Multi-Faceted Science Enabled by the Airborne Glaciological and Oceanographic Observations during NASA's 5-year Oceans Melting Greenland Mission

Ian Fenty[1], Josh Willis[2], Ala Khazendar[1], and Michael Wood[3]

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[2]Jet Propulsion Laboratory
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November 21, 2022

Abstract

For the past 5 years, NASA's Oceans Melting Greenland (OMG) mission has been motivated by the question: "to what extent are the oceans melting Greenland's ice from below?" Three out of the mission's four observational components employed aircraft to collect data on and around the ice sheet: (i) airborne gravity above the continental shelf to infer seafloor geometry, (ii) airborne radar (GLISTIN-A) to measure year-to-year glacier elevation changes, and (iii) airborne-deployed oceanographic instruments (AXCTDs, ALAMO and APEX floats, XBTs, and drifters) to measure year-to-year ocean temperature and salinity changes. After highlighting the mission's operational parameters and key scientific findings, we will detail our rationale for designing the mission to include extensive aircraft-based measurements. Now that OMG has completed its final observational campaign, we will summarize our experience with using aircraft in polar environments and suggest ways in which aircraft could be used to efficiently extend the ocean climate data record started by OMG and the potential for using aircraft in future missions to make similar oceanographic measurements around Antarctica.

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Tuesday, 14 December 2021: 09:54 - 10:02 CST
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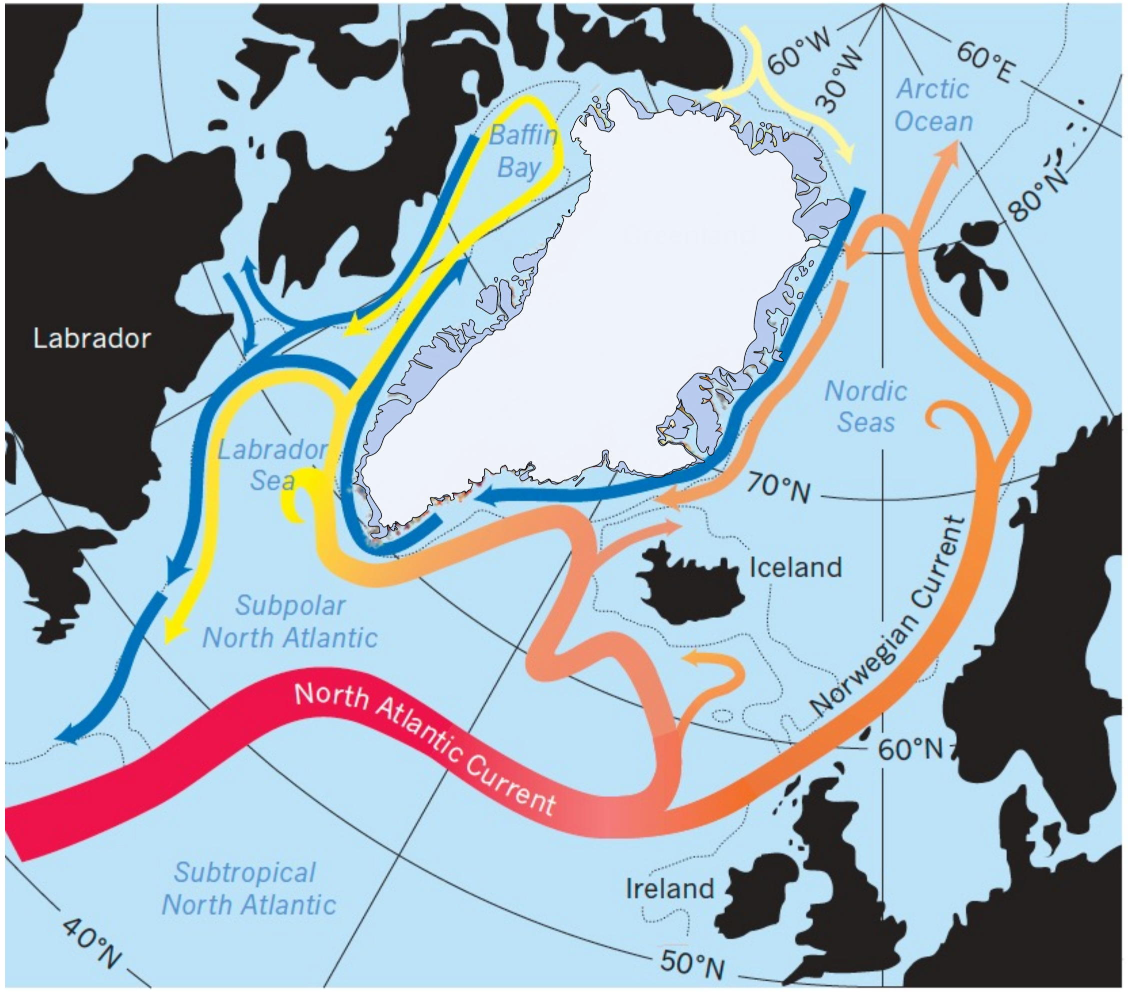

Straneo and Heimbach, (2013)

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In the late 1990's oceanographers detected **a warming signal** in some of these waters while also observing changes in many glaciers that flow into the ocean: frontal retreat, thinning, and accelerating.

When glaciers accelerate, more grounded ice is evacuated to the ocean, **contributing to global sea level rise.**

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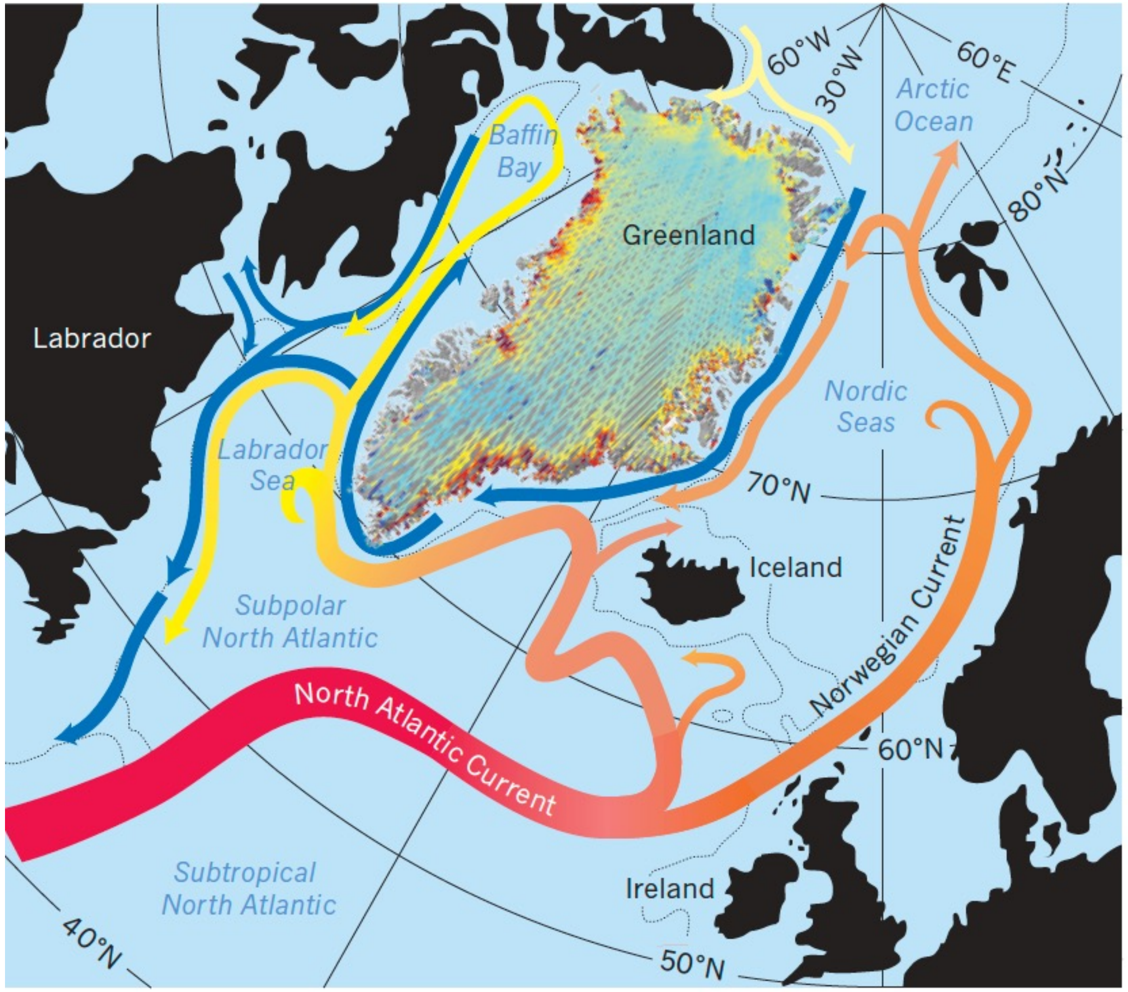

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Interestingly, both sectors have:

1) Many marine-terminating glaciers. (glaciers that flow into the ocean)
2) relatively warm offshore waters

However, at that time there were **extremely few in-situ ocean measurements** near the glaciers and **limited measurements of glacier elevation change**

- no ICESat and pre-ICESat-2

Seafloor Depth (Bathymetry)

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However, many deep canyons cut across the continental shelf and provide a pathway for warm subsurface waters to reach the glaciers.

In the mid 2010's these deep canyons had been identified **but not mapped close to shore**.
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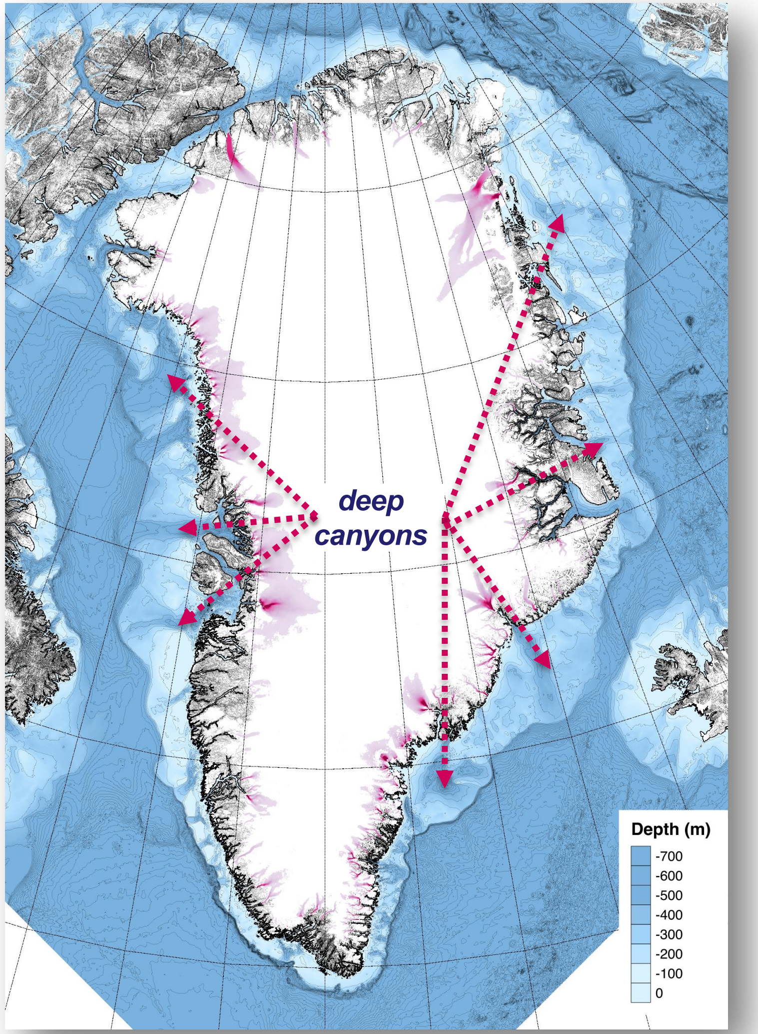

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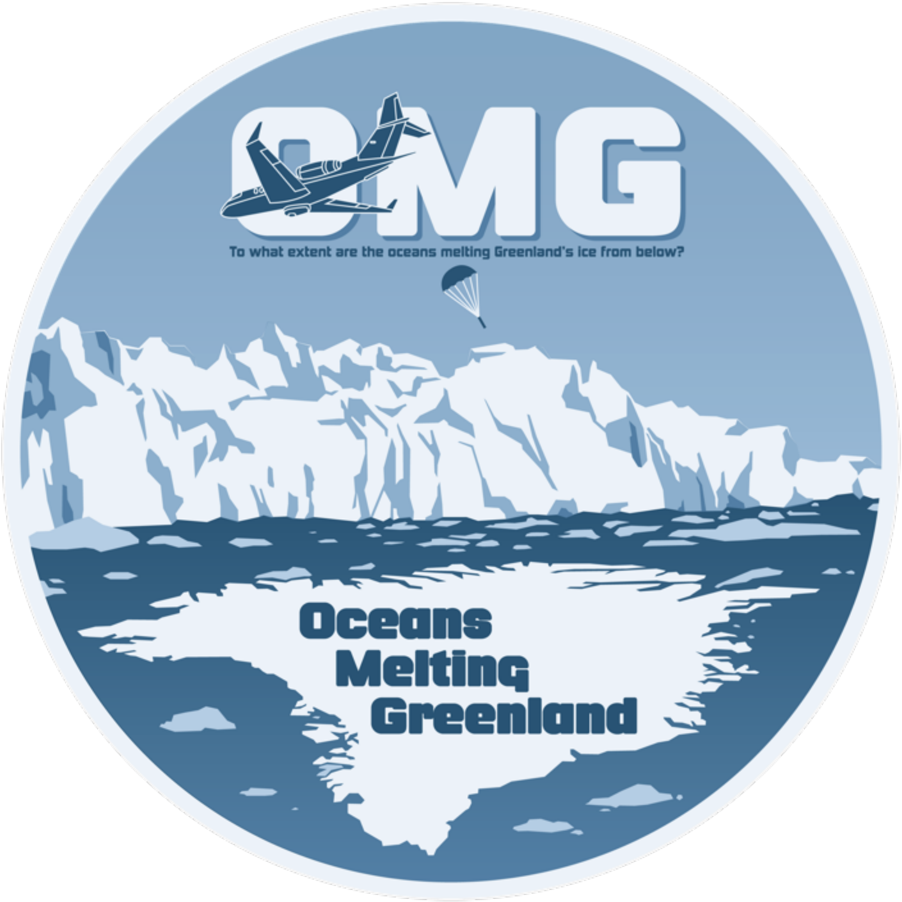

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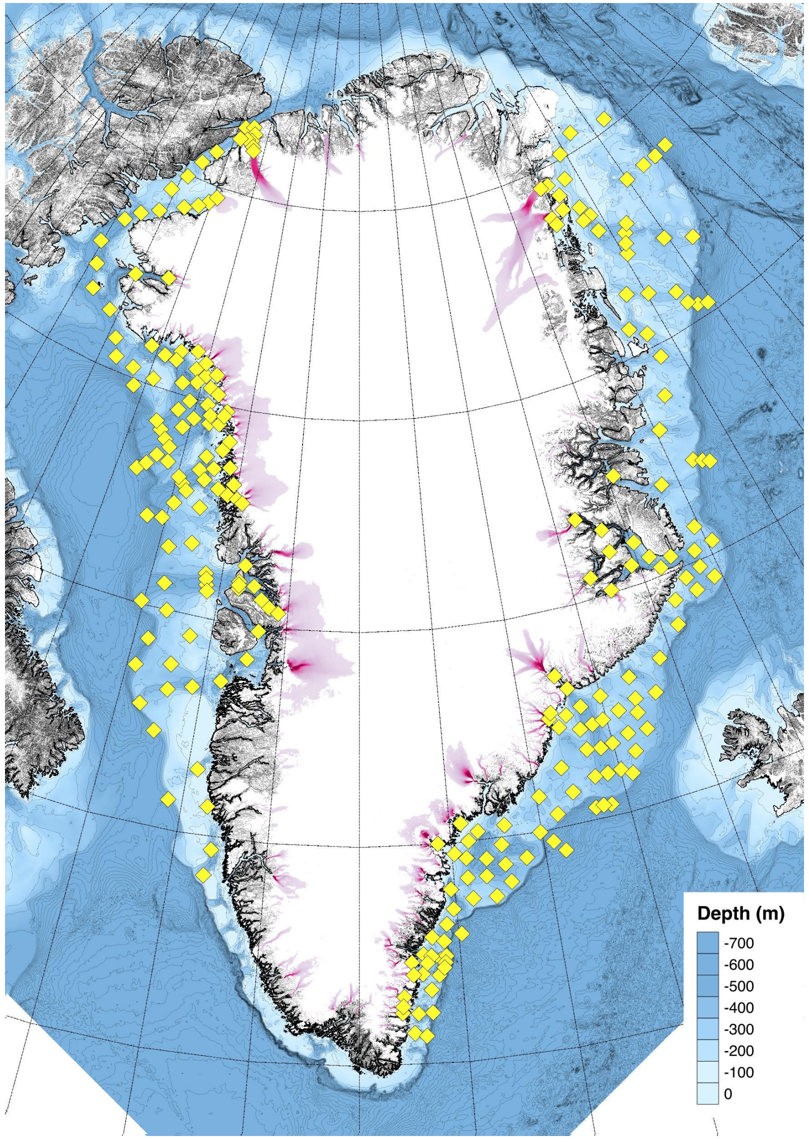

- 250 sites

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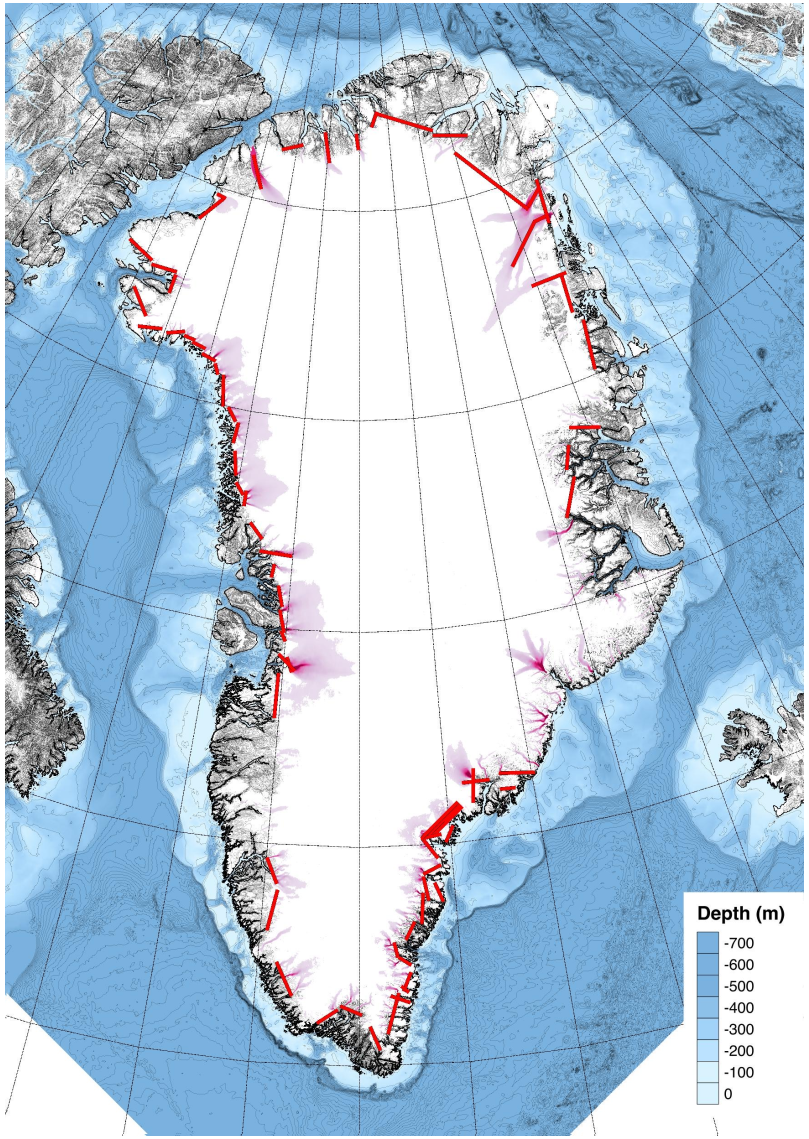

- 82 swaths
- 100 km length (avg)
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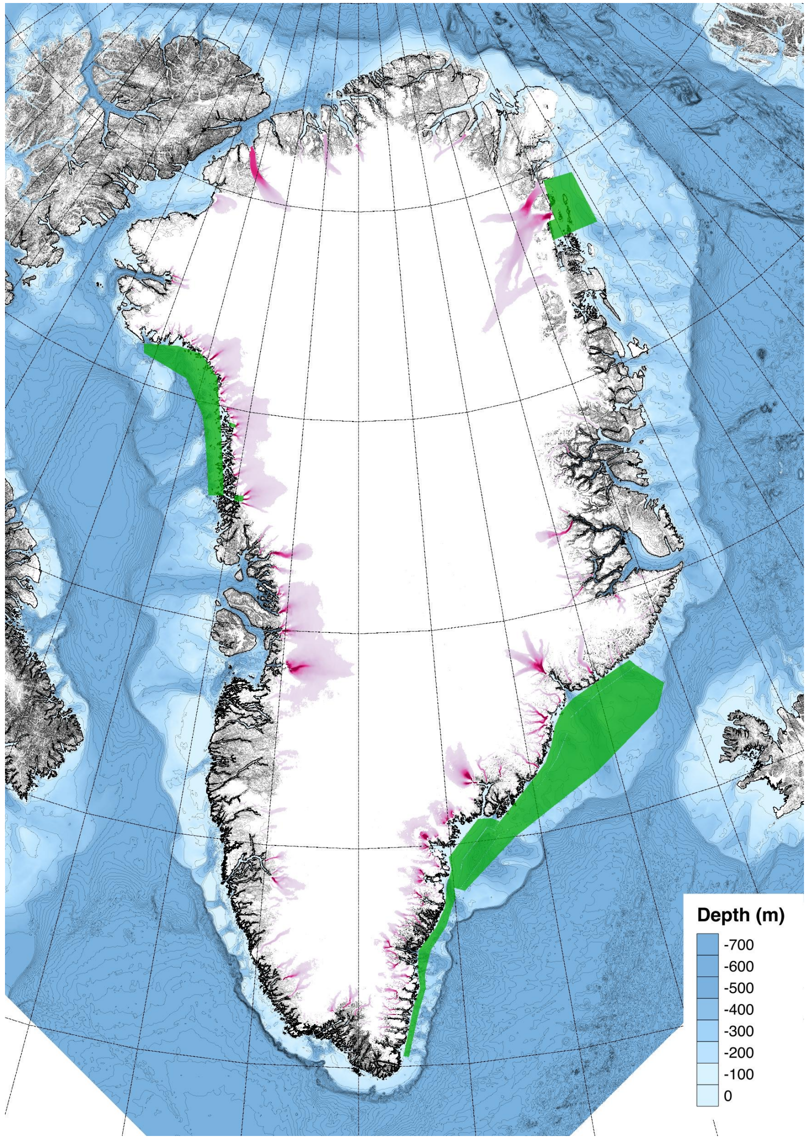

- Total ~140,000 km^2

WHY DID WE DESIGN THE MISSION TO INCLUDE EXTENSIVE AIRCRAFT-BASED MEASUREMENTS?

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"**Earth Venture Suborbital-3 (EVS-3)** program element solicits science proposals for multi-year, Principal Investigator-led, **suborbital** campaign-based investigations to advance Earth system science objectives in order to better understand the current state of the Earth and to predict future change."

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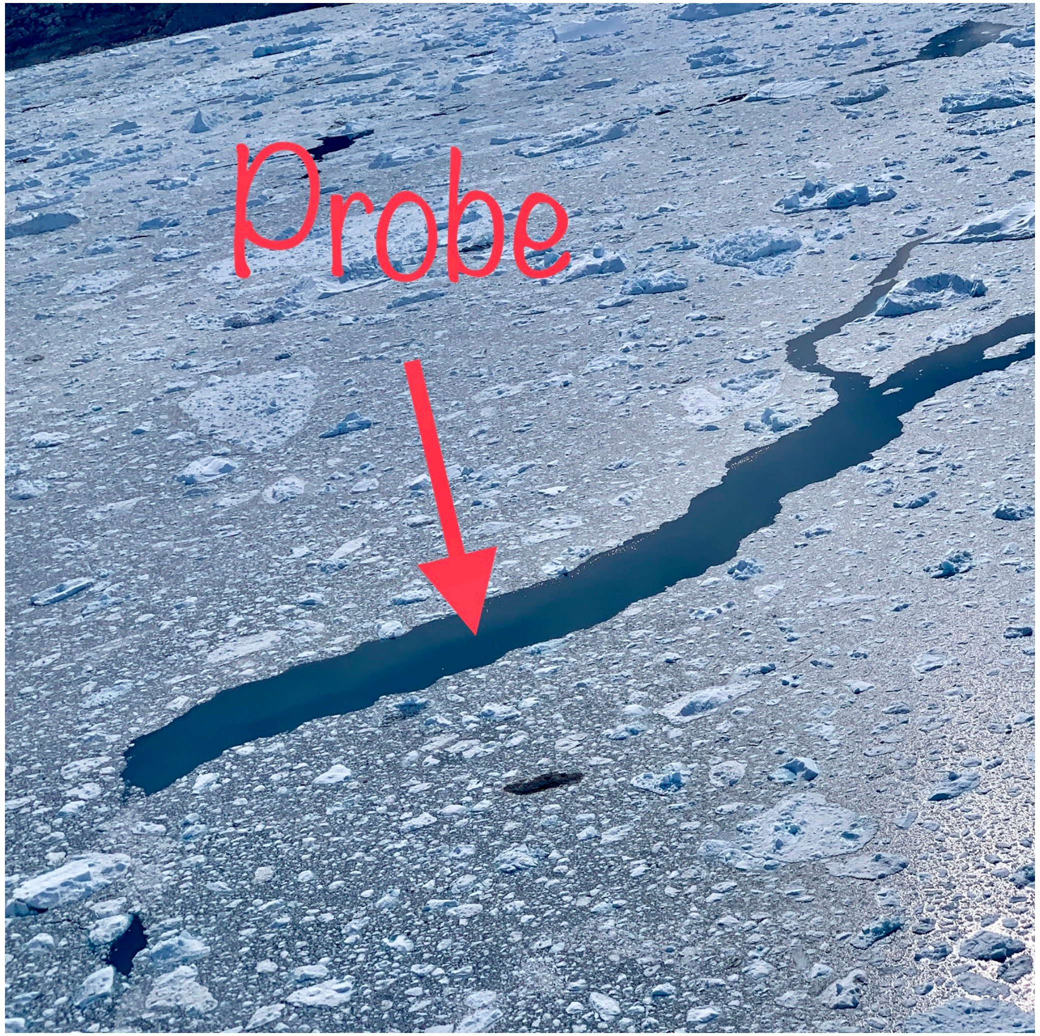

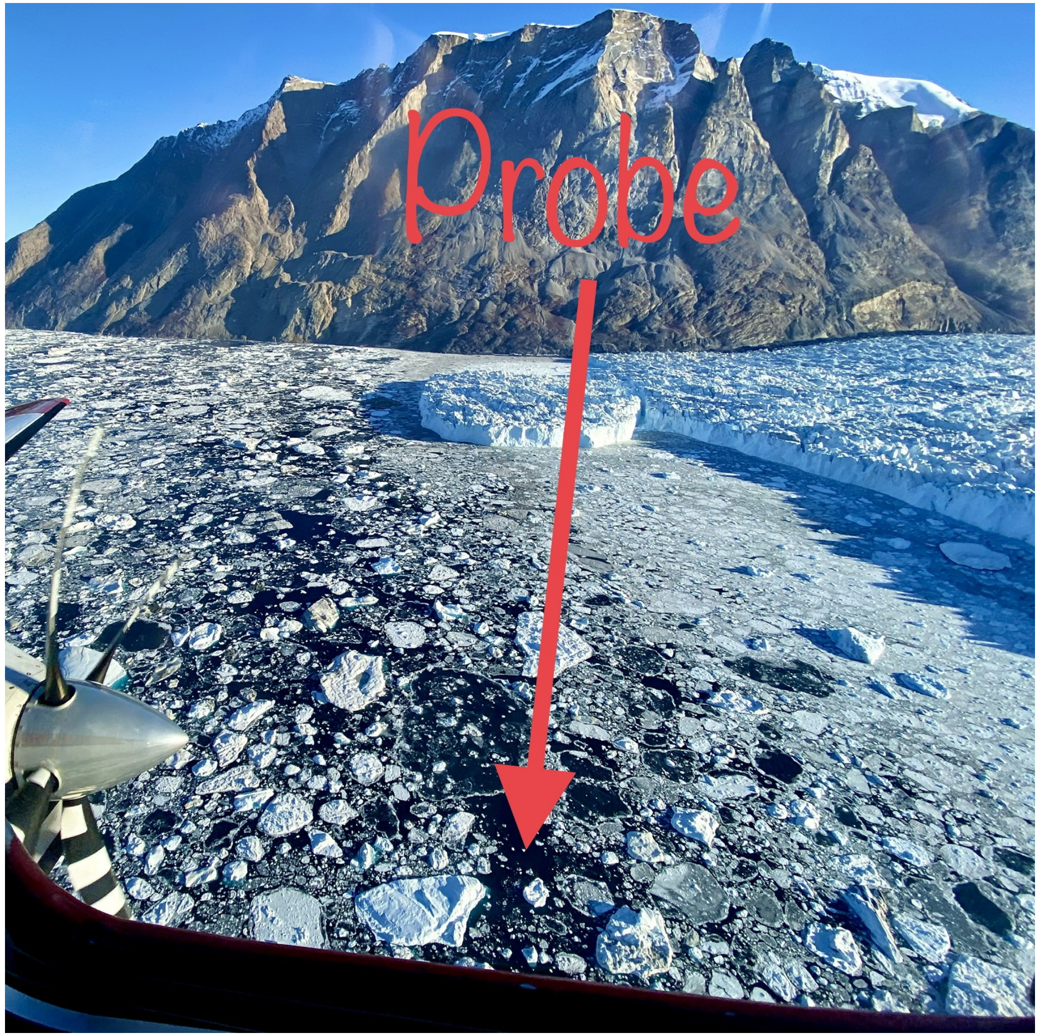

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MID-MISSION AIRCRAFT CHANGES IMPROVED OUR OCEAN SCIENCE DATA RETURN

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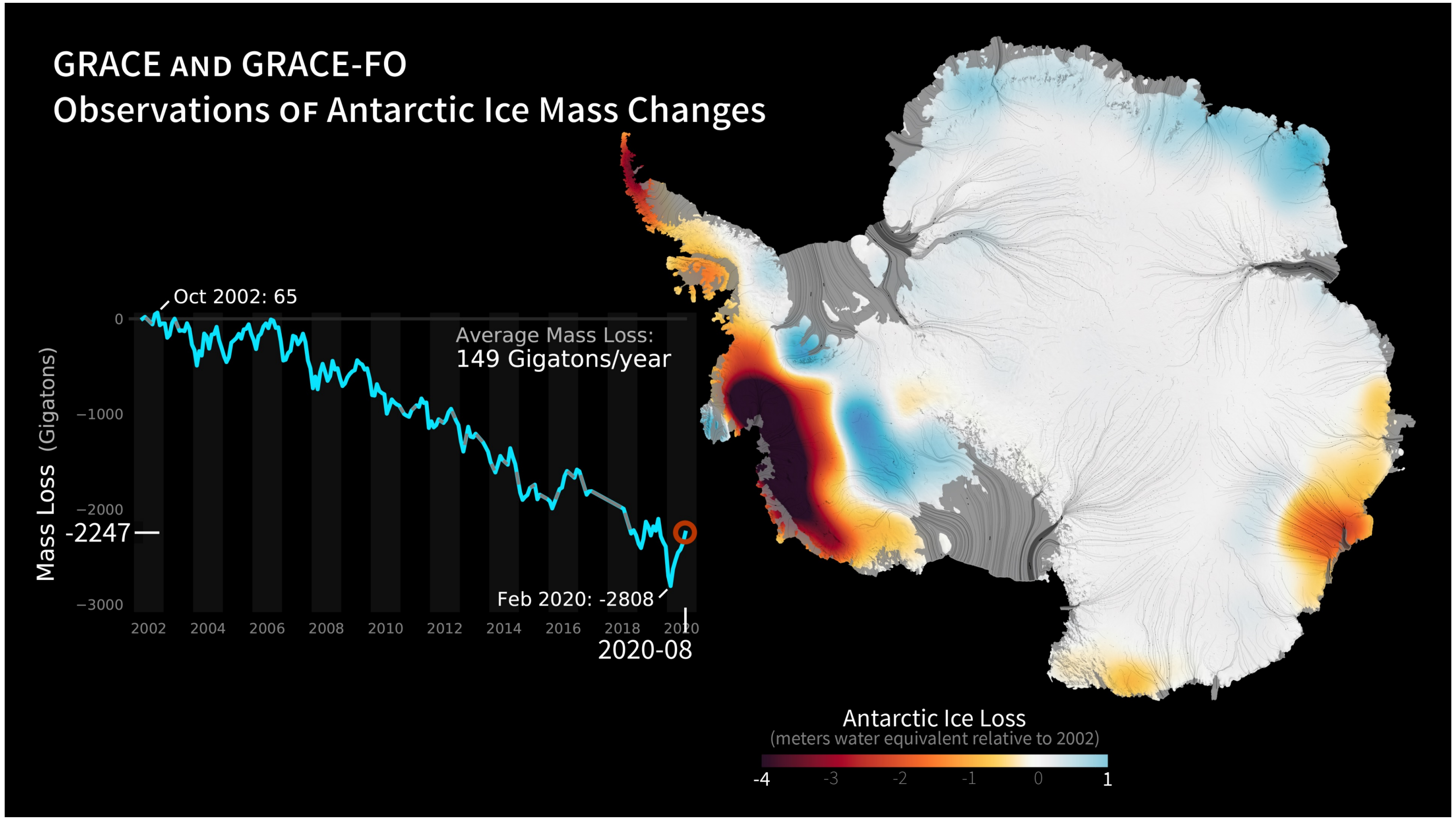

Many of the same challenges that apply in Greenland apply for Antarctica:

1) Very large and varied area
2) Extensive sea-ice & icebergs
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THANK YOU

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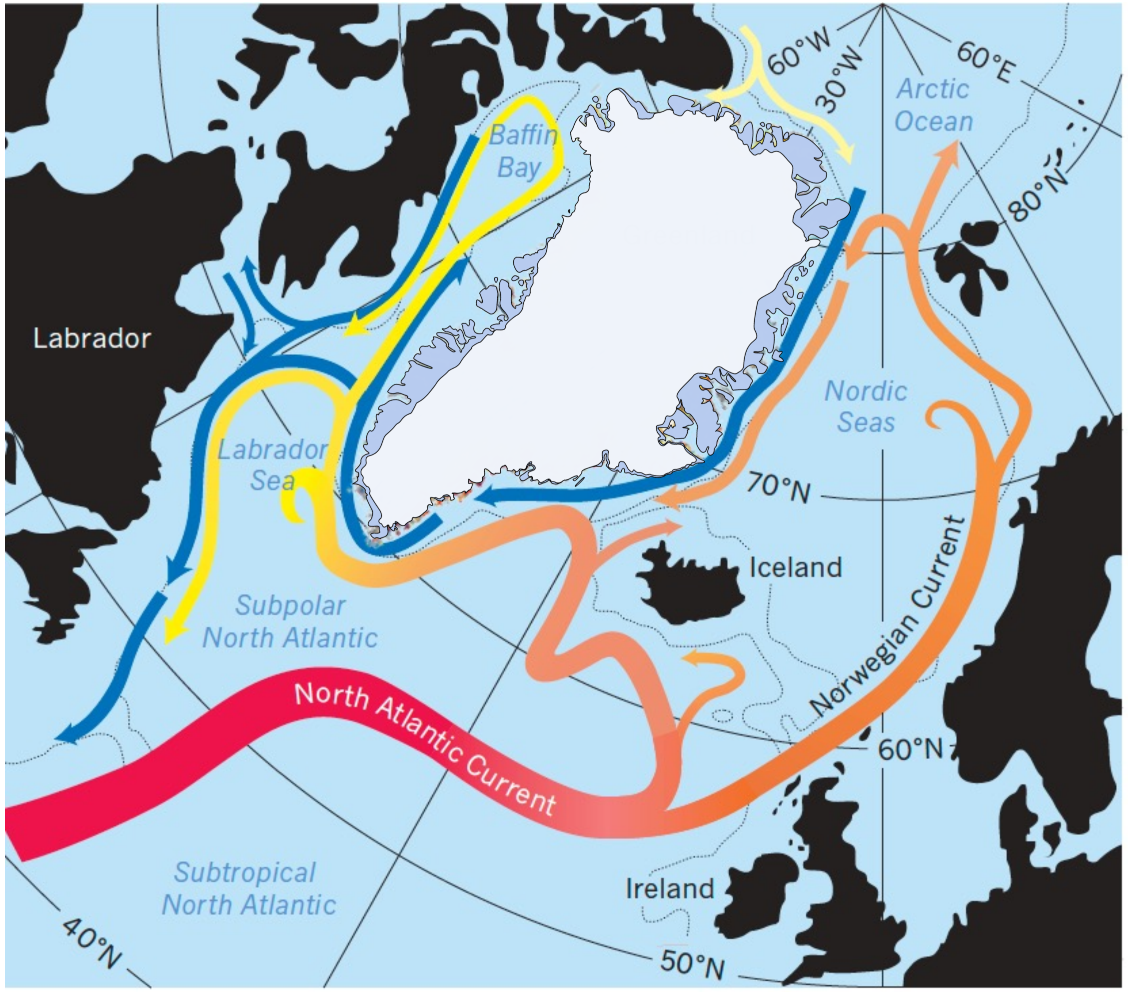

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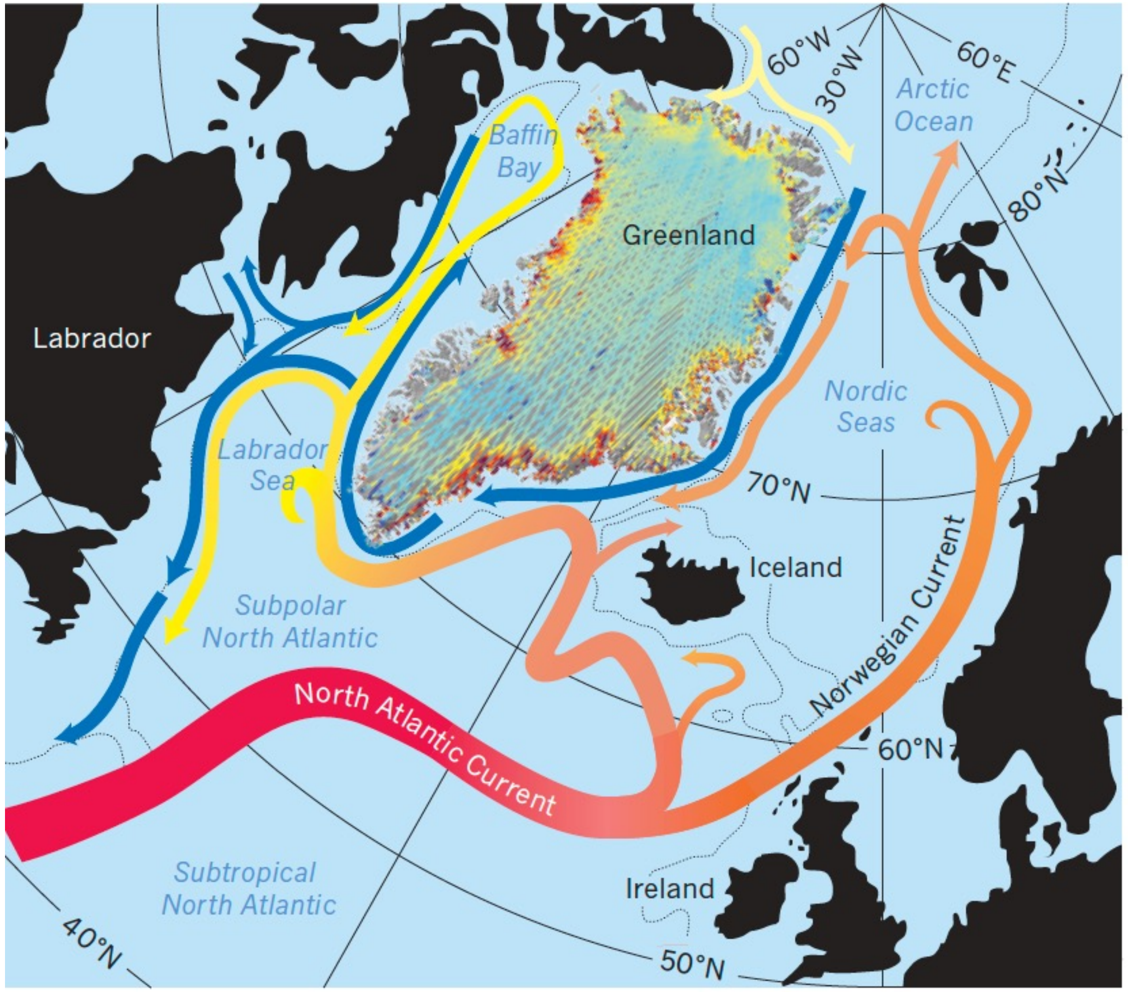

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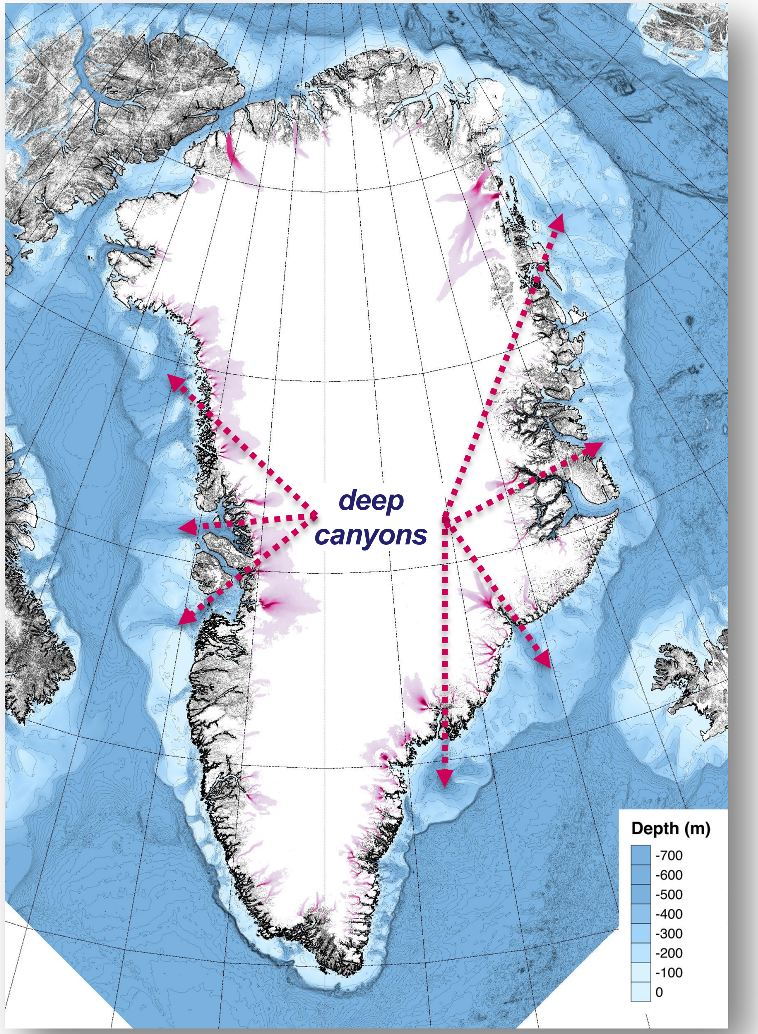

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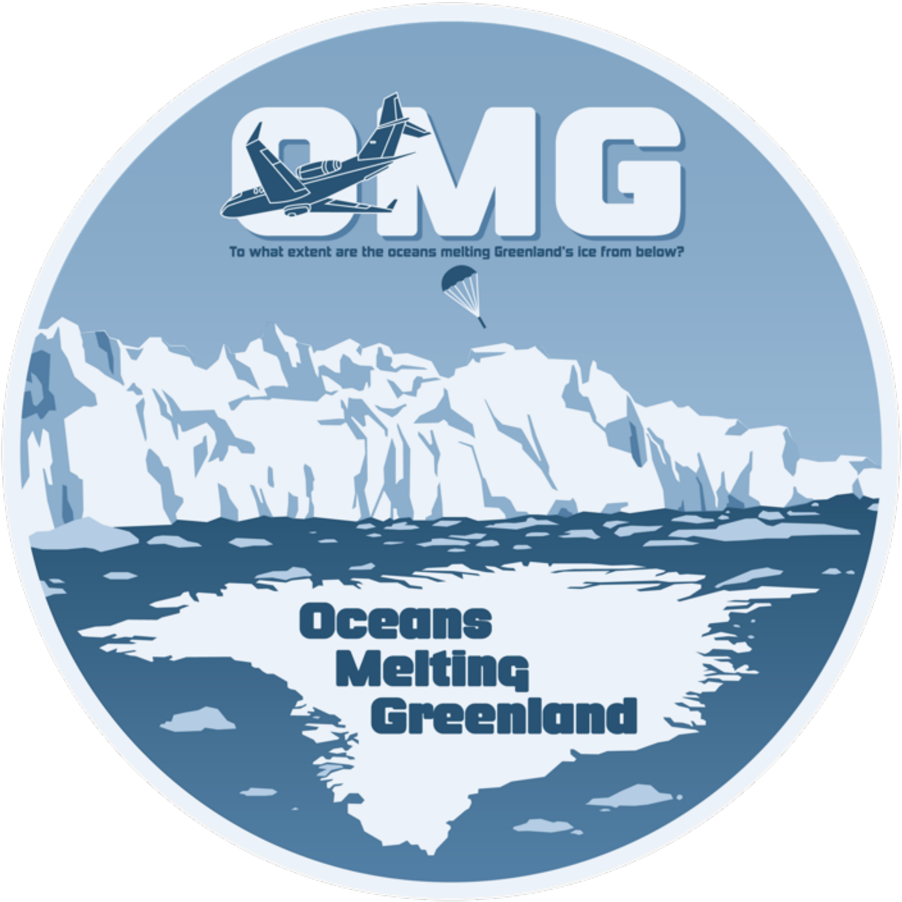

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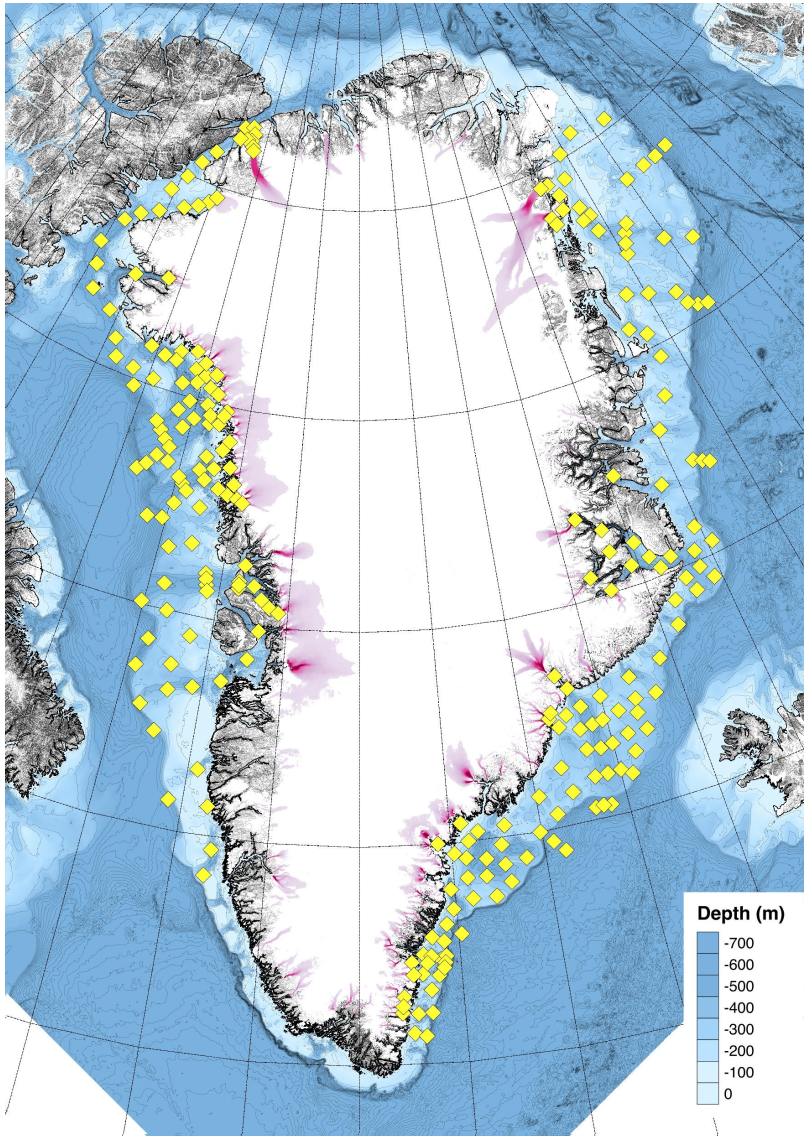

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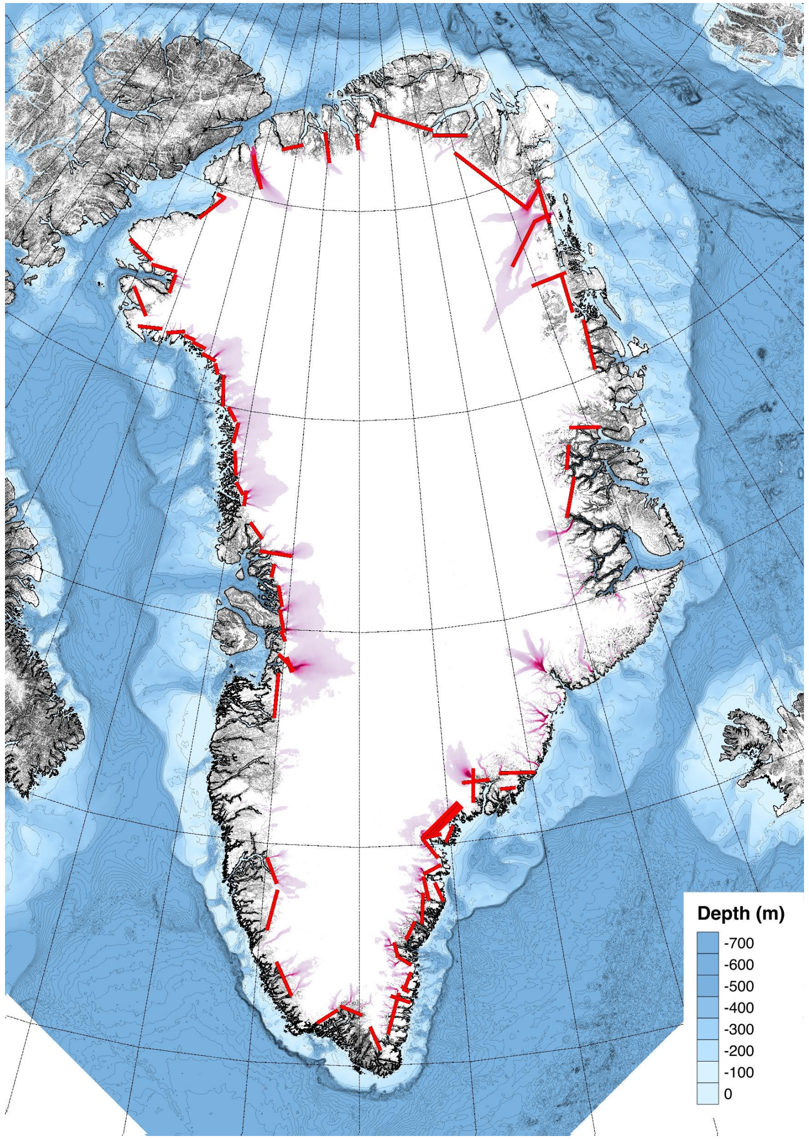

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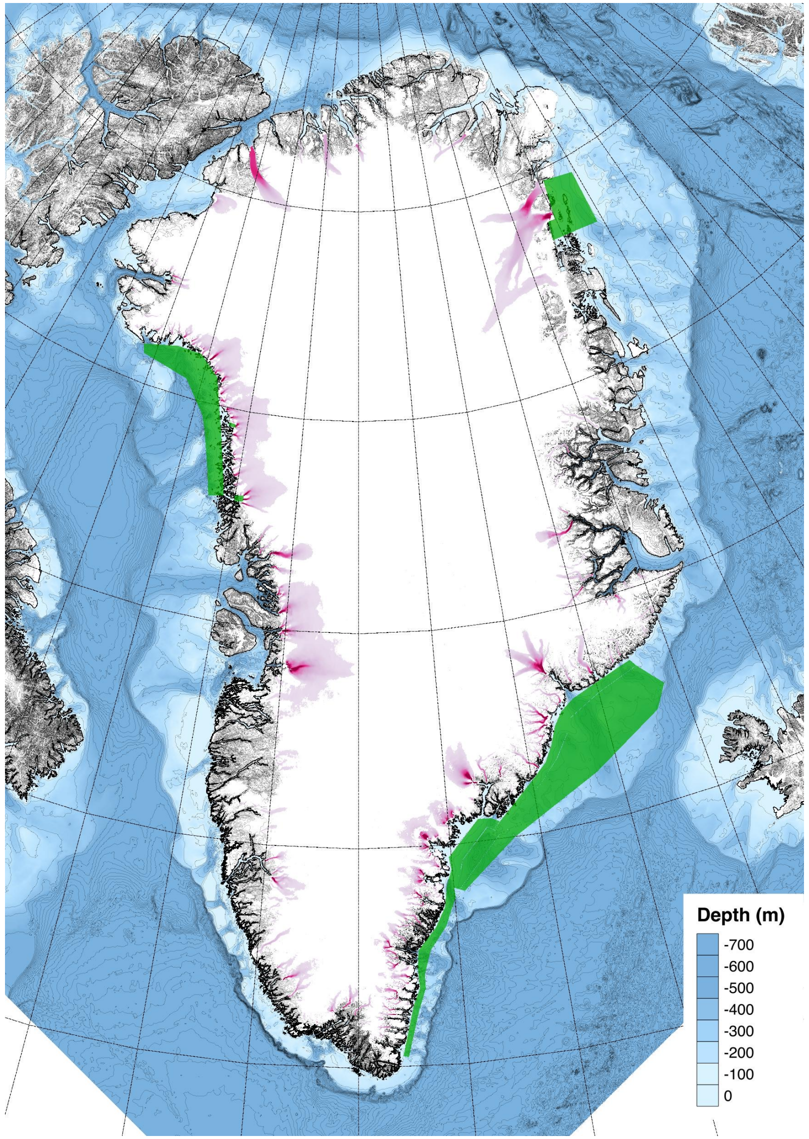

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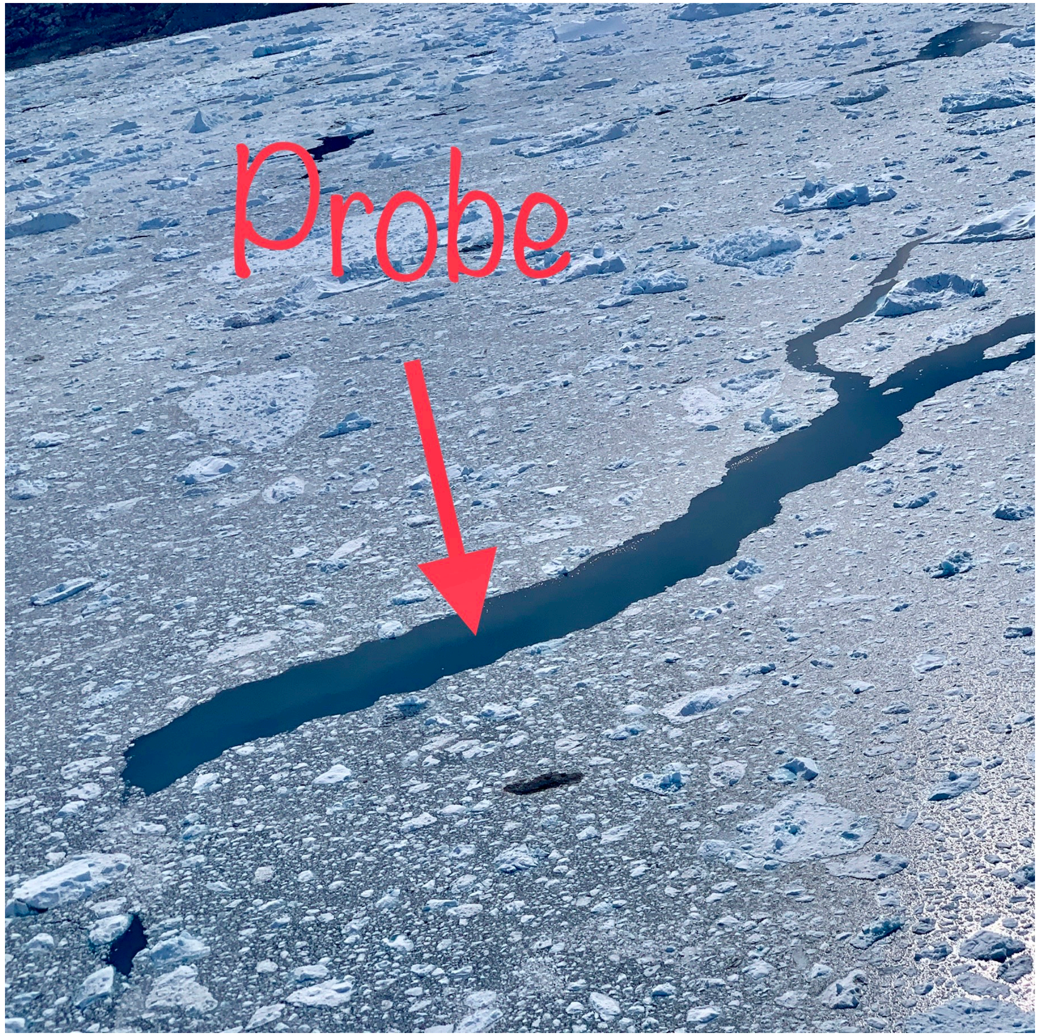
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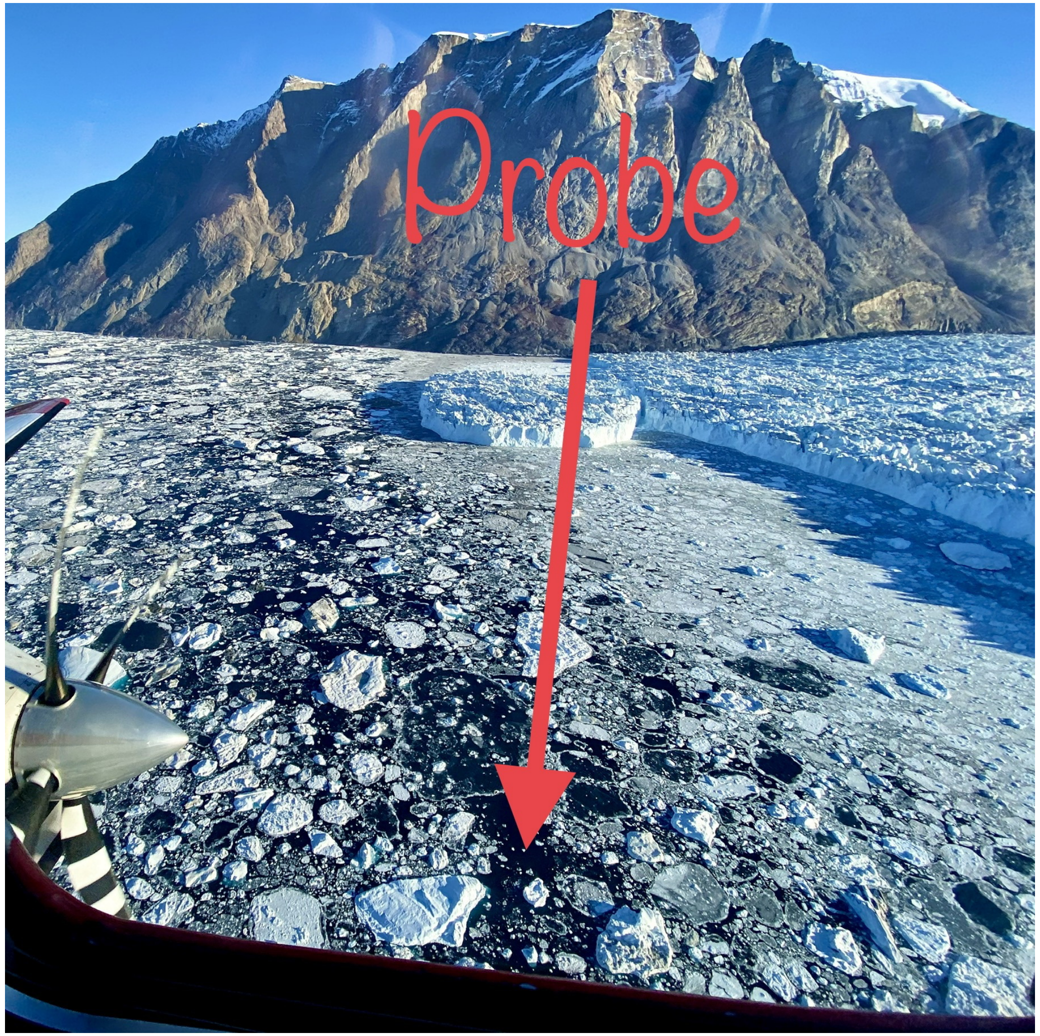
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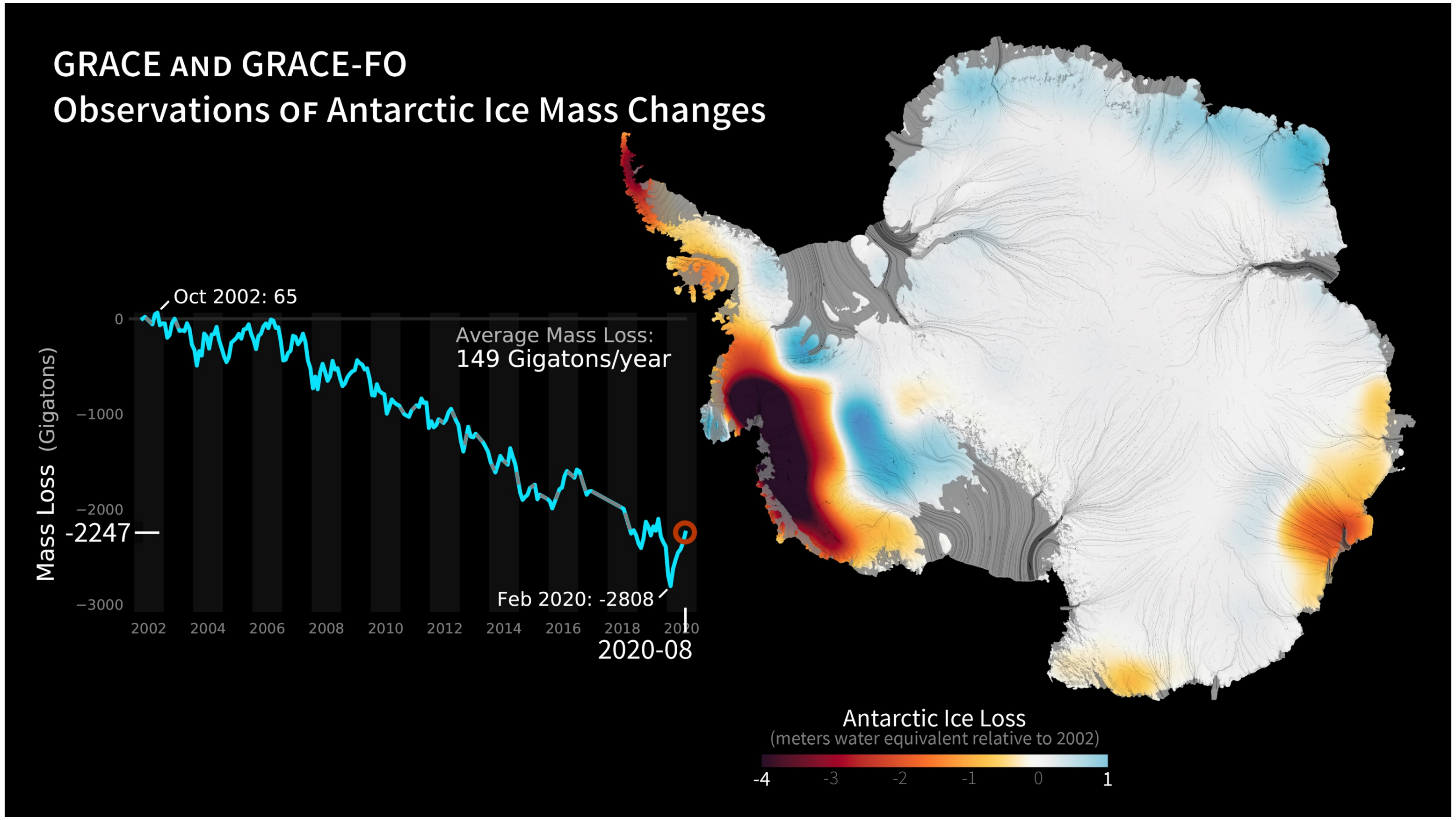

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