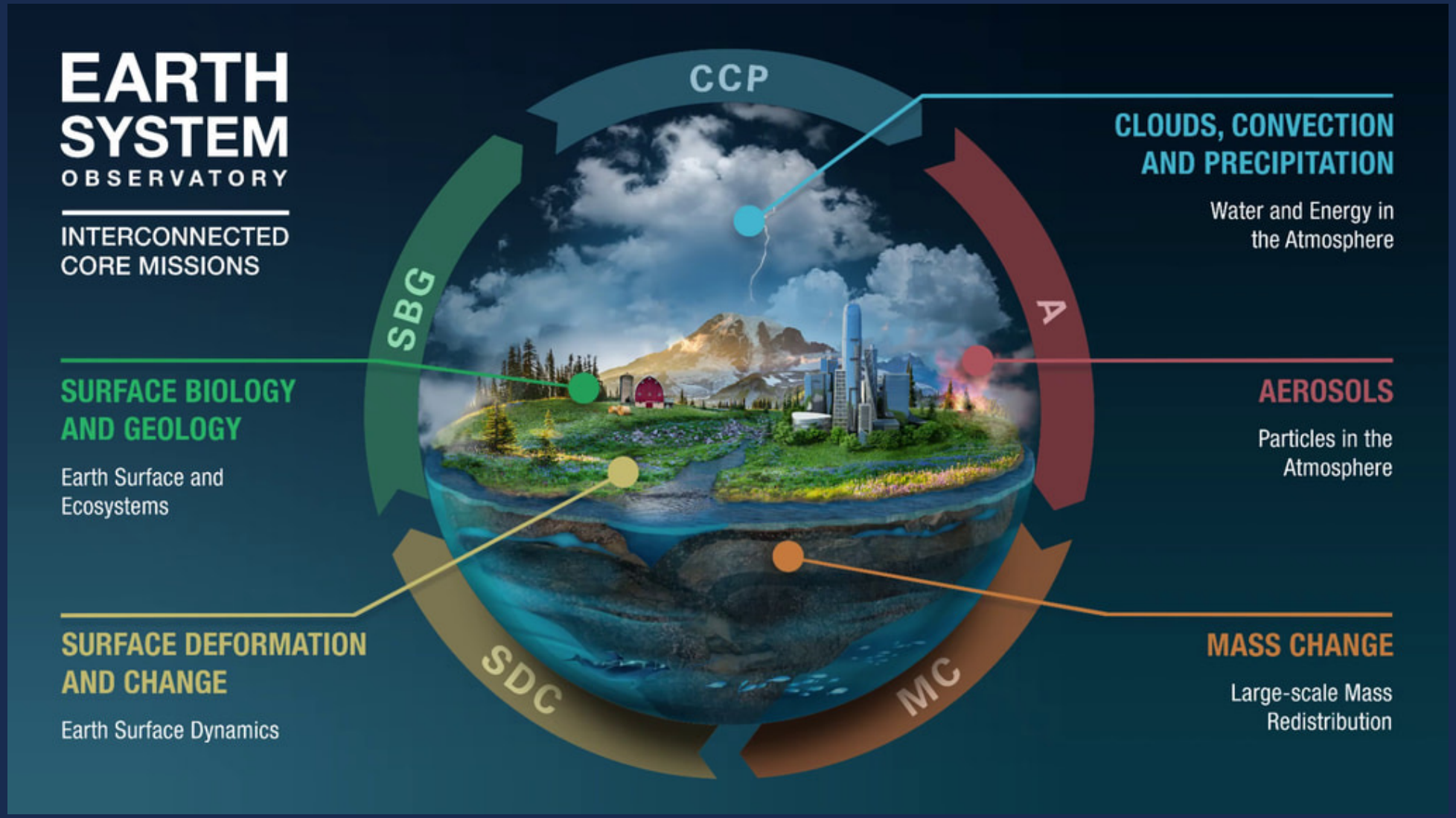
Surface Biology and Geology, ECOSTRESS, and EMIT

3DEC Meeting, 2024
Presented by: K. Dana Chadwick
dana.chadwick@jpl.nasa.gov

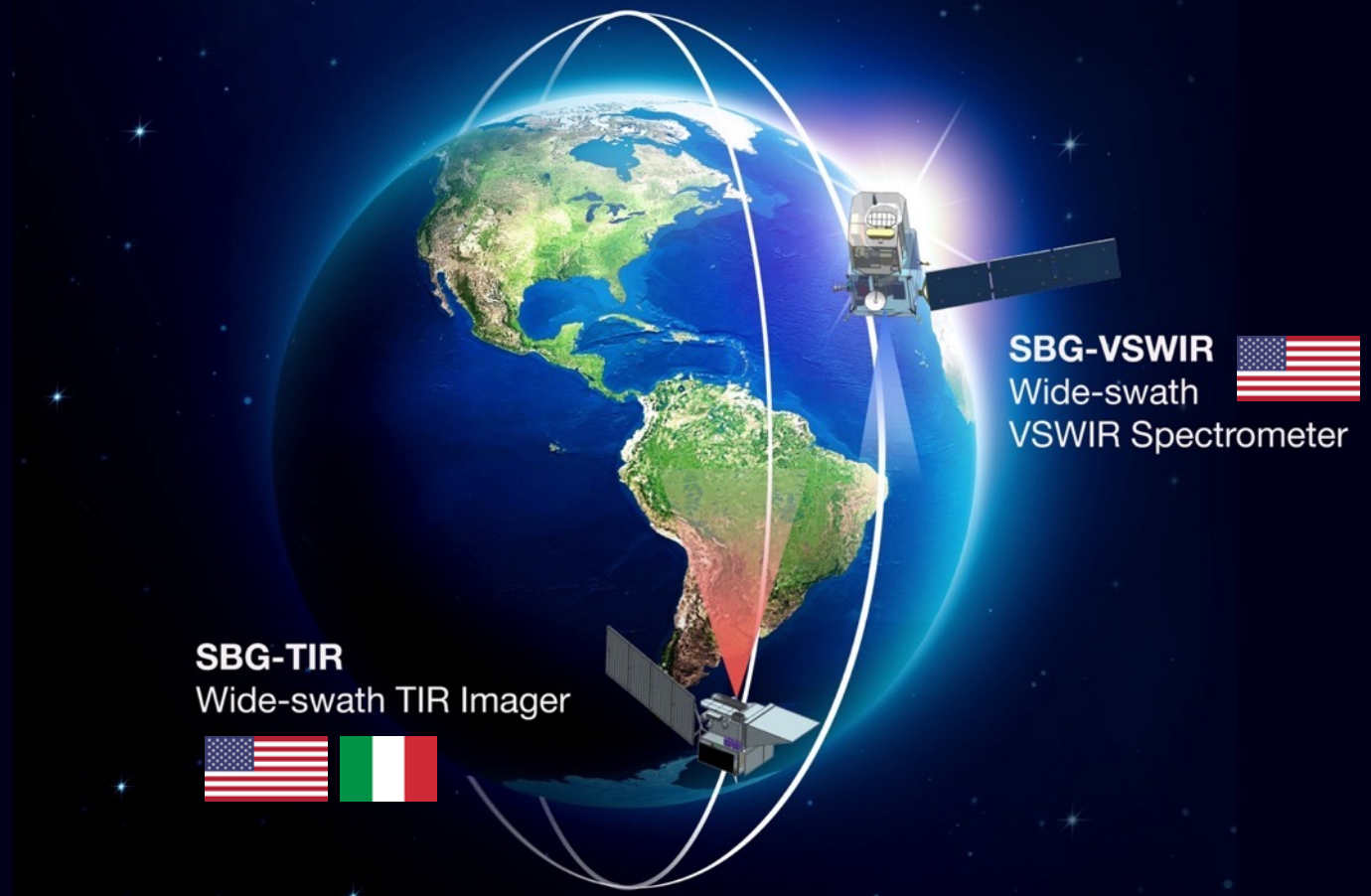
Jet Propulsion Laboratory
California Institute of Technology

What is the Surface Biology and Geology Mission?



What is the Surface Biology and Geology Mission?

SBG-TIR - US Instrument, Italian sensor, spacecraft, launch and science
SBG-VSWIR - US Flight Project



VSWIR
185 km swath
10 nm spectral sampling
30 m GSD
16 day revisit

TIR
935 km swath
8 MIR and TIR channels
60 m GSD
3 day revisit

TIR-VNIR (Italy)
Boresited with TIR
30-60 m GSD
2-3 channels

SBG will meet Decadal Survey priority objectives to enable transformative science & applications

Subhead

E-1. **What are the structure, function, and biodiversity of Earth's ecosystems? (7 observables)**

Conservation and Biodiversity

E-2. **What are the fluxes between ecosystems and the atmosphere, the ocean, and the solid Earth, and how and why are they changing? (1 observable)**

Conservation and Biodiversity

E-3. **What are the fluxes (of carbon, water, nutrients, and energy) within ecosystems? (2 observables)**

Coral Reef Ecosystems

S-1. **How can large-scale geological hazards be accurately forecast? (5 observables)**

S-2. **How do geological disasters directly impact the earth system? (3 observables)**

Strategic Mineral Resource Mapping

H-1. **How is the water cycle changing? (3 observables)***

Global Food Security

H-2. **How do anthropogenic changes in climate, land use, water use, and water storage, interact and modify the water and energy cycles? (4 observables)**

Agriculture and Water Resources

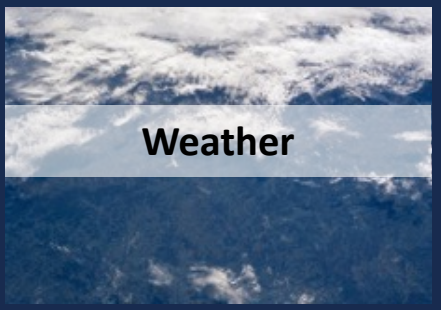
H-4. **How does the water cycle interact with other Earth system processes to change the predictability and impacts of hazardous events and hazard chains (1 observable)**

Algal Bloom and Water Quality Mapping

C-3. **How large are the variations in the global carbon cycle? (1 observable)**

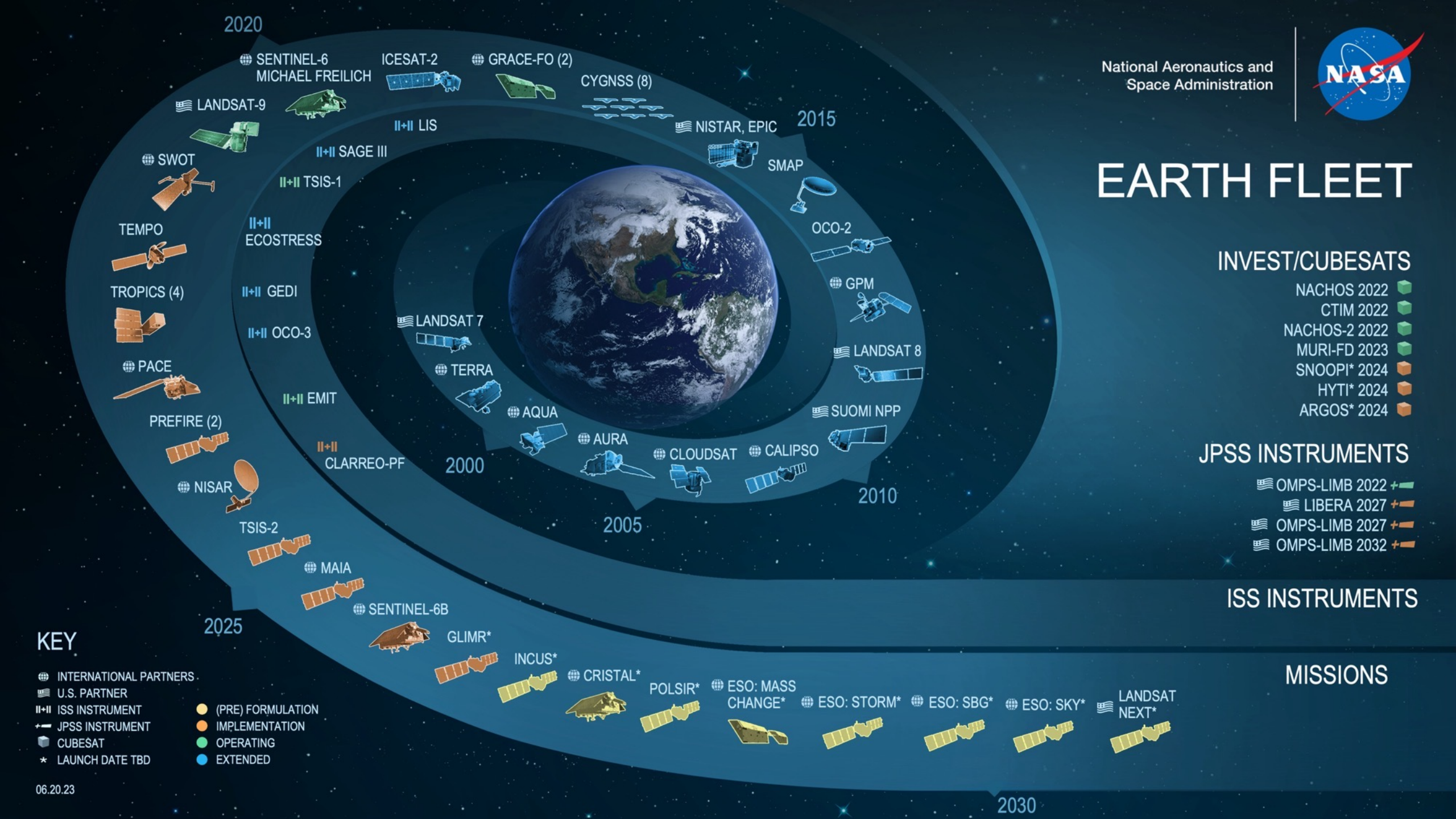
Urban Heat and Health

Fire Ecology and Risk



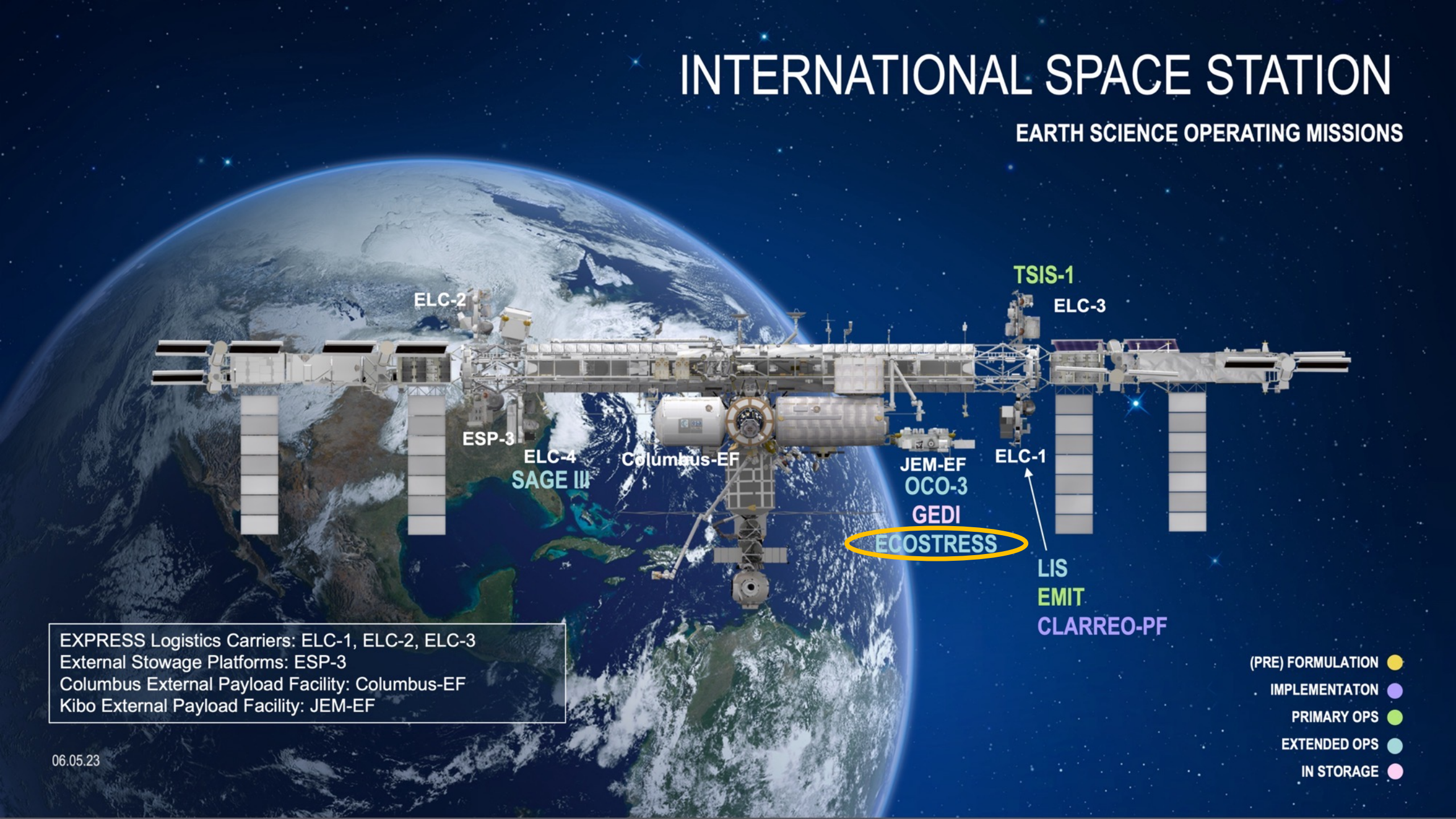
W-3. **How do spatial variations in surface characteristics modify transfer between domains? (1 observable)**

Fire Ecology and Risk


National Aeronautics and Space Administration
NASA
EARTH FLEET
2020
SENTINEL-6 MICHAEL FREILICH
ICESAT-2
GRACE-FO (2)
CYGNSS (8)
LANDSAT-9
LIS
NISTAR, EPIC
2015
SAGE III
SWOT
SMAP
TSIS-1
TEMPO
ECOSTRESS
OCO-2
GPM
TROPICS (4)
GEDI
LANDSAT 7
OCO-3
LANDSAT 8
TERRA
PACE
EMIT
SUOMI NPP
AQUA
PREFIRE (2)
AURA
CLOUDSAT
CALIPSO
CLARREO-PF
2000
2010
NISAR
2005
TSIS-2
MAIA
SENTINEL-6B
2025
GLIMR*
INCUS*
CRISTAL*
POLSIR*
ESO: MASS CHANGE*
ESO: STORM*
ESO: SBG*
ESO: SKY*
LANDSAT NEXT*
2030
INVEST/CUBESATS
NACHOS 2022
CTIM 2022
NACHOS-2 2022
MURI-FD 2023
SNOOPI* 2024
HYTI* 2024
ARGOS* 2024
JPSS INSTRUMENTS
OMPS-LIMB 2022
LIBERA 2027
OMPS-LIMB 2027
OMPS-LIMB 2032
ISS INSTRUMENTS
MISSIONS
KEY
INTERNATIONAL PARTNERS
U.S. PARTNER
ISS INSTRUMENT
JPSS INSTRUMENT
CUBESAT
LAUNCH DATE TBD
(PRE) FORMULATION
IMPLEMENTATION
OPERATING
EXTENDED
06.20.23

INTERNATIONAL SPACE STATION

EARTH SCIENCE OPERATING MISSIONS



EXPRESS Logistics Carriers: ELC-1, ELC-2, ELC-3
External Stowage Platforms: ESP-3
Columbus External Payload Facility: Columbus-EF
Kibo External Payload Facility: JEM-EF

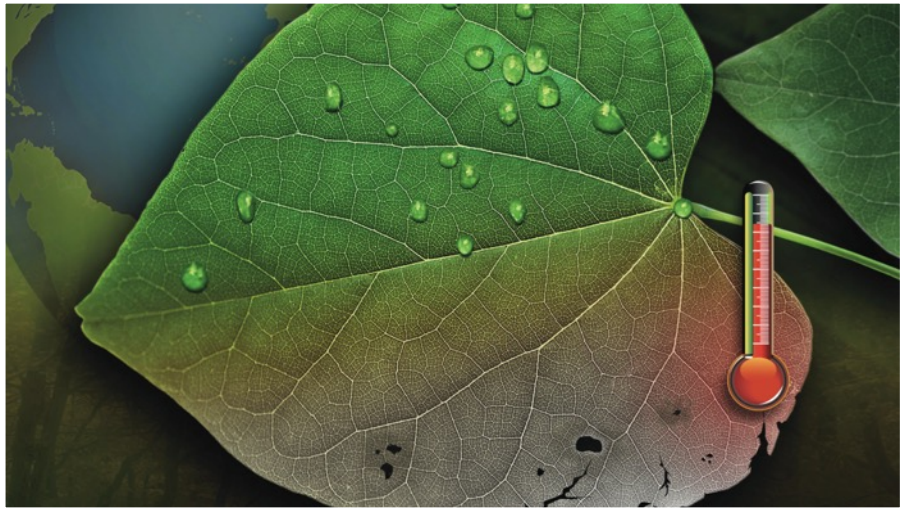
06.05.23

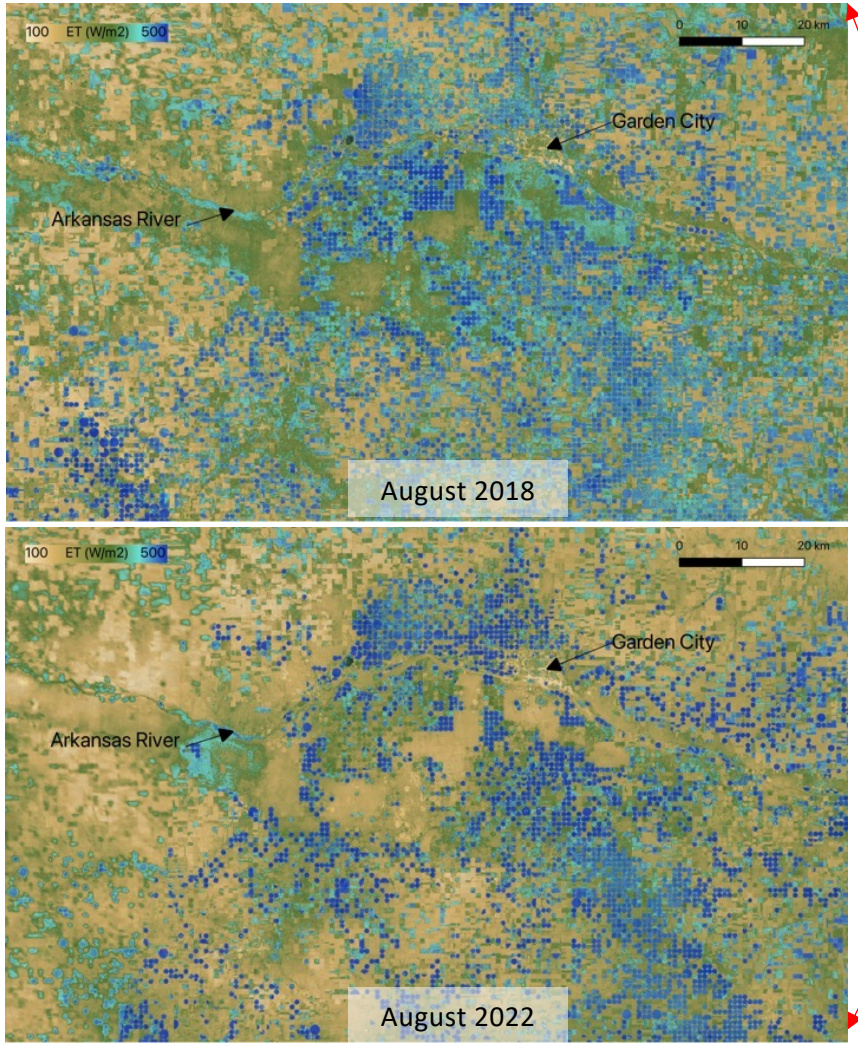
(PRE) FORMULATION
IMPLEMENTATON
PRIMARY OPS
EXTENDED OPS
IN STORAGE

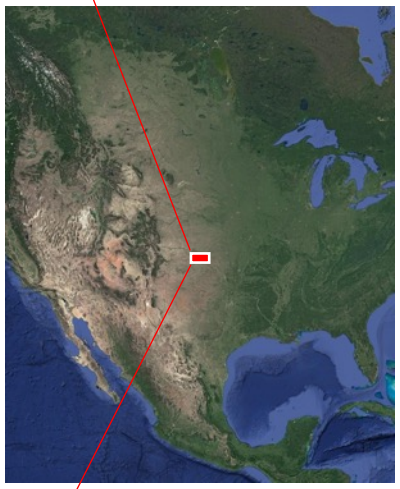
ECOsystem Spaceborne Thermal Radiometer Experiment on Space Station

ECOSTRESS is addressing 3 science questions:

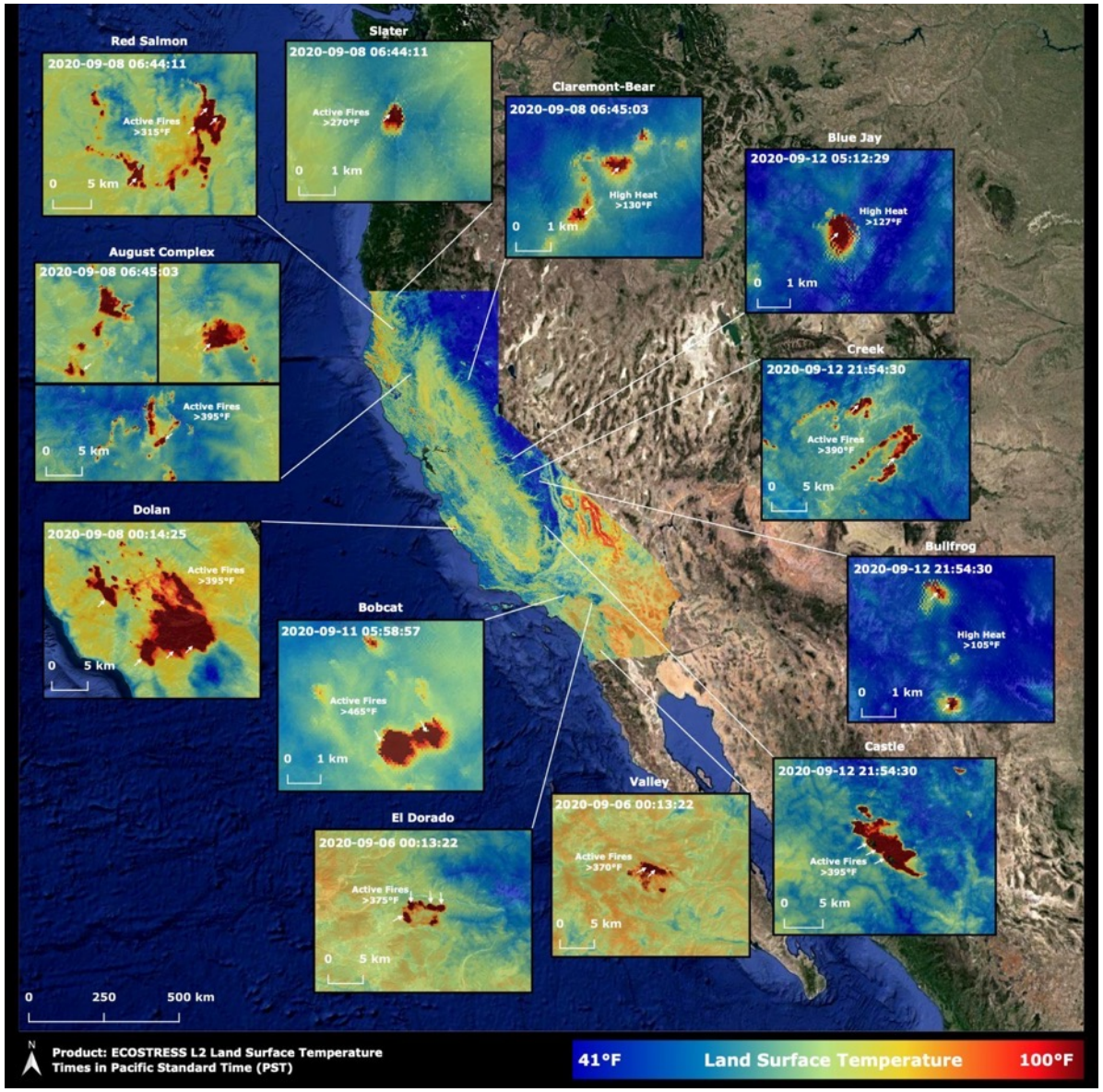
1. How is the biosphere responding to changes in water availability?
2. How do changes in vegetation water stress impact the global carbon cycle?
3. Can agricultural vulnerability be reduced through advanced monitoring of agricultural water consumptive use and improved drought estimation?

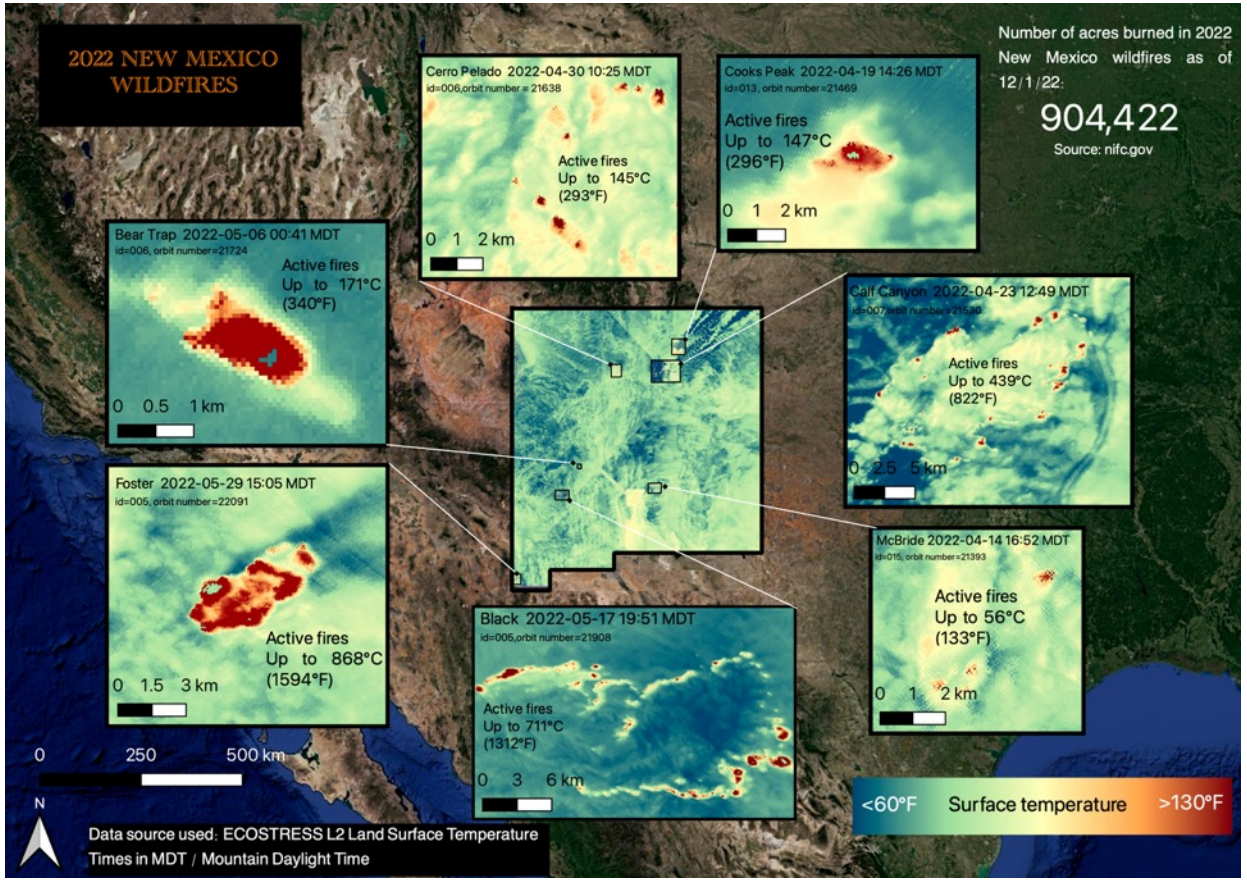




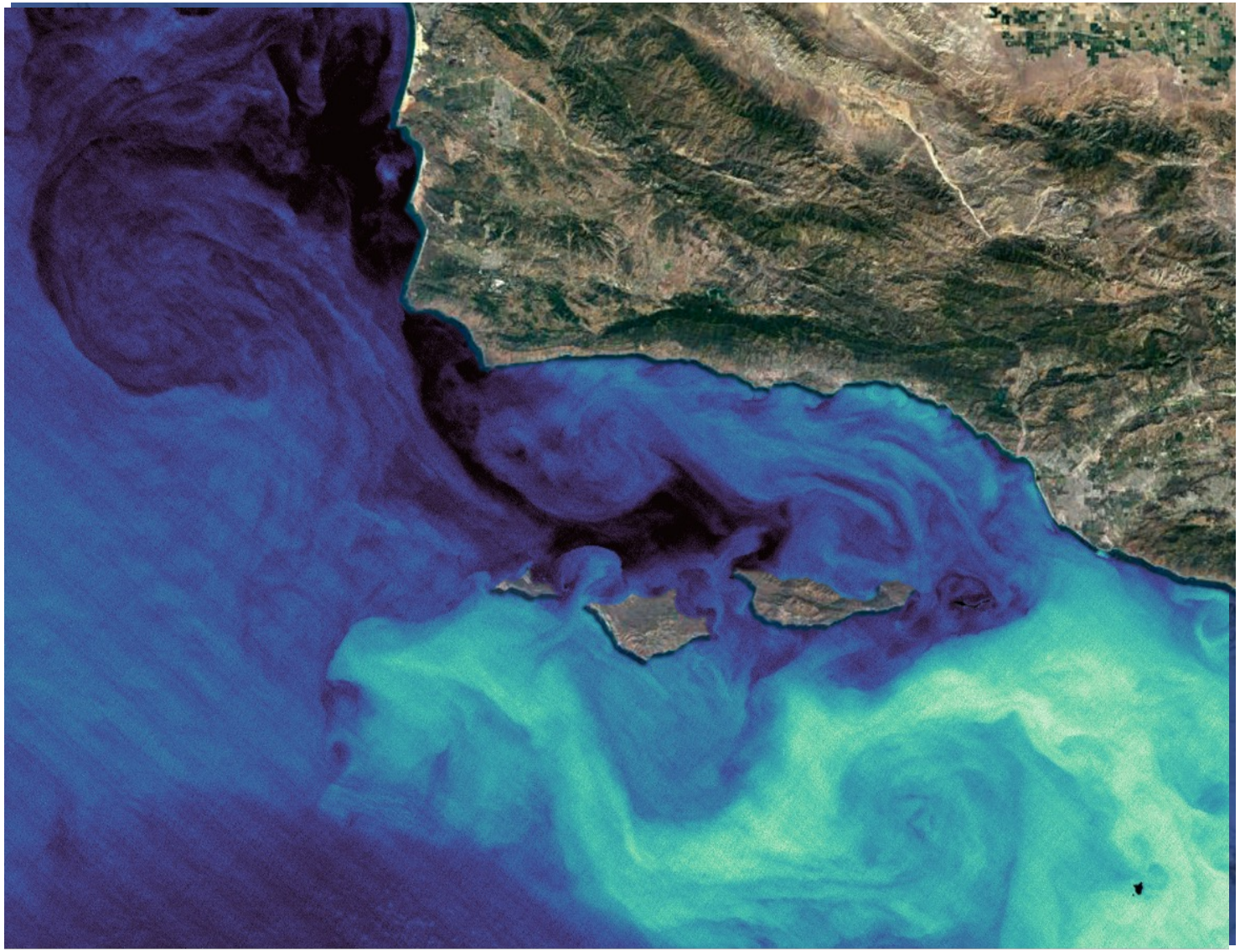


ECOSTRESS: Active Fire Monitoring





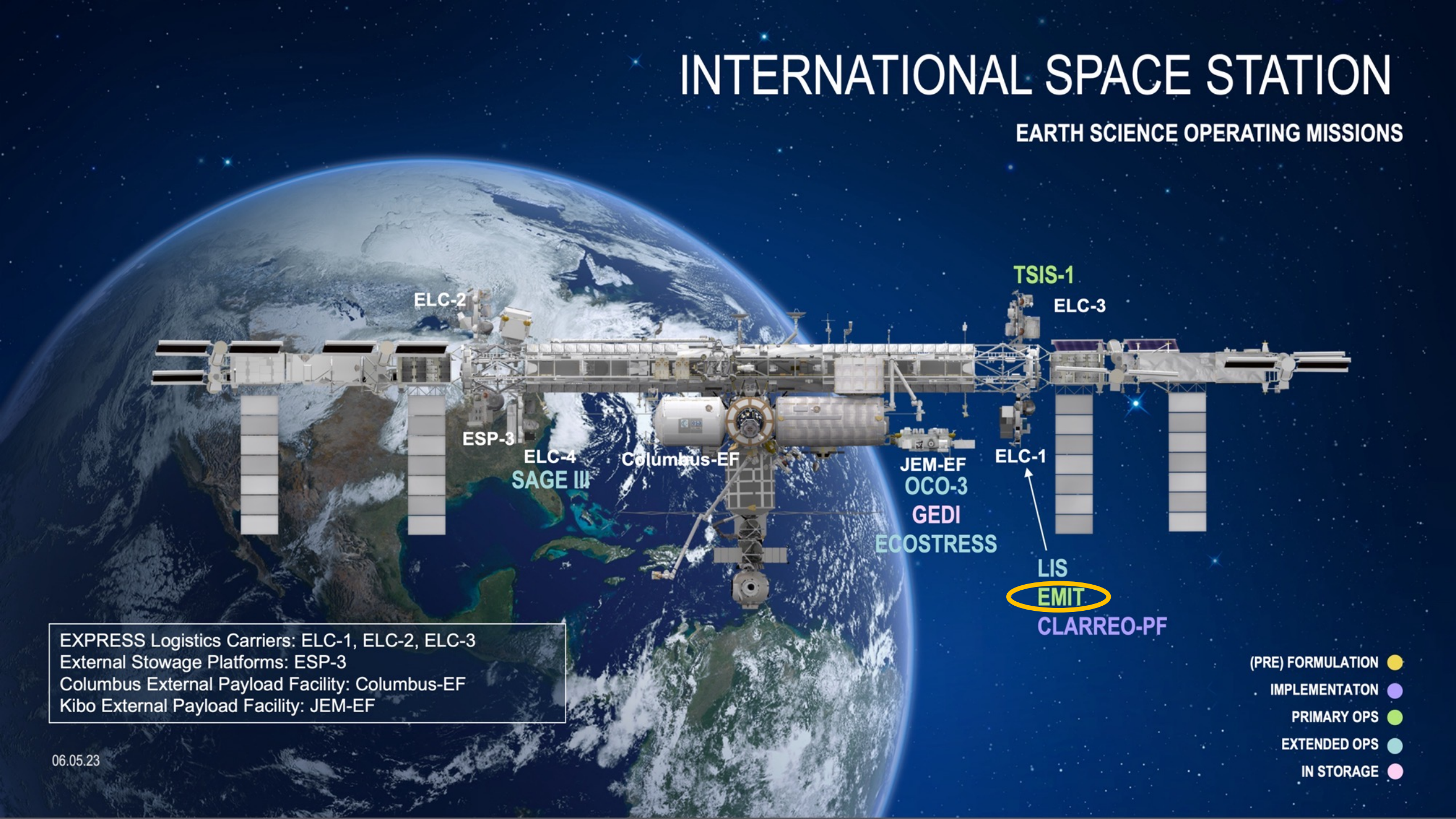
ECOSTRESS: Surface Water Temperature



ECOSTRESS Surface Temperature
September 8, 2022
Credit: C. Lee

INTERNATIONAL SPACE STATION

EARTH SCIENCE OPERATING MISSIONS



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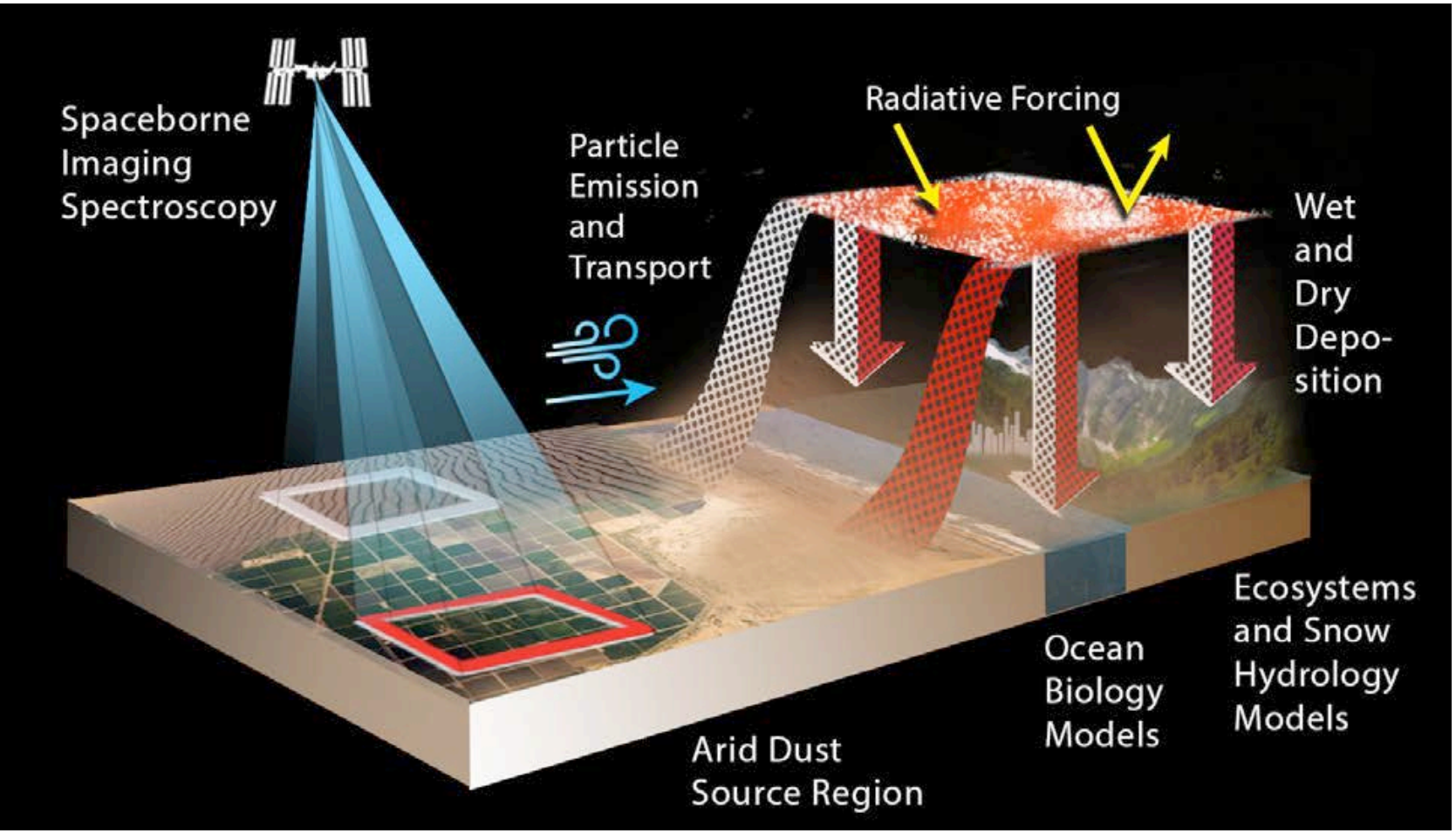
06.05.23

- (PRE) FORMULATION
- IMPLEMENTATON
- PRIMARY OPS
- EXTENDED OPS
- IN STORAGE

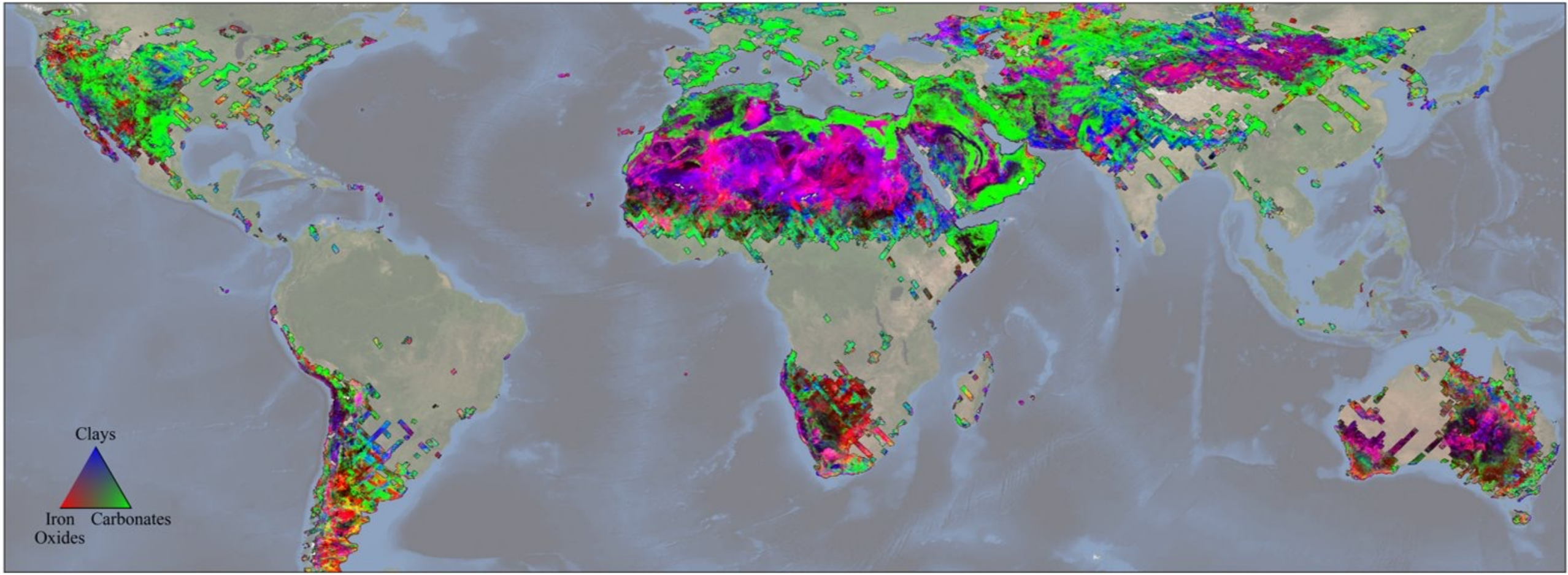
Integrating Imaging Spectroscopy and Earth System Modeling



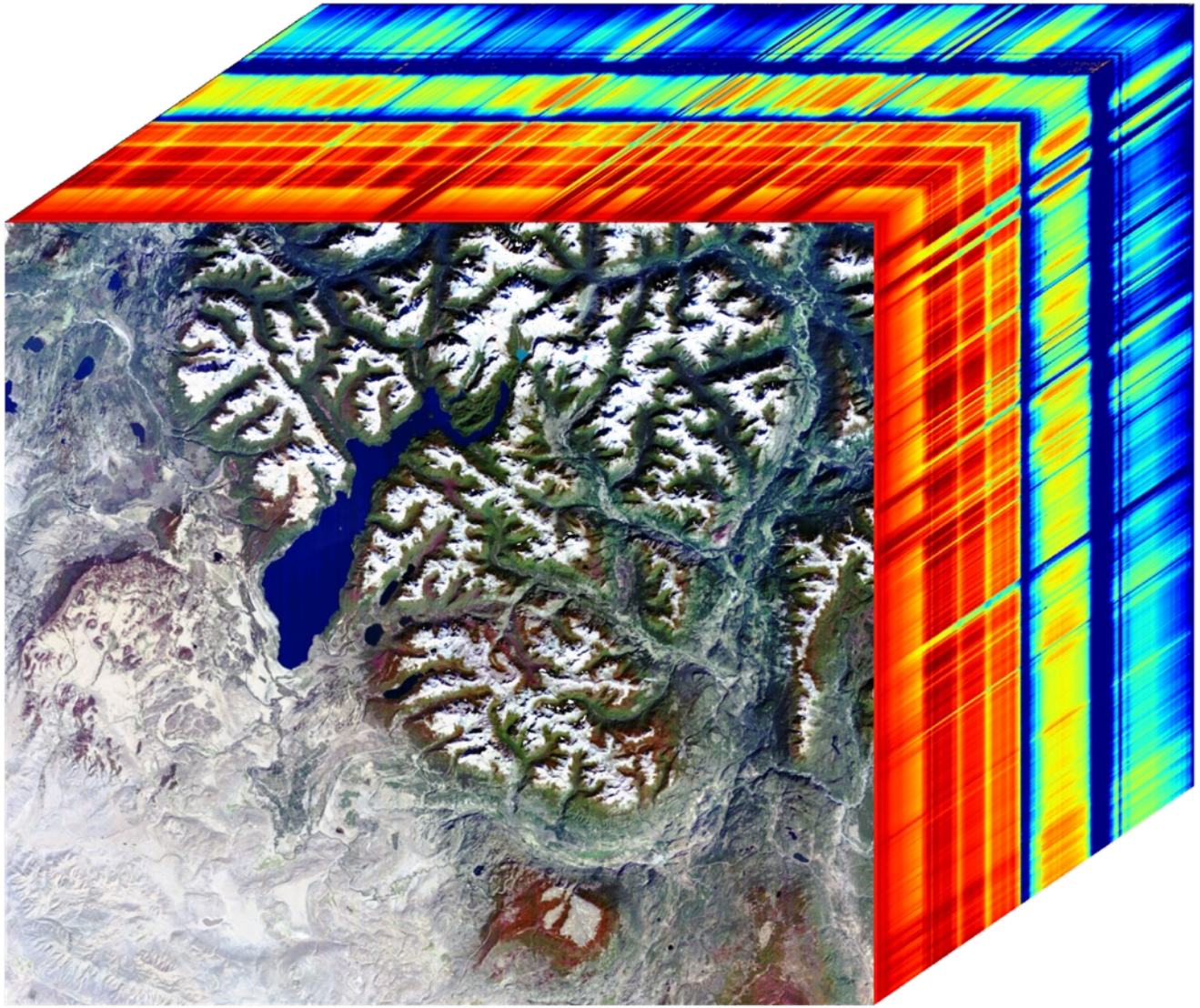
1) Constrain the sign and magnitude of dust-related radiative forcing at regional and global scales by ***acquiring, validating and delivering updates of surface mineralogy*** used to initialize Earth System Models.

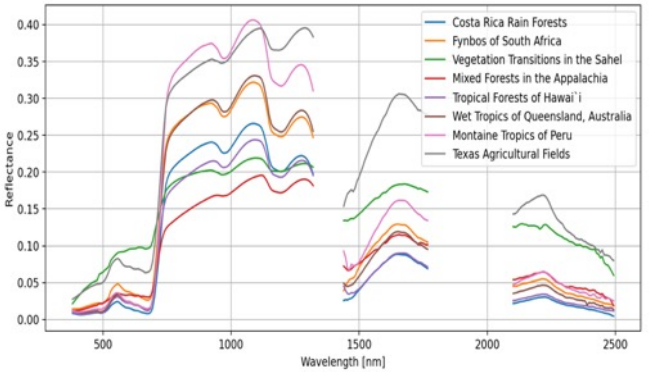
2) Predict the increase or decrease of available dust sources under future climate scenarios by ***initializing Earth System Model forecast models with the mineralogy*** of soils exposed within at-risk lands bordering arid dust source regions.

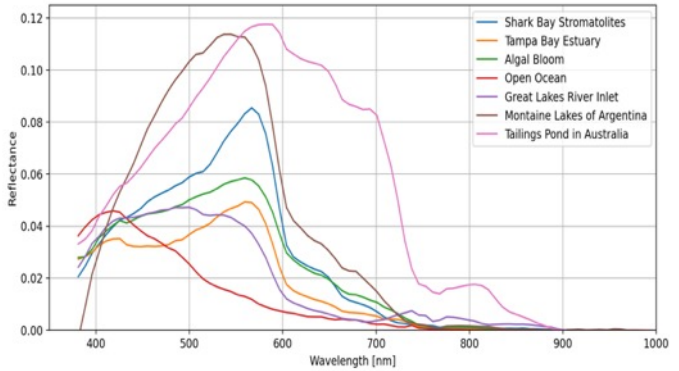
EMIT: Global Mineral Mapping

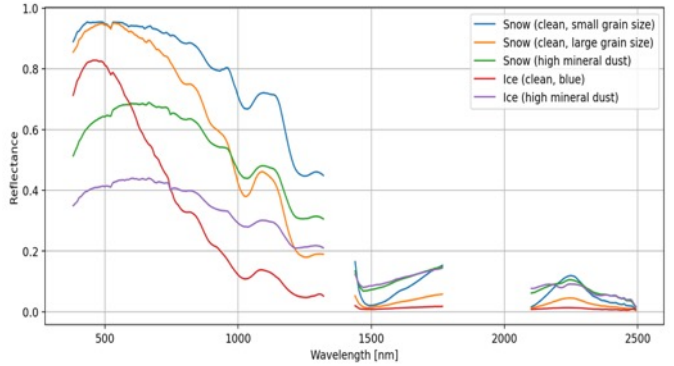


EMIT: Collecting Spectra Across the Planet

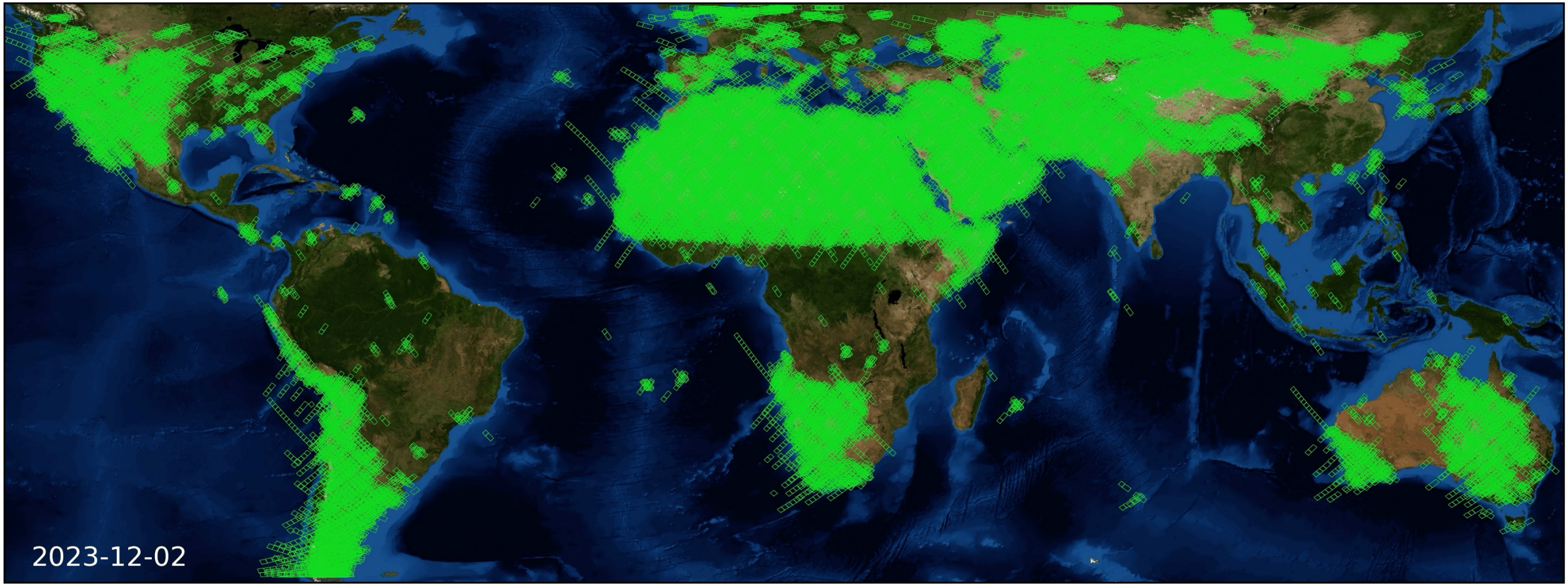








EMIT: Extent of data collection is growing



Example VSWIR + TIR Science and Applications

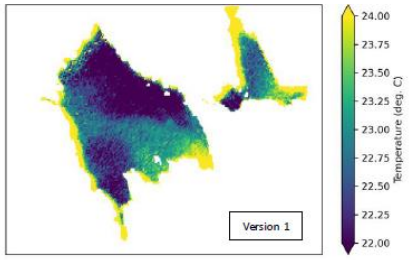
Aquatic Ecosystems – Harmful Algal Blooms

SBG VSWIR + TIR are critical to understanding environmental controls (e.g., marine heat waves) on harmful algal blooms for public health management

San Luis Reservoir, California Example – August 14, 2022

EMIT - Chlorophyll

ECOSTRESS - Water Surface Temperature



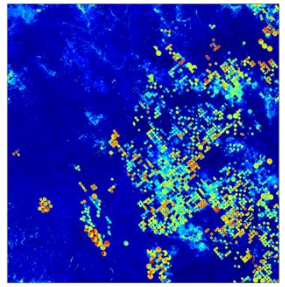
Credit: K. Luis

Terrestrial Ecosystems - Agriculture

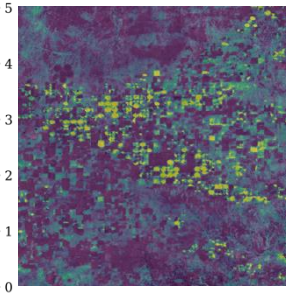
SBG VSWIR + TIR will provide critical information on vegetation water stress and water availability to guide agricultural water consumptive use and improve drought estimation

Texas Example – August 2022

EMIT Equivalent Water Thickness

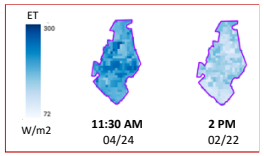


ECOSTRESS Evapotranspiration



Credit: N. Bohn

Santa Barbara – Spring 2022



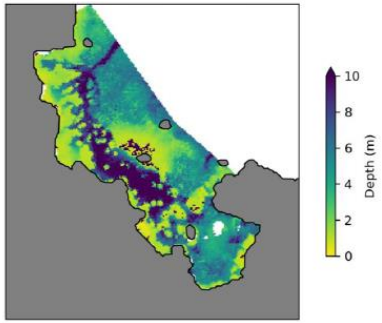
Credit: C. Wong

Aquatic Ecosystems – Coral

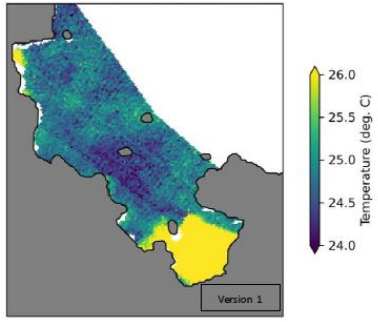
SBG VSWIR + TIR are critical to understanding the composition and condition of benthic habitats

Kāne'ohe Bay, Hawai'i Example – March 25, 2023

EMIT - Depth



ECOSTRESS - Water Surface Temperature c

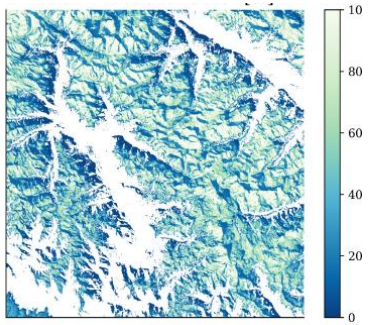


Credit: K. Luis

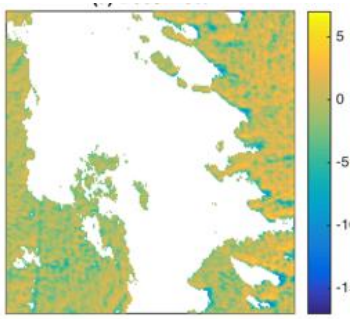
Hydrology & Water Resources – Snow

SBG VSWIR + TIR are critical to understanding and quantifying snowmelt and ice worldwide driven by topographic variability.

EMIT- Snow Fractional Cover %

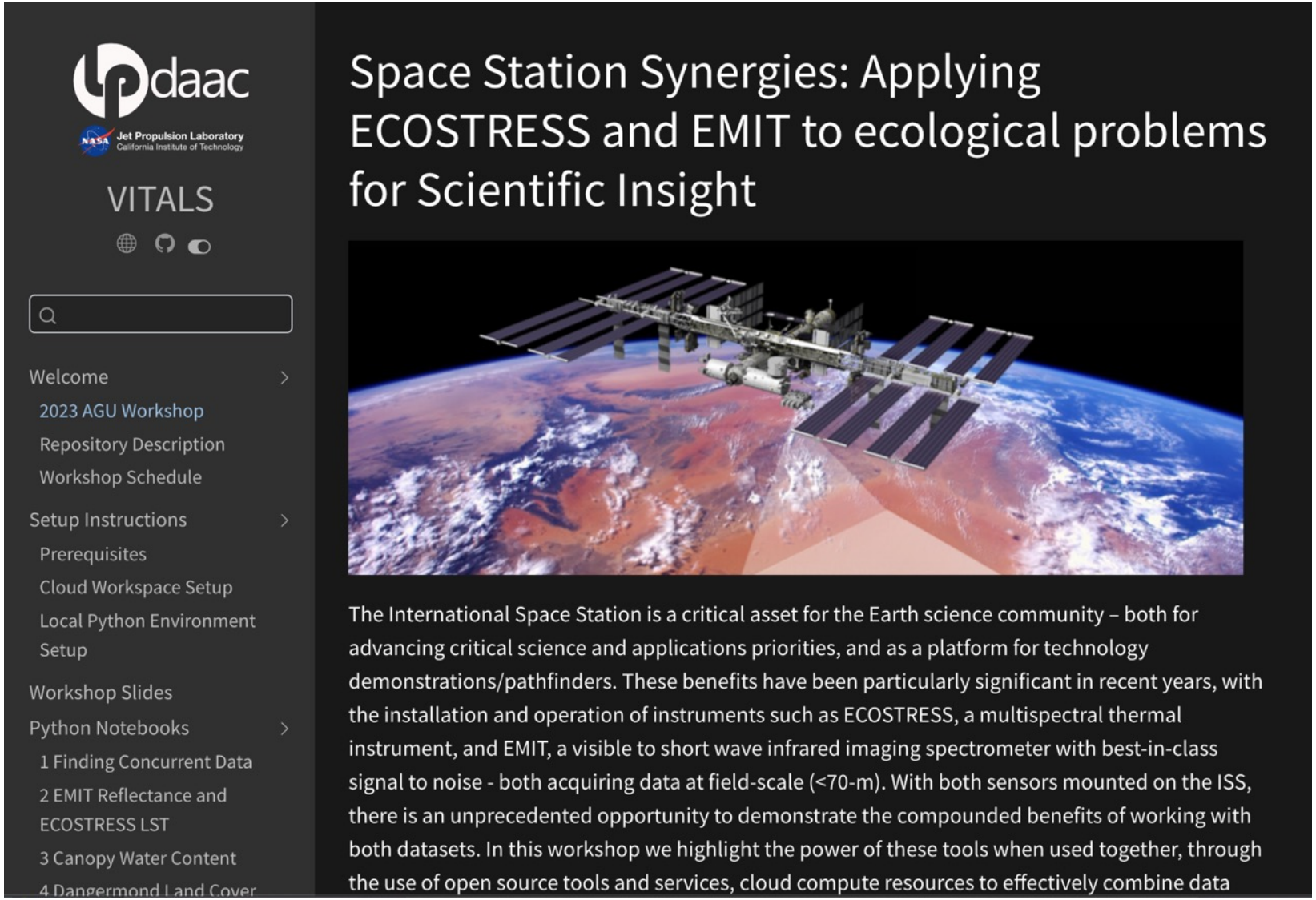


ECOSTRESS - Snow Surface Temperature



Credit: Painter

VITALS – Finding coincident data



Check out VITALS! The **V**SWIR **I**maging and **T**hermal **A**pplications, **L**earning, and **S**cience Repository on github.

daac

Jet Propulsion Laboratory
California Institute of Technology

Join the SBG, EMIT, and ECOSTRESS Communities!

Join us at the SBG Technical Interchange Meeting,
May 29-31 at NASA HQ and online everywhere!

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