Climate Risk Management 9 (2015) 30–40

Contents lists available at ScienceDirect

Climate Risk Management

journal homepage: www.elsevier.com/locate/crm

Making climate science accessible in Toledo: The linked boundary chain approach

Scott E. Kalafatis [a,*], Ashlee Grace [b], Elizabeth Gibbons [b]

[a] University of Michigan School of Natural Resources and the Environment and GLISA, USA
[b] University of Michigan Climate Center, Graham Sustainability Institute, USA

ARTICLE INFO

Article history:
Available online 4 May 2015

Keywords:
Boundary organizations
Boundary chains
Usable science
Mainstreaming climate change adaptation
Policy entrepreneurs

ABSTRACT

For many cities throughout the world, climate change not only presents challenges in the form of new risks and expenses, but also opportunities to connect work around climate change to other development and environmental initiatives. This study presents the City of Toledo in the heart of America's Rust Belt as a case study of the policy process that gives rise to proactive action on climate change. Using thick description, we trace Toledo's adaptation policy process through the lens of Kingdon's "multiple streams" model to identify factors that have shaped the emergence of climate adaptation work around water management in Toledo. Through doing so, we give particular attention to the knowledge resources that those in the City have relied on, especially its boundary chain connection with two supporting boundary organizations: GLAA-C and GLISA. Policy entrepreneurs pushing for climate adaptation around water policy in Toledo emerged around two separate pieces of the policy process. The first entrepreneur was involved with raising general awareness about sustainability and climate change in the City's problem stream, and the other was specifically involved with integrating climate change information into a particular aspect of the City's policy stream, water management. While these relationships were important for mainstreaming climate change adaptation into efforts to address existing challenges, they were also representative of the City's ability to cultivate broader partnerships around climate adaptation. Toledo's polycentric climate change network ultimately helped the City sustain its adaptation work as it weathered its own period of internal transition.

Introduction

For the past five decades, cities in the Great Lakes region have gone through dramatic change. Much of the region includes America's "Rust Belt" which was once a booming center of manufacturing production whose economic influence and population has steadily declined since the late 1960s (High, 2003). Many of these cities have begun improving their economic fortunes and at least stabilizing their populations (Wilson and Wouters, 2003). Climate change now presents both new challenges to these efforts in the form of potential costly impacts and adaptations and new opportunities as this relatively cool and water-rich region is expected to emerge as an attractive environment in a warming world (Kingson, 2014).

In this paper, we look closely at the experience of one Rust Belt city, Toledo, Ohio, which has taken a leading role in leveraging its efforts to address climate change and its impacts as a part of achieving its sustainability goals. We explore how and

* Corresponding author.
E-mail address: scottkal@umich.edu (S.E. Kalafatis).

http://dx.doi.org/10.1016/j.crm.2015.04.003
2212-0963/

why Toledo became engaged in climate adaptation. Through using Toledo as a case study, we look to identify factors that might shape adaptation planning in other cities in the region and beyond. We focus especially on the role of strategic partnerships with multiple boundary organizations that tailor climate information to meet user-determined demands. Such decision support partnerships have emerged in at least several countries in recent years (Albers et al., 2015; Lemos et al., 2014; Heaphy, 2014), suggesting that there is a need to examine their role in the process of policy change in participating cities.

We use Kingdon's (1984) multiple streams policy change model (i.e. problems, policies, and politics) to examine how and why the City of Toledo has moved forward with recent efforts to address water challenges and the role of information resources in that process. We then rely on the literature focusing on knowledge brokerage and intermediation to explore the different ways scientific knowledge in general and climate information in particular may have shaped the three streams, especially related to water management in the city. We use 'thick description' and qualitative data to identify and map out the different processes that have shaped adaptation action in Toledo.

Thick description is a methodological approach that is particularly well-suited to exploring why a city engages in climate change adaptation work. While thick description, by necessity, involves the detailed description of the facts about a particular event, it specifically aims to also provide information about the complex context and intentions that underlie the act itself as well (Denzin, 1989, p. 33; for a review see Ponterotto, 2006). By specifically investigating and reporting an action such as the pursuit of climate adaptation in reference to the history and actors associated with it, thick description provides a basis through which richer interpretation of the event is possible (Denzin, 1989). The goal of thick description then is to provide enough information for the reader to understand not only what occurred, but follow a convincing narrative about how and why it actually happened because they can place themselves in the context that it occurred within.

In order to develop such a narrative, we first present an introduction to the multiple streams model. Next we provide necessary contextual information on Toledo and the partnering boundary organizations forming a supportive "boundary chain" (Lemos et al., 2014) that provided information resources for the city's adaption work. Then we explore Toledo's case, first by discussing the *problem* in greater detail – Toledo's decades-long bombardment of economic and stormwater challenges. We then focus on one of Toledo's primary strategies for moving ahead with dealing with these issues: building a strategic partnership with the University of Michigan's Climate Center (specifically its GLAA-C project) that has bolstered Toledo's ability to craft *policy* around climate adaptation. Finally, we examine the *politics* of working on water-related issues in the City of Toledo, looking at what factors have contributed to Toledo's recent progress in addressing its stormwater issues. The paper concludes with a brief analysis placing Toledo's case in relation to other communities grappling with climate change adaptation and efforts to understand the processes that influence policy change and action.

Policy streams and boundary chains

John Kingdon developed the multiple streams model in order to explain why certain policies are addressed on governmental agendas and others aren't (Kingdon, 1984, p. 2–3; see Zahariadis, 1999 for a review). Drawing on Walker (1981) and Cohen et al. (1972) along with his own research at the federal level, Kingdon described a policy context in which the issues to address and the means of addressing them are not clear (1984, p. 91). Instead, three coexisting yet separate "streams" flow independently of one another: the problem stream, the policy stream, and the politics stream. The problem stream involves the awareness that a certain condition exists and the recognition that something should be done about it (p. 115–116). Evolution occurs in the problem stream through awareness raising about issues (p. 104), reclassification of an existing condition as something else (p. 117), or through "focusing events" that change the implications of existing conditions (p. 99–102).

In this process, issue framing defines the scope of both the problem and the potential solutions that are likely to emerge. It also affects the kind of mobilizing resources that are likely to influence what items get into the societal and governmental agenda and why (Nisbet, 2009; Nisbet and Mooney, 2007). In this context, scientific knowledge not only can create and define the problem but also influence what are legitimate and desirable ways to solve it (Nisbet, 2009). Climate change is the quintessential science-driven problem (Sarewitz and Pielke Jr., 2007) and many of the problem definition challenges it poses are attributed to the fact that while causes are developed in the present, consequences might not be visible or perceived in the present (Weber, 2006). Particularly In the case of impact projections that define the dimension of the threat to communities and infrastructure (i.e. exposure), one complication is that the high level of uncertainty and lack of precision of most available climate model projections makes it hard for decision makers to justify the high costs of many adaptation actions (Lemos and Rood, 2010). The pursuit of climate change policies in cities often depends upon successfully framing climate change as a means to simultaneously achieve "co-benefits" (IPCC, 2001, p.711) such as economic development (Lambright et al., 1996; Bulkeley and Kern, 2006).

The policy stream consists of the ideas that are held amongst those who are involved with the development of policies (Kingdon, 1984, p. 122). These ideas form a kind of "primeval soup" in which ideas are born, develop and often die off through research and debate (p. 122–123). It is also the place where government actors are particularly influential and where especially entrepreneurial individuals can be pivotal in pushing items like adaptation into the agenda and designing solutions (e.g. Carmin et al., 2012, Anguelovski and Carmin, 2011). The politics stream is the prevailing state of the political

landscape in which public mood, pressure groups, administrations, legislative dynamics, and elections shape what kinds of policies are currently viable (p. 152).

In the model, substantive policy change can emerge when the three streams come into alignment around a particular problem that needs to be addressed, an available solution to address it, and an existing political opening through which it can get done (p. 92–94). The alignment of such "policy windows" is often attributable to the efforts of policy entrepreneurs who advocate for their preferred policies (p. 129). Policy entrepreneurs are often able to expertly balance an intimate understanding of the policy context they work within with access to innovative information from outside of their local context (Mintrom and Norman, 2009; Teodoro, 2011). Entrepreneurs improve policies' viability by familiarizing others in the policy sphere, incorporating feedback (p. 134–136) and brokering the connection between the definition of a problem, the policies that can solve it, and the political capital that could make these solutions possible (p. 188–192). Policy windows are short-lived and the preparation work performed by entrepreneurs is critical for the policy to be ready to fill in the opportunity when it arises (p. 174). Opening and taking advantage of these windows may therefore be pivotal to the development of interventions and policies that enhance the capacity of cities to respond and adapt to climate change. And while many factors influence these processes, empirical research suggests that scientific knowledge may play a critical role in defining and supporting adaptation action (e.g. Moss et al., 2013; Cash et al., 2006; Rice et al., 2009).

In this context, knowledge sources and brokers may act both in support of policy entrepreneurs and as spanners of action in their own right. In an update of his book, Kingdon (1990) describes that while "academics, researchers, and consultants" are rarely the most important actors involved, they very often play an important role in the process (p. 57). These sources and brokers of information impact the emergence of policies in two different ways. The first is a direct impact and occurs when policy makers realize that information can be immediately relevant to an existing problem that they have to deal with and fold it into their effort to develop solutions in the policy stream (p. 59). The second emerges more broadly as research slowly alters the general "climate of ideas" that circulates and shapes policy makers' thinking over time (p.59).

Boundary organizations act as such important knowledge sources and brokers (Guston, 2001, 2007). They are agencies that stabilize the distinction between the production of science and its use in policy while facilitating supportive interactions between these two worlds (Kirchhoff et al., 2013). In this role, boundary organizations broker information between science and decision making in ways that are acceptable and understandable for both sides (Lynch et al., 2008). This brokerage work is a resource-intensive process, and most of these organizations face limitations set by their available resources (Kirchhoff et al., 2013; McNie, 2007). Strategic partnerships have emerged as a means to leverage existing capacities to more efficiently provide demand driven climate information to cities through programs such as RISA in the United States (Lemos et al., 2014), Climate Proof Cities in the Netherlands (Albers et al., 2015), and the United Kingdom's Adaptation and Resilience in a Changing Climate (Heaphy, 2014). The concept of "boundary chains" offers a means of describing the key partnerships tailoring climate information for use within a more complex decision making context (Lemos et al., 2014).

The context: The City of Toledo, GLAA-C, and GLISA

In pre-settlement times, much of the Great Lakes region was covered in wetlands, marshes, and crisscrossed by streams and rivers, all of which eventually emptied out into the Great Lakes system. Although today many of these marshy areas have been filled in and streams put under ground, cities in the region are still linked to the Great Lakes unique freshwater regime. How each city deals with stormwater impacts the health of the overall system. The region's common waterways also mean that many cities share similar histories of development including the fact that many were important hubs for commerce and industry due to their convenient location along main shipping routes. However, growth in the region did not last once resources became depleted and train, air, and interstate highways took over as the go-to transportation means for freight and travel. Since the late 1960s (High, 2003), the Great Lakes region has experienced a steady decline in industry and population. Many cities are now struggling with shrinking tax bases and increasing demands on infrastructure investment as systems age and become outdated. Climate change has only amplified these infrastructure challenges by increasing the amount of precipitation falling in the heaviest storms in the region by 37% since the 1950's (United States Global Change Research Program, 2014).

While every city in the Great Lakes region has its own defining characteristics influencing its capacity to adapt, the City of Toledo, Ohio embodies many common traits. These include a shrinking population which now hovers around 284,000 (Census 2010; Messina and Reiter, 2014), high poverty level (26.8%), and declining manufacturing industry. Also, like many Rust Belt cities around the Great Lakes region, owing to its outdated water infrastructure, Toledo is currently under a consent decree from the United States Environmental Protection Agency (USEPA) to come into compliance with the national Clean Water Act. Thus, its experience in recent decades addressing stormwater, especially as it relates to climate adaptation, may elucidate both key problems as well as solutions for cities inside and outside the Great Lakes region facing similar challenges.

In response to a growing concern over the potential impacts of climate change on water management, Toledo's Department of Public Utilities (DPU) formed a relationship with a University of Michigan Climate Center project, the Great Lakes Adaptation Assessment for Cities (GLAA-C). This relationship is part of a larger "boundary chain" partnership between GLAA-C and another organization, the Great Lakes Integrated Sciences and Assessments (GLISA), that links climate change data with decision makers interested in integrating locally relevant and timely climate information in their adaptation efforts (Lemos et al., 2014; Kirchoff et al., 2015). We've provided a timeline that outlines key moments during this

partnership in Appendix A. The city's participation in a boundary chain model with GLAA-C draws attention to the question of what role boundary chains play in the process of policy change. Asking this question is important because it not only addresses the actual impact that boundary chains have, but also sheds light on a research assumption that these partnerships adapt themselves to meet a variety of information user needs (Lemos et al., 2014).

In Toledo's case, GLISA and GLAA-C's involvement formed a "linked chain" connection between complex climate information and the information needs of DPU staff (Kirchhoff et al., 2015; Lemos et al., 2014) (see Fig. 1). In this case, GLISA is the first boundary organization in the chain. It employs and directly engages with climate scientists as it facilitates the development of climate information that meets the specific needs of GLAA-C who worked directly with city staff to further their municipal adaptation strategy implementation.

GLISA is a collaborative program between the University of Michigan and Michigan State University funded by the National Oceanic and Atmospheric Administration (NOAA). GLISA is part of a national network of NOAA Regional Integrated Sciences and Assessments (RISAs) programs that focus both on developing regionally relevant climate information and advancing the implementation of this knowledge in policy, planning, and management practices throughout the country. GLISA relies on interdisciplinary research and participatory processes in order to better understand the context in which decisions are made and how best to integrate climate science within these various adaptation-related realms (Bidwell et al. 2013) (for perspective on challenges GLISA climate scientists face in boundary chain work see Briley et al. 2015).

GLAA-C is the second boundary organization in this linked chain. GLAA-C is an Integrated Assessment project funded by the Kresge Foundation and the University of Michigan's Graham Sustainability Institute. It focuses on providing mid-size cities throughout the Great Lakes region with the resources and expertise needed to increase their understanding of climate change and implement adaptation strategies. The end-user in this boundary chain, DPU staff, seek distilled and customized climate and adaptation information that can inform water management decisions and investments.

The relationship between the City of Toledo and the GLAA-C project began in the spring of 2012 when a partnership formed between the City of Toledo and a University of Michigan graduate student master's project supported by GLAA-C that assessed the city's adaptive capacity (Barclay et al. 2013). The students' research included interviews with city staff, elected officials, and key regional partners. These interviews, along with accompanying demographic and historical research, were used to frame where the city stood in terms of the opportunities and challenges it faced in pursuing climate change adaptation. They applied a well-known heuristic to start a conversation that ranged from perceived assets that could be used towards adaptation to more intangible resources that are influential in building capacity for decision making across systems (Gupta et al. 2010).

In late 2012, GLAA-C distributed a call to cities across the region to apply to participate in a two year boundary chain model process between GLISA (providing climate information resources), GLAA-C (providing guidance on identifying priorities and information needs), and other selected cities. Toledo applied and was chosen to be a part of the process, thus becoming one of the six cities GLAA-C engaged with consistently over the subsequent two years.

Engagement with each of these cities varied according to the local context. In the case of Toledo, a high priority was to combine resources from regional activities taking place through the USEPA, NOAA's Coastal Services Center, and other Lake Erie Watershed and Maumee River Watershed efforts with decision relevant climate information. To do this, GLISA produced locally-relevant data that GLAA-C staff used in presentations along with resources GLAA-C helped gather from the various regional activities mentioned above. The materials and resources GLISA staff generated to assist GLAA-C's work with Toledo included climate presentation slides, graphics, and informational handouts that were used in conferences, meetings and other awareness raising efforts. In return, GLISA enhanced its capacity to generate accessible climate information and develop narratives that connect flooding issues to climate change.

The *problem stream*: A need for locally relevant climate data to inform decision making

Flooding is a prevalent problem throughout the City of Toledo. Toledo is located along the Western shore of Lake Eerie and at the mouth of the Ottawa and Maumee River watersheds. Nearly all of the eastern area of these watersheds, including the Toledo metro area, were part of the expansive Great Black Swamp during pre-settlement times. This rich wetland covered an area the size of Connecticut. Today, the Black Swamp is only 5% of its historic size, significantly impacting the area's natural hydrological regimes. As a result of being built over the Great Black Swamp, ground saturation and stormwater overflow pose threats to the city's infrastructure and public health.

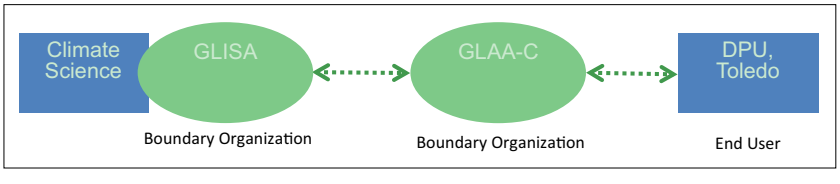


Fig. 1. The relationship between GLISA, GLAA-C, and DPU forms a *linked boundary chain.*

In addition to flooding, water quality is also a major stormwater management priority in Toledo due to its position along the Lake Erie shore, a Great Lake that receives a great deal of financial and regulatory attention. The Lake Eerie watershed is home to over twelve million people, eleven million of whom depend on the lake for safe drinking water (USEPA, 2014). The number of industries and cities operating alongside it, combined with the lake's relatively shallow depth make it highly vulnerable to water quality issues, including major harmful algae blooms. Toledo is also situated at the mouth of the Maumee River, a watershed that drains over 8000 square miles and includes 775 square miles of designated area of concern by the USEPA. While this contamination designation is partially due to agricultural runoff, it is in large part due to runoff from industrial sites and combined sewer overflows in the City of Toledo (USEPA, 2013).

Following a decade-high discharge of raw sewage into the Maumee River, the USEPA sued the City of Toledo in 1991, claiming that the city was violating the Clean Water Act (Abraham 07/24/2001). The original resulting consent decree was drafted in 1991, amended in 1992, and required that the City of Toledo meet the objectives of the USEPA's "Combined Sewer Overflow Policy" and eliminate sanitary sewer discharges (Consent Decree, 1991). After nearly a decade of litigation, the City and the federal government finally reached an agreement in 2001 that was approved by voters in 2002. The 2002 consent decree required the City to expand its sewage treatment plant and construct a large storage basin to capture excess water from the combined stormwater and sewer system. This basin would hold water during major storm events so it could be properly treated and released over time. Knowing that more would need to be done to address Toledo's sewer overflow issues, the consent decree was revisited and amended in 2010 to require that the City invest in significant upgrades and expand its sewer system. The upgrades are estimated to cost $315 million and are intended to reduce the average number of untreated sewage discharge events from thirty-five a year to four or less (Department of Justice 2010). The 2010 amendment actually relieved the City from making additional improvements to the wastewater treatment plant based on the 2002 agreement because the 2010 improvements would have a much larger impact.

Adding to these watershed and infrastructure challenges, the major storms that contribute large quantities of precipitation and runoff within Northwest Ohio are expected to increase in the next century (GLISA, 2012). Over the last sixty years, Northwest Ohio has seen a 7% increase in precipitation annually with seasonal increases of over 6% in the summer and winter and over 17% in the fall. Precipitation is also occurring with increasing severity, further exacerbating the risk of run-off and erosion (GLISA, 2012).

Historically, Toledo has struggled to implement effective stormwater management practices and programs. Reasons for this include a lack of locally relevant climate and adaptation information and a lack of strong political will to make recognizing and confronting these conditions a priority. However, in the last few years tackling Toledo's ongoing water quality concerns has become a top priority for elected officials' and city staff's current effort to rebrand "the Glass City" as sustainable and green. This movement has led members of the City's Department of Public Utilities (DPU) to participate in a number of workshops and projects and for a few key policy entrepreneurs to emerge.

The *policy stream*: Strategic partnership with the great lakes adaptation assessment for cities (GLAA-C)

Before the City of Toledo began working with GLAA-C and GLISA, the policy community in the city had already begun preliminary work that would eventually support climate change adaptation. In the interviews with the Master's project team, city officials explained that they were pursuing many projects related to sustainability that reduced energy usage, provided green sources of energy, or were "green" infrastructure approaches such as rain gardens and bioswales. All six of the staff members who were asked by the Master's project team pointed to then-Commissioner of Environmental Services within the DPU, Tim Murphy, as a critical figure advocating for these kinds of policies. Commissioner Murphy himself linked his current work to a 2012 Institute of Sustainable Communities conference on "Creating, Leading, and Managing Change." He explained that he drew on that experience as he worked with city departments and other organizations such as Owens Corning, the University of Toledo, the YMCA, and the Toledo Zoo to integrate "green" considerations into ongoing projects throughout the city. However, these initiatives were explicitly not framed as environmental ones. Instead, the commissioner explained that he was trying to frame projects around whatever other benefits might make them attractive such as economic development or cost-effectiveness.

As part of Commissioner Murphy's efforts to bring sustainability and green initiatives to Toledo, he played a leading role in organizing a 2012 Green Town event entitled "Green Town: The Future of Community." Billed as a zero waste, carbon neutral experience, the conference brought together stakeholders from the private and public sectors to 'connect the dots' on developing a healthy, sustainable and thriving community. Although climate change and adaptation were not prominent components in the Green Town event, in his 2012 interview, Murphy expressed that he felt those he worked with in Toledo would be open to thinking about climate change if it could be presented in a relevant and impactful way. Based on the interviews there was an awareness that Environmental Services needed to begin raising awareness about how projected changes in climate might exacerbate the city's existing problems, including those with water infrastructure. He believed recognizing that climate change played a central role in Toledo's sustainability efforts was an important step in encouraging the City to seek partnerships with climate resource providers like GLAA-C.

When Commissioner Murphy and the Toledo team attended GLAA-C's "Forwarding Adaptation in the Great Lakes Region Conference" in November 2012, the shift to bringing climate adaptation into city policy and programs began. The conference brought together leaders from twelve mid-size Great Lakes cities to discuss challenges and best practices for moving urban

adaptation forward in the region. Over the course of the workshop the Toledo team identified key climate threats, existing community resources, critical barriers to action, information and resource needs, and prioritized next steps coming out of the workshop. Several key points from the Toledo team's conference report included:

- The conference allowed them to identify opportunities they didn't see before and discover better strategies to engage the community in climate change adaptation.
- After the conference, the team planned to establish a sustainability commission that would be comprised of key players in the region and would address regional climate adaptation planning. (*Since the conference, DPU played a key role in supporting the efforts of the Toledo-Lucas County Sustainability Commission and also bringing together a regional Green Infrastructure Task Force*).
- They wanted to organize a climate change workshop with NOAA and State officials to begin integrating climate change into existing plans beyond Toledo. (*Since the conference, Toledo has helped convene numerous meetings and workshops, including the two described in the following paragraphs*).

After Toledo was selected to be a part of the two year boundary chain model process following the November 2012 conference, the project manager of GLAA-C joined the planning committee for Toledo's next major conference, entitled "Climate and Coastal Resilience," which took place June 19–20, 2013. The first day of the conference was intended for a much larger, regional audience and included an opening plenary on climate change and impacts across the Lake Erie Basin. The second day of the conference provided the opportunity for a more pointed discussion about Toledo's adaptation issues and challenges. During this day, GLAA-C's project manager led a breakout session attended by fifteen key staff members and stakeholders from Toledo. At this break-out session, stormwater was identified as the major climate adaptation priority for the City, particularly given the anticipated impacts of increasing precipitation in the region (United States Global Change Research Program, 2014).

Two major outcomes resulted from the break-out session to address this newly identified climate adaptation priority. The first was another Master's student project aimed at updating Toledo's twelve-year-old stormwater credit program. Work began on that project in the fall of 2013. The team reviewed best practices from around the country, worked with Toledo staff to understand their various needs and concerns around stormwater management, and researched the specific challenges Toledo faces when dealing with stormwater, including the increasing precipitation issues related to climate change. The students presented their recommended credit program updates in December 2013. Several of the student's recommendations were incorporated into the City's updated credit manual and as of this writing, a final version of the updated manual is set to be released in the spring of 2015.

The second major outcome was organizing another workshop with a specific focus on helping municipalities better understand how to plan for and cope with stormwater challenges due to climate change and aging infrastructure. This workshop took place in November 2013 and was organized by GLAA-C, Sea Grant, and Old Woman Creek National Estuarine Research Reserve. GLAA-C brought in GLISA staff to begin the workshop with a general presentation on what climate change means for the Great Lakes region and specifically for urban environments like Toledo and the surrounding area. This was intended to help frame discussions throughout the rest of the day around climate change's potential impact on stormwater management and planning.

Toledo's DPU and GLAA-C have continued to collaborate on addressing stormwater challenges and opportunities in Toledo. While GLAA-C has focused on connecting Toledo with the expertise and resources it needs, the DPU has searched for constituents, decision makers, and other opportunities to tie these climate-based stormwater resources into. In relation to these efforts, the City of Toledo worked with low-income, flood-vulnerable neighborhoods to spread awareness and implement green infrastructure practices. It has also helped launch a regional Green Infrastructure Task Force. The City has sought strategic relationships with major non-residential private owners, including GM, Smuckers, and Teledyne to promote green infrastructure adoption in the private sector. Overall, DPU has tried to use discussions about flooding and stormwater management to make their outreach about climate change more tangible.

The *politics stream:* The discretion for policy entrepreneurs to act

The third stream referred to in the multiple streams framework is politics. In Toledo's case, the political atmosphere and specifically, the political will of few key policy entrepreneurs, has been instrumental in moving proactive stormwater planning forward in recent years.

The City of Toledo is a strong mayor system in which division heads often rotate based on city-wide leadership and the mayor prepares and administers the city budget with council approval. This authority can mean that a strong mayor exercises substantial influence over the actions of city departments. However, according to city staff that the first Master's project team interviewed, Toledo's mayor from 2010–2014, Mayor Michael Bell, left his departments a great deal of discretion over their actions. Mayor Bell was an Independent in a strongly Democrat-leaning city who was allied with Ohio's Republican Governor Kasich and whose main interest was in reducing Toledo's deficit. Still, in the Master's students' interviews, staff described Mayor Bell as someone who "got it" on climate change and sustainability, even if he wouldn't publicly advertise the city's "Green Mayor" policies because he didn't want "to be labeled an Al Gore." Importantly though, he allowed actions

being cultivated by others throughout the city government to develop through giving his departments consistent funding and independence to pursue their own initiatives.

Another key element that helped produce a supportive political atmosphere for action in Toledo was the fact that active entrepreneurs around the issue made sure to capitalize on the momentum they were generating and build upon each successful endeavor. City staff often expressed that a strong mayor system makes them reluctant to initiate progressive programs as they can be undone once leadership changes. In spite of this, then-Commissioner Murphy forged planning and supporting events like the Green Town Conference and other climate adaptation-related opportunities that advanced the City's adaptation efforts. This constant forward momentum helped cultivate a larger, regional effort to promote green infrastructure and a more sustainable, climate resilient region. The Toledo Metro Area Council of Governments is now focused on implementing and monitoring the effectiveness of green infrastructure and the Toledo-Lucas County Sustainability Plan has become more focused on water quality issues than it was just a few years ago.

Most of these events and actions were made possible by a political atmosphere that generally accepted that stormwater was becoming an increasing problem throughout related departments and units. Importantly, another key policy entrepreneur, the City's Stormwater Coordinator, worked with GLISA to integrate climate change considerations into politically viable policy options, taking advantage of a policy window for progressive stormwater management action. In collaboration with GLAA-C, Commissioner Murphy and the Stormwater Coordinator were able to effectively convene the expertise of partners inside and outside the city to effectively link Toledo's major priority of managing stormwater to the climate science and adaptation tools GLISA and GLAA-C provide.

Beyond creating a temporary policy window, these policy entrepreneurs' efforts built institutional resilience so that even after the policy window closed, Toledo's DPU continued advancing stormwater policy. In January, 2014, a new administration took office, bringing with it a new mayor and a new Director of Public Utilities. Over the course of the year, the Director was replaced a second time, policy entrepreneur Tim Murphy left his position with the City, and many other leadership changes occurred, including the sudden death of the new mayor. Yet, despite this significant turn-over, DPU has continued moving forward with many of the initiatives it began during its partnership with GLAA-C and GLISA, including the adoption of the revised stormwater credit program in early 2015. DPU staff admit that getting new leadership up to speed on all the climate work that had already been done came with a steep learning curve and took time. However, the City's Stormwater Coordinator cites their established relationship with GLAA-C and other regional partners as a key reason staff members were able to convince leadership to continue pushing climate-related initiatives forward.

Discussion

Kingdon's multiple streams model helps frame our considerations about the broader lessons of Toledo's efforts to implement new climate change-related stormwater management programs and practices. The problem stream can be similarly traced to many other cities, not just across the Great Lakes region but throughout the world. As the impacts of climate change continue to escalate, managing stormwater is a common challenge (Kessler 2011). Decision-makers will need to understand locally-relevant climate information in order to update critical infrastructure and implement appropriate adaptation programs that prepare their municipalities for the changing climate (Revi et al., 2014). Something this study highlights is that policy entrepreneurs may seek different kinds of information based on the development of the problem stream. Early on, when Toledo's entrepreneurs needed to learn and raise awareness about climate change, it was valuable for Commissioner Murphy and others to attend general information workshops and presentations provided by GLAA-C and GLISA. However, once the connection had been established between climate change and the problem of stormwater management, more specific information was required. Tailored historical observations and a narrative presentation about stormwater management and climate change in the City resulted from GLISA and GLAA-C's collaboration with the Stormwater Coordinator. The provision of both general, awareness-raising information and specific information that addresses a particular issue echoes the dual role that Kingdon (1990, p. 59) argued producers and brokers of information fulfill.

The political situation in Toledo can also be viewed in a larger context. Climate change action did not emerge in Toledo as a direct stand-alone policy issue on the city's agenda. The city's strong-mayor could have committed to imposing such a focus, but stood aside as others integrated climate change into various city activities such as compliance with their consent decree and rebranding as a "Green City." Following Kingdon's (2002) distinction between the broader political agenda and more specific policy agendas, Uittenbroek et al. (2014, 2013) have explored the relationship between climate change action as its own goal on the city's broader agenda (a dedicated approach) and climate change action as a means of meeting other established goals (a mainstreaming approach). As they would anticipate, in the absence of a direct political commitment to climate change, a mainstreaming approach emerged in Toledo through entrepreneurial networking and strategic framing (Uittenbroek et al., 2014).

Mainstreaming adaptation can result in defined, tangible actions that are financially and institutionally consistent with existing efforts as well as relatively unaffected by changes in the municipal agenda or individual political ambitions (Uittenbroek et al., 2014). However, the political commitment in a dedicated approach might not only produce quicker results, but instill less erratic and more lasting ones as well through resetting underlying organizational routines and structures (Uittenbroek et al., 2014). Toledo's case can shed some light on governance processes that help balance the strengths

and weaknesses of both approaches and function regardless of direct or indirect municipal political commitment (Uittenbroek et al., 2014).

Despite the administrative changes Toledo has faced in the last year and Commissioner Murphy's exit, the city has continued its efforts. The city's mainstreaming approach to climate adaptation did result in specific, feasible actions that were consistent with the existing governing system. However, the City also took part in a multilevel (Bulkeley and Betsill, 2013; Betsill and Bulkeley, 2006) or polycentric (Ostrom, 2010) process in which they pursued these actions alongside other levels of government and non-governmental groups. Over the course of the project, city staff members developed relationships around adaptation with GLAA-C, GLISA, NOAA's Coastal Service Center, The Toledo Metro Area Council of Governments, and the Toledo-Lucas County Sustainability Plan that sustained attention on adaptation in the city's broader network as the city itself weathered a period of transition. Such institutionalization of a broader adaptation agenda (Bulkeley and Kern, 2006; Sippel and Jenssen, 2009) is more reminiscent of the sustained organizational changes associated with the dedicated approach (Uittenbroek et al., 2014). By cultivating a broader adaptation information and governance network, the City of Toledo may have pursued a mainstreaming approach while also developing a network that provided the organizational change benefits of a dedicated approach.

Other research on sustaining efforts to connect climate science with decision-making has already explored the role of this networking process in other contexts. For example, Dilling and Lemos (2011) have highlighted the critical role of boundary organizations in taking ownership over the development of supportive conditions and mechanisms that can sustain action over time. Kalafatis et al. (2015) have described how the different roles played by broader and more local networks can iteratively expand and deepen the capacity to integrate climate science into decision-making. Research on the City of Melbourne in Australia has offered a particularly compelling case of polycentric networks sustaining climate change-informed stormwater management between a municipality and its larger metropolitan region (Brown et al., 2013; Ferguson et al., 2013).

But while that research might point to the potential for such relationship-building processes to emerge around other cities' policy streams, how practically likely is it that they actually will? GLAA-C (largely privately funded) and GLISA (largely federally funded) are dependent on particular targeted funding sources. Both globally (IPCC, 2014) and in the United States specifically (Bierbaum et al., 2012) there is a persistent gap in the availability of funds to support the need for adaptation. Still, we point to two reasons to anticipate that Toledo's adaptation policy development experiences will be replicated elsewhere in the future.

The first is that, while GLAA-C and GLISA played key supportive roles in the process, their involvement can be viewed as participants within a larger network of support. Focusing on adaptation cases in cities in the Global South, Carmin et al. (2012) have detailed the ability of policy entrepreneurs to successfully stitch together the necessary political, informational, and financial resources to pursue informed climate adaptation. Commissioner Murphy may have benefited from his relationship with GLAA-C and GLISA, but the ability to continuously cultivate coalitions with whatever other resources are around is a fundamental characteristic of policy entrepreneurs generally (Mintrom and Norman, 2009). As they navigate a governing context that is increasingly fragmented and polycentric (Bulkeley, 2010), we anticipate that such urban policy entrepreneurs will form partnerships that will fulfill similar needs to those we saw met in this case as they arise. This case suggests that these networks can ultimately standardize collaborations around climate change and represent lasting institutional changes.

Secondly, as more and more public and private leaders begin to recognize the impacts of climate change, there is growing support for boundary organizations and relationships. For example, despite the continued political debate over climate change in the United States (Marquart-Pyatt et al., 2014), the Presidential Task Force on Climate Preparedness and Resilience recommend opening up more funding for adaptation efforts. Specifically, the Task Force recommends that the Federal Government "shape or reshape programs, policies, information sources, and other forms of assistance" to help communities better prepare for climate change. (p2, State, Local, and Tribal Leaders Task Force). Additionally, GLISA is part of a national network of NOAA-funded integrated sciences and assessment programs. Thus, Toledo's solution of finding locally relevant climate science through a resource provider like GLISA may be more possible in the near future.

Conclusion

Like many cities in the Great Lakes region and throughout the world, Toledo, Ohio is attempting to tie together its preparations for the impact of climate change with efforts to address existing concerns. Led in particular by Environmental Services Commissioner Tim Murphy, the City of Toledo entered into a "boundary chain" with two partnering boundary organizations, GLAA-C and GLISA, that provided the City with tailored climate change information and decision support. In the effort to produce demand driven, decision relevant information, strategic partnerships like these are becoming more prevalent. Therefore, it is important to examine the role of these kinds of decision support relationships on the process of policy change in participating cities. In order to assess the process of policy change that unfolded during this project and the role of boundary chains within it, we used thick description of Kingdon's three streams (problems, policies, and politics).

In line with other studies on climate change policy entrepreneurs (e.g. Carmin et al., 2012; Anguelovski and Carmin, 2011) and the mainstreaming of climate change policy into ongoing policy goals (Uittenbroek et al., 2014), particular individuals in

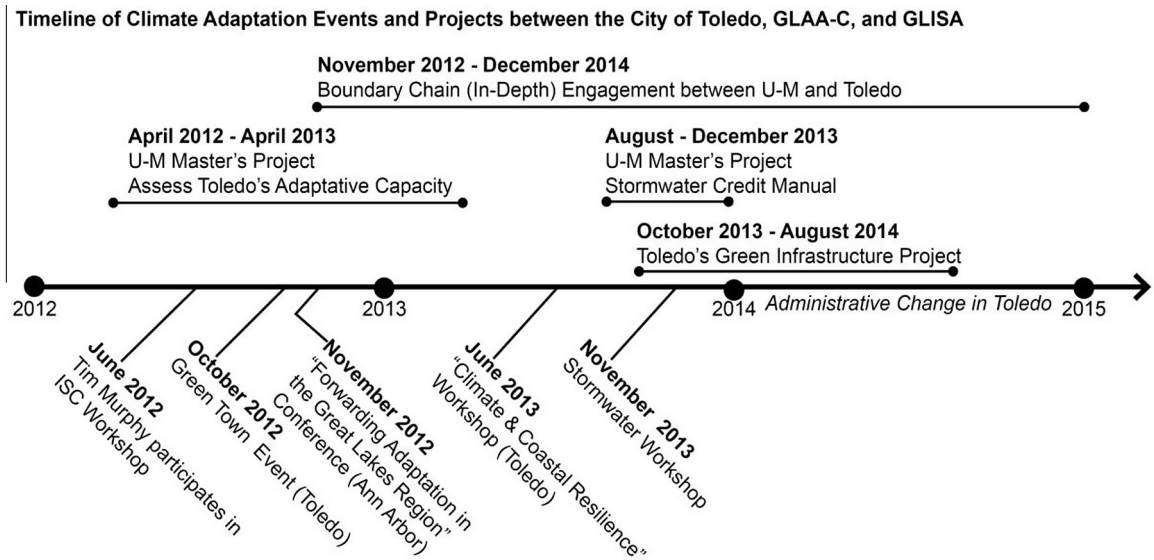
Toledo drove the integration of climate change into existing challenges. Over the course of the project, climate change adaptation was connected to the City's efforts to take on its stormwater problems. The GLAA-C/GLISA boundary chain adapted to suit two distinct information provision stages of the process: awareness-raising about climate change so that city staff could see implications for their own work and specific climate information tailored to particular decisions once they had developed. In this sense, the boundary chain played a role both in defining the City's prevailing problem stream around climate change and providing direct information support in its policy stream.

The mayor's public apathy about climate change represented an absence of strong political commitment to the issue in the City. At the same time, it also gave policy entrepreneurs on staff the discretion to form strategic partnerships with others inside and outside of the city. A mainstreaming approach to adaptation resulted in which climate change was strategically tied to existing efforts. Such a mainstreaming approach can feature clarity and policy consistency, but also suffer from failure to realize organizational changes needed to permanently sustain engagement that are more typical of directed actions backed by clear political commitment (Uittenbroek et al., 2014). However, the partnerships Toledo formed around adaptation with both climate change focused groups (GLAA-C and GLISA) and key regional stakeholders like the Toledo Metro Area Council of Governments represented organizational changes that helped the City sustain its adaptation work through a period of substantial internal transition. This example invites future attention to the influence that polycentric networks of boundary organizations and other stakeholders have on the role of political commitment to climate change within cities. Future research will be needed to see how these partnerships evolve, how they ultimately shape adaptation work over time, and how they affect the expansion of adaptation across policy domains. We hope and anticipate that many more examples of sustained decision support around climate adaptation will emerge in cities that will make such research possible.

Acknowledgments

This research was supported by National Oceanic and Atmospheric Administration's Climate Program Office through Grant NA10OAR4310213 which supports GLISA and the Kresge Foundation which supports GLAA-C. The authors would like to thank all of those in the City of Toledo who they have worked with them over the last several years. This paper would also have not been possible without the effort of the Master's Project group who performed the interviews referenced. Their names are: Pamela Barclay, Cara Bastoni, David Eisenhauer, Masooma Hassan, Melody Lopez, Leila Mekias, Sundeep Ramachandran, and Ryan Stock. We would also like to thank our fellow Special Issue authors who provided feedback over the course of the development of this paper, especially Maria Carmen Lemos. Finally, we are grateful for the very helpful feedback we have received on this paper from our anonymous reviewers.

Appendix A.



References

Abraham, Lisa. 2001. EPA pact on sewers will cost $400 million. The Toledo Blade. 07/24/2001.

Albers, R.A.W., Bosch, P.R., Blocken, B., van den Dobbelsteen, A.A.J.F., van Hove, L.W.A., Spit, T.J.M., 2015. Overview of challenges and achievements in the climate adaptation of cities and in the Climate Proof Cities program. Building and Environ. 83, 1–10.

Anguelovski, Isabelle, Carmin, JoAnn, 2011. Something borrowed, everything new: innovation and institutionalization in urban climate governance. Curr. Opin. Environ. Sustain. 3 (3), 169–175.

Barclay, Pamela, Bastoni, Cara, Eisenhauer, David, Hassan, Masooma, Lopez, Melody, Mekias, Leila, Ramachandran, Sundeep, Stock, Ryan, 2013. Climate Change Adaptation in Great Lakes Cities. Master's Project. School of Natural Resources and the Environment, University of Michigan, Ann Arbor.

Betsill, Michele M., Bulkeley, Harriet., 2006. Cities and the multilevel governance of global climate change. Glob. Gov. 12 (2), 141–159.

Bidwell, David, Dietz, Thomas, Scavia, Donald, 2013. Fostering knowledge networks for climate adaptation. Nat. Climate Change 3, 610–611.

Bierbaum, Rosina, Smith, Joel B., Lee, Arthur, Blair, Maria, Lynne Carter, F., Stuart Chapin, I.I.I., Fleming, Paul, Ruffo, Susan, Stults, Missy, McNeeley, Shannon, Wasley, Emily, Verduzco, Laura, 2012. A comprehensive review of climate adaptation in the United States: more than before, but less than needed. Mitig. Adapt. Strat. Glob. Change 18 (3), 361–406. http://dx.doi.org/10.1007/s11027-012-9423-1.

Briley, Laura, Brown, Daniel, Kalafatis, Scott E., 2015. Overcoming Barriers during the Co-Production of Climate Information for Decision-Making. Climate Risk Management 9, 41–49.

Brown, Rebekah R., Farrelly, Megan A., Loorbach, Derk A., 2013. Actors working the institutions in sustainability transitions: the case of Melbourne's stormwater management. Glob. Environ. Change 23 (4), 701–708. http://dx.doi.org/10.1016/j.gloenvcha.2013.02.013.

Bulkeley, Harriet, 2010. Cities and the Governing of Climate Change. Annu. Rev. Environ. Res. 35, 229–253. http://dx.doi.org/10.1146/annurev-environ-072809-101747.

Bulkeley, Harriet, Betsill, Michele M., 2013. Revisiting the urban politics of climate change. Environ. Polit. 22 (1), 136–154. http://dx.doi.org/10.1080/09644016.2013.755797.

Bulkeley, Harriet, Kern, Kristine, 2006. Local government and the governing of climate change in Germany and the UK. Urban Stud. 43 (12), 2237–2259.

Carmin, JoAnn, Anguelovski, Isabelle, Roberts, Debra, 2012. Urban climate adaptation in the global south: planning in an emerging policy domain. J. Plan. Educ. Res. 32 (1), 18–32.

Cash, D.W., Borck, J.C., Patt, A.G., 2006. Countering the loading-dock approach to linking science and decision making – comparative analysis of El nino/southern oscillation (ENSO) forecasting systems. Sci. Technol. Human Values 31 (4), 465–494. http://dx.doi.org/10.1177/0162243906287547.

Cohen, Michael D., March, James G., Olsen, Johan P., 1972. A garbage can model of organizational choice. Adm. Sci. Q. 17 (1), 1–25.

Consent Decree, 1991. United States of America and State of Ohio v. City of Toledo, Ohio, Civil Action No. 3:91:CV7646. Available: <http://www2.epa.gov/sites/production/files/2013-09/documents/toledo-cd.pdf>.

Denzin, Norman K., 1989. Interpretive Interactionism. Sage, Newbury Park, CA.

Department of Justice, Office of Public Affairs, 2010. Toledo, Ohio, Agrees to Make Major Improvements to City's Sewer System at an Estimated Cost of $315 Million. [Press Release]. Retrieved from <http://www.justice.gov/opa/pr/toledo-ohio-agrees-make-major-improvements-city-s-sewer-system-estimated-cost-315-million>.

Dilling, Lisa, Lemos, Maria Carmen, 2011. Creating usable science: opportunities and constraints for climate knowledge use and their implications for science policy. Glob. Environ. Change 21 (2), 680–689. http://dx.doi.org/10.1016/j.gloenvcha.2010.11.006.

Ferguson, Briony C., Frantzeskaki, Niki, Brown, Rebekah R., 2013. A strategic program for transitioning to a Water Sensitive City. Landscape Urban Plan. 117, 32–45. http://dx.doi.org/10.1016/j.landurbplan.2013.04.016.

Great Lakes Integrated Sciences and Assessments, 2012. Historical Climatology: Northwest Ohio. Retrieved from <http://glisa.umich.edu/media/files/climaticdivs/ohio/Ohio_Climatic_Division_1.pdf>.

Gupta, Joyeeta, Termeer, Catrien, Klostermann, Judith, Meijerink, Sander, van den Brink, Margo, Jong, Pieter, Nooteboom, Sibout, Bergsma, Emmy, 2010. The adaptive capacity wheel: a method to assess the inherent characteristics of institutions to enable the adaptive capacity of society. Environ. Sci. Policy 13 (6), 459–471.

Guston, David H., 2001. Boundary organizations in environmental policy and science: an introduction. Sci. Technol. Human Values 26 (4), 399–408.

Guston, David H., 2007. Between Politics and Science: Assuring the Integrity and Productivity of Research. Cambridge University Press.

Heaphy, Liam. 2014. Making climate data talk: an analysis of the links between applied research on urban climate and planning policy. In: ICAD Conference Paper: Better together? Reconciling the Supply of, and Demand for, Climate Knowledge in Adaptation Decision Making. September 9–11, 2014.

High, Steven, 2003. Industrial Sunset: The Making of North America's Rust Belt, 1969–1984. University of Toronto Press.

Intergovernmental Panel on Climate Change (IPCC) (Fourth Assessment Report) 2001. Climate Change, 2001: Mitigation. In: Metz, B., Davidson, O., Swart, R., Pan, J. (Eds.). Cambridge: Cambridge University Press.

Intergovernmental Panel on Climate Change (IPCC) (Fifth Assessment Report), 2014. Summary for policymakers. In: Field, C.B., Barros, V.R., Dokken, D.J., Mach, K.J., Mastrandrea, M.D., Bilir, T.E., Chatterjee, M., Ebi, K.L., Estrada, Y.O., Genova, R.C., Girma, B., Kissel, E.S., Levy, A.N., MacCracken, S., Mastrandrea, P.R., White, L.L. (Eds.), Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 1–32.

Kalafatis, Scott E., Lemos, Maria Carmen, Lo, Yun.-Jia, Frank, Kenneth A., 2015. Increasing information usability for climate adaptation: the role of knowledge networks and communities of practice. Glob. Environ. Change 32, 30–39.

Kessler, Rebecca, 2011. Stormwater strategies: cities prepare aging infrastructure for climate change. Environ. Health Perspect. 119 (12), a514–a519. http://dx.doi.org/10.1289/ehp.119-a514.

Kingdon, John W., 1984. Agendas, Alternatives and Public Policies. Little, Brown and Company, Boston.

Kingdon, John W., 1990. Agendas, Alternatives and Public Policies. Harper Collins, New York.

Kingdon, John W., 2002. Agendas, Alternatives, and Public Policies. Harper Collins, New York.

Kingson, Jennifer A. 2014. Portland Will Still Be Cool, but Anchorage May Be the Place to Be. New York Times. 9/22/2014.

Kirchhoff, Christine J., Lemos, Maria Carmen, Dessai, Suraje, 2013. Actionable knowledge for environmental decision making: broadening the usability of climate science. Annu. Rev. Environ. Res. 38, 393–414.

Kirchhoff, Christine J., Kalafatis, Scott E., Lemos, Maria Carmen., 2015. Creating synergy with boundary chains: can they improve usability of climate information? Climate Risk Management 9, 77–85.

Lambright, W., Chagnon, S., Harvey, L.D., 1996. Urban reactions to the global warming issue: agenda setting in Toronto and Chicago. Clim. Change 34, 463–478.

Lemos, Maria Carmen, Rood, Richard B., 2010. Climate projections and their impact on policy and practice. Wiley Interdiscip. Rev. Clim. Change 1 (5), 670–682. http://dx.doi.org/10.1002/wcc.71.

Lemos, Maria Carmen, Kirchhoff, Christine J., Kalafatis, Scott E., Scavia, Donald, Rood, Richard B., 2014. Moving climate information off the shelf: boundary chains and the role of RISAs as adaptive organizations. Weather Clim. Soc. 6 (2), 273–285.

Lynch, A.H., Tryhorn, L., Abramson, R., 2008. Working at the boundary: facilitating interdisciplinarity in climate change adaptation research. Bull. Am. Meteorol. Soc. 89, 169–179.

Marquart-Pyatt, Sandra T., McCright, Aaron M., Dietz, Thomas., Dunlap, Riley E., 2014. Politics eclipses climate extremes for climate change perceptions. Glob. Environ. Change 29, 246–257.

McNie, Elizabeth C., 2007. Reconciling the supply of scientific information with user demands: an analysis of the problem and review of the literature. Environ. Sci. Policy 10 (1), 17–38.

Messina, Ignazio, Reiter, Mark, 2014. Toledo again loses population, but more slowly. Toledo Blade. 5/22/2014.
Mintrom, Michael, Norman, Phillipa, 2009. Policy entrepreneurship and policy change. Policy Stud. J. 37 (4), 649–667.
Moss, R.H., Meehl, G.A., Lemos, M.C., Smith, J.B., Arnold, J.R., Arnott, J.C., Behar, D., Brasseur, G.P., Broomell, S.B., Busalacchi, A.J., Dessai, S., Ebi, K.L., Edmonds, J.A., Furlow, J., Goddard, L., Hartmann, H.C., Hurrell, J.W., Katzenberger, J.W., Liverman, D.M., Mote, P.W., Moser, S.C., Kumar, A., Pulwarty, R.S., Seyller, E.A., Turner II, B.L., Washington, W.M., Wilbanks, T.J., 2013. Hell and high water: practice-relevant adaptation science. Science 342 (6159), 696–698.
Nisbet, Matthew C., 2009. Communicating climate change: why frames matter for public engagement. Environ. Sci. Policy Sustain. Dev. 51 (2), 12–23.
Nisbet, Matthew C., Mooney, Chris, 2007. Framing science. Science 316 (5821), 56.
Ostrom, Elinor, 2010. Polycentric systems for coping with collective action and global environmental change. Glob. Environ. Change 20 (4), 550–557. http://dx.doi.org/10.1016/j.gloenvcha.2010.07.004.
Ponterotto, Joseph G., 2006. Brief note on the origins, evolution, and meaning of the qualitative research concept 'thick description'. Qual. Rep. 11 (3), 538–549.
Revi, A., Satterthwaite, D.E., Aragón-Durand, F., Corfee-Morlot, J., Kiunsi, R.B.R., Pelling, M., Roberts, D.C., Solecki, W., 2014. Urban areas. In: Field, C.B., Barros, V.R., Dokken, D.J., Mach, K.J., Mastrandrea, M.D., Bilir, T.E., Chatterjee, M., Ebi, K.L., Estrada, Y.O., Genova, R.C., Girma, B., Kissel, E.S., Levy, A.N., MacCracken, S., Mastrandrea, P.R., White, L.L. (Eds.), Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 535–612.
Rice, Jennifer L., Woodhouse, Connie A., Lukas, Jeffrey J., 2009. Science and decision making: water management and tree-ring data in the western United States1. JAWRA J. Am. Water Res. Assoc. 45 (5), 1248–1259. http://dx.doi.org/10.1111/j.1752-1688.2009.00358.x.
Sarewitz, Daniel, Pielke Jr., Roger A., 2007. The neglected heart of science policy: reconciling supply of and demand for science. Environ. Sci. Policy 10, 5–16.
Sippel, Maike, Jenssen, Till, 2009. What about Local Climate Governance? A Review of Promise and Problems. Institute of Energy Economics and Rational Energy, Stuttgart, Discussion Paper.
Teodoro, Manuel P., 2011. Bureaucratic Ambition: Careers, Motives, and the Innovative Administrator. Johns Hopkins University Press, Baltimore.
Uittenbroek, Caroline J., Janssen-Jansen, Leonie B., Runhaar, Hens A.C., 2013. Mainstreaming climate adaptation into urban planning: overcoming barriers, seizing opportunities and evaluating the results in two Dutch case studies. Reg. Environ. Change 13 (2), 399–411.
Uittenbroek, Caroline J., Janssen-Jansen, Leonie B., Spit, Tejo J.M., Salet, Willem G.M., Runhaar, Hens A.C., 2014. Political commitment in organizing municipal responses to climate adaptation: the dedicated approach versus the mainstreaming approach. Environ. Polit. 23 (6), 1043–1063. http://dx.doi.org/10.1080/09644016.2014.920563.
United States Environmental Protection Agency, 2013. Great Lakes Areas of Concern. Retrieved November 4, 2014 from <http://www.epa.gov/greatlakes/aoc/maumee/index.html>.
United States Environmental Protection Agency, 2014. Great Lakes: Lake Eerie. Retrieved November 18, 2014 from <http://epa.gov/greatlakes/lakeerie/index.html>.
United States Global Change Research Program, 2014. 2014 National Climate Assessment Full Report. Retrieved August 2, 2014 from <http://nca2014.globalchange.gov/report>.
Walker, Jack L., 1981. The diffusion of knowledge, policy communities and agenda setting: the relationship of knowledge and power. In: Tropman, John E. (Ed.), New Strategic Perspectives on Social Policy. Pergamon Press, pp. 75–96.
Weber, Elke U., 2006. Experience-based and description-based perceptions of long-term risk: why global warming does not scare us (yet). Clim. Change 77, 103–120.
Wilson, David, Wouters, Jared, 2003. Spatiality and growth discourse: the restructuring of America's Rust Belt Cities. J. Urban Aff. 25 (2), 123–138.
Zahariadis, Nikolaos. 1999. Ambiguity and Multiple Streams, third ed. In: Sabatier, Paul A., Weible, Christopher M. (Eds.). Westview Press.

Further reading

Armitage, D., Plummer, R., 2010. Adaptive Capacity and Environmental Governance. Springer, Berlin.
Bulkeley, Harriet, 2013. Cities and Climate Change. Routledge, New York.
Cohen, Philippa J., Evans, Louisa S., Morena, Mills., 2012. Social networks supporting governance of coastal ecosystems in Solomon Islands. Conserv. Lett. 5 (5), 376–386.
Lynn, Kathy, MacKendrick, Katharine, Donoghue, Ellen, 2011. Social Vulnerability and Climate Change: Synthesis of Literature. Gen. Tech. Rep. PNW-GTR-838. U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station, Portland, OR. 70 p. (<http://www.fs.fed.us/pnw/pubs/pnw_gtr838.pdf>).
Rosenzweig, C., Solecki, W.D., Hammer, S.A., Mehrotra, S. (Eds.), 2011. Climate Change and Cities: First Assessment Report of the Urban Climate Change Research Network. Cambridge University Press.
United States. State, Local, and Tribal Leaders Task Force on Climate Preparedness and Resilience. *Recommendations to the President*. Washington. November 2014. <http://www.whitehouse.gov/administration/eop/ceq/initiatives/resilience/taskforce>.
United States Census Bureau, 2014. State and County QuickFacts: Toledo, OH. Retrieved August 15, 2014, from <http://quickfacts.census.gov>.