Are You Prepared for the Next Winter Storm?

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AIR WORLDWIDE®

Look Back at the Recent Winter Season

- Temperatures in Feb. 2015 broke records
- First half of 2015 had losses dominated by winter storms affecting NE U.S. and Canada
- Overall losses: ~USD 4.3bn
- Insured losses: ~USD 3.2bn
- Winter storms in Feb. in U.S. and Canada: ~USD $1.8bn in insured losses

2015 – A Cold and Snowy Season

Winter of 2015 will be remembered for the numerous storms that tracked through the Maritimes in Canada, leaving behind some staggering tallies on snowfall totals

Saint John, NB

2015 – A Cold and Snowy Season

Winter of 2015 will be remembered for the numerous storms that tracked through the Maritimes in Canada, leaving behind some staggering tallies on snowfall totals

Boston, MA

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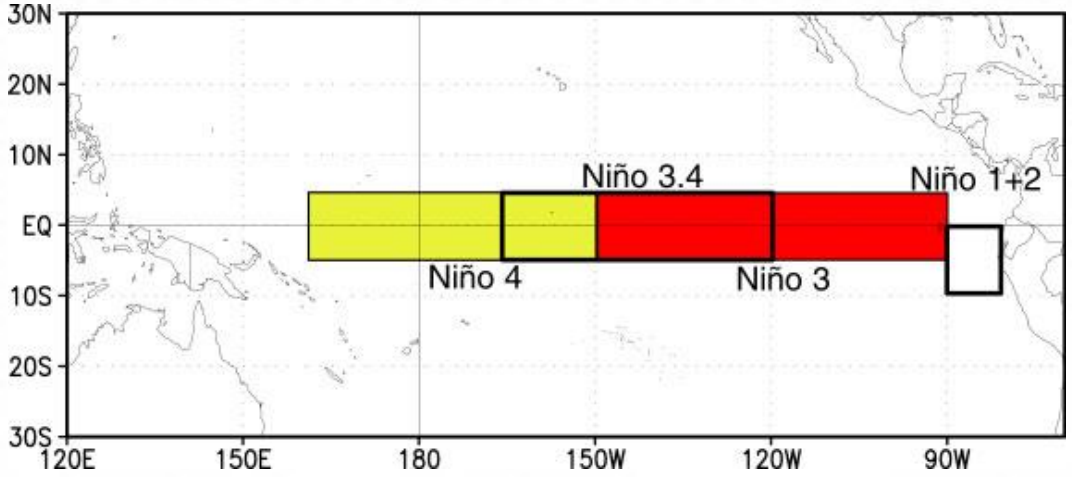
Winter of 2015 will be remembered for the numerous storms that tracked through the Maritimes in Canada, leaving behind some staggering tallies on snowfall totals

Boston, MA

We Are Currently in a Strong El Niño

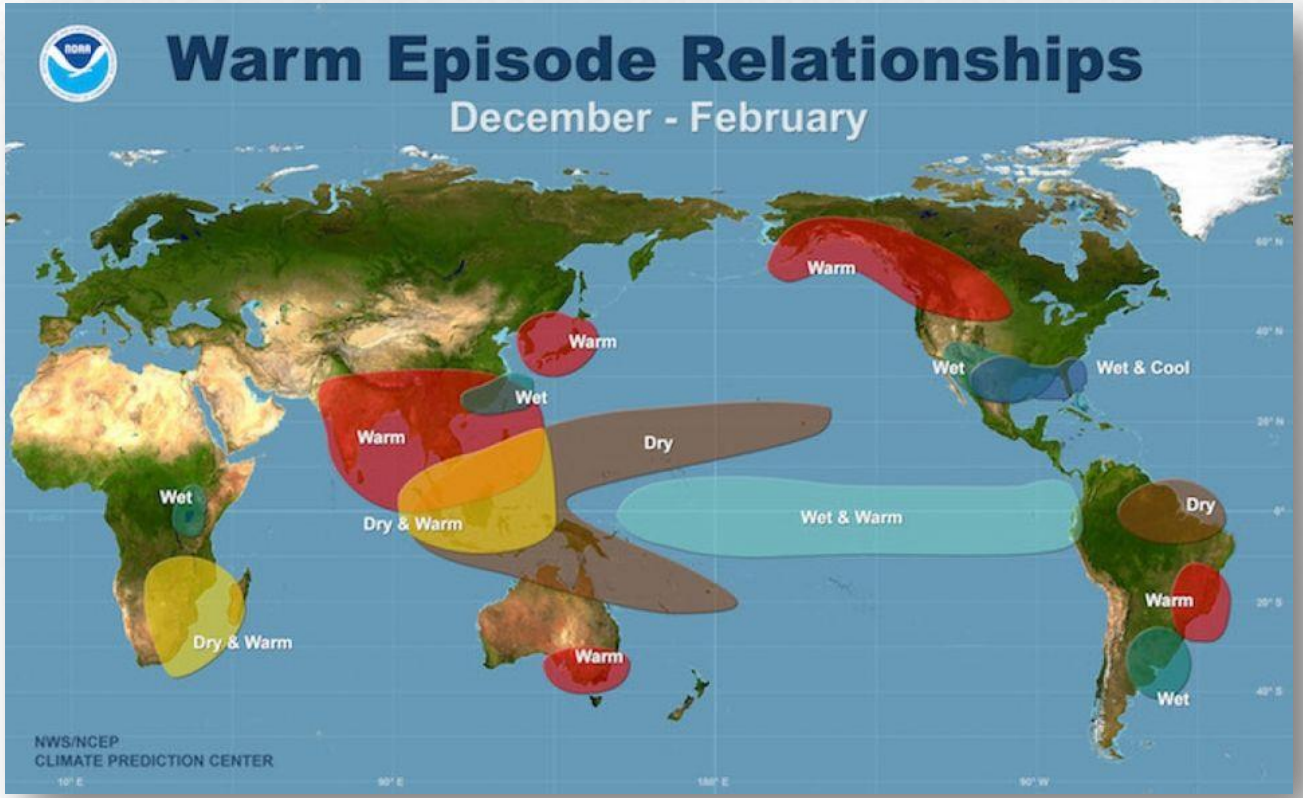
El Niño is a warming of the central to eastern tropical Pacific Ocean

It is measured by sea surface temperature averages, typically in the Niño 3.4 region



Source: Golden Gate Weather Services

El Niño Affects Weather Outside of This Region, Including Canada



What's in Store for this Winter Season?

Strong El Niño

- Historically associated with mild temperatures, and less precipitation

Mild winters do not necessarily mean storm-free winters

- The 1998 Ice Storm occurred during a strong El Niño event.

An Overview of the AIR Winter Storm Model

Comprehensive Vulnerability

Multiple Sub-Perils

TOUCHSTONE®

Historical and Stochastic Viewpoints

Winter Storm Model - Hazard

AIR

How Does AIR Classify a Winter Storm?

AIR's event definition of a winter storm:

- Region of low pressure and cyclonic rotation within the contiguous US and/or Canada
- Typically associated with winds or snow in excess of 20 m/s or 20mm, respectively

Source: Bill Jarvis, 2011

AIR's Canada Winter Storm Model Explicitly Accounts for Ice Storms and Other Winter Perils



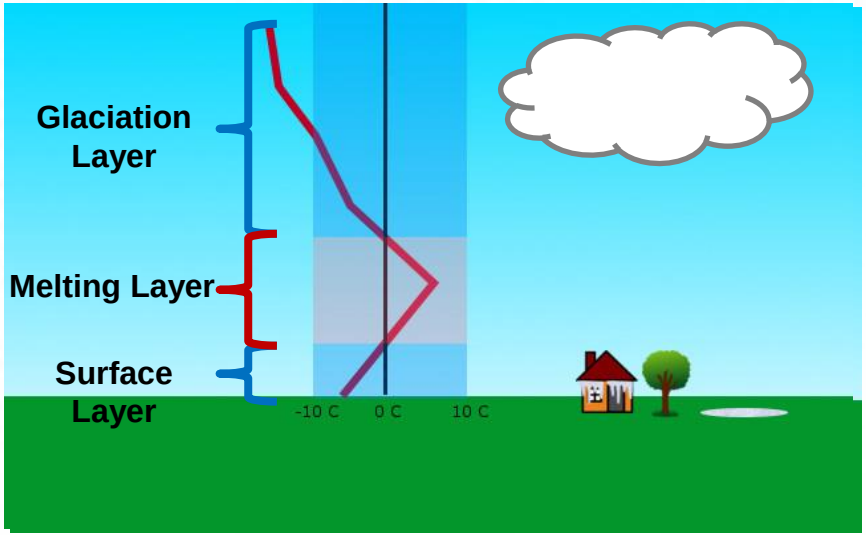

Wind

Freezing Temperatures

Snow and Freezing Rain

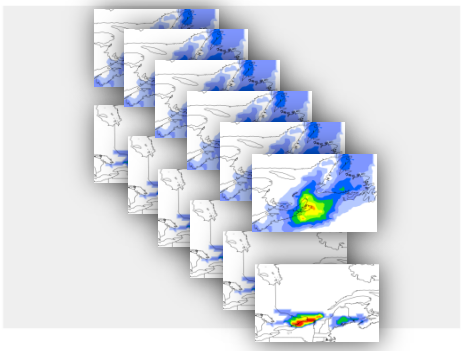
How Do Freezing Rain and Snow Form?

Freezing rain occurs when precipitation falls through a warm layer into a sub-zero layer near the surface.



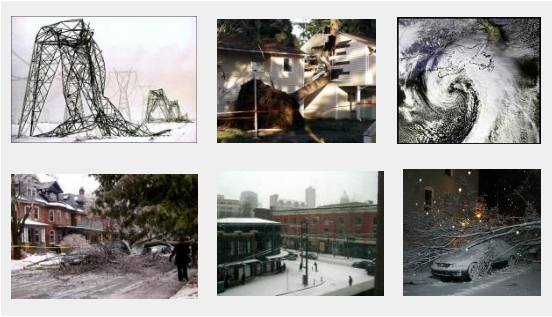
Available Catalogs Allow Many Types of Analyses

10K Stochastic



5 Extreme Disaster Scenarios (EDS)

6 Historical Events



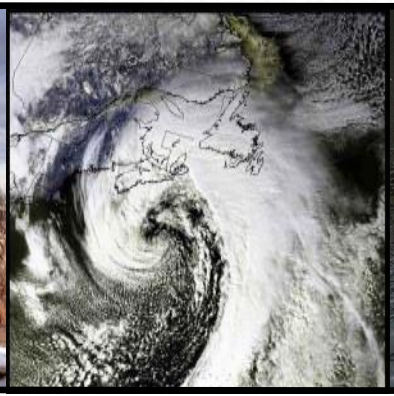
ALERT™ WORLDWIDE

During a Major Winter Storm: AIR ALERT

● Event Summary ● Estimated Losses ● Shapefile ●

Canada Winter Storm Marquee Events Cover Multiple Sub-Perils and Regions





1996 Victoria Blizzard

1998 Ice Storm

2004 White Juan

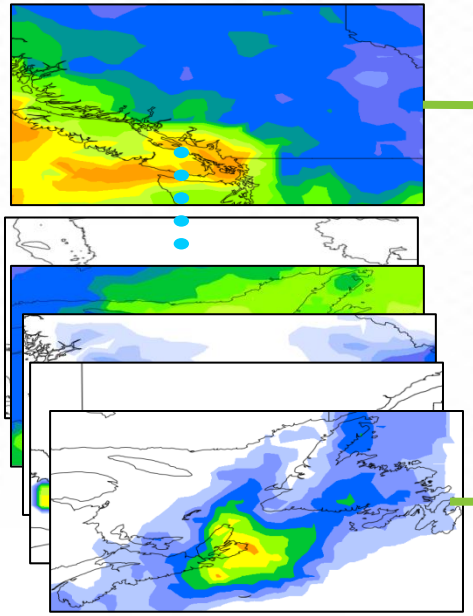
2006 Nov-Dec Storms

2013 Toronto Ice Storms

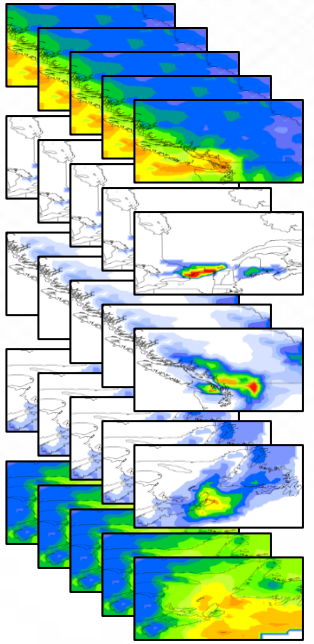
Goal: Create a Set of Physically Realistic Stochastic Perturbations

- Numerical weather prediction (NWP) coupled with reanalysis data
- Select a set of representative “seed” storms
- Perturb physical parameters based on historical experience
- Stochastic catalog consists of a set of these perturbed events

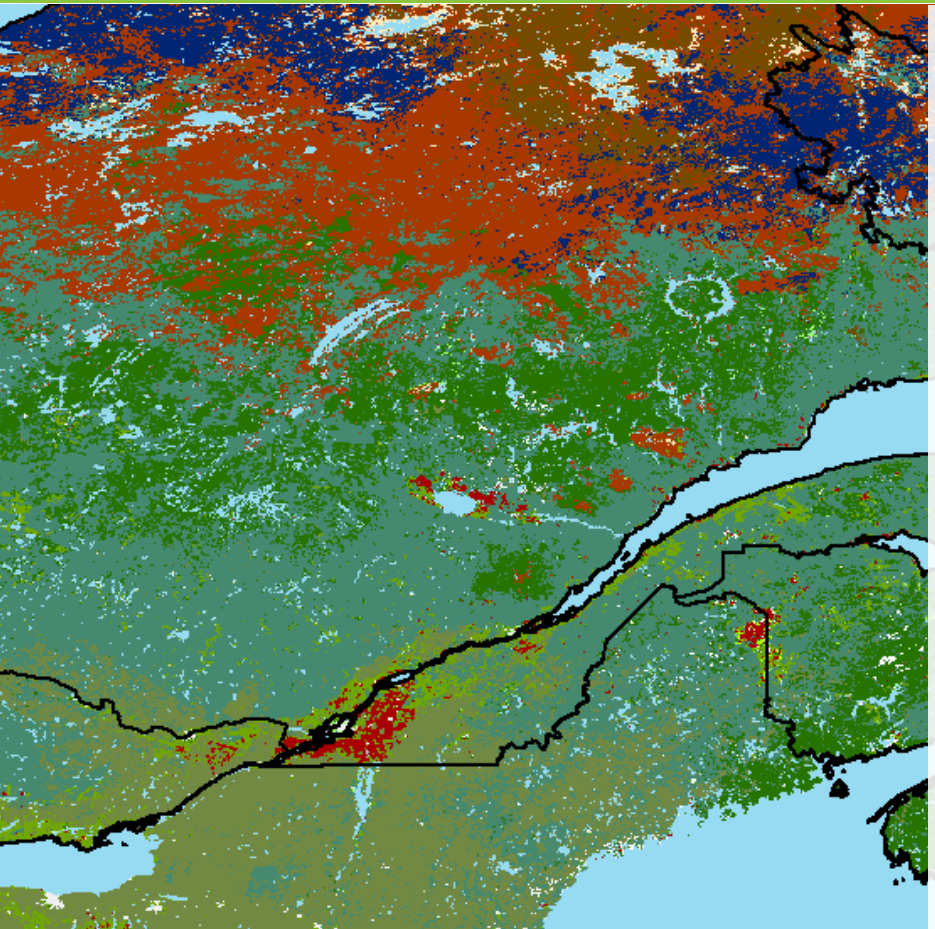
Historical Storm Seeds



Stochastic Catalog (10K)

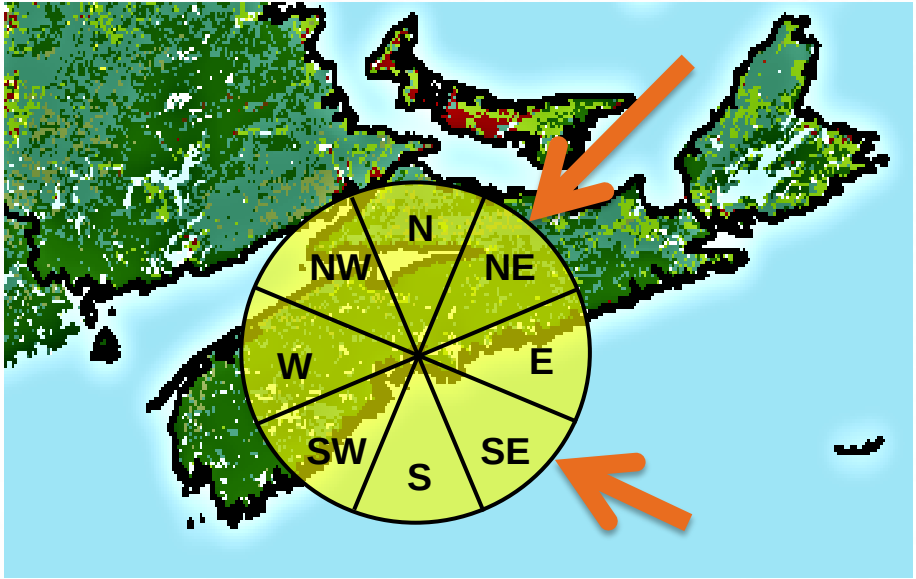


Global Land Use Land Cover (LULC) Data



- Native resolution of roughly 1 km
- LULC data are essential for estimating the roughness of and turbulence generated by land and water surfaces
- The rougher the terrain, the more quickly wind speeds dissipate
- USGS LULC categories provide information for distinguishing urban and rural areas

Directional Dependence of Surface Friction Is Explicitly Modeled



- In many areas, surface friction is highly dependent on the direction from which the winds emanate
- The friction adjustment for each location is now dependent on wind direction
- Provides a more robust definition of risk, particularly in areas where the LULC has significant variation

Hazard Validation

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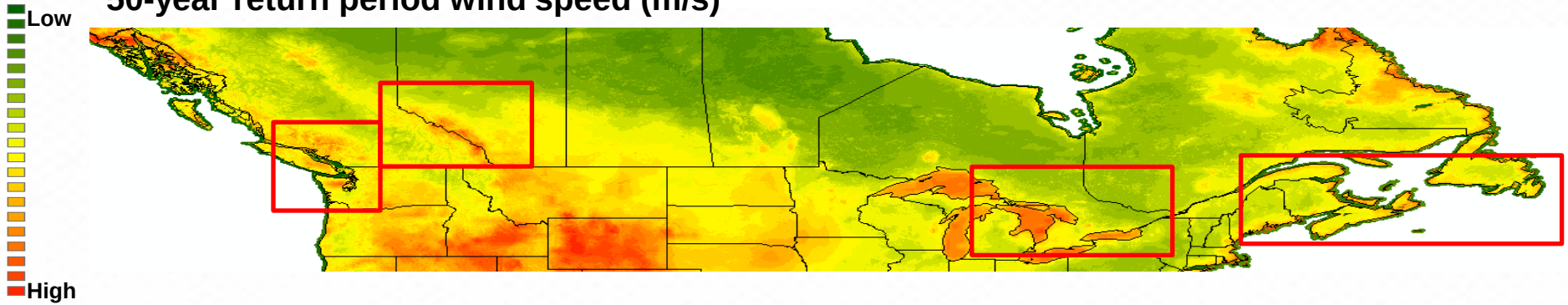
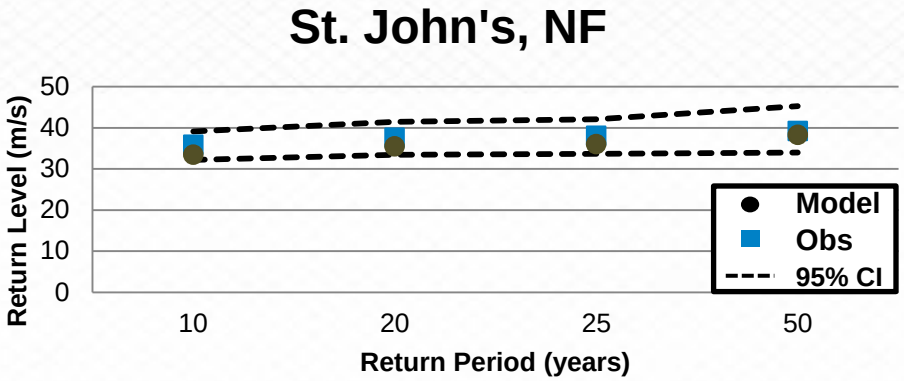
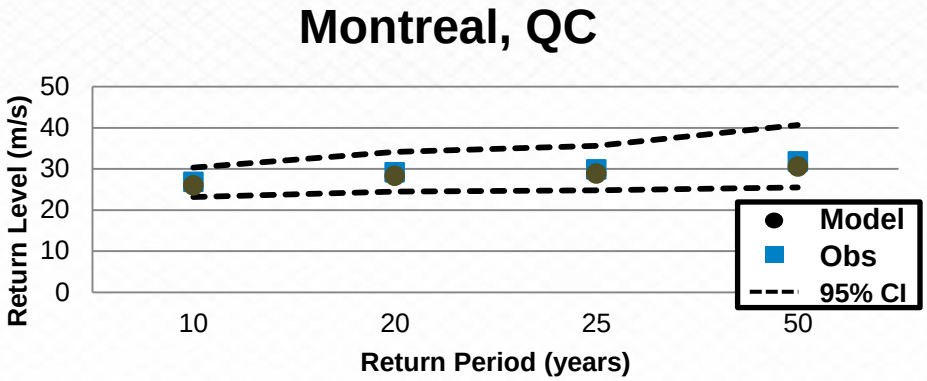
Spatial View of Wind Risk

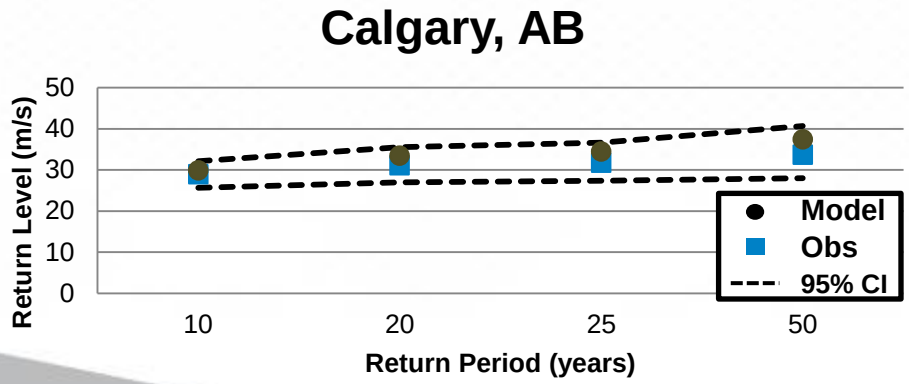
50-year return period wind speed (m/s)

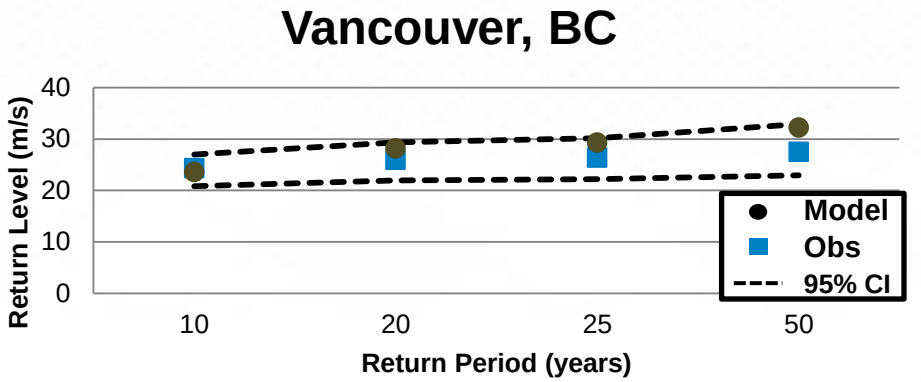


Sampling of Popular Cities with Wind Return Periods



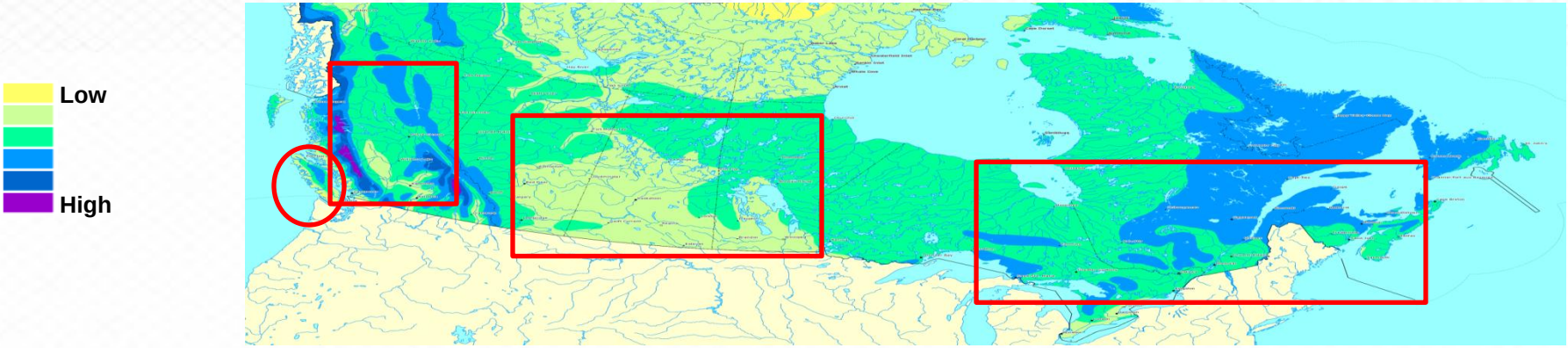




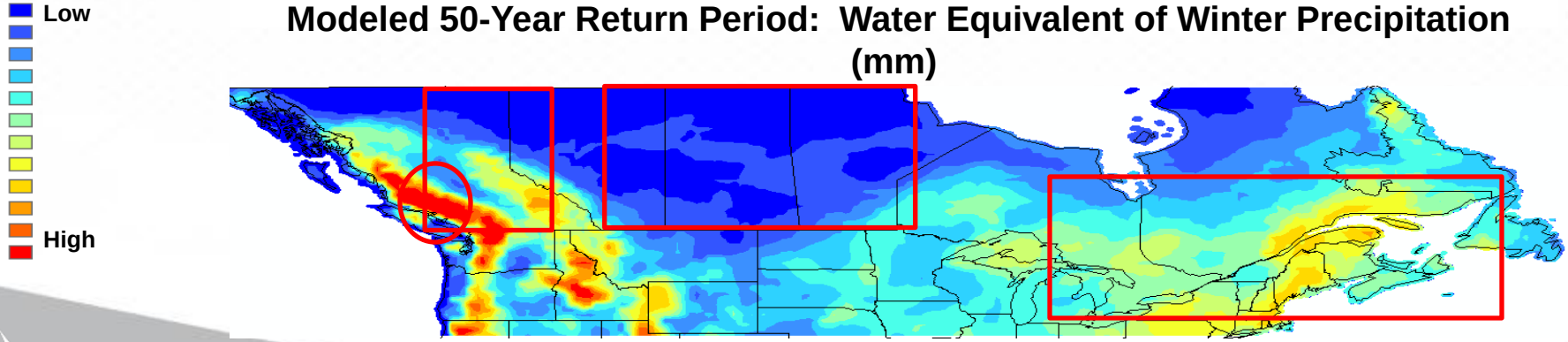


Regional Patterns of Winter Precipitation Match Well with Observations

Observed Average Annual Total Snowfall (cm)

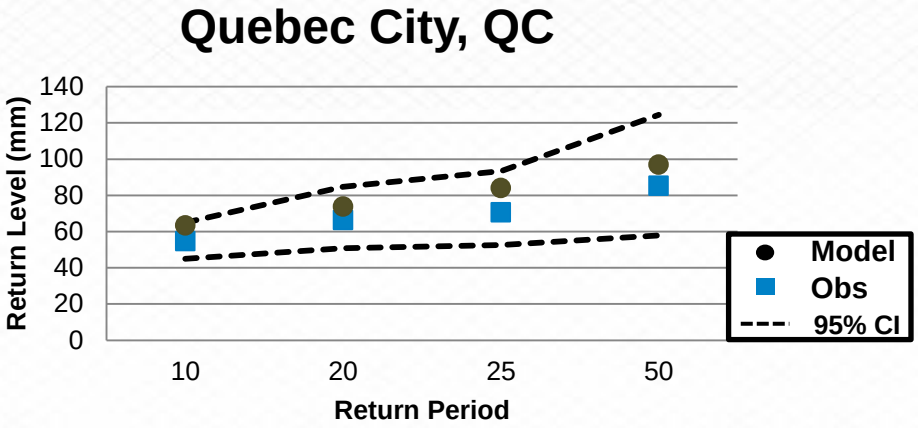


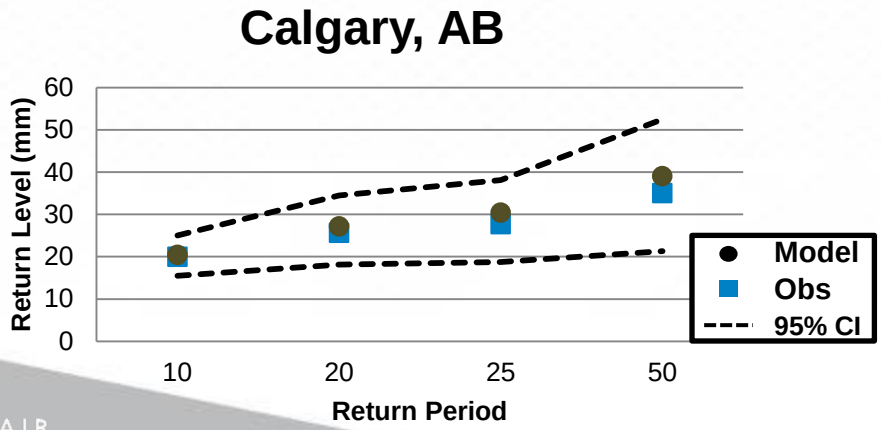
Modeled 50-Year Return Period: Water Equivalent of Winter Precipitation (mm)

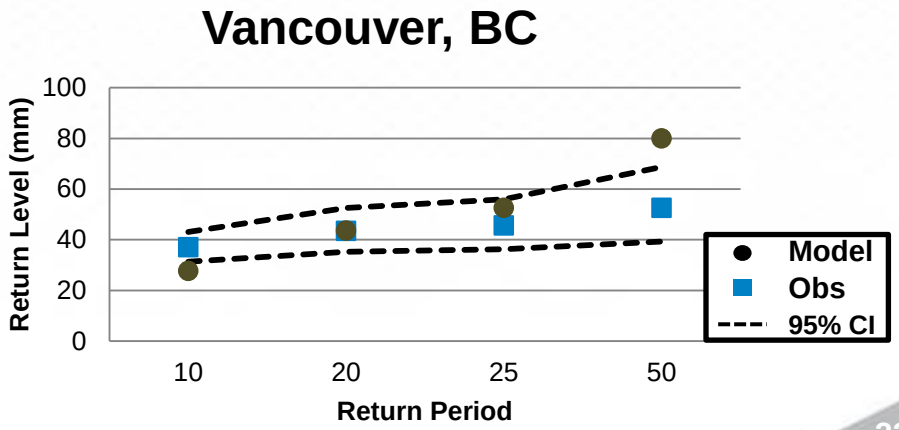


Snowfall Station Data

- Station data only reported 24-hour precipitation totals
- Precipitation type was not reported
  - Precipitation type determined by station temperature







Winter Storm Model - Vulnerability

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Canadian Experts AIR Worked With

Insurance Research Lab for Better Homes

Public Safety Canada

The Boundary Layer Wind Tunnel Laboratory

PROPERTY CLAIM SERVICES PCS CANADA

IBC BAC | Insurance Bureau of Canada / Bureau d'assurance du Canada

Winter Storm Damage Comes from Different Perils

Winter Precipitation

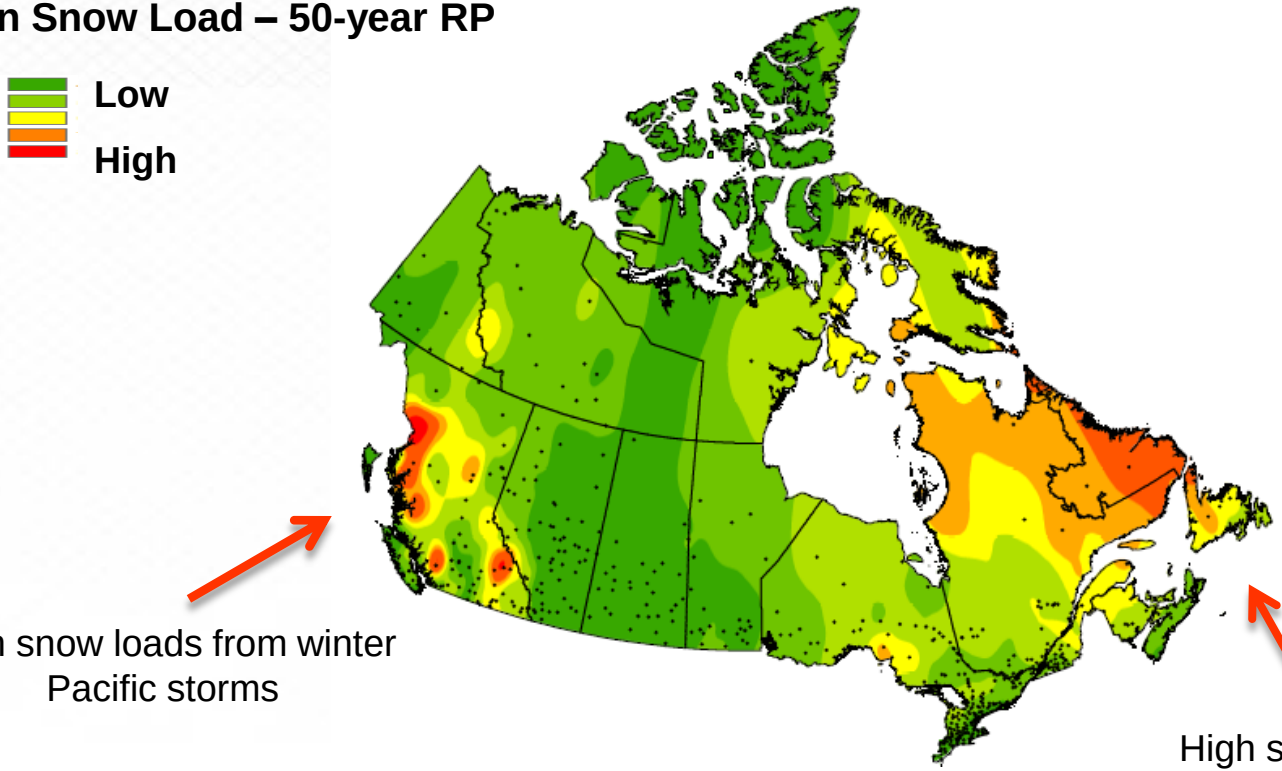
- Roof collapse under the weight of winter precipitation
- Damage to nonstructural elements
- Water damage from ice dams

Source: Bill Jarvis, 2011

Source: Steve Bunn, Roof Design Considerations in Cold and High Altitude Regions

Vulnerability Varies Regionally and by Peril

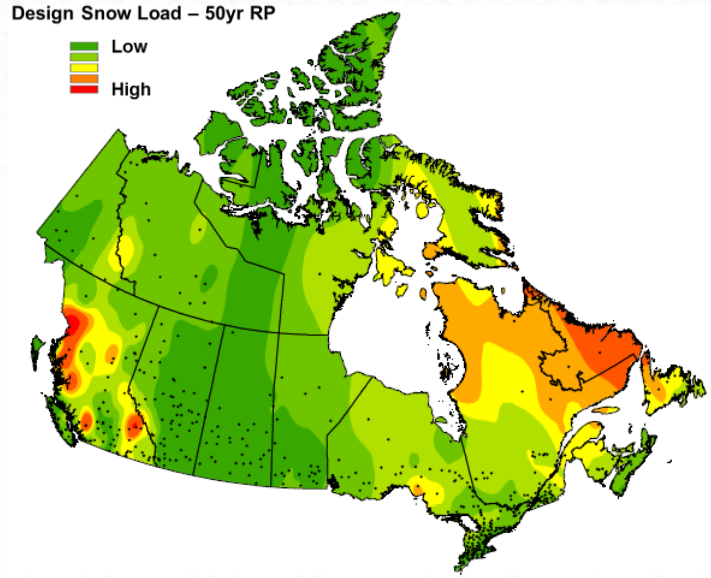
Design Snow Load – 50-year RP

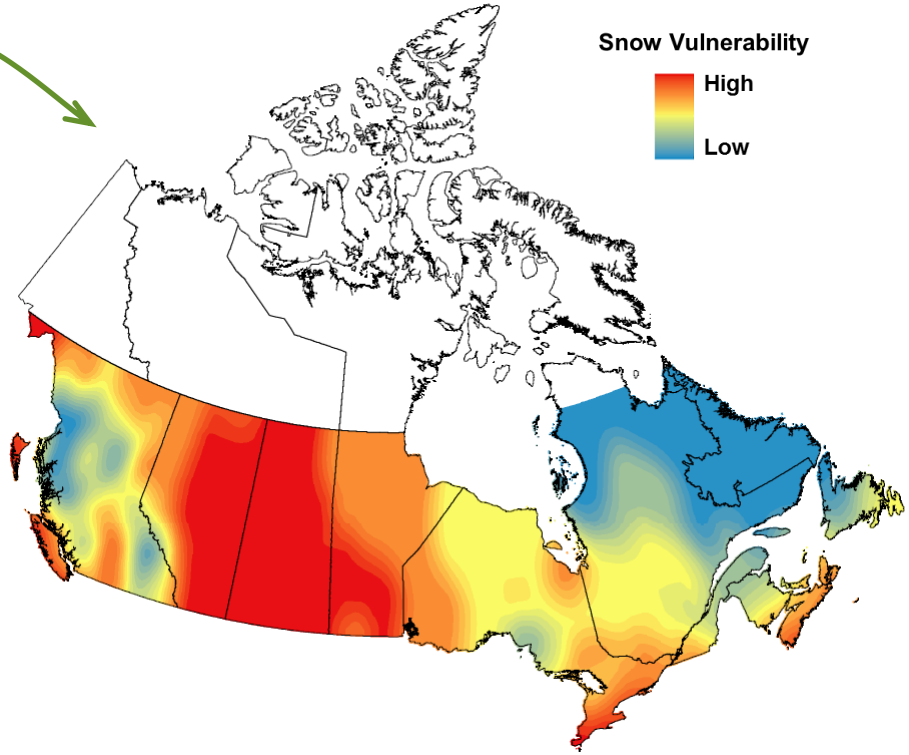


High snow loads from winter Pacific storms

High snow loads from winter Atlantic storms (Nor'easter)

Vulnerability Varies Regionally and by Peril





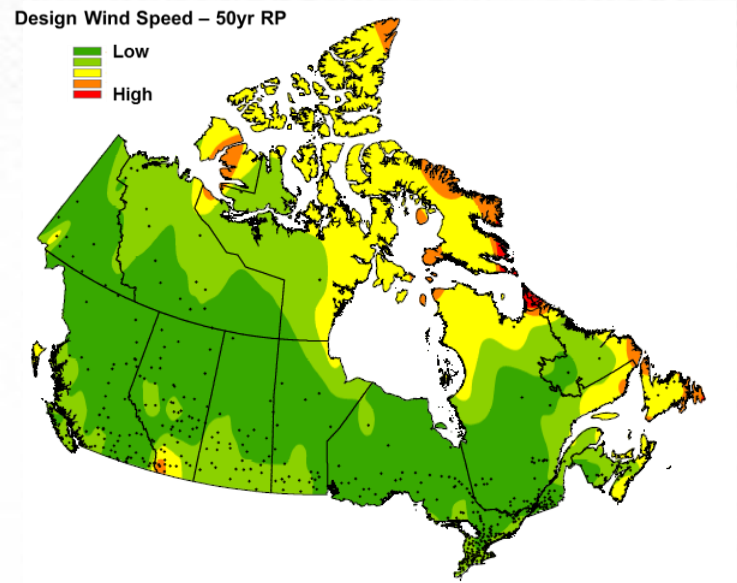
Winter Storm Damage Comes from Different Perils

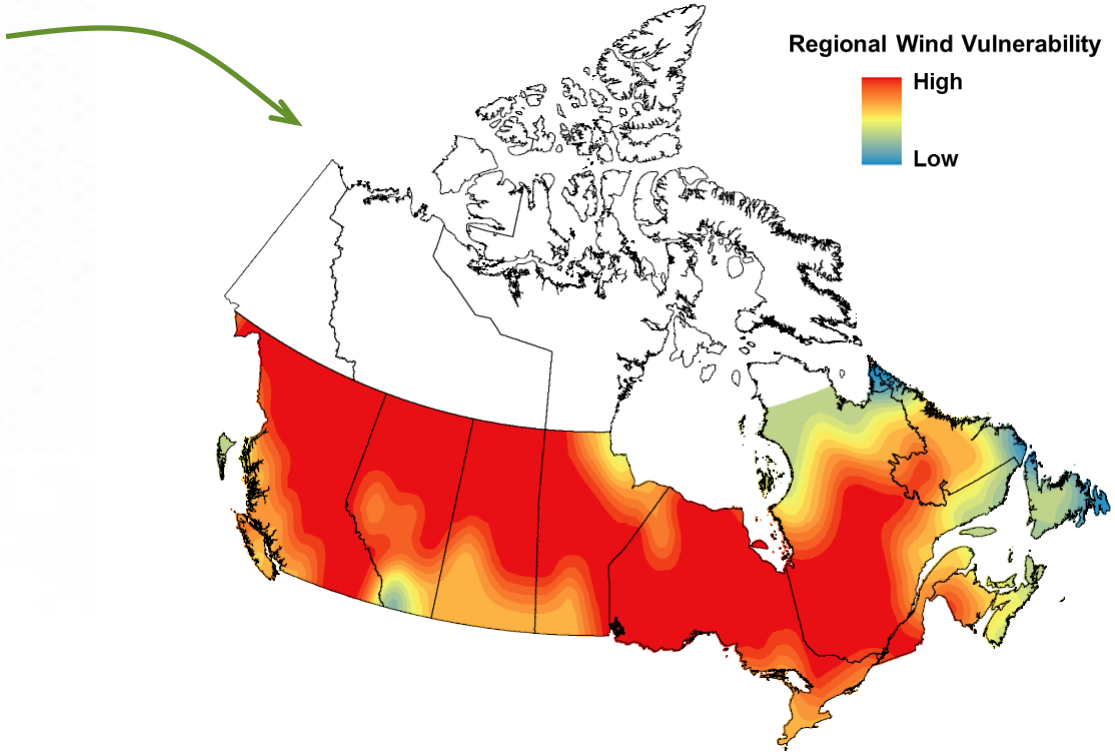
Wind

- Roof cladding failure
- Roof damage from falling trees
- Structural and nonstructural damage

Source: CBC Canada

Vulnerability Varies Regionally and by Peril



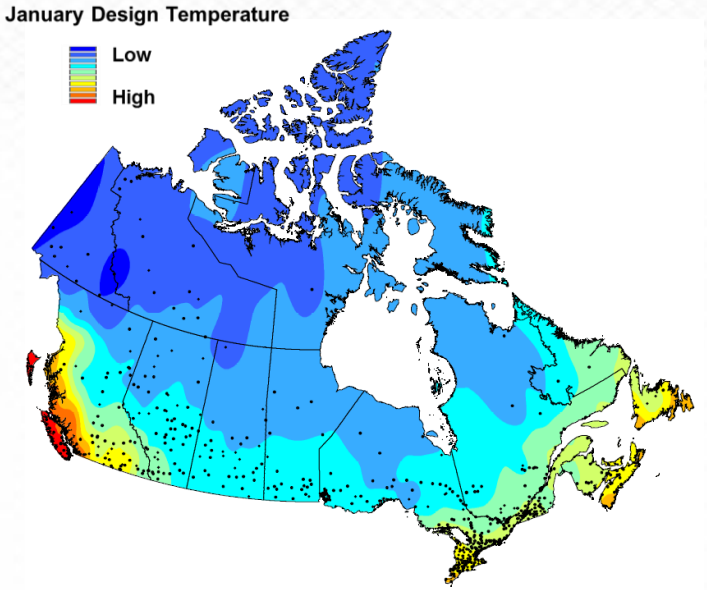


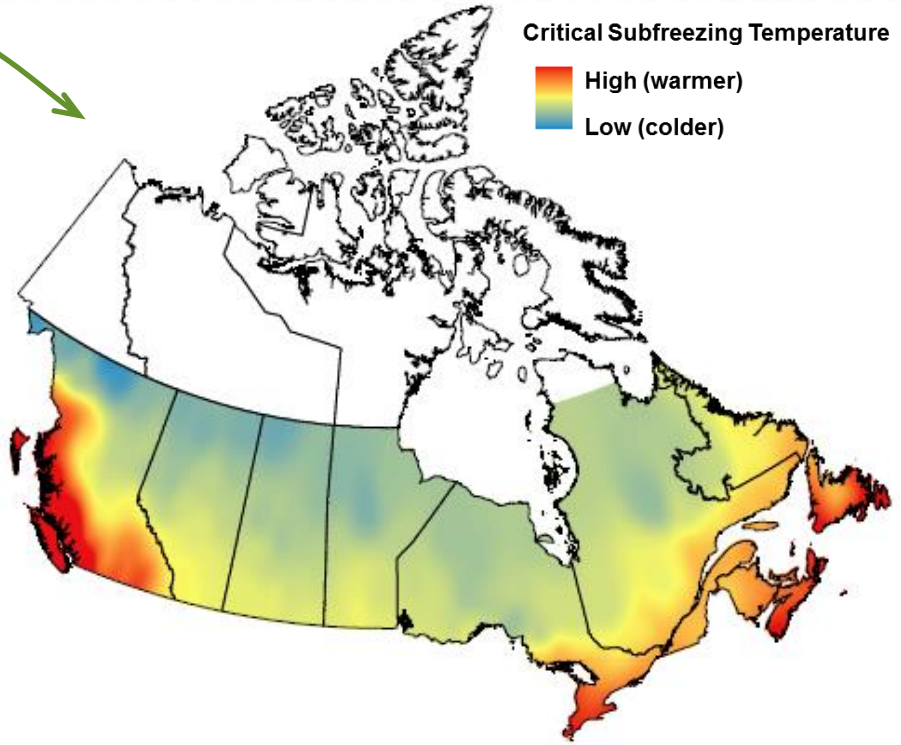
Winter Storm Damage Comes from Different Perils

Freezing Temperature

Water damage from bursting pipes

Vulnerability Varies Regionally and by Peril



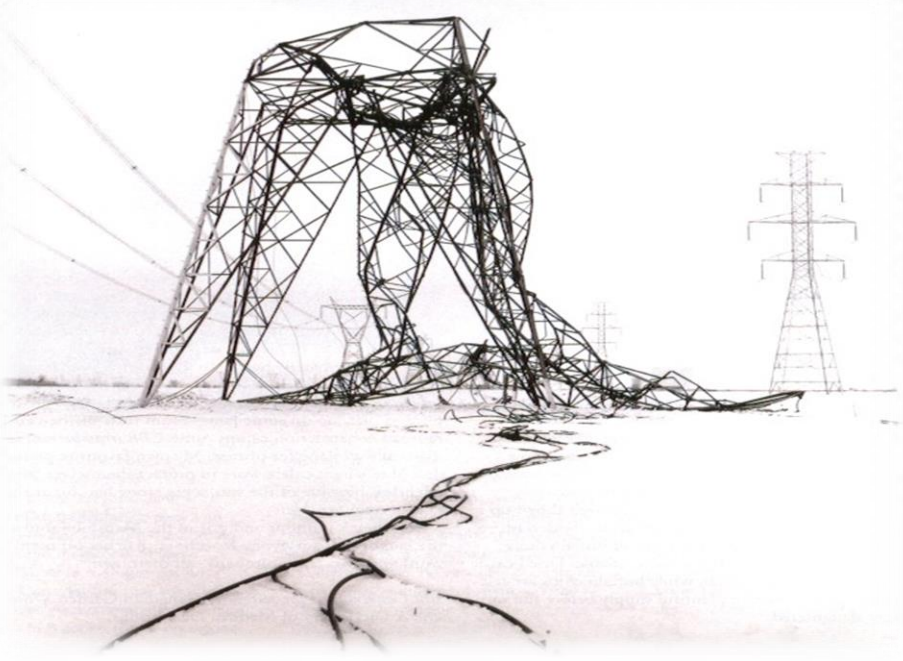


10 mm Freezing Rain Can Disrupt a Region

Source: Wikipedia, "December 2013 North American Ice Storm"

Damage due to falling trees

Freezing Rain Can Disrupt a Region: Power Outage



Collapsed transmission towers, Quebec, 1998 ice storm

Power Outage

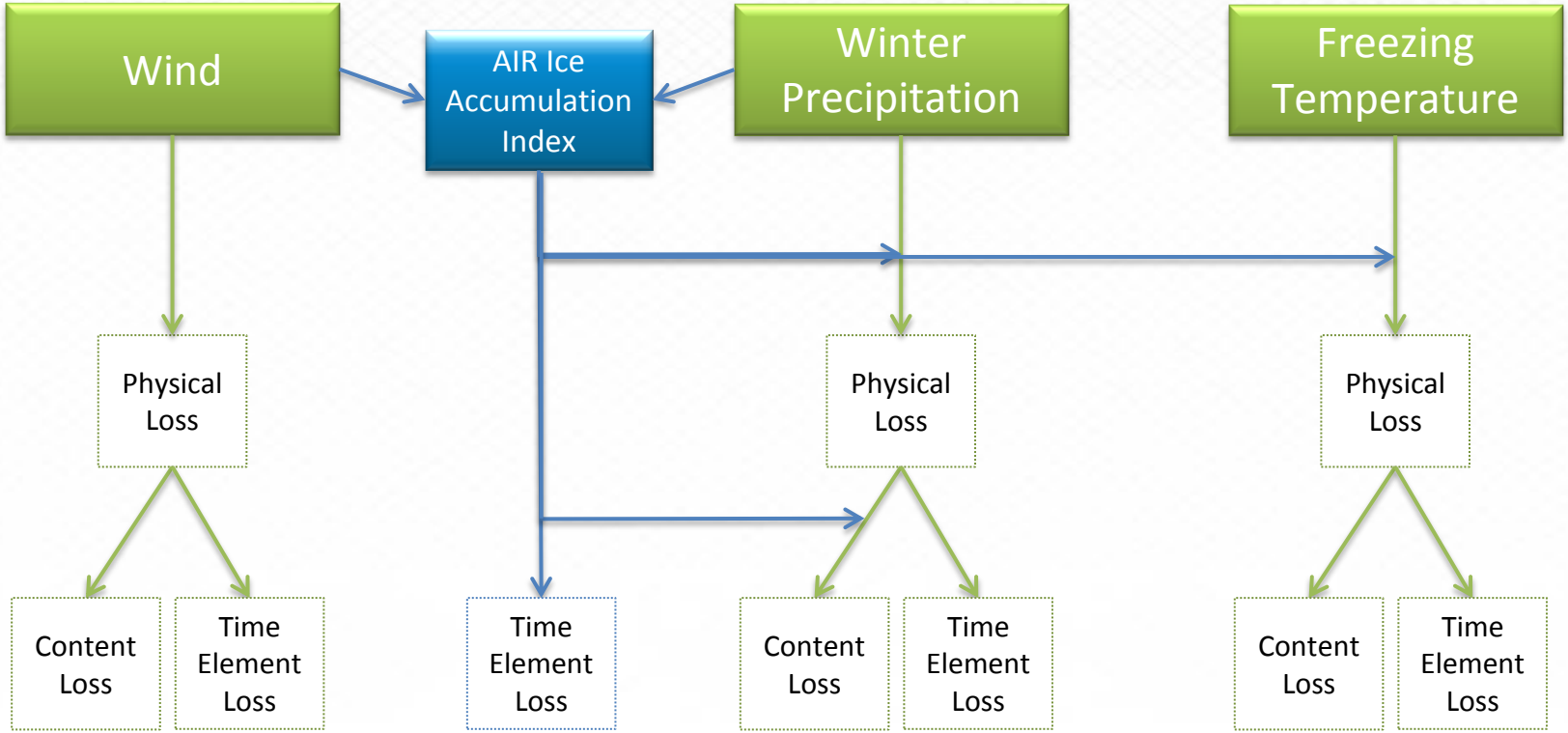
- Additional business interruption and living expenses losses
- Increasing building damage from freezing temperature
- Additional content losses

The Sperry-Piltz Ice Accumulation Index Is a Tool to Capture Ice Storm Severity

The Sperry-Piltz Ice Accumulation Index

Ice and Wind: Radial Ice in Inches; Wind in Miles per Hour.	< 15 mph	15-25 mph	25-35 mph	> = 35 mph
0.10 – 0.25 inches	0	1	2	3
0.25 – 0.50 inches	1	2	3	4
0.50 – 0.75 inches	2	3	4	5
0.75 – 1.00 inches	3	4	5	5
1.00 – 1.50 inches	4	5	5	5
> 1.50 inches	5	5	5	5

Physical, Content, and Time Element Losses Make Up the Total Losses



Salient Feature of the Vulnerability Module

Explicit damage functions for wind, winter precipitation, and freezing temperature.

Supporting damage functions for building, content, and time element losses

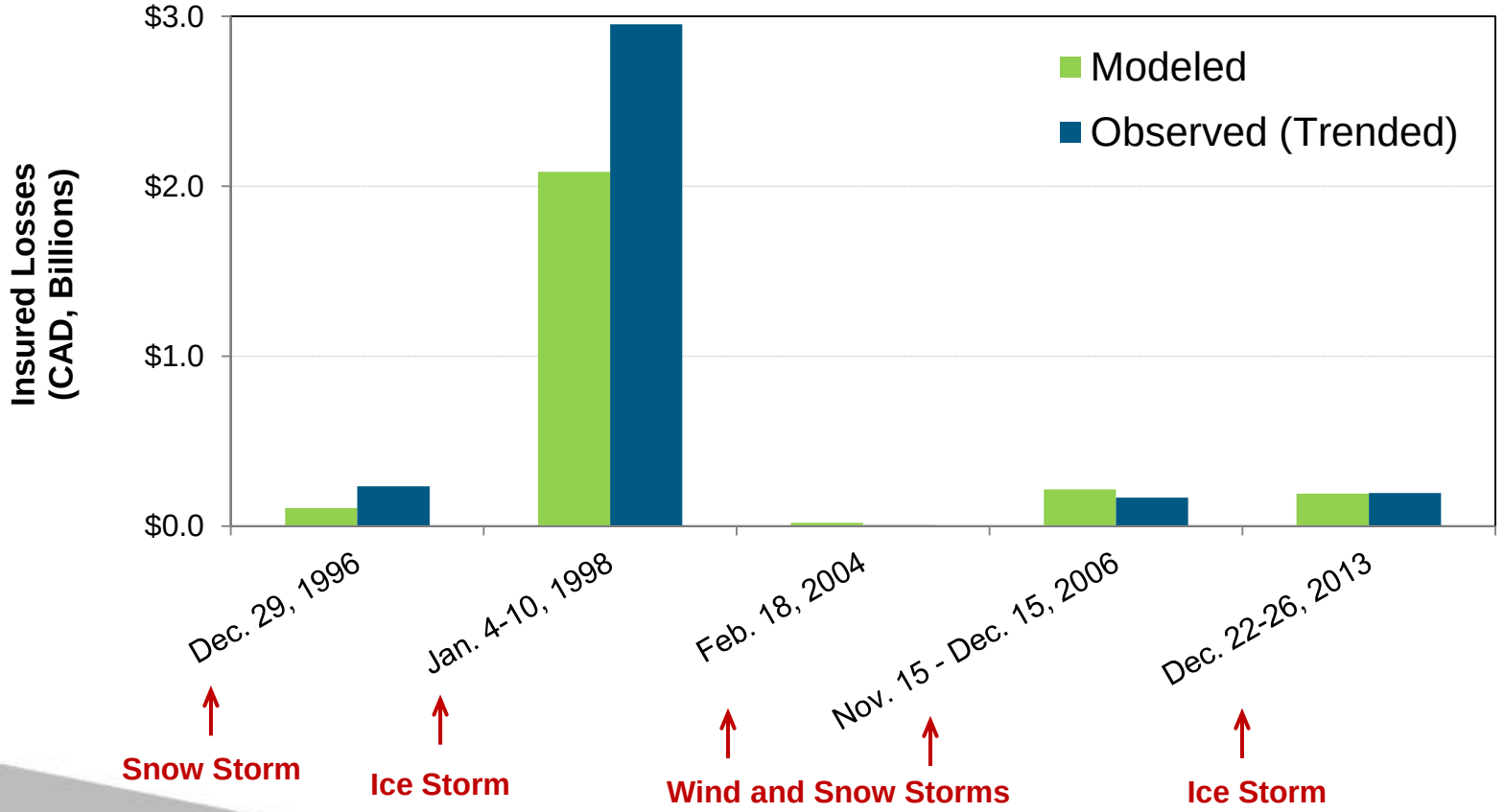
Supporting residential, commercial, and small and large industrial facilities for different construction types as well as auto and mobile homes

Accounting for temporal variation in vulnerability due to changes in construction practices and materials, as well as aging and deterioration

Supporting different building heights

Explicitly modeling the regional vulnerability for wind, snow, and freezing temperature

Historical Events Validation



What Does the Model Tell Us About the 1998 Ice Storm?

Some Things to Consider…

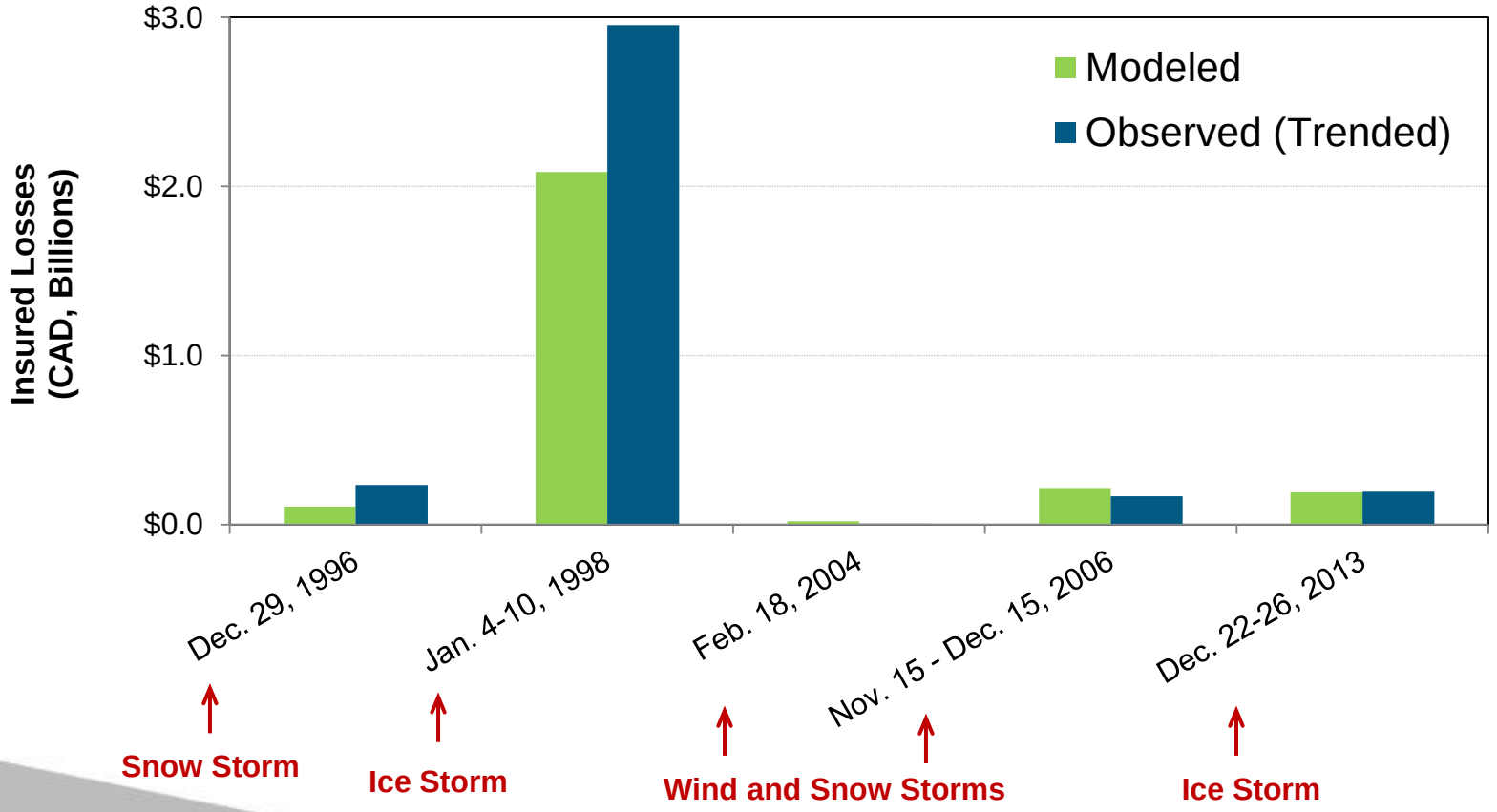
Anti-Cascade Transmission Towers

Reinforced Distribution Poles

Redundant Power Supply Systems

Changes in Food Spoilage Deductibles

Historical Events Validation



Risk Across All Perils: Canada

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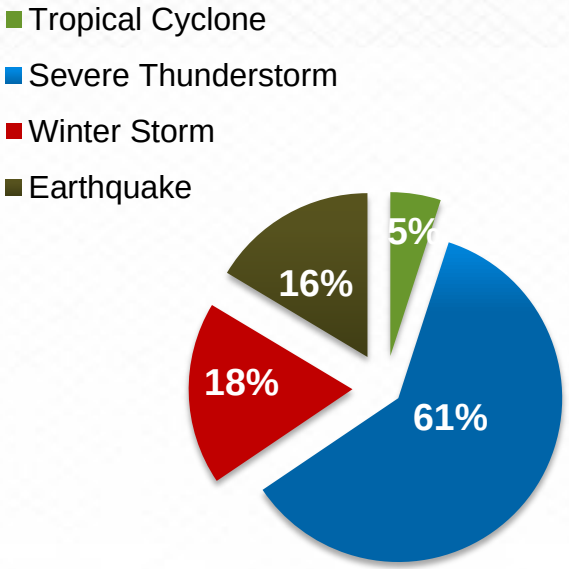
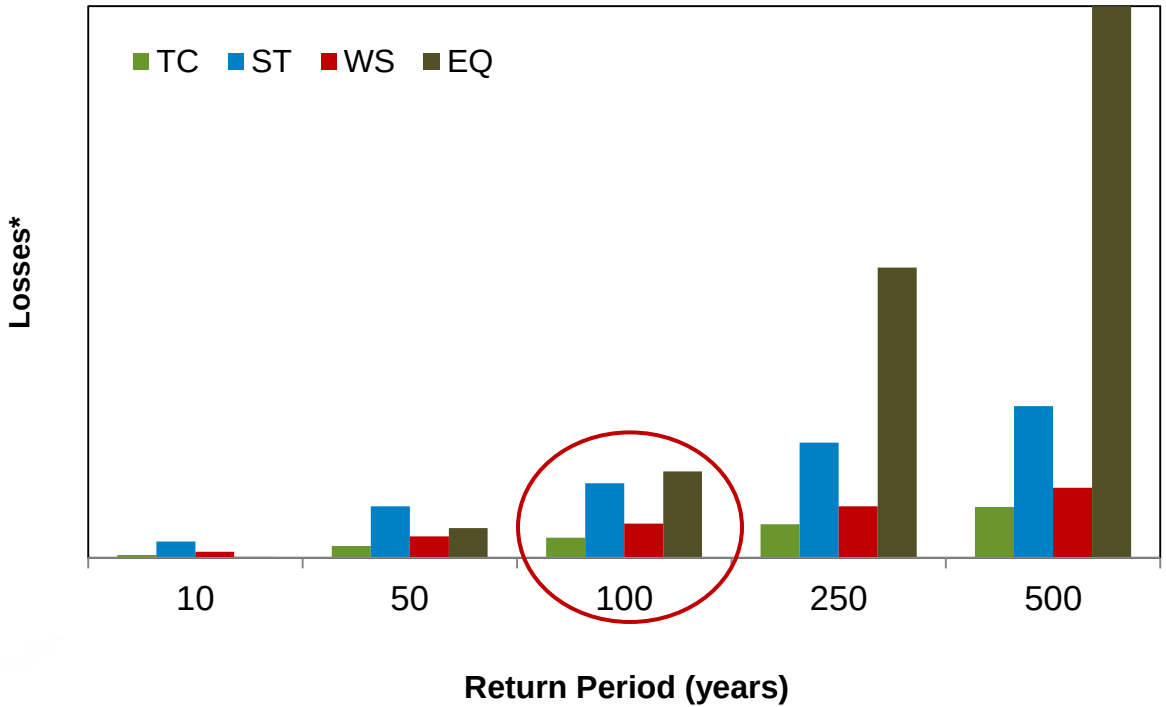
In Canada, All Perils Have Non-Negligible Contribution to the Losses

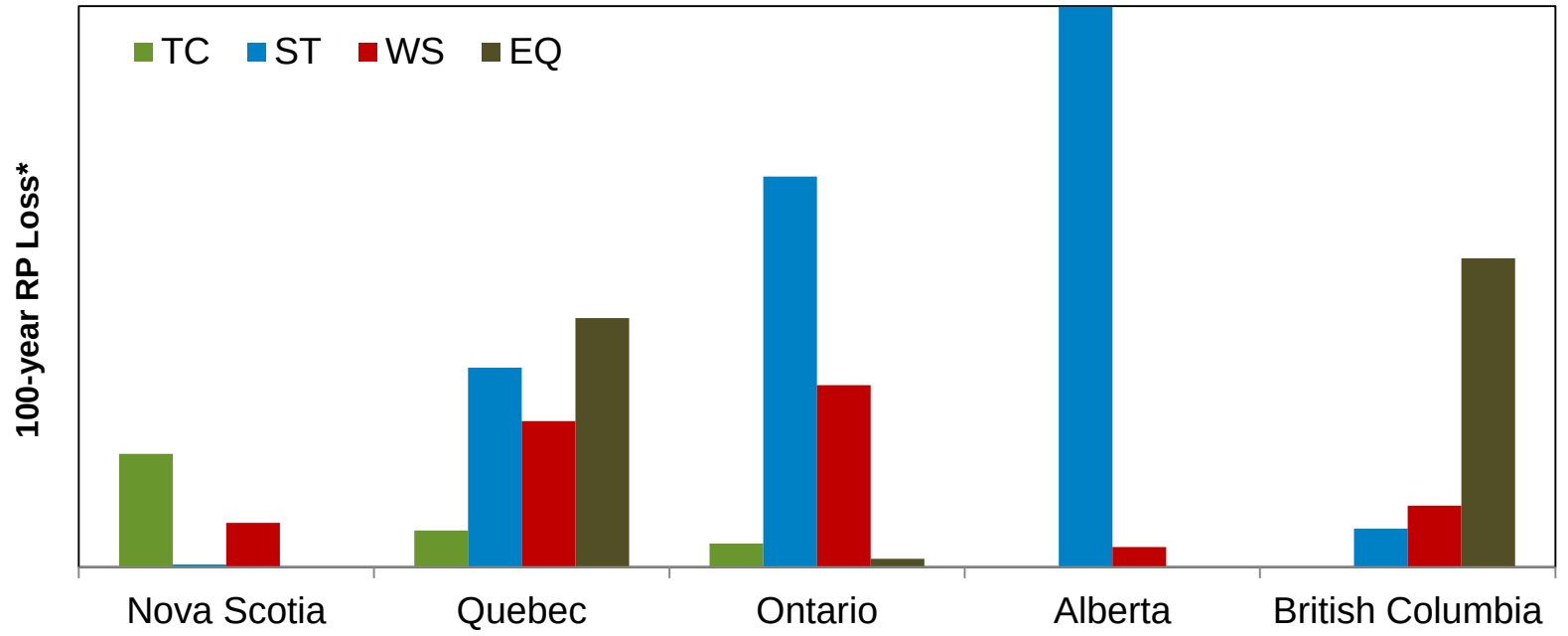


Canada AAL
(Agg., Gross, Insured, All LOB)



**Gross, Occurrence, Insured, All LOB*

In Each Region, Different Perils Dominate the Exceedance Probability Curve



*Gross, Occurrence, Insured, All LOB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