Faculty of Geo-Information Science and Earth Observation, ITC

This HE Teaching Material was supported by the EGU Higher Education Teaching Material Grant 2023

CROP WATER PRODUCTIVITY

AN ONLINE SHORT COURSE BY
DR. EGOR PRIKAZIUK
WITH SUPPORT OF
THE EUROPEAN GEOSCIENCE UNION, EGU

YOU WILL LEARN TO

1. **Explain** the link between **crop yield** and **crop water demand** (reading, lecture)

2. **Link** the **components** of crop water productivity (CWP), plant productivity, evapotranspiration, with the respective **Earth Observation (EO) based modelling techniques** (reading, lecture)

3. **Calculate crop yield** from EO-based **gross primary productivity** (GPP) estimates (exercise, Excel)

4. Identify **phenological metrics** (start, end of the growing season) from EO data (exercise, Excel)

5. Produce **meaningful**, growing season-related **estimates** of CWP (exercise, WaPOR)

6. Conclude on the **efficiency of the water management scheme** in the study area (case study)

$$gross\ WP = \frac{\Sigma_{SOS}^{EOS} GPP}{\Sigma_{SOS}^{EOS} ET}$$

PENMAN-MONTEITH (PM) EQUATION

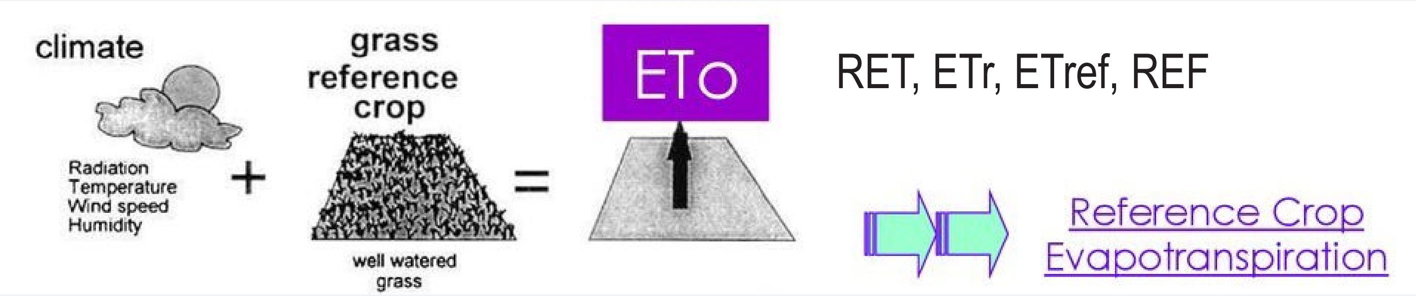
BY FAO

$$\lambda ET = \frac{\Delta(R_n - G) + \rho_a c_p \frac{(e_s - e_a)}{r_a}}{\Delta + \gamma(1 + \frac{r_s}{r_a})}$$

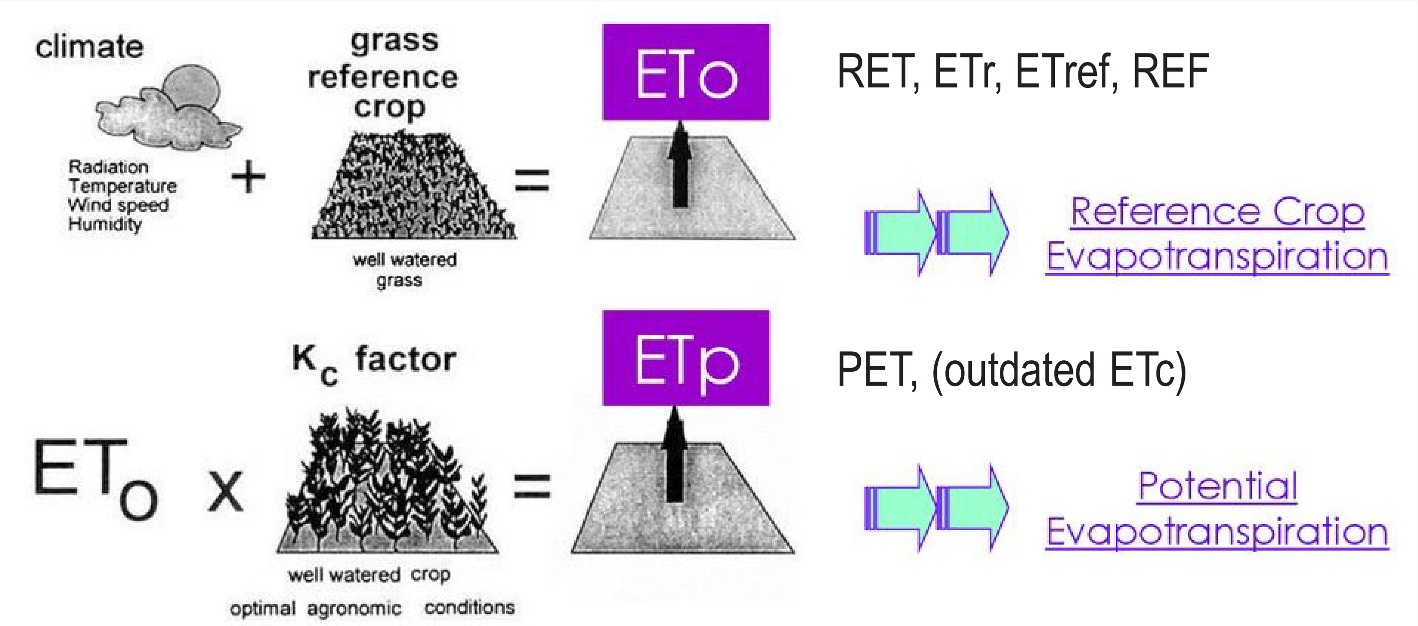
- Rn – G = A – available energy
- Δ - slope of e_s to air temperature curve (de_s / dT)
- $e_s - e_a$ = VPD – vapour pressure deficit of air
- ρ_a, C_p, γ, λ – constants
- r_s, r_a – resistances, surface and aerodynamic (depend on wind speed and canopy type)

WaPOR User manual p 12-13, eq 3 https://www.fao.org/3/I7315EN/i7315en.pdf

$$gross\ WP = \frac{\Sigma_{SOS}^{EOS} GPP}{\Sigma_{SOS}^{EOS} ET}$$



$$gross\ WP = \frac{\Sigma_{SOS}^{EOS} GPP}{\Sigma_{SOS}^{EOS} ET}$$



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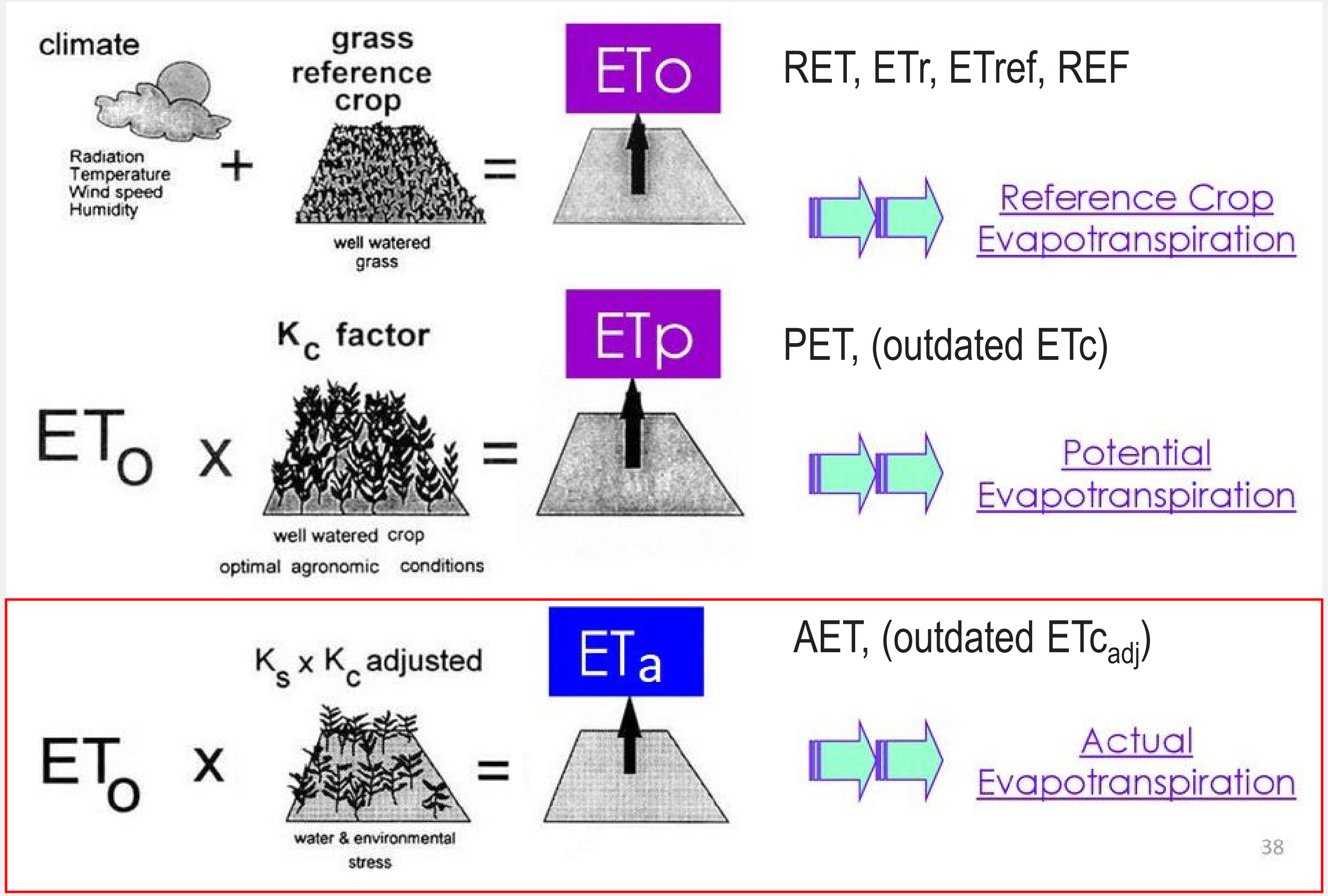
$$gross\ WP = \frac{\Sigma_{SOS}^{EOS} GPP}{\Sigma_{SOS}^{EOS} ET}$$



- CWP uses **actual** evapotranspiration, AET

https://slideplayer.com/slide/16104877/

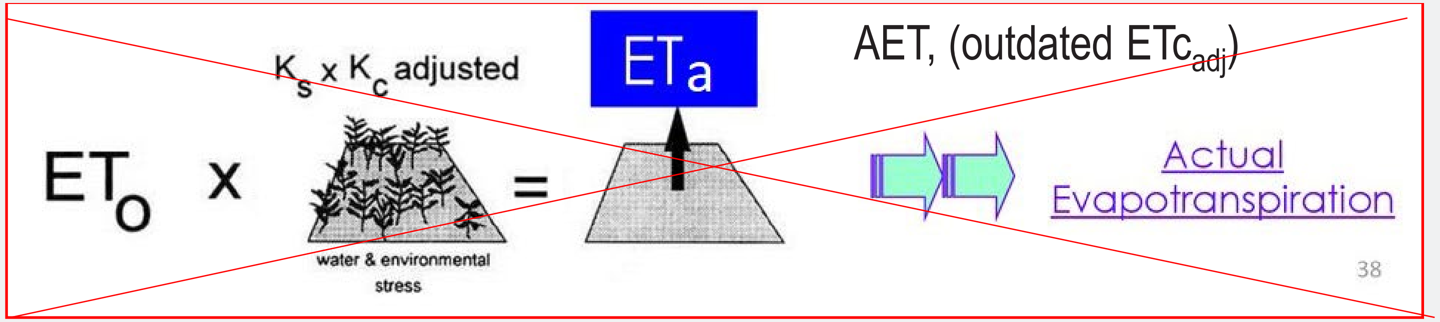
$$gross\ WP = \frac{\Sigma_{SOS}^{EOS} GPP}{\Sigma_{SOS}^{EOS} ET}$$

$$\lambda E = \frac{\Delta(R_{n,soil} - G) + \rho_a c_p \dfrac{(e_s - e_a)}{r_{a,soil}}}{\Delta + \gamma(1 + \dfrac{r_{s,soil}}{r_{a,soil}})} \quad (4)$$

$$\lambda T = \frac{\Delta(R_{n,canopy}) + \rho_a c_p \dfrac{(e_s - e_a)}{r_{a,canopy}}}{\Delta + \gamma(1 + \dfrac{r_{s,canopy}}{r_{a,canopy}})} \quad (5)$$

Fractional cover computed from NDVI

- partitions net radiation Rn between soil (E) and canopy (T)
- adjusts resistances



- CWP uses **actual** evapotranspiration, AET
- WaPOR computes Penman-Monteith without crop coefficients

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