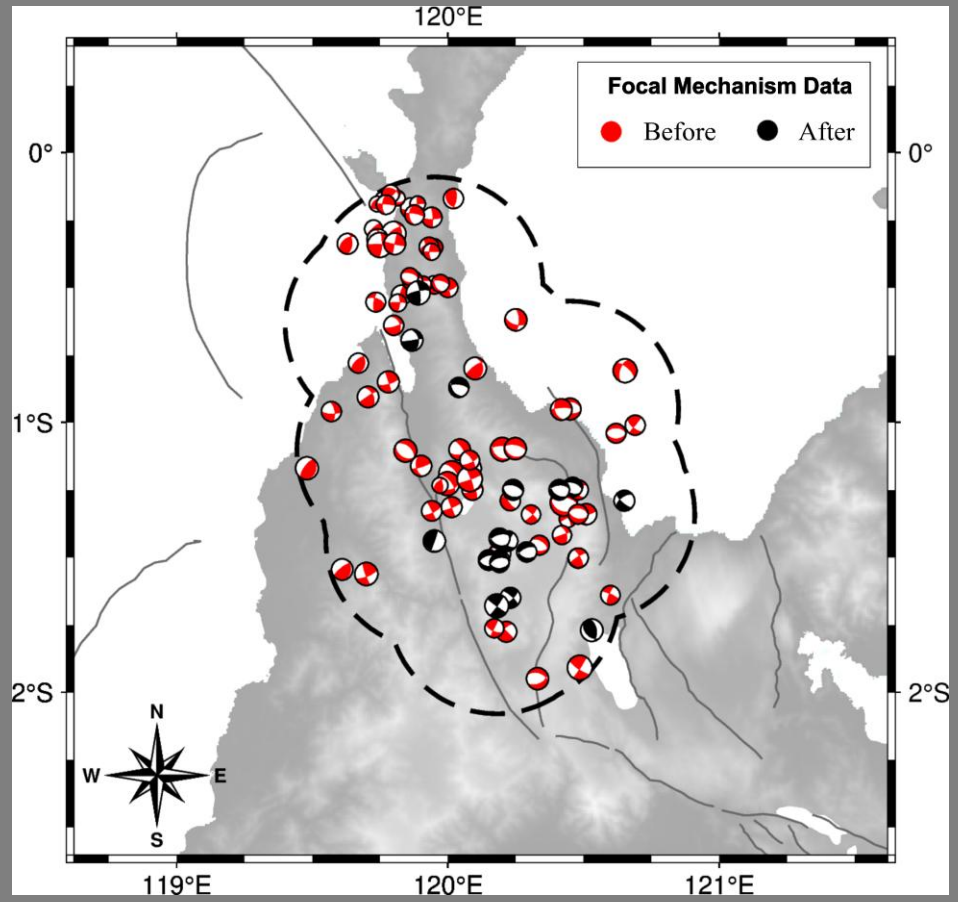
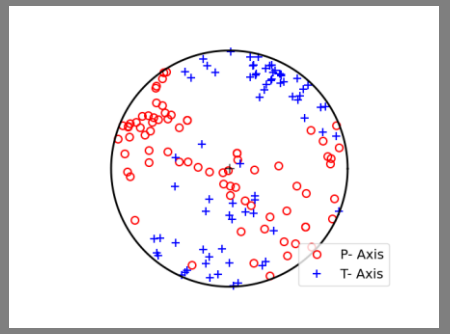
Stress Orientation Rotation of the 2018 Mw 7.5 Palu Earthquake

Focal Mechanisms Data

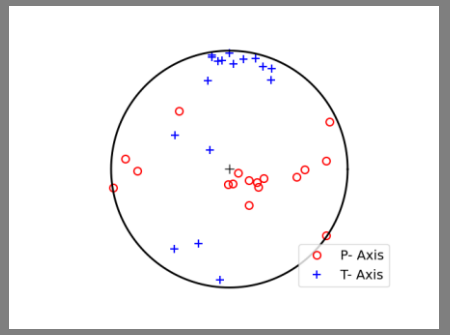


Before 2018 Mw7.5 Palu



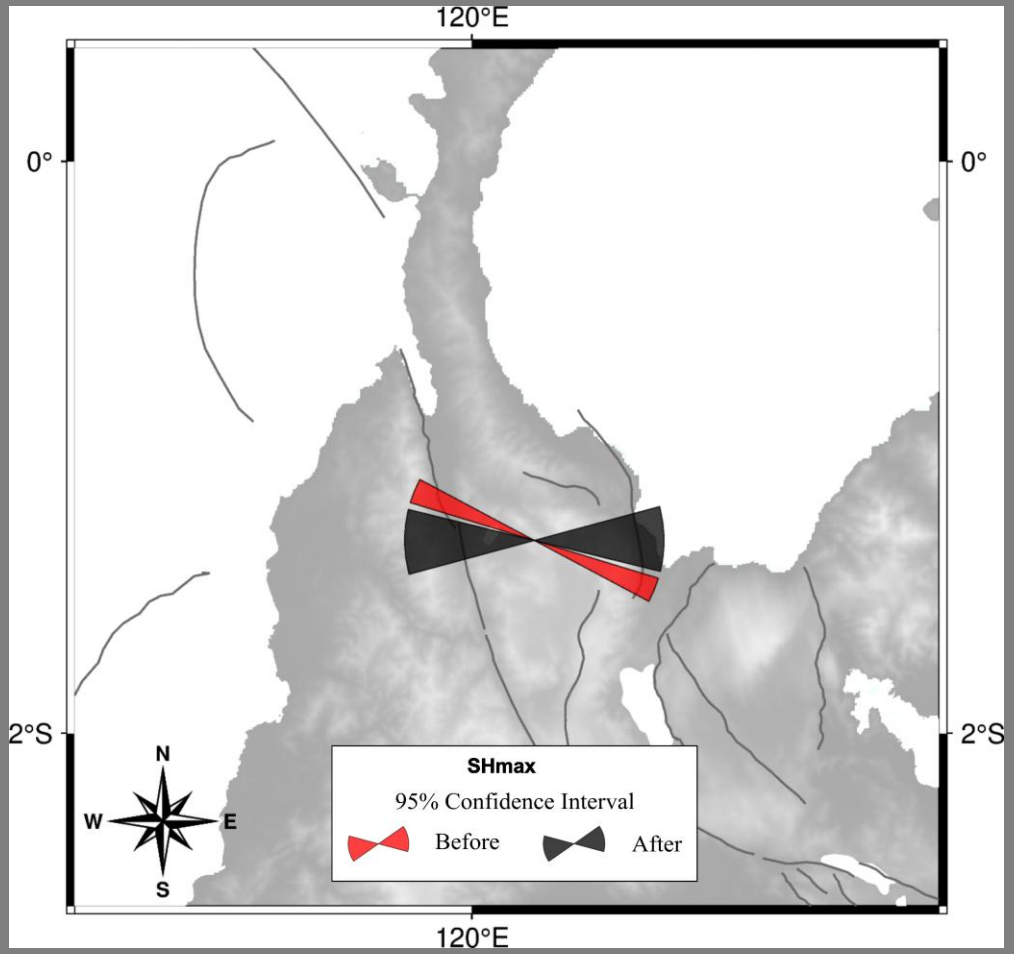
76 events
May 1977 – Sep 2018

After 2018 Mw7.5 Palu

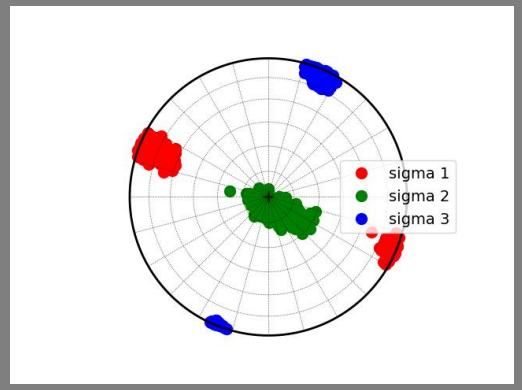


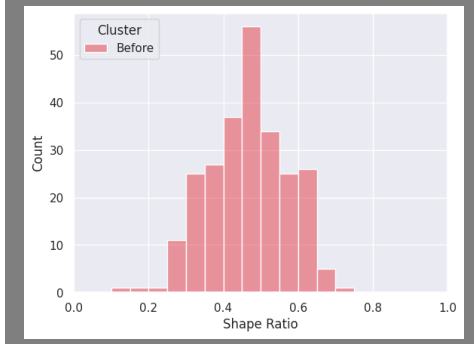
17 events
Sep 2018 – Nov 2021

Stress Inversion Result

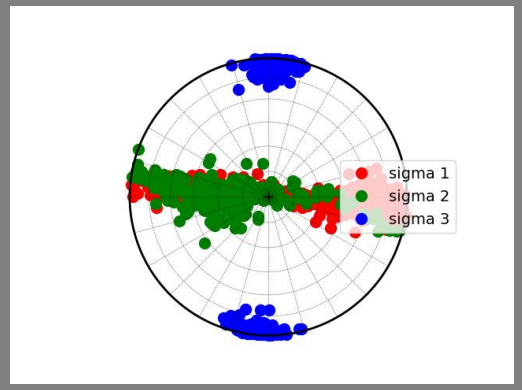


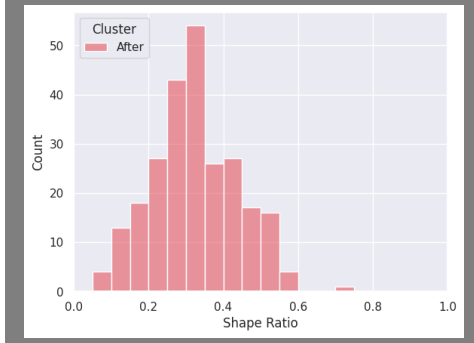
Before 2018 Mw7.5 Palu





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	112.2 ± 5.7	13.0 ± 12.6	141.2 ± 75.5	75.7 ± 12.1	22.8 ± 5.7	6.3 ± 6.0	112.5 ± 5.5
After	97.1 ± 20.6	42.5 ± 39.7	98.8 ± 45.1	45.5 ± 39.1	3.4 ± 11.0	9.1 ± 9.0	89.3 ± 14.5
Δ	-15.1	29.5	-42.4	-30.2	-19.4	2.8	-23.2

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 $\Delta\theta$

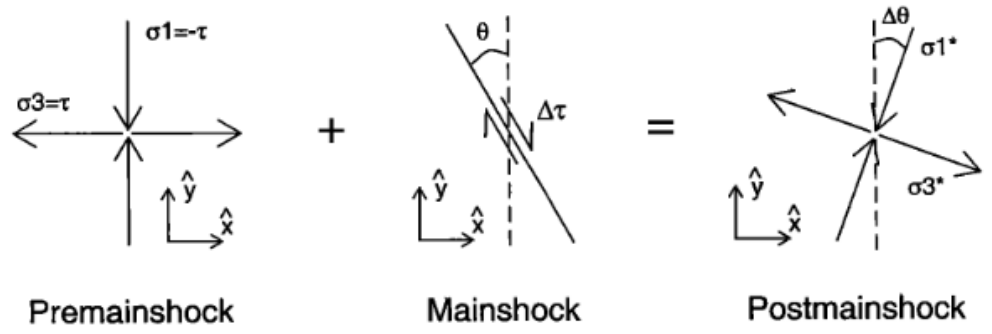


Figure 8. Assumed geometry of a stress rotation due to slip on a fault. The postmainshock stress state is equal to the premainshock stress state plus the stress change due to the earthquake. The problem is assumed to be two-dimensional, so it can be represented entirely in the σ_1-σ_3 plane. θ is the angle from the fault trend to the σ_1 axis, clockwise positive. $\Delta\theta$ is the rotation of the s[illegible], 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

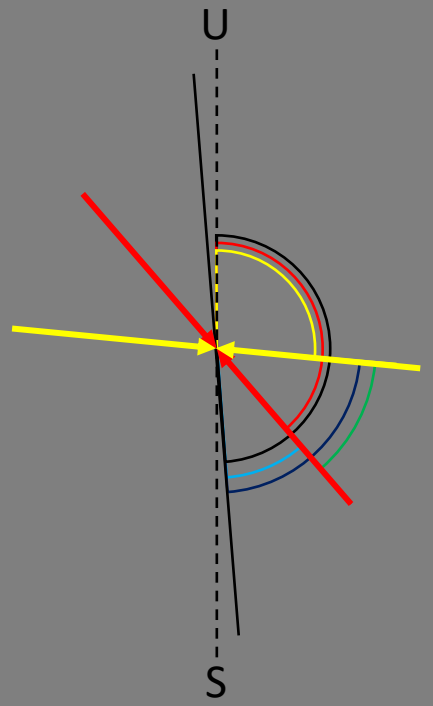
348 · 57 · -15 87 · 77 · -146

$\theta = 168 - 113.51 = 54.48$

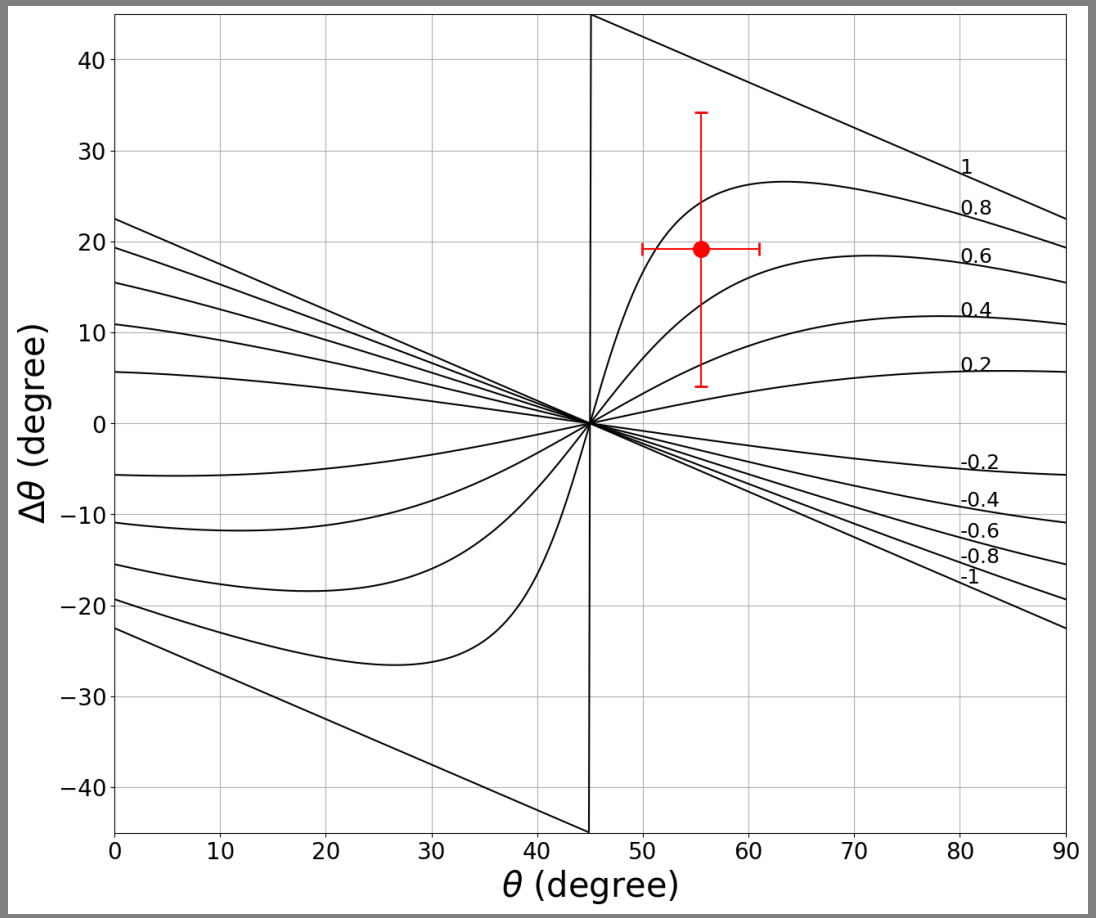
$\theta_a = 168 - 97.16 = 70.84$

$\Delta\theta = 70.84 - 54.48 = 16.36$

Fault | ***Before*** | ***After*** | $\theta + \Delta\theta$ | θ | $\Delta\theta$



Model Stress Drop 2018 Mw 7.5 Palu by SHmax



$$\theta_b = 55.5 \pm 5.5\ (50.0 - 61.0)$$
$$\Delta\theta = 19.1 \pm 15.1\ (4.0 - 34.2)$$
$$\frac{\Delta\tau}{\tau} = 0.72 \pm 0.31\ (0.31 - 0.92)$$