THE UNIVERSITY OF ARIZONA
Cooperative Extension

az2191 February 2026

Using OpenET Platform and LI-710 Sensor for Irrigation Management in Arizona

Diaa Eldin Elshikha, Said Attalah, Clinton Williams, Kelly R. Thorp, Dong Wang, and Elsayed Ahmed Elsadek

Introduction

While freshwater is renewable, water resource depletion is occurring considerably more quickly than expected. With population growth and socioeconomic development, global water consumption has increased nearly sevenfold in the last century (Gleick, 2000), impacting the long-term sustainability of agriculture. The agriculture sector, the largest water user, accounts for over two-thirds of withdrawals. Therefore, precise irrigation is vital in arid regions where agriculture uses a significant share of water resources. Crop evapotranspiration (ETc) accounts for most of irrigation water use, especially in dry climates. Thus, accurate ETc estimation is important. Different methods are used to estimate ETc, such as lysimeters, Bowen ratio, surface renewal, and eddy covariance (EC), but they are costly and require expertise (Elsadek et al., 2025). Remote sensing models can also be used to estimate ETc, but their applications are limited by cost, expertise, and computational requirements (Volk et al., 2024). Recently, the OpenET platform has been developed to offer free, high-resolution ET data suitable for US irrigation management. The LI-710 sensor (LI-COR Inc., Lincoln, Nebraska, USA) was also presented as a lower-cost, user-friendly alternative to EC systems, providing continuous ETc measurements with less maintenance. Limited studies evaluated OpenET for irrigated alfalfa in Arizona; however, no cited studies evaluated OpenET or LI-710 for late-planted cotton in Arizona (Attalah et al., 2025, 2024). The following guide leverages a field study that cross-validates cotton ET from OpenET and LI-710 against soil water balance (SWB) estimates in Gila Bend, Arizona, aiming to identify the best technique for estimating cotton ET for irrigation management under arid conditions.

OpenET: Description and Data Acquisition

The LI-710 includes an ET sensor and an IoE Module (Figure 1). The sensor measures water vapor from evaporation and transpiration, providing data every 30 minutes. It connects via a cable to the Internet of Environment (IoE) Module, which supplies power, transmits data to the LI-COR Cloud, and allows remote access. The IoE Module may include a cellular plan, backup data logging, a charge controller, optional solar and battery power supply, along with a mounting structure and enclosure. Paired with the IoE Module, the LI-710 acts as a water node on the LI-COR Cloud, enabling ET monitoring

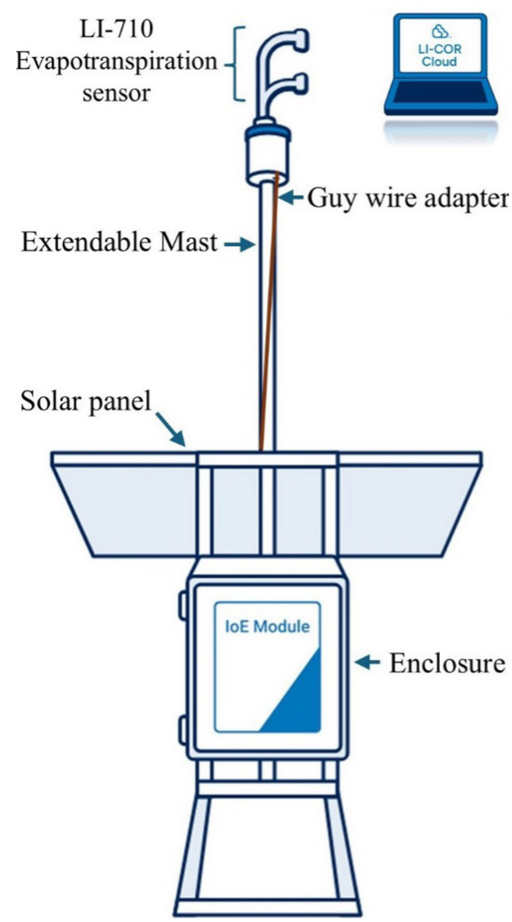

Figure 1. Components of the LI-710 device.

across multiple locations with automatic GPS updates. The LI-710 uses eddy covariance calculations, combining wind speed and humidity measurements to estimate ET from the surrounding area, called the "fetch footprint," typically 50-100 times the sensor's height. Proper placement ensures the footprint covers a uniform area or the upwind region for the measured crop. More details are at https://www.licor.com/support/LI-710/manuals.html, accessed on December 6, 2025.

Evaluation of Techniques for Estimating Cotton ET

A field study was conducted from June to October 2025 in Gila Bend, Arizona, USA, to evaluate the performance of the OpenET models (ALEXI/DisALEXI, eeMETRIC, geeSEBAL, PT-JPL, SIMS, and SSEBop), their Ensemble, and the LI-710 (LI-COR Inc., Lincoln, Nebraska, USA) in simulating cotton evapotranspiration (ET_c) compared to the more conventional soil water balance (SWB) method. The SWB approach estimate crop water use by keeping track of rainfall, irrigation, soil moisture, runoff, and other water losses. Four statistical evaluation metrics, the normalized root-mean-squared error (NRMSE), mean bias error (MBE), simulation error (S_e), and coefficient of determination (R^2), were employed to evaluate the performance of OpenET models, their Ensemble, and the LI-710 in estimating cotton ET. In general, OpenET models and their Ensemble approach were linearly correlated to soil water balance-derived evapotranspiration (ET_{SWB}) with a coefficient of determination (R^2) > 0.57.

Statistical analysis indicated that the ALEXI/DisALEXI, geeSEBAL, and PT-JPL models substantially underestimated ETSWB, with simulation errors ranging from -26.92% to -20.57%. The eeMETRIC, SIMS, SSEBop, and Ensemble provided acceptable ET estimates (22.57% ≤ NRMSE ≤ 29.85%, -0.36 mm. day-1 ≤ MBE ≤ -0.16 mm. day-1, -7.58% ≤ Se ≤ 3.42%, 0.57 ≤ R2 ≤ 0.74). Meanwhile, LI-710 simulated cotton ET acceptably with a slight tendency to overestimate daily ET by 0.21 mm in early September. A strong positive correlation was observed between daily ETSIM from LI-710 and ETSWB, with Se and NRMSE of 4.40% and 23.68%, respectively.

Conclusion

Our results showed that, with the exception of the SIMS model, all OpenET models and the Ensemble underestimated actual cotton evapotranspiration (ET), with errors ranging from acceptable to poor. The PT-JPL, ALEXI/DisALEXI, and geeSEBAL models consistently underestimated crop ET and were considered unreliable for early planted cotton, while eeMETRIC, SIMS, SSEBop, and Ensemble performed within acceptable ranges based on statistical metrics. LI-710 slightly overestimated ET but provided reliable measurements by capturing spatial variability caused by microclimate and soil texture differences.

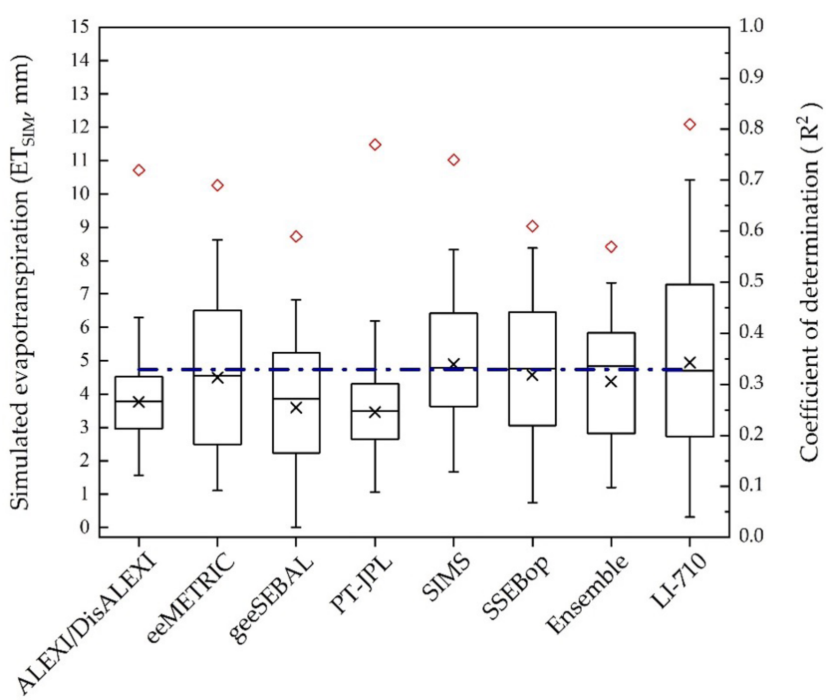

Figure 2. Average biases in simulated daily cotton evapotranspiration (ET_{SIM}) by six OpenET models, their Ensemble, and LI-710 during 2025 in Gila Bend, Arizona, USA. The blue dashed line represents the average soil water balance ET (ET_{SWB}). The cross and line within the box mark the average and median ET_{SIM}, respectively, and whiskers above and below the box indicate the maximum and minimum ET_{SIM} values. The red diamonds indicate the coefficient of determination (R^2).

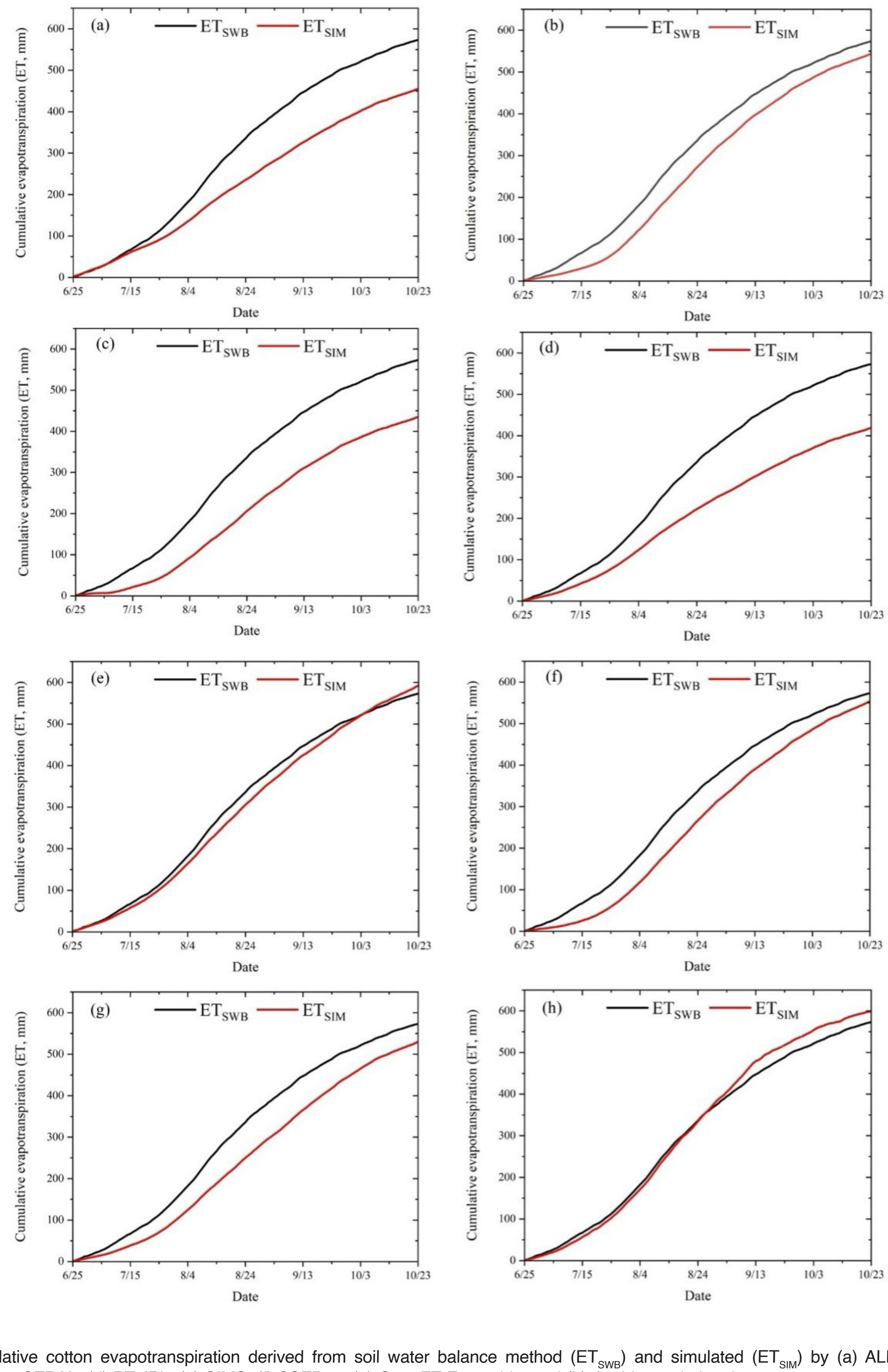

Figure 3. Cumulative cotton evapotranspiration derived from soil water balance method (ET_{SWB}) and simulated (ET_{SIM}) by (a) ALEXI/DisALEXI, (b) eeMETRIC, (c) geeSEBAL, (d) PT-JPL, (e) SIMS, (f) SSEBop, (g) OpenET Ensemble, and (h) the LI-710 during the 2025 cotton growing season in Gila Bend, Arizona, USA.

These findings highlight the limitations of OpenET models under arid and semi-arid conditions, specifically for late-planted cotton. Key sources of uncertainty include soil background effects on reflectance and surface temperature, cloud cover, and management practices that can further change soil conditions. Together, these limitations highlight the need to supplement OpenET estimates with ground-based measurements and apply local calibration to improve ET estimates for late-planted crops in Arizona.

Despite the limitations of OpenET models and some maintenance challenges of the LI-710, our findings highlight the great potential of using an OpenET model, such as eeMETRIC, SIMS, and SSEBop, the Ensemble, as well as the LI-710 sensor for efficient irrigation management of late-planted cotton in arid and semi-arid regions, like Arizona.

Acknowledgement

This work was supported by the University of Arizona Cooperative Extension Water Irrigation Efficiency Program, which is funded by the Arizona State Legislature.

Disclaimer

This publication provides an objective summary of an irrigation experiment and does not endorse or promote any brand, product, or trademark. Any references to product names, trademarks, or companies are included for informational purposes only.

References

Attalah, S., Elsadek, E.A., Waller, P., Hunsaker, D., Thorp, K., Bautista, E., Williams, C., Wall, G., Orr, E., Elshikha, D.E., 2024. Evaluating the Performance of OpenET Models for Alfalfa in Arizona, in: 2024 Anaheim, California July 28-31, 2024, ASABE Paper No. 2400041. American Society of Agricultural and Biological Engineers, St. Joseph, MI, p. 1. https://doi.org/10.13031/aim.202400041.

Attalah, S., Elsadek, E.A., Waller, P., Hunsaker, D.J., Thorp, K.R., Bautista, E., Williams, C., Wall, G., Orr, E., Elshikha, D.E.M., 2025. Evaluation and comparison of OpenET models for estimating soil water depletion of irrigated alfalfa in Arizona. Agric. Water Manag. 320, 109850. https://doi.org/10.1016/j.agwat.2025.109850.

Elsadek, E.A., Ali, M.A.H., Williams, C., Thorp, K.R., Elshikha, D.E.M., 2025. A Novel Framework for Predicting Daily Reference Evapotranspiration Using Interpretable Machine Learning Techniques. Agriculture 15, 1985. https://doi.org/10.3390/agriculture15181985

Elsadek, E.A., Attalah, S., Williams, C., Thorp, K.R., Wang, D., Elshikha, D.E.M., 2026. Comparing Cotton ET Data from a Satellite Platform, In Situ Sensor, and Soil Water Balance Method in Arizona. Agriculture 16, 228. https://doi.org/10.3390/agriculture16020228

Elshikha, D.E., Attalah, S., Waller, P., Hunsaker, D.J., Thorp, K.R., Bautista, E., Williams, C., Wall, G.W., Orr, E., Elsadek, E.A., 2025. Can OpenET Transform Irrigation Management in the Southwestern U.S.? College of Agriculture, Life, and Environmental Sciences, University of Arizona, USA.

Gleick, P.H., 2000. A Look at Twenty-first Century Water Resources Development. Water Int. 25, 127–138. https://doi.org/10.1080/02508060008686804.

Volk, J.M., Huntington, J.L., Melton, F.S., Allen, R., Anderson, M., Fisher, J.B., Kilic, A., Ruhoff, A., Senay, G.B., Minor, B., Morton, C., Ott, T., Johnson, L., Comini de Andrade, B., Carrara, W., Doherty, C.T., Dunkerly, C., Friedrichs, M., Guzman, A., Hain, C., Halverson, G., Kang, Y., Knipper, K., Laipelt, L., Ortega-Salazar, S., Pearson, C., Parrish, G.E.L., Purdy, A., ReVelle, P., Wang, T., Yang, Y., 2024. Assessing the accuracy of OpenET satellite-based evapotranspiration data to support water resource and land management applications. Nat. Water 2, 193–205. https://doi.org/10.1038/s44221-023-00181-7.

THE UNIVERSITY OF ARIZONA
Cooperative Extension

AUTHORS

Diaa Eldin Elshikha
Assistant Professor and Irrigation Specialist, Biosystems Engineering, Tucson, Arizona

Said Attalah
Research Associate, Biosystems Engineering, Tucson, Arizona

Clinton Williams
Soil Scientist, Leader of the Water Management and Conservation Research Unit, Arid Land Agricultural Research Center, Maricopa, Arizona

Kelly R. Thorp
Agricultural Engineer, USDA Agricultural Research Service, Grassland Soil & Water Research Laboratory, Temple, Texas

Dong Wang
Agricultural Engineer, Water Management and Conservation Research Unit, Arid Land Agricultural Research Center, Maricopa, Arizona

Elsayed Ahmed Elsadek
Research Associate, Biosystems Engineering, Tucson, Arizona

CONTACT
Diaa Eldin Elshikha
diaaelshikha@arizona.edu

This information has been reviewed by University faculty.
extension.arizona.edu/pubs/az2191-2026.pdf

Other educational materials from Arizona Cooperative Extension can be found at:
extension.arizona.edu/pubs