Exploring complex normal faulting systems through physics-based dynamic rupture modeling

10-12 min talk!

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ANR EQTIME Project

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Outline

Motivation

Settings

Results

Motivation

Seismic Hazard in Central Italy

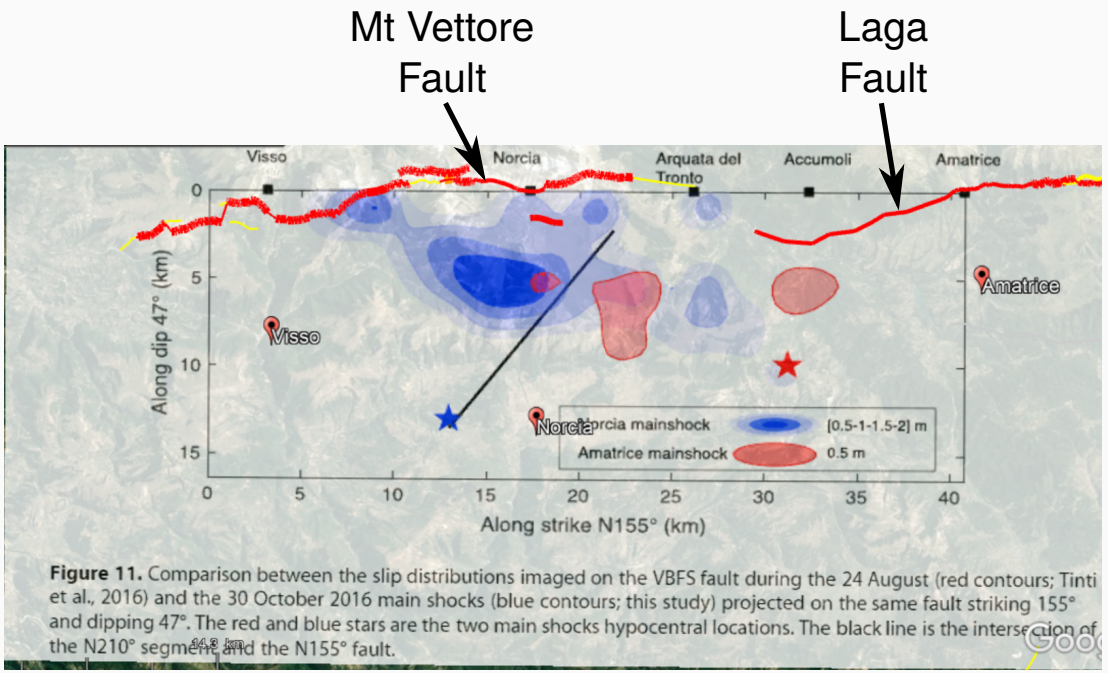

Figure 11. Comparison between the slip distributions imaged on the VBFS fault during the 24 August (red contours; Tinti et al., 2016) and the 30 October 2016 main shocks (blue contours; this study) projected on the same fault striking 155° and dipping 47°. The red and blue stars are the two main shocks hypocentral locations. The black line is the intersection of the N210° segment and the N155° fault.

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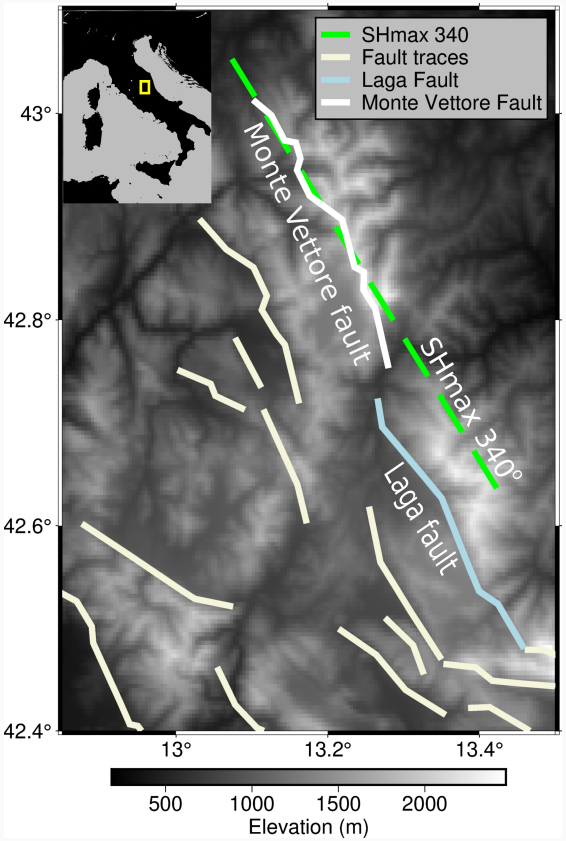

Map based on Walker et al. (2021)

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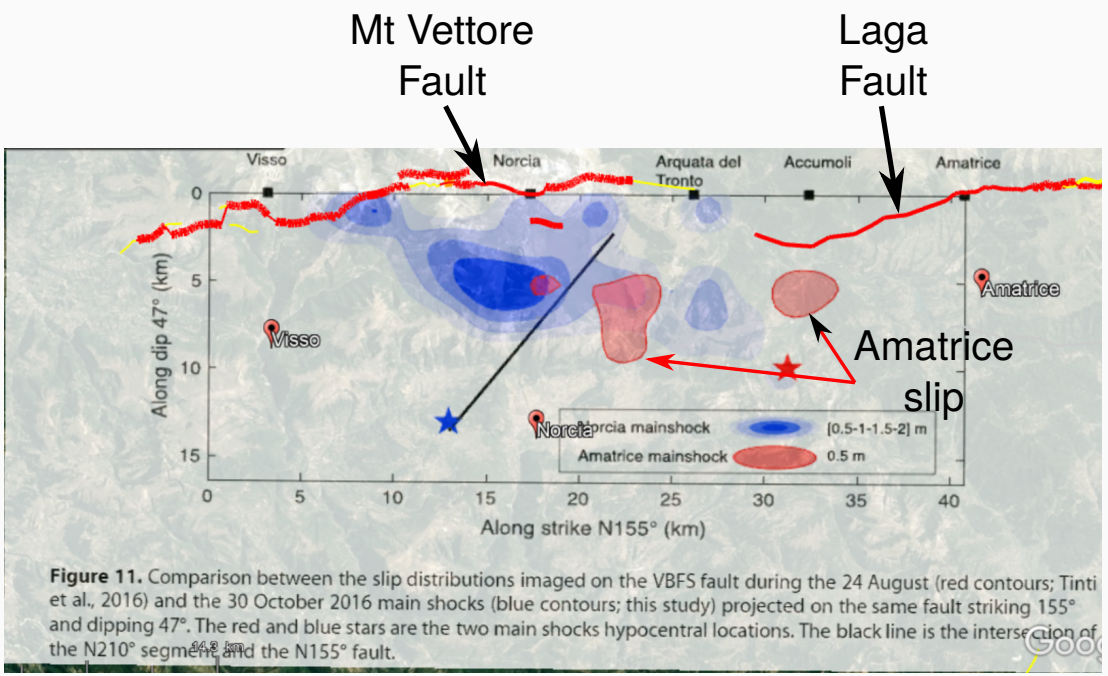

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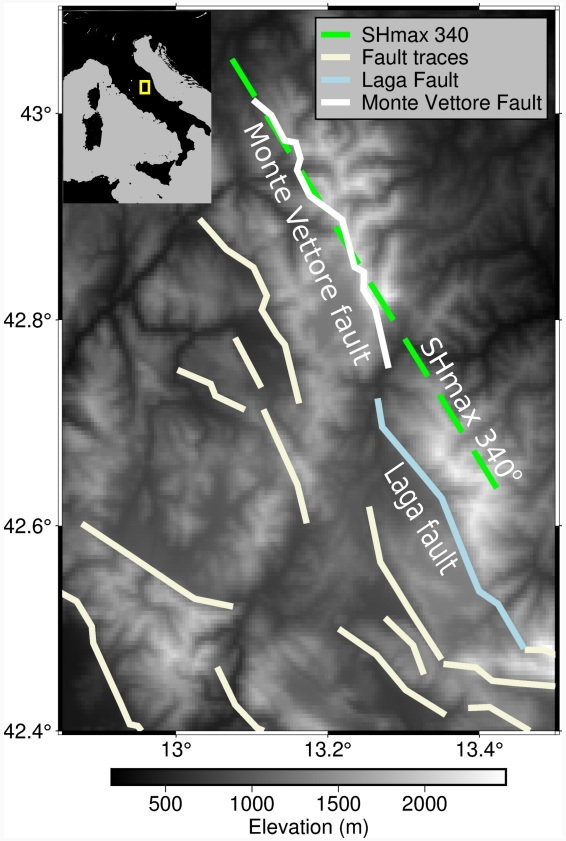

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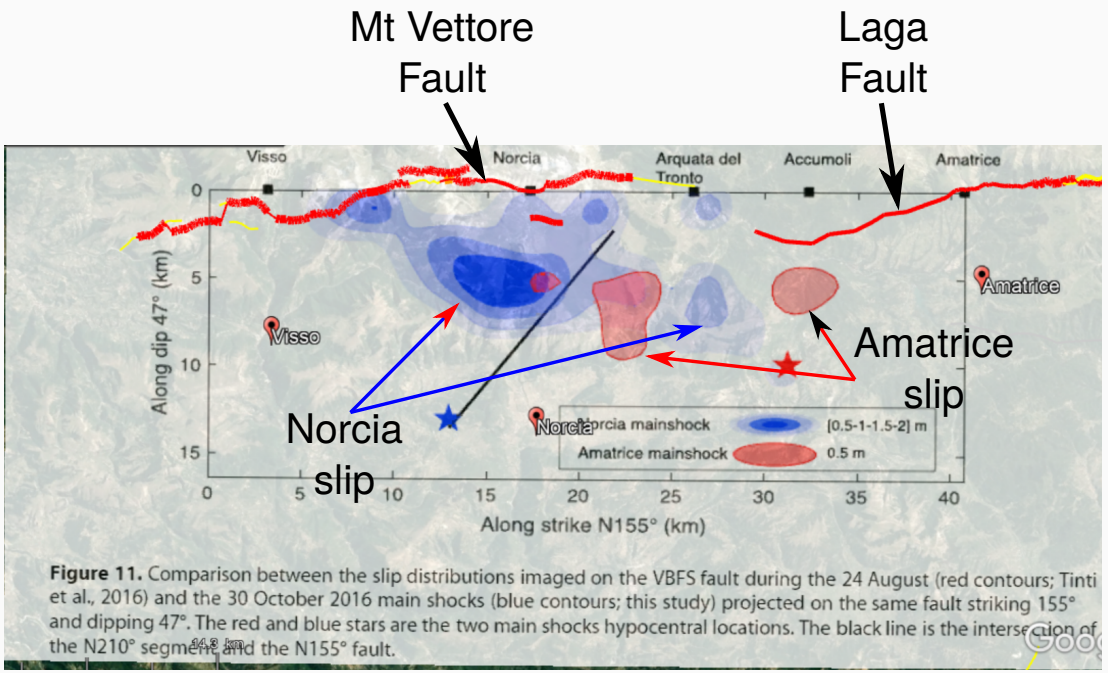

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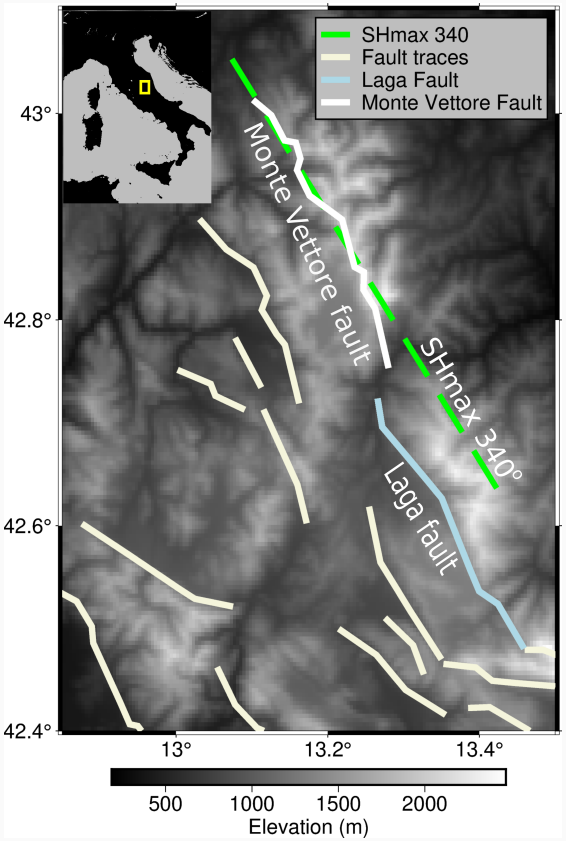

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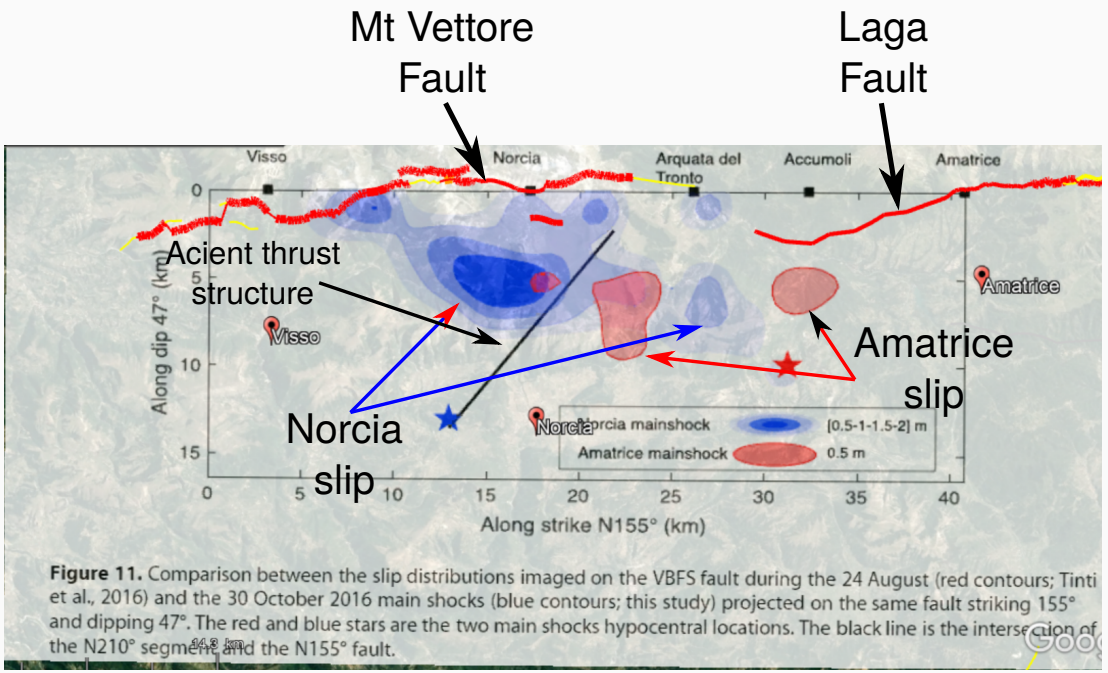

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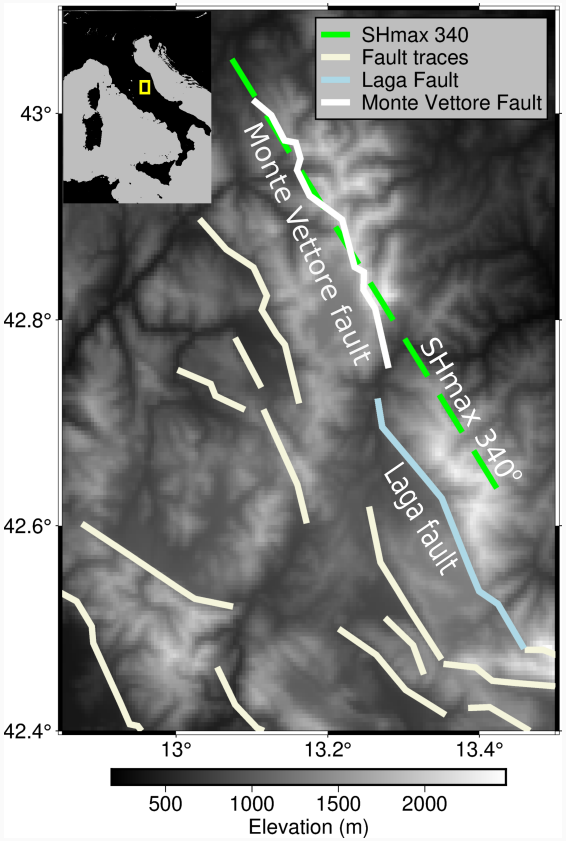

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Rupture jumps across step-overs

Previous studies focused on strike-slip fault systems: Galis et al. (2015); Hu et al. (2016); Bai and Ampuero (2017); Li and Liu (2020); Oglesby (2008), and more ...

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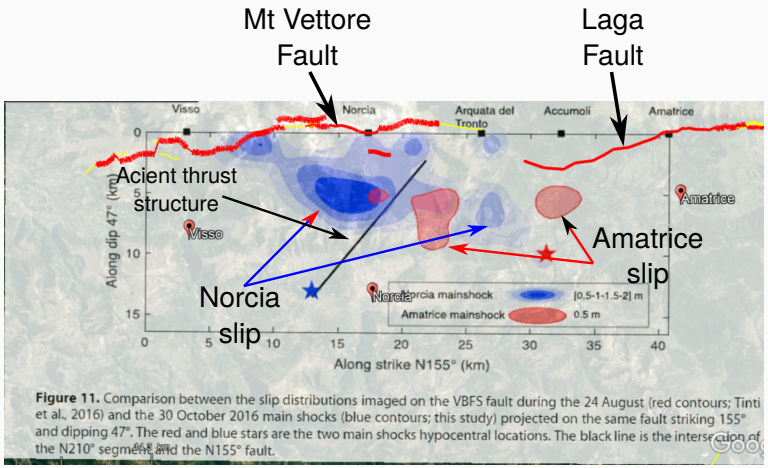

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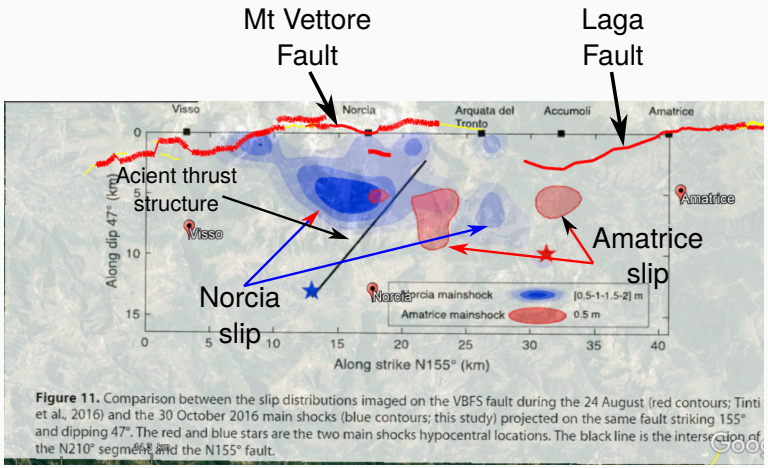

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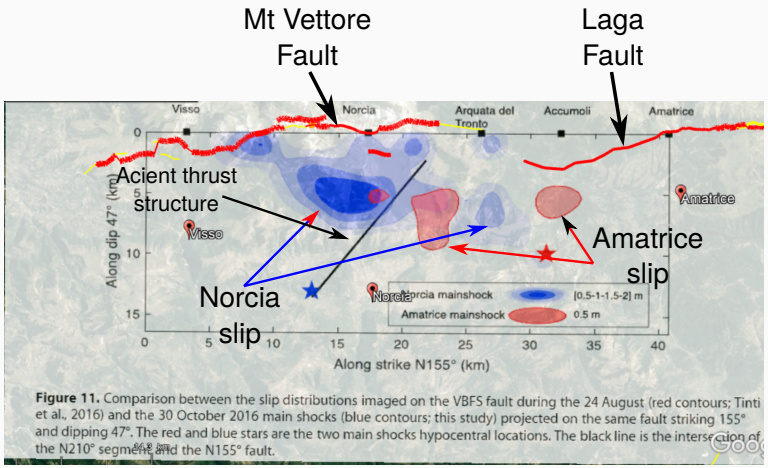

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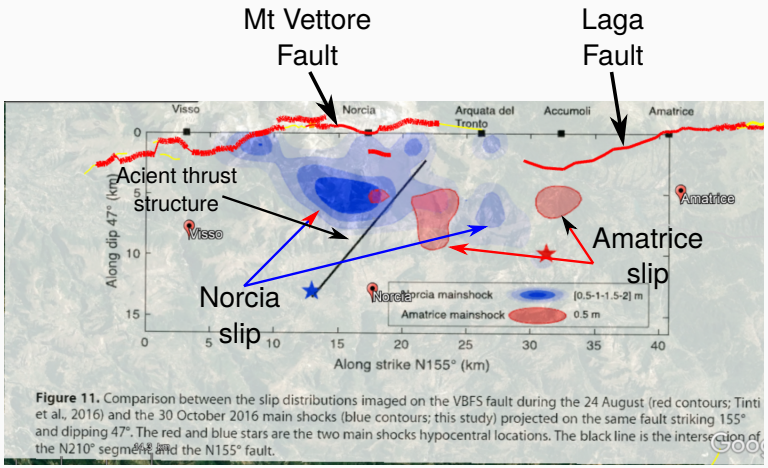

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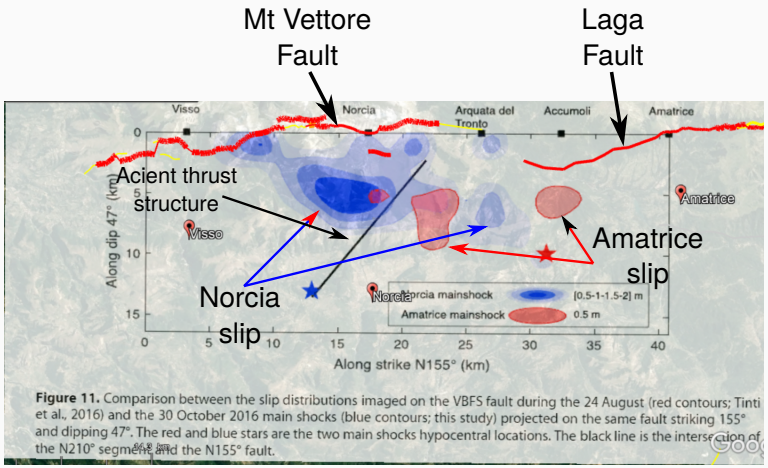

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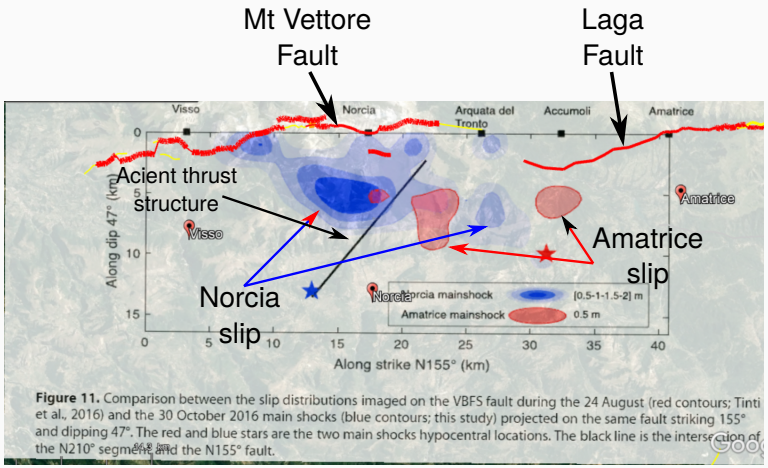

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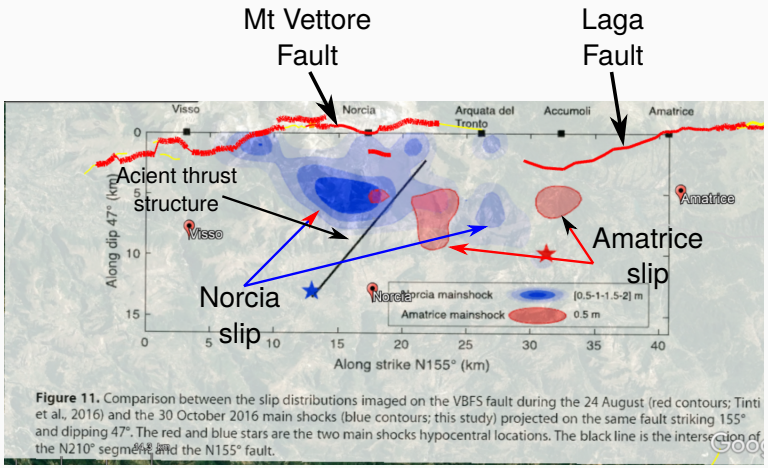

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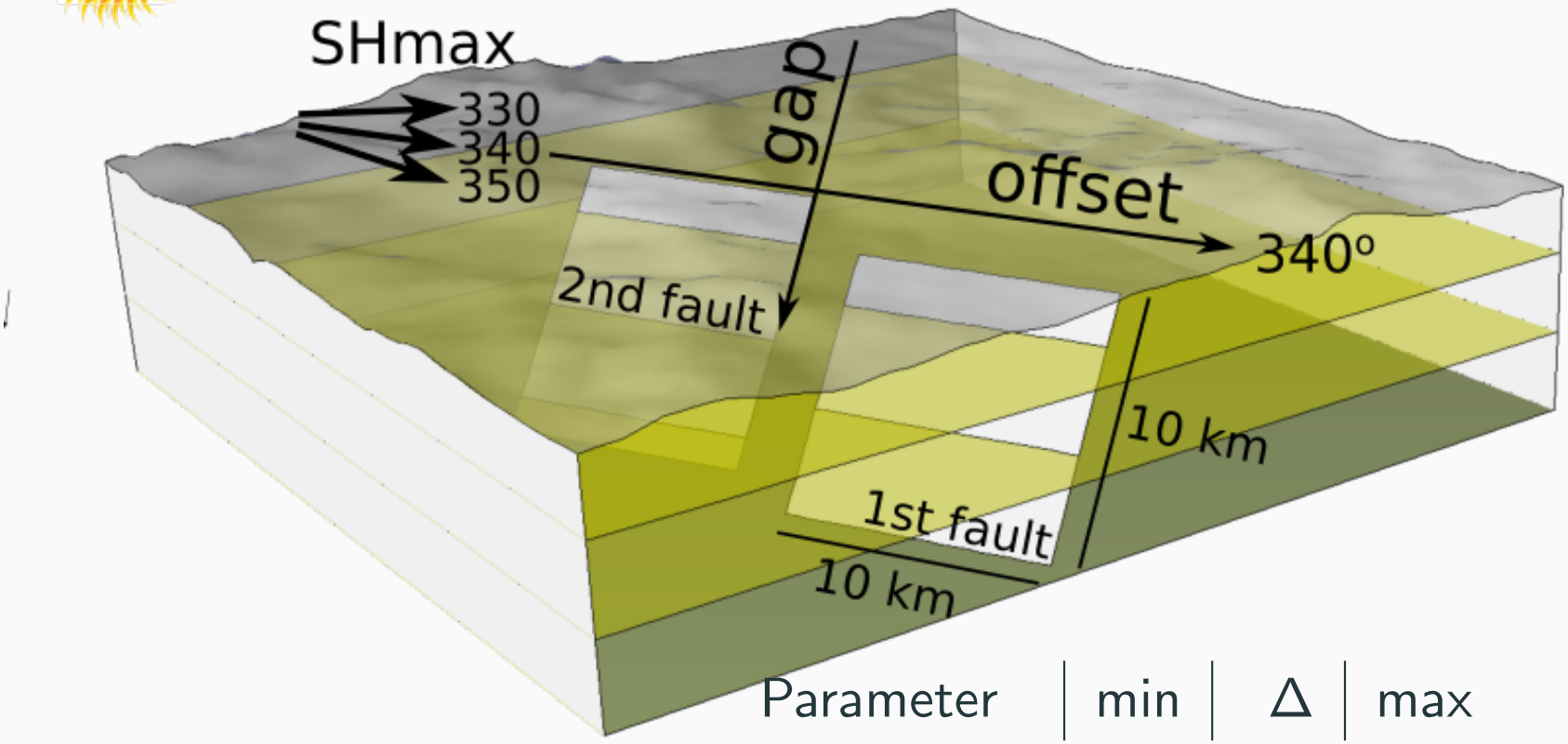
Investigate the physical conditons promoting rupture jumps across step overs regarding normal fault systems

Settings

Geometry and parameters explored



Parameter	min	Δ	max

www.seissol.org

(e.g., Wollherr et al., 2018; Ulrich et al., 2019)

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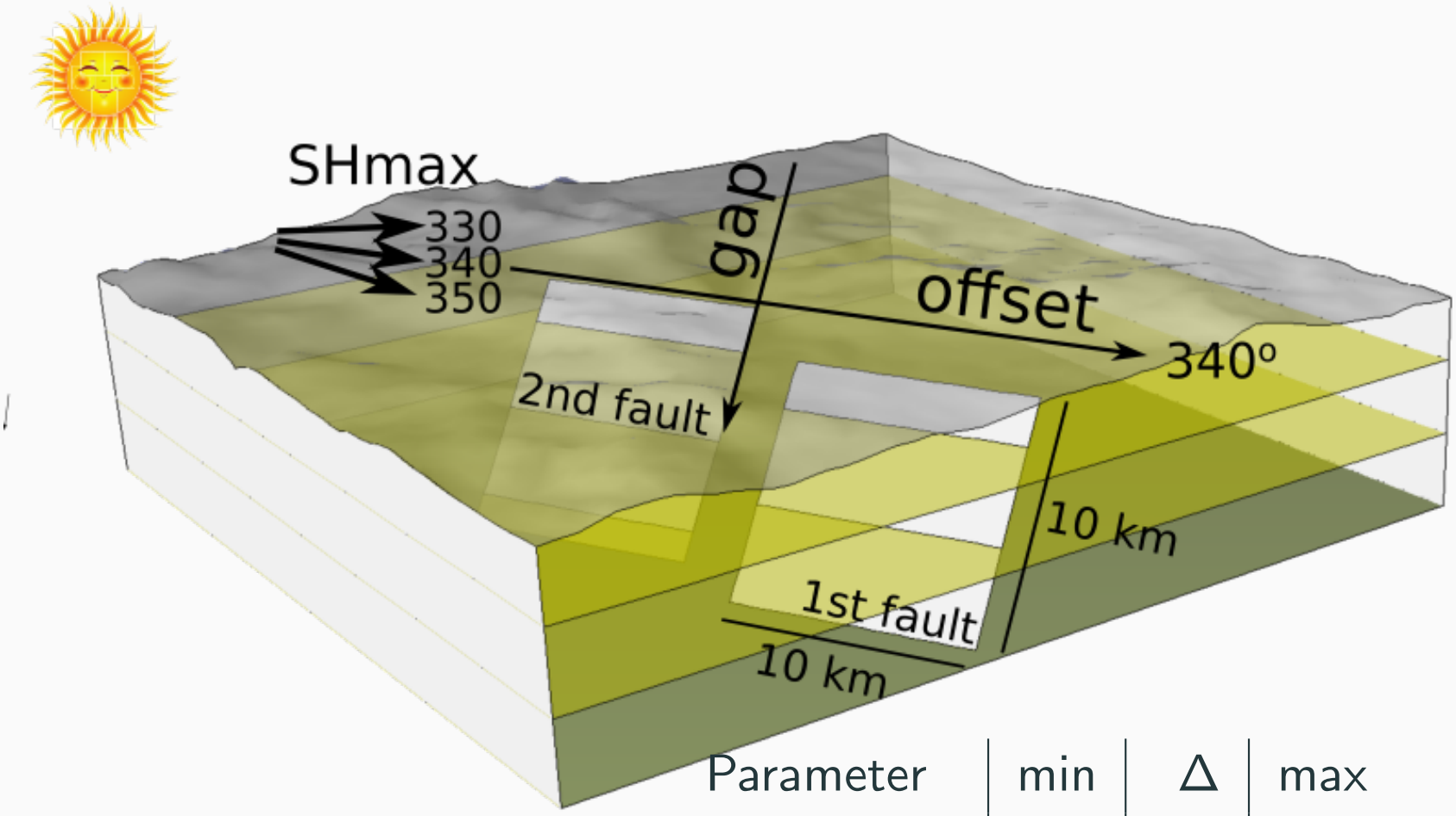

Parameter	min	Δ	max
Offset (km)	-5	2.5	+5

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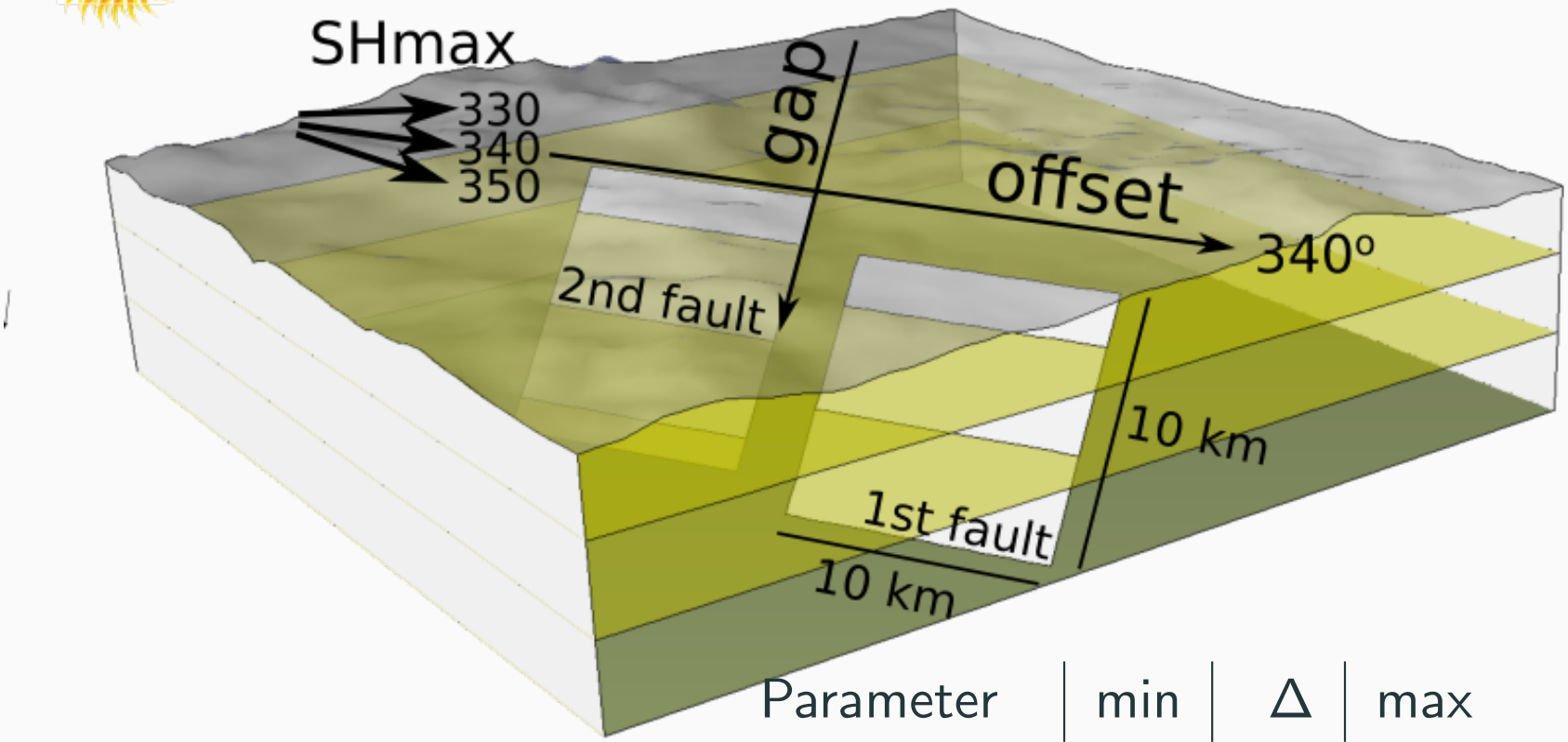

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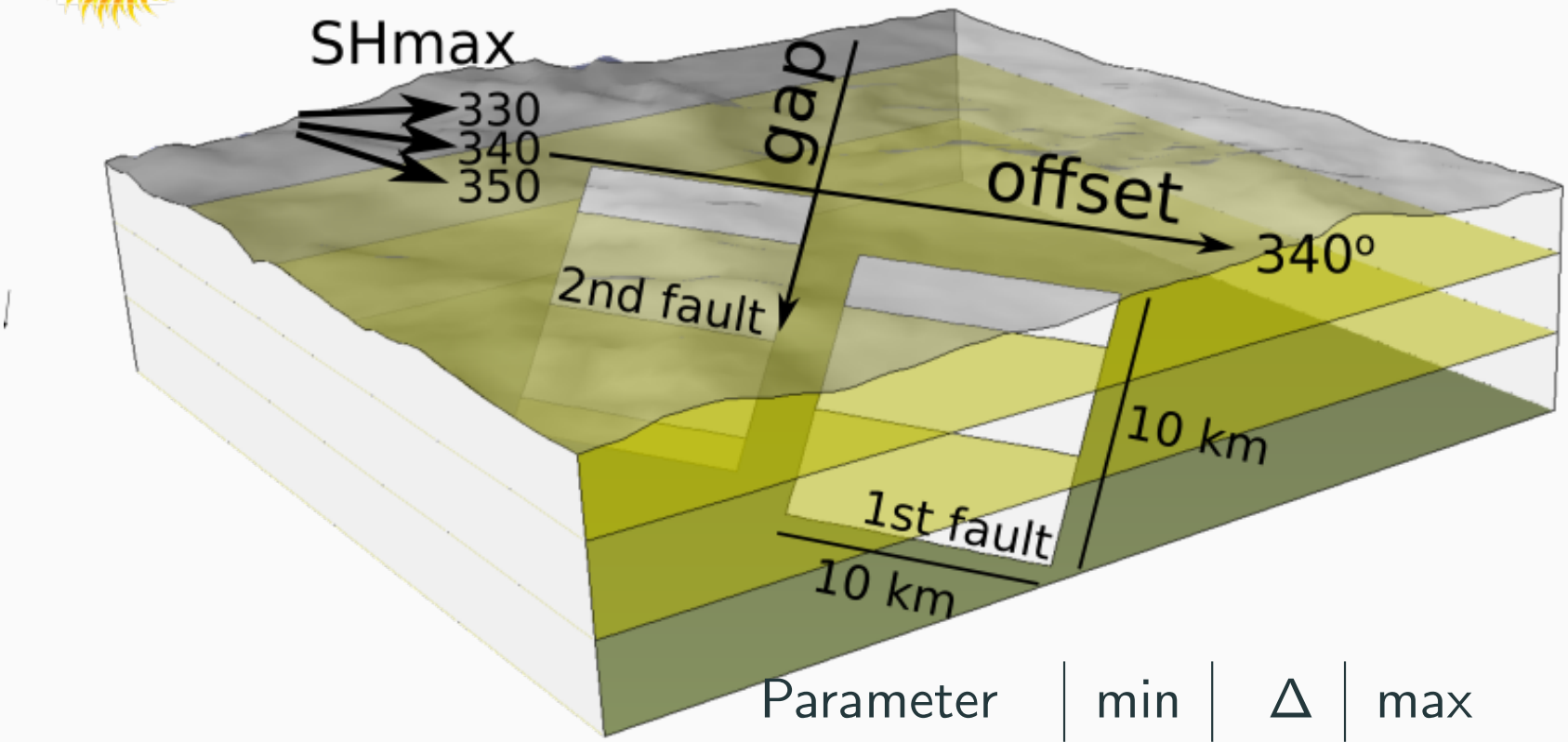

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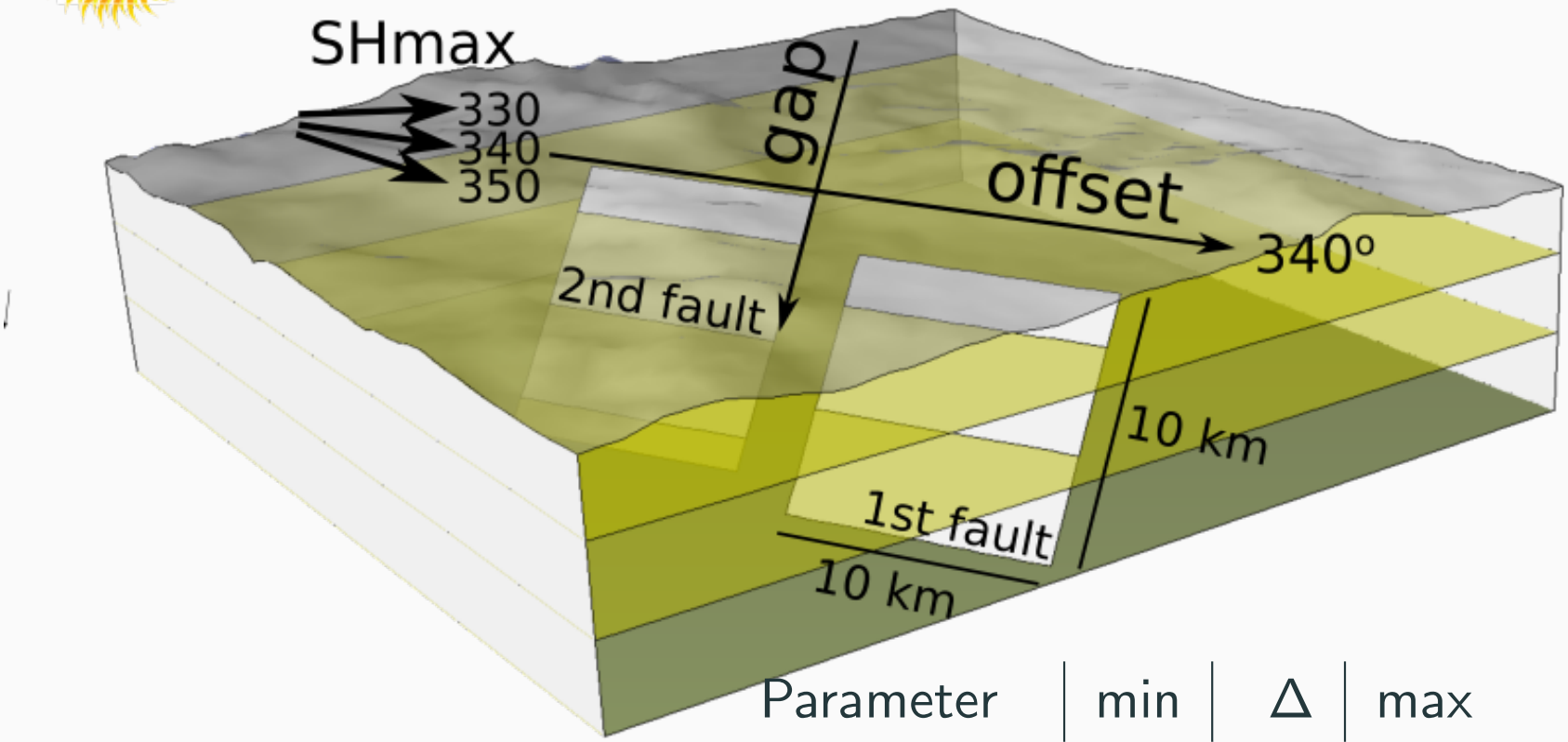

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SH_{max} (^{o})	330	10	350

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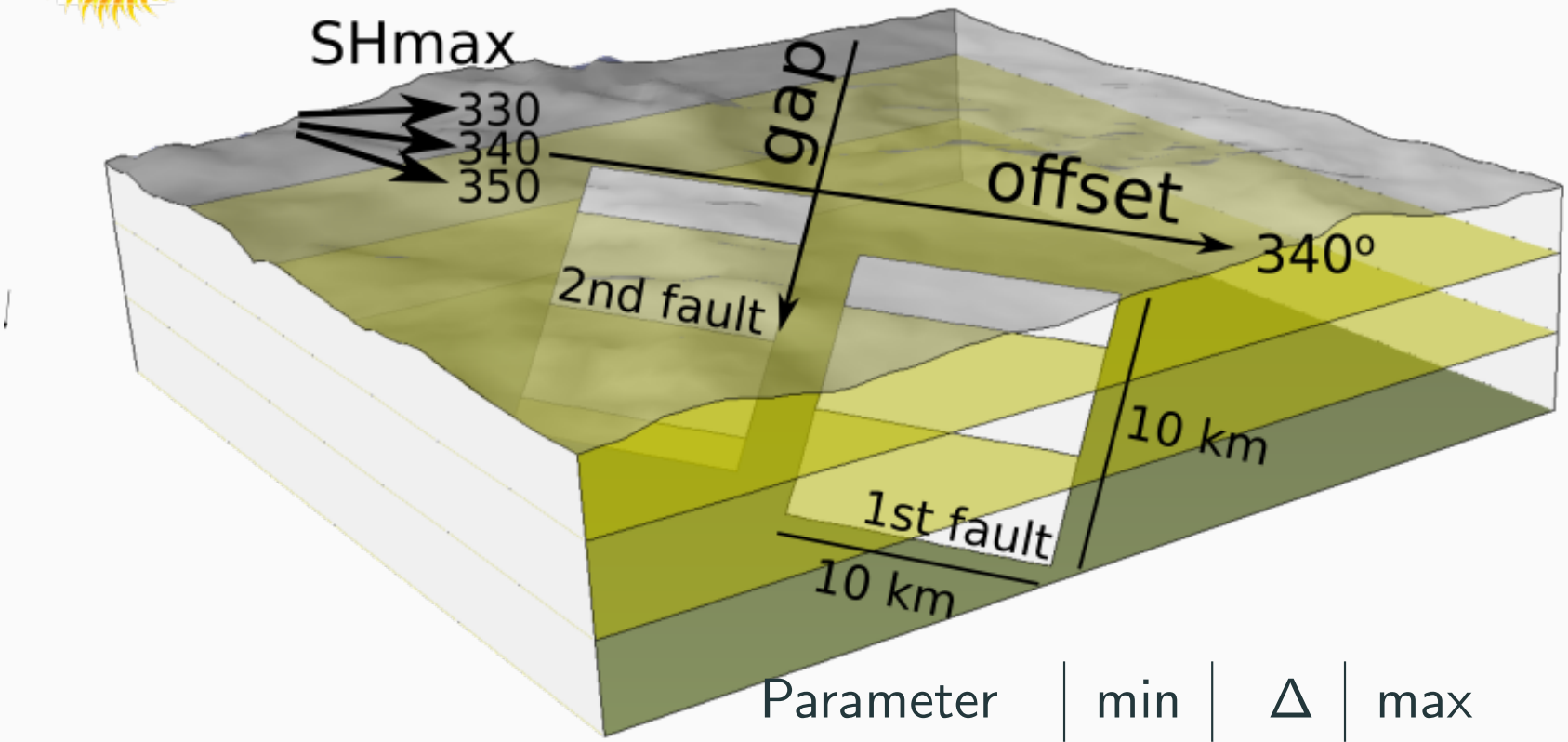

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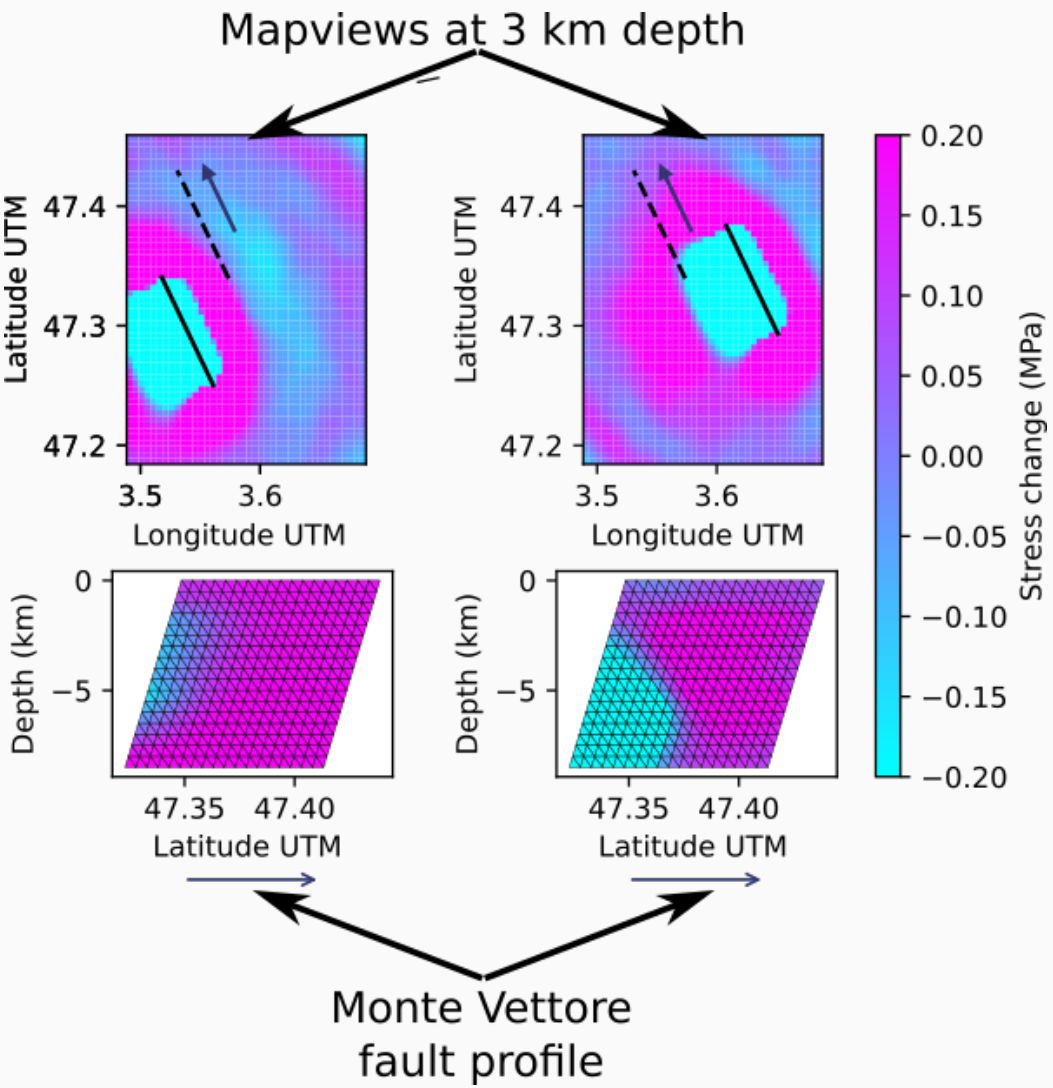
Static analysis ... jump? break-away?

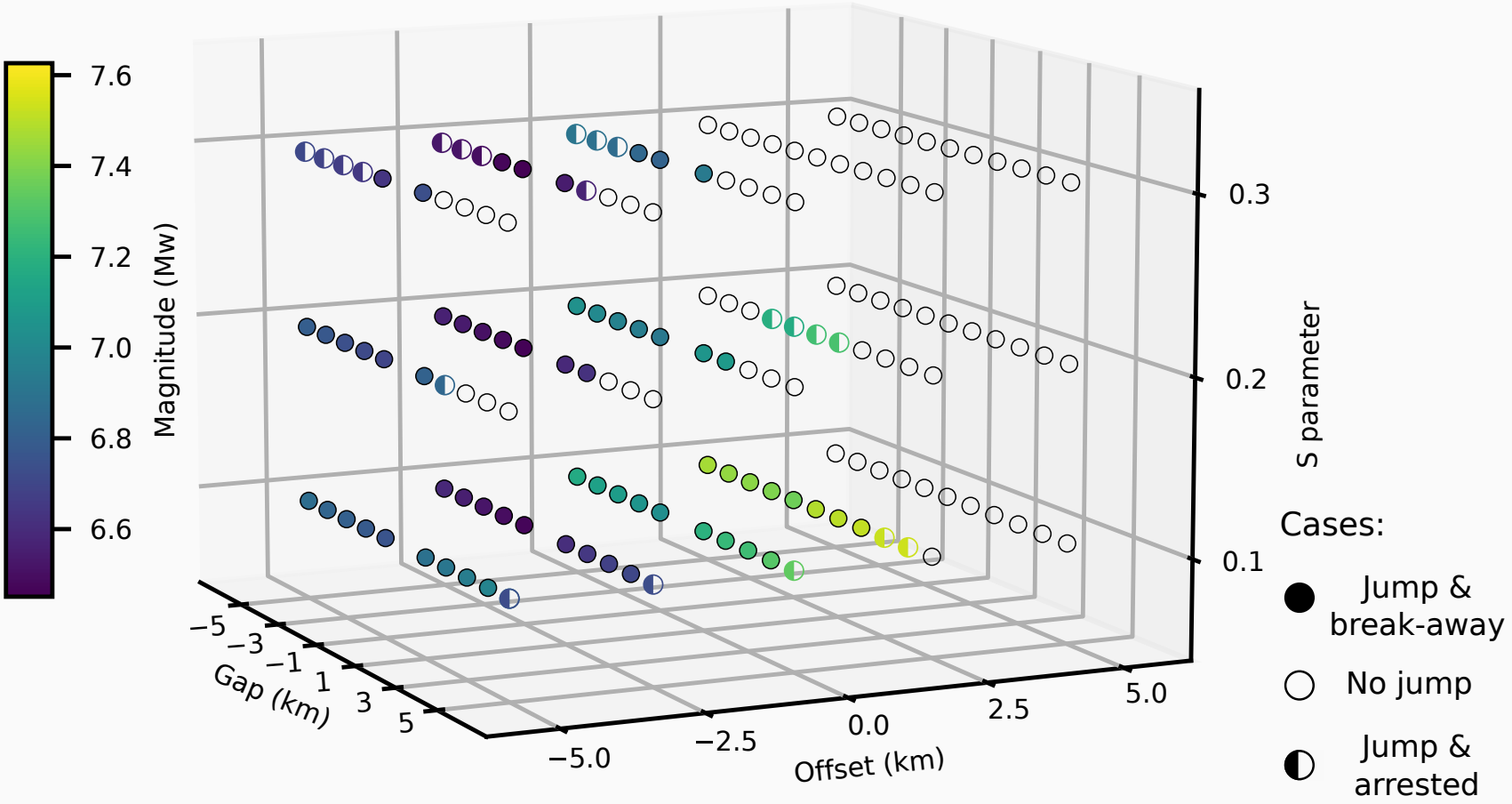


Are jumps and breakaway behavior prone to happen in both cases?

Is a static analysis enough to determine such behaviors?

Results

Results ... summary from 158 simulations



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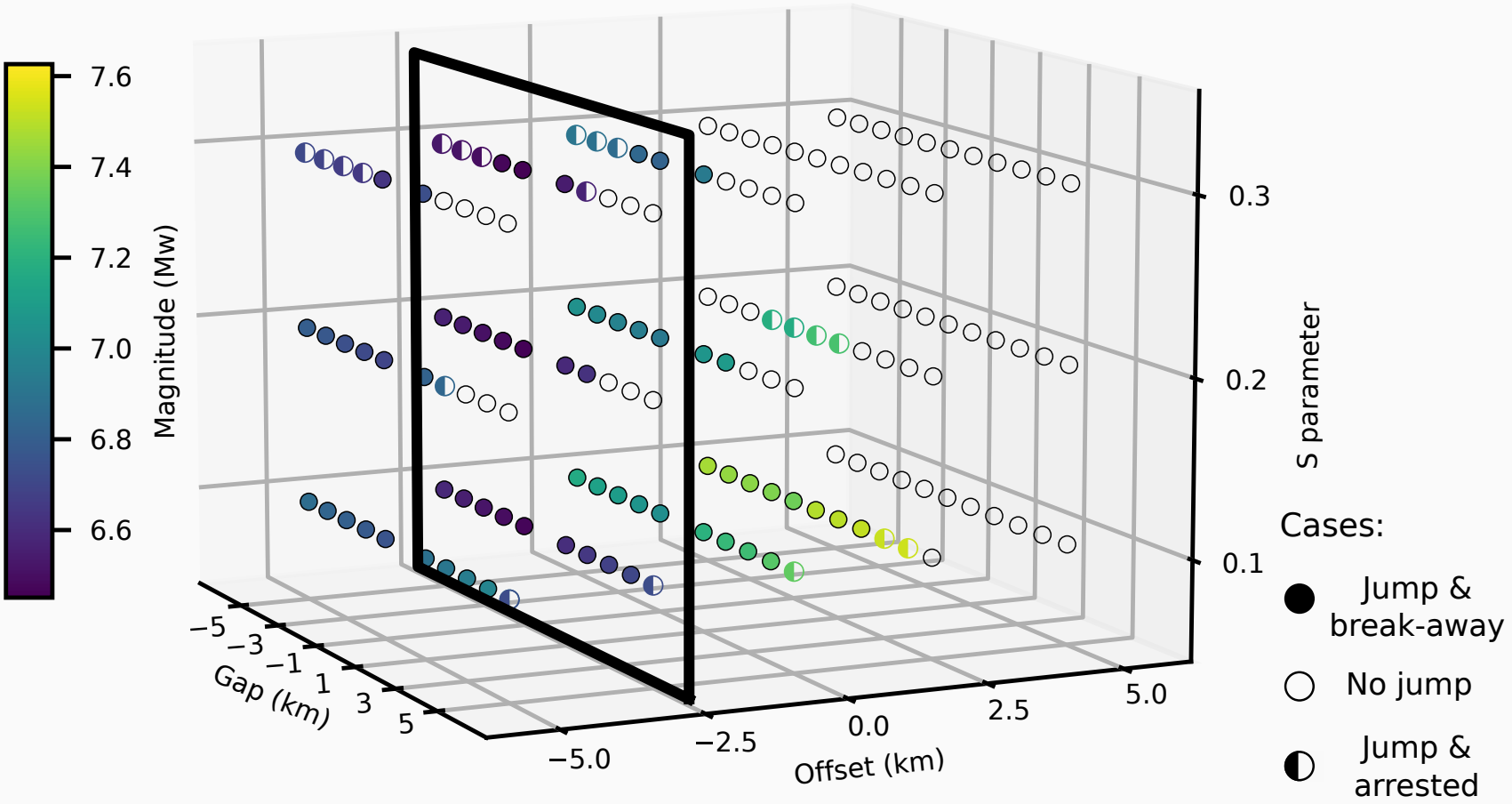
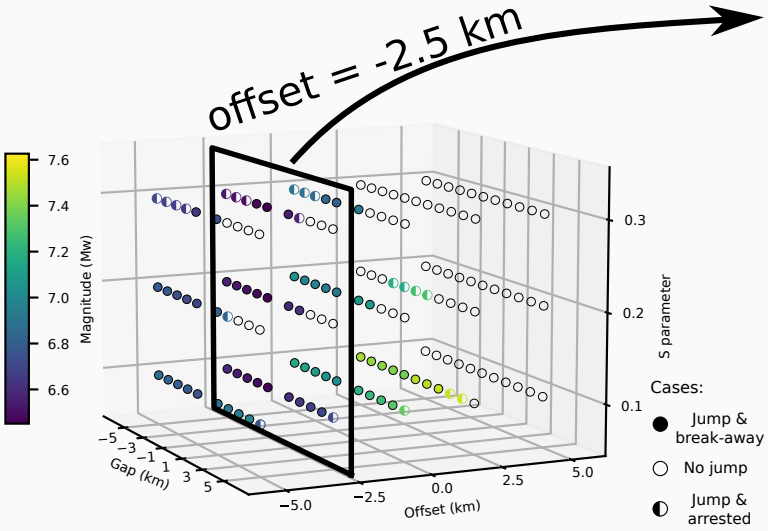


Let's see in detail some results at

a given offset ... at offset $= -2.5$ km ($\frac{1}{4}$ overlaped)

Results: Hangig/foot wall Asymmetric behavior



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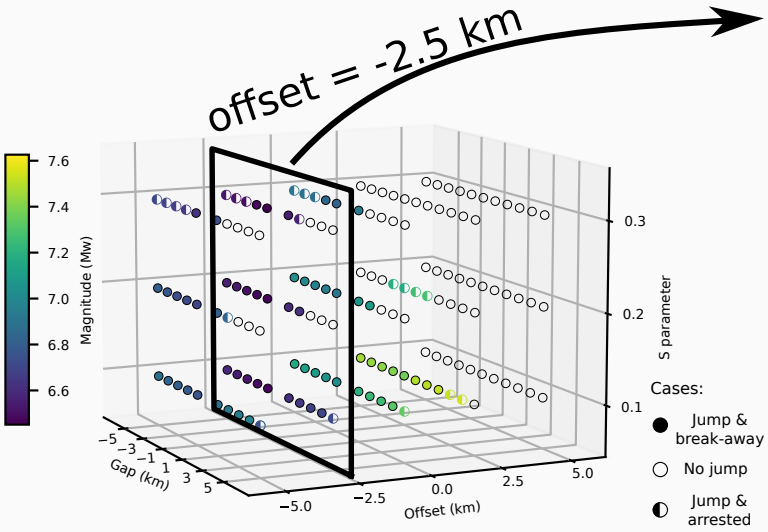
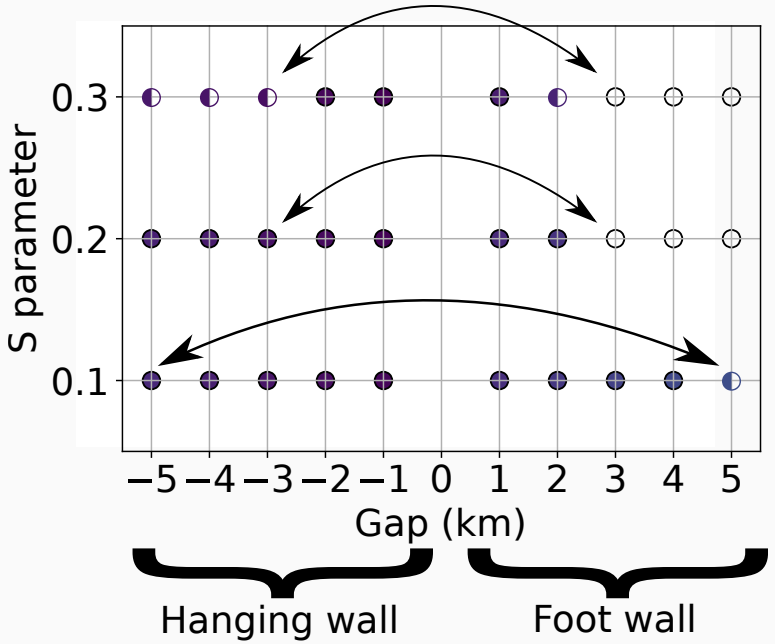


Compressive/Extensive Asymmetry



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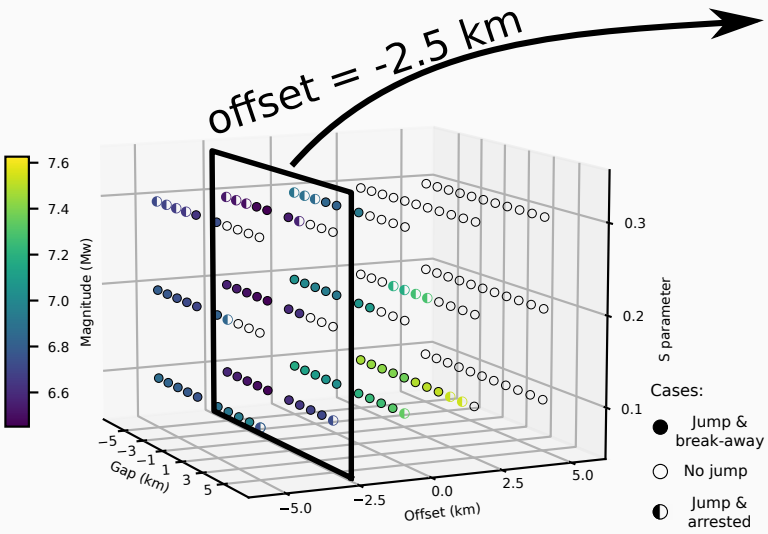

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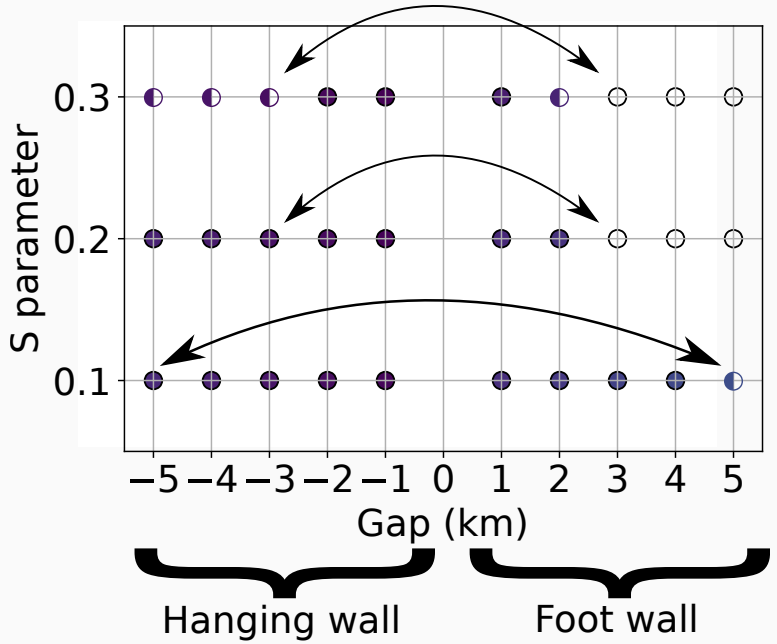
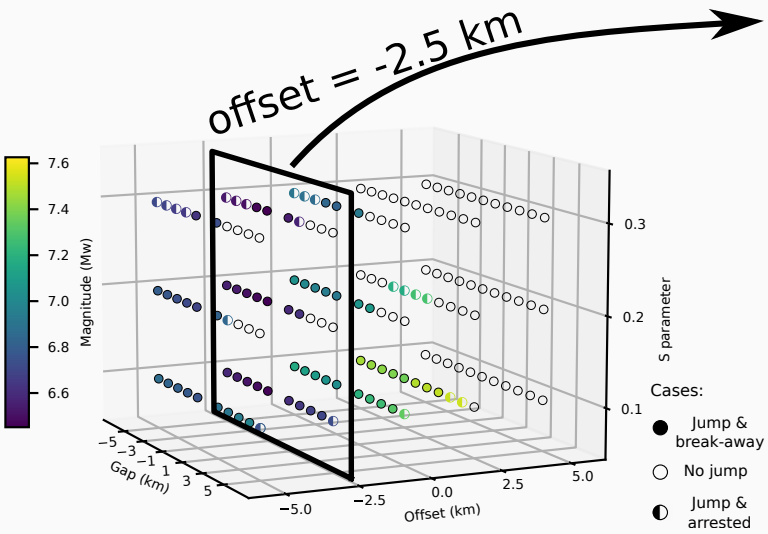


☞ **Hanging/foot wall asymmetry:**

When the 2nd fault is on the hanging wall (Gap < 0), the rupture is more likely to

- be triggered
- be sustained

Results: Stress shadow ☞ expected magnitudes



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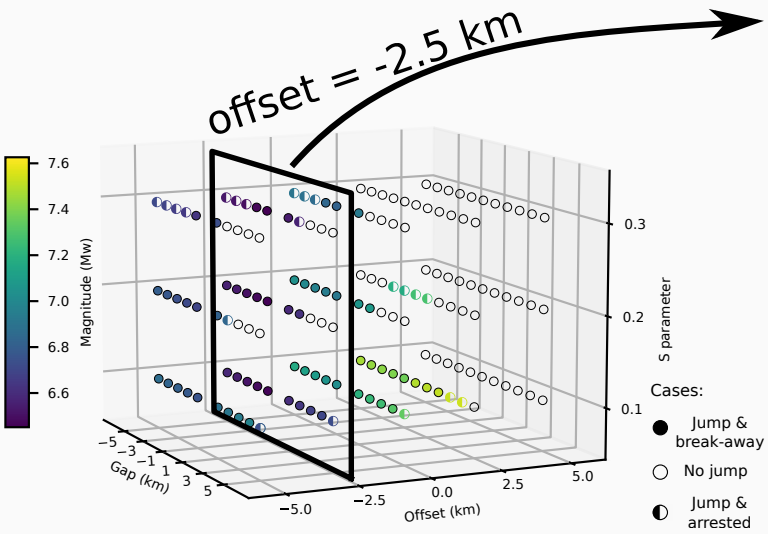
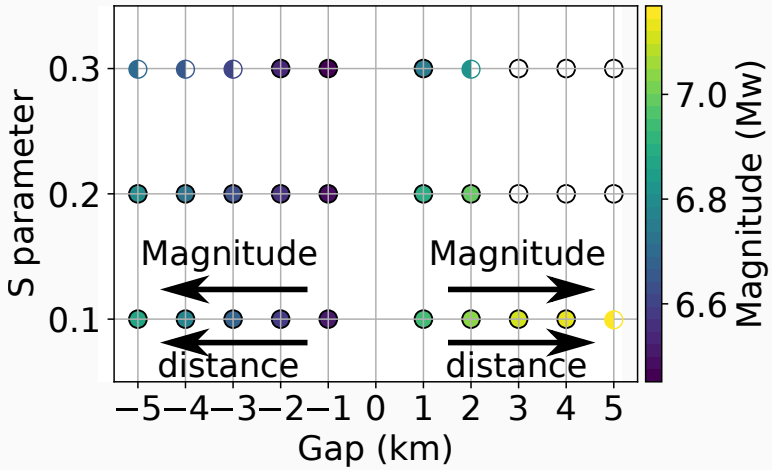


Proximity VS magnitude



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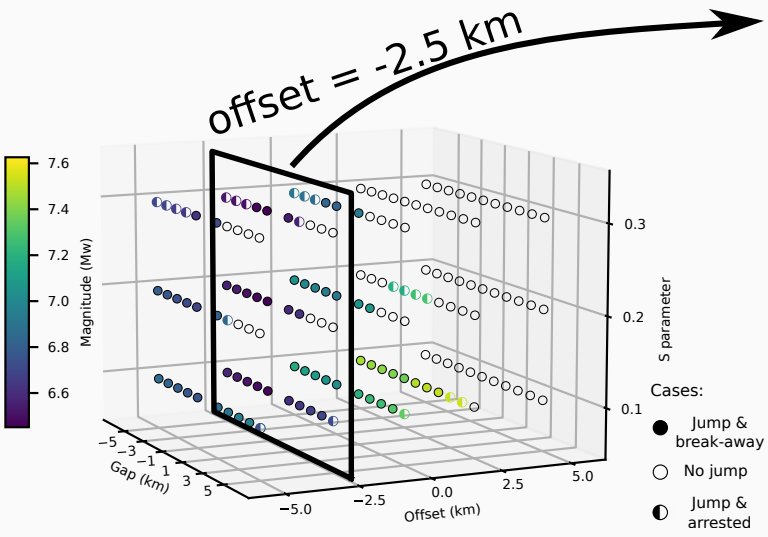

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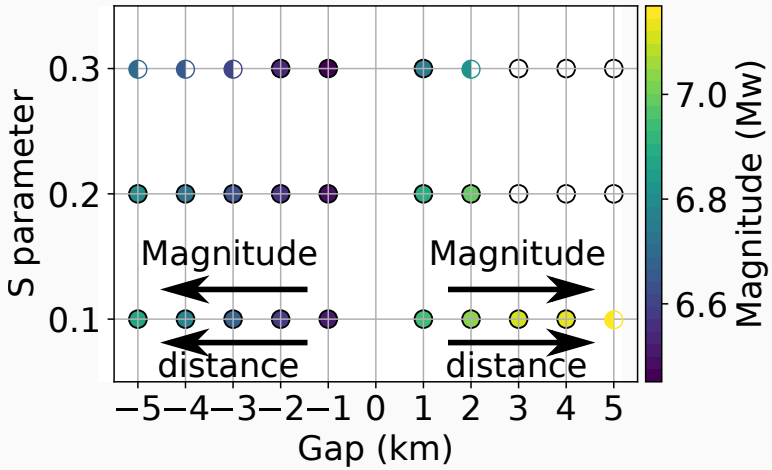

☞ **Stress shadow:**

The final energy released ($\approx M_w$) increases/decreases according to the distance between faults.

References

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