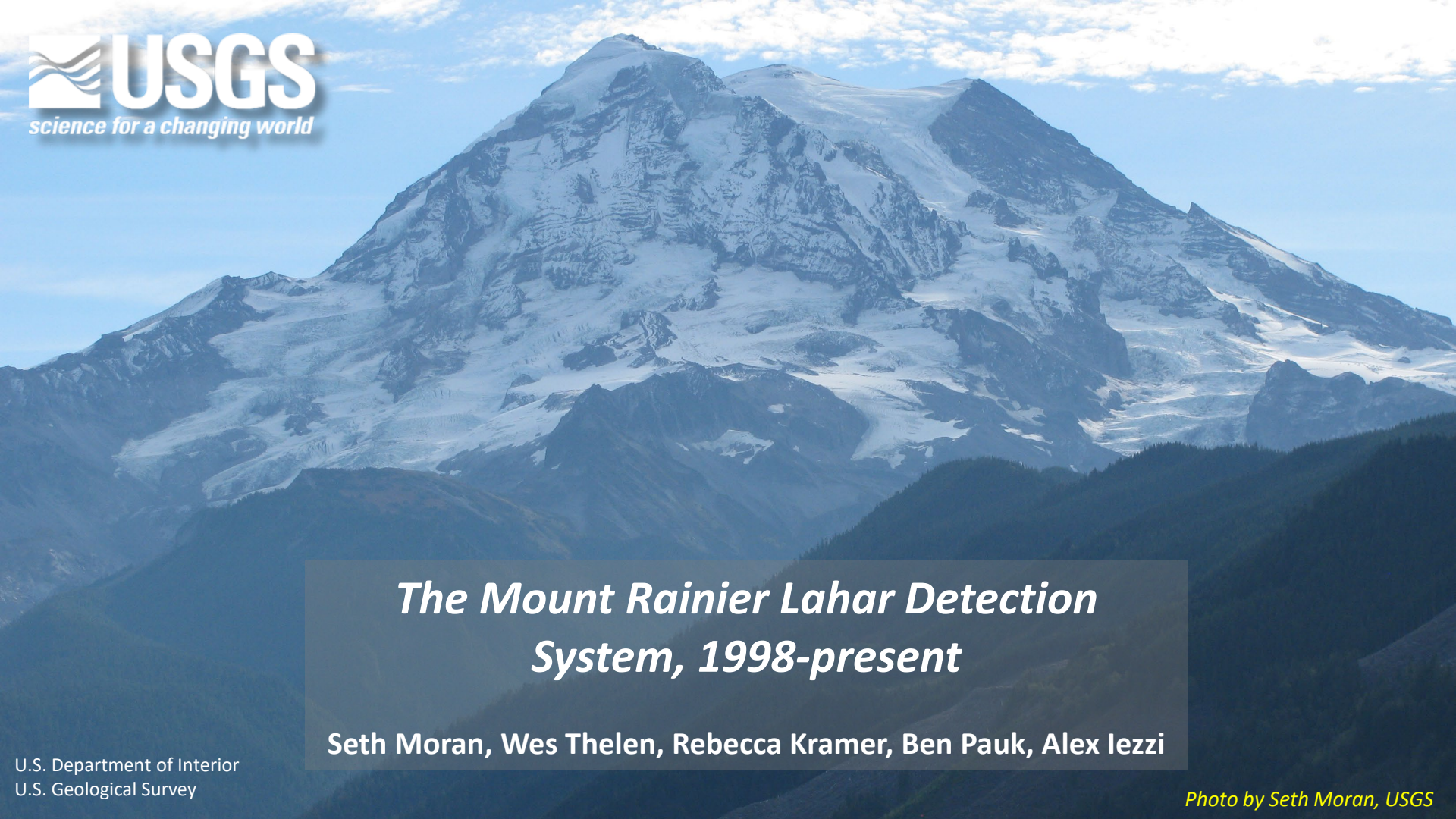


The Mount Rainier Lahar Detection System, 1998-present

Seth Moran, Wes Thelen, Rebecca Kramer, Ben Pauk, Alex Iezzi

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

Photo by Seth Moran, USGS

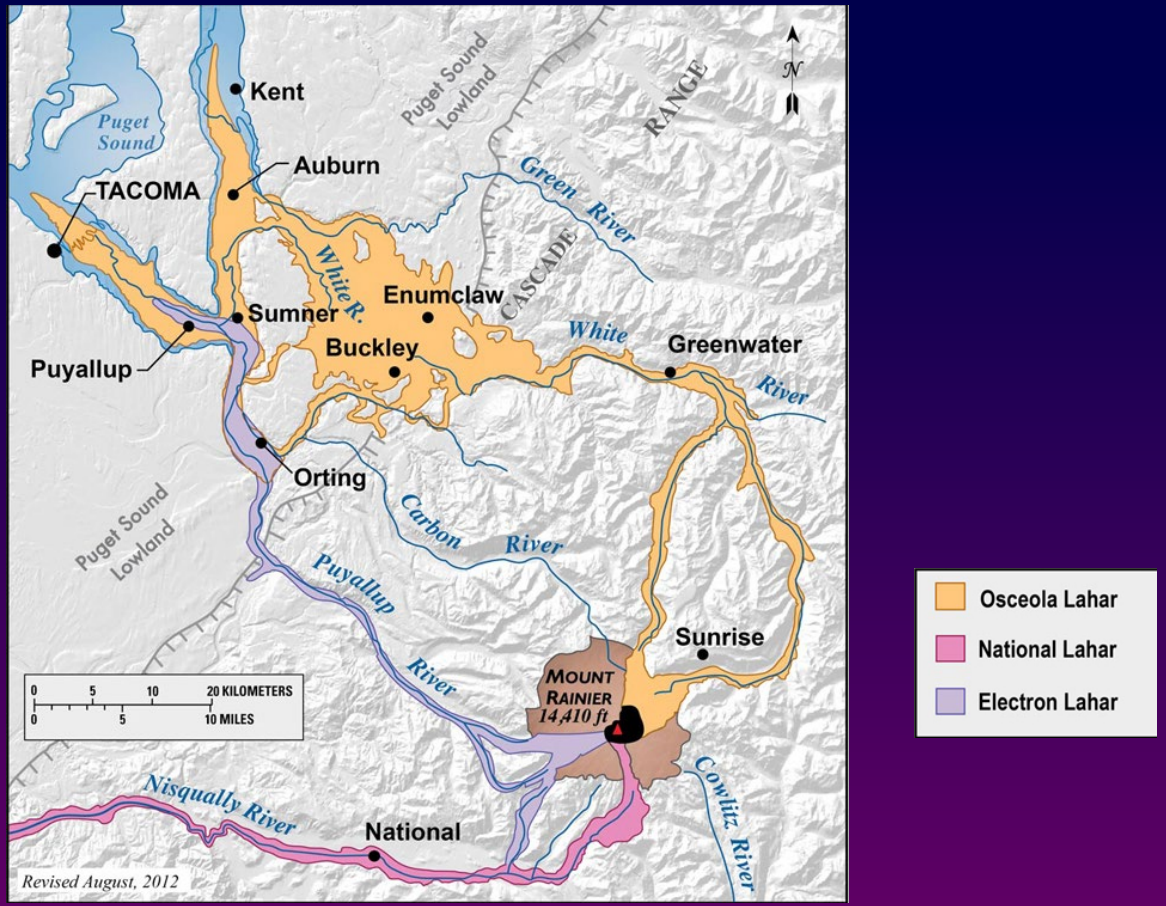
Rainier Volcano Hazards:

- ~40 eruptions in last 10,000 years.
- Most recent eruption ~1,000 years ago; largest ash-producing eruption ~2,200 years ago
- At least 9 large lahars in last 5,600 years have reached now-densely populated areas.
- Most recent large lahar: ~1500 A.D. (Electron Mudflow)
- Most large lahars associated with eruptions; Electron was not.
- >90,000 people live in Rainier lahar hazard zones

USGS

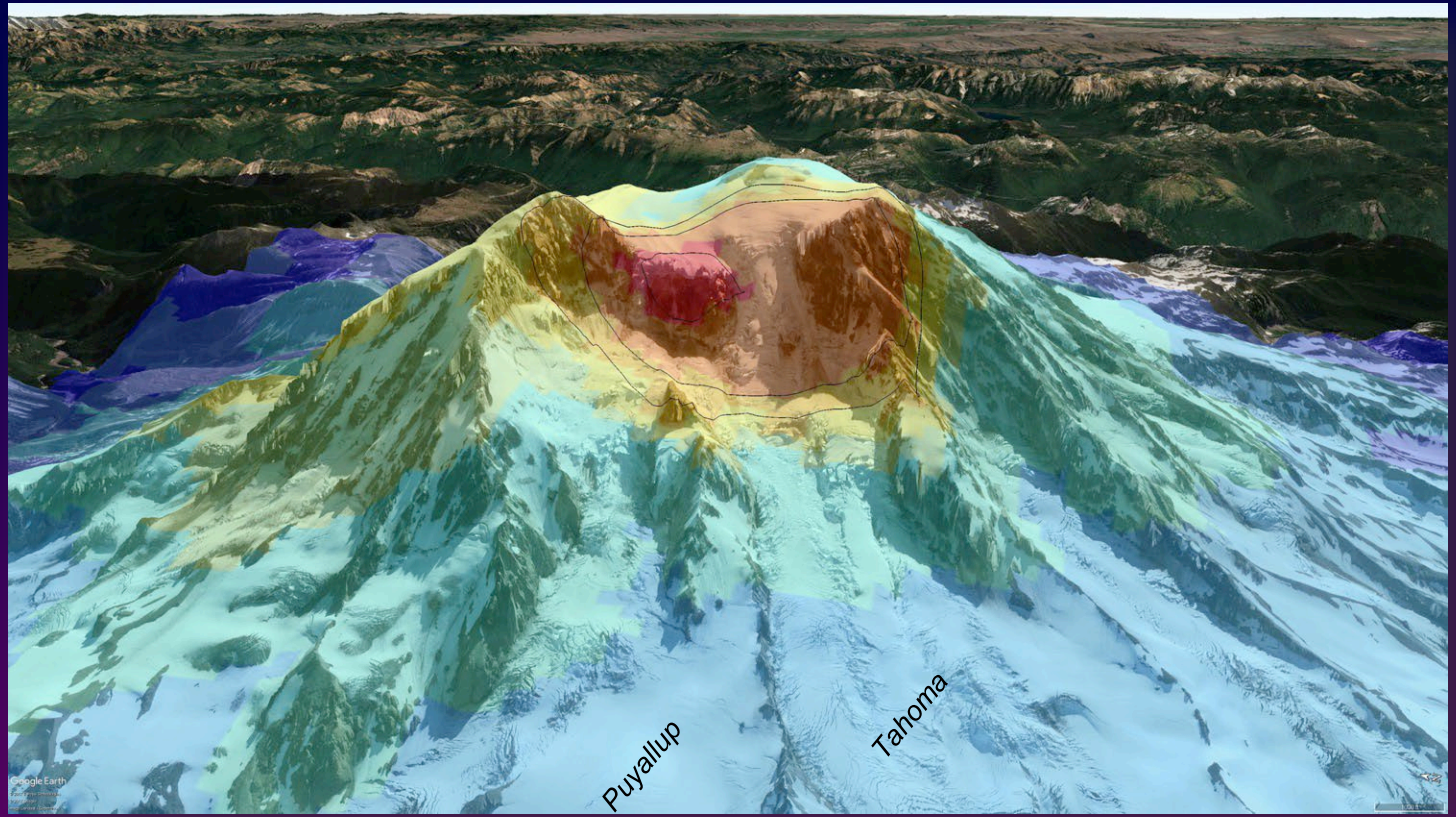
Photo by Seth Moran, USGS

Rainier Lahar Hazards



USGS

Rainier Lahar Hazards

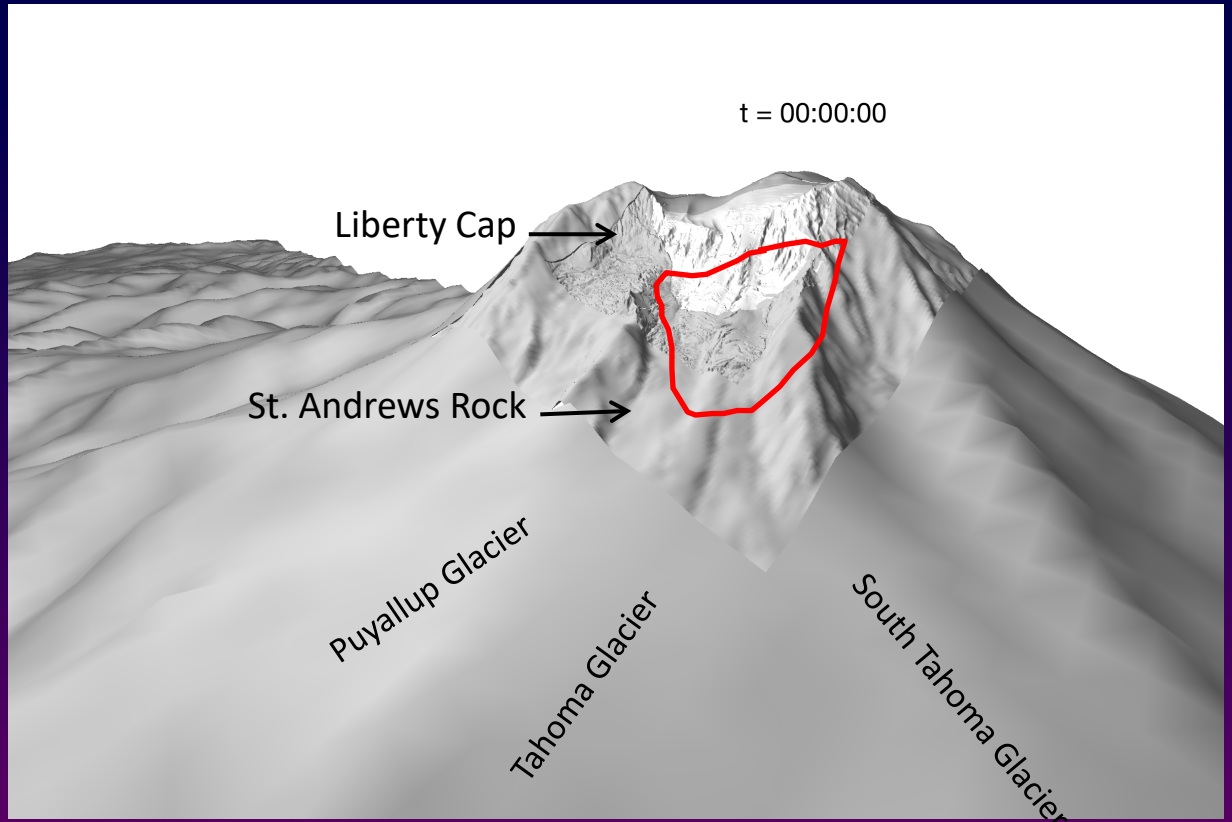


Reid et al. (2001), Finn et al (2001) – area of instability on west flank

USGS

Rainier Lahar Hazards

D-Claw Model: Uses 260 M m^3 debris avalanche in least- stable source region

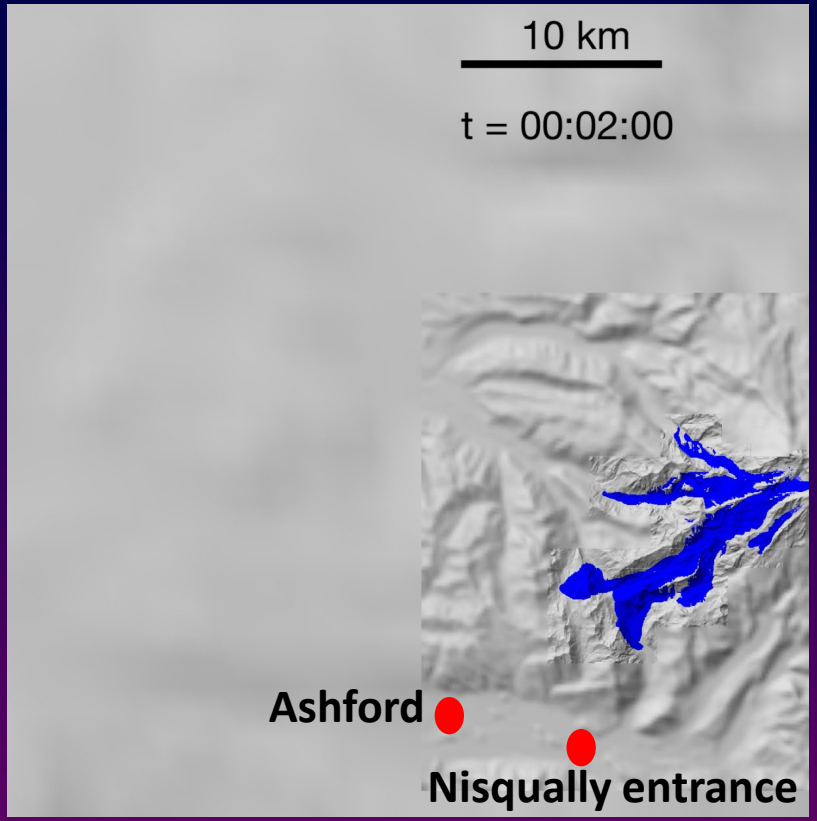


George et al., 2022

USGS

Rainier Lahar Hazards

t = 2 minutes

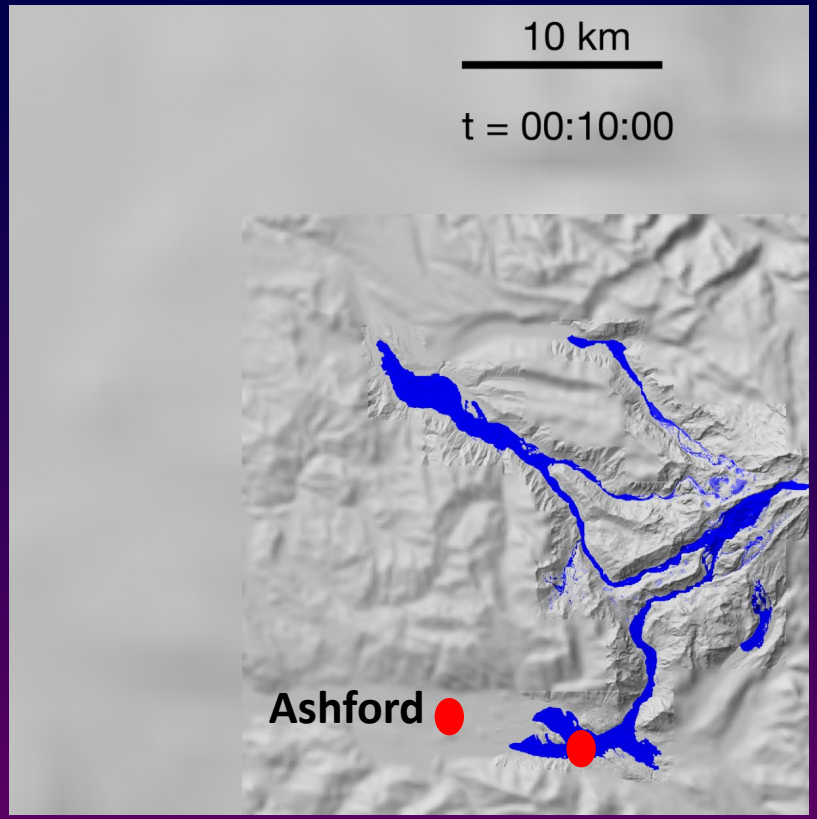


George et al., 2022

USGS

Rainier Lahar Hazards

t = 10 minutes

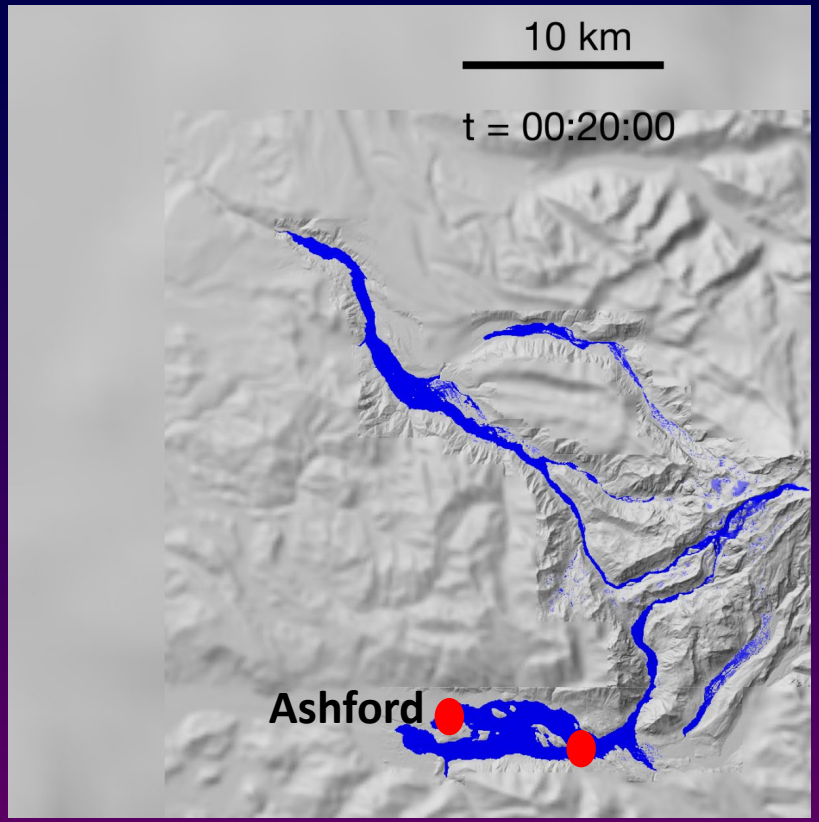


George et al., 2022

USGS

Rainier Lahar Hazards

t = 20 minutes

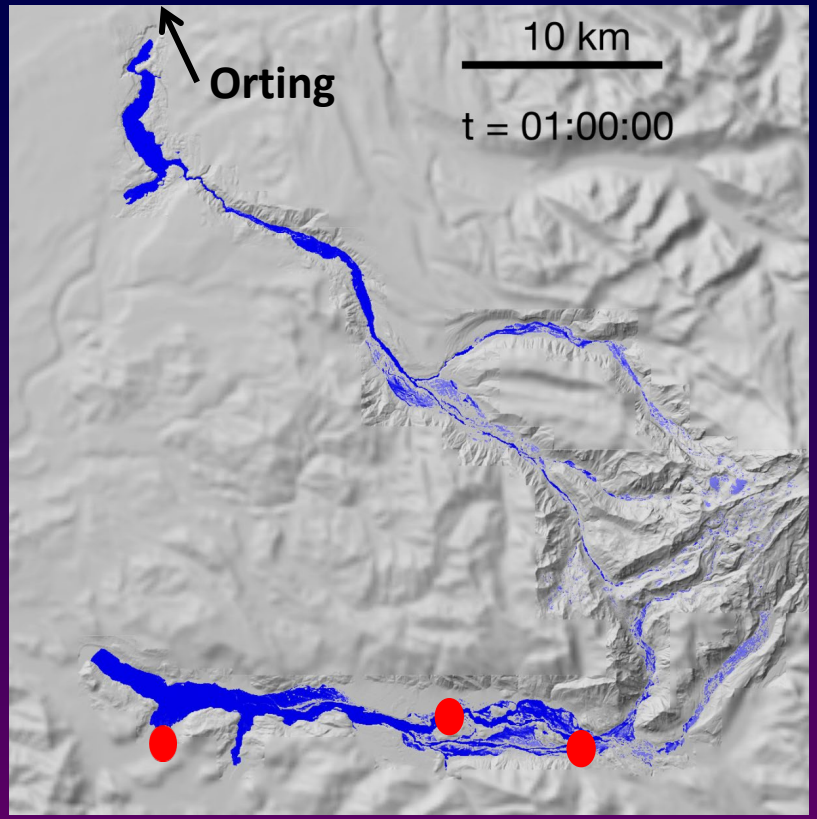


George et al., 2022

USGS

Rainier Lahar Hazards

t = 60 minutes



George et al., 2022

USGS

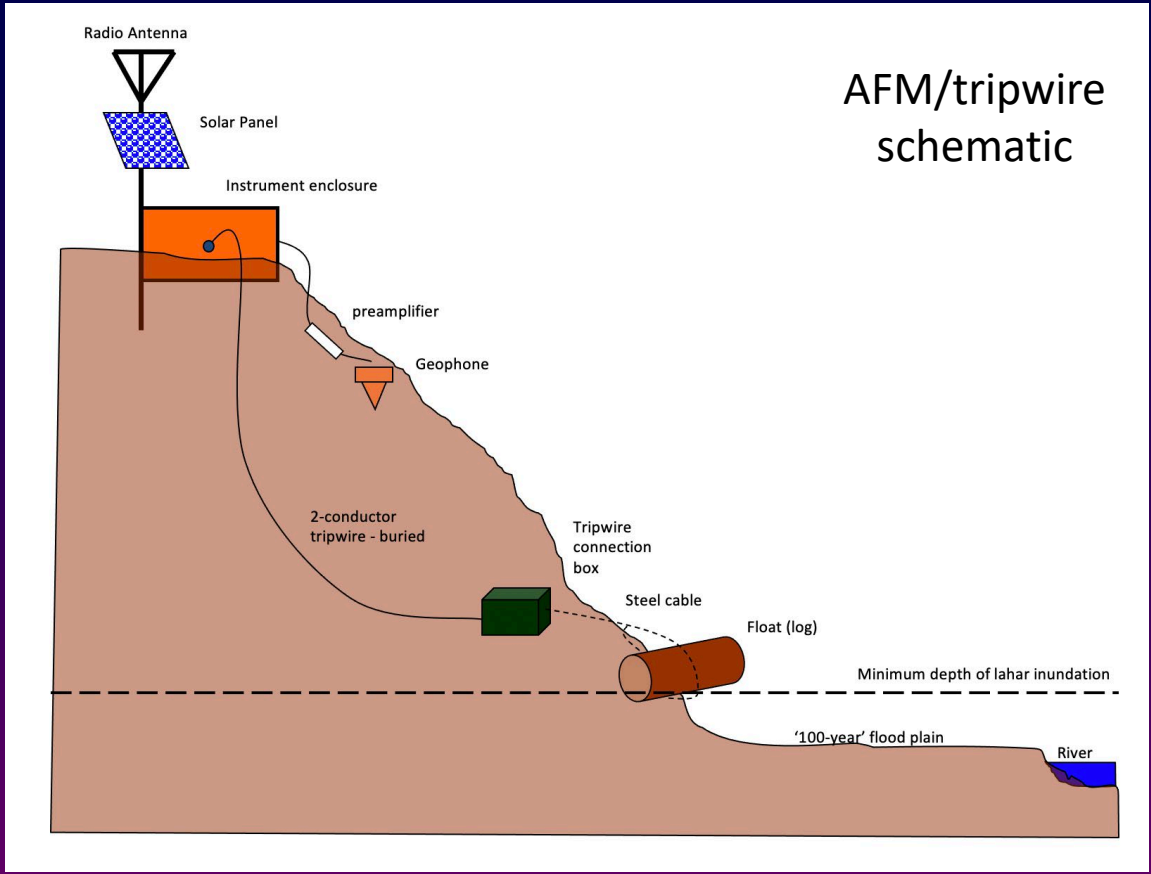
Rainier Lahar Detection System v 1.0: 1998

1998 system:

- Separate detection & alarm components
- USGS designs & installs detection component:
  - 6 AFM stations & several tripwires in Puyallup & Carbon Rivers.
  - Detection software runs on computers at WA EMD and South Sound 911 24/7 EOCs
  - Pierce County responsible for M&O
- Alarm component operated by 24/7 EOCs at WA EMD & South Sound 911
  - Requires SOPs, training, rigorous testing, & periodic M&O by USGS, WA EMD, and/or South Sound 911 IT staff.

USGS

Rainier Lahar Detection System v 1.0: 1998

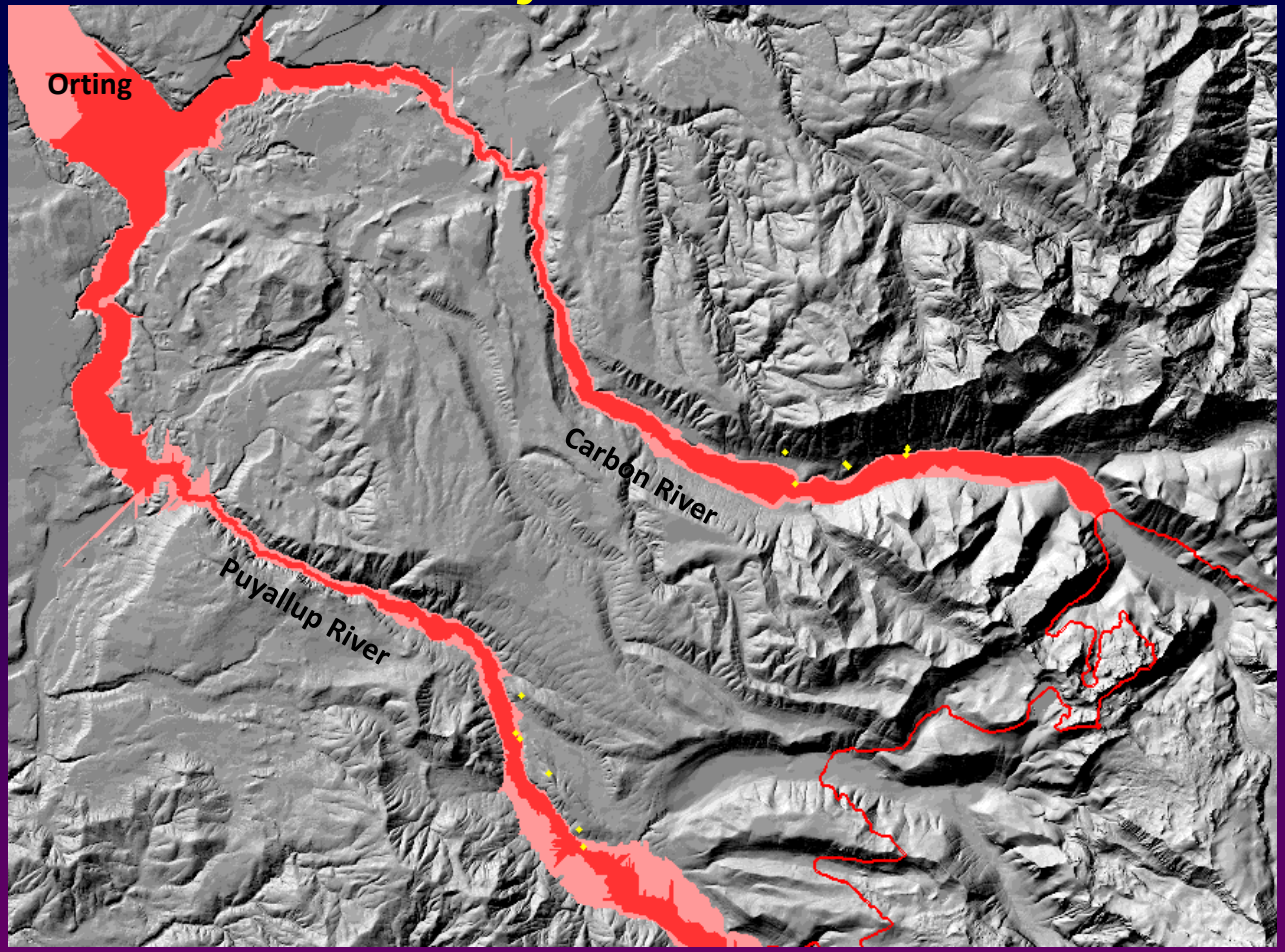


Andy Lockhart

USGS

Rainier Lahar Detection System v 1.0: 1998

- Red = 40 million m^3
- Pink = 250 million m^3
- Yellow dots = AFM/tripwire station locations.



USGS

Andy Lockhart

Rainier Lahar Detection System v 1.0: 1998

Challenges w/ 1998 system:

- **No real-time seismic data (only 2-min RSAM)**
  - **> 2-minute delay in alert**
  -
  -
- **Onl & trip**
- **Didn't have coverage for Tahoma Creek (lahar hazard)**
- **Not integrated with Rainier volcano monitoring network**
- **No dedicated $$ for M&O (performed by Pierce County)**

USGS receives Congressional funding for upgrading RLDS in 2017 & has received annual appropriations through FY23

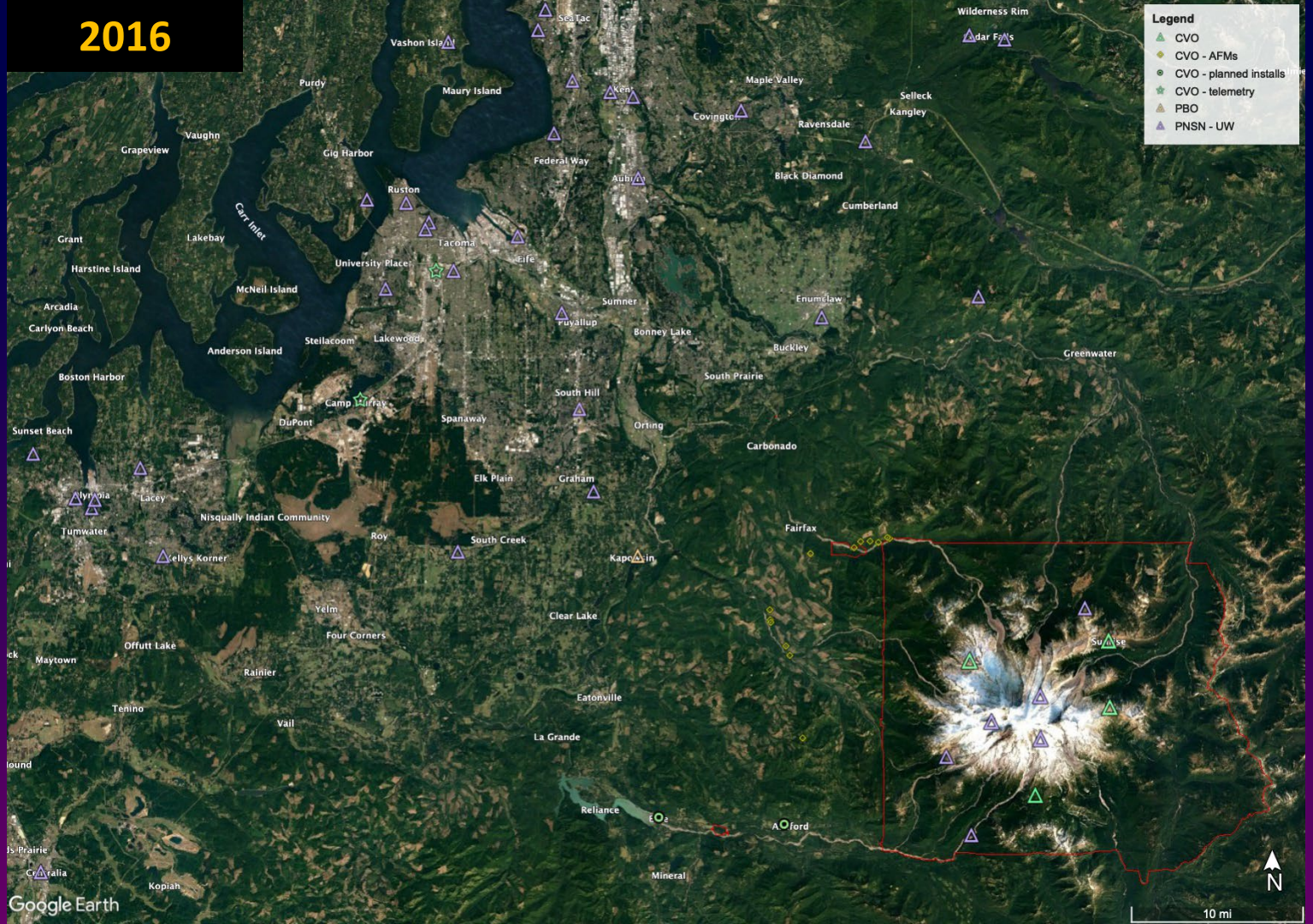
USGS

Rainier Lahar Detection System: 2017-present

Goals for new system:

- Real-time data transmission
- Use broadband seismometers & add other sensors (infrasound, webcams) for new detection capabilities
- Install new stations closer to volcano to improve warning time, particularly along Tahoma Creek.
- Integrate RLDS with existing volcano monitoring network.
- USGS performs M&O
- One thing unchanged from 1998: USGS does the detection, WA EMD/Pierce County/South Sound 911 do the warning.

USGS


2016
Legend
CVO
CVO - AFMs
CVO - planned installs
CVO - telemetry
PBO
PNSN - UW
Wilderness Rim
Maple Valley
Selleck
Kangley
Ravensdale
Black Diamond
Cumberland
Enumclaw
Buckley
Greenwater
Bonney Lake
Sumner
Puyallup
South Prairie
Carbonado
Orting
South Hill
Spanaway
DuPont
Camp Murray
Elk Plain
Graham
Fairfax
Roy
South Creek
Kapowsin
Clear Lake
Yelm
Four Corners
Offutt Lake
Maytown
Rainier
Eatonville
Tenino
Vail
La Grande
Reliance
Mineral
Kopiah
Nisqually Indian Community
Tumwater
Lacey
Olympia
Sunset Beach
Boston Harbor
Anderson Island
Steilacoom
Lakewood
University Place
Tacoma
Fife
Ruston
Gig Harbor
Federal Way
Auburn
Kent
Covington
Maury Island
Vashon Island
SeaTac
Purdy
Vaughn
Grapeview
Grant
Lakebay
Harstine Island
McNeil Island
Arcadia
Carlyon Beach
Carr Inlet
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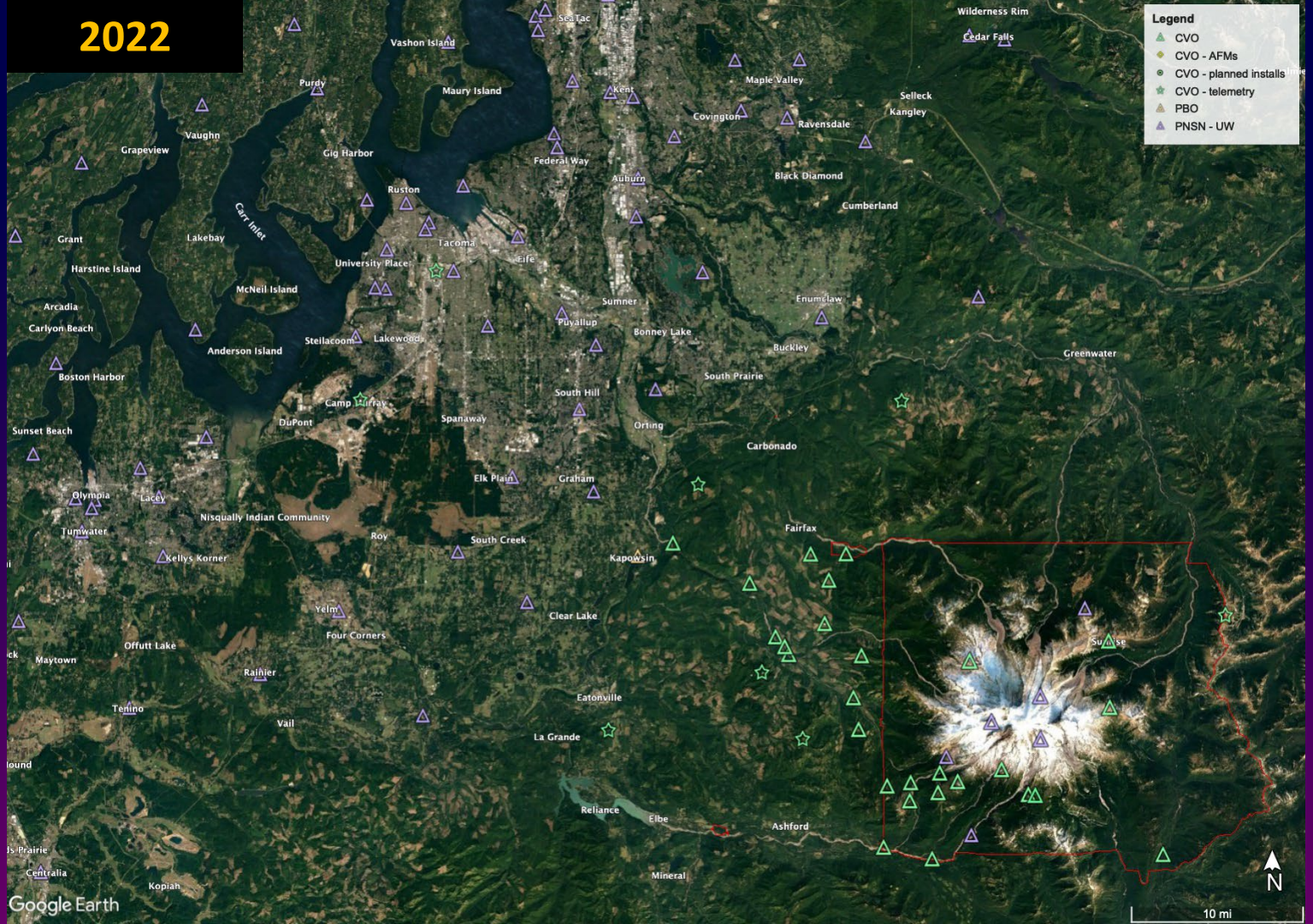
2022
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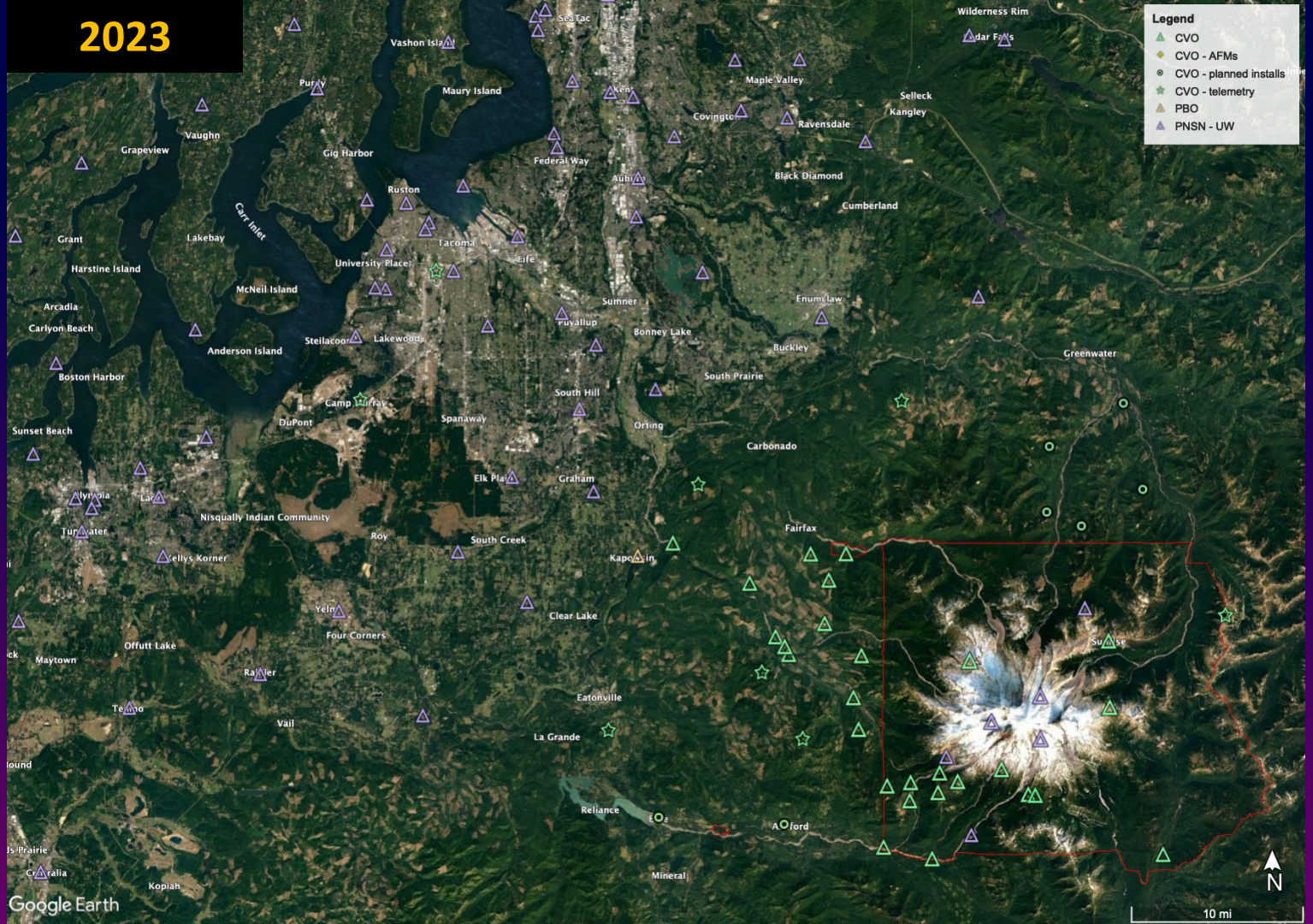
2023



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USGS

Rainier Lahar Detection System: 2025

Lahar Detection Network (volcano network + new lahar stations):

- # of instrument types:
  - 40 broadbands
  - 7 GPS
  - 30 infrasound sites
  - ~5-6 webcams (some operated by NPS)
  - ~10 telemetry repeaters
  - CVO responsible for M&O at ~45 sites
- Still has gaps!!!
  - Does not adequately cover all lahar-prone drainages (would be primary focus w/ unrest).

USGS