EGU25-7305

# A Cloud-Based Post-Processing Pipeline for Eddy Covariance Flux Datasets: From Actual Evapotranspiration Measurements to Spatial Water Balance

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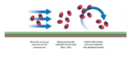
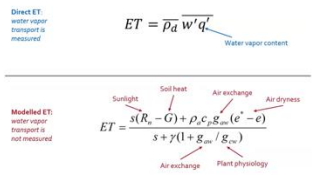


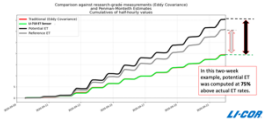
Figures 1,2,3: LI-710 and conceptual representation of the eddy covariance method to quantify fluxes over a landscape.

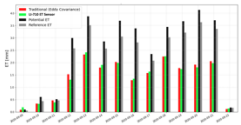
## Introduction

- The LI-710 measures Actual Evapotranspiration (ETa) using **the Eddy Covariance method**. (1)
- The LI-710 Evapotranspiration Sensor when paired with an Internet of the Environment (IoE) Module becomes a connected sensor: **the Water Node.**
- The Water Node feeds measurement data at set intervals defined by the user to **LI-COR Cloud.**
- The information presented to the user is built on sophisticated, community-accepted data cleaning, gap filling and aggregating procedures. Users can receive alerts, share data and collaborate with stakeholders from a common cloud platform.

## Actual Evapotranspiration Measurements



Figures 4,5,6: Comparison of ETa from eddy covariance-based measurements and modelled ET.

- **Actual ET** from the LI-710 is a direct measurement of ET, as opposed to modelled values (2) which represent idealized conditions and overestimate ET in most real-world conditions.
- Real-time ET data is calculated from 10 Hz measurements over a flux averaging interval (~18000 records, 30 minutes).

## Supporting Measurements

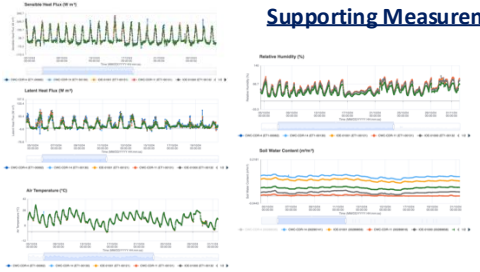




Figure 7,8,9,10,11: Time series plots of sensible heat flux, latent heat flux, air temperature, relative humidity, and soil water content

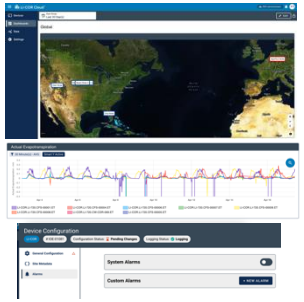
- In addition to **Actual ET** from the LI-710, additional supporting measurements are provided which provide context for the core measurements, and help inform analysis of energy balance, soil conditions, atmospheric conditions, and other analysis.
- **Additional peripheral sensors can be added** to accomplish specific research goals, including net radiation, using SDI-12.

## Edge Processing: Water Node

- The LI-710 connects to an IoE Module which contains embedded power, communications, and is pre-configured to transmit measured actual evapotranspiration and supporting measurements to LI-COR Cloud.
- Minimal configuration and time-onsite is required by the researcher. Interaction with data is primarily through the web-based cloud interface.
- Analytics are built on the data streams ingested from the water node and are exposed to the user as features in the user-interface. Furthermore, data will be accessible to 3rd party applications, including custom interfaces using an API.

## Cloud Platform: LI-COR Cloud


Figure 16: Conceptual representation of the data flow from the Water Node to LI-COR Cloud.




Figures 17,18,19: Data visualization, Alerts, and Export user interface examples.

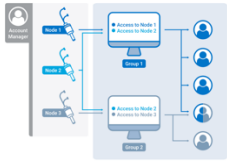



Figure 20: Conceptual representation of Shared Networks.

- LI-COR Cloud provides users with core functionality including data visualization, alerts and notifications, data exports, and data sharing.
- Data sharing is made possible through the implementation of "Shared Networks" where Nodes are added to groups, and users are invited to access.

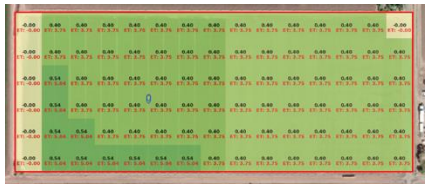
## Post-Processing: LI-COR Cloud

Figure 21: Data pipeline steps, from raw data to gap filled data.

**Automated Data Cleaning & Gap Filling**
- Thresholds and Diagnostics
- Outlier Detection and Removal
- MDS Gap Filling (3) as a service

**Daily Flux Footprint Climatology**
- Calculated using met inputs with Kljun 2D Footprint model. (4)

**Spatial Extrapolation of Water Balance Inputs**
- Scaling based on spectral index per pixel from coincident Sentinel2 satellite imagery for area of interest (AOI)



Figures 22, 23: Daily flux footprint and spatial extrapolation of ET.

## References

(1) Burba, George. "Eddy covariance method." LI-COR Biosciences, Lincoln, NE 630 (2013).

(2) FAO. "Chapter 2 - FAO Penman-Monteith Equation." *FAO Irrigation and Drainage Paper 56*, Food and Agriculture Organization, https://www.fao.org/4/X0490E/x0490e06.htm. Accessed 25 Sept. 2024.

(3) Reichstein, Markus, et al. "On the separation of net ecosystem exchange into assimilation and ecosystem respiration: review and improved algorithm." *Global change biology* 11.9 (2005): 1424-1439.

(4) Kljun, Natascha, et al. "A simple two-dimensional parameterisation for Flux Footprint Prediction (FFP)." *Geoscientific Model Development* 8.11 (2015): 3695-3713.



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