



2444-9

College on Soil Physics – 30th Anniversary (1983–2013)

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Agroclimatic data collection and processing

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Food and Agriculture Organization
Land and Water Division



Training modules

3. Agroclimatic data collection and processing

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prepared by Dirk Raes

FAO Penman Monteith equation

$$ET_o = \frac{0.408 \Delta (R_n - G) + \gamma \frac{900}{(T+273)} u_2 (e_s - e_a)}{\Delta + \gamma (1 + 0.34 u_2)}$$

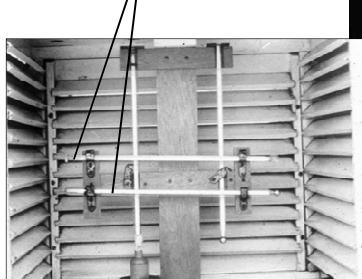
radiation air temperature air humidity
 Rn 900 γ
 G $(T+273)$ u_2
 T wind speed

ET_o reference evapotranspiration [mm day⁻¹],
R_n net radiation at the crop surface [MJ m⁻² day⁻¹],
G soil heat flux density [MJ m⁻² day⁻¹],
T mean daily air temperature at 2 m height [°C],
u₂ wind speed at 2 m height [m s⁻¹],
e_s saturation vapour pressure [kPa],
e_a actual vapour pressure [kPa],
e_{s-ea} saturation vapour pressure deficit [kPa],
Δ slope vapour pressure curve [kPa °C⁻¹],
γ psychrometric constant [kPa °C⁻¹].

1. Temperature data (T)

$$T = \frac{T_{\min} + T_{\max}}{2}$$

minimum and maximum thermometers



ET_o calculator

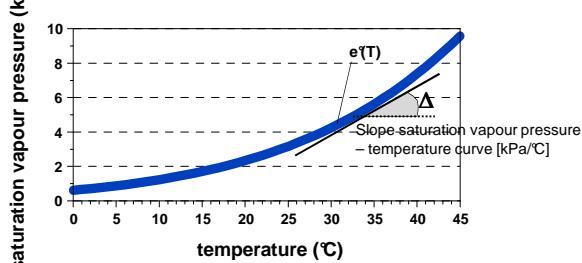
Input data description

Air temperature	
<input type="checkbox"/> Mean temperature	<input checked="" type="radio"/> ° Celsius
<input type="checkbox"/> Minimum and Maximum temperature	<input type="radio"/> ° Fahrenheit

2. Vapour pressure deficit ($e_s - e_a$)

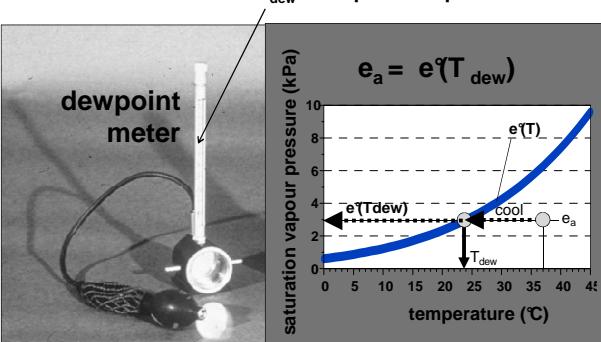
e_s : saturation vapour pressure (kPa)

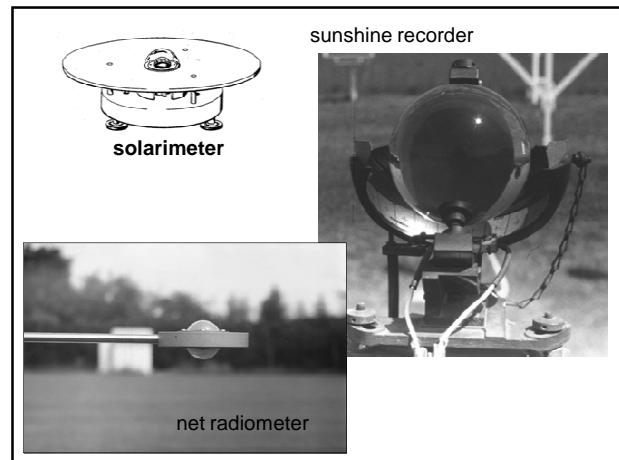
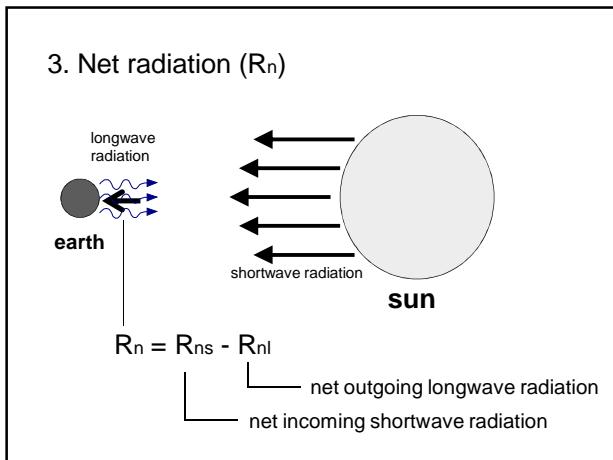
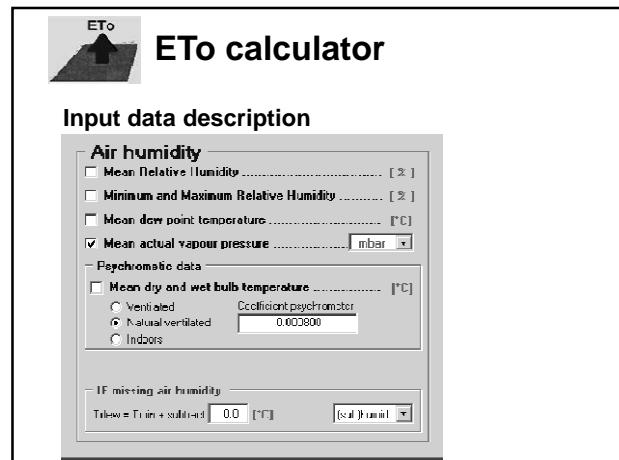
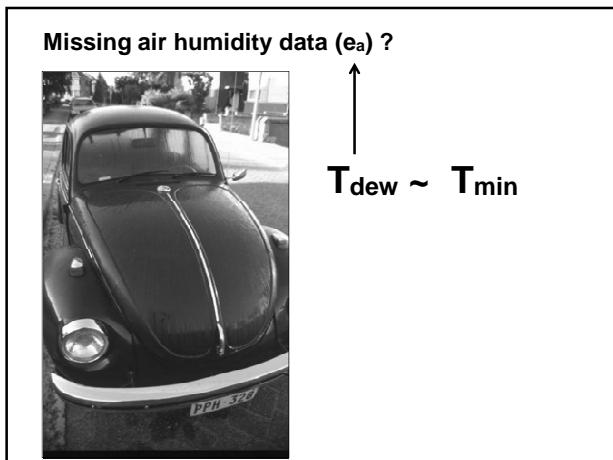
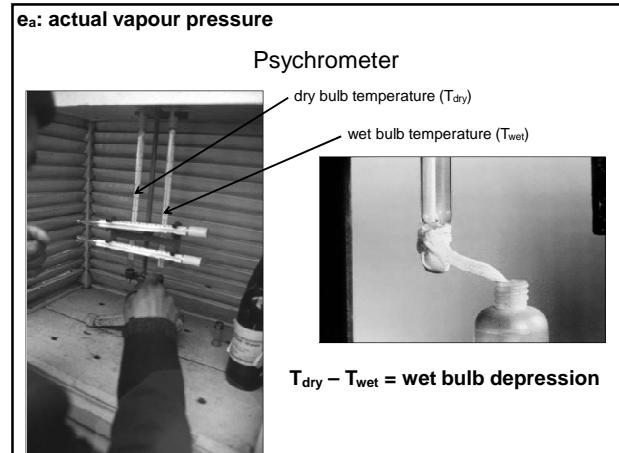
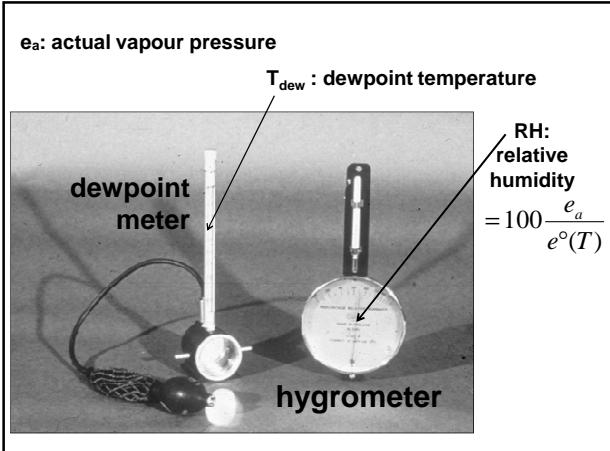
e_a : actual vapour pressure (kPa)

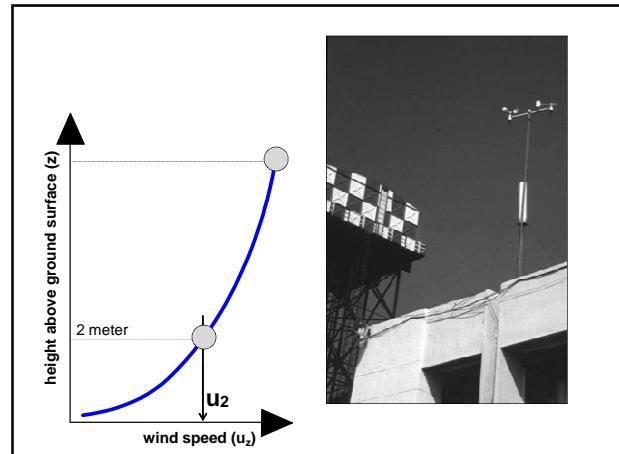
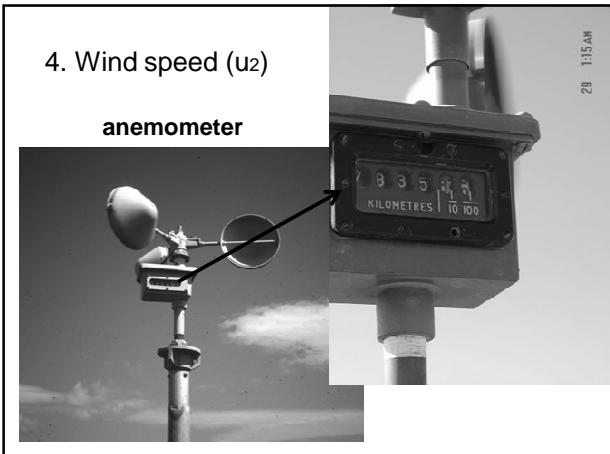
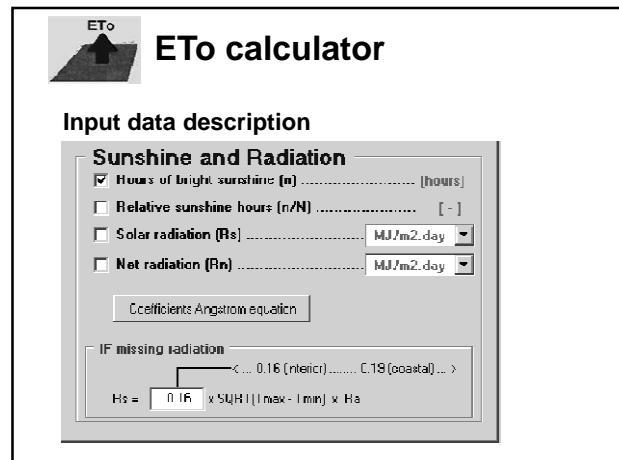
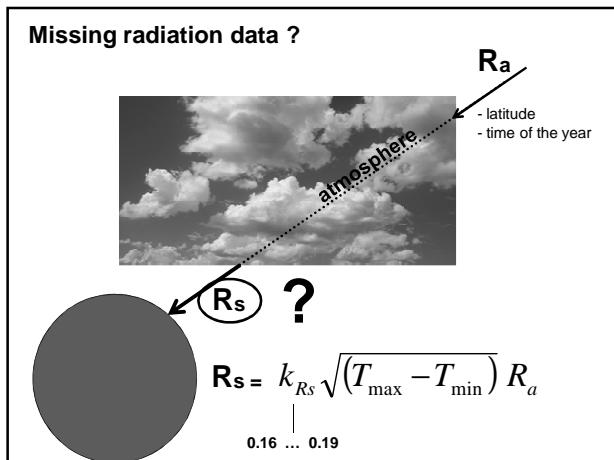
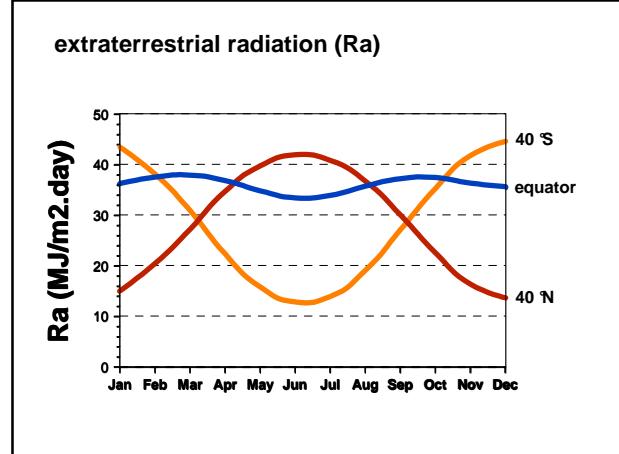
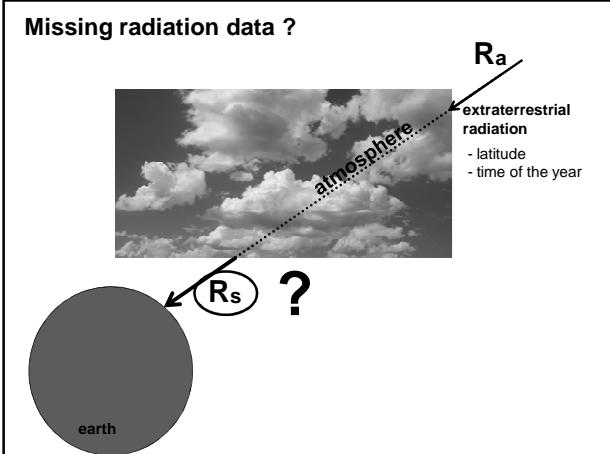


e_a : actual vapour pressure

T_{dew} : dewpoint temperature







 **ETO calculator**

Input data description

Wind speed

Mean wind speed m/sec [x]
height of measurement 10.0 [meter]

IF missing wind speed
U2 = 2.0 m/sec light to moderate wind

$$ET_o = \frac{0.408 \Delta (R_n - G) + \gamma \frac{900}{(T+273)} u_2 (e_s - e_a)}{\Delta + \gamma(1 + 0.34 u_2)}$$

G : soil heat flux ~ 0 for day and ten-day periods

γ : psychrometric constant $\longrightarrow f(\text{altitude})$

Δ : slope of saturation vapour pressure curve
 $\longrightarrow f(\text{temperature})$

 **ETO calculator**

Station description

Location: Degrees and Minutes Decimal degrees

Latitude: 22 degrees 22 minutes North

Longitude: 22 degrees 22 minutes East

Altitude: 222 meter above sea level

Meteorological Data

Type: Daily 10-daily Monthly

Time range:

Location

- at the coast
- interior location
- in arid or semiarid area
- in semihumid or humid area
- light winds in area
- light to moderate winds in area
- moderate to strong winds in area