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OPINION

Empowering Early Career Polar Researchers in a changing climate: Challenges and solutions

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Climate change is rapidly reshaping the research landscape in the polar regions. As such, Early Career Researchers (ECRs) face increasingly daunting challenges. These challenges include international and institutional competition for funding, shifting research demands and priorities, limited data sharing, and the need for strong mentorship.

ECRs in polar research face various challenges that are common to other research fields; e.g., they can encounter difficulties in securing funding and publishing [1, 2], which can lead to elevated stress and even job loss [3, 4]. Institutional barriers include pressure on senior scientists to retire prematurely and pervasive gender and social inequalities [5]. Of the approximately 5,000 members of the Association of Polar Early Career Scientists (APECS), 57% identify as female [6]. While specific data on gender distribution among APECS ECRs is unavailable, insights from the International Association for Hydro-Environment Engineering and Research (IAHR) reveal that women constitute 25% at all career stages, with ECRs representing 33%; this proportion exhibited minimal growth in recent years [7]. Anticipated trends suggest a more balanced gender distribution among APECS ECRs relative to their counterparts at advanced career stages, with potentially greater gender imbalances in developing countries and certain research fields [7]. Barriers to interdisciplinary polar research include demanding workloads, uncertain funding and employment prospects, and limited support for work-life balance [8]. The benefits of open science practices for ECRs, including reputational gains and increased chances of publication, as well as the associated challenges have also been noted [9]. In light of these challenges, addressing the climate and biodiversity crisis necessitates a reevaluation of academia's activities to ensure a safe and just space. This reevaluation calls for a balance that respects the environmental boundaries of the planet while ensuring social equity and justice [10].

In response, we propose the following solutions: (i) Creating more funding opportunities directed toward ECR-led projects, such as the Scientific Committee on Antarctic Research (SCAR) fellowships or the research grants offered by the European Consortium for Ocean Research Drilling (ECORD), an integrated member of the International Ocean Drilling Programme (IODP); (ii) Increasing cooperation among research groups and local communities, with emphasis on decreasing the ecological footprint of fieldwork and increasing stakeholder

and rightsholder engagement; (iii) Encouraging and supporting data sharing via open databases and platforms (e.g., Baseline Surface Radiation Network, BSRN; the Aerosol Robotic Network, AERONET; PANGAEA) to enhance communication and research efficiency; (iv) Building a support network for effective mentorship and career advancement for ECRs with emphasis on promoting diversity, fostering inclusivity, and facilitating interdisciplinary collaboration.

(i) Creating more funding opportunities. We propose creating more funding opportunities directed mainly toward supporting ECR-led projects. E.g., European initiatives, including the ECORD Grant, provide valuable funding avenues, but geographic restrictions often apply which limit opportunities for ECRs based outside of specific regions. Other programs, such as the International Association of Sedimentologists (IAS) and International Union for Quaternary Research (INQUA) Grants offer support, but funding availability predominantly manifests as travel grants rather than research grants for ECR-led projects (Table 1). ECRs without permanent positions encounter difficulties accessing national funding, as seen in countries like Spain and Canada, which do not adjust grant amounts for inflation (Table 1). Other challenges pertaining to eligibility and project specificity persist, highlighting the need for continued efforts to financially support ECRs in response to this challenge.

Table 1. Funding opportunities for ECRs and other career stages in polar research, sorted by databases, grants, fellowships, and station access.

Funding Opportunity (not only) for ECRs	Source
Association of Polar Early Career Scientists (APECS) Funding Database	https://www.apecs.is/career-resources/funding-database.html
Research Professional Funding Database	https://www.researchprofessional.com
European Consortium for Ocean Research Drilling (ECORD) grants	https://www.ecord.org/education/research-grant/
International Association of Sedimentologists (IAS) grants	https://www.sedimentologists.org/grants
International Union for Quaternary Research (INQUA) grants	https://inqua.org/funding/grants
Integrated European Long-Term Ecosystem, Critical Zone and Socio-Ecological Research grant	https://elter-ri.eu/transnational-remote-access-ta-ra
Climate and Cryosphere (CliC) Project grants	https://climate-cryosphere.org/clic-grants/
Arctic Field Grant (AFG)	https://www.forskningsradet.no/en/svalbard-science-forum/ssf-tools-and-funding-schemes/arctic-field-grant-afg
International Arctic Science Committee (IASC) fellowship program	https://iasc.info/capacity-building/fellowship-program
Scientific Committee on Antarctic Research (SCAR) fellowships	https://www.scar.org/awards/fellowships/overview/
The Centre for Arctic Knowledge and Exploration Postdoctoral Fellowship, Canadian Museum of Nature	https://nature.ca/en/our-science/arctic-centre/centre-arctic-knowledge-exploration-postdoctoral-fellowship/
Polar Knowledge Canada Fellowship Program	https://www.canada.ca/en/polar-knowledge/fundingforresearchers.html#fellowship
Korea Polar Research Institute (KOPRI) fellowship programs	https://www.kopri.re.kr/eng/html/comm/04030401.html
Svalbard Integrated Arctic Earth Observing System (SIOS) Research Infrastructure Access Programme	https://sios-svalbard.org/RIAccess
International Network for Terrestrial Research and Monitoring in the Arctic (INTERACT)	https://eu-interact.org/accessing-the-arctic/tacall/
Sustainable Access to Atmospheric Research Facilities (ATMO-ACCESS)	https://www.atmo-access.eu/tna-call-application/
EU Polar Cluster	https://eu-polarnet.eu/directory-of-european-polar-research-funding-programmes/

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(ii) Increasing cooperation and reducing ecological footprint. ECRs should consider transitioning to remote data collection to succeed in the forecasted changing world. E.g., transferring instruments from well-established networks like BSRN and AERONET to local/regional communities can provide several advantages, including enhanced collaboration with stakeholders and rightsholders, supporting local economies, and more effective project cost management. Such a transition allows ECRs to focus on robust data analyses while fostering inclusivity and interdisciplinary collaboration. Concomitantly, this approach ultimately diminishes the necessity for extensive travel for fieldwork, decreasing costs and ecological footprints. Researchers can also increase their environmental awareness and best practices by using tools such as the Green Algorithms computing calculator [11] to calculate the carbon footprint of their research activities.

(iii) Encouraging data sharing and open-access publishing. Facilitating data sharing through open databases and platforms (e.g., BSRN, AERONET, PANGAEA) can bolster communication and research efficiency. Open-access journals and more streamlined peer review processes in the digital age facilitate the rapid dissemination of scientific results. These benefits facilitate the career advancement of ECRs.

(iv) Building a support network for mentorship, career advancement, and local collaboration. Effective science communication plays a crucial role in properly contextualizing and conveying scientific data and implementing results into policies that impact efforts toward climate change mitigation and adaptation. ECRs can contribute through active mentoring of students, public engagement, and involvement with educators and communities. To empower ECRs in this capacity, it would be prudent to establish a support network for mentorship and career advancement that aligns with the mandates of existing organizations such as the North Pacific Marine Science Organization (PICES) with its Advisory Panel on Early Career Ocean Professionals (AP-ECOP) that currently support ECRs. Additionally, fostering the establishment of national branches of APECS can be instrumental in providing more regional support, particularly for ECRs whose native language is not English. Furthermore, providing economic support to APECS national branches to organize annual conferences and meetings in local languages can better prepare ECRs for international and interdisciplinary collaborations, as well as promote diversity and inclusivity.

By supporting and implementing these (and other) collective initiatives, we believe that the polar research community would be better positioned to address the challenges faced by ECRs. It is essential to foster and promote a professional community in which ECRs have equitable access to funding, resources, and mentorship so that they can continue to contribute to their respective scientific disciplines while advancing their careers. To achieve this, collaboration and shared responsibility among established researchers (including peers), institutions, and agencies is crucial. By working together, we can facilitate a more collegial and secure future for polar sciences and support research that continues to study the impacts of anthropogenic climate change and how best to manage it.

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