Community Health and Climate Change

Mapping exposure, sensitivity, and adaptive capacity to four health-related climate hazards in Interior Health

Interior Health

Licker Geospatial Consulting

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Climate Change and Health

Climate change is already influencing our lives in British Columbia (BC). Over the next decades, we expect BC to see an increase in several climate-related hazards, including heat events, poor air quality, flooding, and other extreme weather events. We know that these hazards negatively affect the physical and mental health of residents living in the regions served by Interior Health (IH).

Working off a previous project with researchers from University of British Columbia (UBC), Vancouver Coastal Health, and Fraser Health Authority, IH has created a series of maps that spatially represent community vulnerability to four important hazards: higher summer temperatures, wildfire smoke events, coastal and river flooding, and lower winter temperatures. These hazards can lead to a number of negative physical outcomes, including injury, illness, and death, as well as mental health impacts like stress, anxiety, and trauma.

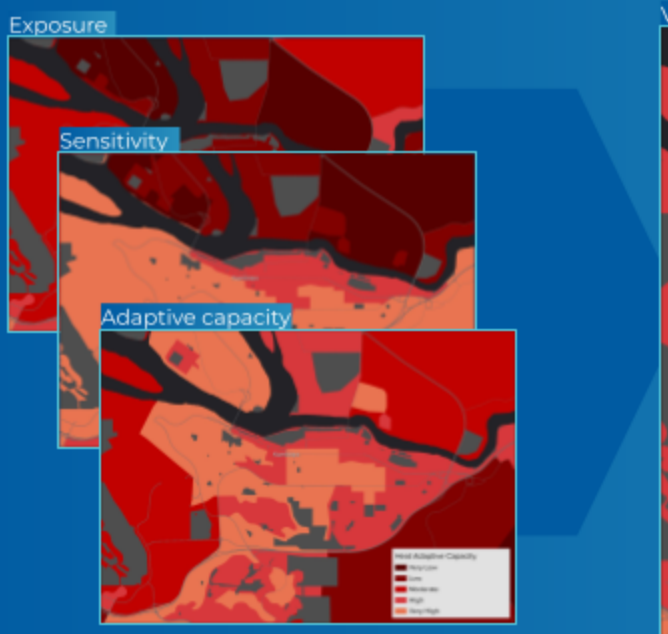
A major goal of this work is to show that climate hazards do not affect all people equally and that efforts to support and protect our health in the face of climate change need to consider the social determinants of health. This broad range of personal, social, economic and environmental factors determine individual and population health and may include income and social status, access to health status, housing, and other factors.

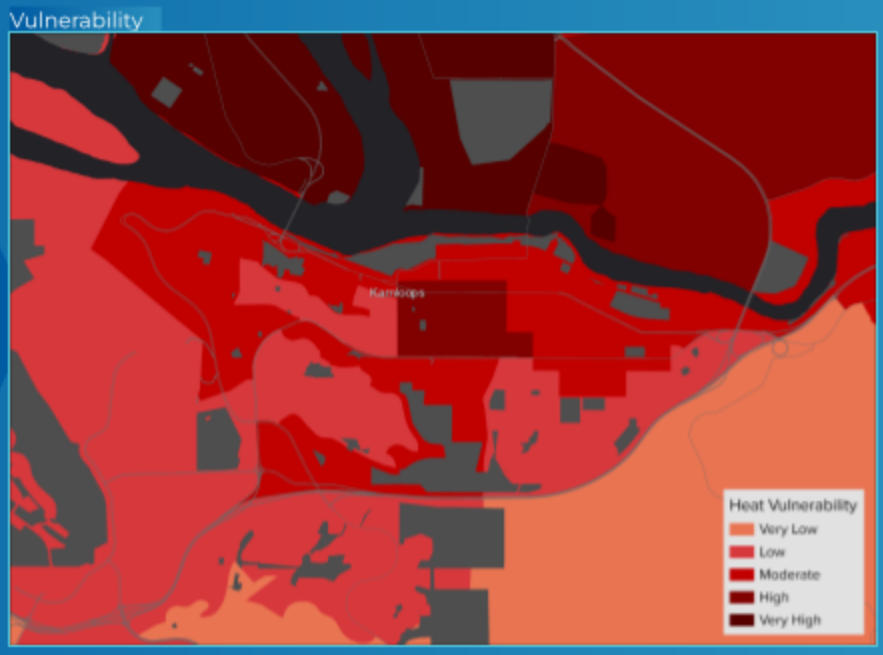
We hope these maps will advance our collective understanding of what increases the impacts of climate change for some individuals and communities, and contribute to conversations about becoming more resilient.

Mapping Climate and Health Vulnerability

The model that underpins the maps was created by a team of UBC researchers who studied the characteristics that make people more or less vulnerable to climate hazards. These characteristics were categorized into three broad and well-established elements that make up a community's climate vulnerability: exposure, sensitivity, and adaptive capacity.

Adapted from: Buse, C. G. (2018). Why should public health agencies across Canada conduct climate change and health vulnerability assessments? Canadian Journal of Public Health, 109(5–6), 782–785.





You can interact with these maps online. Visit the Interior Health story map for more info!

Exposure

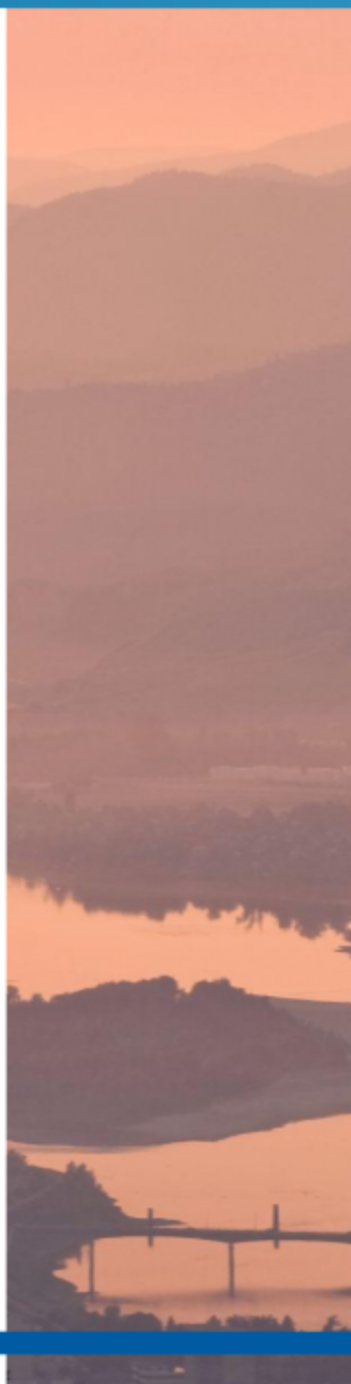
Exposure is the likelihood that someone will come into contact with an identified hazard. For example, people who live in communities that are further away from rivers and waterways are less exposed to flooding that those who live closer to bodies of water. Exposure is represented in the maps using a single variable for each hazard, as summarised in the table below.

Higher summer temperatures	Degree days greater than 18 °C (PRISM Climate Normals 1981-2010)
Flooding	% of dissemination area in identified 200-year floodplains (various datasets)
Wildfire smoke events	% of days with PM2.5 concentration ≥ 25 µg/m^3 (BC Centre for Disease Control)
Lower winter temperatures	Degree days less than 0 °C (PRISM Climate Normals 1981-2010)

Although the variables used to define exposure are based on past or present data, they provide a picture of where and how communities will be exposed to these climate-related hazards in the future. For example, daily maximum temperatures are expected to increase with climate change, but variations in this increase will likely be distributed in roughly the same way they are today.

Sensitivity

Sensitivity represents the role of an individual's physiological characteristics of their health when exposed to an identified hazard. Two primary sources of data are used to represent sensitivity: age (under 5 years of age and over 65 years of age) and pre-existing health conditions (e.g. cardiovascular, respiratory, or renal disease, chronic health conditions, and pregnancy). The selection of these two variables was guided by the literature and the statistical method of analysis used for the project (described below). For example, we know that children, pregnant women, older adults, and people living with chronic health conditions are more sensitive to climate hazards. This can be seen in the maps below which display sensitivity across Kamloops.



Adaptive Capacity

Adaptive capacity is an individual or community's ability to adjust to climate change and reduce associated health risks. Adaptive capacity is made up of several variables, many of which correspond to the social determinants of health as defined by the Public Health Agency of Canada. The factors presented below determine adaptive capacity for each of the four hazards, and were selected based on epidemiological literature as well as data availability.

	Higher temperature	Flooding	Lower temperatures	Wildfire smoke
Income and social status	✓	✓	✓	✓
Rurality/population density	✓	✓	✓	
Education and literacy	✓	✓	✓	✓
Physical environment (housing, tree canopy, etc.)	✓	✓	✓	
Social supports and coping skills		✓		✓
Immigration status, English as a second language		✓		✓
Access to health services		✓		
Gender				✓
Race/racism	✓	✓	✓	✓

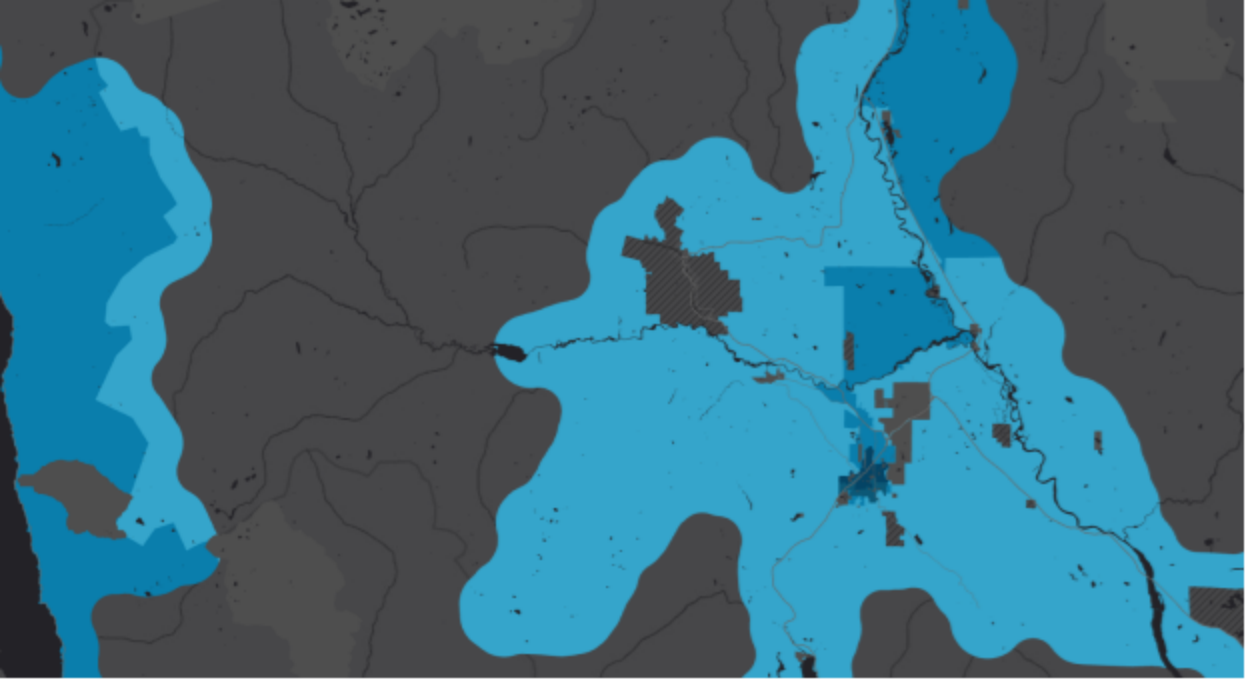
The variables that make up adaptive capacity give us a sense of the resources available to individuals and communities when exposed to a hazard. For example, because of historical and current structural, political, cultural, and economic power imbalances, some communities lack the political power and economic resources to quickly recover from hazard events. On the other hand, good quality housing in an area with a number of trees providing shade can help people cope during periods of extreme heat.

Principal Component Analysis (PCA)

The scores/values represented on the maps were produced using an inferential statics method known as principal components analysis (PCA). PCA is a *data dimensionality reduction* approach, which means that it is used to reduce a theme captured by multiple variables (like those listed above for the "theme" of adaptive capacity) into a single variable (like the adaptive capacity score itself). Statistically speaking, we reduce many variables into one by grouping variables into *components* and creating component weights based on the data distribution. The components are used in a calculation of an overall score.

The scores we have created for each climate hazard are *exposure*, *sensitivity*, and *adaptive capacity*. We calculate overall *vulnerability* with the equally-weighted mean of exposure, sensitivity, and adaptive capacity. For this project, we have conducted scoring and mapping for each of the regional districts in Interior Health. Each map will show analysis at the *dissemination area* scale, a geographical unit associated with Census data, and calculated relative to the data within the regional district, and as such, **should not** be compared to other regional district maps.

The PCA results allow us to see how vulnerability differs across a regional district. As described in the limitations section, PCA may overlook important contextual factors, which is why the maps should be used to support conversations about climate and health vulnerability, and not relied on as a complete picture of community health vulnerability to climate change.



Ways to Use the Maps

The vulnerability maps can be used to:

- ➔ *Raise awareness* of the climate hazards that communities are facing and advance conversations about climate change and health
- ➔ *Mobilise multi-sectoral efforts* to improve community health outcomes
- ➔ *Help pinpoint some of the physiological and social determinants* of health that play key roles in climate vulnerability
- ➔ *Help identify the neighbourhoods or communities that may need more resources* or support to help cope with current and future climate-related stresses and shocks

Resources that are available include:

- ➔ An interactive story map for each of the four climate hazards
- ➔ Regional maps with selectable layers that can be used to generate screenshots
- ➔ Raw data and GIS layers relating to each dissemination area is available by request

Overall, these maps offer users with a **starting point for discussion** when it comes to planning for the health impacts of the four hazards they address. They will be incorporated into larger climate change adaptation planning activities that will ensure services continue to protect the health of the population well into the future. They will also be used to deepen collaboration with Indigenous and non-Indigenous communities as we work towards the common goal of supporting healthy communities as our climate changes. The maps also offer a resource for those involved in decision making in the built environment, policy development, and program delivery. The findings represented in the maps could support efforts to improve community amenities, address gaps in service provision, increase the quality of housing and infrastructure, and other resilience-building endeavours.

Limitations of the Maps

While the maps will be useful for supporting conversations around vulnerability and resilience, it is also important to understand their limitations.

- We know that many of the variables that may contribute to a community's adaptive capacity are not easily quantified, let alone mapped. For example, the social capital and resourcefulness shown in many remote and Indigenous communities during severe weather events points to an important source of adaptive capacity that was not represented in this study. As a result, many remote and Indigenous communities that show relatively high overall vulnerability may in fact have significant social and cultural resources to draw on in times of climate stresses or shocks.
- When the maps were created, they relied on available data to get a general sense of vulnerability in each area. For many variables, this meant relying on the 2016 Census tract data, which shows where people live, not where they work. Therefore, hazards that are largely felt over the daytime (like heat waves) may misrepresent the number and location of vulnerable people because many people are away from home and are at work.

- Maps, in general, are interpretive – their authors and designers must make choices on what and how to display the information of greatest interest. For these maps, the researchers decided to generate a vulnerability score using PCA, as described above. This grouping of the variables could result in some variables being given more weight than others based on their selection. For example, a score might be calculated using a number of physical health measurements for respiratory disease (e.g., rate of chronic obstructive pulmonary disease and rate of asthma) for people over the age of 65. In this situation, because the rate of chronic obstructive pulmonary disease and the rate of asthma both aim to measure the same phenomenon (respiratory disease), their use as indicators may be correlated and result in an overemphasis of the presence of respiratory disease and a de-emphasis of being over the age of 65.

More Information

A background report produced by UBC in 2020 is available online at the the University of British Columbia's Open Collections. This report outlines the original methodology undertaken at UBC that was applied to this project.

For more information or to access any of the resources listed above, please email us at hbe@interiorhealth.ca

? Have any questions? Spot any mistakes or have feedback you would like to share with us? We'd like to hear from you! Email us at hbe@interiorhealth.ca

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