CABBI
CENTER FOR ADVANCED BIOENERGY AND BIOPRODUCTS INNOVATION

Artificial Neural Networks Estimate Evapotranspiration for *Miscanthus x giganteus* as Effectively as Empirical Model but with Fewer Inputs

Background/Objective

Estimations of actual evapotranspiration (*ET*) are crucial for understanding how vegetation impacts the water balance of ecosystems. *ET* estimation via empirical modeling involves many parameters and is very complex. This study explores whether artificial neural networks (ANNs), which require fewer and more common meteorological parameters, can estimate *ET* as well as empirical models.

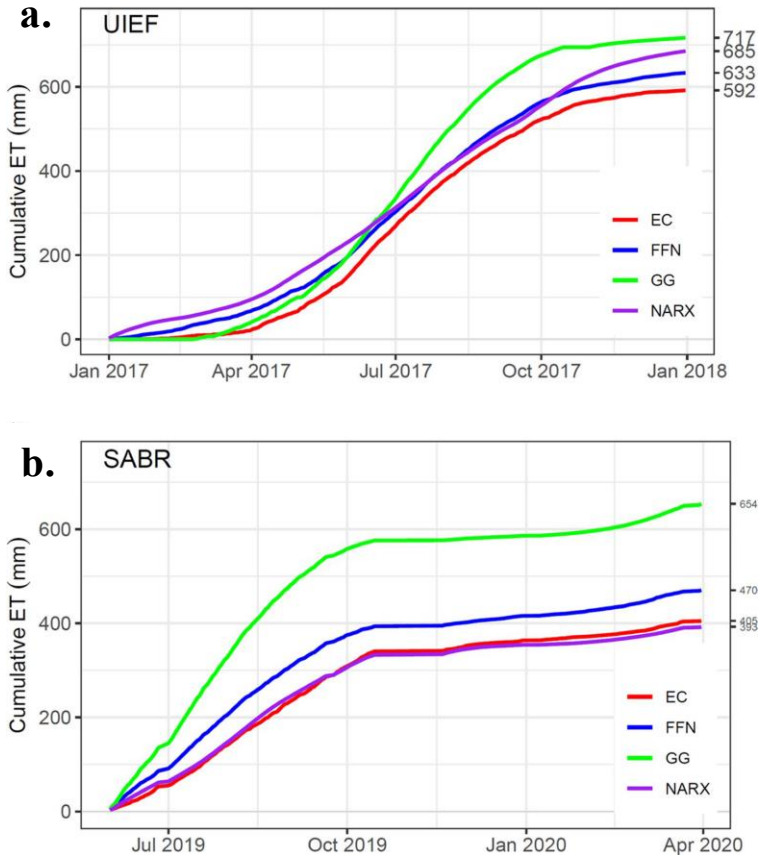
Approach

Researchers trained two ANNs, one using a feed-forward approach (FFN) and the other a nonlinear autoregressive network (NARX), to predict *ET* and compared them to the commonly used empirical model Grainger and Gray (GG). Models were trained on a 9-year eddy covariance dataset for *Miscanthus x giganteus* (*Mxg*) for Illinois (UIEF) and tested using out-of-sample data from UIEF and a separate location in Iowa (SABR).

Results

Model	Inputs	R^2 (UIEF)	R^2 (SABR)	Findings
FFN	$T_a + R_s$	0.84	0.70	Best accuracy, simple input
NARX	T_a	0.70	0.70	Most generalizable
GG	T_a, R_h, R_s, u, G	0.83	0.60	Poor generalization, more inputs

T_a: air temperature, R_s: solar radiation, R_h: relative humidity, u: average daily wind speed, G: soil heat flux



Cumulative *ET* models: NARX, GG, and FFN compared to observed *ET* from eddy covariance (EC) for (a) the UIEF during 2017 and (b) the SABR site from June 2019 to April 2020.

Significance/Impacts

This analysis demonstrates that ANN approaches are as accurate as empirical approaches for estimating *ET* but require fewer inputs.

Aslan-Sungur et al. 2025. "Artificial Neural Networks Estimate Evapotranspiration for *Miscanthus x giganteus* as Effectively as Empirical Model but with Fewer Inputs." *Theoretical and Applied Climatology.* DOI: 10.1007/s00704-025-05812-5.