

# Improving UAVSAR Results with GPS, Radiometry, and QUAKEs Topographic Imager

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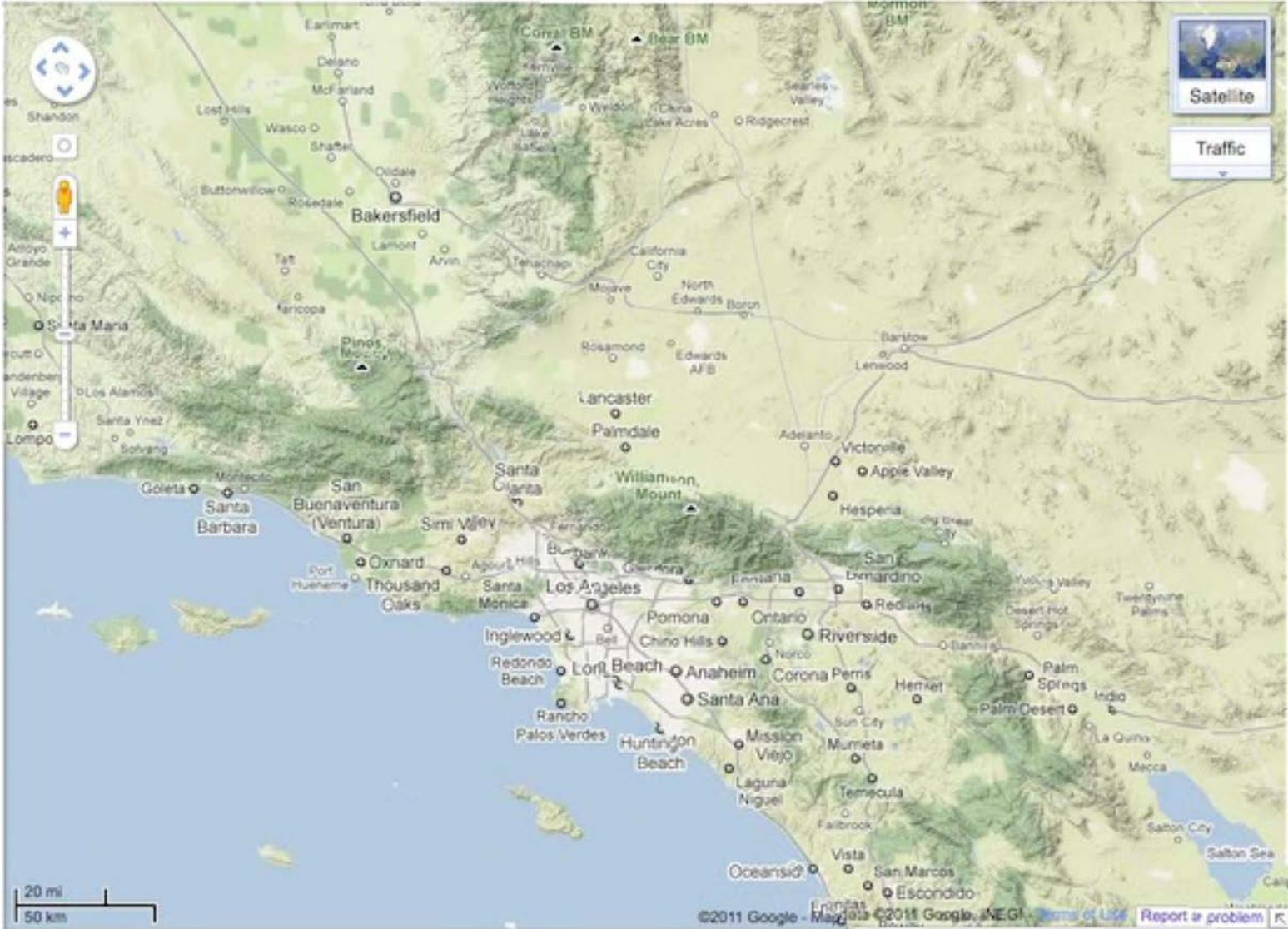
*Jet Propulsion Laboratory, California Institute of Technology*



# Observing Land Surface Processes with Geodetic Imaging



# Conceptual View of Southern California Fault Motions



# UAVSAR

- NASA's L-band InSAR platform
- Sub-cm detection of surface deformation
- Has measured
  - Landslides
  - Levees
  - Subsidence
  - Earthquakes
  - Volcanoes
  - Wildfire scars
  - Glaciers



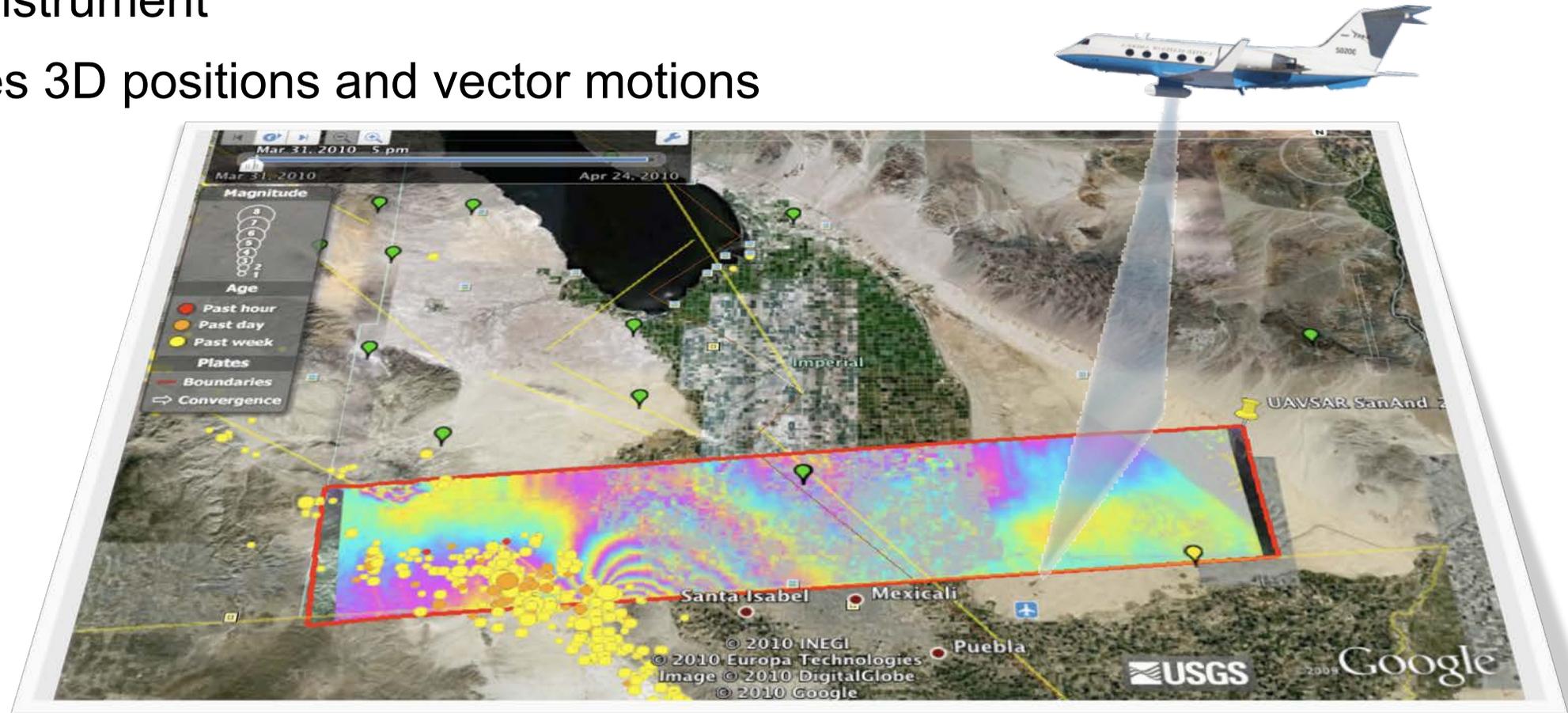
# GNSS Complements UAVSAR

- Precise position time series
- Daily to sub-daily solutions
- Accuracies are sub-mm globally
- Provide rates to better than 1 mm/yr
- Limitations
  - Stations widely separated by 10 km or more
  - Difficult to infer smaller scale processes



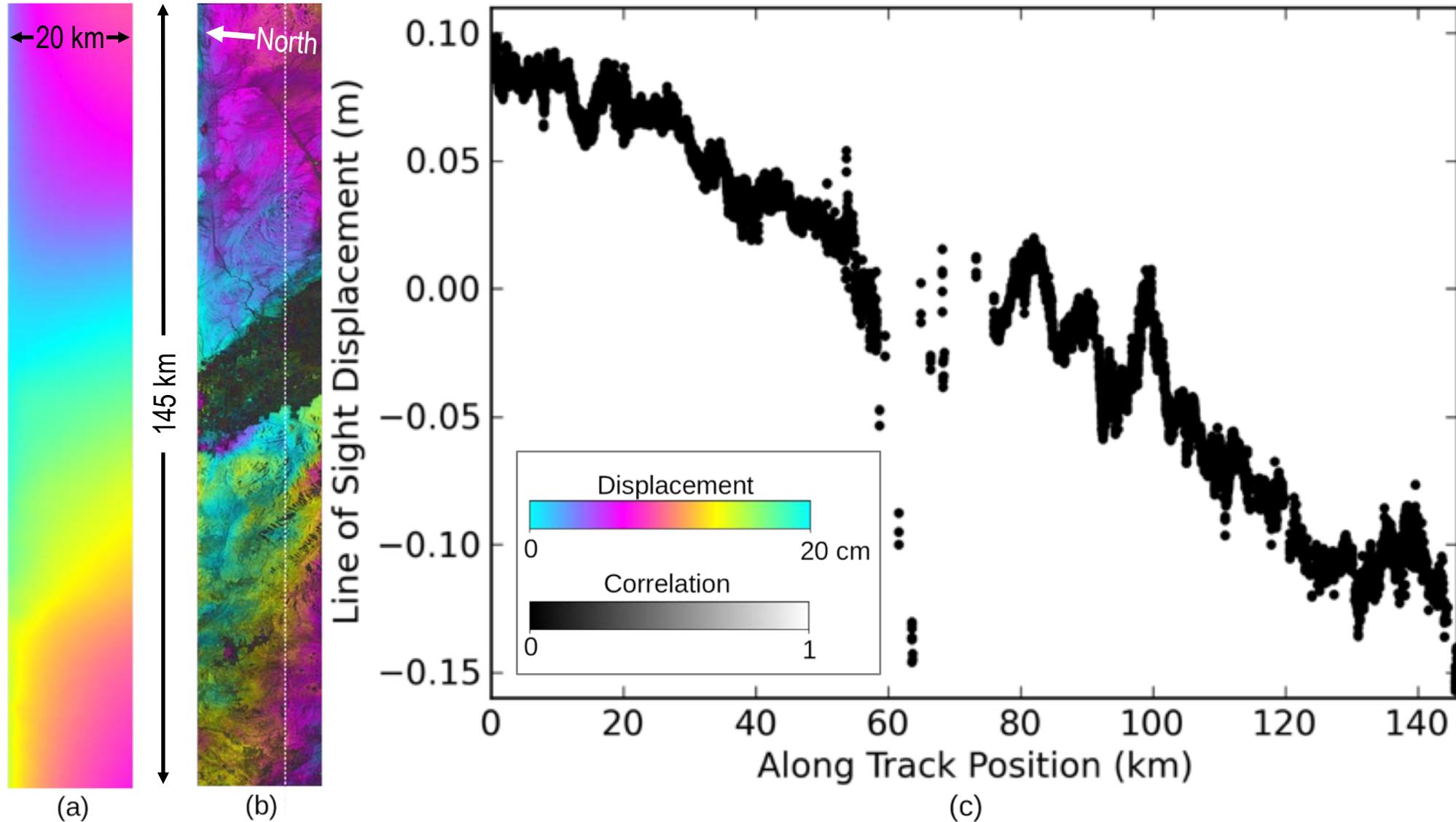
# Geodetic Imaging

- UAVSAR products provide ground changes in a line of sight direction to/from the instrument
- GPS provides 3D positions and vector motions

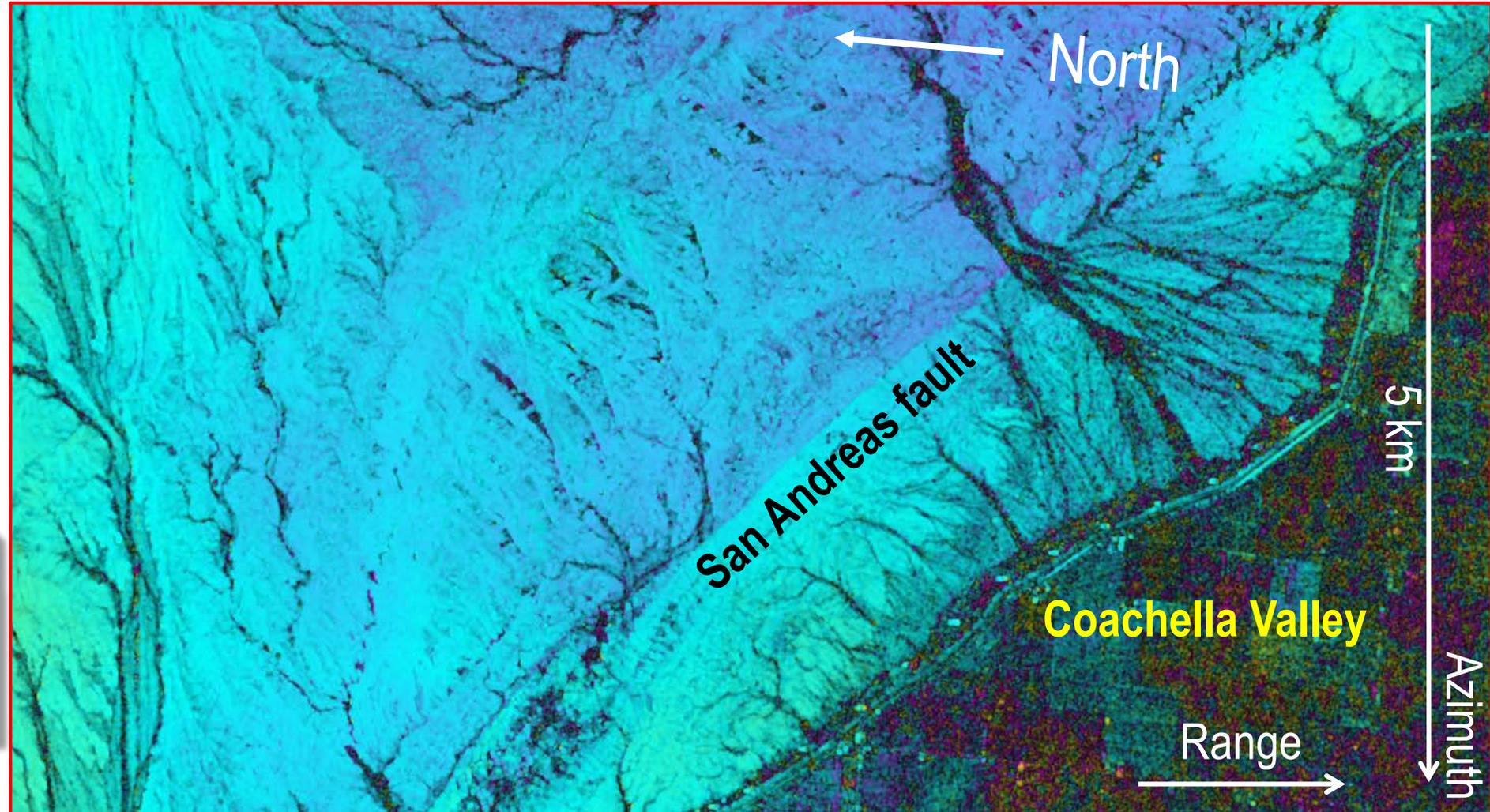
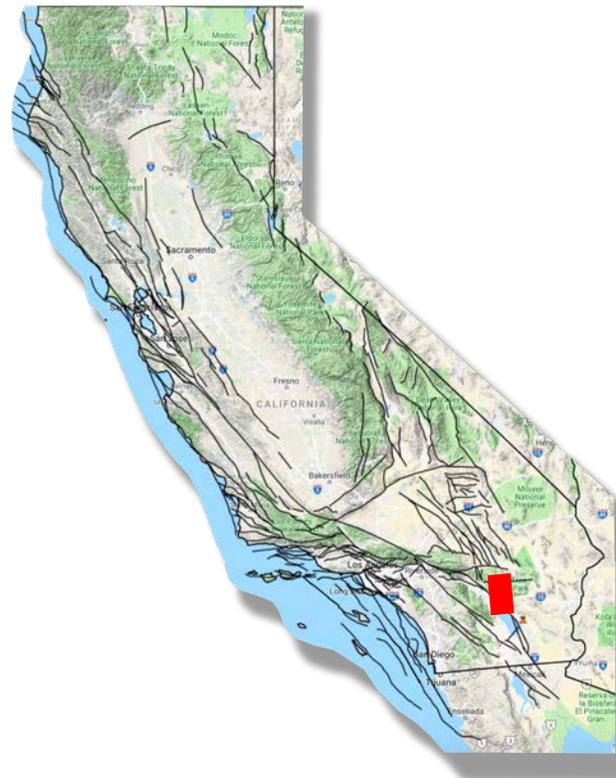




# GPS Adjusted InSAR Displacements

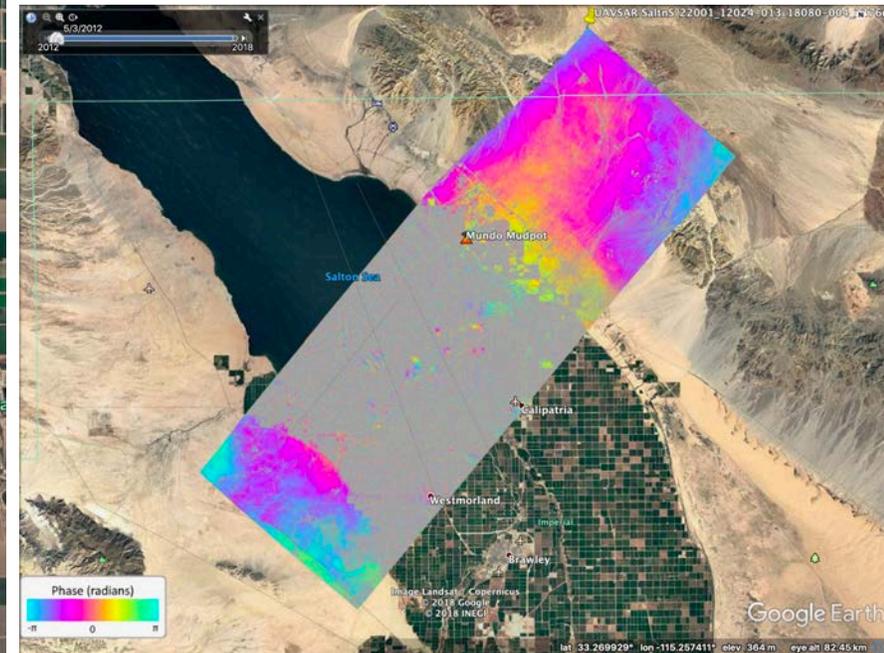
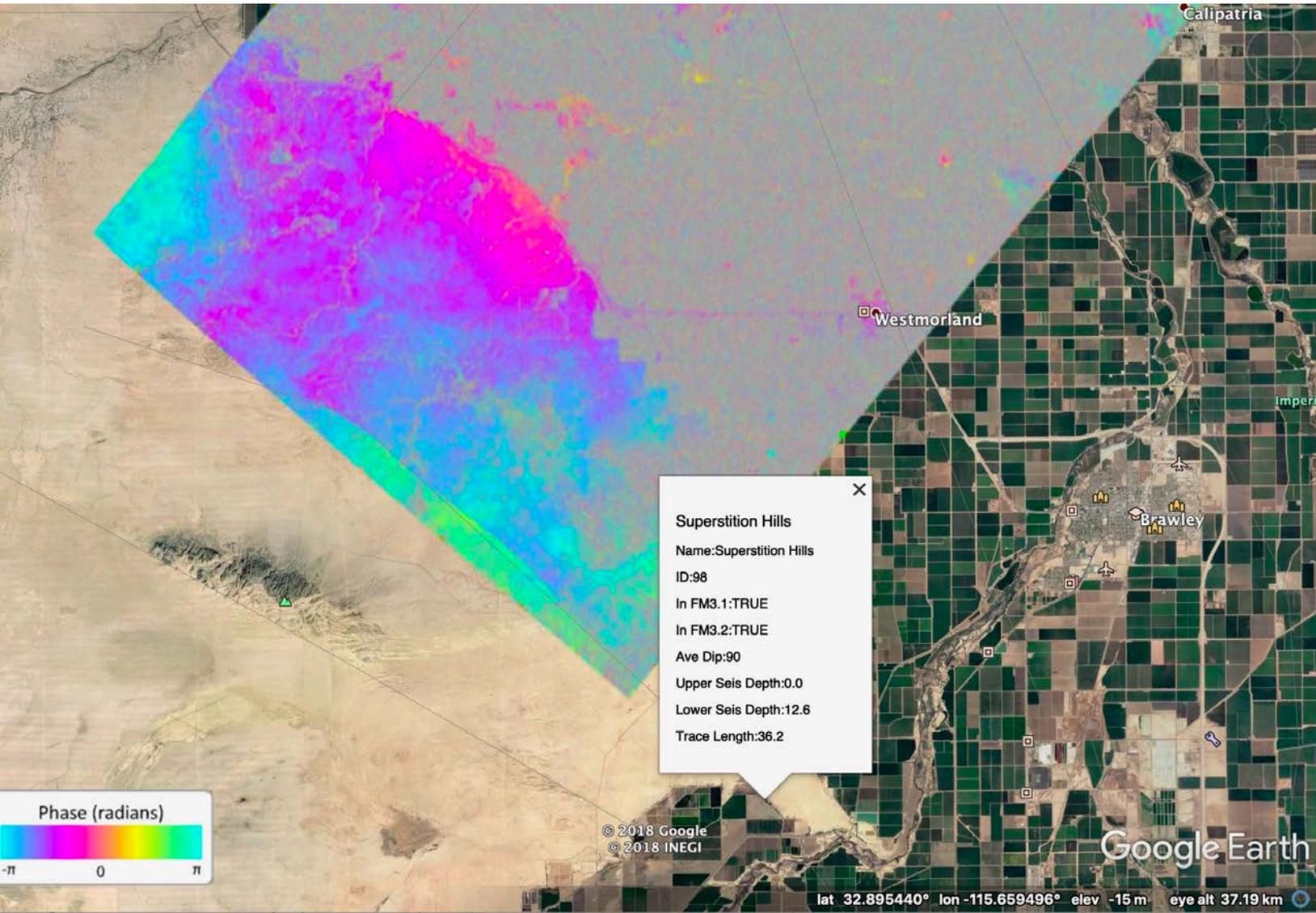


# San Andreas Fault Slip

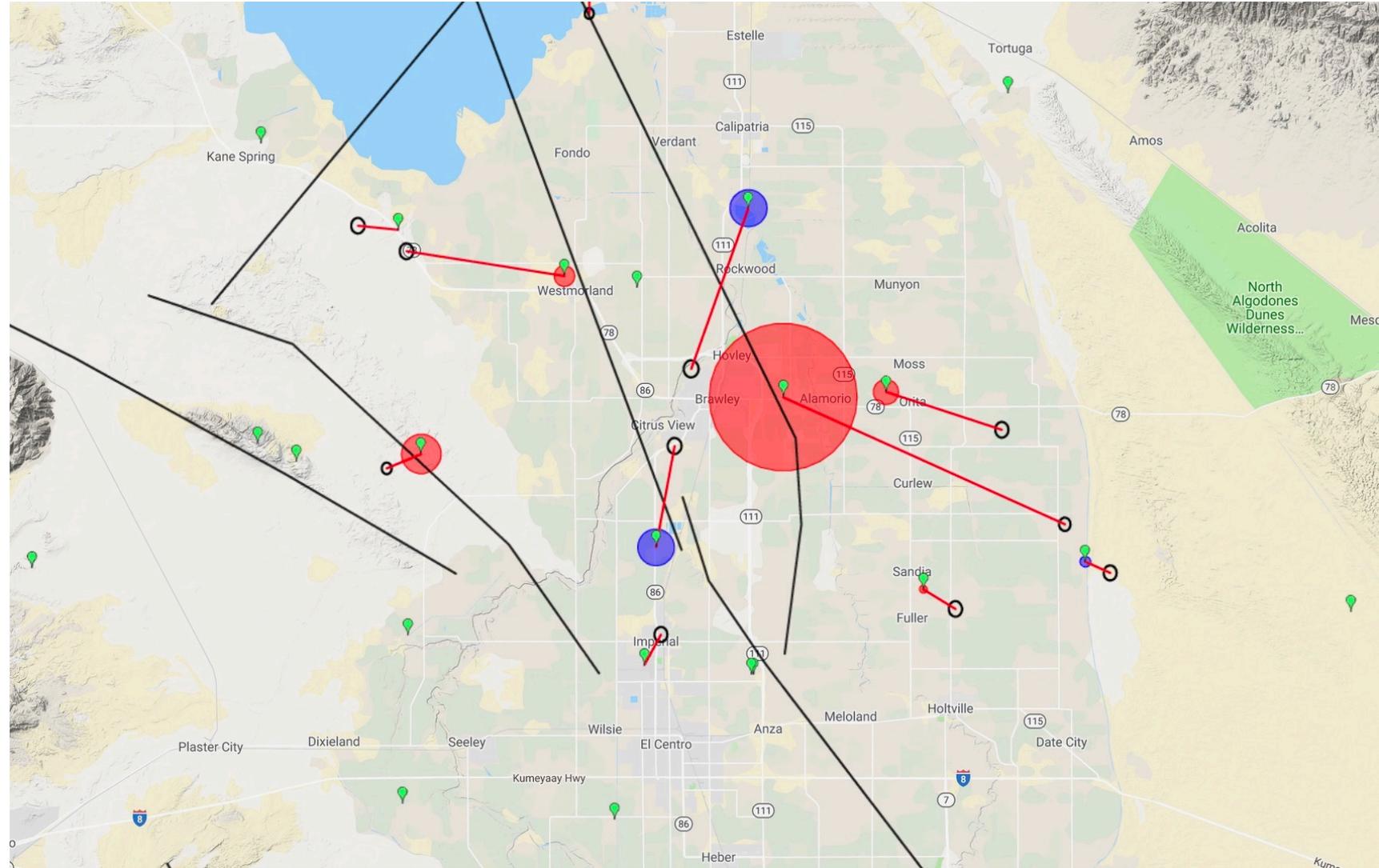
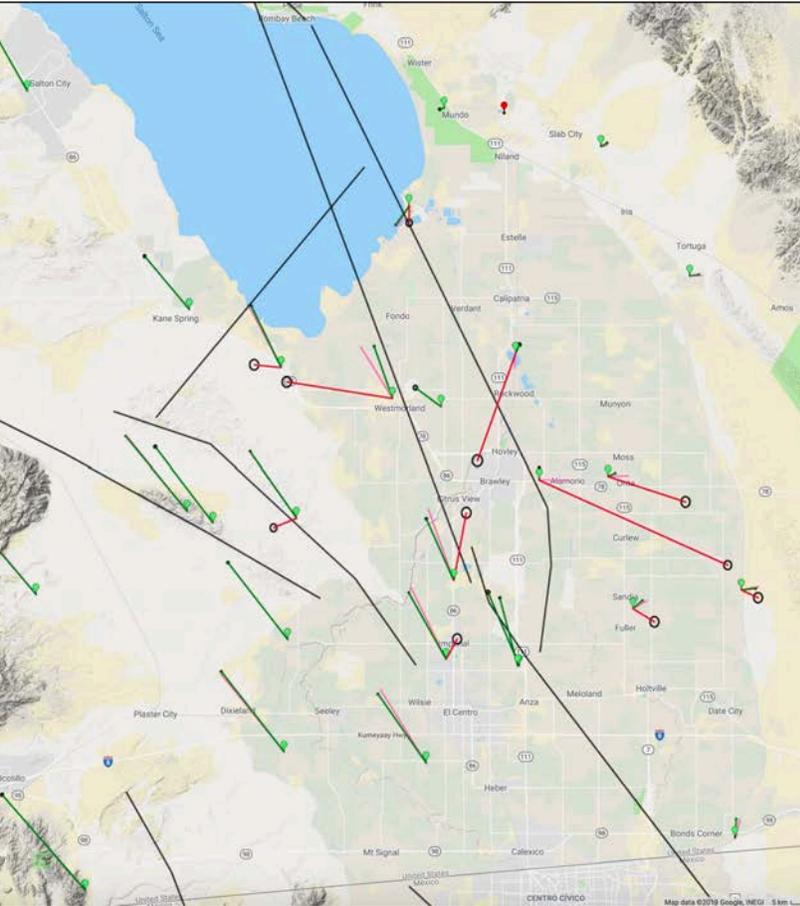


# UAVSAR Line 22001

## May 4 2012 - November 5, 2018

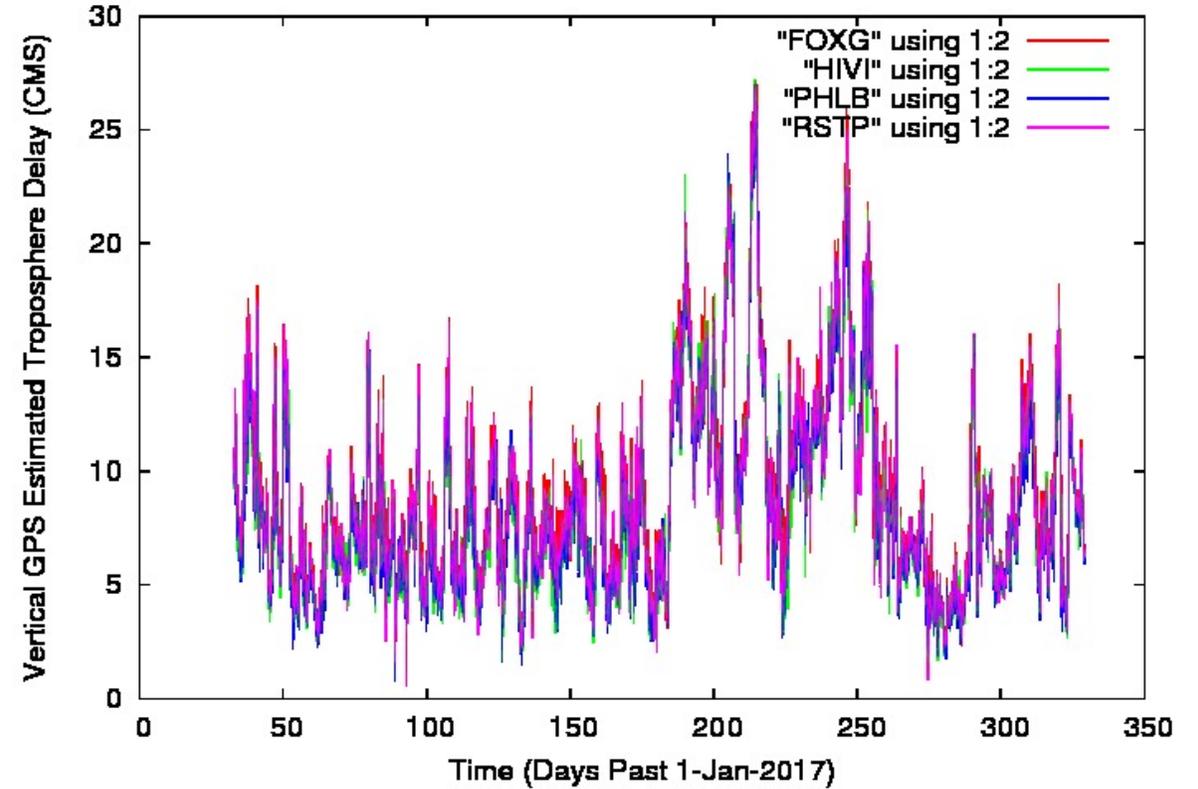
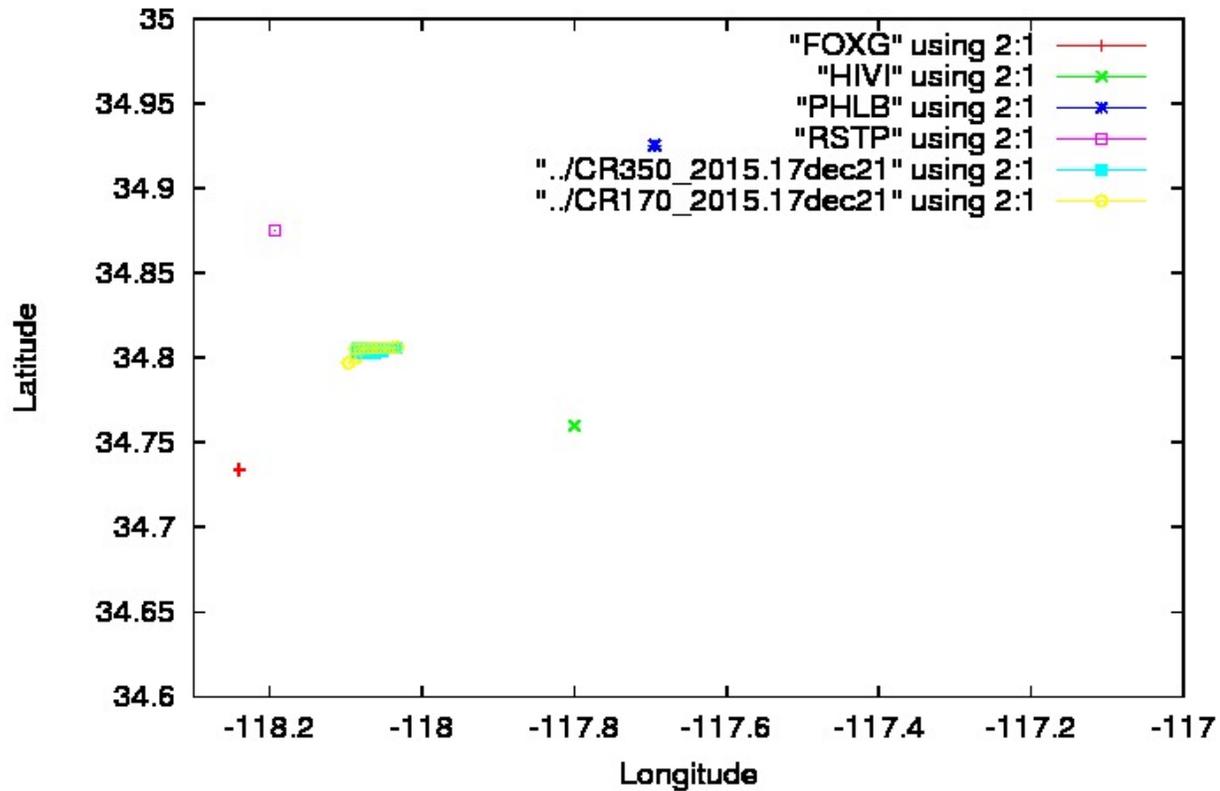


# Fault Slip Due to 2012 Brawley Swarm

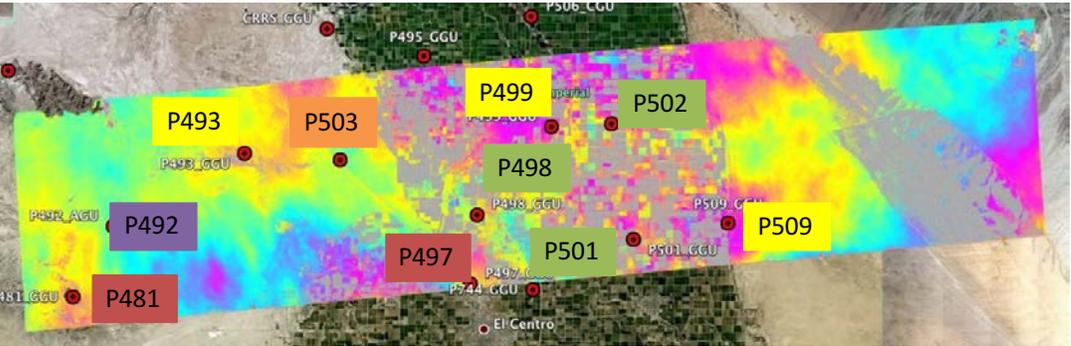


# Troposphere Variation Rosamond Corner Reflector Array

Rosamond Corner Reflectors and 4 GPS Stations



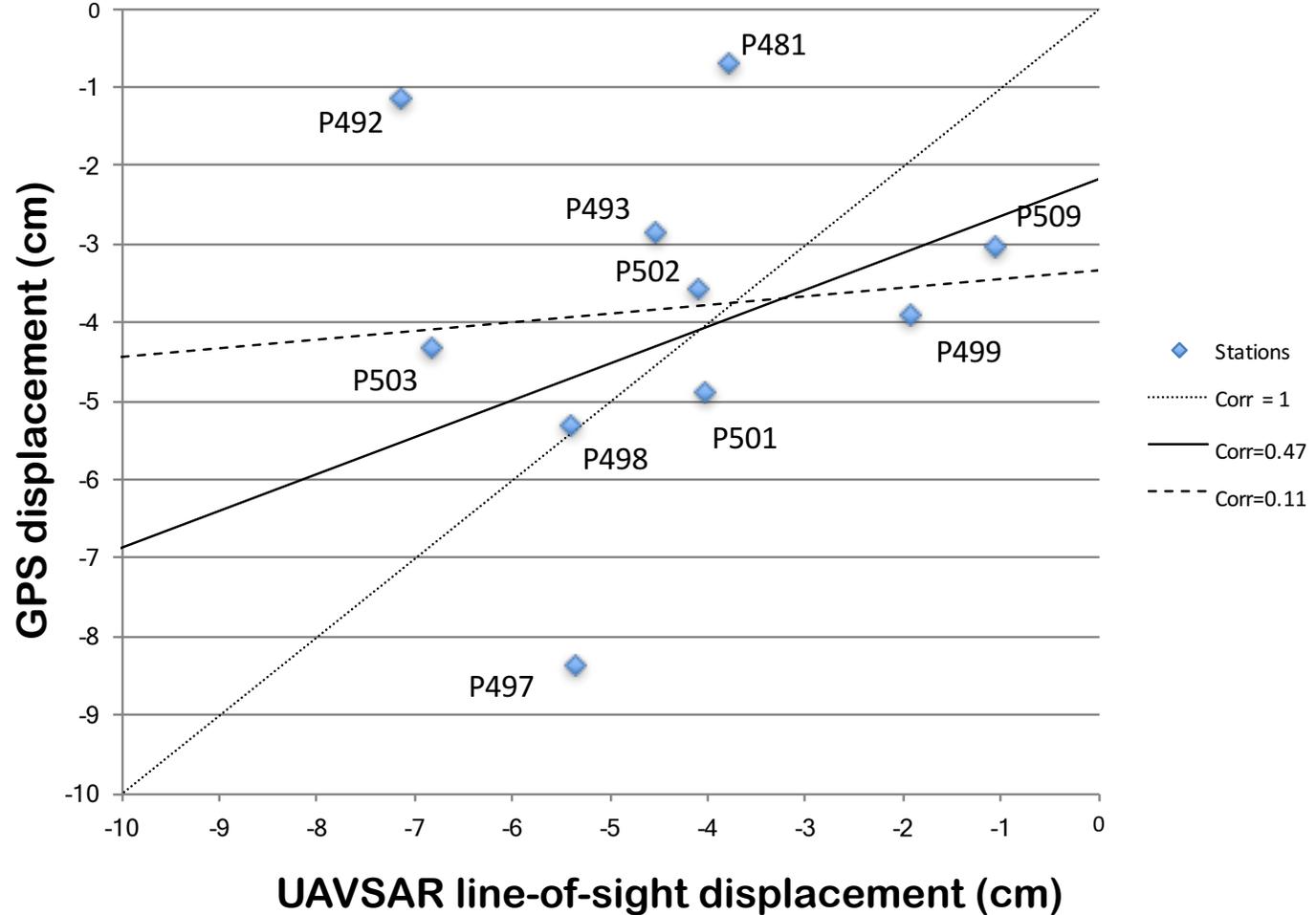
# UAVSAR/GPS Correlation



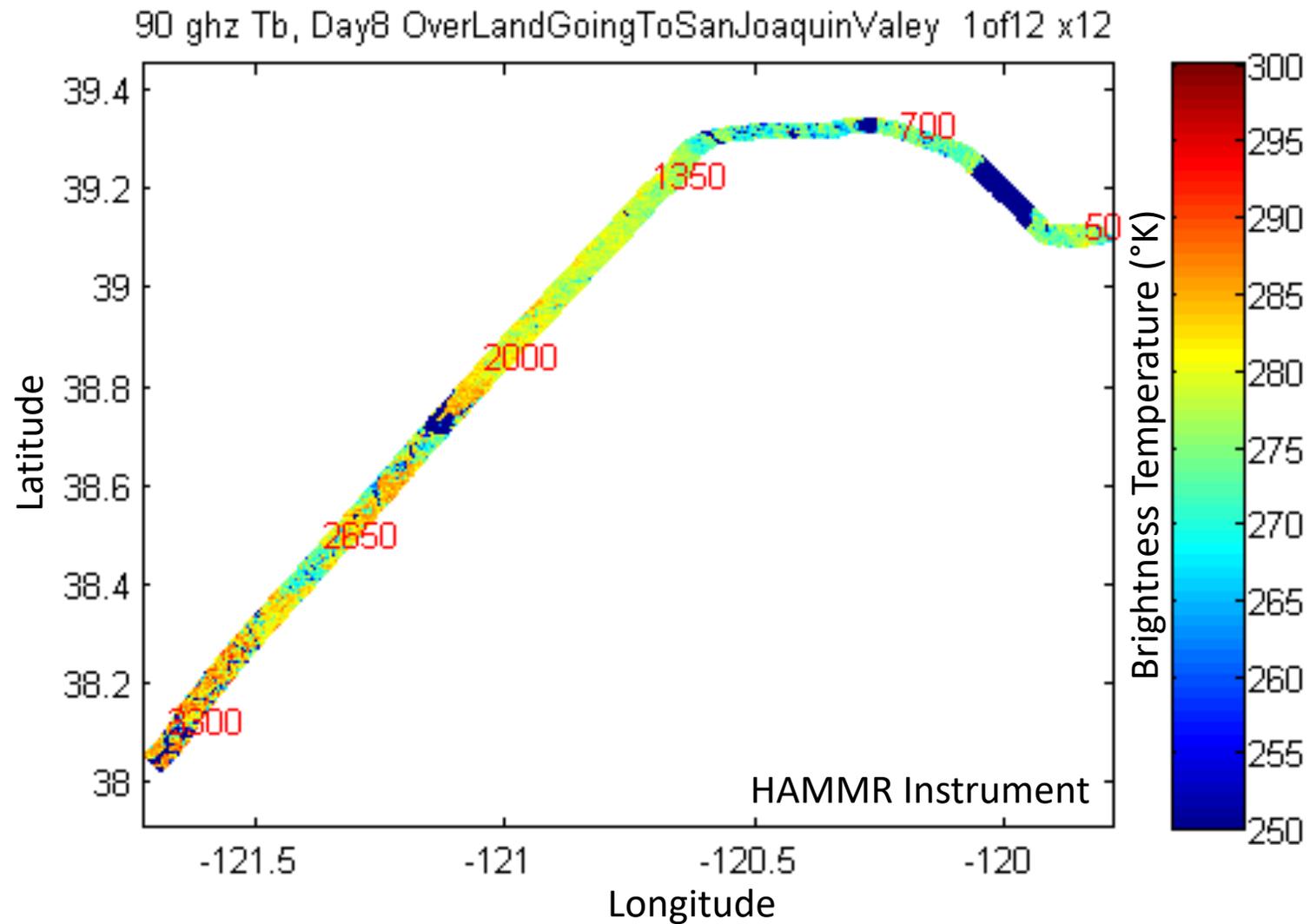
UAVSAR pixels are averaged over ~1x1 km box  
 GPS N, E, U are converted to LOS for elevation and azimuth at UAVSAR point  
 Offset of 15.12 cm is added to UAVSAR by averaging differences between GPS and UAVSAR LOS  
 P492 is not included in the average or first correlation (solid line)

|GPS-UAVSAR|   ■ < 1 cm <   ■ < 2 cm <   ■ < 3 cm <   ■ < 4 cm <   ■

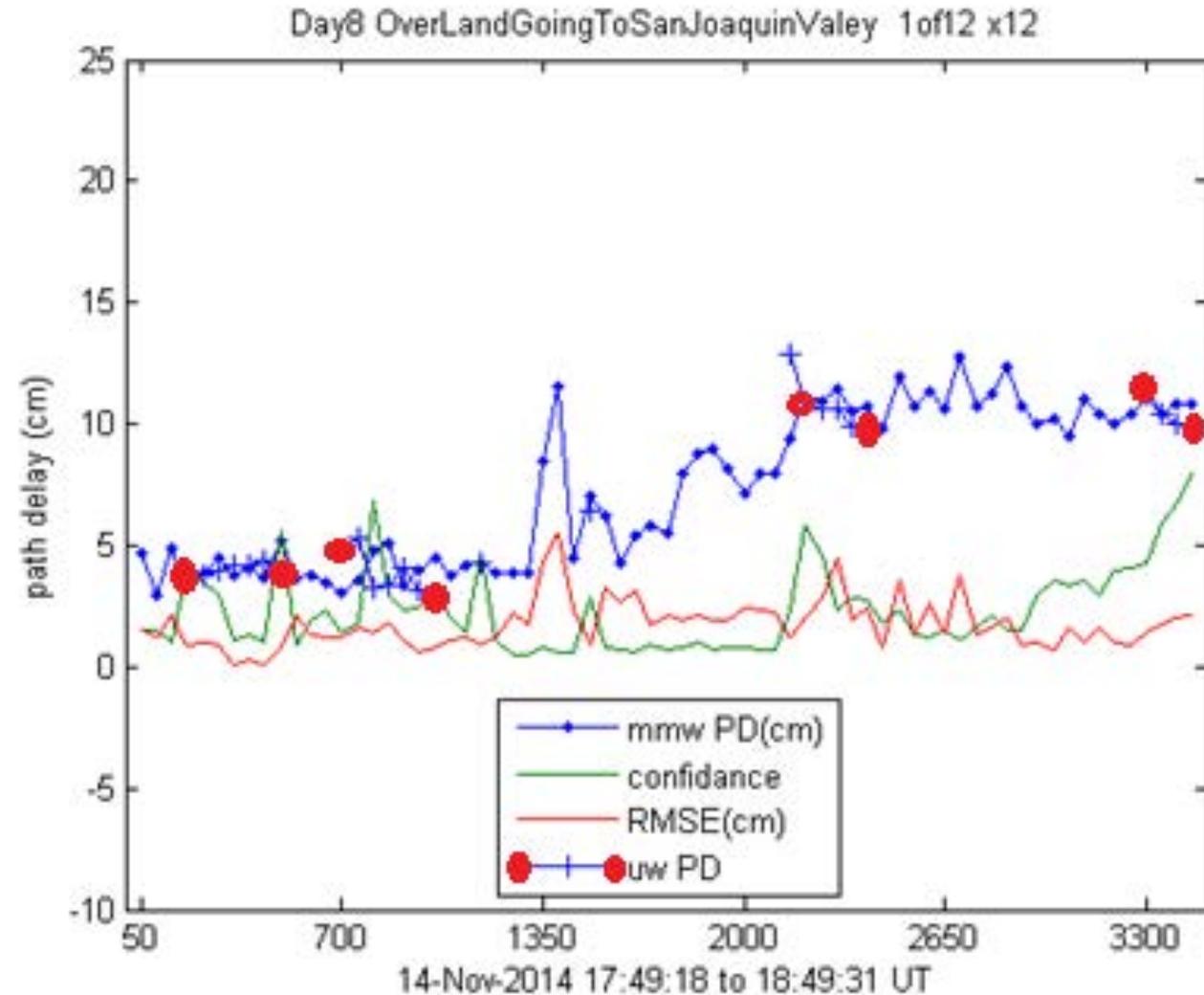
26505 Coseismic: 10/20/09 - 4/12/10

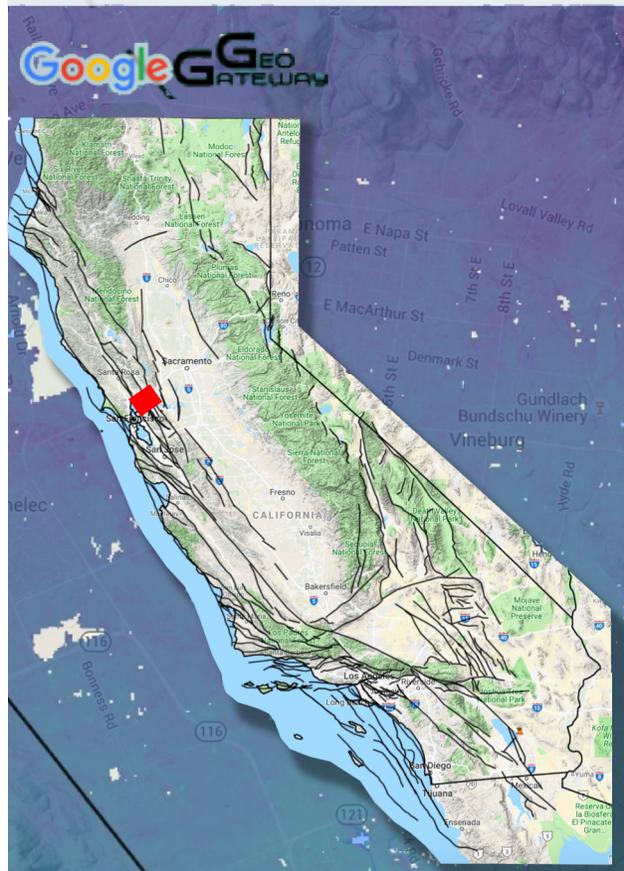
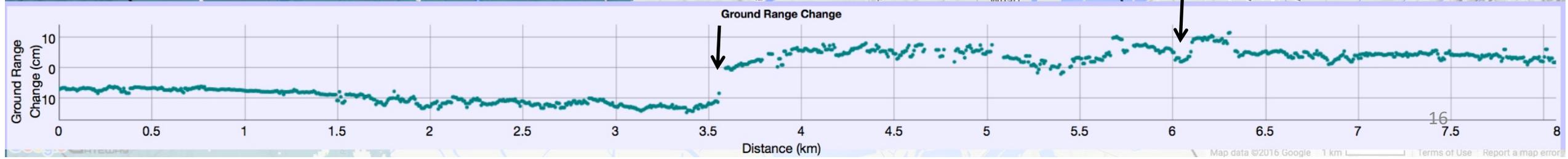
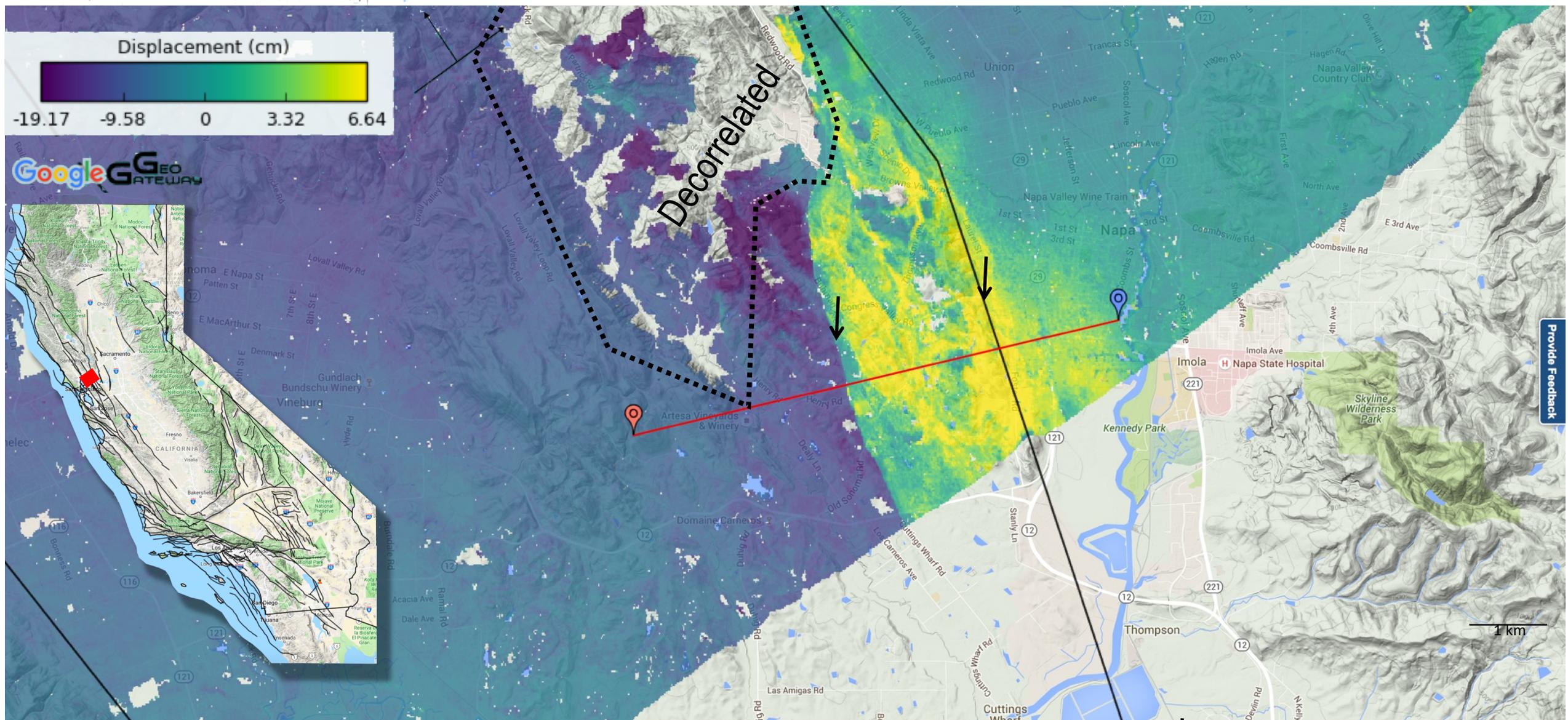


# Surface Emissions Map



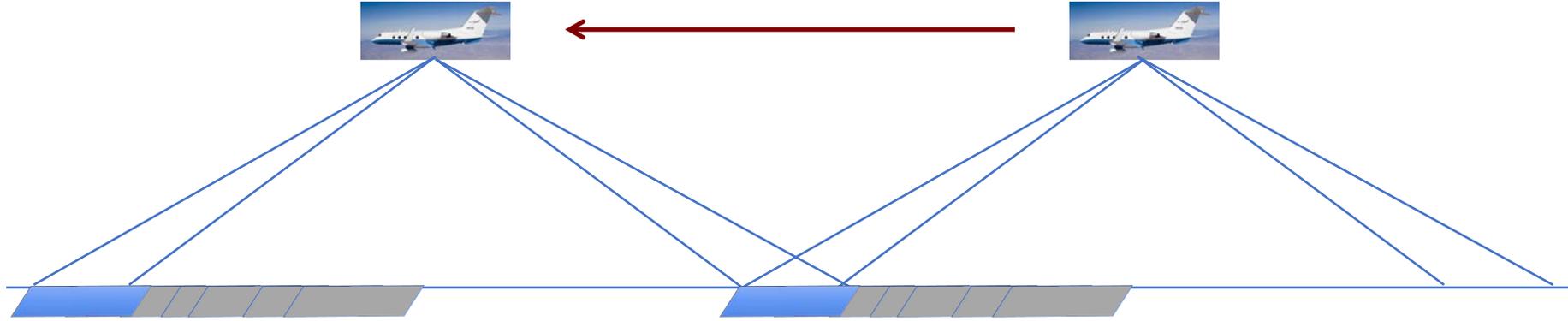
# Millimeter Wave Retrievals





Provide Feedback

# Fixed Stereo Push-Frame Concept



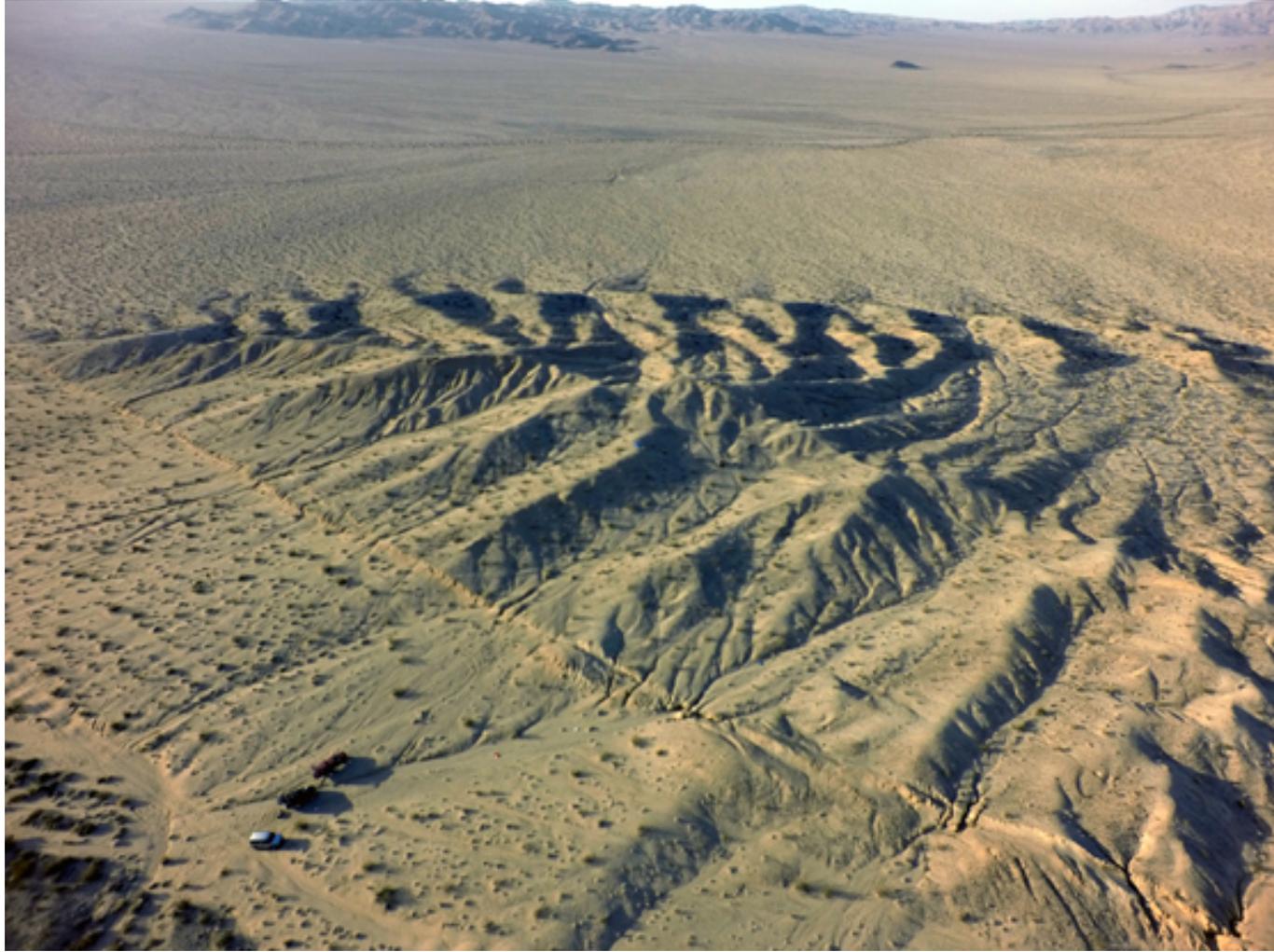
- Pair of cameras in a fixed pose
  - Angular separation of the cameras are +/- 22.6 degrees
  - Synthetic baseline of 5km from a standoff of 12.5km
  - Crosstrack Field of View will be needed to cover 12km



- Reference Design
  - Lens Focal Lengths: 100mm, 135mm
  - <math>F/12</math>
  - CMV20000 FPA - Mars 2020 EECAM Baseline
    - Bayer Coated CMOS Visible Focal Plane

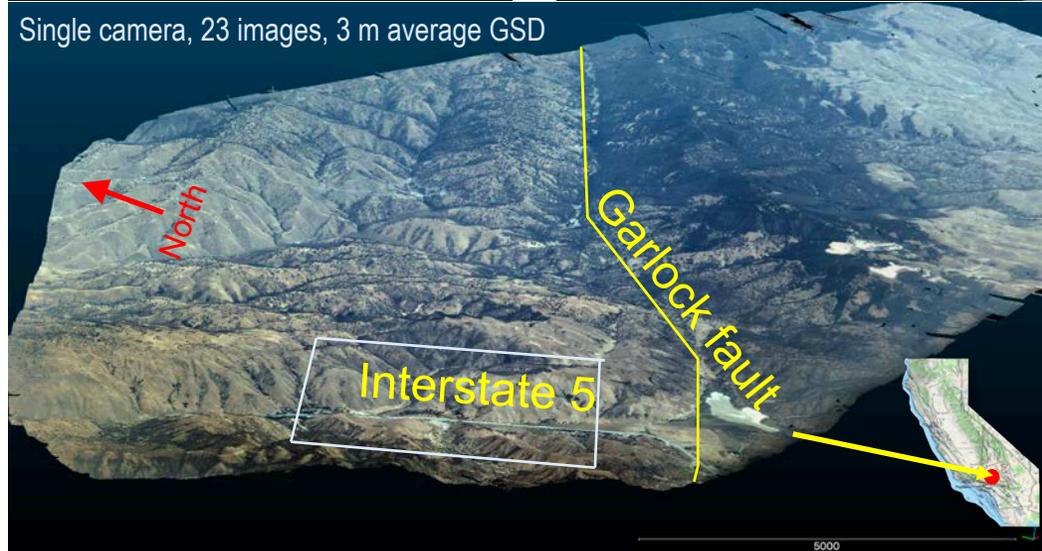
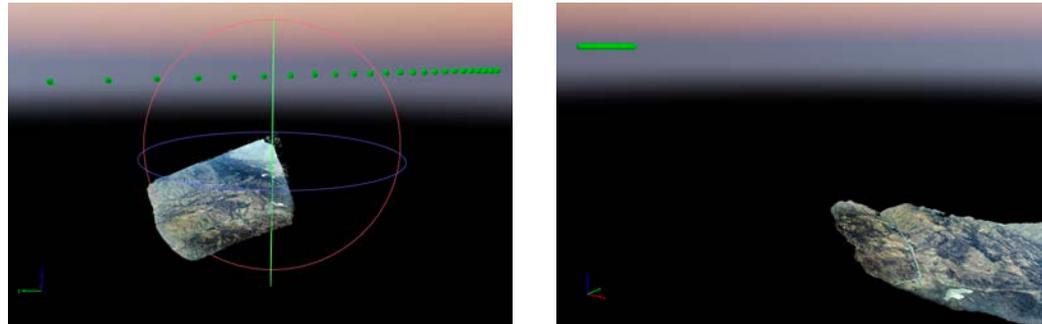




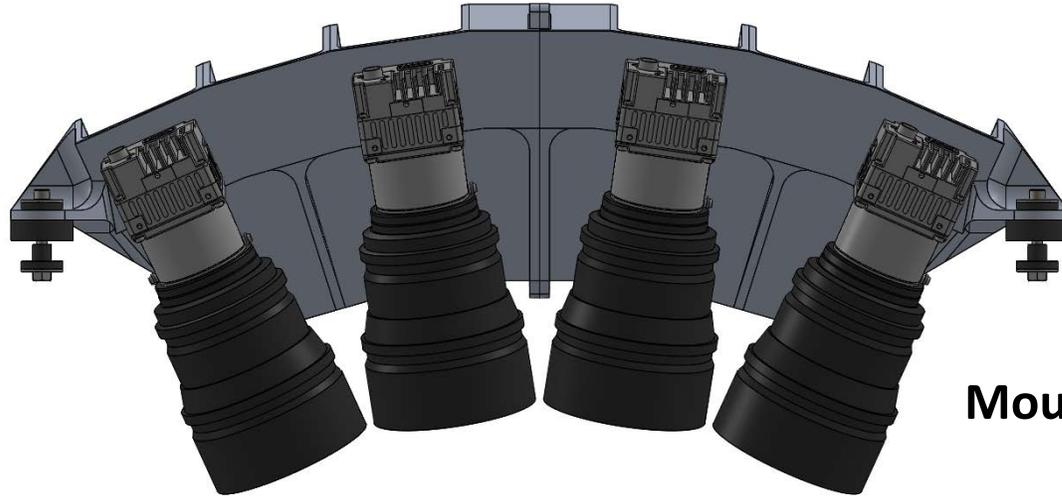


# Sample Reconstruction

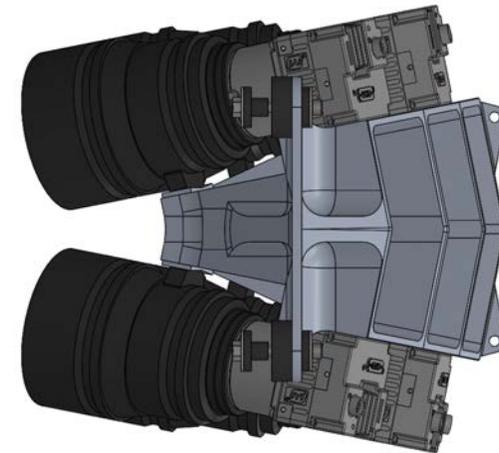
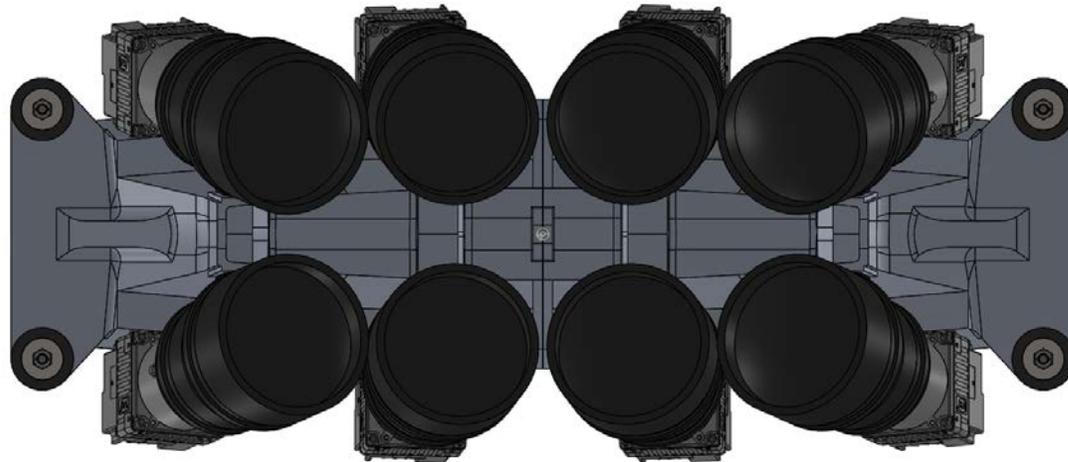
Camera Positions



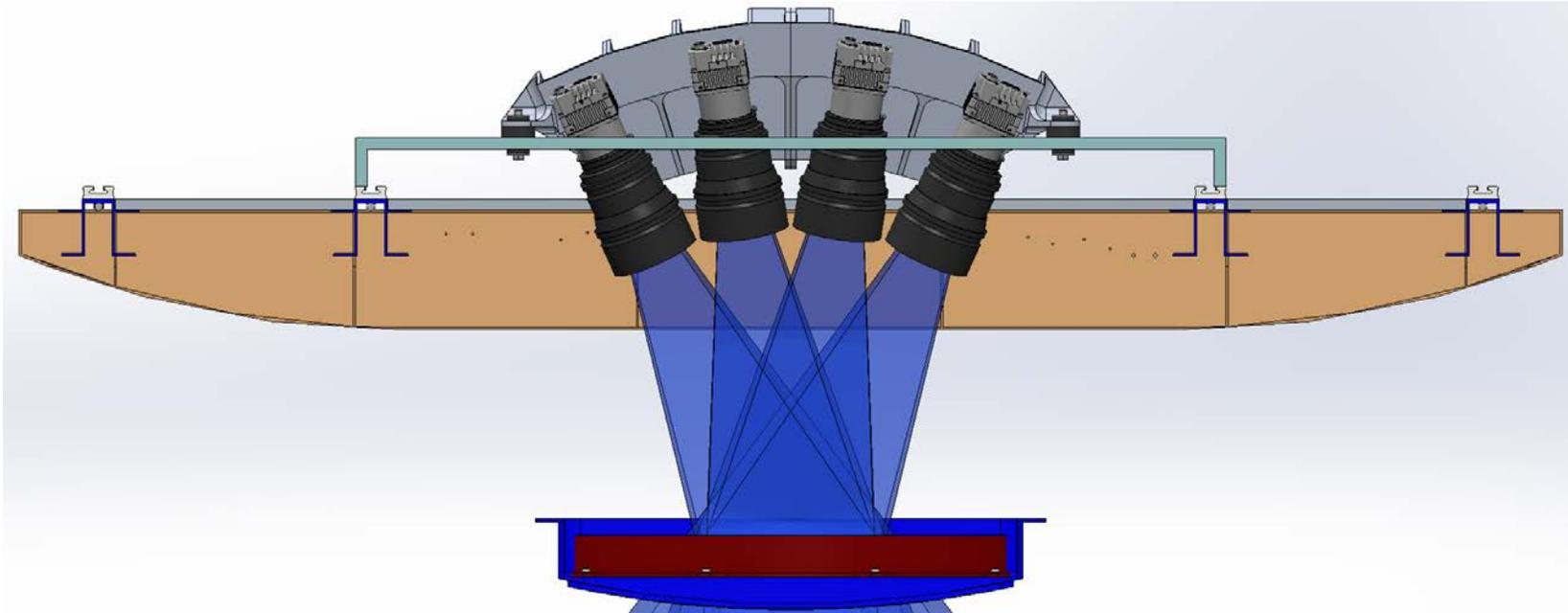
# Reference Design



**Mounting Arch with 8X Camera Configuration**



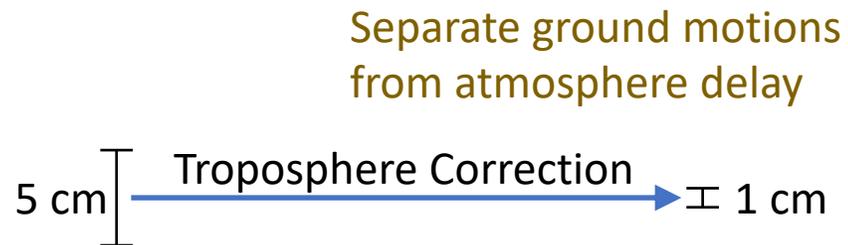
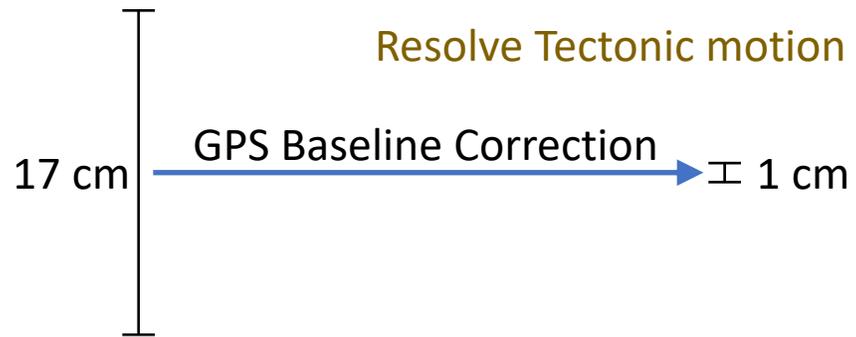
# Reference Design



**Mounting and FOV Inside Jet**

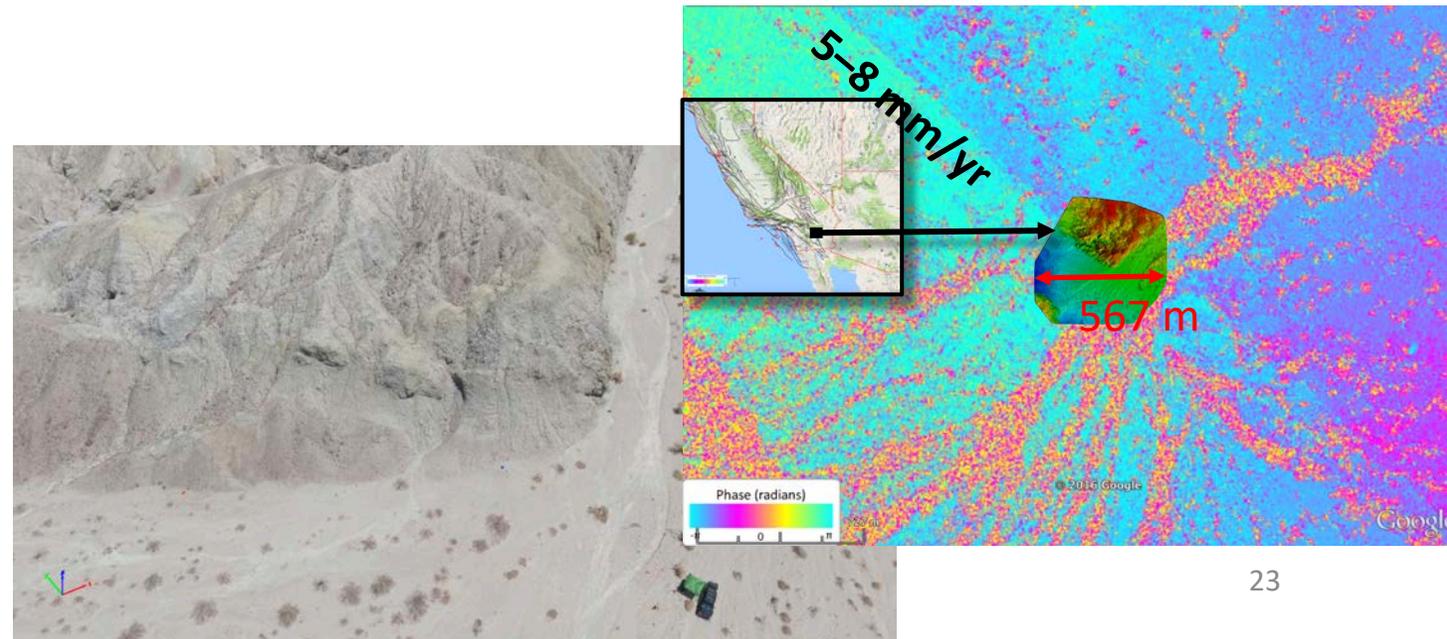
# Summary

## UAVSAR Corrections



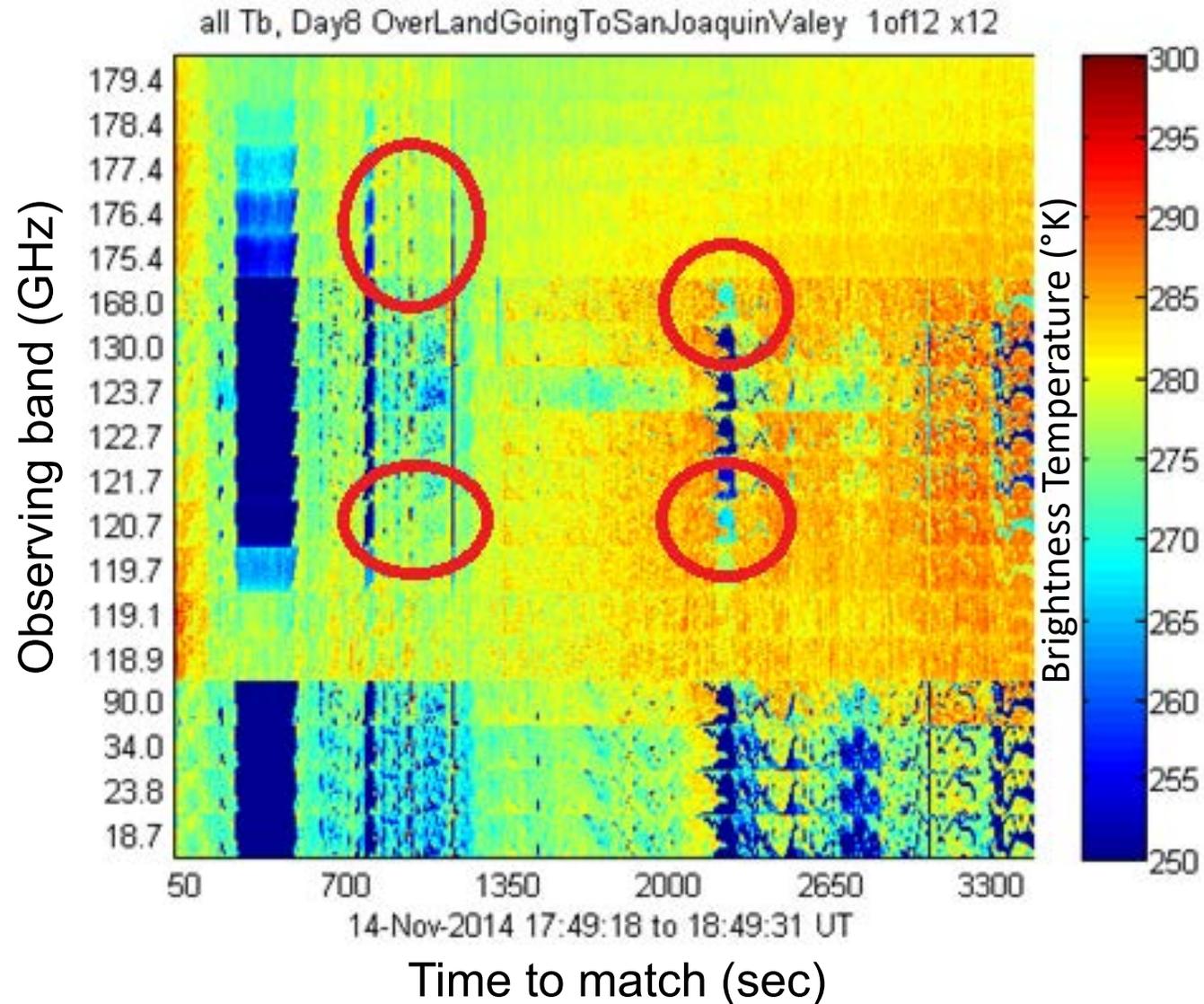
## Imager

- Validate observations
- Fill large area gaps where decorrelated
- Geomorphology
- 3D slip of fault zones
- Disaster response





# All Channels of HAMMR Instrument



# Atmospheric Opacity

