QUAKES-A: Quantifying Uncertainty and Kinematics of Earthquake Systems

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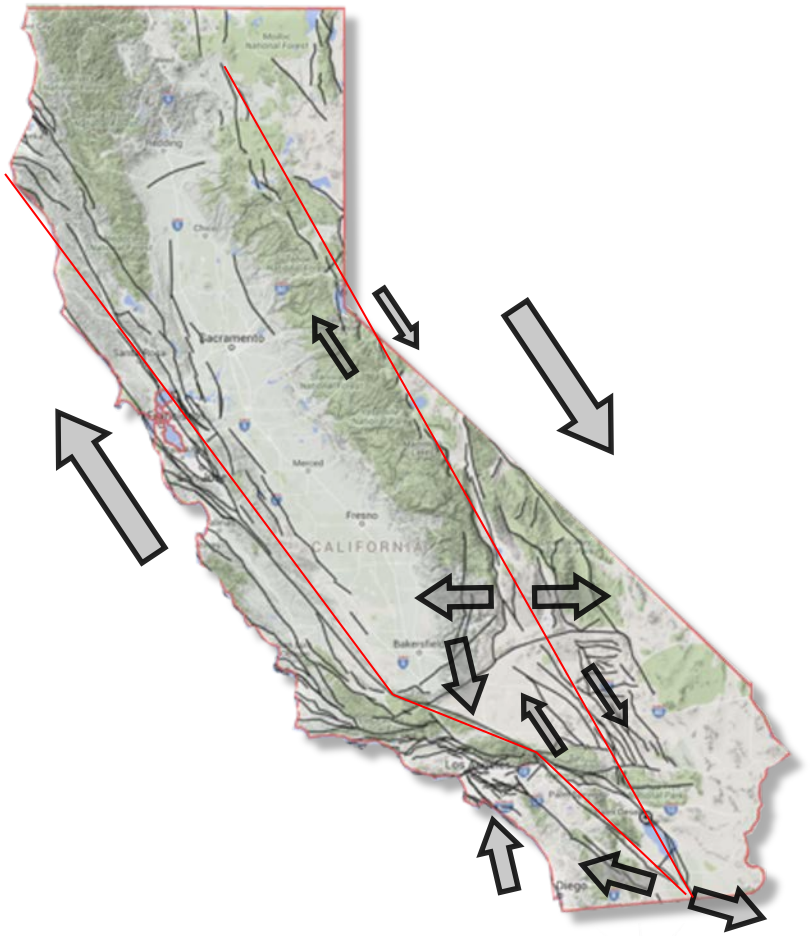
Objective

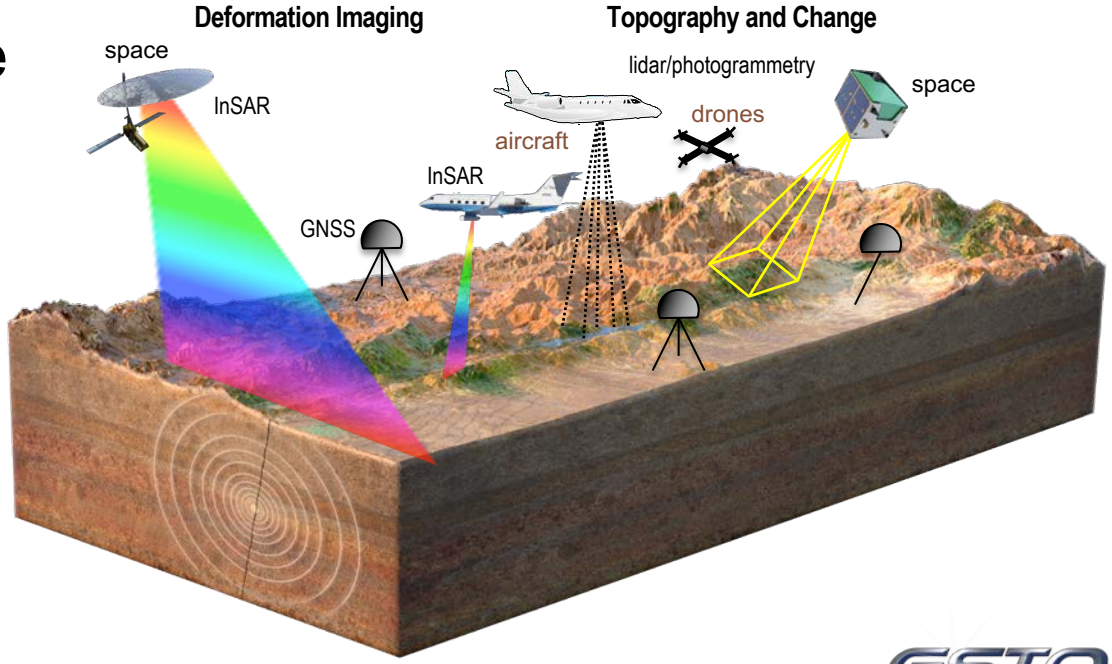
Create a uniform crustal deformation reference model for the active plate margin of California

- Fused InSAR, topographic, and GNSS geodetic imaging data
- Quantify uncertainties for the reference model
- Improve earthquake forecast models
- Improve understanding of the physical processes leading to and following earthquakes

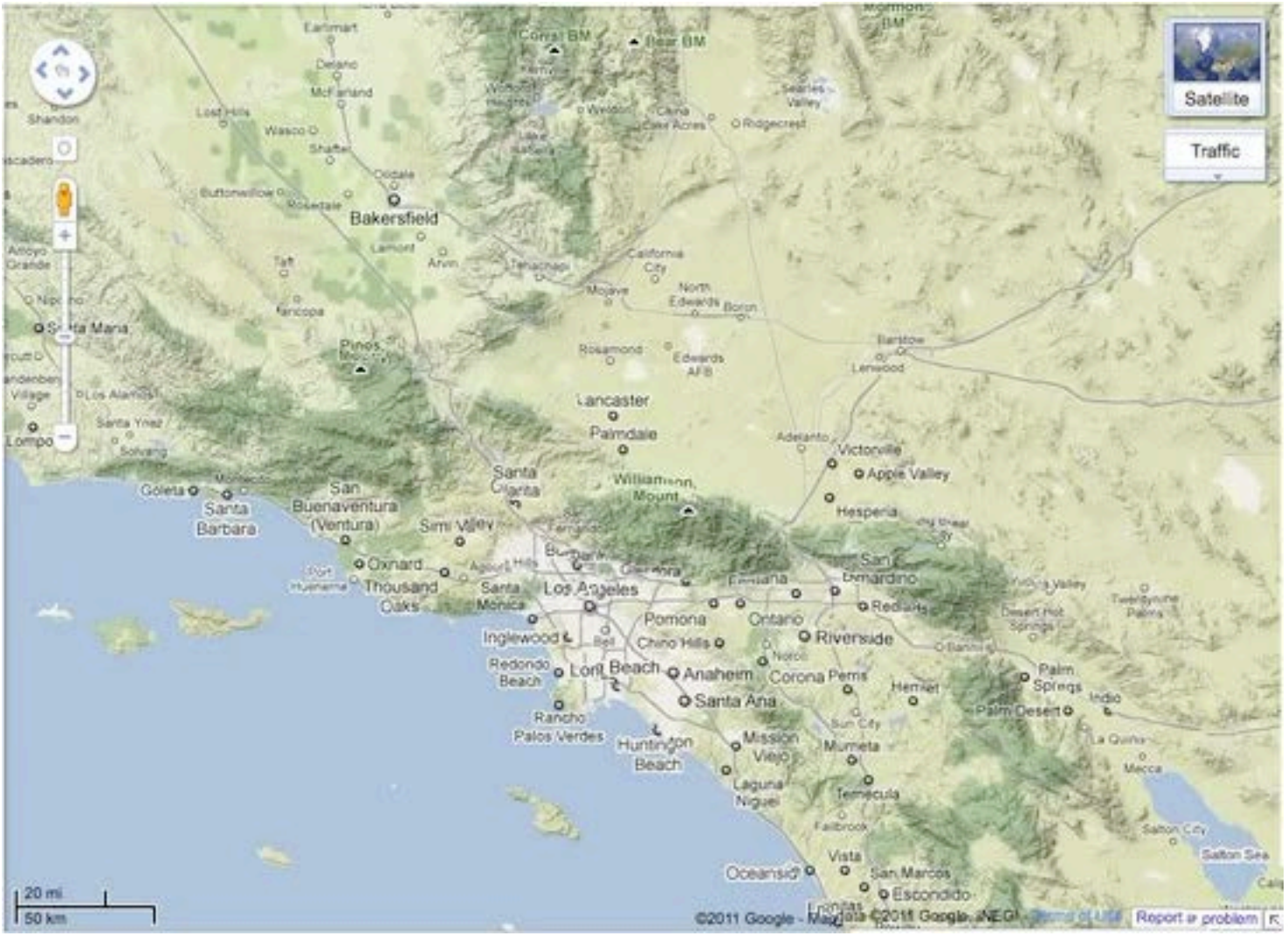


Approach

- Adjust UAVSAR processing with GNSS displacements and extract slip features
- Identify and rank active fault systems using GNSS cluster analysis
- Fuse and interpolate geodetic products to provide a uniformly sampled deformation field
- Assimilate and correlate the crustal deformation products into seismicity-based earthquake forecasts

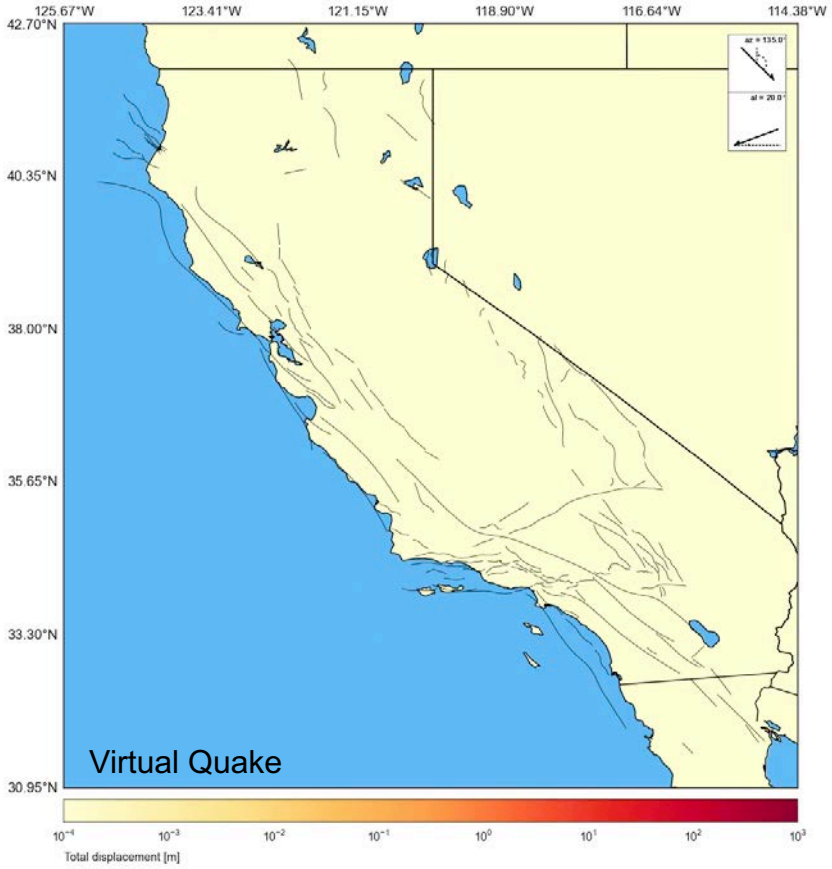


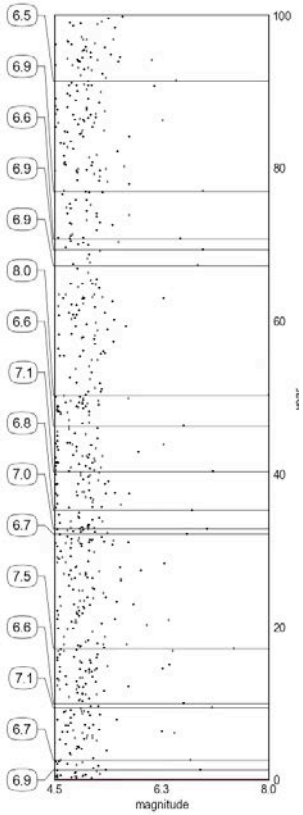
Conceptual View of Southern California Fault Motions

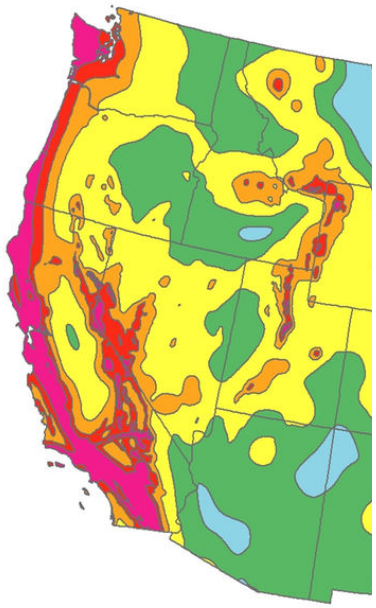


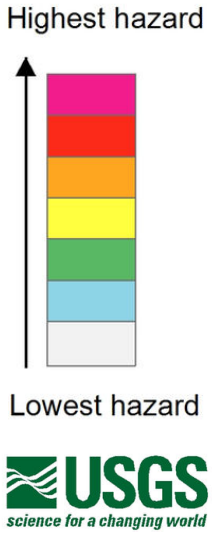
Crustal Deformation and Earthquakes are Non-Uniform in Space and Time

Motivates need for time-dependent gridded (uniform) crustal deformation model









USGS science for a changing world

ESTO Earth Science Technology Office

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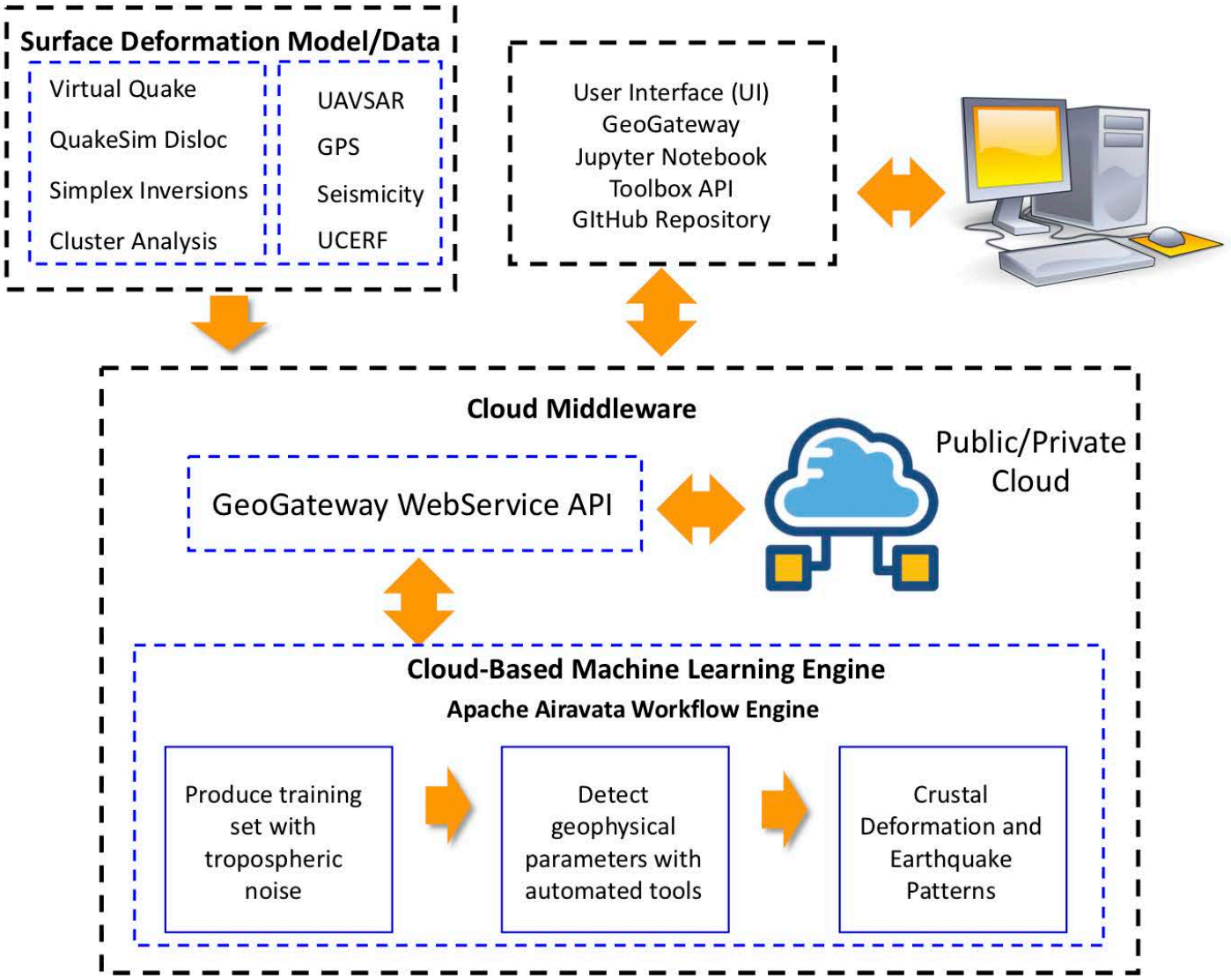
Architecture

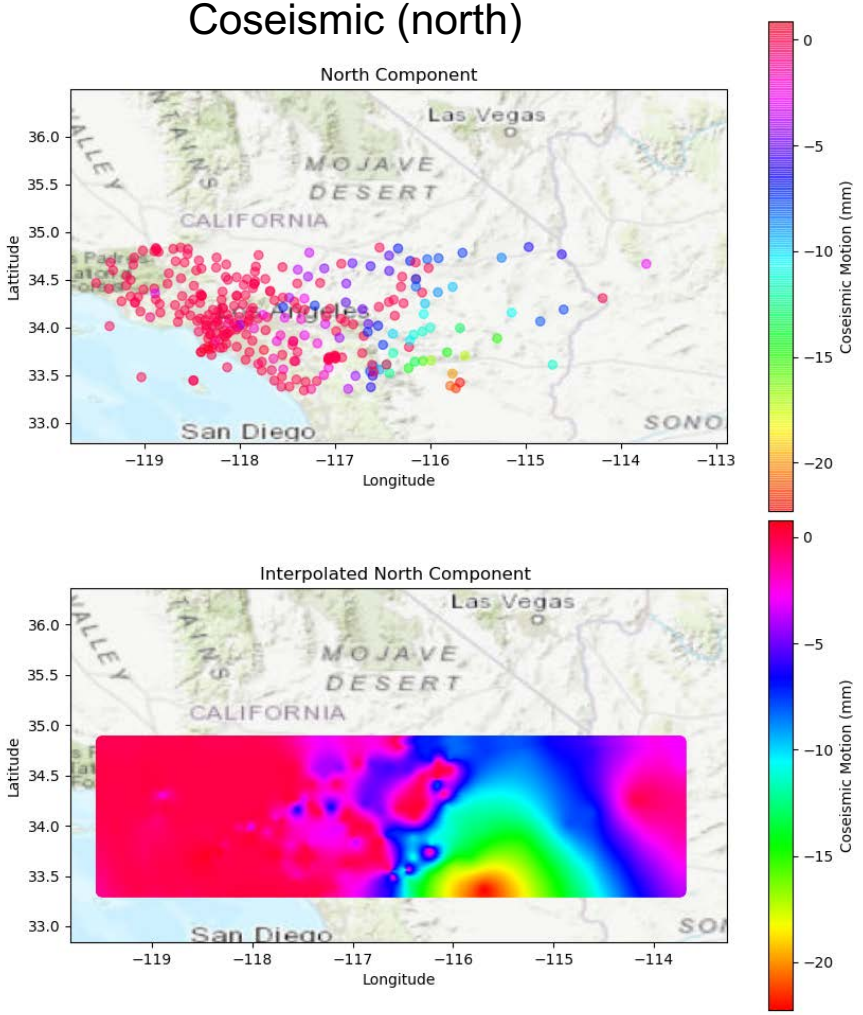


Components

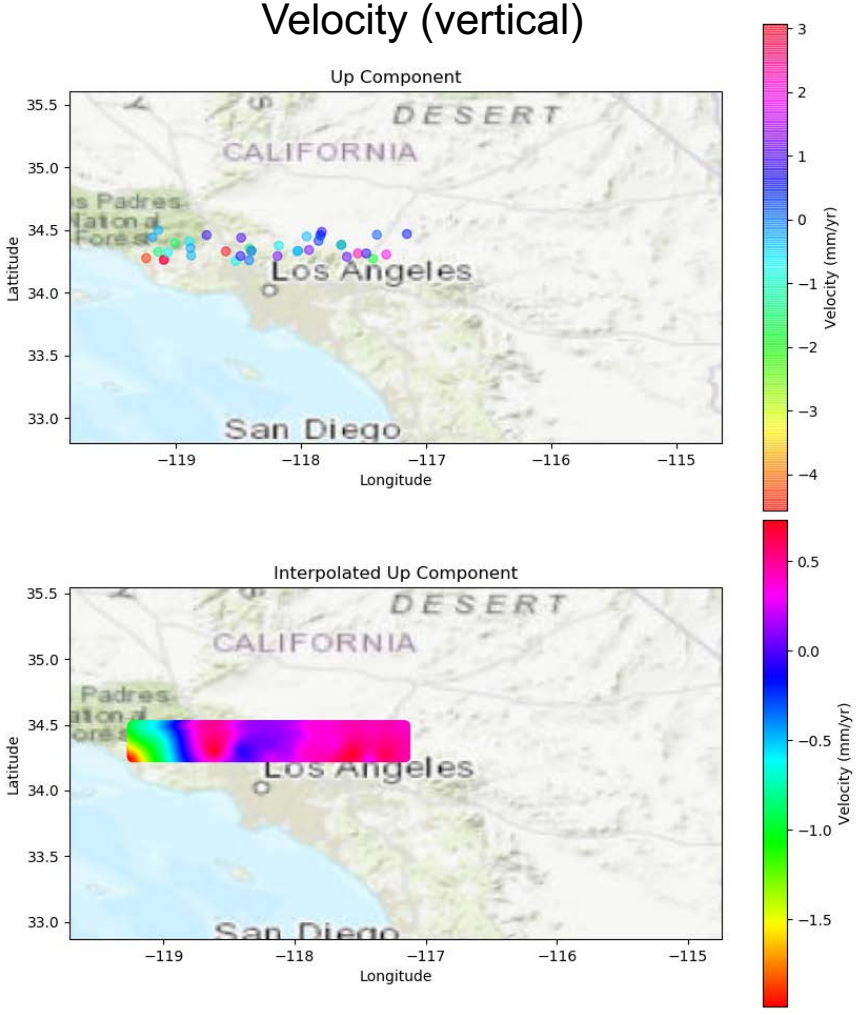
Software	Process	Data Types/Products
Disloc Forward elastic dislocation model	**Fault Slip** Rupture, creep, triggered	**GNSS** Network based Deformation and Displacement
Virtual Quake Elastic with fault friction boundary element model	**Distributed Slip** Surface cracking, deformation	**InSAR** Deformation and Displacement Airborne: Configurable flight path Spaceborne: Global systematic
GeoFEST Viscoelastic finite element model	**Plate Boundary Motions** Crustal deformation	**Stereo Photogrammetry** Topography and Change Near Surface: targeted ultra high resolution Airborne: configurable high resolution wide swath Spaceborne: Global wide area
TailorView Deformation map component viewer	**Long-term deformation** Landscape growth and erosion	**Lidar** Topography and Change Near-Surface: high resolution Airborne: fault scale coverage Spaceborne: Global systematic
TectLandEx Landscape feature extraction software		

Interpolation

Coseismic (north)

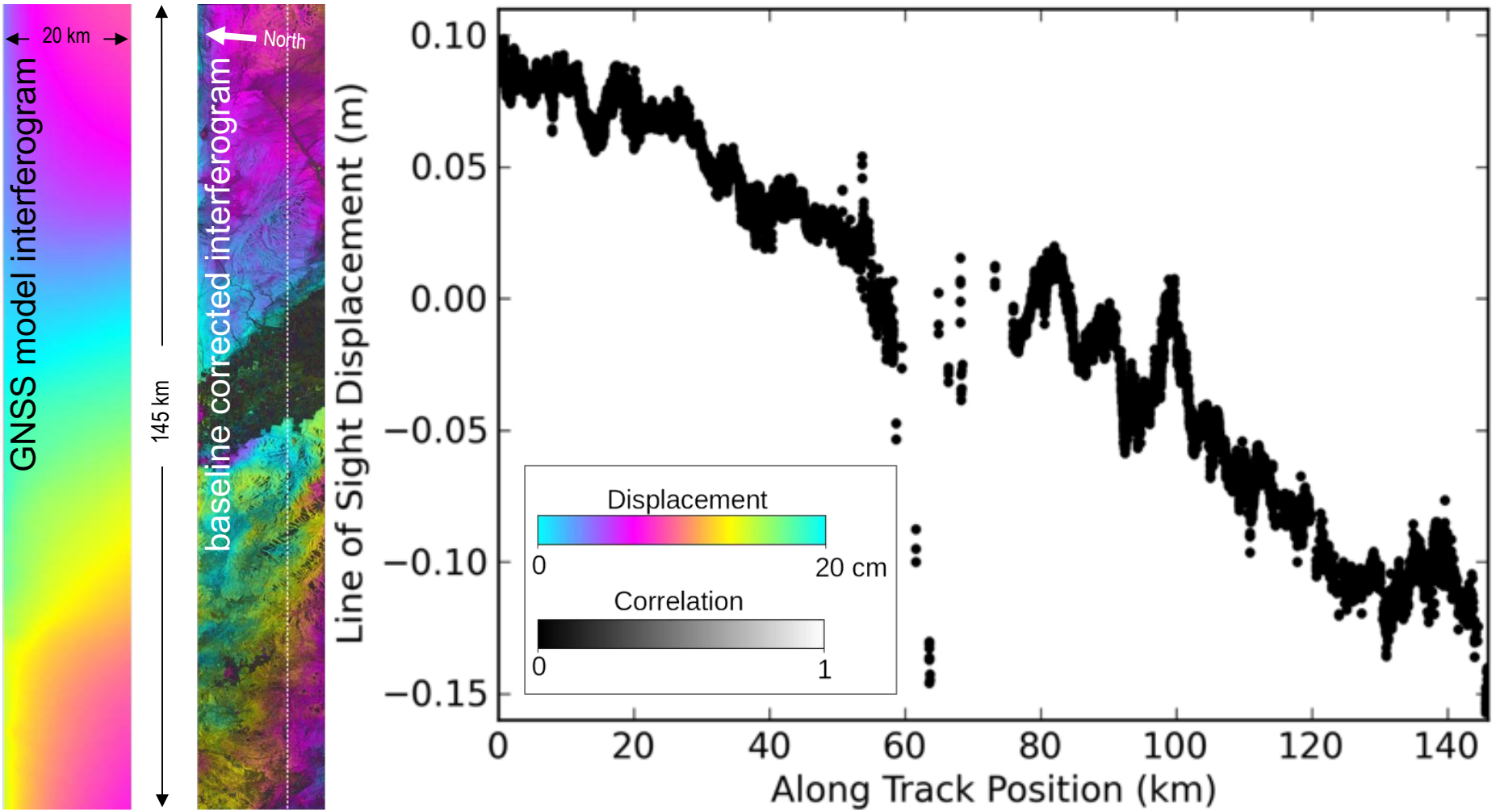


Velocity (vertical)



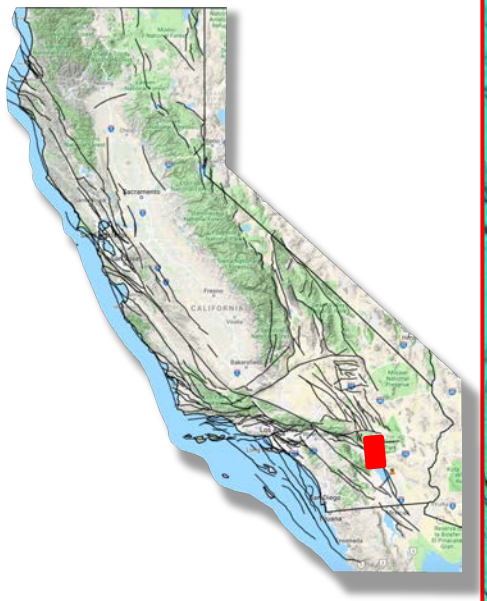
1. Creates synthetic interferogram for UAVSAR baseline adjustment
2. Creates initial uniform posting gridded deformation field

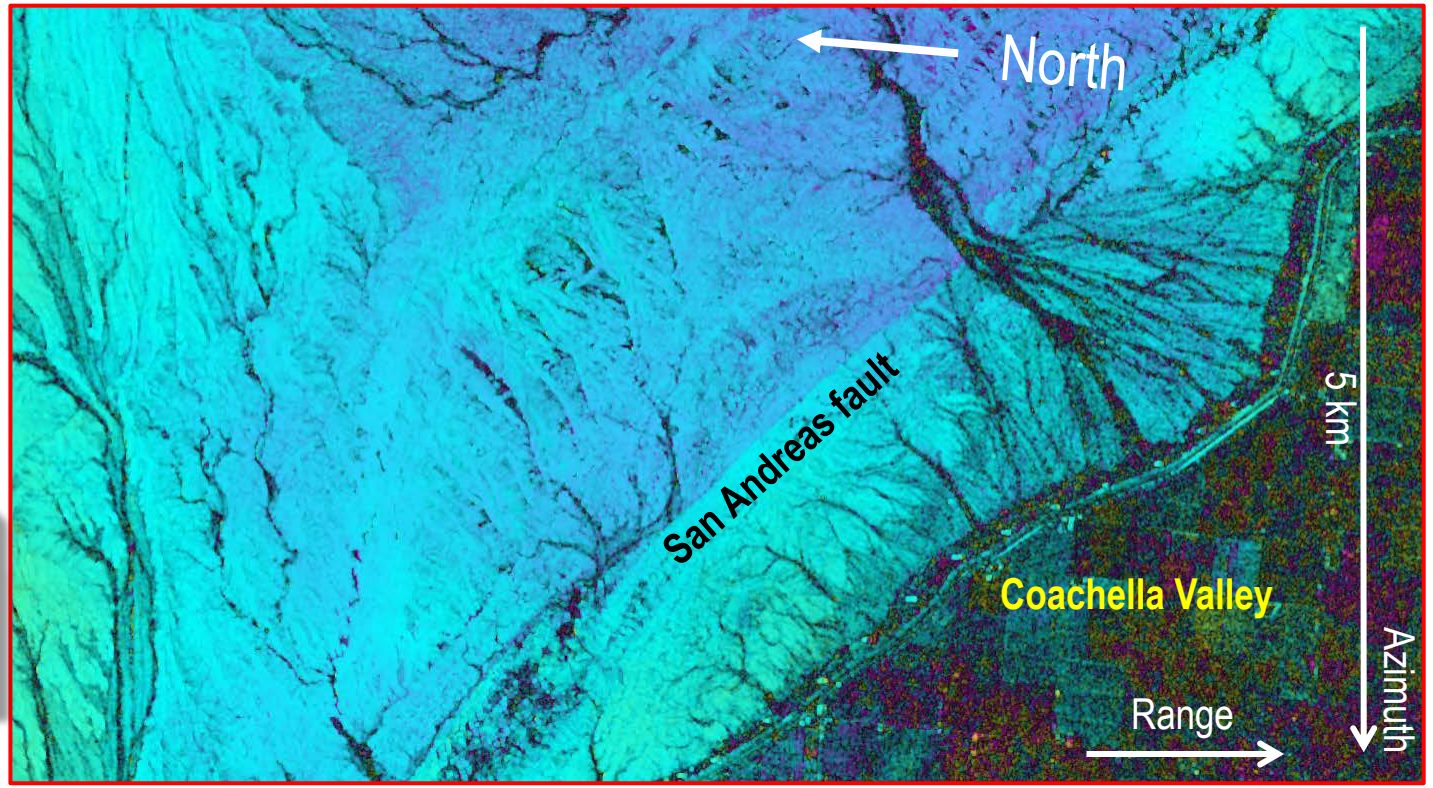
UAVSAR Baseline Adjustment

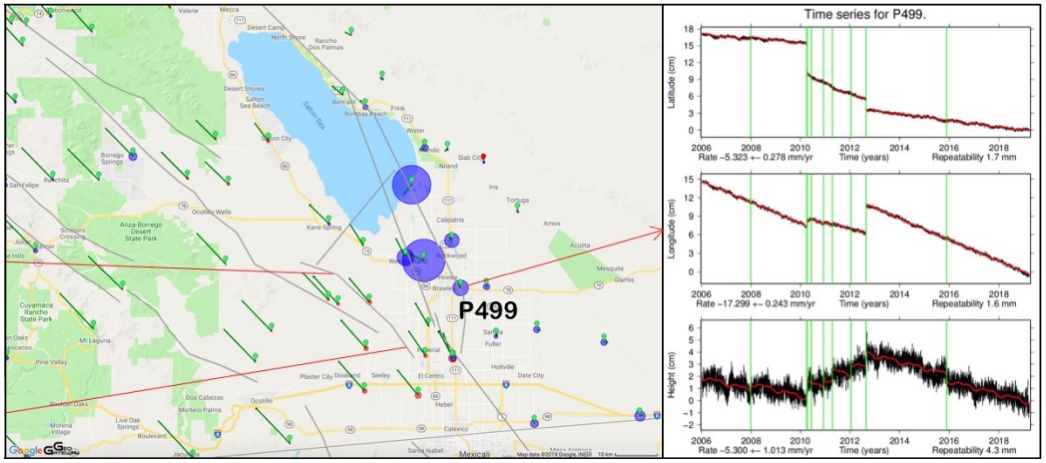
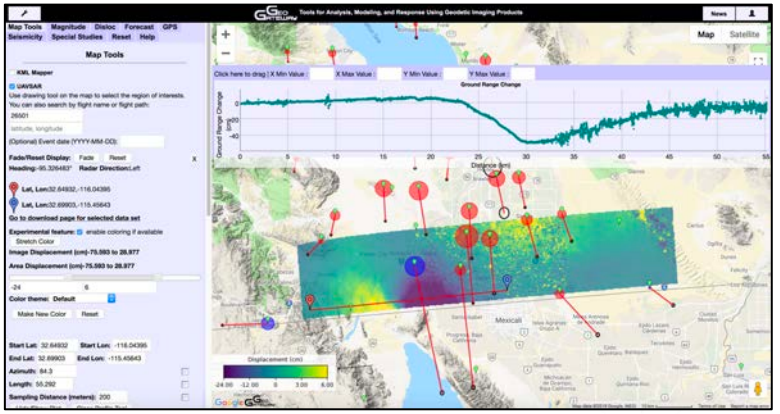


Enables extraction of plate tectonic motion and variations

Baseline Adjustment Highlights Fault Creep





Summary

- Fuse multiple geodetic methods to determine spatio-temporal variations in crustal deformation
- Construct a time-dependent uniformly gridded product
- Serves as reference for modeling and analysis