

Characterization of Shallow Slip Variability in California UAVSAR Repeat-Pass Interferograms



National Aeronautics and Space Administration



Jay Parker, Andrea Donnellan, Margaret Glasscoe

Jet Propulsion Laboratory/California Institute of Technology

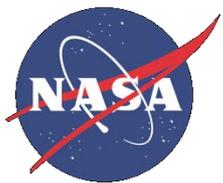
Marlon Pierce, Jun Wang

Indiana University

With thanks to NASA programs:

Advanced Information Systems Technologies, Earth Surface and Interior

Applications of Geodetic Imaging, Decision Support Through Earth Science Research Results



UAVSAR Pod On Gulfstream III

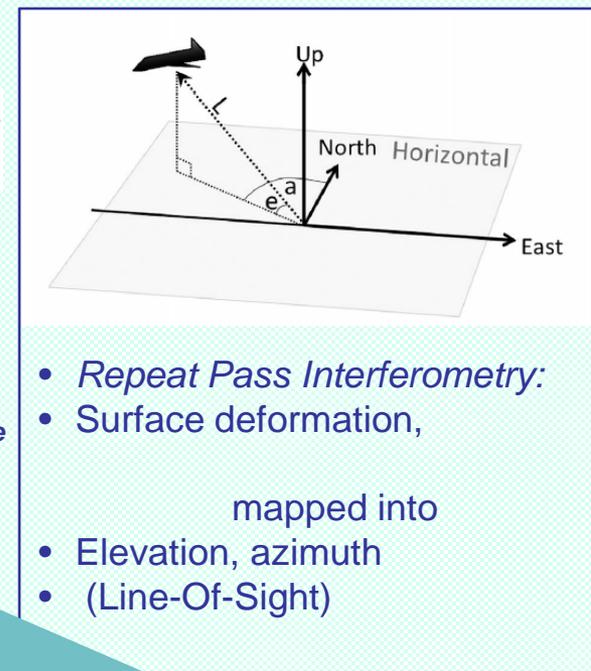
Gulfstream 3 semi-piloted aircraft



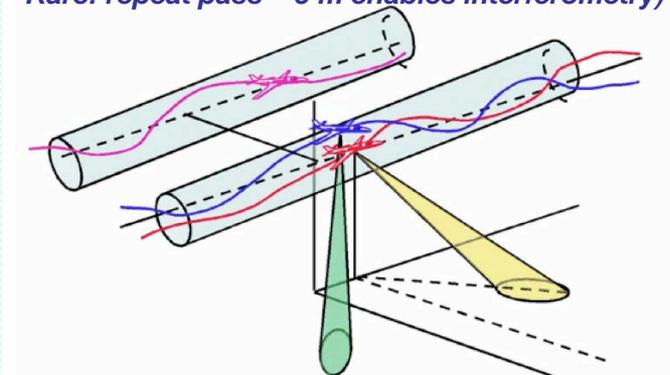
- Radar for studying earth processes
- Repeat visit → landscape *change* image
- High-definition: 7 m pixel size:
- >120 Megapixel images
- Sensitive: sees 1 cm surface fault slip

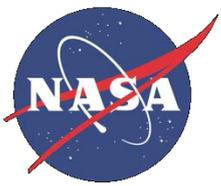


One day on Global Hawk or other drone?



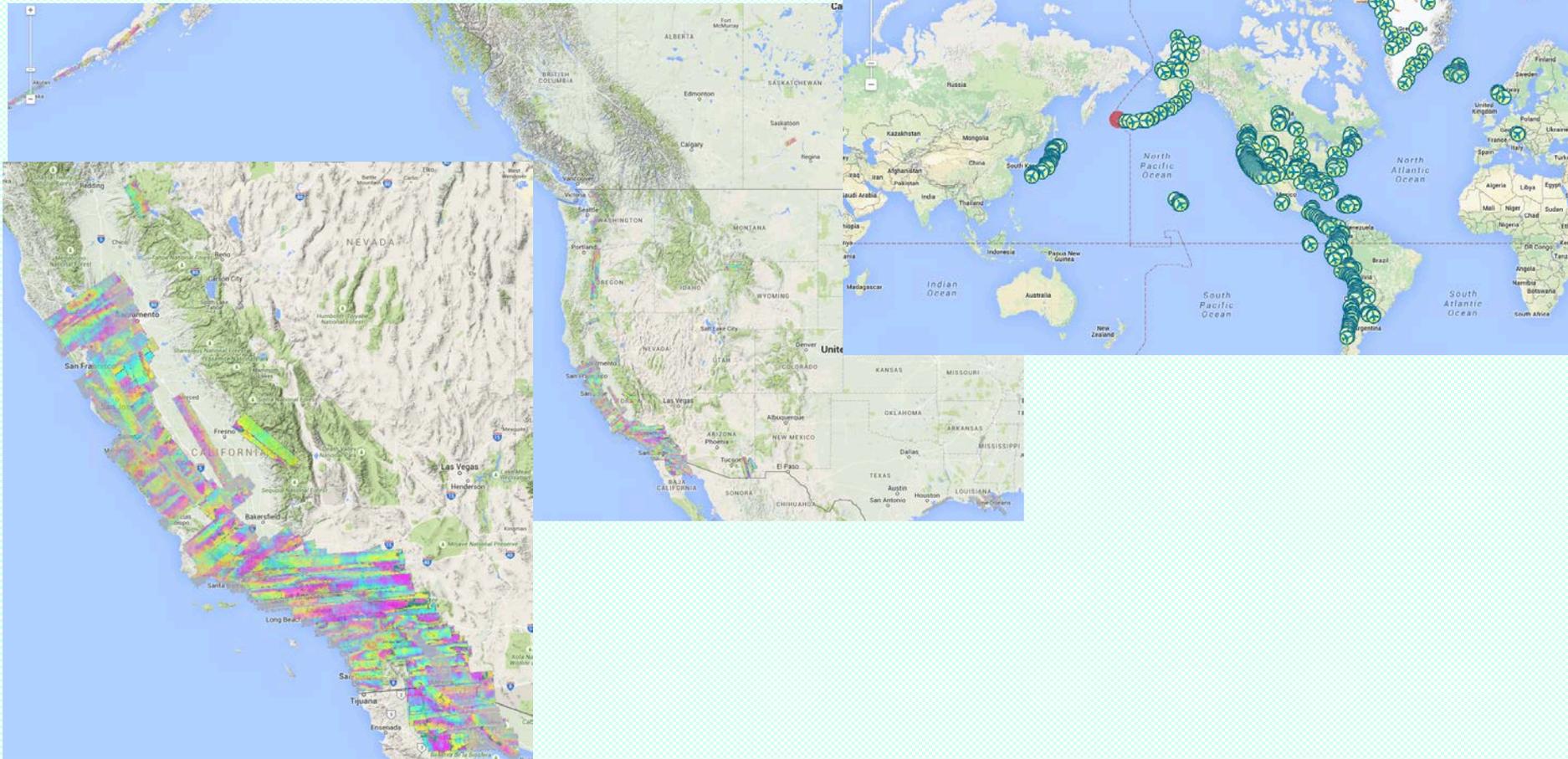
Rare: repeat pass ~ 5 m enables interferometry)

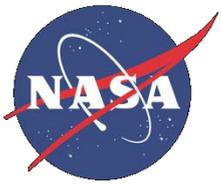




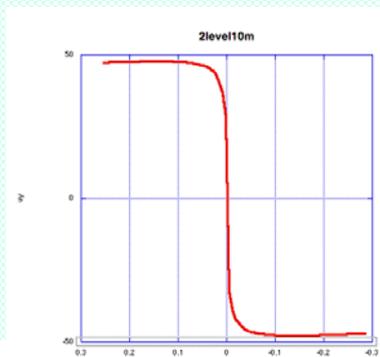
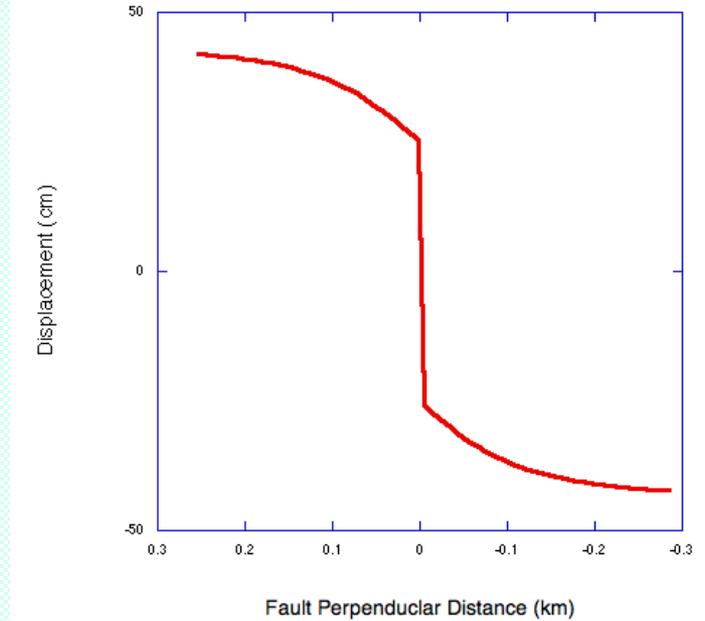
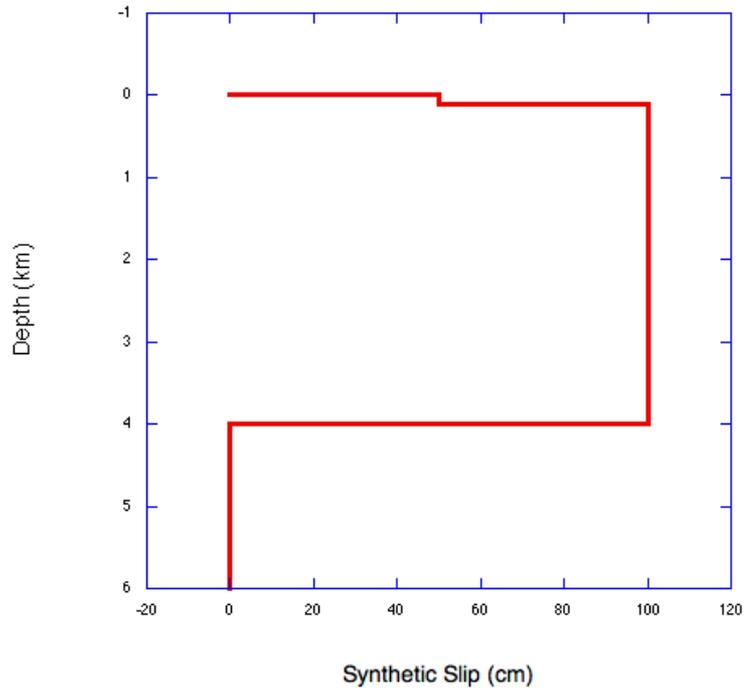
UAVSAR flights, public interferograms

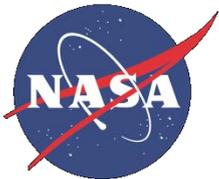
- Global maps, top: uavsar.jpl.nasa.gov flights; center: Geo-Gateway interferograms. Each flight line has potentially many repeats.



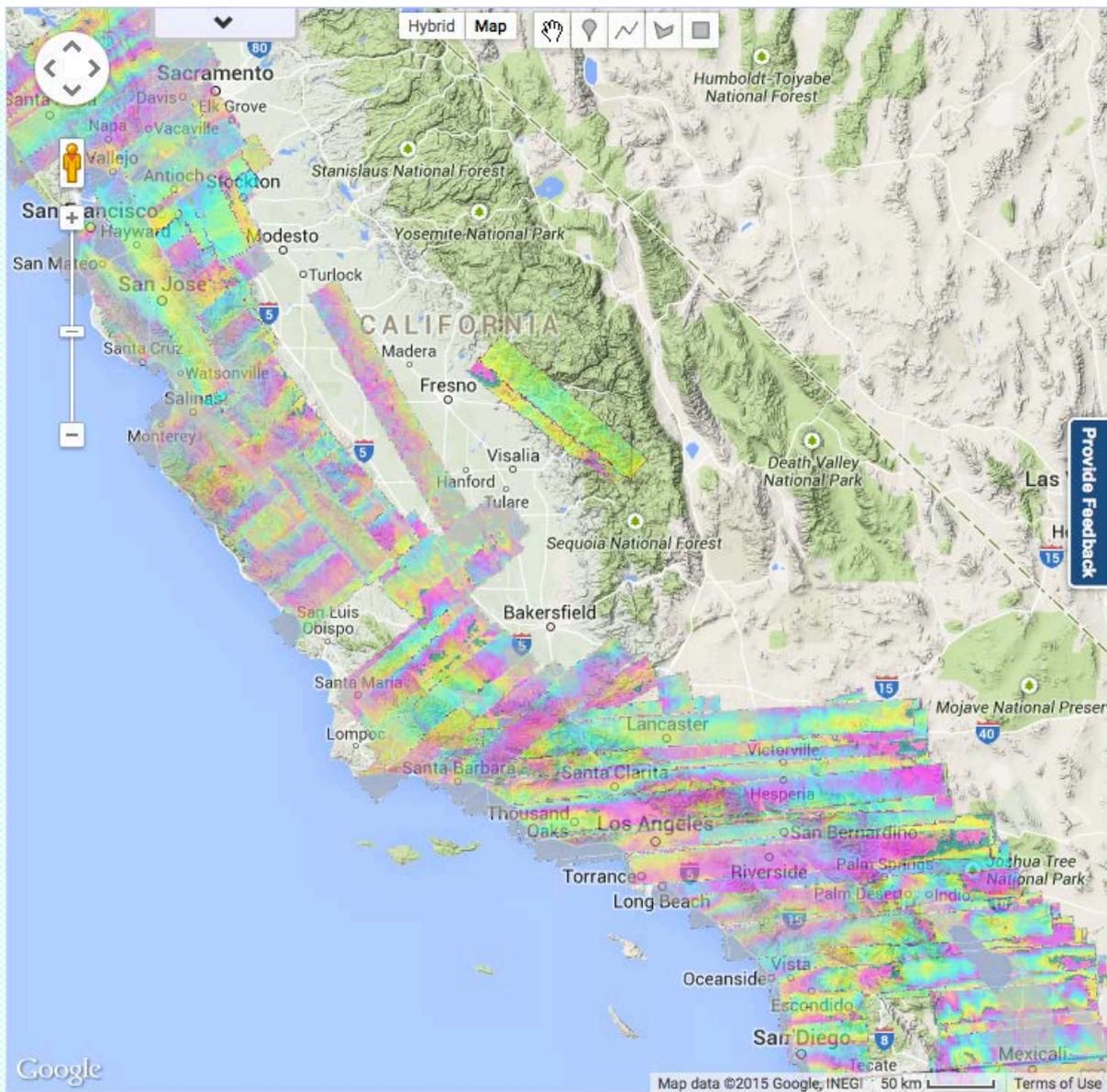


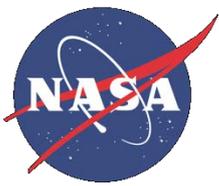
Simulation: two slip depths





Locations of Study Areas





South Napa Earthquake, Line 23511

Map Tools Magnitude Disloc Forecast GPS Reset Help

Map Tools

KML Mapper

UAVSAR
Use drawing tool on the map to select the region of interests. You can also search by flight name or flight path:
23511
(Optional) Event date (MM/DD/YYYY): mm/dd/yyyy

Fade/Reset Display: X

Heading:-125.270847° Radar Direction:Left

Lat, Lon:38.27336,-122.33986

Lat, Lon:38.27458,-122.33385

[Go to download page for selected data set](#)

Experimental feature: enable coloring if available

Start Lat: 38.27336 Start Lon: -122.3398

End Lat: 38.27458 End Lon: -122.3338

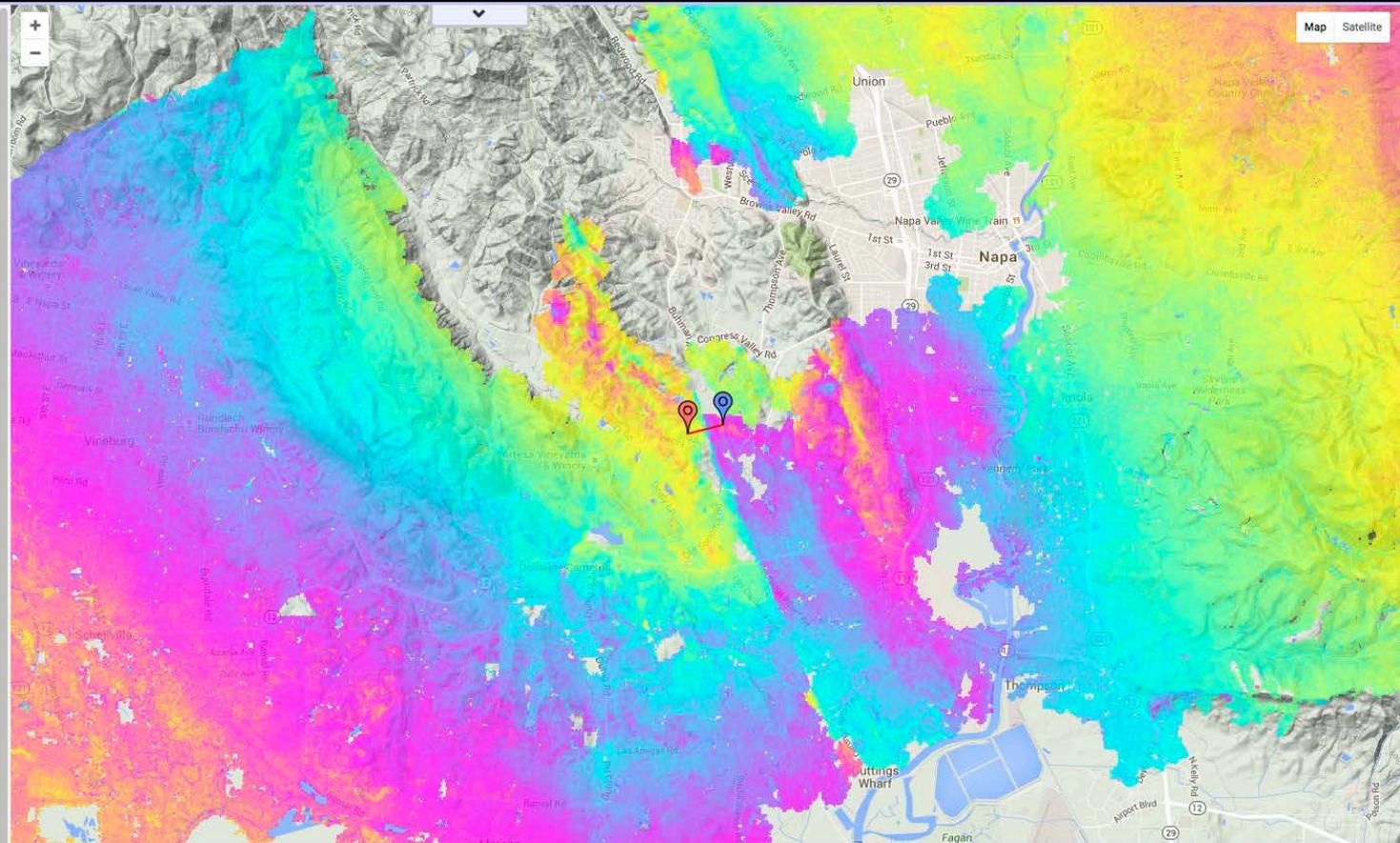
Azimuth: 75.5

Length: 0.542

Sampling Distance (meters):

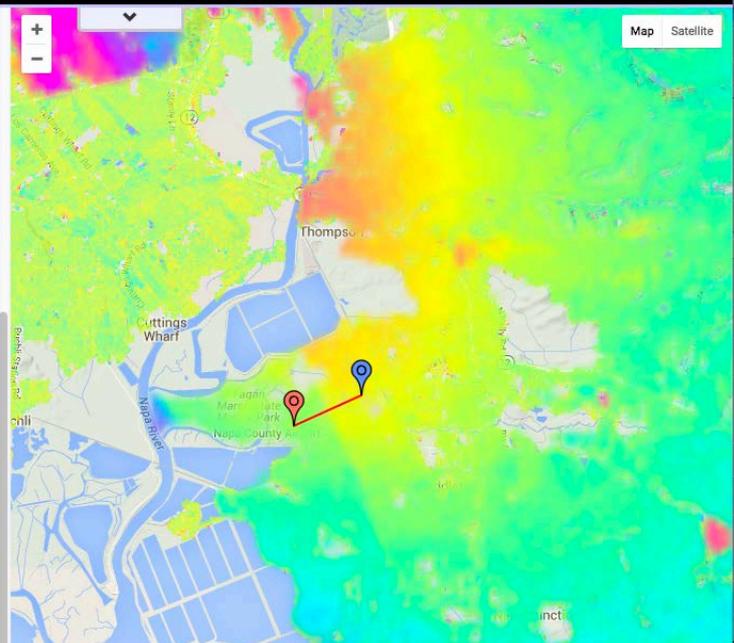
[Download LOS Data](#)

<input type="checkbox"/>	SanAnd_23511_10037-010_10077-009_0170d_s01_L090HH_01	11-May-2010 22:45:55 UTC	28-Oct-2010 21:40:02 UTC
<input type="checkbox"/>	SanAnd_23511_14068-001_14128-002_0092d_s01_L090HH_01	29-May-2014 18:52:06 UTC	29-Aug-2014 17:49:16 UTC
<input checked="" type="checkbox"/>	SanAnd_23511_14068-001_14128-002_0092d_s01_L090HH_01_bh1	29-May-2014 18:52:06 UTC	29-Aug-2014 17:49:16 UTC
<input type="checkbox"/>	SanAnd_23511_14068-001_14128-002_0092d_s01_L090HH_02	29-May-2014 18:52:06 UTC	29-Aug-2014 17:49:16 UTC
<input type="checkbox"/>	SanAnd_23511_14128-002_14157-007_0054d_s01_L090HH_01	29-Aug-2014 17:48:46 UTC	22-Oct-2014 21:17:38 UTC



Start Lat: 38.21306 **Start Lon:** -122.2841
End Lat: 38.21590 **End Lon:** -122.2760
Azimuth: 66.0
Length: 0.777
Sampling Distance (meters): 7

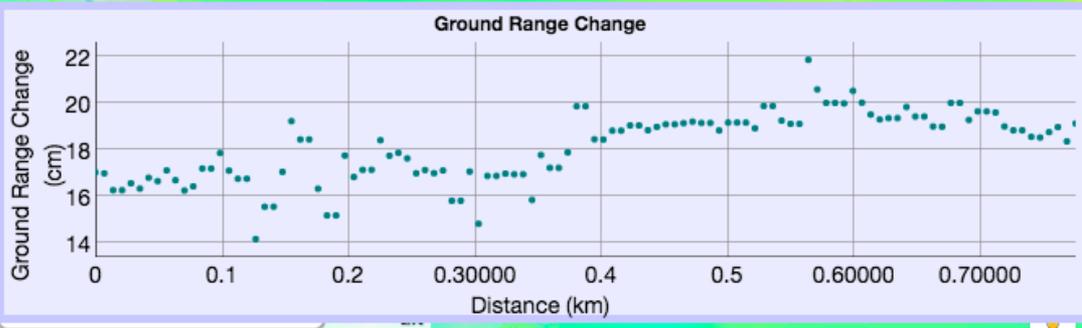
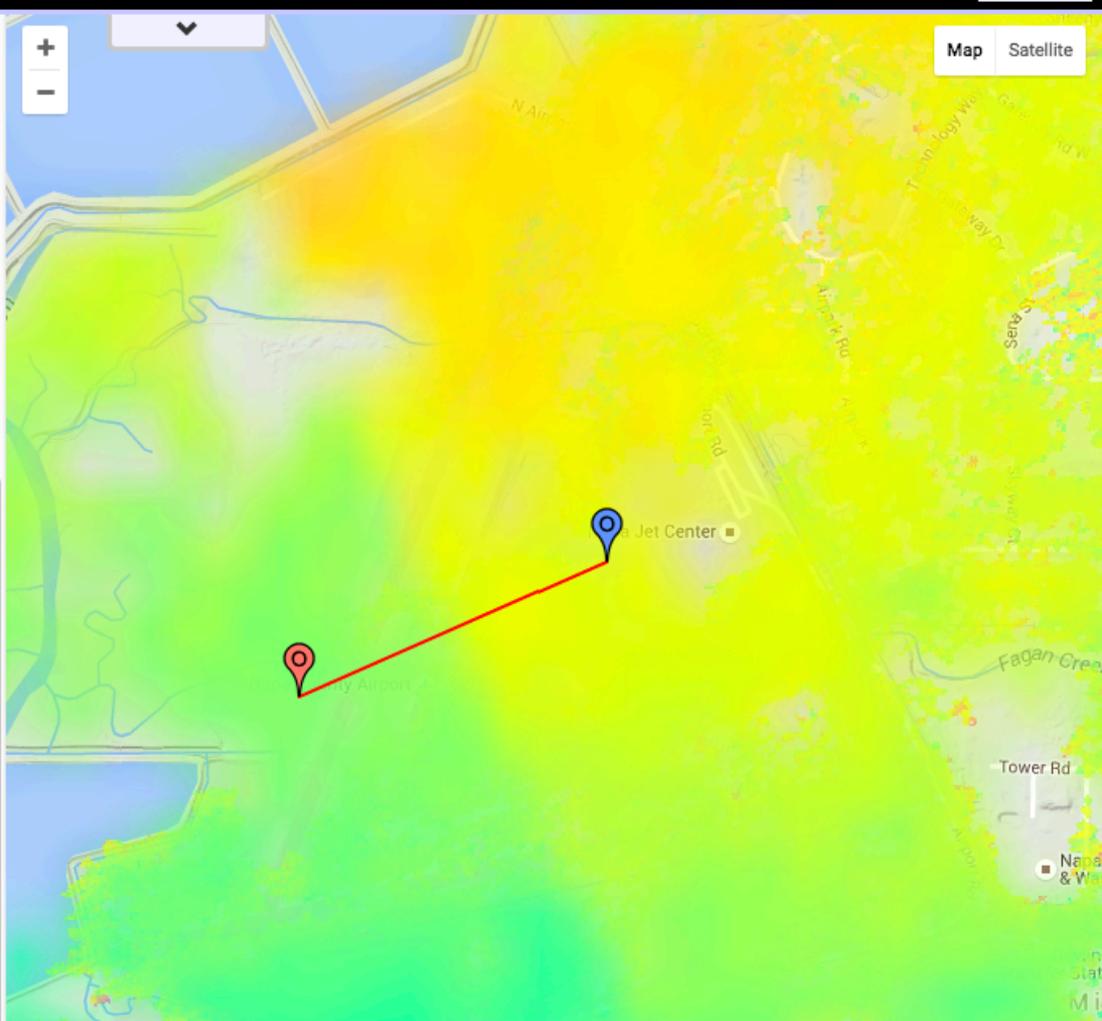
Tools: SERCPages Genealo JPL SW Meshing Other Bookmarks
 Analysis, Modeling, and Response of Geodetic Imaging Products

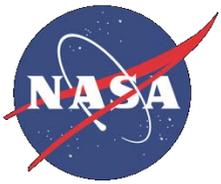


SanAnd_05510_13165-004_14068-000_0210d_s01_L090HH_01
 31-Oct-2013 18:39:34 UTC 29-May-2014 18:33:59 UTC

SanAnd_05510_13165-004_14157-006_0356d_s01_L090HH_01
 31-Oct-2013 18:39:05 UTC 22-Oct-2014 20:58:30 UTC

- UCERF3 Faults
- Show State Boundaries
- Show Coastlines
- Show Your Location





Superstition Hills, Elmore Ranch, Imperial

Lat, Lon: 32.91436, -115.70183
Lat, Lon: 32.93223, -115.68629
Go to download page for selected data set

Experimental feature: enable coloring if available
Start Lat: 32.91436 Start Lon: -115.7018
End Lat: 32.93223 End Lon: -115.6862

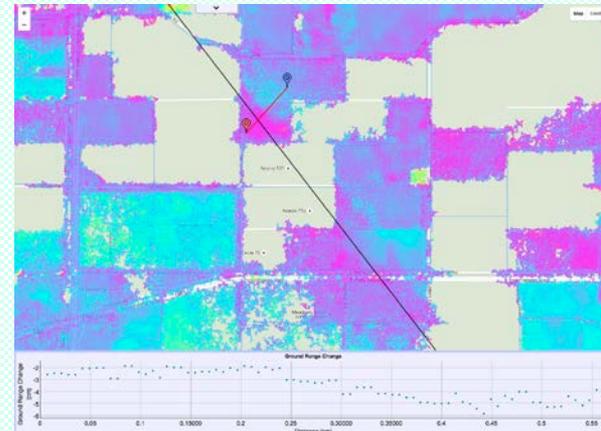
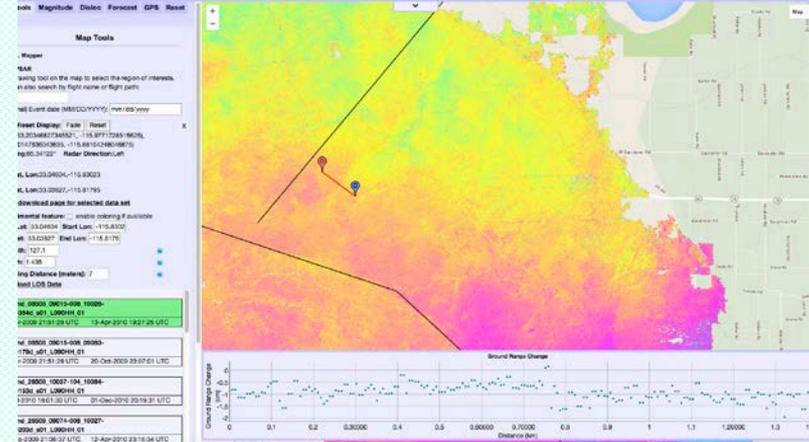
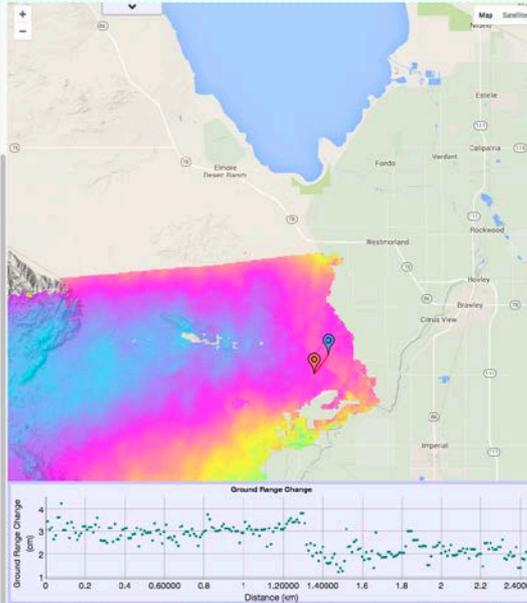
Azimuth: 36.1
Length: 2.462

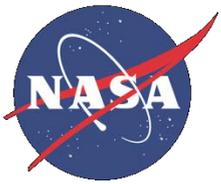
Sampling Distance (meters): 10

Download LOS Data

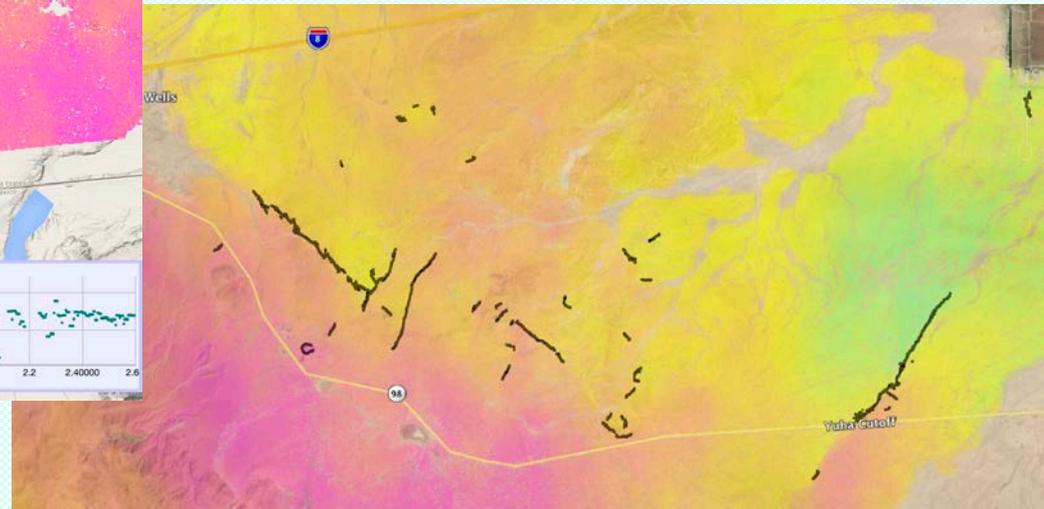
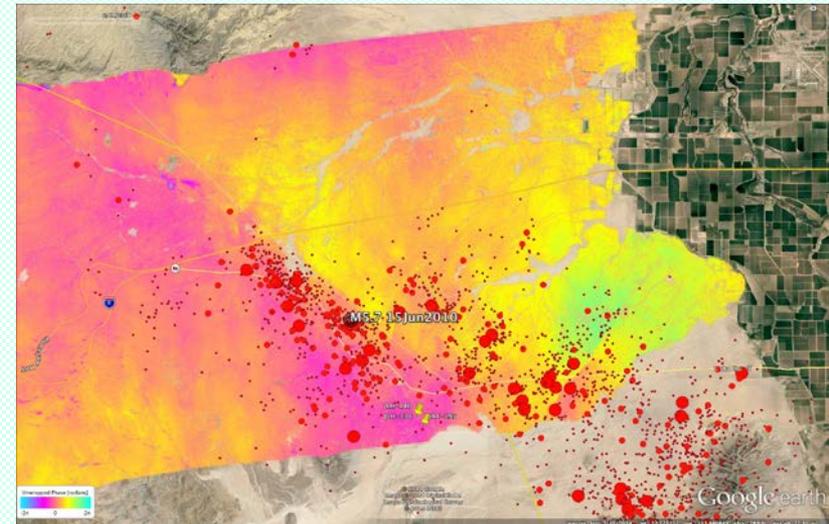
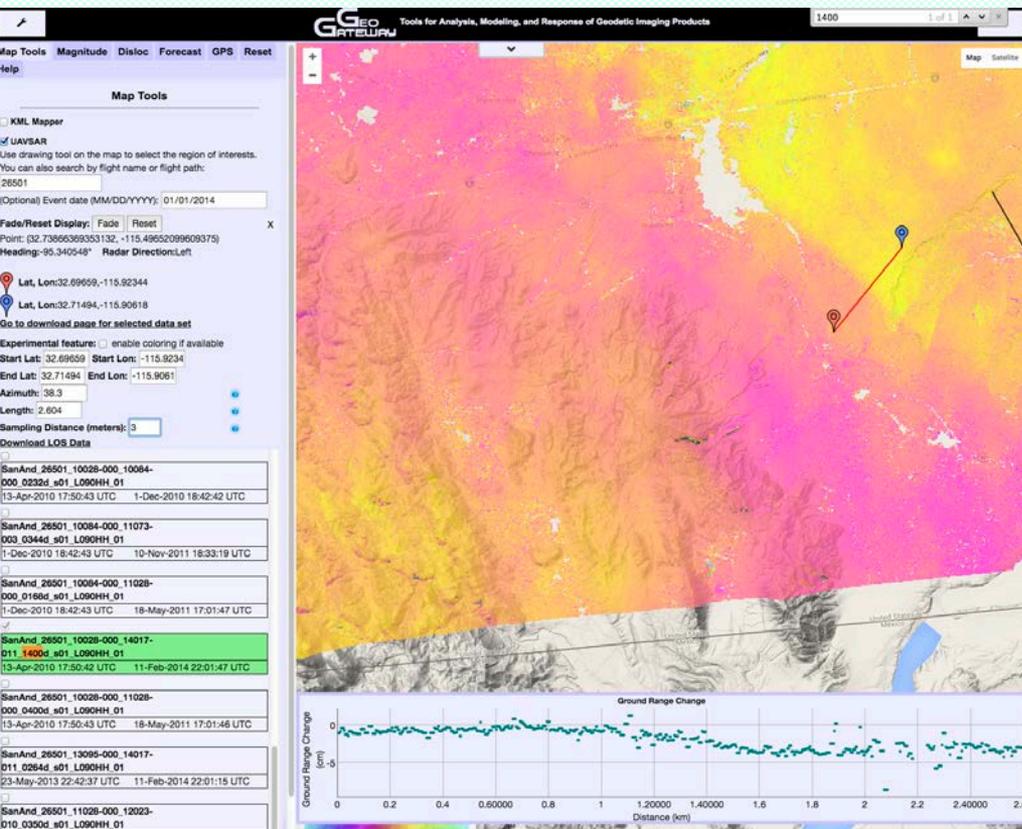
- SanAnd 26050_09083-006_10027-005_017462_s01_L090HH_99
20-Oct-2009 23:27:08 UTC 12-Apr-2010 22:18:50 UTC
- SanAnd 08508_09083-005_10028-004_017562_s01_L090HH_01
20-Oct-2009 23:14:52 UTC 13-Apr-2010 19:34:46 UTC
- SanAnd 08508_09083-005_10071-002_034362_s01_L090HH_01
20-Oct-2009 23:14:52 UTC 28-Sep-2010 19:21:42 UTC
- SanAnd 08508_09015-008_10057-102_043362_s01_L090HH_01
24-Apr-2009 21:58:59 UTC 1-Jul-2010 17:52:18 UTC
- SanAnd 08508_09015-008_10071-006_052942_s01_L090HH_01
24-Apr-2009 21:58:36 UTC 28-Sep-2010 19:21:42 UTC
- SanAnd 26050_09083-006_10071-002_034362_s01_L090HH_01
20-Oct-2009 23:36:50 UTC 28-Sep-2010 18:48:00 UTC
- SanAnd 08508_09083-005_10057-102_025942_s01_L090HH_01
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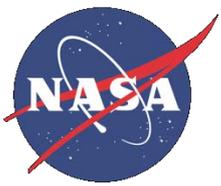
UCERF3 Faults
 Show State Boundaries
 Show Coastlines





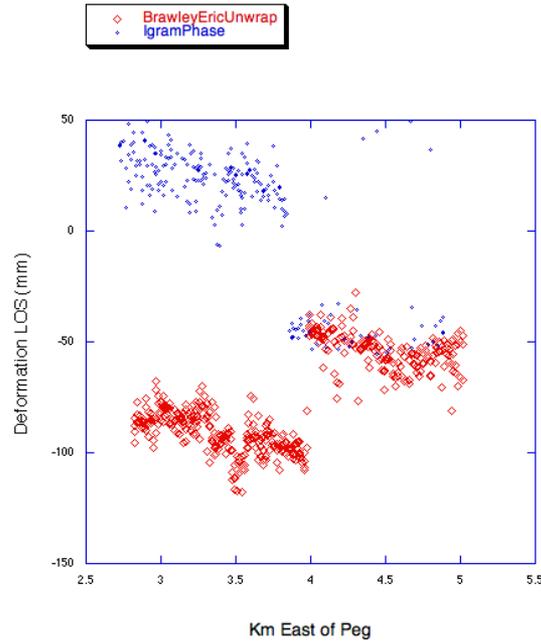
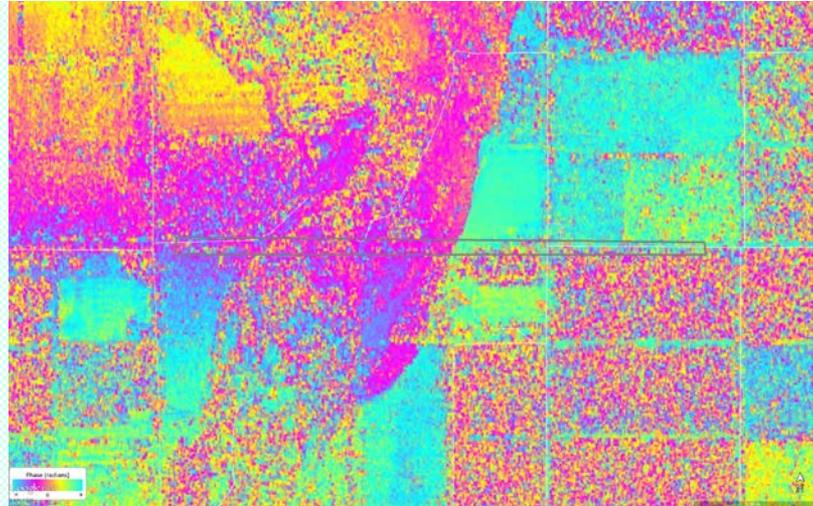
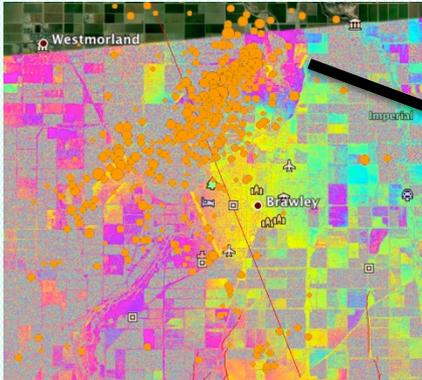
M5.7 Transition Fault June 15, 2010

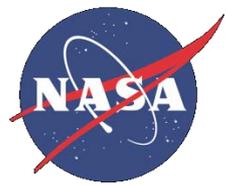




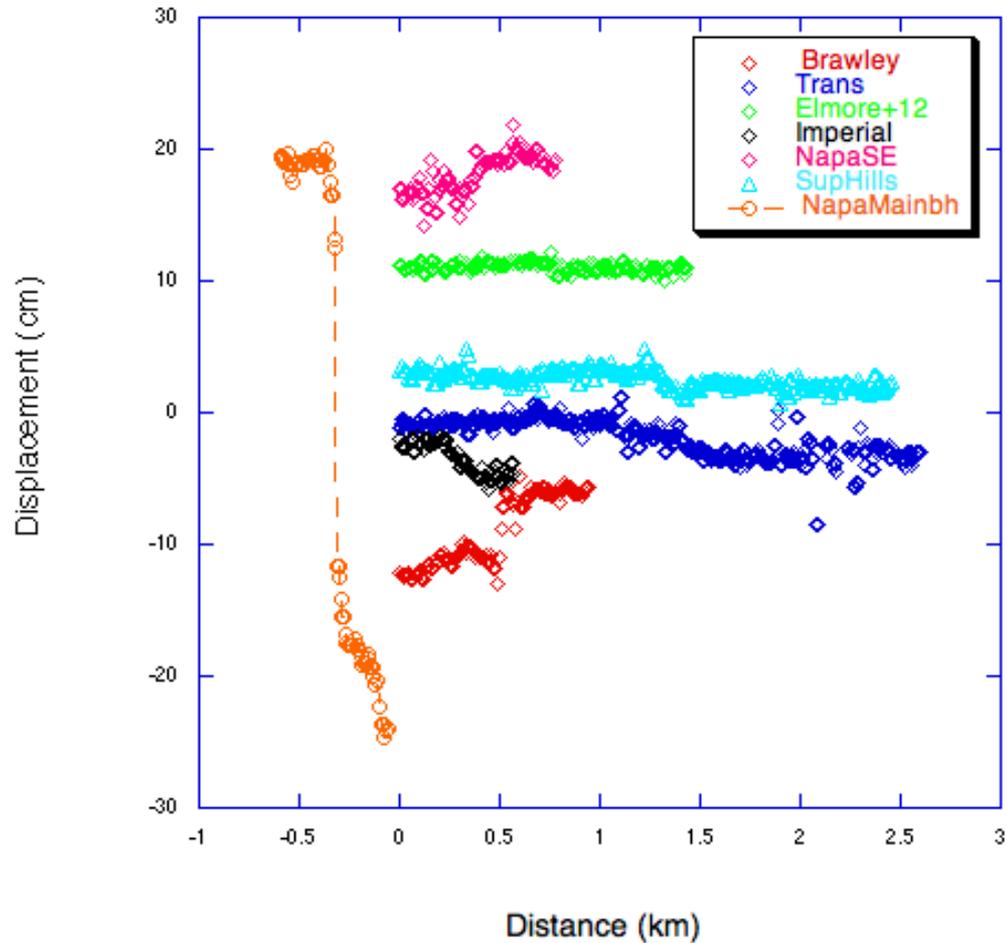
Brawley Swarm August 2012

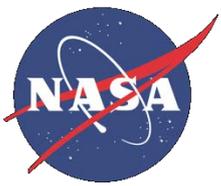
Brawley Swarm Imperial Valley, 2012



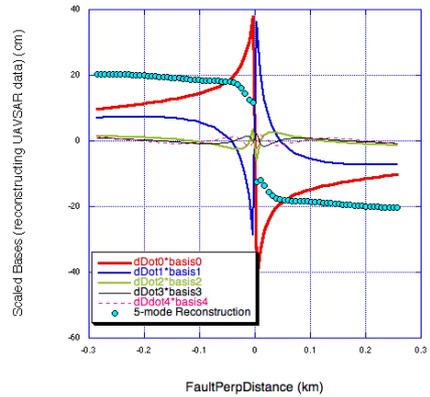


Slip Patterns Compared

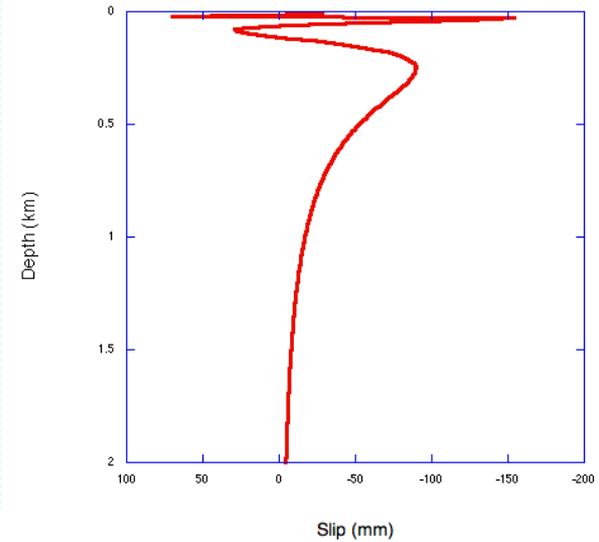
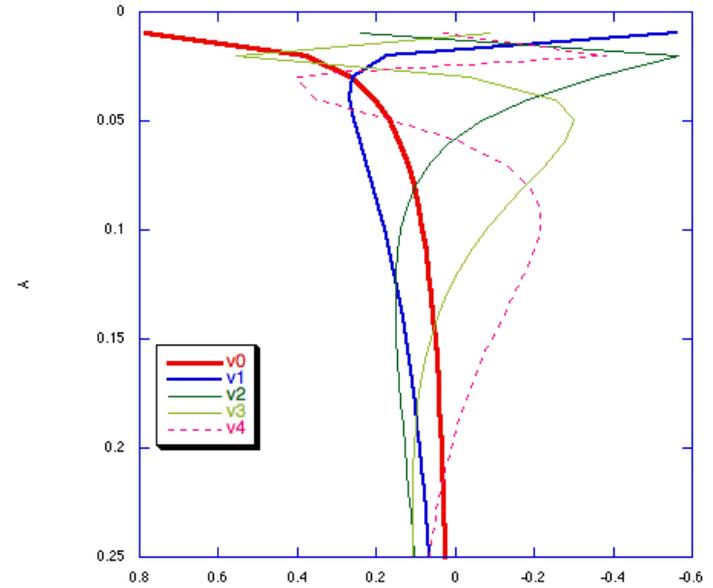
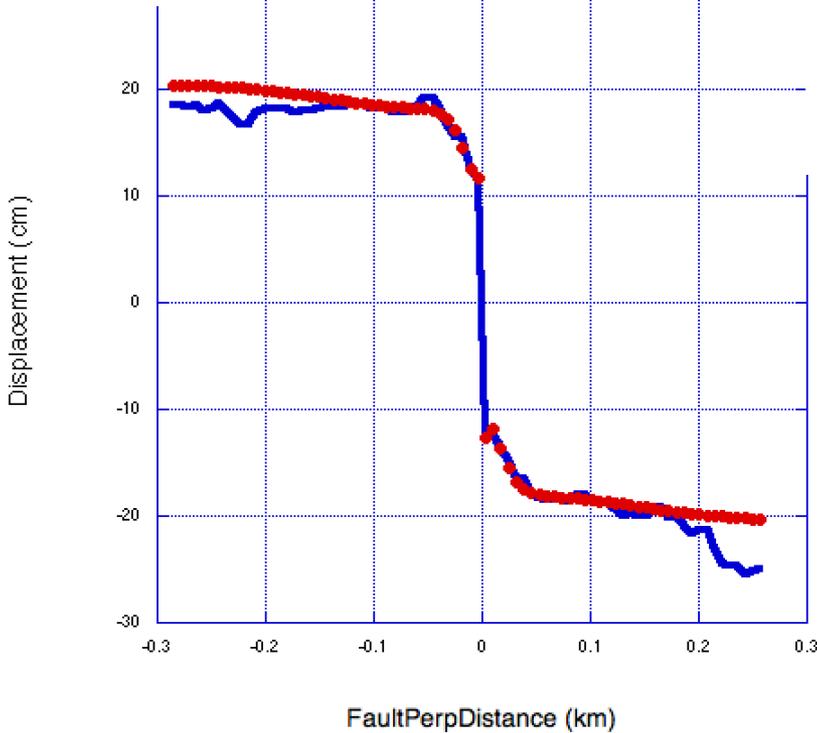




South Napa: Inversion and Reconstruction



5-mode Reconstruction
CenteredJump UAVSAR





Next Steps, Conclusions

Next Steps

- Determine detectable slip patterns for smaller cases
- Try constrained inversion
- Extend to dipping faults, dip slip
- Compare with satellite InSAR.

Conclusions

- Shallow slip variability reproduces UAVSAR fault features
- High UAVSAR sampling rate appears to improve near-surface resolution