



APPLYING ECO-EVOLUTIONARY OPTIMALITY PRINCIPLES TO PREDICT LEAF AREA INDEX

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LAI/fAPAR framework

Assumption:

- (1) available carbon allocated to foliage is primarily limited by availability of carbon (energy) or water;
- (2) plants optimize carbon-water trade-off for maximum net carbon gain

Energy-limited fAPAR

$$P_n = A_0 * \underbrace{[1 - \exp(-k * LAI)]}_{\text{Vegetation greenness (fAPAR)}} - \underbrace{z}_{\text{Construction \& main-tenance cost of leaf}} * LAI$$

Net carbon gain

P_n reaches maximum when

$$LAI = (1/k) * \ln(kA_0/z), \text{ thus}$$

$$fAPAR = 1 - (z/kA_0)$$

Water-limited fAPAR

$$A = G_s * C_a(1 - \chi) = A_0 * fAPAR$$

CO₂ conductance

Optimal C_a/C_i ratio

$$T = 1.6G_s * VPD$$

Vapor pressure deficit

$$\text{Assume } f_0 = T/P,$$

$$fAPAR = [C_a(1 - \chi)/1.6VPD] * [f_0 * P/A_0]$$

Simulation Scheme

