EFFECTS OF DISASTERS ON LOCAL CLIMATE ACTIONS: CLIMATE CHANGE MITIGATION AND ADAPTATION ACTIONS

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This dissertation investigates the effects of natural disasters and political institutions on municipalities' climate change policies. Although most theoretical frameworks on policy adoption highlight the roles of extreme events as exogenous factors influencing policy change, most studies tend to focus on the effects of extreme events on policy change at the national level. Additionally, the existing theoretical frameworks explaining local policy adoption and public service provision do not pay attention to the roles of extreme events in local governments' policy choices. To fill those gaps, this dissertation explores the roles of natural disasters and political institutions on municipal governments' climate change policies. It does this by applying the theory of focusing events to local climate mitigation and adaptation actions. Based on the policy change framework, the political market model, and the institutional collective action frameworks, this dissertation develops and tests hypotheses to examine the effects of natural disasters and political institutions on municipalities' climate mitigation and adaptation policies. The dissertation uses 2010 National League of Cities (NLC) sustainability surveys and the 2010 International City/County Management Association (ICMA) sustainability survey to test the hypotheses. Analytical results show that floods and droughts influence local climate change policies and suggest that local governments can take advantage of extreme events when initiating a policy change. The results also suggest that political institutions can shape the effects of natural disasters on municipalities' climate mitigation and adaptation actions.

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TABLE OF CONTENTS

Page

LIST OF TABLES

Page

LIST OF FIGURES

Page

CHAPTER 1

INTRODUCTION

This dissertation investigates the effects of natural disasters on local governments' policies to address the impacts of climate change. Climate change, at the most general level, refers to a change in the average weather conditions, such as an increase in the average temperature (IPCC 2014). The combined average temperature over the land and ocean increased by 0.85˚C in the period 1880–2012, and the changed weather conditions cause frequent or heavy precipitation, heat waves, melting ice, a premature bearing of crops, and shifting geographic ranges of species (IPCC 2014; King 2004). An increase in the average temperature by 2˚C can intensify the negative impacts and create disastrous consequences. Most scientists agree that climate change can be attributed to greenhouse gases generated from anthropogenic sources, such as fossil-fuel powered plants and vehicles as well as deforestation (Cook 2017; National Research Council 2008, 2011).

At the global level, the United Nations has established frameworks to mitigate greenhouse gas emissions. In 1997, 37 industrialized countries and European countries signed an agreement, called the Kyoto protocol, that required participating parties to reduce, on average, 5% of greenhouse gas emissions against the 1990 level during the first commitment period (2008–2012) and at least 18% of emissions during the second commitment period (2013–2012). As of October 5, 2016, about 197 countries had joined the Paris Agreement, and 92 had signed the agreement to reduce greenhouse gas emissions and limit the increase of the global temperature (UNFCCC, 2016). Recently, the United Nations also developed the Sendai Framework to guide countries to reduce the risk of disasters and address the negative impacts of climate change (UNISDR, 2015). The framework stresses

developing ways to better prepare for and respond to the impacts of extreme events exac erbated by changing weather conditions.

In contrast to the intensified global efforts, in the United States, the current federal government is reluctant to address the impacts of climate change. In 2017, for instance, the Trump Administration determined to withdraw from the Paris Agreement the Obama Administration had joined (Tabuchi and Fountain 2017). The former administration had developed the Clean Power Plan, which requires states to limit greenhouse gas emission below the 2005 levels by 32 percent (US EPA 2017a). The current administration proposed to repeal the plan and curtailed the former administration's efforts to reduce greenhouse gas emission by revoking the moratorium on coal mining and removing the restriction of off-shore drilling (Guillen 2017; US EPA 2017b). The current administration also has not developed a concrete plan to facilitate the coordination of federal agencies' efforts in adapting to the negative consequences of climate change (Halper 2017).

In spite of the national government's inaction, subnational governments showed strong commitments to addressing climate change. U.S. cities criticized the Trump Administration decision and pledged to uphold the Paris Agreement (Popovich and Schlossberg 2017). For example, Bill de Basio, mayor of New York City supported the Agreement by developing a three-year plan to limit greenhouse gas emission and align with the global accord (New York City 2017). Regardless of the federal government's withdrawal, as of October 26, 2017, around 180 U.S. local governments have membership in Cities for Climate Protection (CCP) campaign, which promotes the integration of climate change mitigation in government decision making. About 1060 mayors of the United States have participated in the Climate Protection Agreement to meet or outperform the targets of the Kyoto Protocol. In response to the president's withdrawal decision, governors of Washington, New York, and California formed the United States Alliance to achieve the U.S. goal

of the existing Paris Agreement and exceed the target of the Clean Power Plan, and soon ten other states joined the alliance to support the Paris Agreement.

However, collective action problems may inhibit local governments' efforts to address the impacts of climate change. Numerous jurisdictions at multiple scales contribute to climate change and benefit from climate actions (Stern 2006). The impacts and mitigation of climate change affect localities differently because of differences in geographic, ecological, and economic circumstances (Ostrom 2010). The differences in the benefits and the costs of climate actions across the entities can create different incentives in adopting and implementing the actions and may limit the collective efforts to mitigate and adapt to the negative consequences of climate change (Cole 2008).

The different incentives and the global benefit of climate actions may motivate the involved entities to strategically behave in collectively addressing climate change. Fragmented authorities and heterogeneous incentives regarding climate actions can raise the costs of negotiating and enforcing a region-wide agreement to combat climate change (Cole 2008; Levin et al. 2010). Without a strong monitoring and enforcement mechanism, some localities may enjoy the benefits of other entities' mitigation actions but may not contribute to the reduction of greenhouse gases (Ostrom 2010). The absence of an enforceable agreement induces emitters to move from localities with strong mitigation restrictions to those with weak restrictions.

Research Questions

The following research questions guide this dissertation:

1. Do different types of natural disasters have different effects on local governments' climate mitigation and adaptation actions?

2. What are the roles of political institutions in local governments' climate chang e mitigation and adaptation actions?

3. Are there differences in the effects of disasters and political institutions depending on local governments' climate mitigation and adaptation actions?

The theory of focusing events was used to answer the first research question. The theory highlights natural disasters as focusing events, which occur suddenly and rarely, generate massive damage at a time, and attract the intensive attention of the public as well as government decision makers to the relevant problems (Birkland, 1996, 1997). Natural disasters may heighten the policy attention to climate change and facilitate local governments' efforts to address the problem. Different types of disasters may have different effects on local governments' climate actions due to the differences in the relevance of the problems, the difficulty of forecasting, the scope of physical impacts, and policy entrepreneurship. Droughts and heat waves are most relevant to climate change and may have greater triggering effects on local governments' adaptation policy actions to address the impacts of the problems than hurricanes and floods, which may involve resistance from development interests. Although earthquakes are not very relevant to climate change, the dread of the unknown nature and the broad physical impacts may create a wider window of opportunity for local policy entrepreneurs to adopt measures to mitigate the impacts of geophysical disasters as well as climate change.

For this dissertation, the political market model and the institutional collective action (ICA) framework were applied to answer the second research question. The political market model explains policy change as a contract relationship between suppliers and demanders of policy change, and the model highlights the incentive structure of local governments (Lubell, Feiock, and Ramirez 2005; see also Feiock 2016). The managerial form of government, for example, may result in a stronger motivation to adopt climate policies because city managers have the desire to build national reputations for innovation and improvement of their constituents' lives. The ICA

framework emphasizes institutional structures that can facilitate and impede collective action among fragmented regional authorities (Feiock 2007). High levels of regional fragmentation may discourage local governments from adopting actions to mitigate and adapt to the impacts of climate change because of the high costs of monitoring the participants. State policies can be a coordinating framework for local governments to collectively address climate change and may facilitate local actions to mitigate and adapt to the impacts of the problem.

Finally, in this dissertation, we identify the differences in the effects of natural disasters and political institutions on climate mitigation and on adaptation actions considering the nature of the two types of climate actions. Mitigation actions are efforts to limit greenhouse gas emissions and include emission targets, energy efficiency, renewable technology, and compact development (Lutsey and Sperling 2008). Adaptation actions are to reduce the vulnerability to the impacts of climate change and include improvements in water efficiency to prepare for droughts and adoption of land-use plans to inhibit the development in floodplains (National Research Council 2011). Local governments may be better motivated to adopt adaptation actions than mitigation actions after disasters because adaptation actions provide immediate benefits to local jurisdictions. The council-manager form of government may be more likely to adopt mitigation actions than adaptation actions because the former can help city managers improve their national reputations for innovation. High levels of regional fragmentation increase the cost of monitoring the actions of the entities involved and discourage local governments from taking either type of action. State policies can be a coordinating framework for local governments to overcome collective action problems when adopting mitigation or adaptation policies.

Contributions to Theory and Practice

Theoretical Contributions

This dissertation makes at least two theoretical contributions to the literature on public policy and local governments. First, the dissertation contributes to the understanding of how extreme events play in local governments' policy changes and public service provision. Although extreme events are known to intensify the attention of the public as well as government decision makers and can create policy change at the local level, most public policy literature uses case studies to examine the roles of extreme events in policy change at the national level (Birkland 1996, 1997, 2004; Farley et al. 2006; Johnson 2005; Zahariadis 2003). Similarly, the literature on the political market model and the ICA framework has focused on local governments' policy changes and public service provision under stable conditions, but not in adverse conditions created by extreme events, such as natural disasters. The frameworks do not presume that local governments as institutional actors can pay attention to limited options due to their disproportionate access to information (Baumgartner and Jones 1993; Jones and Baumgartner 2005; Jones 2009). The examination of the effects of natural disasters on local governments' climate change policies will improve the understanding of local policy changes.

In addition, this dissertation enhances our understanding of the difference in the motivating factors between climate mitigation and adaptation actions. Although both types of actions are critical for local governments to address the impacts of climate change (Stern 2007), the existing literature usually focuses on climate mitigation actions but not both types of actions (e.g., Bae and Feiock 2013; Krause 2011b, 2012; Kwon et al. 2014; Pitt 2010; Wang 2013). The examination of the effects of natural disasters on both actions will advance the understanding of local governments' policy choices to address the impacts of climate change.

Policy and Practical Implications

The dissertation also has two policy and practical implications to public management and climate change policies. First, the investigation of the roles of extreme events and political institutions on policy change at the local level will inform public managers of how to take advantage of extreme events and institutional environments. Because public managers have motivation to enhance their policy goals (Schneider, Teske, and Mintrom 1995), they will explore an opportunity to use extreme events, such as natural disasters, to advance preferred policy alternatives. Natural disasters can provide windows of opportunity for policymakers to upgrade the destroyed infrastructure to disaster-resilient and energy-efficient structures (Mileti 1999; Skidmore and Toya 2002).

In addition, this dissertation contributes to the understanding of how to facilitate local governments' efforts to reduce greenhouse gases and the vulnerability to the impacts of climate change. The subnational governments' climate actions become more important than before since the Trump Administration decided to withdraw from the Paris Agreement and curtailed efforts to reduce greenhouse gas emissions by revoking the moratorium on coal mining and removing restrictions on off-shore drilling (Guillen 2017; Tabuchi and Fountain 2017). The examination of the impacts of natural disasters and political institutions on climate change policies will inform subnational governments as to how to improve their capabilities to mitigate and adapt to the impacts of climate change.

Organization of the Dissertation

In the following chapters, the dissertation presents a literature review, hypotheses, a research design, analytical results, and a discussion of the results to develop an understanding of

the effects of natural disasters and political institutions on local governments' climate change policies. Chapter 2 provides a review of the literature regarding the roles of extreme events in policy change and the drivers of local governments' mitigation and adaptation actions. The chapter first discusses the assumptions of public policy theoretical frameworks, including the punctuated equilibrium theory, the advocacy coalition framework, and the multiple streams approach (MSA), as well as the arguments put forth in these frameworks regarding the roles of extreme events. After that, the chapter introduces a) sociodemographic factors, such as home ownership, population, and education; b) governmental characteristics, such as form of government and state mandates; and c) environmental characteristics, such as coastal location and precipitation, examined in the existing work for a better understanding of local governments' adoption of climate mitigation and adaptation actions.

Chapter 3 presents theoretical frameworks to provide a better understanding of the roles natural disasters play in local governments' climate mitigation and adaptation actions. The theory of focusing events was applied to develop testable hypotheses and examine the effects of different types of natural disasters, such as hurricanes, floods, droughts, and earthquakes, on local governments' actions to reduce greenhouse gases and reduce vulnerability to climate change. The political market model and the ICA framework were used to investigate the effects of forms of government, state policies, and regional fragmentation on local governments' actions.

Chapter 4 describes the research design, which contains the data, variables, and analytical models used to test the hypotheses that propose to explain the effects of natural disasters and political institutions on local governments' climate change policies. For this purpose, we adopted two national surveys of U.S. municipalities: the 2010 NLC sustainability surveys and the 2010 ICMA sustainability survey. The dependent variables are policy priorities and policy actions on

climate mitigation and on adaptation actions. We used presidential disaster declaration and property damage as the disaster variables; as additional independent variables, we examined environmental interest groups, forms of government, regional fragmentation, and state climate change policies. Multilevel ordered logistic regression and multilevel count regressions were used to analyze the data.

Chapter 5 presents the analytical results of the multilevel regression models. Floods have positive and significant effects on local governments' mitigation and adaptation actions, while other types of disasters do not. The prevalence of environmental interest groups is shown to strengthen the effects of hurricanes, droughts, and earthquakes on local governments' effort to reduce greenhouse gas emissions or the vulnerability of the local jurisdictions to the impacts of climate change. Droughts or heat waves have greater impacts on local governments' climate actions under a mayor-council form of government than under a managerial form of government. State climate change policies have positive and significant effects on local governments' mitigation actions, while we did not find evidence of this for local governments' adaptation actions.

Chapter 6 discusses the theoretical and practical implications of the dissertation. The study of the effects of natural disasters on local governments' climate actions improves the understanding of policy change at the local level and contributes to the literature on public policy and local governments. The findings can help inform public managers of the roles of extreme events as windows of opportunity to adopt preferred policy alternatives and ways to improve local efforts to address the impacts of climate change.

CHAPTER 2

POLICY CHANGE AND EXTREME EVENTS

Policy Change

Policy change can be incremental as well as radical. An incremental change means a government's marginal modification of existing public policy, while a radical change is a profound shift from its existing policy condition (Cashore and Howlett 2007, 535; Hall 1993). Policy changes can be incremental when the developments are gradual and evolve from the previous conditions. On the other hand, governments can change their policy orientation and adopt a policy with a marked difference from the previous orientation (Cashore and Howlett 2007; Hall 1993). Those policy developments are revolutionary changes that discontinue the previous path (Capano 2009; Gerlach and Hines 1973). Furthermore, governments can adopt or implement a new policy (Berry and Berry 2014). When a jurisdiction does not have an emission standard in place but adopts a new one, the action is regarded as a radical policy change.

The concept of "muddling through" assumes that policy change occurs through an incremental decision making rather than radical decision making (Lindblom 1952). Lindblom (1952) suggested that public policies change through "incremental adjustments" rather than "in leaps and bounds" (p. 84). Decision makers cannot comprehend complex aspects of policy problems due to the limitations of intellectual capacity, so decision makers simplify policy problems (Simon 1957). Decision makers do not have the capacity to assess all consequences of each alternative in formulating a public policy; therefore, they examine a few alternatives with marginal differences.

Recent theoretical developments have considered incremental changes as well as radical changes in public policy. The punctuated equilibrium theory, for example, argues that the stability

and punctuation of policy change occurs at the system level (Baumgartner and Jones 1993; Jones and Baumgartner 2005). Similarly, the multiple streams approach (MSA) suggests that streams of problems, politics, and policies can be combined to create a policy change based on the garbage can model (Kingdon 1995). The advocacy coalition framework (ACF) contends that a change in core policy beliefs or in value orientation can lead to a major policy change or a radical policy change (Sabatier and Jenkins-Smith 1993). The framework posits that exogenous events, such as extreme events, can create a radical change in policy. The frameworks highlight the roles of extreme events in explaining a change in policy.

Theoretical Frameworks Explaining Policy Change

Punctuated Equilibrium Theory

The general punctuated equilibrium hypothesis explains the pattern of stability as well as occasional punctuations of policy change in the U.S. national political system based on a model of disproportionate information processing (Baumgartner and Jones 1993; Jones and Baumgartner 2005). The cognitive limitations of decision makers do not allow governments to address problems comprehensively but incrementally, and incremental decision making leads to near-stasis in policy change. The political systems in the US also bolster the stability of policy change. Separate institutions and overlapping jurisdictions of the political systems allow many governmental actors to promote different interests of groups, and intergroup competition discourages abrupt changes to public policies (Jones and Baumgartner 2005).

The model of disproportionate information processing can also help explain a sudden change in policy. Because the government does not have the ability to process all information and its attention is scarce, policy image, which highlights certain aspects of a problem, plays a critical

role in policy change. Policy image is socially constructed as a mix of empirical information and emotional appeal (Baumgartner et al. 2014). For instance, proponents of civilian nuclear power promote the idea of economic prosperity from the energy, while opponents of the power criticize the potential safety issues related with the energy. The punctuated equilibrium theory posits that punctuations in policy outputs reflect interactions between environments and dynamics of policy subsystems, which are composed of responsible federal agencies and congressional committees (Baumgartner and Jones, 1993). Altering a subsystem of a policy requires a change of policy image prevailing from the environment, which is outside the subsystem (Jones and Baumgartner 2005). A shift in the dominant image leads to punctuation in public policy.

Image shifts are attributed to disproportionate information processing in government (Jones and Baumgartner 2005). Government decision makers cannot process all information and prioritize certain information over information supplied by various sources. They are overwhelmed by the quantity of information provided by interest groups, think tanks, and different levels of government. Decision makers often ignore important aspects of problems until the problems become severe or policy entrepreneurs highlight a change in response to the problems. Decision makers process information selectively, and they pay particular attention to problems that attract the intense attention of the public to gain broad support from their constituents.

Although the punctuated equilibrium theory is useful for understanding the distribution of policy changes at the system level (i.e., stability and punctuation), the framework is not helpful for understanding a policy change in a specific policy area (True, Baumgartner, and Jones 2007). The framework seeks to understand incremental and radical policy changes at a system level or a governmental function level (e.g., defense and welfare), but it does not provide a clear understanding of changes to a specific policy. Studies in the literature that have adopted the

framework have examined a change in the budget of the functional areas (e.g., defense budget rather than the modification of the requirements or the adoption of a new policy) (Baumgartner and Jones 2002). The framework does not explain changes in the content of a policy (Capano 2009).

Advocacy Coalition Framework

The ACF uses belief systems to explain policy change and policy stability. The framework posits that public policy is a procedure for achieving desired outcomes or a translation of policy belief (Sabatier and Jenkins-Smith 1993). Advocacy coalitions are groups that composed of actors that share core policy beliefs within a policy subsystem, which set boundaries between actors on a given policy topic. Actors have bounded rationality and process information through belief systems. Actors have core policy beliefs, which are value orientation with regards to policy subsystems, their overall assessment of the seriousness of a problem, and their preferred solution to the problem. Actors also have secondary beliefs that pursue specific instruments, such as administrative rules, statutory reinterpretation, and budget allocations, to achieve desired outcomes or realize policy beliefs. A change in core policy beliefs is a major policy change within the policy subsystem, while a change in secondary beliefs is a minor policy change.

The ACF literature identifies external and internal sources that can lead to a major policy change. External sources are outside the control of actors and are beyond the ability of the policy subsystem participants to influence (Sabatier and Weible 2007). Examples of such external events include changes in sociodemographic conditions, regime change, and extreme events, such as crises or disasters. A major policy change also results from internal events that occur within policy subsystems and are influenced by the subsystem participants (Sabatier and Weible 2007).

Advocacy coalitions can use internal events, such as fiascos, scandals, and failures, to frame a problem or heighten the attention to the severity of a problem. Internal events can strengthen the belief of the marginal groups and weaken the support for the dominant coalitions' policy beliefs. External or internal events are not sufficient to trigger a major policy change but require facilitating factors, such as intensified attention of the public and decision makers, agenda changes, the redistribution of resources, and the opening of venues.

According to the ACF, extreme events can be necessary conditions but not sufficient conditions for policy changes (Sabatier and Weible 2007). Without facilitating factors, such as intensified attention of the public and the redistribution of resources, external events are not sufficient for a major policy change (Nohretedt 2008; Albright 2011). The Chernobyl disaster did not create favorable power distribution for the nuclear power opponent groups in shaping Swedish nuclear power policies and led to a minor policy change after that extreme event (Nohretedt 2008). Similarly, a favorable change in the political environment, along with multiple occurrences of flooding, triggered a major change in Hungarian flood policy (Albright, 2011). The democratic revolution in the country opened access to the flood control decision-making venues for pro-environment nonprofit groups to contribute. The change in the political environment and the occurrence of multiple extreme flooding events allowed the country to change its flood control approach from an engineering approach to a comprehensive approach that takes into account the ecological aspects of the control measures.

The ACF has limitations in explaining the roles of extreme events in policy changes, while the framework helps understand how extreme events interact with political streams or institutions. On the one hand, the literature considers the roles of political entrepreneurs and the structure of opportunity as mediating mechanisms to understand the effects of external effects on policy change.

For instance, opposing groups can frame extreme events as the failure of dominant groups and take advantage of the event to lead the relevant policy subsystems (Boin, t Hart, and McConnell 2009). On the other hand, the framework does not specify how external factors explain the changes in participants' behavior (Real-Dato, 2009). The ACF literature does not provide a clear understanding of how external events can trigger a major policy change, as the MSA/focusing events literature does.

Multiple Streams Approach (MSA)

The MSA applies the garbage can model to explain radical policy changes under conditions of ambiguity. The garbage can model follows the assumption of bounded rationality (Simon 1957). Decision makers have cognitive limitations when it comes to paying attention to various issues, and they do not have the capacity to consider all the alternatives and examine them in sequence. Policymakers also confront time constraints that limit their attention to various alternatives. The model posits that participants' attendance fluctuates, their preferences are problematic, and their problems and solutions drift in terms of decision making (Cohen, March and Olsen 1972). The model stresses complex and chaotic aspects of the decision-making process.

Following the logic of the garbage can model, the approach assumes that streams of problems, policies, and politics flow independently through government systems. The MSA posits that each stream has its own rules and flows independently (Kingdon 1995; Zahariadis 2014). Problems are conditions to which the public and decision makers pay attention. Politics are the political discourse that shapes public policies; this discourse is composed of public opinion, interest groups, and election results. Policies are developed in policy communities of specialists in specific policy fields. When policy entrepreneurs combine the three streams at the same time, they

can heighten the possibility of adopting a preferred policy.

Under conditions of ambiguity, symbols attract wide and intense attention from the public as well as from decision makers to the problem, make political discourse emotional, and facilitate the adoption of the solution (or policy) associated with the problem (Zahariadis 2014). Because decision makers' attention is scare, it is critical to direct their attention to a problem. Policy entrepreneurs use symbols to manipulate decision makers' attention toward a particular problem. Symbols emphasize certain aspects of a problem and create emotional attachment to a specific solution. Policy entrepreneurs frame the problems and preferred solutions (or policies) in a favorable way that makes political gains from the adoption of their preferred solutions easily recognizable by policymakers. Policy entrepreneurs attach attractive symbols to their preferred solutions.

The policy window provides opportunities for policy entrepreneurs to push their preferred solutions and attract the attention of the public and decision makers to a problem of interest (Kingdon 1995). The policy window can open due to an event in either problem or political streams infrequently and shortly. The separate streams are more likely to converge—and policy proposals are more likely to move up to a legislative stage—when the problem window is open. A pressing problem can open a policy window for advocates of certain policies. For instance, the collapse of the Penn Central Railroad generated demands for governmental actions to resolve the financial problems of public railroad systems, and it opened the window for policy proposals, such as subsidies and deregulation (Kingdon 1995). A favorable change in political streams, such as congressional composition, can open the window for the adoption of policies pushed by the president (e.g., Johnson's Great Society initiatives). When windows are opened in problem and political streams at the same time, policy entrepreneurs push their preferred policy proposals better

than when only one window opens.

In particular, the literature suggests that extreme events can create a policy window for policy change. The literature identifies natural disasters (Birkland 1996; Farley et al., 2006; Johnson, 2005), oil spills (Busenberg 2001), aviation disasters (Birkand 2004), and railroad accidents (Zahariadis 2003) as extreme events that create such policy windows. When an extreme event becomes a focusing event, it can cause or facilitate a policy change that would not be feasible in regular times. For instance, the September 11 terrorist attack created the window for a change in the national security policy (Birkland, 2004). The aviation disaster heightened the attention to the issue of security and resulted in congressional actions to strengthen the regulation of screeners; it also induced the Federal Aviation Administration to improve the standards of cockpit security. This dissertation contains a discussion of the characteristics of focusing events in the theory section.

The approach has a limitation in terms of understanding how extreme events, as problem streams, interact with other streams and create policy changes. The approach ignores the possibility that three streams can interact with each other, assuming that three streams are developed in accordance with their own rules. A change in one stream can reinforce a change in another, and a policy entrepreneur can couple multiple streams strategically and purposively (Mucciaron 1992). For example, a supply-side tax cut supported by Republican conservatives was tied to U.S. tax reform before the emergence of the Reagan Administration. The approach also fails to specify how multiple streams adapt mutually to each other. Solutions can be developed in response to the emergence of problems (Sabatier 2007).

Although the three frameworks highlight the roles of extreme events in policy change, the literature provides little understanding of the roles of extreme events in policy change at the local level. The theoretical frameworks of policy dynamics have been mainly applied at the national

level (Birkland 1996, 1997, 2004; Farley et al. 2006; Johnson 2005; Zahariadis 2003). The studies did not provide a systematic understanding of the roles of extreme events in policy change because they relied on a few cases. Although the studies' findings provide useful insight about the roles of extreme events in policy change, the studies may not be generalizable.

To fill this gap, this study examines the effects of natural disasters on municipalities' climate mitigation and adaptation actions. Natural disasters are extreme events and act as focusing events, which can lead to a policy change. Such disasters have led municipalities to develop plans to mitigate greenhouse gas emission and adapt to their changed environments (Bulkeley and Kern 2006; Lindley et al. 2006; Pitt 2010; Whitehead 2013). The following sections discuss the definitions of climate mitigation and adaption actions, along with the factors that influence these actions.

Climate Change Mitigation Adaptations: Mitigation and Adaptation Actions Defined

Local governments adopt policies related to mitigation and adaptation actions to address climate change. Climate change mitigation refers to actions designed to limit human activities that generate greenhouse gas emissions in the atmosphere. First, the most common approach is to impose emission targets on polluting industries and induce regulated entities to reduce greenhouse gas emissions (Lutsey and Sperling 2008). Governments can motivate the regulated entities to follow the performance targets by imposing penalties for noncompliance (National Research Council 2012). Second, governments can also employ alternative energy sources for their operations to reduce greenhouse gas emissions. Local communities can switch energy sources for their operations from fossil fuels to solar or wind power, which generate lower greenhouse gasses emissions (Kane and Shogren 2000). Third, governments can provide incentives for the use of

energy-efficient appliances or devices so that businesses or residents can reduce their reliance on fossil fuels for electricity generation (Bassett and Shandas:2007).

Localities can take adaptation actions to reduce their vulnerability to the negative consequences of the changing climate conditions. Cities can choose to make more efforts in terms of climate change adaptation if national and international communities take no action in responding to climate change. For instance, regional or local communities may construct sea walls or relocate residents from coastal areas with intensified storm surges (National Research Council 2011). Those communities may improve water use efficiency or build more reservoirs to adjust to the extended drought seasons (Revi 2008). Regional and local authorities may also strengthen building codes of structural buildings so that the physical infrastructure can withstand the impacts of intensified meteorological events, such as tornadoes (National Research Council 2011).

However, mitigation actions require globalized or regionalized actions, not just localized benefits. Climate mitigation actions benefit neighboring entities as well as other regions in addressing climate change (Fussel and Klein 2006; Kane and Shogren 2000). One entity's unilateral mitigation efforts can be offset or enjoyed freely by the other entities at the global level. The former cannot exclude the access of the latter to the benefits of the mitigated risk of climate change and cannot be successful without the latter's cooperation. At the regional level, a local government needs to cooperate with other neighboring entities in adopting mitigation measures, such as improved public transportation (Kern and Alber 2007). Municipalities share technical systems, such as transportation systems, which transcend local boundaries in a metropolitan region. Regional cooperation allows neighboring localities to avoid excessive competition and low environmental standards in attracting external investors.

Table 2.1. Mitigation vs. Adaptation

	Mitigation	**Adaptation**
Basic concept	Reducing greenhouse gas emissions	Adjusting to future loss
Policy tools	Emission targets (National Research Council 2008) Alternative energy use (Kane and Shogren 2000) Energy efficiency (Bae and Feiock 2012; Krause 2012) Compact development (Ewing et al. 2007)	Sea wall construction (National Research Council 2011) Relocation/retrofitting (National Research Council 2011) Water conservation (Revi 2008) Open spaces (Body et al. 2017).
Scope	Globalized/localized	Localized/regionalized

Although the high nonexclusivity of mitigation actions may discourage localities from adopting the policy options, localized benefits can encourage municipalities to adopt the actions. Municipalities may pursue mitigation actions with sustainable development goals, such as cost reduction, air quality improvement, and an increase in the livability of the communities affected (Bestill 2001; Kern and Alber 2007). For instance, the adoption of energy efficiency standards and renewable energy generation can reduce the long-term energy costs of governmental and commercial buildings.

Adaptation actions require regional cooperation and allow governments to provide localized benefits to municipalities. Because administrative boundaries do not match ecological boundaries, the fragmented authorities within the same region need to plan and implement actions collectively in addressing climate variability and future extreme events (Kern and Alber 2007). For example, municipalities along rivers are to take collective action to protect their local jurisdictions against flooding events. On the other hand, adaptation actions can be less exclusive than the mitigation of climate change (Fussel and Klein 2006; Kane and Shogren 2000). For instance, the benefits of climate change adaptation can become exclusive when individual

localities strengthen their buildings code to adjust to future frequent tornado events. Others cannot enjoy the benefits of the local entities' adaptation efforts.

What Explains Municipalities' Climate Mitigation Actions?

Although the globalized nature of climate mitigation actions discourages local governments from adopting them, localities do take actions to mitigate climate change (Bulkeley and Kern 2006; Lindley et al. 2006; Pitt 2010; Whitehead 2013). Local governments can seek localized benefits, such as such as cost reduction, air quality improvement, and an increase in the livability of the communities involved, due to the mitigation measures (Bestill 2001). Factors that influence municipalities' adoption of climate mitigation and adaptation actions are divided into three characteristics: sociodemographic, local political, and environmental.

Sociodemographic Characteristics

Sociodemographic characteristics of localities, which represent residents' demands, can influence municipalities' adoption of community-wide climate mitigation actions or sustainability actions (Homsy and Warner 2015; Kwon et al 2014; Opp et al. 2014; Svara et al. 2013). For instance, the more housing units are occupied by owners, the fewer sustainability actions municipalities implement. Homeowners may bear a great burden of implementing highly sustainable actions, such as retrofitting of buildings for energy efficiency, while the benefits are dispersed to others (Kwon et al. 2014; Homsy and Warner 2015). For instance, in 2017, Saint Louis County Building Commission, Missouri adopted residential energy building codes that generate less energy efficiency than other localities. In the short run, however, in order to satisfy the home builders, the building codes reduce the housing construction costs (Saint Louis Public Radio 2017).

On the other hand, more highly populated or educated populaces tend to demand more sustainability actions. Populated cities have great needs of pollution control and have better financial capacity to allocate resources for mitigation or sustainability actions. For example, Chicago City, whose population is about 2.7 million, sets goals to improve energy efficiency and to promote residential renewable power (City of Chicago 2017). Educated residents have a better understanding of sustainability actions (Opp et al. 2014; Svara et al. 2013), and the residents may demand more mitigation actions. For example, Plato Alto City of California has 79 percent of population with college degree or above, and parts of Stanford University are located at the city boundary. The city-operated utility company uses renewable energy, such as landfill gas, wind, solar power, to supply electricity to the residents and the businesses of the city (Murphy 2005).

Demands from organized interest groups can facilitate or impede the adoption of climate mitigation actions. Environmental interest groups find climate mitigation and adaptation actions aligned with their goals (i.e., environmental protection), especially mitigation measures that can improve the quality of the global environment (Deslatte and Swann 2015). Pro-environmental policy entrepreneurs may gain support from organized environmental interest groups that promote climate mitigation actions (Sharp, Daley, and Lynch 2011). Elected officials may respond to the demands of interest group and express their pro-environmental will by joining the membership. For instance, environmental justice groups support the Mayor of New York City, Bill de Blado's climate initiatives. The groups also encourage the mayor to take specific policy actions related to climate change (Giambusso 2017). On the other hand, developers or neighborhood associations oppose mitigation and adaption measures that affect their development and home prices (Deslatte and Swann 2015). Strengthened building codes or retrofitting can add costs to prices of buildings or homes.

Characteristics of Local Politics/Local Governance

Local governments mediate the public's demand for the adoption of climate mitigation actions and sustainability actions. The literature highlights certain governmental characteristics that influence the adoption of sustainability actions, such as financial capacity, International Council for Local Environmental Initiatives (ICLEI) membership, and form of government (Krause 2011b, 2012; Opp et al. 2014). For instance, municipalities with greater financial capacity are more likely to implement various climate protection actions, including greenhouse gas inventories, emission targets, efficiency standards, and recycling. The municipalities' ability to allocate resources for programs and activities is important for their adoption of various climate protection actions (Krause 2012).

Form of government shapes local governments' motivation to adopt climate mitigation and adaptation actions. Mayors tend to seek actions that provide immediate returns for their reelection, while city managers pursue innovative practices that improve their national reputations for future positions. Bae and Feiock (2012) found that the council-manager form of government has positive effects on the adoption of energy efficiency measures into government operations among U.S. cities with populations over 20,000, while this form of government has negative effects on the adoption of community-wide mitigation measures. City managers focus on the efficiency of internal operations rather than community-wide sustainability efforts because the professional managers are less responsive to members of the public who demand community-wide energy efficiency initiatives. In addition, Opp, Osgood, and Rugeley (2014) found that the council-manager form of government has positive effects on the adoption of environmental protection measures among municipalities with at least 2,500 people, a more inclusive study than that of Bae and Feiock (2012). City managers have strong motivation to engage in more innovative practices,

such as sustainability actions, for their long-term career aspirations; elected mayors, however, have a short-term horizon for reelection (Opp and Sanders 2013). For instance, City of Denton, TX has a council-manager form of government; and, the city government has taken actions to improve energy efficiency in governmental operation as well as residential energy efficiency such as energy audits and energy efficiency rebates (City of Denton 2017).

Local governments' collective efforts and their high level of policy orientation can facilitate municipalities' adoption of climate mitigation and adaptation actions. Interlocal or intralocal collaboration can facilitate the implementation of sustainable practices, including energy efficiency (Swann 2015). An intergovernmental collaborative mechanism helps municipalities address collective action problems in implementing sustainability actions, such as green building and energy efficiency. This is because the involvement of regional stakeholders helps overcome the barriers of the implementation of community-wide mitigation tools, which require the coordination of various interests across jurisdictions in the same region.

In addition, state mandates can provide a wider window of opportunity for localities to implement climate actions. Although a few research studies did not find significant effects of state climate change policies on municipalities' climate protection membership or mitigation actions (Krause 2011b; Pitt 2010), other research has suggested that municipalities whose states have climate actions or stringent climate targets are more likely to adopt climate mitigation actions or sustainability actions because states can provide a coordinating framework for various local governments (Homsy and Warner 2015). Not surprisingly, strong state mandates on carbon emission targets can force localities to adopt mitigation actions, which the low-level governments may be reluctant to take, to avoid punishments, such as reduction in financial support from high levels of governments.

Environmental Characteristics

Although municipal governments can find cues from local environmental characteristics, (e.g., coastal locations, climate conditions, and past extreme events) in adjusting their responses to future negative consequences of climate change, the literature does not provide a clear understanding of the effects of hazards or climatic conditions on municipalities' climate mitigation and adaptation actions. Studies have shown mixed effects of coastal location on local governments' climate mitigation actions (Pitt 2010; Zahran et al. 2008). For instance, Pitt (2010) found that, among 260 U.S. municipalities, coastal locations have positive effects on the adoption of climate mitigation measures, such as sustainable land-use policies and alternative transportation policies. On the other hand, Zahran et al. (2008) did not find significant effects of climatic risk, which include precipitation, hazard causalities, and coastal location, on metropolitan areas' membership in the Cities for Climate Protection (CCP) campaign.

What Explains Municipalities' Climate Adaptation Actions?

Adaptation actions have been less considered at the local level than mitigation actions (Kern and Alder 2007). While local governments can link mitigation measures to their local economic development, the governments may develop adaptation strategies after identifying a scientific basis for the specific impacts of climate change on the jurisdictions. The literature identifies factors that influence municipalities' climate adaptation actions: sociodemographic characteristics, local political characteristics, and environmental characteristics. These help explain the adoption of climate adaptation actions.

Sociodemographic Characteristics

Populated areas can be at great risk from the negative impacts of climate change. Sea level rise can expose populations to flooding risks, and extended heat waves create stress among people. Hultiquist et al. (2017) found that that an increase in population has positive effects on the adaptation of municipalities in the Great Plains region. Municipal governments can take more adaptation actions in response to their increasing populations, thus reducing the vulnerability of the jurisdictions to the impacts of climate change. In California, for example, sprawling population is exposed to wildfires that were intensified by climate change (Meyer 2017).

Local Political Characteristics

Financial capacity is critical for municipalities to assess the impacts of climate change on the local jurisdictions. Large municipalities have the capacity to hire external experts, assign internal staff to climate adaptation actions, and advance the adaptation policy from awareness to detailed actions (Dannevig, Rauken, and Hovelsrud 2012). External policy experts help municipalities assess the vulnerability of the local jurisdictions to the impacts of climate change and improve the awareness of adaptation actions. In this vein, Mullin and Rubado (2016) discovered that Texas municipalities that serve large populations are more likely to impose water restrictions earlier than those serving small populations. Large municipal governments may have broad government authority as well as extensive technical expertise and human resources to detect water shortage problems and prepare for future droughts.

Environmental Characteristics

Local governments can take climate adaptation actions in response to future risk from their

environmental conditions. For instance, sea level rises can expose coastal cities to flooding risks. The literature has mixed findings regarding the relationship between coastal locations and climate adaptation actions. In a study of 10 selected U.S. cities, Gerber (2015) did not find any significant relationship between coastal locations and climate adaptation actions, concluding that the risk of floods does not drive municipalities to adopt climate mitigation and adaptation actions. On the other hand, according to Wang (2013), coastal locations have positive effects on climate adaptation actions (i.e., climate change impact analysis) among California cities but not on climate mitigation actions. These findings suggest that municipalities that are located within coastal regions are vulnerable to sea level rises and are more willing to adopt climate adaptation actions but not mitigation actions.

In addition, extreme events can drive municipalities to adopt climate adaptation actions. Extreme events can provide learning opportunities for municipalities that had no prior-understanding of the negative impacts of climate change; this can facilitate efforts to reduce damage from similar future events. For example, Amundsen, Berglund and Westskog (2010) found that Norwegian municipalities adopted adaptation actions after extreme events, such as severe storm and flooding events. The affected municipalities replaced building materials and built structures to prevent damage from future extreme events. Similarly, Mullin and Rubado (2016) reported that Texas water districts are responsive to severe drought events. Water authorities are more likely to adopt adaptation actions, such as emergency planning for water usage restriction, immediately after extreme events to mitigate potential damage from future droughts or heat waves.

Research Gaps

The existing literature has several weaknesses when it comes to examining the effects of

extreme events on policies. First, most research does not provide a systematic understanding of the effects of extreme events on policies, especially at the local level. Natural disasters can provide a policy window, which is an opportunity for a policy advocate to direct people's attention to a certain problem or its solution; this also allows policy entrepreneurs to push their preferred policy alternatives (Birkland 1997; Kingdon 1995). Local governments can take advantage of extreme events to promote the adoption of new policy solutions and innovative practices, which would not be politically feasible in usual times. Extreme events can increase public attention on the mitigation of the hazards that trigger such extreme events and legitimize the adoption of policy solutions would not normally be politically feasible. However, there is only a limited understanding of extreme events and their impacts on policy change or governmental operations at the local level. Only a few public administration research studies have provided qualitative understanding of how extreme events can influence the operation of public organizations or local governments (e.g., Donahue and O' Leary 2011; Kapucu, 2006; Moynihan 2008).

Second, the existing research usually does not differentiate between types of disasters. Different types of disasters may have different degrees of impact on property and infrastructure (Peter et al. 2012). For example, extreme events caused by earthquakes, hurricanes, or tornadoes usually tend to have more destructive effects on buildings and infrastructure than droughts do. Municipalities that experience the former types of disasters have better opportunities to rebuild the buildings in a more sustainable way than those with the latter types of disasters. Natural disasters also have differences in terms of the predictability of occurrence of an event and political mobilization. For instance, earthquakes are rarer and more dreadful the former types of disasters result in more political mobilization for hazard mitigation actions than hurricanes (Birkland, 1996, 1997).

Finally, the existing research does not provide much understanding of the drivers of local governments' simultaneous climate mitigation and adaptation actions. Municipal governments can make strategic choices in response to demands from the public and the local environment. Most research has focused on mitigation actions without examining how the risk of extreme events can shape municipal governments' policy choices, although there are exceptions (e.g., Gerber 2015; Wang 2013; Hultiquist, et al. 2017). The literature fails to provide a theoretical framework to develop an understanding of what motivating factors differentiate climate adaptation actions from mitigation actions. The studies in the literature have mostly focused on one state or a few states (i.e., the Great Plains), but the findings may not be generalizable to all U.S. municipalities, which have great variations in terms of their sociodemographic, governmental, and environmental characteristics. The following section provides a theoretical framework to develop a better understanding of why municipal governments adopt climate mitigation and adaptation actions.

CHAPTER 3

EFFECTS OF NATURAL DISASTERS ON CLIMATE MITIGATION AND ADAPTATION ACTIONS

This chapter provides an explanation of the effects of natural disasters on climate change mitigation and adaptation actions. The chapter explains the effects of natural disasters and political institutions on climate mitigation and on adaptation actions. The theory of focusing events can explain the effects of natural disasters on climate change mitigation and adaptation actions. The theory has been used to explain policy changes in various areas of public policy (Zahariadis 2014). This chapter describes the characteristics of focusing events and explains why a natural disaster can be treated as a focusing event leading to a policy change.

Theory of Focusing Events

A focusing event increases government attention on societal issues and triggers a government action or a policy change. As the punctuated equilibrium theory suggests, government decision-makers process information selectively and do not take actions in proportion to the severity of the problem (Jones and Baumgartner 2005). The decision makers pay attention to a problem that shapes the prevalent policy image. A focusing event, such as a natural disaster, attracts the decision makers—who, as noted, have cognitive limitations—because such an event generates intense interest on the part of the public, which demands a significant action in response to the problem (Birkland 1997).

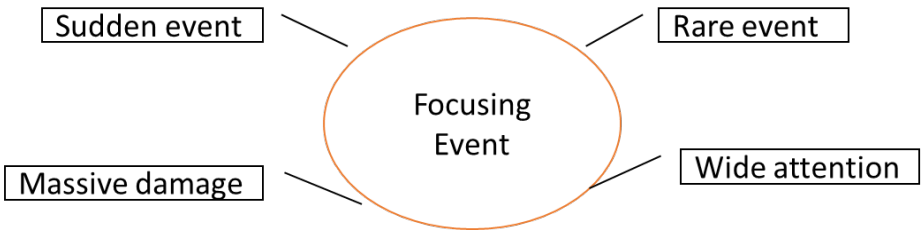
Public policy scholars stress the roles of focusing events in government agenda setting. For example, Kingdon (1995) argued that focusing events call attention to a certain problem and represent powerful symbols that attract the attention of policymakers and the public. Climate

change, as a problem, is not obvious to government decision makers based on climactic indicators, such as an increase in the average global temperature. Such a low-prioritized item needs notable events to become a visible item and ultimately end up on a government agenda.

Characteristics of Focusing Event

Birkland (1997) provided further explanations about how focusing events become focal. He formulated a more specific definition of focusing events, arguing that an event can be focal in several ways. First, a potential focusing event does not occur gradually but suddenly. A sudden event triggers intense interest and elevates an agenda. Such an event helps groups that support an issue on the agenda to attract greater attention to a certain problem compared to slowly occurring events.

Figure 3.1. Characteristics of Focusing Event



Second, a potential focusing event is a rare event rather than a common one (Birkland 1997). A frequent event, such as an automobile accident, does not have focal power as a single incidence but as an aggregation of the number of accidents during a specific period. While routine events need time to gain intense attention, a rare event as a single incidence is fixed at a time and can be focal. Although there is a difference between rare events in terms of degree of certainty, such an event is not predictable. One cannot predict when such an event will occur exactly. An event with a low predictability is associated with a sudden event and creates the fear of social dread related to the event. A frightening event can be focal because such an event can attract the public's

attention and result in demands for mitigation efforts. Participants in policymaking processes can refer to the focusing event to promote the issues relevant to them on the government agenda.

Third, a potential focusing event poses harm to a large number of people and properties (Birkland 1997). Harm to property and human lives is usually concentrated in a certain geographic area in the case of natural disasters, while the impacts of technological disasters, such as the Exxon Valdez oil spill, tend to affect people in the fishing industry throughout a nation or a region. The level of harm is revealed by a current event or a possible future event. The sufficiently great harm of such an event creates intense attention and leads to a rise in the importance of an issue on the government agenda.

Finally, members of policy communities and the public are informed of a focusing event simultaneously (Birkland, 1997). Although policy groups have a direct interest in such an event before it is reported by mass media, the public can learn about the event immediately from radio or news. Groups that seek to prevent a relevant issue from being elevated to a government agenda will find it difficult to do so when it comes to focusing events that attract the broad attention of the public.

A focusing event, which is sudden and rare and poses significant harm in a geographical area or other areas of interest can create a policy window. A policy window is an opportunity for a policy advocate to promote attention to a certain problem or to its solution (Kingdon 1995). Advocates look forward to favorable times to convert their policy proposal into a special problem. If the policy window does not open frequently, the advocate can miss the window and then must wait a long time. When a scarce policy window opens shortly, the policy advocates attach a preferred solution to the problem, which may result in a significant change in public policy. The open window is a critical opportunity for policy advocates who aim to promote a certain policy

proposal for a certain problem because the window enables a policy entrepreneur to create a complete linkage of problems, politics, and proposals that had previously been floating separately.

Natural Disasters as Focusing Events

Natural disasters have important characteristics that qualify them as focusing events. First, natural disasters have broad impacts on society in terms of loss of life or property damage (Birkland 1997). Developing countries experience significant loss of life from natural disasters (e.g., the Indian Tsunami); the number of deaths from natural disasters is declining in developed countries, such as the United States. Although the loss of life is declining in the United States, areas of the country suffer from property damage due to natural disasters, such as hurricanes and earthquakes. The massive damage by natural disasters means that single events are covered widely by news media (Gans 2005), and such events generate intense interest of the part of the public as well as government decision makers seeing support from their constituents. Members of the public who experience a natural disaster or perceive similarly vulnerable to an event in their neighboring jurisdictions demand government actions to address the impacts of natural disasters(Prater and Lindell 2000).

Natural disasters provide governments opportunities to adopt hazard mitigation measures. Although hazard mitigation actions are not popular is regular times because of the low probability of disasters, the prevailing policy image can change immediately after extreme events because the public demands protection measures, and government decision makers have strong incentives to respond to those demands (Birkland, 1996, 1997). News media cover the images of devastated communities and dramatize the events after a disaster, and this coverage can increase policymakers' interests as well as public attention to the hazard (Gamson and Modigliani 1989). Governments or

policymakers are exposed to public scrutiny, as the public demands protective actions against future disasters. A policy entrepreneur can use an extreme event to highlight the vulnerability of the community to the impacts of climate change and the importance of mitigation and adaptation actions to address climate change.

Government can take climate change mitigation and adaptation actions to alleviate potential damage from natural disasters intensified by climate change immediately after a natural disaster. Natural disasters can serve as policy windows for policy entrepreneurs who seek climate mitigation and adaptation actions by highlighting the vulnerability of the community to the impacts of climate change. Climate change is known to contribute to more frequent or heavy precipitation, heat waves, melting ice, and rising sea levels, all of which cause severe natural disasters (IPCC 2014; King 2004). Because extreme hazard events are closely related to climate change, governments that have previous experience with such events are more likely to adopt climate mitigation and adaptation actions. Of course, warmer temperatures are known to intensify heat waves, and governments that experience climatological disasters are more likely to adopt climate mitigation and adaptation actions.

After a disaster, municipalities can choose to upgrade destroyed functions or infrastructure to better mitigate the negative consequences of such disasters in the future. Extreme events can provide opportunities for communities to upgrade technologies, leading to long-term economic growth, even though natural disasters have negative impacts on the short-term growth (Skidmore and Toya 2002). When communities rebuild the destroyed buildings of infrastructure from disasters, they can adopt policies that facilitate the adoption of advanced technologies that will promote economic growth. Localities may adopt more energy-efficient buildings and infrastructure that generate fewer greenhouse gasses and mitigate the impacts of climate change in

recovering from a disaster. For instance, Greensburg, Kansas rebuilt and renovated its public and private buildings in a sustainable way after a massive tornado hit the city in 2007 (Paul and Che 2011; U.S. Department of Energy, 2012). The city implemented a comprehensive plan to rebuild the destroyed building and to renovate the existing building so that the buildings can have high energy efficiency. The city also implemented alternative fuel generation and rainwater recycling after the disaster.

A natural disaster can also provide an opportunity to adopt adaptation actions to reduce vulnerability to the repeated damage from the extreme event driven by climate change. Policy entrepreneurs in a city can take advantage of the time immediately after a disaster in adopting an adaptation policy option to reduce future damage (Mileti 1999; Mileti and Gailus 2005). In the recovery process, localities consider the future impacts of hazard events in rebuilding the destroyed buildings and infrastructure. Municipalities can choose whether to rebuild the destroyed infrastructure of buildings in a conventional way or in a sustainable manner (Ingraham et al. 2006; Mileti 1999; Paul and Che 2011). The Federal Emergency Management Agency (FEMA) allows disaster relief funds to be used for implementing actions to reduce future disaster damage (Mileti, 1999).

Type of Natural Disasters

Type of disasters may have different effects on climate change mitigation and adaptation actions. Natural disasters are divided into four groups: geophysical, meteorological, climatological, and hydrological disasters. Geophysical disasters are caused by a hazard from solid earth (e.g., earthquakes and volcanoes). Meteorological disasters are results of short-lived extreme weather and atmospheric conditions (e.g., hurricanes, storms, and fog). Climatological disasters are

products of long-lived atmospheric processes (e.g., droughts and wildfires). Hydrological disasters are caused by surface water or subsurface water (e.g., floods).

Economists focus on the effects of different types of disasters on economic growth. For instance, Skidmore and Toya (2002) showed that countries vulnerable to hurricanes and floods tend to experience less loss of human lives than those with earthquakes, although both the former and the latter result in massive amounts of damage to physical capital. Communities with disasters that cause significant loss of human lives tend to invest in human capital, improve total factor productivity, and generate long-term economic growth. Those with disasters that cause more casualties suffer from a lack of human capital and have lower economic growth than before. A developed country like the United States may not have a significant difference in the loss of human lives between these types of disasters. Besides the economic impacts, different types of natural disasters have differences in terms of the difficulties of forecasting, physical impacts, and policy entrepreneurship.

Predictability

Societies do not have a clear understanding of geophysical disasters and do not know when such hazard events will occur; communities predict other type of events better and adapt to the impacts of those events more effectively (Mileti 1999; Skidmore and Toya 2002). For instance, although in the United States, California and its neighboring states are known to be regularly influenced by severe earthquakes, it is hard to predict when those rare events will occur. On the other hand, hurricanes usually hit Gulf and southeastern areas of the United States during a particular season (Birkland 1996, 1997). Communities that are exposed to meteorological disasters are better able to forecast the future events due to the development of satellite technology, and this

allows them to take protective actions, such as evacuation, against the impending events. Similarly, short-term forecasting of droughts is provided to the general public (Mileti 1999), and the prediction of floods has progressed, although it is quite difficult to forecast flash floods (Sorenson 2000).

Table 3.1. Characteristics of Different Type of Disasters

Type of Disasters	Geophysical	Meteorological	Hydrological	Climatological
Examples	Earthquakes	Hurricanes, Tornadoes	Floods	Droughts
Difficulty of forecasting	High	Middle	Middle (flash floods: high)	Middle
Scope of physical impacts	High	High	Middle	Low
Policy entrepreneurship	High	Low	Low	Low

Scope of Physical Impacts

Different types of disasters require different ways to recover from the damage of the hazard events. For example, earthquakes or hurricanes have destructive impacts on buildings and infrastructure in the disaster-affected areas (Birkland 1996, 1997), and repairing such damage requires a large investment in capital in the recovery processes, but floods or droughts do not have such impacts on physical structures (Loyaza et al. 2012). Communities hit by geophysical or meteorological disasters have greater opportunities to rebuild their infrastructure and buildings in a sustainable manner than those with hydrological or climatological disasters.

Political Mobilization and Policy Entrepreneurship

Different types of disasters also change the political dynamics of promoting hazard mitigation actions at the national level. Geophysical disasters are more likely to be elevated on the government agenda than other types of disasters because of the nature of this type of hazard event and the related political interest. For instance, in the United States, policy entrepreneurs are more

prominent in the domain of earthquakes than hurricanes (Birkland, 1996, 1997). A few experts promote hazard mitigation actions after major earthquakes in congressional hearings or other venues, while few policy entrepreneurs operate in the domain of hurricanes.

The unknown nature of geophysical disasters creates great dread among the public because these hazard events are less frequent and more difficult to predict than hurricanes (Birkland 1996, 1997). The unknown nature of earthquakes motivates policymakers to rely on scientific experts to mitigate future harm. In the earthquake domain, hearings are conducted and testimonies are given in science-oriented congressional committees, such as the House Science, Space, and Technology Committee, and scientific and technological experts contribute to agenda activities. Policy entrepreneurs are more likely to appear in the policy processes, and hazard mitigation efforts are supported by the scientific community. After an earthquake, congressional hearings and testimonies involve disaster relief as well as scientific issues; after a hurricane, congressional agendas are dominated by disaster relief.

On the other hand, in the domain of meteorological disasters, the agenda activities involve less scientific expertise than the domain of geophysical disasters. Hearings and testimonies for the hurricane domain are heard in public work committees that stress reconstruction and disaster relief rather than hazard mitigation (Birkland 1996, 1997). The hurricane policy domain relies more on a distribution policy orientation and less on scientific expertise than the earthquake policy domain. The economic benefits of construction projects after hurricanes prevail over strong hazard mitigation measures, such as land regulation, in the disaster affected areas. Thus, there is no national statute to mitigate the risk of hurricanes, while there is the National Earthquake Hazard Reduction Act, a national statute, to mitigate the risks of seismic hazards.

Similarly, the domains of climatological and hydrological disasters have few policy

entrepreneurs or no strong political support in the national policymaking process of the United States (Botterill 2013). At the national level, the drought domain lacks strong political support to establish a national framework or statute. In the domain of floods, there is weak political support to promote stringent hazard mitigation actions because the actions, such as relocation and elevation of buildings, restrict local businesses' location decisions and create financial burdens for local businesses owners. Although there are the National Flood Insurance Program (NFIP) and other relevant statutes to mitigate the damage from flooding events, the NFIP tends to encourage economic development in hazardous areas by insuring development (Birkland et al. 2003). The insurance coverage allows property owners to maintain or develop their properties in areas with a high risk of flooding.

Type of Disasters and Climate Mitigation and Adaptation Actions

The nature and political dynamics regarding types of disasters may determine the extent to which each type of disaster can become a focusing event for governments' adoption of mitigation and adaptation actions. Although geophysical disasters are not directly related to climate change, the extreme events can create wide policy windows for climate mitigation actions compared to other types of disasters because of the unknown nature and the prominence of policy entrepreneurs in the policymaking processes. The low predictability of earthquakes generates a great amount of fear on the part of the public and motivates government decision makers to rely on scientific experts rather than on short-term political interests (Birkland, 1996, 1997). Policy entrepreneurs may provide recommendations to prevent the disruption of transportation and electricity generation and encourage governments to adopt alternative transportation methods and renewable energy generation, which are aligned with climate mitigation actions (Mileti 1999). Immediately

after earthquakes, governments will have opportunities to rebuild buildings and infrastructure so that their jurisdictions can improve energy efficiency and reduce greenhouse gas emissions.

Climatological disasters may not be strong focusing events for climate mitigation but for adaption actions. Extreme events do not provide opportunities for the adoption of climate mitigation actions, such as energy-efficient buildings, because such extreme events usually do not result in physical damage. Although climatological disasters are considered as being closely related to climate change, this type of disaster does not motivate localities to take actions to reduce greenhouse gases. Even localities with longer dry seasons are shown to be less likely to adopt climate mitigation and adaptation actions (Hultiquist, et al. 2017). On the other hand, localities may be more responsive to severe drought events. The public may demand governmental actions to address future droughts or heat waves immediately after the events, and governments will adopt adaptation actions, such as emergency planning for water usage restrictions (Mullin and Rubado 2016).

Meteorological or hydrological disasters may be weak focusing events for governments' adoption of climate mitigation and adaptation actions because of development interests. Immediately after these two types of disasters, governments may consider upgrading their buildings and infrastructure in a more sustainable manner. However, the political dynamics regarding the two types of disasters are not favorable to climate mitigation and adaptation. Government agenda activities are dominated by structural mitigation rather than nonstructural mitigation, which reduces the damage from extreme hazard events (Birkland et al. 2000). Government decision makers have political interests to foster development in hazardous areas, and they have low levels of interest in unpopular actions, such as climate mitigation and adaptation actions, which can impose economic burdens on their constituents.

Hypothesis 1a: Municipalities experiencing a geophysical disaster will be more likely than those experiencing a meteorological, climatological, or hydrological disaster to adopt a climate mitigation action.

Hypothesis 1b: Municipalities have a climatological disaster, as opposed to a meteorological or hydrological disaster, will be more likely to adopt a climate mitigation action.

Hypothesis 1c: Municipalities experiencing a geophysical disaster will be more likely than those experiencing a meteorological, climatological, or hydrological disaster to adopt a climate adaptation action.

Hypothesis 1d: Municipalities that have climatological disaster, as opposed to a meteorological or hydrological disaster, will be more likely to adopt a climate adaptation action.

Environmental Interest Groups

Organized interest groups can clarify the preferences of the public to municipal governments, and government decision makers as policy entrepreneurs are better able to adopt climate actions with support from interest groups. Organized interest groups are known to be powerful in mobilizing resources and personnel to promote their preferred agenda in government decision making (Balla, 1998; Yackee, 2006). According to Kingdon (1995), policy entrepreneurs can use a window opportunity to set a favorable government agenda when streams of politics, problems, and solutions are favorably combined. As environmental interest groups are known to be active in policymaking processes immediately after an environmental disaster, such as an oil spill or a nuclear power plant melt-down (Birkland 1997), the interest groups can have a significant influence on local climate actions. For instance, Sharp et al. (2011) discovered that cities with a high prevalence of environmental groups are more likely to join ICLEI, which promotes climate protection. Pro-environmental policy entrepreneurs may gain support from environmental interest groups that promote sustainability actions or climate actions. Similarly, environmental interest groups tend to support the reconstruction of the destroyed buildings or infrastructure in a

sustainable manner after a disaster to emphasize the image of the negative consequences of climate change.

> *Hypothesis 2a*: The prevalence of environmental interest groups will strengthen the effects of natural disasters on municipalities' climate mitigation actions.
>
> *Hypothesis 2b*: The prevalence of environmental interest groups will strengthen the effects of natural disasters on municipalities' climate adaptation actions.

Roles of Political Institutions

The political market model and the ICA framework help explain the roles of political institutions in municipalities' adoption of climate mitigation and adaptation. The political market model focuses on the interactions between political institutions and constituents as suppliers and demanders. The political structure, such as a particular form of government, can shape chief executives' motivation to adopt climate mitigation and adaptation actions, and the demands of interest groups can influence the adoption of the actions. The ICA framework provides theoretical foundations for understanding how transaction costs can affect municipalities' self-organized efforts for the adoption of climate mitigation and adaptation, which have the nature of public goods. Municipalities' self-organized efforts for climate mitigation and adaptation can be influenced by various environmental characteristics, such as regional fragmentation and state-level rules, which determine transaction costs.

Political Market Model

The political market model can be used to understand the mediating roles of political institutions in interpreting the demands of the public and groups into the adoption and implementation of climate mitigation and adaptation actions. The political market model explains policy change by contract relationship between suppliers and demanders of change in a community

(Feiock 2006). Demands or community preferences are represented by sociodemocratic characteristics, such as population and education levels, and businesses and environmental interest groups. Governments respond to the needs expressed by the general public as well as by interest groups, and the governmental response is mediated by the structure and organization of the government and local institutions (Lubell, Feiock, and Ramirez 2005). Different types of political institutions may have different policy preferences, and they may have different policy responses to the demands of the public and different groups.

Form of Government

Literature suggests that government structure or council-manager versus mayor-council form of government can influence the adoption of municipal governments' climate mitigation and adaptation actions in different ways. In a study of 406 cities in Florida, Lubell, Feicok, and Ramirez (2009) found that the council-manager form of government is more likely to adopt growth-oriented land-use plans as opposed to conservation-oriented use. City managers have been shown to be driven by economic development incentives, while the strong mayor form of government is responsive to the demands of the general public for conservation.

On the other hand, most studies have shown that the council-manager form of government has positive effects on municipalities' adoption of sustainability actions among nationally sampled cities (Bae and Feiock, 2012; Hultquist et al. 2017; Opp, Osgood, and Rugeley 2014). For instance, Bae and Feiock (2012) found that the council-manager form of government has positive effects on the adoption of energy efficiency measures in government operations among U.S. cities with a population over 20,000, while this form of government has negative effects on the adoption of community-wide mitigation measures. City managers focus on the efficiency of internal operations

rather than on community-wide sustainability efforts because the professional managers are less responsive to the public, which demands community-wide energy efficiency initiatives.

In addition, Opp, Osgood and Rugeley (2012) found that the council-manager form of government has positive effects on the adoption of environmental protection measures among municipalities with at least 2,500 people, which represents a more inclusive sample than that of Bae and Feiock (2012). City managers have strong motivations to perform more innovative practices, such as sustainability actions, for their long-term career aspirations; on the other hand, elected mayors have a short-term horizon for reelection.

The council-manager form of government may be better able to adopt climate mitigation actions immediately after a disaster if the damage is not severe enough to discourage the adoption of the actions. City managers have strong career motivations to take credit for such actions by promoting innovative policies (Schneider, Teske, and Mintrom 1995). Although city managers tend to focus on growth-orientated plans rather than conservation (Lubell et al. 2009), chief executives with long-term horizons may use disasters as policy windows for the adoption of innovative practices after extreme events to improve their reputations for future positions. Because career managers are less responsive to the demands of cheap and fast recovery, they may adopt energy efficiency tools to generate reductions in cost in the operation of governments as well as to gain reputation. On the other hand, elected chief executives cannot take credit for actions that take years to produce returns; therefore, they may avoid climate mitigation and adaptation actions that impose financial burdens on their constituents after natural disasters.

> *Hypothesis 3a*: Municipalities with a council-manager form of government are more likely than a mayor-council form of government to adopt climate mitigation.

> *Hypothesis 3b*: Municipalities with a council-manager form of government are more likely than a mayor-council form of government to adopt climate adaptation actions.

Hypothesis 3c: The effects of disasters on climate mitigation actions will be greater for municipalities with a council-manager form of government, compared to those with a mayor-council form of government.

Hypothesis 3d: The effects of disasters on adaptation actions will be greater for municipalities with a council-manager form of government, compared to those with a mayor-council form of government.

Institutional Collective Action (ICA) Framework

The ICA framework may help us understand the process of how fragmented authorities are self-organized to adopt and implement climate mitigation and adaptation actions collectively under uncertainty of the related interactions (Feicok 2009, 2013; Feiock and Scholz 2010). Individual institutional actors have bounded rationality, which does not allow the actors to identify partners and the partners' opportunistic behaviors (Williamson 1985). The partners can take advantage of the limited information and deceive the focal actors. The uncertainty of interactions creates transaction costs for collective action, such as the costs of identifying partners and partners' opportunism. Institutional actors rely on governance structures to address uncertainty. Collective actions may fail unless the participants create a mechanism to reduce the transaction costs and maximize the benefits of the participants. Joint actions among agencies are inhibited unless they do not fully appreciate the benefit of collaboration over the cost.

Fragmented public authorities confront collective action dilemmas in undertaking and adopting climate mitigation and adaptation actions because of the public's good nature (Feiock, 2013). Climate mitigation and adaptation actions benefit municipalities that implement the actions, and neighboring localities benefit as well (Feiock et al., 2009; Feiock, 2016). For instance, the expansion of renewable energy can improve local air quality and have positive impacts on local employment (Pew Charitable Trust 2009) and smart growth, which consists of climate mitigation

measures that can reduce traffic congestion within the municipalities that implement these measures.

In addition, climate mitigation and adaptation actions have collective benefits for local jurisdictions within a region. For instance, the expansion of renewable energy for electricity generation can reduce greenhouse gasses as well as other pollutants and improve regional quality. Municipalities can adopt climate mitigation and adaption measure when they perceive that the benefits of these unilateral actions outweigh the costs. Even though one municipality implements various climate mitigation and adaptation actions, such as emission targets, energy efficiency, and land-use regulations, the neighboring municipalities also enjoy the benefits provided by the municipality, even if they do not contribute.

However, the externality of the collective benefits of climate protection may create transaction costs for collective action and prevent wide adoption of the actions within the affected regions (Feicok 2016). Although the adoption of measures provides collective benefits, governmental authorities sacrifice their immediate interests over long-term collective benefits. An example of this would be the adoption of community-wide energy efficiency requirements that reduce the emissions of greenhouse gasses and other pollutants but impose high upfront costs on residents. Cities that compete with their neighboring cities to attract potential residents may not adopt such expensive measures. In addition, fragmented authorities also confront challenges in adapting collectively to the impacts of climate change, which are future severe hazard events. Governments often share ecological boundaries, such as rivers and watersheds, with other governmental authorities. When individual jurisdictions do not share the priority of mitigating the risk of flooding over development, the governments may not improve the existing climate adaptation measures. Thus, fragmented authorities may address transaction costs to mitigate the

risk of opportunism by authorities by adopting a wide range of climate mitigation and adaptation actions.

The ICA framework identifies the determinants of transaction costs of collective action, which can encourage or discourage the adoption of climate mitigation and adaptation actions. Local governments' self-organized collective efforts depend on state-level rules, transaction characteristics of services and goods, characteristics of communities and regions, and political structures (Feiock 2007, 2009). State-level rules specify strategies to address the negative externality of local actors, and states vary in incentives and mandates to facilitate collective action among local actors. The transactional characteristics of services and goods, such as outcome measurability and asset specificity, influence the risk of collaboration between local actors. The less asset-specific or the more measurable goods and services exchanged between actors are, the less opportunistic the partners are. The more homogeneous the community preferences are, the lower the transaction costs that fragmented authorities bear in taking collaborative efforts. The political structure can determine the chief executive's motivation and attitude toward regional collective efforts. City managers are prone to adopt innovative measures to improve their national reputations for future high-paying positions (Schneider et al., 1995), and mayors have aspirations to improve their reputations among a broad range of constituents (Bicker and Stein 2004).

Regional Fragmentation

The ICA framework suggests that fragmented authorities face challenges in creating and enforcing an agreement to deliver goods with spillover effects (Feiock 2009). Fragmented jurisdictions create interlocal competition for innovation, and localities may consider climate mitigation actions to brand their localities as sustainable cities regionally and nationally (Hughes

2016). However, high fragmentation of regional authorities generates high transaction costs for producing nonexcludable goods and service collectively (Feiock 2009). Numerous local jurisdictions within a particular region are more likely to have different sociodemographic characteristics and heterogeneous community preferences (Feiock 2004). Localities confront challenges to overcome differences in community preferences in coordinating region-wide climate mitigation actions immediately after disasters. Similarly, Sharp et al. (2011) found that metropolitan fragmentation reduces the likelihood that municipalities will join ICLEI, an organization with a strong commitment to climate change protection initiatives. Municipalities in highly fragmented metropolitan areas are less likely to implement climate actions.

> *Hypothesis 4a*: An increase in regional fragmentation will decrease municipalities' adoption of climate mitigation actions.
>
> *Hypothesis 4b*: An increase in regional fragmentation will decrease municipalities' adoption of climate adaptation actions.

State-Level Rules: State Climate Action Plan

State-level rules may facilitate the adoption of climate change mitigation and adaptation actions after natural disasters. State-level rules allow municipalities to reduce transaction costs in addressing the externalities of collective action because the rules specify strategies to address the negative externalities for local actors (Feicok 2007). Of course, top-down prescriptive rules can create transaction costs in terms of compliance, and they can restrict localities' innovation and discretion to include localities' priorities (Fiorino 2006). Even though state mandates assign the roles of local governments to environmental planning and management, low-level governments can be indifferent to the direction of government entities at higher levels. However, state-level rules can provide a wider window of opportunity for localities to implement climate actions. State-level rules can be a coordinating framework for localities in adopting and implementing

sustainable actions (Homsy and Warner 2015), and state mandates encourage local governments to have plans to limit development in hazardous areas (Dalton and Burby 1994). Municipalities can leverage the state's support in recovering from natural disasters and implementing climate change mitigation and adaptation actions. Local governments will be more likely to take advantage of the window opportunity resulting from a natural disaster in implementing climate actions when states stress actions to mitigate or adapt to the impacts of climate change.

> *Hypothesis 5a.* State action will increase the municipalities' adoption of climate mitigation actions.
>
> *Hypothesis 5b.* State action will increase the municipalities' adoption of climate adaptation actions.

Climate Change Mitigation vs. Adaptation

Effects of Natural Disasters

Although natural disasters as focusing events provide policy windows for both climate mitigation and adaptation actions, the effects of disasters may be greater for adaptation actions because of the time of return and nonexclusive benefits. A high nonexclusivity of the benefits of climate mitigation policies may discourage localities from adopting such policies. As the ICA framework suggests (Feicok 2007, 2009), nonexclusivity of goods and services exchanged between actors can create costs of creating an agreement to produce the relevant collective goods and services. Climate mitigation actions benefit neighboring entities as well as other regions, while adaptation actions benefit the focal entities or the neighboring jurisdictions (Fussel and Klein 2006; Shardul and Samuel 2008; Kane and Shogren 2000). One entity's unilateral mitigation efforts can be enjoyed freely by the other entities. Governments that implement such policies cannot exclude others from access to the benefits of the mitigated risk of climate change. However, the benefits of climate change adaptation become exclusive when individual localities strengthen their building

codes to adjust to future frequent tornado events. That is, others cannot enjoy the benefits of the local entities' adaptation efforts. The nonexclusivity of climate mitigation may create higher transactions costs for localities to adopt mitigation actions compared to adaptation actions.

Table 3.2. Mitigation vs. Adaptation: Hypothetical Effects

	Mitigation	Adaptation
Proposed effects of natural disasters	Low to Medium	Medium to High
Proposed effects of political institutions		
Council-manager	+	No effects
State-level rules (climate actions)	+	+
Regional fragmentation	+/-	-

In addition, severe disaster damage may overwhelm localities and discourage them from considering climate mitigation actions in the recovery phase. The localities may select a policy option of rapid and cheap recovery to respond to business interest groups rather than an option with high upfront costs and nontangible benefits (Paul and Che 2011). Although the destroyed buildings and infrastructure can be rebuilt into energy efficiency buildings, community-wide requirements may dissatisfy business interest groups and residents who may not be able to afford the advanced reconstruction options. Of course, geophysical disasters may create wider windows of opportunity for climate mitigation actions than other types of natural disasters. As discussed above, after earthquakes, policy entrepreneurs may provide recommendations to prevent the disruption of transportation and electricity generation and encourage governments to adopt alternative transportation options and renewable energy generation, which are aligned with climate mitigation actions (Mileti 1999).

> *Hypothesis 6*. Natural disasters will have greater impacts on municipalities' adoption of climate change adaptation actions than mitigation actions.

Different Effects of Form of Government

A particular form of government may have different effects on climate mitigation actions and on adaptation actions because of chief executives' career motivations. The political market model suggests that political structures determine the response of political institutions to the demands of residents (Feiock, 2006). Localities can consider climate mitigation actions immediately after a disaster if the damage is not severe enough to discourage the adoption of the actions. Chief executives with long-term horizons or city managers may use disasters as policy windows for adopting climate mitigation actions after extreme events to improve their reputations for future positions. Professional managers may link climate mitigation actions, which include energy efficiency measures, with economic development and efficiency gains (Bae and Feiock 2012). At least, managers may adopt energy efficiency tools to generate reductions in the operational costs of governments after extreme events and thus gain reputation.[1]

On the other hand, the professional managers may not be active in adopting climate adaptation actions. Some of the adaptation actions, such as relocation and land regulations, can limit economic development in managers' jurisdictions (Birkland 2000). Professional managers who seek economic development in their jurisdictions may comply with the business sector's demands for cheap and fast recovery. Similarly, elected chief executives who need quick electoral rewards may not adopt climate adaptation actions to gain support from their constituents and may follow the demands for a cheap and fast recovery after a disaster.

> *Hypothesis 7:* The managerial form of government will have greater effects on climate mitigation actions than on adaptation actions.

[1] Steve Hewitt, the former of city administrator of Greensburg, Kansas, has demonstrated that a career chief executive is interested in adopting innovative practices. He recalled, "The thought was, if we don't do something unique and different, we're just going to be another community that was hit by a tornado and hardly ever recovered" (Farmer, 2013).

Effects of Regional Fragmentation

Climate mitigation and adaptation actions may not differ in the effects of regional fragmentation and state-level rules. Regional fragmentation may have negative effects on both climate mitigation actions and climate adaptation actions. Of course, fragmented jurisdictions create interlocal competition for innovation, and localities may consider climate mitigation actions to brand their localities as sustainable cities regionally and nationally as long-term benefits (Hughes 2016). However, the ICA framework suggests that fragmented authorities face challenges in creating and enforcing an agreement to deliver goods with spillover effects. High fragmentation of regional authorities generates high transaction costs for producing nonexcludable goods and service collectively (Feiock 2009). Regional fragmentation will negatively affect not only climate mitigation actions but also adaptation actions because adaptation actions can suffer from a fragmented authority whose jurisdictions share ecological boundaries (Birkland et al. 2000). Numerous local jurisdictions within a region are more likely to have different sociodemographic characteristics and heterogeneous community preferences (Feiock, 2004). Localities confront challenges to overcome differences in community preferences by coordinating region-wide climate mitigation and adaptation actions immediately after disasters.

> *Hypothesis 8*: The effects of regional fragmentation will have no significant difference between climate mitigation and adaptation actions.

Effects of State-level Climate Actions

State-level rules may have positive effects on both climate mitigation actions and climate adaptation actions. The ICA framework suggests that state-level rules allow municipalities to reduce transaction costs in addressing the externalities of collective action because the rules specify strategies to address the negative externalities for local actors (Feicok 2007). Of course,

top-down prescriptive rules can create transaction costs in terms of compliance, and they may restrict localities' innovation and discretion to include localities' priorities (Fiorino 2006). Even though state mandates assign the roles of local governments to environmental planning and management, low-level governments can be indifferent to the direction of high-level government entities. However, state-level rules can provide a wider window of opportunity for localities to implement climate actions. State-level rules can be a coordinating framework for localities in adopting and implementing sustainable actions (Homsy and Warner 2015), and state mandates encourage local governments to have plans to limit development in hazardous areas (Burby and Dalton 1996).

> *Hypothesis 9*: The effects of state-level climate actions will show no difference between climate mitigation and adaptation actions.

CHAPTER 4

RESEARCH DESIGN

Data

Four major datasets were employed to determine the effect of natural disasters on climate change mitigation and adaptation actions. This chapter discusses the various data sources and the methods of analysis.

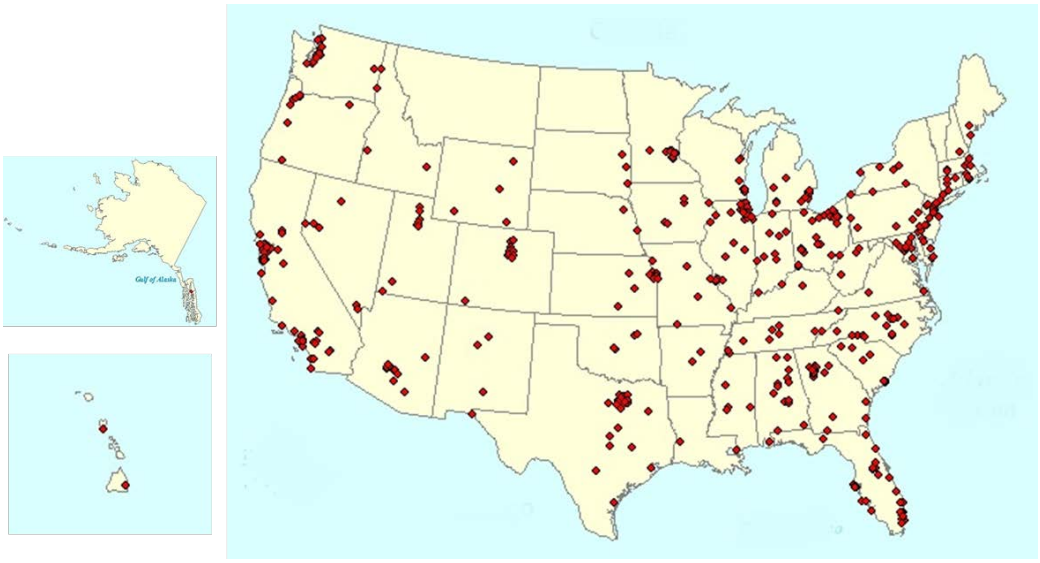
2010 National League of Cities (NLC) Survey

The primary data come from the 2010 NLC survey and the 2010 ICMA sustainability survey. The NLC sent the survey to 1,708 U.S. mayors via email in 2010, and responses were received from 442 cities; the response rate was 26.6%. The response was representative of U.S cities regarding populations and regions (Feiock et al. 2015). The survey data provide information about climate actions these cities have taken.

2010 ICMA Sustainability Survey

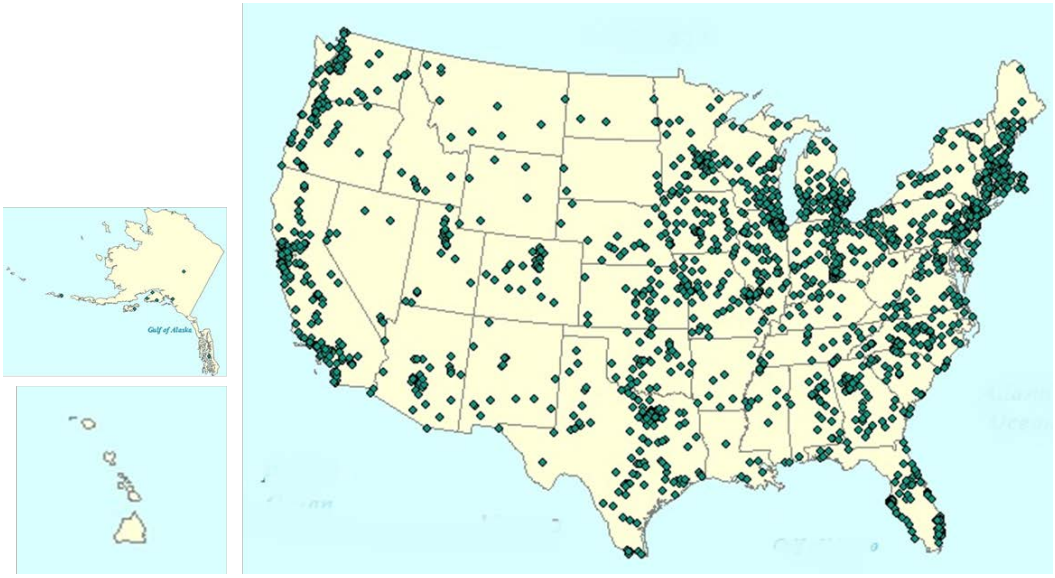
The second survey asked municipal governments what sustainability actions the governments had implemented in their operations and the communities. The survey was administered to 8,569 U.S. local governments and 1,874 cities, and 302 county governments responded to the survey. The response rate was 25.4%. This study used survey responses from municipal governments because the paper focuses on municipalities' sustainability actions. The survey data was used to understand cities' adoption of sustainability actions (Homsy and Warner 2015; Kwon et al. 2013; Opp, Osgood, and Rugeley 2013; Opp and Saunders 2013; Svara et al. 2013), and the data contain information about the climate actions municipalities have adopted.

Figure 4.1. Map of NLC Surveyed Units



*red points indicate municipalities that responded to the survey

Figure 4.2. Map of ICMA Surveyed Units



*blue points indicate municipalities that responded to the survey

Figures 4.1 and 4.2 present the geographic locations of the municipalities that responded to the two surveys. The two surveys include municipalities that represent most states of the United States. The NLC survey contains survey responses from municipalities in 47 states and Washington D.C., with three states with no municipalities responding (i.e., Montana, North Dakota, and

Vermont). The ICMA survey data contain survey responses from 48 contiguous states and Alaska, with no survey responses from Hawaii. The two surveys have 179 common municipalities.

Table 4.1 compares the municipalities that responded to the two surveys and the United States in terms of sociodemographic characteristics. On average, the NLC-surveyed units are more populated and more educated than the ICMA-surveyed units. The NLC-surveyed units have lower average rates of owners occupying their own houses and a lower average proportion of elderly in the population than the ICMA-surveyed units. Both sets of survey data have municipalities with larger populations, higher levels of education, a greater proportion of housing occupied by owners, and a lower proportion of population than the average municipalities of the United States.

Table 4.1. Characteristics of Surveyed Units: NLC vs. ICMA Surveys

	NLC-surveyed units	ICMA-surveyed units	United States (average)
Population	90,717 (158,810)	34,960 (200,685)	9, 873 (80,170)
Housing units occupied by owners	63.62 % (13.05%)	66.17% (13.36%)	72.13% (0.15%)
Education (bachelor's degree or above)	32.79% (15.86%)	27.39 % (16.30%)	20.92% (0.15%)
Elderly population (65 years old and above)	12.63% (5.06%)	14.61% (5.62%)	16.44% (11.26%)

*Numbers indicate the average value of the characteristics; () standard deviation

Presidential Disaster Declarations Data

In addition to the two survey datasets, we used the FEMA presidential disaster declaration (PDD) data. The data record county-level disasters declared by the U.S president, and we used 10 years of PDD data (2000–2009) for this dissertation. A presidentially declared disaster represents the theoretical characteristics of a focusing event: it has a rapid-onset and is rare, it creates massive damage at one time, and it attracts a great deal of attention from the public as well as decision makers. A disaster occurs suddenly and is a rare event in the affected municipalities compared to other types of events, such as traffic accidents (Birkland 1997). The federal disaster declaration

requires the affected states and local governments to demonstrate that the severity and the magnitude of the hazard event exceed the governments' capabilities and show the need for federal aid to respond effectively (44 CFR§206.36). Although a PDD can be made for political reasons, actual disaster damage is shown to be a critical element for the approval of such a declaration (Husted and Nickerson 2014; Reeves 2011; Sylves and Buzas 2007). Finally, the declared disasters become regional as well as national events that attract the intense attention of the residents and high-level decision makers, such as mayors, governors, and the president.

Spatial Hazard Events and Losses Database

The Spatial Hazard Events and Losses Database (SHELDUS) was used to obtain information about disasters and property damage from hazard events that occurred from 2000 through 2009 in the localities studied. The University of Southern Carolina Hazards and Vulnerability Research Institute (2016) runs SHELDUS, a database which contains comprehensive natural hazard event information, such as dates of events, affected counties, and losses caused by events. The institute has constructed the database aggregating data from multiple sources, such as the National Climatic Data Center (NCDC) storm data records, the National Center for Environmental Information, and the U.S. Geological Survey. Although all the hazard events were not declared as disasters, the data complement the FEMA disaster declaration data, which may not cover all disasters that were not declared federally.

Other Data Sources

For this study, we adopted data from the ICMA, the National Center for Charitable Statistics (NCCS), and the Center for Climate Energy Solutions (C2ES) to gain information about

municipalities' forms of government, environmental interest groups, and state climate action plans. U.S. Census data were also used for this study—the aim here was to control for the sociodemographic characteristics of the cities.

Operationalization of Variables

Dependent Variables

Table 4.2 presents two types of variables that capture municipalities' adoption of climate mitigation adaption actions: (1) policy priorities and (2) policy actions. The use of these two types of dependent variables capture a range of policy changes involving policy orientation and actual policy actions.

The first types of dependent variables are "*mitigation priority"* and "*adaptation priority,"* which indicate policy priorities on mitigation and adaptation action. A policy priority is "a clear manifestation of institutional commitments of government" (Jacoby and Schneider 2001, 546). As Baumgartner and Jones (1993, 2005) suggested, policymakers prioritize problems due to the limitation of cognitive capacity. A policy priority represents the policy orientations of governments and is an indicator of what a government plans to do or not to do (Jacoby and Schneider 2001).

The "*mitigation priority"* and "*adaptation priority* variables were measured by using survey items, which asked respondents to rate the level of their cities' priorities in terms of climate change mitigation. The survey item asked: "Please rate the level of priority your city places on the following in regard to your sustainability goals/initiatives." The response categories of these two variables range from 1 ("not a priority") to 4 ("high priority"). Responders were provided with a list of 21 priorities. For the purpose of this dissertation, only two items from the responses were used, i.e., "Climate Change Mitigation" and "Climate Change Adaptation." The mean values of

mitigation policy priorities and adaptation policy priorities are 2.09 and 1.87 respectively.

Table 4.2. Dependent Variables

Variables	Descriptions	Sources	Mean (S.D)
Mitigation Priority	Level of city's priority on climate change mitigation (i.e., 1: Not a priority; 4: High priority).	NLC Sustainability Survey (2010)	2.09 (0.94)
Adaptation Priority	Level of city's priority on climate change adaptation (i.e., 1: Not a priority; 4: High priority).		1.87 (0.82)
Government-wide mitigation Policy Actions	Number of government-wide climate mitigation-related actions.	ICMA Sustainability Survey (2010)	4.21 (3.62)
Community-wide mitigation Policy Actions	Number of community-wide climate mitigation-related actions.		4.88 (4.07)
Adaptation Policy Tools	Number of climate adaptation-related actions.		1.65 (1.54)

A Pearson's correlation was performed to differentiate whether the selected variables, i.e., priority and policy actions of climate change mitigation as well as climate change adaptation, are mutually exclusive. Two-tailed Pearson Correlation tests show that the correlation coefficients of mitigation and adaptation actions are 0.480 and 0.210; and, that they are significant at the level of 0.01. The variables overlapped somewhat. This is not surprising because when local governments placed a higher policy priority on mitigation or adaptation, municipalities are more likely to perceive stronger policy actions.

Table 4.3a. Classification of Climate Change Mitigation and Adaptation Policy Actions

	Mitigation policy Tools	Adaptation policy tools
Government operation	Energy efficiency for government vehicles and buildings (19 items) Alternative transportation for employees (four items)	[Not Surveyed]
Community-wide actions	Energy efficiency support for individual residence and businesses (10 items) Alternative transportation for residents (nine items) Smart land use (three items) Zoning code for high density (two items) Zoning for mixed use (one item)	Water conservation (five items) Purchase/transfer of open space (one item)

In addition to climate change policy orientations, the second dependent variable measured municipalities' climate mitigation and adaptation policy actions by dividing them into two sustainability actions categories—which are measured from 54 survey items of the 2010 ICMA sustainability survey—into two categories: (1) mitigation actions and (2) climate actions. Climate mitigation actions are divided into government operation policy tools and community wide policy actions (see Table 4.3a) (Bae and Feiock 2012; Swann 2016). The list of the actions contains mitigation and adaptation actions surveyed by the existing research (Hultquist et al. 2017; Krause 2011a; Wood, Hultquist, and Romsdahl. 2014). A higher value of the measure indicates a greater number of government-wide/community-wide mitigation or adaptation actions implemented by the municipality, while a low value of the measure means a lower number of the actions. On average, cities adopted nine mitigation policy actions and two adaptation actions (see Table 4.3b).

Table 4.3b. List of Climate Change Mitigation and Adaptation Policy Actions

Climate Change Mitigation Actions/Adaptation Actions	Percentage
Mitigation: Government operations	
Established a fuel efficiency target for the government fleet of vehicles	12%
Increased the purchase of fuel efficient vehicles	44%
Purchased hybrid electric vehicles	23%
Purchased vehicles that operate on compressed natural gas	8%
Installed charging stations for electric vehicles	6%
Conducted energy audits of government buildings	62%
Installed energy management systems to control heating and cooling in buildings	45%
Established policy to only purchase Energy Star equipment when available	16%
Upgraded or retrofitted facilities to higher energy efficiency office lighting	55%
Upgraded or retrofitted traffic signals to improve efficiency	40%
Upgraded or retrofitted streetlights and/or and other exterior lighting to improve efficiency	33%
Upgraded or retrofitted facilities to higher energy efficiency heating and air conditioning	38%
Upgraded or retrofitted facilities to higher energy efficiency pumps in the water	25%
Utilize dark sky compliant outdoor light fixtures	15%
Installed solar panels on a government facility	12%
Installed a geo-thermal system	6%

Climate Change Mitigation Actions/Adaptation Actions	Percentage
Generated electricity through municipal operations such as refuse disposal, waste	6%
Require all new government construction projects to be LEED or Energy Star certified	12%
Require all retrofit government projects to be LEED or Energy Star certified	7%
Mitigation: Community-wide actions	
Energy Audit-Individual residences	8%
Weatherization- Individual residences	14%
Heating / air conditioning upgrades- Individual residences	8%
Purchase of energy efficient appliances- Individual residences	7%
Installation of solar equipment- Individual residences	4%
Energy Audit-Businesses	5%
Weatherization-Businesses	4%
Heating / air conditioning upgrades-Businesses	5%
Purchase of energy efficient appliances-Businesses	4%
Installation of solar equipment-Businesses	4%
Take mass transit to work	7%
Carpool to work	6%
Walk to work	4%
Bike to work	5%
Expanded dedicated bike lanes on streets	36%
Added biking and walking trails	63%
Added bike parking facilities	30%
Expanded bus routes	21%
Requiring sidewalks in new development	58%
Widened sidewalks	28%
Require charging stations for electric vehicles	1%
Require bike storage facilities	8%
Require showers and changing facilities for employees	4%
Permit higher density development near public transit nodes (Building and Land U	20%
Permit higher density development where infrastructure is already in place	21%
Adaptation Actions:	
Actions to conserve the quantity of water from aquifers (Water)	35%
Use of grey-water and/or reclaimed-water use systems (Water)	17%
Sets limits on impervious surfaces on private property (Water)	31%
Use water price structure to encourage conservation (Water)	37%
Other incentives for water conservation behaviors by city, residents, and business	30%
A program for the purchase or transfer of development rights to preserve open space	13%

Independent Variables: Disasters

This study adopts three types of disaster variables: frequency of disasters, type of disaster, and damage amount (see Table 4.4). First, the study differentiates natural disasters into four types: meteorological, hydrological, climatological, and geophysical disasters (EM-DAT 2016; Peter et al., 2015). Four variables indicate whether the region of a municipality had a PDD between 2000 and 2009 for each type of disaster. A meteorological disaster is an event caused by a short-lived atmospheric process such as storm, hurricane, or tornado. A hydrological disaster is an event caused by the normal water cycle (e.g., floods). A climatological disaster is an event caused by a long-lived process (e.g., extreme heat and wildfires). A geophysical disaster is an event originating from the earth (e.g., earthquakes, mud/landslides, and volcanoes). The classification helps capture various types of natural disasters comprehensively. Previous studies have focused on a single type of disaster (Barone and Mocetti 2014) or only disasters caused by three or four types of hazards (Loyaza et al. 2012; Skidomore and Toya 2002).

Table 4.4. Independent Variables (Disasters)

Independent variables	Descriptions	Sources	NLC mean (S.D.)	ICMA mean (S.D.)
Meteorological disaster	Whether the locality had a PDD for a meteorological disaster (e.g., storm, hurricane, or tornado)	FEMA PDDs	0.87 (0.34)	0.86 (0.35)
Hydrological disaster	Whether the locality had a PDD for a hydrological disaster (e.g., floods)		0.10 (0.30)	0.11 (0.31)
Climatological disaster	Whether the locality had a PDD for a climatological disaster (e.g., extreme heat and wildfires)		0.17 (0.37)	0.15 (0.35)
Geophysical disaster	Whether the locality had a PDD for a climatological disaster (e.g., earthquake, mud/landslides, and volcano)		0.04 (0.19)	0.03 (0.17)
Meteorological damage	Property damage amount from meteorological hazard events (in millions of dollars)	SHELDUS	189 (640)	101 (454)
Hydrological damage	Property damage amount from hydrological hazard events (in millions of dollars)		26.9 (80.2)	27.1 (252)

Independent variables	Descriptions	Sources	NLC mean (S.D.)	ICMA mean (S.D.)
Climatological damage	Property damage amount from climatological hazard events (in millions of dollars)		28.7 (206)	16.9 M (27.1)
Geophysical damage	Property damage amount from geophysical hazard events (in millions of dollars).		16.4 (110)	9.2 (252)

In addition, we used information on property damage from hazard events to estimate the severity of disasters in a locality. Disaster property damage is operationalized as property damage caused by four types of natural hazard events. Greater amounts of property damage indicate the higher severity of different types of natural disasters in a locality. Previous research studies considered economic losses due to different types of disasters to examine the impacts of natural disasters on economic development across countries (Schumacher and Strobl 2011). This dissertation uses the total amount of county-level property damage caused by the four types of disasters.

Other Independent Variables

Three independent variables were operationalized to test the effects of political institutions and interest groups on municipalities' climate mitigation and adaptation actions: managerial form of government, fragmentation, and state influence (see Table 4.5). A managerial form of government indicates whether the municipal government has a council-manager form of government. If the municipality has a managerial form of government, the variable is coded as "1"; otherwise, it is "0,". The measure captures differences in the chief executives' motivational base for the adoption of climate mitigation and adaptation actions. Previous research studies tested the effects of forms of government on mitigation actions, such as energy efficiency, and showed that

the managerial form of government is more likely to adopt sustainability actions (Bae and Feiock 2012; Hultiquist et al. 2017; Opp and Saunders 2013; Opp et al. 2014).

The variable capturing environmental interest indicates the extent of mobilization of environmental interest groups. The variable was operationalized by the proportion of the total municipal population to the total county population times the total number of nonprofit environmental organizations (Sharp et al. 2011). Prevalent environmental interest groups in the jurisdiction help pro-environmental policy entrepreneurs initiate the adoption of climate mitigation and adaptation actions. Previous research studies used the measures to test the effects of environmental interest groups on cities' ICLEI membership and found that an increase in the prevalence of environmental interest group leads to an increase in the adoption of ICLEI membership and the number of actions completed, which indicates the expansion of climate mitigation actions (Sharp et al. 2011).

Table 4.5. Independent and Control Variables

Variables	Descriptions	Sources	NLC mean (S.D.)	ICMA mean (S.D.)
Independent variables				
Managerial form of government	Whether the municipality has a managerial form of government ("1"; otherwise, "0")	ICMA	0.64 (0.48)	0.61 (0.49)
Regional fragmentation	Number of municipalities in the metropolitan area	US Census	18.74 (21.41)	12.00 (19.44)
Environmental interest	Total number of nonprofits with an nonprofit environmental organization.	NCCS (2009)	9.50 (26.5)	3.16 (15.30)
State mitigation plan	Whether the state has a climate mitigation plan (greenhouse gas reduction target)	C2ES	0.50 (0.50)	0.50 (0.50)
State adaptation plan	Whether the state has a climate adaptation plan		0.59 (0.49)	0.63 (0.48)

Variables	Descriptions	Sources	NLC mean (S.D.)	ICMA mean (S.D.)
Control variables				
Financial capacity	Own source revenue per capita, thousand dollars (U.S. Census of Governments, 2007)	C2ES	1.79 (1.43)	1.49 (1.28)
Senior population	Percentage of population over 65 years old	US Census (2010)	12.63(5.06)	14.61 (5.62)
White population	Percentage of the white population		67.11 (20.47)	74.10 (22.21)
Education	Percentage of population with a bachelor's degree or above		32.80 (15.86)	28. 98 (16.30)
Home ownership	Percentage of housing units occupied by owners		63.24 (12.86)	66.17 (13.36)
Coastal area	Location of the municipality in a coastal area (Yes = 1; No = 0)	NOAA	0.44 (0.50)	0.43 (0.50)

Regional fragmentation was examined to capture the extent to which the metropolitan area where the municipality is located is fragmented and is measured as the number of municipalities in the metropolitan area (Sharp et al. 2011). A greater number of general purpose governments indicates a higher level of fragmented authorities in a region, which leads to greater competition for innovation as well as lower coordination for collective action, such as region-wide climate mitigation and adaptation actions (Feiock 2004). Previously existing research made use of the measure to test the effects of metropolitan fragmentation on the adoption of ICLEI membership and the number of mitigation actions adopted (Sharp et al. 2011).

State-level mitigation plans and adaption plans indicate how strongly a state government influences municipalities' environmental activities and is measured as whether the state has a greenhouse gas reduction target or adaptation action. If the state has a greenhouse gas reduction target, the state mitigation plan is coded as "1'; otherwise, it is "0". If the state has an adaptation

plan, the state adaptation plan is coded as “1”; otherwise, it is “0”. Previously existing research studies examined state mitigation plans to test the effects of state climate actions on climate mitigation and on adaptation actions but did not differentiate state adaptation actions from mitigation actions (Krause 2012; Homsy and Warner 2015; Hultiquist et al. 2017). Because state mitigation and adaptation actions have distinctive aims to address climate change, in this dissertation, we distinguish the two types of climate mitigation and adaptation actions at the state level.

Control Variables

For this study, we adopted seven control variables representing socioeconomic characteristics of the municipalities that may affect the needs of environmental sustainability actions (see Table 2b): (1) financial capacity, (2) senior population, (3) white population, (4) education, (5) homeownership, and (6) coastal area.

First, financial capacity is measured as per capita own source revenue (Krause 2012; Opp et al. 2014; Svara et al. 2013). Higher per capita levels of own source revenue indicate greater financial capacity to make sustainability efforts (Feiock, Krause, and Hawkins 2017; Homsy and Warner 2015). Municipalities with high levels of financial capability will be better able to initiate climate mitigation and adaptation actions that require municipalities to bear high upfront costs while the actions provide long-term benefits, such as cost-savings and reduced future disaster damage for the adopted municipalities.

Second, senior population is measured as the percentage of population over 65 years old. Municipalities, where the aged population is prominent, may have great needs of residential conditions to reduce the vulnerability to climate change. Aged population may have difficulties

with cope with the negative impacts of climate change, such as extreme heat without improvement in the residential and neighborhood conditions because of their physical weaknesses (EPA 2016).

Third, the white population variable represents the racial composition of the municipality and is measured as the percentage of the white population (Homsy & Warner, 2015; Opp et al., 2014; Svara et al., 2013). Localities dominated by white populations may be more affluent than other localities and tend to have great demand for environmental sustainability. In contrast to the expectations, previous research studies found a negative association between the proportion of the white population and environmental protection activities (Homsy and Warner 2015; Opp et al. 2014; Svara et al. 2013).

Fourth, education represents the civic capacity of the residents of the municipality and is estimated as the percentage of the population with a bachelor's degree or above (Krause, 2011; Opp et al., 2014; Svara et al., 2013). Highly educated residents may have clear understanding of the seriousness of climate change and may demand more mitigation and adaptation actions to address the negative impacts of climate change. Cities with highly educated populations tend to take aggressive climate mitigation and adaptation actions.

Fifth, home ownership was measured as the percentage of housing units occupied by owners (Homsy and Warner 2015; Svara et al. 2013). Although homeowners may support environmental protection activities to improve their property values, empirical research has revealed opposite results in regard to the relationship between the proportion of homeownership and environmental activities. Homeowners may be opposed to the municipality's mitigation and adaptation actions, such as retrofitting, relocation, and elevation, which require a financial investment.

Finally, the coastal area variable accounts for the location of the municipality. This was

measured according to whether a county is located in a coastal area, and it is coded "1" if so (Pitt 2010; Wang 2013; Zahran et al. 2008). The National Oceanic and Atmospheric Aadministration has identified counties as coastal if they have at least 15% of their land area located in a coastal watershed (NOAA 2012). Municipalities located in coastal areas may perceive great needs in terms of adapting to disasters and may take more or less environmental sustainability actions.

Analytical Methods

For this dissertation, two regression modeling methods were employed to analyze the combined data: (1) multilevel ordered logistic regression analysis and (2) multilevel negative binomial modeling. First, a multilevel ordered logistic regression analysis was used to test the relationships between the first dependent variable (i.e., the policy priority variable and the independent and control variables). Cities, the basic unit of analysis, are nested within states (Level 1: municipality; Level 2: state), and the policy priority variables are based on ordered responses of mitigation/adaptation policy priorities. The regression analysis accounts for the clustering effects of observations and ordered categorical outcomes; it also helps resolve the underestimation of correlated errors and is at a constant distance between cases, which a standard regression analysis does not address (Raudenbush and Bryk 2002).

Second, a multilevel negative binomial regression analysis was used to test the associations between the third dependent variable (i.e., the action variable) and the independent and control variables. Cities, the basic observations, within the same states tend to cluster, and the dependent variables are the numbers of mitigation or adaptation actions adopted by municipalities. The regression analysis accounts for the clustering effects of the observations and the count outcomes, which a standard regression analysis does not address (Raudenbush & Bryk, 2002). The estimated

residual variance at the state level shows that there was a significant variance between states before the modeling.

CHAPTER 5

DATA ANALYSIS AND FINDINGS

This chapter reports the findings of the multilevel ordered logistic regression analyses and multilevel negative binomial regression analyses. The chapter presents the effects of natural disasters and political institutions on climate change mitigation and adaptation actions, respectively, and compares the effects of the independent variables on climate change mitigation and adaptation actions.

Effects of Natural Disasters

Table 5.1 reports the regression results, estimating the effects of natural disasters, political institutions, and sociodemographic conditions on municipalities' policy priorities and policy actions on climate change mitigation. The first and second models used multilevel ordered logistic regressions (MOLR) to estimate the main effects of the independent variables, and the other four models employed multilevel negative binomial regression (MNBR) to estimate the effects of disasters on climate mitigation policy actions. The first model contains disaster variables measured as PDDs, and the latter two models helped us estimate the effects of natural disasters using the total amount of property damage and property damage per capita by each type of hazard event.

Are Mitigation Actions Influenced by Natural Disasters?

It was expected that natural disasters would have different effects on mitigation priority and policy actions (H1a and H1b). The model results show that no type of federally declared natural disaster has a significant effect on mitigation priority, although the disaster variables have different coefficients (H1a and H1b). Model 2's results show that property damage from

hydrological disasters has positive effects on mitigation priority (p value < 0.05), while other types of disasters do not have significant effects. A 1% increase in property damage from flooding events leads to a 0.10 increase in the log odds of being at a higher level of policy priority on climate change mitigation. On the other hand, federal natural disasters and disaster property damage do not have significant effects on municipalities' government-wide and community-wide climate mitigation policy actions. Although the four types of natural disasters have different coefficients and signs, the coefficients are not statistically significant (> 0.1).

Table 5.2 presents results showing estimated interaction effects between natural disasters and environmental interests on mitigation actions (H2a). Property damage from meteorological disaster damage and the influence of environmental interest groups have positive interaction effects on mitigation priority (p value < 0.1). When there is a 1% increase in the number of environmental interest groups, a 1% increase in property damage by a meteorological disaster leads to a 0.05% increase in the log odds of being at a higher mitigation policy priority. Similarly, property damage from meteorological disasters has positive interaction effects with environmental interests (p value < 0.05). When there is a 1% increase in the number of environmental nonprofit interest groups, a 1% increase in the amount of property damage from meteorological disasters leads to a 0.004 increase in the expected log count of the number of government-wide mitigation actions.

Table 5.1. Results of Multi-Level Regressions Estimating Mitigation Actions: Main Effects

Dependent variable: Mitigation priority/policy action	Model 1		Model 2		Model 3		Model 4		Model 5		Model 6	
	Mitigation priority		Mitigation priority		Government-wide mitigation		Government-wide mitigation		Community-wide mitigation		Community-wide mitigation	
	Coef.	S.E.	Coef.	Coef.	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.
Meteorological Disaster (PDD)	0.12	0.35			0.01	0.06			-0.02	0.06		
Hydrological Disaster (PDD)	-0.12	0.42			0.03	0.07			0.02	0.08		
Climatological Disaster (PDD)	-0.39	0.37			0.00	0.07			0.00	0.08		
Geophysical Disaster (PDD)	-0.93	0.77			0.06	0.15			0.09	0.16		
Meteorological Disaster Damage (logged)			0.07	0.05			0.01	0.01			0.01	0.01
Hydrological Disaster Damage (logged)			**0.10*** **	0.03			0.00	0.01			0.01	0.01
Climatological Disaster Damage (logged)			-0.03	0.02			0.00	0.00			0.00	0.00
Geophysical Disaster Damage (logged)			0.03	0.03			0.00	0.01			0.00	0.01
Environmental Interest	**0.44*** **	0.09	**0.41*** **	0.09	**0.06*** **	0.01	**0.06*** **	0.01	**0.05*** **	0.01	**0.05*** **	0.01
Managerial form of government	-0.02	0.23	-0.03	0.24	**0.23*** **	0.04	**0.23*** **	0.04	**0.22*** **	0.04	**0.21*** **	0.04
Regional fragmentation	0.10	0.12	-0.06	0.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Own source revenue per capita	0.18**	0.08	0.22***	0.08	0.09***	0.02	0.09***	0.02	0.10***	0.02	0.10***	0.02
White (percent)	0.01	0.01	-0.00	0.01	-0.00***	0.00	-0.00***	0.00	-0.00	0.00	-0.00***	0.00
Home ownership (percent)	-0.01	0.01	-0.02*	0.01	-0.01***	0.00	-0.01***	0.00	-0.01***	0.00	-0.01***	0.00
Education (percent)	0.00	0.00	0.00	0.00	0.01***	0.00	0.01***	0.00	0.01***	0.00	0.01***	0.00
Senior population (percent)	-0.01	0.02	-0.02	0.02	0.00	0.00	0.00	0.00	-0.02***	0.00	-0.02***	0.00
Coastal (dummy)	0.44	0.28	0.26	0.28	-0.05	0.05	-0.06	0.05	-0.09*	0.05	-0.09*	0.05
Threshold 1	-0.61	0.78	1.19	1.04								
Threshold 2	1.56	0.78	3.42	1.06								
Threshold 3	3.19	0.80	5.09	1.08								
Constant					1.94***	0.07	1.80***	0.15	1.79***	0.14	1.61***	0.15
State level intercept	0.33	0.21	1.16	1.04	0.03	0.01	0.01	0.01	0.04	0.01	0.04	0.01
State Mitigation Action	**0.78** **	0.32	**0.72** **	0.33	**0.20*** **	0.13	**0.21*** **	0.07	**0.18** **	0.08	**0.19** **	0.08

***<0.01; **<0.05; *<0.1 (two-tailed).

Table 5.2. Results of Multi-Level Regressions Estimating Mitigation Actions: Interaction Effects (Environmental Interest)

Dependent variable: Mitigation priority/policy action	Model 7		Model 8		Model 9		Model 10		Model 11		Model 12	
	Mitigation priority		Mitigation priority		Government-wide actions		Government-wide actions		Community-wide mitigation		Community-wide mitigation	
	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.		
Meteorological Disaster (PDD)	0.42	0.48			0.02	0.06			0.00	0.06		
Meteorological Disaster (PDD) X Environmental Interest	-0.17	0.24			0.02	0.02			**0.06*** **	0.02		
Hydrological Disaster (PDD)	-0.31	0.67			0.02	0.07			0.02	0.08		
Hydrological Disaster (PDD)x Environmental Interest	0.07	0.32			**0.08** **	0.03			**0.08** **	0.03		
Climatological Disaster (PDD)	-1.30**	0.53			-0.02	0.07			-0.04	0.08		
Climatological Disaster (PDD)x Environmental Interest	**0.53** **	0.23			**0.03***	0.02			**0.06*** **	0.02		
Geophysical Disaster (PDD)	-6.85**	2.98			0.03	0.16			0.09	0.17		
Geophysical Disaster (PDD) x Environmental Interest	**2.78** **	1.41			0.00	0.09			-0.05	0.09		
Meteorological Disaster Damage (logged)			-0.01	0.07			0.01	0.01			0.00	0.01
Meteorological Disaster Damage (logged)x Environmental Interest			**0.05***	0.03			**0.00** **	0.00			0.00	0.00
Hydrological Disaster Damage (logged)			0.14***	0.04			0.00	0.01			0.01	0.01
Hydrological Disaster Damage (logged)x Environmental Interest			-0.03	0.02			0.00	0.00			0.00	0.00
Climatological Disaster Damage (logged)			-0.01	0.03			0.00	0.00			0.00	0.00
Climatological Disaster Damage (logged) x Environmental Interest			-0.01	0.02			0.00	0.00			0.00	0.00
Geophysical Disaster Damage (logged)			-0.02	0.05			0.00	0.01			0.00	0.01
Geophysical Disaster Damage (logged)x Environmental Interest			0.03	0.02			**0.01*** **	0.00			**0.01** **	0.00
Environmental Interest	0.48**	0.23	0.10	0.38	0.04**	0.02	-0.02	0.03	-0.01	0.02	0.03	0.03
Managerial form of government	-0.01	0.24	-0.04	0.24	0.22***	0.04	0.22***	0.04	0.21	0.04	0.21	0.04
Regional fragmentation	0.16	0.08	-0.09	0.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Own source revenue per capita	0.00	0.01	0.22***	0.08	0.09***	0.02	0.09***	0.02	0.10	0.02	0.10***	0.02
White (percent)	-0.01	0.01	0.00	0.01	0.00***	0.00	0.00***	0.00	0.00	0.00	0.00	0.00

Dependent variable: Mitigation priority/policy action	Model 7		Model 8		Model 9		Model 10		Model 11		Model 12	
	Mitigation priority		Mitigation priority		Government-wide actions		Government-wide actions		Community-wide mitigation		Community-wide mitigation	
	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.		
Home ownership (percent)	0.00	0.00	-0.01	0.01	-0.01***	0.00	-0.01***	0.00	-0.01	0.00	-0.01***	0.00
Education (percent)	-0.02	0.02	0.00	0.00	0.01***	0.00	0.01***	0.00	0.01***	0.00	0.01***	0.00
Senior population (percent)	0.46	0.29	-0.02	0.02	0.00	0.00	0.00	0.00	-0.02	0.00	-0.02***	0.00
Coastal (dummy)	-0.01	0.24	0.27	0.29	-0.05	0.05	-0.05	0.05	-0.08	0.05	-0.10*	0.05
Threshold 1	0.86	0.33	0.40	1.27								
Threshold 2	0.86	0.33	2.66	1.28								
Threshold 3	0.86	0.33	4.35	1.30								
Intercept: municipal level					1.92***	0.13	1.74	0.14	1.75	0.14	1.58***	0.15
Intercept: state level	0.39	0.24	0.43	0.24	0.03	0.01	0.02	0.01	0.04	0.01	0.04	0.01
State mitigation action	0.86**	0.33	0.77**	0.34	0.20	0.07	0.19***	0.07	0.18	0.08	0.18**	0.08

***<0.01; **<0.05; *<0.1 (two-tailed).

Local governments that experience flooding events are more likely to increase the number of mitigation policy actions when there are prevalent environmental interest groups in their jurisdictions. Hydrological disasters and environmental interest groups have positive interaction effects on government-wide and community-wide mitigation policy actions but not on mitigation policy priorities. The coefficient of mitigation is 0.07 and is not statistically significant at the level of 0.1. On the other hand, the coefficients of the two other interaction terms are both 0.08 and statistically significant (p value < 0.05). A federally declared disaster leads to a 0.08 increase in the expected log count of the number of government-wide and community-wide mitigation policy actions.

Climatological disaster and environmental interest groups have positive interaction effects on mitigation priority and government-wide and community-wide mitigation policy actions. The coefficients of the interactions terms are 0.53 (p value < 0.05), 0.03 (p value < 0.01), and 0.06 (p value < 0.05) (models 7, 9, and 11). When there is a 1% increase in the number of nonprofit environmental organizations, a presidentially declared climatological disaster results in a 0.53 increase in the log odds of being at a higher level of policy priority on climate mitigation actions. A federal disaster leads to a 0.03 increase in the number of government-wide mitigation actions and a 0.06 increase in the expected log count of community-wide mitigation actions.

Geophysical disasters and environmental interest groups have positive interaction effects on mitigation policy priorities and policy actions. The coefficient of the interaction term between federal climatological disasters and environmental interest groups is 2.78 and is statistically significant at the level of 0.05 (model 7). A PDD results in a 2.78 log odds of being in a higher level of policy priority on climate mitigation. In addition, the coefficients of the two interaction terms between property damage and environmental interest groups are both 0.01 and are

statistically significant at the level of 0.05 (models 10 and 12). A 1% increase in the property damage amount of geophysical disasters leads to a 0.01 increase in the log odds of the number of government-wide and community-wide mitigation actions.

Are Adaptation Actions Influenced by Type of Natural Disasters?

Table 5.3 presents the results of MOLR and MNBR estimating the effects of natural disasters on climate adaptation policy priorities and adaptation policy actions. Meteorological disasters and geophysical disasters do not have significant effects on the two dependent variables (p value > 0.1). On the other hand, hydrological disasters have positive effects on policy priorities and policy actions on adaptation. Property damage from hydrological hazard events has positive effects on adaptation priority (p value < 0.1), while other types of disasters do not have significant effects. A 1% increase in property damage from hydrological events results in a 0.05 increase in the log odds of being at a higher level of policy priority on adaptation (H1c and H1d). A presidentially declared hydrological or climatological disaster has positive effects on adaptation policy actions. The coefficients are 0.24 and 0.19 and are statistically significant at the level of 0.05. A federal hydrological disaster and climatological disaster result in each 0.25 and 0.19 increase in the expected log count of adaptation policy actions.

Table 5.3. Results of Multi-Level Regression Estimating Adaptation Actions: Main Effects

Dependent variable: Adaptation priority/Policy action	Model 13		Model 14		Model 15		Model 16	
	Adaptation priority		Adaptation priority		Adaptation policy actions		Adaptation policy actions	
	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.
Meteorological Disaster (PDD)	-0.05	0.34			-0.07	0.07		
Hydrological Disaster (PDD)	-0.26	0.42			**0.24*** **	**0.08**		
Climatological Disaster (PDD)	-0.01	0.35			**0.19** **	**0.09**		
Geophysical Disaster (PDD)	-0.71	0.76			0.19	0.17		
Meteorological Disaster Damage (logged)			0.04	0.05			0.01	0.01
Hydrological Disaster Damage (logged)			**0.05***	**0.03**			0.00	0.01
Climatological Disaster Damage (logged)			0.01	0.02			0.00	0.00
Geophysical Disaster Damage (logged)			0.01	0.03			0.00	0.01
Environmental Interest	**0.30*** **	0.09	**0.27*** **	0.09	**0.01***	0.01	**0.02** **	0.01
Managerial form of government	-0.19	0.24	-0.22	0.24	**0.14*** **	0.05	**0.15*** **	0.05
Regional fragmentation	0.15	0.12	0.02	0.13	0.00	0.00	0.00	0.00
Own source revenue per capita	0.16**	0.07	0.18**	0.08	0.09***	0.02	0.09***	0.02
White (percent)	-0.01	0.01	-0.01	0.01	0.00	0.00	0.00	0.00
Home ownership (percent)	0.00	0.01	0.00	0.01	0.00	0.00	0.00**	0.00
Education (percent)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Senior population (percent)	0.00	0.02			-0.02***	0.00	-0.02***	0.00
Coastal (dummy)	0.50*	0.28			0.03	0.06	0.05	0.06
Threshold 1	0.28	0.78	1.18	1.00				
Threshold 2	2.66	0.79	3.58	1.02				
Threshold 3	4.43	0.82	5.36	1.05				
Intercept: municipal level					0.29*	0.17	0.19	0.19
Intercept: state level	0.20	0.19	0.20	0.04	0.12	0.03	0.16	0.05
State adaptation action	0.45	0.30	0.44	0.30	0.14	0.13	0.13	0.13

***<0.01; **<0.05; *<0.1 (two-tailed).

Table 5.4. Results of Multi-Level Regressions Estimating Adaptation Actions: Interaction Effects (Environmental Interest)

Dependent variable: Adaptation priority/Policy action	Model 17		Model 18		Model 19		Model 20	
	Adaptation priority		Adaptation priority		Adaptation policy actions		Adaptation policy actions	
	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.
Meteorological Disaster (PDD)	0.55	0.49	-0.07	0.07	-0.07	0.07		
Meteorological Disaster (PDD) X Environmental Interest	-0.37	0.23	-0.00	0.02	-0.00	0.02		
Hydrological Disaster (PDD)	0.04	0.64	0.24	0.09	0.24	0.09		
Hydrological Disaster (PDD)x Environmental Interest	-0.20	0.32	0.03	0.03	0.03	0.03		
Climatological Disaster (PDD)	-0.56	0.49	0.17	0.09	0.17	0.09		
Climatological Disaster (PDD)x Environmental Interest	0.35	0.22	0.03	0.02	0.03	0.02		
Geophysical Disaster (PDD)	-2.79*	1.67	0.25	0.19	0.25	0.19		
Geophysical Disaster (PDD) x Environmental Interest	1.01	0.69	-0.08	0.09	-0.08	0.09		
Meteorological Disaster Damage (logged)							0.01	0.01
Meteorological Disaster Damage (logged)x Environmental Interest							0.00	0.00
Hydrological Disaster Damage (logged)							0.00	0.01
Hydrological Disaster Damage (logged)x Environmental Interest							0.00	0.00
Climatological Disaster Damage (logged)							0.00	0.00
Climatological Disaster Damage (logged) x Environmental Interest							0.00	0.00
Geophysical Disaster Damage (logged)							0.00	0.01
Geophysical Disaster Damage (logged)x Environmental Interest							0.00	0.00
Environmental Interest	0.56**	0.23	0.00	0.02	0.00	0.02	-0.02	0.03
Managerial form of government	-0.15	0.24	0.14***	0.05	0.14***	0.05	0.14***	0.05
Regional fragmentation	0.16	0.12	0.00	0.00	0.00	0.00	0.00	0.00
Own source revenue per capita	0.13*	0.08	0.09***	0.02	0.09***	0.02	0.10***	0.02
White (percent)	-0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00
Home ownership (percent)	0.00	0.01	0.00**	0.00	0.00**	0.00	0.00**	0.00

Dependent variable: Adaptation priority/Policy action	Model 17		Model 18		Model 19		Model 20	
	Adaptation priority		Adaptation priority		Adaptation policy actions		Adaptation policy actions	
	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.
Education (percent)	0.00	0.00	0.00*	0.00	0.00*	0.00	0.00***	0.00
Senior population (percent)	0.00	0.02	-0.02***	0.00	-0.02***	0.00	-0.02	0.00
Coastal (dummy)	0.52*	0.28	0.01	0.06	0.01	0.06	0.01	0.06
Threshold 1	2.54*	1.42						
Threshold 2	4.70***	1.44						
Threshold 3	6.35***	1.45						
Intercept: municipal level			0.31*	0.17	0.31*	0.17	0.19*	0.19
Intercept: state level	0.34***	0.21	0.13***	0.04	0.13***	0.04	0.16***	0.05
State Adaptation Action	0.51*	0.30	0.12	0.13	0.12	0.13	0.12	0.13

***<0.01; **<0.05; *<0.1 (two-tail)

As shown in Table 5.4, the interaction results do not support the second hypothesis of adaptation action (H2b). Interaction terms between three types of natural disasters and environmental interests do not have significant effects on climate adaptation actions (p value < 0.1). Unexpectedly, the interaction term between the amount of property damage from hydrological disasters and environmental interest groups has negative effects on policy priorities on adaptation. When there is a 1% increase in the number of nonprofit environmental organizations in the jurisdictions, a 1% increase in the amount of property damage from hydrological disasters will result in a jurisdiction being at lower levels of policy priority on climate change adaptation. When a municipality is hit by a severe flooding event, environmental interest groups that promote mitigation policies may oppose certain adaptation actions, such as structural improvements that can affect the natural environment negatively.

Effects of Political Institutions

Form of Government: Main Effects

Table 5.1 shows that the findings related to forms of government partially support the expectations that the managerial form of government is more likely to adopt climate mitigation actions than the other forms of government (H3a). The government structure variables do not have significant effects on mitigation priority. The coefficients of managerial form of government in the first two models are 0.10 and -0.06, and they are not statistically significant at the level of 0.1. Municipalities with managers as chief executives do not significantly differ from municipalities with elected officials as chief executives in shaping mitigation policy priorities.

On the other hand, the managerial form of government has positive significant effects on government-wide and community-wide mitigation policy actions. Table 5.1 shows that the

coefficients of managerial form of government in the four latter models are 0.22 and 0.21, and they are statistically significant at the level of 0.01. Managerial forms of government are more likely to have a greater count of mitigation policy actions in terms of governmental operation as well as community land use and energy use.

Similarly, the findings regarding the effects of forms of government on adaptation actions partly support the expectations (H2b). The managerial form of government has positive and significant effects on adaptation policy actions but not on policy priorities on adaptation. As Table 5.3 shows, the coefficients of managerial form of government are -0.19 and -0.22 in the first two models, and they are not statistically significant at the level of 0.1. The findings suggest that managerial forms of government are not significantly different from the other forms of government in shaping policy priorities on climate adaptation. On the other hand, the managerial form of government variables in the latter two models are statistically significant at the level of 0.01. Managerial forms of government are more likely to adopt a greater number of climate adaptation actions than governments such as the mayor-council form of government.

Form of Government: Interaction Effects

Tables 5.5 and 5.6 show that forms of government have mixed interaction effects with natural disasters on climate mitigation and on adaptation actions, although it was expected that there would be consistent positive interaction effects between natural disasters and mitigation and adaptation actions (H3c and H3d). Meteorological disasters do not have any interaction effects with forms of government. Hydrological, climatological, and geophysical disasters have positive or negative significant interaction effects with forms of government on climate mitigation and on adaptation actions.

Hydrological disasters have significant interaction effects with forms of government on government-wide mitigation-wide policy actions; this is not true for the variables on policy priorities on mitigation and adaptation and community-wide actions on climate mitigation actions. Table 5.3 shows that the coefficients of the interaction terms between federal hydrological disasters and forms of government are 0.19 and 0.04, but they are not statistically significant at the level of 0.1. The coefficient of the interaction terms between property damage from hydrological events and forms of government is -0.01 and is not statistically significant. Table 5.4 presents the results of the interaction effects between hydrological disasters and forms of government. The interaction terms are not statistically significant at the level of 0.1. On the other hand, property damage from hydrological disasters has negative and significant effects on policy priorities on climate mitigation. The coefficient of the interaction term between property damage from hydrological events and forms of government is -0.10 and is statistically significant at the level of 0.05. Under the managerial form of government, a 1% increase in the amount of property damage from a hydrological event leads to a 0.10 decrease in the log odds of being at a higher level of policy priority on climate mitigation. In other words, the mayoral form of government is more likely to shape policy priorities on mitigation than the managerial form of government..

Table 5.5. Results of Multi-Level Regressions Estimating Mitigation Actions: Interaction Effects (Form of Government)

Dependent variable: Mitigation priority/Policy Action	Model 7		Model 8		Model 9		Model 10		Model 11		Model 12	
	Mitigation priority		Mitigation priority		Government-wide mitigation		Government-wide mitigation		Community-wide mitigation		Community-wide mitigation	
	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.
Meteorological Disaster (PDD)	0.04	0.62			0.03	0.09			-0.05	0.10		
Meteorological Disaster (PDD) X Managerial form of government	0.17	0.70			-0.04	0.11			0.05	0.11		
Hydrological Disaster (PDD)	-0.19	0.67			0.00	0.10			0.00	0.11		
Hydrological Disaster (PDD) X Managerial form of government	0.19	0.84			0.04	0.13			0.03	0.13		
Climatological Disaster (PDD)	1.44	0.90			-0.12	0.14			0.05	0.14		
Climatological Disaster (PDD) X Managerial form of government	**-2.06****	**0.93**			0.14	0.14			-0.06	0.14		
Geophysical Disaster (PDD)	-1.22	1.05			0.18	0.20			0.30	0.21		
Geophysical Disaster (PDD) X Managerial form of government	0.62	1.30			-0.19	0.22			-0.32	0.22		
Meteorological Disaster Damage (logged)			0.09	0.07			0.00	0.01			0.00	0.01
Meteorological Disaster Damage (logged) X Managerial form			-0.06	0.08			0.01	0.01			0.01	0.01
Hydrological Disaster Damage (logged)			0.10**	0.05			0.01*	0.01			0.01	0.01
Hydrological Disaster Damage (logged) X Managerial form			0.01	0.06			**-0.02***	**0.01**			-0.01	0.01
Climatological Disaster Damage (logged)			0.04	0.04			0.00	0.01			0.01	0.01
Climatological Disaster Damage (logged) X Managerial form			**-0.09***	**0.05**			0.00	0.01			-0.01	0.01
Geophysical Disaster Damage (logged)			-0.05	0.05			0.01	0.01			0.01	0.01
Geophysical Disaster Damage (logged) X Managerial form			**0.10***	**0.06**			-0.01	0.01			-0.02	0.01
Environmental Interest	0.42***	0.09	0.41***	0.09	0.06***	0.01	0.06***	0.01	0.05	0.01	0.05***	0.01
Managerial form of government	-0.09	0.68	0.83	1.38	0.25**	0.11	0.27	0.17	0.19*	0.11	0.27	0.17
Regional fragmentation	0.14	0.13	-0.04	0.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Own source revenue per capita	0.18**	0.08	0.22***	0.08	0.09***	0.02	0.09***	0.02	0.10***	0.02	0.10***	0.02
White (percent)	0.00	0.01	0.00	0.01	0.00***	0.00	0.00***	0.00	0.00	0.00	0.00***	0.00

Dependent variable: Mitigation priority/Policy Action	Model 7		Model 8		Model 9		Model 10		Model 11		Model 12	
	Mitigation priority		Mitigation priority		Government-wide mitigation		Government-wide mitigation		Community-wide mitigation		Community-wide mitigation	
	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.
Home ownership (percent)	-0.02*	0.01	-0.02	0.01	-0.01***	0.00	-0.01***	0.00	-0.01***	0.00	-0.01***	0.00
Education (percent)	0.00	0.00	0.00	0.00	0.01***	0.00	0.01***	0.00	0.01***	0.00	0.01	0.00
Senior population (percent)	-0.02	0.02	-0.02	0.02	0.00	0.00	0.00	0.00	-0.02***	0.00	-0.02	0.00
Coastal (dummy)	0.52	0.28	0.25	0.28			-0.06	0.05	-0.09*	0.05	-0.09*	0.05
Threshold 1	-0.61	0.91	1.68	1.30								
Threshold 2	1.58*	0.92	3.94	1.32								
Threshold 3	3.23	0.93	5.62	1.34								
Intercept					1.93	0.15	1.78***	0.18	1.81	0.15		
State level intercept	0.35	0.22	0.41	0.26	0.03	0.01	0.03	0.01	0.18	0.08	0.04	0.01
State Mitigation Action	0.76**	0.32	0.71**	0.33	0.20***	0.07	0.20***	0.07	0.18**	0.08	0.18**	0.08

***<0.01; **<0.05; *<0.1 (two-tailed).

Table 5.6. Results of Multi-Level Regression Estimating Adaptation Actions: Interaction Effects (Form of Government)

Dependent variable	Model 26		Model 27		Model 28		Model 29	
	Adaptation priority		Adaptation priority		Adaptation policy actions		Adaptation policy actions	
	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.
Meteorological Disaster (PDD)	-0.29	0.56			-0.18*	0.11		
Meteorological Disaster (PDD) X Managerial form of government	0.35	0.66			0.16	0.12		
Hydrological Disaster (PDD)	-0.70	0.71			0.24**	0.11		
Hydrological Disaster (PDD) X Managerial form of government	0.65	0.85			-0.01	0.14		
Climatological Disaster (PDD)	0.60	0.91			0.23	0.15		
Climatological Disaster (PDD) X Managerial form of government	-0.68	0.95			-0.06	0.15		
Geophysical Disaster (PDD)	0.02	1.03			0.40	0.25		
Geophysical Disaster (PDD) X Managerial form of government	-1.36	1.35			-0.28	0.24		

Dependent variable	Model 26		Model 27		Model 28		Model 29	
	Adaptation priority		Adaptation priority		Adaptation policy actions		Adaptation policy actions	
	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.
Meteorological Disaster Damage (logged)			0.07	0.07			0.00	0.01
Meteorological Disaster Damage (logged) X Managerial form			-0.04	0.08			0.02	0.02
Hydrological Disaster Damage (logged)			0.02	0.05			0.01	0.01
Hydrological Disaster Damage (logged) X Managerial form			0.06	0.06			-0.02	0.01
Climatological Disaster Damage (logged)			0.10**	0.04			0.00	0.01
Climatological Disaster Damage (logged) X Managerial form			**-0.10****	0.05			-0.00	0.01
Geophysical Disaster Damage (logged)			-0.02	0.05			0.01	0.01
Geophysical Disaster Damage (logged) X Managerial form			0.03	0.06			-0.02*	0.01
Environmental Interest	0.29****	0.09	0.26***	0.09	0.01*	0.01	0.02*	0.01
Managerial form of government	-0.47	0.63	-0.16	1.35	0.03	0.12	0.12	0.19
Regional fragmentation	0.17	0.12	0.04	0.13	0.00	0.00	0.00	0.00
Own source revenue per capita	0.16**	0.08	0.18**	0.08	0.09***	0.02	0.09***	0.02
White (percent)	-0.01	0.01	-0.01	0.01	0.00	0.00	0.00	0.00
Home ownership (percent)	0.00	0.01	0.00	0.01	0.00**	0.00	-0.00**	0.00
Education (percent)	0.00	0.00	0.00	0.00	0.00	0.00	0.00*	0.00
Senior population (percent)	0.00	0.02	-0.01	0.02	-0.02***	0.00	-0.00***	0.00
Coastal (dummy)	0.54*	0.28	0.36	0.28	0.04	0.06	0.02	0.06
Threshold 1	0.13	0.88	1.30	1.25		1.51		
Threshold 2	2.52	0.89	3.74	1.27		1.53		
Threshold 3	4.30	0.91	5.53	1.29		1.55		
Constant					0.02***	0.01	0.21	0.22
State level	0.20	0.18	0.24	0.21	0.13***	0.04	0.16***	0.04
State Adaptation Action	0.45	0.30	0.47	0.30	0.13	0.12	0.11	0.13

***<0.01; **<0.05; *<0.1 (two-tailed).

Mayoral forms of government are more likely to take advantage of climatological disasters in shaping policy priorities on mitigation. Climatological disasters have negative interaction effects with forms of government on policy priorities on climate mitigation and on adaptation actions. In model 17, the coefficient of federal climatological disasters (or PDD) is -2.06 and is statistically significant at the level of 0.01. A federal climatological disaster results in -2.06 lower odds of being at a higher level of policy priority on climate mitigation under the managerial form of government than the other forms of government, such as the mayoral form of government.

Property damage from climatological disasters has negative interaction effects with the managerial form of government on climate mitigation. The coefficient of climatological disaster damage is 0.09 and is statistically significant at the level of 0.1. When a municipality has a managerial form of government, a 1% increase in the amount of property damage from a climatological disaster leads to a 0.09 decrease in the log odds of being at a higher level of policy priority on mitigation. In other words, for a municipality, the mayoral form of government may be better able to elevate mitigation policy orientation than the managerial form of government when there is a greater amount of disaster damage.

Geophysical disasters have significant interaction effects with forms of government on mitigation policy orientation but not on adaptation policy orientation and policy actions on mitigation and adaptation. Table 5.5 shows that the coefficients of the interaction terms between federal geophysical disasters and forms of government are 0.62 and -1.90, and they are not statistically significant. In models 10 and 12, the coefficients of the interaction terms between property damage from geophysical events and forms of government are -0.01 and -0.02, and they are not statistically significant at the level of 0.1. Table 5.6 presents the nonsignificant findings of the interaction terms between federal geographical disasters and forms of government regarding

policy priorities and policy actions on adaptation. On the other hand, the interaction term between property damage of geophysical events and forms of government has positive and significant effects on policy priorities on mitigation. In model 8 (Table 5.5), the coefficient of the interaction term is 0.10 and is statistically significant at the level of 0.1. Under the managerial form of government, a 1% increase in the amount of property damage from geophysical disasters leads to a 0.10 increase in the log odds of the municipalities placing a higher priority on mitigation.

Regional Fragmentation

The findings do not support the expectations that an increase in regional fragmentation would lead to a decrease in the municipalities' climate mitigation actions or adaptation actions (H4a and H4b). Regional fragmentation does not have significant effects on climate mitigation and on adaptation actions. As Tables 5.1 and 5.3 indicate, any regional fragmentation variable is not statistically significant at the level of 0.1. Fragmentation of regional authorities does not seem to have consistent effects on both climate change policy priorities and policy actions. Regional fragmentation may create collective action problems for climate change mitigation and adaptation actions as well as foster interlocal competition for policy innovation.

State-level Policies

The findings partly support the expectations that state policies will increase municipalities' climate mitigation and adaptation actions (H5a and H5b). Table 5.1 shows the effects of state mitigation actions on municipalities' policy priorities and actions on mitigation. All coefficients of the models are positive and significant at the level of 0.05. The presence of a state mitigation action plan leads to a 0.78 or 0.72 increase in the log odds of its municipalities placing a higher priority

on mitigation. When a state has its mitigation action, its municipalities have 0.20 or 0.21 greater log count of government-wide mitigation actions and 0.18 and 0.19 greater log count of community-wide mitigation actions.

On the other hand, state adaptation actions do not have significant effects on adaptation actions. Table 5.3 presents the effects of state adaptation actions on municipalities' policy priorities and policy actions on adaptation. The coefficients of the state adaptation variables are positive but are not statistically significant at the level of 0.1. Municipalities may have stronger incentives to seek adaptation actions regardless of state-level actions because they can gain localized or regionalized benefits from the actions.

Mitigation vs. Adaptation

Effects of Natural Disasters

Table 5.7 summarizes the findings regarding the effects of natural disasters and political institutions on local governments' mitigation and adaptation actions. The findings partly support the expectation that natural disasters would have greater effects on municipalities' adaptation actions than mitigation actions (H6). The effects of natural disasters have subtle differences between mitigation and adaptation actions. Meteorological or geophysical disasters do not have significant effects on policy priorities and actions. Climatological disasters have positive effects on adaptation policy actions, and hydrological disasters have positive and significant effects on policy priorities on both mitigation and adaptation. An increase in the amount of property damage from hydrological events may heighten policy attention on the two types of climate mitigation and adaptation actions. However, climatological or hydrological disasters do not have significant effects on mitigation policy actions but on adaptation policy actions. When a municipality has a

climatological or hydrological event approved as a federal disaster, it is more likely to have a greater number of adaptation policy actions. Thus, hydrological disasters have greater effects on adaptation policy actions than on mitigation policy actions.

Form of Government

The findings do not support the expectation that managerial forms of government would have greater effects on climate mitigation actions than on adaptation actions (H7). Forms of government do not have different effects on mitigation and adaptation actions. The managerial form of government does not have significant effects on either of the policy priority variables. The variables have positive significant effects on both mitigation and adaption policy actions. Governments with managers as chief executives may pursue innovative actions to mitigate or adapt to the negative impacts of climate change.

On the other hand, interactions' effects between forms of government and types of natural disasters have subtle differences between mitigation and adaptation actions. Climatological disasters have negative and significant effects on both policy priorities on mitigation and adaptation. Governments with elected officials as chief executives are more likely to place higher policy priorities on mitigation and adaptation after climatological disasters than the other forms of government. The managerial form of government has negative significant interaction effects with property damage from hydrological events on government-wide mitigation actions but not on adaptation actions. The mayor-council form of government is more likely to take advantage of increased hydrological property damage to improve the mitigation capacity of governmental operations. Similarly, managerial form of government has positive and significant effects with geophysical disasters on mitigation actions but not adaptation actions. Managerial forms of

government are more likely than the other forms of government to heighten policy attention on mitigation actions.

Regional Fragmentation

The findings support the expectation that effects of regional fragmentation would result in no significant difference between climate mitigation and adaptation actions (H8). Regional fragmentation does not have different effects on mitigation and adaptation actions. The findings do not support the expectation that regional fragmentation would have greater negative effects on mitigation actions than on adaptation actions. The variables have the same signs of coefficients, and none of the variables are statistically significant. The results show that regional fragmentation does not predict either mitigation or adaptation actions. Fragmented regional authorities may create a stimulus for policy innovation as well as collective action problems for both mitigation and adaptation actions.

Effects of State-Level Policies

The findings do not support the hypothesis that effects of state-level climate actions would cause no difference between climate mitigation and adaptation actions (H9). State-level rules have different effects on mitigation and adaptation actions. State-level mitigation action has positive and significant effects on policy priorities and actions on mitigation. The presence of state-level mitigation actions heightens municipalities' policy attention on mitigation as well as on the adoption of a greater number of mitigation policy actions. On the other hand, state-level adaptation actions do not have significant effects on localities' policy priorities and policy actions on adaptation. The state's actions on adaptation may not shape the municipalities' efforts to adapt to the negative impacts of climate change in their local jurisdictions.

Other Effects

Additionally, Table 5.1 and 5.3 present effects of governmental, sociodemographic, and environmental characteristics on municipalities' mitigation and adaptation actions. Financial capacity, measured as revenue per capita, has positive significant effects on both mitigation and adaptation actions. The coefficients of the variables are all positive and statistically significant at the level of 0.01 or 0.05. The findings indicate that financial capacity is a necessary condition for adopting a greater number of climate policy actions.

Sociodemographic characteristics have expected and unexpected effects on municipalities' climate actions. Homeownership, measured as proportion of houses occupied by owners, has negative effects on mitigation policy actions but positive effects on adaptation policy actions. Mitigation policy actions, such as energy efficiency and alternative energy use, create burdens on homeowners without tangible benefits. Adaptation policy actions, such as water conservation, can provide tangible benefits to home owners. In addition, the significant positive influence of education suggests that residents' awareness of climate change drives local governments' climate mitigation and adaptation actions. Local governments may gain support for climate actions from their educated residents.

Table 5.7. Summary of the Findings

	Mitigation			Adaptation	
	Policy priority	Government-wide policy actions	Community-wide policy actions	Policy priority	Policy actions
Meteorological disasters	n.s.	n.s.	n.s.	n.s.	n.s.
Hydrological disasters	+ (sig.)	n.s.	n.s.	+ (sig.)	+ (sig.)
Climatological disasters	n.s.	n.s.	n.s.	n.s.	n.s.
Geophysical disasters	n.s.	n.s.	n.s.	n.s.	n.s.
Environmental interest	+ (sig.)	+ (sig.)	+ (sig.)	+ (sig.)	+ (sig.)
Meteorological x Environmental interest	+ (sig.)	+ (sig.)	+ (sig.)	+ (sig.)	n.s.

	Mitigation			Adaptation	
	Policy priority	Government-wide policy actions	Community-wide policy actions	Policy priority	Policy actions
Hydrological x Environmental interest	n.s.	+ (sig.)	+ (sig.)	-(sig.)	n.s.
Climatological x Environmental interest	+ (sig.)	n.s.	+ (sig.)	n.s.	n.s.
Geophysical x Environmental interest	+ (sig.)	+ (sig.)	+ (sig.)	n.s.	n.s.
Managerial form of government	n.s.	+ (sig.)	+ (sig.)	n.s.	+ (sig.)
Meteorological x Managerial form of government	n.s.	n.s.	n.s.	n.s.	n.s.
Hydrological x Managerial form of government	n.s.	- (sig.)	n.s.	n.s.	n.s.
Climatological x Managerial form of government	- (sig.)	n.s.	n.s.	-(sig.)	n.s.
Geophysical x Managerial form of government	+ (sig.)	n.s.	n.s.	n.s.	n.s.
Regional fragmentation	n.s.	n.s.	n.s.	n.s.	n.s.
State-level rules: mitigation	+(sig.)	+(sig.)	+(sig.)	N/A	N/A
State-level rules: adaptation	N/A	N/A	N/A	n.s.	n.s.

On the other hand, a white population has negative significant effects on the municipality's mitigation actions but not on adaptation actions. Unexpectedly, an increase in the proportion of the population that is white results in a decrease in the counts of government-wide and community-wide mitigation actions. Similarly, a senior population has negative significant effects on community-wide mitigation actions and adaptation actions. Unexpectedly, a greater percentage of people aged 65 or older leads to a decrease in the log count of the number community-wide mitigation actions and adaptation actions. Finally, a coastal location has

negative effects on community-wide mitigation actions. A coastal location of a municipality may create additional costs of mitigation measures, such as energy efficiency buildings, which requires protection from potential coast-related hazards.

CHAPTER 6

DISCUSSION AND CONCLUSION

Do Types of Disasters Have Different Effects on Climate Change Mitigation and Adaptation Actions?

Theories of public policy highlight that extreme events like natural disasters can trigger policy changes. Extreme events can attract government decision makers' attention to the important parts of problems that are ignored in usual times (Baumgartner and Jones 1993; Jones and Baumgartner 2005). In particular, the theory of focusing events explains how extreme events like natural disasters become focal and cause policy change. Focusing events occur suddenly and rarely, generate significant harm in an area of interest, and attract the intensive attention of the public as well as decision makers (Birkland 1997). Such events create policy windows that policy advocates can promote, linking their preferred policy alternatives to relevant problems (Kingdon 1997). Certain types of extreme events create greater political support than other types of extreme events because of the nature of the events and economic interests (Birkland 1996, 1997; Skidmore and Toya 2002).

The literature on public policy and local governments does not provide a systematic understanding of the roles of extreme events, such as natural disasters, on policy change at the local level. The roles of extreme events have mainly been studied to understand policy change at the national level but not at local levels (Birkland 1996, 1997, 2004; Farley et al. 2006; Johnson 2005; Zahariadis 2003). The existing studies relied on case studies to examine how extreme events, such as natural disasters, oil spills, aviation disasters, and railroad accidents, shape national policies. Similarly, the literature on the political market model or the ICA framework has mostly been used to understand policy outputs or the provision of public goods and services, such as sustainability actions under normal conditions (Bae and Feiock 2012; Deslatte and Swann 2015;

Yi, Feiock and Berry 2017; Yi et al. 2017). The studies on the model and the framework in the literature do not pay attention to how extreme events can shape policy choices at the local level. In particular, the ICA framework does not presume that institutional actors can be emotionally attached to possible options or that they can do a limited search rather than a rational calculation of possible transactions with other actors (Jones 2009).

Applying the theory of focusing events, this dissertation is aimed at understanding the effects of natural disasters on local governments' climate change policies. The dissertation tested whether types of natural disasters have different effects on local governments' climate actions. Floods and droughts have positive and significant effects on local governments' climate policies, while other types of disasters do not. Frequent flash flooding or a prolonged period of low rainfall may intensify the attention of the public and decision makers in terms of climate change compared to other types of disasters. Moreover, a high prevalence of environmental interest groups strengthens the effects of hurricanes, droughts, and earthquakes on local governments' efforts to reduce greenhouse gas emissions or the vulnerability of the local jurisdictions to the impacts of climate change. Advocacy groups may be important for policy entrepreneurs to take advantage of a focusing event as a window of opportunity for prioritizing and adopting climate change policies.

This dissertation contributes to the understanding of how extreme events play roles in policy change and public service provision at the local level. Also, this paper extends the application of the public policy theoretical framework to the local level and provides a systematic understanding of the roles of extreme events in local public policy processes. That is, extreme events such as natural disasters are important triggers for policy change at the national level and at the local level. The findings also suggest that local public managers can take advantage of extreme events to initiate a preferred policy change, which is not politically feasible in regular

times. Extreme events allow the affected localities to search a limited range of options, to which public managers can attach their preferred policy goals.

The dissertation demonstrates that interest groups can strengthen the effects of extreme events on policy change. Environmental interest groups play critical roles in shaping climate change policies after natural disasters. The prevalence of environmental interest groups intensifies the attention of policymakers to the effects of natural disasters. Environmental interest groups at the local level also influence local government's policy efforts after natural disasters. This is consistent with the existing research, which found that national environmental interest groups were active in demanding national policy actions after environmental disasters, such as oil spill (Birkland 1997). This results also support Kingdon's (1995) argument that highlights the convergence of streams of politics, problems, and solutions in the agenda setting. Policy entrepreneurs can gain leverage in shaping local governments' policy when there are strong political support from organized interest groups.

What are the Roles of Political Institutions in Climate Change Mitigation and Adaptation Actions?

The political market model and the ICA framework emphasize the importance of political institutions in local policy choices and public service provision. The political model explains policy change by the contract relationship between suppliers and demanders of change in a community (Feiock 2006). Local governments as suppliers adopt a policy to respond to the demands of the public, and different forms of government may determine the response to those demands (Lubell, Feiock, and Ramirez 2005). The ICA framework suggests that institutional structures can facilitate or impede collective action among local governments. Fragmented regional authorities generate high costs in terms of coordinating collective action, and state-level

rules can be used to address the negative externalities among participating actors (Feiock 2007).

The theoretical frameworks have not been frequently utilized to understand how political institutions play roles in local governments' climate change policies. Few studies have applied the frameworks to understand the effects of forms of government on sustainability actions and climate protection agreements (Bae and Feiock 2012; Deslatte and Swann 2015; Yi, Feiock and Berry 2017). Most studies in the literature lack a theoretical understanding of how political institutions influence local governments' climate actions (Hughes 2016), as they have largely focused on socioeconomic characteristics of municipalities, such as education and population size. An increasing application of the frameworks can enhance the theoretical understanding of how political institutions shape the motivation of local governments' efforts to mitigate and adapt to the impacts of climate change.

Applying the political market model and the ICA framework, we aimed to examine the effects of forms of government, regional fragmentation, and state policies on local climate change policies. City managers may have stronger motivations to adopt climate change policies to build their national reputations for the improvement of livelihood and innovation. Regional fragmentation may decrease local governments' adoption of climate actions because it can generate collective action problems and discourage local governments' adoption of climate change policies due to the high transaction costs of monitoring the parties involved. State-level rules can be coordinating opportunities for municipalities to overcome collective action problems and adopt adaptation actions that benefit local governments broadly (Feiock 2007; Homsy and Warner 2015), although top-down rules can discourage bottom-up innovation (Fiorino 2006).

The research study found that forms of government and state policies have positive effects on local governments' adoption of climate change policies, while regional fragmentation does not.

First, city managers are more likely than elected officials to pursue more climate change policy actions, which can improve their national reputations for their future careers. The negative interaction effects between climatological disaster and the managerial form of government indicate that elected officials seem to heighten policy attention on mitigation and adaptation after climatological disasters. Elected officials may be better able to mobilize political support for policy change rapidly than career public officials and to seek climate change policies to avoid criticism from their constituents, who may punish them for their ill-preparation in anticipation of disasters (Arceneaux and Stein 2006). Second, regional fragmentation does not have significant effects on local governments' climate change policies. Climate actions, especially mitigation actions, provide benefits of long-term energy savings and branding effects for municipalities, while mitigating climate change has a globalized nature (Bestill 2001; Hughes 2016). Finally, state climate change policies have positive effects on local governments' climate change policies. State policies, as state-level rules, are critical mechanisms to address the negative externalities of collective action (Feiock 2007) and can be coordinating mechanisms for municipalities to overcome collective action problems in adopting climate actions.

The examination of the effects of political institutions on local governments' climate change policies enhances the theoretical understanding of the effects of political institutions on local governments' adoption of climate change policies. This dissertation bridges the gap since few research studies have developed theories to understand local governments' efforts to mitigate and adapt to the impacts of climate change (Hudghes, 2017). The findings demonstrate that multilevel institutions can shape local governments' climate change policies; this was accomplished by applying the political market model and the ICA framework. The study also broadens the theoretical applications to local governments' policy change processes by considering

how local institutions and state institutions operate in local governments' climate actions. A few studies adopted the theoretical framework and focused more on local institutions (i.e., forms of government) less than on regional or state institutions.

The investigation also has policy implications, in that state governments can play critical roles in mitigating climate change in the absence of the nation-wide action. In June 2017, the Trump Administration decided to withdraw from the Paris Agreement, which requires a national commitment to climate change mitigation. A few leading states expressed their strong commitment to meet U.S. climate mitigation targets despite the national government's retreat from climate mitigation efforts (Tabuchi and Fountain 2017). State governments need to provide a strong coordinating framework to strengthen state-wide climate actions that involve their localities. State regulations and incentives will be critical for their localities to adopt and implement climate actions vigorously.

Are there Differences in the Effects of Disasters and Political Institutions between Climate Change Mitigation and Climate Change Adaptation?

Although local governments can also mitigate the impacts of climate change, most studies in the literature have examined what influences municipalities' adoption of climate change mitigation actions. Climate mitigation actions are efforts to limit greenhouse gas emissions; adaptation actions are to reduce the vulnerability to the negative consequences of climate change, such as frequent extreme weather events and sea level rises (Lutsey and Sperling 2008). To mitigate climate change, local governments can set emission targets and adopt energy efficiency and renewable technologies into their buildings. To adapt to the negative impacts of climate change, local governments can develop land-use planning to inhibit the development of the vulnerable areas or adopt water-efficiency devices to adjust to extended droughts. Mitigation actions provide

localized benefits, such as cost savings, as well as globalized benefits, such as greenhouse gas reduction, while adaptation actions usually provide regionalized or local benefits, such as saving of residents' lives and property (Fussel and Klein 2006; Kane and Shogren 2000).

Most studies have focused on local governments' socioeconomic characteristics or membership in environmental organizations to provide an understanding of municipal governments' motivations to adopt mitigation actions (e.g., Homsy and Warner 2015; Krause 2012; Kwon, Jang, and Feiock. 2014; Opp, Osgood, and Rugeley 2013; Pitt 2010). For instance, populated and educated municipalities of the United States are more likely to adopt a greater number of mitigation actions (Homsy and Warner 2015), and cities that have ICLEI membership are more likely to implement climate actions, including greenhouse gas reduction efforts (Krause, 2012).

For this dissertation, we investigated whether there are differences in the effects of disasters and political institutions between climate change mitigation and climate change adaptation actions. Local governments may be better motivated to adopt the latter actions because they provide more immediate benefits to the adopted entities than the former actions, which have globalized benefits. The council-manager form of government may be more motivated to adopt the former actions than the latter actions because the former action can enhance the city managers' reputations for innovation. State policies may have similar effects between the two types of actions by providing a coordinating framework for local adoption of both actions. Regional fragmentation may increase the costs of coordination for local governments' adoption of both actions.

During the research conducted for this dissertation, we found that U.S. municipal governments have subtle differences or similarities in terms of the effects of natural disasters and political institutions between climate mitigation and adaptation actions. First, floods have positive

effects on the number of adaptation policy actions, while property damage from hydrological events has positive effects on both policy priorities on mitigation and adaptation. The findings imply that flooding events shape local governments' policy priorities on both types of actions, but the different types of disasters create wider windows of opportunity for the adoption of adaptation policy actions compared to mitigation policy actions. Second, forms of government affect local governments' adoption of mitigation actions as well as adaption actions. The managerial form of government is more likely than the other forms of government to adopt mitigation policy actions as well as adaptation policy actions. Public managers can improve the localities' livelihood and improve their reputations for their career goals by adopting innovative adaptation measures, such as open space conservation. Third, regional fragmentation does not have significant effects on climate mitigation or on adaptation actions. Local governments can confront the collective action dilemma as well as gain localized benefits from adopting both actions. Finally, state policies have significant effects on local governments' mitigation actions but not on adaptation actions. State mitigation policies are strong mandates that require local governments to take mitigation actions and provide a coordinating framework that allows municipalities to overcome collective action problems (Homsy and Warner 2015); state adaptation policies may pose less stringent demands on local governments so that the lower levels of government can accommodate their local conditions flexibly.

This investigation contributes to the theoretical understanding of the differences in the motivating factors of climate change mitigation and adaptation actions. The investigation bridges the gap in the literature, which focuses more on local governments' mitigation actions but less on adaptation actions. Although a few research studies have examined the factors that influence both actions, the studies have seldom provided a theoretical understanding of the differences in the

nature of the two types of actions. The subtle differences in the effects of natural disasters and political institutions highlight the importance of understanding the distinctive nature of the two types of policy actions to address the impacts of climate change.

Limitations and Implications for Future Studies

This dissertation has three important limitations, which can be addressed in future studies. The dissertation uses cross-sectional data to examine local governments' policy changes. Although the findings can be used to infer the casual relationship between the independent variables and the dependent variables, the findings fail to verify the causal relationships. One more time point would enable researchers to verify the causal relationships between the variables.

Second, this dissertation operationalizes natural disasters at the county level rather than at the municipal level. The FEMA disaster declarations are made for counties, and SHEDUS contains county-level information about hazard events. The current data does not account for the different magnitude of damage among municipalities within the counties where disasters were declared. When the county covers broad areas, there might be some municipalities less affected by a given disaster than other nearby municipalities. Future research can verify the relationship between the variables better if by obtaining city-level disaster data.

Finally, the analyses do not account for a broad range of adaptation policy actions. The adaptation measures contain only water conservation and open space preservation; other important adaptation actions, such as relocation and elevation, had to be left out. The findings regarding adaptation policy actions may reflect this limited range of adaptation policy actions. Future studies could survey a broader range of adaptation actions to arrive at findings that better explain adaptation policy actions.

Conclusions

This dissertation highlights the importance of an extreme event as a focusing event for local governments' policy changes through a systematic examination of the effects of natural disasters on municipalities' climate change mitigation and adaptation actions. The examination enhances the understanding of the roles of extreme events from national policy settings to local policy settings. The findings imply that types of natural disasters create a window of opportunity for elevating local governments' policy priorities on mitigation and adaptation actions and adopting relevant policy actions. The policy process literature highlights extreme events as important external factors that influence policy changes at the national level through case studies, but previous studies have not examined the roles of the events at the local level.

This dissertation also contributes to the theoretical understanding of local governments' climate change policies. Most literature lacks theories to examine the motivating factors of local governments' efforts to mitigate and adapt to the impacts of climate change. The dissertation applies the theory of focusing events, the political market model, and the ICA framework to examine the effects of natural disasters, forms of government, regional fragmentation, and state policies on local governments' climate policy actions. This dissertation identifies the subtle differences in the effects of natural disasters and political institutions on mitigation and adaptation actions. The findings imply that adaptation actions need to be differentiated from mitigation actions in understanding local governments' efforts to address the impacts of climate change.

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