



Sub-national government efforts to activate and motivate local climate change adaptation: Nova Scotia, Canada

Brennan Vogel¹ · Daniel Henstra² · Gordon McBean³

Received: 15 May 2018 / Accepted: 21 August 2018 / Published online: 25 August 2018
© Springer Nature B.V. 2018

Abstract

The impacts of climate change due to more frequent and intense storms, fires, and floods are felt most acutely at the community scale, and local adaptation policy and planning is critically important. However, local practitioners face many barriers that can undermine their capacity to adopt and sustain adaptation initiatives to reduce exposure and vulnerability and strengthen resilience to climate risks. Existing scholarship suggests that national governments play an important role in providing leadership and resources to support local adaptation policy development. However, less research attention has been devoted to investigating sub-national, regional government initiatives to support local adaptation policy and planning in federal states, despite their financial resources and constitutional responsibility to oversee municipalities. This article analyzes how one sub-national government, the provincial government of Nova Scotia (Canada), activated and motivated local adaptation policy and planning through a combination of policy instruments and municipally focused capacity-building initiatives. In addition to describing the structure and dynamics of the provincial mandate for municipal adaptation planning in Nova Scotia, we provide case study evidence to draw insights about the enabling conditions for the successful implementation of climate change adaptation governance initiatives of this kind.

Keywords Adaptation planning · Municipalities · Regional governance · Nova Scotia

✉ Brennan Vogel
bvogel@uwo.ca

Daniel Henstra
dhenstra@uwaterloo.ca

Gordon McBean
gmcbear@uwo.ca

¹ Centre for Environment and Sustainability, University of Western Ontario, London, ON N6A 3K7, Canada

² Department of Political Science, University of Waterloo, Waterloo, Canada

³ Department of Geography, University of Western Ontario, London, Canada

1 Introduction

Extreme weather associated with climate change poses significant risks for communities (IPCC 2014a, b, 2012). The World Economic Forum ranks extreme weather and the failure of climate change mitigation and adaptation policies as the most impactful global risks for the next 10 years (WEF 2018, 2017, 2016). Managing climate change risks and impacts demands *adaptation policies*—governance actions targeted at reducing the vulnerability of populations, assets, and operations to climate change risks by thinking about and making adjustments in decisions and activities because of observed or expected changes in climate, in order to moderate harm or take advantage of new opportunities (Vogel and Henstra 2015; Smit and Wandel 2006). Climate change impacts are highly variable and ultimately manifest at the local scale, so local adaptation is essential to achieving broader resiliency to climate change at the national level (Dickinson and Burton 2011; Corfee-Morlot et al. 2009; Burton et al. 2002). From this perspective, a country's ability to adapt to climate change is correlated with the adaptive capacities of its cities and communities to avoid harm associated with climate impacts such as floods and storms, while taking advantage of opportunities associated with climatic changes (Bicknell et al. 2009). However, local practitioners face significant economic and social barriers that undermine municipal capacity to adopt and sustain adaptation initiatives (Biesbroek et al. 2013).

We seek to identify the enabling conditions that sub-national governments can employ to support local adaptation planning in communities as a means of reducing disaster risks associated with climate impacts at regional scales. The regional case study examined in this research article identifies how and why social and political factors affect adaptation governance efforts. First, we review the findings of other regional adaptation studies to identify differences and commonalities across jurisdictions. We draw on the literature to highlight the barriers local governments face in formulating adaptation policies, as well as the factors that can enable local adaptation. Second, we provide new evidence and analysis based upon the findings of a case study of a regional adaptation governance initiative in the province of Nova Scotia, Canada. We describe the case study environment and provide background information about Nova Scotia's policymaking context and details about the provincial government's deliberate adaptation governance intervention. We then describe the research design and mixed methods, before presenting and discussing our findings in relation to existing literature. We also discuss the broader relevance of our findings and conclude with scholarly insights that may help to inform future research directions. Through the examination of the context of the provincial adaptation governance and policymaking environment in Nova Scotia, our objective is to produce transferable lessons about the factors that can help to enable regional adaptation governance success elsewhere.

2 Local governments and regional adaptation governance

Many studies have investigated what motivates and activates action on regional and local adaptation initiatives. In Canada, provinces—like their sub-national, regional counterparts in other federal states—are crucial actors for enabling adaptation at the local level of cities, towns, and communities vulnerable to climate impacts such as wildfires, storms, and floods (Hanna et al. 2014). In unitary states lacking a regional level of government (e.g., Sweden, Norway, Finland, UK), scholars have documented important

roles that national governments play in setting the central policy direction and providing resources for local adaptation (Amundsen et al. 2010; Juhola 2010). However, for regional authorities in federal states such as Canada and others (e.g., Australia, Brazil, India, USA), sovereignty is constitutionally divided between the two levels of government. Regional (provincial) governments have autonomy from the federal government through holding exclusive legislative jurisdiction over the subordinate municipal governments within their borders (Andrew and Graham 2014; Bakvis and Skogstad 2012).

Much of the adaptation policy and governance research has focused on actions at the local or national levels, while regional adaptation actions have received less attention (Dannevig and Aall 2015). The local scale is argued to be the appropriate level of government for adaptation policy development and various studies have investigated drivers of local climate adaptation (Porter et al. 2015; Ekstrom and Moser 2013). Municipalities play key roles in public functions that are central to adaptation including land-use planning and development regulation, building inspection, critical infrastructure protection, and emergency planning and response (Auld and MacIver 2007; Wakeford and McGillivray 2006).

Scholars have identified variable ways that higher-level governments activate and motivate adaptation at the local scale. One tool used by national and regional governments, increasing guidance and support, has been widely documented (e.g., Giest and Howlett 2013; Keskitalo 2010). Other studies suggest regional governments are well positioned to support local adaptation because they have an intermediary perspective on climate change (Hanna et al. 2014). Regional governments are capable of designing solutions that address the local concerns and the contextual factors affecting municipal vulnerabilities, exposure, and sensitivity to climate impacts (Galarraga et al. 2011; Termeer et al. 2011). Regional authorities are close enough to local governments to understand the contextual aspects of local climate risks and gaps in capacities for adaptation, but distant enough to recognize broader strategic priorities at the regional scale and opportunities for supporting local resiliency.

Regional factors can influence how and why an adaptation policy agenda unfolds. For instance, regional experiences with extreme weather events can serve as “focusing events” that prompt public officials to engage in adaptation policy discussions (Birkland and DeYoung 2013; Brunner and Nordgren 2012). Extreme weather events can direct policymakers’ attention toward local vulnerabilities to climate change, highlighting the vulnerabilities and needs for adaptation (Henstra 2012; Penning-Rowsell et al. 2006). However, in a large survey of drivers for adaptation in US municipalities, Dilling et al. (2017:16) found that extreme weather events are not sufficient to motivate climate action. However, extreme weather experiences may make stakeholders and decision-makers more receptive to discussing climate change, potential impacts and adaptation planning as a means of reducing local vulnerabilities. Focusing events associated with extreme weather can help decision-makers make cognitive associations between current vulnerability and future climate change impacts.

The local level is optimal for testing innovative climate change policies, plans, and practices on smaller scales (Mehdi 2006). Regional governments have an array of policy tools to influence local adaptation, with the flexibility to combine authority and network-based coordination to secure local compliance with climate change policy mandates (Mercer-Clarke et al. 2016; Henstra 2015). Political legitimacy can be achieved through regional leadership on shared initiatives that build collaboration and consensus among local stakeholders (Hanssen et al. 2013). Despite formidable sociopolitical challenges, local adaptation as a field of practice has expanded dramatically over the past two decades (Hughes

2015; Carmin et al. 2012), and municipal adaptation plans and policies have proliferated and become increasingly sophisticated (Stults and Woodruff 2016).

Economic tools are used to encourage local governments to take action on adaptation by financially rewarding action and penalizing inaction. Regional political authorities can economically leverage funding to secure local compliance with climate change policy goals, while provincial legislation and regulations can require municipal governments to take action and plan for climate change adaptation. Economic incentives from higher-level governments can be a critical motivation for local adaptation planning. In Chile, Valdivieso et al. (2017) found that financial transfers from regional governments positively correlated with local adaptation efforts.

A strong mandate from a higher level of government can be an influential driver of local action on adaptation, as evidenced in Norway, the UK, and the USA (Dilling et al. 2017; Porter et al. 2015; Amundsen et al. 2010). Regional governments making clear and firm commitments to adaptation as an important and ongoing policy priority creates the governance conditions for inter-jurisdictional collaboration and local innovations in adaptation efforts. However, how legal mandates for adaptations are applied and enforced has implications for local compliance with national or regional policy priorities. In New Zealand, for example, a national legal mandate for adaptation required local governments to consider the effects of climate change in local planning decisions, but it failed in part due to lack of resources, a lax reporting structure and minimal oversight from higher government (Lawrence et al. 2015). The study identified a number of factors to better enable local adaptation-planning implementation including: (1) information-based tools, such as a consistent risk assessment methodology; (2) financial support for regional risk assessments; and (3) capacity-building and regulatory changes to allow regional approaches to adaptation planning and development. These findings suggest that regional authorities can activate and motivate local adaptation through financial incentives, legal mandates and supportive capacity building. Mandated action, financial leverage and capacity supports offer regional authorities a powerful combination of policy tools to raise the profile and increase the legitimacy of adaptation planning for municipal governments.

Providing municipalities with climate change science and offering information resources to support and build local capacities through facilitated skills and training activities can aid local authorities in adaptation planning and policy development. While each of these approaches has strengths and weaknesses, combining them in strategic ways can enable regional governments to be more effective in convincing local governments to undertake adaptation efforts (Mees et al. 2014). Closer proximity to key stakeholders and the public gives local policymakers access to contextual knowledge about place-based exposure and sensitivity to climate risks, and local officials are well positioned to participate in developing customized adaptation strategies tailored to community needs (Corfee-Morlot et al. 2011; Larsson 2003). Public engagement and mobilization in support of adaptation can also be more effective at the local level. Specific community risks and experiences with climate impacts (e.g., past experiences with storm or flooding related infrastructure damage) can tangibly demonstrate local vulnerabilities and the importance of actively planning to avoid harms associated with climate change impacts (Hunt and Watkiss 2011).

There remains substantial social barriers to adaptation policy development at the local level (Ford and King 2013; Bassett and Shandas 2010). Many communities lack fiscal resources and staff capacity to formulate and implement adaptation policies and plans (Porter et al. 2015; Measham et al. 2011). Difficulties understanding the long-term nature of climate change and the intangible risks future climate change presents to community well-being represents another cognitive barrier for both decision-makers

and the public (Wagner and Zeckhauser 2012). While citizens abstractly perceive climate change as a problem, adaptation to climate change lacks sufficient public demand to prompt sustained attention for government interventions, giving elected officials little political incentive to commit scarce resources to climate adaptation policy and planning actions (Corfee-Morlot et al. 2011; Lorenzoni and Pidgeon 2006). Public stakeholders tasked with decision-making view the costs of adaptation as visible and immediate and the benefits as largely intangible and mainly in the future. In the face of immediate spending priorities and with low public demand for adaptation, decision-makers will invest in limited priorities and proposals that generate short-term returns (Reisinger et al. 2011; Simonsson et al. 2011).

Other barriers to local adaptation are widely reported across the adaptation literature (Biesbroek et al. 2013). Regionally, legislative frameworks do not always include regulatory guidelines for local authorities to reduce community vulnerability (Raikes and McBean 2016). Schaufli (2014) found the chief barriers to municipal adaptation in municipalities surrounding the Bay of Fundy included a lack of financial and human resources, weak public concern, insufficient political will, and an absence of support from higher levels of government. Other differences in the capacities and approaches of smaller versus larger municipalities can influence adaptation readiness (Ford and King 2013). Whereas larger municipalities with more resource have greater flexibility to make adaptive investments, smaller and under-resourced municipalities lack the same capacities (Raikes and McBean 2017). Nordgren et al. (2016) identified lack of funding and staff time as the chief barriers to adaptation action among US municipalities. Ekstrom and Moser (2013) found that decision-makers' attitudes, negative values, and motivations, combined with a lack of resources and funding, were the predominant social barriers to local adaptation in the San Francisco Bay area, and the biggest opportunities for overcoming social barriers to adaptation planning were associated with changing policy and management structures to be more responsive to climate change priorities.

Adaptation studies have emphasized that knowledge and information resources from higher-level governments provide an important support mechanism for developing local adaptation plans. Räsänen et al. (2017) suggest local governments need technical information (e.g., short-term climate projections, locally specific climate data, and decision-making tools) to weigh the costs and benefits of adaptation options. Nordgren et al. (2016) assert that public officials require resources to support climate change goal setting and planning to isolate the most pressing needs, as well as frameworks for monitoring and evaluation of climate change actions. Dilling et al. (2014) report that facilitation of local adaptation stakeholders can be improved with access to better baseline climate data and hydrological data to develop adaptation plans and monitor and track changes in local impacts over time. Other studies suggest that targeted resources can increase local officials' capacities for adaptation planning through education and training workshops, seminars, and learning forums that contribute to advancing knowledge of climate change and sustainability solutions at the local scale (Vize 2012; National Research Council 2011).

Providing local governments with climate information may be unhelpful without addressing more fundamental needs for supporting human resources, skills and training to enable localities to use the information in strategic ways that support adaptation planning and decision-making (Porter et al. 2015). Adaptive capacities to respond to climate change at the local scale relate to factors such as access to economic resources, technology, information related to climate variability and the skills to make use of this information (Smit and Wandel 2006). Barriers to these integral elements of adaptive capacity are felt particularly acutely at the local scale of municipal governments in Canada (OAG 2018).

Despite the obstacles, the literature suggests that regional governments offer a key leverage point to instigate climate change actions aimed at the local scale, and regional political authorities possess nuanced capacities to facilitate municipal efforts to help reduce local vulnerability to climate change risks. Targeted regional governance interventions can inform, educate and engage local stakeholders in adaptive capacity-building initiatives and regional adaptation efforts may help reduce potential harms associated with climate impacts at the local scale. Information-based resources, financial leverage and support, capacity building and regulatory measures may provide a suite of regional adaptation governance tools to incite climate change adaptation in municipalities (Lawrence et al. 2015).

3 Climate change adaptation in Nova Scotia, Canada

Nova Scotia's provincial government employed a mandatory, regulatory policy intervention to incite, activate and motivate adaptation planning among municipal governments. The historical and sociopolitical policymaking context of how and why the regional government of Nova Scotia introduced a mandatory, regulatory requirement for municipal adaptation planning is presented first. Then, we present analyses of our findings explaining how and why Nova Scotian municipalities responded to the provincial Municipal Climate Change Action Plan (MCCAP) mandate for mandatory municipal climate change adaptation planning. Our research objective is to utilize the MCCAP case study to generate new insights into the social and political factors and enabling conditions that can contribute to effective regional adaptation governance interventions.

3.1 Background of municipal climate change action planning in Nova Scotia, Canada

Nova Scotia is an isthmus located on the east coast of Canada, narrowly connected to the Canadian mainland to the west by the Chignecto Peninsula and otherwise bordered by the Bay of Fundy and Atlantic Ocean. The population of Nova Scotia is 921,727 (2011), with almost half the population (390,096) residing in the capital city of Halifax (Statistics Canada 2012). Halifax Regional Municipality (HRM) is the seat of the provincial government and the largest and most populous municipality in the province, significantly contributing to the provincial and Atlantic Canadian economy. The provincial government has constitutional authority to oversee the 50 municipal governments, which have jurisdictional responsibilities for administering land-use planning, engineering and related infrastructure policies (e.g., water, wastewater, transportation) at the community scale. Given the geographic and climatic exposure and sensitivities associated with Nova Scotia's maritime location, climate change adaptation has increasingly become an important issue for the Nova Scotia provincial government and municipalities (ClimAdapt 2005).

In the coming decades, more frequent and intense extreme weather in Nova Scotia and sea level rise, both due to climatic warming, will increase risks of coastal flooding impacts such that municipalities located in vulnerable coastal zones need to prepare and implement adaptation plans (Natural Resources Canada 2016; ICLR 2012). These types of climate change hazards are already impacting coastal zone Nova Scotia communities.

The Nova Scotia MCCAP mandate finds its political origins in the national "New Deal for Cities and Communities" (SNSMR 2011). This tri-governmental policy framework redistributes taxation revenues collected by the federal government through the sale of

gasoline back to the provincial governments. In turn, provinces redistribute gas tax funding to municipalities on a per-capita basis to provide a stable funding mechanism for local sustainability and infrastructure projects. Each province negotiates the terms of its gas tax agreement separately with the federal government and municipalities based on calculations reflecting the distribution of population across Canada, with the transfers to municipalities in turn based on population distribution within the provinces.

The first phase of the national gas tax agreement concluded in 2010 and was subsequently renewed indefinitely by the federal government as means of financing municipal infrastructure via provincial oversight. Since 2005, Canada's municipal governments have used gas tax funding to pay for maintaining and developing infrastructure and implementing sustainability projects in areas such as transportation, water, wastewater, energy, and other infrastructure projects that contribute to "clean air, clean water and a healthy environment" (SNSMR 2011). During the first phase of the gas tax funding (2005–2010), there was a mandatory reporting requirement for all Canadian municipalities to develop an Integrated Community Sustainability Plan (ICSP). The ICSP mandate prompted sustainability goals and priorities for municipal planning to be developed through community and stakeholder engagement and consultation (Connelly et al. 2009). The federal ICSP mandate played out variably across the country. In Nova Scotia, municipal ICSP reporting requirements were directly linked to the dispersing, by the province, of gas tax funding worth 145.2 million dollars to recipient municipalities for infrastructure spending and related sustainability projects.

During the second phase of the gas tax agreement in Nova Scotia (2011–2014), more than \$223 million dollars in funding for municipal infrastructure was leveraged the provincial government as a financial incentive and a collateral motivation for inciting and activating municipal climate change adaptation planning. The policy innovation that occurred in Nova Scotia was that, in order to continue to be eligible to receive their apportioned amount of gas tax funding, municipal governments were mandatorily required to complete a MCCAP by 2014 (SNSMR 2011). The MCCAP mandate simply built on the ICSP framework, and mandated municipalities to assess local climate change risks and vulnerabilities to climate change impacts (e.g., sea level rise, extreme weather events) and to identify key priorities for adaptation planning and actions. The MCCAP mandated all Nova Scotia municipalities to complete climate change action plans or face the forfeiture of gas tax funding for infrastructure and programs. Nova Scotia is the only Canadian province to have used the gas tax as a financial lever to incentivize, activate and motivate local adaptation planning, exemplifying a unique regional adaptation governance framework.

4 Methods

Various methodologies exist to conduct investigations into the enabling conditions for adaptation planning in local and regional governments (e.g., Valdivieso et al. 2017). Comparative studies have produced valuable evidence about local government adaptation decision-making and the operational rules and incentives framing how stakeholders make decisions about climate adaptation priorities and actions.

Our case study contributes to this body of work by assessing the impact of Nova Scotia's MCCAP mandate on municipalities. We adopted a conceptual framework for analyzing adaptation governance based on Moser (2009). Building on Moser's approach, we utilized mixed methods to collect and analyze a rich variety of data drawn from the

MCCAP, a recent example of a regional adaptation governance intervention. Our study objective was to characterize, describe and illustrate three key aspects of the MCCAP regional adaptation governance approach: (1) the structure of the regional and municipal decision-making arena; (2) the actors involved in initiating, developing and implementing adaptation policies at both regional and municipal scales; and (3) the stakeholders involved with influencing adaptation decision-making.

Because the MCCAP represented a unique, deviant case of an active regional government intervention to incite, activate and motivate local adaptation policy and planning by using a financial incentive (Seawright and Gerring 2008), Nova Scotia was selected as our regional case study for investigating and analyzing how and why regional governments adopt intentional, substantial and concrete adaptation policy interventions (Dupuis and Biesbroek 2013). Although other Canadian provinces have the jurisdictional authority and capacity to implement similar approaches, the MCCAP framework has not been replicated elsewhere in the country.

Mixed methods were employed to collect, triangulate and validate information by using: (1) content analysis of MCCAP documents; (2) targeted, thematic focus groups; (3) semi-structured interviews with key stakeholders; and (4) a targeted, online survey with municipal and regional adaptation policy and planning stakeholders. These valuable primary and secondary data sources provided a depth and breadth of empirical evidence for a detailed description of the MCCAP case (Baxter and Eyles 1997; Eisenhardt 1989). This type of adaptation-planning assessment research is conceivably useful for describing and illustrating innovative features of regional adaptation policymaking activities, and to identify and explain the sociopolitical factors and conditions enabling municipal adaptation planning. More universally through MCCAP analysis, we aimed to enhance opportunities for knowledge transfer to other municipal and regional governments concerned with adaptation governance frameworks for policy and planning. The homogeneous conditions created by the MCCAP policy mandate provided an opportunity for conducting small, comparative investigations of similarities and differences in adaptation-planning processes between Nova Scotia municipalities. We probed and benchmarked how similar and variable social factors impacted adaptation-planning processes in three municipalities (Shelburne, Bridgewater & Amherst, see Tables 1 and 2). Interviews with municipal and provincial stakeholders allowed further investigation of the variance in perspectives about the MCCAP from stakeholders directly involved with the MCCAP mandate. Throughout the study, we limited the temporal period of interest to the 2010–2014 planning window for municipal climate adaptation stakeholders to comply with the MCCAP mandate, and the field research was conducted with key stakeholders in Nova Scotia in 2014–2015.

We note that of the sample of staff from Nova Scotia municipalities represented in focus groups, interviews and targeted online surveying, there was a small overlap in the participation of some of the individuals involved in these research activities. However, cross participation was not significantly large enough to skew the overall study results and the regional map included in the Additional Supplement documents the cross-participation of municipal representatives in focus groups and survey activities. There were also a small number of cross-participating interviewees in the focus groups and survey activities, however research ethics commitments to confidentiality prohibit the disclosure of this information. The Additional Supplement provides further methodological details about the mixed methods used in this regional adaptation governance case study research.

Table 1 Municipal case studies

Community	Shelburne	Bridgewater	Amherst
Population	1686	8241	9717
Population growth (2006–2011)	–10.3%	+3.7%	+2.2%
Land area	9 km ²	13.6 km ²	12 km ²
Top adaptation concerns	Coastal flooding, inland flooding, drought	Extreme weather, flooding, lack of capacity for emergency planning; vulnerable infrastructure and populations; social and economic vulnerabilities	Marshland flooding and inland flooding

Table 2 MCCAP planning processes and capacity-building resources

Social factors	Amherst	Bridgewater	Shelburne
External research and consulting collaborations	Academic research collaboration aerial LiDAR mapping and risk assessment of coastal marshes of coastal marshlands subject to tidal flooding and regional infrastructure impacts	Paid academic collaboration (river flood study) of storm surge and inland flooding river scenarios Regional Hazard Risk Vulnerability Assessment (HRVA)	Consulting—HRVA (multi-day workshops with regional and municipal stakeholders)
Multi-level governance capacity building resources	Provincial capacity-building resources: MCCAP guidebook, stakeholder knowledge forums, webinars, workshops		
MCCAP process design	Internal staff-led process	Staff led; included stakeholder consultations and community engagement	Consultant-led public participation on MCCAP committee

Table 3 Survey responses regarding agenda setting and problem framing

	#/22	%
Agenda setting		
Gas tax was most influential initiating factor for MCCAPs	19	86.3
Gas tax provided an economic incentive for adaptation planning	21	95.5
Problem framing		
Historical focusing events were somewhat/very important for framing MCCAPs	18	81.8
Gas tax was a somewhat/very important for framing MCCAPs	19	86.3

Table 4 Municipal interviewee perspectives regarding the gas tax incentive

Interviewee	Quote
Land-use planner Municipality A	The gas tax was instrumental
Councillor Municipality B	Who is going to pass up that opportunity? And how do you explain that to your constituency? If you said, no, we decided not to focus on climate and give up the money that comes along with it. That's definitely a big incentive. I think it played a very important role. It's a strong incentive
Sustainability planner Municipality B	Which affected the development process the most...? I would say that without a doubt that is the gas tax
Chief administrative officer Municipality C	The impetus to do it really did come from being forced to do it
Emergency measures coordinator Municipality B & C	[MCCAPs] wouldn't have happened without (the gas tax)
Mayor Municipality C	Would it have happened without the gas tax? I would have to say I would hope it would have. But highly unlikely and I mean basically it may not have... it was the push... you will do it or you don't get the money

5 Study findings

Our methods produced a rich variety of quantitative and qualitative data reflecting the collective and nuanced views of Nova Scotia municipalities on topics of regional adaptation governance and planning, and the inclusion of three illustrative descriptions of MCCAP processes probed the contextual variance of municipal planning approaches. As we anticipated, there was widespread agreement among focus group participants that the gas tax incentive was an important driver for municipal adaptation planning, and that the likelihood of adaptation planning occurring without the incentive was negligible (see: Additional Supplement). The majority of survey respondents further affirmed that the gas tax incentive was somewhat or very important for initiating or framing the MCCAP adaptation-planning process (Table 3). These results were replicated in content analysis findings and the municipal interviewees unanimously confirmed the importance of gas tax funding as the primary motivating factor for municipal adaptation planning (Table 4).

5.1 The gas tax as an activating financial enabler for municipal adaptation planning

The unanimity of opinion in the case study data collected from focus groups, interviews, content analysis, and survey suggests that money is a great motivator for spurring local climate change adaptation actions. The MCCAP policymaking process succeeded by building on the familiar 2005–2010 ICSP/gas tax municipal reporting framework. When the regional government introduced the MCCAP reporting requirement as an ICSP extension in 2010, local stakeholders accepted it as a legitimate, reasonable mechanism to motivate local planning for climate change risks. The NGO interviewee noted that by building on the success of the previous ICSP policy framework, the innovative MCCAP built upon an existing familiarity with gas tax reporting requirements. Stakeholders were pre-accustomed to a monetary incentive being attached to the preparation of sustainability action plans by 2010; therefore, the next gas tax reporting requirement to produce MCCAPs by 2014 was not seen very differently. Similarly, the consulting and governmental stakeholders interviewed in this study affirmed the importance of the two MCCAP policy levers (provincial regulatory mandate and gas tax financial incentive) to activate and motivate municipal adaptation planning.

Confirming these impressions, the provincial policymaker involved with the MCCAP formulation noted that financial incentives and regulatory mandates were integral to policy success. The interviewee stated:

If we hadn't made this [MCCAP] as a reporting requirement of the second part of the gas tax agreement, we probably would not have got every municipality in this province... We were the only province in Canada to take that second phase of the gas tax and to do that... The gas tax was the classic carrot and stick approach. It worked very well because there was an incentive, and it was also tied to a flow of funding. It had the desired effect certainly. (Provincial policy-maker: September 12 2014)

The evidence suggests regional adaptation governance can be very effective by leveraging an existing policy framework and financial incentive involving prior mandatory reporting requirements related to sustainability planning, at the sub-national level. Nova Scotia's provincial experience shows that regional governments can effectively operationalize climate change adaptation-planning activities in subordinate municipalities by using penalization and reward approaches, or more tactfully the carrot and stick approach. As the Nova Scotia MCCAP evidence suggests, financial levers and mandatory reporting requirements provide a powerful combined suite of leverage points for regional governments to secure the compliance of subordinate municipal units in actively initiating adaptation-planning activities to address regional risks and vulnerability issues associated with climate change impacts.

5.2 Hurricane Juan: A provincially motivating focusing event for municipal adaptation planning

Beyond the gas tax incentive, 18 out of 22 survey respondents affirmed that historical focusing events (e.g., storms, damages) were somewhat or very important for initiating or framing the MCCAP adaptation-planning process. Seven of ten participants interviewed discussed how historical experiences with climate change hazards had affected municipal

planning and motivated regional governance agendas prior to the mandated MCCAP process. All non-municipal interviewees identified how past experiences with climate hazards and impacts acted as a socially important factor in setting the policy agenda for climate change planning actions at the regional scale.

The most notable regional-scale focusing event impacting Nova Scotia was Hurricane Juan in 2003. Juan was a Category Two tropical cyclone that brought high winds, driving rain, massive waves, and a storm surge of nearly two meters that raised water levels in Halifax Harbour to historically high levels, causing widespread damage to the Halifax waterfront (Bowyer 2003). In its wake, Juan's occurrence opened a policy window that incrementally led to a decade of climate change adaptation policy developments in Nova Scotia. The evidence seems to suggest that Juan served as a regional-scale focusing event providing an important impetus for the regional adaptation governance developments leading up to the acceptable use of the MCCAP policy instrument in 2010 (SNSMR 2011). The importance of Juan was also directly evidenced in the MCCAP framework which emphasized assessing local climate change risks based on community's historical experiences with extreme events.

We suggest that Hurricane Juan acted as a focusing event opening a policy window that enabled a legacy of reactive and proactive regional adaptation policy and planning developments in Nova Scotia. 'Pre-MCCAP' policymaking activities shaping the regional policy landscape included a provincial vulnerability assessment supported and conducted by multiple stakeholders, including the provincial and federal government in the wake of Hurricane Juan (ClimAdapt 2005). In 2007, the HRM Climate SMART municipal climate adaptation and preparedness program launched. This program was a result of a tri-governmental effort to support and prepare for climate change impacts in Nova Scotia's largest municipality. Other regional initiatives and municipal pilot programs also contributed to framing the historical sociopolitical context of MCCAP. For example, the provincial Climate Change Adaptation Fund administered by the Department of Environment provided opportunities for municipalities and local stakeholders to engage in adaptation-planning initiatives and studies prior to the MCCAP mandate. Related and reinforcing regional policy activities included the provincial Climate Change Action Plan and Renewable Energy Plan (2009a, b), and the Union of Nova Scotia Municipalities Memorandum of Understanding on Climate Change (2009) with the provincial government.

5.3 Regional capacity building, resources, and support: Enabling and motivating municipal adaptation planning

Our research findings suggest that formulating and prioritizing municipal adaptation options and plans closely align with the regional provision of capacity-building resources, municipal stakeholder education, and collaborative knowledge-sharing forums. Survey results indicated that participants felt their capacities to identify risks and prioritize actions when preparing the MCCAP were enabled by attendance at and participation in municipally focused meetings, regional conferences, workshops, and/or webinars on topics of climate risks and adaptation planning. Focus group and interview participants similarly agreed that capacity-building support from the regional government aided, enabled, and facilitated Nova Scotia's municipalities with climate risk reduction and adaptation-planning processes. The NGO representative discussed how the provincial government facilitated capacity-building workshops, webinars, and collaborative multi-stakeholder

adaptation research initiatives, influentially affecting how the MCCAP policymaking process unfolded.

The MCCAP guidebook served as a common informational tool enabling all municipalities tasked with adaptation policy and planning. It provided a literal guide for the formulation of adaptation plans and it described policy process options to develop risk priorities for adaptation actions. The regional government recommended municipalities use small committee roundtable discussions and a stepped planning framework approach to identify and assess climate change hazards and risks. The provincial policymaker discussed how the MCCAP guidebook was widely distributed to all municipalities as the framework for MCCAP reporting. The guidebook recommended using scientific baselines for planning, such as those developed from Environment Canada climate change research findings related to the scientific probability of future occurrences of climate change risks and hazards in Nova Scotia. According to the interviewee, the guidebook provided a uniform scientific baseline and context for municipalities to 'branch out and broaden the scope of discussion' pertaining to how climate change impacts contextually affect or impact Nova Scotia municipalities.

In the three profiled municipalities, municipal informants discussed how external research and consulting collaborations and regional governance capacity-building resources were integrated into MCCAP planning processes. Stakeholders also identified the MCCAP guidebook and supplemental stakeholder knowledge-sharing forums such as meetings, conferences, workshops, seminars, and webinars provided by the regional government as contributing factors enabling municipal adaptation-planning efforts. In two of three municipalities profiled, a staff person internally led the MCCAP process: a land-use planner in one case and a sustainability planner in the other case. In these two municipalities, hazard, risk, and vulnerability assessments (HRVA) and municipal collaborations in academic studies were employed to model river impacts of overland and sea level flooding associated with extreme weather, as well as marshland exposure and vulnerability to sea level rise. In the third municipality, a consultant was commissioned to facilitate the MCCAP planning process which included a regional HRVA and multi-day planning workshop with a small municipal committee to complete the MCCAP.

6 Discussion

This case study of regional adaptation governance in Nova Scotia builds upon case-based analyses and sub-national investigations concerning the enabling conditions for successfully implementing regional adaptation policy initiatives. The existing literature provides a rich conceptual foundation for conducting case investigations about policy initiatives like the MCCAP to identify the opportunities associated with regional climate change adaptation planning in Canadian municipalities (Burch 2010; Connelly et al. 2009; Burton et al. 2007). In the MCCAP case, we have learned how one regional governance mandate for adaptation succeeded by exploiting an existing policy framework and incentive structure to instigate municipal adaptation policy and planning.

In Nova Scotia, local climate change planning was effectively initiated through a combination of three policy instruments: (1) a legal mandate requiring all municipalities to formulate a MCCAP; (2) collaborative capacity-building and support resources from the province; and (3), most importantly, an intergovernmental economic incentive, the gas tax. Evidence collected for this study suggested overwhelmingly that the incentive funding for

adaptation planning was the most important enabling condition for local adaptation planning and that the MCCAP succeeded by combining the leverage of financial and regulatory measures to incite, activate and motivate local climate change actions.

The carrot and stick approach shows a promising policy model for regional governments to advance municipal adaptation planning. Porter et al. (2015) and Ekstrom and Moser (2013) have identified important local scale social barriers such as lack of resources, inadequate or unreliable funding and intergovernmental 'politics' involving cross-scalar political leadership, multi-level governance institutional limitations and fragmentation (including poor policy coordination) as key hindrances to developing and implementing tangible climate plans and actions on adaptation issues at the local scale in the USA and UK. Porter et al. conclude that there is a wide range of social barriers importantly including a lack of financial and human resources to plan for disasters and increase local capacities for adaptation. We similarly find a need for sustained regional support for municipal capacity building and climate change actions. Nova Scotia's MCCAP combined use of financial incentives, capacity-building support, and a legal mandate for adaptation planning may provide a promising suite of policy levers to help to overcome existing barriers to municipal adaptation.

Regional governments considering policy designs for regional adaptation initiatives may draw from the Nova Scotia MCCAP case the important lesson of mainstreaming and integrating adaptation policymaking and planning into preexisting policymaking and planning activities in order to facilitate maximum political legitimacy and leverage social acceptance among municipal decision-makers. The MCCAP process exemplified how an existing governance framework was leveraged to activate and motivate municipal climate change adaptation planning by leveraging a preexisting financial incentive tied to a mandatory reporting requirement. The MCCAP mandate deliberately built on the previous ICSP/gas tax policy framework that had generated collaboration and trust between provincial and municipal officials during the first phase of gas tax funding (2005–2010). This preexisting municipal familiarity with the incentivized gas tax reporting requirements provided political legitimacy among local governments to accept the MCCAP mandate during the second phase of gas tax funding (2010–2014). The financial incentive of the gas tax funding for municipal infrastructure offered a tangible municipal reward for compliance and a penalty for non-compliance. The MCCAP policy development was ultimately activated by the regional government's carrot and stick approach enabled by a legal mandate built upon an existing policy framework involving a financial incentive. Further stakeholder collaborations and capacity-building support for aiding municipalities tasked with climate change planning also enabled regional adaptation policy success.

The evidence from this research also suggests that the MCCAP mandate was linked to the historical influence of Hurricane Juan (2003). Juan served as a regional focusing event leading to a decade of layered sociopolitical developments that lay the groundwork for widespread social acceptance of the regional government's imposition of the mandatory MCCAP mandate. This finding supports the assessment of Dilling et al. (2017) who suggested that extreme weather events alone are insufficient to motivate climate change policy actions. We suggest that in this case, a focusing event like Hurricane Juan served an important contextual role for awakening sentiments and instilling contextual knowledge that ultimately informed regional perceptions of climate change risk, serving as an important regional catalyst for activating and motivating sub-national adaptation policy and planning over a decadal time frame. Juan created opportunities for generating capacity and building political support for incrementally taking actions to promote and engage in climate adaptation activities over time (Henstra 2012). The evidence from Nova Scotia suggests that

when framed and acted upon appropriately, focusing events like Hurricane Juan can motivate and spur the political will for action to address climate adaptation concerns through substantial and concrete governance measures (Dupuis and Biesbroek 2013).

In Nova Scotia, federal, provincial, and municipal ‘change agents’ harnessed an opportunity to construct a ‘hazard’ problem frame around the impacts of Hurricane Juan. In turn, this framing successively contributed to a policymaking legacy that enabled and motivated stakeholders to pursue regional adaptation-planning activities, importantly including some of Canada’s first efforts toward provincial and municipal climate change risk assessments and adaptation policy developments in HRM (2007).

As the case of Nova Scotia illustrates, adaptation policy formulation requires deliberate regional governance efforts (Corfee-Morlot et al. 2009). Leadership engagement to convene and inform stakeholders requires coordinating forums to discuss how adaptation plans can be formulated and how policy priorities, implementation strategies, and monitoring mechanisms can help to reduce the likelihood of local harm from climate change risks. Adaptation case studies indicate that there are key roles and opportunities for regional adaptation governance interventions like the MCCAP mandate to initiate and sustain municipal climate change adaptation efforts aiding with reducing climate change risks and supporting the mitigation of emissions at the local scale (e.g., Porter et al. 2015; Hanna et al. 2014; Ekstrom and Moser 2013). Lawrence et al. (2015) suggest that providing municipal governments with information-based tools, financial support, and capacity building, when combined with mandatory regulatory measures, might provide the appropriate suite of regional policy levers to incite local climate change adaptation efforts. The evidence from the MCCAP in Nova Scotia supports this hypothesis.

7 Conclusion

The MCCAP case from Nova Scotia, Canada, offers fresh insights into why regional adaptation governance initiatives originate and develop and how policy mandates and financial incentives can impact and motivate climate change adaptation planning in municipalities. The MCCAP case substantiates that top-down adaptation governance frameworks positively enable and advance local adaptation actions by setting agendas and framing problems to legitimately and widely initiate regional actions related to enabling climate adaptation planning at the local scale (Corfee-Morlot et al. 2009). The Nova Scotia evidence offers insights into the sociopolitical factors that activate, motivate, and enable climate change adaptation policy and planning processes in local and regional governance contexts. While our pilot study was small and limited, our equivocal findings point to important factors that influence how and why regional adaptation governance initiatives can be successful in motivating municipal actions to reduce vulnerability to climate change through adaptation-planning responses.

The findings of this study suggest that regional governments play important and integral roles in activating and motivating local climate change adaptation planning in municipal governments. Specifically, we highlight the potential for regional government mandates and incentive structures for municipal funding to be used as policy instruments to leverage municipal climate adaptation-planning actions. Comparative research across different national and sub-national jurisdictions is likely necessary to further identify the strengths and weaknesses of mandatory intergovernmental policy mechanisms and approaches to

activate and motivate local climate adaptation policy through means of hierarchical governance mandates and incentives.

In the case of Nova Scotia, tangible evidence of the key social drivers for enabling progress on climate adaptation planning at the local scale also suggests that municipalities were enabled to plan for climate change through capacity-building mechanisms enabled by opportunities for communications, networking and relationship building, partnerships and formal cooperation (Ekstrom and Moser 2013). In Nova Scotia, regulatory measures were complemented with provincial capacity-building support that beneficially provided information-based tools, financial support, and capacity-building resources to municipalities tasked with adaptation planning. While the MCCAP was a mandatorily incentivized planning process, there was a common municipal perception reported that the MCCAP provided an productive opportunity for initiating adaptation-planning actions to deal with climate change risks occurring at the local scale.

The findings of this study share synergies with other adaptation cases studies indicating key roles for higher governments to spur adaptation governance approaches that manifest and distribute resources to enable adaptation via the social processes of municipal adaptive capacity-building. Future adaptation case studies should examine how targeted funding for municipal staff and capacity-building resources determines or influences the variability of local governments' adaptive capacities to implement policies and actions that reduce vulnerability and increase resiliency to climate impacts. Further exploring how differences in municipal staff capacities might affect the variability of municipalities' abilities to concretely integrate climate change into operational decision-making, land-use planning, emergency management and infrastructure development deserves greater scholarly documentation and research longitudinally, in Nova Scotia and more globally.

Acknowledgements The authors wish to acknowledge the Marine Environmental Observation Prediction and Response Network and the Canadian Network of Centres of Excellence program; the Social Sciences and Humanities Research Council–Insight Development program; and the Ontario Graduate Scholarship program for providing funding for this research. Dr. Vogel extends his gratitude to the Department of Geography at the University of Western Ontario, the School of Community and Regional Planning at the University of British Columbia, in addition to the Nova Scotia Planning Director's Association, Union of Nova Scotia Municipalities, and the Nova Scotia Department of Municipal Affairs for providing the necessary support to conduct this doctoral research study.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

References

- Amundsen, H., Berglund, F., & Westskog, H. (2010). Overcoming barriers to climate change adaptation: A question of multilevel governance? *Environment and Planning C: Government and Policy*, 28(2), 276–289. <https://doi.org/10.1068/c0941>.
- Andrew, C., & Graham, K. (Eds.) (2014). *Canada in cities: The politics and policy of federal-local governance*. In *Fields of governance: Policy making in canadian municipalities 7*. Montreal & Kingston: McGill-Queen's University Press.
- Auld, H., & MacIver, D. (2007). *Changing weather patterns, uncertainty and infrastructure risks: Emerging adaptation requirements*. Occasional Paper 9. Ottawa: Environment Canada.
- Bakvis, H., & Skogstad, G. (Eds.). (2012). *Canadian federalism: Performance, effectiveness, and legitimacy* (3rd ed.). Don Mills, ON: Oxford University Press.

- Bassett, E., & Shandas, V. (2010). Innovation and climate action planning: Perspectives from municipal plans. *Journal of the American Planning Association*, 76(4), 435–450. <https://doi.org/10.1080/01944363.2010.509703>.
- Baxter, J., & Eyles, J. (1997). Evaluating qualitative research in social geography: Establishing 'rigour' in interview analysis. *Transactions of the Institute of British Geographers*, 22(4), 505–525. <https://doi.org/10.1111/j.0020-2754.1997.00505.x>.
- Bicknell, J., Dodman, D., & Satterthwaite, D. (Eds.). (2009). *Adapting cities to climate change: Understanding and addressing the development challenges*. London, Washington DC: Earthscan. <https://doi.org/10.1080/17535069.2013.846001>.
- Biesbroek, G. R., Klostermann, J. E. M., Termeer, C. J. A. M., & Kabat, P. (2013). On the nature of barriers to climate change adaptation. *Regional Environmental Change*, 13(5), 1119–1129. <https://doi.org/10.1007/s10113-013-0421-y>.
- Birkland, T. A., & DeYoung, S. E. (2013). Focusing events and policy windows. *Routledge handbook of public policy*. New York, NY: Routledge. <https://doi.org/10.4324/9780203097571.ch14>.
- Bowyer, P. (2003). Hurricane Juan storm summary. Environment Canada. <http://www.ec.gc.ca/ouraganshurricanes/default.asp?lang=en&nB1A7B85A>. Accessed 11 February 2014.
- Brunner, R., & Nordgren, J. (2012). *Climate adaptation as an evolutionary process: A white paper*. The Kresge Foundation. <http://kresge.org/library/climate-adaptation-evolutionary-process-white-paper>. Accessed 11 August 2016.
- Burch, S. (2010). Transforming barriers into enablers of action on climate change: Insights from three municipal case studies in British Columbia, Canada. *Global Environmental Change*, 20(2), 287–297. <https://doi.org/10.1016/j.gloenvcha.2009.11.009>.
- Burton, I., Bizikova, L., Dickinson, T., & Howard, Y. (2007). Integrating adaptation into policy: Upscaling evidence from local to global. *Climate Policy*, 7(4), 371–376. <https://doi.org/10.1080/14693062.2007.9685662>.
- Burton, I., Huq, S., Lim, B., Pilifosova, O., & Schipper, L. (2002). From impacts assessment to adaptation priorities: The shaping of adaptation policy. *Climate Policy*, 2, 145–159. <https://doi.org/10.3763/cpol.2002.0217>.
- Carmin, J., Nadkarni, N., & Rhie, C. (2012). *Progress and challenges in urban climate adaptation planning: Results of a global survey*. Cambridge, MIT. http://resilient-cities.iclei.org/fileadmin/sites/resilient-cities/files/Resilient_Cities_2012/Urban_Adaptation_Report_23May2012.pdf. Accessed 29 November 2017.
- ClimAdapt Consortium. (2005). *Adapting to a changing climate in Nova Scotia vulnerability assessment and adaptation options*. Halifax, Nova Scotia: Province of Nova Scotia.
- Connelly, S., Markey, S., & Roseland, M. (2009). Strategic sustainability: Addressing the community infrastructure deficit. *Canadian Journal of Urban Research*, 18(1), 1–23.
- Corfee-Morlot, J., Cochran, I., Hallegatte, S., & Teasdale, P. J. (2011). Multilevel risk governance and urban adaptation policy. *Climatic Change*, 104, 169–197. <https://doi.org/10.1007/s10584-010-9980-9>.
- Corfee-Morlot, J., Kamal-Chaoui, L., Donovan, M. G., Cochran, I., Robert, A., & Teasdale, P. J. (2009). *Cities, climate change and multilevel governance*. OECD Environmental Working Papers No 14. OECD Publishing. <https://doi.org/10.1787/220062444715>.
- Dannevig, H., & Aall, C. (2015). The regional level as boundary organization? An analysis of climate change adaptation governance in Norway. *Environmental Science & Policy*, 54, 168–175. <https://doi.org/10.1016/j.envsci.2015.07.001>.
- Dickinson, T. & Burton, I. (2011). Adaptation to climate change in Canada: A Multi-level mosaic of climate change adaptation. In J. Ford, & L. Berrang-Ford (Eds.), *Adaptation in developed nations: From theory to practice* (Chapter 7). Advances in Global Change Research 42. Springer. https://doi.org/10.1007/978-94-007-0567-8_7.
- Dilling, L., Haywood, B., Dow, K., Lemos, M. C., Berggren, J., & Kalafatis, S. (2014). What stakeholder needs tell us about enabling adaptive capacity: The intersection of context and information provision across regions in the U.S. *Weather, Climate, and Society*, 7(1), 5–17. <https://doi.org/10.1175/wcas-d-14-00001.1>.
- Dilling, L., Pizzi, E., Berggren, J., Ravikumar, A., & Andersson, K. (2017). Drivers of adaptation: Responses to weather- and climate-related hazards in 60 local governments in the intermountain Western U.S. *Environment and Planning*. <https://doi.org/10.1177/0308518X16688686>.
- Dupuis, J., & Biesbroek, R. (2013). Comparing apples and oranges: The dependent variable problem in comparing and evaluating climate change adaptation policies. *Global Environmental Change*, 23, 1476–1487. <https://doi.org/10.1016/j.gloenvcha.2013.07.022>.
- Eisenhardt, K. M. (1989). Building theories from case study research. *Academy of Management Review*, 14, 532–550. <http://www.jstor.org/stable/258557>.

- Ekstrom, J. A., & Moser, S. C. (2013). Institutions as key element to successful climate adaptation processes: Results from the San Francisco Bay Area. In S. C. Moser, & M. T. Boykoff (Eds.), *Successful adaptation to climate change* (pp. 97–113). New York: Routledge. <https://doi.org/10.4324/9780203593882>.
- Ford, J. D., & King, D. (2013). A framework for examining adaptation readiness. *Mitigation and Adaptation Strategies for Global Change*, 20(4), 505–526. <https://doi.org/10.1007/s11027-013-9505-8>.
- Galarraza, I., Gonzalez-Eguino, M., & Markandya, A. (2011). The role of regional governments in climate change policy. *Environmental Policy and Governance*, 21(3), 164–182. <https://doi.org/10.1002/eet.572>.
- Giest, S., & Howlett, M. (2013). Multi-level governance and place-based policy-making for climate change adaptation: The European experience and lessons for British Columbia. *BC Studies*, 176: 133–54. http://pics.uvic.ca/sites/default/files/uploads/publications/GiestHowlett_MLGPLacedBasedPolicy.pdf. Accessed 24 November 2016.
- Halifax Regional Municipality. (2007). HRM Climate SMART (Sustainable Mitigation and Adaptation Risk Toolkit) Climate Change Risk Management Strategy. <http://www.halifax.ca/climate/>. Accessed 14 April 2014.
- Hanna, K., Dale, A., Filion, P., Ling, C., & Seasons, M. (2014). *National municipal adaptation survey of Canadian local governments: Results*. <http://www.localadaptation.ca/resources/NMAP>. Accessed 16 May 2015.
- Henstra, D. (2012). Toward the climate-resilient city: Extreme weather and urban climate adaptation policies in two Canadian provinces. *Journal of Comparative Policy Analysis*, 14, 175–194. <https://doi.org/10.1080/13876988.2012.665215>.
- Henstra, D. (2015). The tools of climate adaptation policy: Analysing instruments and instrument selection. *Climate Policy*, 16(4), 496–521. <https://doi.org/10.1080/14693062.2015.1015946>.
- Hughes, S. (2015). A meta-analysis of urban climate change adaptation planning in the u.s. urban climate. *Elsevier Science*, 14(1), 17–29. <https://doi.org/10.1016/j.uclim.2015.06.003>.
- Hunt, A., & Watkiss, P. (2011). Climate change impacts and adaptation in cities: A review of the literature. *Climatic Change*, 104(1), 13–49.
- Institute for Catastrophic Loss Reduction (ICLR). (2012). *Telling the weather story*. http://iclr.org/images/telling_the_weather_story.pdf. Accessed 13 September 2013.
- Intergovernmental Panel on Climate Change (IPCC). (2012). Managing the risks of extreme events and disasters to advance climate change adaptation. In *A Special report of working groups I and II of the intergovernmental panel on climate change (IPCC)*. Cambridge: Cambridge University Press. <https://doi.org/10.1017/cbo9781139177245>.
- Intergovernmental Panel on Climate Change (IPCC). (2014a). Adaptation planning and implementation. In C. B. Field, V. R. Barros, D. J. Dokken, K. J. Mach, M. D. Mastrandrea, T. E. Bilir, M. Chatterjee, K. L. Ebi, Y. O. Estrada, R. C. Genova, B. Girma, E. S. Kissel, A. N. Levy, S. MacCracken, P. R. Mastrandrea & L. L. White (Eds.), *Climate change 2014: Impacts, adaptation, and vulnerability. Contribution of working group II to the fifth assessment report of the intergovernmental panel on climate change*. (pp. 1–41). Cambridge: Cambridge University Press. <https://doi.org/10.1017/cbo9781107415379.020>.
- Intergovernmental Panel on Climate Change (IPCC). (2014b). Summary for policymakers. In C. B. Field, V. R. Barros, D. J. Dokken, K. J. Mach, M. D. Mastrandrea, T. E. Bilir, M. Chatterjee, K. L. Ebi, Y. O. Estrada, R. C. Genova, B. Girma, E. S. Kissel, A. N. Levy, S. MacCracken, P. R. Mastrandrea & L. L. White (Eds.), *Climate change 2014: Impacts, adaptation, and vulnerability. Contribution of working group II to the fifth assessment report of the intergovernmental panel on climate change* (pp. 1–32). Cambridge: Cambridge University Press. <https://doi.org/10.1017/cbo9781107415379.003>.
- Juhola, S. (2010). Mainstreaming climate change adaptation: The case of multi-level governance in Finland. In E. C. H. Keskitalo (Ed.), *Developing adaptation policy and practice in Europe—multi-level governance of climate change* (pp 149–187). London: Springer. https://doi.org/10.1007/978-90-481-9325-7_5.
- Keskitalo, E. C. H. (2010). The development of adaptive capacity and adaptation measures in European countries. In E. C. H. Keskitalo (Ed.), *Developing adaptation policy and practice in Europe: multi-level governance of climate change* (pp 339–366). London: Springer. https://doi.org/10.1007/978-90-481-9325-7_5.
- Larsson, N. (2003). Adapting to climate change in Canada. *Building Research and Information*, 31(3/4), 231–239.
- Lawrence, J., Sullivan, F., Lash, A., Ide, G., Cameron, C., & McGlinchey, L. (2015). Adapting to changing climate risk by local government in New Zealand: Institutional practice barriers and enablers. *Local Environment*, 20(3), 298–320. <https://doi.org/10.1080/13549839.2013.839643>.
- Lorenzoni, I., & Pidgeon, N. F. (2006). Public views on climate change: European and USA perspectives. *Climatic Change*, 77, 73–95. <https://doi.org/10.1007/s10584-006-9072-z>.

- Measham, T. G., Preston, B. L., Smith, T. F., Brooke, C., Gorddard, R., Withycombe, G., et al. (2011). Adapting to climate change through local municipal planning: barriers and challenges. *Mitigation and Adaptation Strategies for Global Change*, *16*, 889–909. <https://doi.org/10.1007/s11027-011-9301-2>.
- Mees, H. L. P., Dijk, J., van Soest, D., Driessen, P. P. J., van Rijswick, M. H. F. M. W., & Runhaar, H. (2014). A method for the deliberate and deliberative selection of policy instrument mixes for climate change adaptation. *Ecology and Society*. <https://doi.org/10.5751/ES-06639-190258>.
- Mehdi, B. (Ed.). (2006). *Adapting to climate change: An introduction for Canadian municipalities*. Ottawa: Canadian Climate Impacts and Adaptation Research Network.
- Mercer-Clarke, C., Manuel, P., & Warren, F. (2016). Chapter 3. In D. Lemmen, & F. Warren (Eds.), *Assessment of climate change sensitivity, risk and adaptation along Canada's marine coasts*. Ottawa: Natural Resources Canada, Government of Canada.
- Moser, S. C. (2009). Whether our levers are long enough and the fulcrum strong? Exploring the soft underbelly of adaptation decisions and actions. In W. N. Adger, I. Lorenzoni, & K. L. O'Brien (Eds.), *Adapting to climate change: Thresholds, values, governance* (pp. 313–334). Cambridge: Cambridge University Press.
- National Research Council. (2011). *Climate change education: Goals, audiences, and strategies*. Washington, DC: The National Academies Press.
- Natural Resources Canada. (2016). Canada's marine coasts in a changing climate. In D. S. Lemmen, F. J. Warren, T. S. James, & C. S. L. Mercer Clarke (Eds.). Ottawa: Government of Canada.
- Nordgren, J., Stults, M., & Meerow, S. (2016). Supporting local climate change adaptation: Where we are and where we need to go. *Environmental Science and Policy*, *66*, 344–352. <https://doi.org/10.1016/j.envsci.2016.05.006>.
- Offices of the Auditor General of Canada (Alberta, British Columbia, Manitoba, New Brunswick, Newfoundland and Labrador, Nova Scotia, Ontario, Prince Edward Island, Saskatchewan, Northwest Territories, Nunavut, Yukon). *Perspectives on Climate Change Action in Canada—A Collaborative Report from Auditors General—March 2018*. http://www.oag-bvg.gc.ca/internet/English/parl_otp_201803_e_42883.html. Accessed 10 April 2018.
- Penning-Rowsell, E., Johnson, C., & Tunstall, S. (2006). 'Signals' from pre-crisis discourse: lessons from UK flooding for global environmental policy change? *Global Environmental Change*, *16*, 323–339. <https://doi.org/10.1016/j.gloenvcha.2006.01.006>.
- Porter, J., Demeritt, D., & Dessai, S. (2015). The right stuff? Informing adaptation to climate change in British local government. *Global Environmental Change*, *35*, 411–422. <https://doi.org/10.1016/j.gloenvcha.2015.10.004>.
- Province of Nova Scotia. (2009). Toward a greener future: Nova Scotia's climate change action plan. Nova Scotia Department of Environment. <https://climatechange.novascotia.ca/sites/default/files/uploads/ccap.pdf>. Accessed 17 February 2016.
- Province of Nova Scotia. (2009). Toward a greener future: Nova Scotia's energy strategy. Nova Scotia Department of Environment. <https://energy.novascotia.ca/sites/default/files/Energy-Strategy-2009.pdf>. Accessed 17 February 2016.
- Raikes, J., & McBean, G. (2016). Responsibility and liability in emergency management to natural disasters: A Canadian example. *International Journal of Disaster Risk Reduction*, *16*, 12–18. <https://doi.org/10.1016/j.ijdrr.2016.01.004>.
- Raikes, J., & McBean, G. (2017). *Natural disaster management: Behavior and response in the City of Vancouver and District of Maple Ridge*. British Columbia: Regional Environmental Change. <https://doi.org/10.1007/s10113-017-1179-4>.
- Räsänen, A., Jurgilevich, A., Haanpää, S., Heikkinen, M., Groundstroem, F., & Juhola, S. (2017). The need for non-climate services: Empirical evidence from Finnish municipalities. *Climate Risk Management*, *16*, 29–42. <https://doi.org/10.1016/j.crm.2017.03.004>.
- Reisinger, A., Wratt, D., Allan, S., & Larsen, H. (2011). The role of local government in adapting to climate change: Lessons from New Zealand. In J. D. Ford, & L. Berrang-Ford (Eds.), *Climate change adaptation in developed nations: From theory to practice* (pp. 303–319). New York: Springer. https://doi.org/10.1007/978-94-007-0567-8_22.
- Schauffler, M. (2014). *Municipal climate change adaptation around the Bay of Fundy: Status and needs*. Gulf of Maine Council on the Marine Environment & Gulf of Maine Council Climate Network. <http://www.gulfofmaine.org/2/wp-content/uploads/2014/03/Bay-of-Fundy-Adaptation-Report.pdf>. Accessed 14 September 2014.
- Seawright, J., & Gerring, J. (2008). Case selection techniques in case study research: A menu of qualitative and quantitative options. *Political Research Quarterly*, *61*(2), 294–308. <https://doi.org/10.1177/1065912907313077>.

- Service Nova Scotia and Municipal Relations (SNSMR). (2011). *Municipal climate change action plan guidebook*. Canada-Nova Scotia agreement on the transfer of federal gas tax funds. Halifax: Province of Nova Scotia.
- Simonsson, L., Swartling, A. G., André, K., Wallgren, O., & Klein, R. J. T. (2011). Perceptions of risk and limits to climate change adaptation: Case studies of two Swedish urban regions. In J. D. Ford, & L. Berrang-Ford (Eds.), *Climate change adaptation in developed nations: From theory to practice* (pp. 321–334). New York: Springer. https://doi.org/10.1007/978-94-007-0567-8_23.
- Smit, B., & Wandel, J. (2006). Adaptation, adaptive capacity and vulnerability. *Global Environmental Change, 16*, 282–292. <https://doi.org/10.1016/j.gloenvcha.2006.03.008>.
- Statistics Canada. (2012). Census metropolitan area of Halifax, Nova Scotia. <https://www12.statcan.gc.ca/census-recensement/2011/as-sa/fogs-spg/Facts-cma-eng.cfm?LANG=Eng&GK=CMA&GC=205>. Accessed 19 February 2015.
- Stults, M., & Woodruff, S. C. (2016). Looking under the hood of local adaptation plans: Shedding light on the actions prioritized to build local resilience to climate change. *Mitigation and Adaptation Strategies for Global Change*. <https://doi.org/10.1007/s11027-016-9725-9>.
- Termeer, C., Dewulf, A., van Rijswick, H., van Buuren, A., Huitema, D., Meijerink, S., et al. (2011). The regional governance of climate adaptation: A framework for developing legitimate, effective, and resilient governance arrangements. *Climate Law, 2*(2), 159–179. <https://doi.org/10.3233/CL-2011-032>.
- Union of Nova Scotia Municipalities. (2009). Memorandum of understanding on climate change between the Union of Nova Scotia Municipalities and the Province of Nova Scotia. http://www.unsm.ca/doc_download/435-memorandum-of-understanding-on-climate-change.html. Accessed 14 March 2016.
- Valdivieso, P., Andersson, K. P., & Villena-Roldán, B. (2017). Institutional drivers of adaptation in local government decision-making: Evidence from Chile. *Climatic Change, 143*(1–2), 157–171. <https://doi.org/10.1007/s10584-017-1961-9>.
- Vize, S. (2012). Using education to bring climate change adaptation to Pacific communities. *Journal of Education for Sustainable Development, 6*(2), 219–235. <https://doi.org/10.1177/0973408212475202>.
- Vogel, B., & Henstra, D. (2015). Studying local climate adaptation: A framework for comparative policy analysis. *Global Environmental Change, 31*, 110–120. <https://doi.org/10.1016/j.gloenvcha.2015.01.001>.
- Wagner, G., & Zeckhauser, R. (2012). Climate policy: Hard problem, soft thinking. *Climatic Change, 110*, 507–521. <https://doi.org/10.1007/s10584-011-0067-z>.
- Wakeford, C., & McGillivray, G. (2006). Climate change: The changing municipal risk environment. *Municipal World, 116*(8), 17–19.
- World Economic Forum. (2018). *The global risks report 2018: 13th edn*. Geneva. <https://www.weforum.org/reports/the-global-risks-report-2018>. Accessed 19 April 2018.
- World Economic Forum. (2017). *The global risks report 2017: 12th edn*. Geneva. http://www3.weforum.org/docs/GRR17_Report_web.pdf. Accessed 12 July 2016.
- World Economic Forum. (2016). *The global risks report 2016: 11th edn*. Geneva. http://www3.weforum.org/docs/GRR/WEF_GRR16.pdf. Accessed 12 July 2016.