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Daily timings of sap production in sugar maple in Quebec, Canada

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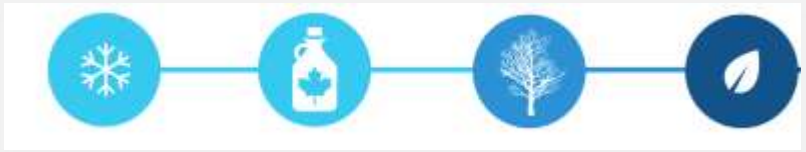
Sugar maple with hole for connecting pipes

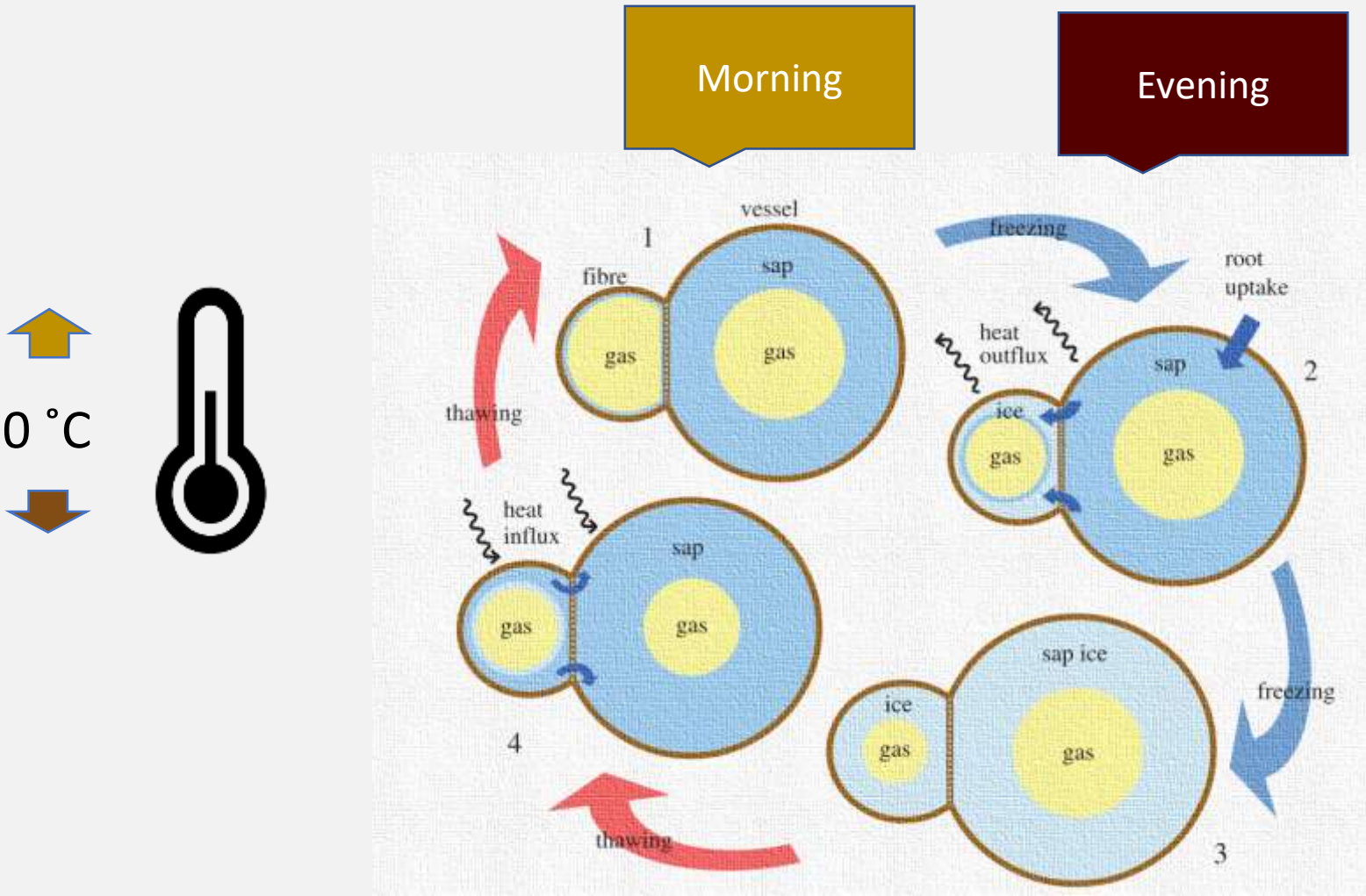
Sugar maple trees with pipes



‘Cabane à sucre’ where it has the reservoir

Evaporator for the final product

ENVIRONMENTAL AND PHYSIOLOGICAL EXPLANATION FOR SAP PRODUCTION IN SUGAR MAPLE



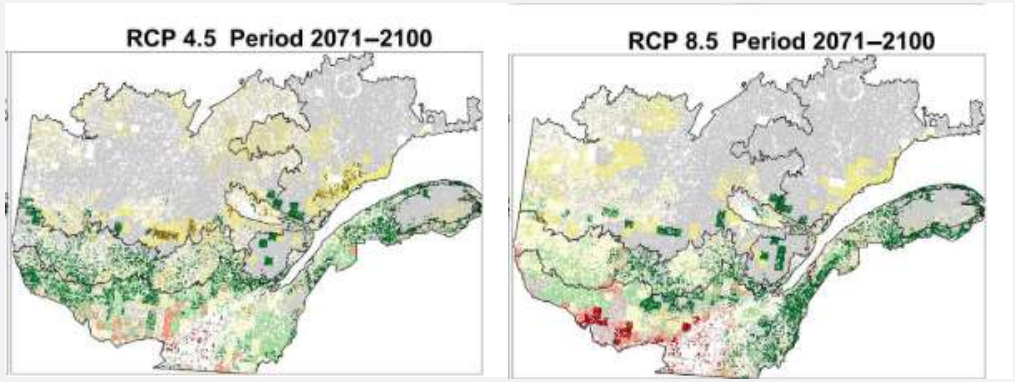
Stages in the freeze–thaw cycle. Various stages in the freeze–thaw cycle are depicted within an adjacent fibre–vessel pair. Source: Graf et al. 2015

2020
$ 645million

69 countries

April

Increase of 2.6˚C and 3.9˚C in 2050 and 2090 → 15 to 22 % decrease in sap production

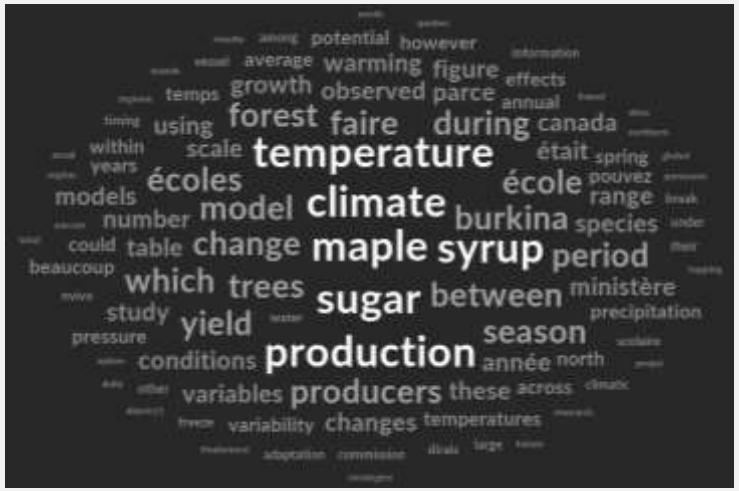


Source: Boulanger et al. 2021

Representative Concentration Pathways (continuous greenhouse gas high emissions) in 2100

RCP4.5(middle scenario) → 3.9 ° C
RCP8.5 (high scenario) → 8.5 °C

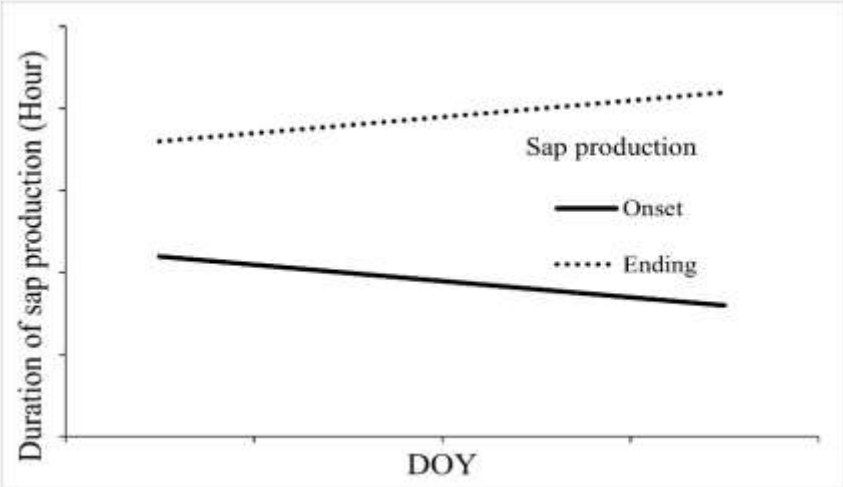
Challenge



Word cloud of the main papers related to sap production and climate

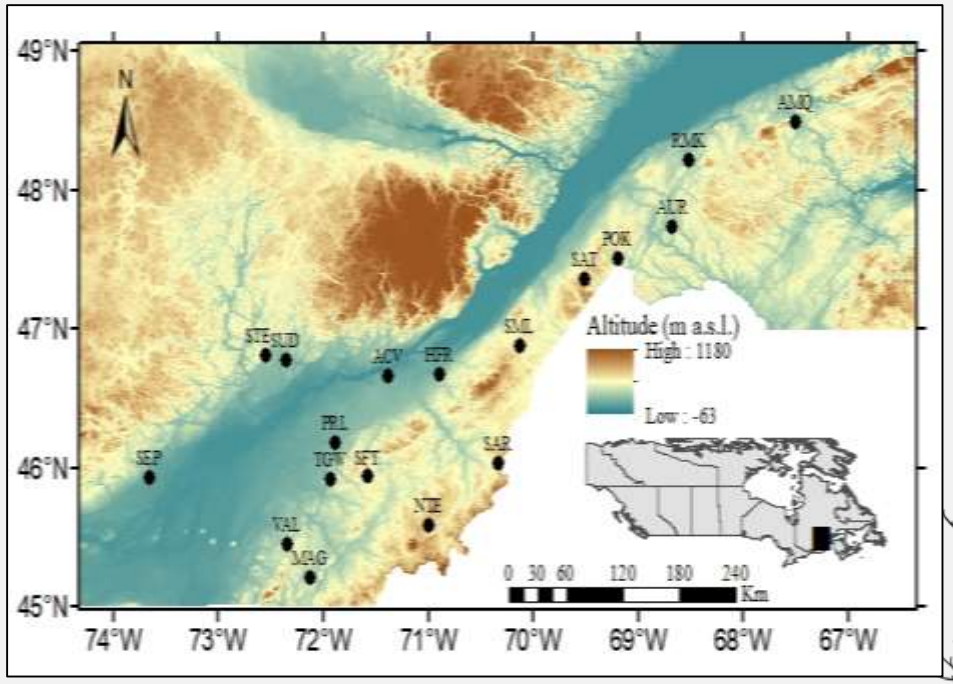
Objective: Determining the hours of onset and ending of sap production in spring

Hypothesis: the difference between the daily onset and ending times of sap production increases over the days

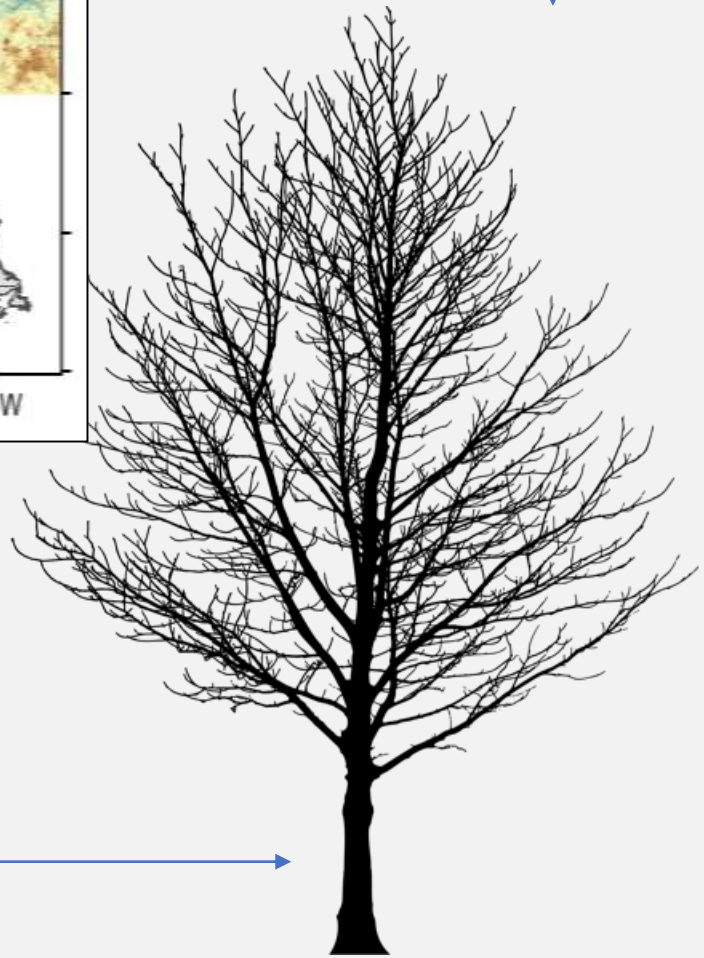


Duration of sap production at an hourly scale along the days of the year (DOY)

STUDY SITES



ERA5 Land database

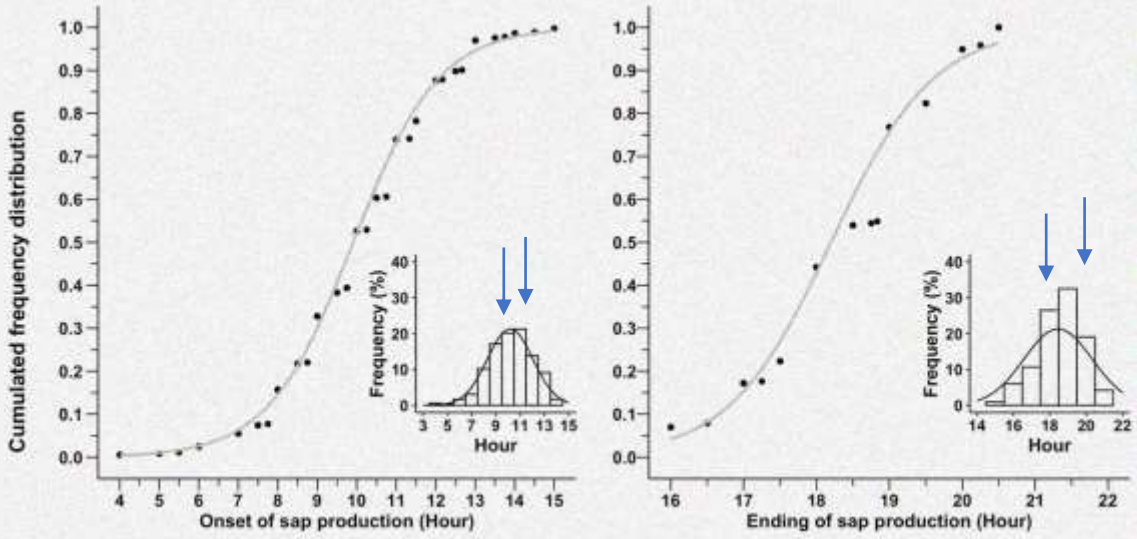


Local weather station

DATA COLLECTION AND ANALYSES

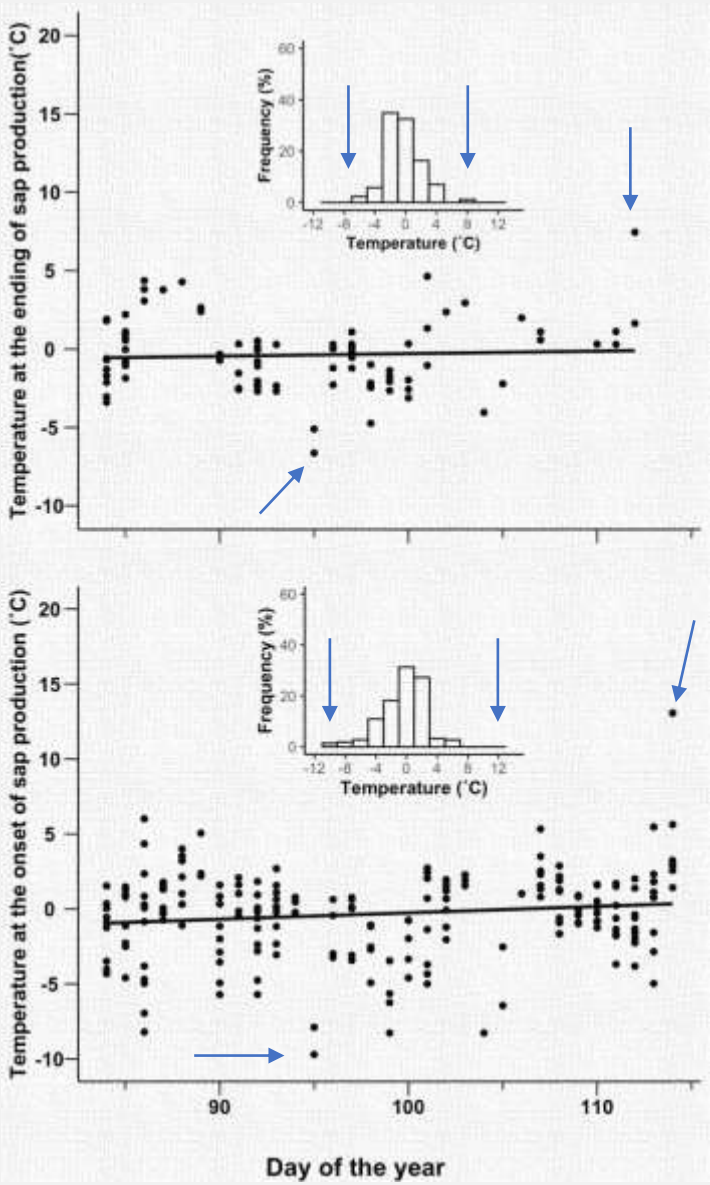
- **Onset:** the time when the first drop passes through the pipe.
- **Ending:** the time when the flow of sap water ran out.

Temporal changes in the timings of sap production were assessed by repeated measurements mixed models with autoregressive covariance structure using the day of the year (DOY) and phenological events (onset and ending) as continuous and categorical variables, respectively.



Cumulative and frequency distribution of onset and ending of sap production recorded in 19 sugarbushes in Quebec, Canada.

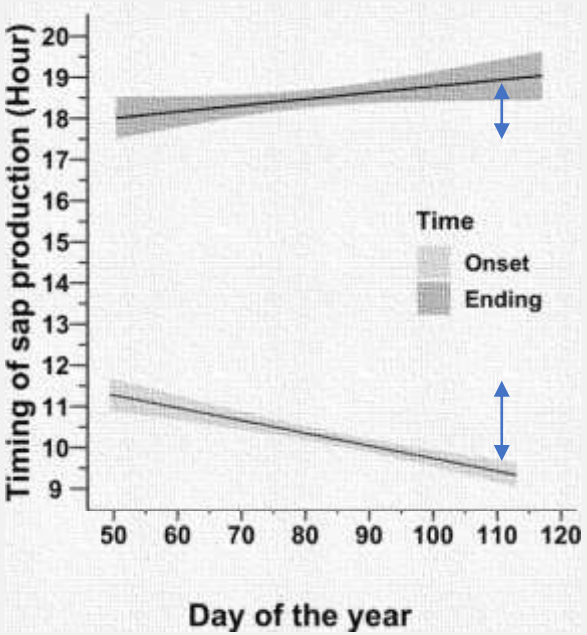
- Sap production onset ranged from **4 AM** to **2 PM**, but more frequent values were observed between 10 AM and 11 AM
- Sap production ending ranged from **3 PM** to **8 PM**. 71% of the ending of sap production was concentrated between 6 PM and 8 PM.



- The temperature at the ending of sap production ranged between **-6** and **7** ˚**C**, with 58% of temperatures occurring between **-2 and 2** ˚**C**

- The temperature at the onset of sap production ranged between **-10** and **13** ˚**C**, with 60% of temperatures occurring between **-2 and 2** ˚**C**

Temperature recorded at the onset and ending of sap production. Line represents a regression.



Onset and ending of sap production during the springtime. Shaded areas represent the confidence interval.

- During the study period from DOY 50 to 120, the onset advanced by 2 hours and ending was delayed by 1 hour.

- **ENVIRONMENTAL EXPLANATION**

Sequential events closely connected with changes in temperature

- **PHYSIOLOGICAL EXPLANATION**

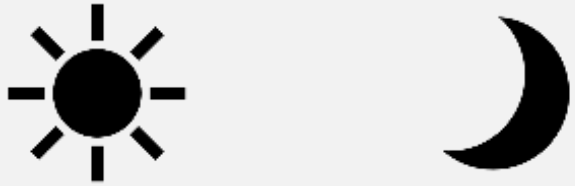
The positive pressure of the sap originates from the stem rather than the roots

- **PHYSICAL EXPLANATION**

Temperatures close to or lower than 0 °C increase the viscosity of the water or convert the water into ice, thus reducing or preventing the flow through the tubes

- **CLIMATE SCENARIO**

Daytime temperature variation is typically greater than nighttime temperature variation (Easterling et al. 2000)

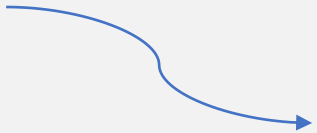


- Warming climate → 0 °C could be reached faster or earlier in winter.

- The circadian cycle of freezing and thawing is a critical factor for the timings of sap production

- Producers to prepare the field activities and stem tapping sufficiently in advance

- Warming scenario may advance sap production



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

CRSNG NSERC

FONDATION UQAC

Producteurs et productrices acéricoles du Québec

ACER
Centre de recherche, de développement et de transfert technologique acéric

Thank you!

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