Climate Change, Older Adults and Immigrants: Exploring Community Vulnerability and Resilience

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BACKGROUND

Canada continues to experience warming at a greater rate than the global average (1). Climate change is projected increase the number of warm nights and hot days in Edmonton, Alberta, Canada (2,3).

Climate change is having critical impacts on health. Two pathways include extreme weather and air pollution. Groups such as older adults and some immigrant communities may be at higher risk due to underlying conditions, social isolation, and limited access to services (4-6).

PROJECT

Our aim was to explore community-level impacts of weather and air pollution in Edmonton, with a focus on older adult and immigrant populations (Figure 1).

METHODS

- Model and map the relationship between community-level socio-demographic factors (sensitivity), environmental factors (exposure), adaptation (adaptive capacity), and health outcomes (cardiovascular, respiratory, mental health, and injuries) using available information

- Explore the knowledge, attitudes, practices, perceptions, and resiliency of both older and immigrant populations through focus group discussions

(1) Environment Canada 2014, (2), City of Edmonton, (3) Smoyer-Tomic et al. 2003
(4) Health Canada 2012, (5) Hansen et al. 2013, (6) Cheng et al. 2010

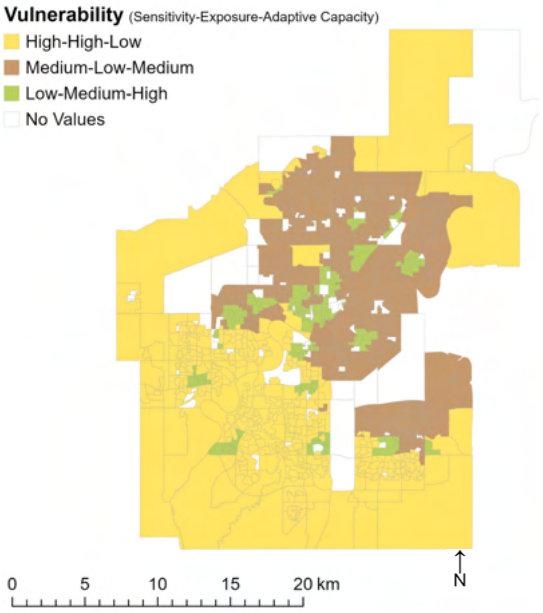

Figure 1: Vulnerability index map of Edmonton for older adults and immigrants

- Yellow: high sensitivity, high exposure, low adaptive capacity
- Brown: medium sensitivity, low exposure, medium adaptive capacity
- Green: low sensitivity, medium exposure, high adaptive capacity
- White: no values

KEY FINDINGS

Older adults are at higher risk of adverse health events from weather and air pollution exposures

Refugees are at higher risk of adverse health events from weather and air pollution

Air pollution and weather monitoring limitations are hindering efforts to measure health impacts

There is room to foster adaptive capacity in our neighborhoods and populations

CLIMATE CHANGE, OLDER ADULTS AND IMMIGRANTS: EXPLORING COMMUNITY VULNERABILITY AND RESILIENCE

Final report - CitiesIPCC

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BACKGROUND

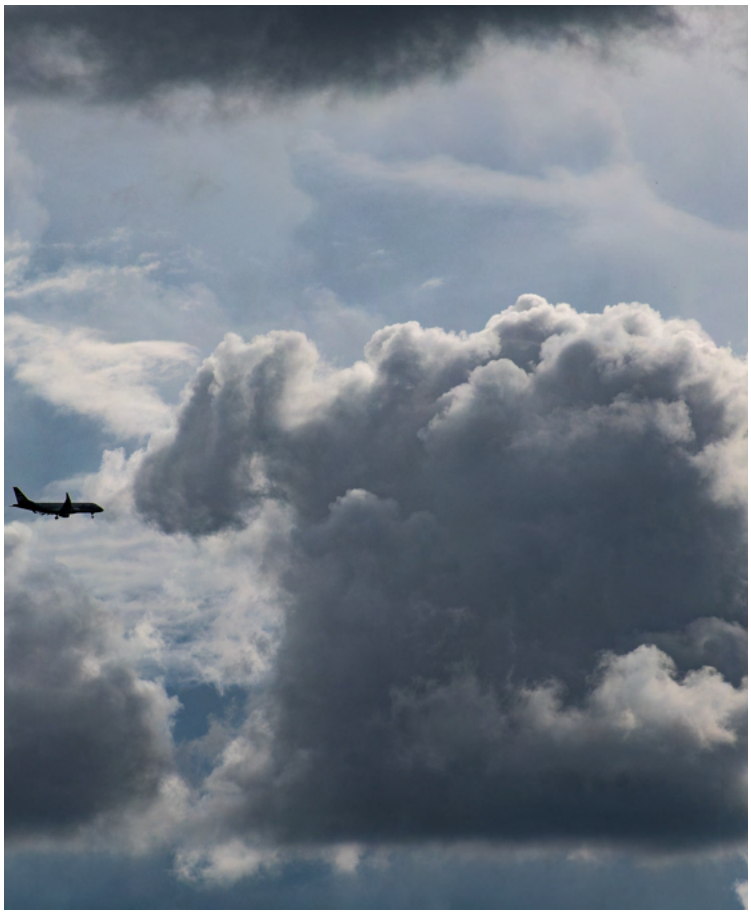
Climate change represents one of the largest public health challenges this century and is threatening to undermine the last 50 years of global health gains (1,2). Between 1948 and 2009, the average winter and spring temperature in Canada increased by 2.4°C and 1.8°C, respectively, an increase greater than most other regions globally (3,4). Greater rates of temperature change in Alberta are also expected over the next century, compared to global averages (5).

Edmonton will likely experience an increasing number of warm nights and hot days (6,7). Future projections (2050) also indicate a trend of increasing wildfire frequency, resulting in worsened air quality for Edmonton (6,8,9).

Older adult and immigrant populations may be at greater risk of climate change health impacts as compared to the general population due to physiological or sociological factors, among others (1).

Identifying the needs and capacity of immigrant and older adult populations is therefore critical for informing Edmonton's climate change adaptation strategies. By 2041, 32% of Edmonton's population is projected to be ≥55 years of age (10). Immigration will also dramatically change the landscape of Edmonton's senior population (10).

A lack of appropriate and substantive climate change adaptation research and initiatives inclusive of older adult and immigrant populations can increase the marginalization of these groups (9,11).



CLIMATE CHANGE AND HEALTH

Climate change is disproportionately affecting some groups. Older adults (65 plus years of age) and immigrant communities can experience higher risks. Walking on ice and snow in winter is the second leading activity associated with fall-related injuries and injury-related hospitalization in those ≥65 years in Canada (12). Increases in the number of hot days and warm nights can also lead to significant increases in morbidity and mortality from cardiovascular, respiratory and cerebrovascular disease in older adults (6, 13, 14).

Extreme weather and air pollution may also affect recent immigrants. Socioeconomic challenges, limited access to health and social service programs, cultural differences, language barriers, and occupational exposures can compound risks (15-17).

RESEARCH OBJECTIVES

The purpose of this work is to generate local data about community-level evidence of climate change and health vulnerability among older adult and immigrant communities and to explore potential opportunities to promote resilience to help inform future short, medium and long-term planning activities (e.g., “resilience hubs”) (6).

Objective 1: Map and explore the relationship between community-level factors (environmental, demographics, socioeconomic status, social isolation, active living environment, health facility, senior and community service availability) and community health indicators (cardiovascular, respiratory, mental health, and musculoskeletal outcomes) in Edmonton; and

Objective 2: Explore in more depth the knowledge, attitudes, practices, perceptions, and resiliency of both older and immigrant populations in Edmonton using qualitative methods (Stakeholder Engagement Day and focus group discussions).

METHODS

We modelled and mapped the relationship between different factors:

Environmental (weather/air pollution/industrial emissions)

Community-level socio-demographics (age/sex/immigrants/marital status/material and social deprivation/income/education/dwellings in need to major repairs)

Social isolation (living alone/shared accommodations/dwellings in need of major repairs)

Active living environment (dwelling density/intersections/interest points/transit stops/greenness)

Health and service availability (clinics/hospitals/emergency services/seniors and community organizations)

Health indicators (cardiovascular/respiratory/mental health/musculoskeletal outcomes)

Three domains (sensitivity, exposure, adaptive capacity) were generated using variables identified from statistical models and prior research, which were then combined and mapped:

- **Sensitivity**: Characteristics that may increase the risk of an adverse health outcome (e.g., material and social deprivation, age)

- **Exposure**: Exposure to weather and air pollution, proximity to industrial emissions

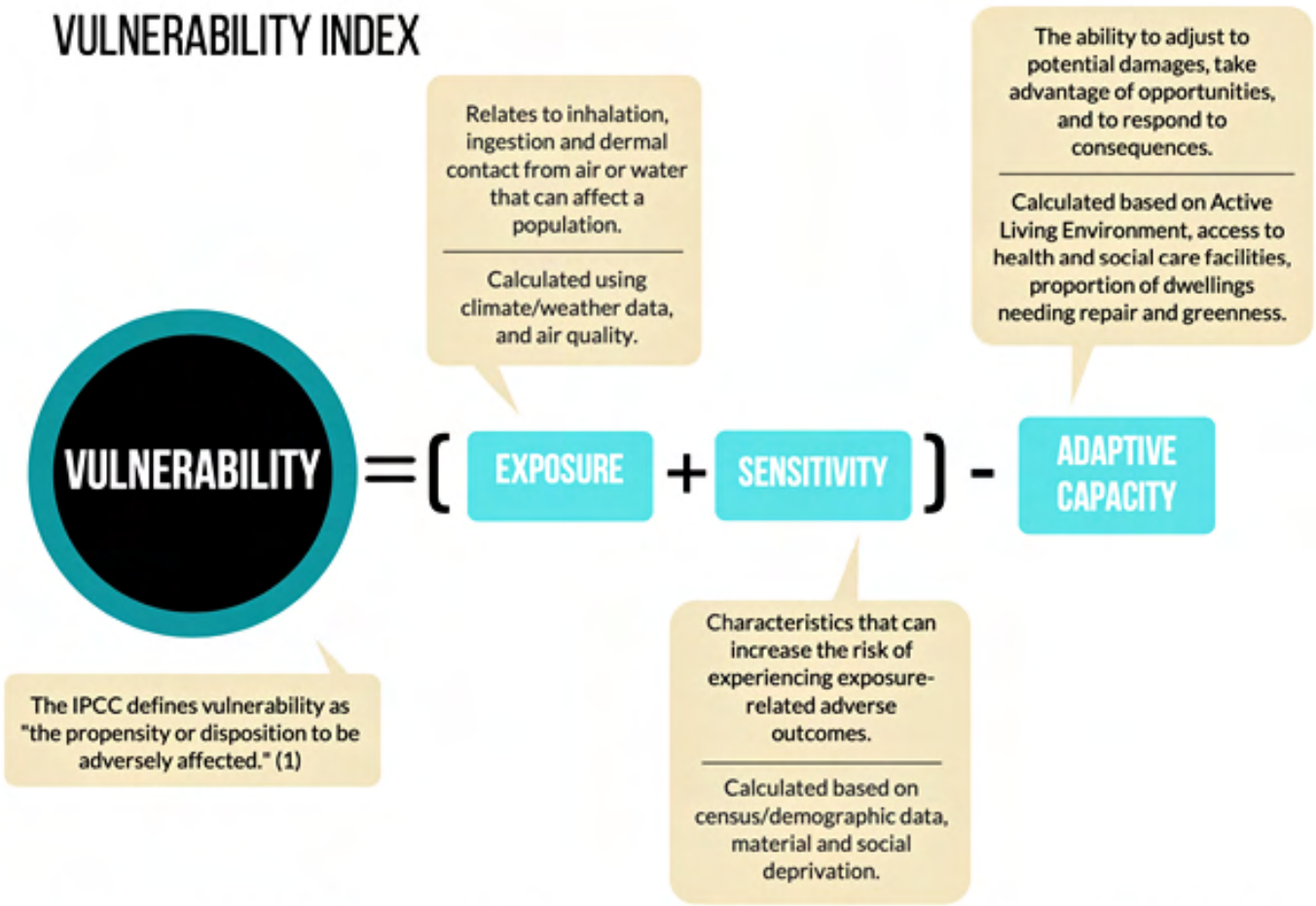
- **Adaptive capacity**: Ability to adjust to potential damage, take advantage of opportunities, or respond to consequences (e.g., access to parks, proportion of dwellings in need of major repair)

VULNERABILITY INDEX

Principal component analysis was used to identify clusters of variables for each domain (sensitivity, exposure, adaptive capacity). Cluster values were then mapped for dissemination areas, census geographical units of between 400 to 700 people (18).

A vulnerability index was developed by combining the domains of sensitivity, exposure, and adaptive capacity (below).

Each domain and the vulnerability index were then mapped (see findings).



(1) Oppenheimer M, Campos M, Warren R, et al. Emergent risks and key vulnerabilities. Climate Change 2014 Impacts, Adaptation and Vulnerability: Part A Global and Sectoral Aspects2015:1039-1100.

OBJECTIVE 2

To share our findings, solicit feedback on deliverables, and discuss climate change and health issues in Edmonton, we hosted two virtual Stakeholder Engagement Days workshops on April 28th and 29th, 2021. We invited stakeholders from the City of Edmonton, immigrant-serving and seniors' agencies, and environmental organizations.

Conversations with Edmontonians who identify as older adults and immigrants was undertaken as part of parallel work funded by the Commission for Environmental Cooperation.

Our preliminary findings and maps were presented. This was followed by breakout conversation circle sessions with participants.

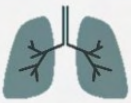
The group engaged in discussions about climate change effects on communities in Edmonton, community climate change vulnerabilities, shared initiatives, and ways to promote climate change resilience in communities and organizations.

Feedback was subsequently incorporated into the project.

FINDINGS: MODELS

Through our modelling, we identified several factors associated with cardiovascular, respiratory, mental health, and injury events.

- Exposure to certain air pollutants (fine particulate matter or $PM_{2.5}$) and proximity to industrial emissions increased the risk of health events like hospital visits
- Higher temperatures and precipitation increased the risk of injury, respiratory, and cardiovascular events
- Greenness and a favorable active living environment lowered the risk (protective) of health events
- Older age (65 and up) was an important risk factor for all health events
- Refugees face higher risks of injuries and respiratory events compared to the general population. Conversely, immigrants (economic classes such as skilled workers) experience lower risks of cardiovascular, injury, and mental health events compared to the general population.
- Material and social deprivation was identified as a critical risk factor for cardiovascular, injury, mental health, respiratory events

	 Cardiovascular	 Injury	 Mental Health	 Respiratory
 Exposures	Risk factors • ↑ $PM_{2.5}$ • ↑ industrial air pollution • ↑ precipitation Protective factors • ↑ O_3 • ↑ diurnal temperature change	Risk factors • ↑ $PM_{2.5}$* • ↑ NO_2 • ↑ industrial air pollution • ↑ mean temperature	Risk factors • ↑ industrial air pollution Protective factors • ↑ O_3	Risk factors • ↑ $PM_{2.5}$* • ↑ industrial air pollution • ↑ mean temperature Protective factors • ↑ O_3
 Important Covariates	Risk factors • ↑ average age • ↑ proportion of ≥65 years • Social deprivation Protective factors • ↑ proportion of all immigrants, and economic immigrants • ↑ Greenness	Risk factors • ↑ average age • ↑ proportion of ≥65 years • ↑ proportion of males • ↑ Material and social deprivation • ↑ proportion of refugees • Warm months Protective factors • ↑ proportion of economic immigrants • ↑ favorable active living environment	Risk factors • ↑ average age • ↑ proportion of ≥65 years • ↑ Material and social deprivation Protective factors • ↑ proportion of economic immigrants	Risk factors • ↑ average age • ↑ proportion of ≥65 years • ↑ proportion of refugees • ↑ Material and social deprivation Protective factors • ↑ favorable Active Living Environment

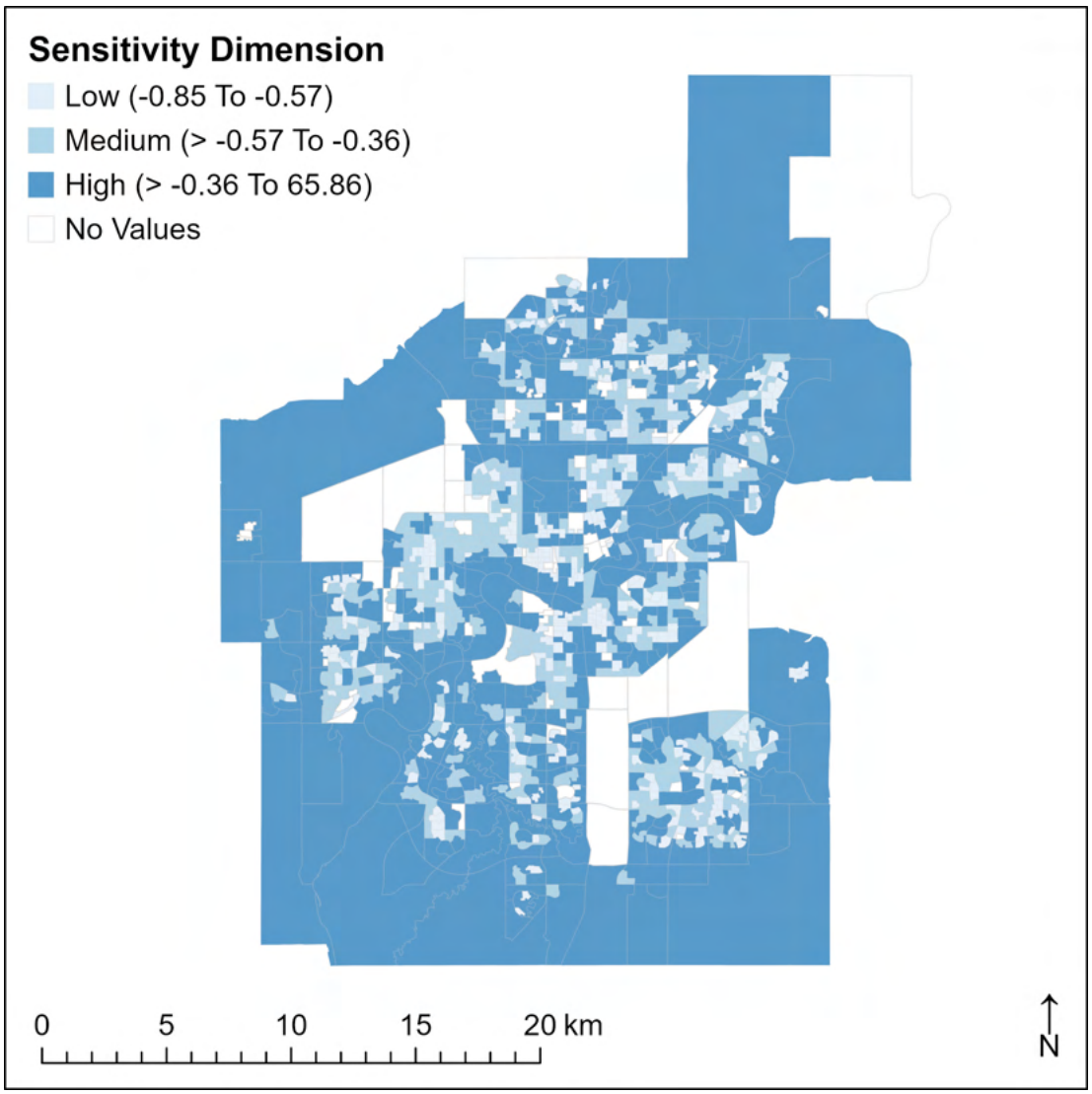
*All indicators significant at a p-value ≤ 0.05 unless specified, * Marginally significant*

FINDINGS: MAPS - SENSITIVITY

We combined the relevant variables into each of the three vulnerability domains of sensitivity, exposure, and adaptive capacity.

The first map shows areas of different sensitivity (e.g., age, dwelling type, income, immigrant status, education, social deprivation). Light to dark shading represents lower to higher sensitivity.

Findings from the sensitivity map indicate spatial variation across the city. Some areas of the city have higher sensitivity, represented by the darker blue areas. Higher sensitivity can increase the risk of experiencing weather and air pollution-related health events.



Map showing sensitivity for older adults and immigrants in Edmonton. Dark blue indicates >-0.36 to 65.86. Medium blue indicates >-0.56 to -0.36. Light blue indicates -0.85 to -0.57. White indicates no values. Categories are the result of quantile classification.

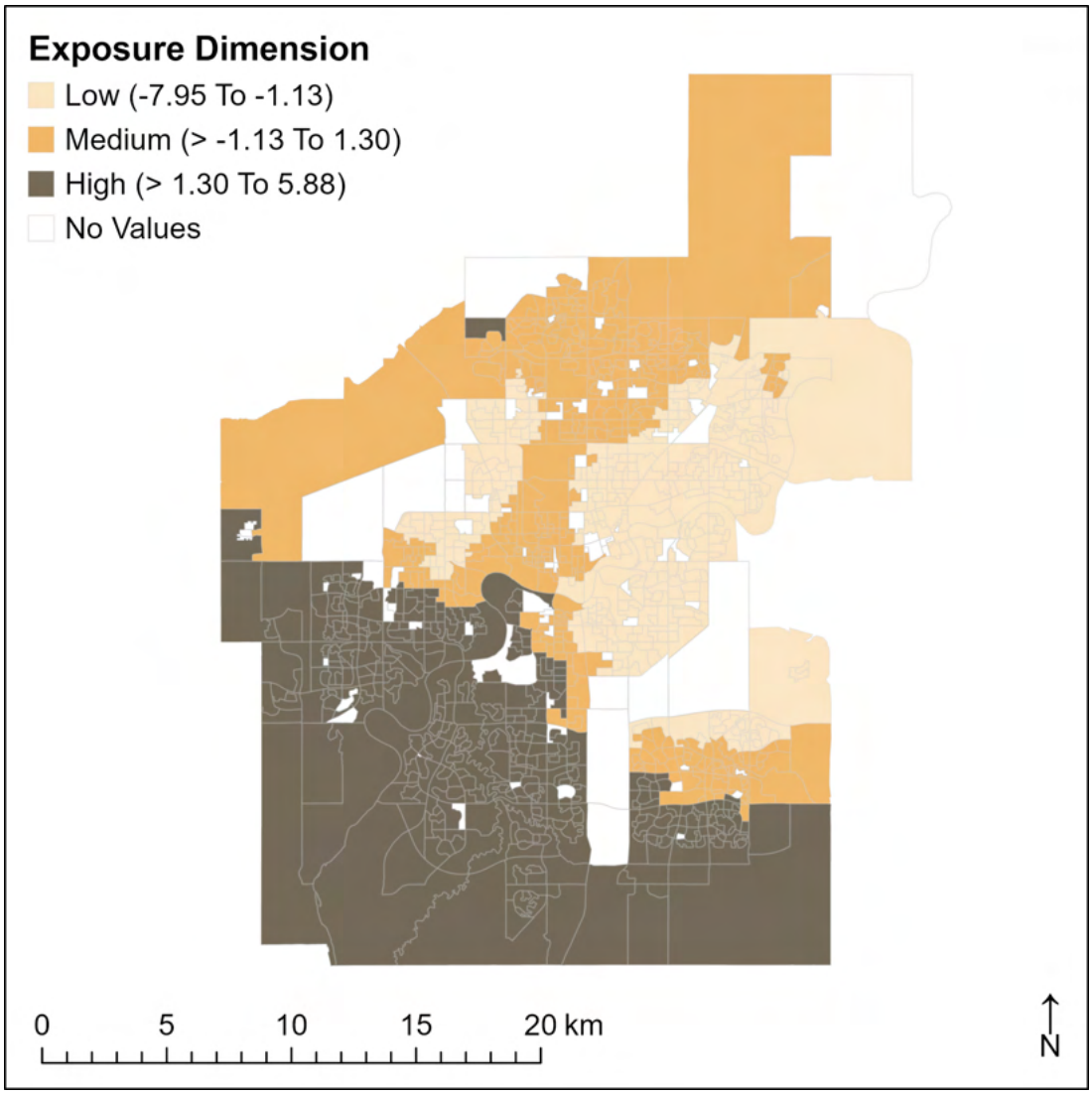
FINDINGS: MAPS - EXPOSURE

Light to dark shading represents lower to higher weather-related and air pollution exposures (e.g., air pollutants, weather variables).

Findings from the exposure map indicate spatial variation across the city. Dark brown shaded areas are experiencing relatively higher weather and air pollution exposures in relation to other areas of the city.

Important note:

Exposure data is constrained by a lack of exposure variability across areas of the city as monitoring data is only available from a few stations, primarily located in older and central parts of Edmonton. Land use regression data was used but was limited to the years 2015 and 2016.

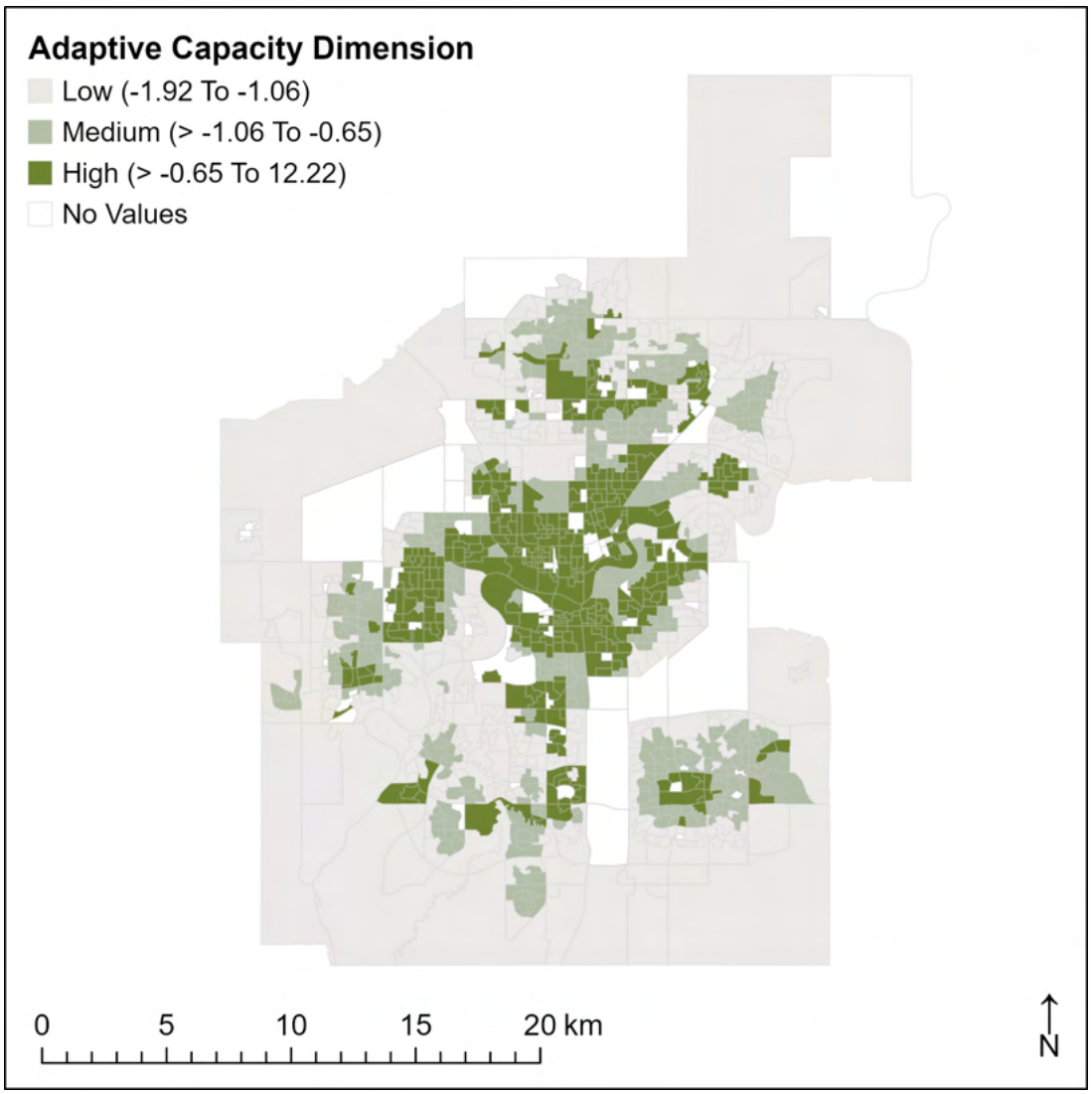


Map of exposure for older adults and immigrants in Edmonton. Brown indicates >1.3 to 5.88. Dark Orange indicates >-1.13 to 1.3. Light orange indicates -7.95 to -1.13. White indicates no values. Categories are the result of quantile classification.

FINDINGS: MAPS - ADAPTIVE CAPACITY

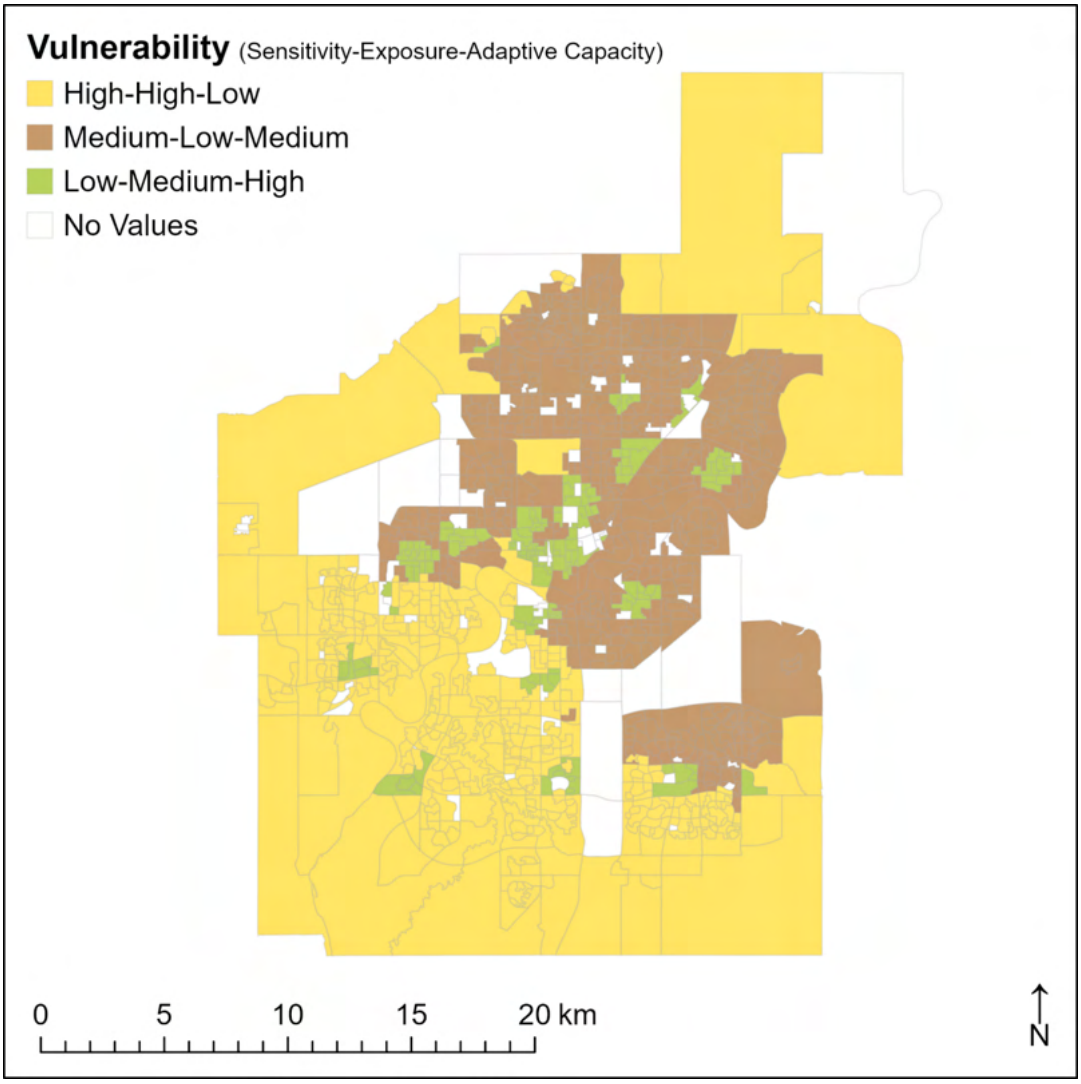
Light to dark shading represents low to high adaptive capacity (e.g., green space, distance to clinics and emergency medical services). Unlike the previous two maps, higher adaptive capacity indicates a higher ability to adjust to potential impacts from weather and air pollution exposures.

Findings from the adaptive capacity maps indicate spatial variation across the city, with higher adaptive capacity indicated in the core and lower adaptive capacity as you move away from these areas. Dark green areas suggest an increased capacity to respond to impacts of weather and air pollution exposures.



Map of adaptive capacity for older adults and immigrants in Edmonton. Dark green indicates >-0.65 to 12.22. Light green indicates >-1.06 to -0.65. Grey indicates -1.92 to -1.06. White indicates no values. Categories are the result of quantile classification.

VULNERABILITY INDEX MAP



The three domains of sensitivity, exposure and adaptive capacity were combined to create an overall vulnerability index.

Yellow shading represents areas with high exposure, high sensitivity, and low adaptive capacity.
Brown shading represents areas with medium exposure, low sensitivity, and medium adaptive capacity.
Green shading represents areas with low exposure, medium sensitivity, and high adaptive capacity.

Findings from the vulnerability index indicate populations across the city are not experiencing the same vulnerability to weather change and air pollution events. We would like to aim for low exposure, low sensitivity, and high adaptive capacity across Edmonton. The yellow and brown areas identify where additions and/or improvements to services and infrastructure will be needed to reduce sensitivity and exposure, and increase adaptive capacity.

Important notes:

Indices are constrained by the data available. The lack of concurrent exposure data is a limitation. Other critical variables may be missing from the index. The algorithm used to generate the index represents only one approach to mapping climate change vulnerability.

FINDINGS: FOCUS GROUPS

QUALITATIVE

Four key themes emerged related to older adults' perceptions and experiences related to climate change (Commission for Environmental Cooperation).

Conflicting Narratives on Climate Change	Overall, older adults were aware of the changing climate and environmental crises, despite a variety of opinions on the causes of these changes and potential solutions.
Lack of Effective Leadership in Managing Climate Change	Older adults showed distrust of leaders and expressed their criticisms of the inability of government to manage climate change issues.
Difficulties Navigating and Evaluating Information on Climate Change	Older adults expressed their need to have access to reliable information about climate change, its effects, and management.
Solutions to the Problems Associated with Climate Change	Older adults emphasized individual responsibility and recommended that every member of society play a crucial role.

LIMITATIONS

There are a number of important limitations of this work that need to be noted:

- Data were missing for some dissemination areas, which could not be mapped
- The aggregate measures used in this study may not represent individual measures
- Exposure data from monitors was limited (geographically). As such, land use regression data were used but were only available for the years 2015 and 2016.
- The models used in this study may have simplified relationships
- Some relevant variables may have been missed in our analyses
- Maps represent a snapshot of current conditions

IMPLICATIONS

Climate change is impacting the health of Edmontonians. Findings from this study suggest that vulnerability is not experienced equally across the population. In particular:

- Older adults are at higher risk from weather and air pollution events
- Refugees are at higher risk of adverse health outcomes from exposure to weather and air pollution
- Upstream determinants like social and material deprivation affect the sensitivity of populations to weather and air pollution
- Lowering air pollution exposures can also improve health as they can compound weather effects
- Limitations in our ability to capture weather and air pollution exposures in other areas of the city can hinder efforts to measure health impacts
- There is room to foster targeted adaptive capacity in our neighborhoods and population

RECOMMENDATIONS

Include the needs of older adult and immigrant communities in climate change planning and policies (e.g., mobility)

Engage older adults and immigrant communities in climate change discussions (e.g., to assess concerns, resilience)

Involve organizations that serve older adult and immigrant communities in climate change discussions (e.g., co-design of interventions)

Consider a range of communication strategies to reach older adult and immigrant communities (e.g., multiple languages)

Promote and foster adaptive capacity in neighborhoods in Edmonton (e.g., parks)

Address upstream determinants of health (e.g., inequalities), which may impact downstream exposures and adaptive capacity

Invest in additional stationary and mobile weather and air pollution monitors, particularly in newer neighborhoods to capture variations in exposure across the city

Consider ongoing surveillance of health impacts related to extreme weather and air pollution to monitor impacts in the population

Promote cross-organizational cooperation to tackle climate change

Engage in community climate change planning as soon as possible

FURTHER INFORMATION

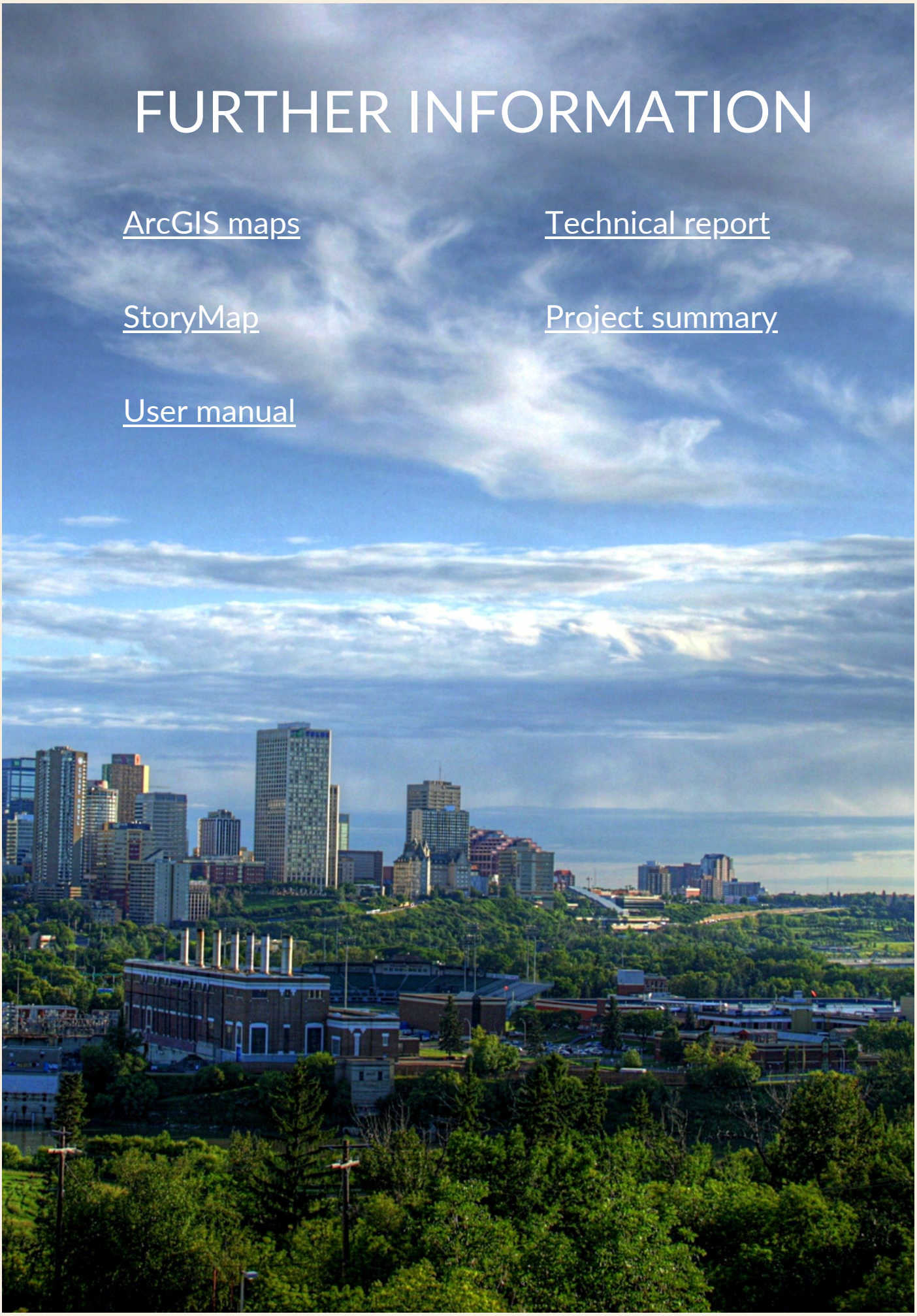
ArcGIS maps

Technical report

StoryMap

Project summary

User manual



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