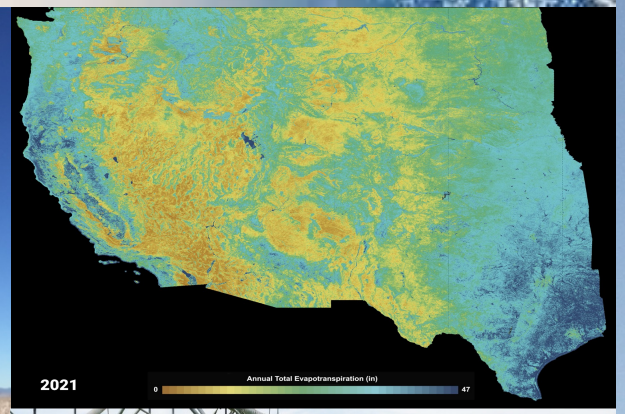


Water-Use and Land-Cover Change Detection Using ECOSTRESS and OpenET

Yun Yang

Department of Forestry, Mississippi State University

Martha Anderson, Feng Gao, Bill Kustas, Jie Xue

USDA-ARS, Hydrology and Remote Sensing Laboratory Beltsville, MD

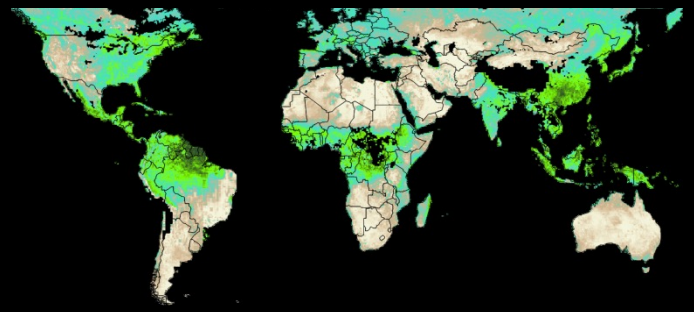
Forrest Melton *NASA - Ames*

Chris Hain *NASA - MSFC*

Ge Sun *USDA – Forest Service*

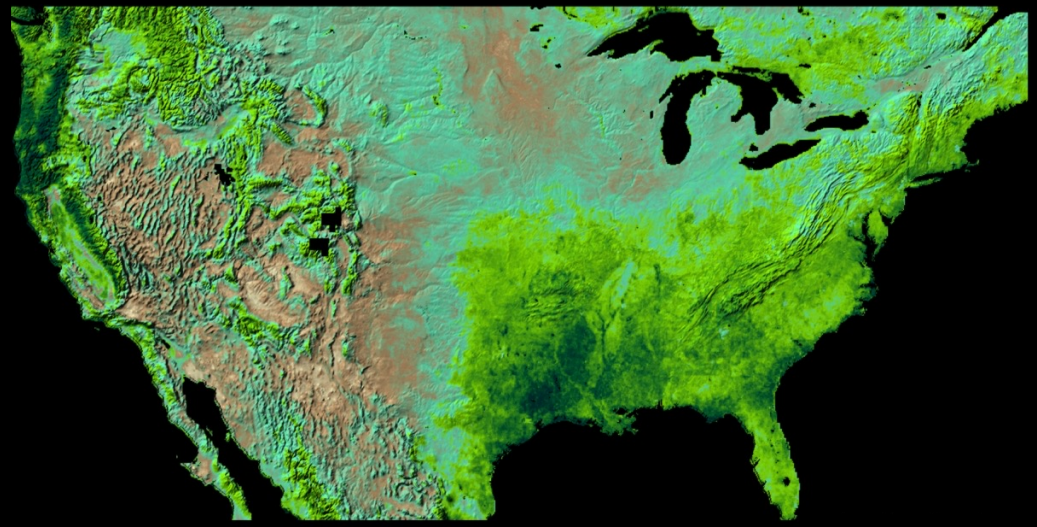
Zhe Zhu *University of Connecticut*

Multi-Sensor/Multi-Scale ET Mapping

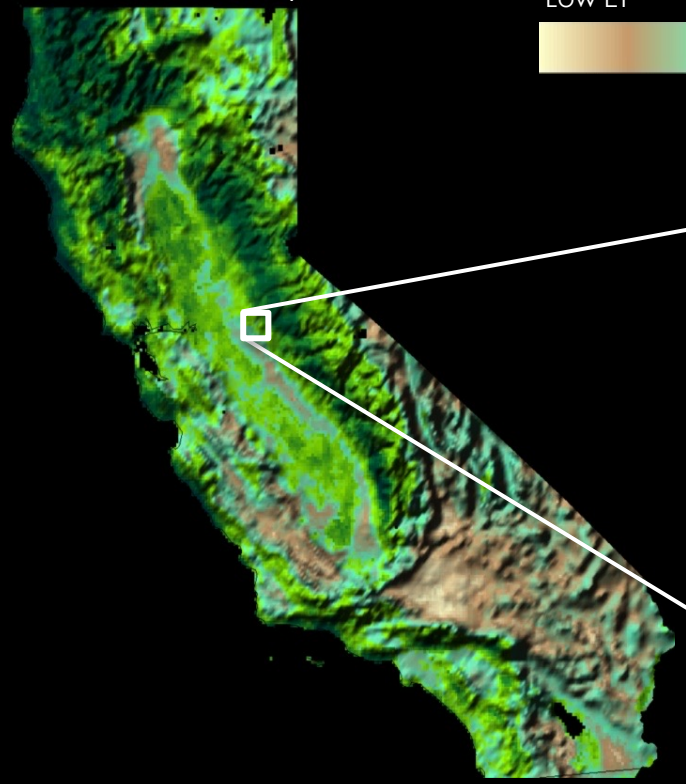


International geostationary constellation
3-5km, 15-min

NOAA Geostationary Operational Environmental Satellites

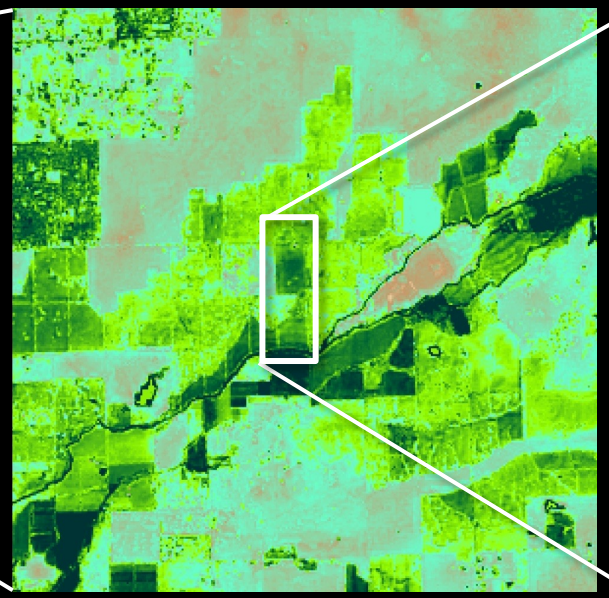


MODIS 1km,daily

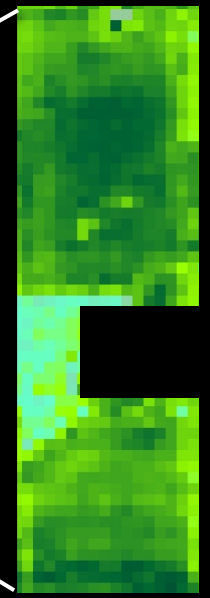


Low ET — High ET

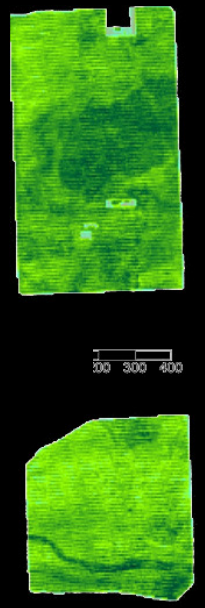
Multi-sensor fusion (daily/30 m)



30m/8-day Landsat



<1m/periodic UAV/Aircraft



Multi-Sensor ET Retrieval

Landsat 8

Launch 2/11/2013

Polar Orbit (16 day)
2 TIR bands (100 m)

VNIR from HLS-Landsat (30 m)

ECOSTRESS

Launch 6/29/2018

ISS Orbit (~4 day)
5 TIR bands (38x69 m)

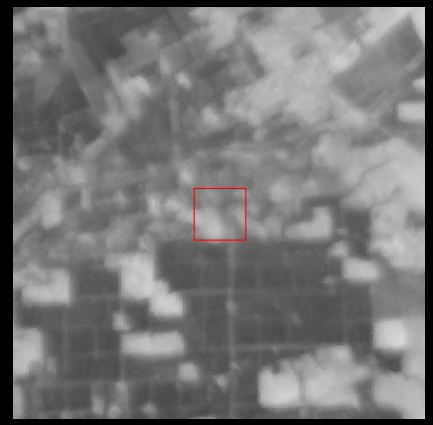
VNIR from HLS (30 m)

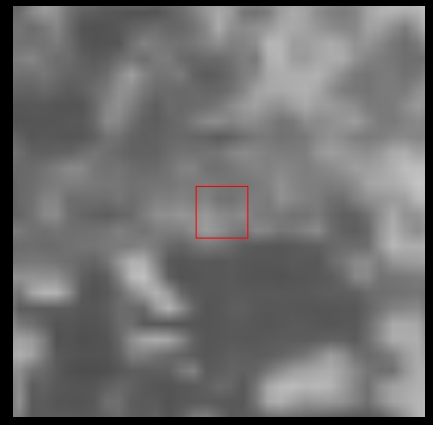
VIIRS

Launch 8/28/2011

Polar Orbit (~1 day)
I5 band (375 m)

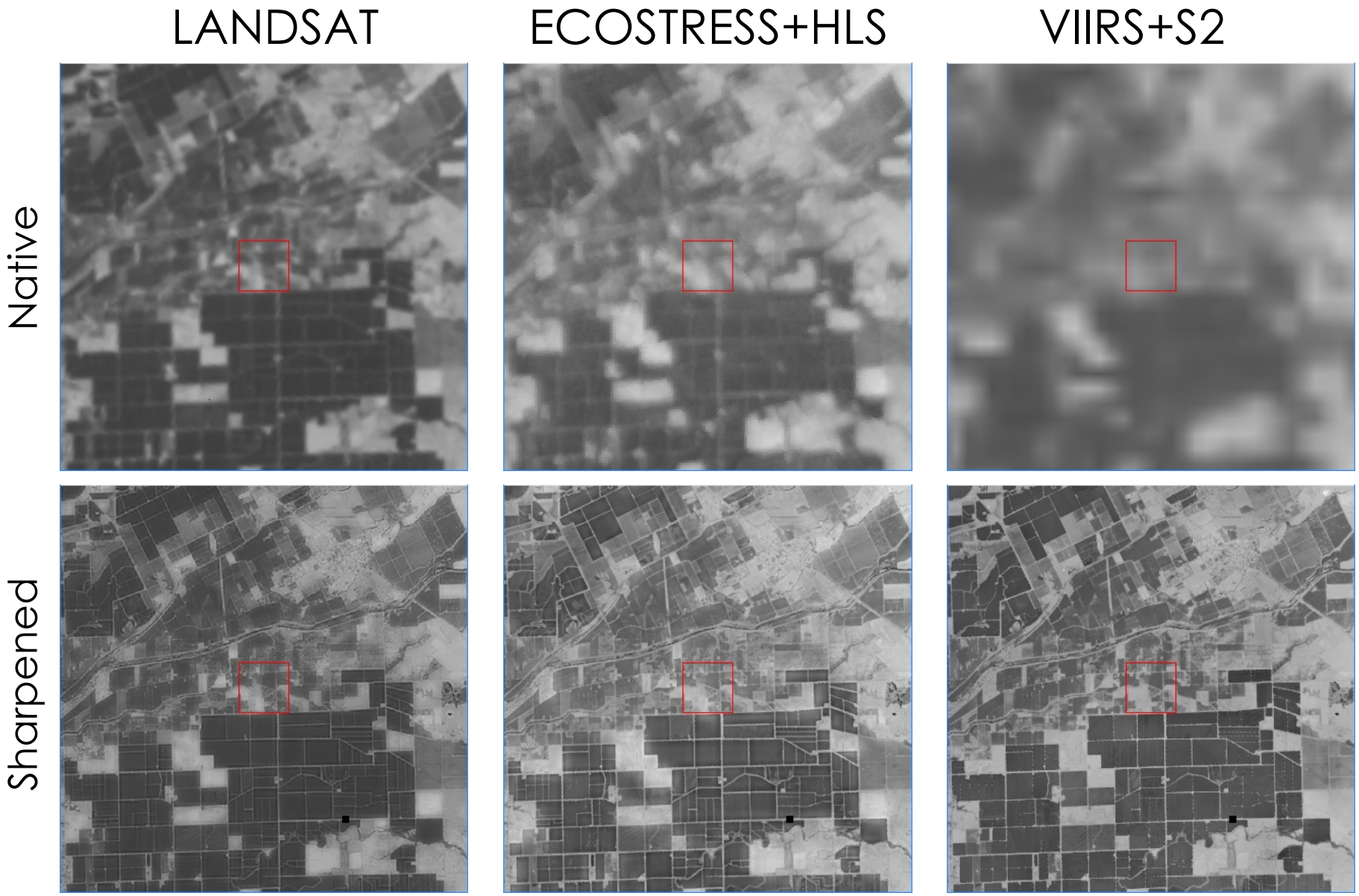
VNIR from HLS-Sentinel 2 (30 m)





LAND-SURFACE TEMPERATURE

Thermal Sharpening



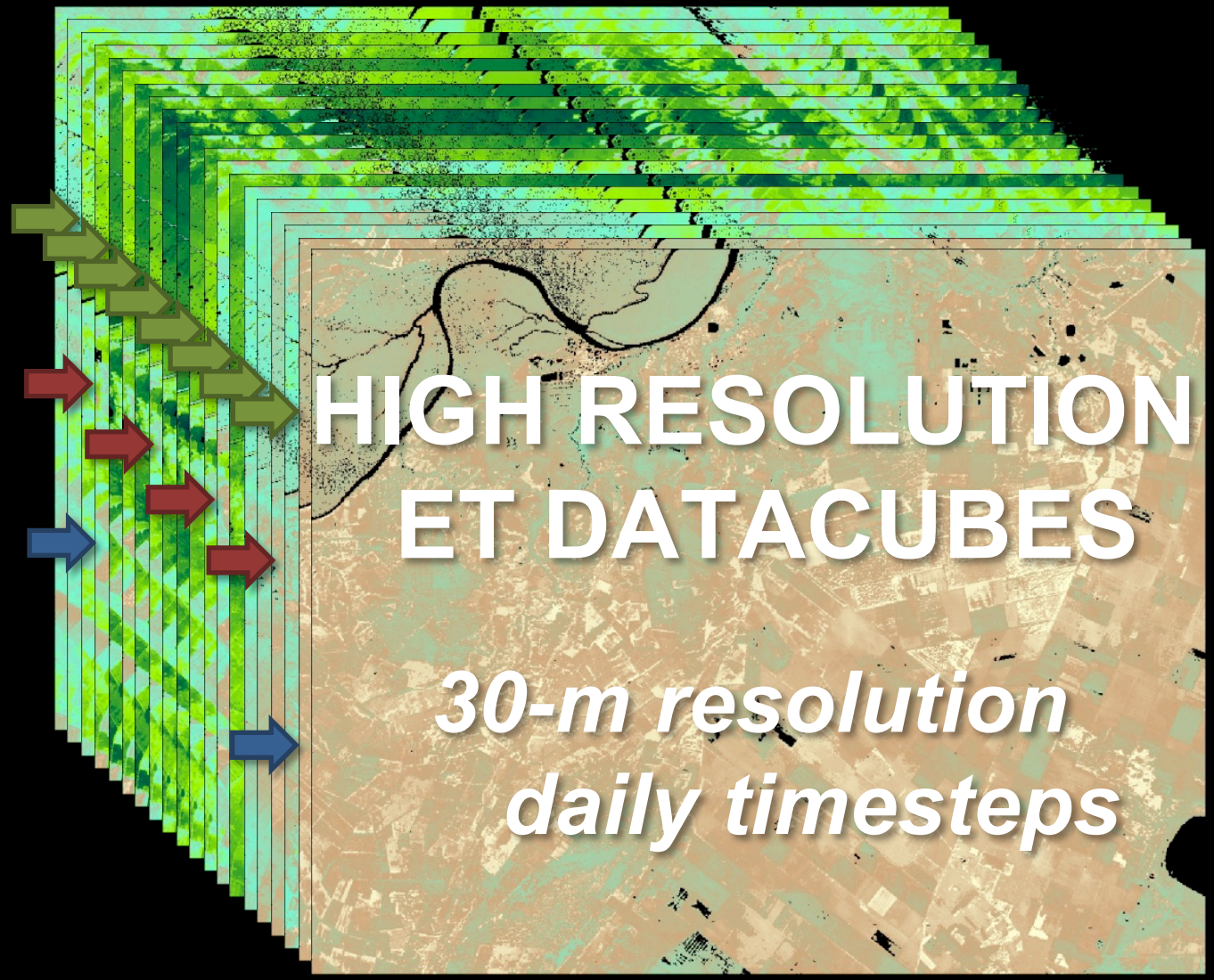
Xue, J., Anderson, M.C., Gao, F., Hain, C., Sun, L., Yang, Y., Knipper, K.R., Kustas, W.P., Torres-Rua, A., & Schull, M.A. (2020). Sharpening ECOSTRESS and VIIRS land surface temperature using harmonized Landsat-Sentinel surface reflectance. *Remote Sensing of Environment, 251, 112055*

Multi-Source Datacube Construction

VIIRS
(Sentinel-2)

ECOSTRESS
(HLS)

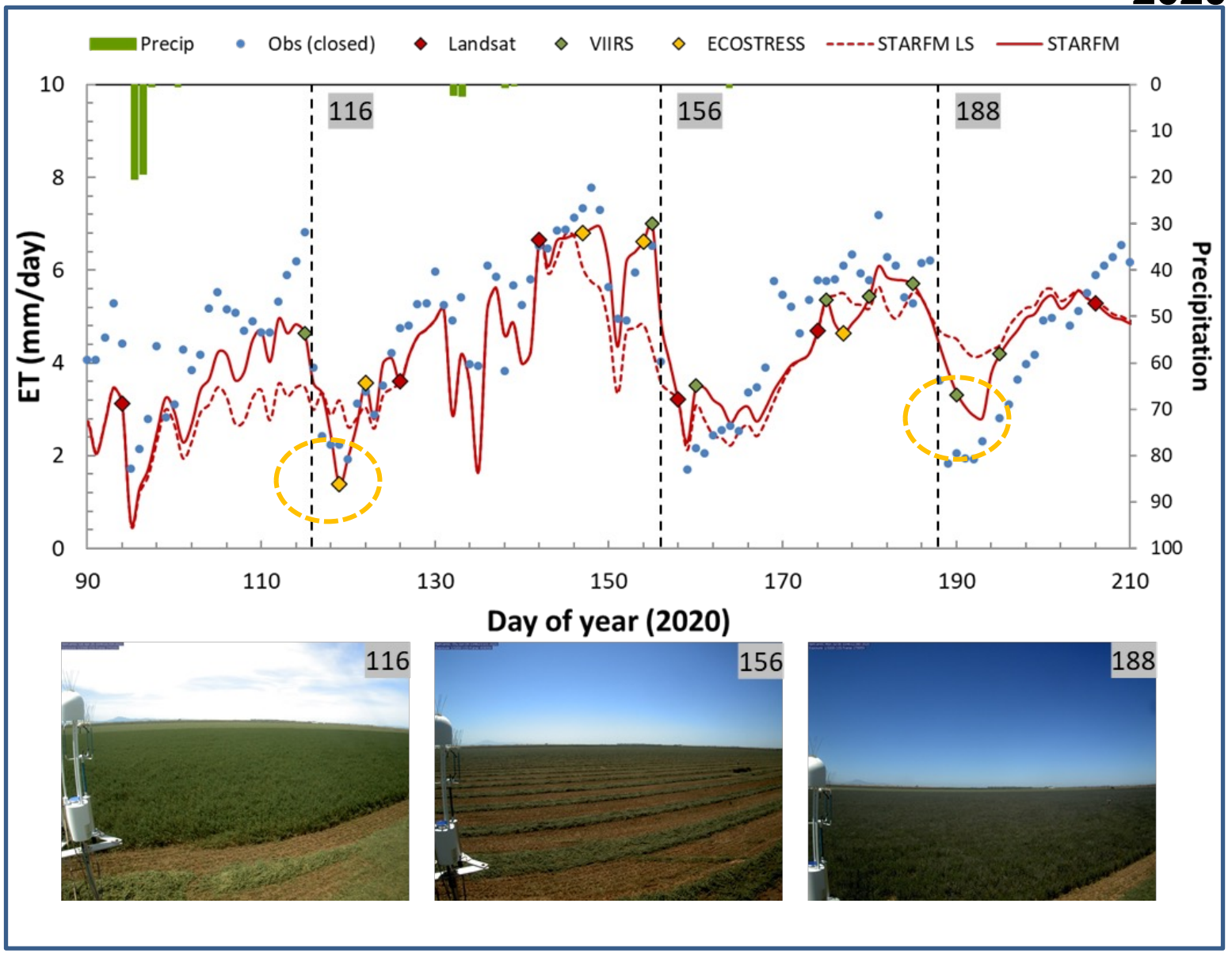
LANDSAT



Funding:
NASA ECOSTRESS EVI program
NASA LCLUC – MuSLI program

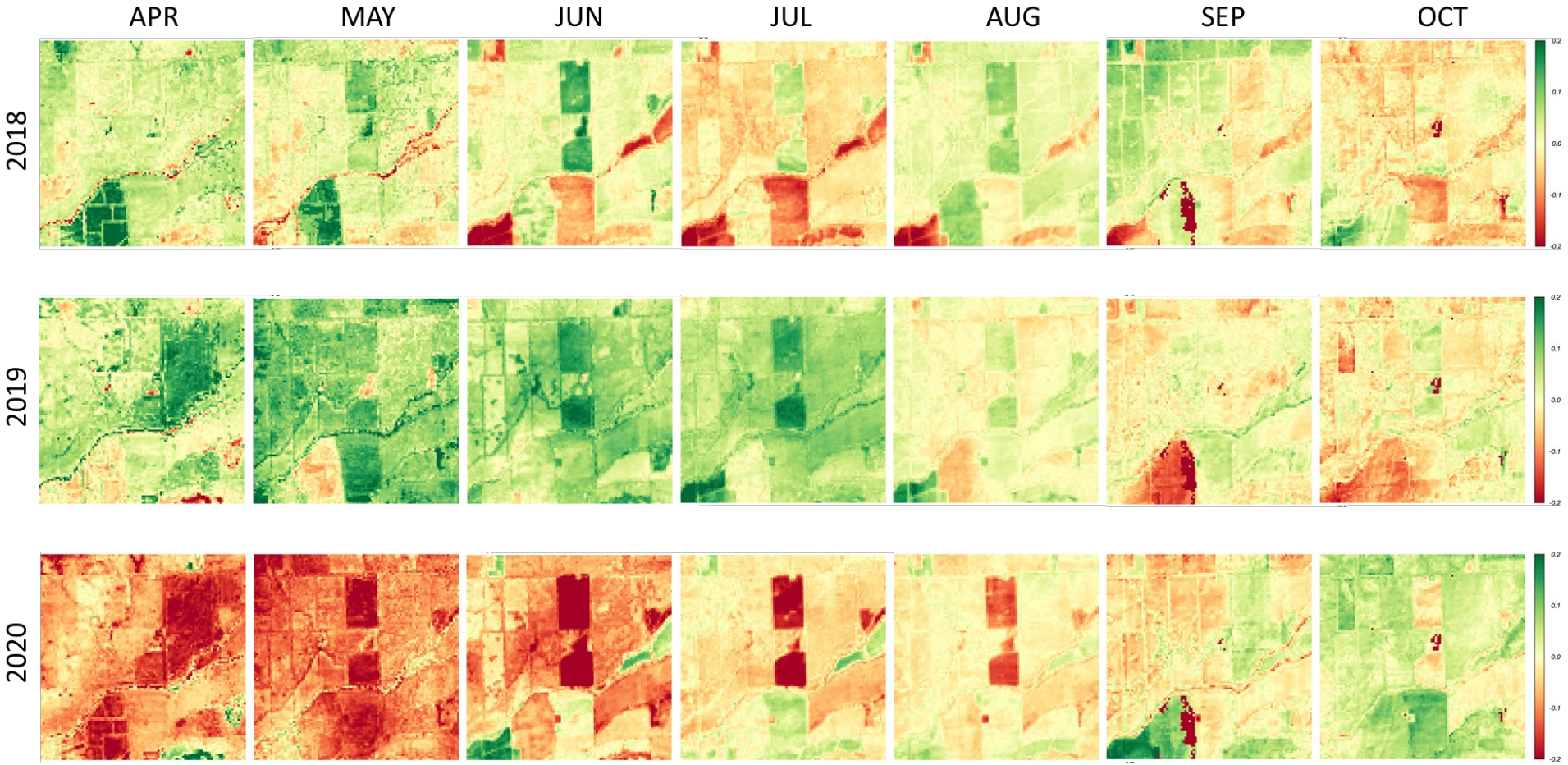
retrospective

USBi1 - alfalfa 2020



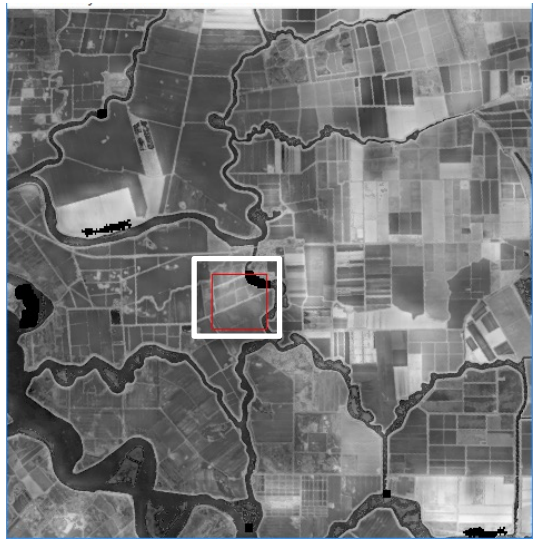
Monthly fRET – ECO+LS+VIIRS

Sierra Loma

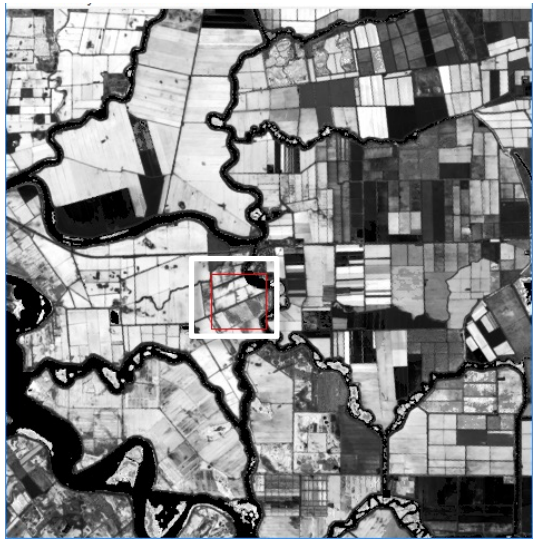


Impact of VI Temporal Mismatch

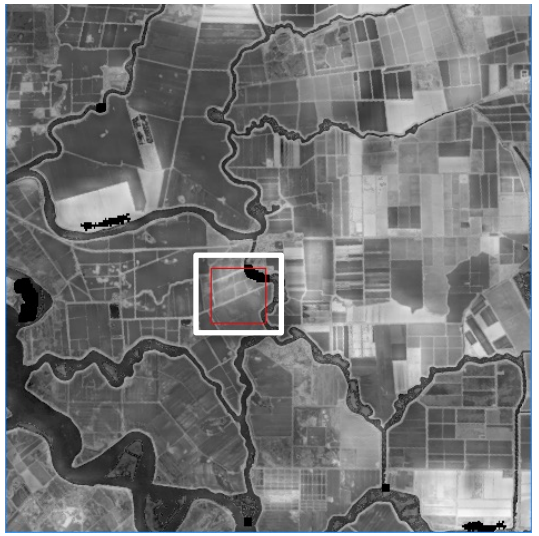
ECOSTRESS
ALFALFA LST (239)



Landsat 8 Pre-cutting
LAI (232)



ET (239)

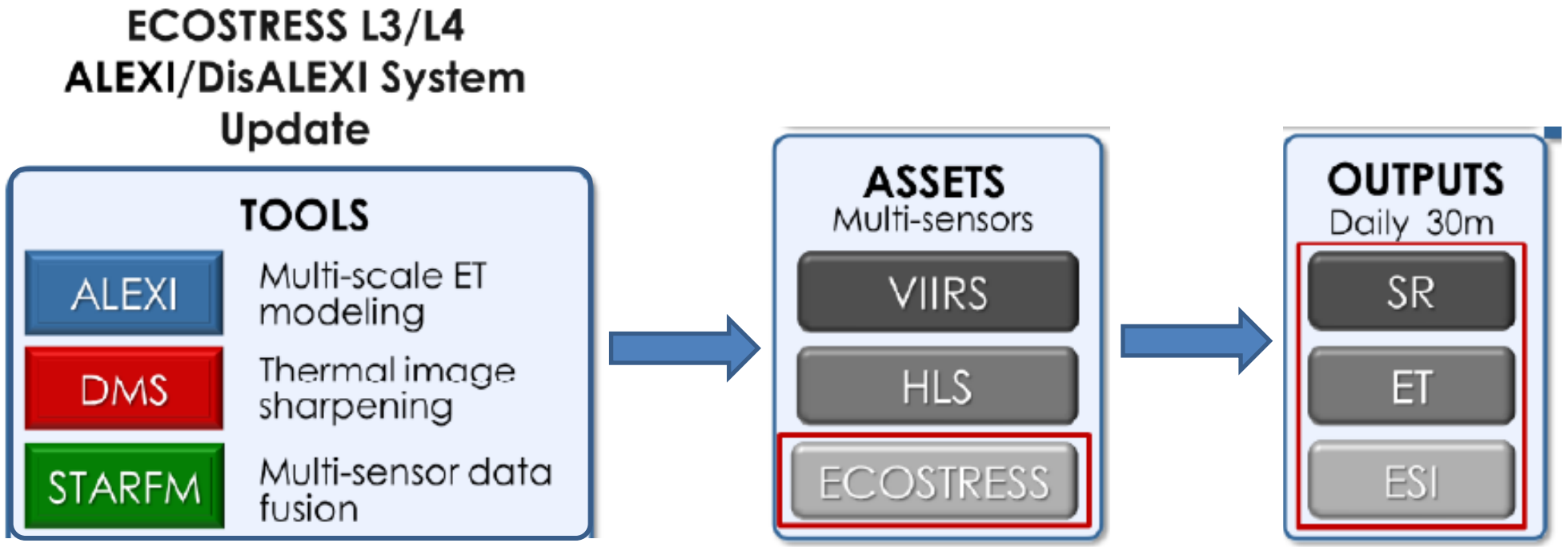


LST (239)
ECOSTRESS

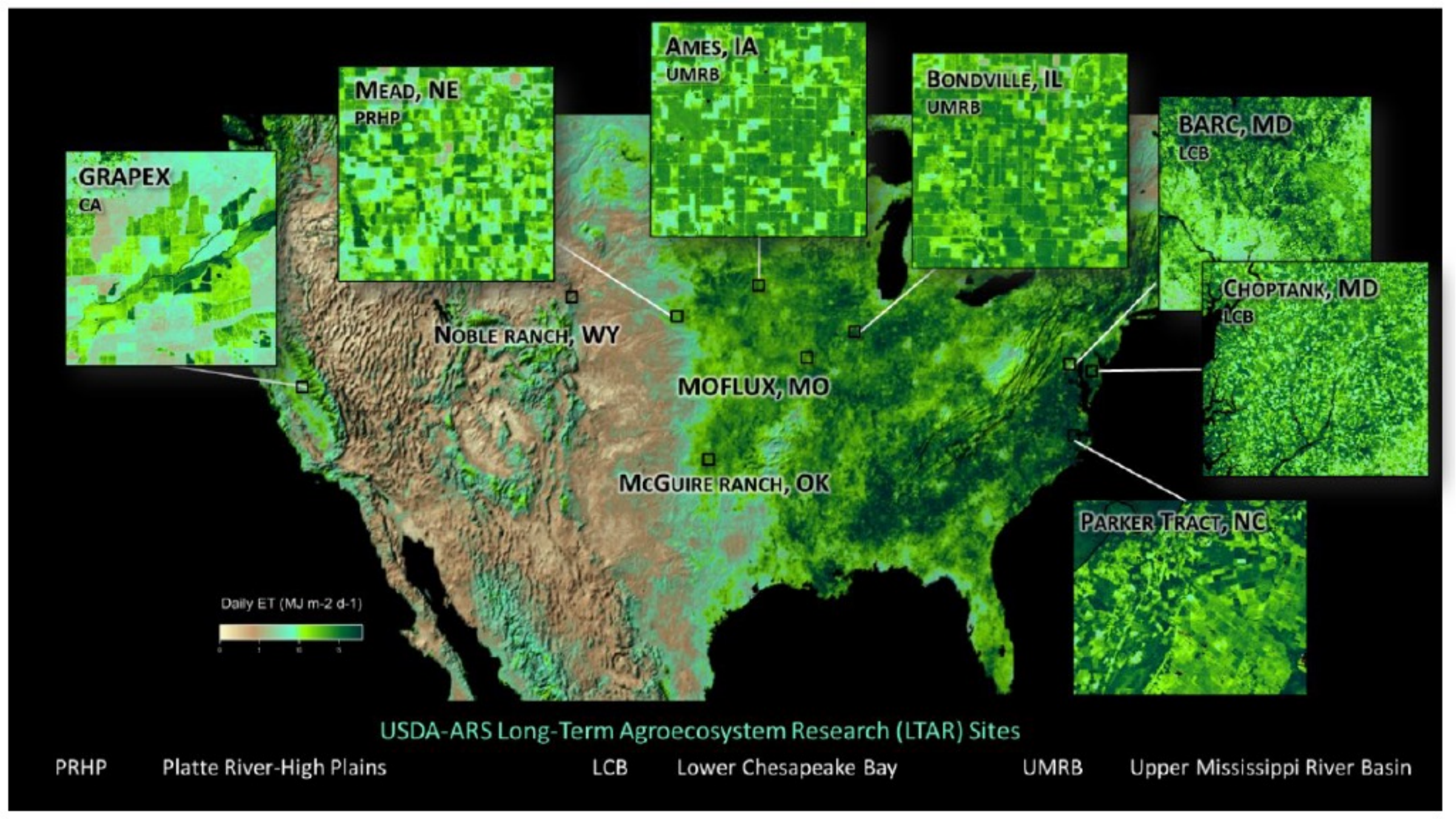
LAI (240)
Landsat 7 Post-cutting

ET (239)

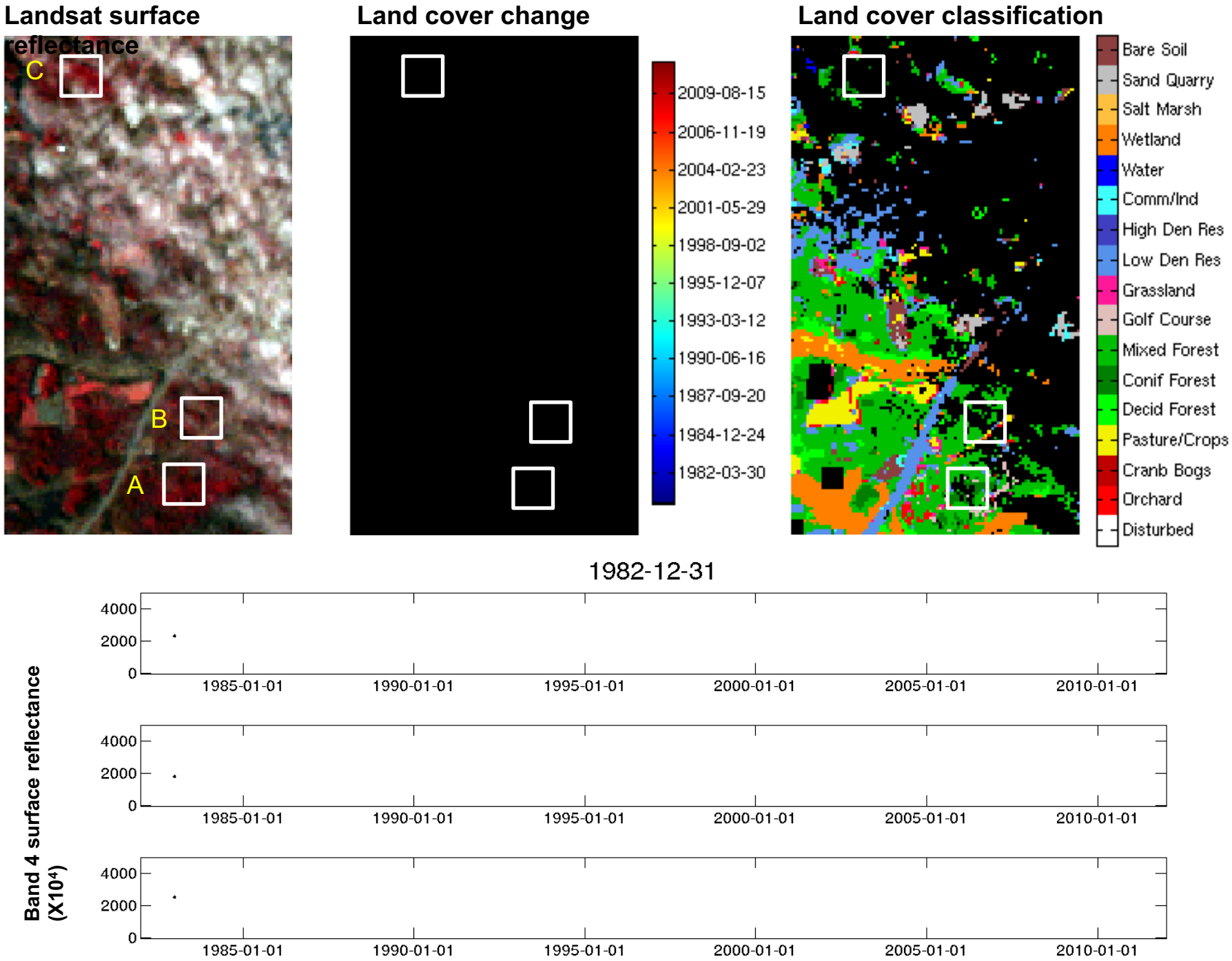
Construct multi-year daily ET, ESI and SR datacubes



Objective 1


AMES, IA
UMRB
MEAD, NE
PRHP
BONDVILLE, IL
UMRB
BARC, MD
LCB
GRAPEX
CA
CHOPTANK, MD
LCB
NOBLE RANCH, WY
MOFLUX, MO
MCGUIRE RANCH, OK
PARKER TRACT, NC
Daily ET (MJ m-2 d-1)
0
1
3
5
USDA-ARS Long-Term Agroecosystem Research (LTAR) Sites
PRHP Platte River-High Plains
LCB Lower Chesapeake Bay
UMRB Upper Mississippi River Basin

Objective 2: Continuous Change Detection and Classification (CCDC)



OPENET

Filling the Biggest Data Gap in Water Management

EDF ENVIRONMENTAL DEFENSE FUND

NASA

Google Earth Engine

USGS science for a changing world

DRI

USDA ARS

University of Idaho

WISCONSIN UNIVERSITY OF WISCONSIN–MADISON

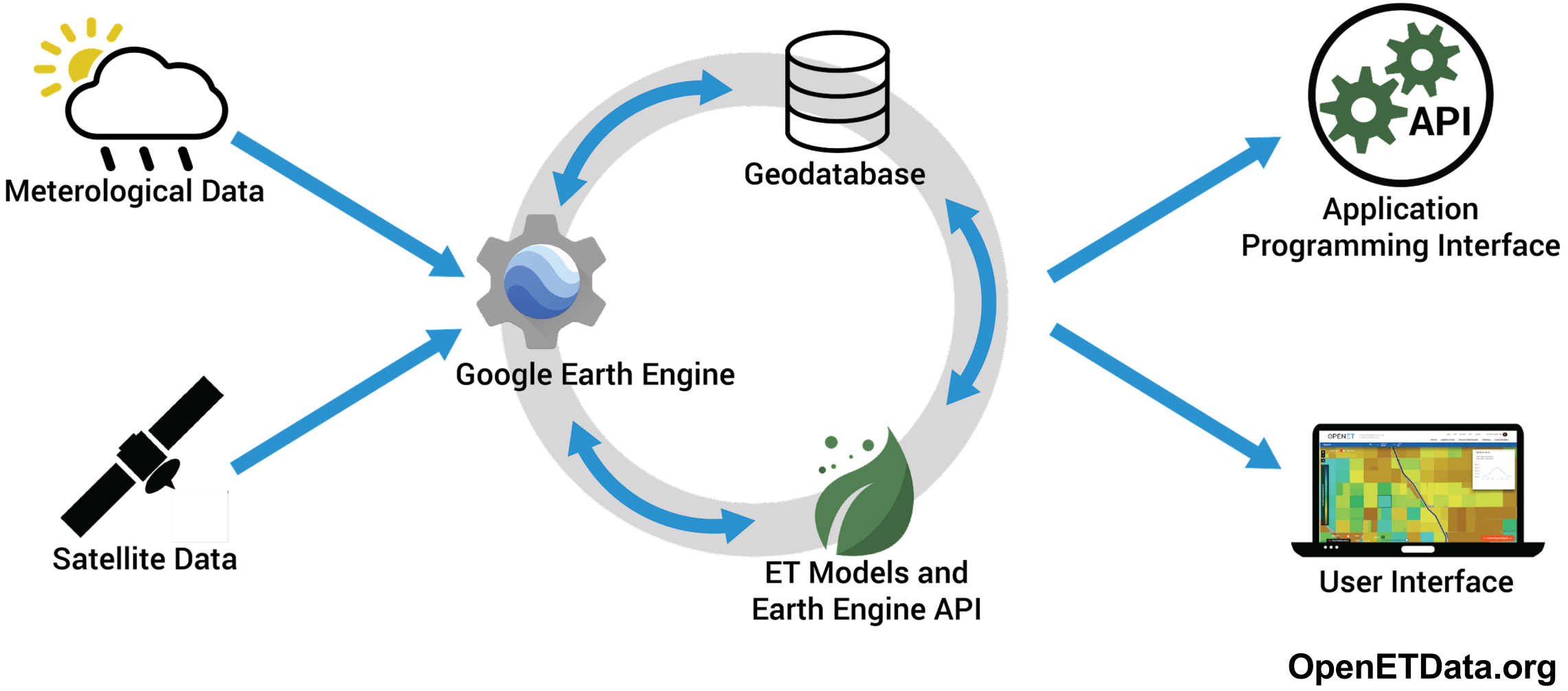
UNIVERSITY OF MARYLAND

University of Nebraska Lincoln

California State University MONTEREY BAY

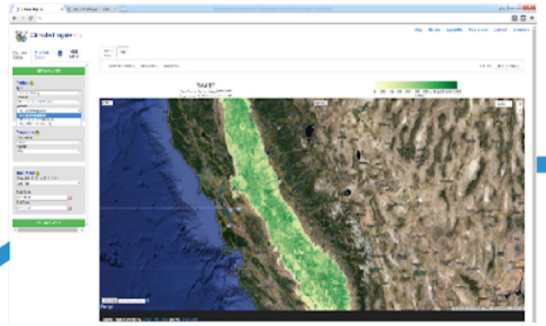
HabitatSeven

How OpenET Works



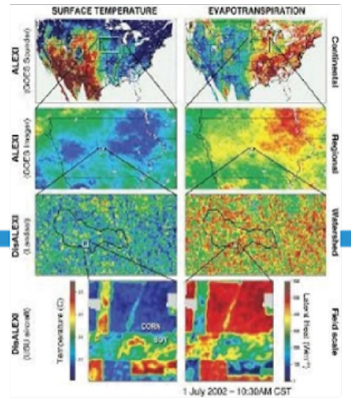
OpenETData.org

Six Well-Established Methods



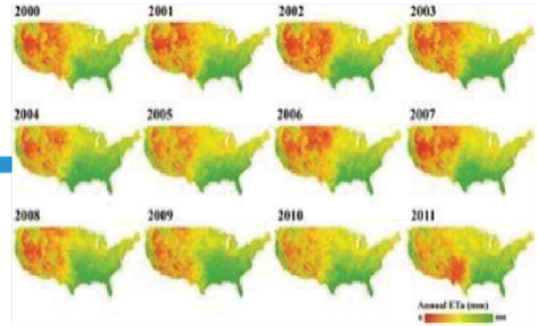
EE METRIC

University of Nebraska,
University of Idaho



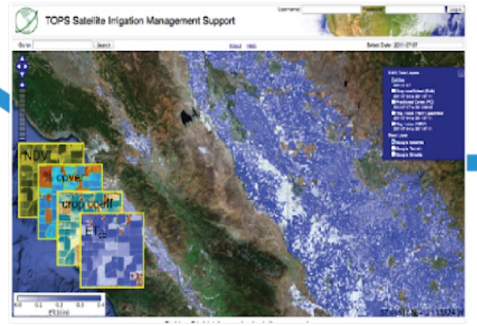
ALEXI/DisALEXI

USDA, NASA, University of Maryland,
University of Wisconsin



SSEBop

USGS

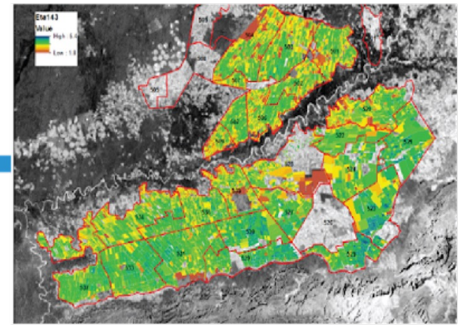


SIMS

NASA, CSUMB, Stanford University

PT-JPL

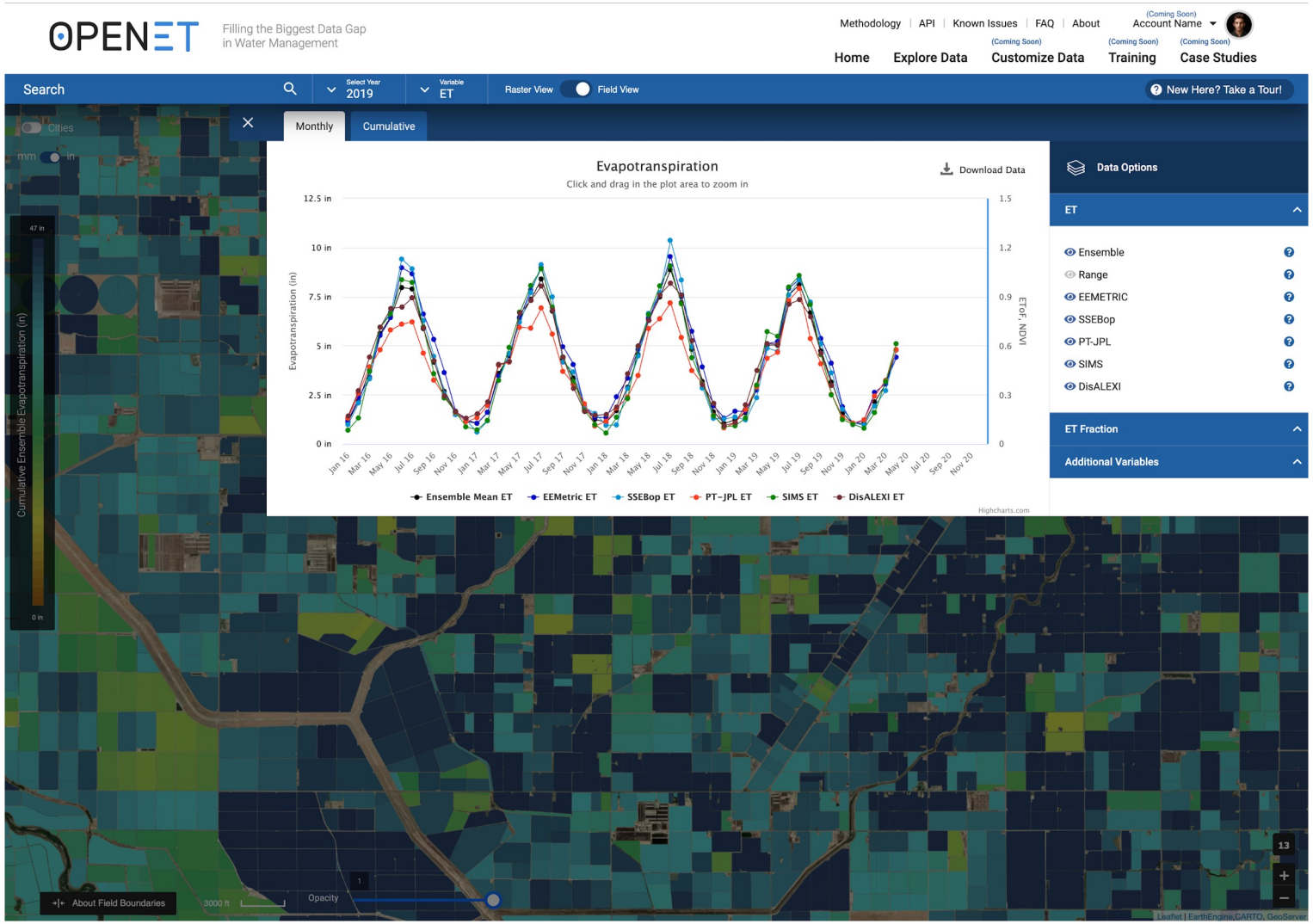
NASA

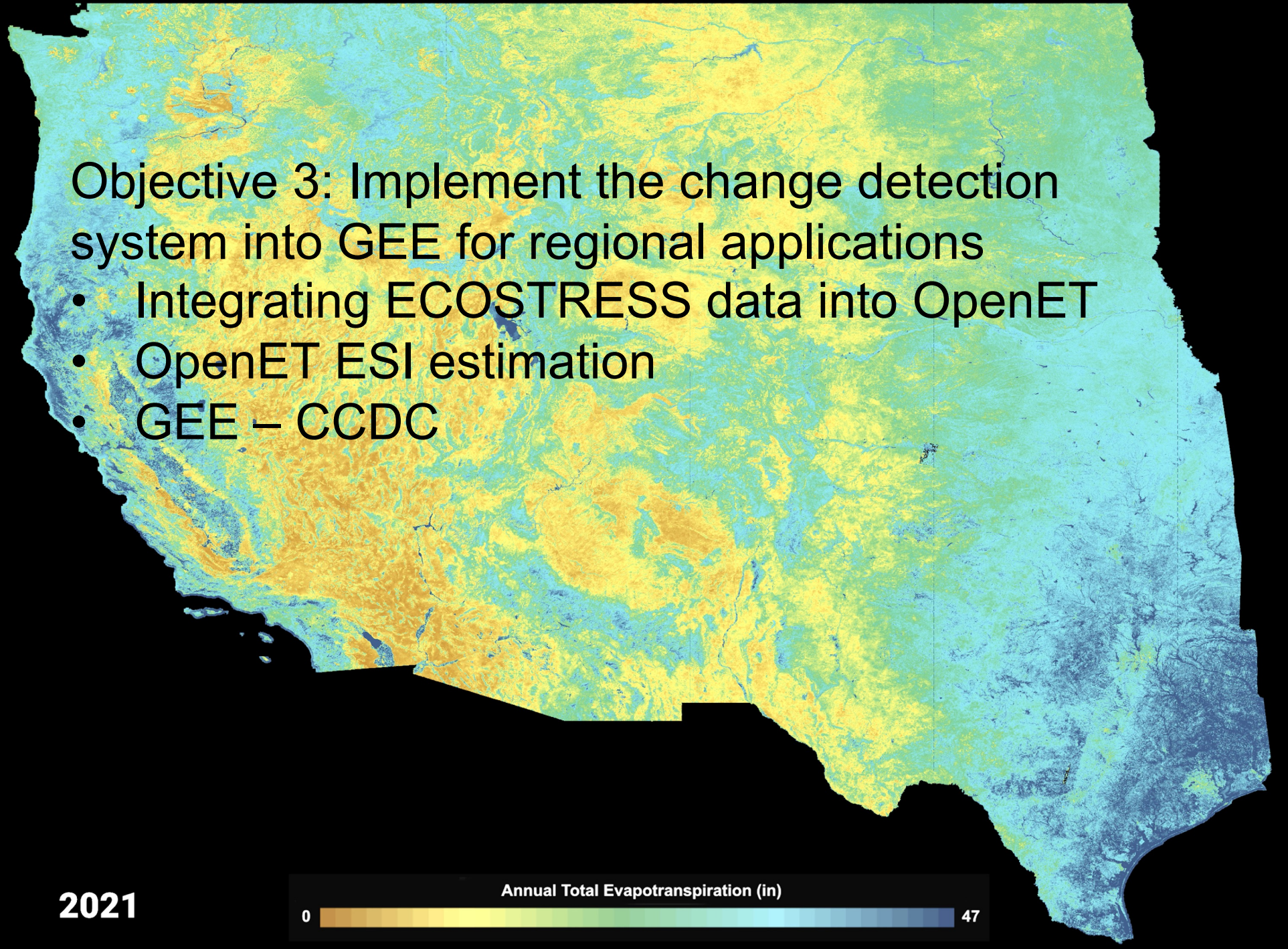


SEBAL

Accuracy assessment and intercomparison study

Evaluation





Objective 3: Implement the change detection system into GEE for regional applications

- Integrating ECOSTRESS data into OpenET
- OpenET ESI estimation
- GEE – CCDC

Conclusions

- Multi-source satellite data fusion with added value from ECOSTRESS.
- Near-simultaneous TIR and VSWIR acquisition will be addressed for better accuracy.
- OpenET provides field-scale ET estimation and integrate ECOSTRESS data will improve accuracy with increased frequency.
- Improved CCDC for water use change detection.