

ECOSTRESS Applications Activities

*and considerations for EV mission
applications*

Christine M. Lee, ECOSTRESS Applications Lead
Jet Propulsion Laboratory, California Institute of Technology

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HyspIRI Science and Applications Workshop

National Aeronautics and
Space Administration



ECOSTRESS

ECOsysteM Spaceborne Thermal
Radiometer Experiment
on Space Station



Monitoring
plant health
and water use
from the
International
Space Station

www.nasa.gov

Applications activities are an important opportunity, especially for EV missions

National Aeronautics and Space Administration



ECOSTRESS

ECOsystem Spaceborne Thermal Radiometer Experiment on Space Station



Monitoring plant health and water use from the International Space Station

Applications activities are an important opportunity, especially for EV missions

- Cost capped
- Accelerated timeframe

ECOSTRESS

ECOsystem Spaceborne Thermal
Radiometer Experiment
on Space Station



Monitoring plant health
and water use
from the
International
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“Requirements” for Applications Activities

- ✓ Support/address a key mission element
- ✓ Science team member “buy-in”
- ✓ Grow capacity to use mission data
- ✓ Demonstrate applications relevance and benefit
- ✓ Increase awareness of mission

ECOSTRESS

ECOsystem Spaceborne Thermal
Radiometer Experiment
on Space Station



Monitoring
plant health
and water use
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Overview of ECOSTRESS applications program

Will go through the various efforts we've undertaken in the last year

- Joint projects
- Trainings / Tutorials
- Piloting a new DEVELOP Fellowship
- Outreach



Image Credit: Jose Eduardo

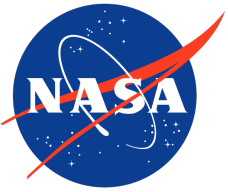
Four applications / applied sciences projects

2 x 10 week projects through NASA DEVELOP program

- Costa Rica Agriculture 1 (Summer 2016)
- Costa Rica Agriculture 2 (Fall 2016, on-going)

2 x 1 year projects through ECOSTRESS Applications
(just launched)



- Costa Rica Drought Monitoring (builds on DEVELOP projects into a M.S. thesis)
- ET model inter-comparison project, leveraging existing CA DWR-funded effort

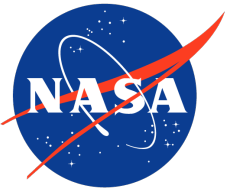


Project 1: Costa Rica Agriculture, P1. Applying Diurnal ECOSTRESS Temperature and ET to Agriculture (10 wk project)



Goal: Set the foundation for understanding the benefit of ECOSTRESS products on agricultural water management

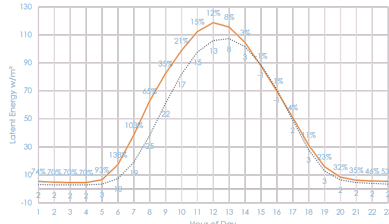
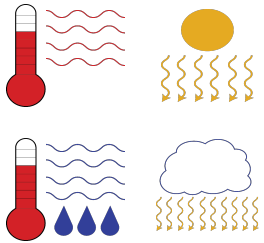
Objectives of Project	Team	Study Area
<ul style="list-style-type: none">• Model diurnal ET to advance the ECOSTRESS data product• Understand under what conditions PT-JPL MODIS 5km with potential PT-JPL ECOSTRESS product would be helpful to EARTH• Develop a proposal / study that defines how one would evaluate the benefits of ET-informed irrigation practices on water use and productivity	<ul style="list-style-type: none">• Advisors: *Josh Fisher, Christine Lee, *Glynn Hulley, Laura Jewell• DEVELOP Team: Gregory Halverson (Lead), Savannah Cooley, Steven Pestana, Mark Barker• Project Partner: Dr. Johan Perret, EARTH University, Costa Rica – researches and advances best practices in precision and sustainable agriculture, manages several thousand ha of production farms	 <p>Guanacaste region of Costa Rica crops (mango, hay, sugar cane)</p>  <p>Image Credit: Johan Perret, EARTH University</p>



Costa Rica Agriculture, P1. Applying Diurnal ECOSTRESS Temperature and ET to Agriculture (10 wk project)



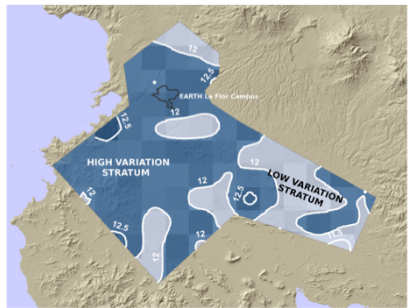
Key Accomplishments and Findings



$\rho = 0.98, R^2 = 0.97, RMSE = 6.65 \text{ W/m}^2$

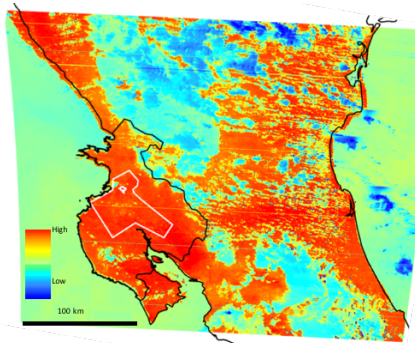
Objective 1

- Modeled diurnal variable inputs using MERRA-2
- NDVI from MODIS
- Output of diurnal PT-JPL compared with FLUXNET sites



Two Year Net Variation of ET (Δ mm/day)

High Δ	Low Δ	Total Sample (n)
74, 37, 7	26, 13, 3	100, 50, 10



Simulated ECOSTRESS LST

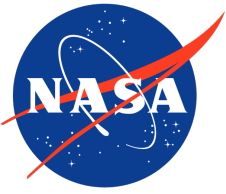
Objective 2

- 5km ET maybe useful for targeting farmer workshops
- Need higher resolution (field-scale) ET data to be relevant for ag water applications





Objective 3

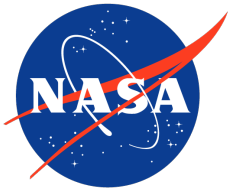
- Defined study group permutations (plot treatments and locations) and
- In situ data collection
- Ideal tower location



Project 2: Costa Rica Agriculture, P2. Analyzing Advantages of ECOSTRESS data as a Tool for Drought Detection and Water management (10 wk project – on-going)





Objectives of Project	Team	Study Area
<ul style="list-style-type: none">• Compare NDVI and ET as methods for drought detection• Compare Landsat and MODIS as platforms for producing NDVI and ET data• Compare simulated ECOSTRESS data with MODIS, Landsat ET• Develop and share tools with partners to use ECOSTRESS data to inform water-use practices	<ul style="list-style-type: none">• Advisors: *Josh Fisher, Christine Lee, *Glynn Hulley, Gregory Halverson• DEVELOP Team: David Comer (Lead), Kate Cavanaugh, Sol Kim, Ian Heming• Project Partner: Dr. Johan Perret, EARTH University, Costa Rica – researches and advances best practices in precision and sustainable agriculture, manages several thousand ha of production farms	 <p>Guanacaste region of Costa Rica crops (mango, hay, sugar cane)</p>  <p>Image Credit: Johan Perret, EARTH University</p>

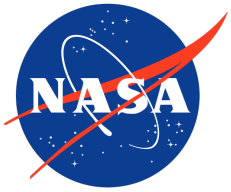


Project 3: Costa Rica Drought. Using simulated ECOSTRESS data to assess drought in Guanacaste, Costa Rica (1 year)



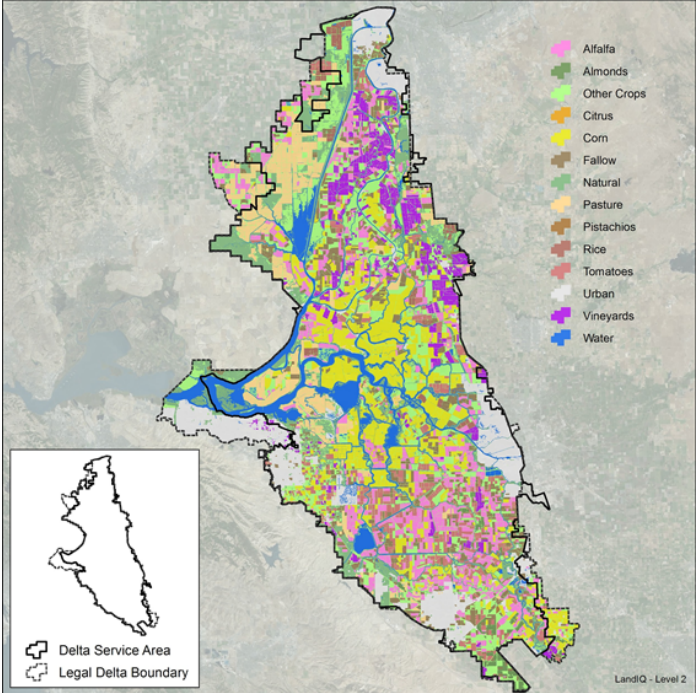
Goal: Build on DEVELOP work and use the L3 simulated ET data to conduct analysis with EARTH University

Objectives of Project	Team	Study Area
<ul style="list-style-type: none">• Magnitude of drought in Guanacaste, use NDVI, ET, SPI• Was the irrigation response effective in mitigating crop stress across the region?• How did drought impact natural (non-irrigated) ecosystems in region?	<ul style="list-style-type: none">• Advisors: Christine Lee, *Josh Fisher, Chris Williams (Clark University)• Student Lead: Savannah Cooley• Project Partner: EARTH University, Costa Rica – researches and advances best practices in precision and sustainable agriculture, manages several thousand ha of production farms	 <p>Guanacaste region of Costa Rica crops (mango, hay, sugar cane)</p>  <p>Image Credit: Johan Perret, EARTH University</p>



Project 4: Using simulated ECOSTRESS data in a model inter-comparison over the CA Bay Delta (1 year, just launched)

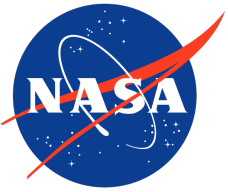
Goal: Evaluate performance of simulated ECOSTRESS data in various ET models

Objectives of Project	Team	Study Area
<ul style="list-style-type: none">Develop Jin team capacity to produce simulated ECOSTRESS data and run through ET modelsInclude and evaluate simulated ECOSTRESS data in ET models and understand performance	<ul style="list-style-type: none">PI: Yufang Jin, UC Davis (with graduate student Andy Wong)ST members included: Martha Anderson, USDA; Chris Hain, NOAA; Josh Fisher, JPL	 <p>2015 Land use in the Sacramento-San Joaquin Delta, by LandIQ.</p>
	Track progress from existing project	
	<ul style="list-style-type: none">https://californiawaterblog.com/2016/10/09/comparing-delta-consumptive-use-preliminary-results-from-a-blind-model-comparison/https://watershed.ucdavis.edu/project/delta-et	

Trainings and Tutorials

Purpose

- Grow capacity to produce and conduct analysis with simulated ECOSTRESS products
- Facilitate ability/access to process data
- Grow understanding and capability to run various ET models critical to mission success
- Discuss future collaborations and tools needed



Summary of Tutorials To-Date and Planned

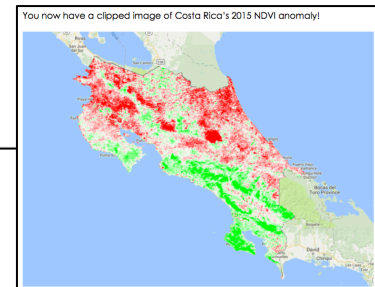
Tutorial	Team	Participants
<ul style="list-style-type: none"> Summer 2016: Tutorial to produce simulated ECOSTRESS Land Surface Temperature 	<ul style="list-style-type: none"> Led by Glynn Hulley 	<ul style="list-style-type: none"> UCDavis, USDA, NOAA, JPL
<ul style="list-style-type: none"> Summer 2016: An overview of evapotranspiration and agricultural applications 	<ul style="list-style-type: none"> Led by DEVELOP team 	<ul style="list-style-type: none"> EARTH University, JPL
<ul style="list-style-type: none"> Fall 2016: Using Google Earth Engine to process and produce NDVI/ET maps 	<ul style="list-style-type: none"> Led by Sol Kim and DEVELOP team 	<ul style="list-style-type: none"> EARTH University
<ul style="list-style-type: none"> Planned Winter 2016: Tutorial to use and produce ET products from open source ALEXI 	<ul style="list-style-type: none"> Led by Chris Hain 	<ul style="list-style-type: none"> NASA HQ, NOAA, USDA, Princeton, JPL, UCDavis, Clark, others

GOOGLE EARTH ENGINE (GEE) TUTORIAL
 NASA DEVELOP NATIONAL PROGRAM –
 JET PROPULSION LABORATORY FALL 2016
 COSTA RICA AGRICULTURE II
 EARTH UNIVERSITY

This tutorial requires **NO** coding experience or familiarity with GEE. You **MUST** have an approved account to use GEE: <https://earthengine.google.com/signup>. This tutorial will serve to act as a showcase of some capabilities that are possible with GEE. It is **NOT** meant to cover every detail of coding in GEE. We will cover a few basics of GEE using javascript:

1. Overview
2. Datasets
3. Graphical User Interface (GUI)
4. Importing Datasets
5. Raster math
6. Importing Shapefiles

OVERVIEW



Credit: Sol Kim

Hosting / Piloting a New DEVELOP Fellow Position (1 year term)

Purpose

- Provide a unique experience for Fellow to gain exposure to and be part of a mission team and support mission applications
- Welcome Sol!

Role

- Facilitate access to and help streamline process for producing and visualizing simulated ECOSTRESS data
- Support / lead proposal concept development with US Drought Monitor, USDA, NOAA
- Develop workshop and tutorial proposals and materials
- Support ECOSTRESS DEVELOP projects



Outreach

- Help interface with various communities on ECOSTRESS
- Utilize the tools available! (work with public affairs / comms offices)



The screenshot shows the NASA Jet Propulsion Laboratory website. The header includes the NASA logo and the text "Jet Propulsion Laboratory California Institute of Technology". Below the header is the ECOSTRESS logo, which features a stylized green and brown leaf next to the word "ECOSTRESS". The main content area is titled "NASA DEVELOP Project - Costa Rica Agriculture Summer 2016". It includes a navigation menu on the left, a central video player showing a man speaking, and a sidebar with "Upcoming Events" listing a workshop and a meeting.



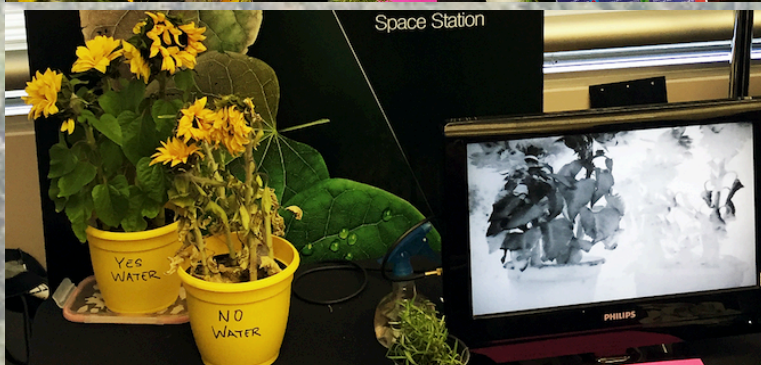
ECOSTRESS:

A technology that will help us understand how plants react to our changing planet

Olivia Mansion

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NASA Jet Propulsion Laboratory Open House June 4-5, 2016



Over 20,000 visitors to Explore JPL

We set up a plant demo (water stressed/not water stressed) and used a thermal camera to look at temperature difference.

Public excited to learn about an ISS-based mission and asked questions about how ECOSTRESS data could help support agriculture and drought issues.

Summary – final thoughts and going forward

- Active year of starting applications projects, partnership development, tutorials, and outreach
- Continue to develop concepts for future projects, keeping in mind our “requirements” and boundary conditions
- Continue to keep an eye out for new opportunities and existing efforts that can be leveraged

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Thank you. Questions?