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Pre-Earthquake Deformation, Coseismic Displacements and Post-Earthquake Transient Motions in the Region of the Ridgecrest Earthquakes From Survey and Continuous GNSS Observations

Michael Floyd¹, Gareth Funning², Rachel Terry^{2,+}, Yuri Fialko³, William Hammond⁴, Thomas Herring¹

¹Massachusetts Institute of Technology, ²University of California, Riverside (⁺now at UNAVCO), ³Scripps Institution of Oceanography, University of California, San Diego, ⁴Nevada Geodetic Laboratory, University of Nevada, Reno





Network of the Americas (NOTA) [Formerly PBO (including SCIGN), COCONet and TLALOCNet networks]

Las Vegas

100 km

Google Earth

PBO Network Status

GPS LSM BSM Seismic Tik San Jose

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0.00.00

Fresno

© 2018 Google Image Landsat / Copernicus Data LDEO-Columbia, NSF, NOAA © 2018 INEGI Los Angeles

Riverside

lacksquare

Bakersfield



Meade and Hager (2005), Figure 9





Office







Zack Young Aren Crandall-Bear Bret Pecoraro Bill Hammond Geoff Blewitt Corne Kreemer

7 stations deployed near Ridgecrest 55 moved to the SW of their network







8 stations deployed (7 semi-continuously)

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Yuri Fialko Jennifer Haase David Sandwell Ignacio Sepulveda Zeyu Jin Katia Tymofyeyeva Xiaohua Xu Ben Brooks Jerry Svarc Eleyne Phillips Mark Murray

CCC

Ashtech



4 short baseline cross-fault arrays 9 sites surveyed (5 on base)



Post– M_w 6.4 earthquake sites

Post– M_w 7.1 earthquake sites









$$M_w 6.4 + 1 \, day$$

Estimated displacements due to M_w 6.4 25 ± 2 mm (95% conf.) - Continuous - Survey 36°30'N 36°00'N () 90 35°30'N Ð 100 km 35°00'N



Five UCR survey sites within 30 km of rupture augment continuous network

Maximum displacements

P595: 10.7 cm PNCL: 7.2 cm

119°00'W 118°30'W 118°00'W 117°30'Ŵ 117°00'W 116°30'W 116°00'W

 M_{w} 7.1 + 4 days

Estimated displacements due to M_w 7.1 100 ± 2 mm (95% conf.) Continuous Survey 36°30'N 36°00'N 35°30'N 35°00'N



Additional five SIO/UCSD survey sites and four NGL/UNR semi-permanent sites augment continuous network for estimating cumulative displacements

Maximum displacements P595: 59.0 cm; TOWG: 58.2 cm

119°00'W 118°30'W 118°00'W 117°30'W 117°00'W 116°30'W 116°00'W PNCL: 80.9 cm







Summary



1945716 (Hammond) 1945728 (Funning) 1945760 (Fialko)



14189 (Funning)
18201 (Funning and Terry)
19106 (Floyd and Herring)

- Survey GNSS field work, particularly earthquake response, still happens
 - Continues to fill near-field gaps, even in the presence of dense continuous networks
 - We need a mechanism to disseminate results from the field quickly and publicly
 - Exchange of survey processed solutions (e.g. SINEX), in addition to raw/RINEX data, would be extremely helpful and facilitate such rapid survey coseismic solutions
- Maximum coseismic displacements are 10.7 cm east of M_w6.4 earthquake, and 58–59 cm (cont.; P595, P580) and 80 cm (surv.; PNCL) southeast of M_w7.1 earthquake
- Cumulative post-earthquake geodetic motion is 2.5 cm (cont.; P595) and 3.5 cm (surv.; PNCL) over four-and-a-half months since earthquakes
 - Any transient motion is, so far, a small fraction (3–4%) of the coseismic displacement
 - cf. South Napa earthquake at about 20–30%

Papers

Floyd, M., G. Funning, Y. Fialko, R. Terry, and T. Herring (in press), Survey and continuous GNSS in the vicinity of the July 2019 Ridgecrest earthquakes, *Seismol. Res. Lett.*

Data

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- Funning, G., R. Terry, and M. A. Floyd (2019), SCEC Mojave 2019, UNAVCO, Inc., GPS/GNSS Observations Dataset, doi:10.7283/TFX5-EJ21.

Products

- Blewitt, G., W. C. Hammond, and C. Kreemer (2018), Harnessing the GPS data explosion for interdisciplinary science, *Eos*, *99*, doi:10.1029/2018EO104623. http://geodesy.unr.edu/
- Herring, T. A., T. I. Melbourne, M. H. Murray, M. A. Floyd, W. M. Szeliga, R. W. King, D. A. Phillips, C. M. Puskas, M. Santillan, and L. Wang (2016), Plate Boundary Observatory and related networks: GPS data analysis methods and geodetic products, *Rev. Geophys.*, 54, doi:10.1002/2016RG000529. https://www.unavco.org/highlights/2019/ridgecrest.html