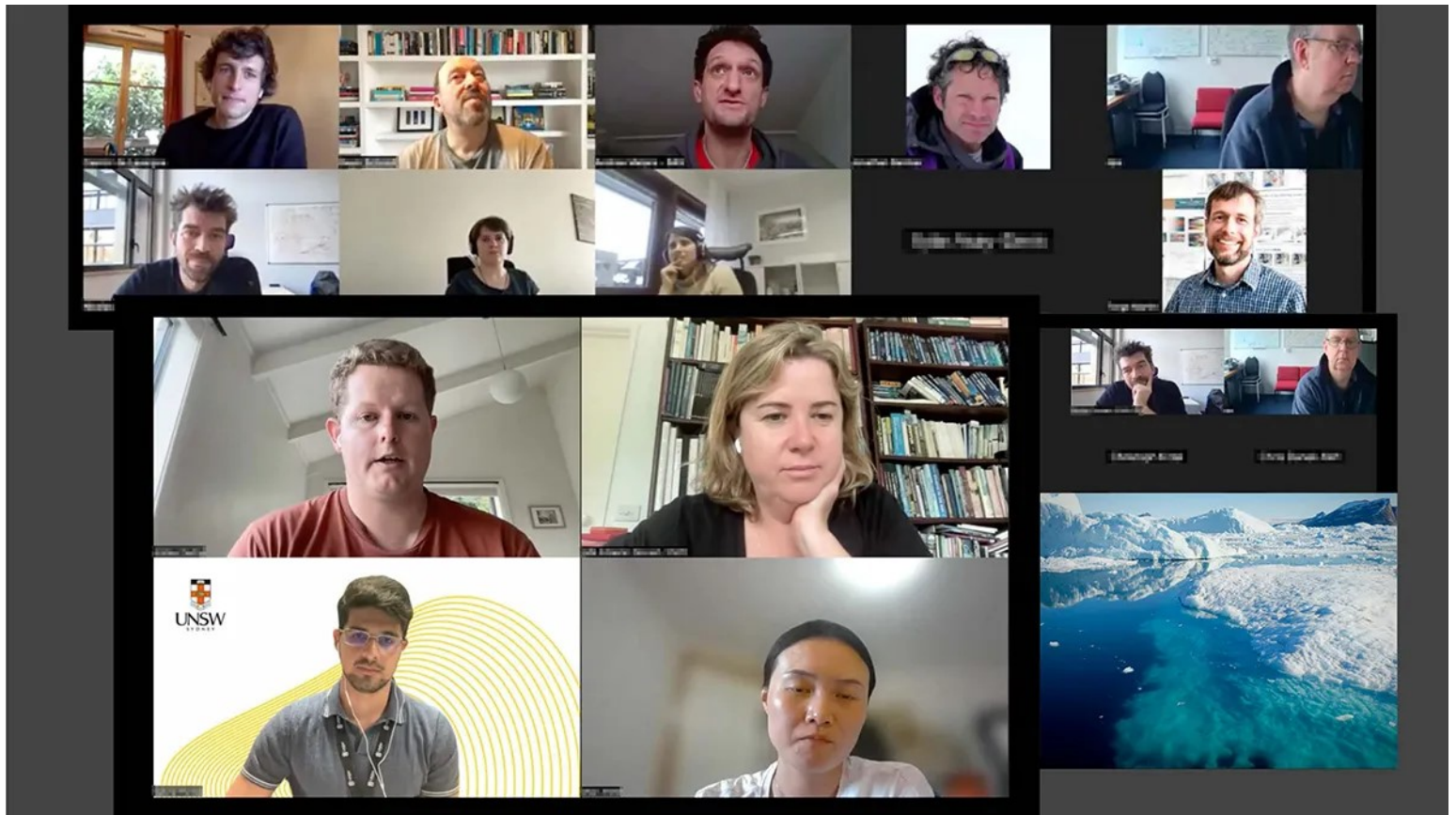


Lessons Learned from Running a Virtual Global Workshop

Online conferences simplify planning needs, lower barriers to participation for a global audience, and reduce environmental footprints, but scheduling, pacing, and moderating sessions can be challenging.

By Gavin A. Schmidt, Julie Arblaster, Kenneth D. Mankoff, Andrew Pauling, and Qian Li

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Participants in a recent virtual global workshop, which focused on meltwater flowing into the ocean from the Greenland and Antarctic ice sheets, are seen in this collage of screenshots from different workshop sessions. The inset image shows icebergs off the Greenland coast. Credit: Inset: Twila Moon, National Snow and Ice Data Center/ Flickr, CC BY 2.0

The world of academic workshops and conferences is changing. Constrained budgets for meeting organizers and attendees, postpandemic reluctance to travel, concerns about environmental footprints, and the need to be more inclusive are all motivating efforts, including in the sciences, to find [workable alternatives](#) to in-person gatherings [[Kremser et al.](#), 2024; [Fraser and Mancl](#), 2024]. Meanwhile, widespread access to improved communication technology and the availability of an ever-growing set of online tools are increasingly making remote workshops more

viable and effective than in the recent past.

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[Online events](#) are particularly attractive for geographically dispersed groups of participants and—because there is no need to work out location-based logistics—for meeting organizers facing tight constraints on the lead time available for planning. Online events, though they have their own challenges, can also minimize the time commitment for attendees and can enable inclusion of a broader group of perspectives, including in multidisciplinary workshops bringing together experts from different fields.

We are a group of Earth scientists, including modelers and observationalists, interested in quantifying and understanding the impacts of the increasing volumes of meltwater flowing into the ocean from the [Greenland](#) and [Antarctic](#) ice sheets. This meltwater [affects the ocean](#) through sea level and density changes, which can have wider impacts on the climate through ocean temperatures and sea ice changes. Data on these fluxes will be an important input for climate models, such as those used in the [Coupled Model Intercomparison Project](#) (CMIP), a vital source of input for international and national climate assessments.

In late 2023, with a looming deadline for submitting input data for the next round of CMIP, we recognized the need for a rapid coordinated global effort to produce datasets characterizing historical freshwater fluxes to support these models. (The deadline was originally in April 2024, although it was subsequently pushed back.) In response, we organized a virtual [workshop](#), held 11–13 February 2024, to gather contributions from a global group of experts. The novel format offered many benefits and was successful, although participant feedback pointed to possible improvements.

Topic, Scope, Format, and Scheduling

The scientific literature is increasingly mentioning effects of meltwater from the Greenland and Antarctic ice sheets. Accurately quantifying meltwater fluxes is important for matching observed and modeled surface temperature and sea ice trends in the Southern Ocean. These fluxes have also been implicated in changes in salinity and temperature in the North Atlantic and tropical east Pacific [[Dukhovskoy et al.](#), 2019; [Dong et al.](#), 2022].

Recent studies have suggested that these fluxes need to be represented in climate model simulations, either by including dynamic ice sheets or by adding freshwater as an external driver, to improve the models’ skill in reproducing observations [[Pauling et al.](#), 2016; [Schmidt et al.](#), 2023; [Li et al.](#), 2023; [Roach et al.](#), 2023].

To address this need, we set three goals for our recent workshop: to develop a community of observationalists and modelers to collate and document the required datasets, to recommend methods for implementing this freshwater flux

in climate models, and to publish the methodology in time for it to be incorporated into the next round of CMIP simulations.

Given this scope and the short timeline we had to work with, we developed a virtual workshop format. In addition to simplifying planning (it took less than 4 months from conception to execution) and its flexibility for participants, this format had financial cost benefits because it eliminated travel expenses and used only preexisting resources.

The conference organizing committee canvassed for potential presenters across the range of topics to be discussed, from ice sheet observations to ocean modeling and preliminary results from coupled systems. We requested that speakers prerecord a focused talk of up to 15 minutes and upload their video and slides to a shared Google Drive folder at least a week before the conference. This format mitigated the usual limitations on speaking time at meetings, so invitations to speak were sent to all of the initially proposed presenters and to others suggested during the organizing process. Not all speakers had experience with self-recording talks, so we provided guidance on useful techniques and software alternatives.

In total, 30 recorded talks with accompanying slides were made available to workshop participants about a week before it started. Attendees who provided feedback after the meeting universally praised this aspect of the workshop, although some expressed frustration that not all speakers kept to the 15-minute limit. Other respondents said they would have preferred more lead time to view the talks in advance. Additional prompting by organizers to encourage participants to watch the talks ahead of the discussion sessions likely would have also helped.

To attract participants on short notice, we promoted the workshop heavily through standard approaches such as mailing lists, word of mouth, and advertising at other meetings. We also spread the word with frequent messaging on social media platforms widely used by scientists—notably X (formerly Twitter) and Bluesky—and we specifically targeted social media accounts that reach underrepresented communities (e.g., @BlkinGeoscience).

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In addition to simplifying planning and its flexibility for participants, the virtual workshop format had financial cost benefits because it eliminated travel expenses and used only preexisting resources.

Approximately 160 people registered for the workshop. Registrants were based around the world, including in (starting at the International Date Line) New Zealand, Australia, Japan, China, India, eastern Europe, central Europe, the United Kingdom, locations across the contiguous United States, and Hawaii. Some were also on ships at sea or in field camps in Antarctica (and connected via Starlink). Using an online multitime zone meeting planner, we quickly assessed which blocks of time were within (or close to) the working day for four

representative zones: the Australian East Coast, central Europe, the U.S. East Coast, and the U.S. Pacific coast.

No time blocks were ideal for all participants, but we identified a 1-hour block (beginning at 20:00 UTC) that minimized the collective inconvenience. We thus chose that time block to host daily “global Zoom” sessions that covered welcoming remarks, summaries of prior sessions, and concluding statements. We also defined three or four 2-hour discussion blocks per day, each of which was convenient for participants in a subset of time zones. (For example, a block from 13:00 to 15:00 UTC was considered convenient for people in Europe and on the U.S. East Coast.) The whole workshop took place over 49 hours.

Immediately after the workshop, all participants were asked to provide feedback on any or all aspects of the format; 16% of the signed-up participants responded.

An Abundance of Information

Zoom sessions during the meeting were all recorded, and those recordings were posted to the shared Google Drive as soon as they were available. In addition, each session had a facilitator and rapporteur whose notes were visible (and editable) on the Google Drive in real time. (See the sidebar for more information on the tools used and other technical considerations for this meeting.)

Survey respondents mostly reported that they at least skimmed the notes from sessions they missed, but few felt they had enough time to review the Zoom session videos. In fact, 50% of respondents did not think the session recordings were useful, whereas 75% thought the notes were more useful. We realized in retrospect that the combination of trying to catch up on both relevant presentations and meeting discussions they’d missed was too much for many participants. (We return to this point below.)

Up to 60 participants at a time attended the regionally specific Zooms, which supported a [rolling discussion](#) of important topics, such as modeling strategies and sources of observational data. The rolling format, designed to keep conversations moving and effectively tap the collective intelligence of a large group, was successful overall and helped to foster the intensity and focus of an in-person workshop.

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However, a limitation of this approach for our event was that in some sessions, few or none of the relevant experts on the particular topic of focus could attend because of inconvenient timing, which limited the depth of discussion slightly. Other criticisms of these sessions related to facilitators not adequately including all participants and an occasional lack of focus in discussions, but most respondents reported that they were able to engage in and follow the conversations.

For questions and answers on the talks and technical discussions, we set up a [GitHub repository](#) accessible to all participants with facilities for uploading data and code. The repository also featured flexible discussion boards [[Braga et al.](#), 2023] tailored to the session topics, technical issues such as dataset formats, and the broader philosophy of model coupling. Most of the survey respondents (74%) said they appreciated having the discussion boards, and even months later, the boards are still in use.

Feedback and Future Improvements

From our perspective as organizers, this global, virtual workshop developed on relatively short notice was a success. Fulfilling our first goal, it indeed brought together a community of researchers to focus on the representation of freshwater fluxes in climate models—and it did so with no dedicated funding and zero travel-related carbon emissions.

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Our experience running the recent meeting and the participant feedback we received offer useful lessons for future efforts.

Large majorities of survey respondents reported that they were very or extremely satisfied with the format (72%) and that they would attend another similar event (84%). They appreciated the time, energy, and money they saved compared to attending an in-person event, and most said they would prefer this format over others, such as multiregion hub meetings or hybrid options for standard workshops.

An additional demonstration of the meeting’s success will come with the timely delivery of the new collated

datasets, the guidance on implementing these fluxes in models that emerged from the meeting, and the paper documenting the implementation process, all of which are in progress.

Our experience running the recent meeting and the participant feedback we received offer useful lessons for future efforts. Suggestions for improving the experience focused on slowing things down. Specifically, people requested that the prerecorded talks be made available further in advance of the workshop. They also requested more time between sessions for breaks, to catch up on prior conversations, or to prepare for upcoming discussions.

We therefore recommend that organizers maximize the time available for attendees to view the uploaded videos beforehand; ideally, it should be at least 2 weeks. Also, considering that people cannot necessarily devote many hours a day to a remote workshop, such events should be

Technical Notes for Running the Workshop

- Global time zone information was gathered using the [World Clock Meeting Planner](#) tool from [timeanddate.com](#).
- A Google Drive folder with more than 10 gigabytes of available storage was used to store prerecorded presentations. Access was granted only to workshop participants (i.e., it was not publicly accessible for uploads).
- Converting speakers’ videos to other formats was sometimes required to ensure that the videos would stream within attendees’ browsers and to avoid the need for manual download.

spread over a longer period than would be normal for an in-person event. We recommend at least a week or possibly two, instead of just a few days. Further, although rolling discussions can work well, organizers should build in open time between sessions to allow people to catch up.

The format of our workshop fostered inclusivity of a geographically dispersed community, but organizers should also make sure that a [broad range of voices and persons](#) with relevant expertise [participate in and are called upon](#) in online sessions. In our case, prepolling to gauge attendance in each regional session and adjusting topics if needed would have been useful. Finally, many participants in this event were unfamiliar with some aspects of the tools being used, so offering training and advice before the event starts is likely to be worthwhile.

Given the benefits outlined above, we strongly encourage other workshop organizers to consider this online meeting format, albeit with some fine-tuning, for future events. Clearly, scientists no longer need to be tied to a specific place, time zone, or modality to foster community and advance important research.

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- Zoom Pro video conference software (provided via a university affiliation) allowed unlimited meeting time, cohosting capabilities, and both local and cloud-based video conversion to produce session recordings. We found that the cloud-based conversion functionality was not reliably fast enough, so we subsequently used local conversions. Recordings could be initiated only by the host institution or an assigned host from within the meeting, and handovers between hosts were needed to ensure recordings were made in different time zones.
 - Note-taking during sessions was done using Google Docs, accessible through the shared Google Drive.
 - Notes, videos, and presentation slides were archived from the Google Drive to [Zenodo](#).
 - Speaker question and answer sessions and discussions were hosted on [GitHub](#), for which participants either had to use an existing account or had to create one for this project.
 - Drafting of the workshop report is being done in [Overleaf](#), a collaborative online [LaTeX](#) platform.

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