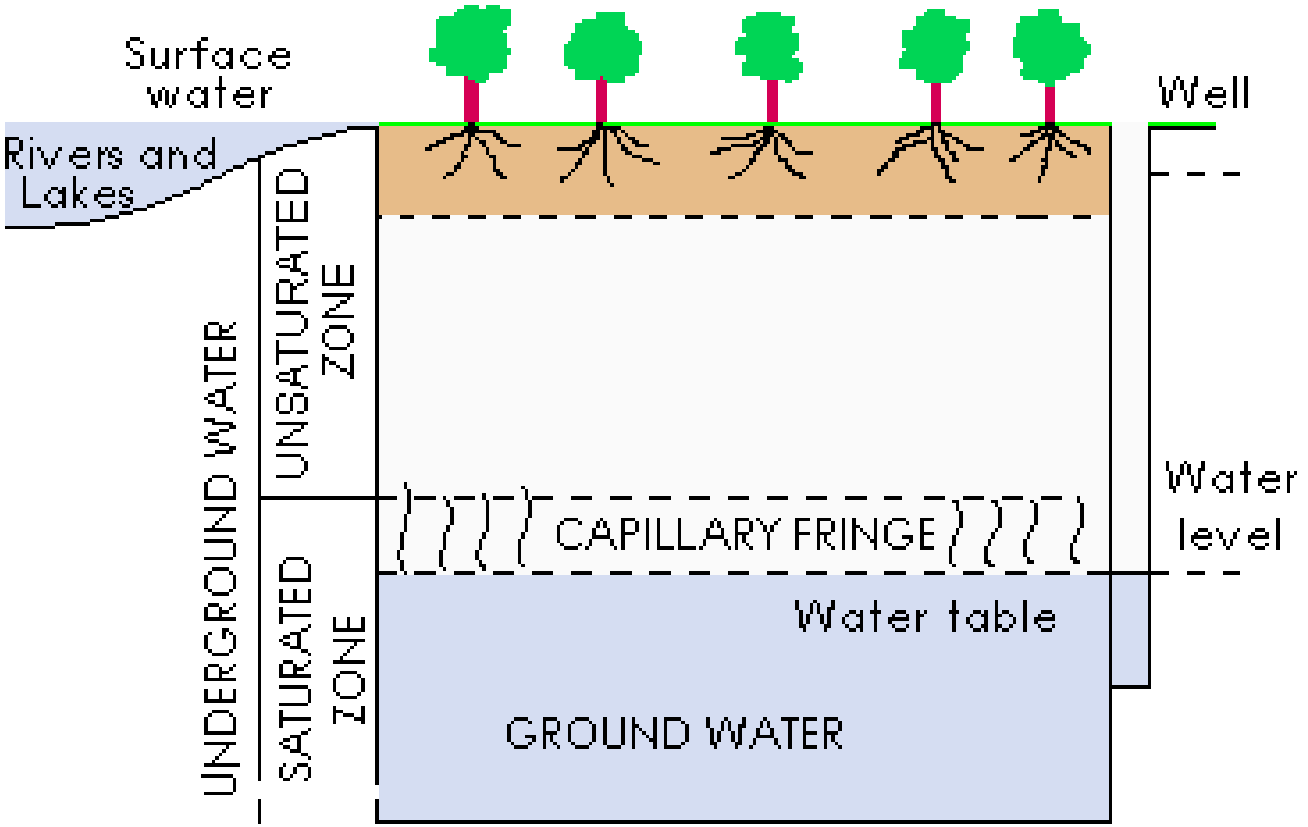
Measurements for water

A.M.J. Coenders

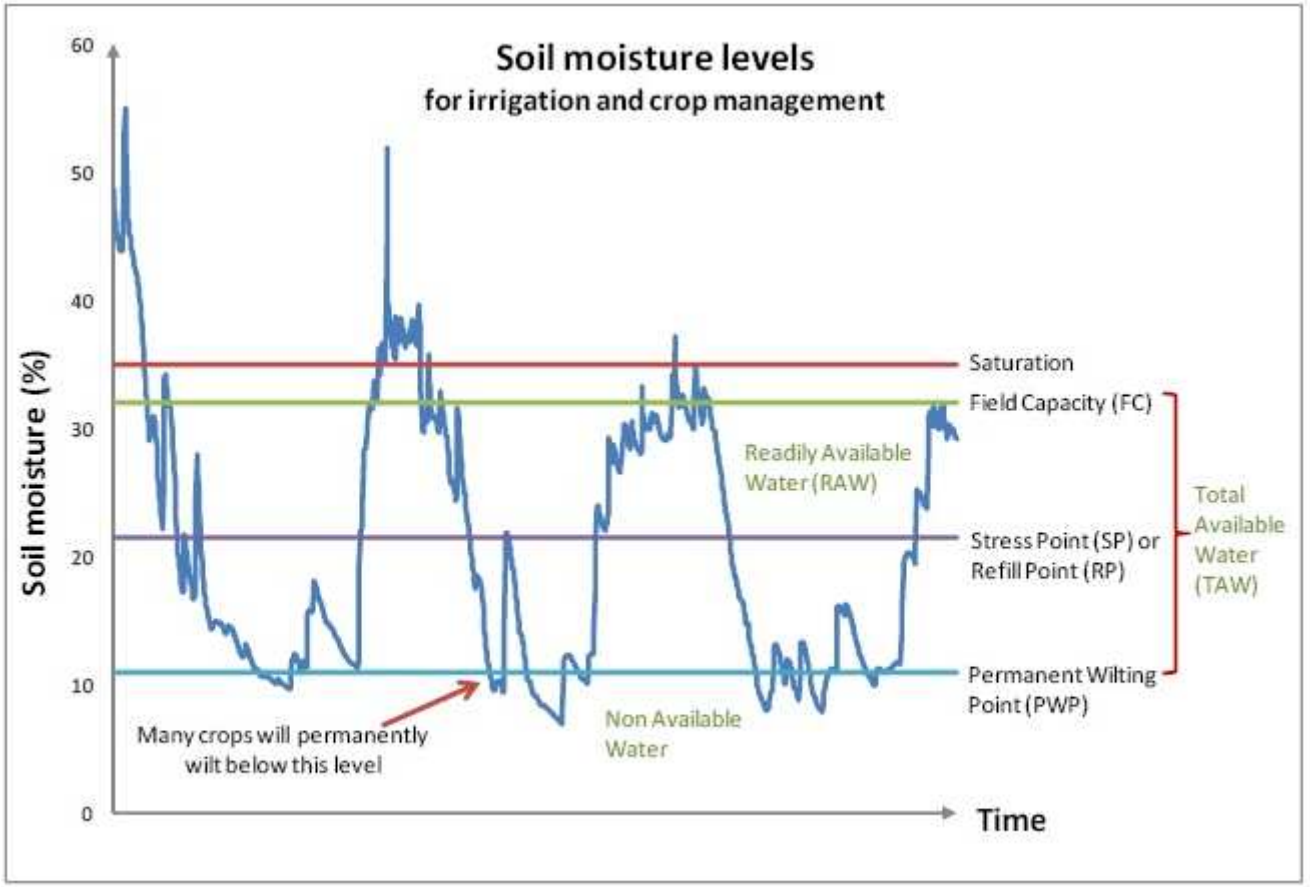
Waterbalans: Soil Water

Water in the soil

Unsaturated zone/ Vadose zone



Why is soil moisture important?



(Please note that these levels are indicative only. The soil water storage ability will vary between sites due to the influence of the sites soil type, aspect and crop type.)

Methods to measure soil moisture

- Direct
  - Gravimetric method
- Indirect by di-electric permittivity
  - Capacitance probe
  - Time Domain Reflectrometer (TDR)
  - Frequency Domain Reflectometry (FDR)
- Indirect by thermal conductivity
  - Heat Pulse Sensors

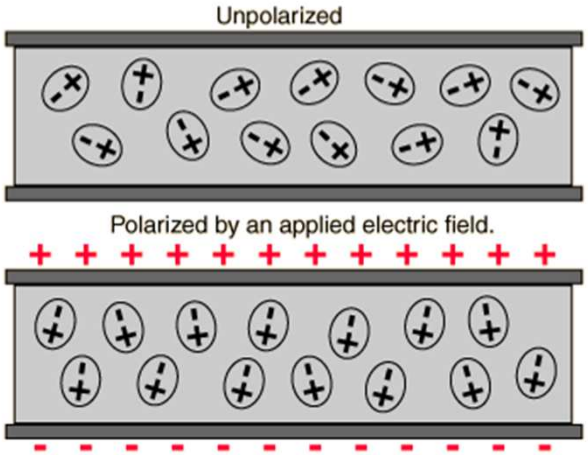
Gravimetric method

$$\theta = \frac{M_{sample} - M_{dry}}{M_{sat} - M_{dry}} = \frac{V_w}{V_t}$$

+ Cheap and straightforward
- Destructive and not continue

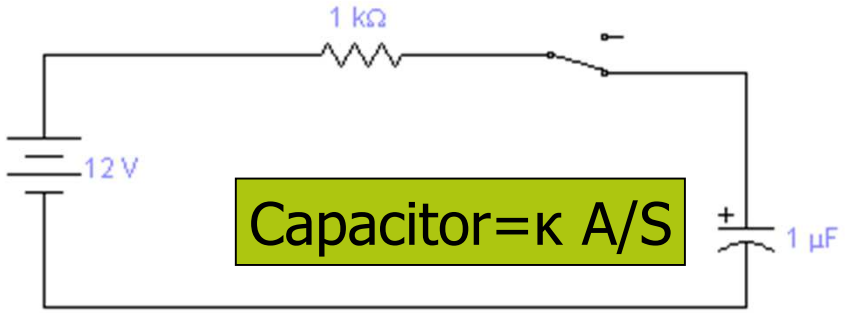
Dielectric permittivity

- Permittivity (ε) is a measure of the ability of a material to be polarized by an electric field
- $\kappa = \varepsilon/\varepsilon_0$ (ε_0 vacuum = 8 x 10^{-12} F/m)
- Dielectric permittivity is function of water content
  - κ vacuum = 1 (per definition)
  - κ soil = 2-5
  - κ water = 80

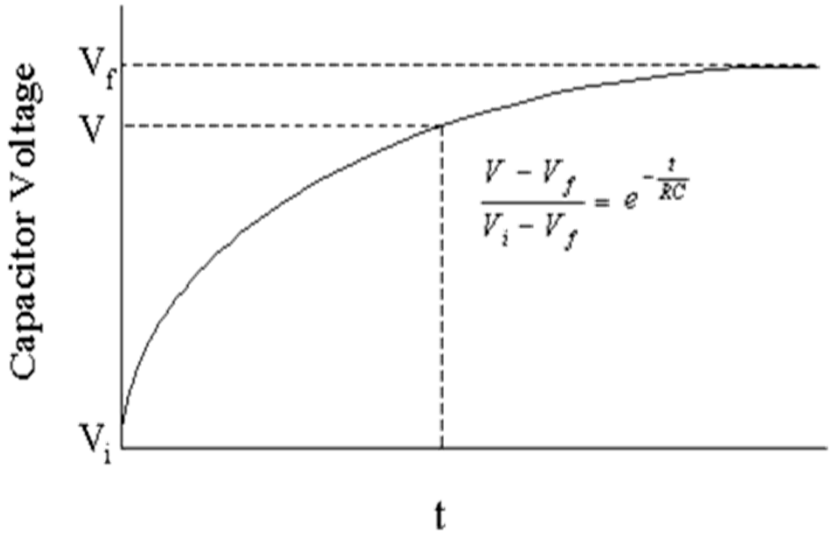


Capacitor probe

- Soil as a capacitor, C= κ A/S
- Measures charge time, t



$$\kappa = \frac{t}{\frac{RA}{S}\ln\left(\frac{V - V_f}{V_i - V_f}\right)}.$$



Time Domain Reflectometry (TDR)

- Measures travel time of high frequency electromagnetic wave

$$\kappa = \left(\frac{tc}{2L} \right)^2$$

- with L the transmission line, c= speed of light

- t short => ε low => θ low

- expensive

+ highly accurate, less sensitive for salinity and temperature

Frequency Domain Reflectometry (FDR)

- Measures frequency difference transmitted and reflected pulse

+ cheaper than TDR
- needs per soil type calibration

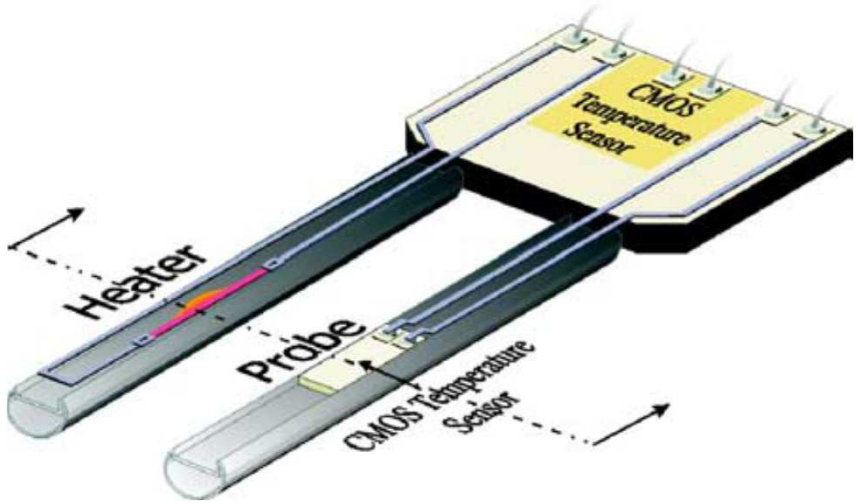
Heat Pulse Sensors

$$\rho c_p = 1.92X_m + 2.51X_o + 4.18\theta_v$$

$$T(r,t) = \frac{Q}{4\pi\kappa t}\exp\left(\frac{-r^2}{4\kappa t}\right)$$

$$Q = \frac{q}{\rho c_p}$$

$$\rho c_p = \frac{q}{\exp \pi r^2 \Delta T_M}$$



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