ECOSTRESS

ECOsystem Spaceborne Thermal Radiometer Experiment on Space Station

An Earth Venture Instrument-2 Proposal

Submitted in response to

AO NNH12ZDA006O EVI2

Prepared for

National Aeronautics and Space Administration
Science Mission Directorate

PI — Simon Hook (JPL)

Science Lead — **Joshua B. Fisher** (JPL)

Science Team — Rick Allen (U. Idaho)
Martha Anderson (USDA)
Andy French (USDA)
Chris Hain (UMD)
Glynn Hulley (JPL)
Eric Wood (Princeton U.)

November 25, 2013

National Aeronautics and Space Administration

Jet Propulsion Laboratory
California Institute of Technology
Pasadena, California

www.nasa.gov

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ECOSTRESS KEY SCIENCE QUESTIONS

1. How is the terrestrial biosphere responding to changes in water availability?

2. How do changes in diurnal vegetation water stress impact the global carbon cycle?

3. Can agricultural vulnerability be reduced through advanced monitoring of agricultural consumptive use and improved drought detection?

ECOSTRESS SCIENCE OBJECTIVES

1. Identify **critical thresholds** of water use and water stress in key climate sensitive biomes (e.g., tropical/dry transition forests, boreal forests);

2. Detect the timing, location, and predictive factors leading to plant water uptake decline and/or cessation over the **diurnal cycle;**

3. Measure agricultural water **consumptive use** globally at spatiotemporal scales applicable to improving drought estimation accuracy.

ECOSTRESS CORE SCIENCE HYPOTHESES

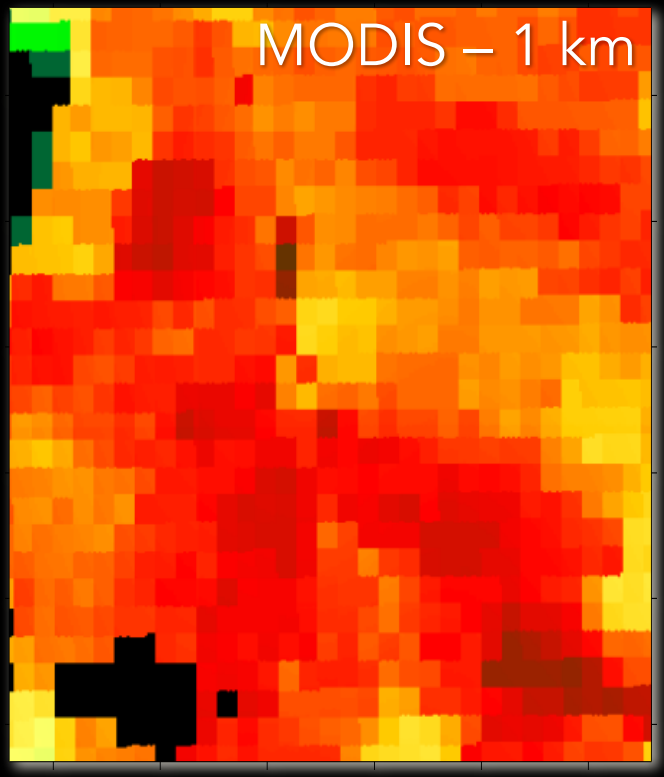
H1: The WUE of a climate sensitive hotspot is significantly lower than non-hotspots of the same biome type;

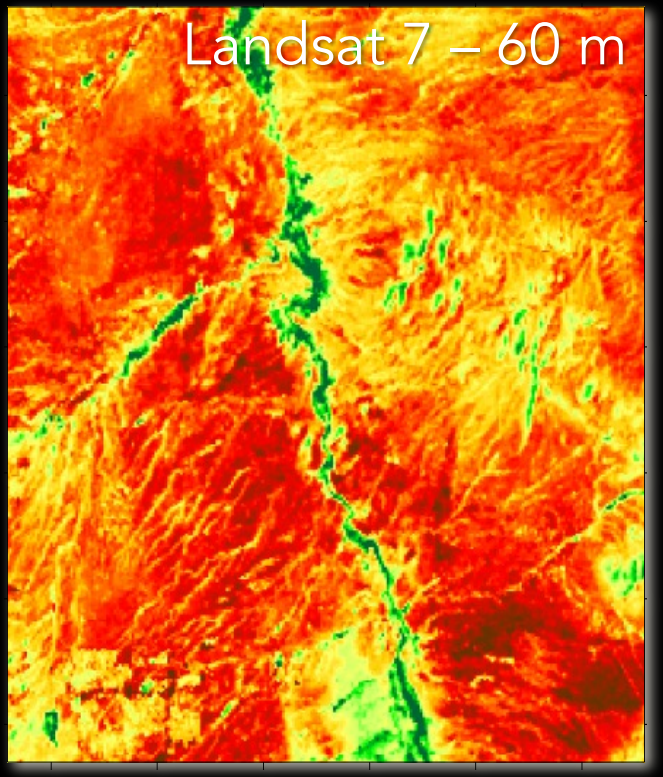
H_2: Daily ET is overestimated when extrapolating from morning-only observations;

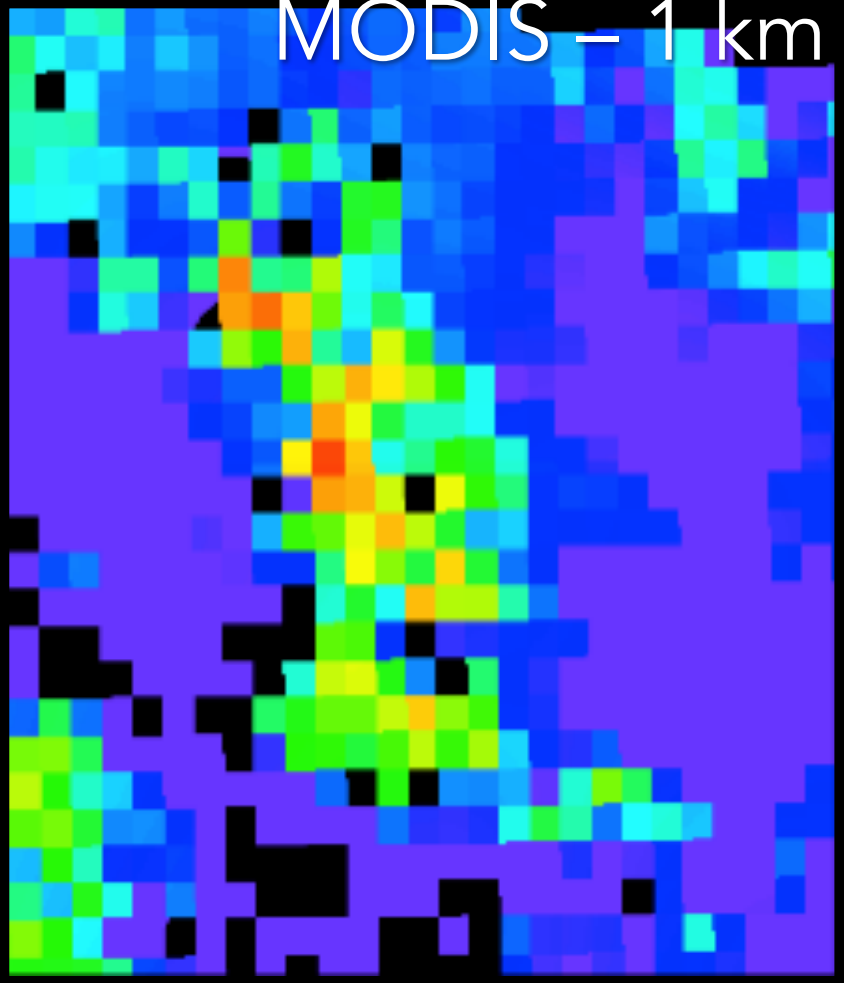
H_3: Remotely sensed ET measured at the field scale will improve drought prediction over managed ecosystems.

A P P R O A C H

What we need: accurate, high spatial, high temporal, diurnal cycle, global, ET.


MODIS – 1 km


Landsat 7 – 60 m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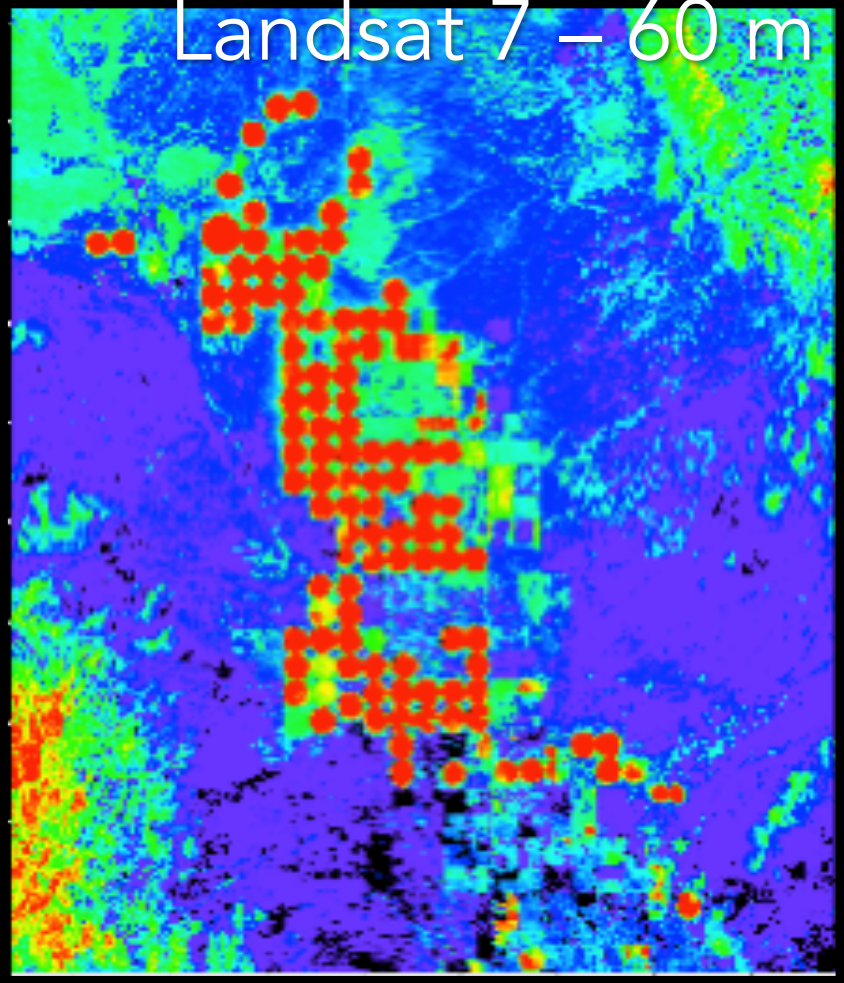
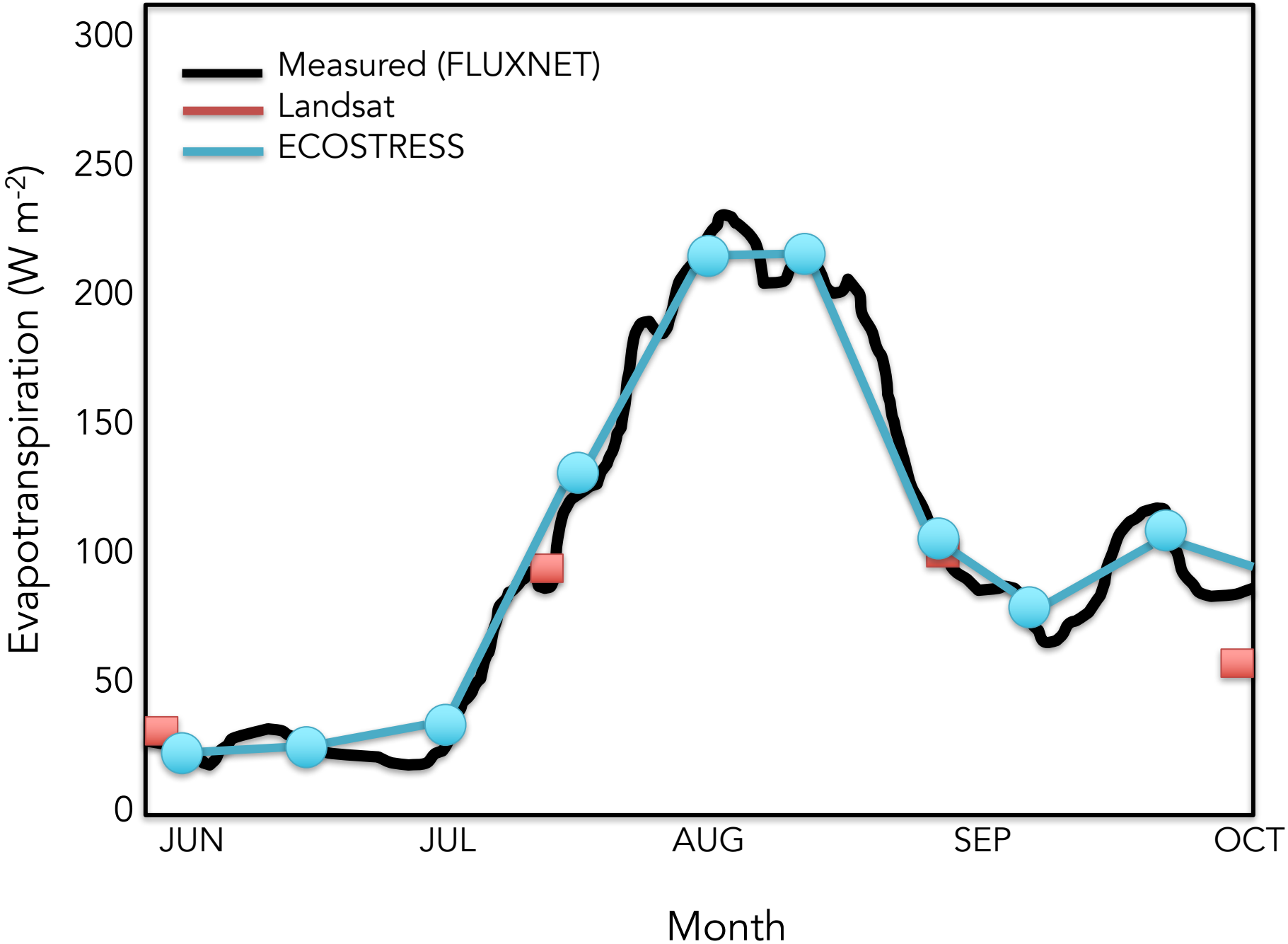
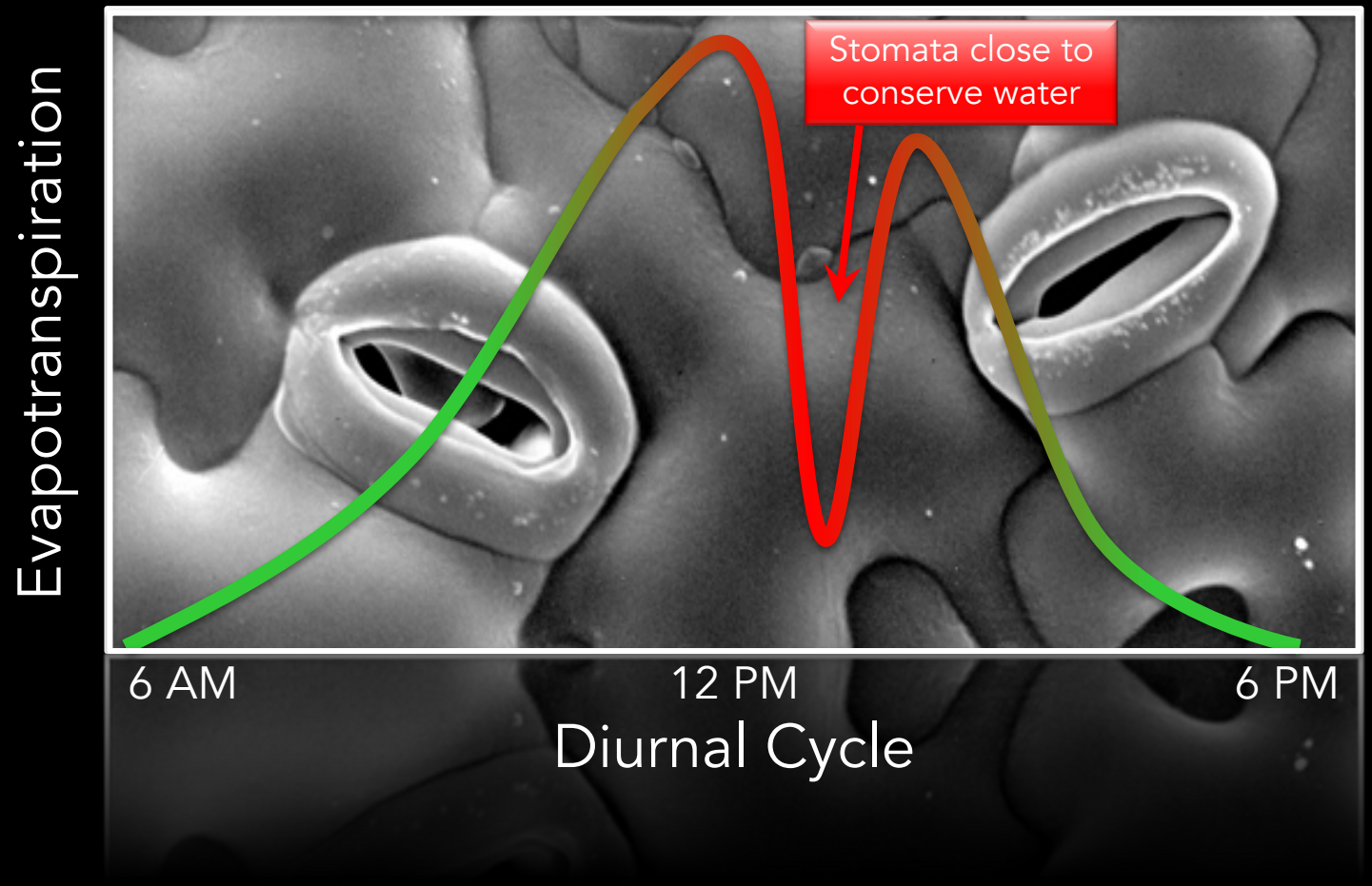
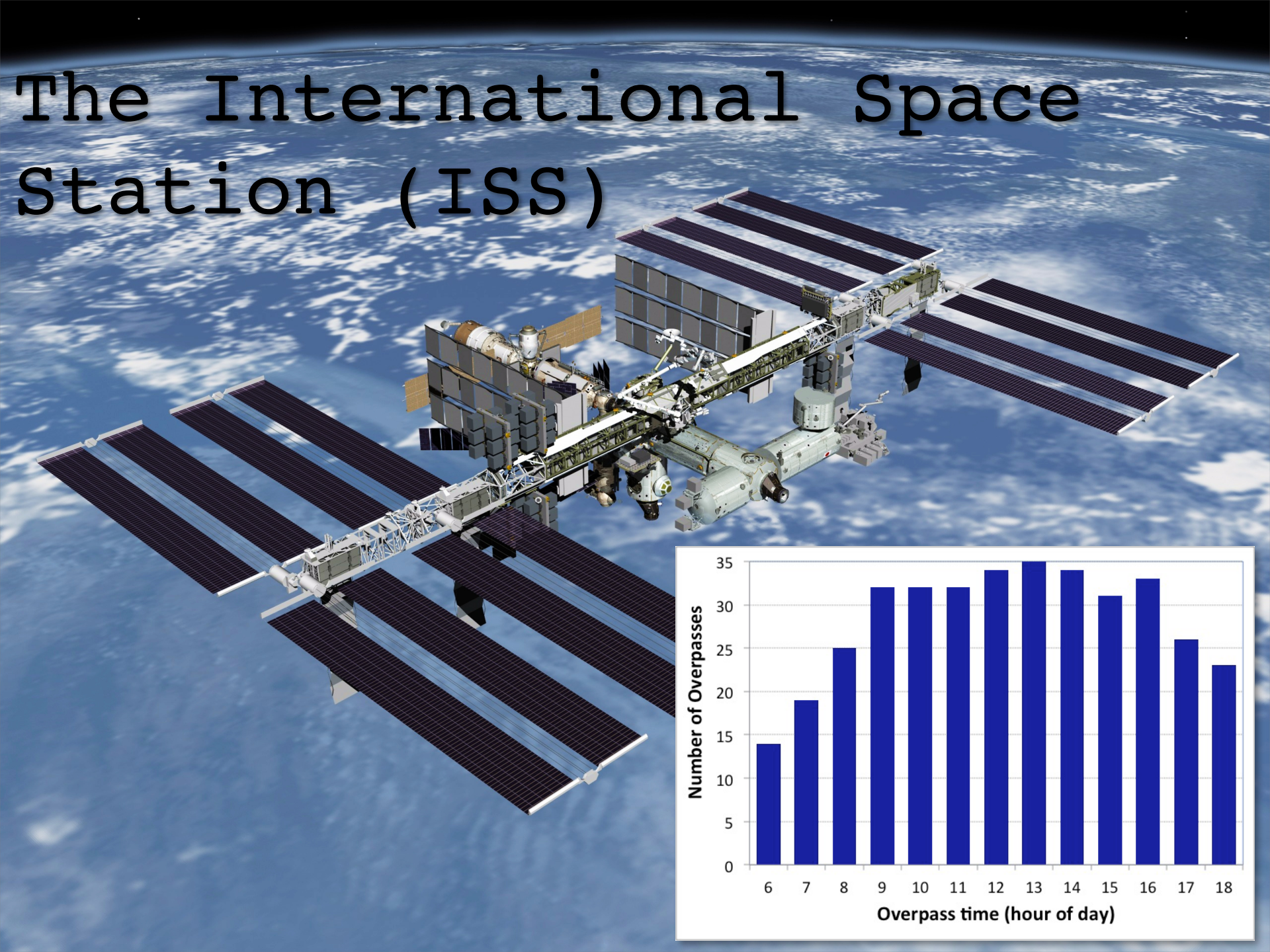

Landsat 7 – 60 m

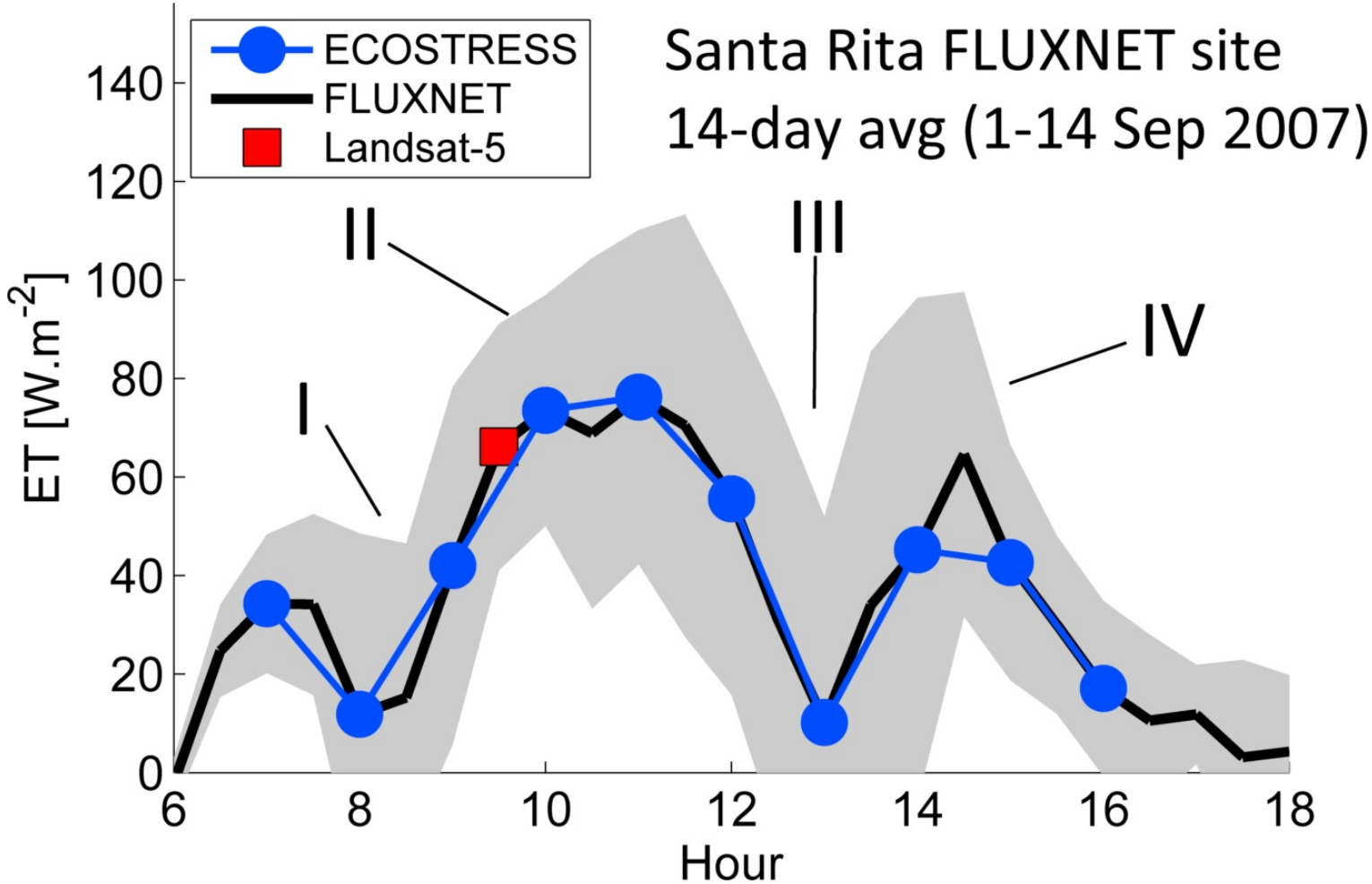

Measured (FLUXNET)
Landsat
ECOSTRESS
Evapotranspiration (W m-2)
300
250
200
150
100
50
0
JUN
JUL
AUG
SEP
OCT
Month

Water Stress Drives Plant Behavior



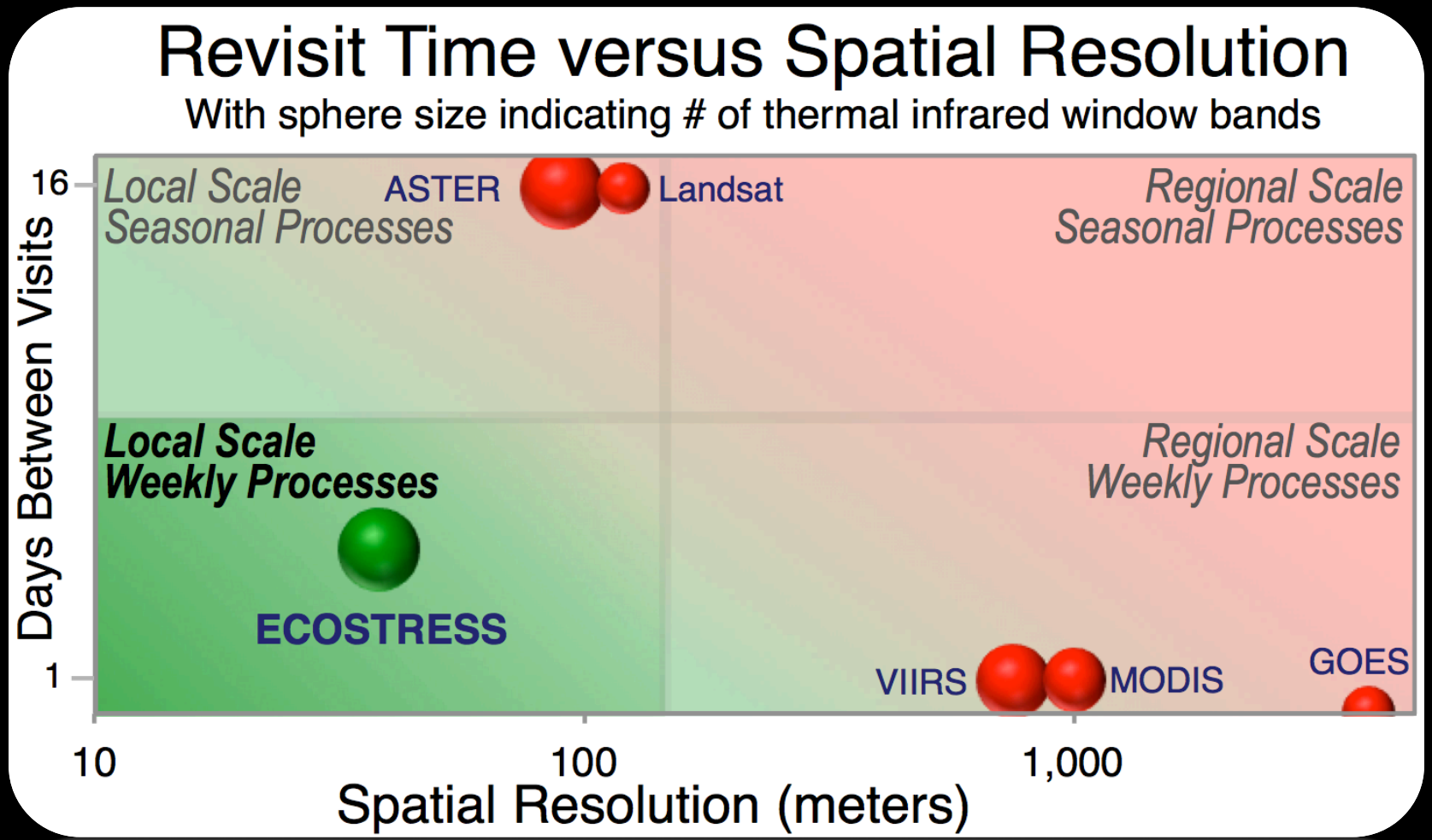
The International Space Station (ISS)





Gray shading represents mean **diurnal variation** in ET over 14-days. The afternoon decline in ET is related to water stress (clear day).

- I Xylem refilling after initial water release.
- II ET at maximum/potential rate in the morning.
- III Stomata shut down water flux in the afternoon.
- IV ET resumes at maximum/potential in early evening when demand is reduced.


Revisit Time versus Spatial Resolution
With sphere size indicating # of thermal infrared window bands
Local Scale
Seasonal Processes
ASTER
Landsat
Regional Scale
Seasonal Processes
Local Scale
Weekly Processes
Regional Scale
Weekly Processes
ECOSTRESS
VIIRS
MODIS
GOES
16
1
Days Between Visits
10
100
1,000
Spatial Resolution (meters)

AGU PUBLICATIONS

Water Resources Research

COMMENTARY

10.1002/2016WR020175

Key Points:

- ET science and applications have significantly advanced across a wide array of fields over the past several decades
- Critical outstanding ET-based research and applied science questions from local to global scales remain due to deficiencies in our observational capabilities
- National and international research priorities should include ET-focused satellite observational investments and programs

Correspondence to:
J. B. Fisher,
jbfisher@jpl.nasa.gov

The future of evapotranspiration: Global requirements for ecosystem functioning, carbon and climate feedbacks, agricultural management, and water resources

Joshua B. Fisher[1], Forrest Melton[2], Elizabeth Middleton[3], Christopher Hain[4,5], Martha Anderson[6], Richard Allen[7], Matthew F. McCabe[8], Simon Hook[1], Dennis Baldocchi[9], Philip A. Townsend[10], Ayse Kilic[11], Kevin Tu[12], Diego D. Miralles[13], Johan Perret[14], Jean-Pierre Lagouarde[15], Duane Waliser[1], Adam J. Purdy[1], Andrew French[16], David Schimel[1], James S. Famiglietti[1], Graeme Stephens[1], and Eric F. Wood[17]

[1]Jet Propulsion Laboratory, California Institute of Technology, Pasadena, California, USA, [2]NASA Ames Research Center Cooperative for Research in Earth Science in Technology, Moffett Field, California, USA, [3]NASA Goddard Space Flight Center, Greenbelt, Maryland, USA, [4]NASA Marshall Space Flight Center, Huntsville, Alabama, USA, [5]NOAA National Environmental Satellite, Data, and Information Service, College Park, Maryland, USA, [6]U.S. Department of Agriculture, Beltsville, Maryland, USA, [7]University of Idaho, Kimberly, Idaho, USA, [8]King Abdullah University of Science and Technology, Thuwal, Saudi Arabia, [9]University of California, Berkeley, California, USA, [10]University of Wisconsin, Madison, Wisconsin, USA, [11]University of Nebraska-Lincoln, Lincoln, Nebraska, USA, [12]DuPont Pioneer, Johnston, Iowa, USA, [13]Ghent University, Ghent, Belgium, [14]EARTH University, San, José, Costa Rica, [15]INRA, ISPA UMR 1391, Villenage D'Ornon, France, [16]U.S. Department of Agriculture, Maricopa, Arizona, USA, [17]Princeton University, Princeton, New Jersey, USA