ECOSTRESS METRIC EVAPOTRANSPIRATION ALGORITHM

Rick Allen, University of Idaho-Kimberly

Ayse Kilic, University of Nebraska-Lincoln

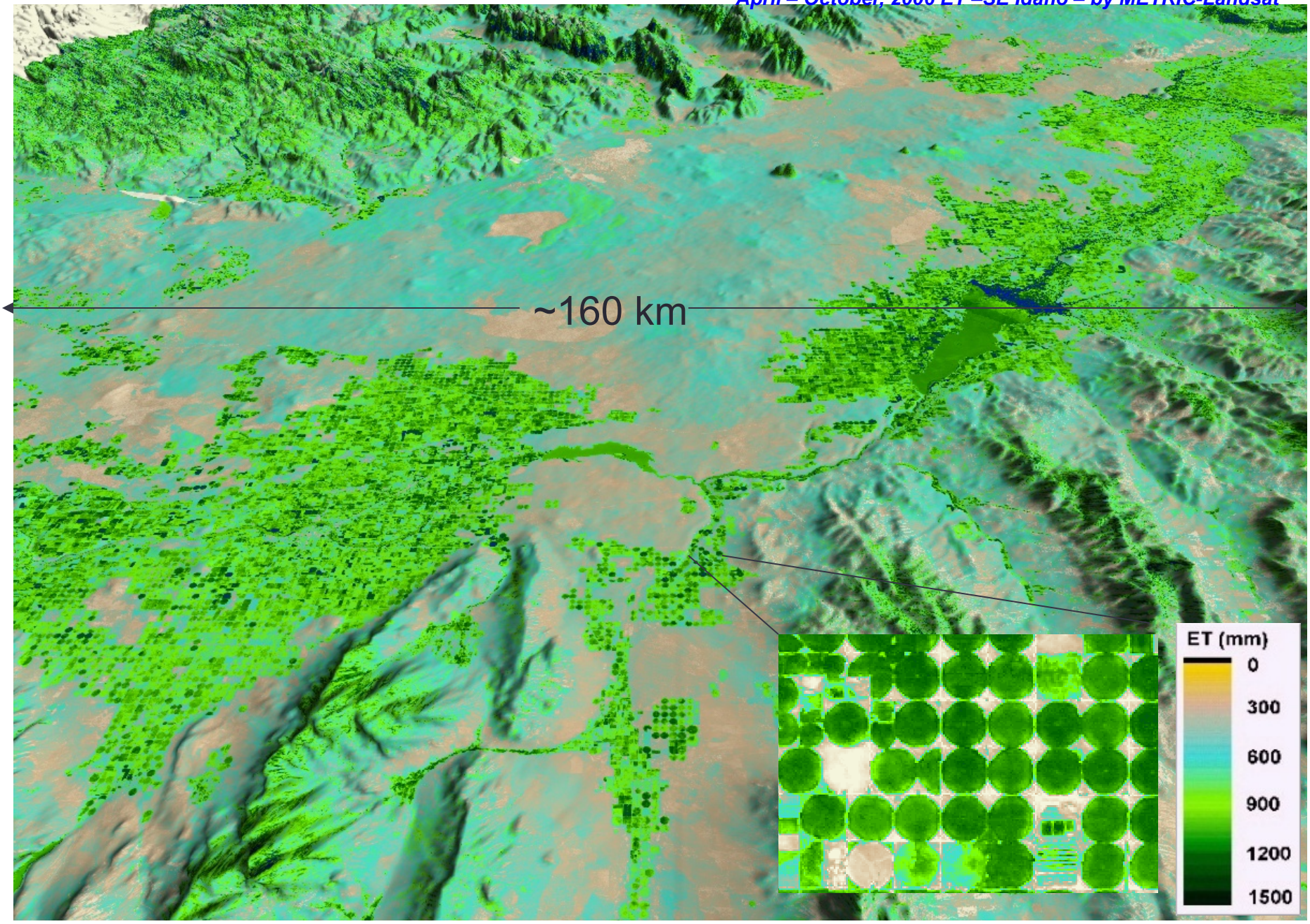
Members of the Landsat Science Team

EcoSTRESS Science Support

Support:

Ricardo Trezza, Univ. Idaho
Clarence Robison, Univ. Idaho
Philip Blankenau, Univ. Nebraska-Lincoln
Samuel Ortega, Univ. Nebraska-Lincoln

ET is needed at the field scale and for historical and present



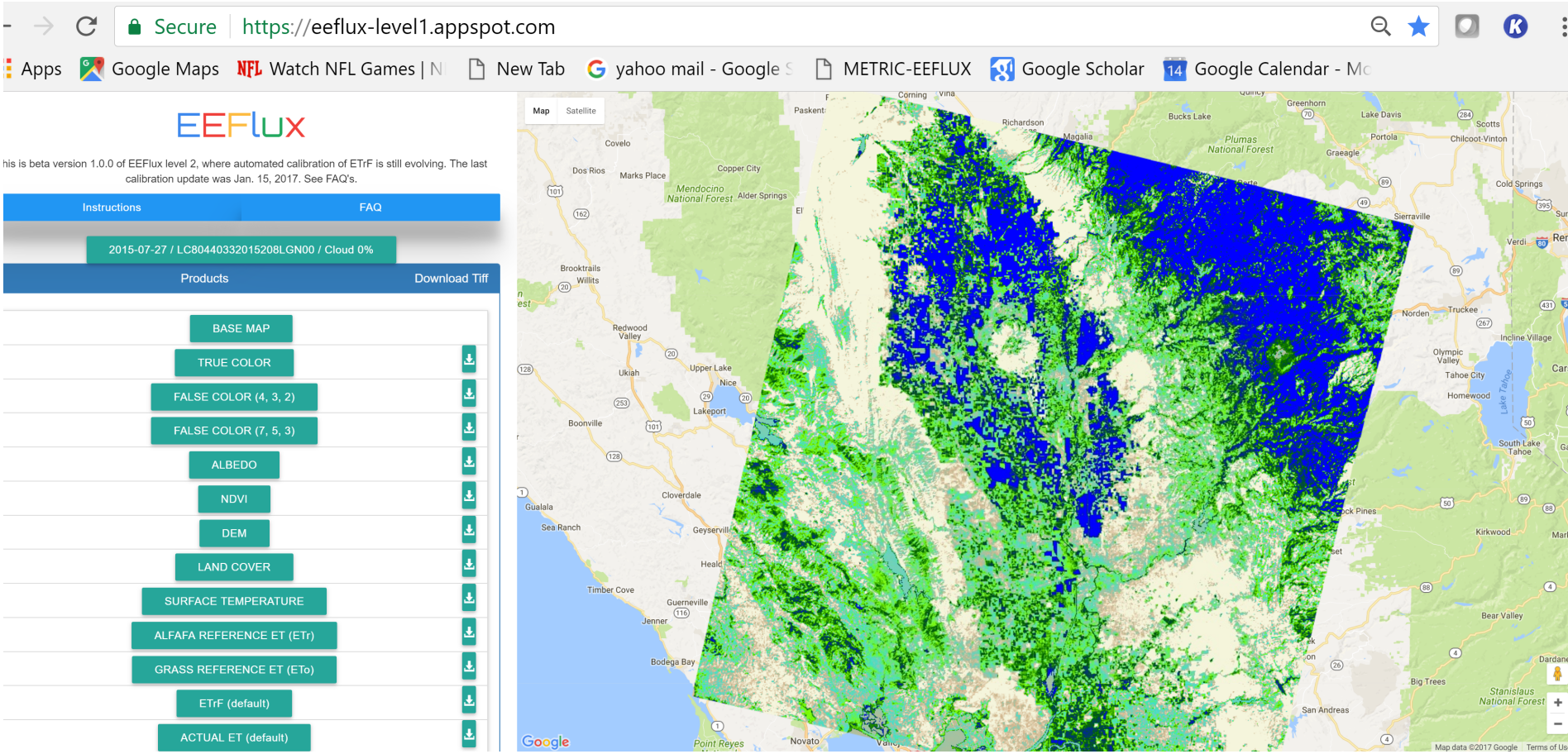
Close up Orbit -- 420 km

International Space Station

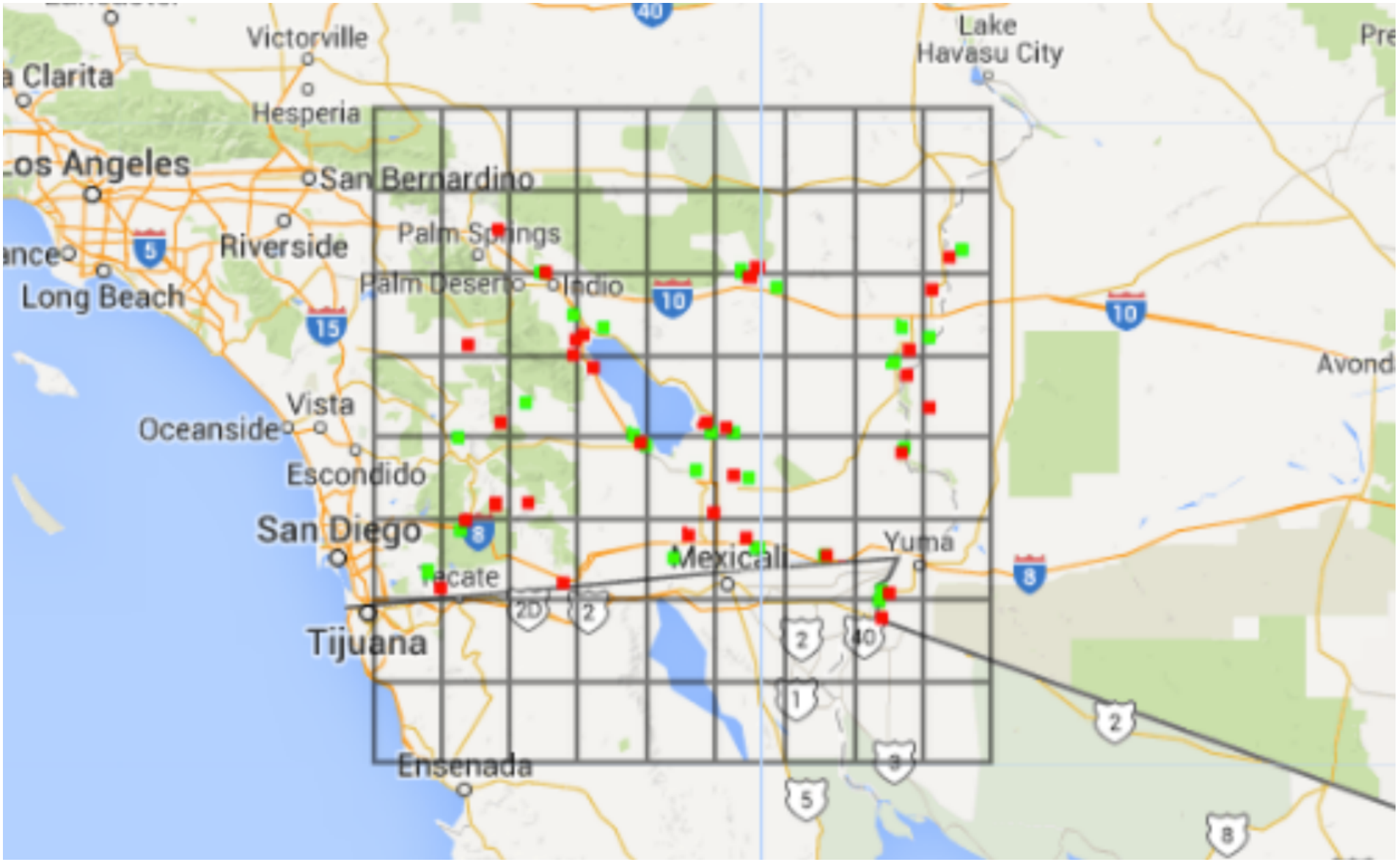
METRIC/EEFLUX-ECOSTRESS

Porting Algorithms

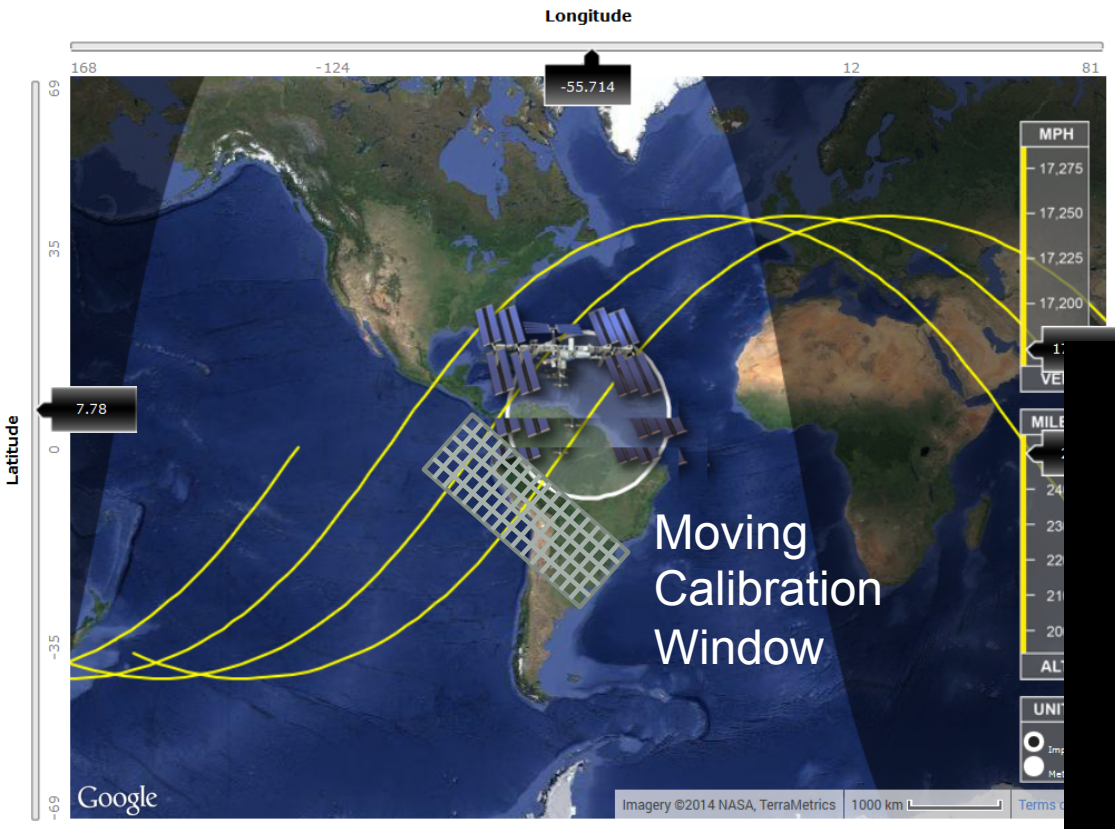
EEFlux – Landsat-based (30 m) ET mapping on Google Earth Engine



Gridded Calibration of Energy Balance in EEFlux – Using Near-Endpoints in Thermal

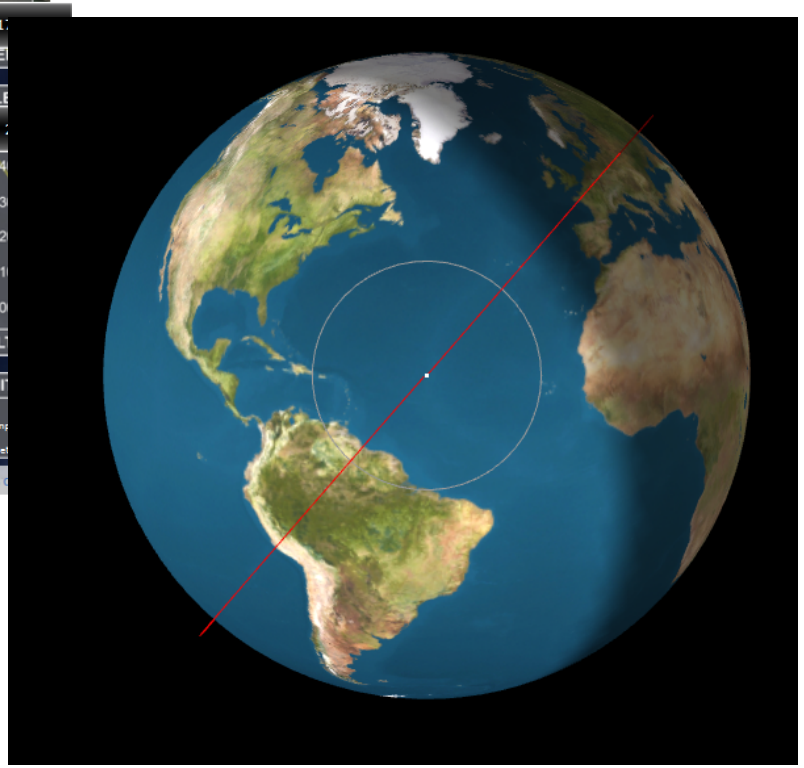


I.S.S. Tracker



Orbital speed
17000 mph
7660 meters/second

Altitude: 420 km



Sun angle continually changing
Land / precipitation conditions continually changing

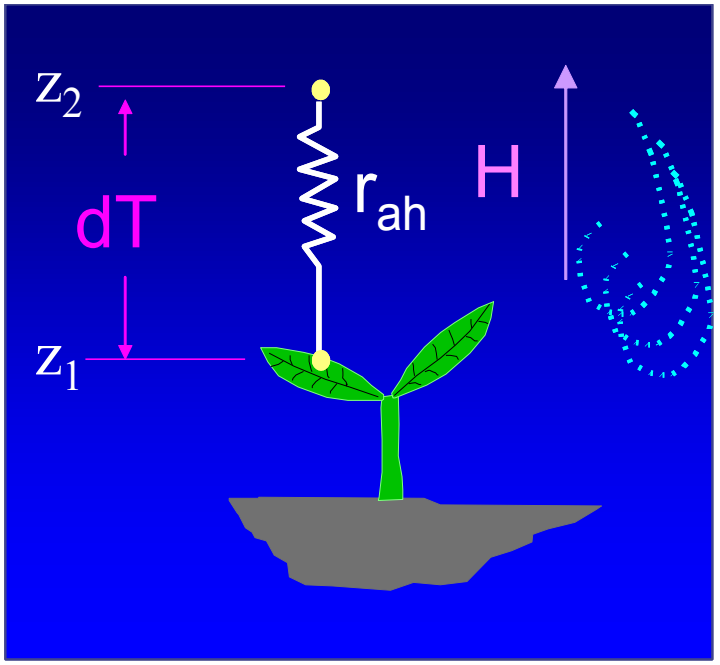
CALIBRATION OF METRIC/EEFLUX:

$bias_{Rn-G}$ → $bias_{H-cal}$ → $bias_{dT}$ → $bias_{H-pixel}$ → LE

unbiased

The Sensible Heat (H) Function with end-member LST calibration *calibrates around Biases in many of the Energy balance components:*

(Biases exist in: net radiation, soil heat flux, aerodynamic stability, aerodynamic roughness, absolute surface temperature, atmospheric correction)



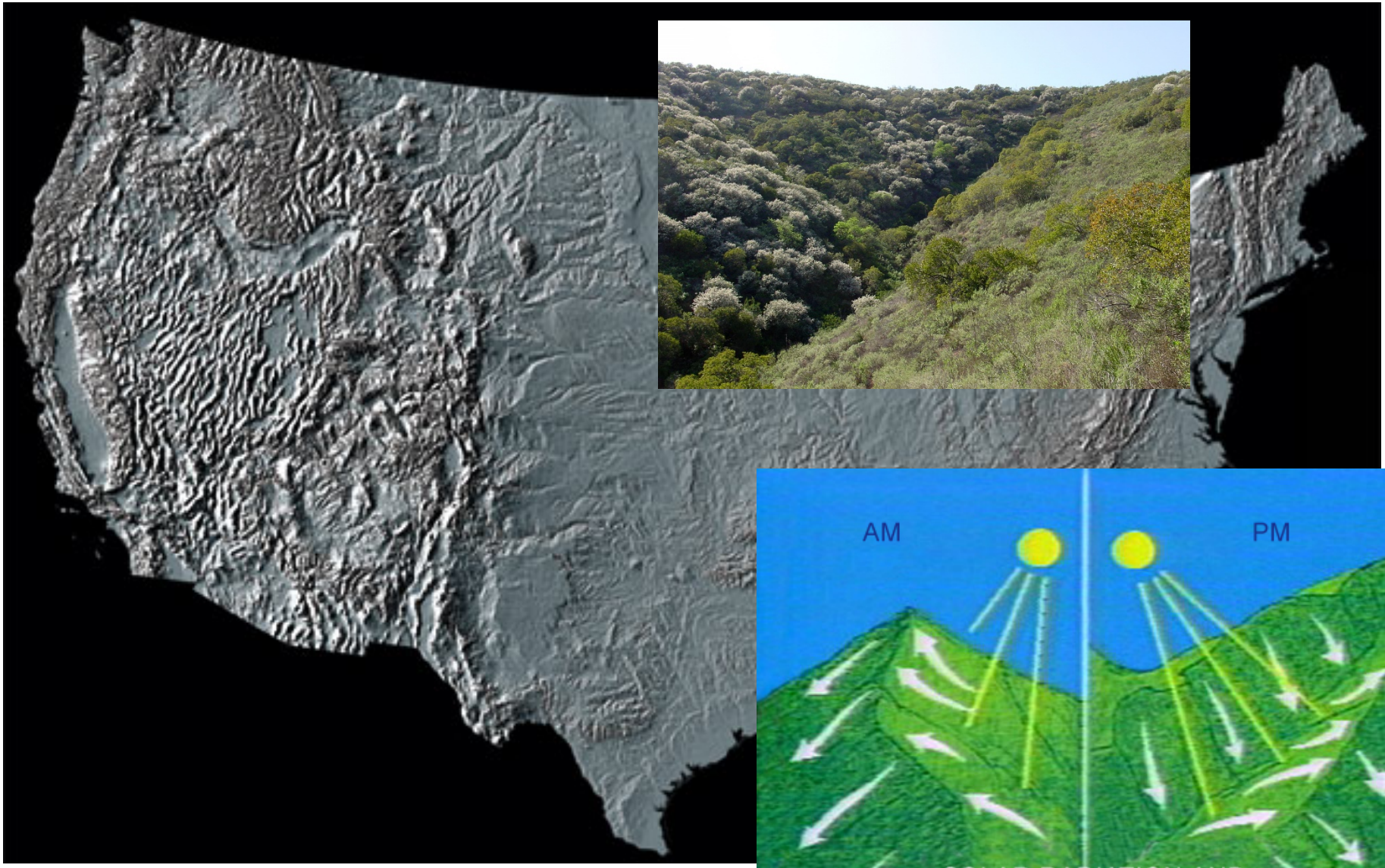
any biases

$H = R_n - G - LE$ *(for calibration)*

$LE = R_n - G - H$ *(during application)*

Biases cancel out

Topography of the United States and World is Complex – impacting solar radiation balance



METRIC includes radiation algorithms for slopes and terrain roughness algorithms

Data Sources

Albedo and Vegetation Indices

- From Landsat, Sentinel II Images Closest/Bracketed in time

Wind Speed, Humidity, Reference ET

- From CFSV2 or GLDAS2 Gridded Weather Data

Science Questions

- How does the ET_rF (ET as a fraction of Reference ET) vary during the day for:
  - Irrigated Crops
  - Rainfed Crops
  - Riparian Systems
  - Rangeland
  - Forest
- How does variation in ET_rF impact time-integrated ET estimation (which often assumes constant ET_rF)?

METRIC-ECOSTRESS

Student Collaboration

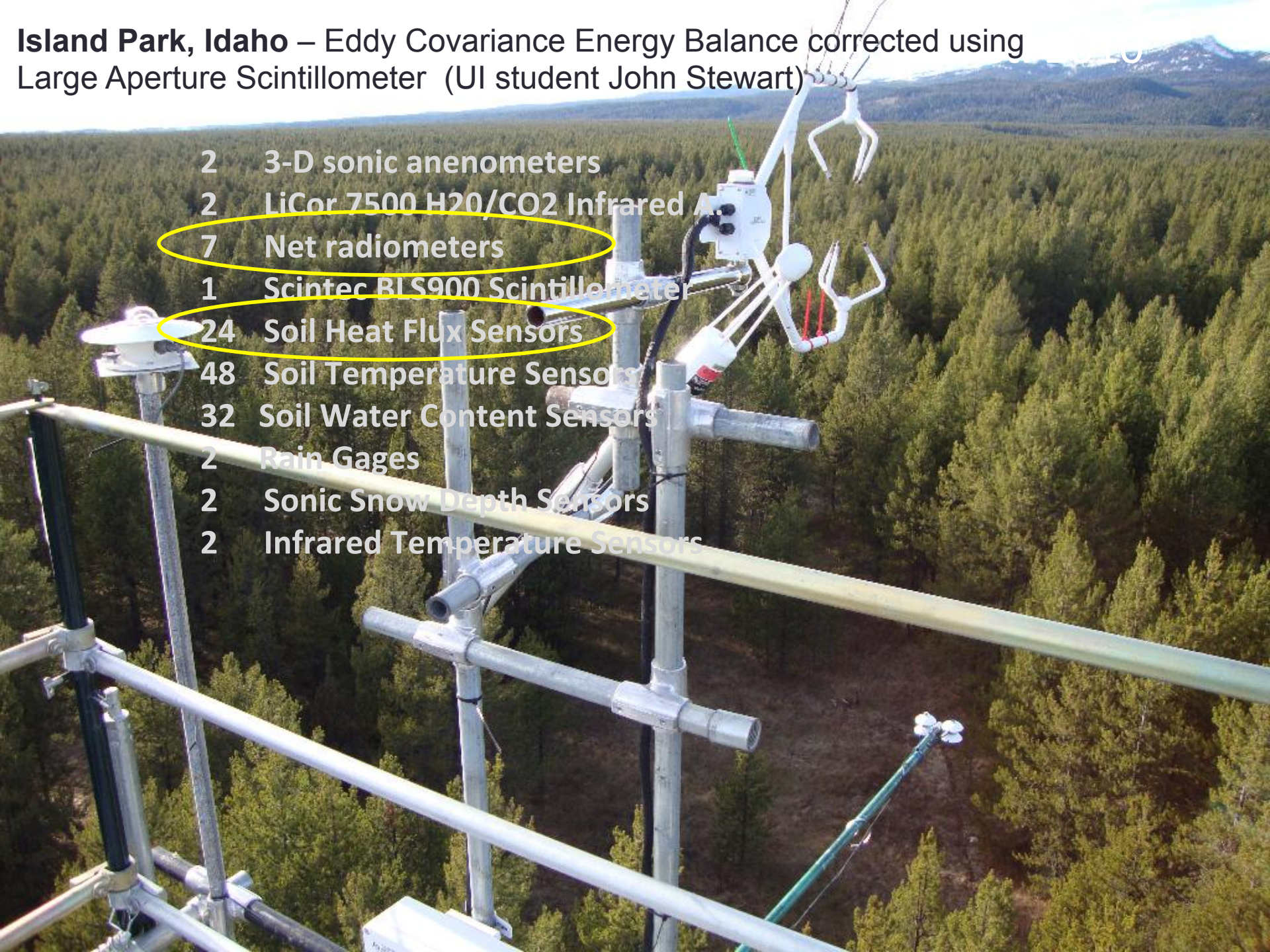
Student Collaboration

- Participation in development of strategies and coding and testing of algorithms for applying a moving window-based calibration scheme to develop endmember based calibration points for the surface energy balance employed in the METRIC ET process.
- Students will conduct **algorithm development** and testing pre-launch using an extensive archive of METRIC-based ET imagery retrieved from Landsat-based processing since 2000.
- Two NSF-supported energy and CO_2 f**lux systems in Idaho** will provide ground data to students for testing the moving window-based calibration against challenging targets of energy balance and ET retrieval from sagebrush and lodgepole pine.
- Post launch testing of algorithms and calibration strategies will be shared with students, as will extension of early ET results with real-time water resources processes in Idaho, California and Nevada, where state Departments of Water Resources will be invited to explore ingestion of ET data into their water operations.

Available Ground Data - Island Park, Idaho Lodgepole Pine

- Installed 2010 – Univ. Idaho

Island Park, Idaho – Eddy Covariance Energy Balance corrected using Large Aperture Scintillometer (UI student John Stewart)



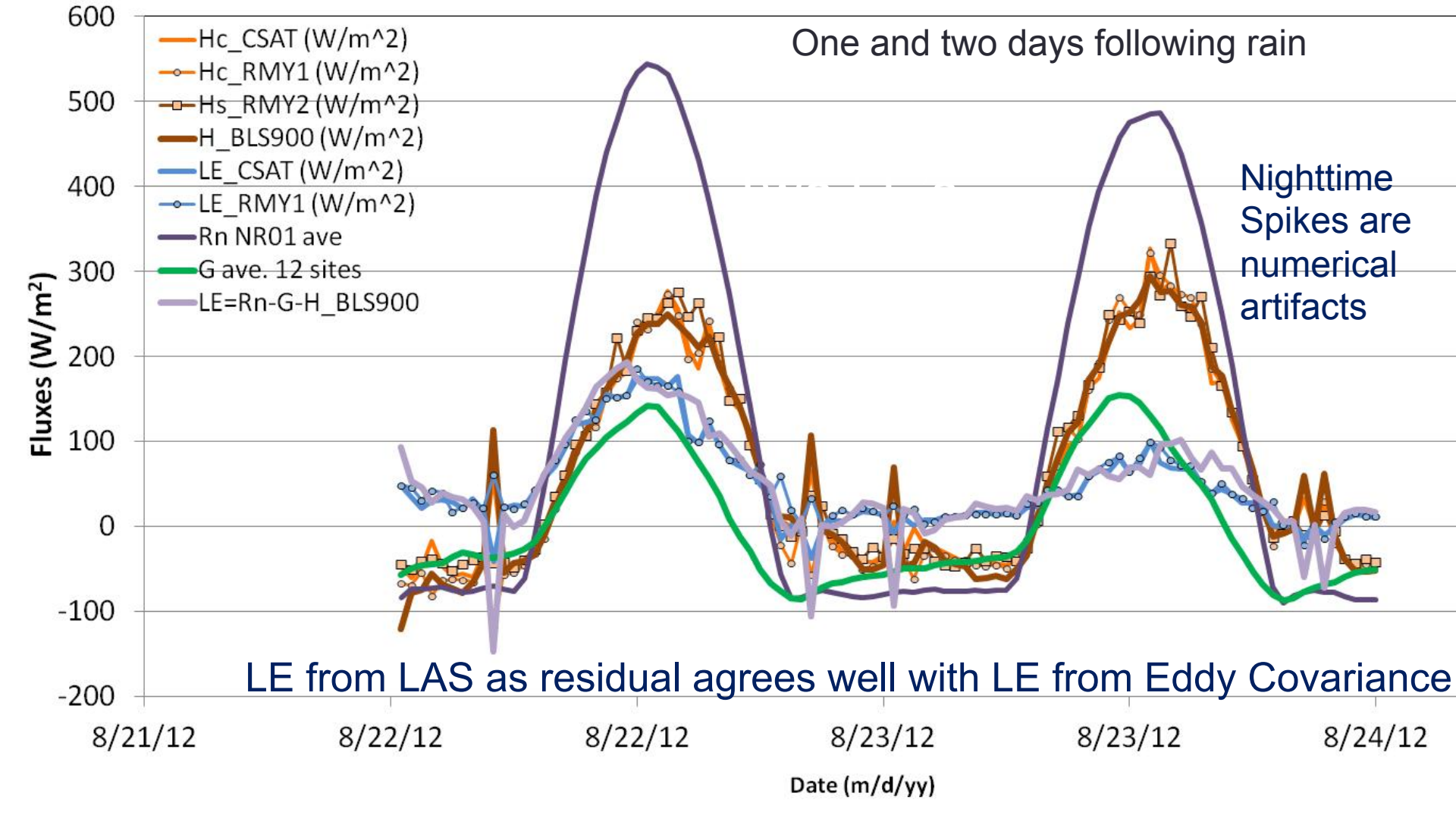
Hollister Sage Brush site
– Installed Feb. 2010

Best combination of 16 Soil Heat Flux sites optimized by UI student Jeremy Greth

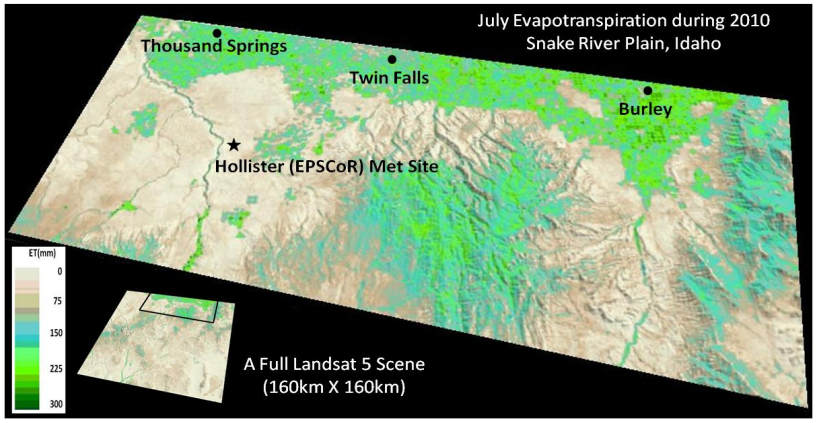
"Sensor Redundancy"

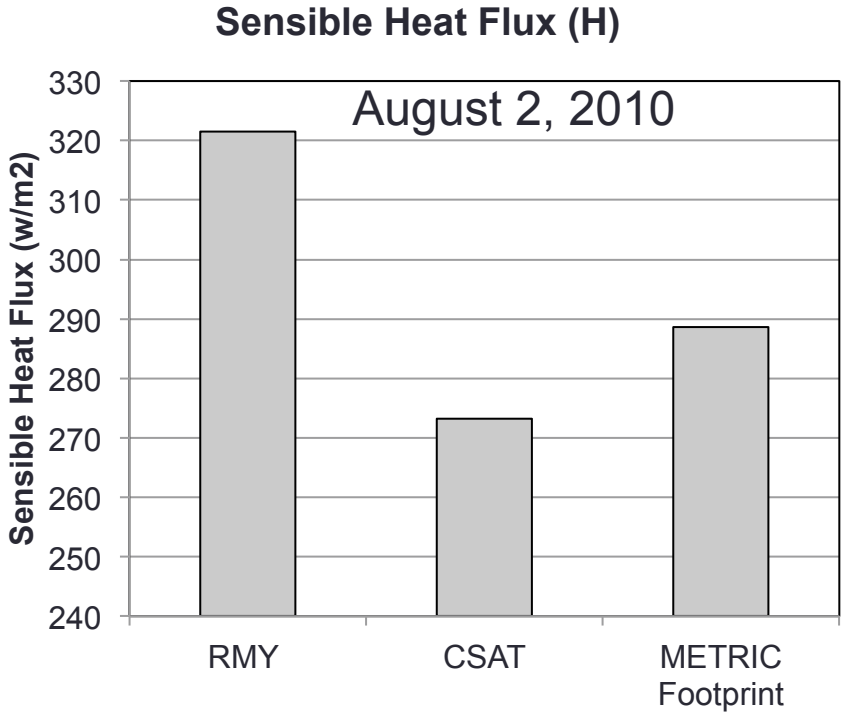
3	3-D sonic anenometers
1	LiCor 7500 H20/CO2 Infrared A.
3	Net radiometers
1	Scintec BLS900 Scintillometer
16	Soil Heat Flux Sensors
32	Soil Temperature Sensors
20	Soil Water Content Sensors
7	Soil Water Potential Sensors
2	Rain Gages
2	Infrared Temperature Sensors

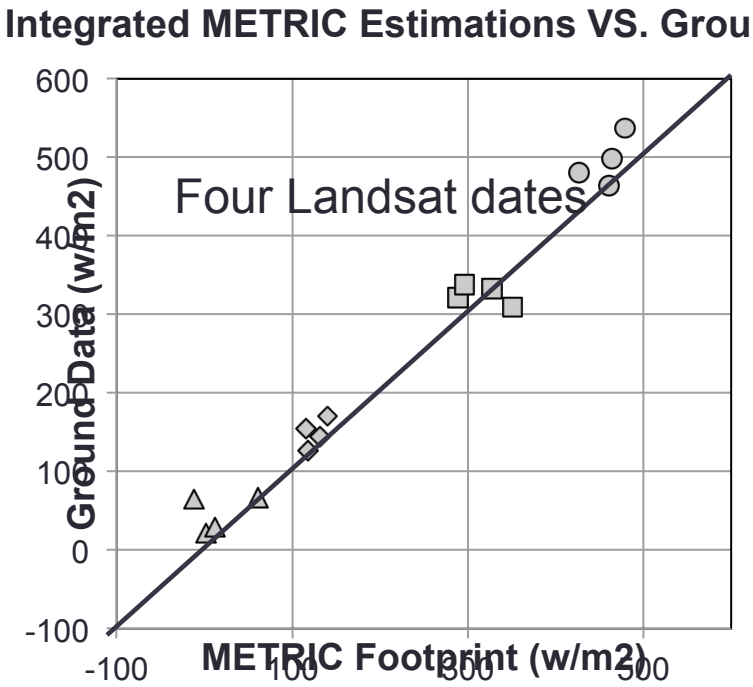
EB Components - Hollister Sage Brush Flux Site



Student-based accuracy assessments



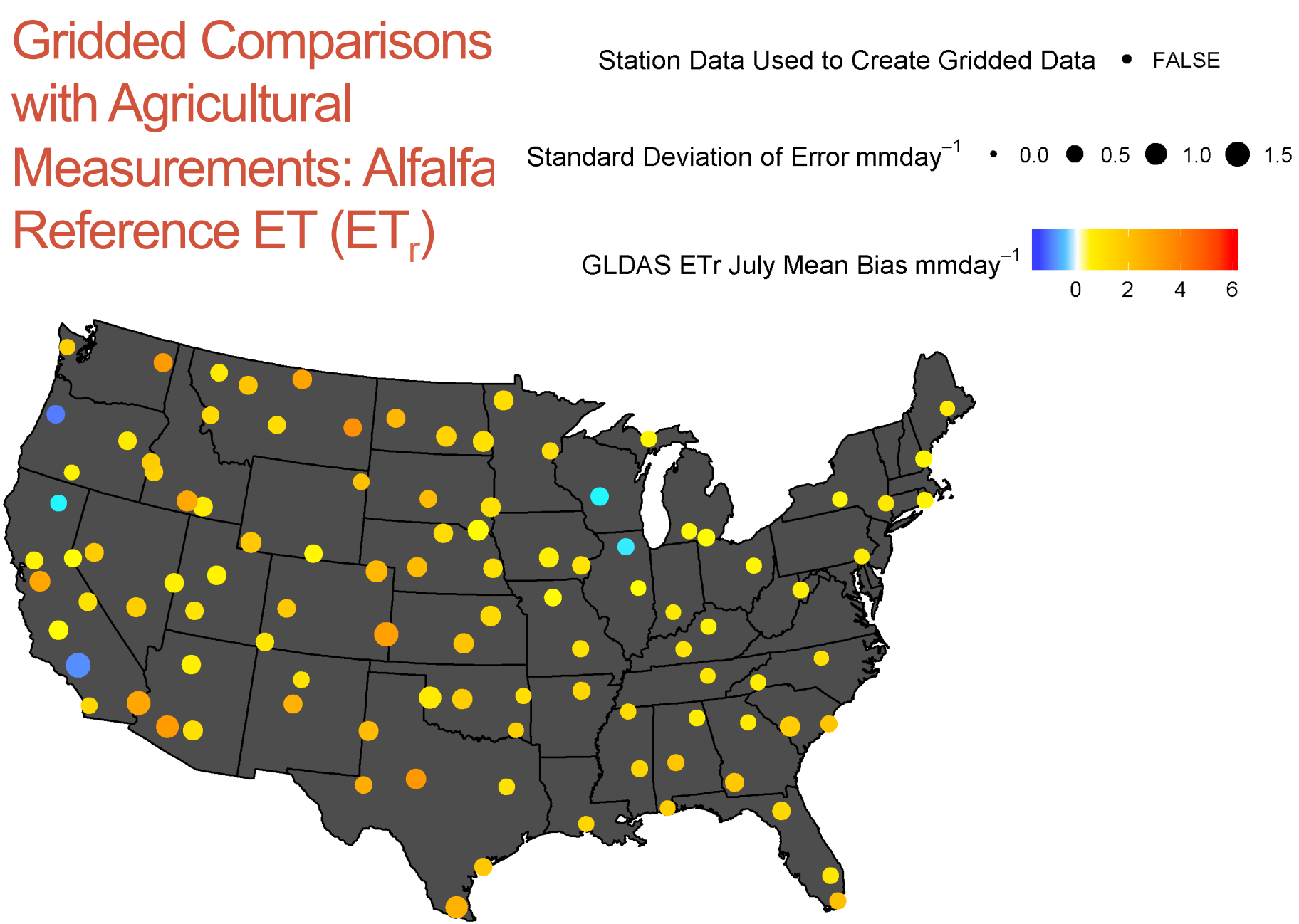




- Soil Heat Flux (G)
- Sensible Heat Flux (H)
- Latent Evaporation (LE)
- Net Radiation (Rn)

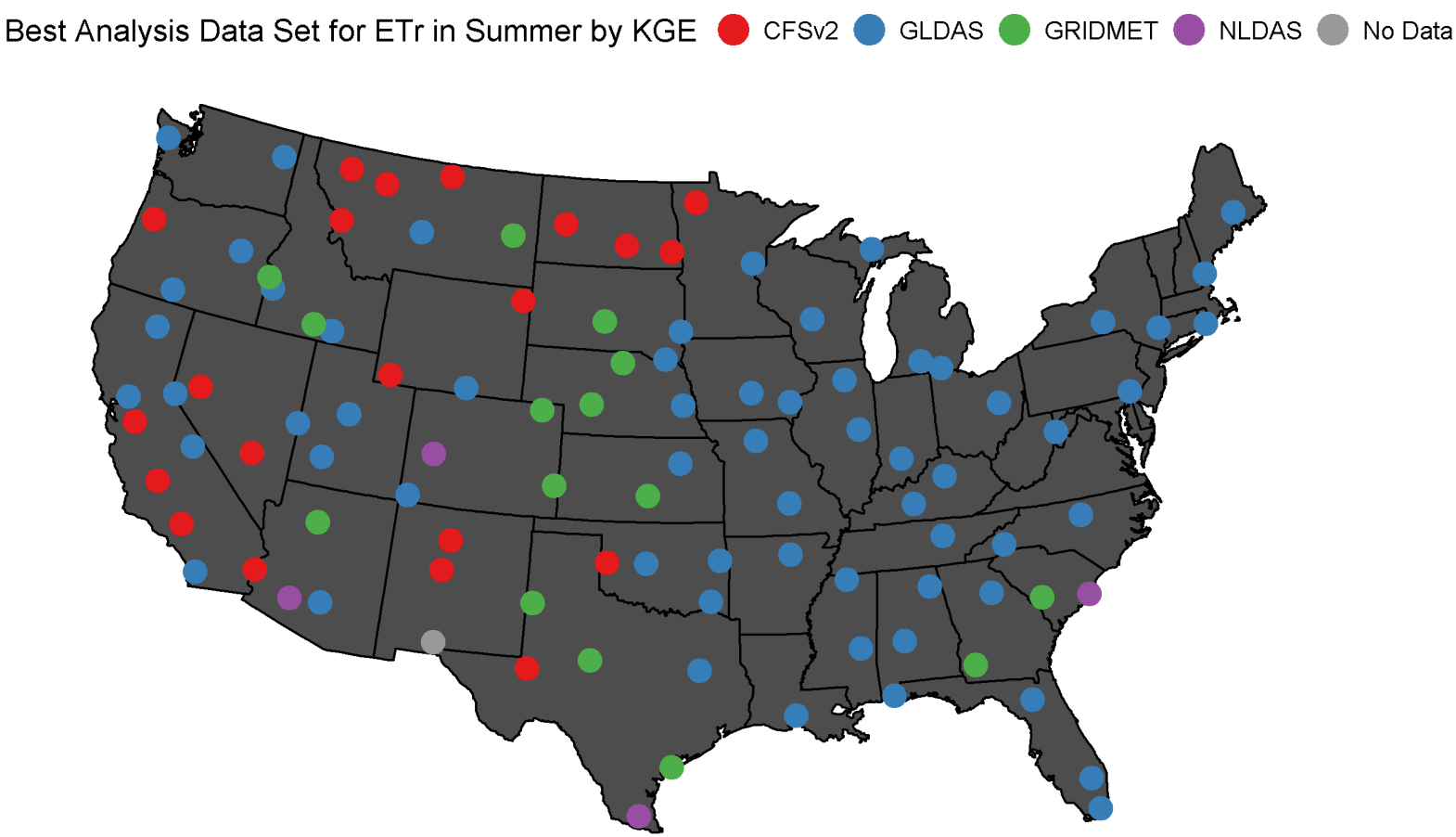
Hollister Sagebrush site, 2010

Gridded Comparisons with Agricultural Measurements: Alfalfa Reference ET (ET_r)



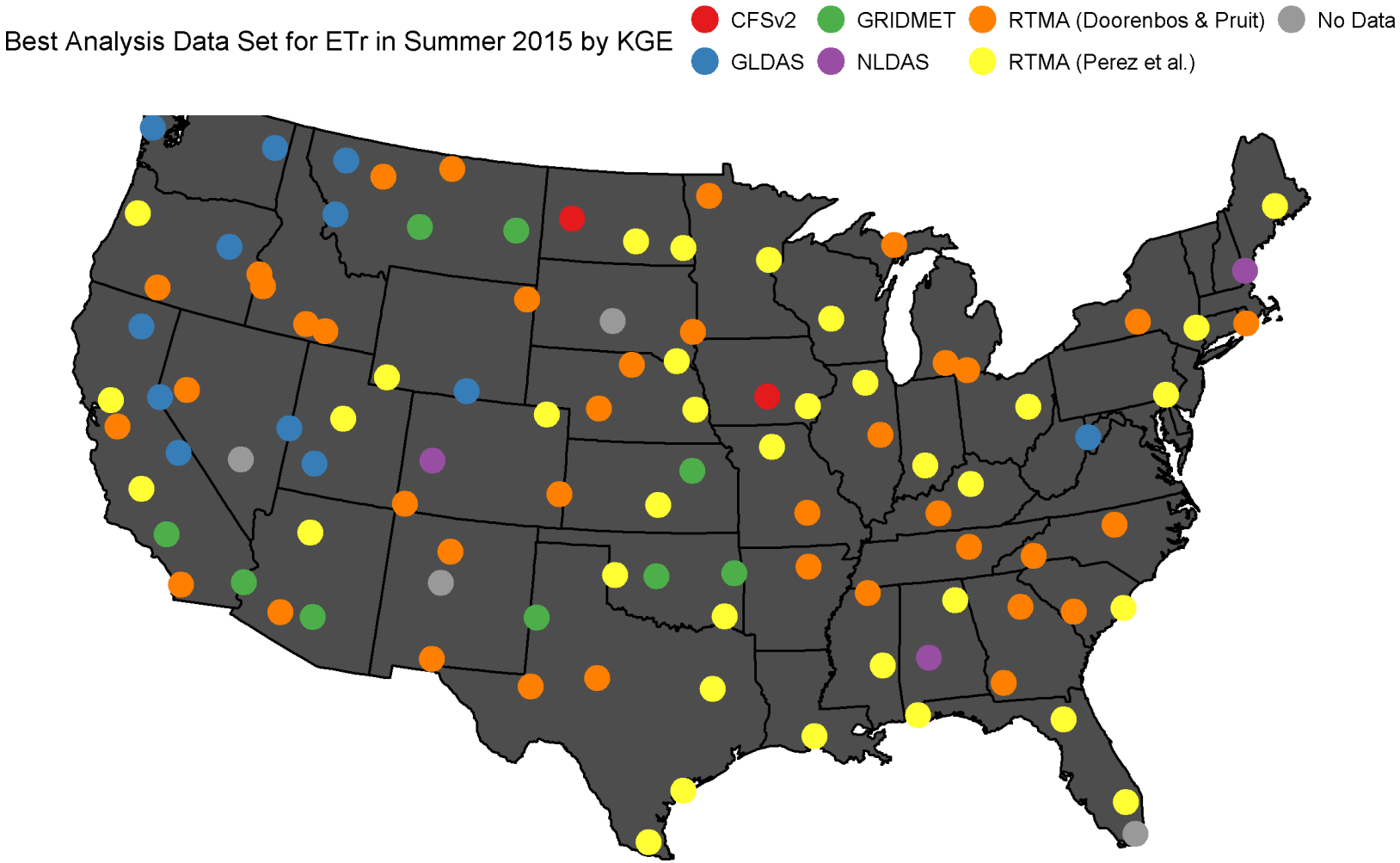
Philip Blankenau, MS Student, UNL – Dr. Ayse Kilic, Advisor

Best Gridded Data sets for Least Bias in Reference ET (ET_r)



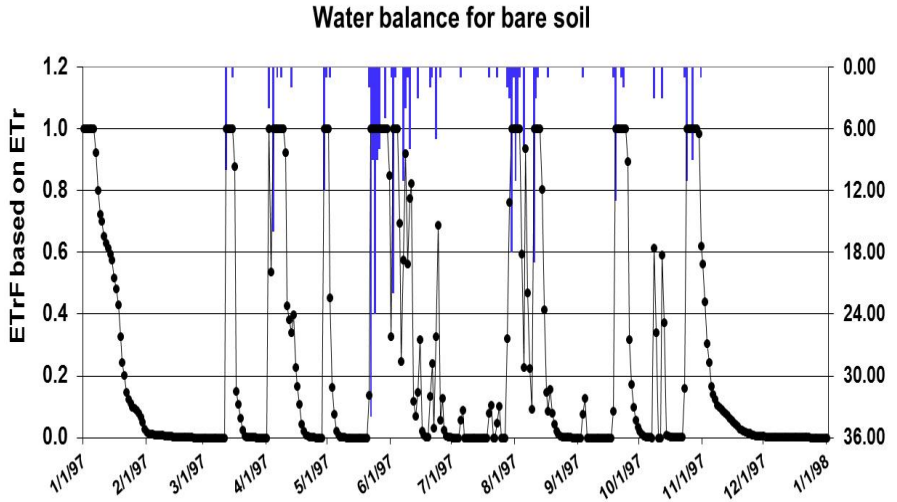
Philip Blankenau, MS Student, UNL – Dr. Ayse Kilic, Advisor

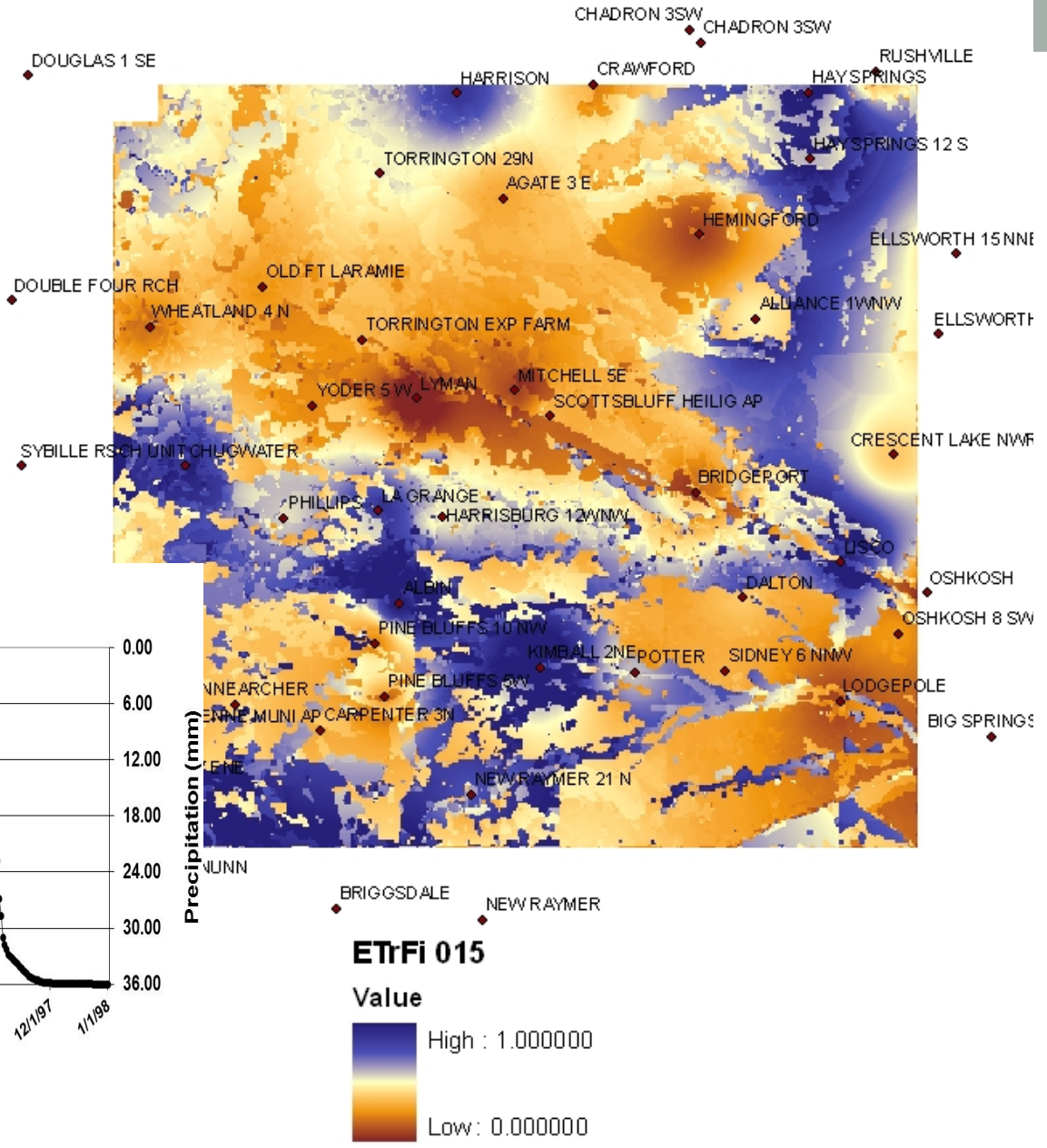
Best Gridded Data sets for Least Bias in Reference ET (ET_r)



Daily water balance using gridded weather and precipitation

EcoEEFlux will use bare soil evaporation from CFSV2 or GLDAS





Secure | https://eeflux-level1.appspot.com

Apps | Google Maps | Watch NFL Games | N | New Tab | yahoo mail - Google | METRIC-EEFLUX | Google Scholar | Google Calendar - Mc

EEFlux

This is beta version 1.0.0 of EEFlux level 2, where automated calibration of ETrF is still evolving. The last calibration update was Jan. 15, 2017. See FAQ's.

Instructions | FAQ

2017-01-29 / LC81730352017029LGN00 / Cloud 2%

Products | Download Tiff

- BASE MAP
- TRUE COLOR
- FALSE COLOR (4, 3, 2)
- FALSE COLOR (7, 5, 3)
- ALBEDO
- NDVI
- DEM
- LAND COVER
- SURFACE TEMPERATURE
- ALFAFA REFERENCE ET (ETr)
- GRASS REFERENCE ET (ETo)
- ETrF (default)
- ACTUAL ET (default)

Phil_Blankenau_s....pptx | Marlow_Allen_Mer....pdf | nrcs141p2_017641.pdf | program.pdf | Show all

Slide 3 of 3 | Notes | 56%

Secure https://eeflux-level1.appspot.com

Apps | Google Maps | Watch NFL Games | N | New Tab | yahoo mail - Google S | METRIC-EEFLUX | Google Scholar | Google Calendar - Mc

EEFlux

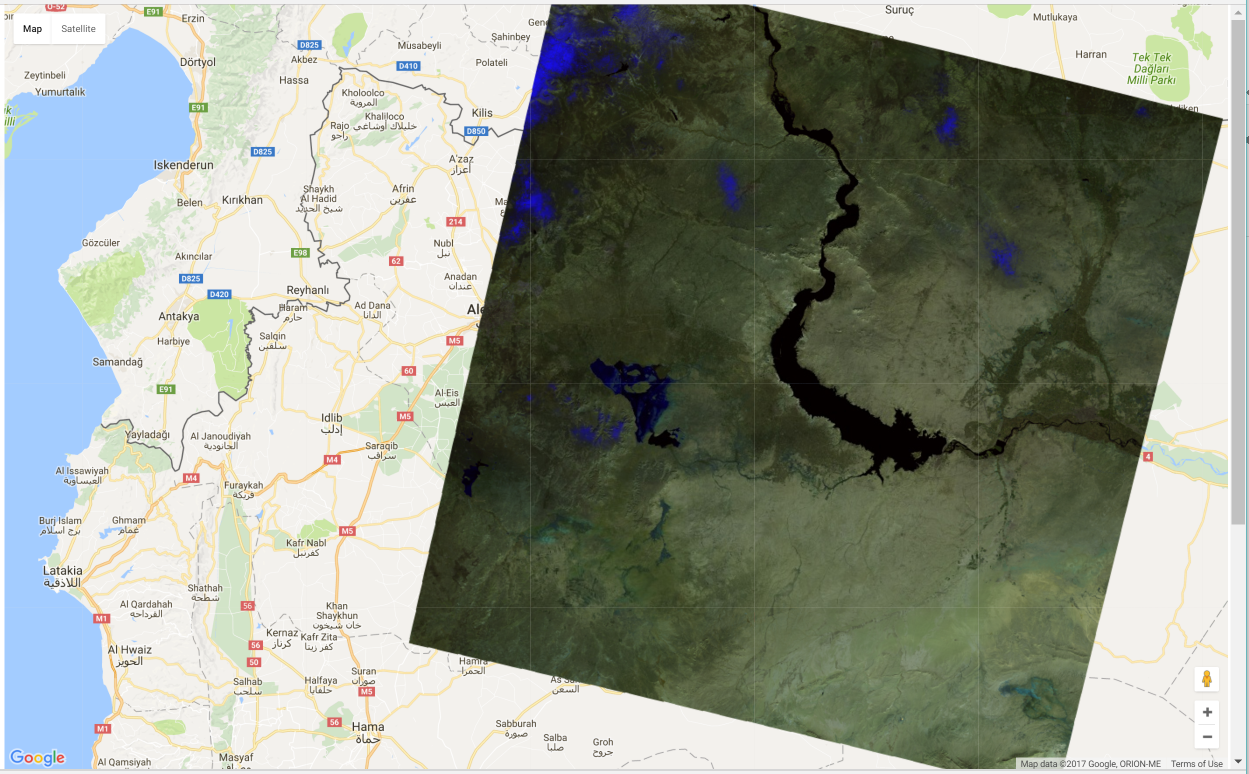
This is beta version 1.0.0 of EEFlux level 2, where automated calibration of ETrF is still evolving. The last calibration update was Jan. 15, 2017. See FAQ's.

Instructions | FAQ

2017-01-29 / LC81730352017029LGN00 / Cloud 2%

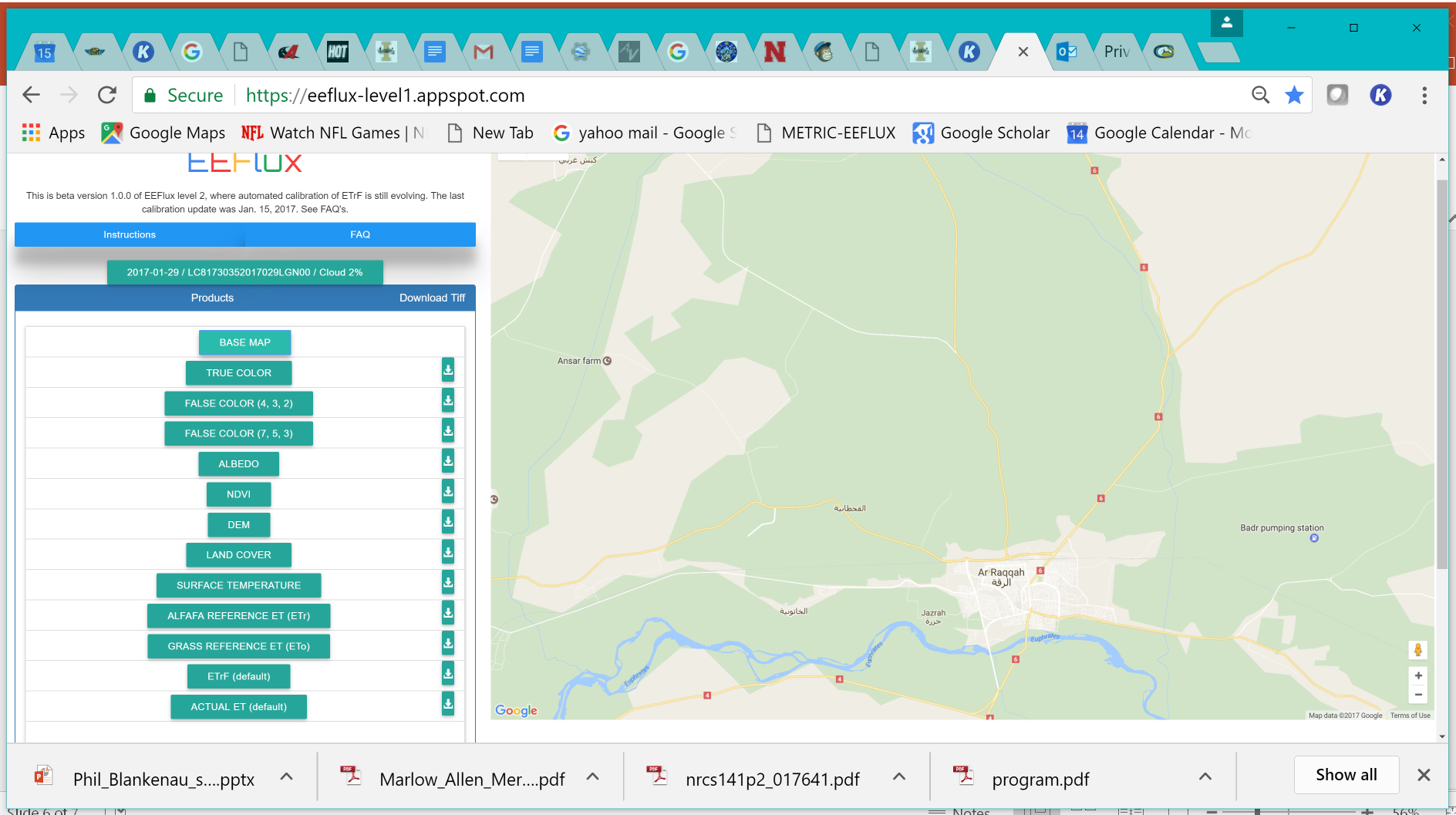
Products | Download Tiff

- BASE MAP
- TRUE COLOR
- FALSE COLOR (4, 3, 2)
- FALSE COLOR (7, 5, 3)
- ALBEDO
- NDVI
- DEM
- LAND COVER
- SURFACE TEMPERATURE
- ALFAFA REFERENCE ET (ETr)
- GRASS REFERENCE ET (ETo)
- ETrF (default)
- ACTUAL ET (default)



Phil_Blankenau_s....pptx | Marlow_Allen_Mer....pdf | nrcs141p2_017641.pdf | program.pdf | Show all

Slide 5 of 22 | Notes | 47%


Secure
https://eeflux-level1.appspot.com
Apps
Google Maps
Watch NFL Games | N
New Tab
yahoo mail - Google
METRIC-EEFLUX
Google Scholar
Google Calendar - Mc
EEFlux
This is beta version 1.0.0 of EEFlux level 2, where automated calibration of ETrF is still evolving. The last calibration update was Jan. 15, 2017. See FAQ's.
Instructions
FAQ
2017-01-29 / LC81730352017029LGN00 / Cloud 2%
Products
Download Tiff
BASE MAP
TRUE COLOR
FALSE COLOR (4, 3, 2)
FALSE COLOR (7, 5, 3)
ALBEDO
NDVI
DEM
LAND COVER
SURFACE TEMPERATURE
ALFAFA REFERENCE ET (ETr)
GRASS REFERENCE ET (ETo)
ETrF (default)
ACTUAL ET (default)
Ansar farm
Ar Raqqah
الرقة
Badr pumping station
Jazrah
جزرة
Euphrates
Google
Map data ©2017 Google
Terms of Use
Phil_Blankenau_s....pptx
Marlow_Allen_Mer....pdf
nrcs141p2_017641.pdf
program.pdf
Show all

Secure https://eeflux-level1.appspot.com

Apps Google Maps Watch NFL Games | N New Tab yahoo mail - Google S METRIC-EEFLUX Google Scholar Google Calendar - Mc

EEFlux

This is beta version 1.0.0 of EEFlux level 2, where automated calibration of ETrF is still evolving. The last calibration update was Jan. 15, 2017. See FAQ's.

Instructions FAQ

2014-04-27 / LC81730352014117LGN00 / Cloud 0%

Products Download Tiff

BASE MAP

TRUE COLOR

FALSE COLOR (4, 3, 2)

FALSE COLOR (7, 5, 3)

ALBEDO

NDVI

NDVI

0 0.2 0.4 0.6 0.8 1

DEM

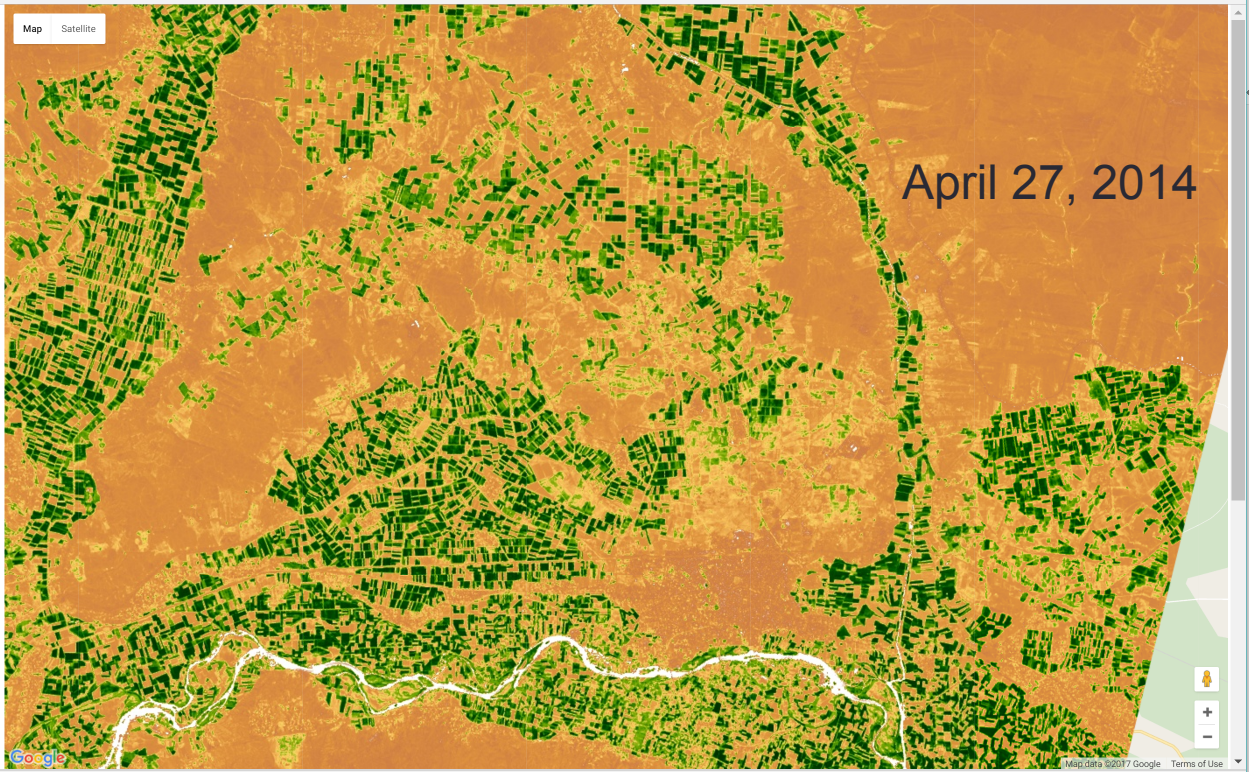
LAND COVER

SURFACE TEMPERATURE

ALFAFA REFERENCE ET (ETr)

GRASS REFERENCE ET (ETo)

ETrF (default)



Phil_Blankenau_s....pptx Marlow_Allen_Mer....pdf nrcs141p2_017641.pdf program.pdf Show all

Slide 8 of 10 Notes 56%

Secure https://eeflux-level1.appspot.com

Apps | Google Maps | Watch NFL Games | N | New Tab | yahoo mail - Google S | METRIC-EEFLUX | Google Scholar | Google Calendar - Mc

EEFlux

This is beta version 1.0.0 of EEFlux level 2, where automated calibration of ETrF is still evolving. The last calibration update was Jan. 15, 2017. See FAQ's.

Instructions | FAQ

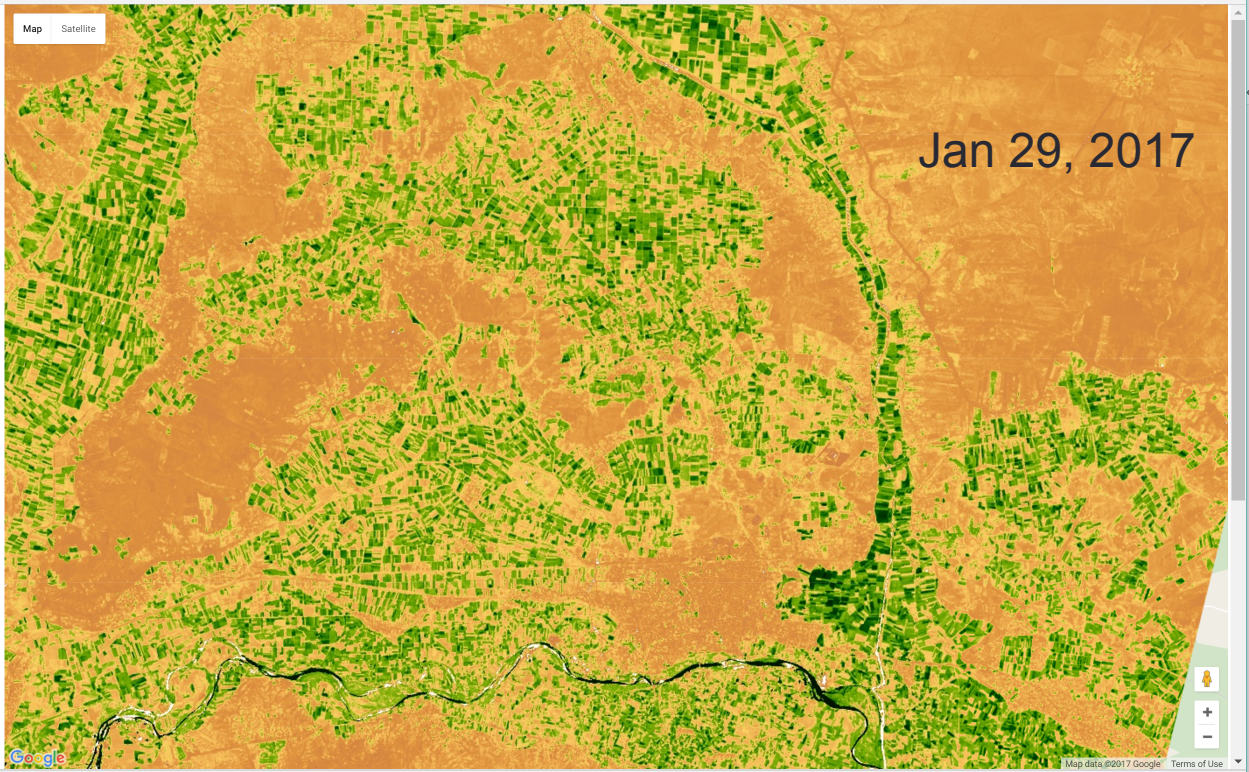
2017-01-29 / LC81730352017029LGN00 / Cloud 2%

Products | Download Tiff

- BASE MAP
- TRUE COLOR
- FALSE COLOR (4, 3, 2)
- FALSE COLOR (7, 5, 3)
- ALBEDO
- NDVI

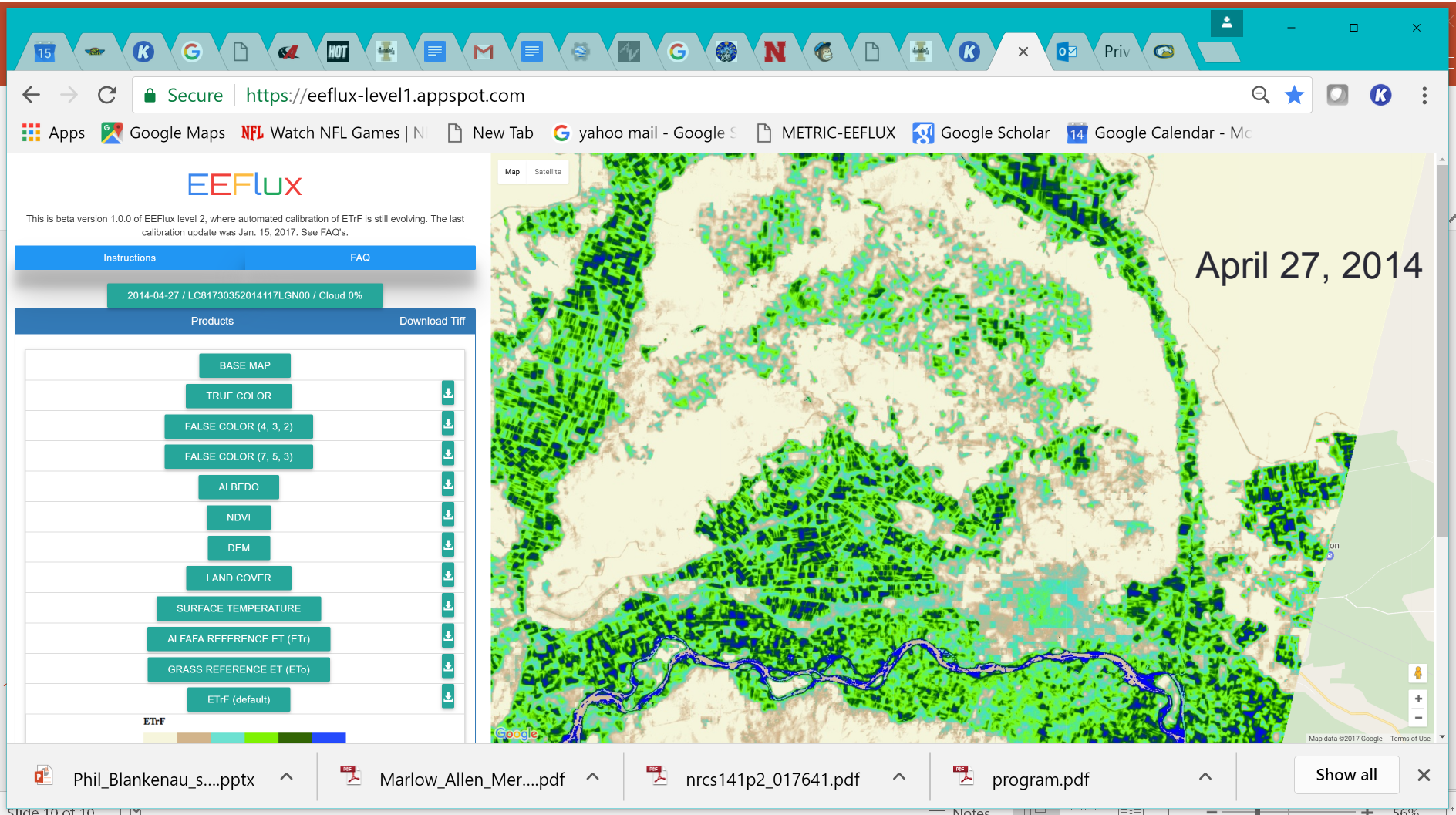
NDVI
0 0.2 0.4 0.6 0.8 1

- DEM
- LAND COVER
- SURFACE TEMPERATURE
- ALFAFA REFERENCE ET (ETr)
- GRASS REFERENCE ET (ETo)
- ETrF (default)



Phil_Blankenau_s....pptx | Marlow_Allen_Mer....pdf | nrcs141p2_017641.pdf | program.pdf | Show all

Slide 8 of 8 Notes 56%


Secure
https://eeflux-level1.appspot.com
Apps
Google Maps
Watch NFL Games | N
New Tab
yahoo mail - Google
METRIC-EEFLUX
Google Scholar
Google Calendar - Mc
EEFlux
This is beta version 1.0.0 of EEFlux level 2, where automated calibration of ETrF is still evolving. The last calibration update was Jan. 15, 2017. See FAQ's.
Instructions
FAQ
2014-04-27 / LC81730352014117LGN00 / Cloud 0%
Products
Download Tiff
BASE MAP
TRUE COLOR
FALSE COLOR (4, 3, 2)
FALSE COLOR (7, 5, 3)
ALBEDO
NDVI
DEM
LAND COVER
SURFACE TEMPERATURE
ALFAFA REFERENCE ET (ETr)
GRASS REFERENCE ET (ETo)
ETrF (default)
ETrF
Map
Satellite
April 27, 2014
Google
Map data ©2017 Google
Terms of Use
Phil_Blankenau_s....pptx
Marlow_Allen_Mer....pdf
nrcs141p2_017641.pdf
program.pdf
Show all

Secure | https://eeflux-level1.appspot.com

Apps | Google Maps | Watch NFL Games | N | New Tab | yahoo mail - Google S | METRIC-EEFLUX | Google Scholar | Google Calendar - Mc

EEFlux

This is beta version 1.0.0 of EEFlux level 2, where automated calibration of ETrF is still evolving. The last calibration update was Jan. 15, 2017. See FAQ's.

Instructions | FAQ

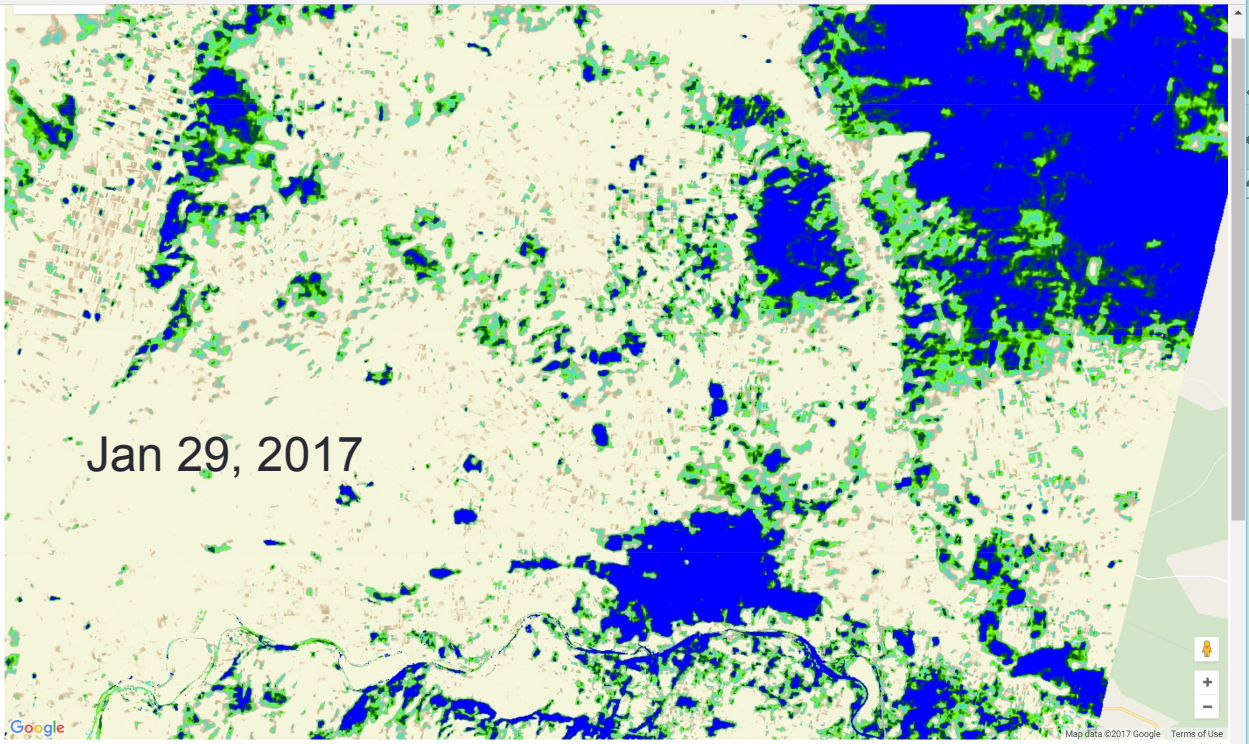
2017-01-29 / LC81730352017029LGN00 / Cloud 2%

Products | Download Tiff

- BASE MAP
- TRUE COLOR
- FALSE COLOR (4, 3, 2)
- FALSE COLOR (7, 5, 3)
- ALBEDO
- NDVI
- DEM
- LAND COVER
- SURFACE TEMPERATURE
- ALFAFA REFERENCE ET (ETr)
- GRASS REFERENCE ET (ETo)
- ETrF (default)

ETrF

0 0.25 0.5 0.75 1 1.25



Phil_Blankenau_s....pptx | Marlow_Allen_Mer....pdf | nrcs141p2_017641.pdf | program.pdf | Show all

Slide 5 of 6 | Notes | 52%

Thank you

Extra Slides