



UNIVERSITY
OF OSLO



INSTANT
INSTABILITIES & THRESHOLDS IN ANTARCTICA

SUBICE workshop 2026 (Oslo)

August 15–16, 2026

Professorboligen, Universitetet i Oslo, Karl Johans Gate 47

Oslo

Norway



Workshop overview

During the weekend of the 15th–16th August 2026, immediately following the Scientific Committee on Antarctic Research (SCAR) Open Science Conference (OSC) in Oslo, a workshop was organized to build upon the first “sub-ice” workshop in October 2023 in Maydena, Tasmania, Australia. The details of that workshop can be found [here](#).

The overarching aim of the SUBICE workshops is to gather scientists across a wide array of institutes and disciplines to discuss uncertainties, exchange ideas, and clarify new research directions pertaining to the sub-ice environment (termed the “ice-bedrock interface zone”, as shown in the above image). The 2026 workshop had a particularly strong Antarctic focus considering its timing and location relative to the SCAR OSC, with key driving themes relating to growing community initiatives such as [RINGS](#), [InSync](#), [Antarctic Boundary Conditions \(ABC\)](#), and GeoBRIDGE aiming to improve observational data coverage across Antarctica and refine the connection between sub-ice observations and ice sheet modeling. The workshop consisted of several invited talks providing various perspectives from the sub-ice community, brainstorming and breakout activities to fuel discussions, and more informal conversations during group lunch and dinner on Saturday (i.e., 17th August). The workshop ran until lunch-time Sunday, with a separate cryoseismology workshop scheduled in the afternoon. Over the course of the weekend, 34 scientists from 20 different institutes attended the workshop.

List of attendees

Name	Institution	Email
Conor Bacon	NORSAR	conor.bacon@norsar.no
Emeric Babut du Marès	The Arctic University of Norway	emerich.m.mares@uit.no
Kim Bente	University of Tasmania	kim.bente@utas.edu.au
Luca Creatini	University of Bologna	luca.creatini03@gmail.com
Knut Christianson	University of Washington	knut@uw.edu
Fiona Clerc	Stony Brook University	fiona.clerc@stonybrook.edu
Megan Kerr	University of Texas Institute of Geophysics	megan.kerr@utexas.edu
Fausto Ferraccioli	National Institute of	fferraccioli@ogs.it

	Oceanography and Applied Geophysics (Italy)	
Michael Field	University of Florida	michael.field@ufl.edu
Jacqueline Halpin	University of Tasmania	jacqueline.halpin@utas.edu.au
Rohaiz Haris	Colorado School of Mines	rohaiz_haris@mines.edu
Andrew Hoffmann	Rice University	andrewhoffman@rice.edu
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Christine Siddoway	Colorado College	csiddoway@coloradocollege.edu
Tobias Stål	University of Tasmania	tobias.staal@utas.edu.au
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Vemund Stenbekk Thorkildsen	Universitetet i Oslo	v.s.thorkildsen@its.uio.no
Kirsty Tinto	Lamont-Doherty Earth Observatory	tinto@ldeo.columbia.edu
Duncan Young	University of Texas Institute of Geophysics	duncan@ig.utexas.edu

Acknowledgements

The workshop was co-convened by Mickey MacKie, Anya Reading, Vemund Thorkildsen, Tobias Stål, and Ian Kelly.

The workshop was supported by SCAR INSTANT and the Australian Research Council Laureate Fellowship Grant FL250100087 (held by Anya Reading) with thanks to the University of Oslo. Mickey MacKie was supported by the UF International Center Global Fellows Program.

Workshop schedule

Day 1 (Saturday)

Time	Event
9:00 – 9:30	Opening remarks + icebreaker activity
9:30 – 10:00	Invited talk by Kenny Matsuoka: “Antarctic RINGS”
10:00 – 10:30	Coffee break + discussions
10:30 – 12:00	Breakout activity #1: Unknown unknowns
12:00 – 14:00	Group lunch at Paleet
14:00 – 14:30	Invited talk by Vemund Thorkildsen: “Consortium for Arctic Seismic Exploration and Monitoring”
14:30 – 16:00	Breakout activity #2: Effort versus impact

	matrix + link with community initiatives
16:00 – 16:30	Day 1 wrap-up
16:30 – 17:00	Invited talk by Christine Siddoway: “Bringing crustal geology perspectives to the ice-bedrock interface zone (IBIZ)”
17:00 – late	Group dinner at Amundsen Bryggeri og Spiseri

Day 2 (Sunday)

Time	Event
9:00 – 9:30	Invited talk by Fausto Ferraccioli: “Synergies in International Airborne Geophysics: an opportunity for InSync/GeoBridge implementation”
9:30 – 10:00	Invited talk by Matthias Scheiter: “Basal boundary conditions – what do ice sheet models need?”
10:00 – 10:30	Overview talk by Mickey Mackie of GeoBRIDGE: Geological Boundary Representation for Ice Dynamics and Glacial Evolution
10:30 – 12:00	Breakout activity #3: Brainstorming for (a) GeoBRIDGE, and (b) InSync “Outlet Glaciers” working group
12:00 – 12:30	Day 2 wrap-up + workshop end

Workshop summary

The below notes and images provide a summary of each workshop event. A full gallery of photos taken during the workshop is shared [here](#), whilst the presentations from the invited talks can be found [here](#).

Day 1 (Saturday)

Invited talk by Kenny Matsuoka: “Antarctic RINGS”

Kenny gave an overview of RINGS, a SCAR Action Group (and proposed Expert Group) driving observational data collection (e.g., bathymetry, bed topography) focused around the continental grounding line, including an outline of recently published and upcoming publications (e.g., Matsuoka et al., 2026; Shackleton et al., 2026; Matsuoka & Shackleton, 2026). Excellent discussions resulted around the overlapping interests of RINGS and the SUBICE community, including how to target data gaps, incorporate ground-based observations (e.g., seismic), and leverage privately-operated logistics.





Breakout activity #1: Unknown unknowns

Participants were split into 4 groups and, using large pieces of paper, prompted to consider the following questions:

What subglacial processes, assumptions, or data/model limitations could potentially produce a major surprise in future sea-level projections? What are our most critical blind spots?

Writing down bullet-point responses, each group was also encouraged to consider categorizing their responses in terms of (1) observational uncertainty, (2) physical process uncertainty, (3) computational limitations, and (4) model representation limitations. Afterwards, the participants then wandered around the room and considered the posters from the other groups, adding comments or stars to points they considered to be particularly important.



Katharina, Olivia, Emeric, Ian, Matthias

② * Coupling between thermodynamics & subglacial lithology / solid Earth + hydrology

> Bed properties = most important!

① * Observational uncertainty in ice sheet model boundary conditions (geothermal heat flow, sediment thickness & distribution, bed topography, subglacial thermal conductivity + state)

① * How to interpolate observational data (eg boreholes, seismic survey lines)

① * How to integrate onshore + offshore observations (offshore logistics easier possibly?)

① * Subglacial erosion & deposition, + impact on ISM boundary conditions

③ * ISM resolution (spatial)

② * Subglacial sediment deformation (+ incorporation into ISMs)

② * Basal ice units + impact on ice flow

① * Thermal memory of the ice sheet

*

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* Basal sliding under advancing ice

- Saltwater intrusions
- effective pressure
- temp. basal friction
- englacial temp (temporal)
- basal thermal state
- sliding laws
- ice velocity profiles
- fabric
- basal unit
- subglacial hydrology
- surface hydrology
- ocean cavity temp/circulation
- grounding zone processes
 - ↳ IBIZ heterogeneity
- observation coverage
- paradigm ~~data~~ inertia evolution
 - ↳ Flow asynchrony
 - ↳ sliding laws
 - ↳ growth like dynamics
 - ↳ tides
 - ↳ reproducibility
- viscosity (link)
- GIA
- logistical bias
- ice fracturing / ice cliff instability
- are ice sheet parameters good enough? ^{isotopes}
- data assimilation
- ~~ice~~ interdisciplinary dialogues → SciComm
 - Obs
 - phys proc.
 - model rep

- Saltwater intrusions*
- effective pressure*
- temp. basal friction
- englacial temp (temporal)*
- basal thermal state*
- sliding laws**
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- are ice sheet parameterizations good enough?*
- data assimilation
- ice interdisciplinary*
 - dialogues → SciComm

AI will make this problem work...

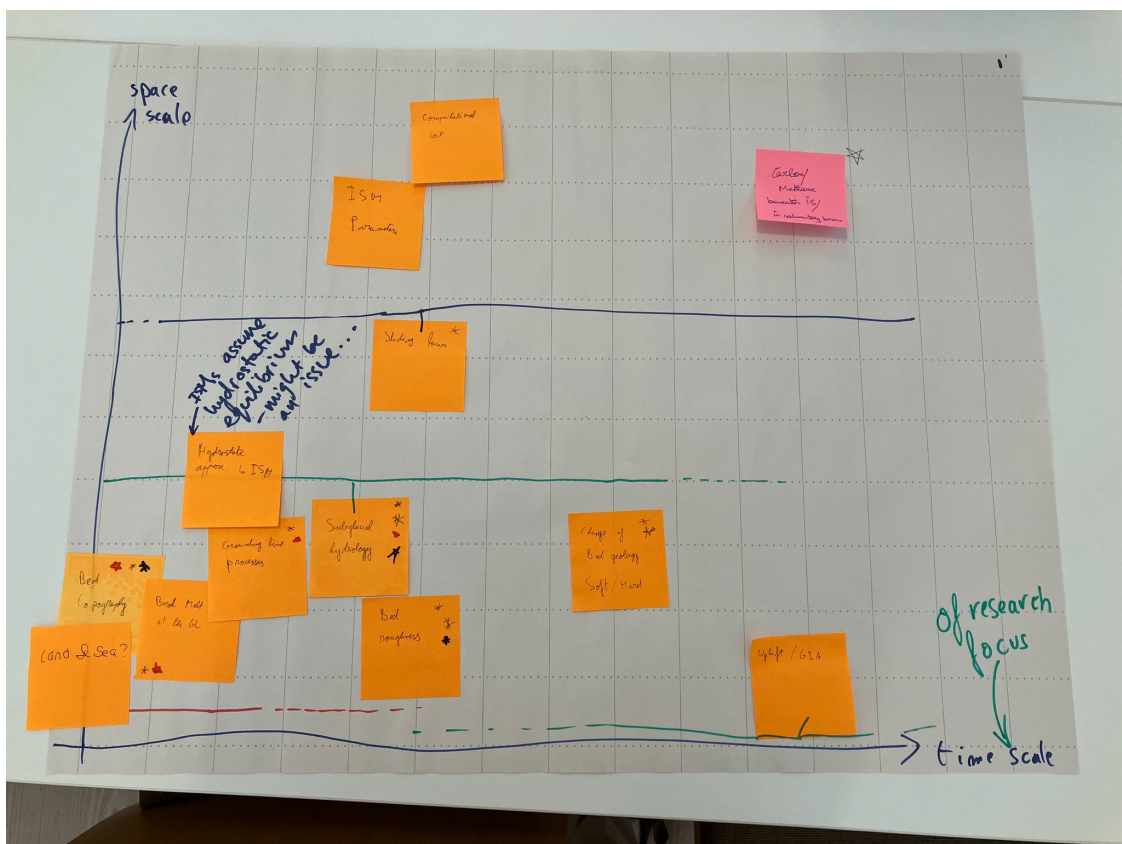
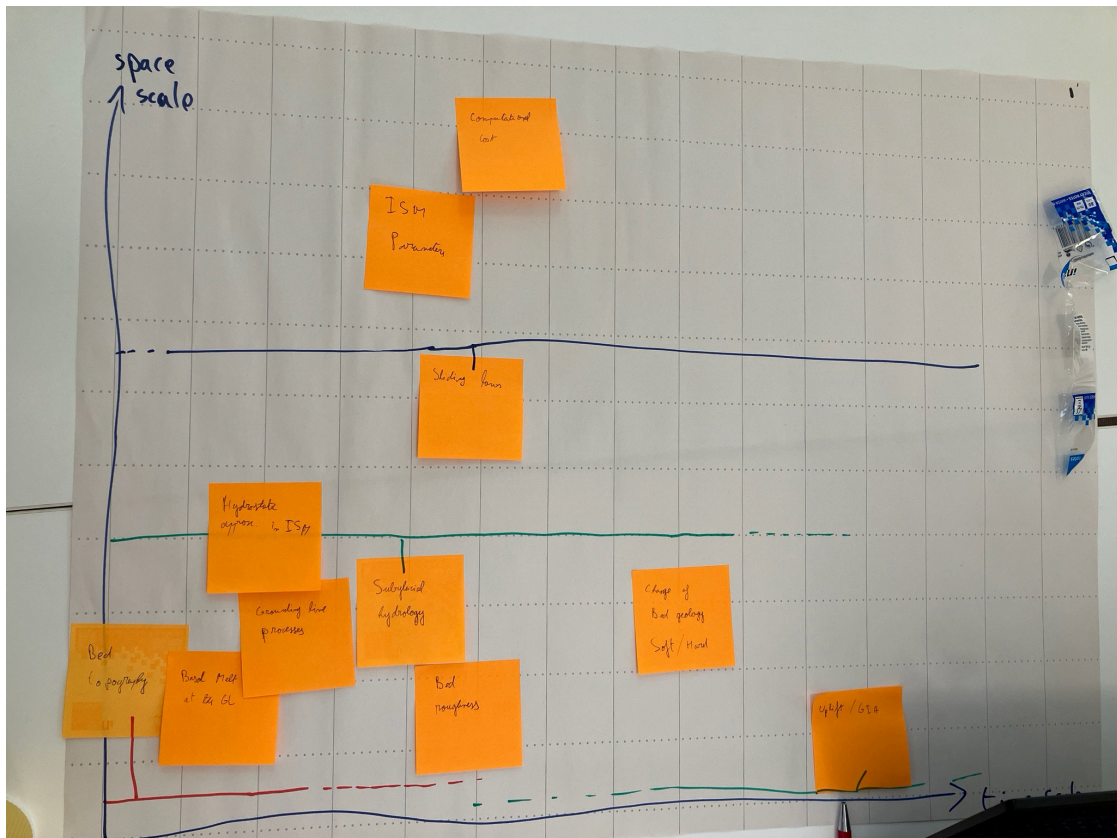
How can old GZ on the cont. shelf compare?

roughness at GZ affects ocean access + unpinning

- Obs
- plays ppe.
- model rep

- 1) OBS. Uncertainty
 - Bed topography
 - ↳ + material properties/sediment
 - Seasonal variability?
 - ↳ often only observed during summer
 - Thermal state
 - Subglacial water
 - Ocean thermal forcing
 - Scale-temporal/spatial
2. Physical process uncertainty
 - Fracturing/calving/Damage
 - Sliding/Basal Friction?
 - Subglacial water
 - ↳ drainage/hydropotential gradients
 - Basal melt parameterisations
 - Carbon Sequestration/Biogeochemical
 - Interactions
 - Predictability of tipping/change
3. Computational Limitations
 - Uncertainty quantification is only ensemble based uncertainty enough?
 - Large spread in ice-sheet models
 - Model Assumptions/approximations
 - Poor model initialisation
4. MODEL Representation limitations
 - Timescales/Spatial scales
 - ↳ eg. coarse: geothermal, fine: subglacial
 - Large spread in ice sheet models
 - Coupling challenging.

- 1) OBS. Uncertainty
 - * • Bed topography * chemistry
 - ↳ + material properties/sediment
 - Seasonal variability?
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 - * • Timescales/Spatial scales
 - ↳ eg. coarse: geothermal, fine: subglacial
 - Large spread in ice sheet models
 - * • Coupling challenging.
- lateral effects multi-scale basal thermal state BED TOPO??
 temp. profiles Sea water intrusion under gravity lines material properties Sediment where? what?



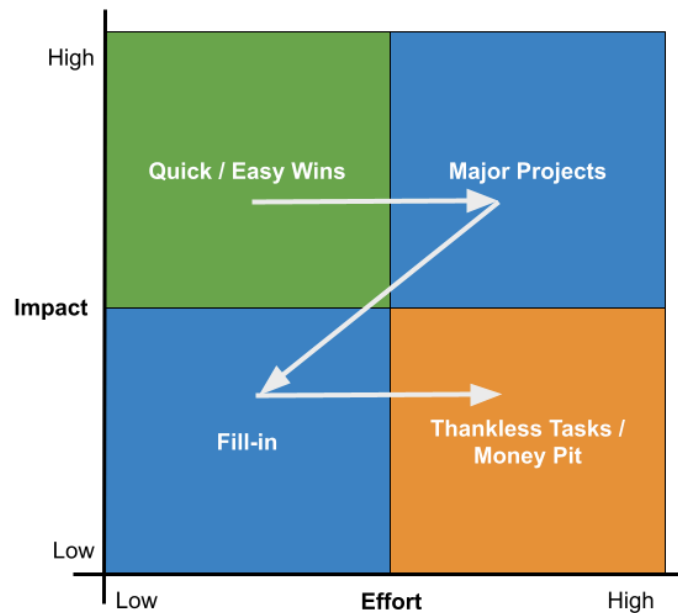
Invited talk by Vemund Thorkildsen: “Consortium for Arctic Seismic Exploration and Monitoring”

Vemund provided an informative cross-polar perspective of seismic surveying in the Svalbard region, highlighting numerous findings of the Arctic subsurface (e.g., permafrost structure, active layer evolution) that map to the Antarctic IBIZ. Vemund also introduced the summer glaciology and geophysics courses at the University Centre in Svalbard (UNIS), offering the opportunity to test new instrumentation and techniques in a relatively accessible and low-effort environment (with logistical support provided by the students!).



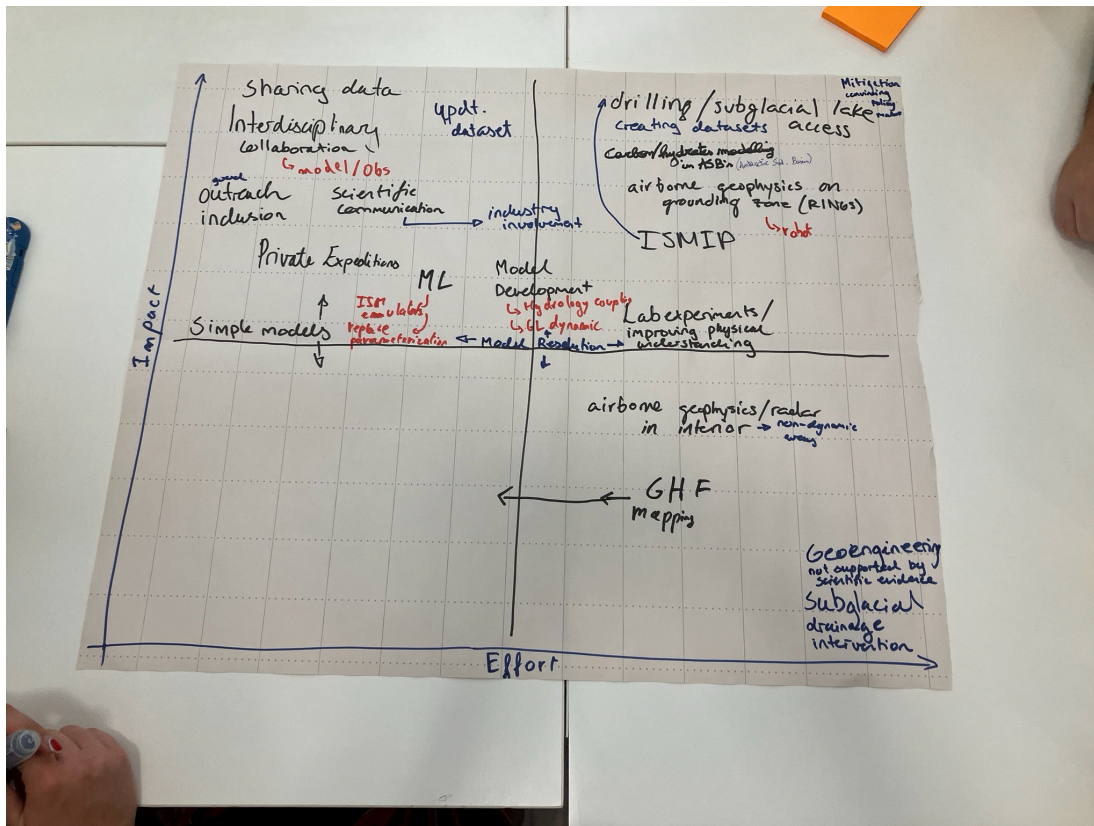
Breakout activity #2: Effort versus impact matrix + link with community initiatives

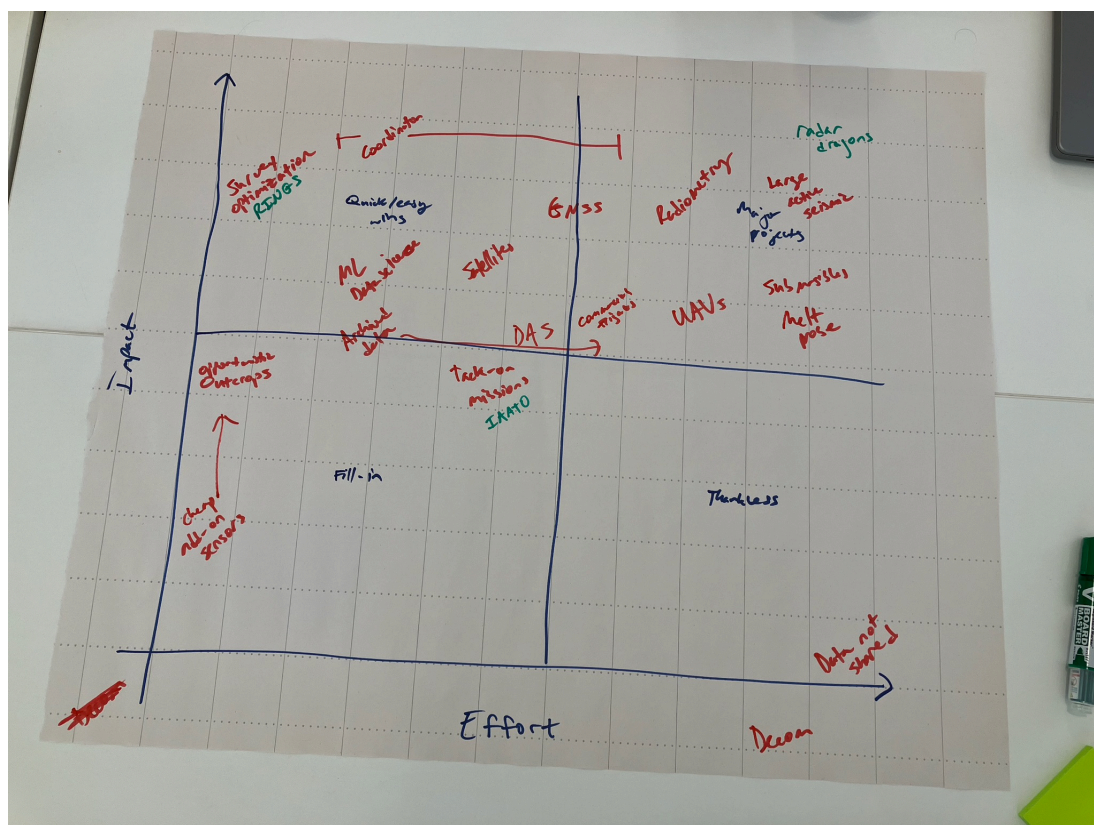
Participants were once again split into 4 groups and, building upon the points identified in breakout activity #1, asked to consider how current and future actions (e.g., emerging technologies, targeted field campaigns, new data products and modeling approaches) are/can working towards addressing the uncertainties in the Antarctic IBIZ within an effort versus impact matrix:

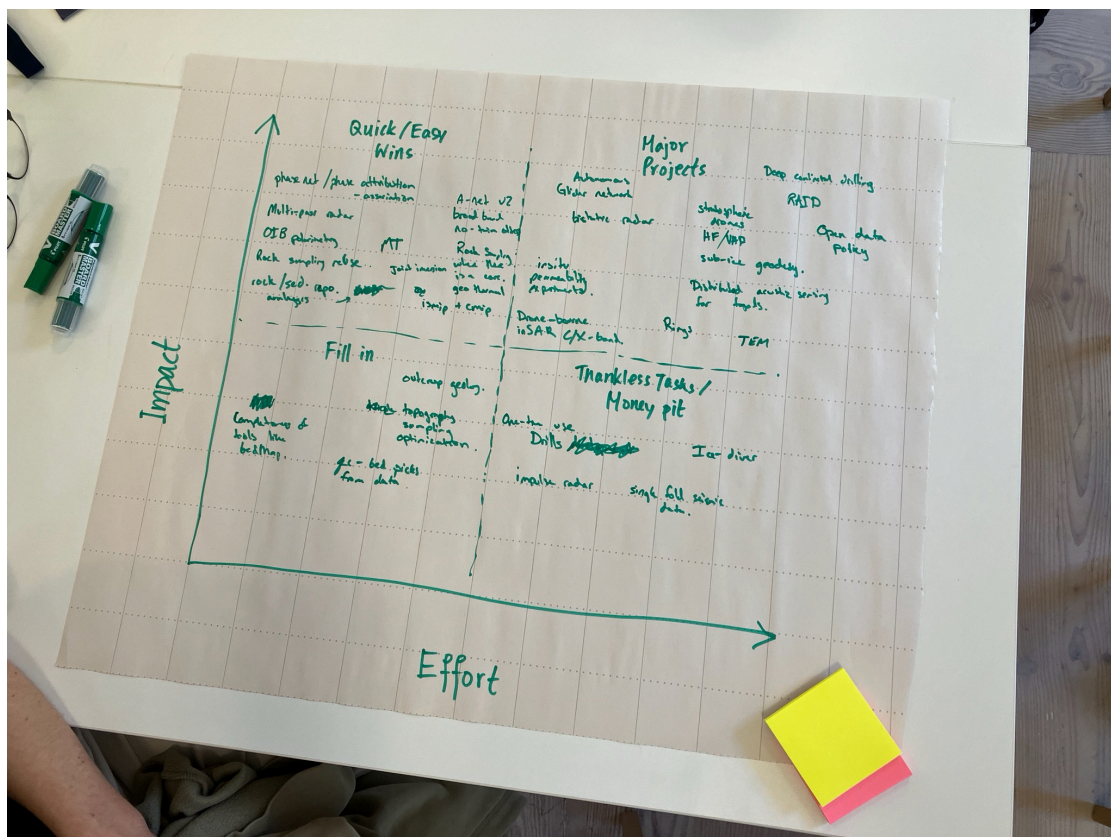


Afterwards, the participants were then encouraged to walk around the room and add comments/stickers identifying which community initiative (e.g., RINGS, InSync, GeoBRIDGE) would be best placed to implement each action.









Invited talk by Christine Siddoway: “Bringing crustal geology perspectives to the ice-bedrock interface zone (IBIZ)”

Christine was kind enough to rush over from the SCAR delegates meeting and provide a geologist’s perspective on the Antarctic sub-ice environment, particularly regarding the under-appreciated role of faults and the simplified treatment of basement geology (i.e., crystalline basement can be permeable as well – not just sedimentary basins!).



Group dinner at Amundsen Bryggeri og Spiseri



Day 2 (Sunday)

Invited talk by Fausto Ferraccioli: “Synergies in International Airborne Geophysics: an opportunity for InSync/GeoBridge implementation”

On Sunday morning, Fausto presented an overview of how future developments and initiatives in airborne geophysics can contribute towards resolving some of the outstanding uncertainties within the Antarctic sub-ice environment. This included recent and upcoming projects with the OGS, such as the proposed “CryoRad” satellite mission and airborne radiometer testing.



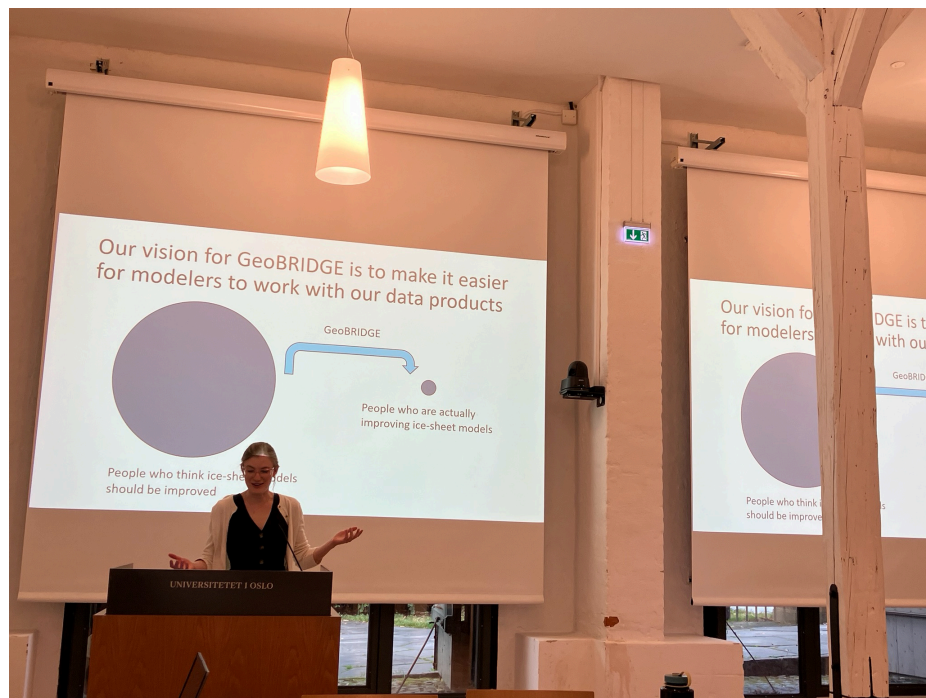
Invited talk by Matthias Scheiter: “Basal boundary conditions – what do ice sheet models need?”

After Fausto’s talk, Matthias gave some valuable insights as an ice sheet modeler into what uncertainties in the Antarctic IBIZ are currently hindering improved estimates of future sea level rise. Matthias highlighted bed topography and bed properties as key priorities, the gap between geophysical inferences and basal sliding parameterizations, as well as the need for gridded datasets that can be easily implemented in ice sheet models.



Overview talk by Mickey Mackie of GeoBRIDGE: Geological Boundary Representation for Ice Dynamics and Glacial Evolution

Matthias' talk was a fantastic segway into Mickey's introduction to GeoBRIDGE, a new initiative to develop data products and Python workflows suitable and readily accessible for ice sheet modelers to explore different basal boundary conditions.

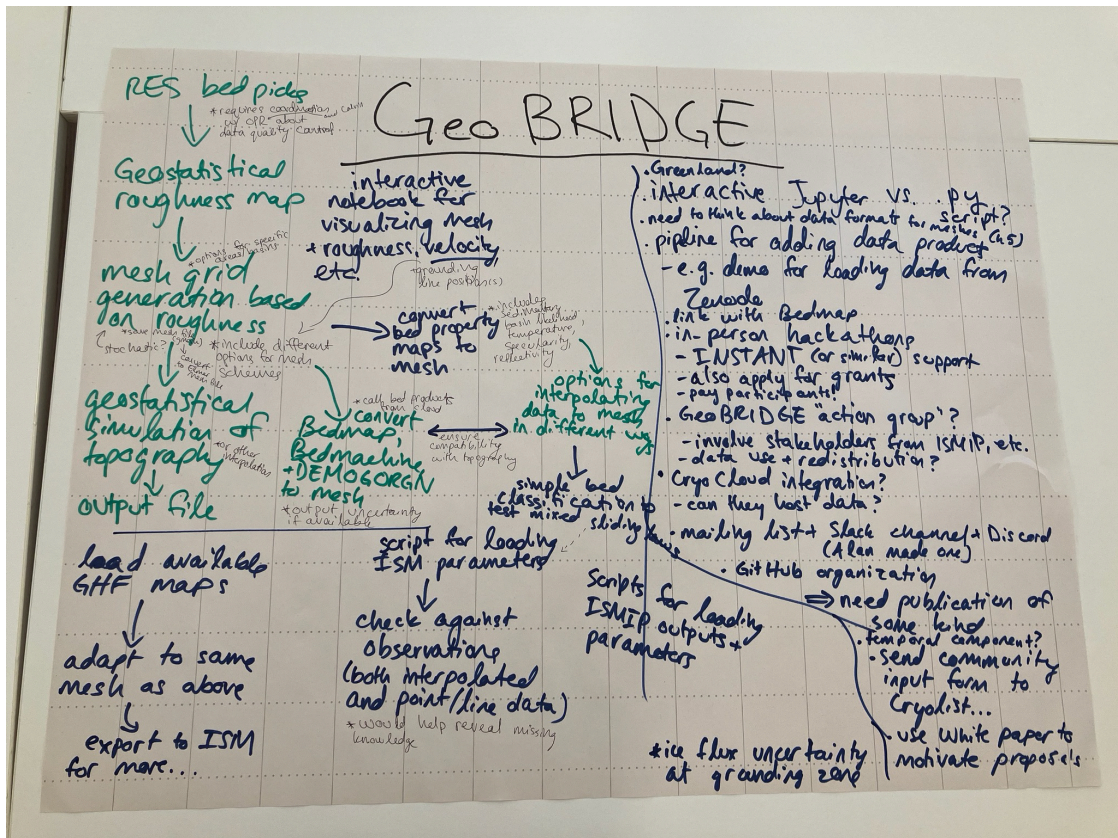


Breakout activity #3: Brainstorming for (a) GeoBRIDGE, and (b) InSync “Outlet Glaciers” working group

The final event of the workshop was split into two breakout activities:

- (a) One breakout group, led by Mickey, focused on brainstorming ideas for GeoBRIDGE – i.e., what data sets should GeoBRIDGE include? What workflows are most needed? How should other community initiatives be involved? These ideas were noted on a poster.
- (b) Another breakout group, led by Anya, was centred around the InSync Working Group [“Subglacial Environments of Changing and Vulnerable Outlet Glaciers”](#). The group brainstormed ideas for a hypothetical field program targeting key outlet glaciers in Antarctica, with \$18 million USD of funding and planned field seasons in 26/27, 27/28, and 28/29. Points of discussion included (i) what outlet glacier(s) should be targeted, (ii) what observations should be collected, (iii) how should the field expeditions be planned, and (iv) who/how many people should be in the field team(s). These discussions involved a continental map for reference, and ideas were also noted on posters.





SKILLS / METHODS

NEUTRON
DATA FROM
ED + NEUTRON
LOCATION

ISOTOPES MASS
RADIANCE
MEASUREMENTS

MEASUREMENTS - ?

AWD
ACTIVE
SEISMIC

SEISMIC
SURVEYS +
IMAGERY
POSITIVE SEISMIC
+ FLIGHTS

GNSS
ON -
GLACIER

MT
DATA
COLLECTION

TOPIC: SEISMIC SURVEYS

? HELI
ACCESS
FROM
SMIA

EM VIBROSEIS
?

DEFORMER
POSITION +
DEFORMATION +
HYDROLOGY

DAS AND
FIBRE OPTIC
CABLES
ON ICE
SURFACE

ISOTOPE
+ IRON
OCEAN
MEASUREMENT

OCEAN
HEAT
SENSING

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MARINE
TECHNIQUES
OVER
ICE

TOPO
GRAPHY

BATHYMETRY

ORGANISATION / LOGISTICS

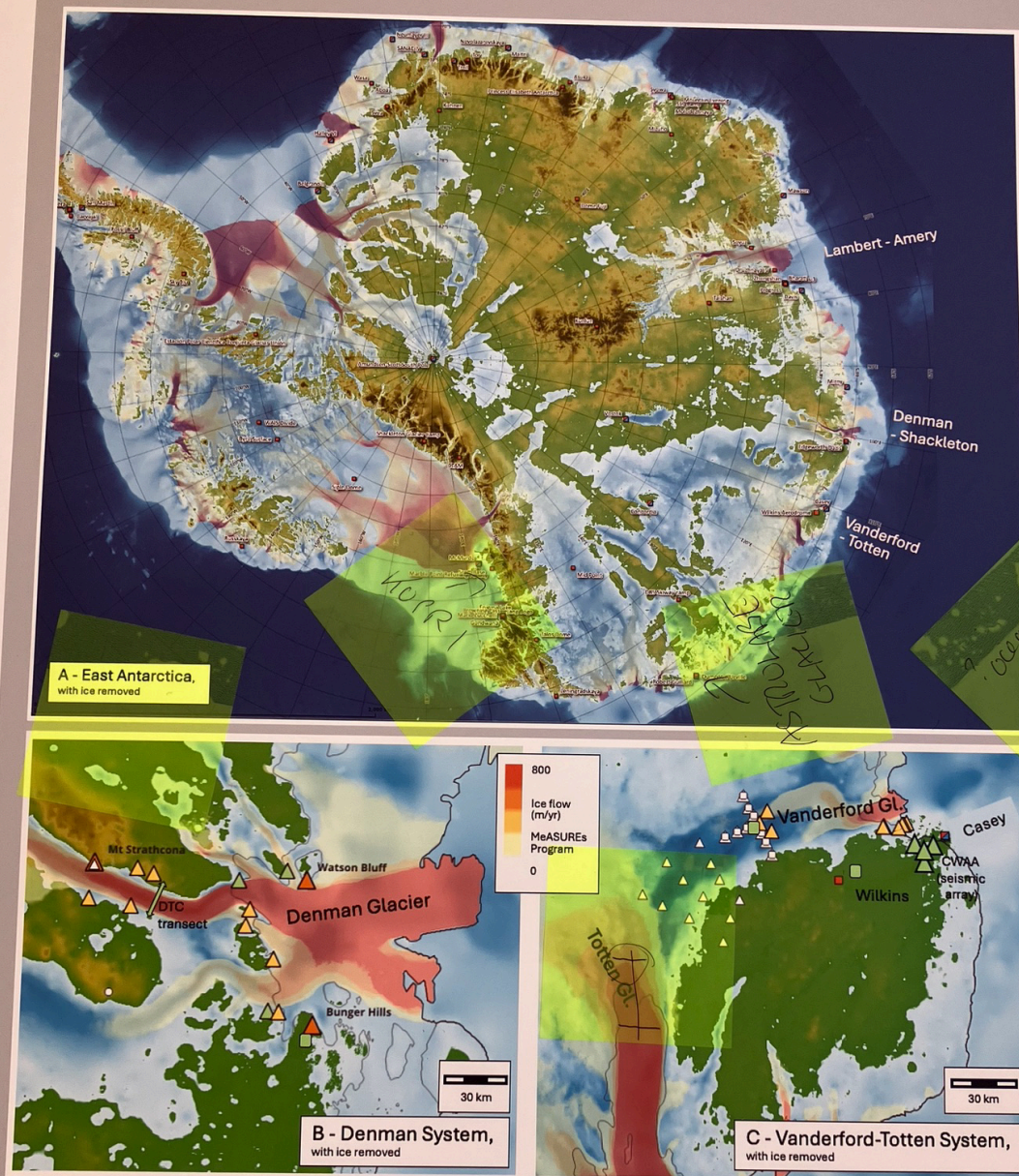
LINK TO
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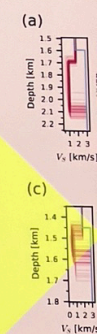


Figure 6:
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Th - is

FIELD DESIGN

26/27

BS
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CREVASSE
SCALING

INST.
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CAPTURE
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POSITIVE
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STATE OF
KNOWLEDGE
HYDRO
ROUTING

27/28

MAIN SEAS
SS + BS
DEPLOY

ACTIVE
LAKES

ACTIVE
LAKES

GRAVITY
TLE

AWS

SNOW
ACCUM.

?SHALLOW
CORE
(ISOTOPE
+ IRON)

28/29

RADIOMETRY
BAT + Z
METR