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EFFECTIVE DISASTERS:
DISASTERS AS A DRIVER OF INTERNATIONAL CLIMATE POLICY CHANGE

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Abstract

At the recent UNFCCC COP23 meetings, many diplomats and political leaders at all levels would start their proposals for policy goals and action on climate change by citing a disaster their country or region had experiences, or one that their neighbors or allies had suffered. While this evidence is anecdotal, disasters are a critical factor in how countries view the effect of climate change. However, the extent to which policy changes are driven by natural disasters is unclear. Using disaster data from the EM-DAT and policy data from the Grantham Institute, we applied a hot spot analysis to identify spatial patterns of countries and their neighbors that are more impacted by major disasters than would be expected. We then compared these hot spots to countries with new climate policies to determine if there is a correlation between high disaster impact over a 5-year period and any subsequent policy. The resulting correlation between high disaster time periods and subsequent policy change was found to be present for 48 policies but the pattern overall in almost every case was not statistically significant or simply not present. We then focus on the 2013 flood of the Danube, Elbe, and Rhine rivers and analyze the policy changes of all nine countries (Austria, Bulgaria, Croatia, Czech Republic, Germany, Hungary, Romania, Serbia, Slovakia) directly impacted by this disaster. The impact of the flood on each country was calculated based on Lifeyears, a non-monetary measure of disaster damage (Noy, 2015). We found that Germany, Hungary, Austria, and Slovakia experienced greater damage than their neighbors, and as a direct result implemented the most relevant disaster policies.

Chapter 1: Introduction

Usually, when the terms effectiveness and disasters are used in the same sentence it is a discussion of disaster prevention, risk management, preparedness, or response. In contrast, here I assess what makes a disaster effective at driving policy change and, further, international climate policy. International climate policy is subject to many factors with diverse actors and complex interests; however, disasters have the potential to lessen these differences and garner international support for the cause of self-preservation or aid to neighboring countries and allied economies. To understand the impact of disasters on policy change we will examine national policy change for climate policy and a case study focusing on disaster policy. Each country has a different method of expediting topics from an agenda to law; therefore, events have different impacts in different governmental organizations, cultures, and locations.

The scope of international climate policy is vast and policies span almost every industry and almost every country. The core of multinational agreements are to improve our global abilities to respond to, prevent further damage from, and adapt to the widespread effects of climate change. Due to the complexities of these issues, climate policies can take years, or even decades, to reach final agreements. Since 1992, with the adoption of the United Nations Framework Convention on Climate Change (UNFCCC), there have been 23 sessions of the Conference of Parties (COP) to discuss treaties and plans for goals on emissions targets, innovation in adaptation efforts for economic development and energy, land use change, and deforestation. One of the key themes of these international meeting are disasters, which tend to set the focus for the meeting.

For example, in 2017 the meetings had many discussions centered around implementation of the Paris agreement using disasters like Hurricane Maria as an example of future potential issues.

These conversations for climate policies are complicated in that the very understanding of "nature", and therefore climate and disasters, varies between people and places. There is a duality of nature and the meaning of the word itself. Nature can be seen as 'external' or 'universal' in this duality context (Smith, 1984). When considering climate change there is much debate over the concepts of nature, especially from this perspective: to what degree do we, as humans, have the capacity to influence such a force? Climate change policy is therefore equally relevant to this question of nature as being influenced by or influencing humans. For some skeptics of climate change, this question could be a major contributing factor to the denial of a need for mitigating policies. If nature cannot be influenced by humans then there would be no reason to even consider a political intervention for something that is deemed impossible. On the other end of the spectrum, to claim nature as only external and ruined by humans is just as far-fetched because, in reality, everything is in some way touched by humans. The idealist view of nature is threatened by human contributions to climate change. There is also external nature in that nature is often treated as something *"which mankind attempts to dominate and oppress, ravage and romanticize…"* (Smith, 1984:26) This perspective could explain part of the resistance to the progress of climate policy and therefore reveal arguable need for disaster-driven catalysts. However, institutional resistance to any kind of policy change should not be forgotten as a contributor to the deadlock in any policy domain, not just those dealing with nature.

These diverse definitions of nature are reflected in the way different people and institutions approach the topic of disasters. In regards to policy mitigation, Cronon (1996) offers a useful description of the way we approach natural disasters:

> *"Often when we label a problem as 'natural', we imply that there's not much we can do about it. It's just the way things are, and we'd better get used to it…Although it may be perfectly natural in an earthquake for wetlands to shake more violently than drier ground, there is nothing natural – common though it may be – about building highways or houses in such places." (Cronon, 1996:30)*

Michael Watts (1983), in *Silent Violence: Food, famine & peasantry in northern Nigeria,* offers a differing definition, describing human crises in terms of a long-term 'natural' disaster:

> *"…much of what passes as natural hazards are not really natural at all; drought may be a catalyst or trigger mechanism in a sequence of events that lead to famine conditions, but the subsistence crisis itself is more a reflection of the structural ability of the socioeconomic system to cope with the unusual harshness of ecological conditions and their effects." (Watts, 1983:17)*

These different perspectives on what is 'nature' add an extra dimension of complexity for climate policy, which already relies upon the convoluted and lengthy international policymaking process.

Place is often a factor in several different policy domains but is particularly evident in environmental policy as they are so intertwined. The emotional investment in a place, which can drive the effort put into policy making, has a very significant impact on the subsequent protection or degradation of that place (Halpenny, 2010). Space and geographic relationships between countries are fundamental to aspects of traditional lawmaking and international negotiations, such as common goods beyond borders. Lefebvre (1991) puts this concisely and ties it back to the previous discussion of nature in his famous *Production of Space*:

> *"…natural space has not vanished purely and simply from the scene. It is still the background of the picture; as décor…Everyone wants to protect and save nature; nobody wants to stand in the way of an attempt to retrieve its authenticity. Yet at the same time everything conspires to harm it." (Lefebvre, 1991:30-31)*

For example, in the negotiations of the UNFCCC, this attitude is exemplified when all the countries had the distinct purpose in meeting to create a solution to anthropogenic climate change. Yet, throughout these discussions, the attitude of the diplomats' actions show more concern with actual or perceived inequalities than solution-driven actions (Vogler, 2015). The pursuit of justice in diplomatic relations is tied back to place and the perceptions of a country's power, space, and place. Disasters that affect multiple countries can potentially change those perceptions and relationships between neighboring countries, regardless of previous relationship, as the countries work towards a common goal of rebuilding.

This research of interactions between disasters and policymakers negotiating international climate policy is important in terms of progress as described by Actor-Network Theory (ANT). ANT offers a way of eliminating the nature-society duality by rejecting that binary paradigm and focusing instead on the relationships between things (Castree and MacMillan, 2001). The idea is to change the conversation from whether nature is affecting humans or humans are affecting nature and instead to look at all of it as a single system.

While this study maintains the separation between humans and nature, by investigating the influence of nature (e.g. disasters) on humans, we draw upon ANT by looking at the combined workings on different countries instead of each as separate individual systems. By understanding the complex workings of international climate policy reform as a single system and not as separate countries, we can identify the

components that are more influenced by disasters. It has been shown that some variables do weigh more than others in terms of disasters and policy and agenda change (Birkland, 1996; Birkland, 1997). In particular, we focus on vulnerability differences for those directly impacted by disaster. This research of climate policy change drivers analyzes the interactions within the extensive network of actors in international policymaking, both directly involved and those removed from disasters, to work toward more solutions and better understand how we can anticipate future disasters and changes.

Thomas Birkland, an expert on the effect of disasters on policy, has looked at this issue in-depth from an American federal policy standpoint. His first book, *After Disaster*, established that major sudden-onset events influence policy agendas but in different ways (Birkland, 1997). In his second book, *Lessons from Disaster*, published ten years later, he looks at these same events but their role in policy change (Birkland, 2006). This research question is a follow-up of Birkland's studies; we ask what makes the difference in these focusing events to determine if they will influence policy agendas or actual policy change, with a focus on climate policy. Climate policy is of interest because climate change itself cannot be seen as a "potential focusing event" by definition because it is not a sudden occurrence; its impacts have taken and will take decades if not centuries to be fully realized. On the other hand, climate policy is a controversial policy domain that has historically experienced repeated deadlocks, both from diplomatic interests and ideological differences. As focusing events are known to dissolve deadlocks, some proposed climate change policies may require the impact of disasters to break the barriers of diplomacy.

This study investigates the geographic relationship between disasters and climate policy, investigating the presence of spatial and temporal correlations between where major disasters occur and where and when policies related to mitigation or adaptation of disasters are adopted. Chapter 2 is a novel approach to how individual countries react to multiple disasters. A world-wide analysis reveals overarching patterns and identifies general relationships between disasters and climate policy implementation. This study asks if a time period of high impact from major climate-related disasters for a single country correlates to climate policy implementations. We expect that these hot spots in disasters would correlate with national climate policy changes to mitigate future impact from disasters. In contrast to Chapter 2, Chapter 3 examines the reaction of multiple countries to the same disaster. This localized case study and focused analysis of disaster policy in a narrower realm will show whether there is any relationship between disasters and policy for a circumstance outside the United States. Finally, in Chapter 4 we offer concluding remarks for the ultimate relevance of the results of these studies.

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Chapter 2: Climate Policy History and Policy Frameworks

Introduction

In the context of this study there have been large movements on international climate policy in the past three decades. The policy process for these changes includes many different actors and components to function and each of these pieces work with different levels of importance depending on the government structure. In general, for a policy to be passed there needs to be a problem identified, that problem needs to be salient enough to be under consideration within the political environment of the time, and solutions need to be provided as options to solve that problem (Kingdon, 1984). Policy windows are moments to take advantage of when those three aspects happen at the same time, which is usually a fleeting moment in which it is easier to pass policy on a specific topic (Kingdon, 1984). While this was the initial viewpoint of the studies to follow, the data available are not adequate to do a complete analysis based on this framework. The data available for policies and events without context for political attitudes of the time or other policy actors involved may be more applicable to a different framework, rather than the frameworks that have been used in studies with similar goals. This chapter will contain a brief overview of two other options for possible policy frameworks to be used for understanding the results of the subsequent studies and they will be evaluated in terms of interpreting the results more effectively later in Chapter 5.

History of Major International Climate Policy

The UN has facilitated international climate policy as a whole. Most of these policy innovations have come through the Intergovernmental Panel on Climate Change (IPCC) and the United Nations Framework Convention on Climate Change (UNFCCC). The IPCC is a group organized by the United Nations Environmental Programme (UNEP) and World Meteorological Organization (WMO) in 1988 to evaluate current research on climate change in three different wide-reaching categories: human impact, adaptation, and mitigation of climate change. The UNFCCC secretariat started as a means to facilitate negotiations on climate change between participating nations after the UNFCCC was adopted in 1992; over time it has also developed to include implementation of agreements. The secretariat organizes regular meetings for negotiations, including the largest of which, the annual Conference of Parties (COP).

COP meetings have been the source of major international agreements on climate change as it provides a forum for all nations to participate in negotiations and sharing of knowledge. The most notable agreements have been the Kyoto Protocol and the Paris Agreement, which will be discussed in slightly greater detail in the following sections, but each year's meetings have different goals and are generally successful in some aspect for progress, at the very least for diplomatic interactions and dissemination of climate change research. While most results of COP meetings are not legally binding they still act as an incentive for national change in policy to keep up with diplomatic efforts (Obergassel et al., 2015).

Major International Climate Policies

Kyoto Protocol

The Kyoto protocol was signed at the end of 1997 and included emissions goals that would be in effect for a five-year period from 2008-2012. The Kyoto Protocol was the first international agreement to put limits on greenhouse gasses (GHG). The structure had goals for GHG emissions but because they could not come to an agreement on one goal for all countries of the same development category. Each country had their own percent of decrease goal (Breidenich et al., 1998).

> "In the climate change regime, the Kyoto Protocol reflects a top-down approach. Although it gives states freedom in how they implement their commitments, it does not give them similar flexibility in defining the form, nature and content of their commitments." (Bodansky, 2011:697)

This freedom and flexibility also translated to disputes in who would be held more responsible for making larger changes in their national emissions profiles. The most developed countries, with the highest emissions, were given larger emissions reduction targets which was a source of contention in the proceedings. Ultimately, many of the world's largest emitters opted out of the agreement and made the overall progress points almost mute.

Paris Agreement

The Paris agreement of 2015 effectively replaced the Kyoto Protocol with new and arguably more realistic goals.

> "The Paris Agreement of 2015 is the first global accord on climate change that contains policy obligations for all countries. It is a hybrid that enshrines both bottom-up and top-down approaches to global climate governance. The new climate deal is a laissez-faire accord among nations that leaves the content of domestic policy to governments but creates international legal obligations to develop, implement, and regularly strengthen actions. National policies are subject to a robust international transparency system and global reviews, and successive policy plans must be progressively stronger." (Dimitrov, 2016:1)

Even with the new structure of goals and accountability there was still argument over whether the quintessential number goal would be to prevent a 1.5 degree rise or a 2 degree rise in temperature. With continuing arguments over responsibility and development the divide was mainly between the industrialized North and the developing South. Even so, the change in accountability methods and efforts for measures to be legally binding make this agreement still have more teeth than the Kyoto Protocol ever did.

Policy Process

The policy process is a complex topic with many explanatory theories by political scientists attempting to pin down the parts and timelines. In reality, it is almost impossible to accurately predict every aspect of the policy process to know if a certain policy will make it past even the first stages of conception. The goal is to find a policy framework that will be most useful for understanding the changes in national policy around the world from disasters as focusing events. We look at national disaster policy as an indicator of climate policy because climate change is a long-term problem and policy decisions are mostly made in the context of short-term results. Disasters can be a

motivator for pushing longer term climate policies because the solutions for small scale disasters are often part of the larger solutions for climate change in general.

Policy Framework Options

Multiple Streams Model

In using the general theory of Kingdon's Multiple Streams Model, we would be able to use observed reactions of major disaster events to be prepared for policy windows as they come from major disaster events in the future.

The problem defining step is very important to establish an issue to then base solutions on. Problems, as they are defined, can then be used to make people aware of the problem so that they can appear on a policy platform, this is known as agenda setting.

> "Problem definition is related to, but different from, agenda setting. Problem definition is concerned with the organization of a set of facts, beliefs, and perceptions – how people think about circumstances. Agenda setting refers to the process by which some problems come to public attention at given times and places." (Weiss, 1989:118)

While they are different processes there are still many overlapping considerations and both are very important to the introduction of policy to the political stage.

Political attitudes play a big part in how policies can progress at any given time. Elected politicians are large actors in most governments around the world right now. By the nature of their elected positions it is in most politicians' best interest to listen to, or at least acknowledge, their constituents' concerns and attempt to solve them. With so many actors focused on self-interest, the stakes are often high for politicians to push

through their policy priorities over others, which in turn brings another consideration in the policy process. At the same time, non-constituent (or not necessarily constituent) interests also put more pressure on politicians as political organizations and lobbyists push priorities on behalf of corporations, communities, and demographic groups as a whole.

Policy solutions undergo a process of, in the most basic sense, natural selection. Many interested parties might participate in policy introductions for solutions to any given problem. Factors that influence whether a policy survives this natural selection could be anything from budgeting, ease of implementation, whether there is anything inherently controversial attached, public opinion, and many other constantly changing considerations.

Policy windows can open when all of the previous three aspects of the process changes in a large way. When a new problem emerges visibly, when the attitudes of the public change, or when the government undergoes a change, like after an election. The policy window will only stay open as long as the issue or change is still happening; when the problem has been 'solved' or has just fallen off the public radar, no solution can be agreed upon, or if the problem does not seem to be solvable, the window will close.

Each of these changes is driven by policy actors and policy entrepreneurs (lobbyists, businesses, think tanks, non-governmental organizations, etc.). The role here in disaster policy is that these policy entrepreneurs may appear only for a short time and may have no previous involvement in policy because of the specialization of disaster policy (Birkland, 1997). Motivations, attitudes, and context are largely important in

understanding the process and actions behind this model and how the streams line up for change to occur.

Policy Diffusion Model

Walker's Policy Diffusion Model looks at how policies passed in one place are used as models for other political units or neighboring states. Policy diffusion in this model is driven by internal and external factors. Internal factors are factors such as socioeconomic status, political parties, conflict, elections, policy entrepreneurs, and institutions (Theodoulou, 2013). External factor are factors including competition between political units and social learning (Theodoulou, 2013). Disasters, by their nature to spark re-evaluation of current policies, would be considered social learning but could influence some of the internal factors like socioeconomic status and policy entrepreneurs.

Applications of the Policy Diffusion Model show that diffusion does happen but not necessarily how or why. The four prevailing mechanisms for international policy diffusion are coercion, learning, imitation, and competition; these are different from mechanisms that would be in play for smaller scales like city or state policy diffusion (Shipan and Volden, 2013). The goal of the Policy Diffusion Model is to differentiate between the mechanisms behind diffusion. For the purposes of this study that doesn't account for motivations we would be unable to pinpoint causation but just look at the change in general.

Punctuated Equilibrium Model

The Punctuated Equilibrium Model is an attempt to explain why radical policy change happens when the normal behavior is by incremental change only. This model assumes long periods of stability interrupted by short periods of instability that then create a new equilibrium on which to base future change. In this model, change is driven by changes in 'policy image' and institutional policy values. Policy images are a compilation of both the information available and the overall attitudes of those involved (True et al., 2007).

Change, according to the Punctuated Equilibrium Model, comes based on the attitude toward problem definitions. When something brings the policy back into view the current state is then evaluated. If the problem definition stands, then the current policy is reinforced and only incremental change will occur. If the problem definition and current policy are questioned, that is when large and fundamental policy changes happen. The change comes from that interaction between the policy image and the political institutions responsible for them.

While this model is most often used in American studies, the use of bounded rationality as an explanation for decision making bodes well as actors working in self-interest but constrained by institutional rules is not exclusively a characteristic of American government.

> "The ubiquity of serial attentiveness and organizational routines of operation lead us to expect that stability and punctuations are a feature of policymaking in many governments." (True et al., 2007:173)

One key requirement for applying this model to other national governments is that the political systems have to be open and democratic, uncontrolled by a central government

force. For an analysis of the whole world this is not always fulfilled. Differences in timelines and interactions between institutions and actors are to be expected but comparative value can still come from this model. The Punctuated Equilibrium Model works best in very specialized policy subsystems, which is exactly the case for climate and disaster policy.

Advocacy Coalition Framework

The Advocacy Coalition Framework is a framework to show the complexity of policy change as an ongoing process, not with distinct stages. The Advocacy Coalition Framework assumes that each issue has its own 'political subsystem' consisting of competing advocacy coalitions, power brokers, and decision makers (Theodoulou, 2013). The independent variables are those relatively stable parts of government such as the constitutional structure and dominant social or cultural values. Of course, these aren't completely stable, they are just considered stable because they are harder to change (Theodoulou, 2013). Dependent variables are quickly changing things like elections, changes in the opinions of those with power or influence, and the state of the economy (Theodoulou, 2013). The framework's conclusion is that change comes by changes in relationships within the subsystem via changes in the beliefs of the advocacy coalition. The main idea of the Advocacy Coalition Framework is that experts in the policy subsystem are who ultimately make decisions on policy change, though they are still influenced by outside factors of society and the economy. These policy actors

coordinate themselves into coalitions based on shared beliefs and policy preferences (Sabatier and Weible, 2007).

Another foundation of the Advocacy Coalition Framework is that there is 'policy-oriented learning' and external shocks to the system, much like the previous Punctuated Equilibrium Model, but that these shocks can redistribute resources as well as attitudes among the policy subsystem (Sabatier and Weible, 2007). Causal links are still being studied in this context but the effects of external shocks have been seen to change the status of power among advocacy coalitions, where those with less influence can become more powerful with the extension of knowledge or change in circumstance following the shock. A recent update to the Advocacy Coalition Model includes an added consideration for internal shocks, differentiated from external shocks. While internal shocks do much the same as external shocks, to redistribute power and resources within a policy subsystem, one important difference is that internal shocks always allow the minority advocacy coalition to increase in power over the dominant coalition because the internal shock inevitably revealed a failure in the current policy regime (Sabatier and Weible, 2007).

Conclusion

Even from this brief overview of the steps and processes that new policies must undergo to be implemented it is amazing that any policy is passed at all. Adding in considerations of diplomacy for international policies, issues related to tragedy of the commons in environmental policy, and the controversy of responsibility for climate

change, international climate change policy is a feat to pass. According to models from the last IPCC report, current policies in place and those pending are still not as rigorous as is required to deal with the impacts of climate change around the world. Although these policies are groundbreaking, there is still much to be done. It is important to be able to understand this policy process and look at the relationships with climate-related disasters so that we can take advantage of the unfortunate situations as they come and be more prepared for future situations so they are not as devastating.

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Chapter 3: Multiple Disasters in Individual Countries

Abstract

When international leaders describe their reasoning behind the need for climate change policy, their usual reference point is a recent disaster. Disasters are a factor in how countries view the effect of climate change, but the real question is how much does that perception make a difference in the policy process. Using disaster data from the EM-DAT and policy data from the Grantham Institute, a hot spot analysis was applied to identify spatial patterns of countries and their neighbors that are more impacted by major disasters than others. The Getis-Ord G_i^* statistic shows hot spots that are then compared to implemented climate policy for the relevant temporal division to look at correlations between high disaster impact over a 5 year period and any subsequent policy. The resulting correlation was found to be present in 48 policies, but the pattern overall in almost every case was not statistically significant or simply not present.

Introduction

The topics involved in international climate policy are widely debated and by their nature influence many aspects of society from trade to transportation to national security to agriculture to manufacturing. Because these policies influence so many people, it is important to understand possible catalytic drivers of policy change or adoption. Natural and environmental disasters can cause millions of dollars of damage

and, all too often, loss of life. As these events unfold they often cause a new push for regulation, deregulation of industry, or a change in other influential policy to hopefully reduce further damage (Birkland, 1997). However, it is unclear why some natural or environmental disasters have greater influence on international policy change than others. This study looks at the geographic relationship between disasters and climate policy and investigates the presence of spatial and temporal correlations between where major disasters occur and where and when policies related to mitigation or adaptation of disasters are adopted. The main hypothesis for this study is a country experiencing a major disaster, that can be attributed to climate change, is subsequently more likely to introduce changes in climate change adaptation policy to reduce future exposure to such impacts than countries that did not experience the disaster.

Heads of state speeches at the most recent UN meeting on climate change, most often began by mentioning some kind of disaster of their own country or of an ally before then recommending action or goals. Disasters are a factor in how countries view the effect of climate change, however, that perception does not always translate into actual policy change. Through the analysis of local statistics at the country level of disaster counts, we test whether a country that is more impacted by disasters over a five-year period has more incentive to pass climate policy as a result.

Policy and Disasters

New legislation, regulations, and treaties are the most tangible examples of policy change, but are not the only indicators of changes. Political party platforms,

working policies of existing organizations, and executive orders are also evidences of policy change along with others. Environmental policy platforms for political parties have changed dramatically over the past few decades in many countries. This study will only consider actual legislation introduction and amendments while previous research has looked at simply agenda change and political party platforms change, which may be a less reliable indicator of change as party platforms can be largely superficial (Birkland, 1996; Birkland, 1997; Party Change Project, 2013; Manifesto Project, 2013). For disasters to drive policy change, the country has to subscribe to the paradigm understanding that risk can be reduced in the future via policy changes. Risk cannot be completely mitigated but risk and vulnerability can potentially be reduced beforehand if relevant action is taken (Baker, 2009). The role of government is widely believed to be responsible for considering the well-being of their citizens, therefore, they are responsible for identifying and reducing risk by mitigating disasters and reduce vulnerability by implementing response policies (Baker, 2009).

Gaps in climate change policy have always been a problem with the effectiveness of climate change mitigation. Disasters, as focusing events, expose holes in policy that may then be pushed to be corrected, attempted to be corrected, or simply ignored until a more influential focusing event. The process of problem solving for the international policy gaps has not been widely studied. On the American federal level, the policy holes exposed by prominent hurricanes in the past two decades, were found mostly in emergency management and the insurance industry (USGAO, 2007). However, other storms have had similar size, power profiles, and impact ranges but did

not have the same effect on policy. The question is, what makes the difference between a potential focusing event and an impactful focusing event in the international sphere?

Attribution studies have been more abundant in recent years to show the relationship between disasters and climate change. Even without attribution studies on every event, governments tend to relate disasters to changes in climate change policy whether it is scientifically founded or not (Pilli-Sihvola and Vaatainen-Chimpuku, 2016; Rivera and Wamsler, 2014; USGAO, 2007). In a look at government documents, national and international, several disasters are identified in governmental reports as precursors to specific policy change. The United States Government Accountability Office list the financial burden of Hurricanes Katrina, Wilma, and Rita, as well as the potential of future earthquakes in the San Francisco and Los Angeles areas, as justification for change in the Federal Natural Catastrophe Insurance (USGAO, 2007). This report was also generated in 2007, and as part of the analysis, classified major cities in the United States on a scale of catastrophe risk. A notable example is that in this report New York City is on the very low end of the risk scale (only higher than Phoenix and Las Vegas) (USGAO, 2007). This report was done before Hurricane Sandy and obviously failed to anticipate risk in that case. The European Parliament identifies specific events of concern to the European continent in a report to European lawmakers about the impact of climate change. Recent disasters identified include the 1999 windstorms in Scandinavia and France, the 2002 flood of the Danube and Elbe rivers, the severe drought of 2004-2005 in Southern Europe, and the heat wave of 2003 that caused large death tolls across the entire continent (Anderson, 2006). This particular document from the European Parliament also cites the 2005 hurricanes that affected the

United States and Caribbean countries as being of significant concern as well, showing the international effect of disasters even when they do not directly impact European nations (Anderson, 2006). The report suggested specific climate policy change for the EU Flood Action Programme and the EU solidarity fund, another example of far-reaching impacts of disasters though this is predicated by the already established economic union of the European Union organization (Anderson, 2006). This is an indicator that disasters that impact neighbors and allies do have an influence on other countries' political response to disaster, and will be considered in the hot spot analysis.

In terms of political context of disasters, some studies have shown that disasters have the ability to provoke a significant policy response at the international, national, and subnational level (Pelling and Dill, 2010). The government is apt to take responsibility for action when pushed by the public but that only happens after the event and not proactively in any case (Birkland, 2004). In this case, the difference in the level of influence could be due to the authority or legitimacy of a country's neighbors and their relationship. In international political theory, there are three reasons that one actor would do as another says: rational persuasion, pressure or fear of adverse consequences, or simply accepting the decision-making process as legitimate (Bodansky, 2007). The third is known as respect for legitimacy of an actor. Legitimacy does not necessarily mean legality; legality of an international institution has to do with its treaty basis which is usually state consent (Bodansky, 2007). Legitimacy is different because a lot of authority can be outside a legal system, such as parental authority or the pressure of some of the UN entities, where there is no legally binding action there but there is still authority.

Data

Data related to recorded disasters worldwide and climate policy implemented were required for this analysis. The spatial analysis was completed using disaster data at a country level. Disaster data are from the EM-DAT: Emergency Events Database, run by the team at the Center for Research on the Epidemiology of Disasters (CRED) at the Université Catholique de Louvain (UCL) in Brussels, Belgium (EM-DAT, 2017). This database, as a whole, records any disaster around the world since 1900 that has killed at least 10 people, affected at least 100 people, caused a declaration of a state of emergency, or pushed for a call for international assistance. For the purposes of this study, only disasters from 1990-2016 were included. This time period was chosen to coincide with the policy data in the topic and include the most recent full year of data. Prior to 1990, there were very few practicing policies on climate change. From the list of disasters within the relevant time frame, these were additionally pared down to only include disasters that could be considered 'climate-related'. These disasters are all in the EM-DAT's "Natural" Disaster Group. This included the entire "Meteorological" subgroup, floods within the "Hydrological" subgroup, and drought[1] and wildfire within the "Climatological" subgroup. The included disasters all belonged, effectively, to five main types of disaster: Extreme Temperature, Storm, Flood, Drought, and Wildfire. 'Extreme Temperature' includes cold waves, heat waves, and any severe winter weather

[1] Drought is not commonly included in studies of focusing events because it is not generally a sudden onset occurrence. It is included here because it is a climate change related disaster and looking at a longer time period for the 5-year hot spot would include extended longevity disaster impacts.

conditions such as snow, ice, frost, or freezes. ‘Storm’ includes extra-tropical storms, tropical storms, and any convective storms such as derechos, hail, lightning, thunderstorms, rain, tornados, sand storms, dust storms, blizzards, storm surge, wind, and general severe weather. ‘Flood’ includes coastal, riverine, ice jam, and flash floods. ‘Wildfire’ includes forest fires and any type of land fire such as brush, bush, or pasture fires. For these disaster data there was one inconsistency in that for one entry at the beginning of the data there is a major disaster included that comes from the Soviet Union. In the analysis, this entry was not included because there was no corresponding Soviet Union on the map for any of the collective time periods. The EM-DAT data does not include geographic data any more detailed than the country level so there was no way to narrow down which modern country it would have fallen into. In context with the policy data there were very few entries to correlate this instance to, so it was not considered a high priority loss of data.

The policy data comes from the Grantham Research Institute on Climate Change and the Environment and Sabin Center for Climate Change Law at the London School of Economics which maintains the database known as Climate Change Laws of the World (Grantham, 2017). This database includes all litigation and legislation on climate change around the world. For the purposes of this analysis only the legislation data that was tagged with the category of adaptation policy from 1990-2017 was included. For this analysis, these were also separated into executive policies and legislative policies, where it is assumed that executive policies are instituted on a shorter time scale than legislative policies.

Methods and Analysis

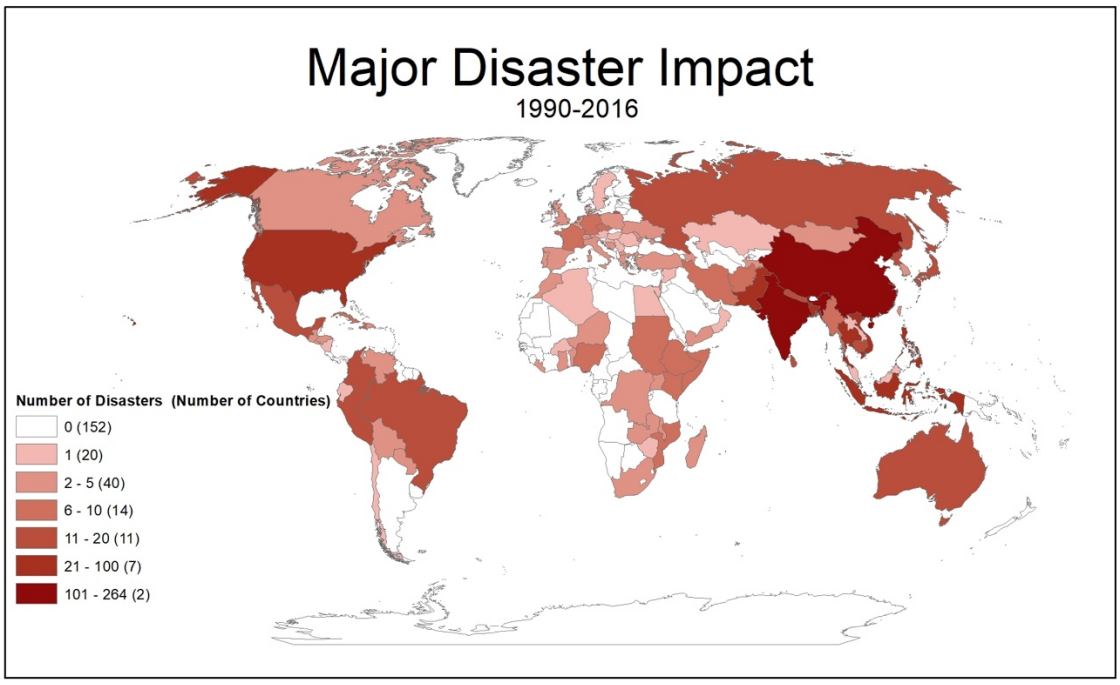
Data analysis was completed in three different sections. First separating and preparing the data for spatial analysis, spatial analysis using local statistical analysis technique, and finally comparing to find correlations between hot spots of high disaster impact and subsequent policy implementation. For each main type of disaster, EM-DAT provides a statistic for number of deaths, number of injuries, number affected, number made homeless, total human impact, and economic damage. To include in the analysis only the most influential disasters these were separated leaving six data categories for each of the five types of disaster. Only those in the top 10% of each category were considered the most influential and therefore were included in the spatial analysis. For example, from the EM-DAT collection of all disasters worldwide first separated only climate-related disasters, as previously described, from 1990-2016, resulting in 4,127 disasters. Of these, 1,183 records were categorized as storm disasters. To determine if a disaster is major or not one might be tempted to look only at casualty counts, for the storm category this could range from a 1991 Bangladeshi flood that reported 138,987 deaths, all the way down to the 292 floods that have zero reported deaths but were recorded by EM-DAT for meeting the requirements with a different indicator.

Judging disasters by their casualties alone gives more weight to those disasters that occur in countries with higher population densities, more geographic vulnerability, or those that are less developed. If one were to instead choose another statistic like total damage, which is recorded economically you would then see a 2005 American storm (presumably Katrina) heading the list at $158,230,000,000, a number that would be

much easier to attain in a more developed country where even small amounts of damage can result in very high monetary costs (not that Katrina was insignificant by any means). The statistic chosen will inevitably favor some countries over others, the only way to avoid this bias was to take the top 10% of each statistic and again for each category to not favor one type of vulnerability over another either. The count used for the spatial analysis was a 'weighted' count, some of the disaster entries appeared in multiple top 10% counts, each category and statistic was considered separately in the weighted count to show those disasters that had a greater impact on the people of that country rather than just the raw number that could neglect those disasters that had major impacts in multiple ways. For example, the previous example, assumed to be Hurricane Katrina, was in the top 10% for number of fatalities and the top 10% for economic damage but was not in the 10% for any other statistic so it was counted as two major 2005 American disasters to show its impact economically and for the people involved whereas in a raw count this would just be one. The final count of major disasters resulted in 591 disasters worldwide, the geographic distribution of which is shown in Figure 1.

The question requires the distribution of disasters spatially and temporally so the data were then separated further into each 5-year time period and analyzed separately to look for changes over time that corresponded with subsequent policy changes. This results in 23 data sets of 5 year periods (1990-1994, 1991-1995, 1992-1996, etc.).

Figure 1. Weighted Count of Disasters
A count of disasters considered significant by appearing in the top 10% in at least one category of measurement for disaster indicators.



To look for spatial patterns an analysis of local spatial autocorrelation was required to find 'hot spots' or places that are more or less impacted by disasters than would be expected. The spatial analysis was done on each of the 5-year period datasets in ArcMap to calculate the Getis-Ord G_i^* statistic and show hot or cold spots for disaster impact. This calculation used the countries' disaster impact weight, as well as its neighbors' disaster impact weight, with priority by inverse distance of neighbors. We use the influence of neighbors based on the political theory that neighbors have an influence on each other even if it is non-binding (Bodansky, 2007). The Getis-Ord G_i^* statistic calculated the expected value under a null model of complete spatial randomness and the variance from that expected value, resulting in a G_i^* statistic that includes a z-score in the calculation against the null hypothesis. This formula is shown as Equation 1 (O'Sullivan and Unwin, 2003; ESRI, 2017). For each dataset only those

G scores that were less than -1.96 standard deviations and greater than 1.96 standard deviations were considered as cold or hot spots, respectively (Bivand and Gomez-Rubio, 2013).

Equation 1. Getis-Ord Local Statistic

Where x_j is the attribute value for feature j, $w_{i,j}$ is the spatial weight between feature i and j, and n is equal to the total number of features.

$$\frac{\sum_{j=1}^{n} w_{i,j}x_j - \left(\frac{\sum_{j=1}^{n} x_j}{n}\right)\left(\sum_{j=1}^{n} w_{i,j}\right)}{\left(\sqrt{\frac{\sum_{j=1}^{n} x_j^2}{n} - \left(\frac{\sum_{j=1}^{n} x_j}{n}\right)}\right)\sqrt{\frac{\left[n\sum_{j=1}^{n} w_{i,j}^2 - \left(\sum_{j=1}^{n} w_{i,j}\right)^2\right]}{n-1}}}$$

After the analysis was done to find hot spots in each 5-year time period globally, the results showed that China and India were the exclusive hot spots for every dataset except for the occasional inclusion of the United States. This is most likely a result of the large gap in the count of disasters for those three countries as opposed to the rest of the world. To combat this bias, the data were then split into four regions to look for regional hot spots, the presence of China and India were maintained, but this allowed some other countries in the Asia/Middle East/Pacific Islands region to also show up in some datasets, and other countries in the Americas, Europe, and African regions to also have a presence. The division of countries is shown in Figure 28.

Each resulting hot spot was then compared to the policy database results to find any matching policies. Policies were classified as either legislative or executive policies based on how they were enacted. Legislative policies are those that are enacted through an official legislative body for that country. Executive policies are those enacted by a government executive, such as a President or Prime Minister, without necessarily going through policymaking negotiations, depending on the executive branch structure.

Policies were also given a tag for whether it acts as a 'framework' policy or not. Framework policies are those that serve as a basis for future policy, usually establishing goals or policies for more detailed policy to come. The assumption is that, in general, executive policies can pass faster than the extensive process of a legislative policy, so they were held to different time frames to determine correlation. An executive policy had to fall within two years of the end of a hot spot time frame and a legislative policy had to fall within five years of the end of a hot spot time frame to account for the policy lag from different types of governing. The resulting policies were considered correlated to high disaster impact before the implementation of the law. As a disclaimer on this measure in the study, a pure count of policies is not always indicative of success in legislating as a count tells nothing about the actual effectiveness of a policy but for the scope of this study a count is the best complete data available.

To accurately confirm statistical significance of the correlations between high disaster impact time frames and subsequent climate adaptation policies two null hypothesis scenarios were also tested. High disaster impact time frames were compared to each null hypothesis, the first being climate transportation policies derived from the Grantham Institute database, and the second being randomly generated fictional policies with the same general characteristics as the climate adaptation policy dataset. The null hypothesis dataset was meant to be a comparable dataset of policies. While this could have originally been done with randomly generated data, the concern was that it would not be as thorough a test because climate policies have very distinct characteristics as they have grown in overall number and prominence since the 1980s. The first attempt was made to perform a null hypothesis test with real policies that were still climate-

related but pertaining to a different subject matter. All of the Grantham Institute records for 1990-2017 were analyzed to find the best fit, the goal being to find a policy category that was the most unrelated to adaptation policy, with the fewest number of overlapping policies (any entry recorded in the Grantham database can have multiple subject matter tags), but also with a similar number of records to compare. The adaptation policy dataset had 347 policies, most from 2003-2017. Comparison to different policy types is shown in Table 1.

Table 1. Potential Null Hypothesis Policy Options
Policy areas compared for matching patterns to Adaptation and Mitigation policies but also with the least overlap.

Policy Type	Most Active Time Period	Number of Policies	Number of Overlapping Policies with Adaptation and Mitigation
Adaptation and Mitigation	**2003-2017**	**347**	**-**
Administrative	1993-2017	726	235
Carbon Pricing	2003-2017	111	32
Energy Demand	1993-2017	582	163
Energy Supply	1990-2017	737	163
Research and Development	1998-2017	330	147
REDD+ LULUC[2]	2000-2017	280	145
Transportation	2000-2017	278	90

From these options, transportation policy was chosen as the best fit because it had the closest overall match of characteristics with the lowest overlap. At the same time, there were still 90 of 278 policies overlapping. Having 33% of the same policies is

[2] Reducing emissions from deforestation and forest degradation in developing countries and land use land use change (REDD+ LULUC)

not necessarily an independent sample, so because of the situation a randomly generated null hypothesis was also created to compare both situations. The random null hypothesis was created using random number generation to create 347 records with random years attributed to each between 1990-2017, a random country indicator for one of 177 countries, and relevant characteristics such as whether it would be classified as a legislative or executive policy or if it was a framework policy or not. According to the average characteristics in the adaptation policy dataset 1/4 of policies were legislative while the remaining 3/4 were executive (also evidence to the policy lag assumption that it is easier to pass executive policies), and 1/3 were framework policies.

Results

Following the spatial analysis for each data set there were resulting significantly impacted countries for each temporal measurement. There never were any less than -1.96, indicating there were no "cold spots" in the data so there are no countries that are significantly less impacted by disasters than any others. There were between 10-18 "hot spots" in each data set. This resulted in 47 countries identified as being significantly more impacted by disasters in at least one of the time periods. Results for each 5-year time period are shown in Figures 2 through 24. The significant results from each time frame were then individually compared to that country's climate policy to look for correlations.

Of the countries found to be significant 10 of them had no applicable climate policy at all, 11 of them had relevant climate policies but none of those correlated with

high disaster time periods. The remaining 26 countries did have correlations between specific policies and times of high disaster impact. Of the 26 that did correlate, 15 of these were executive policy correlations, 2 were legislative policy correlations, and 9 had both executive and legislative correlations in climate policy.

Figure 2. Disaster Hot Spots 1990-1994

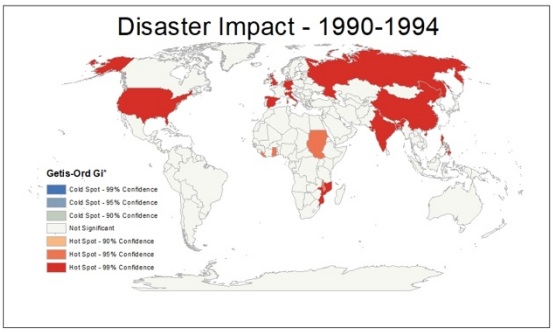


Figure 3. Disaster Hot Spots 1991-1995

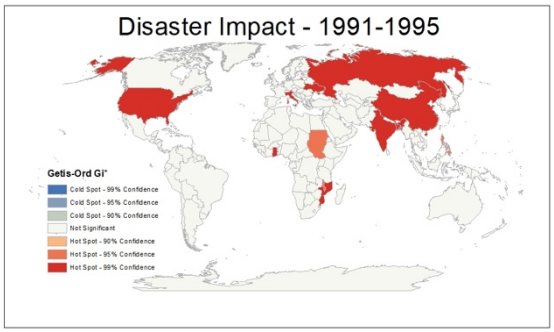


Figure 4. Disaster Hot Spots 1992-1996

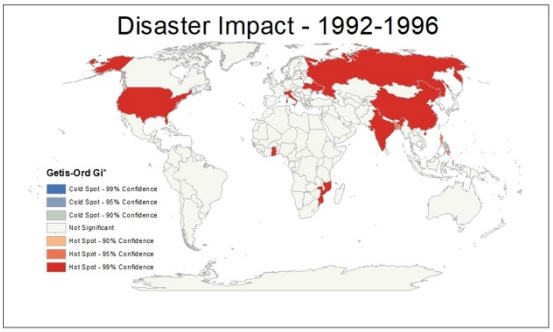


Figure 5. Disaster Hot Spots 1993-1997

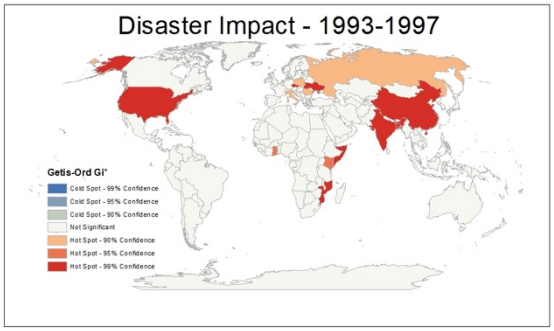


Figure 6. Disaster Hot Spots 1994-1998

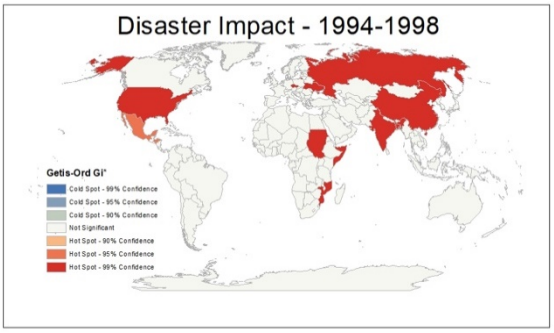


Figure 7. Disaster Hot Spots 1995-1999

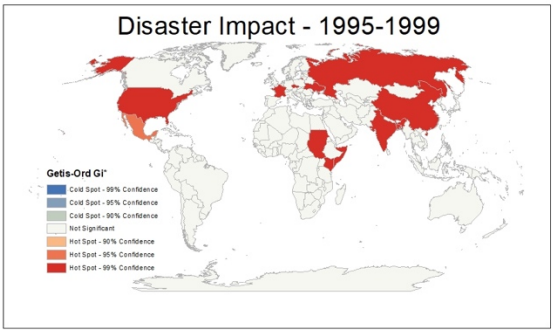


Figure 8. Disaster Hot Spots 1996-2000

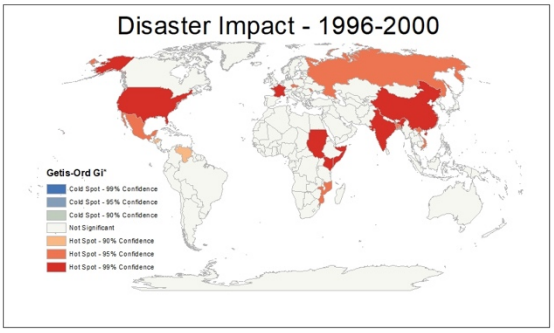


Figure 9. Disaster Hot Spots 1997-2001

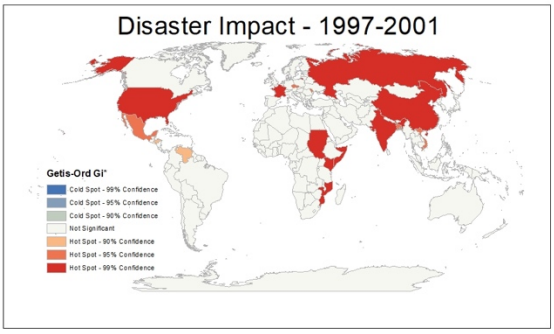


Figure 10. Disaster Hot Spots 1998-2002

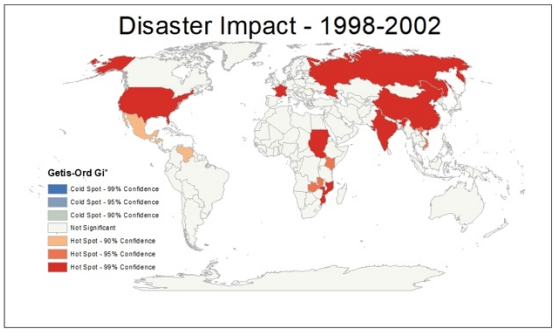


Figure 11. Disaster Hot Spots 1999-2003

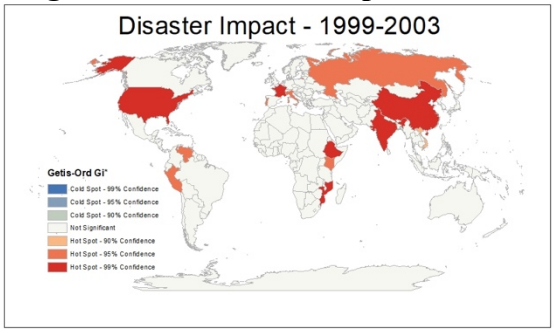


Figure 12. Disaster Hot Spots 2000-2004

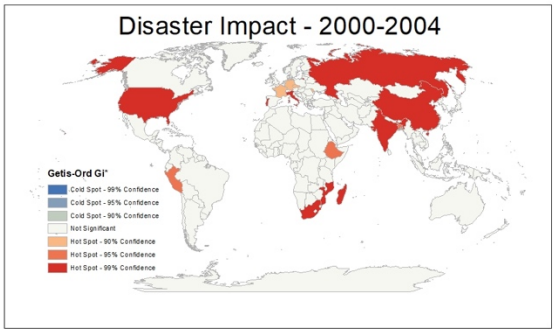


Figure 13. Disaster Hot Spots 2001-2005

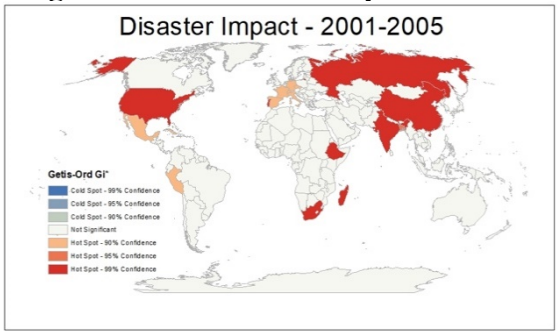


Figure 14. Disaster Hot Spots 2002-2006

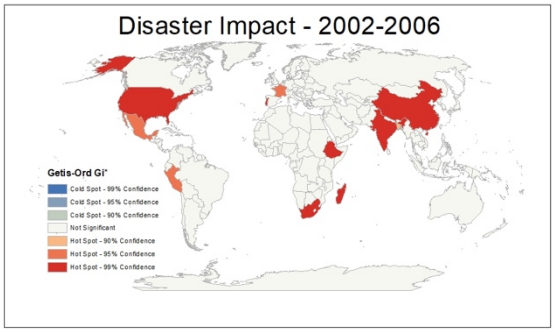


Figure 15. Disaster Hot Spots 2003-2007

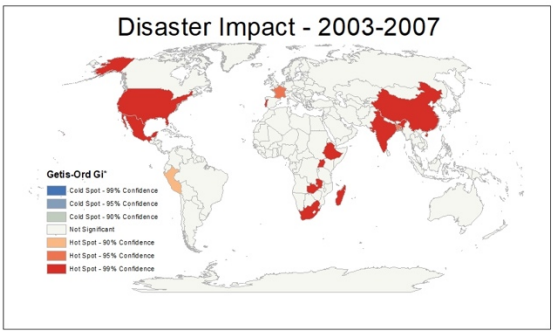


Figure 16. Disaster Hot Spots 2004-2008

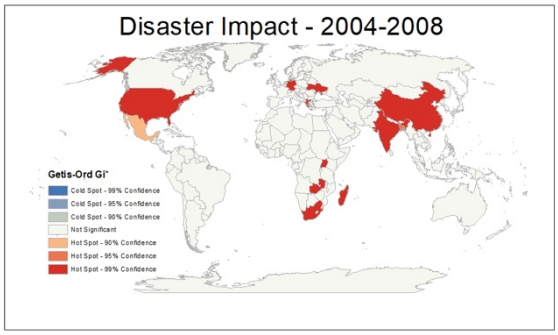


Figure 17. Disaster Hot Spots 2005-2009

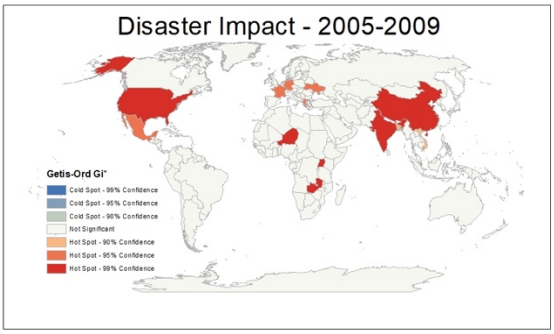


Figure 18. Disaster Hot Spots 2006-2010

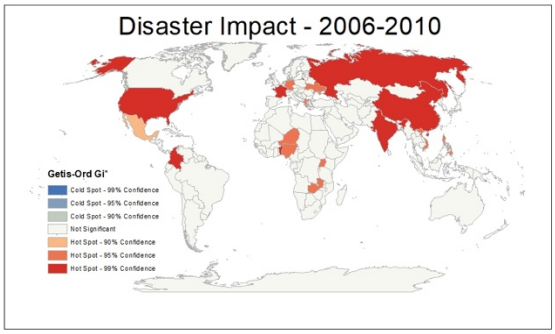


Figure 19. Disaster Hot Spots 2007-2011

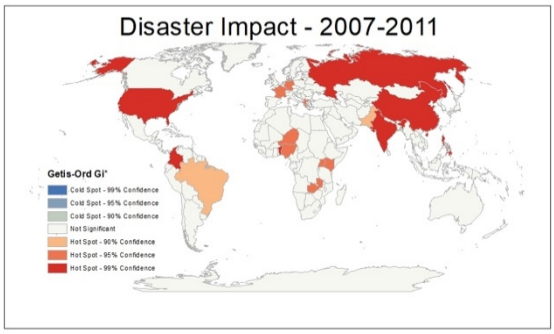


Figure 20. Disaster Hot Spots 2008-2012

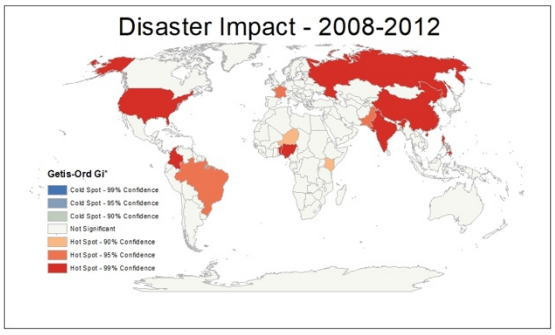


Figure 21. Disaster Hot Spots 2009-2013

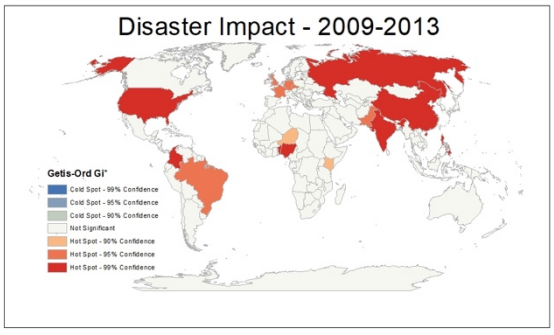


Figure 22. Disaster Hot Spots 2010-2014

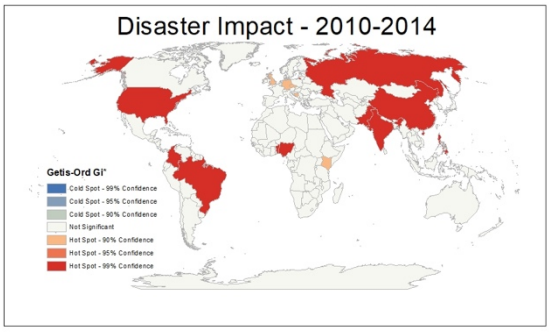


Figure 23. Disaster Hot Spots 2011-2015

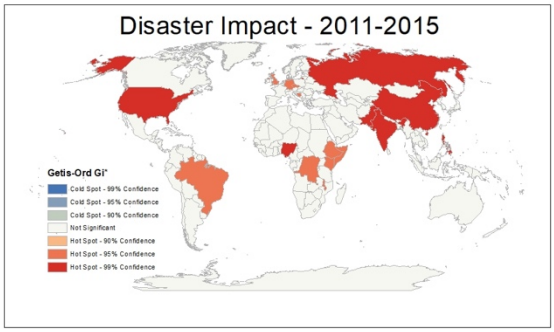


Figure 24. Disaster Hot Spots 2012-2016

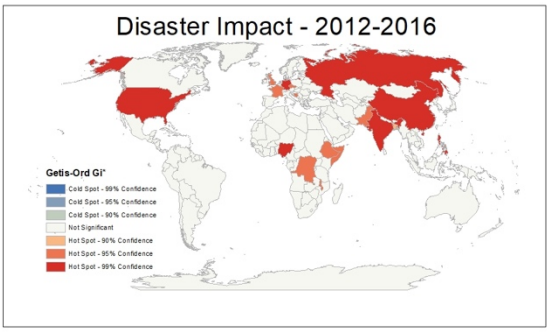


Table 2. Adaptation Policy Matches to High Disaster Time Periods

Policies that matched to correlate with one or more 5-year time period of high disaster impact for their country. The end of the period of high disaster impact must have been within 2 years of executive policy passing and within 5 years of legislative policy passing.

Country	Name	Year Passed	Executive/ Legislative	Framework
Bangladesh	"Bangladesh Climate Change Strategy and Action Plan (BCCSAP)"	2009	Executive	Mitigation and Adaptation
Bangladesh	"6th Five Year Plan (FY 2011-FY 2015)"	2011	Executive	No
Bangladesh	"The Climate Change Trust Fund Act"	2009	Legislative	No
Bangladesh	"Disaster Management Act"	2012	Legislative	No
Benin	"Low Carbon and Climate Change Resilient Development Strategy 2016 2025"	2016	Executive	Mitigation and Adaptation
Brazil	"Law 12805, establishing the National Policy on Farming-Livestock-Forest Integration"	2013	Legislative	No
China	"The National Strategy for Climate Change Adaptation"	2013	Executive	Adaptation
China	"National Plan For Tackling Climate Change 2014-2020"	2014	Executive	Mitigation
China	"12th Five-Year Plan for the Development of National Economy and Society (2011-2015)"	2011	Legislative	No
Colombia	"National Plan for Climate Change Adaptation"	2012	Executive	Adaptation
Colombia	"Law 1450, establishing the National Development Plan 2010 2014	2011	Legislative	No
Colombia	"Law 1523, adopting the National Policy of Risk Management and the National System of Risk Management"	2012	Legislative	No
Czech Republic	"National Programme to Abate the Climate Change Impacts, Government Resolution No. 187"	2004	Executive	Mitigation
France	"Climate Plan 2004"	2004	Executive	No
France	"National Climate Change Adaptation Plan"	2011	Executive	Adaptation
France	"Climate Plan (Policy framework)"	2013	Executive	No
France	"Farming, forest and alimentation Framework Policy No. 2014-1170"	2014	Legislative	No
Germany	"German Strategy for Adaptation to Climate Change (DAS)"	2008	Executive	Adaptation
Kenya	"National Environment Policy 2013"	2013	Executive	No
Kenya	"Climate Change Act, 2016"	2016	Legislative	Mitigation and Adaptation
Madagascar	"National Climate Change Policy"	2010	Executive	Mitigation and Adaptation
Malawi	"National Climate Change Management Policy"	2016	Executive	Mitigation and Adaptation
Mexico	"General Law on Climate Change"	2012	Legislative	Mitigation and Adaptation
Mozambique	"National Environmental Policy"	1995	Executive	No
Niger	"National Policy on Climate Change (PNCC)"	2012	Executive	Mitigation and Adaptation
Nigeria	"Nigeria Vision 2020"	2010	Executive	No
Nigeria	"National Policy on Climate Change"	2013	Executive	Mitigation and Adaptation
Pakistan	"Pakistan 2025: One Nation, One Vision"	2014	Executive	No
Pakistan	"Pakistan Climate Change Act 2016"	2017	Legislative	Mitigation and Adaptation
Peru	"National Strategy on Climate Change, Executive Decree No. 086-2003-PCM"	2003	Executive	Mitigation and Adaptation
Philippines	"Framework Strategy on Climate Change"	2010	Executive	No
Philippines	"National Climate Change Action Plan"	2011	Executive	No
Philippines	"Philippine Disaster Reduction and Management Act (RA 10121)"	2010	Legislative	No
Philippines	"The People?s Survival Fund Act (RA 10171)"	2012	Legislative	No
Portugal	"Council of Ministers Resolutions 104/2006 and 1/2008, establishes and amends the National Climate Change Programme (PNAC)"	2006	Executive	Mitigation
Spain	"National Climate Change Adaptation Plan"	2006	Executive	Adaptation
Spain	"Spanish Strategy for Climate Change and Clean Energy and the related Plan of Urgent Measures"	2007	Executive	Mitigation
Uganda	"National Policy for Disaster Preparedness and Management"	2010	Executive	No
Uganda	"National Climate Change Policy"	2013	Executive	Mitigation and Adaptation
United Kingdom	"National Adaptation Programme"	2013	Executive	Adaptation
United States of America	"Executive Order 13653: Preparing the United States for the Impacts of Climate Change"	2013	Executive	Adaptation
Vietnam	"The National Climate Change Strategy and the No: 2139/QD-TTg Decision on Approval of the National Climate Change Strategy"	2011	Executive	Mitigation
Vietnam	"Decision No. 543/QD-BNN-KHCN: Action Plan on Climate Change Response of Agriculture and Rural Development Sector in the Period 2011-2015 and vision to 2050"	2011	Executive	No
Vietnam	"Decision 1393/QD-TTg: Vietnam Green Growth Strategy"	2012	Executive	No
Vietnam	"Law on Natural Disaster Prevention and Control No: 33/2013/QH13"	2013	Legislative	Adaptation
Vietnam	"Law on Environmental Protection No: 55/2014/QH13"	2015	Legislative	No
Zambia	"National Climate Change Response Strategy"	2010	Executive	No
Zambia	"The Water Resources Management Act, 2011"	2011	Legislative	No

Figure 25. Correlation Rate by Hot Spot Region
Regional average correlation rate for disaster hot spots to adaptation policy.

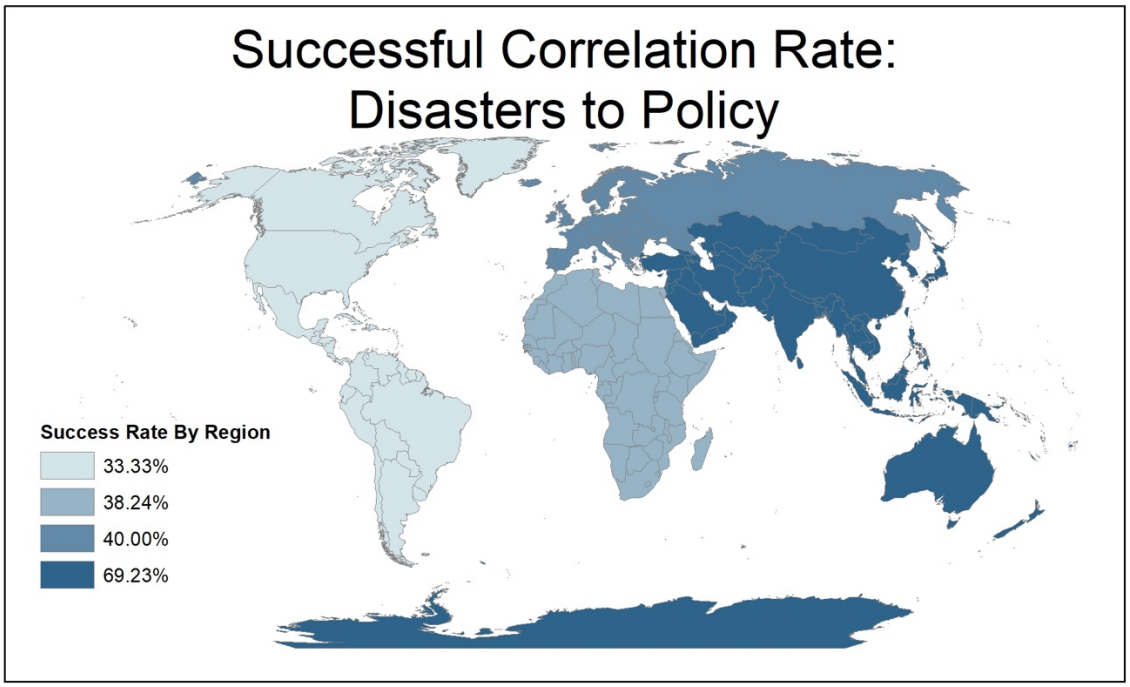


Figure 26. Adaptation Policy Correlations to Disaster Hot Spots By Year
Correlation rates by hot spot in grey show the percent of times a given hot spot is matched to any policy. Correlation rates by policy in blue show the percent of policies matched to a disaster hot spot compared to the number of policies available to match.

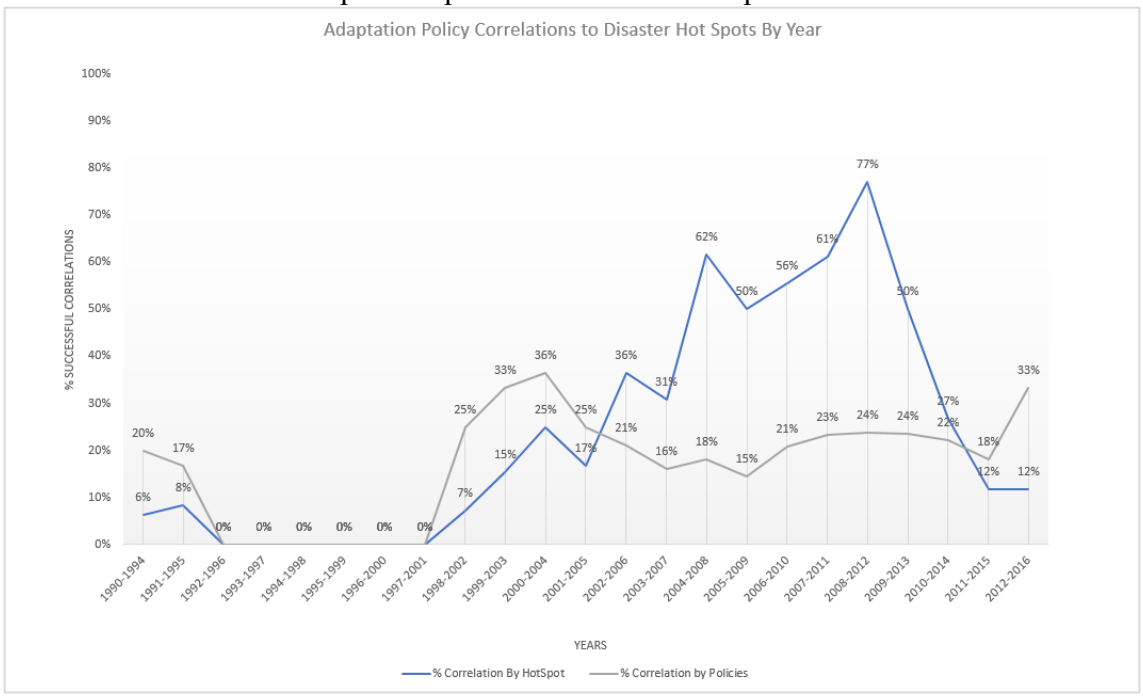


Figure 27. Transportation Policy Correlations to Disaster Hot Spots By Year (Null)

Null hypothesis built based on Grantham Institute entries tagged as transportation policy. Correlation rates by hot spot in blue show the percent of times a given hot spot is matched to any policy. Correlation rates by policy in grey show the percent of policies matched to a disaster hot spot compared to the number of policies available to match.

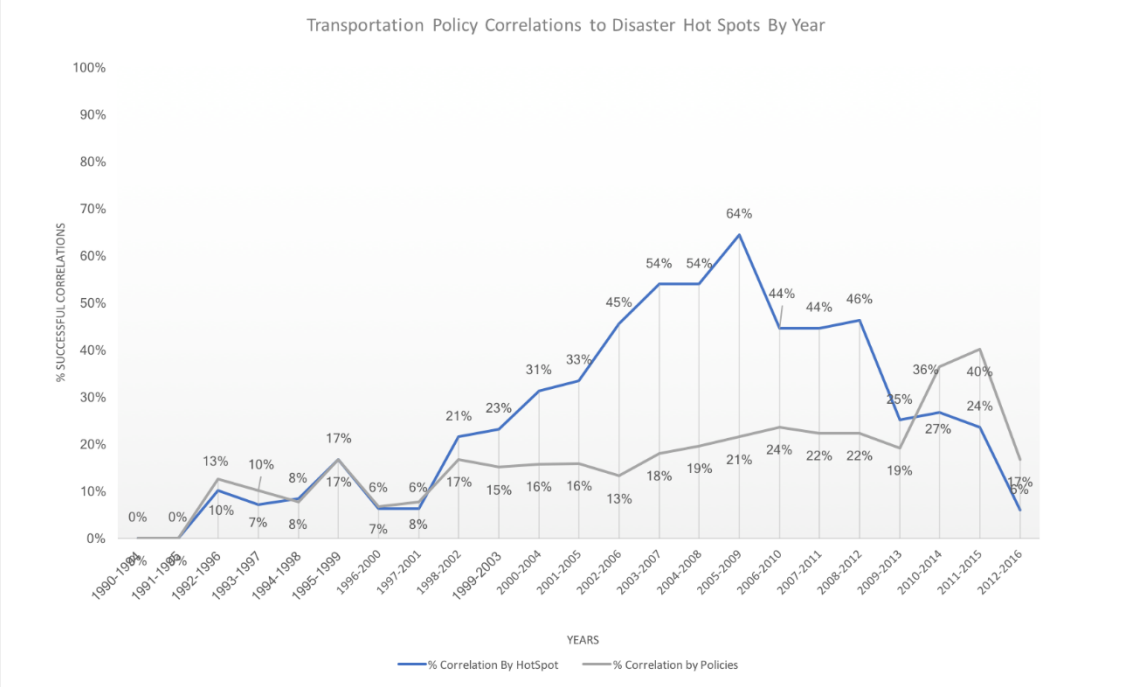
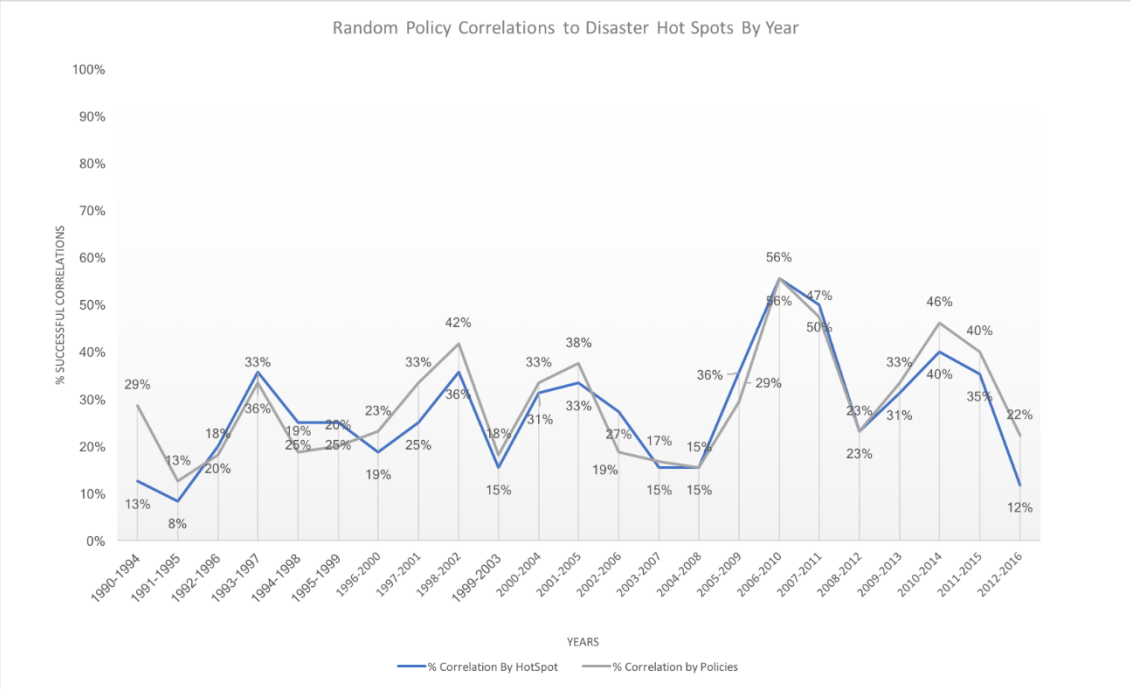


Figure 28. Random Policy Correlations to Disaster Hot Spots By Year (Null) Null hypothesis built based on randomly generated entries with randomly generated policy characteristics matching the general patters of adaptation and mitigation policy from the Grantham Institute. Correlation rates by hot spot in blue show the percent of times a given hot spot is matched to any policy. Correlation rates by policy in grey show the percent of policies matched to a disaster hot spot compared to the number of policies available to match.



Discussion

The results of the correlation study show of the 47 countries, 10 of them have no climate policy at all. Consequently, it is possible to do further analysis of policy changes on only 37 of the 47 countries involved. The 10 countries without climate policies may be a function of not having any perceived need or of the political and economic circumstances of those individual countries. Of the 37 that do have relevant policies, an average of about half correlate with a time of significantly high disaster impact. This is not a very conclusive measure and there are likely other drivers of policy change beyond disasters accounted for in this model. When looking at the data for regional effects, shown in Figure 25, this model is most obviously more successful in the Asia/Middle East/Pacific Islands region but this could also be explained by the constant presence of China and India's hot spots in every 5-year time period, therefore any year they have a policy implemented is guaranteed to be a correlation match. The concern regarding the validity of the transportation null hypothesis was proved valid as shown in the result in Figures 26 through 28. The same general pattern for correlation occurs between adaptation policy and transportation policy over time that does not appear in the random policy scenario, this cannot surely be evidence of a significant pattern between just adaptation and transportation policy because it could possibly be a result of the overlapping policies alone.

Compared to the transportation policy null hypothesis, there is 90% confidence level that disaster policy matches by 5-year time period are at a higher proportion than transportation policy matches, but that is the only statistically significant indicator. With

only one confirmed statistically significant aspect of the hypothesis and several that are statistically significant toward both null hypotheses it shows that disasters alone do not sufficiently contribute to climate policy changes. While the results of the study did not fit the conceptual model hypothesis there are many variables that influence climate policy and future studies have room for future studies on the socioeconomic factors, political factors, major scientific report release timelines, and international treaty timelines.

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Chapter 4: Single Disaster in Multiple Countries

Abstract

Disasters are the most tangible representation of climate change in our time. For policy makers, the easiest way to engage their constituents in new policy is to relate it to a need. Natural disasters are an easily visible reference to remind people of a very pressing need for new disaster policy. The question comes from whether these common references are actually the instigator of policy change, and if so, do those changes coincide with the impact of the referenced disaster by degree. To compare policy responses to disaster it requires the disaster as a constant to see difference to the same disaster. For this reason, the 2013 flood of the Danube, Elbe, and Rhine rivers is the case study topic with a policy analysis across all nine countries (Austria, Bulgaria, Croatia, Czech Republic, Germany, Hungary, Romania, Serbia, Slovakia) that were affected by this one event. To compare equally the disaster impacts across multiple economic situations the use of a non-monetary measure of disaster damage, Lifeyears, was implemented (Noy, 2015). The expectation is that the country most impacted would have the most incentive and therefore implement disaster policy in response. This was found to be true from the policy data that were available.

Introduction

Studies of policy change in the United States show disasters as focusing events in terms of new policy adoption (Birkland, 2004; Birkland, 2006). The question is whether this is the same outside the United States and whether there is a threshold for how severe a disaster has to be before disaster policy is altered to incorporate lessons learned from an experience. The hypothesis is that a country that is more severely impacted by a disaster would have more incentive and therefore pass changes to disaster policy following a major event.

For this case study, a single disaster was required that was considered to be major climatologically, affecting multiple countries, and also not too recent to allow time for policy changes, but not too long ago as to no longer be relevant. From these criteria, the Danube/Rhine/Elbe Rivers flood of 2013 was the best fit with the most data available. This disaster is considered the 7th most severe flood in measurements of economic damage, with $12,900,000,000 (USD 2000) worth of reported damage, and largely impacted nine countries over the period of one month (EM-DAT, 2017). This case also gives the interesting aspect of having eight of the nine involved countries being a part of the larger European Union community, with one completing the joining process in the month of the flood (CIA, 2017).

A comparison technique to include impacts from disaster across income levels was used to most accurately show damages for each country equally. This measure of Lifeyears, invented by Ilan Noy, is based on the World Health Organization's Disability Adjusted Life Years to measure all damage in terms of human life instead of casualties

or economic damage, which can both depend on individual qualities of the country (Noy, 2015).

National disaster policy has a long history of case studies observing action following a single disaster. The government is apt to take responsibility for action when pushed by the public but that only happens after the event, not proactively in any case (Birkland, 2004). Failure of the Tous dam in Spain in 1982 prompted a change from a focus on post-disaster aid and small scale flood controls to mitigation techniques and improved preparedness (Serra-Llobet et al., 2013). Italian landslides have the same indicators that the disasters open policy windows but they do not necessarily cause policy change as an event alone (Scolobig et al., 2014). These examples are of individual nation's response to an individual event with limited comparative value to other situations.

Case Study Background

Disaster Overview

While inland flooding is one of the most common natural disasters the meteorological conditions of the 2013 European flood were rare but very similar to the situation of the major 2002 and 2005 floods of the same region (Grams et al., 2014; Breinl, 2015). The flood occurred from May 28 to June 18th with the effects of lingering floodwaters lasting much longer, in some cases years (EM-DAT, 2017; Liska, 2014). The weeks prior to the flood were already cool and wet, saturating the ground.

Cool air was trapped over the Alps and warmer air was stalled north causing three consecutive cyclones moving westward (which is very unusual) and created a northerly flow against the west-east mountains, which created orographic enhancement of an already heavy precipitation event. This 'warm conveyor belt' process in that direction is a very rare situation but has "high potential for triggering very severe heavy precipitation events" (Grams et al., 2014).

Major floods have become more frequent in the Danube River Basin over time (Bloschl et al., 2013). Major flood event records go all the way back to the 1700s but the more recent events were in 1954, 2002, and 2005 (Bloschl et al., 2013). Many of the areas affected by the 2013 flood are the same that were hit by the 2002 flood which is known to have already instigated policy changes. In some areas flood protection methods had been implemented following the flood of 2002. These avoided some of the damages in 2013 that would have occurred without those preventative measures. Most of those measures were in terms of physical levees rather than citizen education and preparedness (JBA, 2014; Bloschl et al., 2013). Damage evaluations of the entire flood showed the effects of the 2013 flood in Austria, Czech Republic, and Germany, at the same magnitude level of previous major floods in 1954 and 2002, even after the implemented programs over time (Fewtrell et al., 2013). For comparison to previous floods, Passau, Germany, experienced flood levels similar to the highest recorded flood ever from 1501 (Bloschl et al., 2013). The flood magnitude was measured in different locations as anywhere between a 50-year flood to a 1000-year flood (ZIC, 2014).

Geographic Context

Austria

Austria joined the EU in 1995 and has a fairly strong economy tied very closely to Germany. The geography of Austria is mostly mountains with the Danube flowing through. The majority of the population lives in the Northeastern region of the country, because of poor soils and steep slopes most elsewhere (CIA, 2017). The Danube basin covers 96% of Austria, save a very small portion of the western mountains; Austria covers 10% of the entire Danube basin (Gascoigne, 2009). Austria does receive high rainfall amounts in the Alpine mountainous regions, but much lower precipitation rates are recorded in the Northeast (ICPDR, 2006a). The Danube is used for hydroelectric power, amounting to 33% of Austria's total electricity, and is widely used for transportation of goods and for drinking water. The river also has regularly flooded; with virtually all of the available valley being used for urban infrastructure or agriculture, there is very little water storage capacity surrounding the river (ICPDR, 2006a). Austria's political structure is a federal parliamentary republic with a civil law system. Austria's government consists of an executive branch with a President and Chancellors, appointed by the President but determined by the Federal Assembly. The legislative branch is a bicameral Federal Assembly consisting of the Bundesrat, appointed by each of the nine state parliaments, and Nationalrat, directly elected by proportional representation vote (CIA, 2017).

Bulgaria

Bulgaria joined the EU in 2007 and as a former communist country still has one of the lowest per-capita incomes of EU members (CIA, 2017; World Bank, 2017). The Danube River Basin covers almost half of the country and has 46% of the Bulgarian population residing within the basin (Gascoigne, 2009; ICPDR, 2017). Bulgaria's government consists of a parliamentary republic and a civil law system. Bulgaria's federal government consists of a President, elected by absolute majority in a popular vote, and a Prime Minister, elected by the National Assembly. Bulgaria's legislative branch is a unicameral National Assembly, directly elected by proportional vote (CIA, 2017). The Bulgarian corruption perception score is 43, the second lowest in the study region (CPI, 2017). This indicated that the government is not known to be connected with the citizens' interests so policies may not be expected to follow logically after a disaster as those with less corruption would.

Croatia

Croatia joined the EU in 2013, and while it is the one of the wealthiest of the former Yugoslav Republics, for the countries affected by the 2013 flood it is ranked 6th of 9, with a GDP higher only than Bulgaria, Romania, and Serbia (World Bank, 2017). Croatia was in an interesting situation during the flood as they were about to officially join the EU as of July 1, 2013, just after the flood. From this, they did not have any of the policy frameworks from the EU in place, but were eligible to ask for EU aid after the flood. Most of the population of Croatia lives in the northern half of the country with a quarter in Zagreb and the surrounding areas (CIA, 2017). The Danube river

makes up the far eastern most boundary between Croatia and Serbia as it flows southward from Hungary. The Danube basin covers 63% of Croatia, most of the northern and central portion, and 69% of the population (Gascoigne, 2009). The Danube is a major transportation route for international trade in Croatia and provides most of the drinking water for the country. Croatia does have generally wider preserved floodplains than most of their neighbors, but 15% of the mainland is still at regular risk for flooding (ICPDR, 2010). Croatia's political structure is a parliamentary republic with a civil law system. The executive branch has a President, directly elected by a simple majority of the popular vote, and Prime Minister, appointed by the President. The legislative branch has a unicameral Hrvatski Sabor with a variety of voting techniques, depending on the seat, from proportional representation to simple majority by minority populations (CIA, 2017).

Czech Republic

The Czech Republic, or Czechia, joined the EU in 2004 and has been a democratic nation since 1989 (CIA, 2017). The Elbe River Basin covers most of the country and the Elbe itself goes through the capital city of Prague. Most of the previous flood policy has been centered on the Morava River after severe flood events in 1997 and 2002 (ICPDR, 2007a). The Czech Republic's political structure is a parliamentary republic with a new civil law system that was enacted in 2014 (CIA, 2017). Czechia's federal government consists of a President, elected by absolute majority in a popular vote, and a Prime Minister, appointed by the President. The legislative branch has a bicameral Parliament with a Senate and Chamber of Deputies, or Poslanecka

Snemovna, both directly elected for 6- and 4-year terms, respectively (CIA, 2017). The new government that came into place in 2014 has been working on basic reforms to reduce corruption and maintain the economic strength of the country but because of this turnover in the middle of the policy analysis time frame there was a lack of data for any policy changes regarding disasters. It is unknown whether this is because of an actual lack of change or because action from the previous government was truncated.

Germany

Germany is one of the most influential countries in all of Europe with the largest economy and largest population, except Russia (CIA, 2017). Germany was one of the six original members of the EU and the Eurozone. The southern German border is made by the Rhine River and the southern portion of the country, including Bavaria, has the Danube running through it (ICPDR, 2007b). The Danube River Basin only covers 17% of Germany, but Germany has the third largest population residing in the Danube River Basin at 9.4 million people, behind only Romania and Hungary (Gascoigne, 2009). Flooding is the most common natural hazard for which Germany has to plan. With this large flood risk, Germany has taken many steps to develop flood prediction technologies and flood control measures (ICPDR, 2007b; CIA, 2017). Germany's political structure is a federal parliamentary republic with a civil law system. The executive branch has a President, indirectly elected by the Federal Parliament, and Chancellor, elected by the party in the Federal Parliament with the most representatives. Germany's current Chancellor, Angela Merkel, has been serving in that capacity since 2005. The legislative branch is a bicameral Parliament consisting of the Federal Council

or Bundesrat, appointed by state governments, and Bundestag, half elected by proportional representation and half elected by simple majority (CIA, 2017).

Hungary

Hungary's entire population, 10.1 million people, lives in the Danube River Basin and the capital city of Budapest is directly on the Danube itself (ICPDR, 2006b) .The Danube River Basin covers the entire country and Hungary contains the second highest percentage of total area of the basin for a single country at 11.6% (Gascoigne, 2009). A quarter of Hungary's population lives in a floodplain, along with a third of the rail system. Floods in Hungary have been known to last anywhere from hours to months. Because of this threat, they have developed flood protection systems consisting of emergency lowland flood reservoirs (ICPDR, 2006b). Hungary's political structure is that of a parliamentary republic with a civil legal system directly inspired by the German government. The executive branch has a President, indirectly elected by the National Assembly by 2/3 majority, and a Prime Minister, elected by the National Assembly from recommendations via the President. The legislative branch is a unicameral National Assembly, about half directly elected by simple majority and the other half elected by proportional representation along party lines (CIA, 2017).

Romania

Romania was a communist nation until 1996. After the change Romania joined the EU, in 2007 (CIA, 2017). The Danube River forms the southern boundary with Serbia and Bulgaria and the river basin covers 97% of Romania, with 21.7 million

Romanians reside within the basin (Gascoigne, 2009). Romania's water resources are generally limited so they have taken great care to prepare for flood events both structurally and non-structurally with reservoir systems and reforestation programs as well as flood zone maps, education, and warning systems and public encouragement for flood insurance programs (ICPDR, 2006c). Romania's government is a semi-presidential republic with a civil law system. The executive branch consists of a President, directly elected by absolute majority, and a Prime Minister, appointed by the President with the consent of the Parliament. The legislative branch is a bicameral Parliament with a Senat and Chamber of Deputies, both of which are elected by proportional representation via a party list (CIA, 2017).

Serbia

Serbia is the only country included in this case study that is not a current member of the EU. With its turbulent past and ongoing negotiations about the independence of Kosovo there is a goal for entry into the EU by 2020 but not much progress has been made since accession talks began in 2014 (CIA, 2017). The Danube River makes up the northern-most boundary between Serbia and Romania. Ten percent of the Danube River Basin is in Serbia and covers 92% of the country (Gascoigne, 2009). Serbia should have a lot of incentive to develop extensive water and flood policies as 90% of their available water comes from outside the country (ICPDR, 2006d). In northern Serbia there are many levees and in central Serbia every major city lies in a flood plain. Serbia is prone to flash floods on smaller rivers and floods on major rivers are common; yet, their flood protection policy is almost non-existent

(ICPDR, 2006d). Serbia's government structure is a parliamentary republic with a civil law system. The executive branch is made up of the President, directly elected by absolute majority popular vote, and Prime Minister, elected by the National Assembly. The legislative branch is a unicameral National Assembly with members serving in a single nationwide constituency and is elected by proportional representation by party affiliation (CIA, 2017).

Slovakia

Slovakia and the Czech Republic peacefully separated in 1993 and they both joined the EU at the same time in 2004 (CIA, 2017). Slovakia sits on the watershed divide between the Black Sea and the Baltic Sea and hosts parts of five different sub-basins of the Danube River (ICPDR, 2007c). Only 6% of the Danube River Basin is in Slovakia but it covers 96% of the country and 5.2 million residents (Gascoigne, 2009). Slovakia experiences flooding often but it is usually a result of snowmelt and occasionally from summer precipitation. The cities are mostly already outfitted for flood protection along the major rivers (ICPDR, 2007c). Slovakia's government structure is that of a parliamentary republic with a civil law system that was based off the Austro-Hungarian civil codes. The executive branch consists of a President, directly elected by absolute majority, and a Prime Minister, appointed by the President who is usually formerly the leader of the majority party. The legislative branch is a unicameral National Council or Narodna Rada, elected for a nation-wide constituency by proportional representation (CIA, 2017).

Data

Evaluations of the 2013 flood came from several sources, each having varying numbers and no consensus on the actual results. Some sources even claimed different countries were impacted or not. Data from multiple reports and databases were combined to get the most thorough picture of the flood impact. Switzerland, for example, was included in one flood report as being affected by the flood but because there were no reports of damage or any details at all from that source or any other, Switzerland was not included in the analysis.

Noy's Lifeyears measurement requires data for deaths, injuries, those made homeless, those affected, economic damage, recovery time, and per capita GDP (Noy, 2015; EM-DAT, 2017; Liska, 2014; ZIC, 2014; Monguzzi and Norgaard, 2013; World Bank, 2017; UN, 2015; UN, 2017; BLS, 2017; EUROPA, 2017; Pa, 2013). In the original model, very specific data about each death and injury was available to be able to determine exactly how many potential years were lost for each person killed (Noy, 2015). In this case, that level of specificity in data was not available, an average age per country, based on the closest demographic information, was used instead (World Bank, 2017).

Policies were obtained from each individual country's government websites, records, and various reports on the subject. Because of limitations in English content, only policies on the national level are included on a more comprehensive scale and local flood policies are mentioned anecdotally. Information about government structure and transparency came from country profile reports and public international databases (CIA,

2017; CPI, 2017). Most of the policy information was derived from public records from the civil law systems, from UN reports of disaster risk program progress, or requests for aid, where the countries themselves are self-reporting their policies and policy goals as well as the circumstances around them. While these reports could be considered biased because they are self-reported, for our purposes they were deemed reliable. It is in each country's best interest to be the most thorough as far as current policy but to also not exaggerate as the UN could easily check on any reported claims.

Methods

To determine Lifeyears, a modified version of Noy's model was used to incorporate the function of a non-monetary measurement of disaster impact with only estimated and debated data available. The Lifeyears formula is shown as Equations 2 through 7, incorporating the World Health Organization's disability-adjusted life year (DALY) and quality-adjusted life year (QALY) as well as Noy's own formulas. Noy's formula uses metrics for casualties, injured, affected, homelessness, and economic damage but the equation was made for the most detailed of disaster damage reports to which we did not have access in this case. An example of the calculations performed to obtain Lifeyears is shown in Equation 8, for the case of Austria. A compilation of the data used in this formula for each country is included in Table 2.

Disaster policy changes were difficult to identify in some cases and therefore were only compared for countries with policy information available to the public. Each country's policy changes were considered in context with previous policies that were already in place as well as their government structure and general relationships with

their citizens, i.e. are they known to be more representative of public concerns or more separated by corruption or dictatorship.

Equation 2. Lifeyears

$$Lifeyears = L(M, A^{death}, A^{exp}) + I(N) + F(N) + H(N) + DAM(Y, INC)$$

Equation 3. Mortality (L)

$$Where\ L(M, A^{death}, A^{exp}) = \sum_{m=1}^{M} (92 - A^{death})$$

M = number of deaths recorded

A^{exp}= 92, WHO measure of uniform life expectancy

A^{death}= age of death in each case, without that degree of detail we use average age of citizens at the time of disaster

Equation 4. Injured (I)

$$Where\ I(N) = \alpha TN$$

α= for injured and affected, 0.054, welfare reduction weight WHO DALY for "generic uncomplicated disease; anxiety of diagnosis"

T= time to return to normality

for injured it is the length of injury which can be estimated by severity

N= number of injured persons recorded

Equation 5. Affected (F)

$$Where\ F(N) = TN$$

T= time to return to normality

for affected it is the length of time it took the country to recover (usually in years)

N= number of affected persons recorded

Equation 6. Homelessness (H)

$$Where\ H(N) = \beta N$$

β= for homeless, 0.117, WHO QALY

N= number of homeless persons recorded

Equation 7. Economic Damages (DAM)

$$Where\ DAM(Y, INC) = \frac{(1-c)Y}{INC}$$

c= 0.75, acknowledging that we spend most of our time on non-work activities

Y= damage estimates

INC=per capita income at time of disaster

Equation 8. Example Lifeyears Calculation of 2013 Flood in Austria

$$Lifeyears = \sum_{m=1}^{4.75}(92 - 41.42) + (0.054 * 0) + (0.5 * 200) + (0.117 * 500)$$

$$+ \frac{(1-0.75)616298774.33}{53965.43}$$

Table 3. Flood Impact Data Averaged Across Sources

Each source for damage and persons affected in the 2013 flood were slightly different depending on their measurement methods. Here is an averaged number for each country across sources (BLS, 2017; EM-DAT, 2017; EUROPA, 2017; Fewtrell et al., 2013; Liska, 2014; Monguzzi and Norgaard, 2013; Pa, 2013; UN, 2015; UN, 2017; World Bank, 2017; ZIC, 2014).

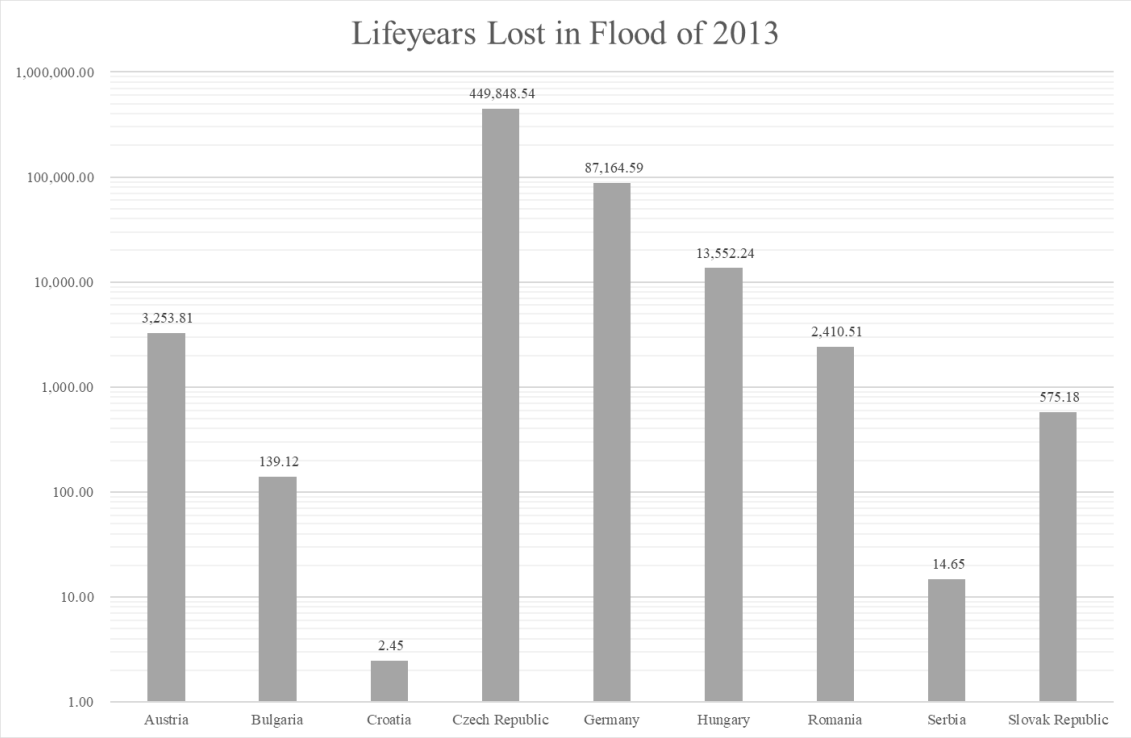
Country	Death	Injury	Homeless	Affected	Damage	Recovery Time	Average Age	Per Capita GDP	Lifeyears
					USD (2018)	Fraction of a Year		USD (2018)	
Austria	4.75	-	500.00	200.00	616,298,774.33	0.50	41.42	53,965.43	3,253.81
Bulgaria	-	-	-	248.40	1,839,661.58	0.33	41.87	8,166.05	139.12
Croatia	-	-	-	-	141,512.43	0.33	41.66	14,443.52	2.45
Czech Republic	11.00	-	12,666.67	882,266.67	566,644,314.46	0.50	42.17	21,190.64	449,848.54
Germany	4.00	-	7,350.00	29,425.00	5,401,713,901.63	2.00	47.46	49,508.89	87,164.59
Hungary	-	-	-	48,565.00	82,077,209.01	0.25	42.02	14,542.44	13,552.24
Romania	4.00	-	-	1,468.80	65,237,229.92	0.42	42.16	10,198.72	2,410.51
Serbia	-	-	-	-	396,234.80	0.08	36.82	6,760.47	14.65
Slovakia	0.50	1.00	245.00	892.00	17,173,948.42	0.33	37.31	19,355.88	575.18

Results

Table 4. Lifeyears Results with Brief Country Profile

Country	Lifeyears	Income Level	EU Member
Austria	3,253.81	High	Yes
Bulgaria	139.12	Upper Middle	Yes
Croatia	2.45	Upper Middle	Yes
Czech Republic	449,848.54	High	Yes
Germany	87,164.59	High	Yes
Hungary	13,552.24	Upper Middle	Yes
Romania	2,410.51	Upper Middle	Yes
Serbia	14.65	Upper Middle	No
Slovak Republic	575.18	High	Yes

Figure 29. Total Lifeyears Lost
Graphical representation of Table 3 on a logarithmic scale.



Lifeyears measurements, shown in Table 3 and graphically in Figure 29, indicate the most affected country was Czech Republic by a large margin. Next was Germany, followed by Hungary, Austria, Romania, Slovakia, Bulgaria, Serbia, and last Croatia.

For each country, there is a very different background of policy pre-2013, many have been influenced by previous floods, but not always in the same ways or to the same degree. There was a major flood of the Elbe River in 2002 and another flood of Danube in 2005. Climatologically, floods have been increasing over time with new records set three times since 2002 (Gascoigne, 2009).

In terms of reliability of representation, each country involved in the study ranks between 41-57 on the Corruption Perception Index, on a scale from 0-100 with 0 being highly corrupt. Germany and Austria are the only countries outside that range at 81 and 75 respectively (CPI, 2017). From this we can gather that there is almost an equal comparison value between all the subjects, excluding Germany and Austria which were already exceptional in their post-flood policy actions.

The Czech Republic, which was the most impacted, did not have much information available regarding any disaster policy, so no conclusions were able to be made about an evaluation of policy changes. A few actions were mentioned in press conferences from the new Czechia government, but none of the statements related to these policies (that were not available publically) mentioned the 2013 floods specifically. The Czechia government did mention the 2002 flood in one instance (Brabec, 2015; Sequensová, 2014).

Germany experienced the major flood of the Elbe River in 2002 and made changes that were adopted in 2005 to improve flood control and define 100-year flood plains (Mrzyglocki, 2015). The full implementations of 100-year flood plain maps were to be done by 2012 and have flood risk management plans done by 2015. The policy also established legal responsibilities for each level of government in flood prevention, warning, and recovery, and funding for research was planned to establish a common strategy for adaptation to climate change. Even with the previous policy changes from floods in the past, Germany did have an acknowledgement of lessons learned from the 2013 flood in their national plan in 2015 when they observed that social media played a role in informing those affected and allowing more efficient distribution of volunteers and first responders (Mrzyglocki, 2015). The goal of the plan was to use this observation to ensure the communication is accurate and efficiently managed.

Hungary was faced with immense damages across the country from the flood. They publically acknowledge that despite high economic damage and many people affected, there were no casualties in Hungary. They attributed this to their "prevention and resilience measures" (Bakondi, 2015). To deal with the high number of people affected with damages, the government instituted a new way to compensate for disaster damages following the flood (Bakondi, 2015). Slovakia already had some flood protection policies in place before the flood, namely a partnership with Ukraine for an early warning system across both of their at risk populations (Burian, 2015). Post-flood Slovakia has moved to create more mitigation and protection plans instead of just warning (Burian, 2015).

Austria's reaction post-flood in terms of disaster policy was to alter their budget to speed previously docketed flood protection plans. While this is a type of reaction it is policy change, it is not a change to include new content (Pichler, 2016). Bulgaria had virtually no policy change shown. Even in public statements on risk reduction, they made no mention of past disasters or any reason to make disaster policy changes in the future. Romania was lacking in public information at all and no conclusion was made as to their policy response post-flood.

In Croatia, they had a devastating flood in 2014 that is mentioned in subsequent policy numerous times while the 2013 flood was not mentioned. Even in the 2014 flood, the statements made in government reports offer only vague objectives, for example,

> *"Recent events in Croatia (2014 floods in Slavonia) will result in many lessons learnt that should be supplemented by lessons learned from future cooperation and exercises and implemented into legislation and practice in order to economize resources and avoid duplications and lack of coordination of activities in all phases of disaster management."* (Holcinger, 2015:44)

The Croatian flood of 2014 in Slavonia, based on a non-exhaustive search for damage statistics, would be estimated at 151,906.02 Lifeyears lost, which would put that flood at about the same level as the magnitude Hungary experienced in the 2013 flood (EM-DAT, 2017). It makes more sense in that context why the government would be much more inclined to make policy changes as a result of that flood rather than the one in this case study. Serbia was much the same case; they were severely affected by the same May 2014 flood that Croatia experienced and they made substantial changes to flood policy following that flood rather than the locally less intense flood of 2013. Following the 2014 flood, Serbia requested aid from the European Union, World Bank, and United Nations to establish flood protection, a disaster risk reduction program, a post-disaster reconstruction law, and, after recovering, even became a donor to the Global Facility for

Disaster Reduction and Recovery to help pay it forward for the aid they received (Blagojevic, 2017).

Observations of regional and international cooperation were also found following the floods. In 2014, the state of Bavaria in Germany and state of Upper Austria in Austria signed agreements on joint flood research and cross-border flood protection measures. They stated the motivation being the effects from the floods of the Oder river in 1990 and the Elbe river in 2002 and 2013 (Mrzyglocki, 2015).

Discussion

The results show that the hypothesis was correct, as far as the data that were available, in that the countries with the most progress in policy following the 2013 floods were Germany and Hungary. Also, supporting the hypothesis, Austria and Slovakia lost more Lifeyears in relation to some of their flood-affected neighbors, and in turn, had changes to their disaster policy following the flood.

The least impacted countries, Bulgaria, Croatia, and Serbia, had virtually no policy change in response to the flood. In the case of Serbia and Croatia, especially, this was not just a function of an unconnected government because both had a legitimate response to a larger flood the year after (EM-DAT, 2017; Holcinger, 2015; Blagojevic, 2017). No conclusions were made about Romania or the Czech Republic because of a lack of information. While the Czech Republic did not seem to have any policy changes in relation to the flood, it is still unknown if this is because there really was no reaction

or if it was a function of their government structure change in 2014 and lack of public record.

A specific threshold for policy change could not be distinguished without more comprehensive data. This analysis opens many new avenues into efficiency evaluations of post-flood policies and the evolution of national disaster risk reduction plans. Toward this goal though, the Croatian and Serbian response to this flood in comparison to their more intense flood the next year shows the relationship between disaster magnitude and policy change does exist in at least one case (Holcinger, 2015; Blagojevic, 2017).

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Chapter 5: Conclusion

Disasters, as a whole, do a lot of damage around the world. Climate change is affecting the disasters and the more we are aware of the changes the more we can do to be prepared. At COP 23 in Bonn, Germany, in November 2017, the President of Chad stood up, referencing disasters that he and his neighbors had experienced, "These are not natural disasters. These are the result of short sighted policy decisions." This is exactly why it is important to make smart policy changes and create solutions out of bad situations, like disasters.

From the results of these studies there is a lot of significance to be drawn. From Chapter 2, looking at how individual countries react to multiple disasters, we found that there are hot spots or time periods in which there are more disasters, and this alone could give rise to countless other research questions surrounding the geographic and temporal distribution of disasters. Second, while the general pattern of disaster hot spot and subsequent policy implementation was found to be statistically insignificant, correlations still exist. Future studies can look at other factors in policy change and other relationships between disasters and climate policy to find means to take advantage of policy windows that disasters create.

From Chapter 3, looking at how multiple countries react to a single disaster, we found that there are differing reactions between countries and some of these difference cannot be explained simply by type of government. There was also a clear example of international cooperation attributed to the disaster. Even though that was not the goal of the study, future studies could look exclusively at international or regional policy

change in response to a collective disaster. Examples from multiple countries showed that the disaster did, in fact, act as an individual actor in the policy scenario, even in cases where there were not as many actual policy changes. In most cases with a lack of policy change, there were references to other floods in which there were more extensive revisions to policy.

While these studies were originally based off Thomas Birkland's work using the Multiple Streams framework, it was obvious with the difference in data available that other frameworks may be more suited to the analysis. Using the framework options outlined in Chapter 2 to interpret the results we come to some conclusions beyond what the Multiple Streams framework can explain. The original studies had access to much more detailed policy data and motivations and political attitude shifts at the same time. With the data publicly available of disasters, only the problem stream encompasses the given variable, which is not useful for making conclusions in this study.

The Policy Diffusion Model seems to match the ideas of the studies very closely. The only missing data is the history of each policy and its process through adoption and implementation. As far as applications of the model, both studies here would fit the variable requirements looking at the temporal nature of policy diffusion, but because the actual policies and their main ideas and goals are not included, it does not fit the requirement to look at horizontal diffusion (Shipan and Volden, 2013). For this aspect, we would need to know content and consequences of policies to differentiate between imitation and learning or to attribute the change to competition or coercion.

The Punctuated Equilibrium Model looks primarily at outcomes by their policy context. Conceptually, it may seem like the first study would not match this outlook at all because there was no depth in policy content, as any implementation was considered to be a singular version of change without designating degree. On the other hand, one of the only statistically significant indicators was that of framework policies, which by definition, would be considered to be major change. This would give the clear indication that it was a case of policy questioned and therefore changed at a fundamental level. For the case study, there were some incremental changes and some major changes but that does not change the idea behind the results. The fact that disasters were attributed to be the cause of policy change by the policy makers themselves indicates that whether the change is incremental or not does not matter, it still shows disasters as a policy change driver. The main limitation in this case is that not every nation included in the studies are democracies and thus it cannot be conclusively determined if they would be motivated by the rationality that backs Punctuated Equilibrium Theory. For the worldwide analysis, the countries with correlations in policy to disasters are almost all democracies (the lack of non-democratic states could be explained by this criteria). For the flood case study, every country included is considered democratic in some sense of the word and can therefore use this model effectively.

While the Advocacy Coalition Theory is extensive and includes innovations in disasters as focusing events, it still, like the Multiple Streams Model, focuses on actions of those policy actors more than the events or policy outputs. While this would be the

most useful in future studies, especially those on truly international climate policies, this does not match the data available for this analysis.

The overall conclusion in regard to a theoretical framework that matches a macro approach to policy change studies is that there isn't one. Each of the frameworks evaluated and generally applied in similar cases were developed and have been applied to work on micro scales with much more detailed data than would be available without large amounts of funding and labor. The framework that best matches the public data available for studies such as this in discussing how disasters may or may not be a driver for international climate policy change is the Punctuated Equilibrium Model. This model is not a perfect match but fits the data better than the others as far as the focus on policy and events rather than policy entrepreneurs and decision makers when that data is not readily available at the scales of analysis.

Lastly, in the concept of nature, we learn from the countless examples of policy change between both studies but especially for specific disaster policy that we can change 'nature' in the way that we react to it. No part of the world is untouched by humans, but we can be responsible in how we deal with the effect of nature by using concepts of flood plain protections instead of levees or education instead of civil engineering to help to handle 'natural' disasters as they come.

As an added observation, the original motivation of this research was climate-related disasters and policy change. As a requirement for definitive conclusions, the disaster would have to be attributed to climate change specifically. While attribution studies are growing in extent, there has not been a study done on every relevant disaster. Perception of the disaster can attribute it to climate change without any scientific

reasoning to back that. In the studies of German disaster policy changes post-2013 floods they specifically state, in a passing section about media involvement, a relationship to climate change for recent natural disasters.

> "The German press landscape (even the mass media) has had a larger focus on natural disasters and the impacts of climate change, at the latest since the Elbe Flood in 2002, 2013 and the Tsunami in 2004." (Mrzyglocki, 2015:59)

While this statement is not necessarily founded in scientific research, (tsunamis are very obviously not climate-related because they are caused by earthquakes, which are geological instead of meteorological) the fact that the media or the government thinks there is a relationship to climate change at all will make them relate the solutions to the wider issue of climate change rather than just disaster planning. That alone, can give us hope.

"After a flood is really just before the next flood" (ZIC, 2014).

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