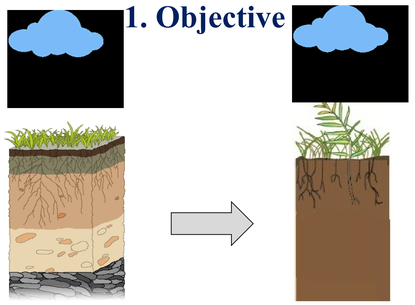
A Drainability Index for Layered Soils

Ali Mehmandoost Kotlar and Quirijn de Jong van Lier
University of Sao Paulo, Centre for Nuclear Energy in Agriculture (CENA), Brazil
(aliko@usp.br)

1. Objective



$$\frac{\partial \theta}{\partial t} = \frac{\partial}{\partial z}\left[k(h)\frac{\partial h}{\partial z} - k(h)\right] - S(h,z,t)$$

$$S(h,z,t) = \alpha(h)S_p = \alpha(h)\beta(z,t)Tp$$

$$T_p(t) = ET_0\left(1 - \exp\left(-kLAI(t)\right)\right)$$

$$ET_0 = \frac{0.408\Delta(R_n - G) + \gamma\frac{900}{T_{ave}+273}u_2\,(e_s - e_a)}{\Delta + \gamma(1 + 0.34u_2)}$$

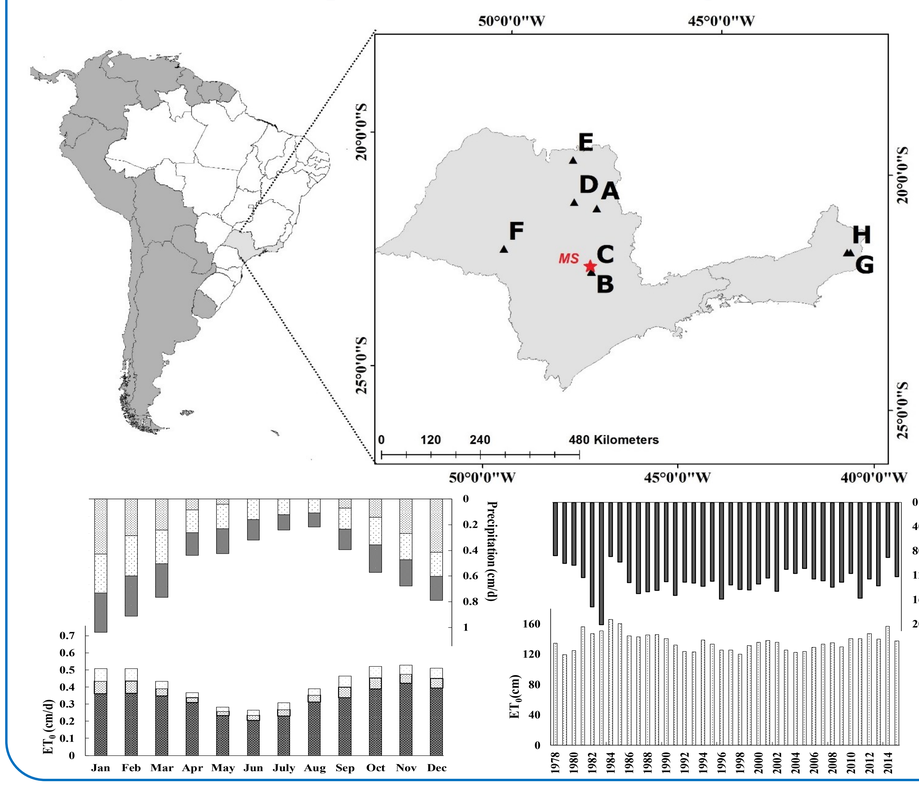
2. Problem?

Feasibility of simple representation of layered soil in order to estimate drainage was proposed using a **"Soil Drainability Index" (SDI)** based on the sum of water storage and relative hydraulic conductivity for all layers at an arbitrary value of field capacity.

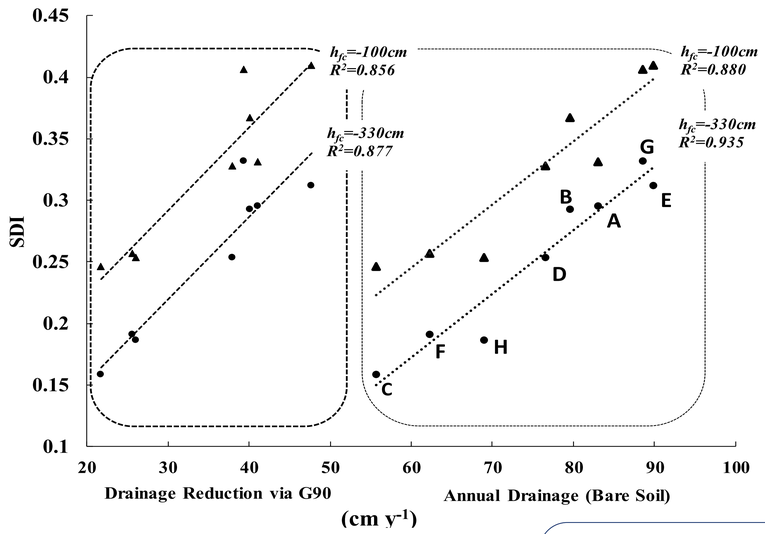
3. How?

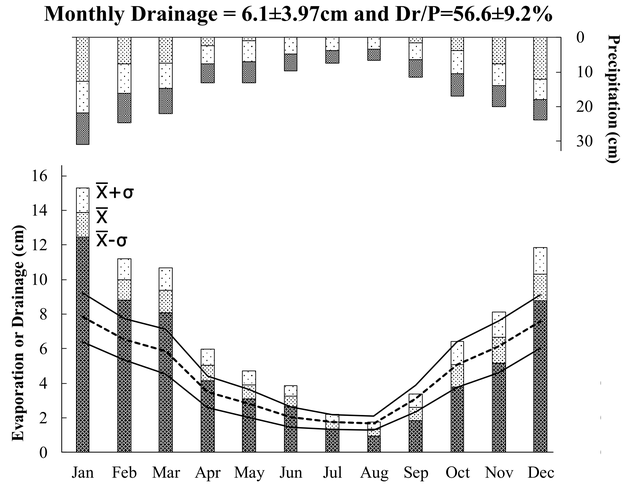
Numerical modeling of water flow for 8 layered soils from Brazil and 38 years of weather data under bare soil and grass covered lands with three different rooting depths (30, 60 and 90 cm) using HYDRUS-1D.

4. Study Site, Soil Samples (A to H) and Meteorological Station:



5. Results



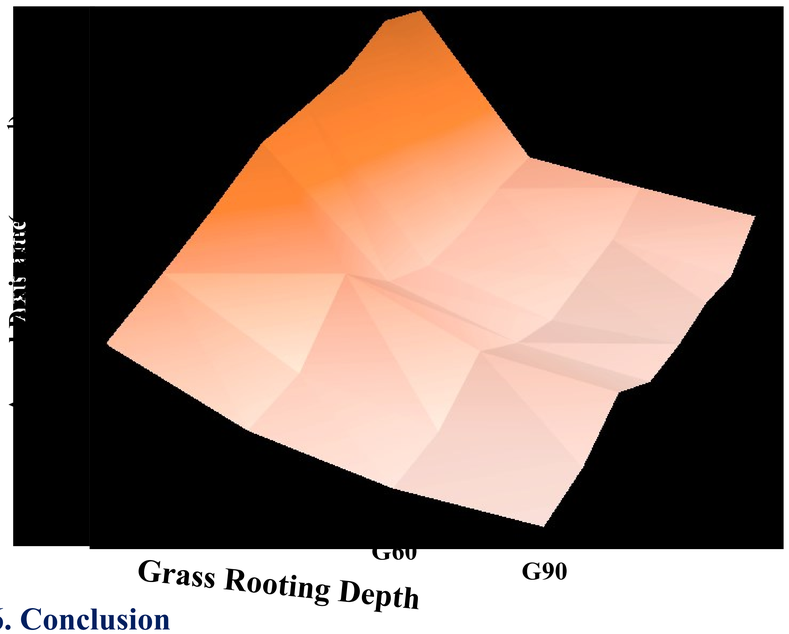


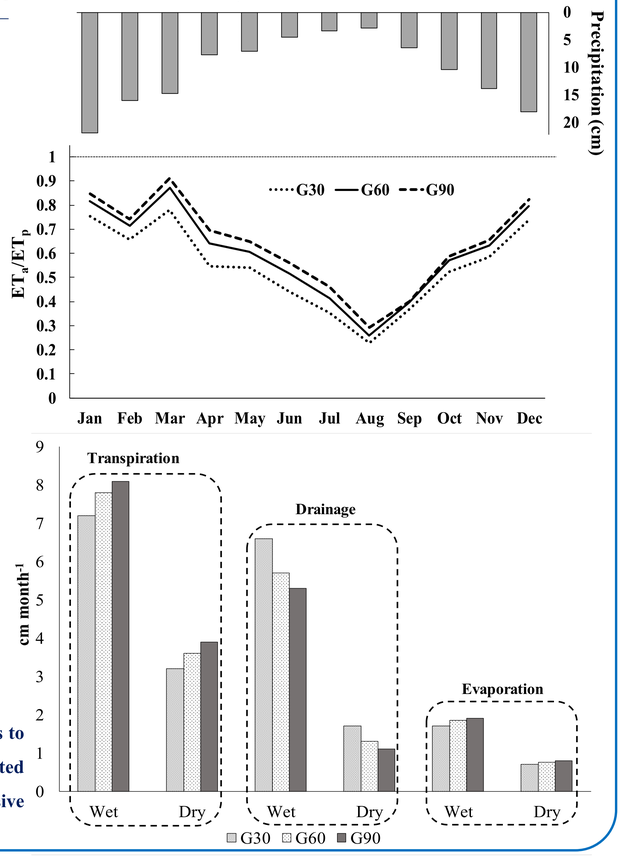
$$SDI = \left(\frac{1}{\sum L_i}\right)\left[\sum_{i=1}^{n}\left(\frac{K(\theta_{fc})}{K_s}L\theta_s\right)_i\right]$$

Static Pressure Head Criterion based on Field Capacity

i is number of layer in soil profile

n total number of layers in soil profile





6. Conclusion

Major: SDI seems an acceptable drainage estimating technique

Minor: 1. All grass scenarios suffered water stress so Rainfed agriculture even in rainy seasons needs to be well managed 2. Drainage increases by 25% if deep rooted savannah is altered by shallow rooted grass for grazing purposes. 3.Numerical modelling results of ET was comparable with expensive experimental studies performed in the literature.