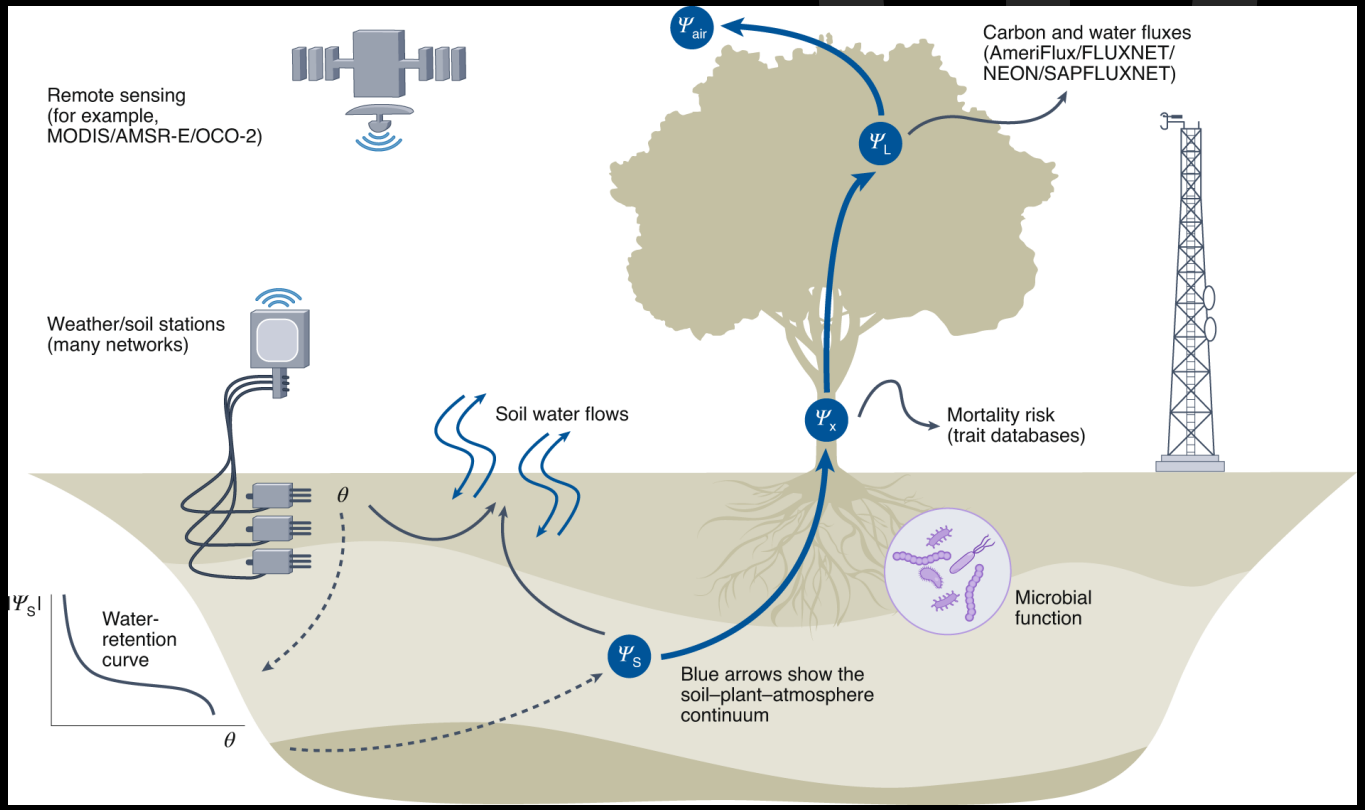
Confronting the water potential information gap

Kim Novick (Indiana U.)
Darren Ficklin (Indiana U.)
Natasha MacBean (Indiana U.)
Dennis Baldocchi (UC-Berkeley)
Ken Davis(Penn State U.)
Yuning Shi (Penn State U.)
Teamrat Ghezzehei (UC-Merced)
Alex Konings (Stanford)
Nina Raoult (LSCE)
Russ Scott (USDA-ARS)
Ben Sulman (ORNL)
Jeff Wood (U. of Missouri)



Novick et al. 2022, Nature Geoscience

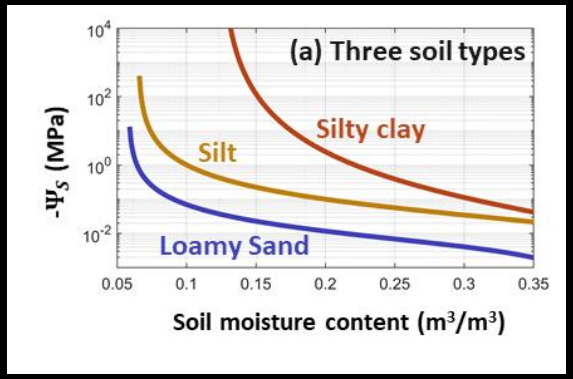
Soil water potential (Ψ_S) is a fundamental driver of soil water flows.

Darcy's law $q_z = -K\left[1 + \frac{d\Psi_s}{dz}\right]$

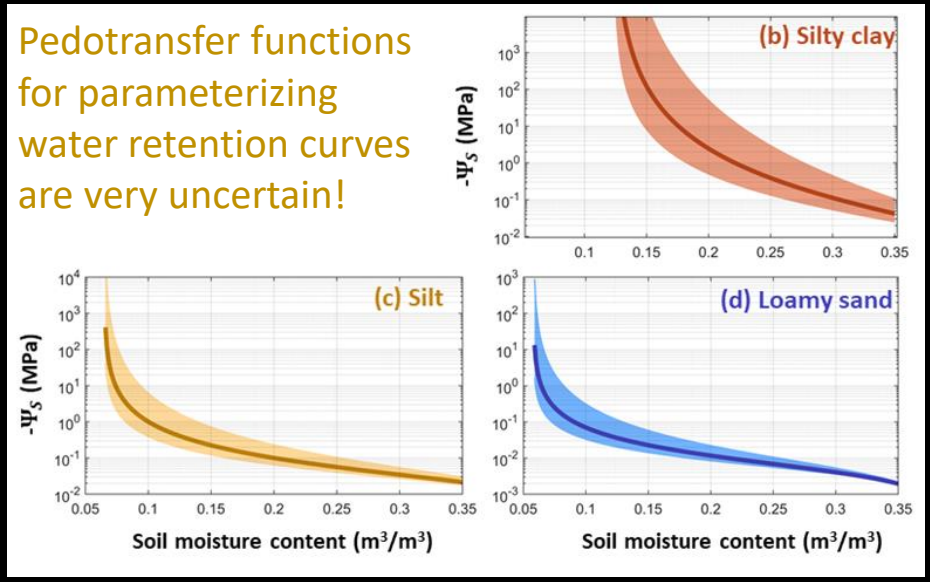
Richards Equation $\frac{\partial\theta}{\partial t} = \frac{\partial K}{\partial z} + \frac{\partial}{dz}\left[K + \frac{\partial\Psi_s}{dz}\right]$

But we don't often measure it. Instead, we measure soil moisture content.

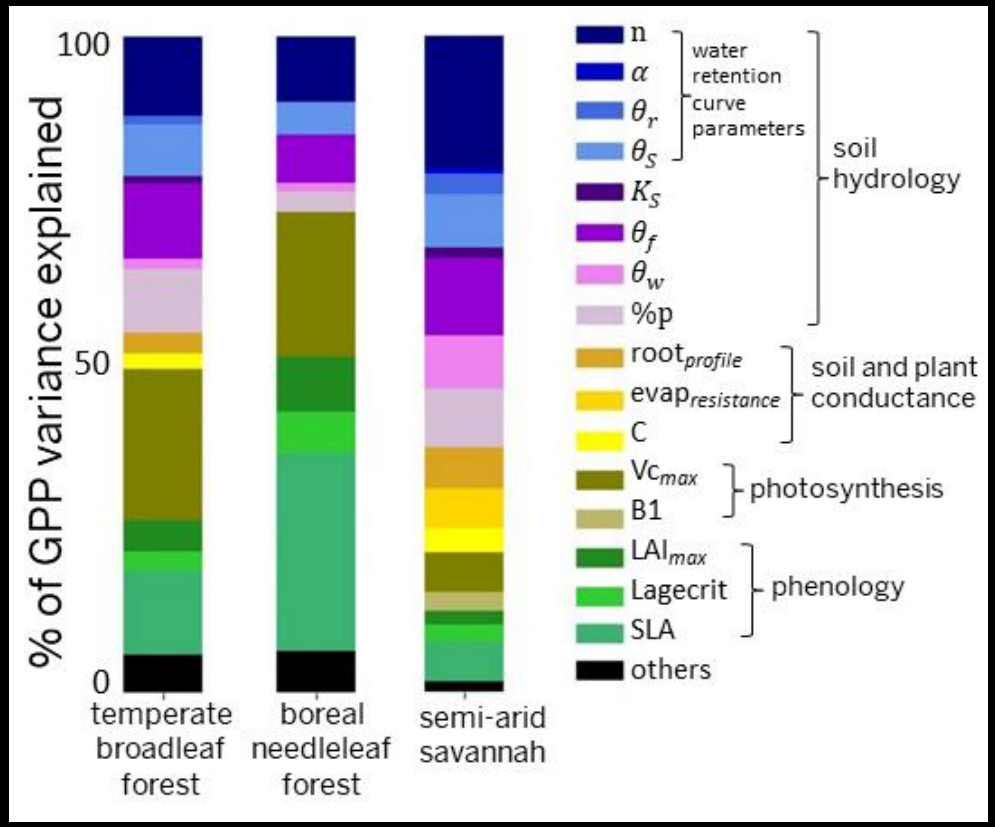
Water retention curves can help, but…



Pedotransfer functions for parameterizing water retention curves are very uncertain!

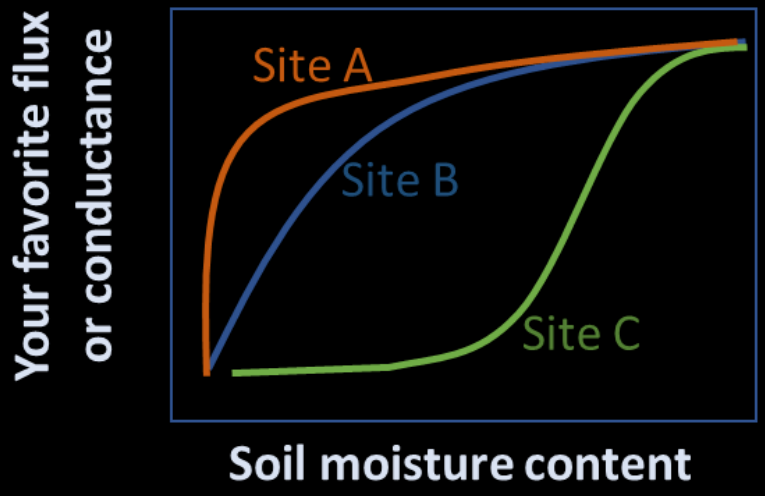


Soil hydrology parameters are a predominant source of uncertainty for ORCHIDEE GPP



Nina Raoult

The soil water potential information gap hinders data synthesis



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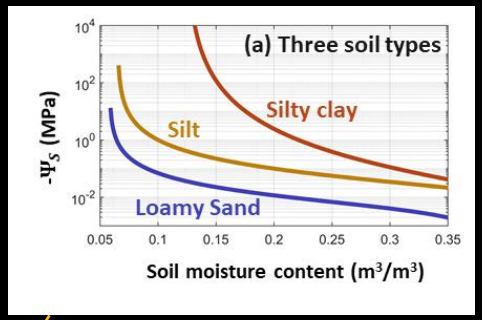

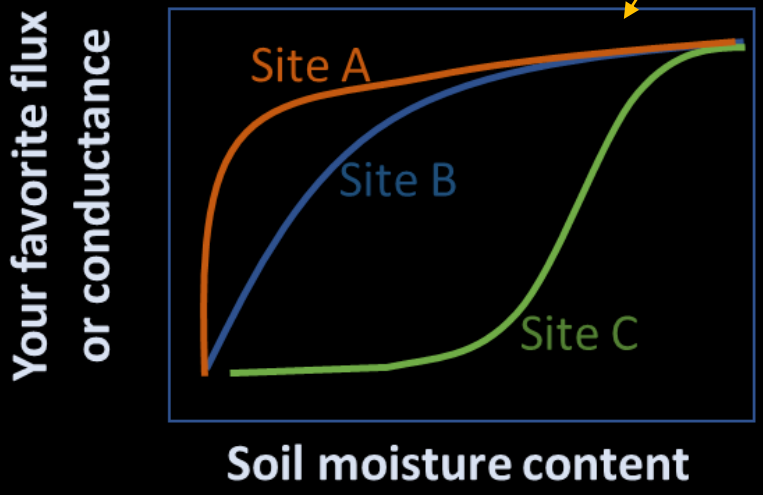

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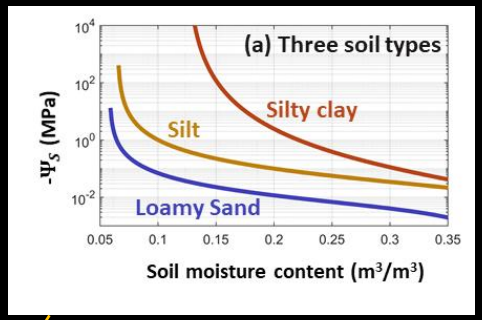
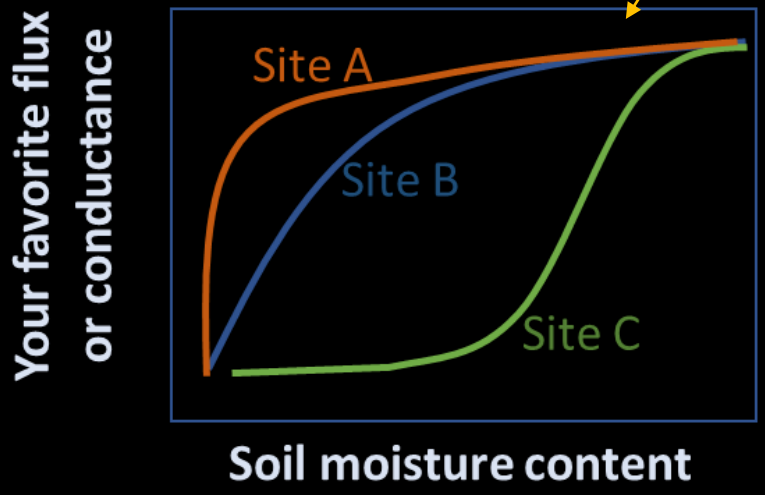
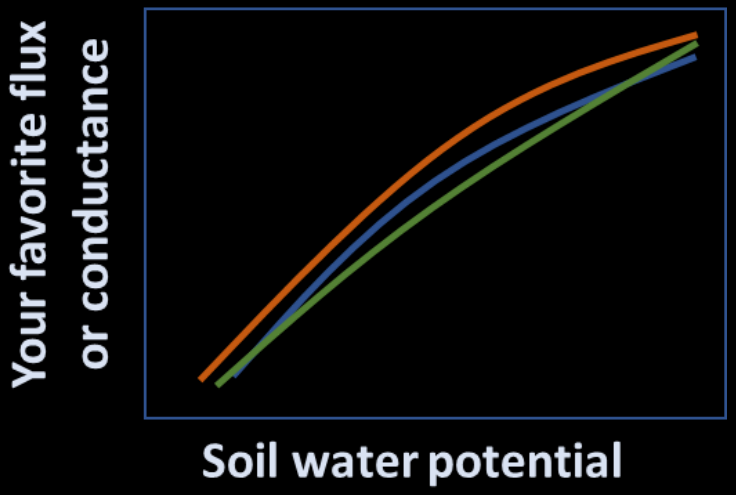






Some solutions:

[1] Harness improving technology for **in-situ measurement**

[2] **More lab-derived water retention curves** with environmental context

We will be generating 40-50 site-level WRC characterizations at AmeriFlux sites as part of the "Year of Water" initiative

[3] Aggregating existing in-situ and lab derived information into **a new network database**

In plants…existing plant water potential data is dominated by "pressure chamber" measurements, timeseries are discrete and undiscoverable.

Things we can't do particularly well right now:

Advance theory of plant water use strategies
(sensu Kannenberg et al. 2021, *Functional Ecology)*

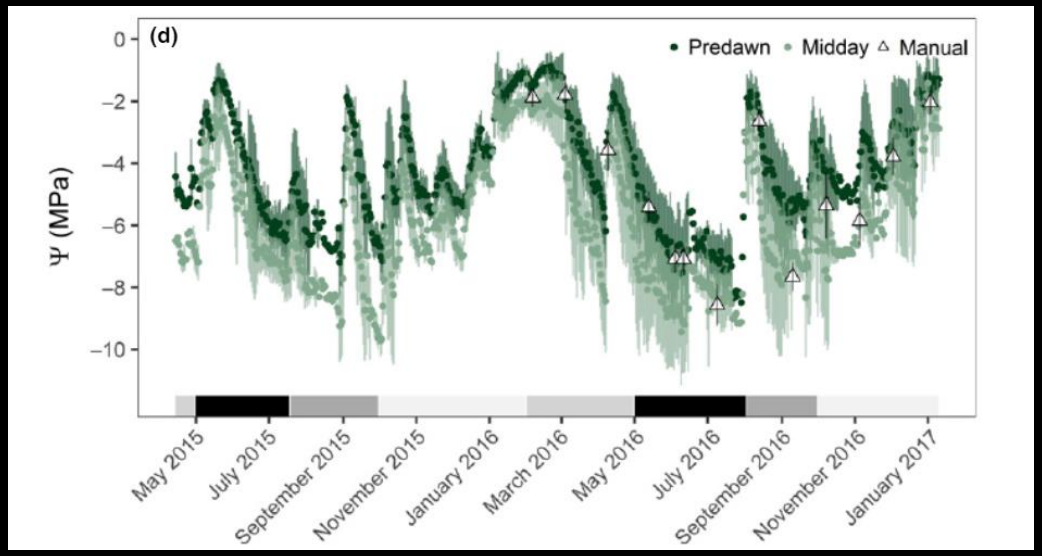
Predict risk of hydraulic failure
(sensu Martínez-Vilalta et al. 2021, *NPH*)

Disentangle the influence of soil moisture versus VPD
(sensu Novick et al. 2019)

Understand the extent of pre-dawn **(dis)equilibration**

Groundtruth **emerging remote-sensing proxies**
(sensu Konings et al. 2021, *GCB*)

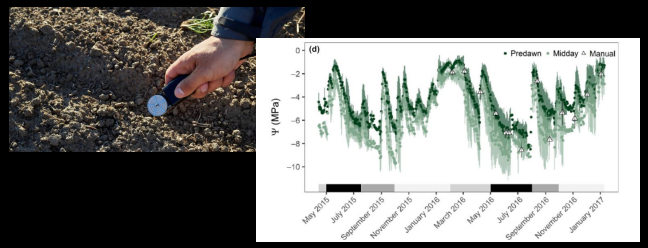
Huge opportunity with psychrometers for continuous water potential observation



Jessica Guo et al. 2019; Creosote, Arizona

The time is right for a centralized network for soil and plant water potential

Harness improving technology for in-situ measurement



More lab-derived water retention curves

Aggregating existing timeseries!

Thanks!! **Co-authors:** Darren Ficklin, Natasha MacBean, Dennis Baldocchi, Ken Davis, Yuning Shi, Teamrat Ghezzehei, Alex Konings, Nina Raoult, Russ Scott, Ben Sulman, Jeff Wood. **Network ideas**: Darren Ficklin, Sebastien Biraud + the AmeriFlux Management Project, Rich Phillips, Nelson Rios, Jessica Guo, Alex Konings, George Koch, Dan Johnson, Rafa Poyatos, Jordi MartÍnez-Vilalta, Bill Anderegg, Kevin Hultine, Rafael Oliveira, Jochen Schenk, Lauren Lowman, Ashley Matheny, Russ Scott, Brendan Choat, Kate McCulloh, Jesse Nippert, Chris Oishi, Daniel Beverly, among others. **Funding:** AmeriFlux**, USDA, NSF-DEB**

Get in touch! knovick@indiana.edu; @Novick_Lab_IU