Urban Climate Adaptation through Design and Planning: A New Zealand Perspective

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ABSTRACT: *Urbanization is one of the twenty-first century's most transformative trends, and increasing urban population along with the impacts of climate change provide new challenges and new opportunities. However, there are significant differences in the way countries are perceiving the phenomenon of climate change and implementing adaptation strategies to improve urban climate. This paper reports on a study carried out in New Zealand and aimed at identifying how the country is implementing adaptation strategies through urban design and planning to improve urban climate in the face of climate change. Semi-structured interviews were conducted with New Zealand scholars studying urban climate related issues, urban design and planning practitioners, and governance. The study was designed to provide a wide range of perceptions rather than a set number of interviews in specific cities. The semi-structured interviews focused upon awareness of the need for climate change adaptation, existing urban climate phenomena because of design decisions, existing design strategies to improve climate adaptation, communication of climate change issues, existing policy instruments and implementation of initiatives. The paper discusses the perceptions of interviewees regarding awareness and urgency of action; the role of citizens, governance, and urban designers and planners in the urban climate adaptation agenda; and the role of dramatic events such as the Christchurch earthquakes on acknowledging the need for appropriate design and planning. Results indicate that the geographical condition of New Zealand and its consequent maritime climate means that climate change – particularly effects related to city design – are not seen as a major issue. However, the recent Christchurch earthquakes have sped up the processes of change, making citizens and governance more aware of consequences of inappropriate design and planning.*

Keywords: *Urban design, urban planning, climate change, adaptation, New Zealand*

Introduction

Urbanization is a twenty-first century transformative trend, and increasing urban population along with climate change provide new challenges and opportunities (Henstra, 2012; Howden-Chapman et al., 2010; Prasad et al., 2009). There are, however, significant differences in the way countries are perceiving and responding to the climate change phenomenon. This study is part of a worldwide research on urban adaptation and similar studies are being conducted in the Netherlands, Bulgaria, South Korea, China, Kenya, and other countries.

A main climate change challenge in New Zealand is sea level rise (RSNZ, 2016), and some important documents have been produced regarding its impact on the built environment (NIWA et al., 2012), the development of National Climate Change Adaptation

Plans (Tait and Ungaro, 2017), and relationships between climate change and human health (Howden-Chapman et al., 2010). Recent earthquakes were also a powerful demonstration of disruption consequences and potential climate change effects. The Christchurch earthquakes, for instance, sped up landscape change processes expected to happen over 100 years (Hughes *et al.*, 2015).

While conversations and documents exist, there is little information about local citizens, urban planners and designers, urban climate experts and politicians'[1] awareness of urban climate phenomenon and to what extent measures to adapt are effective. The objective of this study is, therefore, to investigate the state of the art of urban climate adaptation awareness and response in New Zealand based on three questions: (1) What is the current situation of urban climate adaptation in New Zealand?; (2) What are the current issues related to climate change awareness and communication amongst the groups?; (3) What instruments are used by government to adapt, and how are they implemented?

The study is centred in three main topics: climate change, urban heat islands (UHI) and wind, and urban climate adaptation, and discussions about climate change mitigation and greenhouse gases (GHG) reduction to meet specific targets are beyond the scope of this work. While similar studies have been undertaken in other places (Bulkeley, 2010; Moser and Ekstrom, 2010; Theoharides et al., 2009; Tompkins et al., 2009; Colson et al., 2012), this work helps to understand the New Zealand current reality.

Climate change makes urban residents vulnerable to floods, landslides, and extreme weather events (Henstra, 2012; Wamsler et al., 2013). Reduced access to freshwater, frequent hot days and nights, fewer cold days and nights, heavy precipitation, drought, intense tropical cyclones, and high sea levels (UN-Habitat, 2011) are also foreseen. Climate change effects are driven by GHG generated by a wide variety of human activities (UN-Habitat, 2012), the heat generated by these activities is known as anthropogenic heat (AH).

UHI happen where urban centres are substantially warmer than less or non-urbanised surroundings (Lenzholzer and Brown, 2013) resulting in adverse human health, economic and environmental impacts. UHI intensity is affected by urban design and fabric, types of surfaces within the city, and sky view factor. Climate change is expected to increase UHI occurrence and higher temperatures are expected to impact cities (Corburn, 2009).

"Responding to climate change is about adjusting to risks, either in reaction to or in anticipation of changes arising from changing weather and climate" (Adger *et al.*, 2013, p.

[1] The 'groups' mentioned throughout this article refer to these four groups.

112). Urban planning can improve regional and urban resilience, but its efficiency relies on understanding place-based vulnerability (UN-Habitat, 2015). Climate adaptation, however, tends to get extra attention following extreme weather events rather than gradual changes in average climate conditions (Füssel, 2007), which are happening almost in every location.

Planning for urban climate adaptation focus on reducing potential disruption and exploring opportunities (Henstra, 2012; Smith and Levermore, 2008; Wamsler et al., 2013). The success of these endeavours involves broad measures and diverse stakeholders, including the groups considered in this study.

Methodology

As a part of a larger study, this investigation was based on pre-made interview questions, used for all participating countries. Semi-structured interviews (n=10) were conducted with New Zealand scholars studying urban climate, urban planners and designers, and government employees working on urban responses to climate change. New Zealand is a small country and it soon became clear that there was no need to limit interviewees per city, as most interviewees demonstrated knowledge and experience in various locations. Therefore, the study was designed to provide a wide range of perceptions rather than a set number of interviews in specific cities.

Semi-structured interviews discussed awareness of the need for climate change adaptation, existing urban climate phenomena, existing climate adaptation measures, climate change communication, policy instruments, and implementation of initiatives.

The case of New Zealand

As a case study, New Zealand provided powerful insights into adaptation following disruption, in this case, following earthquakes. Christchurch, in particular, is a city undergoing rapid urban change, relevant for research into adaptation to climate (Tavares, Swaffield and Stewart, in press). The Christchurch events influenced more than only Christchurch, making New Zealanders aware of the consequences of intense disruption, while generating more pressing issues and placing climate change as a lower priority.

New Zealand is in a temperate climate zone between 35°S and 46°S latitude and has a temperate maritime climate (Mullan, Tait and Thompson, 2012). The ocean plays a key role in the local climate as there are no major land masses between the South Island and Antarctica, and the climate is influenced by circulation patterns in the Southwest Pacific

(Huisman, 2014). The three key factors determining New Zealand's climate are prevailing winds, surrounding oceans, and the country's mountain ranges.

Climate change impacts in New Zealand are set to increase over time. According to the Royal Society of New Zealand (RSNZ, 2016), the country is sensitive to climate change because of its population location, freshwater availability and economic basis. The main population centres are located on coastal areas – exposed to rising sea levels, strong storms, and coastal erosion – and in major rivers floodplains – vulnerable to increasing extreme rainfall, floods, and erosion. New Zealand's economy is dependent on primary industries linked to freshwater availability, which associated with urban expansion and increasing droughts is of real concern. Moreover, changing ocean temperature and currents constitute a challenge for fishing, aquaculture, and marine recreational and iconic wildlife. Finally, New Zealand has important international trading links, and climate change-related impacts on other countries are likely to affect the country's trades.

All points above mentioned are important, but unrelated to urban climate, which so far has not been acknowledged as a concern.

Data collection and analysis

Potential interviewees were contacted through email. In total, 38 emails were sent and 10 positive responses were received. For the ones who agreed to participate a phone or Skype interview was arranged. Interviews were recorded and transcribed, and interviewees were anonymised and assigned a code (Table 1). All interviewees had at least four years of experience in their fields of work.

Table 1: Interviewees, their roles and location

Code	Role	City
P1	Urban designer	Auckland
P2	Urban climate expert	Christchurch
P3	Urban designer	Auckland
P4	Urban researcher	Wellington
G1	Government	Christchurch
G2	Government	Nelson
G3	Government	New Plymouth
A1	Academic	Christchurch
A2	Academic	Auckland
A3	Academic	Palmerston North

The interview guide was divided into four categories: awareness, communication, instruments and implementation, also used to present the results. Data analysis was based upon interviews' transcripts. Questions based on the Likert scale (awareness) were analysed using Excel and converted into graphs for visual representation. Open-ended questions were summarised and tabled according to main identified topics. Results are presented next, following the questionnaire structure.

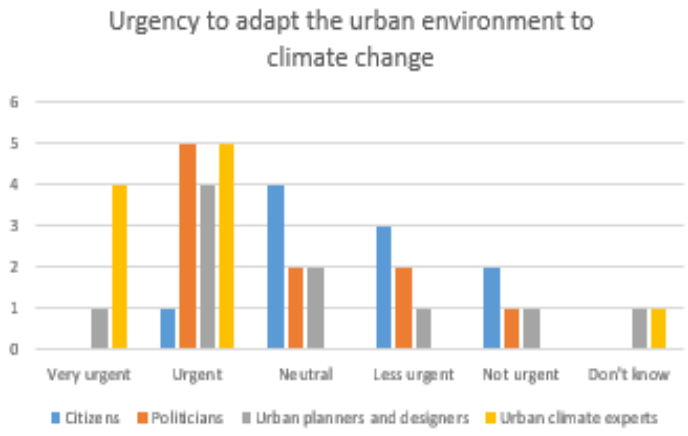
Results

Awareness

Q1. *What is the sense of urgency to adapt the urban environment to climate change amongst the groups in the future in your city?*

Urban climate experts were considered the most aware group regarding urgency for climate change adaptation, followed by urban planners and designers, politicians and lastly citizens (Figure 1).

Figure 1: Urgency to adapt



Urban designers and planners are seen as being aware, but their actions do not lead to changes (P1, A2). While efficient measures depend upon political persuasion, climate change is important and 'politically correct', so politicians use it to attract funding, but not act on it (A2). Their actions tend to focus on short-term issues (P1) within their mandates (A2), and at the local government level (G2). Due to New Zealand's geographical position , citizens are concerned with earthquakes and wind, and do not connect worsening wind conditions to climate change (P4, A2).

Q2. *In case the sense of urgency is low, what is needed to make those groups feel more urgent about adapting the urban environment?*

The work done by local and central government should be promoted. There is a need to "change conversation parameters around the broader range of affects and impacts of climate change on the urban environment", beyond the sea level rise topic (P3). Awareness of the need to change behaviour is also fundamental, and behaviour only changes when the situation gets critical (A2). This was mentioned by other four interviewees who believed citizens only change their minds when their properties are affected (G3), or a disaster occurs (P4, P1). Some councils tried to include sea level rise information on property documents, but faced resistance due to potential impacts on property values (P4, G3).

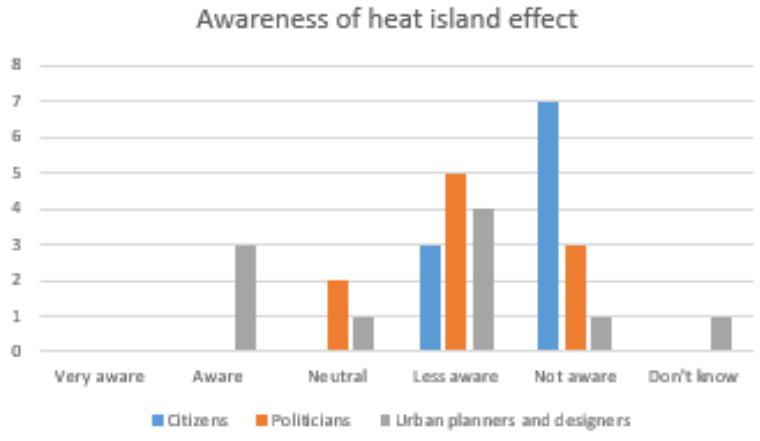
Awareness-raising campaigns can be useful (G3), and politicians need to focus their priority (P2), as they must provide financial support to local governments to implement adaptation measures (A1). Urban planners and designers still follow planning rules and are not strategic (A2), they need to monitor, understand and plan for change (G1). For urban climate experts the main challenge is to connect with people in simple terms and to lead by example (A2).

Q3. *How aware are the groups of the following two urban climate phenomena?*

Urban heat island (UHI)

Responses show UHI is not a well-known phenomenon. No group has been indicated as very aware (urban climate experts were not included in this question) (Figure 2).

Figure 2: Awareness of UHI



UHI is not seen as an issue in New Zealand due to low density cities, wind and maritime climate (P1, P3, A1). Climate change tends to be viewed in a rural context in relation to impacts

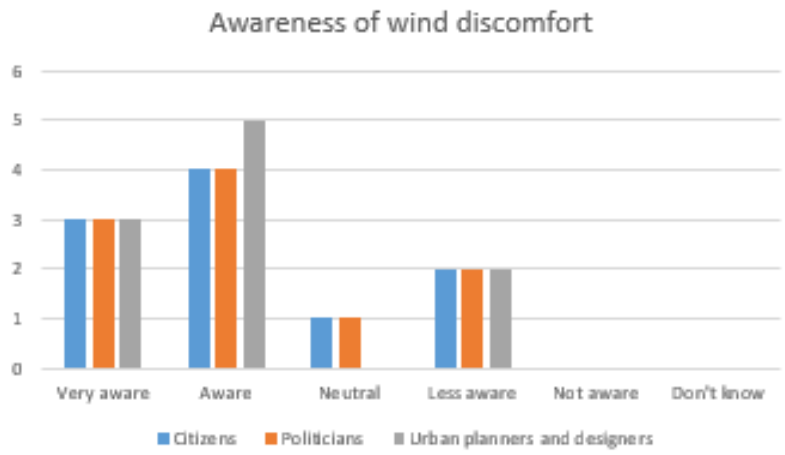
on land use and productivity, not as an urban problem (G2). Some New Zealanders think climate change means their city will be warmer and therefore, as an interviewee pointed out: "If you said to somebody, we're going to develop a heat island, everyone would go ‘yay’" (P4).

While citizens are unaware of UHI (G2, A2), it is difficult to grasp what politicians know as public communication is written for them (A2). Urban planners and designers are aware but not concerned due to prevailing urban morphologies and local maritime climate (G1).

Wind discomfort

Wind discomfort awareness is significantly higher than UHI. Interviewees responses show that all groups are aware of this phenomenon, while most interviewees (at least seven) believe all groups are aware or very aware (Figure 3)

Figure 3: Awareness of wind discomfort



Although all groups are aware of the problem and tend to consider these local conditions when designing residential buildings (P1, G1), they tend to take it as local weather conditions and do not relate the issue to climate change (A2), but as something to adapt to or move elsewhere (A2, A3, P4). The only exception was an interviewee who pointed out that there is awareness of wind damage and climate change is increasing the problem (G3). Urban planners and designers are considered very aware of city layout in relation to cold winds, and the need for sunny and sheltered places (G1, A1, P3, P4).

Q4. *In case awareness is low, what is needed to increase the awareness of two urban climate phenomena mentioned in question 3?*

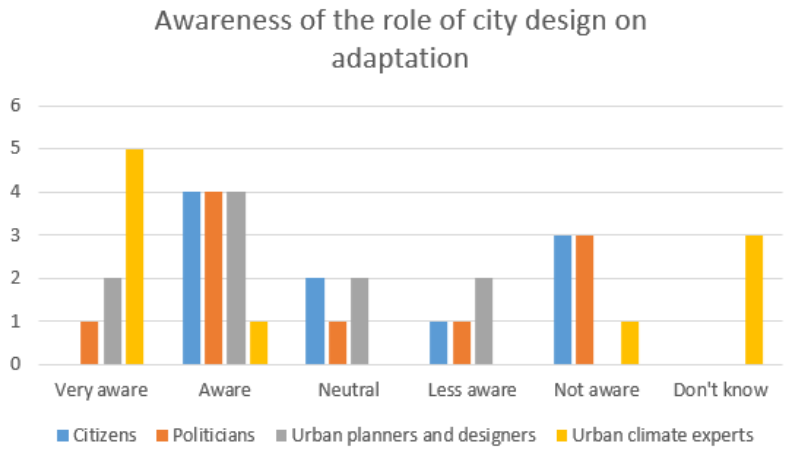
General education (P2, G3, G2), and discussion on how tall buildings locally contribute to wind problems (P3). Citizens need more information through local media on how the issues will affect them (A1). Politicians' priority is based on economy, hence the need to understand relationships between successful precincts and pleasant outdoor climate (P2). Local and central government should provide information for citizens to learn about climate change. Urban planners and designers require confidence for addressing issues (G1). Although they are aware, there is no strategy to work towards solving the issue (P3). They need guidance and reliable data to prompt action (A1).

Q5. *How aware are the groups of following four urban climate adaptation measures?*

City design

Awareness of the role of city design was considered low for citizens, as six interviewees pointed out that their view is neutral or lower. All other groups are considered more aware being urban planners and designers and urban climate experts aware or very aware (Figure 4).

Figure 4: Awareness of city design



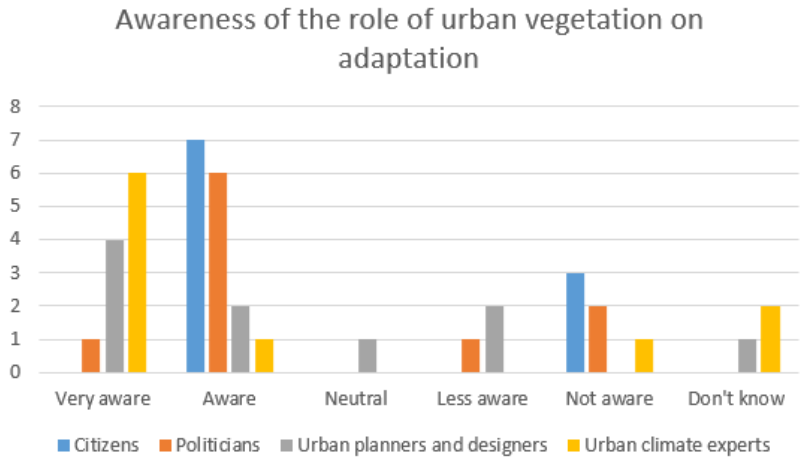
All groups are aware of building orientation to address sun and wind (A1), and that they could do more to prevent flooding in low-lying areas (P4). However, citizens are unaware of solar orientation in public spaces, although they make choices based on sun availability (A2). Politicians understand the issue but do not turn into practical applications. They need to enforce appropriate practices through planning instruments, so developers should address it (G2). Urban Planners and designers are aware, but there is no evidence of it in their

designs. May happen overseas, but not in New Zealand (A3). Urban climate experts discuss issues but not their designs or implementation (A2).

Urban vegetation

Even more than city design, the groups were considered to be aware of the vegetation's role on urban climate adaptation. Seven out of 10 interviewees pointed out that citizens, politicians and urban climate experts are aware or very aware of the vegetation impact on urban climate (Figure 5).

Figure 5: Awareness of urban vegetation

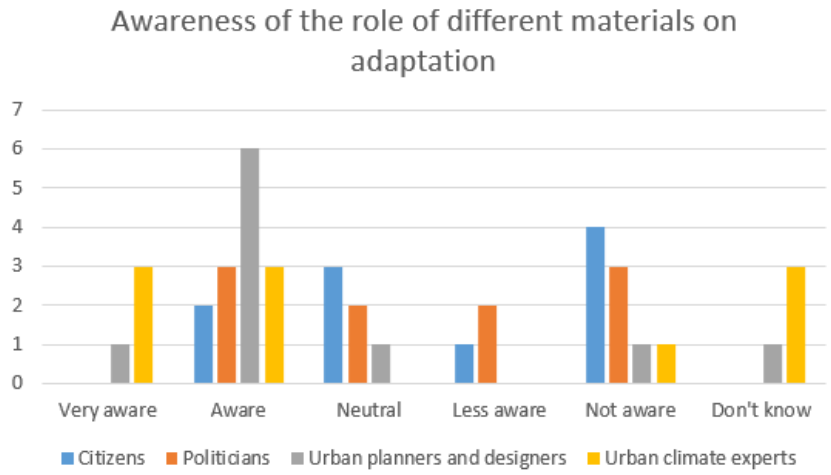


In the Christchurch rebuild, there is a belief that if the gardens are not kept, the city may become warmer (A1). Citizens of Christchurch were also mentioned as being aware due to the city's reputation as a Garden City (Wilson, 2013). This was the strongest view received through community engagement for the new city plan. During the earthquakes, parks provided a kind of sanctuary, but awareness is still stronger due to visual amenity and comfort, rather than linkages with climate change (G1, G3). Politicians are aware due to the popularity of the urban garden and green belt ideas, so councils encourage it (P4).

Use of materials

Seven out of 10 interviewees considered that citizens and politicians are neutral or unaware of the potential use of specific types of materials to improve urban climate. The most aware group was considered to be urban designers and planners (seven) followed by urban climate experts (Figure 6).

Figure 6: Awareness of materials

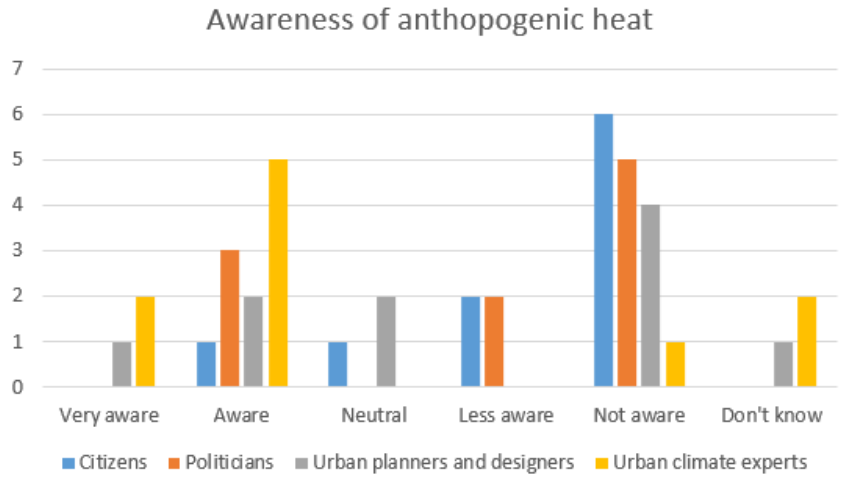


Citizens are more concerned with aesthetics (A1) and are influenced by materials cost and short-term thinking (P1, A2). Politicians have knowledge of ways of creating energy efficiency (A1), but do not apply it (A2). Urban planners and designers are aware regarding public spaces (G3), and that making existing cities sustainable is more efficient than building new ones, but keep doing the same things because changing is risky (A2). Despite that, transport seems to be a more advanced field than other urban design aspects. Planners and designers are looking at environmental-friendly road materials, because of the relationships between heat, roads and buildings (P4).

Anthropogenic heat (AH)

AH was considered a complex concept and nine out of 10 interviewees said citizens are neutral or lower, followed by politician (seven) and urban planners and designers (six). The only group most interviewees (seven) believe to be aware of AH was urban climate experts (Figure 7).

Figure 7: Awareness of AH



Citizens are aware of pollution, but New Zealand has a very car-reliant culture (P1). Politicians are aware but do not promote policy to improve it (P1). Urban planners and designers try to promote public transport and cycling infrastructure (P1), but are uninformed when designing so their designs fail (A1). Urban climate experts are very knowledgeable but are not being heard (P1).

Q6. *In case awareness is low, what is needed to increase the awareness of four urban climate adaptation measures mentioned in question 5?*

Local government should lead by example and provide demonstration projects (G3, A3). An increased media exposure would be beneficial to improve citizens' awareness, as the only current media coverage is related to retreat from the sea (A1). Education through campaign strategies, from the local designers and businesses to their clients and population (G3) and about how these issues fit together, rather than thinking about them in isolation (P3) would also be beneficial.

Amongst politicians, commercial interests tend to dominate (P2), and climate change is a difficult message to get across, but if framed from the cost saving or resilience perspective, it may be effective (G3). Stronger urban climate adaptation policies are needed, and they must be brought into building codes and statutory documents. Local government is likely to initiate change as long as there is community support (A3). Tertiary education needs to embrace it, so the new urban planners and designers are informed (A3).

Communication

Q1. *Which roles do the groups have in the process of planning, designing and implementing urban climate adaptation measures?;* and ***Q2.*** *What are the relationships between these actors in the communication strategies?*

Citizens influence politicians and if mobilised, elected representatives would respond (P1, P2, P4, G1, G2, G3). Politicians represent the public view and should encourage community to think about climate change (P1, G3). At both local and national government, progress is limited if politicians do not communicate that there is a problem (P2). The relationship between citizens and urban designers and planners happens through community consultation processes (P1, G1, G2), and citizens trust these professionals to make the right decisions and promote best practice ideas (P2, G3).

Urban planners and designers should facilitate ideas and guide citizens and politicians towards right decisions (P1). Urban climate experts must communicate potential impacts (G2), provide evidence of urban climate issues and help offer solutions (P2, G3). They should also communicate urban climate change science and the effectiveness of measures being adopted (P3). Natural disasters are driving research into urban planning and design to focus on understanding these issues and bringing it into the government agenda (G1). Urban climate experts can bridge the gap between citizens and politicians (P1, P2) and should work with urban planners and designers to inform all other groups (P2).

Q3. *What is the role of communication to support the planning, design and implementation of adaptation measures?*

Education is important, if citizens were aware of simple adaptation measures they could take, they would act. But this should not only be individual's responsibility, as adaptation issues require system-wide approach (P4). Best practices should be promoted through TV and social media, but the message must be clear and not use jargon (A2). Most councils have only one person working with urban climate, who is likely too busy to be efficient. It should be a prominent work area, especially in local governments (P1).

Q4. *Are there formal guidelines or policies driving the use of communication in the planning, design and implementation of adaptation measures? If yes, can you please name them?*

Some interviewees believed there are no guidelines around sustainability and climate change communication, and that there is a need for an overarching strategy dedicated to it (P3, G3). However, some guidelines were also mentioned. The Report of the Parliamentary Commissioner for the Environment, for example, provides broad instruction to engage with communities about climate change (G2), and consultative procedures in the Local Government Act, sets out principles under which councils must undertake consultation (A1).

Q5. *What are the strengths and weaknesses of the communication process?*

Strengths: Christchurch was cited as an example of relationships between council, designers, developers, and users, as they are "building a program that goes from the design of a building to the occupant and how they behave, [which] is an extraordinary service for New Zealand" (G1). There is also an initiative to encourage people coming into the

Christchurch CBD to think about transport, and the city has an urban design panel which provides review of large scale projects (G1).

Weaknesses: New Zealand's self-image as a green country enforces the perception that issues are not significant and so communication between groups is often limited (P1, P2). When principles are applied, it happens with council's discretion, but it should be applicable to all council's activities. Finally, most RMA provisions reduce the ability for public participation (A1).

Q6. *Is there a need to improve the communication process? If yes, how to improve?*

Climate change needs more exposure and prominence in the design process. It should be a concern from beginning, rather than an afterthought. Could use comparisons between well-designed and poorly-designed areas for driving attention to design (P1).

Instruments

Q1. *Are there legally binding instruments used to implement urban climate adaptation measures? If yes, please explain how they work?*

The Building Code has requirements such as floor heights for the event of flood (G2, G3, P3), and addresses building safety, sanitation and functionality (G1). The City Transition Plan addresses expectations and restrictions around land use (G1), and the New Zealand Coastal Policy Statement addresses planning for 1 in 100 year coastal flood events, and offers prescriptive requirements (G2, G3, P3). The RMA requires local governments to consider climate change effects in their planning and decision-making process, however, local governments must interpret the requirements and apply them locally (G3, A1, P3).

Q2. *What are the strengths and weaknesses of the legally binding instruments used?*

Strength: Allows for the ongoing land use change in areas expected to be impacted by climate change (G1).

Weaknesses: Existing laws are not being enforced (A2), and even when strategies are legally binding, they are often vague (P4). The Building Code acts as a bottom line, but it should state best practice to set higher performance goals concerning resilience to earthquakes and climate change (G1). The RMA requirements focus on issues related to sea level rise, but it does not allow for considering climate change mitigation. It is not possible

to "take into consideration or include any provisions in plans about avoiding GHG emissions" due to potential impact on dairy industry (A1).

Q3. *Are there chances missed when using the legally binding mentioned instruments?*
The lack of compulsory requirements was the main missed opportunity raised by interviewees. Although documents exist, they fail to be effective (P1). The RMA sets out requirements but does not identify how to implement them at the local level (G1). The variations between local instruments makes it confusing, and there is a missing opportunity to have a national set of standards (G2). Information about risk of sea-level rise on property information is a legal document, but does not require action (P4). The government can also issue national environmental standards and policy statements, but have not put one out on climate change. When they exist, they are guidance only (A1).

Q4. *Are there other policy instruments used to implement urban climate adaptation measures? If yes, please explain how they work?*
New Zealand Coastal Policy Statement requires planning for sea level rise and councils are expected to address the issue, but politicians avoid engaging (A1). There is also the Urban Design Protocol (MfE, 2005), which lists seven principles that urban designers should follow, and there is the New Zealand Green Building Council commercial and residential rating tools (G2, G3). Christchurch has management plans, and guides about water sensitive urban design, storm water, and flooding, and over 180 commercial buildings in the Christchurch CBD are being monitored and assessed (G1).

Q5. *What are the strengths and weaknesses of the other policy instruments used?*
Strengths: Incorporation of climate change considerations in infrastructure investment planning is starting to happen (P3).
Weaknesses: The existing documents are broad (G2) and there is scientific debate about the evidence of sea level rise predictions (A1).

Q6. *Are there chances missed when using other policy instruments?*
New buildings in Christchurch are an opportunity to build as promised. Buzzwords such as sustainability have been used, but it would be interesting to see it been applied (P1).

Implementation

Q1. *Which concrete urban climate adaptation measures are currently implementing or have been implemented in your city?*

Councils are using materials that hold less heat, such as permeable paving, and alternative approaches to stormwater (P1). Detailed maps look at the extent of future sea level rise and vulnerable areas. Christchurch City Council (CCC) has undertaken revegetation and restoration of sand dunes along the coast, wetland rehabilitation and establishment of new ones, including providing reserve areas for flood events (G1), and provisions of coastal habitats for species adaptation to climate change (G2).

Development in low lying or beachfront areas at risk of flooding have been restricted, plans for natural barriers were implemented (A1), and managed retreat is starting to be considered (G3, P3). Wellington incorporates wind reduction in urban design, and is increasing surfaces' permeability through water sensitive urban design and planting native vegetation (P4).

Q2. *What are the strengths and weaknesses of these mentioned urban climate measures?*

Strengths: Concrete measures have been undertaken and there has been a move from debating whether climate change was occurring to looking at responses (P4, G1). Christchurch is part of the 100 Resilient Cities Program, which requires measurements of carbon footprint, goals and targets, and reports on mitigation and adaptation to climate change responses. There are also partnerships looking at climate change impacts on health (G1).

Weaknesses: Sea level rise takes all attention, but is countered by vertical land movement in New Zealand, particularly in earthquake-prone areas. "Measuring sea level rise in the New Zealand context is tricky because the dominant feature is more the rate of land uplifting or lowering", and it can challenge the need to make decisions about sea level rise due to climate change (A1).

Q3. *Are there conflicts between aesthetics and these mentioned urban climate adaptation measures?*

Conflicts identified by interviewees regard specific outcomes that clients want (P1), as sustainable design is not considered 'cool' enough (A2), but others said there is no conflict, as the 'aesthetics of sustainability' has become trendy (P3). Existing conflicts were also

identified regarding whether there is a business case for climate adaptation measures, as sometimes it is seen as luxury (G3). In this context, positive outcomes were achieved from restoring or creating artificial dunes promoting a natural character (A1). There is also acceptance of solar panels, however there would probably be opposition to extensive solar farms as they may interfere with the overall city atmosphere (G2).

Q4. *Are there conflicts between urban functions and these mentioned urban climate adaptation measures?*

Conflicts pointed out by interviewees regard the easiness of applying these measures in comprehensive redevelopment or in new developments. However, change should be also happening in dense and well-established areas (P3). Other conflicts regard the use of new materials requiring complex techniques for implementation (P1), green roofs use and their potential loadings and costs, associated to existing ground space in New Zealand, as opposed to Europe (A2). There have been initiatives to increase bicycle lanes by removing car parking along roads, which generated differing views within community (G3).

Q5. *Are there chances missed when implementing these mentioned urban climate adaptation measures?*

Urban climate adaptation needs to be included in financial planning, and if citizens push for adaptation measures it may force government budgets to incorporate it (P4). But citizens want to buy properties right beside the sea and in flood plains and councils do not want to fight. People still want to live by the sea and they do not expect the sea level will rise or that New Zealand should do anything or agree to reduce GHG (A3). Statutory and enforceable policies are needed to deal with this situation (P1).

In summary, results of this study show that awareness exist but urban climate adaptation is not a priority. Communication is successful through community engagement and consultation, but there is a need for more campaigns and education. Instruments exist, but they are not statutory, and there is a need for more extensive and clearer regulation. Overall, measures in response to climate adaptation were implemented, but they are largely related to coastal areas and do not directly relate to urban climate adaptation. The only exception is Wellington and its endeavours to minimise wind tunnels.

Discussion and conclusion

This study aimed at investigating how New Zealand is responding to climate change through planning and design, particularly concerning urban climate. While the small number of interviewees is a limitation of this project, it generated new information and useful insights into the research questions.

Urban climate conditions are not seen as a problem in New Zealand and therefore they are not made priority. This has been highlighted by the apparent lack of urban climate experts in the country. The local temperate maritime climate conditions, in a country where urban settlements are largely low density mean UHI is not major issue. The main problem identified was the discomfort generated by the wind, but this is not seen as something that can be changed or is related to climate change. However, it is likely that in the future damage caused by climate can be frequent and intense.

The challenges identified by the RSNZ (2016) as the main threats to New Zealand largely relate to water, which is understandable considering the geographical condition of the country. In this context, urban climate has not been identified as a major concern, being this a gap mentioned as a pressing issue, as climate change will affect cities where most population live (Adger *et al.*, 2013).

Because urban climate is not priority, existing policies are not regulatory, meaning it lacks enforcement of measures to be adopted in city design. Moreover, there seems to be a need for disruption to happen before action is taken, and due to the earthquakes, Christchurch, in many cases, has been mentioned as an example, including citizens expectation of seeing it as a world-class example of a prosperous economy operating under a low carbon environment.

Finally, there is space for the Christchurch example to be extended and to focus and promote better and resilient cities through design and regulatory planning. In the case of climate change, as in many others, "prevention is better than cure" (G1), as we are likely to experience changes greater than we can adapt to.

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