

Foundations and frontiers in geodetic methods

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Data integration of data we ALREADY have → continuation + ready for large datasets + use existing data for new purposes (improved processing, resolution,...)

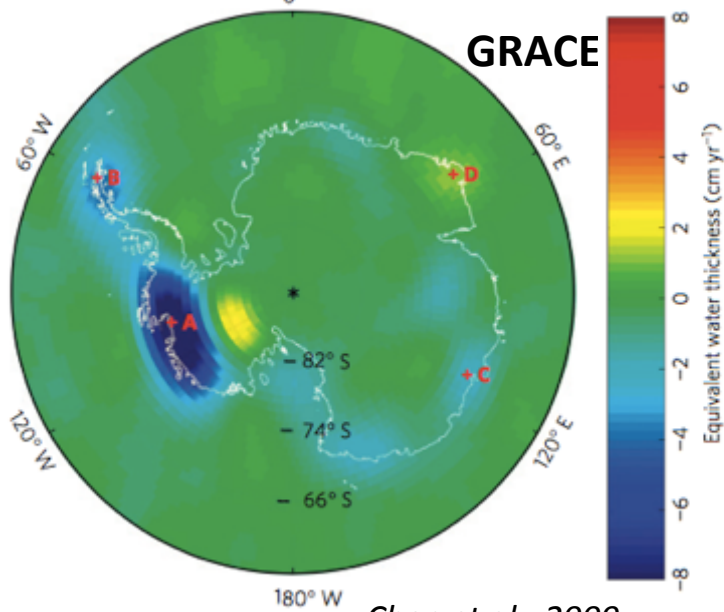
- **GRACE and GOCE (gravity):**
 - Global and regional constraints of gravity field and its temporal evolution
- **GPS:**
 - Time-dependent seismic hazard assessment (inter-, co-, and postseismic stress transfer)
 - New applications: vertical GPS for hydrology, earthquake early warning G-larmS
- **InSAR:**
 - Archive: lower detection threshold -> new applications (interseismic, hydrology, ..)
 - 3D deformation (UAVSAR), global (ALOS), high spatiotemporal resolutions (CSK, TSX)
 - Rapid response (Sentinel) + disaster mapping

New data

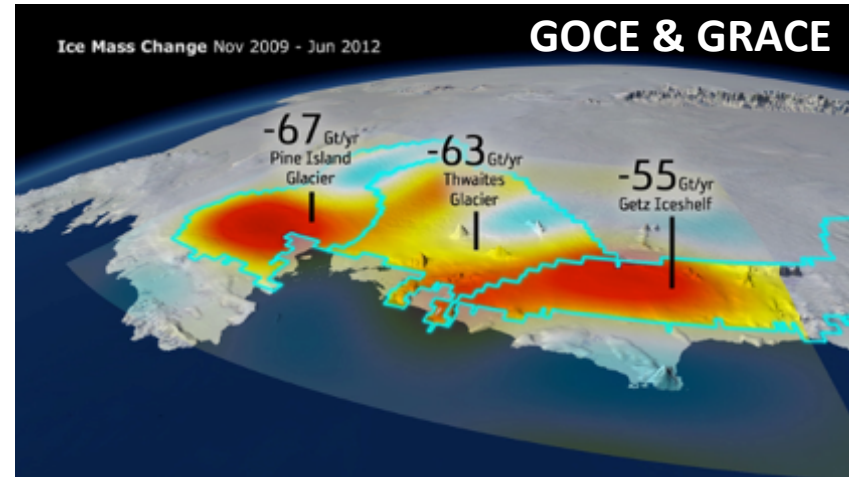
- **Seafloor geodesy**
- **LiDAR + drone + UAV**
- **Ground based InSAR + camera monitoring**
- **Global InSAR with latest & greatest processing from international platforms**
- **Collocation of existing instruments (natural laboratory) -> monitoring, core science, and noise evaluation**

Ice mass changes

Ice mass change from gravity

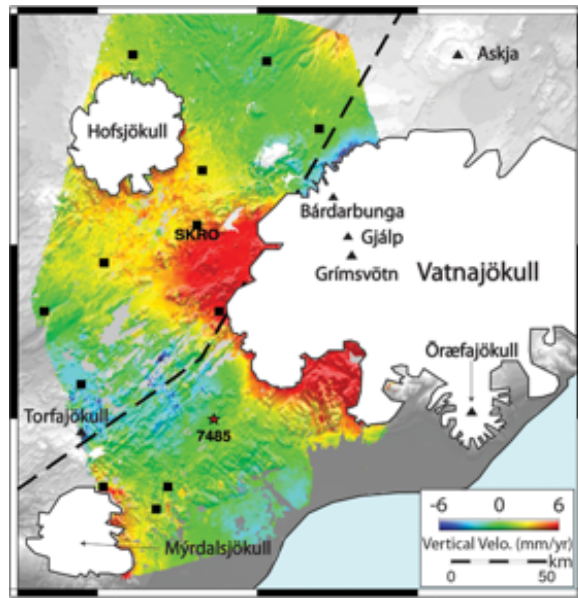


Chen et al., 2009

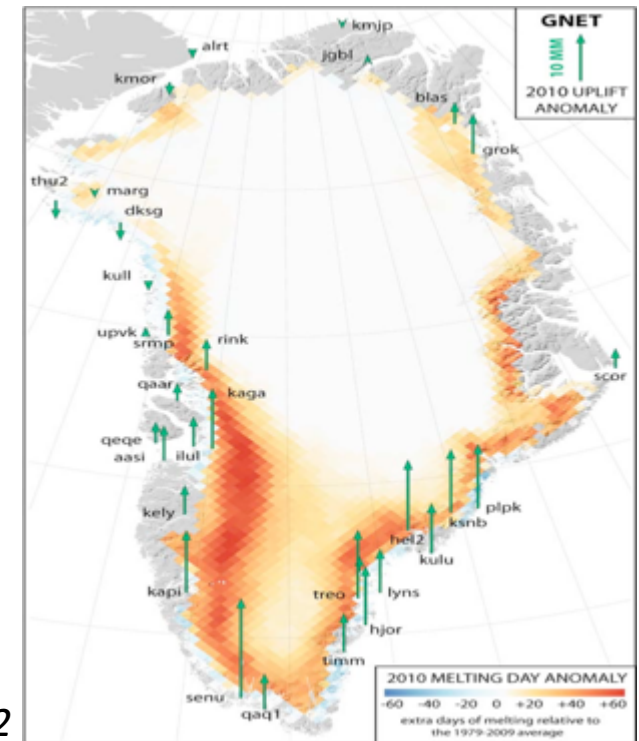


GIA from GPS

GIA from InSAR



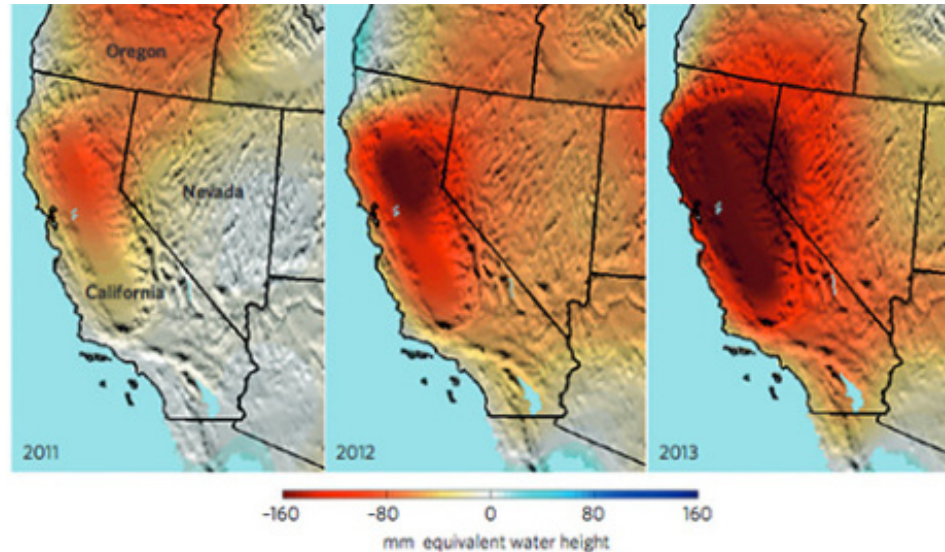
Zhao et al., 2014



Bevis et al., 2012

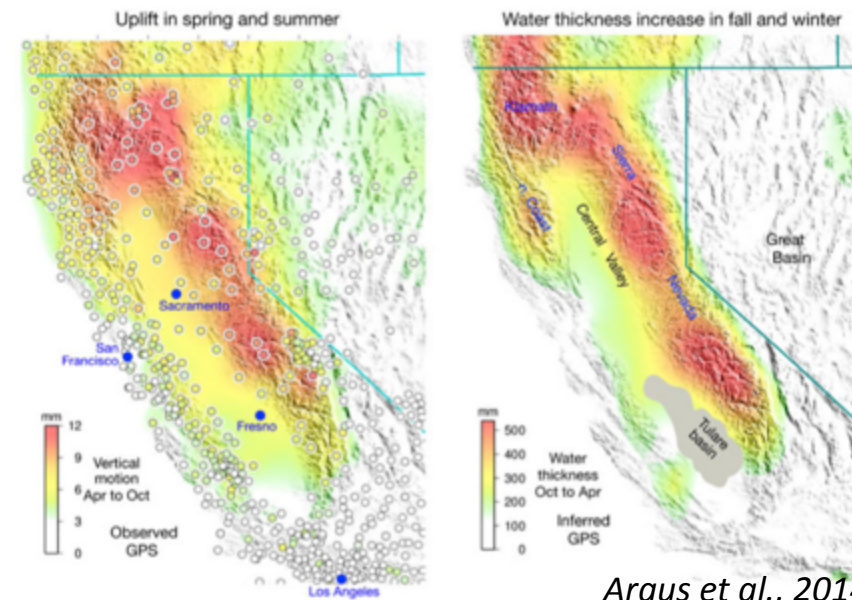
Hydrology

Groundwater storage changes from GRACE

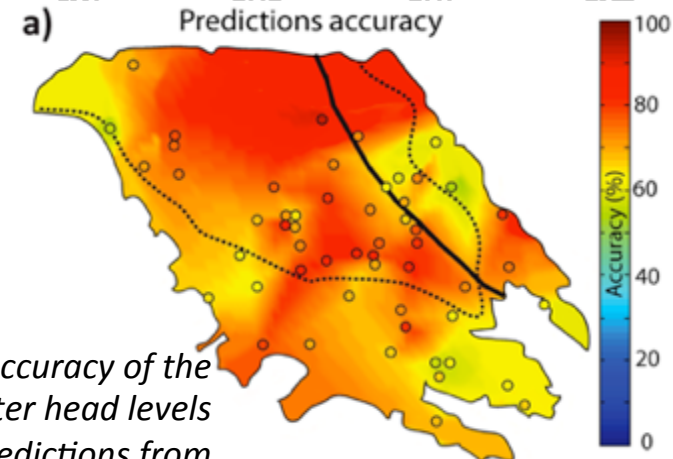
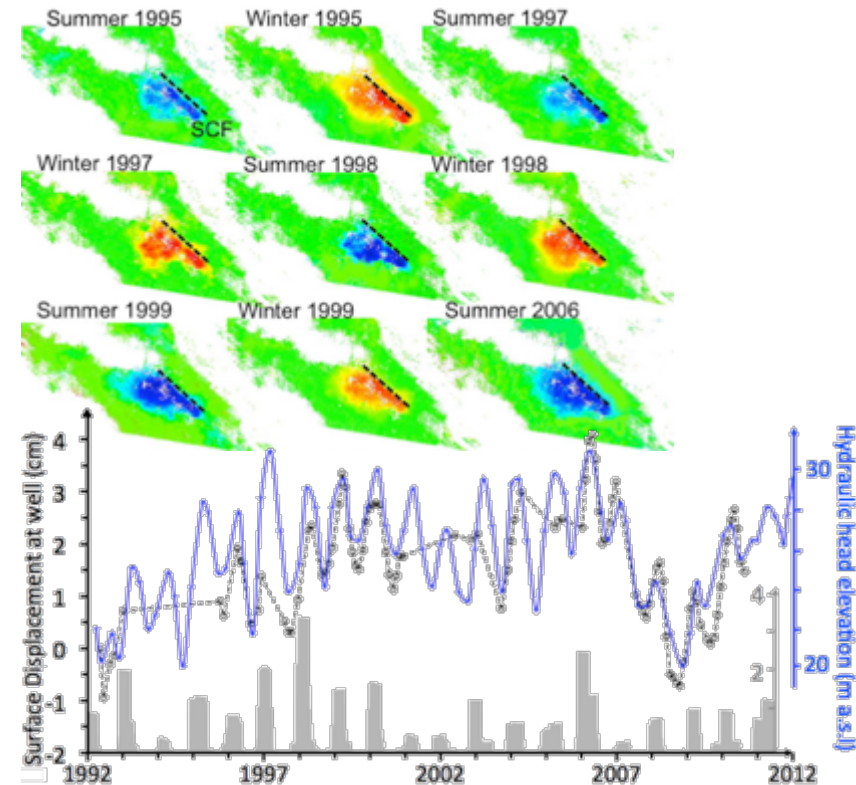


GRACE maps of dry season total water storage anomalies (in mm equivalent water height with respect to 2005–2010).

Vertical GPS for water thickness estimation



InSAR for aquifer characterization

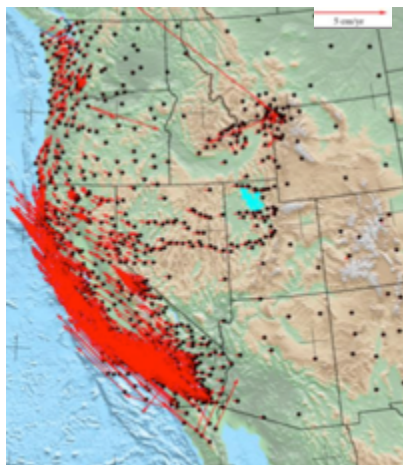


Accuracy of the water head levels predictions from ground deformation

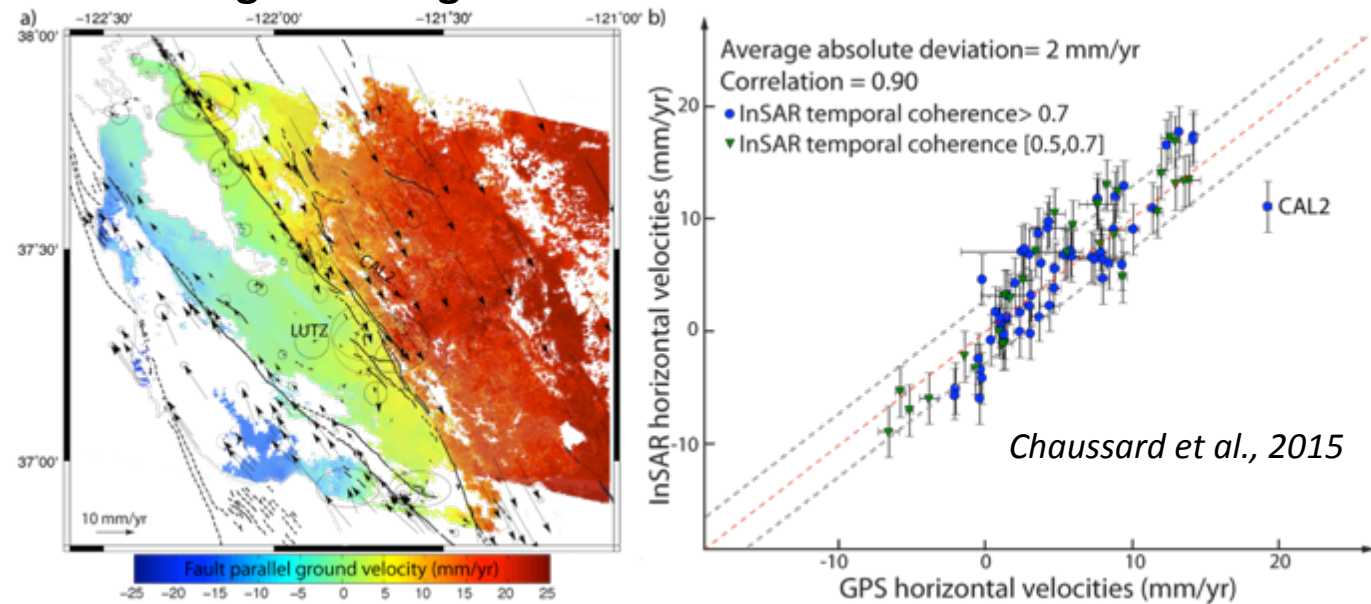
Chaussard et al., 2014

Seismic cycle deformation

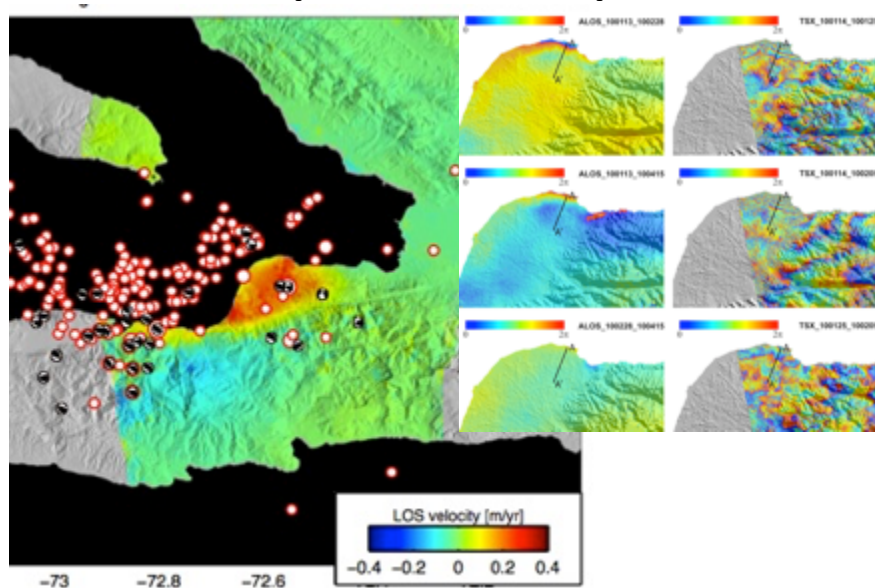
PBO interseismic



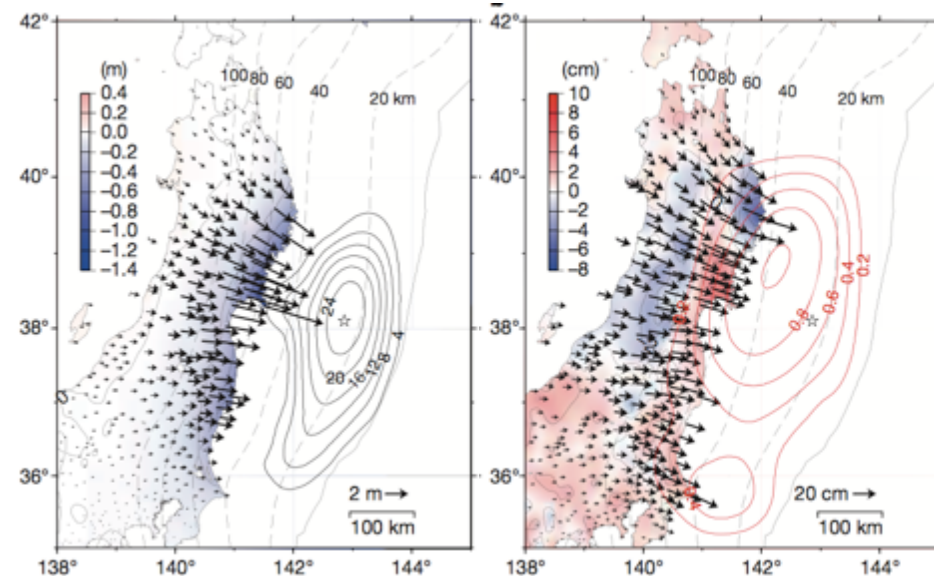
Short and long wavelength interseismic from InSAR alone



InSAR co and post-seismic slip - Haiti

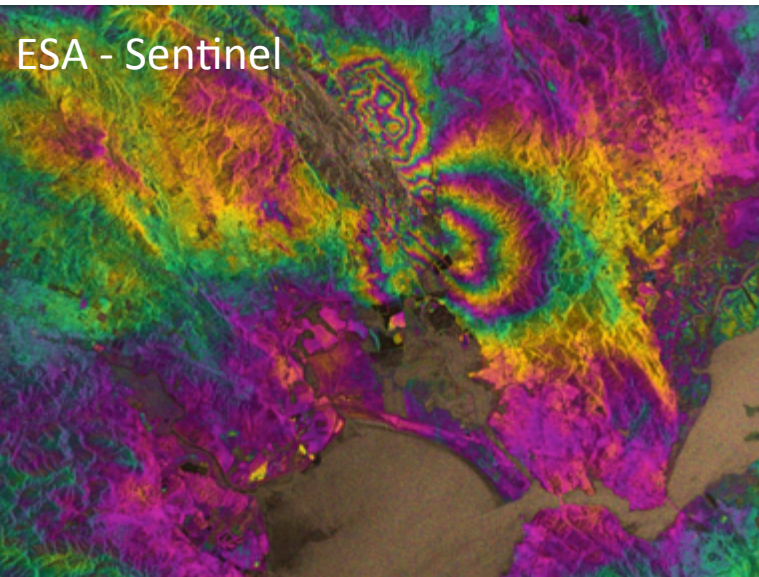


GPS co and post-seismic slip (Tohoku)

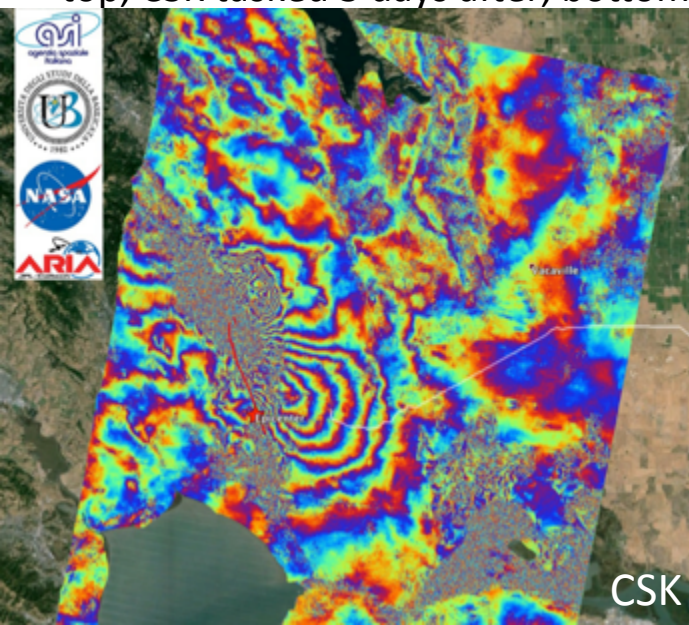


Earthquake rapid response

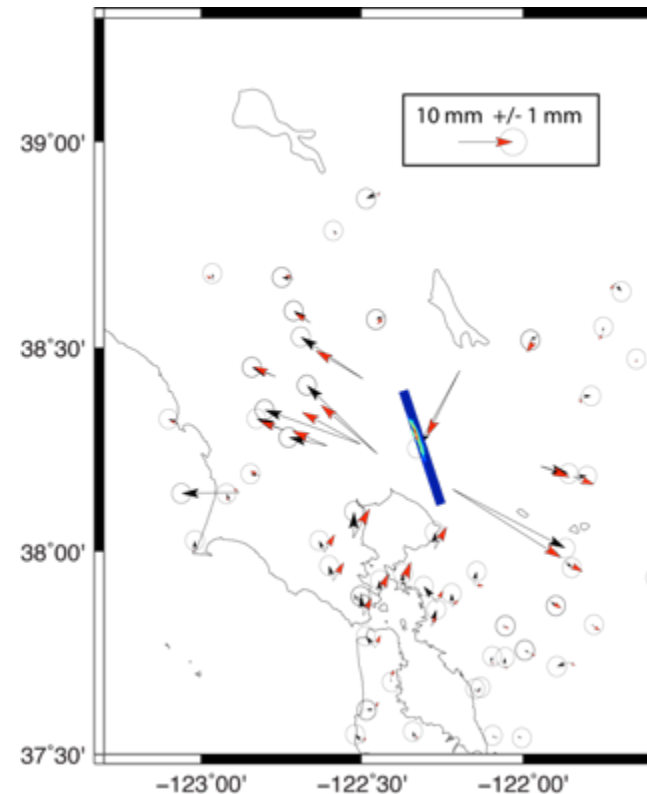
Rapid response: coseismic from InSAR



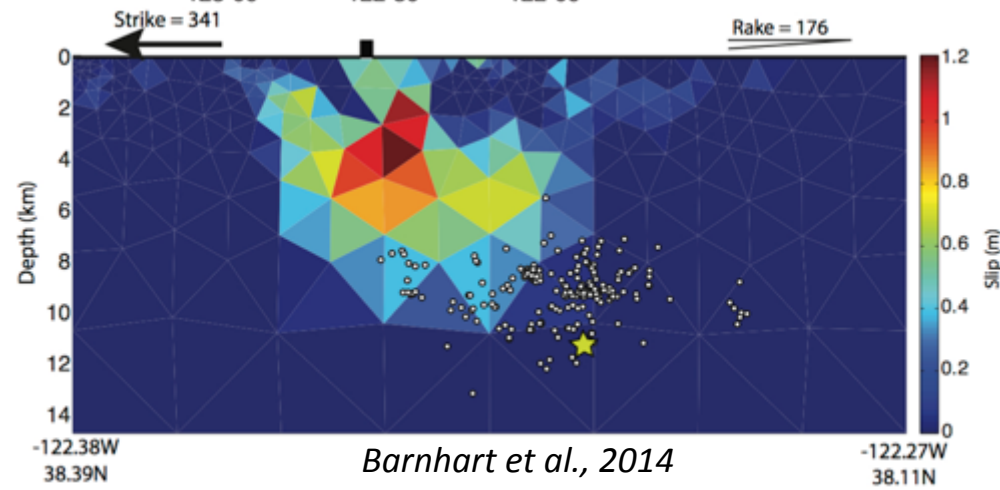
Napa quake (Sentinel tasked 7 days after, top, CSK tasked 3 days after, bottom)



Rapid response: coseismic from GPS

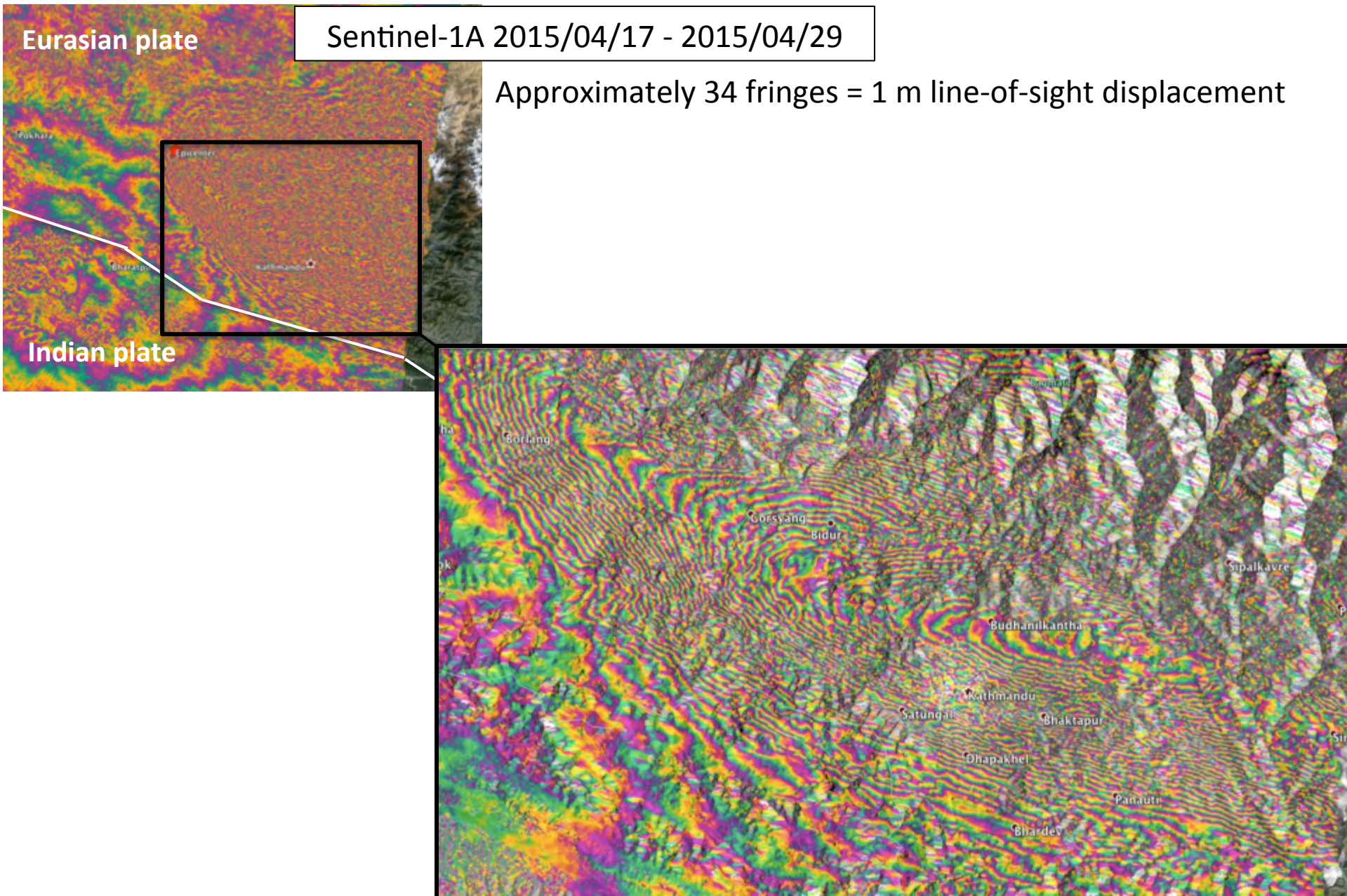


GPS solution
24h after quake



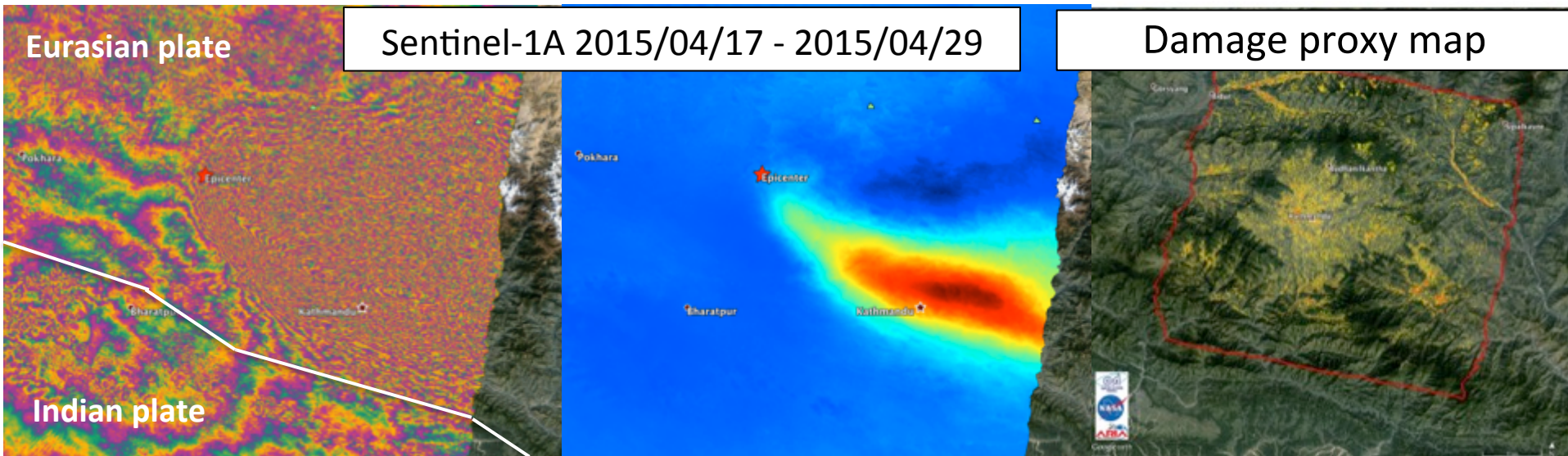
Earthquake rapid response

Nepal Mw7.8 of April 25: InSAR is the first response (before GPS!)

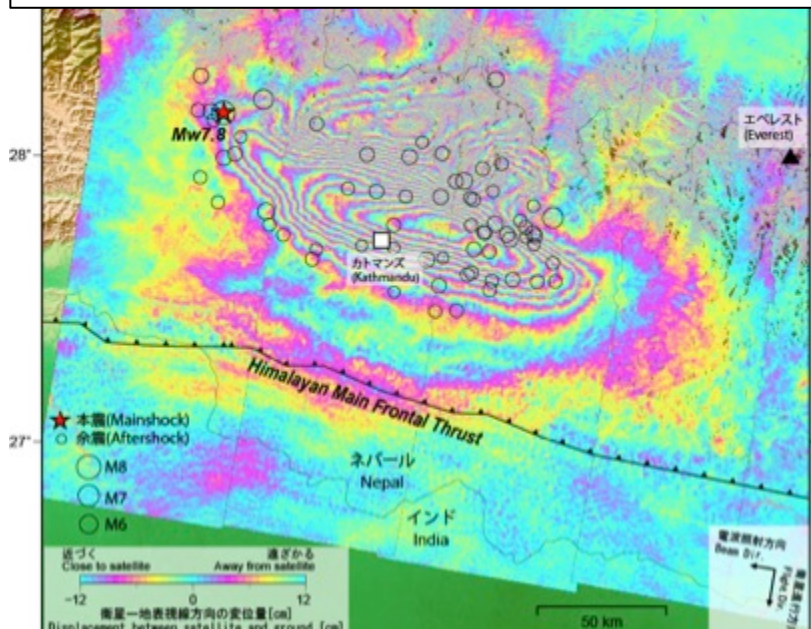


Earthquake rapid response

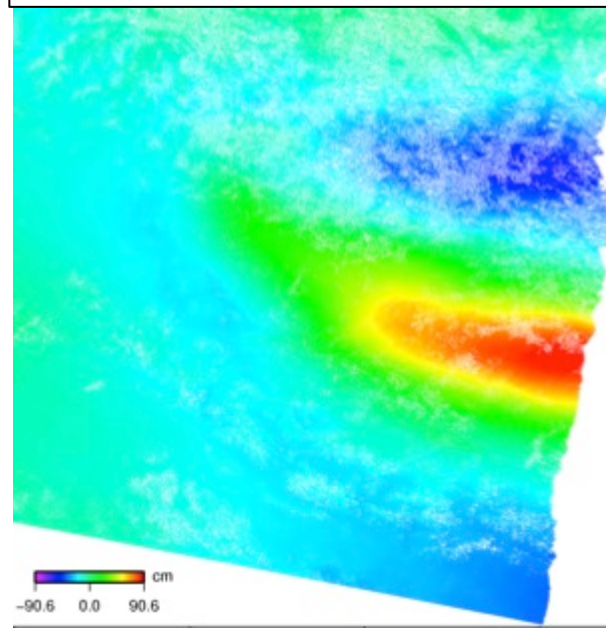
Nepal Mw7.8 of April 25: InSAR is the first response (before GPS!)



ALOS-2 02/17- 04/28 L-Band

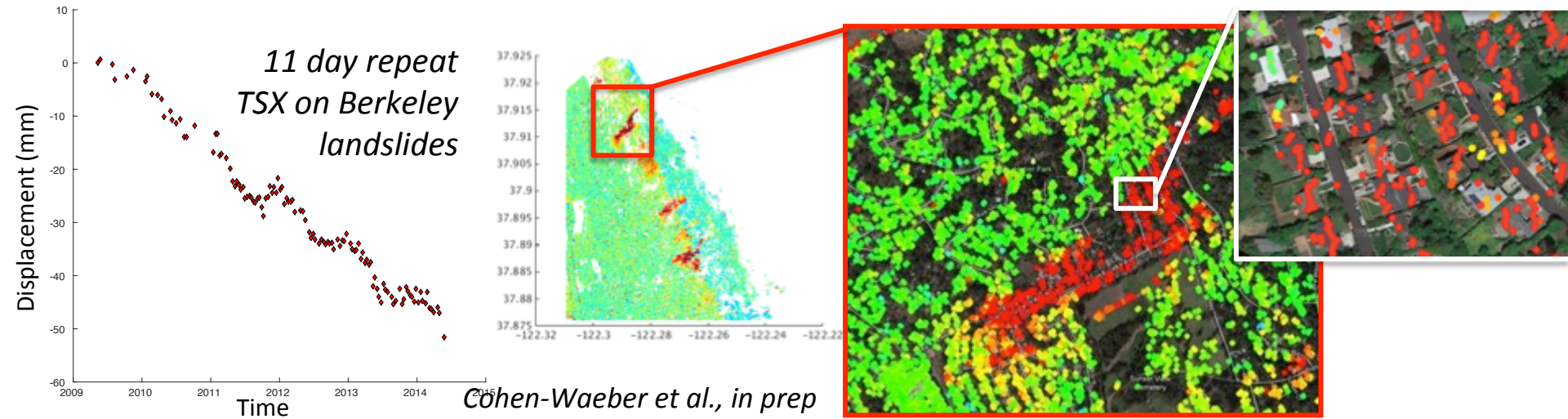


Radarsat-2 04/05-04/29 C-Band

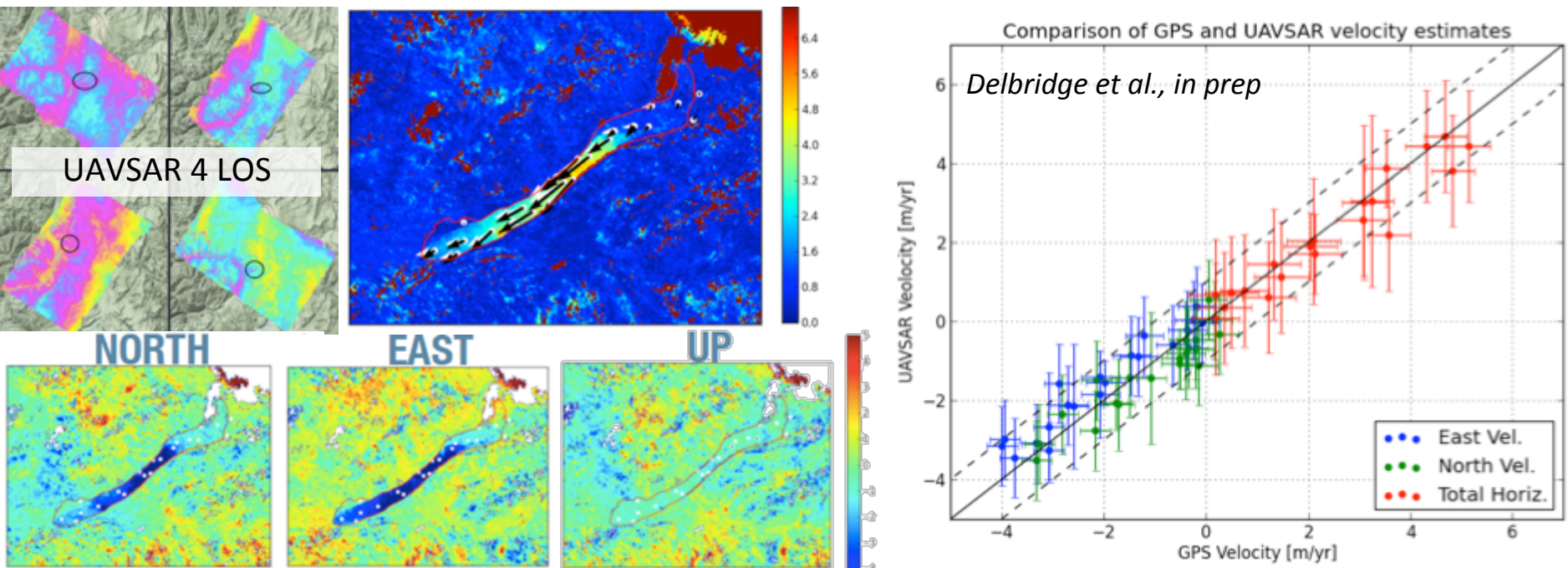


Landslides

High spatial sampling and high temporal repeatability (CSK, TSX, Sentinel)



Full 3D motion from InSAR UAVSAR and comparison with GPS



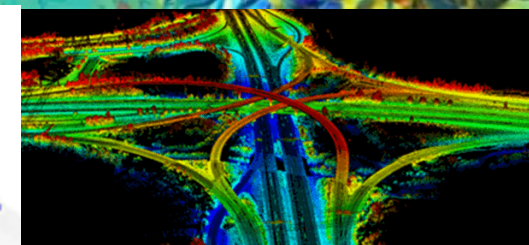
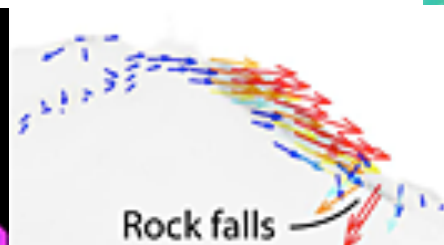
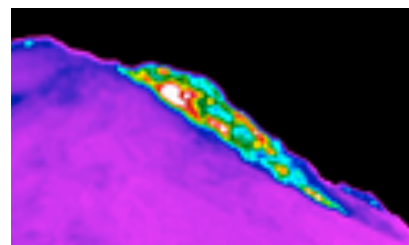
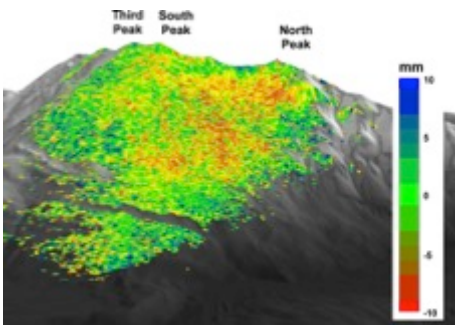
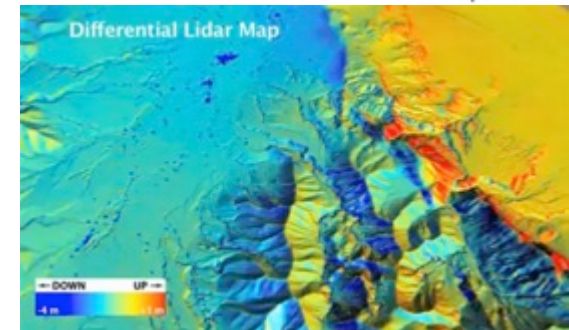
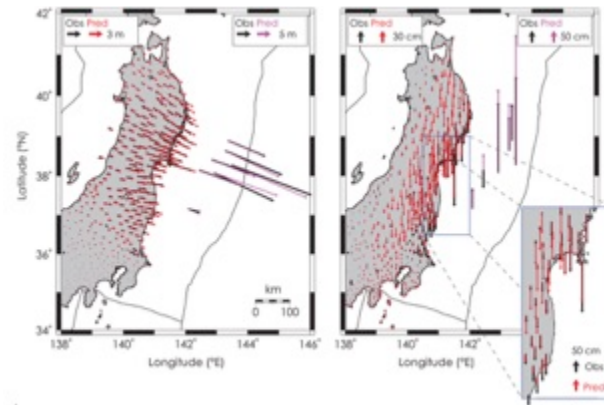
→ **Data integration (InSAR, GPS, GRACE, seismicity, gravimetry...) to get better understanding of earth processes: continuation of existing core is critical!**

- **Long-term missions with high repeatability, L0 to L5 data products**
- **PBO with real-time data** (upgraded to GNSS) + **densification** EEW, tracking volcanic unrest, afterslip, tsunami warning, atmosphere, ..
- **Continuous, global, long-term and semi-real time InSAR data**

→ Reduce losses from hazards with new technologies with global monitoring & risk assessment and rapid response

→ **New data**

- **Seafloor geodesy**
 - **LiDAR + drone + UAV**
 - **Ground based InSAR + camera monitoring**
 - **Collocation of existing instruments (natural laboratory)**
- > monitoring, core science, and noise evaluation



Data integration (InSAR, GPS, GRACE, seismicity, gravimetry...) needs:

→ Infrastructures needs

– Seamless archive of data of **LARGE** datasets with free and open access

- SAR (SSARA) – by 2020 10+SAR satellites from 8 space agencies

Automatic archiving facilities from foreign & domestic providers → 1-stop radar shopping facility from worldwide catalogues + data in subscription-mode

- GPS-GNSS (PBO Unavco)
- GRACE data (JPL)
- New data

... ideally all in one place

– **Computing infrastructures: cloud computing platform**

- for data processing (ESA-GPOD) → for producing different level of data
- for modeling (with compiled codes such as CIG)

– **Infrastructure for sharing processed results**

- Supersites
- Wovodat “modern database of worldwide volcanic unrest
- VHUB “facilitate online collaborative volcano modeling and research”
- Need more..