MARSHAL: a unique tool for deciphering water flow in maize root system hydraulic architectures

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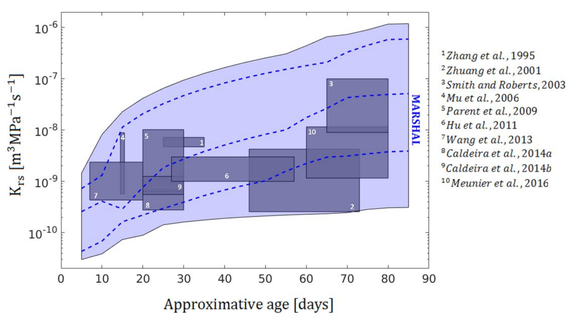
Context

What is the best root system in a specific environment?

- Drought impacts maize production woldwide
- The geometry and hydraulic properties of root systems seem to be good targets for breeders to improve drought tolerance
- Root phenotypes cannot be analyzed without referring to Genotype, Environment, Management and their interactions
- Sensitive root traits? Positive impacts? Always in the same direction (+, neutral or -)

Validation

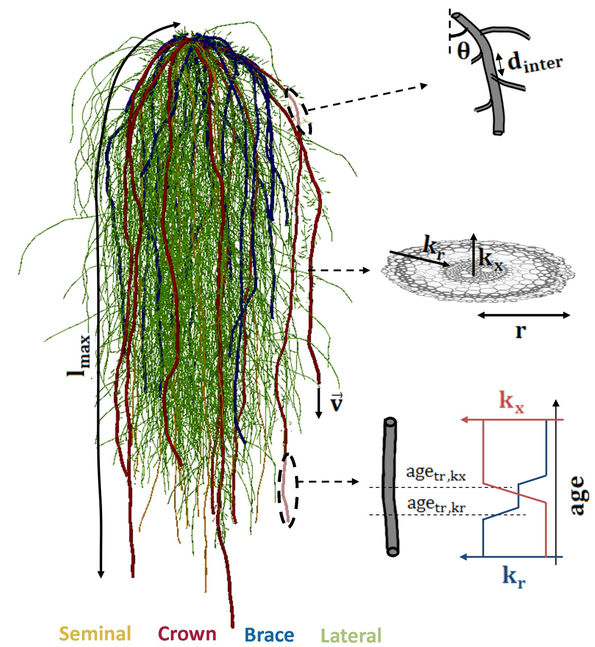
- Validated at the crop/root system scales
- Generates reasonable architectures and hydraulic parameters (not shown):



The model

MAize Root System Hydraulic Architecture soLver

- Coupling of the root system architectural (CRootBox, Schnepf et al. 2017) and hydraulic (hybrid, Meunier et al. 2017) models
- Order (architecture) and order/age (hydraulic) parameterization



- Literature and experiment-based calibration
- Coupled to sensitivity/opt. algorithms, bundled into a R-Shiny app
- Fast (< 1 s) and flexible

TRY IT YOURSELF

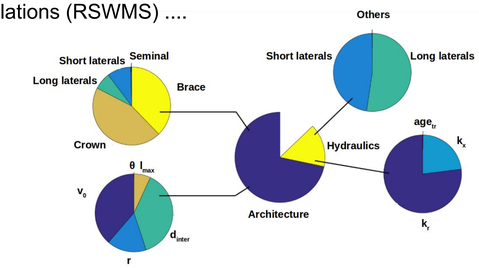
https://plantmodelling.shinyapps.io/marshal

Applications

Freely available!

Examples of applications:

Sensitivity of hydraulic and architectural macroscopic parameters to local traits, impact on crop transpiration, generator of root system hydraulic architectures (optimization of parameters, Crop cycle simulations (RSWMS) ....



Root system conductance at 60 days

MARSHAL is a unique tool gathering state-of-the-art models and exhaustive published data for maize root systems. It is freely available for various applications

Conclusion

More about this work

Meunier et al. 2017 (doi: 10.1016/j.apm.2017.08.011)

Schnepf et al. 2017 (doi: 10.1093/aob/mcx221)

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