

# Is size an issue of time?

Unraveling the relationship

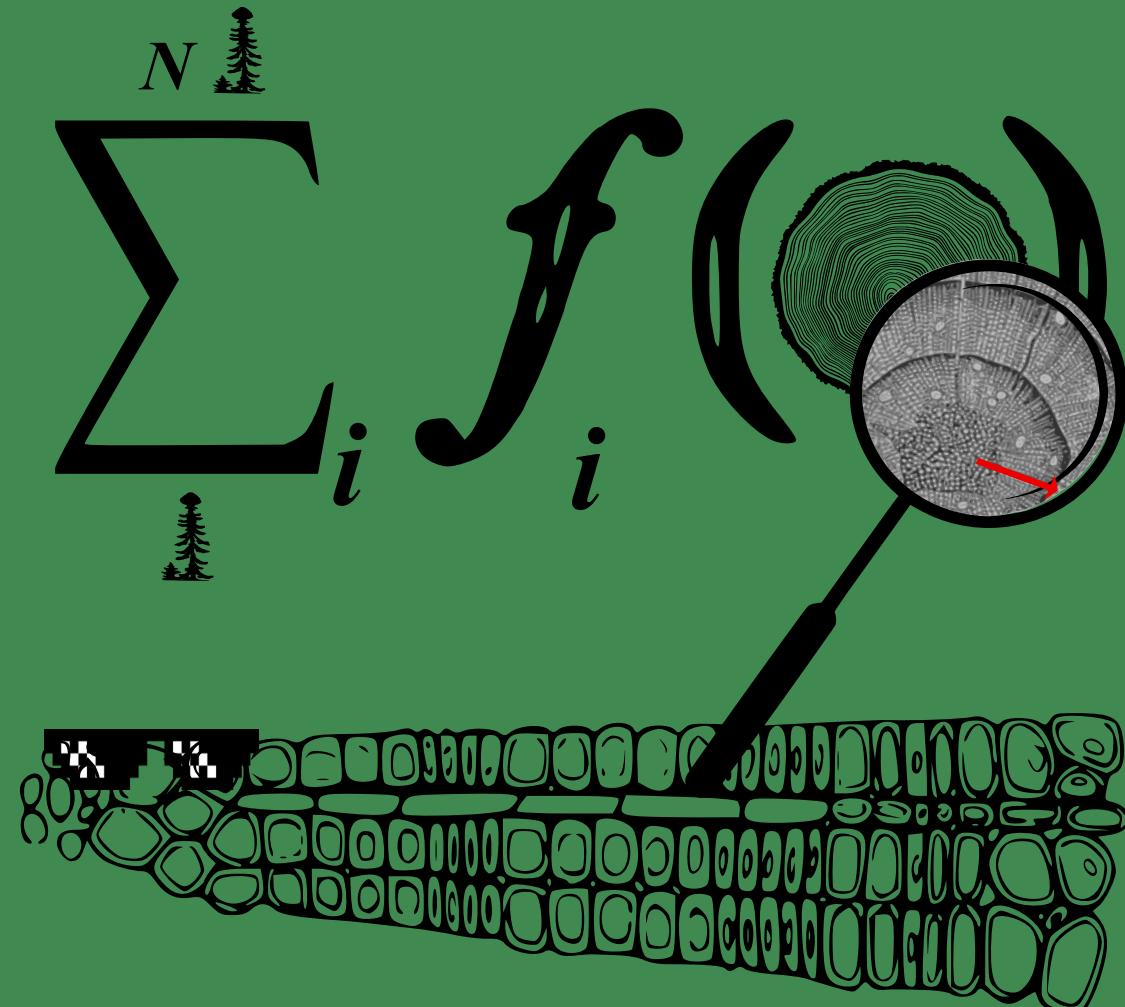
between duration of xylem development and final sizes of cells features

\*Valentina Buttò, Annie Deslauriers, Sergio Rossi, Hubert Morin

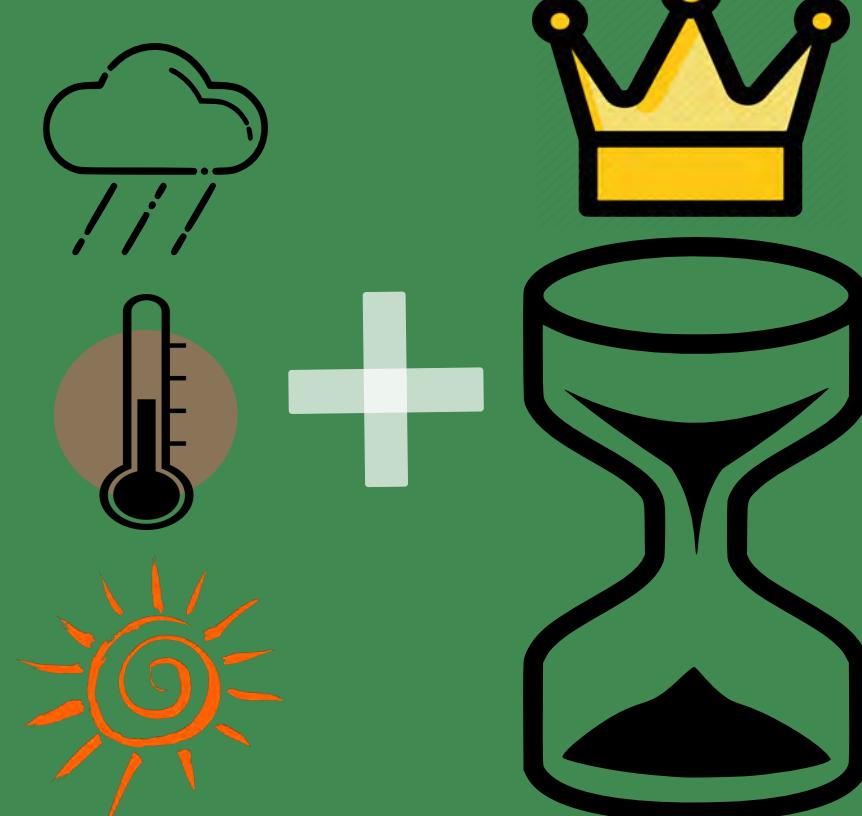
 valentina.butto@uqac.ca

## Introduction

Xylogenesis: the main actor of forest productivity

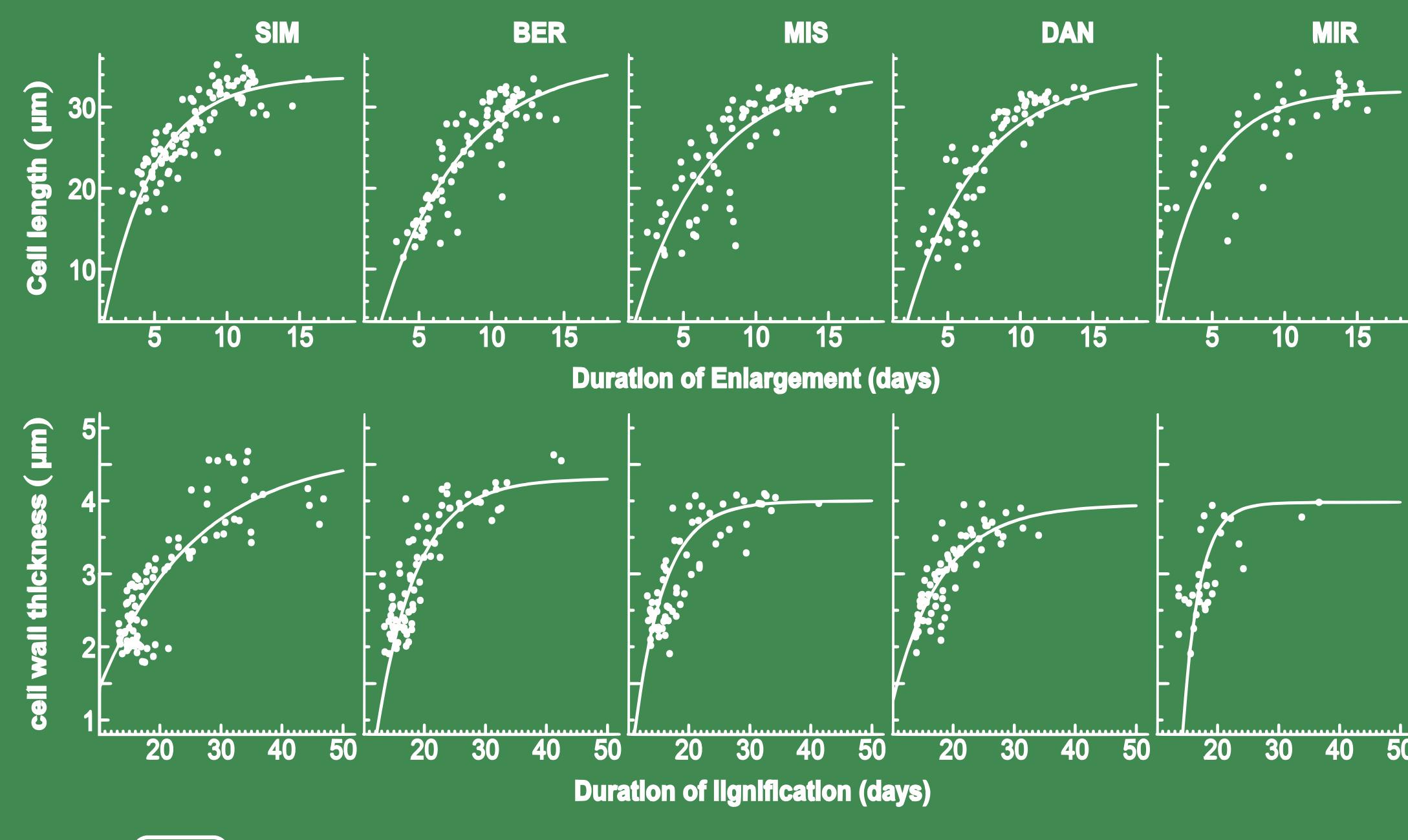


It is function of:



What is the quantitative nature of the relationship between time and cells features?

## Results

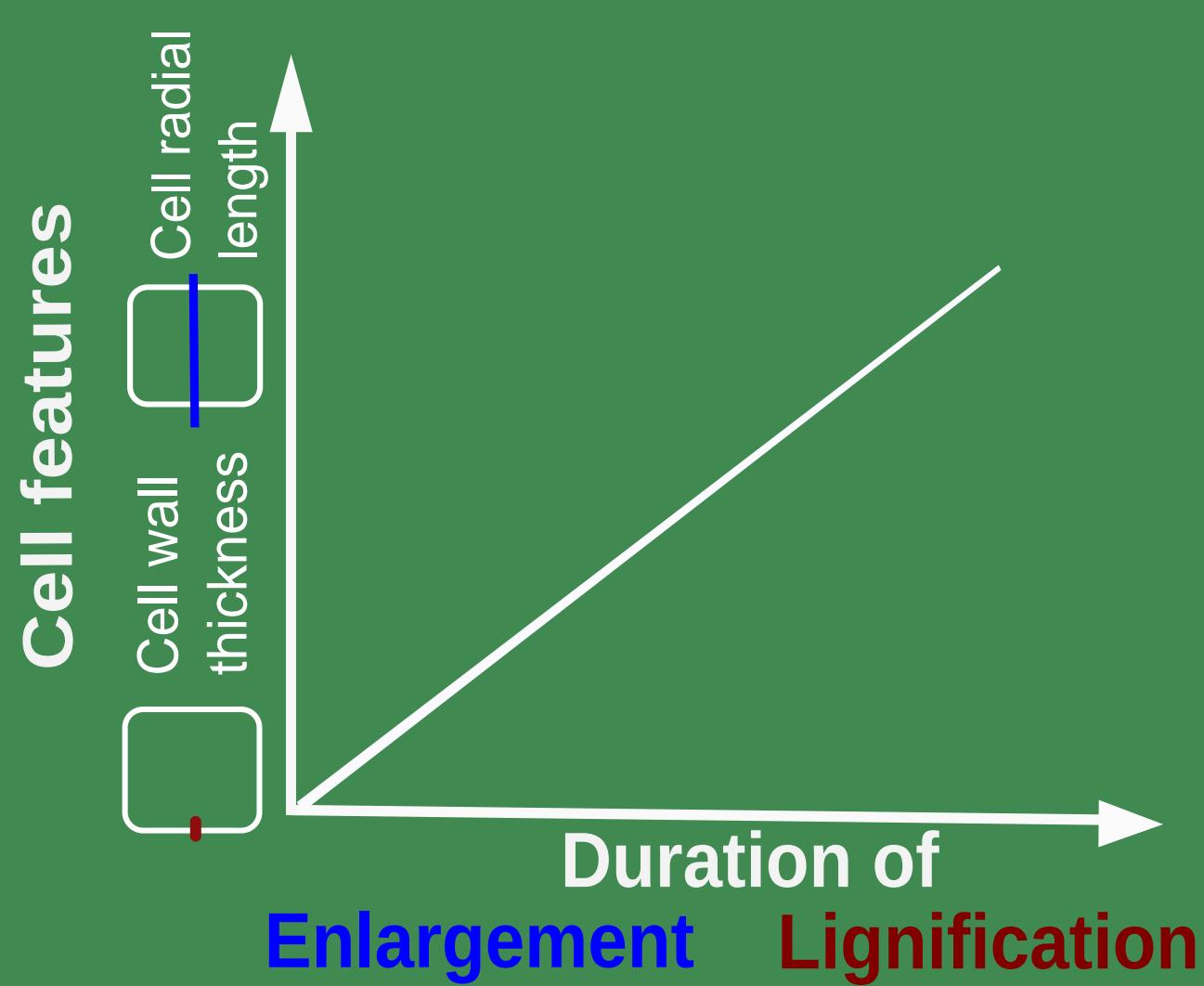


Cell radial length  
Cell wall thickness

$$= A \left( 1 - e^{-K(x-B)} \right)$$

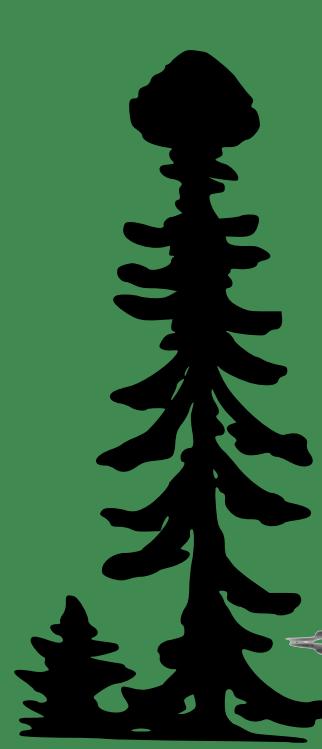
Site	A	K	B
SIM	$33.83 \pm 1.09$	$0.29 \pm 0.05$	$1.10 \pm 0.47$
BER	$35.79 \pm 3.16$	$0.18 \pm 0.05$	$1.81 \pm 0.59$
MIS	$34.38 \pm 2.58$	$0.19 \pm 0.05$	$1.10 \pm 0.64$
DAN	$34.00 \pm 2.80$	$0.20 \pm 0.05$	$1.63 \pm 0.56$
MIR	$32.00 \pm 1.54$	$0.31 \pm 0.08$	$1.00 \pm 0.35$
SIM	$4.68 \pm 0.39$	$0.06 \pm 0.01$	$4.21 \pm 1.98$
BER	$4.31 \pm 0.23$	$0.15 \pm 0.04$	$10.81 \pm 1.17$
MIS	$4.00 \pm 0.27$	$0.20 \pm 0.05$	$10.00 \pm 0.59$
DAN	$3.95 \pm 0.24$	$0.12 \pm 0.03$	$6.98 \pm 1.76$
MIR	$3.98 \pm 0.47$	$0.36 \pm 0.13$	$13.6 \pm 0.38$

## THE HYPOTHESIS



Black spruce (*Picea mariana*)

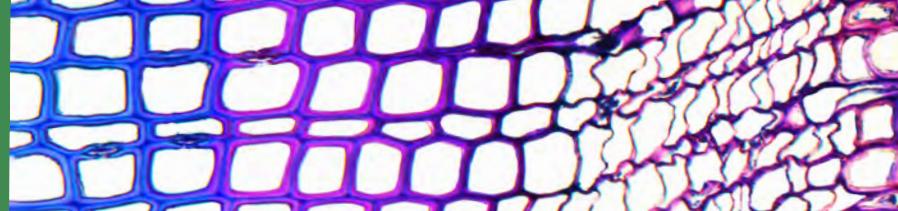
10 trees X site



## Timings & durations

weekly or fortnightly  
for 15 years (only 5 in MIR)

Number of cells in  
Maturation - lignification - enlargement



Deslauriers et al. 2003

## Xylem-cell anatomy

Summer 2017 : June-September

Cell radial length  
cell wall thickness

Rossi et al. 2006 ; Rossi et al. 2009

## GAMs application

Timing of:  
-enlargement,  
lignification, maturation  
Duration of:  
-enlargement,  
lignification  
for each percentile cell position

Cuny et al., 2014; Balducci et al., 2016

## Application of modified VB equation

y = cell parameters

x = duration of the developmental phases

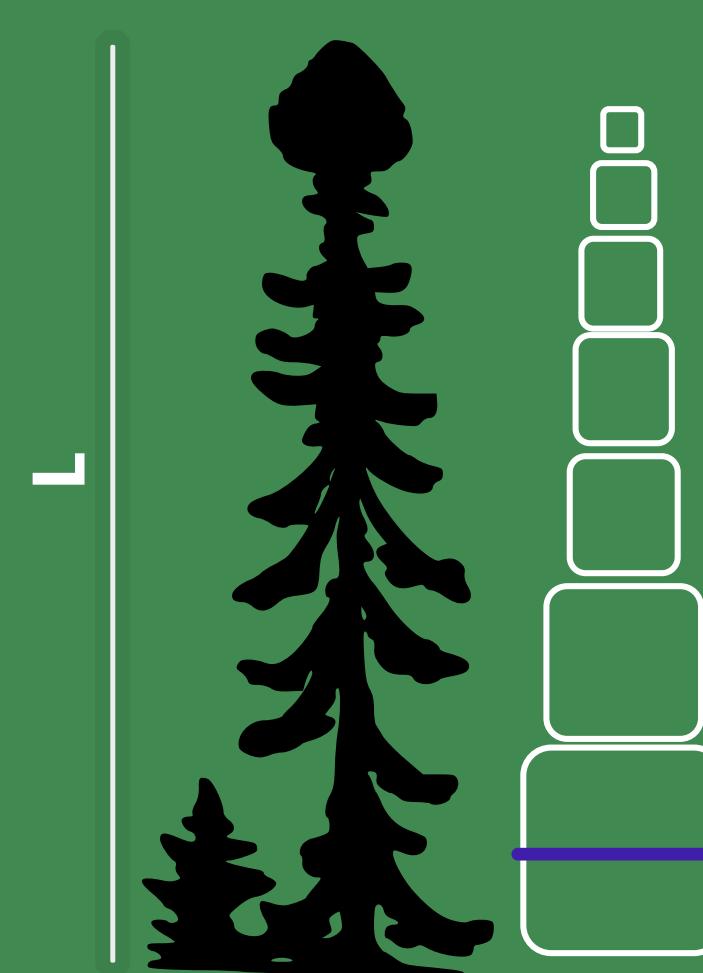
There is a relationship

Cuny et al., 2014

It is positive

It is linear

Vertical pattern



Dh ~ Duration of enlargement

Anfodillo et al., 2011

Dh ~ L

Enquist et al. 1999

## Discussion

### Horizontal pattern



Pattern similar to the vertical one

Carrer et al., 2015

max Dh = A

Sugar models and variations in density linked to increasing negative pressures can explain the limits in cell wall thickness deposition

Deslauriers et al. 2016  
Hacke et al. 2001

Balducci, L. et al., 2016. Compensatory mechanisms mitigate the effect of warming and drought on wood formation. Plant, cell & environment, 39(6), pp.1338–1352.  
Carrer, J. et al., 2015. The influence of environmental information from tree series of conduit size: The standardization issue and its relationship to tree hydraulic architecture. Tree Physiology, 35(1), pp.97–103.  
Cuny, H. E. et al., 2014. Kinetics of tracheid development explain conifer tracheid-ring structure. New Phytologist, 203(4), pp.1231–1241. Available at: <http://doi.wiley.com/10.1111/nph.12871> [Accessed January 8, 2017].  
Deslauriers, A. et al., 2016. The evolution of carbon allocation in black spruce wood. Tree Physiology, 36(1), pp.1–10. Available at: <http://doi.wiley.com/10.1093/treephys/tpv127> [Accessed January 8, 2017].  
Hacke, U.G. et al., 2001. Trends in wood density and structure are linked to prevention of xylem implosion by negative pressure. Ecologia, 128(4), pp.457–461.  
Rossi, S. et al., 2009. Stem structure and dynamics of *Picea mariana* on the northern border of the natural closed boreal forest in Quebec, Canada. Canadian Journal of Forest Research, 39(12), pp.230–238. Available at: <http://www.nrcresearchpress.com/doi/abs/10.1139/x09-152> [Accessed December 30, 2016].  
Rossi, S., Antofilio, T., & Menardi, R., 2006. TREPHOC: A NEW TOOL FOR SAMPLING MICROCORES FROM TREE STEMS Sergio Rossi, Tommaso Antofilio and Roberto Menardi. Iawa Journal, 27(1), pp.89–97.

UQAC

UNIVERSITÉ DU QUÉBEC  
À CHICOUTI MI

Chaire industrielle - CRSNG sur la croissance  
de l'épinette noire

et l'influence de la tordeuse des bourgeons

céf  
Centre d'étude de la forêt