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Toronto and Region Conservation for The Living City

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ONTARIO CLIMATE CONSORTIUM

State of Climate Change Science and Practice in Ontario

Fabio Tonto, Project Manager
Edmundo Fausto, Project Manager

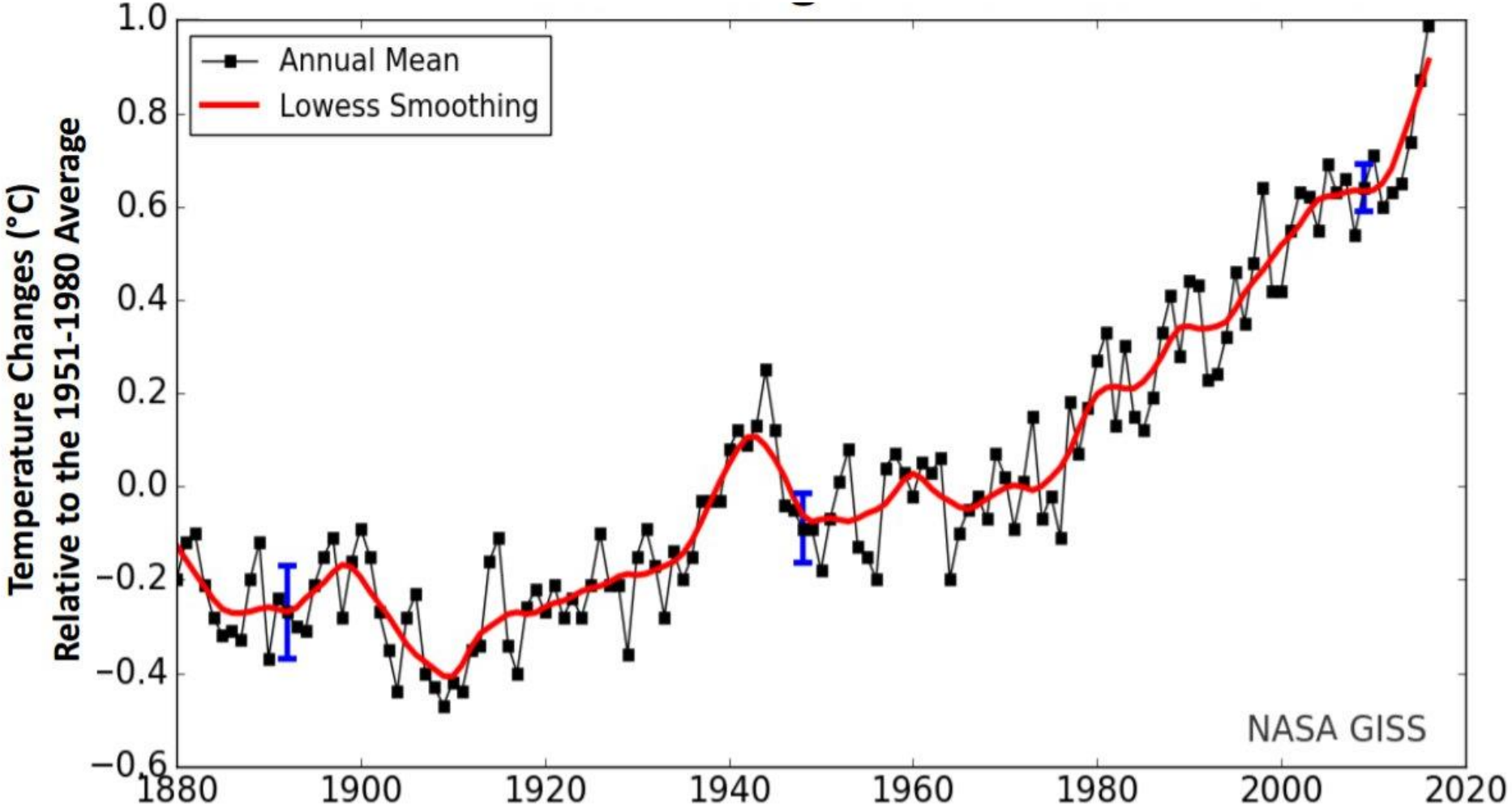
www.climateconnections.ca

With support from: YORK UNIVERSITÉ UNIVERSITY, McMaster University, Western, Region of Peel Working for you, University of Guelph, Toronto and Region Conservation for The Living City

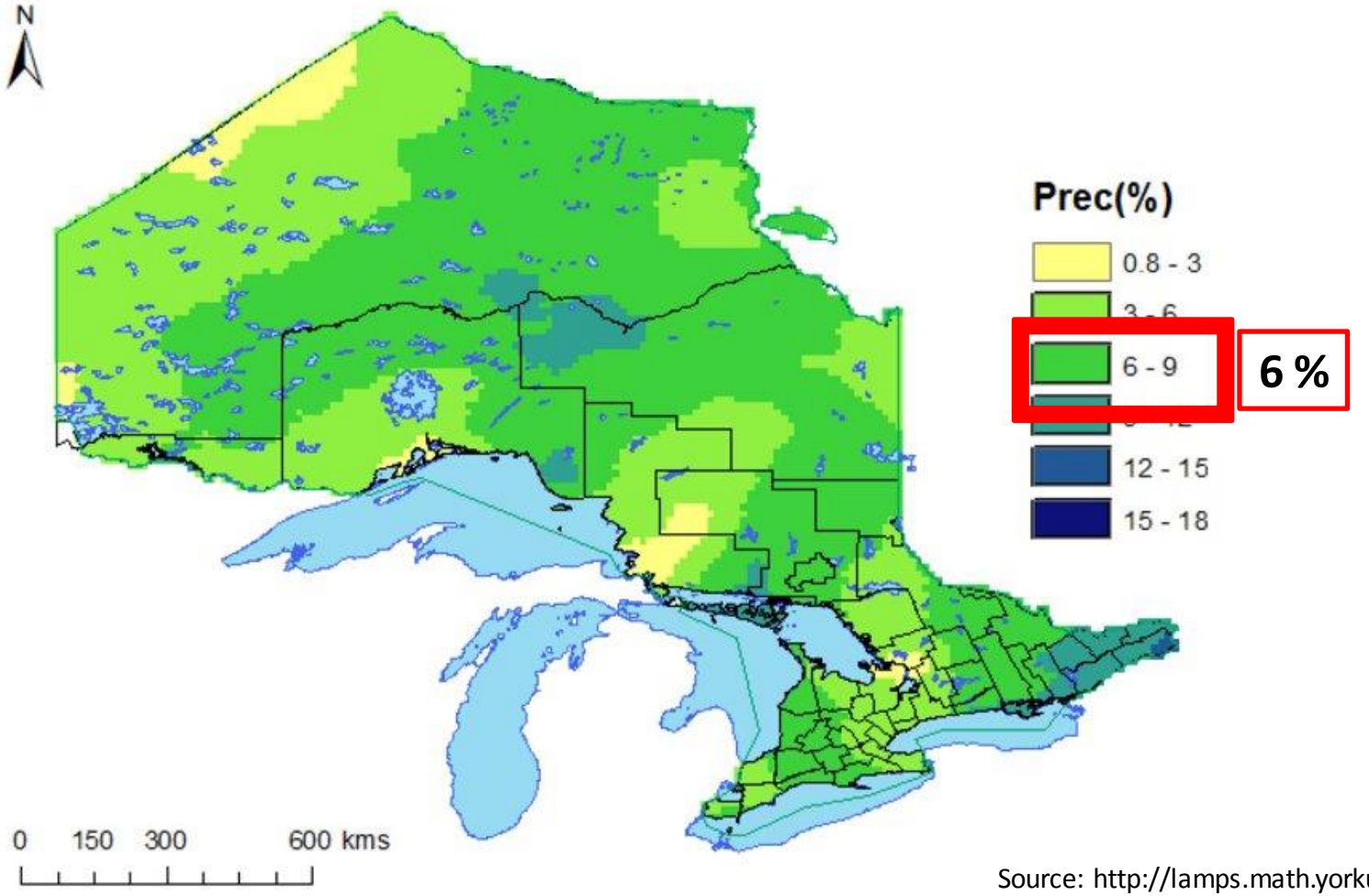
Today's Purpose

- Discuss The Issues and Risks
- Current Methods
- Updated Frameworks to Mitigate Risk

Global Mean Temperatures



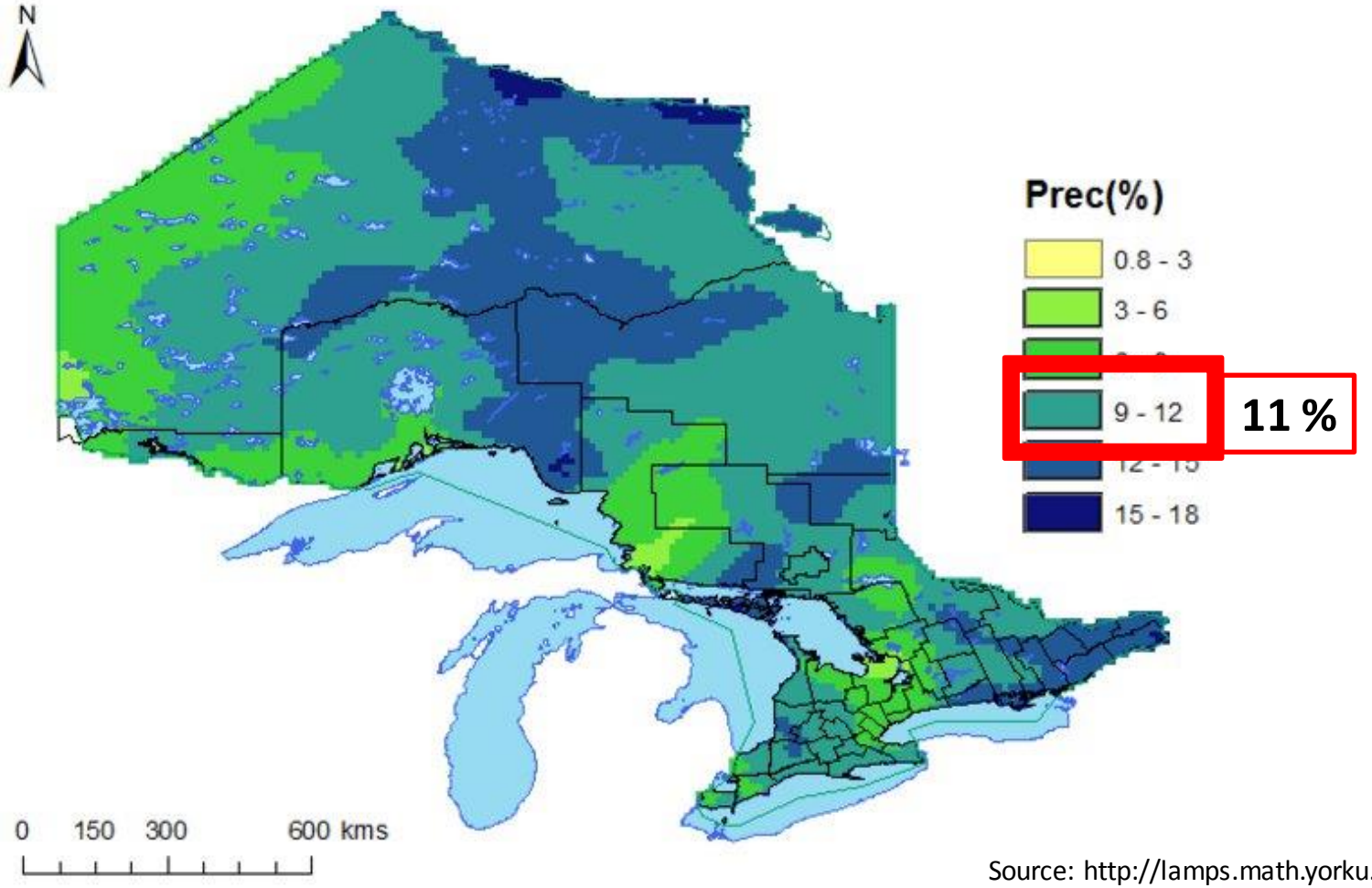
Precipitation changes on the way in Ontario (2050's)



Source: http://lamps.math.yorku.ca

Credit: Zhu and Deng (2014). *Ontario climate change projections*

Precipitation changes on the way in Ontario (2080's)



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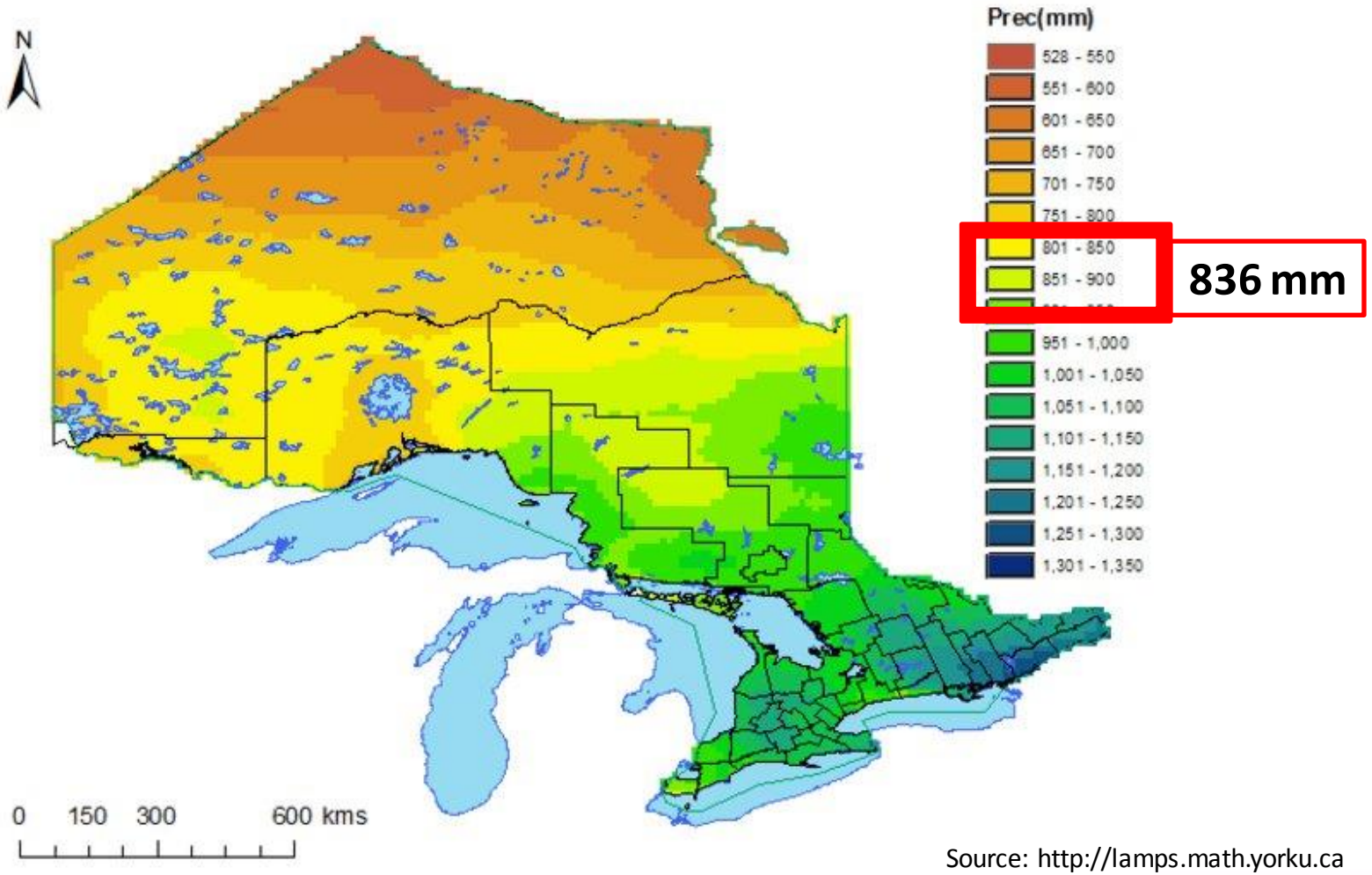
Precipitation changes on the way in Ontario (2050's)



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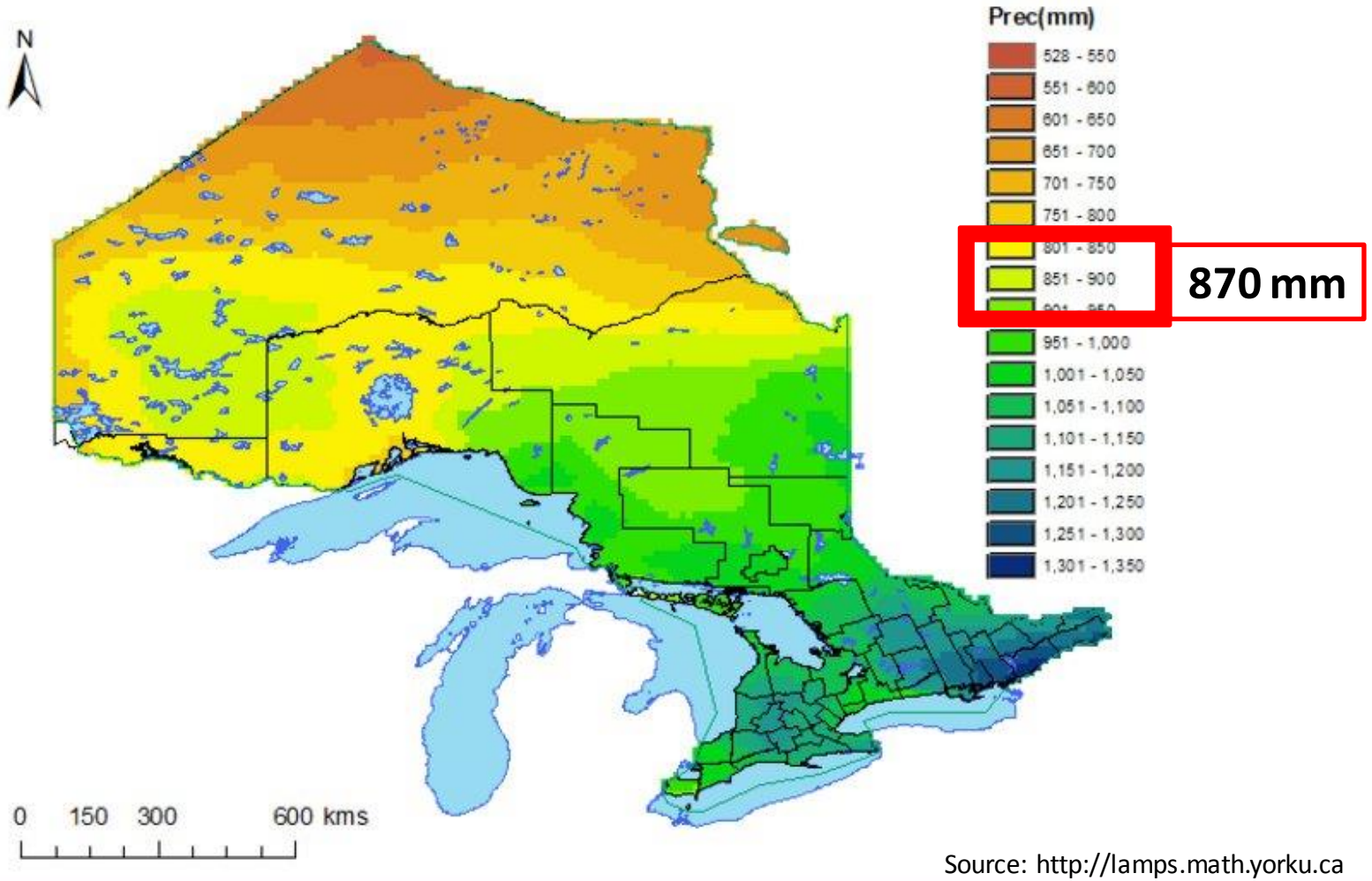
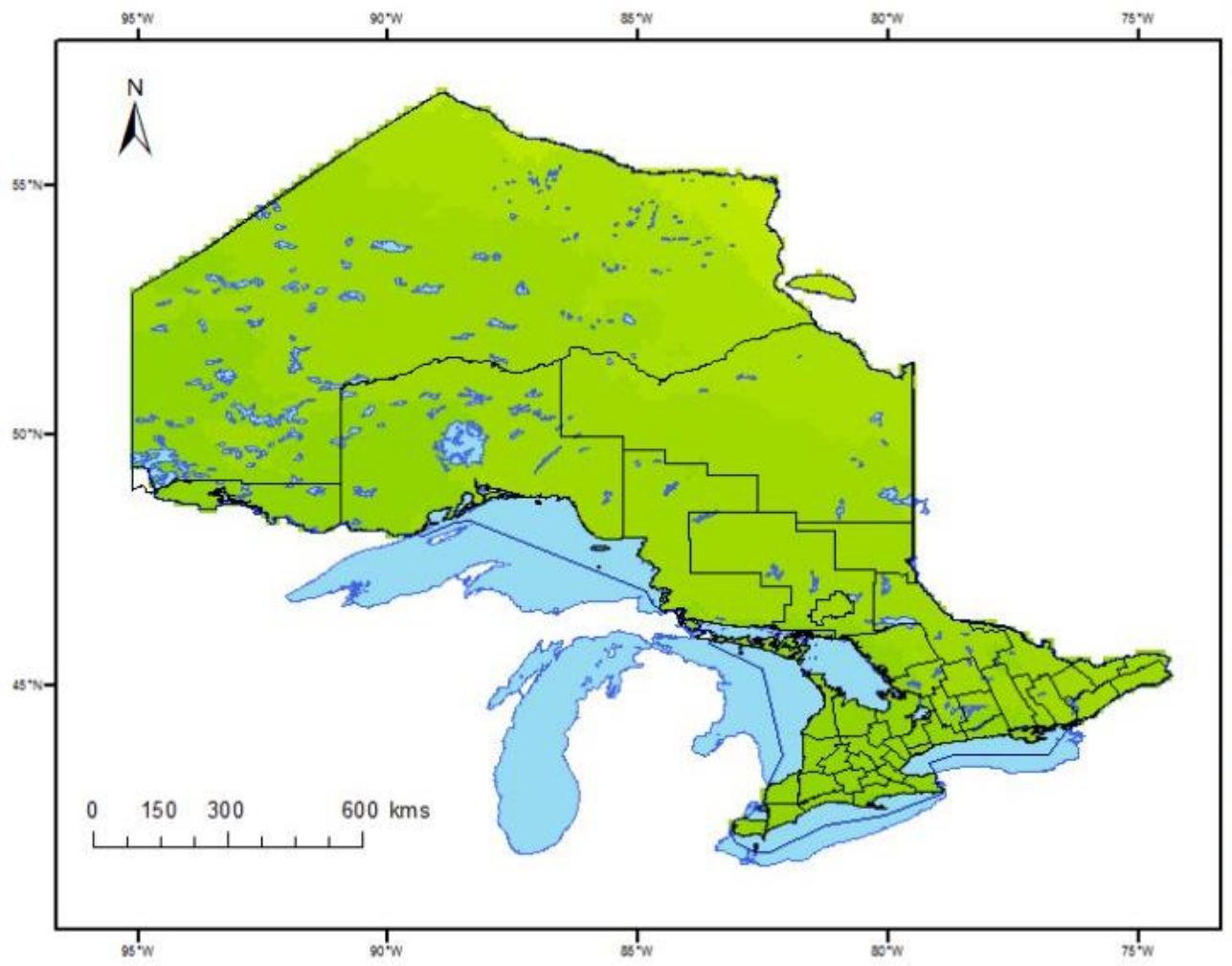
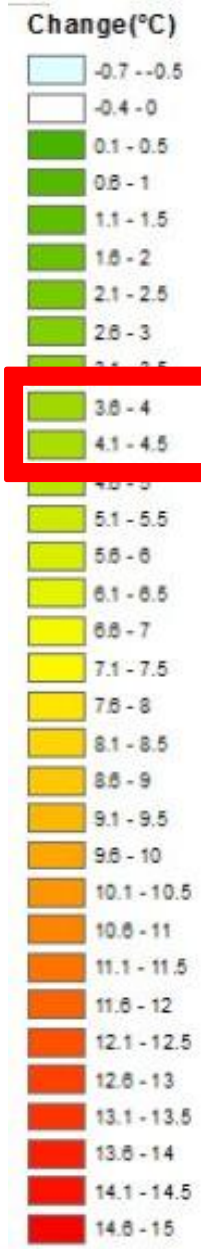
Precipitation changes on the way in Ontario (2080's)



Source: http://lamps.math.yorku.ca

Temperature changes in Ontario (2050's)

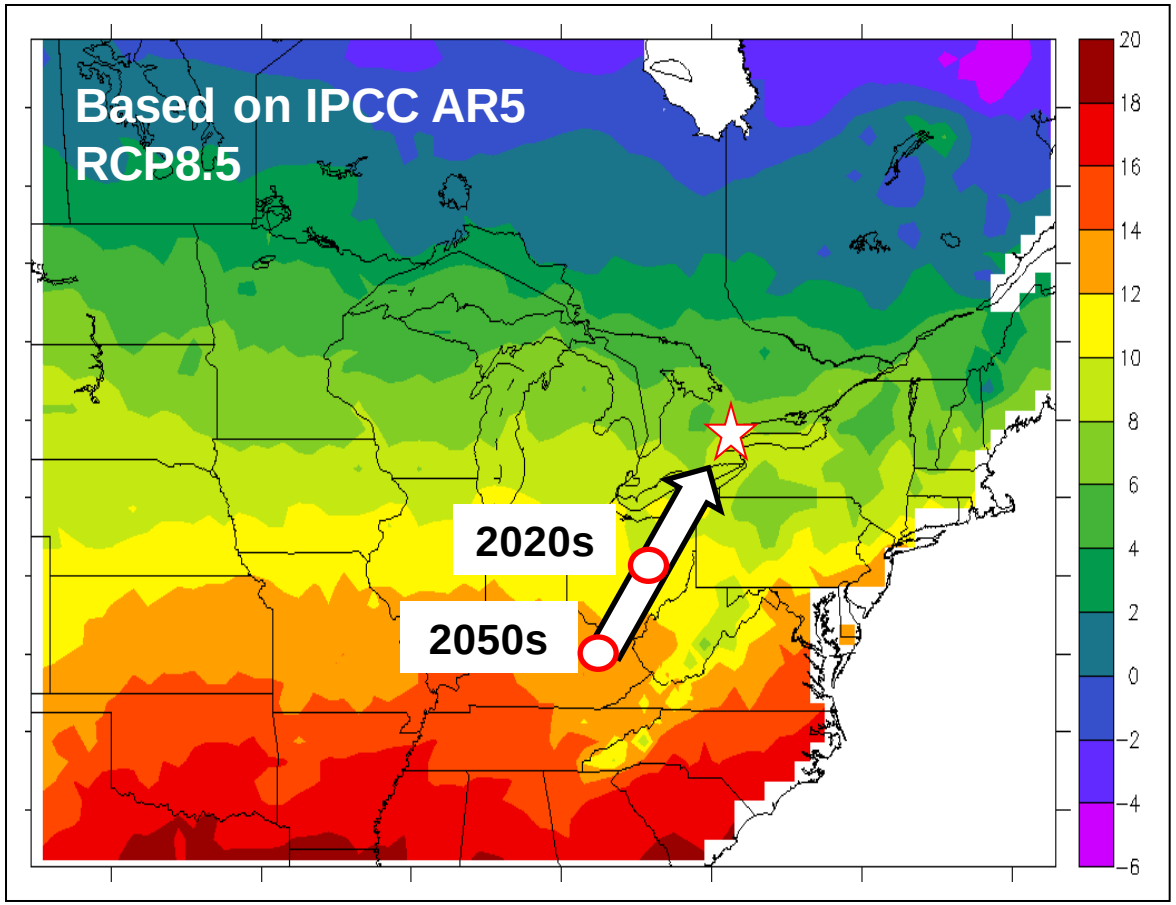




4 C

Source: http://lamps.math.yorku.ca

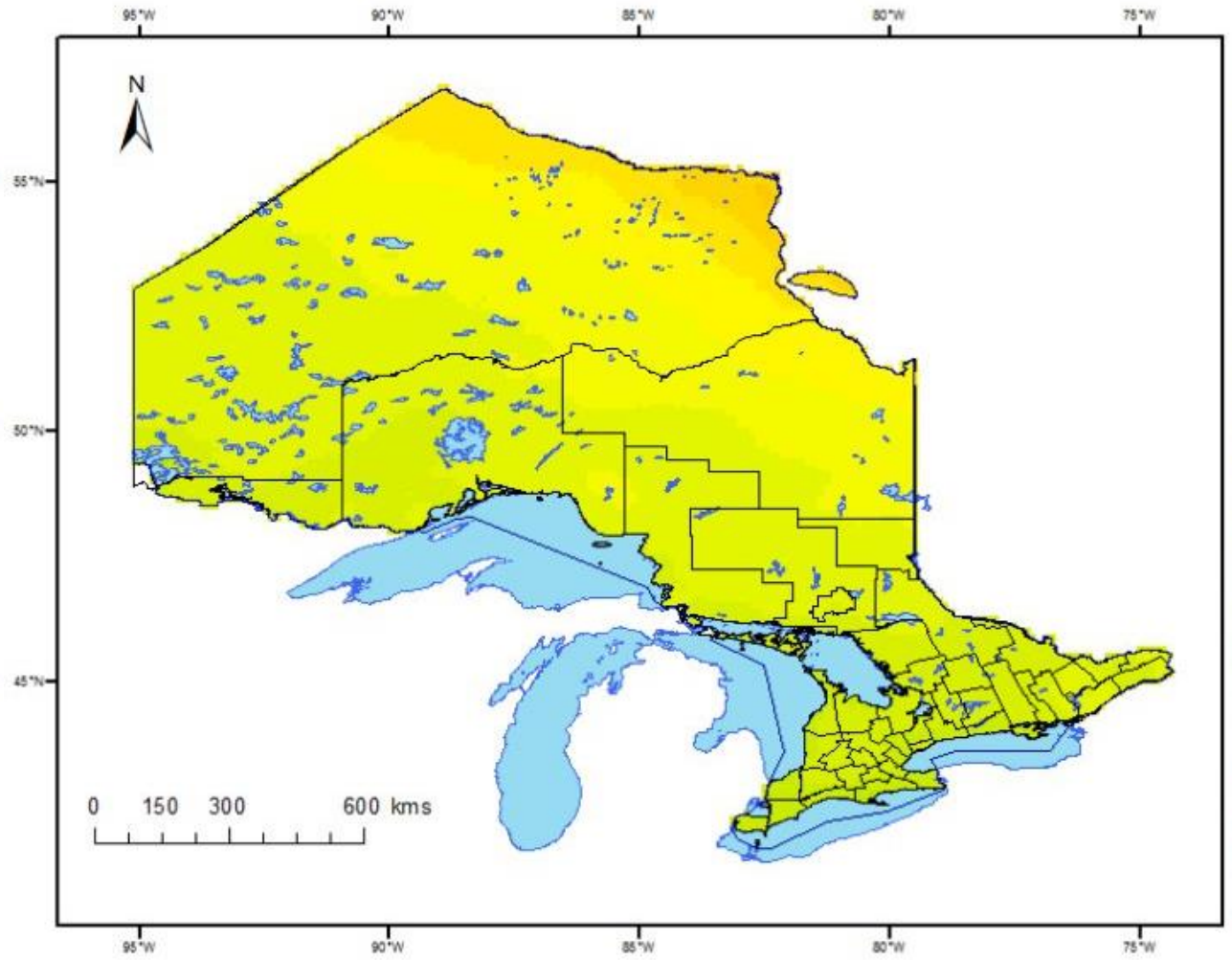
GTHA's Future Climate for 2020s and 2050s

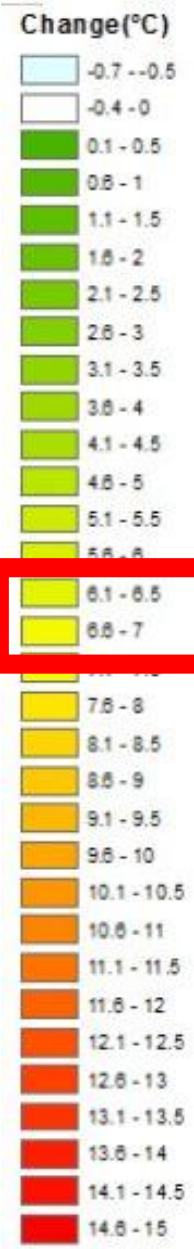


2020s: Ohio

2050s: Kentucky

Temperature changes in Ontario (2080's)

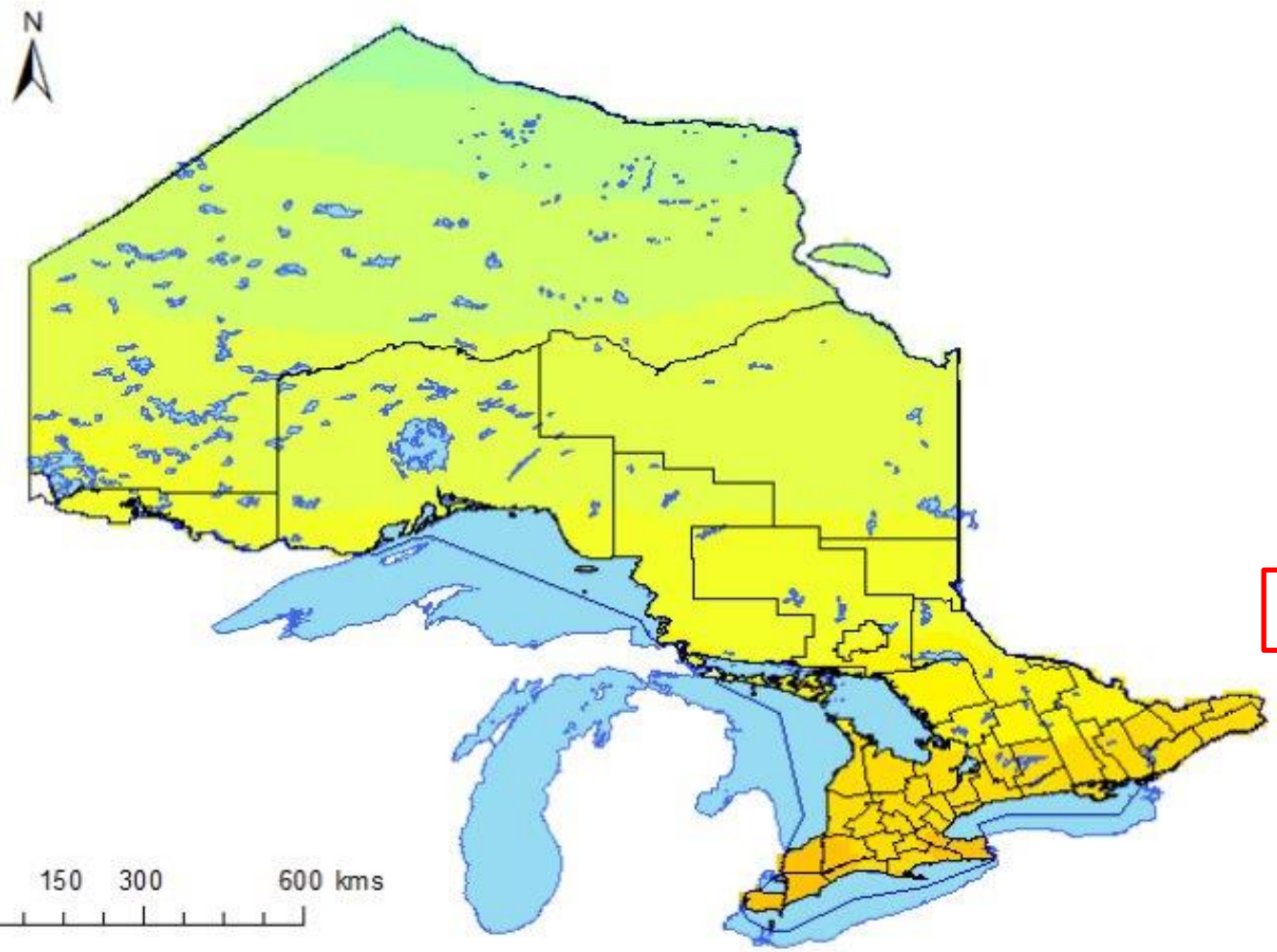


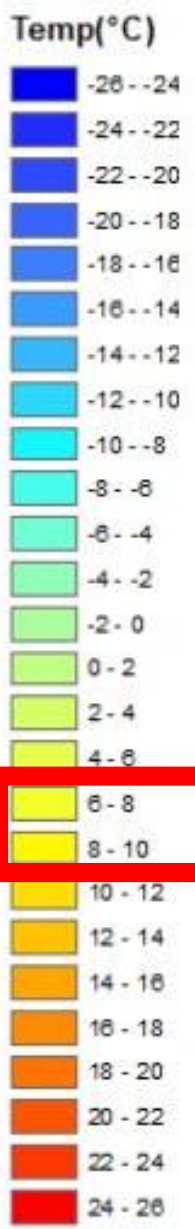


7 C

Source: http://lamps.math.yorku.ca

Temperature changes in Ontario (2080's)





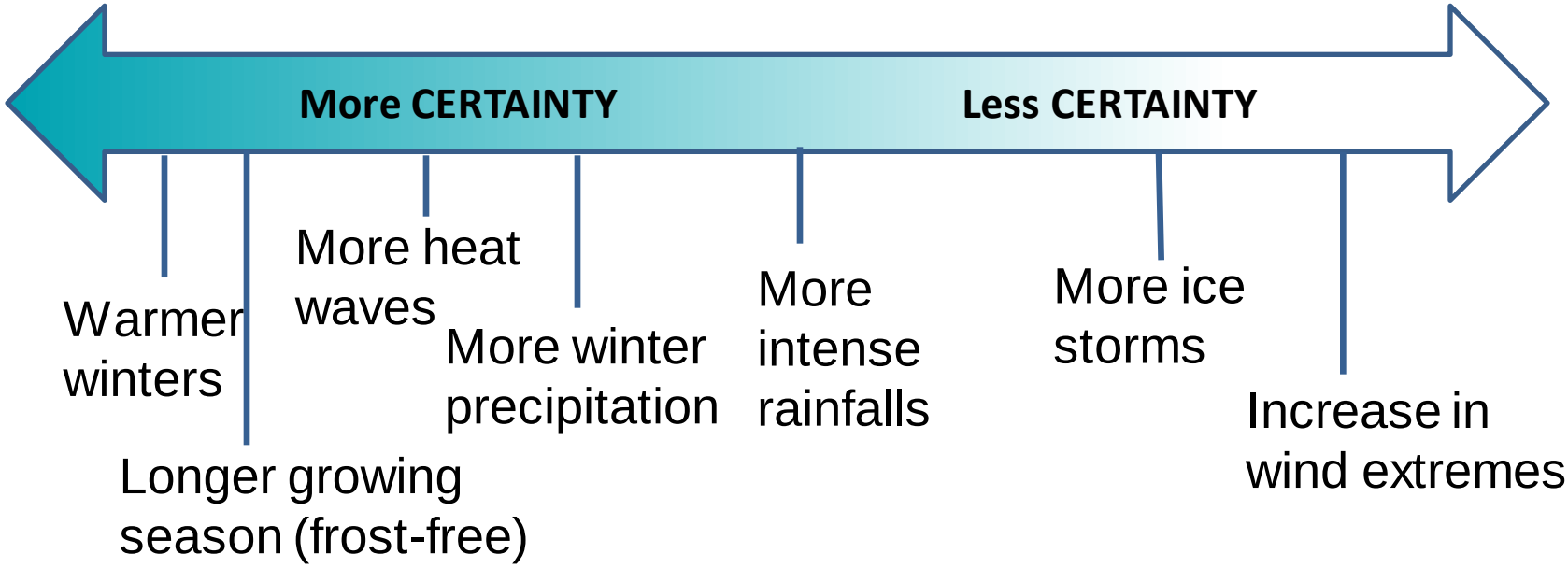
8.1 C

Source: http://lamps.math.yorku.ca

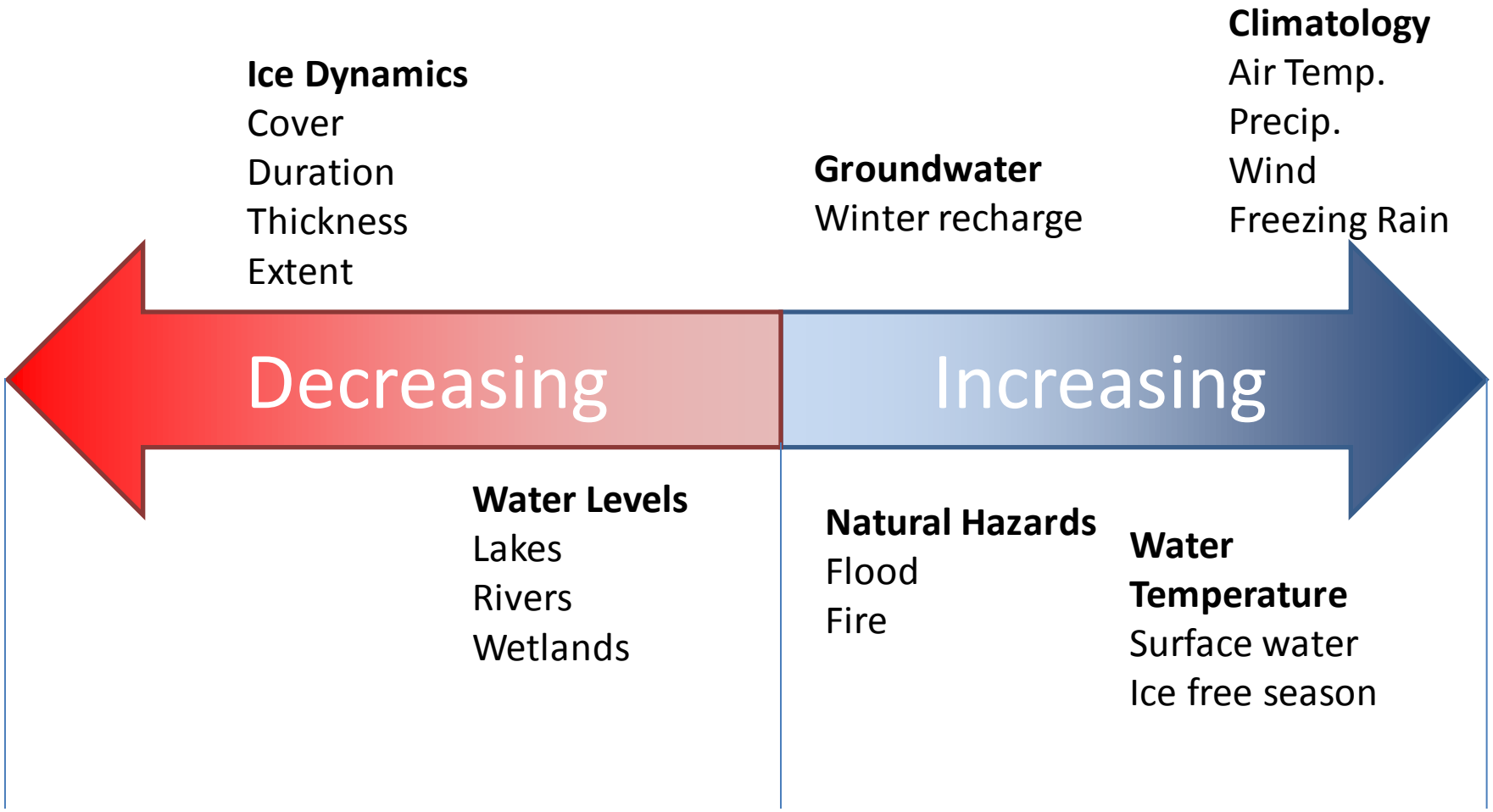
Uncertainty in Future Climate Projections

Climate models more effective at means and large-scale weather systems / storms

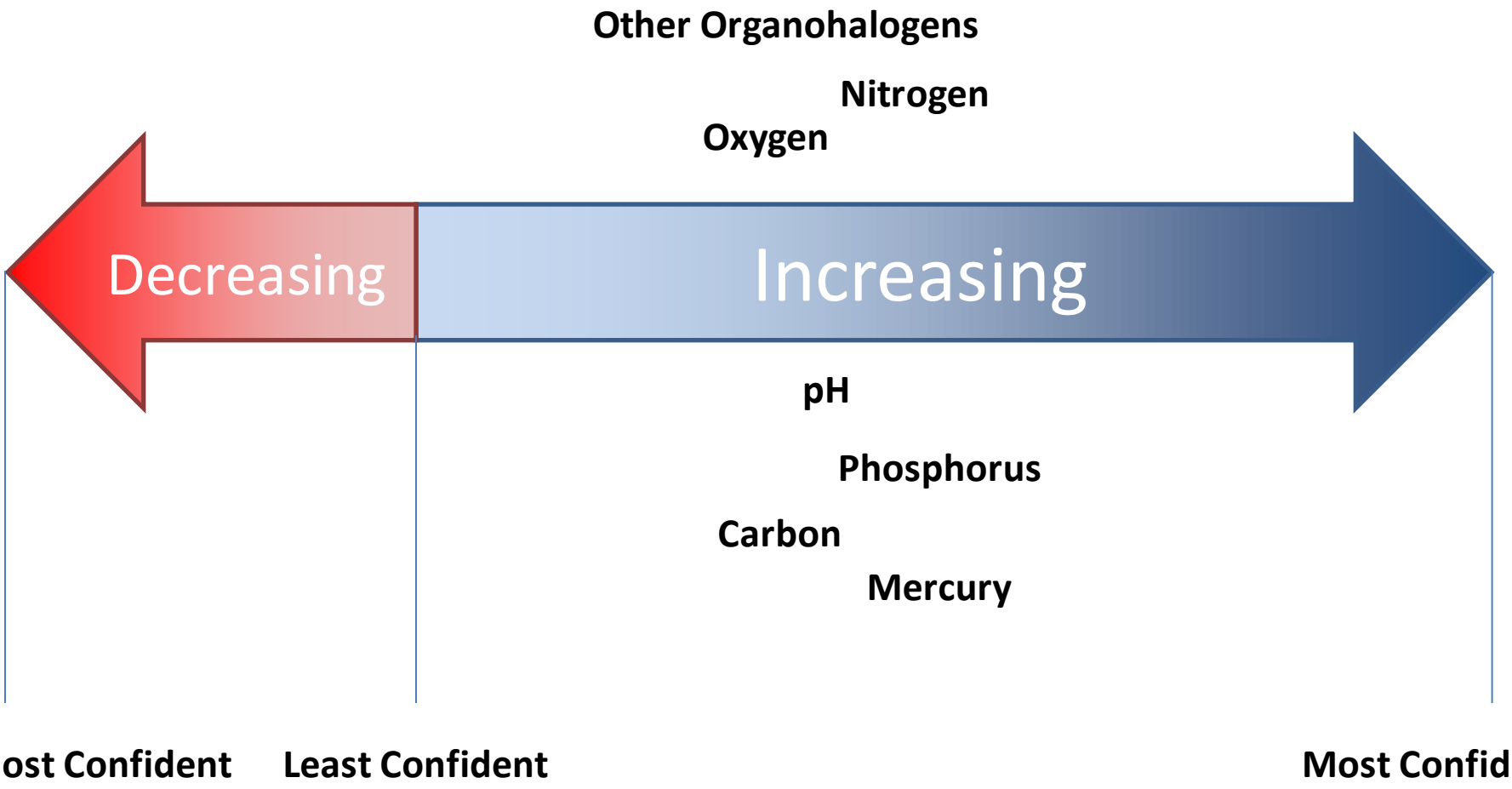
Difficult to resolve convective storms in climate models / historical analysis



Physical Effects



Environmental Chemistry & Pollutants



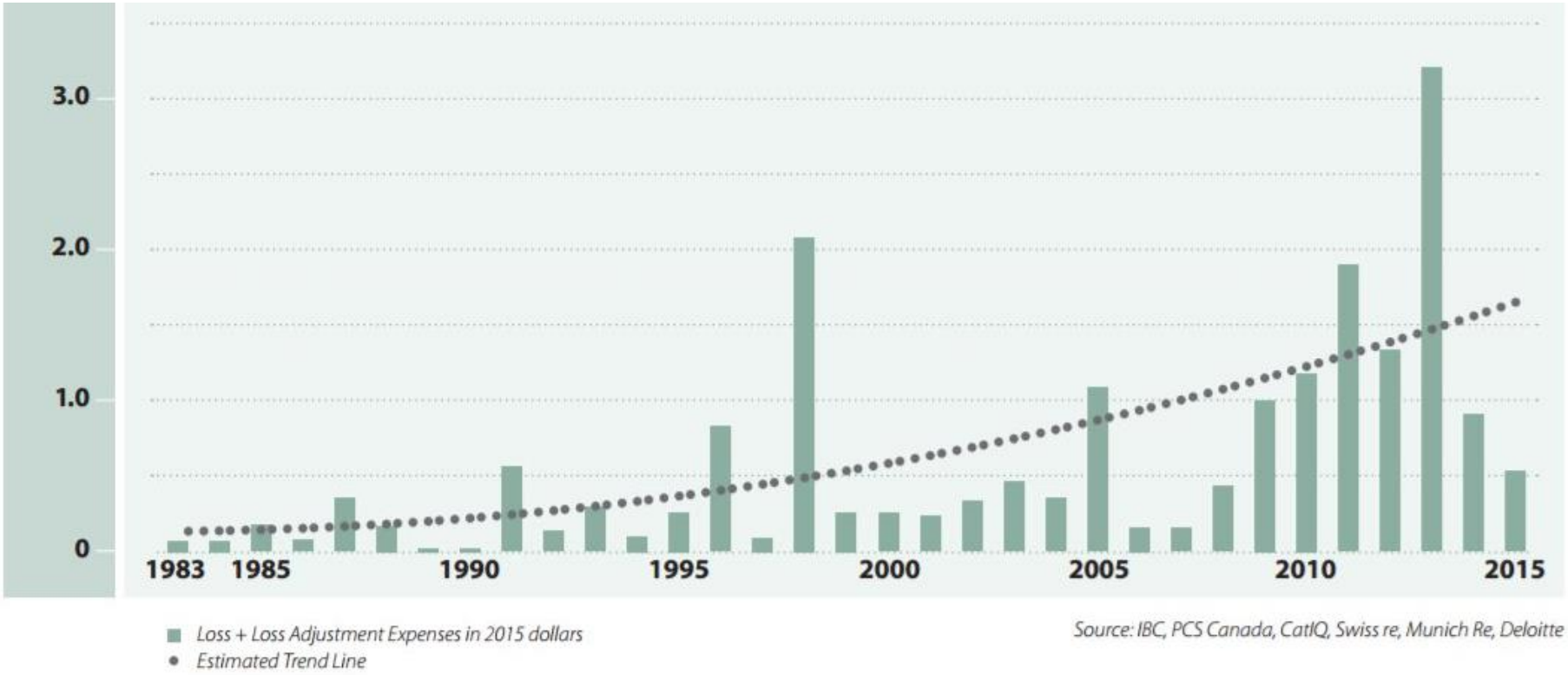
Catastrophic Insurable Losses

Major Events in Canada (2005 – 2014)

- 77 floods
- 31 convective storms
- 6 hurricane / tropical storms
- 4 winter storms

Source: (PBO 2016)

Catastrophic Insurable Losses

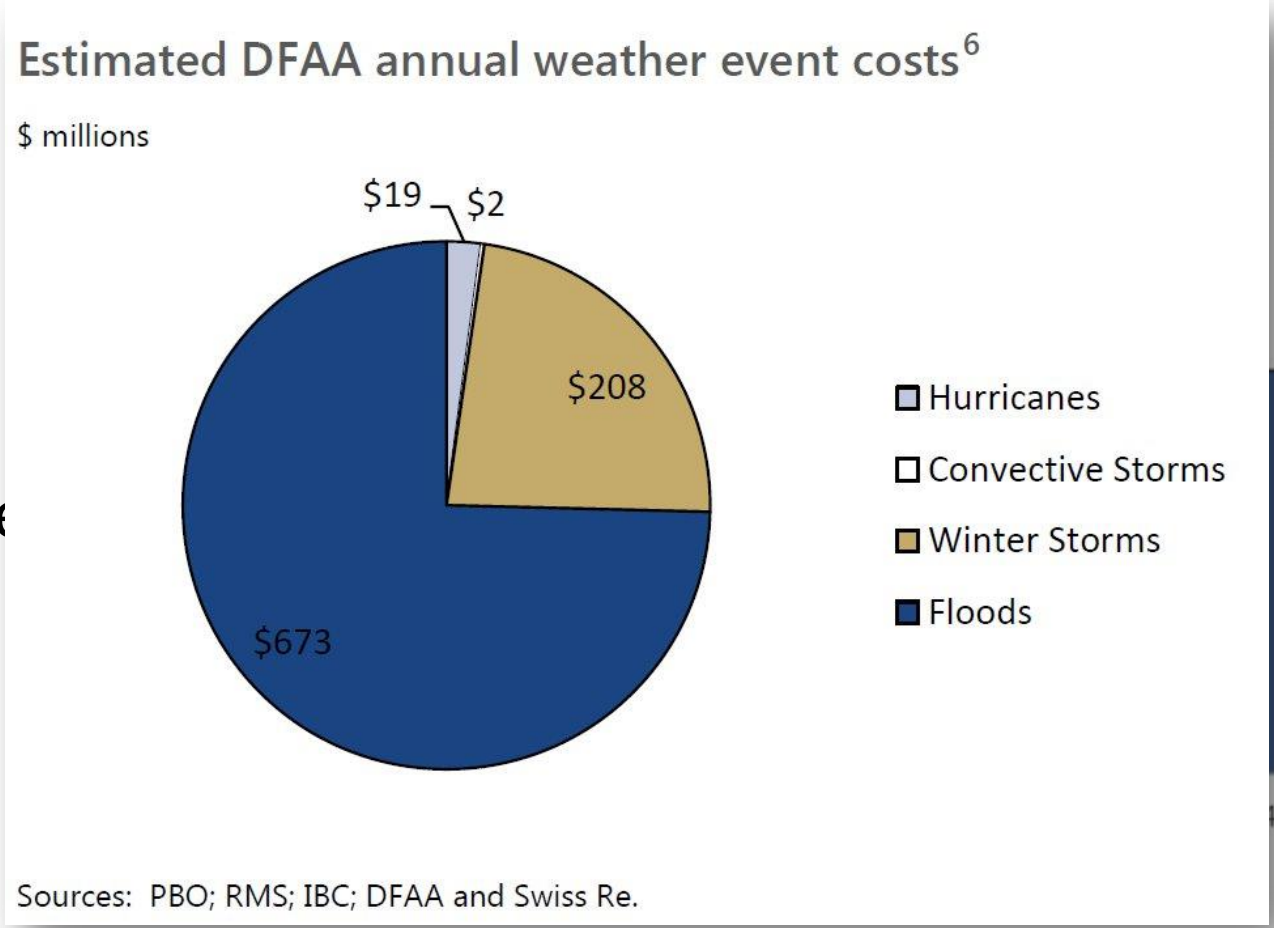


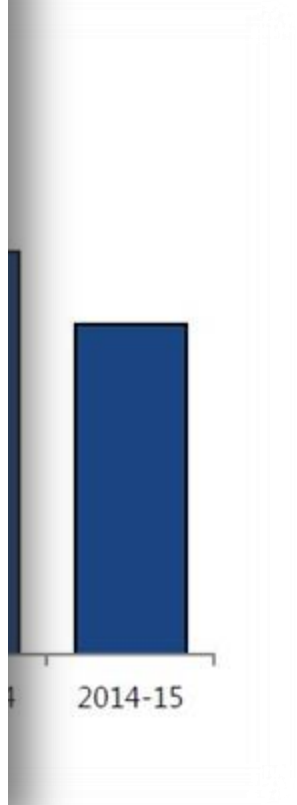
Milestone losses of past decade:

- Hailstorms in Alberta,
- Fire in Alberta,
- Toronto Rains and
- Icestorms

Disaster Financial Assistance

$100 Mil
Budge





Translating Climate Data into Information for Decision Makers

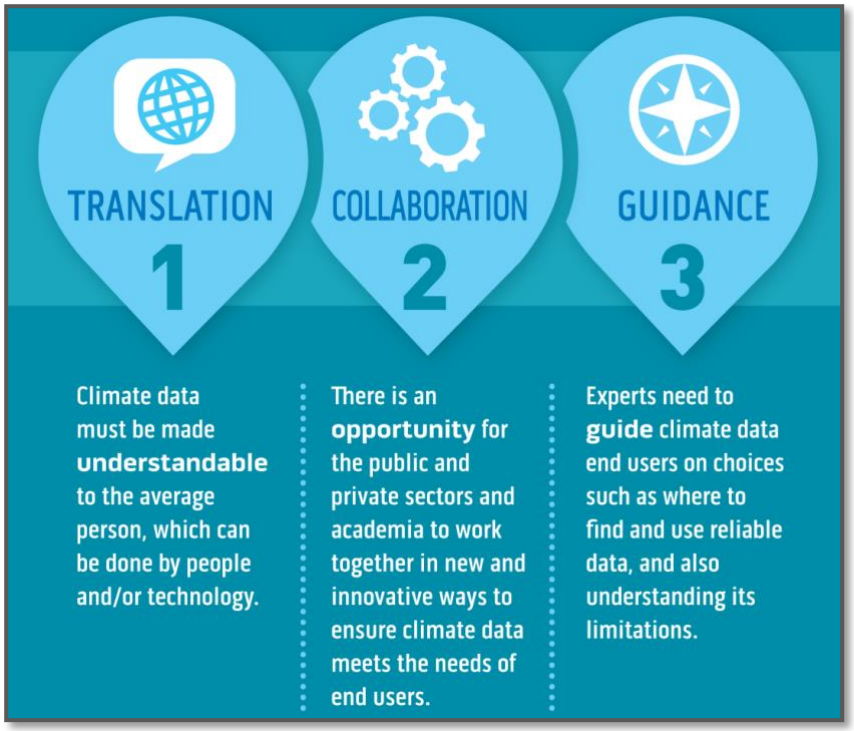
The Problem

Confusion with climate data slows adaptation

Data on climate change can get "lost in translation"

- Environmental Commissioner of Ontario, 2015

The Response



Response

1. Reviewing research on updating IDF curves to take into account climate change
2. Water Infrastructure Design for Adaptation
3. Risk and Vulnerability assessments - Edmundo

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Intensity-Duration Frequency Curve Study

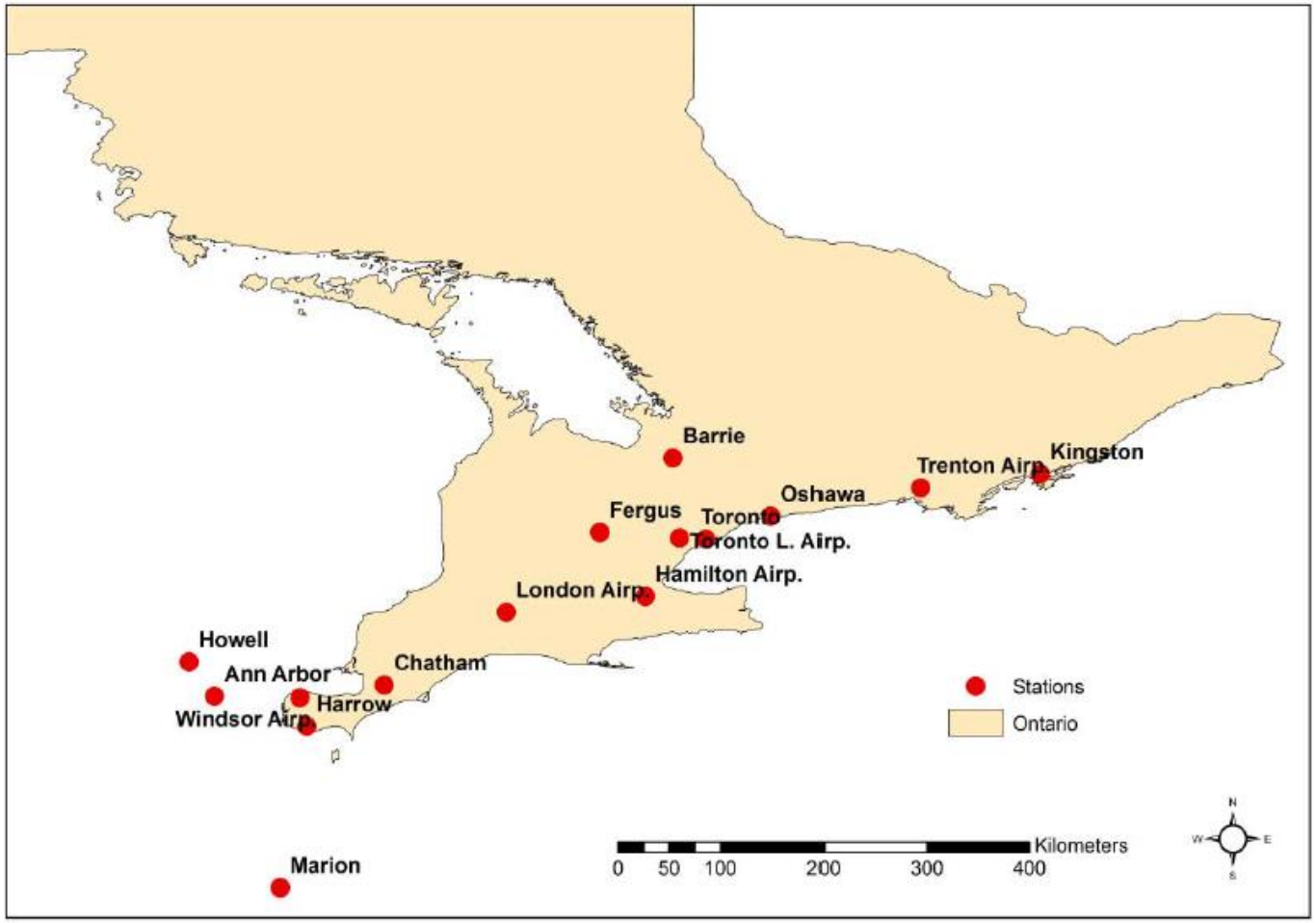
Partners

- Essex Region Conservation Authority
  - John Henderson and
  - Richard Wyma
- McMaster University
  - Dr. Paulin Coulibaly
- University of Waterloo
  - Dr. Donald Burn

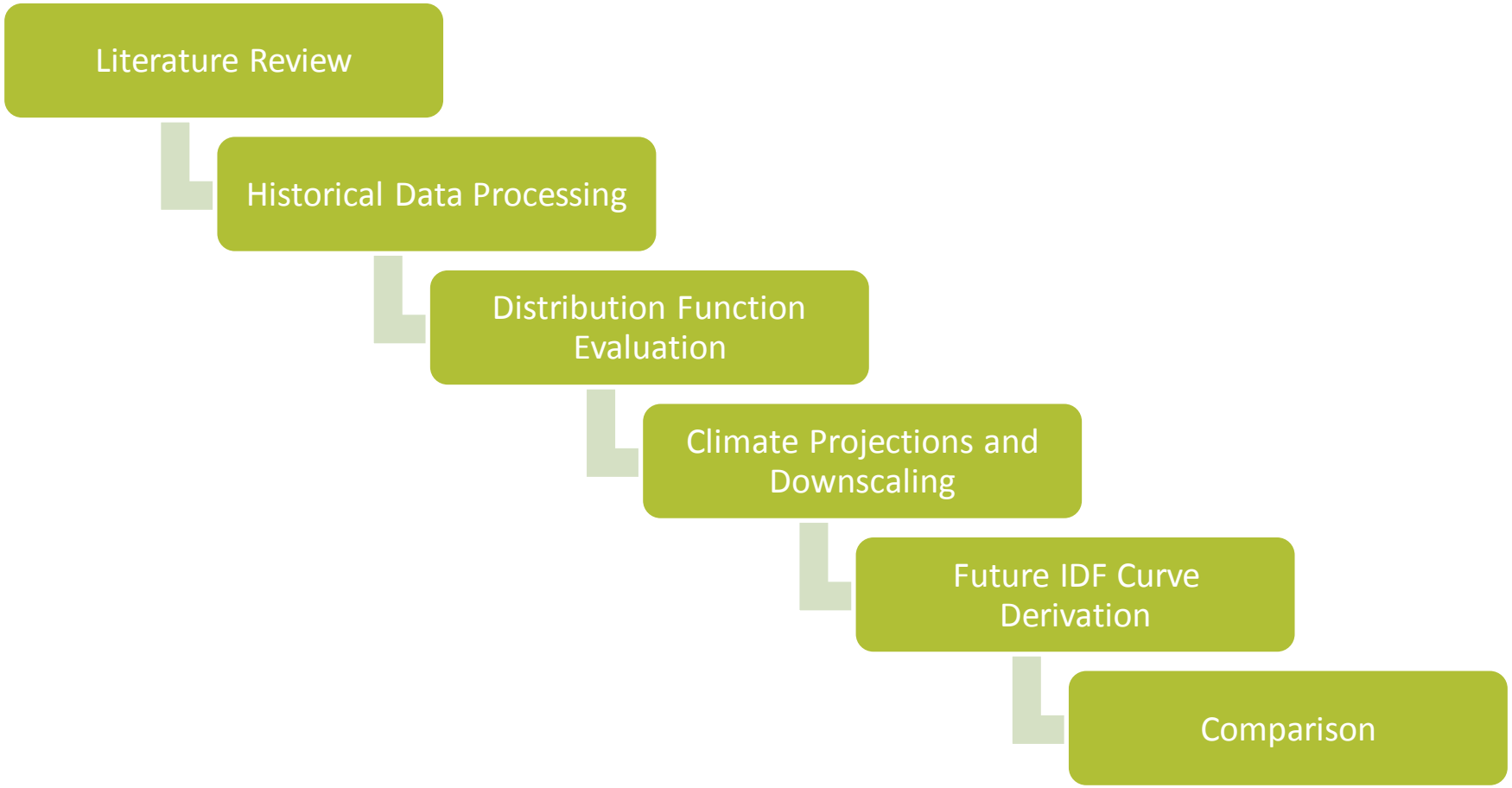
Study Objectives

- To understand the implications of using different methods for incorporating climate change into IDF curves
- To develop an approach to compare outcomes of different permutations of climate model outputs and IDF derivation methods
- To apply this approach to examine outcomes of alternate methods in Essex and Toronto regions

Study Sites


Barrie
Kingston
Trenton Airp.
Oshawa
Fergus
Toronto
Toronto L. Airp.
Hamilton Airp.
London Airp.
Howell
Ann Arbor
Chatham
Harrow
Windsor Airp.
Marion
Stations
Ontario
Kilometers
0 50 100 200 300 400
N
W
E
S

Approach


Literature Review
Historical Data Processing
Distribution Function Evaluation
Climate Projections and Downscaling
Future IDF Curve Derivation
Comparison

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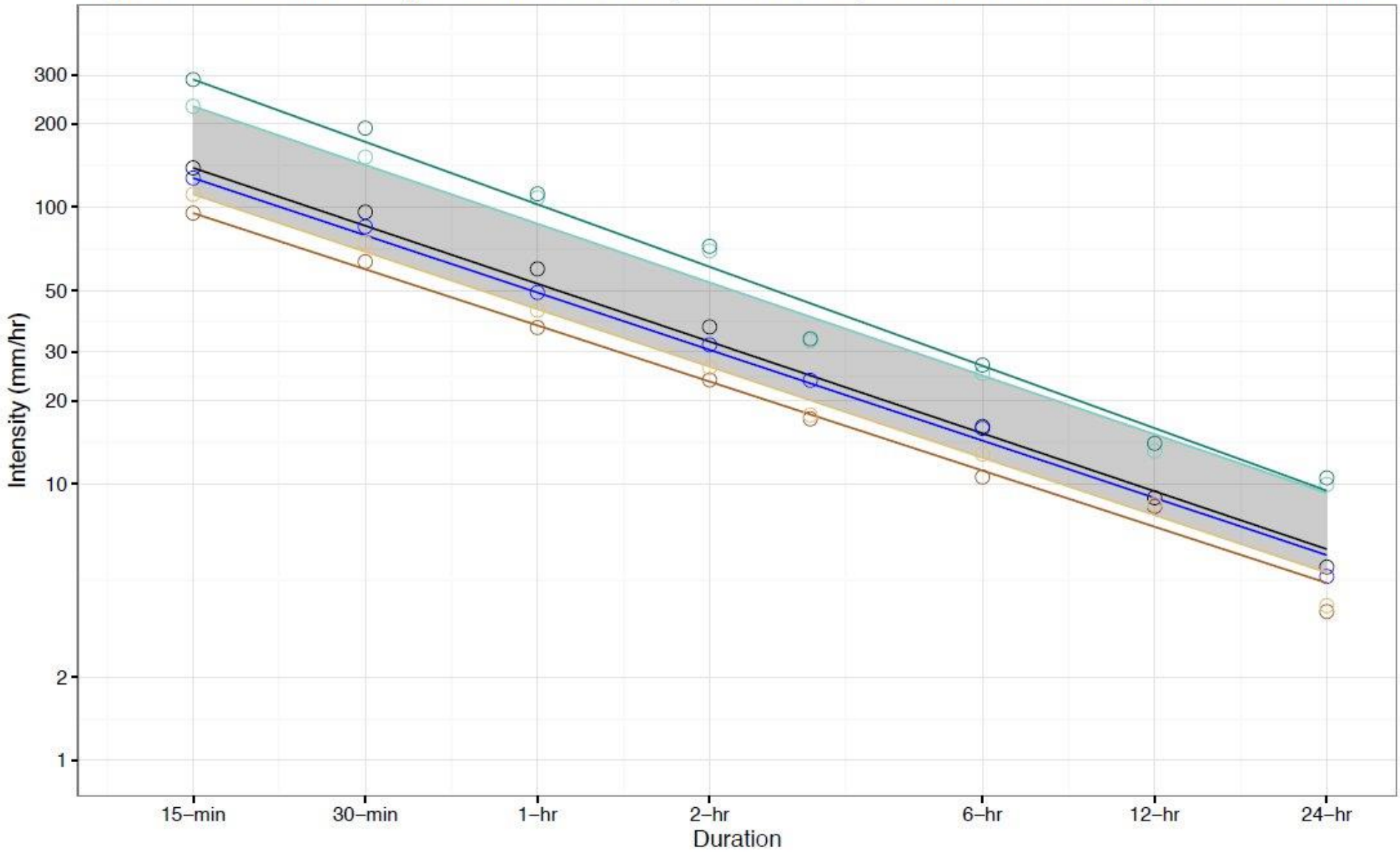
5
Climate Models

1-2
Emissions Scenarios

2
Downscaling Methods

16
Permutations

Figure A–18: IDF Curve Comparison for Pearson Airport, 2090s 100–year Return Period Event (10th–90th Percentile)



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Water Infrastructure Design for Adaptation

-in progress

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Discussion Points

1. Current Best practices in adapting stormwater infrastructure design to a changing climate
2. Systems Approach to Advancing Adaptation and Addressing Risk

Current Best Practices – IDF Curves

- Some jurisdictions have updated their IDF curves using future climate model outputs to consider climate change.
  - What techniques did they use?
  - What guidance has been provided in the use of IDF (current or updated) that may facilitate their use while considering climate change?
  - What is the confidence in the proposed IDF curve solution?

Current Best Practices – Case Studies

- Best practice or case studies that demonstrate decision making processes and actions taken to adapt infrastructure design to a changing climate
  - Why were these approaches taken? Are there any concerns of this approach?
  - How has the uncertainty of climate change projections been taken into account?

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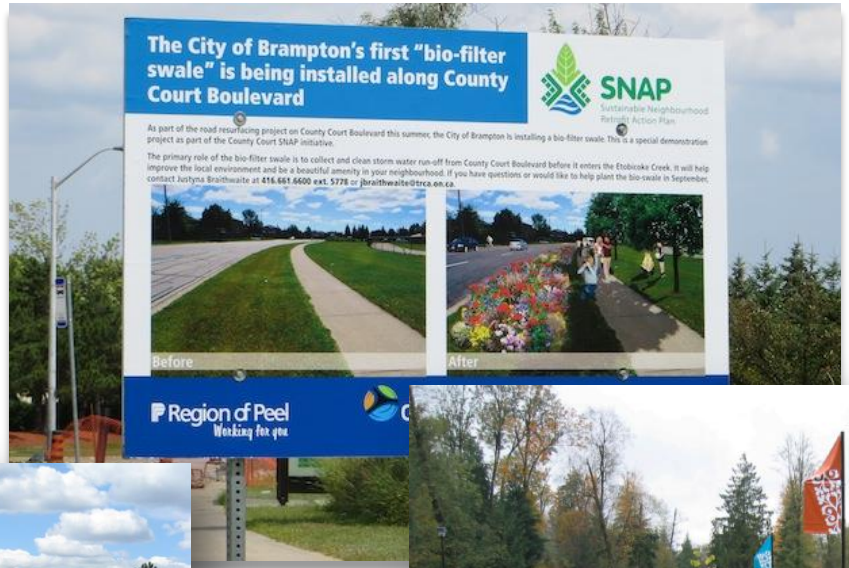
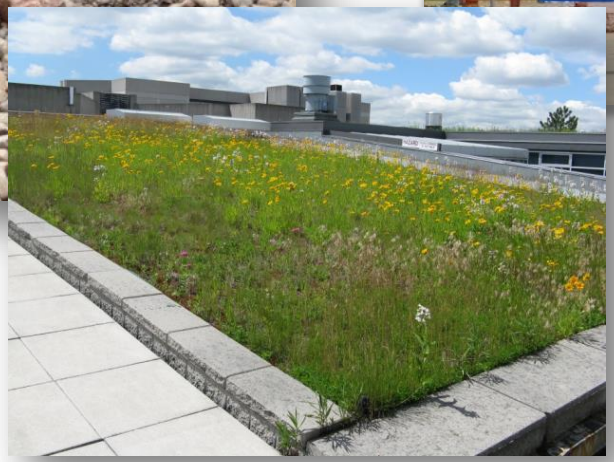
Flexible Solutions with Multiple Benefits





Systems Approach – Temporal/Spatial

- How might the temporal aspect of climate change over the life of the stormwater system be taken into account when replacing infrastructure?

- Is it possible to develop an approach that minimizes the cost of replacing infrastructure while maximizing benefit? How might that be designed?

Risk and Vulnerability Assessments

So What Does The Response Look Like?

↓ Vulnerability = ↑ **Resilience**

- System attributes make it more/less vulnerable or resilient to climate events, including change.

It's Physical Condition

Institutions Governing

People Influencing

*"It is estimated that **one** US dollar invested in anticipatory measures can save up to **7** US dollars in future relief costs"*

- UNFCC

Risk and Vulnerability Assessments
How Vulnerable Am I?

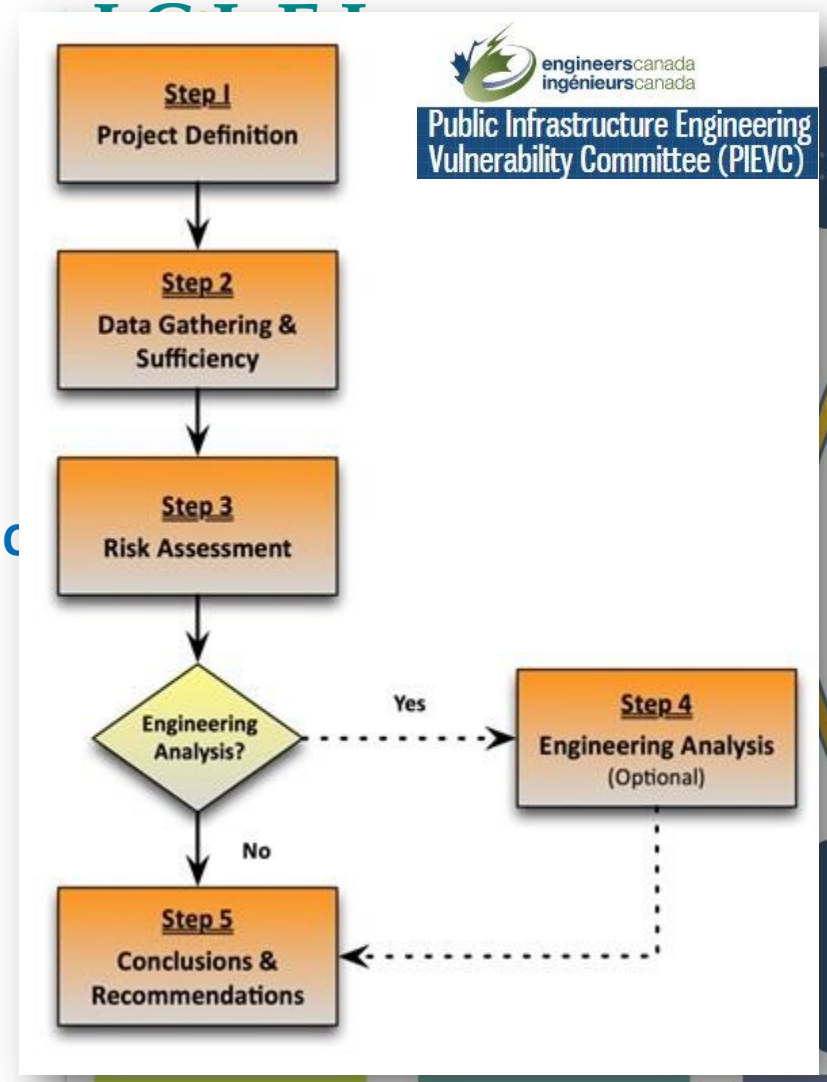
Ice storms

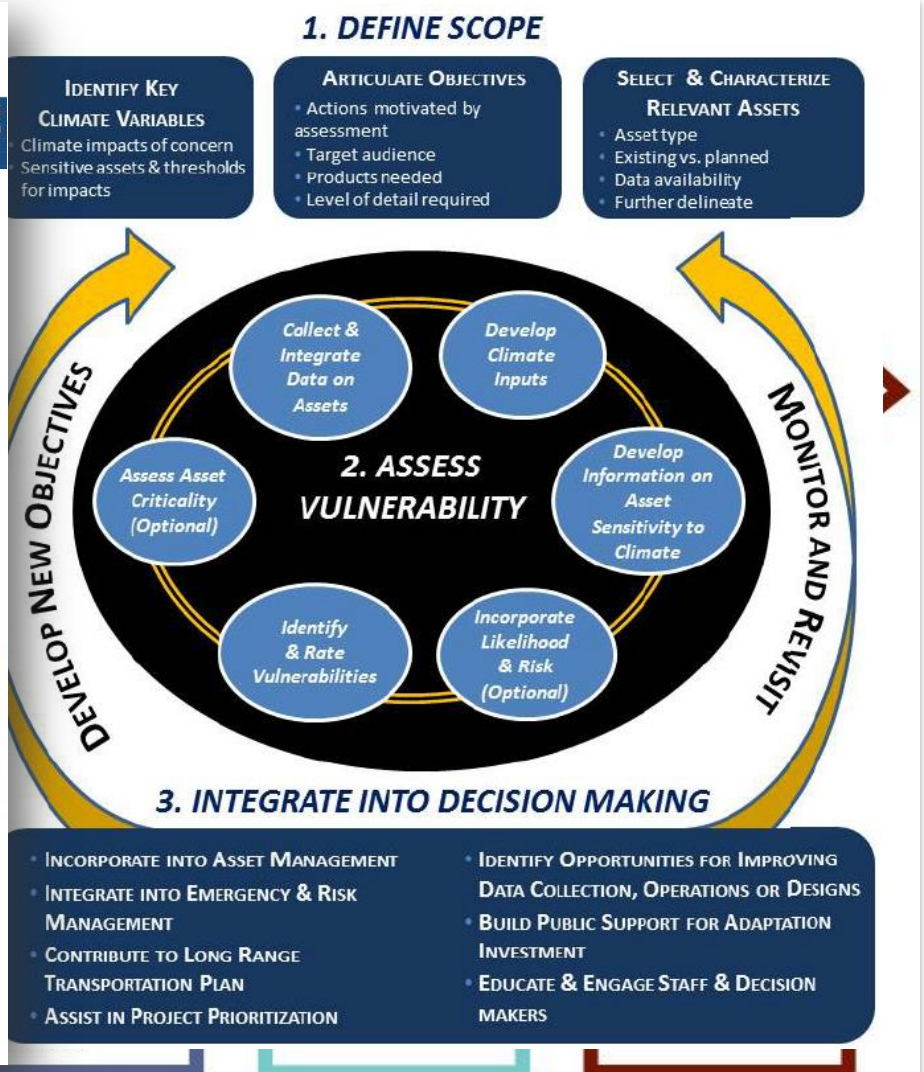
Extreme rainfall

Extreme heat

Tornadoes and other high wind events

Reporting
and
Recommendations





8 CHANGING CLIMATE, CHANGING COMMUNITIES

Government's & Municipalities' Efforts

- System Risk & Vulnerability Assessments
- Standardized Heat Alerts
- Updates on Public Health Standards
- Sustainable Development Initiatives (e.g. LID)
- Flood Plain Updates
- Monitoring Programs
- Adaptation and Mitigation Inclusive sustainability Master Plans

Vulnerability Factors (P-CRAFT)

Vulnerability Factors for the Stormwater System

Stormwater Pipes

Asset Category	Vulnerability Factor	Rationale
Stormwater pipes		
Stormwater pipes		

Asset Category

Stormsewers (Pipes)

Vulnerability Factors

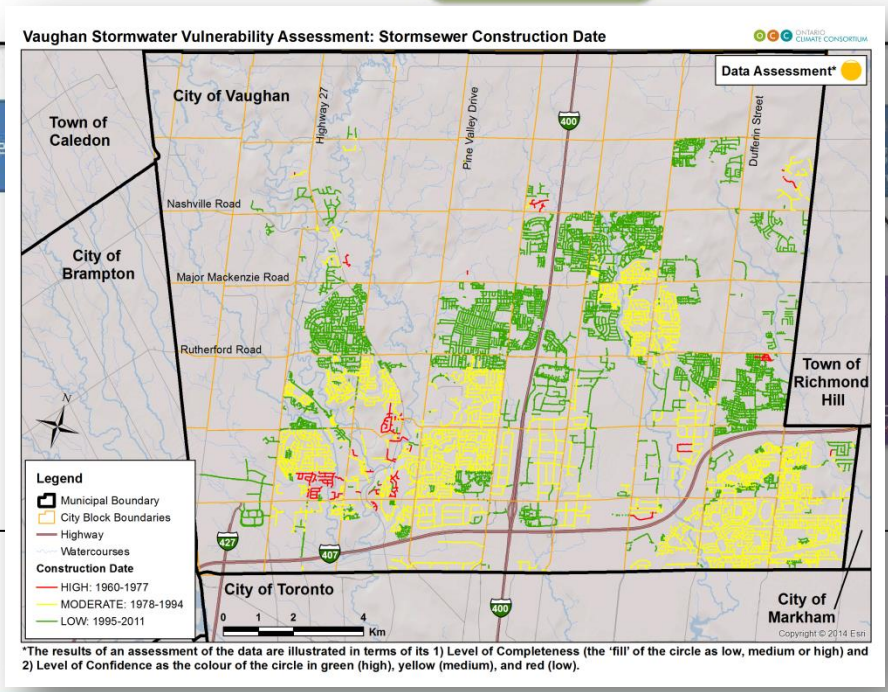
Structural Issues

Vulnerability Indicators

Identified Defects and Floodcalls

Science

Knowledge



Estimating Risk

Present

Future

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Thank-you!

For more information, please visit:

http://climateconnections.org

Contact Email:

ftonto@trca.on.ca

efausto@trca.on.ca