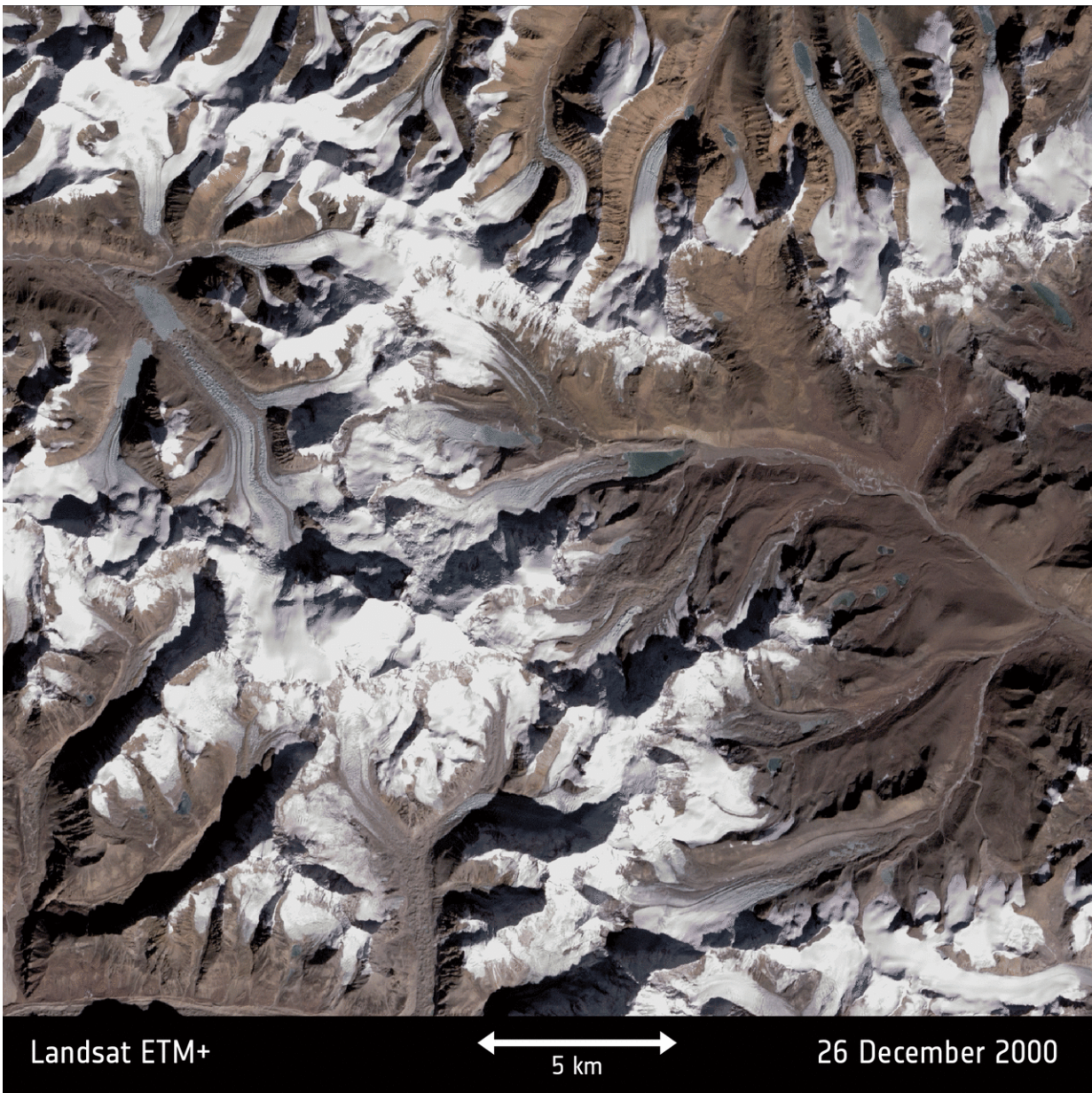


Glaciers lose 9 trillion tonnes of ice in half a century

April 9 2019



A paper published recently in *Nature Geosciences* describes how a multitude of satellite images have been used to reveal that there has actually been a slowdown in the rate at which glaciers slide down the high mountains of Asia. This animation simply shows how glaciers in Sikkim in northeast India have changed between 2000 and 2018. One of the images is from the NASA/USGS Landsat 7 mission captured on 26 December 2000 and the other is from Europe's Copernicus Sentinel-2A satellite captured on 6 December 2018. Credit: NASA/USGS/University of Edinburgh/ETH Zurich/contains modified Copernicus Sentinel data (2018)

When we think of climate change, one of the first things to come to mind is melting polar ice. However, ice loss isn't just restricted to the polar regions. According to research published today, glaciers around the world have lost well over 9000 gigatonnes (nine trillion tonnes) of ice since 1961, raising sea level by 27 mm.

An international team led by the University of Zurich in Switzerland used classical glaciological field observations combined with a wealth of information from various satellite missions to painstakingly calculate how much ice has been lost or gained by 19 different glacierised regions around the world.

Their research, published in *Nature*, reveals that [glaciers](#) lost 9625 gigatonnes of ice between 1961 and 2016.

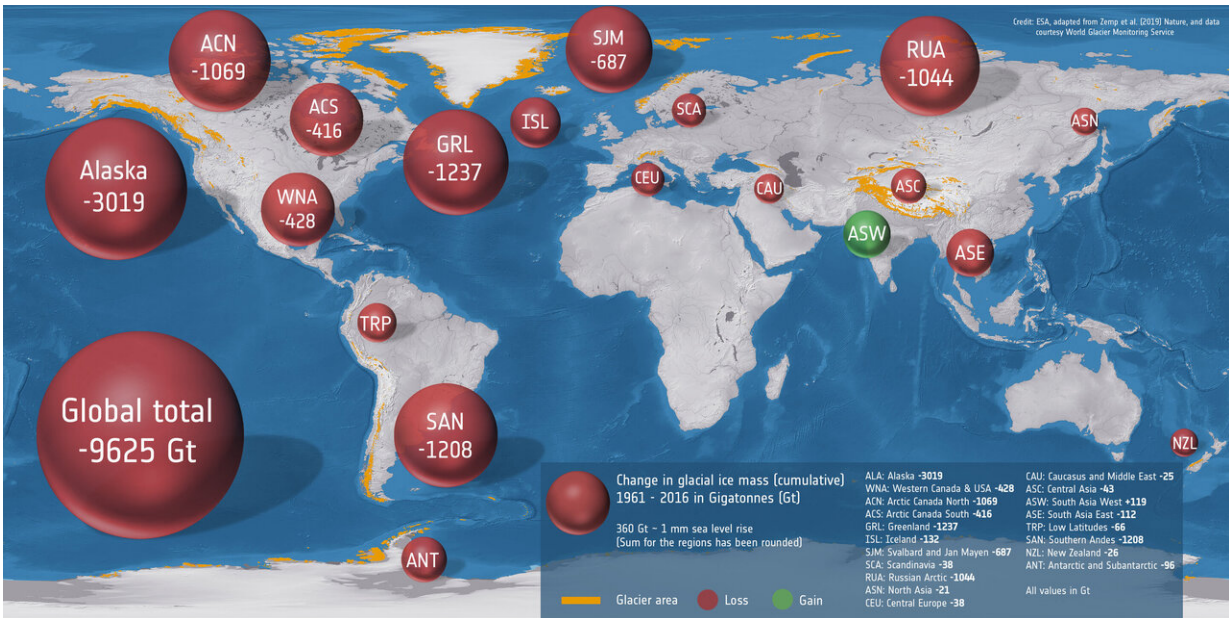
The largest regional losses were in Alaska, followed by glaciers around the edge of the Greenland ice sheet and from glaciers in the southern Andes. Significant amounts of ice were also lost from glaciers in the Canadian and Russian Arctic, as well as from Svalbard.

Glaciers in temperate regions such as in the European Alps and the Caucasus mountain range did not escape ice loss either, but are too small

to make a significant contribution to sea level.

Interestingly, the only area to have gained ice over the 55-year period was southwest Asia (noted on the map as ASW). Here, glaciers amassed 119 gigatonnes of ice, but neighbouring southeast Asia (ASE) lost around the same amount, 112 gigatonnes.

ESA's Climate Change Initiative – a research programme focused on generating global datasets for the key components of Earth's [climate](#), known as essential climate variables – was also key to the research.



Global glacier mass loss 1961–2016. Credit: European Space Agency

The initiative's glacier project, together with ESA's former GlobGlacier project, provided glacier outlines and information on ice mass changes for thousands of individual glaciers.

Frank Paul, co-author of the study explains, "Glacier outlines are needed to make precise calculations for the areas in question. To date, this information came largely from the US Landsat satellites, the data from which are delivered to European users under ESA's Third Party mission agreement.

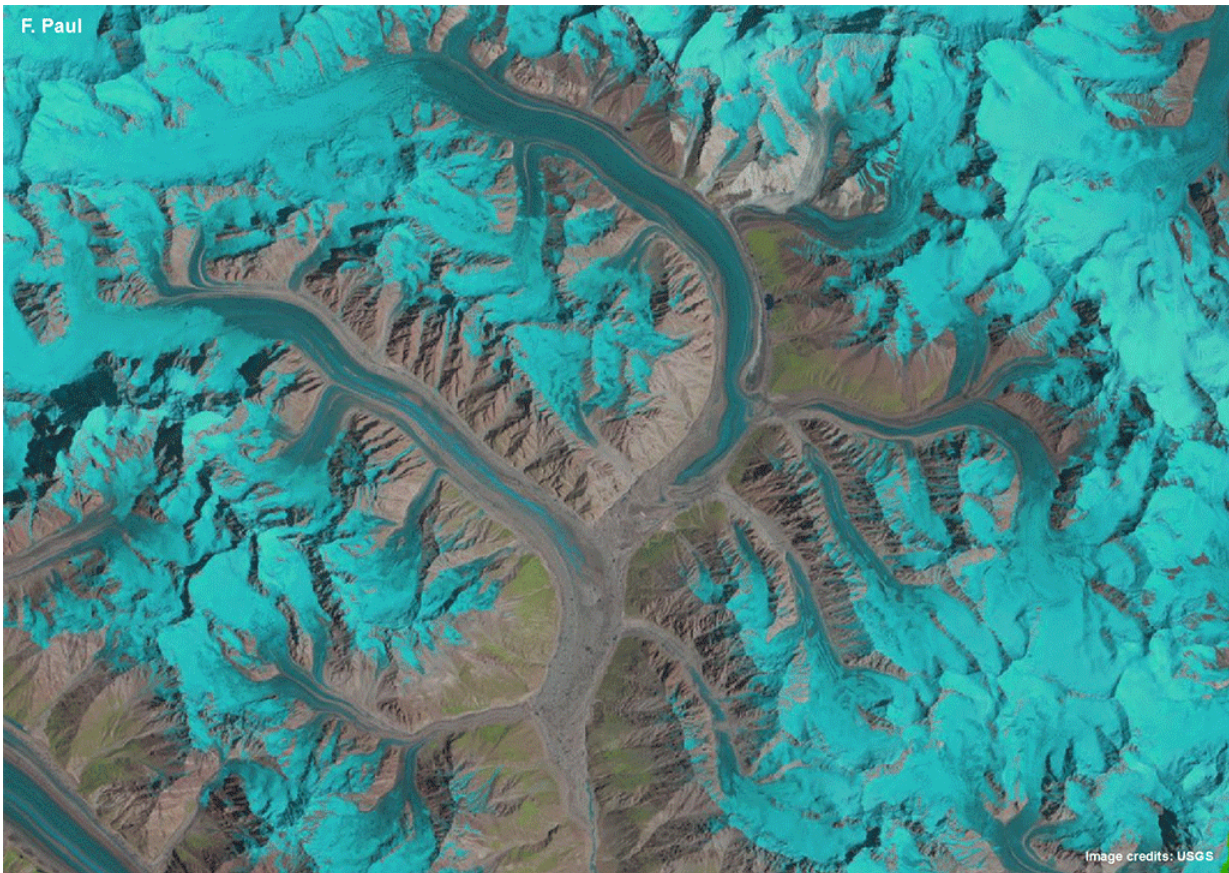
"In the future, the Copernicus Sentinel-2 mission, in particular, will increasingly contribute to the precise monitoring of glacier change."

Digital elevation models, which provide topographic details of a region, were calculated using information from the Japan Aerospace Exploration Agency's ASTER sensor on the US Terra mission and Germany's TanDEM-X mission. Both sources were processed within the Glaciers Climate Change Initiative and other projects.

These data, along with the comprehensive glaciological database compiled by the World Glacier Monitoring Service, allowed the researchers to reconstruct ice thickness changes of 19 000 glaciers worldwide.

By combining these measurement methods and having the new comprehensive dataset, the researchers could estimate how much ice was lost each year in all mountain regions since the 1960s.

The glaciological measurements made in the field provided annual fluctuations, while satellite data allowed them to determine [ice loss](#) over several years or decades.



Using 15 images from Landsat, the animation compresses 25 years of change into just 1.5 seconds to reveal the complex behaviour of the surging glaciers in the Panmah region of the Karakoram mountain range in Asia. Glaciers are shown in pale blue, snow in light blue to cyan, clouds in white, water in dark blue, vegetation in green and bare terrain in pink to brown. Credit: F. Paul, *The Cryosphere*, 2015 & USGS/NASA

Research leader, Michael Zemp, said, "While we can now offer clear information about how much ice each region with glaciers has lost, it is also important to note that the rate of loss has increased significantly over the last 30 years. We are currently losing a total of 335 billion tonnes of ice a year, corresponding to a rise in sea levels of almost 1 mm per year."

While warming ocean water still remains the main driver for sea-level rise, melting glacier ice is the second largest contributor to rising seas.

Dr Zemp added, "In other words, every single year we are losing about three times the volume of all ice stored in the European Alps, and this accounts for around 30% of the current rate of sea-level rise."

Around the world, vanishing glaciers also ultimately mean less water for millions of people, less hydroelectric power and less water for crops. While melting glaciers also result in sea-level rise, they critically increase the risk of other natural hazards such as glacier-lake outburst floods and related debris flows.

The pace at which glaciers are losing mass in the long term is very important to making informed future adaptation decisions. This kind of information, therefore, is critical for international bodies assessing [climate change](#), such as the Intergovernmental Panel on Climate Change.

Mark Drinkwater, Senior Advisor on cryosphere and climate at ESA, added, "Bearing in mind the socio-economic consequences, the fate of glaciers in a future climate is something ESA views seriously."

"It is fundamental that we build upon existing monitoring capabilities using observations from the EC's Copernicus Sentinel missions, and other ESA and Third Party Mission missions. Their data crucially allow us to build a robust climate perspective to reveal regional and year-to-year fluctuations of glaciers and other parts of the cryosphere such as snow cover, sea ice and ice sheets."

More information: M. Zemp et al. Global glacier mass changes and their contributions to sea-level rise from 1961 to 2016, *Nature* (2019). [DOI: 10.1038/s41586-019-1071-0](https://doi.org/10.1038/s41586-019-1071-0)

Provided by European Space Agency

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