Automation of Surface Renewal based micro-met systems to evaluate crop Evapotranspiration(ET_c)

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Watershed Management Experiential Learning for USDA Careers

Executive Summary

Problem: Water is lost from the surface of soil through evaporation and from leaves through transpiration. Together these two processes – evaporation and transpiration – are collectively referred to as evapotranspiration (ET). Estimation of crop ET, referred to as ET_c, is an important component of irrigation water management. ET_c is estimated using lysimeters and micro meteorological systems among other methods. Over the years, with the advent of electronics and cheaper chip cost, micro-met systems have become popular ,customizable, and now, more cost-effective and mobile for agronomic use. However, without some form of automation to make the data available in real-time, they are far from deployment by the average agronomist.

Purpose: Overall, to contribute to better irrigation management and higher crop yield by improving site specific estimation of ET_c.

Methods: This goal was achieved by improving the programming logic of Surface Renewal (SR) stations deployed and managed in this project.

Result: Minimizing the post-processing of data greatly improves the availability of real time data which can be used to better optimize irrigation management practices.

Goals & Tasks

Primary Goal: Reduce the post-processing of data from SR stations through automation methods.

Other Goals:

- The management of older and existing systems
- The deployment of new systems within the Central Valley

Project Tasks:

- Hardware troubleshooting and programming logic
- Maintenance and deployment of SR stations
- Station data collection, processing, and analysis
- Management of field computers, documentation, and data

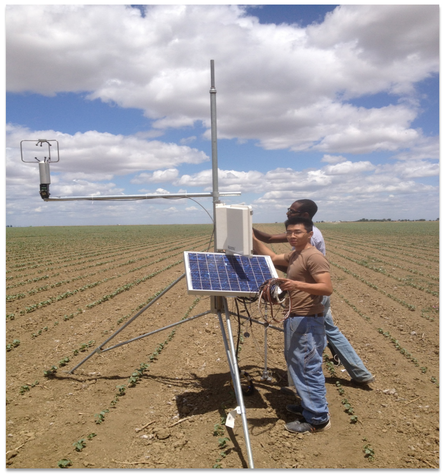
Approach

Tools and techniques used to reduce the post-processing of micro-met data.

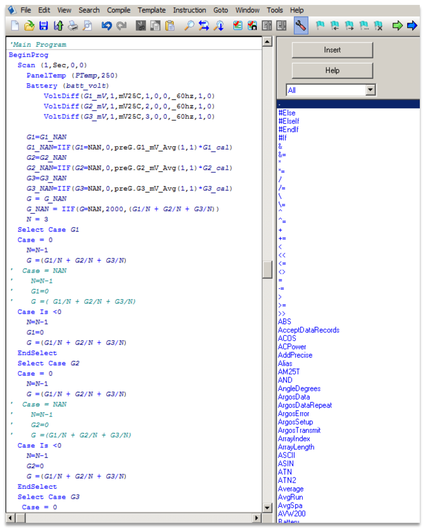
- Modification of existing program of SR stations
- LoggerNet
- CRBasic Editor

Outcome

SR stations typically consist of sensors, a micro-logger, and a power system. The stations involved in this project used various sensors to measure micro-met variables (wind, air temperature and relative humidity, solar radiation, precipitation, and soil temperature).

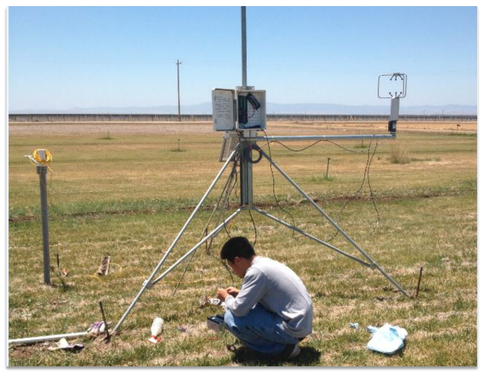


Seven SR stations were deployed and managed throughout the Central Valley; locations included California State University Fresno (CSUF), University of California (UC) Westside Research and Extension Center, and the Panoche Drainage District.



```
'Main Program
BeginProg
  Scan (1,Sec,0,0)
    PanelTemp (PTemp,250)
    Battery (batt_volt)
      VoltDiff(G1_mV,1,mV25C,1,0,0,_60hz,1,0)
      VoltDiff(G2_mV,1,mV25C,2,0,0,_60hz,1,0)
      VoltDiff(G3_mV,1,mV25C,3,0,0,_60hz,1,0)

    G1=G1_NAN
    G1_NAN=IIF(G1=NAN,0,preG.G1_mV_Avg(1,1)*G1_cal)
    G2=G2_NAN
    G2_NAN=IIF(G2=NAN,0,preG.G2_mV_Avg(1,1)*G2_cal)
    G3=G3_NAN
    G3_NAN=IIF(G3=NAN,0,preG.G3_mV_Avg(1,1)*G3_cal)
    G = G_NAN
    G_NAN = IIF(G=NAN,2000,(G1/N + G2/N + G3/N))
    N = 3
  Select Case G1
  Case = 0
    N=N-1
    G =(G1/N + G2/N + G3/N)
'  Case = NAN
'    N=N-1
'    G1=0
'    G =( G1/N + G2/N + G3/N)
  Case Is <0
    N=N-1
    G1=0
    G =(G1/N + G2/N + G3/N)
  EndSelect
  Select Case G2
  Case = 0
    N=N-1
    G =(G1/N + G2/N + G3/N)
'  Case = NAN
'    N=N-1
'    G2=0
'    G =(G1/N + G2/N + G3/N)
  Case Is <0
    N=N-1
    G2=0
    G =(G1/N + G2/N + G3/N)
  EndSelect
  Select Case G3
    Case = 0
```



With the automation code incorporated into future SR deployments, incorrect component readings or total sensor failures will be eliminated from the internal calculations of the program, retaining data integrity and making post data collection work a much smoother process—especially for the average agronomist.

Conclusion

Cost-effective, portable SR stations will be a great tool for collecting site specific ET data especially in areas under saline and other stress conditions, where traditional ET estimates cannot be applied. Although significantly reducing the post-processing of data makes this technology more appealing to farmers and other growers, further improvements in form-factor, structure, and programming should be made. These improvements not only will make this technology more efficient and cost-effective , but more importantly, facilitate deployment on a wider-scale within the agricultural industry. Ultimately, as environmental research and agricultural technology further advance, more SR stations or similar systems will be deployed for irrigation efficiency and crop yield optimization.

Life Lessons

In retrospect, I feel that I have come a long way since the beginning of the internship. This opportunity, not only has increased my awareness and skill set in agriculture and the natural environment, but has also increased my involvement in making a difference; this opportunity has led me to begin my career in environmental health, specifically, in the air quality industry. Though I have accumulated an abundant amount of experience relative to current environmental and agricultural issues, research, and technology, this internship has given me the opportunity to contribute equally as much to the central valley.

Acknowledgements

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