

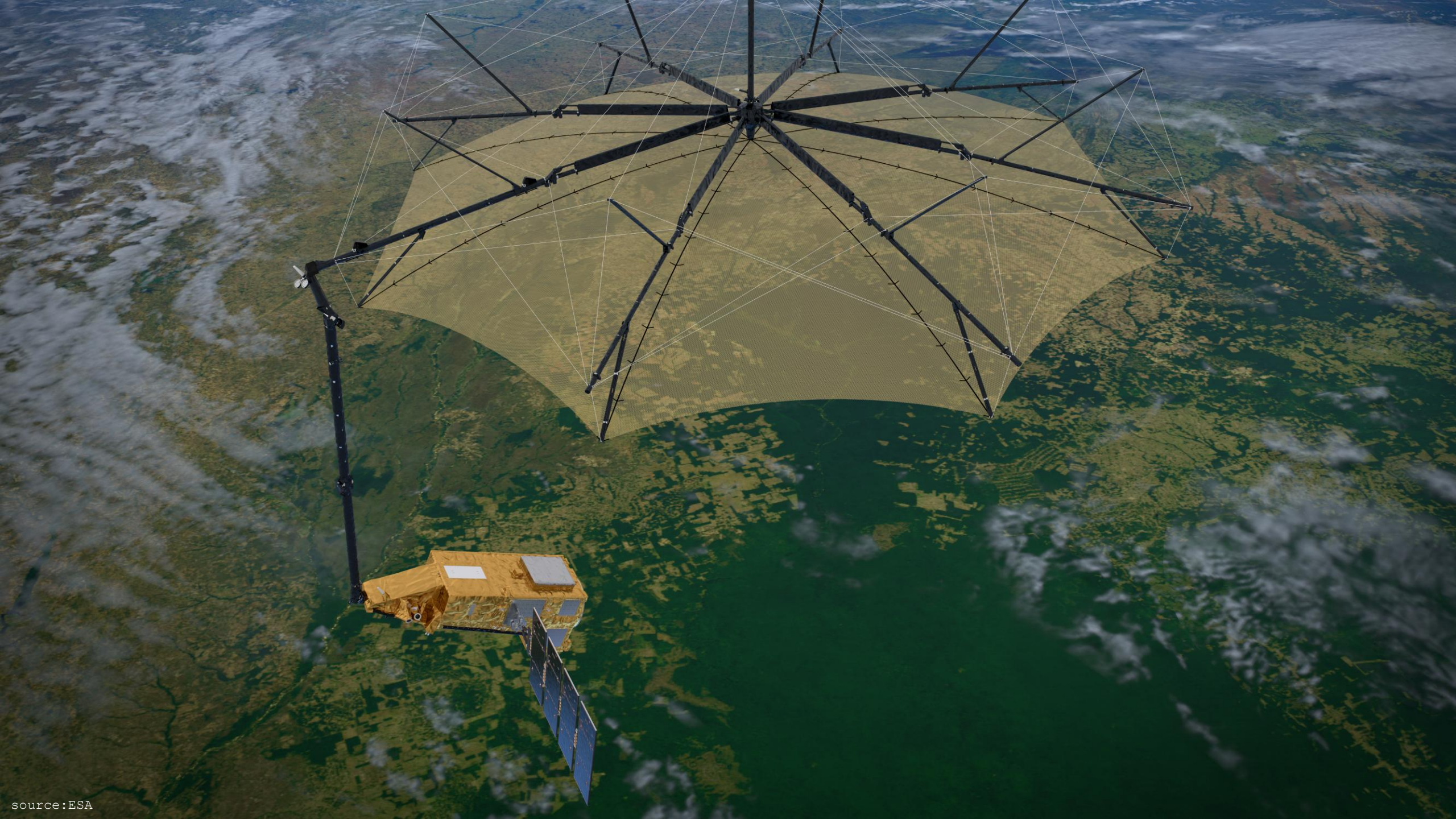


# THE PLANT WATER PUMP

# HOW ARE THE DRIVING FORCE?

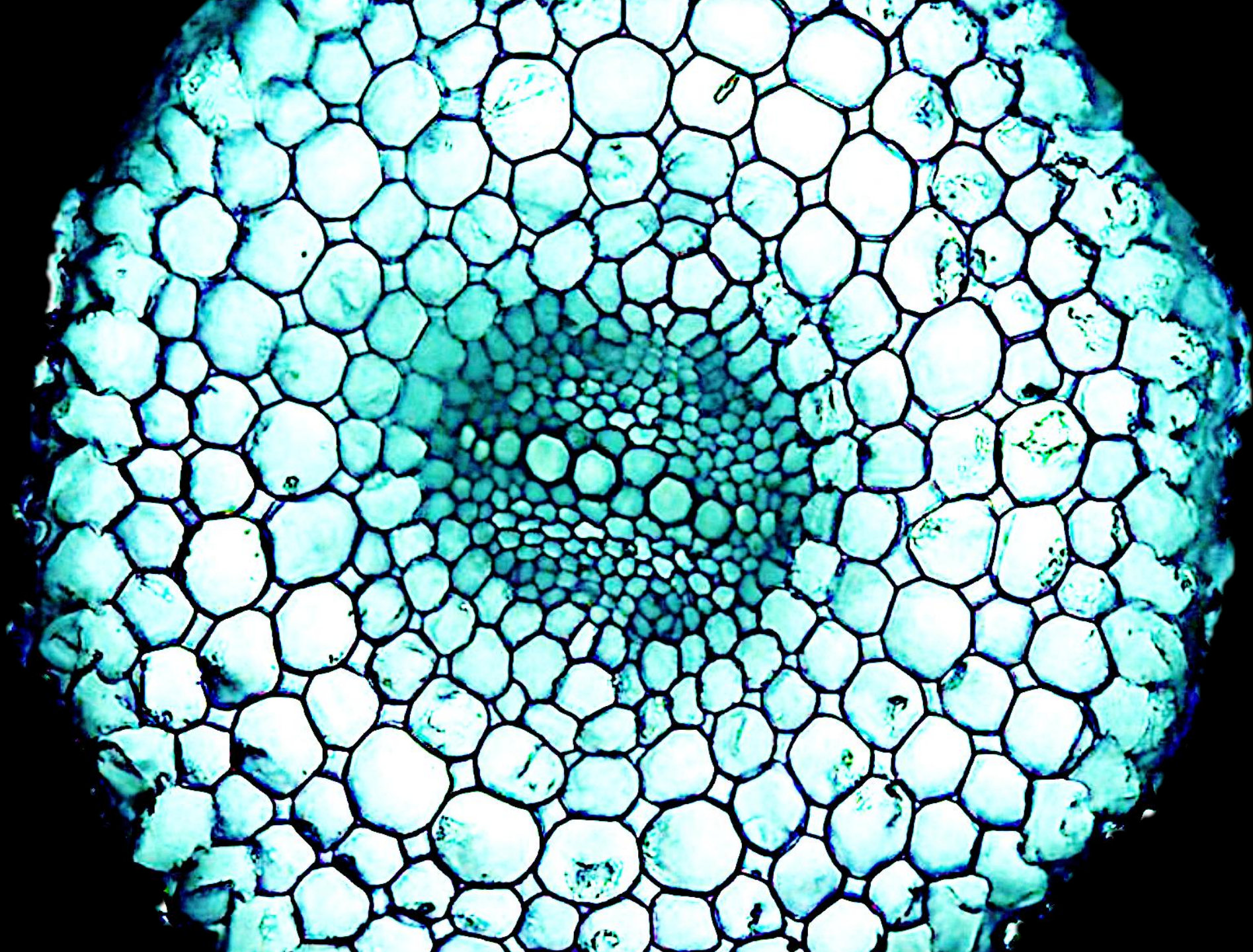
Théo Degand, Marco D'agostino, Lei Ding,  
Moustapha Kolawole, Monica Rothwell, Noémie Thiébaud,  
Daniel Persson, **Valentin Couvreur**

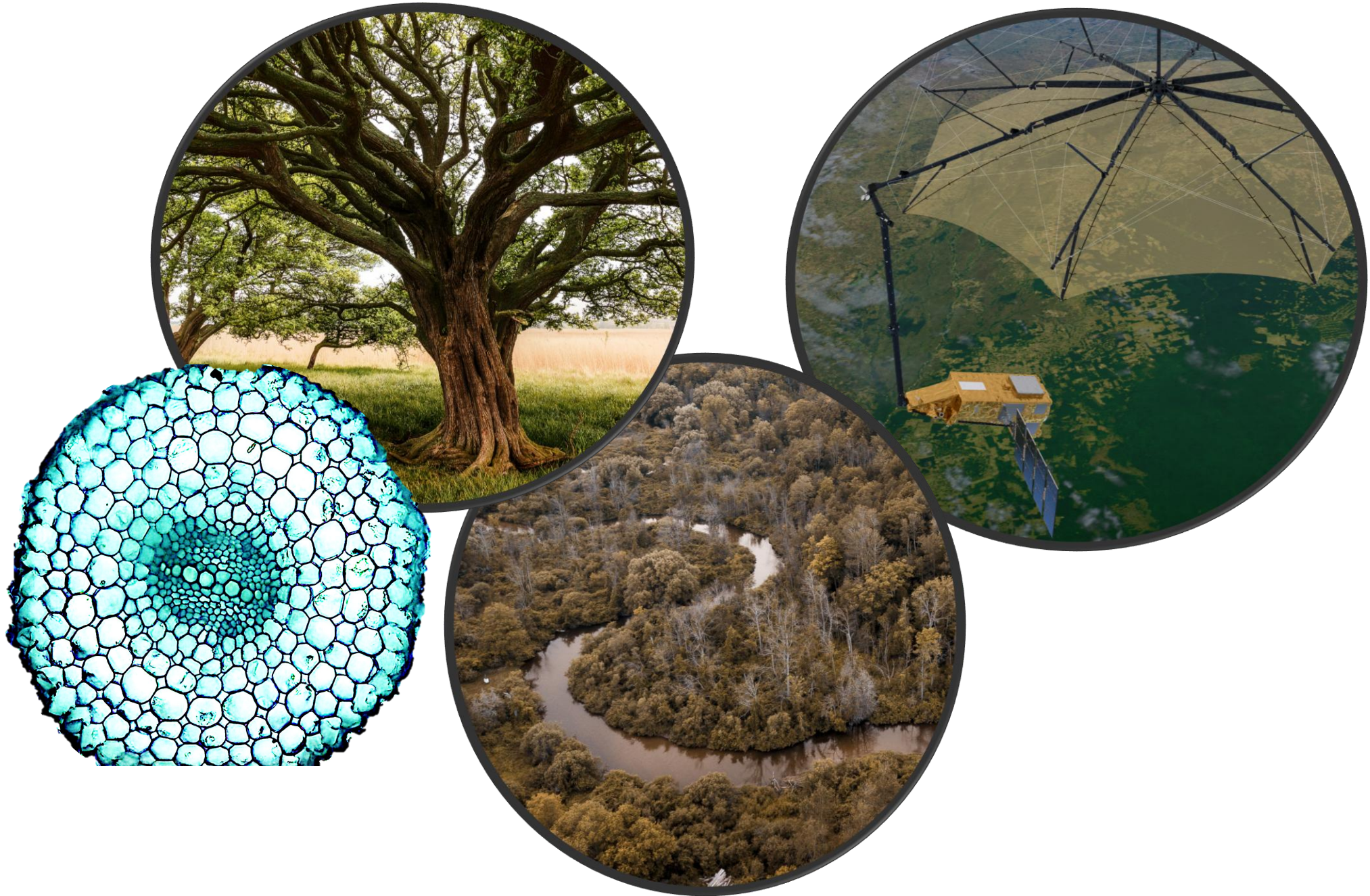




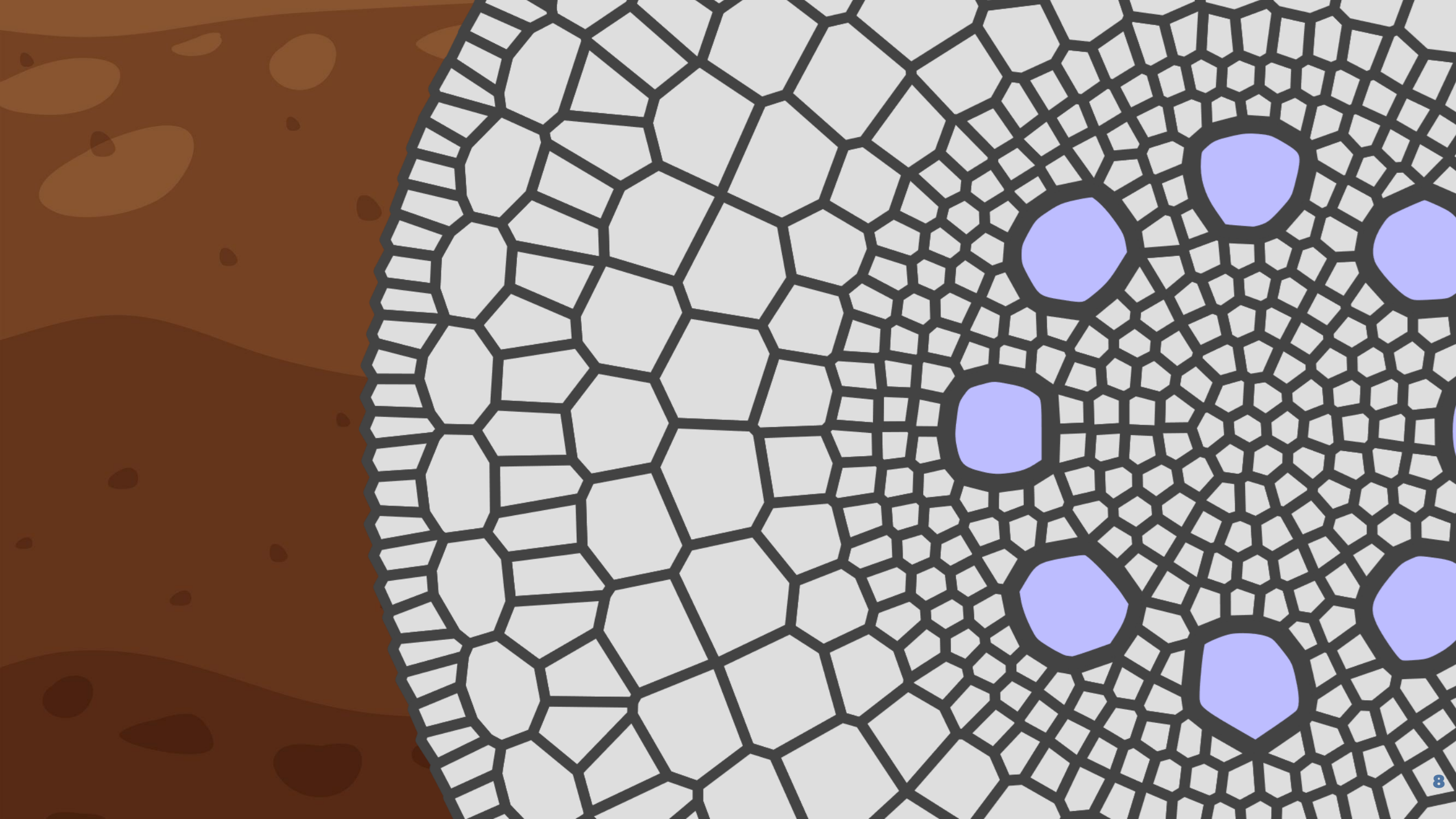


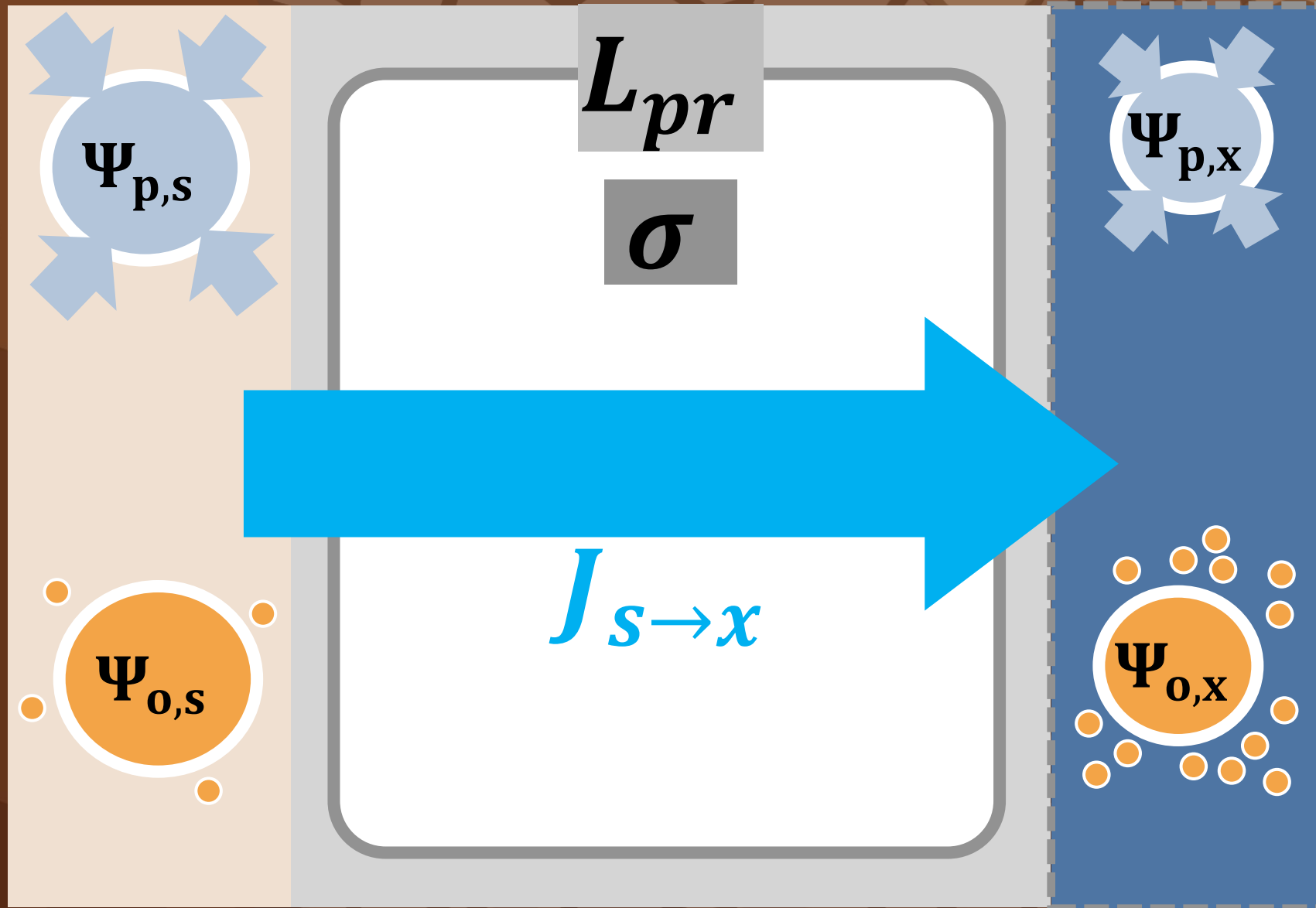








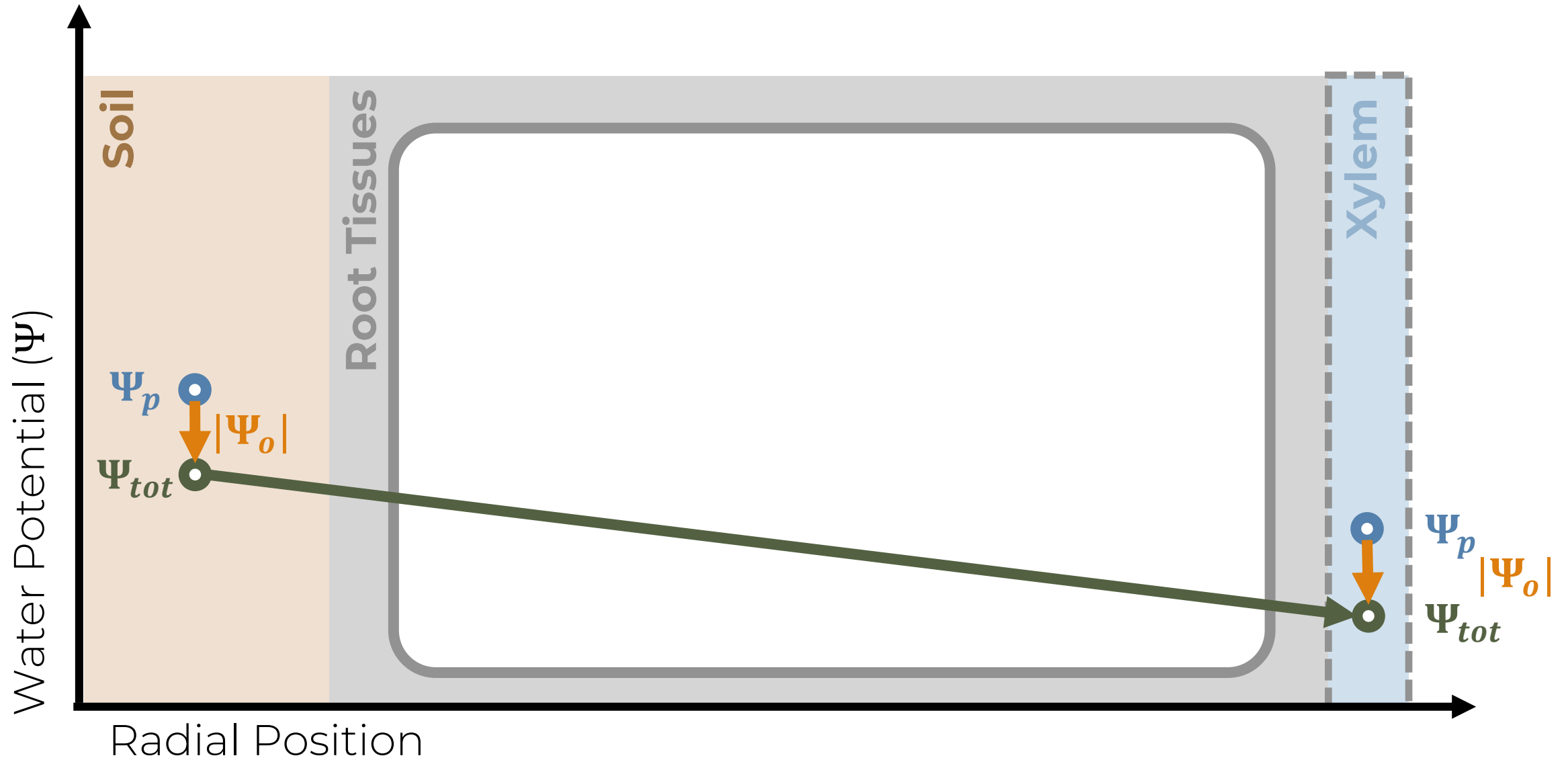


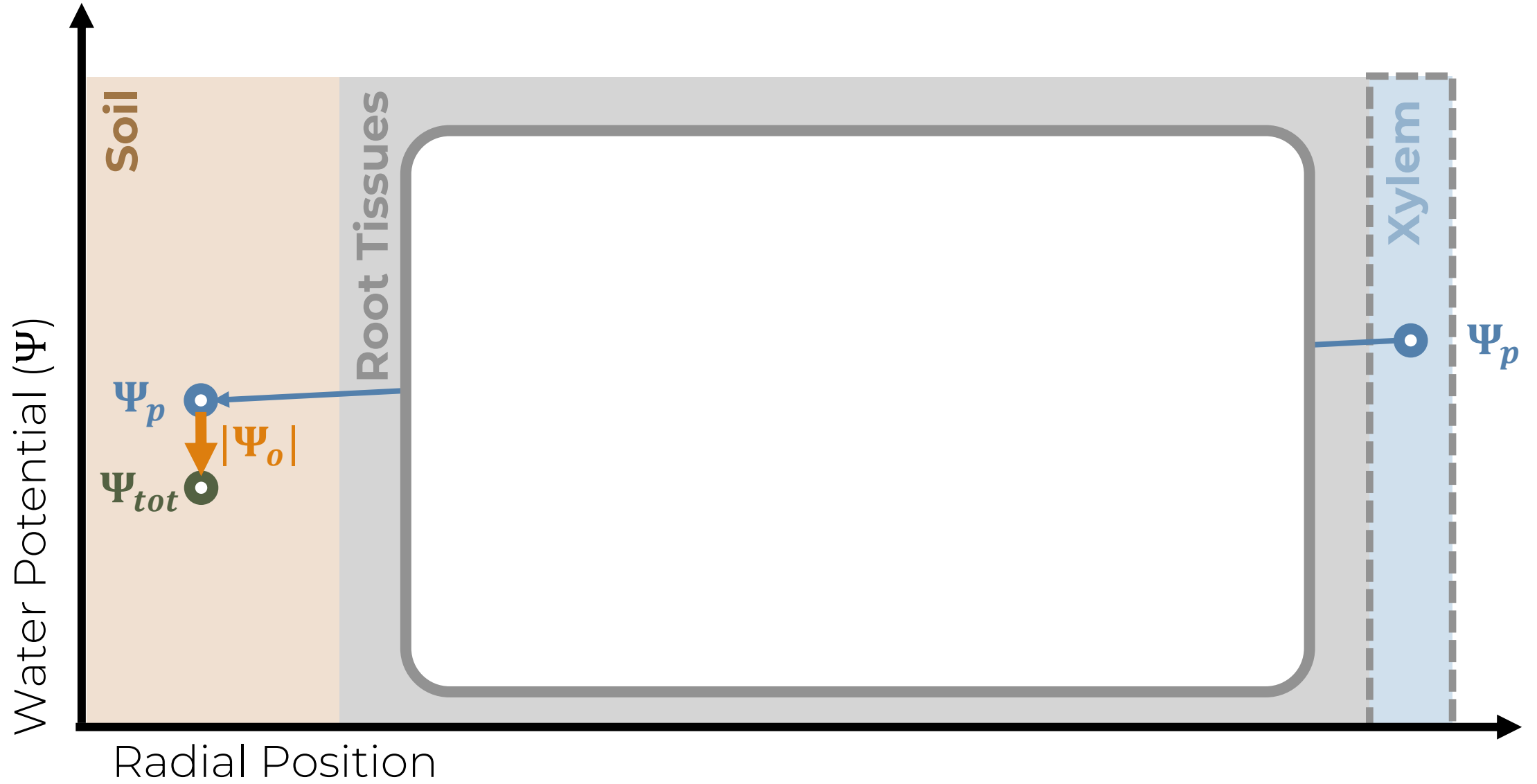


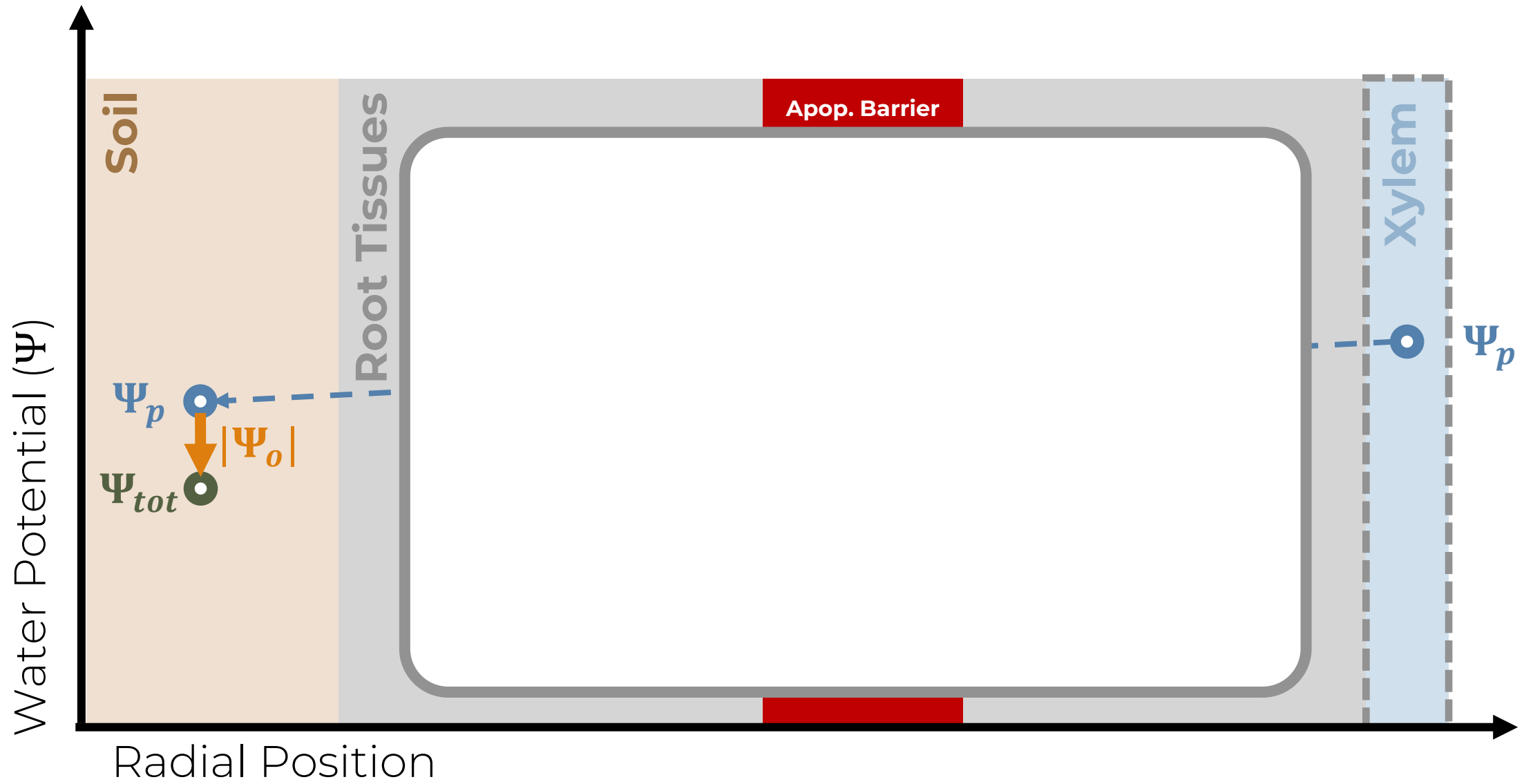
$$J_{s \rightarrow x} = L_{pr} \left[ (\Psi_{p,s} - \Psi_{p,x}) + \sigma (\Psi_{o,s} - \Psi_{o,x}) \right]$$

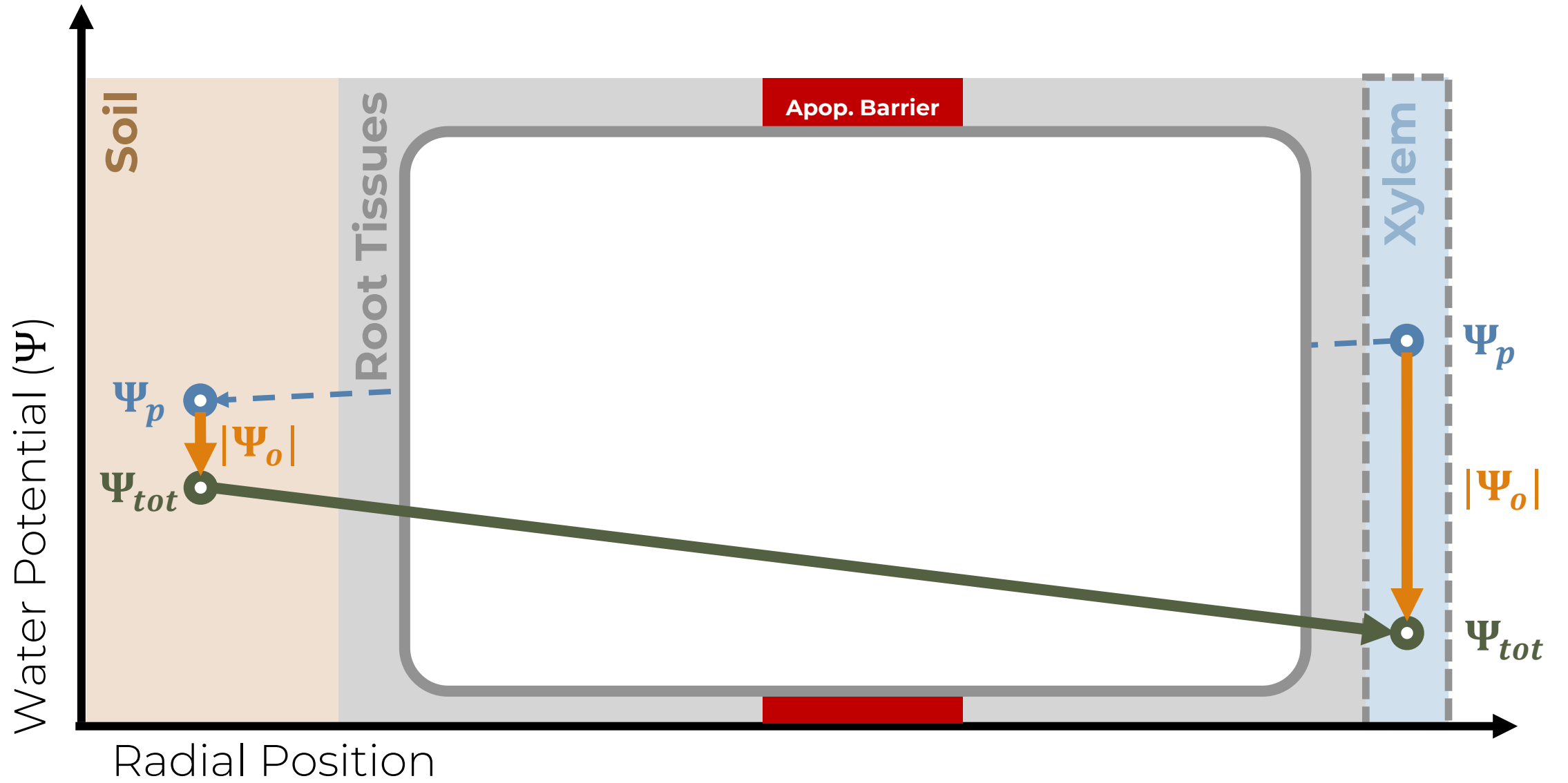
$$J_{s \rightarrow x} = L_{pr} (\Delta\Psi_p + \sigma \Delta\Psi_o)$$

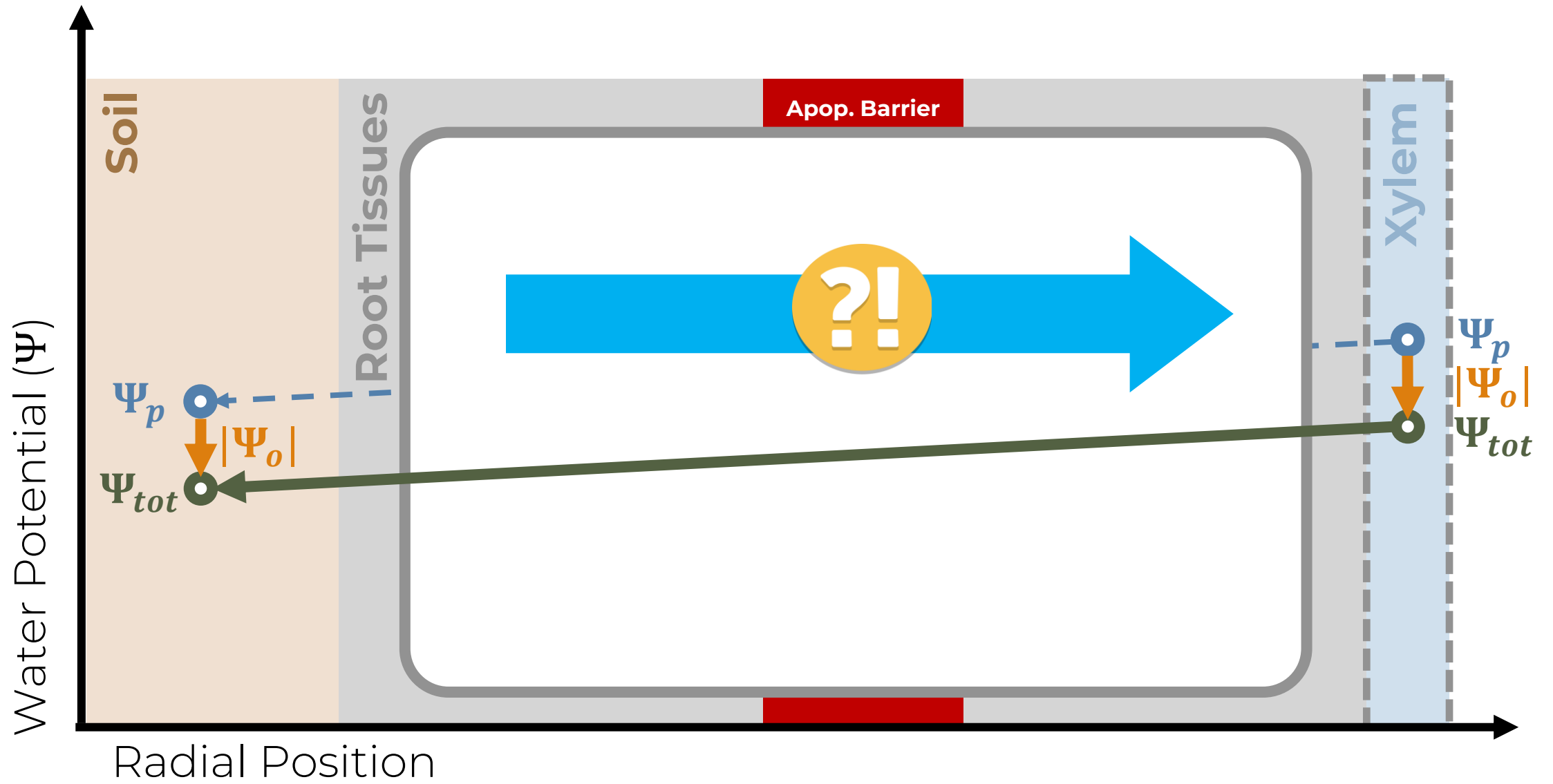
**FISCUS & KRAMER, 1975**











Couvreur et al. 2018

In particular conditions  
(e.g. osmotic experiments),  
**Fiscus and Kramer equation is  
no longer accurate**

Enns et al. 2000

The adjustment in roots is  
**contradicting the osmotic-  
xylem-sap mechanism**



Bai et al. 2007

The phenomenon seemingly  
goes **against the second law  
of thermodynamics**

Couvreur et al. 2021

These paradoxical observations have  
remained a curiosity for the past 35 years,  
and **suggest plants may take up more  
water than predicted**

Couvreur et al. 2021

These paradoxical observations have remained a curiosity for the past 35 years, and **suggest plants may take up more water than predicted**



# THE PLANT WATER PUMP

# AN UPDATED PARADIGM OF PLANT WATER UPTAKE?

 UCLouvain



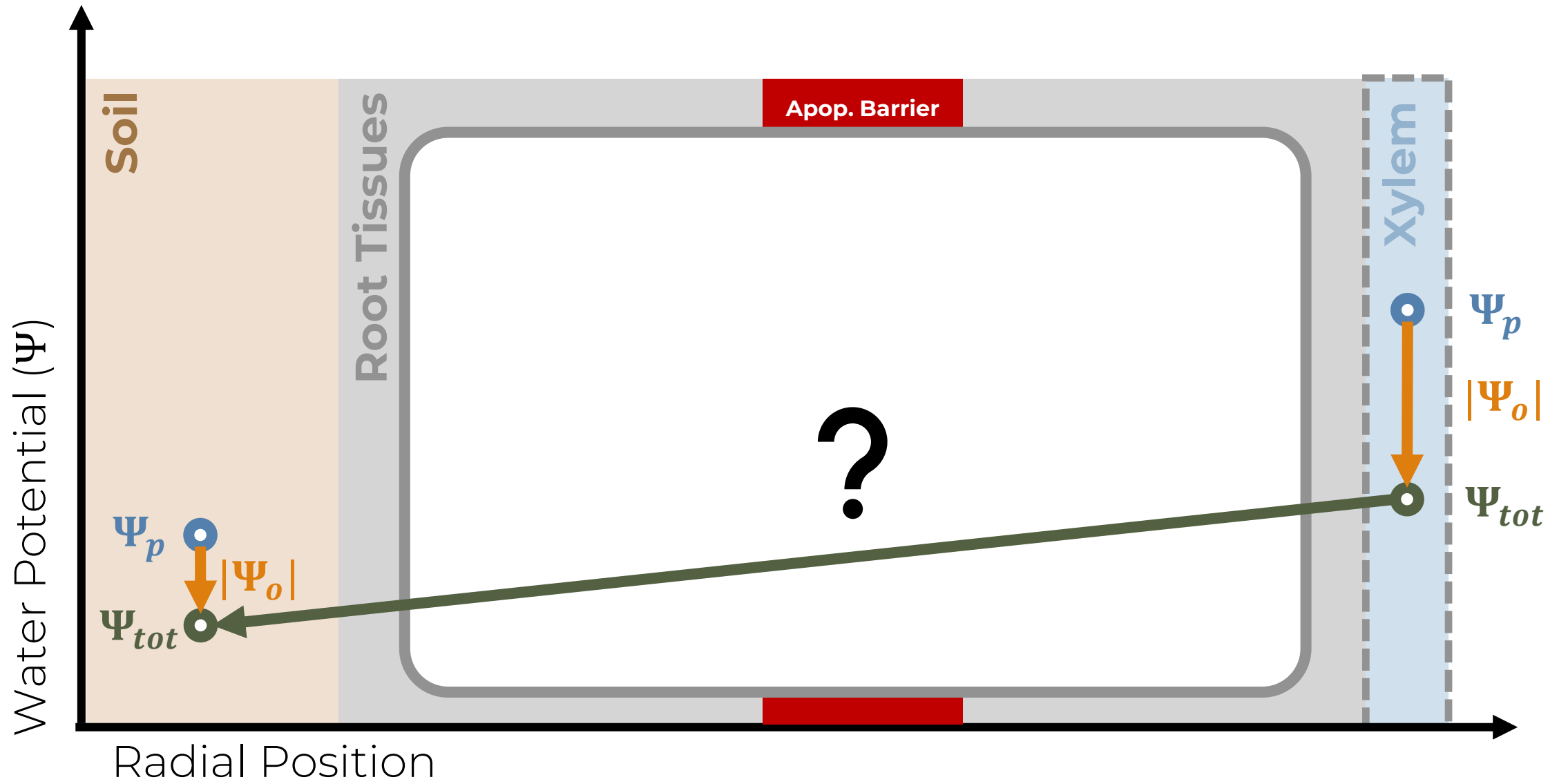
KØBENHAVNS  
UNIVERSITET

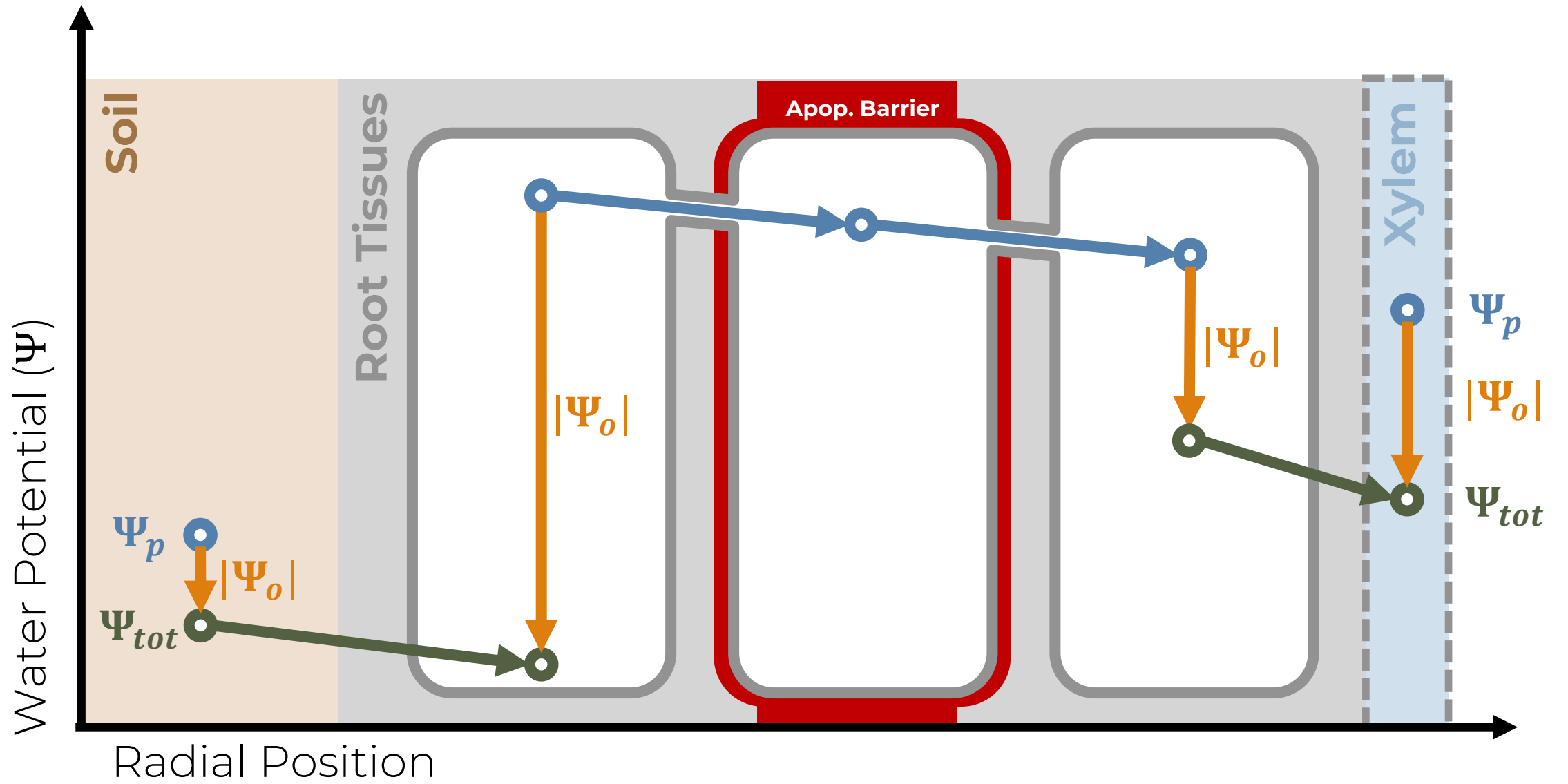


European Research Council  
Established by the European Commission



**fnrs**  
LA LIBERTÉ DE CHERCHER



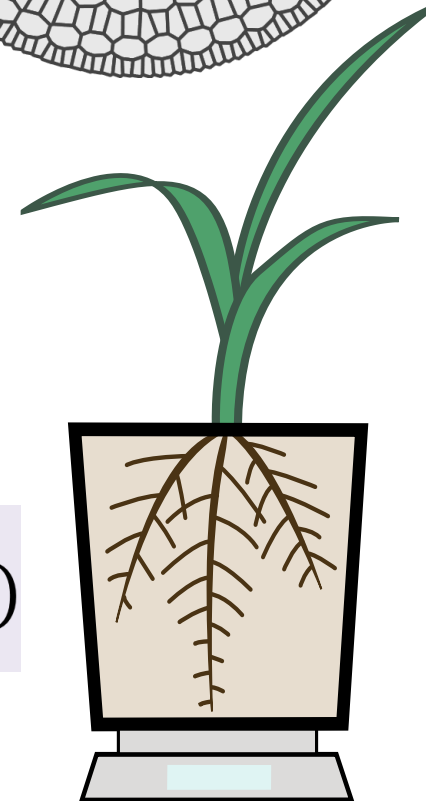
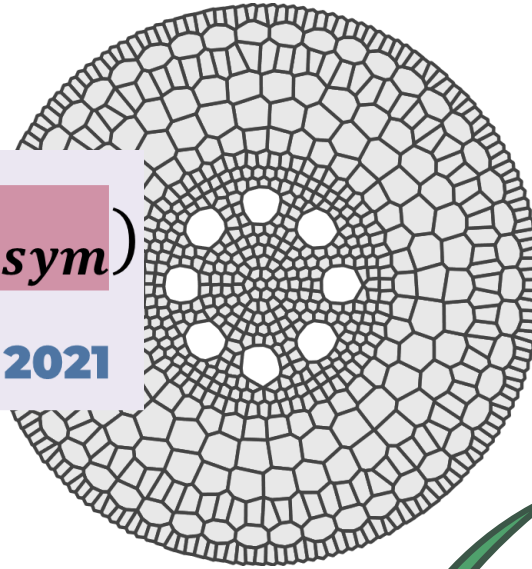



$$J_{s \rightarrow x} = L_{pr} (\Delta\Psi_p + \sigma \overline{\Delta\Psi}_{o,apo} - \sigma \overline{\Delta\Psi}_{o,sym})$$

**COUVREUR ET AL. 2021**

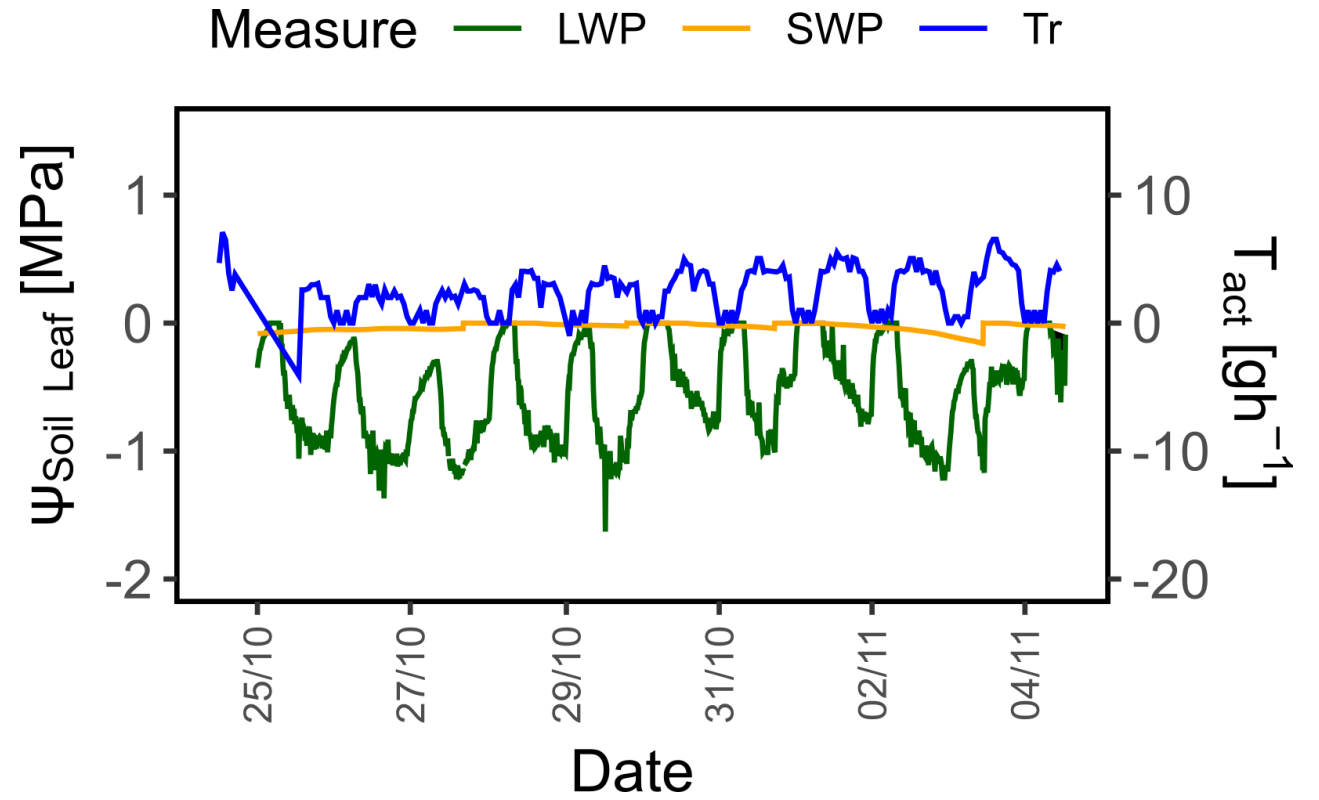
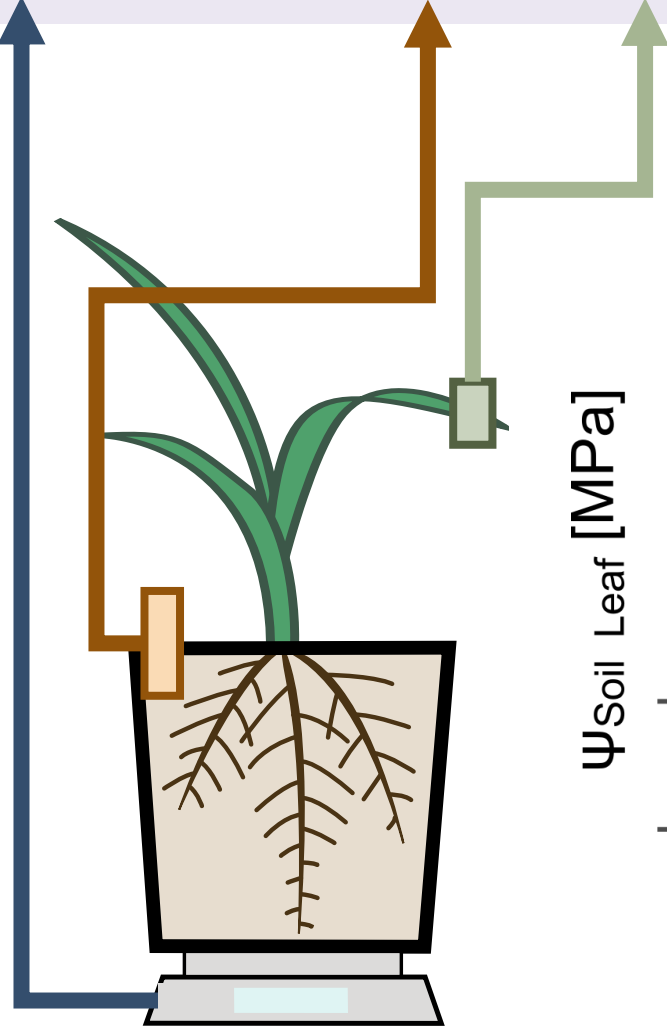
$$J_{s \rightarrow x} = L_{pr} (\Delta\Psi_p + \sigma \overline{\Delta\Psi}_{o,apo} - \sigma \overline{\Delta\Psi}_{o,sym})$$

COUVREUR ET AL. 2021

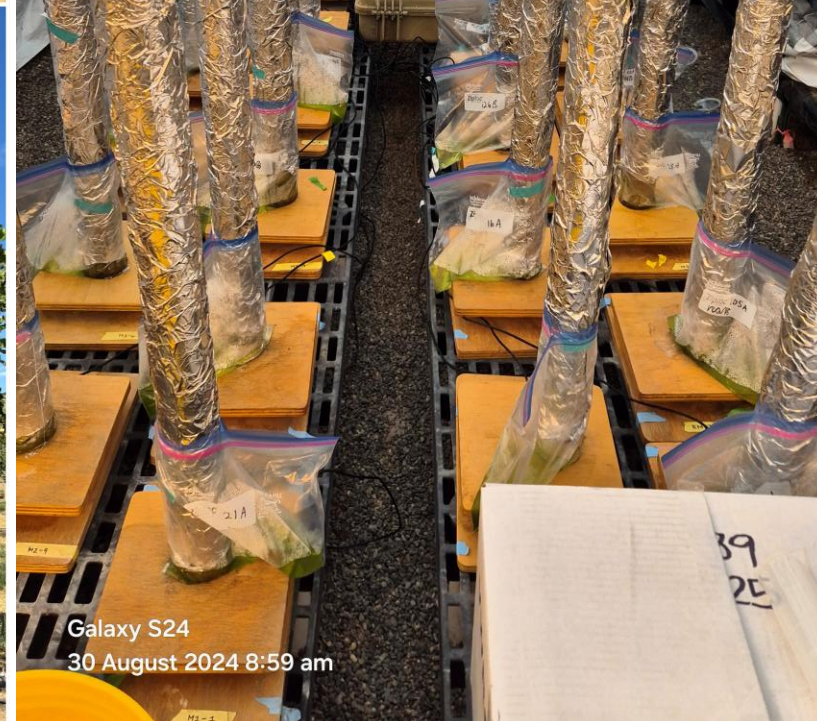


$$T_{act} = K_{rs} (\Delta\Psi_p + \sigma \overline{\Delta\Psi}_{o,apo} - \sigma \overline{\Delta\Psi}_{o,sym})$$

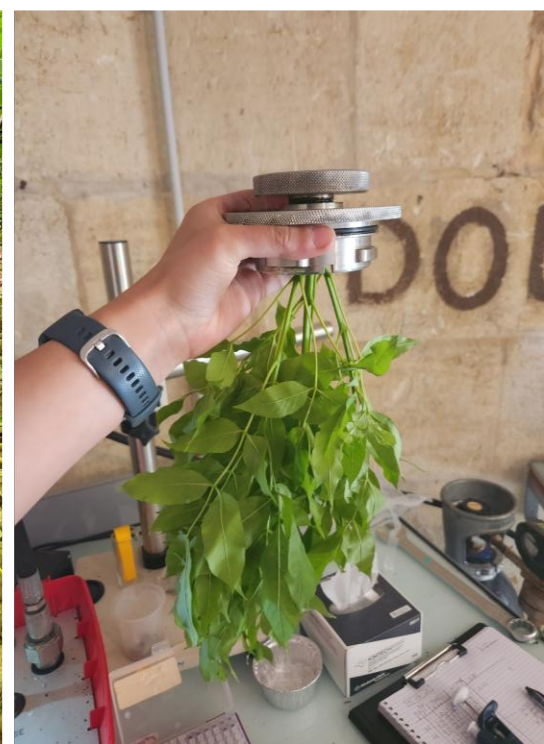
$$T_{act} = K_{rs} \times (\Psi_{soil} - \Psi_{leaf} + \sigma \overline{\Delta \Psi}_{o,apo} - \sigma \overline{\Delta \Psi}_{o,sym})$$







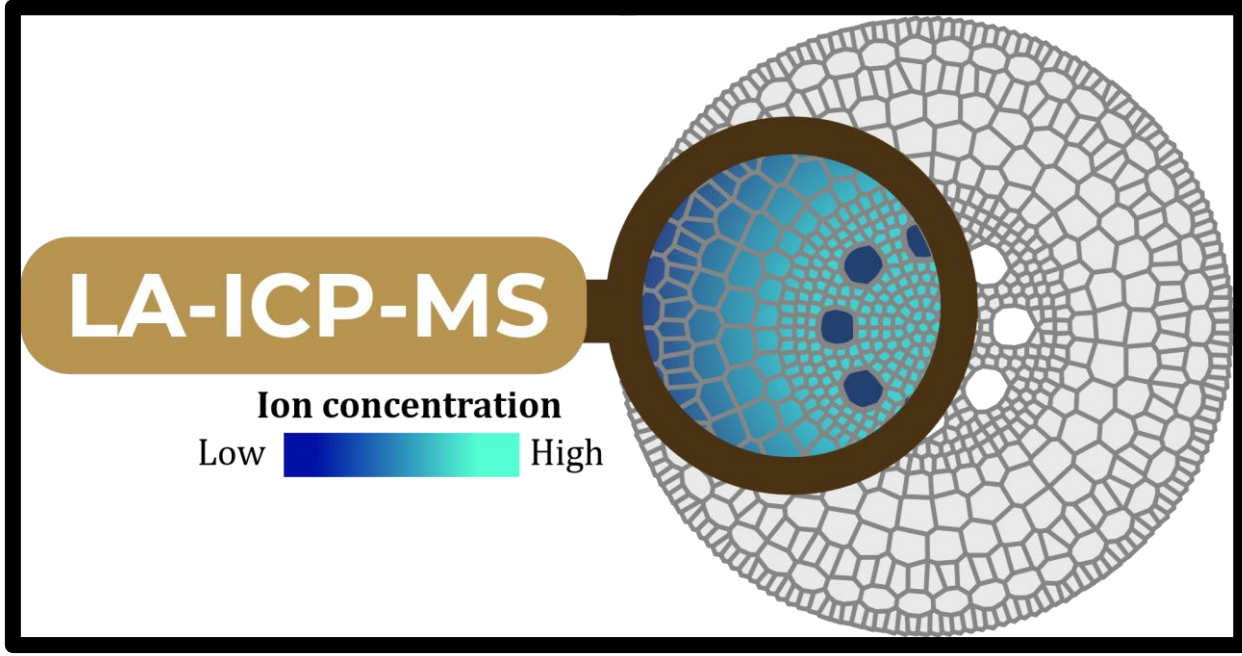
Galaxy S24  
30 August 2024 8:59 am



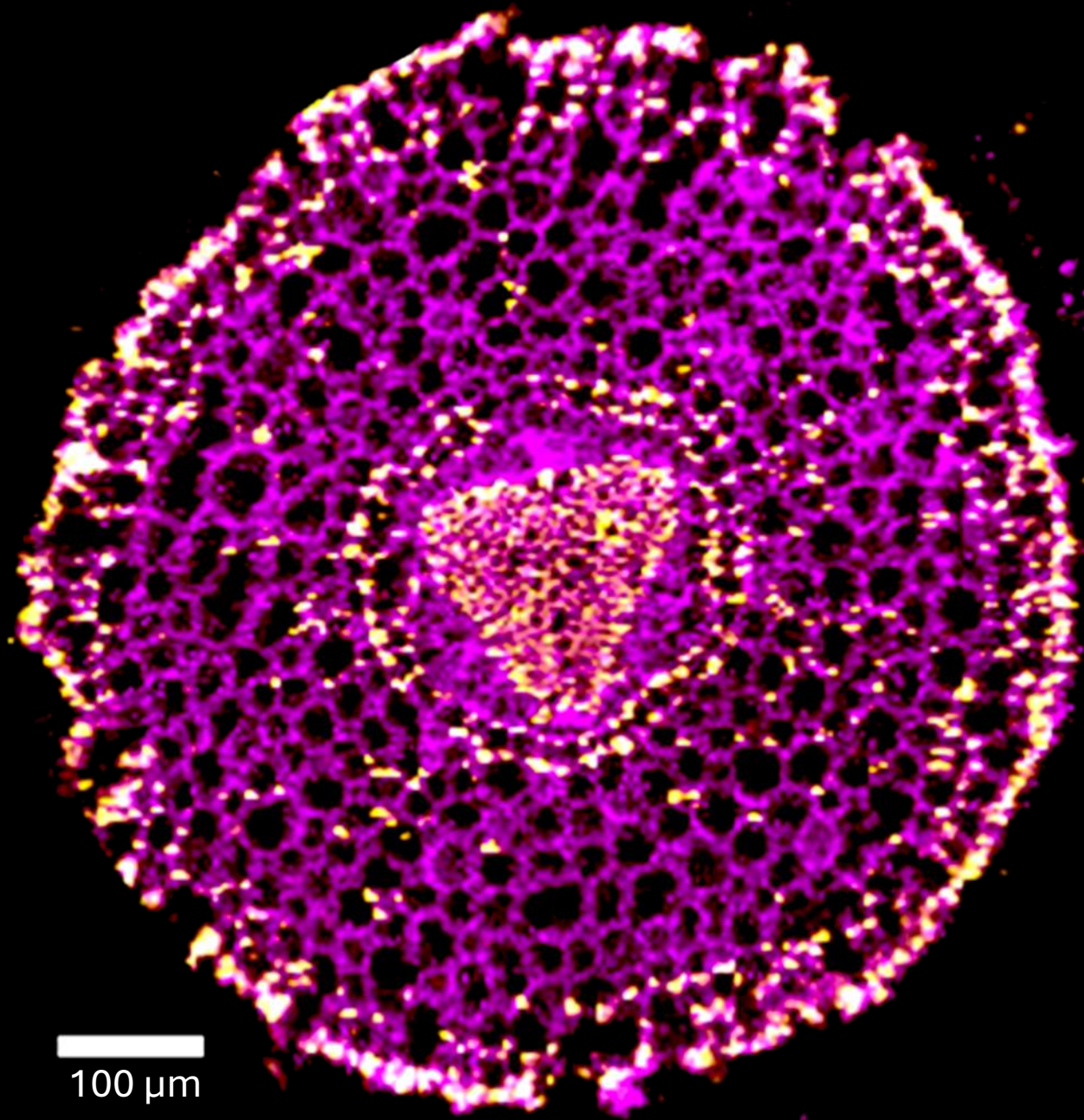
$$T_{act} = K_{rs} \times (\Psi_{soil} - \Psi_{leaf} + \sigma \overline{\Delta\Psi}_{o,apo} - \sigma \overline{\Delta\Psi}_{o,sym})$$



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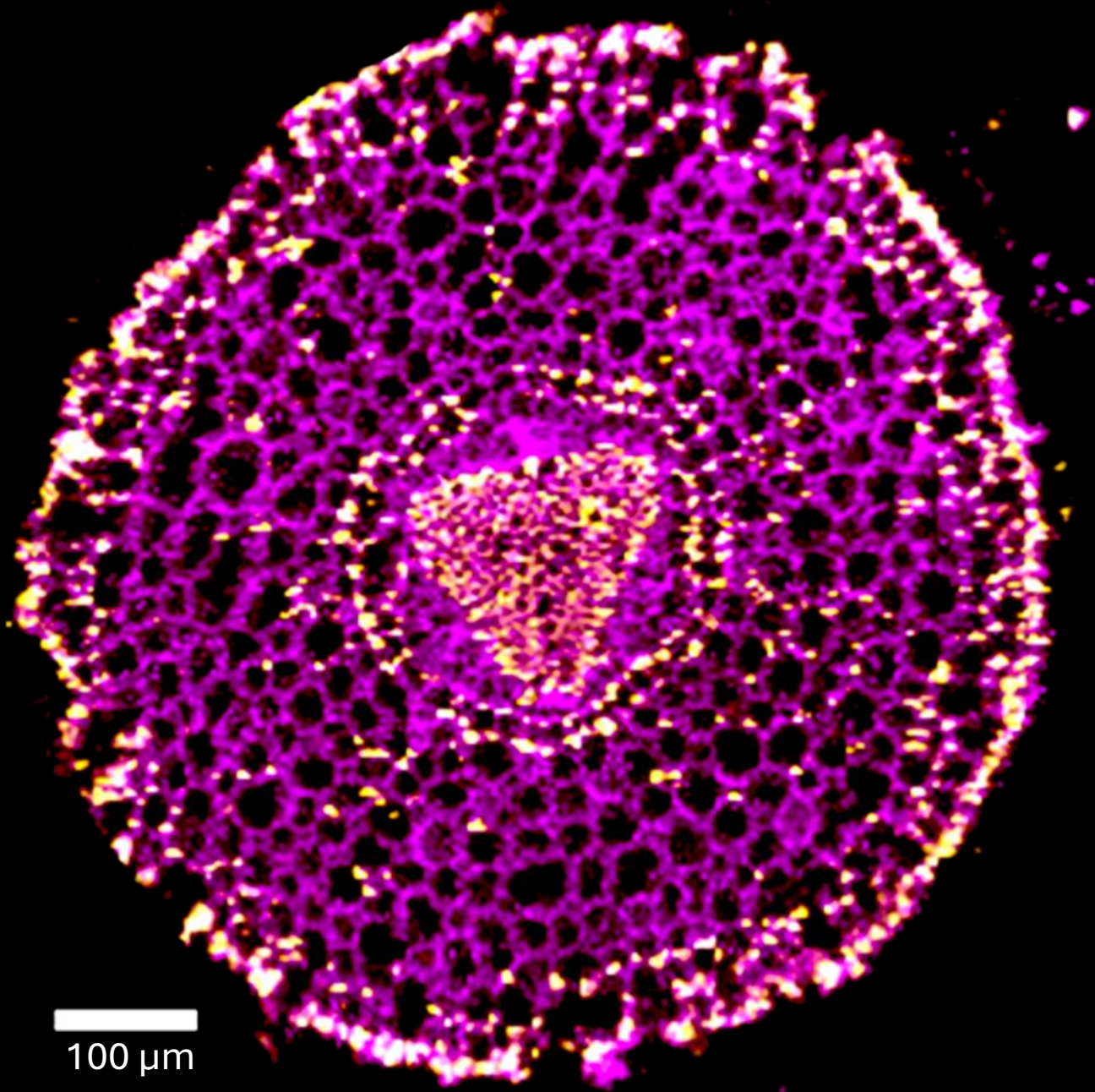


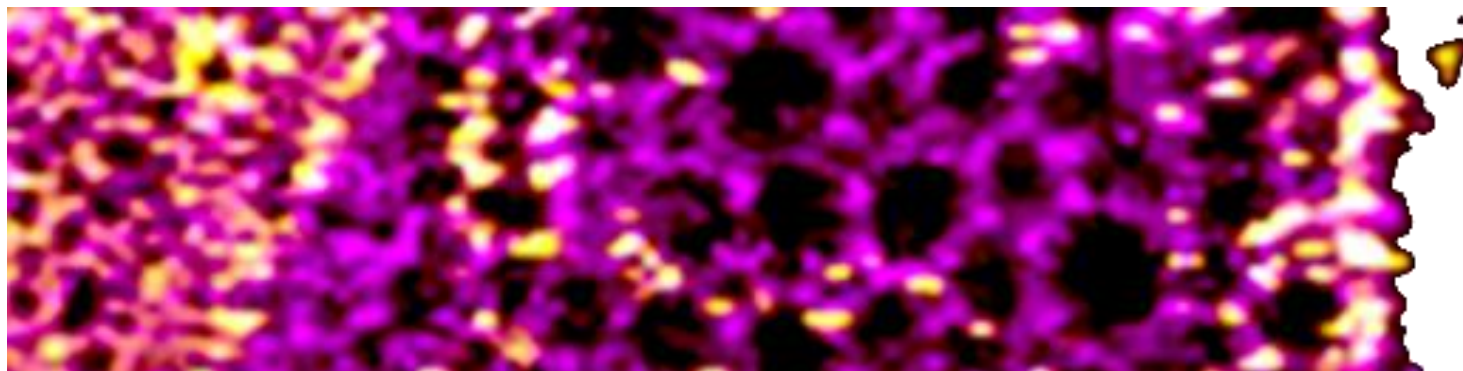
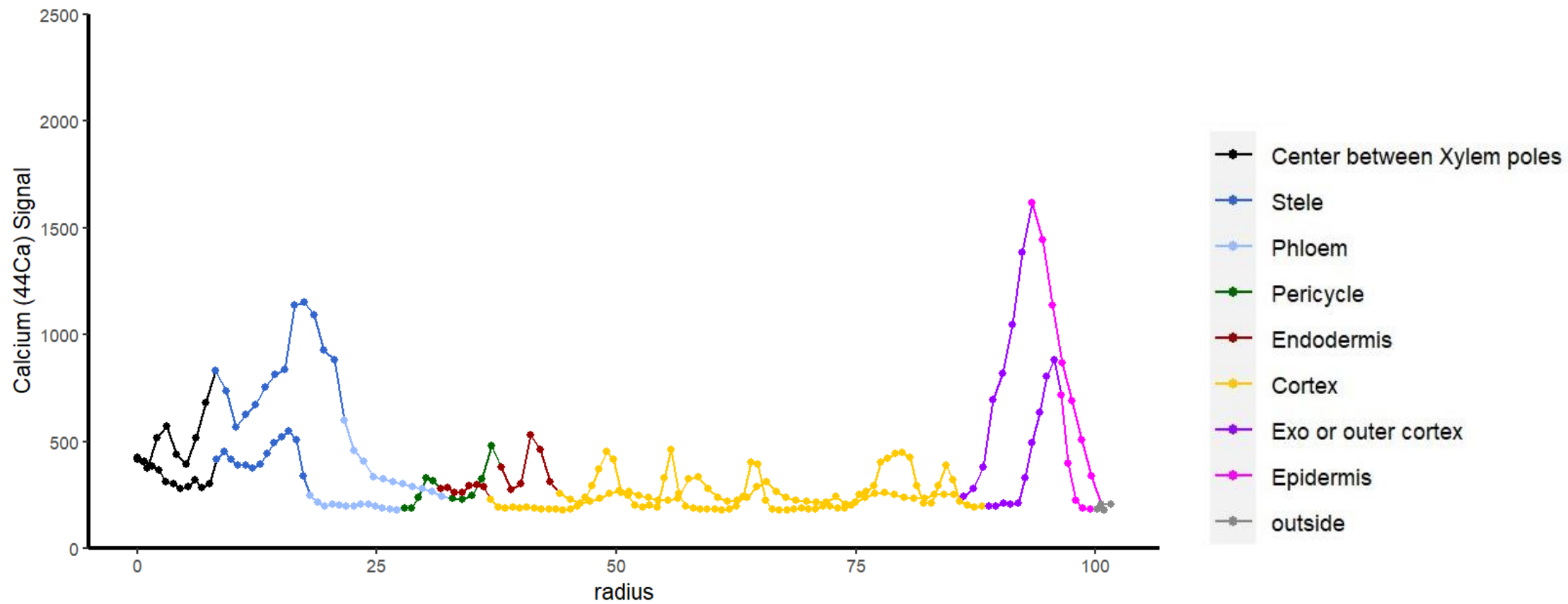
LASER ABLATION – INDUCED COUPLED PLASMA – MASS SPECTROMETRY



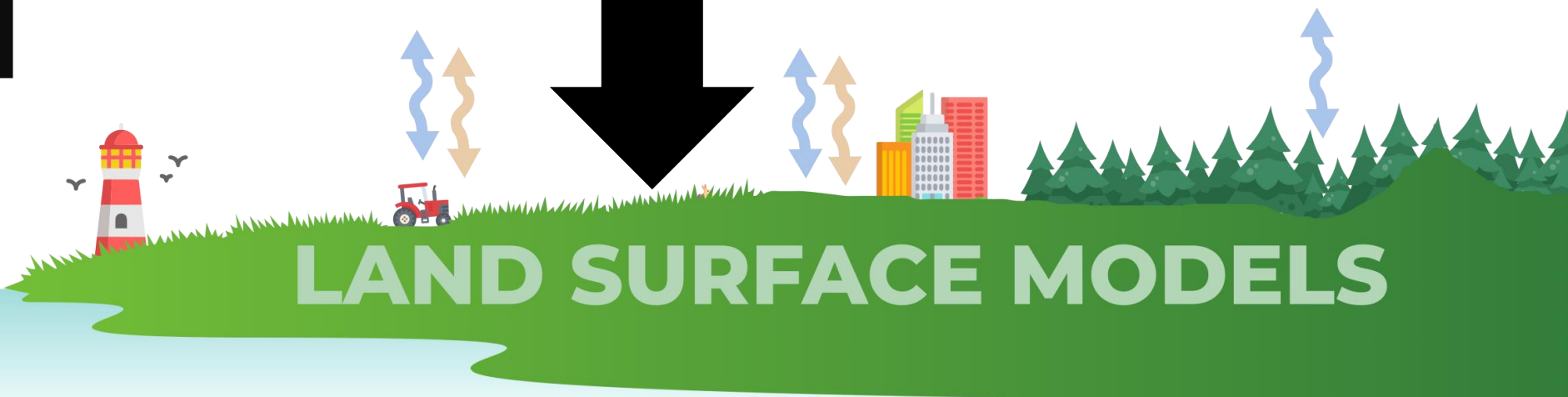
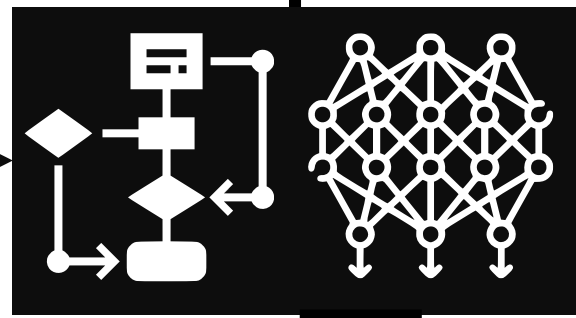
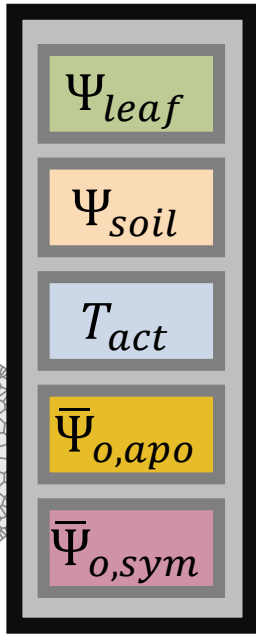
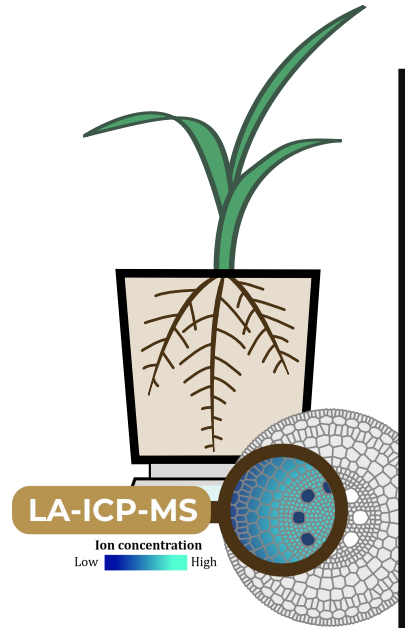
100  $\mu\text{m}$

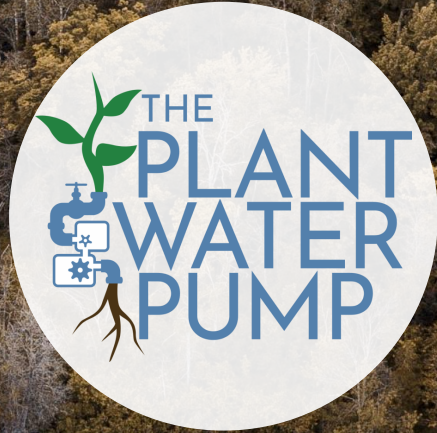
Signals:  
 $\text{Ca}^{2+}$  |  $\text{K}^{+}$





$$T_{act} = K_{rs} \times (\Psi_{soil} - \Psi_{leaf} + \sigma \overline{\Delta\Psi}_{o,apo} - \sigma \overline{\Delta\Psi}_{o,sym})$$







**Monica  
Rothwell**



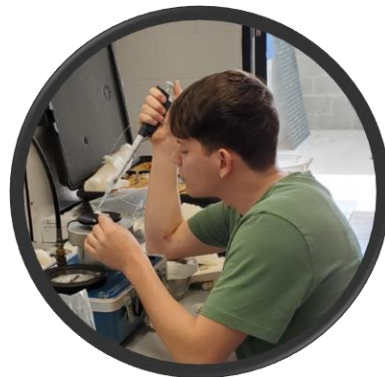
**Valentin  
Couvreur**



**Marco  
D'Agostino**



**Lei  
Ding**



**Théo  
Degand**



**Daniel  
Persson**

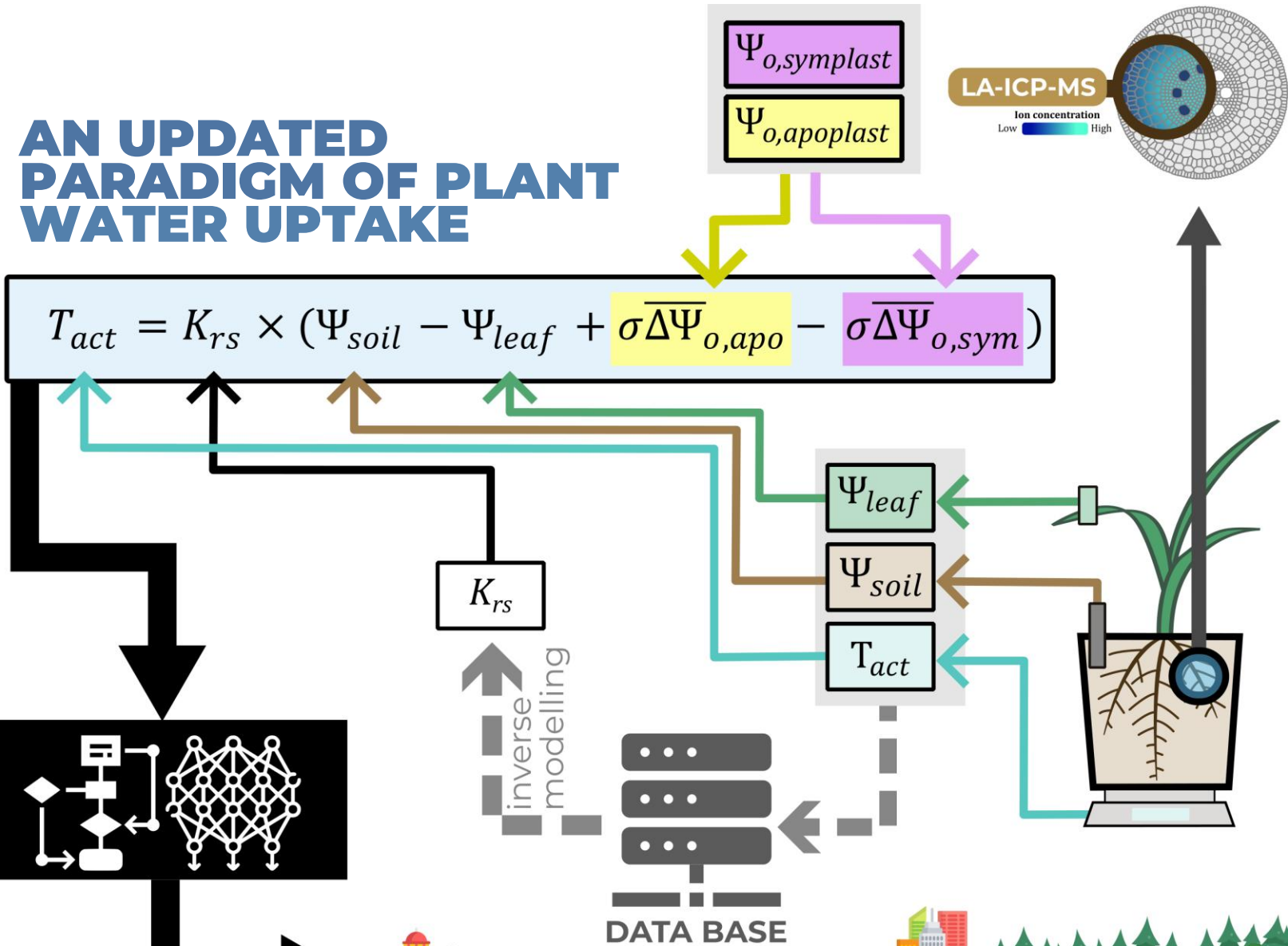


**Noémie  
Thiébaud**



# AN UPDATED PARADIGM OF PLANT WATER UPTAKE

# AN UPDATED PARADIGM OF PLANT WATER UPTAKE



# THE PLANT WATER PUMP

