Earthflow movement revealed by airborne InSAR, satellite InSAR, and optical image correlation

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Motivation

- Earthflows (slow-moving landslides) commonly occur in areas of gently sloping weak, fine-grained rock. These landslides are one of the dominant hillslope erosion processes and can represent a major source of sediment to fluvial systems, as well as present a significant natural hazard.

- Field based measurements of earthflow movement are difficult and limited in spatial resolution. Remote sensing techniques can provide high-resolution measurements over long time periods to allow regional comparison between earthflows.

Questions (that we haven't answered yet)

- What controls earthflow occurrence, spatial extent, and portion of active landscape?

- What controls earthflow activity over short (season to decadal) and long (10^2 - 10^3 year) time scales?

- Are earthflows driven by top down (i.e. sediment supply and uplift limited) or bottom up (i.e. toe erosion and base level lowering) processes?

- Is there a causal relationship between large scale earthflow activity and creeping along the San Andreas Fault?

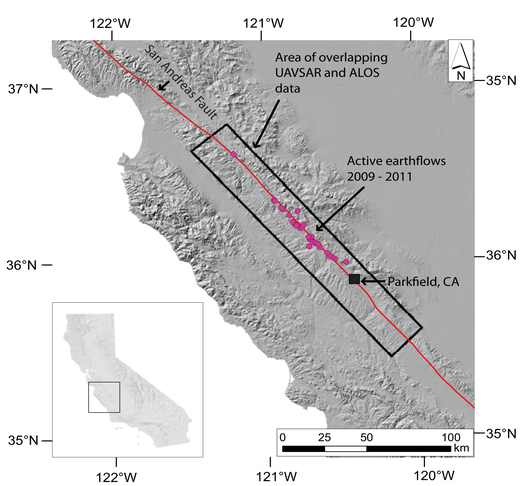
Use of Airborne InSAR for monitoring earthflows

Airborne InSAR (UAVSAR) allows higher spatial resolution measurements of surface deformation than conventional L-band satellite InSAR. We are working on developing this technique specifically for slow-moving landslides. UAVSAR is a promising tool for monitoring earthflows as it:

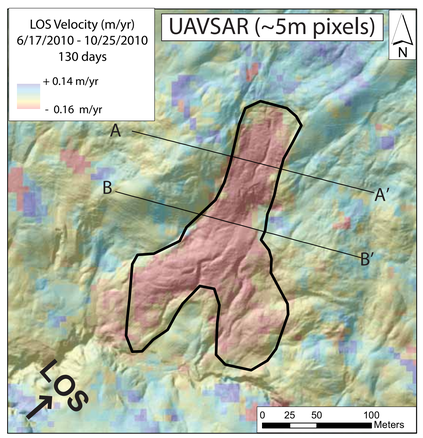
- Allows detection of movement of small landslides (<~200 m wide) which have been difficult to detect with conventional satellite InSAR and optical image correlation.

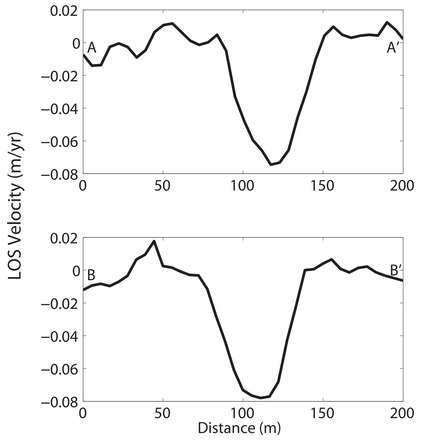
- Provides high spatial resolution of deformation across earthflows which can be used to help constrain mechanical models of landslide motion.

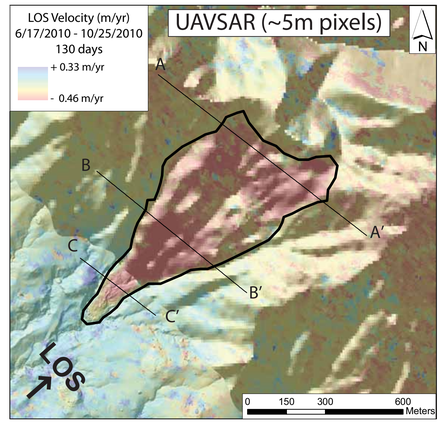
Earthflows present on creeping section of SAF

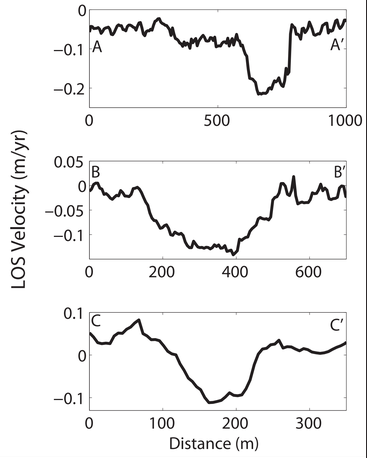


High-resolution earthflow movement detected by airborne InSAR (UAVSAR)









Comparison of airborne InSAR (UAVSAR), satellite InSAR (ALOS) , and optical image correlation (COSI-Corr)

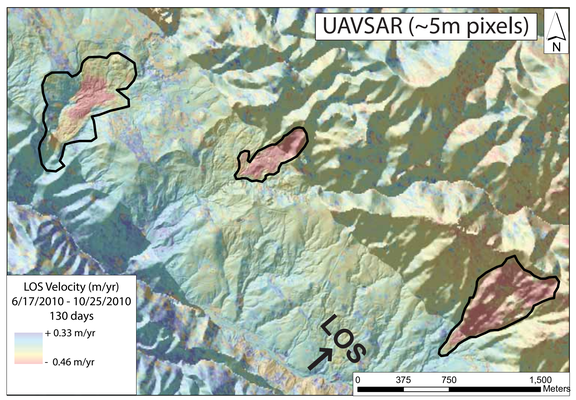
ALOS shows movement of large slides (>200-300 m width), but fails to detect smaller slides revealed by UAVSAR.

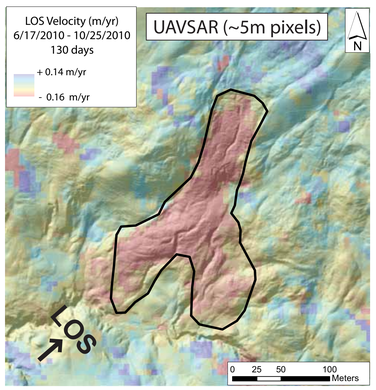
COSI-Corr provides multiple year movement rates on fast moving slides.

Large earthflows

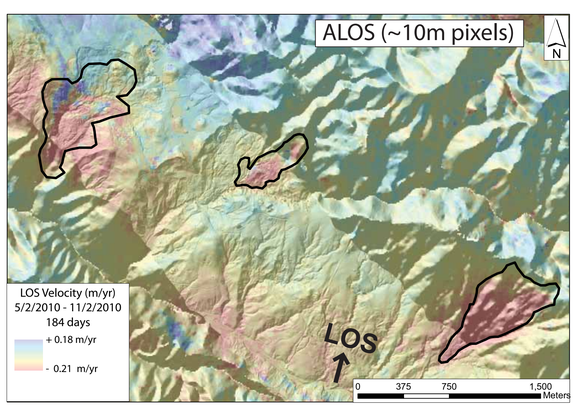
Small earthflows

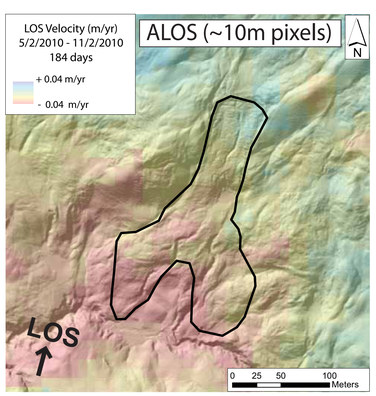
Airborne InSAR (UAVSAR)



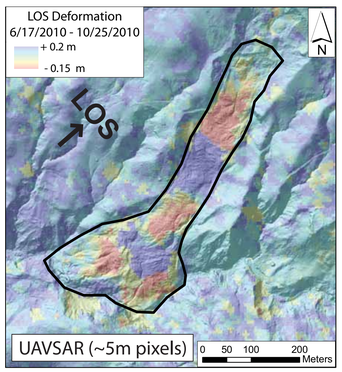


Satellite InSAR (ALOS)





Airborne InSAR (UAVSAR)



Optical Image Correlation (COSI-Corr)