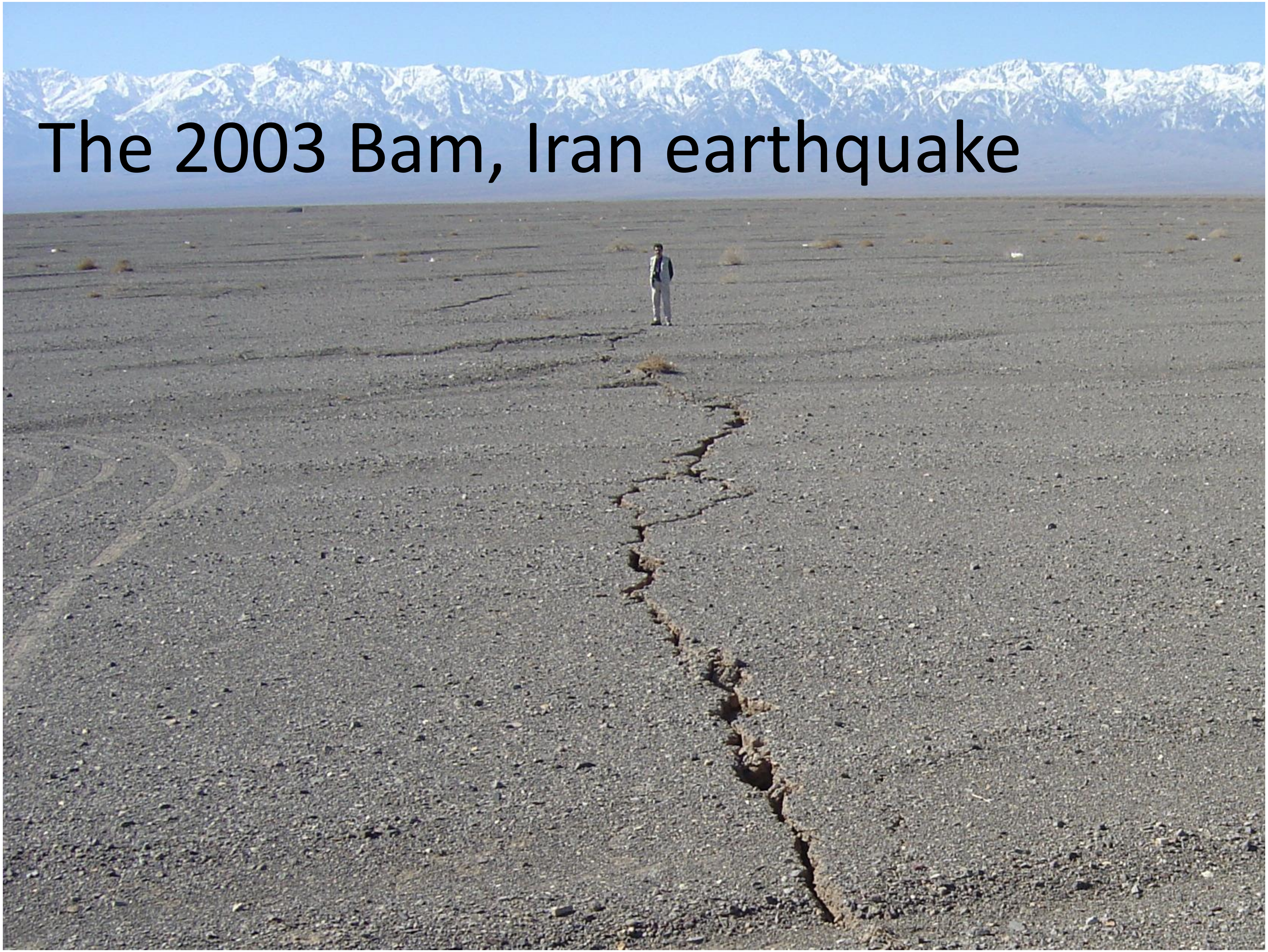
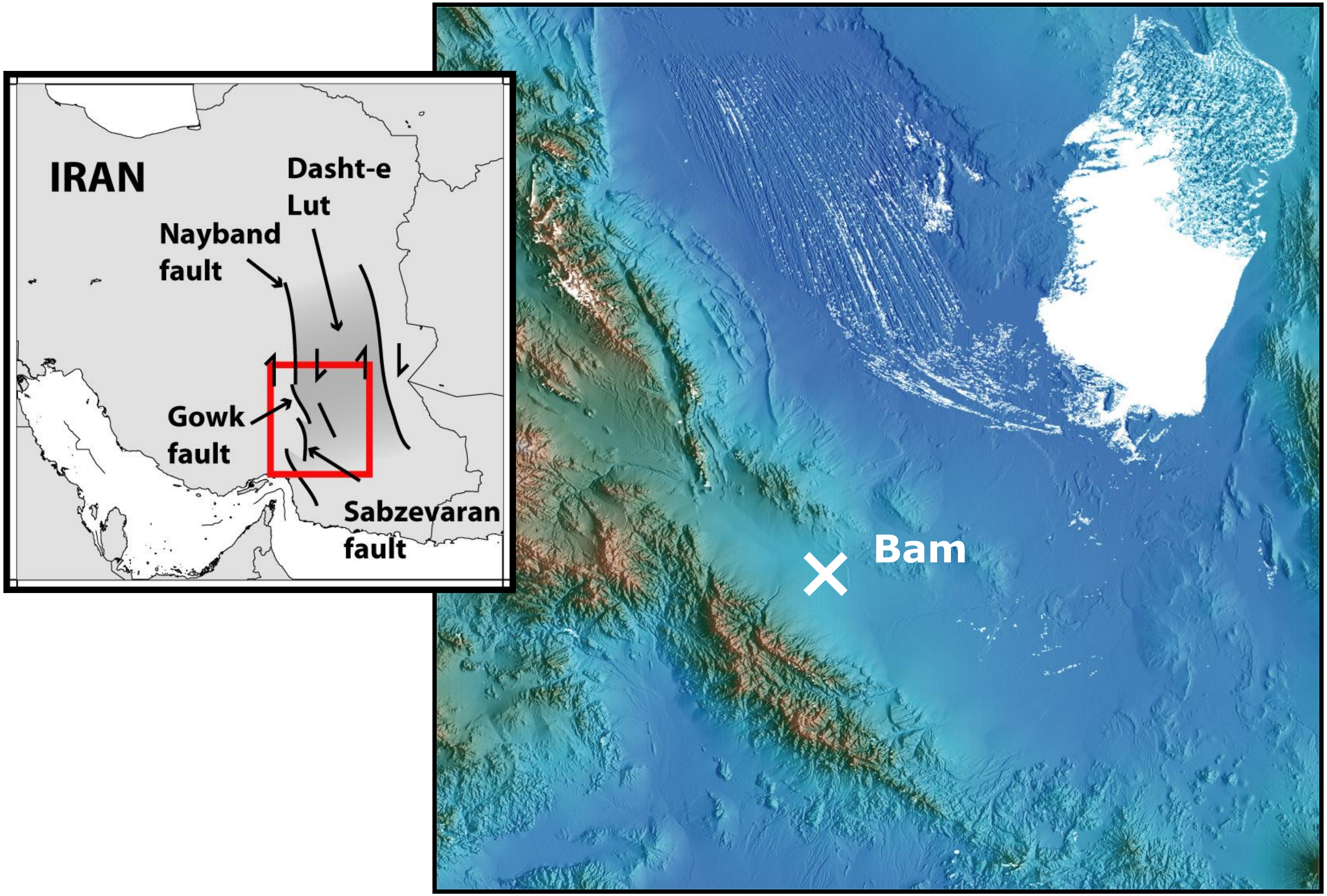
The 2003 Bam, Iran earthquake




• 26th December 2003, 5.26 am local time
• M_w 6.6
• Official death toll 26,000 (some estimates 40,000+)
• Peak ground acceleration 0.97 g in city centre
• S-P time 1.9 s in city centre (i.e. 14 km from hypocentre)

Tectonic setting

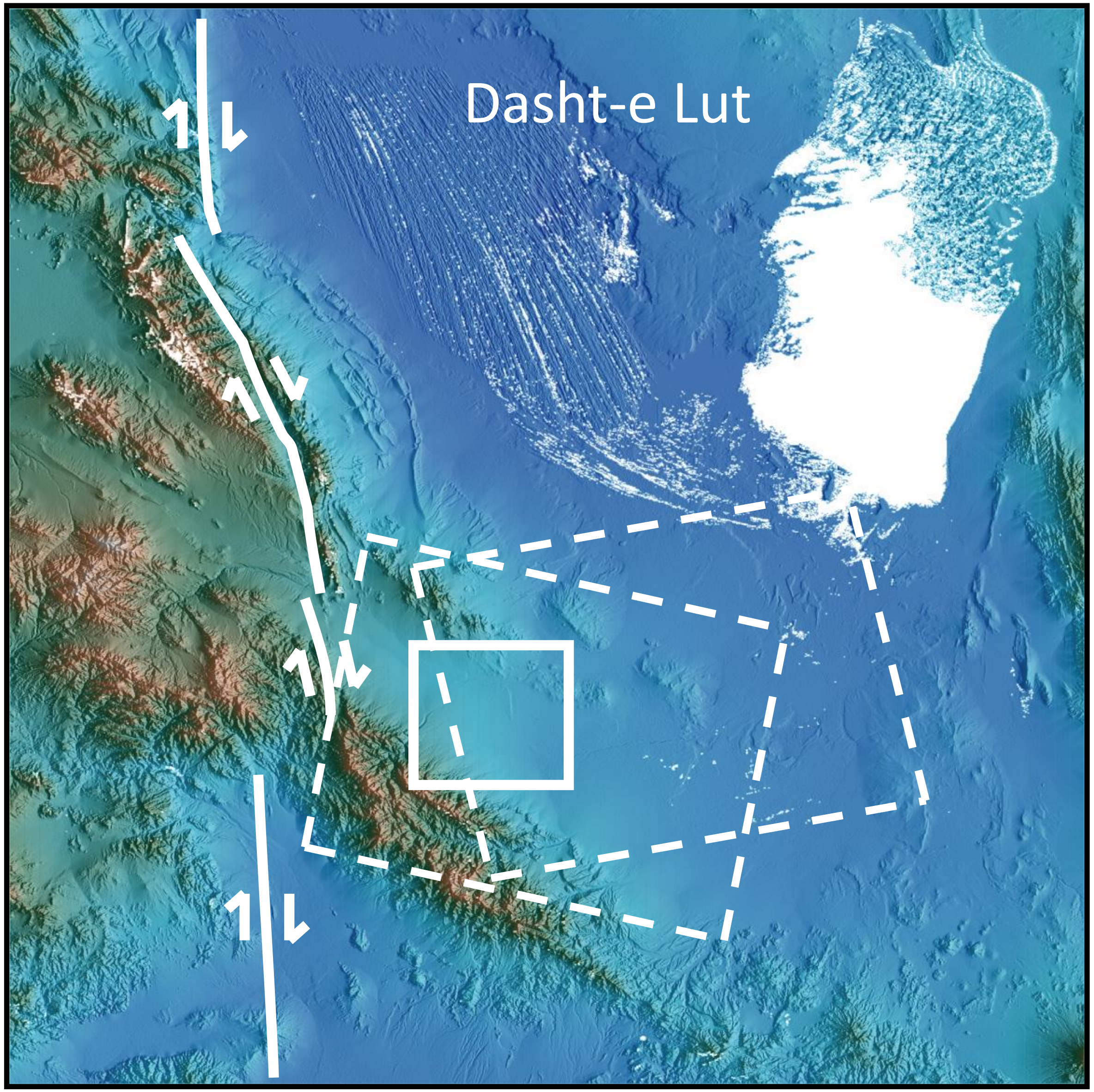


Tectonic setting

Nayband fault

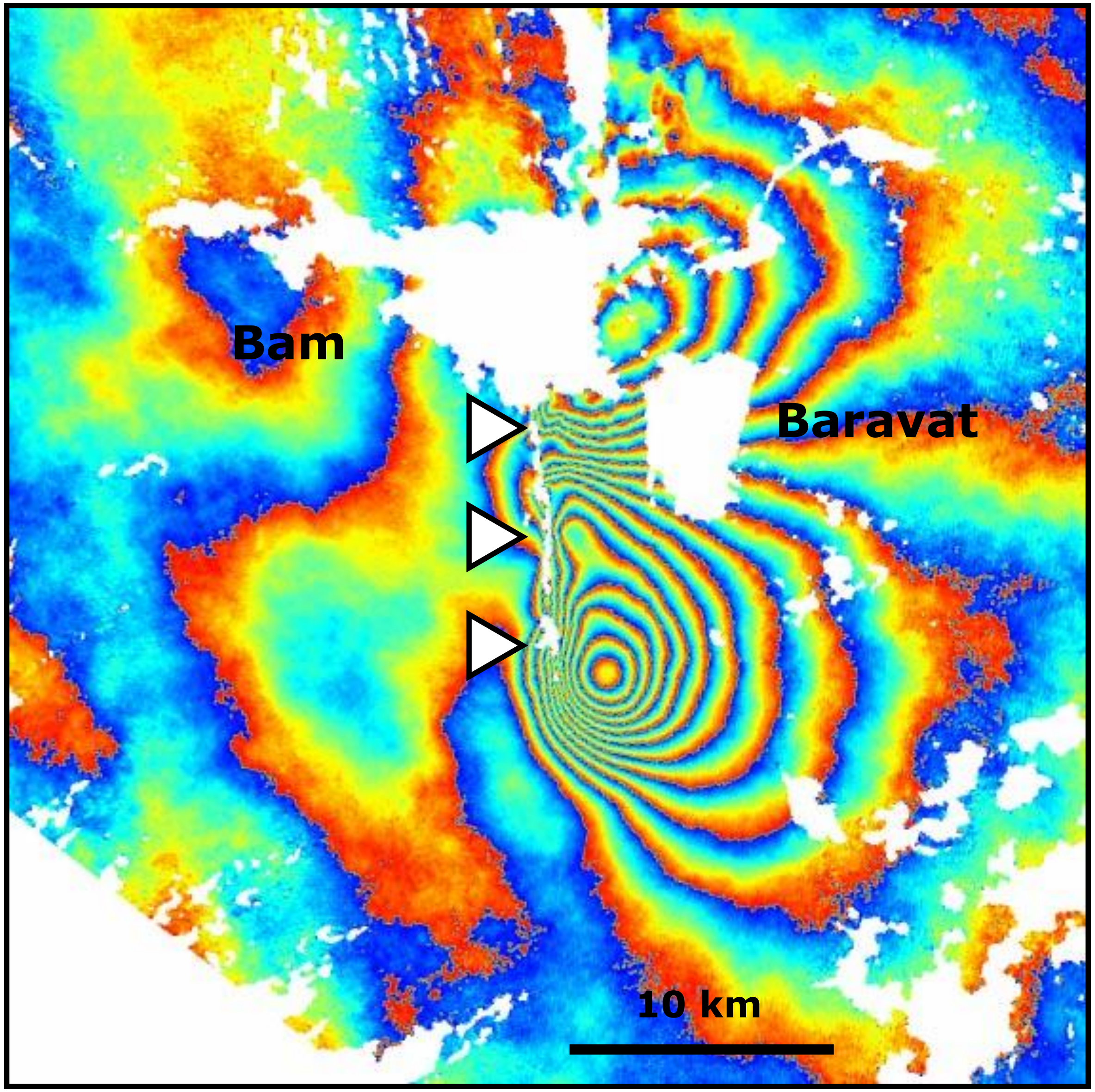
Gowk fault

Sabzevaran fault



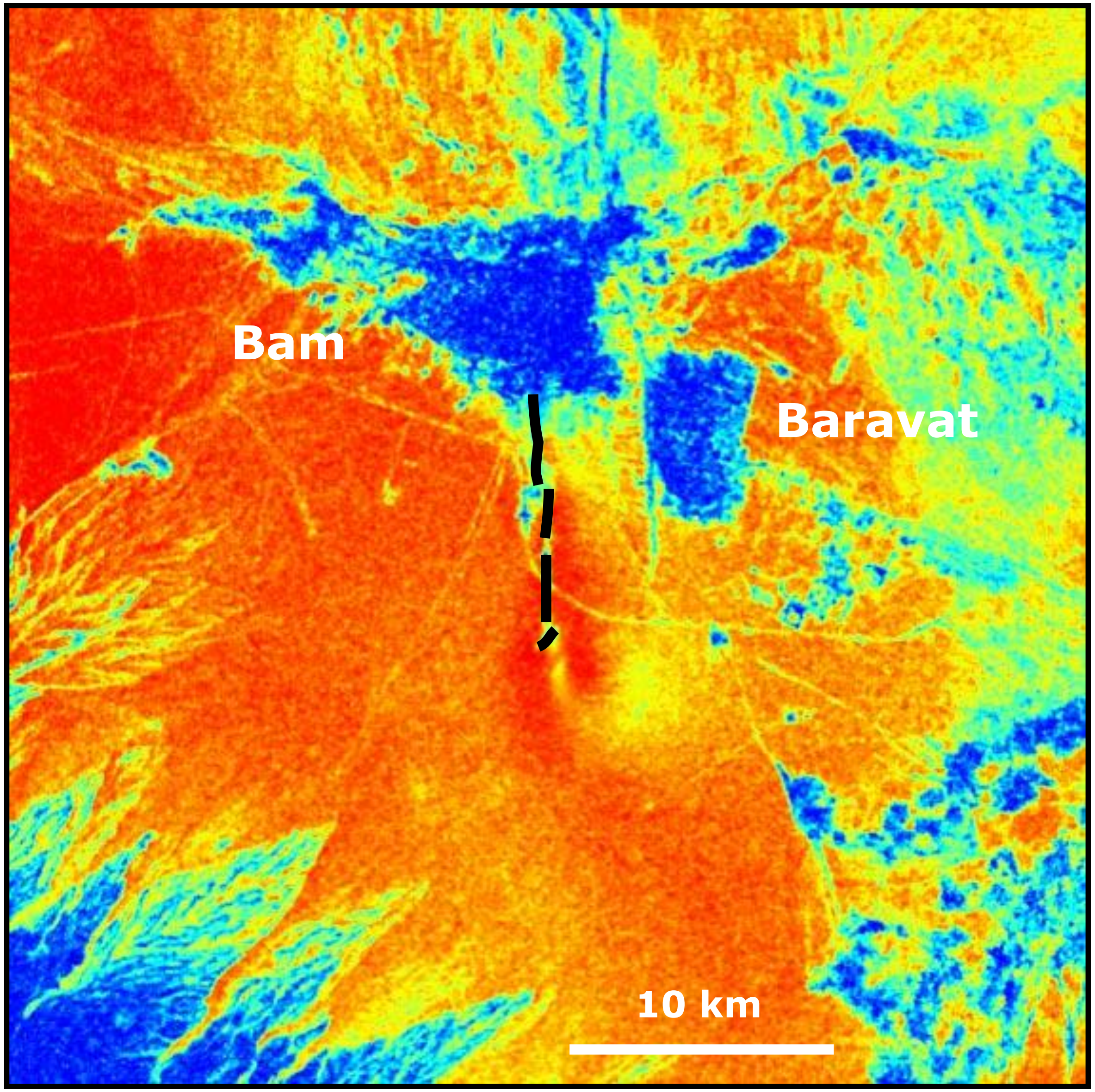
Preliminary InSAR data

There is a prominent band of incoherence running S of Bam

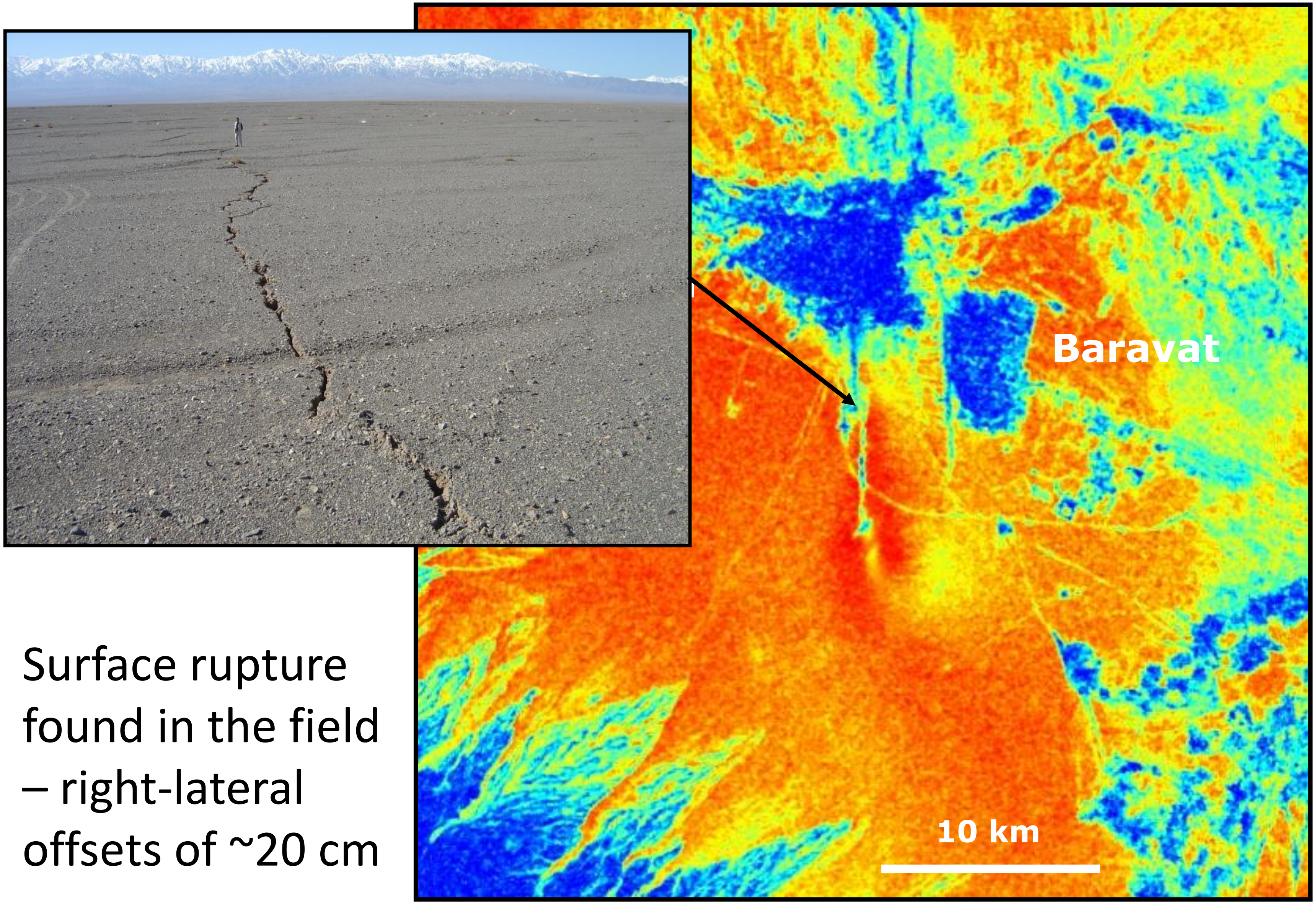


The Bam earthquake main fault

Low coherence indicates vegetation and surface damage

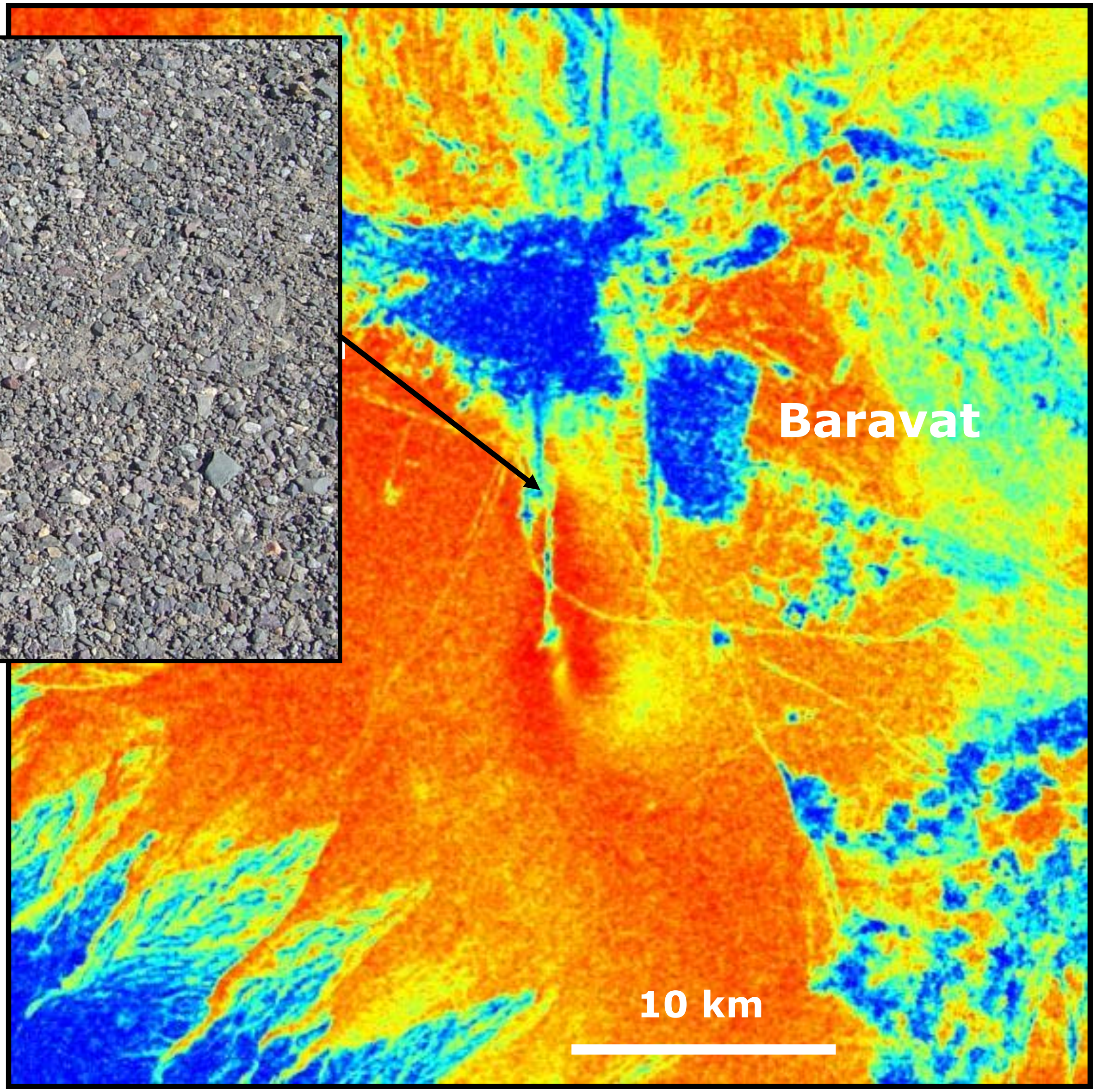


The Bam earthquake main fault



Surface rupture found in the field – right-lateral offsets of ~20 cm

The Bam earthquake main fault

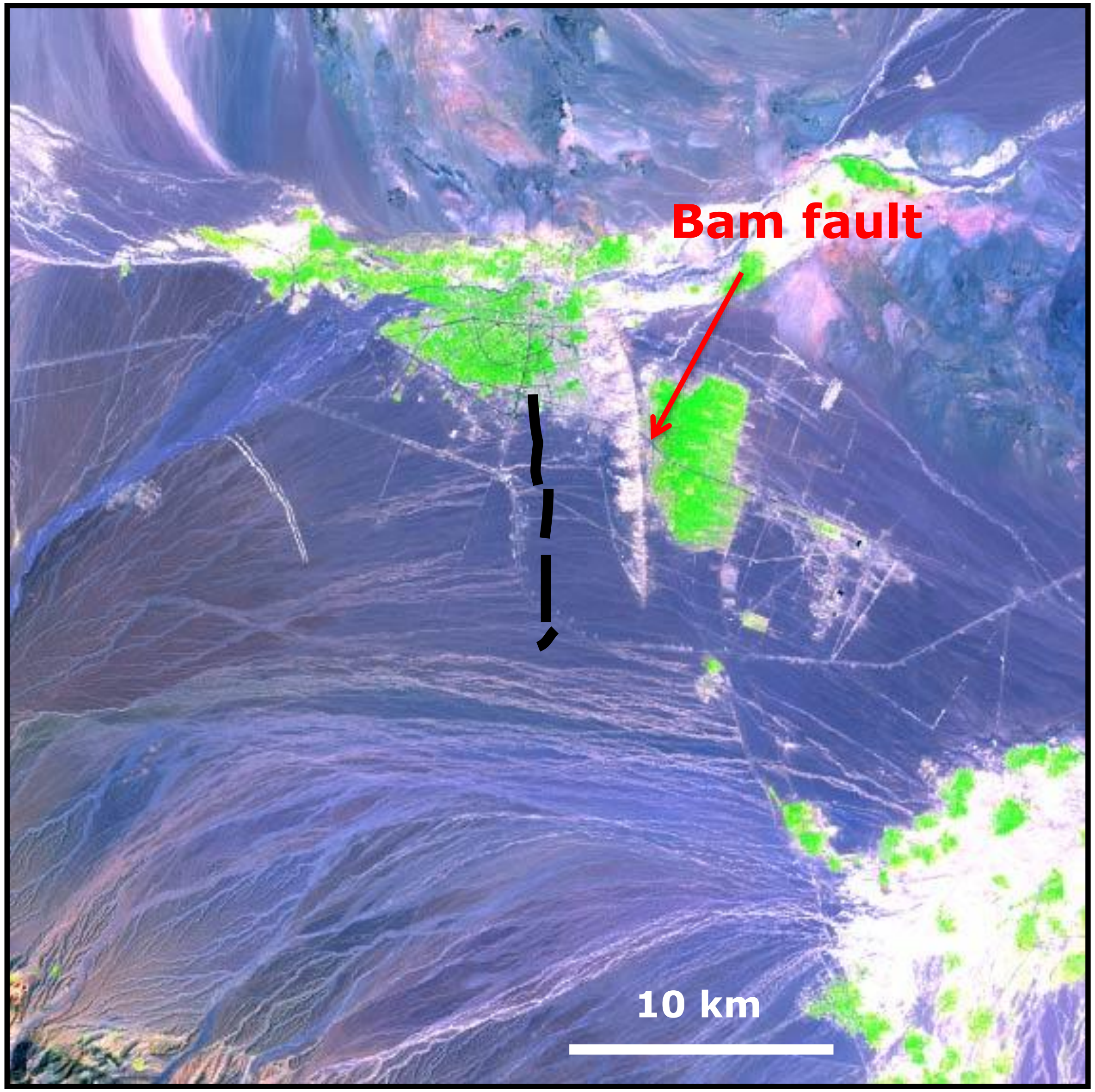


Surface rupture found in the field – right-lateral offsets of ~20 cm

The Bam earthquake main fault

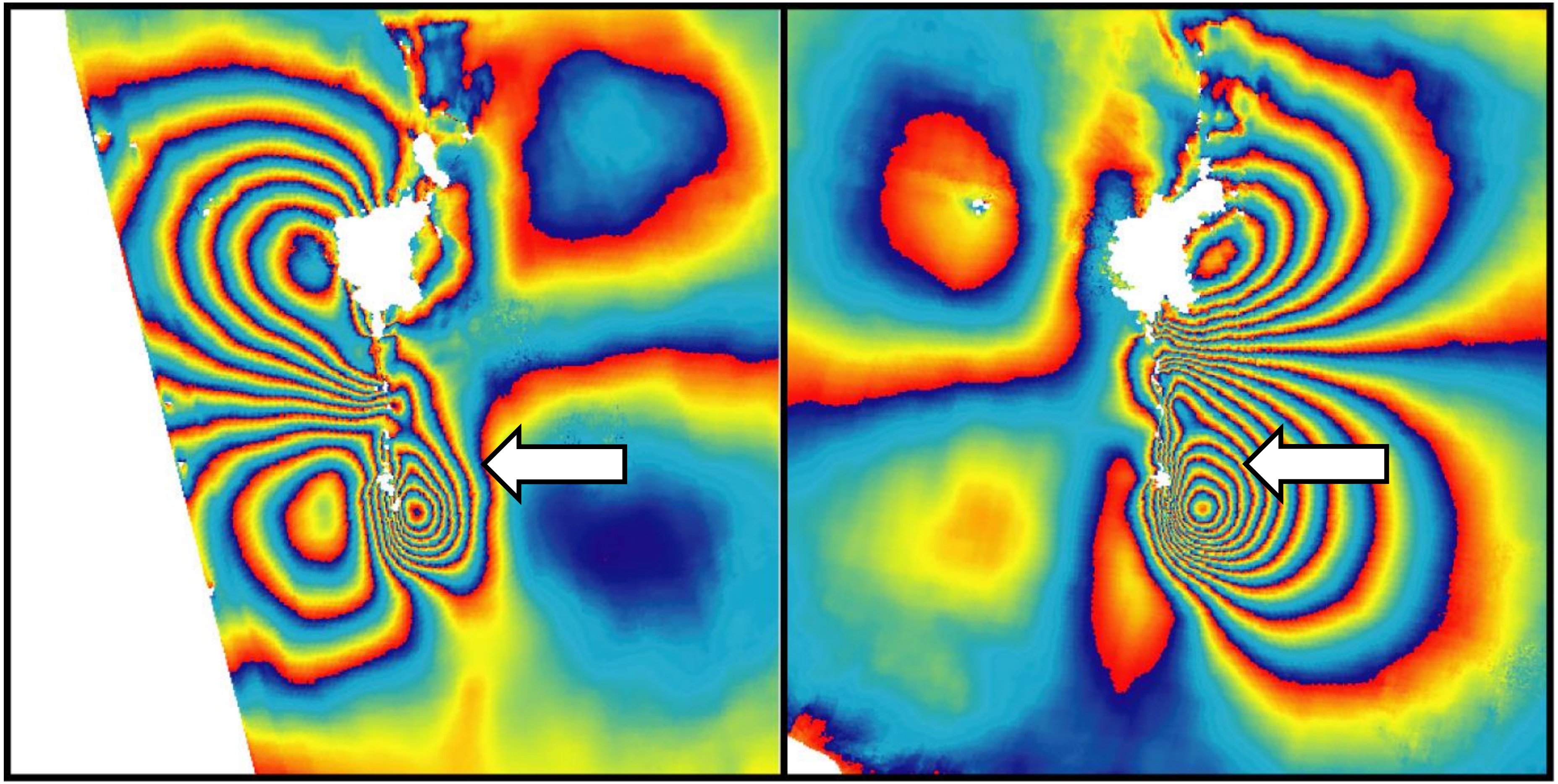
Main fault is
4 km west of the
'Bam fault'

There are no surface features corresponding to this fault – we didn't know it existed



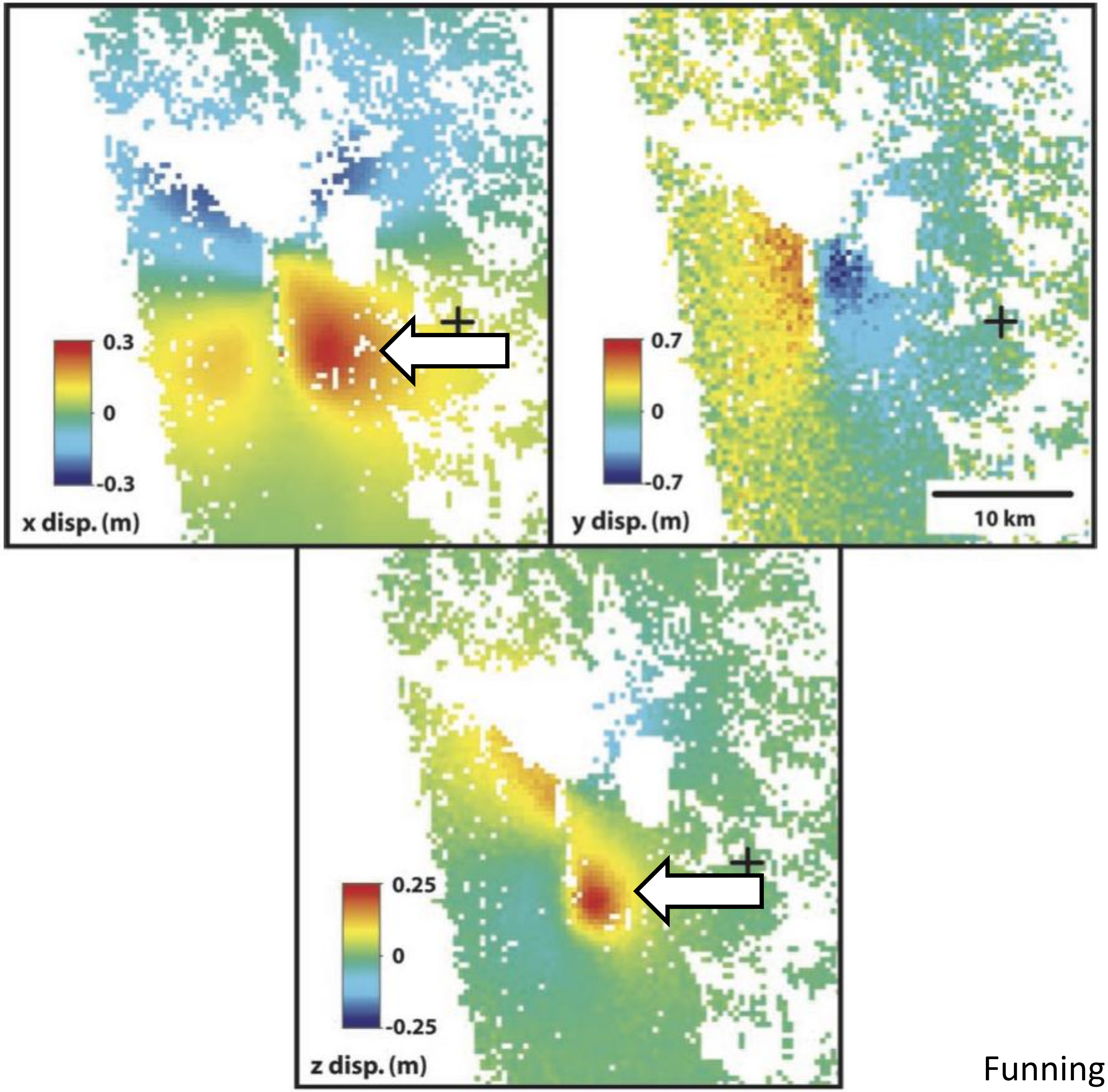
Coseismic interferograms

There is an 'extra' amount of displacement in the SE quadrant



Ascending interferogram

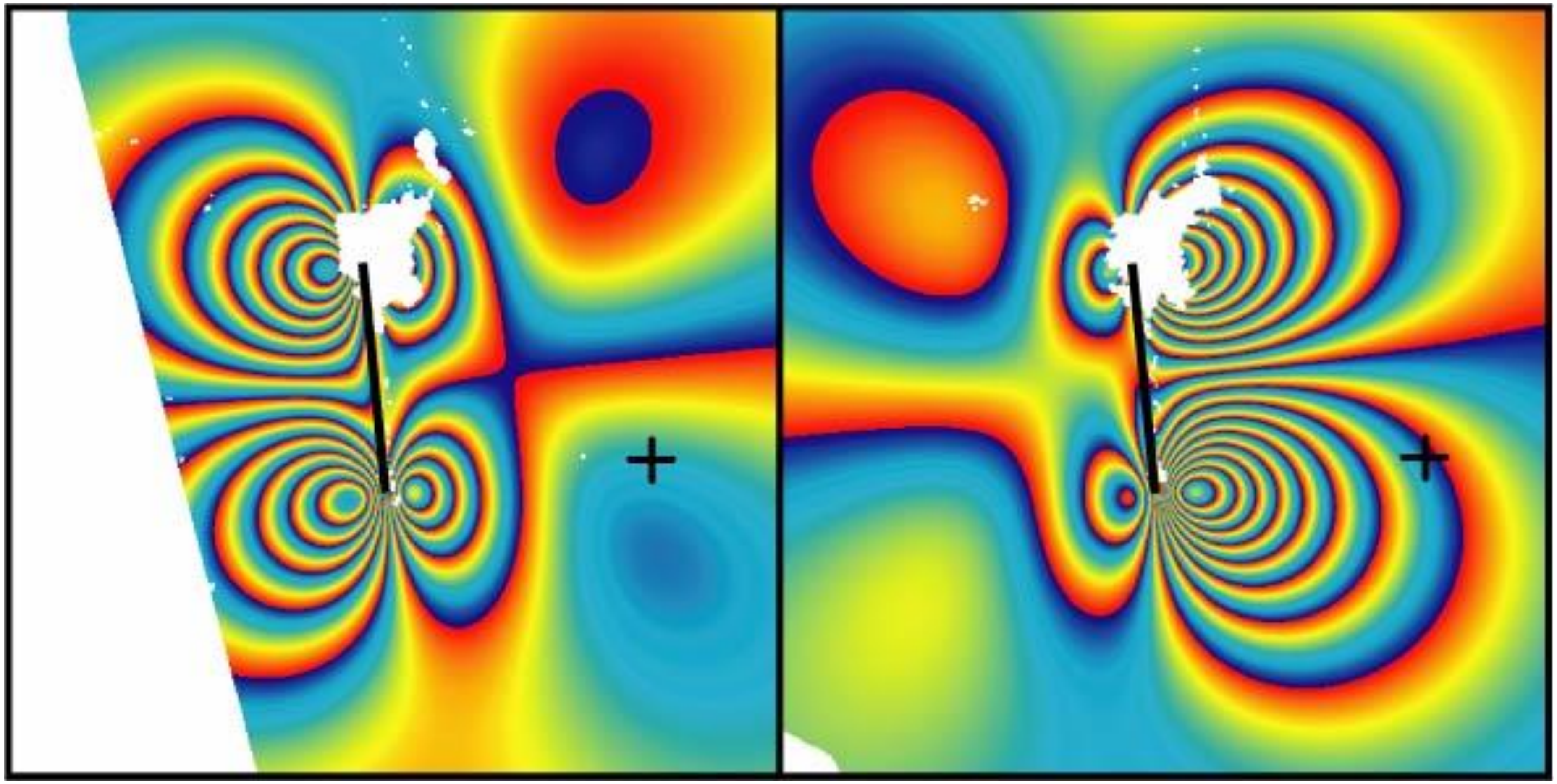
Descending interferogram



Funning et al., 2005

Single fault model

Strike 354 dip 84 rake -177 slip 2.2m length 12km top 1.1km b’m 9.3km



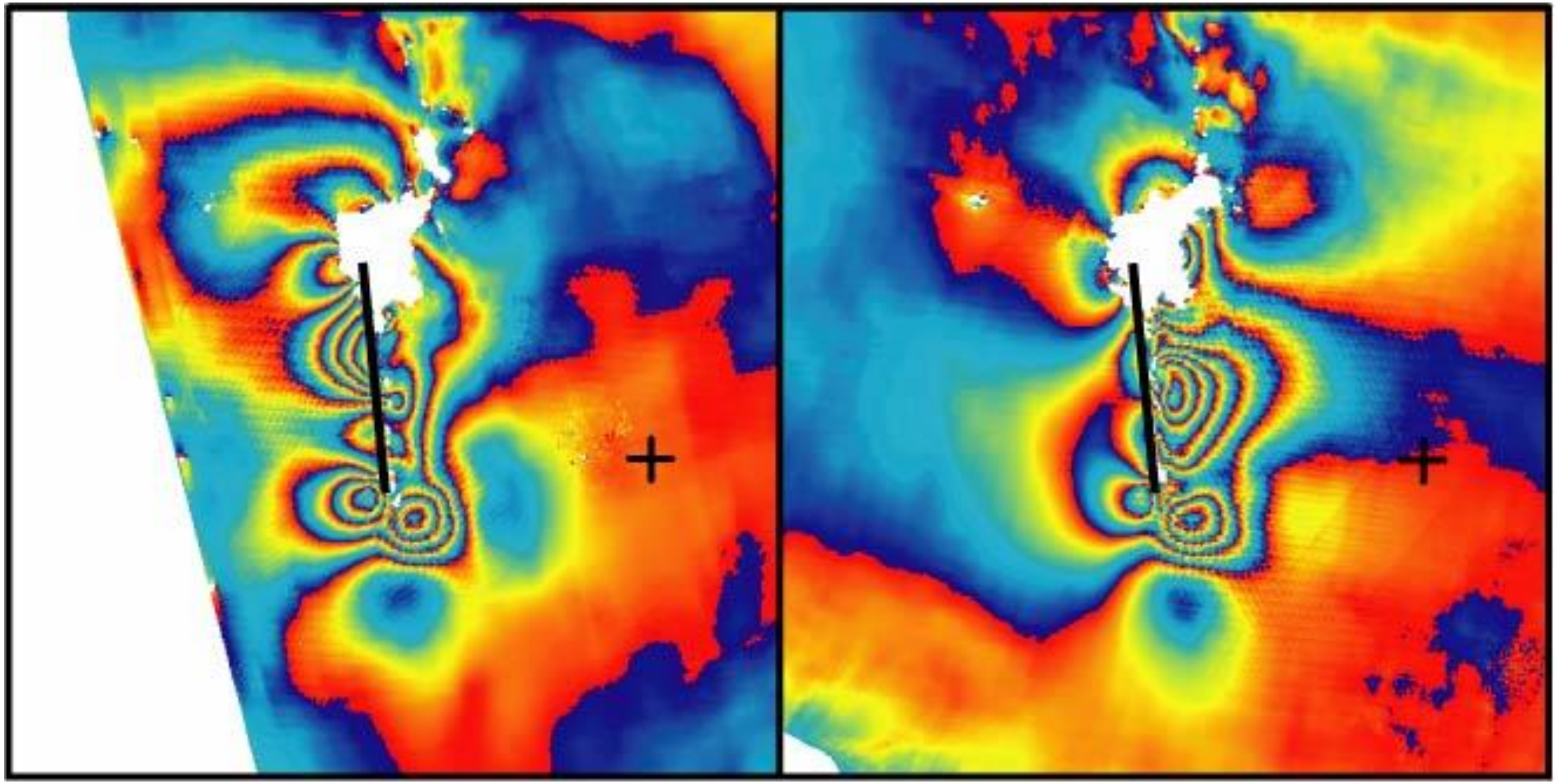
Ascending model

Descending model

Funning et al., 2005

Single fault model

Large residuals, especially in SE quadrant (rms = 25 mm)



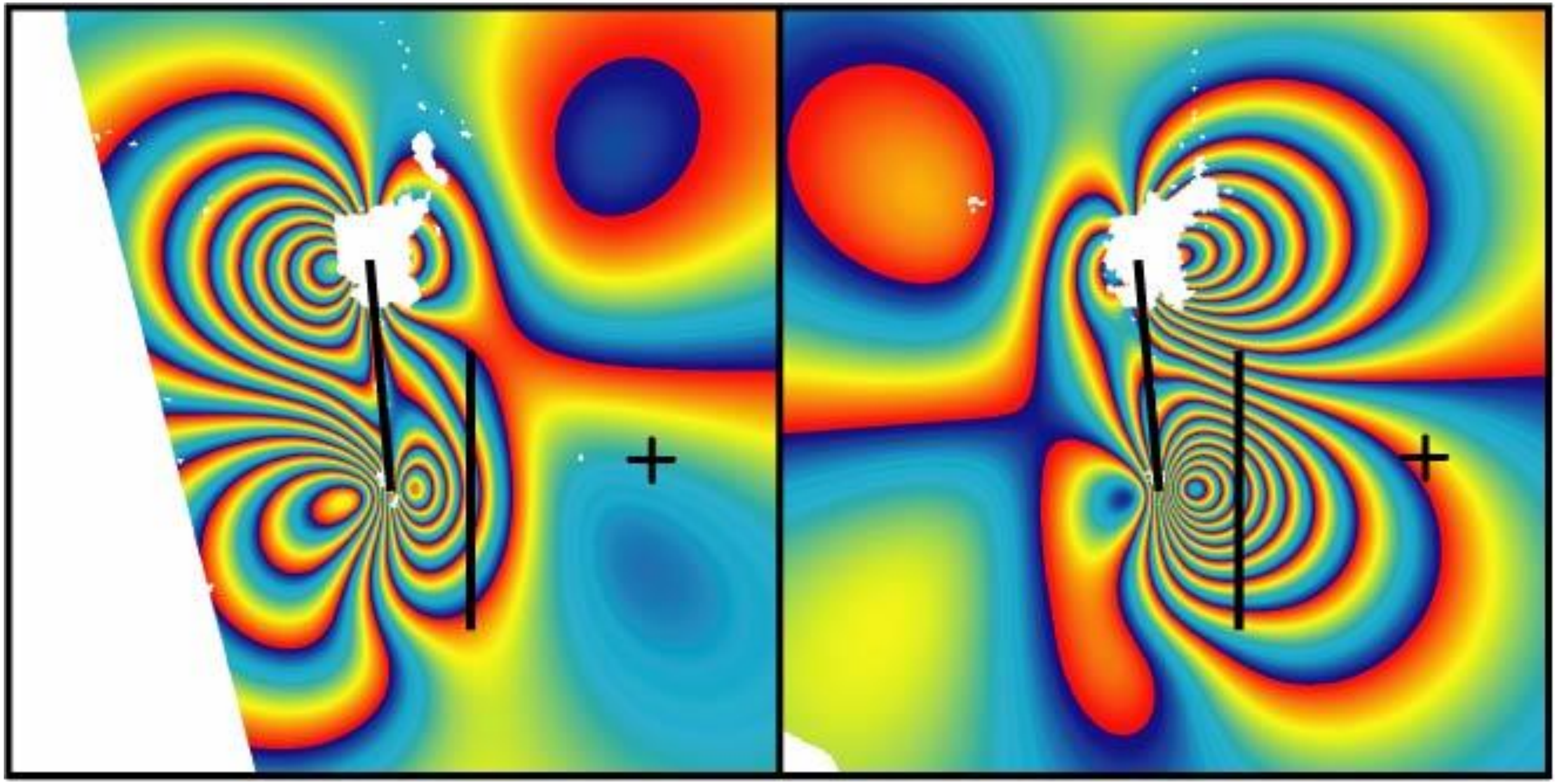
Ascending residual

Descending residual

Funning et al., 2005

Two fault model (uniform slip)

A 'teardrop' feature is reproduced in the SE



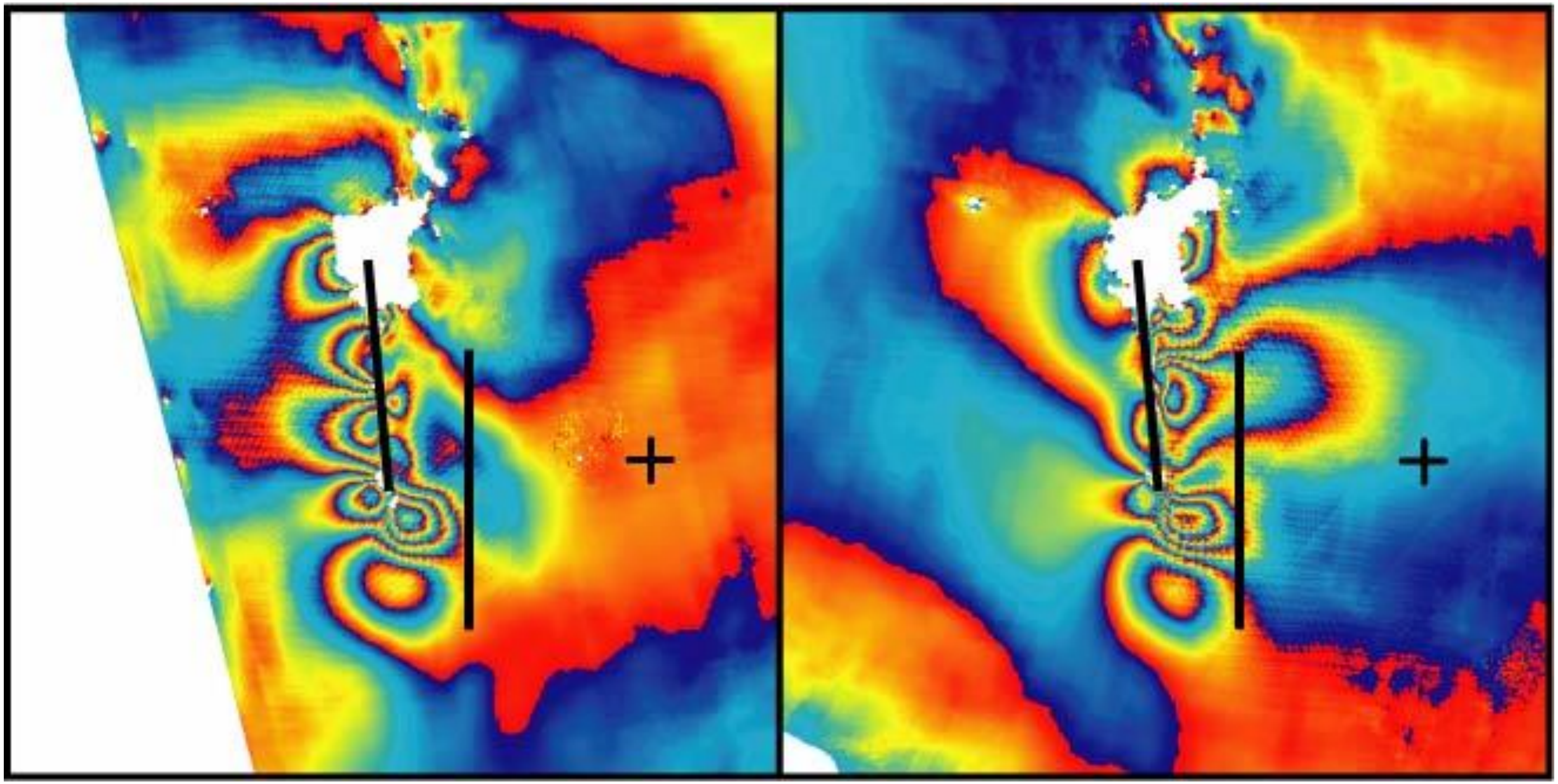
Ascending model

Descending model

Funning et al., 2005

Two fault model (uniform slip)

Improved fit in SE quadrant (rms = 17 mm)

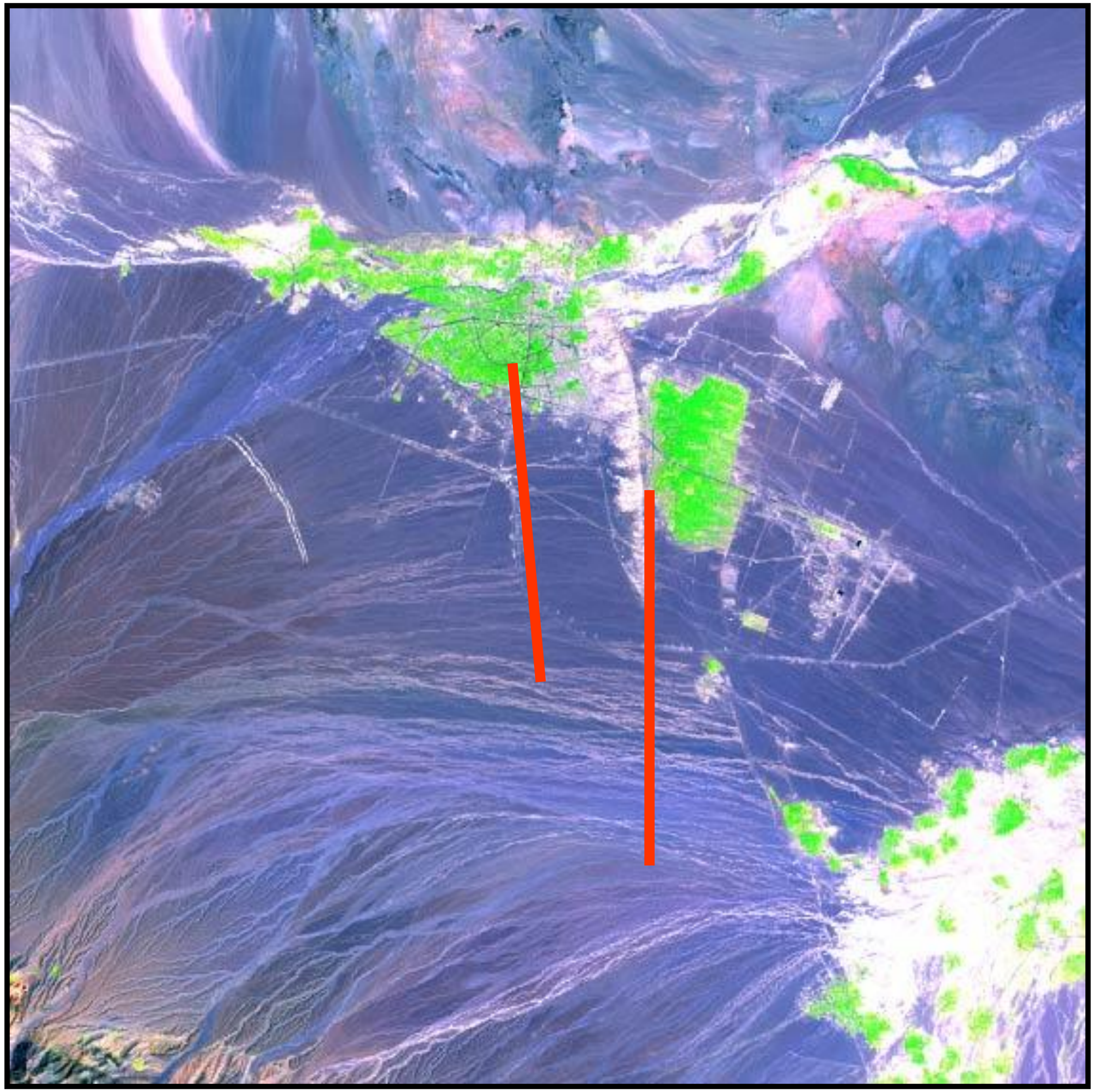


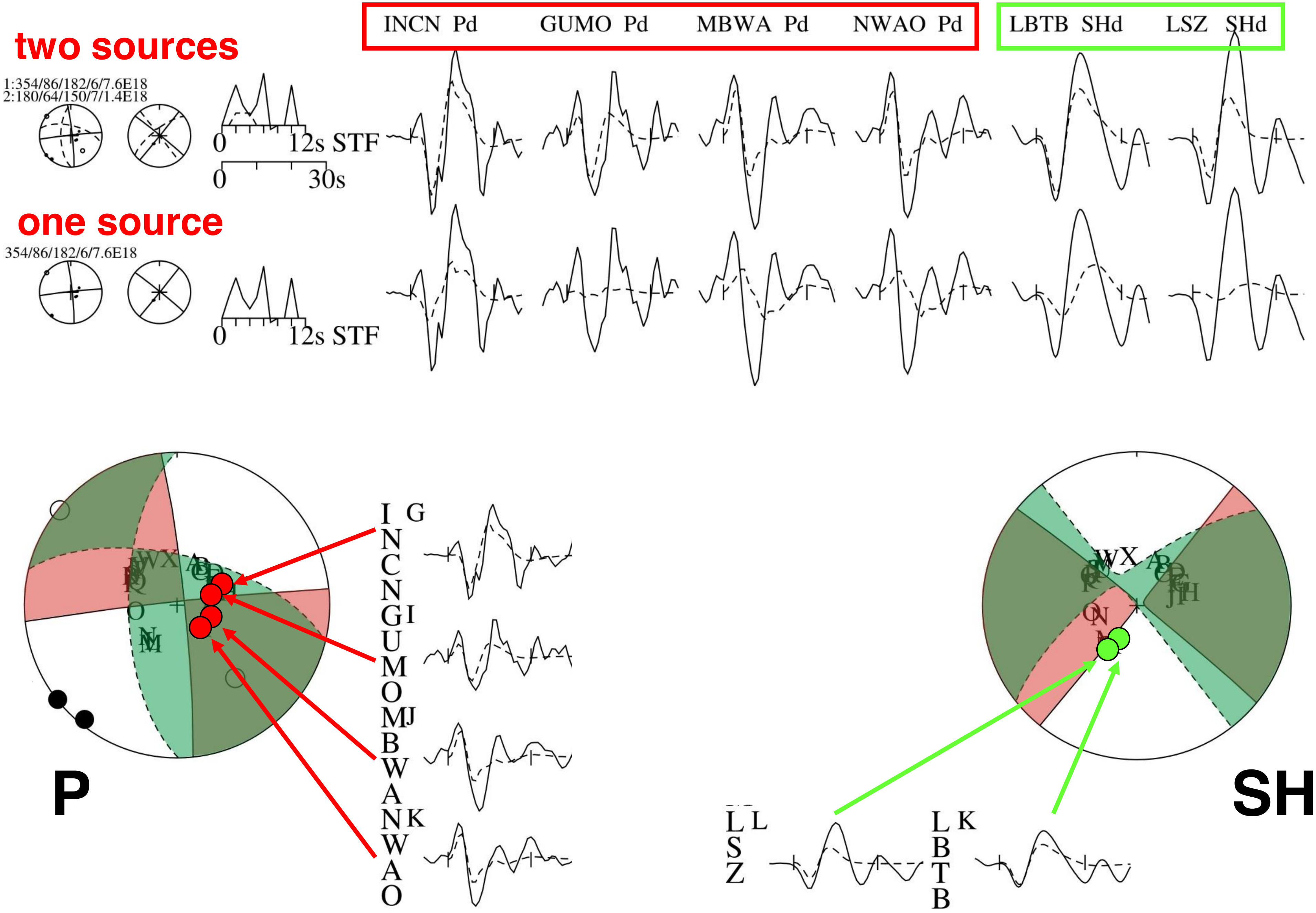
Ascending residual Descending residual

Funning et al., 2005

Two fault model (uniform slip)

Secondary fault appears to be a southward continuation of the Bam fault



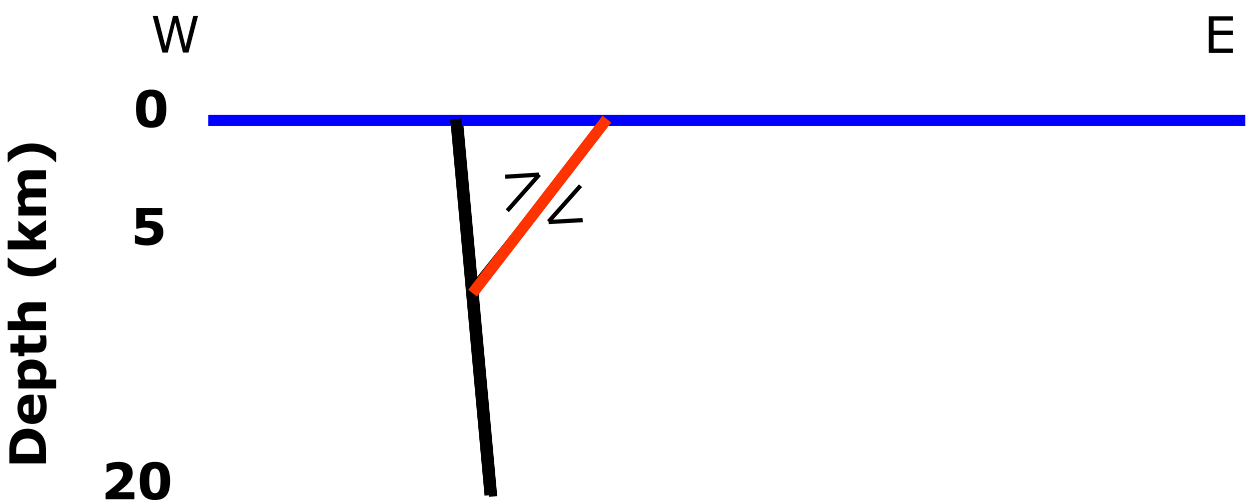


Jackson et al., 2006

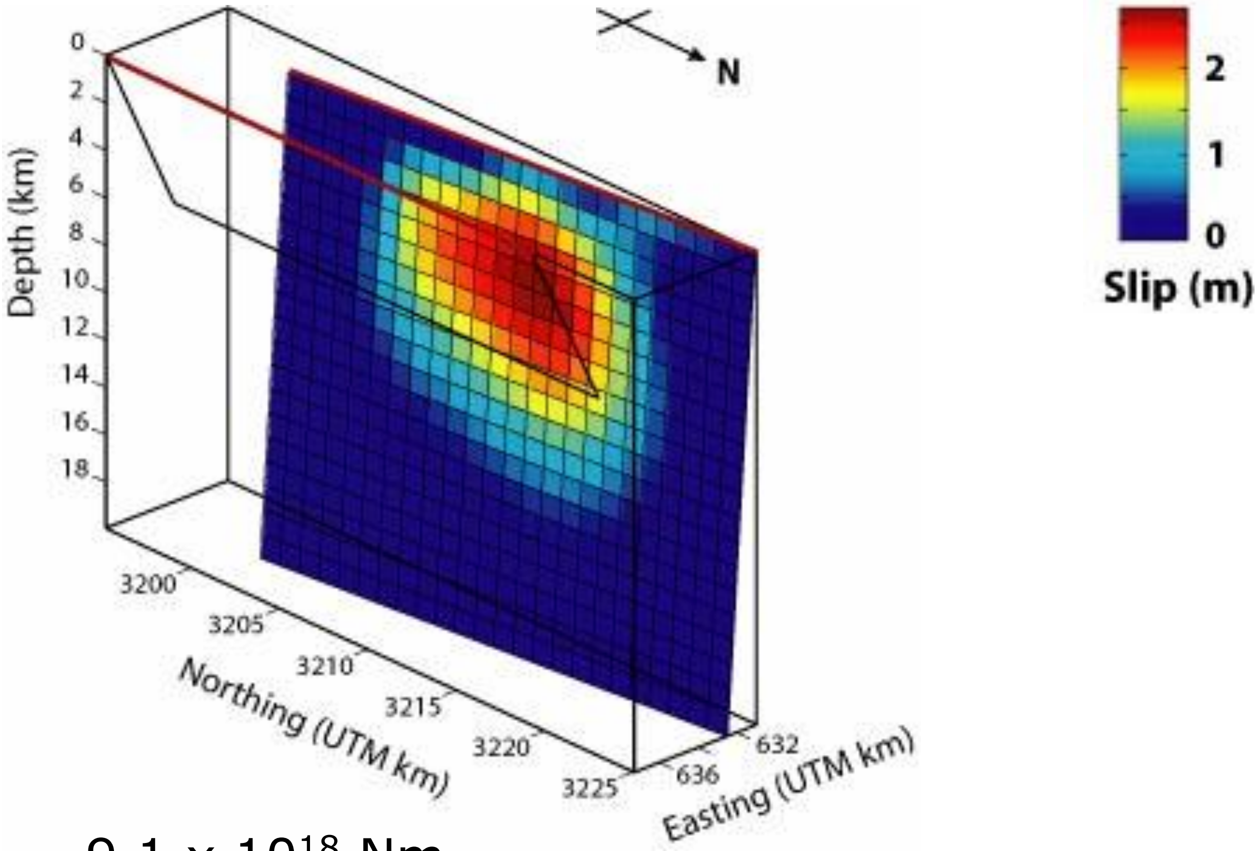
Variable slip modelling

Main fault: 24 km long, 20 km wide, 1 x 1 km patches

Secondary fault: 24 km long, 8 km wide, 1 x 1 km patches



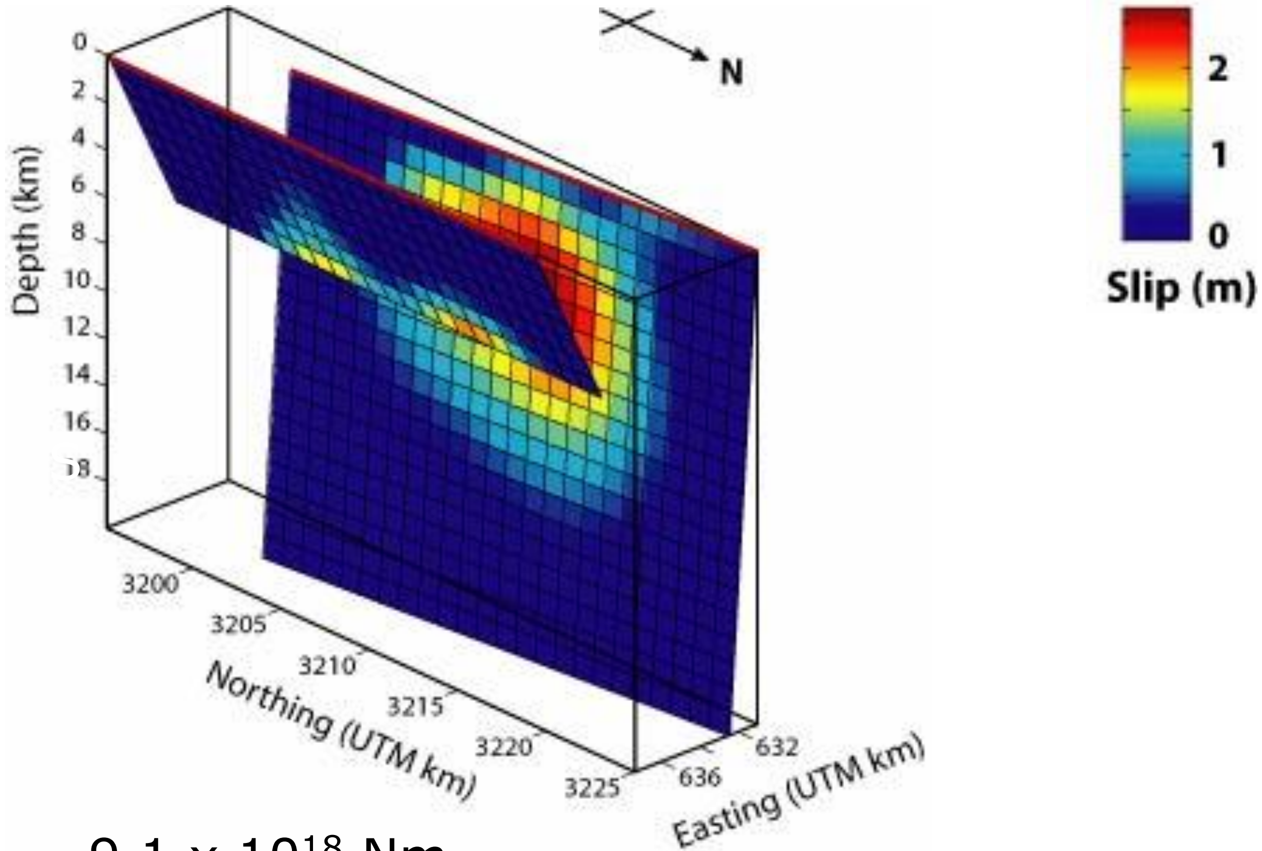
Variable slip model



Main fault, $M_0 = 9.1 \times 10^{18}$ Nm

Funning et al., 2005

Variable slip model

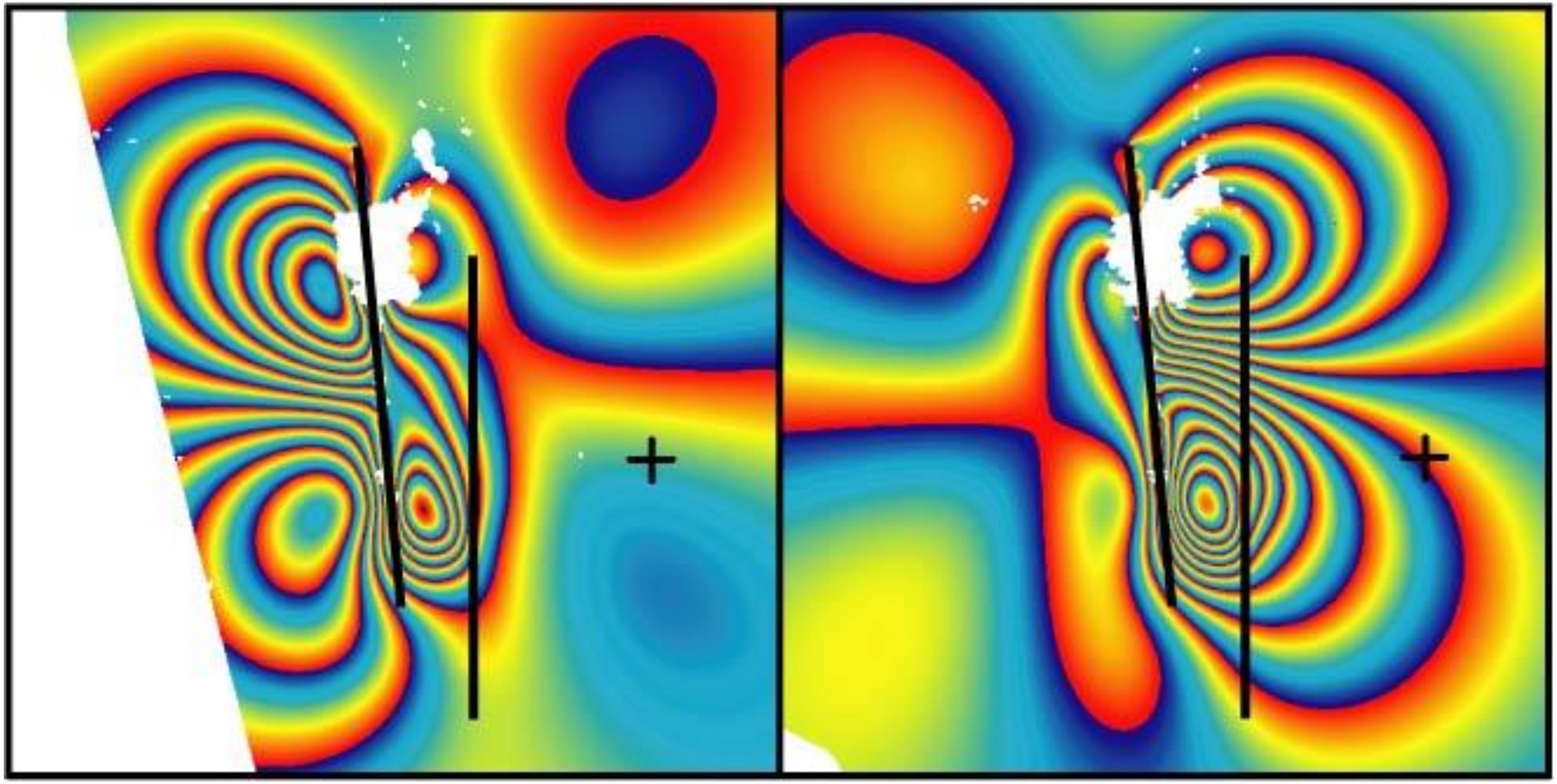


Main fault, M_0 = 9.1 x 10^{18} Nm

Secondary fault, M_0 = 1.6 x 10^{18} Nm

Funning et al., 2005

Variable slip model



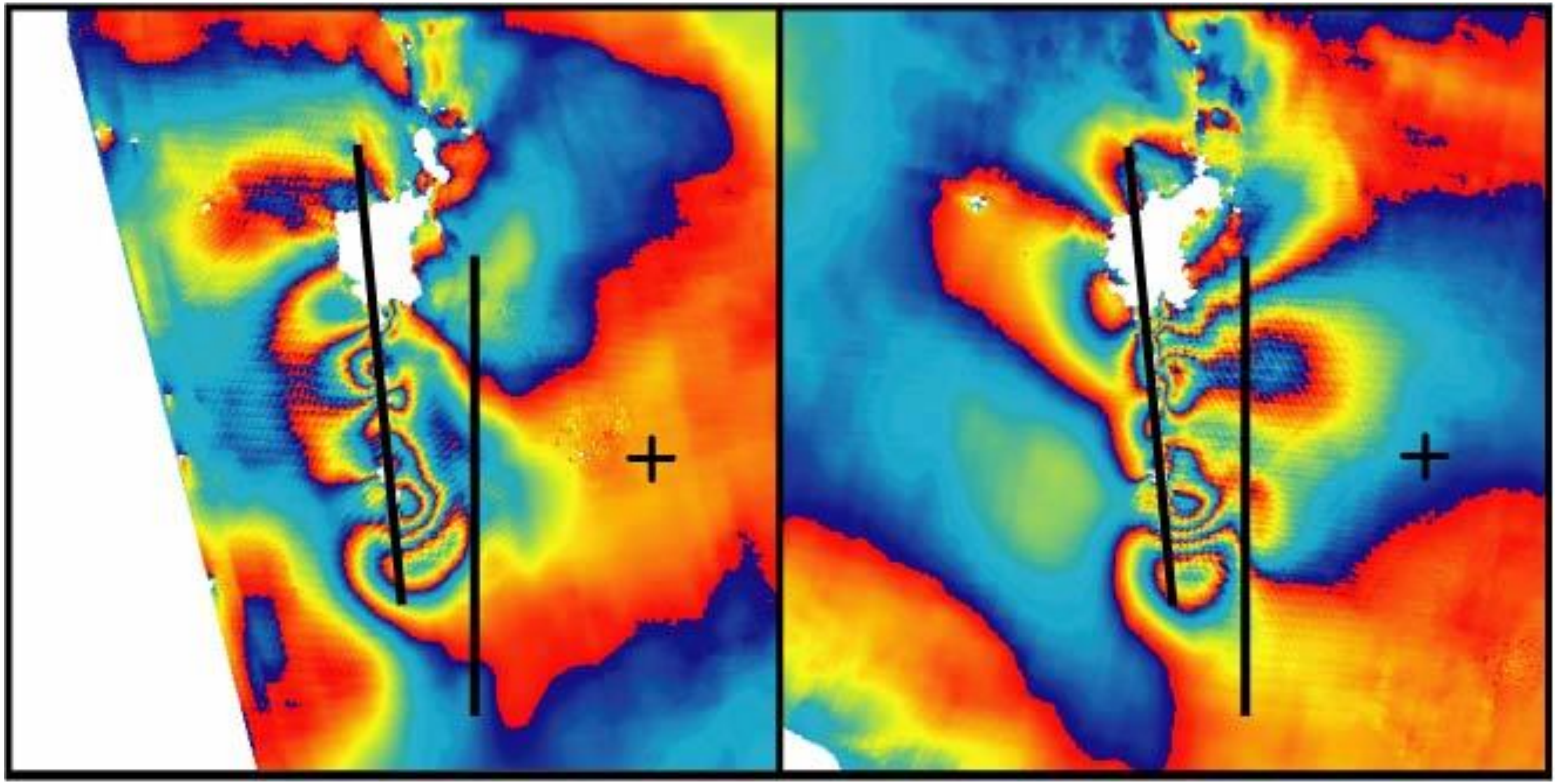
Ascending model

Descending model

Funning et al., 2005

Variable slip model

Significantly improved fit (rms = 13 mm)

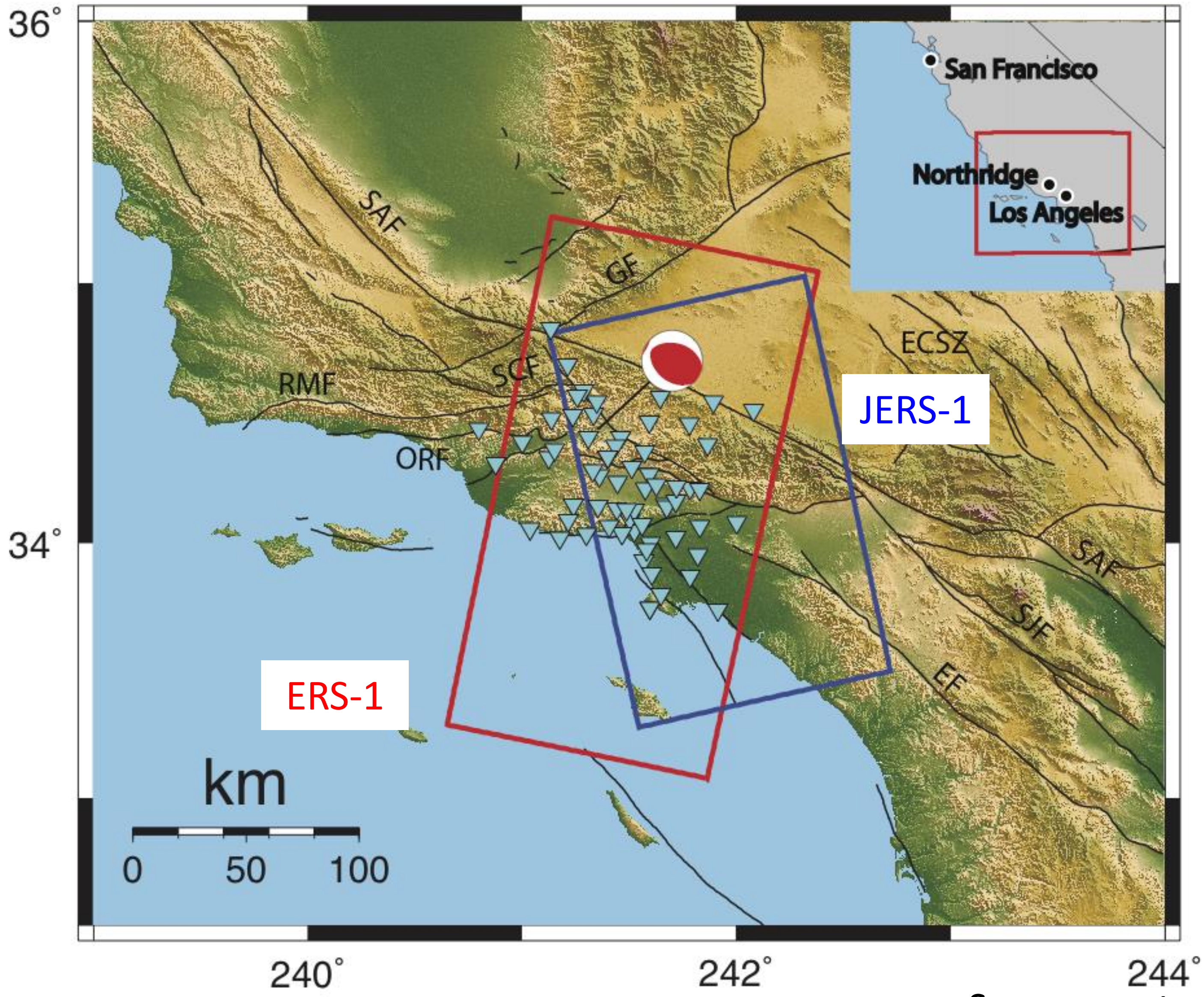


Ascending residual Descending residual

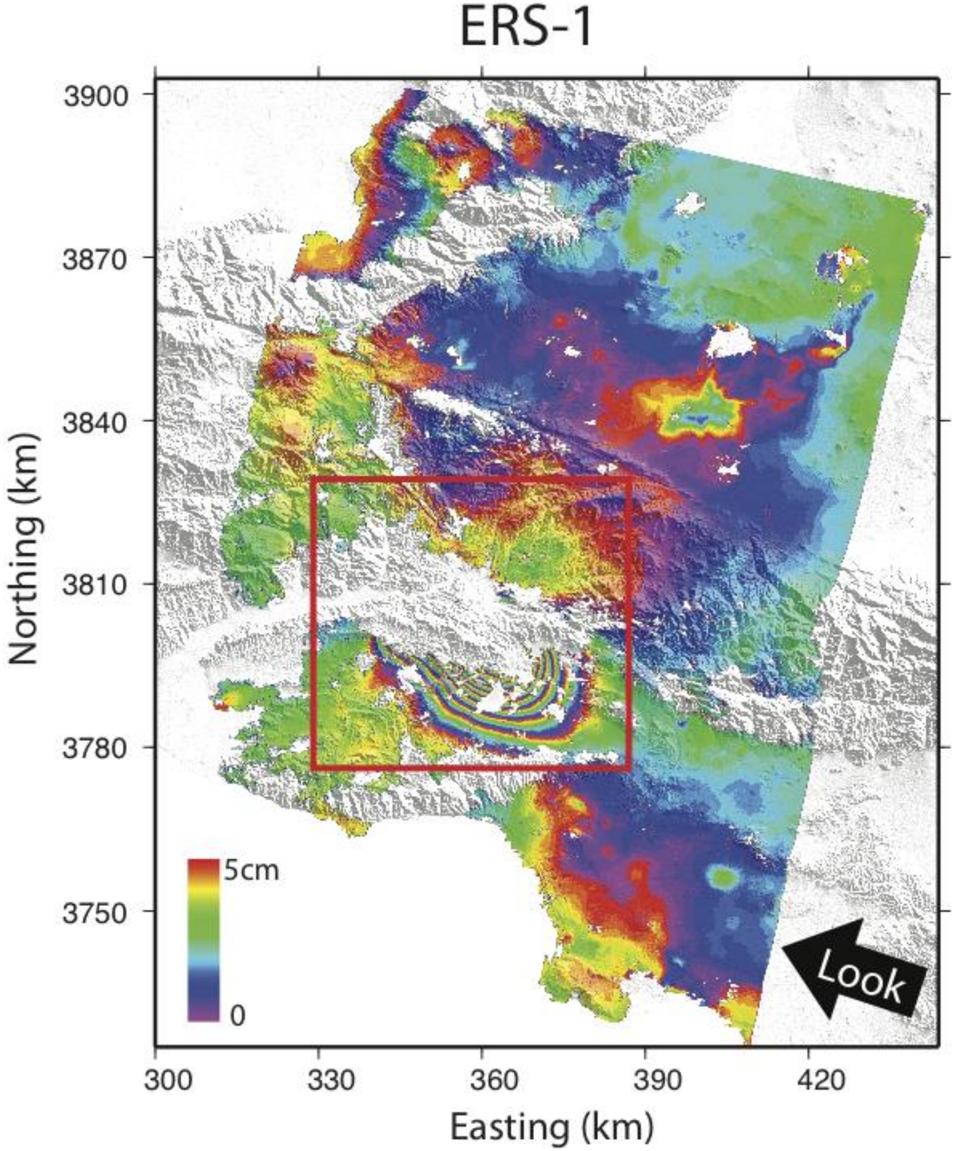
Funning et al., 2005

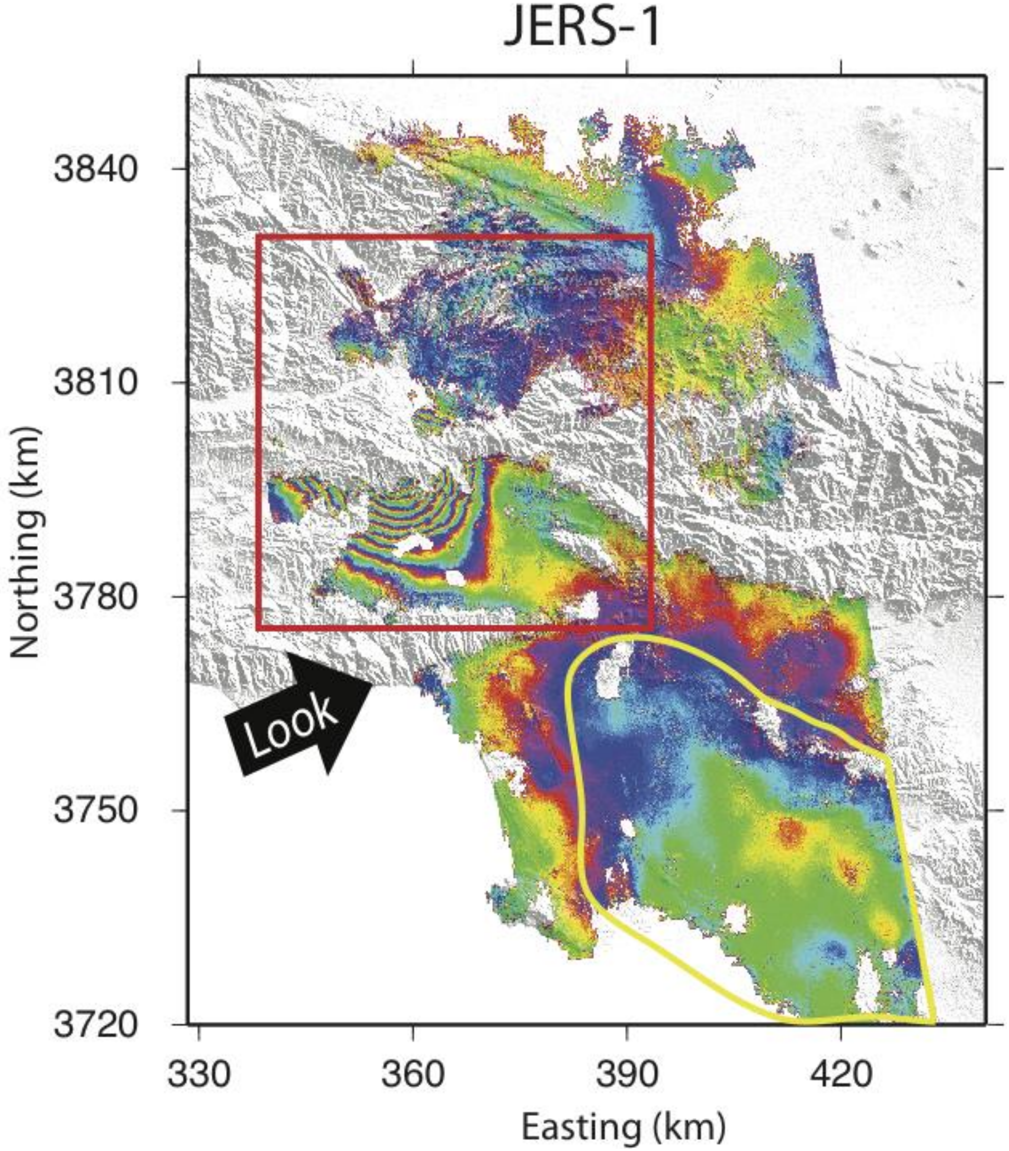
The 1994 Northridge, CA earthquake

The 1994 Northridge, CA earthquake



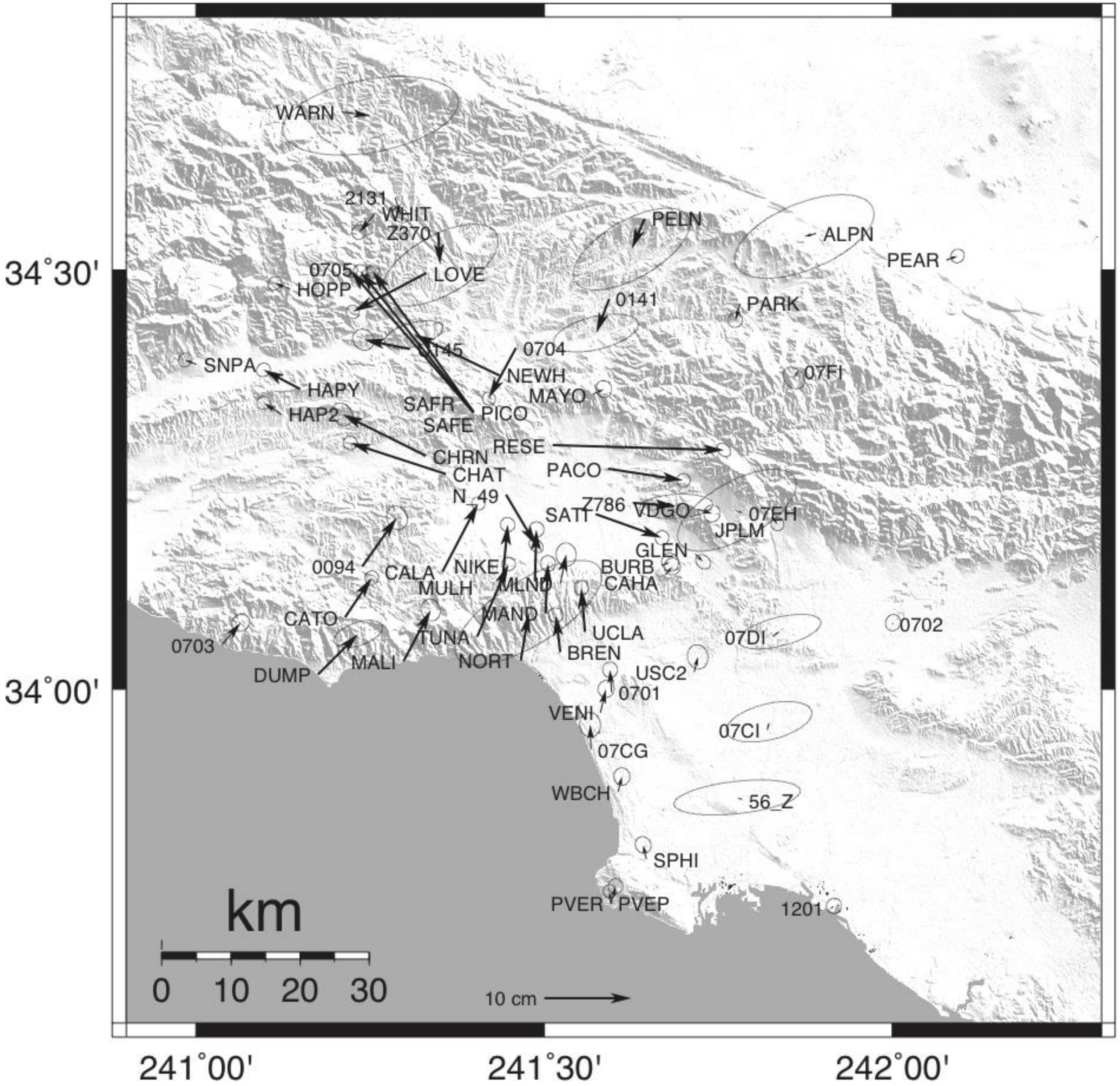
Severson et al., 2013, in prep



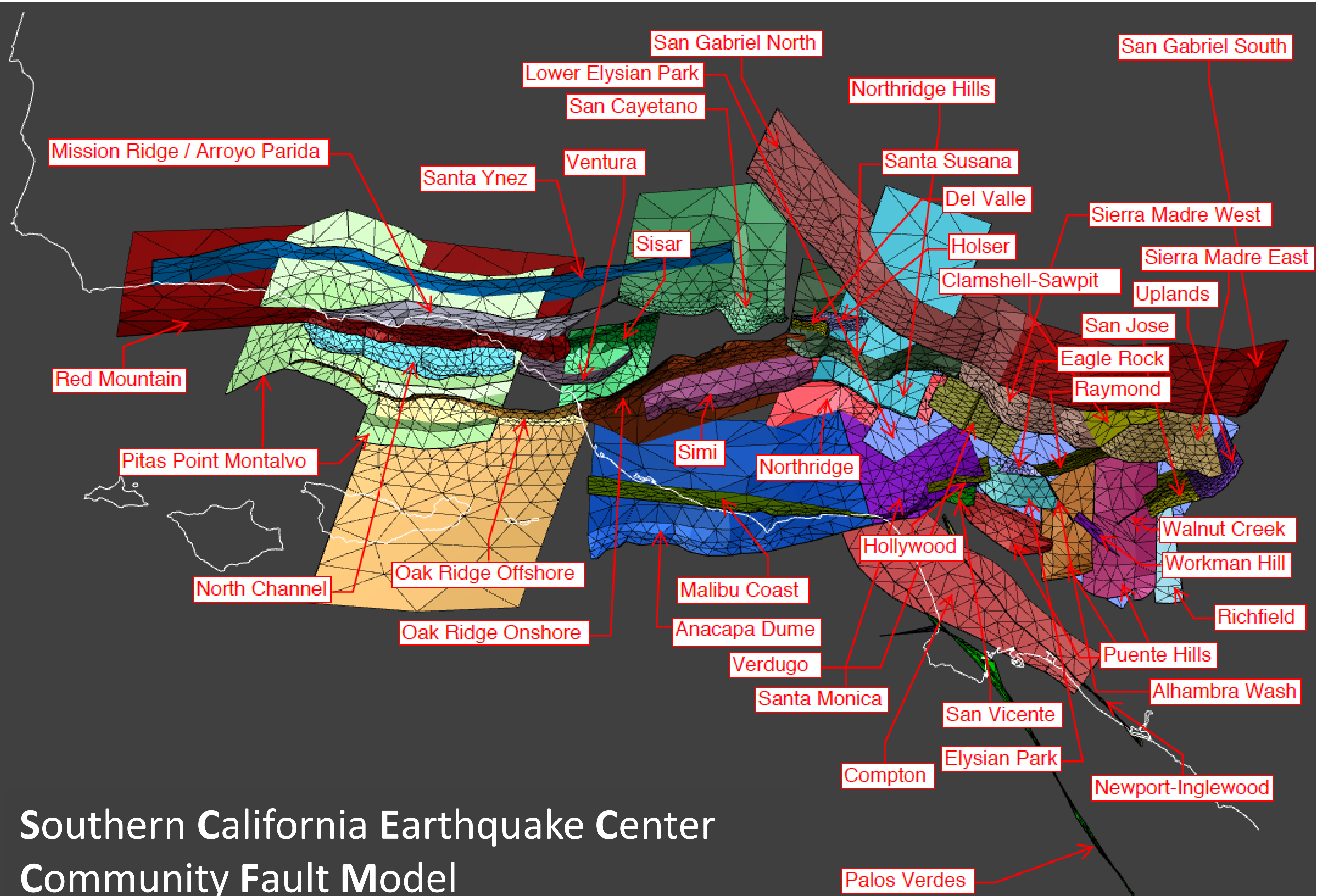


Rewrapped interferograms

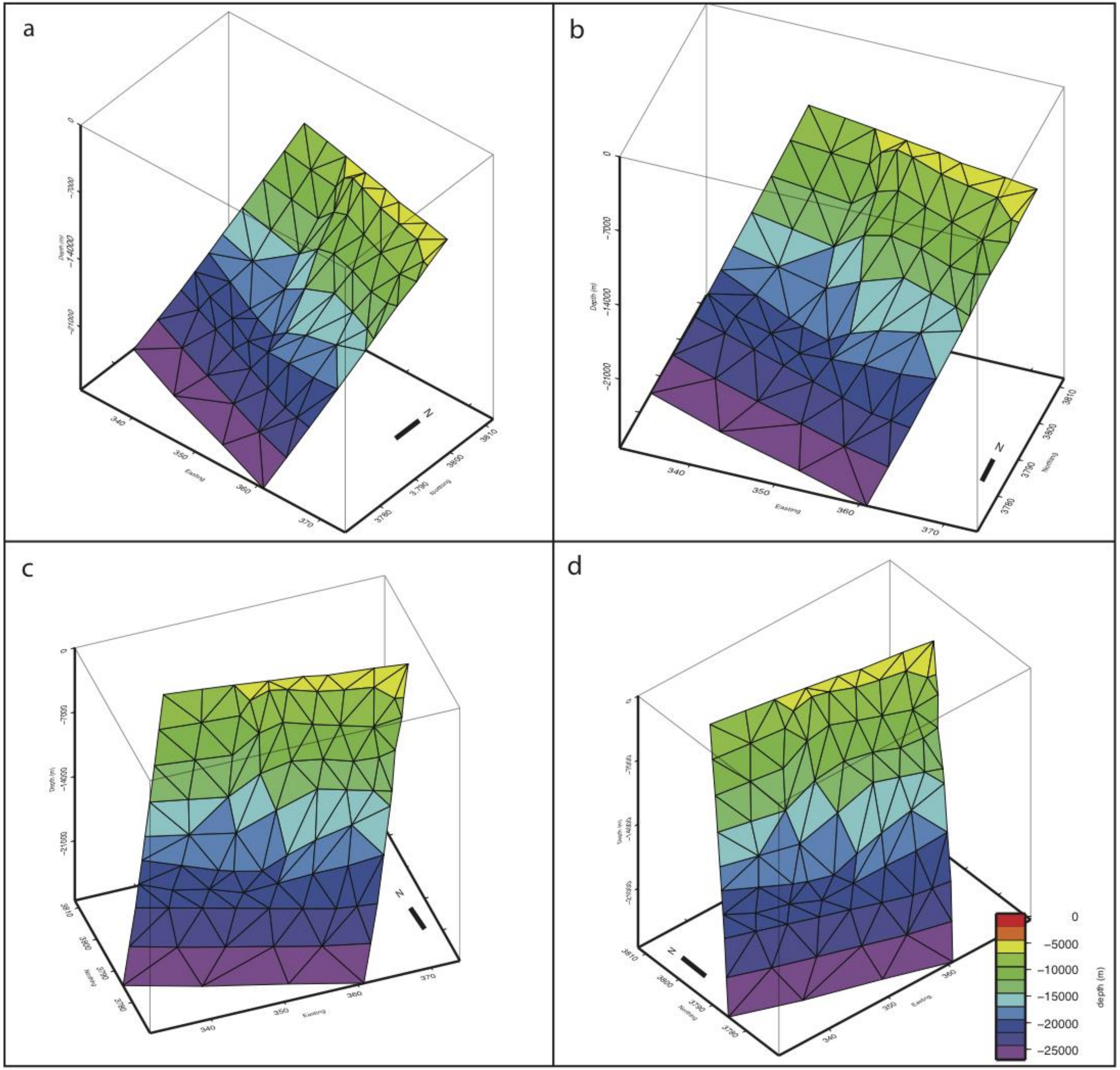
Severson et al., 2013, in prep



Campaign GPS data from Hudnut et al. (1996)



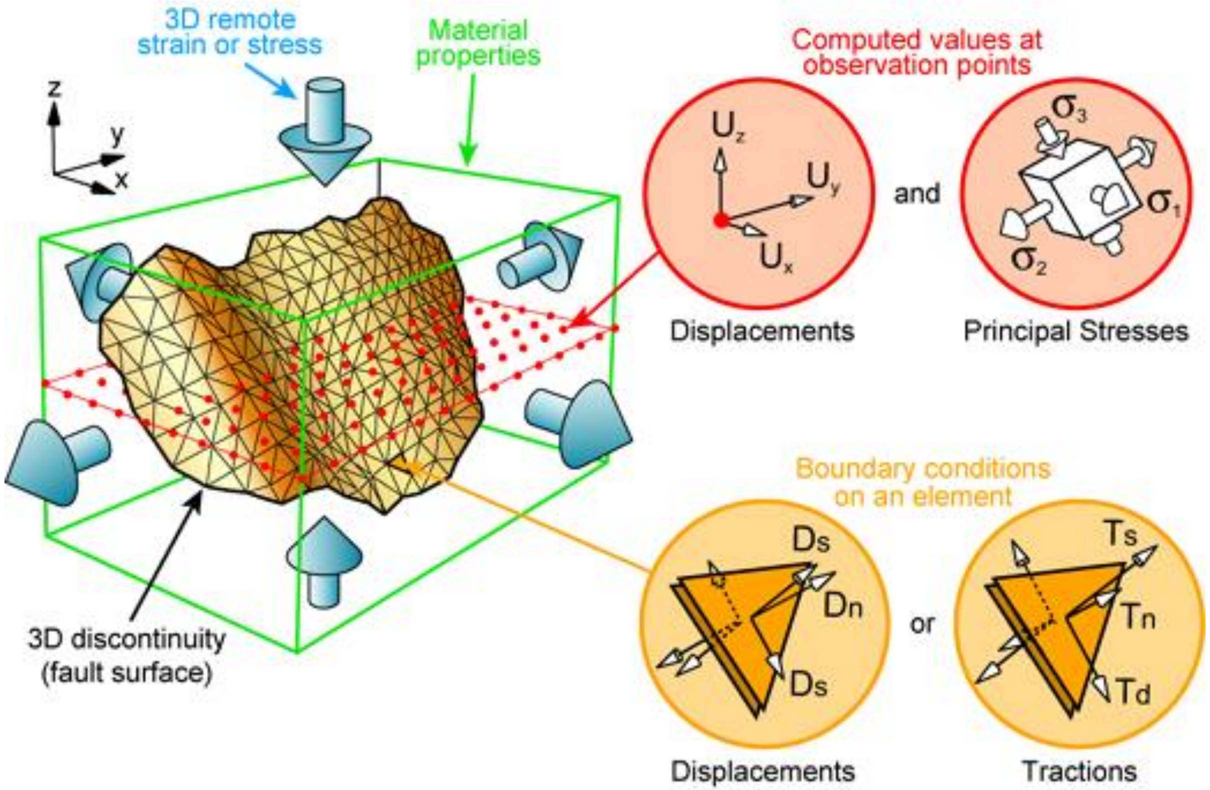
Southern **C**alifornia **E**arthquake **C**enter
Community **F**ault **M**odel
[SCEC-CFM]



Remeshed for more efficient modelling

Severson et al., 2013, in prep

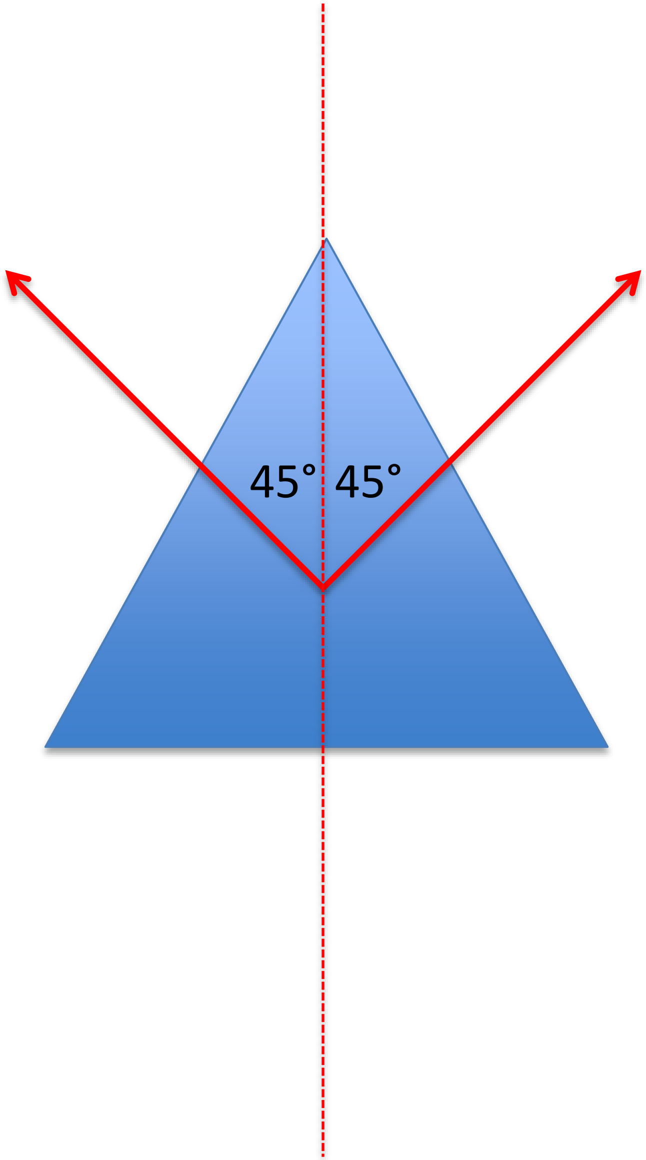
Poly3D



Thomas (1993)

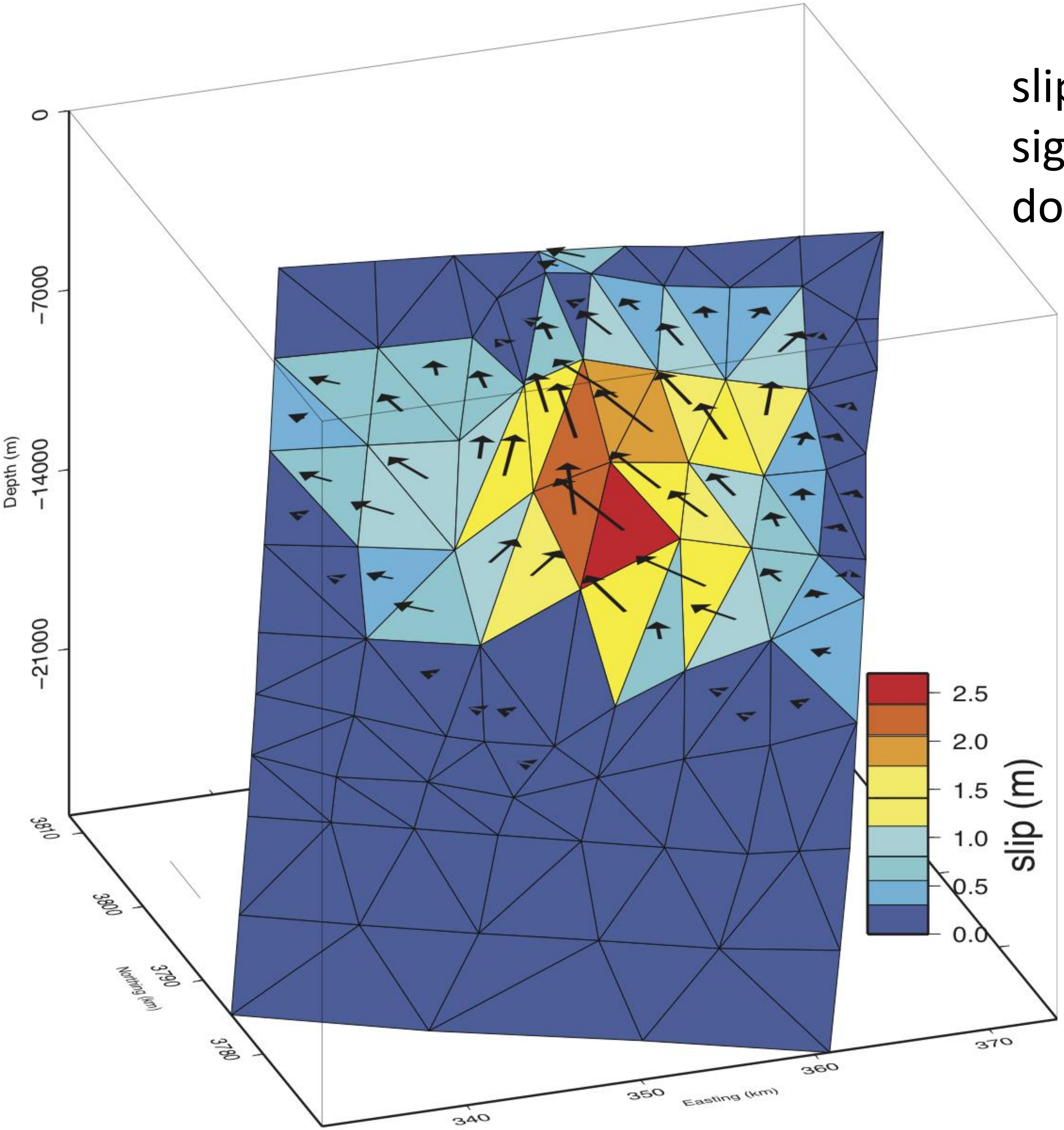
Boundary Element Method (BEM) code

Developed by Stanford Geomechanics group



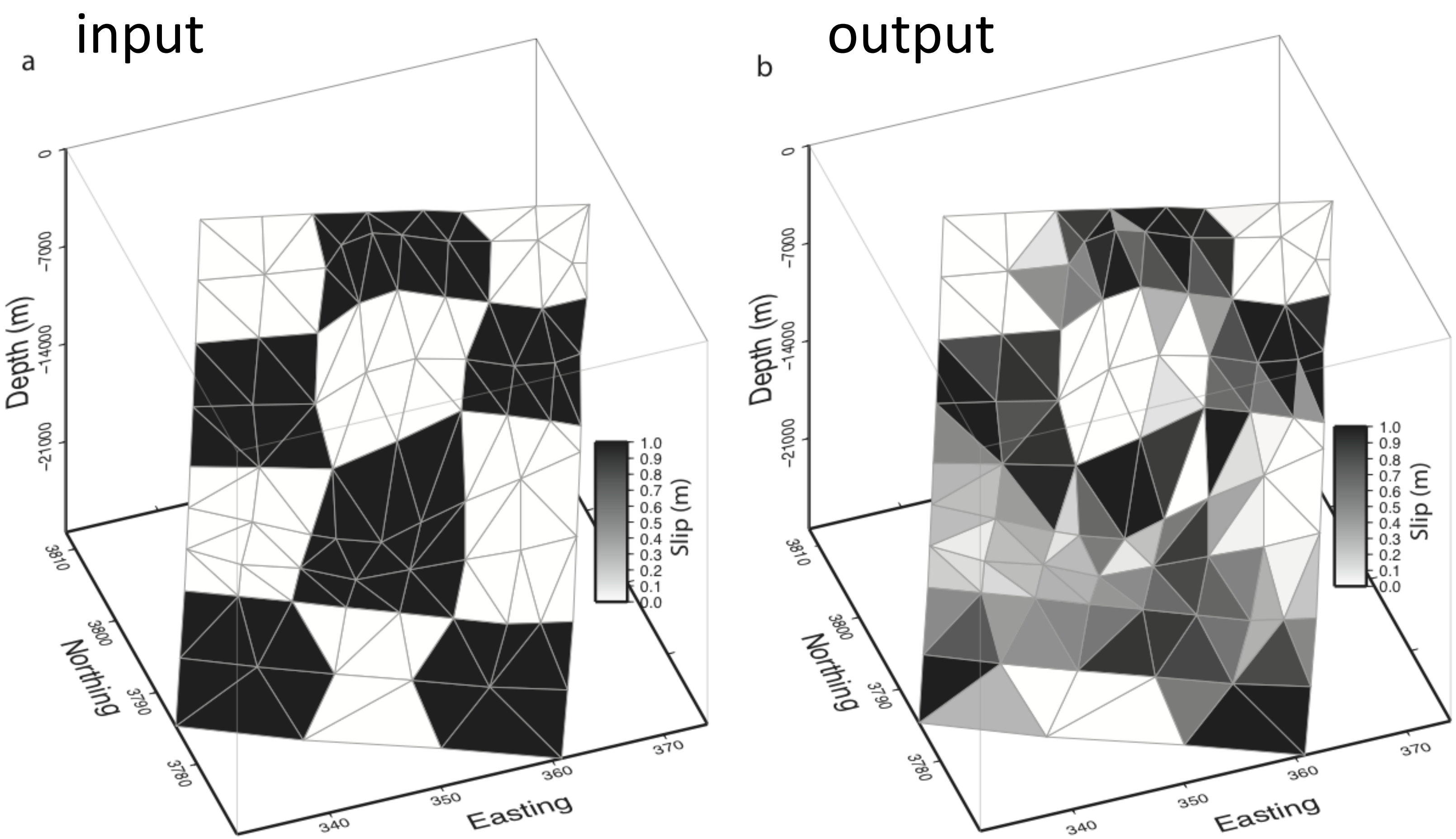
We calculate Green's functions for slip for each element in two orthogonal directions, 45° either side of pure thrusting

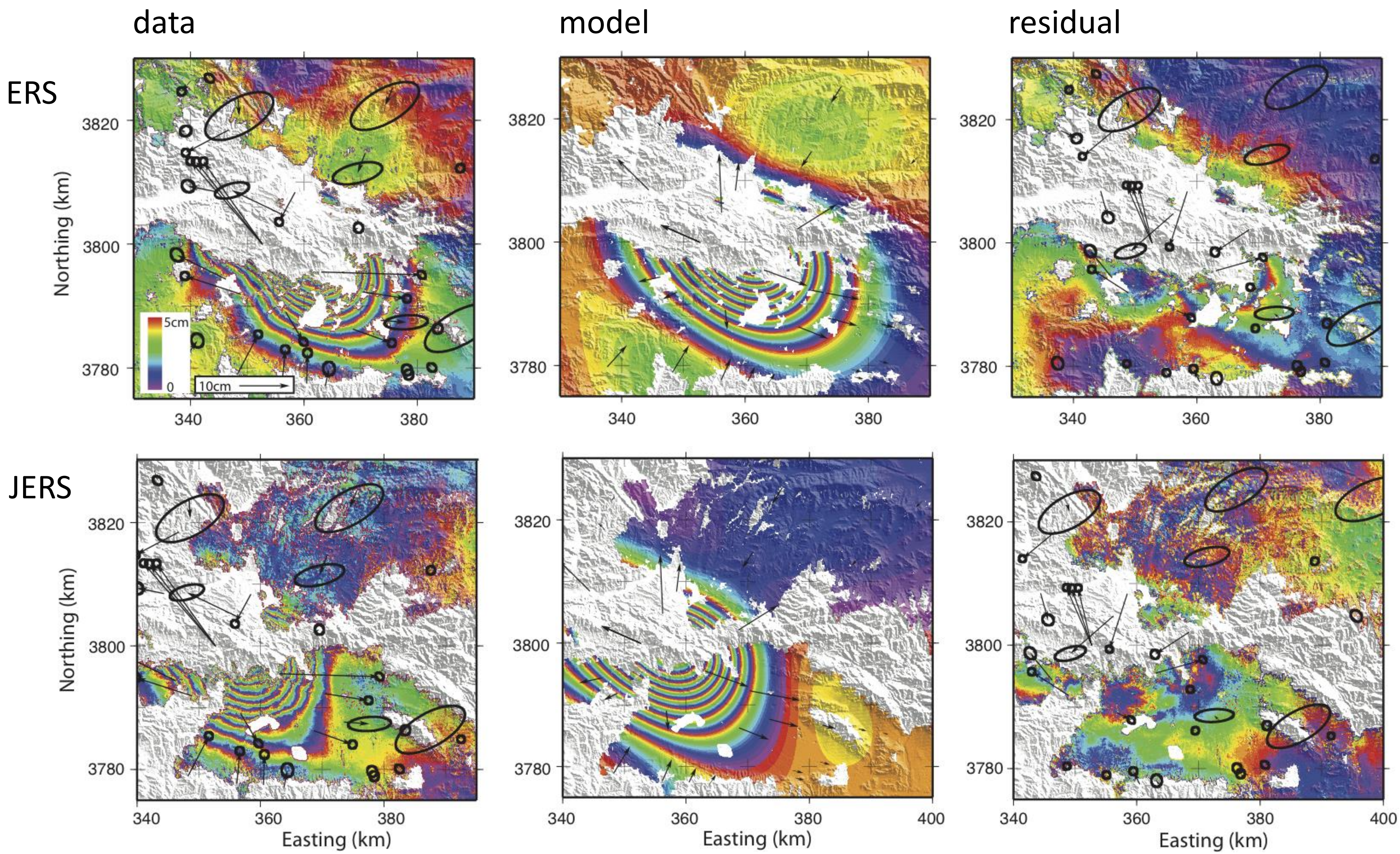
Combined with a positivity constraint for slip in the inversion, this constrains rake in the range 45°–135°



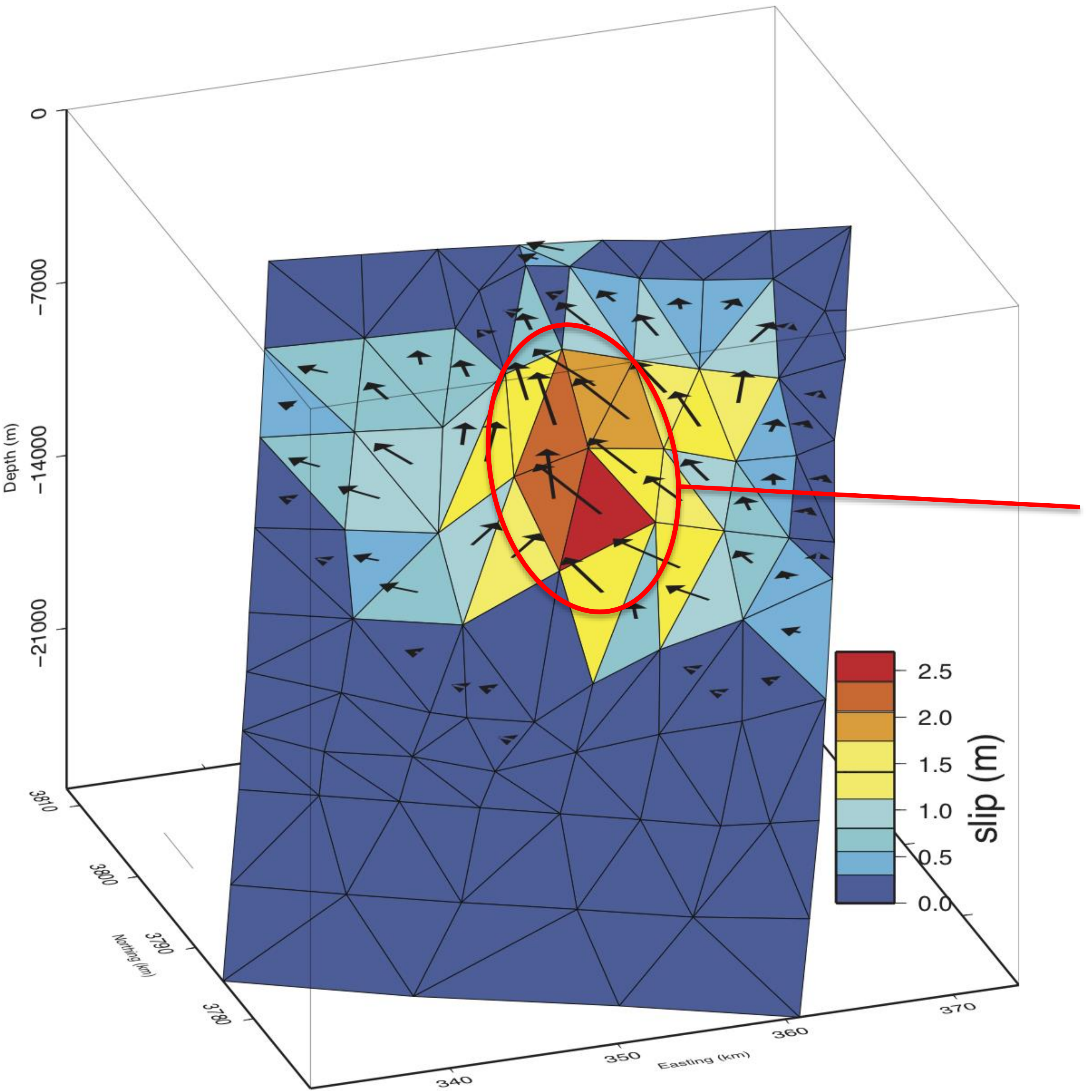
slip model shows significant slip down to ~15 km

Checkerboard test shows that we can resolve features on the upper portion of the fault

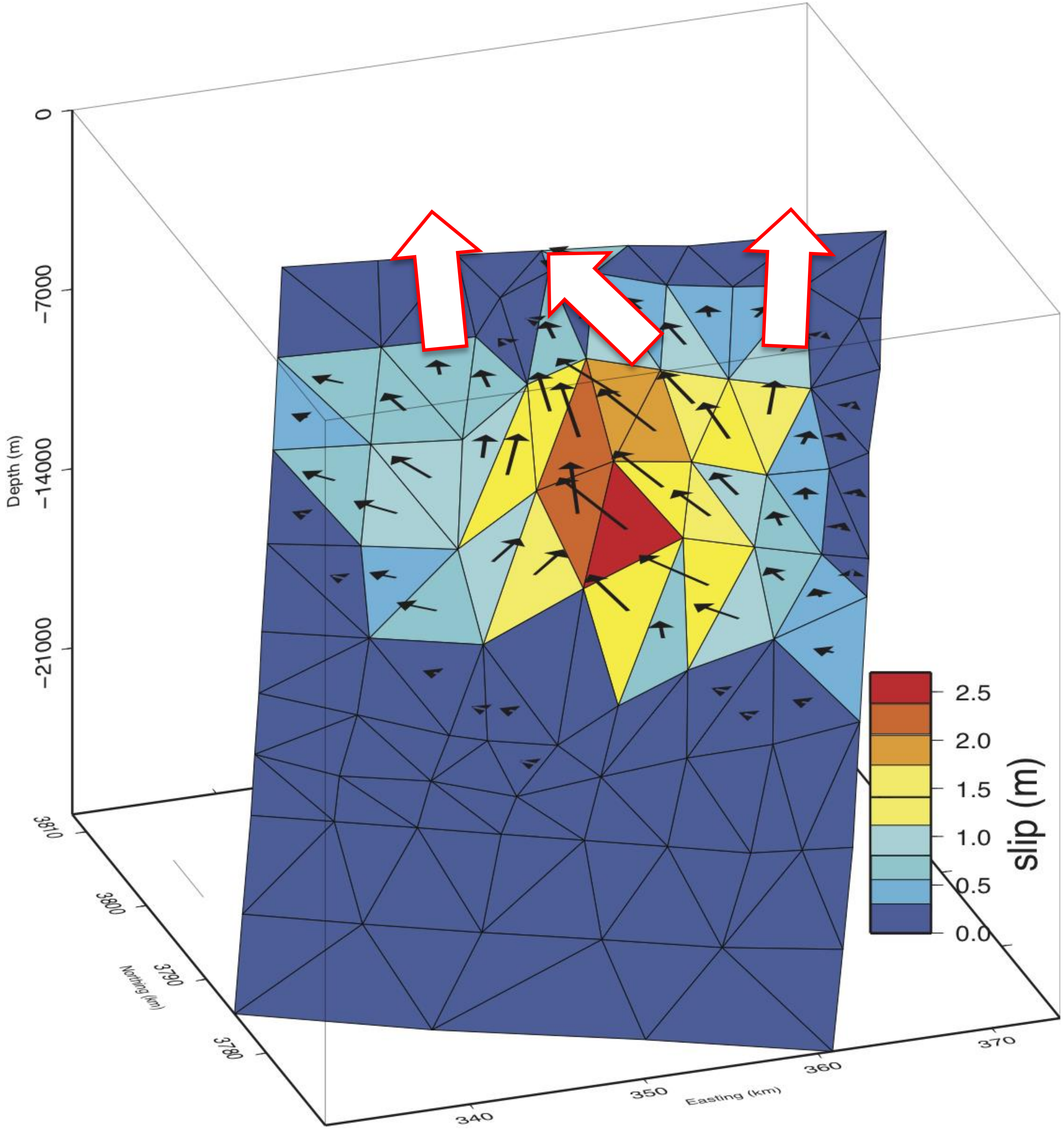




InSAR and far-field GPS data fitted well; near-field GPS data, not so well



1. Peak slip on the corner of the 'lateral ramp' – suggests fault geometry may influence the location of asperities



2. Partitioning of slip between different areas of the fault?

(Consistent with the findings of Marshall and Morris, 2012)