

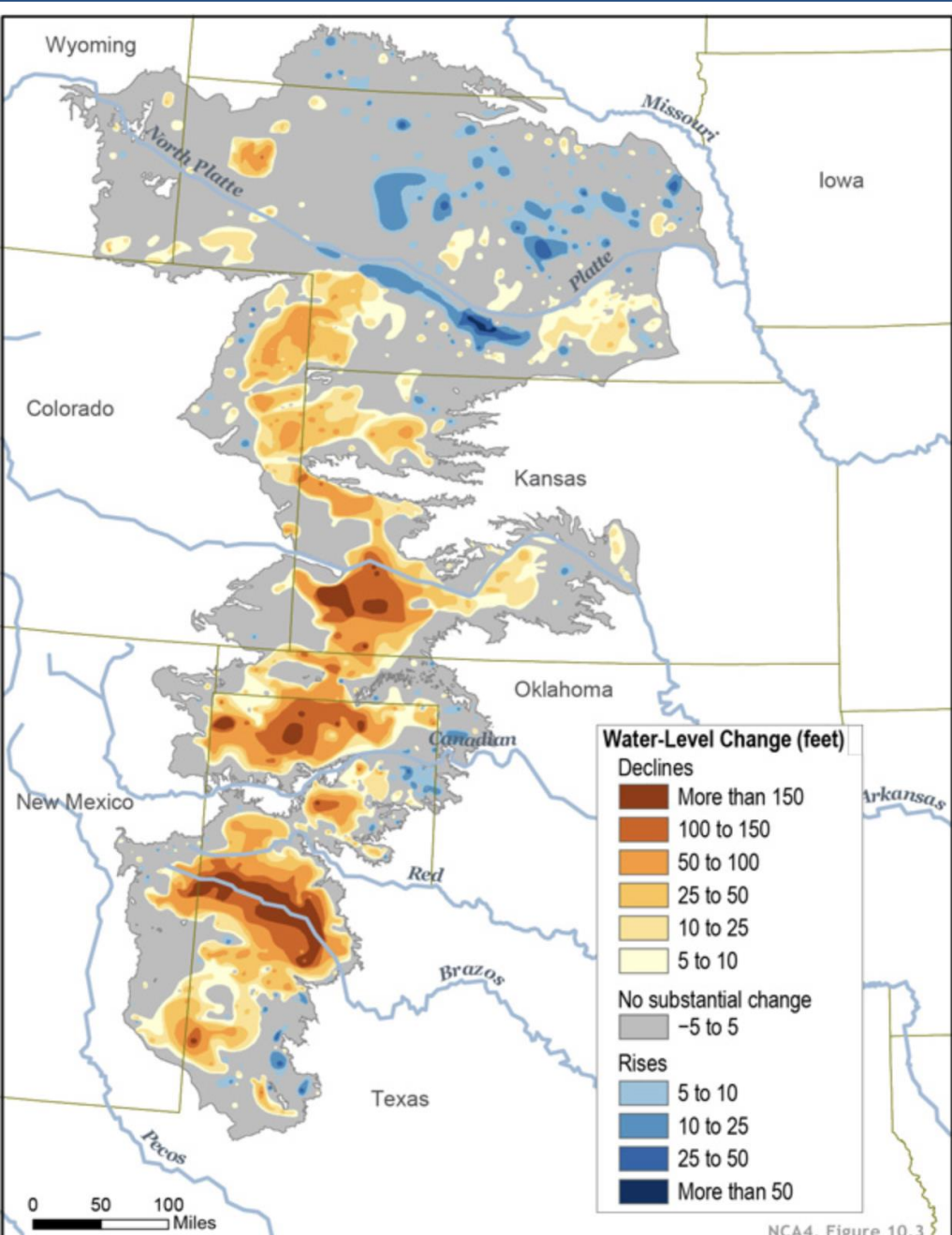
# Quantifying the Effect of Crop Rotation on Seasonal Water Balance Components

Menard A. Soni <sup>a</sup>, Jonathan Aguilar <sup>ab</sup>, Aleksey Y. Sheshukov <sup>a</sup>

<sup>a</sup> Department of Biological and Agricultural Engineering, <sup>b</sup> Southwest Research and Extension Center

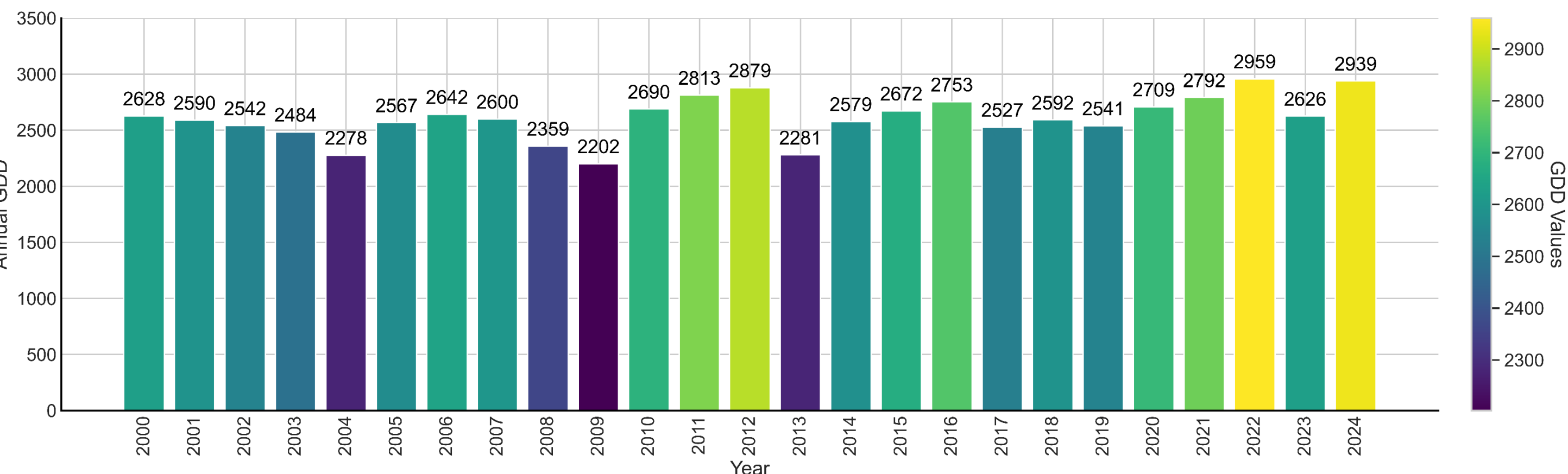
## Introduction

- Ogallala aquifer is depleting
- Water saving strategies needed
- Cotton found to be feasible
- Cotton consumes 30% less water



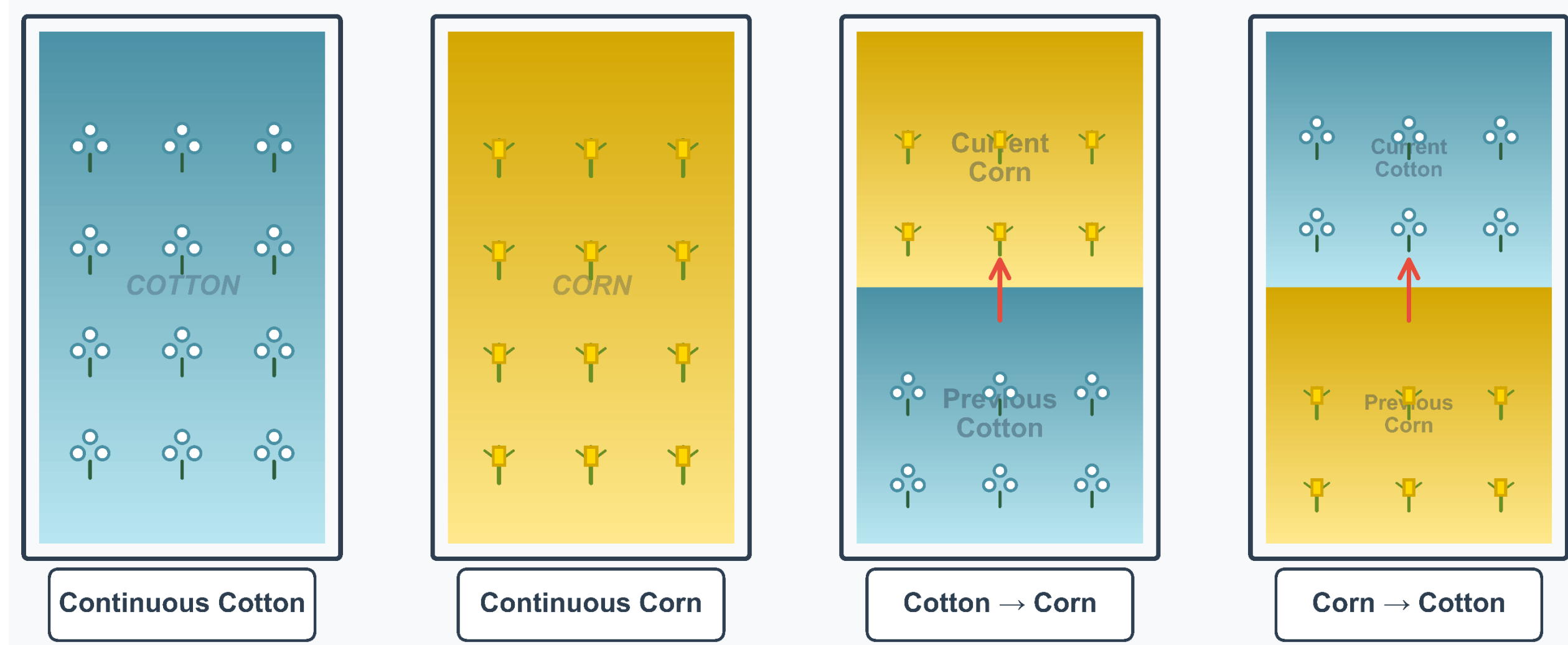
Changes in Groundwater Storage Across the Ogallala Aquifer Region (Scott, 2019)

Total GDD by Year (2000–Present)



## Methods

Field Treatment Cropping Patterns



**WATER IN:** Irrigation + Rainfall

- Rain gauge measured precipitation events
- Rain gauge validated actual irrigation rate

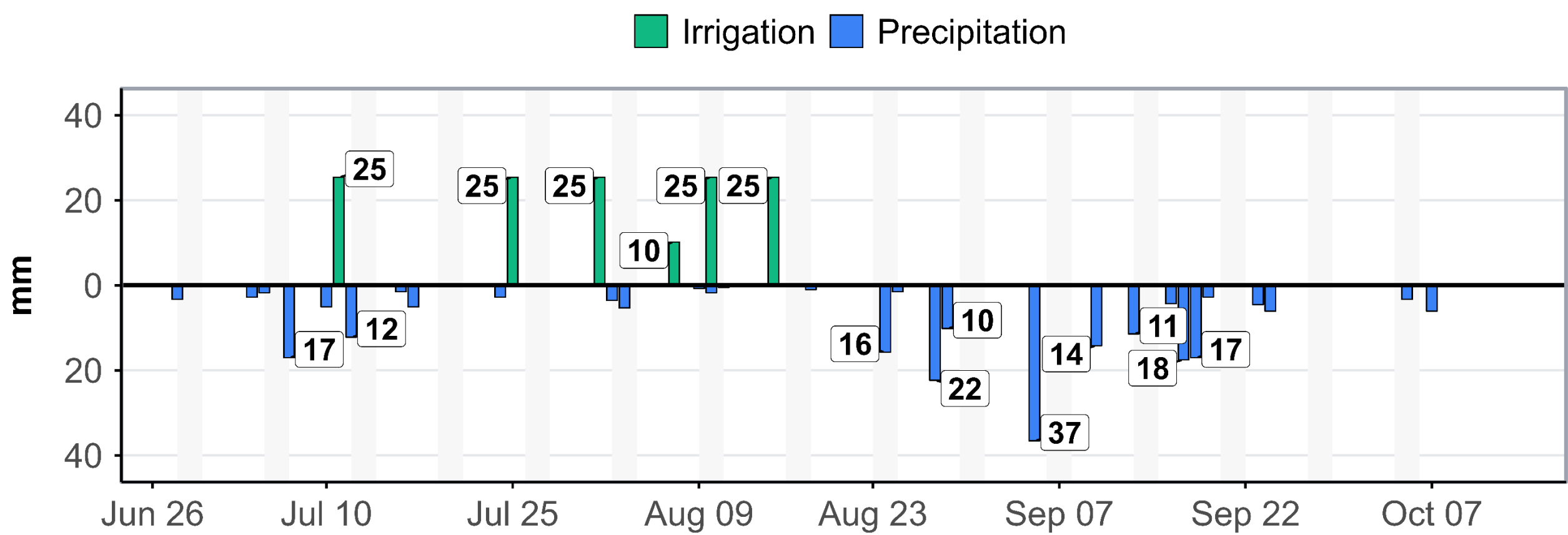
**WATER OUT:** Runoff + Deep Drainage + Storage Change + ETa

- Neutron probe measured water storage
- Neutron probe measured below root zone for deep drainage
- Saturo infiltrometer used for infiltration rate at ponded condition (potential)
- Potential infiltration aided runoff calculation
- $ET_a = (I + P) - (R + D + \Delta S)$

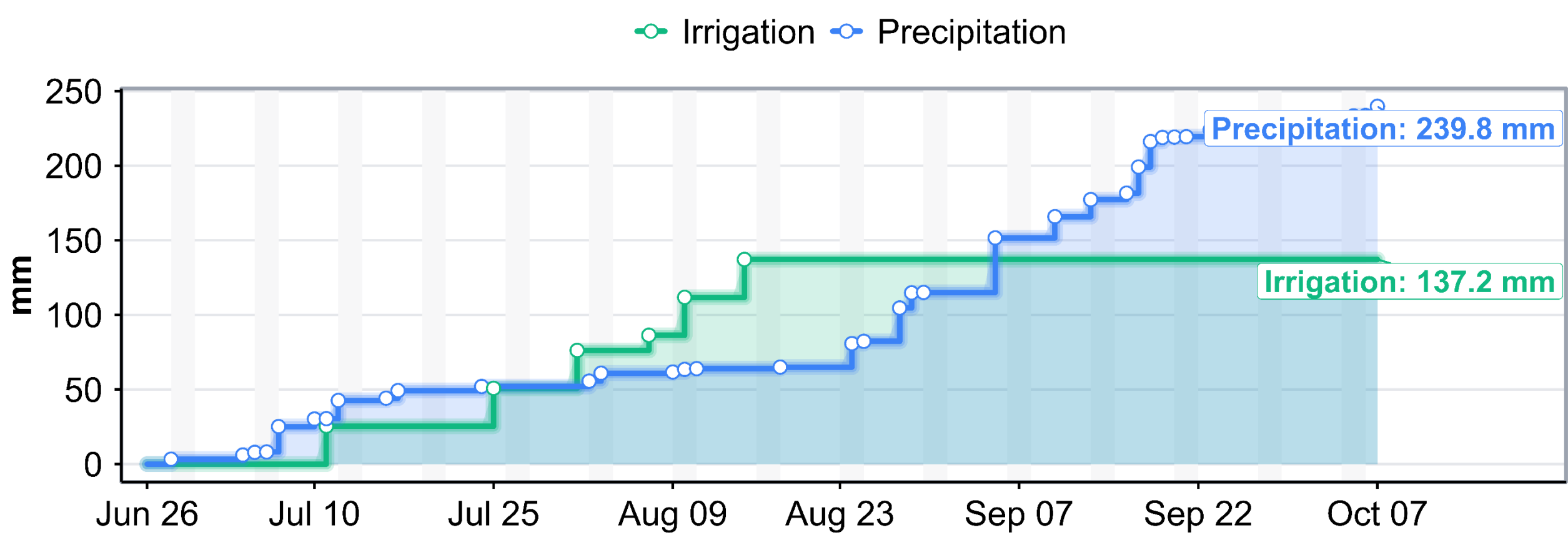
## Results

### Water Inputs Timeline (Mirrored Daily + Cumulative)

Mirrored inputs (Irrigation up | Precipitation down); data values remain positive

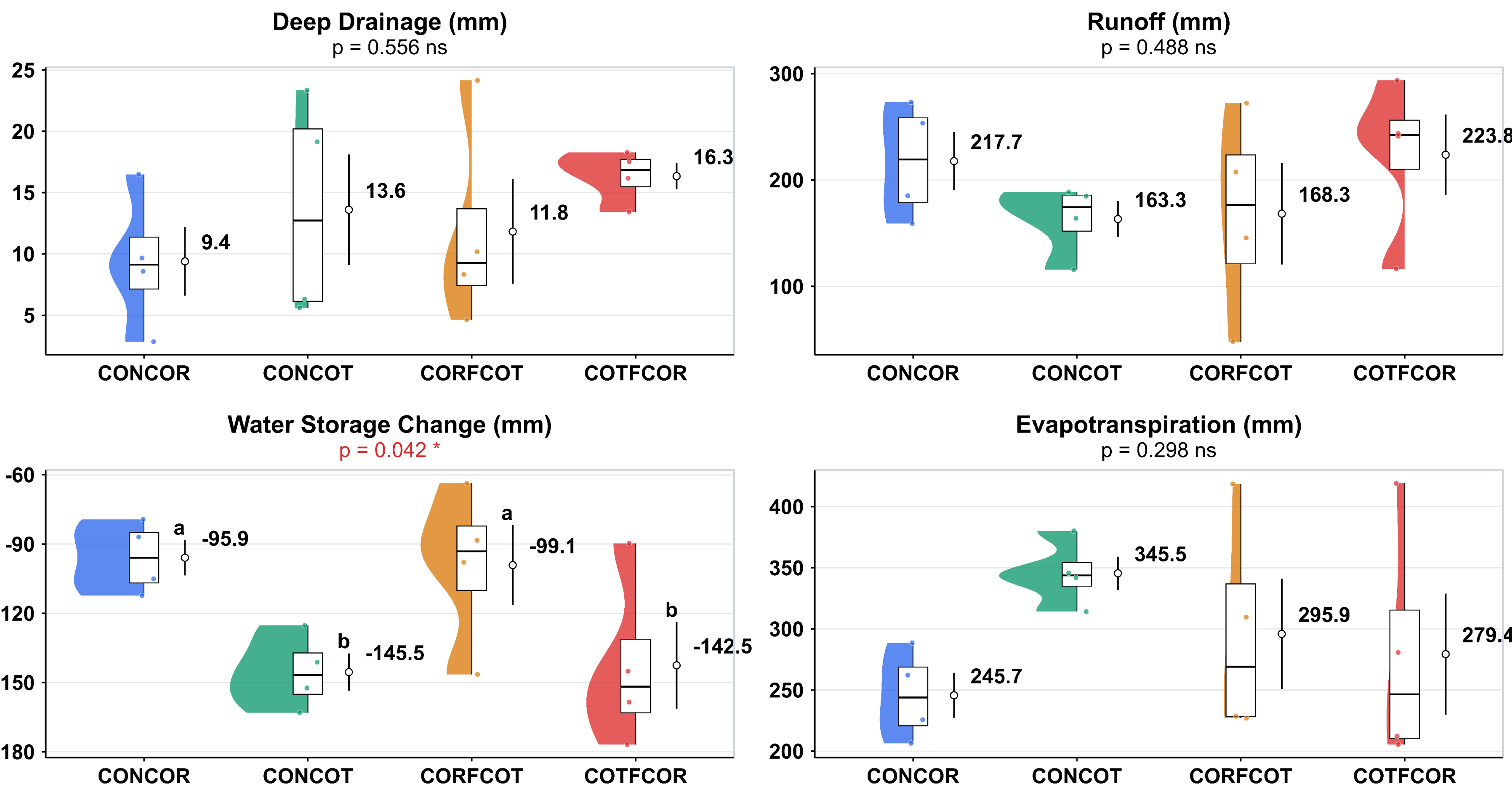


### Cumulative Sums



### Effect of crop rotation on seasonal water balance components

Half-violin (distribution), thin box (median & IQR), jittered replicates, and mean  $\pm$  SE. LSD letters indicate significant differences



## Summary

- Rotations that finish in cotton (CONCOT, COTFCOR) end the season with more negative  $\Delta S$  (drier root zone); rotations that finish in corn (CONCOR, CORFCOT) retain more soil water at season end. Differences are statistically significant.
- The  $\Delta S$  separation reflects timing/depth of use: cotton maintains later-season transpiration and taps deeper moisture, while corn senesces earlier.
- With similar inputs and non-plant losses, the key rotation effect is late-season soil water drawdown in cotton-ending sequences, not higher seasonal ETa.
- ETa, runoff, and deep drainage did not differ significantly among rotations, spreads overlap across treatments

## MANAGEMENT TAKEAWAY

- Late-season irrigation cut-off should differ between cotton and corn rotations; the same stop date leaves cotton fields drier at harvest
- Post-harvest soil moisture affects off-season recharge and next-season starting water; drier profiles after cotton are fine if reduced pumping is planned.
- Since ETa totals didn't differ significantly, cotton's advantage likely lies in timing of water use, not total seasonal consumption.

## Future Work

- Validate across additional year
- Compare the effects to leaf area index (LAI)
- Analyze crop water-use efficiency (WUE)

## Acknowledgments

Funders and partners:

