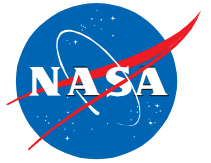


NASA Jet Propulsion Laboratory Data Products

17 April 2014 Emergency Response Spatial Tools Technical Interchange

Maggi Glasscoe

Margaret.T.Glasscoe@jpl.nasa.gov

Sang-Ho Yun

Sang-Ho.Yun@jpl.nasa.gov

Copyright 2014. All rights reserved.

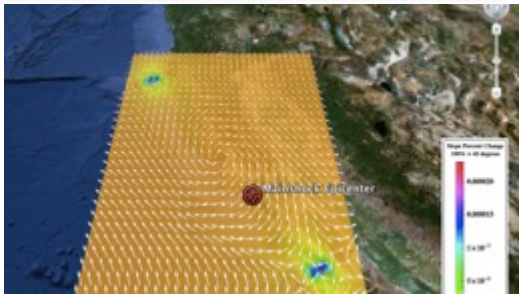
Jet Propulsion Laboratory
California Institute of Technology
Pasadena, CA

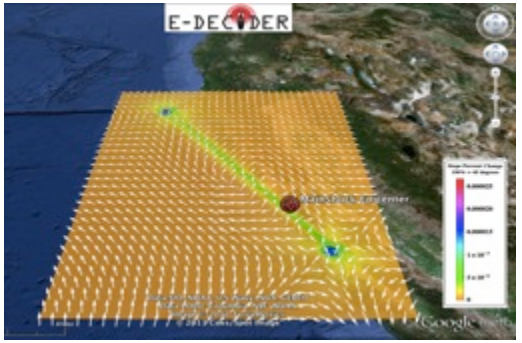
Introduction

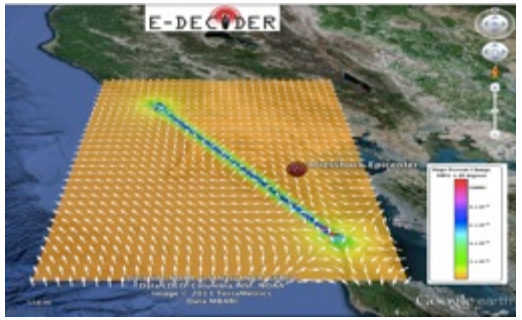
- JPL provides earthquake disaster decision support and an end-to-end data system to deliver rapidly processed geodetic data and actionable data products in the event of an earthquake and other natural disasters
- For the Interchange Discussion we are focusing on three products:
  - Tilt/Slope Change Map
  - Damage Proxy Map (DPM)
  - Infrastructure Database Service

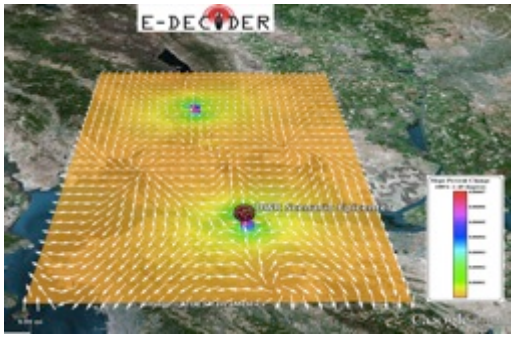
Tilt/Slope Change Map

- Automatic calculation triggered from USGS earthquake event feed for >M5, iteratively refined
- Measurement of the change of slope and direction that can affect water distribution, drainage, and sewage services
- When deformation changes the tilt of essentially flat ground, or increases slopes that may be near the angle of repose, drainage or water conveyance may be affected and landslides may result.
- These products can be imported as layers that can be overlaid upon maps of critical infrastructure to determine which assets are likely to have suffered damage from the earthquake. This facilitates prioritization and assignment of available response resources



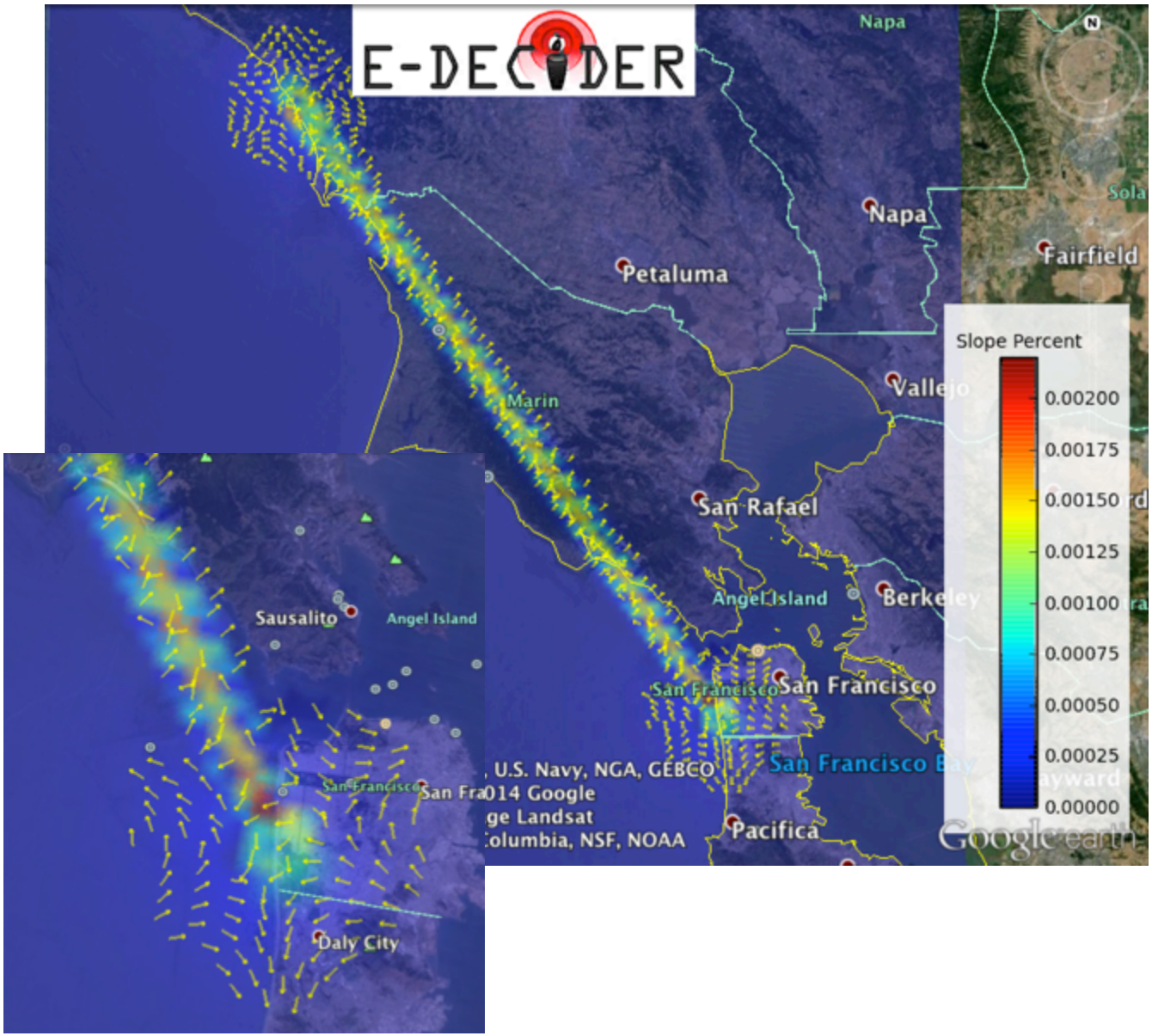






Tilt/Slope Change Map: Slope Percent and Direction

- Slope change map for Golden Guardian Exercise M 6.2 aftershock scenario based on modeled GPS data
- Color shows magnitude of slope change and arrows indicate direction
- This map product can be used in conjunction with infrastructure overlays to identify where damage may have occurred and response needs to be prioritized.



Damage Proxy Map (DPM)

- The DPM applies an automated change detection algorithm to Synthetic Aperture Radar (SAR) that has been demonstrated to detect:
  - Building damage/collapse
  - Liquefaction
  - Landslides
  - Flooding/inundation extent

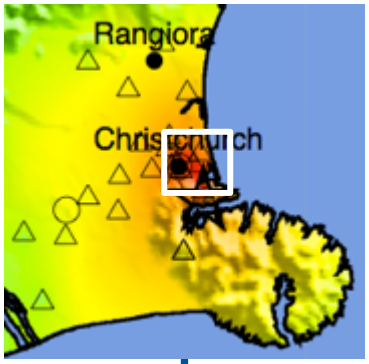
Example of building collapse detected by DPM from Christchurch Earthquake

- A DPM provides both a synoptic view and high spatial detail of damage.
- DPM's are based on radar observations, which can be acquired day or night and can image through clouds, unlike optical imagery.
- DPMs can be provided in KML/KMZ, GeoTIFF, and Shapefile.

Damage Proxy Map: San Francisco

- Close-up of San Francisco from damage proxy map generated for Golden Guardian Exercise
- Red pixels indicate damaged structures in an earthquake. For example map, construction or other changes serve as proxy for damage.
- Map is generated for large region (80 km x 120 km footprint), providing synoptic view of affected areas with spatial details finer than building block scale (24 m x 30 m pixel).

Damage Proxy Map vs. Ground Observations



DPM from radar data

Shakemap released by USGS NEIC

Radar data acquired by ALOS satellite

Official damage map released based on ground observations

Official damage map updated based on ground observations

2011 Feb Mar Apr May Jun Jul Aug Sep Oct

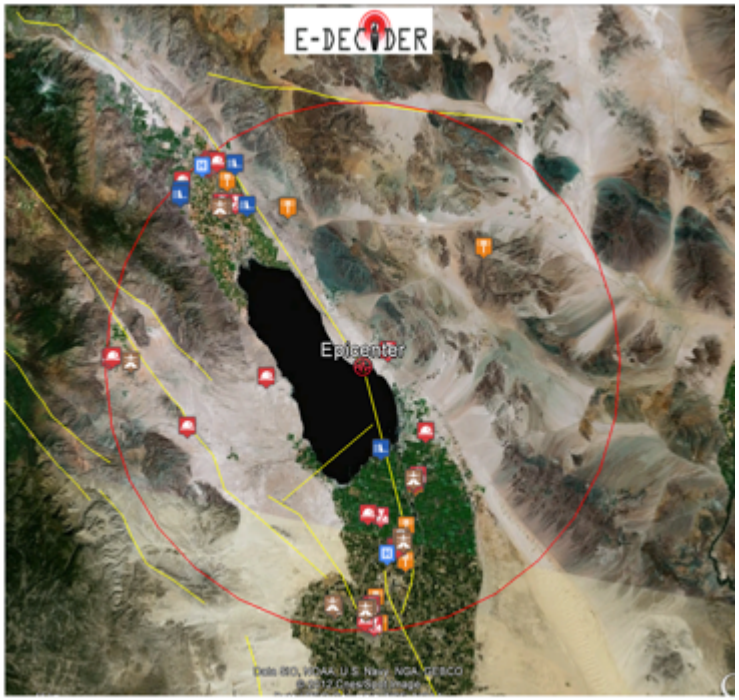
M6.3 Christchurch Earthquake

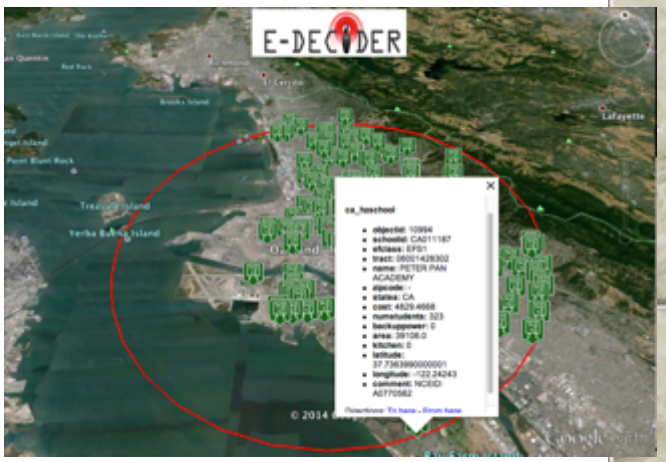
- 185 people killed
- > 1000 buildings destroyed
- Over US $30 billion damage

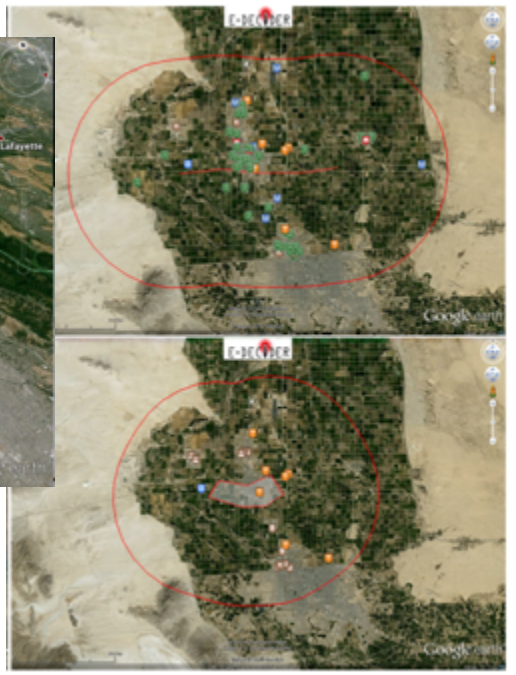
Original ALOS Data © JAXA, METI 2011
Official damage map provided by the New Zealand Government (http://data.govt.nz)

Infrastructure Database Service

- Enables user to access near 30 FEMA critical infrastructure information layers with HSIP Freedom data overlaid upon map data products from E-DECIDER and QuakeSim (or others)
- Supports spatial query for broader range of emergency situations: point (e.g. earthquake), line (e.g. tornado, fault rupture), and polygon (e.g. flood, wildfire), and user-specified search distance; bounding box search is now supported
- Supports KML output for Google Earth and Google Map, GeoJSON output for mobile web applications, and UICDS event adaptor is under development
- Data inventory hosted on third-party GIS server can be added through WFS chain service



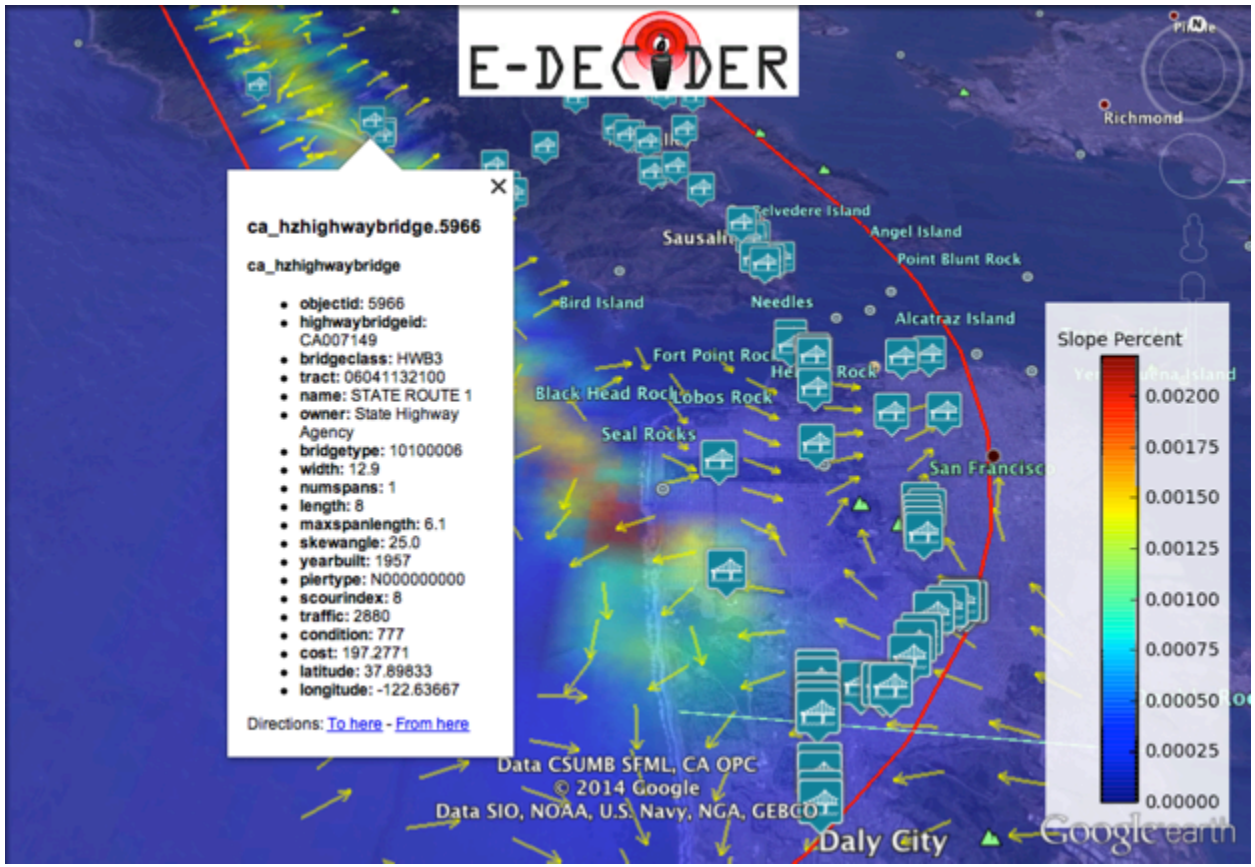




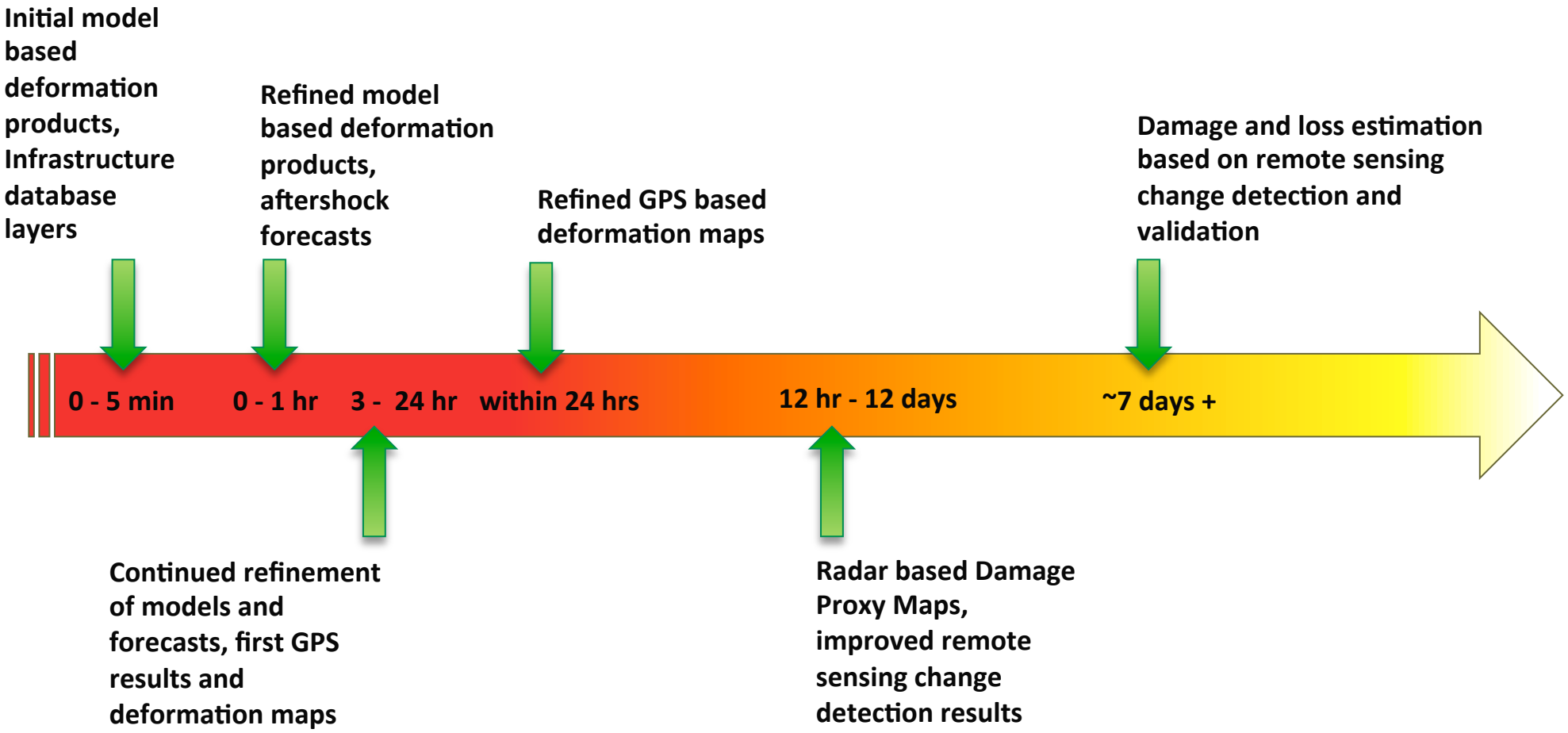
Product layers with overlays

- The tilt or slope change map indicates where vertical changes in the surface have occurred. This is indicated with a color scale showing areas of greater slope change and arrows indicating the direction of change.

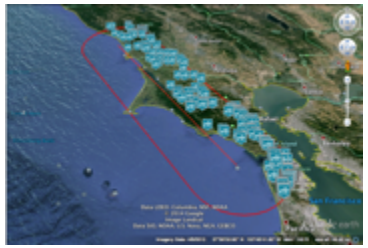
- Critical infrastructure that was potentially exposed to damage can be viewed by specifying an epicenter or fault rupture parameters and radius of interest and then listing the items of interest. The callout in the image shows a highway bridge.

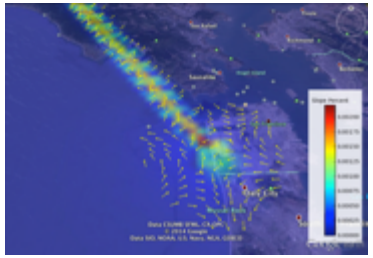


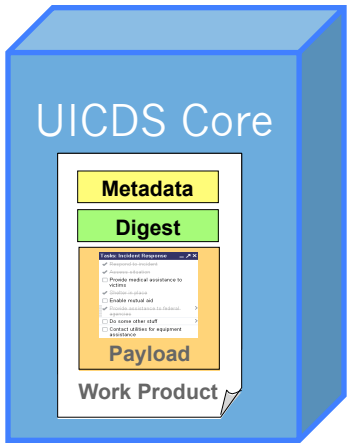
Product latencies: When will they be available?

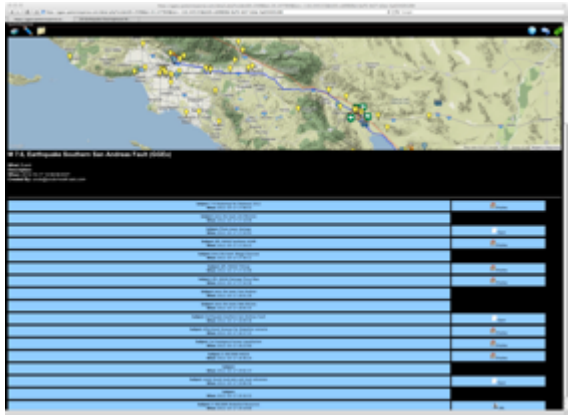


NASA JPL Data Exchange

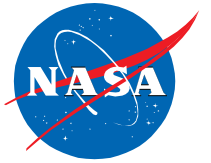








Products Generated → **Post to UICDS** → **Users query products (Spot On Response, NICS, etc)** → **Pass on to Decision Makers (local, state, federal)**



Questions?

Maggi Glasscoe

Margaret.T.Glasscoe@jpl.nasa.gov

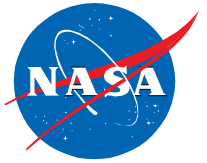
Sang-Ho Yun

Sang-Ho.Yun@jpl.nasa.gov

http://e-decider.org **http://aria.jpl.nasa.gov**

Copyright 2014. All rights reserved.

Jet Propulsion Laboratory
California Institute of Technology
Pasadena, CA



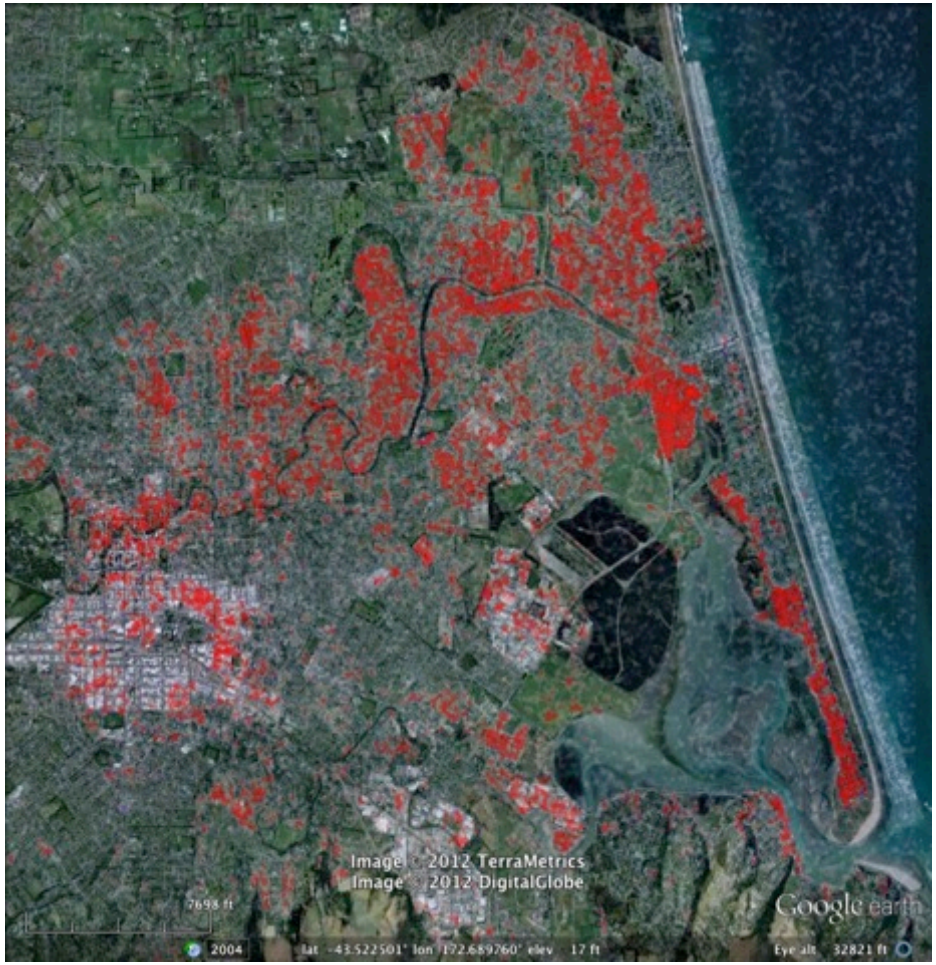
Backup

Copyright 2014. All rights reserved.

Jet Propulsion Laboratory
California Institute of Technology
Pasadena, CA

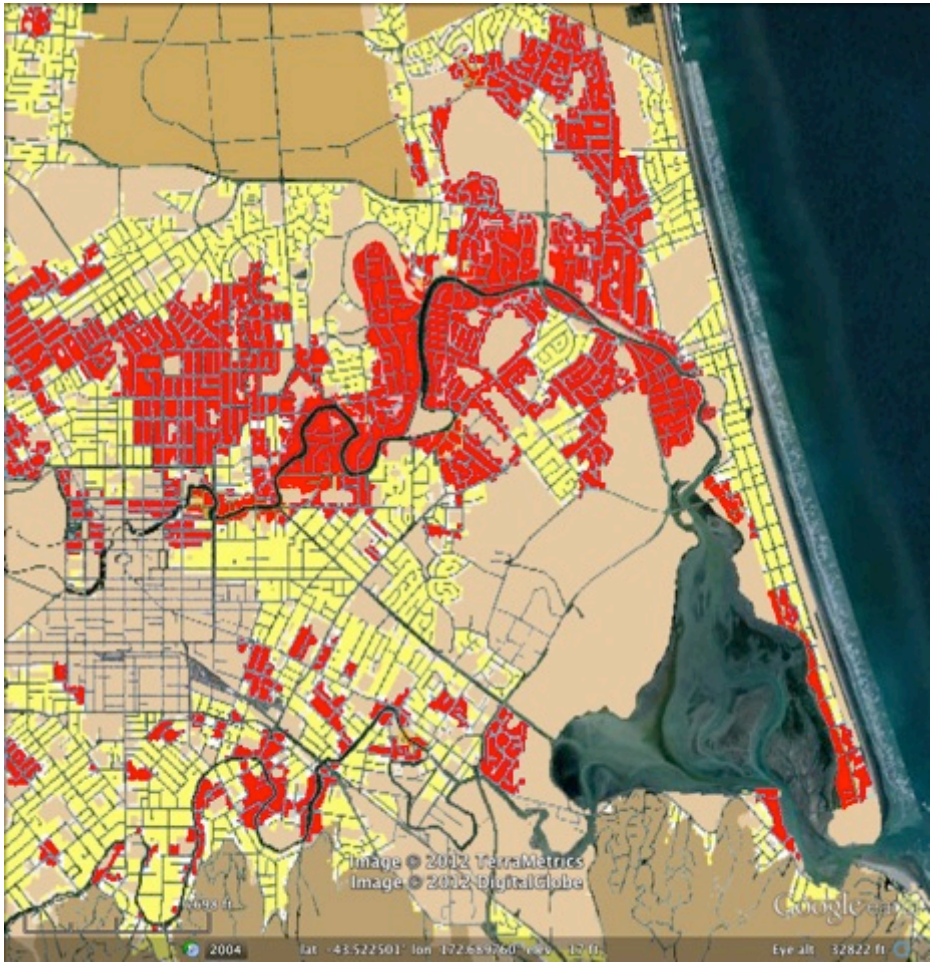
Damage Proxy Map vs Technical Category

Derived from Radar data acquired
3 days after the earthquake



Damage Proxy Map (**ALOS PALSAR**):
2010.10.10 – 2011.01.10 – 2011.02.25

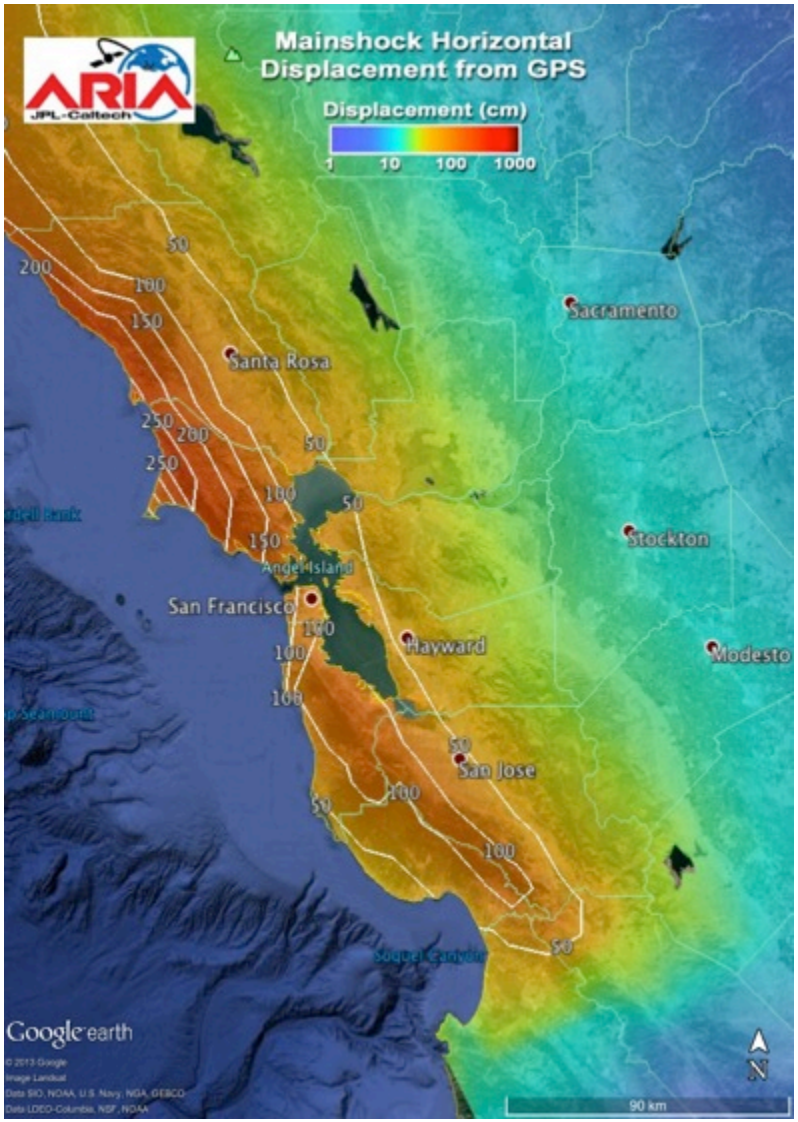
Damage zone map based on house/land inspection
8 months after the earthquake

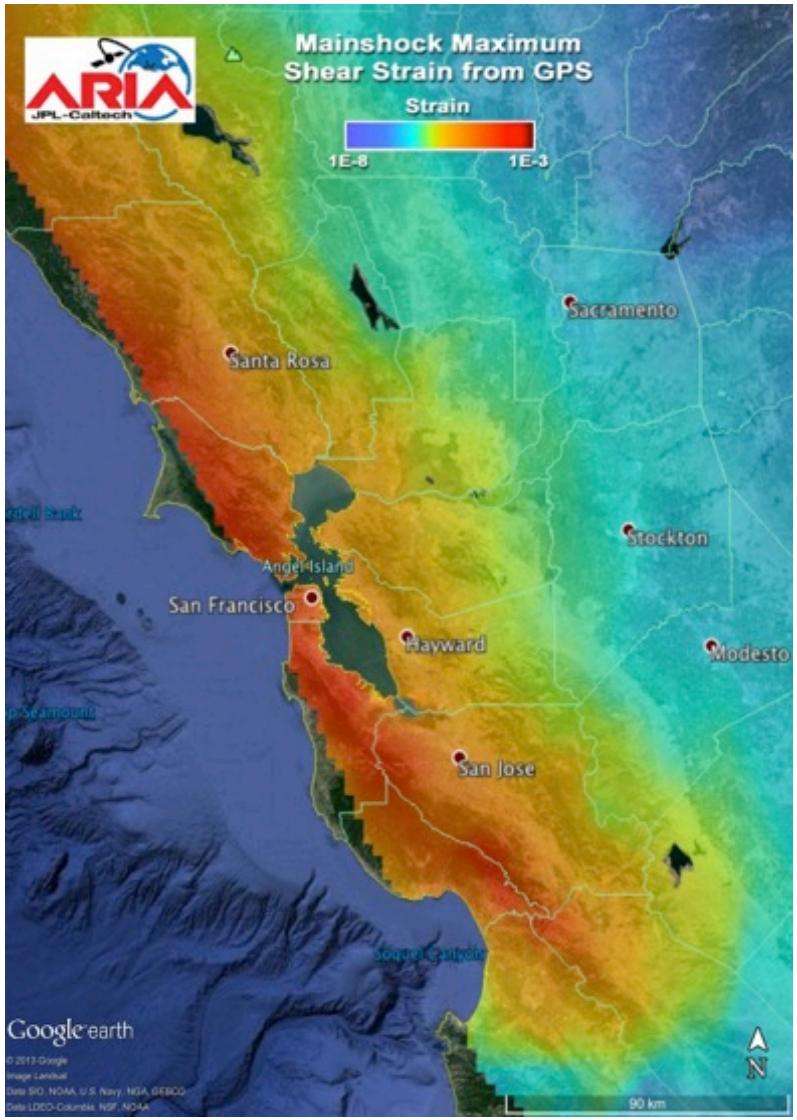


Data provided by the New Zealand Government
2011.10.28 version. http://data.govt.nz

Original ALOS Data © JAXA, METI 2011

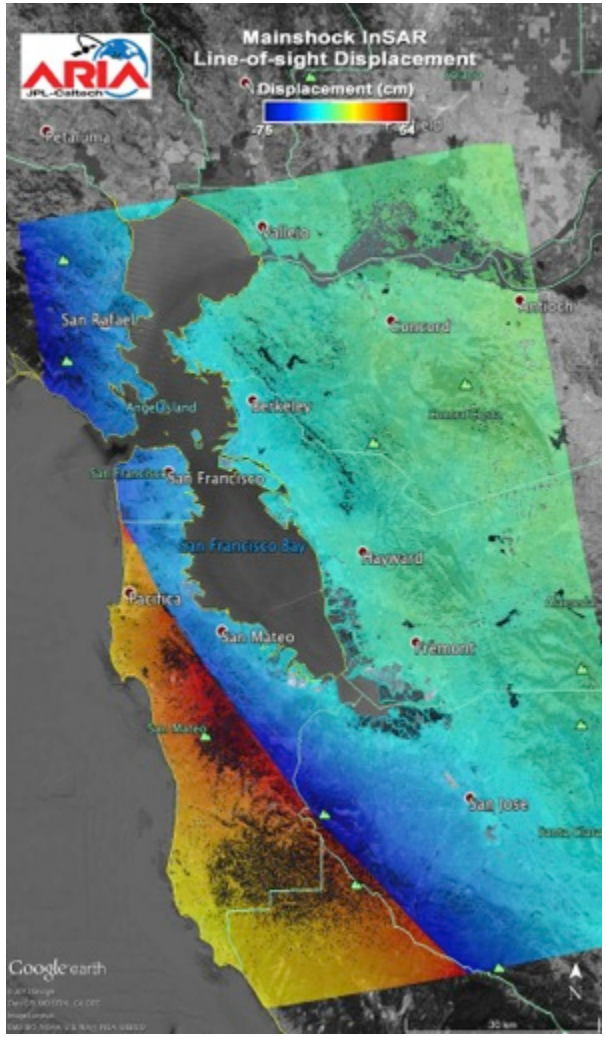
Displacement & Strain Maps

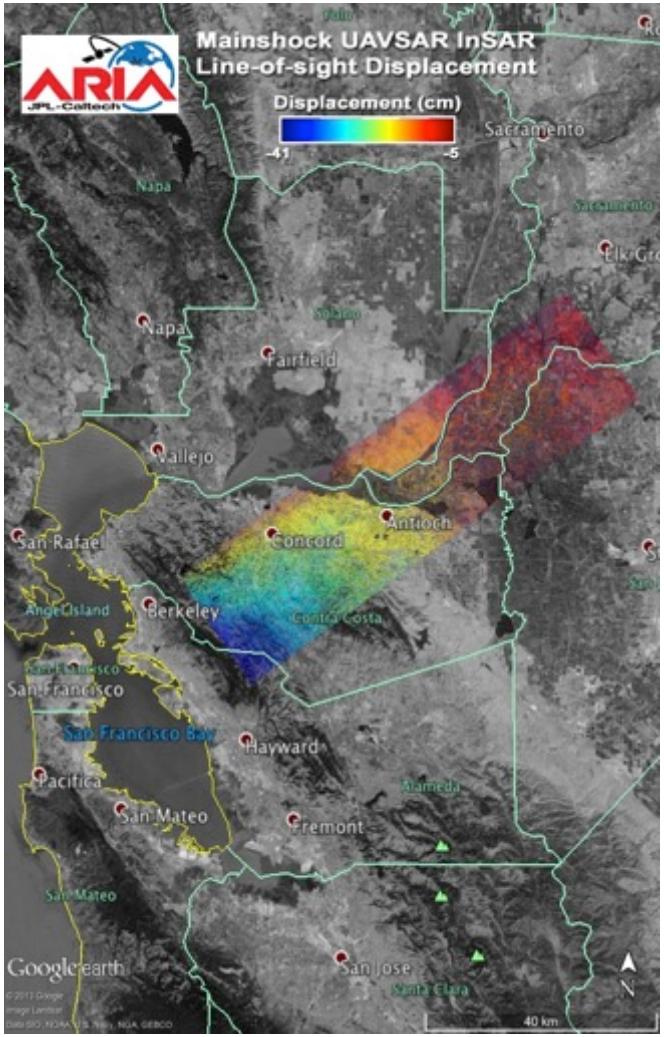




Simulation of GPS results from a San Francisco Bay earthquake, used for California Earthquake Clearinghouse exercise. These products would be produced by ARIA and used for situational awareness by response agencies after a real event.

Displacement and DPM example





A

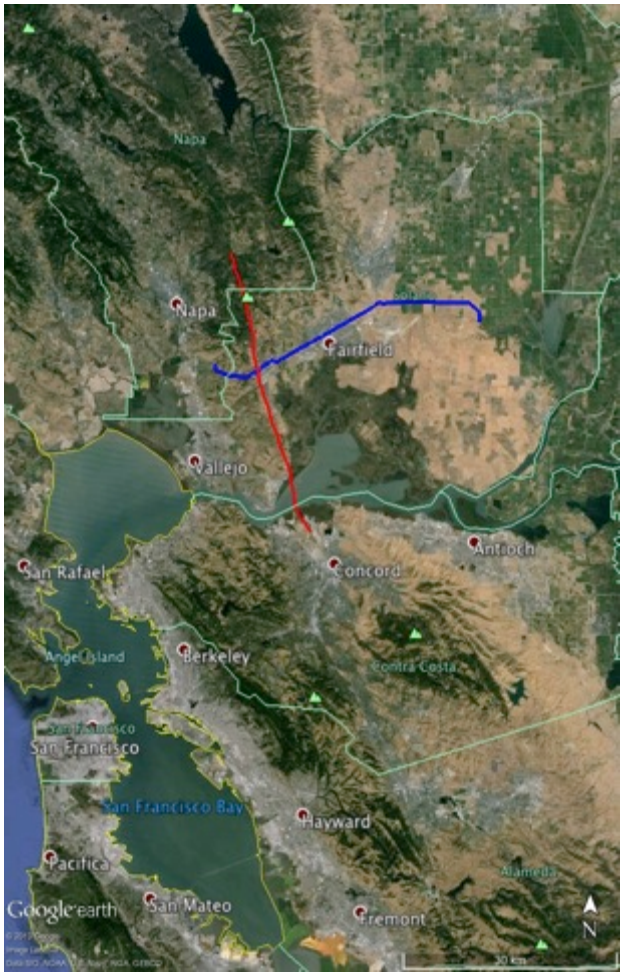
B

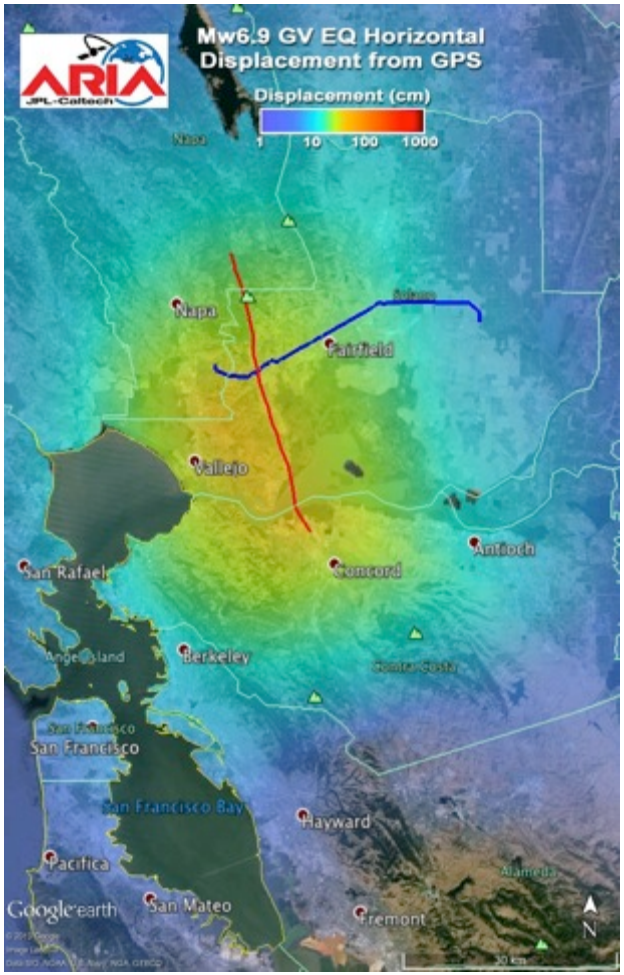
C

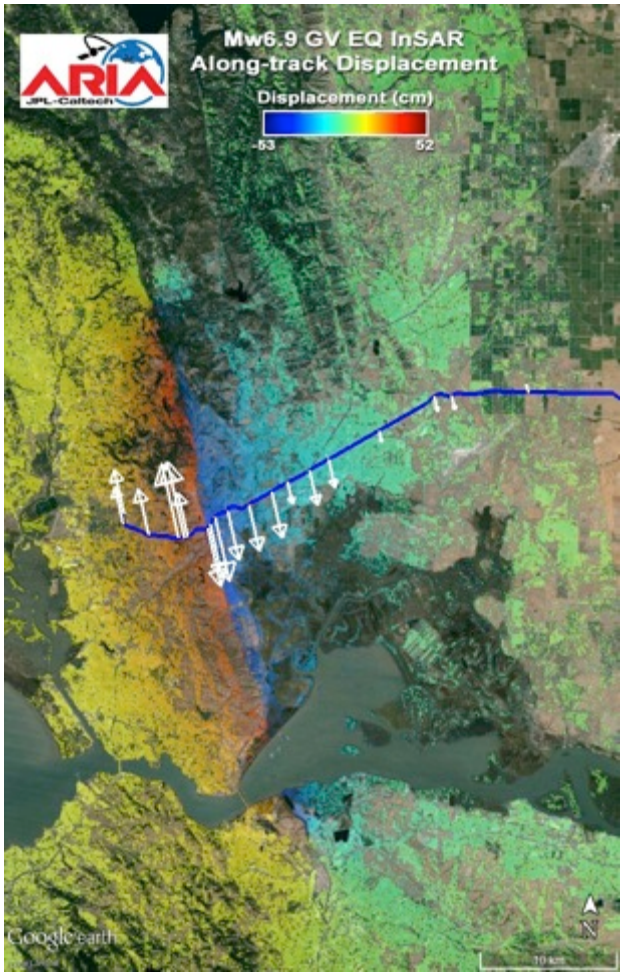
MEDIA **DPM** **Google Earth**

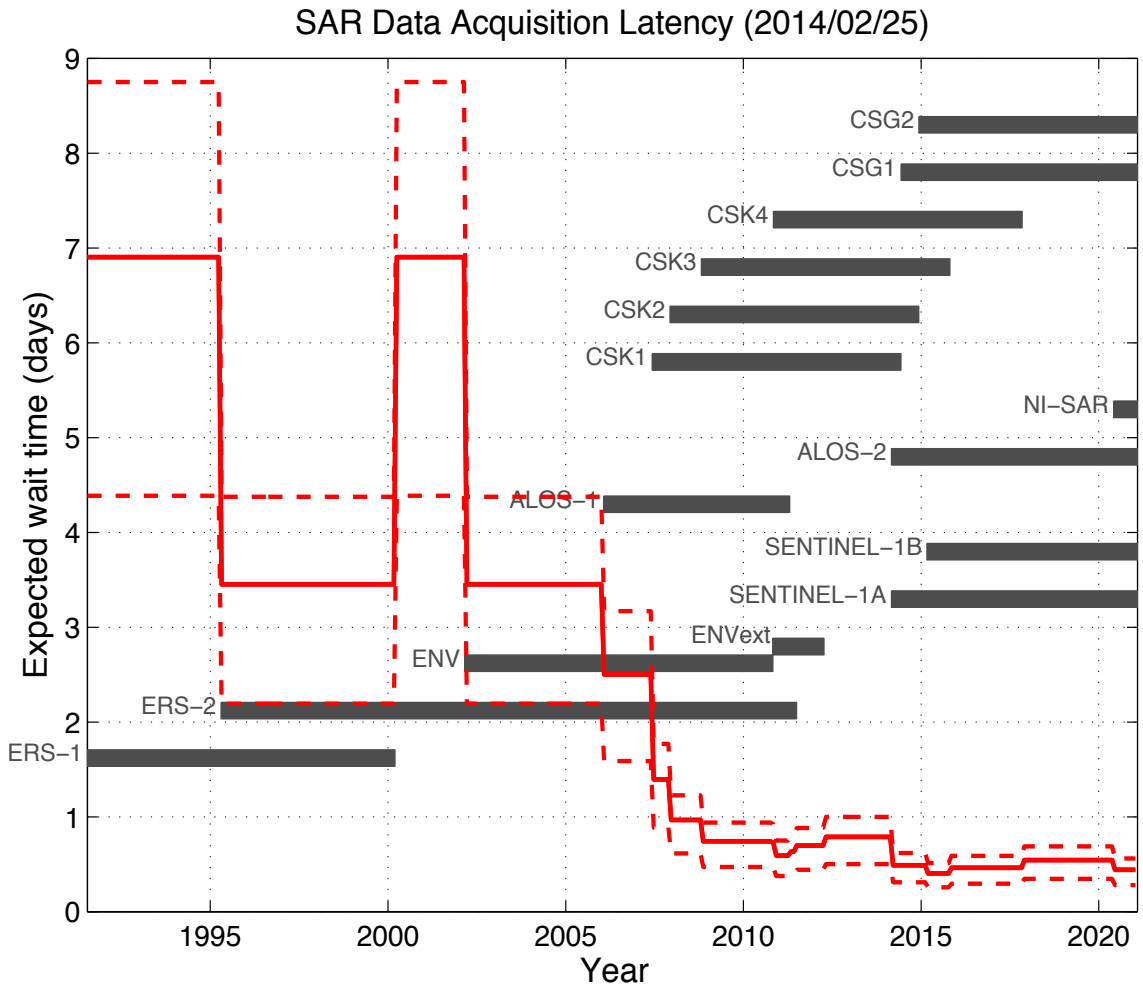
National Aeronautics and Space Administration
Jet Propulsion Laboratory - California Institute of Technology

Mw6.9 earthquake example







SAR Data Acquisition Latency

- Expected wait time until the first SAR satellite to visit after an event
- Ascending + descending orbit
- Right-looking mode
- Latitude : 0°, 38°, 60°
- Present: 19 hours
- 2020: 13 hours