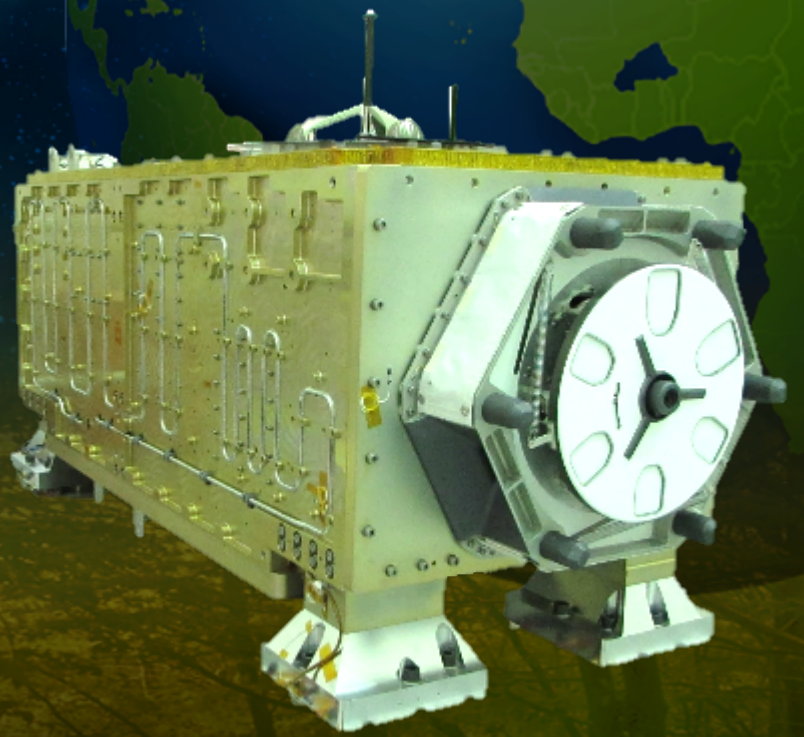
ECOsystem Spaceborne Thermal Radiometer Experiment on Space Station

ECOSTRESS

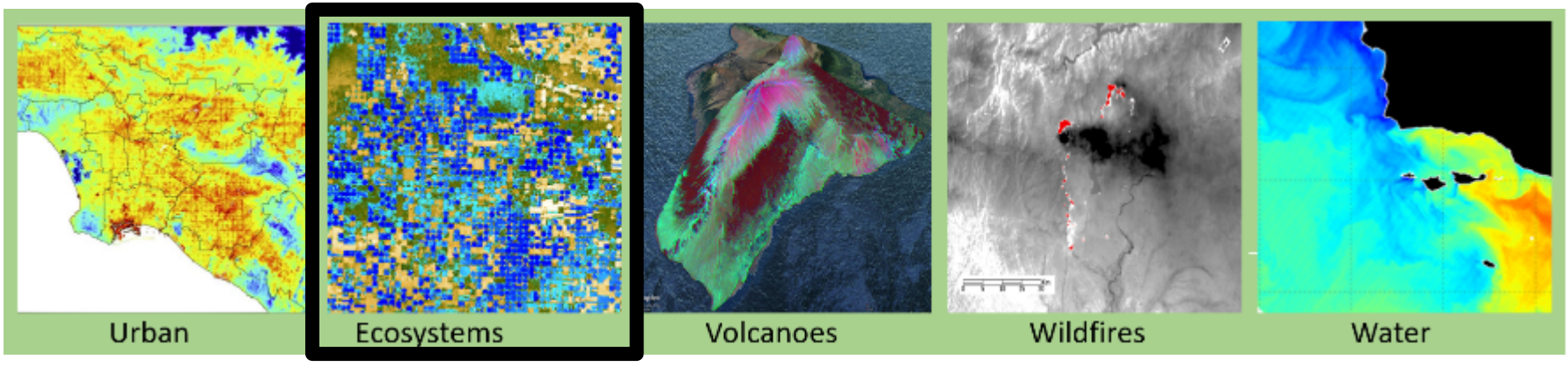
ECOSTRESS Science and Applications Team Meeting

Simon Hook and the ECOSTRESS team

February 2020

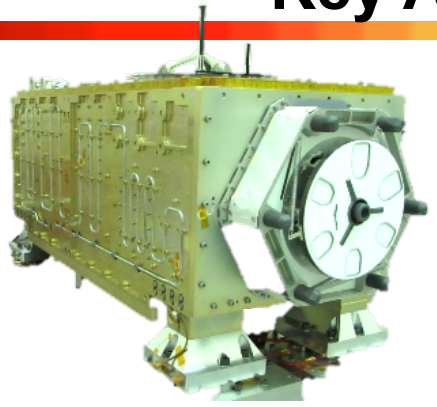


Introduction to ECOSTRESS

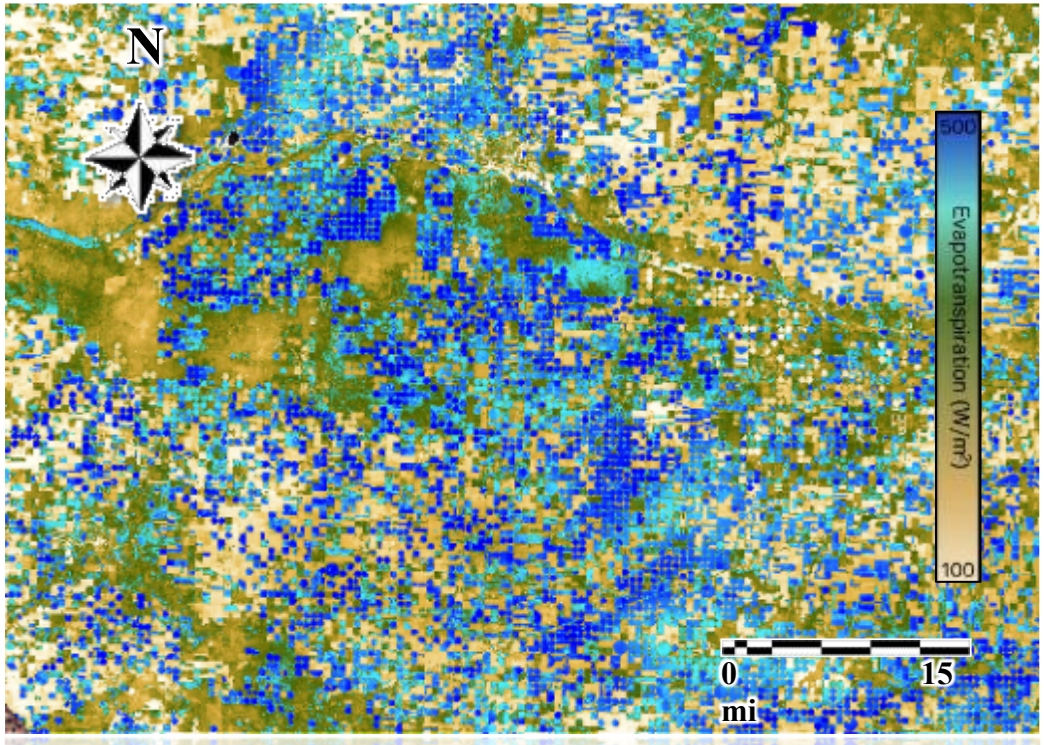


ECOSTRESS was developed for ecological research but the data have many applications

Science Assessment
Key Accomplishments and Results



- Selected July 30, 2014
- Launched June 29, 2018 to the ISS
- Began operations August 20, 2018
- 30 M$ Cost Capped, on schedule, on budget
- Acquired 70,000+ x 400x400 km scenes as of February 2020
- First use of WiFi for a science mission
- Delivers L1-L4 products
- More information at: https://ecostress.jpl.nasa.gov



ECOSTRESS evapotranspiration image over Garden City, Kansas USA | Center pivot irrigation dominates the landscape with circular patterns distributed across this Kansas community. Blue circles and squares indicate recently irrigated fields.

ECOSTRESS Facts and Figures

- ECOSTRESS was proposed to have an average operating daily acquisition rate of 72 scenes. It has had an operating daily acquisition rate of 196 scenes (as of 2/10/20).
- ECOSTRESS has acquired data on 421 days (as of 2/10/20).
- ECOSTRESS has acquired 70,791 400 km x 400 km scenes (as of 2/10/20), enough to cover the land surface of the Earth many times.
- ECOSTRESS has the largest early adopter program ever, with 240 early adopters, now transitioned to the Community of Practice
- All ECOSTRESS data products (L1-L4) were delivered ahead of schedule, via the early adopter program.
- ECOSTRESS L1 data were publicly released on schedule.
- ECOSTRESS L2-L4 data are planned for public release later this month, ahead of schedule.
- The NASA ECOSTRESS science team call was heavily oversubscribed with about 120 Notice of Intents for ~10 selections. This caused NASA to take the unprecedented step of informing proposers their success rate would be low. Even so, 70+ proposals were received and 15 proposals funded.
- Product validation work is well underway and initial results indicate the instrument is well calibrated, similar to Landsat 7 (Landsat 8 has straylight issues).
- ECOSTRESS is the highest spatial resolution multispectral thermal infrared radiometer NASA has ever built. It is the only spaceborne instrument capable of providing data suitable for evaluating data for the Decadal Survey SBG TIR mission.

ECOSTRESS

Maximizing Earth's Precious Resources

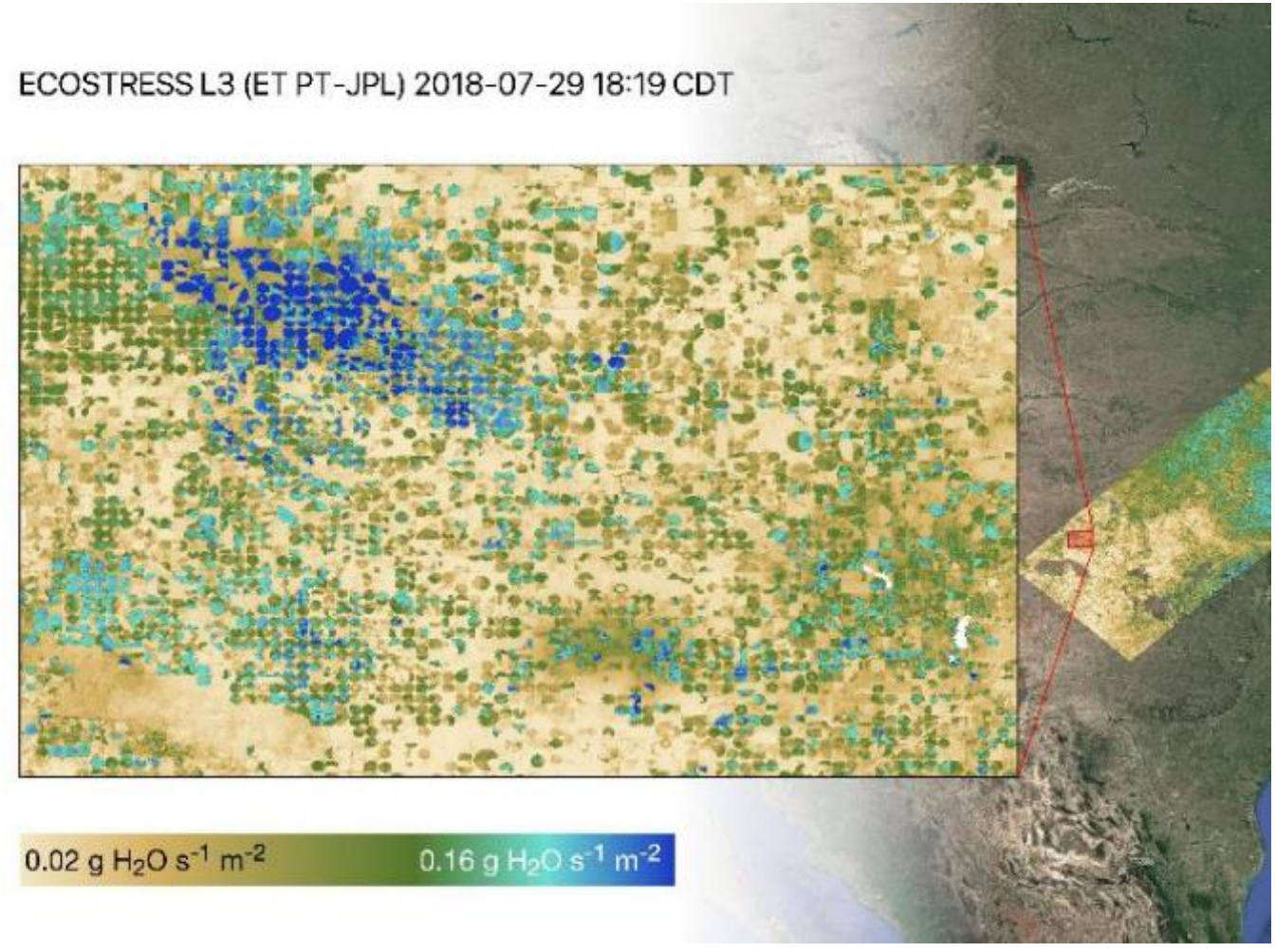
The ECOsystem Spaceborne Thermal Radiometer Experiment on Space Station (ECOSTRESS) will measure the temperature of plants and use that information to better understand how plants respond to heat and water stress. This stress is detectable from space at the scale of an individual farmer's field, and we can use this information to manage water resources and monitor droughts. Evapotranspiration (ET) derived from ECOSTRESS can infer plant stress before any physical degradation is observed with the naked eye.

How do plants respond to changing water availability?

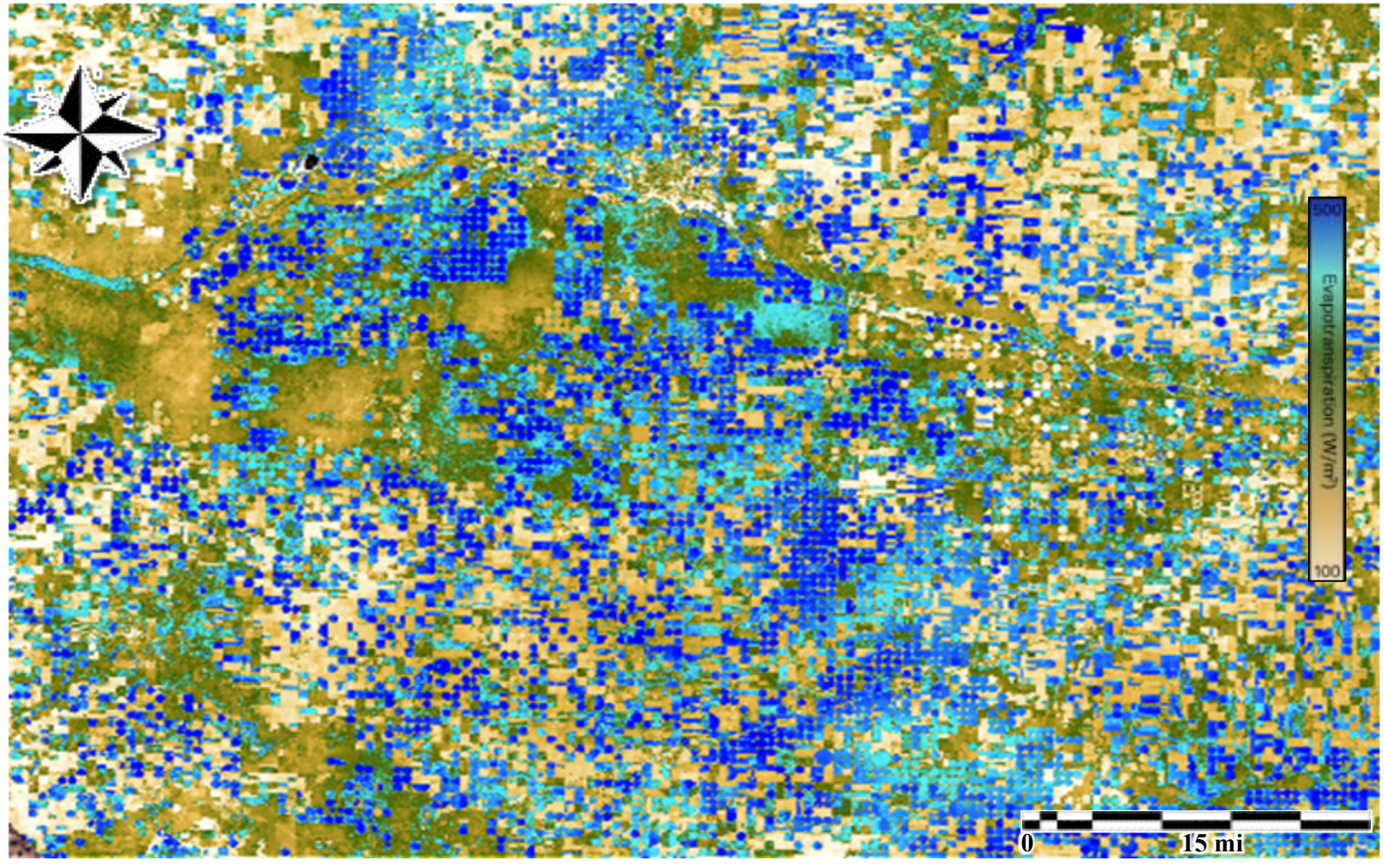
How do changes in evapotranspiration (ET) throughout the day affect vegetation growth?

Can we use ET measurements to optimize agricultural water use?

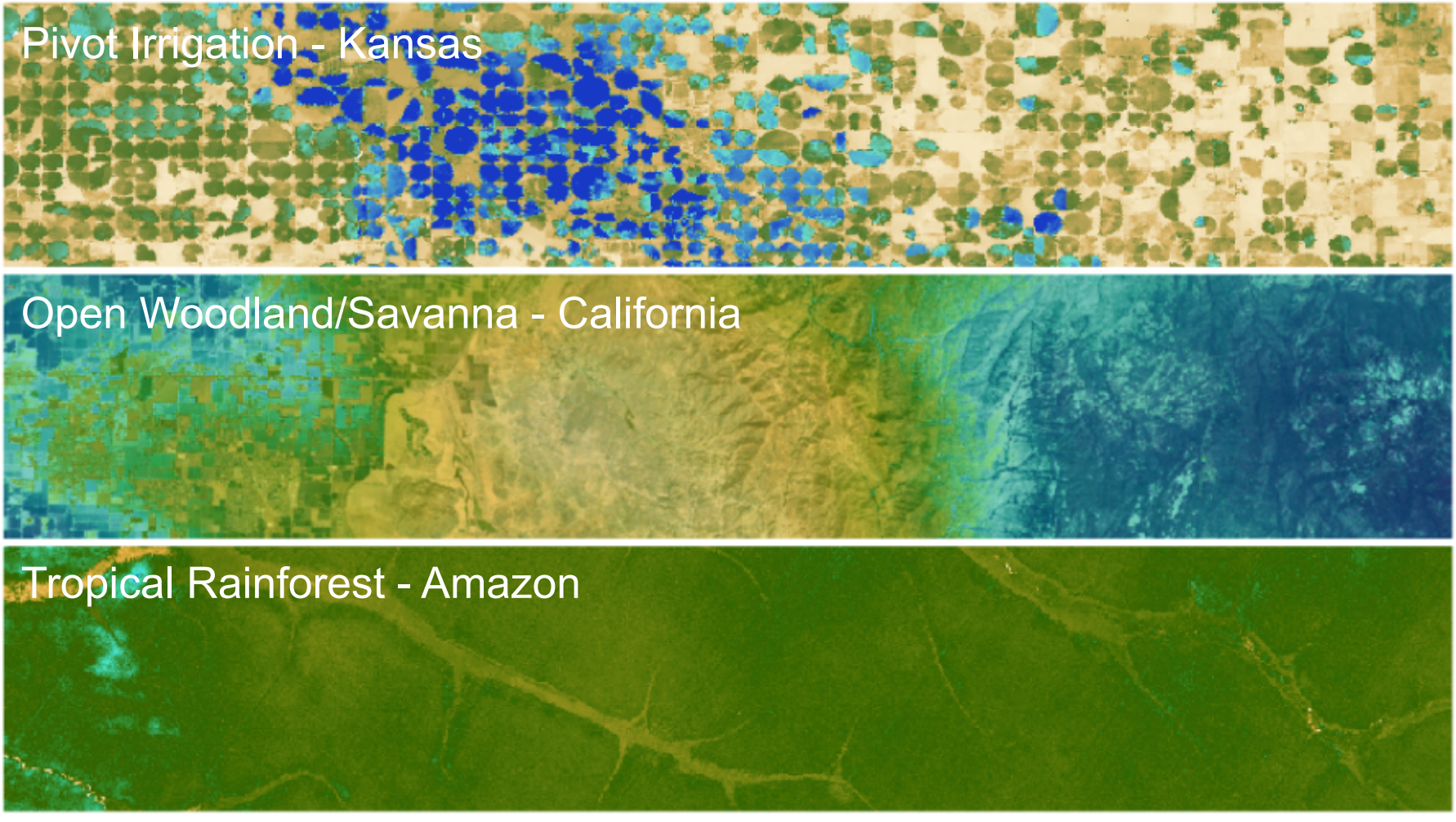
Large Swath + High Spatial Res. + High Accuracy = Sig. Science Advances



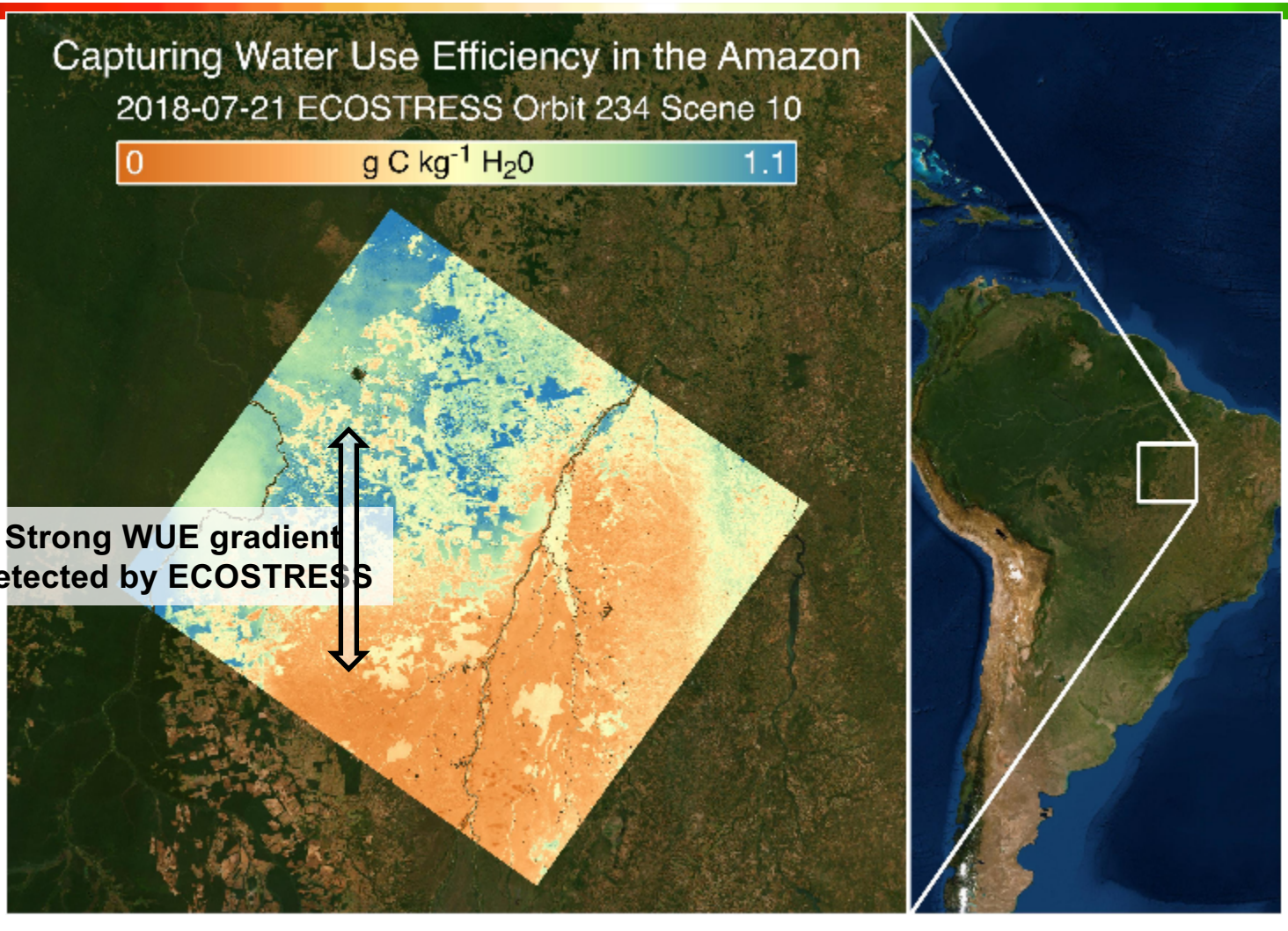
Unprecedented Detail in Plant Water Use



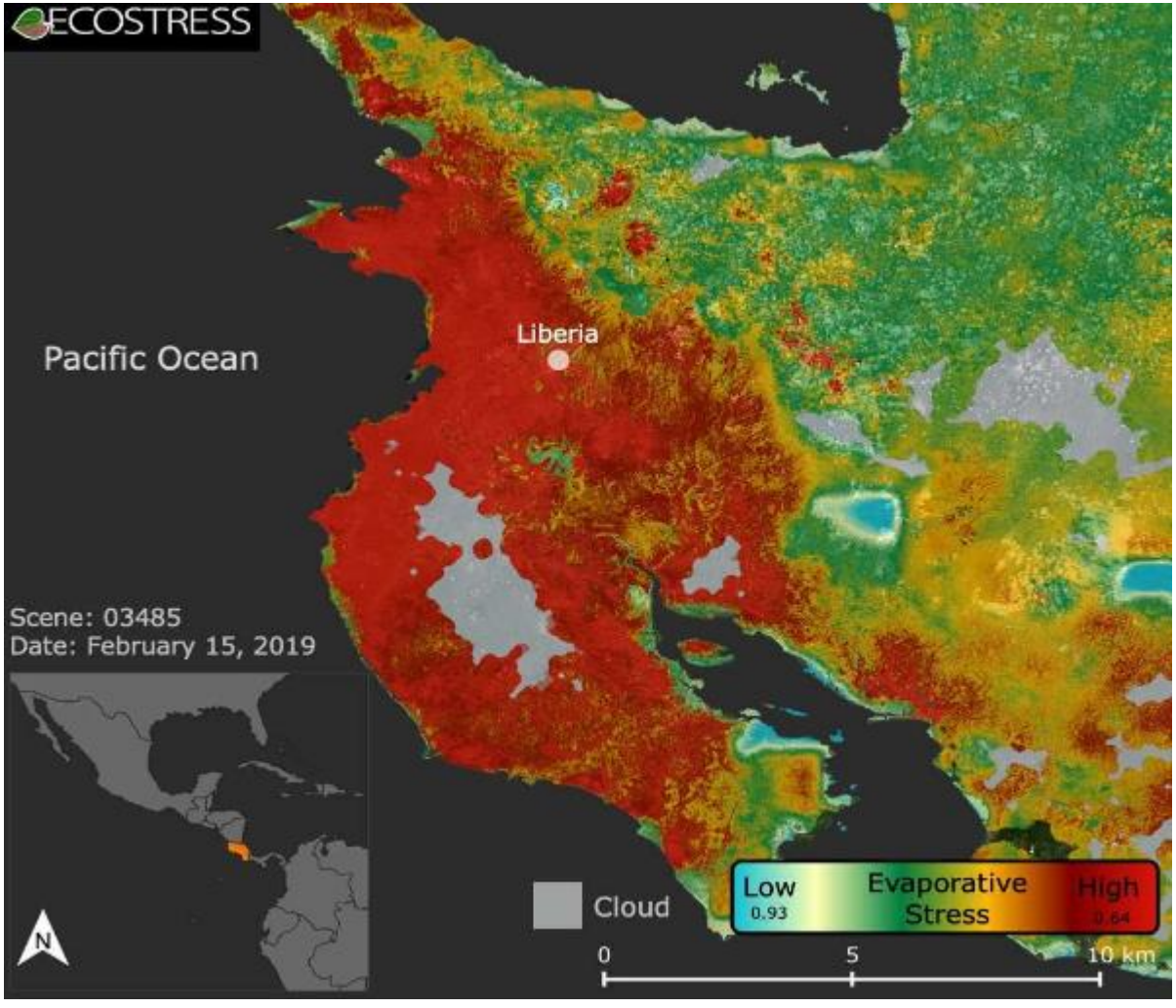
Contrasting Snapshots of Water Use



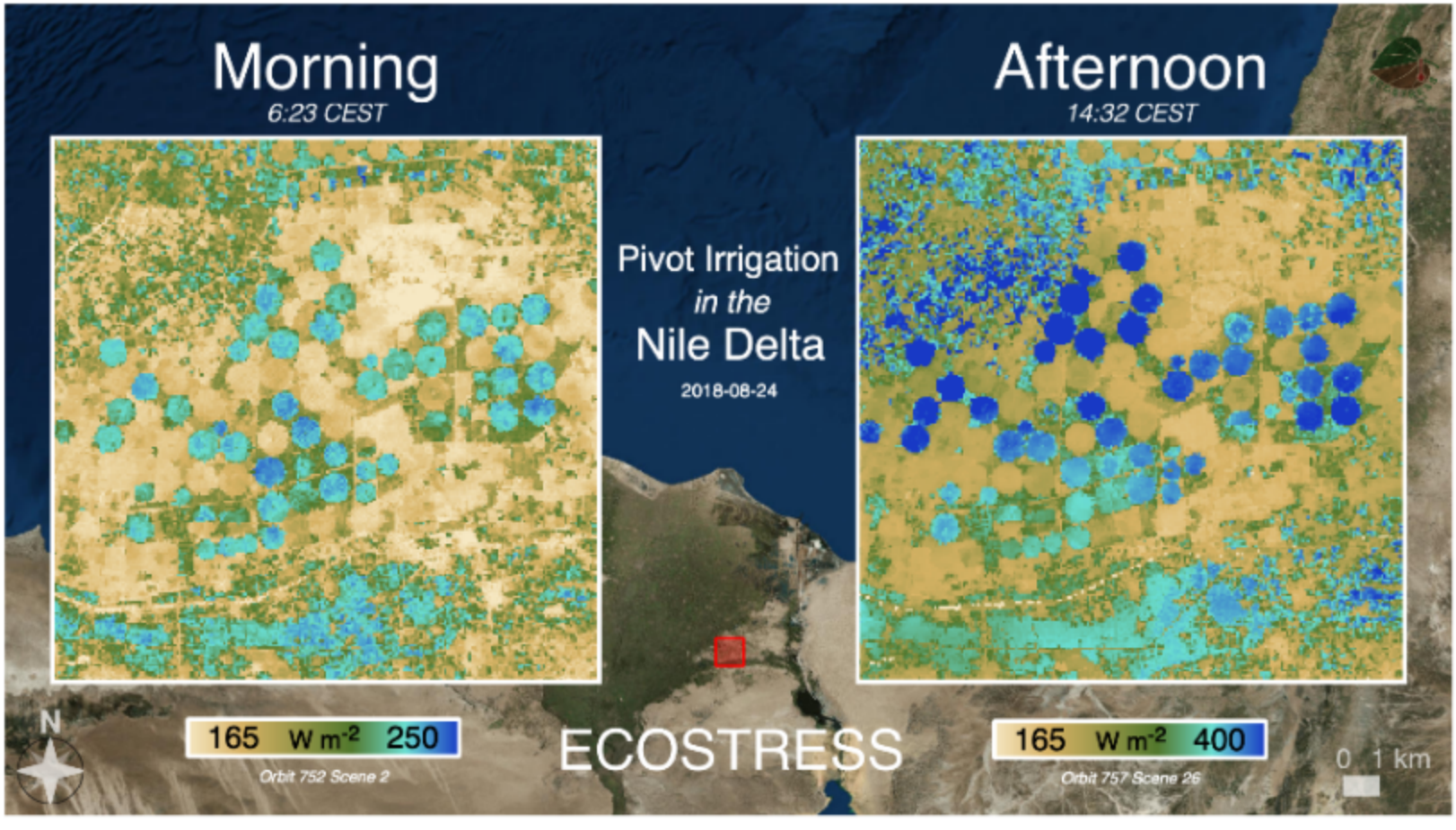
Water Use Efficiency in the Amazon



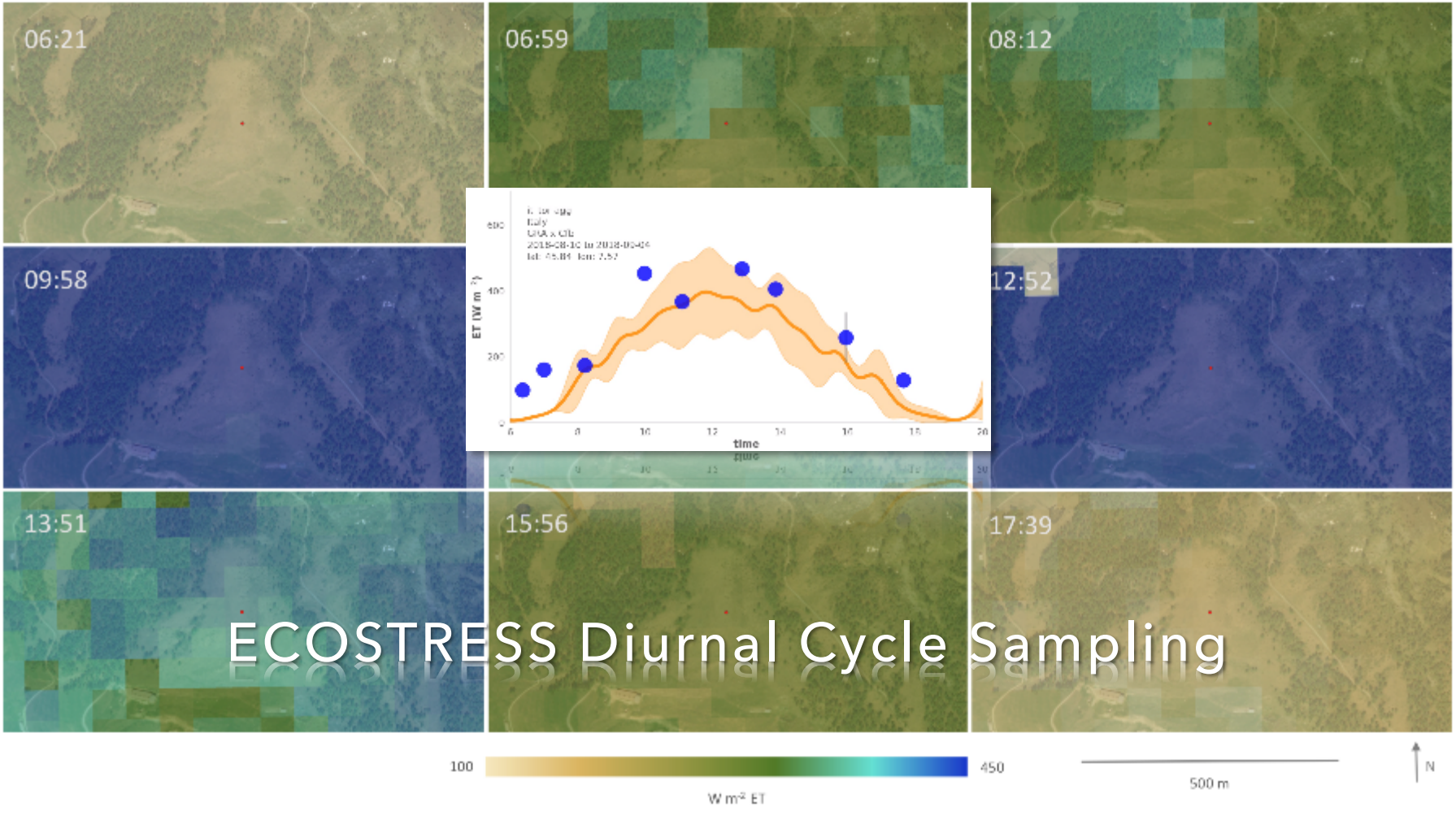
Drought in Costa Rica



Diurnal field-scale ET now seen



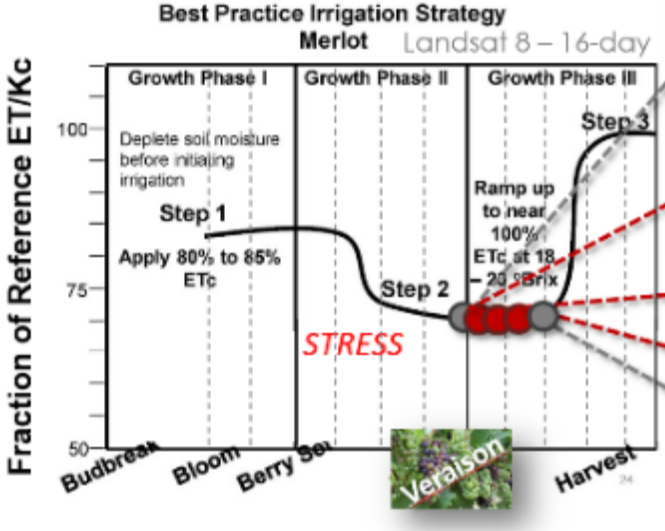
ECOSTRESS Diurnal Cycle Sampling

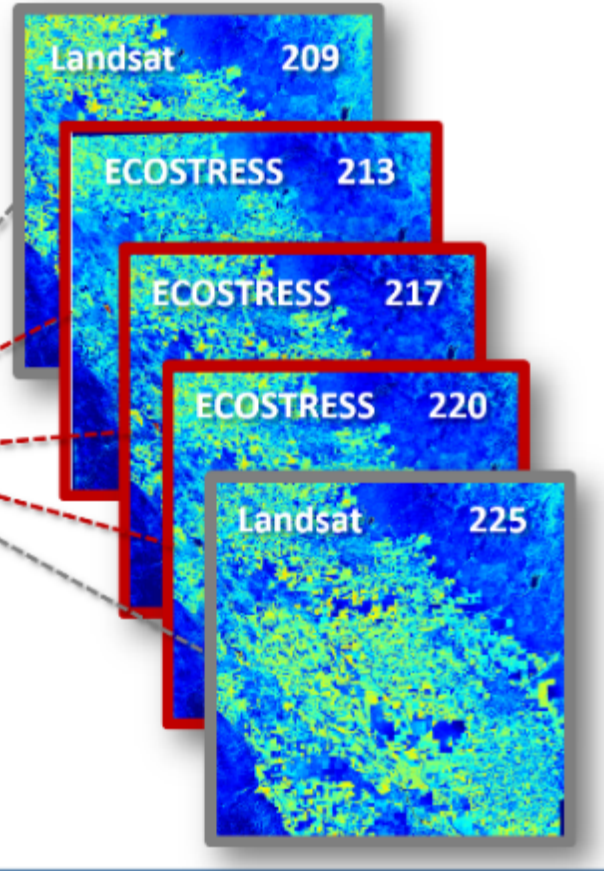


USDA utilizes ECOSTRESS Vineyard Studies

Application: vineyard irrigation

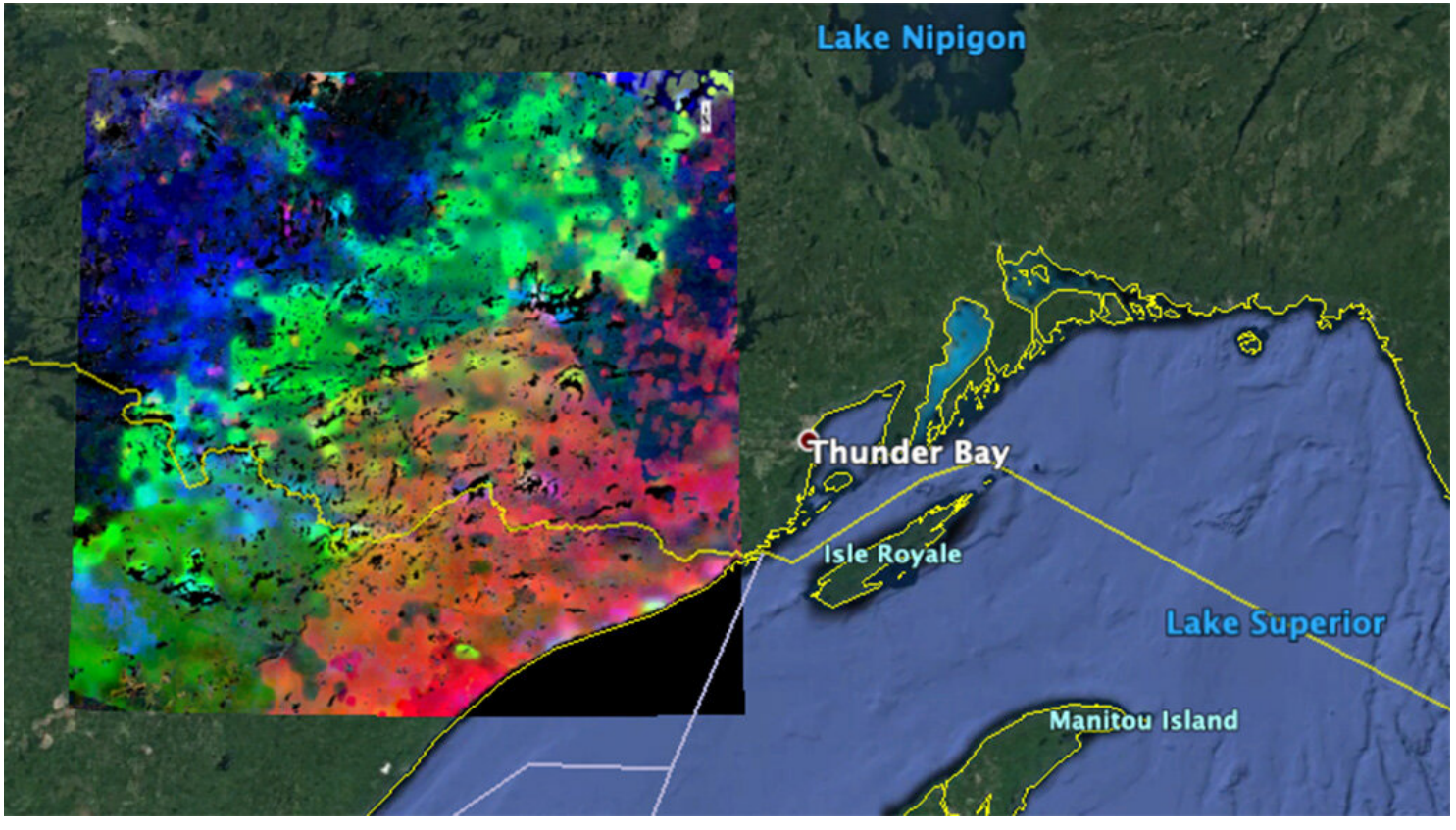
VARIABLE RATE DRIP IRRIGATION (VRDI)





ESA Living Planet – May 2019

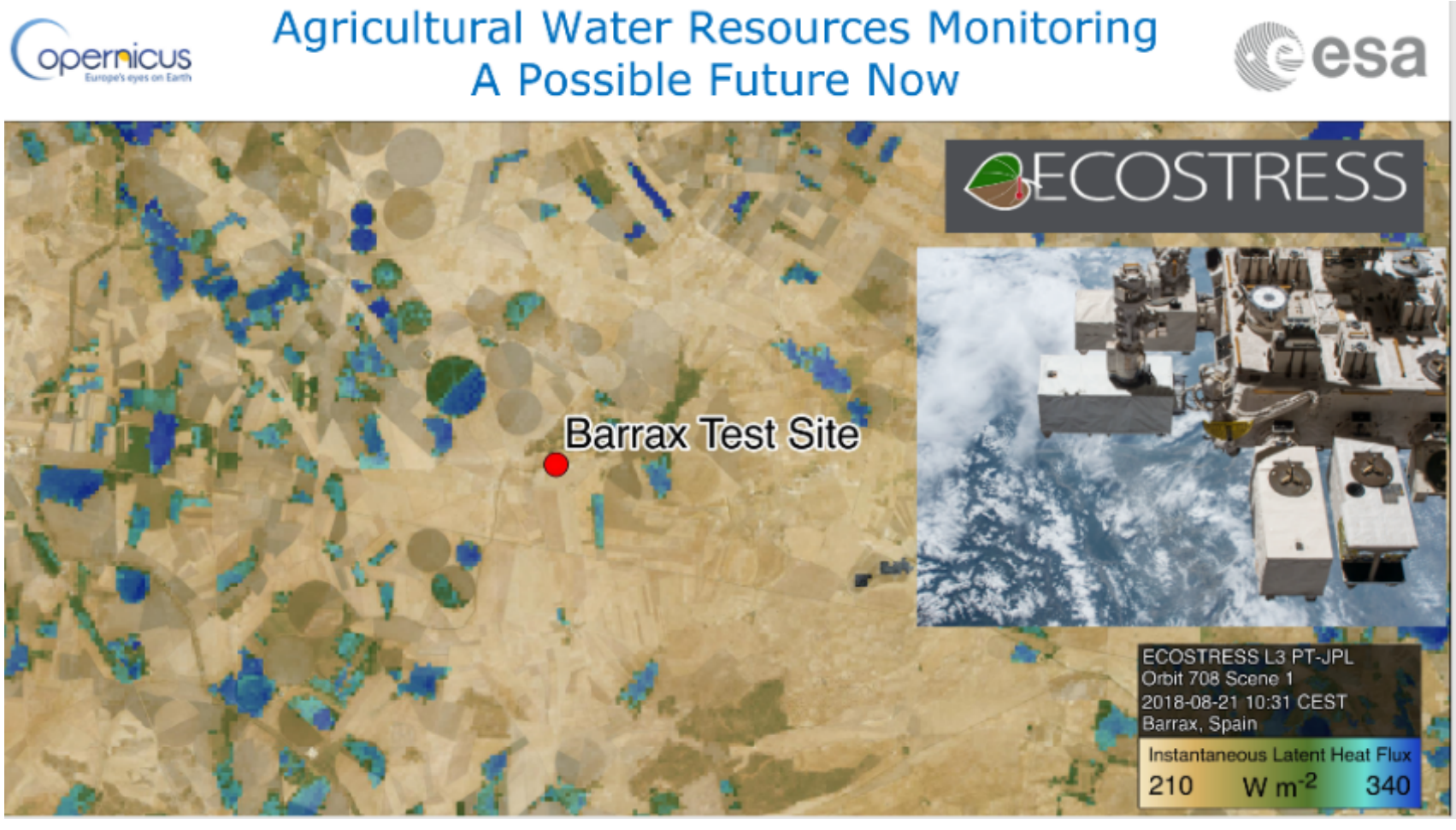
ECOSTRESS Sees Plants “Waking Up”



The image shows plants "waking up" near Lake Superior. Red areas began to wake up at around 7 a.m. local time; green areas awoke around 8 a.m.; and blue areas, at about 9 a.m. The data was acquired by ECOSTRESS during the summer season.

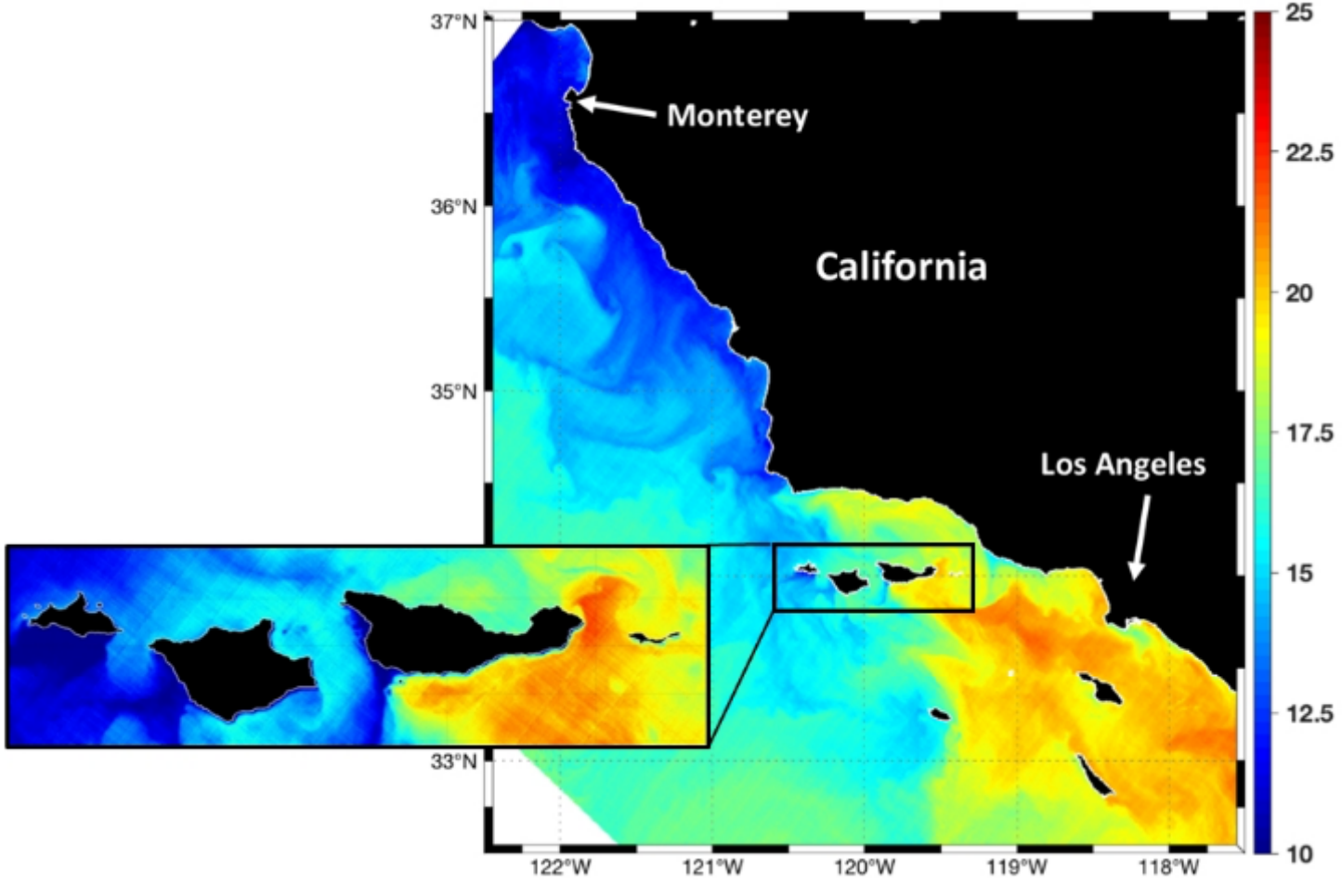
Other Uses of ECOSTRESS Data

ESA Utilizes ECOSTRESS for Copernicus Expansion Demonstration



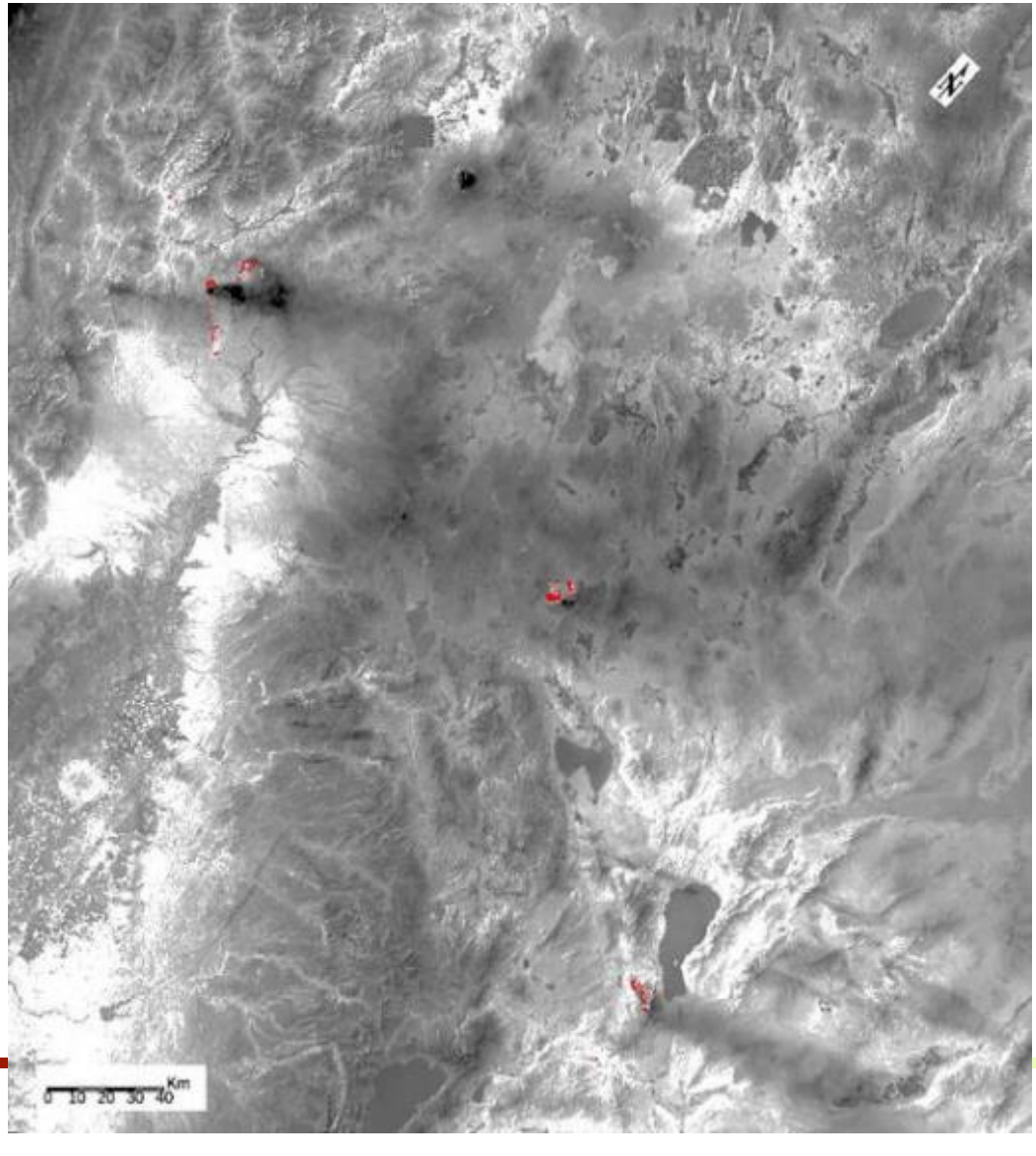
NASA will also use data to simulate SBG Thermal Data

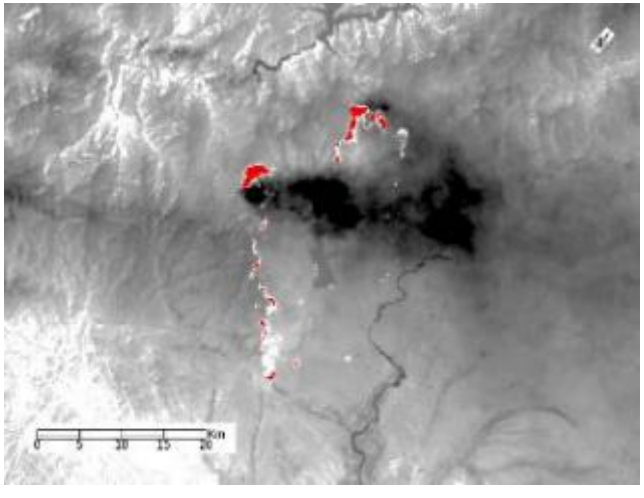
Examining the relation between biodiversity and surface temperature regimes in localized coastal upwelling zones

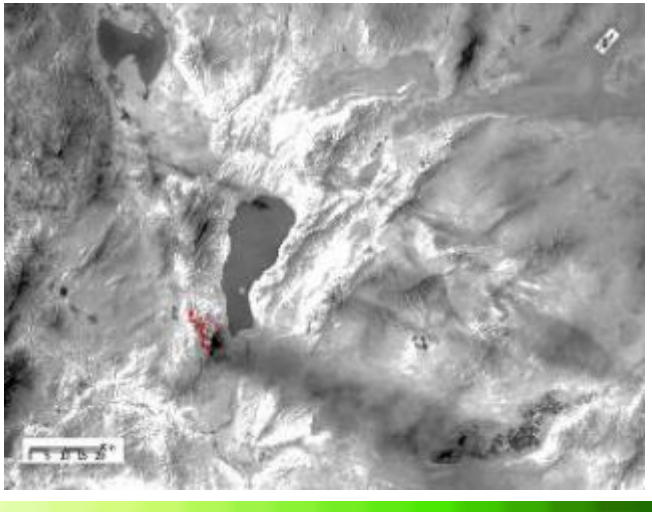


Credit: Early Adopter D. Otis, University of South Florida

NASA's 'Space Botanist' Observes California, Nevada Wildfires





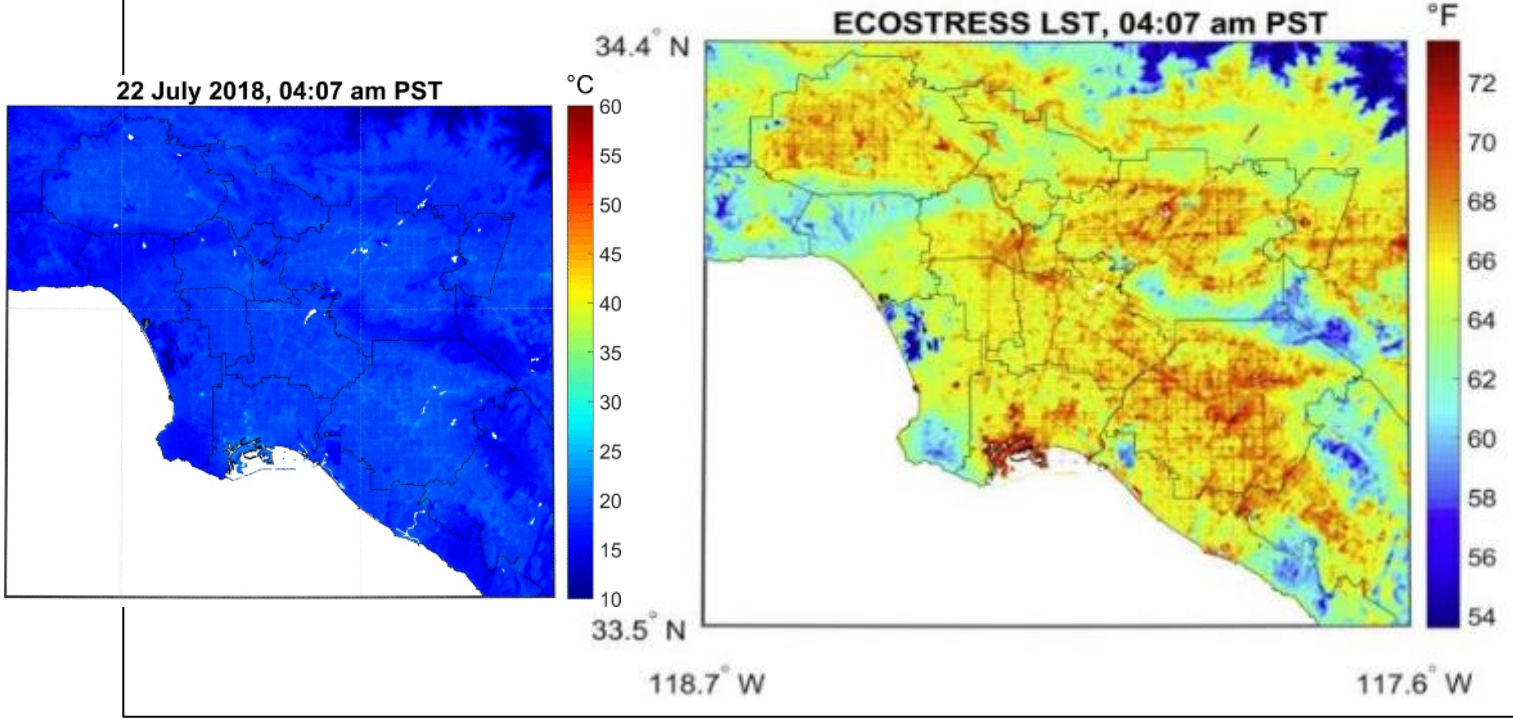


City of LA utilizes ECOSTRESS for Urban Studies

Jet Propulsion Laboratory
California Institute of Technology

NEWS | SEPTEMBER 18, 2018

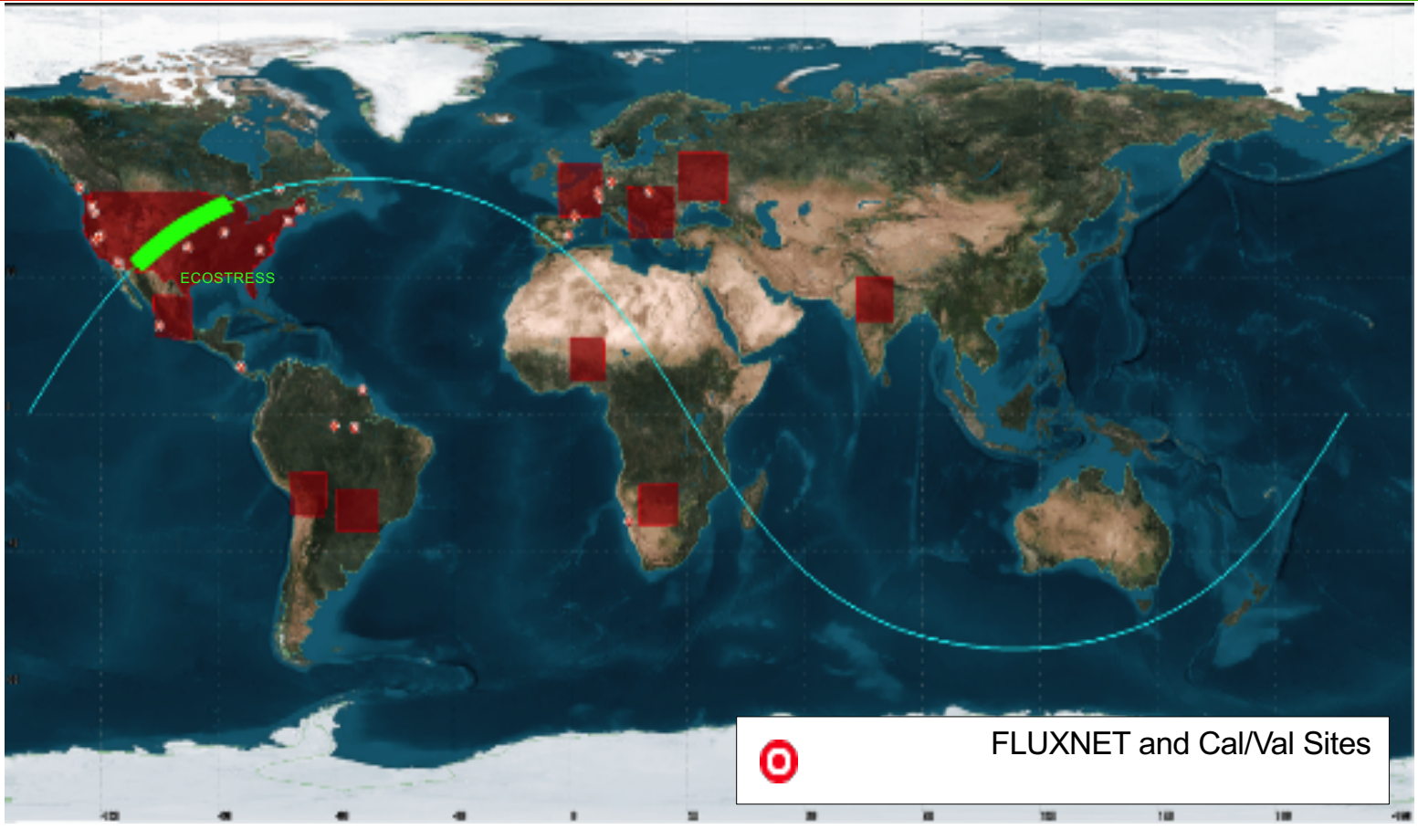
ECOSTRESS Maps LA's Hot Spots



Science Objectives for Senior Review

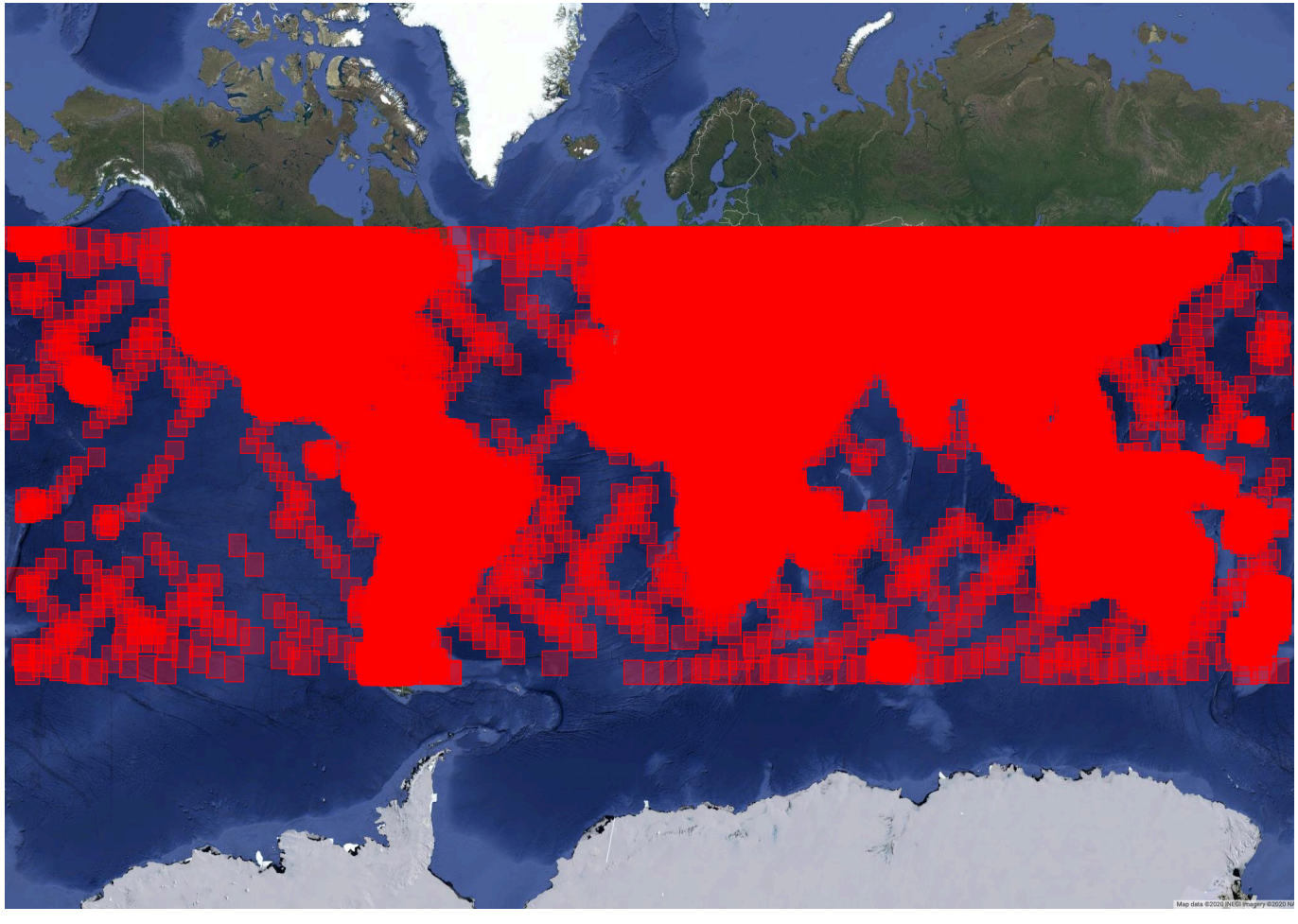
- Continue the science objectives from Prime Mission for selected targets:
  - Identify critical thresholds of water use and water stress in key climate sensitive biomes (e.g. tropical/dry transition forests, boreal forests);
  - Detect the timing, location, and predictive factors leading to plant water uptake decline and/or cessation over the diurnal cycle;
  - Measure agricultural water consumptive use over CONUS at spatiotemporal scales applicable to improving drought estimation accuracy
- Extend the objectives of the prime mission from selected to targets to regions and eventually the globe
- Support the science of the recently selected NASA Science Team
- Move from snapshots to trends over time

Data Product Acquisition and Archive Status



ECOSTRESS proposed acquisitions ~ 70 per day

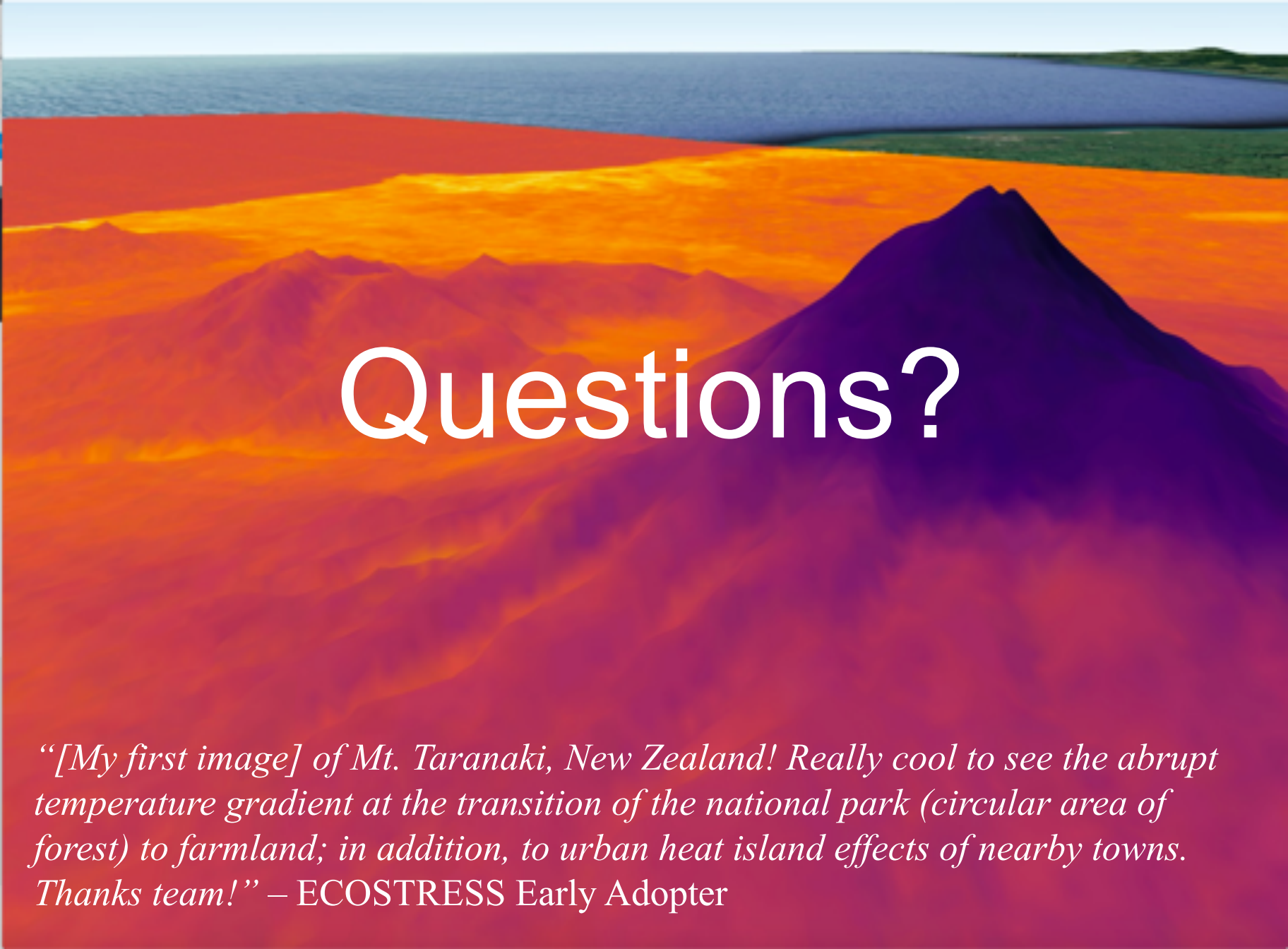
ECOSTRESS Actual Coverage (as of Feb 10, 2020)



All data acquired by ECOSTRESS have now been processed

Summary

- ECOSTRESS has operated 421 days acquiring over 70,000+ 400 km x 400 km scenes
- ECOSTRESS has the largest Early Adopter program ever, with 240 early adopters. Now called the Community of Practice
- L1 – L4 products were released early through the Early Adopter program.
- L1 data products were publicly released on schedule. L2 – L4 data products were publicly released ahead of schedule.
- All issues identified during operations have been solved.
- All Level 1 requirements specified in the PLRA are complete or the path to completion has been identified.
- Instrument health (currents, temperatures and voltages) is nominal, retaining all redundancy with the exception of the MSU which is no longer required.
- Current mode of operation using the synchronized random access memory (SDRAM) for direct file streaming is acquiring 2.5x the proposed average daily scenes.
- ECOSTRESS has proposed an extended mission that includes processing and distributing data outside the originally proposed targets.


Questions?
"[My first image] of Mt. Taranaki, New Zealand! Really cool to see the abrupt temperature gradient at the transition of the national park (circular area of forest) to farmland; in addition, to urban heat island effects of nearby towns. Thanks team!" – ECOSTRESS Early Adopter