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Ice Shelf Area and Ice Shelf Area Change from Sentinel-1 SAR

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Scientific importance of ice shelf area and methodology

The **change in ice shelf area** is an important indicator of ice shelf stability in a warming climate, being affected by grounding line retreat as a possible consequence of ice thinning and calving events at the front, culminating with ice shelf disintegration or collapse.

Ice shelf area changes have been derived with a novel method that was developed to combine the grounding lines derived from Sentinel-1 A/B with contemporaneous Sentinel-1 A/B-based ice shelf fronts. Time series starting in 2015 of complete ice shelf delineations are obtained from annual average calving front and grounding line location. Temporal sampling can be increased if data available.

By analyzing area change based on displacements in the ice shelf front and the grounding line we can attribute area change to either grounding line retreat or ice shelf calving, providing information about the causes of an area change.

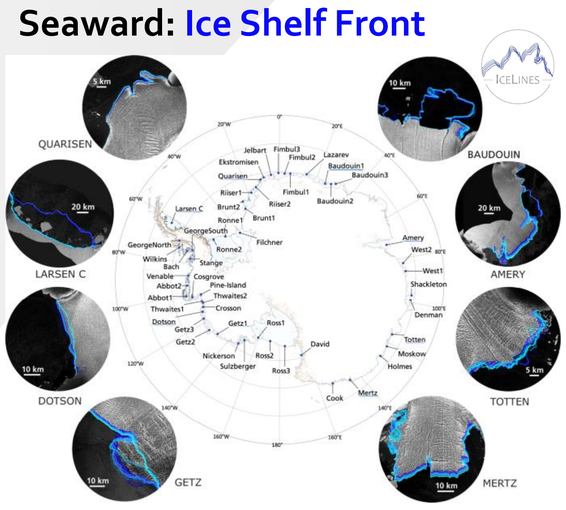
References:

[1] Baumhoer, C.A., Dietz, A.J., Heidler, K. *et al.* IceLines – A new data set of Antarctic ice shelf front positions. *Sci Data* **10**, 138 (2023). https://doi.org/10.1038/s41597-023-02045-x

[2] Ramanath Tarekere, S. et al. (Mar. 11, 2024). "Deep Learning Based Automatic Grounding Line Delineation in DInSAR Interferograms". In: EGUsphere, pp. 1–35

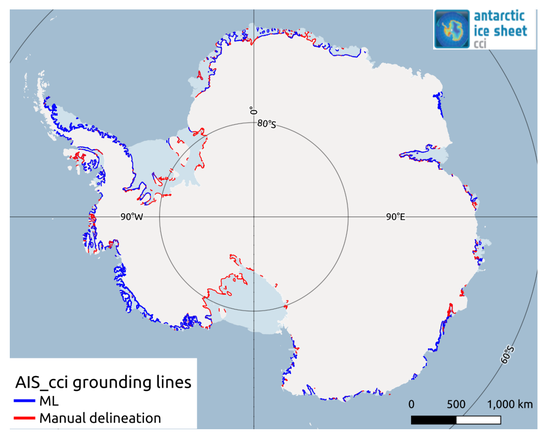
Ice Shelf Boundaries

Seaward: Ice Shelf Front



IceLines: deep learning-based framework providing calving fronts (CF) for Antarctic ice shelves from Sentinel-1 radar imagery [1]. Monthly releases available: https://download.geoservice.dlr.de/icelines/files/

Inland: Grounding Line

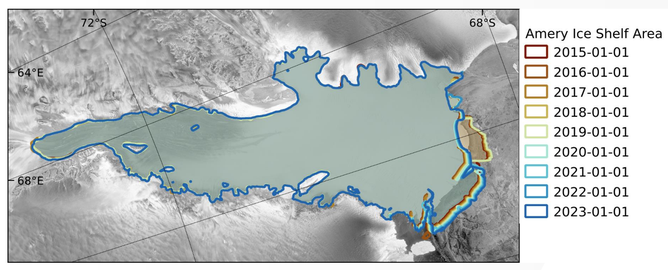


Sentinel-1 A/B InSAR time series (AIS_cci GLL products) and machine-learning delineated [2].

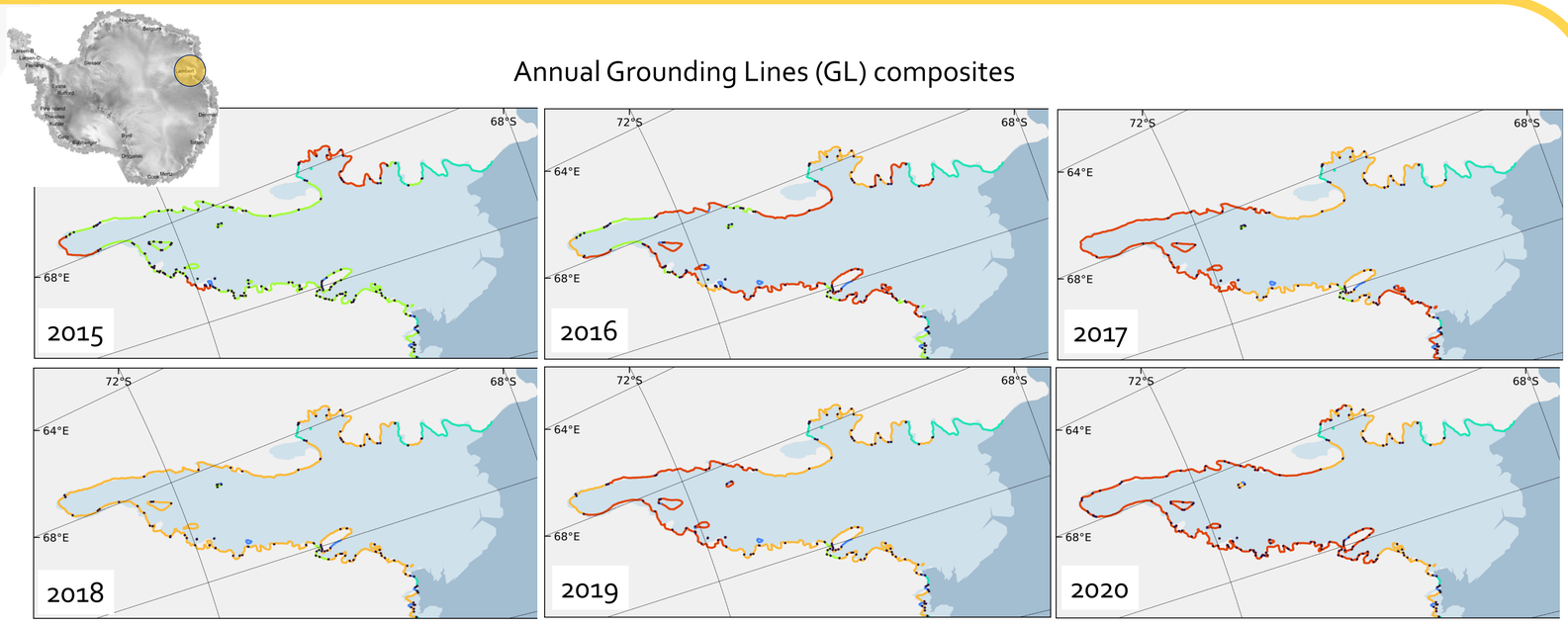
Output: Continuous & gapless grounding line (GL) around selected ice shelves for a desired time period.

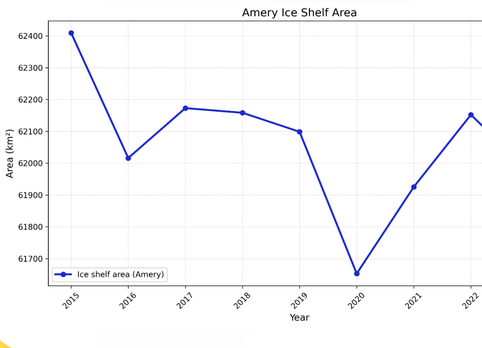
see Poster **L.Krieger: A Novel Method for Creating Complete, Gapless Lines From Fragmented 2D Data of Antarctic Grounding Line Measurements.**

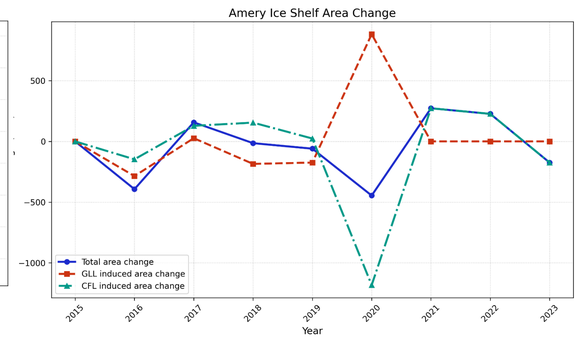
1. Amery Ice Shelf/Lambert Glacier



Input:
- Annual CFs 2015 – 2023
- Annual GLs 2015 – 2020
- Static GL 2021-2023





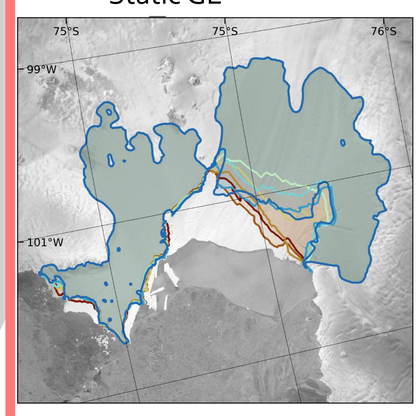


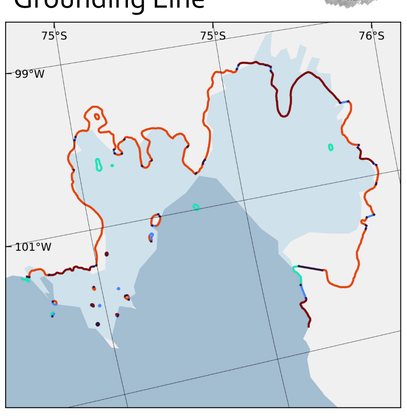
Output:
- Annual ice shelf perimeter1* from 2015 to 2023
- Annual total ice shelf area
- Separated contributions to the total area change

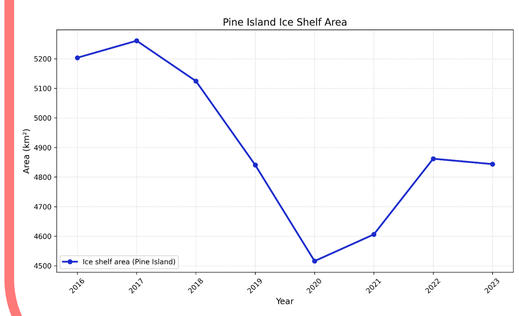
*The combination of a gapless calving front and a gapless grounding line forms the ice shelf perimeter.

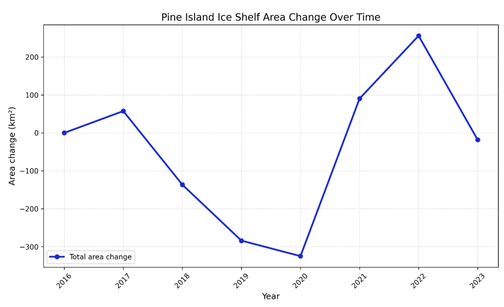
2. Pine Island Glacier (PIG)

Input:
- Annual CFs 2016 – 2023
- Static GL

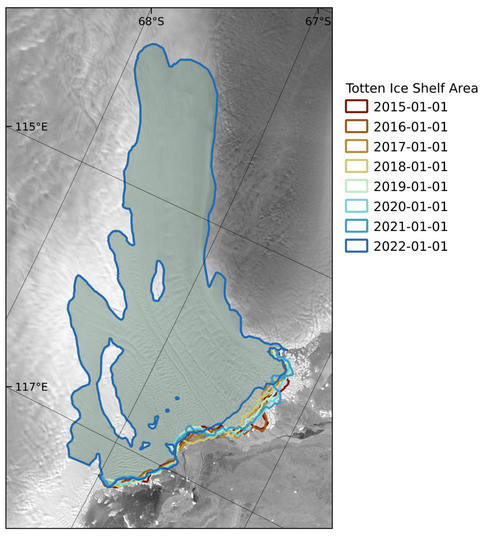


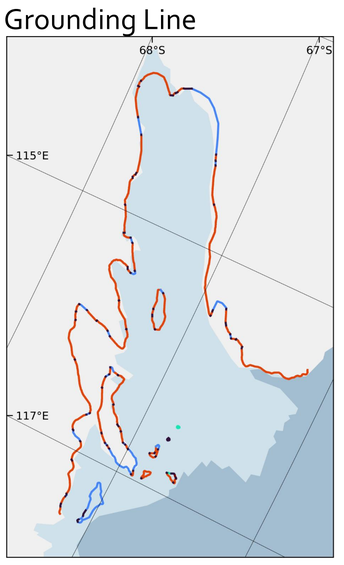




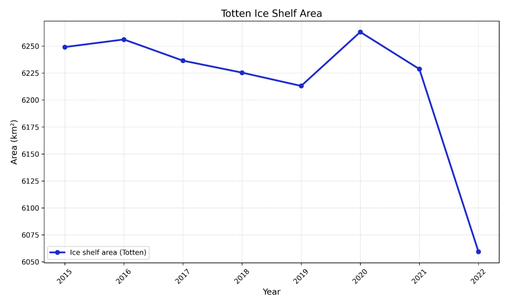


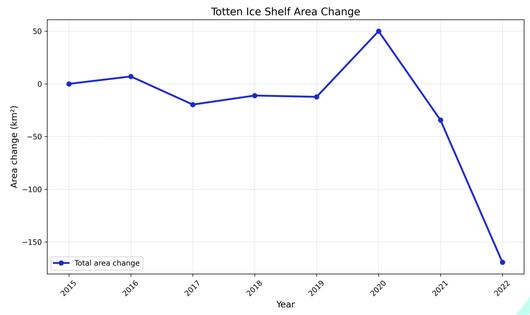
3. Totten Glacier





Input:
- Annual CFs 2015 – 2022
- Static GL





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