

A model of stomatal closure driven by nonlinearities in soil-plant hydraulics (HS 10.1)

How do soil and atmosphere affect terrestrial transpiration?

FABIAN WANKMÜLLER^{1,2 *}, MOHSEN ZAREBANADKOUKI², ANDREA CARMINATI¹

¹ ETH Zürich, ² University of Bayreuth, *Presenter and corresponding author



UNIVERSITÄT
BAYREUTH

27.04.2021, 09:22

ETH zürich

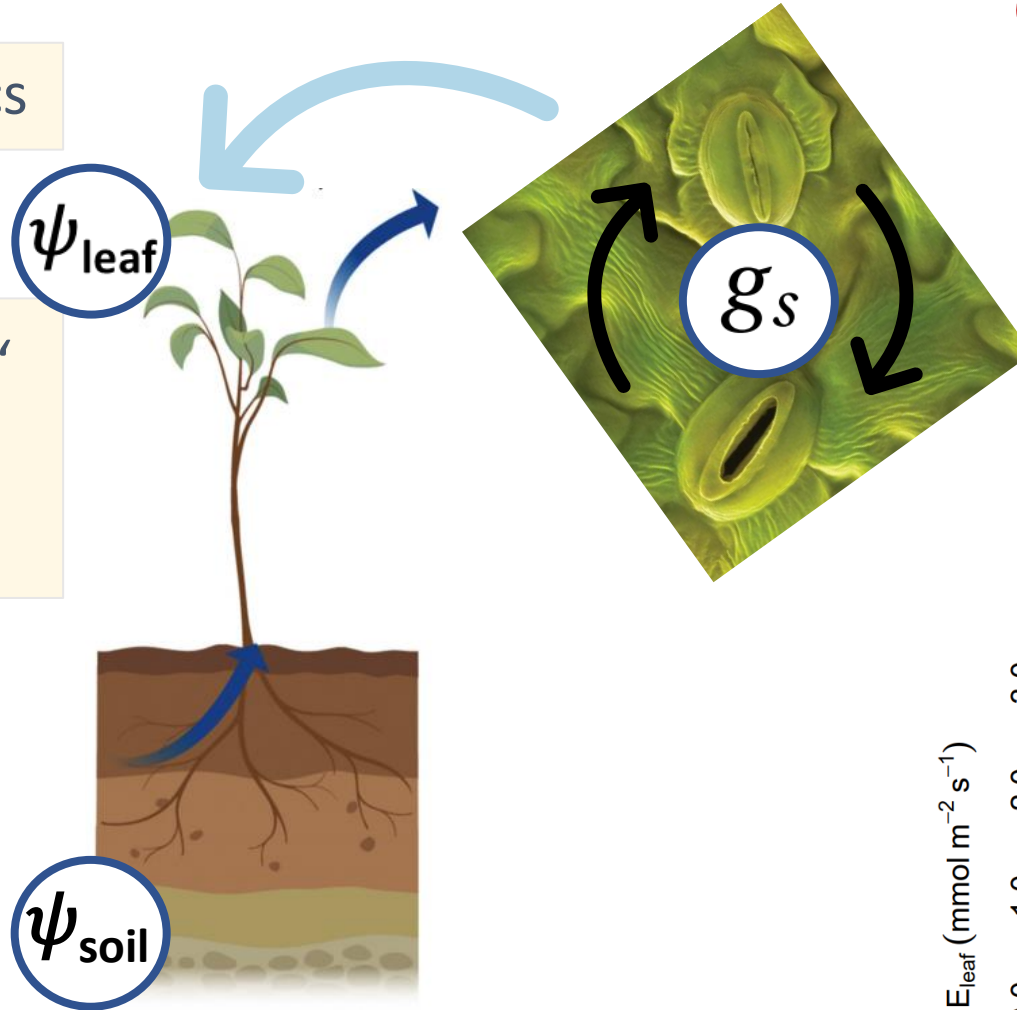
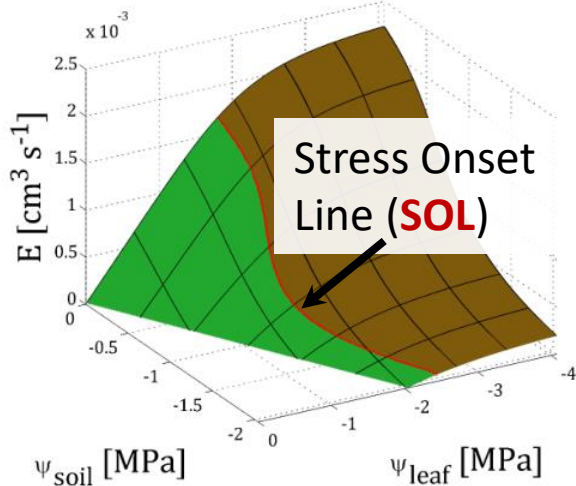
Our modelling approach

A)

Soil-plant hydraulics

‘Hydraulic surface’
of transpiration

$$E(\psi_{\text{soil}}, \psi_{\text{leaf}})$$

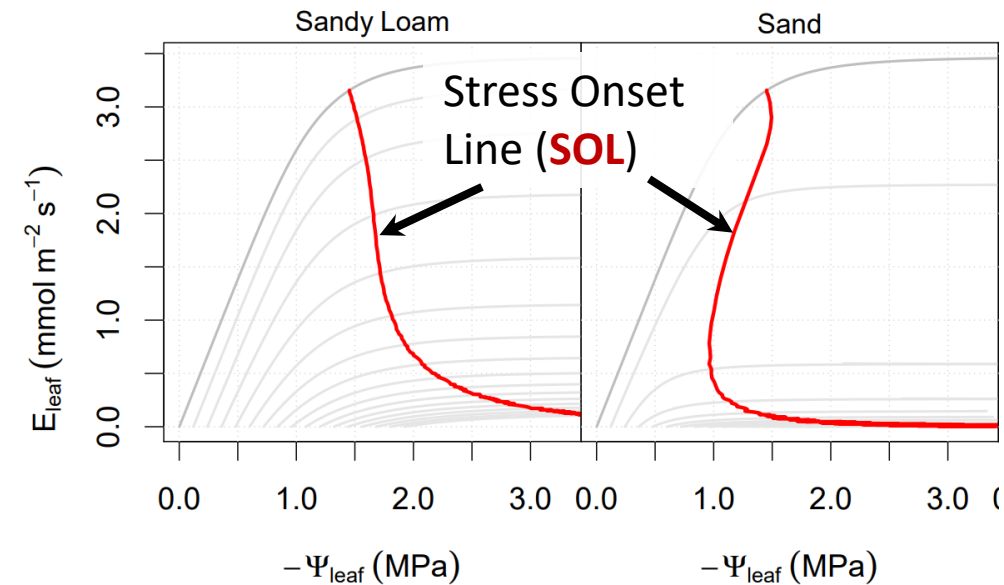


B)

Stomatal responses
to plant water status

Claim:

It needs a **flexible** stomatal ,regulatory principle’ to **navigate** on the **dynamic** hydraulic surface and to **avoid** the nonlinearities



Our modelling approach

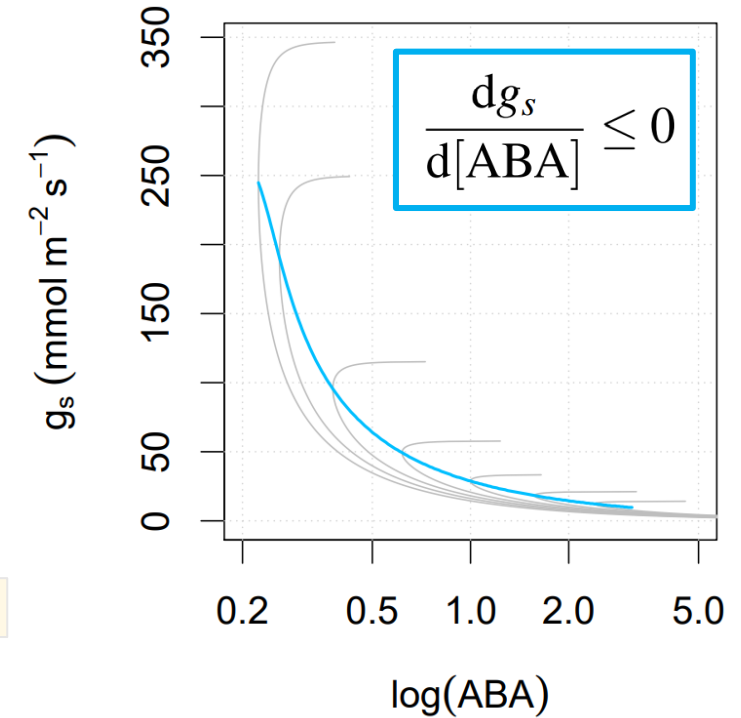
B)

Stomatal responses to plant water status



Hypothesis:

Hormonal regulation (i.e. ABA) as ideal mean for plants to navigate on the hydraulic surface of E (Ψ_{soil} , Ψ_{leaf})?

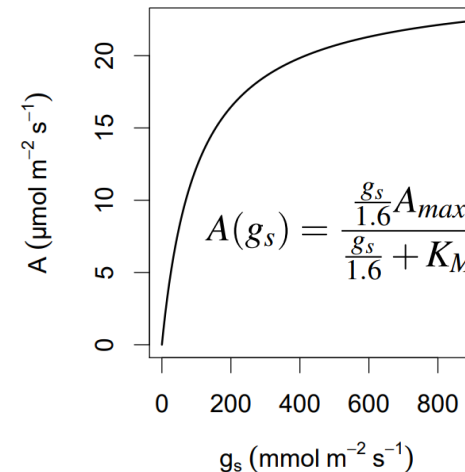
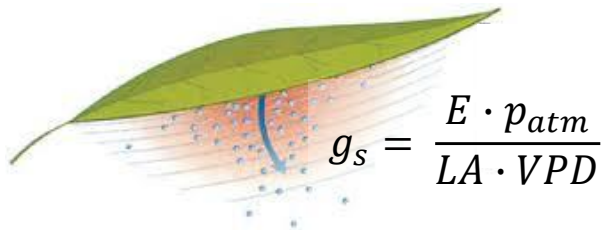


Assumptions:

$$[\text{ABA}] \propto \frac{-\Psi_l + \varepsilon}{A}$$

← Production

← Degradation

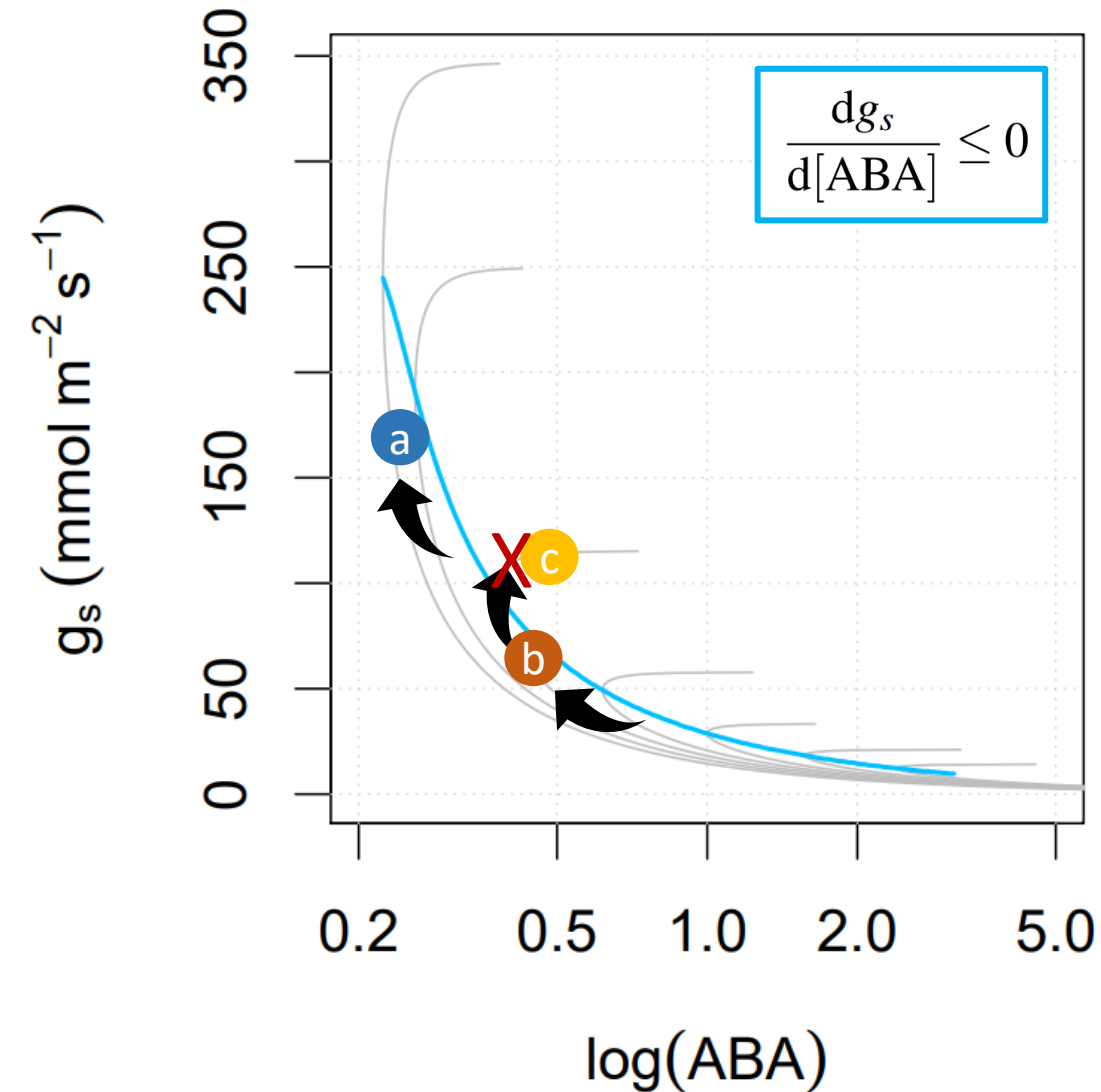


Our modelling approach

B)

Stomatal responses
to plant water status

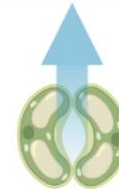
mediated by ABA



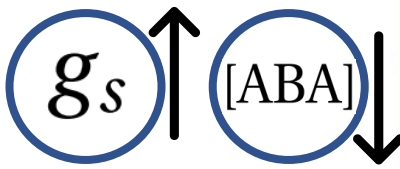
Wet soils

Dry soils

a



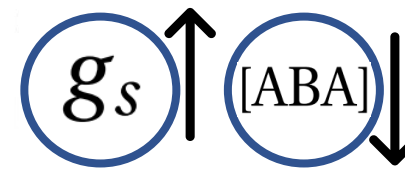
Positive
feedback



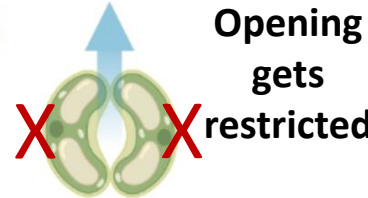
b



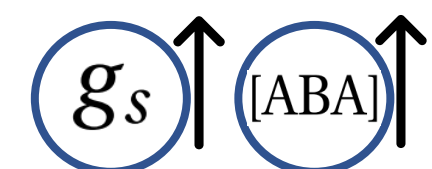
Positive
feedback



c



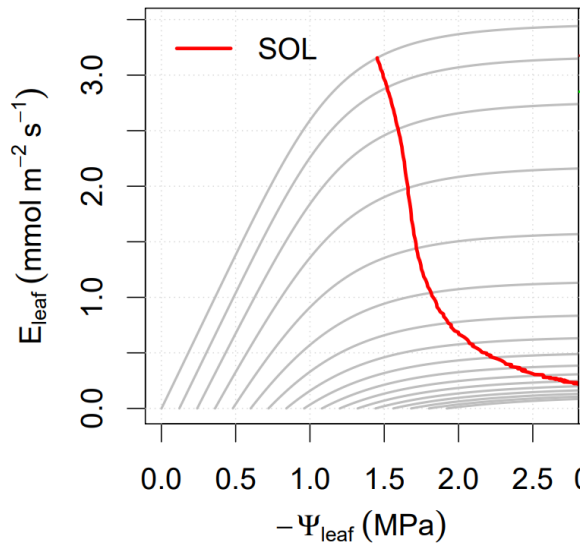
Negative
feedback



Results

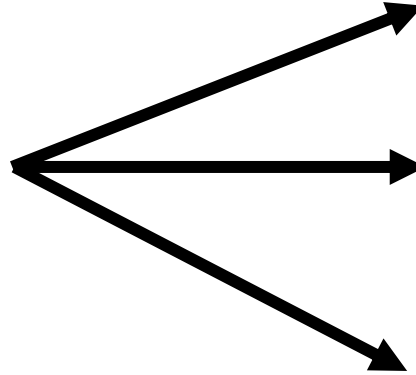
A)

Soil-plant hydraulics



B)

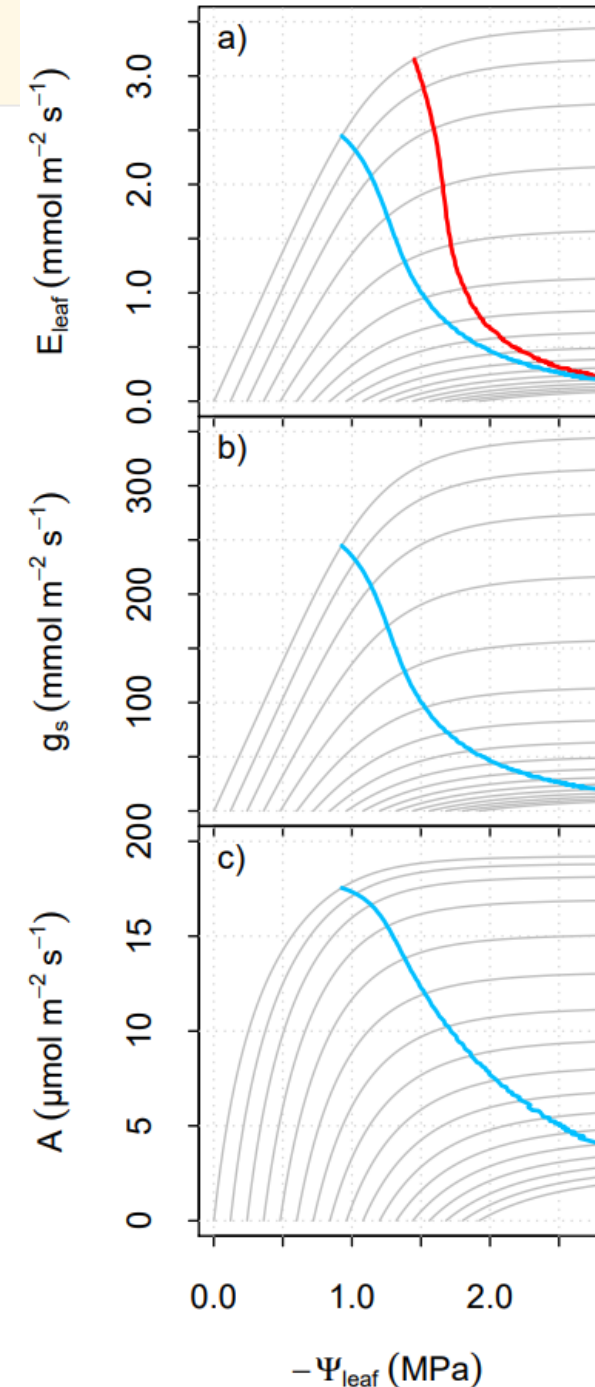
Stomatal responses to plant water status



soil-plant hydraulic limit:
stress onset line (SOL)



stomatal hydraulic
limits



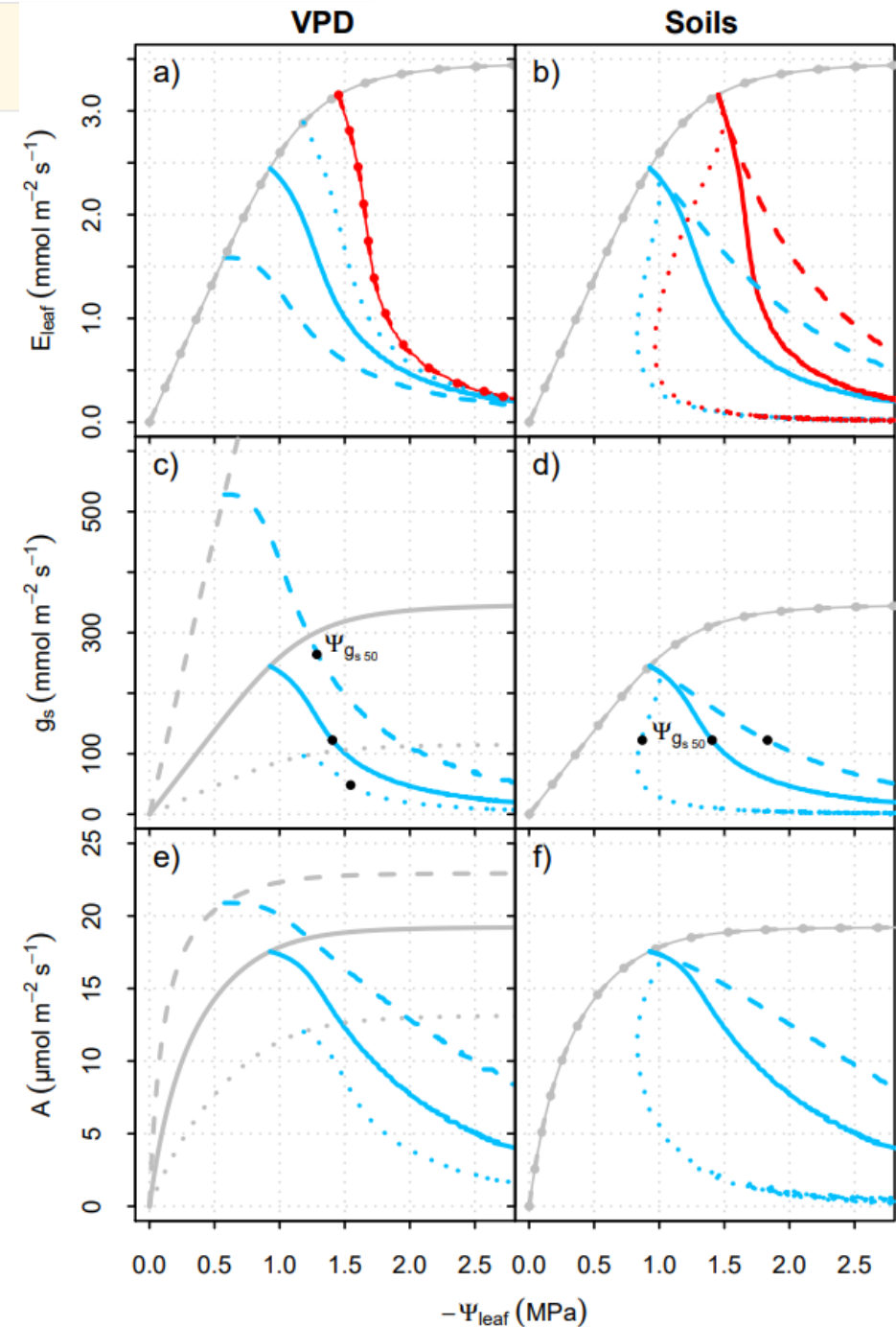
Results

VPD

stomatal hydraulic
limits

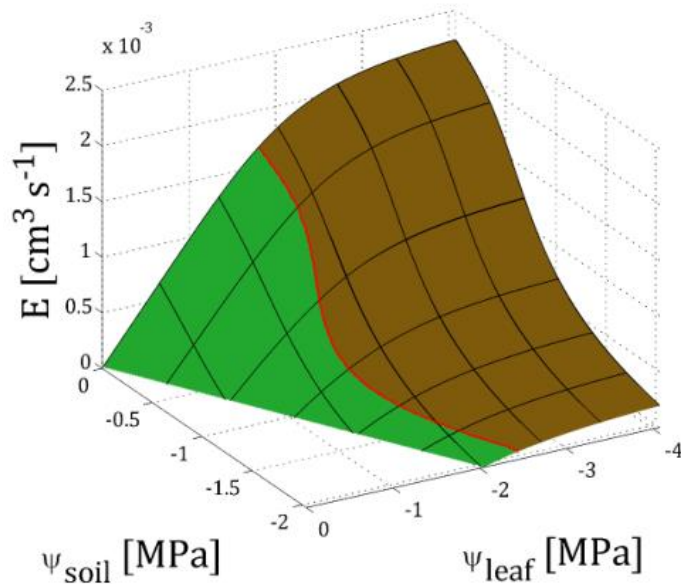
soil-plant hydraulic limit:
stress onset line (SOL)

soil texture,
root architecture,
plant traits, ...



Summary

From **soil-plant** hydraulic limitations to ...



Carminati & Javaux (2020) *Trends in Plant Science*

... hydraulic constraints on **stomatal** conductance (g_s)

