Applications for ECOSTRESS ET and Stress Products in Agriculture

Yang, Yang, Yun Yang, Martha C. Anderson, Feng Gao
USDA-Agricultural Research Service
Hydrology and Remote Sensing Laboratory
Beltsville, MD

Chris Hain
NASA-MSFC

Jason Otkin
University of Wisconsin – Madison
NOAA – NESDIS – STAR
GOES Evapotranspiration and Drought Product System (GET-D)

USDA-ARS Long-Term Agroecosystem Research (LTAR) Sites

PRHP     Platte River-High Plains  UMRB     Upper Mississippi River Basin
Yang, Y., et al. (2017). Daily Landsat-scale evapotranspiration estimation over a forested landscape in North Carolina, USA using multi-satellite data fusion, HESS.

Seasonal flux evaluation

ET (mm/day)

Precipitation

Day of year

Obs (closed)  Landsat  STARFM  Precip

NC1

NC2
Cumulative water use by stand age

$R^2 = 0.61$
Long-term ET Study – Drought Impact and Disturbance

Normalized ET (health) metric:

\[
\frac{f_{RET}}{\text{RefET}} = \frac{\text{ET}}{\text{RefET}}
\]

\[
\Delta f_{RET,d} = f_{RET,d} - \left< f_{RET,d} \right> \quad \text{(anomaly)}
\]
Seasonal $f_{RET}$ Anomalies

**Red** indicates anomalously low seasonal water use (stress or disturbance)

**Green** indicates high water use (healthy stand conditions)
Long-term ET Study – Recovery

a) Monthly Average fRET Anomaly

\[ y = 0.01x - 0.21 \]

\[ R^2 = 0.41 \]

\[ RMSE = 0.13 \]

\[ MAE = 0.11 \]

b) NDVI

\[ y = 0.01x + 0.35 \]

\[ R^2 = 0.36 \]

\[ RMSE = 0.15 \]

\[ MAE = 0.12 \]
Rainfed corn and soybean in NE

- NE1: IRRIGATED
- NE2: IRRIGATED
- NE3: RAINFED

Observed ET
- Landsat retrieval
- Landsat-MODIS fusion
- Precipitation

2012 drought

(Yang et al., 2018)
Mead, Nebraska (near Lincoln)

Growing Season Water Use

Landsat/MODIS ET datacubes
Aligned on calendar date

Corn fields at Mead site

Irrigated corn
Rainfed corn
Soybean
Riparian

fPET = ET/PET

Calendar day of year
Aligned on calendar date

Corn fields at Mead site

Irrigated corn

Rainfed corn
Aligned on crop- (or field-) specific emergence date

Irrigated corn
Rainfed corn

Corn fields at Mead site
Corn fields at Mead site

Maximum correlation with corn yield

Correlation with Yield

Corn yield (Mg ha\(^{-1}\))

Irrigated corn
Rainfed corn

Days from emergence

silking

R = 0.94

fPET = ET/PET

R
Correlations with county-level yields

ESI-based yield estimates (Mg/ha) vs. NASS county-level yield reports (Mg/ha)

GOES (4km pixels)
- Calendar
- Emergence

Landsat (30m pixels)
- Calendar
- Emergence

Saunders Co
Douglas Co
Variations in corn yields 2010-2017

Corn Yield Ames Ecostress Swath

Corn Yield Mead Ecostress Swath

Corn Yield Bonville Ecostress Swath

https://quickstats.nass.usda.gov/
NOAA – NESDIS – STAR
GOES Evapotranspiration and Drought Product System (GET-D)

USDA-ARS Long-Term Agroecosystem Research (LTAR) Sites

YUMA, AZ
Applications: Yuma site (AZ)

Landsat 8 - 2017

Evapotranspiration (mm/day)

- 2017060
- 2017120
- 2017180
- 2017240