



Greenland Glacier Revelations: Unveiling Ice Sheet Destruction

Description

Experiencing the vastness of Greenland from a helicopter presents a profound challenge in grasping the true scale of the landscape. There have been moments when I believed we were gliding just above the undulating waves of a fjord, only to catch sight of a diminutive shadow of a seabird below, leading me to realize that what I had initially perceived as floating fragments of ice were, in fact, icebergs the size of office buildings.

At times, I have felt as though we were suspended high above an expanse of uniform, icy terrain, until we gently descended, revealing that the ice lay merely a few meters beneath us.

Crevasses—cracks in the glacier surface—epitomize this perplexing range of scales. Resulting from stresses at the ice's surface, their orientation and dimensions reveal the dynamics of the ice sheet as it flows toward the ocean.

In the more remote regions, far from the rapid currents that release massive quantities of icebergs into fjords, crevasses can be mere millimeter-wide fissures. However, as the ice accelerates, they can expand to several meters in width, often obscured by misleading snow bridges that necessitate proper safety protocols and rescue training to navigate.

Where the ice meets the ocean, crevasses can grow into colossal spans exceeding 100 meters from wall to wall, and they are increasingly proliferating throughout Greenland.



Cracks large enough for a helicopter to pass through. (Tom Chudley)

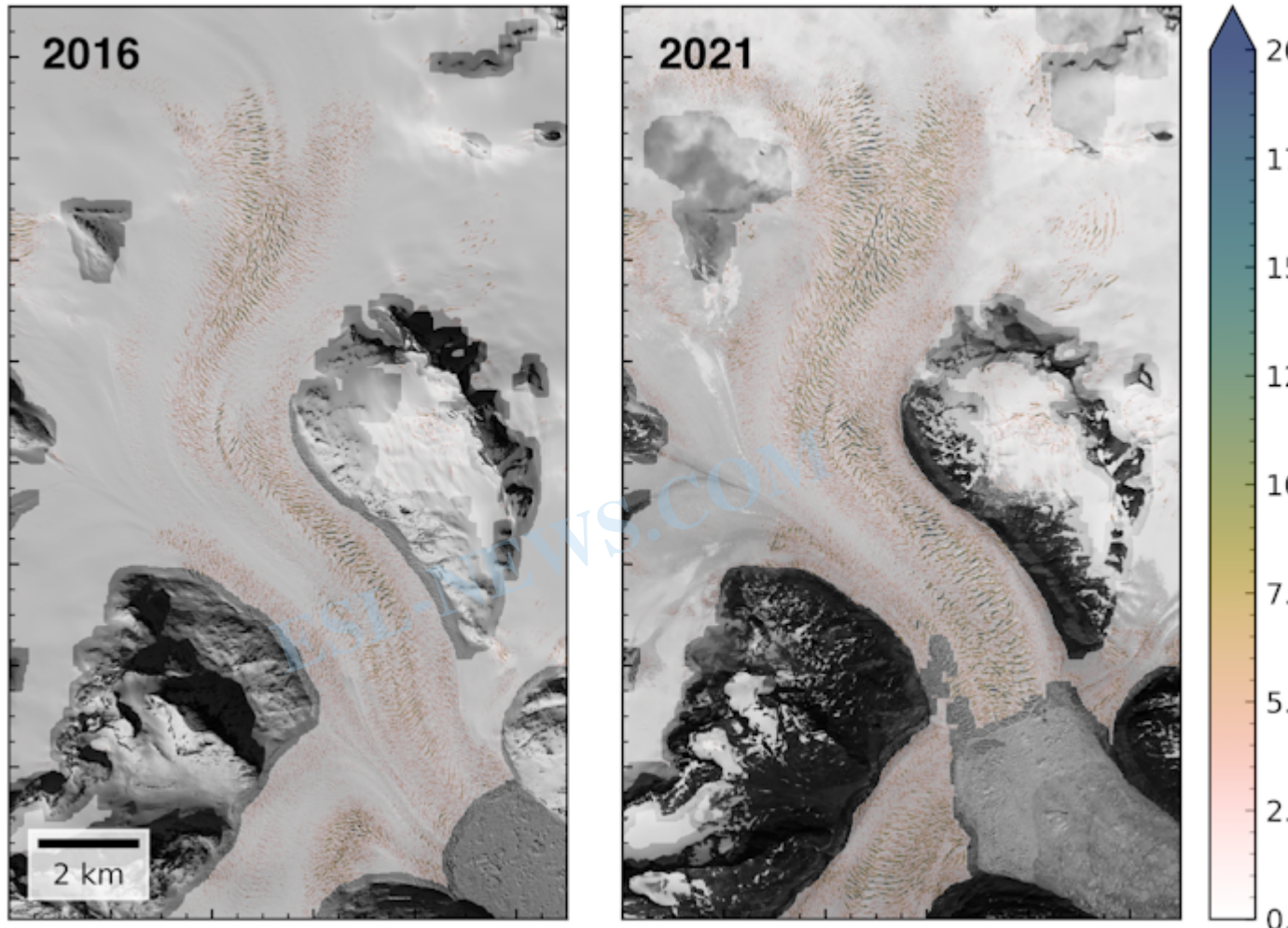
Scientists have anticipated the expansion of crevasses in Greenland as a consequence of ocean warming, which has consequently accelerated the flow of the ice sheet, enhancing the stress on its surface. Nevertheless, due to the inadequate data from satellites and on-the-ground fieldwork, we previously lacked clarity on the extent and rapidity of these changes.

Mapping Crevasses

In a [recent study](#), my colleagues and I meticulously mapped crevasses across the entire Greenland ice sheet using data from 2016 and 2021. We leveraged the "[ArcticDEM](#)," which consists of three-dimensional surface models derived from high-resolution satellite imagery.

Employing advanced image-processing methodologies on over 8,000 maps, we estimated the volume of water, snow, or air required to "fill" each crevasse, enabling us to calculate their depths and volumes while also observing their evolution over time.

Our findings revealed that between 2016 and 2021, there were significant increases in crevasse volume within the ice sheet's rapidly flowing sectors. Notably, in the southeastern regions—particularly vulnerable to ocean-induced acceleration and retreat—crevasse volume surged by over 25 percent.



In numerous Greenland glaciers discharging into the ocean, scientists have observed a marked increase in crevasse size and depth. ([Chudley et al / Nature Geoscience](#))

Surprisingly, however, the overall volume of crevasses across the entire ice sheet increased by only 4.3 percent, indicating a more balanced total than anticipated given the considerable growth in certain areas.

This discrepancy can be attributed to a specific outlet glacier, Sermeq Kujalleq (Danish: Jakobshavn Isbræ), the fastest-flowing glacier on Earth. This glacier, moving at nearly 50 meters daily, significantly contributes to Greenland's overall sea-level rise.

In 2016, Sermeq Kujalleq responded to an influx of cold North Atlantic water by [slowing down and thickening](#). During this period, the crevasses on its surface began to close, thereby counterbalancing increases observed elsewhere in the ice sheet.



This brief deceleration has since ended. Since 2018, Sermeq Kujalleq has accelerated and thinned again due to ongoing environmental warming. Thus, we cannot rely on it to mitigate crevasse growth across the ice sheet in the future.

The Evolution of Crevasses

Crevasses are integral to the life cycles of glaciers, and their expansion poses a serious threat to ice-sheet stability, potentially exacerbating ice loss. They facilitate the downward movement of surface meltwater into the glacier, where it can warm the ice or lubricate the base over which the glacier slides, both of which accelerate its flow into the ocean.

Moreover, at the juncture where ice meets sea, crevasses initiate the fractures from which icebergs may calve, thereby increasing the volume of ice entering the ocean.

In summary, crevasses underpin the dynamic processes at play across Greenland and Antarctica. Nevertheless, these processes remain poorly understood, and their future behavior presents the most significant uncertainty in predicting sea-level rise.

Collectively, the increasing outflow of ice could contribute up to [an additional 10 meters of sea-level rise](#) by 2300, threatening the existence of 75 percent of cities housing over five million residents, all situated less than 10 meters above sea level.

It is imperative to deepen our understanding of these mechanisms, including the role of crevasses, to ensure that our projections for sea-level rise are informed and actionable, forming a basis for confronting the global challenges posed by climate change.

Since 2023, an international alliance of polar scientists has been advocating for the global community to [limit warming to 1.5°C](#) in a bid to avert the most catastrophic scenarios for global glaciers and ice sheets. Recent reports from the EU's Copernicus Climate Change Service have confirmed that 2024 marks the first year in which average global temperatures [exceeded this critical threshold](#).

Each incremental increase in temperature warrants significant concern. There remains a glimmer of hope to mitigate the worst consequences of climate change; however, time is fast running out.

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Vocabulary List:

1. **Crevasses** /krɪˈvæsiːz/ (noun): Cracks in the surface of a glacier typically formed by stress and strain.
2. **Formidable** /ˈfɔːr.mɪ.də.bəl/ (adjective): Inspiring fear or respect through being impressively large powerful or capable.



3. **Proliferating** /prə'lifə,reitɪŋ/ (verb): Increasing rapidly in numbers; multiplying.
4. **Dynamics** /daɪ'næmɪks/ (noun): The forces and motions that govern a system.
5. **Epitomize** /ɪ'pɪtə,maɪz/ (verb): To be a perfect example of a quality or type.
6. **Accelerated** /æk'sɛlə,reitɪd/ (adjective): Increased in speed or rate.

Comprehension Questions

Multiple Choice

1. What are crevasses in a glacier?
Option: A. Undulating waves in a fjord
Option: B. Cracks in the glacier surface
Option: C. Icebergs the size of office buildings
Option: D. Mere millimeter-wide fissures
2. What methodology was used to map crevasses in Greenland ice sheet?
Option: A. Satellite imagery
Option: B. Ground fieldwork
Option: C. Observation from a helicopter
Option: D. Underwater drones
3. What percentage increase in crevasse volume was observed in southeastern regions of Greenland?
Option: A. 10%
Option: B. 20%
Option: C. 25%
Option: D. 30%
4. Which glacier counterbalanced crevasse increases by slowing down and thickening in 2016?
Option: A. Vatnajökull Glacier
Option: B. Sermeq Kujalleq Glacier
Option: C. Jakobshavn Isbræ Glacier
Option: D. Perito Moreno Glacier
5. What process do crevasses facilitate in glaciers?
Option: A. Iceberg formation
Option: B. Downward movement of meltwater
Option: C. Surface freezing



Option: D. Glacier fracturing

6. Which organization has been advocating for limiting warming to 1.5°C to save ice sheets?

Option: A. EU

Option: B. NASA

Option: C. Copernicus Climate Change Service

Option: D. WTO

True-False

7. Crevasses initiate the fractures which result in iceberg calving.

8. Icebergs the size of office buildings are often mistaken for floating fragments of ice.

9. The overall volume of crevasses across the entire ice sheet decreased by 4.3% between 2016 and 2021.

10. Sermeq Kujalleq Glacier is the slowest-flowing glacier on Earth.

11. Crevasses play a minor role in the dynamics of glaciers and ice sheets.

12. The Copernicus Climate Change Service confirmed in 2024 that global temperatures exceeded 1.5°C for the first time.

Gap-Fill

13. The crevasse volume in the ice sheet's rapidly flowing sectors surged by over 25% from 2016 to _____.

14. Environmental warming led Sermeq Kujalleq Glacier to accelerate and thin again since _____.

15. An international alliance of polar scientists has been advocating to limit warming to 1.5°C since _____.

16. The increasing outflow of ice could contribute up to an additional _____ of sea-level



rise by 2300.

17. The existence of 75% of cities housing over five million residents, situated less than 10 meters above sea level, is threatened by the projected rise in _____.

18. Crevasses pose a serious threat to ice-sheet stability, potentially exacerbating _____.

Answer

Multiple Choice: 1. B. Cracks in the glacier surface 2. A. Satellite imagery 3. C. 25% 4. B. Sermeq Kujalleq Glacier 5. B. Downward movement of meltwater 6. C. Copernicus Climate Change Service

True-False: 7. True 8. True 9. False 10. False 11. False 12. True

Gap-Fill: 13. 2021 14. 2018 15. 2023 16. 10 meters 17. sea level 18. ice loss

Vocabulary quizzes

Multiple Choice (Select the Correct answer for each question.)

1. What is a common visual phenomenon that appears as spots or squiggly lines in vision?

- Option: Floaters
- Option: Eruptions
- Option: Interventions
- Option: Chasms

2. Which term describes factors that bring about an effect or result?

- Option: Cognizant
- Option: Causative
- Option: Quantifiable
- Option: Formidable

3. What is the term used for making something less severe or more bearable?

- Option: Exacerbate
- Option: Alleviate
- Option: Proliferate
- Option: Deteriorate

4. What is the term for the gradual decline or deterioration over time?

- Option: Proliferation



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- Option: Acceleration
Option: Degeneration
Option: Correlations
5. Which term refers to the act of becoming involved in a situation to alter the outcome?
- Option: Intervention
Option: Induction
Option: Epitomization
Option: Dynamics
6. What term describes the collection of microorganisms living in a particular environment especially the human body?
- Option: Biomechanics
Option: Microbiome
Option: Magnetosphere
Option: Electromagnetism
7. Which term relates to mental processes such as perception reasoning and memory?
- Option: Cognitive
Option: Radical
Option: Formidable
Option: Innovative
8. What is the term used to describe a relationship or connection between two or more things?
- Option: Inferences
Option: Correlations
Option: Dynamics
Option: Eruptions
9. What describes phenomena associated with the Earth's magnetic field?
- Option: Geomagnetic
Option: Radical
Option: Inductive
Option: Epitomic
10. What term is used to describe a sudden occurrence of a volcanic activity?
- Option: Eruption
Option: Innovation
Option: Acceleration
Option: Deceleration



Gap-Fill (Fill in the blanks with the correct word from the vocabulary list.)

11. An effective _____ might be necessary to address the issue of pollution in our city.
12. The _____ of technology has transformed communication in the modern world.
13. Research often aims to identify _____ factors behind public health concerns.
14. The new medical treatment was designed to _____ the symptoms of the disease.
15. The human _____ plays a critical role in overall health and immunity.
16. Understanding the _____ of social interactions can enhance team performance.
17. The study indicated that _____ skills could be improved with practice.
18. The professor explained that cellular _____ is a normal part of the aging process.
19. The volcanic _____ caused widespread destruction in the surrounding area.
20. She is a _____ opponent who has won many competitions.

Matching Sentences (Match each definition to the correct word from the vocabulary list.)

21. People often notice floaters in their vision when looking at a bright plain background.
22. The researchers were able to establish causative links between the two variables in the study.
23. We are searching for new treatments that can alleviate chronic pain without severe side effects.
24. The scientist focused on the causes of degeneration in neurons during the aging process.
25. Early intervention can significantly improve outcomes for children with developmental delays.
26. The health of our microbiome can influence various bodily functions and immune responses.
27. Cognitive therapies can be effective in treating certain mental health disorders.
28. The study uncovered several significant correlations between diet and mental health.



29. The magnetosphere protects Earth from solar radiation and charged particles from space.

30. The eruption of the volcano sent plumes of ash and smoke into the sky.

Answer

Multiple Choice: 1. Floaters 2. Causative 3. Alleviate 4. Degeneration 5. Intervention 6. Microbiome 7. Cognitive 8. Correlations 9. Geomagnetic 10. Eruption

Gap-Fill: 11. intervention 12. proliferation 13. causative 14. alleviate 15. microbiome 16. dynamics 17. cognitive 18. degeneration 19. eruption 20. formidable

Matching sentence: 1. floaters 2. causative 3. alleviate 4. degeneration 5. intervention 6. microbiome 7. cognitive 8. correlations 9. magnetosphere 10. eruption

CATEGORY

1. Sci/Tech - LEVEL5

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