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Greenland

Greenland has lost 20 per cent more ice than expected

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A group of researchers from the American NASA published the results of their efforts on Wednesday 17 January in the prestigious journal *Nature*. They compiled no less than 236,328 images of the gigantic Greenland polar cap, accumulated by different satellites over 40 years, and revealed that its melting was underestimated by 20 per cent. According to their calculations, 1,000 billion tons of ice have reached the sea between the 2000s and today without being taken into account in climatologists' estimates

How can we explain this failure, in one of the areas of the planet that mobilizes the most climatologists? Simply by the difficulty of accurately following the fluctuating course of the 250 or so peripheral glaciers through which this immense ice cap, three times the size of France, flows towards the sea.

Until now, researchers have focused on either the thickness of this ice monster (1.7 km on average!), the reduction of which can be measured by so-called altimetry techniques; or on its total weight, estimated by another technology called gravimetry.

The NASA team, for its part, has focused on an aspect that has been neglected until now, namely its exact extent, in other words the precise length of these glaciers, defined by the position of the line that separates them from the sea, where at the end of their course they float and then melt. Revealing that 5,000 km² of ice has disappeared in the last twenty years.

“We have compiled some 65,000 manual plots of these lines from satellite photos. This is often difficult, because the surface of the sea sometimes freezes, in whole or in part, there are icebergs passing by, and it can be saturated with small pieces of ice – in the end we see mostly white on white! So you need a lot of expertise to correctly interpret the images,” Chad Greene, from NASA's Jet Propulsion Laboratory, told *Mediapart*.

The team then used these processed images to train an artificial intelligence, which reviewed about 173,000 other available images. Result? “We're seeing a clear shortening of these glaciers, which have been receding for about 20 years, which hasn't been measured before, in part because of the high seasonal variability,” Greene said. Glaciers, in fact, fluctuate constantly, shortening in the summer and then lengthening in the winter.

Researchers are struggling to explain the details of these fluctuations, which vary greatly from one glacier to another: they do not seem to be directly determined by the thickness or shape of the glacier, nor by the temperature of the sea or that of the air... “Further studies will be needed to understand the precise local drivers of melting, which will help us understand the points of fragility in the ice sheet,” says Greene.

“For now, our results suggest that it is the glaciers that fluctuate the most with the seasons and are also the most vulnerable to global warming,” he adds. This is not really reassuring, since the largest glaciers on the island, including the famous Jakobshavn, a monster more than 65 km long, which produces 10 per cent of Greenland's icebergs, are among those that fluctuate the most...

This work is praised by Aurélien Quiquet, a specialist in the Greenland ice sheet at the Laboratory of Climate and Environmental Sciences (LSCE), at the University of Paris-Saclay, who did not participate in the study. “These colleagues have made a major effort to compile data that had not been accomplished until now, using a methodology that appears robust and taking advantage of mature artificial intelligence methods,” he says.

Disruptions to ocean circulation

The French researcher emphasizes that the study is particularly interesting because it concerns a strategic area for the global climate. The Greenland region is in fact one of the most powerful engines of ocean circulation, a set of currents often referred to as an "ocean conveyor belt", which carries excess heat accumulated between the tropics towards the cold seas, and therefore carries out a valuable work of planetary thermal rebalancing. In the Atlantic, this circulation takes the name "Amoc", an acronym for "Atlantic meridional overturning circulation", and includes the famous Gulf Stream, which we know brings northward the warm water accumulated particularly in the Caribbean.
The Amoc is driven by a fascinating phenomenon that occurs every winter in the icy waters of Greenland. When darkness arrives and sea ice forms, the salt in the surface water is expelled, because ice is still made of fresh water.

“It's a physical process that then begins”, Chad Greene explains. “The water just under the ice, which is already very cold, is suddenly enriched with salt: it then flows to the deep sea, because the cold and salt make it denser, and therefore heavier. These millions of cubic metres that sink then create a kind of "suction", which "pulls" the waters of the Atlantic northwards.”

The future of this AMOC is one of the most pressing concerns and controversies in the climate community. In theory, warming, which is particularly rapid in the polar region, could stop it completely: if freezing is less and less strong, the surface water will be less salty and cold, and above a certain threshold it will no longer flow, stopping the "conveyor belt". This would result in an even faster warming of the world's warm regions, and a possible cooling of cold regions – a real catastrophic scenario.

Alas! no one knows where the said threshold is, but a slowdown in this plunge of the waters already seems to be observed, with a study in *Nature* dated 2021 indicating that it was at its lowest point in a millennium. The Intergovernmental Panel on Climate Change (IPCC) considers that a shutdown of the AMOC during the twenty-first century is unlikely, while conversely, a number of specialists believe the risk is real and imminent, with an article in *Nature* in July 2023 predicting it even for the middle of the century, with the current emissions trajectory.

“This debate about the possible shutdown of the AMOC is very complex and I don't want to take sides,” Greene said. “But what is certain is that if billions of tons of additional fresh water arrive in the ocean from melting glaciers, it could upset an already fragile balance, since fresh water, by diluting the salt, slows down the sinking of the waters.”

Suffice it to say that researchers will continue to scrutinize Greenland's ice like water on fire, and that the temperature record broken by the planet in 2023 is not likely to reassure them.

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Translated by ***International Viewpoint*** from **Médiapart**.

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