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Supplementary Materials for

Petermann Glacier on the brink: Progress, challenges and insights

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Supplementary Material

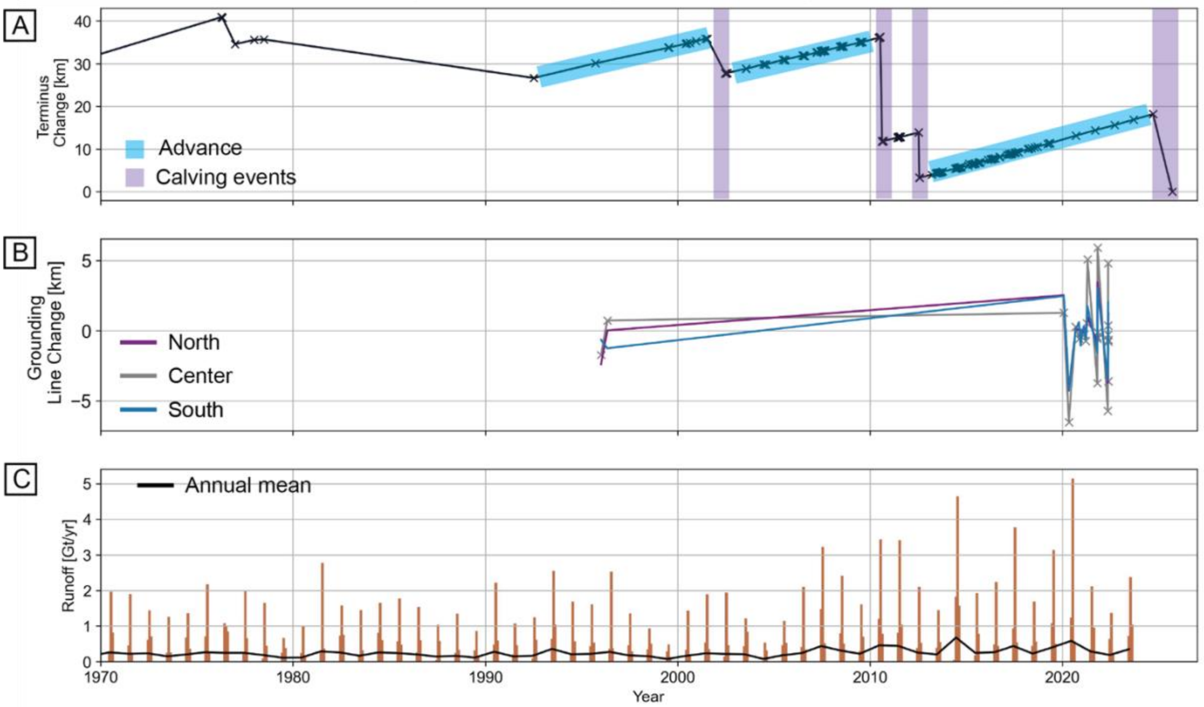

Figure S1 | Terminus and grounding zone change, and subglacial runoff at Petermann Glacier

A) *Terminus position change along the centerline from TermPicks dataset (102, 103) extended to present day using GEEDiT (calculated using MAQiT) (104). Shaded areas mark large calving events (purple) and periods of advance (blue).* ***B)*** *Grounding Line change along the centerline (15).* ***C)*** *Runoff extracted from monthly MAR3.14 (62) reanalysis data as weighted catchment average with annual mean shown in black.*

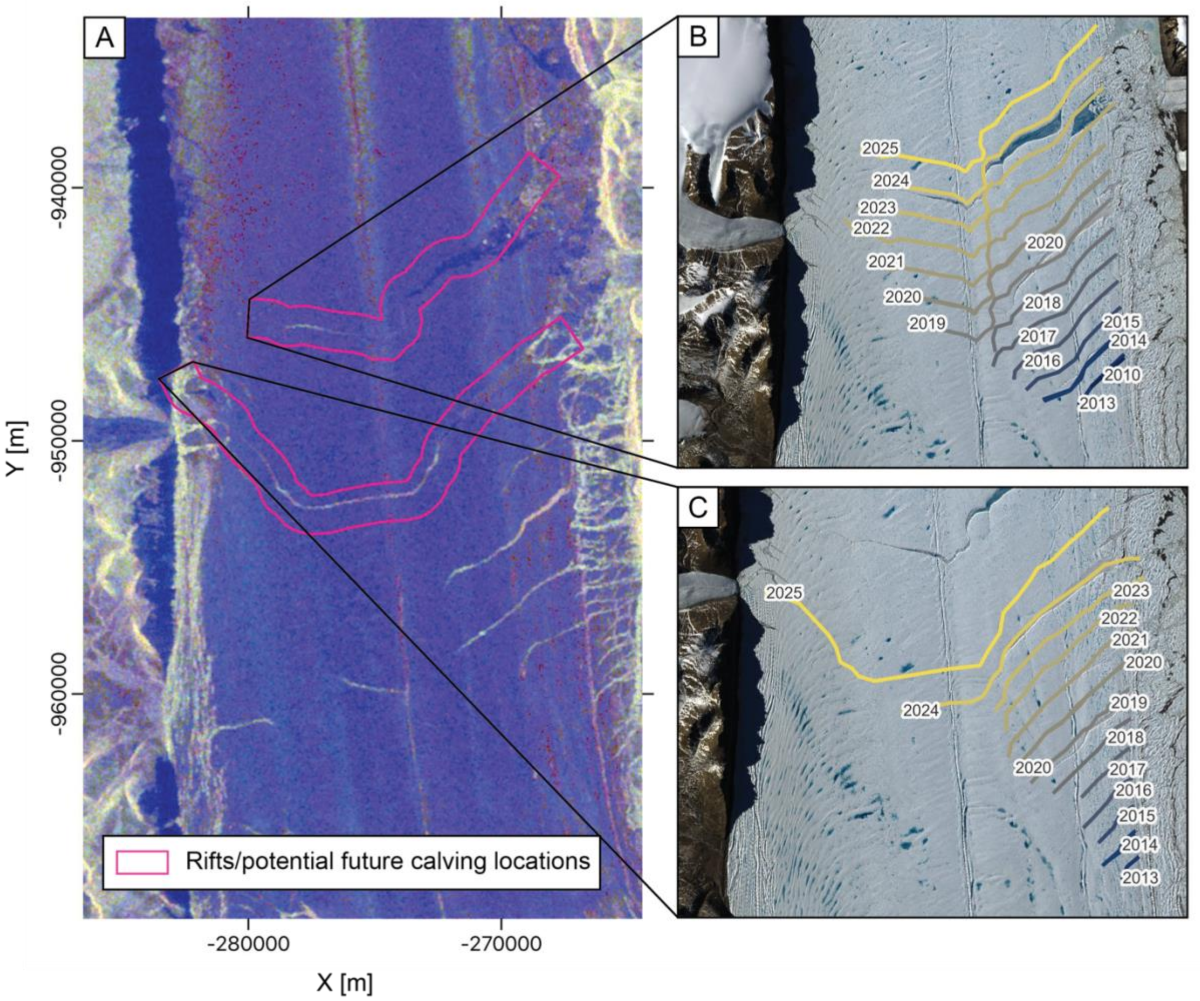

Figure S2 | Sentinel-1 image of ongoing calving event

A) *Stacked Sentinel 1 image (Band1: HH, Band2: HV, Band3: HH): from 19/03/2026 showing two large rifts near the terminus of Petermann Glacier at a distance of ~12.8 and 19 km from the terminus. The rift at 19 km from the terminus appears to have reached the full width of the glacier indicating that a calving event is currently underway.* ***B)*** *Evolution of the rift at ~12.8 km from the terminus delineated using GEEDiT (105) on top of a pansharpened Landsat 8 image from 17/06/2024 (courtesy of USGS/NASA Landsat Program).* ***C)*** *Same as in B) for the rift at ~19 km from the terminus.*

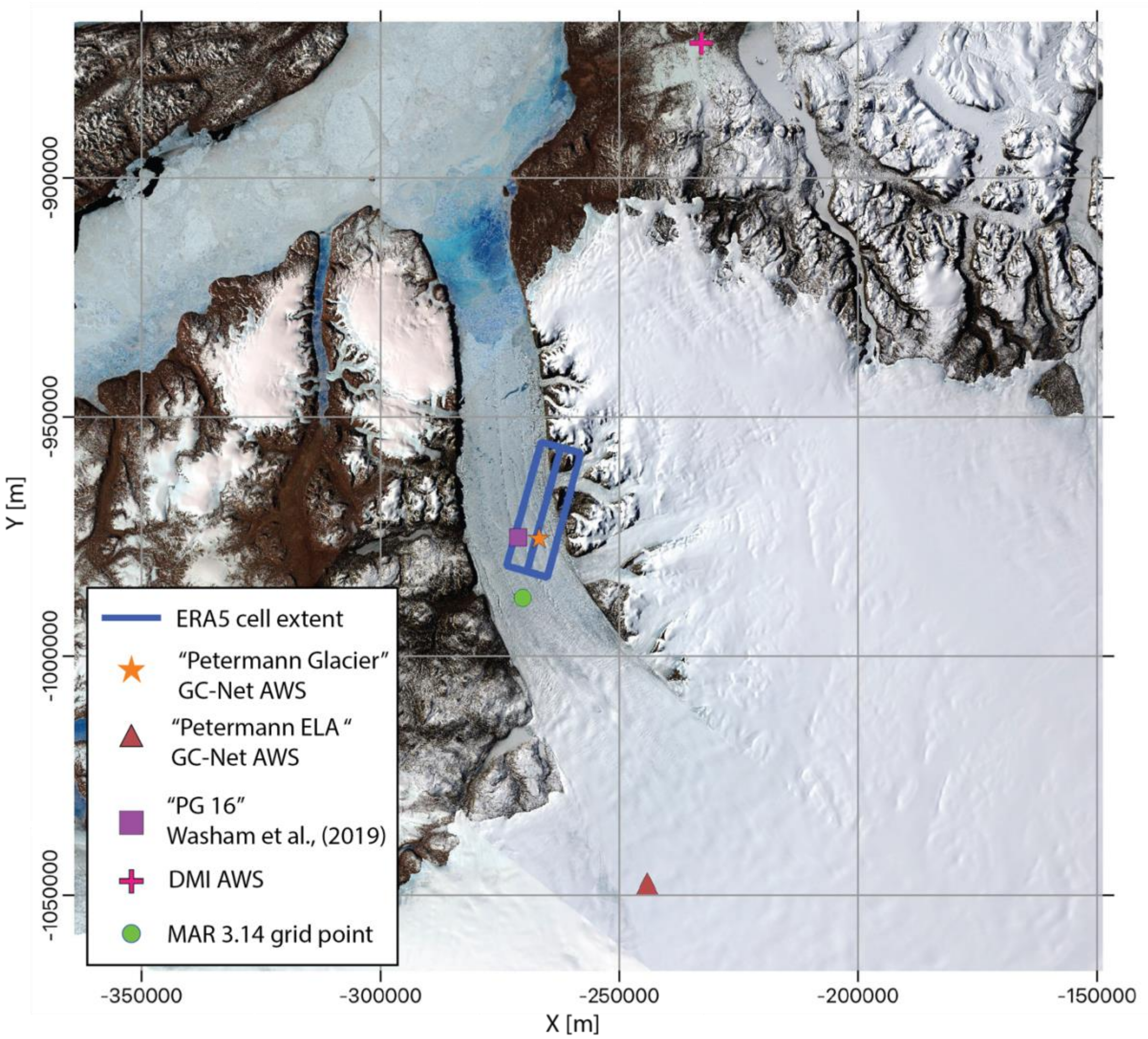

Figure S3 | Petermann weather station overview
Location of ERA5 (61) grid cell, DMI automatic weather station (AWS) in Hall Land (pink cross), GC-Net "Petermann ELA" AWS (red triangle) and "GC-Net "Petermann Glacier" AWS (yellow star) (58, 59), MAR 3.14 grid point (green circle), and PG16 weather station established by the University of Delaware (24). Basemap is a pan-sharpened Landsat-8/9 Mosaic from 17/06/2024 (courtesy of USGS/NASA Landsat Program). Note: Grid cells are equilateral but are distorted due to the Polar Stereographic coordinate system. The X and Y axis are polar stereographic coordinates (EPSG: 3413).

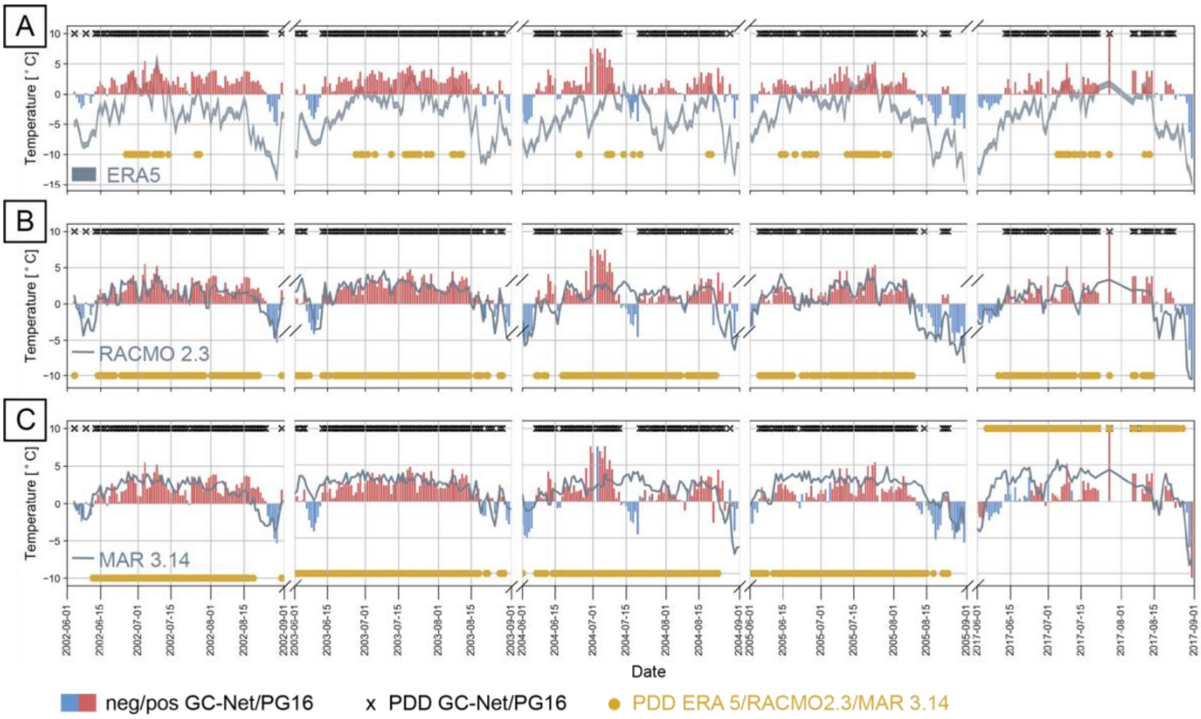

Figure S4 | Positive Degree Day overview

*Positive degree days for **A)** ERA5, GC-Net and PG16, with positive degree days for observational data shown as black x and for reanalysis data as yellow o. **B)** same as A) but for RACMO2.3 reanalysis data. **C)** same as in A) but for MAR 3.14 reanalysis data.*

Table S1 | Overview of solid ice discharge datasets

Overview of solid ice discharge datasets with differences in flux gate locations, velocity products, surface elevation, bedrock topography and temporal resolutions(12, 63, 71–73).

Author	Flux gate distance to 2017 grounding zone	Velocity produts used	Surface elevation	bedrock topography	Temporal resolution
Kochtitzky et al., 2023	~ 5 kilometres	MEaSUREs version 2 (Joughin et al., 2018) ITS_LIVE (Gardner et al., 2019)	Operation Ice Bridge observations (MacGregor et al., 2021) BedMachine version 4 (Morlighem et al., 2017)	BedMachine version 4 (Morlighem et al., 2017)	Decadal
Mankoff et al., 2020	~ 9 kilometers	Sentinel 1 MEaSUREs version 2 (Joughin et al, 2018) MEaSUREs version 2 (Howat et al., 2017)	GIMP DEM (Howat et al., 2014) Surface elevation change rates (Khan, 2017)	BedMachine version 3 (Morlighem et al., 2017)	Monthly
Mouginot et al., 2019	Within 1km of the most retreated grounding line position	Multiple sources (see Mouginot et al., (2019) appendix Table S1)	AeroDEM (Korsgaard et al., 2016) LiDAR ATM (Krabill et al., 2000, Krabill 2010) IceSAT (Zwally et al., 2014) GIMP DEM (Howat et al., 2014) ArcticDEM (Porter et al., 2018)	Direct radar sounder measurements (Gogineni et al., 2001) BedMachine version 3 (Morlighem et al., 2017)	Annually

Table S2 | Decadal mean ice discharge comparison

Comparison of decadal means for each ice discharge data product with change to previous period shown in parenthesis (12, 63, 71–73).

Dataset	Mean ice discharge 1990–2000 [Gt/yr]	Mean ice discharge 2000–2010 [Gt/yr]	Mean ice discharge 2010–2017 [Gt/yr]	Change between 1990-2000 and 2010-2017
Mouginot et al., 2019	10.7	10.6 (-1 %)	11.4 (+7 %)	+ 6 %
Mankoff et al., 2020	12.1	11.4 (-6 %)	11.6 (+2 %)	-4%
Kochtitzky et al., 2023	N/A	10.32	10.42 (+1 %)	+ 1 %

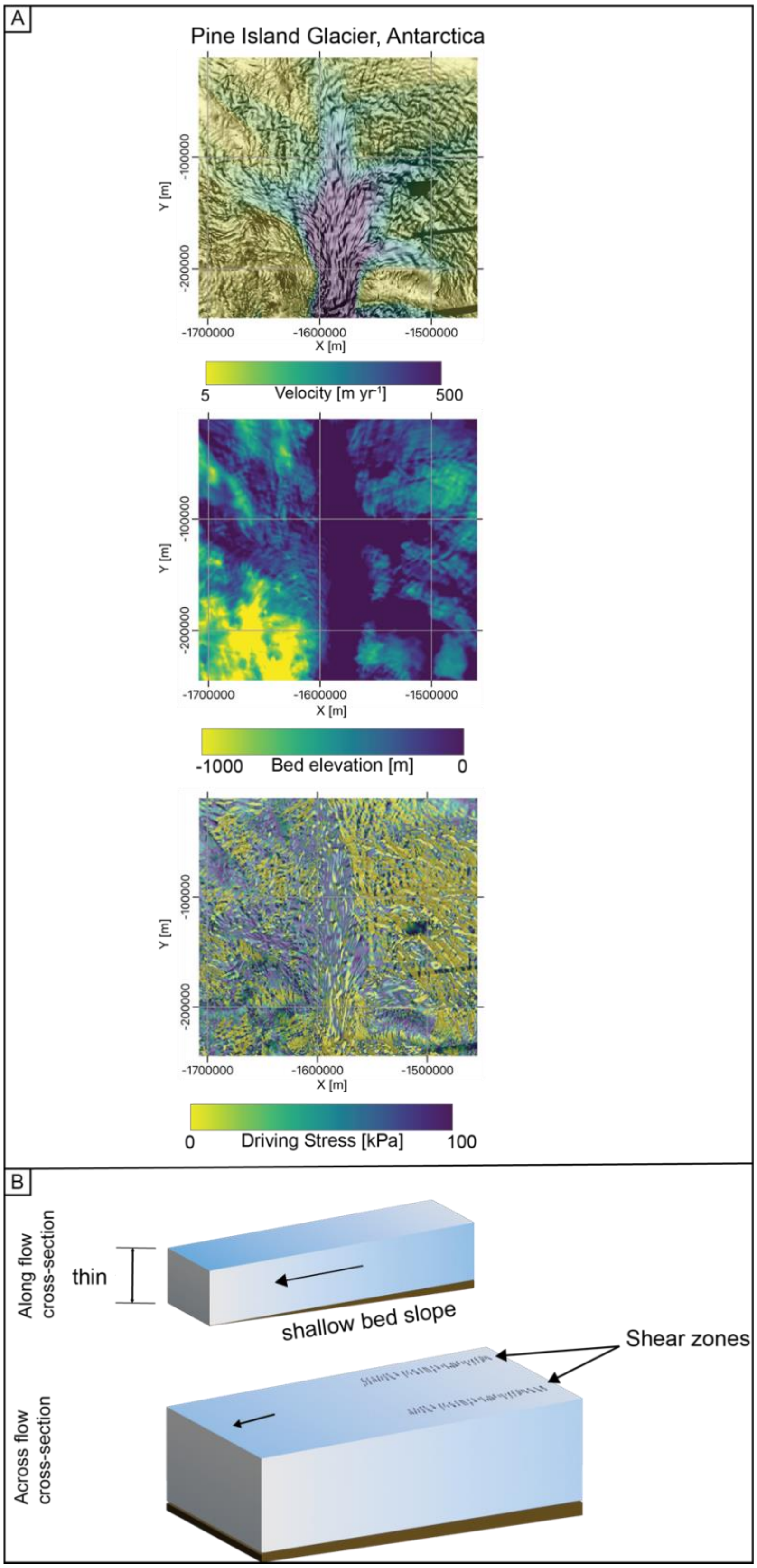

Figure S5 | Onset of Pine Island Glacier Antarctica

A) *Flow-aware hillshade from REMA that mostly highlights the surface expression of basal topographic relief (109) overlaid with a MEaSUREs multi-year velocity mosaic (151–154), bedrock topography from BedMachine Antarctica v4 (155, 156) and driving stress calculated from BedMachine v4 and MEaSUREs multi-year velocity mosaic for Pine Island Glacier, Antarctica. The X and Y axis represents Antarctic polar stereographic coordinates (EPSG: 3031).* ***B)*** *Conceptual sketch for along flow and across flow cross sections for Ice Streams.*

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