Mapping spatial patterns in vulnerability to climate change-related health hazards

8th Annual Public Sector Climate Leadership Symposium
Plenary Session 4 - Collaborative Climate Vulnerability Assessments
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James Lu, Medical Health Officer, Vancouver Coastal Health
Vulnerability to climate change-related events

Complex interactions between

1. **Hazard exposure** (e.g. extreme heat, wildfire smoke, flood, ground level ozone)

2. **Sensitivity** (e.g. age, health status)

3. **Adaptive capacity** (e.g. SES, built environment, social network, community infrastructure)

- Not just about hazard exposure
- Factors influencing sensitivity and adaptive capacity could increase or decrease exposure impacts
- Expect variations even at small spatial units - neighborhoods and communities
The climate change vulnerability mapping project

**Overall goal:** To promote awareness and improve response to population health impacts from climate change at the local community level

**Specific objective:** To create and map health vulnerability indices for:
- Inland flooding; Sea Level Rise;
- Extreme heat;
- Wildfire smoke;
- Ground level ozone air pollution

**Scope:** Geographic areas covered by VCH and FHA
The Mapping Project Team

**UBC**
- Michael Brauer, Prof, SPPH
- Jessica Yu, PhD cand, SPPH
- Kaitlin Castellani, MSc Geomatics
- Angela Yao, PhD cand, SPPH
- Krista Cawley, MSc cand, IRES
- Xuan Zhao, Med Student

**Health Authorities**
- James Lu VCH
- Emily Peterson VCH
- Sara Forsting VCH
- Geoff Ramler VCH
- Lisa Mu FHA
- Elden Chan, VCH
- Duncan Lu, VCH
- Craig Brown, VCH / HealthADAPT
Methods

- Vulnerability constructs: exposure, sensitivity, adaptive capacity
- Question: How does one neighborhood / community compare to another

Variables / Determinants
1. Literature search
2. Assembling available data to census DA level
3. Looking for variables that explain most of the differences in the data set
   --> principal component analysis (PCA)

Indices
1. Separate index for each exposure
2. Weights from PCA
3. Relative scores of vulnerability – not scores of absolute risks
Data collected for 35+ variables

Examples:

- Children and elderly
- Cardiovascular
- Respiratory
- Mental Health

Variables:

- Daily max temperature
- Land area in flood plain
- Daily PM 2.5 concentration
- Ground level ozone

Factors:

- SES
- Housing quality
- Impervious surface
- Social network
- Public transit

Diagram showing the relationship between adaptive capacity, sensitivity, vulnerability, exposure, and various environmental and social factors.
Data sources

- 2016 CEN$, 
- CITY OF VANCOUVER
- my Health
- my Community
- BRITISH COLUMBIA Ministry of Environment
- UBC SPPH
- 2016 CENSUS - RECENSEMENT
- BC Centre for Disease Control
- TRANS LINK
- CANUE
- BC HOUSING
- IRES
- metro vancouver
Strengths and Limitations

Limitations

• Relative vulnerability not absolute burden of illness
• Composite Indices
  • Oversimplification?
  • “Ground-truthing” essential
• Data availability
  • Different data sets have different granularity
  • Lack of granular data in general for rural and remote communities
  • Air conditioning and outdoor work data

Strengths

• Population-level open-source data
• Multiple sources of data and triangulation
• Ability to update with new data
• Interactive map
What are the pros and cons of composite indicators?


**Pros**

summarize complex or multi-dimensional issues to support decision-makers.

provide the big picture. Easier to interpret than trying to find a trend in many separate indicators. Facilitate ranking complex issues.

help attract public interest by providing a summary to compare across communities.

help reduce the size of the indicator list

**Cons**

misleading, if poorly constructed or misinterpreted. Sensitivity analysis can be used to test for robustness.

may invite simplistic policy conclusions. Composite indicators should be used in combination with the sub-indicators and local context

The construction of composite indicators should be transparent and based on sound statistical principles.
Results
Proportional contributions to variations in vulnerability between communities and neighborhoods

- Not just about hazard exposure

- Sensitivity factors explain >40% of the variations between DAs for wildfire smoke

- Adaptive capacity – probably most modifiable in the short term – contributes to a third of the variations
Interactive map under development – extreme heat
Unpacking vulnerability to extreme heat

Heat Exp + Adaptive Capacity

Heat Exp; Top 3 Quintiles

Heat Exp + Sensitivity
Impervious surface within the Metro Vancouver Urban Containment Boundary

Source: Metro Vancouver
Wildfire Smoke - Exposure only

Wildfire Smoke Exposure + Sensitivity
Areas with higher resilience?

maps showing areas in the moderate, low and very low vulnerability quintiles – Metro Vancouver
Spatial analysis possibilities:

Low vulnerability areas for all climate hazards – surprised?
CIHI – Combined (Material and Social) Deprivation Index
Vancouver CMA (2006)
Concluding thoughts and questions

Are these maps useful?
◦ For what, for whom?
  ◦ Planners?
  ◦ Public at large?
◦ How can they be made more useful?
◦ Unintended consequences?
  ➢ Local context, ground-truthing, dialogue

What do these maps tell about equity?
Next steps:

• Complete interactive maps
• Continue stakeholder engagement for feedback
• Make interactive maps accessible

Link to final report:
https://open.library.ubc.ca/cIRcle/collections/facultyresearchandpublications/52383/items/1.0380851

Link to interactive maps: TBD
Feedback / information:
j.yu@ubc.ca or james.lu@vch.ca