UQAC
Laboratoire sur les écosystèmes terrestres boréaux (EcoTer)
Université du Québec à Chicoutimi


# Measuring natural sap production in sugar maple at daily temporal resolution

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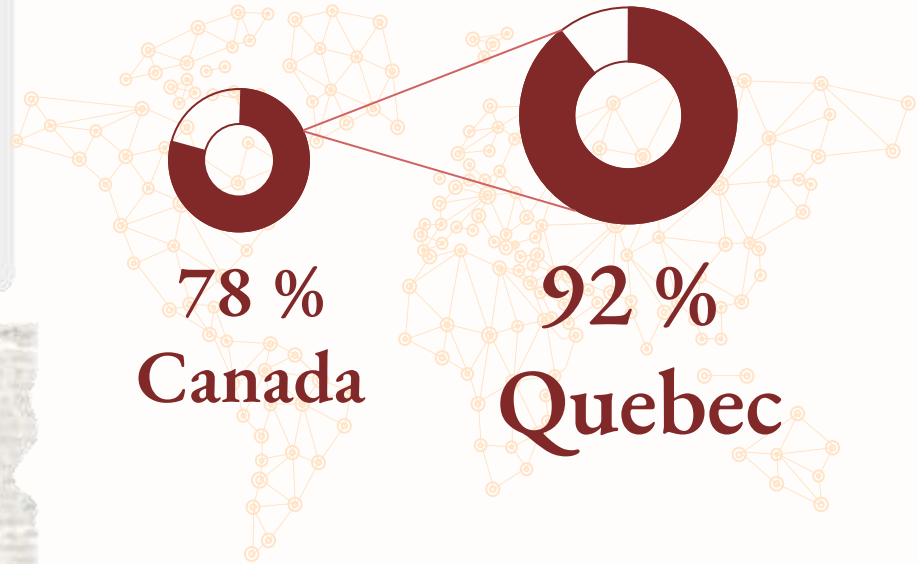
Government of Canada / Gouvernement du Canada

**<<En 2022, l'Amérique du Nord était la seule responsable de la production mondiale de sirop d'érable. L'industrie acéricole canadienne produit environ 78 % de la production mondiale de sirop d'érable, avec 92 % des produits canadiens provenant du Québec>>**

# Introduction

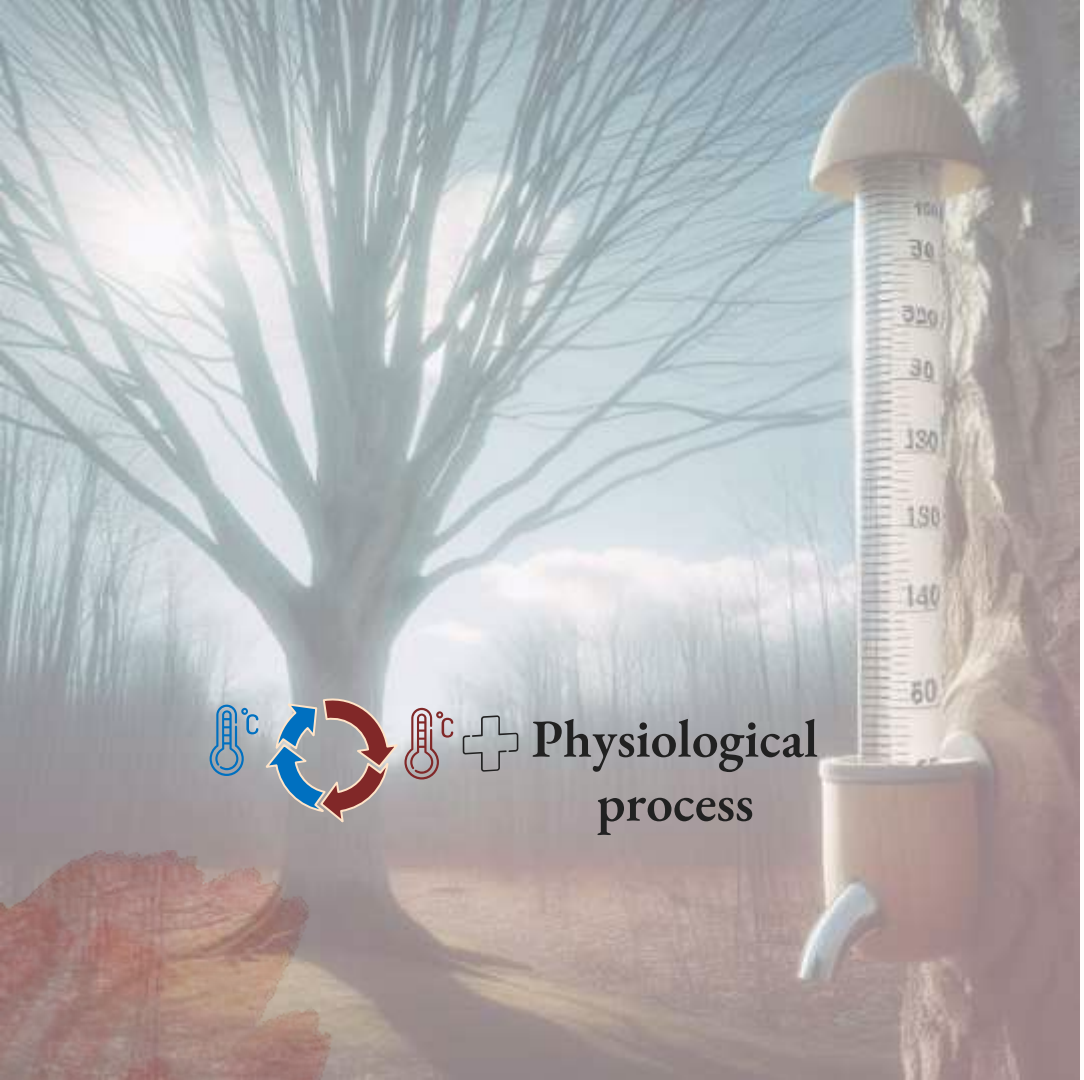


78 %
Canada

92 %
Quebec

69
countries

645
millions




# Best conditions for sap exudation

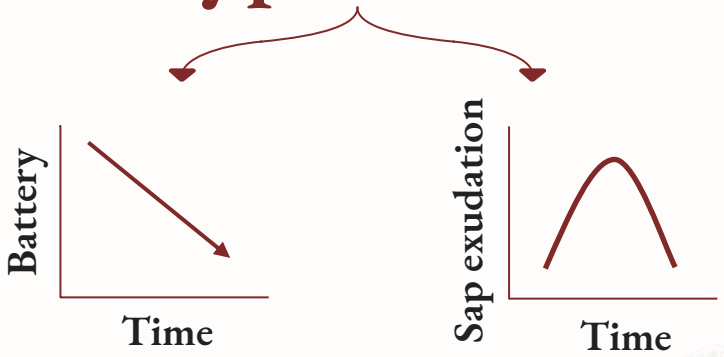
Sap production may vary according to maximum and minimum temperatures

drops sharply with minimum temperatures below -8

# Objectives

To test the use of the rain gauge as a tool for monitoring the timings and dynamics of sap production in sugar maple

# Hypothesis




# And when

Winter and Spring 2022


# Inside the rain gauge

- Data logger measures:

  Daily minimum temperature (°C)

  Daily maximum temperature (°C)

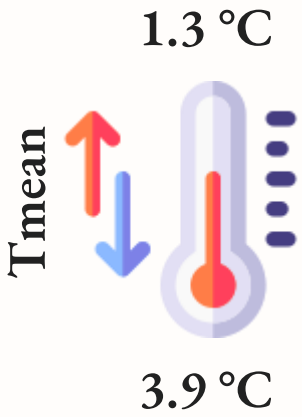
- Tipping-bucket mechanism

  Sap production (ml)

# How the equipment was tested?


Figure 1: Scheme of the rain gauge State of Charge

# Where was the data collected?



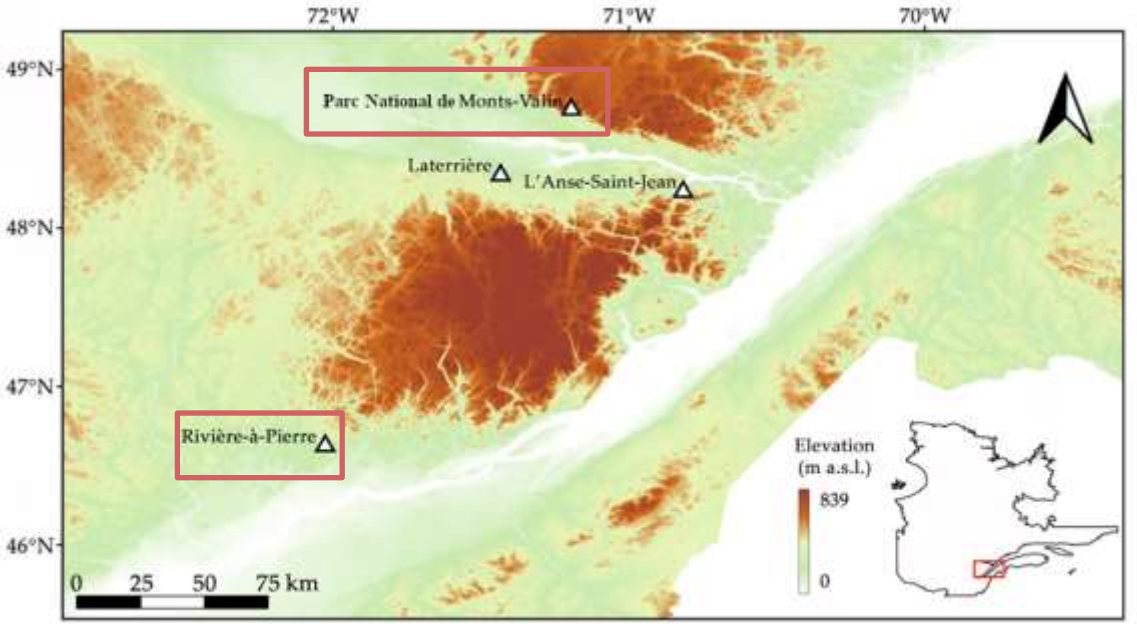




Figure 1: Location of the four study sites in Quebec, Canada

# How was the data collected?

- Recorded continuously
- Stored at hourly resolution
- Daily resolution


Figure 2: Maple tree with rain gauge installed

# What were the results?

- Logging intervals
  15 and 30 minutes
- Temperatures
  between
  -20 to +5 °C

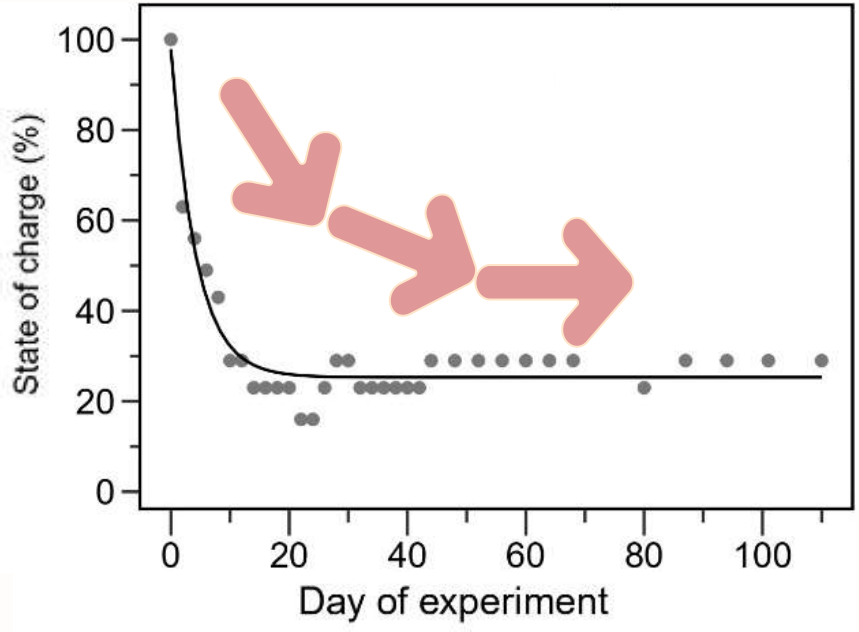
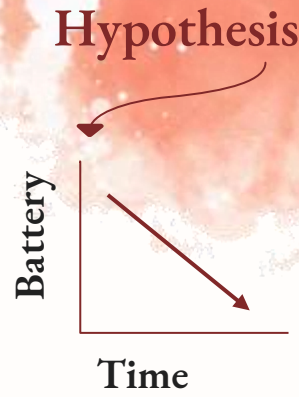



Figure 3: Variation in the state of charge in rain gauges exposed to different temperatures and set at two logging intervals



# What was found?

- The experiment lasted 110 days
- Batteries at -10°C reached stable levels at a similar rate to others
- Higher logging intervals = higher state of charge
- Except at -20°C where 15-minute intervals performed better

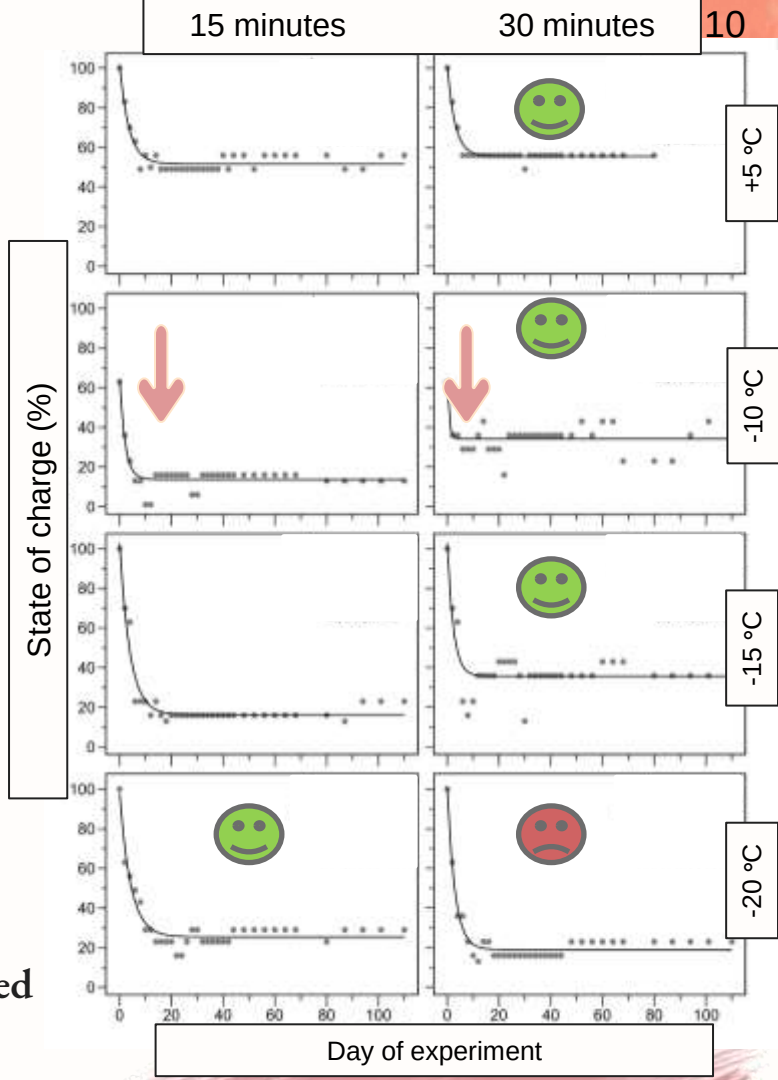
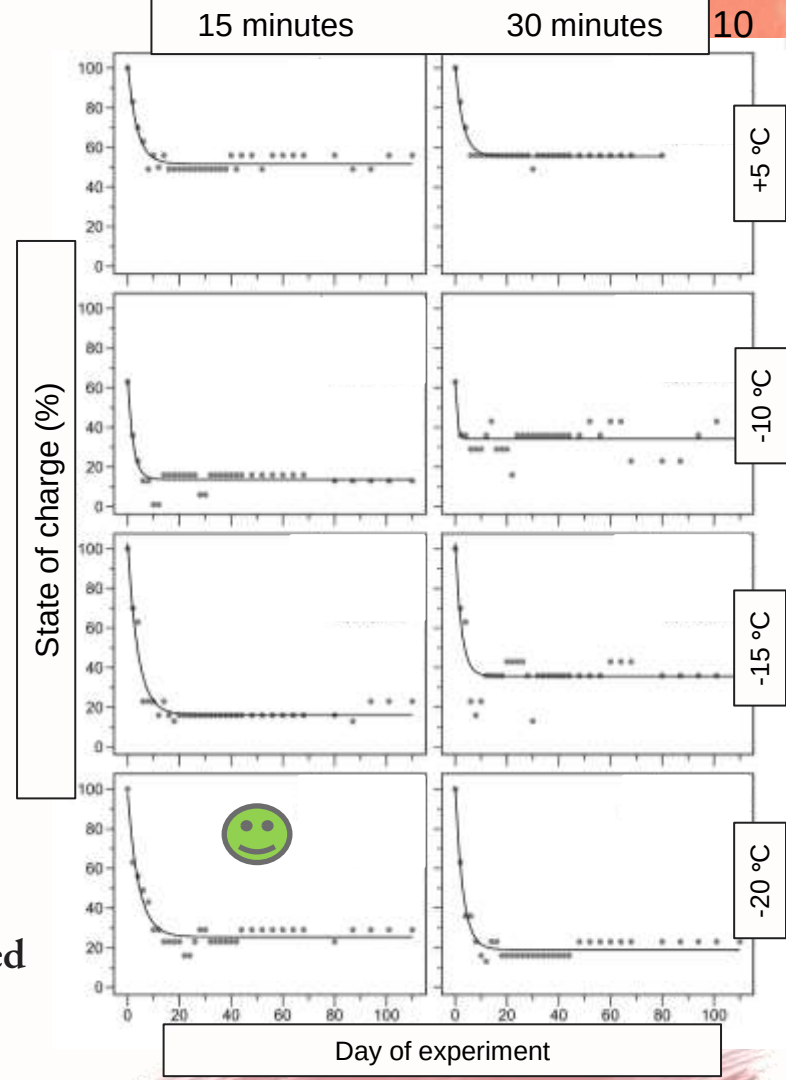



Figure 3: Variation in the state of charge in rain gauges exposed to different temperatures and set at two logging intervals

# What I think

- < 0 °C, battery discharging warms up the cells due to an interaction between electrochemical and thermal processes
- The self-heating process
- A reliable tool for recording sap production

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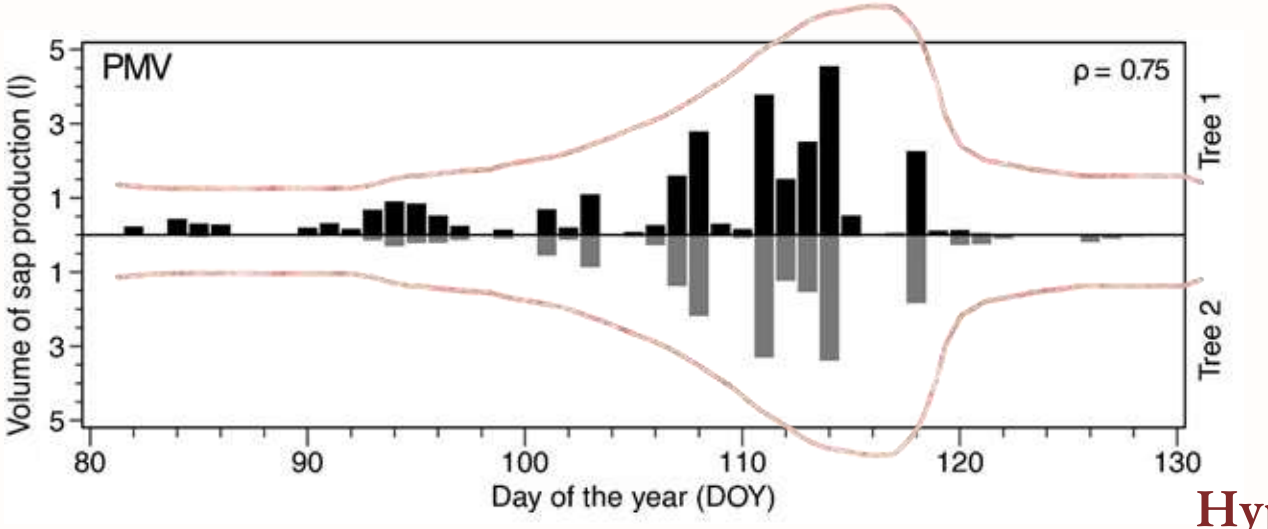
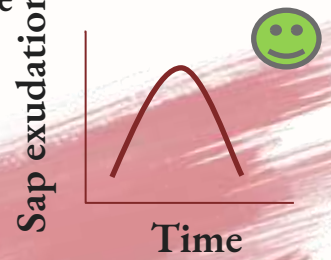



**Figure 4: Daily dynamics of natural sap production in sugar maple and the correlation coefficient of Spearman in each site.**

## Hypothesis



# What were the results?

- ASJ, LAT and PMV showed the highest sap volume occurring in mid-April
- RAP concentrated most sap production at the end - March and April

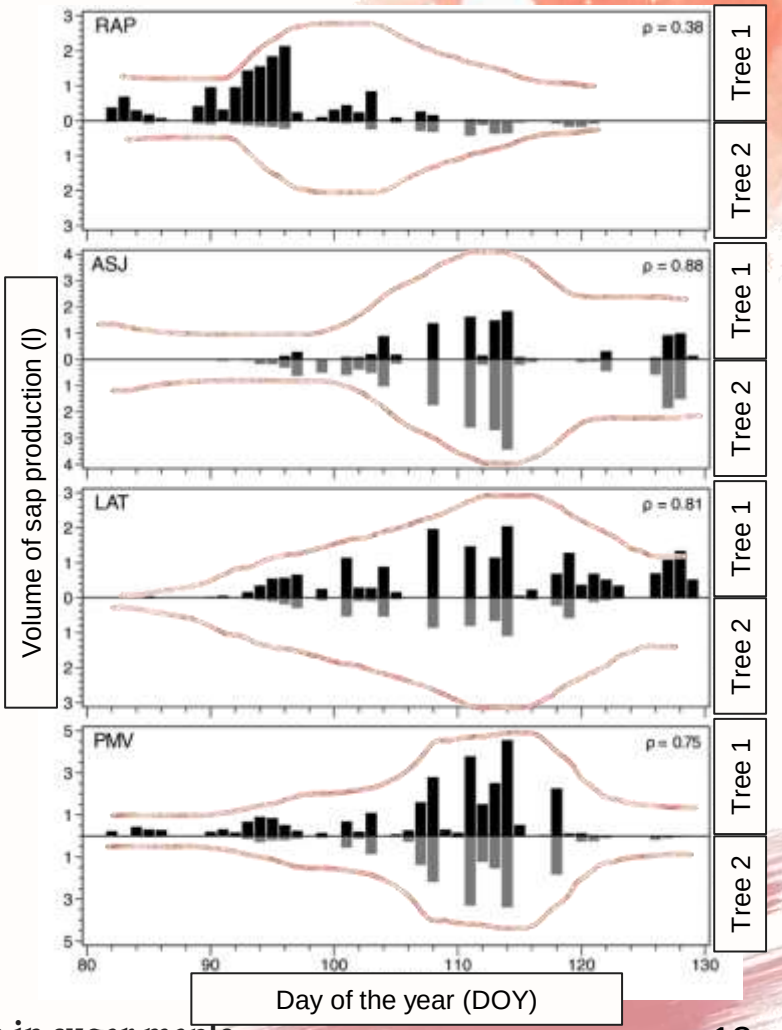



Figure 4: Daily dynamics of natural sap production in sugar maple

# What I think

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- 
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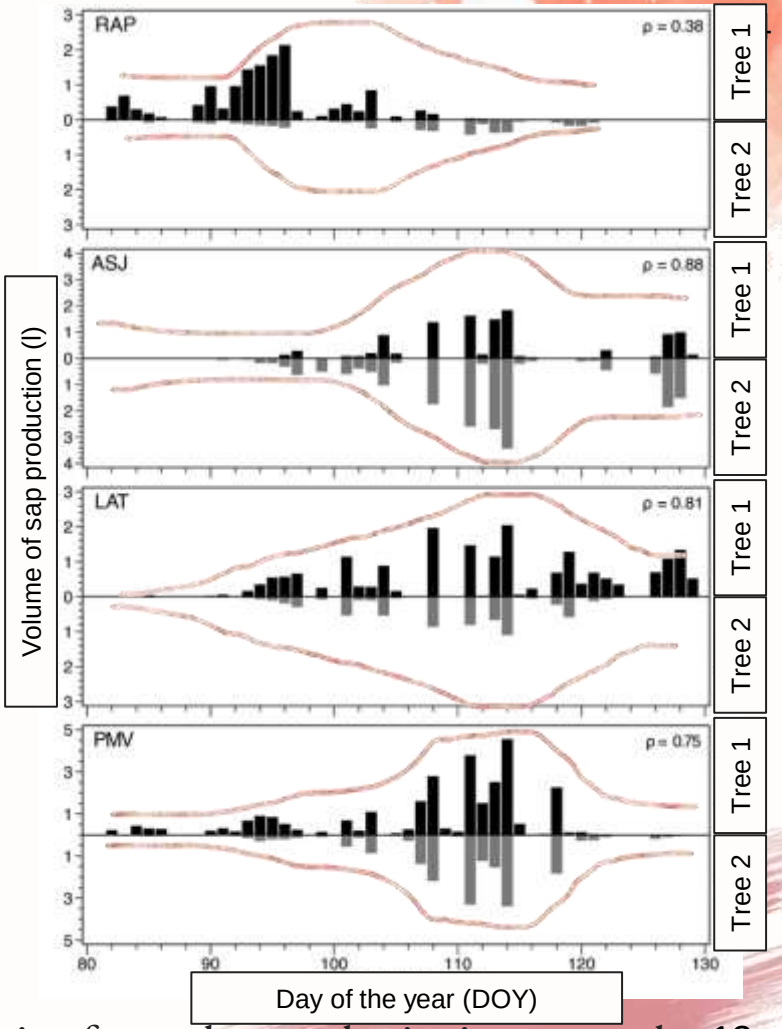


Figure 4: Daily dynamics of natural sap production in sugar maple

# What was found?

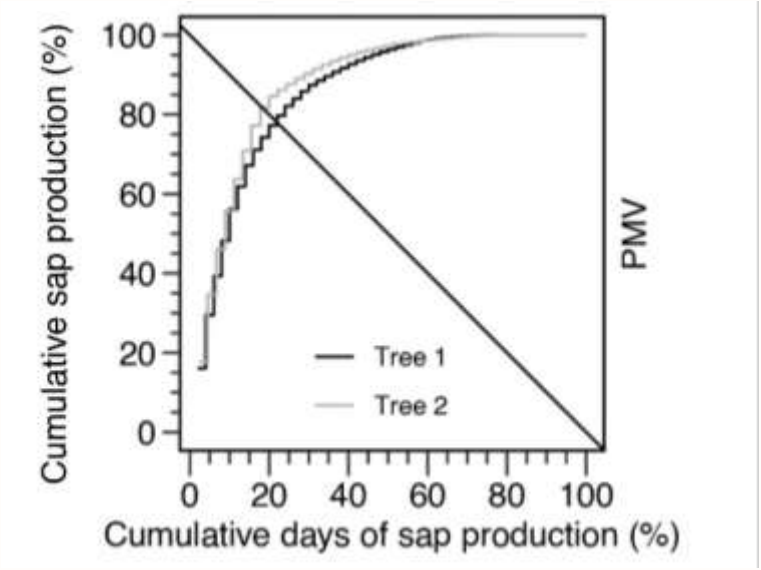


Figure 5: Cumulative percentages of daily sap production.

# What was found?

- Most days had low or no sap production, with patterns similar across different trees and sites
- The cumulative percentages of sap production were very similar
- 74% of total yield → 8 highly productive days → 20% of the entire season
- Significant days in the season (6 to 14 days) showing no sap production

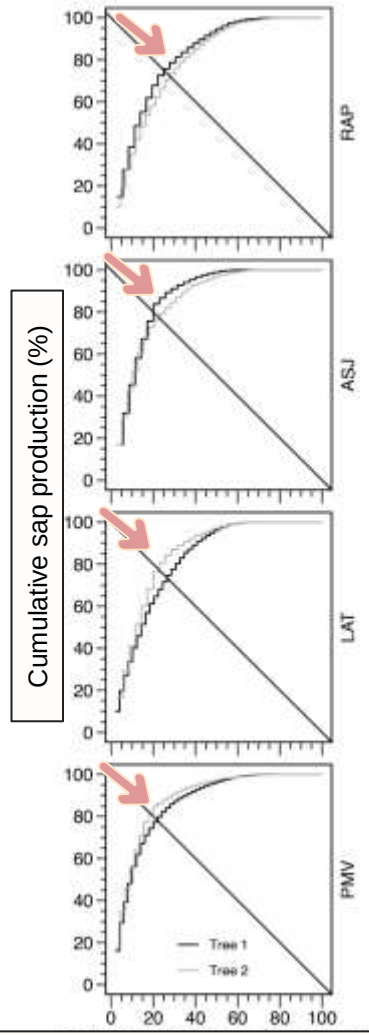


Figure 5: Cumulative percentages of daily sap production.

# What I think

- Either the weather conditions during or preceding the season
- Changes in the frequency of freeze-thaw events
- Affect the occurrence of the most productive days, with potential consequences on the daily sap yield.

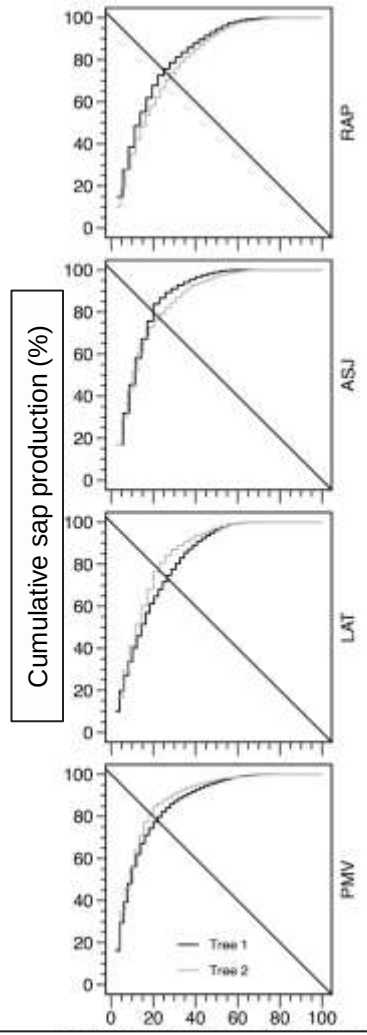


Figure 5: Cumulative percentages of daily sap production.

# Conclusion

- Tipping bucket rain gauges can effectively perform under the harsh spring temperatures
- Daily synchronisms in sap exudation among and within sites
- Few very productive days

# What are the applications of this study?

- The monitoring of the timing of sap exudation
- The precise quantification and comparison of daily sap production

# What can we expect for the future?

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FONDATION UQAC

17e Colloque du cef

# What can we expect for the future?

SYNDICAT DES PRODUCTEURS DE BOIS DU SAGUENAY-LAC-ST-JEAN

## Thank you!

Producteurs et productrices acéricoles du Québec

CRSNG NSERC

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ACER