

Comparison of Evapotranspiration Between Croplands and Forestlands in a Humid Subtropical Region

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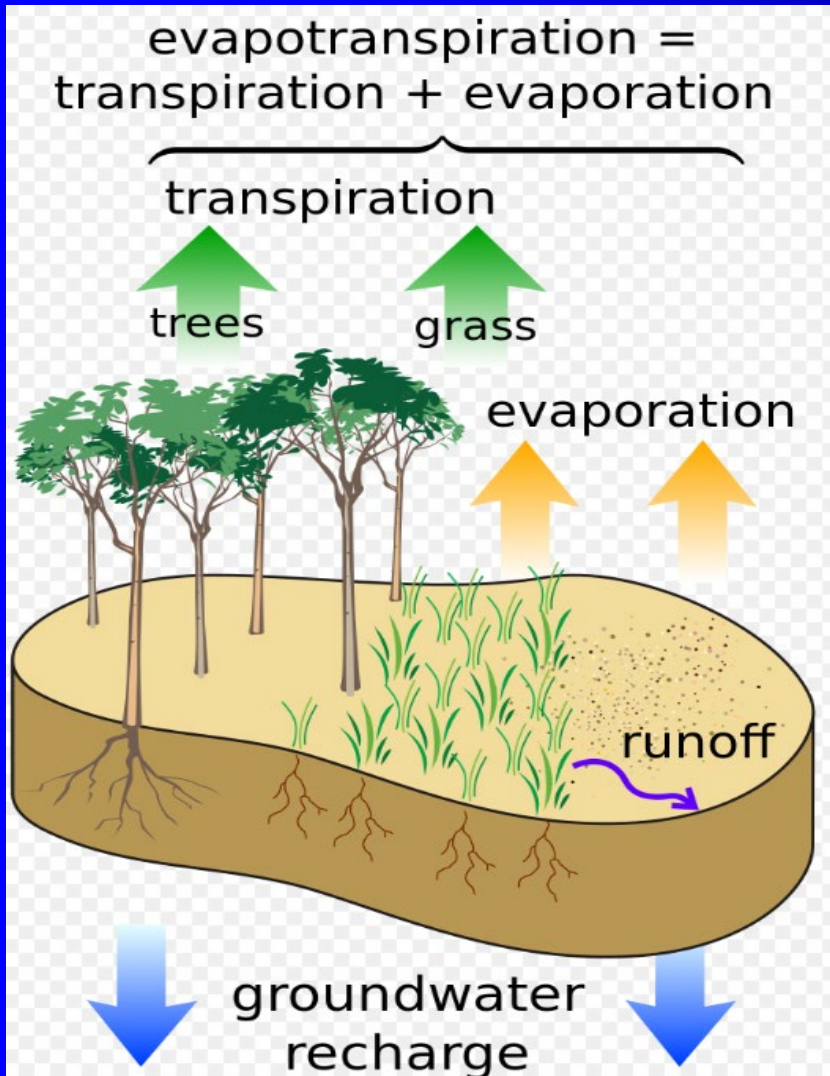
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Presented at the University of Florida Water Institute Symposium
February 20-21, 2024



What is Evapotranspiration?



- **Evapotranspiration (ET) is the sum of land surface evaporation and plant leaf transpiration**
- **ET contributes the largest amount of water loss from earth surface and plays a critical role in hydrological cycle**

Is Forest ET always greater than Crop ET?

- Forestlands are thought to have higher ET than that of croplands
- In a study site in Mississippi, forest soil is wetter than the adjacent bare soil
- SWAT Modeling showed some forestlands have less ET than croplands in Mississippi (Ouyang, 2021, J of Hydrology)

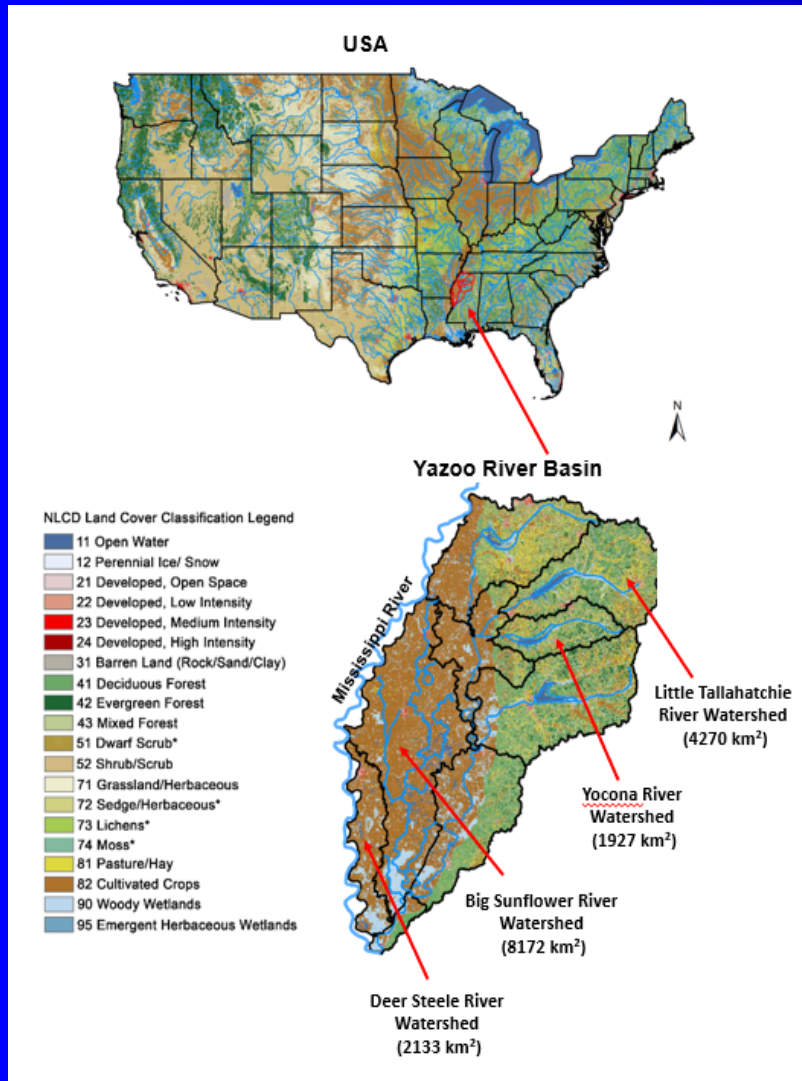
Goal

Compare ET between croplands and forestlands using satellite data from MODIS (Moderate Resolution Imaging Spectroradiometer)

Objectives

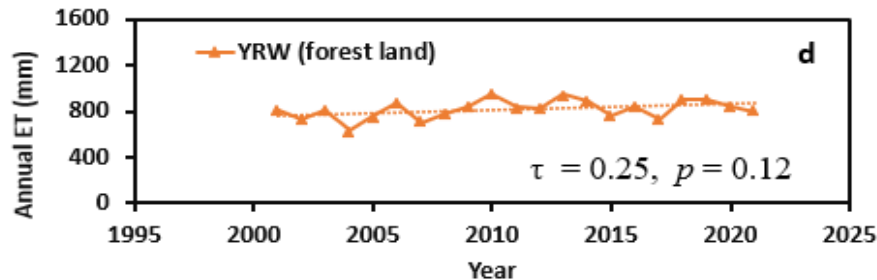
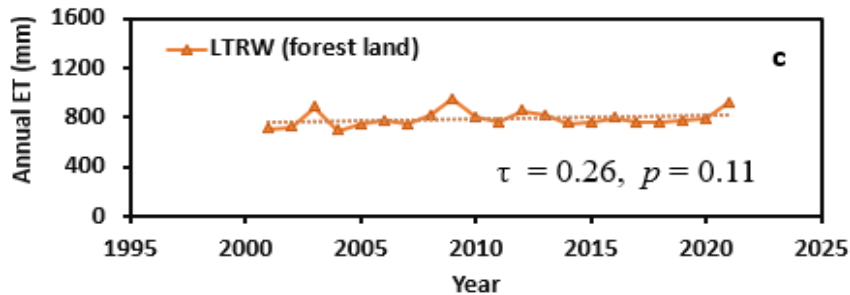
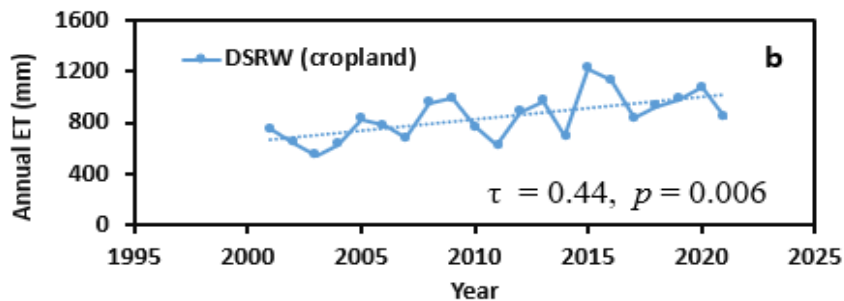
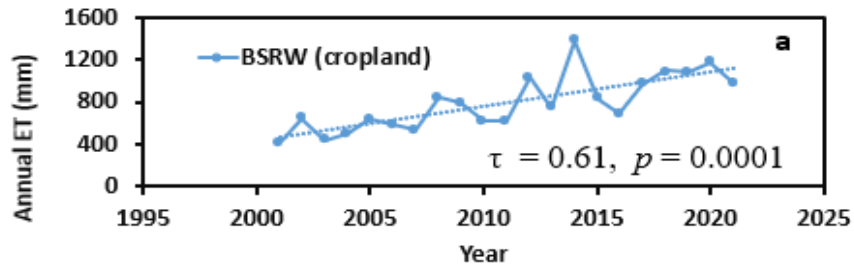
- **Assess variations of ET, air temperature, and precipitation in crop and forest watersheds in the Yazoo River Basin, MS over the past two decades (2001 to 2021)**
- **Identify trends of ET in crop and forest lands using the Mann-Kendall test**
- **Compare ET differences between croplands and forestlands using the Kolmogorov-Smirnov test**

Study Site and ET Data



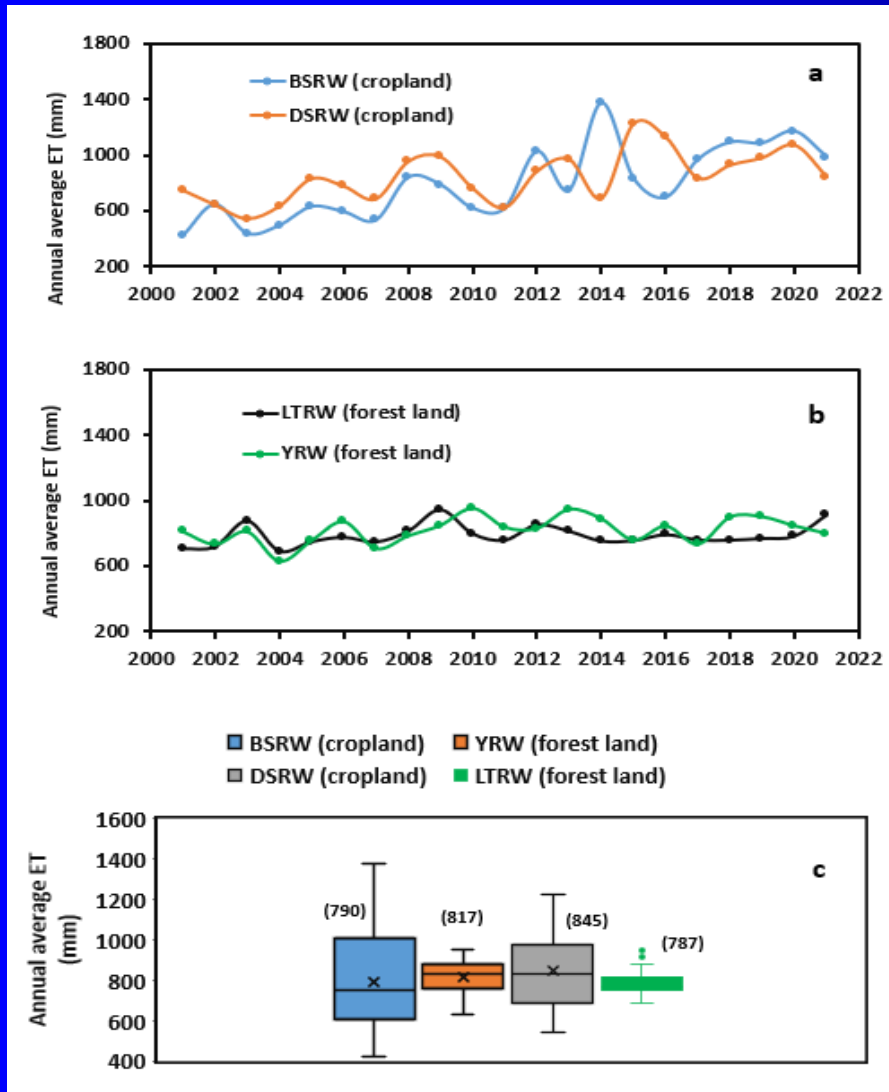
- Yazoo River basin (34,800 km², a humid subtropical region) in Mississippi, USA
- Two forestlands and two croplands
- MODIS 8-day ET Data (<https://modis.gsfc.nasa.gov/data/dataproduct/mod16.php>)
- The TIFF files were converted to numerical ET values using a Python script

Annual ET Trends in Crop and Forest Lands



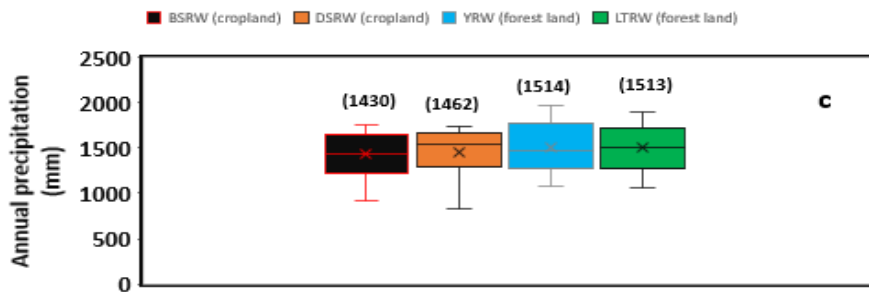
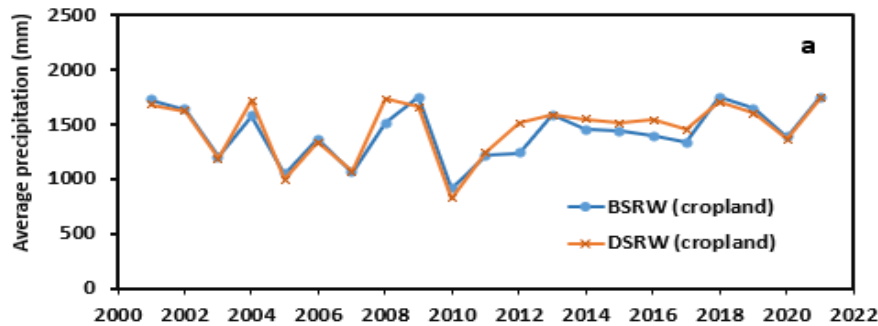
- Increasing ET trends in the croplands from 2001 to 2021 based on Mann-Kendall test
- No ET trends in the forestlands from 2001 to 2021 based on Mann-Kendall test

Comparison of ET Between Croplands and Forestlands from 2001 to 2021



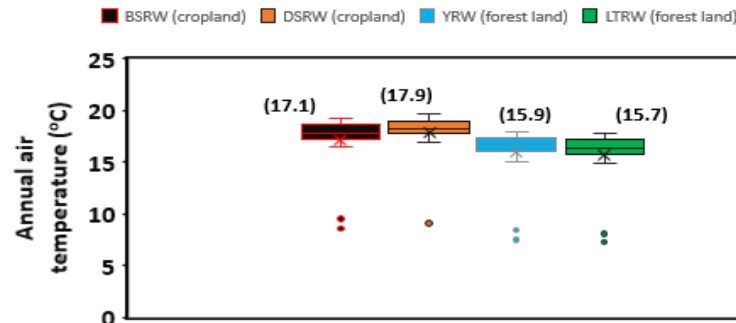
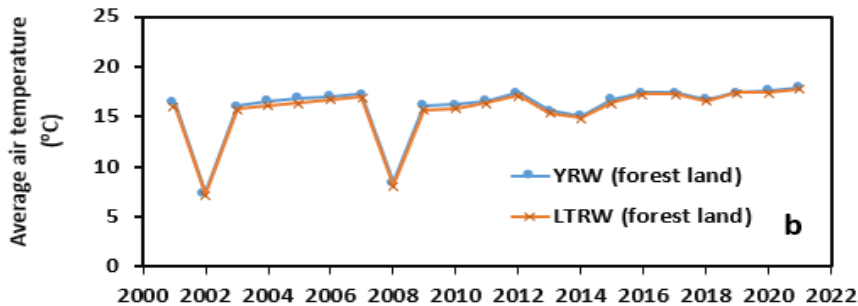
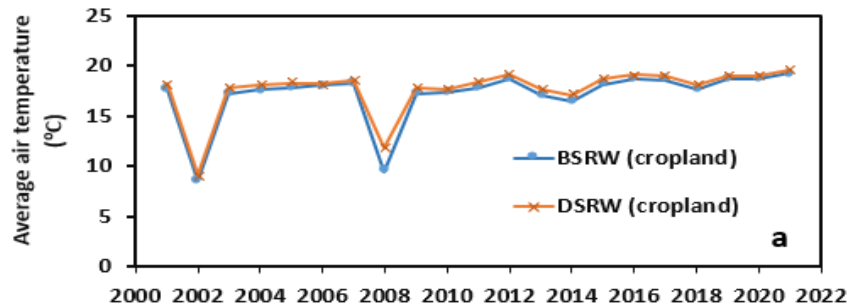
- ET in the croplands was higher than in the forestlands
- Differences in ET between croplands and forestlands were not significant based on Kolmogorov-Smirnov (K-S) test
- ET in forestlands is not higher than in croplands

Comparison of Precipitation Between Croplands and Forestlands from 2001 to 2021



- No significant differences in precipitation among croplands and forestlands from 2001 to 2021 based on K-S test

Comparison of Air Temperature Between Croplands and Forestlands from 2001 to 2021

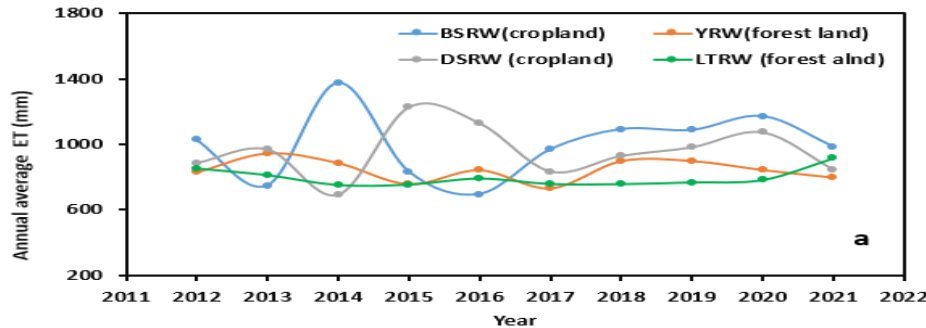


- No significant differences in air temperature among croplands and forestlands from 2001 to 2021 based on K-S test

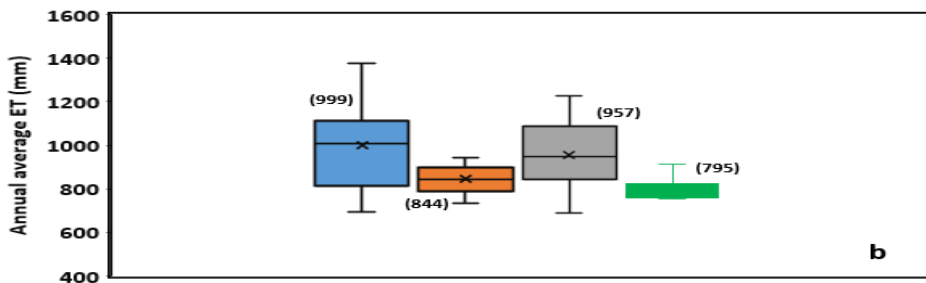
Forestlands have less ET than of croplands?

- No difference in ET between croplands and forestlands over the past 20 years from 2001 to 2021 based on Kolmogorov-Smirnov test
- My hypothesis: Forestlands may have less ET than that of croplands
- An abrupt change (turning point) in ET occurred in 2012 based on Pettitt's test
- Pettitt test is a statistical tool used to identify a single abrupt change (turning point) in a time series dataset

Forestland ET vs. Cropland ET in Recent 10 Years (2012 to 2021)



■ BSRW (cropland) ■ YRW (forest land)
■ DSRW (cropland) ■ LTRW (forest land)



- Very significant differences between croplands and forestlands based on K-S test
- Cropland ET was 19% greater than forestland ET over the recent 10 years from 2012 to 2021
- This occurred because of increasing crop irrigation in recent years

Parameter	Significance Level (α)	D Statistics		Critical Value (n-scaled)	Result
BSRW (cropland) vs. YRW (forestland)	0.05	0.700	>	0.607	Reject H_0
BSRW (cropland) vs. LTRW (forestland)	0.05	0.700	>	0.607	Reject H_0
DSRW (cropland) vs. YRW (forestland)	0.05	0.700	>	0.607	Reject H_0
DSRW (cropland) vs. LTRW (forestland)	0.05	0.700	>	0.607	Reject H_0
YRW (forestland) vs. LTRW (forestland)	0.05	0.500	<	0.607	Accept H_0
BSRW (cropland) vs. DSRW (cropland)	0.05	0.500	<	0.607	Accept H_0

Summary

1. Compare annual ET between croplands and forestlands in the Yazoo River Basin (a humid subtropical region) using MODIS data
2. Very significant increasing trends in ET for croplands but not forestlands over the past 20 years from 2001 to 2021
3. Cropland ET was 19% greater than forestland ET in recent 10 years because of increasing crop irrigation in the region
4. The finding could change our traditional vision on how forests and crops affect ET in the humid subtropical region