ETgage® can provide accurate estimates of reference evapotranspiration

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Introduction

Evapotranspiration (ET) data can be used to estimate water use of most horticultural crops. Reference ET is the volume of water transpired and evaporated by a reference crop, usually grass or alfalfa, which provide a consistent canopy covering 100% of the ground. ET data are usually expressed in inches or millimeters of water lost by the crop. A crop coefficient (Kc) is used to convert ET of the reference crop to the ET of the crop of interest:

$$ETcrop = ETref \times Kc$$

Kc changes as the crop develops and is usually based on the percentage of ground shaded by the leaves of the crop. Previous articles we have written explained how to access reference ET data from the California Irrigation and Information System (CIMIS) website (Salinas Valley Agriulture Blog: May 21, 2010; June 24, 2010). The CIMIS website *(wwwcimis.water.ca.gov)* provides free access to the weather data including, reference ET, for most of the agricultural regions of California.

Although more than 120 CIMIS weather stations are located throughout California, growers sometimes find that the closest station does not accurately reflect the weather conditions of their farm. On the central coast, air temperature, relative humidity, and wind speed can vary over short distances depending on the surrounding terrain or distance from the ocean. In addition, fog patterns, common along the central coast, can vary across distances as short as 1 or 2 miles, and can affect the solar radiation measurement, one of the most important factors in calculating reference ET. To account for the spatial variation in climate, *spatial reference ET* estimates are also available from the CIMIS website. *Spatial ET* uses a combination of satellite and weather station data to estimate reference ET at a 1.6 mile scale.

While spatial ET estimates can be an improvement over conventional estimates of ET provided by CIMIS weather stations, many growers are still interested to measure ET directly at their farms. Several companies sell weather stations that can be set up to measure ET, but they must be sited correctly and maintained to provide accurate data. The staff at the California Department of Water Resources checks the quality of CIMIS ET data on a daily schedule, and maintains and assures the accuracy of instruments on the CIMIS weather stations.

Atmometers are another method used to estimate reference ET. Fabric on top of the atmometer is exposed to the air, and is moistened from below by a wick submerged in a water reservoir. As water evaporates from the surface material, water is wicked up to the fabric, and the water level in the reservoir drops. ET is estimated from the volume of water lost from the reservoir. A commercially available and easy to use atmometer is the *ETgage*® (Fig. 1). It can be read manually or interfaced with a datalogger so that daily ET values can be recorded. For more information about the ETgage, refer to the company's website *(www.etgage.com).*

Evaluation of the ET gage

We evaluated the accuracy of the ETgage to estimate reference ET in Santa Clara County during the 2011 season using the #30 green fabric covering. Other coverings (#54) are available for use with corn and other agronomic crops. One ETgage was located at the edge of a fresh market tomato field, 0.5 miles from Gilroy CIMIS station #211. Another ETgage was located approximately 17 miles from CIMIS station #211 at the edge of a turf grass field northwest of Morgan Hill. We compared readings from the ETgage with ET estimates from the Gilroy CIMIS station and spatial CIMIS for each of the test sites.

Results

Daily estimates of reference ET by the ET gage, CIMIS station, and spatial CIMIS are presented in Figures 2 and 5 for the two test locations. All three methods of estimating reference ET produced similar values at the fresh market tomato site near the Gilroy CIMIS station (Fig. 2). The ET gage values fluctuated more than spatial CIMIS and CIMIS station values between periods of high and low ET. When ET increased, ET gage values tended to be higher than the CIMIS station values, and when ET decreased, ET gage values were generally lower than the CIMIS station values (Fig. 2). However, cumulative ET for all three methods of estimating ET produced similar totals during a 3 month period (Fig. 3). Total ET measured by the ET gage was 0.1 % less the total ET estimated by the CIMIS station, and the total for spatial cimis ET was 5% less than the total ET estimated by the CIMIS station.

Reference ET values recorded by the ET gage corresponded more closely with spatial CIMIS values than with the Gilroy CIMIS station values at the turf grass site (Fig. 4). Both the ETgage and spatial CIMIS had lower ET values than the Gilroy CIMIS station. Also, cumulative reference ET values estimated by spatial CIMIS and the ET gage were nearly identical (Fig. 5), and totaled 16% lower than the Gilroy CIMIS station. Since air temperature is generally higher in Gilroy than northern Morgan Hill, lower ET values would be expected for the ET gage and spatial CIMIS estimates.

Conclusions

Our initial tests demonstrated that the ETgage provided accurate estimates of reference ET. However, the ET values must still be adjusted with a crop coefficient (Kc) to estimate the ET of a crop other than alfalfa or grass.   Also, the ETgage needs to be sited correctly to provide accurate data. Locating it near a building, tree, or in a parking lot will affect the ETgage readings.   The instructions also recommend positioning the top of the ETgage higher than 39 inches above the ground and at least a foot above the crop canopy. For our tests, we located the instrument in a field unobstructed by structures and beside a crop.   It would be best to locate the ETgage near well watered grass or pasture if possible. We also found that the ETgage required some maintenance. The reservoir needed to be refilled periodically with distilled water, and the green material covering the top of the ETgage would sometimes come loose or become dusty. Finally, the ETgage required a person to collect readings on regular schedule or periodically download the datalogger.

Figure 1. ETgage® mounted on a post adjacent to a lettuce field. Photo by M. Cahn.

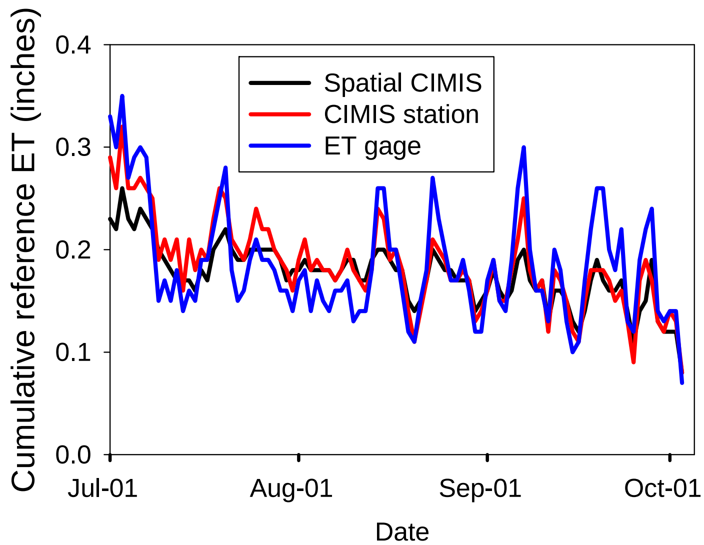

Figure 2. Comparison of daily reference ET values for spatial CIMIS, Gilroy CIMIS station and an ETgage in Gilroy during July-Sept, 2011.

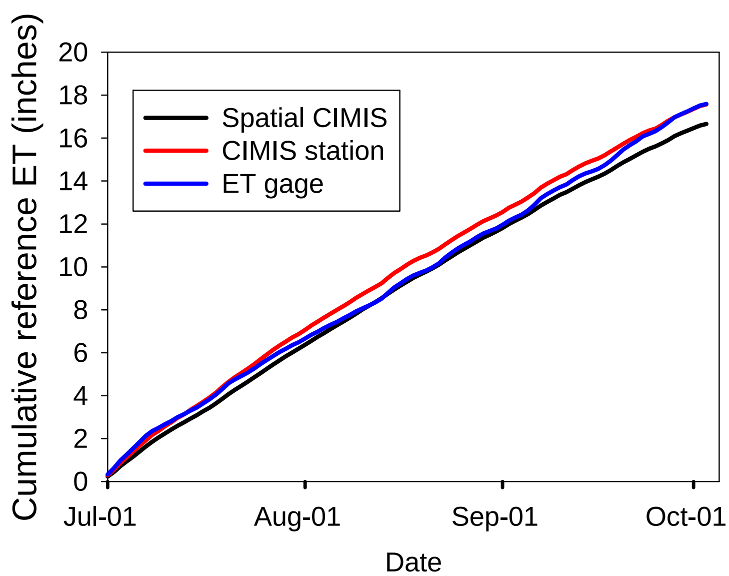

Figure 3. Cumulative reference ET for spatial CIMIS, Gilroy CIMIS station, and ETgage in Gilroy during July – Sept, 2011.

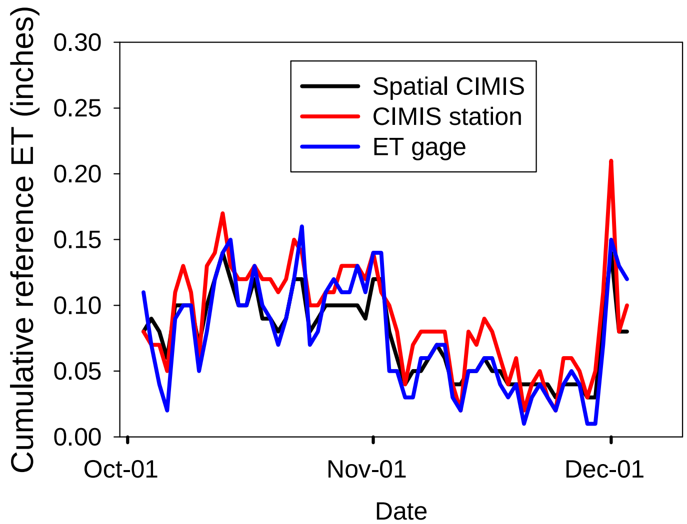

Figure 4. Comparison of daily reference ET values for spatial CIMIS, Gilroy CIMIS station and the ETgage north of Morgan Hill during Oct-Dec, 2011.

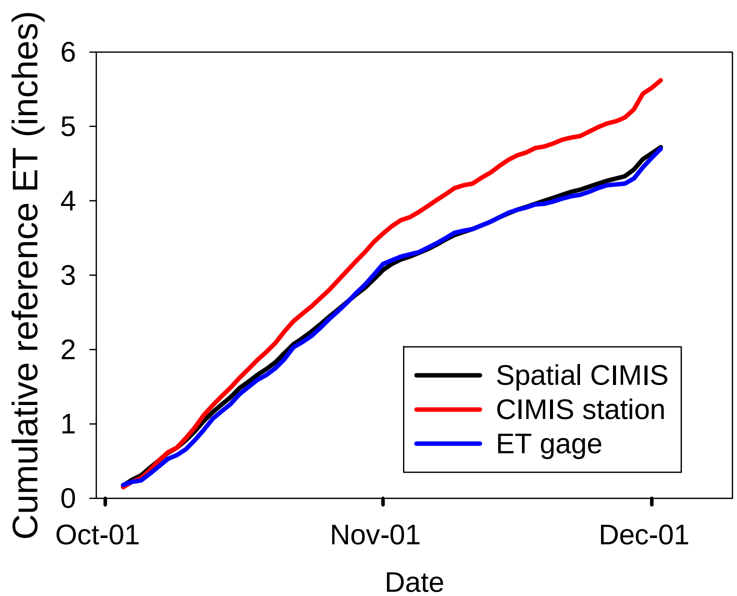

Figure 5. Cumulative reference ET for spatial CIMIS, Gilroy CIMIS station, and ETgage north of Morgan Hill during Oct-Dec, 2011.