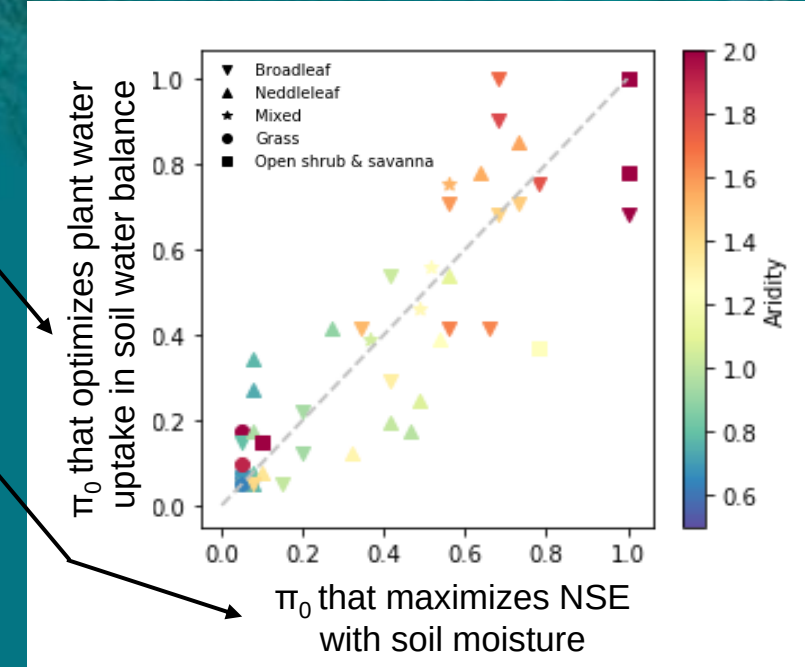
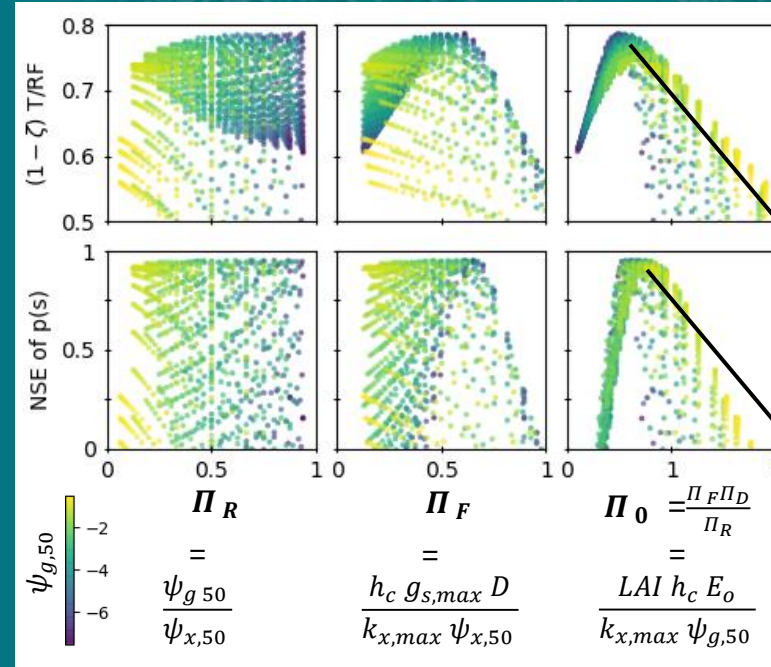
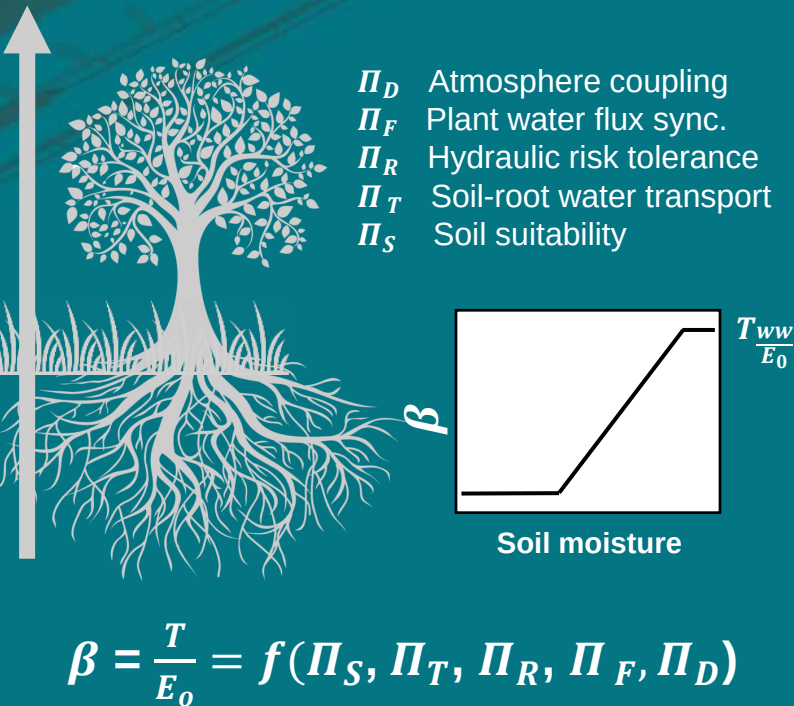


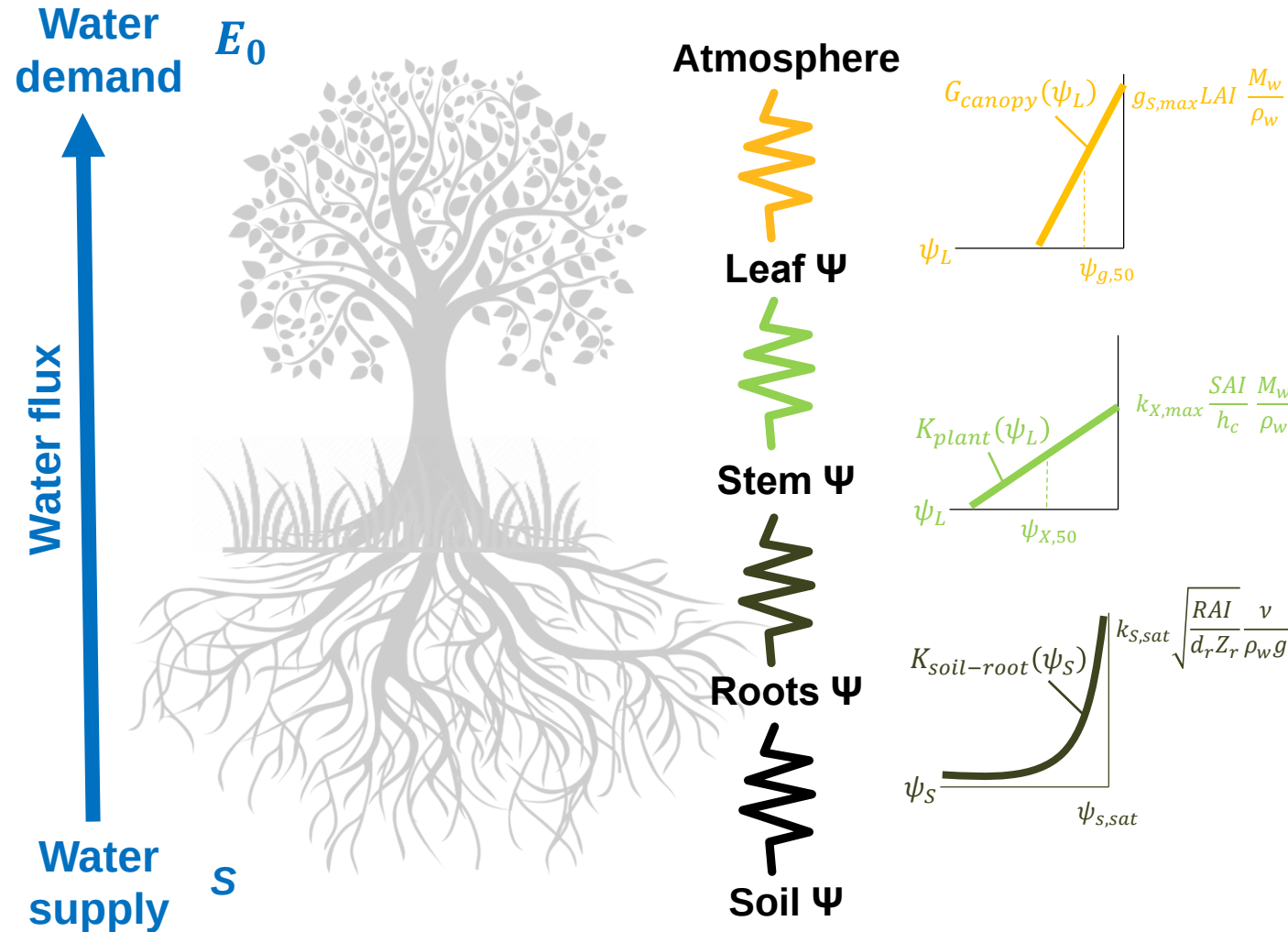


We reduce the complexity of the water flux through the soil-plant-atmosphere continuum by grouping plant functional traits with soil and climate variables into non-dimensional Π groups.

We derive an analytical equation for β as a function of these π groups, a simplified relation between soil moisture (s), atm. demand (E_0) and transpiration (T).

We explore trait values to find Π groups that match observed water balance and soil moisture probability distributions ($p(s)$). A dominant axis of variation in water use strategies ($\Pi_0 = \frac{\Pi_F \Pi_D}{\Pi_R}$) can characterize a diversity of co-existing species in an ecosystem. Π_0 depends on stomatal and xylem characteristics and accounts for veg. structure but is independent of plant functional type.

Observations in 60 biomes indicate that coordination in plant traits represented in Π_0 maximize growing season mean fraction of T to rainfall (RF) for local pedoclimatic conditions while minimizing the cost of vegetation stress (ζ). We can thus infer ecosystem water use strategies through Π_0 with a stochastic soil water balance and a parsimonious optimality criteria: $\max \left[\frac{T}{RF} (1 - \zeta) \right]$



Reduce the complexity of the soil-plant-atm. continuum with non-dimensional Π groups

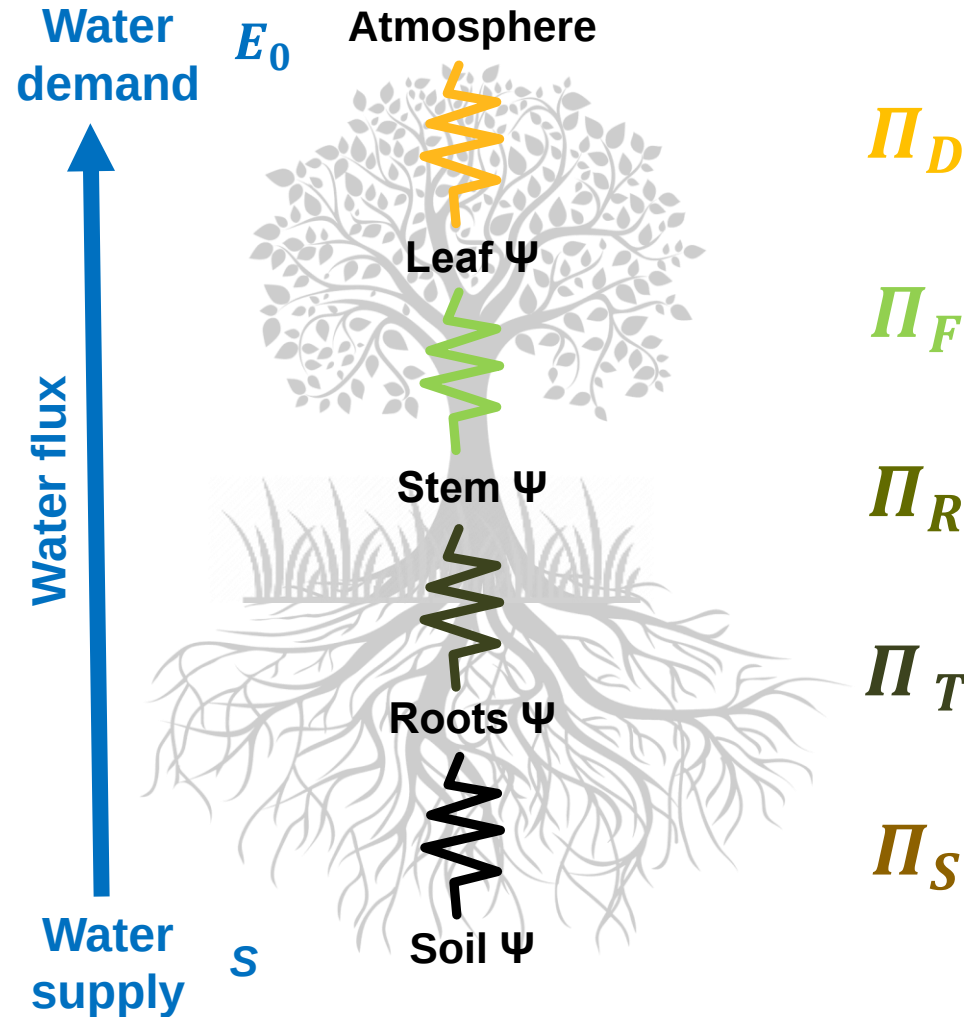
Π_D Atmosphere coupling

Π_F Plant water flux sync.

Π_R Hydraulic risk tolerance

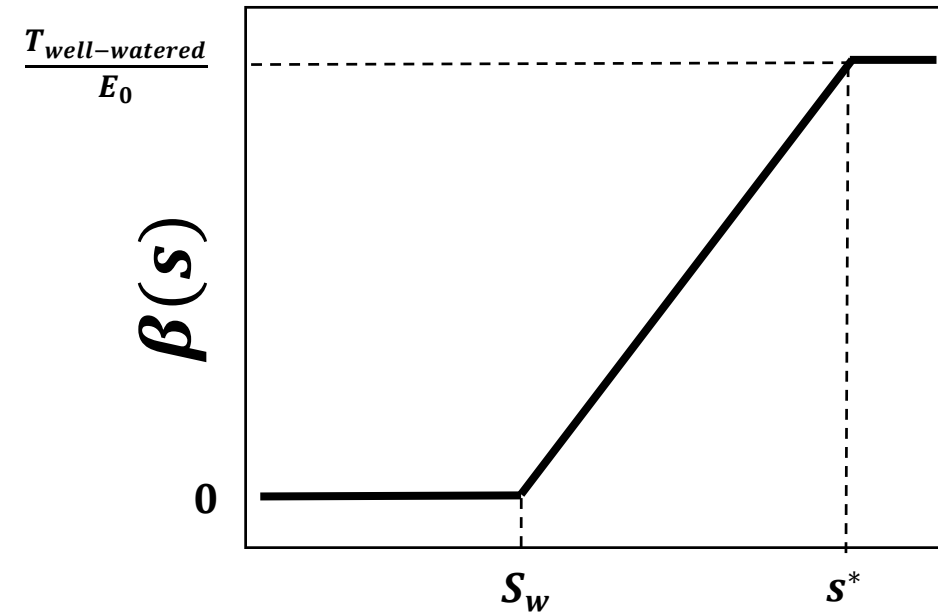
Π_T Soil-root water transport

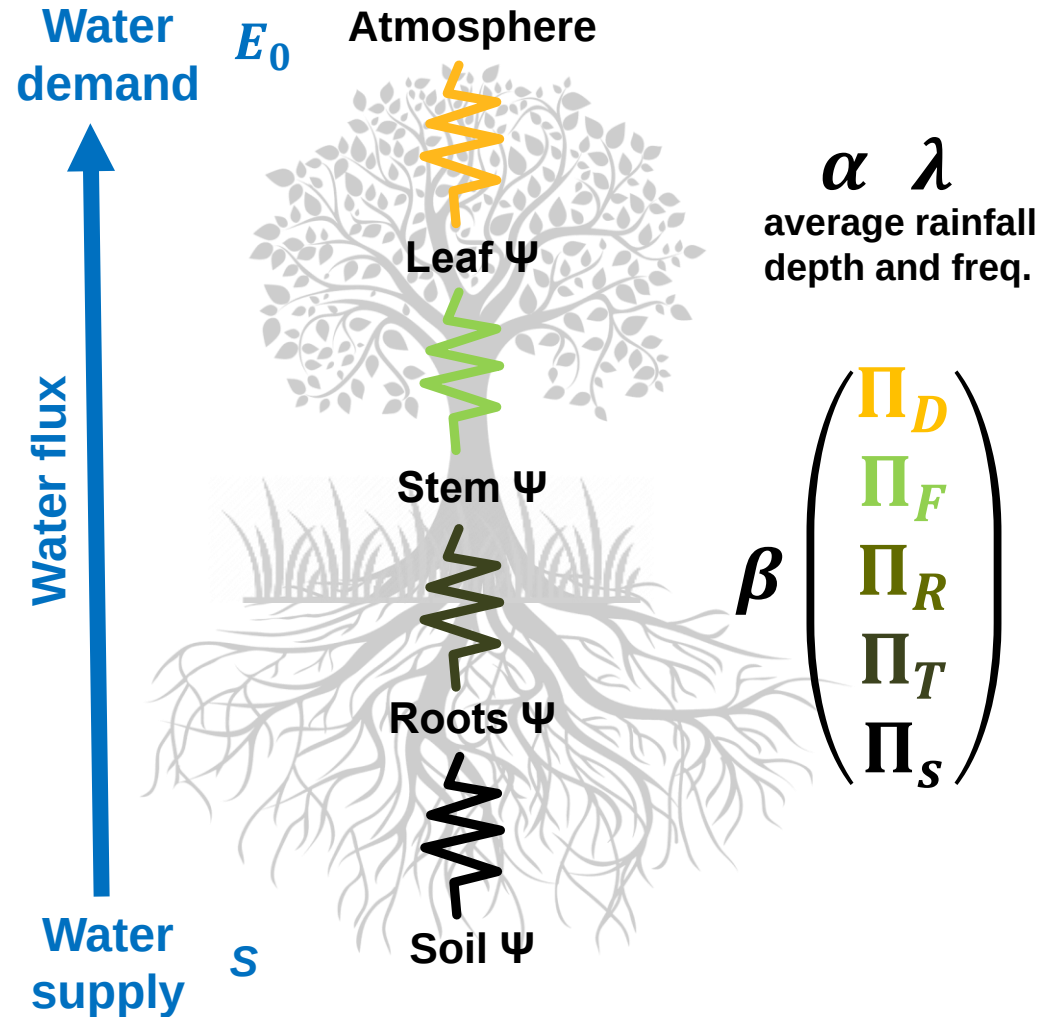
Π_S Soil suitability



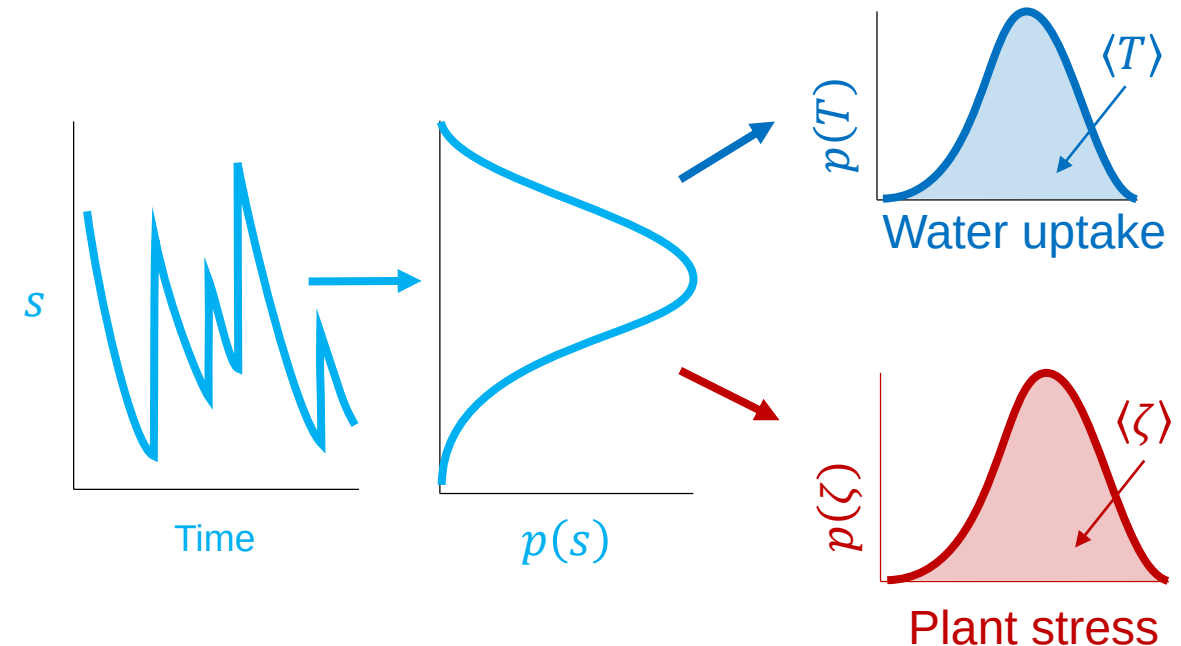
Simplified relation between transpiration (T), soil moisture (s), and atmospheric demand (E_0) as a function of Π groups

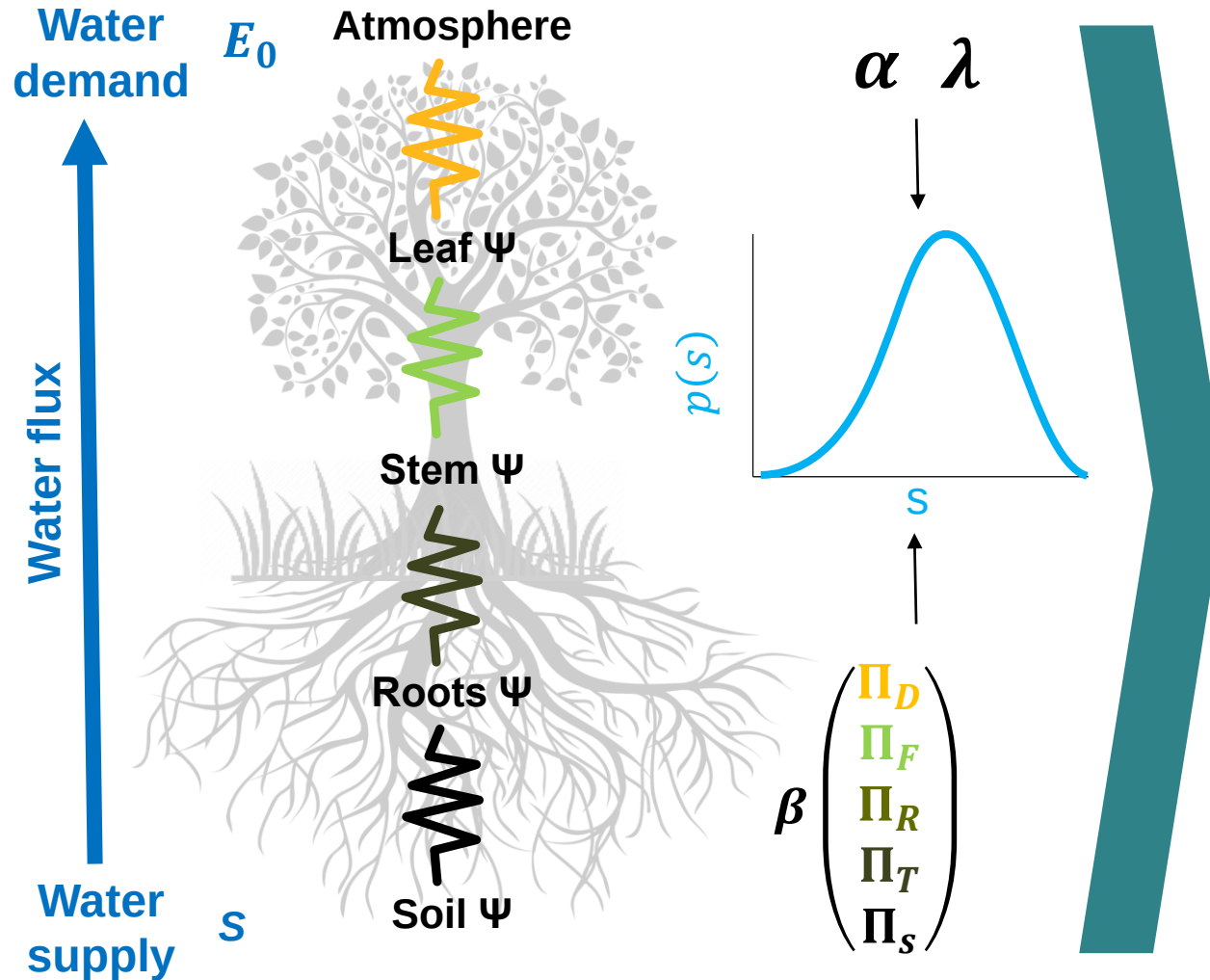
$$\beta = \frac{T}{E_0} = f(\Pi_S, \Pi_T, \Pi_R, \Pi_F, \Pi_D)$$



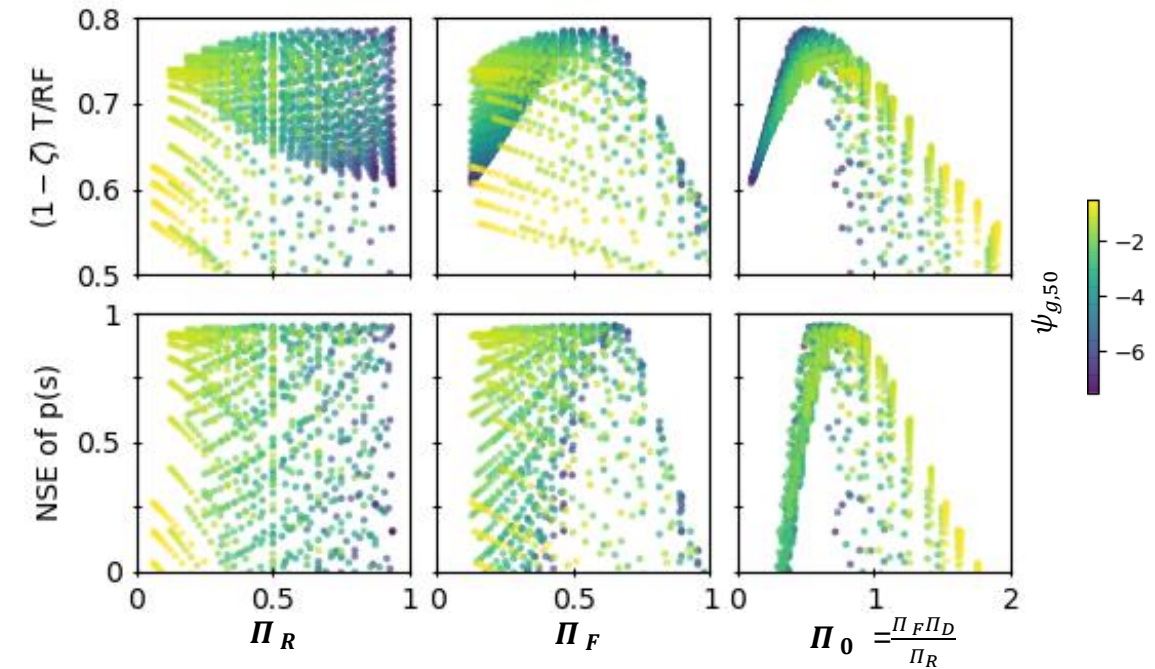


Implement the analytical function $\beta(\Pi)$ into a soil water balance forced with stochastic rainfall inputs and obtain probability density functions and long-term mean T and stress (ζ)

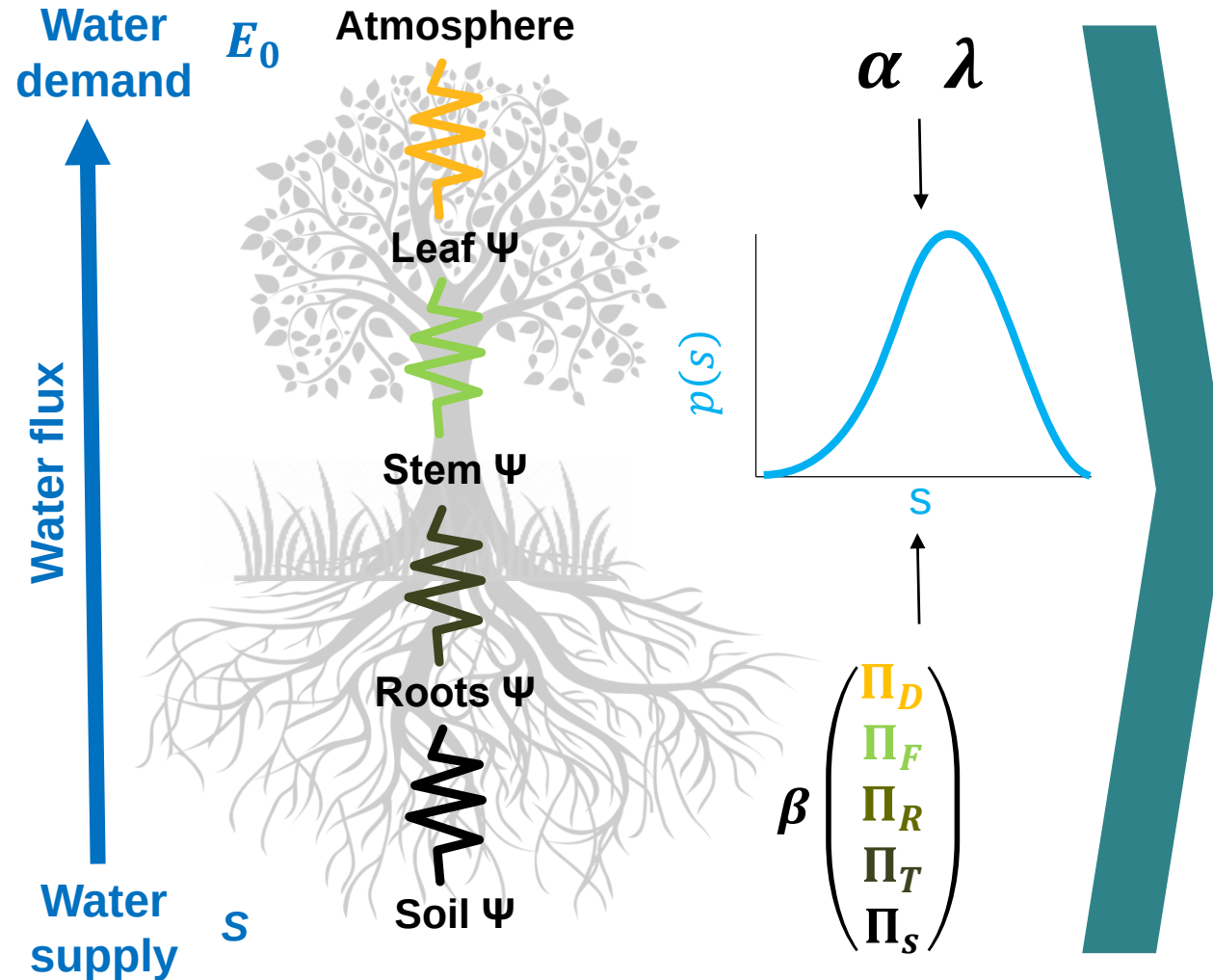




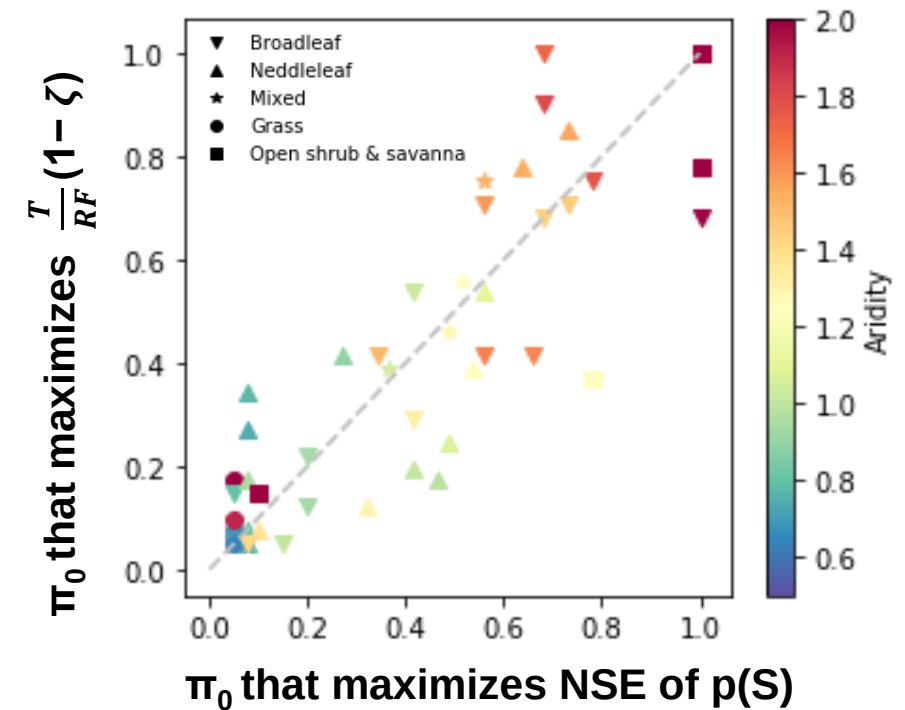
Π_0 , dominant axis of variation can characterize a diversity of co-existing species in an ecosystem.



Π_0 depends on stomatal and xylem characteristics and accounts for vegetation structure but is independent of plant functional type.



Use data in 60 biomes and explore plant trait values to find



Coordination in ecosystem traits optimize plant water uptake during the growing season