

Hybrid conferences: opportunities, challenges and ways forward

1 **Eleonora Puccinelli^{1,2}, Daniela Zeppilli³, Paris Stefanoudis^{4,5}, Annaïg Wittische-Helou³,**
2 **Marjorie Kermorgant³, Sandra Fuchs³, Jozée Sarrazin³, Erin E. Easton⁶, Alexandra Anh-Thu**
3 **Weber^{3,7,8*}**

4 ¹ Department of Oceanography, University of Cape Town, Rondebosch 7701, Cape Town, South
5 Africa

6 ² University of Brest- UMR 6539 CNRS/UBO/IRD/Ifremer, LEMAR – IUEM, Plouzané, France

7 ³ Univ Brest, CNRS, Ifremer, UMR6197 BEEP, F-29280 Plouzané, France

8 ⁴ Department of Zoology, University of Oxford, Oxford, United Kingdom

9 ⁵ Nekton Foundation, Oxford, United Kingdom

10 ⁶ School of Earth, Environmental, and Marine Sciences, University of Texas Rio Grande Valley,
11 Brownsville, Texas, USA

12 ⁷ Marine Invertebrates, Museums Victoria, Melbourne, Victoria, Australia

13 ⁸ Department of Aquatic Ecology, Eawag, Swiss Federal Institute of Aquatic Science and
14 Technology, Dübendorf, Switzerland

15 *** Correspondence:**

16 Alexandra Anh-Thu Weber
17 alexandra.weber@eawag.ch

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20

21 **Abstract**

22 Hybrid conferences are in-person events that are also accessible online. This type of meeting format
23 was rare pre-COVID-19 but started to become more common recently given the asynchronous global
24 progression of the pandemic and the uneven access and distribution of vaccines that led to a large
25 proportion of participants being unable to attend international conferences in person. Here we report
26 the organization of a middle-sized (581 participants: 159 onsite, 422 online) international hybrid
27 conference that took place in France in September 2021. We highlight particular organizational
28 challenges inherent to this relatively new type of meeting format. Furthermore, we surveyed both in-
29 person and online participants to better understand their conference experience and to propose
30 improvements based on the feedback received. Finally, we compare the advantages and disadvantages
31 of three types of conferences (onsite-only, online-only and hybrid) and suggest that hybrid events
32 should be favored in the future because they offer the most flexibility to participants. We conclude by
33 proposing suggestions and ways forward to maximize accessibility and inclusivity of hybrid
34 conferences.

35 **1 Introduction**

36 Scientific conferences are essential components of researchers' lives, allowing them to stay up to date
37 with the latest research trends while disseminating their work to the scientific community. These events
38 are essential for networking and developing collaborations, especially for early-career researchers
39 (ECRs; students and pre-tenure postgraduates) who use meetings as an opportunity to plan their next
40 career step (Oester et al., 2017). Because of the COVID-19 pandemic and the resulting travel bans and
41 restrictions, many in-person meetings since March 2020 were canceled, rescheduled, or changed to an
42 online format, allowing scientists to present their research and interact with members of their respective
43 communities virtually (Stefanoudis et al., 2021).

44 Online-only meetings have a number of advantages, for instance: (i) enhanced accessibility by allowing
45 attendance during periods of fieldwork or teaching (Bartlett et al., 2021), (ii) reduced carbon footprint
46 (Burtscher et al., 2020; Tao et al., 2021), and (iii) lower participation costs with potentially reduced
47 registration fees and no travel and accommodation costs. These advantages have greatly improved
48 inclusivity for researchers and students from developing countries and with limited financial means
49 (Chou and Camerlink, 2021; Wu et al., 2022) and were the reasons why a large online international
50 conference on photonics was held just before the COVID-19 pandemic (Reshef et al., 2020). Thanks
51 to these advantages, many online conferences showed higher registration rates compared to previous
52 in-person meetings (e.g., Castelvecchi, 2020; Stefanoudis et al., 2021). Online conferences, however,
53 have a number of drawbacks, including: (i) fewer interactions among participants, especially if
54 presentations are pre-recorded (Roos et al., 2020); (ii) increased fatigue after hours on screen (Bennett
55 et al., 2021); (iii) fewer possibilities for spontaneous discussions and meetings (Roos et al., 2020); and
56 (iv) technical issues during live talks resulting in schedule delays (Archibald et al., 2019).

57 Hybrid meetings, which have in-person attendance with a possibility to attend online, represent a
58 promising solution that could address some of the shortcomings inherent of in-person or online-only
59 meeting formats. There have been calls for adopting a hybrid format after all COVID-19 travel
60 restrictions have been lifted (Joo, 2021), and there seems to be an interest amongst the scientific
61 community for that format (Stefanoudis et al., 2021). However, due to the novelty of the hybrid format,
62 conference organizers have to be creative to organize a successful event in which both in-person and
63 online attendees are satisfied. So far, studies on hybrid meetings are scarce and focus on organizational
64 and logistical aspects without accounting for the participant experience (Fulcher et al., 2020; Weiniger
65 and Matot, 2021).

67 Here, we present information on the logistics of a recent international meeting, the 16th Deep-Sea
68 Biology Symposium (16DSBS), a 5-day, medium-sized (581 attendees) hybrid conference that took
69 place in Brest (France) in September 2021. We then compare the hybrid format to the in-person and
70 online meeting formats in terms of costs and widening access. Finally, we report the participants'
71 experience using an online questionnaire to identify what worked well and less so. Based on those
72 experiences we make some recommendations on how future organizers can improve the hybrid
73 meeting experience.

74 **2.1 Hybrid meeting logistics**

75 **2.1 Pre-meeting considerations**

76 An important starting point for the organizing committee is defining the concept of the hybrid event,
77 i.e., defining to what extent the online attendees participate in the conference. Can they be presenters,
78 or do they only attend the conference? What is the expected level of interaction between and among
79 onsite and online attendees? While informal interactions tend to form naturally among onsite attendees
80 during coffee breaks and meals, these interactions are lacking for online attendees who usually need a
81 screen break during these times. Hence, if the organizers wish that online participants interact among
82 each other and with onsite participants, they have to organize special events to do so.

83 *2.1.1 How to choose a venue for onsite attendance?*

84 The onsite organization for in-person attendance is analogous to a traditional in-person conference, and
85 we thus focus mainly on the organizational aspects specifically related to the hybrid aspect. A major
86 component of these events is that presentations should be recorded and live broadcasted, so
87 infrastructure to support this component is essential at the selected venue. The required infrastructure
88 can be: (i) provided by the venue (built-in cameras and sound system; personnel from the venue
89 handling the retransmission); (ii) outsourced to an external company (an extra room is needed for the
90 filming crew); and (iii) a static temporary camera installed / using the built-in cameras of laptops (with
91 members of the local organizing committee (LOC) handling the retransmission, for instance via zoom).
92 A combination of these options is also possible.

93 *2.1.2 Which platform(s) to choose for online attendance and communication?*

94 The choice of an appropriate online platform for a hybrid conference is crucial because it should ideally
95 (i) provide easy access to the online content of the conference (live talks; on-demand talks; posters)
96 and (ii) aim to enhance all types of exchange and communication among onsite and online participants
97 (e.g., live chat).

98 For pre-meeting communications, emails and a dedicated website are usually the best solution.
99 However, they may not be the best way to communicate with online and onsite attendees during the
100 conference. Rapid messaging through a dedicated mobile application for the conference, or via online
101 platforms (e.g., Slack), is an efficient way to communicate important information rapidly. Important
102 aspects to take into account are: (i) making sure that all participants have access to these messaging
103 platforms and (ii) providing enough time to participants to become familiar with these platforms.

104 *2.1.3 Which format to choose for presentations?*

105 **Talks:** While presenting live is the norm for onsite presenters, it is more challenging for online
106 presenters. For online speakers, giving a live talk has a number of advantages, such as more interactions
107 and the possibility to answer questions live. However, it also has a number of drawbacks, such that
108 time slots for talks will inevitably not be suitable for the time zones of all participants, and live online
109 talks are more prone to technical issues that can result in delays. Organizers should decide which
110 option(s) they want to give online presenters, such as (i) presenting live and answering questions live,
111 (ii) sending a pre-recorded talk but answering questions live and (iii) sending a pre-recorded talk and
112 not being present for questions (e.g., if time zones are incompatible). Offering all three options is the
113 most flexible for online speakers, however this flexibility entails more expense, organization, and risks
114 of delay.

115 **Posters:** In-person poster sessions are not different from a classical onsite-only conference. However,
116 in-person and online posters should be available to view on the conference platform. Ideally, a chat
117 box next to each poster should be accessible for questions and answers, and a live online poster session
118 should be organized to allow for live interactions with online presenters.

119 *2.1.4 What additional considerations does the hybrid format entail from an organizational
120 perspective?*

121 Organizing a hybrid conference entails the usual logistics required for an in-person-only and an online-
122 only conference, but there is additional work for the LOC that is inherent to the hybrid format.

123 **More communication, flexibility and file handling:** Clear communication with participants is essential
124 and common to all conferences but the hybrid format adds complexity due to several types of
125 participation. For instance, any registration change (e.g., onsite to online, or vice-versa) has to be
126 followed by updates in internal databases, mailing lists and the program. Communication efforts also
127 increase because customized instructions have to be provided to online and onsite participants and
128 presenters. Furthermore, a considerable amount of work has to be done ahead of the conference to
129 receive and organize all presentation files (e.g., pre-recorded talks and posters).

130 **More complexity to design the program:** The hybrid format typically implies a larger participation,
131 compared to in-person conferences, which can result in more requests for talks and thus competition
132 for the available time slots. Ideally, the talk schedule should be organized according to the time zone
133 of the online speakers. However, this consideration is not always compatible with the scientific sessions
134 and venue hours of operation. To avoid organizing a two-tier conference with onsite participants
135 getting much more interactions than online participants, the LOC should organize online-only events
136 beyond talks and posters to enhance interactions among online participants and between onsite and
137 online participants.

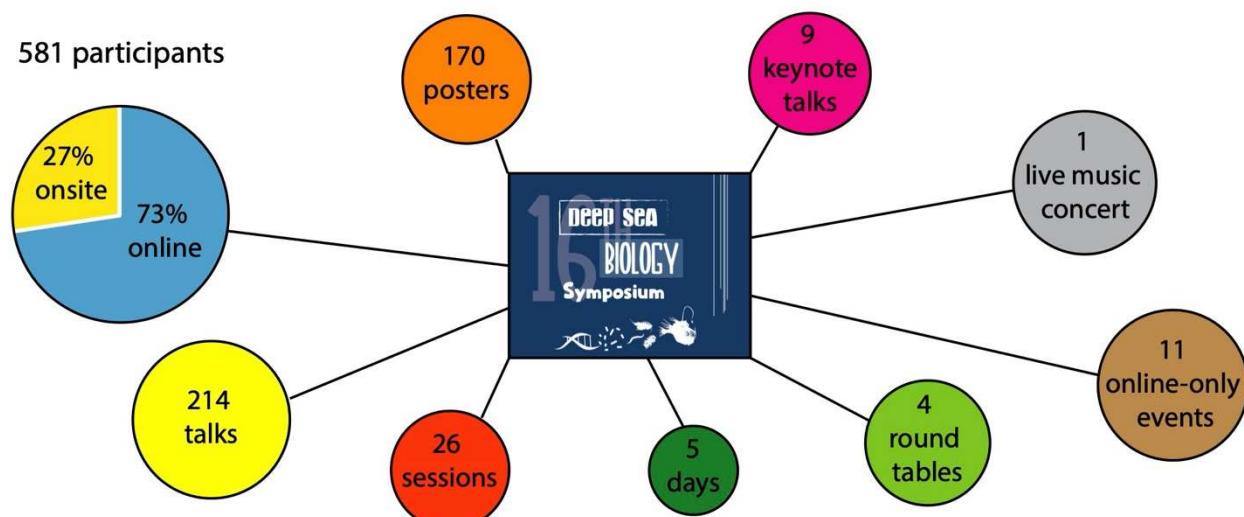
138 **More support personnel:** The above-mentioned tasks require increased administration pre-conference
139 workload for the LOC. Furthermore, during the conference, additional chair and co-chair persons are
140 needed to facilitate question-and-answer sessions from the onsite and online audience (passing on
141 microphones; checking the chat box). To increase inclusivity, chairs can be online participants,
142 however, an onsite co-chair would also be needed. Finally, members of the LOC are also required to
143 moderate online-only events and respond to the requests of online attendees.

144 **2.2 Case study**

145 The Deep-Sea Biology Symposium is an international in-person conference organized every three
146 years by the Deep-Sea Biology Society (DSBS) and a LOC. For reasons related to the global COVID-

147 19 pandemic, the French Research Institute for Exploitation of the Sea (Ifremer) was asked to replace
148 the planned LOC for the 16th Deep-Sea Biology Symposium (16DSBS) approximately a year before
149 the event took place. The symposium was held 12-17 September 2021 in Brest, France, at the Aquarium
150 Océanopolis. The conference consisted of two parallel sessions divided into two rooms: a room which
151 had built-in cameras suitable for broadcasting managed by the personnel venue and a second room in
152 which an external company was hired to organize the live broadcasting. This company also set up the
153 streaming website on which all live and on-demand talks could be watched up to two weeks post-
154 conference. The team of the conference venue was formed by two people in the control room and one
155 sound engineer; while the external company consisted of a crew of five people: two people in the
156 control room, one sound engineer and two cameramen.
157

158 In terms of scientific content, the 16DSBS contained 214 contributed talks (64% acceptance rate) and
159 170 posters over five days (Fig. 1; File S1). To enhance their visibility, poster presenters were asked
160 to provide a 2-min video pitch of their poster, in addition to a PDF and/or a printed version of their
161 poster, depending on their attendance type. In addition, in order to maximize the participation of online
162 attendees, we organized a total of 11 online-only events across different time zones. These were: an
163 early career researcher/student mixer; five zoom lunches with keynote speakers of the day; a round
164 table on decolonizing deep-sea science; a 3-hour poster session; an online Gala dinner with social
165 activities, and the annual general meeting of the Deep-Sea Biology Society. The conference was
166 attended by 581 participants, with approximately three quarters of them attending online (Fig.
167 1). Finally, both onsite and online participants could present either talks or posters (the talk selection
168 process did not take attendance type into account); live or pre-recorded for online participants.
169



170
171 **Figure 1:** Summary of attendance and content of the hybrid conference 16DSBS. The 26 scientific
172 sessions were presented in two parallel sessions.

173 *2.2.1 Pre-meeting organization*

174 A conference website with all pre-conference information was hosted on servers of Ifremer (Table 1).
175 A dedicated email address was created including relevant mailing lists to address different participants
176 (e.g., all attendees; onsite only-attendees; online-only attendees; all presenters (talks & posters)).
177 Online attendees were offered the choice to (i) present live and answer questions live (ii) send a pre-
178 recorded talk but answer questions live, or (iii) send a pre-recorded talk and not be present for questions
179 (e.g., if time zones were incompatible). Online presenters were asked to send a pre-recorded version

180 of their presentation to be used as a backup. We aimed to obtain a maximum of live talks, and we thus
181 adjusted the talk schedule according to the time zone of online speakers. However, it was not always
182 possible due to each talk being scheduled within its relevant scientific session of which there were 26.

183 *2.2.2 Online access to the conference*

184 At the time when the 16DSBS was organized, there was no single online platform available to host all
185 online content of a hybrid conference. Furthermore, outsourcing the development of such a platform
186 was out of financial reach for the society-based 16DSBS. Hence, a streaming channel including (i) live
187 talks, (ii) chat box for live questions from the online audience, and (iii) on-demand talks was developed
188 by the external company hired for the live filming and broadcasting (<https://16dsbs.attwm.fr>). For other
189 online content (e.g., access to online posters; online-only events; etc), we relied on free platforms or
190 platforms whose costs were covered by the hosting institution Ifremer and the Deep-Sea Biology
191 Society. Overall, this resulted in a large number of different platforms (Table 1).

192
193 **Table 1:** Summary of online platforms used for 16DSBS and their purpose.
194

Description	Access	Aim	Cost
Conference website	Open	General information; registration; abstract submission	Supported by organizing institution Ifremer – not in conference budget
Conference email address	Open	Pre-conference communications	Supported by organizing institution Ifremer – not in conference budget
Streaming channel/website	Password-protected	Live and pre-recorded talks; talks on replay; live chat from online audience for questions to speakers	46% of total budget; see Fig. 2
Private page on conference website	Password-protected	Access to posters in pdf format; links to short video pitches of the posters	Supported by organizing institution Ifremer – not in conference budget
Private YouTube Channel	Private link	Access to short poster videos	Free
Zoom	Password-protected	Live talks from online speakers; Online poster session; online-only events	Supported by the DSBS – not in conference budget
Slack	Invitation via email	Communication before and during the conference; sharing of different passwords; asking non-live questions	Free
Twitter conference account	Open	Communication and public engagement before and during the conference	Free
Gather Town	Open	Networking and social events	Free

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196 *2.2.3 Budget*

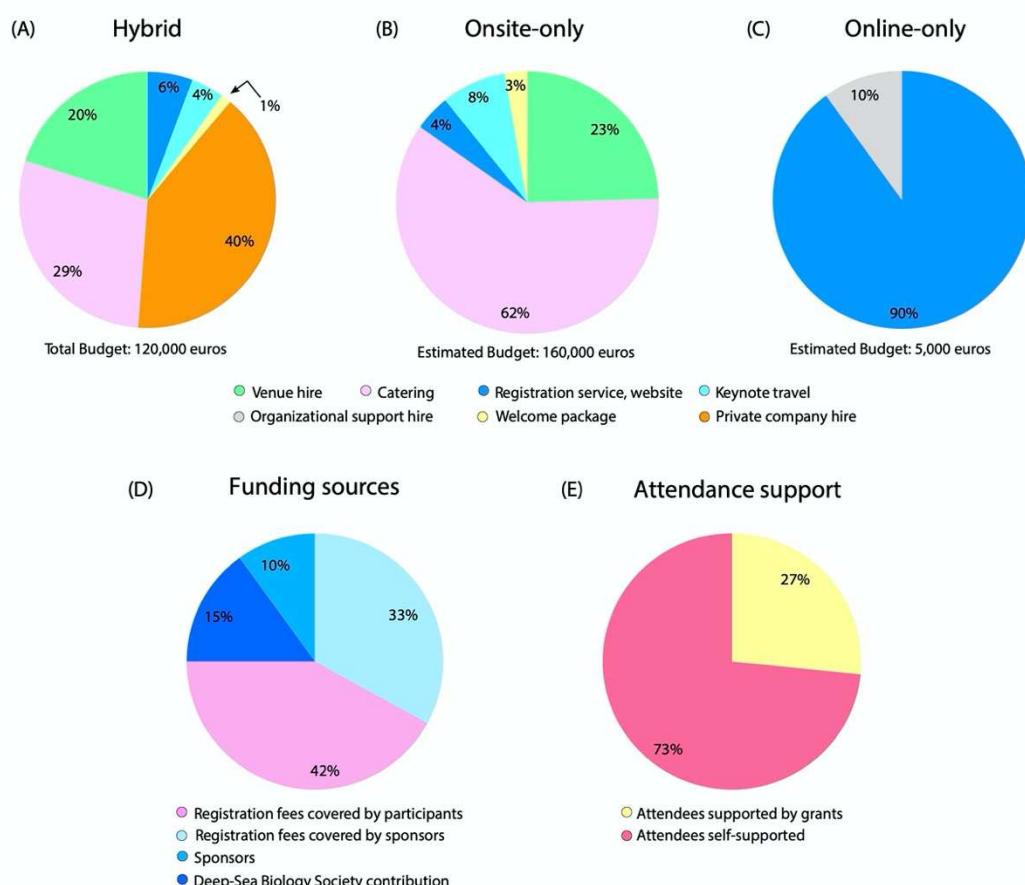
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198 For the hybrid 16DSBS, the total budget was slightly lower than an estimated budget for a same-sized
199 onsite-only conference (Fig. 2). Details of the different budgets are provided in File S2. We refer to
200 the costs provided by Stefanoudis et al., (2021) for a budget for an online-only event. The budget for
201 an onsite-only event was estimated using the onsite costs of the 16DSBS projecting the costs associated
202 with 200 people expected to attend onsite to 581 attendees, which was the total number of 16DSBS
203 online and onsite attendees.

204 Compared to this estimated budget, the 16DSBS catering and food service fees were reduced and
 205 audio-visual costs were higher. Specifically, a significant part of the 16DSBS budget was dedicated to
 206 the hire of a professional company (5 people) that (i) organized the filming of in-person talks for one
 207 session, (ii) organized the live broadcasting, (iii) ran pre-tests with online speakers, (iv) set up the
 208 streaming website for live talks and on which recorded talks were available on demand for two weeks
 209 after the conference, and (v) uploaded the recorded talks at the end of each day. This service could not
 210 have been accomplished by the LOC itself. To minimize registration fees for attendees, the LOC
 211 decided to use other platforms for the other events and presentations (Table 1); however, this cost-
 212 saving measure increased the complexity of navigating among platforms for online participants.
 213 Another relevant cost is represented by hiring dedicated staff member(s) for the organization of the
 214 conference. In our case, two people were specifically hired for one year to organize the event, however
 215 this cost was supported by Ifremer, and thus did not affect the final budget.

216 While the hybrid 16DSBS and the estimated onsite-only conference budgets are similar, the estimated
 217 budget of an online-only conference of a similar size is considerably reduced (Fig. 2). Indeed, expenses
 218 for virtual conferences exclude most in-person conference costs except for administration and
 219 registration and website platforms. Nevertheless, as for hybrid conferences, additional costs are
 220 incurred for virtual platforms to host the conference and cloud storage costs to make presentations
 221 available for a designated time (Fig. 2) (Stefanoudis et al., 2021).

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223

224 **Figure 2:** Relative contribution (%) of the budget from the three types of conference: (A) hybrid, (B)
 225 online only and (C) onsite only. The budget in (A) reflects the total costs of the hybrid 16DSBS. Budget
 226 estimates are based on a conference with 581 participants: (B) if it was hosted onsite-only at the
 227 Océanopolis Aquarium and (C) if it was organized exclusively online following the budget of eDSBS,
 228 an online-meeting (Stefanoudis et al., 2021). Organizational support hire includes costs associated to

229 hire staff member(s) dedicated to the event organization. (D) General proportion of the funding sources
230 for 16DSBS, including the amount of the registration costs covered by sponsors, in particular the DSBS
231 and the International SeaBed Authority. (E) Relative proportion of attendees who were supported by
232 travel grants offered by the DSBS together with the International SeaBed Authority. The total number
233 of participants was 581.

234 For the 16DSBS, 42% of the costs were covered by the registration fees of participants. The remaining
235 funding was acquired by the LOC through sponsoring or from contributions of the Deep-Sea Biology
236 Society (DSBS) (Fig. 2d). Financial support from sponsors and the DSBS was provided either as direct
237 payment to the LOC (25%) or in the form of travel/registration grants to attendees (33%).

238 The 16DSBS registration fees for online-only attendance were lower than onsite-only, and rates for
239 student/researcher from developed and developing countries were not differentiated (Table 2).
240 Registration costs for online attendance and the holding of an in-person event raised a debate within
241 the deep-sea community for a few months prior to the event. Notably, critics reported (i) the
242 inaccessibility for some prospective attendees to afford such costs and (ii) the inability for many to
243 participate onsite due to travel restrictions associated with the COVID-19 pandemic. While the LOC
244 acknowledges that it may have lacked transparency during the organizational phase, it uses the present
245 article to provide some clarity and perspective. First, it should be noted that overall budgets for online-
246 only and hybrid conferences are very different (Fig. 2A-C), which is inevitably transferred to
247 registration costs to some extent. Second, the 16DSBS online registration costs are within or below the
248 range of other hybrid conferences held in 2021 and 2022 (Table 2). And third, about a quarter of
249 attendees (mainly ECRs and researchers from developing countries) were supported by
250 travel/registration grants (Fig. 2E).

251 **Table 2: Non-exhaustive examples of registration fees for 2021-2022 hybrid conferences.** Ranges
252 include all rates from the highest discounts, generally for students, society members, and low-income
253 countries, to the maximum costs for onsite registration. All registration costs have been converted to
254 euros to simplify comparisons (the original prices are in brackets). Conference information last
255 accessed on 22 February 2022.

Name	Dates	Onsite registration	Online registration	Online speakers	website
16th Deep-Sea Biology Symposium	12.09.21-17.09.21	380-600 EUR	100-375 EUR	yes; interspersed (live or pre-recorded)	https://www.ifremer.fr/16dsbs/
Annual Meeting of the Association for Information Science and Technology	30.10.21-02.11.21	311-745 EUR (350-850 USD)	22-439 EUR (25-495 USD)	yes (live or pre-recorded)	https://www.asist.org/am21/
International Conference on Biodiversity, Ecology and Conservation of Marine Ecosystems	03.01.22-07.01.22	139-276 EUR (161-321 USD)	70-139 EUR (81-161 USD)	yes (format not specified)	https://www.become2022.com

2022 Conference on General Education, Pedagogy, and Assessment	10.02.22-12.02.22	386-582 EUR (75-675 USD)	110-241 EUR (50-275 USD)*	yes; single (format specified)	day not	https://www.aacu.org/events/2022-conference-general-education-pedagogy-and-assessment
2022 Conference on Diversity, Equity, and Student Success	17.03.22-19.03.22	386-582 EUR (75-675 USD)	110-241 EUR (50-275 USD)*	yes; single (format specified)	day not	https://www.aacu.org/events/2022-conference-diversity-equity-and-student-success
American Educational Research Association	21.04.22-26.04.22	83-846 EUR (95-590 USD)	57-605 EUR (65-485 USD)	yes; dedicated sessions (format not specified)		https://www.aera.net/Events-Meetings/Annual-Meeting
2022 World Aquaculture and Fisheries Conference	18.05.22-19.05.22	648-911 EUR (739-1039 USD)	385-560 EUR (439-639 USD)	yes (live or pre-recorded)		https://www.worldaquacultureconference.com/
World Biodiversity Forum 2022	26.06.22-01.07.22	312-768 EUR (325-800 CHF)	144-240 EUR (150-250 CHF)	yes (format not specified)		https://www.worldbiodiversityforum.org
16 th World Congress on Bioethics	20.07.22-22.07.22	210-577 EUR (225-620 CHF)	210-577 EUR (225-620 CHF)	no		https://iab2022.org/
24 th Biennial Conference on the Biology of Marine Mammals	01.08.22-05.08.22	131-701 EUR (150-800 USD)	88-351 EUR (100-400 USD)	yes; dedicated sessions (pre-recorded)		https://www.smmconference.org/

*Online includes a single day of virtual conference and live streaming of plenary on the remaining days.

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3. Participants' perspective

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3.1 Participation in comparison with previous meetings

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Comparisons with previous deep-sea-biology-themed meetings indicate a marked increase in participation, 49% against an in-person meeting in the USA (15DSBS), 343% against an in-person meeting in Colombia (ISDSC7, which had a narrower scientific focus on deep corals), and 65% against an online meeting (eDSBS, Table 3). The proportion of ECRs also increased (55% of all participants) in comparison to in-person meetings (25-36%) but decreased to the online-only meeting (65%) that prioritized ECR presentations (Stefanoudis et al., 2021) (Table 3). This enhanced ECR participation also translated into more presentations delivered by ECRs (57%) compared to 23% (15DSBS), 42% (ISDSC7), and 79% (ECR-focused eDSBS).

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Furthermore, the proportion of participants from low and middle-income countries represented at the hybrid 16DSBS was 11%, which was lower than the eDSBS (14%) and ISDSC7 (40%), but higher

272 than the 15DSBS (7%). It should however be noted that in terms of total low- and middle-income
273 participants, the 16DSBS was the second highest following the ISDSC7 in Colombia (Table 3).
274 Overall, there is poor representation of low- and middle-income researchers in the field of deep-sea
275 biology (Costa et al., 2020), and although the hybrid format can aid participation of those researchers,
276 holding an in-person meeting or the in-person aspect of a hybrid meeting in a low- to middle-income
277 nation can be much more effective in widening participation.
278

279 **Table 3.** Comparison between in-person, online and hybrid deep-sea biology meetings in terms of
280 demographic composition by sex, career stage and country of institutional affiliation. Sex ratio
281 estimates excluded non-binary, or those that chose not to disclose sex. Students include PhD candidates
282 too, while tenure includes any equivalent permanent position. For 15DSBS, no separation was made
283 between students and post-PhD but pre-tenure. Number of participating countries was identified from
284 participants' institutional affiliations. Country categories based on the 2021 classification by the World
285 Bank (last accessed on 16 February 2022). N/A = Not applicable.

Conference name	15DSBS	ISDSC7	eDSBS	16DSBS
Conference format	In-person	In-person	Online	Hybrid
Country	USA	Colombia	N/A	France
Number of participants	388	169	352	581
Sex ratio (female / male)	N/A	N/A	N/A	1.66
Participant career stage				
Students	98	42	157	218
Post-PhD but pre-tenure		19	70	106
Other	290	108	125	257
Presentations				
Students	86	46	34	146 (106 online + 40 onsite)
Post-PhD but pre-tenure		25	32	73 (52 online + 21 onsite)
Other	280	76	32	166 (115 online + 51 onsite)
Participant affiliation				
Low and middle-income	27	67	49	59 (55 online + 4 onsite)
High income	361	102	303	522 (367 online + 155 onsite)
Number of participating countries				
Low and middle-income	8	11	12	18
High income	25	16	26	28

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287 **3.2 Questionnaire for participants**

288 To gather impressions and feedback from participants, we organized an online survey focusing on
289 the 16DSBS content and organization. The full questionnaire and replies are available in the
290 supplementary File S3. A total of 164 participants replied (28% of total participants), 104 online (25%
291 of online) and 60 onsite (38% of onsite) participants.

292 *3.2.1. Meeting format and technical considerations*

293 From a technical perspective, both online and onsite participants enjoyed the live conference
294 experience (72-92%, Q17-20), with all platforms utilized (i.e., to allow online participation, online
295 Q&A, and accessing of live and recorded presentations) deemed as sufficient and easy-to-use (57-74%,
296 Q21,23,30-31). However, a sizable proportion found that the number of platforms used was too high

297 (38%, Q32) and suggestions for future usage of fewer and more all-encompassing platforms were made
298 (See Supporting information). Moreover, most agreed with the number of talks allocated per day and
299 the overall duration of the conference (75%, Q35) and did not support a future third parallel session to
300 accommodate more talks (66%, Q41).

301 The majority of participants regarded live talks as an integral part of the conference (79%, Q11) as it
302 enhances interactions (60%, Q36). The option of pre-recorded talks to cater for those with technical
303 issues or time zones differences was considered essential (84%, Q12). The on-demand feature was
304 overwhelmingly well-received (92%, Q13) with most indicating they viewed content post-conference
305 (79%, Q14). However, opinion was split on if the 2-week post-conference availability of that feature
306 was adequate (Q15), with some suggestions to increase the duration to a month or more in the future
307 (See Supporting information).

308 Most agreed with the format of online posters (64%, Q42) and found the additional short-video pitch
309 useful (66%, Q43), although it should not substitute the pdf file of the poster (70%, Q46). There were
310 mixed feelings on the duration of the poster sessions, with more satisfaction for onsite (55%, Q44)
311 compared to online (43%, Q45), although it is not clear from the questionnaire and comments received
312 if the session should have been shorter or longer. Based on comments received, it became apparent that
313 future hybrid meetings should aim to better link online and onsite poster sessions, perhaps by including
314 Q&A sessions with presenters, either live (69%, Q47) or online (70%, Q48).

315 3.2.2. *Networking*

316 In terms of networking more than two thirds indicated that they were able to connect with other
317 researchers (70%, Q70), although the number of questions they received compared with past in-person
318 or online meetings was less for 48% and 54% of onsite and online participants, respectively (Q72-73).
319 The latter finding is interesting, and is probably best explained by the fact that the majority of online
320 (54%) and onsite (69%) participants did not interact with the other group of participants (Q74-75), with
321 only 44% of all participants engaging with both groups (Q71), thus limiting the number of potential
322 interactions per participant.

323 Several online social events were organized to enhance the online conference experience, most of
324 which were generally well-liked, including the early-career focused scientific illustration workshop
325 (64%, Q58), the lunch-time social gatherings events with the respective keynote speaker of the day,
326 (80%, Q59), and the online Gala activities (88%, Q67). However, comments indicated participation in
327 these events was limited by time-zone conflicts and from onsite attendees, with only 22% of onsite
328 attendees indicating that they participated in several online social events (Q62).

329 3.2.3. *Overall experience and moving forward*

330 The vast majority of participants agreed or strongly agreed that the conference was an enjoyable
331 experience (88%, Q2), inclusive (72%, Q3) and of high scientific quality (72%, Q4). Online and onsite
332 attendees experienced the event slightly differently, with the former finding it more difficult to
333 concentrate (39% vs. 22%, Q5-6) and dedicate time (53% vs. 18%, Q7-8) for this meeting compared
334 to past in-person meetings. Time zone conflicts and work duties (teaching, lab work) were some of the
335 reasons evoked by online participants. There were mixed feelings about the amount of registration fees
336 (Q9), although approximately half agreed that awards from the Deep-Sea Biology Society were
337 sufficient to cover registration and attendance fees for those in need (52% agreed vs. 10% disagreed,
338 Q10).

339 Moving forward, the overwhelming majority of participants indicated that they want future Society-
340 sponsored meetings to be hybrid (79%, Q81), with considerably less appetite for future in-person only
341 or online-only events (11% and 21%, respectively, Q82-83). Finally, additional small online events,
342 including webinars, lectures series and journal clubs, to be held between symposia were largely favored
343 as well (79%, Q84).

344 **4. How to organize a hybrid conference?**

345 **4.1 Summary**

346 This paper highlights what the organization of a medium-sized hybrid international conference entailed
347 in 2021. As organizers, we report our experience and gathered feedback from both types of delegates
348 to highlight successes and possible ways of improvement. Below we highlight key relevant points that
349 should be accounted for and possible solutions to improve the organization of such events in the
350 future.

351 **4.2 Advantages and disadvantages of the hybrid format**

352 We summarized the pros and cons of the three types of existing meetings in Table 4 (onsite-only,
353 online-only, hybrid). Overall, we believe that hybrid meetings are better than onsite-only or online-
354 only meetings for participants because they offer more flexibility to delegates. Indeed, for those who
355 can travel, they provide the much-needed in-person interactions offered by onsite meetings while
356 offering the possibility to attend online for researchers with limited financial means, other
357 commitments (e.g., work or care duties) or who do not wish to travel for environmental
358 reasons. Indeed, hybrid meetings have overall lower carbon footprints than similar-sized onsite-only
359 conferences. However, there are two main downsides to hybrid meetings: (i) they are more complex to
360 organize (see section 2.1.4), which can lead to (ii) generally more expensive meetings for online
361 participants (but see section 4.3).

362
363 **Table 4.** Summary of advantages and disadvantages of onsite-only, online-only and hybrid meetings
364 for participants.

365

Onsite-only		Online-only		Hybrid	
Advantages	Disadvantages	Advantages	Disadvantages	Advantages	Disadvantages
Extensive opportunities for networking and social interactions	High registration and travel costs limits accessibility	Reduced registration costs and absence of travel / accommodation expenses enhances accessibility	Limited opportunities for networking and social interactions	More flexibility for delegates implies an overall higher participation	Overall higher organization costs compared to online-only meeting may lead to higher registration fees for online participants compared to online-only conferences
Visiting a new city or country; learn about a new culture	High carbon footprint due to travel	Low carbon footprint	Screen fatigue	Extensive opportunities for networking and social interactions (onsite participants)	Online participants may feel excluded from networking and social activities
	Incompatibilities with other commitments (e.g., teaching, fieldwork, lab work, personal life)	Recorded presentations can be available post-conference for a given time	Potential time zone issues	Recorded talks can be available after the conference for a given time for all participants	Increased workload for the organizing committee (e.g., general organization; program scheduling; communication with online and onsite attendees)
	Typically, no recording of presentations	Limited schedule delays if pre-recorded	Without subtitles, might be more	Reduced international travel for online	

		presentations are broadcasted	exclusive for people with impaired hearing	participants: decreased carbon footprint	
		Adding subtitles to pre-recorded talks may aid non-native speakers and/or people with impaired hearing		Adding subtitles to pre-recorded talks from online speakers may aid non-native speakers and/or people with hearing impairments	

366

367 **4.3 Recommendations for future hybrid meetings:**

368 **1. Define clearly the extent of online participation**

369 As mentioned in the introduction, a substantial part of hybrid meeting complexity and increased
370 costs is linked to the extent of participation of online attendees. If they can only attend the
371 conference without presenting, the complexity decreases drastically, however it disadvantages
372 individuals not able to travel. Furthermore, if they can present, offering them the choice to
373 present live or ask them to send a pre-recorded talk (or present both options) adds another layer
374 of complexity. Finally, organizers can also choose to what extent they wish to organize extra
375 online-only events beyond talks and posters to maximize interactions among online attendees.
376 We believe it is fairer that online attendees can also present their research in the way it suits
377 them best, and that they have a number of opportunities to network. Indeed, scientific
378 conferences are not only meant to present one's research, but also interact with the members of
379 their own community. However, the more options there are for online attendees, the more work
380 there is for the organizing committee, which may translate in higher registration costs for
381 everyone, especially online attendees. For each hybrid event, there is a fine balance to find
382 between offering the best experience for all types of attendees, and keeping registration costs
383 low without overwhelming the organizing committee.

384 **2. Maximize inclusivity**

385 We believe that the main aim behind organizing hybrid conferences is to broaden the
386 participation of scientists by offering them flexibility for the attendance type. Hence, providing
387 an inclusive conference is likely a goal of each organizing committee. While registration costs
388 of the 16DSBS were similar to or lower than those of other hybrid conferences (Table 2), we
389 acknowledge that registration costs for students or researchers from low- and middle-income
390 countries could have been differentiated, and thus even lower.

391 Here are some propositions to maximize inclusivity of a hybrid event: (i) reach out to numerous
392 sponsors to lower registrations fees; (ii) differentiate registration fees by attendance type
393 (online; onsite), career stage (student; post-doc; established researcher), nation income category
394 (low, medium and high-income country), if it is a society meeting (member; non-member), time
395 of registration (early bird; regular; late registration), (iii) provide additional travel and
396 registration awards; (iv) aim to have the meeting organized by developing nations; and (v) reach
397 out to the scientific community before the event (e.g., via online surveys) to better understand
398 individual needs and challenges.

399 Finally, as participants are not necessarily aware of the additional logistical requirements
400 needed for hybrid conferences, we suggest publishing a cost breakdown along with registration
401 fees on the conference website. Hence, potential higher costs of hybrid events in comparison
402 with online-only events are better justified.

403 **3. Simplify (online) access and communication**

404 We received a recurrent negative feedback from online attendees: there were too many
405 platforms to access the conference and interact with other online attendees and their use was
406 too complicated (Table 1). We acknowledge this issue, however, at the time when we organized

407 the 16DSBS, there was no single platform available for this kind of event. Furthermore, the set-
408 up of a dedicated platform for the purpose of this conference by an external company would
409 have increased costs.

410 In addition, efficient communication to all participants before and during the conference was
411 not optimal. A large number of emails were sent before the conference. During the conference,
412 we attempted to use Slack to communicate rapidly with all participants, however, it was mainly
413 online participants who used it, and not everyone did use it (there was some reticence from
414 first-time users).

415 We thus recommend future organizers to aim for a single platform to access live and on-demand
416 talks, posters, ask questions to speakers, and more generally interact with other online attendees
417 via chats or videoconferences, as well as to receive information from and communicate with
418 the organizing committee for potential issues. Ideally, we suggest that a combination of a
419 dedicated website for viewing and a linked mobile app for rapid communication would be the
420 best option. Nevertheless, we realize this centralization is a difficult endeavor, and hope that in
421 the future such platforms will exist or their set-up by external companies will be more
422 affordable.

423 **4. Maximize interaction opportunities between online and onsite attendees**

424 Finally, while onsite and online participants had equal access to scientific talks, we noticed that
425 for the remaining scientific activities (e.g., poster sessions; online-only events) the two types
426 of delegates were not really interacting with each other. For instance, onsite participants
427 appeared to prefer getting some rest or interacting with onsite colleagues rather than
428 participating in online-only events. Furthermore, online participants did not have an easy way
429 to interact with onsite participants if the latter were not using Slack.

430 We realize that there is probably no way to fully overcome this issue, however, we believe that
431 organizers should aim at minimizing this problem. For instance, developing a mobile app that
432 all participants would have to download will likely make communication and networking
433 among all attendees easier (e.g., II Joint Congress on Evolutionary Biology, Montpellier, 2018).

434 **4.4 Conclusion**

435 Despite some organizational challenges, we advocate to keep organizing hybrid conferences beyond
436 the COVID-19 pandemic. Indeed, they allow for a wider participation by giving more flexibility to
437 participants to choose an attendance type that suits their needs best. Furthermore, online-only
438 conferences cannot fully replace in-person formal and informal interactions. Although hybrid events
439 require additional work and are currently more expensive in comparison to online-only events for
440 online participants, we think that with early planning, sufficient sponsors, and technological advances,
441 hybrid events represent the most inclusive way to hold international conferences.

442 Furthermore, hybrid conferences have lower carbon footprint compared to onsite-only conferences,
443 hence they offer an interesting opportunity to combine scientific networking with environmentally-
444 friendly decisions (Glausiusz, 2021). For instance, students and researchers could decide to attend
445 conferences in-person whose locality is reachable by train, while attending online conferences taking
446 place on other continents.

447 We would like to emphasize that having an online option for a conference should not become an excuse
448 for institutions and funding sources not to fund students and researchers to attend the conference onsite
449 anymore. In-person networking is an essential part of a researcher's work to develop collaborations,
450 especially for ECRs who can find their next career step during these events. In addition, we would
451 encourage the in-person element of international hybrid meetings to take place in low- and middle-
452 income nations as it enhances diverse participation or to change continents to benefit all geographies
453 equally. As hybrid conferences become more common, their organization may become more

454 straightforward. This article reports the organization of one of the first hybrid conferences, and we
455 hope that our experience will be valuable to the organizers of future hybrid events.

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506 **Conflict of Interest**

507 The authors declare that the research was conducted in the absence of any commercial or financial
508 relationships that could be construed as a potential conflict of interest.

509 **Author Contributions**

510 DZ, AWH, AATW, EP, MK, SF, JZ, MM and LM were members of the 16DSBS local organizing
511 committee. AATW initiated and led manuscript preparation and writing. All authors contributed to the
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539 **Supplementary Material**

540 **File S1:** 16DSBS program overview

541 **File S2:** Detailed budget for same-sized: (i) 16DSBS hybrid conference, (ii) onsite-only conference
542 (estimation for 581 people), (iii) online-only conference (estimation for 581 people).

543 **File S3:** 16DSBS post-conference questionnaire with responses.

544 **Data Availability Statement**

545 The dataset analyzed for this study (16DSBS and participant replies) can be found in the supplementary
546 material File S3.