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 InSAR

Zhao et al., 2014

GIA from GPS

Bevis et al., 2012
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

Argus et al., 2014

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

Chaussard et al., 2015

InSAR co and post-seismic slip - Haiti

GPS co and post-seismic slip (Tohoku)
Earthquake rapid response

Rapid response: coseismic from InSAR

ESA - Sentinel

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

Rapid response: coseismic from GPS

GPS solution 24h after quake

Barnhart et al., 2014
Earthquake rapid response

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

Sentinel-1A 2015/04/17 - 2015/04/29

Approximately 34 fringes = 1 m line-of-sight displacement
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

Damage proxy map
Landslides

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

11 day repeat TSX on Berkeley landslides

Cohen-Waeber et al., in prep

Full 3D motion from InSAR UAVSAR and comparison with GPS

Delbridge et al., in prep

Comparison of GPS and UAVSAR velocity estimates

UAVSAR 4 LOS

NORTH  EAST  UP
→ 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..