



SSEER
SOCIAL SCIENCE
EXTREME EVENTS
RESEARCH

2022 SSEER CENSUS



The results of the 2022 Social Science Extreme Events Research (SSEER) Census are based on responses gathered from social scientists who completed the **SSEER membership survey** between its release date on July 8, 2018 and December 31, 2022.

AS OF DECEMBER 31, 2022,
1,521 RESEARCHERS HAD JOINED THE
SSEER NETWORK.

In many instances, we compare the results of the 2022 Census to what we published in **previous annual reports**. Specifically, where possible and as relevant, we separate data by year for 2018, 2019, 2020, 2021, and 2022 to provide greater context regarding the continued growth and evolution of the network. The SSEER survey, de-identified SSEER dataset, and data documentation that informed this and prior annual reports are published on **DesignSafe** and are available for download.

HOW MANY SOCIAL SCIENTISTS HAVE JOINED THE SSEER NETWORK?

As of December 31, 2022, 1,521 researchers had joined the SSEER network. The largest proportion of members joined in 2018 (N = 647; 42.54%), which was the year that SSEER was launched. In 2019, 302 (19.86%) new SSEER members joined the network, while slightly more signed up in 2020 (N = 322; 21.17%). Fewer members joined in 2021 (N = 124; 8.15%) and 2022 (N = 126; 8.28%) (see **Figure 1**).

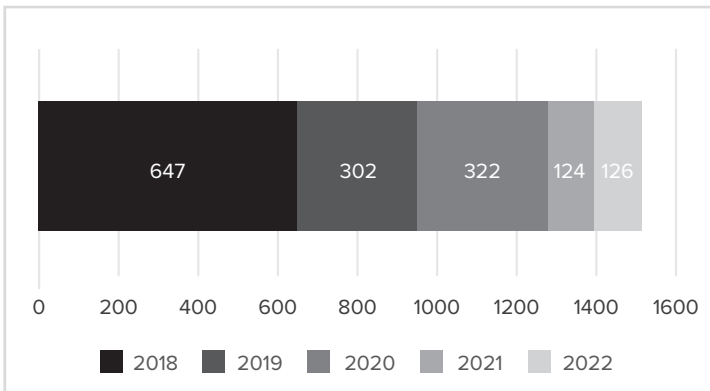


Figure 1. SSEER Membership by Year, 2018-22.*

*Readers of previously published SSEER Census annual reports may notice small differences in numbers stated throughout this report when compared with earlier versions. These discrepancies are the result of members updating their data and our data-cleaning activities. To account for these slight variations across years, we use what demographers refer to as the vintaging method. This allows each year's data independence from previous years; this is like the strategy employed by the United States annual population estimates. In this 2022 SSEER Census, we use the most up-to-date data. Interested readers can find the de-identified versions of the SSEER data published on [DesignSafe](#) and referenced at the end of this document.

WHERE ARE SSEER RESEARCHERS LOCATED?

The online **SSEER map** is organized by United Nations (UN) regions and subregions. Users can search for researchers by name, location, disciplinary foci, methodological expertise, and the types of hazards or disasters they study (see **Figure 2**).



Figure 2. SSEER Interactive Web Map.

An expanded SSEER member profile, with name, title, institution, and areas of expertise.

Our team created the SSEER map to highlight the contributions of social scientists who study hazards and disasters. Since its online launch in 2019, thousands of users from across the United States and around the world have accessed the map. It is often used in the aftermath of disaster as it allows users to rapidly locate locally-affected researchers as well as those in any region who may hold expertise relevant to an unfolding event.

Figure 3 shows the region of residence of SSEER members who joined the network by December 31, 2022. Most SSEER members reside in the Americas (N = 1,211; 79.62%). Additional members are located in Europe (N = 123; 8.09%), Asia (N = 106; 6.97%), or Oceania (N = 49; 3.22%). Just over 2% of members reside in Africa (N = 32; 2.10%).

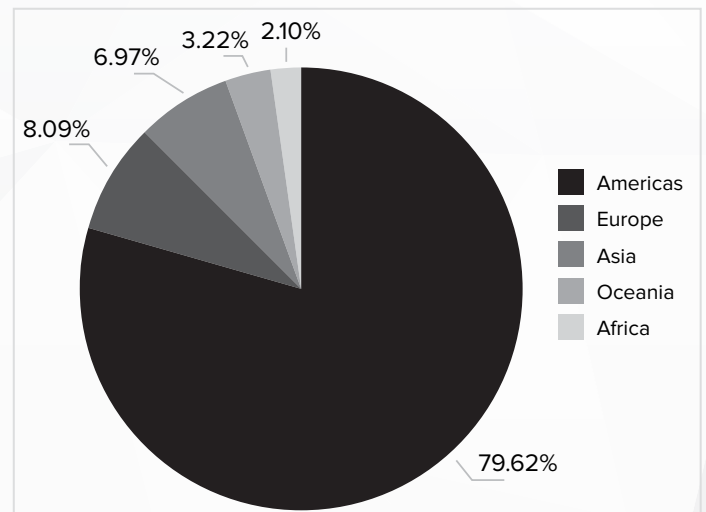


Figure 3. Percent Distribution of SSEER Researchers by UN Region.



UN Region	# of SSEER Members in the Region	UN Subregion	# of SSEER Members in the Subregion	Country	# of SSEER Members in the Country
Africa	32	Eastern Africa	13	Ethiopia	2
				Kenya	4
				Madagascar	1
				South Sudan	1
				Uganda	2
				Zambia	3
		Southern Africa	7	Botswana	1
				South Africa	6
		Western Africa	12	Nigeria	12
Americas	1,211	Caribbean	3	The Bahamas	2
				Jamaica	1
		Central America	6	Guatemala	1
				Mexico	5
		Northern America	1,162	Canada	62
				United States	1,100
		South America	40	Argentina	8
				Bolivia	1
				Brazil	12
				Chile	11
				Colombia	3
				Ecuador	1
				Peru	3
		Venezuela	1		
Asia	106	Eastern Asia	26	Hong Kong	1
				Japan	15
				People's Republic of China	8
				Republic of Korea	2
		South-Eastern Asia	15	Indonesia	3
				Malaysia	1
				Philippines	5
				Singapore	1
				Thailand	3
				Union Republic of Myanmar	1
				Vietnam	1
		Southern Asia	55	Afghanistan	1
				Bangladesh	7
				Bhutan	1
				India	25
				Iran	2
				Nepal	8
				Pakistan	9
				Sri Lanka	2
		Western Asia	10	Israel	4
				Kingdom of Saudi Arabia	1
Turkey	4				
United Arab Emirates	1				

Table 1. SSEER Researchers by UN Region, Subregion, and Country (continued on page 4).



UN Region	# of SSEER Members in the Region	UN Subregion	# of SSEER Members in the Subregion	Country	# of SSEER Members in the Country
Europe	123	Eastern Europe	1	Romania	1
		Northern Europe	57	Denmark	3
				Finland	4
				Iceland	1
				Norway	2
				Scotland	1
				Sweden	5
				United Kingdom	41
		Southern Europe	25	Greece	2
				Italy	6
				Portugal	13
				Spain	4
		Western Europe	40	Austria	7
				France	11
				Germany	11
The Netherlands	9				
Switzerland	2				
Oceania	49	Australia and New Zealand	48	Australia	23
				New Zealand	25
		Melanesia	1	Solomon Islands	1
				Total	1,521

Table 1. SSEER Researchers by UN Region, Subregion, and Country (continued from page 3).

Table 1 provides a more detailed snapshot of SSEER members by region, subregion, and country. As shown in the table, most SSEER members work in the United States (N = 1,100; 72.32%). SSEER members from Canada (N = 62; 4.08%) are the next most common in the dataset, followed by those from the United Kingdom (N = 41; 2.70%), India, and New Zealand (N = 25; 1.64% each).

SSEER MEMBERS WORK IN
67 DIFFERENT COUNTRIES
AROUND THE WORLD.



WHAT ARE THE DISCIPLINARY BACKGROUNDS AND AREAS OF EXPERTISE OF SSEER RESEARCHERS?

As noted in our prior annual census reports, there is no single, universal **definition for which disciplines are included in the social sciences**. There are, however, several distinct disciplines that focus on individuals, groups, institutions, and/or society, which are often included under the broad umbrella of the social sciences.

The SSEER membership survey asks researchers to identify their primary discipline—or set of disciplines for those with multidisciplinary training—as shown in **Figure 4**. The figure does not sum to the number of SSEER members (N = 1,521) because researchers could, and often did, select more than one discipline.

Of the 20 disciplines offered on the SSEER survey, most members identified with Disaster Science (N = 491). The second most popular discipline is Decision-Making and Risk Analysis (N = 336), followed by Public Administration/Emergency Management and Sociology (N = 328, each). Geography (N = 324) completes the list of top five disciplines selected by SSEER members.

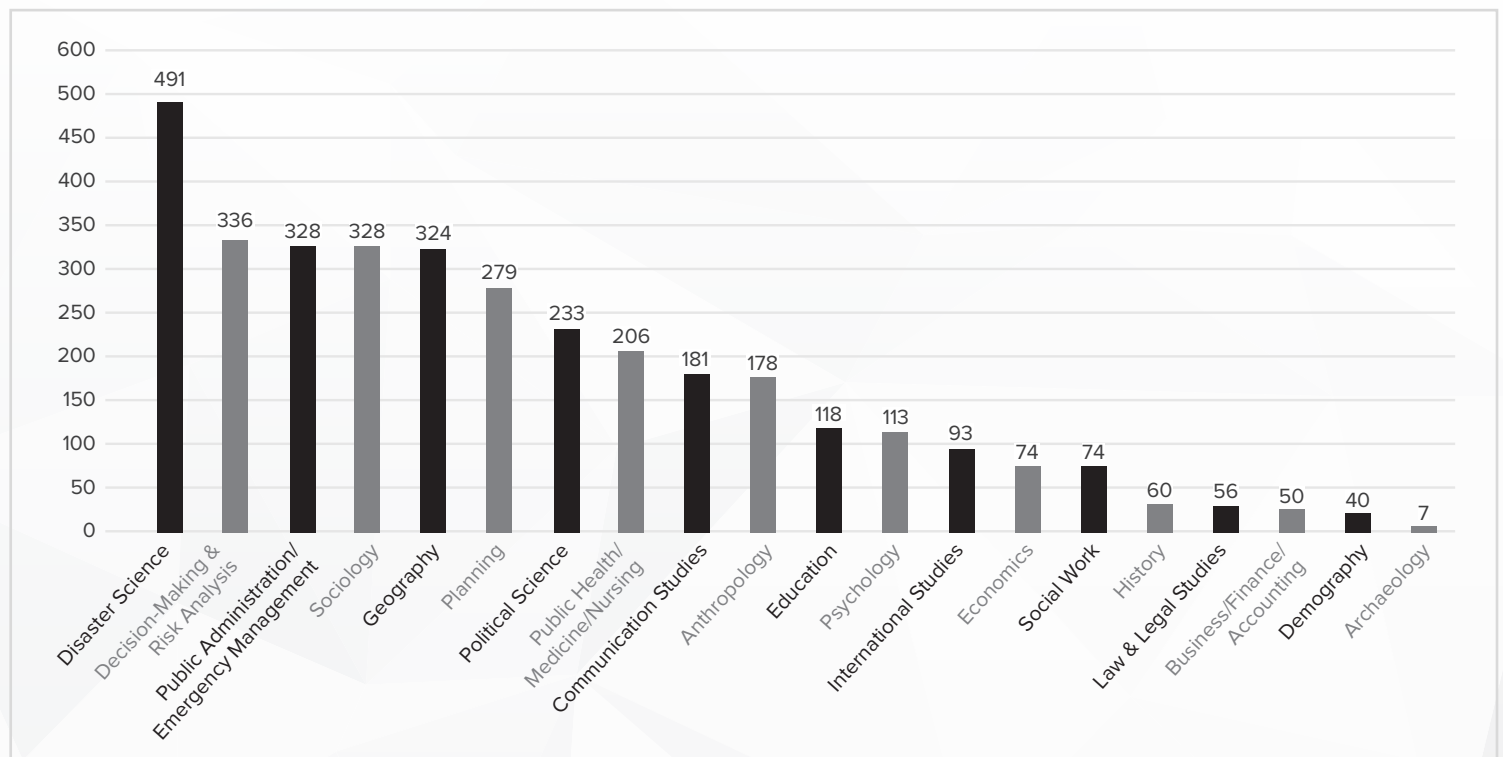


Figure 4. SSEER Researchers and Their Self-Selected Disciplinary Backgrounds.

WHAT ARE THE EDUCATIONAL AND PROFESSIONAL BACKGROUNDS OF SSEER RESEARCHERS?

The SSEER membership survey prompts researchers to share information about their educational attainment (see **Figure 5**). Most SSEER researchers hold a doctoral degree (N = 906; 59.57%). The second most common level of attainment is a master's degree (N = 413; 27.15%). Fewer members hold a bachelor's degree (N = 98; 6.44%) or an associate's degree (N = 18; 1.18%). Educational attainment data are missing for just over 5% of SSEER members (N = 86; 5.65%).

**MORE THAN 85%
OF SSEER MEMBERS HAVE
A GRADUATE DEGREE.**

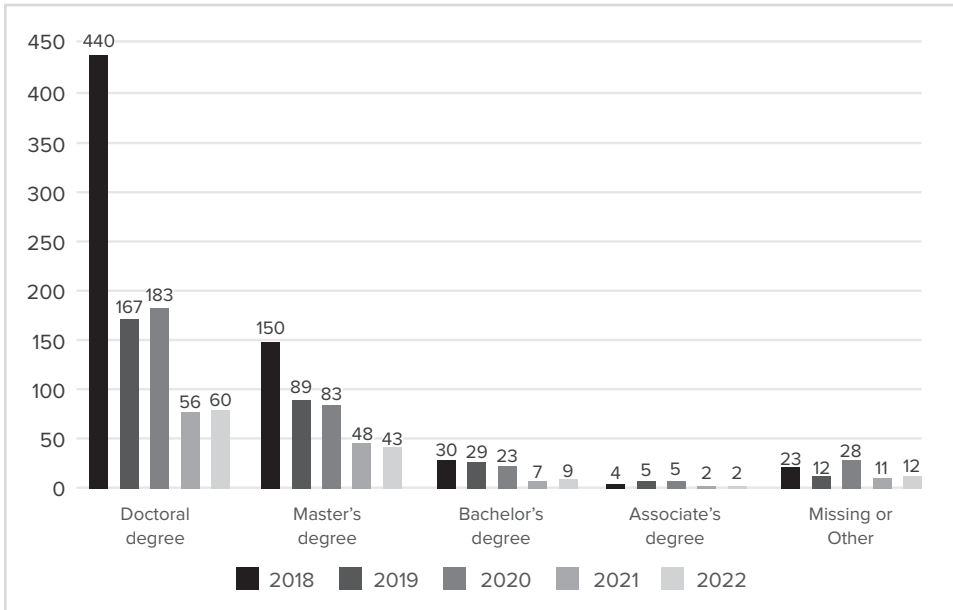


Figure 5. Number of SSEER Researchers by Highest Academic Degree Completed, 2018-22.

In terms of primary professional status, most SSEER researchers identify as academic researchers (N = 859; 56.48%), followed by students (N = 283; 18.61%) and government researchers (N = 137; 9.00%). Fewer members identify as non-profit researchers (N = 78; 5.13%), independent researchers (N = 64; 4.21%), or private-sector researchers (N = 35; 2.30%). The remaining members identify as another kind of professional, indicate they are retired, or have missing data (N = 65; 4.27%). **Table 2** shows that the primary professional statuses of SSEER members have been fairly consistent from 2018 to 2022.

	2018		2019		2020		2021		2022		Total	
	N	%	N	%	N	%	N	%	N	%	N	%
Academic Researcher	404	62.44	156	51.66	187	58.07	51	41.13	61	48.41	859	56.48
Student	95	14.68	60	19.87	57	17.70	38	30.65	33	26.19	283	18.61
Government Researcher	57	8.82	32	10.60	24	7.45	14	11.29	10	7.94	137	9.00
Non-Profit Researcher	25	3.86	17	5.63	20	6.21	7	5.64	9	7.15	78	5.13
Independent Researcher	29	4.48	14	4.63	11	3.43	6	4.84	4	3.17	64	4.21
Private-Sector Researcher	14	2.16	11	3.64	6	1.86	1	0.81	3	2.38	35	2.30
Other or Missing	23	3.56	12	3.97	17	5.28	7	5.64	6	4.76	65	4.27
Total	647	100	302	100	322	100	124	100	126	100	1,521	100

Table 2. SSEER Researchers by Primary Professional Status, 2018-22.

WHAT IS THE LEVEL OF INVOLVEMENT OF SSEER MEMBERS IN HAZARDS AND DISASTER RESEARCH?

Our team published an expanded typology of levels of involvement in the hazards and disaster field (see [Peek, Champeau, Austin, et al. 2020](#)). We use the typology from that paper in the SSEER membership survey and ask each respondent to select which of the following best describes their status as a hazards and disaster researcher:

- **Core Researcher:** Strongly self-identifies as a hazards or disaster researcher, has a deep commitment to the field, and has engaged in hazards or disaster research for a sustained period of time.
- **Periodic Researcher:** Is not primarily engaged in hazards or disaster research but focuses on related topics from time to time throughout one's professional career.
- **Situational Researcher:** Not previously trained or involved in the hazards or disaster field but had the opportunity to study new phenomena or processes based on a situational event; for example, a researcher who undertook a study after their community was affected by a major disaster.
- **Emerging Researcher:** Includes students and others who are new to the hazards or disaster field and who are still learning about its disciplinary, multidisciplinary, or interdisciplinary histories, theories, methods, and approaches. Emerging researchers may have limited experience or may not have yet conducted their own original empirical research.

Nearly four out of ten SSEER members identify as Core Researchers (N = 594; 39.05%). One-quarter identify as Emerging Researchers (N = 384;

25.25%), one-fifth identify as Periodic Researchers (N = 328; 21.56%), and less than 10% identify as Situational Researchers (N = 118; 7.76%). **Figure 6** illustrates patterns of researcher self-identification for 2018 through 2022.

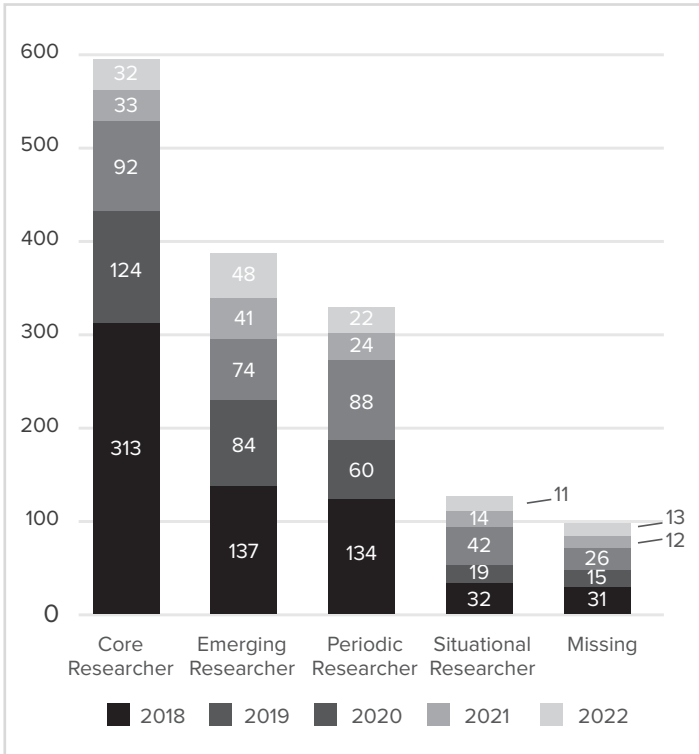


Figure 6. Number of SSEER Researchers by Level of Involvement in the Field, 2018-22.

JUST OVER **ONE-QUARTER** OF SSEER MEMBERS IDENTIFY AS **EMERGING RESEARCHERS** WHO ARE NEW TO THE FIELD AND ARE STILL LEARNING ITS FUNDAMENTALS.

WHAT METHODS AND APPROACHES DO SSEER RESEARCHERS USE IN THEIR WORK?

The SSEER membership survey asks researchers to select each of their primary approaches to data collection and analysis. As summarized in **Figure 7**, the most frequently chosen methodological approaches include survey research (N = 893), in-depth interviews (N = 886), and case studies (N = 873). The numbers in the figure do not sum to the sample size of 1,521 because researchers had the option to choose more than one approach, and most did so.

WHAT PHASES OF THE DISASTER CYCLE DO SSEER RESEARCHERS STUDY?

Social scientists who research hazards or disasters often study distinct disaster phases including preparedness, emergency response, short-term reconstruction, long-term recovery, and mitigation (see **Figure 8**).

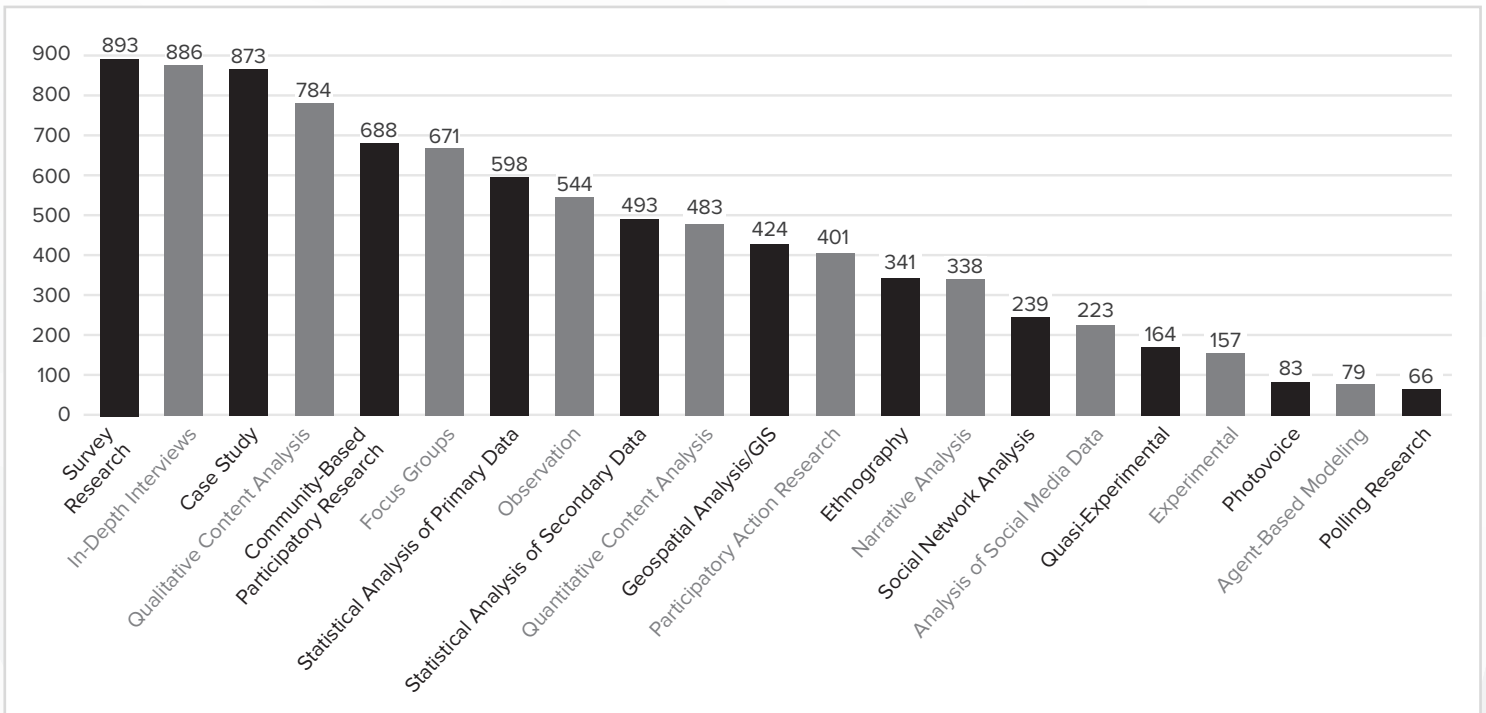


Figure 7. Preferred Methodological Approaches of SSEER Researchers.





Figure 8. The Disaster Cycle.

SSEER MEMBERS CONTRIBUTE NEW KNOWLEDGE ACROSS EVERY PHASE OF THE **DISASTER CYCLE**.

Figure 9 shows the different phases across the disaster cycle that SSEER researchers study. Most SSEER researchers focus on disaster preparedness (N = 1,139), followed by mitigation (N = 931), emergency response (N = 879), long-term recovery (N = 856), and short-term reconstruction (N = 560). The numbers in the text and in Figure 9 do not sum to the sample size of 1,521 because researchers had the option to choose more than one phase, and most did so.

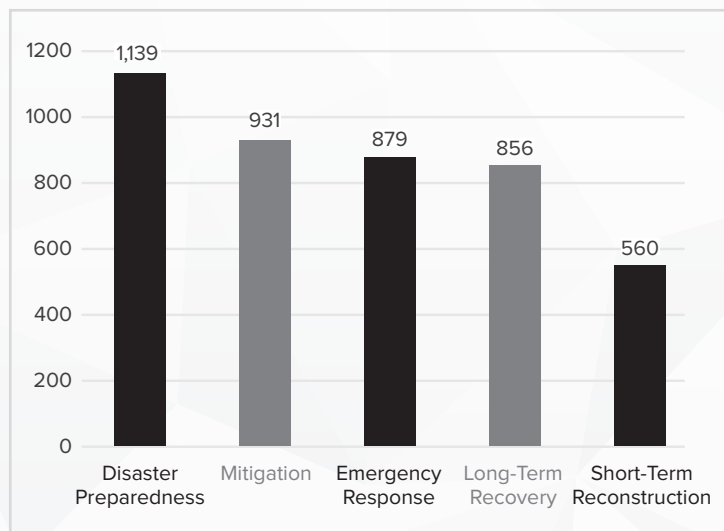


Figure 9. Disaster Phases Studied by SSEER Researchers.

WHAT HAZARD TYPES DO SSEER RESEARCHERS STUDY?

Figure 10 includes a summary of the hazard types that SSEER members indicate having studied. As shown, the majority of SSEER members study natural hazards (N = 1,392), which include geophysical, meteorological, hydrological, climatological, biological, and extraterrestrial events. In addition, a smaller set of respondents study technological hazards (N = 382) such as industrial accidents, transport accidents, and toxic exposures. The smallest portion of SSEER respondents focus on terrorism or other willful acts of violence such as school shootings (N = 282). The numbers in the figure do not sum to the sample size of 1,521 because researchers had the option to choose more than one hazard type, and many did so.

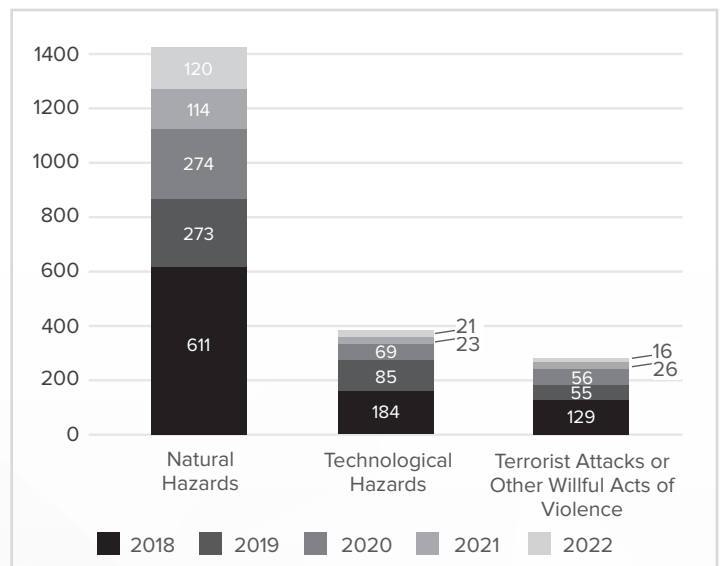


Figure 10. Hazard Types Studied by SSEER Researchers, 2018-22.

HOW MANY DISASTER EVENTS HAVE SSEER RESEARCHERS STUDIED?

The SSEER membership survey asks respondents to identify up to 10 specific named disaster events that they have studied during their career. Between 2018 and 2022, we received more than 1,400 unique responses to this question, which include disasters studied across several centuries and multiple geographic and cultural contexts. The disasters that SSEER researchers have studied, along with keywords characterizing research expertise, are viewable through each [researcher's profile in the SSEER map](#).



SSEER RESEARCHERS HAVE STUDIED MORE THAN 1,400 UNIQUE DISASTER EVENTS.

Based on responses detailing disasters studied by name of event and year, just under one in three SSEER members either refrained from responding to the question or had not studied any named disaster events (N = 469; 30.83%). Almost as many respondents had studied one disaster event (N = 235; 15.45%) as had studied two events (N = 215; 14.14%). A moderate number of SSEER members studied three (N = 160; 10.52%) or four events (N = 119; 7.82%). Fewer than 100 members studied five (N = 91; 5.98%) or six (N = 61; 4.01%) disaster events. An even smaller number of SSEER members had researched seven (N = 38; 2.50%), eight (N = 35; 2.30%), or nine events (N = 31; 2.04%), respectively. Less than 5% of members researched 10 events (N = 47; 3.09%), and a small number of members responded to the survey with 11 or more events (N = 20; 1.31%) (see **Figure 11**).

On average, SSEER members studied 2.61 events; however, variation exists between different levels of involvement in the field of social science hazards and disaster research (see **Figure 12**). Core Researchers report studying an average of 3.98 events (se = .1326; 95% CI = 3.72 to 4.24). Those who identify as Periodic Researchers reported the next-highest average at 2.26 events studied (se = .1368; 95% CI = 1.99 to 2.53). Emerging Researchers report studying 1.63 disaster events on average (se = .1044; 95% CI = 1.42 to 1.83), slightly higher than the 1.61 events (se = .1655; 95% CI = 1.28 to 1.94) studied by those who identify as Situational Researchers.

THE AVERAGE SSEER MEMBER HAS STUDIED 2.61 NAMED DISASTER EVENTS.

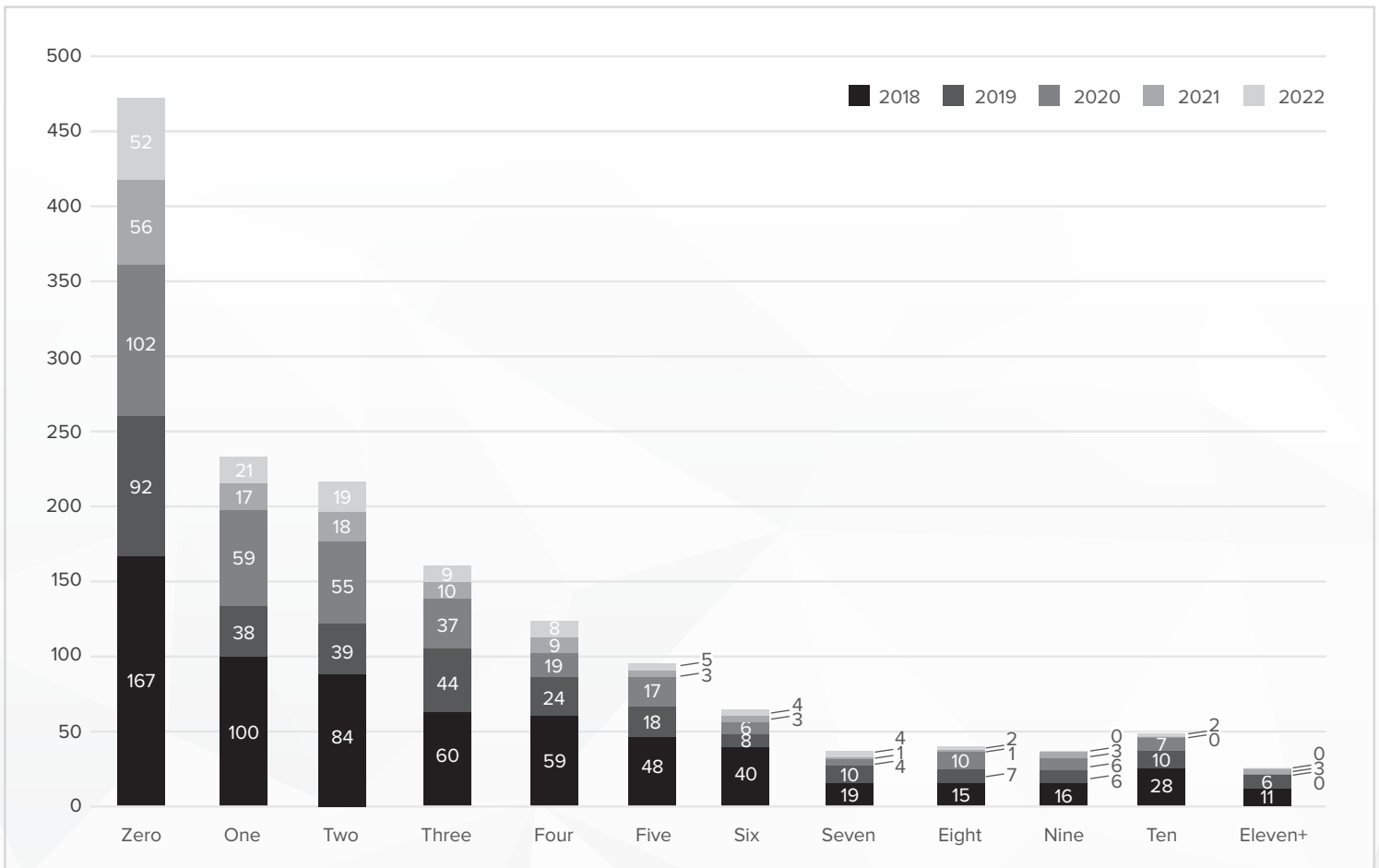


Figure 11. Number of Disaster Events Studied by SSEER Members, 2018-2022.



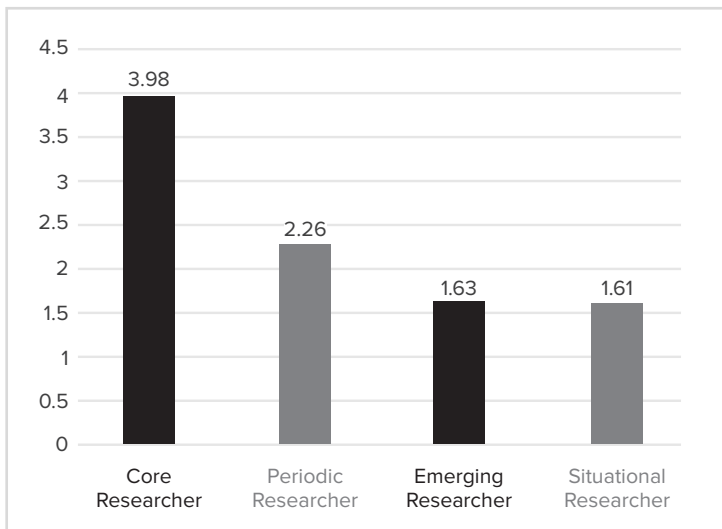


Figure 12. Average Number of Disaster Events Studied by Level of Involvement in the Field.

WHAT NAMED DISASTER EVENTS HAVE SSEER RESEARCHERS STUDIED?

Hurricane Katrina remains the most commonly studied disaster event in the SSEER database (N = 255), followed by **Hurricane Harvey** (N = 158), **Hurricane Maria** (N = 147), and **Hurricane Sandy** (N = 137). While these four hurricanes were the most studied disasters since the release of our first SSEER Census in 2018 through last year's report in 2021, **Hurricane Irma** (N = 103)—previously the fifth most studied event—was overtaken by interest in the novel coronavirus (N = 116). Now the fifth most commonly studied event by SSEER members, **COVID-19** debuted at number 10 in the 2020 Census and demonstrates the process by which interest in new disaster events gains salience to the field.

COVID-19 IS NOW THE FIFTH MOST STUDIED DISASTER IN THE SSEER DATABASE.

Our analyses for this year's report show that pandemic-related research surpassed the numbers of members who studied the **9/11 terrorist attacks** (N = 81), the **2004 Indian Ocean earthquake and tsunami** (N = 73), and the **2011 Fukushima/Great East Japan earthquake and tsunami** (N = 73). As shown in **Table 3**, the **2010 BP Deepwater Horizon oil spill** (N = 64) rounds out the ten most commonly studied disaster events.

Disaster Event	Year Event Was Named	N
Hurricane Katrina	2005	255
Hurricane Harvey	2017	158
Hurricane Maria	2017	147
Hurricane Sandy	2012	137
COVID-19	2020*	116
Hurricane Irma	2017	103
9/11 Terrorist Attacks	2001	81
Indian Ocean Earthquake and Tsunami	2004	73
Fukushima/Great East Japan Earthquake and Tsunami	2011	73
BP Deepwater Horizon Oil Spill	2010	64

Table 3. Most Commonly Researched Disaster Events by SSEER Members.

*The World Health Organization declared COVID-19 a pandemic on March 11, 2020.

WHAT IS THE DEMOGRAPHIC COMPOSITION OF THE SSEER RESEARCH WORKFORCE?

To characterize the demographic composition of the social science hazards and disaster workforce, the SSEER survey ends with a series of questions regarding respondent age, years of experience, race, ethnicity, and gender identity.

In the 2022 Census, SSEER researchers ranged in age from 20 to 87 years. The average SSEER researcher is 44.03 years old and has 11.7 years of research experience in the hazards and disaster field. More than one-fifth of SSEER respondents (N = 324; 21.30%) did not provide their age in the membership survey.

THE AVERAGE SSEER RESEARCHER HAS MORE THAN 11 YEARS OF EXPERIENCE IN THE HAZARDS AND DISASTER FIELD.

The SSEER survey prompts respondents to select which racial and ethnic category or categories best describe their identity. Most SSEER respondents identify as White (N = 835; 54.90%). Fewer SSEER members identify as Asian/Asian American (N = 207; 13.61%), Hispanic/Latino (N = 115; 7.56%), or Black/African American (N = 85; 5.59%). A small percentage of respondents selected two or more racial or ethnic categories (N = 19; 1.25%) or some other provided identity option (N = 14; 0.92%) such as Indigenous, Native Hawaiian/Pacific Islander, or Arab/Arab American/Middle Eastern.

	2018		2019		2020		2021		2022		Total	
	N	%	N	%	N	%	N	%	N	%	N	%
White	402	62.14	170	56.29	149	46.28	55	44.35	59	46.83	835	54.90
Asian/Asian American	87	13.45	39	12.91	49	15.22	10	8.06	22	17.46	207	13.61
Hispanic/Latino	41	6.34	22	7.28	29	9.01	12	9.68	11	8.73	115	7.56
Black/African American	29	4.48	16	5.3	23	7.14	12	9.68	5	3.97	85	5.59
Two or more racial/ethnic identities	5	0.77	6	1.99	5	1.55	1	0.81	2	1.58	19	1.25
Some other provided racial/ethnic identity	5	0.77	3	1.00	5	1.55	1	0.81	0	0.00	14	0.92
Missing or a different identity	78	12.05	46	15.23	62	19.25	33	25.82	27	21.43	246	16.17
Total	647	100	302	100	322	100	124	100	126	100	1,521	100

Table 4. Racial/Ethnic Identity of SSEER Researchers, 2018-22.

	2018		2019		2020		2021		2022		Total	
	N	%	N	%	N	%	N	%	N	%	N	%
Woman	341	52.70	152	50.33	168	52.17	71	57.26	74	58.73	806	52.99
Man	274	42.35	125	41.39	120	37.27	40	32.26	37	29.37	596	39.19
Some other answer	32	4.95	25	8.28	34	10.56	13	10.48	15	11.90	119	7.82
Total	647	100	302	100	322	100	124	100	126	100	1,521	100

Table 5. Gender Identity of SSEER Researchers, 2018-22.

The survey also includes “prefer not to answer” and “prefer to self-describe” response options, in recognition that some respondents, both inside and outside the United States, may not use the offered fixed identity categories, which were adapted from the U.S. Census. Just over 16% (N = 246; 16.17%) of SSEER respondents were coded as “missing” because they did not respond to the race/ethnicity question, chose “prefer not to answer,” or selected “prefer to self-describe” (see **Table 4**).

More women (N = 806; 52.99%) than men (N = 596; 39.19%) have joined the SSEER network. Additionally, a small portion of members provided some other answer (N = 119; 7.82%), including refraining from responding or identifying as nonconforming/nonbinary. Responses regarding the gender identity of SSEER members for 2018 through 2022 appear in **Table 5**.

CONCLUSION

Established in 2018, the SSEER network is now in its fifth year. In this relatively short period of time, the network has more than doubled in size and now includes a total of 1,521 researchers from 67 countries.

SSEER members are predominantly located in the United States. As noted in previous reports, it is not clear if there are, in fact, more social scientists who study disasters in the United States, or if that is where we have been most successful at identifying researchers and encouraging them to join SSEER. Historically, there have been relatively strong investments in social science and multidisciplinary hazards and disaster research in the United States, but the predominance of members here may be more a reflection of our reach as a U.S.-led and U.S.-funded network.

Members of the SSEER network study natural hazards, technological hazards, and terrorism and other willful forms of violence. Social scientists in the network report studying more than 1,400 named disaster events. The most frequently studied disasters include major hurricanes that have affected the mainland United States and its territories, the COVID-19 pandemic, and the 9/11 terrorist attacks, among other disasters of national and global significance. It is noteworthy that the 10 most frequently studied disasters all occurred in the 21st century and most of these events happened in the United States. This is likely because SSEER membership is heavily concentrated in the United States, although these particularly devastating named events attracted broad media coverage and international interest as well.



As indicated in this report, social scientists use a range of methods and approaches to collect and analyze data. The most commonly used methods include survey research, case studies, and in-depth interviews. It is worth noting, however, that SSEER members are methodologically adept and often use more than one methodological approach in their research.

The **demographic composition of the hazards and disaster research workforce** has long been of interest to leaders within the field. One area of special concern is whether researchers reflect the demographic characteristics of the populations being studied. Our analyses in this and prior reports offer the first systematic characterization of the years of experience and racial, gender, and age composition of the social science research community.

Moving forward, we will continue to release annual **SSEER Census** results via the **CONVERGE website** so that we can monitor and assess the status of the social science hazards and disaster research workforce. We also update the interactive **SSEER map** quarterly; if you are a social scientist who studies extreme events and have not yet joined, you are invited to do so by completing the **SSEER membership survey**.

RECOMMENDED CITATIONS FOR THE 2023 CENSUS AND DATA

Champeau, Heather, Jessica Austin, and Lori Peek. 2023. **“2022 Social Science Extreme Events Research (SSEER) Census,”** in Social Science Extreme Events Research (SSEER) Network Data, Survey Instrument, and Annual Census. DesignSafe-CI.

For reference to the data used in this year’s SSEER Census, please see:

Peek, Lori, Heather Champeau, and Jessica Austin. 2023. **“2022 Social Science Extreme Events Research (SSEER) Network,”** in Social Science Extreme Events Research (SSEER) Network Data, Survey Instrument, and Annual Census. DesignSafe-CI.

SSEER ANNUAL REPORTS AND DATA PUBLICATIONS

Previously published SSEER Census reports are available via the **CONVERGE website** and through the **DesignSafe** project page for SSEER.

The de-identified SSEER datasets and data documentation that informed prior annual reports are **published and available for download on DesignSafe**.

ABOUT SSEER

SSEER is a **global network** of social scientists who study hazards and disasters. SSEER **identifies** researchers to develop the social science workforce and **coordinates** social science research teams in large-scale disasters to **advance scholarship** on the root causes and human consequences of extreme events.

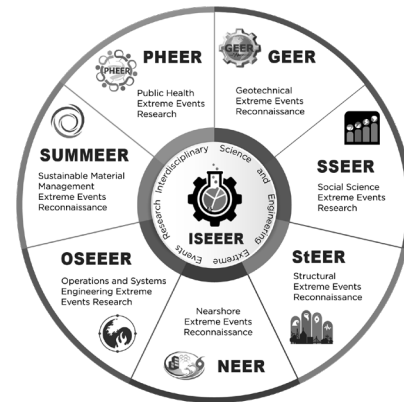


Figure 13. SSEER is part of a larger ecosystem of federally-funded **extreme events reconnaissance and research networks**.

The networks shown in **Figure 13** were established with support from the National Science Foundation (NSF) and Centers for Disease Control and Prevention (CDC) to coordinate disciplinary communities in engineering, the social and natural sciences, and public health, while also encouraging cross-disciplinary information sharing and interdisciplinary integration. More information on SSEER and the other networks is available on the **CONVERGE website**.



SSEER | CONVERGE | Natural Hazards Center
 Institute of Behavioral Science | University of Colorado Boulder
 483 UCB | Boulder, CO 80309-0483 | (303) 735-5844
sseer@colorado.edu | <https://converge.colorado.edu/research-networks/sseer>



SSEER is funded by the National Science Foundation (NSF), Division of Civil, Mechanical, and Manufacturing Innovation, Program on Humans, Disasters, and the Built Environment (NSF Award #1745611 and #1841338). Any opinions, findings, conclusions, or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the NSF.

