

# Hazards Breakout: Earthquakes, Volcanoes and Landslides

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Q: Broad science question   C: Capability needed   D: Data needed

## EARTHQUAKES

Q: How do ground motions/deformation evolve in real time?

C: High rate GPS has significant science applications;  
Delivering high rate GPS is most effective in real time;  
Such delivery has profound hazard evaluation implications.

Earthscope should provide reliable data and infrastructure  
Community develops applications

Examples: real time earthquake rupture estimates from differential GPS  
Earthquake and tsunami alerting

Earthscope is ideally situated to **lead** efforts to use data for hazard characterization

Q: What is relative activity of faults?

Fundamental physics of faults and rupture prior to and during earthquakes  
Also what is long term behavior?

Q: Where are slip heterogeneities (spatial)? What do they mean?

Better models needed for distributed slip  
Need to understand rheology (= gap between data and models)

Q: What is attenuation structure of crust?  
Affects propagation of seismic waves  
Can be used to aid in siting critical facilities

Q: What are mechanisms for dynamic triggering?  
How do large earthquakes trigger other earthquakes?  
Stress transfer and Coulomb failure criteria  
How do large earthquakes trigger volcanic eruptions or unrest?  
How do large earthquakes trigger landslides, on land and submarine?

Q: What are motion, size, and strain accumulation on Basin and Range faults?  
D: Same question from original science plan but many years data needed to answer

Q: What are state of the art earthquake locations?  
Need to use 3D velocity models to locate earthquakes

## VOLCANOES

Q: What happens at volcanoes prior to and during eruptions?

Three volcano case studies reveal surprises

Augustine – shallow dike but deeper chamber

Mt St Helens – magma already at shallow depth

Redoubt – very little deformation prior to eruption

D: Need to partner with NASA to use UAVSAR

D: Need to better utilize TerraSAR (German satellite)

Q: How much magma is stored beneath volcanoes? (inventory)

Can use seismic tomography to determine

Q: What drives earthquake swarms at large calderas? Pore pressure?

Magma movement?

Recent Yellowstone swarm has non DC earthquakes and GPS offset

Need to use 3D models to better locate earthquakes

Q: What are mechanisms of non-double couple earthquakes?

How do they illuminate processes?

Q: How long does magma reside in magma chambers?

U/Th disequilibrium studies of products of Holocene

## LANDSLIDES

Q: Can we identify natural laboratories for intensive study?

Characterize landscape for hazard

Lidar data shows headscarps (and faults)

Q: Where are the biggest gaps in coverage?

D: Need Lidar data for Alaska (almost none exists)

D: Some early Lidar data needs to be recollected

Q: What are conditions that produce submarine landslides, both triggered and not (do they fall under Earthscope purview?)

Q: How do landslides transition from creep to catastrophic large scale collapse?

How do pulse-like earthquakes transition into continuous large scale cracks?

## SYNERGIES:

Q: Do large earthquakes (and ETS?) trigger other earthquakes, landslides and volcanic eruptions?