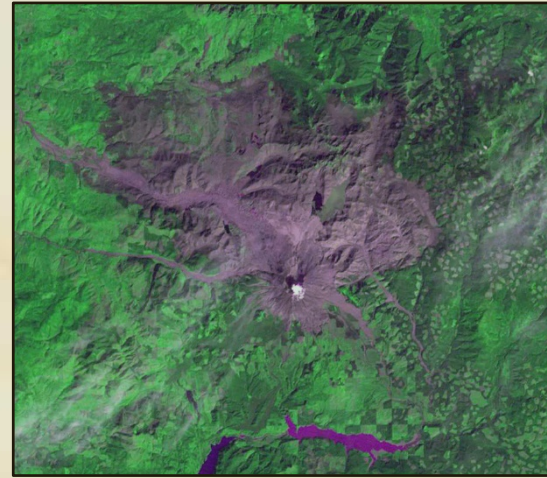


# Mount Saint Helens

Environmental Analysis (1979-2015)



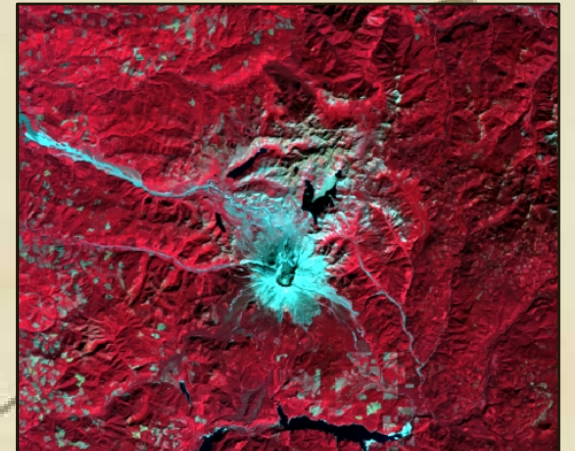
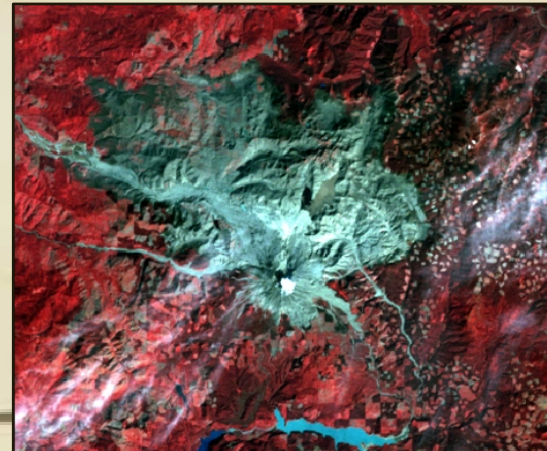
1979



1980



2015



# Mount Saint Helens

## Pre-eruption Environment

- Stratovolcano located in the Pacific Northwest
- Part of the Cascade Mountain Range
- Immersed in heavy tree canopy (boreal forest system)
- Dominated by old-growth Douglas Fir, Western & Mountain Hemlock, and Pacific Silver Fir
- Lake and river systems common throughout the area

1979

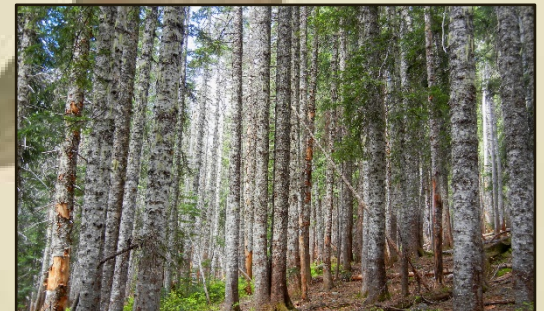
1979 Landsat 1



Douglas Fir



Pacific Silver Fir



# Mount Saint Helens

## Catastrophic Eruption

- May 18, 1980 – successive 5.0 & 5.1 earthquakes
- Collapse of north face into a horseshoe crater
- Created largest known debris avalanche in recorded history at the time
- Pressure in upper magma chamber rapidly decreases and results in a catastrophic explosion
- Volcanic Explosivity Index of 5
- 24 megatons of thermal energy released
- Debris avalanches & pyroclastic flow cause over 230 square miles of destruction
- Volcanic ash reaches altitudes of 80,000 feet in 15 minutes and circles the Earth in 15 days



1980

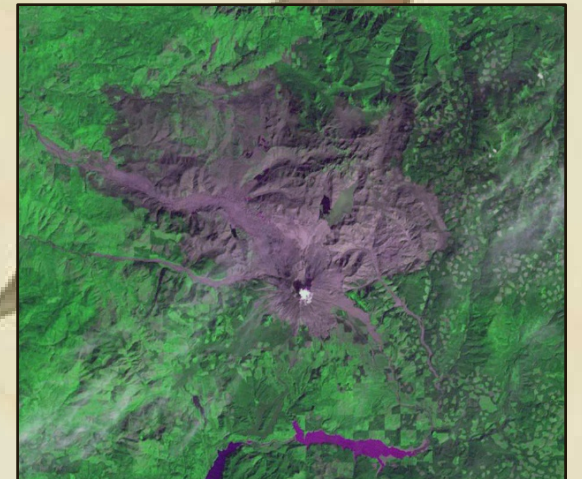
VEI	Ejecta	Classification	Description	Plume	Frequency	Troposphere	Stratosphere	Eruptions
<span style="border: 1px solid black; padding: 2px;">5</span>	> 1 km <sup>3</sup>	Peléan/Plinian	Paroxysmic	> 10 km (Plinian)	≥ 10 yrs	substantial	significant	<a href="#">Vesuvius (79)</a> , <a href="#">Fuji (1707)</a> , <a href="#">Mount Tarawera (1886)</a> , <a href="#">St. Helens (1980)</a> , <a href="#">Puyehue (2011)</a>

# Mount Saint Helens

## Destruction

- 230 square miles of impact
- Pyroclastic flow inflicts catastrophic damage on everything in its path.
- Massive flooding occurs as waterways are breached by avalanches
- 14 miles of North Fork Toutle River buried to an average of 150 feet with some places up to 600 feet
- 4 billion board feet of timber smashed down
- Free floating and built up heavy ash deposits create additional environmental damage

1980

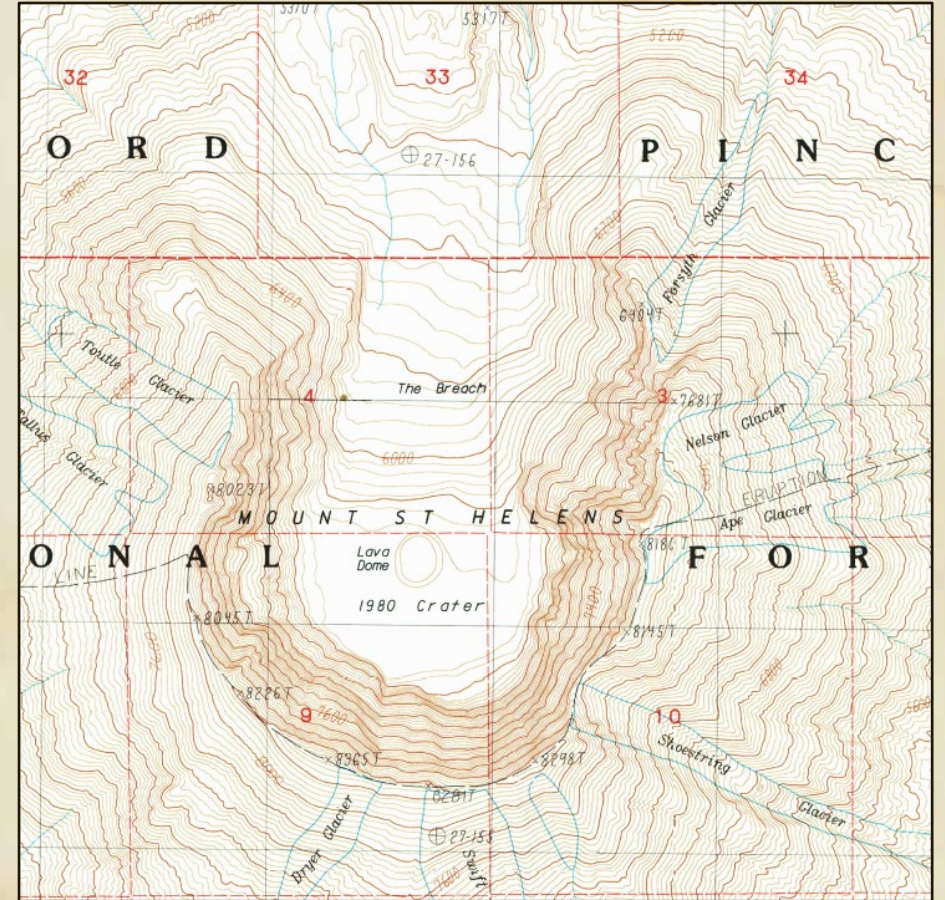


# Mount Saint Helens

## Topography

- Published USGS topographic map
- Compiled from aerial photography
- Shows collapse of north face
- Crater rim over 3,000 feet lower than pre-eruption summit
- Topography reveals lava/pyroclastic flow direction
- Lava dome present in collapsed crater

1983



**MOUNT ST. HELENS, WASH.**

**PROVISIONAL EDITION 1983**

**46122-B2-TF-024**

# Mount Saint Helens

## Subsequent Eruptions

- Several low level eruptions & magmatic bulging
- Recorded by USGS time lapse photography
- Formation of Whaleback
- Taller than the Empire State Building
- Subsequent low level eruptions through 2008
- Eruptions declared over on July 10, 2008

2005-2008



# Mount Saint Helens

## Vegetation Recovery

- Pacific Silver Firs bent over but survive with intact root systems
- Huckleberry & Salmonberry survive blast in snow covered isolated pockets behind steep ridges
- Various plant types cling to and survive on soil clumps attached to root systems of overturned trees
- Weedy plants such as Fireweed & Pearly Everlasting most common survivor which first sprout from original soil surfaces in clear cut areas
- Prairie Lupines (a plant that extracts nitrogen directly from the atmosphere) reappear on volcanic deposits and eventually become part of the base of pockets of soil that begin to appear.
- Northwest Quadrant first to recover (late 1980s)
- Area east of Spirit Lake makes significant recovery (late 1990s)
- Pumice Plain only area left that remains without significant recovery (2014)
- Prairie Lupine process currently in progress at Pumice Plain

1980-2015

1980



2015



Prairie Lupine



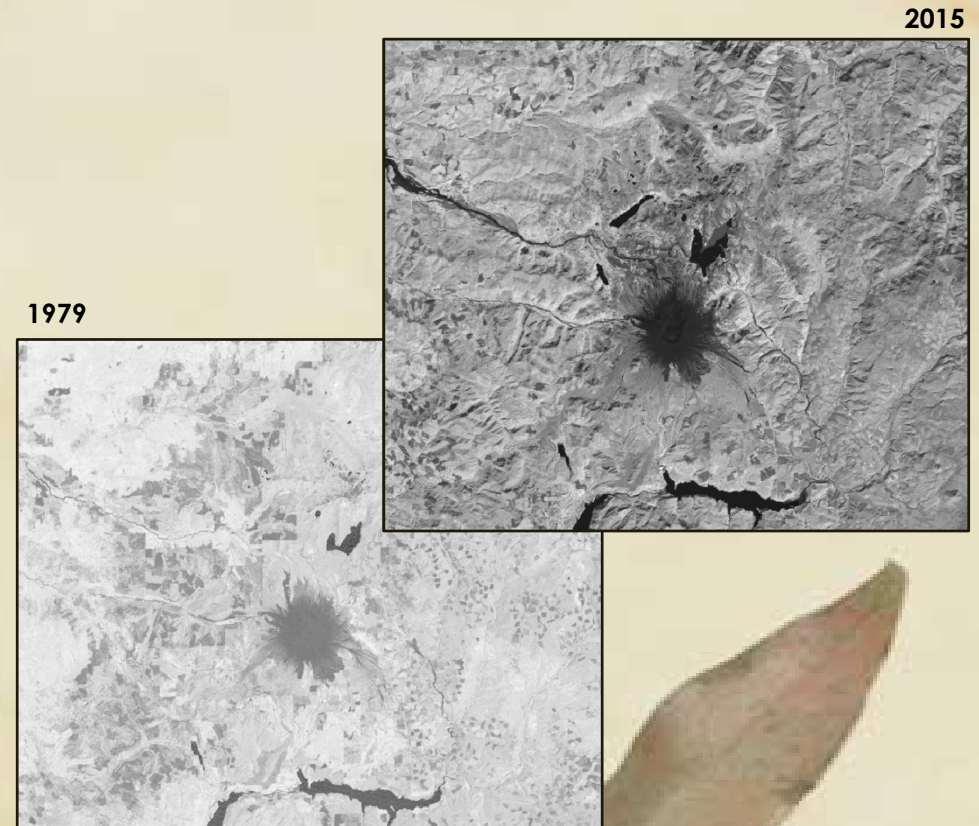
# Mount Saint Helens

## Normalized Difference Vegetation Index

$$\text{NDVI} = \frac{(\text{NIR} - \text{VIS})}{(\text{NIR} + \text{VIS})}$$

- Threshold determination (critical)
- Spatial resolutions
- Bit depths
- Band layer arrangements
- Temporal resolutions
- Cloud & suspended ash cover

1979-2015



1979 > 0.46  
2015 > 0.30

Year	Value Total	Value Max	Histogram Total	Value Total	Value Max	Histogram Total
1979	-9.68	0.77	2,926,773	30.30	0.77	1,808,141
2015	61.05	0.59	2,940,232	47.36	0.59	1,610,106



# Mount Saint Helens

## Analysis

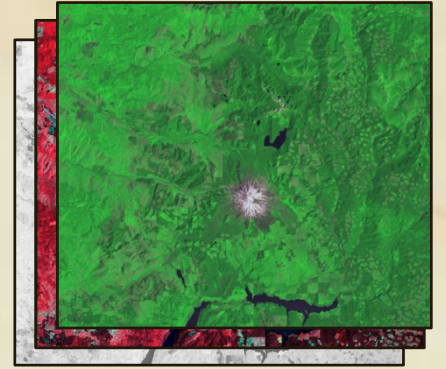
Mount Saint Helens is a stratovolcano surrounded by a boreal forest system that has a known scientific history of explosive eruptions and recoveries. Prior to the 1980 eruption, the vegetative environment surrounding Mount Saint Helens was heavy and thriving. After the explosion, over 230 square miles of forested land was decimated yet some plant populations were able to survive this event and start the recovery process. Plant species that are adept to survival such as the Prairie Lupine and Fireweed also aided in this process by providing organic footholds on barren rough terrain.

The volcanic debris that was ejected is now in the process of becoming an underbed for a layer of soil created in part by the decaying of new growth vegetation. It is this foundation that is stimulating a fast and steady recovery process. The only area left that has not shown significant improvement is Pumice Plain (heaviest deposits). However, field analysis has shown that Prairie Lupine is now present in that area and so, it is most likely just a matter of time until Pumice Plain returns to its pre-1980 state.

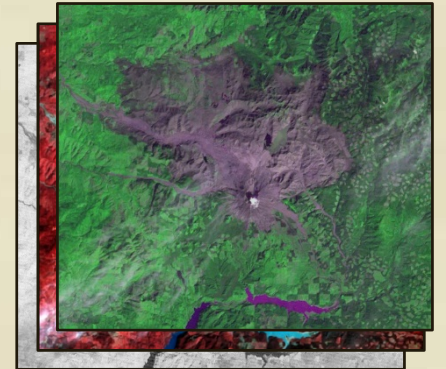
Current visible and infrared imagery analysis indicates that dense vegetation has returned to the Mount Saint Helens area but still has less overall coverage than 1979. The NDVI calculation results supports this conclusion.

2015

1979



1980



2015

