

Imagerie hyperspectrale appliquée au bois

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GT Imagerie / GDR Sciences du bois





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Review of near infrared hyperspectral imaging applications related to wood and wood products

Laurence Schimleck, Te Ma, Tetsuya Inagaki & Satoru Tsuchikawa

1997–2022

91 ref.

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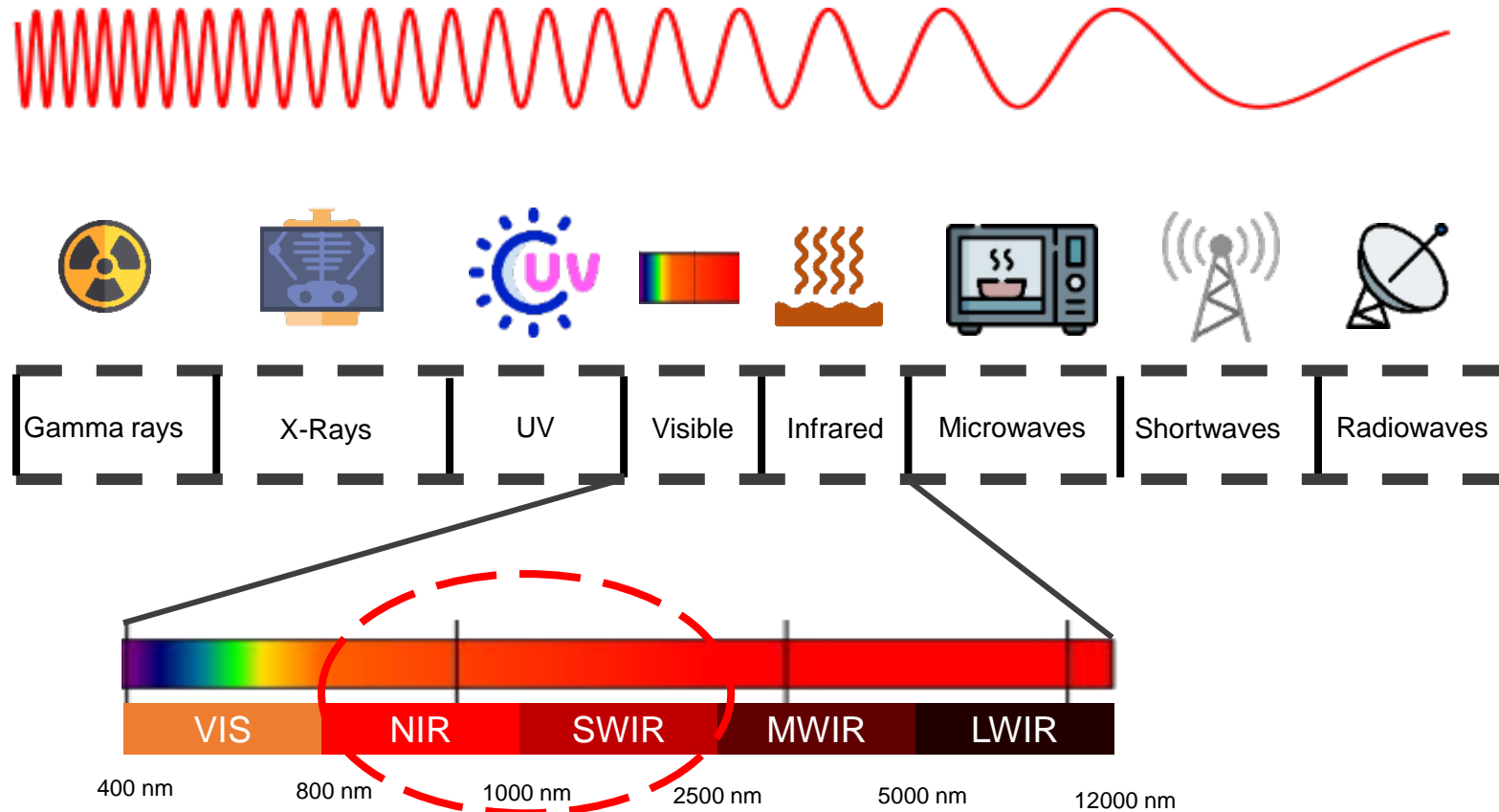
Hikaru Kobori*, Nathalie Gorretta, Gilles Rabatel, Véronique Bellon-Maurel, Gilles Chaix, Jean-Michel Roger and Satoru Tsuchikawa

Applicability of Vis-NIR hyperspectral imaging for monitoring wood moisture content (MC)

Rappel principes spectroscopie proche infrarouge – spectroscopie vibrationnelle

Spectral domain

Interaction between light and WOOD!



Energie de vibration (E_V)

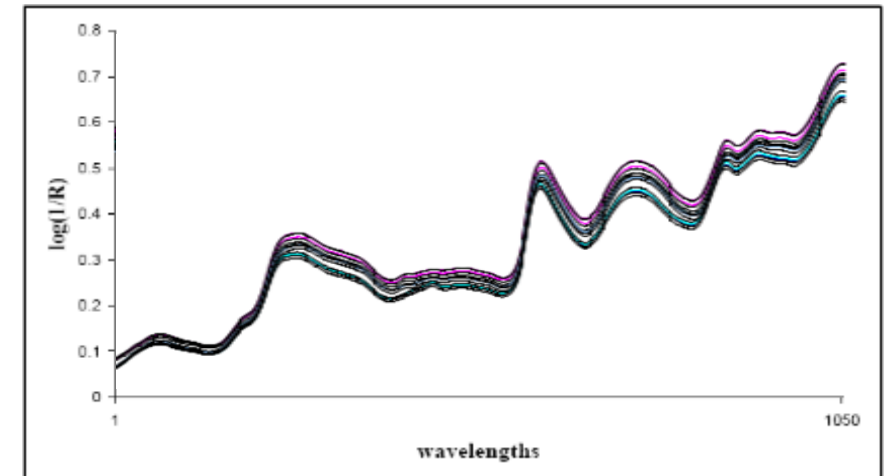
Energie de rotation (E_R)

Rappel principes spectroscopie proche infrarouge – base réflexion diffuse

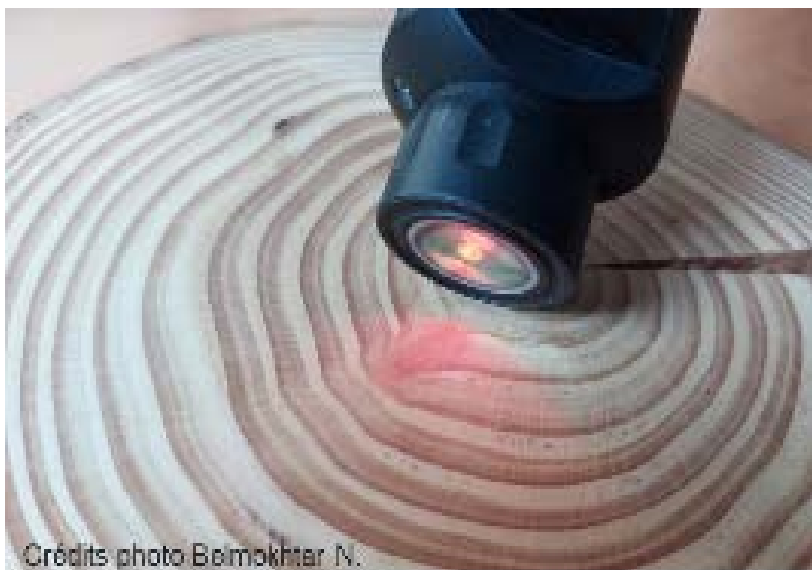


$$\text{Absorbance} = \text{Log} (1/R) \text{ or } -\text{Log}(R)$$

$$\text{Absorbance} = k \cdot [c]$$

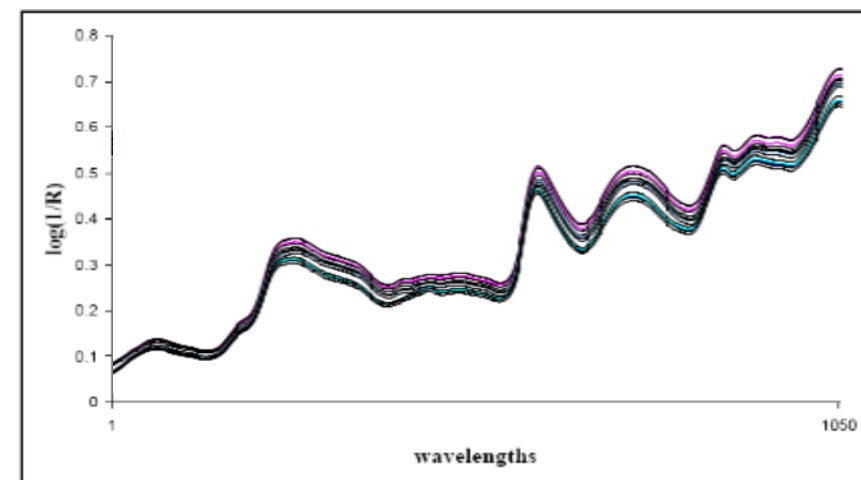


Rappel principes spectroscopie proche infrarouge – base réflexion diffuse

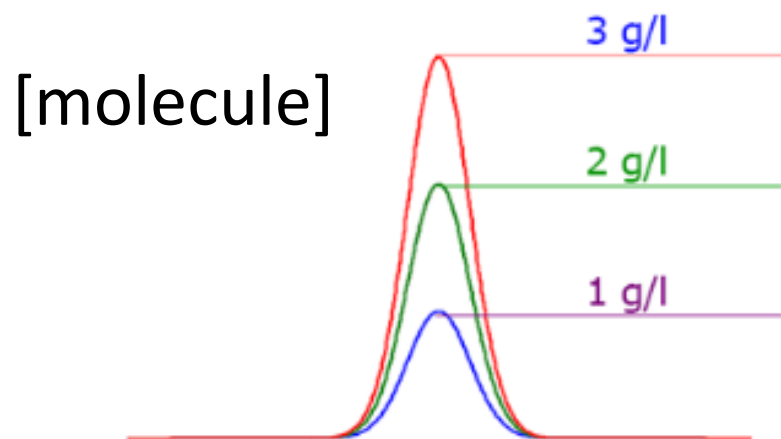


$$\text{Absorbance} = \text{Log} (1/R) \text{ or } -\text{Log}(R)$$

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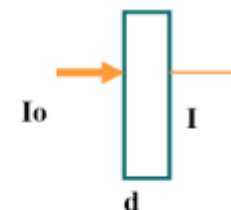


Transmission measurement



Univariate
Calibration
 $Y = X \cdot \beta + R$

Beer – Lambert's Law



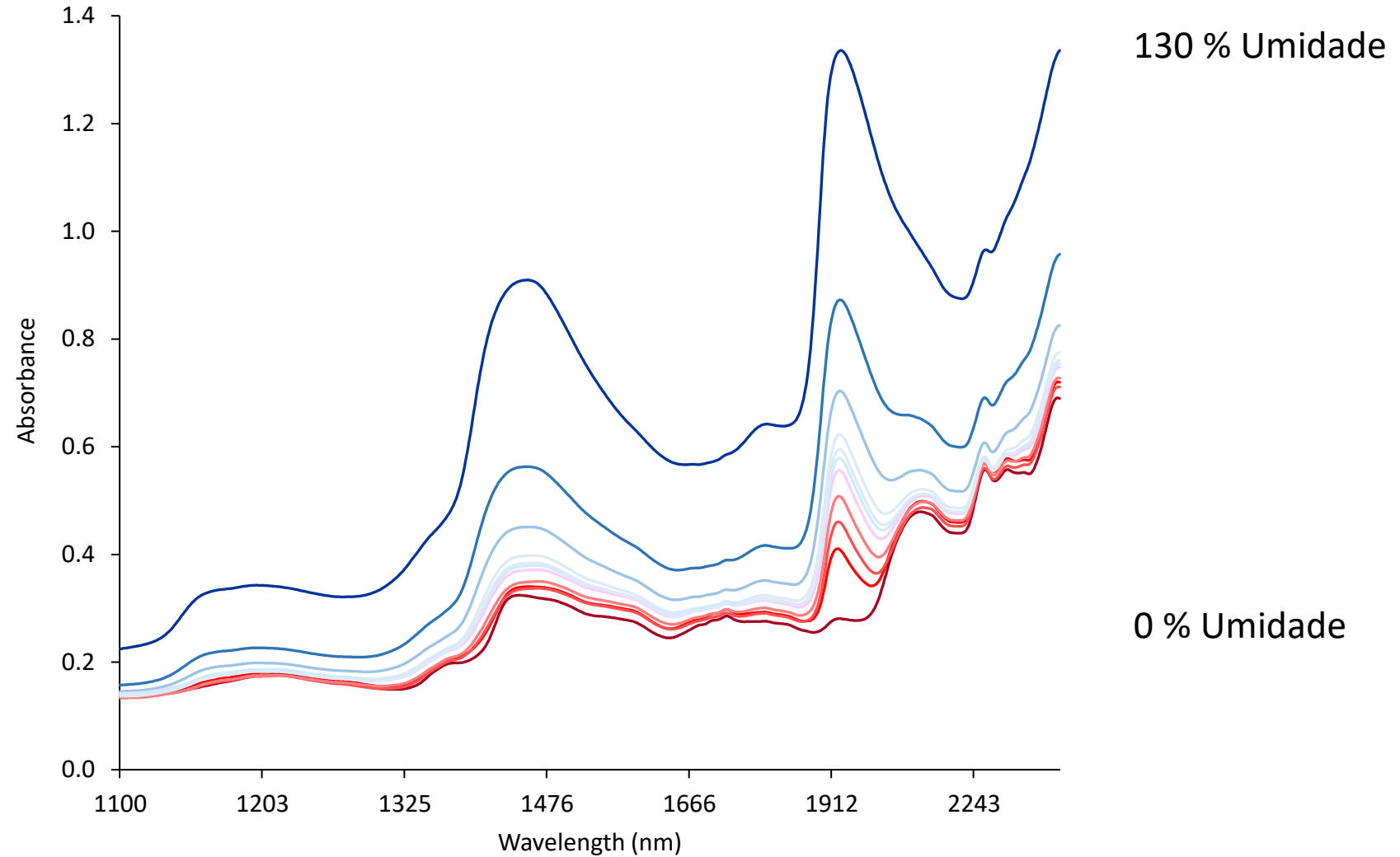
$$I/I_0 = e^{-C \cdot k \cdot d}$$

C Concentration in absorbant compound
k Absorption coefficient

$$\text{Absorbance} \quad A = Ckd = -\log(I/I_0)$$

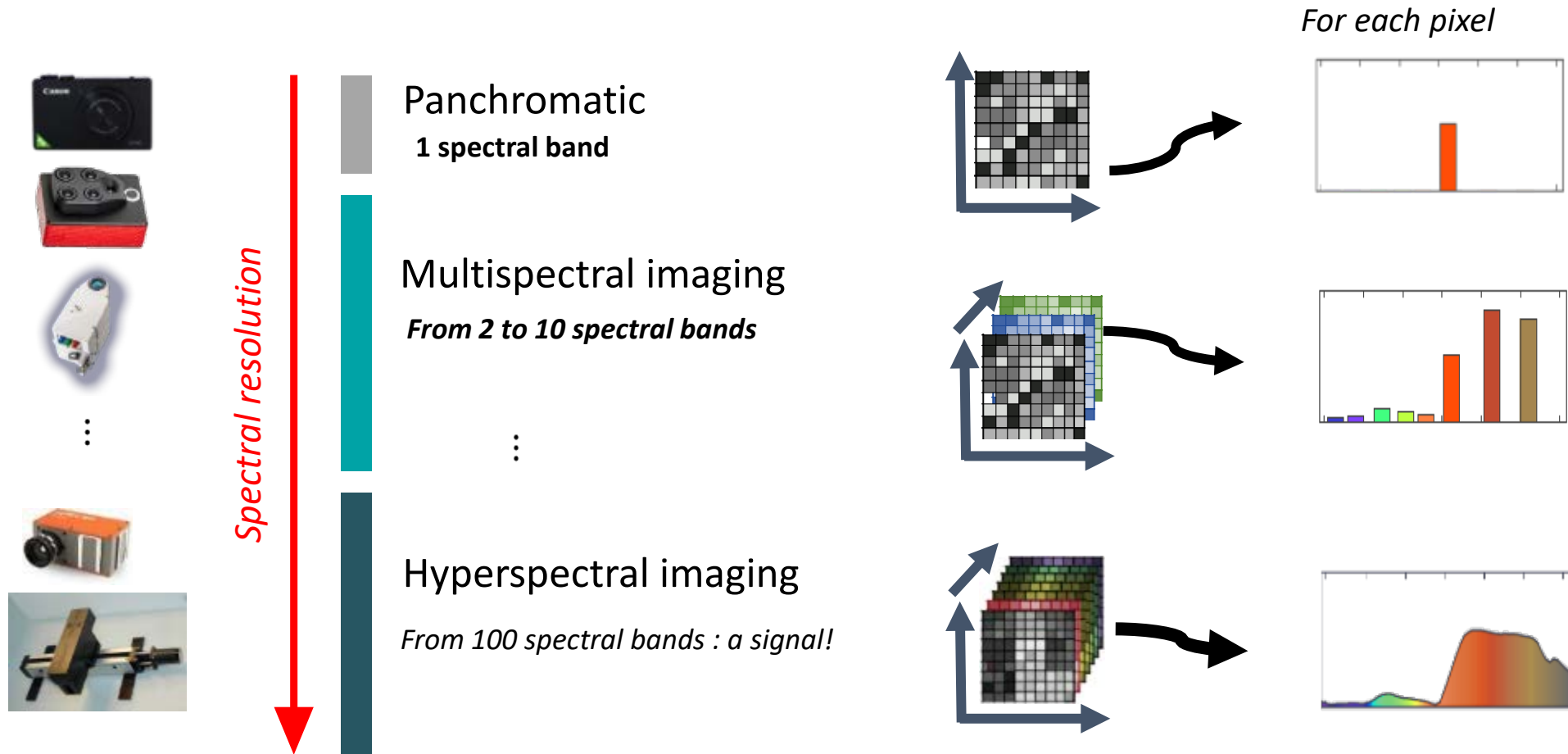
A higher concentration leads to higher absorbance value

Rappel principes spectroscopie proche infrarouge – eau dans bois



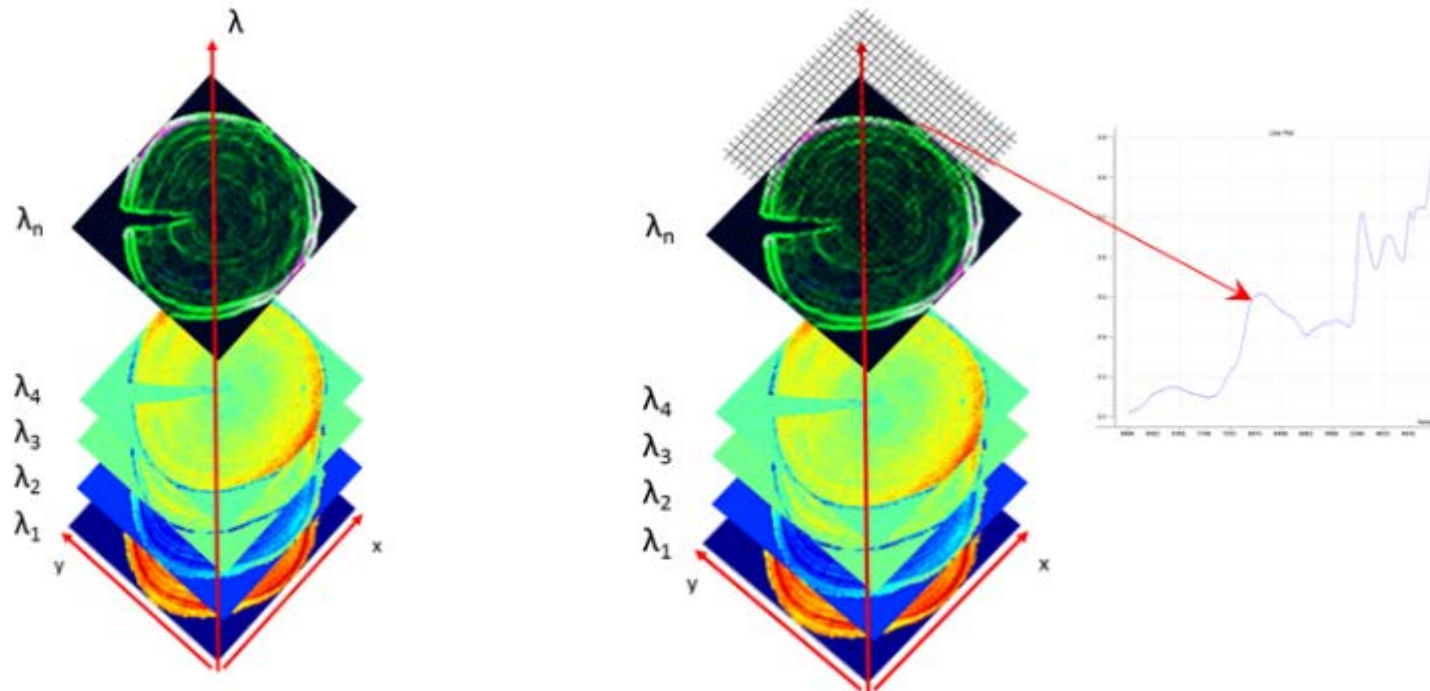
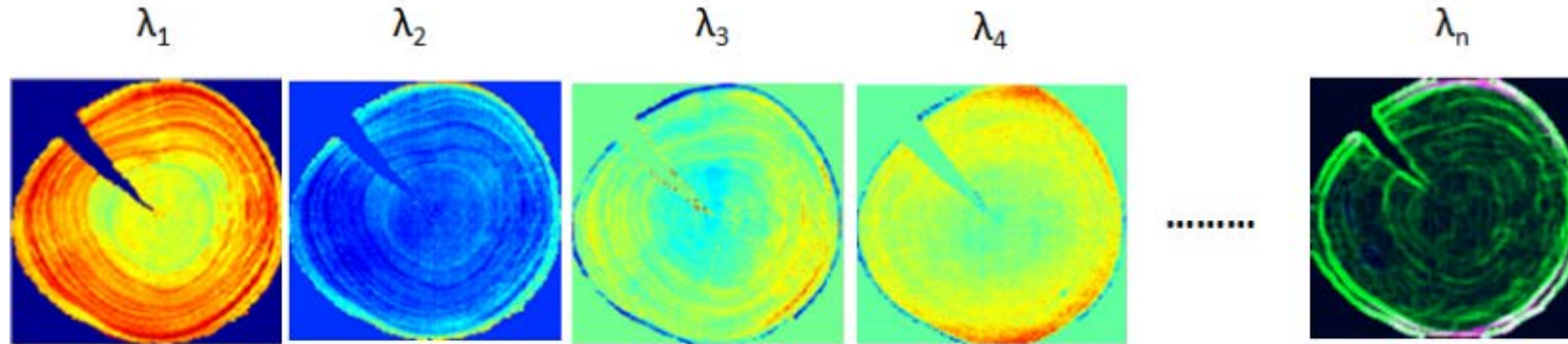
Rappel imagerie hyperspectrale (proche infrarouge)

From spectroscopy to imaging!





Rappel imagerie hyperspectrale (proche infrarouge)



Imagerie hyperspectrale – Etalonnage de la caméra

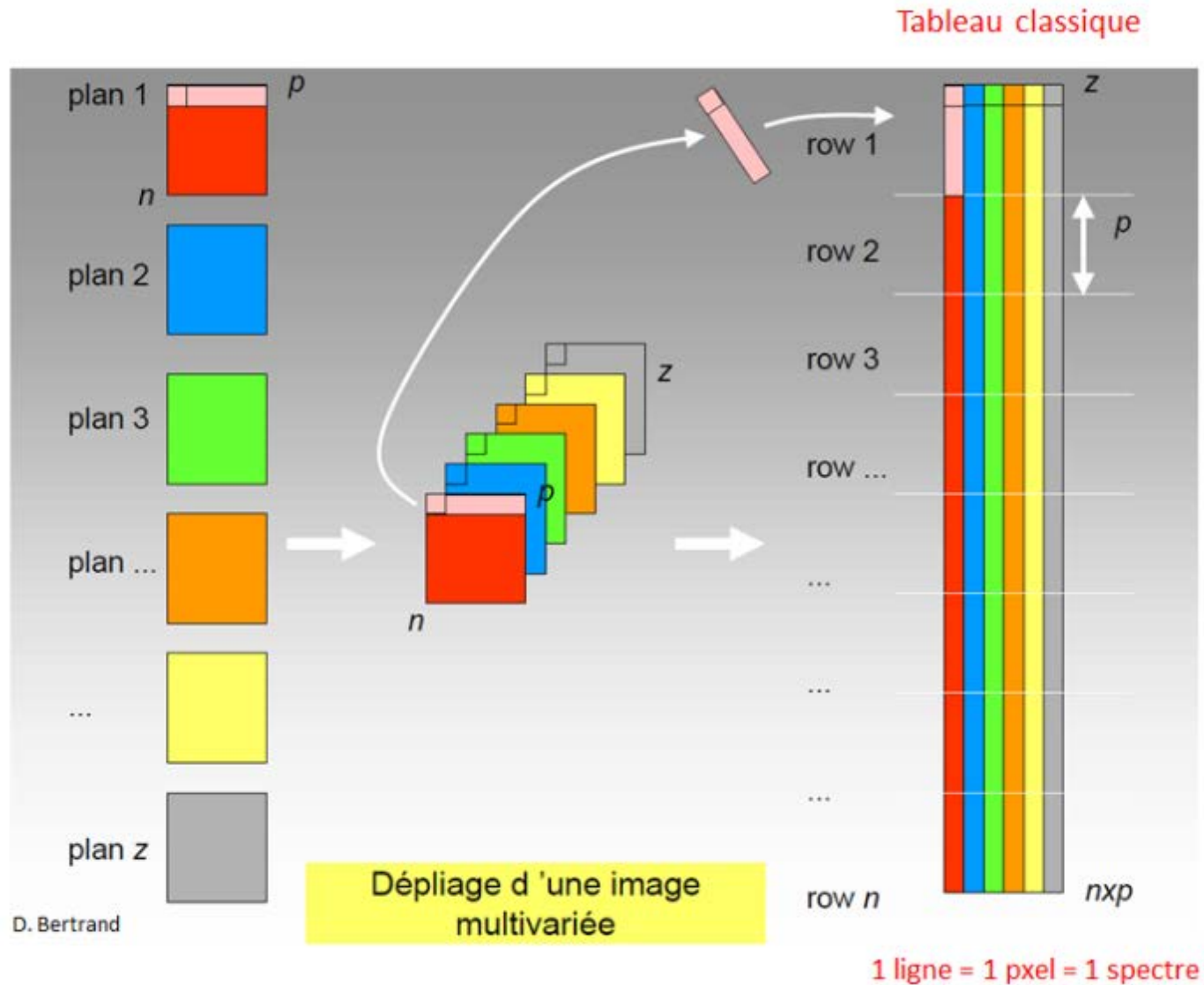
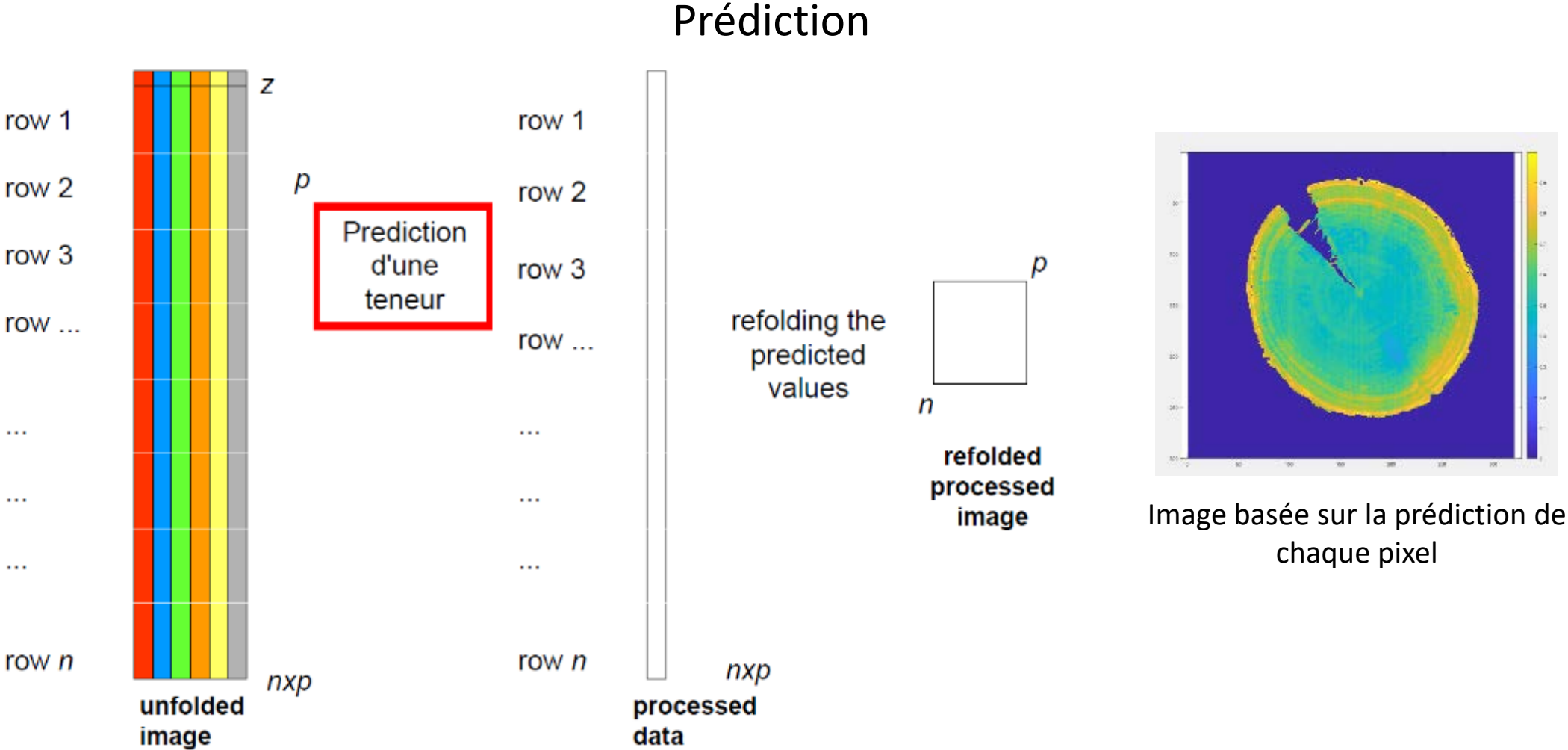


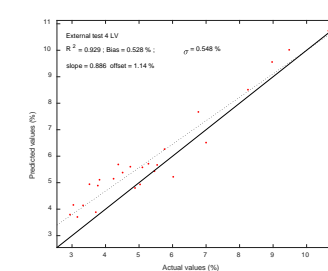
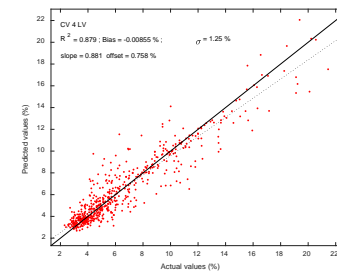
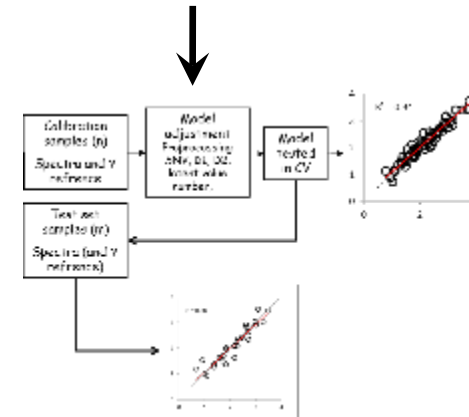
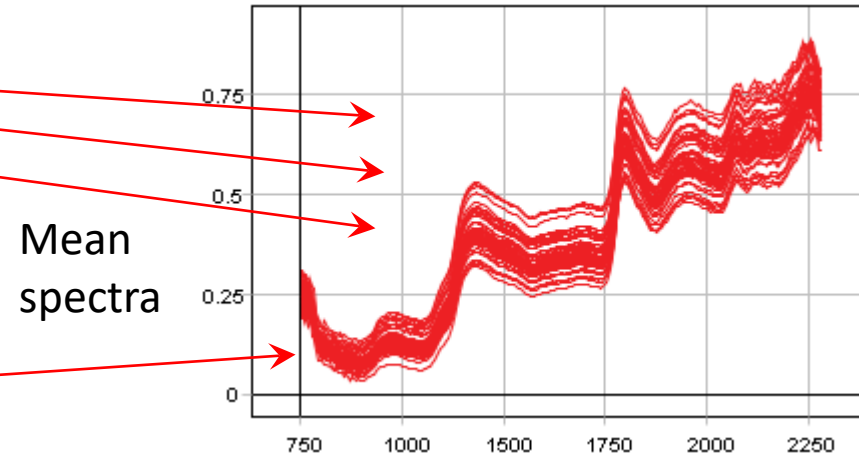
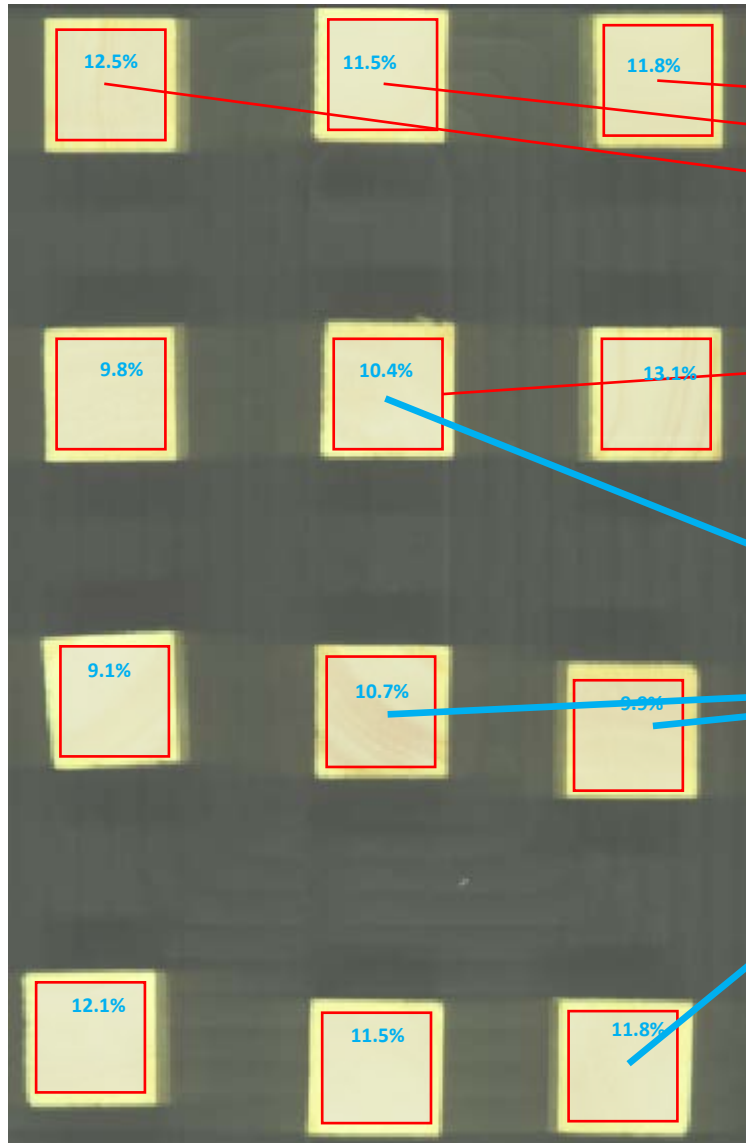
Tableau pouvant être traité de la même manière qu'en spectroscopie

- ACP
- Discrimination
- Etalonner
- Prédire

Imagerie hyperspectrale – Etalonnage de la caméra

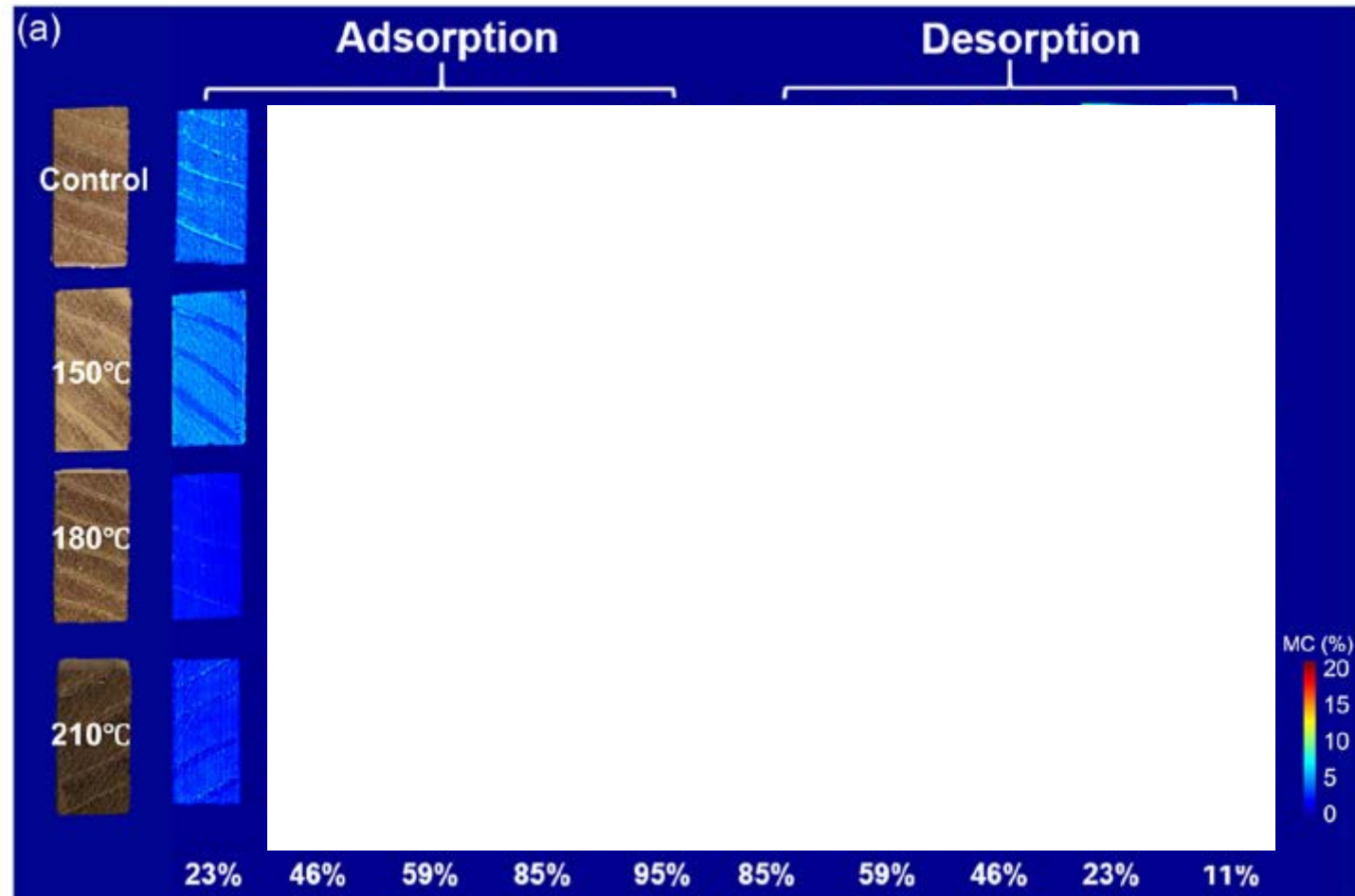


Imagerie hyperspectrale – Etalonnage direct de la caméra



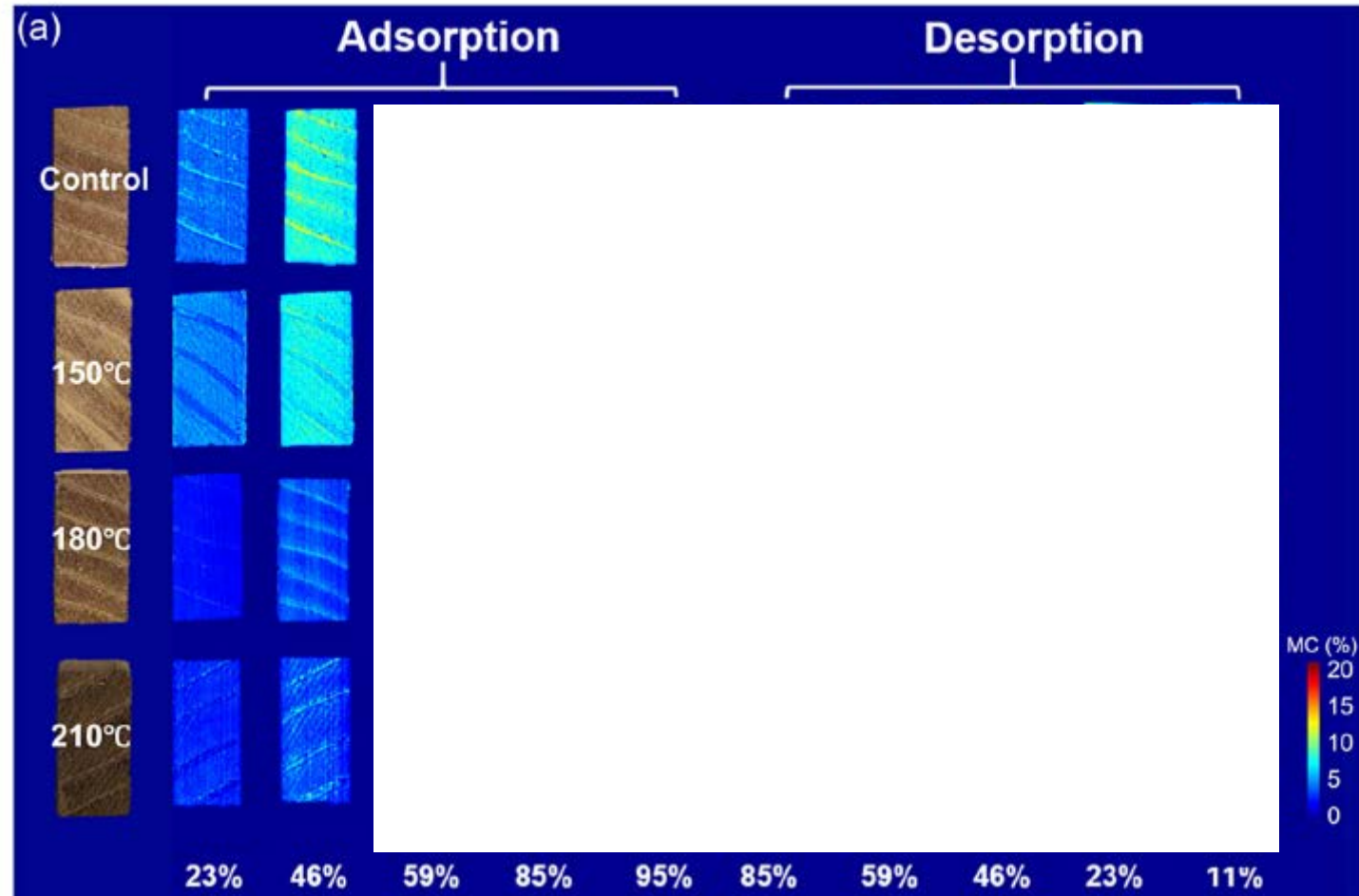
Imagerie hyperspectrale - Eau dans le bois

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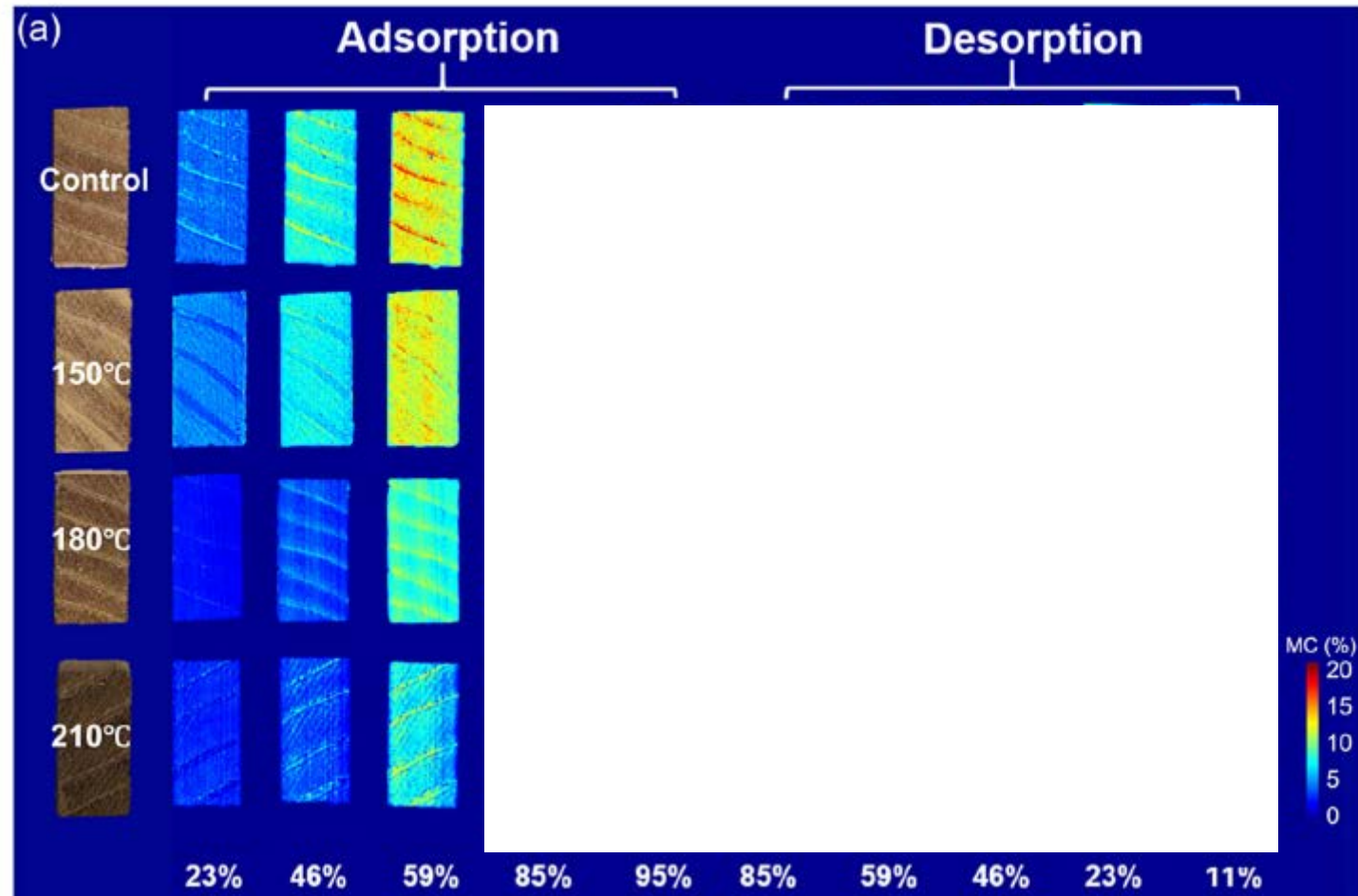
Imagerie hyperspectrale - Eau dans le bois

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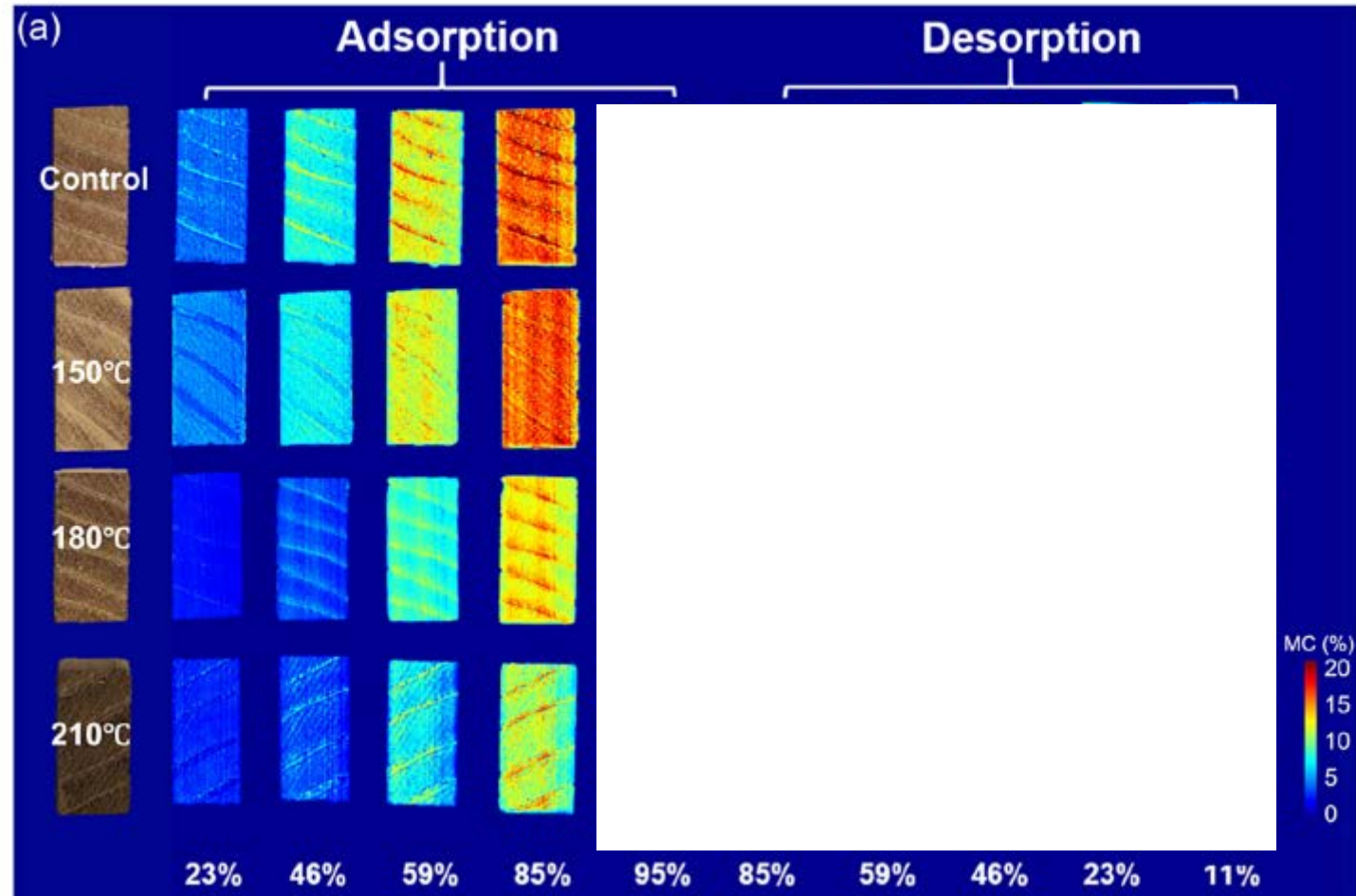
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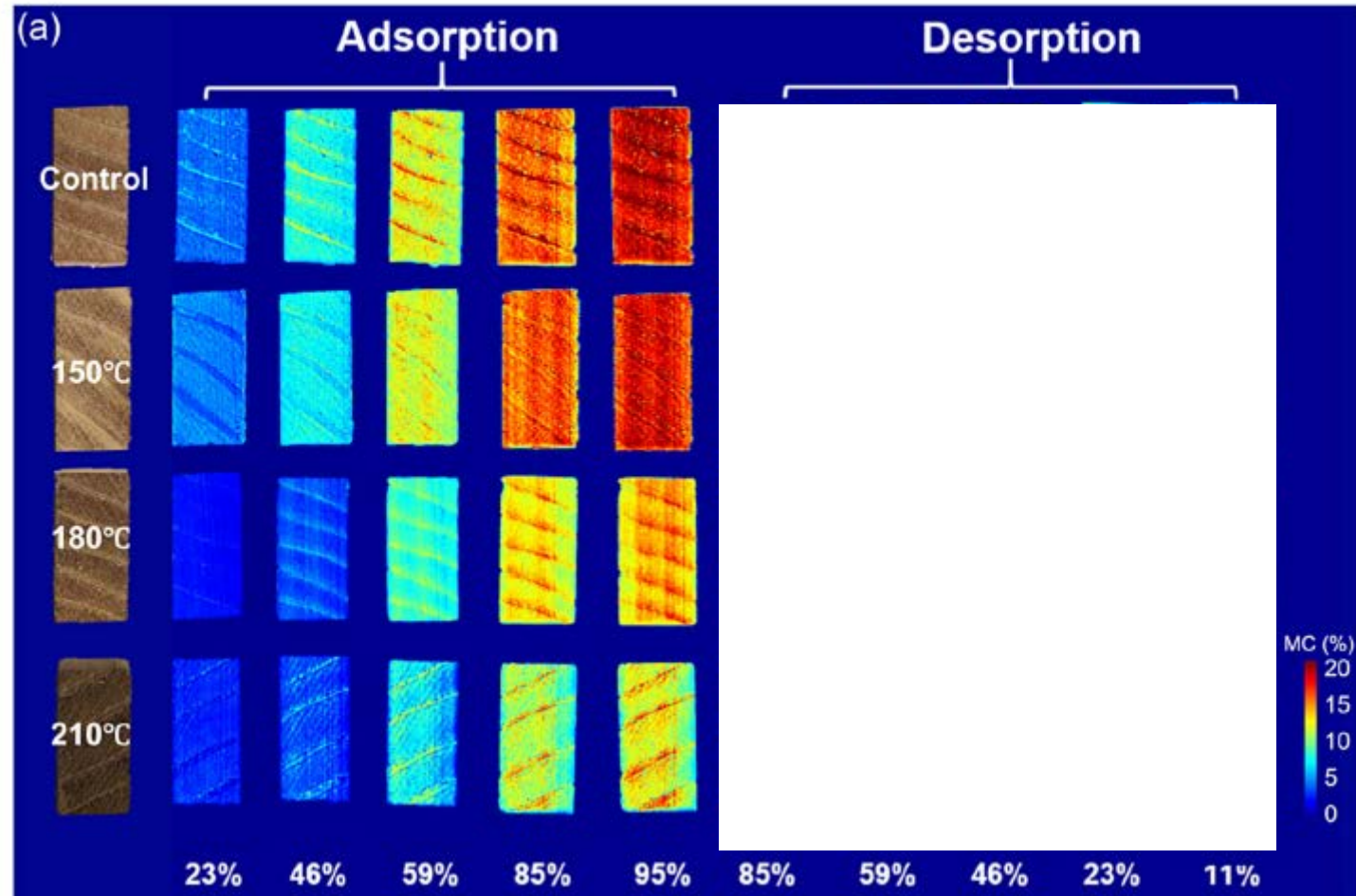
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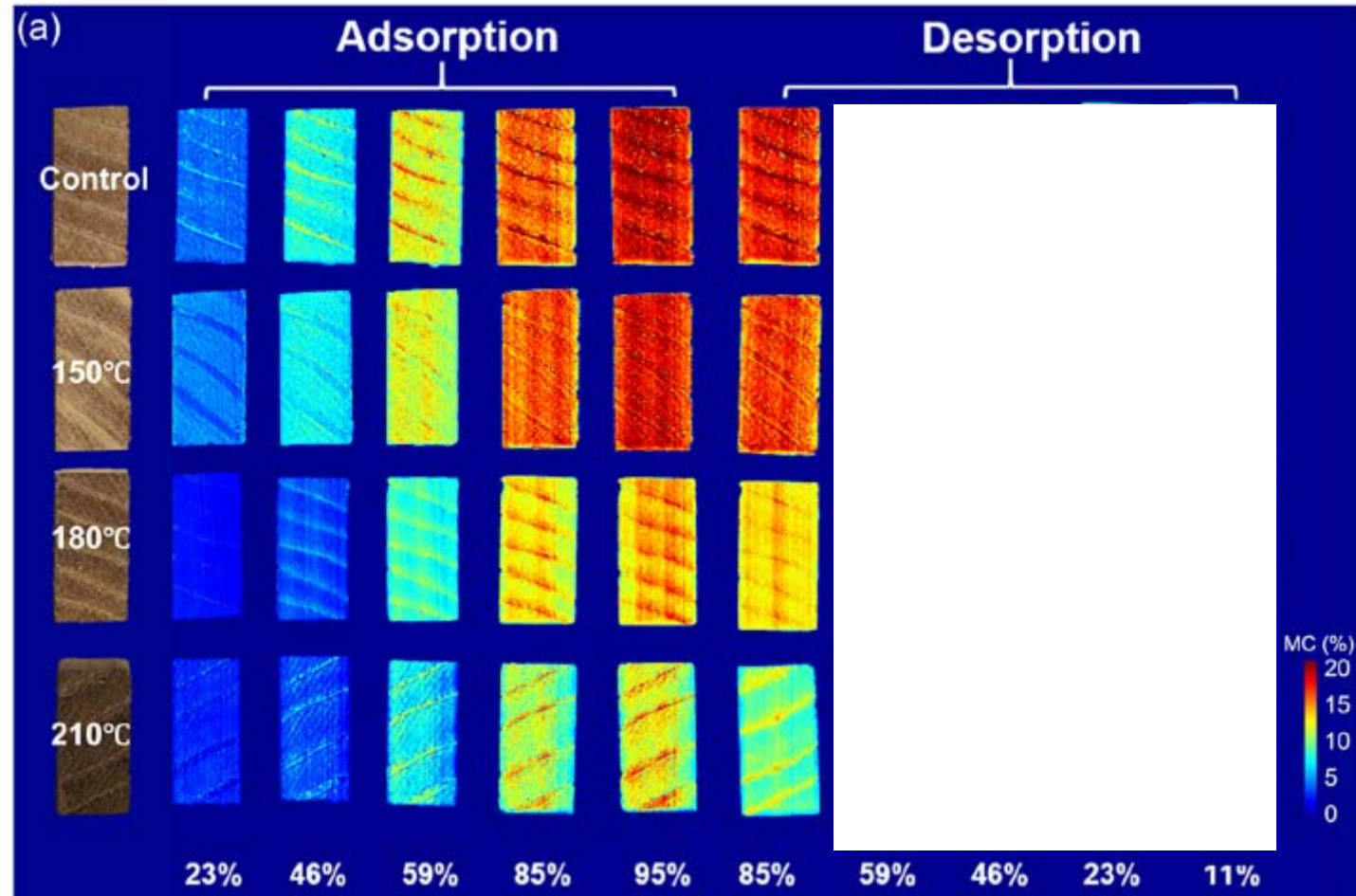
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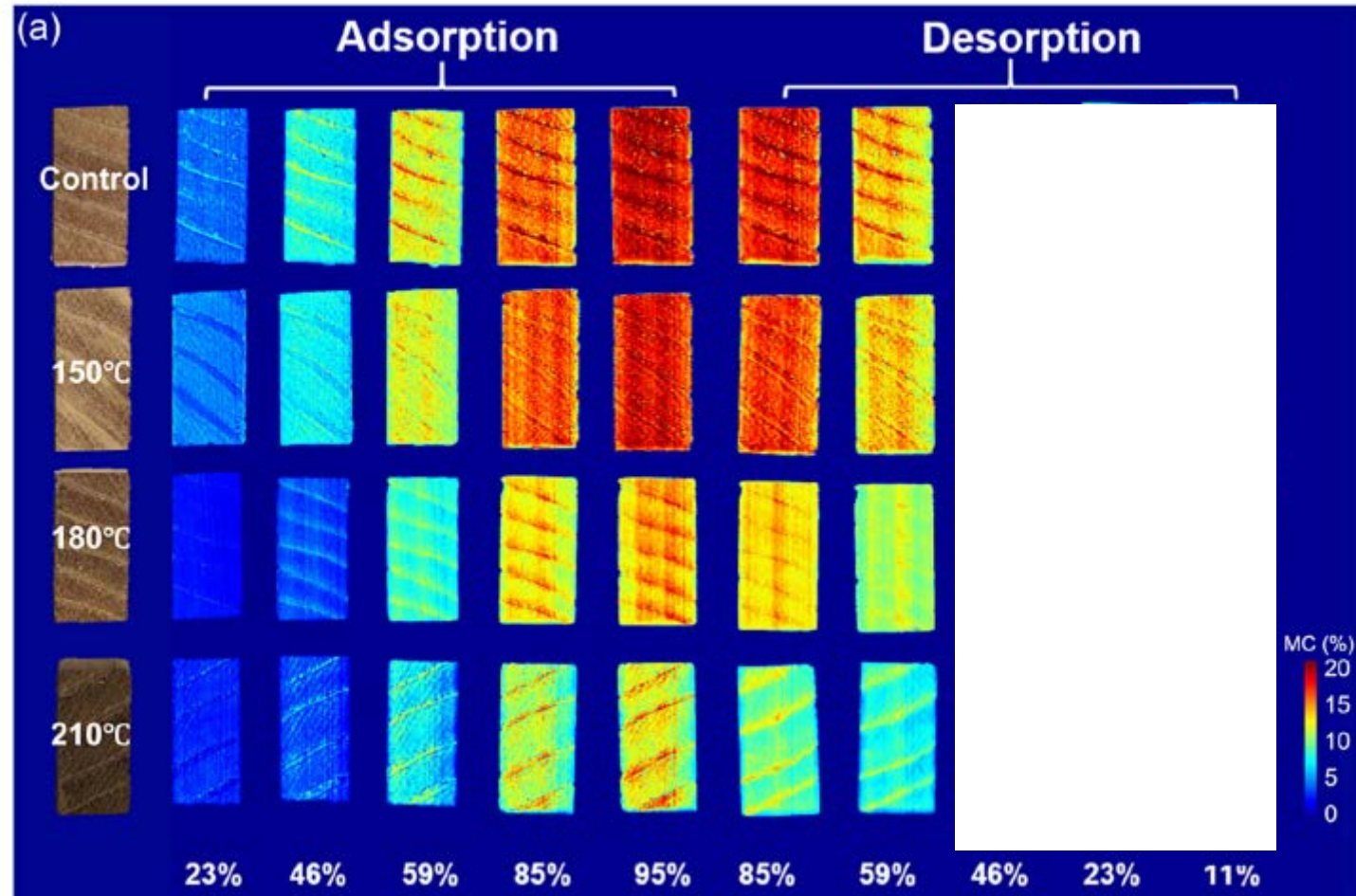
Imagerie hyperspectrale - Eau dans le bois

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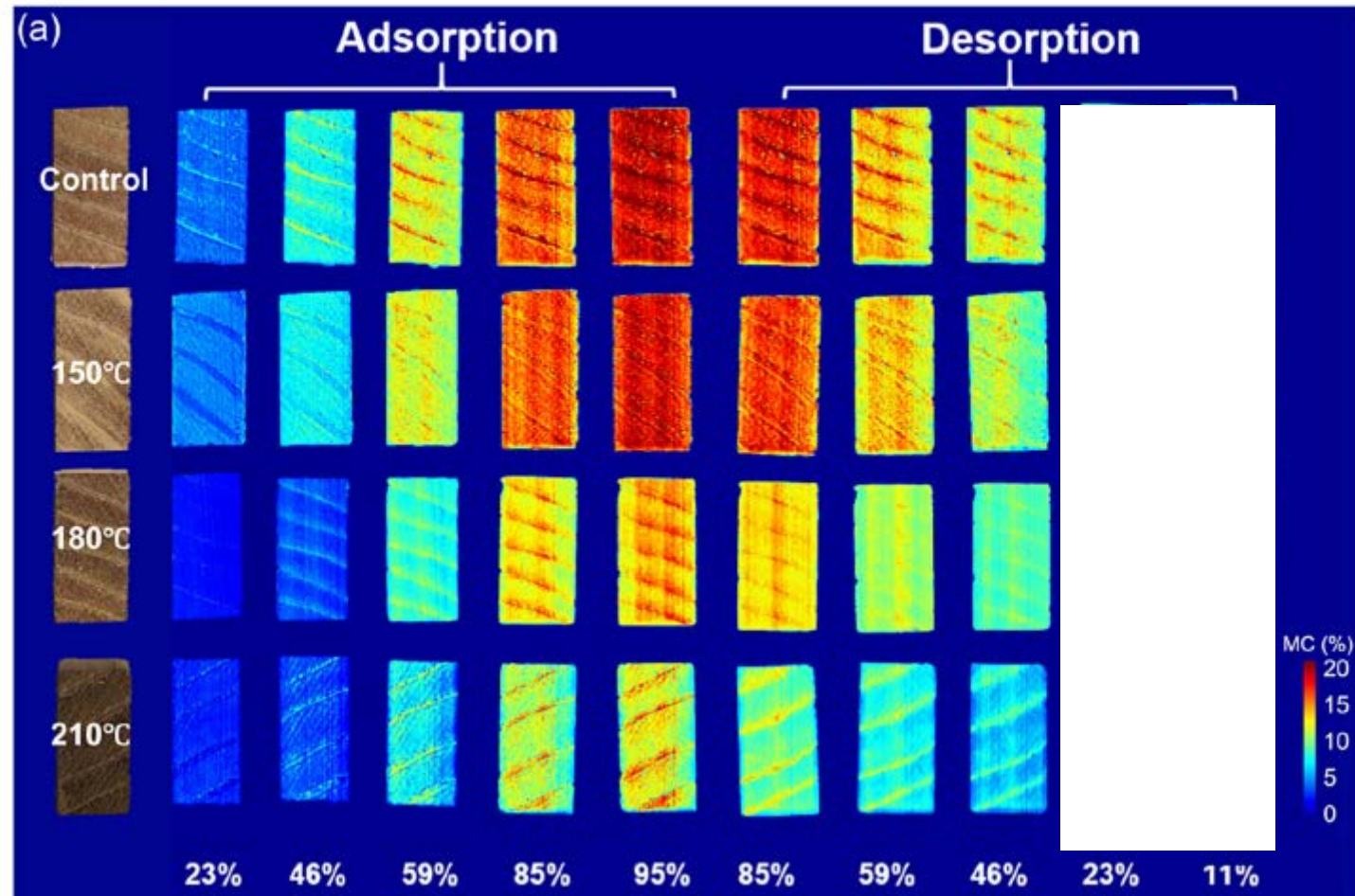
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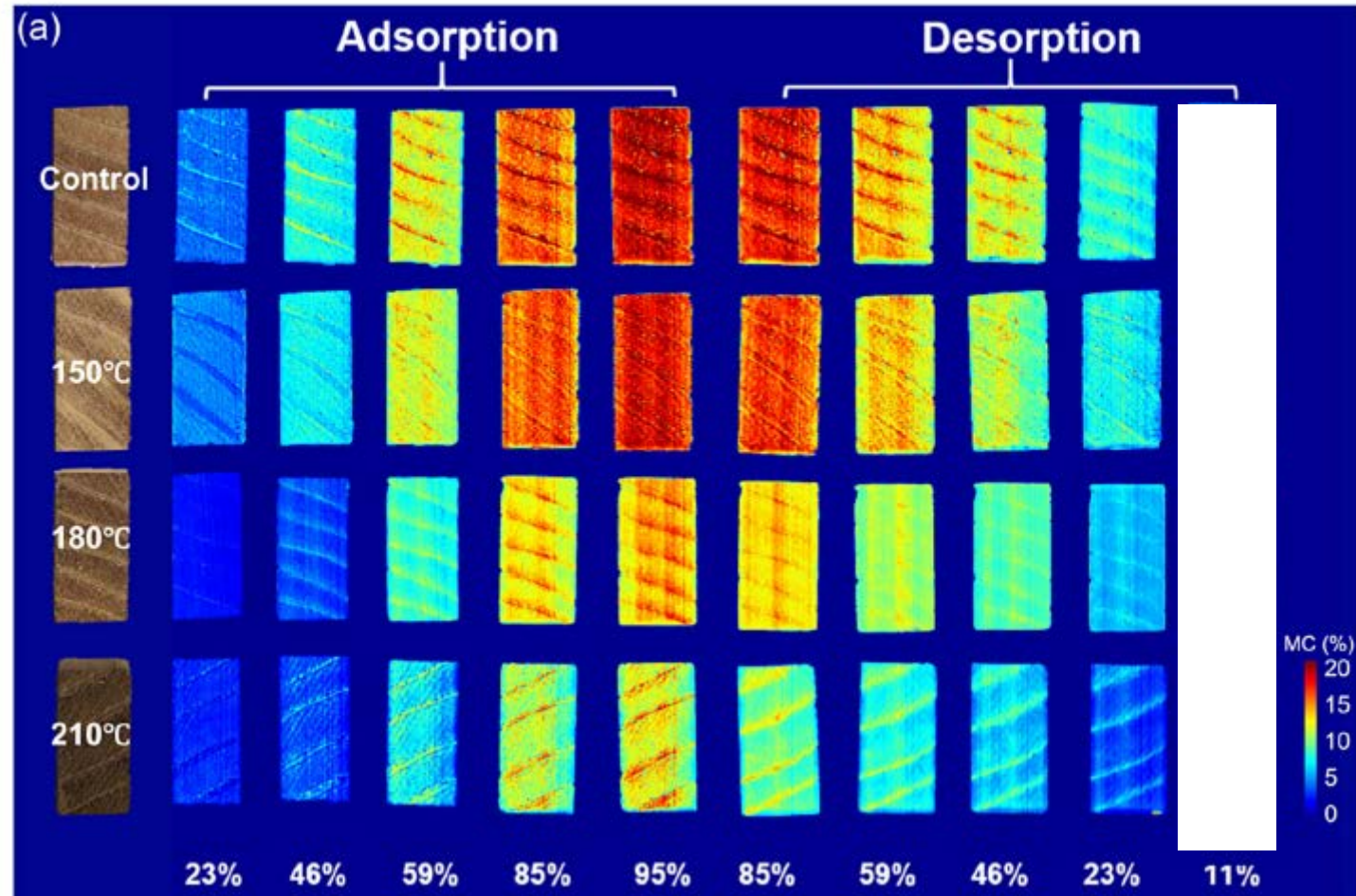
Imagerie hyperspectrale - Eau dans le bois

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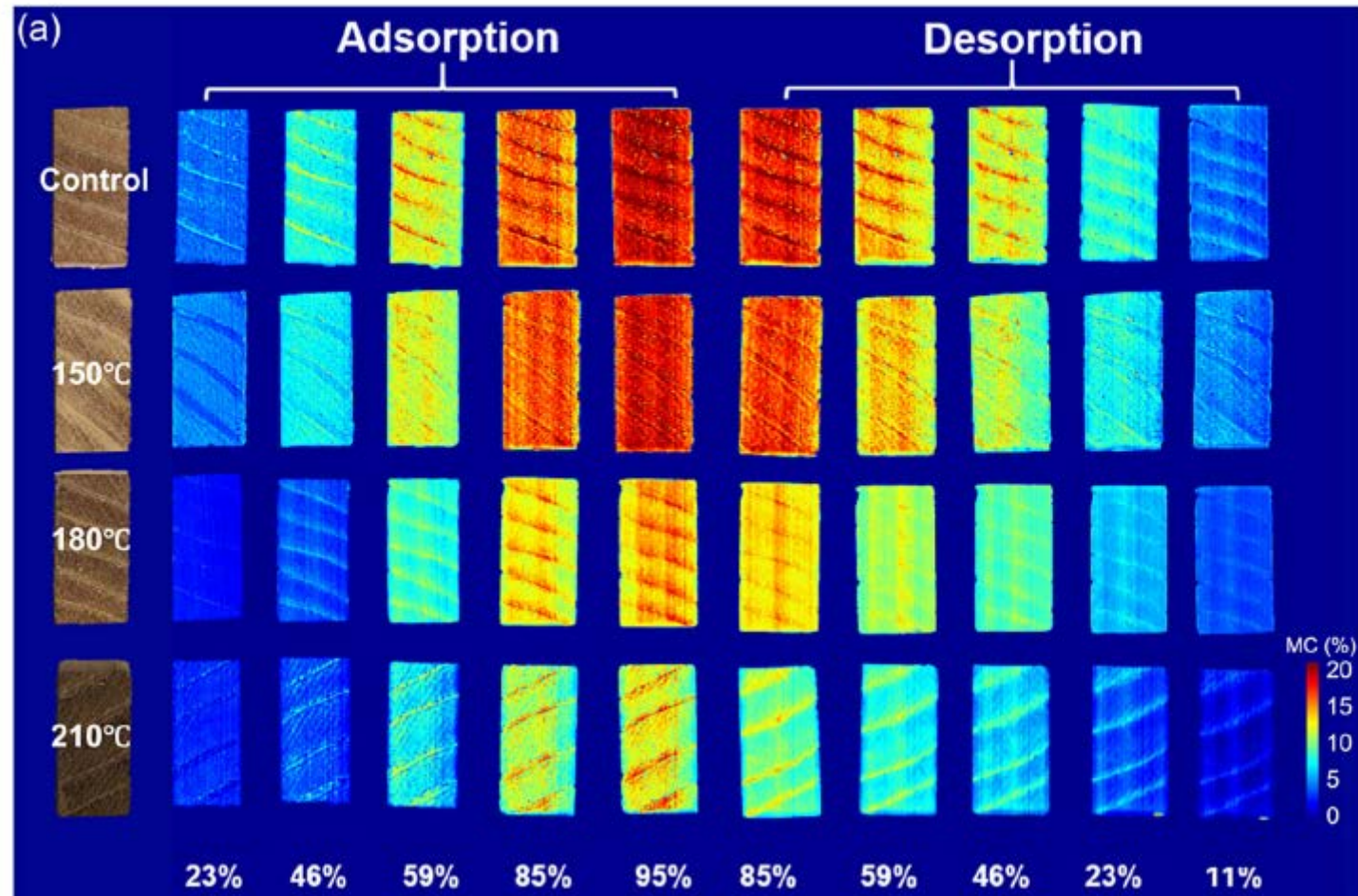
Imagerie hyperspectrale - Eau dans le bois

18  L. SCHIMLECK ET AL.



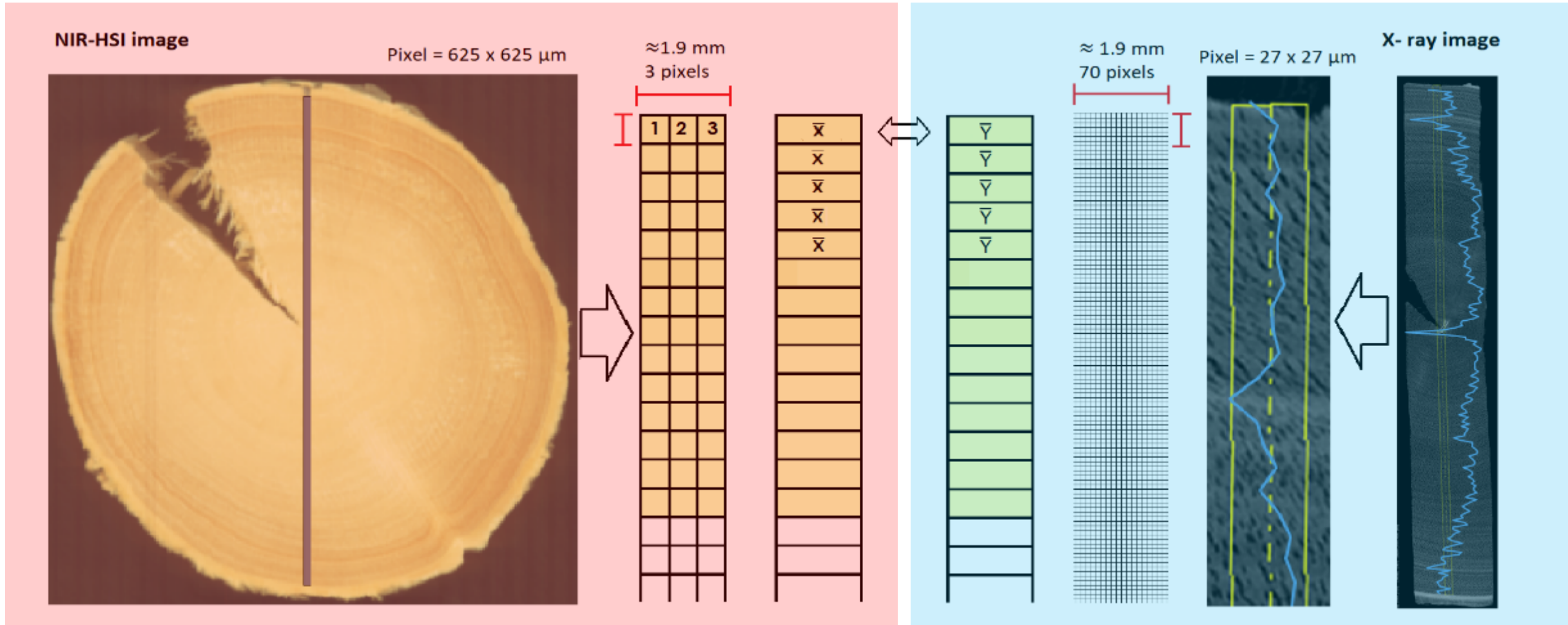
Imagerie hyperspectrale - Eau dans le bois

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Imagerie hyperspectrale – densité du bois

Calibration HIS and wood density

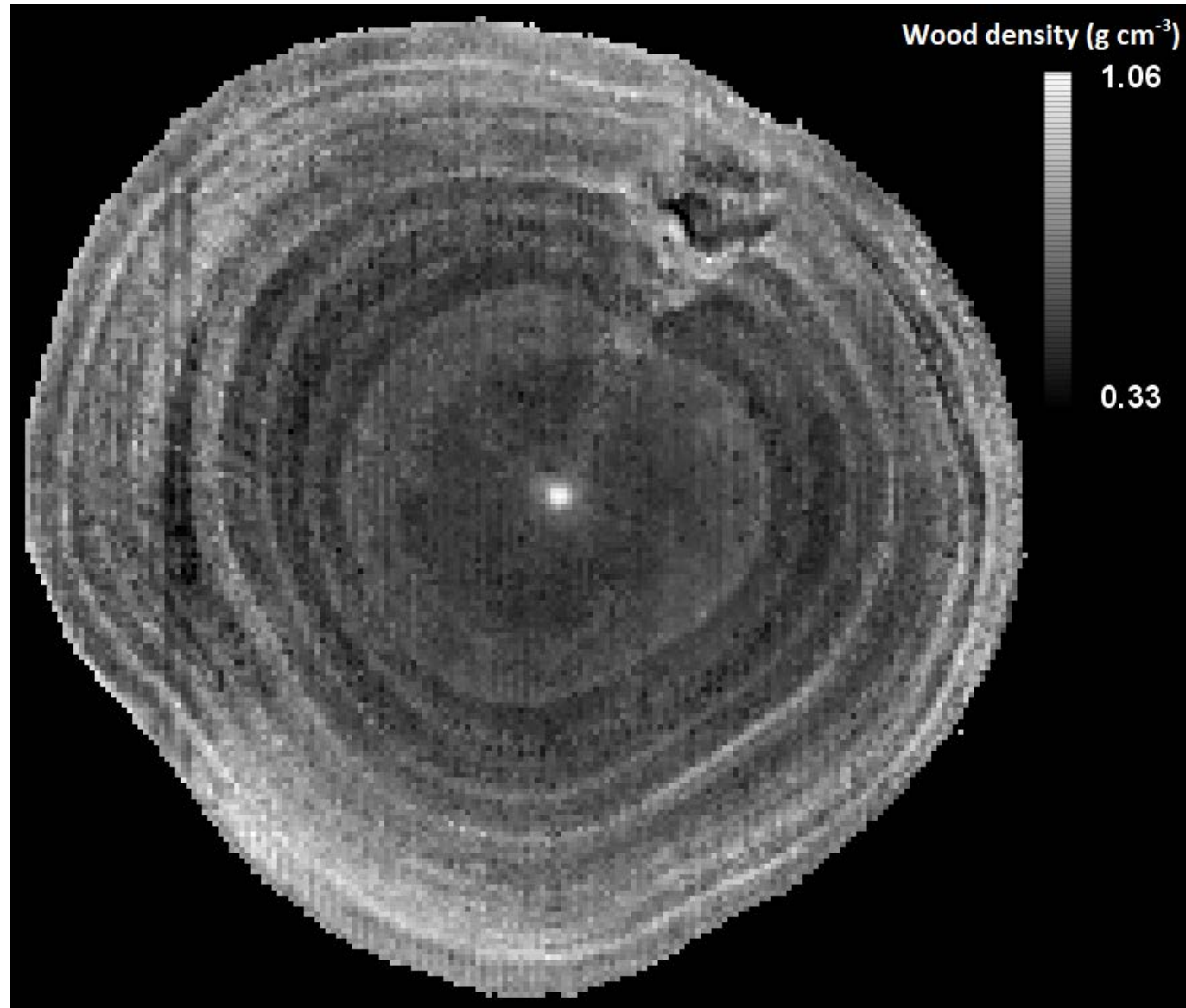


Data base

14 wood disks

2478 spectres and wood density values

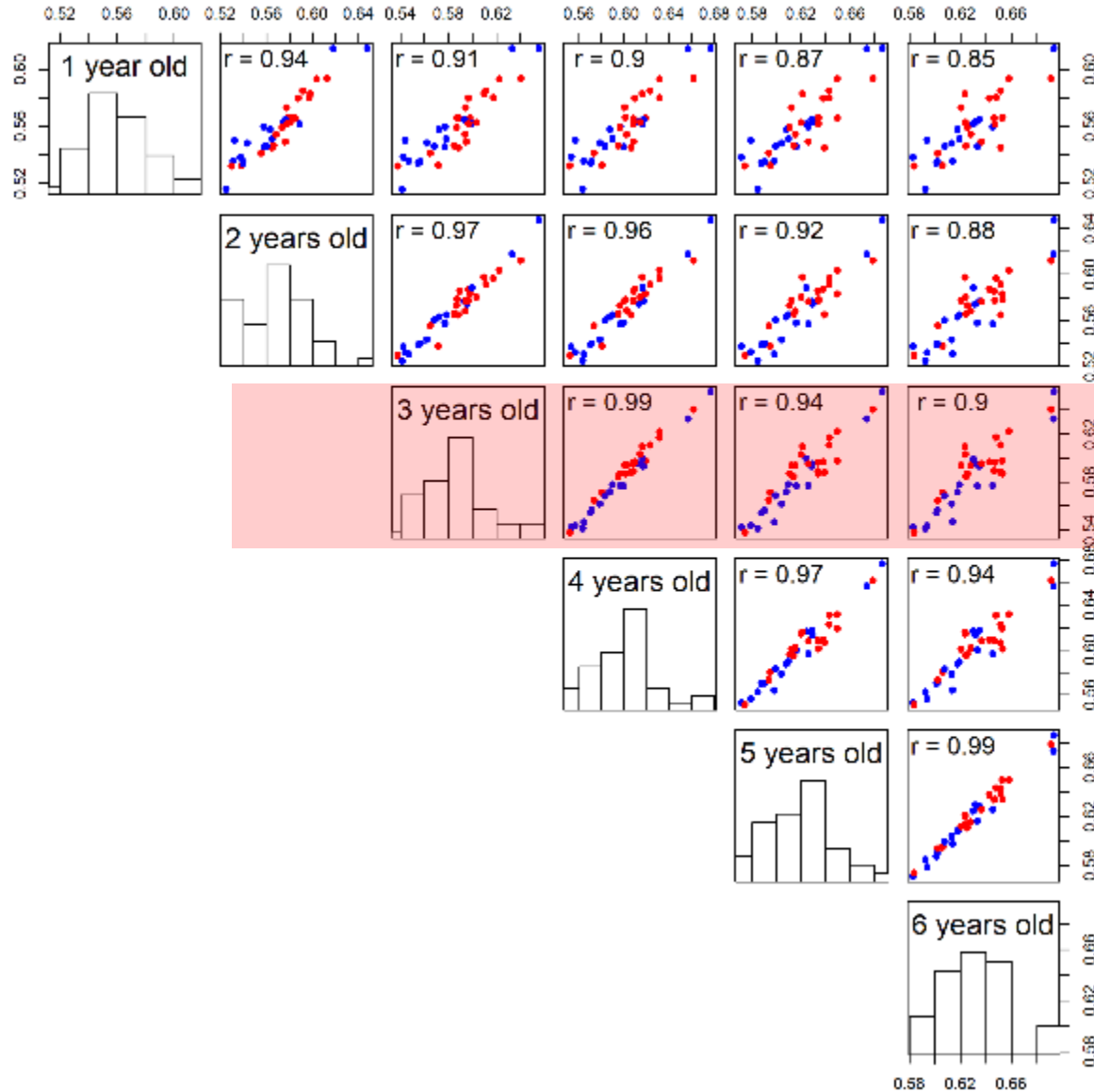
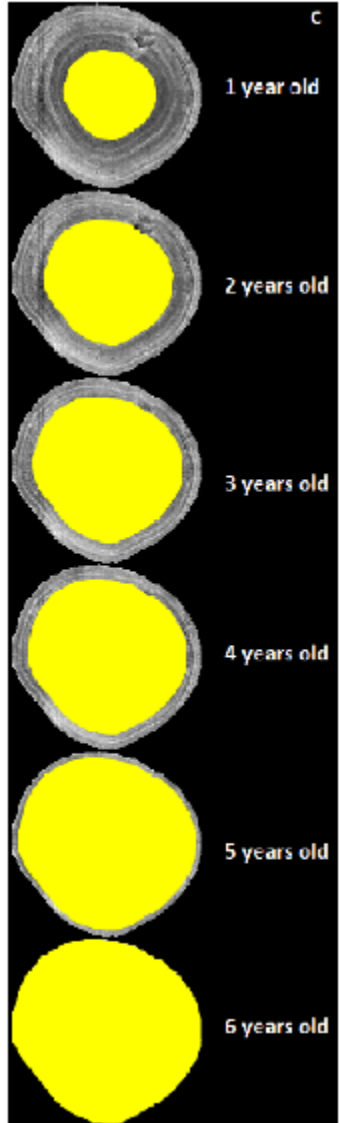
Imagerie hyperspectrale – densité du bois



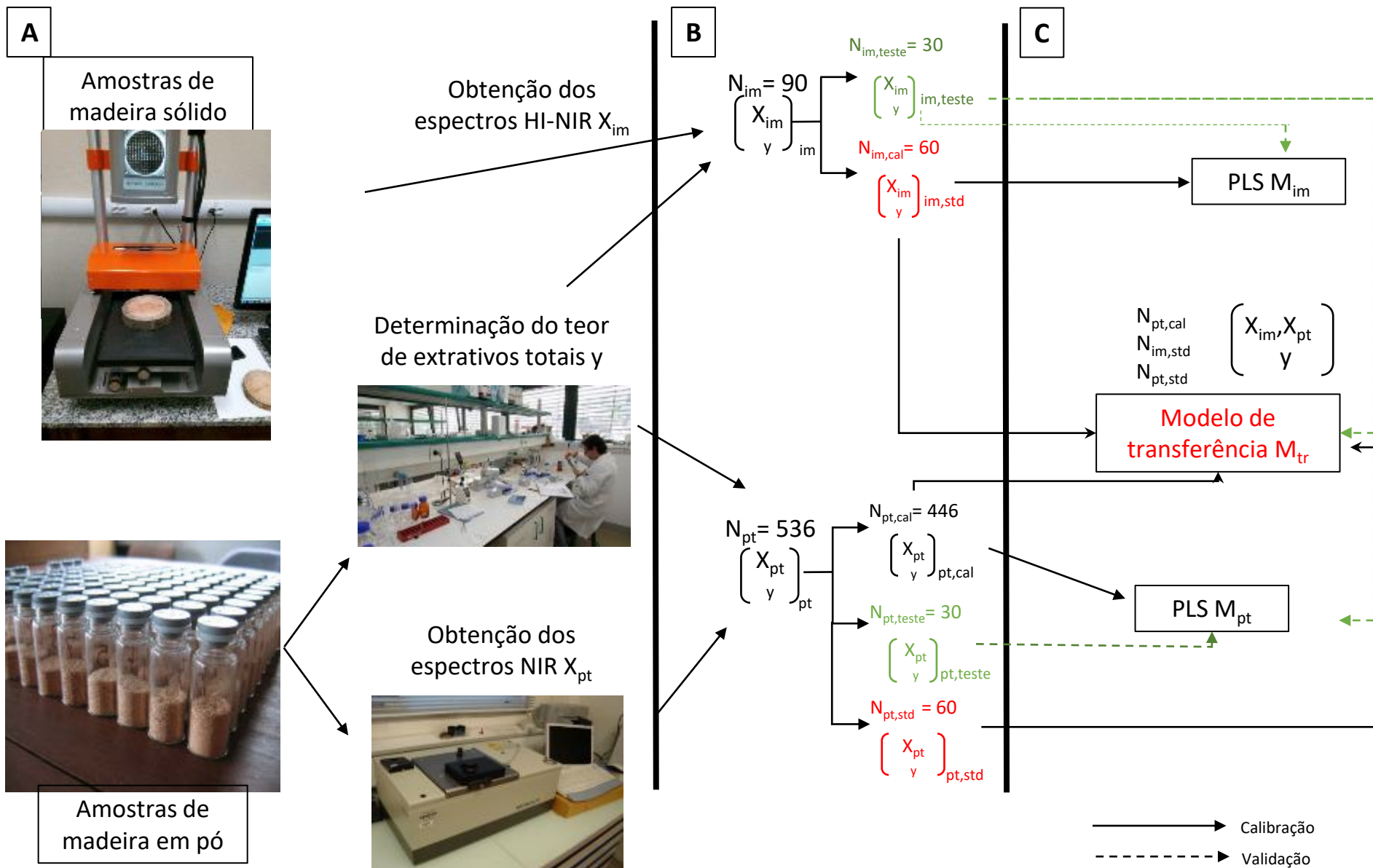
Imagerie hyperspectrale – densité du bois

Age-age correlations

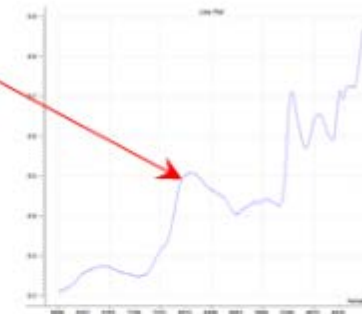
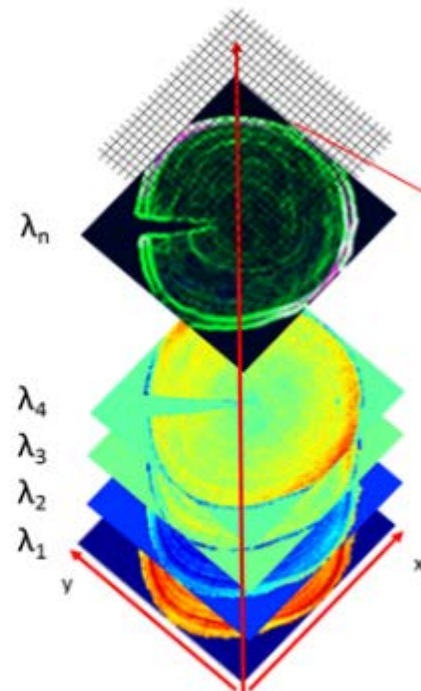
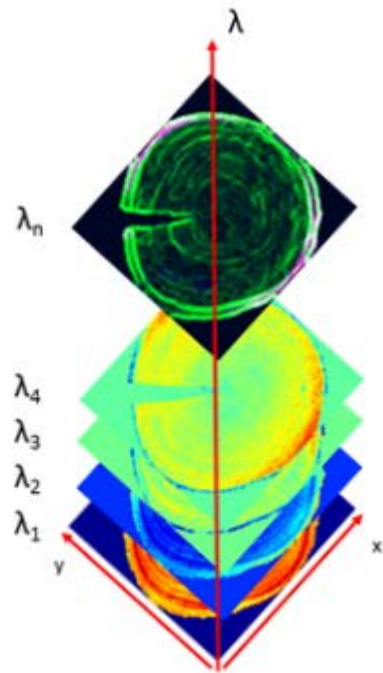
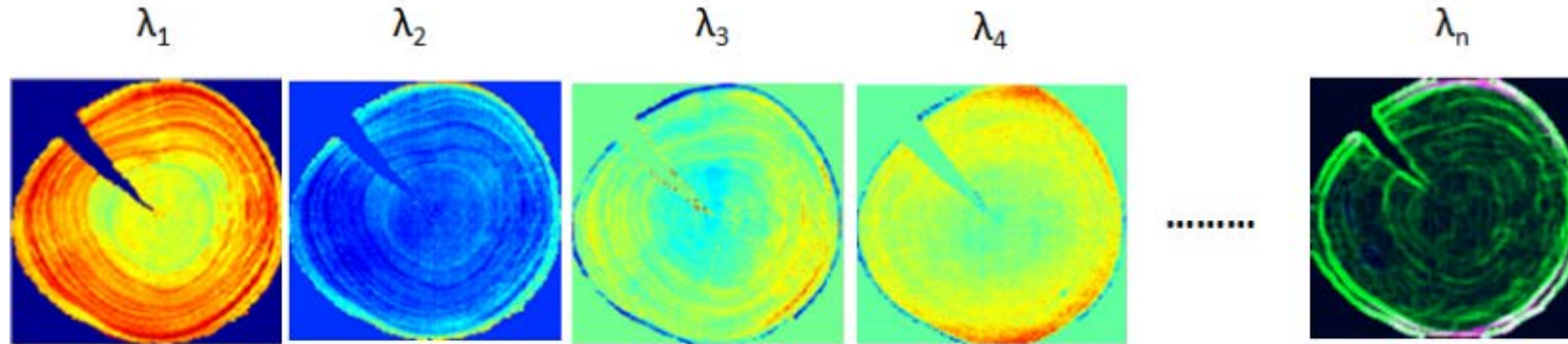
All trees



Imagerie hyperspectralale – Etalonnage indirect de la caméra par transfert étalonnage



Imagerie hyperspectrale – Explorer les données sans étalonnage



Pour chaque pixel on a un spectre d'absorbance que l'on peut traiter par ACP, PLS régression,

Analyses de données issues d'imagerie hyperspectrale - ACP

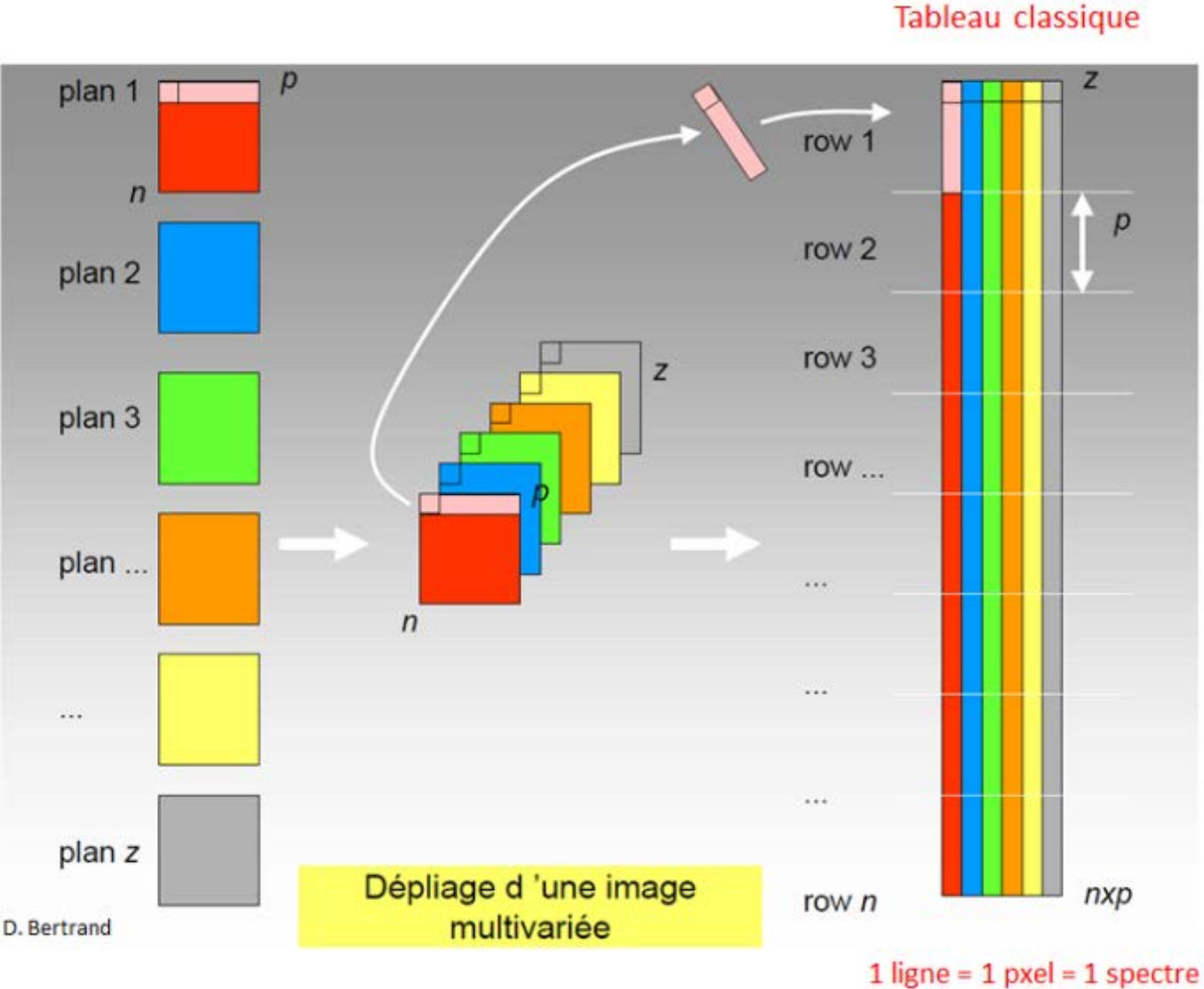


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Analyses de données issues d'imagerie hyperspectrale - ACP

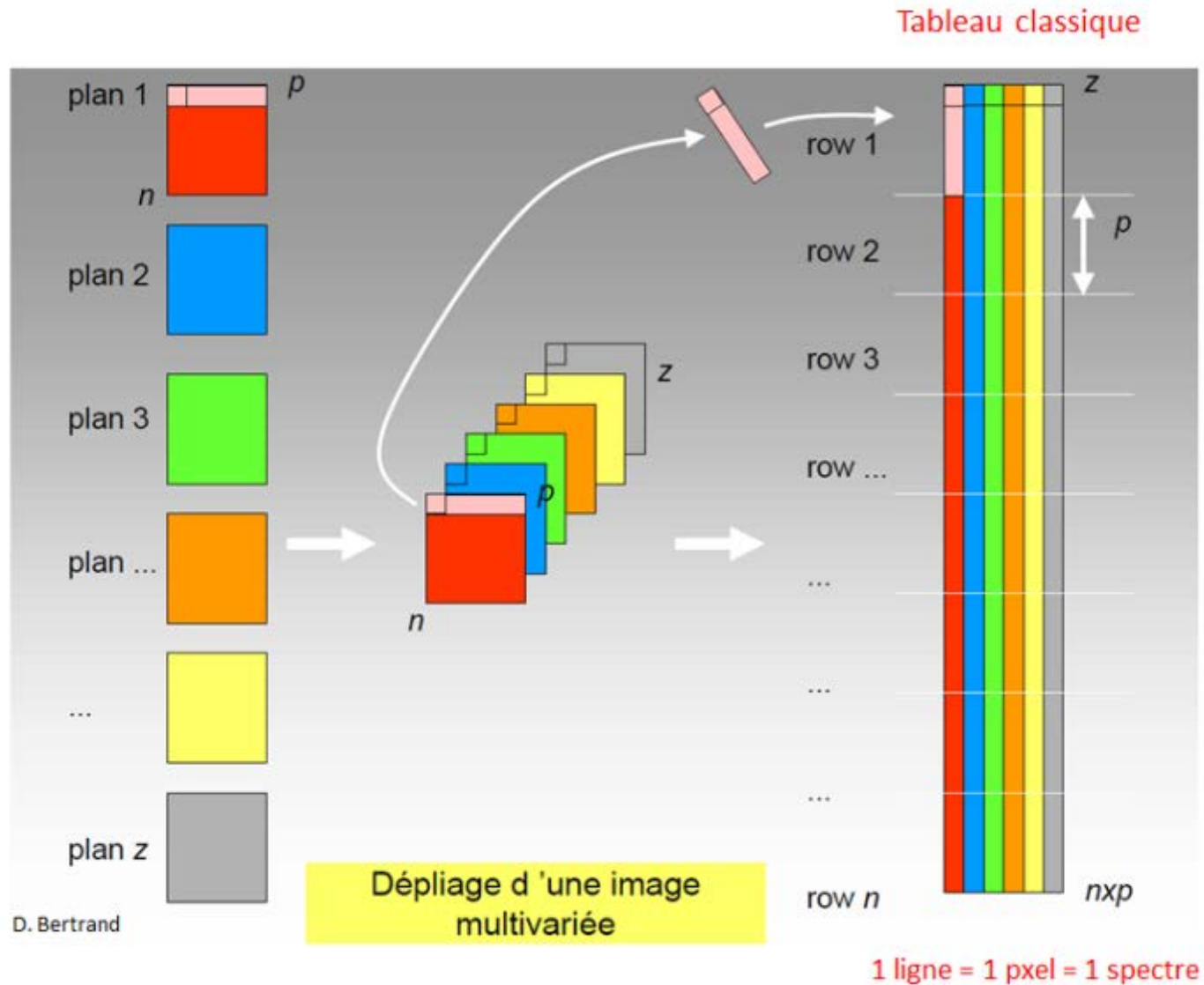
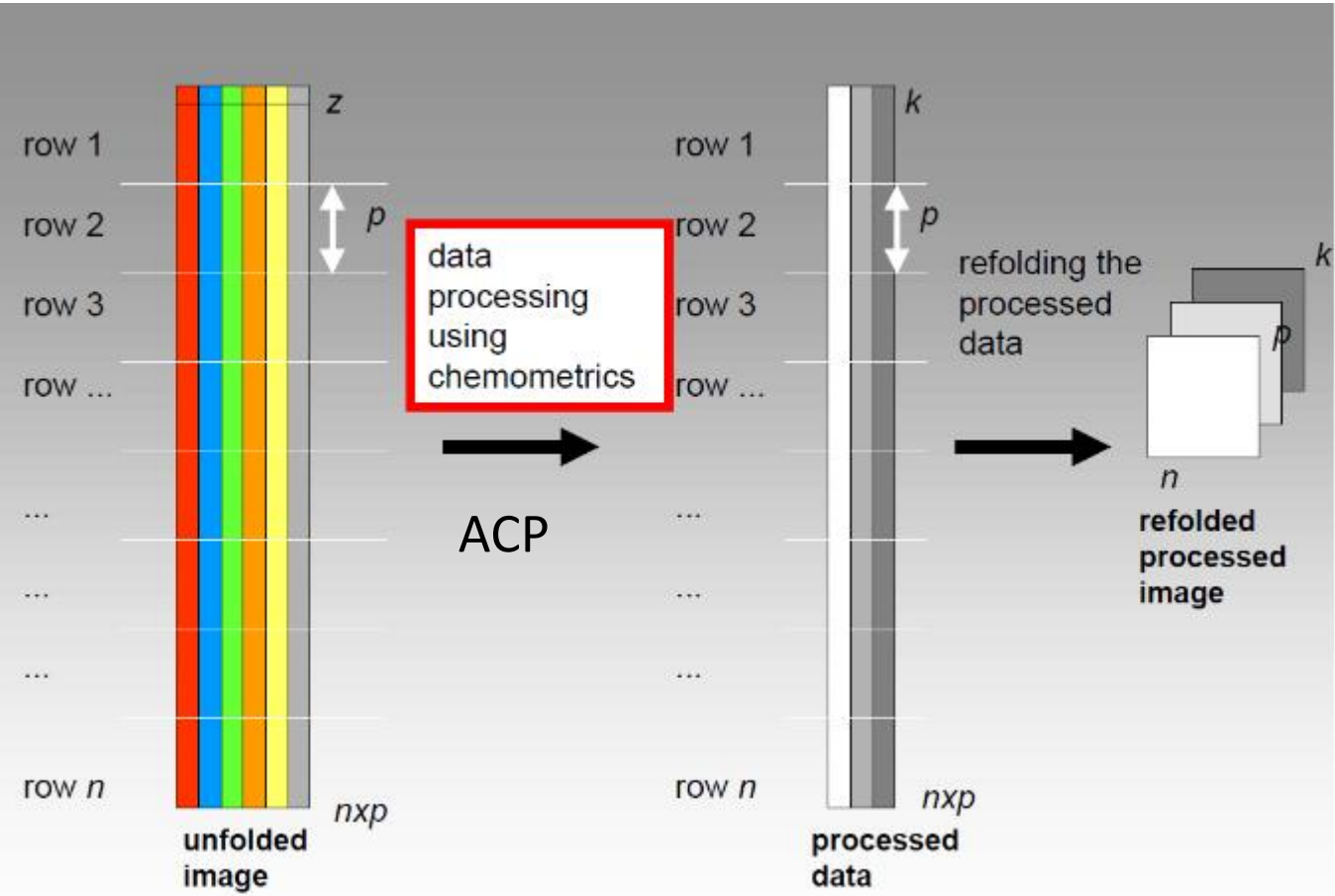


Tableau pouvant être traité de la même manière qu'en spectroscopie

- **ACP**
- Discrimination
- Etalonner
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Analyses de données issues d'imagerie hyperspectrale - ACP



D. Bertrand

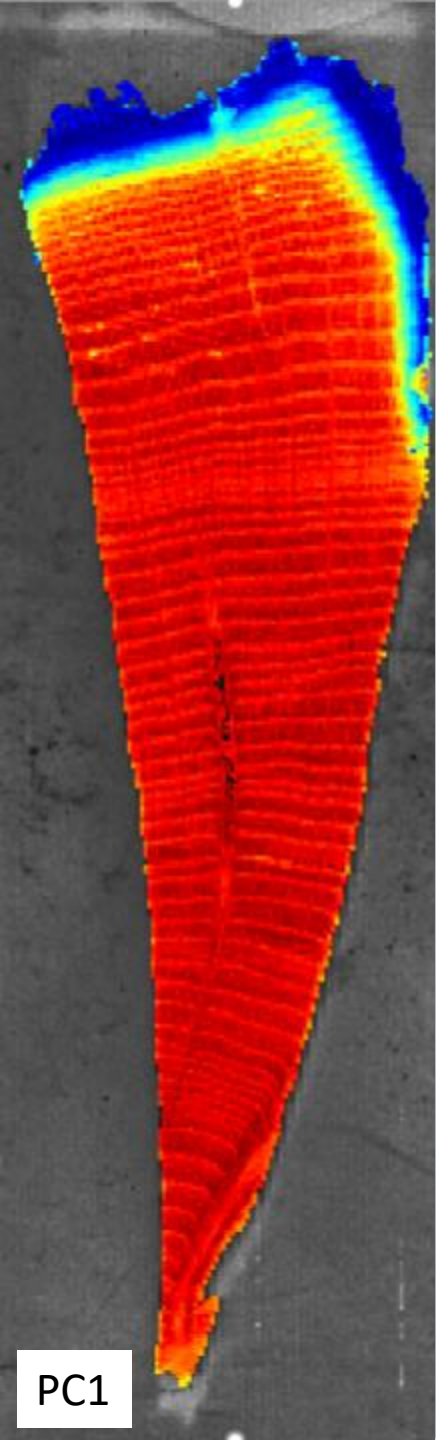
Pour chaque composante principale 1 image

ACP – Bois de notre Dame (Master Sciences du Bois UM !!!!!)



Maxime Ryckewaert, **Matteo Boucharnin**, Gilles **Chaix**
Chloe Cailleaud, Ryad Bendoula, Daphné Héran, **Joseph Gril**

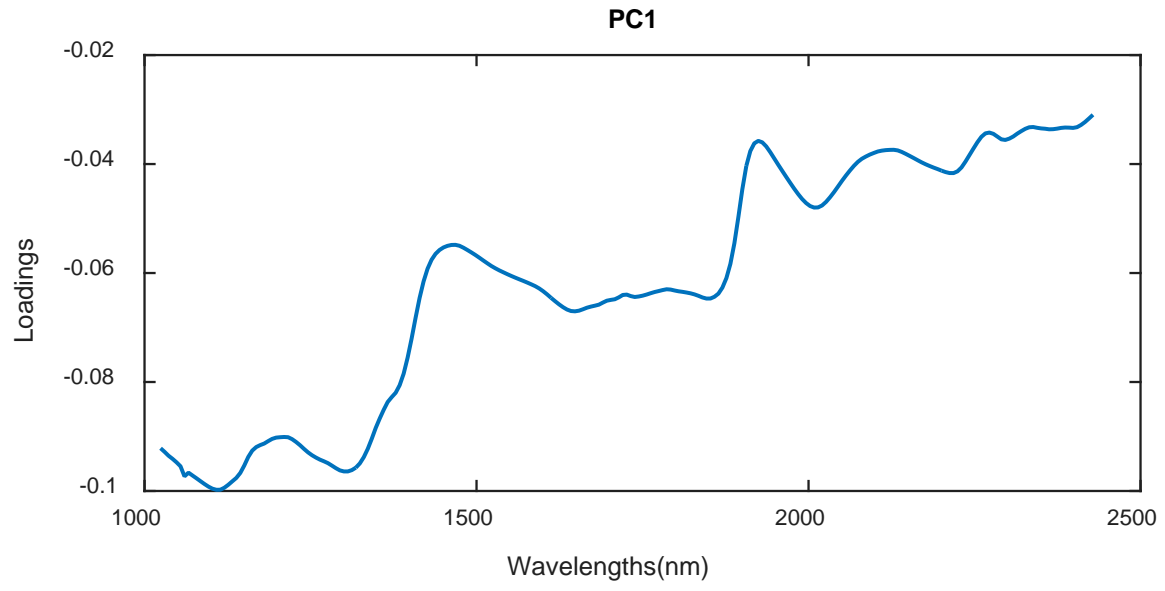


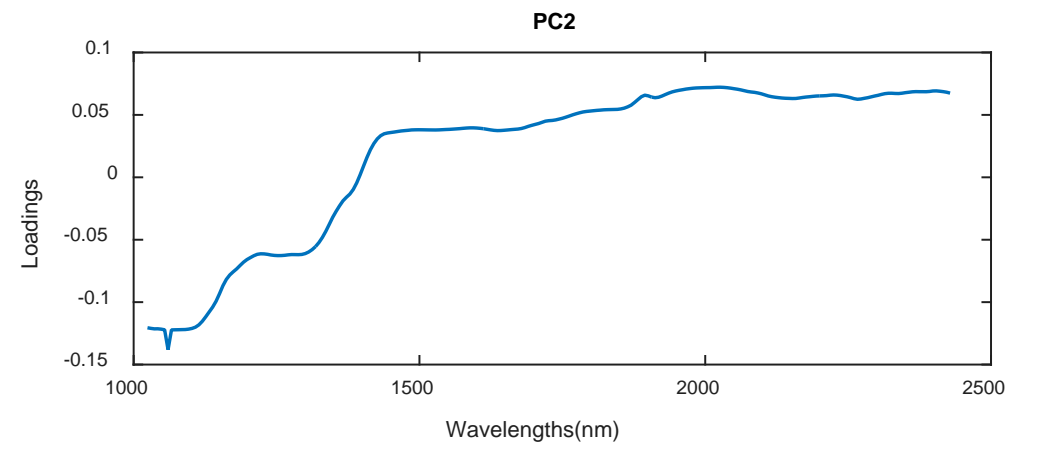
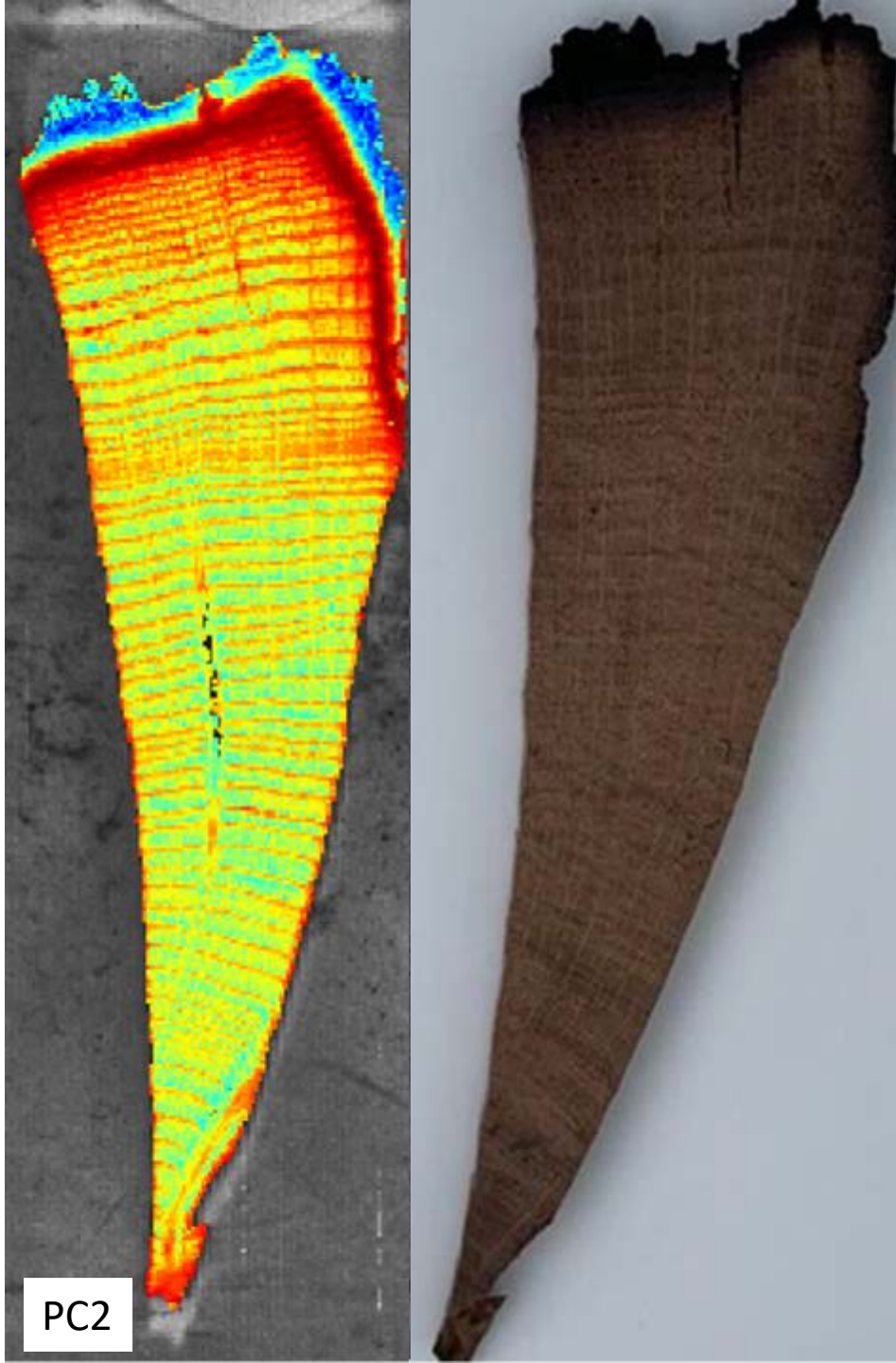


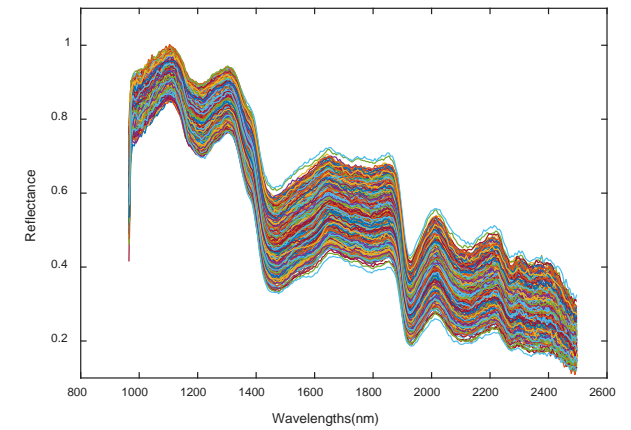
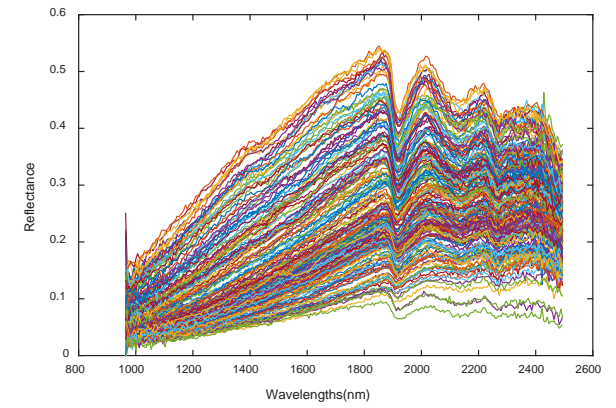
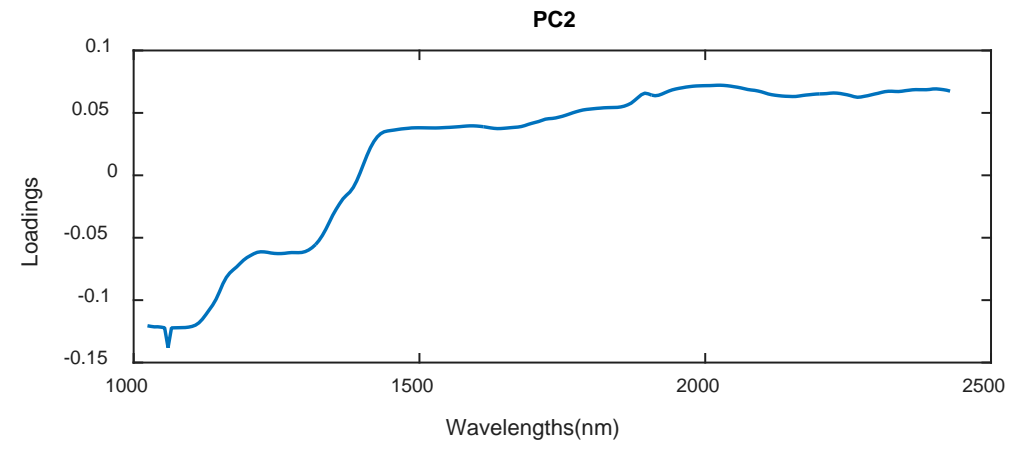
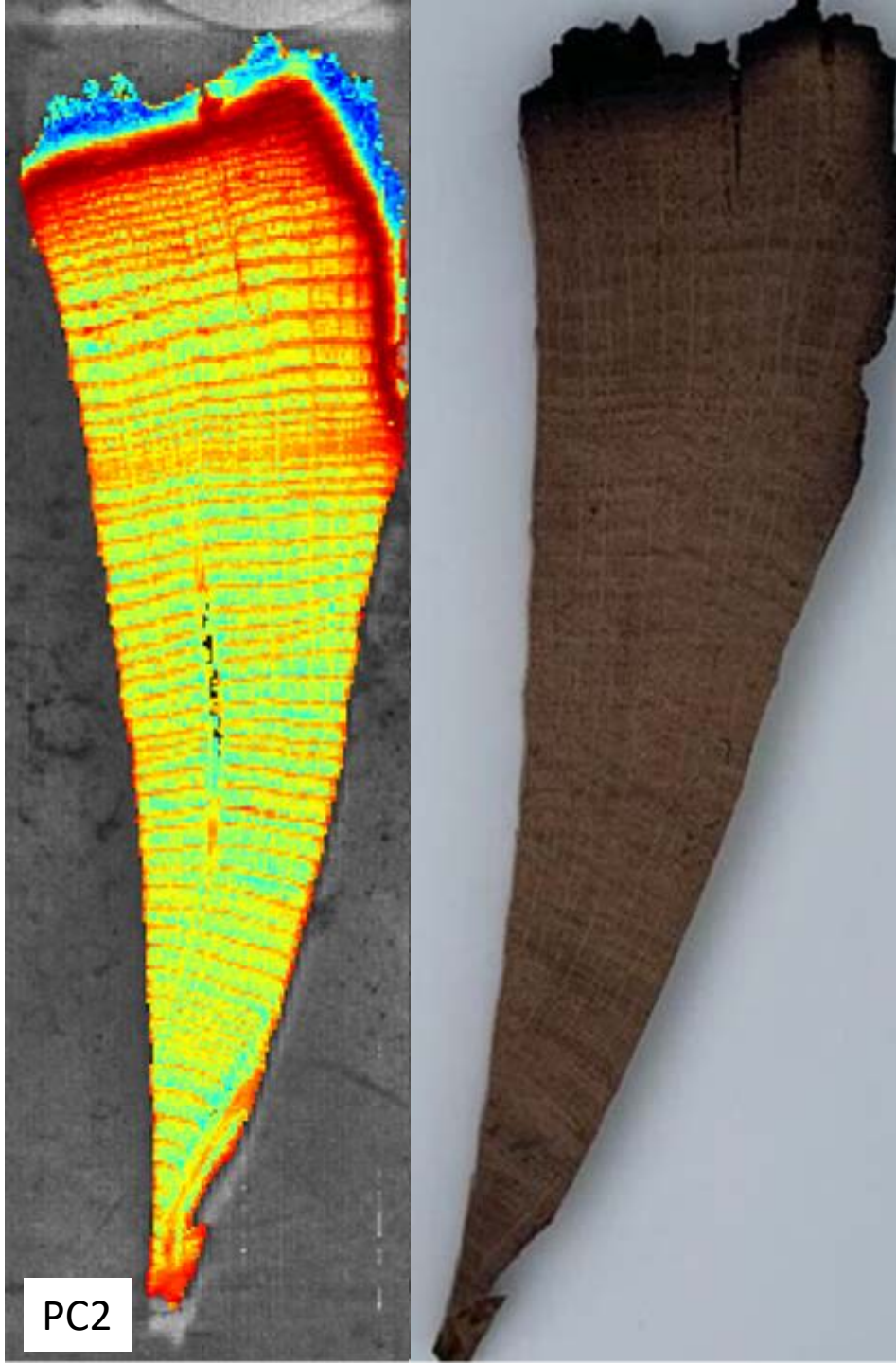
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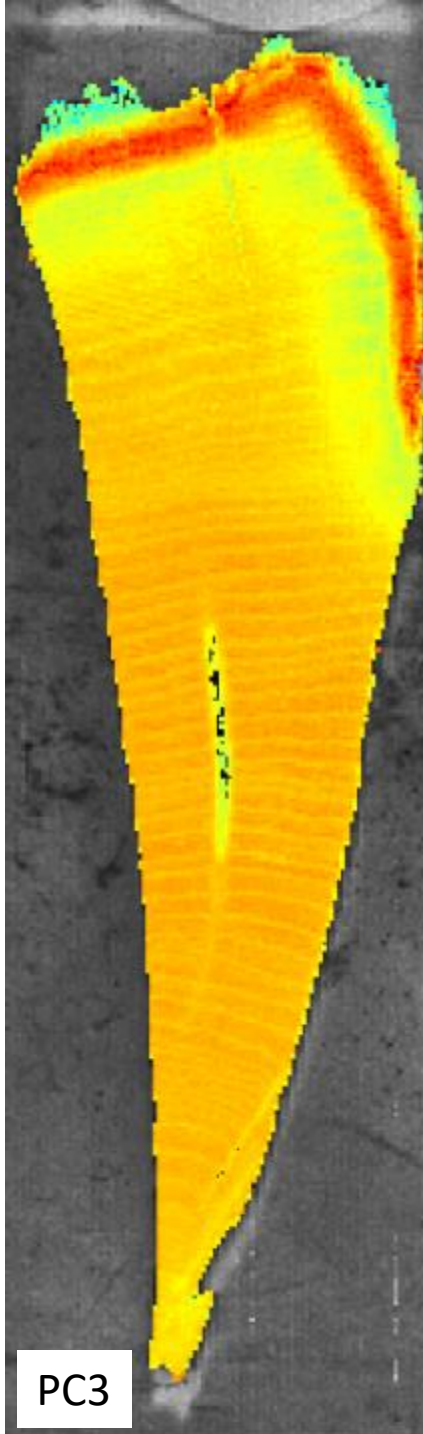


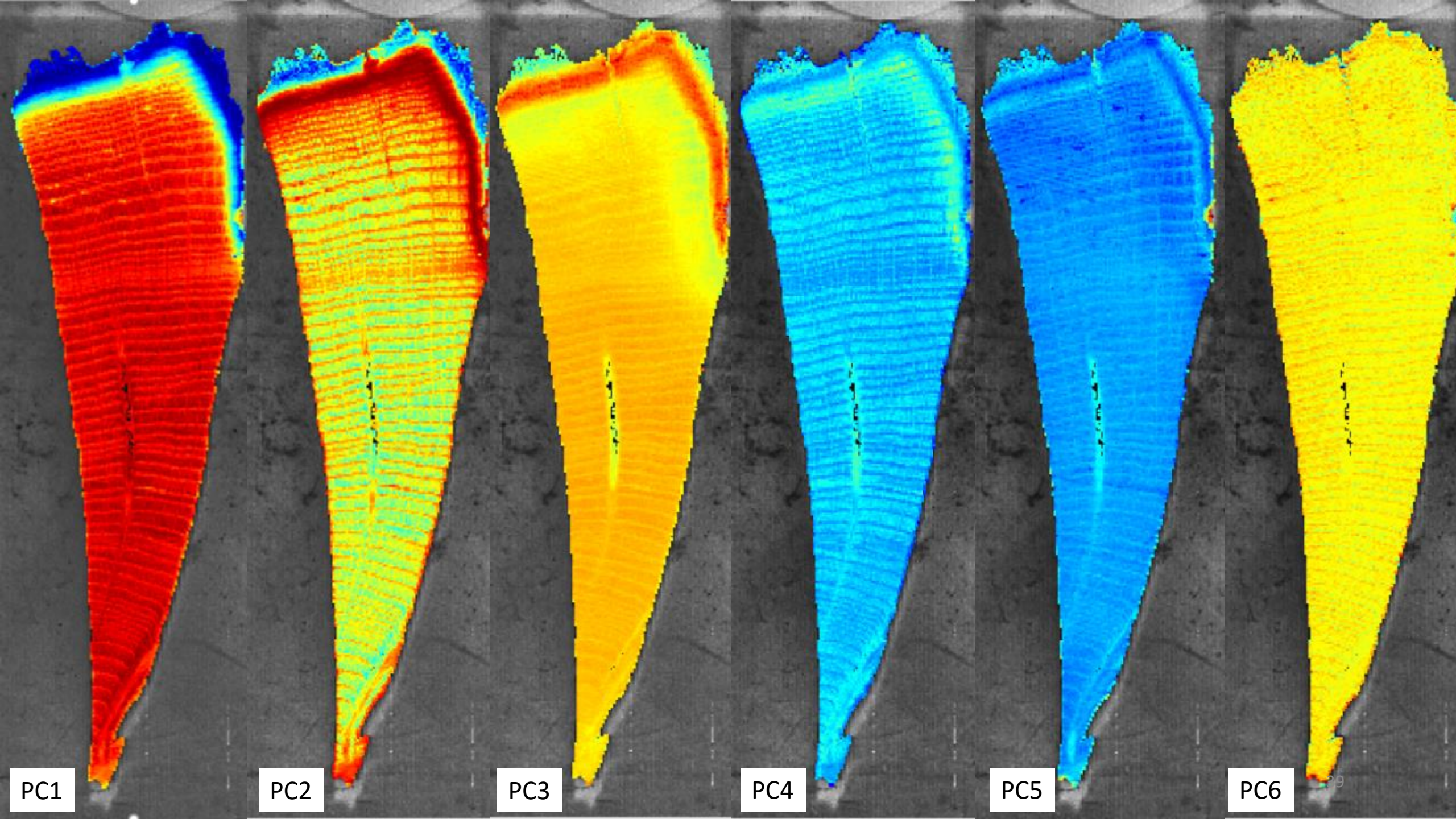
PC1











Merci !!!

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journal homepage: www.elsevier.com/locate/chemometrics

A novel approach to combine spatial and spectral information from hyperspectral images

Belal Gaci^{a,b,c,*}, Florent Abdelghafour^{b,c}, Maxime Ryckewaert^{b,c}, Silvia Mas-Garcia^{b,c}, Marine Louargant^a, Florence Verpont^a, Yohana Laloum^a, Ryad Bendoula^{b,c}, Gilles Chaix^{c,d,e}, Jean-Michel Roger^{b,c}