ plane is horizontal, so the angle used is SHmax with respect to the strike of fault.

Nodal plane 2018 Mw 7.5 Palu

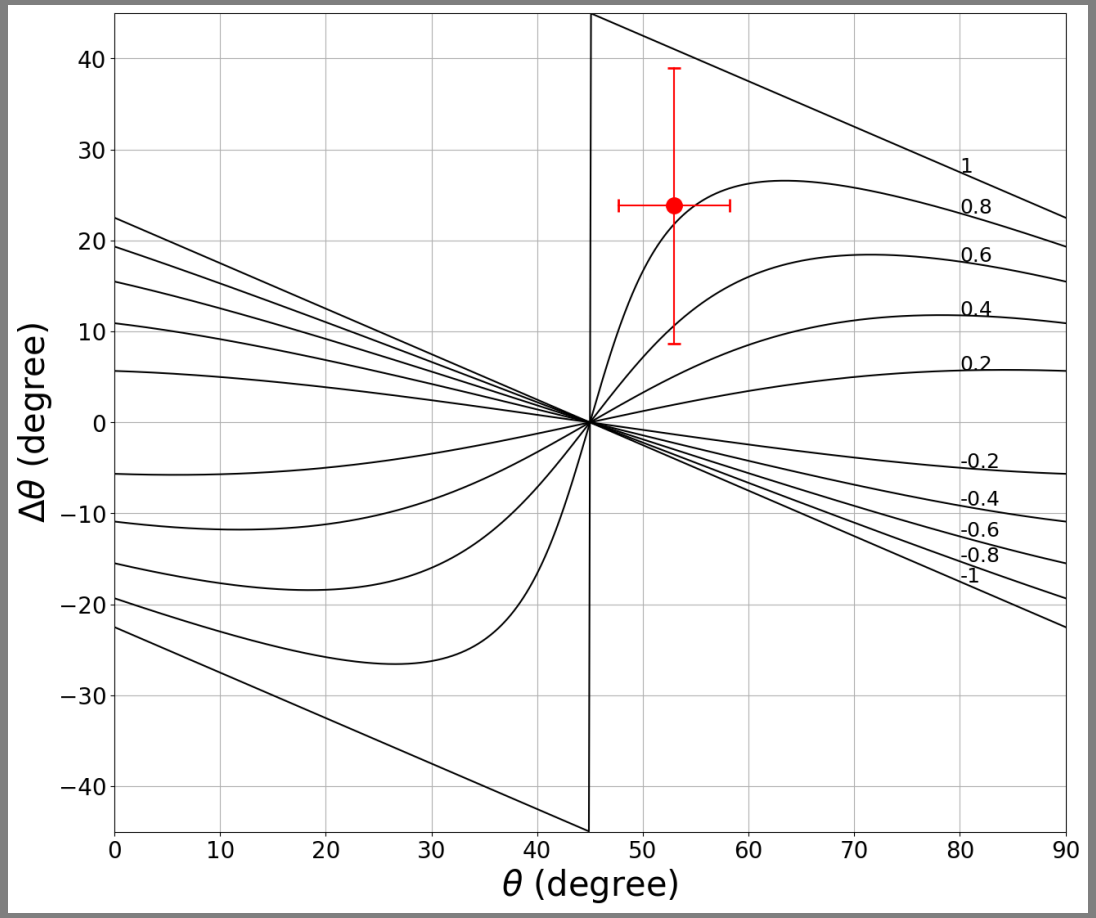
348 · 57 · -15 87 · 77 · -146

$$\theta = strike - before$$
$$\theta_a = strike - after$$
$$\Delta\theta = \theta_a - \theta$$

Fault | ***Before*** | ***After*** | $\boldsymbol{\theta + \Delta\theta}$ | $\boldsymbol{\theta}$ | $\boldsymbol{\Delta\theta}$



Model Stress Drop 2018 Mw 7.5 Palu by SHmax



$$\theta_b = 52.95 \pm 5.29\ (47.66-58.24)$$
$$\Delta\theta = 23.80 \pm 15.12\ (8.69-38.92)$$
$$\frac{\Delta\tau}{\tau} = 0.83 \pm 0.23\ (0.50-0.97)$$