

Communication

# Integrating Climate Change into Hazard Mitigation Planning: A Survey of State Hazard Mitigation Officers

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**Abstract:** The increased number of catastrophic disasters in the United States in recent decades has been accompanied by consequences of climate change, including rising sea levels, floods, storms, extreme temperatures, drought, and wildfires. Climate change and extreme events are interrelated, and climate change is likely to lead to more frequent and severe hazards. Hazard mitigation offers tools to address the hazards that are influenced by climate change and minimize community-level exposure or vulnerability. State Hazard Mitigation Officers in the 56 U.S. states, territories, and the District of Columbia involved in FEMA's Hazard Mitigation Grant Program were surveyed to assess the extent to which climate change has been integrated into State Hazard Mitigation Plans (SHMPs) and the barriers and facilitators to such climate change integration. The majority of responding states reported integration of climate change into SHMPs, and increased climate change projection evidence was commonly cited as a driver of such integration. However, lack of funding and competing hazard mitigation priorities were the most commonly reported barriers to integration. Political prioritization was reported as both a barrier to and facilitator of integration. There is an ongoing need to effectively translate climate change research to practitioners to support evidence-based hazard mitigation policy and practice.

**Keywords:** climate change; hazard mitigation; disasters; emergency management; planning; adaptation

## 1. Introduction

In 2017, there were 16 disaster events in the United States that each cost over one billion USD, nearly three times the average amount of annual storms since 1980. The cumulative cost of disaster events exceeded 300 billion USD, breaking historic disaster response cost records [1]. This increase in billion-dollar disasters corresponds with an increased occurrence of climate-related hazards overall, including rising sea levels, floods, storms, extreme temperatures, droughts, and wildfires [2]. These natural hazards can exacerbate or trigger technological hazards, such as critical infrastructure damage or water contamination. Despite broader patterns of changing hazard frequency and intensity that are likely to result from climate change [3], a recent survey indicates that a majority of Americans believe that the U.S. government is not doing enough to reduce the effects of climate change [4].

Climate change is a complex and multidimensional phenomenon [3]. Whether climate change is understood to be a factor that influences the severity or frequency of hazards, or is considered a hazard itself, hazard mitigation provides planners with tools to minimize community-level exposure or vulnerability.

The U.S. Federal Emergency Management Agency (FEMA) has defined hazard mitigation as “the effort to reduce loss of life and property by lessening the impact of disasters” [5]. The risk of such

hazards becoming disasters is dependent on the complex interaction between the hazard and factors that influence a community's exposure and vulnerability [6].

State commitment and capacity, planning, and implementation activities have long been recognized as key elements of an effective intergovernmental mitigation system [7]. The U.S.'s Disaster Mitigation Act of 2000 (DMA) updated guidelines for state hazard mitigation planning and implementation. In addition, the DMA established that federal disaster assistance was contingent on federal approval of a State Hazard Mitigation Plan (SHMP) [8]. However, a state's hazard mitigation planning and capacity building capabilities, indicated through its staffing, funding, and policies and programs, have been shown to vary widely across states for a variety of reasons, including staffing and funding fluctuations, experiences with past disasters, and the state's commitment to hazard mitigation [9].

The literature has effectively described conceptual alignments between climate change adaptation and disaster risk reduction [10,11]. Nonetheless, the global advance of climate change challenges traditional risk assessment approaches that rely on historical hazard patterns among states with different baseline capabilities. FEMA finalized its Climate Change Adaptation Policy in 2012 that requires its programs and policies to incorporate climate change adaptation considerations [12]. In 2015, FEMA updated its State Mitigation Plan Review Guide (hereafter, FEMA's 2015 Plan Review Guide update) to require states to include considerations related to changing environment or climate conditions in their risk assessments, which went into effect in 2016 [13]. However, the requirement is broad and does not provide specific guidance to hazard mitigation officers on how to effectively leverage climate-related data when developing adaptation activities, especially if their SHMP does not extensively discuss climate change in the first place.

There is currently little evidence specific to addressing climate change through tangible hazard mitigation planning practices. A recent content analysis of 30 local hazard mitigation plans found that although a majority of communities addressed how climate change may alter their community's hazard profile and incorporated hazard mitigation strategies accounting for climate change, there was little consistency in how communities were integrating climate change into hazard planning [14]. A variety of climate change adaptation activities were broadly underutilized, and few plans included formal commitments to climate adaptation or included clear mechanisms for incorporating emerging climate information into plan revisions [14].

At the state level, a separate content analysis categorized plans based on the extent of climate change integration, ranging from no or inaccurate discussions of climate change to thorough discussions and the inclusion of climate adaptation actions [15]. There was significant variability in the level of climate integration, with coastal communities boasting more integration than inland communities [15]. Yet, most plans analyzed were published nearly five years before FEMA's 2015 Plan Review Guide update and do not reflect consequential plan changes [15]. They also predate global policy frameworks and agreements on climate change that have since been adopted, such as the United Nations Framework Convention on Climate Change's Paris Agreement [16].

While these studies provide an overview of the explicit integration of climate change into hazard mitigation plans, they do not describe determinants (e.g., barriers and facilitators) of the types (e.g., simple mentions or adaptation strategies) of integration into SHMPs and planning processes. In response, this exploratory work sought to determine if and how evolving climate change risk is considered in state hazard mitigation planning through a survey of State Hazard Mitigation Officers (SHMO). Herein, we present findings on if and how climate change has been integrated into SHMPs, state hazard mitigation program approaches to addressing climate change risk, as well as barriers and facilitators to addressing climate change through SHMPs and planning processes.

## 2. Methods

Fifty-six SHMOs—one designated for each U.S. state, the District of Columbia, and five major territories (American Samoa, Guam, Northern Mariana Islands, Puerto Rico, and U.S.

Virgin Islands)—were invited by email to participate in a brief, 25 question online survey administered through SurveyMonkey (SurveyMonkey Inc., San Mateo, CA, USA: [www.surveymonkey.com](http://www.surveymonkey.com)).

The survey featured questions about division-level perceptions of climate change, the extent to which climate change was incorporated into their jurisdiction's SHMP, if and how climate change considerations were affected during plan updates, and the barriers and facilitators the division faced to integrate climate change into their SHMPs and planning processes. The survey design was informed by similar surveys conducted in the fields of public health and land use planning to gauge how climate change is perceived and integrated into each practice [17–20]. Prior to distribution, the survey was reviewed by a local hazard mitigation officer in Washington State to assess and improve question relevance and clarity. The survey was open for responses from March to May of 2018. Follow-up reminders were made by email or phone.

SHMOs (as of March 2018) and their contact information were identified from a publicly available list maintained and posted online by FEMA. We also reviewed this list for updates throughout the survey response period and contacted new SHMOs as we became aware of any changes. We requested that the SHMOs coordinate with their colleagues so that each state submitted only one response. Some respondents forwarded our request to a new SHMO or other person in their division responsible for hazard mitigation planning.

The research team designated each responding jurisdiction as coastal or non-coastal. Coastal jurisdictions were defined as those having at least one contiguous boundary with the Atlantic Ocean, Pacific Ocean, or Gulf of Mexico. Summary statistics were calculated using Microsoft Excel and Stata 15 (StataCorp. 2017. Stata Statistical Software: Release 15. College Station, TX: StataCorp LLC). This study was determined to be human subjects research that qualifies for exempt status by the University of Washington Human Subjects Division.

### 3. Results

Thirty-five (62.5%) SHMOs responded to the survey. There was at least one respondent from each FEMA region, and regional response rates ranged from 25% to 100%. A little less than half (45.7%) of respondents were from coastal states. Most (68.6%) of those completing the survey were SHMOs themselves. Respondents had varied years of experience in their current role: <1 year (17.1%); 1–3 years (28.6%); 3–6 years (25.7%); 6–9 years (11.4%); and >9 years (17.1%).

#### 3.1. Program-Level Perceptions of Climate Change

Most state hazard mitigation programs consider climate change to be a threat now (64.7%) and/or in the future (81.8%), as well as identified their jurisdiction to be at risk for climate change as a standalone hazard (83.9%). No coastal jurisdictions reported that climate change is not a threat now, nor that their jurisdiction is not at risk for climate change as a standalone hazard (Table 1). The majority of divisions indicated that climate change influenced the severity or frequency of natural hazards (82.9%). In contrast, exactly half of respondents reported that they were unsure whether climate change influenced the severity or frequency of technological hazards. Among a list of natural and technological hazards whose severity or frequency may be influenced by climate change, 100% of question respondents indicated that they were at risk of flooding and at least 80% of question respondents indicated that their jurisdiction was at risk for each of the following hazards: power outages, extreme weather, critical infrastructure damage, water contamination, wildfires, drought, extreme heat, climate change, extreme cold, and infectious disease outbreaks.

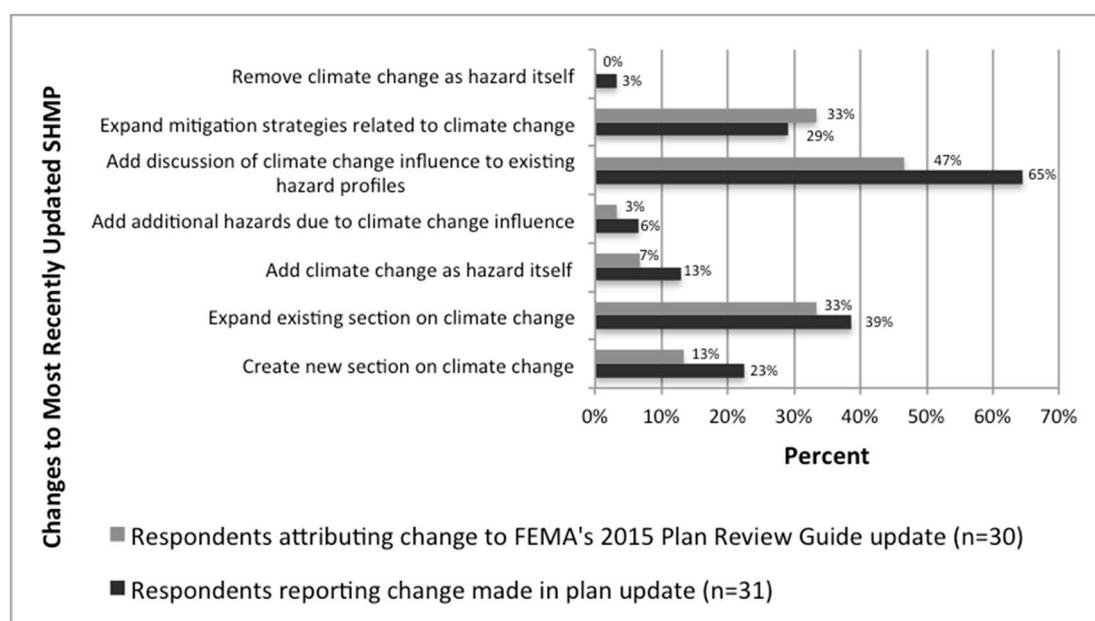
**Table 1.** Program perceptions of threat of climate change and influence on hazard risk.

Question	Overall % (n)	Coastal States % (n)	Non-Coastal States % (n)
<b>The division perceived climate change to be a threat ...</b>			
Now			
Yes	64.7 (11)	50.0 (3)	72.7 (8)
No	17.7 (3)	0 (0)	27.3 (3)
Unsure	17.7 (3)	50.0 (3)	0 (0)
In the future			
Yes	81.8 (18)	75.0 (9)	90.0 (9)
No	4.6 (1)	8.3 (1)	0 (0)
Unsure	13.6 (3)	16.7 (2)	10.0 (1)
<b>The division perceived climate change to be a factor the influences the severity or frequency of ...</b>			
Natural hazards			
Yes	82.9 (29)	75.0 (12)	89.5 (17)
Yes, but not within its state	2.9 (1)	0 (0)	5.3 (1)
No	5.7 (2)	6.3 (1)	5.3 (1)
Unsure	8.6 (3)	18.8 (3)	0 (0)
Technological hazards			
Yes	35.3 (12)	13.3 (2)	52.6 (10)
Yes, but not within its state	0 (0)	0 (0)	0 (0)
No	14.7 (5)	26.7 (4)	5.3 (1)
Unsure	50.0 (17)	60.0 (9)	42.1 (8)
<b>The division perceived its jurisdiction to be at risk for the hazard of climate change</b>			
At risk	83.9 (26)	100 (13)	72.2 (13)
Not at risk	6.5 (2)	0 (0)	11.1 (2)
Unsure	9.7 (3)	0 (0)	16.7 (3)
<b>In SHMP, climate change is discussed as a ...</b>			
Hazard itself only	2.9 (1)	0 (0)	5.3 (1)
Risk factor for other hazards only	71.4 (25)	56.3 (9)	84.2 (16)
Both risk factor for other hazards and hazard itself	11.4 (4)	25.0 (4)	0 (0)
Neither	14.3 (5)	18.8 (3)	10.5 (2)
<b>The SHMP includes mitigation strategies that address human drivers of climate change</b>			
Yes	22.9 (8)	31.3 (5)	15.8 (3)
No	65.7 (23)	62.5 (10)	68.4 (13)
Unsure	11.4 (4)	6.3 (1)	15.8 (3)

State-level hazard mitigation program perceptions of climate change risk, state hazard mitigation program perceptions of the influence of climate change on hazard risk, and how climate change is discussed in each respondent's SHMP.

### 3.2. Climate Change Integration into State Hazard Mitigation Plans

Climate change was incorporated into the majority of state hazard mitigation plans (85.7%). It was typically discussed as a risk factor for other hazards (71.4%) (Table 1). During SHMP updates, 100% of divisions reported integration of meteorological natural hazards that require mitigation because of climate change influence, while only 77.8% reported integrating either non-meteorological natural hazards or technological hazards, respectively (data not shown). Among divisions that were updating their SHMPs, the majority of respondents (65.6%) indicated that they were adding a discussion of the impacts of climate change to existing hazard profiles and approximately one third of respondents indicated that they were expanding existing sections that discuss the role of climate change in hazard mitigation (37.5%) or expanding their mitigation strategies related to the impact of climate change (28.1%) (Figure 1). Respondents reported that FEMA's 2015 Plan Review Guide update was a driving factor for integration with over half of the divisions attributing increased climate change integration in their next SHMP update to the policy (64.7%). Figure 1 shows how FEMA's 2015 Plan Review Guide update motivated climate change integration. Yet, almost two thirds (65.7%) of divisions shared that their SHMPs do not include mitigation strategies that address the human drivers of climate change (Table 1).



**Figure 1.** Changes to climate change integration into SHMP during most recent update, overall and in order to comply with the Federal Emergency Management Agency's (FEMA's) 2015 Plan Review Guide update.

Figure 1 presents the proportion of respondents that indicated that their division made climate-change related changes to their SHMP during its most recent update. The black bar indicates respondents that reported a change was made during the most recent SHMP update, regardless of cause. The grey bar indicates respondents that reported a change was made during the most recent SHMP update and attributed the change to compliance with FEMA's 2015 Plan Review Guide update.

### 3.3. Facilitators and Barriers to Climate Change Integration

Table 2 outlines the different factors that facilitate or impede the integration of climate change into SHMPs that responding divisions reported facing and their status with different resources to support climate change mitigation activities. The most commonly reported facilitator was increased evidence for climate change projections (70.6%). Many respondents also indicated that recent disasters in their or a neighboring jurisdiction (47.1%) facilitated climate change integration.

**Table 2.** Reported facilitators and barriers to integrating climate change in SHMPs, as well as available resources to support climate change integration.

Question	Percent
<b>Facilitators to climate change integration that divisions face (n = 34)</b>	
Community participation	14.7
Increased evidence for climate change projections	70.6
Political prioritization, state-level	35.3
Political prioritization, national	26.5
Political prioritization, international	2.9
Recent disaster events in their jurisdiction or neighboring jurisdiction	47.1
Other factors	26.5
Division has not integrated climate change into SHMP	8.8
<b>Barriers to climate change integration that divisions face (n = 30)</b>	
Lack of evidence to support impacts of climate change in their jurisdiction	20.0
Lack of funding to support climate change adaptation and mitigation activities	36.7
Low political prioritization, state-level	33.3
Low political prioritization, national	3.3
Low prioritization of climate change compared to other hazard mitigation concerns	43.3

Table 2. Cont.

Question	Percent
Other state agencies or commissions address climate change adaptation (avoid duplicating efforts)	16.7
Reliance on historical patterns of hazard exposure instead of future projections	30.0
Other factors	20.0
Division has not integrated climate change into SHMP	10.0
<b>Sufficiency of State Hazard Mitigation Program resources to plan for and implement climate-related mitigation activities</b>	
<i>Data/evidence (n = 33)</i>	
Sufficient or abundant resources	48.5
Insufficient or no resources	36.4
Unsure	15.2
<i>Funding (n = 32)</i>	
Sufficient or abundant resources	31.3
Insufficient or no resources	53.1
Unsure	15.6
<i>Staffing: capacity (n = 33)</i>	
Sufficient or abundant resources	33.3
Insufficient or no resources	54.6
Unsure	12.1
<i>Staffing: expertise (n = 33)</i>	
Sufficient or abundant resources	39.4
Insufficient or no resources	42.4
Unsure	18.2

Political prioritization of climate change was considered both a facilitator and a barrier to integration among respondents. State-level prioritization was commonly cited as both a facilitator (35.3%) and a barrier (33.3%), whereas national prioritization was much more commonly regarded as a facilitator (26.5%) than a barrier (3.3%) (Table 2).

Low prioritization of climate change relative to other hazard mitigation concerns (43.3%) was reported as the most common barrier to its integration. A lack of funding (36.7%) and a reliance on historical hazard exposure data instead of future projections (30.0%) were other common barriers. Less than half of all respondents indicated that their divisions had sufficient resources in the form of data and evidence, funding, staff capacity, or staff expertise to carry out climate change-related mitigation activities (Table 2).

#### 4. Discussion

The majority of state hazard mitigation programs recognize the role of climate change in their state's hazard risk and are incorporating climate considerations into their risk assessments and hazard mitigation planning. Most divisions considered climate change to be a factor, actual or potential, that affects hazards in their jurisdiction, considered climate change to be a threat, either now or in the future, believed that climate change influences natural hazards and at least considered whether it influences technological hazards, and discussed climate change in their SHMP as a factor in hazard exposure. Among the states that were updating their SHMPs, many added or expanded sections about climate change as it related to hazard mitigation.

Most respondents reported insufficient resources to effectively integrate climate change into their SHMP and reported a lack of resources and competing hazard mitigation priorities as barriers to integration of climate change into SHMPs. In fact, only 33.3% and 39.4% of respondents indicated that they had sufficient or abundant staffing capacity and expertise respectively to plan for and implement climate-related mitigation activities. Access to tools developed by researchers and practitioners in other jurisdictions may empower more hazard mitigation divisions to assess and address risk with limited resources.

The most commonly reported facilitator of climate change integration was increased evidence for climate change projections. However, only 48.5% of respondents indicated that they had access to sufficient or abundant data or evidence to plan for and implement climate-related mitigation

activities. Increased funding for state-level climate change research could facilitate the development of additional jurisdiction-specific evidence to inform hazard mitigation policy and practice at the state and local levels.

Climate change research cannot inform hazard mitigation activities if practitioners cannot access it. Hazard mitigation divisions may consider developing or strengthening relationships with research organizations to facilitate information sharing and expand access to climate change data and information. Research organizations may consider developing platforms or mechanisms to promote such collaboration. For example, the National Oceanic and Atmospheric Administration's Regional Integrated Sciences and Assessments (RISA) Program serves as an intermediary between scientists and decision makers by providing climate change knowledge that can inform adaptation policies and programs managed by the public, private, and non-profit sectors [21]. In addition, California Polytechnic State University has held Climate Action Planning Conferences with state and local government officials to enhance their climate adaptation knowledge and has assisted policymakers developing local and regional climate action plans [22].

Given the immediacy of the threat of climate impacts, states should direct resources to facilitate mitigating climate-associated hazards. Researchers could work with SHMOs to translate climate projections to legislators and emergency management leadership in order to make the case for the prioritization of climate change within hazard mitigation planning. However, as more states and jurisdictions rely on climate change evidence to inform their hazard projections, mitigation strategies, and decisions, there will be an increasing requirement for tools and techniques to deal with the inherent uncertainty in climate change projections. As tools and techniques to inform decision making in the face of uncertainty continue to be developed [23], dissemination to and training of hazard mitigation practitioners should be prioritized.

Respondents reported political prioritization of climate change as both a facilitator and a barrier to climate change integration into SHMPs. However, only one respondent reported low national-level prioritization of climate change as a barrier to climate change integration. In fact, our findings suggest that FEMA's 2015 Plan Review Guide update was a highly motivating factor for recent climate change integration. Yet, federal agency policy continues to evolve. For example, FEMA's 2018–2022 Strategic Plan omits discussion of climate change entirely [24]. Evolving national policy necessitates continuous monitoring of federal policy influence on state-level climate change and hazard mitigation integration efforts. Moreover, it underscores the need to continue efforts to advance other identified facilitators of climate change integration into SHMPs, such as increasing the evidence base, and to minimize known barriers.

### *Limitations*

While this study provides useful descriptive information on how state hazard mitigation programs and plans are approaching climate change, its reliance on respondent recall may introduce bias. Moreover, as the topic of climate change remains a politically charged issue in the United States, respondents may have been motivated to answer the questions in a socially or politically desirable way. While the majority of SHMOs responded to our survey, those that did not might be systematically different than those that did. SHMPs are only one mechanism for addressing climate impacts, and SHMOs may also be unaware of other climate-related planning or mitigation activities going on in their state. As such, the study results may underestimate statewide resource availability or ongoing activities related to climate change integration into hazard mitigation.

As our exploratory survey only provides a high-level overview of the frequency of perceived barriers and facilitators, key informant interviews with SHMOs could reveal additional information about how they impact climate integration, as well as ways to address them. Future investigations should explore the impact of determinants (e.g., prior experience with hazards, political influences, etc.) on climate change perceptions and actions among hazard mitigation divisions.

Additional research should also systematically review local, state, federal, and international mitigation plans to identify mechanisms of climate change integration and evaluate the effectiveness of these mechanisms at mitigating climate-related hazards. Previously developed plan quality assessment techniques should be adapted to evaluate the level of climate change integration in state hazard mitigation plans [25].

## 5. Conclusions

Climate change influences hazard frequency and intensity, and hazard mitigation provides a key opportunity to reduce community exposure or vulnerability to the impacts of climate change. Most U.S. state-level hazard mitigation divisions consider climate change to be a factor, actual or potential, that affects hazards in their jurisdictions. Since FEMA required SHMPs to consider climate and environmental change in their risk assessment processes starting in 2016, most divisions reported adding or expanding upon climate change integration in their most recent or in-process SHMP updates. Increased evidence for climate change projections was the most common facilitator of climate change integration into SHMPs and a lack of resources and competing hazard mitigation priorities were the most commonly reported barriers. Future research should further explore the impacts and determinants of climate change integration, as well as identify and evaluate planning practices and quality of climate change integration in local, state, federal, and international hazard mitigation plans and strategies.

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