

# Improving Evapotranspiration Estimates Using Soil Heat Flux

**Joseph Ipson, Snow College/Utah State University**  
 Research Mentors: Scott Jones, Kay Parajuli, Utah State University

## Overview

- Soil heat flux (G) is the thermal energy flowing into or out of the soil.
- To estimate G, soil heat flux plates & thermocouple arrays were installed at twelve existing iUTAH climate stations.
- Evapotranspiration (ET) is a key component for understanding Utah's water cycle. Estimation of ET using energy balance requires G, which can be used to validate/improve other ET methods.

## Energy Balance

- Net Radiation ( $R_n$ ) comes in from the atmosphere where it either heats the atmosphere as sensible heat flux (H), goes into the soil as soil heat flux (G), or evaporates water as latent heat (LET):

$$R_n = H + LET + G$$

- We can use G with this equation to calculate an estimate of ET.

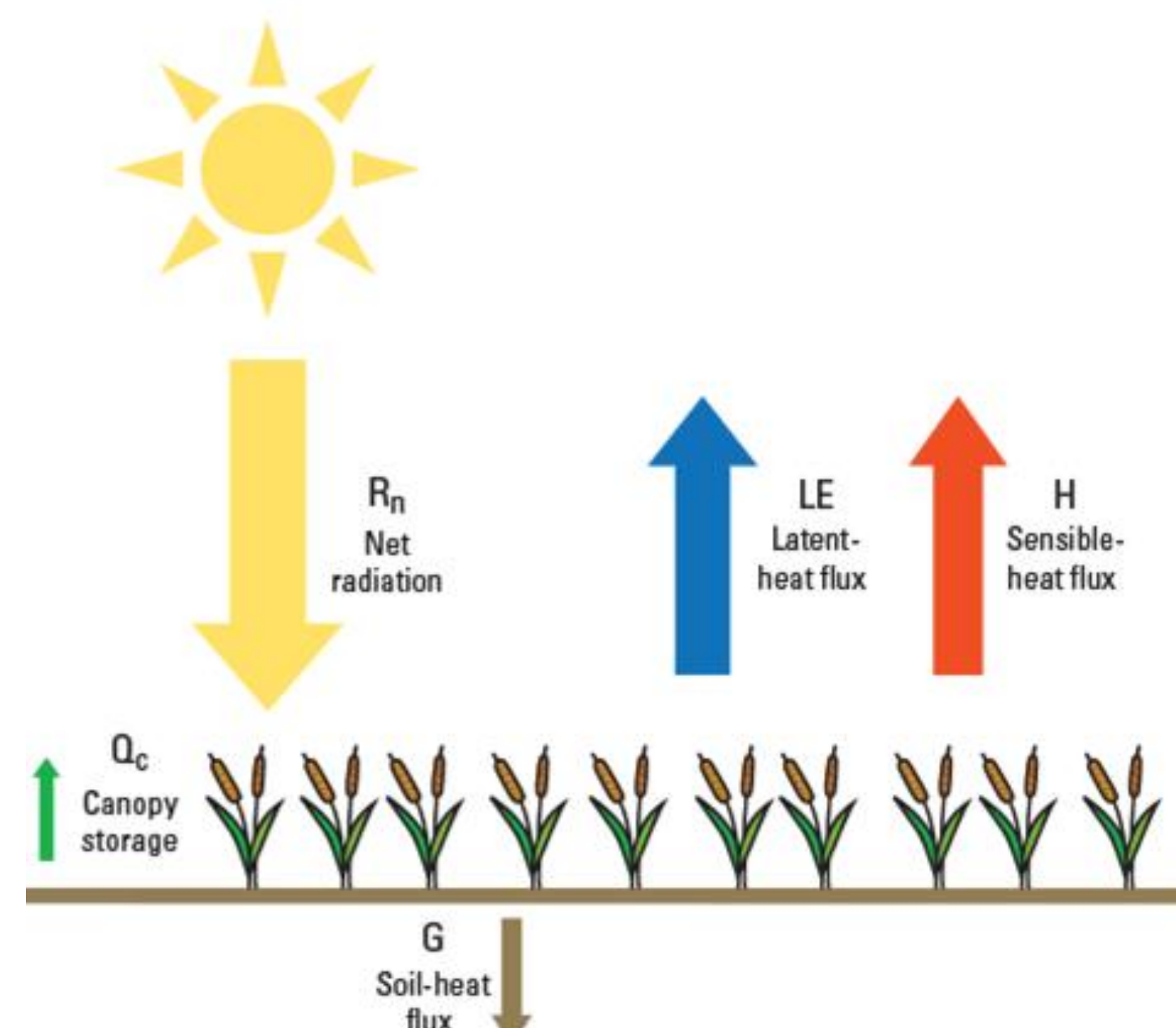


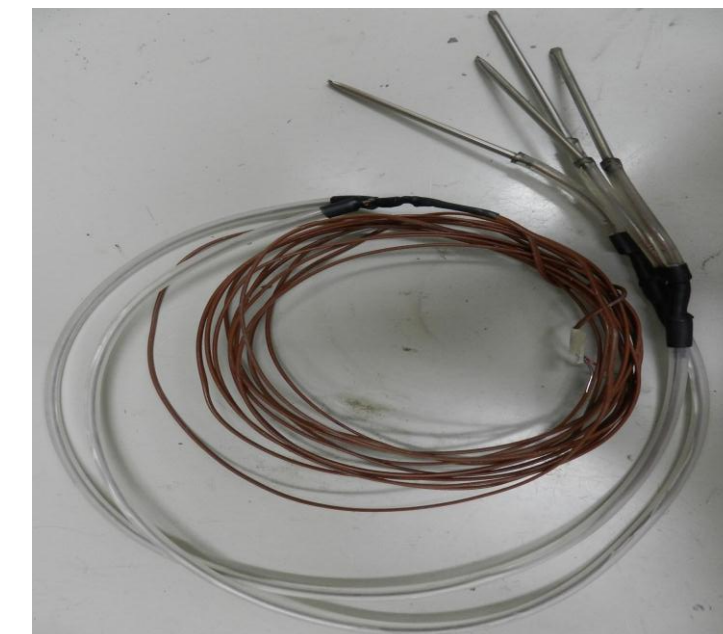
Figure 1. Surface Energy Balance  
 From <http://pubs.usgs.gov/sir/2013/5014/figure2.html>

## Data Collection

Existing iUTAH climate stations already monitor  $R_n$  and H. We installed soil heat flux plates to estimate G.



### Thermocouple Array



The thermocouple array and existing soil moisture sensor are combined to estimate soil heat storage.

### Soil Heat Flux Plates

Soil heat flux plates installed 8 cm below the surface employ a thermopile to determine heat flow.



Figure 2. Installed soil sensors

## Results

- Preliminary surface energy balance data from the Logan Golf Course site shown in Fig. 3 are consistent with expected summertime values.
- Agreement between the ET calculated using surface energy balance and the Penman-Monteith methods are well correlated in Fig. 4.
- Reliable ET predictions will be critical to estimating and understanding water balance patterns throughout Utah.

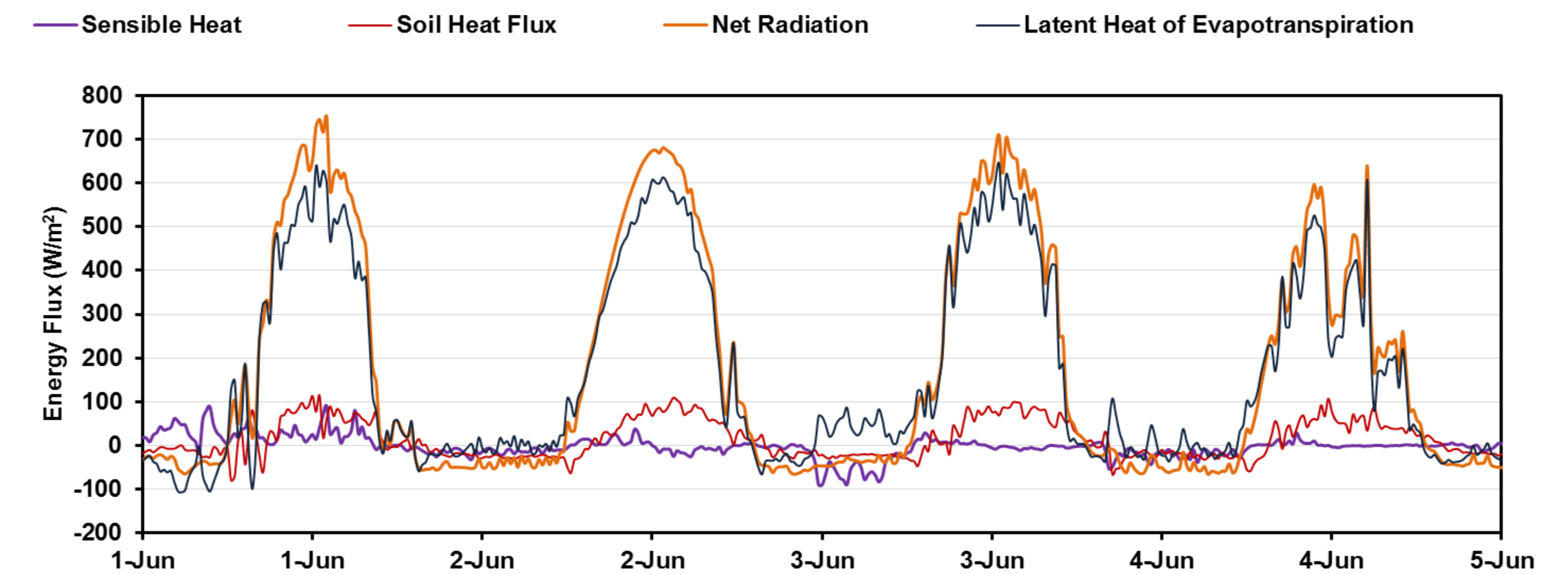


Figure 3. All four Energy Balance Equation Components for the Logan Golf Course

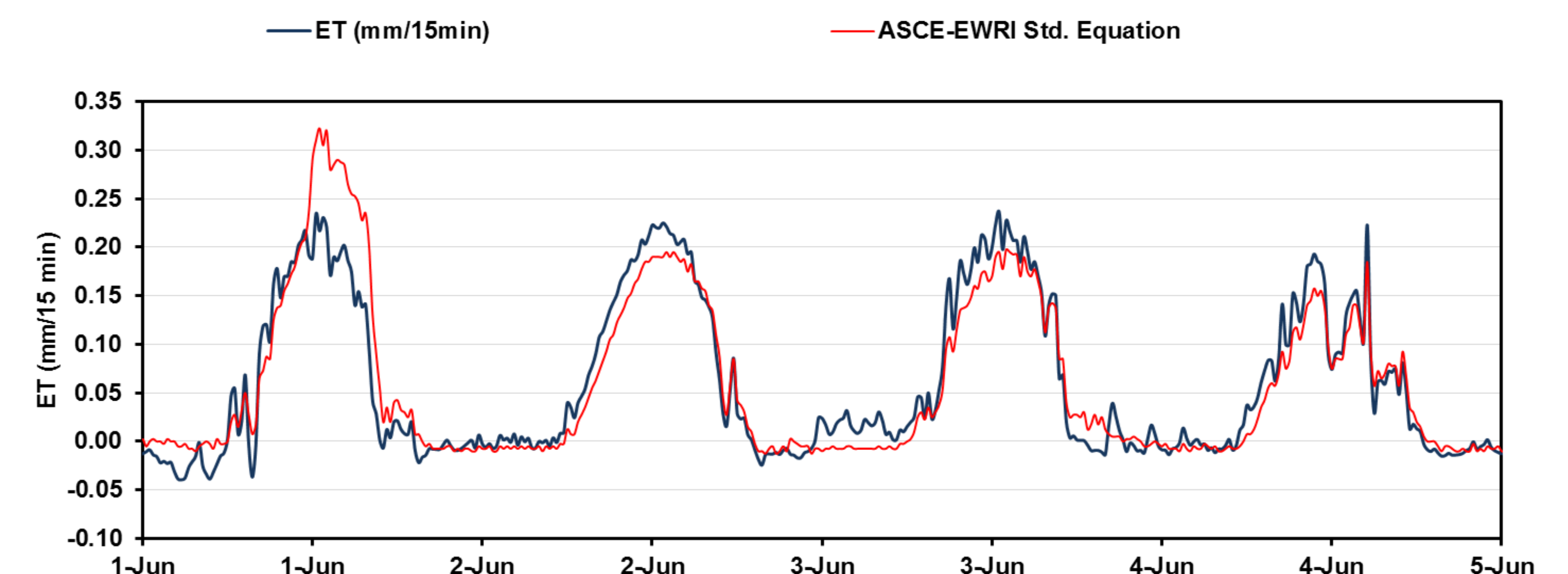


Figure 4. Comparison of ET at the Logan Golf Course using Energy Balance Calculations to ET using the ASCE-ERWI Std. Equation (Jury, W.A. and R. Horton. Soil Physics, 6<sup>th</sup> Ed. Hoboken, NJ, 2004)

**IFELLOWS UNDERGRADUATE RESEARCH PROGRAM**

