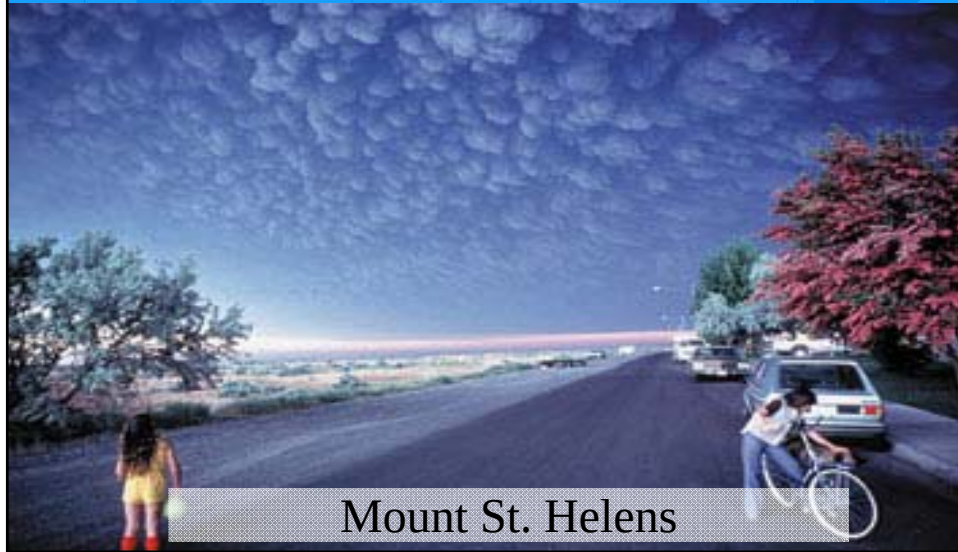


EASC 421 - Volcanology



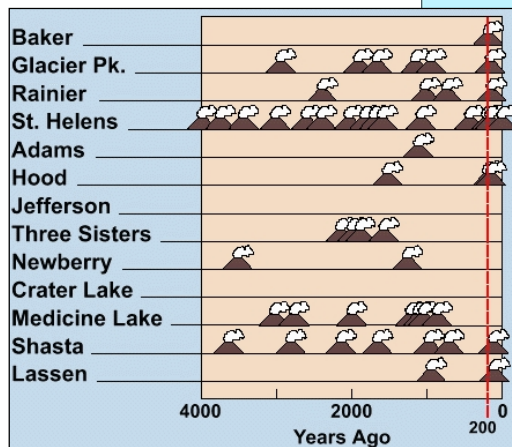
Mount St. Helens



Cascades Volcanoes

EASC 421

- ✦ Most active Cascade Arc volcano in past 4000 years

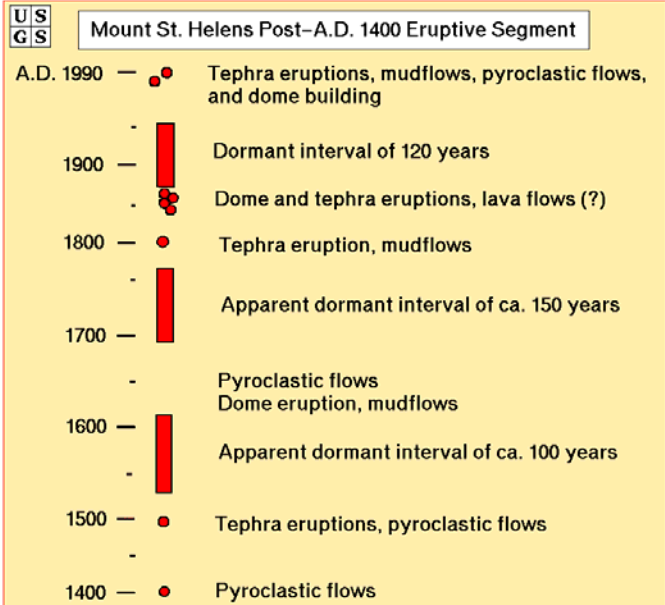




Previous eruptions of Mt. St. Helens

EASC 421

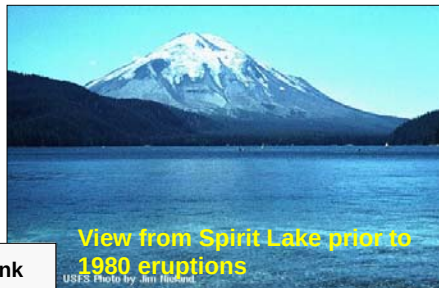
- From previous activity, was a fairly high probability that it would again erupt before the millenium



1980 Eruption

EASC 421

- Before 1980, Mt. St. Helens was 2930 m in elev.
- In early 1980, after a few small ash eruptions
 - distinct bulge began to develop on north flank



- May 1980 mountain covered with thin layer of ash and small crater formed

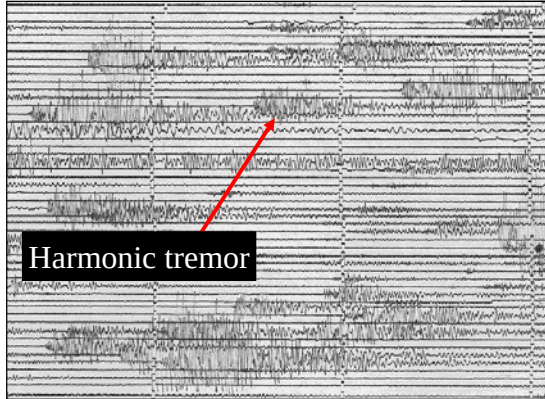


Stage 1: Precursory activity 20 Mar.-18 May EASC 421

- ✦ First phreatic eruption occurred on 27 March 1980
- ✦ Explosions continued...
- ✦ Eruptions of 13, 18 April consisted of steam and ash



30 March 1980 eruption



- ✦ M4.1 earthquake recorded on 20 March
- ✦ 1 April, harmonic tremor observed
 - ✦ continuous seismic signal of similar wavelength



Precursory activity: Deformation-Bulge! EASC 421

10 April 1980

17 May 1980



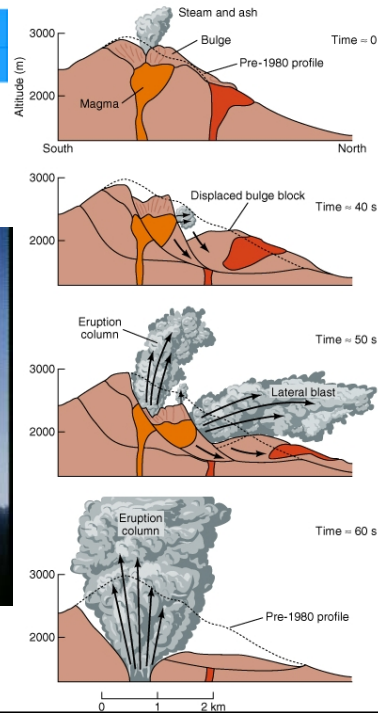
- ✦ The bulge first detected on the NNE flank on 19 April 1980
- ✦ Deformation was as high as 5 feet/day !
- ✦ Indication of magma movement into volcano edifice
- ✦ Simultaneously, eruptive activity decreased during 14-23 April
- ✦ Very little SO_2 detected – sealing and pressure build up!



Stage 2: Climactic eruption

0832 local time

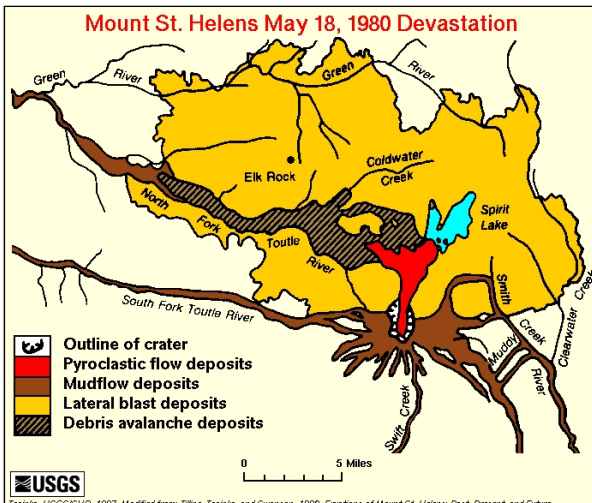
- initial blast
- M 5.1 EQ at ~ 1.5 km depth



Sector collapse & debris avalanche

EASC 421

Mount St. Helens May 18, 1980 Devastation



- 2.8 km³ (uncompacted)
- Buried N. Fork Toutle River to avg. depth of 46 m (max. 180 m)
- 110 – 240 km/hr



Debris avalanche deposit

EASC 421

looking upstream toward volcano



USGS Photo by Lyn Topinka, August 12, 1985



Before & After

EASC 421

✦ May 17 1980: 2950 m elevation



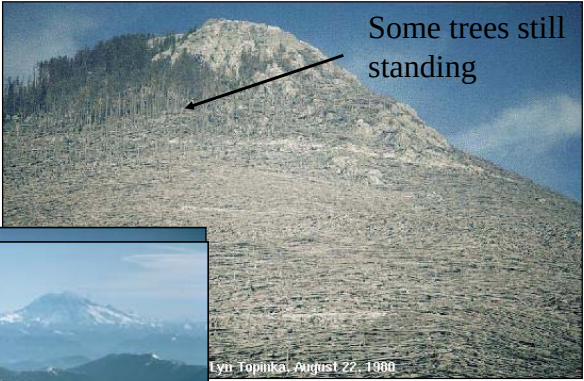




The lateral blast

EASC 421

- ✦ The lateral blast was +/- cool (100-300°C)
- ✦ Speed up to 500 km/hr
- ✦ 0.2 km³ (uncompacted)
- ✦ 24 MT thermal energy



Some trees still standing

Lynn Topinka, August 22, 1980



- ✦ Devastated very large area (180°, up to 20 km dist.)
- ✦ Tree blow down enough to build 300,000 log cabins



Evacuation: Most except Harry Truman EASC 421



Harry Truman & his 16 cats. The 83-year-old operated a lucrative lodge on Spirit Lake. "I think the whole damn thing is over exaggerated... Spirit Lake and Mount St. Helens are my life... You couldn't pull me out with a mule team."

57 people killed: geologists & people who violated evacuation order



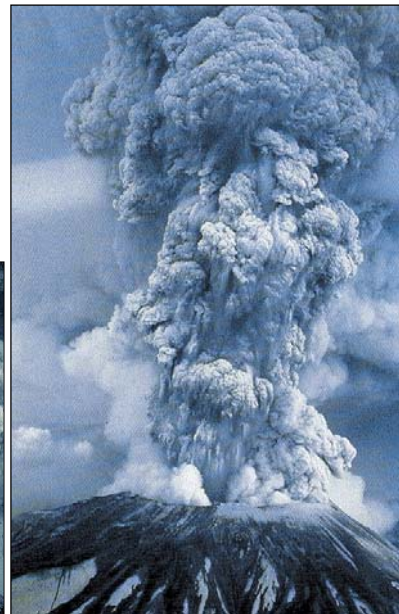
Eruption Column EASC 421

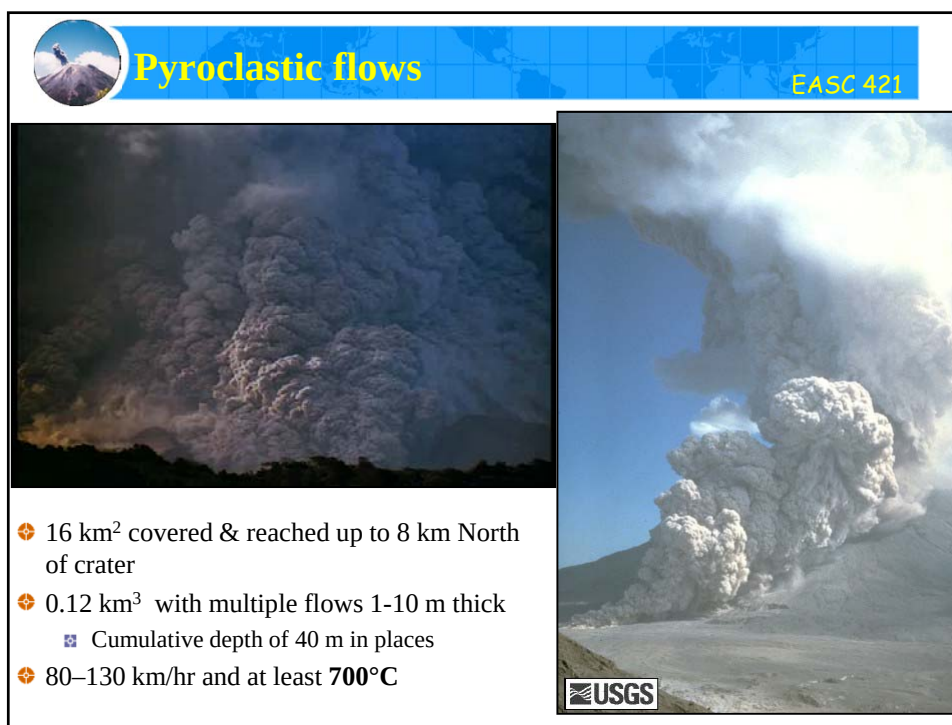
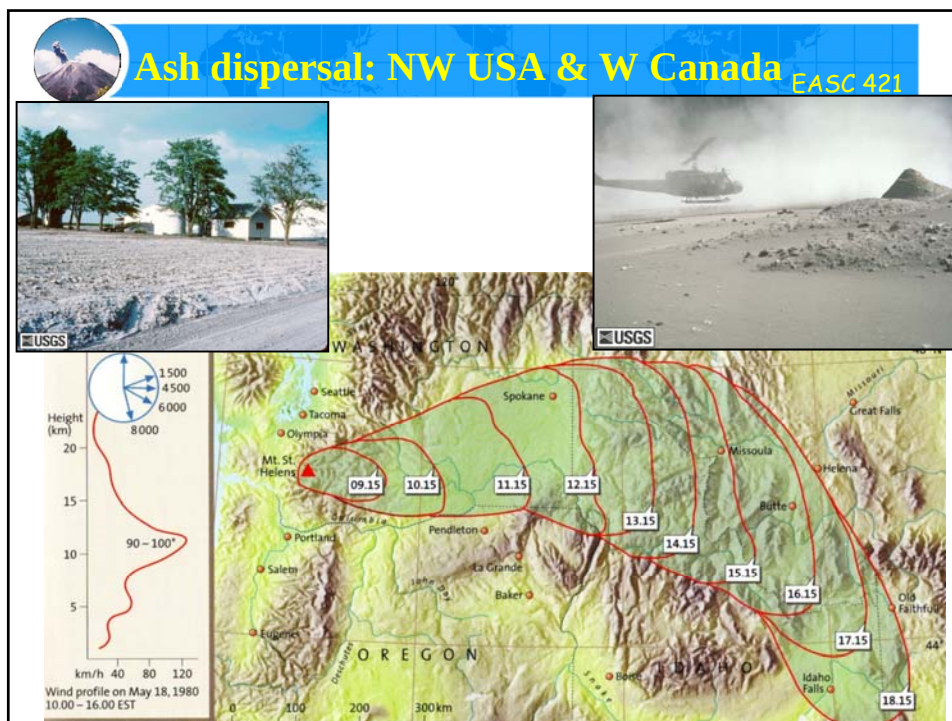
- ✦ 24 km high in less than 15 min,
- ✦ Across US in 3 days, circled the globe in 15 days
- ✦ 1,083,700,000 m³ of ash (~1 km³)
- ✦ 25 cm thick at 16 km; 2.5 cm at 96 km; ~1 cm at 483 km downwind
 - ✦ detectable levels over 57,000 km²



USGS

USGS Photo by D.A. Swanson, May 18, 1980







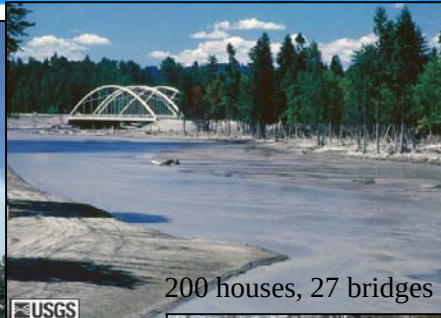
Lahars

EASC 421



USGS

\$ 2.7 billion US damage



USGS

200 houses, 27 bridges

- ✦ 15-40 km/h
- ✦ 300 km of road & highway
- ✦ 24 km of railway
- ✦ Reduced depth of Columbia R. from 12 to 4 m
- ✦ Stranded 31 ships

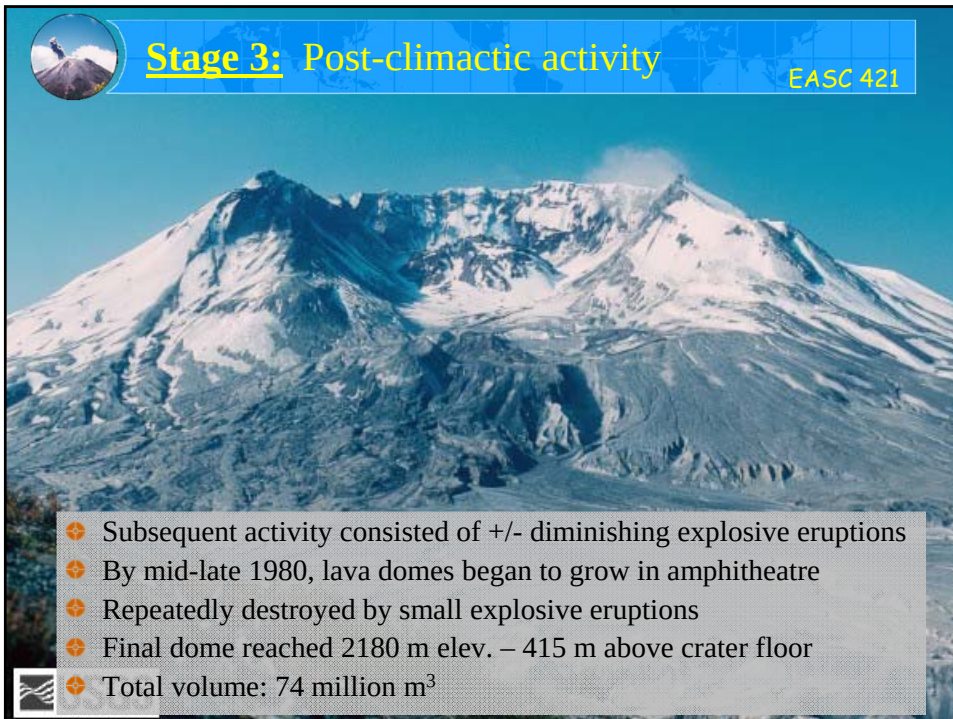


USGS



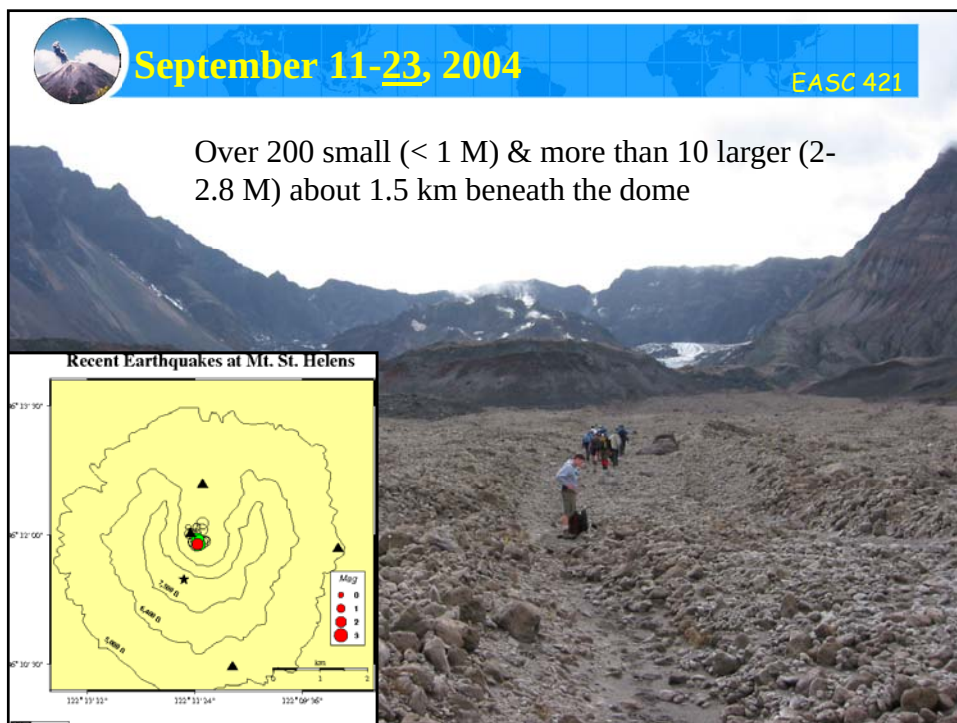
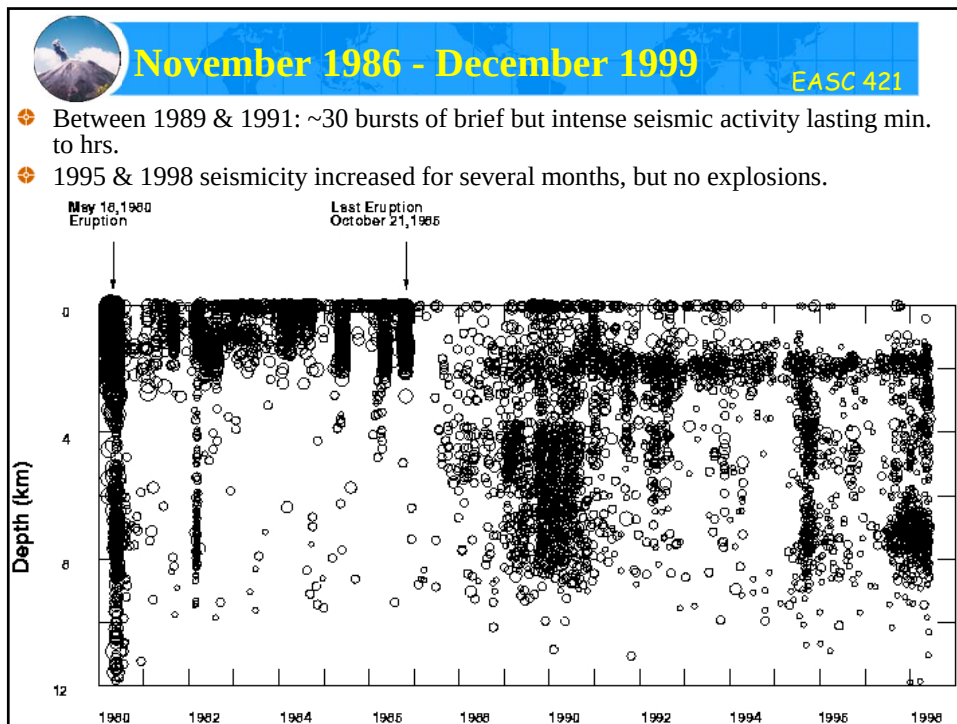
Stage 3: Post-climactic activity

EASC 421



- ✦ Subsequent activity consisted of +/- diminishing explosive eruptions
- ✦ By mid-late 1980, lava domes began to grow in amphitheatre
- ✦ Repeatedly destroyed by small explosive eruptions
- ✦ Final dome reached 2180 m elev. – 415 m above crater floor
- ✦ Total volume: 74 million m³



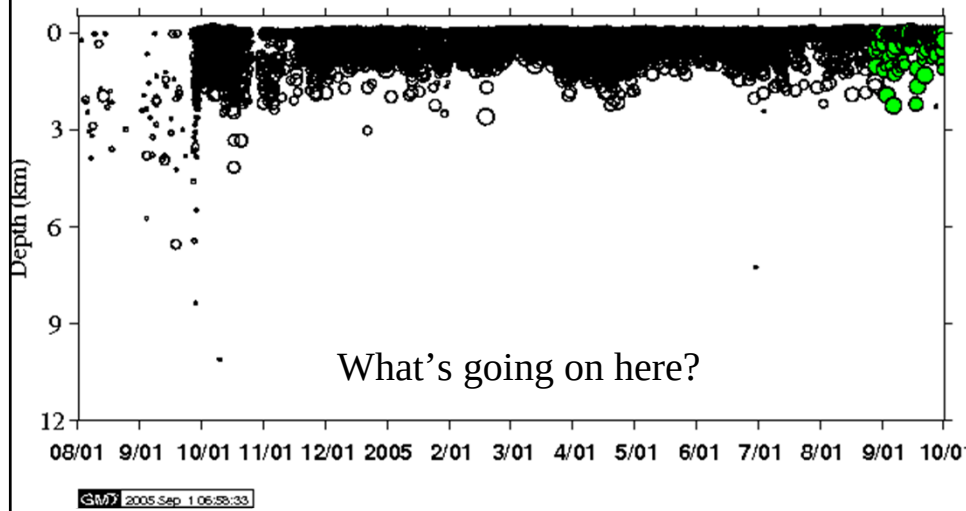




Recent Seismicity

EASC 421

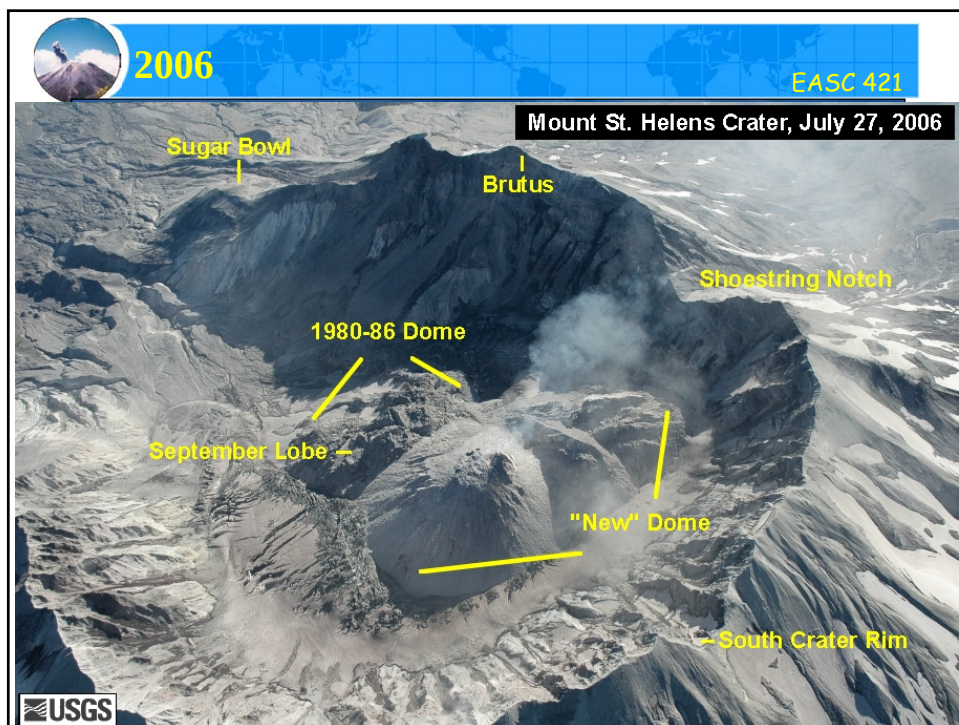
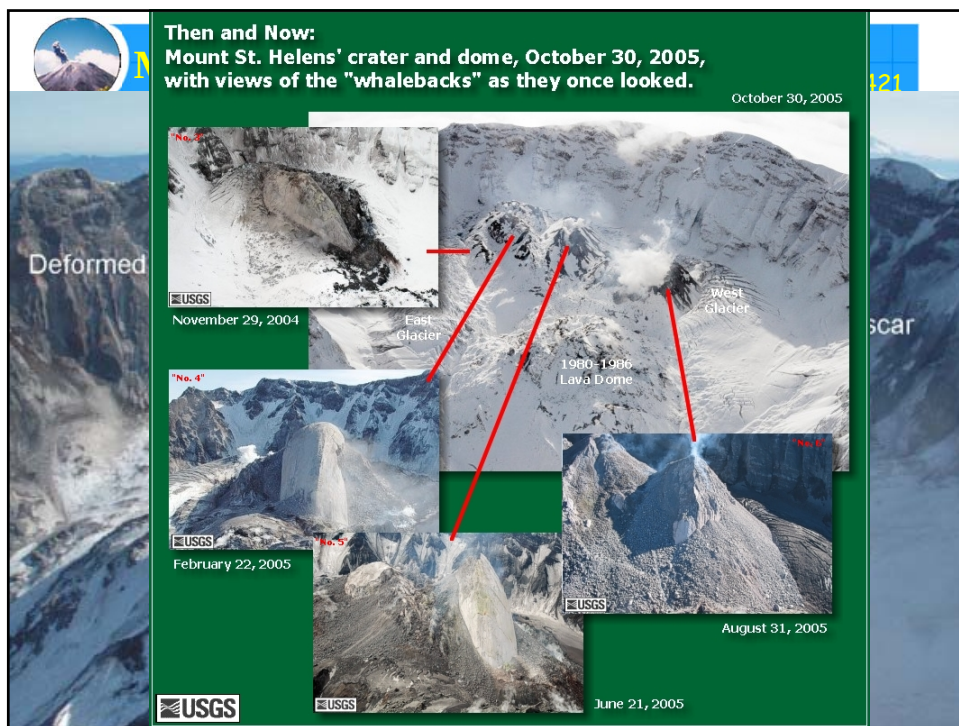
Mt. St. Helens Seismicity, 08/01/04 - 09/01/05

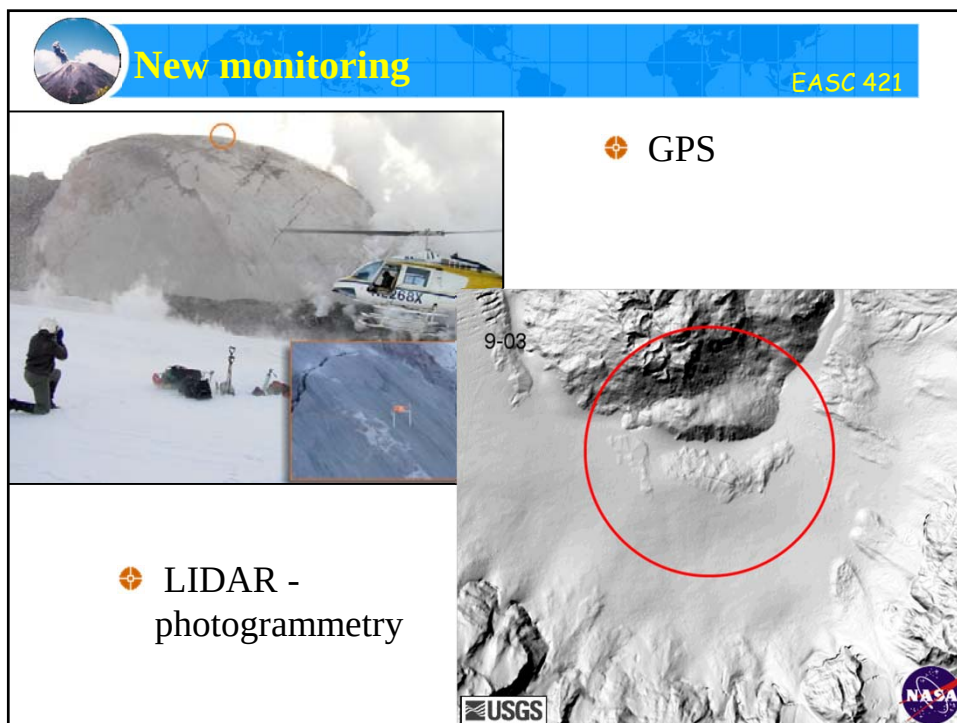
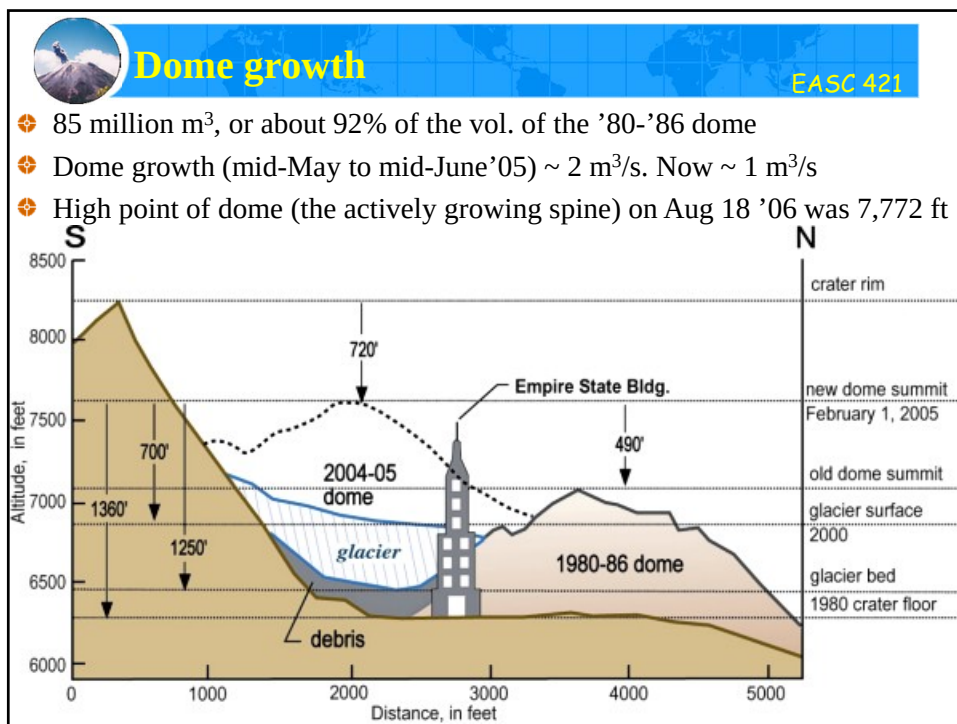


October 2004

EASC 421









New monitoring

EASC 421



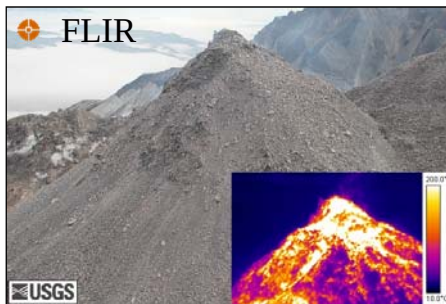
AFM



FLYSPEC



FLIR



Current Hazards

EASC 421

Mount St. Helens

- Hazard zone 1**
Area vulnerable to passage of high-concentration (high density) flows, including pyroclastic flows, lava flows, and proximal parts of lahars.
- Hazard zone 2**
Area vulnerable to pyroclastic surges (low-density) flows.
- Hazard zone 3**
Intermediate and lower reaches of valley that could be inundated by lahars.

Hazard zonation map for Mount St. Helens. Map modified from Wolfe and Pierson, 1995; U.S. Geological Survey Open-File Report 95-497.

