USGS
science for a changing world

Science to Reduce Landslide Risk

AGI Critical Issues Webinar

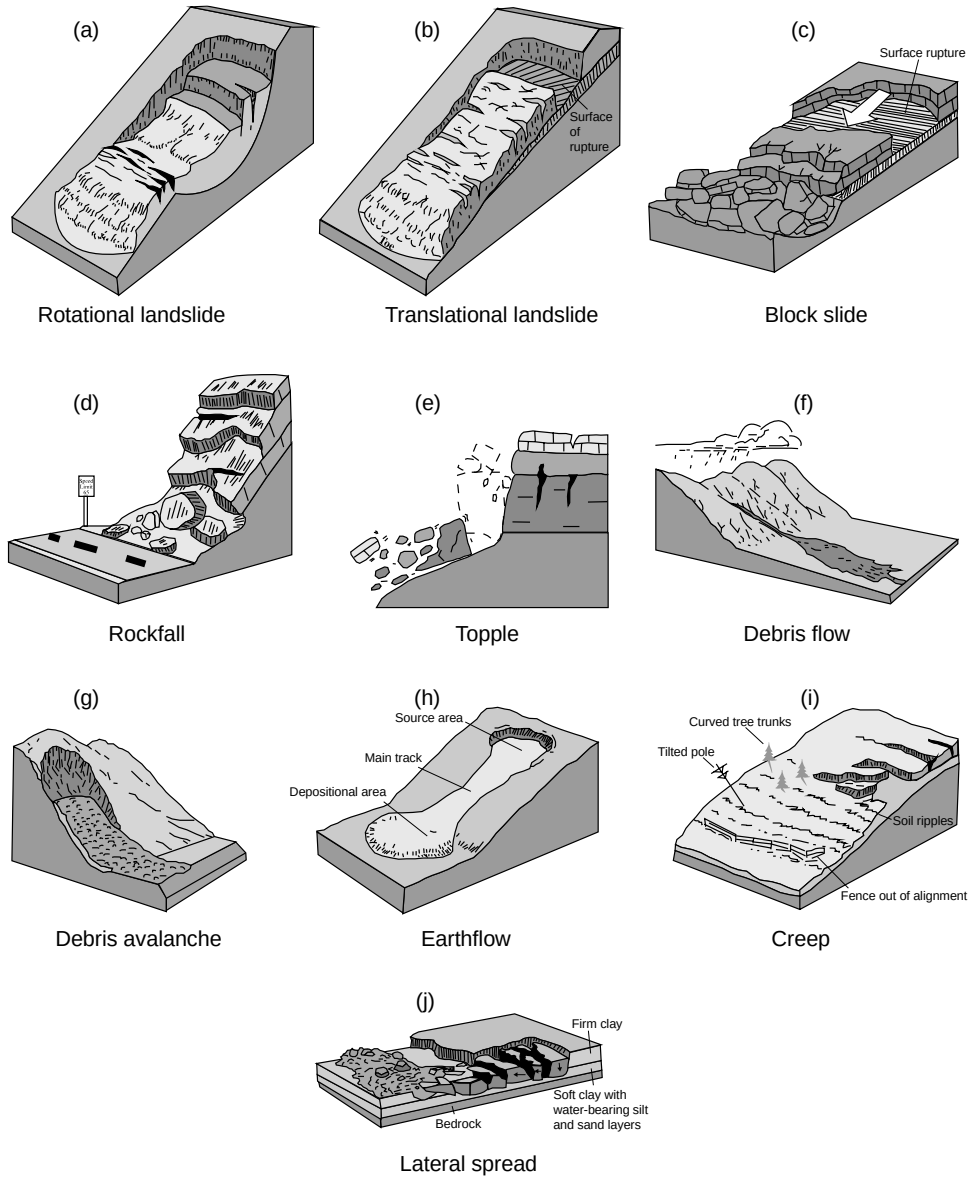
April 17, 2019

Jonathan Godt PhD
Acting Science Advisor for Earthquake and Geologic Hazards
jgodt@usgs.gov

https://www.usgs.gov/natural-hazards/landslide-hazards

U.S. Department of the Interior
U.S. Geological Survey

Landslides are downslope movements of earth materials

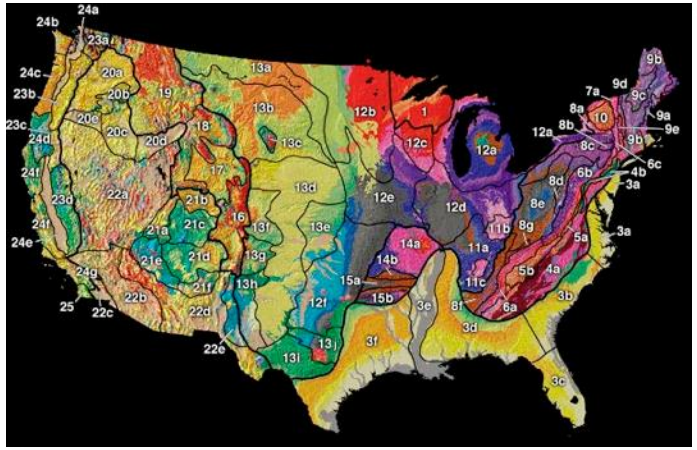


Debris flows can be particularly destructive

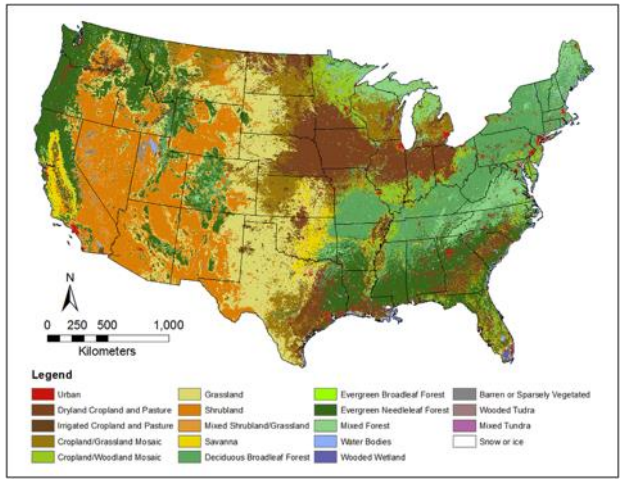
Hiroshima Prefecture, Japan, Photo: IBT

Landslide occurrence is influenced by:

Geology and topography

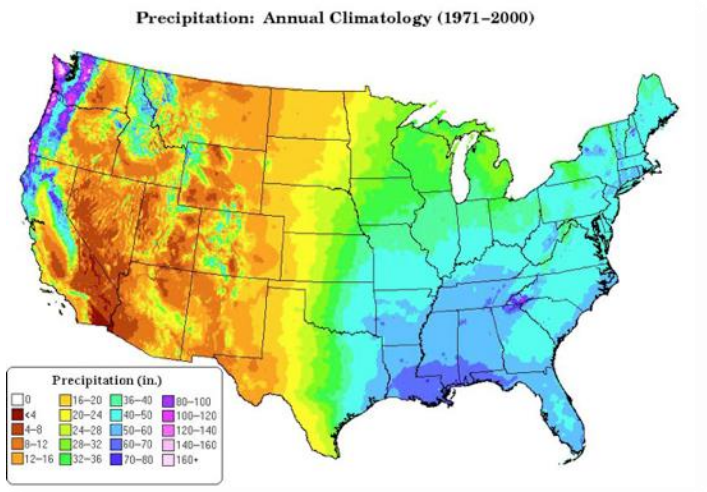


Land use – land cover – disturbance



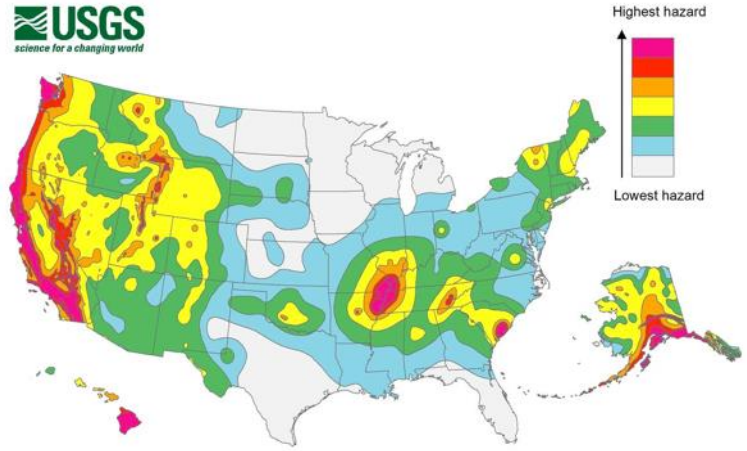
Volcanic activity

Climate

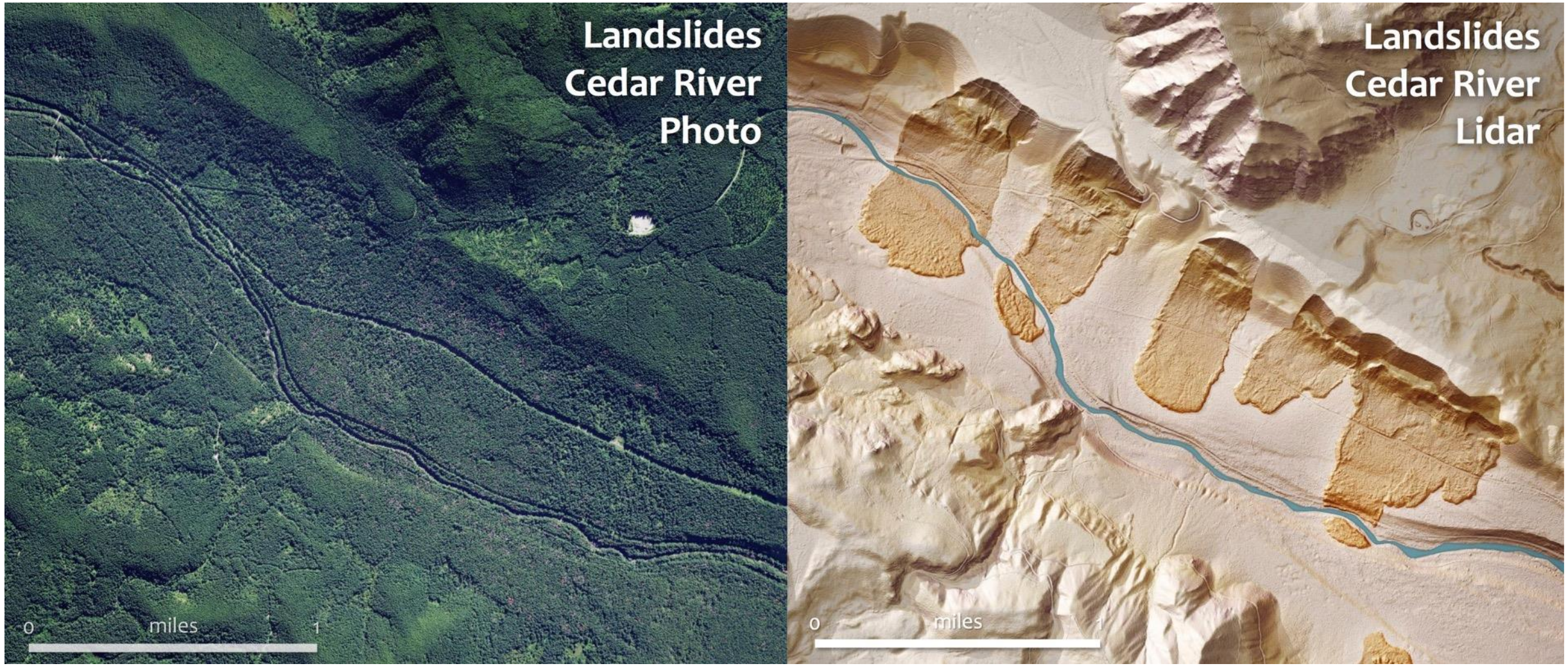


Wildfire

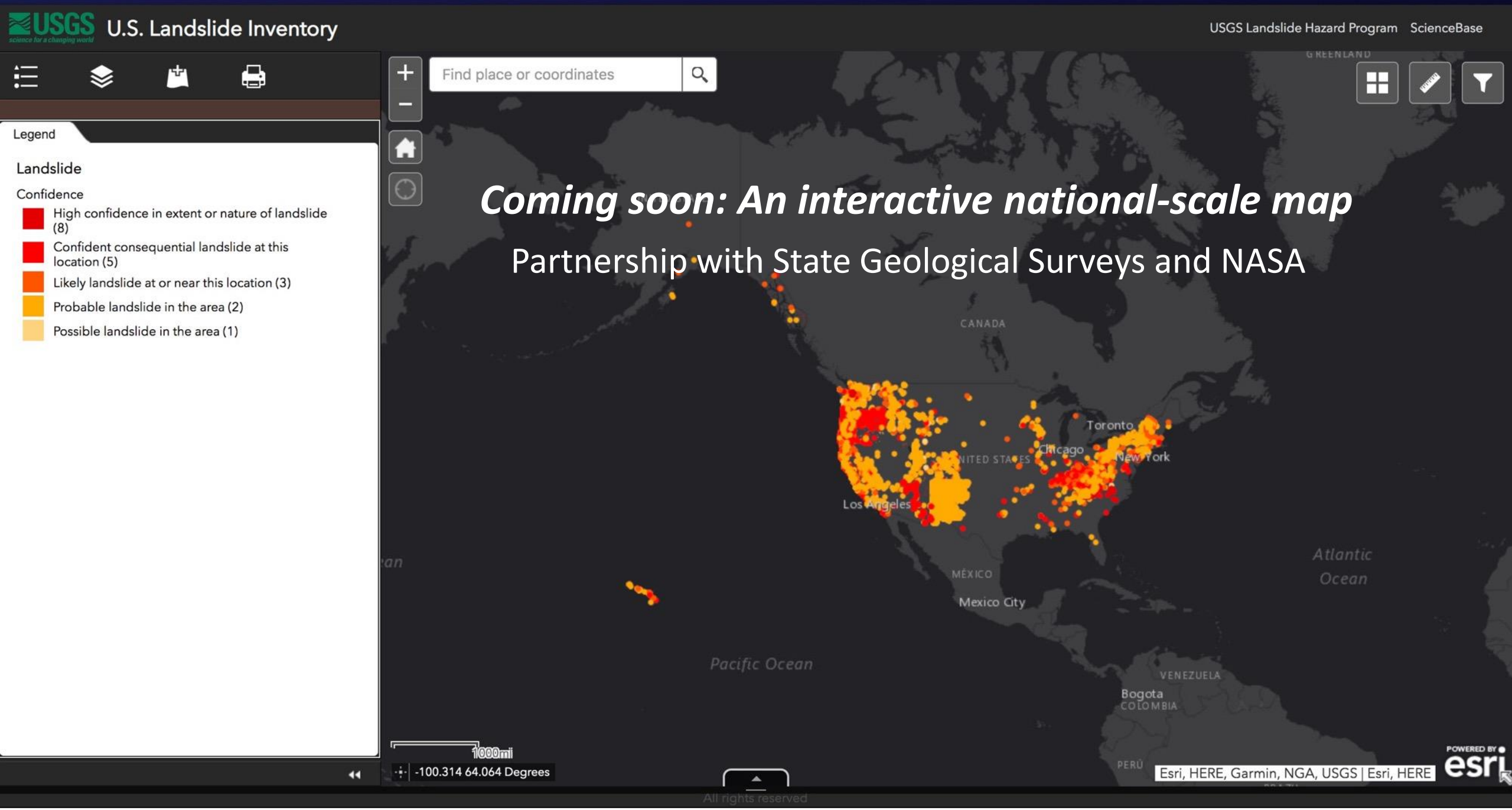
Active tectonics and earthquakes



Lidar technology has revolutionized landslide mapping



Images courtesy of Dan Coe – Washington State Geological Survey
(https://www.dnr.wa.gov/lidar)



Jones and others, 2019, *Landslide Inventories Across the United States;* USGS Data Release

USGS

Intense rainfall can create destructive debris flows

January 9, 2018 Montecito, CA Debris-Flows

- **Largest post-fire losses since 1934**
- **23 Deaths**
- **400+ damaged or destroyed homes**

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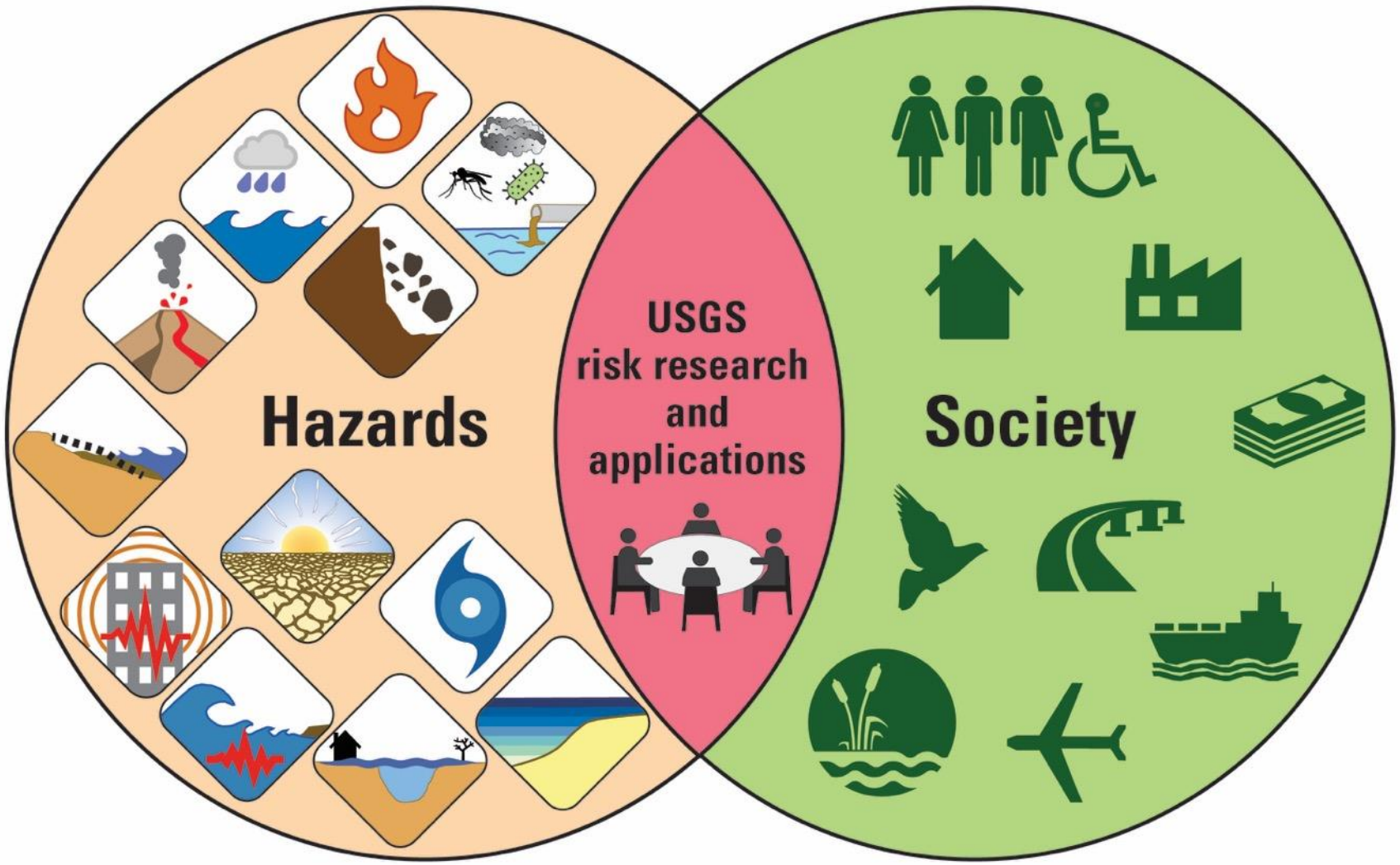
science for a changing world

Science for a Risky World: a USGS Plan for Risk Research and Applications

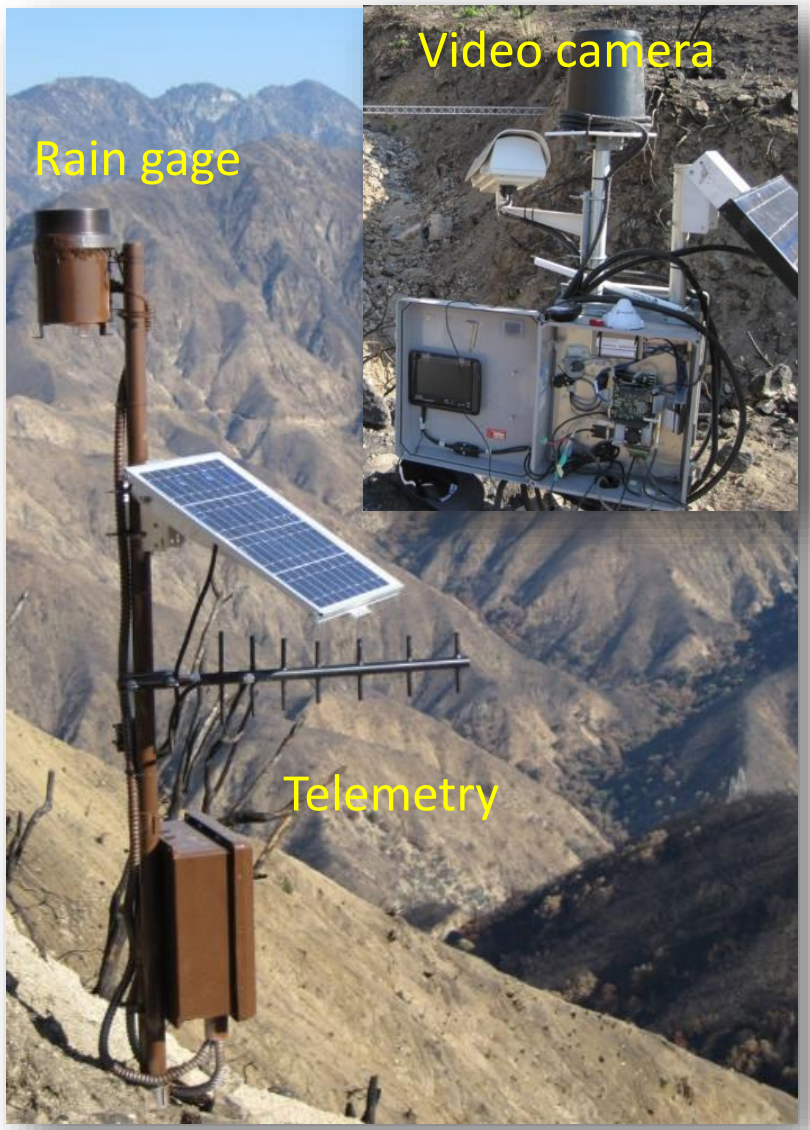
To serve as the analytical foundation upon which decision makers can make more informed risk decisions in a dynamic and uncertain world

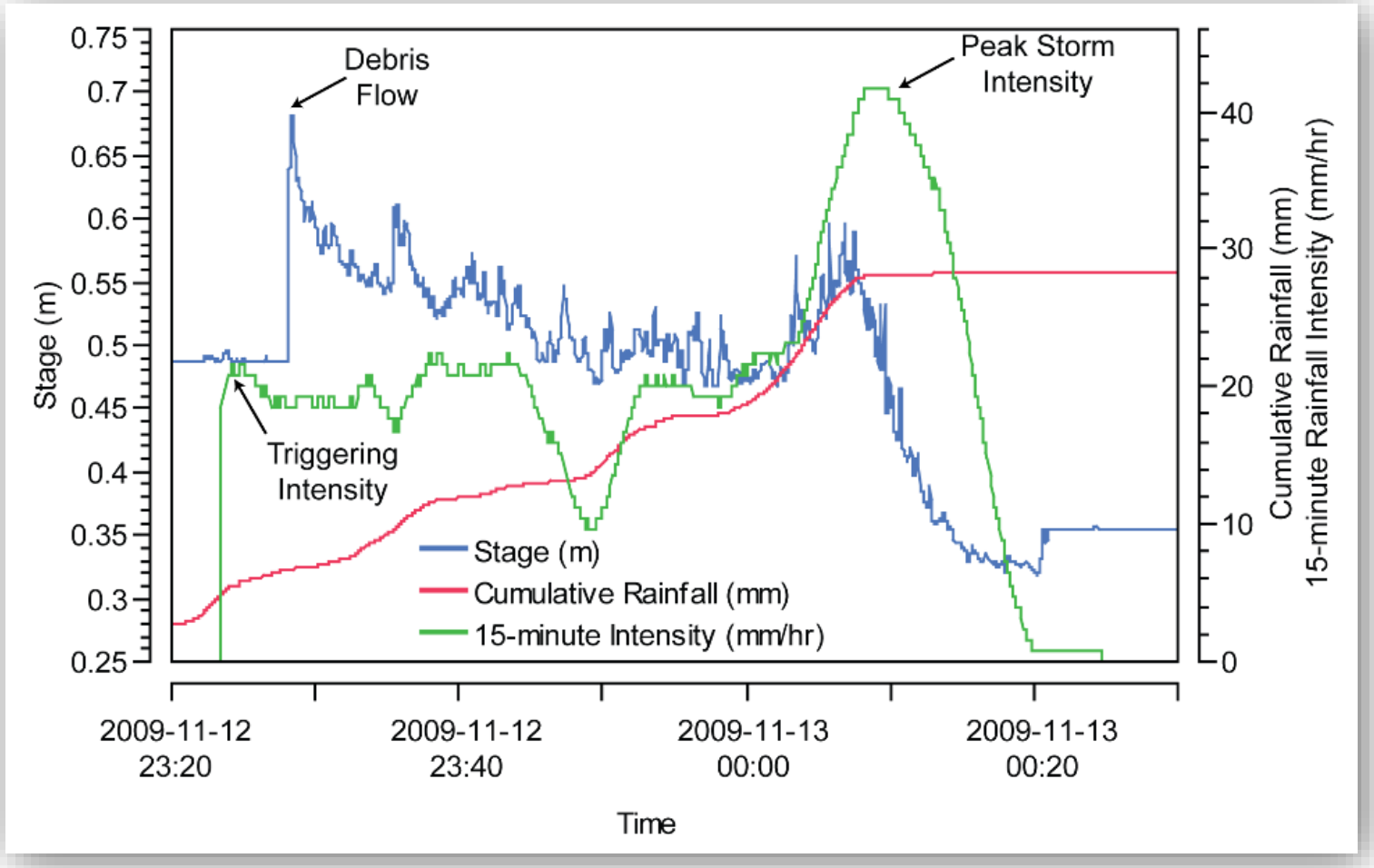


USGS

Ludwig and others (2018) https://pubs.usgs.gov/circ/1444/cir1444.pdf

Science guides debris-flow risk reduction strategies





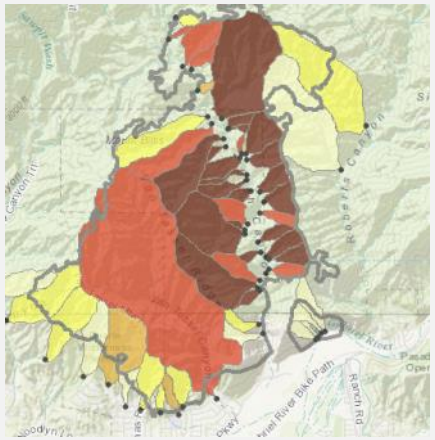
USGS role in post-fire debris-flow risk

Debris flow hazard maps and rainfall thresholds help emergency managers plan for post-fire impacts

Not yet addressed

Where?

What drainages are most susceptible?



Probability model

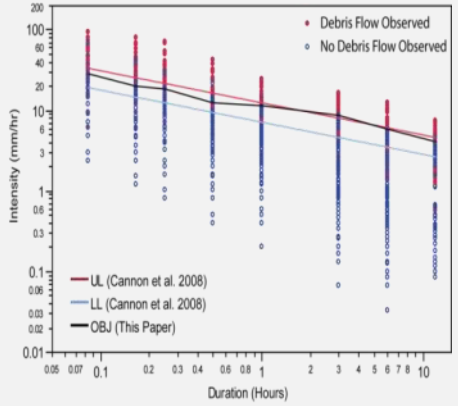
How big?

How large will the flows be?

Volume model

When?

How much rain will it take?



Rainfall criteria

How far?

Where will the flow go?

Inundation model

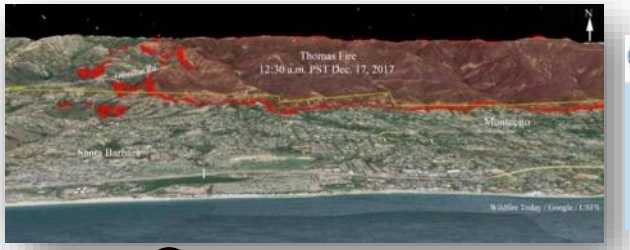
https://landslides.usgs.gov/hazards/postfire_debrisflow/

Thomas Fire timeline

Start of fire

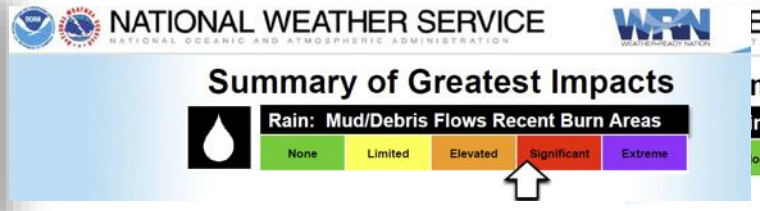
Dec 4, 2017

Progression to Montecito

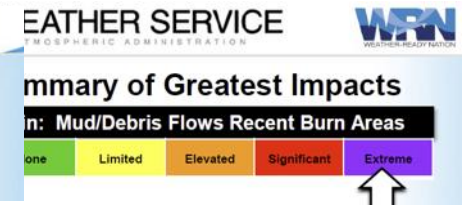


Dec 17

NWS issues **outlook** for debris flow



Jan 2



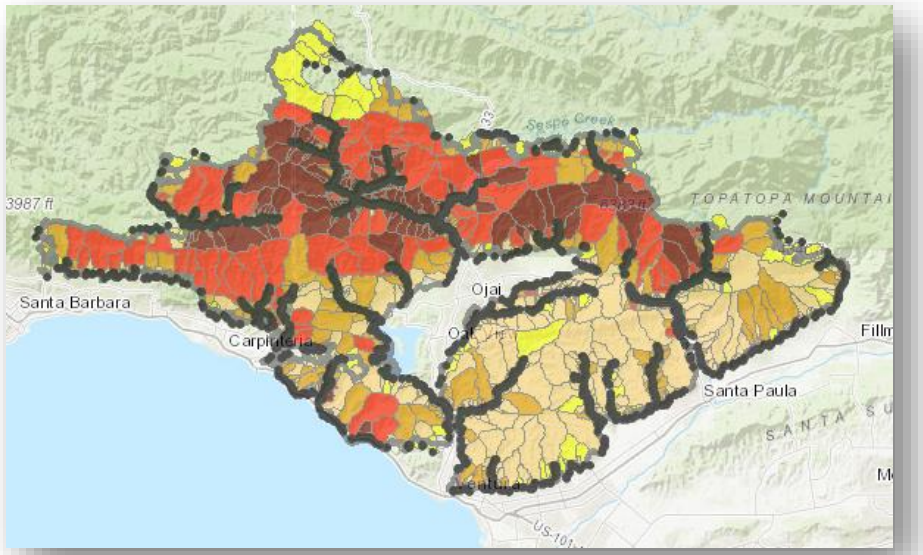
Jan 5

NWS issues **warning**

Jan 8

Jan 9 2:30am

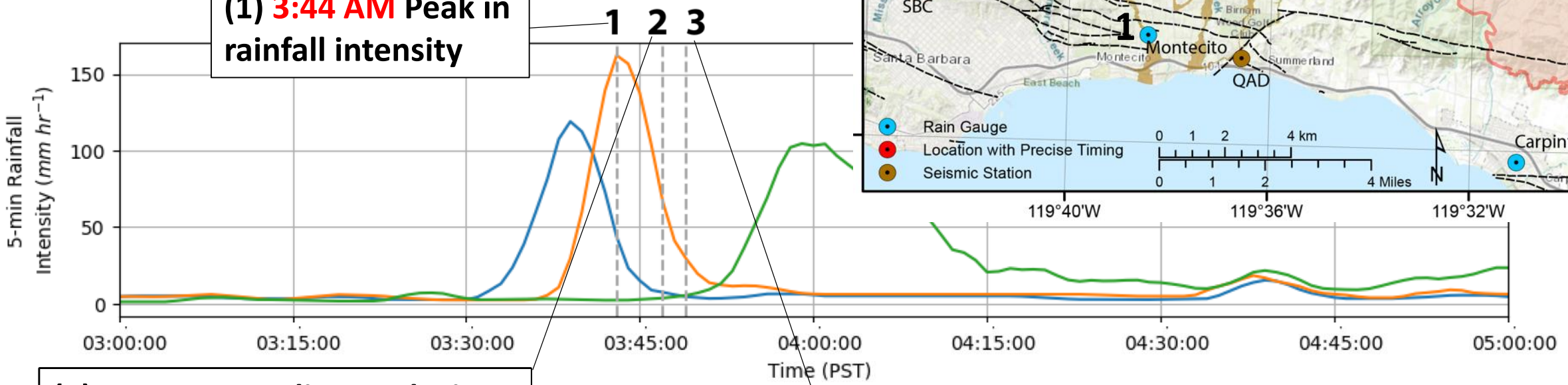
USGS debris-flow hazard assessment released



Largest evacuation orders in Santa Barbara County history

Debris flows ~5 minutes after intense rainfall

(1) 3:44 AM Peak in rainfall intensity



(2) 3:47 AM Gas line explosion

(3) 3:49 AM Flow front recorded on security camera

Kean and others (in press)

Living on the Real World

Policy challenge #1: Risk-reduction that emphasizes appropriate land-use, rigorous building codes, and resilient infrastructure, **minimizing interruption to people's lives and livelihoods**.

Policy challenge #2: **Social trends** such as urbanization, globalization of commerce and food security, and dependence on critical infrastructure operate on time scales that are **short relative to the return period of extreme events**. Risk reduction requires innovation to forestall increasing societal vulnerability form those trends.

Policy challenge #3: Framework that allows public, private, and academic sectors to **collaborate** in building a resilient society.

William H. Hooke, American Meteorological Society (Livingontherealworld.org)