

The background of the slide is an aerial photograph of a vast agricultural landscape. In the foreground, the white and silver engines of a large commercial airplane are visible, angled upwards towards the top left. The land below is divided into numerous rectangular farm fields, some green and some brown, suggesting different crops or fallow land. A few small buildings and roads are scattered among the fields. Distant mountains are visible under a clear sky.

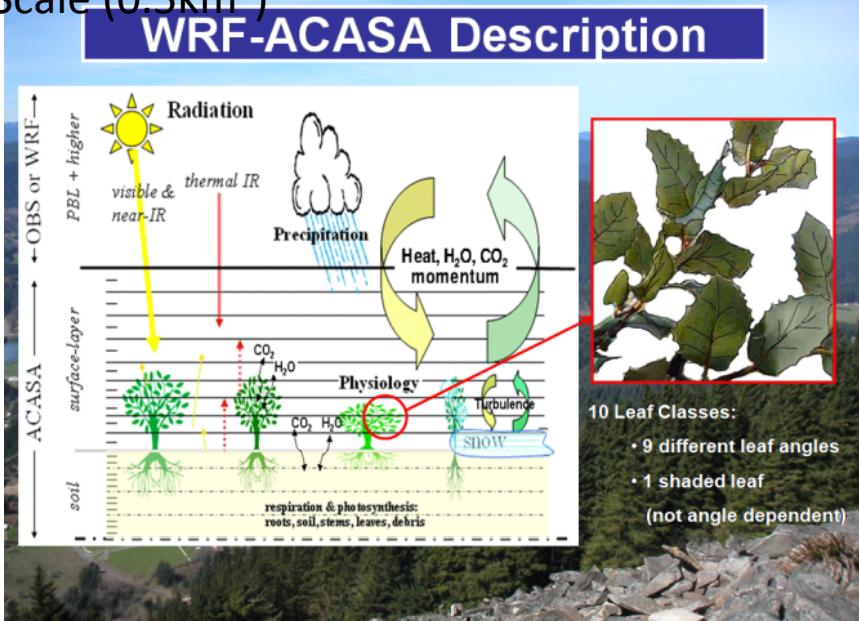
Evapotranspiration using remote
sensing and weather data in linked
mesoscale and local scale physically
base models

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Matthias Falk, Dave Pyles, Shuhua
Chen, Kyaw Tha Paw U

University of California Davis

Linked NCAR Weather Research Forecasting (WRF) and UCD Advanced Canopy-Soil Algorithm (ACASA) Model For Estimating And Predicting Fluxes

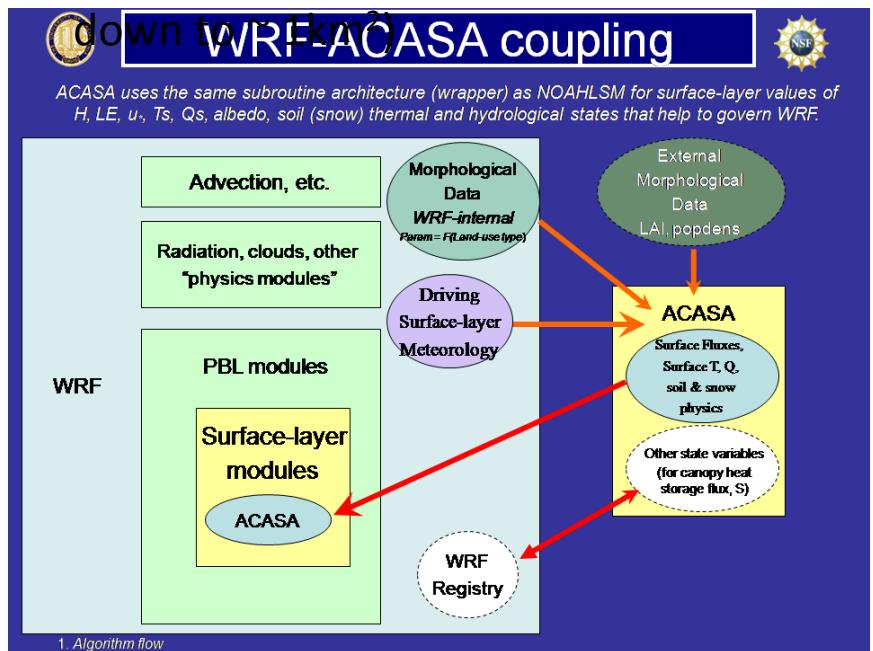
ACASA: An SVAT Flux Model that Accounts for Vertical and Spatial Heterogeneity at Local Scale (0.5km^2)



Schematic Overview of ACASA

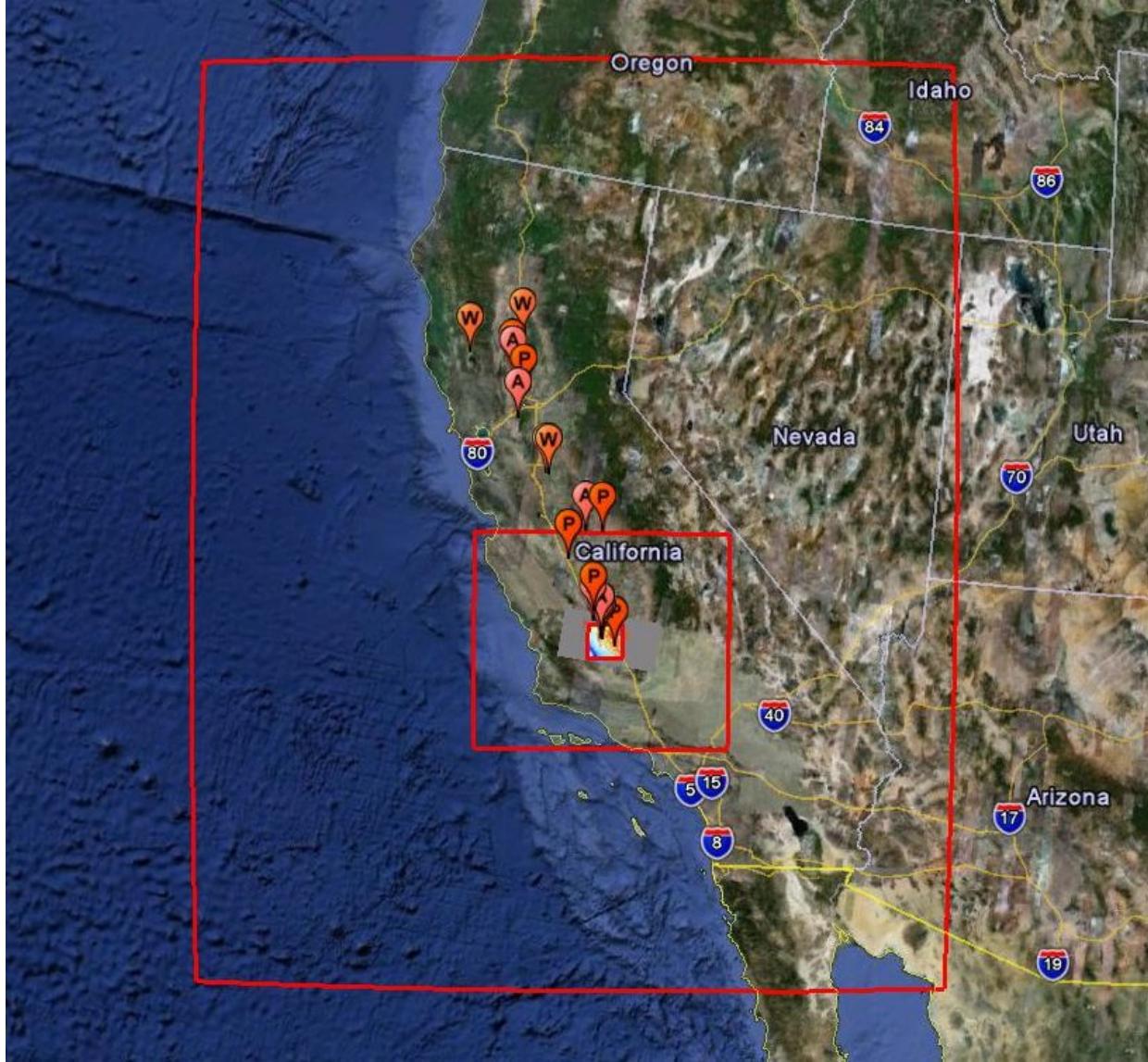
ACASA is a type of Surface Vegetation Atmosphere Transfer (SVAT) model

WRF: Atmospheric Physics Model to Estimate Fluxes at Regional Scales (cells down to 1km^2)



WRF with ACASA Surface Layer Scheme

Nested WRF-ACASA Domains with 16 km, 4 km, 1km, 0.5km Horizontal Resolution



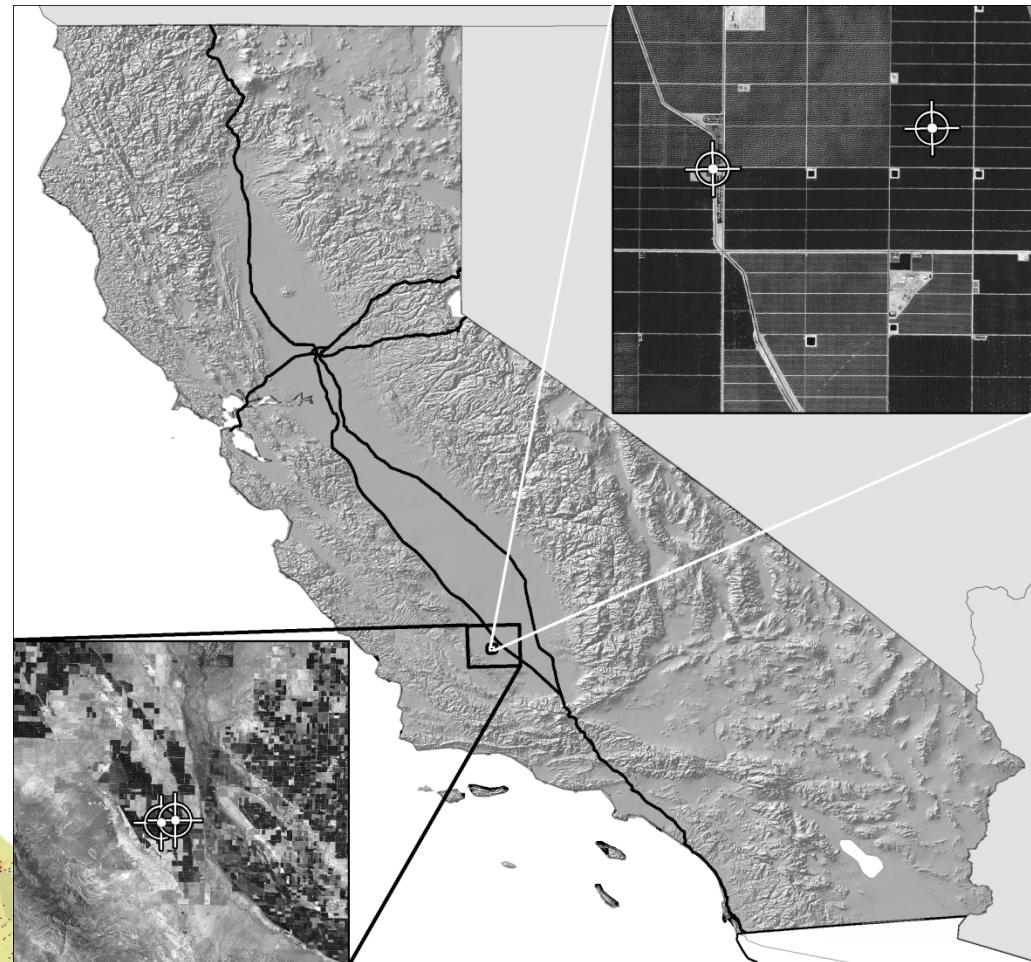
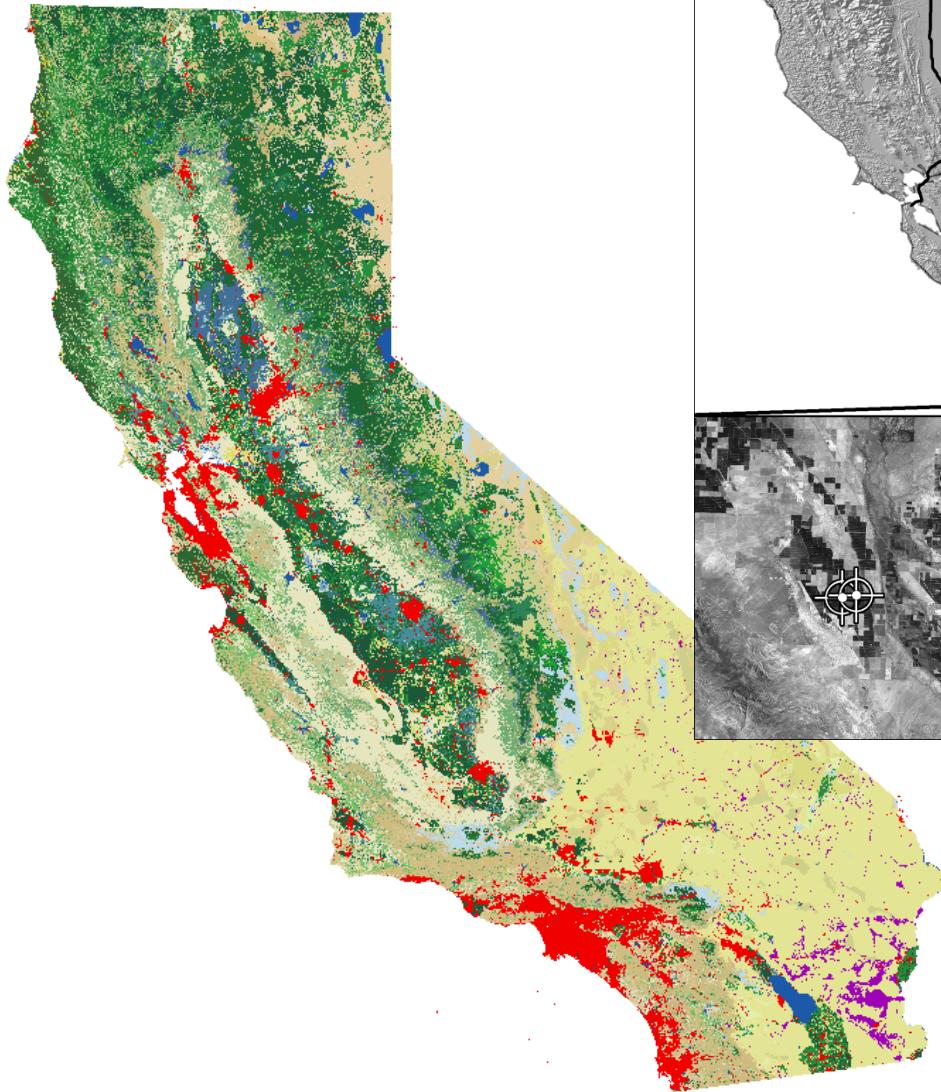
Typical sequence of nested WRF-ACASA Domains over California and the Central Valley (rectangles). Almond and pistachio orchard locations (balloons)

SCRI WRF-ACASA: Experimental Domain

California Augmented
Multisource Landcover map

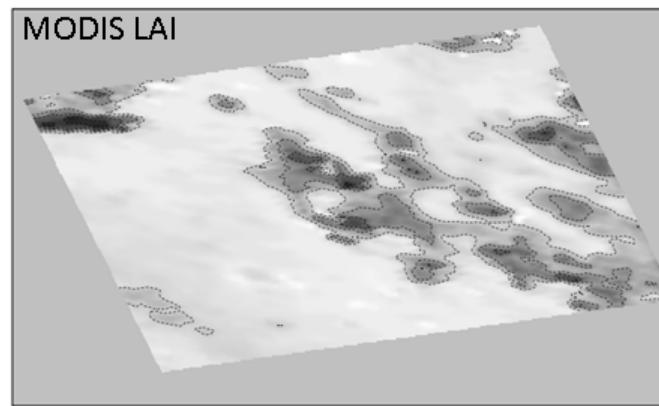
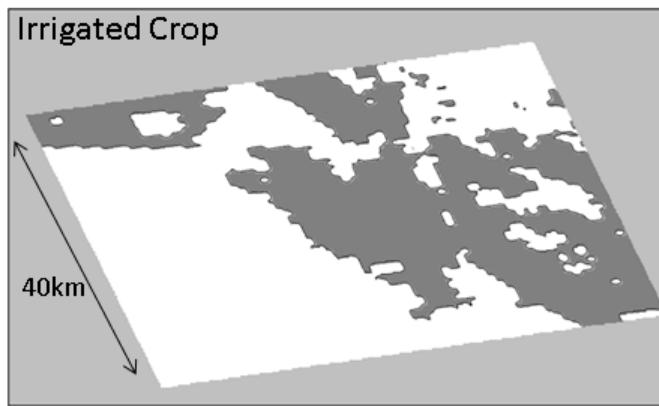
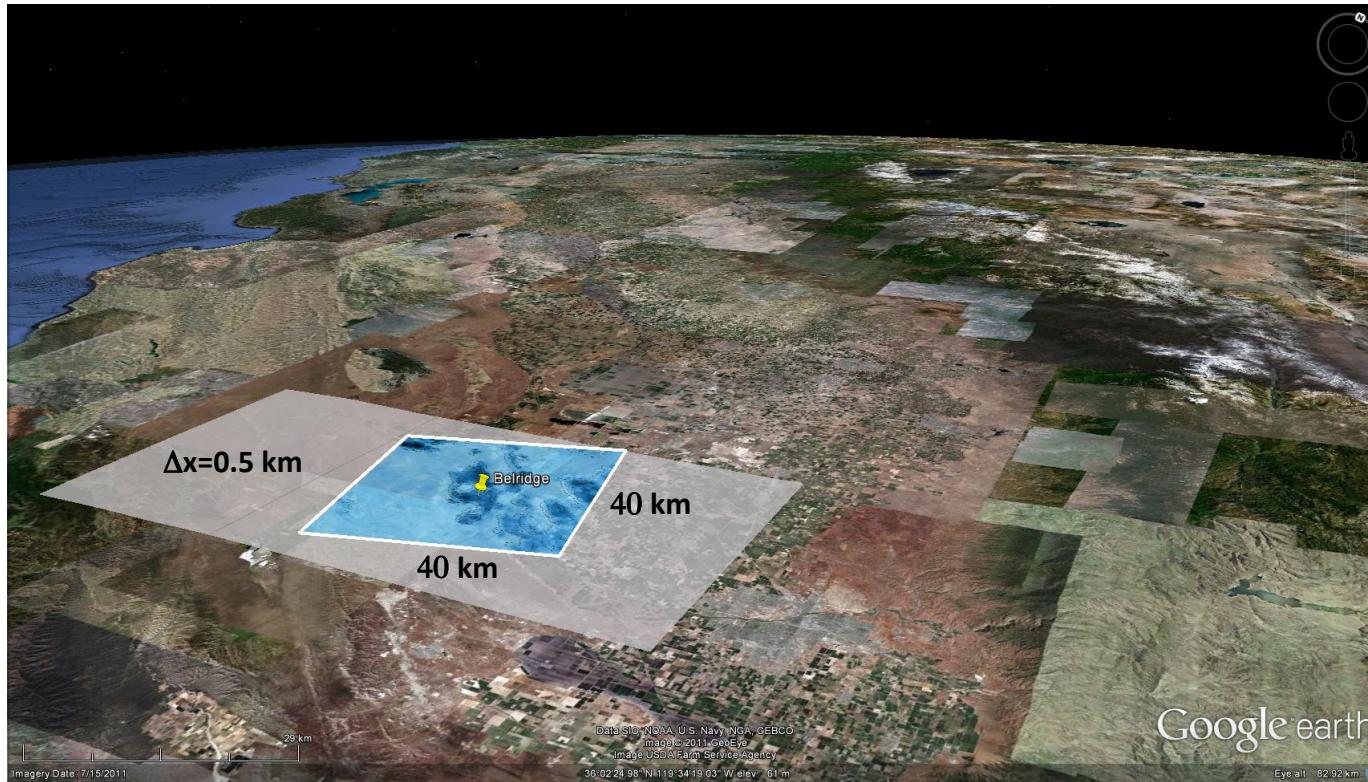
100 meter resolution

<http://cain.ice.ucdavis.edu/caml>



40 km x 40 km scene with 0.5 km pixels

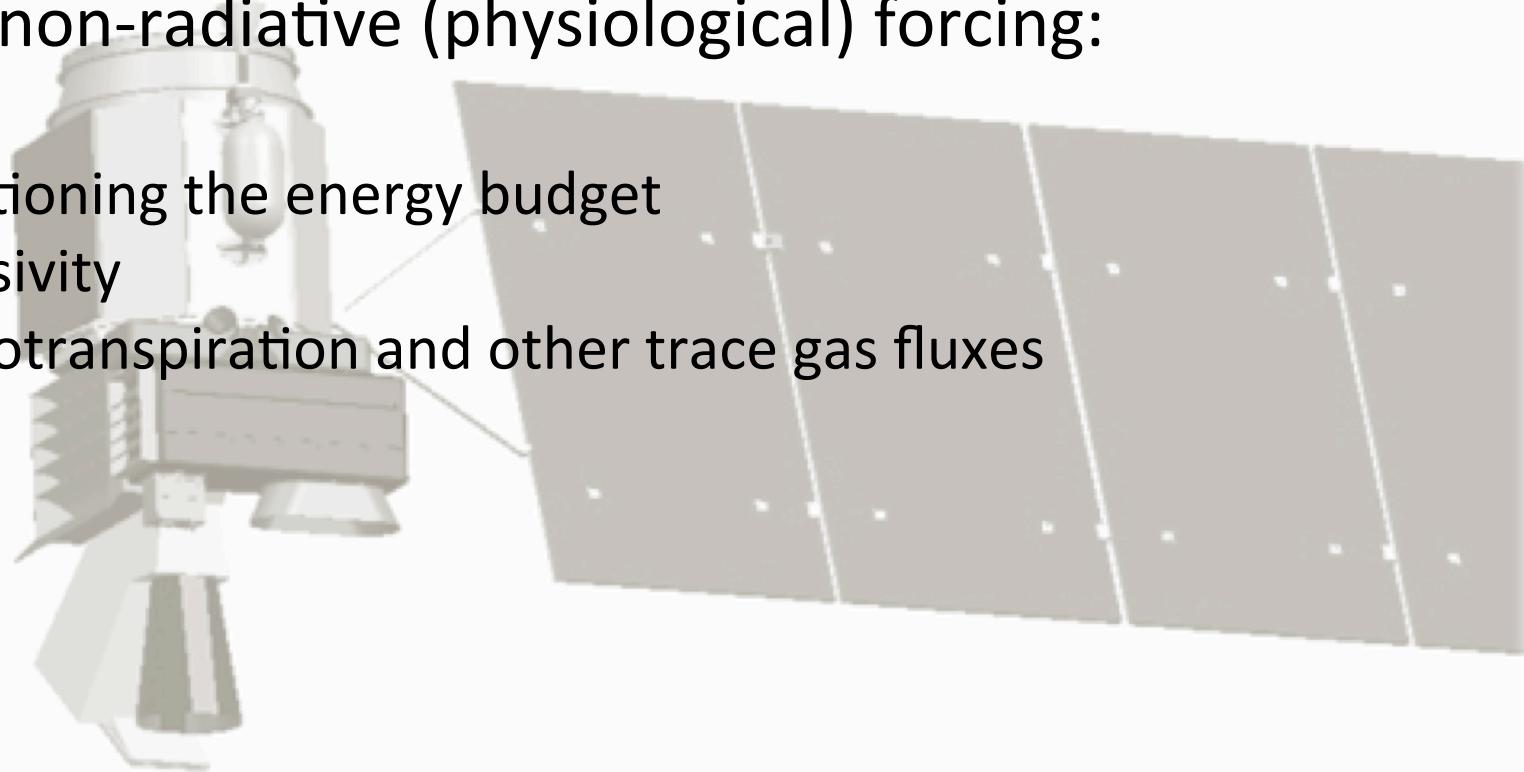
SCRI WRF-ACASA: Experimental Domain



The spatial, spectral, and temporal resolutions of HyspIRI data can contribute to improved estimates of radiative and non-radiative (physiological) forcing:

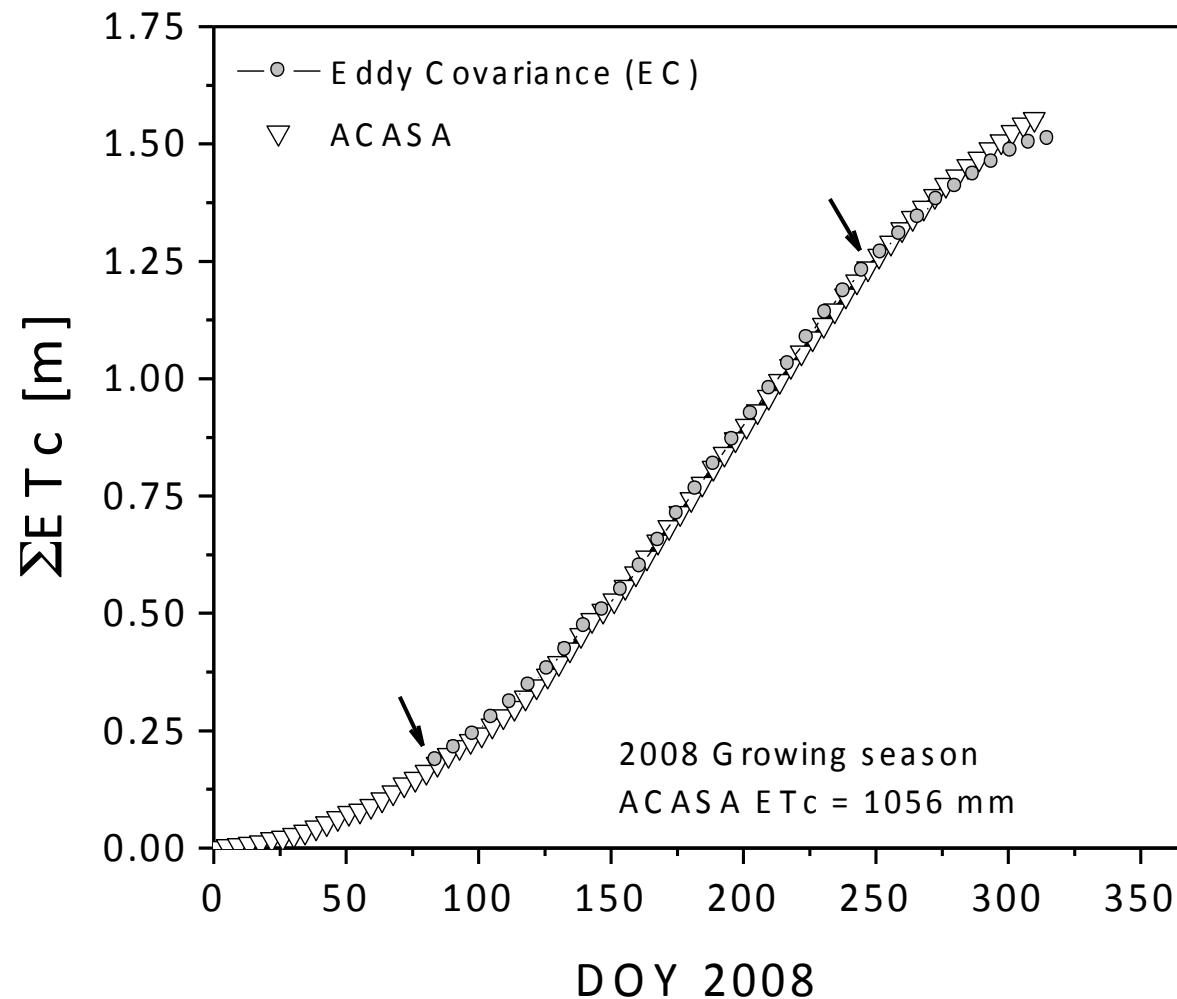
partitioning the energy budget
emissivity

Evapotranspiration and other trace gas fluxes

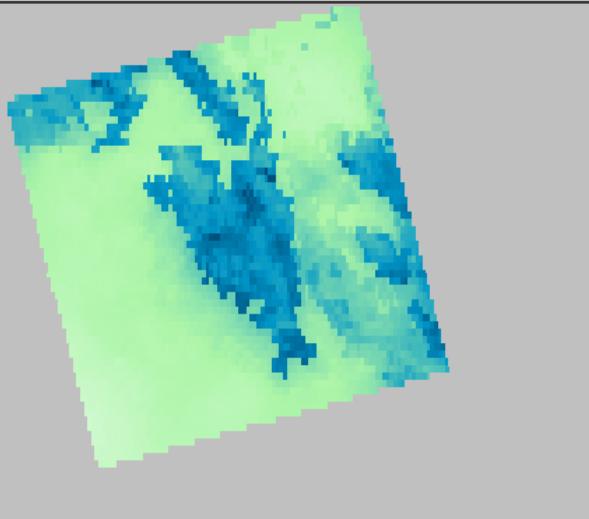


- 60m pixel resolution
- Imaging spectrometer + 8 TIR bands
- 19 day and 5 day repeat global coverage
- High SNR, Stability & uniformity

2008 ACASA vs. Flux Tower ETc Estimates



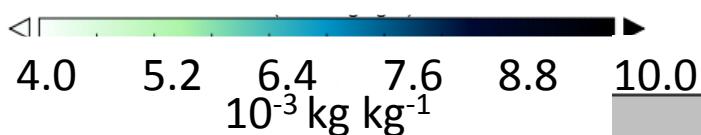
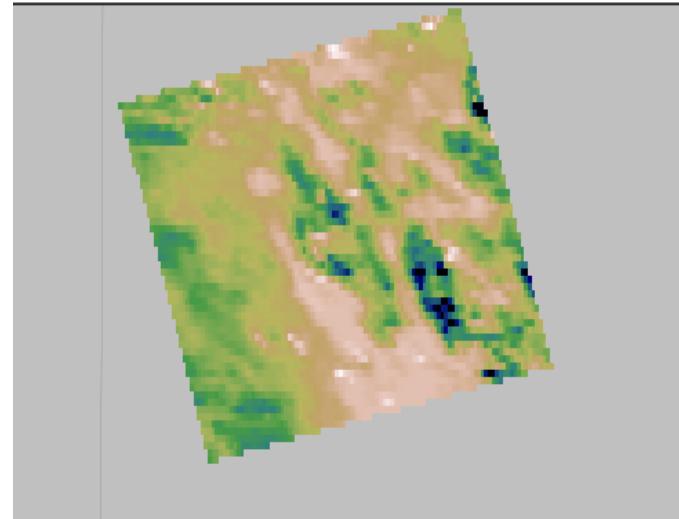
Specific Humidity



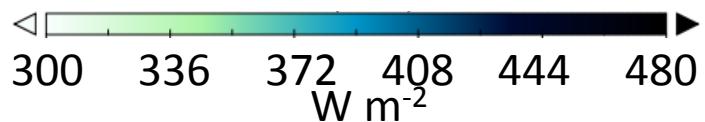
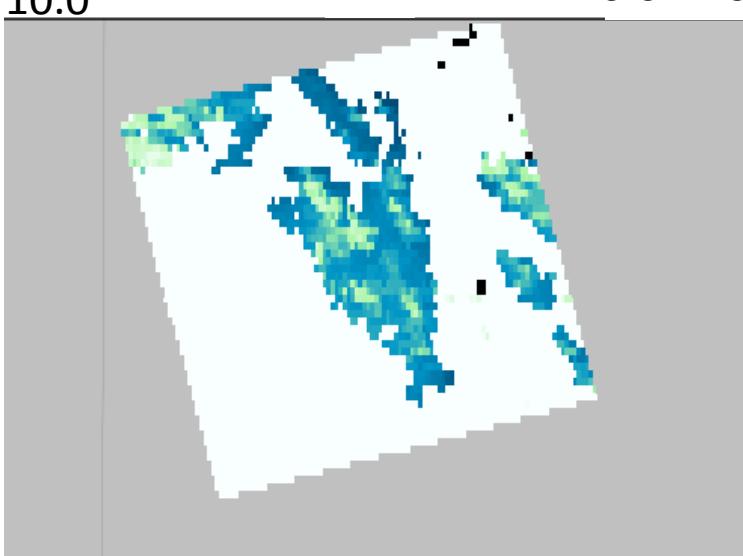
April

Composite
Vegetation density,
Humidity,
Evapotranspiration
12 PM Local Time
(20:00 UTC)

LAI

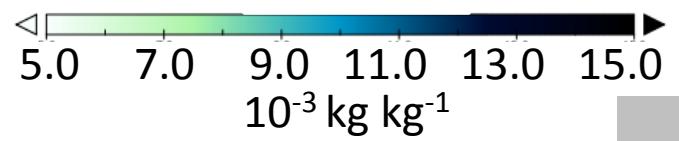
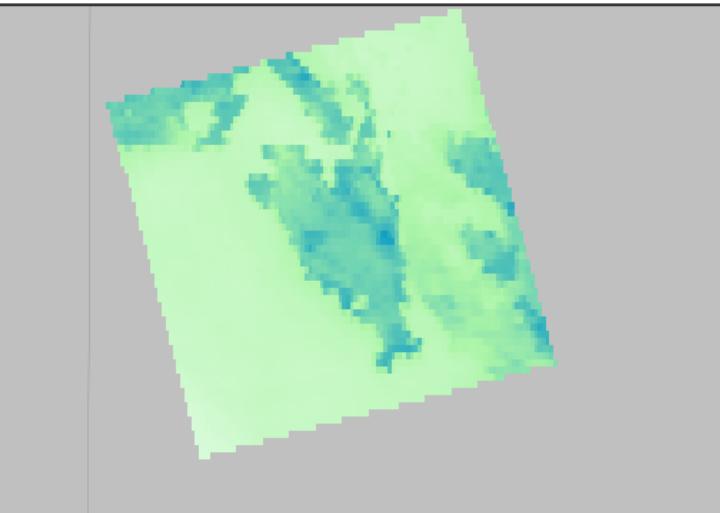


LH



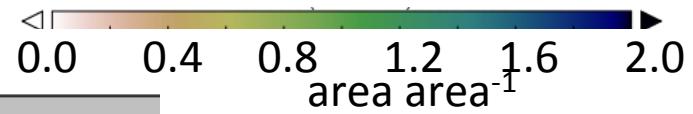
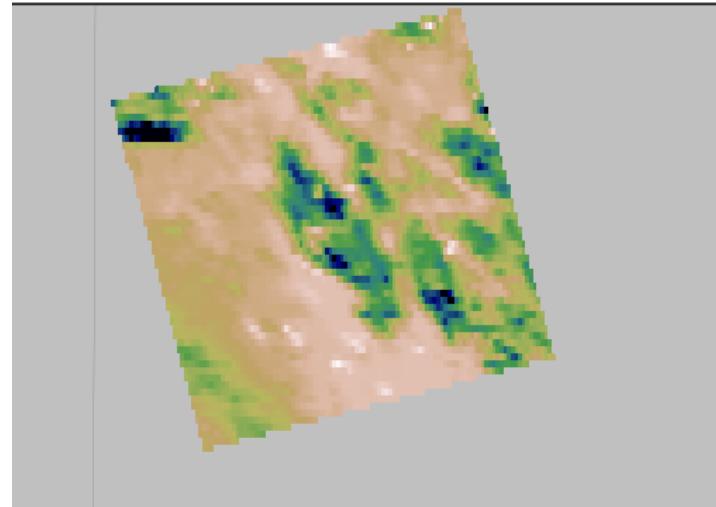
Range set to illustrate
Within crop differences

Specific Humidity

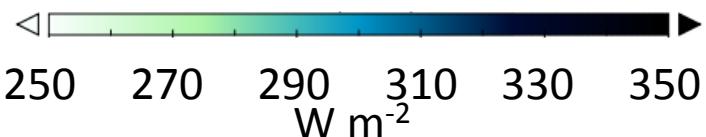
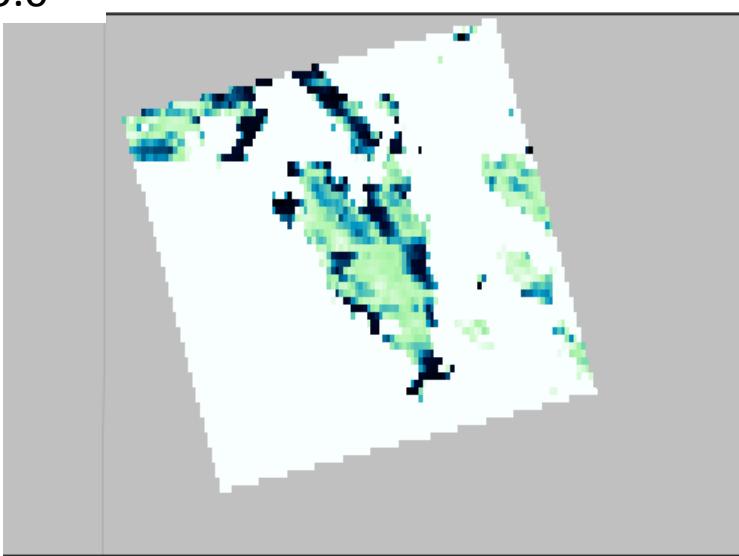


May
Composite
Vegetation density,
Humidity,
Evapotranspiration
12 PM Local Time (20:00
UTC)

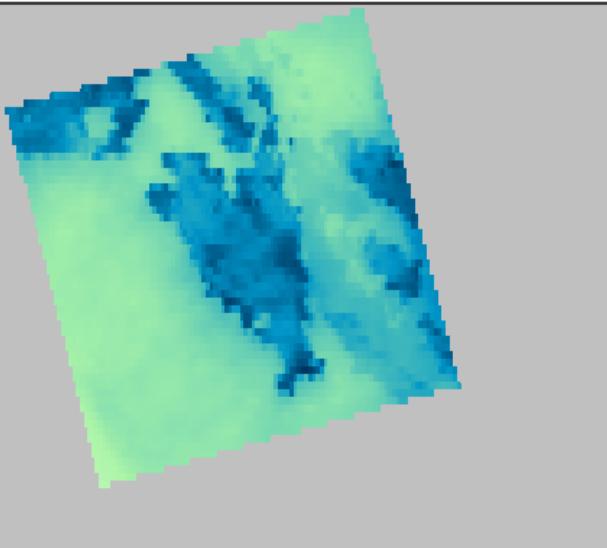
LAI



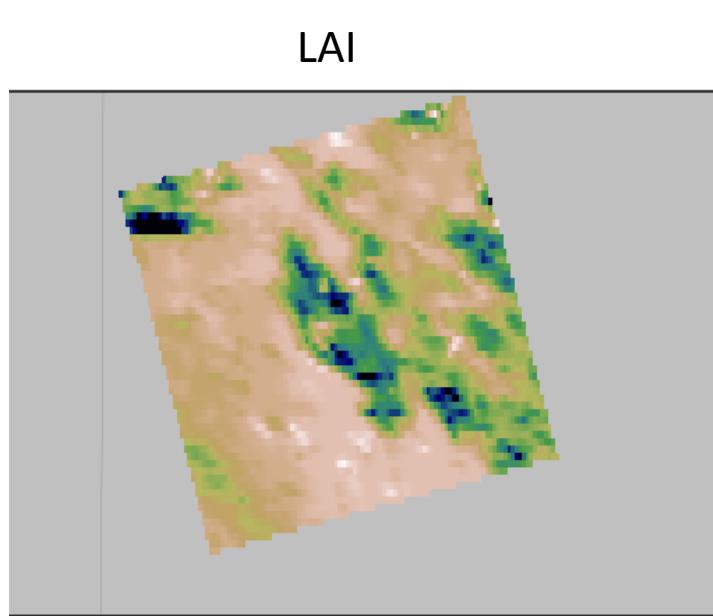
LH



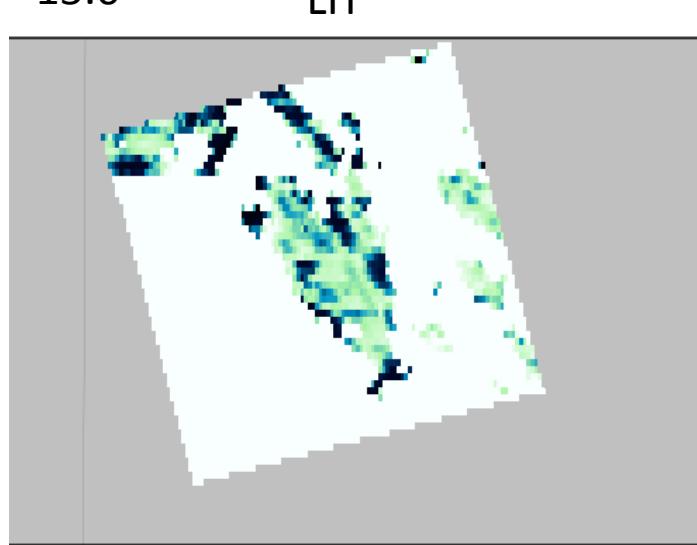
Specific Humidity



June
Composite
Vegetation density, Humidity,
Evapotranspiration
12 PM Local Time
(20:00 UTC)



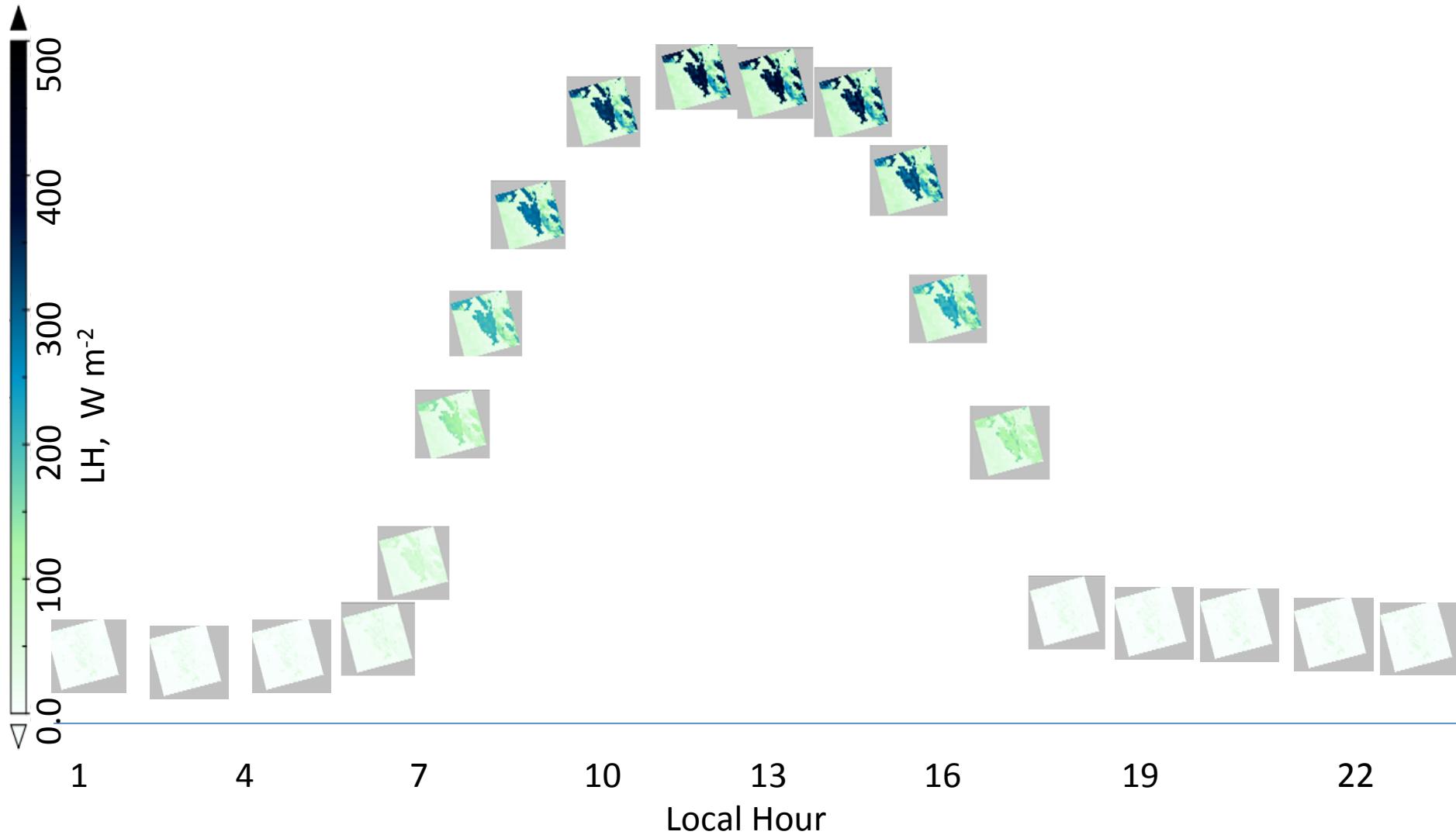
LAI



LH
300 320 340 360 380 400
 W m^{-2}

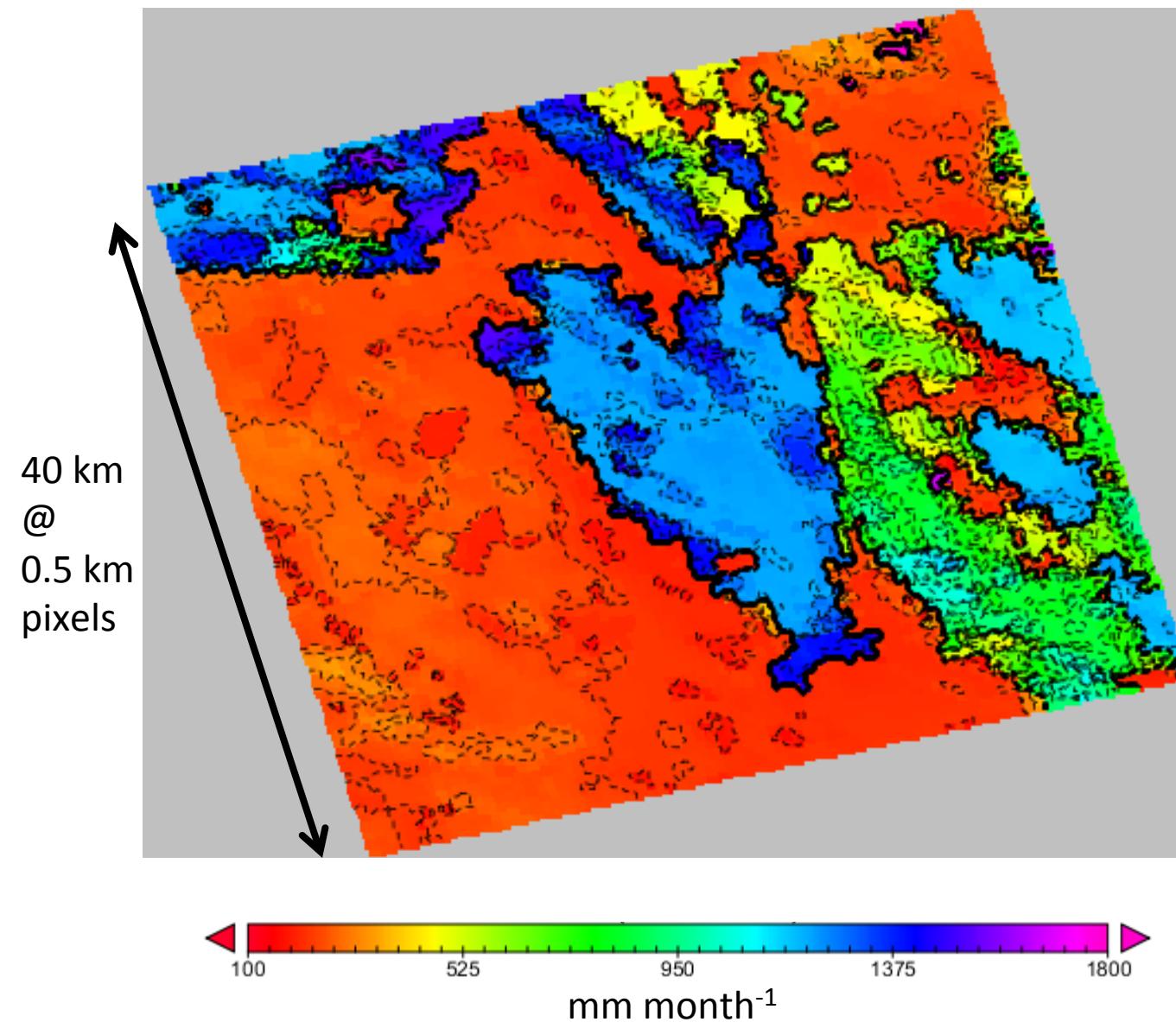
April: composite-averaged diurnal cycle for Latent Heat

Note: similar curves for May, June, Jul...but maxima are ~100 Wm⁻² greater



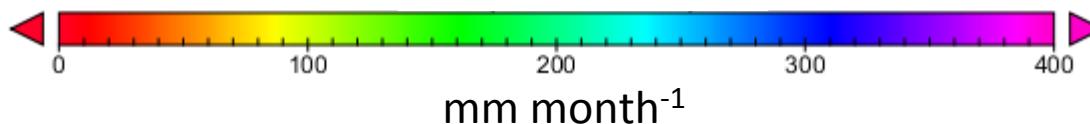
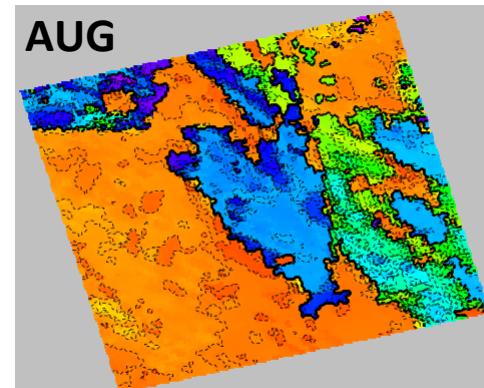
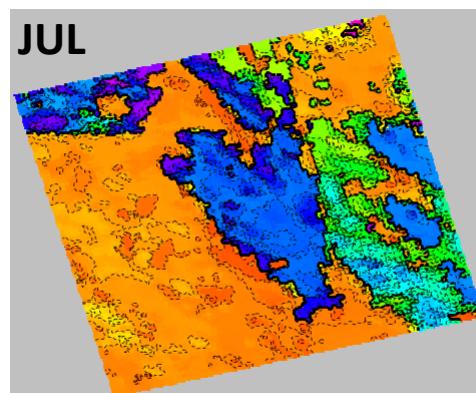
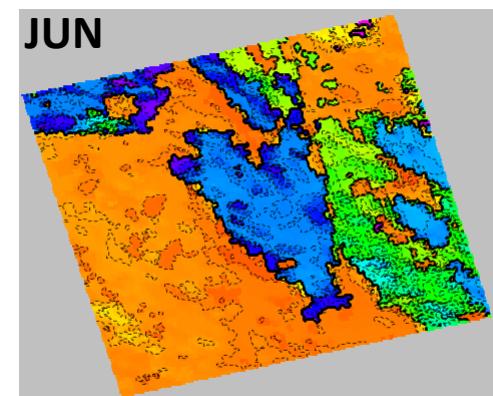
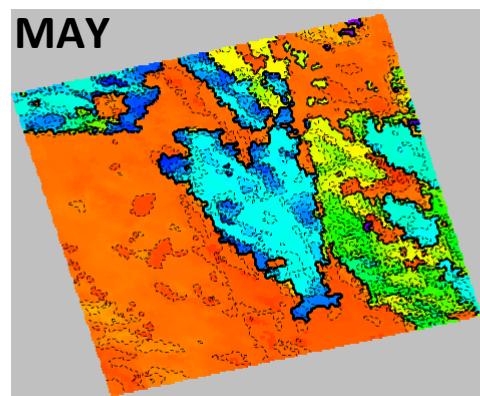
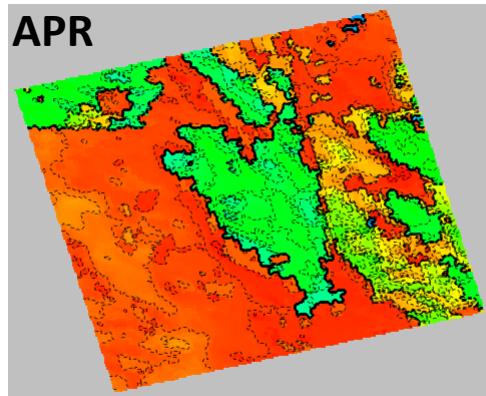
Note: y-axis indicates value of maximum LH for each plot & color scale

Total Seasonal Crop Evapotranspiration (ET_c) for Almond Orchards in the San Joaquin Valley
April 1st through August 31st 2008



Monthly Evapotranspiration (ET) for Almonds in the San Joaquin Valley

April through August 2008



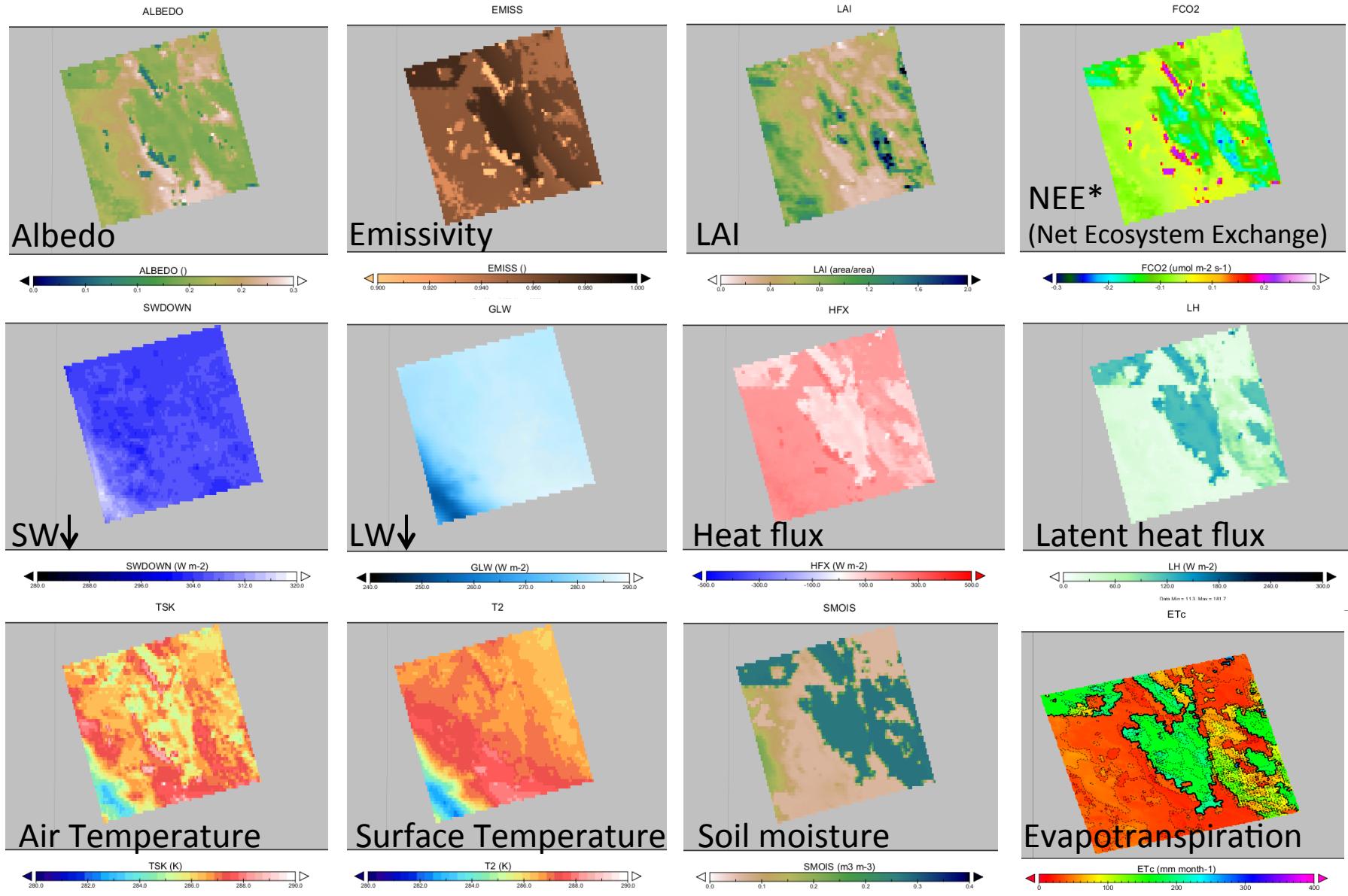
WRF-ACASA Model Inputs Improved by HypIRI

- Updated vegetation map/ crop type*
 - ACASA can differentiate more plant communities and canopy types
- Leaf Area Index* (LAIgreen) ($\text{m}^2 \text{ m}^{-2}$ 1-sided)
- Leaf PAR reflectivity (0.3-0.7 micron wavelength)
- Leaf NIR reflectivity (0.7-2.0 micron wavelength)
- Soil bkg. PAR reflectivity (0.3-0.7 micron wavelength)
- Soil bkg. NIR reflectivity (0.7-2.0 micron wavelength)
- Vcmax (maximum RuBisCO) ($\mu\text{mol m}^{-2} \text{s}^{-1}$) and Jmax
 - Total chlorophylls, carotenoids, xanthophyll cycle, water, Nitrogen, dry matter;
- Distributed skin temperature and emissivity
- Fractional cover

* WRF-ACASA now uses MODIS LAI product, California Augmented Multisource Landcover map

other parameters are assigned via WRF parameter table for each landuse type

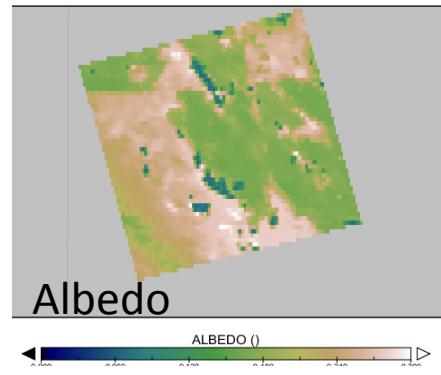
April Composite-averaged Plots; 17:00 LT (00:00 UTC)



* Can output GPP, NPP, heterotrophic respiration

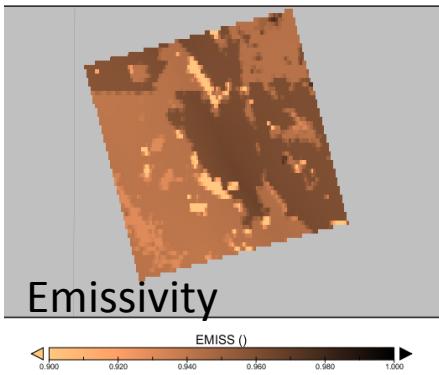
May Composite-averaged Plots; 17:00 LT (00:00 UTC)

ALBEDO



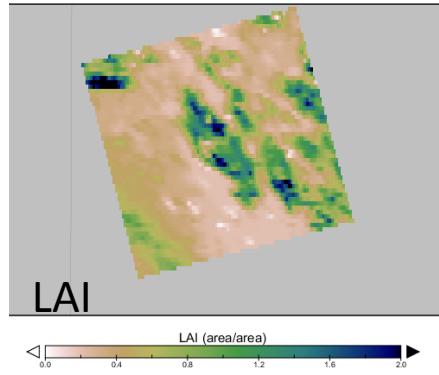
Albedo

EMISS



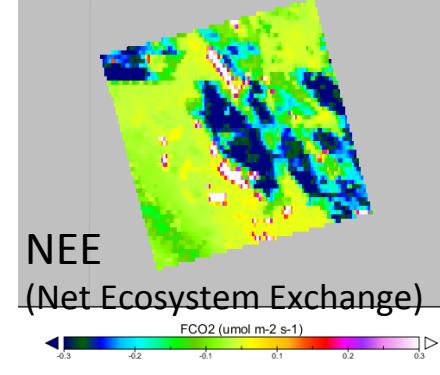
Emissivity

LAI

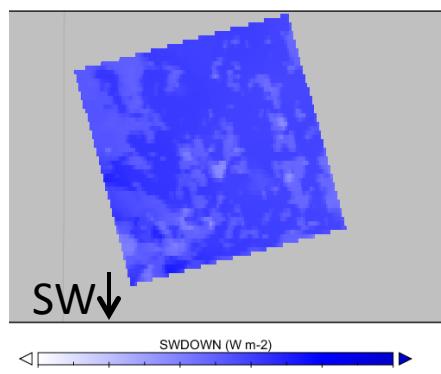


LAI

FCO2

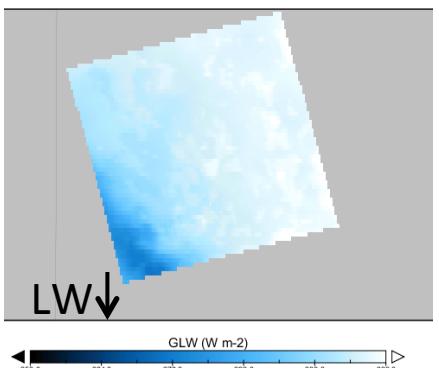
NEE
(Net Ecosystem Exchange)

SWDOWN



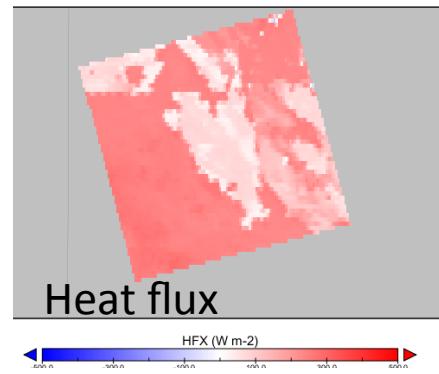
SW↓

GLW



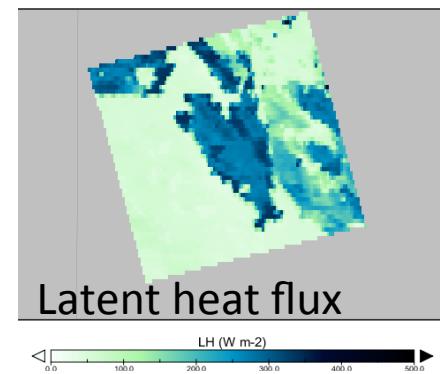
LW↓

HFX



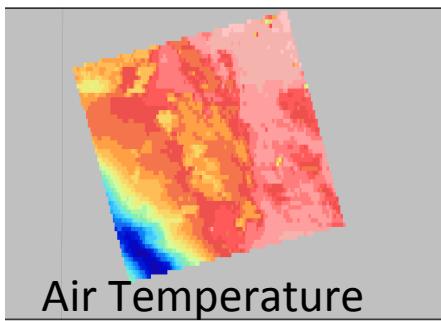
Heat flux

LH



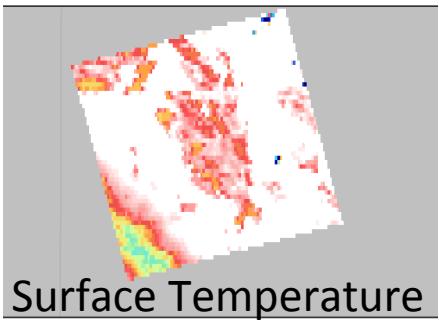
Latent heat flux

T2



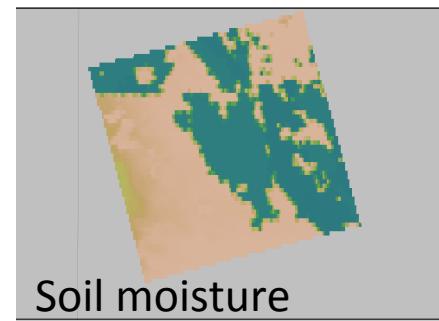
Air Temperature

TSK



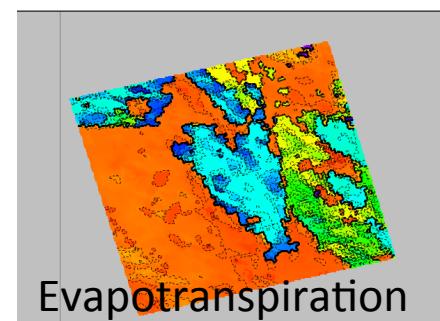
Surface Temperature

SMOIS



Soil moisture

ETc



Evapotranspiration

T2 (K)

TSK (K)

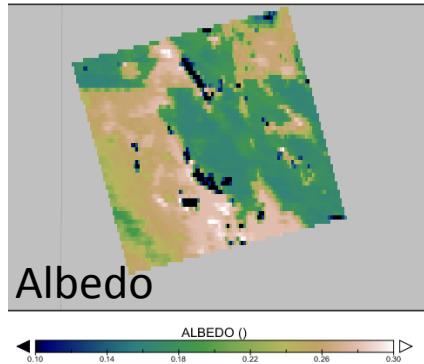
SMOIS (m³ m⁻³)

ETc (mm)

Date Min = 26, Max = 363

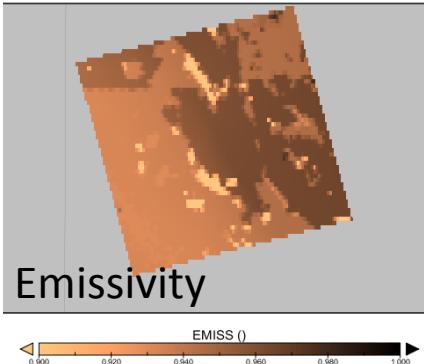
June Composite-averaged Plots; 17:00 LT (00:00 UTC)

ALBEDO



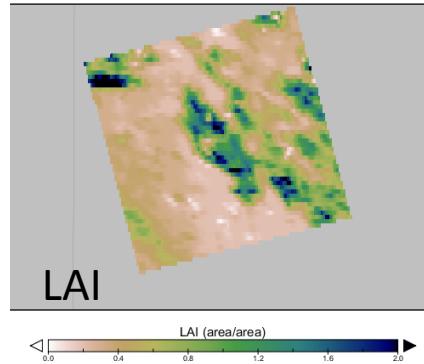
Albedo

EMISS



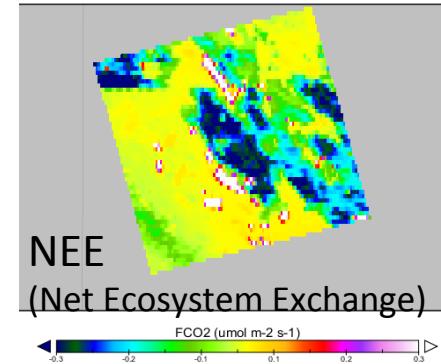
Emissivity

LAI

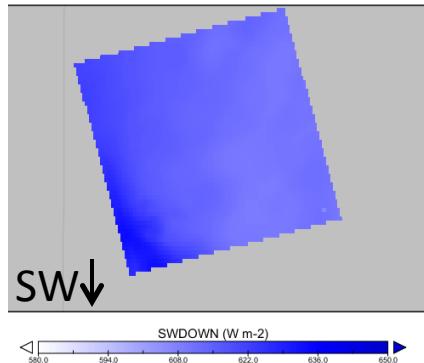


LAI

FCO2

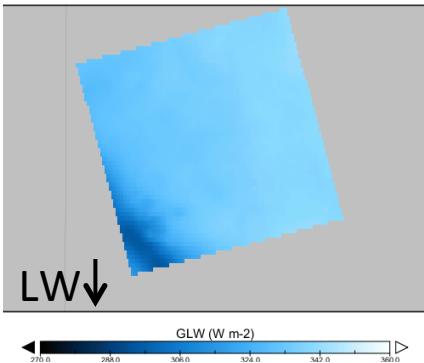
NEE
(Net Ecosystem Exchange)

SWDOWN



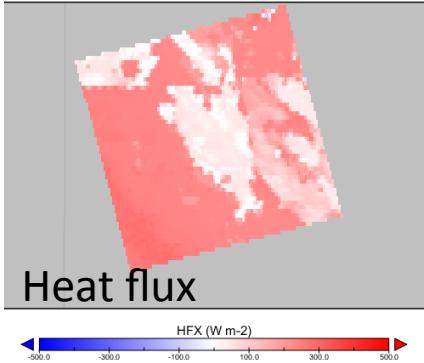
SW↓

GLW



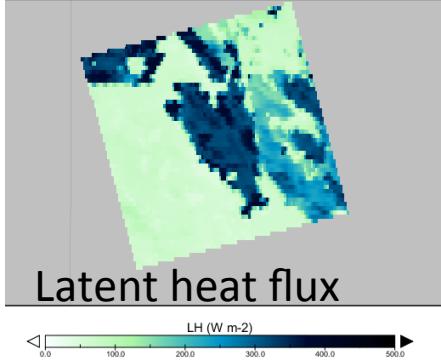
LW↓

HFX



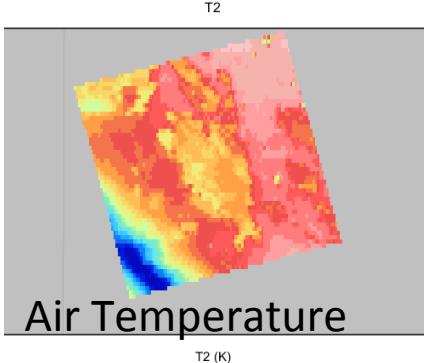
Heat flux

LH

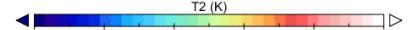


Latent heat flux

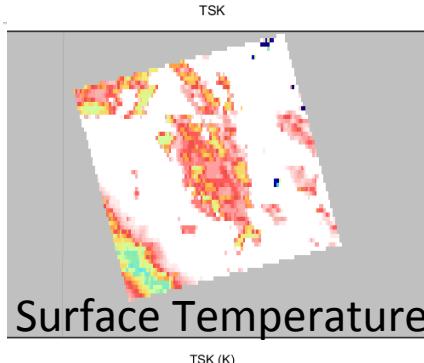
T2



Air Temperature



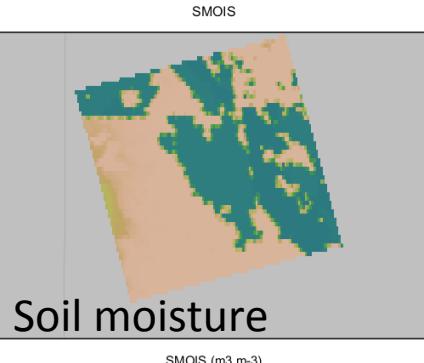
TSK



Surface Temperature



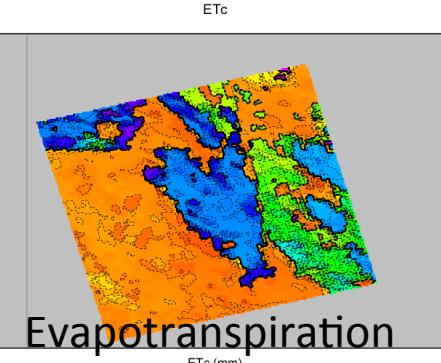
SMOIS



Soil moisture



ETc



Evapotranspiration

