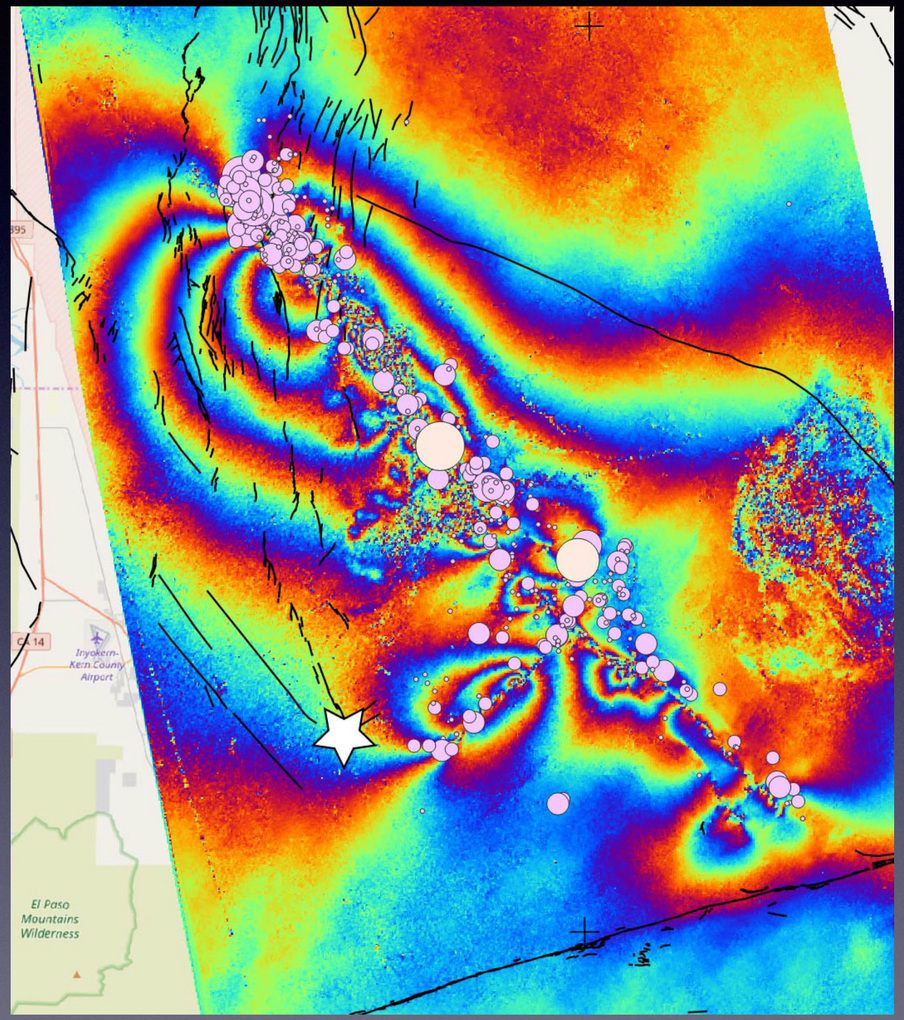
National Aeronautics and
Space Administration



Surface deformation from the 4th of July Mw 6.4 and 5th of July 2019 Mw 7.1 Ridgecrest Earthquakes in California– SAR and GPS perspective

Eric Jameson Fielding
Jet Propulsion Laboratory, California Institute of Technology

Original ALOS-2 data JAXA (2019). Analyzed by the NASA-JPL/Caltech ARIA team. Epicenters Z. Ross, Caltech

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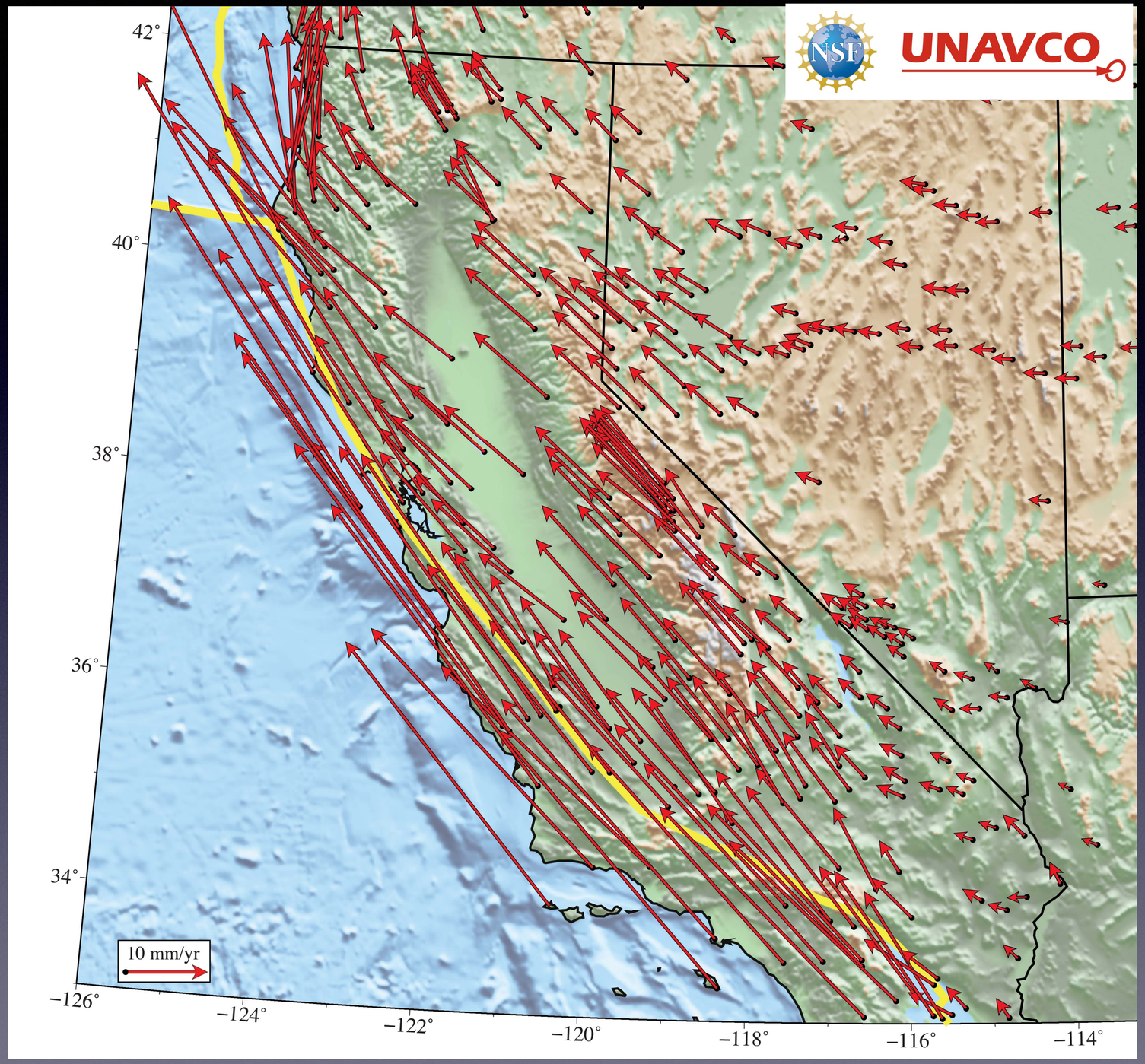
Government sponsorship
acknowledged.

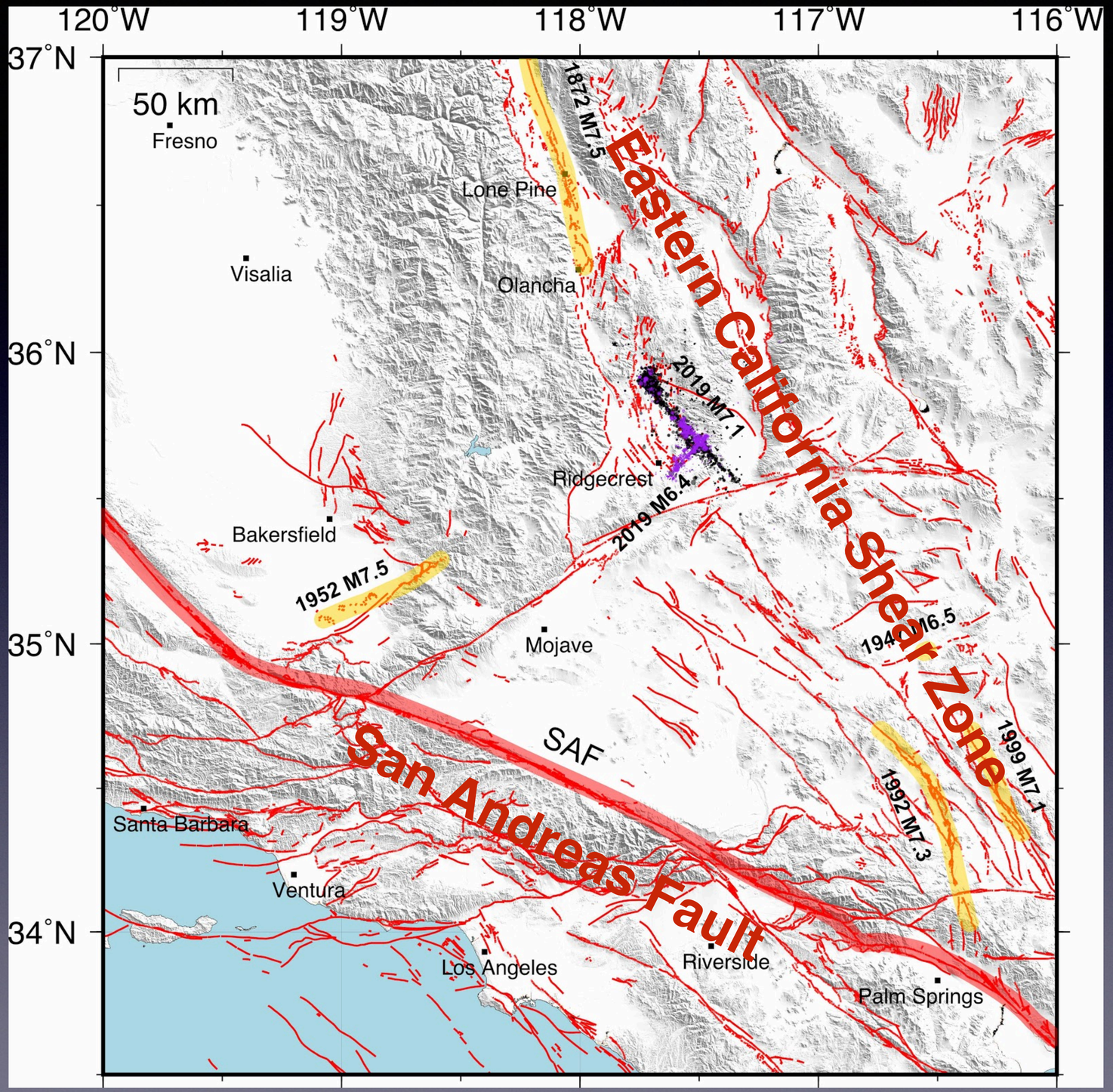
Tectonic Motions of California

Horizontal motion measured by GPS Network of the Americas (formerly Plate Boundary Observatory)



Southern California earthquakes

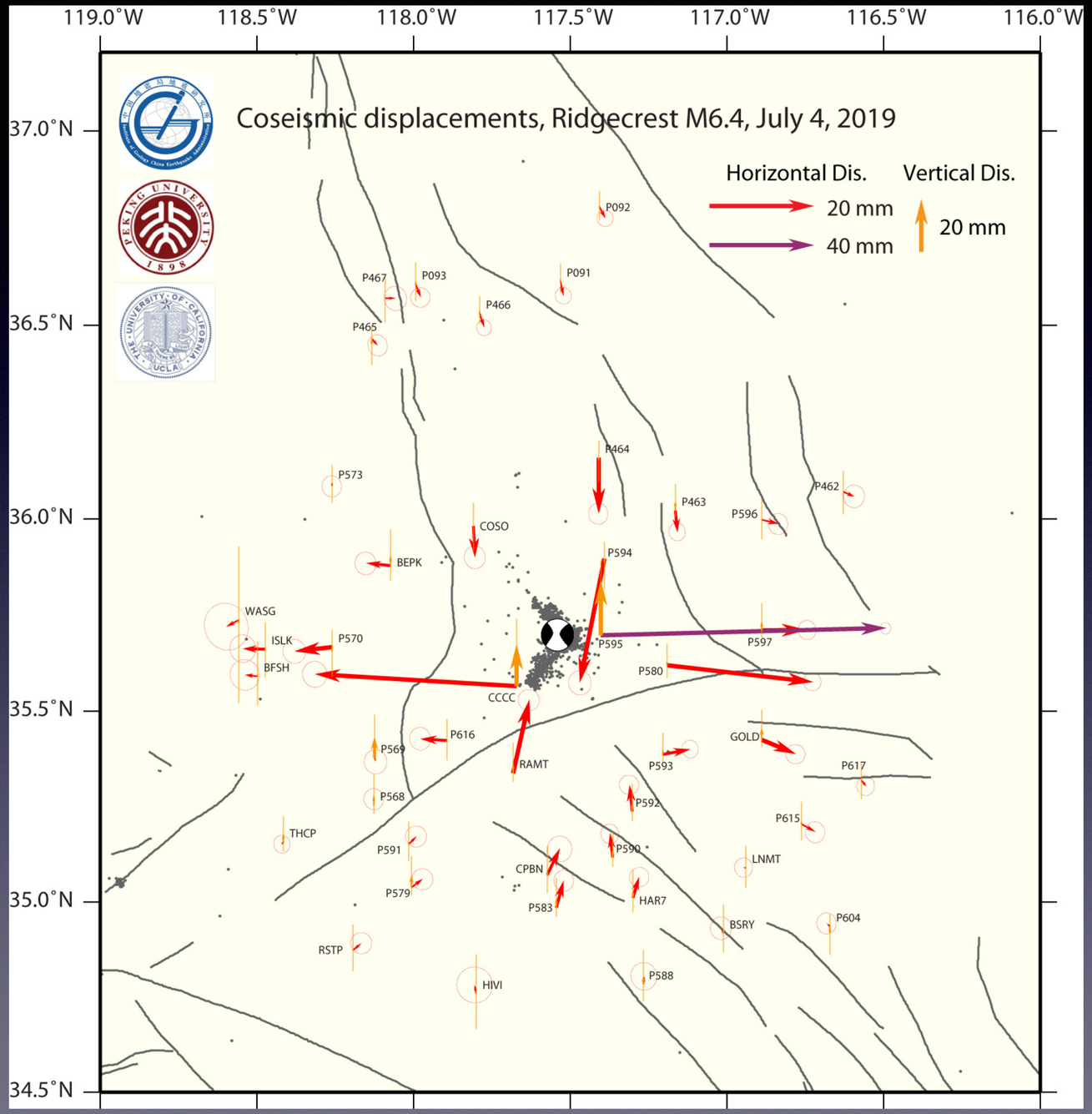
- San Andreas Fault last earthquake 1857
- Eastern California Shear Zone 1872-1992-1999



map by Benjamin Idini, Caltech

2019 Mw 6.4 Ridgecrest Earthquake

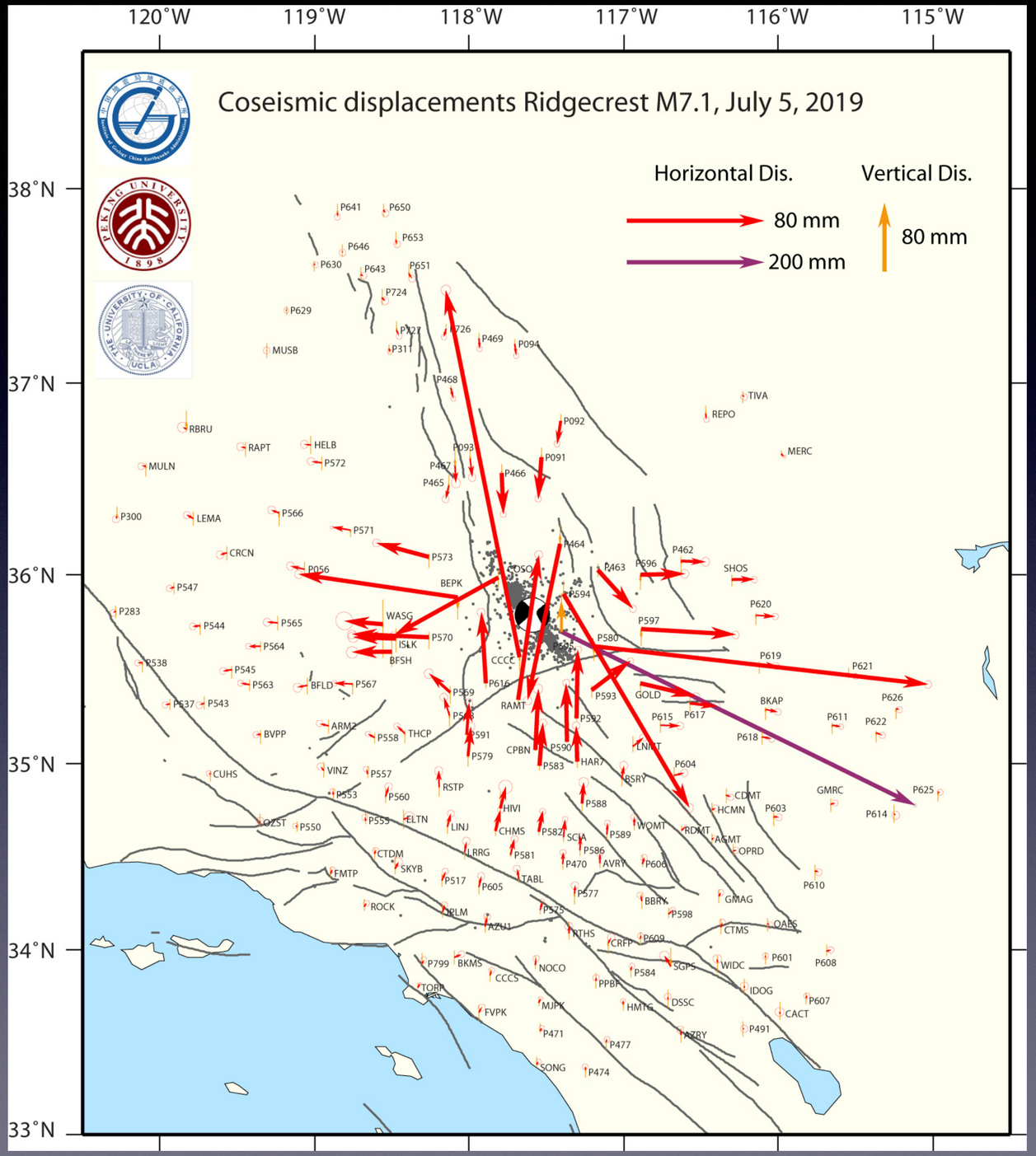
- 4th of July 10:33:48 PDT
- 17:33 UTC
- Mww 6.4
- GPS displacements show main rupture on NE-SW fault
- left-lateral



map Zheng-Kang Shen, UCLA, pers. comm.

2019 Mw 7.1 Ridgecrest Earthquake

- 5th of July 05 20:19:52 PDT
- 6 July 03:20 UTC
- Mww 7.1
- GPS displacements show main rupture on NW-SE fault
- Right-lateral



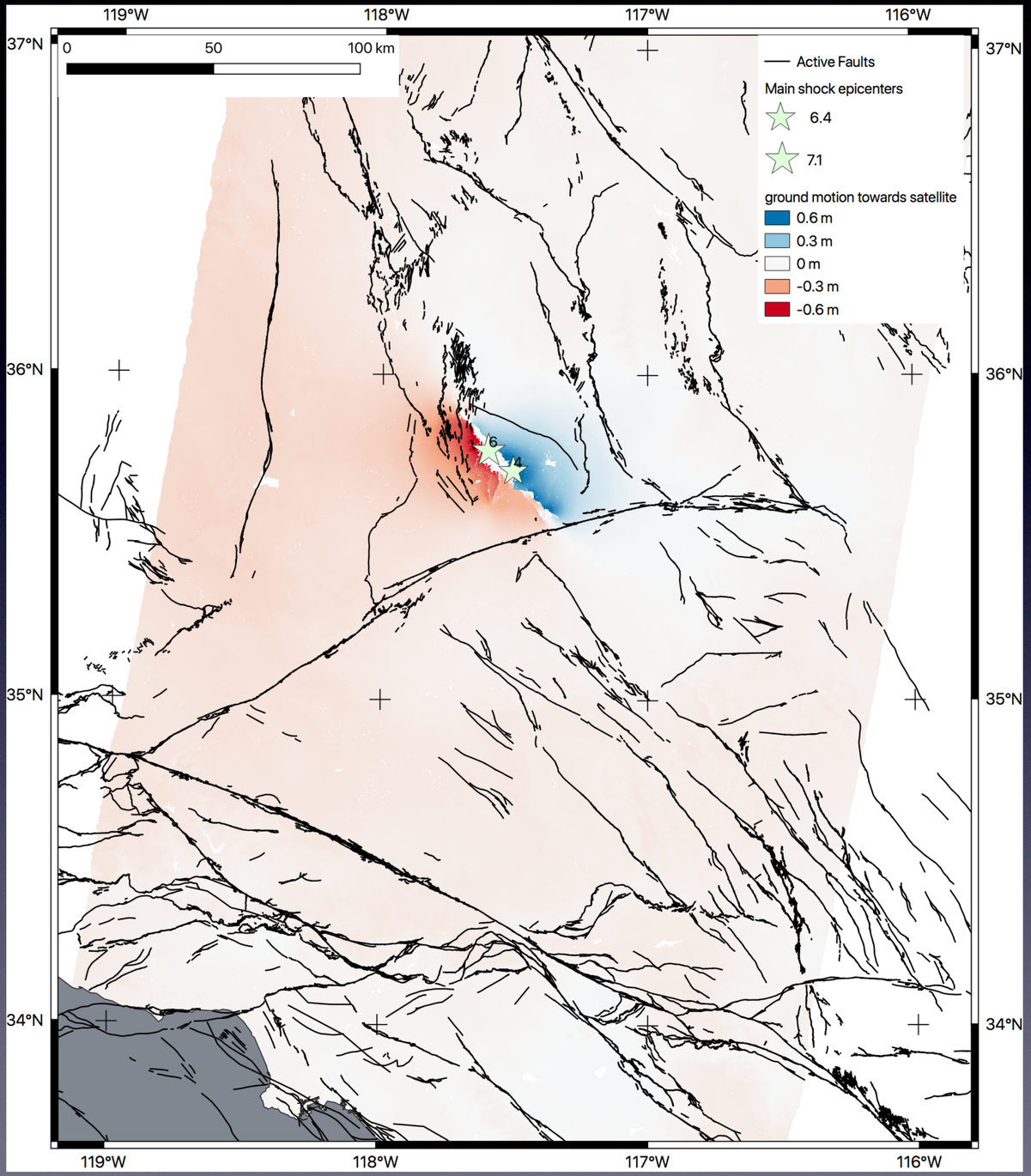
map Zheng-Kang Shen, UCLA, pers. comm.

Radar Interferometry

Copernicus Sentinel-1
SAR 2019/07/04 and 07/16

Radar line-of-sight

NASA Caltech-JPL ARIA processing



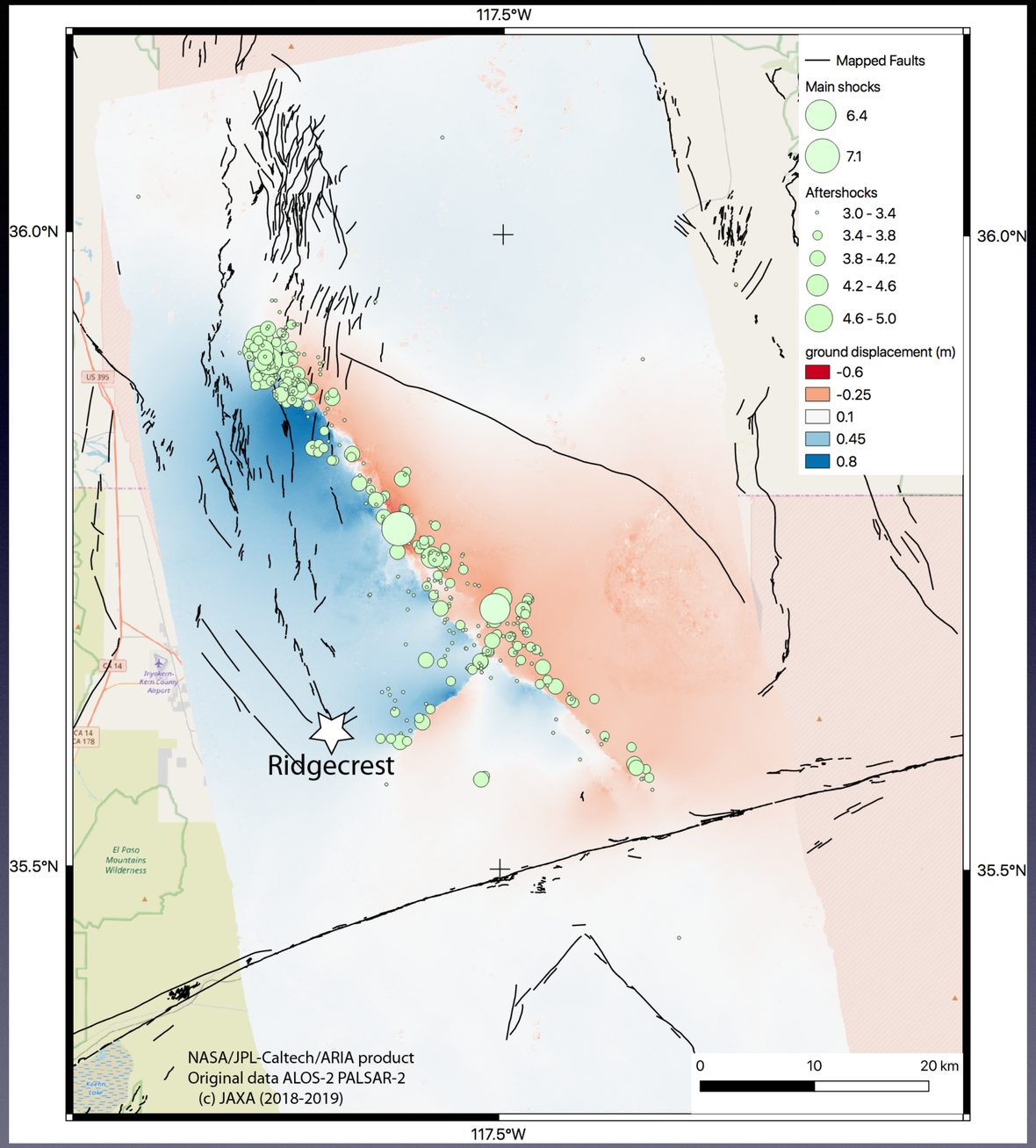
Contains modified Copernicus Sentinel data, processed by ESA. Analyzed by the NASA-JPL/Caltech ARIA team.

Radar Interferometry

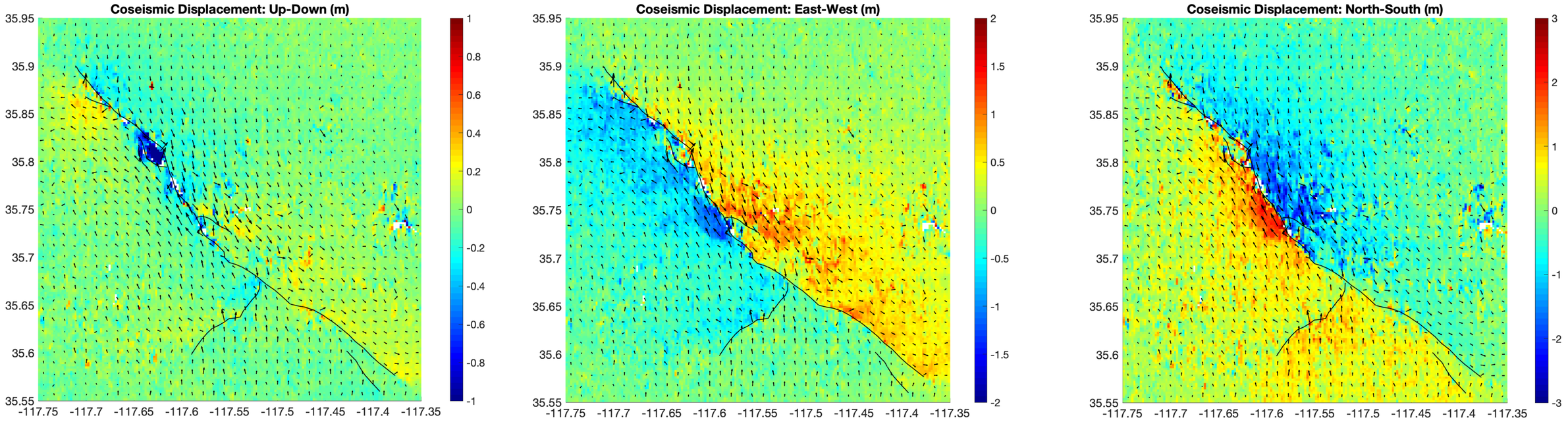
JAXA ALOS-2 SAR
2018/04/16 and
2019/07/08

Radar line-of-sight

NASA Caltech-JPL ARIA
processing



Radar pixel tracking

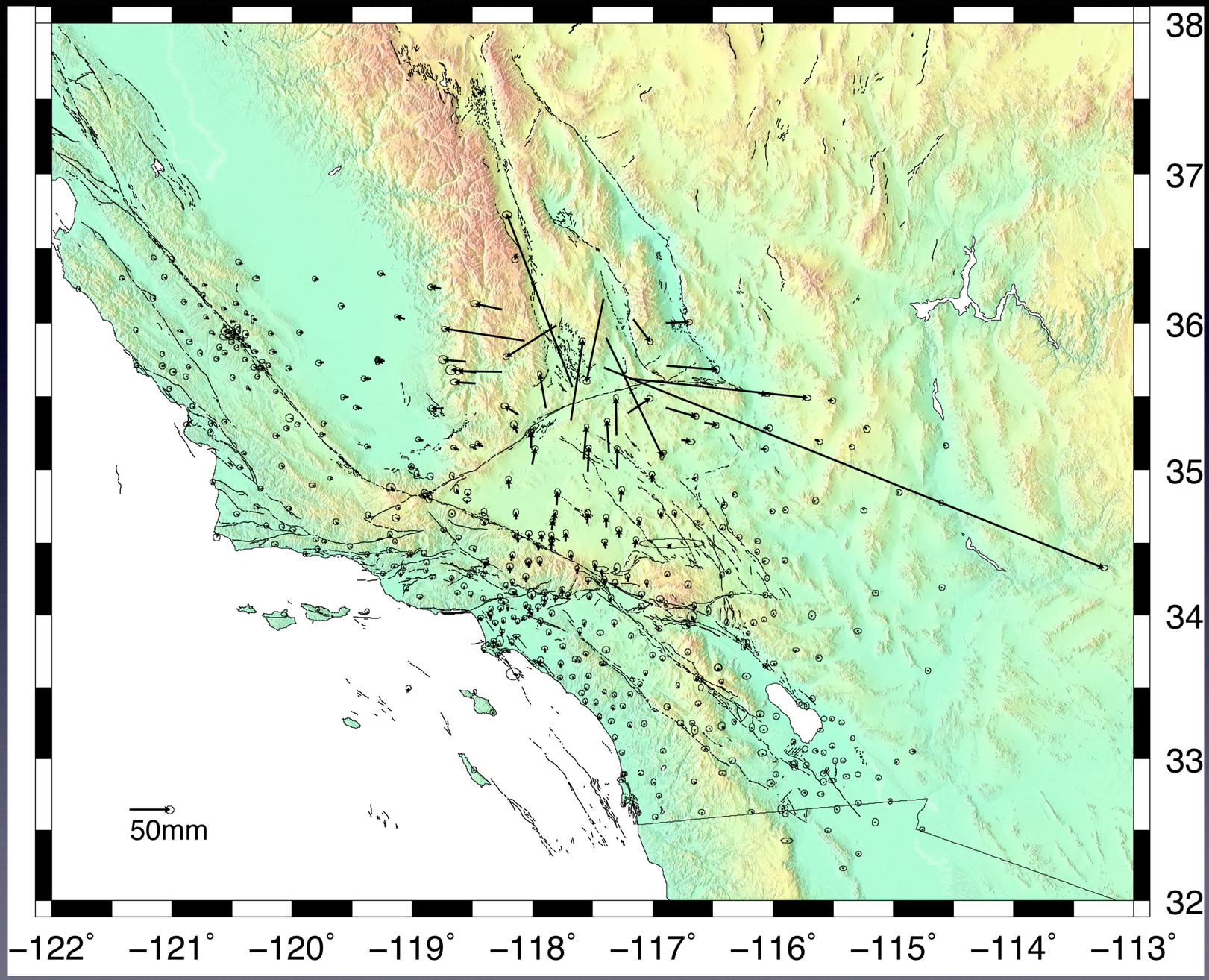


Copernicus Sentinel-1 SAR 2019/07/04, 07/10 and 07/16
pixel offsets from SAR image cross-correlation
combined two tracks to get 3D
Mong-Han Huang, University of Maryland

GPS coseismic

GPS offsets from two earthquakes together

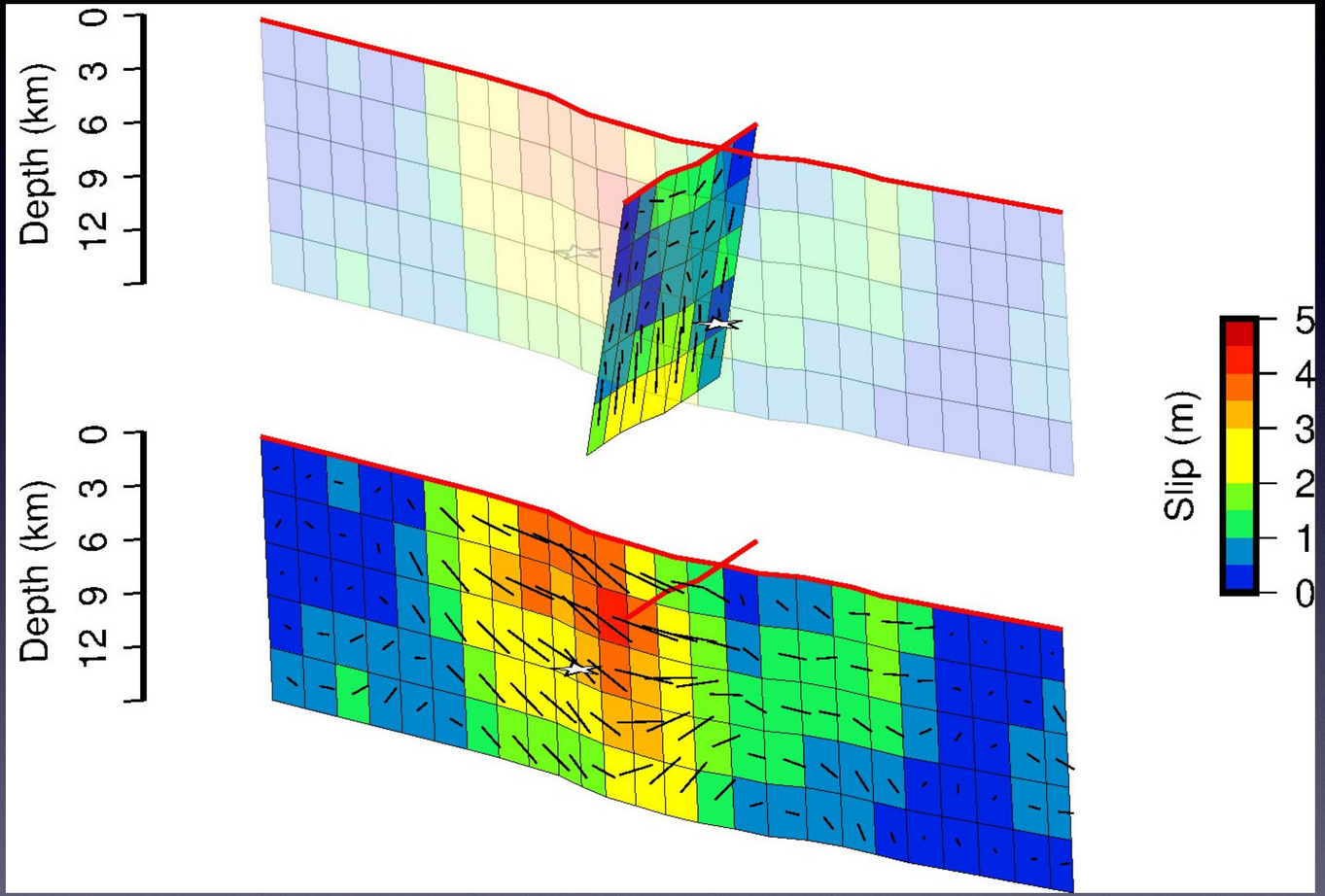
NASA Caltech-JPL ARIA processing



Fault Slip Models

Surface deformation maps (InSAR and GPS) constrain fault slip models

Preliminary model of both events with simple faults



Courtesy Benjamin Idini, Caltech

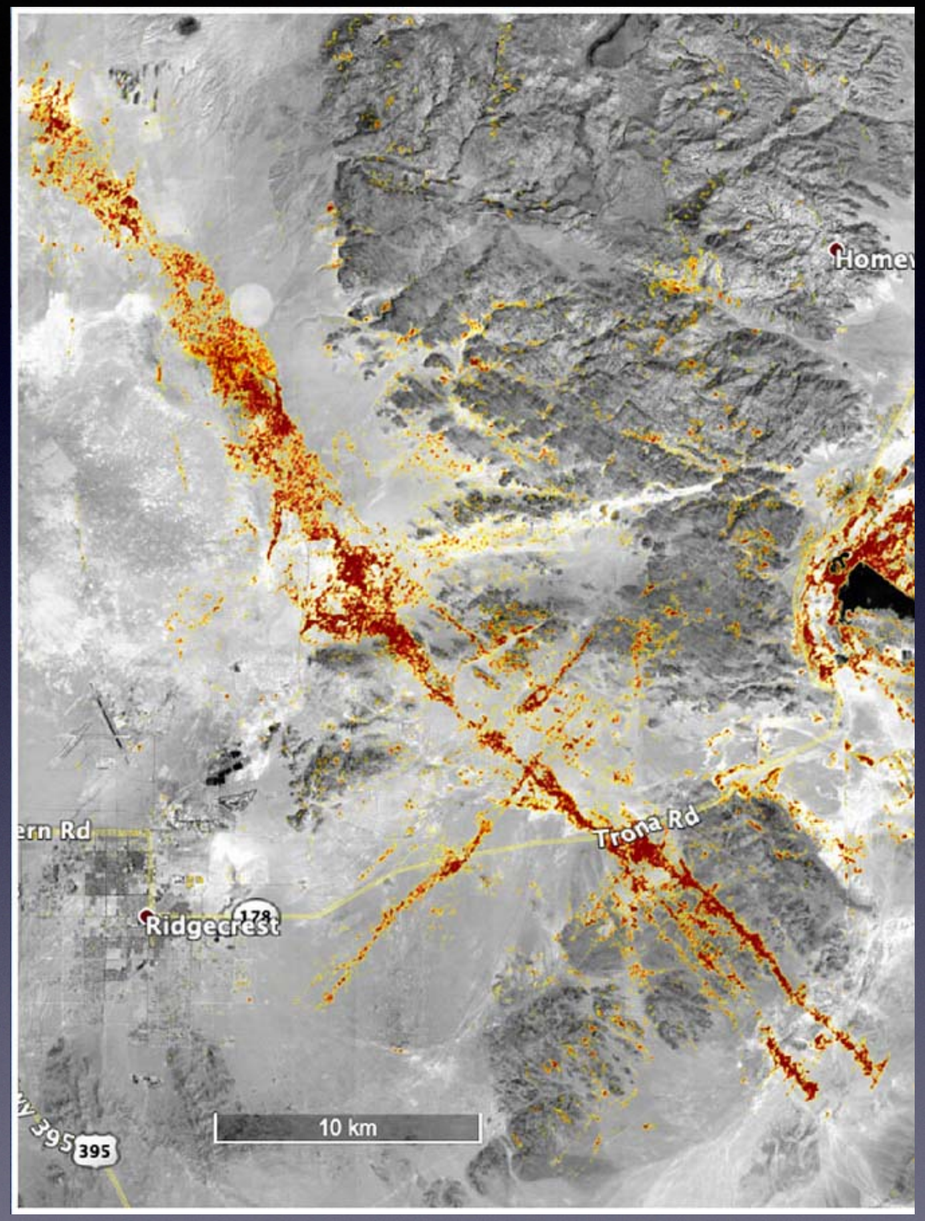
Damage Proxy Maps

Copernicus Sentinel-1 SAR
2019/06/28, 07/04, and 07/10

Change of interferometric coherence

NASA Caltech-JPL ARIA processing

map by Sang-Ho Yun, JPL and Google Earth



Contains modified Copernicus Sentinel data, processed by ESA. Analyzed by the NASA-JPL/Caltech ARIA team.

Conclusions

- Main rupture of Mw 6.4 earthquake left-lateral on NE-trending fault
- Main rupture of Mw 7.1 earthquake right-lateral on NW-trending fault
- Complex pattern of fault ruptures in the earthquake sequence
- Surface deformation mapped by radar satellites constrains models of fault slip at depth
- Radar also maps change due to faulting and other surface damage
- NASA-ISRO SAR (NISAR) mission launching January 2022