

Trends in natural hazards research funding by the National Science Foundation

Geoscience Research Programs' Adaptations to Natural Disruptive Events (GRANDE)

Leila Gonzales and Christopher Keane
American Geosciences Institute

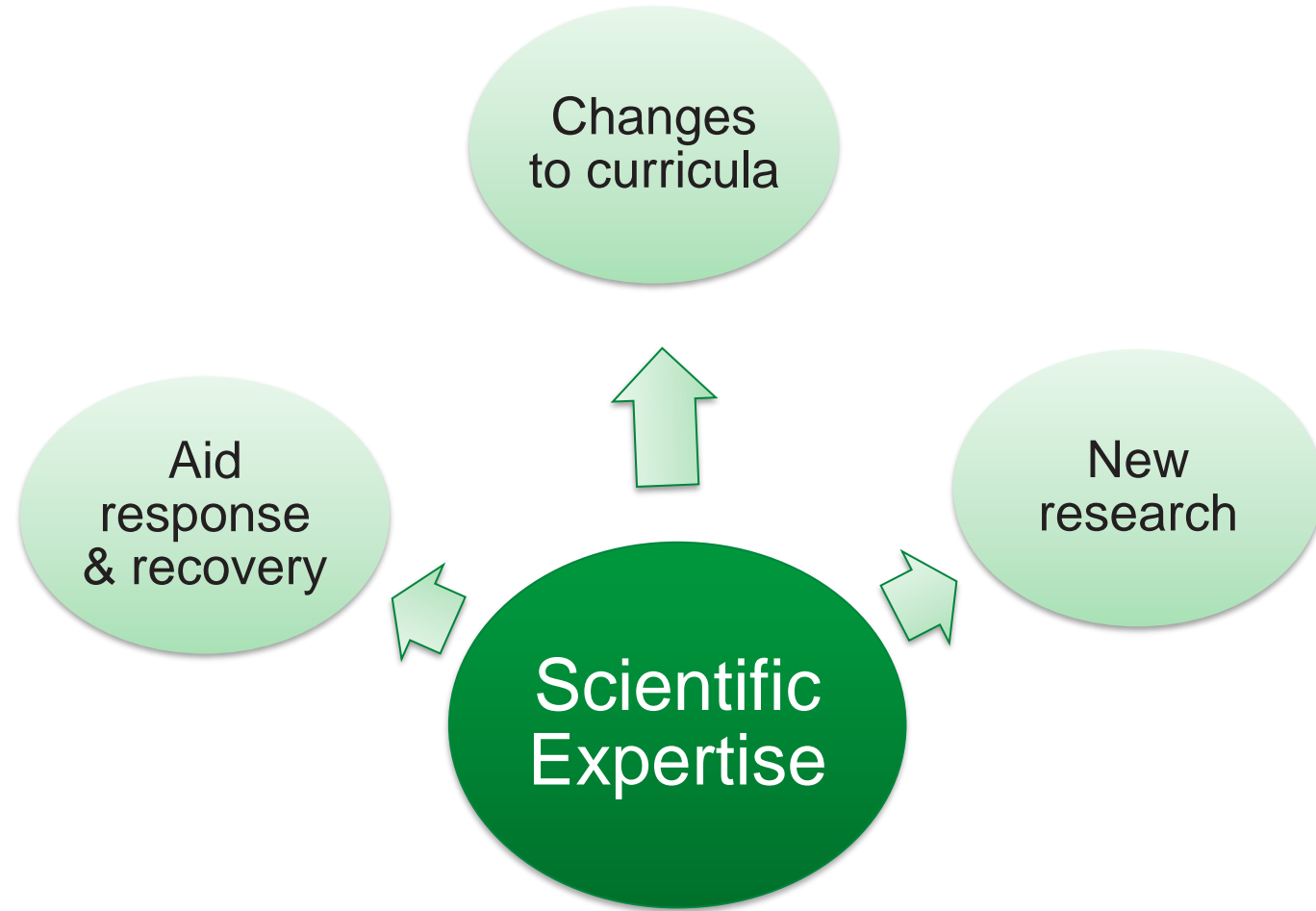
Funding for this project is provided by the National Science Foundation (Award #2223004).

The results and interpretation of the survey are the views of the American Geosciences Institute and not those of the National Science Foundation.

Project Overview

Geoscience departments have the expertise for understanding the causes, impacts and risk of natural hazard events.

How do they leverage these events as opportunities for learning and research, and to aid response & recovery efforts?



Project Goals

1

Assess disaster
impacts on education
and research

2

Identify operational
and pedagogical
outcomes from
impacted
departments

SURVEY

3

Examine how the
community has
leveraged events for
research, instruction,
and mitigation efforts

SURVEY

4

Gain the perspectives
of students and early-
career geoscientists
on the impacts to the
geosciences

SURVEY

Assessing impacts on geoscience education

Map departments
to federally
declared disasters

Examine
published
literature

Assess
research &
curricula
production

Identify faculty
size and
specialty
changes

Evaluate
federal
funding
opportunities

- Analyze trends in NSF funding from 2000 to 2019 to identify changes in number of awards and funding levels related to specific events and/or natural hazard types.

Questions to investigate

*How much has NSF
invested in natural hazards
research?*

*Which directorates have
invested the most in
natural hazards research?*

*What trends are there
relative to types of
natural hazard awards over
the 2000-2019 period?*

*Are there trends in types
of research by type of
natural hazard?*

Methodology



Download NSF awards and funding announcements (2000-2019)



Given a pre-defined list of natural hazards, use an AI Large Language Model (mixtral-8x7b) to classify awards and funding announcements as either related to one or more natural hazards or as “not a natural hazard”



Use mixtral8x-7b to identify the type of research for each award.



Use mixtral8x-7b to identify if awards relate to specific natural hazard events.



Manually identify award funding mechanisms such as SGER, EAGER, RAPID.



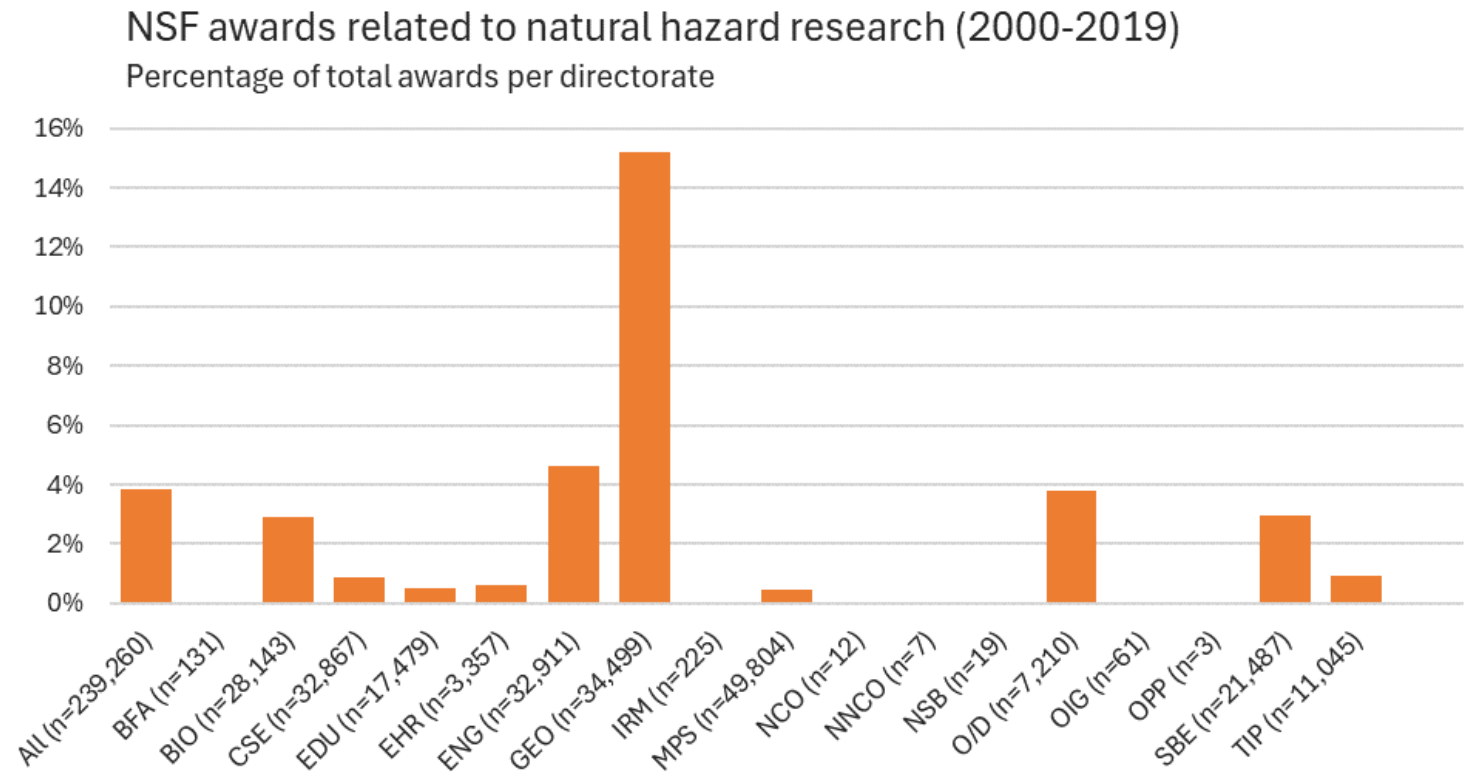
Manually identify facility/instrumentation and meeting/workshop/travel awards.

Overview of natural hazard research funding

Natural hazard-related awards comprised 3.9% of all NSF awards between 2000-2019.

GEO awarded the largest share of awards (5,239) which was 15.2% of all GEO awards.

ENG awarded the next largest share of awards (1,521) which was 4.6% of all ENG awards.



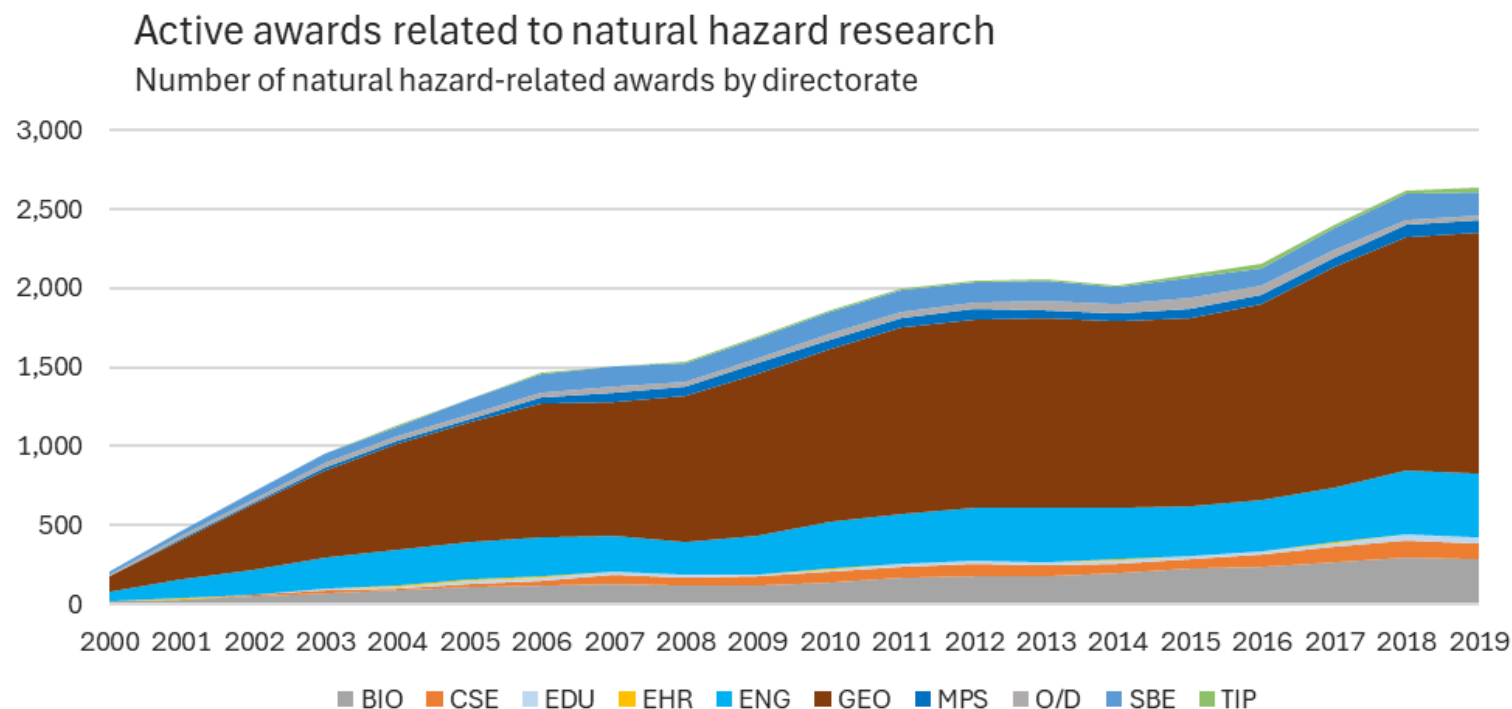
Trends in active natural hazard research funding

Active awards

For a given year, an award is considered active if the year falls between the award's start and end dates.

GEO is driving the increase in natural hazard-related research at NSF.

Increases also seen in BIO, CSE, EDU, ENG, MPS, SBE, TIP



Active natural hazard award proportions

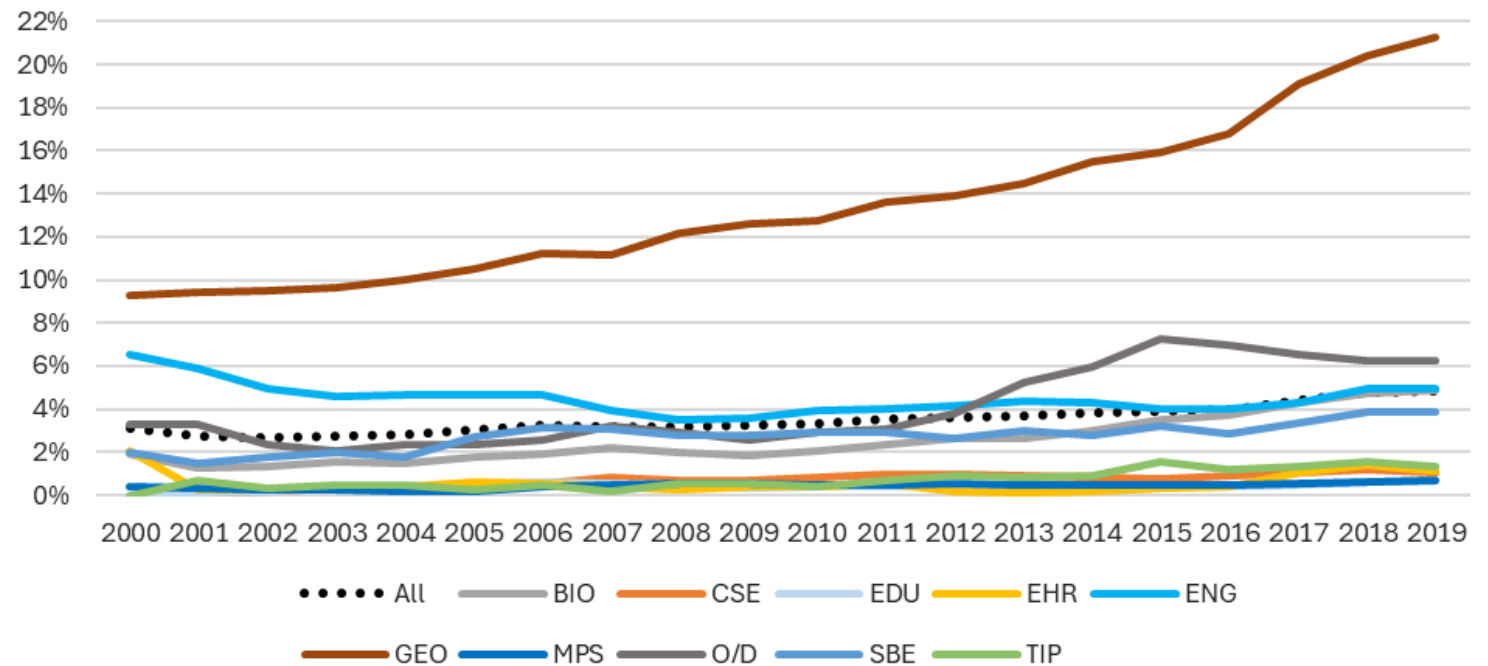
Considering natural hazard awards as a percentage of total awards by directorate:

A steady increase in natural hazard-related awards from GEO, especially since 2003.

Meanwhile, there has been a slight decline in the percentage of natural hazards awards from ENG.

The percentage of O/D natural hazard awards increased after 2011.

Active awards related to natural hazard research
Percentage of total awards by directorate

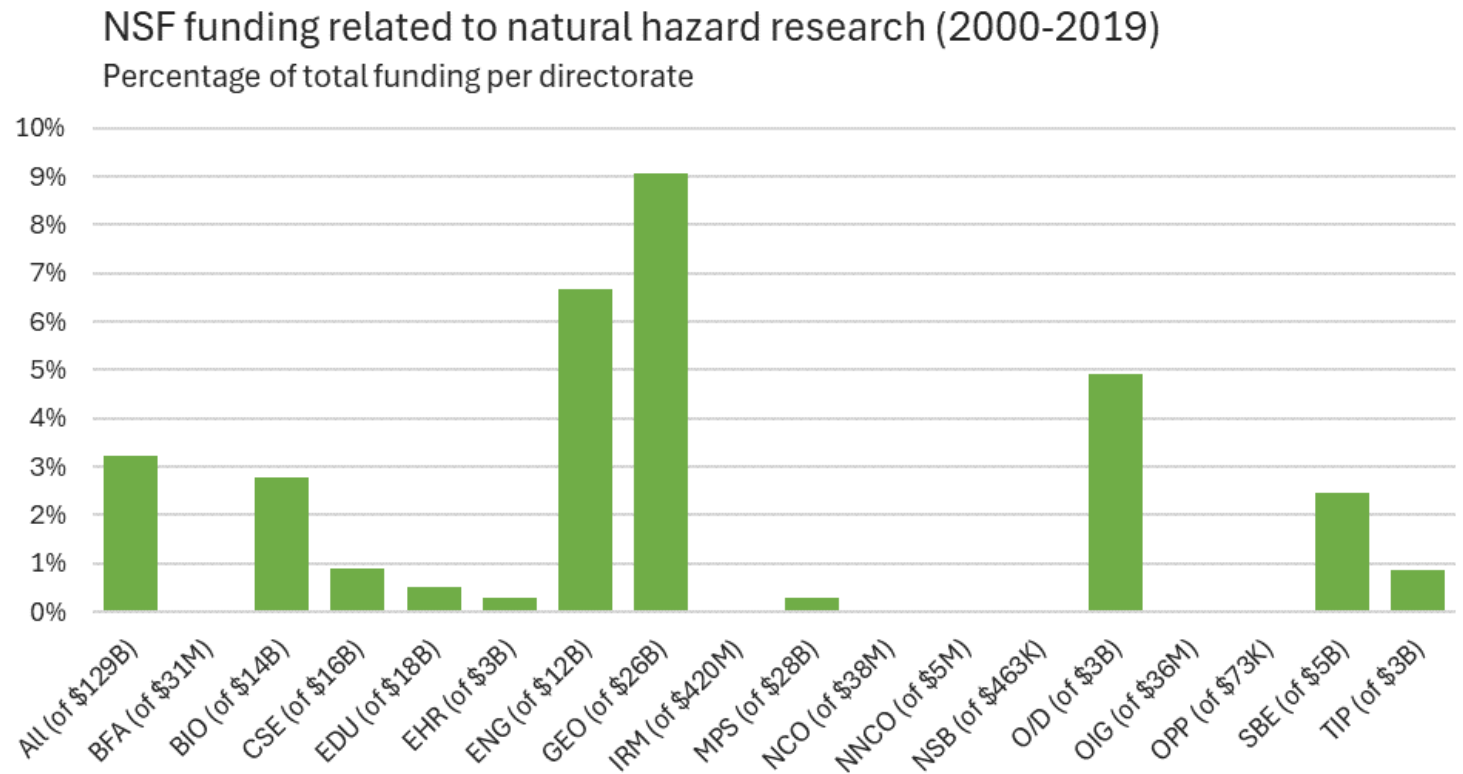


Funding amounts by directorate

Between 2000 and 2019, NSF invested just over \$4 billion in natural hazards research, which was 3.2% of all research funding over the period.

\$2.3 billion was invested by the GEO directorate, which equated to 9.1% of its total funding.

\$797 million was invested by the ENG directorate, which equated to 6.7% of its total funding.



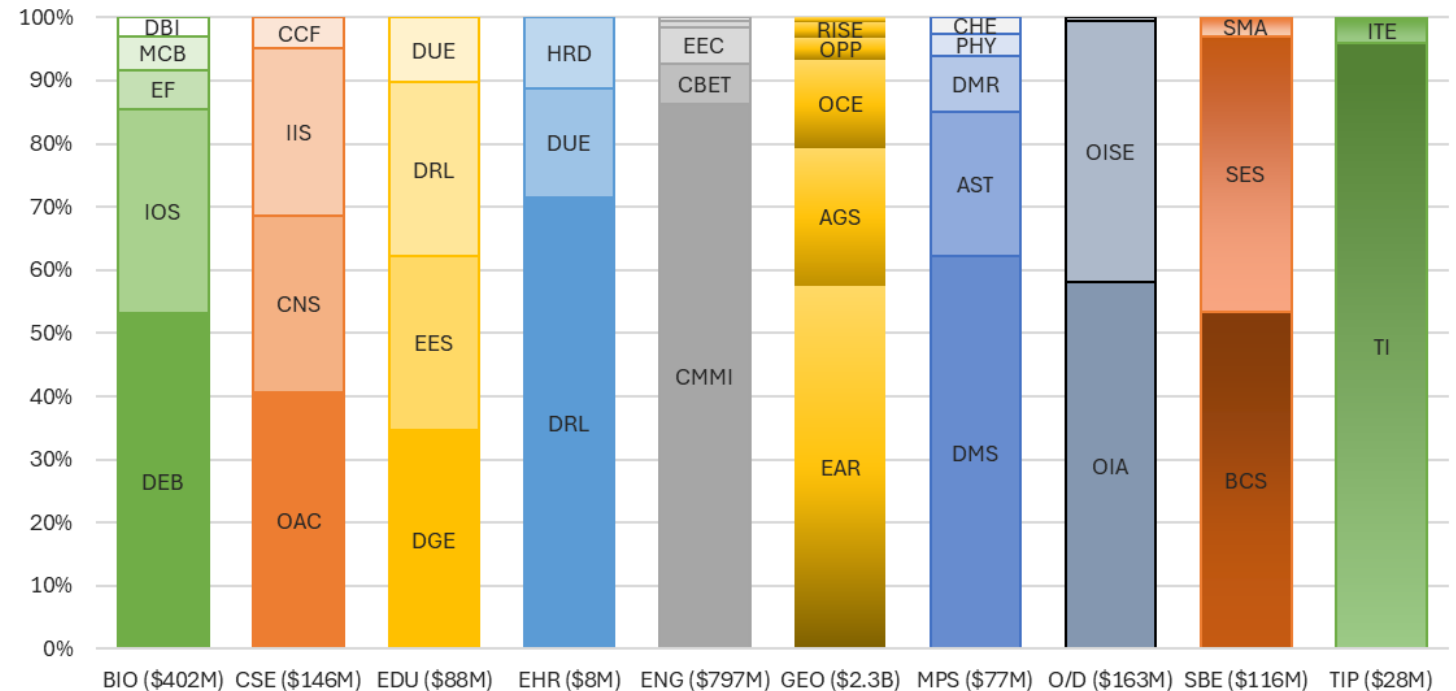
Funding amounts by division

61% of NSF natural hazard research funding was from

- GEO-EAR (32%)
- ENG-CMMI (17%)
- GEO-AGS (12%)

The proportion of natural hazard research funding by division within each directorates varies considerably.

Natural hazard research funding by directorate and division
Percentage of total natural hazard funding by division per directorate



Not labelled in chart due to space limitations and small percentages:
ENG: ECCS, EFMA | GEO: GEO, DPP | O/D: EPS

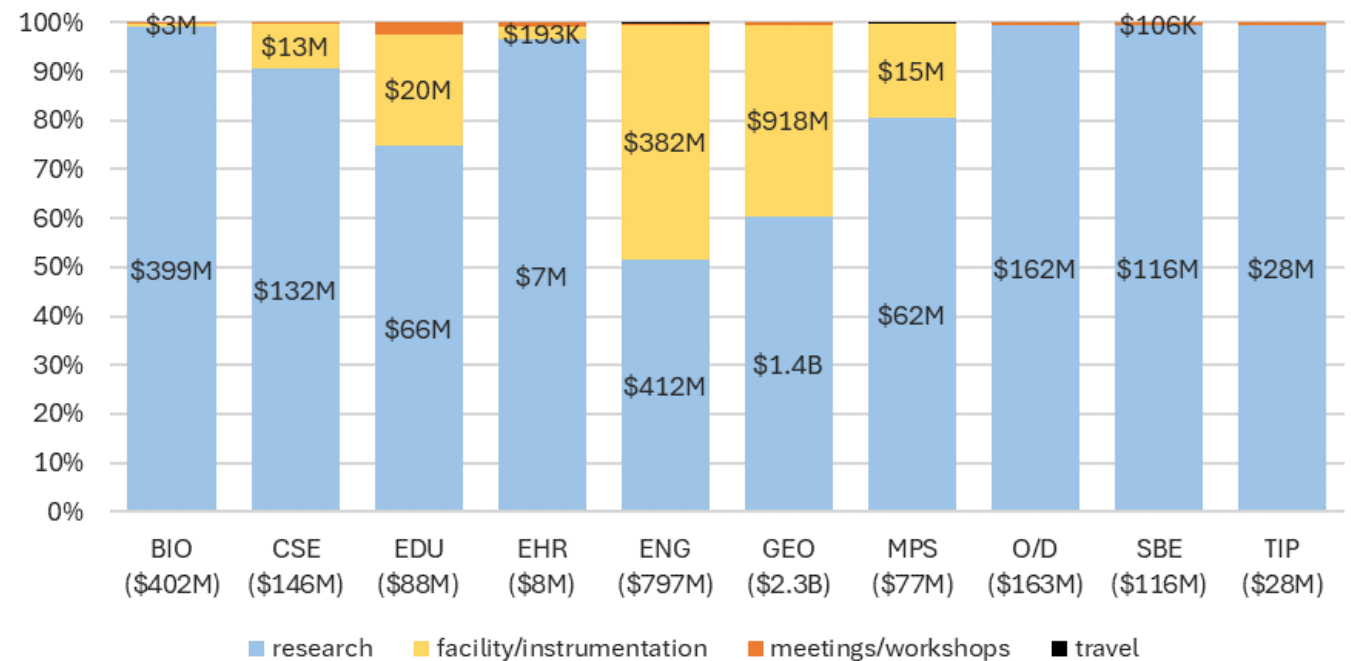
Funding amounts type of award

Most natural hazard funding per directorate was for research awards.

Funding for facility and instrumentation awards was largest for

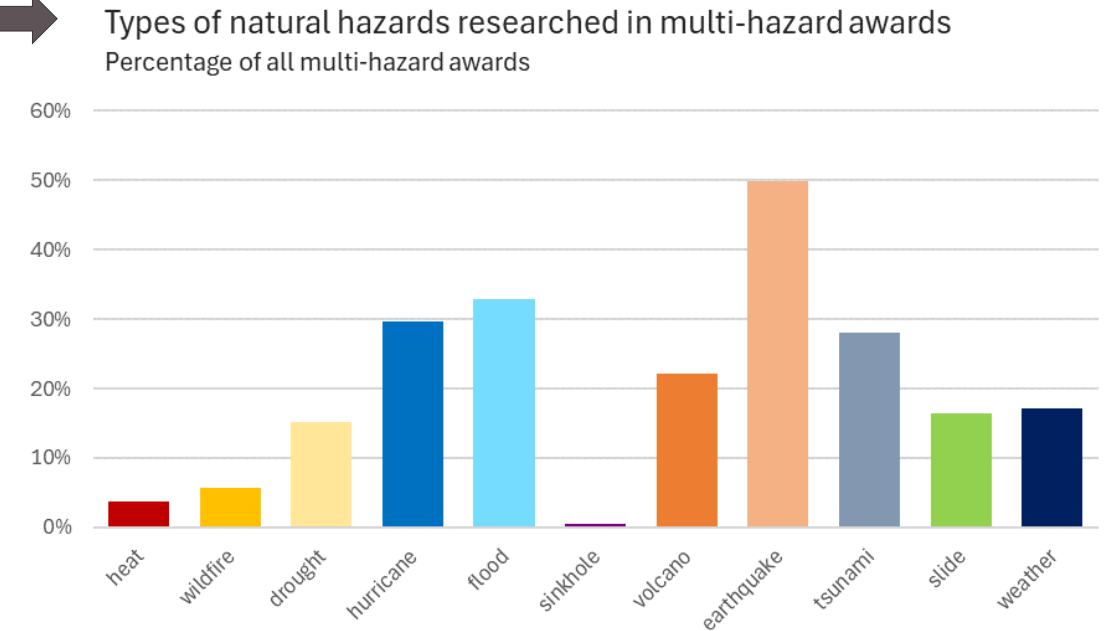
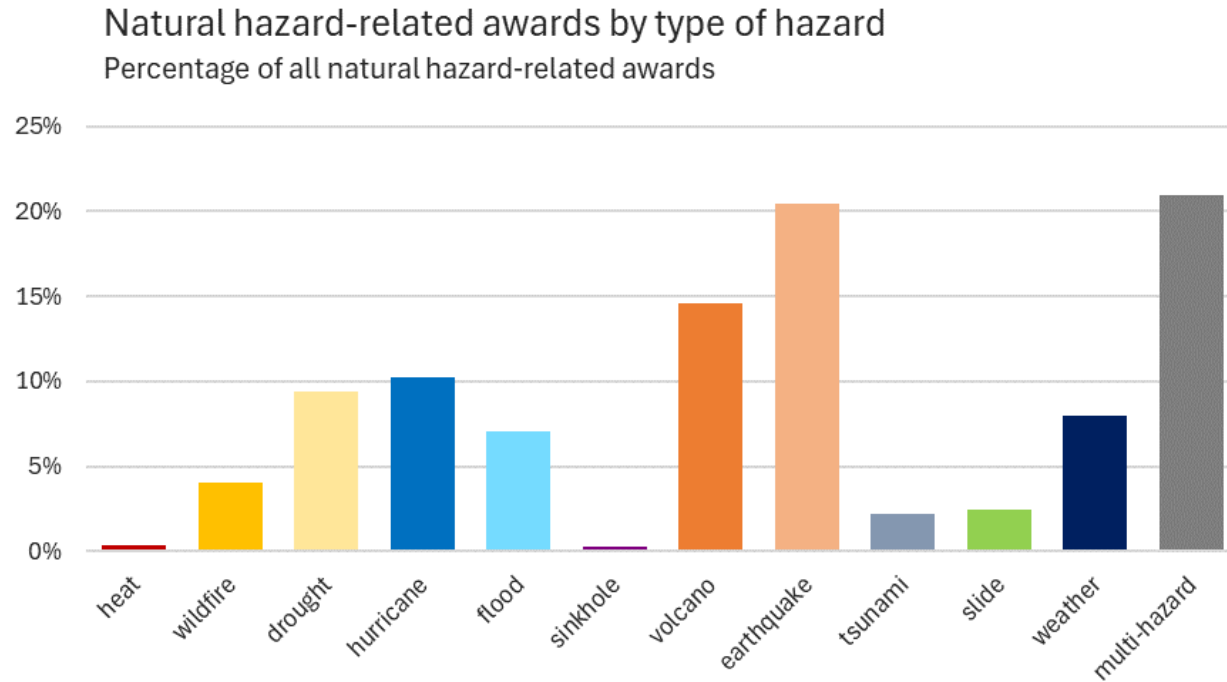
- ENG (48%)
- GEO (39%)
- EDU (23%)
- MPS (19%)

Natural hazard research funding by directorate by type
Percentage of total natural hazard funding by type per directorate



Values shown for research and facility/instrumentation funding

Types of research being conducted



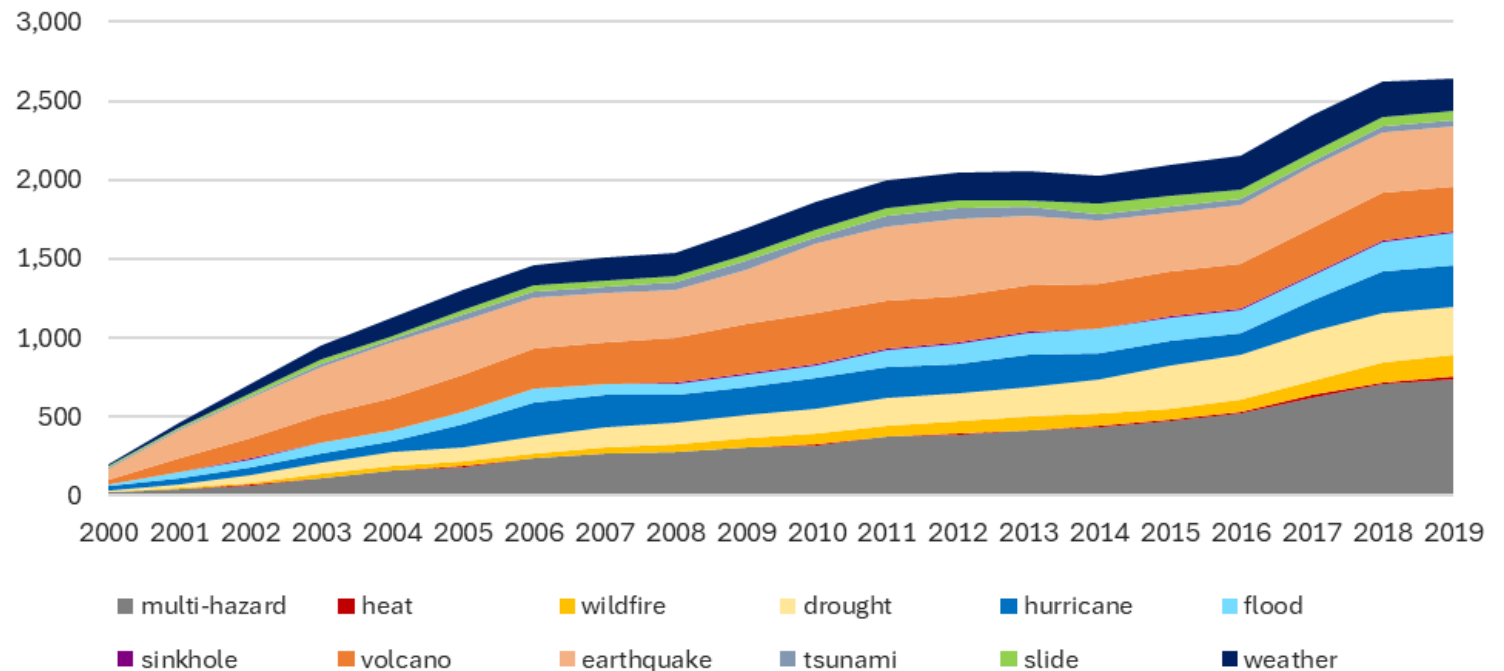
Active natural hazard award proportions

Active awards

For a given year, an award is considered active if the year falls between the award's start and end dates.

Overall increase in natural hazards research, with a shift in focus on awards investigating multiple natural hazards.

Active awards related to natural hazard research by type of hazard
Number of natural hazard-related awards per year



Active natural hazard award proportions

By 2019, multi-hazard awards comprised 28% of all active awards, up from 10% in 2000.

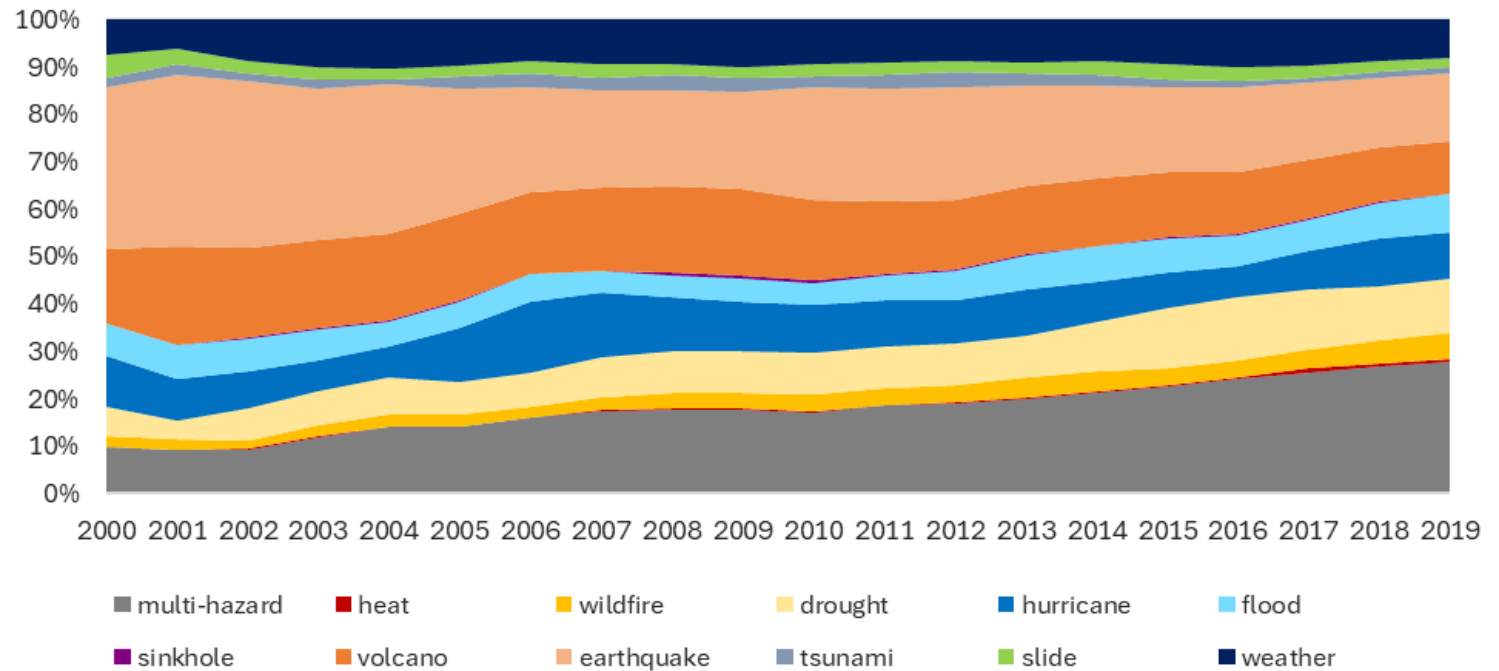
Other increases:

Drought, wildfire

Declines:

Earthquakes, volcanoes, slides

Active awards related to natural hazard research by type of hazard
Percentage of natural hazard-related awards per year



Funding amounts type of award

Funding focus varies by directorate.

Multi-hazard funding was 18% or more of directorate funding.

GEO: 42% to multi-hazard

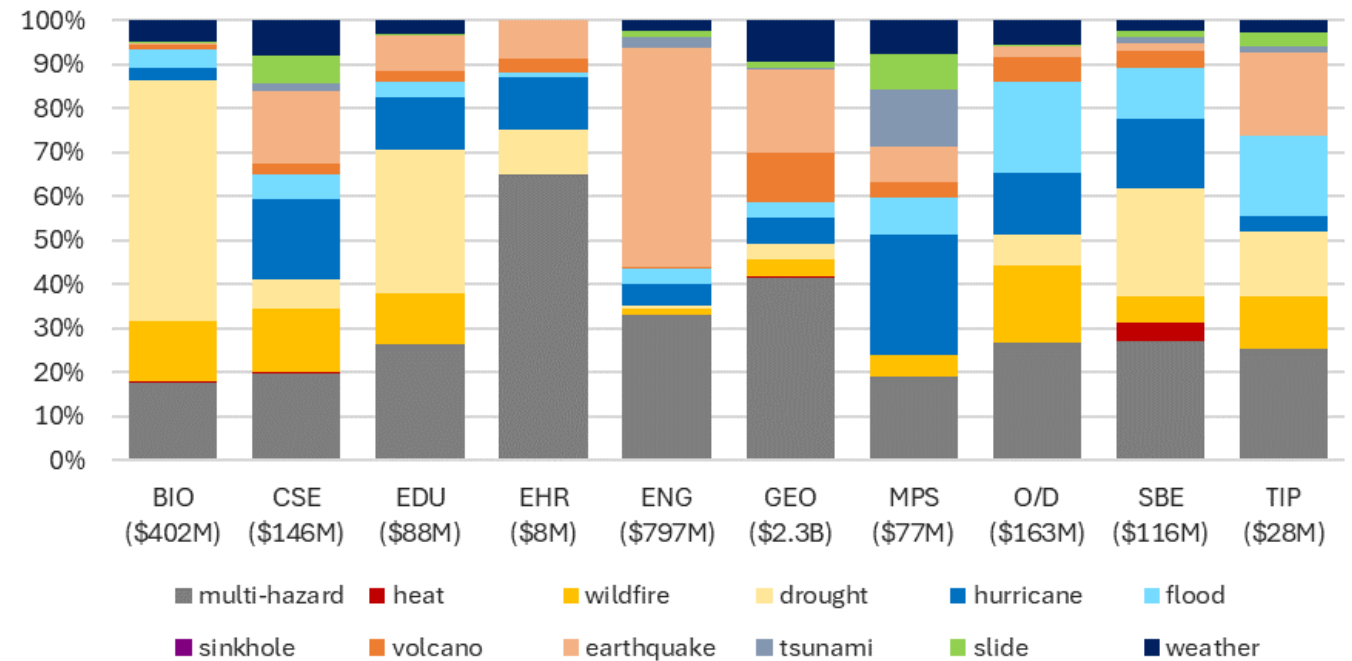
ENG: 50% to earthquakes
33% to multi-hazard

BIO: 55% to drought

EDU: 33% to drought

EHR: 65% to multi-hazard

Research funding by directorate and natural hazard type
Percentage of total natural hazard funding by hazard type per directorate

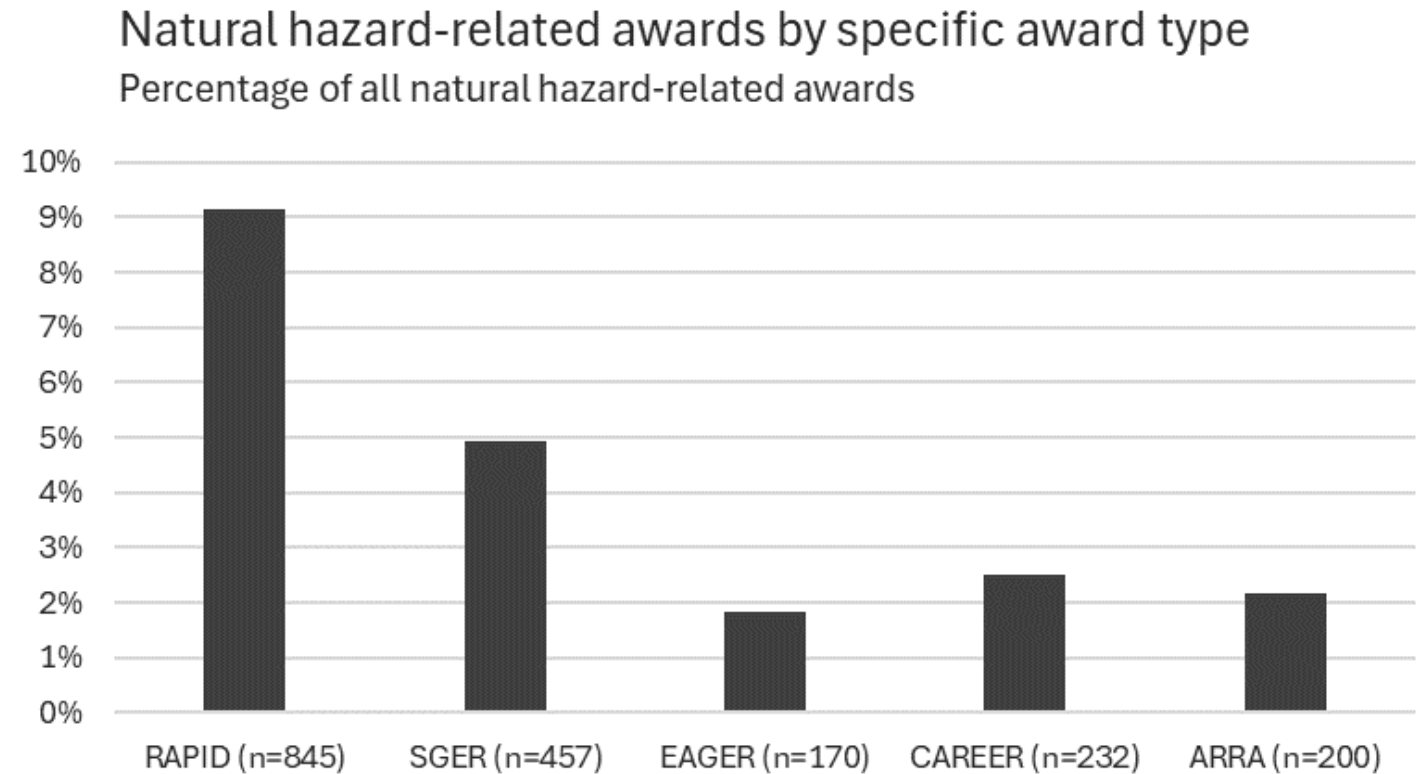


Funding mechanisms

RAPID awards comprised just over 9% of all natural hazard-related awards.

SGER awards comprised 5% of all natural hazard-related awards.

EAGER, CAREER, and ARRA each comprised < 5%.

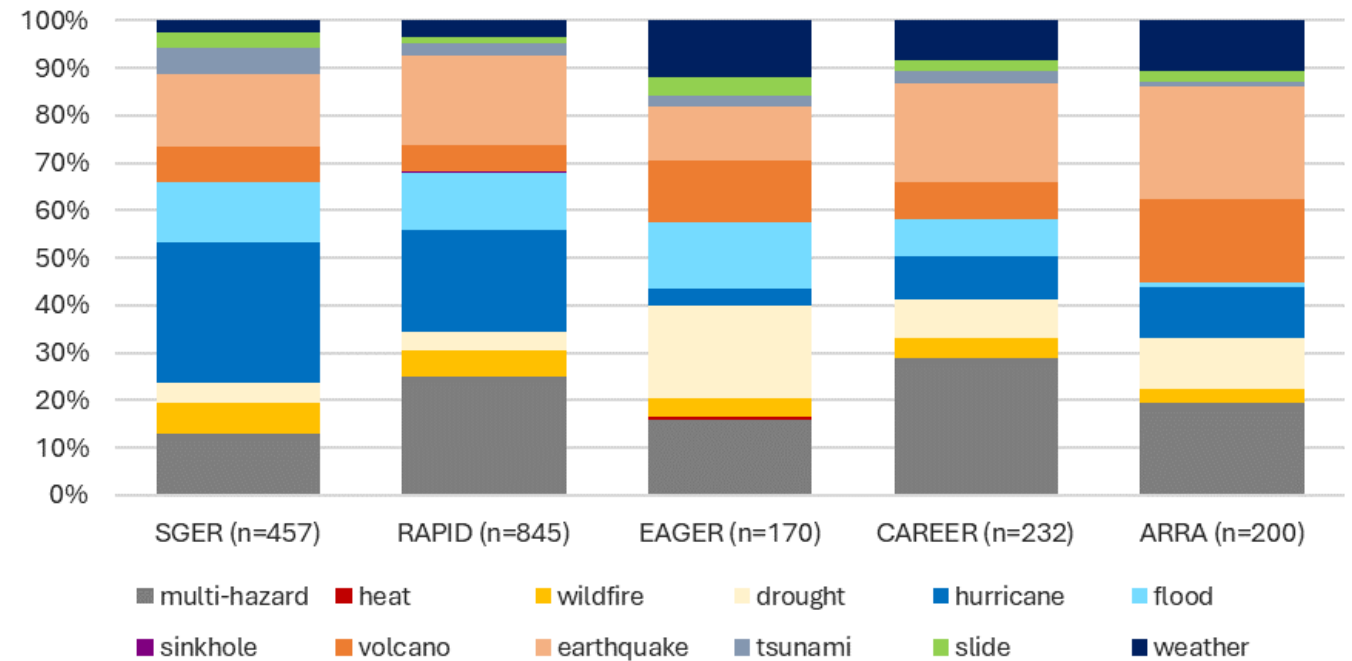


Funding mechanisms by natural hazard type

Types of natural hazards researched by funding mechanism varies.

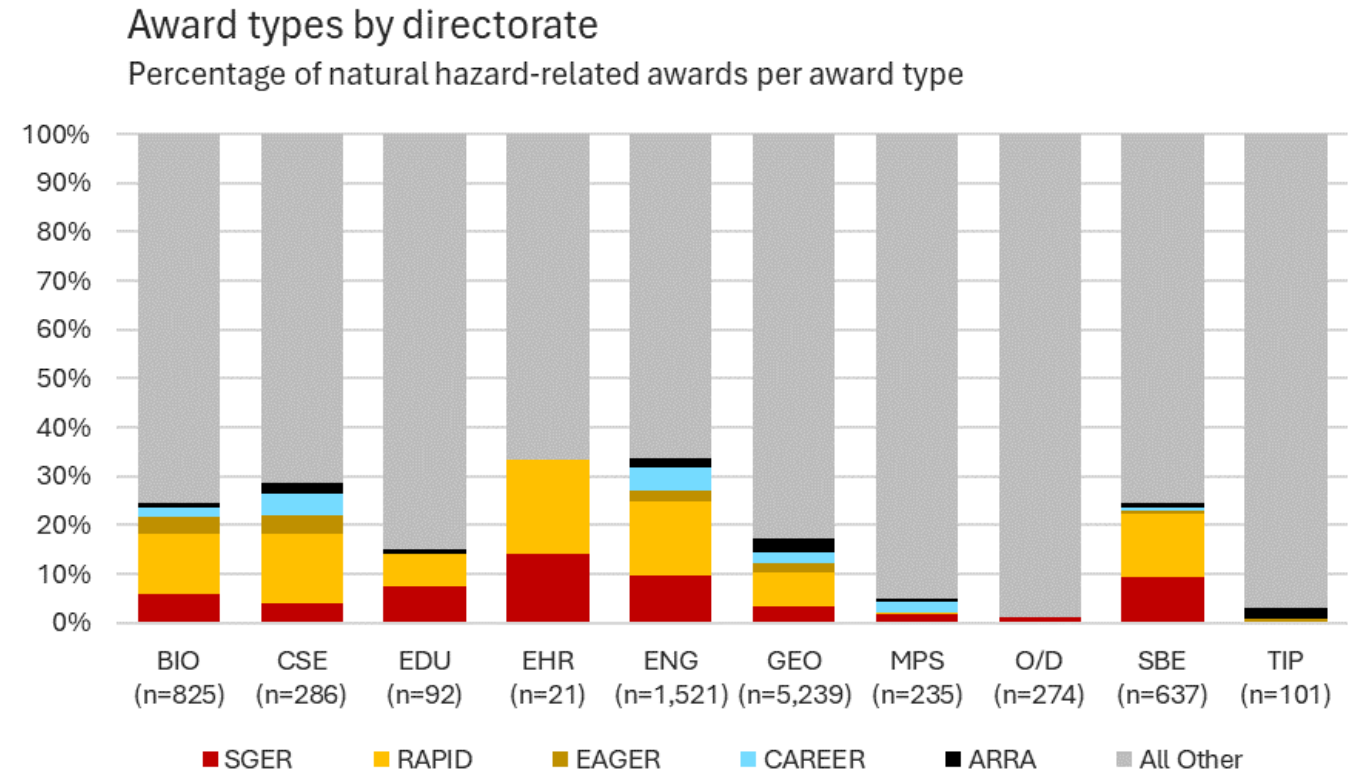
Top natural hazard types across funding mechanisms included:
Multi-hazard, earthquakes, hurricanes, and drought

Natural hazard-related awards by type of award
Percentage of natural hazard-related awards per award type



Funding mechanisms by directorate

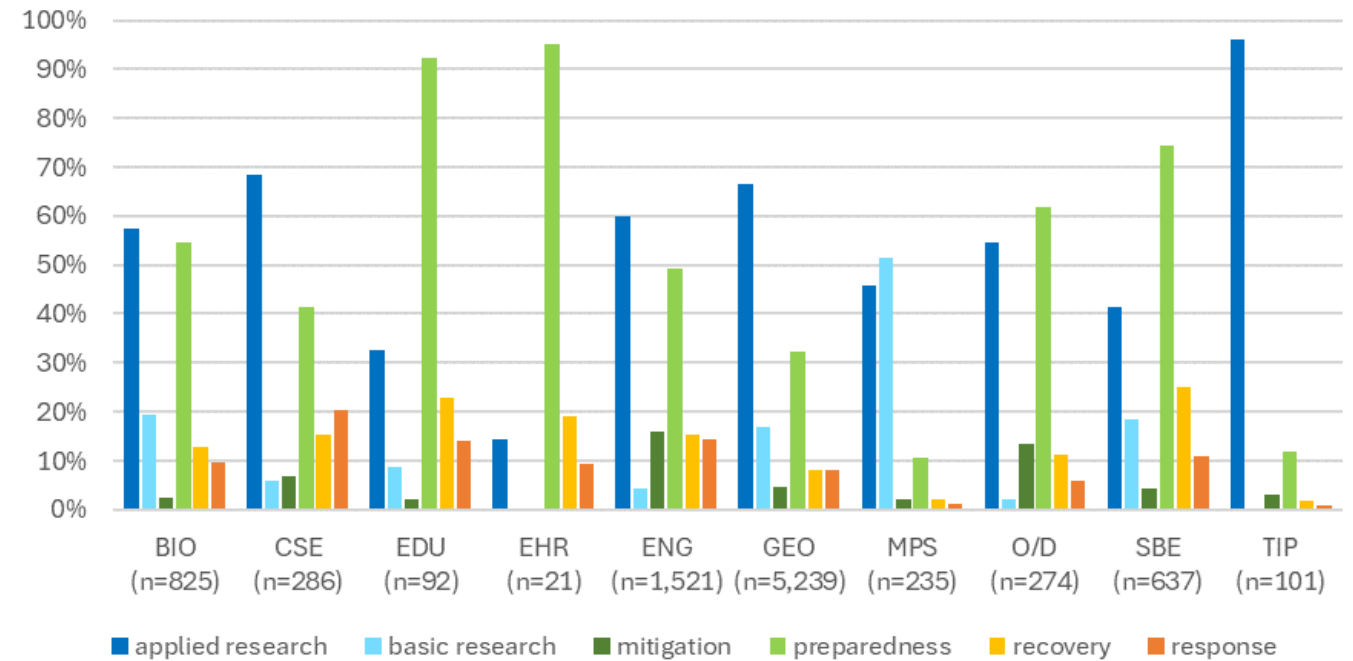
Of these mechanisms, RAPID and SGER awards were most common, comprising 1/3 or less of all natural hazard-related awards.



Types of research

Applied research and research related to natural hazard preparedness were the most common types of research conducted across directorates.

Types of research conducted
Percentage of natural hazard awards per directorate



Awards related to named events by natural hazard

Hurricanes, earthquakes, and volcanoes were the most common named events.

Top events named in awards:

2005 Hurricane Katrina: 175

2017 Hurricane Harvey: 133

2017 Hurricane Irma: 78

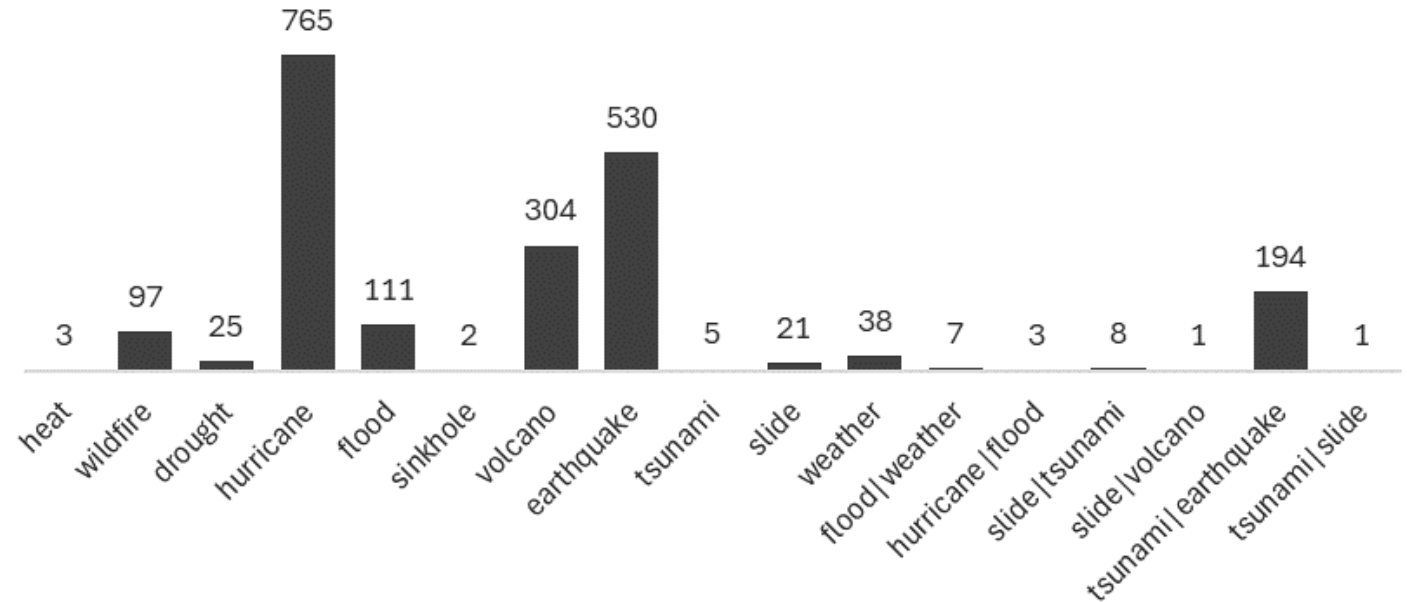
2003 Tohoku, Japan earthquake: 73

2017 Hurricane Maria: 71

2004 Indian Ocean earthquake: 64

2012 Hurricane Sandy: 58

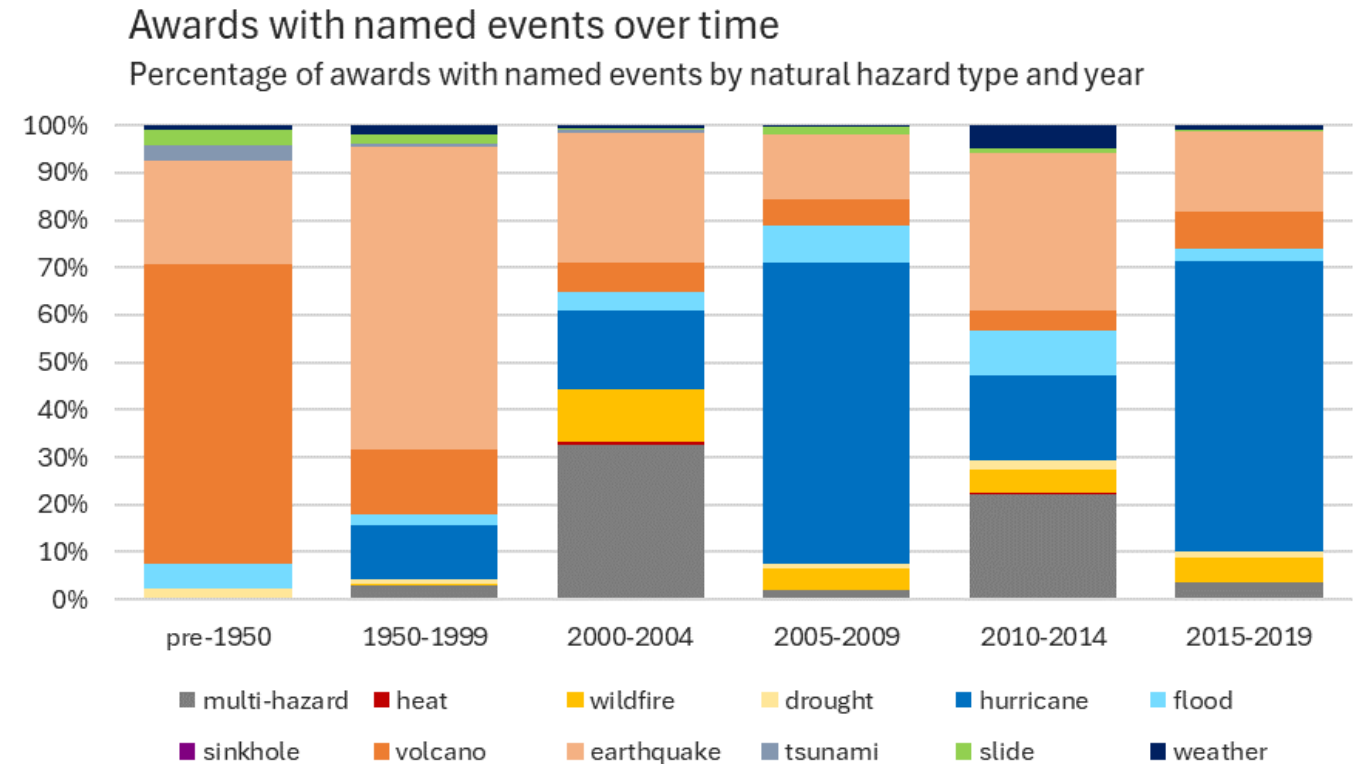
Natural hazard-related awards by type of named event
Number of awards by natural hazard type



Awards related to named events by natural hazard

Top events by year bracket

- **pre-1950:** 29 different volcanic events
- **1950-1999:** Turkey, Taiwan, and Northridge earthquakes
- **2000-2004:** Indian Ocean earthquake & tsunami, 2002 Denali earthquake
- **2005-2009:** Hurricanes Katrina and Rita
- **2010-2014:** Tohoku earthquake & tsunami; Hurricane Sandy, New Zealand earthquakes, Haiti earthquake, Chile earthquake & tsunami
- **2015-2019:** Hurricanes Harvey, Irma, Maria, Florence, Michael, and Matthew; Nepal earthquake

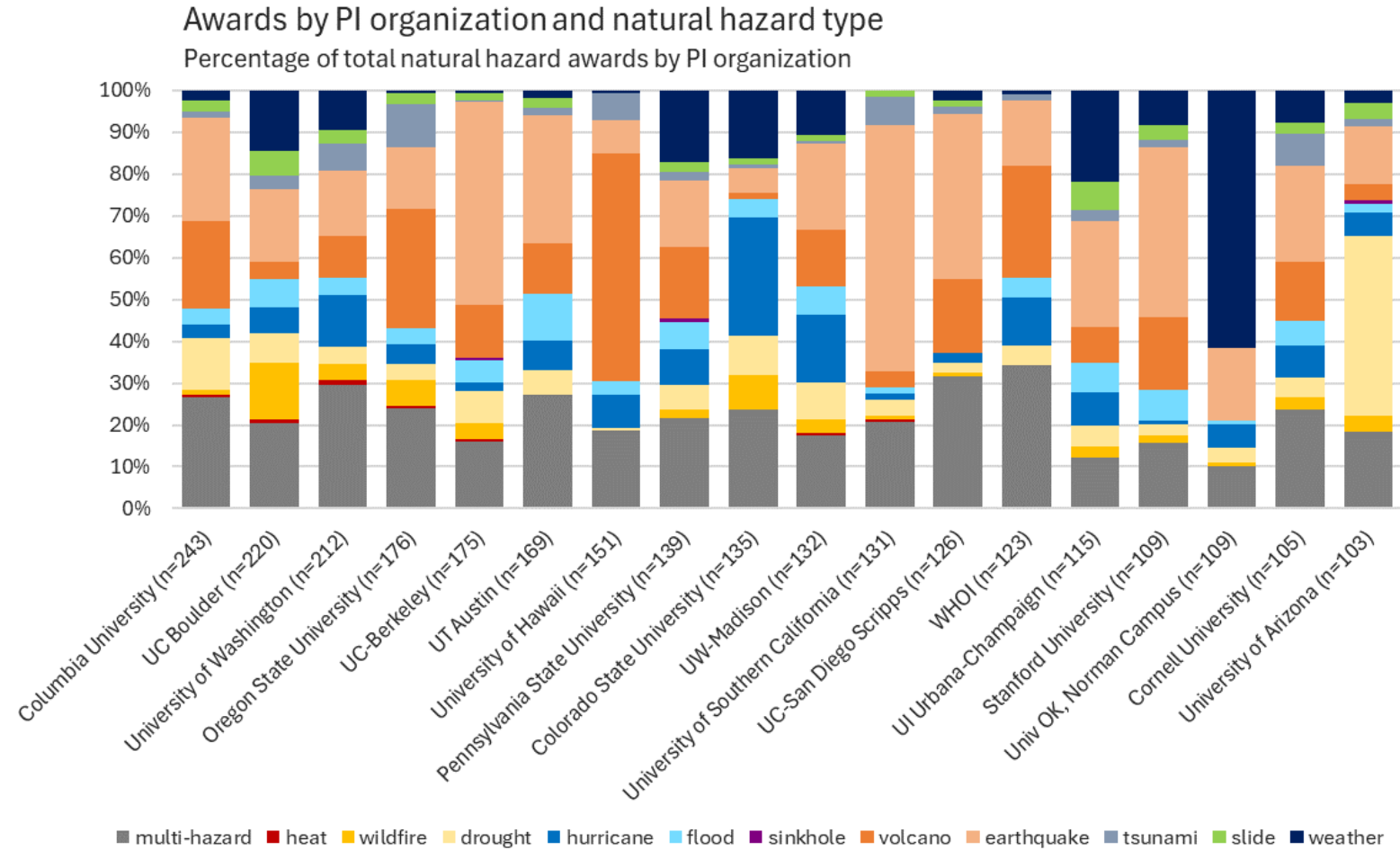


Top PI Organizations

PI organizations receiving 100 or more natural hazard-related awards.

These organizations received 29% of all natural hazard-related awards.

Funding for these organizations totaled \$1.09 billion.



NSF opportunities by natural hazard type

1% of opportunities related to natural hazards (42 of 3,023)

RAPID/EAGER/SGER

2005 Hurricane Katrina: 2

2010 Haiti earthquake: 1

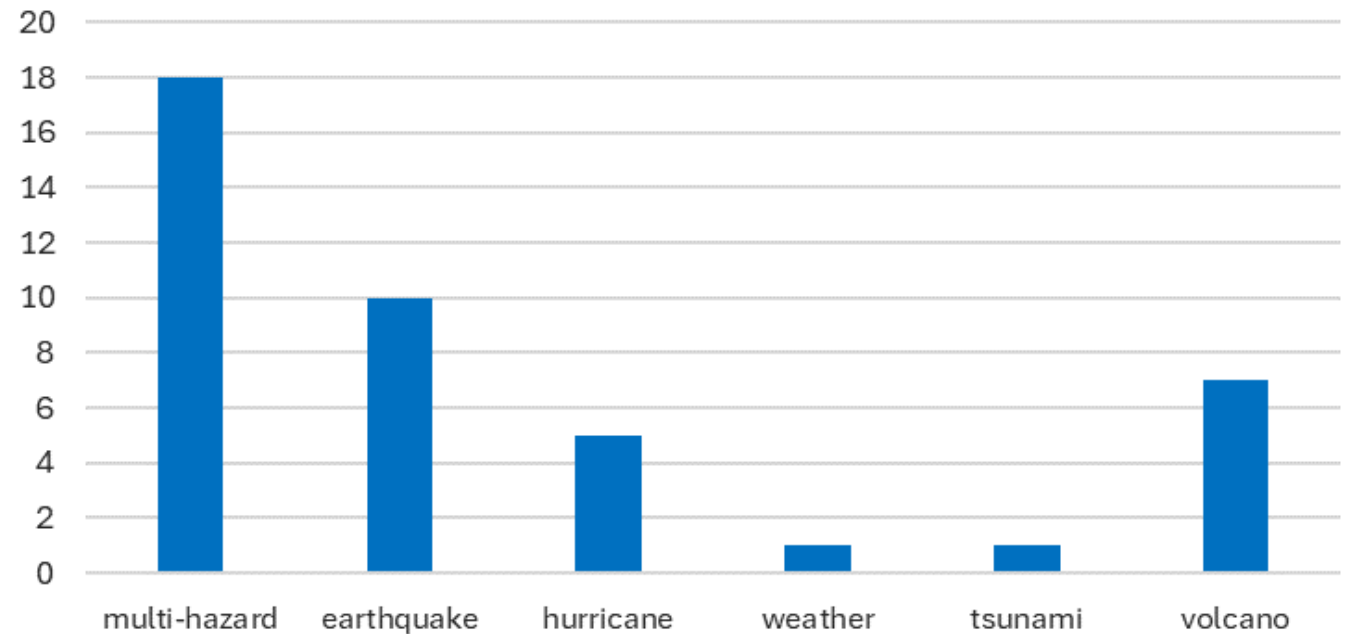
2011 Earthquakes in Japan & New Zealand: 3

2017 Hurricane Harvey: 1

2017 Hurricane Irma: 1

2018 Hurricane Season: 1

Opportunities by natural hazard type
Number of natural hazard-related opportunities



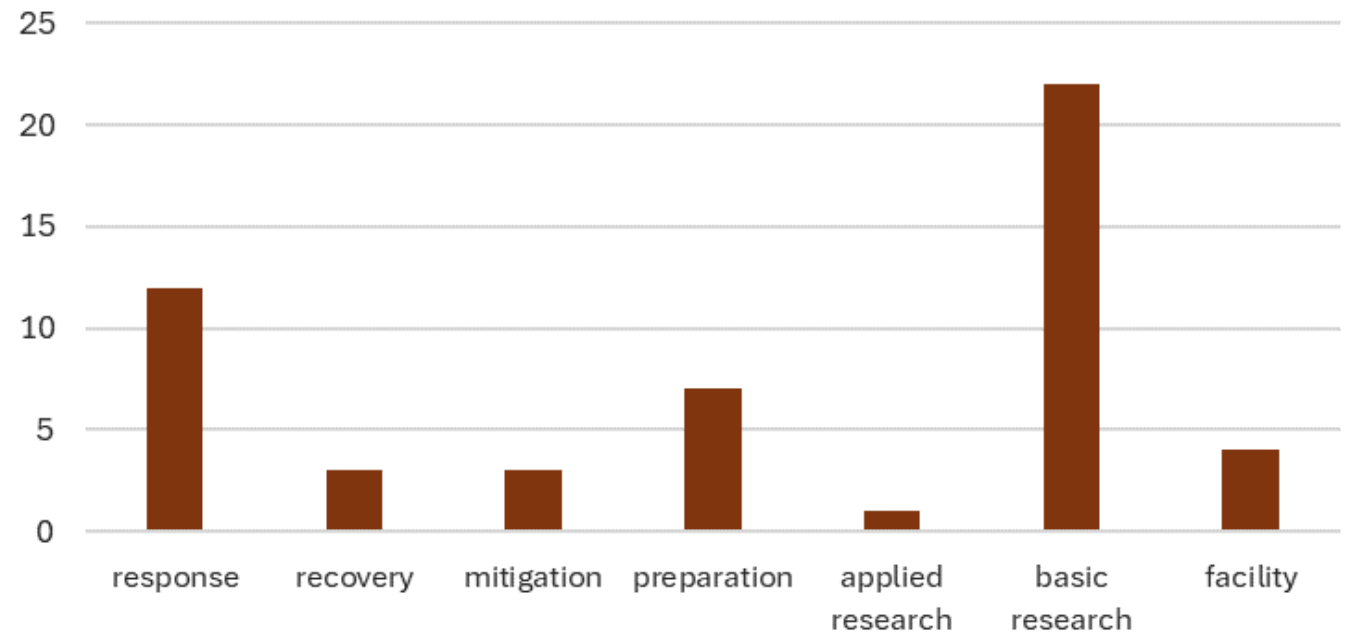
NSF opportunities by research type

Basic research opportunities were primarily for:

- EarthScope research
- NEESR research
- GEO programs:
Petrology & Geochemistry
Geophysics

Note – opportunities could be categorized into multiple research types.

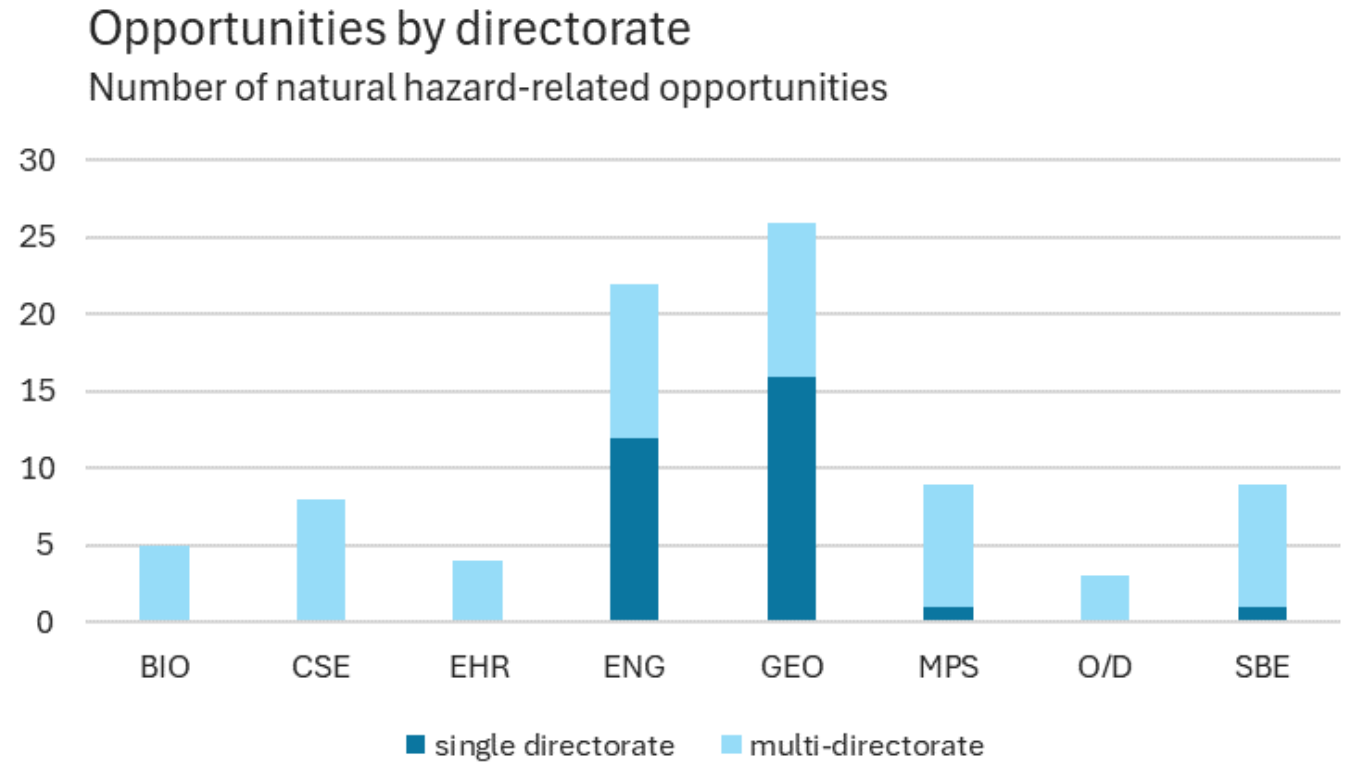
Opportunities by type of research
Number of natural hazard-related opportunities



NSF opportunities by directorate

Most opportunities were funded by GEO or ENG.

12 were funded by multiple directorates, with the majority related to RAPID/SGER/EAGER types of opportunities.



Next steps...

- Extend this analysis through 2024 to see if there are any changes in research funding and opportunities for natural hazard research.
 - Include additional funding mechanisms such as CRISES and CHIRP in the extended analysis.
- Extend analysis of literature and curriculum resources to 2024 to see if there is a change in the production of natural hazard related literature and curriculum resources.