Evaluation of SEBAL and METRIC Energy Balance Models for Evapotranspiration Estimation in Precision Agriculture

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GU2020--Online session display -HS6.8 Irrigation estimates and management from remote sensing and hydrological modelling

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Many techniques have been developed for irrigation scheduling.

- **Water Balance Methods**
- **Checkbooks**
- **Soil Moisture Sensors**
- **Computer Models**
- **Mobile Apps**

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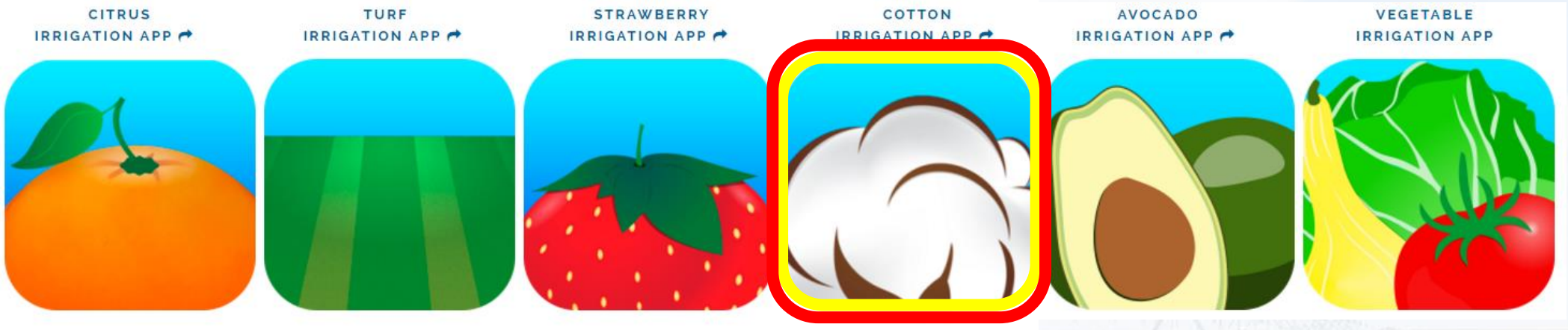
Smartphone Apps for Irrigation Scheduling



Available for
iOS and Android

Beta testing by farmers
Available 2019

Under development
Available 2020

www.smartirrigationapps.org

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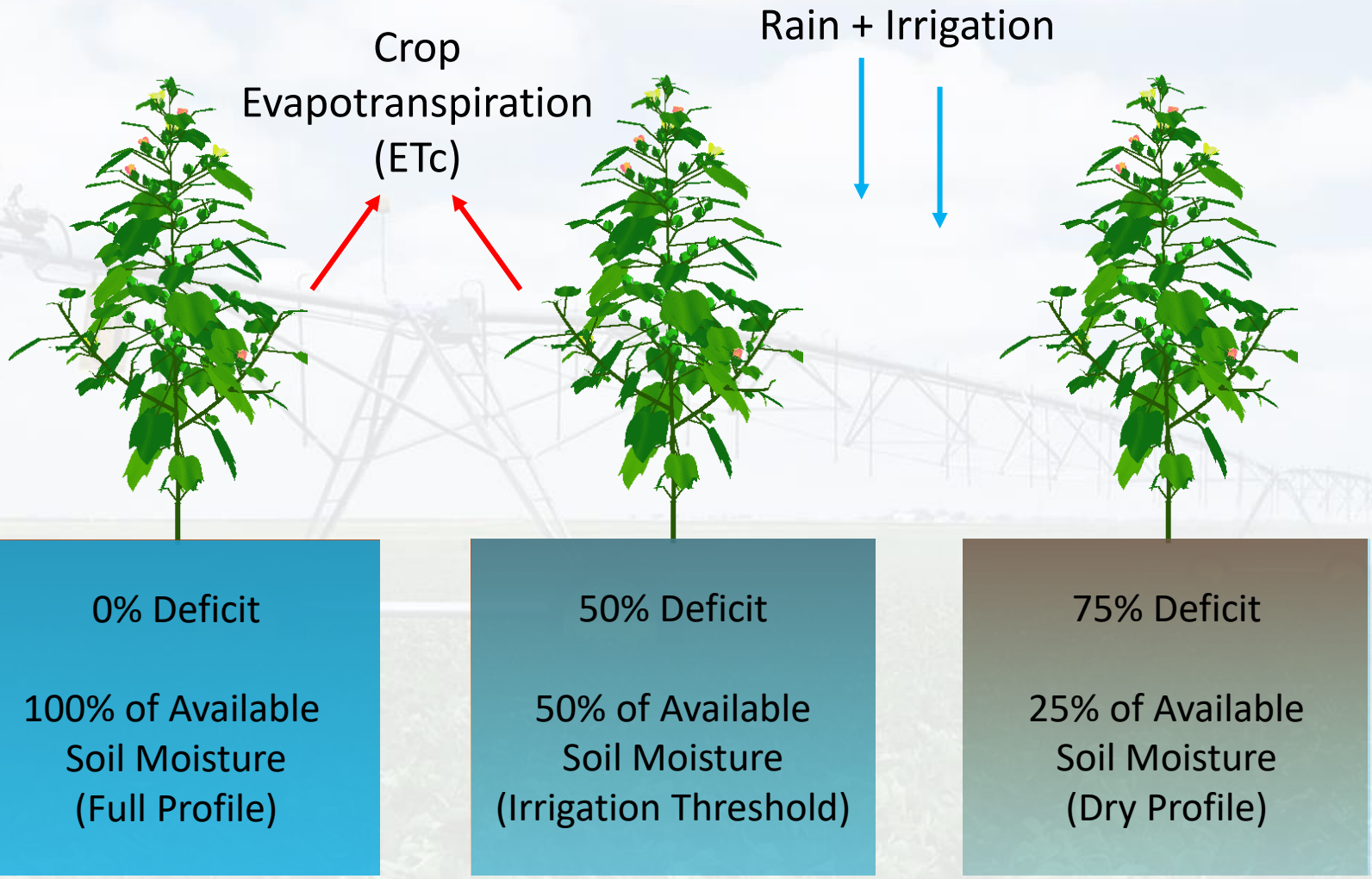
Soil Profile Water Balance



$$ETc = ETo \times Kc$$

where

ETc = estimated crop ET

Kc = crop coefficient

ETo = Penman-Monteith reference ET (FAO 56)

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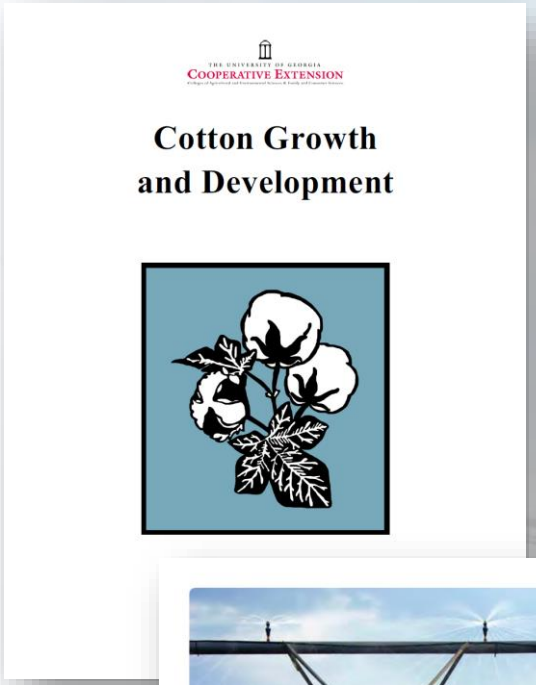
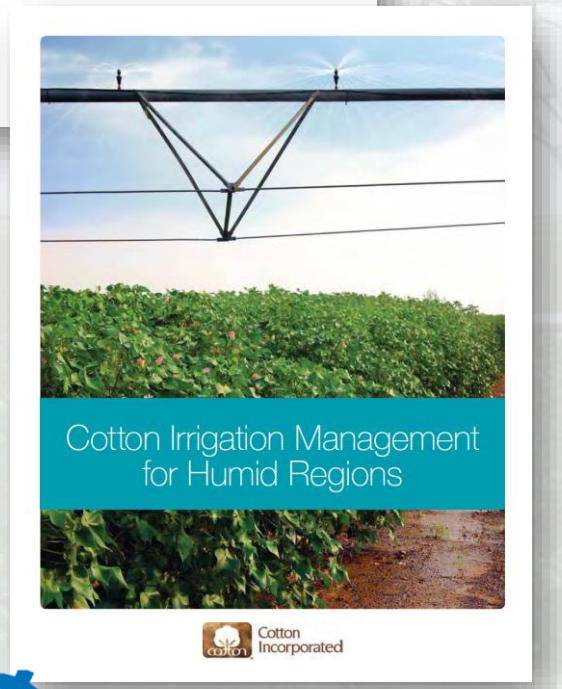
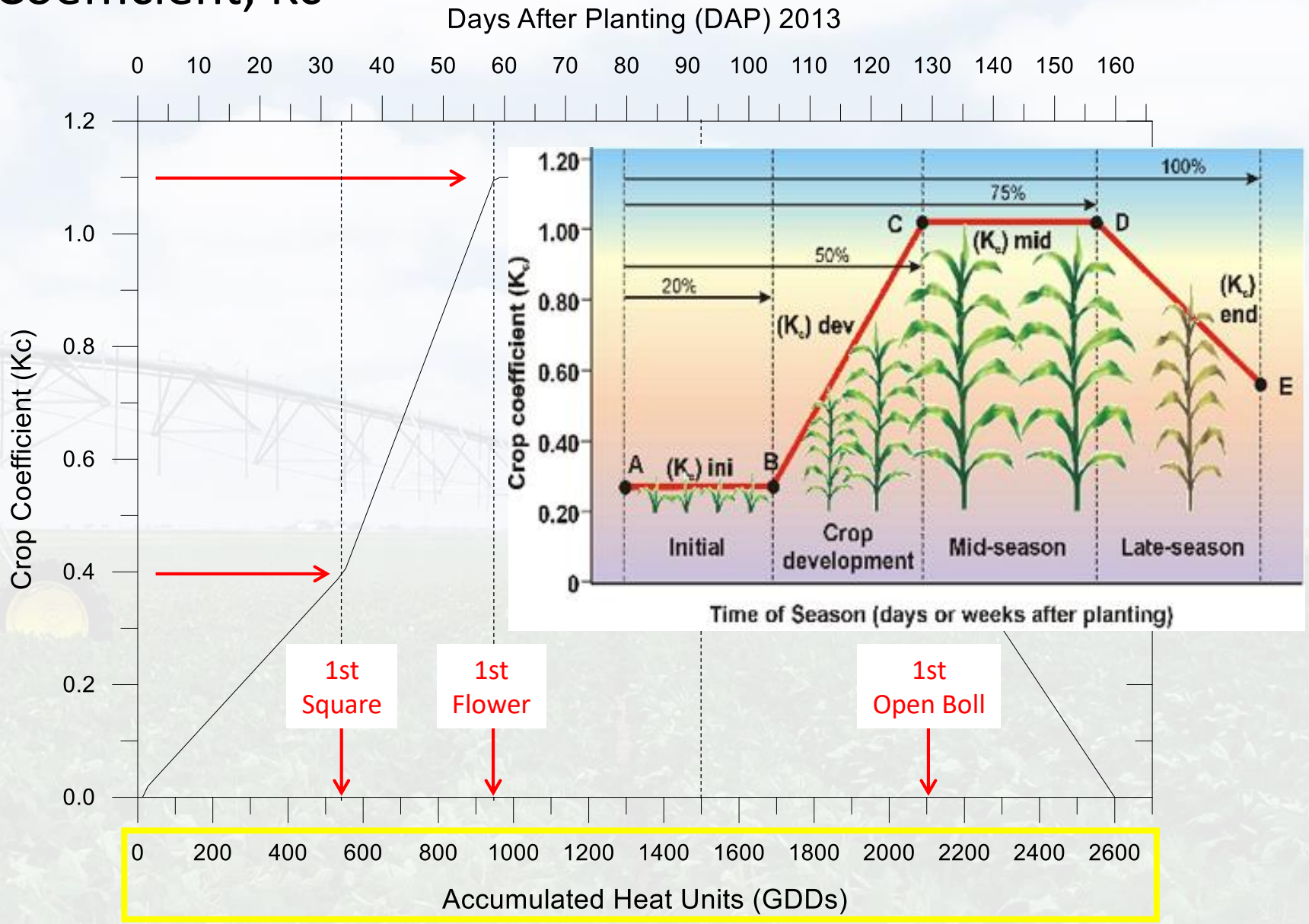
Crop Coefficient, Kc

$$ETc = ETo \times Kc$$







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Objectives

- Find a Suitable model to directly estimate crop Evapotranspiration (ETc) through remotely sensed data.

- Test the model against ground-truth data to evaluate the applicability of integrating the model into the SmartIrrigation Apps.

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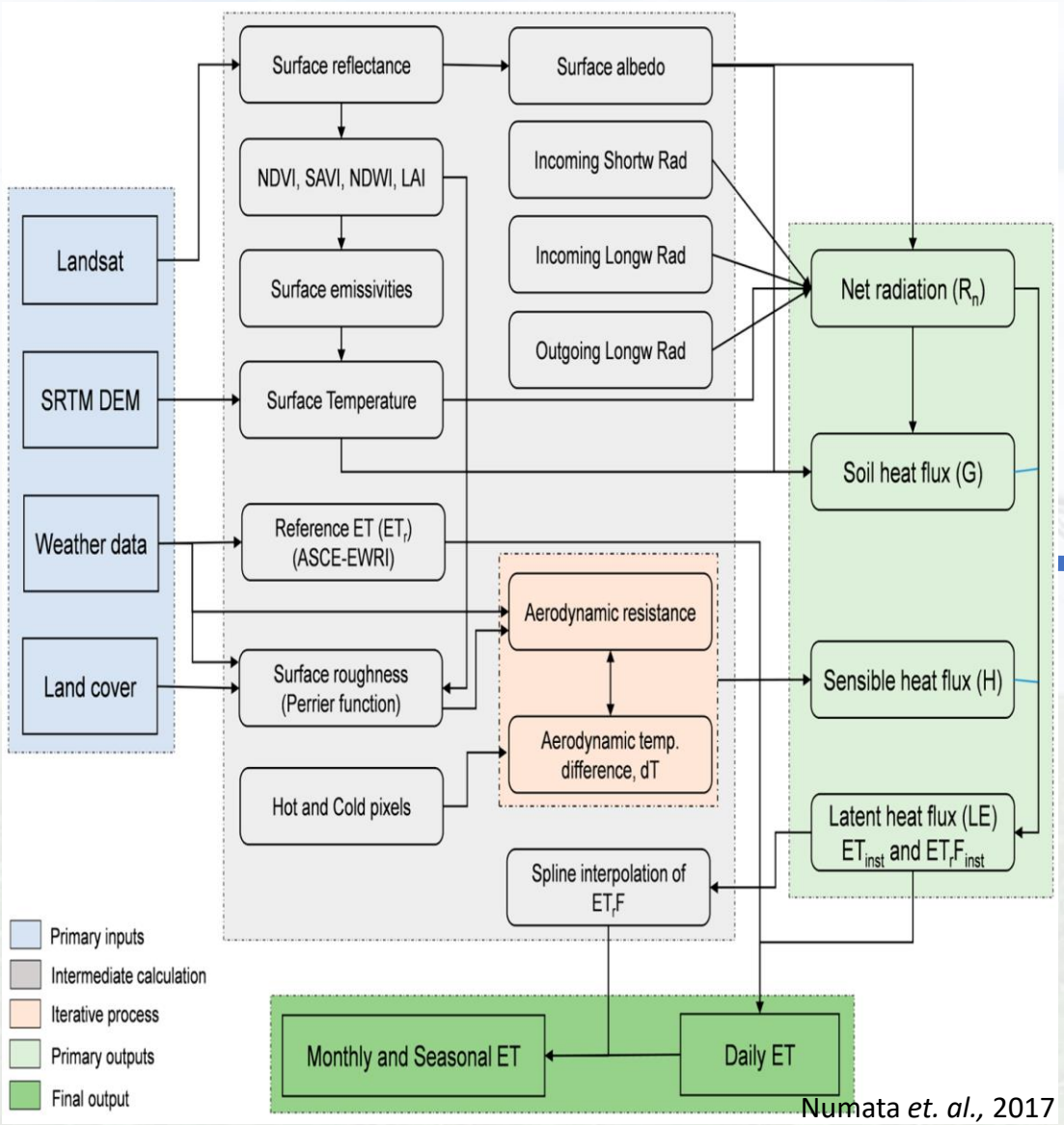
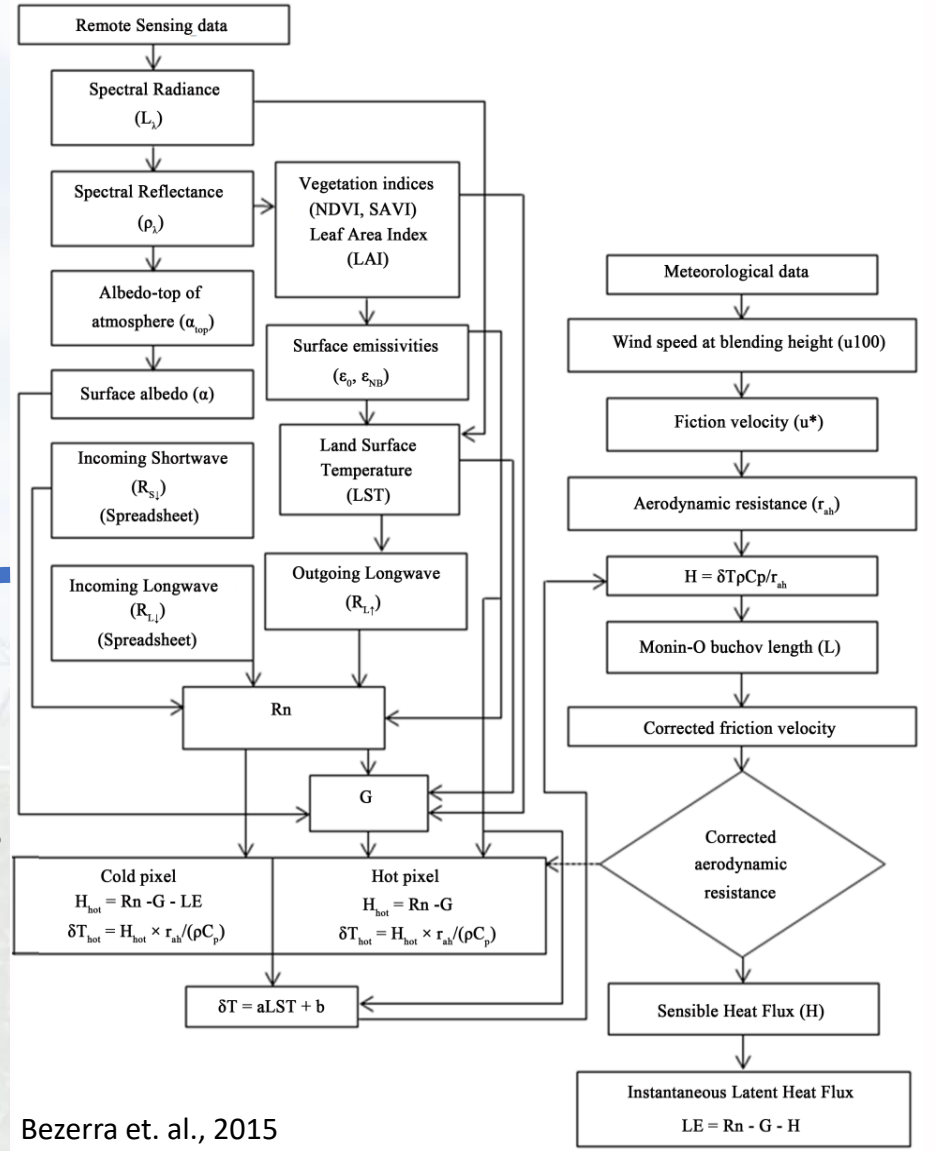
Flowchart of METRIC model



Numata *et. al.,* 2017

Flowchart of SEBAL model



Bezerra et. al., 2015

Data processing

Crop Evapotranspiration

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Study area

Tift County, Georgia, USA

Soil: Loamy sand

Plant: Corn

Area: 60 Acres

Season: 2016

Eddy Covariance Flux Tower

Ground-truth
Crop Evapotranspiration (ETc)
measurements

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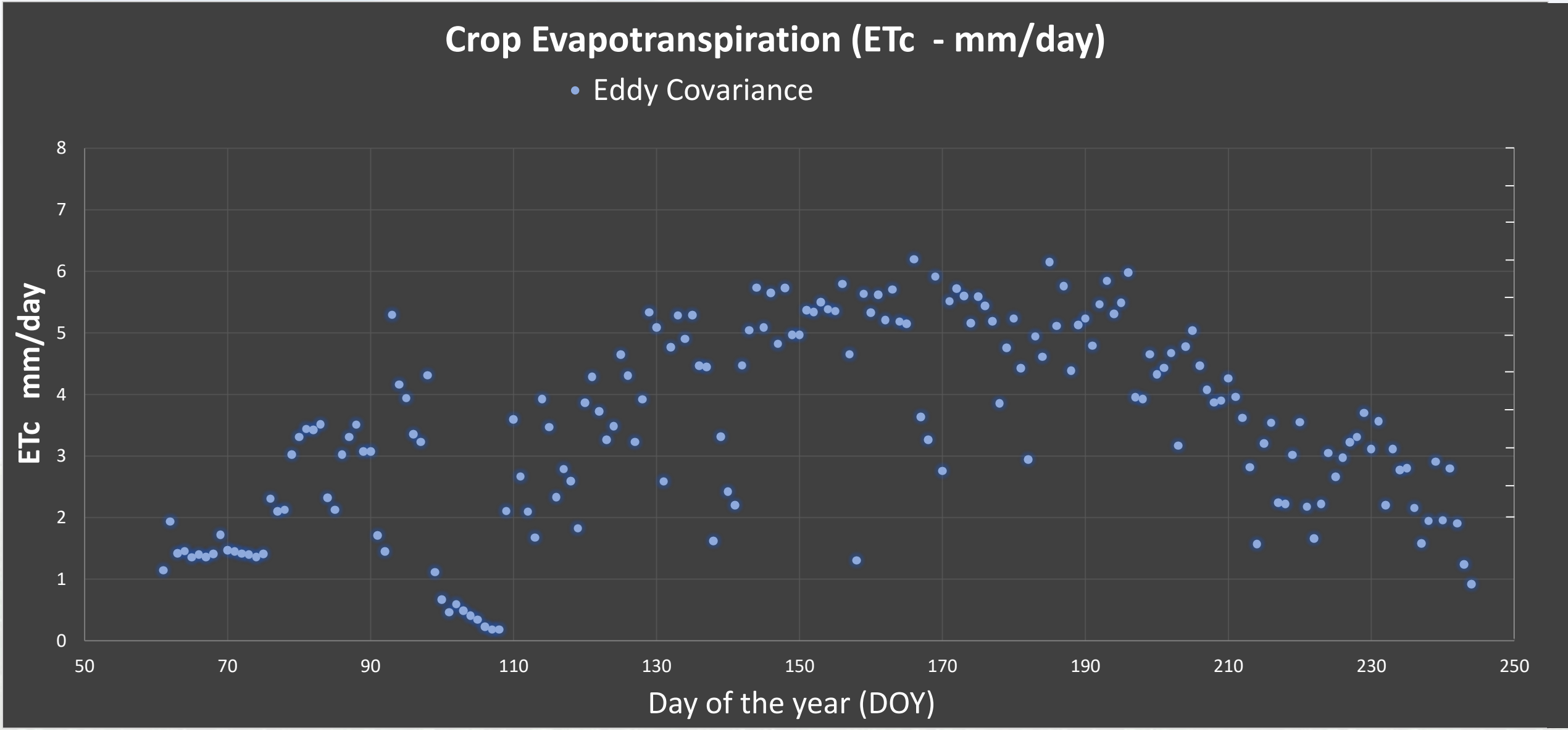

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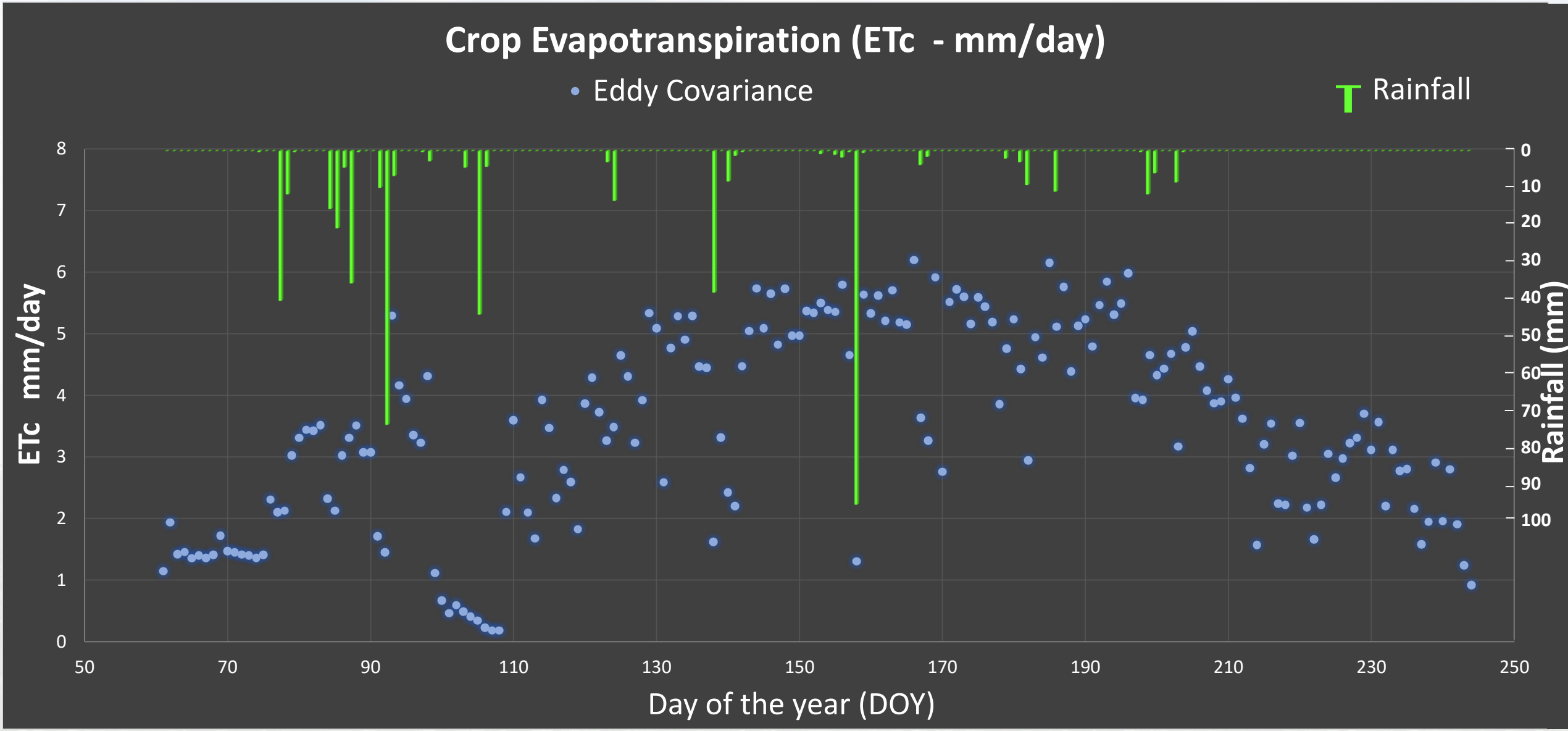

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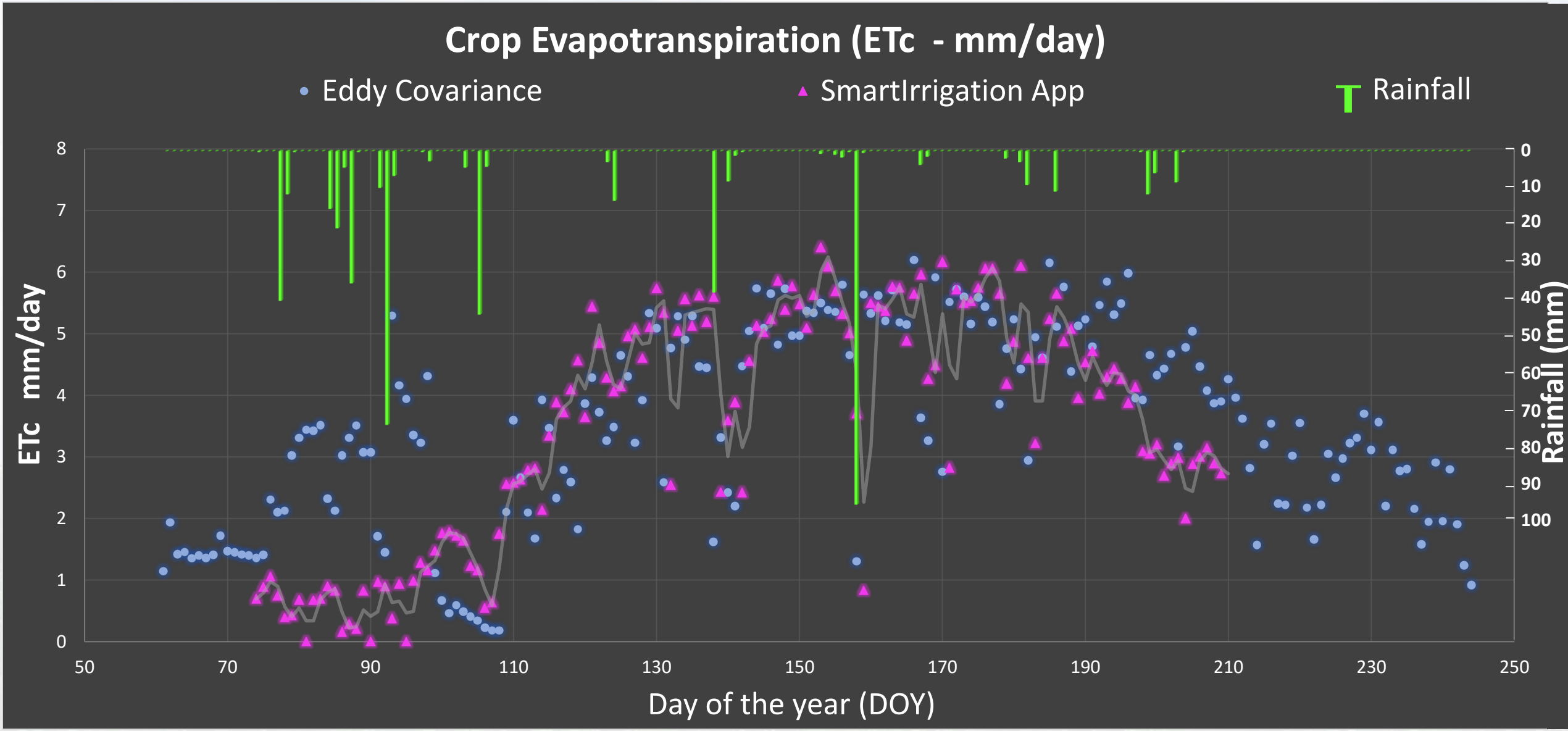

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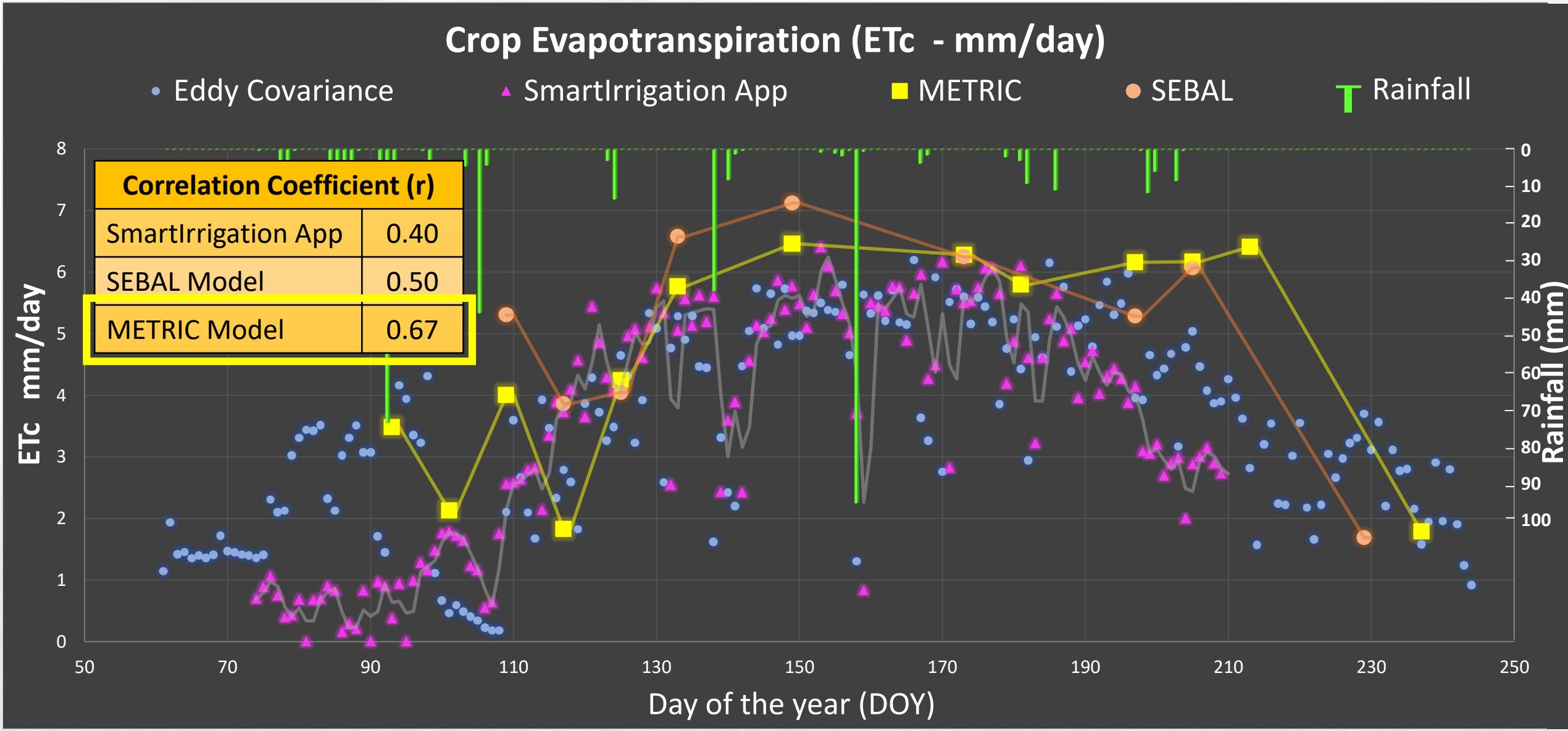

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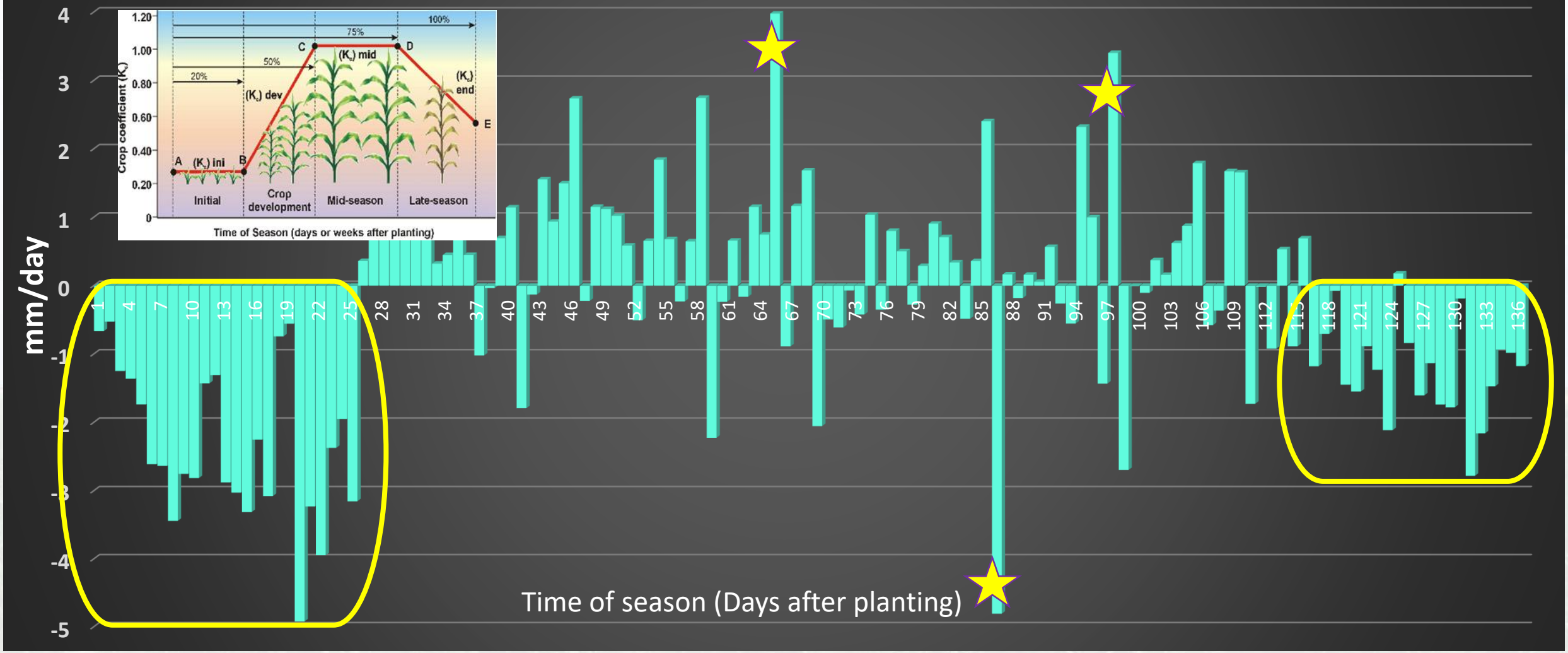
SmartIrrigation App - Over & Under Estimation of ETc (mm/day)



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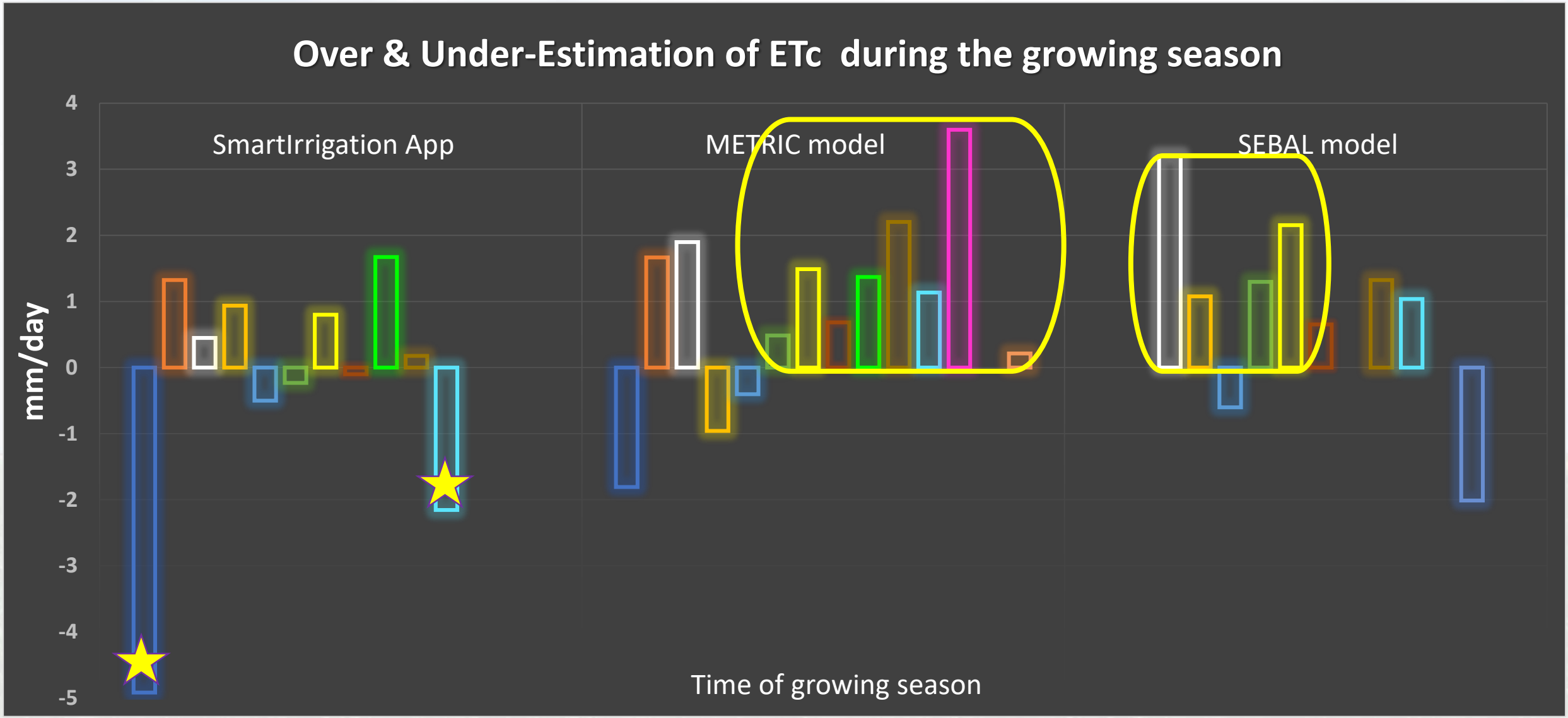

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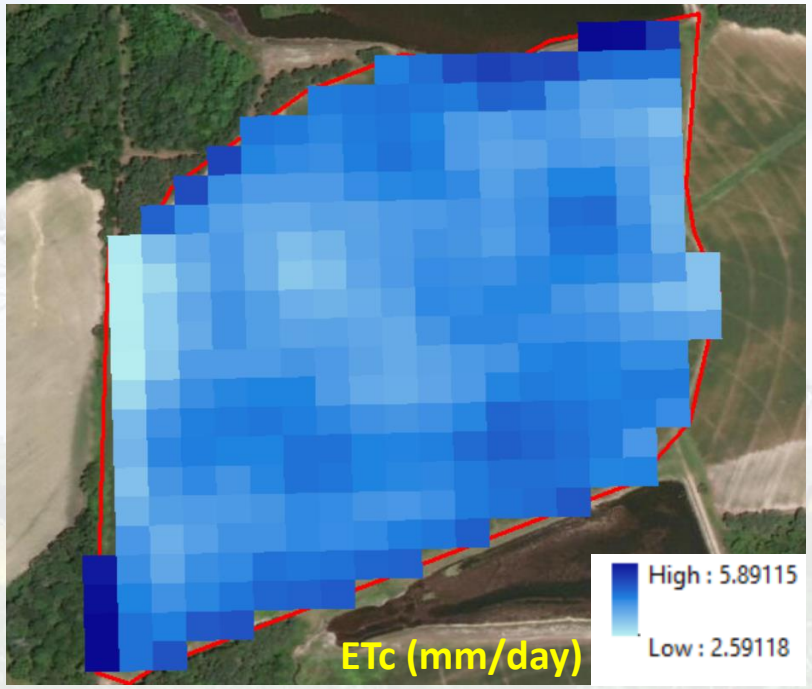
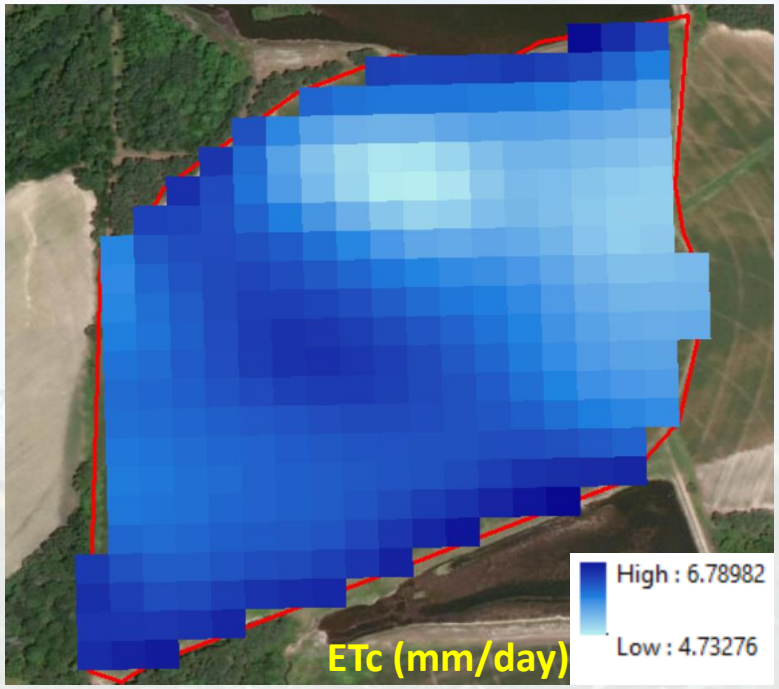
Crop Evapotranspiration Maps

Experimental Location



SEBAL Model
9 maps during the season



METRIC Model
13 maps during the season

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Conclusions

- Using the crop coefficient curve in the SmartIrrigation mobile App to estimate crop evapotranspiration led to underestimation of crop water requirements during both the first and the last growing stages.
- Rainfall amount input from a rain gage in the field or close weather station enhances significantly the ETc estimations
- METRIC model showed the highest correlation to the ground-truth data with overestimated values of ETc by the end of the growing season.
- Integrating the METRIC model into the SmartIrrigation App may enhance the App efficiency in irrigation scheduling.
- SEBAL model needs to be adjusted before applying in humid environments.

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Future work

- Repeat the same methodology over a number of years to form a clearer picture about the efficiency of the SmartIrrigation Apps and both SEBAL and METRIC models in estimating the crop evapotranspiration
- Integrate the METRIC model into the SmartIrrigation app to improve the irrigation scheduling during the growing season
- Comparing the performance of the SmartIrrigation app before and after the integration of the METRIC model with ground truth values of evapotranspiration

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