

14th International Conference on Paleoceanography

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The International Conference on Paleoceanography (ICP) has a 40-year-long tradition connecting the global research community that uses marine archives and modeling approaches to reconstruct and simulate the history of the ocean and its role in changing climate. Arranged by the community, this event is held every three years at different locations. In 2022, ICP was arranged for the 14th time (pastglobalchanges.org/calendar/128671), hosted in Bergen, Norway, by the Bjerknes Centre for Climate Research, the University of Bergen, and NORCE Norwegian Research Centre (Fig. 1). ICP14 brought together 551 researchers from 33 countries (including 175 students) covering all subdisciplines of paleoceanography.

The conference program reflected the diversity of current paleoceanography research and was centred around five themes. In the first theme, "Climate and Ocean Biochemistry", a focus was set on the reconstruction of biogeochemical cycles, seawater chemistry and elemental cycling in the ocean, factors that are intimately coupled to global climate and marine ecosystems. The second theme, "Ocean Circulation and its Variability", addressed the state, rate and sensitivity of past ocean circulation and its

relationship to climate and carbon-nutrient cycling, while the third theme, "System Interactions and Thresholds", was dedicated to studies on interactions between the ocean and other Earth system components, and how these interactions generate climate variability across different timescales. This theme also covered ecosystem impacts of changes in the ocean and climate. New insights on the ocean and climate dynamics during past warm climate states were presented under the fourth theme, "Improving our Understanding of a Warmer World". Finally, the fifth theme, "Innovation to Overcome Knowledge Gaps", aimed to bring the community up to date on the development of new proxies and approaches to reconstruct and model climate change, and enhance our understanding of relevant processes. In addition, focus was set on how to integrate such different approaches to further enhance our understanding of the Earth system.

The conference followed the well-established ICP format: a limited number (28) of invited plenum lectures presented state-of-the-art results and ideas regarding each of the five themes of the conference. Three longer perspective lectures informed of new insights from adjacent research fields

that are relevant to paleoceanography. At ICP14, perspective lectures focused on the nitrogen cycle in the mixed layer and its impact on export fluxes, the global overturning circulation, and the role of paleoceanography in the latest IPCC reports. In addition, a keynote talk highlighted advances in the organic geochemistry toolbox. The daily program also included five vibrant plenum discussions on the topics presented each day with all speakers.

The plenary program was complemented by extensive poster sessions allowing for ample discussion time. Poster sessions are the key element of every ICP, where the whole breadth of research is covered. The ICP14 program included 543 poster presentations, among which, 40 were virtual.

For early-career researchers (ECR), ICP contributes to professional development and provides an opportunity to connect with leading scientists, as well as their peers. To support participation of ECRs and scientists from low-income countries, 13 travel and virtual participation grants were provided thanks to funding from ICP13 and PAGES. The outstanding quality of ECR presentations was noted by many of the participants, and three graduate students received a poster award sponsored by PAGES. To facilitate ECR networking, the PAGES Early-Career Network (ECN) organized an open ECR meeting focusing on scientific publishing.

In addition to the scientific program, networking and discussions were facilitated at a range of social activities, another cherished ICP tradition. The social program of ICP14 included the icebreaker, a welcome reception by the City of Bergen in the medieval Håkonshallen, a conference dinner, and the traditional Paleomusicology concert. The concert once again featured excellent and impressive performances by some of the conference attendees.

Outreach activities included an event for high school students by some of the ICP14 attendees and the Bjerknes Centre, strong social media presence, and visits of the Lego Ninja, a Bjerknes Centre local who frequently follows us during fieldwork and other activities (Fig. 2).

ICP as a hybrid conference and other measures to widen participation

ICP14 was the first ICP to be held in a hybrid format with the aim to allow for participation by those affected by travel restrictions related to the COVID-19 pandemic, as well as those who cannot, or prefer not to, travel for other reasons. In addition, the organizers



Figure 1: ICP14 logo inspired by the storage houses of medieval Bryggen in Bergen, the wharf of the Hanseatic League's trading empire from the 14th to the mid-16th century and the "warming stripes" graphic, first shown by the climate scientist Ed Hawkins at the University of Reading (showyourstripes.info). Image credit: Suet Chan.

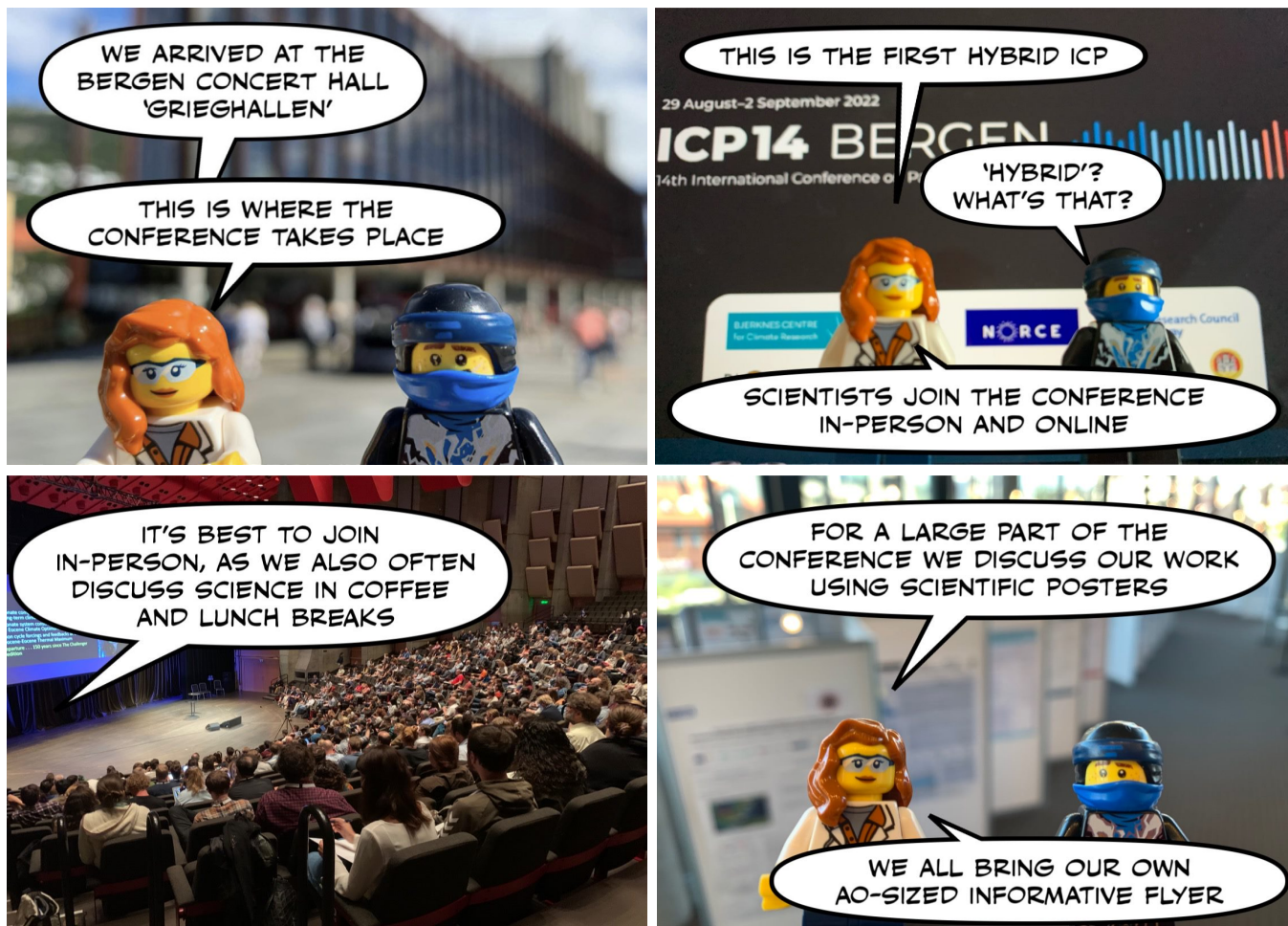


Figure 2: Excerpts from the Lego Ninja story (shorturl.at/CKST2) about its experience at ICP14. Image credit: Petra Langebroek.

hoped that the reduced costs for remote participation would allow more colleagues to participate. A digital solution allowed for remote participation of plenary speakers, poster presenters and other participants.

All registered participants had access to the digital poster gallery and were invited to contribute to discussions. The poster gallery was already available prior to the conference and for the two subsequent weeks. This opened opportunities for participants to preview posters, and to also continue visiting posters after the conference. Furthermore, the digital solution allowed for streaming plenary events or watching the recordings at more convenient times.

Given that ICP14 took place at the tail end of the pandemic, and unfortunately some participants fell sick during the conference, the hybrid format allowed speakers and other participants to continue their participation, and, in many cases, prevented the need for last-minute changes. However, while the hybrid format has many advantages, it is important to mention that it leads to a considerable cost increase, for the professional online platform and streaming solutions, and additional conference organization tasks. The community therefore needs to discuss whether the benefits of wider participation options, the added flexibility, and the potential carbon footprint reduction outweigh the extra costs and efforts that are needed.

A survey conducted among ICP14 participants after the conference revealed that the overwhelming majority (85% of 200 respondents) also support hybrid formats for future ICPs, and most respondents (almost 90%) did not mind some of the presentations being given remotely. Those that specified their reasons for online participation did so for various reasons (COVID-19 restrictions, personal reasons, lower costs, other commitments, health), but only few (less than 5%) due to the reduced carbon footprint.

Online posters were seen as added value to the conference by roughly half of the respondents, whereas 23% did not think so. The responses suggest that the online poster gallery was not used to its full potential in this first hybrid iteration of ICP. While about two-thirds of all respondents uploaded a virtual poster, only half of the in-person participants ended up looking at the online posters. Feedback suggested that if virtual-only posters are included (as was the case at ICP14), they should receive more dedicated attention during the meeting (e.g. pitch talk session, dedicated screens, more attention to discussion function for virtual posters).

Feedback on how to broaden participation at ICP included multiple aspects. Regarding speaker selection, most respondents support community nominations of speakers, with the scientific committee making the selection. Many respondents advocated for the importance of diversity in the scientific

committee regarding both scientific and non-scientific aspects.

An idea brought up at the conference was the establishment of regional hubs for increasing participation and decreasing carbon footprint, while still allowing for networking. This suggestion was, however, met with varied responses from survey respondents. Around half of the respondents did not have a clear opinion, and the rest were divided into those seeing the positive sides regarding carbon footprint and widening participation in general, while others worry that the hubs would in fact prevent international networking and not help with diversity, equity and inclusion.

Overall, ICP14 was a great success. The community discussion regarding a potential hybrid future for ICP, and other adjustments, should be continued in order to keep this special conference a vibrant, cherished, and welcoming meeting place for the global paleoceanography community.

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2k-CVAS Topical Science Meeting: Centennial climate variability at regional scale in models and reconstructions

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Potsdam, Germany, 6-10 March 2023, jointly with 2k Network workshop: Hydroclimate synthesis of the Common Era and CVAS workshop: Role of scaling in the future of prediction & emerging themes

Understanding climate variability is at the heart of climate science and one of the main focus areas of several PAGES working groups (WGs). In particular, the Climate Variability Across Scales (CVAS) WG (pastglobalchanges.org/cvas) and the 2k Network (pastglobalchanges.org/2k-network) use different approaches to understand variability from sub-annual to millennial timescales.

To stimulate deeper interactions between the communities, the two groups gathered in Potsdam, Germany, in March 2023 (pastglobalchanges.org/calendar/134682). The week-long meeting started with individual two-day meetings of the 2k Network and CVAS WGs, discussing hydroclimate variability and climate variability mapping, respectively. Then the two groups joined for a Topical Science Meeting (TSM) on centennial variability. While it is a key timescale, similar to the one of anthropogenic warming, it is less studied and understood than decadal or millennial to multi-millennial timescales. This is partly due to the lack of a significant forcing on this timescale making the expected signal weaker than for glacial-interglacial cycles, for instance. In addition, analyzing centennial variability over the last 2 kyr is associated with many challenges, both on the data and climate modeling sides.

Many proxy timeseries at annual resolution are too short to faithfully reconstruct centennial variations, while longer series may have inadequate resolution or age

control. In the meantime, while most climate models simulate some centennial-scale variability, the magnitude, especially regarding surface-temperature variations, is smaller than in proxy-based reconstructions and the spatial patterns vary greatly between models. A TSM on this subject was, thus, an opportunity to review the main issues and prepare actions to make progress on the most critical ones.

The goal of Phase 4 of the 2k Network is to reconstruct and understand hydroclimate variability during the Common Era. The first half of the workshop was used for plenary talks to set the scene for breakout sessions during the second half. An introduction on the history of hydroclimate research within the 2k Network, presented by Thomas Felis, was followed by two talks related to the first goal of the WG: to build a database to reconstruct spatiotemporal hydroclimate variability over the Common Era. Chris Hancock presented work on a Holocene hydroclimate database, and Bronwen Konecky described the process of building the Iso2k database. Seminars by Kira Rehfeld and Nathan Steiger focused on the integration of information from hydroclimate simulations and reconstructions.

The second half of the workshop was used for discussions within the three regional focus groups of Phase 4 to define the research questions and map out pathways towards answering them. The Tropical Pacific and South Asia group identified

the reconstruction of ENSO-hydroclimate teleconnections and the variability of large-scale monsoon/circulation patterns as priority targets, whereas the Southern High-Latitude group focused on the reconstruction of extreme hydroclimate events and the understanding of atmospheric blocking events. The North Atlantic group identified large-scale atmospheric modes of variability during climate extremes of the Common Era as a first reconstruction target. All discussions included identifying sources of hydroclimate information, including those not yet in PAGES databases or similar (e.g. x-ray fluorescence [XRF] data), and addressing technical issues related to ensuring adherence to the FAIR data principles to increase interoperability of 2k data products.

The second workshop of Phase 2 of the CVAS project was held to bring together experts using different strategies for climate-related predictions/projections, discuss the possibility of scanning a larger parameter space in climate models and their effect on simulated climate variability, and discuss the progress on the variability mapping. In plenary talks and breakout groups, the experts presented their perspectives on the role of stochastic versus deterministic models and the best way to utilize climate models to improve confidence in climate projections. The discussion highlighted the importance of alternative modeling approaches and looked at first results from scanning the physical parameter space in climate models

Millennial Variability PSD_{1000–3000 years} (Pollen)

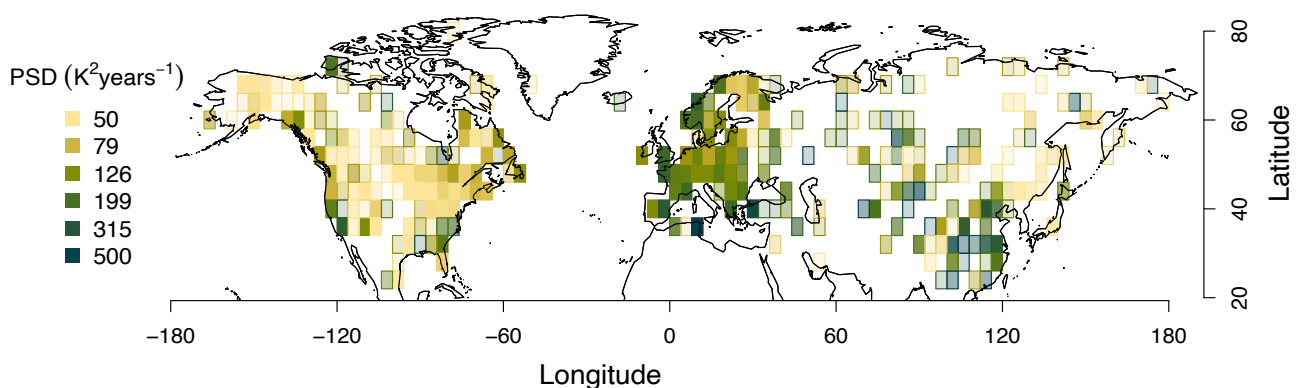


Figure 1: Figure modified from Hébert et al. (2022). Spatial pattern of millennial summer temperature variability from pollen-based reconstructions gridded on a 2° x 2° grid. The variability corresponds to the mean power spectral density over the 1000-3000 years timescale band.