AntArchitecture Action Group
2018-2020 Report

Summary

Report Author(s)

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Group Summary

Approved as a SCAR Action Group at the June 2018 SCAR Delegates Meeting in Davos, *AntArchitecture* aims to develop a continent-wide age-depth model of Antarctica's ice using the internal layers and surfaces imaged by radar-sounding. The product will underpin the wider goal to determine the stability of the Antarctic Ice Sheets over past glacial cycles, and feeds into additional SCAR Groups such as PAIS, IPICS, and AntClim21.

It has two primary 2-year milestones; the first being production of a white paper for 2020, outlining the need for an Antarctic radar-layers database, the potential applications, and methods for achieving it; the second being the aspiration to publish, in 2022, an online dataset and paper reporting the 3D internal architecture of the Antarctic Ice Sheet. At the time of reporting we are in the final months of achieving milestone 1, and we have made some good progress with efforts towards milestone 2, as will be reported below.

With thanks to the SCAR office, we launched a website in March 2019 https://www.scar.org/science/antarchitecture/home/ which outlines the project in more details, and serves as a forum for communicating our activities and achievements. At the same time we also generated a mailing list for AntArchitecture, which has grown over the past year to 121 subscribers.

Summary of activities from 2018-20

- Our primary activity has been the development of a white paper outlining the need for an Antarctic radar-layers database and recommendations for its future use. This is a non-trivial undertaking requiring engagement from international data providers, and a community of existing users (mainly from the radioglaciological and parts of the ice-sheet modelling community) and potential users (e.g. from the ice-core and wider ice-sheet modelling community):
  - Much of 2018-19 was spent in **engagement activities** designed to build up a group of white paper authors.
  - The group held its **3rd annual science meeting** (the first as a SCAR Action Group!) at the July 2019 International Glaciological Society Symposium on

Radioglaciology at Stanford University, with the white paper and building up an authorship list a central part of the meeting.

- o **Paper writing** began in earnest in late 2019 with an authorship group of 20 members representing a mix of expertise, nationalities and career levels, and the group was aiming to complete the bulk of the task at a Writing Workshop planned to be held in Odense, Denmark, in April 2020.
- o With CV-19, we switched the **Writing Workshop** to a series of telecon meetings, which worked well, although overall CV-19 has delayed finalisation of the manuscript, which we are now expecting to submit in summer 2020. **This represents delivery of the first 2-year milestone, on schedule.**

- The group has also undertaken some research activities towards the 4-year milestone of developing an Antarctic-wide dataset of internal layers:
  - o Winter, Eisen and others (2019) published an age stratigraphy along the East Antarctic Ice Divide that will form an important sub-dataset for AntArchitecture.
  - o Ashmore, Bingham, Ross and others (2020) traced the internal architecture of the Weddell Sea Sector of West Antarctica, allows us to identify where the oldest ice is buried in the study region and provides evidence that flow of the ice sheet interior has been stable during the Holocene.
  - o Delf, Bingham and others (2020) compared different methods for automating or optimising the extraction of information from englacial layers as preparation for future applications of the AntArchitecture dataset.
- o Quartini, Blankenship and Young (in review, very close to accepted) used englacial layer data as part of their evaluation of subglacial volcanism in West Antarctica, in a contribution to a special volume coordinated by SCAR's ANTVOLC Expert Group.
- o UK/NERC funded PhD studentships are in place at the University of Edinburgh and Newcastle University to work on AntArchitecture over the coming years.

Summary Budget 2019 to 2022

	2019	2020	**2021**	**2022**
	Spent	Allocated	Request	Request
(US$)	0		2,000	2,000

We are not quite sure how to fill out the table above (!), but for clarity:
- Our allocation for the period 2018-2020 was USD4000
- We considered using some of this to fund ECR researchers to attend the Stanford meeting discussed above, but in the end the conference organisers were able to subsidise this anyway, so we deliberately reserved all our funds to pay for the planned Writing Workshop in Denmark in April 2020.
- The cancellation of the Writing Workshop has left us in the unfortunate position of reporting no spend over the first two years, but you will appreciate from our plans below that we will still require funds for future activities to 2022.

Progress to date

Sub-group Outcomes Summary
(*Summarize the above and in each case provide your sub-group name in left hand column to assist Science Group COs in compiling their reports*)

Sub-group	Activity/Outcome/Benefit/Achievement
AntArchitecture	Annual Science Meeting July 2019 – community engagement, planning white paper.
AntArchitecture	20-author white paper in advanced prep, intention to submit August 2020. Will set the agenda for next two years of building database.
AntArchitecture	Science activities. 3x papers published in *Earth System Science Data*, *Geophysical Research Letters*, *Annals of Glaciology*.

Sub-group Cash Flow
(*From previous Delegates meeting to date*)

Sub-group	Allocation	Amount spent		
		2018	2019	2020
AntArchitecture	4000	n/a	0	0*

* See notes above in Summary Budget 2019-2020 re lack of spend.

Future plans

Planned activities in 2020 to 2022

Sub-group	Planned activity
AntArchitecture	Building database of englacial layers/slopes across West Antarctica – paper and open access repository
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AntArchitecture	Scientific activities designed to improve extraction of information from layers so as to speed buildup of databases – various peer-reviewed papers

Planned use of funds for 2020 to 2022

Year (YYYY)	Purpose/Activity	Amount (in USD)	Contact Name	Contact Email
2021	Bring AntArchitecture community together at appropriate international conference (EGU/SCAR/AGU) to plan database building activities / engender some further international partnerships e.g. with China, Russia, Japan. Funds prioritised to ECRs / capacity building.	4,000	Robert Bingham	r.bingham@ed.ac.uk

2022	Support for AntArchitecture ECRs to assemble at side meeting at SCAR 2022, to plan next stage of project alongside PIs and also present AntArchitecture results within main conference.	2,000	Robert Bingham	r.bingham@ed.ac.uk
2022	Funds required to support outreach video of final database, as done for Greenland version https://www.nasa.gov/content/goddard/nasa-data-peers-into-greenlands-ice-sheet	2,000	Robert Bingham	r.bingham@ed.ac.uk
Total		**8,000**		

Any additional detail on funds usage and desired results/outcomes
We are working on an assumption that we can roll over into 2021 the USD4,000 that we were allocated for 2018-2020, and which only CV-19 stepped in to prevent us from using.

Percentage of the budget to be used for support of early-career researchers
2020: n/a (no spend anticipated)
2021: 75-100%
2022: 50%

Percentage of the budget to be used for support of scientists from countries with developing Antarctic programmes
2020: n/a
2021: ~50%
2022: 25-50%

Membership

Leadership

Role	First Name	Last Name	Affiliation	Country	Email	Date Started	Date Term is to End
Convenor	Robert	Bingham	Univ. Edinburgh	UK	r.bingham@ed.ac.uk	2018	2022
Convenor	Olaf	Eisen	AWI	Germany	olaf.eisen@awi.de	2018	2022
Convenor	Nanna	Karlsson	Geological Survey Denmark (GEUS)	Denmark	nbk@geus.dk	2018	2022
Convenor	Joseph	MacGregor	NASA Goddard	USA	joseph.a.macgregor@nasa.gov	2018	2022
Convenor	Neil	Ross	Newcastle Univ.	UK	neil.ross@newcastle.ac.uk	2018	2022
Convenor	Duncan	Young	Univ. Texas Austin	USA	duncan@ig.utexas.edu	2018	2022

*Please identify early-career researchers with * in first column*

NB that in our recent White Paper writing meetings we have also been discussing widening the Leadership group to include some ECRs and to diversify the group further in terms of gender and nationality. This will be implemented over the forthcoming reporting year.

Other members

There are 121 subscribers overall to the AntArchitecture list, who can all be considered members. Listed below is the current authorship of the group's white paper (in prep.), and the authorship may yet expand slightly to include some further data providers.

First Name	Last Name	Affiliation	Country	Email
David	Ashmore	Univ. Liverpool	UK	ashmore@liverpool.ac.uk
*Julien	Bodart	Univ. Edinburgh	UK	julien.bodart@ed.ac.uk
Andreas	Born	Univ. Bergen	Norway	andreas.born@uib.no
* Marie	Cavitte	Universite Catholique Louvain	Belgium	marie.cavitte@uclouvain.be
* Winnie	Chu	Georgia Tech. Univ.	USA	wchu38@gatech.edu
* Nicholas	Holschuh	Amherst College	USA	nholschuh@amherst.edu
Michelle	Koutnik	Univ. Washington	USA	m.koutnik@uwashington.edu
Gwendolyn	Leysinger Vieli	Univ. Zurich	Switzerland	gwendolyn.leysingervieli@uzh.ch
* Emma	MacKie	Stanford Univ.	USA	mackie3@stanford.edu
* Elisa	Mantelli	Princeton Univ.	USA	mantelli@princeton.edu
Carlos	Martin	British Antarctic Survey	UK	cama@bas.ac.uk
Frederic	Parrenin	Univ. Grenoble	France	frederic.parrenin@univ-grenoble-alpes.fr
*Johannes	Sutter	Univ. Bern	Switzerland	johannes.sutter@climate.unibe.ch
* Kate	Winter	Northumbria Univ.	UK	k.winter@northumbria.ac.uk

*Please identify early-career researchers with * in first column*

Additional information (optional)

Please add any more detail here that you wish, on your subgroup activities, papers published, etc.

Notable Papers
(Five to ten most notable papers – see the example below, which includes a brief statement (shaded) indicating the link to the group)

1. Winter, A., Steinhage, D., Creyts, T.T., Kleiner, T., and Eisen, O. (2019): Age stratigraphy in the East Antarctic Ice Sheet inferred from radio-echo sounding horizons, Earth Syst. Sci. Data, **11**, 1069–1081.

This work provides an age stratigraphy across East Antarctica, and is the most extensive distribution of internal horizons in East Antarctica to date.

2. Ashmore, D.W., Bingham, R.G., Ross, N., Siegert, M.J., Jordan, T.A. and Mair, D.W.F. (2020) Englacial architecture and age-depth constraints across the West Antarctic Ice Sheet. Geophysical Research Letters, 47, e2019GL086663.

In this paper we trace and place age constraints on stratigraphic horizons across a large portion of the West Antarctic Ice Sheet, including regions where fast ice flow has disrupted the ice sheet stratigraphy. The resulting data set allows us to identify where the oldest ice is buried in the study region and provides evidence that flow of the ice sheet interior has been stable during the Holocene.

3. Delf, R., Schroeder, D.M., Curtis, A., Giannopoulos, A., Bingham, R.G (2020) A comparison of automated approaches to extracting englacial-layer geometry from radar data across ice sheets. Annals of Glaciology, in press.

In this paper we present a methodology to assess the performance of automated layer-tracking and layer-dip-estimation algorithms through their ability to propagate a depth-age model.

Direct support from outside organisations received for your activities
(Numbered list with values indicated if direct cash support. Please restrict in-kind support to substantive in-kind support only)

Major collaborations your Science Group has with other SCAR groups and with organisations/groups beyond SCAR
(Numbered list of substantive collaborations)

Within SCAR
1. PAIS
2. SERCE
3. IPICS
4. AntClim21
5. ANTVOLC
6. Written into plans for forthcoming INSTANT Programme

Outside SCAR
1. International Glaciological Society
2. EGU Cryosphere Division

Outreach, communication and capacity-building activities
Brief highlights of any activities undertaken since the SCAR Delegates meeting in 2018.

SCAR fellowship reviewers

Please list one or more people (name and email address) from your group who would be willing to serve as reviewers for the next few years, along with 1-3 keywords on their principal expertise.

First Name	Last Name	Email	Principal Expertise
Robert	Bingham	r.bingham@ed.ac.uk	Glaciology
Olaf	Eisen	olaf.eisen@awi.de	Glaciology
Neil	Ross	neil.ross@ncl.ac.uk	Glaciology, permafrost, ice sheet history