Modélisation visco-élastique des contraintes de maturation dans le bois en relation avec les mesures de recouvrance-hygro-thermique, en particulier du bois de tension

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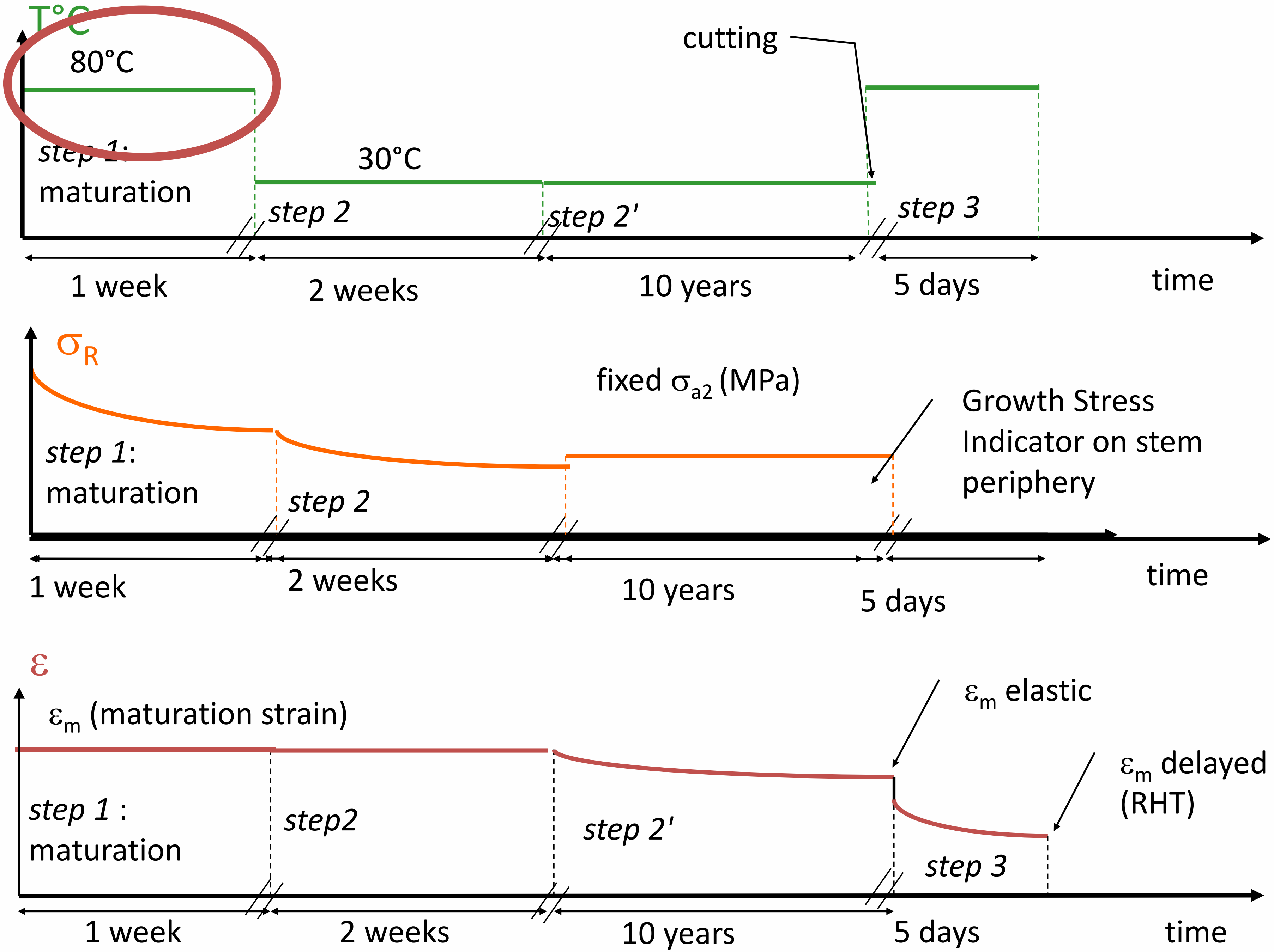
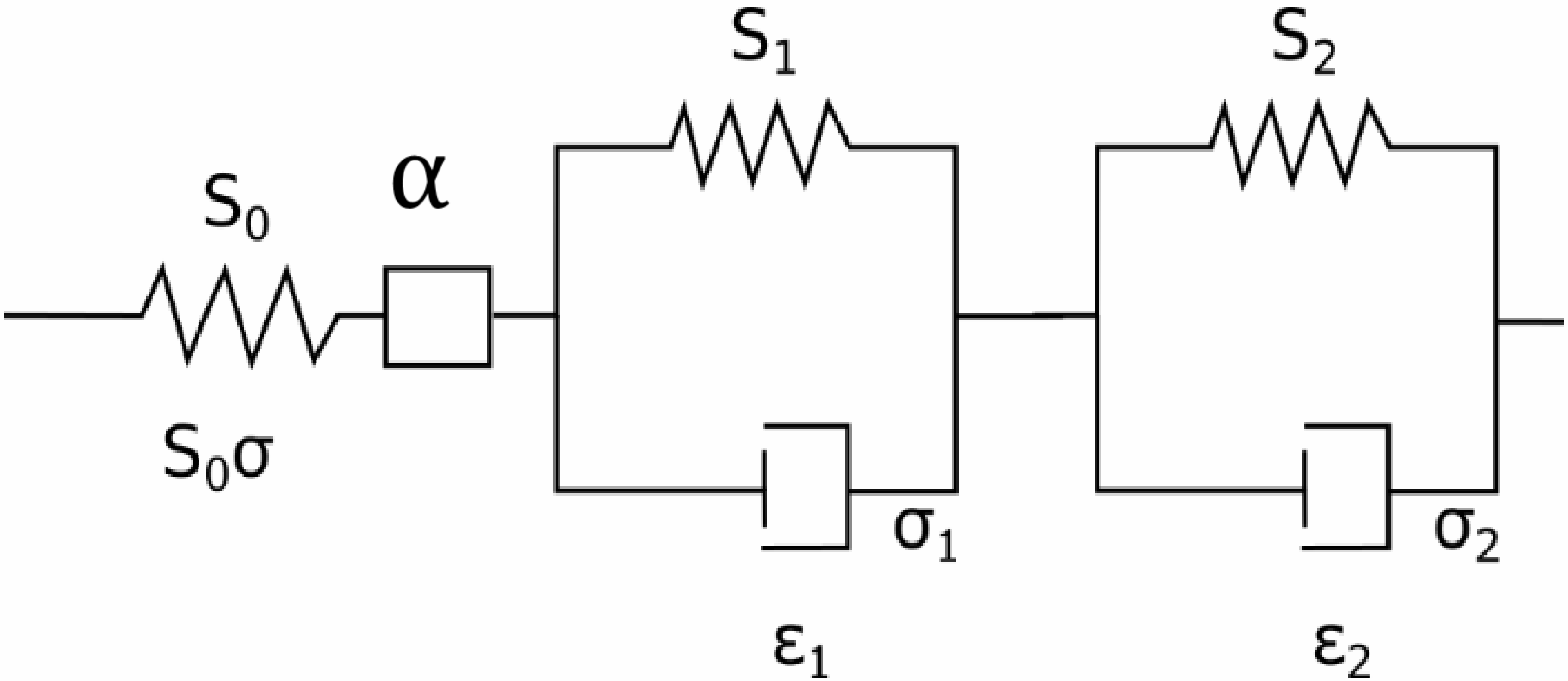
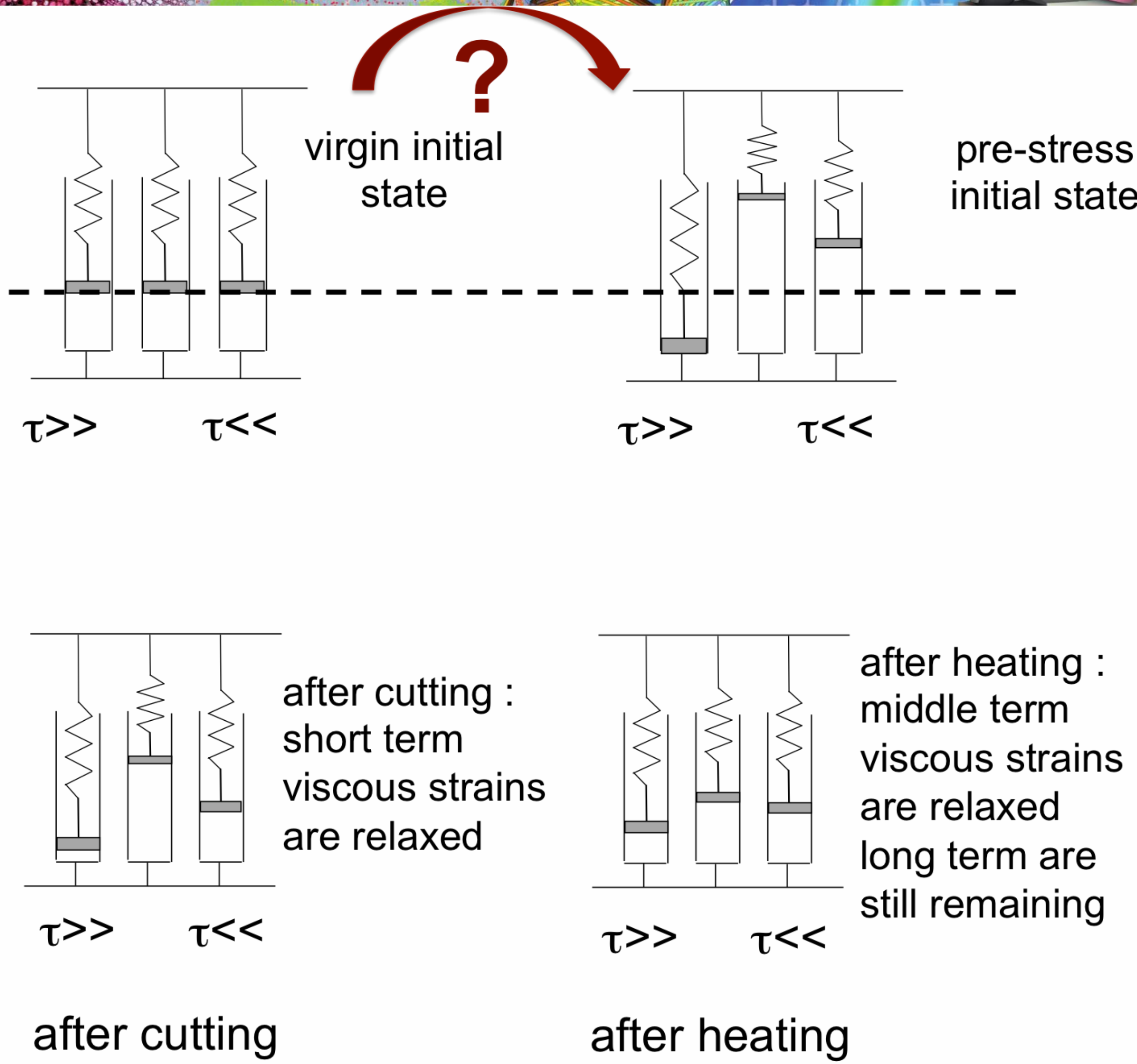
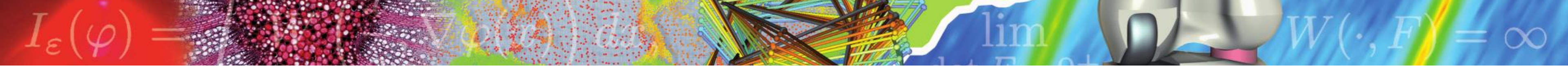

T°C
80°C
cutting
step 1:
maturation
30°C
step 2
step 2'
step 3
1 week
2 weeks
10 years
5 days
time
σR
fixed σa2 (MPa)
Growth Stress
Indicator on stem
periphery
step 1:
maturation
step 2
1 week
2 weeks
10 years
5 days
time
ε
εm (maturation strain)
εm elastic
εm delayed
(RHT)
step 1 :
maturation
step2
step 2'
step 3
1 week
2 weeks
10 years
5 days
time



S₀ → S_0

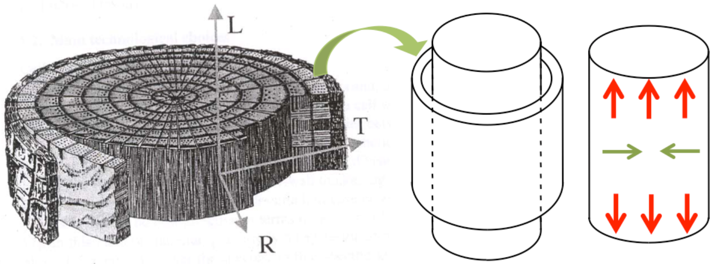


l’état rhéologique du bois lors de la maturation cellulaire peut être assimilé à l’état du bois vert chauffé, c’est-à-dire que les éléments visqueux sont « mous ».



Where do locked-in strains come from ?

1. Cell maturation process

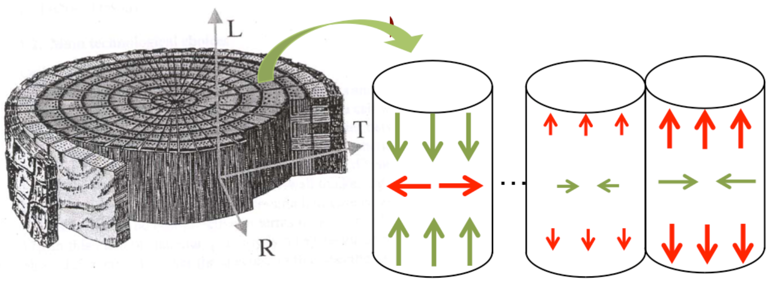


- last step of the genesis of a wood cell
- increase of rigidity
- tendancy to shrink along the fibre and expand transversally
- deformations are prevented by previously formed layers

> longitudinal tension and tangential compression

+

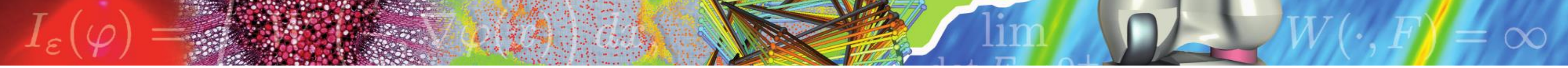
2. Loading history during tree



- formation of layers : redistribution of tangential stresses
- successive disposition of concentric layers
- growth stress depends on radial position

→ inversion of stress (T: compression near the bark, tension near the pith)

> pre-stress level of the wood in the tree depends on the direction and the age of wood



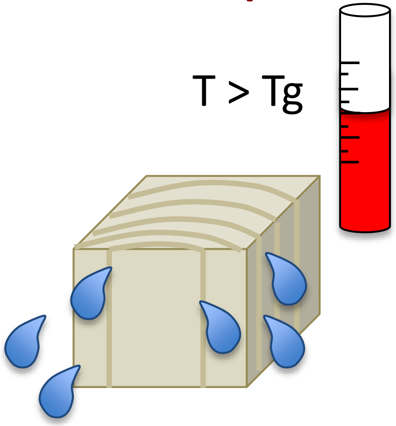
How to release locked-in strains?

1. Elastic part = short-term viscous strains

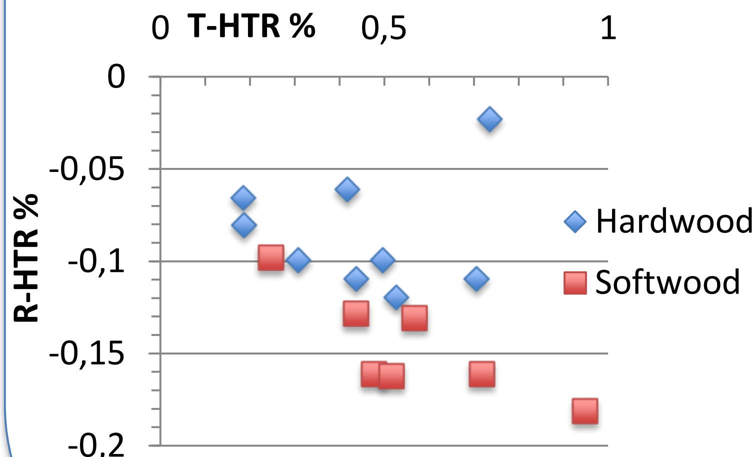
Tree felling

Growth Stress Indicator on periphery

2. Viscous part = long-term viscous strains



Hygro-thermal Recovery



Radial HTR against tangential HTR from literature (Gril 93)

HTR in T and R direction in the literature :

Reference	Duration (min)	T °C	Species
Koehler, 1933	1440	89	Pine, birch, oak
Mac Lean, 1952	30-45	99	Maple, beech, poplar, oak, hickory, douglas, fir, spruce,
Kubler, 1959	150	95	Beech
Grzeczynsky, 1962	60	100	Beech
Yokota and Tarkow, 1962	180	80	Sitka spruce
Sasaki and Okuyama, 1983	60	100	Sugi
Gril et al., 1983	60	90	Jujube tree

Radial and tangential HTR conditions from literature