**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

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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;

H2: DAILY ET IS OVERESTIMATED WHEN EXTRAPOLATING FROM MORNING-ONLY OBSERVATIONS;

H3: REMOTELY SENSED ET MEASURED AT THE FIELD SCALE WILL IMPROVE DROUGHT PREDICTION OVER MANAGED ECOSYSTEMS.
APPROACH
What we need: accurate, high spatial, high temporal, diurnal cycle, global, ET.
Water Stress Drives Plant Behavior

Evapotranspiration

6 AM  12 PM  6 PM

Diurnal Cycle

Stomata close to conserve water
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

Days Between Visits

Spatial Resolution (meters)

Local Scale Seasonal Processes

Local Scale Weekly Processes

Regional Scale Seasonal Processes

Regional Scale Weekly Processes

ASTER

Landsat

ECOSTRESS

VIIRS

MODIS

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

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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 problems need to be elucidated for global climate change.
- National and international research and programs should include ET-focused satellite observational investments and priorities.

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