Getting your Feet Wet in California: Improving Crop Coefficients

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AIAM

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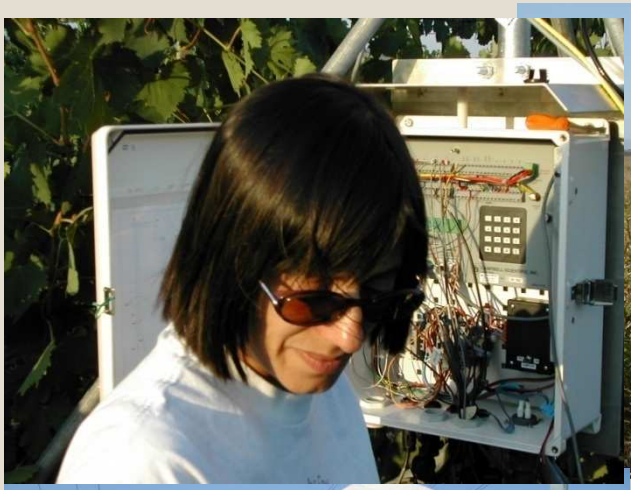
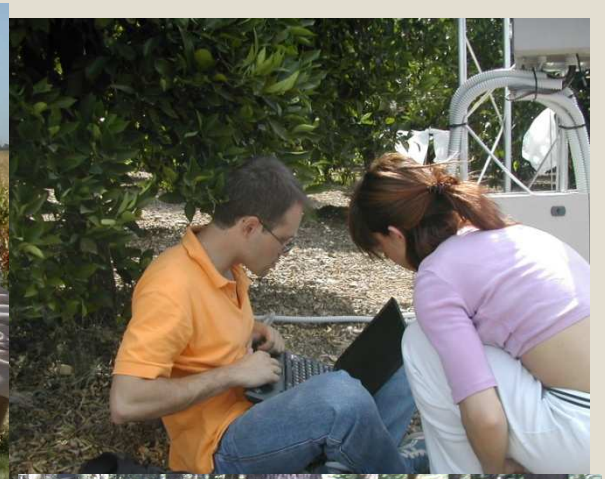
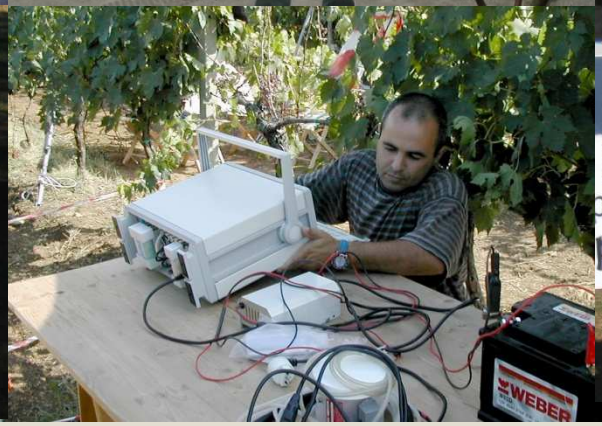




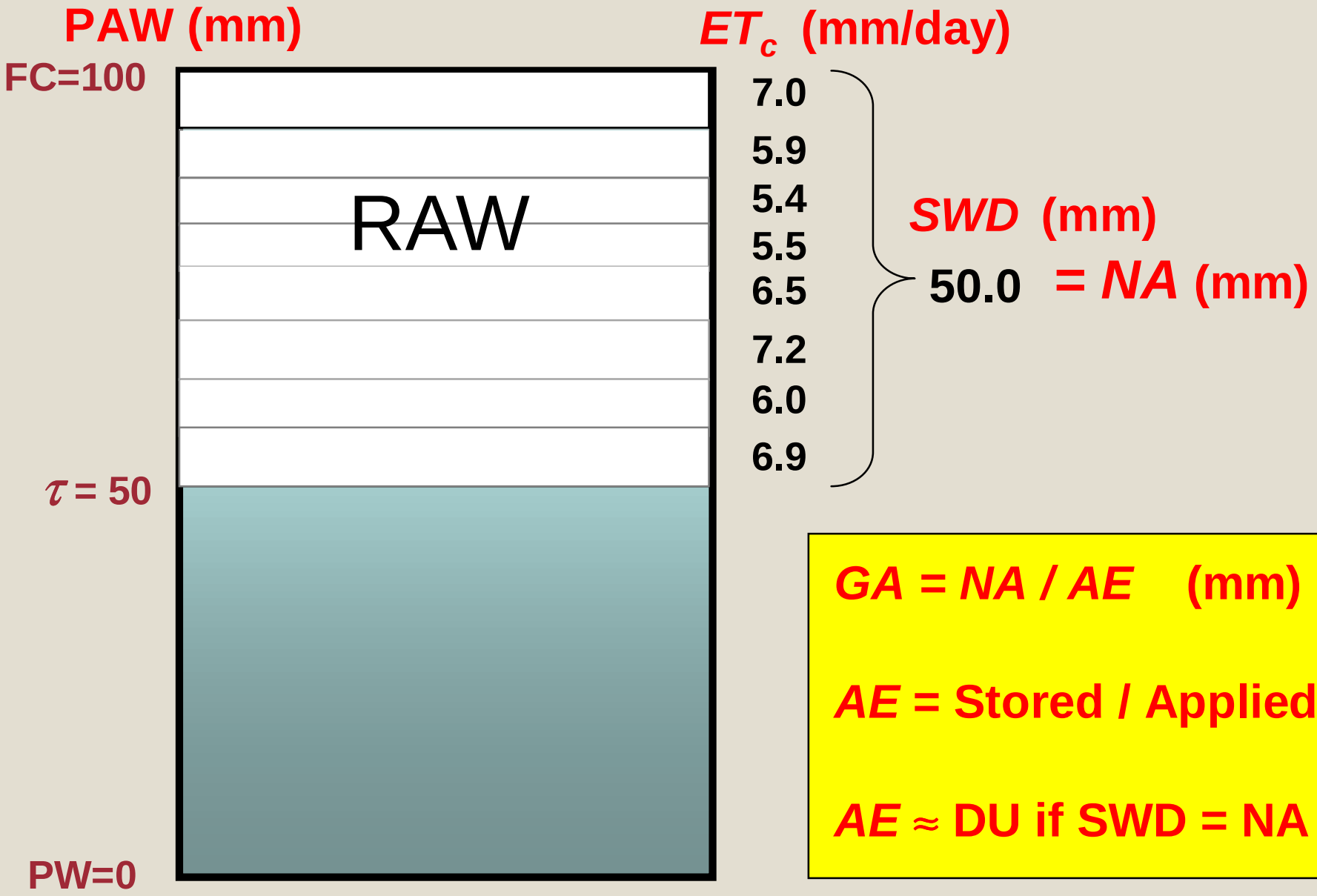

DAVIS
SAILING


ABEL'S
PUMPKIN
PATCH


WEBER


ABEL'S
PUMPKIN
PATCH

Basic Irrigation Scheduling



GA = NA / AE (mm)

AE = Stored / Applied

AE ≈ DU if SWD = NA

Research Needed

1. Crop Coefficients
2. Separating E & T
   a. Irrigation Method
   b. Wetting Frequency
   c. Row Orientation
3. Fog, Dew, and Light Rain
4. Water Tables
5. System Evaluations

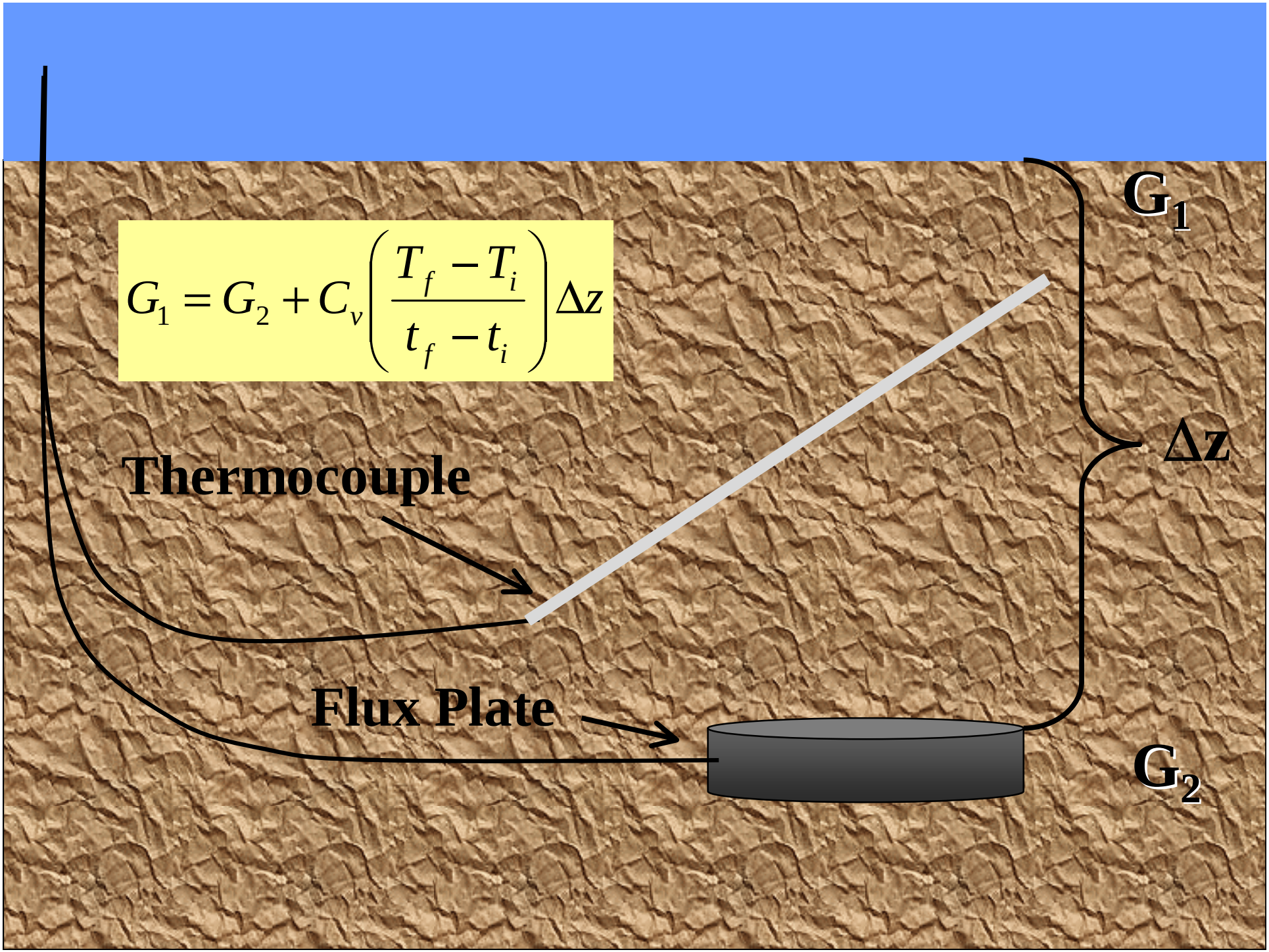
$$LE = R_n - G - H$$

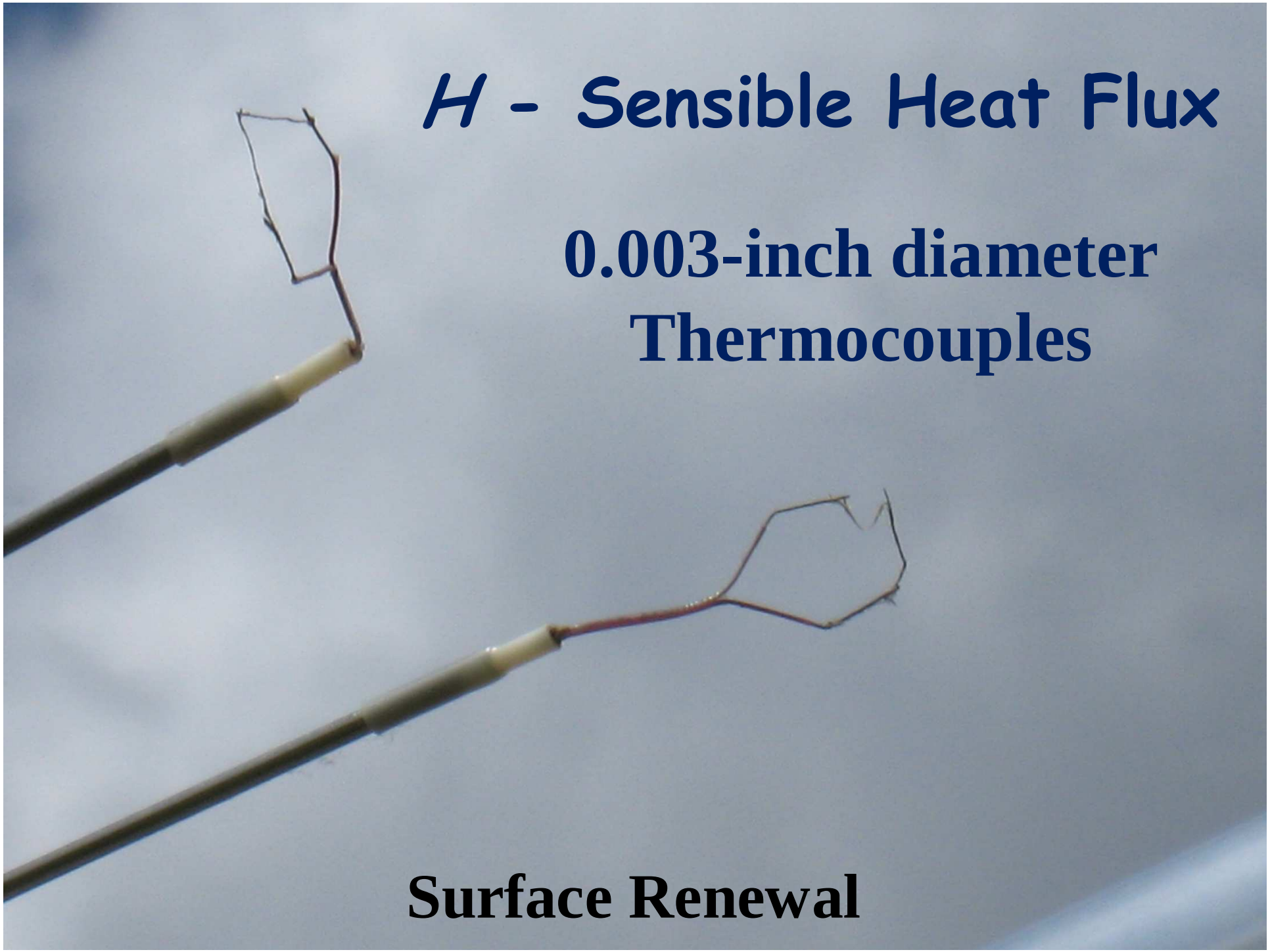
- R_n - **Net Radiation**
  (net radiometer)
- *G* – **Water & Soil Heat Flux Density**
  (heat flux plates & thermistors)
- *H* - **Sensible Heat Flux Density**
  (sonic or surface renewal)

LE/L=E=ET **where *L* = 2.45 MJ kg^{-1}**

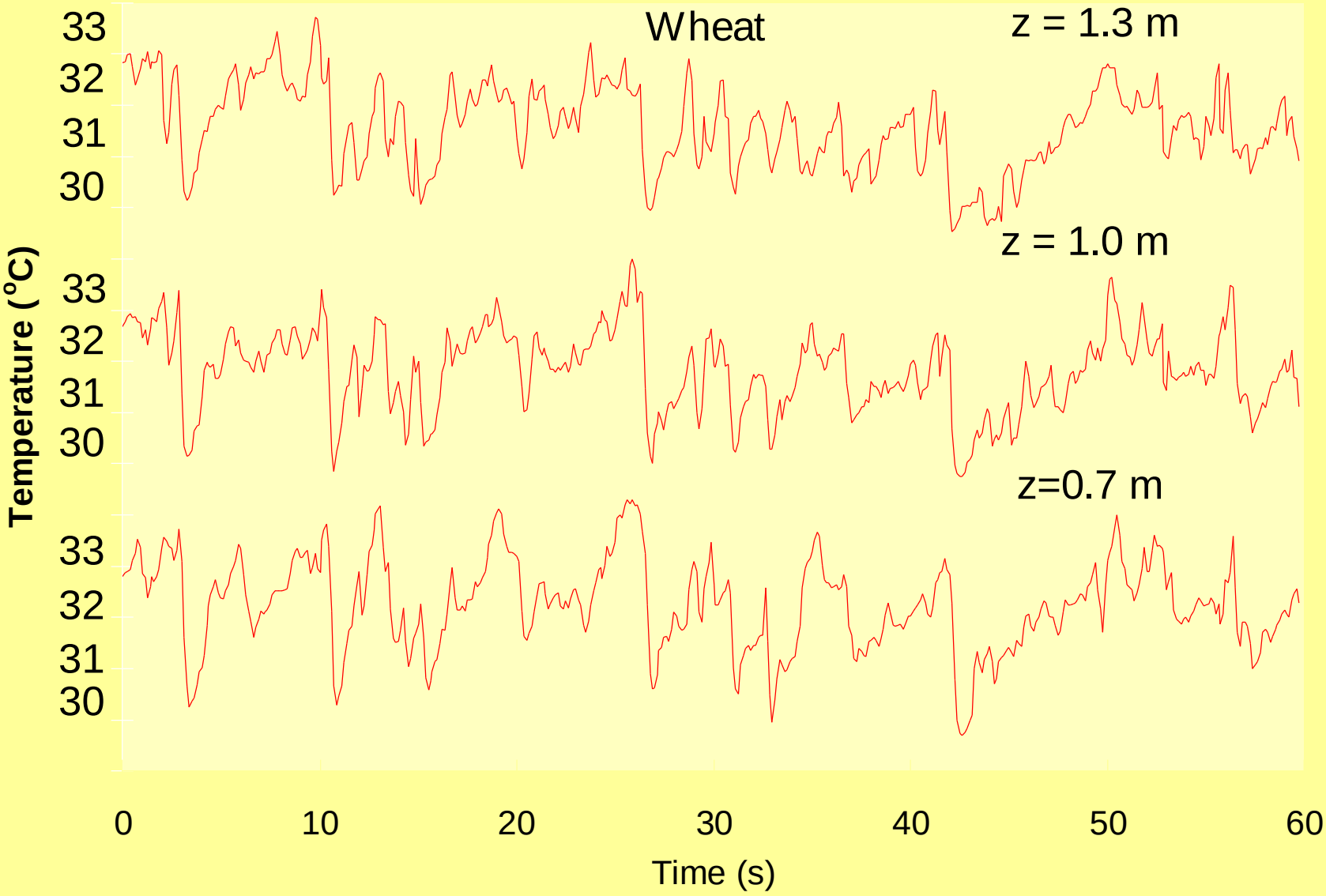
Anemometer

Net Radiometer

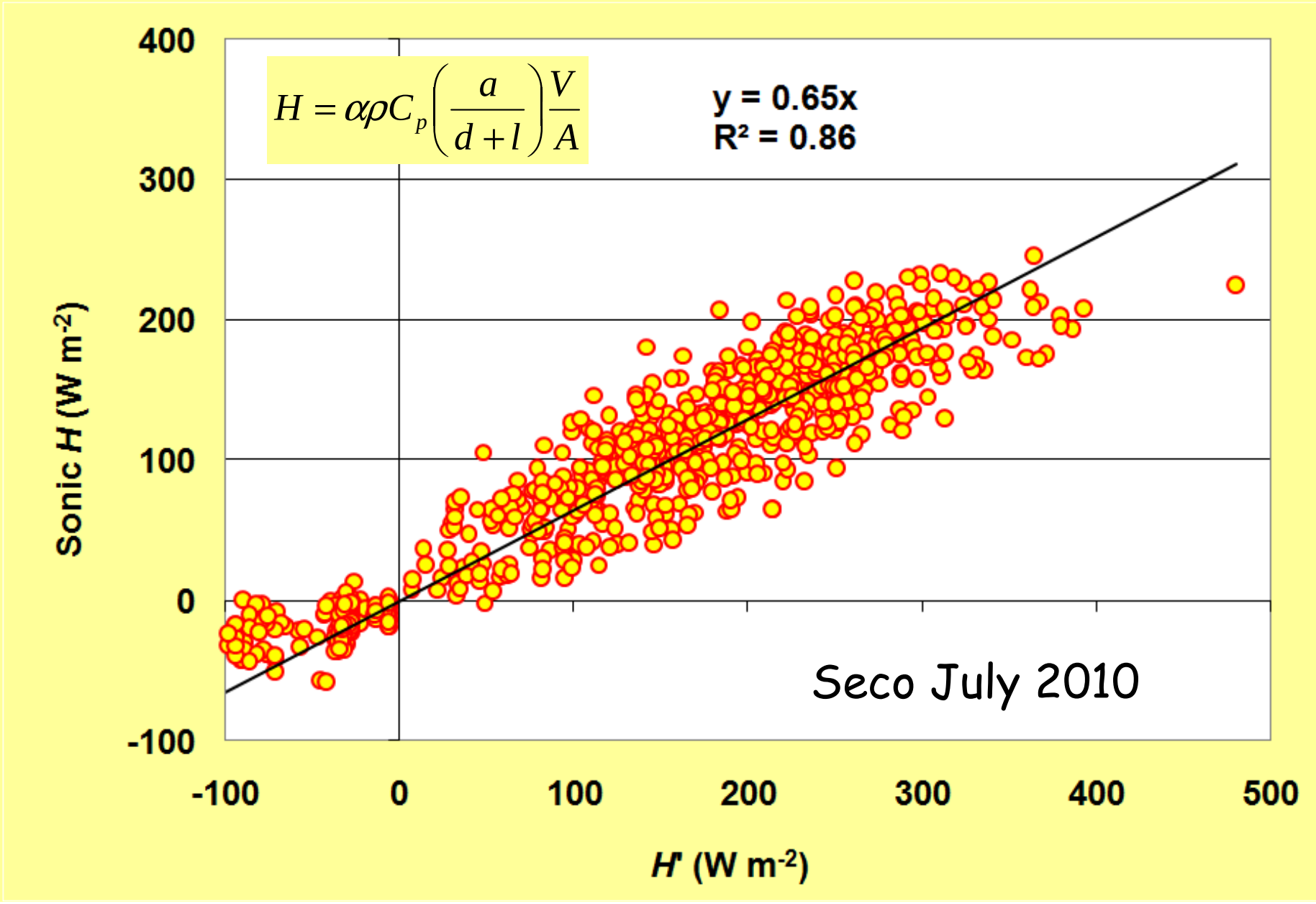

$G_1 = G_2 + C_v\left(\frac{T_f - T_i}{t_f - t_i}\right)\Delta z$
G1
Δz
Thermocouple
Flux Plate
G2


H - Sensible Heat Flux
0.003-inch diameter
Thermocouples
Surface Renewal

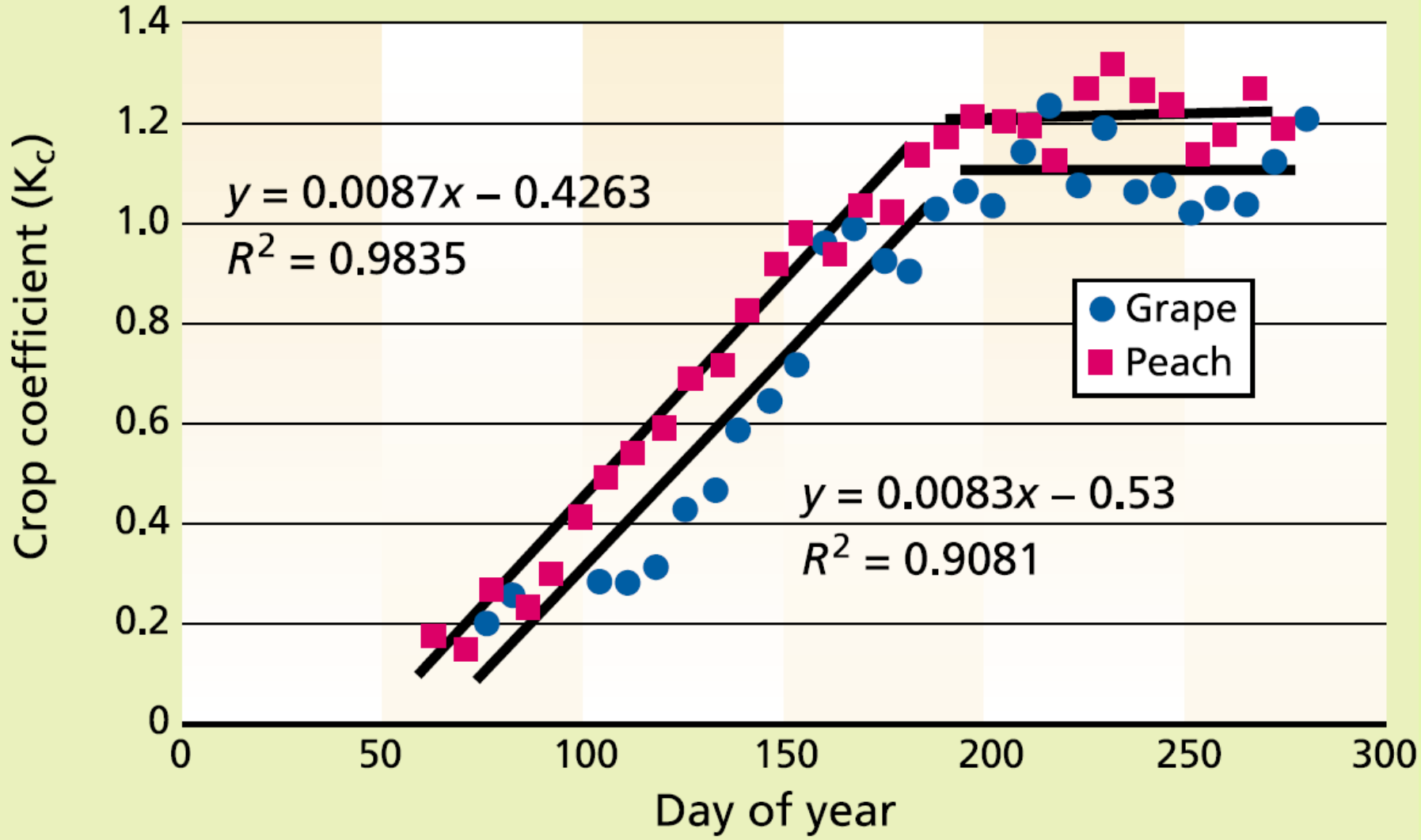
One minute of 8 Hz temperature data



Surface Renewal Calibration



Peach & Table Grape



Johnson et al. (2000) Calif. Agric.

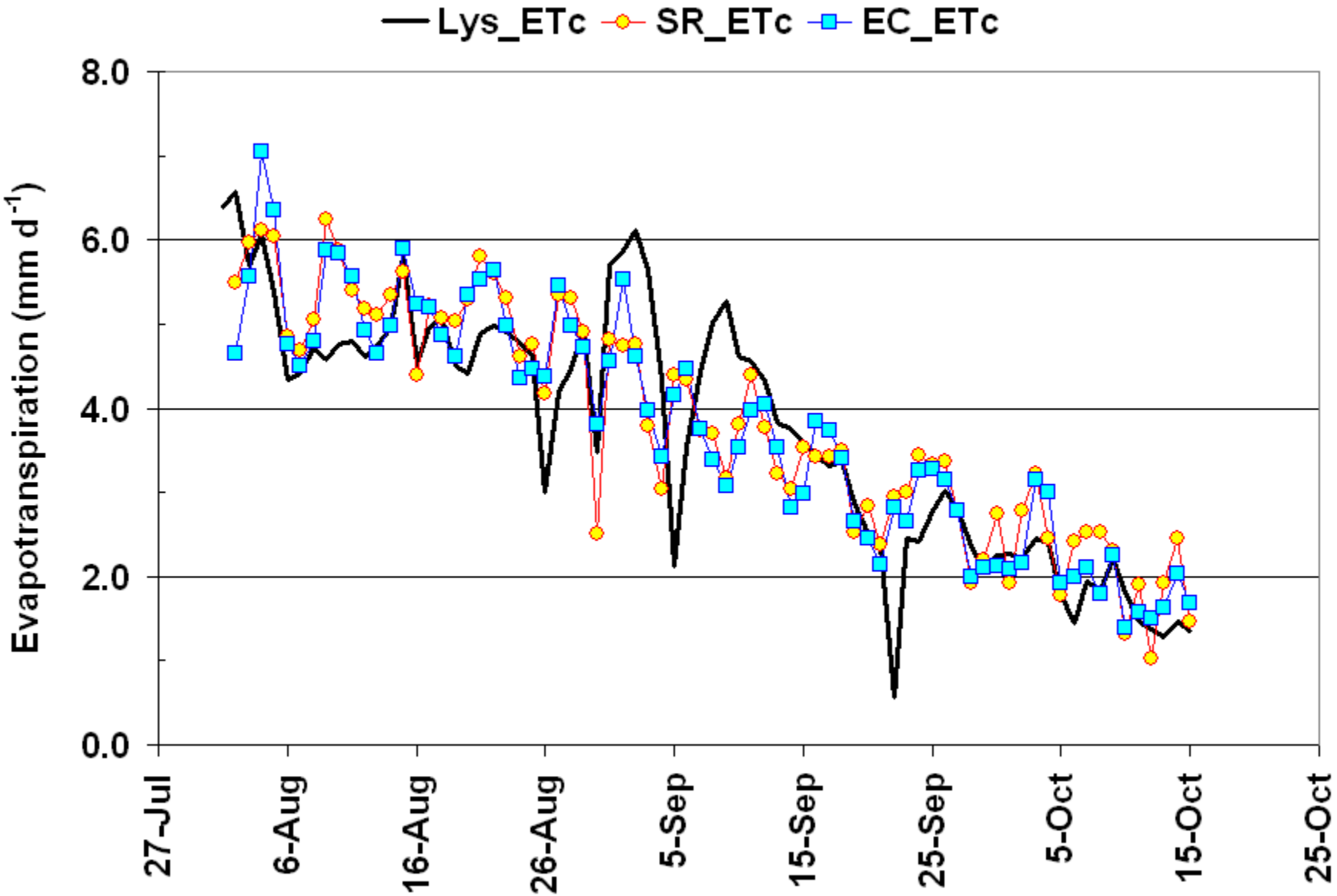
Peach Orchard

Kearney Research and Extension Center

Parlier, California

Lysimeter

Peach Orchard 2007 Kearney AEC

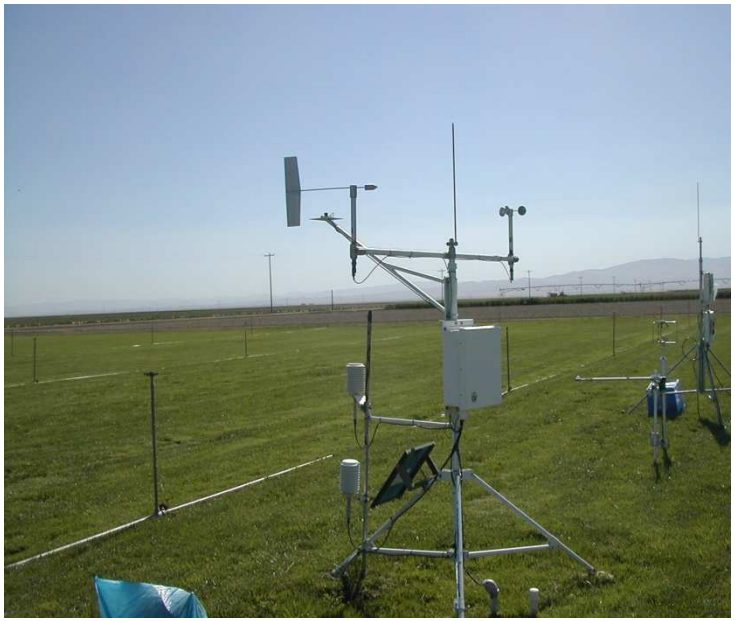


Grass Reference

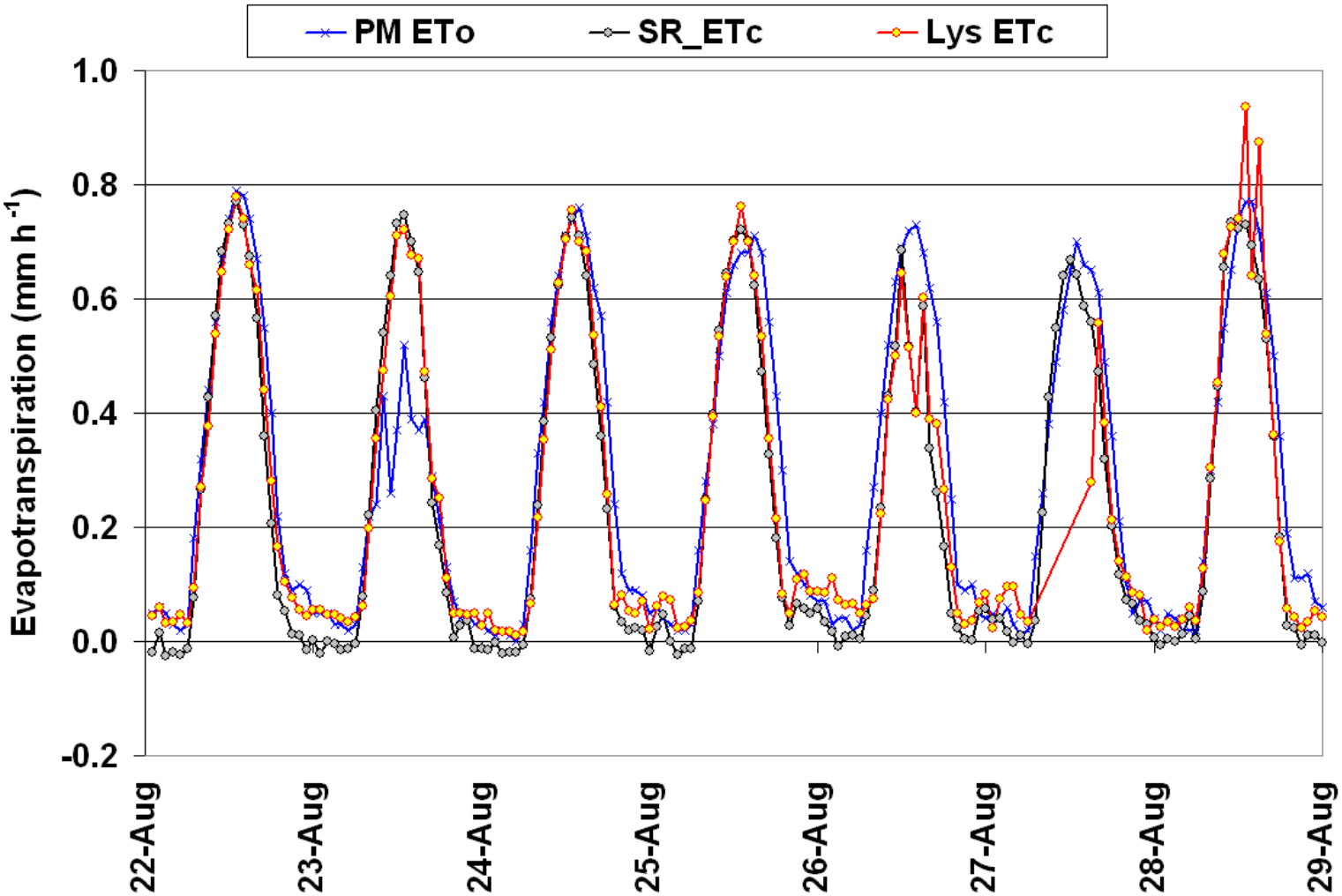
West Side Research and Extension Center

Five Points, California

Lysimeter



Observed Grass ETc and ETo

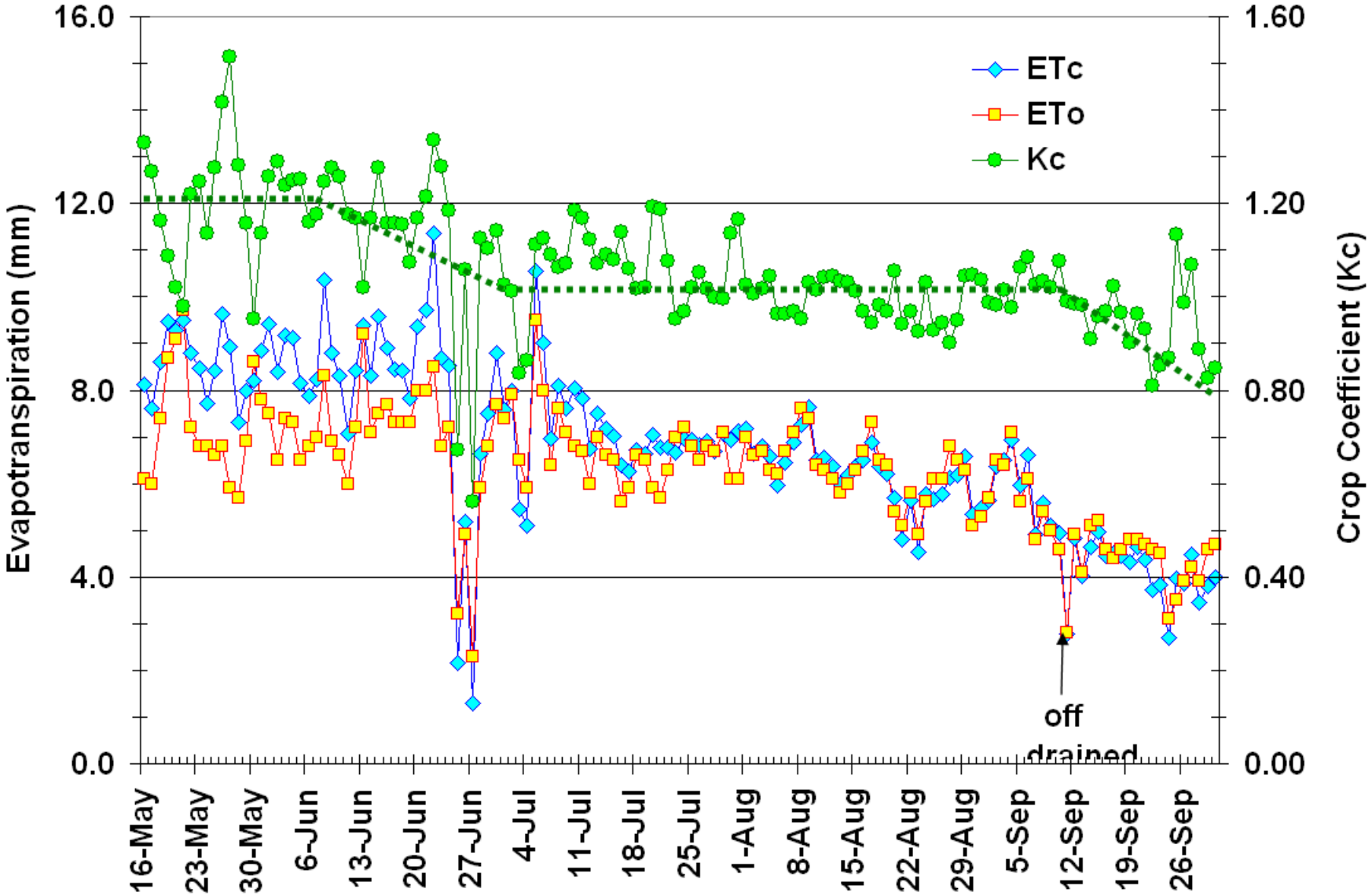


Rice 2007

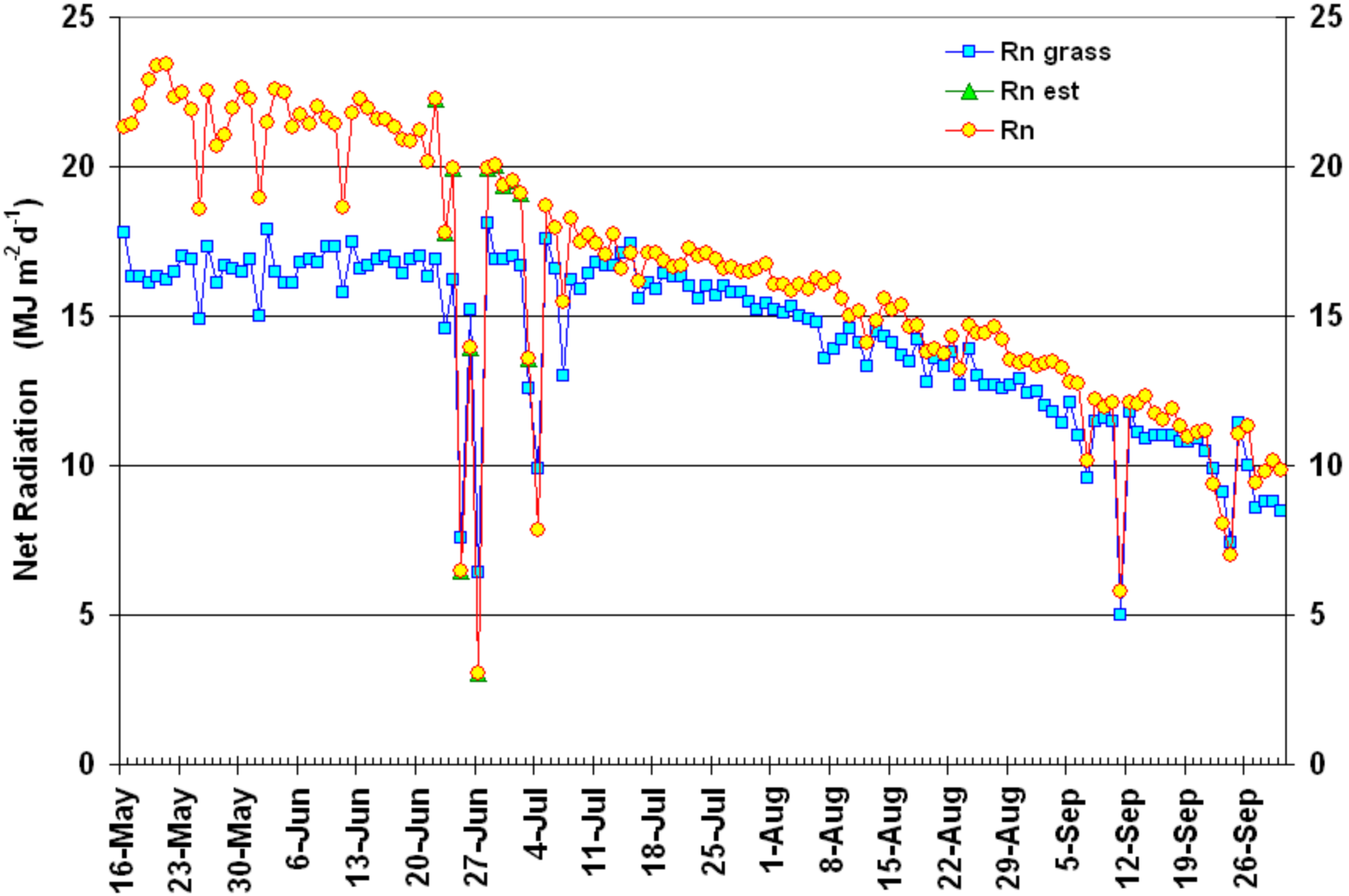
Nicolaus, California

Colusa, California

2001 - Rice ET_c, ET_o, and K_c



2001 - Rice R_n Vs *Date*



Rice 2009

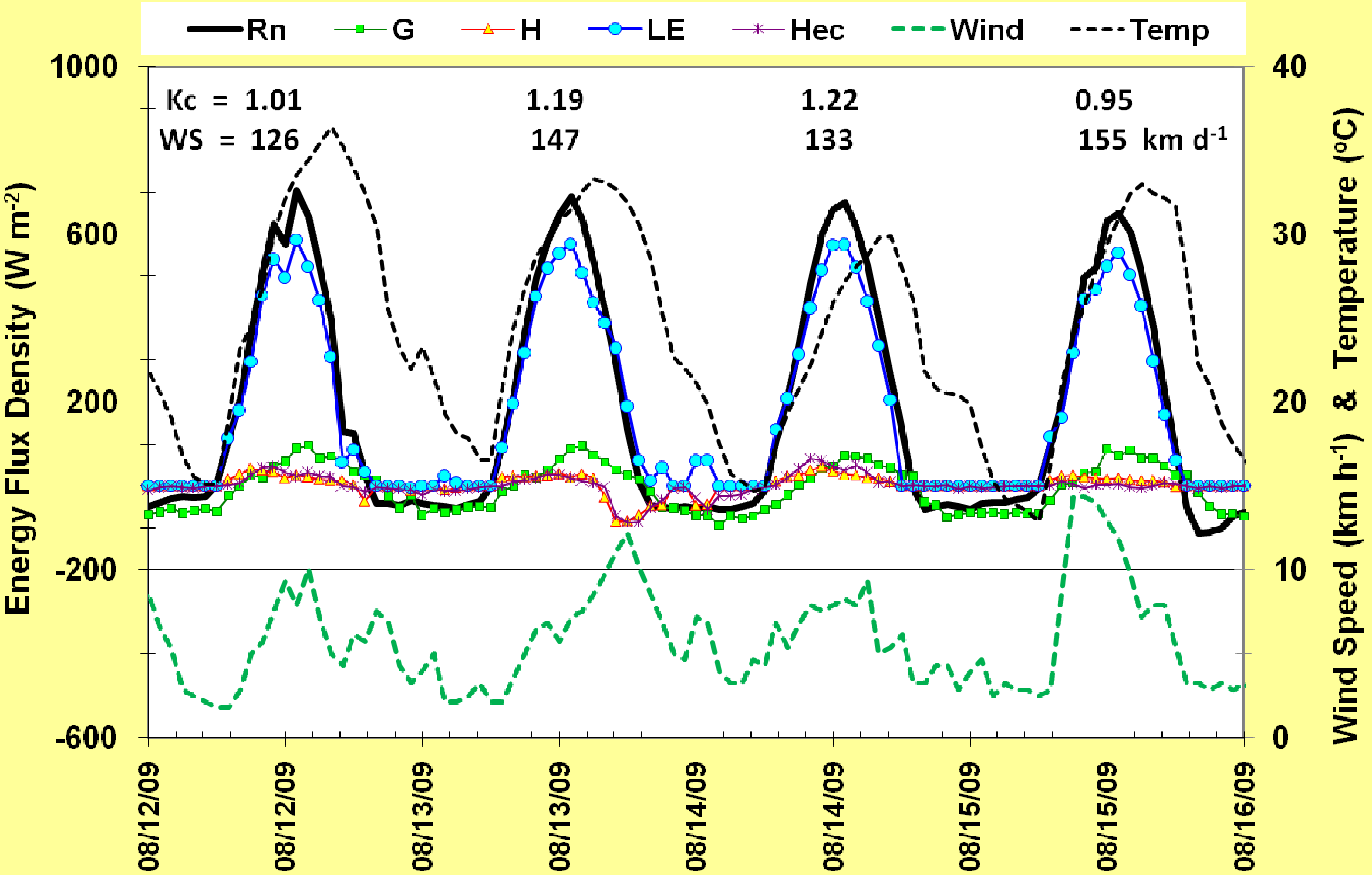
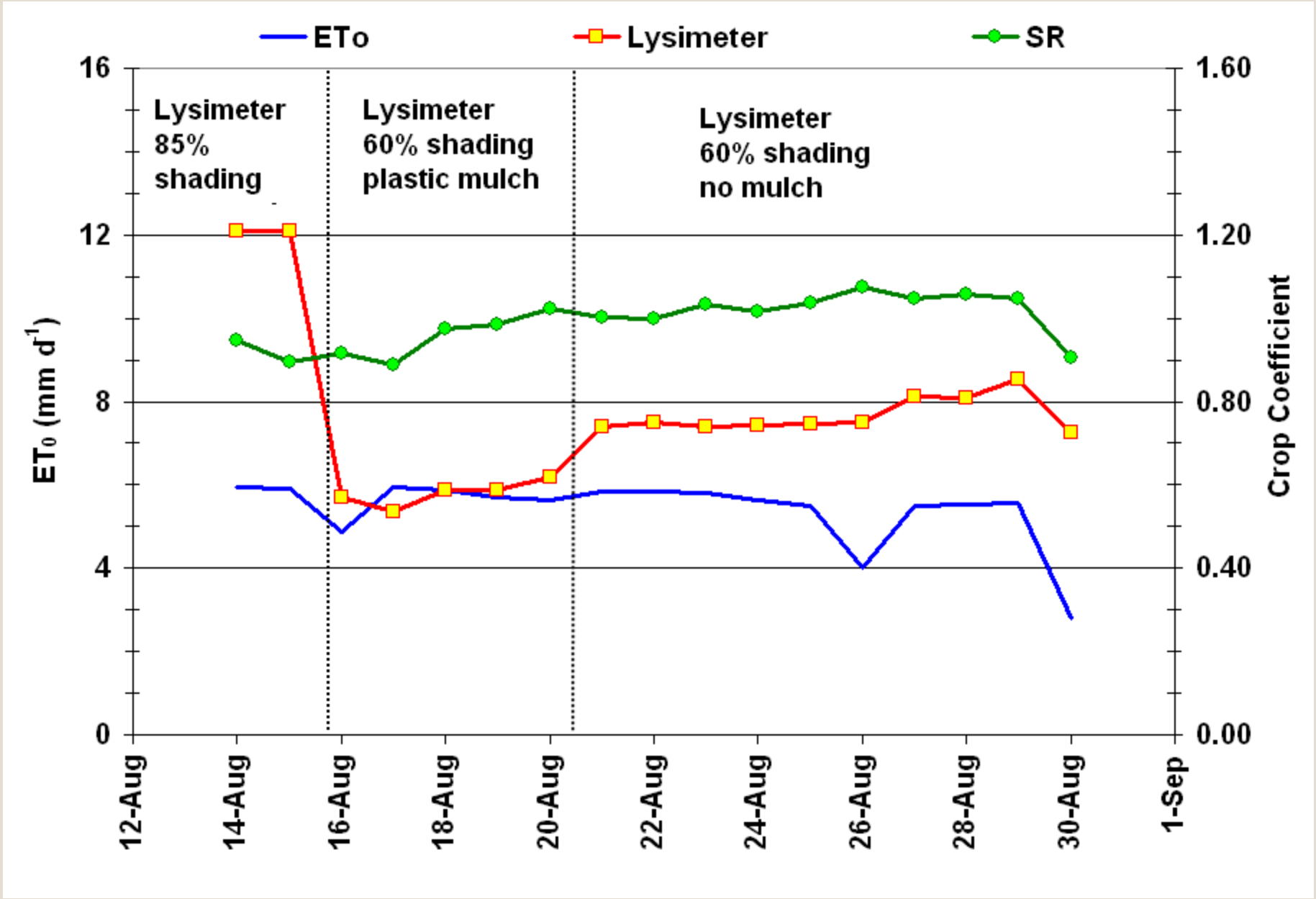
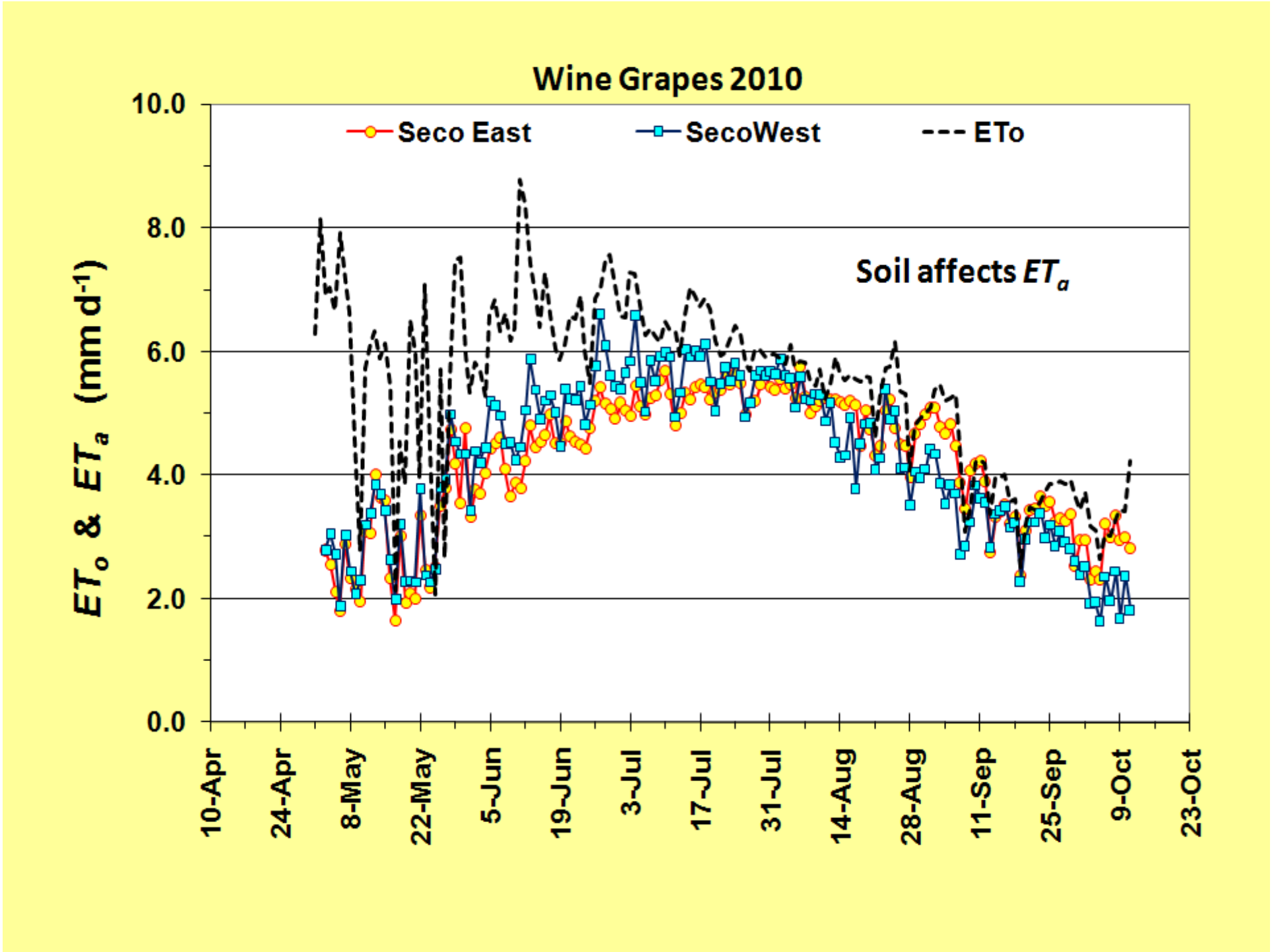

Rn
G
H
LE
Hec
Wind
Temp
Kc = 1.01
1.19
1.22
0.95
WS = 126
147
133
155 km d-1
1000
600
200
-200
-600
40
30
20
10
0
Energy Flux Density (W m-2)
Wind Speed (km h-1) & Temperature (°C)
08/12/09
08/12/09
08/13/09
08/13/09
08/14/09
08/14/09
08/15/09
08/15/09
08/16/09

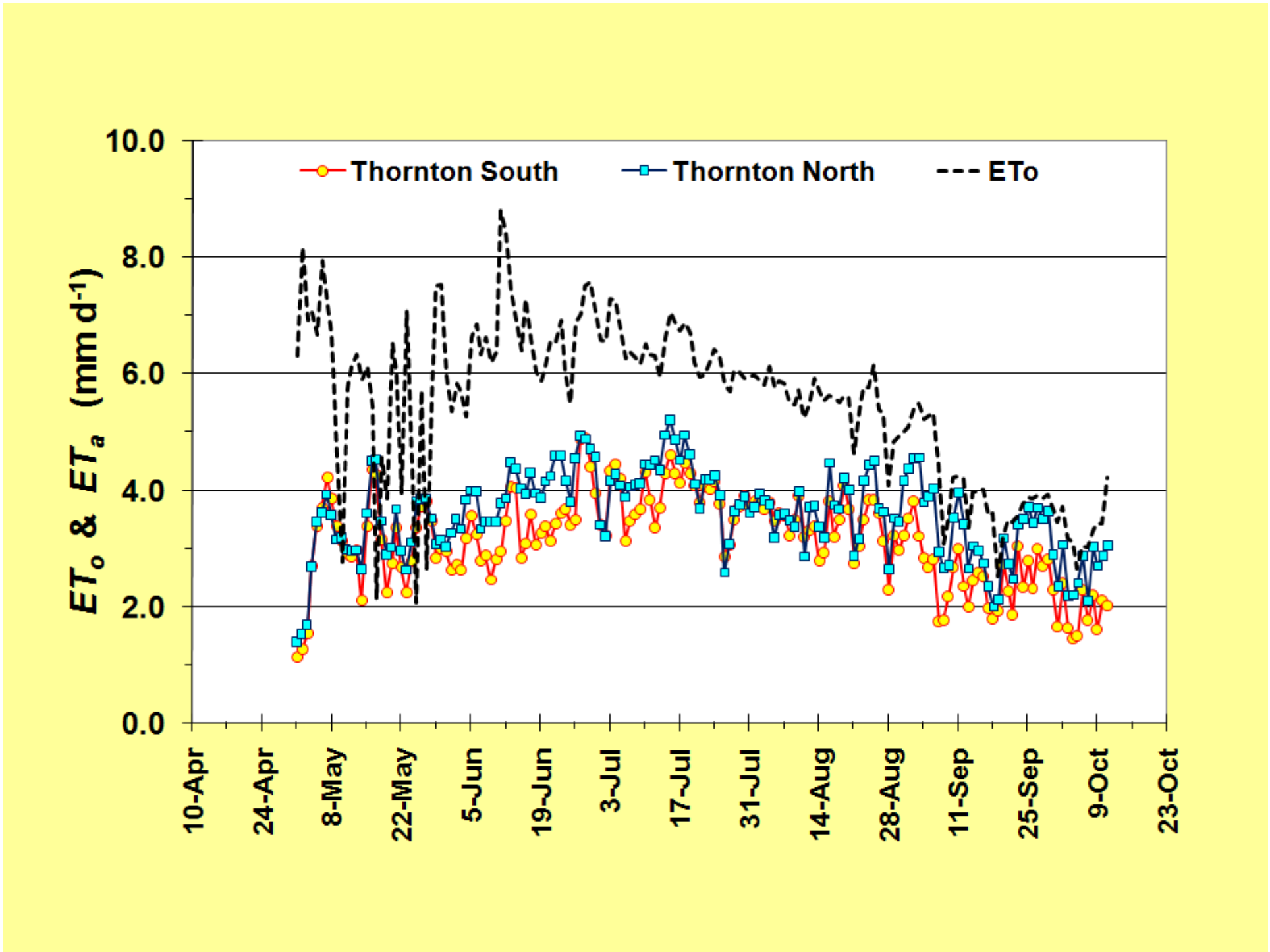
Table Grape ET Measurements

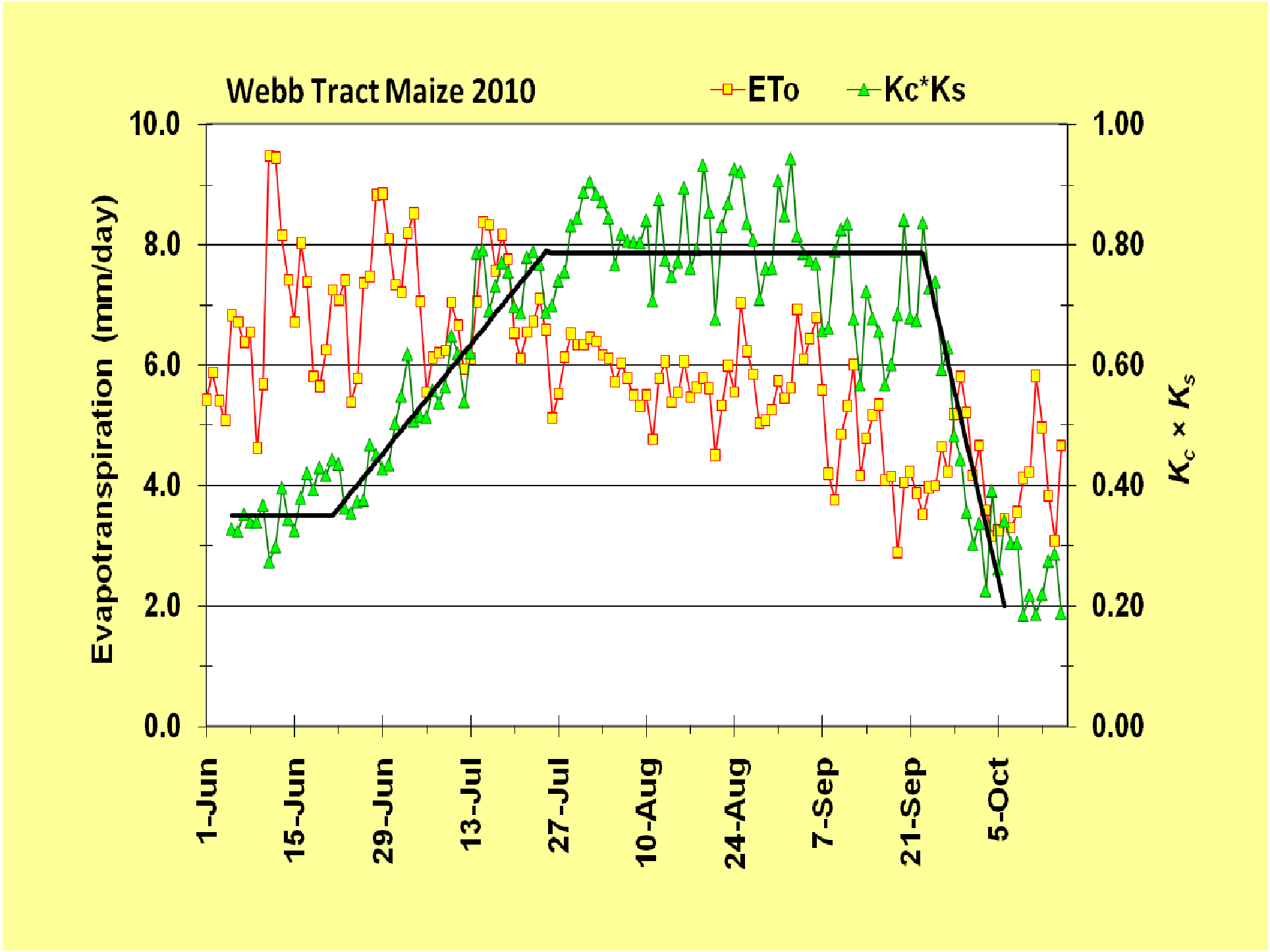
Lysimeter – overhead trellis

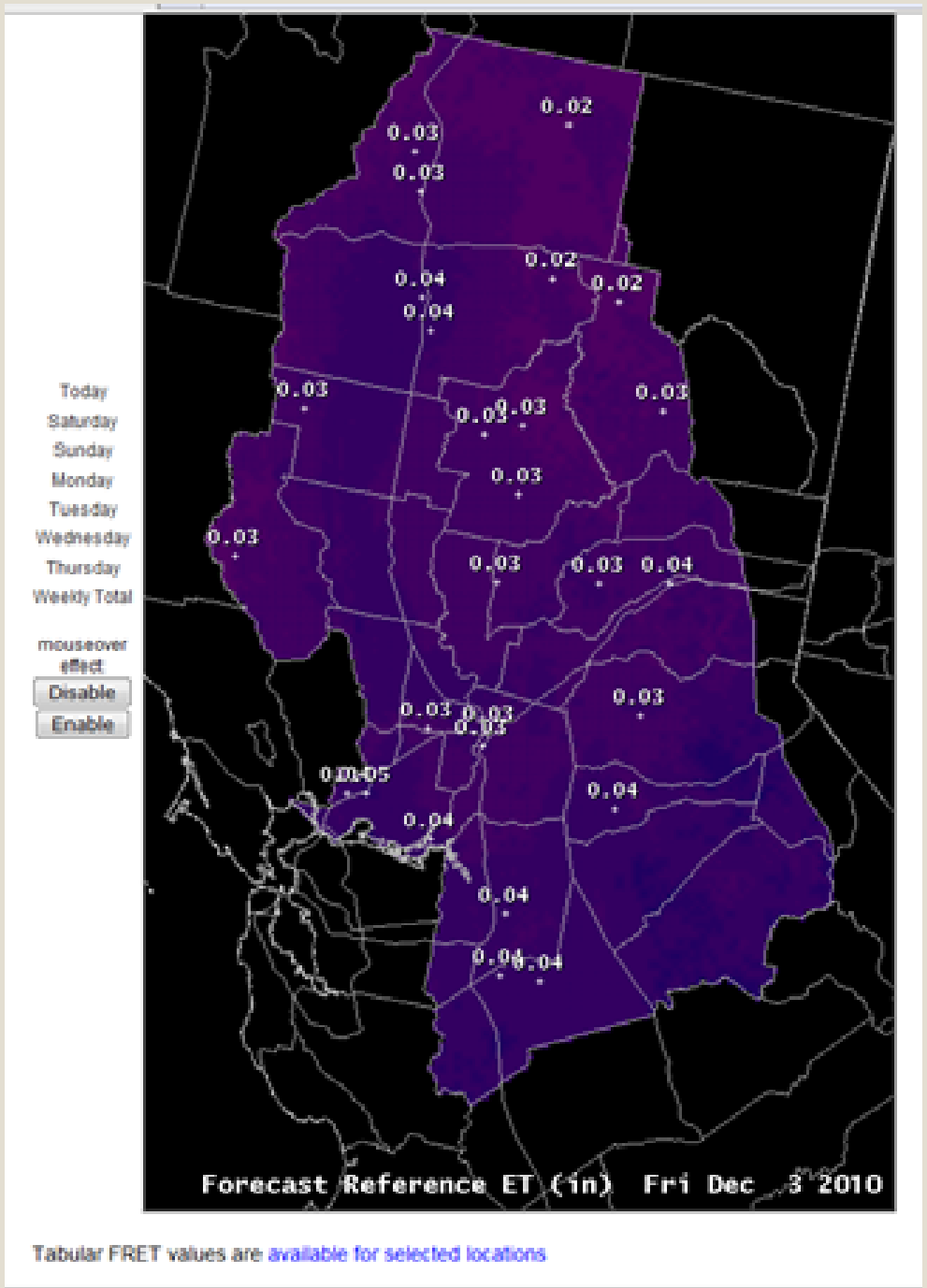
Surface Renewal – curtain


ETo
Lysimeter
SR
Lysimeter 85% shading
Lysimeter 60% shading plastic mulch
Lysimeter 60% shading no mulch
ET0 (mm d-1)
Crop Coefficient
16
12
8
4
0
1.60
1.20
0.80
0.40
0.00
12-Aug
14-Aug
16-Aug
18-Aug
20-Aug
22-Aug
24-Aug
26-Aug
28-Aug
30-Aug
1-Sep


Wine Grapes 2010
Seco East
SecoWest
ETo
Soil affects ET_a
ET_o & ET_a (mm d^{-1})
10.0
8.0
6.0
4.0
2.0
0.0
10-Apr
24-Apr
8-May
22-May
5-Jun
19-Jun
3-Jul
17-Jul
31-Jul
14-Aug
28-Aug
11-Sep
25-Sep
9-Oct
23-Oct


Thornton South
Thornton North
ETo
ET_o & ET_a (mm d^{-1})
10.0
8.0
6.0
4.0
2.0
0.0
10-Apr
24-Apr
8-May
22-May
5-Jun
19-Jun
3-Jul
17-Jul
31-Jul
14-Aug
28-Aug
11-Sep
25-Sep
9-Oct
23-Oct


Webb Tract Maize 2010
ETo
Kc*Ks
Evapotranspiration (mm/day)
10.0
8.0
6.0
4.0
2.0
0.0
1.00
0.80
0.60
0.40
0.20
0.00
$K_c \times K_s$
1-Jun
15-Jun
29-Jun
13-Jul
27-Jul
10-Aug
24-Aug
7-Sep
21-Sep
5-Oct



EVAPOTRANSPIRATION

NATIONAL WEATHER SERVICE NORTHERN SACRAMENTO INTERIOR CA

432 PM PST THU DEC 2 2010

SHASTA DAM	0.02	0.03	0.03	0.03	0.03	0.03	0.02
BURNEY	0.02	0.02	0.02	0.02	0.02	0.03	0.03
REDDING	0.03	0.03	0.03	0.03	0.03	0.03	0.03
RED BLUFF	0.03	0.03	0.03	0.03	0.04	0.04	0.04
CHICO	0.03	0.02	0.03	0.03	0.04	0.04	0.04
OROVILLE	0.03	0.03	0.03	0.03	0.04	0.04	0.04
MARYSVILLE	0.03	0.03	0.03	0.03	0.04	0.04	0.03
SACRAMENTO	0.03	0.04	0.03	0.03	0.04	0.04	0.03
TRAVIS	0.03	0.04	0.03	0.04	0.04	0.04	0.04
STOCKTON	0.04	0.04	0.03	0.03	0.04	0.03	0.04
MODESTO	0.04	0.05	0.03	0.03	0.04	0.04	0.04
LAKEPORT	0.03	0.02	0.03	0.03	0.03	0.03	0.03
PARADISE	0.04	0.03	0.03	0.04	0.04	0.04	0.04
QUINCY	0.03	0.03	0.03	0.03	0.03	0.04	0.04
CHESTER	0.02	0.02	0.02	0.02	0.02	0.03	0.03
COLUSA	0.03	0.03	0.03	0.03	0.03	0.04	0.03
DAVIS	0.03	0.04	0.03	0.03	0.04	0.04	0.03
OAKDALE	0.04	0.04	0.03	0.03	0.04	0.04	0.04
ORLAND	0.03	0.03	0.03	0.03	0.04	0.04	0.04
PATTERSON	0.05	0.05	0.04	0.03	0.05	0.04	0.05
TWITCHELL	0.04	0.04	0.03	0.03	0.04	0.04	0.04
WINTERS	0.04	0.04	0.04	0.04	0.04	0.04	0.04

http://www.wrh.noaa.gov/forecast/evap/FRET/FRET.php?wfo=sto

Conclusions

1. Energy balance gives good estimates of ET
2. Tree and vine Kc values are higher
3. Midseason rice Kc values are lower
4. Timing of wind & temperature affects Kc
5. Light interception is a key ET factor
6. Soil characteristics affect ET
7. There is no perfect method for measuring ET
8. Cold wind can decrease ET
9. ETo forecasts are now available from NWS

Questions

Thanks

R.L. Snyder
http://biomet.ucdavis.edu