E5 NERC Summer Research Experience Placements 2026

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A. Supervisor (s) - Name, email and affiliation

I. **Beatriz Recinos Rivas, NERC Independent Research Fellow, beatriz.recinos@ed.ac.uk School of GeoSciences.**

II. **Bertie Miles, Chancellor's Fellow, Bertie.Miles@ed.ac.uk, School of GeoSciences.**

B. Student Mentor (current PhD student) Name, email and affiliation

Harry Davis, H.Davis@ed.ac.uk, PhD student at School of Geosciences

C. Department/School

School of GeoSciences

D. Placement Project Title

Towards a new glacier inventory for Antarctic Peripheral Glaciers

E. Job purpose

The purpose of this role is to deploy and evaluate an automated workflow for generating glacier outlines of Antarctic peripheral glaciers using hydrological and satellite-derived data on a high-performance computing (HPC) system. The student will assess the accuracy of coastline partitioning and drainage basin delineation, contributing to the development of an improved glacier inventory for Antarctica.

F. Host and project outline

Antarctic Peripheral Glaciers and Ice Caps (APGs), located on islands surrounding the Antarctic continent, represent the largest glacierised area outside the Greenland and Antarctic ice sheets (~132,867 km²). Situated in rapidly warming regions like the Antarctic Peninsula, these ice bodies are acutely vulnerable to current and future climatic warming. Understanding how much ice these glaciers store is crucial for assessing their potential contribution to meltwater input, which could influence regional ocean circulation, ecosystems, and contribute to global sea-level rise.

Despite their importance, there are few reliable estimates of ice volume and thickness for many of these glaciers. This is primarily due to a lack of accurate and consistent glacier inventories.

Most global estimates, including those by Hock et al. (2023), Farinotti et al. (2019), and Millan et al. (2022), rely on the Randolph Glacier Inventory (RGI), which in this region is largely based on glacierised area outlines compiled by Bliss et al. (2017).

Many of these outlines are derived from outdated or heterogeneous data sources—some dating back several decades—and may suffer from georeferencing errors or inconsistencies in glacier front positioning (see red outlines in Figure panel b). Accurate glacier outlines are fundamental boundary conditions for a wide range of glaciological applications. Errors in these outlines can propagate into biases in ice thickness estimates, surface mass balance calculations, and projections of sea-level contribution. Furthermore, reliable glacier delineation is essential for remote sensing analyses and for reporting Antarctica's contribution to sea-level rise in major assessments such as those by the IPCC.

This project focuses on improving glacier outlines for Antarctic Peripheral Glaciers and Ice caps, aiming to generate and evaluate automated glacier outlines using a hydrological approach. The student will deploy **an existing, fully developed workflow in Python on a high-performance computing (HPC) system to derive glacier drainage basins and assess their validity as glacier outlines.**

The workflow integrates high-resolution REMA DEM mosaics (2–4 m resolution), satellite-derived ice velocity, and coastline data. Glacier fronts are automatically identified by partitioning the Antarctic Digital Database (ADD) coastline into glacier-terminating and land-terminating segments using DEM-derived properties (e.g. slope, aspect) and ice velocity signals (see image below). These fronts serve as outlet (pour) points for an automated watershed delineation algorithm, which uses precomputed D8 flow-direction rasters to generate drainage basins corresponding to individual glaciers.

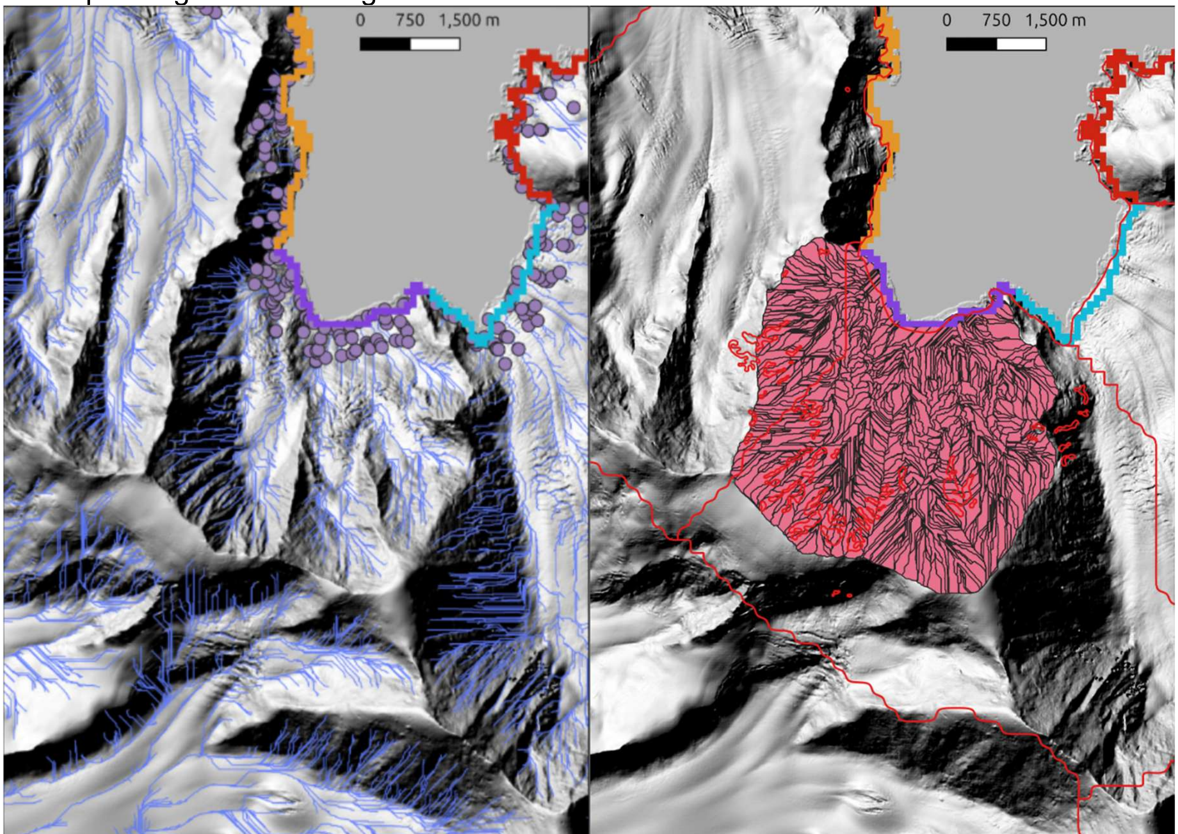

Figure 1. Example of workflow for automatic glacier outline delineation using hydrological tools. Both panels show a 2 m resolution DEM mosaic from REMA, colourful segments in both panels indicate coastline segments that belong to a specific glacier catchment. Panel A: Purple lines

indicate streamlines and pouring points computed via automated hydrological tools. Panel B: Example of a glacier basin outline derived with automatic watershed delineation algorithm. Red outlines show the current Randolph Glacier Inventory v7.0.

The student will play a key role in evaluating this process, particularly:
- Assessing the accuracy of coastline partitioning into glacier versus land fronts
- Validating glacier front locations using satellite-derived ice velocity along the coastline and DEM properties like slope angle, aspect and flow stream accumulation and direction.
- Reviewing the resulting drainage basins to determine how well they represent glacier extents

The outcome of the project will contribute to the development of an updated Randolph Glacier Inventory (RGI) for Antarctic peripheral glaciers.

References

Hock, R., Maussion, F., Marzeion, B. & Nowicki, S. What is the global glacier ice volume outside the ice sheets? Journal of Glaciology 69, 204–210 (2023).

Maussion, F., Hock, R., Paul, F., Raup, B., Rastner, P., Zemp, M, Andreassen, L., Barr, I., Bolch, T., Kochtitzky, W., McNabb, R. and Tielidze, L: The Randolph Glacier Inventory version 7.0 User guide v1.0, 2023. doi:10.5281/zenodo.8362857. Online access: https://doi.org/10.5281/zenodo.8362857.

Maussion, F., Butenko, A., Champollion, N., Dusch, M., Eis, J., Fourteau, K., Gregor, P., Jarosch, A. H., Landmann, J., Oesterle, F., Recinos, B., Rothenpieler, T., Vlug, A., Wild, C. T., and Marzeion, B.: The Open Global Glacier Model (OGGM) v1.1, Geosci. Model Dev., 12, 909–931, https://doi.org/10.5194/gmd-12-909-2019, 2019.

Millan, R., Mouginot, J., Rabatel, A. *et al.* Ice velocity and thickness of the world's glaciers. *Nat. Geosci.* **15**, 124–129 (2022). https://doi.org/10.1038/s41561-021-00885-z

Farinotti, D. et al. A consensus estimates for the ice thickness distribution of all glaciers on Earth. Nat. Geosci. 12, 168–173 (2019).

Li, F., Maussion, F., Wu, G., Chen, W., Yu, Z., Li, Y. and Liu, G.: Influence of glacier inventories on ice thickness estimates and future glacier change projections in the Tian Shan range, Central Asia, Journal of Glaciology, doi:10.1017/jog.2022.60, 2023.

Huber, J., Cook, A. J., Paul, F., and Zemp, M.: A complete glacier inventory of the Antarctic Peninsula based on Landsat 7 images from 2000 to 2002 and other preexisting data sets, Earth Syst. Sci. Data, 9, 115–131, https://doi.org/10.5194/essd-9-115-2017, 2017.

Bliss A, Hock R, Graham Cogley J. A new inventory of mountain glaciers and ice caps for the Antarctic periphery. Annals of Glaciology. 2013;54(63):191-199. doi:10.3189/2013AoG63A377

Gerrish, L., Ireland, L., Fretwell, P., & Cooper, P. (2024). High resolution vector polygons of the Antarctic coastline (Version 7.10) [Data set]. NERC EDS UK Polar Data Centre. https://doi.org/10.5285/4ecd795d-e038-412f-b430-251b33fc880e

G. Main responsibilities

- Validate glacier front locations using satellite velocities and DEM data (30%). Analyse and validate automatically derived glacier front positions using satellite-derived ice velocity along the coastline and DEM-derived properties (e.g. slope, aspect, flow accumulation, and flow direction). All the data has been already collected for the student (Weeks 1–3)
- Evaluate drainage basin outputs as glacier outlines (40%)
  Review and assess the delineated drainage basins to determine how accurately they represent glacier extents, identifying errors and inconsistencies in the automated workflow. (Weeks 3–4)
- Support workflow deployment to additional regions (20%)
  Assist in scaling and applying the existing processing pipeline to previously unprocessed Antarctic islands using HPC resources. (Weeks 5–6)
- Report on differences between new and existing inventories (10%)
  Produce a short report comparing glacier area estimates from the newly generated outlines with previous inventories, highlighting key differences.

Key contacts and relationships

- Beatriz Recinos Rivas (NERC IRF) is the developer of the automated workflow
- Bertie Miles (Chancellor Fellow) will advise on optical imaging for validation of glacier outlines and terminus positions
- (student) will advise on the Research culture within the group and the school

H. Knowledge, skills and experience required for the role

Attribute	Essential	Desirable
Education, Qualifications & Training	• 4th year Undergraduate or Master's student in a relevant field (e.g. Geosciences, Environmental Science, Geography, Physics, Mathematics, or a related discipline)	• Coursework or training in one or more of the following: computer science, statistics, glaciology, remote sensing, or climate science
Knowledge & Experience	• Basic understanding climate change; experience working with scientific datasets	• Experience working with raster and vector geospatial data (e.g. DEMs, satellite data) • Familiarity with remote sensing data (e.g. satellite-derived ice velocity)

I. Planning and organising

- Good time management and ability to follow structured programming tutorials and workflows

J. Problem solving

- Able to troubleshoot issues with data, models, or code using available resources and documentation

K. Decision making
• Demonstrates initiative in identifying and exploring solutions beyond the methods given for the project.
L. Length and timing of placement
8 weeks. Start date to be agreed.
M. Budget
£500 use of computer resources in GeoSciences
N. Location and Equipment
Computer laptop with all the software needed by the student installed. Desk and access to the school computer facilities. Remote working is possible, but the student must be present for at least 2 days a Week (or during the first weeks) to have good instruction time from the main supervisor.
O. Health & Safety requirements
N/A
P. Job hazards specific to the role
N/A
Q. Alternative/adjusted placement (remote placement only).
N/A