Recovering the post-seismic slip of the 2019 Mw 7.1 Ridgecrest Earthquake using InSAR, along-track Burst Overlap Interferometry and GNSS measurements

Magen, Yohai (1,2); Baer, Gidon (2); Inbal, Asaf (1); Ziv, Alon (1); Nof, Ran N. (2)

1 - Department of Geophysics, Tel-Aviv University, Tel Aviv, Israel
2 - Geological Survey of Israel, Jerusalem, Israel

Porter School of the Environment and Earth Sciences

The Raymond and Beverly Sackler Faculty of Exact Sciences
Tel Aviv University

הפקולטה למדעים מדויקים ע"ש ריימונד ובברלי סאקלר
אוניברסיטת תל אביב

בית הספר לסביבה ולמדעי כדור הארץ על שם פורטר

המכון הגיאולוגי
GEOLOGICAL SURVEY OF ISRAEL
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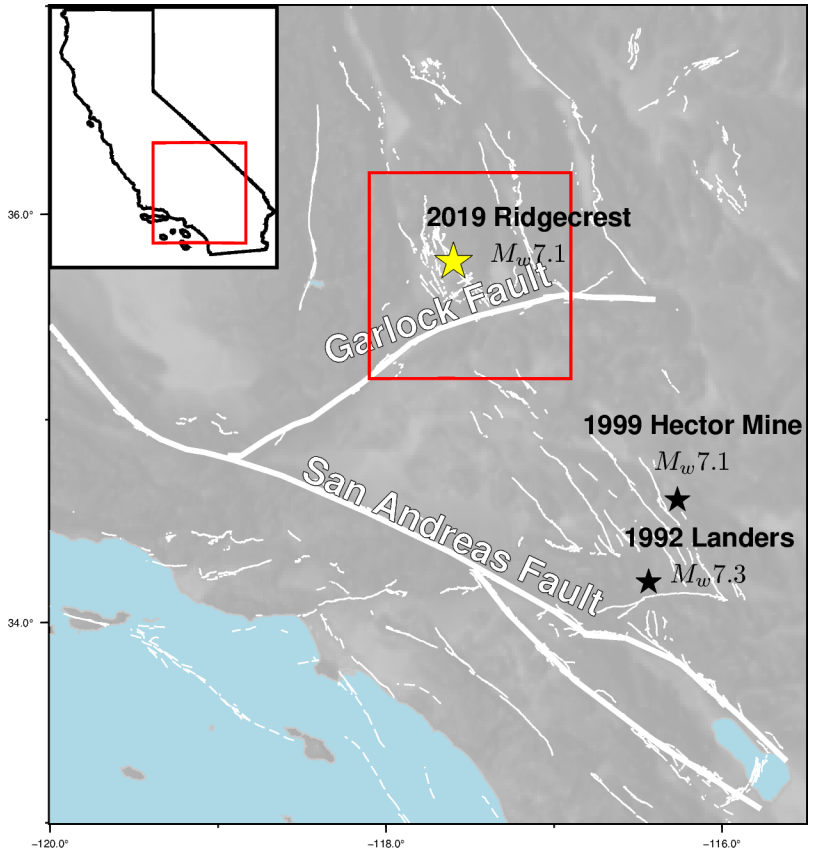
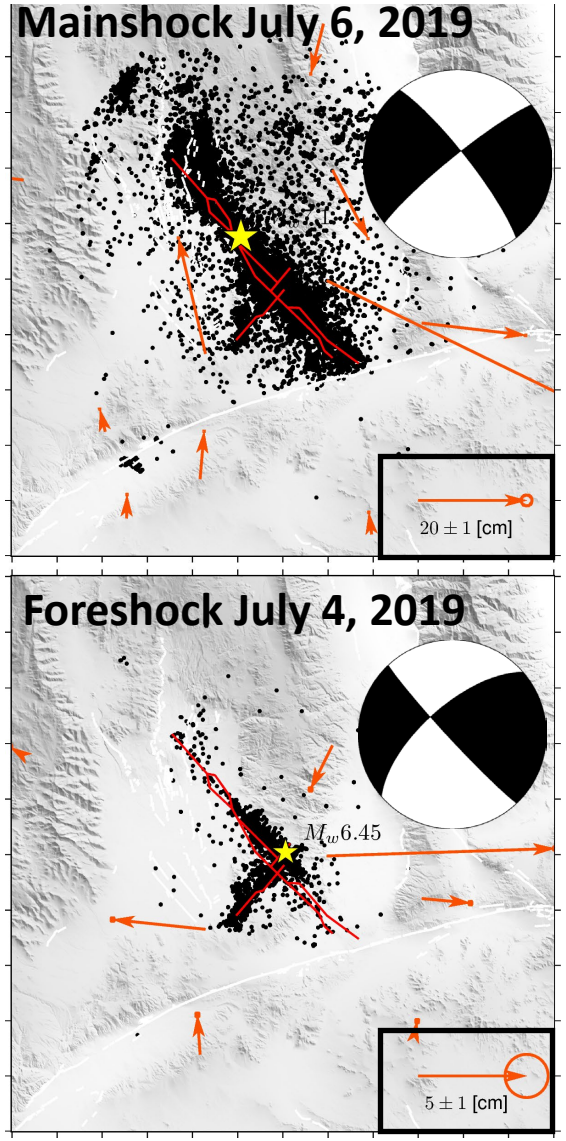
The Ridgecrest Earthquakes Sequence



GNSS co-seismic displacements



The foreshock seismicity pattern indicates an orthogonal fault system striking to the NW and NE.

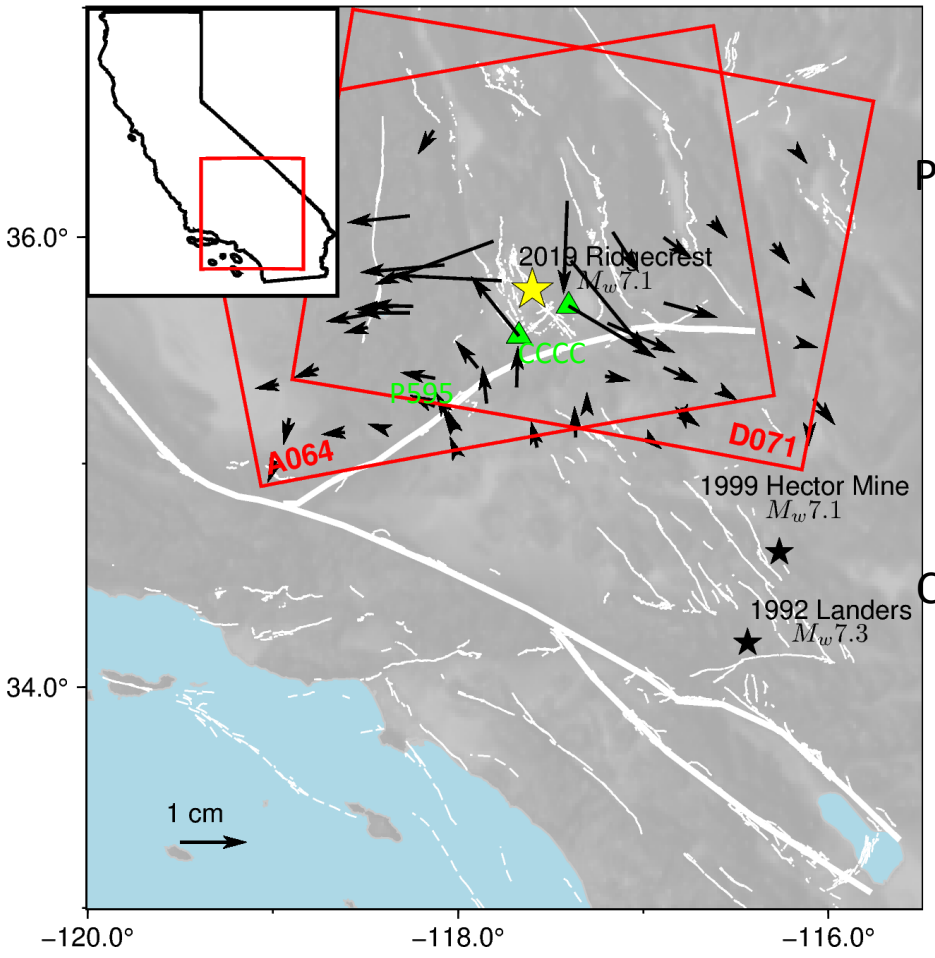
The foreshock ruptured both the NW and NE striking faults.

The mainshock ruptured only the NW striking fault.

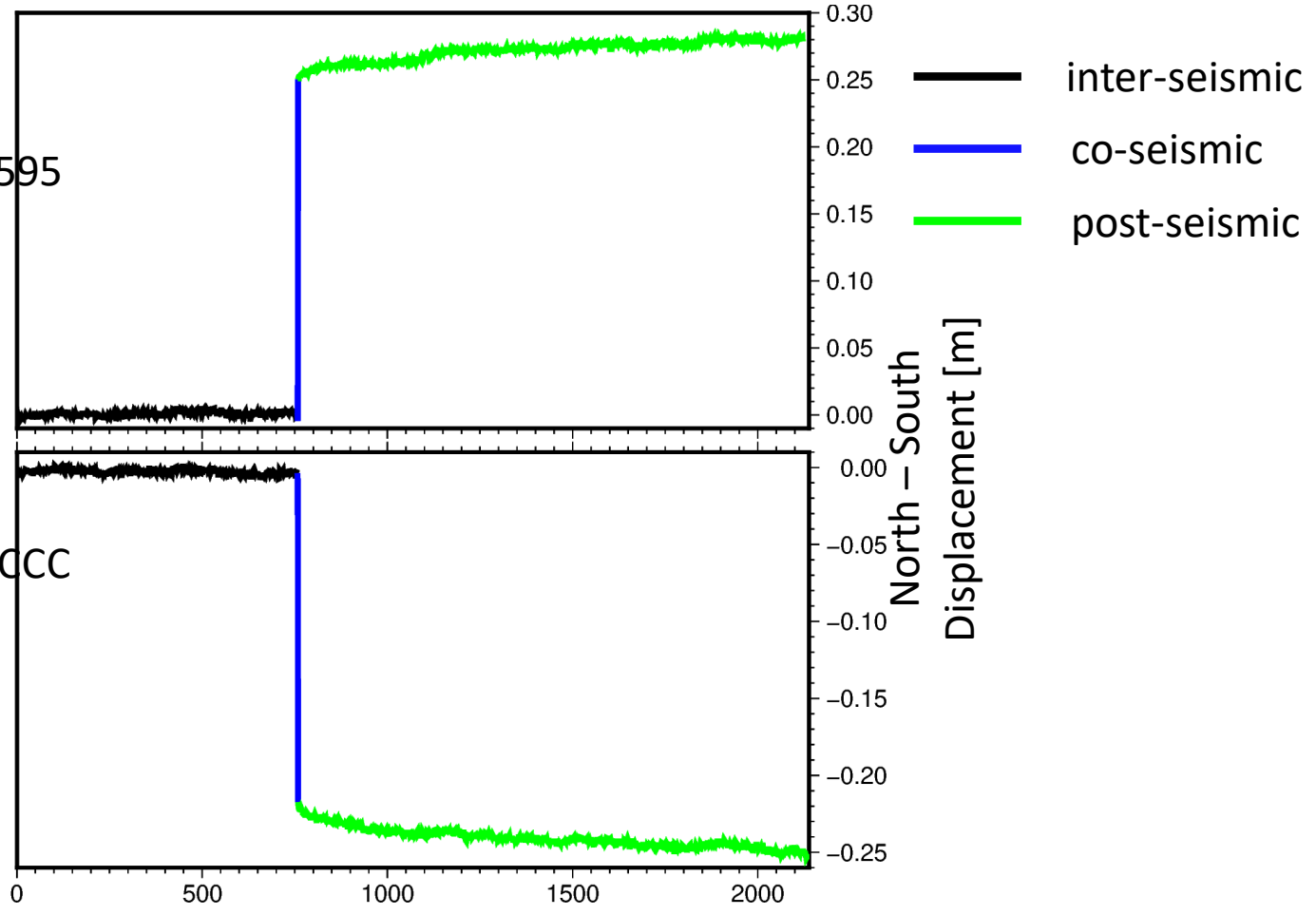
Magen et al., 2020

GNSS post-seismic displacements

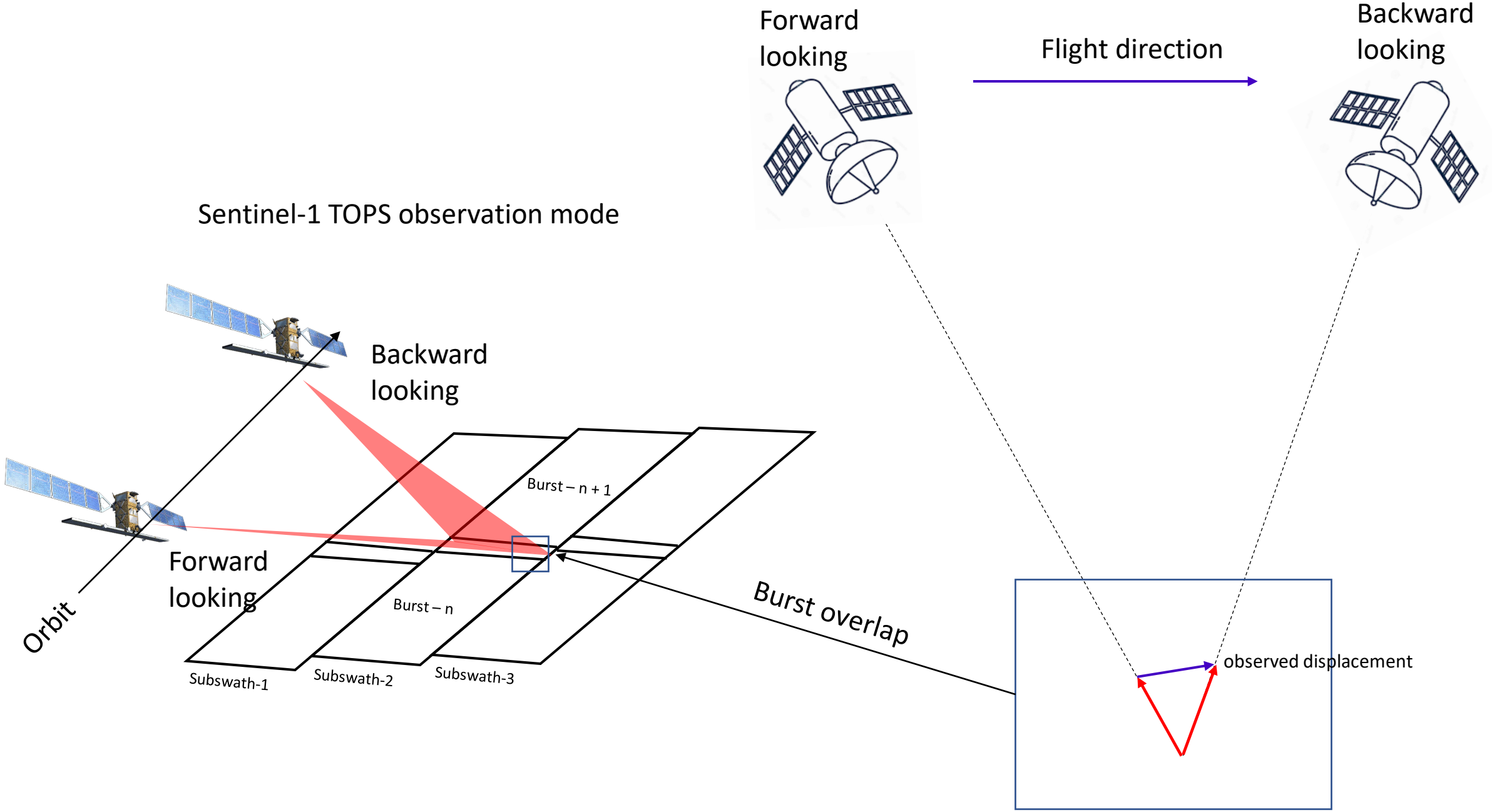
GNSS post-seismic displacement
July 6, 2019 – November 25, 2019



GNSS time series



Burst Overlap Interferometry (BOI)

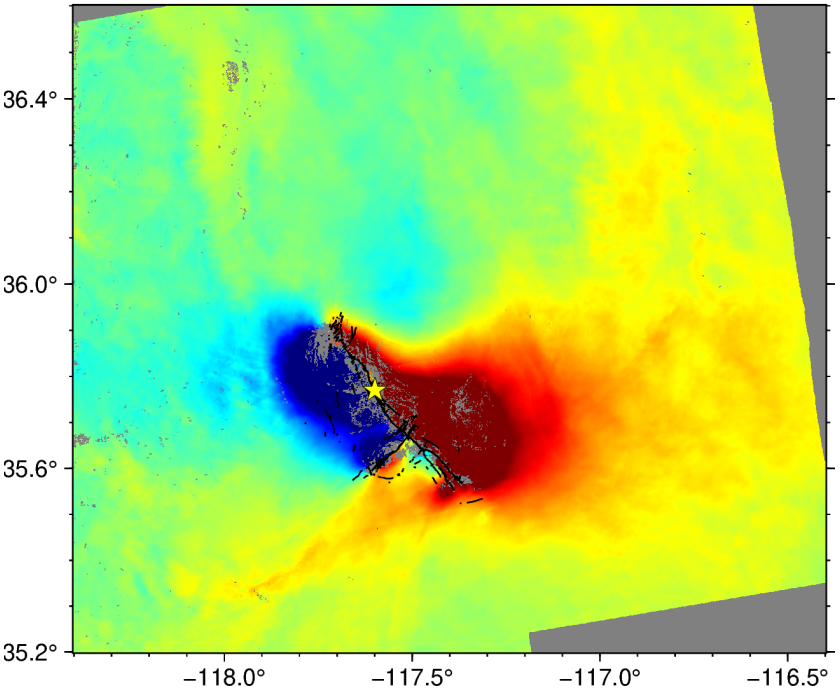


Coseismic Displacements

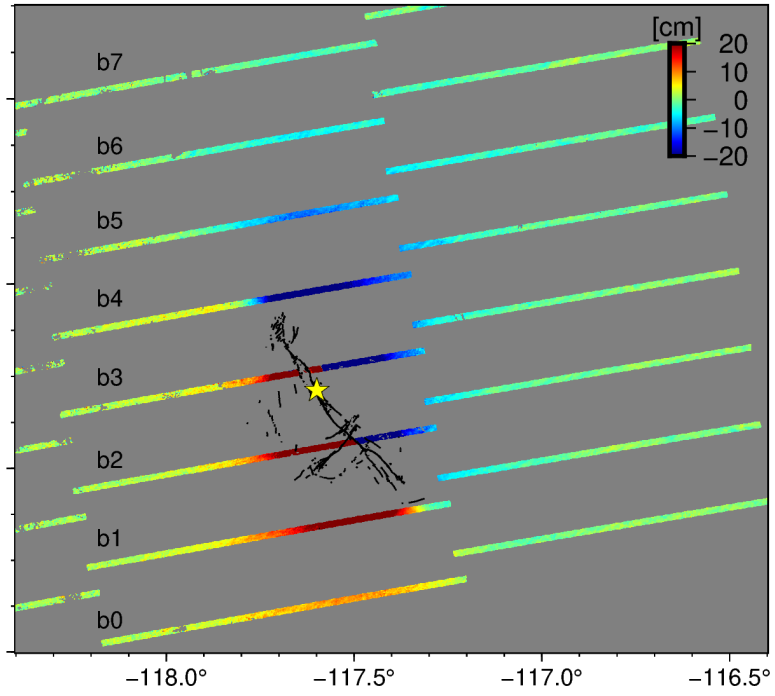
June 28, 2019 – July 10, 2019

The BOI is capable of viewing approximately the N-S component of the displacement field

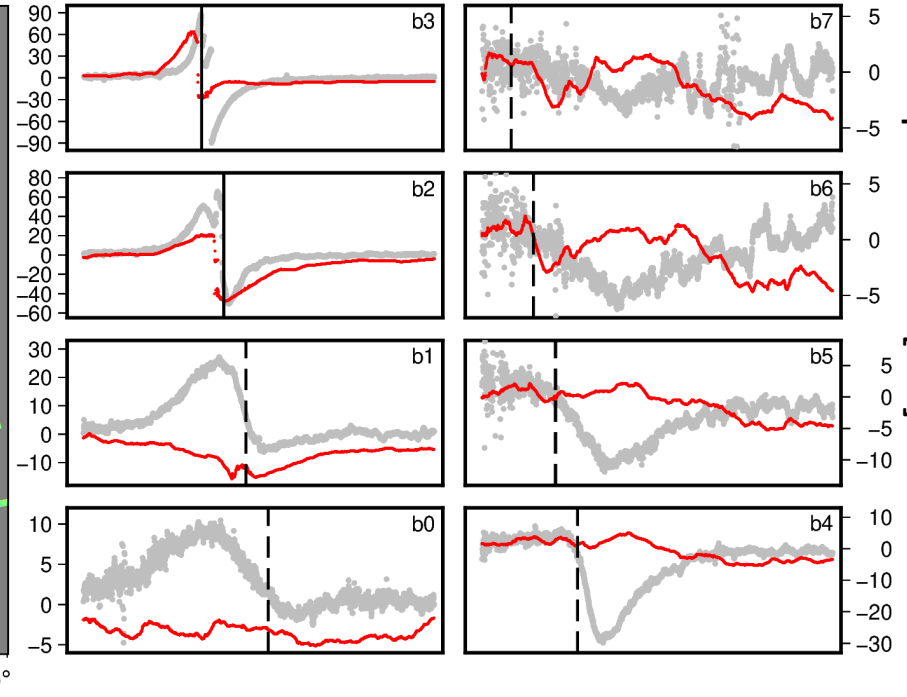
InSAR line of sight (LOS) displacements



BOI displacements



LOS and BOI profiles



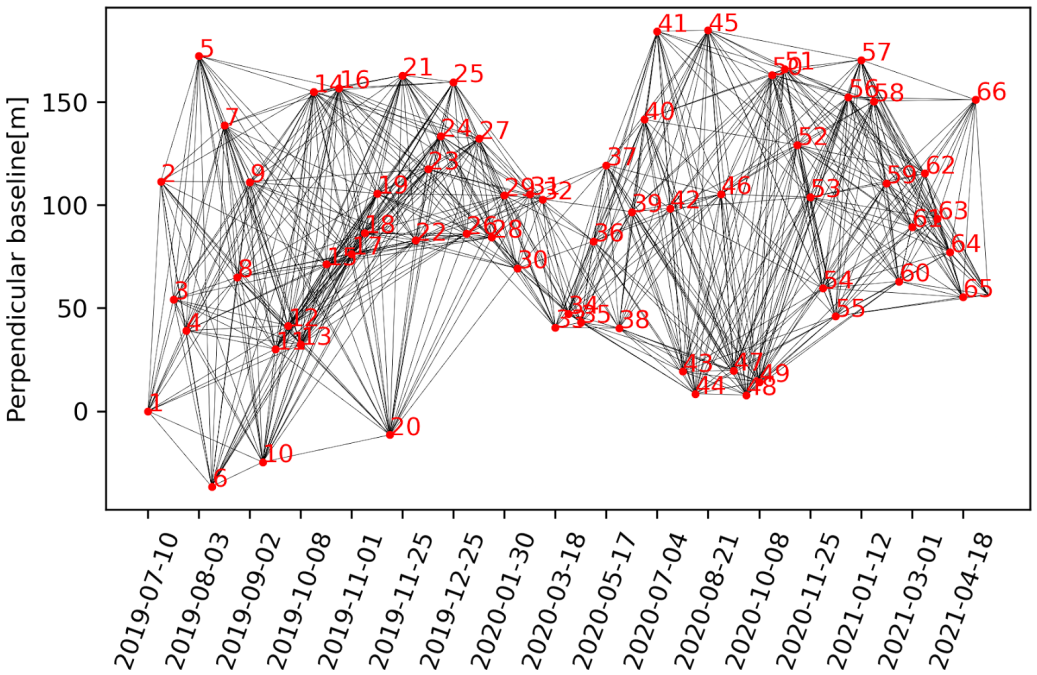
InSAR LOS displacements

BOI displacements

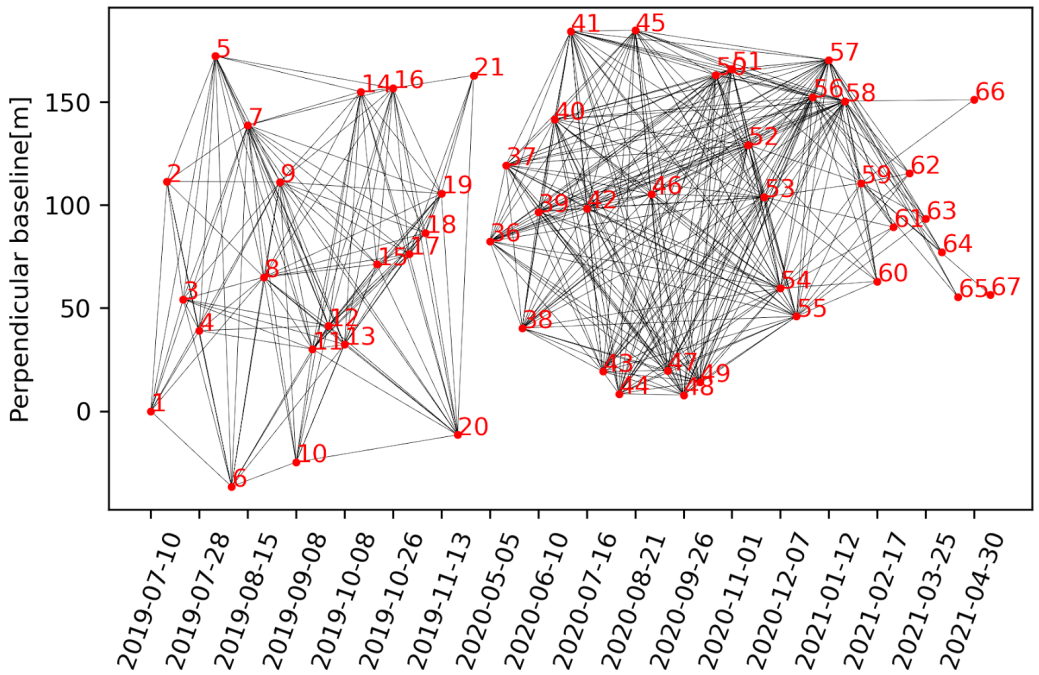
Small Baseline Subset (SBAS) post-seismic time series analysis

For a network of N dates with M interferograms we solve a system of N-1 x M equations to get the displacement time series for each pixel

D071 693 interferograms



A064 472 interferograms

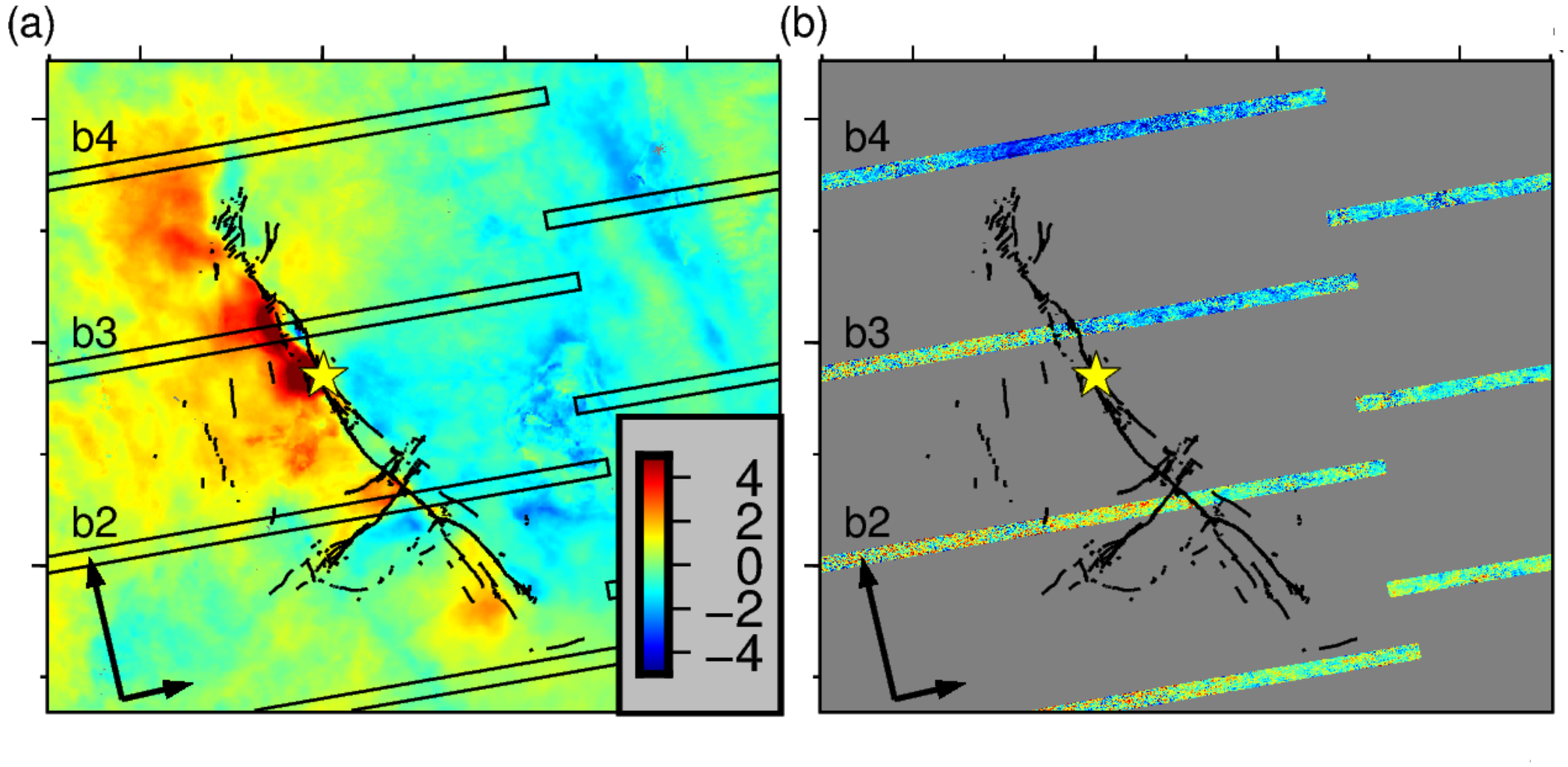


Postseismic Displacements

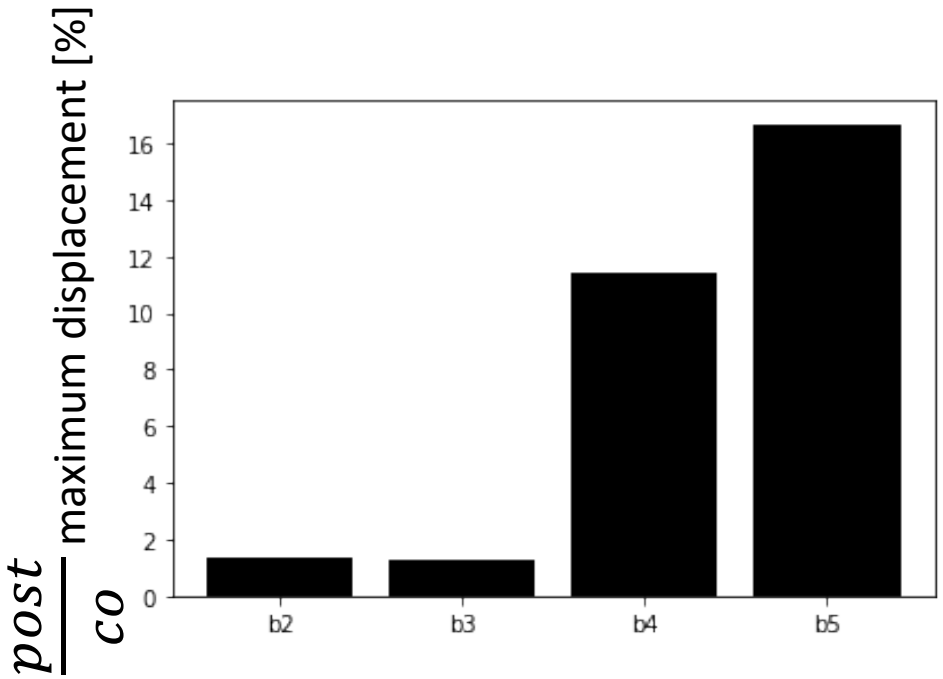
July 10, 2019 – November 25, 2019

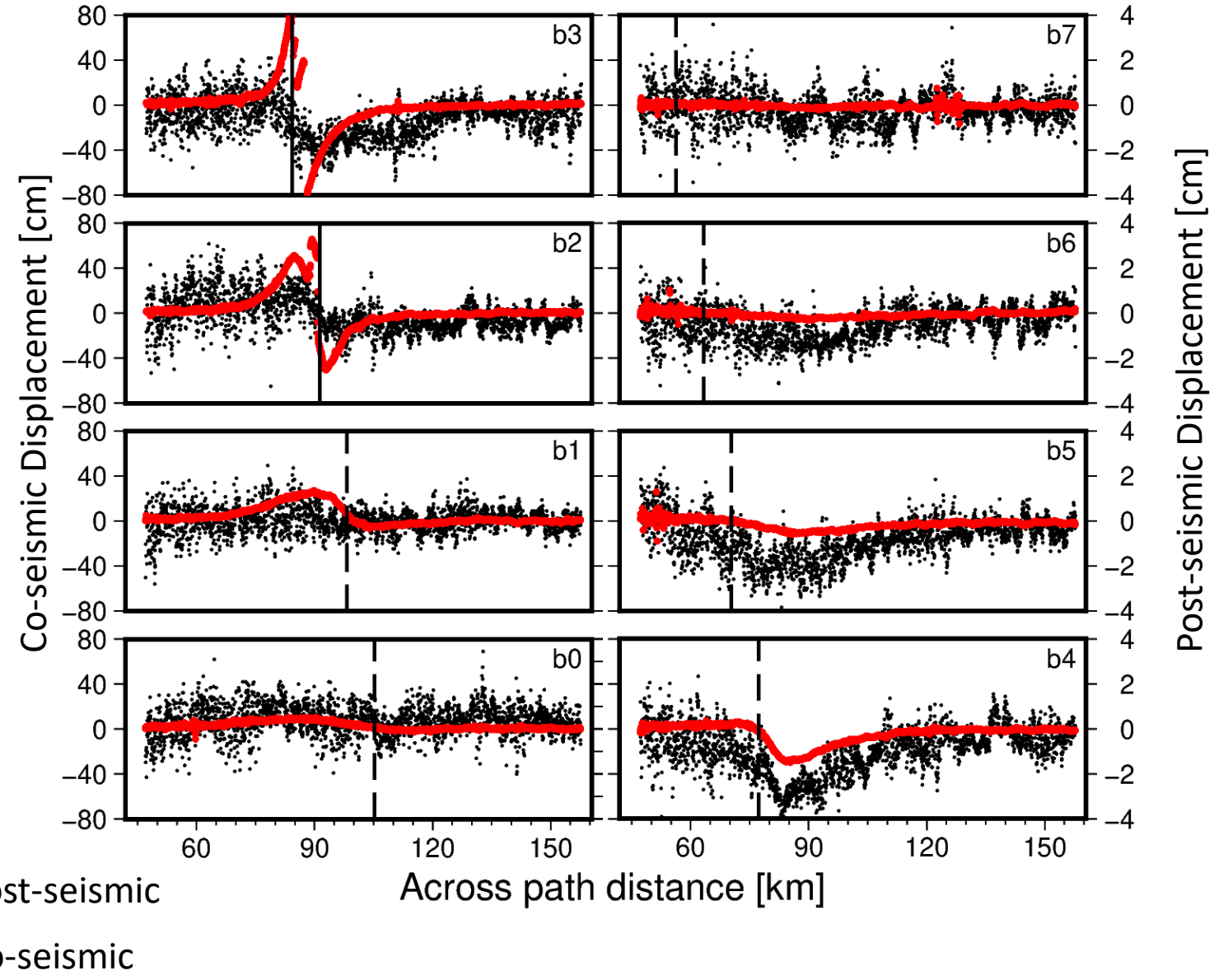
InSAR line of sight (LOS)

BOI displacements

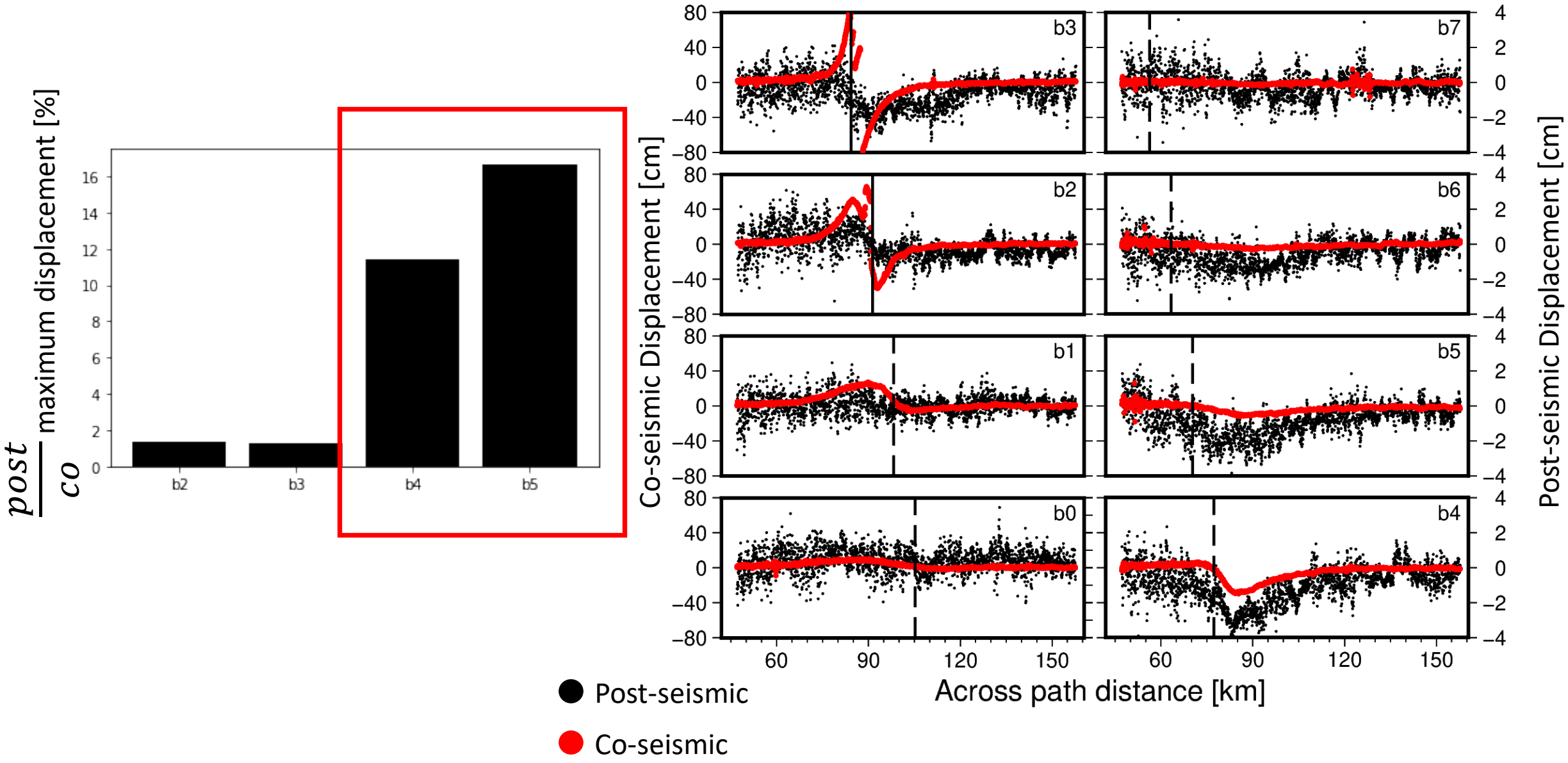


Post-seismic vs Co-seismic BOI Displacements





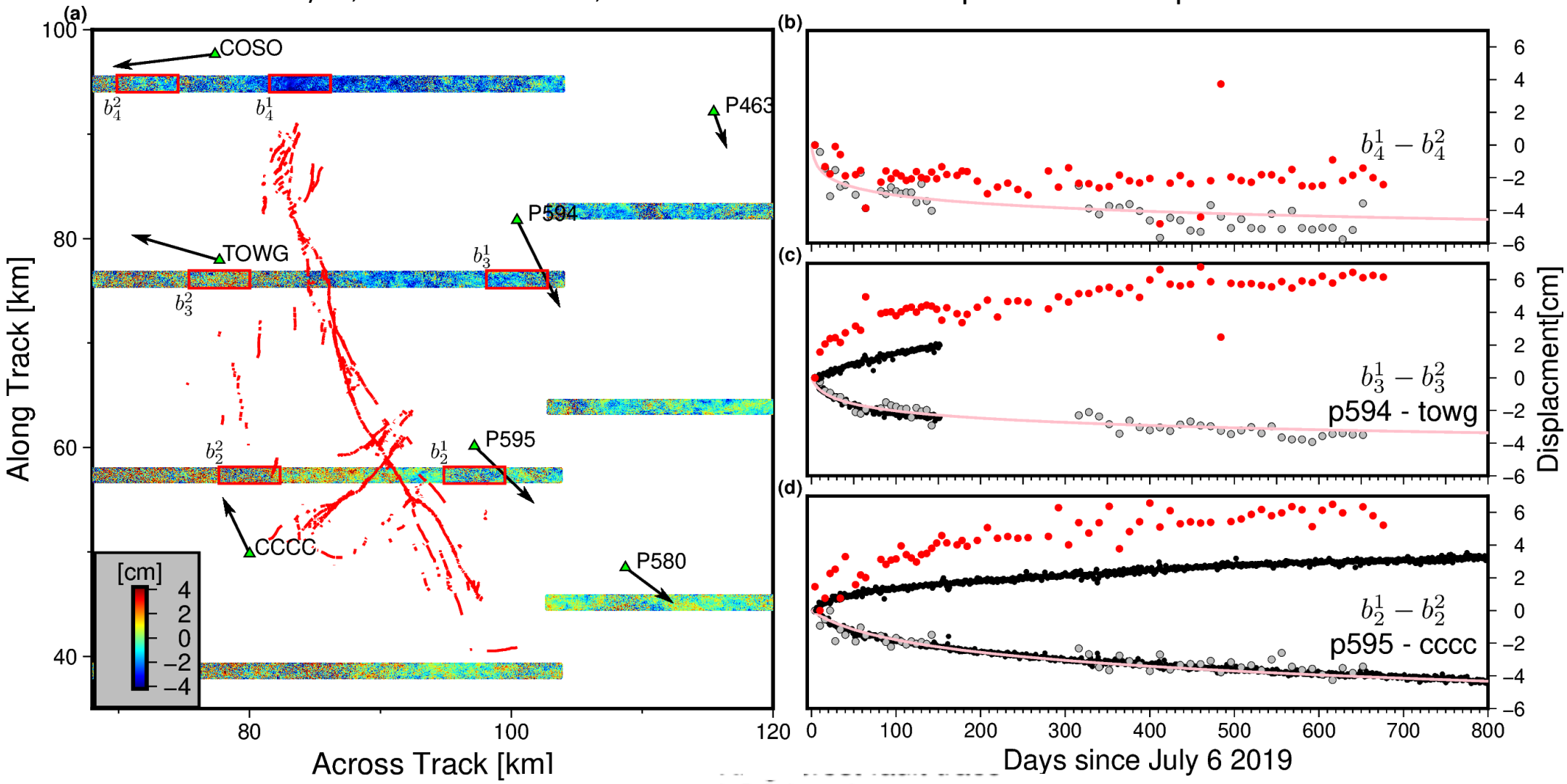
Post-seismic vs Co-seismic BOI Displacements



Ridgecrest Post-seismic temporal evolution

BOI July 10, 2019 – November 25, 2019

Displacement temporal evolution

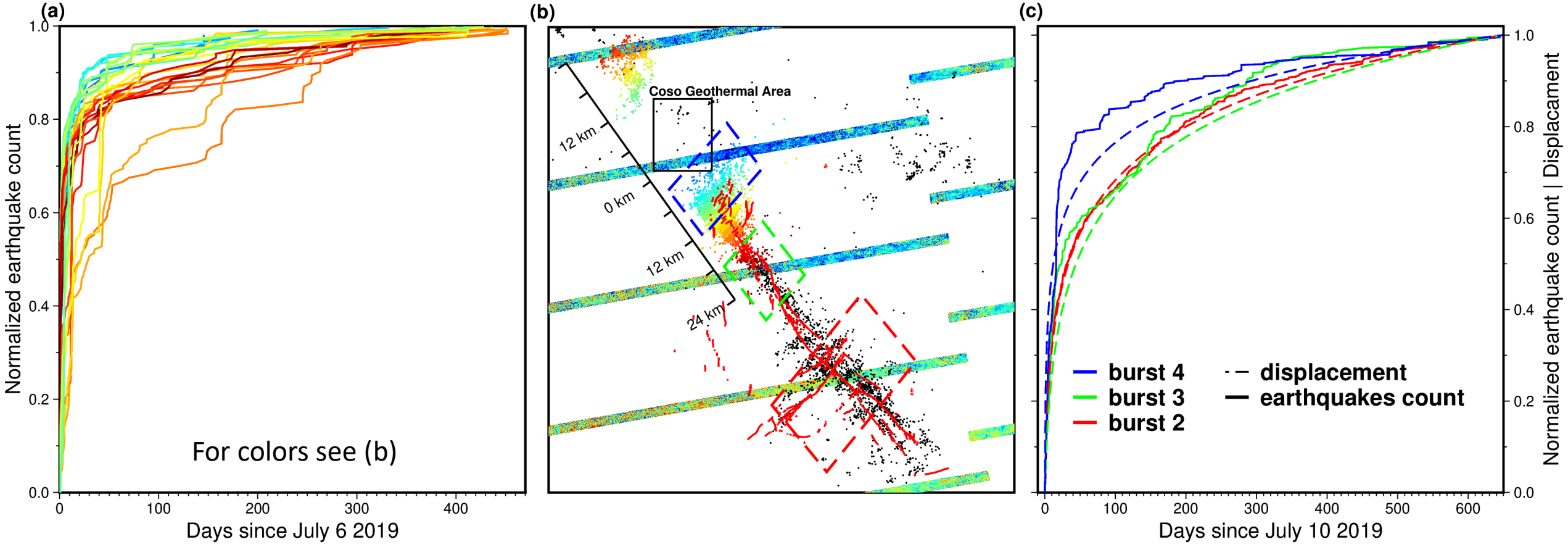


Temporal decay of seismicity and deformation

Seismicity decay with distance from Coso

Postseismic Seismicity

Seismicity and Displacement decays

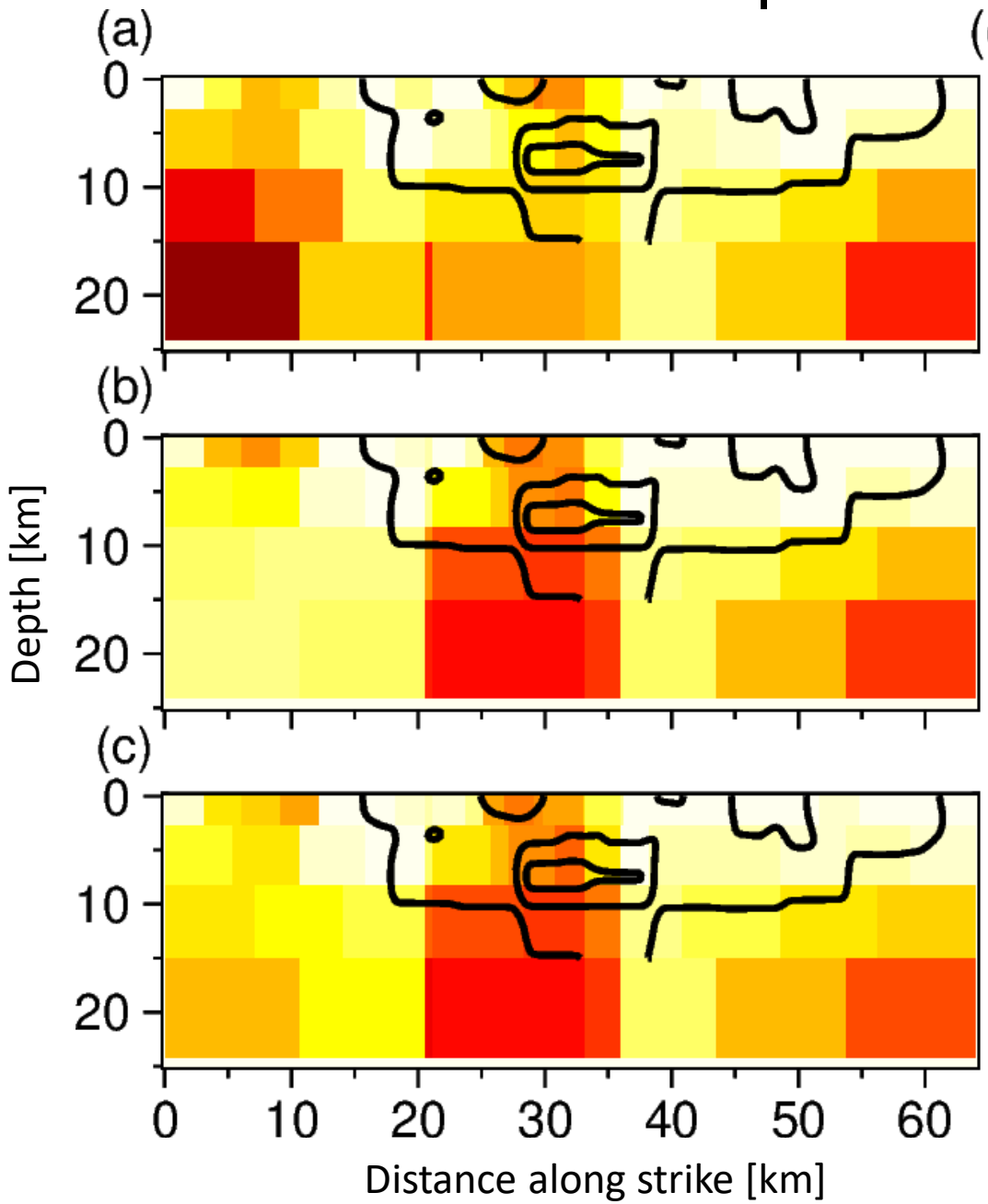


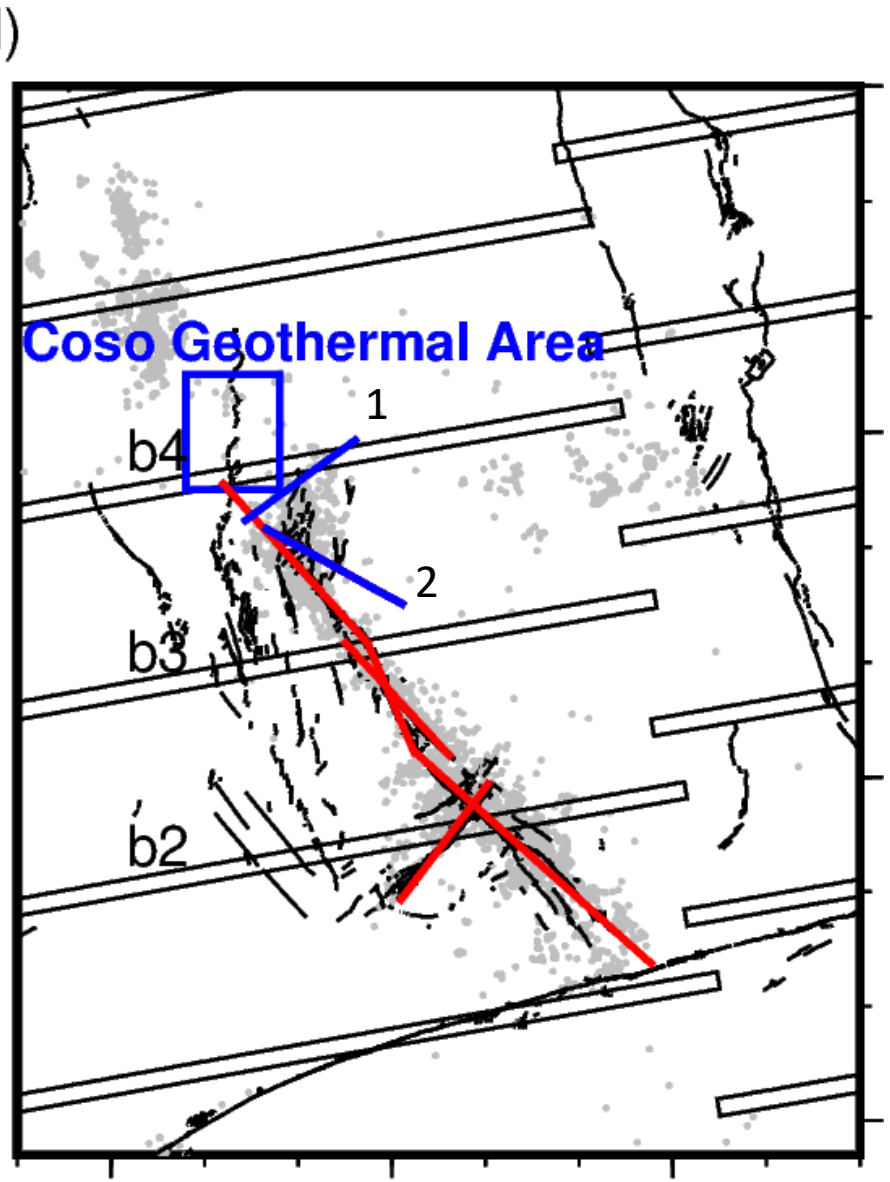
Post-seismic slip models

Model 2: slip on main fault and Off-fault 2

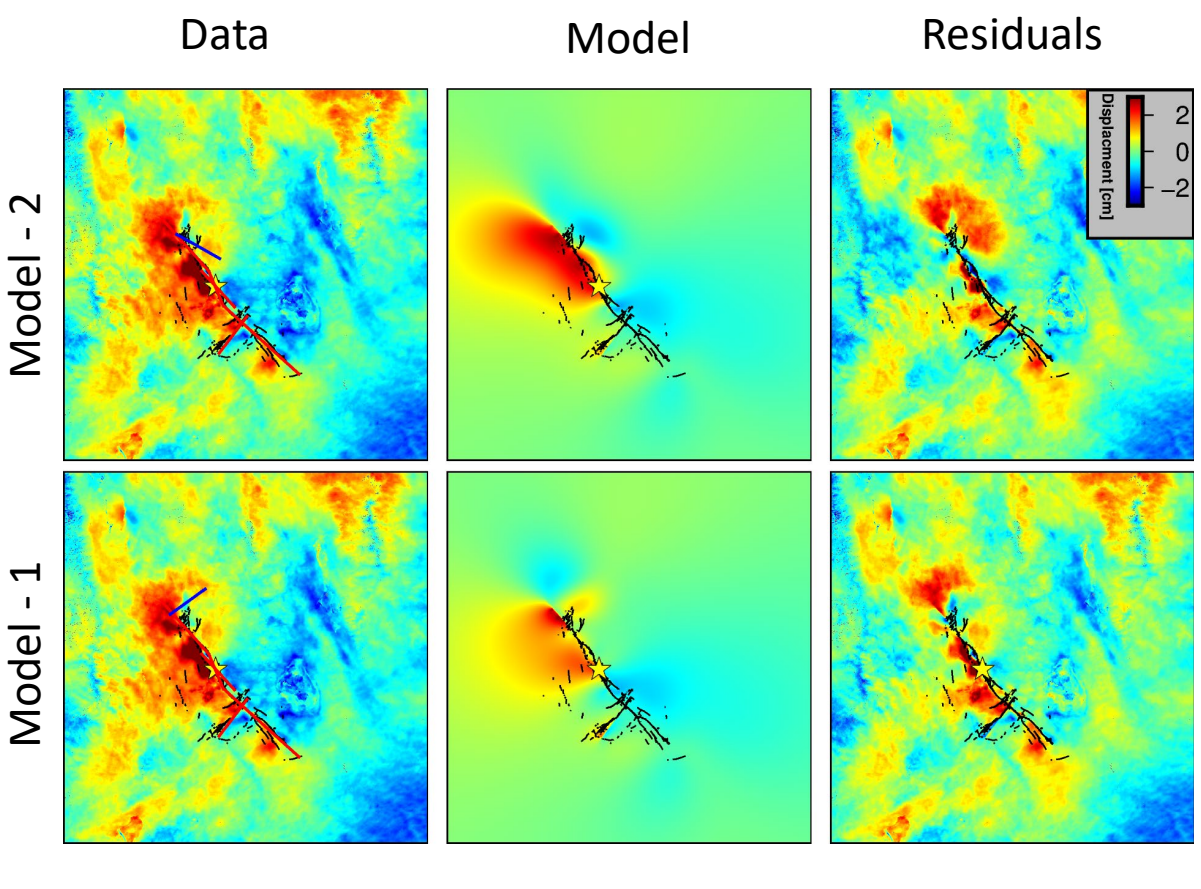
Model 1: slip on main fault and Off-fault 1

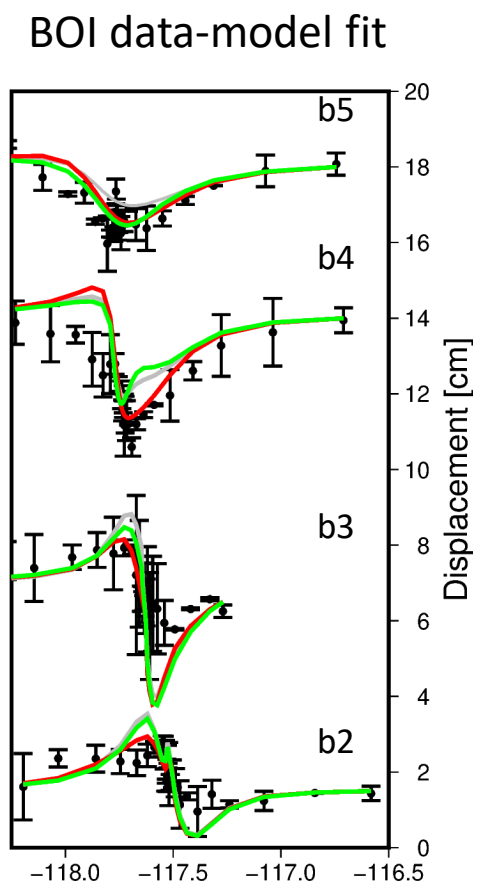
Model 0: slip on main fault only





Post-seismic data-model fit



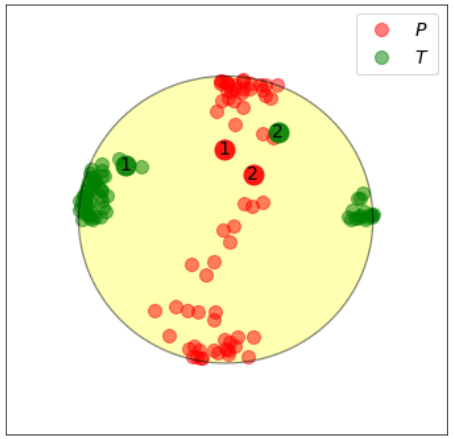


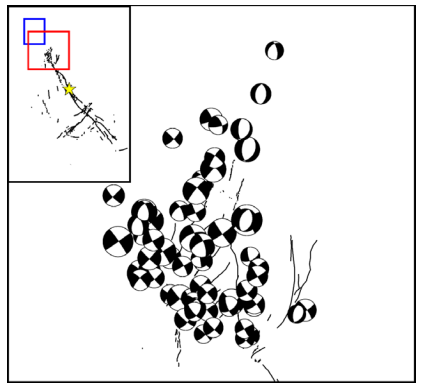
Model - 0

Model - 1

Model - 2

Moment tensor stress regime





- Poor fit near the M_w7.1 hypocenter
- Possible poro-elastic rebound (Wang and Bürgmann, 2020)
- Model 1 better agrees with stress regime (Wang and Zhongwen, 2020)
- Model 2 better agrees with BOI

Summary

- We used Sentinel-1 LOS and Burst Overlap Interferometry to measure postseismic surface deformation following the 2019 M_w7.1 Ridgecrest, California earthquake.
- BOI reveals ~2-3 cm fault parallel motion across the mainshock fault in the first 140 days after the mainshock.
- BOI displacement of ~4 cm is observed 10 km northeast of the mainshock fault rupture.
- These results highlight the importance of BOI for resolving fault-parallel motions; the NE off-fault displacement was completely unnoticed by InSAR and GNSS geodetic networks.
- Slip inversion suggests the off-fault motion may be explained by transient slip to the NE of the coseismal ruptured faults