Mt St Helens, USA, 1980

"Vancouver, Vancouver, this is the big one!" Such were the last words spoken by geologist David Johnston of the United States Geological Survey as he radioed his headquarters in Vancouver, a city on the Columbia River in Washington. His transmission came in at 8:32 a.m. on May 18, 1980.

ABOVE By May 23, 1980, the devastation was apparent—this ash-covered truck, and pine trees felled and stripped bare of their branches, were caught in the massive blast and pyroclastic surge from the 1980 eruption. Enough trees to build 300 new homes were destroyed.

RIGHT A Plinian column of hot ash and gas erupted skyward from the summit on May 18, 1980. The eruption was triggered by an earthquake which set off landslides on the mountain's northern face. The eruption sent masses of material surging into the valleys and rivers below.

Johnston, who was camped on Coldwater Ridge just a few miles from Mt St Helens, was witnessing the collapse of the entire north face of the volcano. The swollen and over-steepened north flank had been destabilized by a magnitude 5.1 earthquake. The giant avalanche, traveling at over 150 miles per hour (240 km/h), was immediately followed, and rapidly overtaken, by a massive explosion of escaping gas moving at about 300 miles per hour (480 km/h). Moments later, his transmission was cut. Johnston was completely obliterated by a menacing gray wall of hot gas, ash, rocks, and other debris.

Photographers face death

Geologists Keith and Dorothy Stoffel were in a light aircraft directly above the summit when the eruption took place. Running out of film probably saved their lives. They managed to dive steeply and swing their plane to the south, narrowly missing the rapidly rising vertical cloud column.

Elsewhere on the mountain, photographer Robert Landsberg also realized that there was no escape from the ground-hugging cloud flattening everything in its path. He continued to shoot the approaching cloud until the last moment. Just before the end, he quickly rewound the film into its canister in the camera, returned the camera to its case, placed it in his backpack together with his wallet, and then lay on top to protect the film. Seventeen days later, the backpack and his body were recovered from the ash. Landsberg's heroic actions have left a photographic legacy so that future generations of geologists can study volcanic processes first hand.

Mt St Helens volcano in Washington State forms part of the Cascade Mountain Range. It is one of a chain of hundreds of active volcanoes that line the edge of the Pacific Plate. This circum-Pacific belt of intense volcanic and earthquake activity is aptly named the Pacific "Ring of Fire." Its volcanoes are constantly being destroyed and rebuilt by rising molten material called magma that is generated as the oceanic plates of the Pacific are forced beneath the continental North American Plate.

Youngest, most active major volcano

Louwala-Clough or smoking peak was the name for Mt St Helens used by the Native Americans of the Pacific Northwest. Its visible cone has grown up entirely within the last 2,200 years and the oldest volcanic ash deposits date back only 40,000 years, which makes it the youngest major volcano in the Cascade Range. As such, Mt St Helens' slopes are smooth and symmetrical compared with its older, glacially scarred, neighbors—Mt Rainier, Mt Adams, and Mt Hood. The volcano was intermittently active in the mid-nineteenth century between 1831 and 1857, but apart from some minor steam explosions, it had not been a hazard since that time.

As such, to the twentieth-century residents of the area, Mt St Helens was a serene, graceful, conical peak known as the Mt Fuji of America. Visitors came by the thousands, lured by the mountain's reputation for tranquility, to fish and swim in the clear water lakes, or hike and camp on its forested slopes. However, all of that changed in May 1980 when the upper 1,300 feet (397 m) of the mountain's summit was blown away, leaving a 1⅕ mile by 2 mile (2 km by 3.5 km) horseshoe-shaped crater.

The sudden pressure release due to the avalanche allowed the superheated groundwater around the volcano's magma chamber to flash to steam. It blasted laterally northward, out of the avalanche scar, and formed a hot, destructive, ground-hugging, gas-charged mixture of ash and debris. Immediately north of the volcano a once-productive coniferous

FACTS AND FIGURES

DATE	May 18, 1980
LOCATION	Washington State, USA
DEATH TOLL	57
DAMAGE	Destruction included 153,000 acres (61,965 ha) of forest, 200 houses and cabins, 185 miles (300 km) of highways and roads, 15 miles (24 km) of railroad, and 27 bridges
VOLCANIC EXPLOSIVITY INDEX	5
ERUPTION TYPE	Plinian
COLUMN HEIGHT	16 miles (26 km)
MATERIAL EJECTED	⅓ cubic miles (1.2 km^3)
COMMENTS	Duration of eruption: 9 hours

The Blizzard of 2003, USA

The two-part President's Day Storm of 2003 pounded the United States' midwestern and southern regions for days, reaching the east coast on February 15 with light snowfalls. The second part hit the northeast with the fury of a blizzard on February 16, soon becoming a deadly nor'easter with whiteout conditions, terrifying snowstorms, and dangerous wind chills.

Record snowfalls across the seaboard paralyzed major cities, and buried most of the United States northeastern states in snowfalls from 1.5 to 4 feet (30 cm to 1.2 m). Gale-force winds blew the snow into high drifts, effectively shutting down coastal transportation. The blizzard caused 44 deaths, cost over US$65 million in repair and snow removal, and over US$1 billion in other damages.

By February 10 there were warnings that a major snow event would occur by the weekend, and that this would be brought in by two successive storm fronts. On February 14, the initial storm front began in the Rocky Mountains, causing heavy rain, snow, and freezing across the country. Iowa had approximately 11 inches (28 cm) of snowfall, and ice storms froze and shutdown Kentucky.

Snow started falling in Washington DC, Virginia, and Maryland on February 15. A low-pressure front formed in the Carolinas as the storm slowly climbed northward, creating very heavy precipitation from Tennessee to West Virginia. Overnight, the low front was impacted by a cold mass of air coming down from Canada, and just before dawn on February 16, heavy snow began falling at a rate of approximately 2 inches (5 cm) per hour across the DC metropolitan region. Over the next five hours, Washington DC became blanketed in almost a foot of snow.

Fueled by the cold air mass, the storm built up momentum quickly, dropping record amounts of snow. It fell up to 4 inches (10.2 cm) per hour as the storm headed into Philadelphia, with temperatures dropping to 15°F (-10°C).

FACTS AND FIGURES

DATE	February 14 to 18, 2003
LOCATION	US northeast, midwest, and south from Tennessee through to Nebraska and from Maine to West Virginia
DEATH TOLL	44
DAMAGE	More than US$1.5 billion
WINDSPEED	60 mph (97 km/h)
RAIN/SNOW	16 to 40 inches (41 to 102 cm) of snow
COMMENTS	Even with the storm's passing, the conditions throughout the eastern seaboard remained dangerous. Travel conditions and transportation remained treacherous for days. Heavy equipment and manpower were in high demand.

The second storm strikes

By evening on February 16, the snow had become sleet and freezing rain in Delaware's south, and a state of emergency had been declared for Virginia, Pennsylvania, Maryland, and Delaware. Overnight, another low-pressure system off the Virginia coast, moving northeast, upgraded the storm to a nor'easter, and it struck New York and New England on the morning of February 17.

Snow stopped late that night in New York, but continued in Boston on February 18 before losing its intensity. Snowfalls ranged from around 16.7 inches (42 cm) at Reagan National Airport, Washington's fifth-highest amount on record, to 40 inches (102 cm) in Garrett County, Maryland. Boston had 27 inches (69 cm), while New York received 20 inches (51 cm), the fourth-highest total ever recorded in its weather history. With 27 inches (69 cm), Baltimore, Maryland had some its highest levels of snowfalls.

The State Department of Transportation of Rhode Island used its entire fleet of 400 snow-clearing vehicles to clear the roads for stranded commuters.

There were 44 fatalities across 13 states. In the state of Tennessee, a seven-year-old girl and her 12-year-old brother died after being swept away in a flooded stream. Four of the deaths in Maryland were also children, killed by carbon monoxide poisoning in snowbound cars. Major airports in Washington, Pennsylvania, and New York shut down and over 2,000 flights were cancelled. In Baltimore, the roof of the historic 1884 Baltimore and Ohio Railroad museum collapsed, destroying many of the valuable displays of railway artifacts. A roof collapsed at an Edison, New Jersey trade school, killing one man. The heavy snowfall and the extensive flooding from the melting of the snow caused structural damage across the affected regions.

The heavy snowfalls made driving near impossible (above). The residents of the US Northeast began digging out snowdrifts that were several feet high to clear the way for their cars (far left, above). Commuters frequently experienced vehicle breakdowns due to the severe conditions and many were forced to face the bitter outdoor conditions (far left, below).

WHAT IS A NOR'EASTER?

A nor'easter is a powerful storm that occurs in America between October and April, and has a counter-clockwise center of rotation like a hurricane, with winds from the northeast. Two elements create the necessary conditions—a warm low-pressure system from the Gulf Stream providing counter-clockwise winds, and a cold high-pressure system from Canada with a clockwise rotation. The warm air cutting up through the cold air creates an unstable front; the more disparate the temperatures, the faster and more violent the storm. A nor'easter brings immense dark storm clouds, heavy rain or snowfall, flooding, storm surges, and gale-force winds.

Europe, 2002

Several days of heavy rain resulted in massive flooding in several European countries in August 2002. Over 100 people were killed and tens of thousands were forced to evacuate. Damages ran into billions of euros. Old and historic buildings were ruined, and public transportation was severely disrupted.

ABOVE Residents of Prague in the Czech Republic adapt to life after the floods. Major structural damage was caused to buildings. Forty thousand people were evacuated from areas near the Vltava and Elbe rivers.

RIGHT People spent months cleaning up their businesses and properties after the flood. This man is emptying river silt, washed up on the promenade, back into the flood-swollen river.

What has been called a 100-year flood hit Europe starting around August 12, 2002. Storm fronts caused heavy rainfalls across the Italian, Bavarian, and Austrian Alps. The storms traveled across Bavaria and into the Czech Republic, causing massive flooding. The cities of Prague and Dresden sustained the bulk of the worst damage to buildings, infrastructure and transportation systems.

Evacuation of villages and cities

The storm's deluge soaked the Bohemian Forest, where the Elbe and Vltava rivers rise. The river surges caused massive rises in water levels through Austria and the Czech Republic as the rivers overflowed and the waterways expanded. In Northern Bohemia, Thuringia, and Saxony, several villages were swept away by the raging torrents of water. Saxony suffered nine casualties and nearly 20,000 people were evacuated by military and police.

At 4:00 a.m. on Wednesday, August 14, residents of Prague, in the Czech Republic, woke to find firemen banging on their doors and ordering them to evacuate. Streets full of people fleeing with bundles of possessions in their arms was a sight that had not been seen since World War II. Over 50,000 people were evacuated while firefighters and emergency volunteers rapidly built barriers to minimize flood damage. Despite this, approximately 9 feet (2.7 m) of water washed through the Karlin district near the Old Town, sweeping away the sandbag walls and damaging historic buildings. The violent flood and overflowing rivers tore down bridges, submerged roads and railway lines, and carried away all manner of possessions, from furniture to vehicles. The Metro, an underground rail system, was disrupted and damaged by flooding. Millions of euros' worth of damage was caused and thousands of people were left homeless. However, thanks to efficient warning systems, much of the historic and culturally important art in the city was moved to higher ground long before the floods arrived.

Dresden, Germany was also forced to conduct massive evacuations. Over a quarter of the city's 480,000-strong population fled from the rising flood waters. The Elbe River surpassed a record high of 30 feet (9 m) on August 16, according to the Dresden Emergency Centre. As in Prague, numerous buildings were damaged as the floodwaters breached emergency retaining walls, forcing the rescuers to retreat further. The Zwinger Palace and neighboring Semper Opera opera house were also flooded. Across Germany, over 435 miles (700 km) of roadways and 180 bridges were destroyed.

Damages and disaster management

The Danube River also reached record-breaking levels, but minimal flooding occurred in Vienna due to extensive and effective flood management systems. In the worst-hit areas, the extent of the damage was attributed to the combination of towns built on floodplains and widespread deforestation that had occurred in recent years. The Regional Environmental Center for Central and Eastern Europe commented to reporters that, "The more trees and plants that an area loses, the faster the run-off and the more water that ends up in the river. In the industrial north and mid-latitudes in the northern hemisphere, forest area, and vegetation coverage in general had shrunk rapidly every year due to acid rain and developments in industry, transport, and nature."

While the flood damage was widespread, there were relatively few fatalities due to good emergency management of the disaster situation. All of the evacuations were carried out in time following the reasonably accurate flood predictions. However, experts still insist that better pre-disaster planning is needed in more regions, along with redesign of areas to take massive flooding potential into account. In all, the 2002 flood resulted in damages and restoration costs exceeding 2 billion euros.

FACTS AND FIGURES

DATE	August 12 to 16, 2002
LOCATION	Europe: Italy, Austria, the Czech Republic, and Germany; especially the cities of Bavaria, Bohemia, Thuringia, and Saxony
DEATH TOLL	100
DAMAGE	Over 2 billion euros
FLOODING	Between 9 and 20 feet (2.7 and 6 m)
COMMENTS	Many historic buildings were damaged but loss of life was minimized due to good emergency management and planning

ABOVE A German fire brigade technician cleans a filter of a pump that is pumping water from a suburban street in Prague. Fire brigades traveled 435 miles (700 km) from Frankfurt am Main in Germany to help their Czech counterparts.