# Melting Greenland glacier prompts tsunami events

**BY CHRIS MOONEY**
THE WASHINGTON POST

When Greenland's melting glaciers lose large chunks of ice, it's a violent process. Last year, for instance, scientists documented that gigantic glacial earthquakes are triggered by the rolling and tumbling of billion-ton icebergs as they break away and hit the glaciers to which they once belonged — hard.

But large masses of ice falling into the waters of Greenland's fjords do something else, too. Depending on the mass of ice lost and the particular configuration of the water and the fjord into which it surges, these events also can create destructive tsunamis, albeit of a relatively small scale (compared with how big open ocean tsunamis can get). And now, a recent study has found that at least one notable Greenland glacier, these tsunamis appear to be getting worse as melting advances.

Martin P. Luthi and Andreas Vieli of the University of Zurich in Switzerland studied what they call an "exceptionally well-documented" tsunami event that happened in July 2014 in the fjord that terminates at the glacier Eqip Sermia. It's one of the many large ocean-terminating glaciers of southwest Greenland and a popular tourist spot, since it has the advantage of being relatively close to the town of Ilulissat and reachable in a few hours by boat.

Not only did the researchers have tide gauges and other instruments set up in the area around Eqip Sermia — a tourist boat was about 2624 feet away from the glacier when the ice collapse that triggered the tsunami happened. So the scientists also could analyze video from the boat that was published on YouTube.

The new study of these tsunamis, recently published in the open access journal The Cryosphere, contains some startling findings about the scale of these events.

In the closely studied 2014 event, Eqip Sermia lost what the researchers calculate to be some 31,783,200 cubic feet of ice in a landslide from its 656 feet tall ice cliff face. For a Greenland glacier, 31,783,200 cubic feet is not actually a very big loss. The monstrous nearby Jakobshavn glacier can lose well over a square mile in glacier area (as measured at its surface, in two dimensions) at a single time.

Nonetheless, when this particular ice mass fell into the fjord, whose waters are quite shallow near the front of the glacier, it created a sudden tsunami wave of some 164 feet in height, based on the researchers' analysis of the video above, taken from the tourist boat. (This means that wall of water was much larger than it may have appeared in the video.)

"This is like a bulldozer at [about 98 feet] a second, going into this water, and pushing it forward," said Luthi.

Fortunately, in this case, the boat was far enough away that by the time the swell reached it, it was not damaged (though the boat certainly bobbed up and down quite a bit as the tsunami traveled by).

However, at the far shore 2.33 miles away from the glacier front, it was another story. Here, the resulting wave, arriving 160 seconds later, reached heights of 32 to 49 feet.

Greenland's 200 or so outlet glaciers have always calved and lost ice, so what makes this behavior at Eqip Sermia so unique?

The researchers say that Eqip Sermia — which is only "medium sized" in Greenland terms, with an ice front of just under 2.5 miles in width — has been undergoing changes lately that seem to prompt worse tsunami events.

In particular, the glacier has sped up its losses and its retreat inland toward the massive center of the Greenland ice sheet. In the process, as more ice has been lost, the retreating glacier formed an unusually high cliff face, extending between about 492 and 656 feet out of the water of the fjord, around 2012. It is this sheer height that appears to have allowed more ice to collapse into the water at one time, and thus "induced calving events that lead to 15m tsunami waves upon landfall which had not been observed before."

"What's exceptional for that glacier is the height of the front, it's [about 652 feet], it's really really high," said Luthi. "And I've never seen any glacier with such a high front. This is just not stable, that's why it collapses constantly."

Luthi thinks this is only a temporary configuration of the glacier — with further retreat, it might lose some of this height and, with it, the proclivity to generate such alarming tsunamis.

The researchers add that before 2012, Eqip Sermia's cliff face was only about 164 feet high, and while collapses still produced tsunamis, they were considerably smaller.

"This is really special, it probably will stay like this for a couple more years, causing crazy waves like that, and after that, it will be different," said Luthi.

But for now, on a weekly basis during the summer, calving events and tsunamis occur, the study says, creating hazards for those visiting the area. Additional evidence that this is unique and new, at least in its scale, is that "old vegetation including birch bushes high on the shores" has now been hit by and "eroded" by the waves, the paper says. Presumably the vegetation had survived in this location for a long time.

"This supports the notion that such high tsunami waves are a novel phenomenon on a decades-to-century timescale," the study notes.

Again, the good news is that this one spot in Greenland seems to be unique. But while it's a special instance, it also can be interpreted in the context of a much broader tapestry of transformation.

"The glaciers are changing like crazy, really rapidly," said Luthi. "Everything changes, and people cannot rely on their experience from generations. Suddenly things happen that nobody thought of before."

# Climate scientists predict more wildfires

## US Southwest expected to see more high temperatures and drought

**BY DARRYL FEARS**
THE WASHINGTON POST

ROBERT GALBRAITH | REUTERS

Fire burns at the base of trees along Highway 20 during the Rocky Fire in Lake County, California, in 2015. Continued drought and high heat led to more wildfires in the Southwest, and experts expect the situation to get worse in the years to come.

The burning sensation in the southwestern United States was diagnosed by climate scientists more than a year ago.

As California broiled in high temperatures and drought last year, academic institutions across the country released study after study that suggested rising temperatures and less moisture were part of a new normal for the state. One study by NASA predicted in February that the Southwest can expect to endure a 30-year megadrought starting as early as 2050. In early March, a study from Stanford University said California could face a drought every other year based on a 30-year trend of higher-than-normal temperatures and dwindling rainfall.

In August, Columbia University's Earth Institute found evidence that global warming has contributed to California's drought. And in September, NASA and Columbia teamed up to produce a study showing that five centuries have passed since the Golden State has been as dry as it currently is. Each of the studies drew on research that goes back decades.

None of the studies could explain exactly why the West is baking today. Temperatures reached 120 degrees Fahrenheit in parts of California this week. Since October, 26 million trees have died in six counties across 760,000 acres in the Sierra Nevada mountains that run along California's spine.

That brings the number of dead trees to 66 million over four years of drought, the service said. A combination of heat, dryness and a greedy little beetle, according to the latest estimate by the U.S. Forest Service.

In Arizona, where temperatures reached 118 degrees in Yuma on Tuesday, a pair of tourists who went for a hike died on the trail under the scorching heat. A third member of their party informed authorities because he was the only one strong enough to straggle back for help.

California, Nevada, New Mexico and Arizona are experiencing large wildfires fairly early in the season. Two large fires burning near Santa Barbara, California, are threatening to combine, and another is burning north of San Francisco, stretching thin the personnel and material needed to fight them.

When a monster wildfire struck Colorado in 2012, Sherman Harris, then-undersecretary at the U.S Department of Agriculture, which oversees the Forest Service, acknowledged that big fires driven by climate were here to stay. The wildfire season that ran from June to September expanded to include May and October.

Since then, it has gotten even worse. The season starts in March and ends in December. Once, it was rare to see 5 million cumulative acres burn in a year; recent seasons have recorded twice that. Last year's wildfire season set a record with more than 10 million acres burned — more land than Maryland, the District of Columbia and Delaware combined, the Forest Service said.

More than half the fires were in Alaska, where dryness due to historically low mountain snowpack and a freak lightning storm created perfect conditions for a huge blaze. But there also were mammoth fires in Washington and Oregon, where drought had left forests dry and ready to burn.

"The climate is changing, and these fires are a very strong indicator of that," Sherman said in 2012, predicting what was to come.

The Earth Institute study was silent on wildfires, but it said increased warming is creating a pattern in which the small amount of moisture stored in plants and the soil evaporates into the drier atmosphere.

"A lot of people think that the amount of rain that falls out the sky is the only thing that matters," said Park Williams, a bio-climatologist at Columbia University's Lamont-Doherty Earth Observatory and the study's lead author. "But warming changes the baseline amount of water that's available to us, because it sends water back into the sky."

The Earth Institute study analyzed month-to-month climate data between 1901 and 2014 to find fluctuations in precipitation, wind, temperature and humidity. It found that the average temperature in California increased by 2.5 degrees Fahrenheit over 113 years.

And, starting in the 1960s, heat increased with the introduction of more greenhouse gases from automobiles and other sources. Warming, the study said, increased the impact of natural conditions by as much as 25 percent.

Over the past 15 years, temperatures have risen in California, resulting in annual periods of extreme heat. At the same time, low and moderate precipitation cycles in the state haven't changed since 1977. That means it's far more likely that extreme-heat years will mingle with dry years.

# Strawberry-pink snow in Arctic pretty but alarming

**BY BEN GUARINO**
THE WASHINGTON POST

Pink snow was a high-latitude curiosity described by Arctic explorers such as Britain's John Ross. Upon receiving word of the reddish snow, the London Times speculated in 1818 that the color came from meteoric iron deposits. Biologists know now that the red hue is the result of a chemical reaction within the algae Chlamydomonas nivalis and other cold-loving species. These algae are normally green, but as they start to suck up ultraviolet rays, they turn red.

What may look like an Arctic accident involving gallons of pink lemonade is, in fact, reddish algae blooming in the snow. The unusual phenomenon is also found in high altitudes, and sometimes called watermelon snow or blood snow.

Despite the Willy Wonka tinge, the snow hides a sobering reality: According to a new study, the algae cause Arctic melts, which are already happening at an unprecedented pace because of climate change,to worsen.

Although scientists had already figured out why the snow was pink, the effects that the algae had on the wintry environment remained an understudied and fairly obscure topic.

But the new research from a team of geobiologists in Germany and Britain could expand that niche status. In their paper published Wednesday in the journal Nature Communications, the researchers examined 40 red-snow samples, representing 16 glaciers and snowfields from four Arctic countries: Greenland, Norway, Sweden and Iceland. The red algae darkens the snow, they found, causing it to melt faster than its white counterpart.

Specifically, the European scientists measured the red snow's albedo, the proportion of light reflected from a surface. It is a property of color: Dark objects, by definition, absorb a higher percentage of incoming light. When a British company, Surrey NanoSystems, created the blackest substance known to science — a paste of carbon nanotubes called Vantablack — its albedo was measured at 0.035. That is, it absorbed 99.965 percent of incoming light.

Because light is energy, objects that take in more light become hotter. Conversely, lighter-colored objects reflect more energy and stay cooler. Albedo is why Lawrence of Arabia was smart to wear white robes. It is why former energy secretary Steven Chu championed painting rooftops white to keep structures cooler, as dark gravel or shingles would mean buildings are converting light to heat.

This principle is also why scientists are concerned about darker snow — it would be a bit like a glacier tossing on a red shirt (lower albedo) instead of a plain white tee (high albedo).

The presence of red algae, on average, decreased albedo by 13 percent over the duration of the melting season. The researchers note that current climate-change models account for details such as black carbon from forest fires and Saharan dust. The scientists suggest algae, too, needs to be considered.

Exactly how large or small a role algae plays in melting glaciers is unclear, and the scientists plan to study it in more depth. But the geobiologists are concerned that the decrease in albedo may act like a positive feedback loop. As more algae bloom, more snow thaws — and, nourished by the unfrozen water, even more of the microorganisms are able to grow. And so on.

# Man misidentified in the iconic flag-raising photo on Iwo Jima

**BY THOMAS GIBBONS-NEFF**
THE WASHINGTON POST

The Marine Corps admitted in a statement Thursday that it had misidentified one of the six men pictured in the iconic flag-raising photo taken during the battle for Iwo Jima in 1945.

An internal investigation, led by a retired Marine general and prompted by an inquiry from documentary filmmakers last year, determined that one of the men, a Navy Corpsman named John Bradley, was not one of the six depicted in Joe Rosenthal's Pulitzer Prize-winning photograph. Instead, the man second from the left in the photo is Franklin Sousley, who has long been identified in the photo but in the wrong place. The man who took almost a century to identify, who stood where Sousley was thought to be, is Pfc. Harold Schultz from Detroit.

Schultz, a mortarman with Easy Company, 2nd Battalion, 28th Marine Regiment, accompanied the 40-man patrol that snaked up Mount Suribachi on the morning of Feb. 23, 1945. Atop the 550-foot-tall mountain, at the southern tip of the tiny volcanic island, the Marine Corps determined that Schultz would help Marines Rene Gagnon, Ira Hayes, Harlon Block, Michael Strank and Franklin Sousley raise a piece of Japanese irrigation pipe affixed with the American flag that would soon make history.

Schultz, who was wounded on the island three weeks after the flag raising, died in 1995 at age 70. He never spoke publicly of his part in the flag raising.

"Our history is important to us, and we have a responsibility to ensure it's right," said Marine Commandant Gen. Robert Neller in a statement.

Schultz had been identified in the picture namely by the way he carried his M1 Garand rifle, according to Matthew Morgan, a Marine who worked as a producer on the Smithsonian Channel documentary that prompted the Marine Corps investigation into the photo. According to pictures taken on the mountain that day, Schultz can be seen holding his rifle with a sling that had been jury-rigged after one of the sling's mounts probably failed earlier in the battle. According to Morgan, the rifle's low position on Schultz's back in the photograph was one of the main reasons they were able to determine Schultz's place in the picture.

"Nothing about this discovery or revelation takes anything from John Bradley," Morgan said. "He's in every sense a hero."

Bradley was awarded the Navy Cross, an award second only to the Medal of Honor, for actions that took place two days before the flag raising.

Bradley's place in the photograph had been called into question before the Marines' announcement. Amateur historians had their findings published in a 2014 Omaha World-Herald article that pointed out differences in Bradley's gear that were not displayed in the photo. Bradley's son, James, was not immediately available for comment but told The Washington Post in an earlier interview that he did not think his father was in the iconic picture, for some time. Bradley's book about his father and the other flag raisers, titled "Flags of Our Fathers," was turned into a 2006 movie directed by Clint Eastwood.

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Rosenthal's iconic photograph captured the second flag raising on the mountain that day. The first flag had been determined as too small and was quickly taken down, only to be replaced by Schultz and his fellow Marines. The picture would soon become an enduring symbol of America's effort in World War II and a monument to the bloody battle on Iwo Jima. Known as Operation Detachment, the roughly month-long battle to secure the island and its small airfield would claim the lives of more than 6,000 Marines and almost all of the 20,000 Japanese defenders.

For the men of Easy Company who climbed Suribachi to raise the twin American flags, only five would walk off the island unscathed. Of the six men caught in Rosenthal's photo, three would die on Iwo Jima.

"Although the Rosenthal image is iconic and significant, to Marines it's not about the individuals and never has been," Neller said in a statement. "Simply stated, our fighting spirit is captured in that frame, and it remains a symbol of the tremendous accomplishments of our Corps — what they did together and what they represent remains most important. That doesn't change."

The Marine Corps has since adjusted their history and will now replace Bradley's name with Schultz wherever it is found.