

SBG-TIR Ecosystems

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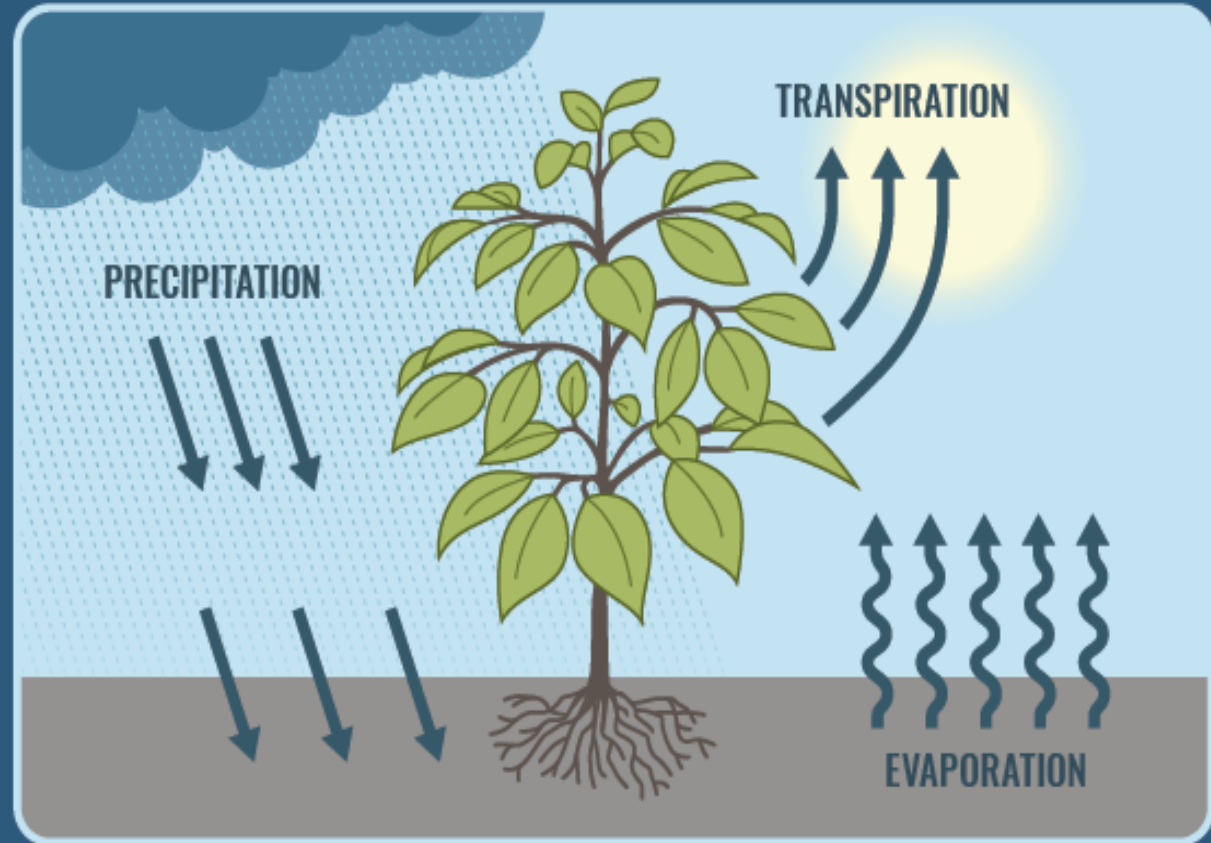
WHAT IS EVAPOTRANSPIRATION?

**EVAPORATION
+ TRANSPIRATION**

= EVAPOTRANSPIRATION

Healthy plants release water in order to regulate heat (similar to the way humans perspire).

This transpiration, together with water evaporating from the soil, is evapotranspiration.



Decadal Survey Research Objectives and Priorities

HYDROLOGY



H-1. How is the water cycle changing?

H-2. How do anthropogenic changes in climate, land use, water use, and water storage, interact and modify the water and energy cycles locally, regionally and globally.

H-4. Hazards, extremes, and sea level rise. How does the water cycle interact with other Earth system processes to change the predictability and impacts of hazardous events.

WEATHER



W-3. How do special variations in surface characteristics (influencing ocean and atmospheric dynamics, thermal inertia and water) modify transfer between domains?

ECOSYSTEMS AND NATURAL RESOURCES



E-1. What are the structure, function, and biodiversity of Earth's ecosystems, and how and why are they changing in time and space?

E-2. What are the fluxes of carbon, water, nutrients, and energy between ecosystems and the atmosphere, the ocean, and the solid Earth, and how and why are they changing?

E-3. Fluxes within ecosystems. What are the within ecosystems, and how and why are they changing?

CLIMATE



C-3. How large are the variations in the global carbon cycle and what are the associated climate and ecosystem impacts?

SOLID EARTH



S-1. How can large-scale geological hazards be accurately forecast in a socially relevant time frame?

S-2. How do geological disasters directly impact the Earth system and society following an event?

ECOSTRESS

Maximizing Earth's Precious Resources

The ECOsystem Spaceborne Thermal Radiometer Experiment on Space Station (ECOSTRESS) will measure the temperature of plants and use that information to better understand how plants respond to heat and water stress. This stress is detectable from space at the scale of an individual farmer's field, and we can use this information to manage water resources and monitor droughts. Evapotranspiration (ET) derived from ECOSTRESS can infer plant stress before any physical degradation is observed with the naked eye.



How do plants respond to changing water availability?



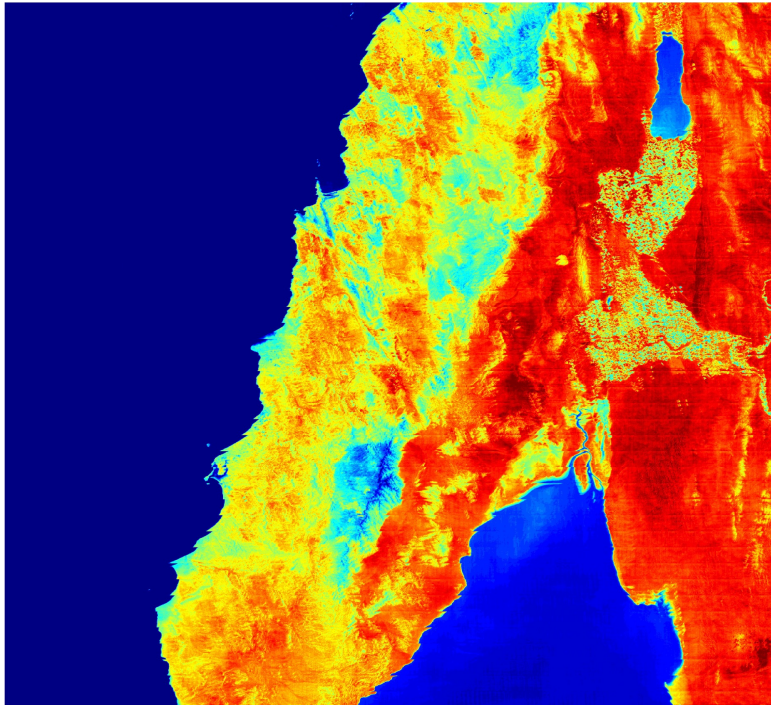
How do changes in evapotranspiration (ET) throughout the day affect vegetation growth?



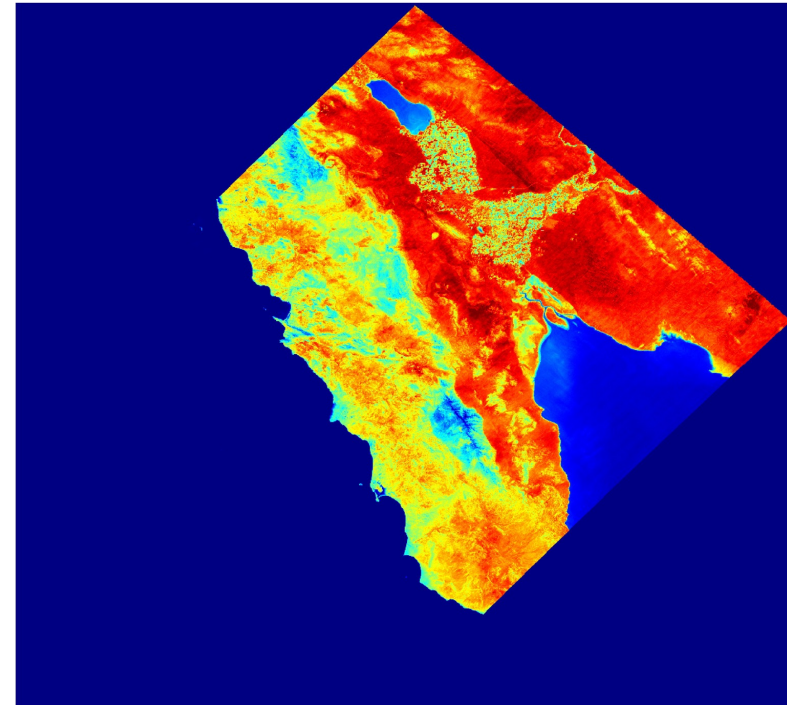
Can we use ET measurements to optimize agricultural water use?

ECOSTRESS: Lessons learned

HDF5 swath format



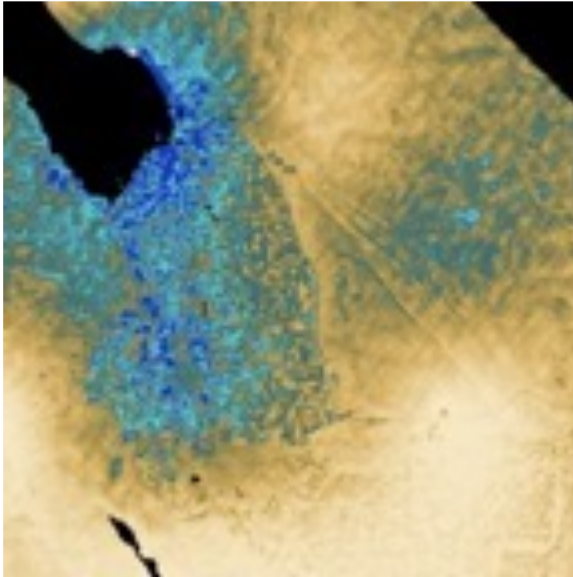
Geotiff on Sentinel tile extents



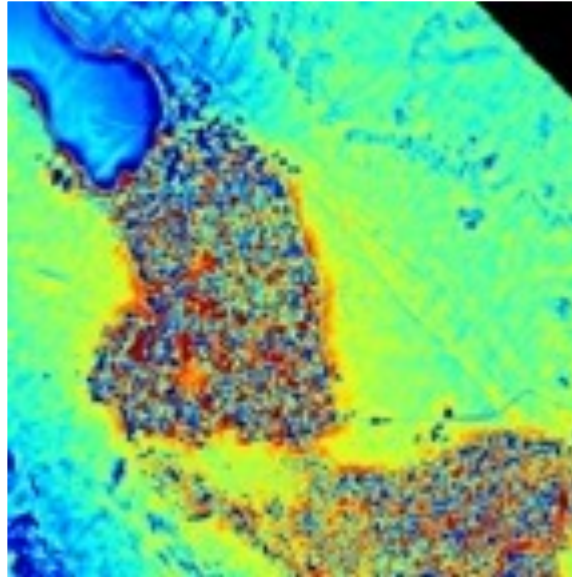
User-friendly formats!

ECOSTRESS: Lessons learned

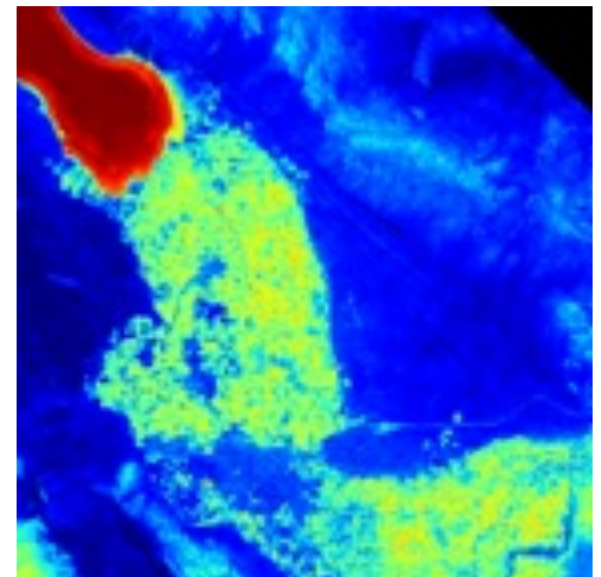
Soil moisture input



Meteorology inputs

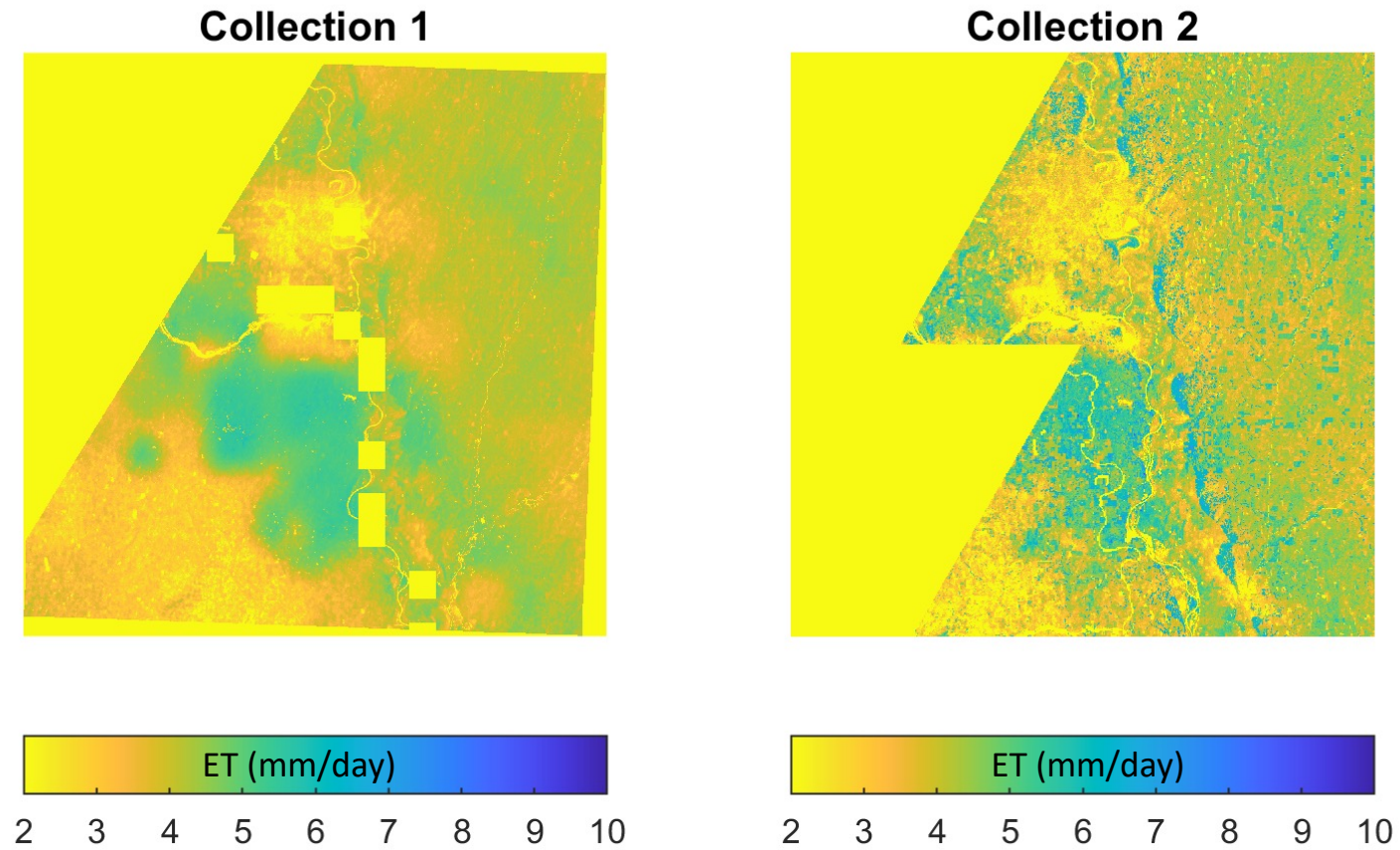


Surface energy balance inputs



Share model inputs!

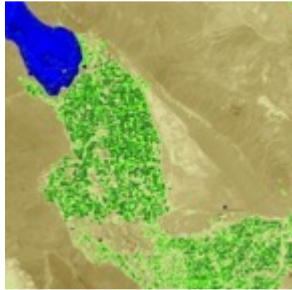
ECOSTRESS: Lessons learned



Coincident NDVI!

ECOSTRESS Collection 2 provides new products and easy-to-use formats

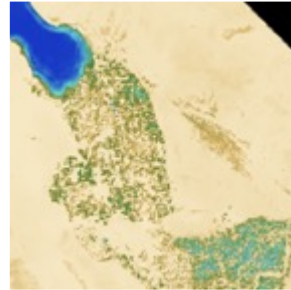
L2T_STARS (gridded, tiled geotiff)



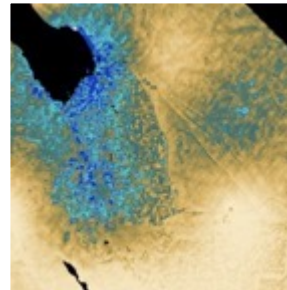
NDVI
Albedo



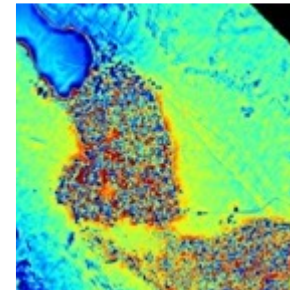
L3T_JET



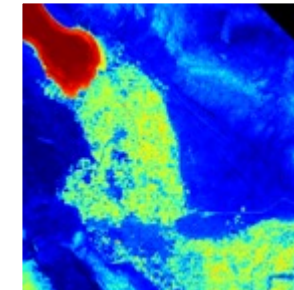
L3T_SM



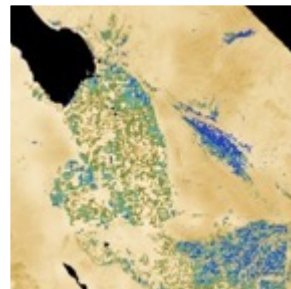
L3T_MET



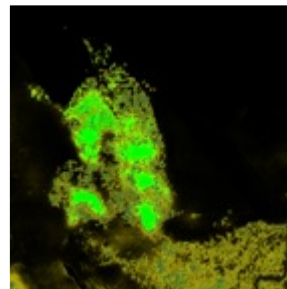
L3T_SEB



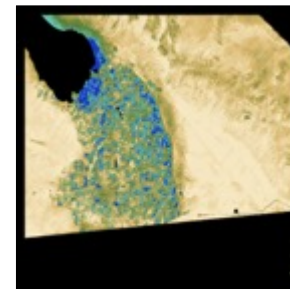
L4T_ESI_PTJPL



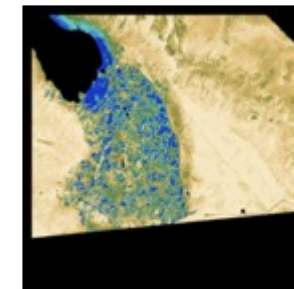
L4T_WUE



L3T_ET_ALEXI



L4T_ESI_ALEXI



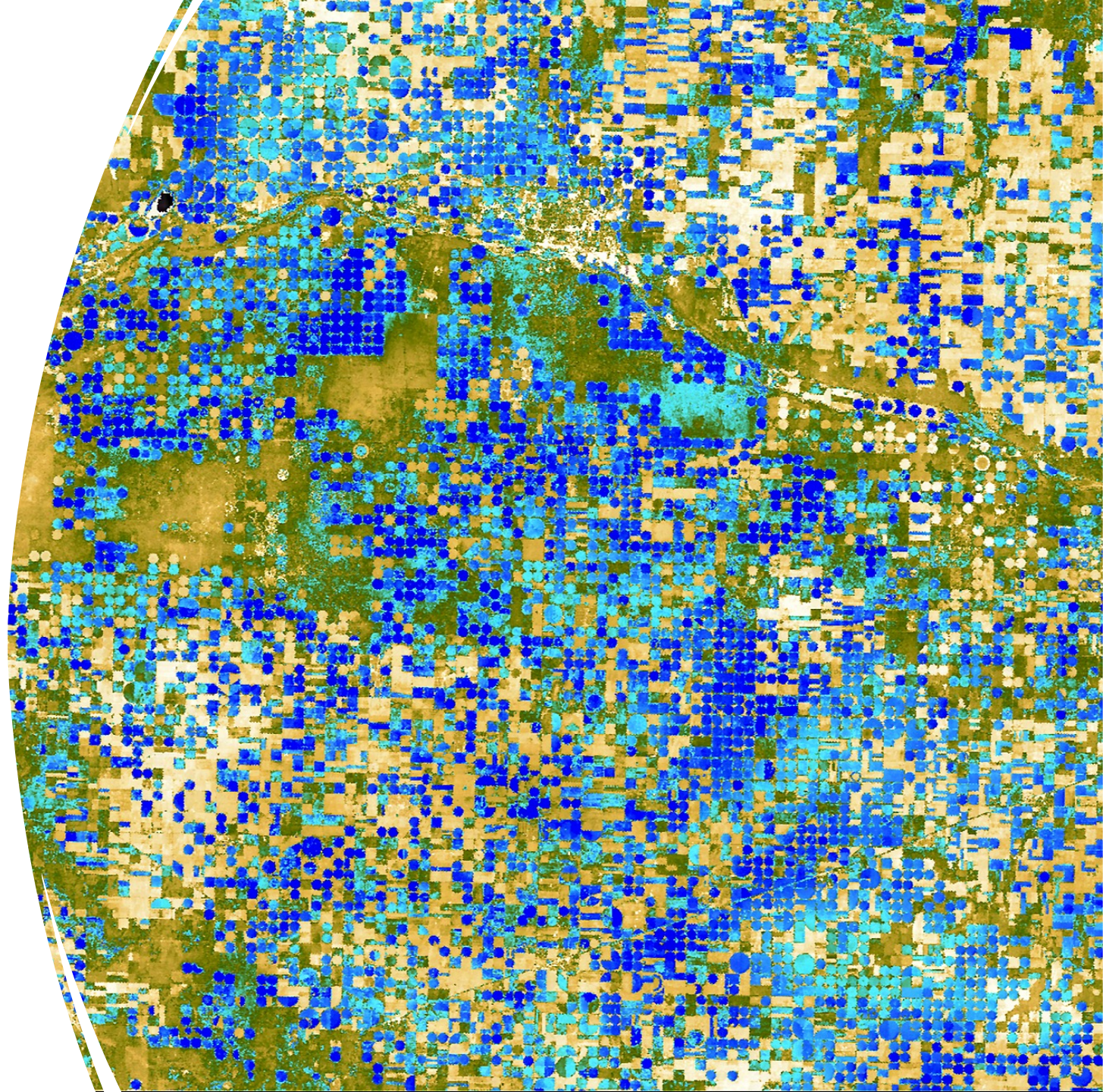
Multiple ET models:
PT-JPL-SM
MOD16
BESS
STIC

JET – JPL ET ensemble
SM – soil moisture
MET – meteorological products, such as air temperature and humidity
SEB – surface energy balance products, such as net radiation

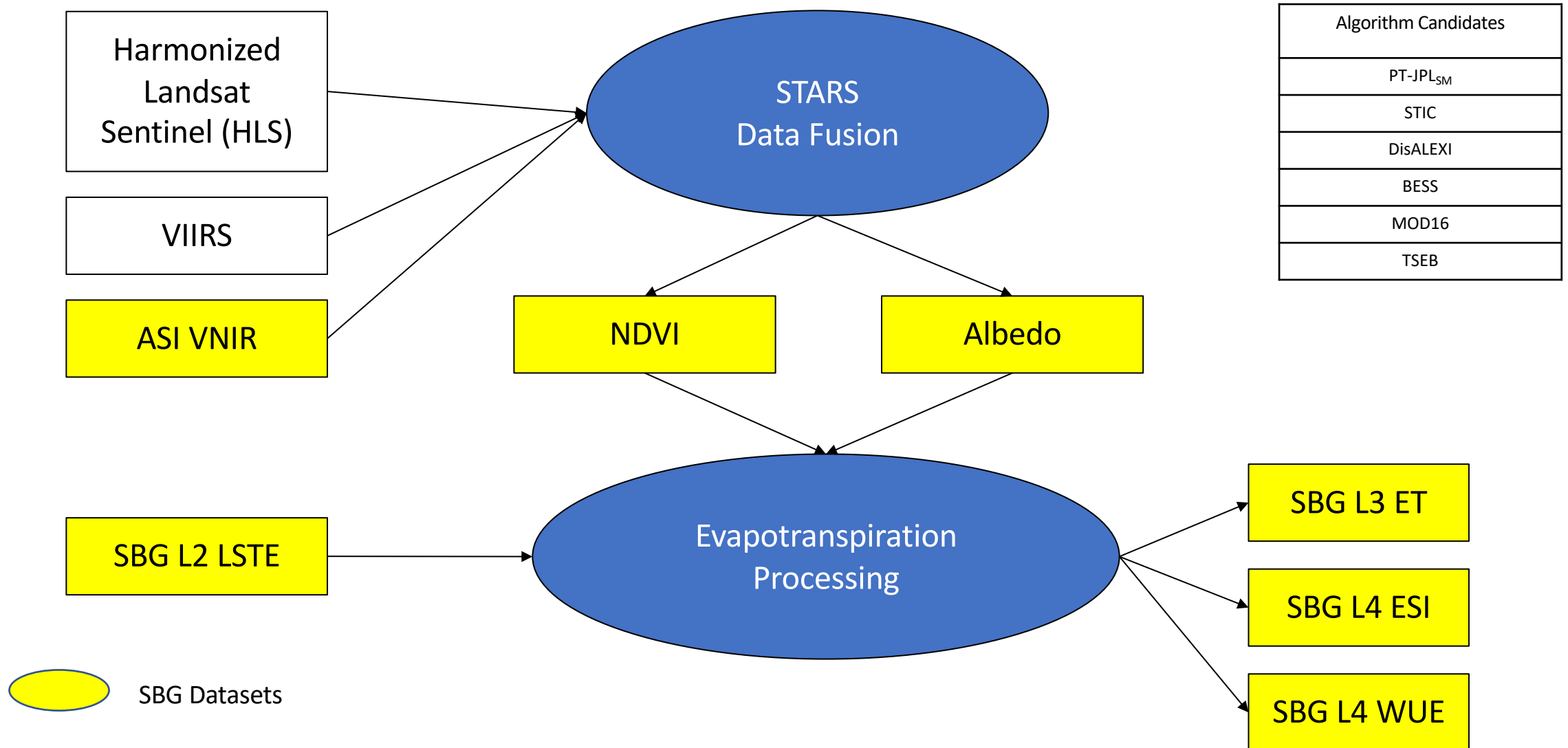
All gridded, cloud-optimized geotiffs on Sentinel tiles

Evapotranspiration+

- Led by Gregory Halverson
- Goals:
 - Adapt ECOSTRESS algorithms
 - Coincident VNIR
 - Sensitivity analysis
- Products:
 - Evapotranspiration
 - Evaporative stress index
 - Water use efficiency



Evapotranspiration Processing Workflow

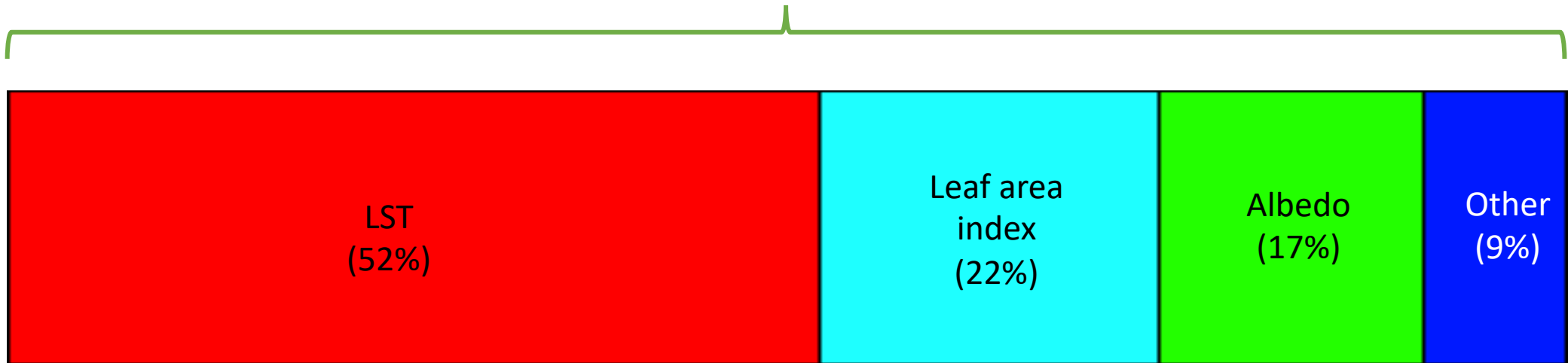


Nuances of Evapotranspiration Models

PT-JPL_{SM}	The Priestley Taylor Jet Propulsion Laboratory (PT-JPL) model uses the Priestley Taylor equation estimate latent heat flux with a set of constraints to partition latent heat flux to soil, canopy, and interception. The PT-JPL-SM model improves upon this approach by incorporating soil moisture and canopy height into these partition constraints.
STIC	The Surface Temperature Initiated Closure (STIC) model aims to produce a thermally sensitive evapotranspiration estimate using an iterative approach to Penman Monteith.
DisALEXI	DisALEXI uses a multi-scale approach by estimating evapotranspiration at coarse spatial resolution using the Atmosphere Land Exchange Inverse model, and then downscales this coarse image to the fine-scale spatial structure of surface temperature, vegetation index, and albedo images by iteratively running the TSEB model.
BESS	The Breathing Earth System Simulator (BESS) model iteratively produces coupled estimates of photosynthesis in the form of gross primary production (GPP) and surface energy balance in the form of net radiation and evapotranspiration.
MOD16	The MOD16 algorithm is an expanded form of the Penman Monteith model that has been long established as a MODIS product.
TSEB	The Two-Source Energy Balance (TSEB) model takes an iterative approach to estimating sensible heat flux and then assumes evapotranspiration as the residual of the surface energy balance.

DisALEXI ET uncertainty

1 mm/day



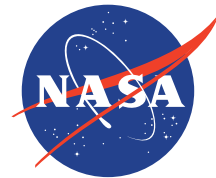


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