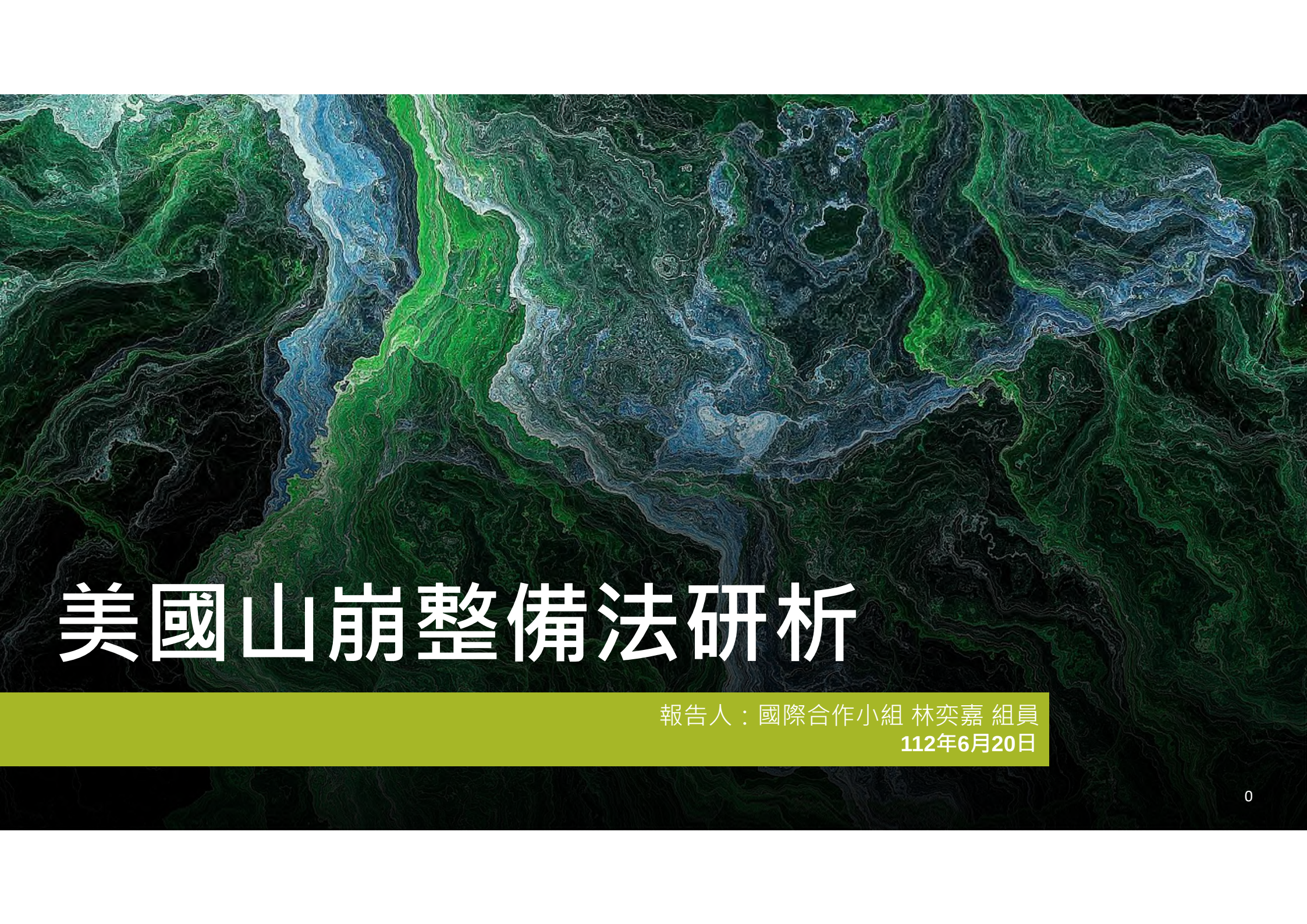




美國山崩整備法研析

報告人：國際合作小組 林奕嘉 組員
112年6月20日



Outline

- National Landslide Preparedness Act
- USGS Landslide Programs
- Landslide Preparedness in the US
- Comparison of Landslide Preparedness (TW vs. US)



History

DEC 13, 2017		Earlier Version — Ordered Reported This activity took place on a related bill, H.R. 1675
JUN 3, 2019		Source Bill — Passed House (Senate next) This activity took place on a related bill, H.R. 1261 on H.R. 8810 (116th).
JUL 30, 2020		Identical Bill — Passed Senate (House next) This activity took place on a related bill, S. 529 (116th) H.R. 8810 (116th).
NOV 24, 2020		Introduced Bills and resolutions are referred to committees by sending it on to the whole chamber. Read Text »
NOV 27, 2020		Text Published Updated bill text was published as of Preprint (Sus) Read Updated Text » See Changes »
DEC 3, 2020		Passed House (Senate next) The bill was passed in a vote in the House. It goes to the Senate so no record of individual votes was made. Read Updated Text » See Changes »
DEC 16, 2020		Passed Senate The bill was passed by both chambers in identical form. The President may sign or veto the bill. The vote was by Unanimous consent. Read Updated Text » See Changes »
JAN 5, 2021		Enacted — Signed by the President The President signed the bill and it became law.

U.S. H.R. 8810 (116th Congress) National Landslide Preparedness Act 美國國家山崩整備法

2017年起，美國開始推動相關法案

2020年12月3日通過眾議院(House)

2020年12月16日通過參議院(Senate)

2021年1月5日川普總統簽署

根據美國地質調查局(U.S. Geological Survey, USGS)統計，山崩相關災害在美國50州均有發生的可能，**每年約造成25-50人死亡，經濟損失10-20億美元(300-600億台幣)**

簡報內容 1、<https://www.usgs.gov/>

參考資料：2、<https://www.govtrack.us/congress/bills/116/hr8810>



Trump signs National Landslide Preparedness Act, designed with input from **Washington officials**

The National Landslide Preparedness Act was signed into law at an important time for Washington state.

Oso - Large Catastrophic Landslide

- March 22, **2014**, 10:37
- **300–400 mm** of rainfall fell at Oso in the 21 days prior to the landslide.
- The landslide covered about **2.6 km²** (**260 ha**)
- Sediments **8 million m³**
- **Rotational landslide, sand, silt, clay**
- **43 people killed, 49 buildings destroyed**
- Damages - **\$150 million USD**





National Landslide Preparedness Act

國家山崩整備法架構

國家山崩整備法主管機關為美國內政部(Department of the Interior) ,
授權美國地質調查局(U.S. Geological Survey, USGS)為執行單位

Section 1. Short title

Section 2. Definitions

Section 3. National Landslide Hazards Reduction Program

國家山崩減災計畫

Section 4. Ground Subsidence 地層下陷

Section 5. 3D Elevation Program 三維高程計畫



Sec 3. National Landslide Hazards Reduction Program 國家山崩減災計畫

計畫目的

- (1) to identify and understand landslide hazards and risks
辨識和瞭解山崩災害與風險
- (2) to reduce losses from landslides;
減少山崩損失
- (3) to protect communities at risk of landslide hazards
保護具山崩風險之社區
- (4) to help improve communication and emergency preparedness,
including by coordinating with communities and entities responsible for
infrastructure that are at risk of landslide hazards.
改善通訊及應變整備工作，包括與社區及負責山崩整備之單位進行協調



計畫內容

◆ National Strategy 國家策略(白皮書)

Not later than **1 year** after the date of enactment of this Act, and **every 5 years**...
a national strategy for landslide hazards, risk reduction, and response in the United States

◆ National Landslide Hazards Database 國家山崩災害資料庫

...a **publicly accessible** national landslide hazard and risk **inventory database**

◆ Landslide Hazard and Risk Preparedness for Communities 社區山崩防災整備

landslide planning and risk reduction guidance, guidelines, maps, tools, training materials

◆ Debris Flow Early Warning System 土石流早期預警系統

expanding the early warning system for **post-wildfire** debris flow to include **recently burned areas** across the western United States

◆ Emergency Response Activities 緊急應變行動

establish and support emergency response procedures for the **rapid deployment of Federal scientists, equipment, and services** to areas impacted by a **significant landslide event**



其它項目

- ◆ Interagency Coordinating Committee on Landslide Hazards 跨部會協調委員會
The Committee shall be composed of the Secretary of Interior(chairperson), Agriculture, Army, Commerce, Homeland Security, Transportation...
 - (A)advise and **oversee** the program;
 - (B)**facilitate communication and coordination across Federal agencies** in the planning, management, budgeting, and execution of landslide activities; and
 - (C)**support** the development and execution of the **national strategy**
- ◆ Advisory Committee 諮詢委員會
not fewer than 11 members—representatives of States, Territories... research institutions, institutions of higher education, local emergency management agencies...
- ◆ Grant Programs 補助計畫
Cooperative landslide hazard mapping and assessment program-**內政部對地方政府補助**
National landslide research grants-**國家科學基金會對合格實體(entity)補助**



其它項目

◆ Biennial Report 雙年度報告

the Secretary(內政部長) shall submit to Congress a biennial report

(1)the goals and accomplishments of the **Committee** in carrying out the **national strategy**

(2)the **results** of the activities of the **Committee**

(3)the extent to which any **recommendations** of the **Advisory Committee**

◆ Significant Events 重大事件

Not later than 1 year after a significant landslide event in the United States occurs, the Secretary shall publish on a publicly available website...

◆ Funding 經費

for each of fiscal years 2021 through 2024

United States Geological Survey(**USGS**), **\$25,000,000** (7.5億)

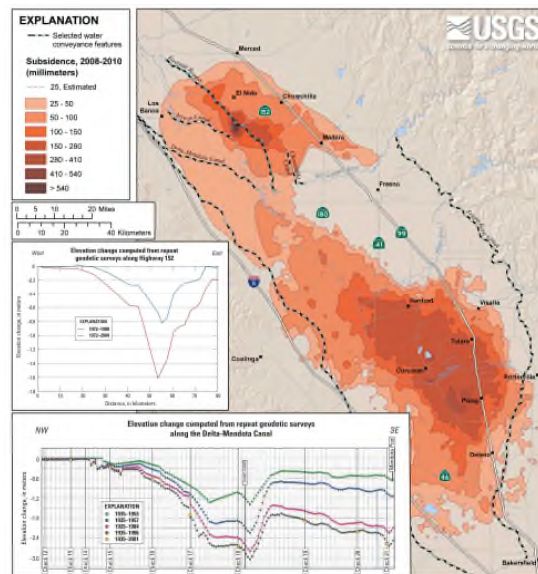
National Science Foundation(**NSF**), **\$11,000,000** (3.3億)

National Oceanic and Atmospheric Administration(**NOAA**), **\$1,000,000**(3千萬)



Sec 4. Ground Subsidence 地層下陷

...the Secretary, **through existing programs**, shall advance the identification, mapping, research, and monitoring of subsidence and groundwater resource accounting, **particularly in areas affected by drought.**



<https://www.usgs.gov/mission-areas/water-resources/science/land-subsidence#overview>





Sec 5. 3D Elevation Program 三維高程計畫(DEM)

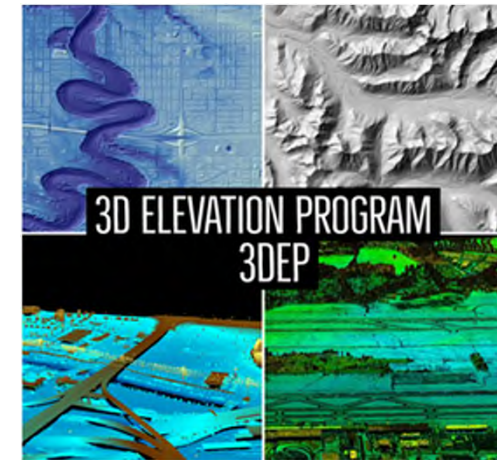
- (A) to provide 3D elevation data coverage for the United States...
- (B) to coordinate and facilitate the collection, dissemination, and use of 3D elevation data among Federal departments and agencies and non-Federal entities;
- (C) to produce standard, publicly accessible 3D elevation data products...

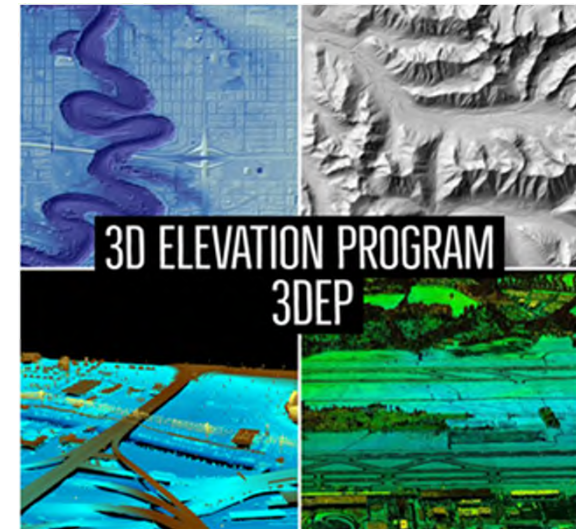
Establishment:

3D Elevation Federal Interagency Coordinating Committee 跨部會協調委員會
Subcommittee of National Geospatial Advisory Committee 諮詢委員會

Funding

For each of fiscal years 2021 through 2024, there is authorized to be appropriated to the Secretary \$40,000,000(12億台幣)





The USGS already operated

- a **Landslide Hazards Program** within its Natural Hazards Program and

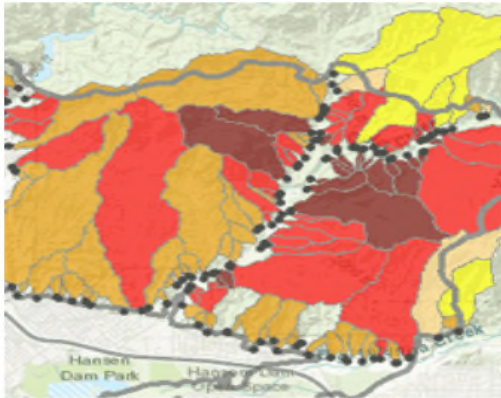
- a **3D Elevation Program** within its National Geospatial Program.

The new act **broadens** the USGS's current **activities** and **requires coordination with other federal agencies**.



Landslide Hazards Program

Themes



Post-Fire Debris Flows



Rainfall-Induced Landslides



Coseismic Landslides



Large Catastrophic Landslides



Hazard and Risk Assessments



Event Response Reports

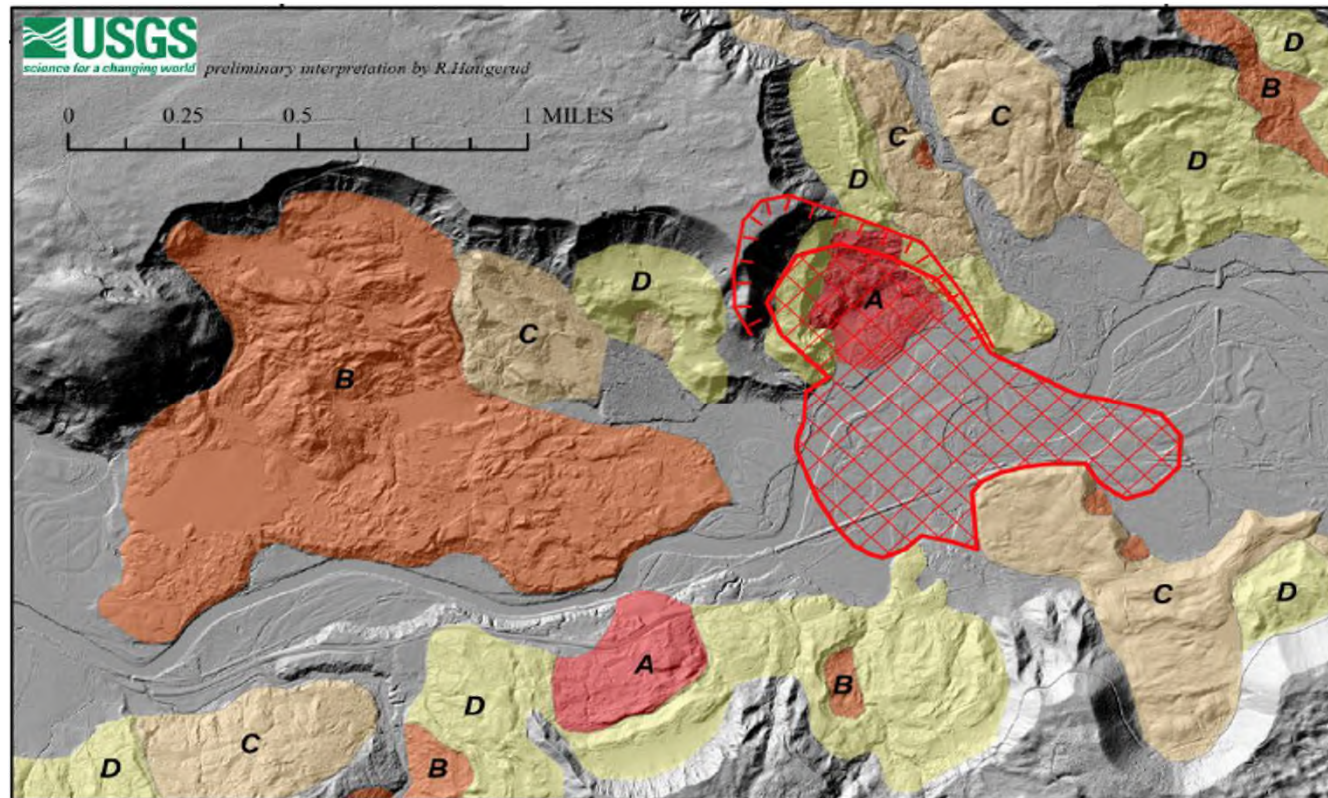


Large Catastrophic Landslide 大規模災難性山崩

Such relatively uncommon landslides are **difficult to predict**.

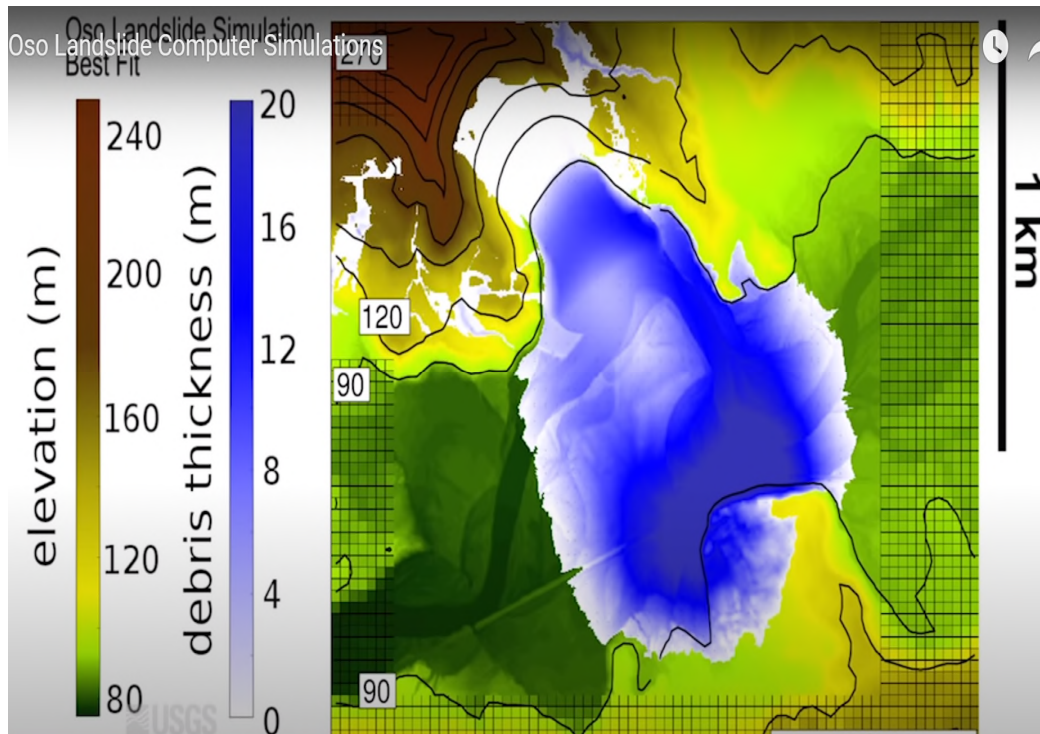
The Oso landslide had **historically moved short distances**, but in March 2014, it failed catastrophically and **crossed the entire Stillaguamish River Valley, killing 43 people**.

1.3km long; 21m deep

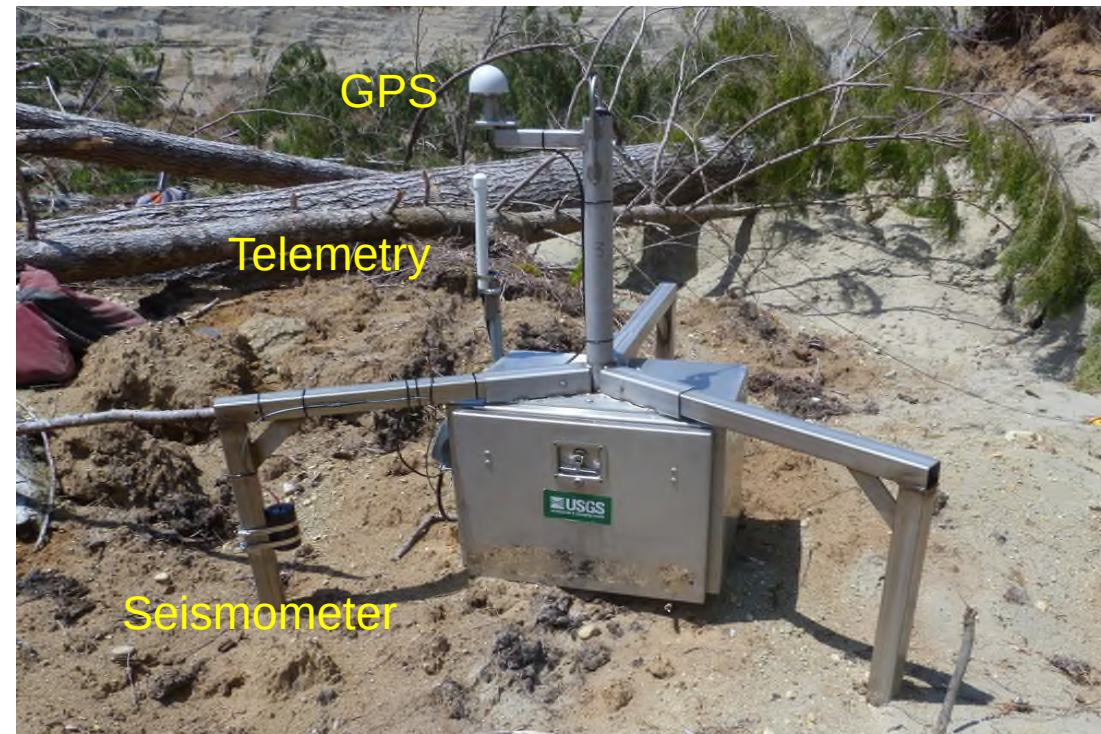


Colored areas (**2013 lidar**) show older landslide deposits, A-youngest, to D-oldest. The red cross-hatched area marks the approximate extent of deposits of 2014 landslide.

Oso Landslide Computer Simulations material **mobility**



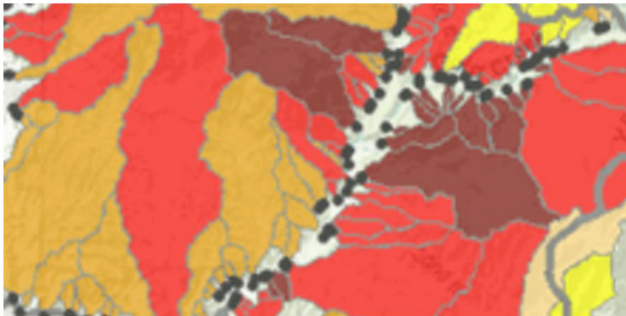
A volcano monitoring “**spider**”
deployed to the Oso landslide





Maps

Post-Fire Debris-Flow Hazards



Estimates of the probability and volume of debris flows that may be produced by a storm in a recently burned area, using a model with characteristics related to basin shape, burn severity, soil properties, and rainfall.

[More Info and Maps](#)

U.S. Landslide Inventory and Interactive Map



A web-based interactive map with a consistent set of landslide data. The searchable map includes contributions from many local, state, and federal agencies and provides links to the original digital inventory files for further information.

[View Map](#)

Earthquake-Triggered Ground-Failure

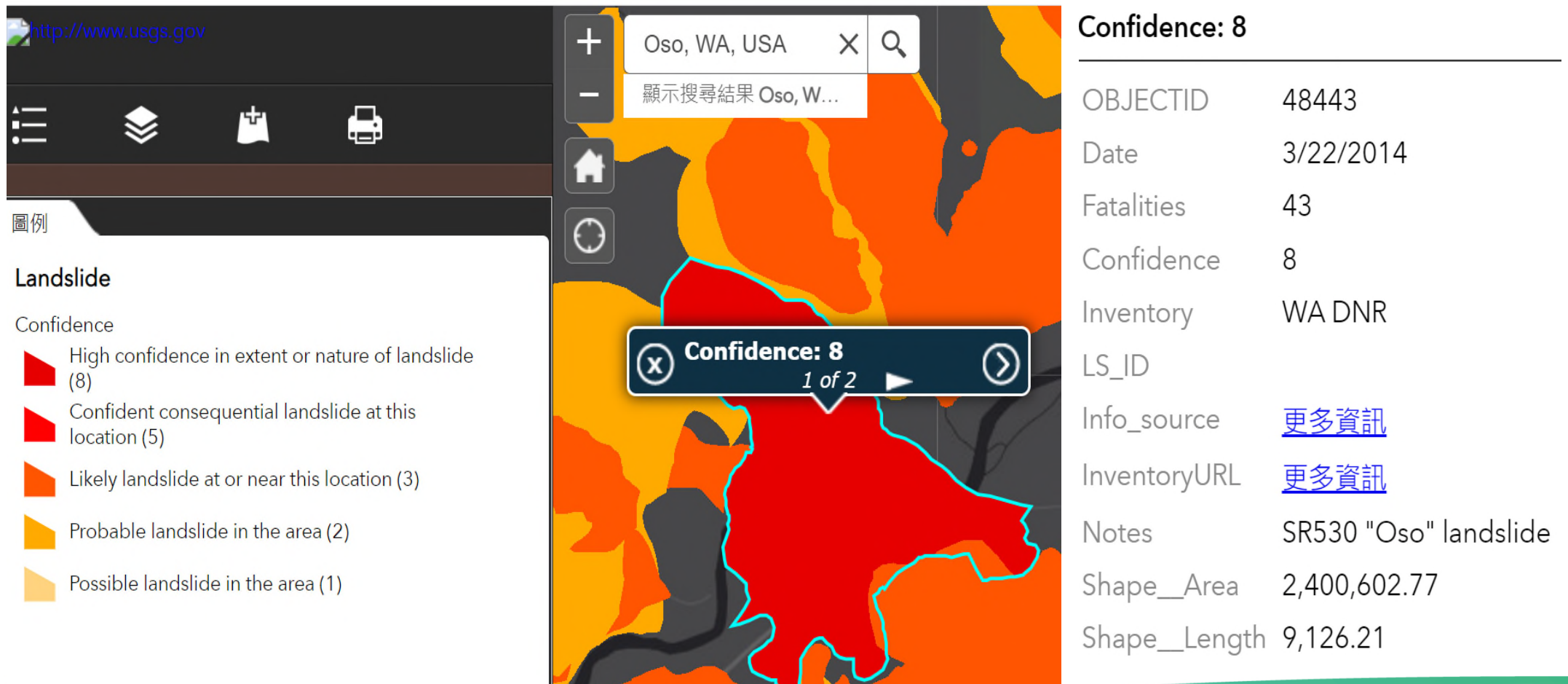


A web-based interactive map showing earthquake-triggered ground-failure, such as landsliding and liquefaction.

[View Map](#)

US Landslide Inventory 美國山崩目錄

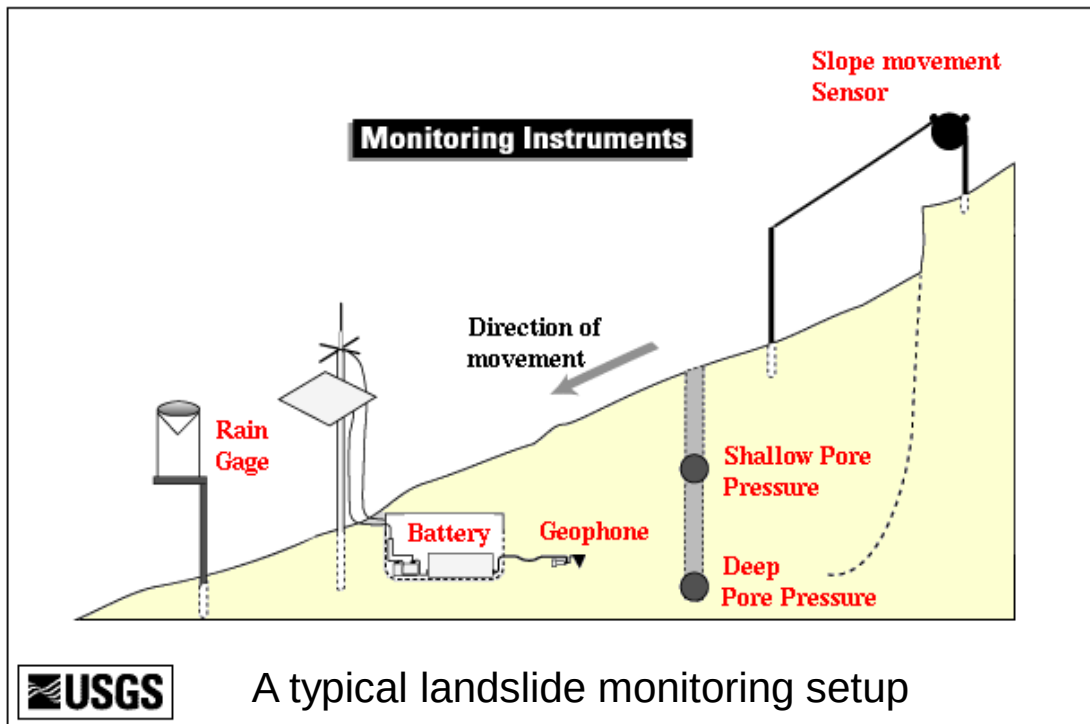
A web-based interactive map



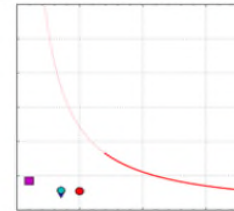


Monitoring

USGS monitors **selected landslides and hillsides** in order to learn more about the physical processes that trigger landslides or control their movement.



Software



Date published: FEBRUARY 28, 2018

THRESH

Software for tracking rainfall thresholds for landslide and debris

Attribution: *Natural Hazards, Landslide Hazards Program, Geolog*

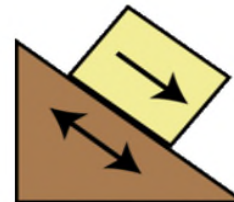


Date published: APRIL 10, 2015

Scoops3D

Scoops3D is software to analyze three-dimensional slope stability

Attribution: *Natural Hazards, Landslide Hazards Program, Geolog*

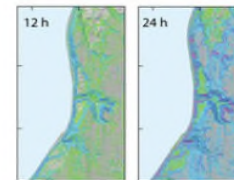


Date published: NOVEMBER 12, 2014

SLAMMER

SLAMMER is a Java program that facilitates performing a variety

Attribution: *Natural Hazards, Landslide Hazards Program, Geolog*



Date published: OCTOBER 20, 2009

TRIGRS

A Fortran Program for Transient Rainfall Infiltration and Grid-Ba

Attribution: *Natural Hazards, Landslide Hazards Program, Geolog*

Education and Publications

Paper



Fact sheet

Landslide Types and Processes

Landslides in the United States occur in all 50 States. The primary regions of landslide occurrence and potential are the coastal and mountainous areas of California, Oregon, and Washington, the States comprising the intermountain west, and the mountainous and hilly regions of the Eastern United States. Alaska and Hawaii also experience all types of landslides.

Landslides in the United States cause approximately \$3.5 billion (year 2001 dollars) in damage, and kill between 25 and 50 people annually. Casualties in the United States are primarily caused by rockfalls, rock slides, and debris flows. Worldwide, landslides occur and cause thousands of casualties and billions in monetary losses annually.

The information in this publication provides an introductory primer on understanding basic scientific facts about landslides—the different types of landslides, how they are initiated, and some basic information about how they can begin to be managed as a hazard.

TYPES OF LANDSLIDES

The term "landslide" describes a wide variety of processes that result in the downward and outward movement of slope-forming materials including rock, soil, artificial fill, or a combination of these. The materials may move by falling, toppling, sliding, spreading, or flowing. Figure 1 shows a graphic illustration of a landslide, with the commonly accepted terminology describing its features.

The various types of landslides can be differentiated by the kinds of material involved and the mode of movement. A classification system based on these parameters is shown in figure 2. Other classification systems incorporate

additional variables, such as the rate of movement and the water, air, or ice content of the landslide material.

Although landslides are primarily associated with mountainous regions, they can also occur in areas of generally low relief. In low-relief areas, landslides occur as cut-and-fill failures (roadway and building excavations), river bluff failures, lateral spreading landslides, collapse of mine-waste piles (especially coal), and a wide variety of slope failures associated with quarries and open-pit mines. The most common types of landslides are described as follows and are illustrated in figure 3.

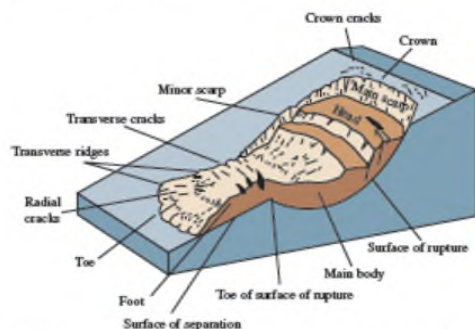


Figure 1. An idealized slump-earth flow showing commonly used nomenclature for labeling the parts of a landslide.



Report

National Landslide Hazards Mitigation Strategy—A Framework for Loss Reduction



La Conchita, coastal area of southern California. This landslide and earthflow occurred in the spring of 1995. People were evacuated and the houses nearest the slide were completely destroyed. This is a typical type of landslide. Photo by R.L. Schuster, U.S. Geological Survey.

SLIDES: Although many types of mass movements are included in the general term "landslide," the more restrictive use of the term refers only to mass movements, where there is a distinct zone of weakness that separates the slide material from more stable underlying material. The two major types of slides are rotational slides and translational slides.

Rotational slide: This is a slide in which the surface of rupture is curved concavely upward and the slide movement is roughly rotational about an axis that is parallel to the ground surface and transverse across the slide (fig. 3A). **Translational slide:** In this type of slide, the landslide mass moves along a roughly planar surface with little rotation or backward tilting (fig. 3B). A **block slide** is a translational slide in which the moving mass consists of a single unit or a few closely related units that move downslope as a relatively coherent mass (fig. 3C).

FALLS: Falls are abrupt movements of masses of geologic materials, such as rocks and boulders, that become detached from steep slopes or cliffs (fig. 3D).

Circular 1244

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

Report

Earth and Planetary Science Letters 413 (2015) 157–168

Contents lists available at ScienceDirect

Earth and Planetary Science Letters

www.elsevier.com/locate/epsl

Landslide mobility and hazards: implications of the 2014 Oso disaster

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numerical modeling
hazards

ABSTRACT

Landslides reflect landscape instability that evolves over meteorological and geological timescales, and they also pose hazards to people, property, and the environment. The severity of these hazards depends largely on landslide speed and travel distance, which are collectively described as landslide “mobility.” To investigate causes and effects of mobility, we focus on an infamous landslide that occurred on 22 March 2014 near Oso, Washington, USA, showing a long period of anomalously wet weather. The landslide’s impacts were severe because its mobility exceeded that of prior historical landslides at the site, and also because it was a debris avalanche. The ~8 × 10⁶ m³ landslide originated on a gently sloping (<10°) riverbed that was 180 m high, yet it traveled across the entire ~1 km stream to the adjacent floodplain and spread laterally a similar distance. Geomorphological evidence indicates that high-speed, flowing motion of the landslide began after about 50 s of preliminary slope movement, and observational evidence supports the hypothesis that the high mobility of the landslide resulted from liquefaction of water-saturated sediments at its base. Numerical simulation of the event using a newly developed model indicates that liquefaction and high mobility can be attributed to compressions and/or shear-induced sediment contraction that was strongly dependent on initial conditions. An alternative numerical simulation indicates that the landslide would have been far less mobile if its initial porosity and water content had been only slightly lower. Sensible dependence of landslide mobility on initial conditions has broad implications for assessment of landslide hazards.

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1. Introduction

Landslide mobility has long intrigued earth and planetary scientists (Legros, 2002). The vexing nature and practical significance of the phenomenon were first recognized in 1861, when much of the town of Elm, Switzerland, was buried by a landslide involving about 10⁷ m³ of material that traversed a path 2017 m in length (L) as it descended from a maximum height (H) of 613 m (Hsu, 1978). The Elm disaster motivated development of a landslide mobility index known as the *fahrbühnenindex* (Heim, 1882, 1932), or more commonly, as the *H/L* ratio (Corominas, 1996). The Elm landslide had *H/L* ≈ 0.3, and *H/L* < 0.6 was once thought to be indicative of anomalously low intrinsic friction exhibited by many landslides with volumes greater than about 10⁶ m³ (Scheidegger, 1973). Recent field, laboratory and theoretical investigations have largely discredited this notion, in part because *H/L* is an inadequate measure of bulk frictional resistance (e.g., Corominas, 1996; Iverson, 1997; Dade and Huppert, 1998; Legros, 2002; Iverson et al., 2011; Farin et al., 2014). Nevertheless, *H/L* values (or their reciprocals, *L/H* values) serve an important practical purpose be-



National Strategy for Landslide 山崩國家策略(白皮書)

USGS Landslide Hazards Program

National Strategy for Landslide Loss Reduction



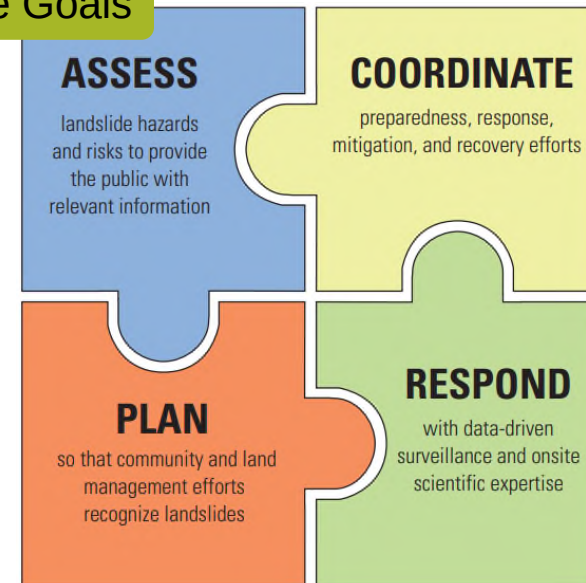
Open-File Report 2022-1075

<https://www.usgs.gov/publications/national-strategy-landslide-loss-reduction>

Main Challenges:

1. Gaps in basic information needed
2. Difficulty in accurately mapping and forecasting landslide hazards
3. Communication and coordination

The Goals





Landslide Preparedness in the US

United States Geological Survey



- 制定國家山崩整備策略
- 山崩監測、繪製及發佈風險地圖
- 設定警戒機制及早期預警模式
- 科學資訊揭露，推廣科普教育

National Oceanic and Atmospheric Administration



- 氣象監測及預警
- 發布警報(洪水、特別氣象)
- 與USGS聯合建立土石流警報系統

Federal Emergency Management Agency



整合性的聯邦防救災單位，提供地方災害整備之相關資源等(bottom-up)

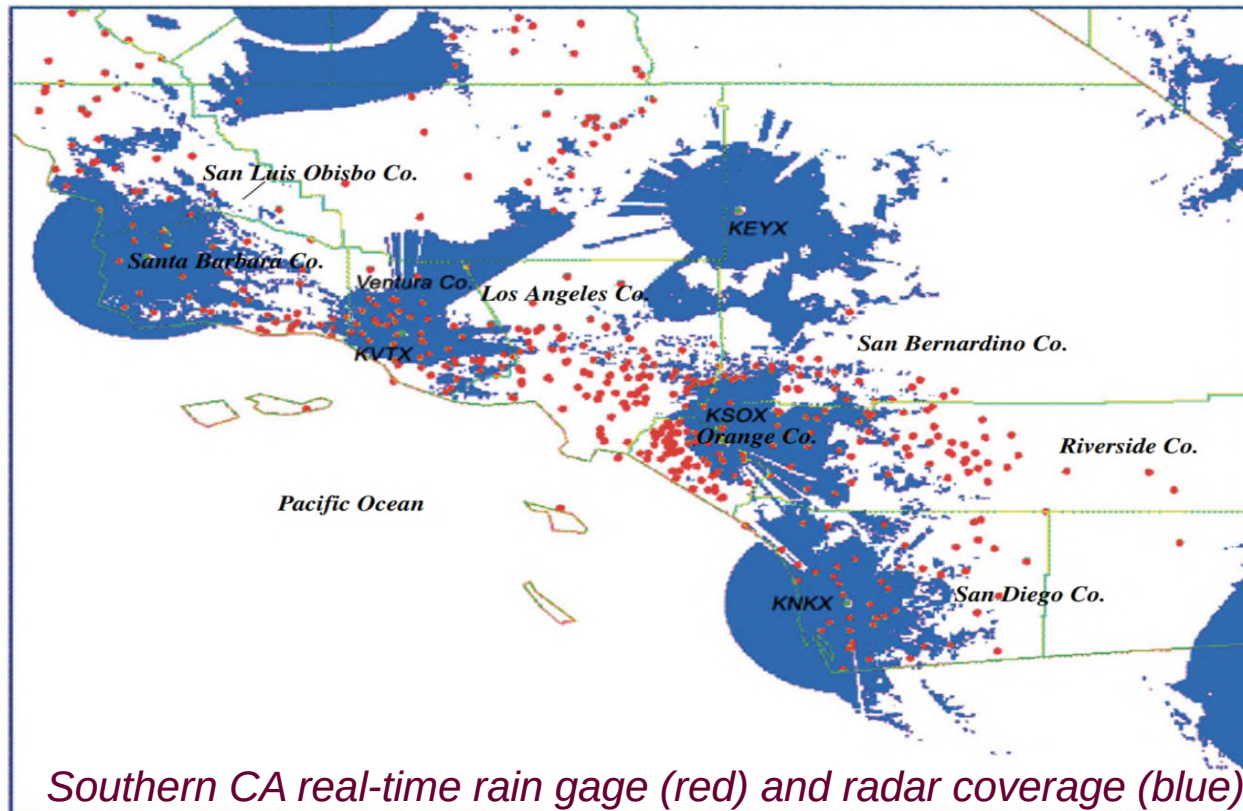
However...

Goal 2. Landslide Hazard Mitigation, Preparedness, Response, and Recovery Efforts Are Coordinated Across Federal, State, Tribal, Territorial, and Local Levels

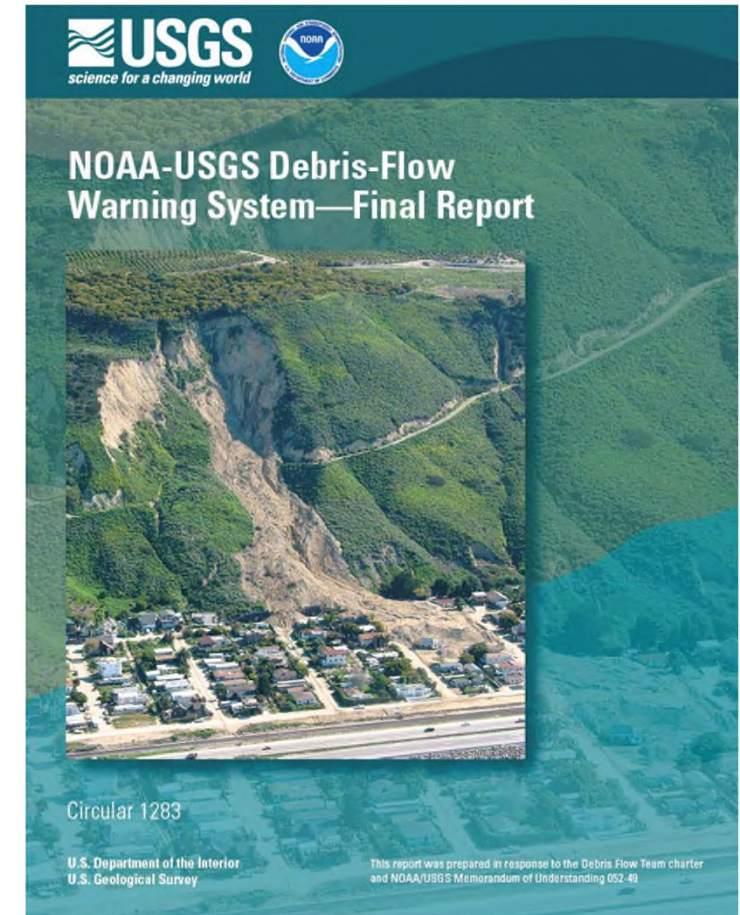
More than 10 different Federal agencies are responsible for research or emergency management activities related to landslide hazards. Currently, there is no platform for these agencies to exchange data, best practices, and guidance, or to collaborate on issues related to landslide hazards. Further, there is no forum for similar exchanges across the numerous State, Tribal, territorial, local, private, and academic entities that study, mitigate, prepare for, respond to, or recover from landslide hazards. Creating formal and informal mechanisms to foster these exchanges is critical to advancing landslide preparedness, mitigation, response, and recovery. The communities of practice that emerge from these coordination efforts and the professional relationships that are established in advance of disaster events will improve and streamline the Nation's readiness for future landslide hazard events across all phases of the emergency management cycle.



NOAA-USGS Early Warning System



<https://www.usgs.gov/programs/landslide-hazards/science/early-warning-system#overview>



<https://pubs.er.usgs.gov/publication/cir1283>



U.S. Geological Survey (USGS) Partnership with National Oceanic and Atmospheric Administration (NOAA) – National Weather Service (NWS)



Provide sound scientific guidance on the physiographic, hydrologic, and meteorological conditions that contribute to landslide and debris-flow initiation and growth.



Provide forecasted and real-time monitoring of meteorological conditions, and technical infrastructure for issuance of outlooks, watches, and warnings.



Comparison of Landslide Preparedness (US vs. TW)

• 法制架構

- US：山崩整備法詳細描述了執行目標及計畫內容（如建立預警系統、山崩資料庫、社區整備工作等），但其下較缺乏明確的技術及執行規範。
- TW：由災害防救法簡要的律定法定天然災害主管機關，再由主管機關訂定作業要點、業務計畫等規範，訂定相關技術及執行細則。

• 行政分工

- US：聯邦政府訂定全國性監測及預警工作，其工作由USGS為主、NOAA/NWS為輔，但礙於國土幅員廣大，災害整備及應變工作主要是由地方政府（州、郡）主導，如災害規模超過地方所能負荷，則由聯邦政府(FEMA)加入緊急應變工作。
- TW：依災防法規定本局為主管機關，執行全國性監測、預警及訂定疏散避難機制等工作，並由地方政府執行疏散工作。

• 早期預警機制

- US：因為林火後土石流影響嚴重，進而發展相關土石流預警機制，山崩災害則以公布風險資料方式。
- TW：發展土石流及大規模崩塌預警及疏散機制。



報告完畢 敬請指教



行政院農業委員會水土保持局
與您一起打拼