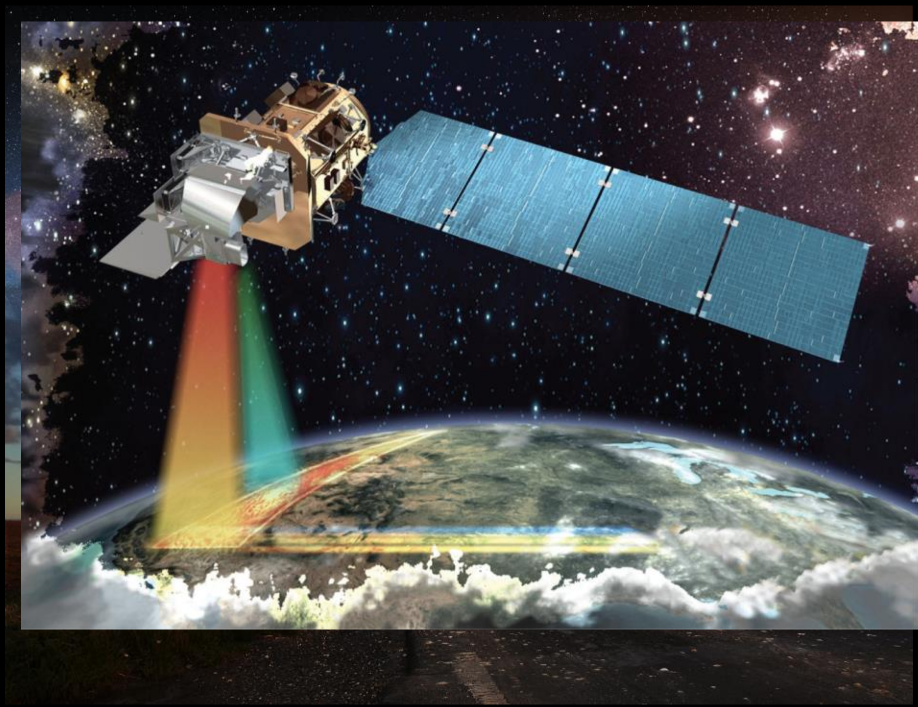
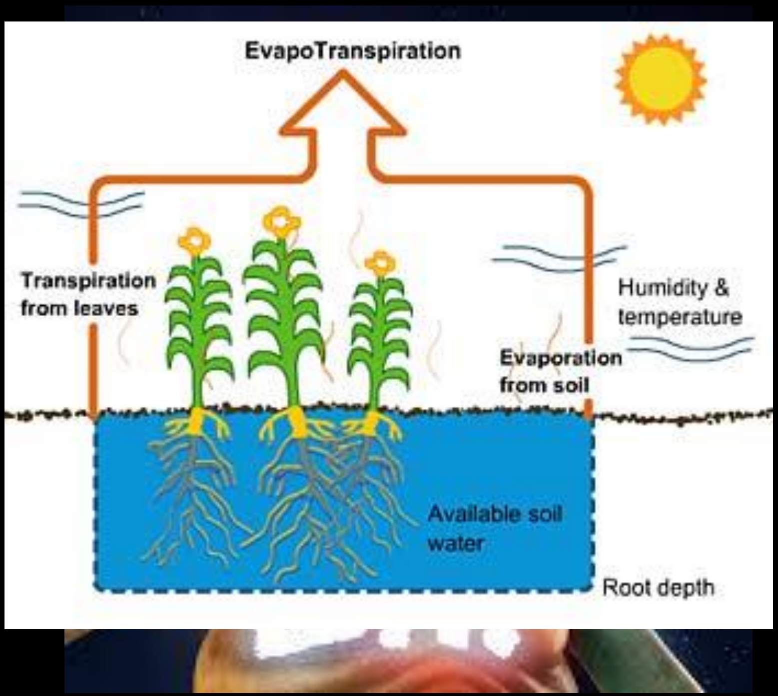
2015 International Workshop on Evapotranspiration Mapping for Water Security

Day 1 Summary

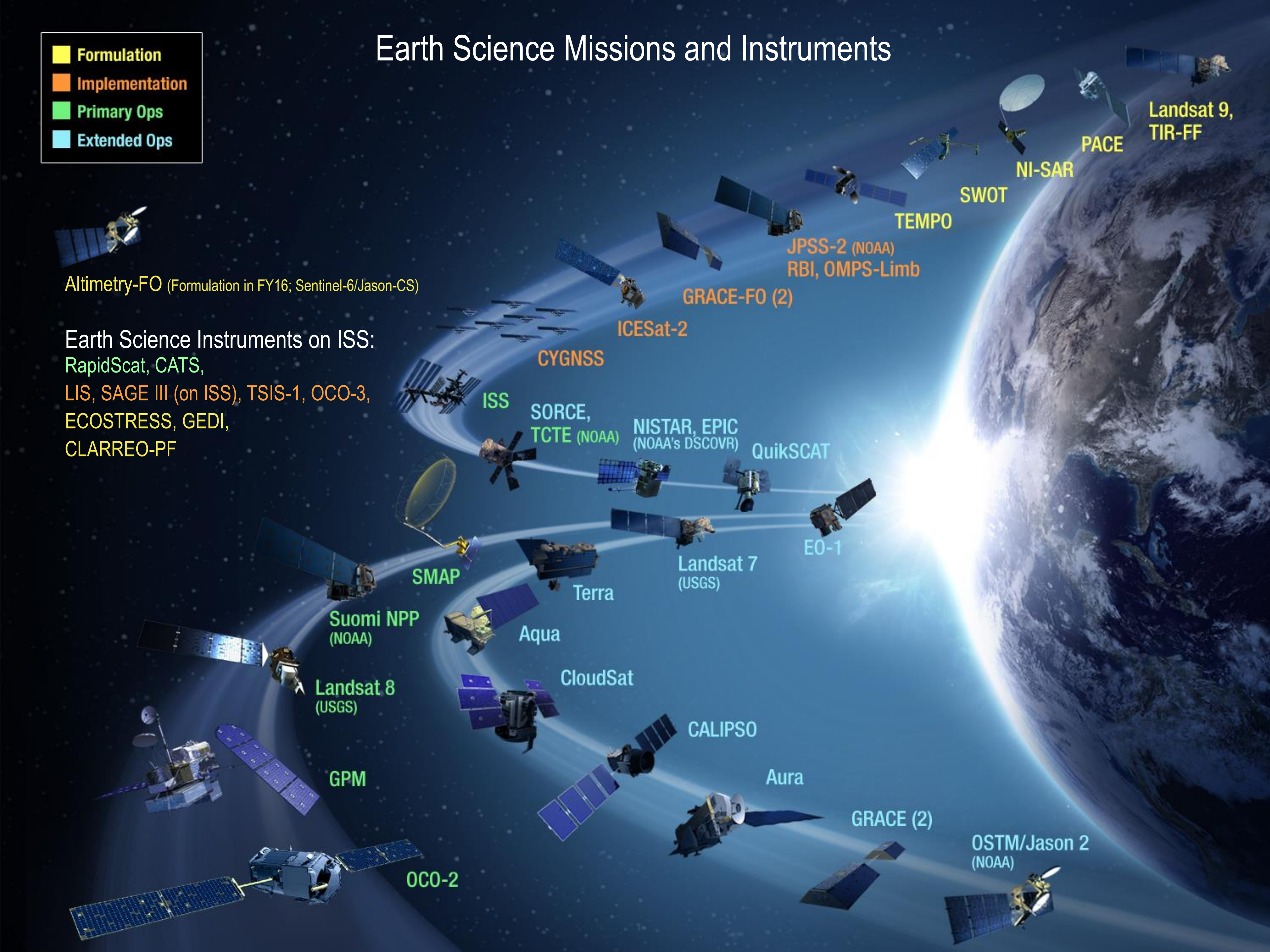
Forrest Melton
NASA ARC-CREST
forrest.s.melton@nasa.gov

NASA + ET?





Evapotranspiration (ET): water consumed (lost to atmosphere) through the combined processes of soil evaporation & plant transpiration


Earth Science Missions and Instruments
Formulation
Implementation
Primary Ops
Extended Ops
Altimetry-FO (Formulation in FY16; Sentinel-6/Jason-CS)
Earth Science Instruments on ISS:
RapidScat, CATS,
LIS, SAGE III (on ISS), TSIS-1, OCO-3,
ECOSTRESS, GEDI,
CLARREO-PF
Landsat 9, TIR-FF
PACE
NI-SAR
SWOT
TEMPO
JPSS-2 (NOAA)
RBI, OMPS-Limb
GRACE-FO (2)
ICESat-2
CYGNSS
ISS
SORCE,
TCTE (NOAA)
NISTAR, EPIC
(NOAA's DSCOVR)
QuikSCAT
EO-1
Landsat 7
(USGS)
Terra
SMAP
Suomi NPP
(NOAA)
Aqua
Landsat 8
(USGS)
CloudSat
CALIPSO
GPM
Aura
GRACE (2)
OSTM/Jason 2
(NOAA)
OCO-2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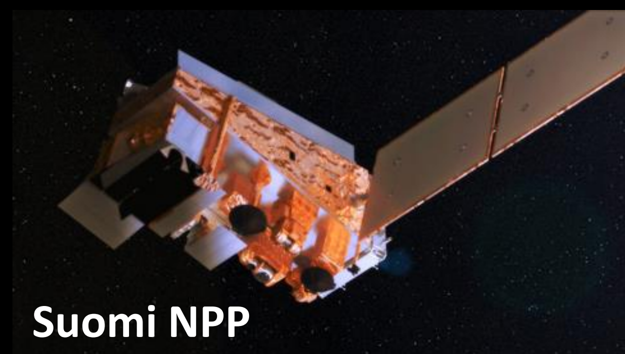
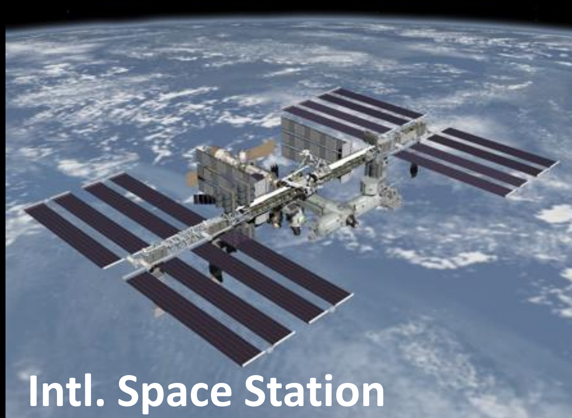
Contributing to
Water Cycle and
Food Security
Studies

Remote Sensing Platforms for Mapping ET

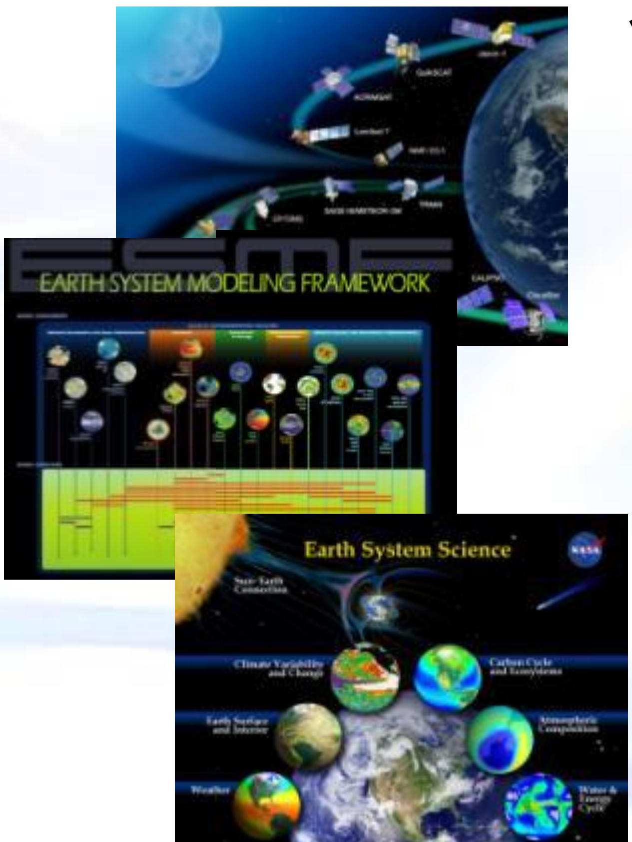




NASA Applied Sciences Program
A Pathway Between Earth Science & Society

Results of NASA Earth Science Research

Uses by Partners and Stakeholder Communities



NASA Applied Sciences Program

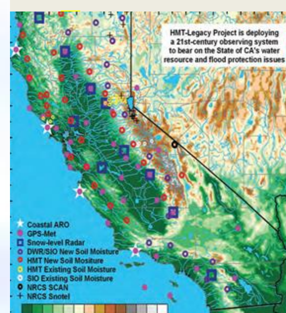
GEOSS Societal Benefit Areas

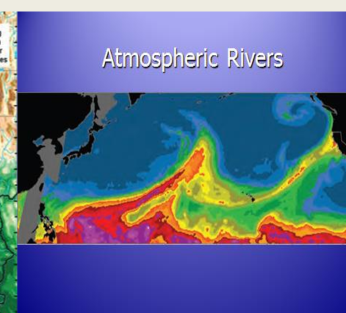
Perspectives on Value of Remotely-Sensed ET

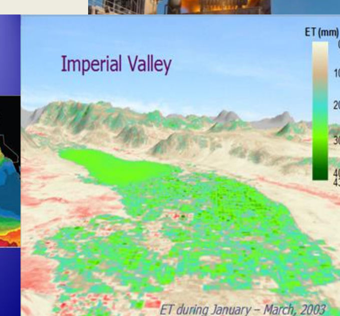
The future growth and prosperity of the western states depend upon the availability of adequate quantities of water of suitable quality

Priority State & Federal Actions

- Increase support/funding for data
- Identify and close data gaps
- Gather/disseminate real-time data
- Foster remote sensing capabilities
- Reduce costs through innovation







Tony Willardson,
Western States Water Council

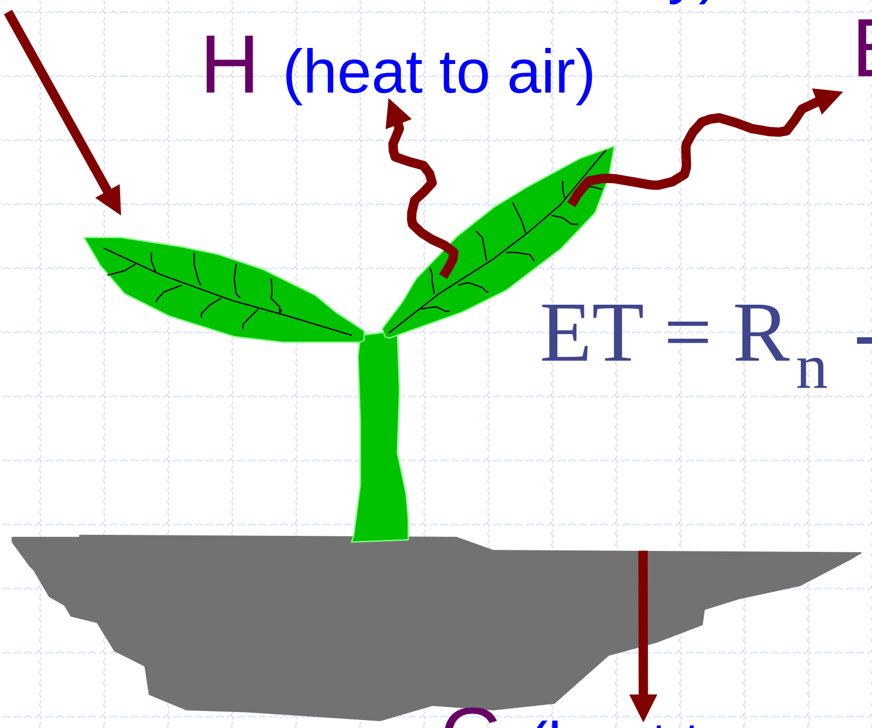
Why use an "Energy balance"?

- ET is calculated as a "residual" of the energy balance – driven by THERMAL

R_n (radiation from sun and sky)

H (heat to air)

ET

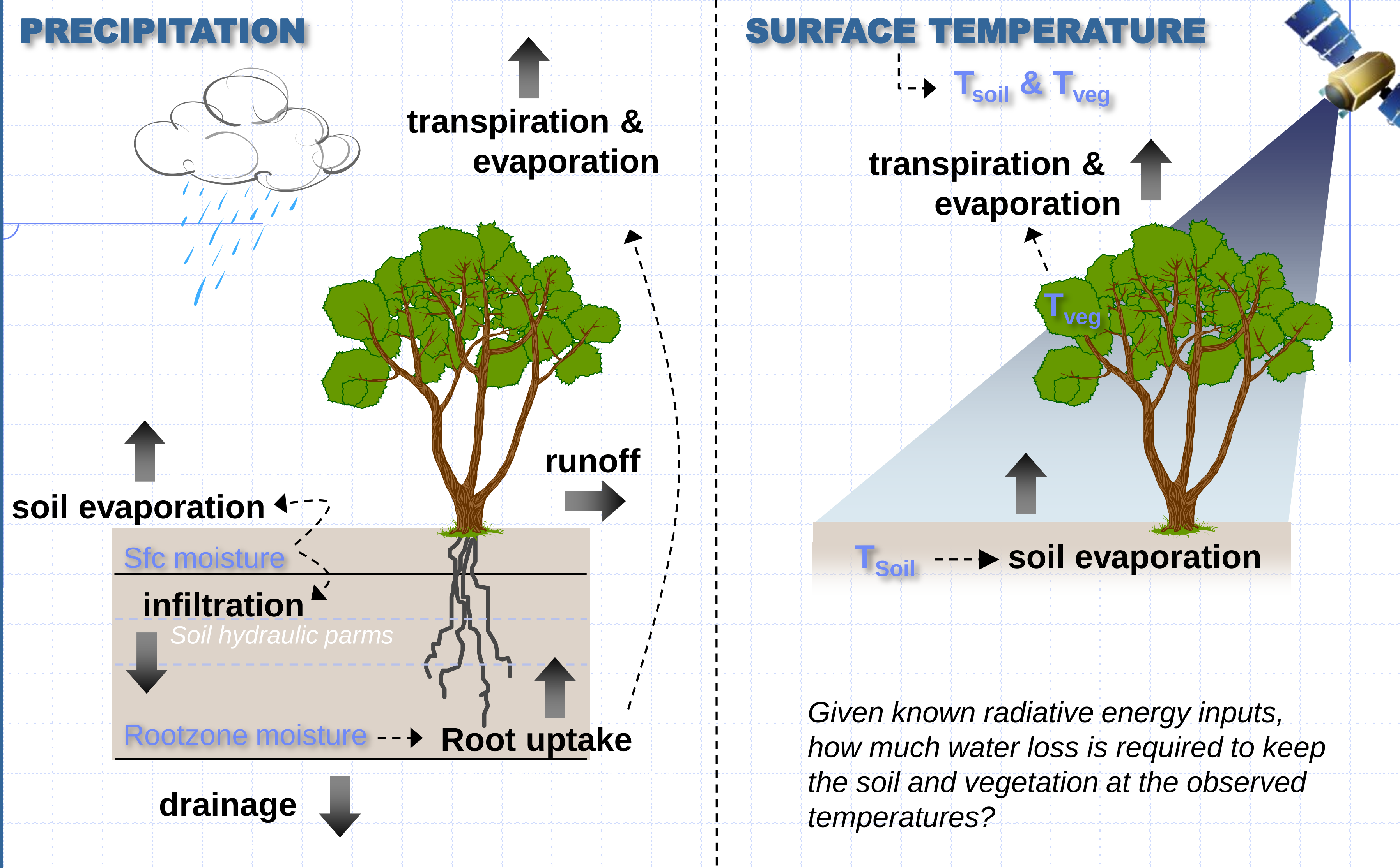


$$ET = R_n - G - H$$

G (heat to ground)

Basic Truth:
Evaporation consumes Energy

Approaches to mapping ET

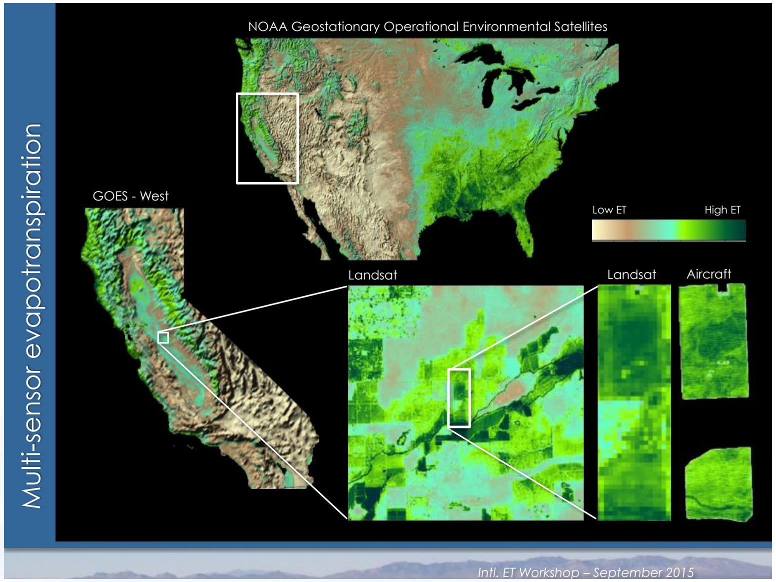


Given known radiative energy inputs, how much water loss is required to keep the soil and vegetation at the observed temperatures?

WATER BALANCE APPROACH	***ENERGY BALANCE APPROACH***
(prognostic modeling)	*(diagnostic modeling)*

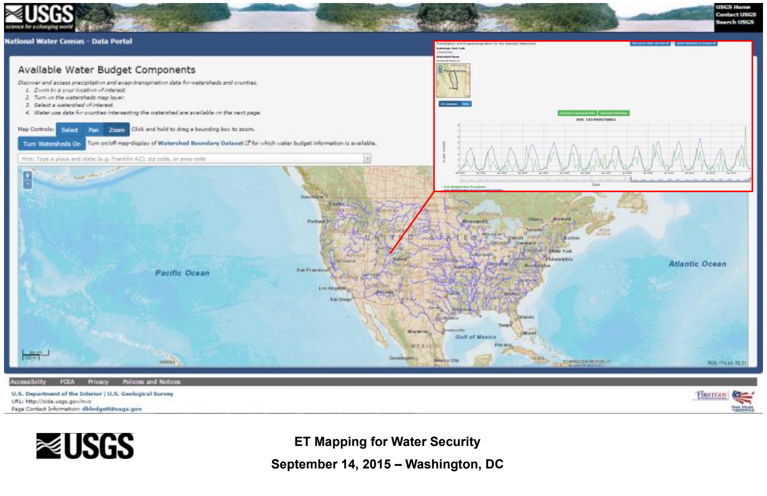
US Applications at the National Scale

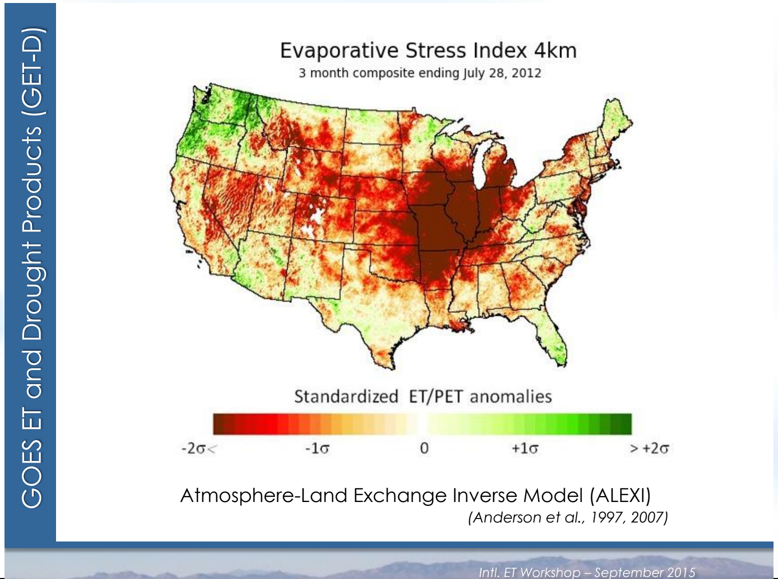
Martha Anderson, USDA ARS

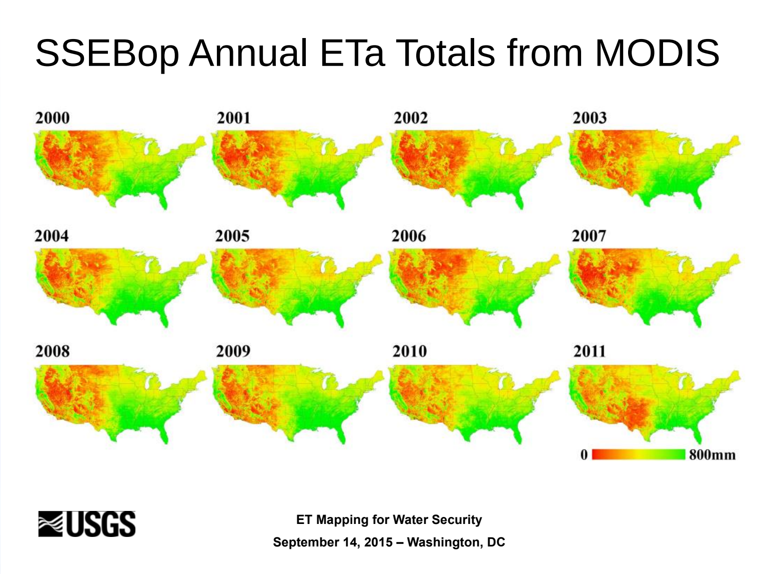


Jim Verdin, USGS

National Water Census – Data Portal





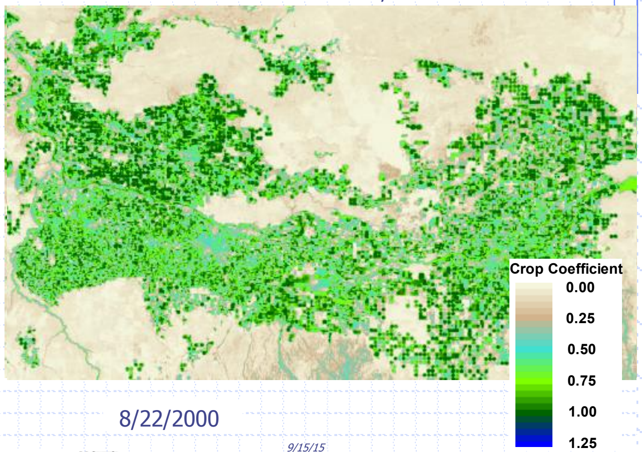


Rick Allen, University of Idaho

METRIC Applications in Idaho

- Water Planning
- Aquifer Depletion
- Hydrologic Modeling
- Endangered Species
- Agricultural Water Use
- Legal Finding-of-Fact
- Water Rights Buy-Back
- Water Rights Compliance
- In-Season Water Demand
- Tribal Water Rights Negotiations

Time Series of ET near Twin Falls, ID

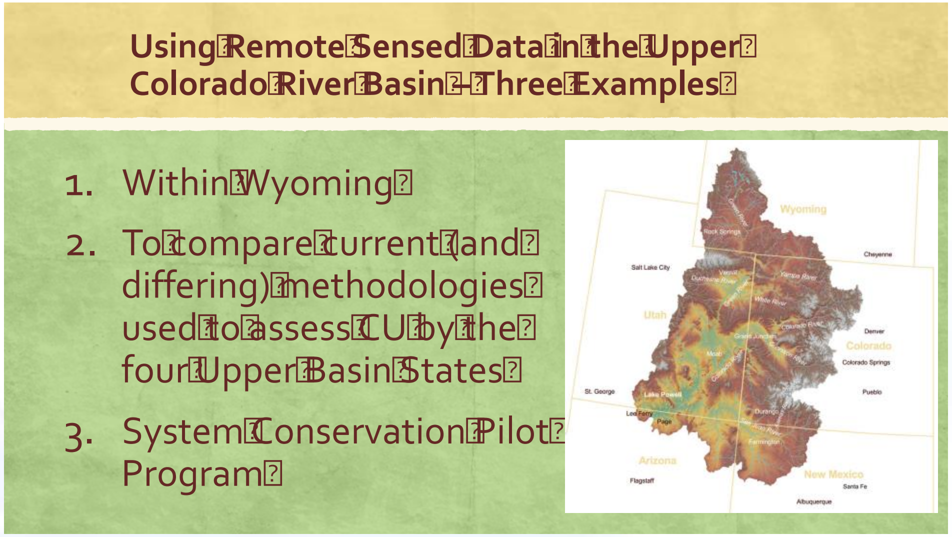


8/22/2000

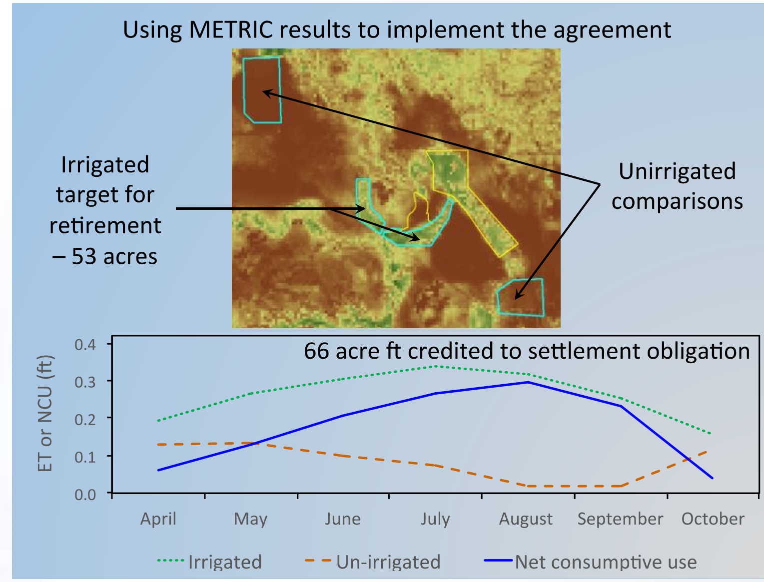
9/15/15

Applications of METRIC for Water Management

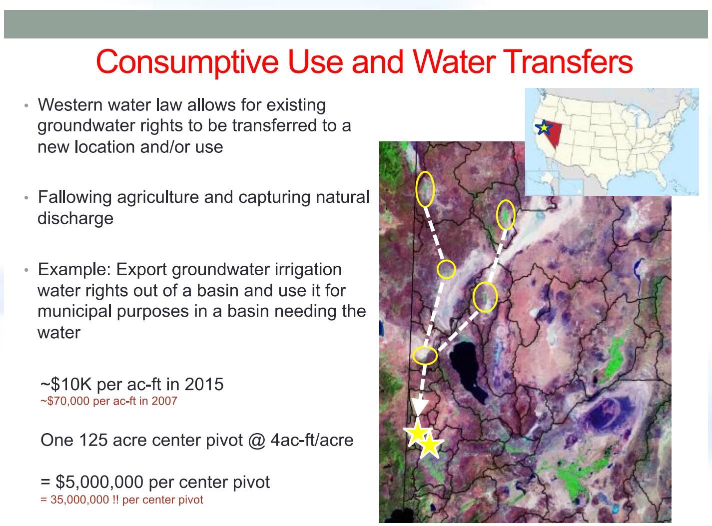
Steve Wolff, Wyoming State Eng. Office



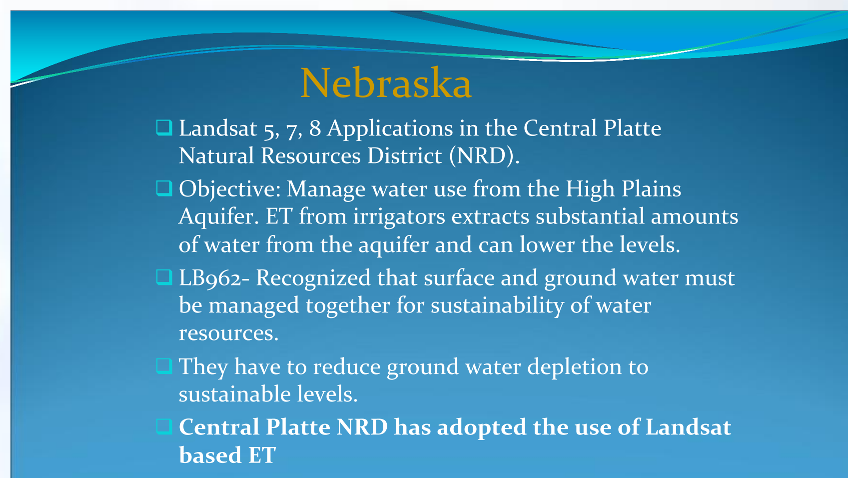
Larry Dunsmore, Klamath Tribes



Justin Huntington, DRI



Duane Woodward, Central Platte NRD



ET Applications for Irrigation Management

Sonia Salas, Western Growers

Use of ET

Challenges

- ET data gaps due to lack of local/ representative weather stations in certain locations
- Lack of local commodity specific irrigation scheduling calculators (Real-time crop, regional/site specific conditions should be considered when using ET)

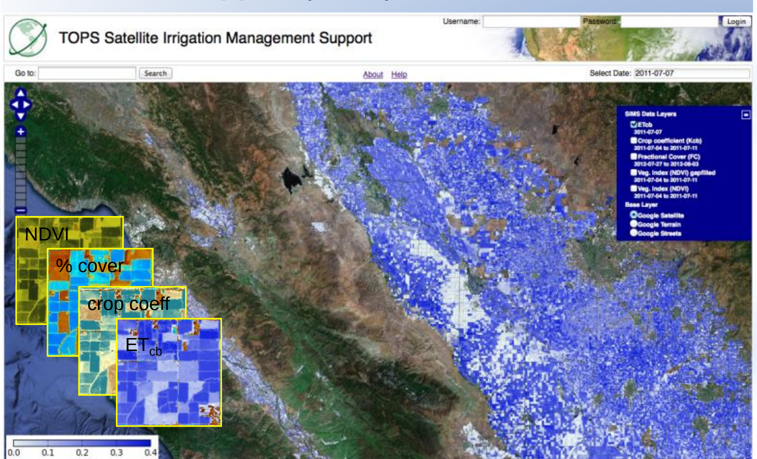
Opportunities

- ET data enhancement. For example, CIMIS * is utilizing remotely sensed satellite data to generate ETo maps and address data gaps.
- Support/continue successful efforts that consider crop, regional/site specific conditions (irrigation calculators for avocados, lettuce, almonds, wine grapes)

*** California Irrigation Management Information System (CIMIS)**

Forrest Melton, NASA ARC-CREST

Satellite Irrigation Management Support (SIMS) Web Services



Martin Mendez-Costabel, E & J Gallo

PRESENT Model for deployment of Satellite-Based applications

- Desktop and mobile based – information delivered to growers real time via mobile applications
- Use of 'Landsat web services' and cloud computing systems via:
  - Amazon S3
  - Google Earth Engine
- Custom mobile applications for:
  - Viewing
  - Editing
  - Collection
- ***24-HOUR DELIVERY***

8

Custom Irrigation Schedules

- Growers get access to authoritative content (Maps/Apps – real time information)
- Mobile-based
- Farming to tier & specific stress index

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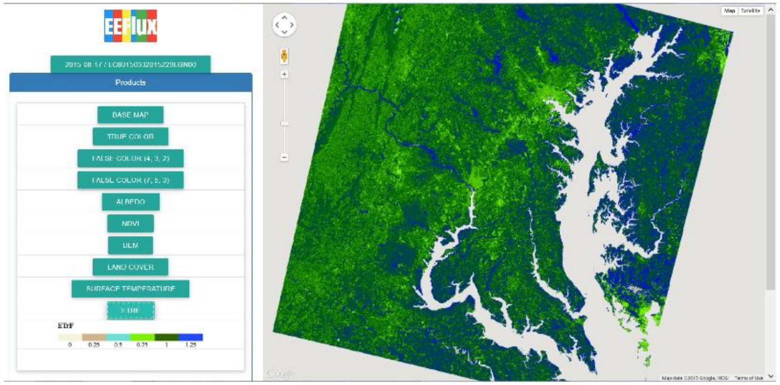
Advancing ET Applications with Cloud Computing

Ayse Kilic, Univ. of Nebraska

Google Earth Engine Evapotranspiration Flux - EEFlux

ETrF--Fraction of Reference ET

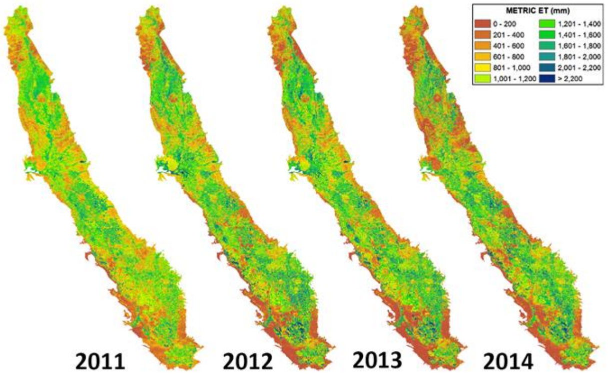


$ET_rF = ET/ET_{ref}$

ET_{ref} is reference ET- ASCE-Penman Monteith Alfalfa reference

Justin Huntington, DRI

Testing Large Area Applications of Automated METRIC Energy Balance on NEX



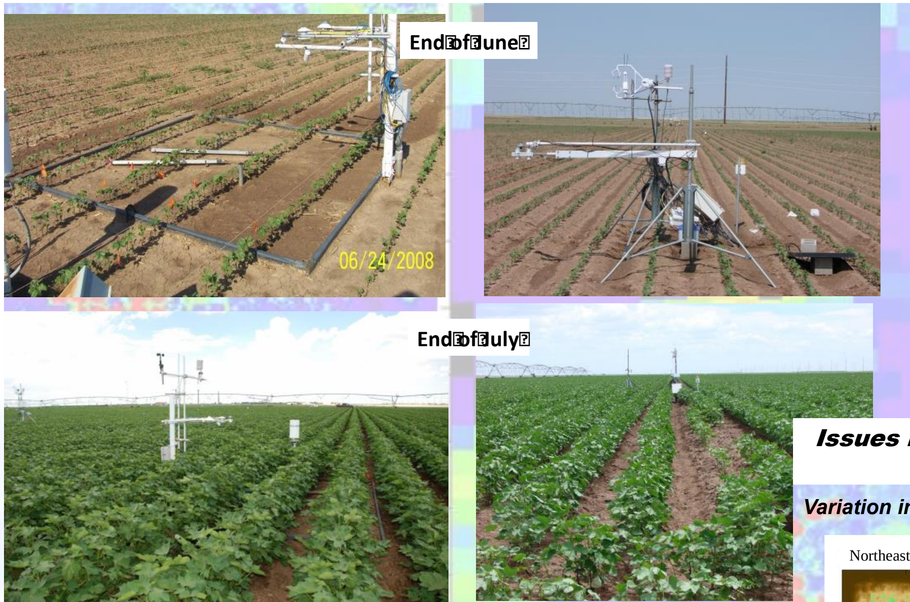
NASA Earth Exchange

Collaboration with Forrest Melton

You can't Manage what you can't Measure!

Evaluating ET Measurements

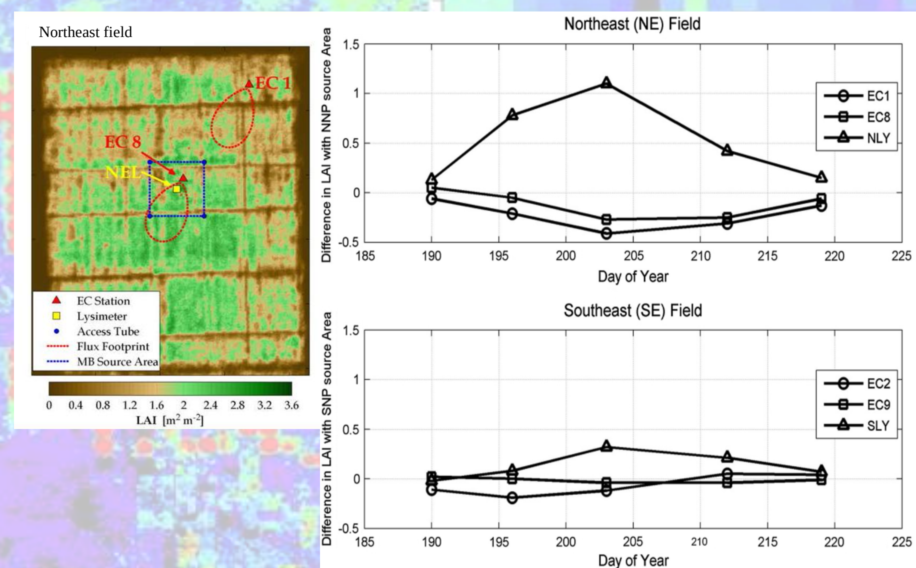
Issues in Evaluating ET Model Output Using Measurements and Model Inter-comparisons



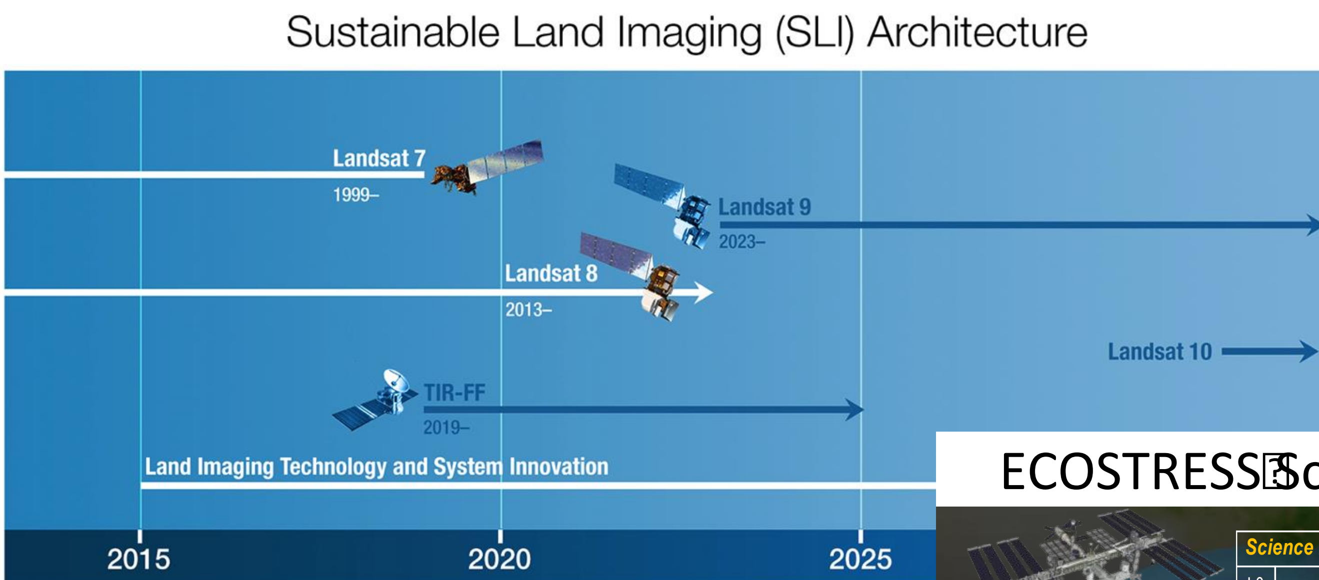
Bill Kustas, USDA ARS

Issues in Evaluating ET Model Output Using Measurements and Model Inter-comparisons

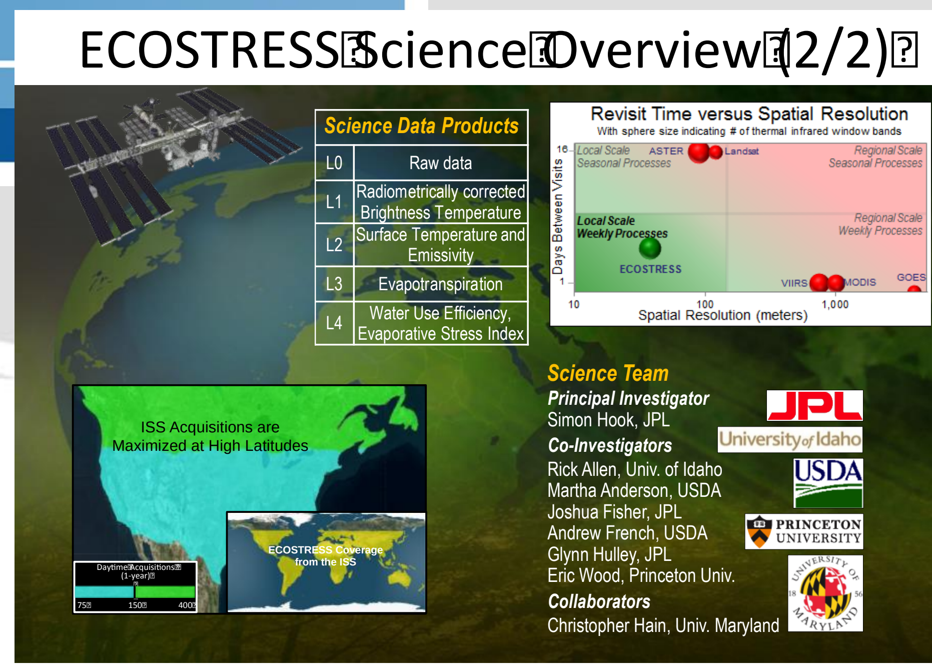
Variation in source area/flux footprint affecting the measurements by NP, LY and EC systems



Upcoming Missions to Support Water Management



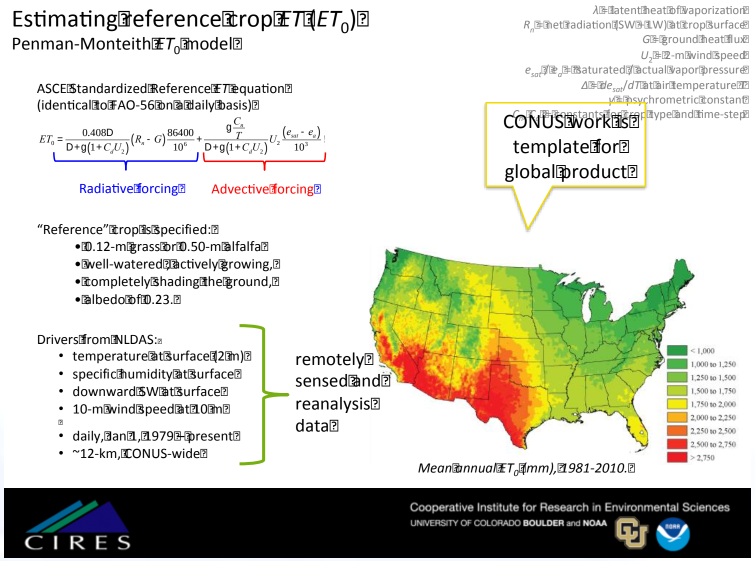
Brad Doorn, NASA HQ



Josh Fisher, NASA JPL

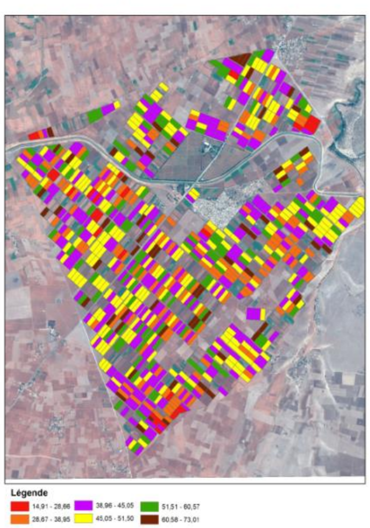
Other Topics

Mike Hobbins, NOAA

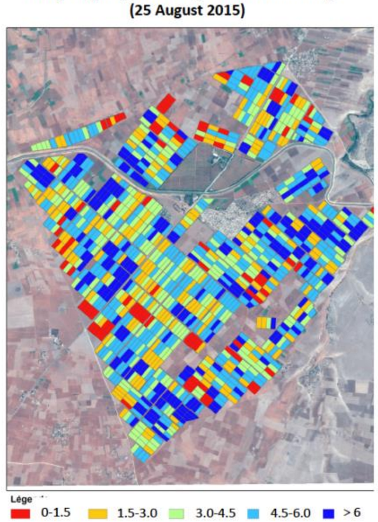


Mutlu Ozdogan, Univ. of Wisconsin

Cumulated ET (mm) from Jan 27 to Apr 17, 2015



Daily ET (mm) processing from Landsat image (25 August 2015)



Tim Newman, USGS

U.S. Geological Survey Stakeholder Outreach

- USGS Requirements, Capabilities & Analysis (RCA) activity
- Landsat Science Team
- National Geospatial Advisory Committee - Landsat Advisory Group
- USGS Fort Collins Science Center Surveys and Case Studies
- Department of the Interior Remote Sensing Working Group
- Office of Science & Technology Policy-led Earth Observation Assessment
- U.S. Group on Earth Observations (USGEO)
- National Research Council Earth Science Decadal Survey
- Landsat Ground Station Operators & Technical Working Groups
- AmericaView Nationwide Consortium for Remote Sensing
- Committee on Earth Observation Satellites (CEOS)
- Intergovernmental Group on Earth Observations (GEO)
- Joint Agency Commercial Evaluation (JACIE) Workshop
- Day-to-day interaction with users, meetings, conferences, workshops

Themes from Day 1

1. Remotely-sensed ET data products are currently used for water management applications in 22 states in the U.S., and for national-scale applications including drought monitoring and the U.S. Water Census

2. Advances in use of cloud computing and web services / mobile devices are increasing access to remotely sensed ET data

3. Improving frequency of 30-100m satellite observations would enhance water management applications in U.S. and internationally