

ECOSTRESS Science and Applications Team Meeting, 2023

# EMIT mission introduction, applications

Presented by:

K. Dana Chadwick; Scientist, Water & Ecosystems Group; EMIT Mission Applications Lead

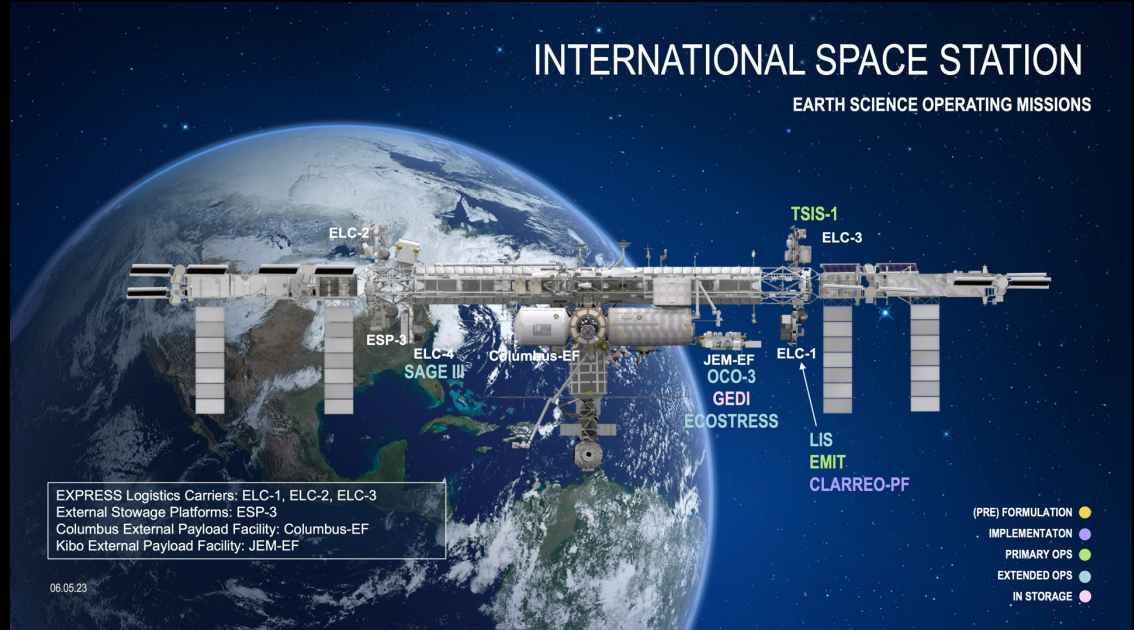
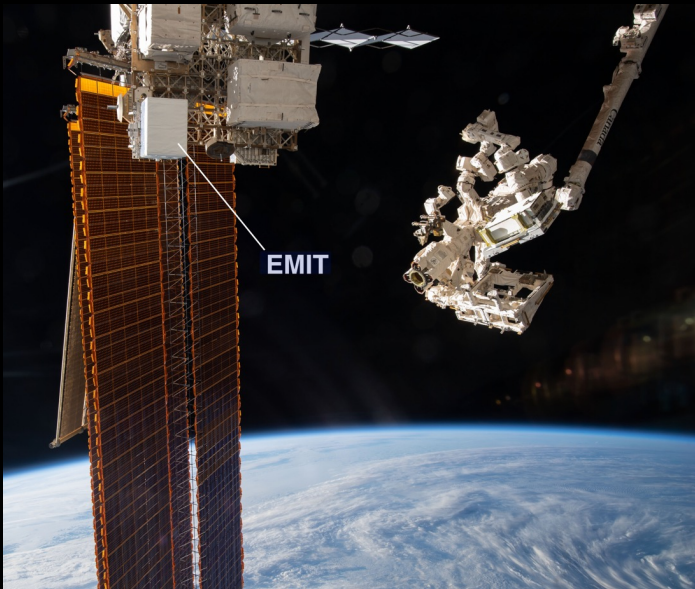
This document has been reviewed and determined not to contain export controlled technical data.

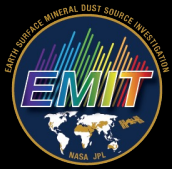


**Jet Propulsion Laboratory**  
California Institute of Technology



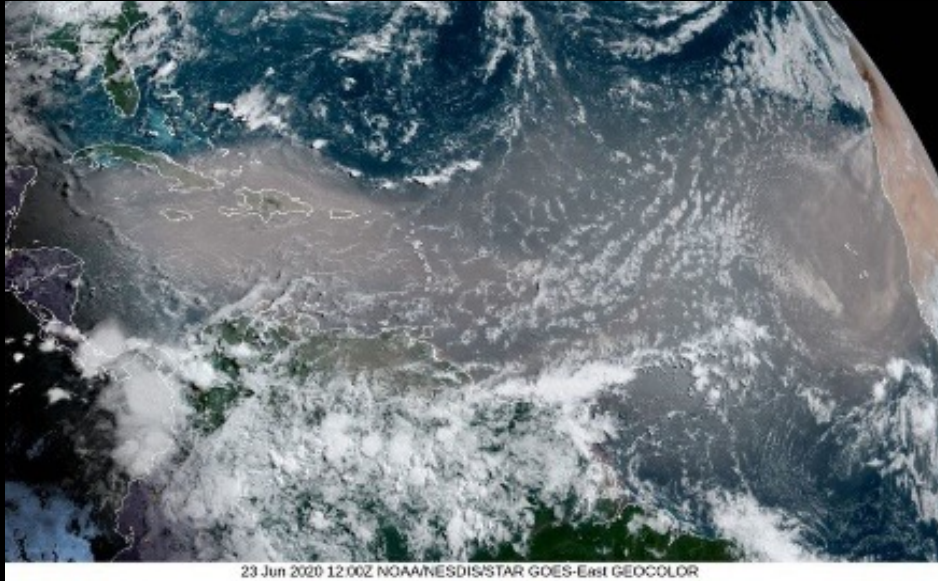
# Earth surface Mineral dust source InvesTigation





# EMIT Science Objectives

What is the current and future role of mineral dust in atmospheric forcing?

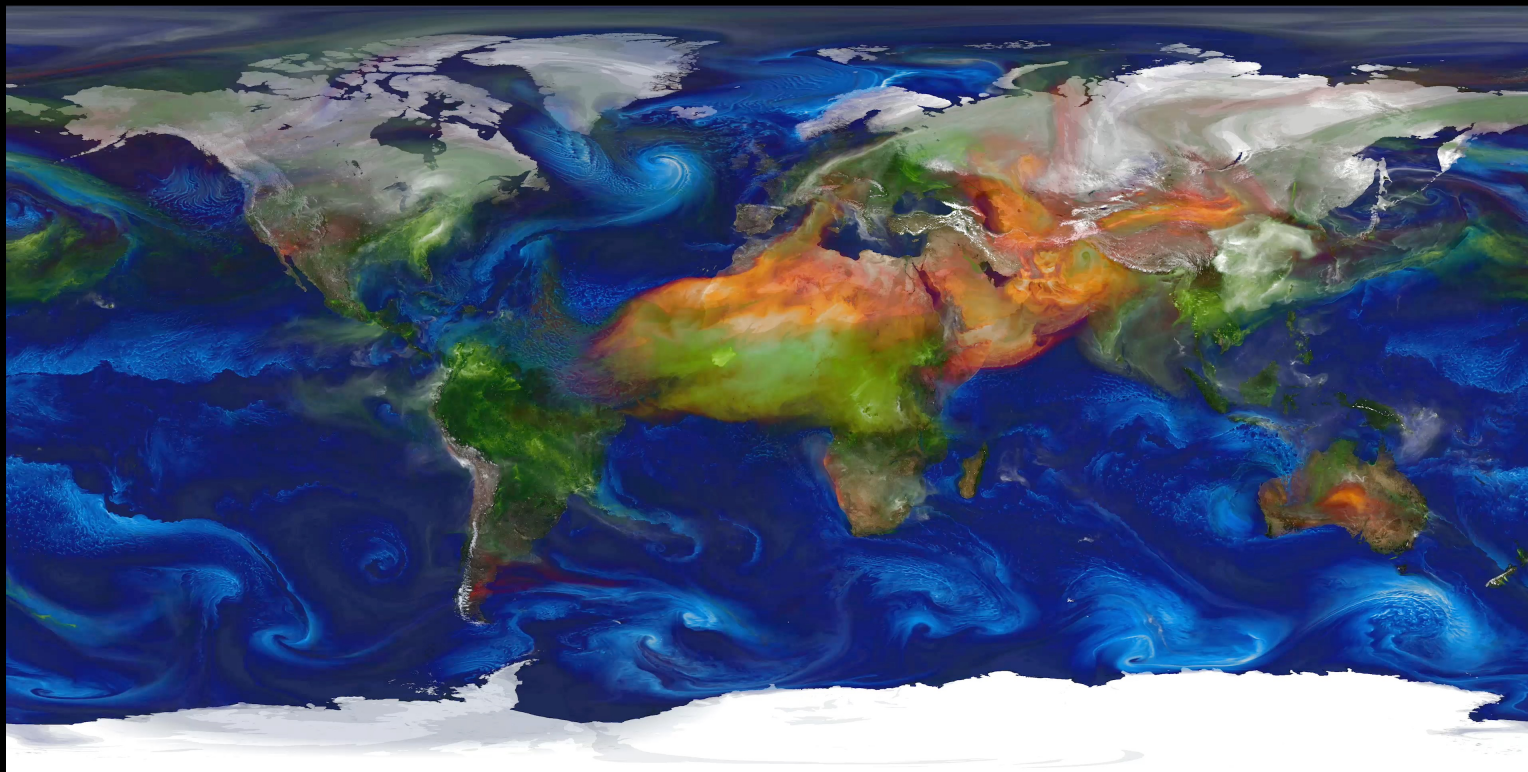
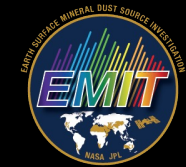


**23 June 2020 African Dust Storm reached the U.S.**



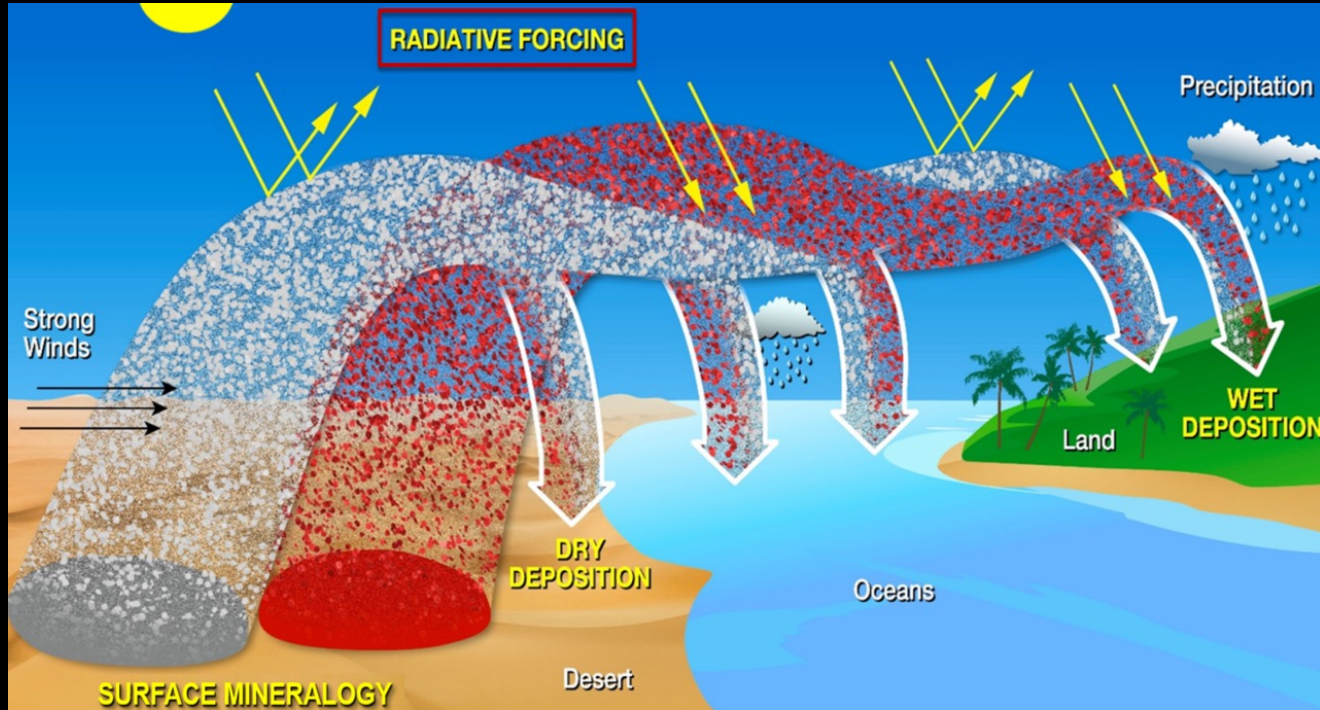
**26 Oct 2007 African Dust Storm seen by MODIS**

# EMIT Science Objectives



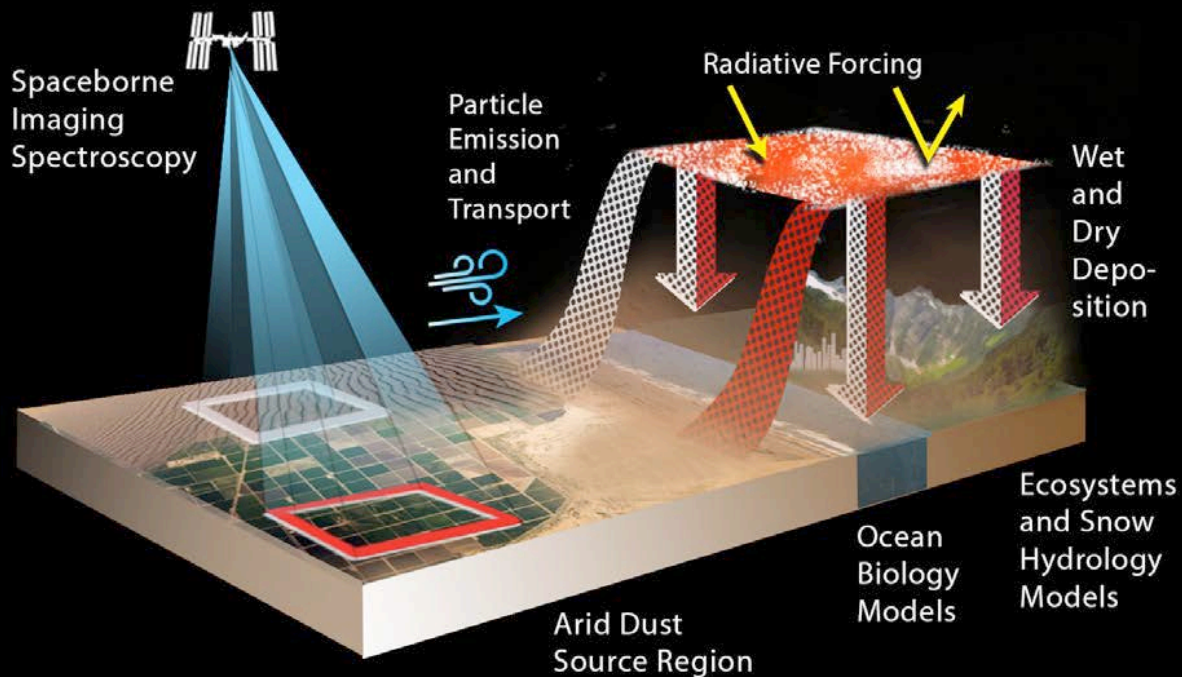
# EMIT Science Objectives

## The role of the mineral dust cycle in radiative forcing



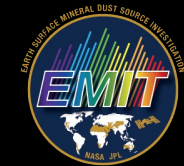
# EMIT Science Objectives & Approach

## 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.

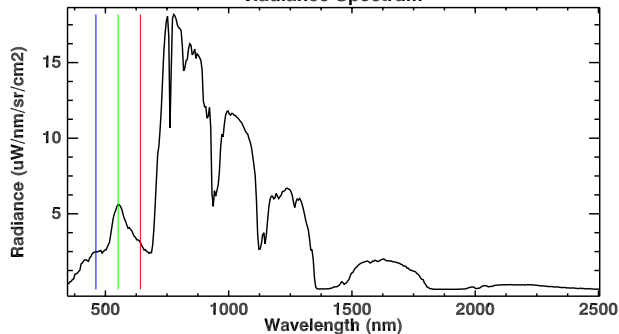
2) Predict the increase or decrease of available dust sources under future climate scenarios objective by **initializing Earth System Model forecast models with the mineralogy** of soils exposed within at-risk lands bordering arid dust source regions.



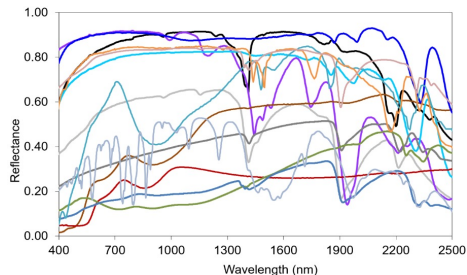
# Visible to shortwave infrared imaging spectroscopy

## Opportunities for Understanding Earth's Surface

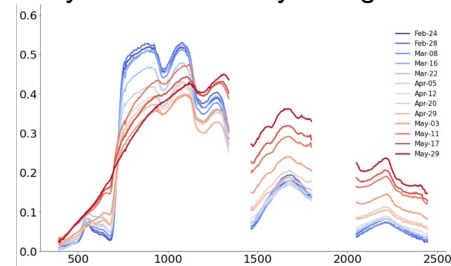
Radiance Spectrum



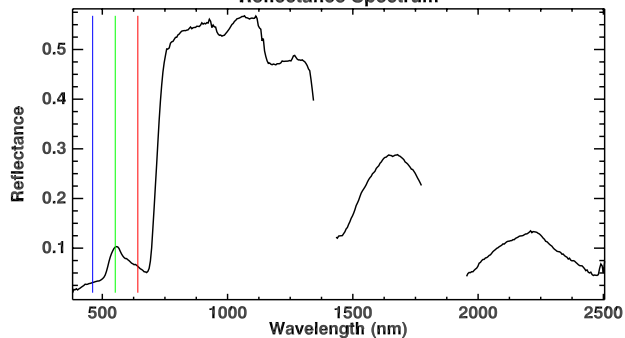
Geology: Mineral Spectral Signatures



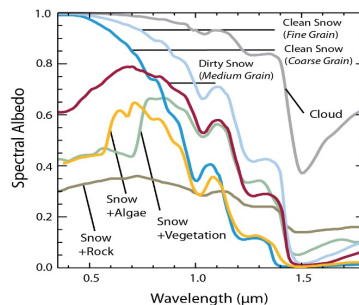
Ecosystems: Diversity of Signatures



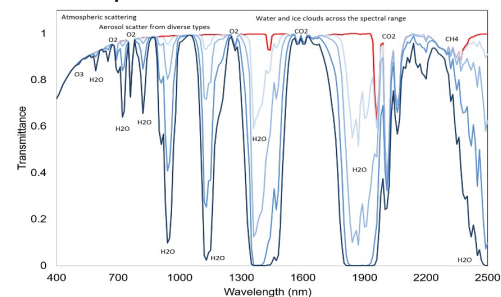
Reflectance Spectrum



Snow/ice: Grain size, Dust, Albedo, Melt



Atmosphere: Gases, Aerosols, Clouds



# EMIT Science Approach

## Imaging spectroscopy to map dust source regions

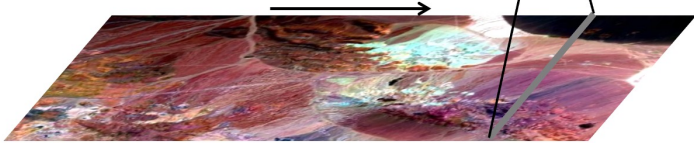


Detector Array

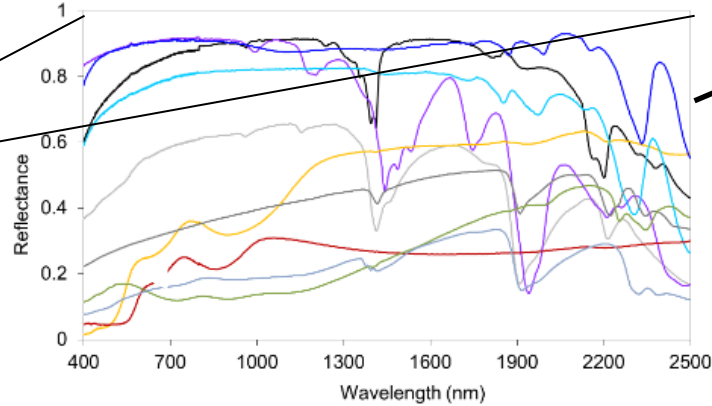
Spectrometer

Slit

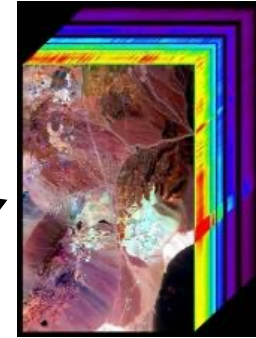
Telescope



### Mineral Spectral Signatures

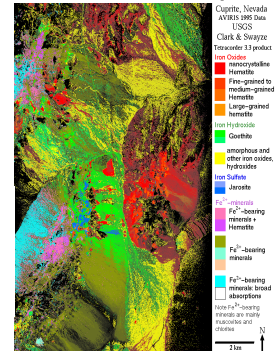


- Kaolinite  $Al_4[Si_4O_{10}](OH)_8$
- Montmorillonite  $(Na,Ca)_0.33(Al,Mg)_2Si_4O_{10}(OH)_2 \cdot nH_2O$
- Goethite  $FeO \cdot OH$
- Gypsum  $CaSO_4 \cdot 2H_2O$
- Dolomite  $CaMg(CO_3)_2$
- Calcite  $CaCO_3$
- Illite  $(K,H_3O)(Al,Mg,Fe)_2(Si,Al)_4O_{10}(OH)$
- Hematite  $Fe_2O_3$
- Vermiculite  $(Mg,Fe+2,Al)_3(Al,Si)_4O_{10}(OH)$
- Chlorite  $(Mg,Fe)_3(Si,Al)_4O_{10}(OH)_2 \cdot (Mg,Fe)_3(OH)_6$



Calibrated Image Cube (60m)

### Mineral Map

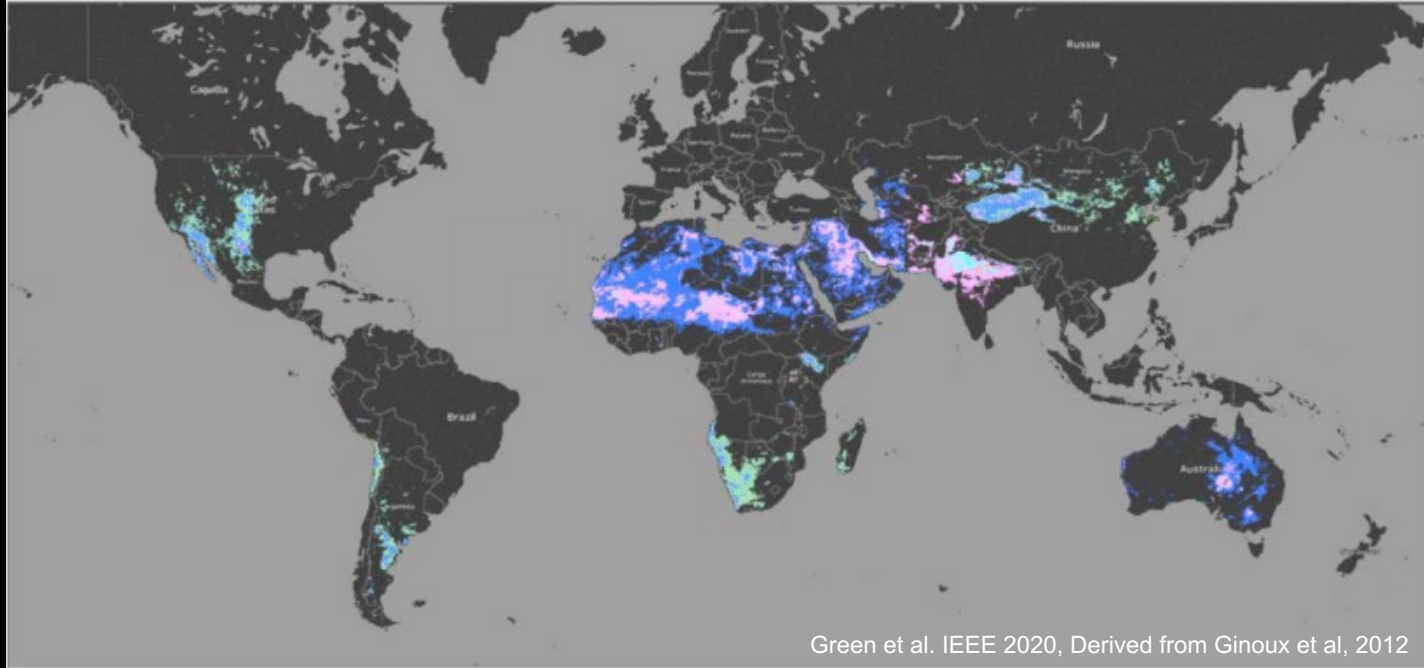






# EMIT Science Approach

## Mapping surface mineralogy from dust emitting regions



Green et al. IEEE 2020, Derived from Ginoux et al, 2012

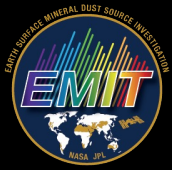


# EMIT Science Approach

## Data Collection is Ongoing

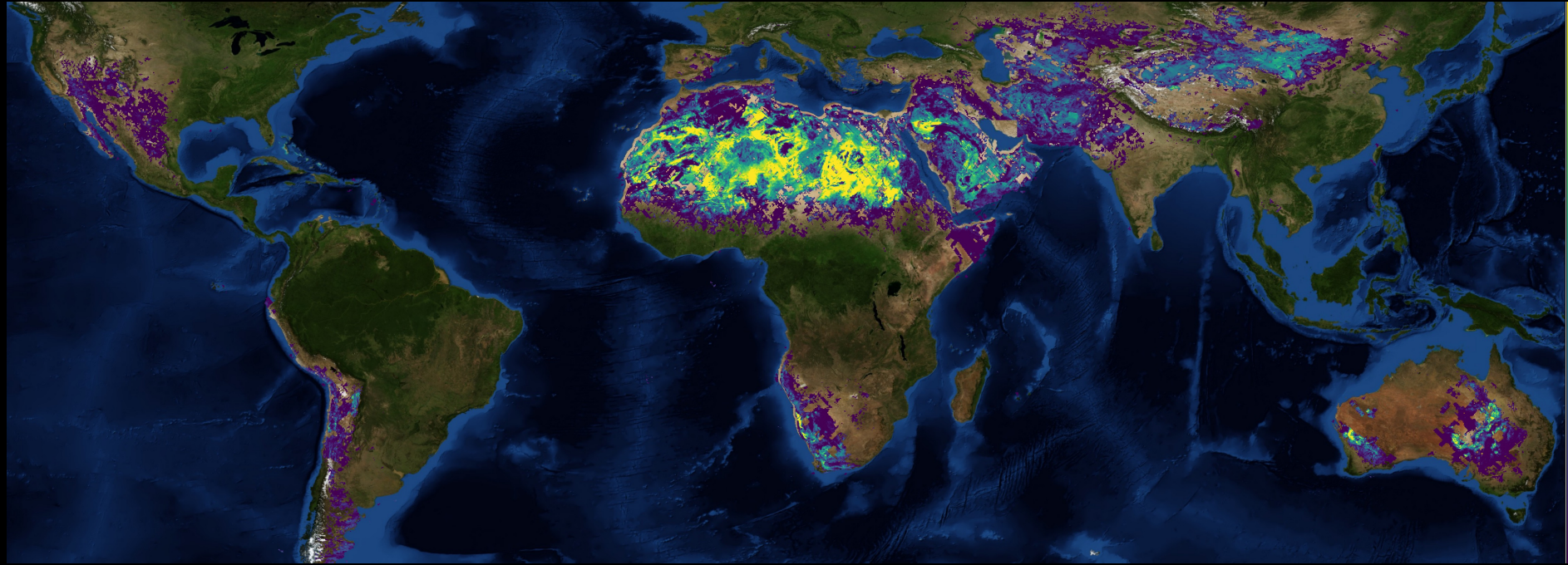


2022-08-10



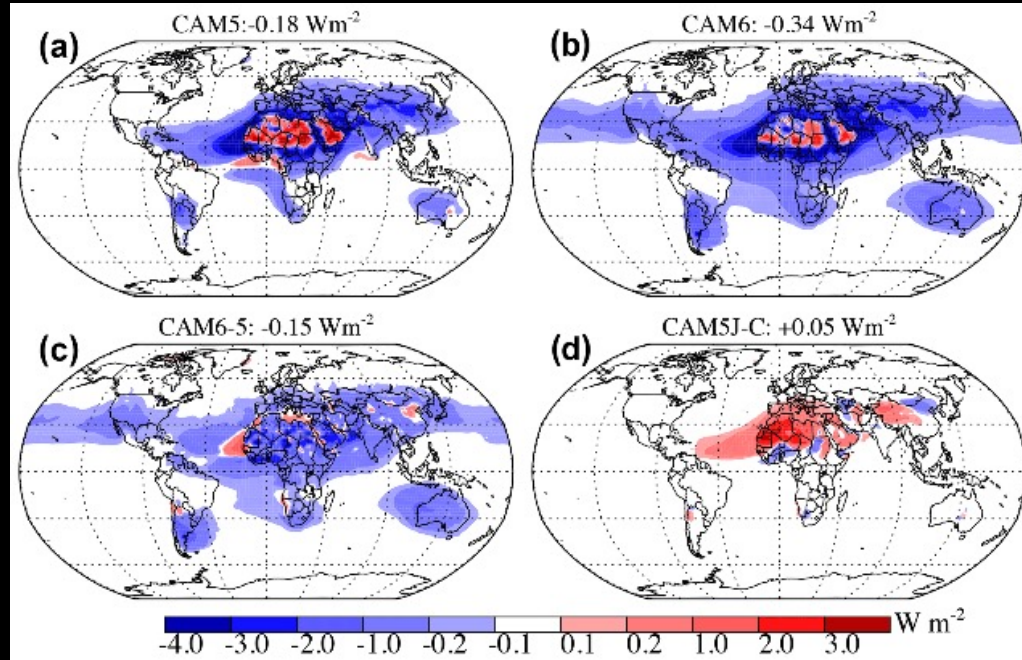
# EMIT Science Approach

Mosaiced mineral maps are in development



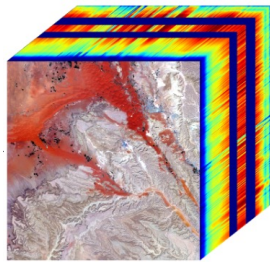
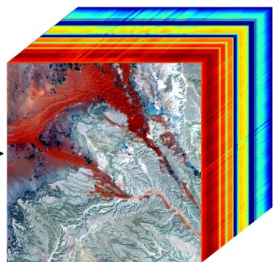
# EMIT Science Approach

Integrate mineralogy into Earth System Models for forcing assessment

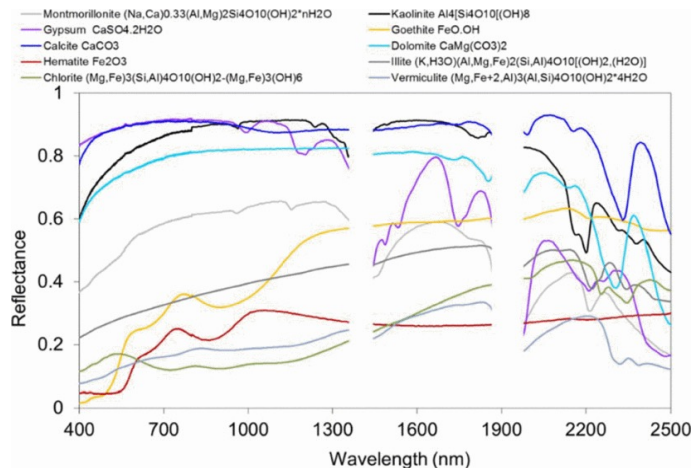
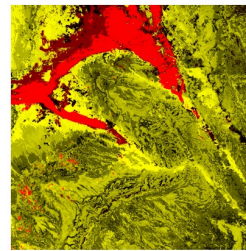


# EMIT Science Data Products

Available on the LP DAAC!



Dominant Mineral Abundances - Iron Oxides



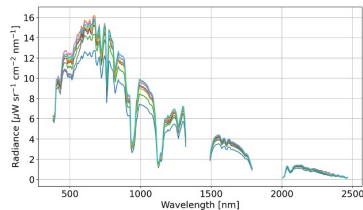
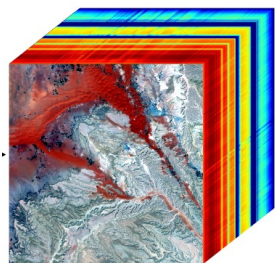
**L1b: Radiance at Sensor**

**L2a: Surface Reflectance**

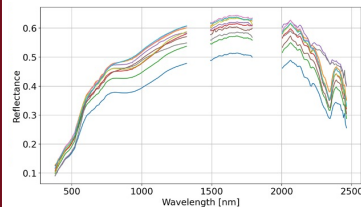
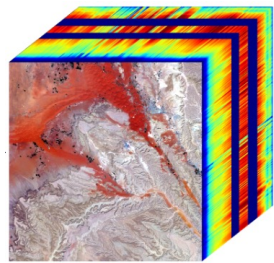
**L2b: Mineral Maps**

# EMIT Science Data Products

## Available on the LP DAAC!

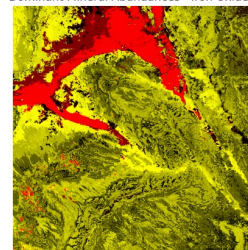


**L1b: Radiance at Sensor**



**L2a: Surface Reflectance**

Dominant Mineral Abundances - Iron Oxides

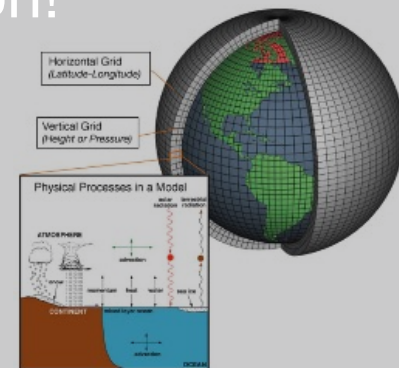


**L2b: Mineral Maps**

## Coming Soon!



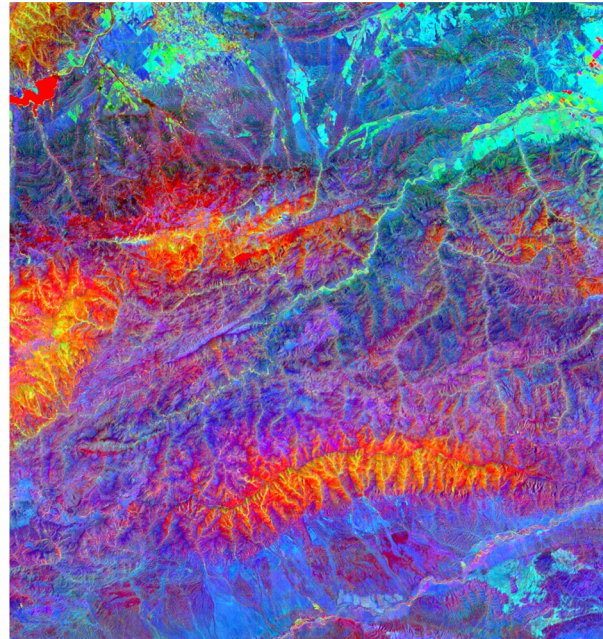
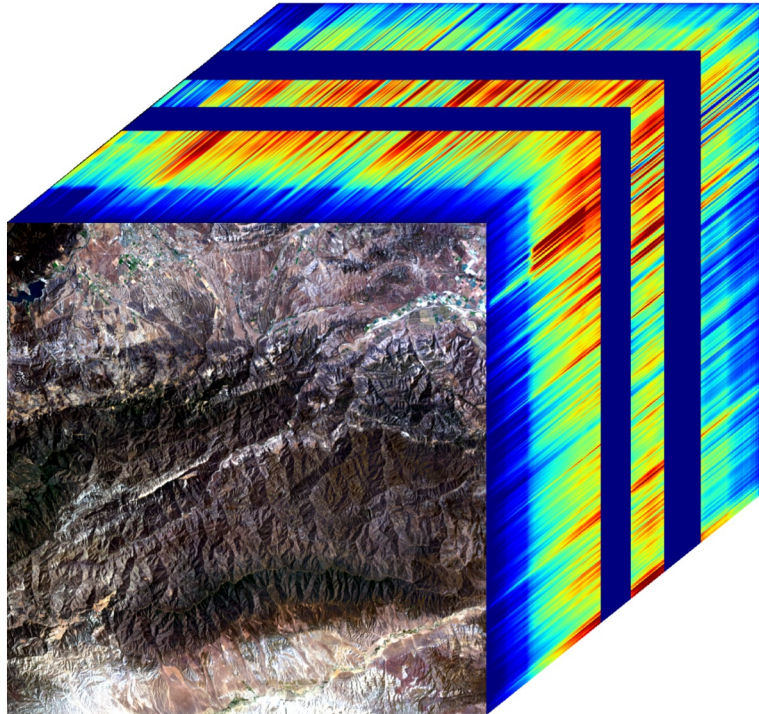
**L3: Aggregated Mineralogy**



**L4: CESM, GISS Model Runs**




# Vegetation function and structure

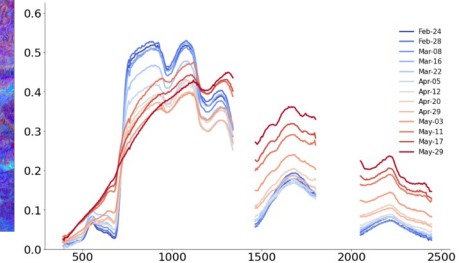
## Santa Barbara County



Example ecosystem spectral diversity

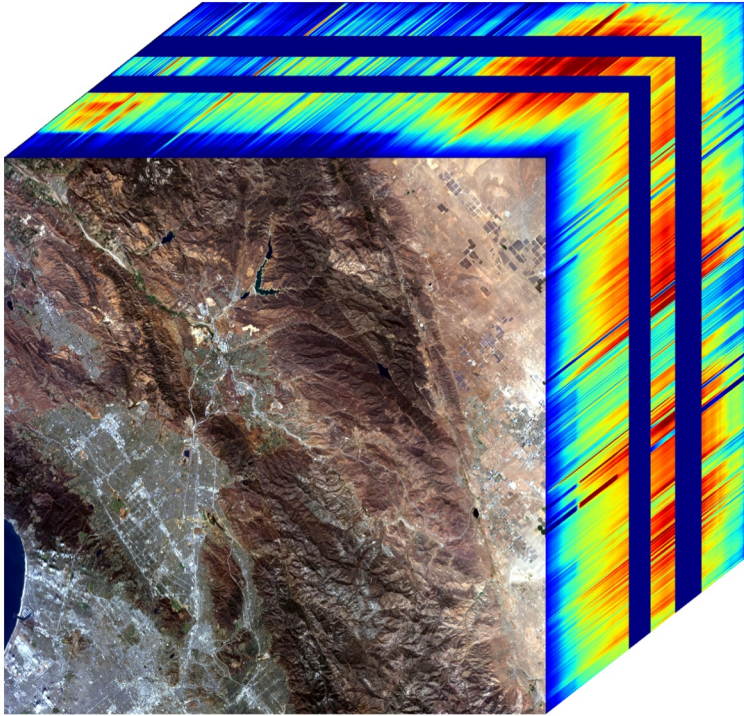
Foliar Trait Indices

-  Leaf Mass per Area
-  Leaf Water Content
-  Nitrogen

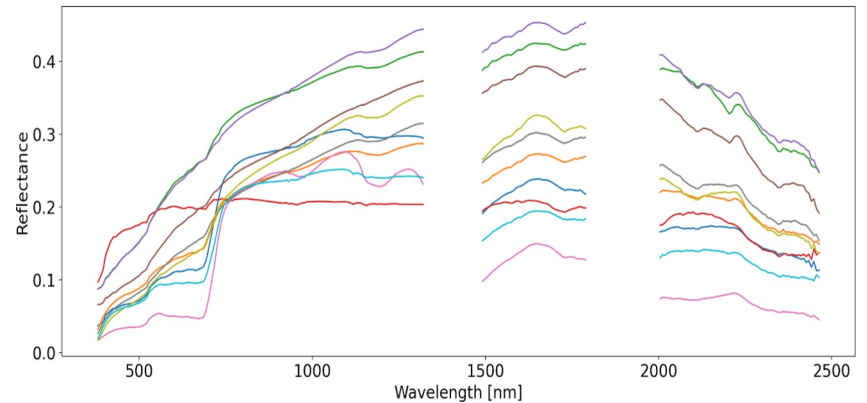


# Urban, Arid Land Ecosystems, and Agriculture

## Southern California



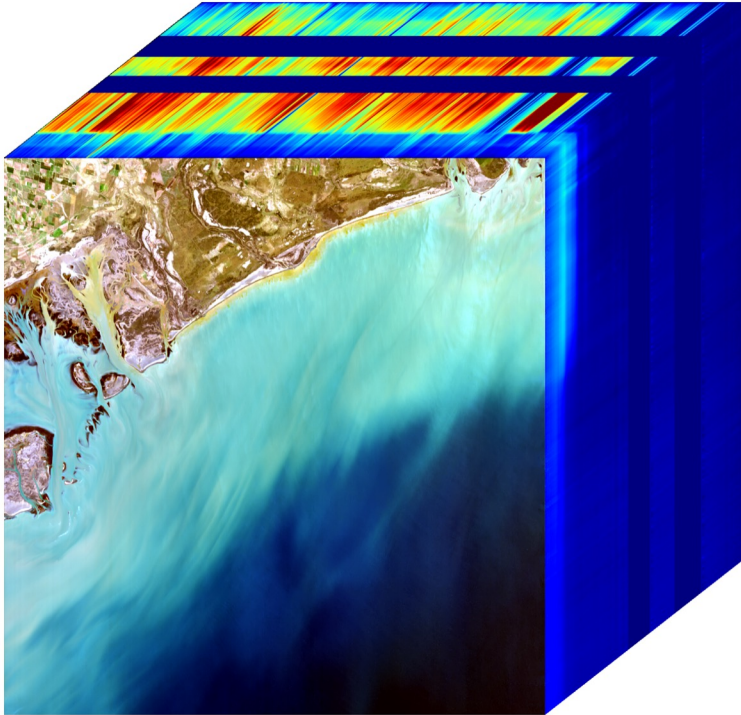
- Urban surface composition
  - Impervious surface
  - Vegetation and albedo (cool/heat)
- Solar panel mapping
- Dry land ecosystem (C. F. S.)
- Crop type, health, status



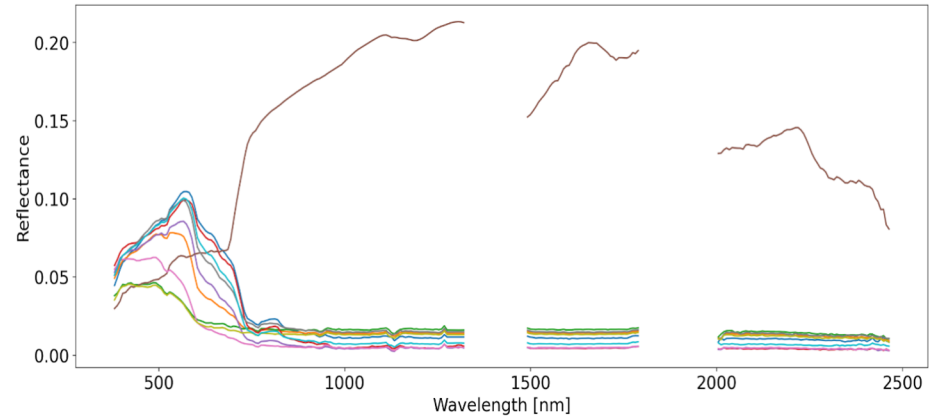


# Coastal Observation – Aquatic constituents

## Bahía Blanca, Argentina

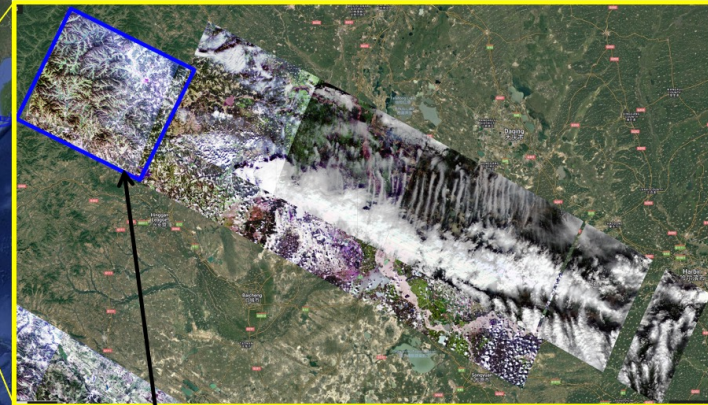
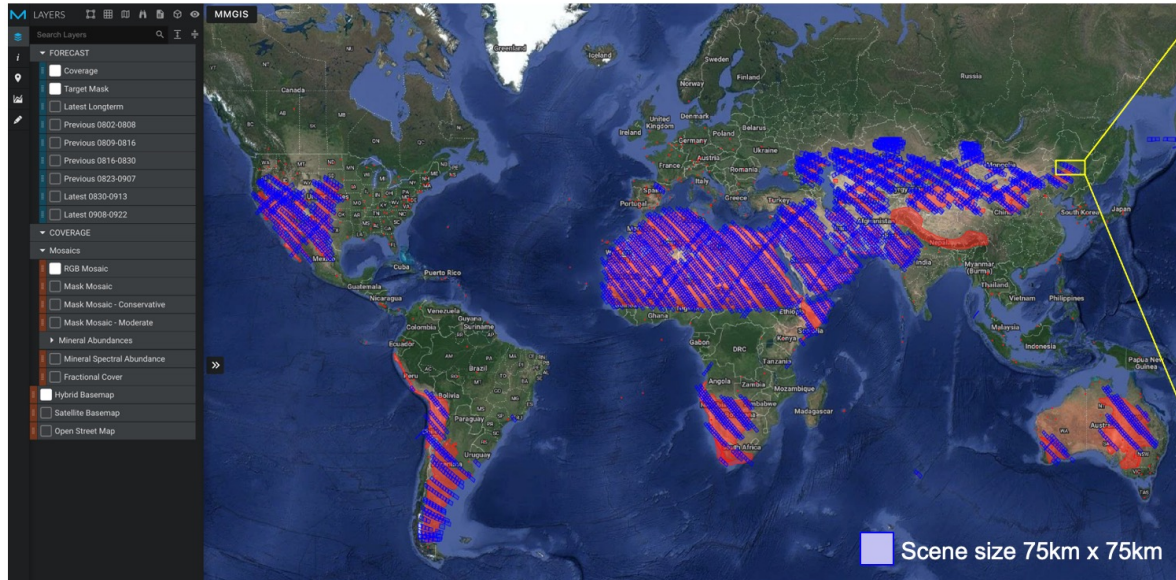


- Water constituents
- Algal blooms and types
- Sediment
- Shallow water benthic cover
- Coral environments
- Local coastal ecosystems



# Supporting open science and applications

## VISIONS: Portal supporting EMIT Data Visualization & Access



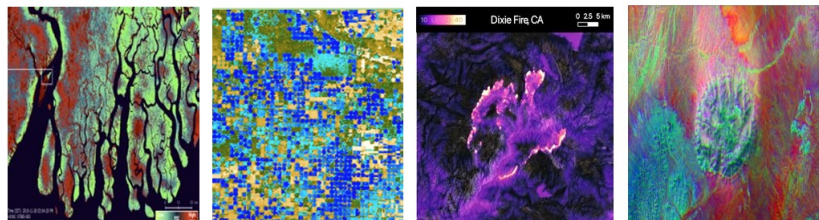
EMIT Scene

Web portal for rapid visualization with links to Land Processes DAAC for primary data access

# ECOSTRESS & EMIT – An Awesome Team!

Contemporaneous data acquisitions from the ISS enable many applications

## ECOSTRESS

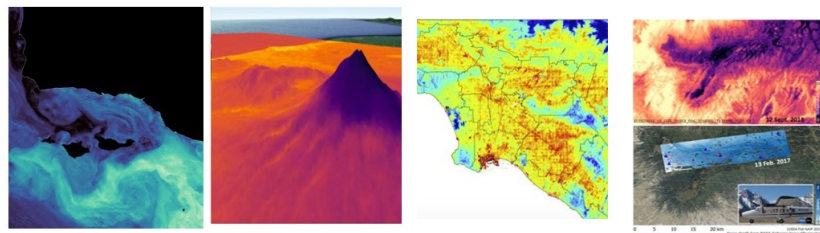


Natural Ecosystems

Agriculture

Wildfires

Mineralogy



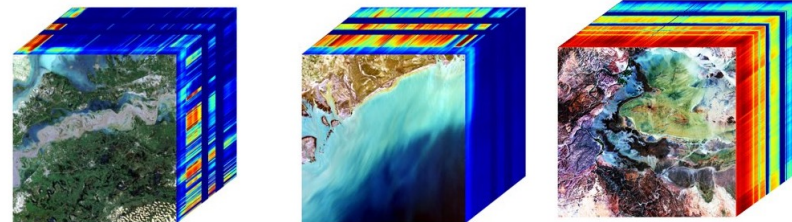
Coastal Ecosystems

Volcanoes

Urban Heat and Public Health

Cryosphere and Water Resources

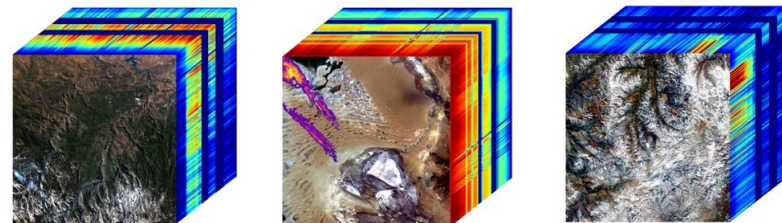
## EMIT



Natural Hazards

Aquatic Ecosystems

Mineral mapping



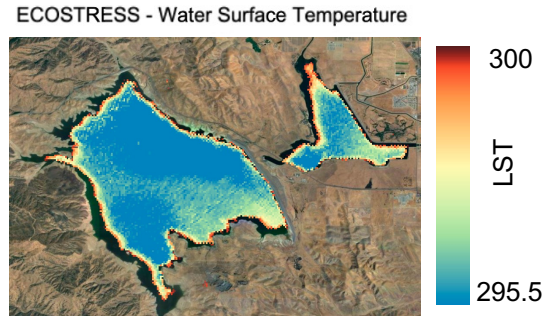
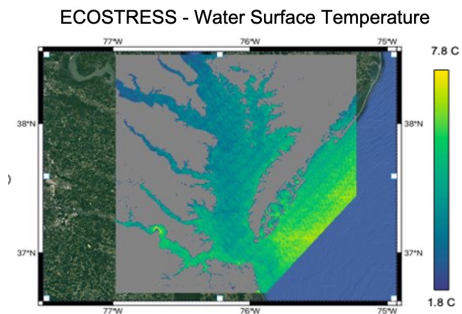
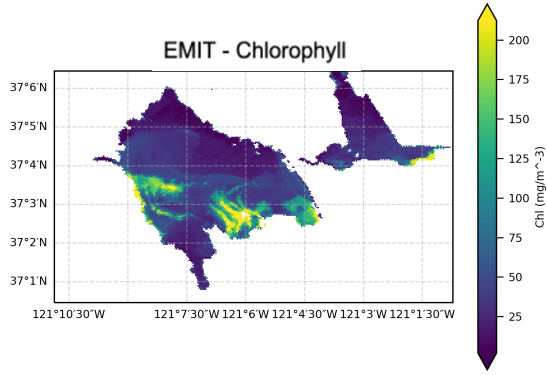
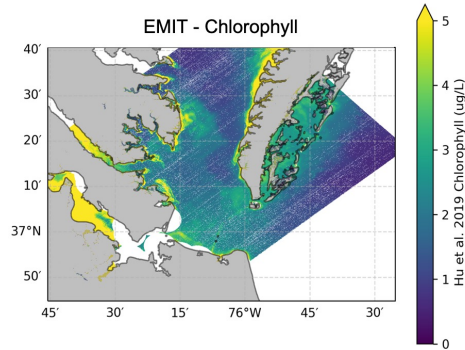
Forest Management and Wildfires

Greenhouse Gas Emissions

Cryosphere and Water Resources

# ECOSTRESS & EMIT – An Awesome Team!

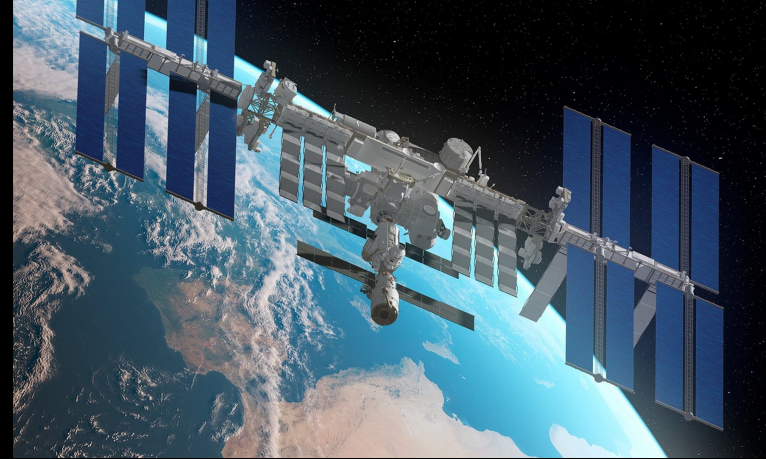
## Early aquatic observations



Stick around for our tutorial on how to explore EMIT and ECOSTRESS data overlaps for your study area!



# Join the EMIT community!



Come to our AGU Townhall

Email me to join our Slack channel and community email list

# Thank you! Questions?

