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Relating changes in seabed properties and retreating glacier fronts in West Antarctic fjords

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Content

ICEBERGS project: 3 West Antarctic Peninsula Fjords with retreating glaciers. Using sound waves to investigate present day glacier dynamics. Changes to seabed in front of glaciers over time. Changes to glacier fronts over time.

Message

There has been considerable delay in our data analyses and this presentation presents snap shots of datasets and the rationale behind the study.



- West-Antarctic Peninsula glaciers generally retreat from fjords due to warm(ing) oceans (Cook et al., 2019).
- Climate-driven factors also include air temperature, and both surface water temperature and deep-water temperature needs considering.
- Local (and unique) fjord conditions include morphology of fjord (incl. topographic restrictions slowing down retreat), (reverse) slope of bed on which margin is grounded, basal drag from underlying bedrock, erodibility of subglacial sediments,...

The ICEBERGS project

ICEBERGS: IMPACTS OF DEGLACIATION ON BENTHIC MARINE ECOSYSTEMS IN ANTARCTICA

UK-Chile Collaboration (NERC - CONICYT): Three research cruises on RRS James Clark Ross, 2017, 2018 and 2019-20



https://earth.google.com/web/@-89.13857172,24.48667778,988.966593 83a,12993406.02566242d,35y,272.742 01883h,0t,0r

Site selection based on study by Cook et al. (2016).



Changes to seabed in front of glaciers over time.

-> How important are seabed geological factors in retreat dynamics?

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FJORD 1

Marian Cove King George Island South Shetland Islands







Using sound waves to help document the seabed:

MBES bathymetry + Backscatter Intensity (-> Seabed composition) (stars represent sample sites: grabs, multi-cores, video etc.)







William Glacier Börgen Bay Anvers Island

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MBES bathymetry

Börgen Bay

(stars represent sample sites: grabs, multi-cores, video etc.)





Sheldon Glacier

Ryder Bay / Sheldon Cove Adelaide Islands



MBES bathymetry Sheldon Cove

(stars represent sample sites: grabs, multi-cores, video etc.)

Barnes et al., 2020

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3 Field seasons => time-lapse data

Repeat bathymetry data => changes in erosion and deposition over time.

Repeat backscatter data (ground-truthed with sediment samples: changes of sediment composition over time) -> hampered by data coverage and quality due to vessel turning to avoid icebergs...

From repeat MBES bathymetry data in **Börgen Bay:**



Changes to glacier fronts over time.

-> How diagnostic is 3D geometry of ice front (upwards from grounding line)?

The shape of the ice fronts near the grounding zone?



Unpublished work

William Glacier ice front, **Börgen Bay**

Correlation between seabed characteristics and ice margin morphologies Do undercut areas correlate with erosion? © Authors. All rights reserved

William Glacier ice front, Börgen Bay

Unpublished work



Preliminary observations

- Variations along the fronts and variations from year to year in these fjords:
- Ice front morphology
- Ice front retreat rates
- Seabed erosion and deposition (sediment discharge)

How do these variations relate to detailed variations in water properties, fjord geomorphology, hinterland geology, sediment discharge (erosion and deposition),...? -> ongoing work (delayed progress in quantifications and laboratory analyses...)

Glacier retreat best explained as a product of "simply" both oceanic and atmospheric warming, or do local conditions shape the response of the margin? Oceanographic, geological and glacial elements to be investigated to disentangle factors impacting ice retreat observed in these West Antarctic Peninsula fjords. 17

References

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Cook A.J., Holland, P.R., Meredith, M.P., Murray, T., Luckman A., Vaughan, D.G. (2016) Ocean forcing of glacier retreat in the western Antarctic Peninsula. Science 353, 283–286. DOI: 10.1126/science.aae0017