Advancing Health & Disaster Resiliency in Minnesota

CO-PRODUCING CLIMATE & HEALTH INFORMATION FOR THE EMERGENCY MANAGEMENT SECTOR

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Advancing Health & Disaster Resiliency in Minnesota: Co-producing Climate & HealthInformation for the Emergency Management Sector

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Executive Summary

Protecting communities from climate-related disasters through effective emergency management (EM) and disaster resiliency planning requires a consideration of climate information, particularly climate projection data(CPD). Currently, EM data users in Minnesota face multiple barriers to accessing and applying CPD. Co-production of knowledge between scientists and end-users is a promising approach for bridging these barriers. This paper describes a novel effort to develop, promote, and evaluate the application of CPD for EM planning through the co-production of knowledge with local emergency managers. Drawing on a literature review, interviews, workgroup proceedings, and surveys, this paper describes the development and content of information products aimed at increasing climate literacy among EM and their partners. Surveys of EM professionals on attitudes, intentions, and perceived barriers regarding CPD indicate a strong commitment to use CPD in support of EM planning and preparedness efforts, but also highlight challenges related to availability of time and resources and perceived lack of support by key partners. As a case study of climate data co-production, this effort enables discussion of a number of relevant and essential themes related to advancing disaster resiliency, including the role of state agencies as boundary organizations, the power of framing climatedata with local impacts, and the need for better downscaled CPD accessible to the public. A 2021 review of all hazard mitigation plans in Minnesota indicates the usefulness of CPD resources. Lessons learned advance a path forward for others interested in adopting and adapting this project for their state and local jurisdiction

Introduction

Climate change is fueling a devastating rise in extreme weather disasters along with a broad range of impacts onthe health and well-being of individuals and communities. Emergency management (EM) professionals strive to protect our communities from the worst of these impacts, and climate change is making this work more critical and more challenging than ever before. EM and their partners need additional resources to meet the increasing demands climate change poses for this essential sector.

Effective planning to protect communities from climate-related disasters requires a consideration of climate information, particularly climate projection data (CPD). CPD are estimates of future climate phenomena (e.g.,temperature and precipitation) derived from complex global circulation models (GCM) for time scales many decades into the future (IPCC 2014). These data, while imbued with various levels of uncertainty, offer data users a glimpse into potential climate futures at multiple high resolution spatial and temporal scales.

Historically, data users relied on observed climate and weather data to use in their planning and design work.However, given widespread consensus that past climate patterns have changed and will change further (IPCC2014), continued reliance on historical data to model future weather and climate risk drivers could introducesubstantial inaccuracies into essential planning efforts across sectors and disciplines (Shortridgeand Camp 2018).

This is a particular concern regarding EM and disaster planning (Bosomworth et al. 2017; Labadie 2011). In 2020, the United States experienced 22 natural disasters with losses exceeding a billion dollars each. Together these events cost the nation well over 96 billion dollarsin infrastructure damage and crop loss for just a single year (NOAA, 2021). For Minnesota specifically, the state has experienced 19 billion-dollar disasters in the last 15 years (2005-2020), including drought, flooding, severe storms, and wildfire, costing the state approximately 10-20 billion dollars (NOAA, 2021). These coarse estimates fail to capture additional costs associated with lost lives, injuries, unemployment or wage loss, disruption to essential services (e.g., health care and schooling), and lingering emotional trauma that can further derail a community and stall recovery (Bell et al. 2018; Schmitt et al. 2016). Attribution research is revealing that many of these disaster typesare influenced by climate changes (Ornes 2018). EM at all levels of government can help mitigate the physical, social, and economic impacts of these disasters.

In 2015, the U.S. chapter of the International Association of Emergency Managers (IAEM-US) released a positionstatement titled “The Critical Role of Emergency Management in Climate Change Planning.” In this document, the IAEM-US recognizes that “Emergency managers should use climate research data to target emergency mitigation, preparedness, and response actions for their communities” (IAEM, 2015). This formal recommendation from the nation's largest association of EM professionals, a majority representing city and county jurisdictions, reflects a growing movement to open and broaden access to climate projection data, particularly at the local level. This movement, essential to advancing effective climate and disaster resiliency strategies, is fueled by an ever-increasing number of efforts aimed at the co-production of climate knowledge.

Co-production of knowledge is the process of producing actionable science through an in-depth collaboration between scientists and those who use the science to make policy and management decisions (Meadow et al. 2015). Meadow et al. (2015) identified several benefits to this approach that are especially relevant to advancingclimate and disaster resiliency:

- Co-produced knowledge is more transparent and meaningful to end-users because they participate in its production.
- The information is more likely to be at spatial and temporal scales useful to end-users.
- Resulting knowledge is easier to integrate with existing information because it fits into the decision framework of the agency or organization.
- End-users gain a greater sense of ownership over the final product because they contributed to it.

Given that climate science can be very complex, and many end-users are new to working with climate data, particularly CPD, necessitates the co-production model for achieving actionable information. A growing body of research has detailed the co-production of knowledge within the climate science domain, including examples focused on key end-users, such as land managers (Zanocco et al. 2018), farmers (Prokopy et al. 2017), municipalplanners (Ziervogel et al. 2016), and public health practitioners (Hoppe et al. 2018).

EM professionals represent a key group of climate information users who have co- produced knowledge with forecasters and research scientists that has, for example, guided the dissemination of real-time warning information (Baumgart et al. 2008)and informed the design of weather radar networks (Bass et al. 2009; League et al. 2010). Despite this pivotal role in shapingelements of the modern weather enterprise, there are few documented efforts describing the co-production of future-oriented climate information, particularly CPD, with and for EM professionals. Such a need has been identified widely by experts in EM, disaster risk reduction, and other related areas of study and practice (Gall et al. 2015; Ismail-Zadeh et al. 2017). Addressing this need will help this important user group, which is often under-resourced and over-burdened (Bosomworth et al. 2017; Labadie 2011), fulfill its duty to protect communities against disasters.

This white paper describes a novel effort in Minnesota to develop, promote, and evaluate the application of climate information, particularly CPD, for EM planning through the co-production of knowledge with state andlocal emergency managers. Acting as a boundary organization, the Minnesota Climate and Health Program (MNCHP), within the Minnesota Department of Health, led this effort by leveraging nearly a decade's worth of experience working with CPD in the domain of public health and resiliency planning. This experience was gained in part through participation in a capacity-building framework, called Building Resilience Against Climate Effects (BRACE), developed by the Centers for Disease Control and Prevention (Conlon et al. 2016). BRACE is an iterative, multi-faceted process for developing and implementing climate change resiliency strategies with an emphasis on threats to community health and well-being (Marinucci et al. 2014).

A large body of empirical research has emerged over the last two decades on boundary organizations for facilitating collaborative production, dissemination, and application of climate information for a broad range of disciplines (Briley et al. 2015; Flagg et al. 2018; Kirchhoff et al. 2015). Boundary organizations are essential for increasing the rate by which climate information, particularly CPD, are made accessible and applicable to key end-users (Kirchhoff et al. 2015). As a case study of climate data co-production, the project enables a discussion of a number of relevant and essential themes related to advancing disaster resiliency and protecting communities, including the role of state agencies as boundary organizations, the power of framing climate data with local impacts, and the need for better downscaled CPD accessible to the public.

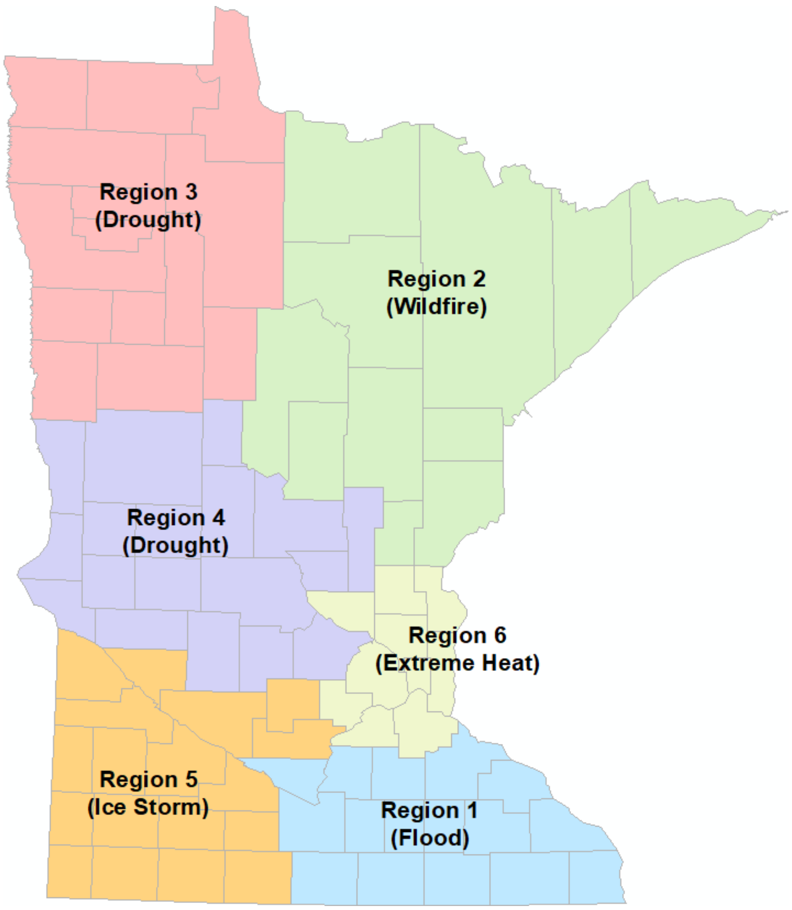
Drawing on a literature review, surveys, interviews, and workgroup meetings with EM professionals, this paper describes the development and content of information products aimed at increasing climate literacy among EM and their partners. Lessons learned from efforts to communicate CPD to this essential group of climate resiliency actors and next steps to encourage others to adopt and adapt this project for their state and local jurisdictions are highlighted.

Methods & Data

Co-production of MN HSEM Climate Data Profiles

In 2016, an advisory team of state and local EM professionals in partnership with MNCHP discussed an assessment of literature that identified hazard mitigation strategies that could be used by EM to address climatechange impacts (MDH 2015). Results from the literature review demonstrated, in part, that many hazard mitigation strategies used to prevent property damage and loss of life are similar to strategies identified throughout the climate resiliency literature. The primary difference is that hazard mitigation planning focuses onhistorical conditions, response, and short-term planning, while climate resiliency efforts are focused on future conditions, prevention, and long-term planning. The challenges stemming from this discrepancy in focus and approach between traditional EM planning versus climate resiliency planning have been previously identified in the literature (Bosomworth et al. 2017; Labadie 2011; Schneider 2011).

MN EM advisors expressed that a lack of understanding of climate data, particularly CPD, was a major obstacle to advancing local level disaster planning. To overcome this obstacle, the MNCHP partnered with the EM advisory team and other key EM and public health preparedness professionals to develop climate data profiles,featuring CPD, for Minnesota’s six Homeland Security and Emergency Management (HSEM) regions (Figure 1) through a series of in-person meetings and one-on-one interviews.



Early input from EM partners recommended that climate information for an EM audience should be easy to access, read, and understand in a short amount of time and should fit in well with EM planning efforts and supporting documents.

Collaboration objectives and activities between MNCHP and EM partners were structured to reflect the elements of knowledge co-production relevant to disaster risk research articulated by Ismail-Zadeh and colleagues (2017) (Table 1). A communications expert translated all content into a product that the EM advisorsconsidered effective and easy to comprehend.

Table 1. Comparison of key elements of knowledge co-production in disaster risk research with relevant activities from the MN HSEM Climate Data Profile Project

Elements of knowledge co-production in disaster risk research*	MN HSEM Climate Data Profile Project actions
Natural hazard analysis should be considered holistically and conducted on a common interdisciplinary stage.	Project team members represented a range of key disciplines involved in some aspect of disaster resiliency, including public health, emergency management, public health preparedness, and climatology, with responsibilities across various levels of state and local government.
Exposure and vulnerability are the key determinants of disaster risk and the main drivers of disaster loss.	MNCHP has extensive experience conducting climate-related exposure and vulnerability assessments for informing public health intervention strategies. The knowledge and tools used in these efforts were shared with project team members and helped inform both the content of the HSEM climate profiles and promotion among EM end-users.
Disaster is not a natural but a social phenomenon.	Profiles provide discussion and data on vulnerable populations (children and seniors) and evidence of disaster-related impacts on factors in the social, economic, and physical environments (i.e., determinants of health) to underscore the numerous ways that disasters disrupt normal function of a community.
An outstanding knowledge of disaster risks itself is little help in reducing risks and disasters unless the knowledge is implemented into practice.	To help steward application of the profiles into EM practice, MNCHP staff provided a webinar and presented at MN HSEM regional staff meetings and state conferences. Profiles were also included in the 2019 MN State Hazard Mitigation Plan, and EM consultants are working with local EM planners to incorporate profiles into county and city EM planning documents.
Unconsolidated scientific efforts will not contribute significantly to risk reduction without an integrated, co-designed and co-produced approach to disaster risk research and implementation.	Project team members are working to identify opportunities for advancing interdisciplinary disaster risk research through scenario planning exercises, most likely targeting specific climate-related hazards, like drought.

*based on Ismail-Zadeh et al. (2017

Disseminating the Profiles

MNCHP released the profiles publicly via a webinar. The primary aim of the webinar was to provide EM with comprehensive information on the regional climate data profiles that were developed for each of the six HSEM jurisdictions in Minnesota. The webinar included an explanation of CPD, the importance of these data for effective disaster resiliency planning, the role for EM in advancing resiliency, and a step-by-step description of the profile contents. Special emphasis was placed on the use of a case study disaster incident, or "focusing event", in each profile to put climate projection estimates in a context meaningful to the EM audience. Attendees were provided with suggestions on how the profiles could beused to inform disaster response planning. Following the webinar, MNCHP further disseminated the profiles by presenting them in person at quarterly EM staff meetings within each of the six HSEM regions, using a presentation similar in structure to the webinar.

Evaluating the Resource and Effort

The webinar and regional presentations were evaluated to better understand EM's intent of using CPD. The main goal of co-producing the profiles was to ensure that EM would have useable, tailored information that could readily support their resiliency planning and/or preparedness efforts. To better determine the use of CPD and technical assistance needs in the short-term, MNCHP created an online and paper survey based on the following questions:

- Do EM intend to use the information in the profiles?
- How do EM intend to use the information in the profiles?
- What barriers exist to EM and their partners using the information in the profiles?

The Theory of Planned Behavior (TPB) informed the survey design (Ajzen 1991). TPB has been used successfully to predict and explain a large range of intentions and behaviors within the health domain (Asare 2015; Godin and Kok 1996). TPB theorizes that attitude toward the behavior, subjective norm, and perceived behavioral control influence behavior. Questions aimed at assessing these three factors were framed using a 5-point Likertscale, which allowed for responses to be summed to create a group average for each question. Questions on intentions and barriers to CPD use were framed using a multiple-choice format. EM project advisors assisted with developing all response choices for these questions. Results of the evaluation are described in the next section.

In 2021 after the release of the Profiles and regional presentations, the Program reviewed a sample of recently approved local all hazard mitigation plans to determine if the profiles were included and to assess the incorporation of climate change in plans over time. The sample included 18 plans (17 counties and one city); covering about 20% of local plans in the state and representing all HSEM regions. The review compared plans approved in 2019 and 2020 with their previous iterations approved between 2010 through 2013. The review assessed if the profiles were included in the plans and if climate change was incorporated across three areas: 1) inclusion of content in the plans, 2) climate and health word counts, and 3) composition of climate-related mitigation actions.

Results

Content Development

The climate data were aggregated to seasons for early drafts for three climate variables (maximum temperature,minimum temperature, total precipitation) for each MN HSEM region. The type and granularity of data providedwere constrained by what was available through the primary data sources at the time (Table 2). Aggregated population data, including mid-century projections of child and senior population changes, was presented for each MN HSEM region.

Table 2. Description of data sources used to develop HSEM climate data regional profiles.

Data Type	Characteristic	Temporal Scale	Spatial Scale	Source
Climate	Temperature: - Average summer maximum (June, July, August) -Average winter minimum (December, January, February) Precipitation: -Average early summer (June, July) -Average early fall (September, October)	Historical trend: 1981-2010 Future projections (based on RCP8.5): 2050-2075	Individual county-level data averaged for a single region estimate	National Climate Change Viewer, United States Geological Survey (USGS, 2019)
Disaster event	Temperature: -Maximum -Minimum Precipitation: -Total	Historical: 1981-2010 Future (based on RCP8.5): 2050-2075 Event timeline: varies with event *All trend and projection data were scaled to match months with event timeline.*	Individual county-level data averaged for counties impacted by disaster event	Climate at a Glance, National Oceanic and Atmospheric Administration. (NOAA, 2019)
Population	Child: 0-14 years old Senior: 65 years and older	Historical: 2015 Future: 2050	Individual county-level data averaged for a single region estimate	MN Demographic Center (MNSDC, 2019)

Early drafts were shared with the EM advisory team and several key suggestions emerged. First, while the EM advisory team acknowledged the importance of getting climate data, particularly CPD, into the hands of EM professionals, they felt that the original form in which they were provided in the profiles would mask their meaning for the intended audience. Climate data were summarized and presented as singular, numerical estimates with little explanatory content. The advisory team emphasized that EM practitioners are focused on real-life, societal impacts from climate and weather events, and that numerical trends or estimates disassociatedfrom these impacts may fail at both engaging the EM audience and showing the relevancy ofCPD to their field of practice.

In addition, the EM advisory team recommended including for each regional profile an example of a recent disaster event that may have been influenced by similar climate phenomena projected for the future. This was a pivotal suggestion and developed into a key organizing principle for each profile. Comparing and contrasting historical climate data (1981-2010) and future projection data (2050-2075) with observed measures from a recent extreme event not only demonstrates that patterns are changing but links those changes with a recent disaster that may have involved many EM professionals in the target audience. Providing temperature and precipitation data associated with a recent disaster event alongside future temperature and precipitation projection estimates for the same region speaks to the potential of these climate drivers to influence future disasters and links these drivers to potential impacts. In a sense, recent disaster events are used as case studies to impress upon EM planners and responders the urgency, diversity, andincreased frequency of climate change threats (by linking these incidents with CPD) while focusing the narrative on impacts (the area of primary concern for EM professionals). MNCHP made clear to EM end-users that the profiles were not intended as attribution research, i.e., stating definitively that the case study disasters were explicitly connected to the small range of climate estimates provided. Certainly, disasters such as wildfires can be attributed to other influential factors, such as land use and development decisions, other than weather and climate. Yet, this simple exercise aligning CPD with a recent disaster event capitalized on the power of disasters as “focusing events” (Birkland 1998) highlighting evidence of known impacts, while introducing, at least for many EM readers, a source of information that is new.

The EM advisory team identified case study disasters for each HSEM region including flood, drought, wildfire, extreme heat, and severe ice storm (Figure 1). Half of these events warranted a federal disaster declaration, andall had occurred between 1988 - 2013. After final review by state and local EM regional coordinators and the EMadvisory team, all six regional profiles were made available to the public for download through the MNCHP website: https://www.health.state.mn.us/communities/environment/climate/data.html

Evaluation

Survey (Short-term Evaluation)

Of 150 surveys completed following the webinar and regional presentations, 74 respondents identified as an EMprofessional. Only EM responses were analyzed for this paper as they were the main audience for the profile reports. Participating EM responded most positively (i.e., Likert score ≤ 3) to the TPB questions about attitude (95% positive, average score = 3.8) and social norm (96% positive, average score = 3.7), and less positively to perceived behavioral control (59% positive, average score = 2.9) (Table 3).

Table 3. TPB survey questions (Likert scale) with response results.

Construct	Question	Scale	1	2	3	4	5
Attitude	How helpful would it be to use climate projection data in support of emergency management planning and/or preparedness efforts? n=74	1=Not at all helpful 2=Somewhat helpful 3=Helpful 4=Very helpful 5=Extremely helpful	0% (0)	5.4% (4)	25.7% (19)	51.4% (38)	17.6% (13)
Subjective Norm	If your peers were knowledgeable about it, would they use climate projection data in support of emergency management planning and/or preparedness efforts? n=73	1=Not at all likely 2=Somewhat likely 3=Likely 4=Very likely 5=Extremely likely	0% (0)	4.1% (3)	37.0% (27)	43.8% (32)	15.1% (11)
Perceived Behavioral Control	How confident do you feel in your ability to use climate projection data in support of emergency management planning and/or preparedness efforts? n=73	1=Not at all confident 2=Somewhat confident 3=Confident 4=Very confident 5=Extremely confident	4.1% (3)	36.5% (27)	28.4% (21)	23.0% (17)	8.1% (6)

Note: Total number of respondents for each question varies given that some left the question incomplete.

Regarding intended use of CPD, 100% of EM responded that they intend to use CPD in one or more ways to support planning and/or preparedness efforts (Table 4). The top intended use was to integrate CPD into hazard mitigation and response plans to assist with identifying community vulnerabilities and determining mitigation actions to reduce future damages. The two most commonly identified barriers to CPD use were insufficient timeor resources and a lack of support from key partners.

The total number of respondents for each question in Table 4 varies given that some left the question incomplete. Total number of answers per question also varies given that respondents could select more than one answer option. Counts in parentheses reflect number of respondents who selected that answer option. Percentages reflect that count divided by total number of respondents for that question.

Table 4. Intentions and barriers survey questions (multiple choice) with response results.

How do you intend to use climate projection data in support of emergency management planning and/or preparedness efforts? Check all that apply.

Response Options	Results n=73
I intend to integrate the data into hazard mitigation and response plans.	(57) 78.1%
I intend to integrate the data into other plans related to emergencies.	(32) 43.8%
I intend to use the data to engage key partners in local planning and projects.	(38) 52.1%
I intend to factor the data into training and exercises related to emergencies.	(31) 42.5%
I do not intend to use the data.	(0) 0%

If you checked first the box in the previous question, “I intend to integrate the data into hazard mitigation andresponse plans”, how do you plan on doing this? Check all that apply.

Response Options	Results n=56
Use it to assess the probability of future severe weather events.	(44) 78.6%
Use it to predict and plan for changes in the spread of vectorborne diseases.	(11) 19.6%
Use it to identify community vulnerabilities.	(53) 94.6%
Use it to determine mitigation actions to reduce damages from future impacts.	(46) 82.1%
Use it to inform the planning process to make sure plans are climate change ready.	(28) 50.0%

What barriers do you anticipate to using climate projection data in support of emergency management planning and/or preparedness efforts? Check all that apply.

Response Options	Results n=74
Key partners (within your organization, community leaders, others) may not be supportive of using the data.	(30) 40.5%
The data may conflict with what we are actually seeing in terms of natural disasters.	(17) 23.0%
I may not be able to find ways to use the data in my work.	(12) 16.2%
I may not have the time or resources to use the data.	(36) 48.6%
My peers may not be comfortable with the level of uncertainty in the data.	(20) 27.0%
The spatial scale of the data may not be useful for the efforts I work on.	(7) 9.5%
I do not anticipate any barriers to using climate projection data.	(16) 21.6%

All Hazard Mitigation Plan Review (Long-term Evaluation)

In 2021, the Program reviewed a sample of recently approved local all hazard mitigation plans to determine if the profiles were included and to assess the incorporation of climate change in plans over time. The profiles were included in 67% of new plans and climate change incorporation increased in all three areas assessed: 1) inclusion of content in the plans, 2) climate and health word counts, and 3) composition of climate-related mitigation actions.

The sample included 18 plans (17 counties and one city); covering about 20% of local plans in the state and representing all HSEM regions. The review compared plans approved in 2019 and 2020 with their previous iterations approved between 2010 through 2013. Plans reviewed included Anoka, Beltrami, Blue Earth, Brown, Clay, Clearwater, Cook, Lac Qui Parle, Lake of the Woods, Martin, Murray, Norman, Pipestone, Redwood, Sherburne, St Paul (City of), St. Louis, and Swift.

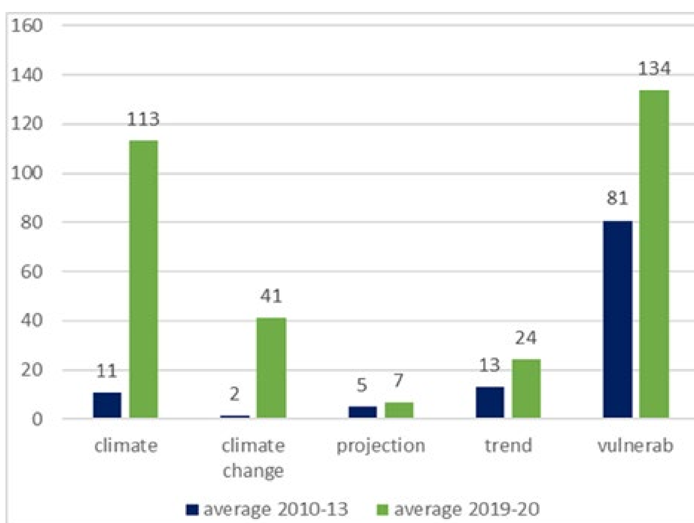
Table 5 shows that the majority (12 of 18) of new plans included the Program resource as an appendix. As climate projection data was a primary focus of the resource, it's important to note that 67% of new plans now include it in the appendix and 50% also included it in the body of the plan, compared to 11% of previous iterations including any mention of it. The assessment also showed that more new plans incorporate climate change through inclusion of a climate change section (+39%), discussion of climate trends (+39%), and discussion of climate change for every hazard (+78%). Appendix A includes the information in Table 5 broken out by individual plan.

Table 5. Comparison of Climate Change Incorporation in 2019-20 vs 2010-13 Plans

Criteria	2019-20 Plans (n=18)	2010-13 Plans (n=18)
Inclusion of the Program resource as an appendix	**12 (67%)**	**NA**
Climate projections discussed in body	9 (50%)	2 (11%)
Climate change section included in body	12 (67%)	5 (28%)
Climate trends discussed in body	13 (72%)	2 (11%)
Climate change discussed for every hazard	14 (78%)	0 (0%)

The review used word counts of climate and health-related words as an additional check of the inclusion of this content in plans over time. **Figure 1** shows that the average counts of all climate and health-related words increased for new plans. Specifically, average counts of "climate change" increased by 96%, with counts ranging from 0-6 in 2010-13 plans and 0-127 in 2019-20 plans.

Figure 1. Word Counts in Plans (Averages)



The Program categorized and counted mitigation actions in plans to determine which hazards were being addressed and how this has changed over time. **Table 6** shows the breakdown of mitigation actions by the primary hazard[1] addressed, with the composition of action counts within individual plans averaged across approval date category[2]. Severe storms and floods are the top climate-related hazards addressed by mitigation actions in both 2010-13 and 2019-20 plans. Plans have shifted towards higher compositions of actions to address climate-related hazards, with the greatest increases in actions addressing flood (10.1%) and severe storms (8.4%). Actions to address hazards *not* related to climate (categorized as "other") decreased by 18% in newer plans. Examples of other hazards include technological, terrorism, hazardous wastes, and infectious diseases. Appendix A includes tables with the count of mitigation actions by plan.

Table 6. Composition of Mitigation Actions in Plans by Hazard Addressed and Plan Approval Date

Plan Approval Date	Dam Failure	Flood	Erosion	Drought	Extreme Temps	Severe Storms	Wildfire	Other *(not climate-related)*	All-Hazards	Total
2010-13	0.8%	18.1%	1.7%	2.8%	1.8%	19.3%	9.0%	28.7%	17.8%	100%
2019-20	2.0%	28.2%	3.7%	3.4%	1.8%	27.7%	11.3%	10.7%	11.2%	100%
Change	1.2%	10.1%	1.9%	0.6%	0.0%	8.4%	2.3%	18.0%	-6.6%	0%

Discussion & Next Steps

This section summarizes lessons learned and actions the MNCHP is taking to further address the co-productionof knowledge with EM professionals and partners to protect the public's health from climate change impacts.

Continuous Co-production of Knowledge

An essential factor for advancing disaster and climate resiliency through knowledge co-production is sustainedinteraction between climate information producers and users. This factor is identified by Ismail-Zadeh and colleagues (Table 1) as well as many others as essential for the successful application of climate information (Briley et al. 2015; Flagg and Kirchoff 2018; Lemos and Morehouse 2005). Based on survey results and EM partner input, the following actions have been undertaken to sustain a collaborative application of CPD for EM planning.

[1] If a mitigation action addressed more than one hazard, the reviewer used discretion to select the primary hazard intended to be addressed. If a mitigation action was too general to ascertain a particular hazard, it was categorized as "all hazards."

[2] Normalizing data was necessary as action counts varied widely across plans, averaging 54 actions in 2010-13 plans (range 13-124) and 36 actions in 2019-20 plans (range 17-79). Hazard categories included climate-related (dam failure, flood, erosion, drought, extreme temperatures, severe storms, wildfire), other (not climate-related), and all hazards (too general to assess climate relationship).

Minnesota Climate Data Community of Practice

Results from the TPB survey revealed a widespread level of interest and support among EM respondents for using CPD. However, a number of barriers to use were also identified. With the aim of helping EM and their partners to overcome these barriers as well as to ensure sustained interactions with MNCHP and other climate information producers, the MNCHP convened the MN Climate Data Community of Practice (CoP). The objectives of the CoP were to connect diverse end-users with climate scientists working in MN; share insights for obtaining, selecting, preparing, and applying CPD; brainstorming solutions for overcoming barriers; create a space for peer feedback on data applications; and further transdisciplinary collaborations for climate resiliency. As of 2021, the MNCHP transferred leadership to the Minnesota Climate Adaptation Partnership.

Boundary Organizations have a Key Role

CPD are becoming more available to non-climatologists for diverse applications (Swart et al. 2017). However, these data are a relatively new source of information to end-users, like EM professionals, underscoring the needfor more boundary organizations to help steward use, particularly at the state and local level. Results of an analysis of climate data use in Germany and the United Kingdom showed that when the capacity to use climate projections is confined to relatively small groups, competing pressures on staff may lead to "side-lining" engagement with these data or at the very least minimizing facilitated dissemination (Lorenz et al. 2017). In their survey of climate data producers and users in the UK, Porter and Dessai (2017) demonstrate that climate scientists are often overwhelmed by pressures to tailor output to the broad range of needs and interests voiced by end-users. Yet, the authors argue that by providing a common source of CPD (i.e., UKCP09; DEFRA 2011), the UK government has helped advance climate risk research and adaptation activities in numerous areas, including infrastructure, utilities, and transportation. This need for a common source of CPD was also identified by the MNEM advisory team. Currently, MN CPD users across different agencies and sectors obtain their data from a variety of sources, which has led to some conflicting output and interpretations of future climate concerns. A single, vetted source of CPD for MN promoted for all CPD users in the state would help reduce the risk of confusingdecision-makers and the public with conflicting messagesand contribute to greater transparency. Provisioning this common source of CPD, such as through a user-friendly data portal, is an ideal task for a boundary organization. Example of this exist, such as California's Cal-Adapt site, administered by the California Energy Commission (CEC, 2019), or Massachusetts's resilient MA site, administeredby the Executive Office of Energy and Environmental Affairs (MAEEA, 2017).

Results from the TPB survey show that EM are motivated to use CPD but identify a lack of time and resources as the main barriers to use. This is similar to findings by others who identify that lack of climate information use by diverse end-users is largely due to the context of use rather than characteristics of the information or process of information production (Flagg and Kirchoff 2018; Lorenz et al. 2017; Porter and Dessai 2017). One of the primaryroles of a boundary organization is to help overcome these barriers for end-users (Flagg and Kirchoff 2018; Lemos et al. 2014). By leveraging time, past experience working with

CPD, and a network of transdisciplinary partnerships, MNCHP filled this role for the project. MNCHP does not produce original CPD; however, it is an organization capable of assisting novice end-users with applying these data and presenting it in a packaged formthat can be easily understood and incorporated into planning documents. As observed by Lorenz and colleagues (2017), “effective and efficient planning is considered dependent not only on climate information at appropriatescales but also on extending the notion of the ‘expert’ in the decision-making process.” As more state agencies gain experience accessing and applying CPD, the broader agenda of advancing climate and disaster resiliency willbe better served if these new “experts” look to share their knowledge with partners and colleagues through the boundary organization framework that has been well described and increasingly put into practice (Agrawala et al. 2001; Kirchoff et al. 2015; Lemos et al. 2014).

We Need More and Better Information

Climate Data

There is a pressing need for CPD that can represent future climate phenomena at better spatial and temporalscales (Porter and Dessai 2017). The data source relied on for climate projection estimates was the National Climate Change Viewer (NCCV) administered by the United States Geological Survey (USGS 2019). This data source has a number of advantages: 1) the portal is simple to negotiate and data are easily selected by “pointand click” or pull down menus; 2) there are a range of Representative Concentration Pathways scenarios (vanVuuren 2011) available from which to select data; 3) data are spatially downscaled to the county level; and 4)end-users can select data from a single GCM (30 total to choose from) or choose an ensemble mean (i.e., an average of all models).

Yet, there were also substantial disadvantages. First, at the time data were obtained, USGS NCCV data were available as monthly estimates only. Monthly estimates mask the daily, even hourly extremes of climate variables, particularly precipitation, that influence occurrence of an extreme event, such as flash floods or landslides. EM partners desired sub-monthly timescales and a range of values (e.g., 5^{th} or 95^{th} percentile) in order to better capture potential acute events, not just averages or maximum/minimum estimates.

Second, USGS NCCV allows users to select data from individual GCMs or a mean model; yet, there is no guidanceon which choice is best for capturing phenomena for specific states or counties. In the absence of such guidance,end-users often select results from the mean model in the absence of knowing which particular GCM(s) best represent phenomena in their local jurisdictions. However, substantial differences can exist between these choices. For example, research by Harding and colleagues (2013) evaluated individual GCMs for which best represented downscaled precipitation estimates for the Central USA. Projected estimates of precipitation from that GCM (CMCC-CM) are often quite different compared to estimates from the ensemble mean. For example, projections from CMCC-CM for June, the wettest month in Minnesota, suggest that future June months will become much wetter, with a gain of an inch or more on average for most areas of the state. Yet, estimates of June rainfall from the ensemble mean estimate that June will be a much drier month for the state. Taken at face value, what message should an end-user take from this discrepancy? Should MN EM professionals prepare for a higher risk of floods in early summer or a higher risk of drought?

These are issues that most states across the U.S. are facing given that very few subnational jurisdictions have obtained downscaled projection datasets specifically developed to best approximate future climate phenomena in these more spatially resolved areas. This is an information gap that must be addressed before climate resiliency planning can match the current and future needs of disaster risk reduction. Over the last few decades,CPD have dramatically improved at global, even national scales, but by wide consensus the most effective resiliency measures are developed, implemented, and managed locally (Brugger and Crimmins 2015; Porter and Dessai 2017; UNDRR 2019), requiring that supporting data are matched to these scales. As found through co- producing climate information for EM professionals, not only are coarse scale projection data less useful for local planning, depending on parameter selection, these data can lead end-users to make the wrong assumptions about future climate threats. Yet, higher spatial resolution datasets do have drawbacks. As noted in Porter and Dessai (2017), confidence in spatial data is highest at continental scales but lowest at the local scale that most interest users. In addition, these data are not spatially coherent, i.e., data from more than one locale cannot be merged to represent a larger area. These tensions need to be understood by CPD end-users.

In addition, currently available CPD do not always align with best available climate research. For example, the EM advisory team requested that an ice storm be included as a focusing event for at least one of the MN HSEM jurisdictions. Ice storms can be extremely dangerous, damaging infrastructure and disrupting utility services, andthus are a leading concern for EM professionals in this region of the U.S. In response to this request, an April 2013 ice storm was selected as the focusing event for HSEM Region 5 located in southwestern MN (Figure 1).

Emerging research suggests that the risk of late winter or early spring extreme events, like ice storms, may increase due to climate change phenomena like arctic amplification (Cohen et al. 2018; Francis and Vavrus 2012). Yet, the small selection of climate variables and coarse temporal resolution of the USGS NCCV data mask this potential. In fact, taken at face-value these data suggest to a novice end-user that warming trends will reduce risk of extreme ice and snow events in the future. This disconnect, between what available projections can communicate and what climate experts are discovering through targeted research, also exists for tornadoes,another major disaster of concern for MN EM professionals.

It is tempting to side-step discussion of these particular extreme weather events due to the complexities of the science and deficiencies in the data out of concern that new end-users may lose confidence in the projection data and doubt its overall relevancy and utility for understanding and planning for any future disaster events. However, the MNCHP and EM team felt that this was an opportunity to honor the importance of transparency, a key factor in the knowledge co-production process (Meadow et al. 2015), and address head-on the occasional inability of available CPD to consistently reflect future trends emerging from developing research. Thus, a discussion of this issue was included in the Region 5 profile to demonstrate to EM data users the complexities of climate research in parallel with circumspect usage of available projection data. Maintaining awareness of emerging climate research and the caveats associated with CPD is another important role boundary organizations can play to accelerate proper usage of CPD for climate resiliency efforts.

Finally, the EM advisory team expressed interest in data representing climate variables beyond what were available through the USGS NCCV and included in the MN HSEM profiles, i.e., temperature and precipitation. Projections on wind speed, solar radiation, and lake level changes were often requested, similar to data-user feedback presented by Porter and Dessai (2017). While these data requests cannot be fulfilled through the NCCV, they highlight critical data needs, particularly for EM professionals. Efforts are underway in MN, includingwithin the MN Climate Data CoP, to catalogue desired climate variables from a broad range of potential CPD end-users. This list has a dual purpose. First, as progress is made toward obtaining CPD downscaled for the state,climate modelers will need to know what climate variables to populate. Second, the list demonstrates to state decision leaders the existing need and broad, transdisciplinary utility of CPD. In effect, this list of desired CPD variables becomes an advocacy tool and speaks on behalf of state and local data-users.

Disaster Event

While it is widely recognized that disaster impacts on a population vary substantially across small scales, there are few systems in place to capture and characterize these impacts at the local level. This knowledge is crucial in order to identify individuals who are at the highest levels of vulnerability and tailor resiliency strategies to the most damaging effects. Some impact information is available on an incident if it receives federal disaster declaration by FEMA, but often this is limited to coarse cost estimates related to major infrastructure damage (FEMA 2019, for example). The U.S. National Weather Service also provides some limited information on impacts following an extreme weather event, but again it usually consists of broad cost estimates on infrastructure or largescale landscape damage (NWS 2019). Occasionally post-incident reports may be conducted by federal agencies, like the USGS (e.g., following a major flood event; Ellison et al. 2011) or state agencies (e.g., following drought; MNDNR 1989). However, development of these reports is contingent on dedicated funding, and as such, availability is inconsistent at best, despite their value. Unfortunately, few post-disaster assessmentscapture the wide-ranging impacts on the long-term health and well-being of affected individuals. Some health data related to the event on mortality, emergency department visits or hospitalizations can be captured by existing health care systems, but the externalcause of the health outcomes are rarely recorded so that directly attributing healthcare visits to the event requires time and epidemiologic study (Sarofim et al. 2016). Additionally, many health-related impacts from a disaster, such as emotional distress or lost wages, arenot so obvious nor easily assessed (Joseph et al. 2014; Schwartz et al. 2017).

One noteworthy public health tool that can be deployed to characterize local disaster impacts on health and health determinants is a Community Assessment for Public Health Emergency Response (CASPER). CASPER methodology was developed by the CDC as a rapid needs survey to quickly gather household level information on the health status and related needs of communities for public health and EM decision makers. CASPERs can be used to inform all phases of disaster planning, i.e., preparedness, response, and recovery. From 2012-2016, 99 CASPERS were conducted across the U.S., approximately half of which were focused on preparedness, 27% on response or recovery, and 19% were not related to a disaster (Schnall et al. 2017). While CASPERs have a growing evidence-base demonstrating their utility for capturing health-related disaster impacts (Subaiya et al. 2019), use of CASPERs are sporadic and contingent on resources immediately available, particularly funding andtrained field practitioners. To date, only a modified CASPER has been conducted in Minnesota, but because of early termination, no results are available. The most valuable resource MNCHP staff relied upon for identifying local-level disaster impacts were newspapers and media outlets representing small community and tribal populations. Journalists for these local media sources may not realize that they are filling a vital information gapby delivering testimony from affected individuals and highlighting the myriad ways communities are disrupted by disasters. Community newspapers and media outlets can provide a crucial communication channel, linking local populations, particularly in rural areas, with public health and EM decision-makers at higher levels of government who need a detailed understanding of local impacts in order to effectively target response and resiliency actions, particularly over the long-term.

Population

Advancing disaster resiliency depends on addressing a broad range of population vulnerabilities. This reality is reflected in the statement by Ismail-Zadeh and colleagues (2017) that “Disaster is not a natural but a social phenomenon.” These vulnerabilities may be related to a specific climate threat (e.g., residing in a floodplain) or generalizable across threats (e.g., living below the poverty level or dependent on others for care). These vulnerabilities align with the World Health Organization’s (WHO) “determinants of health”, described as factors in our social, economic, and physical environments, including a person’s individual characteristics and behaviors,that together affect health and well-being (WHO 2019). In most cases, EM professionals have far greater control over addressing population vulnerability than whether a disaster event occurs in the first place. Results from oursurvey demonstrate that EM professionals are already aware and interested in using CPD for identifying community vulnerabilities (Tables 2 and 3). However, to do so successfully requires an understanding of what those vulnerabilities are, what individuals are disproportionately affected, how their communities’ population may change over time, and how different factors may interact to exacerbate one’s existing and potential vulnerability. According to the Third National Climate Assessment (IPCC 2014): “Vulnerability is a function of the character, magnitude, and rate of climate variations to which a system is exposed, its sensitivity, and its adaptivecapacity”. In the guidance document, “Assessing Health Vulnerability to Climate Change”, the CDC outlines a series of “best practice” steps for identifying, aligning, and analyzing data representing these major contributing factors to vulnerability (Manangan et al. 2016). Given that vulnerability is inversely related to resiliency, minimizing the former advances the later.

Vulnerability assessment as a tool for identifying opportunities to build community resiliency is similar in processand objective to the parallel modeling approach introduced in the IPCC Fifth Assessment report (IPCC 2014) for the formation of RCPs and promoted by Greiving and colleagues (2017) for assessing impacts of climate change and extreme events. Both methods involve aligning datasets representing climate change threats, exposure, sensitivity, and adaptive capacity. However, the parallel modeling approach described by Grieving et al. places particular emphasis on the use of projection data as well as the comprehensive characterization of sensitivity- related factors contributing to vulnerability and/or resilience. In fact, Grieving et al. states that “change of the sensitivity (i.e., demographic change, economic change and change in land-use patterns) may determine….the extent of climate- and weather-related impacts in the near future more significantly than the changing climate.” The authors stress that only recent or projected data on these factors should be used when characterizing potential impacts from climate change and extreme events.

However, these data are often hard to access or don't exist. MNCHP encountered this challenge developing the HSEM regional climate data profiles. It was difficult to locate and obtain data projected to represent future demographic, economic, or land use changes across Minnesota, particularly at regional or county scales. The MNDemographic Center does produce demographic projections for decadal timescales out to 2045 but only for total population, sex, and age (MNSDC 2019). Regional demographic projection data for 2045 compared to 2015were included in each HSEM profile for child (0-4 years) and senior (65+ years) populations given how often these two groups are prioritized as especially vulnerable to climate change threats (Gamble et al. 2015; Salas et al. 2019). A secondary intent of including these data, which was pointed out in the profile narrative, was to increase overall awareness among EM of the importance of considering the unique characteristics of the populations they serve and how these may be changing over time in such a way as to impact climate and disaster resiliency.

Yet, these data, reflecting intrinsic characteristics of the population, are still not enough. EM professionals, like all climate resiliency planners, need access to data that will facilitate their understanding of how the wide range of extrinsic health determinants (i.e., factors in one's environmental, social, economic, cultural realms) may be vulnerable to disaster events. Results from an extensive survey effort by Bosomworth and colleagues (2017) demonstrate that EM professionals are well aware of the increasing complexity of disaster events, driven by dynamic interactions between environmental, social, and technical changes. They note, as an example, an uptickin the number of people moving into areas where emergency services are limited or underfunded. Yet these residents bring with them expectations of the same social safety net they enjoyed in urbanized areas, not undertaking self-resiliency measures that more experienced "off the grid" residents accept. According to Bosomworth and colleagues (2017), EM professionals are also well aware of the growing interdependencies between energy, transport, and food systems, which are consolidating into ever bigger systems, compounding the risk that disaster impacts experienced in one system will derail the others and thus affect many communitiesin many significant ways.

Clearly, more comprehensive and accessible data are needed to characterize sensitivity factors across sectors and systems to support EM planning. Ideally, these data would be scaled to a future time scenario to align with CPD. While developing (and funding) these datasets will take time and resources, EM professionals and their partners have a well-vetted tool on hand for conducting the type of advanced vulnerability assessments (i.e., future facing assessments based on the parallel modeling approach with projection estimates) that are needed for disaster and climate resiliency: scenario planning. Originally conceived for the business sector, scenario planning is a powerful method for engaging diverse stakeholders in a facilitated consideration of alternative futures around a complex topic and making informed decisions when faced with the pressures of uncertainty. Scenario planning, sometimes referred to as scenario analysis or contingency planning, has been applied to disaster risk research and EM planning (Rawluk et al. 2018; Sangha et al. 2019; Serrao-Neumann and Choy 2018)and has also been recognized as useful for informing climate resiliency strategies (Deere et al. 2017; Star et al. 2016). Climate and disaster vulnerability assessments can feed the scenario planning process by identifying sensitivity factors that influence a population's exposure to climate hazards and the potential threats to healthand well-being. Stakeholders can manipulate these factors to represent a range of future scenarios, to explorepotential threats alongside opportunities to mitigate these threats through targeted resiliency strategies.

Scenario planning adjusts for the absence of directly relevant, quantified data, by instead focusing consideration on relatable, tangible narratives of risk and vulnerability, which can be developed with a broad array of information, e.g., future and historical, quantitative and qualitative, environmental and socioeconomic, etc.

Information in the HSEM climate data profiles, including climate and population projection data and examples ofobserved impacts, can help develop narratives for consideration as part of a scenario planning effort to support EM and their partners in advancing planning around a single disaster or even co-occurring disasters. Put in broader context, scenario planning addresses many of the elements of knowledge co-production considered relevant to advancing disaster risk research and planning (Ismail-Zadeh et al. 2017; Table 1).

Conclusion

This article reports on a systematic effort to co-produce actionable climate projection information with a state health department acting in the role of a boundary organization and EM professionals who serve on the front lines of protecting communities from climate-related disasters. Co-development of the HSEM climate data profiles lead to substantial improvements in the information within the profiles that were instrumental in improving usability for an EM audience. Short-term evaluation results found that the majority of surveyed EM professionals intended to use CPD to support their work, primarily by integrating CPD into hazard mitigation and response plans and using these data to engage key partners in planning and projects. Long-term evaluation results showed that the climate data profiles were included in 67% of new all hazard mitigation plans, and climate change incorporation increased in three additional areas compared to previous iterations of the plans. Although several major challenges were associated with packaging useable climate information, CPD remain the best tools for planners and policy makers alike to prevent and plan for future climate-related disasters. Results demonstrate that the co-development of knowledge for usage by EM was successful, and that this method and lessons learned from this effort are adaptable to other states and local jurisdictions for advancing climate data literacy among EM forimproving disaster resiliency.

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Appendix A. Additional Information from All Hazard Mitigation Plan Review

Table 7. Word Counts and Climate Change Inclusion by Individual Plan

Jurisdiction	HSEM Region	Year Approved	climate word count	climate change word count	projection word count	trend word count	vulnerab* word count	MDH profile included as appendix	climate change section included (in body)	climate trends discussed (in body)	climate projections discussed (in body)	climate change discussed for every hazard (in body)
Anoka	6	2010-2013	9	0	0	52	93	NA	no	no	no	no
Anoka	6	2019-2021	9	0	0	52	96	no	no	no	no	no
Beltrami	3	2010-2013	6	3	6	6	77	NA	yes	no	no	no
Beltrami	3	2019-2021	130	49	8	11	135	yes	yes	yes	yes	yes
Blue Earth	1	2010-2013	14	3	2	6	35	NA	no	no	no	no
Blue Earth	1	2019-2021	101	20	6	34	179	yes	yes	yes	yes	yes
Brown	5	2010-2013	8	0	6	4	27	NA	no	no	no	no
Brown	5	2019-2021	154	50	4	14	114	yes	yes	yes	yes	yes
City of St Paul	6	2010-2013	9	0	3	6	313	NA	no	no	no	no
City of St Paul	6	2019-2021	242	127	5	66	375	no	yes	yes	yes	yes
Clay	3	2010-2013	13	2	7	15	94	NA	no	no	no	no
Clay	3	2019-2021	144	52	8	17	151	yes	yes	yes	yes	yes
Clearwater	3	2010-2013	9	2	18	8	47	NA	yes	yes	yes	no
Clearwater	3	2019-2021	144	51	7	14	122	yes	yes	yes	yes	yes
Cook	2	2010-2013	11	3	2	5	49	NA	yes	no	no	no
Cook	2	2019-2021	132	52	9	14	100	yes	yes	yes	no	no
Lac Qui Parle	5	2010-2013	14	0	11	22	41	NA	no	no	no	no
Lac Qui Parle	5	2019-2021	17	0	12	24	71	no	no	yes	no	no
Lake of the Woods	3	2010-2013	14	4	19	5	60	NA	yes	yes	yes	no
Lake of the Woods	3	2019-2021	138	46	7	13	123	yes	yes	yes	yes	yes
Martin	5	2010-2013	31	0	1	13	88	NA	no	no	no	no

Jurisdiction	HSEM Region	Year Approved	climate word count	climate change word count	projection word count	trend word count	vulnerab* word count	MDH profile included as appendix	climate change section included (in body)	climate trends discussed (in body)	climate projections discussed (in body)	climate change discussed for every hazard (in body)
Martin	5	2019-2021	129	47	6	15	188	yes	yes	yes	no	yes
Murray	5	2010-2013	1	0	2	9	36	NA	no	no	no	no
Murray	5	2019-2021	82	31	8	32	35	no	no	no	no	yes
Norman	3	2010-2013	15	2	5	15	80	NA	no	no	no	no
Norman	3	2019-2021	168	51	7	14	134	yes	yes	yes	no	yes
Pipestone	5	2010-2013	1	0	0	8	52	NA	no	no	no	no
Pipestone	5	2019-2021	84	35	8	33	67	no	no	no	no	yes
Redwood	5	2010-2013	1	0	1	10	73	NA	no	no	no	no
Redwood	5	2019-2021	57	25	8	30	69	no	no	no	no	yes
Sherburne	6	2010-2013	14	6	0	34	231	NA	yes	no	no	no
Sherburne	6	2019-2021	136	48	6	15	140	yes	yes	yes	yes	yes
St Louis	2	2010-2013	10	2	2	6	33	NA	no	no	no	no
St Louis	2	2019-2021	147	60	6	17	220	yes	yes	yes	yes	yes
Swift	4	2010-2013	16	0	6	11	24	NA	no	no	no	no
Swift	4	2019-2021	21	0	6	23	90	no	no	no	no	no

Table 8. 2010-13 Plans: Composition of Mitigation Actions by Hazard Addressed

Jurisdiction	Dam Failure	Flood	Erosion	Drought	Extreme Temps	Severe Storms	Wildfire	Other	All-Hazards	Total
Anoka		13			1	12	4	32	22	**84**
Beltrami		3				7	2	1		**13**
Blue Earth	1	9	2	1	1	7		11	16	**48**
Brown	1	9	2	2	2	4	7	22	1	**50**
Clay		22	5	6	1	18	4	9	12	**77**
Clearwater		5				6	4	6	2	**23**
Cook		6			2	11	8	19	1	**47**
Lac Qui Parle		18				15	5			**38**
Lake of the Woods		5				3	3	6		**17**
Martin		5		1	1	5		2	7	**21**
Murray				5		16	6	27		**54**
Norman		45	7	3		27	3	13	14	**112**
Pipestone		8		5		15	7	11		**46**
Redwood				4		11	6	22		**43**
Sherburne	1	4				10	5	33	71	**124**
St Louis	5	18			4	12	21	38		**98**
St Paul (City of)		4	1		6	6		26	26	**69**
Swift		3				4	3	3	2	**15**
Total	**8**	**177**	**17**	**27**	**18**	**189**	**88**	**281**	**174**	**979**
Percent of Total	**1%**	**18%**	**2%**	**3%**	**2%**	**19%**	**9%**	**29%**	**18%**	**100%**

Table 9. 2019-20 Plans: Composition of Mitigation Action by Hazard Addressed

Jurisdiction	Dam Failure	Flood	Erosion	Drought	Extreme Temps	Severe Storms	Wildfire	other	All-Hazards	Total
Anoka		11			1	7	1	11	16	**47**
Beltrami	1	1	1			8	3		3	**17**
Blue Earth	2	11	5		1	7			14	**40**
Brown	1	11	4	2	2	7	1		2	**30**
Clay	1	12		1	1	8	2		3	**28**
Clearwater		3	1			8	5		2	**19**
Cook		9	3	2	1	12	13		12	**52**
Lac Qui Parle	2	15		2		15	5			**39**
Lake of the Woods		8			1	11	4		2	**26**
Martin		6	4	1	2	6			2	**21**
Murray	2	11		3		9	3	23		**51**
Norman		12			1	8			2	**23**
Pipestone		7		5		9	6	14		**41**
Redwood		17		1		9	6	16		**49**
Sherburne		6	3			6	5		4	**24**
St Louis	2	13	2		1	7	8		3	**36**
St Paul (City of)		15	1		1			6	8	**31**
Swift	2	16		5		44	12			**79**
Total	**13**	**184**	**24**	**22**	**12**	**181**	**74**	**70**	**73**	**653**
Percent of Total	**2%**	**28%**	**4%**	**3%**	**2%**	**28%**	**11%**	**11%**	**11%**	**100%**