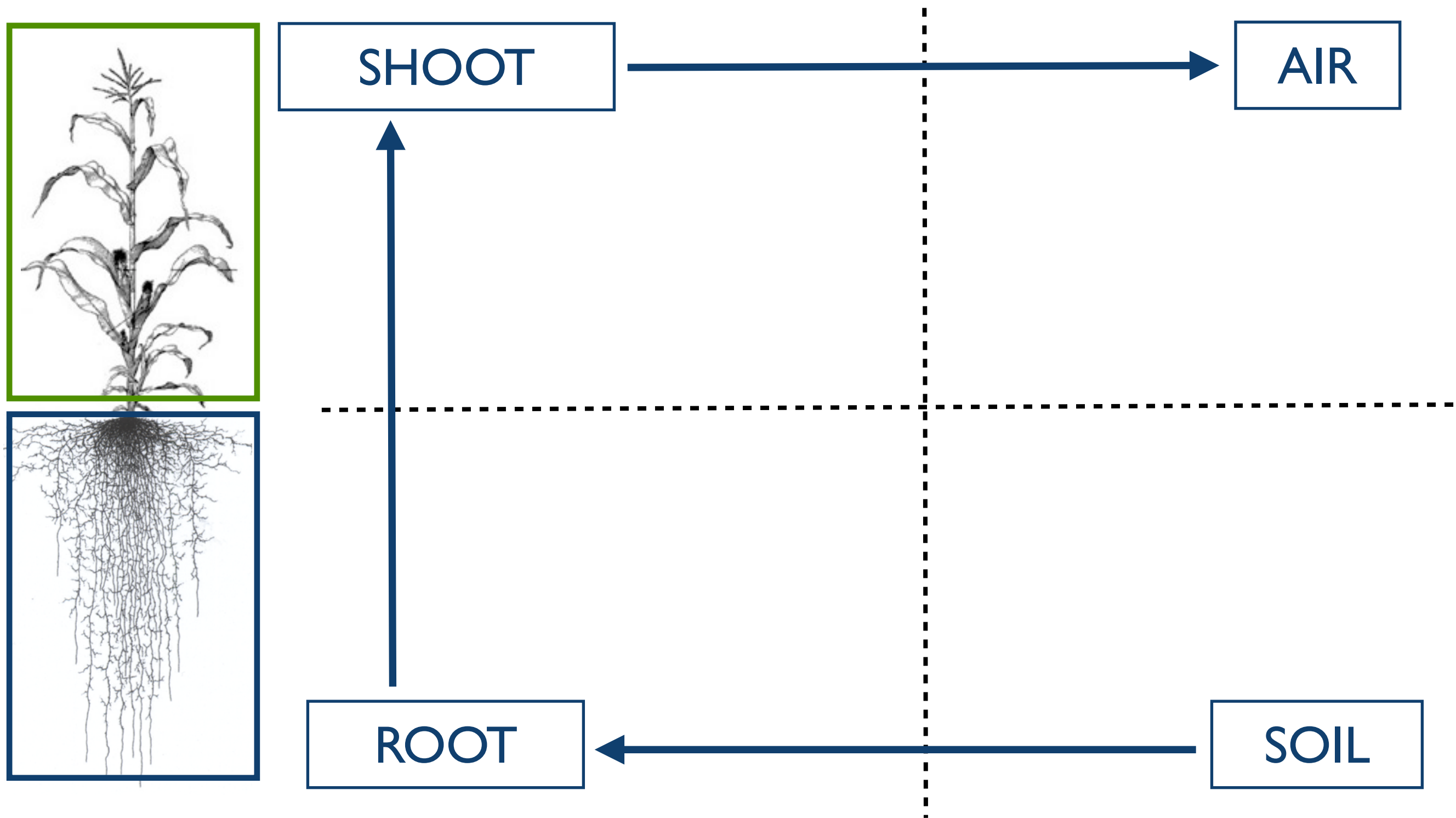


New insights on the role of radial root conductivity on the overall water uptake dynamics

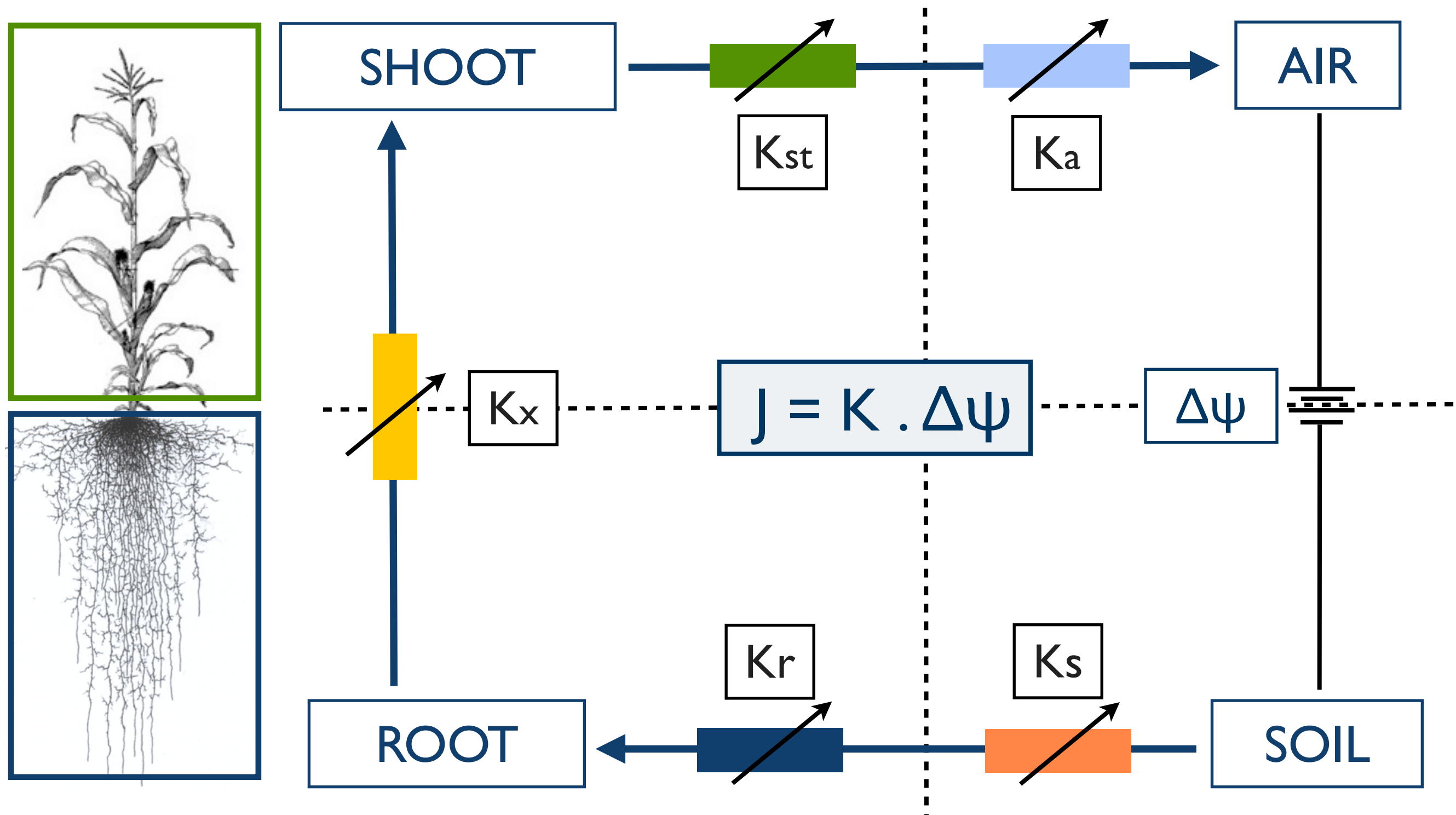
Guillaume Lobet, Valentin Couvreur,
Mathieu Javaux and Xavier Draye

Water fluxes in the plant



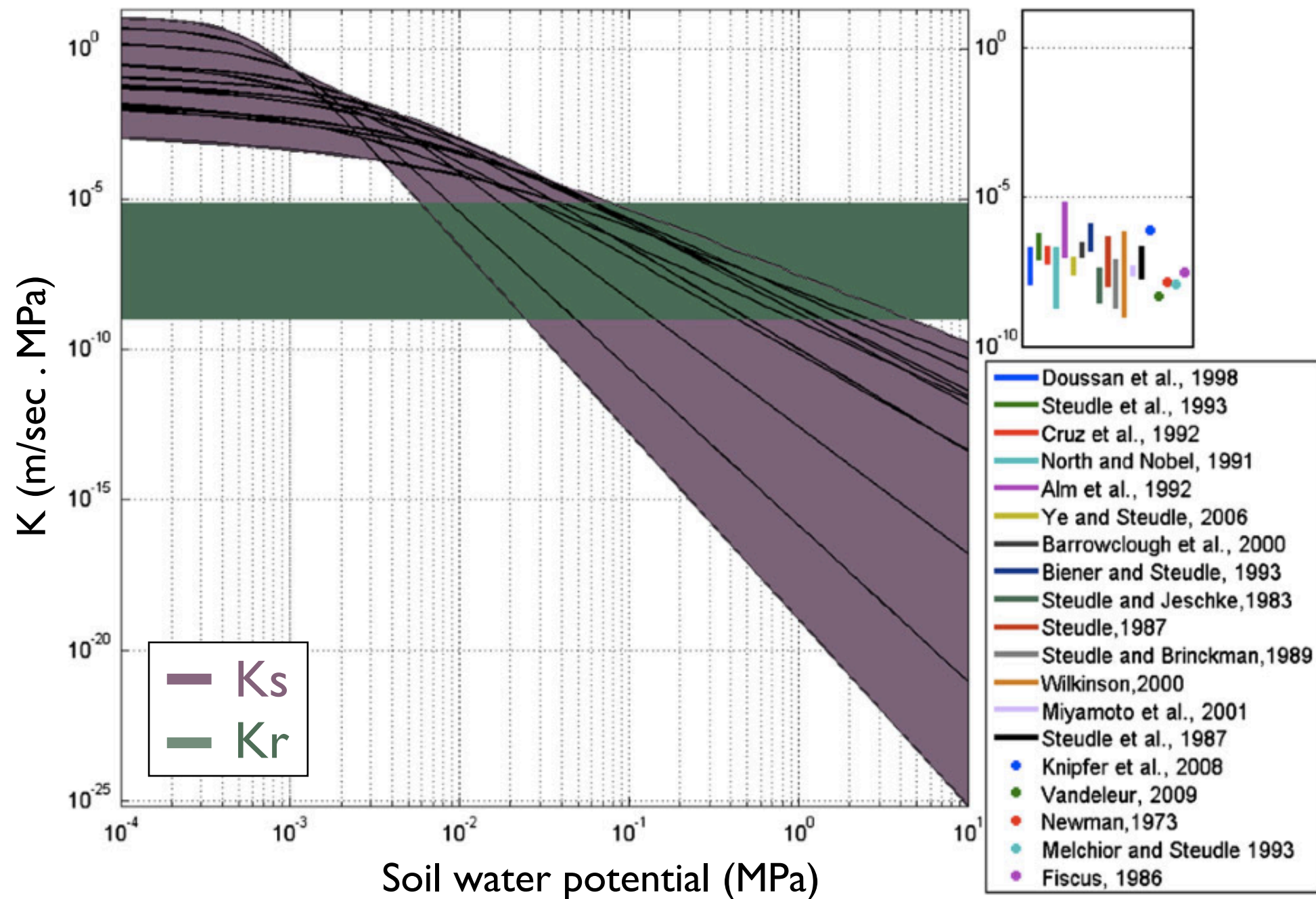
Root image from Kutschera et al., 1997

Water fluxes in the plant

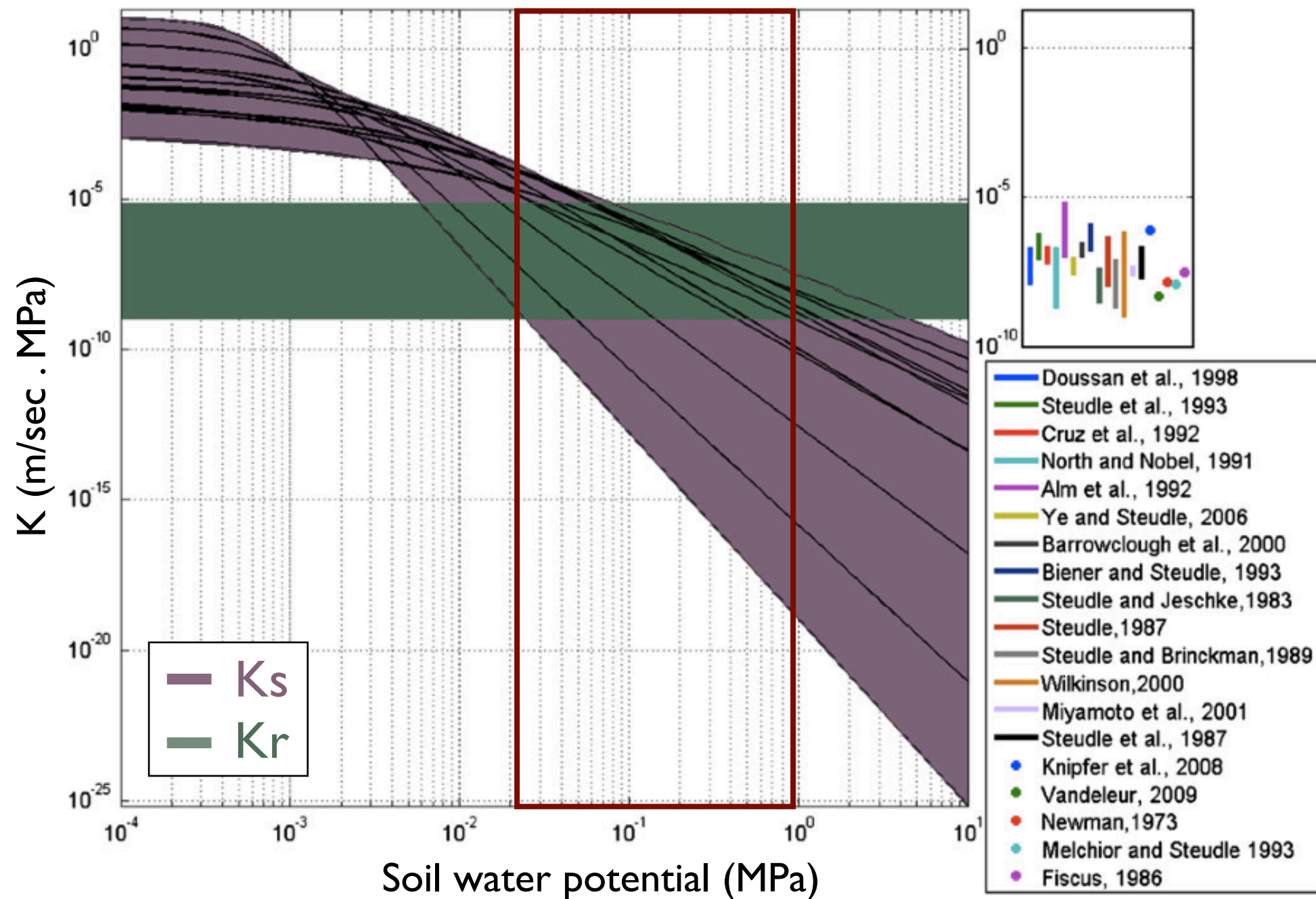


Root image from Kutschera et al., 1997

Relative ranges of conductivities

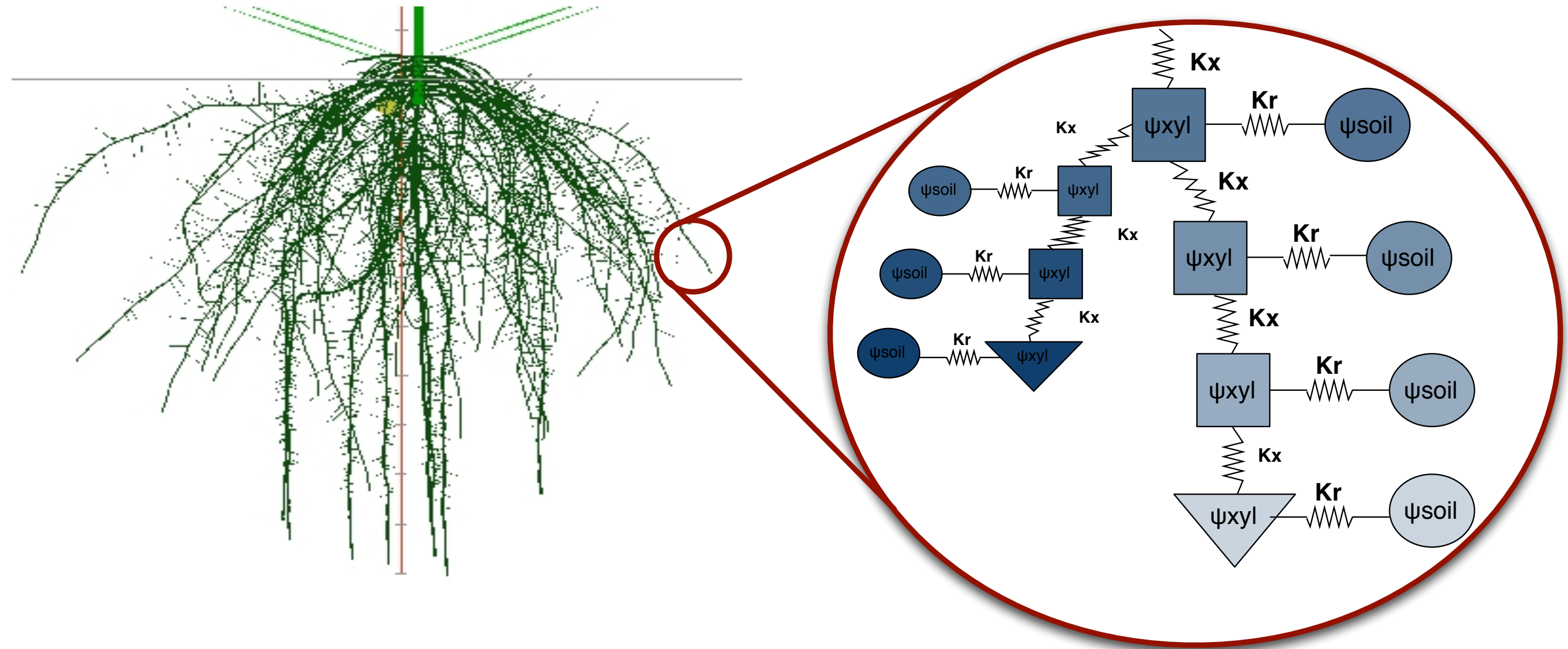


Relative ranges of conductivities



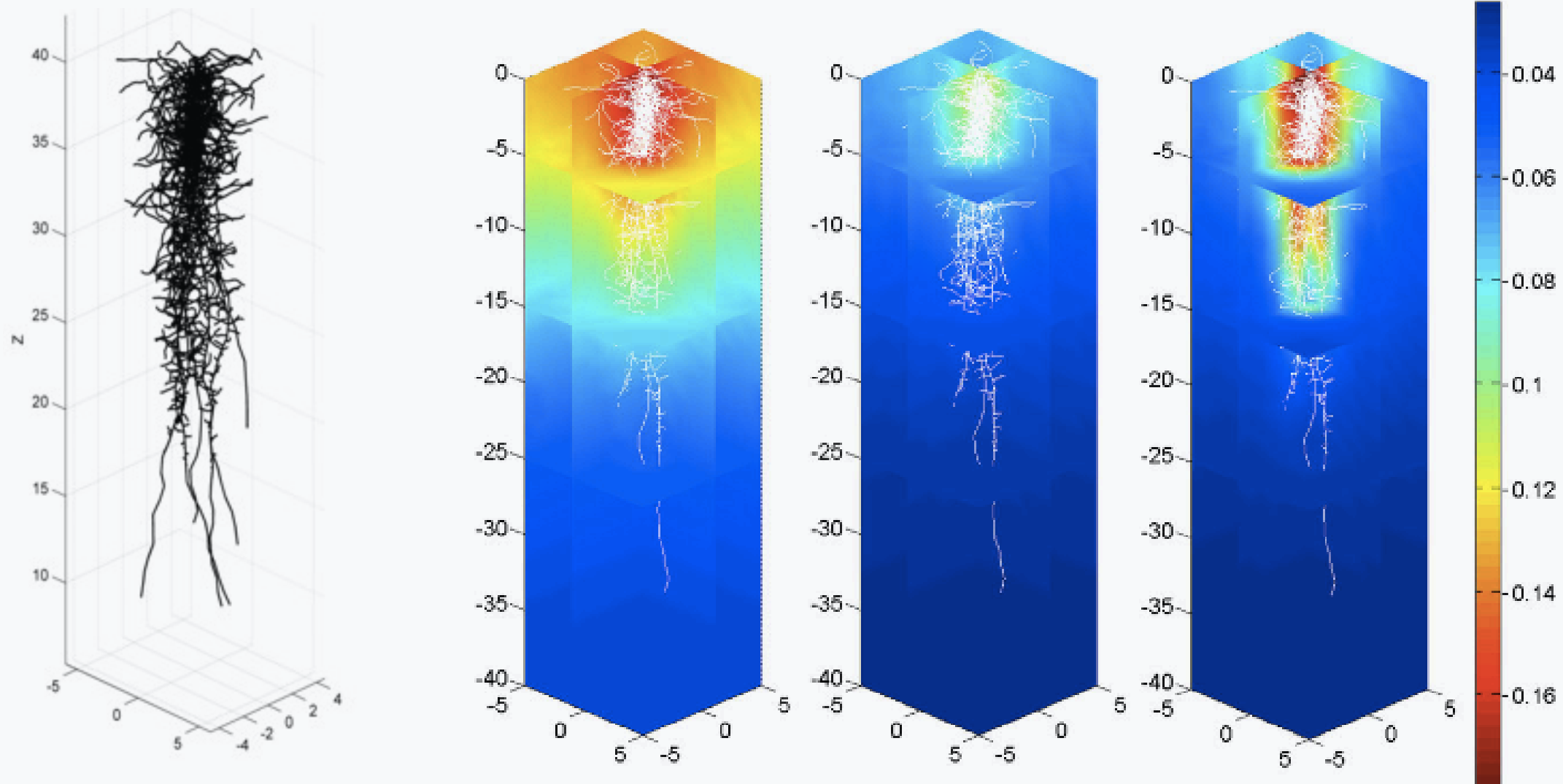
Draye et al. 2010, J Exp Bot 61 (8)

Hydraulics and architecture



Influence of the soil conductivity

Simulation with R-SWMS



Javaux et al. 2008, Vadoze Zone J 7

Objectives

Can we extend these concepts
to study the plant behaviour ?

Conceptual
framework



Real
situation

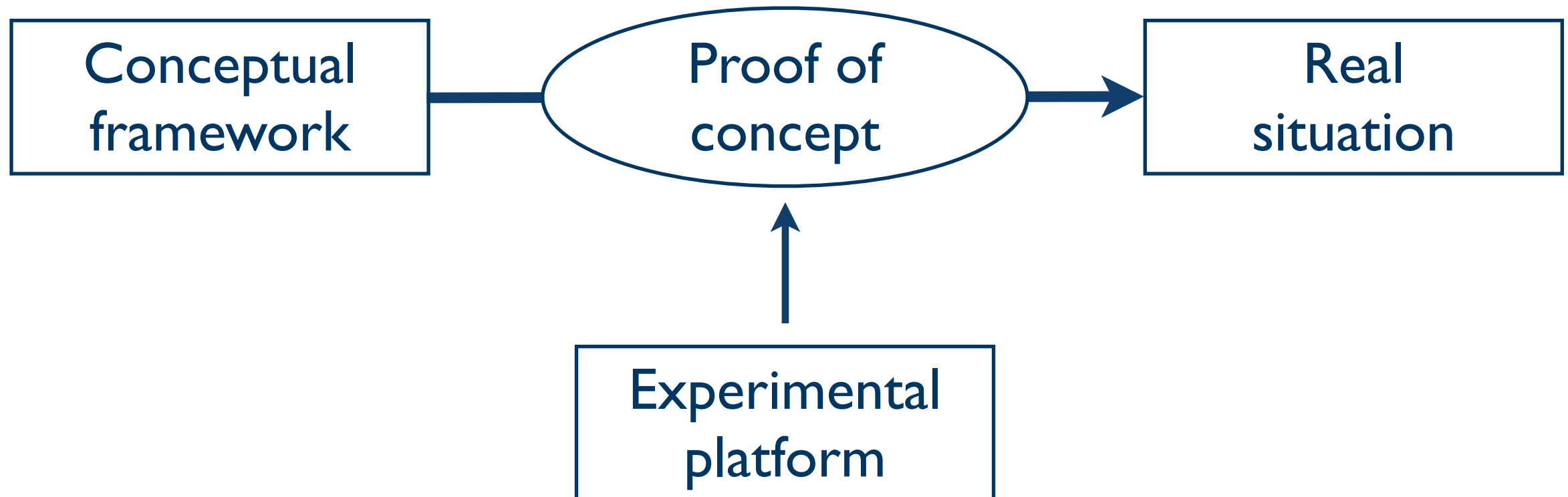
Objectives

Can we extend these concepts to study the plant behaviour ?



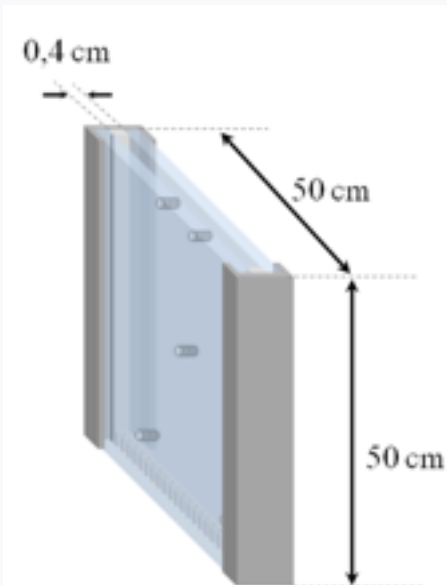
Objectives

Can we extend these concepts to study the plant behaviour ?



Experimental platform

Zea mays



Rhizotrons

Light Transmission

Visible light



Rhizotron



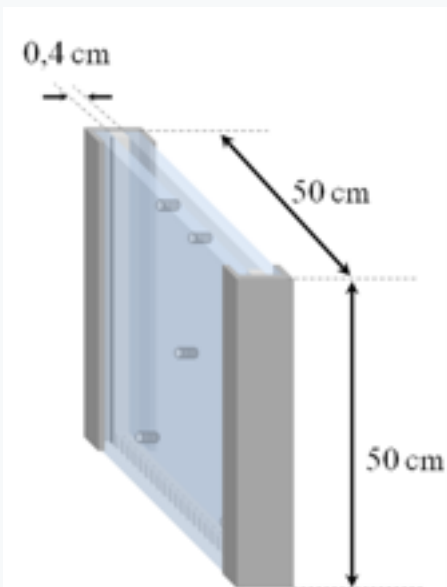
CCD camera

Soil θ



Experimental platform

Zea mays



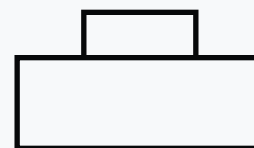
Rhizotrons

Light Transmission

Visible light



Rhizotron



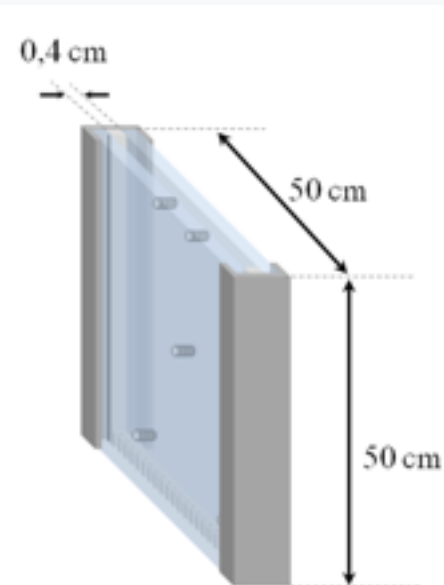
CCD camera

Soil θ



Experimental platform

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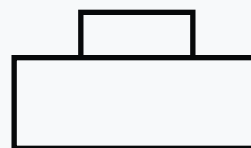
Rhizotrons

Light Transmission

Visible light

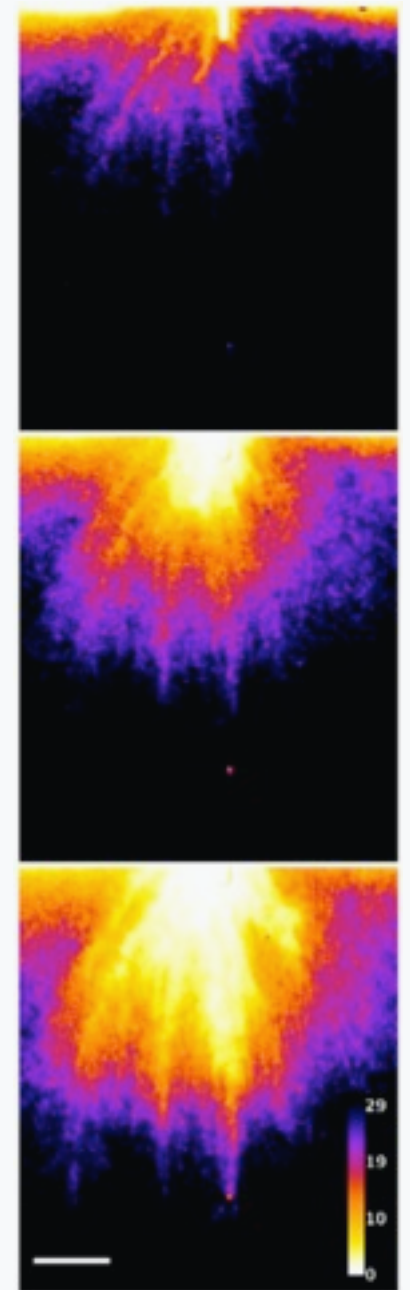


Rhizotron



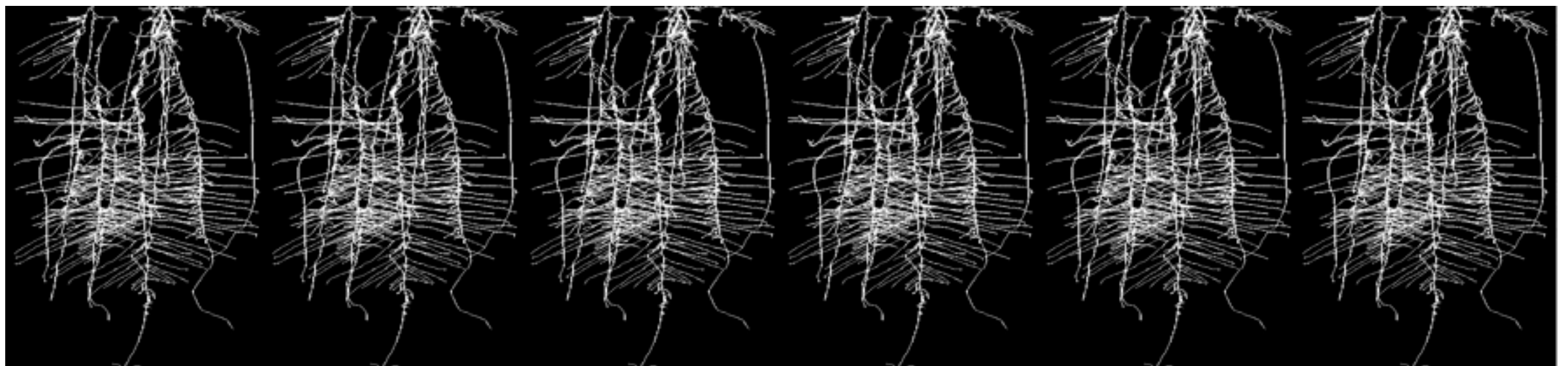
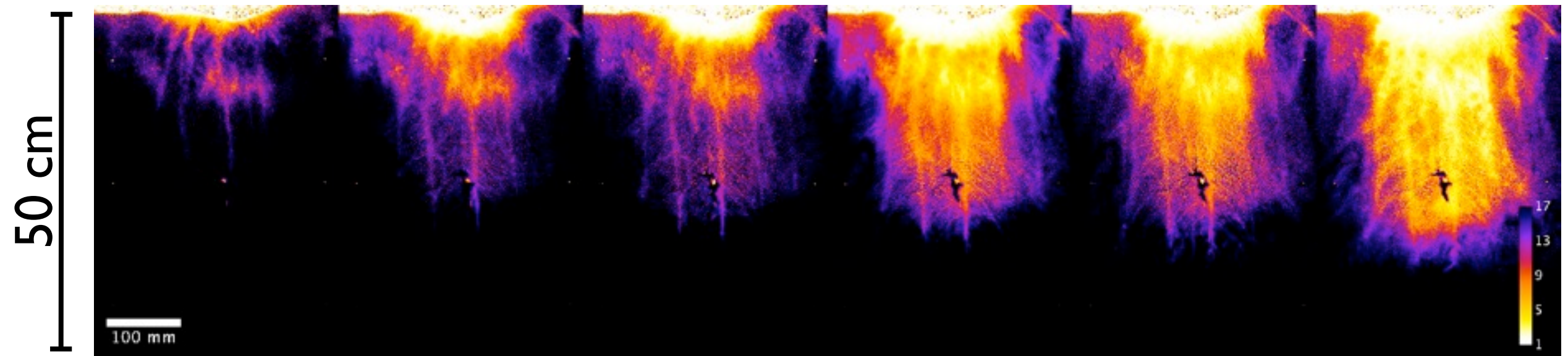
CCD camera

Soil θ



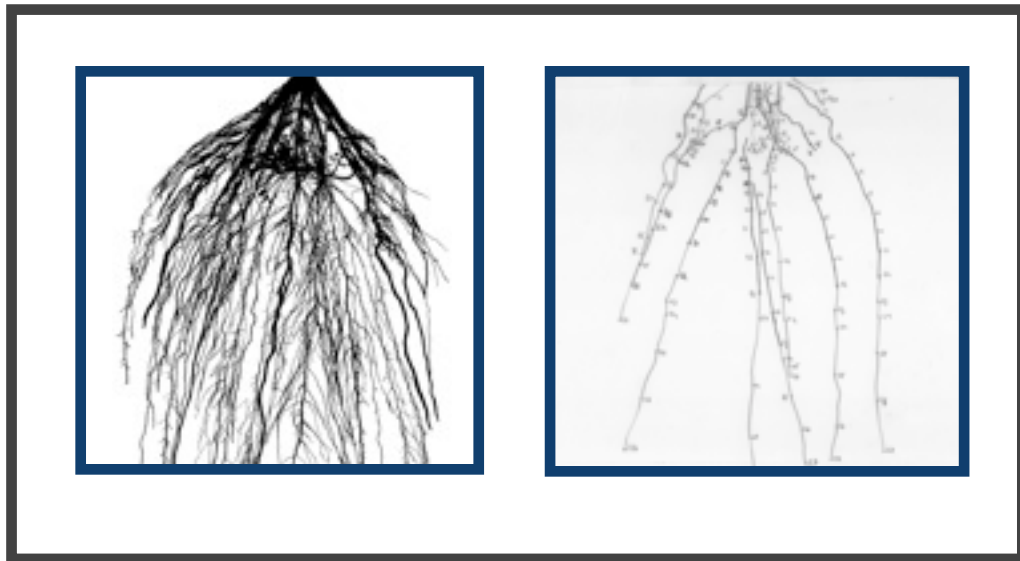
Uptake overview

Water uptake follows a downward dynamics during a water deficit episode

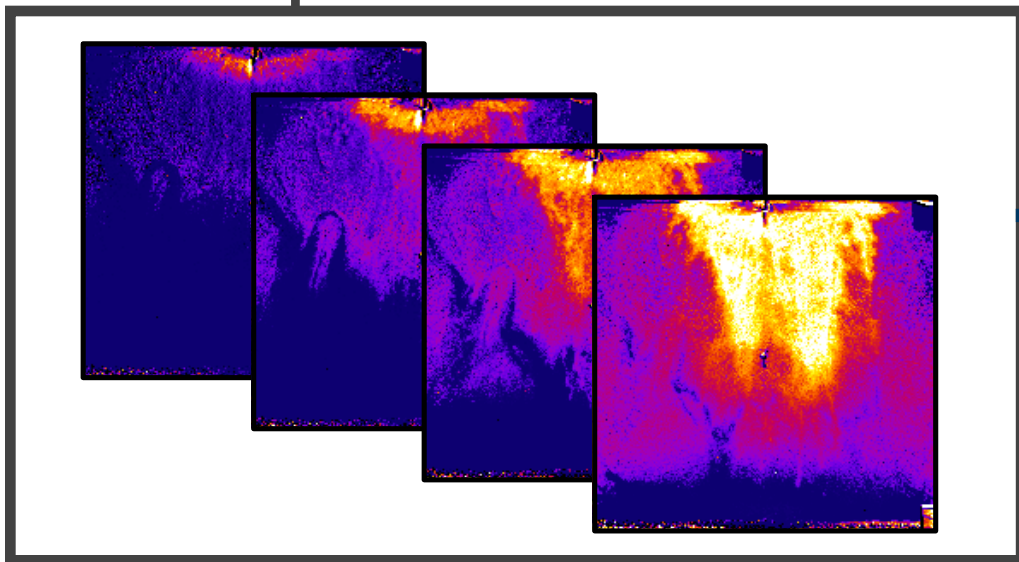


Local uptake analysis

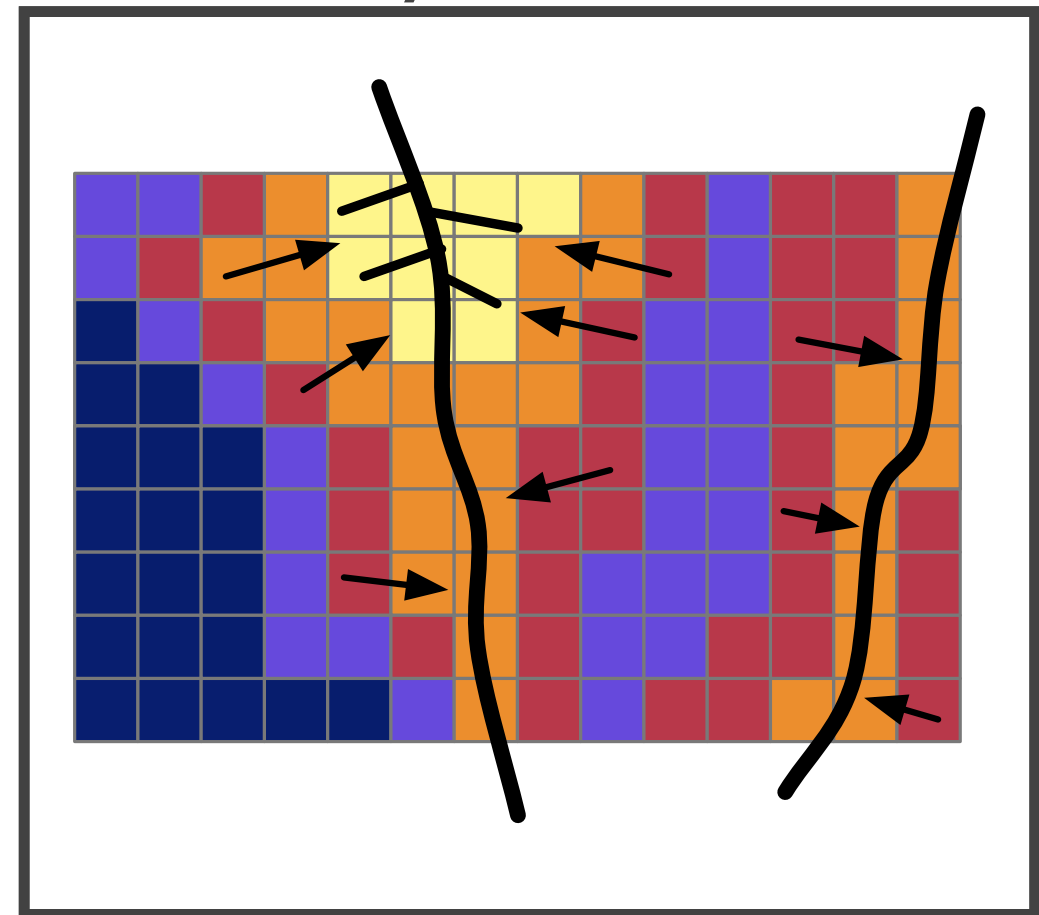
Root data



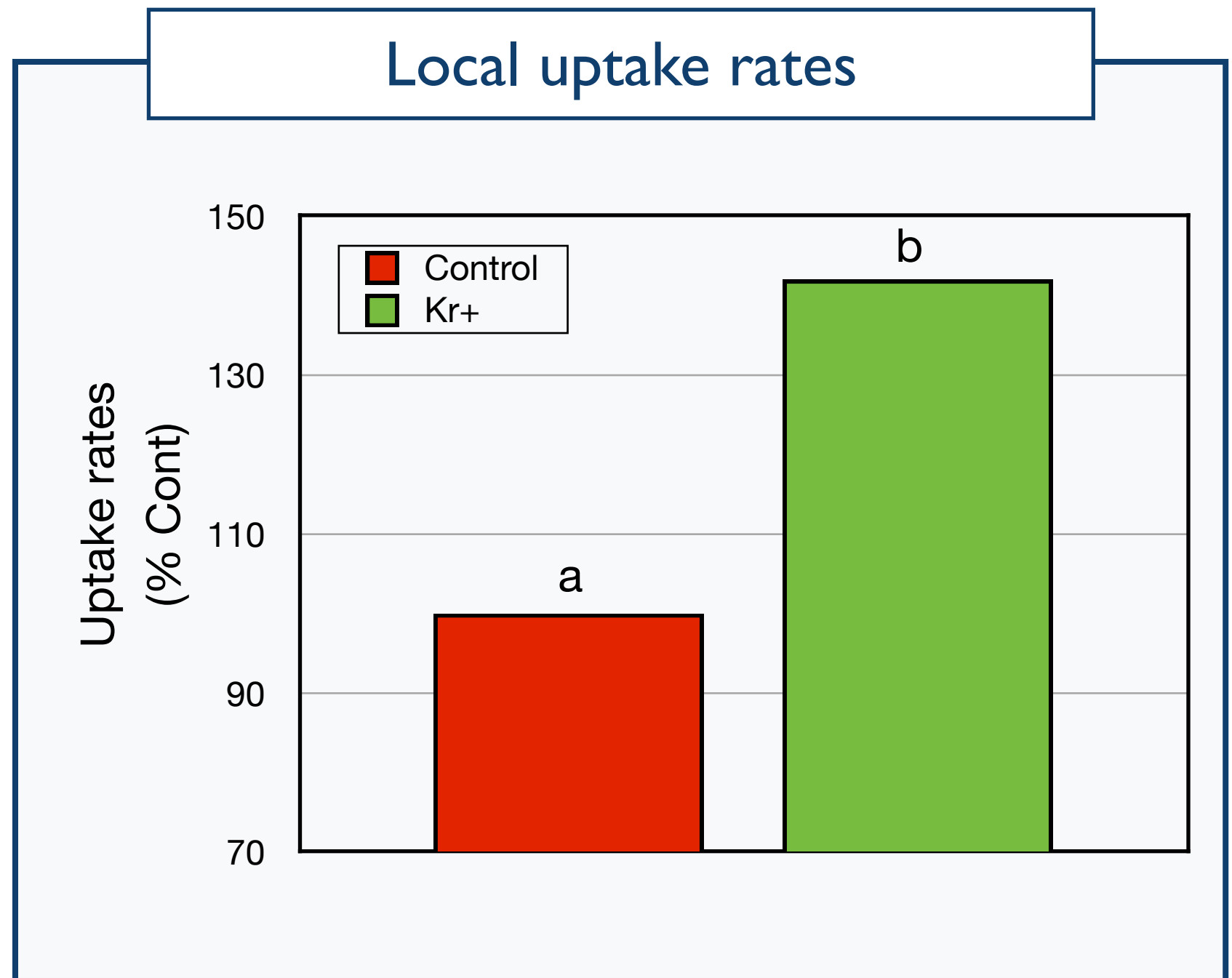
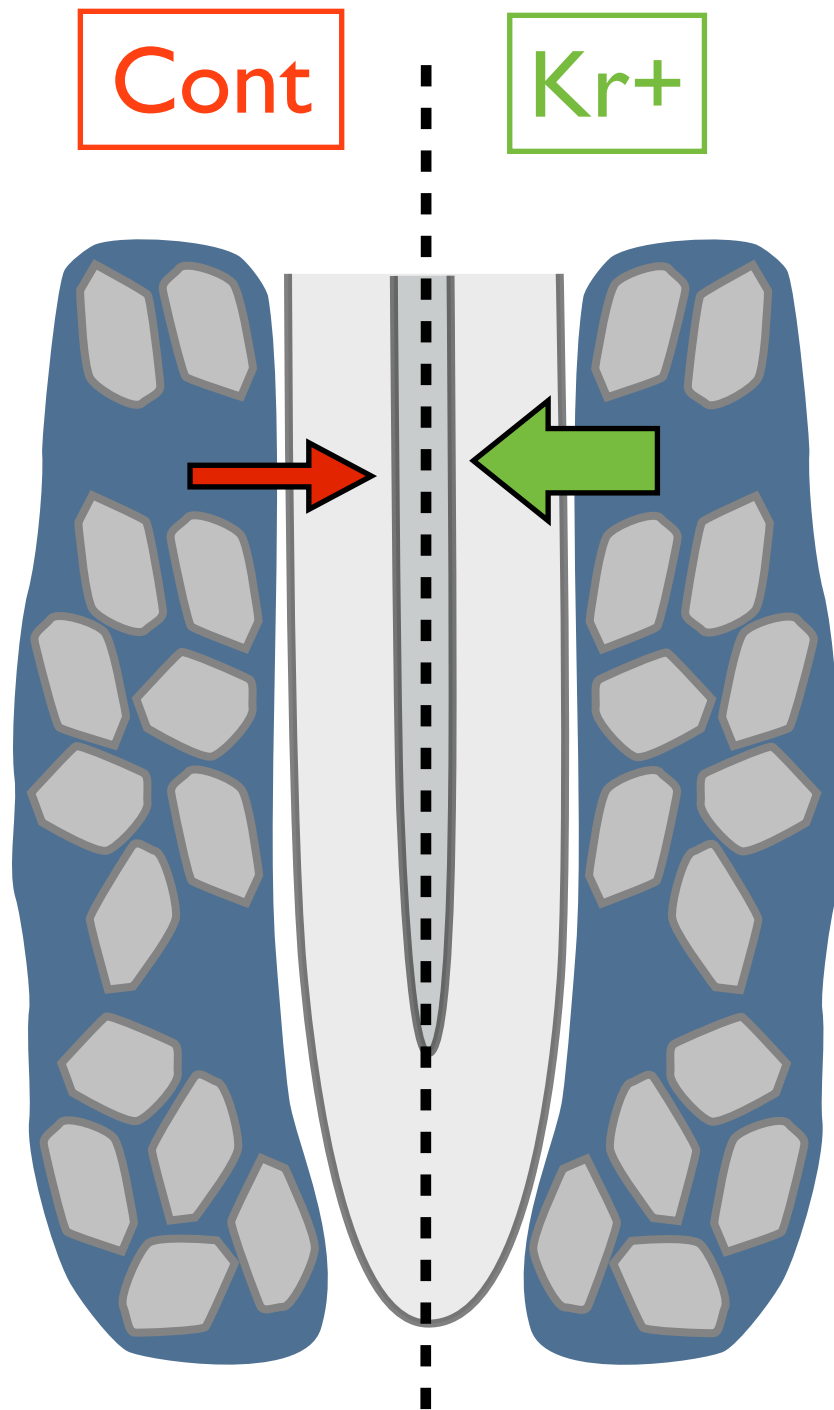
Water potential data



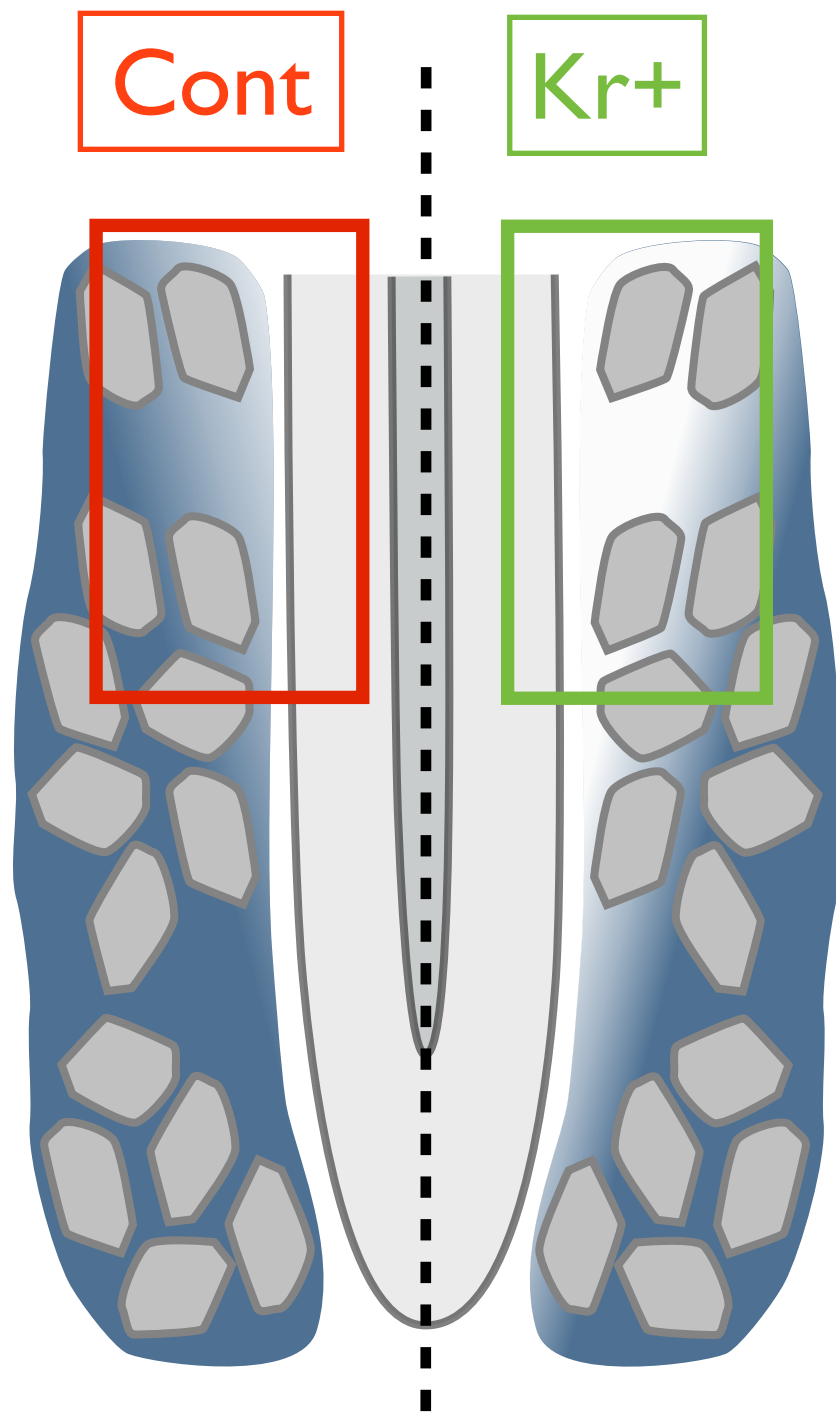
Local analysis



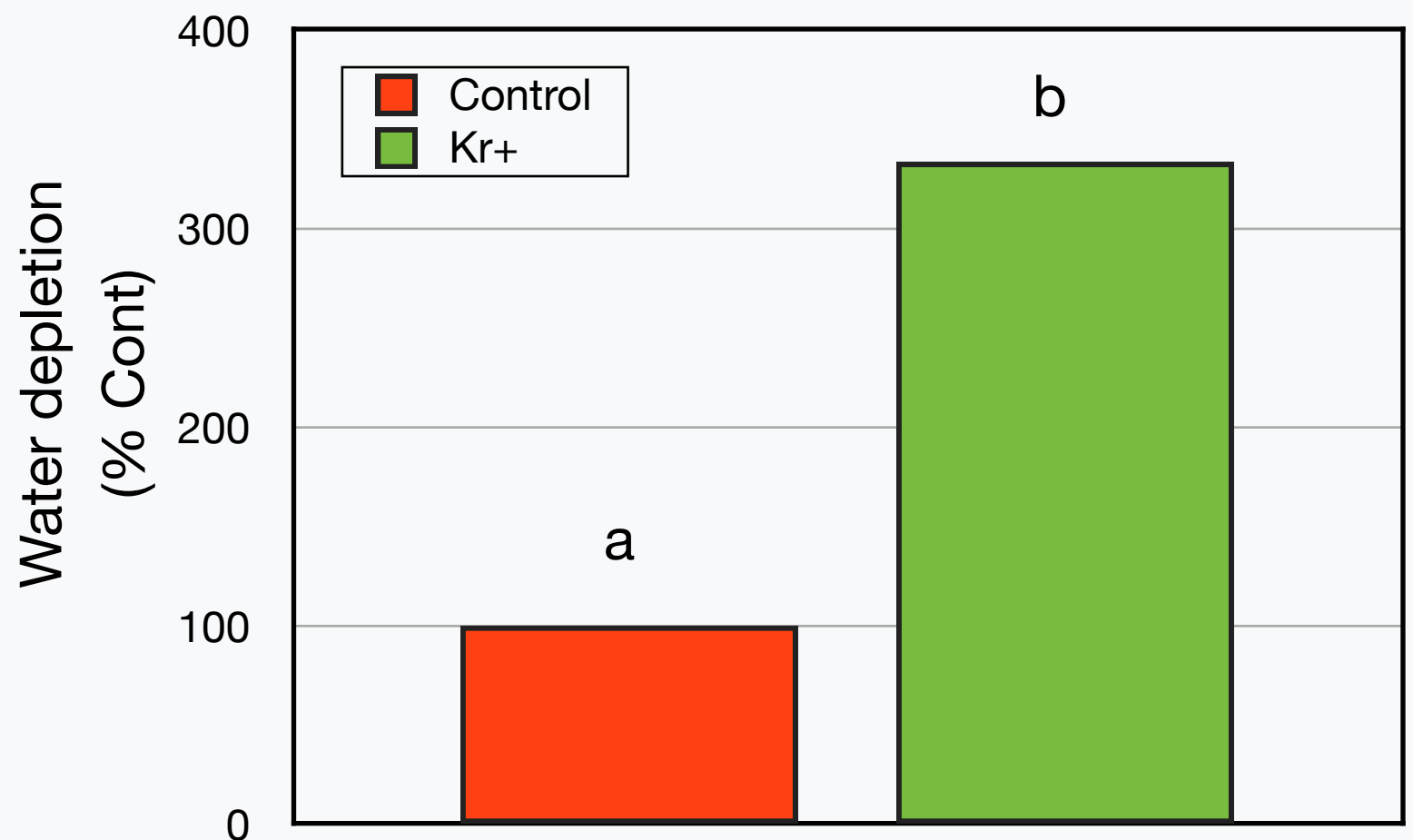
Kr influences local uptake rates



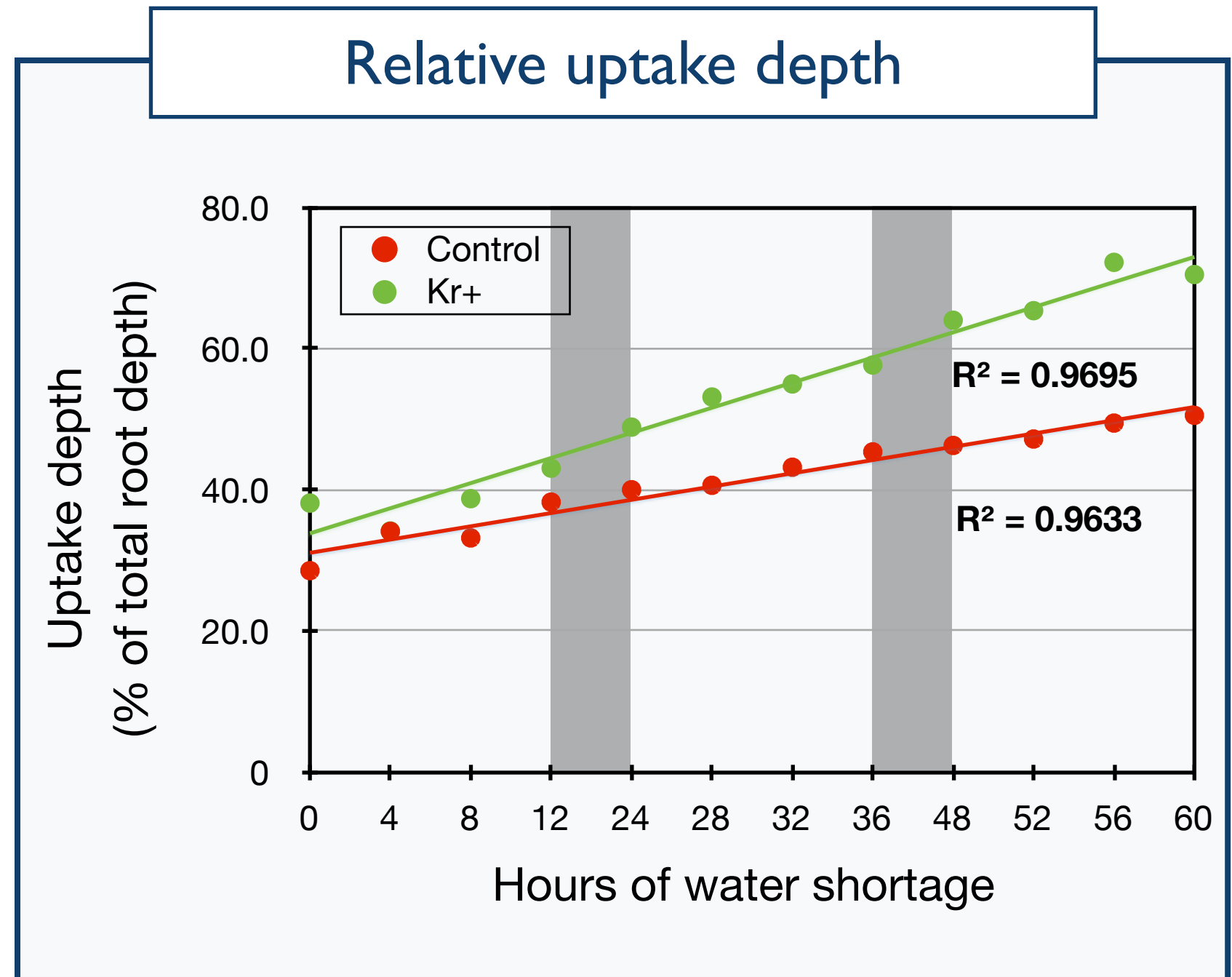
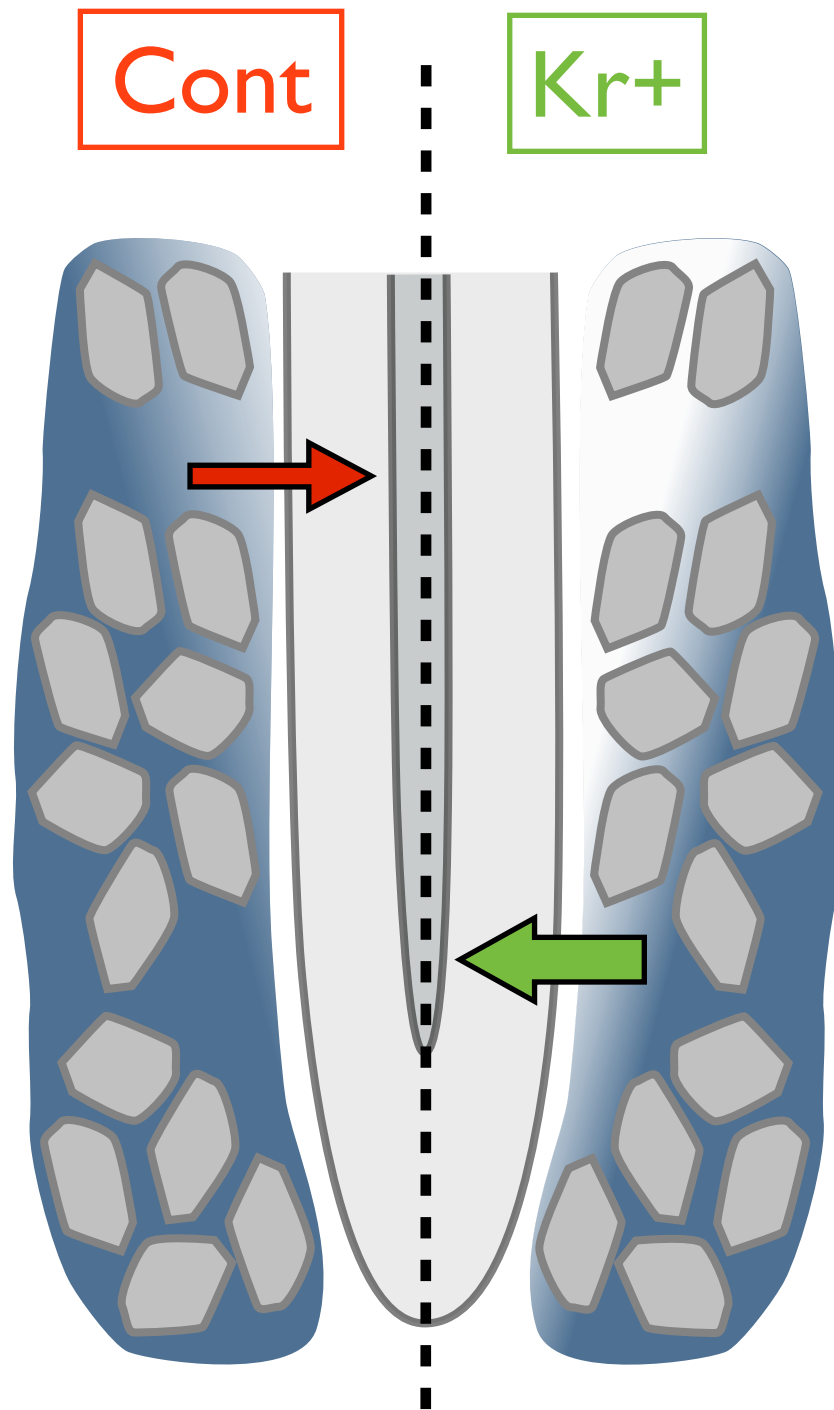
Uptake rate influences water depletion



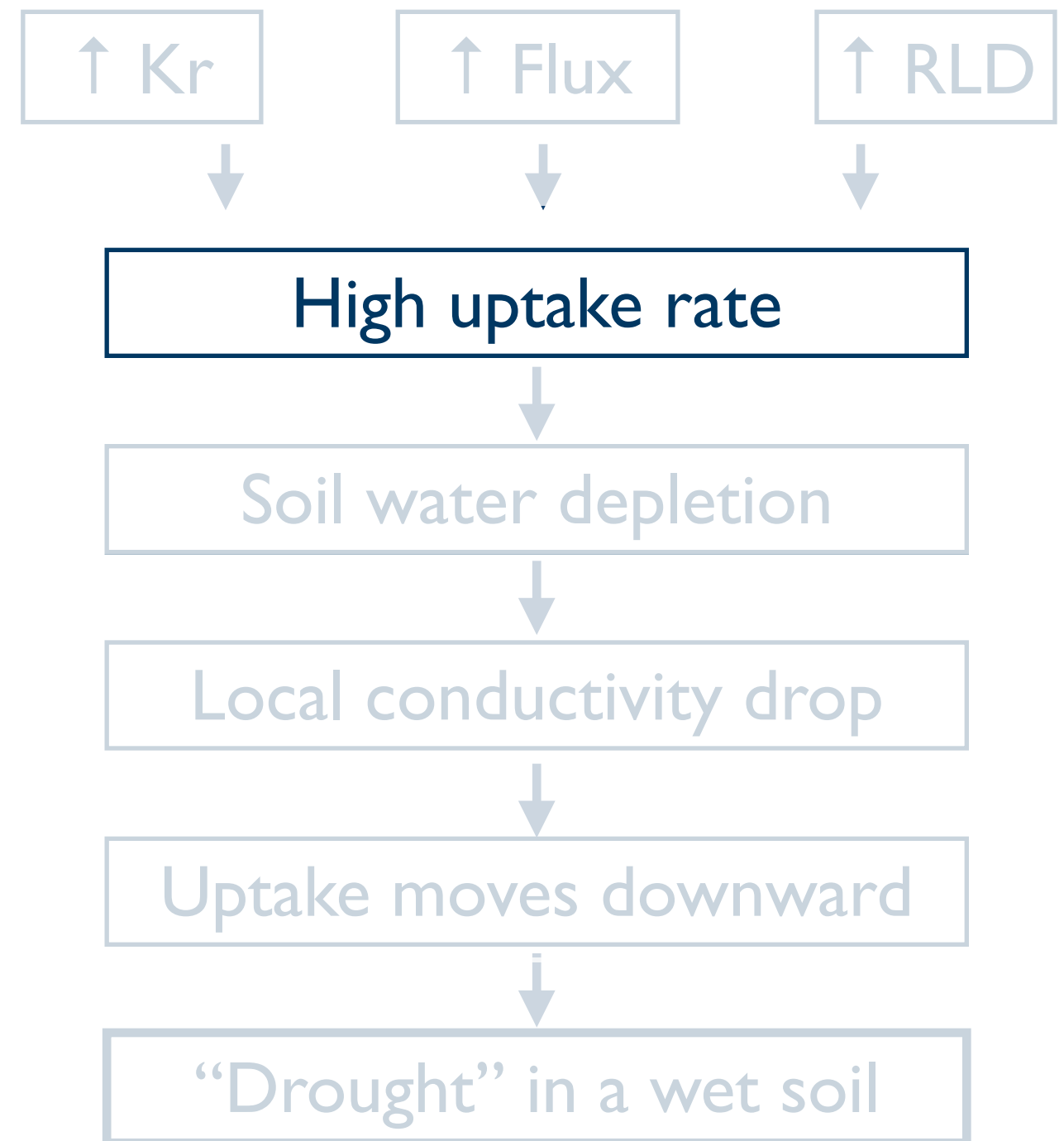
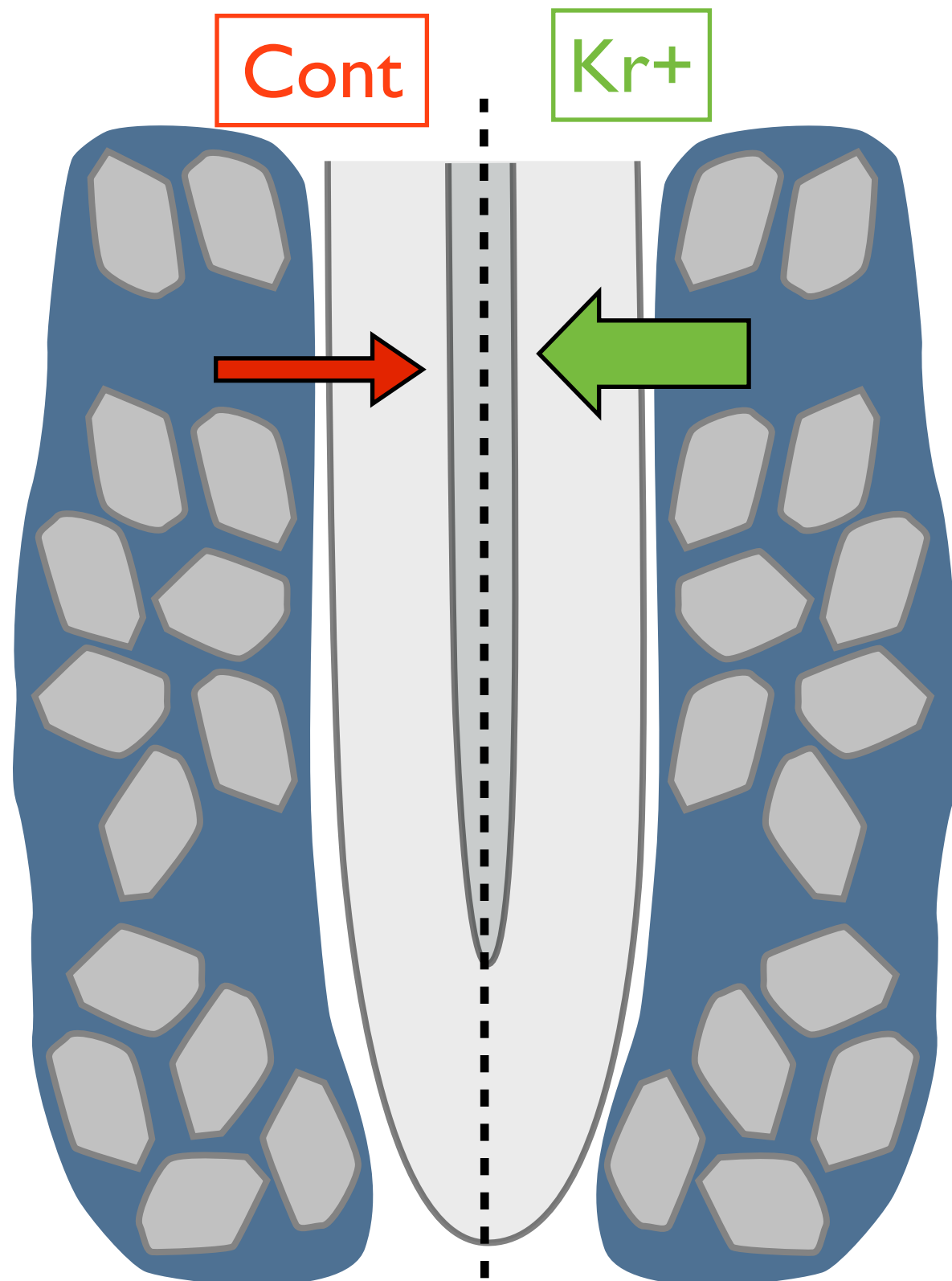
Water depletion around the roots



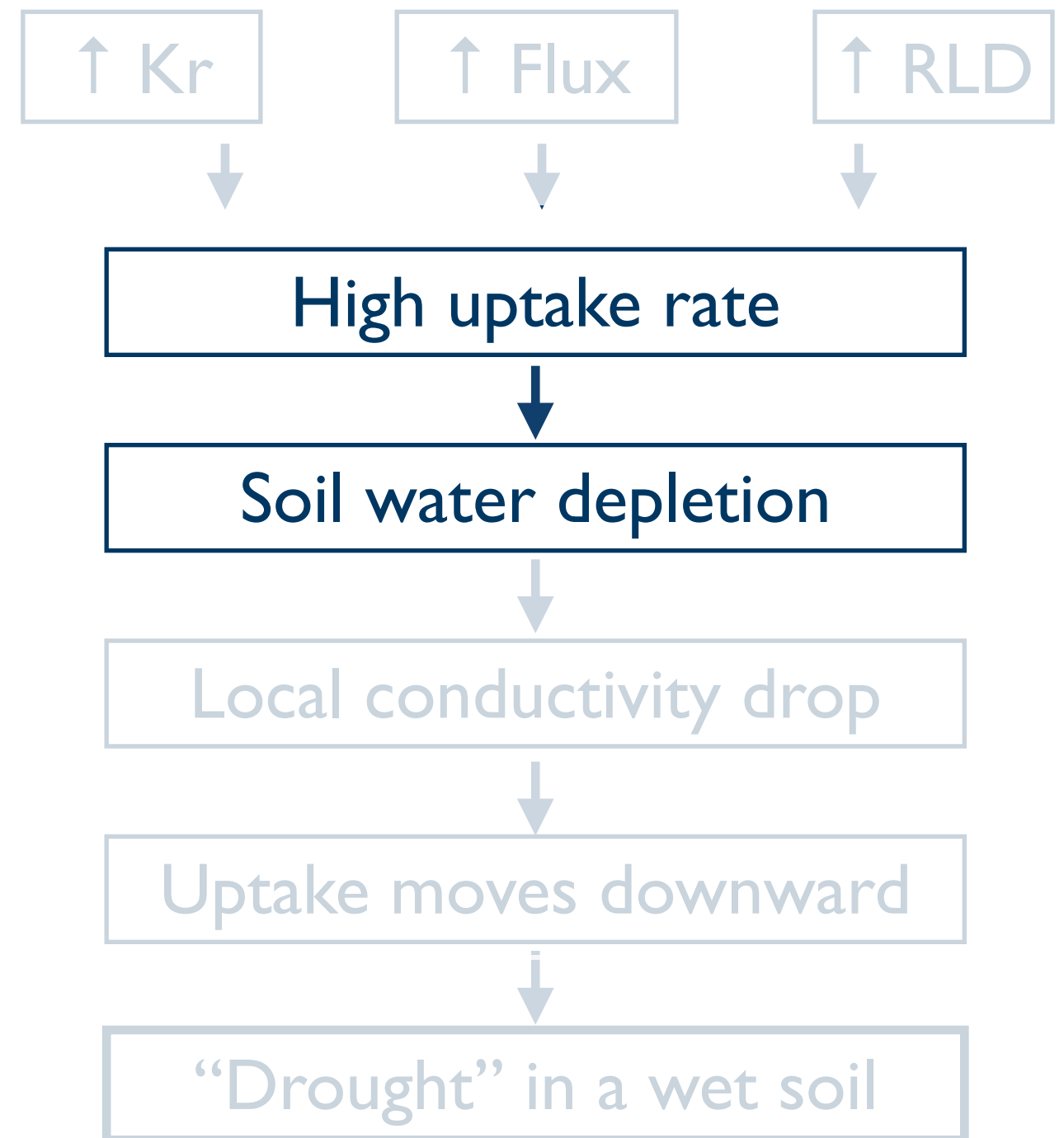
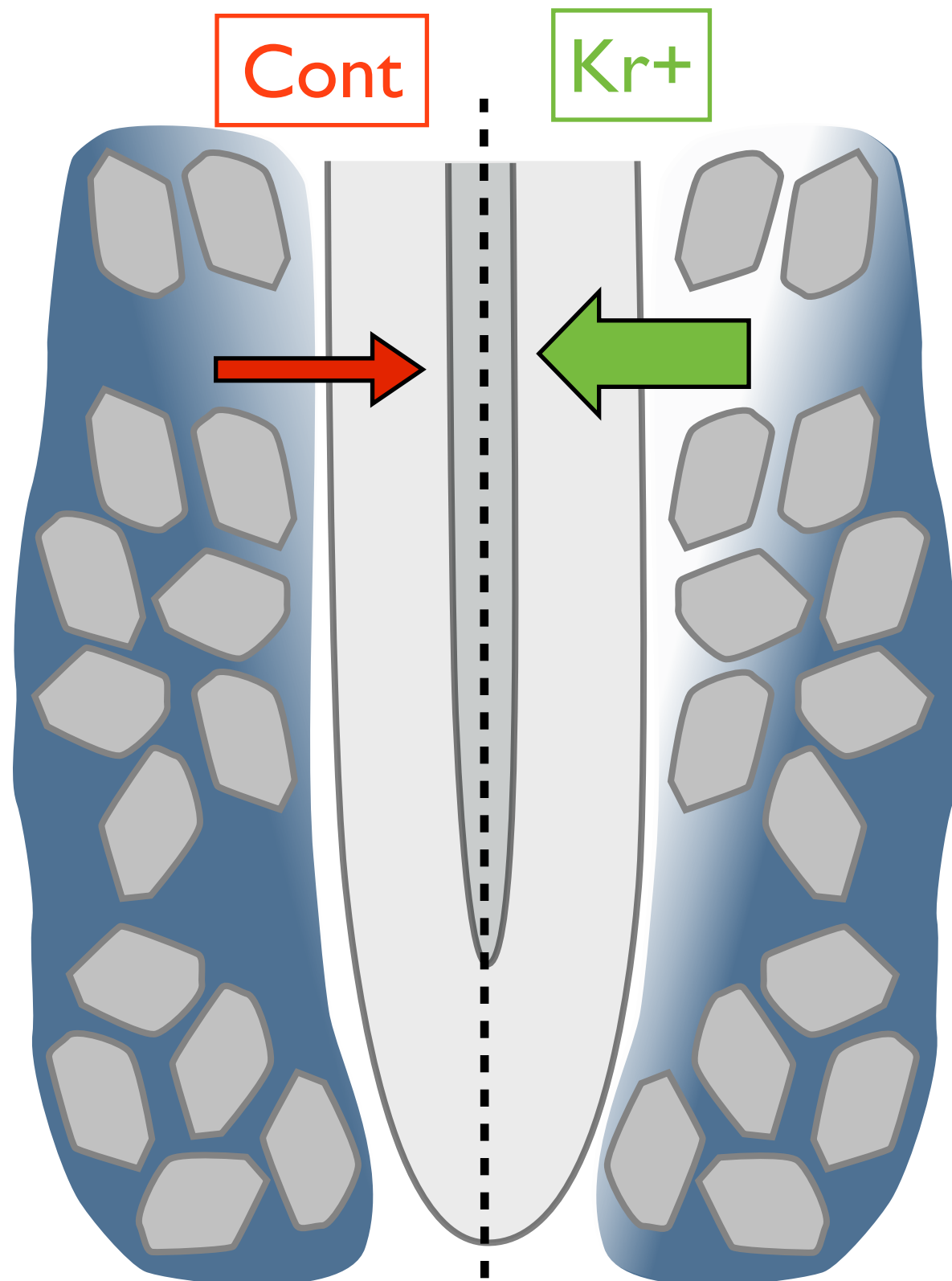
Water depletion influences dynamics



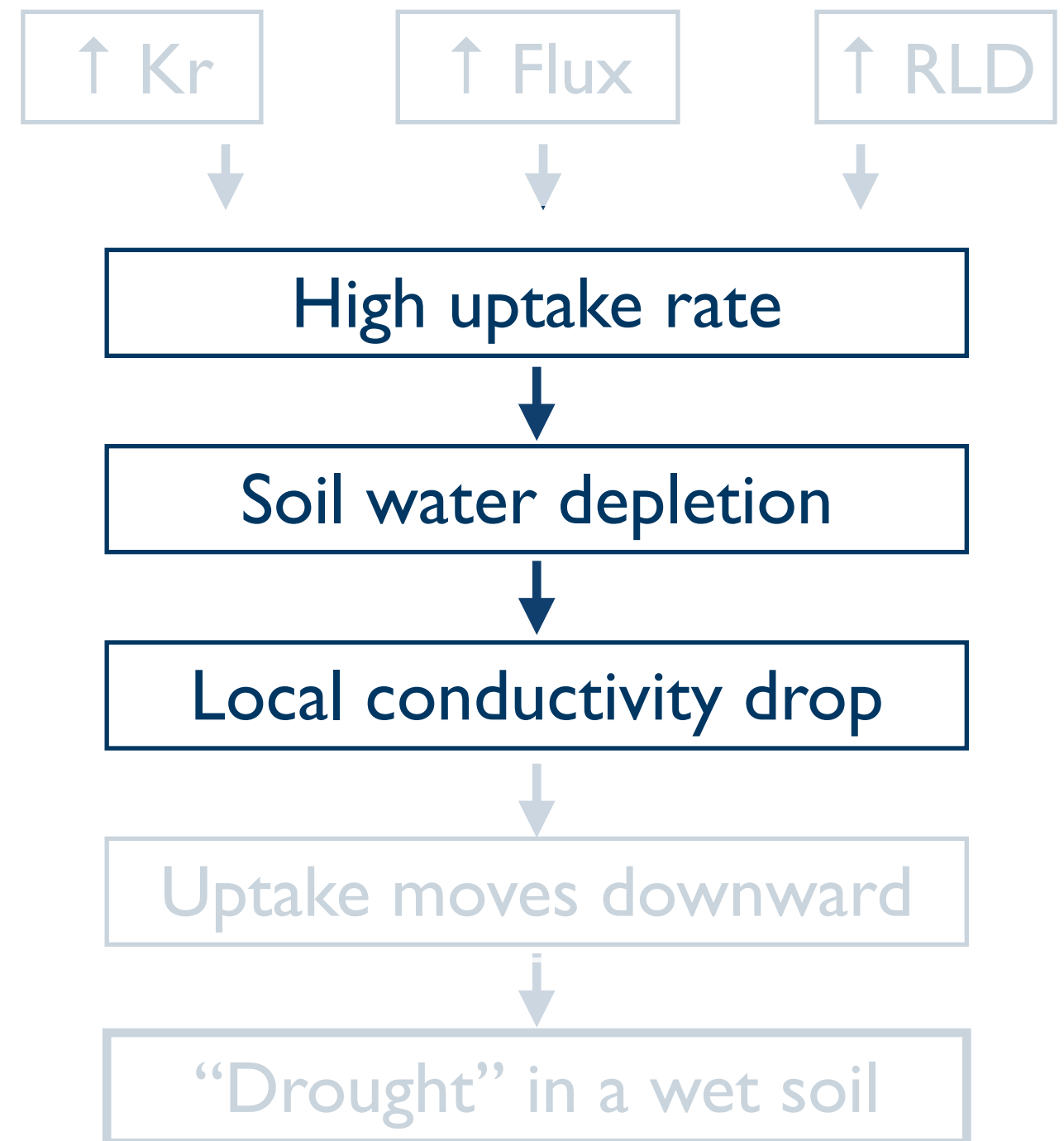
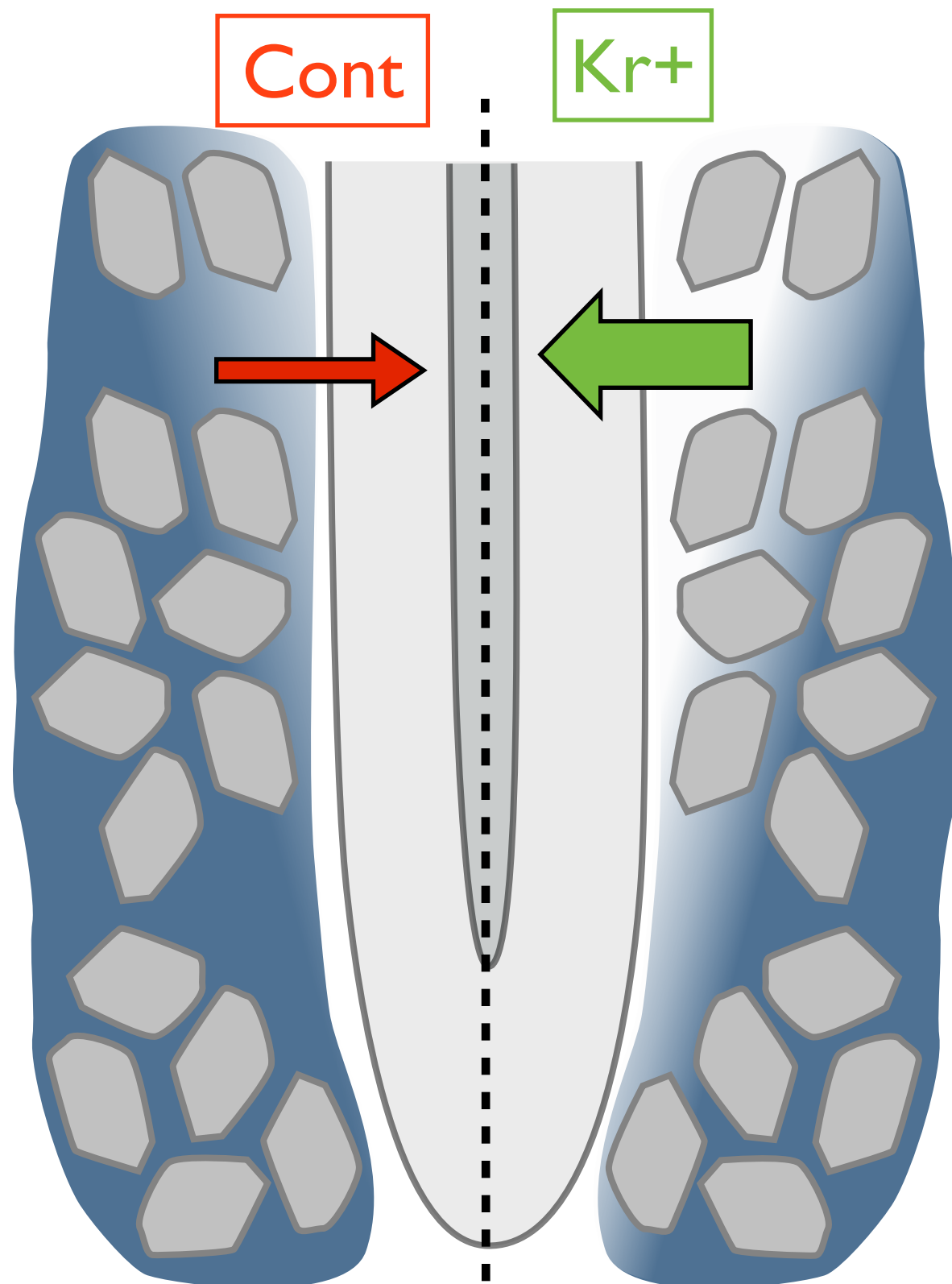
Integration of root and soil parameters



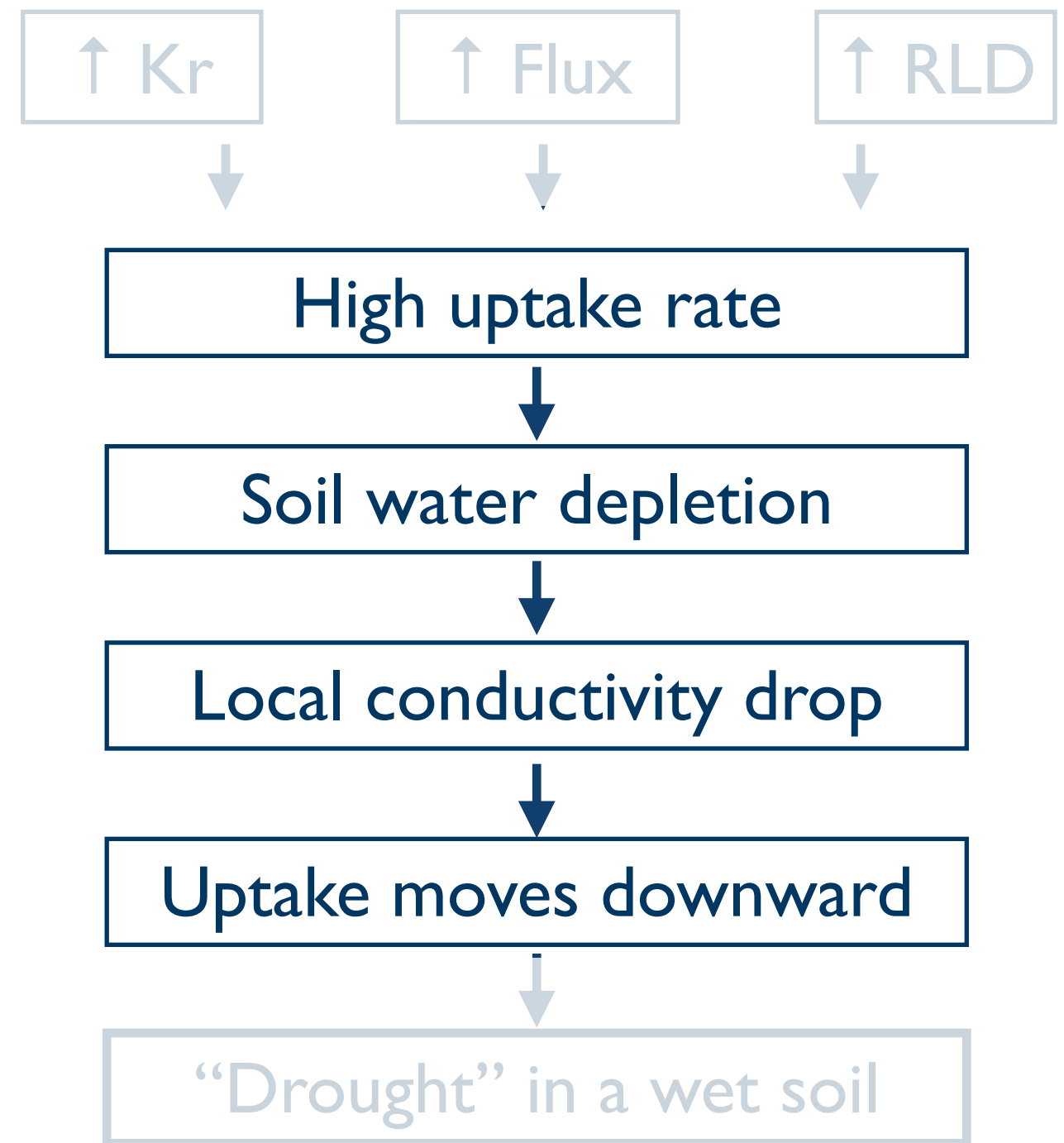
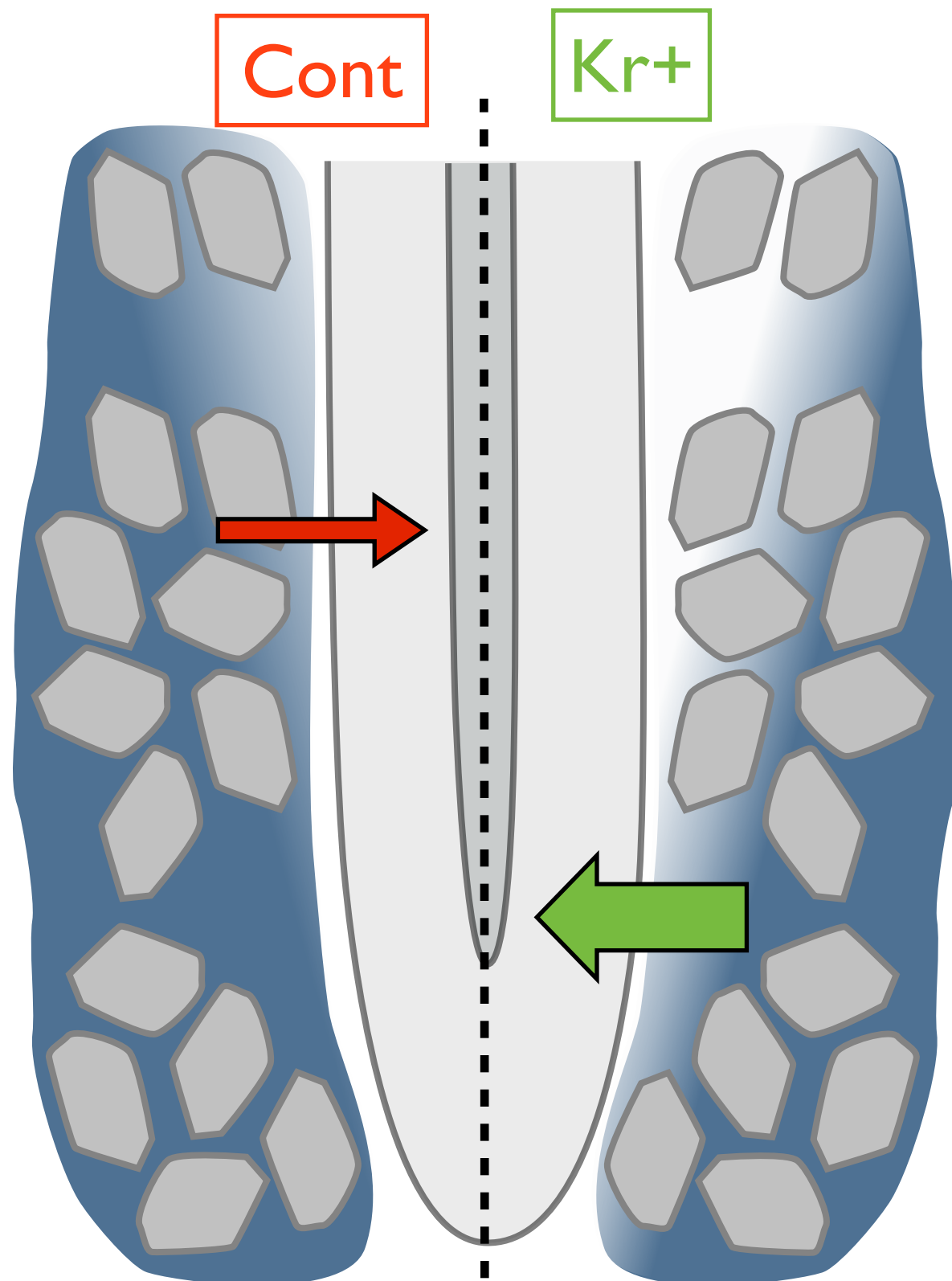
Integration of root and soil parameters



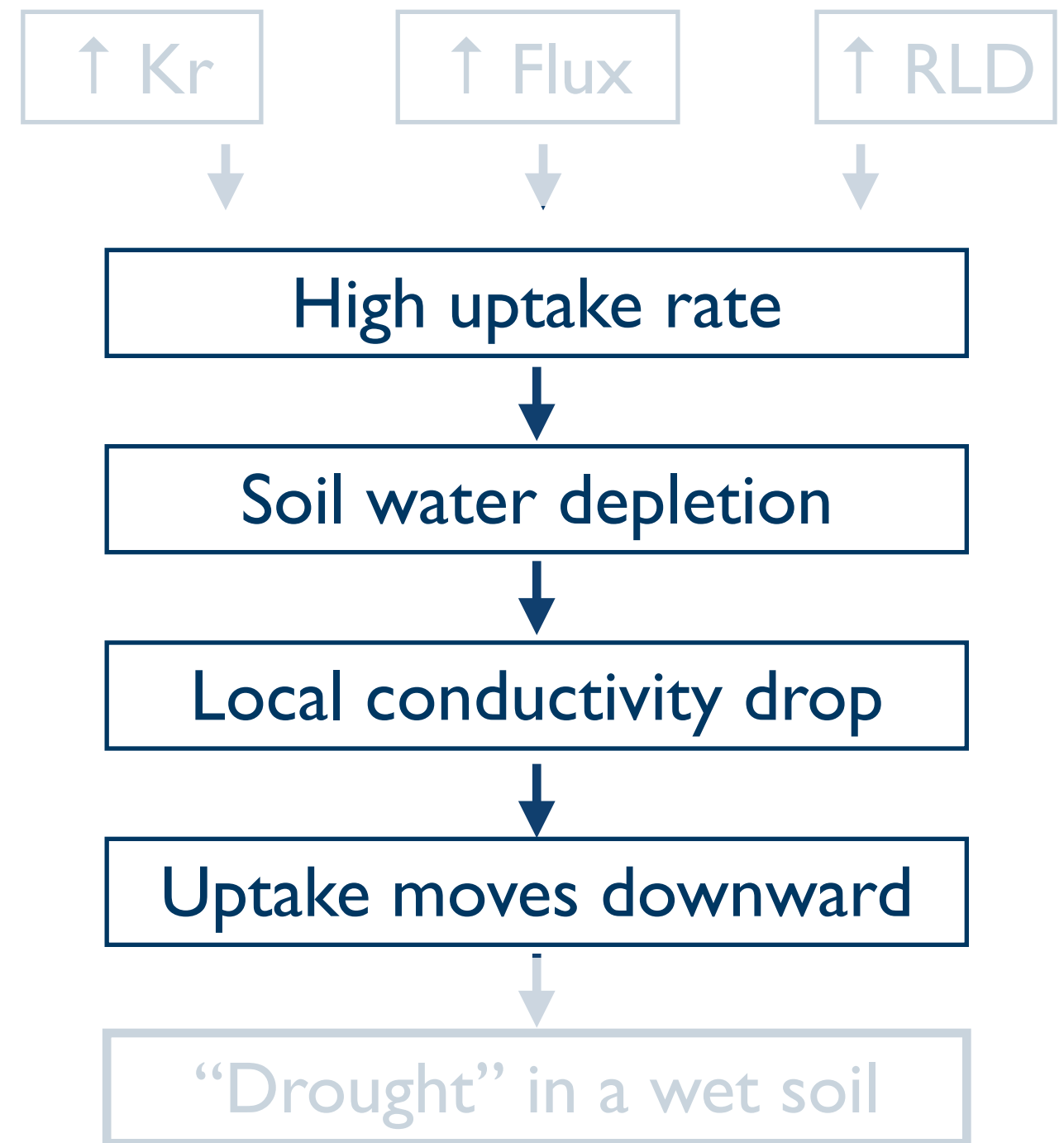
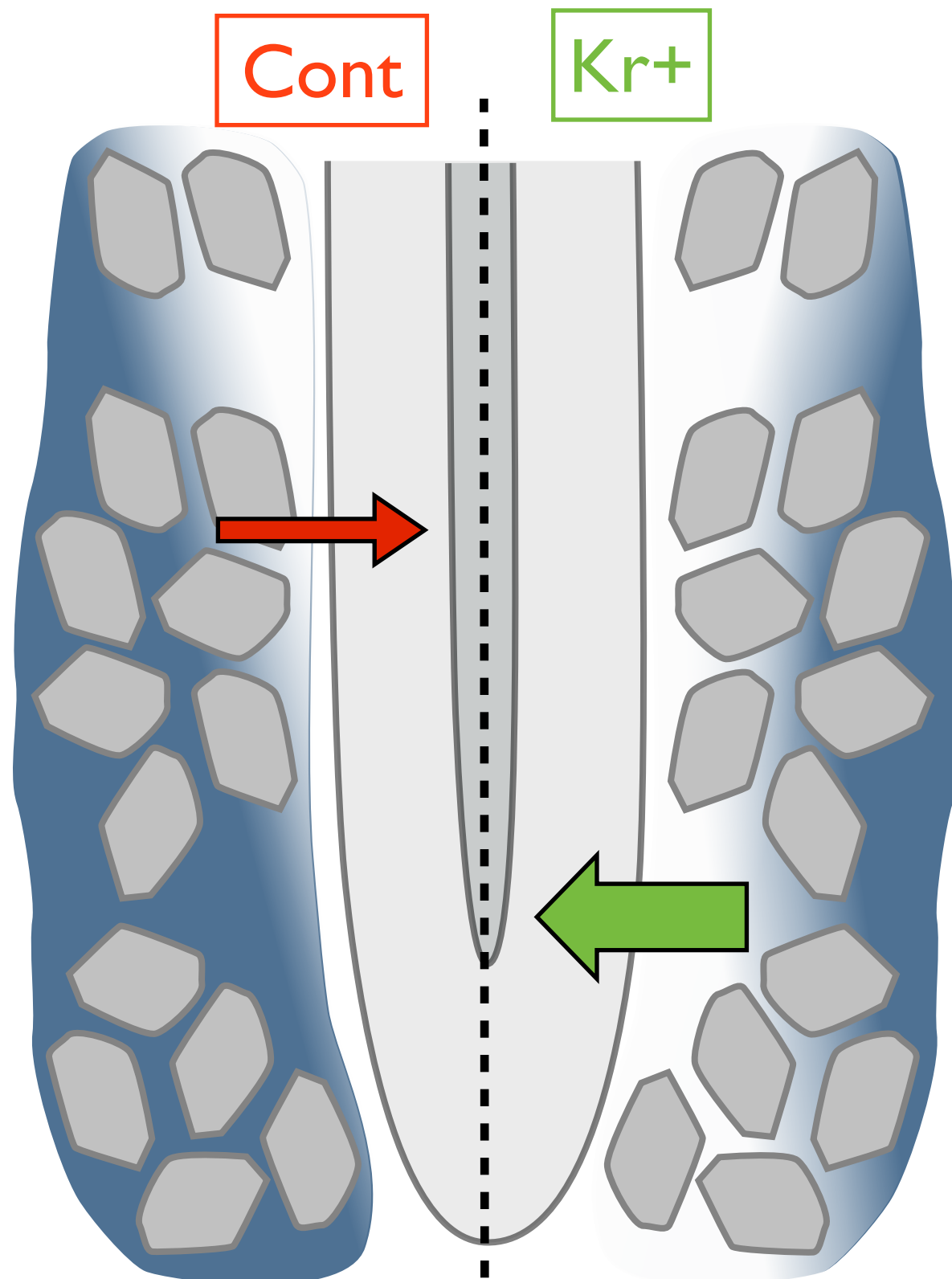
Integration of root and soil parameters



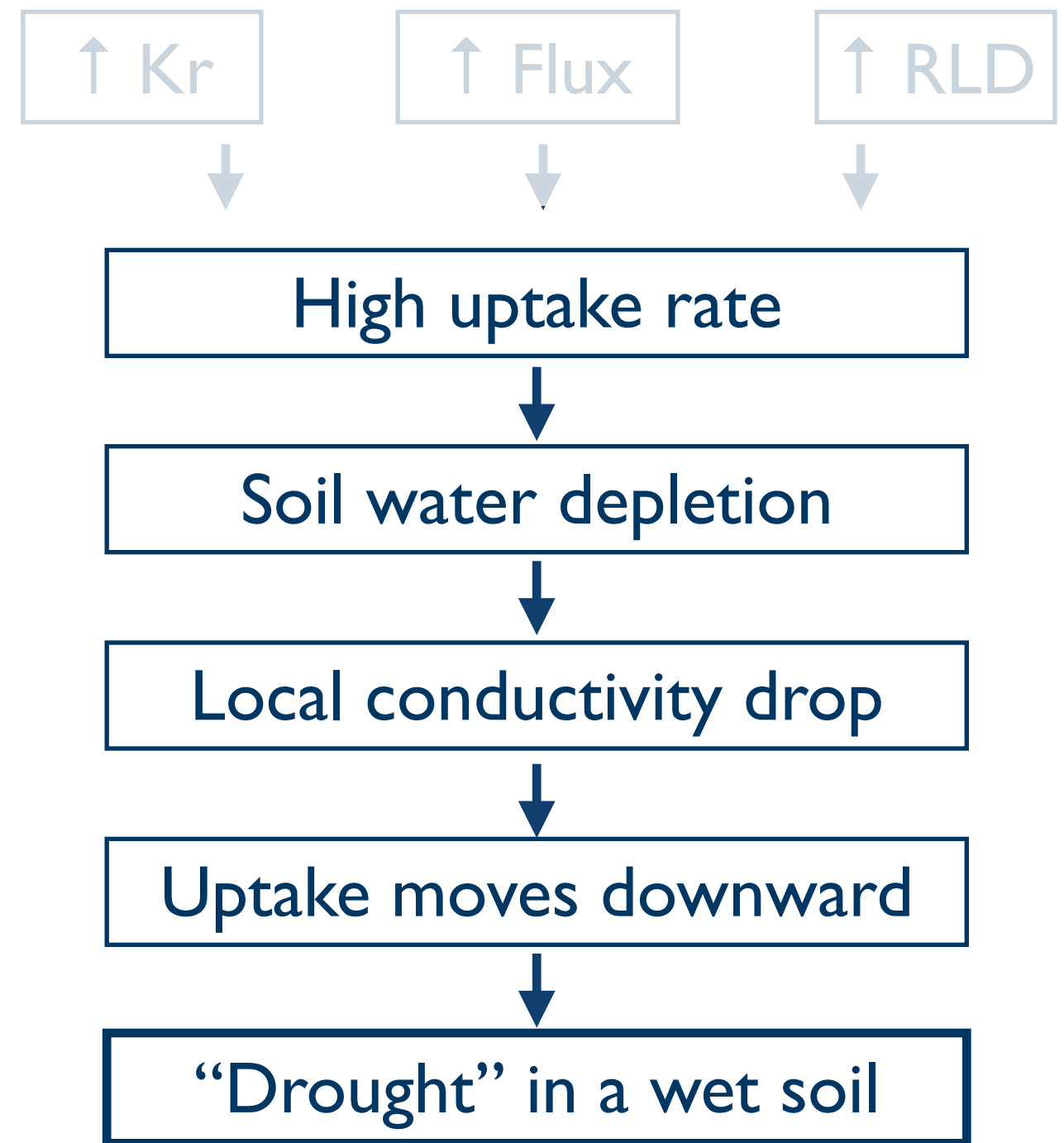
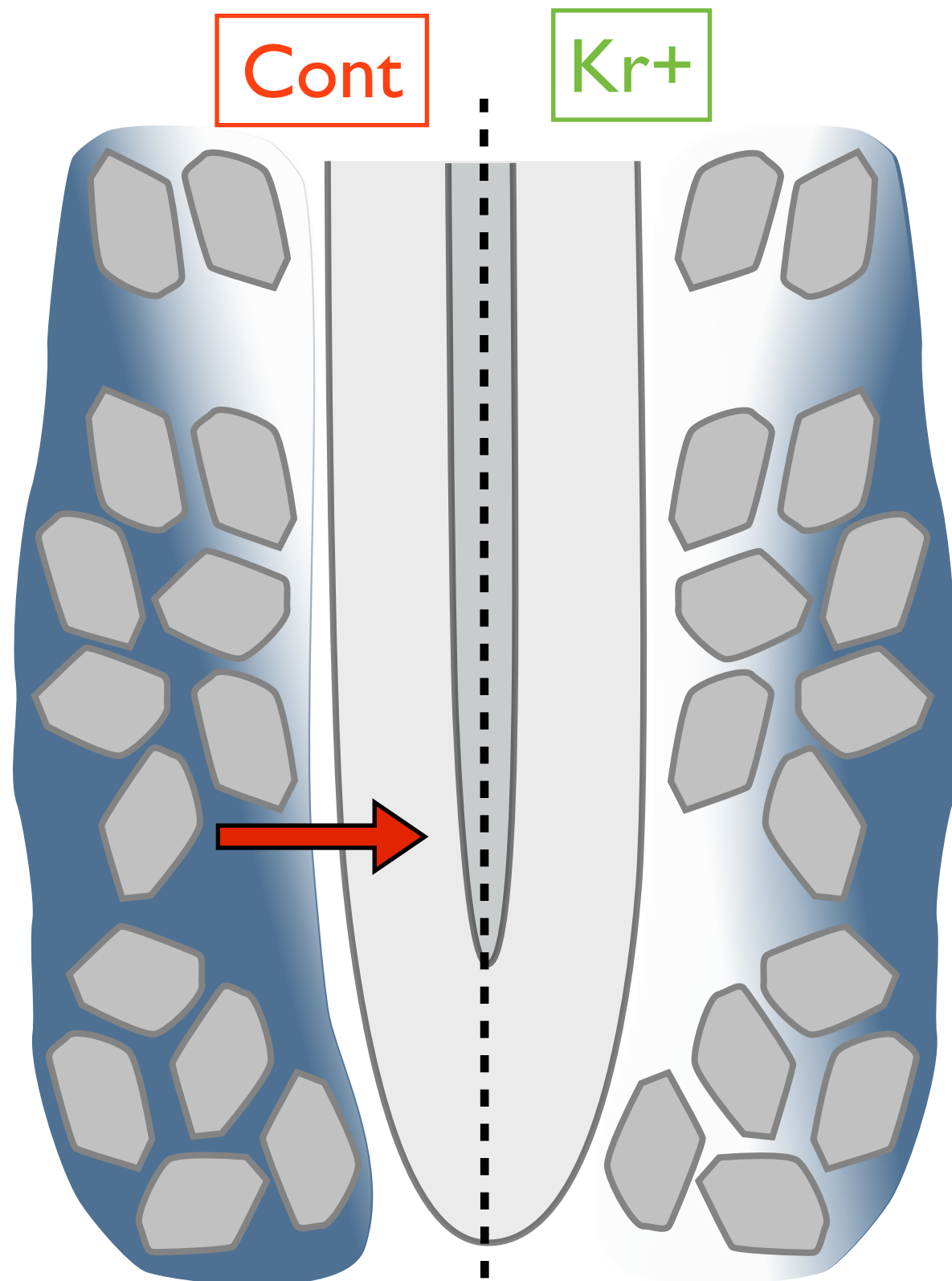
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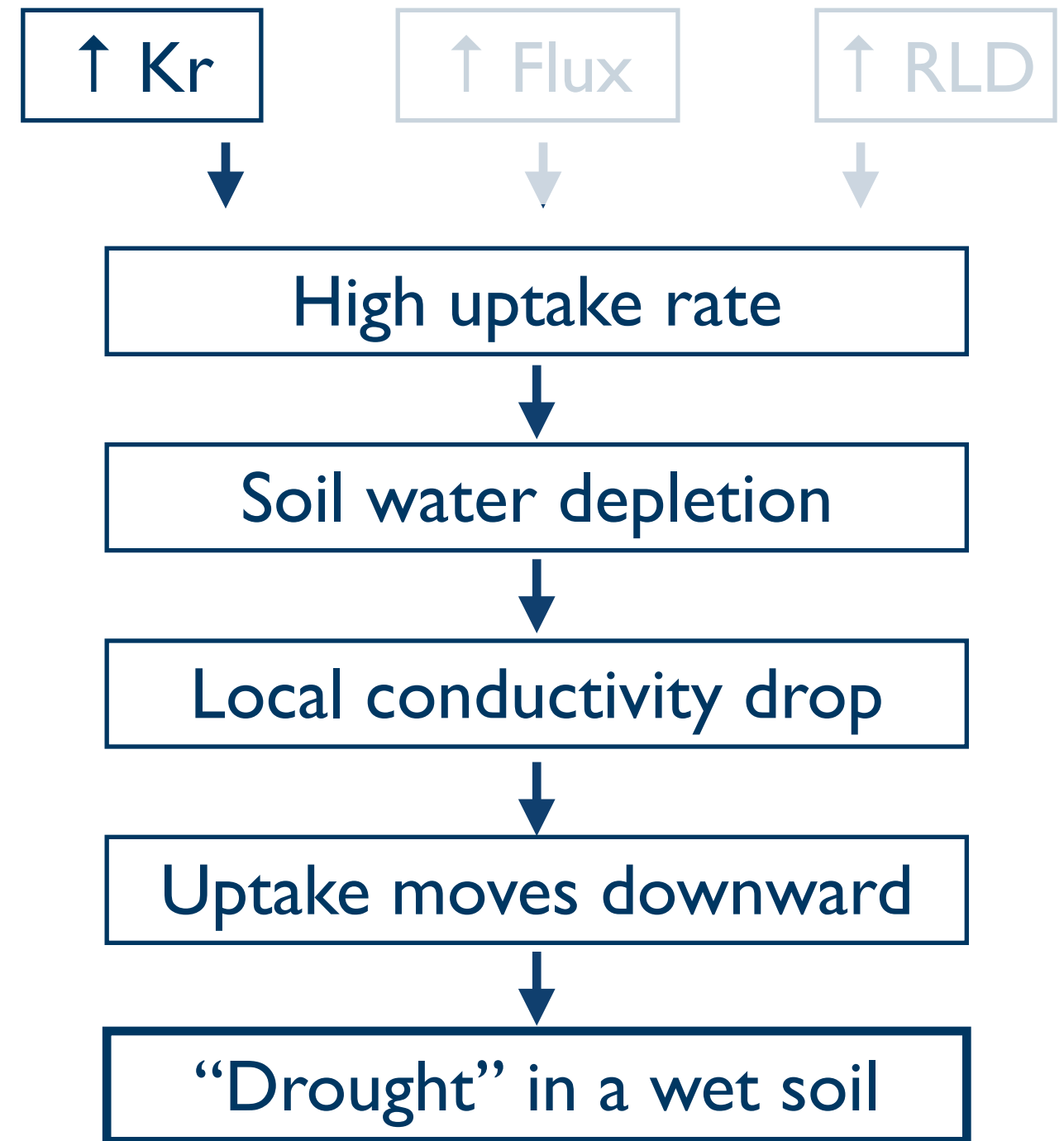
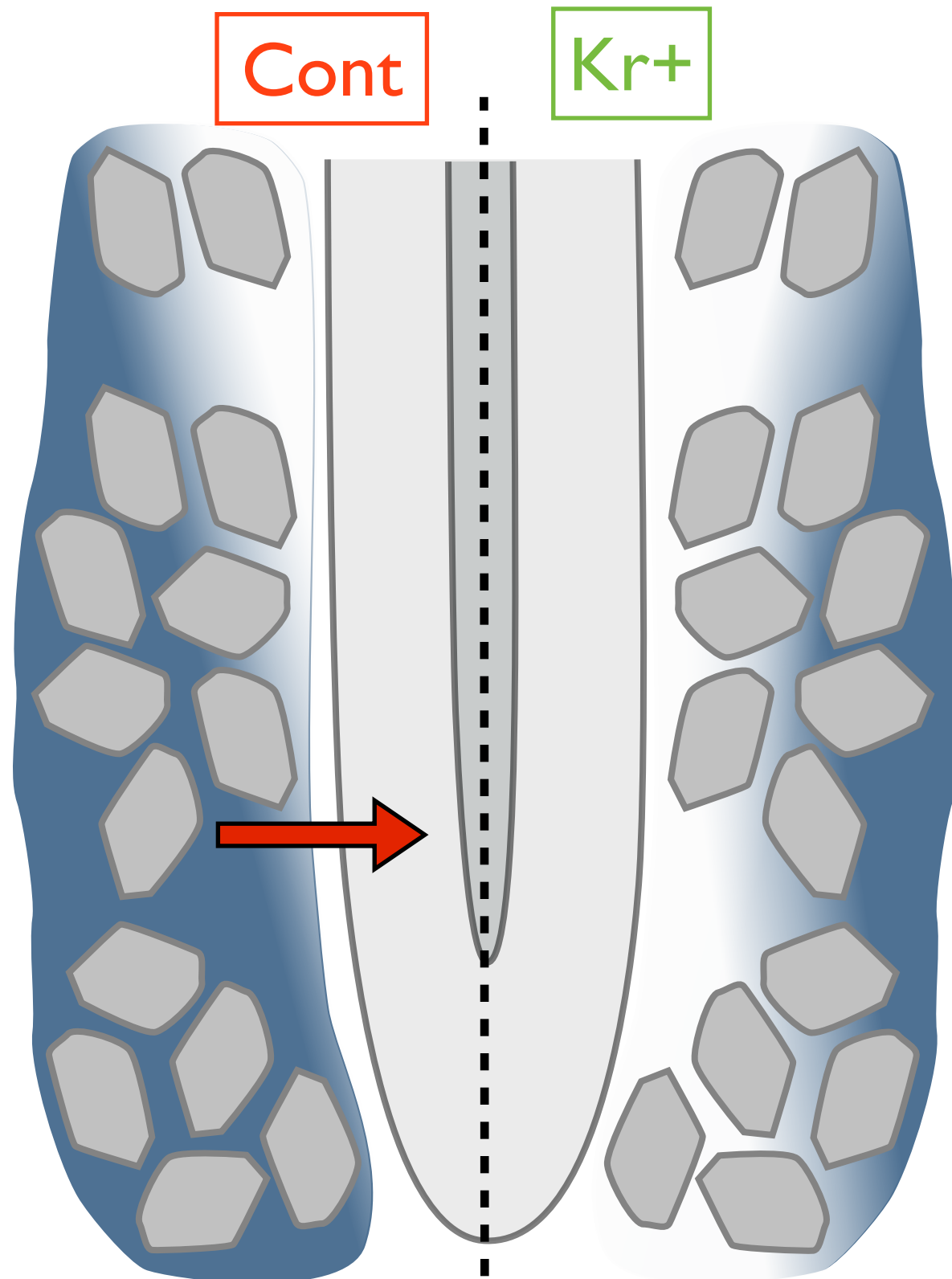
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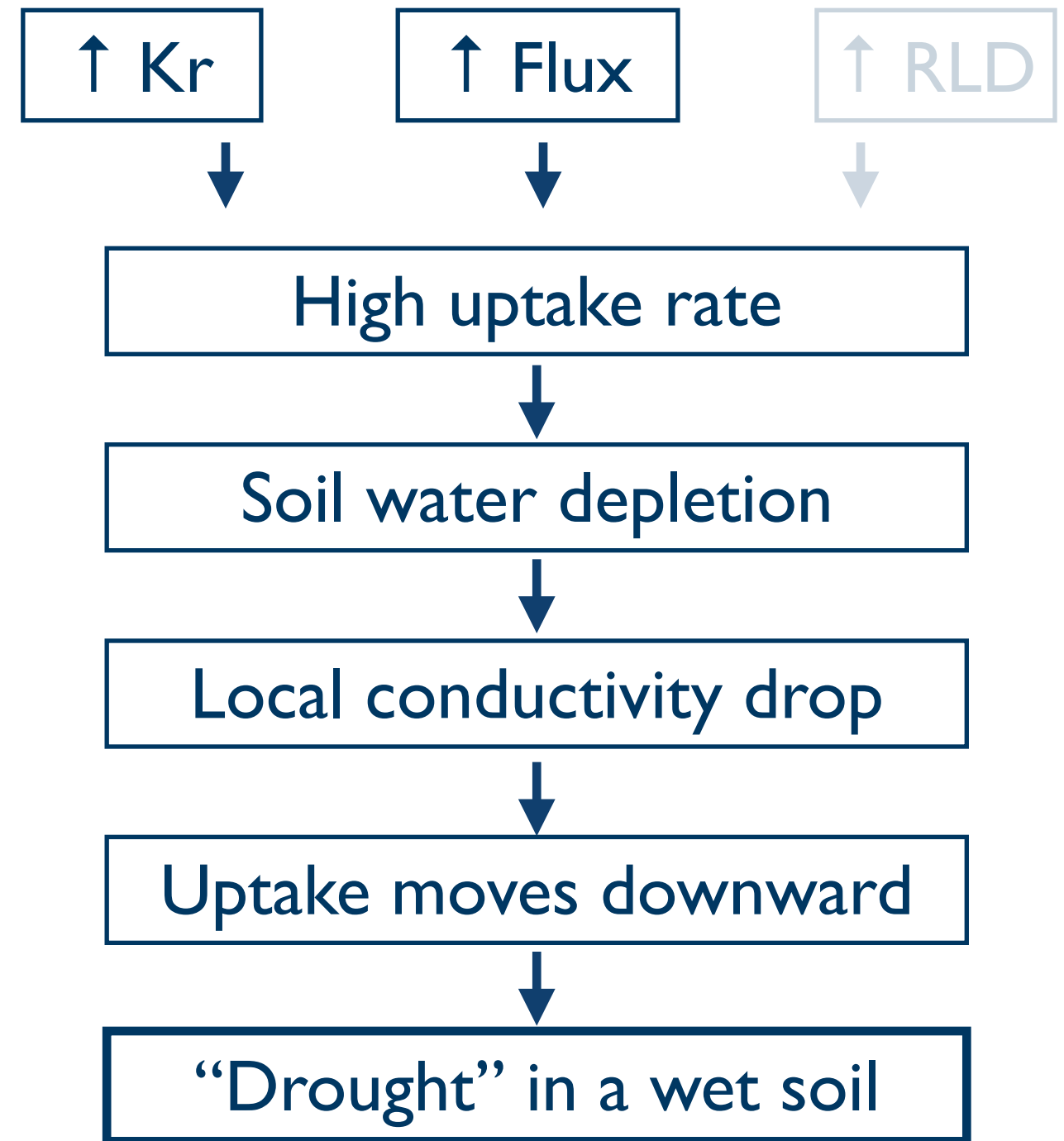
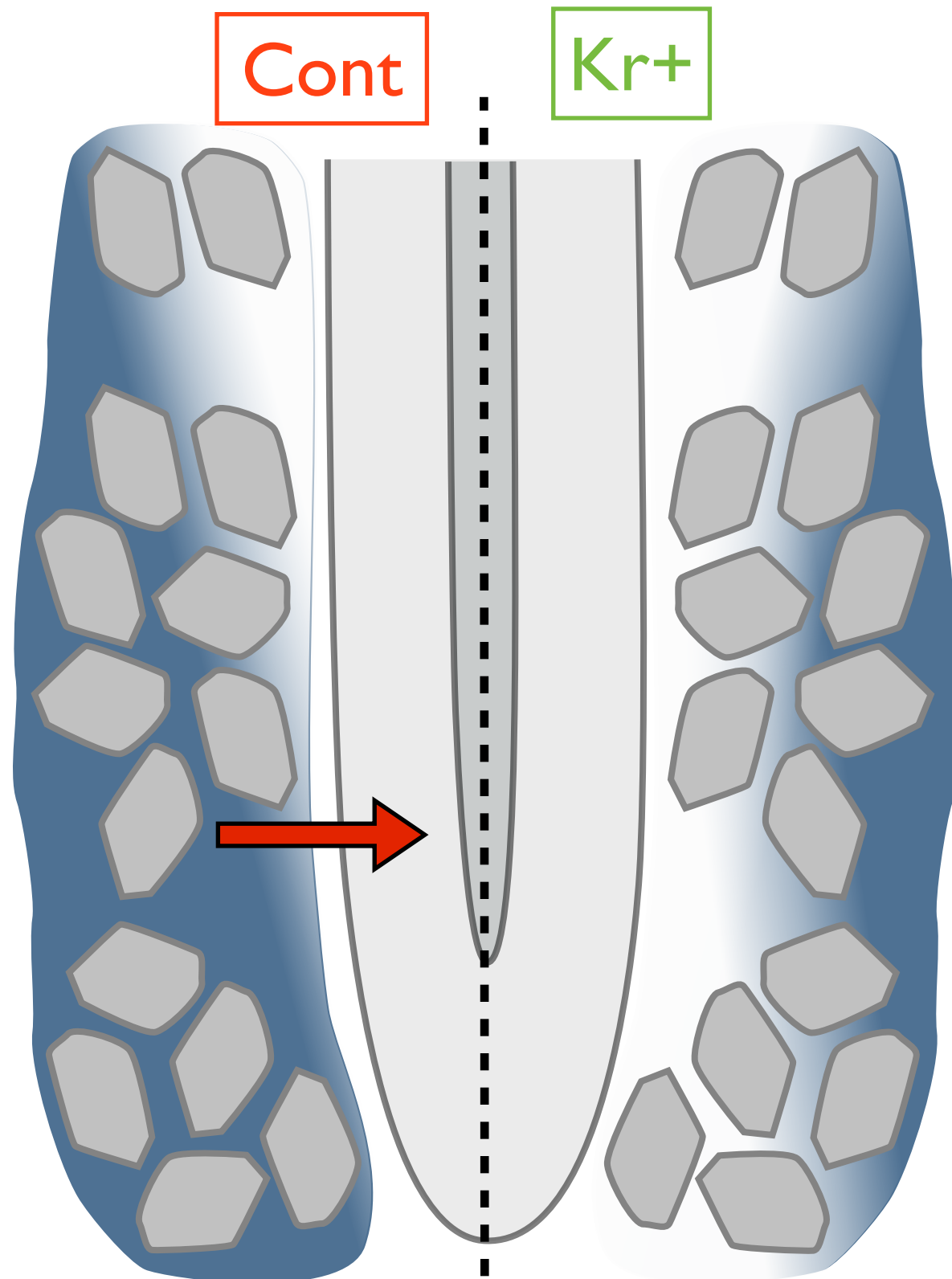
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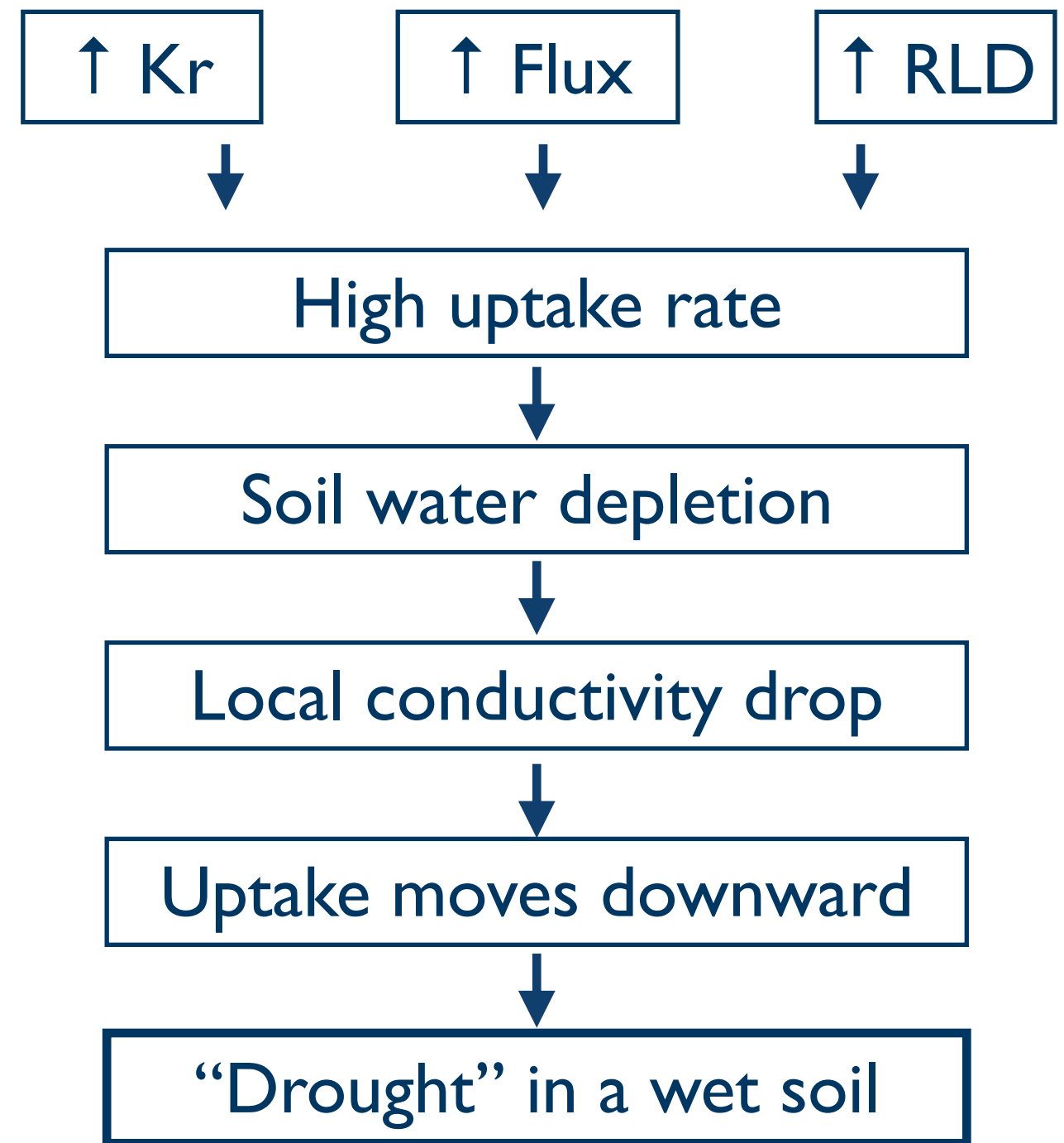
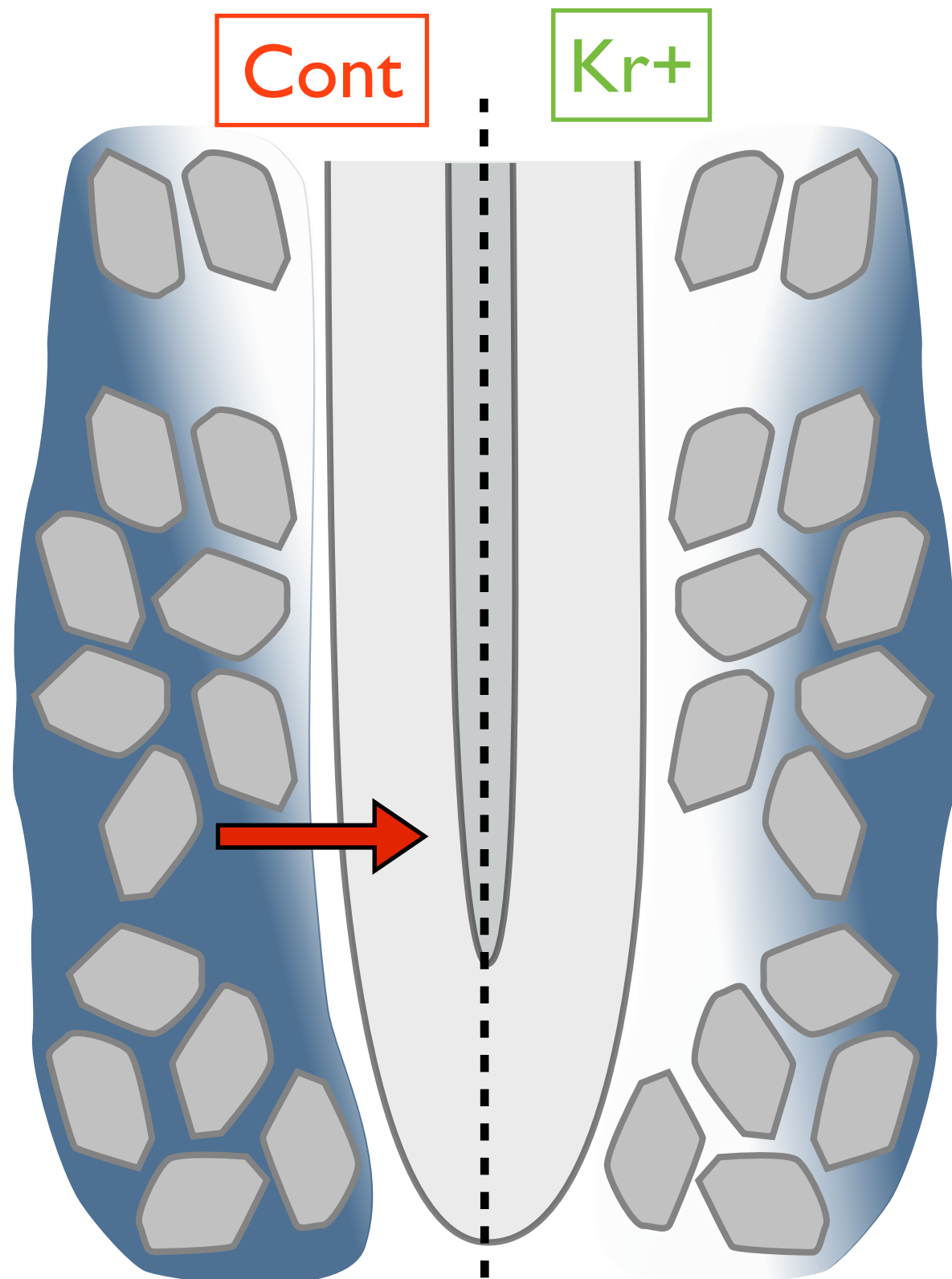
Integration of root and soil parameters



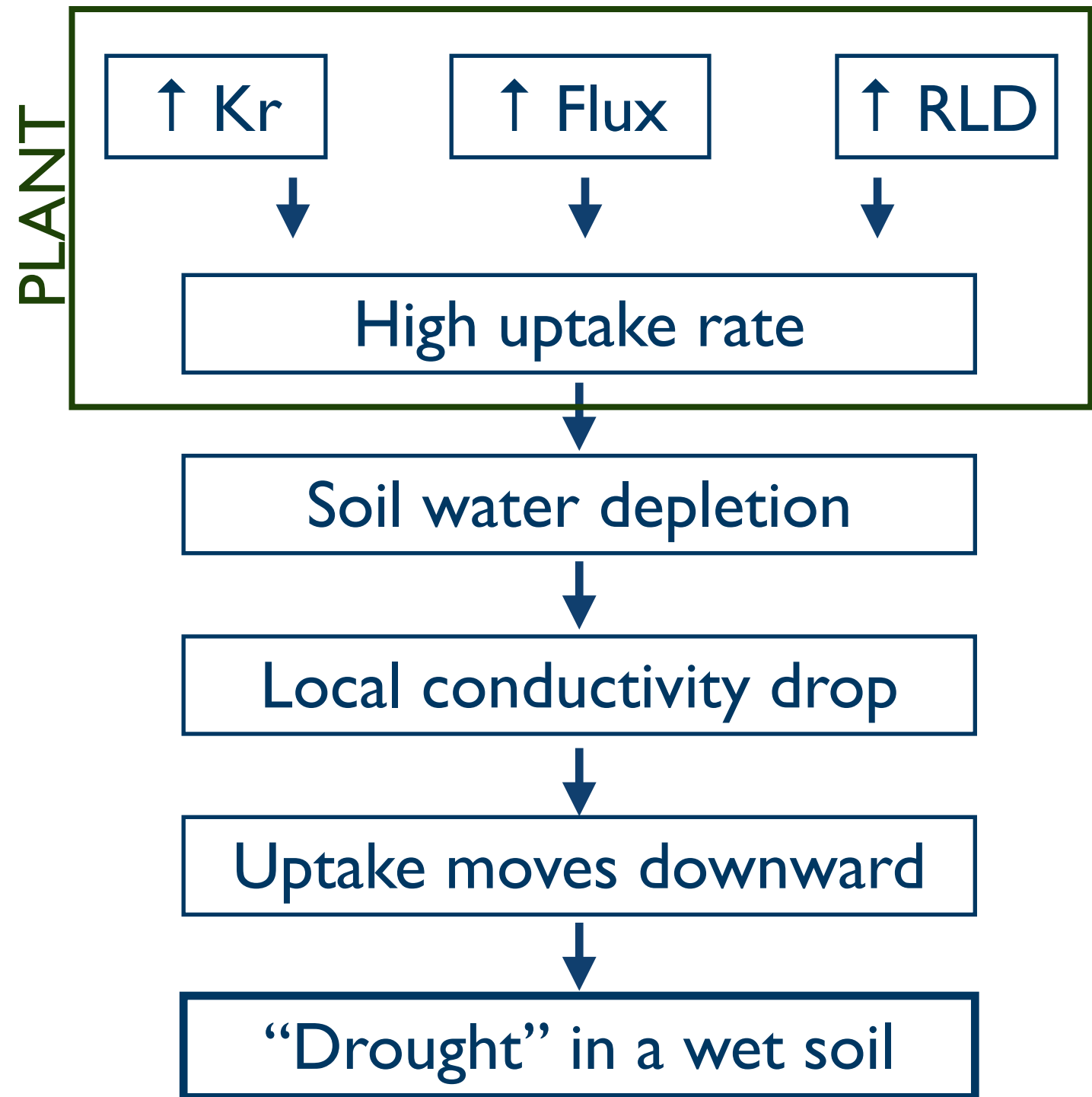
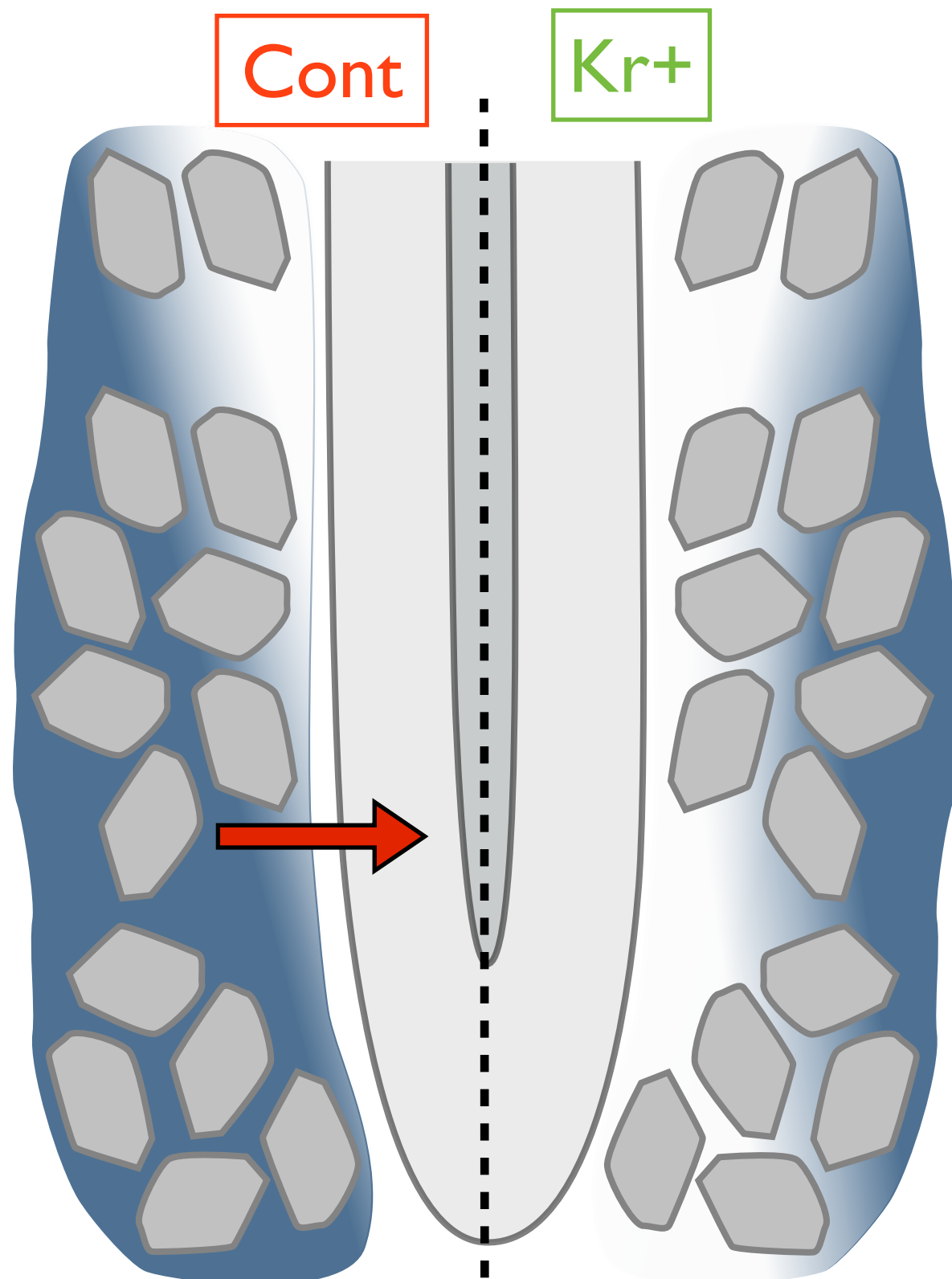
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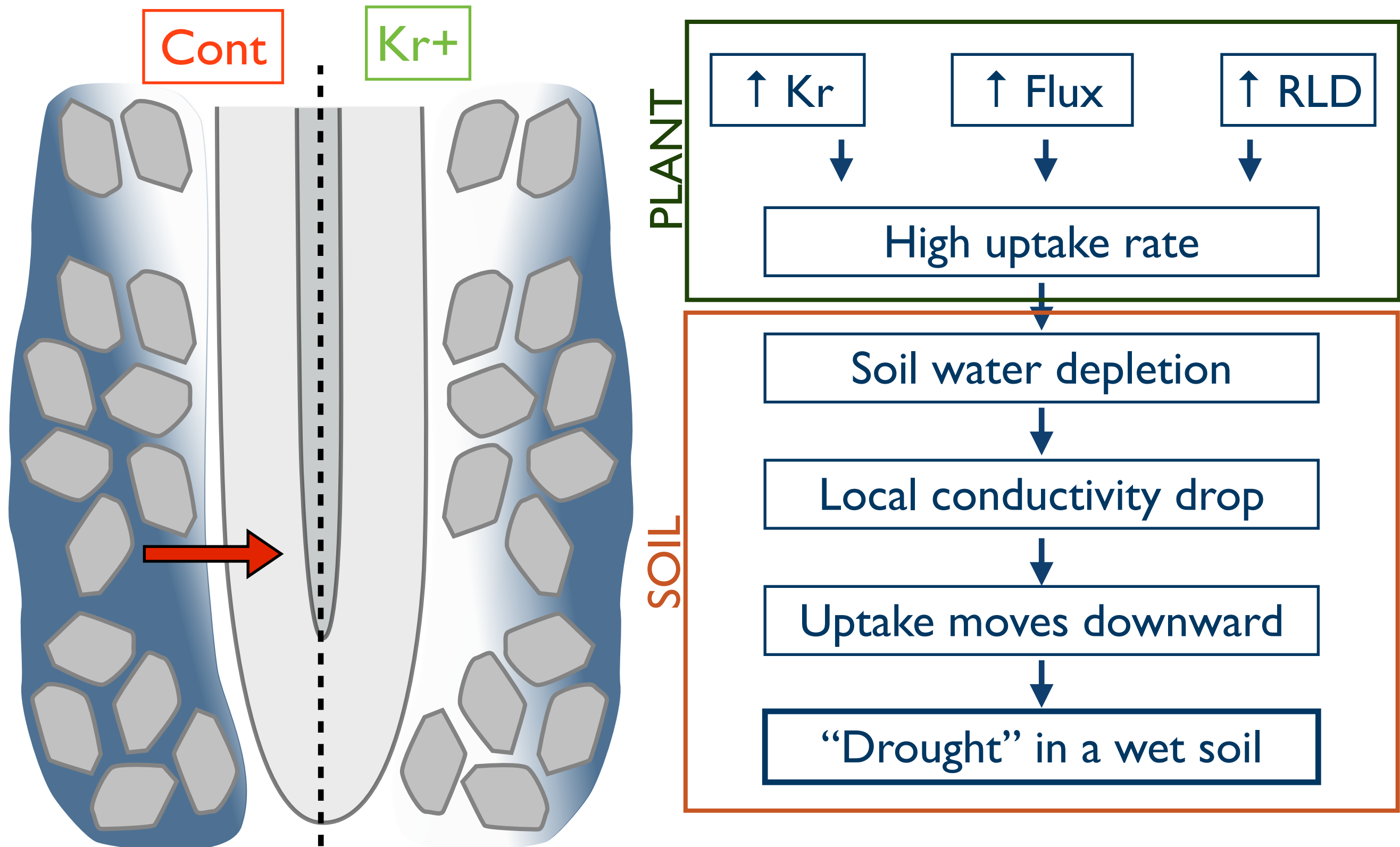
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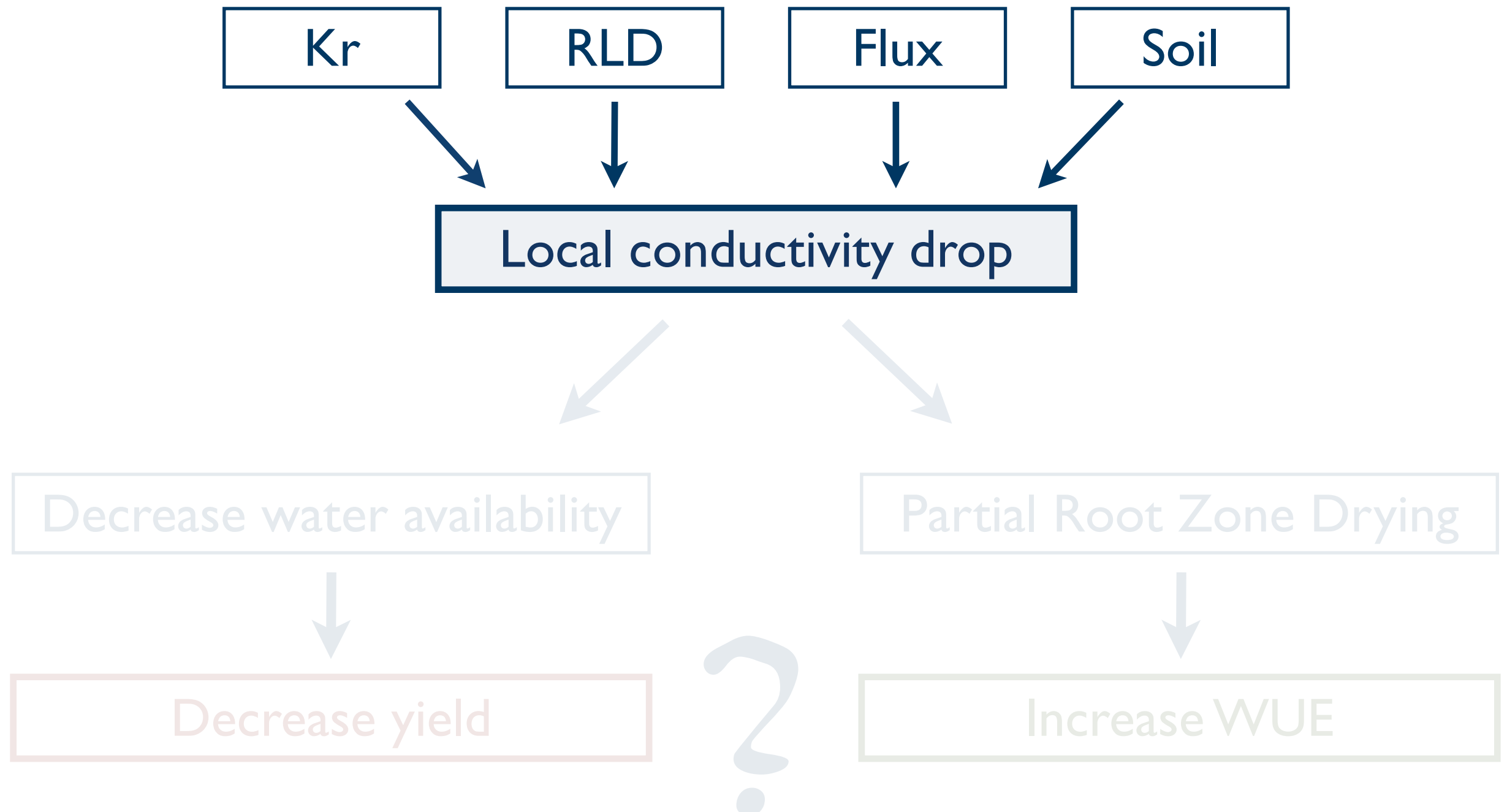
Integration of root and soil parameters



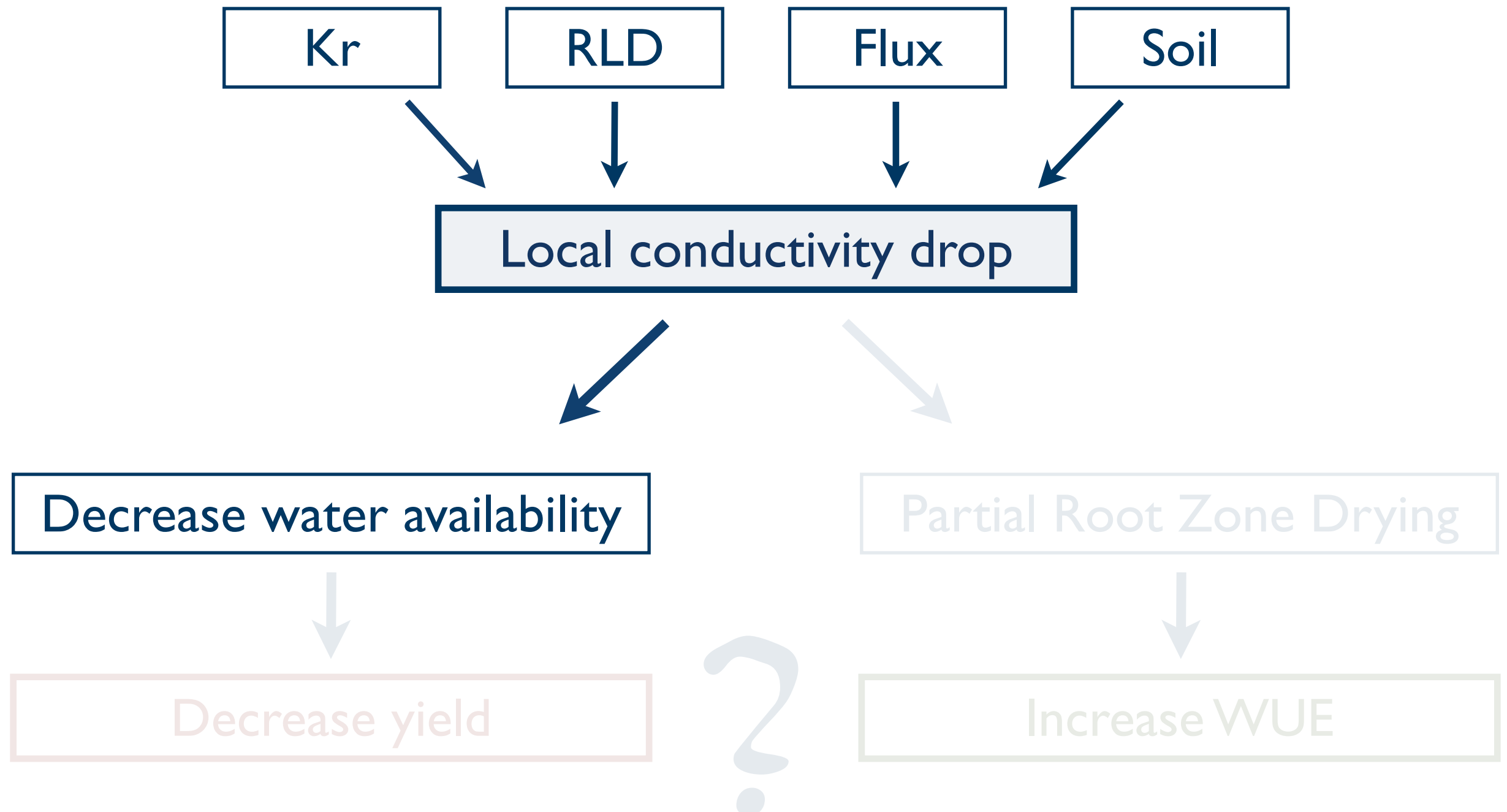
Integration of root and soil parameters



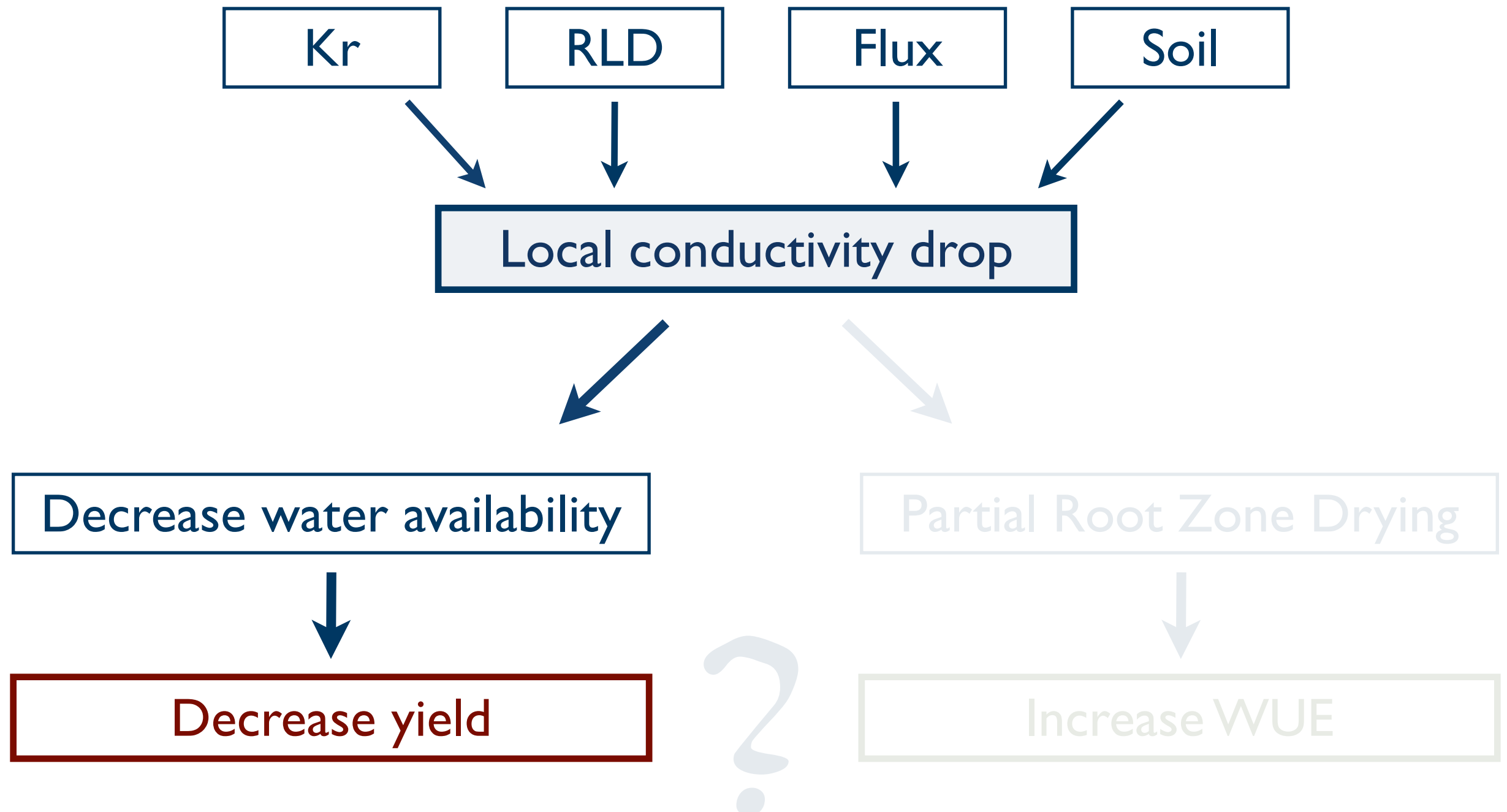
New insights



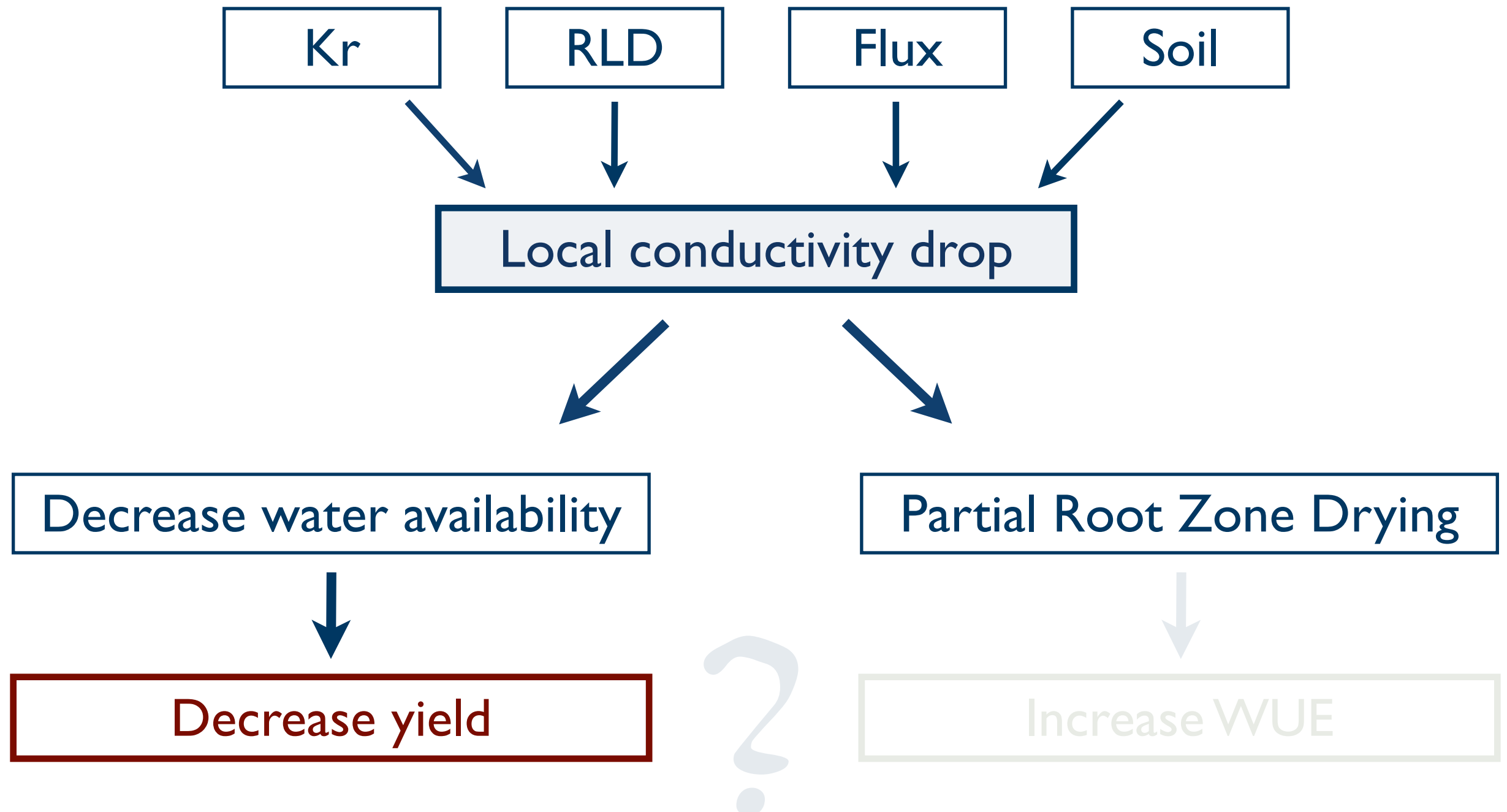
New insights



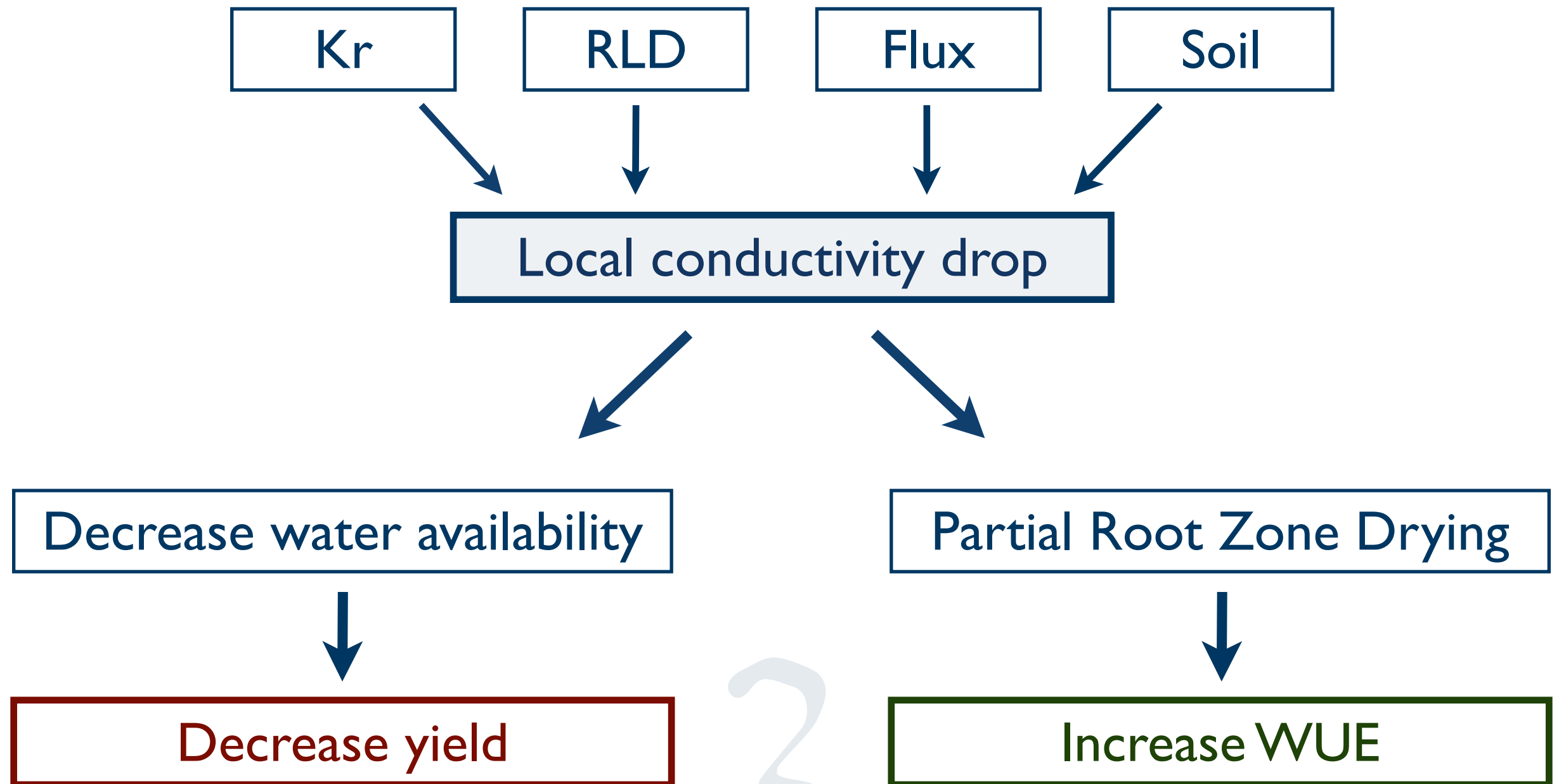
New insights



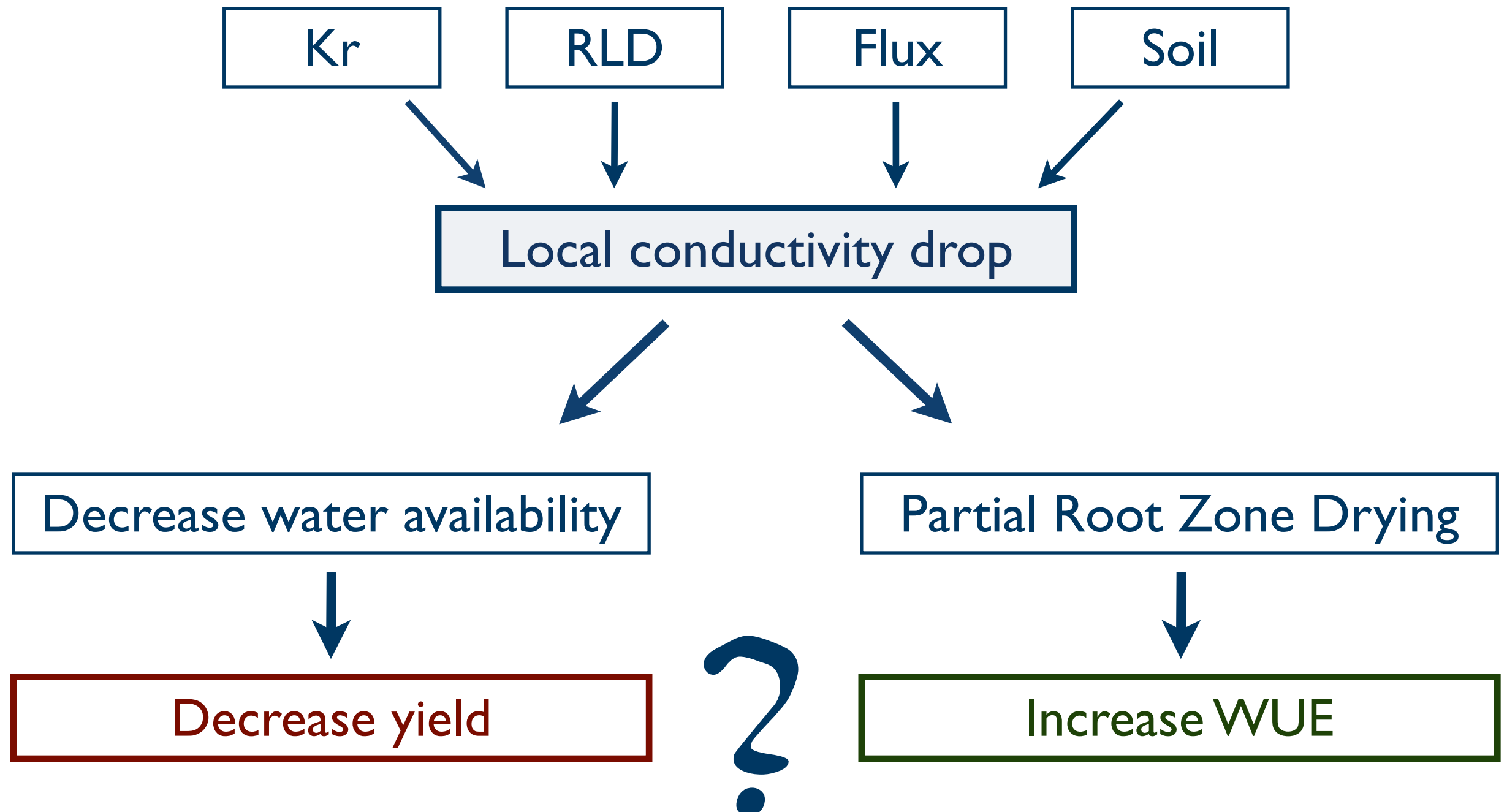
New insights



New insights



New insights



Practical implications at the plant scale

Influence uptake dynamics



Change soil properties



Change root characteristics

Change root architecture

King et al. 2003, Ann Bot 91 (3)

Bernier et al. 2009, Field Crops Res 110

Change K_r and K_x

Richards et al., 1989, Aust J Agr Res 40

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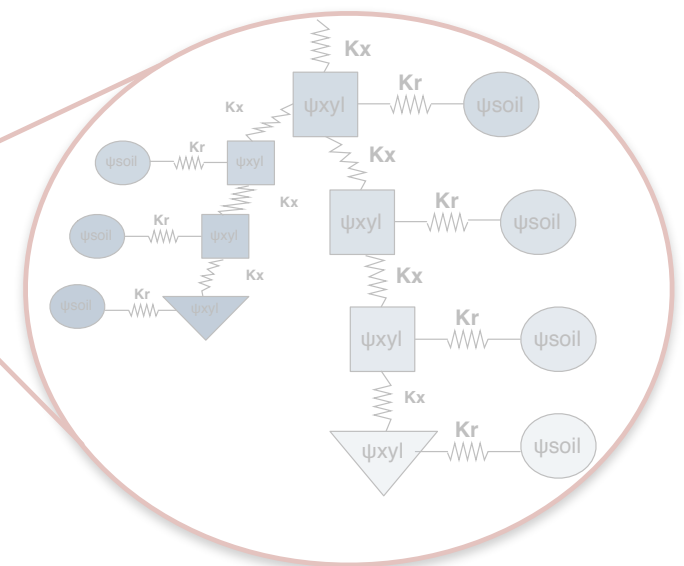
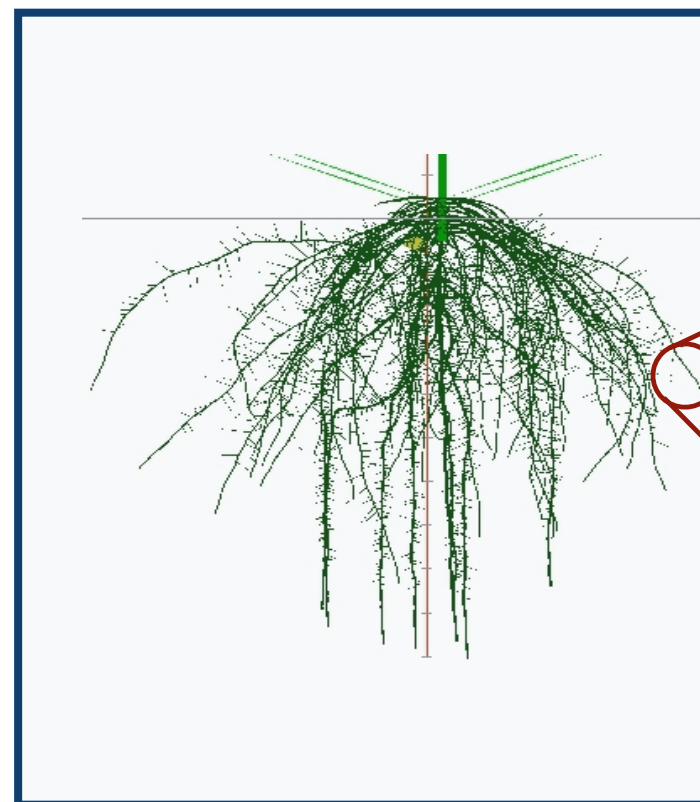
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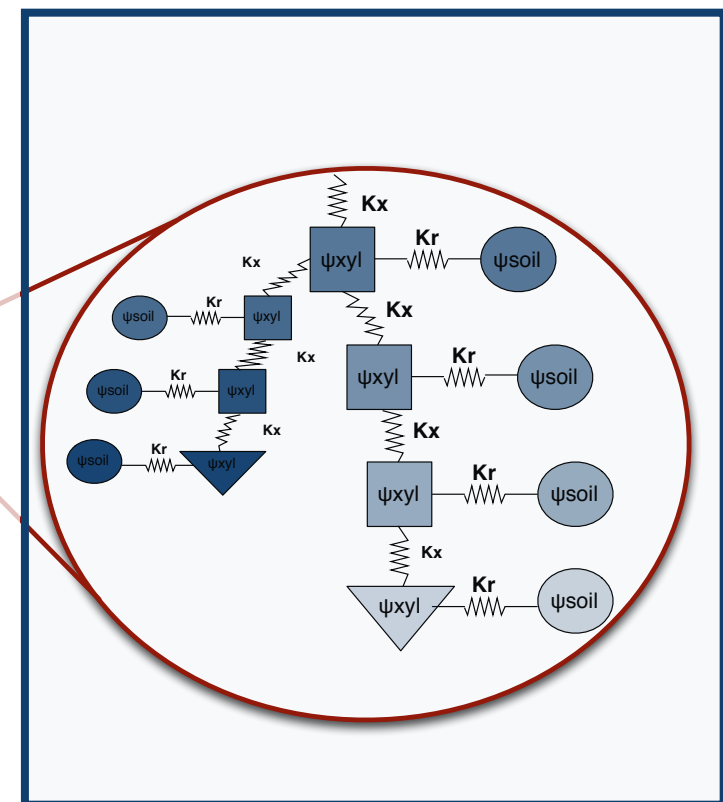
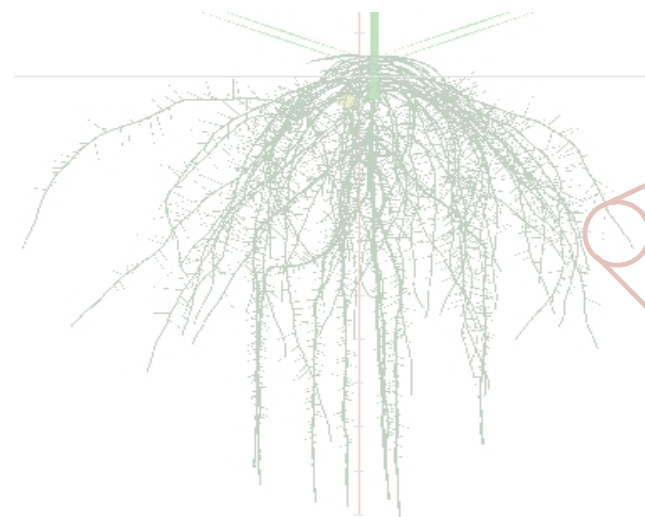
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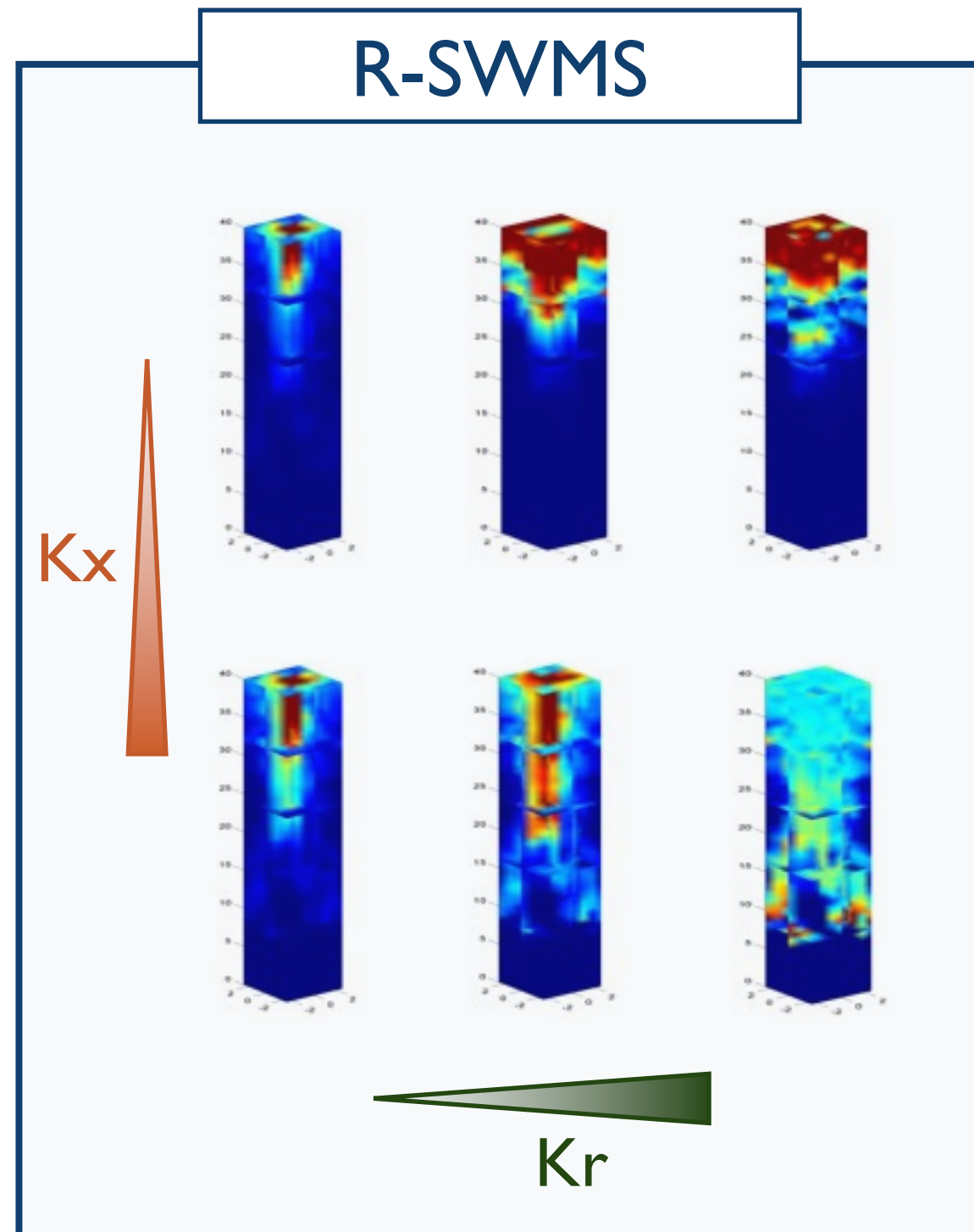
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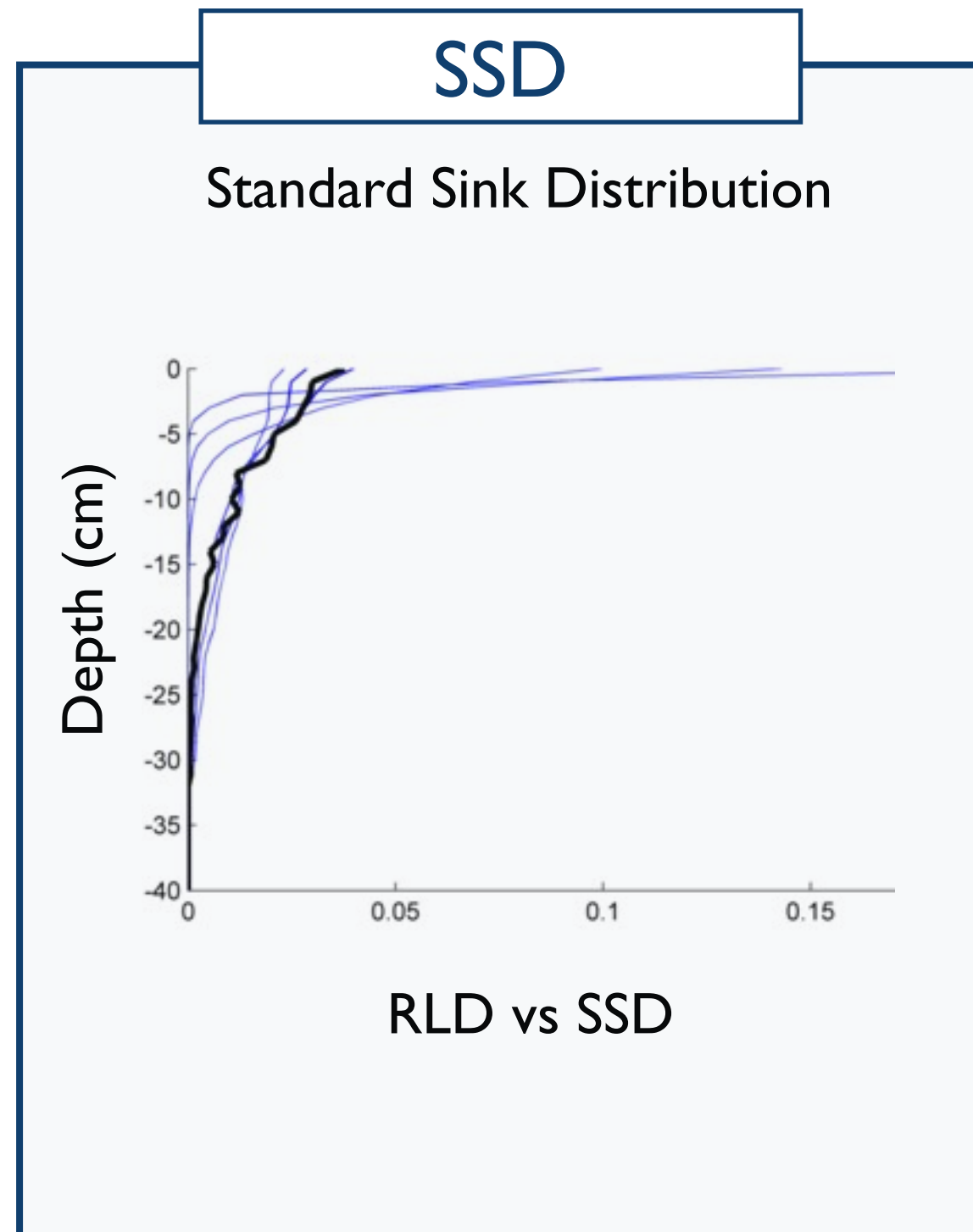


Computer modeling
can be used to
design water
extraction strategies
and ideotypes

Modeling as an ideotype design tool

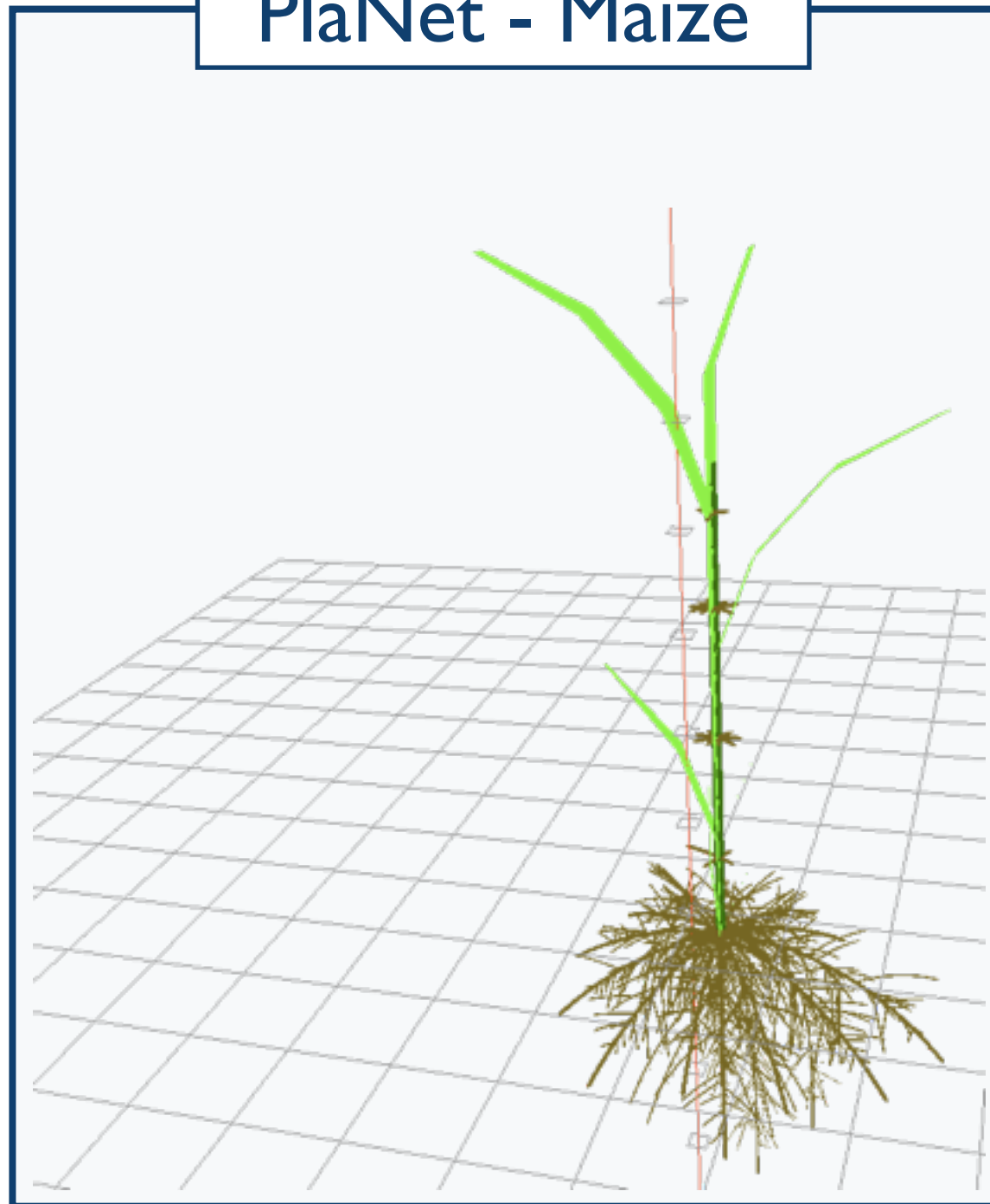


Modeling as an ideotype design tool



Modeling as an ideotype design tool

PlaNet - Maize



Take home message



Uptake pattern matters

Need to integrate root system architecture and hydraulic properties (root and soil)

Importance of multi-scale and space-time dynamics

Experimental and modeling tools are available

Acknowledgments

Collaborations

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Prof. François Chaumont
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INRA Avignon

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Walloon region

P.A.I.

