
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)

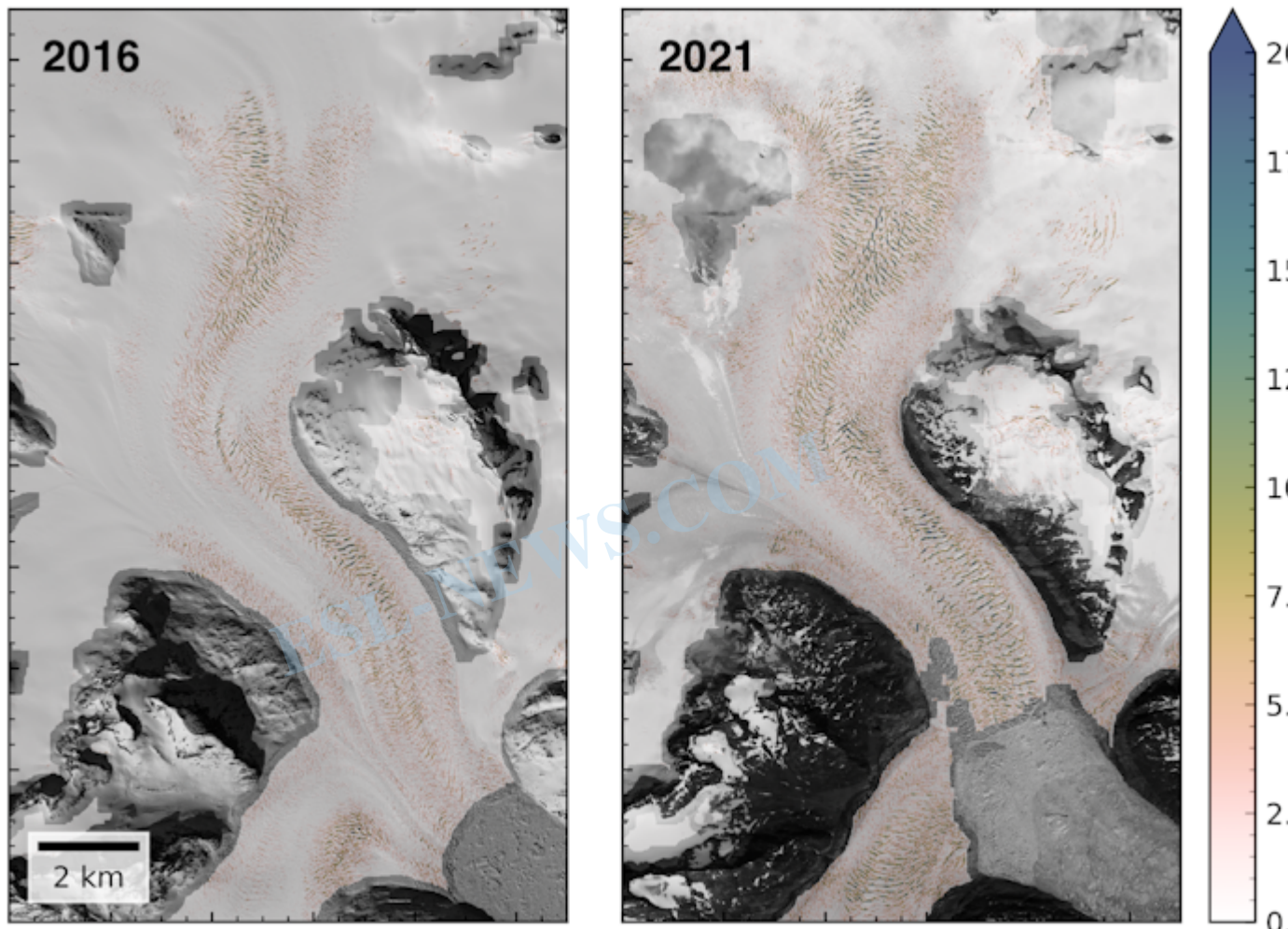
Scientists have anticipated the expansion of crevasses in Greenland as a consequence of ocean warming, which has consequently accelerated the flow of the ice sheet, enhancing the stress on its surface. Nevertheless, due to the inadequate data from satellites and on-the-ground fieldwork, we previously 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 are small dark shapes that people may sometimes see moving in their field of vision?

- Option: Bacteria
- Option: Floaters
- Option: Plasma
- Option: Antibiotics

2. What term refers to the community of microorganisms that live in and on the human body?

- Option: Neurons
- Option: Microbiome
- Option: Fossils
- Option: Herbivores

3. What is a term for an action taken to improve a medical condition or situation?

- Option: Resolution
- Option: Intervention
- Option: Inflation
- Option: Mutation

4. What is the ability of an organism to detect magnetic fields for navigation and orientation?

- Option: Magnetoreception



- Option: Hydration
- Option: Erosion
- Option: Inversion

5. Which term relates to processes such as thinking learning and remembering?

- Option: Cognitive
- Option: Metabolic
- Option: Synthetic
- Option: Conductive

6. What term describes a mutual relationship or connection between two or more things?

- Option: Correlations
- Option: Distortions
- Option: Luminosity
- Option: Repudiation

7. What word describes an increase in the rate or speed of something?

- Option: Decelerated
- Option: Accelerated
- Option: Stagnated
- Option: Deviated

8. Which term refers to favoring or making changes that are revolutionary or extreme?

- Option: Traditional
- Option: Radical
- Option: Conservative
- Option: Conventional

9. What term refers to the forces or properties that stimulate growth progress or change within a system or process?

- Option: Statics
- Option: Dynamics
- Option: Kinetics
- Option: Mechanics

10. Which term refers to new methods ideas or products introduced for the first time?

- Option: Traditions
- Option: Concepts
- Option: Innovations
- Option: Conventions



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

11. _____ is the rapid increase or spread of something.
12. Doctors often prescribe medications to help _____ pain and discomfort.
13. Yoga and meditation can help expand the mental _____ of individuals.
14. The success of the project was easily _____ through specific metrics.
15. Aging is often associated with the _____ of certain bodily functions.
16. One of the challenges in investing in the stock market is the _____ of future returns.
17. Mount Everest presents a _____ challenge to even the most experienced climbers.
18. The volcanic _____ caused widespread destruction in the surrounding area.
19. The process of _____ involves reasoning from specific cases to general principles.
20. Technological _____ have revolutionized many aspects of modern life.

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

21. The rapid of fake news on social media platforms is a growing concern for society.
22. Effective medical can significantly improve a patient's health outcomes.
23. Neglecting regular maintenance can lead to the of machinery over time.
24. Deep in the glacier posed a danger to the team of explorers.
25. The study of Earth's field helps scientists understand magnetic phenomena.
26. His dedication and hard work the values of our organization.
27. The interaction of electrical currents and magnetic fields is a key principle in .
28. The implementation of new technology the pace of production in the factory.



29. Natural such as the auroras are awe-inspiring displays in the sky.

30. The company decided to take a approach to redesigning its business model.

Answer

Multiple Choice: 1. Floaters 2. Microbiome 3. Intervention 4. Magnetoreception 5. Cognitive 6. Correlations
7. Accelerated 8. Radical 9. Dynamics 10. Innovations

Gap-Fill: 11. Proliferation 12. Alleviate 13. Capacities 14. Quantifiable 15. Degeneration 16. Unpredictability
17. Formidable 18. Eruption 19. Induction 20. Innovations

Matching sentence: 1. Proliferation 2. Interventions 3. Deterioration 4. Crevasses 5. Geomagnetic 6. Epitomize
7. Electromagnetism 8. Accelerated 9. Phenomena 10. Radical

CATEGORY

1. Sci/Tech - LEVEL5

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