Bottom-up approach

Transpiration $= \sum_j Q[j]$

H_{collar}

$Q[j]$

$H_{soil}[j]$ $K_x[j]$ $K_r[j]$ $H_x[j]$

3D root system architecture

$Q_{up}[i] = \sum_{j \in i} Q[j]$

$H_{soil}[i] \approx constant\ in\ i$

Upscaled 1D root water uptake model

H_{soil} Q_{up}

upscaling

$Q_{up}[i]$ $H_{soil}[i]$

Layer i

$$\mathbf{Q_{up}} = \mathbf{C4}\ \mathbf{H_{soil}} + H_{collar}\mathbf{C_5}$$

Top-down approach

Parallel root system   Big root system

H_{collar}

$Q_{up}[i]$ $K_{x,up}[i]$

$H_{soil}[i]$

$K_{r,up}[i]$

Estimation of root conductances in soil layers from root segment conductances
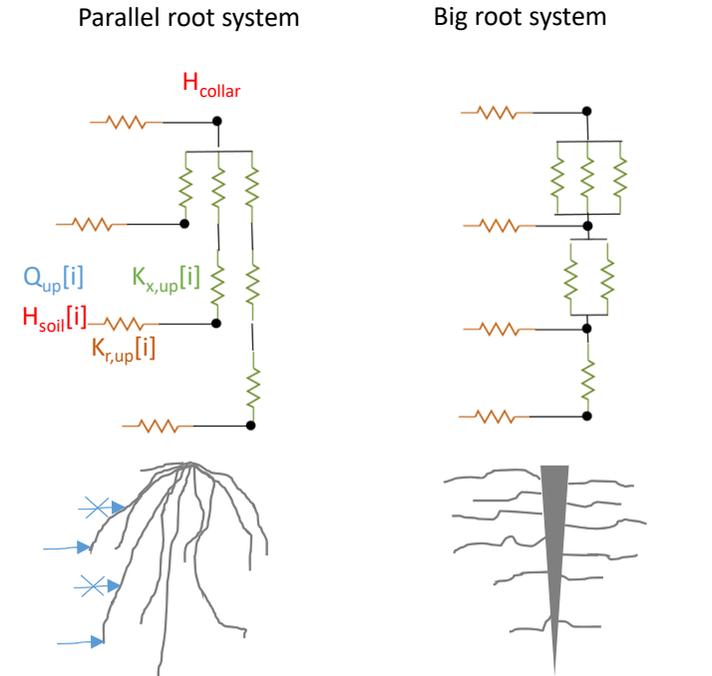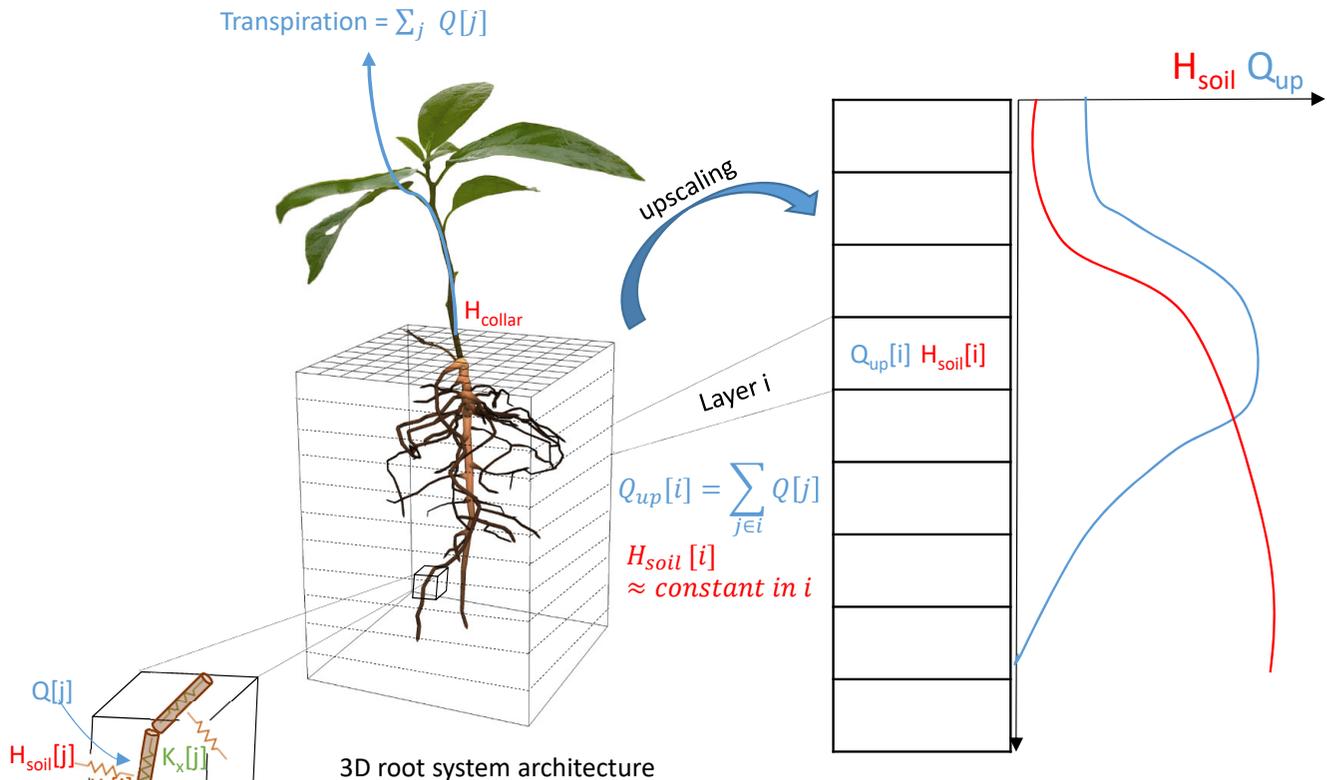
$K_{r,up}[i] = \sum_{j \in i} K_r[j]$ $K_{r,up}[i] = \sum_{j \in i} K_r[j]$

$K_{x,up}[i] = \infty$ $K_{x,up}[i] = f(K_x[j])_{j \in i}$

C$_4$ and **C$_5$** depend root segment conductances K_r and K_x and the connection of the segments in the 3D root architecture

C$_4$ and **C$_5$** depend on upscaled root segment conductances $K_{r,up}$ and $K_{x,up}$ and are derived based on an a priori concept of the root architecture and the connection of the segments