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Open Research Case Study

Revealing Antarctica's Climate Archive: Open Access to Internal Ice Layer Data

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Introduction

The Antarctic Ice Sheet holds one of the most comprehensive natural archives of Earth's climate. Internal ice layers record climate changes stretching back hundreds of thousands of years, revealing past temperatures, atmospheric compositions, and ice dynamics. As highlighted in a recent Scientific Committee for Antarctic Research (SCAR) paper, mapping and dating internal ice layers underpins the SCAR Action group AntArchitecture's goal of determining past ice-sheet stability (Sanderson et al., 2025). In response to this call from the international community, I developed and made publicly available a dataset of traced and dated internal ice layers across East Antarctica. The release of this dataset led to new scientific understanding of ice evolution and the location of ice older than 100,000 years, informing survey design for the US National Science Foundation Center for Oldest Ice Exploration (NSF COLDEX).

Research context

This research formed part of my PhD thesis on Antarctic Ice Sheet dynamics and fit within the SCAR AntArchitecture framework -an international effort to map and reinterpret the ice sheet internal structure through open data and collaboration. Conducted under the NERC-funded ONE Planet Doctoral Training Partnership (NE/S007512/1), the project involved collaboration with the British Antarctic Survey (BAS), University of Edinburgh, and University of Texas Institute for Geophysics. My work contributed to AntArchitecture by generating and releasing reproducible datasets of internal ice layers traced from airborne and ground-based radar. I presented this work in AntArchitecture workshops, co-authored papers and data products, and coordinated workflows linking UK and US research teams. By making internal layer data openly available, my contributions advanced transparency, reproducibility, and international collaboration in understanding Antarctic Ice Sheet evolution.

Open practices

Radar data were processed using geophysical open-access tools (OpendTect and QGIS) and formatted following open data standards developed and later adopted through the AntArchitecture community (Sanderson et al., 2025). The data were published in CSV format with full metadata and DOI via the NERC/UKRI Polar Data Centre (Sanderson et al., 2023). These practices ensured long-term accessibility and reuse, enhanced transparency and reproducibility, and reinforced FAIR principles in open Antarctic science. My datasets have underpinned high-impact international studies, including publications in Journal of Glaciology, The Cryosphere and Geophysical Research Letters (Sanderson et al., 2024; Franke et al., 2025, Young et al., 2025).

Benefits realised

The scientific community benefitted from the generation and release of this dataset, as evidenced by the above publications that accessed and used the data. Furthermore, the dataset was used to design aerogeophysical survey flights for the 2023/2024 US NSF COLDEX project.

My collaboration with COLDEX scientists ensured the dataset could be accessed during remote Antarctic fieldwork and provided direct guidance on the location of ice older than 100,000 years. Researchers now have access to a spatially extensive dataset that will accelerate climate change computer modelling efforts, facilitate cross-comparison with other geophysical datasets and inform Antarctic ice core drilling projects, while reducing duplication efforts.

Challenges

Three challenges emerged: 1) The survey data were collected over multiple decades using varied instruments and conventions. To reconcile these, we directed and implemented common data standards and performed extensive quality checks to increase the dataset's long-term value; 2) Highly technical datasets risk excluding non-specialist users. We addressed this by providing thorough documentation and clear metadata with each file; and 3) There is a long history of reluctancy in sharing data openly, fearing a loss of academic priority. By using DOIs, making data available through the NERC Polar Data Centre and promoting citation practices, we created a framework in which credit and visibility were assured.

Lessons learned

A key lesson from this project is the value of designing for openness from the start by structuring datasets, metadata, and file formats with reuse in mind. This simplified later publication and integration into existing data frameworks. Detailed documentation and consistent formatting turned what could have been a static archive into a resource that others can readily build upon. The open access data also led directly to new collaborations with researchers in geology and computer science, demonstrating how transparent data practices can expand the reach and scientific impact of research.

Conclusion

My open research and data generation has enabled advances in Antarctic scientific discovery, including the location of ice over 100,000 years old. Creating and publishing freely available data through the NERC Polar Data Centre emphasises Newcastle University's leadership in polar science while building on collaboration with BAS and researchers in Texas and Edinburgh. Likewise, the release of this data feeds directly into the SCAR AntArchitecture group, strengthening international collaborations with NASA and the Alfred-Wegener-Institute, Germany, while generating a culture of collective research and Antarctic exploration