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ORIGINAL PAPER

Diversity, equity, and inclusion in paleolimnology: insights from the 2022 IAL-IPA symposium

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Abstract This report provides insights into ways that paleolimnology is becoming, and can continue to be more diverse, equitable and inclusive. Ideas presented here came during the organization, and in part, out of a special session held during the Joint Meeting of the International Association of Limnogeology (IAL) and the International Paleolimnology Association (IPA), conducted virtually (27–29 April 2022) and in-person, in Bariloche, Argentina (27 November to 1 December 2022). It was the first time in 55 years that the combined IAL-IPA meeting (held separately prior to 2018) hosted a special session to address issues beyond the value of scientific information in lake

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sediments. That session, "Beyond just research data: the value of outreach, education, equality, and inclusion around lakes," included topics such as Third Mission activities, i.e., the economic and social missions of universities and how they contribute to the broader community. It also addressed challenges to diversifying our Earth Science community, which is still characterized by underrepresentation of women, especially at the highest academic levels, suffers from the "parenthood effect," which affects both women and men, and often fails to adequately support dual-career couples, especially in Europe. Efforts to enhance diversity, equity and inclusion (DEI) included: (1) a virtual IAL-IPA meeting for Early Career Researchers (ECRs), conducted months before the in-person conference in Argentina, (2) a special session on DEI challenges and values, (3) financial support for ECRs and attendees from low-income countries, (4) equitable ECR awards, (5) consideration of gender equity during plenary and oral presentations, (6) remote presentations, including both live and pre-recorded talks, (7) utilization of multiple communication platforms to disseminate information to conference participants, and organization of science-communication activities, and (8) pre- and post-conference courses and workshops. These efforts were supported by the local organizing committee and by the establishment of the first DEI Working Group. ECRs dominated the in-person Joint Meeting (200 of 300 attendees), which we view as an opportunity to promote changes in our discipline. We encourage members of our community to work collaboratively to shape diverse research groups and identify leaders who will promote more equitable and inclusive workplaces.

Keywords Special conference session · DEI · Third mission · Inclusivity · Dual-career couples · Equitable workplaces · Limnogeology · Paleolimnology · Early career researchers

Introduction

The Joint Meeting of the International Association of Limnogeology (IAL) and the International Paleolimnology Association (IPA) was held virtually from 27 to 29 April 2022, with a focus on engaging ECRs, including graduate students, postdocs, those in the early years of faculty appointments, and young scientists in governmental and non-governmental (NGO) positions. The virtual format made it possible to reach individuals who were uncertain about whether they would be able to attend the in-person conference in Bariloche, Argentina, 27 November to 1 December 2022. The overarching theme for both meetings was "Earth Systems and Climate-Environment-Cultural Changes". Additionally, different initiatives were undertaken to enhance DEI (Fig. 1).

A special session entitled "Beyond just research data: the value of outreach, education, equality, and inclusion around lakes" was held at the conference in Argentina. It was the first such limnogeology/paleolimnology meeting in 55 years to address issues beyond the scientific value of information in lake deposits, and reflected the recent cultural transformation that has occurred with respect to DEI in our discipline, and how we, as scientists, interact with the inhabitants who live around the lakes we study. The idea for the session came out of the IPA working group on "Diversity, Equity and Inclusion" and was designed to highlight challenges for DEI and demonstrate our commitment to DEI values. Promotion of inclusive and respectful communication is fundamental to fruitful scientific collaborations, which are essential for solving the world's environmental problems. We therefore sought to highlight the visibility of these values and promote them at our scientific conference.

Our interdisciplinary research requires that we spend considerable time working in and around lakes, where we often witness and become entangled in complex webs of social, economic, and political factors that influence the well-being of the waterbodies we study. Transparent communication and collaboration with local communities is key to conducting successful paleolimnological studies. This was a main topic of our special session, in which we: (1) highlighted our commitment to DEI among our scientific peers and in our dealing with local communities, as we seek to improve conditions in freshwater ecosystems around the world, and (2) reported on best practices for engaging with local communities to gather data that inform management strategies for the common good. Scientists who investigate paleoclimate/paleoenvironment come from many sub-disciplines

Fig. 1 Graphical summary showing the different efforts made during the 2022 IAL-IPA Joint Meeting to enhance diversity, equity, and inclusion (DEI)

and represent a range of nationalities, races, ethnic backgrounds, gender identities and ages. It is therefore necessary to identify the barriers that individuals face in their career paths and ensure equity and inclusion at work, issues that are rarely discussed at conferences, but are key for creating a healthy academic environment.

The two-hour special session "Beyond just research data: the value of outreach, education, equality, and inclusion around lakes" included ten speakers from diverse backgrounds, with respect to gender, age, nationality, parenthood, and academic rank, and showcased the diversity of researchers who work in our field (Table 1, Fig. 2). The session attracted ~ 50 participants, comparable to attendance at many of the conference research talks. Presentations in the unique session addressed topics of importance to researchers in the aquatic sciences and beyond, including outreach and educational activities, and DEI.

Outreach, education, and data availability

We began with presentations on successful outreach projects in Europe, North America, South America, and Africa. Below, we summarize the main takeaways from each of those talks.

(1) The *Tiefer-Sehen* (Deep-Seeing) project highlighted the value of environmental education for young people in Austria. Children between the ages of 4 and 14 became familiar with lakes near their schools, learned about the fundamentals of paleolimnology (e.g., core chronology), and studied sediment variables used to infer past environmental change. The children participated in an excursion

Table 1 List of talks during the special session FS7 "Beyond just research data: the value of outreach, education, equality, diversity and inclusion around lakes" at the 2022 IAL-IPA Joint Meeting in Bariloche, Argentina (arranged in presentation order)

Authors	Title
Molenaar A, Lantschner M, Pöll J, Strasser M, Daxer C, Moernaut J	Look at lakes (Tiefer Sehen): Investigating lacustrine sedimentary archives with local school children
Martinez-Abarca R, García-León S, Sámano R, Cárdenas-Fuentes E	Three years communicating geosciences in social networks: Divulgación Terróloga
Martinez L, Crosa V, Aniere M, Tonello MS, Rayó C, Romanelli A, Lipori M, Esquius S	Donde nacen las aguas (DNLA): building new local collective practices for the defense of a common good
Contreras S, FDL&O 2022, Agrupación Junquillar, Barrera F, Stuardo A	Learning & Service (L + S), a methodology to promote social awareness and a tool to generate basic environmental information about lake ecosystems
García-Villalba E, Youm CI, Gueye A, Sow IS, Doumbouya MF, Sow E, Ezzoura E, Morales JA	The Lake Retba geomorphosite (Senegal): evaluation and promotion for sustainable human and socio-economic development
Benito X, Feitl M, Carrevedo MI, Velez M I, Escobar J, Tapia PM, Steinitz-Kannan M, Fritz SC	Towards an inclusive and community-driven Iberoamerican geo-limnology science: the tropical South American diatom database
Echeverría-Galindo P, Bonilla K, Pérez L	Women, science and development in Latin America: the case of limnologists and paleolimnologists in the Organization of Women in Science for the Developing World – OWSD
Halac SR, Lecomte K, Sterren A, Ávila P, Borda L, Coppa Vigliocco A, Coppo R, Echegoyen C, Leone F, Nóbile J, Pannunzio Miner E, Pisani N, Serra F, Sferco E, Soto Rueda E	Current situation in the positions and hierarchical spaces in an Earth Sciences research center (CICTERRA, Argentina): a gender perspective approach
Pérez L, Bücker M	Challenges faced by bi-cultural, dual-career academics and suggestions for how to address them
de Tezanos Pinto P	Gender and parenthood effects in career advancement, evidence from the national scientific and technical research council – Argentina (CONICET)

that involved traveling by boat to collect sediment cores. They analyzed the retrieved material and at the end of the program, presented their results and interpretations in a symposium.

(2) The "Learning & Service (L + S)" method is practiced by a Chilean University to promote social awareness and to generate basic information about lakes. Students interact with local stakeholders and have the opportunity to design studies that address environmental issues.

(3) A group of Argentine women is leading the initiative *Donde Nacen las Aguas* ("Where the Waters Are Born"), which is organizing a local collective to defend water resources that are threatened by an ever-increasing number of tourists who visit a mountain ecosystem in a National Park. Members of the collective participate in field activities that include monitoring water variables at multiple sites, data sharing, and building collaborations and communication bridges with local stakeholders to improve water quality in montane freshwater ecosystems.

(4) An Ibero-American initiative has created an open database on tropical diatom taxonomy and ecology. Such information is helpful for scientists who are interested in using these bioindicator organisms in studies of lake eutrophication.

(5) The value of social media platforms in science outreach was shown in a presentation about the Mexican webpage *Divulgación Terróloga* ("Earth Science Outreach", https://www.facebook.com/watch/DivTierra/), developed by a team of ECRs.

(6) One example, from Lake Retba, Senegal, showed how outreach activities are key for promoting sustainable development of freshwater ecosystems in Africa.

The outreach projects described were successful in large part because they were conducted by well-organized, highly motivated, and action-oriented teams that worked collaboratively and effectively with local people outside the academic community. The

Fig. 2 Session "Beyond just research data: the value of outreach, education, equality, and inclusion around lakes" during the IAL-IPA Joint Meeting in Bariloche, Argentina. The session was organized and convened by the Working Group on Diversity, Equity, and Inclusion (Credits: Liseth Pérez, Bárbara Moguel)

approach revealed the deep desire of local inhabitants to learn about and protect the environment, and created conditions in which equitable knowledge exchange occurred. That block of presentations highlighted our societal obligation to conduct outreach through *Third Mission* activities, which involve societal engagement beyond university teaching and research, and emphasize activities like community outreach, knowledge transfer, and collaboration with non-academic partners (e.g., government agencies, NGOs, businesses), to address real-world environmental challenges for the benefit of society. In many respects, we should see these activities as obligatory, especially if our university or agency positions, and the projects we undertake, are taxpayer-funded. We have the capacity to make substantial positive changes in and around our study lakes.

Challenges to DEI within our scientific community

Underrepresentation of women scientists in the Earth Sciences

Several Latin-American participants reported on the underrepresentation of female scientists in the Earth Sciences, especially in senior ranks.

(7) The presentation of the Argentine Earth Sciences Research Center (CICTERRA-CONICET) showed statistics that highlighted a history of male dominance at the two highest academic research levels in the country. Whereas there is female dominance in the two lowest academic levels, not a single woman occupies a position at the two highest levels.

(8) Another presentation showed that the gender gap within the scientific and technological center of the National Scientific and Technical Research Council (CONICET) of Argentina, with about 12,000 researchers, was similar to that of the Earth Sciences Research Center (CICTERRA-CONICET). There was also discussion of the "parenthood effect," which manifests as lower scientific output, and consequently slower advancement for researchers with children, compared to those without children. Whereas both men and women are subject to the "parenthood effect," there is a disparity between the sexes, in that fathers face fewer barriers than do mothers.

(9) The Organization of Women in Science for the Developing World (OWSD) provides research training and enables networking among participants at different career stages to support women in science and fight gender inequality. Persons interested in receiving information on courses offered, awards, job opportunities, etc., can join the mailing list at https://lists.ictp.it/mailman/listinfo/owsdw-update. Another important source of information is the OWSD newsletter (https://owsd.net/news/owsd-newsletter).

Whereas most of the presentations described above draw from Latin American experiences, gender inequities in the Earth Sciences are a global issue (Popp et al. 2019; Maas et al. 2021). Although gender inequity may not be intentional, addressing and correcting it must be deliberate (Sardelis et al. 2017). Our research community must take actions to address gender and motherhood barriers to academic success and advancement. The good news is that change is happening, even if it appears to occur slowly. For example, Dr. Julieta Massaferro (Argentina) and Professor Helen Bennion (UK) currently lead the International Limnogeology Association and International Paleolimnology Association, respectively.

Dual-career couples

Dual-career couples in our scientific community are becoming more common. Nevertheless, such couples often face severe employment challenges, i.e., difficulty securing two positions in the same institution, or even the same city. Dual-career couples of different nationalities confront additional problems, such as difficulties with establishing residency and obtaining work permits. Issues of language proficiency and culture shock may also come into play, as can the challenge of raising small children in a foreign environment.

The COVID pandemic highlighted the challenge for many parents and dual-career couples. As schools and day-care facilities closed in spring 2020, many women took on full-time care of their children, thereby slowing their career trajectories and reducing their opportunities for securing permanent positions.

(10) As noted above, it can be very difficult for both spouses to find jobs in the same city, and nearly impossible for both to land permanent positions in the same academic institution. Trailing spouses can sometimes find a "job," but not a stable "career" path, a situation that is common in many European countries. In contrast, some universities in the US have dealt with the problem by creating "spousal accommodation" programs. For instance, if a candidate is offered an academic position at the University of Florida (Gainesville, US) the "Dual Career Academic Hire" process can be used to help a qualified spouse find a position in the same university (https://aa.ufl.edu/resources/dual-career-services/dual-career-academic-hire-procedures/). Whereas a spousal slot is not guaranteed, some academic institutions in the US have made more progress on this topic than many European institutions, as described by a bi-national (Guatemalan/German) dual-career couple who reside in Germany with their two small children. In their presentation, they discussed the professional challenges they have faced and presented some

possible solutions. They also raised several issues that ECRs should consider when choosing a country in which to seek academic employment.

Key statistics and strategies for equity and inclusivity in the 2022 IAL-IPA joint meeting

Pre IAL-IPA early-career virtual meeting (27–29 April 2022)

A first commitment to inclusion, particularly for Early-Career Researchers (ECRs) from low-income countries, involved designing and hosting an online meeting open to all. This initiative, supported by PAGES-ECN (Past Global Changes-Early Career Network), EAWAG (Swiss Federal Institute of Aquatic Science and Technology) and ETH Zürich (Federal Institute of Technology-Zürich) enabled young scientists to present and network. The opportunity was especially important for individuals who were uncertain as to whether they would be able to attend the Joint Meeting in Bariloche, Argentina. The scientific program included oral and poster presentations, keynote speakers who covered an array of topics on paleolimnology, climate and ecological change, novel techniques, and professional development.

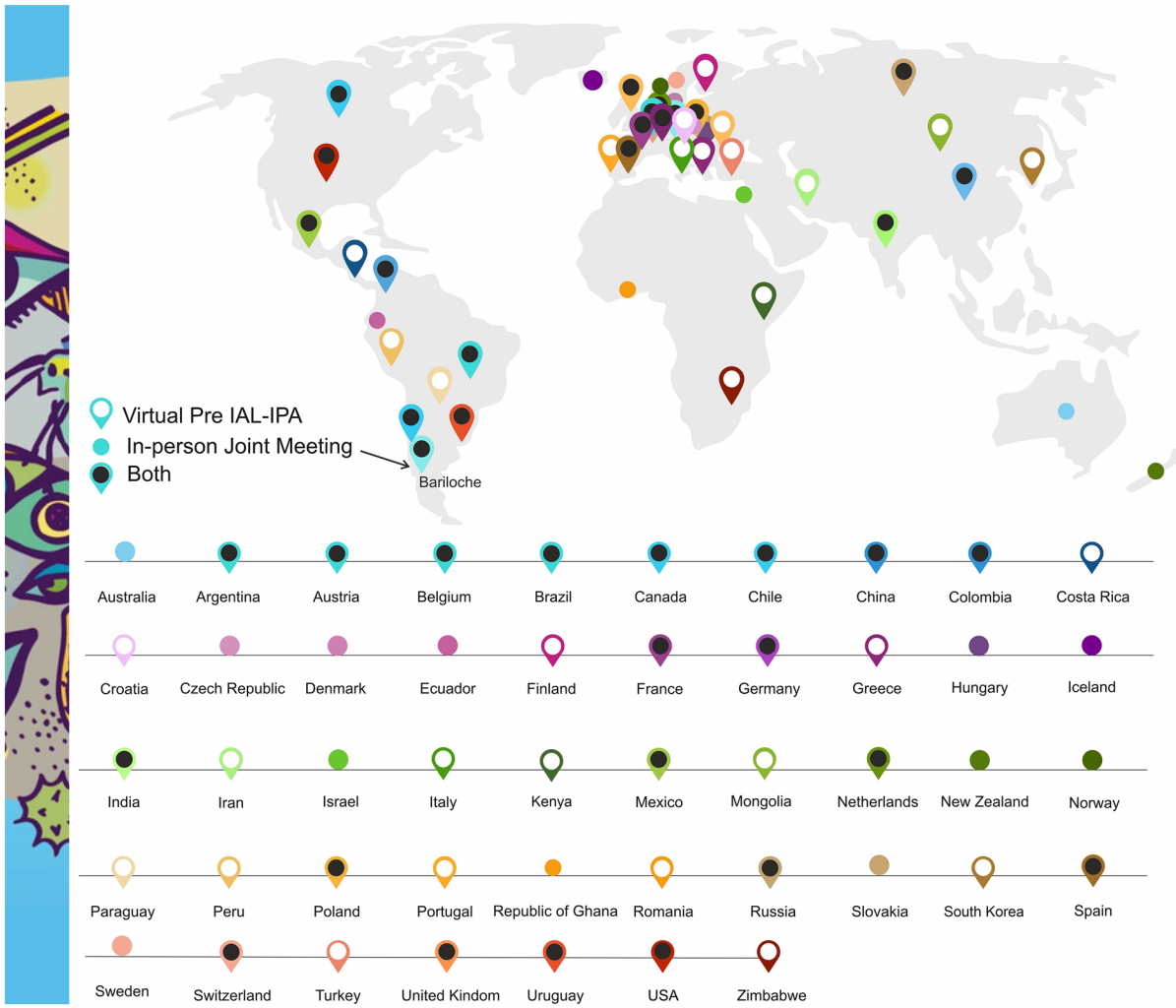


Fig. 3 Country of residence for participants who attended (1) the virtual Pre IAL-IPA Meeting for ECRs, and (2) the in-person IAL-IPA Joint Meeting in Bariloche, Argentina

Participants

Approximately 150 ECRs from 35 countries participated in the Virtual Pre IAL-IPA Meeting, and 300 participants (200 ECRs and 100 non-ECRs) from 32 countries attended the in-person IAL-IPA Joint Meeting in Bariloche (Fig. 3). The substantial participation of ECRs and the extensive representation of affiliated countries highlights the importance of conducting virtual meetings, even after the waning of the COVID-19 pandemic. We also want to highlight achievements that were evident at the in-person meeting in Bariloche. More than half of the 300 attendees (155) were women, and two-thirds (200) were ECRs, which is a positive sign for the future. Nearly one-third of the participants (94) came from Latin America, a region that is generally poorly represented at the meetings.

Establishment of the first DEI working group

In preparation for the IAL-IPA Joint Meeting in Bariloche, four scientists from our community created the first "Working Group on Diversity, Equity and Inclusion". They are Liseth Pérez and Paula Echeverría-Galindo (RWTH Aachen University, TU Braunschweig, Germany), Paula de Tezanos Pinto (UNDAV-CONICET, Argentina) and Fernanda Charqueño (CENAC, Argentina), and were supported by the local organizing committee. Their main objectives were to encourage a respectful and inclusive atmosphere during the conference, and to convene the special session "Beyond just research data: the value of outreach, education, equality, and inclusion around lakes." To achieve the first objective, the group sent an e-mail to the broader community via the paleolimnology listservice (subscribe at: listserv@lists.ufl.edu, or contact Thomas Whitmore at whitmore@usf.edu), and to the list of all registered meeting participants, with information on the symposium code of conduct (https://www.paleolim.org/copy-of-guidelines), along with a guide for inclusive language to be used during the meeting.

Financial support for ECRs and attendees from low-income countries

Support was provided to all ECRs who applied for financial assistance, most of whom came from low-income countries. More than 40 participants benefited from free accommodation and registration, thereby diminishing economic barriers to their active engagement.

ECR awards

A special committee assessed and equitably distributed awards to recognize the quality of ECR contributions in poster and oral presentations. Such recognitions highly motivate younger members within our scientific community (Fig. 4).

Fig. 4 Best poster and oral presentation award ceremony (left). Poster presentations and evaluations (right; credits: Natalie Dubois, Facundo Pardo)

Fig. 5 Gender alternation during plenary and oral presentations was encouraged during the IAL-IPA Joint Meeting in Bariloche, Argentina (Credits: Facundo Pardo, Liseth Pérez)

Fig. 6 Plenary speaker presenting remotely (Credits: Facundo Pardo)

Gender equity during oral presentations

Session conveners were encouraged to organize the order of their presenters by study regions and to alternate between genders and academic levels, as much as possible (Fig. 5). This approach underscored both geographic diversity and gender parity at the conference.

Remote participation of scientists

The local organizing committee facilitated remote participation of some scientists (Fig. 6). The live and pre-recorded presentations enabled the participation of plenary researchers who could not be present, recipients of association awards who could not attend, and presenters who could not come because of visa or health issues.

Pre- and post-conference courses and workshops

Both the virtual and in-person IAL-IPA meetings offered courses and workshops (online and in person) that provided opportunities, especially for ECRs, for personal and academic development. These included: (1) The Neotoma Paleoecology Database, (2) An Introduction to GIS, (3) CREST R, (4) Human Traces, and (5) PAGES ECN (Fig. 7).

Use of different communication platforms

The local organizing committee disseminated information about the meeting on multiple social communication platforms, ensuring that details about the programs reached a diverse audience (Fig. 7). E-mail and social media platforms are great tools for connecting with participants of different ages, backgrounds, and interests. This strategy allows interactive engagement and real-time updates that maximize communication and help build community.

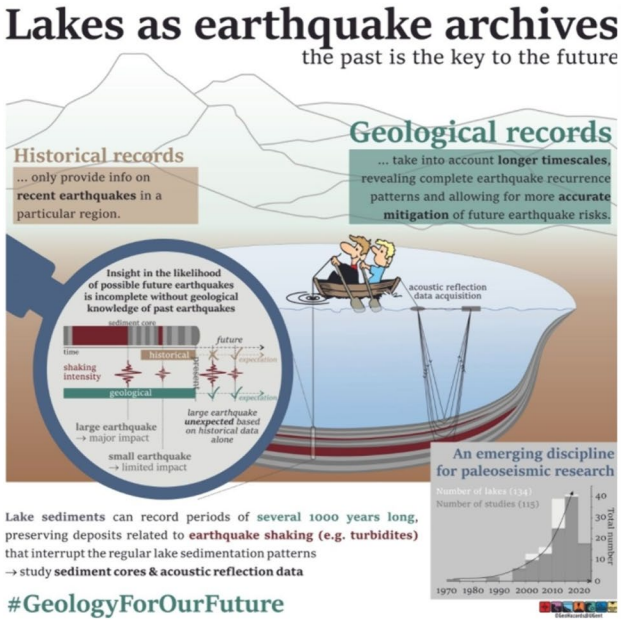
Communicating science to a diverse audience

The organizers of the Pre IAL-IPA Virtual Meeting for ECRs engaged participants in hands-on activities designed to present complex scientific concepts through visual aids such as drawings, cartoons, comics, photographs, and short videos (Fig. 8). Art is a powerful tool to communicate science. During the conference, Ingrid Roddick exhibited her artworks, which were inspired by glacial Lake Nahuel Huapi, the waterbody just down the hill from the conference center.

Final thoughts: opportunities and perspectives

About 150 and 200 ECRs participated in the 2022 IAL-IPA virtual and in-person meetings, respectively, which presented an excellent opportunity to promote changes in how we carry out and present our research. Our members are increasingly aware of

Fig. 7 Post-Conference workshop on CREST R (left), hosted by Manuel Chevalier. Information about the courses and workshops was posted regularly on different social media platforms (Credits: Paula Echeverría-Galindo, Liseth Pérez)



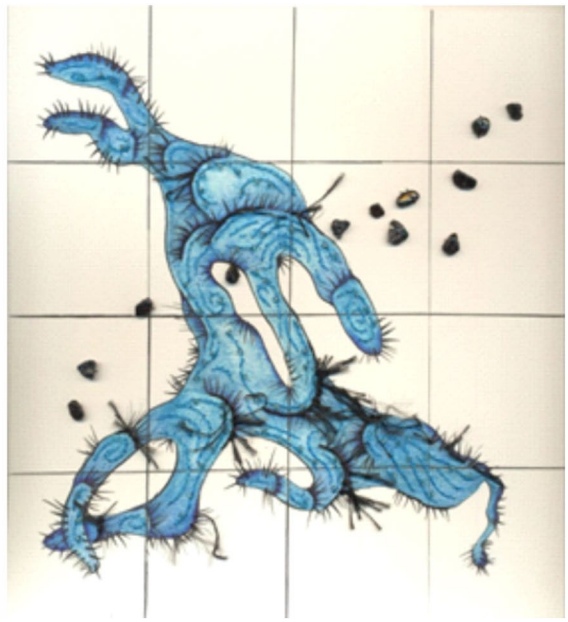


Fig. 8 Example of science communication activities at the Pre IAL-IPA Virtual Meeting for ECRs (Credits: Lacustrine Paleoseismology by Katleen Wils, left) and the artwork of Ingrid Roddick, inspired by Lake Nahuel Huapi and displayed at the 2022 IAL-IPA Joint Meeting in Bariloche, Argentina (right)

how our research community can better promote DEI, and environmental justice, especially as they relate to water resources. We are optimistic that our scientific community is working towards a better future. We encourage other members of the Earth Science community to include similar sessions in their national and international symposia, and address strategies to improve DEI. Such sessions enable discussions about ways to improve environmental conditions in the regions where we conduct field work, and promote more diverse, equitable and inclusive conditions in our workplaces. Even "passive participants" in these sessions are exposed to the content, which may help shape their attitudes about gender equity (Jackson et al. 2014). In addition to gender-related topics, we encourage colleagues to discuss other dimensions of diversity that are lacking in Earth Science, including race/ethnicity, disability, gender identity, sexual orientation, class/income, and others. Country of origin is also a challenge for some scientists. For instance, African scientists are rarely co-authors on journal articles in Earth Science, even when they are involved in the studies (North et al. 2020). Also, with respect to faculty appointments and evaluations, we suggest that in addition to traditional metrics like scientific publications, grants, and graduate student mentoring, the importance of outreach and DEI activities should be considered. For instance, great examples are the guidelines and evaluation criteria used by the Natural Sciences and Engineering Research Council of Canada (https://www.nserc-crsng.gc.ca/NSERC-CRSNG/Policies-Politiques/assessment_of_contributions-evaluation_des_contributions_eng.asp). Much work by our community is needed before our science is truly diverse, equitable, and inclusive. We should believe that each of us can make a difference in our everyday actions and that any action is better than no action.

Future sessions and workshops on these themes should consider ways to encourage participants to ask questions and make comments. These might include: (1) enabling them to submit questions/comments anonymously, either on paper or using a mobile phone application, (2) allowing participants to ask questions and make comments in their mother language, which others can translate, to enable less confident individuals to speak and thereby make sure that all voices are heard, (3) using more interactive formats, such as lunch/dinner discussions, with cartoons or other visuals

to stimulate the conversation, instead of only the traditional 15-min-talk format. Traditional presentations have the drawback that they have time limits, which may prevent some questions from being addressed.

The Pre-IAL-IPA Virtual Meeting for ECRs was well received and enabled us to engage participants from more countries than during the in-person event. We strongly encourage future IAL and IPA organizers to continue with this initiative. Additionally, we recommend alternating the location of future IAL-IPA meetings between "wealthy countries" and developing nations, e.g., many in the Global South, to ensure participation of community members with less financial resources.

We were thrilled to see almost gender parity among the attendees at the meeting in Bariloche and were very pleased to see the equitable gender mix among the plenary speakers and oral presenters.

Although there is undoubtedly a legacy of more men than women in senior positions in the paleosciences, and hence a greater number of male (17) than female (6) awardees of the IPA Lifetime Achievement (Battarbee) Award since its initiation in 2009, we expect that with the full adoption of DEI principles by our scientific community, we will see an improved gender parity among those who receive this and other prestigious awards (e.g., IPA ECR Awards and the IAL Bradley Medal) in the future.

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Declarations

Conflict of interest The authors declare no competing interests.

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