UNIVERSITY of GUELPH

CHANGING LIVES IMPROVING LIFE

Influence of Changing Climate On Agricultural Water Management In Ontario

*Ramesh P. Rudra, Rituraj Shukla, Trevor Dickinson, Jaskaran Dhiman, Prasad Daggupati, Pradeep K. Goel**

Water Resources Engineering
University of Guelph

***Ontario Ministry of the Environment, Conservations and Parks**

Questions

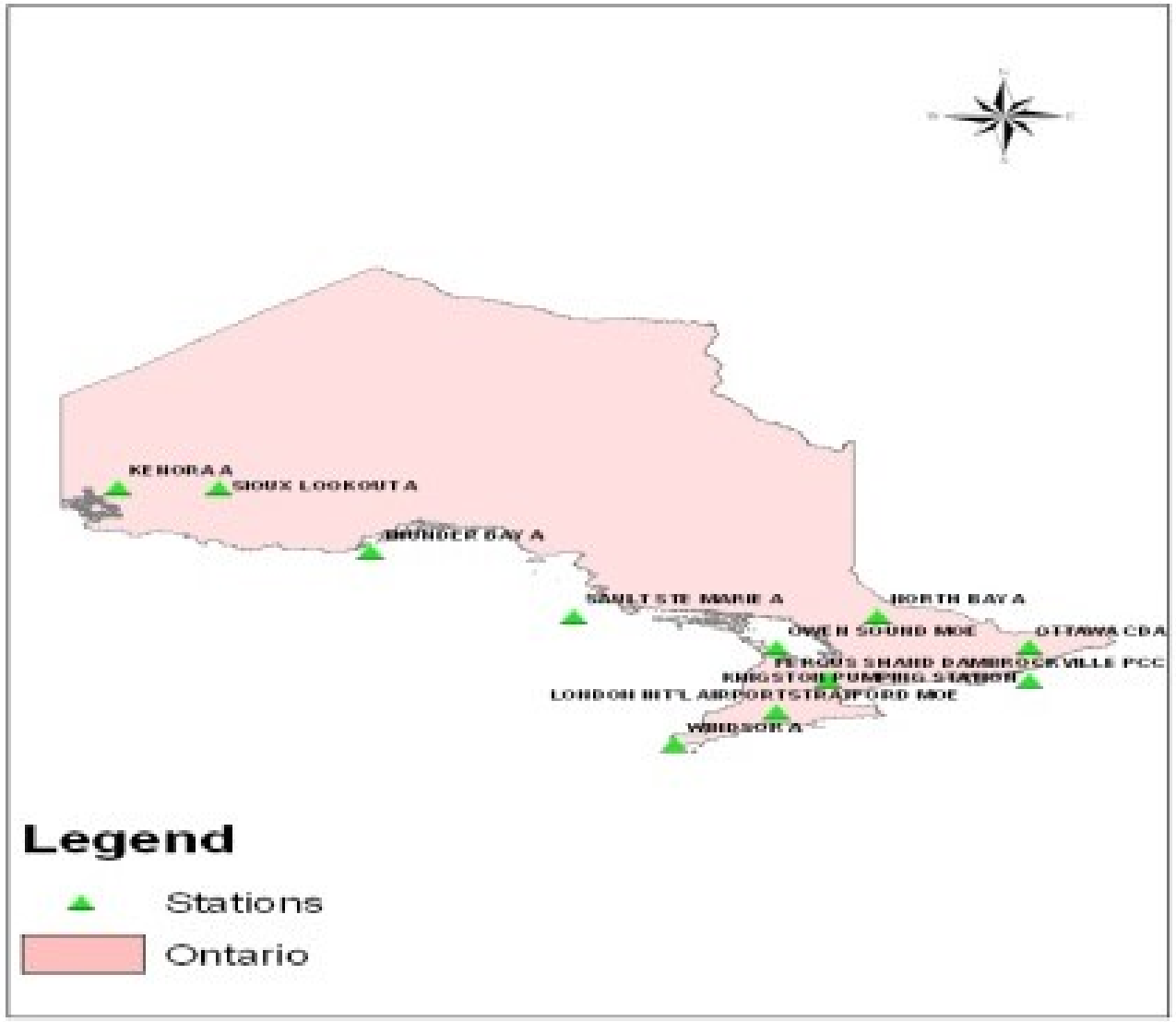
Has the hydrology climate and hydrology changed across Ontario?

- Winter temperatures
- Winter rainfall and snowfall amounts
- Impact on runoff, infiltration, tile drainage, soil erosion and water quality
- Impact on the number of available growing days

UNIVERSITY of GUELPH

CHANGING LIVES IMPROVING LIFE

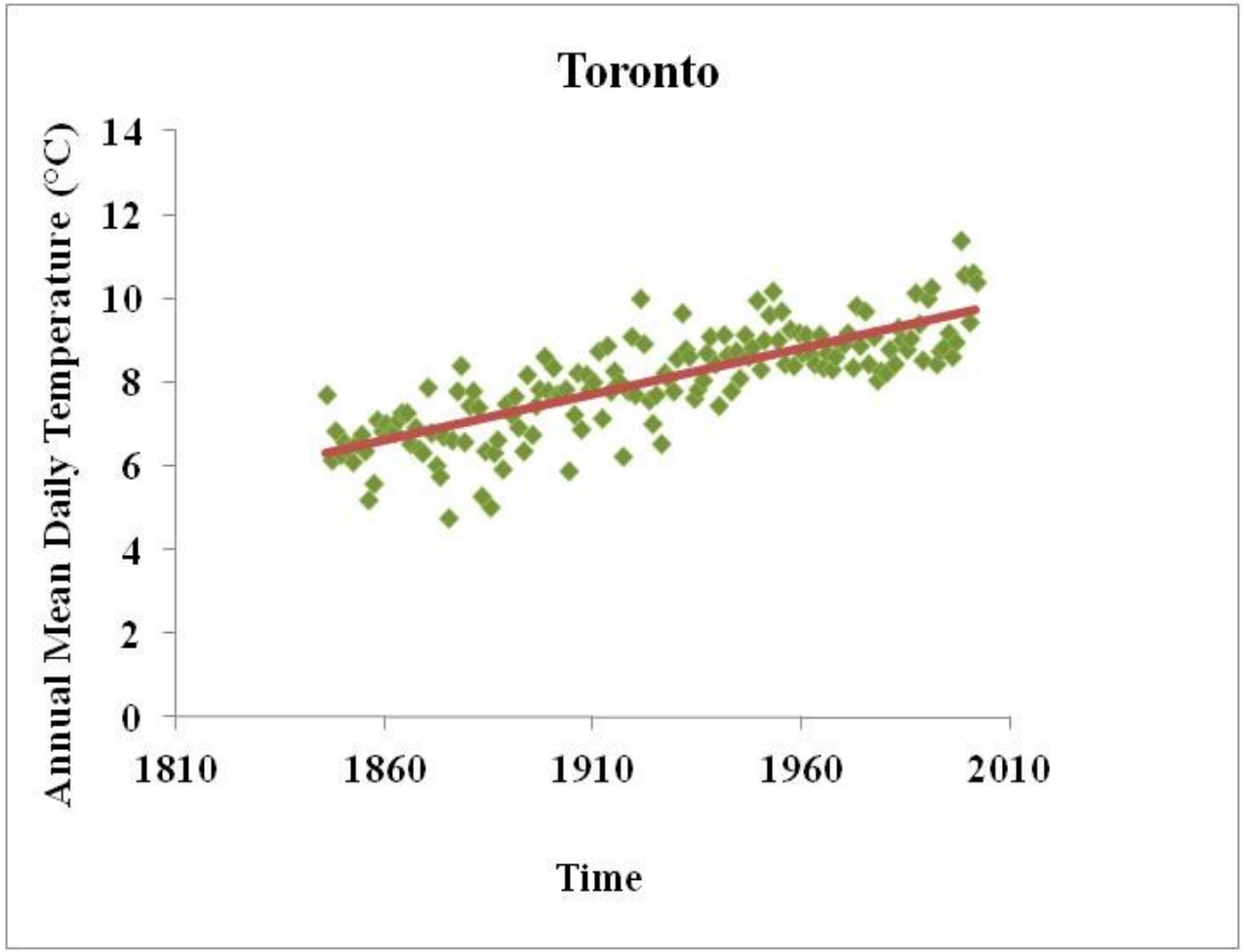
Study Area



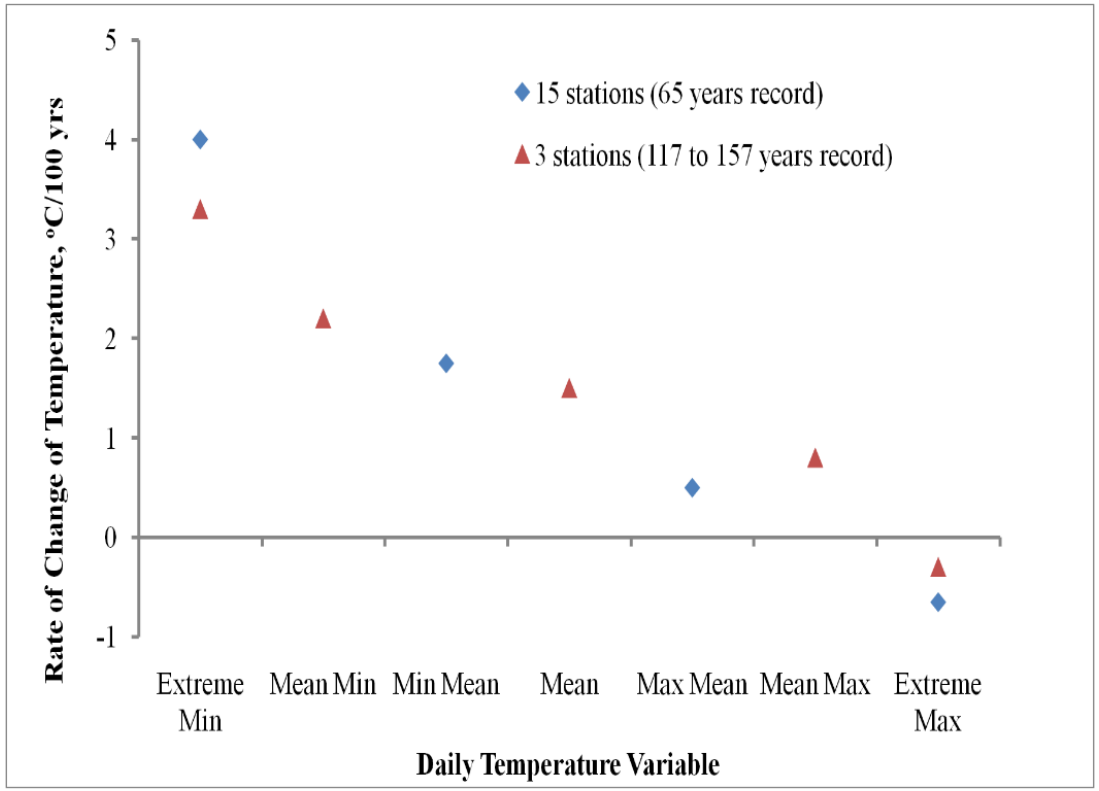
Study Area and Data

- 18 stations
- Daily temperatures *(mean daily min., max., extreme min., max.)*
- Winter Season – Nov-April
- Prime record: 1940 to 2003
- Some records back to 1890, 1873, and 1846

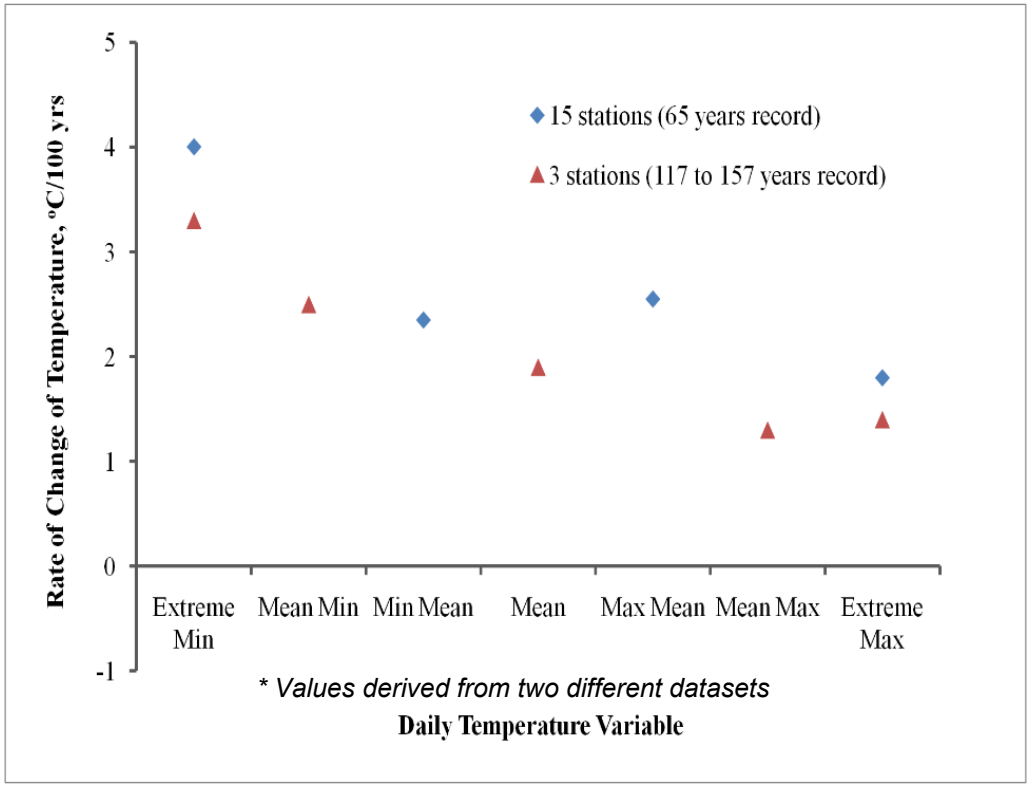
Annual Temperature Trend



Rate of Change: Annual and Winter Temperatures



Annual Temperature

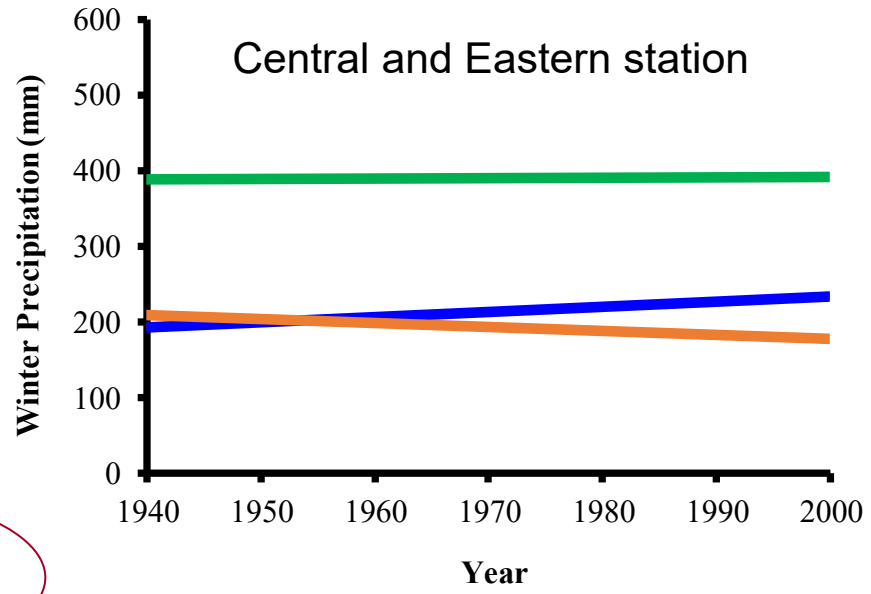


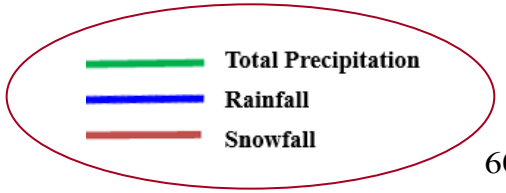
Winter Temperature

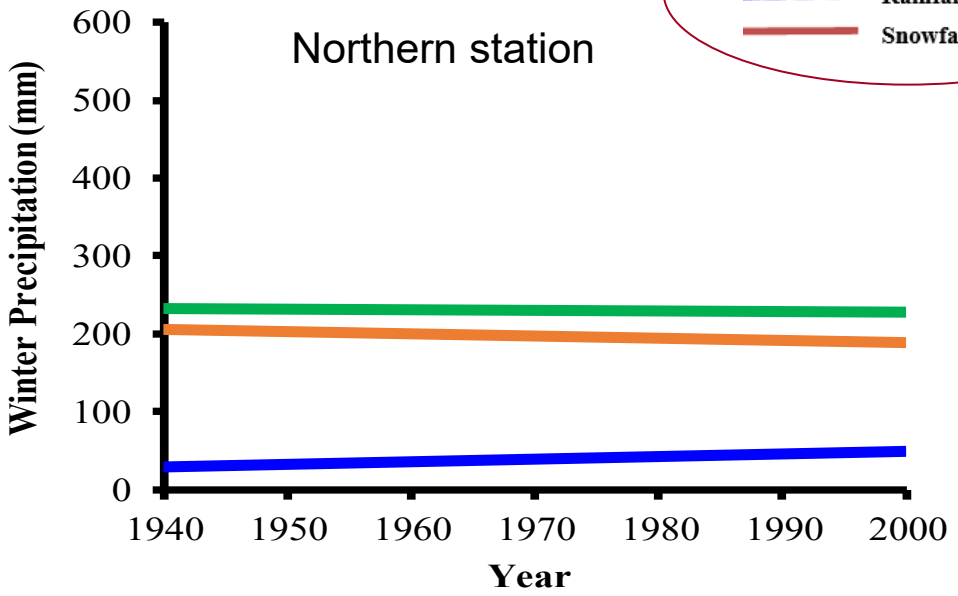
Likely Impacts

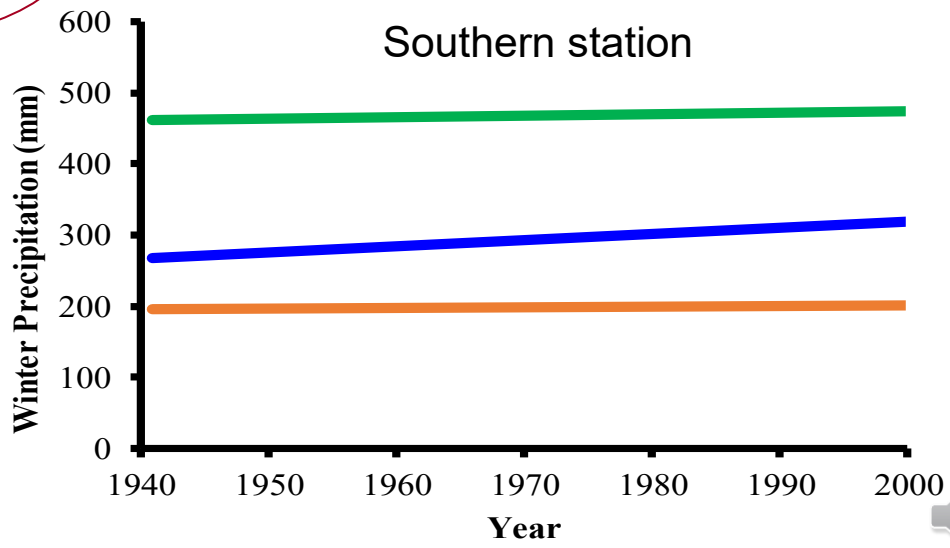
- Winter runoff events have likely increased in number and volume, as winter rainfall has increased.
- Winter ground water recharge & tile flow events have likely increased in number and volume, as winter temperatures and rainfall have increased.
- Spring snowmelt floods have likely decreased in volume and peak discharge, as the spring snowpack has become smaller.

Changes in Winter Precipitation







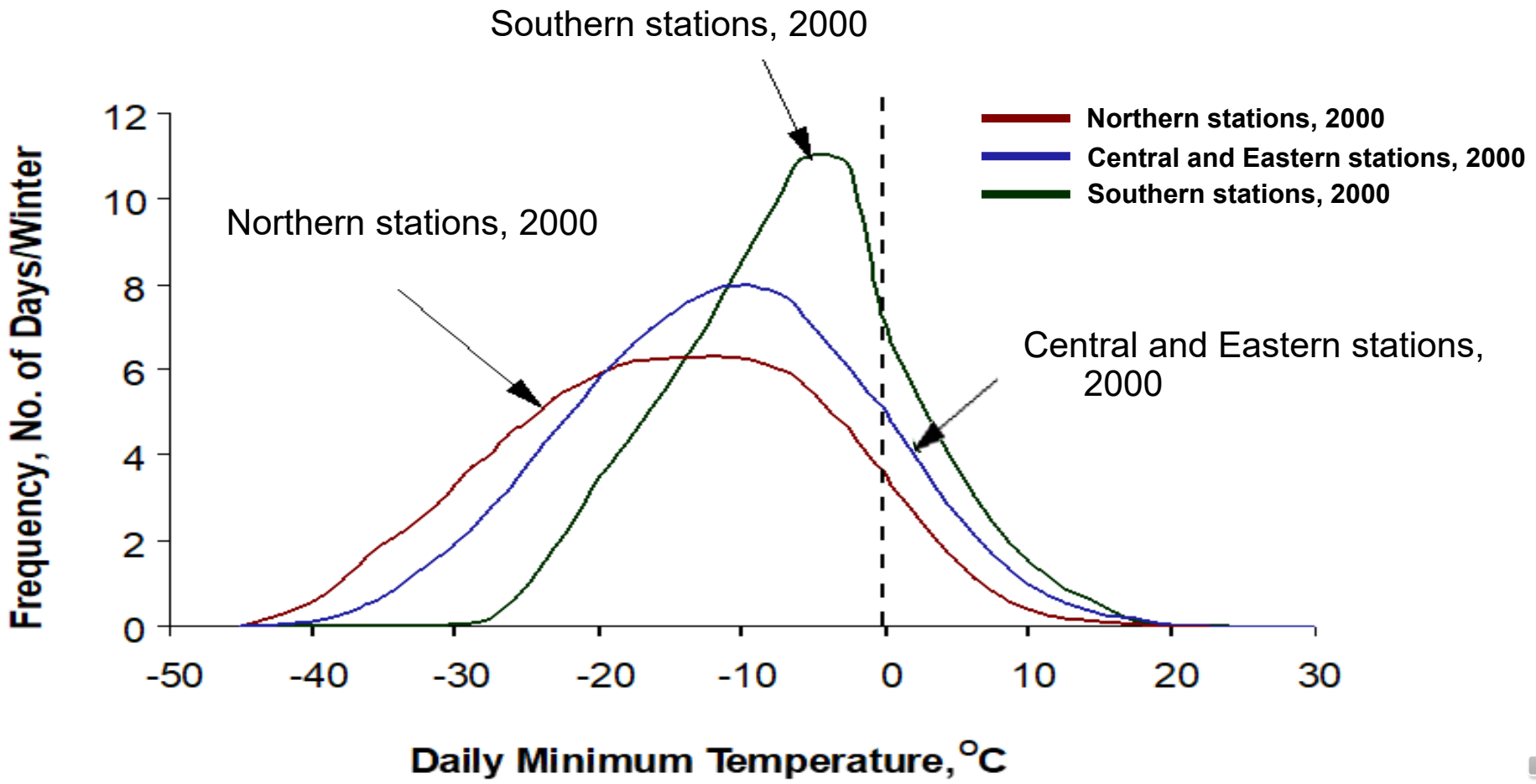


Other Temperature Integrals

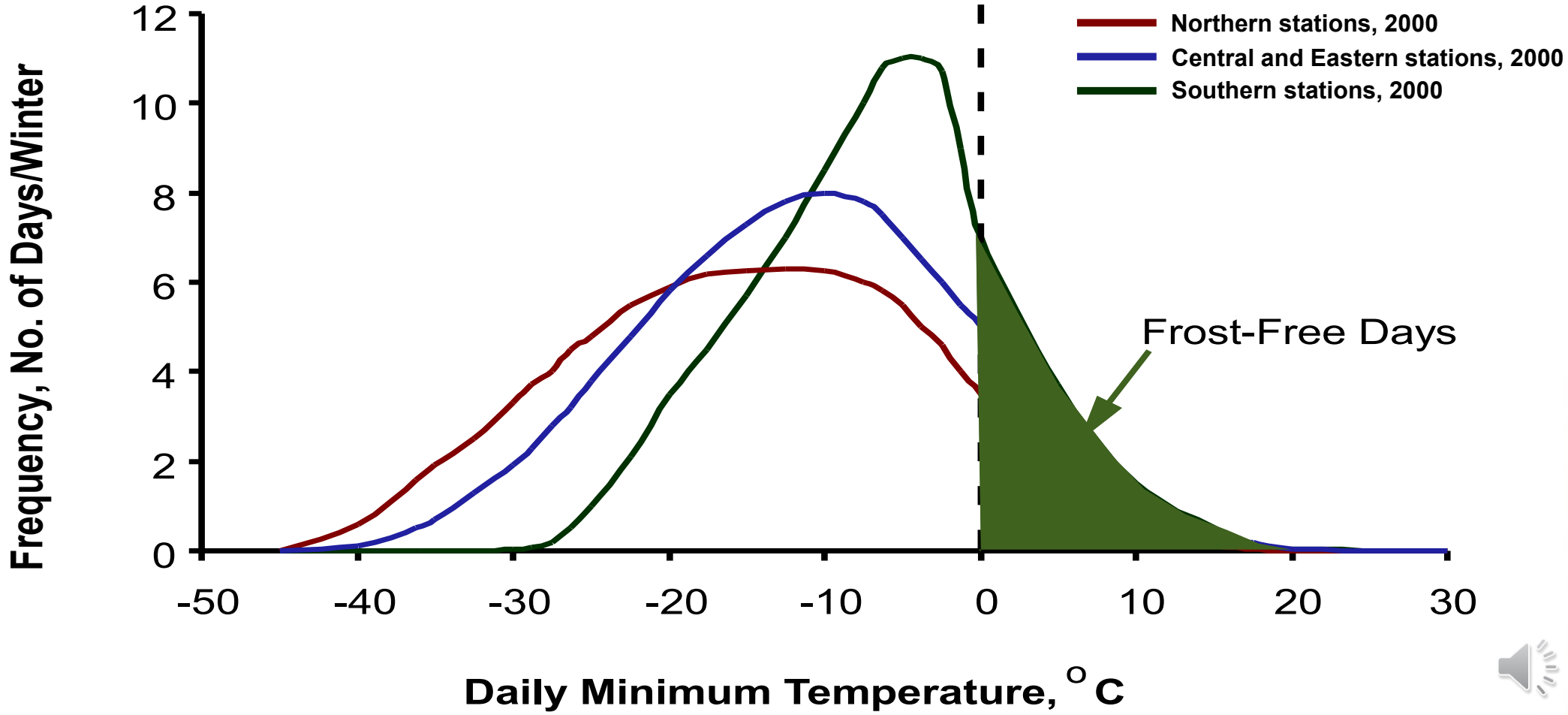
- What about other integrals relating to temperature?
  - growing days
  - degree-days
  - snowmelt
  - end-of-winter snowpack

  and associated biological phenomena

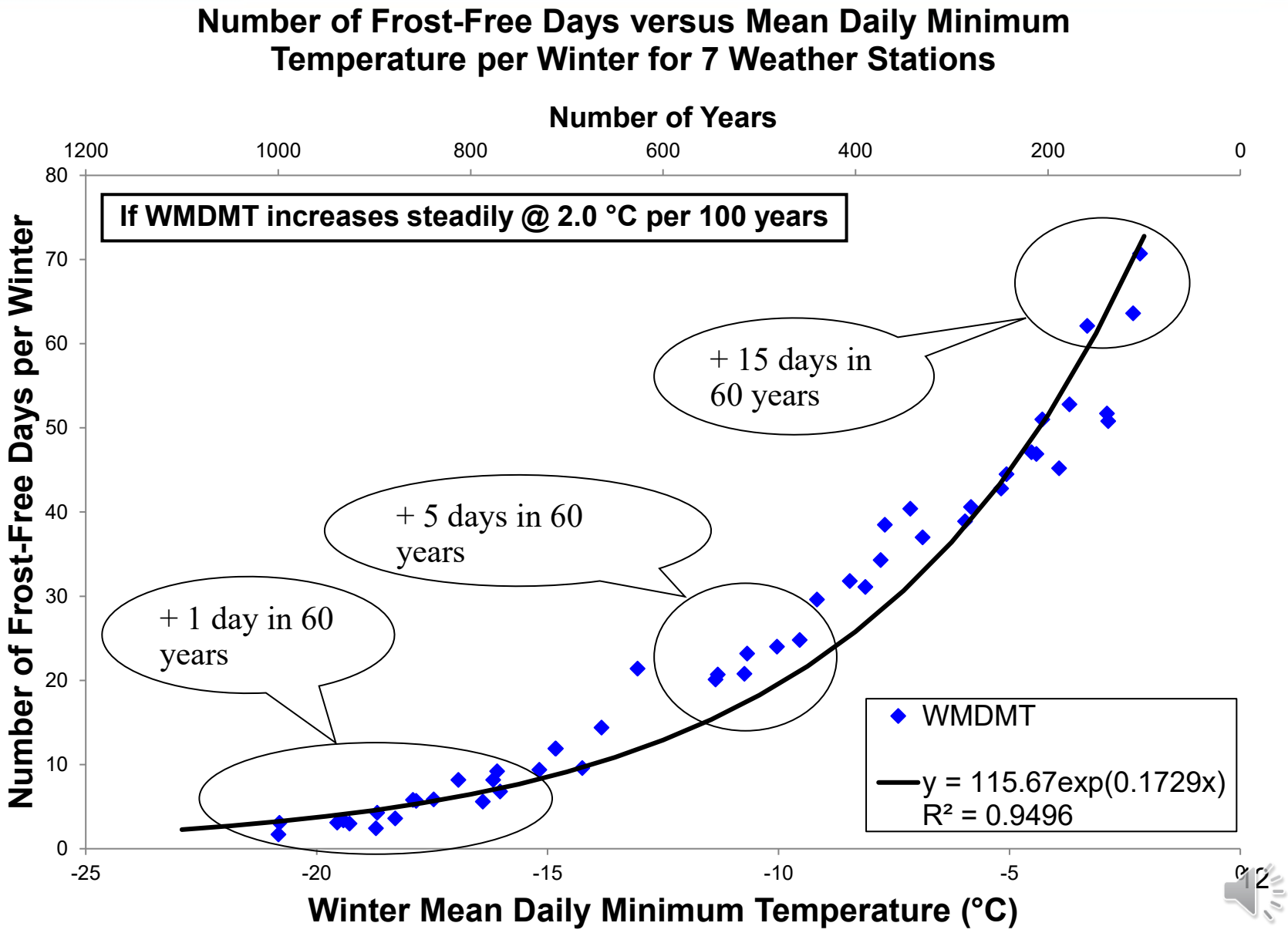
Frequency of Winter Daily Minimum Temperatures



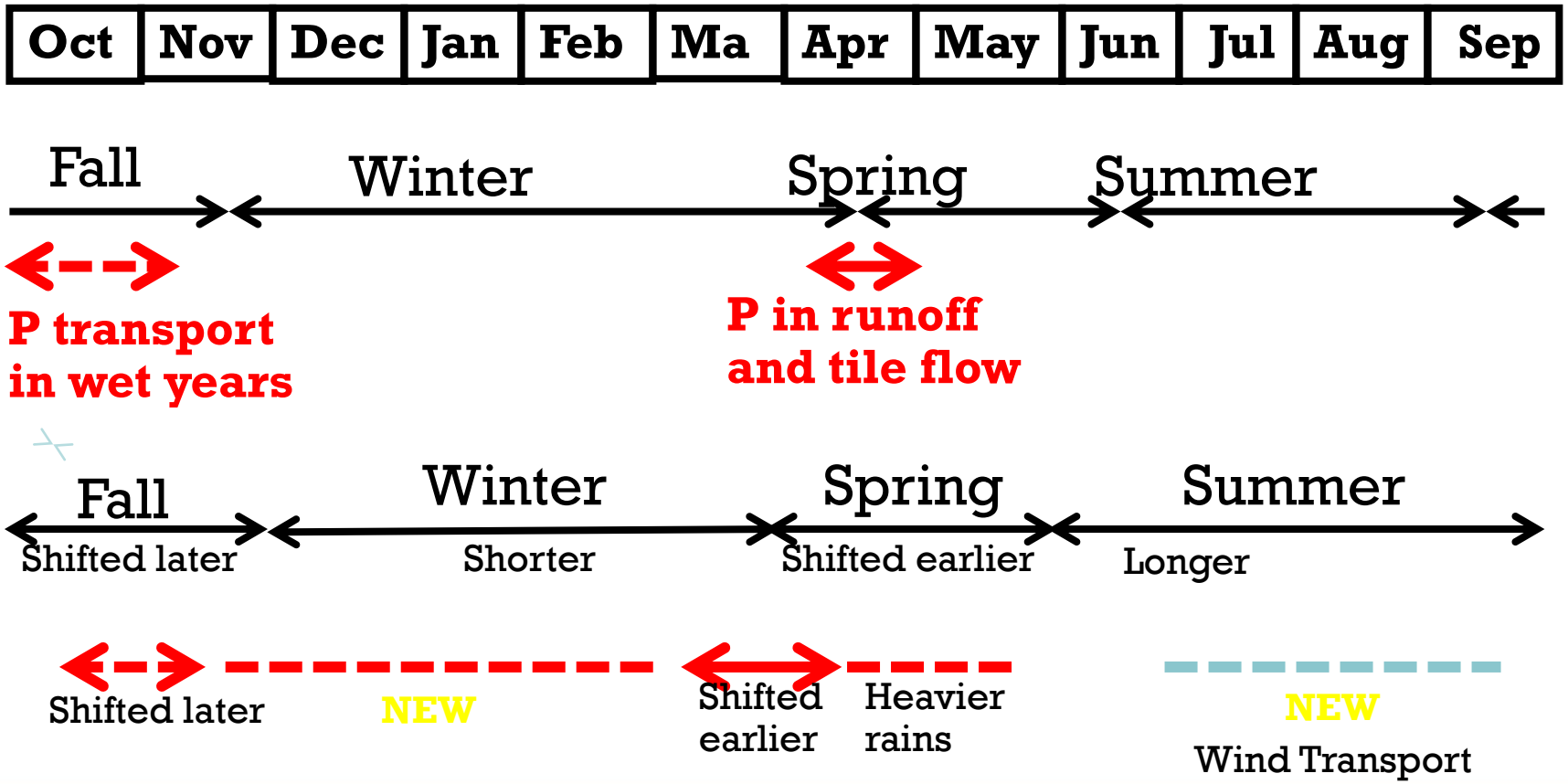
Frost-Free Days



Frost-Free Days



Possible Impacts on P Transport



The Emerging Storyline

Temperatures have risen – the lowest the most

↓

The number of frost-free days has increased significantly, affecting growing season

↓

Winter precipitation has been changing from snowfall to rainfall, affecting water management

↓

Winter runoff, infiltration & tile flow, and spring snowmelt runoff, have likely been impacted

UNIVERSITY of GUELPH

CHANGING LIVES IMPROVING LIFE

Conclusions

- Winter Hydrology has changed across Ontario.
- For some variables, the changes have been relatively steady for up to 70 to 150 years.

  e.g. winter temperatures rising, winter rainfall increasing, winter snowfall decreasing
- For frequency-oriented variables, such as frost-free days, the changes have involved increases at increasing rates e.g. the exponential rise in frost-free days.
- The impacts & implications for winter runoff and tile flow, snowmelt runoff, soil erosion and water quality , appear to be far-reaching!

UNIVERSITY of GUELPH

CHANGING LIVES IMPROVING LIFE

Output/Impact

- Rudra, R.P., W. Dickinson, S. Ahmed, P. Patel and J. Zhou. 2015. Changes in Rainfall Extremes in Ontario. International Journal of Environmental Research, 9 (4), 117-1126.

https://ijer.ut.ac.ir/article_1000_0.html

- Ahmed, S.I., R.P. Rudra, W.T. Dickinson and M. Ahmed. 2014. Trend and Periodicity of Temperature Time Series in Ontario. Amer. J. of Climate Change, 3(3):272-288.

https://www.scirp.org/html/4-2360173_49927.htm


Thank you