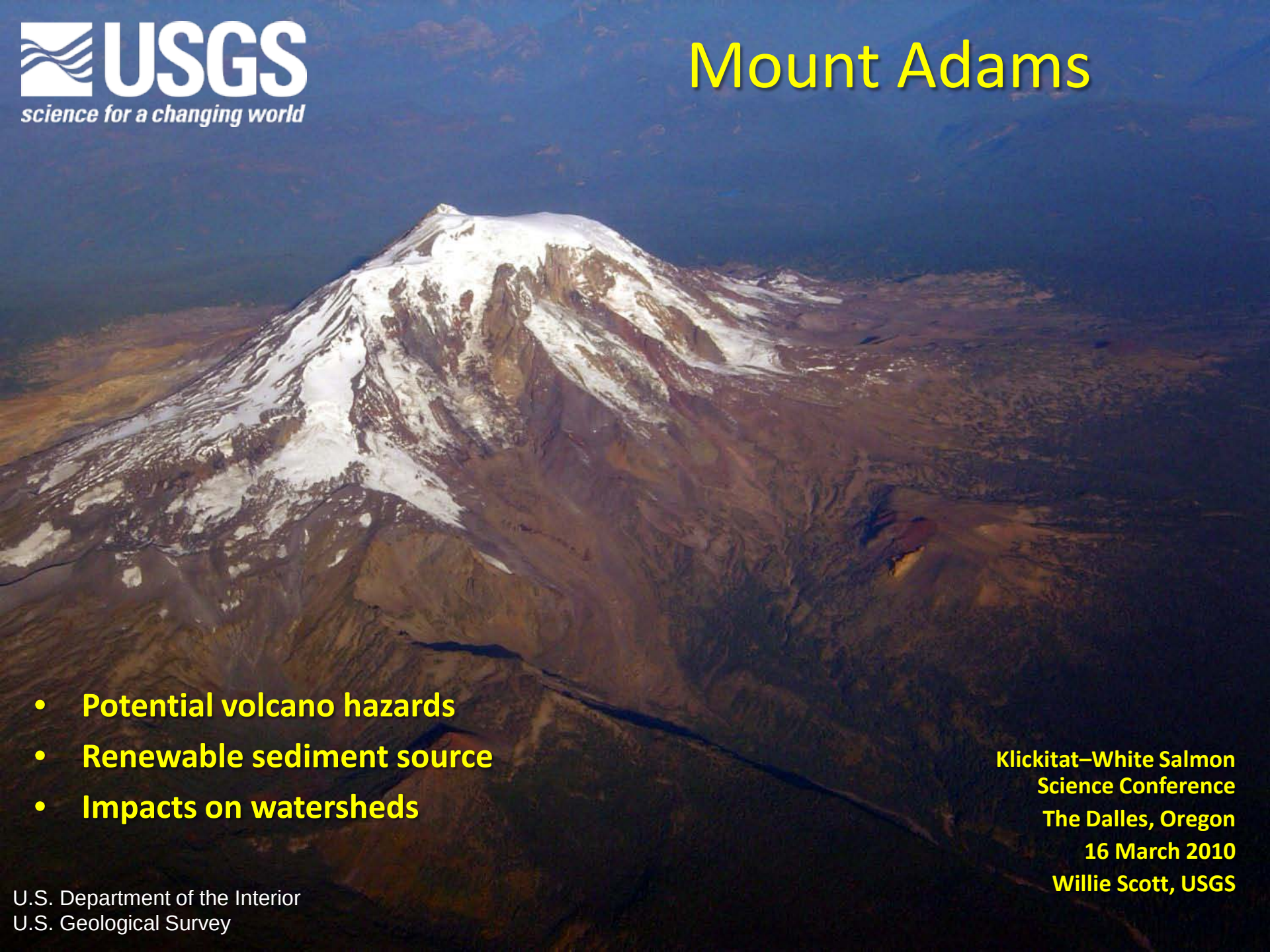


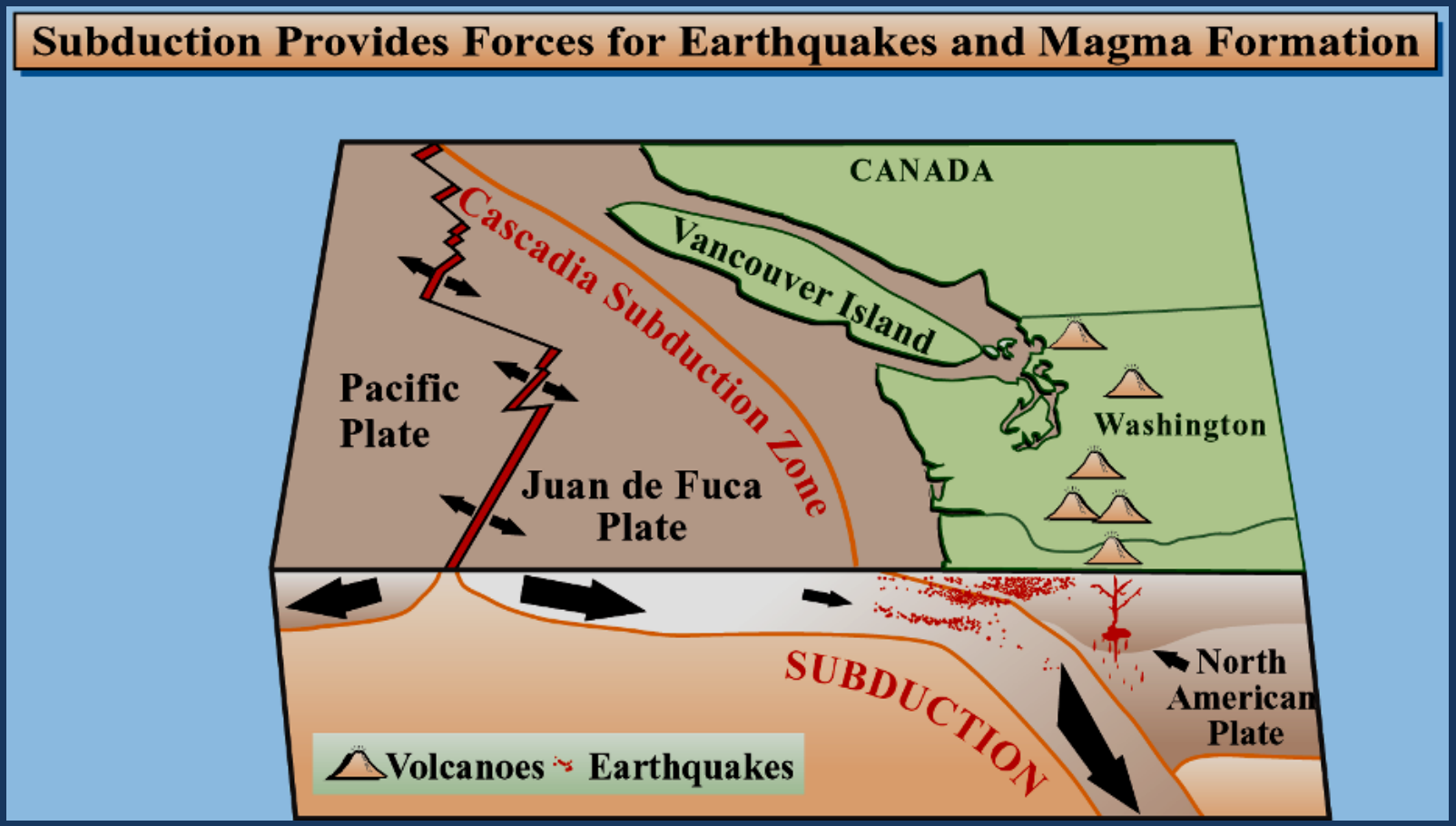
USGS
science for a changing world

Mount Adams

- **Potential volcano hazards**
- **Renewable sediment source**
- **Impacts on watersheds**

Klickitat–White Salmon Science Conference
The Dalles, Oregon
16 March 2010
Willie Scott, USGS

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

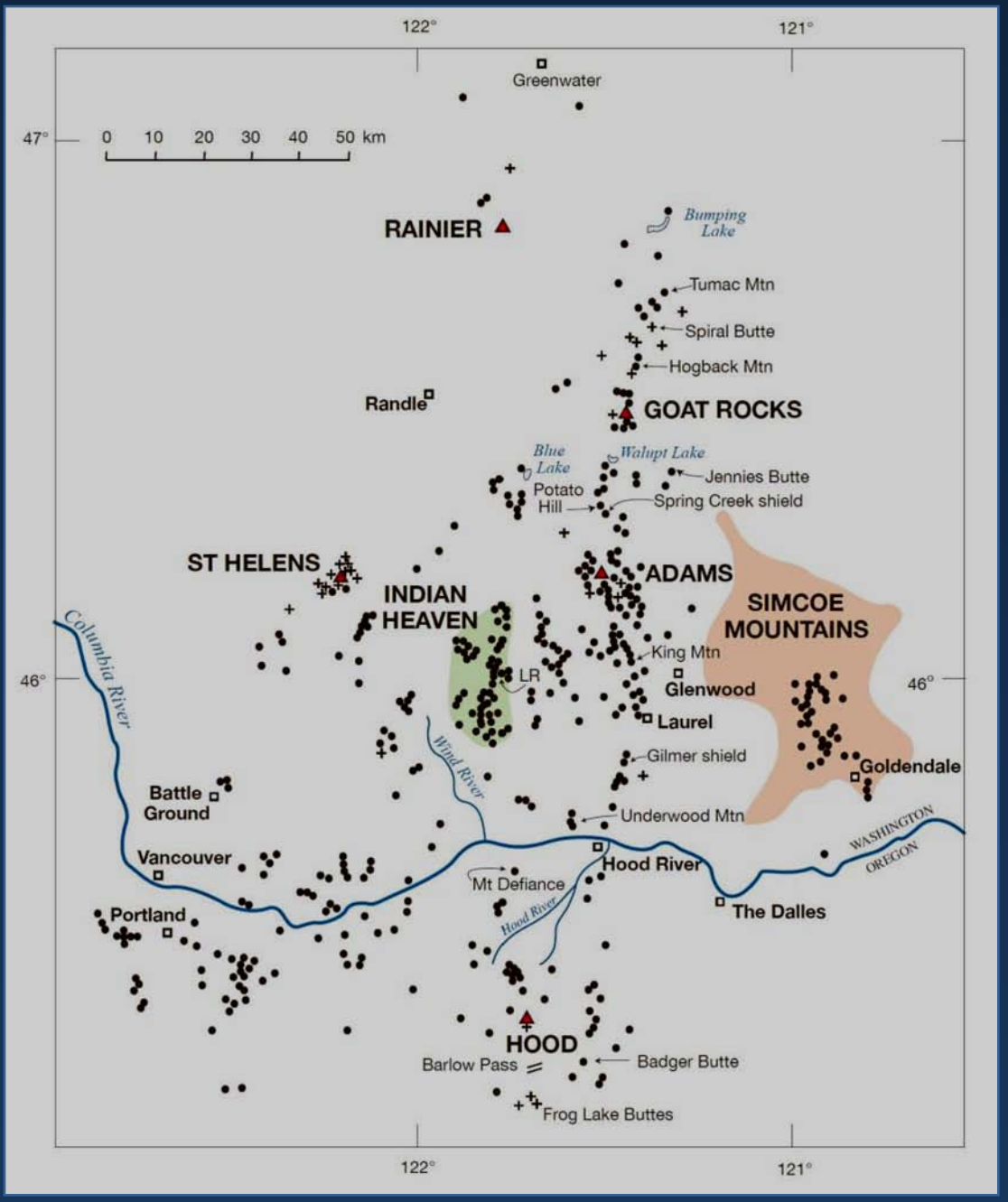


Cascade Volcanic Arc

- Meager Mountain, B.C., to Lassen Peak, Calif.—750 miles
- More than 3,000 volcanic vents active in past 2 million yrs

USGS

Central Cascade Volcanic Arc



- ▲ 4 major active, long-lived centers [Rainier, St. Helens, Adams, Hood]
- ● ~300 short-lived volcanoes
- 100-mile wide from west of Portland to Goldendale
- Columbia River

From Hildreth, USGS Prof. Paper 1744

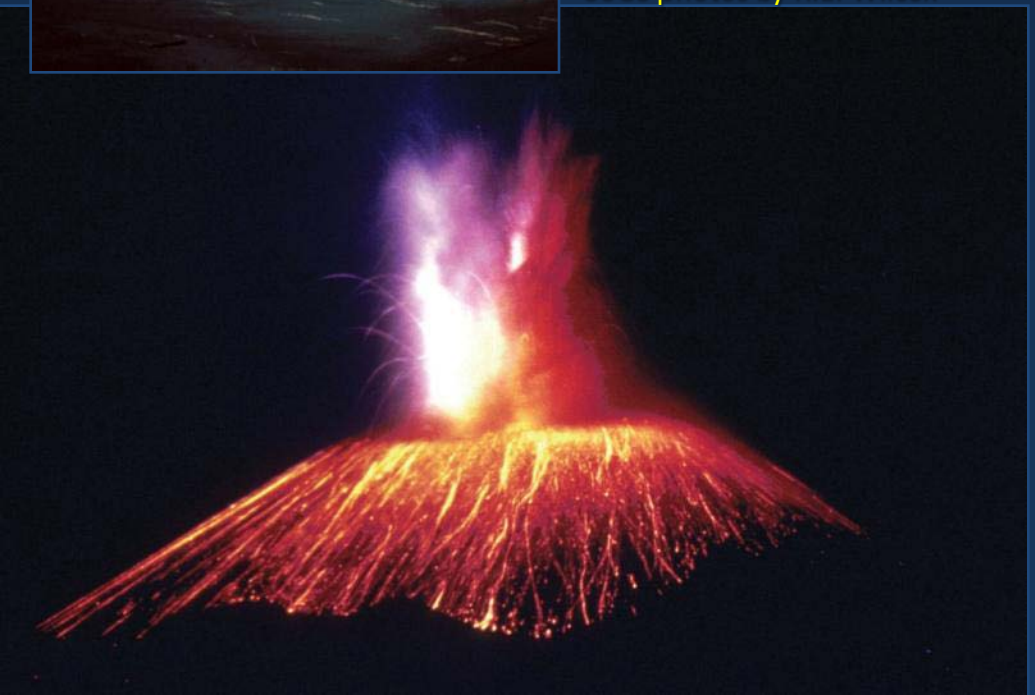
USGS

Paricutín, Mexico, 1943–1952

Short-lived volcano; one of many in a broad volcanic field

USGS photos by R.E. Wilcox

Tephra fallout and lava flows



Local analogs:

- Little Mountain (near Trout Lake)
- Little Mount Adams
- Also larger shield volcanoes; King Mountain

USGS photos by F.W. Foshag

Lava Flows and Tephra Erupt from Summit and Flank Vents

Hot eruptive products can swiftly melt snow and ice; water incorporates rock debris to make lahars (debris flows)

USGS

Effects of tephra fall (ashfall)

Photos without credit are from USGS

USGS

Lahar (debris flows)

- Water-mobilized slurries of mud, rock, and organic debris
- Follow valleys
- Range of sizes

  Large flows extend tens of miles; cover valley floors

  - Swift melting of ice and snow during eruptions
  - Debris avalanches of weakened, saturated rock

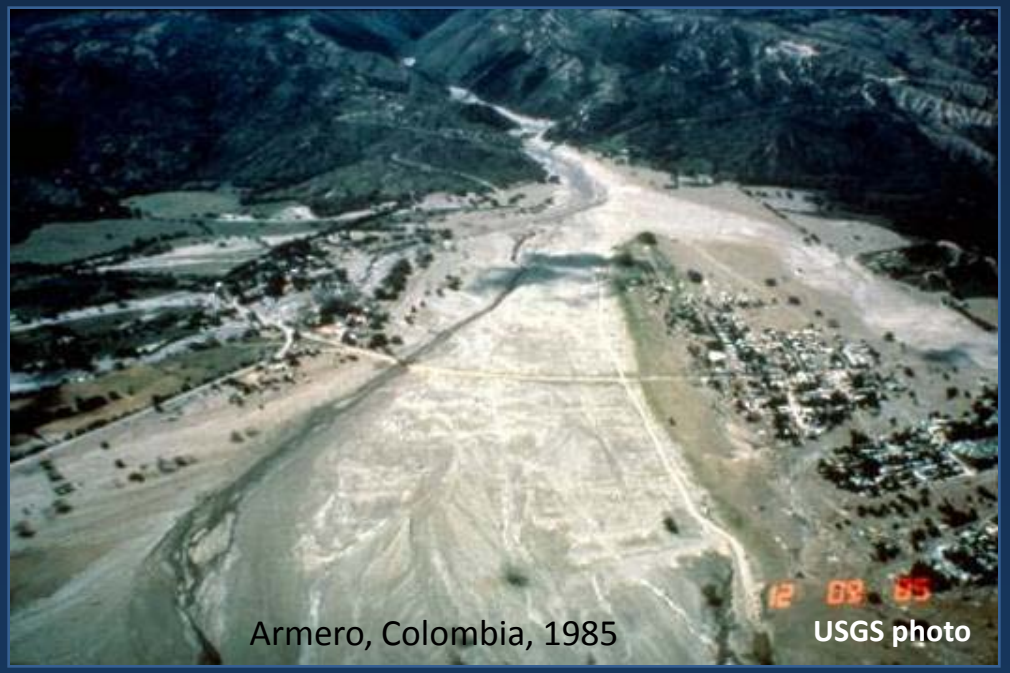
  Small flows extend up to a few miles

  - Rainfall and glacier outbursts
  - Small landslides

USGS

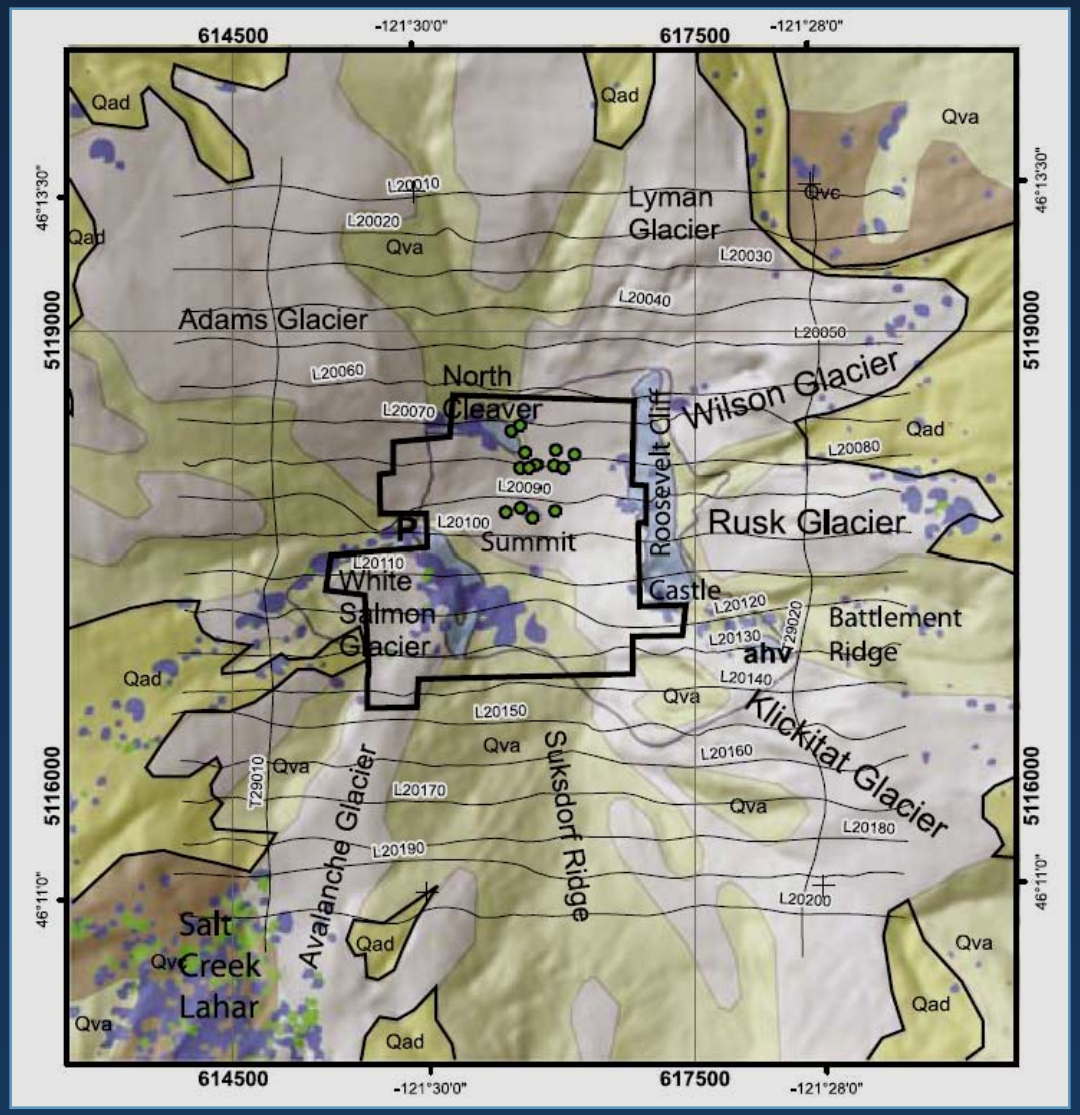
Lahar effects=

- Erosion
- Burial
- Impact forces
- Altered channels



Sediment impacts on river channels can last for decades

Widespread Hydrothermal Alteration

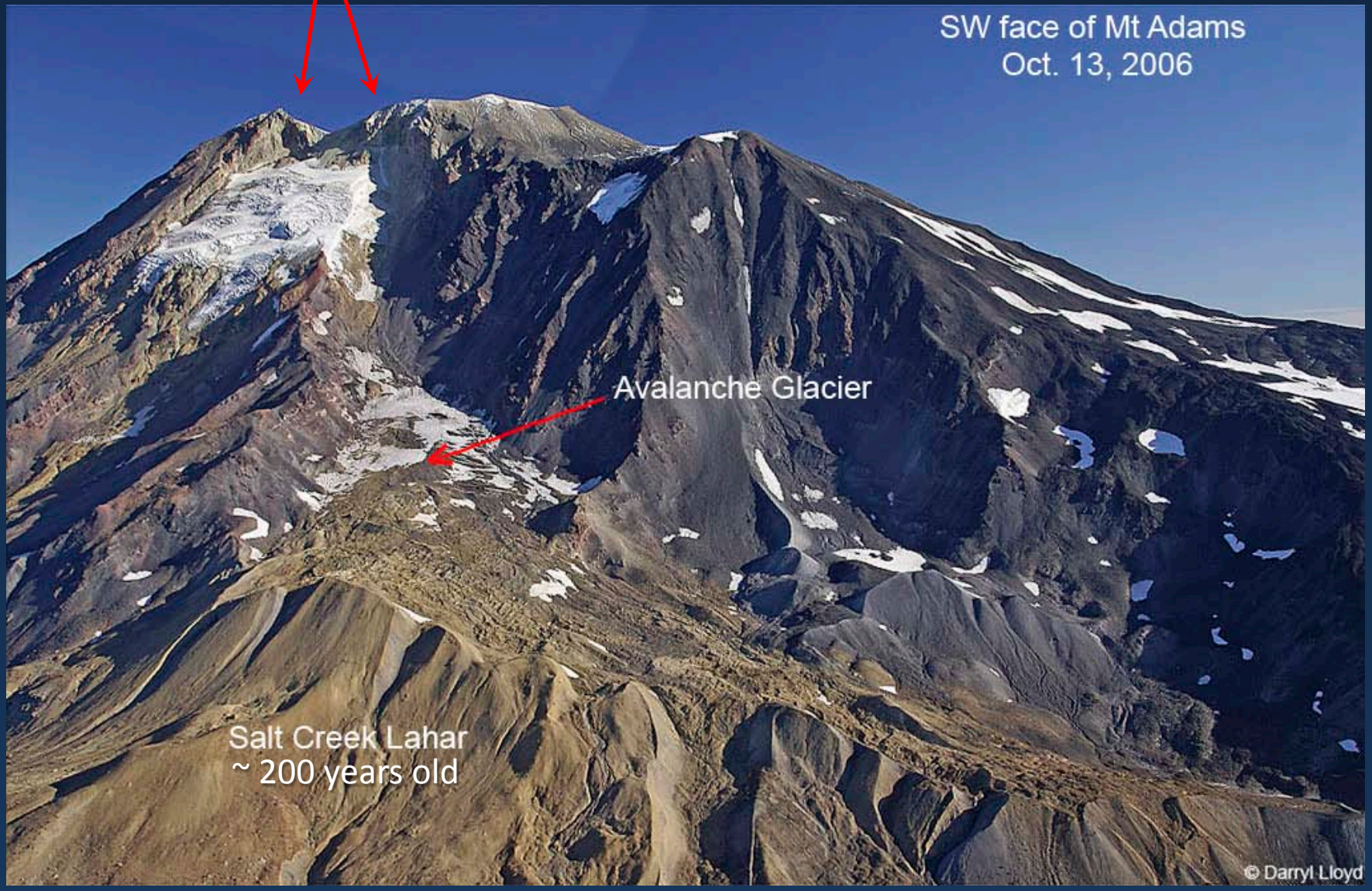


Finn and others, 2007, JGR

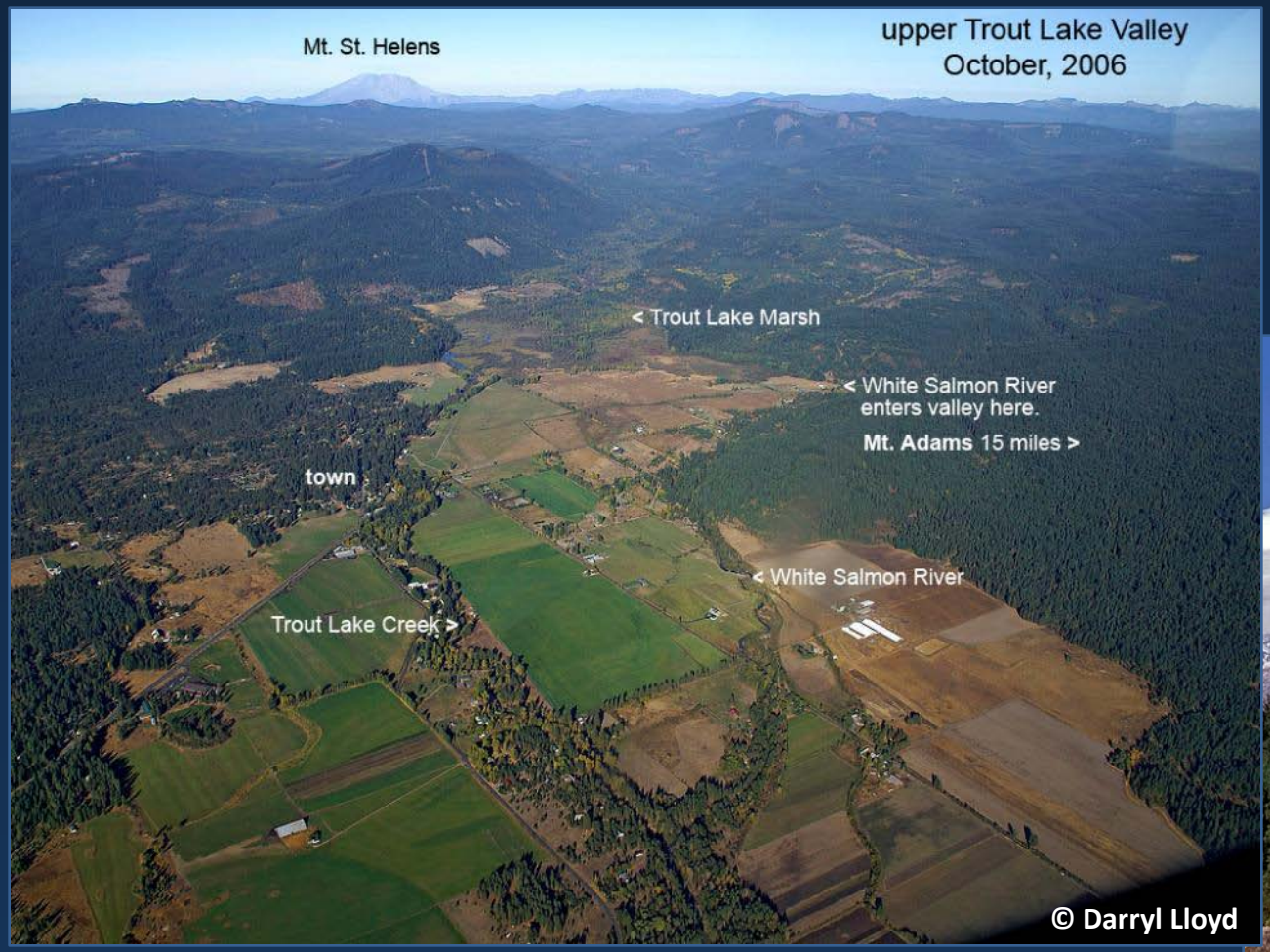
- Almost ½ cubic mile of altered material
- Bowl-shaped mass
- Largest mass of altered material high on a Cascade volcano???

USGS

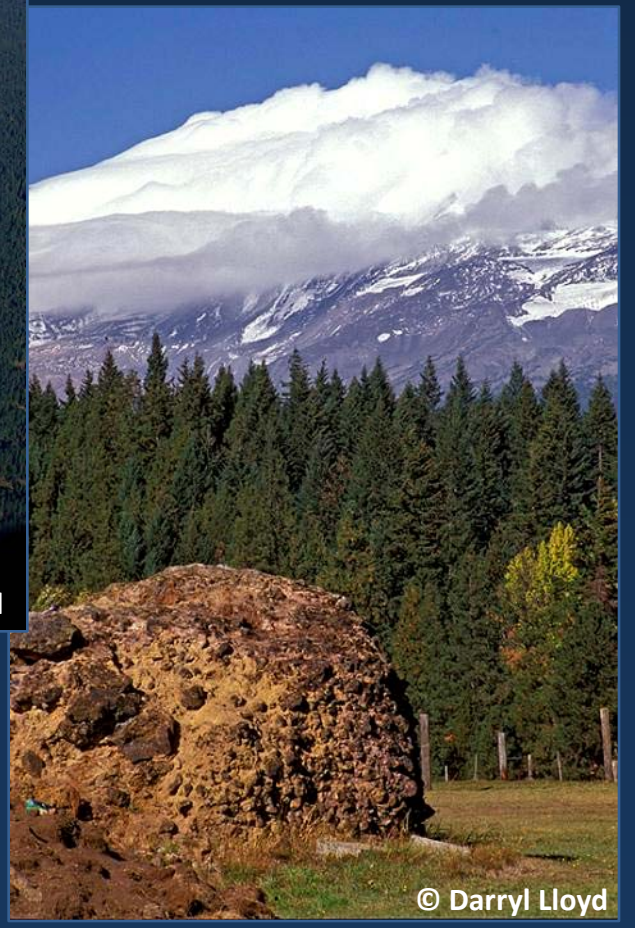
Source of 3 large debris avalanches and lahars (and many smaller ones) during past 10,000 years



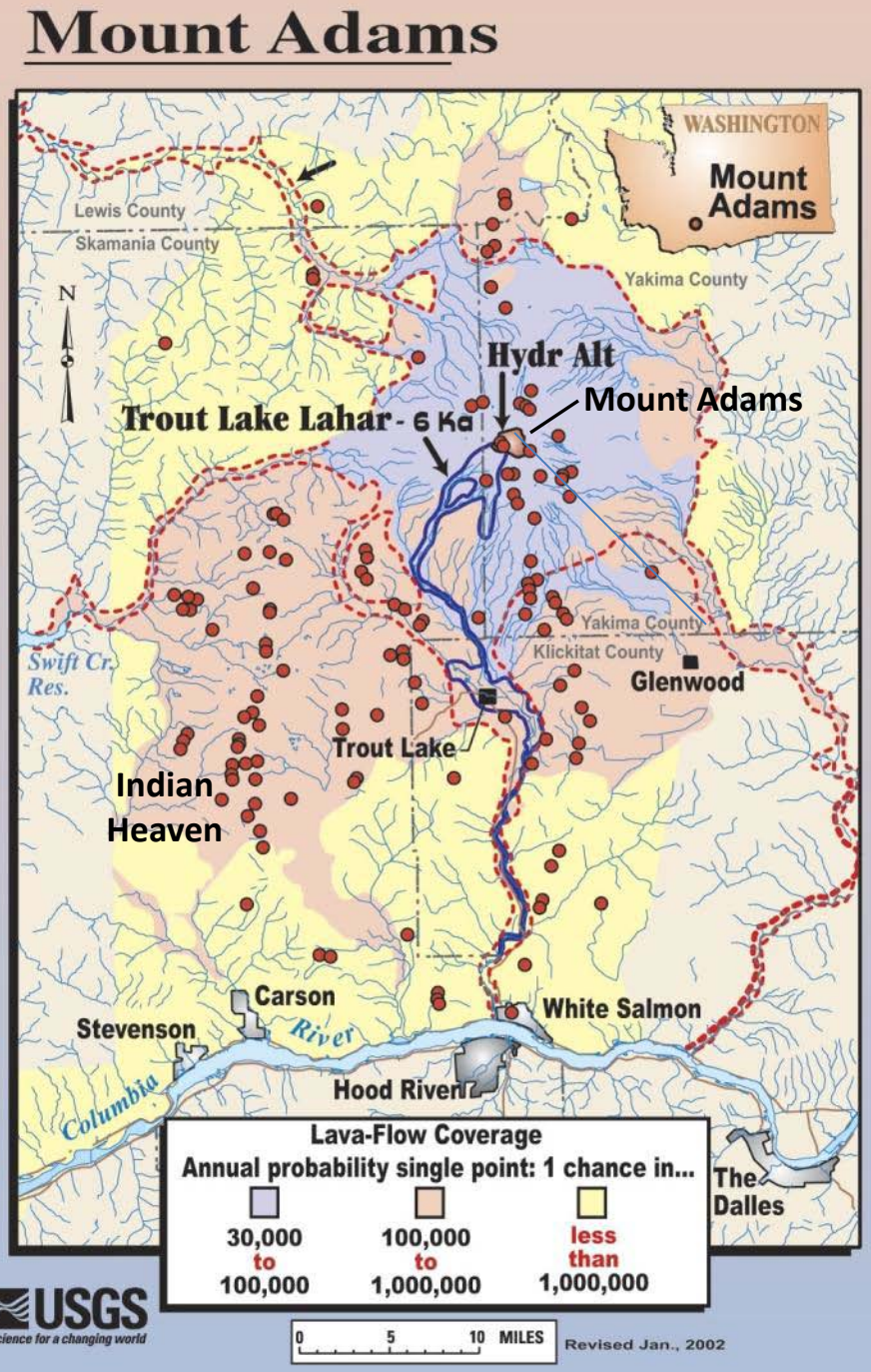
Large debris avalanches spawn large lahars



Largest ~100 million cubic yards; 6,000 years ago



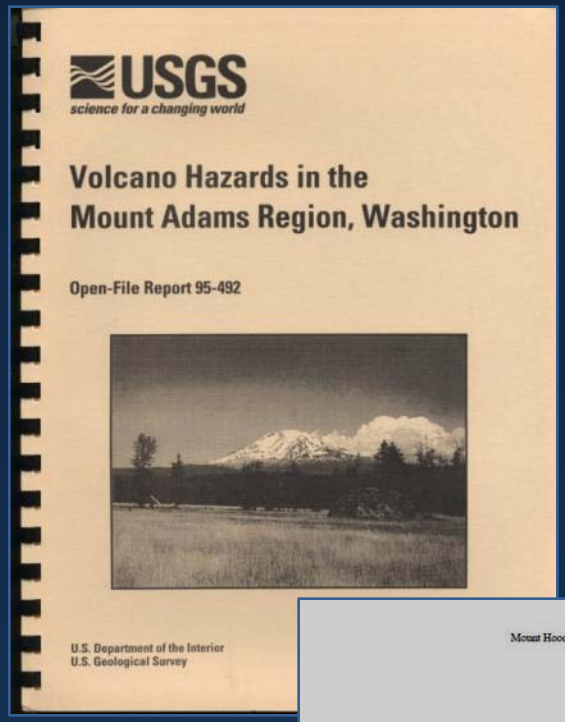
Probability of larger-volume avalanches increases during time of unrest or eruption, but how large is possible during quiet times?

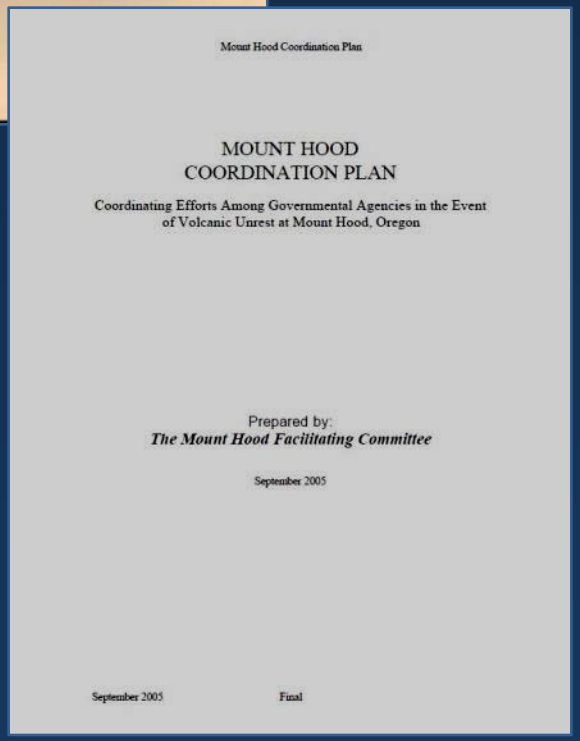


Volcano-Hazard Map

- Adams long-lived, recurrently active
  - Past 500,000 years
- Chief hazards
  - Debris avalanches, lahars and floods (red-dashed lines)
  - Lava flows (blue area) and tephra
- Fields of short-lived volcanoes such as Indian Heaven
- Chief hazards
  - Lava flows (pink and yellow areas) and tephra

Hazard Assessment and Coordination Planning





[http://vulcan.wr.usgs.gov/Volcanoes/Adams/Hazards/OFR95-492/framework.html; also includes link to digital data]

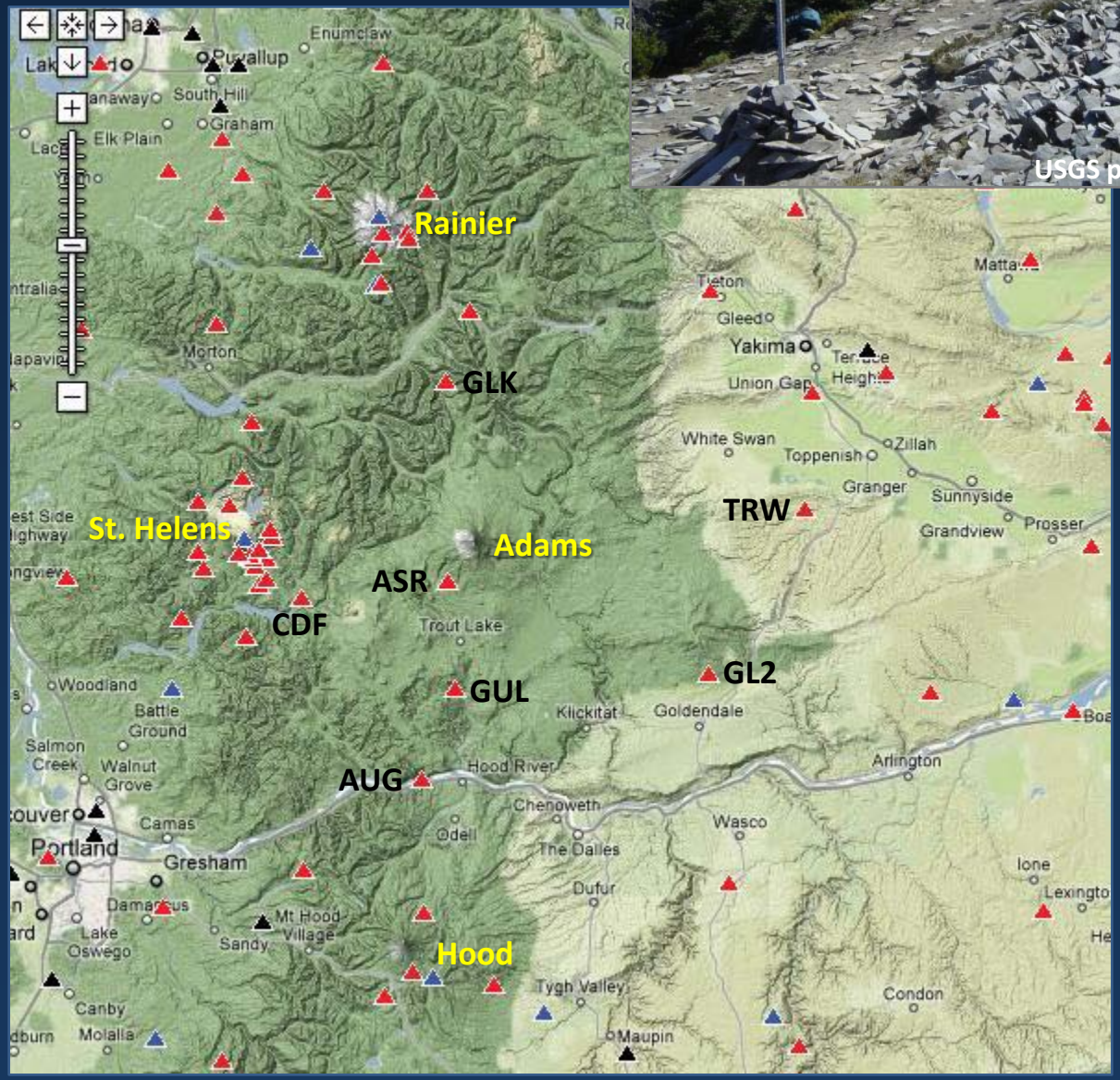
Multi-agency coordination planning underway for St. Helens-Adams region

WS-EMD and DNR, GPNF, Yakama Nation, USGS, counties, FEMA

USGS

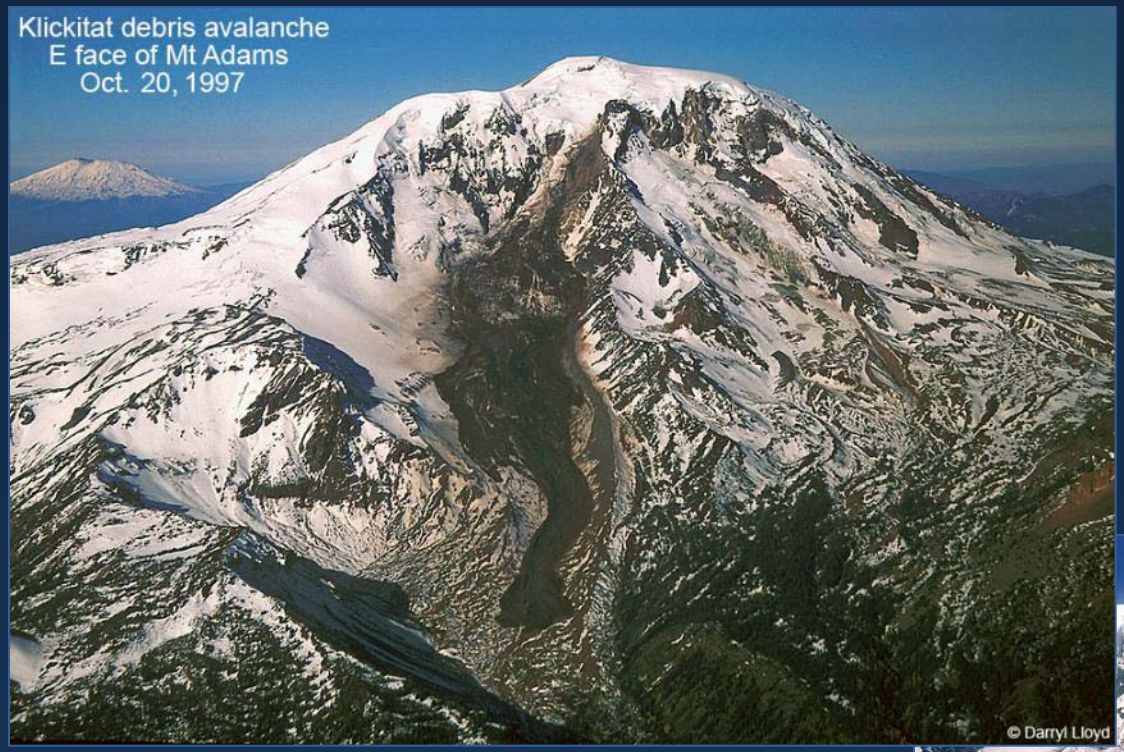
Volcano Monitoring

Pacific Northwest Seismic Network

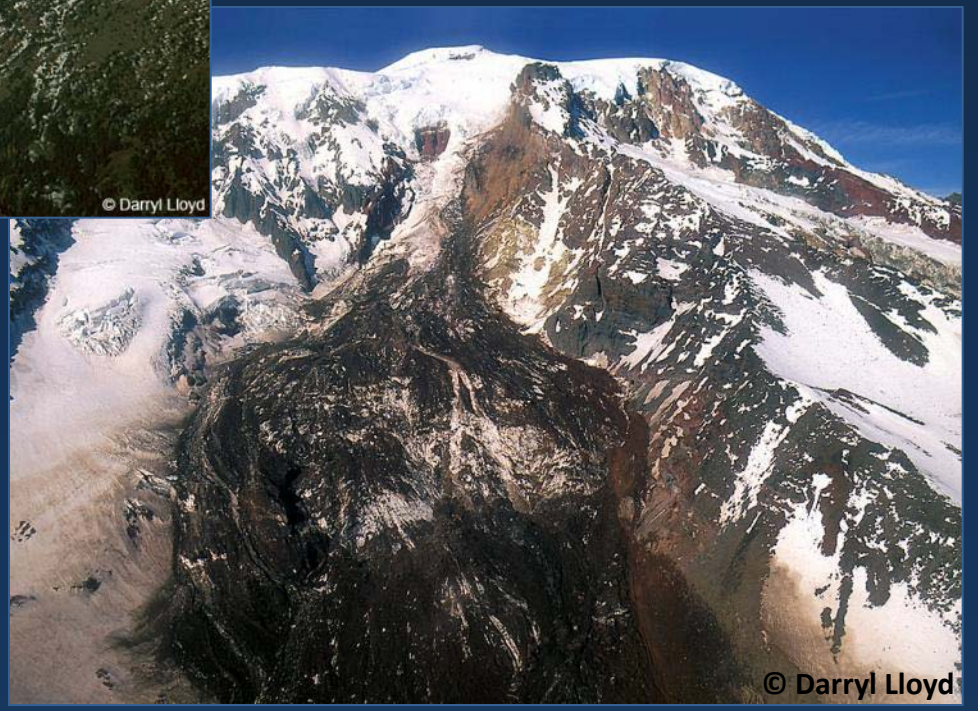


- Volcanoes require dense seismic networks to locate small events
- Adams not well monitored
- Continuous GPS stations for real-time monitoring of ground deformation
- USGS proposal to upgrade volcano monitoring in US and Territories

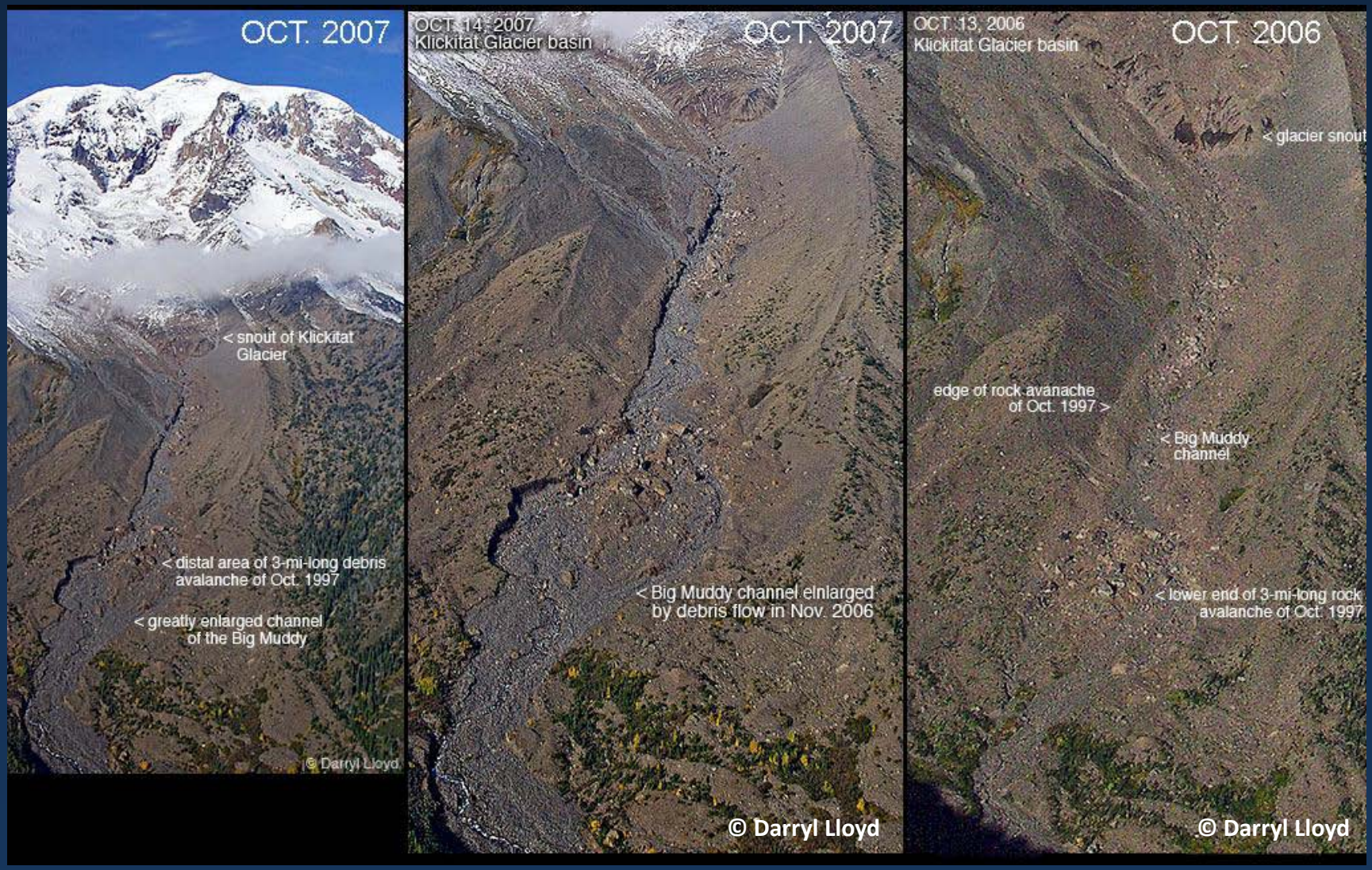
An almost unlimited sediment source:



- Steep, locally weakened, upper flanks subject to rockfalls and avalanches
- Since 1921, range in volume up to 5 million cubic yards

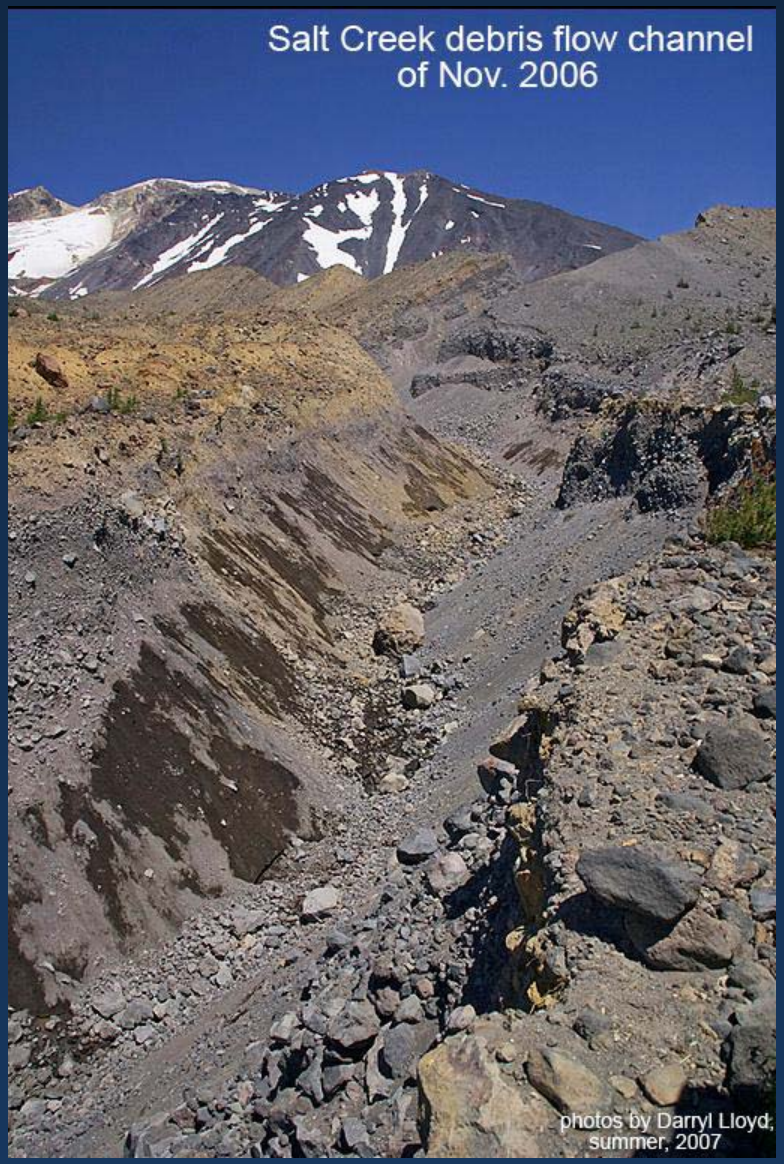


Floods and debris flows generated by heavy rainfall (11/06) and major rain-on-snow events; also glacier outbursts



Upper channels incised by water floods, entrain debris, become debris flows; or begin as landslides

Deposition in lower reaches; fans and channel fills; creation of new channels



Both environments remain potential sediment sources between main events

Fall Chinook Mortality from High Sediment Concentration in Klickitat River

Nov 2006

Oct 2003

- Kills (dozens to few hundred fish) every few years in Oct-Nov
- High sediment concentration; modest increase in flow
- Many originate at Adams; others in eastern tributaries
- Rain, rain-on-snow, landslides

Joe Zendt and Bill Sharp, YKFP

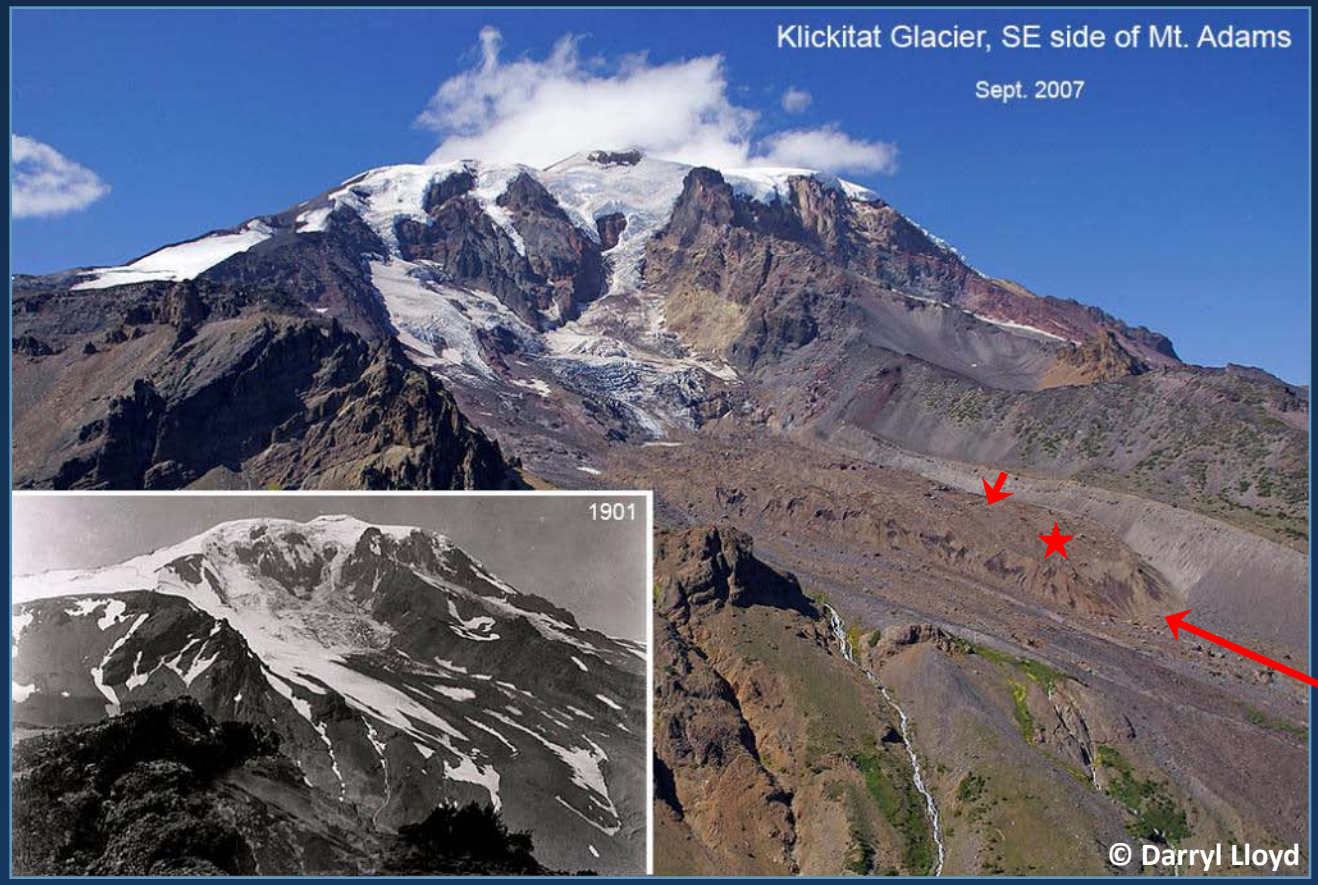
What are effects of retreating glaciers on sediment budget?

Retreat/thin for past ~200 years

Exposes debris

Creates debris-covered snouts ★

Exposes cliffs



Other climate-change possibilities:

- Increased intensity or frequency of autumn rainstorms?
- Less effective snowpack "sponge"?

More questions than answers, but high sediment yields are going to continue to be an issue on Klickitat and White Salmon

Mount Rainier as Analog?

Streams within Mount Rainier NP

- Most channels are aggrading
- Recent average rate up to ten times historical rate; may be decreasing

MRNP staff

Channels downstream from Mount Rainier National Park

- Some aggrading, some incising, some not changing
- Role of changing glacier and climate conditions???

USGS, Wash. Water Sci. Ctr

Conclusions

- Complex channel responses in space and time
- Effects of levees, development?
- Similar processes as in past
- Role of changing glacier and climate conditions uncertain

Summary

- Potential hazards from Mount Adams and surrounding volcanic fields [http://vulcan.wr.usgs.gov/Volcanoes/Adams/Hazards/OFR95-492/framework.html; also includes link to digital data]
  - Lava flows and ashfalls
  - Adams' lahars are greatest potential threat
  - Debris avalanches from weakened summit rocks (esp. White Salmon)
- Region warrants enhanced volcano monitoring

- High sediment fluxes and debris flows are expectable
- What will be watershed response to ongoing environmental changes? Ripe research topic

USGS