NSF EPSCoR Research Infrastructure Improvement (RII) in Idaho
EPS-0814387

Water, Energy and CO2 Flux Monitoring in Sagebrush, Invasive Cheatgrass and Lodgepole Pine Systems

Great Basin Consortium Conference

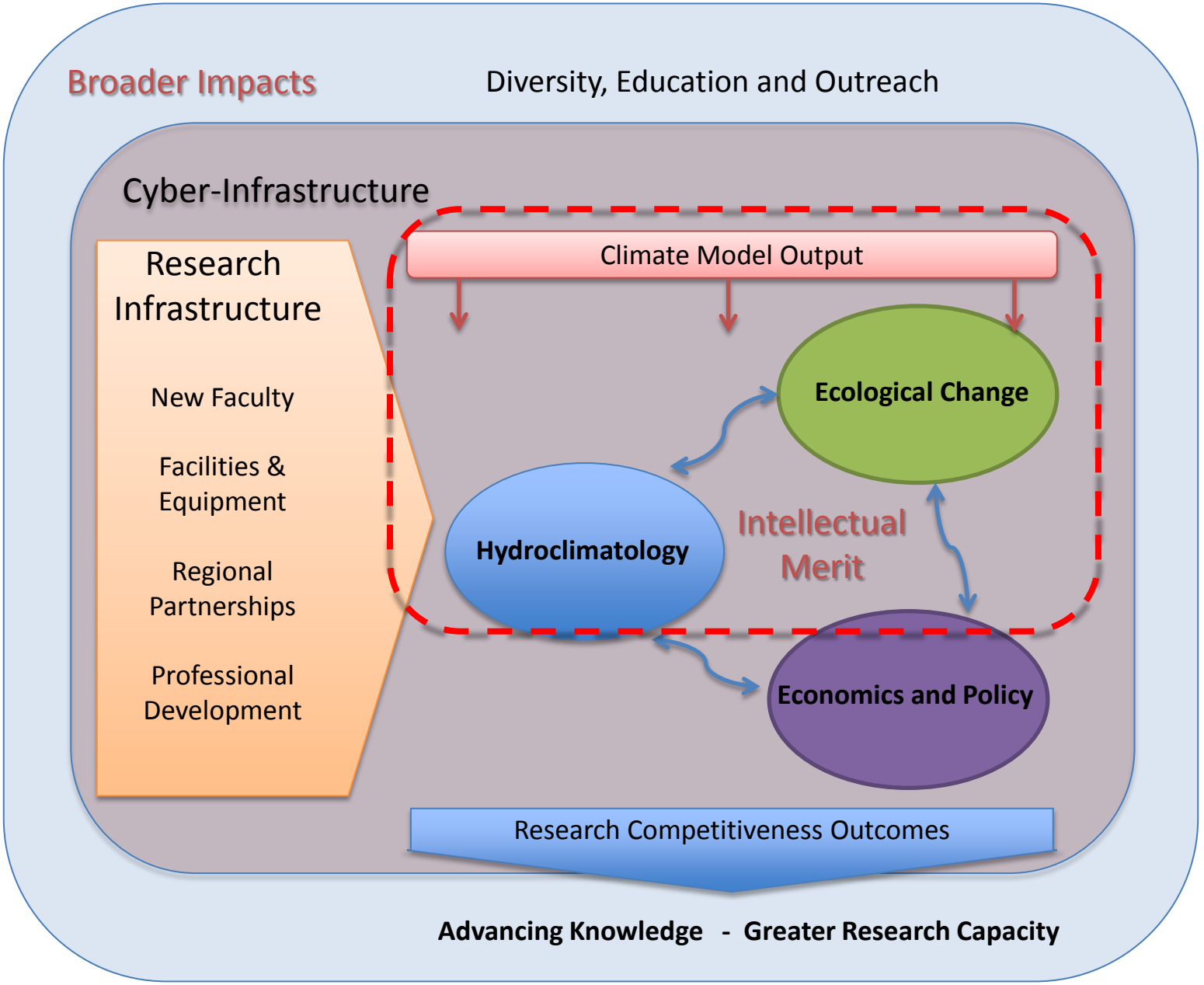
Rick Allen, HydroClimate Lead, *Water Resources in a Changing Climate*

IDAHO EPSCoR

Experimental Program to Stimulate Competitive Research

Project Integration – Hydroclimate and Ecological change

Hydro-Climatology and Ecological Change



Research Niche - Climate Change & Indirect Effects

Hydroclimate

- Establish field sites to
  - improve measurement capabilities;
  - understand surface energy and mass balances for hydrologic modeling and remote sensing;
  - understand behavior of natural vegetation.

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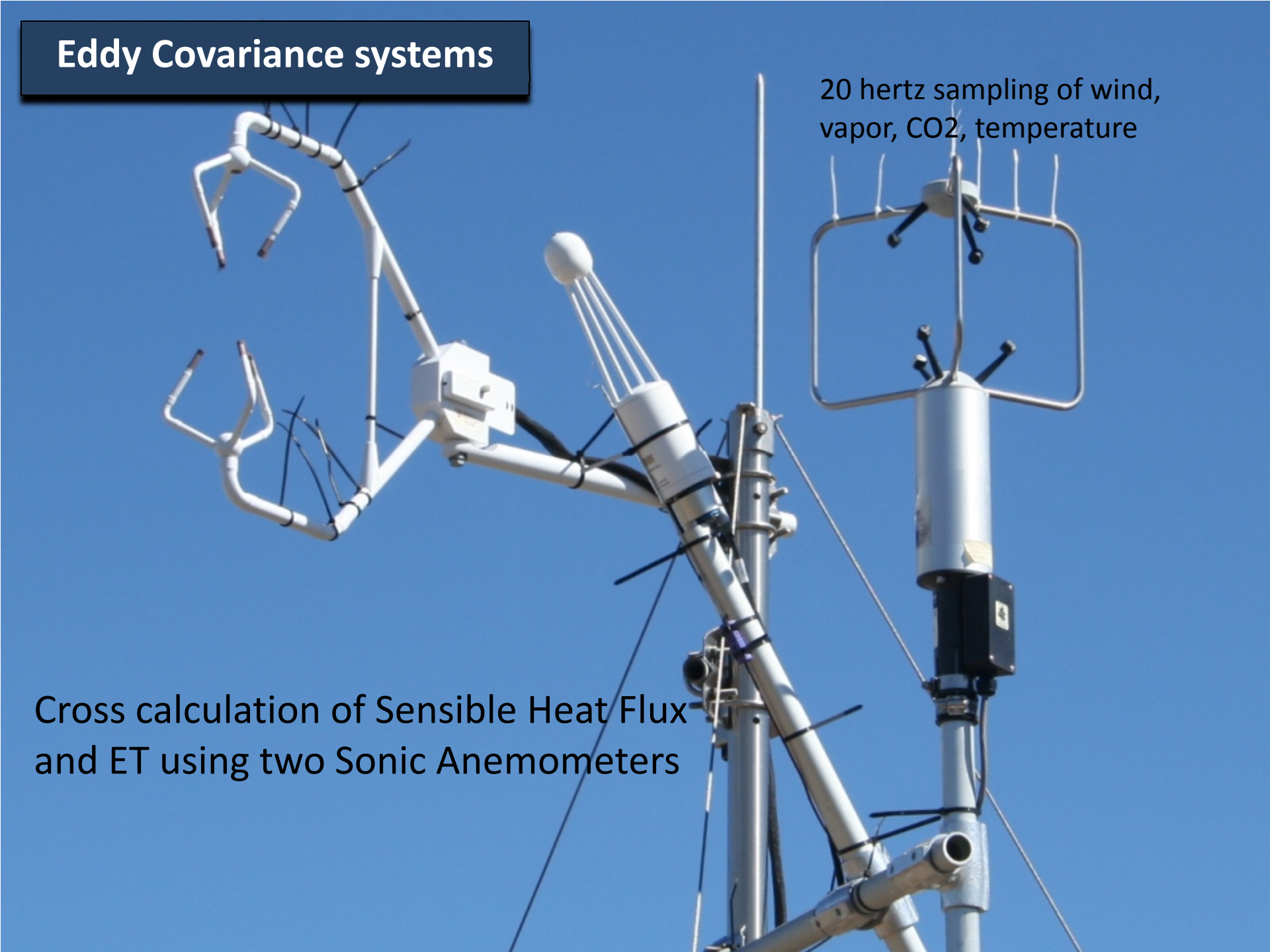
Experimental Program to Stimulate Competitive Research

Eddy Covariance systems



20 hertz sampling of wind, vapor, CO_2, temperature

Cross calculation of Sensible Heat Flux and ET using two Sonic Anemometers

Large Aperture Scintillometers

Sampling of temperature-driven density fluctations of eddies using an infrared beam

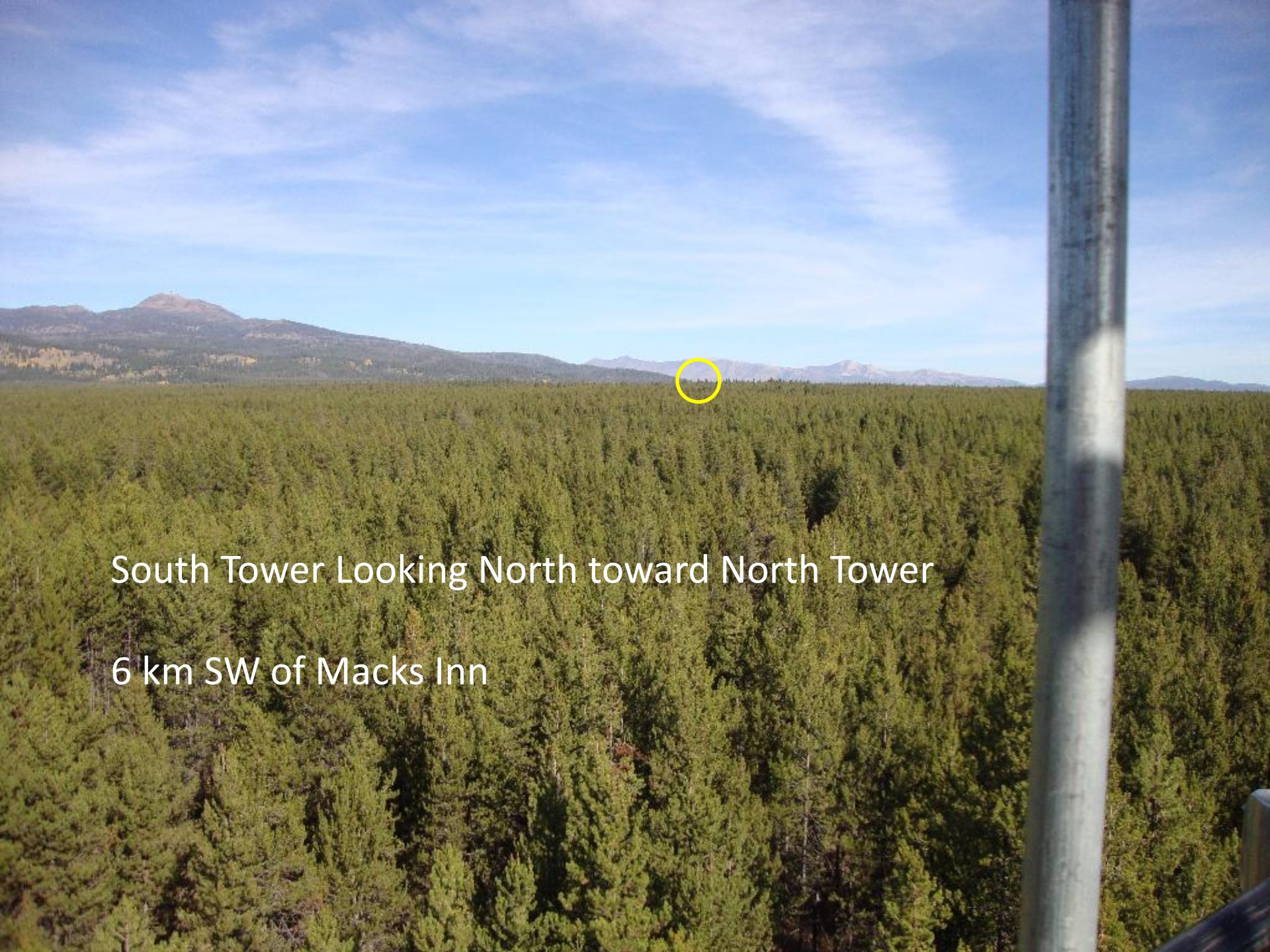
Three Idaho flux sites

(installed 2009-2010)

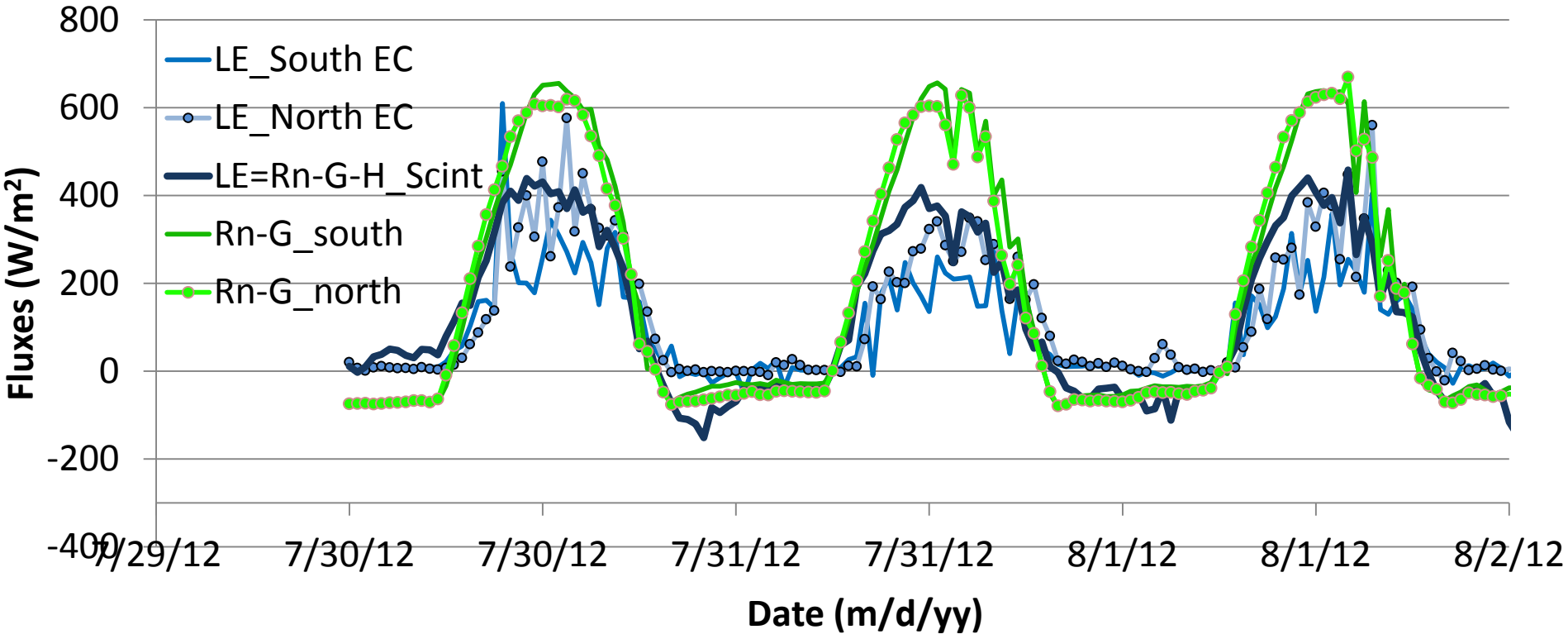
- We hope to run these long term if we can keep funded


South Tower
w/ Scintillometer Receiver
1600 m path


North Tower
w/ Scintillometer Transmitter

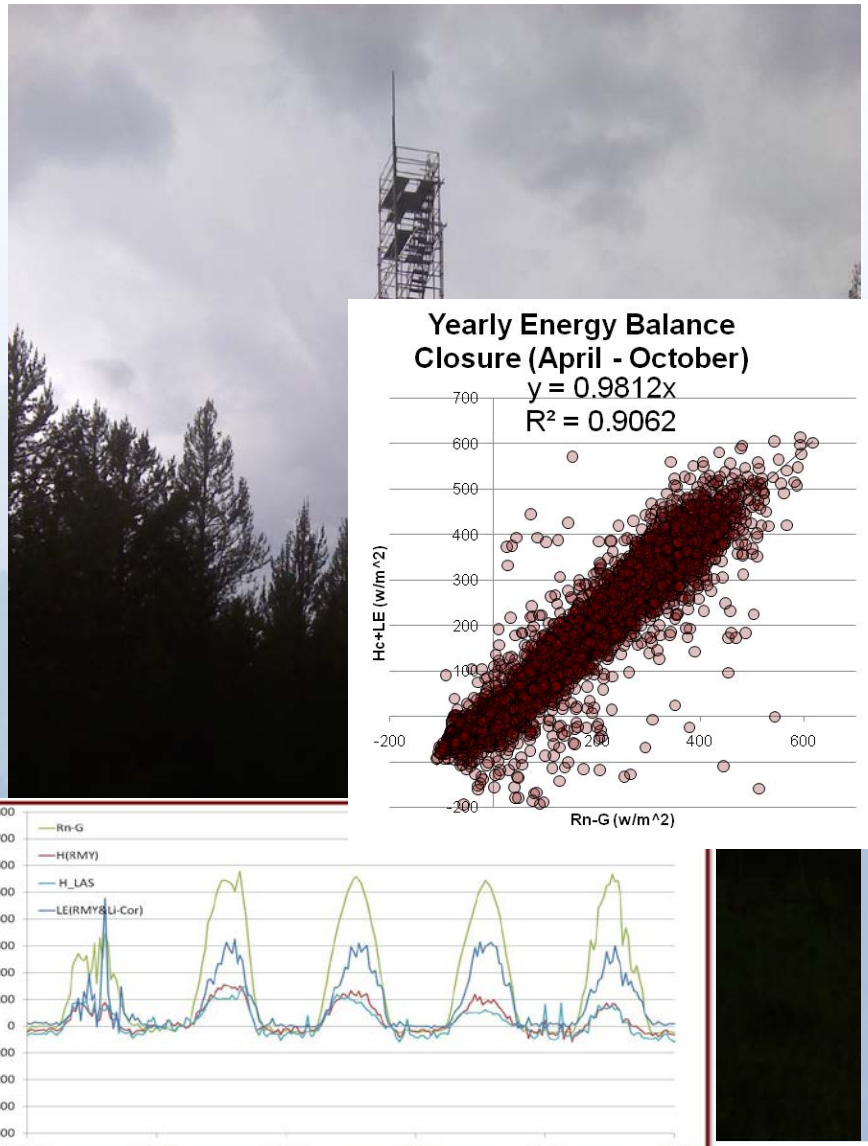

South Tower Looking North toward North Tower
6 km SW of Macks Inn

Island Park Lodge-pole Pine Energy Balance – Hourly Data



Research Niche - Climate Change & Indirect Effects

Hydroclimate



Important Tenents

- Substantial Replication and Redundancy in Sensor Deployment (good EB closure)
- An extensive QA/QC process
- Hope to operate long-term over ranges of weather and wetting patterns
- Couple with satellite-based flux methods to extrapolate
- Partner with other modeling and analysis studies

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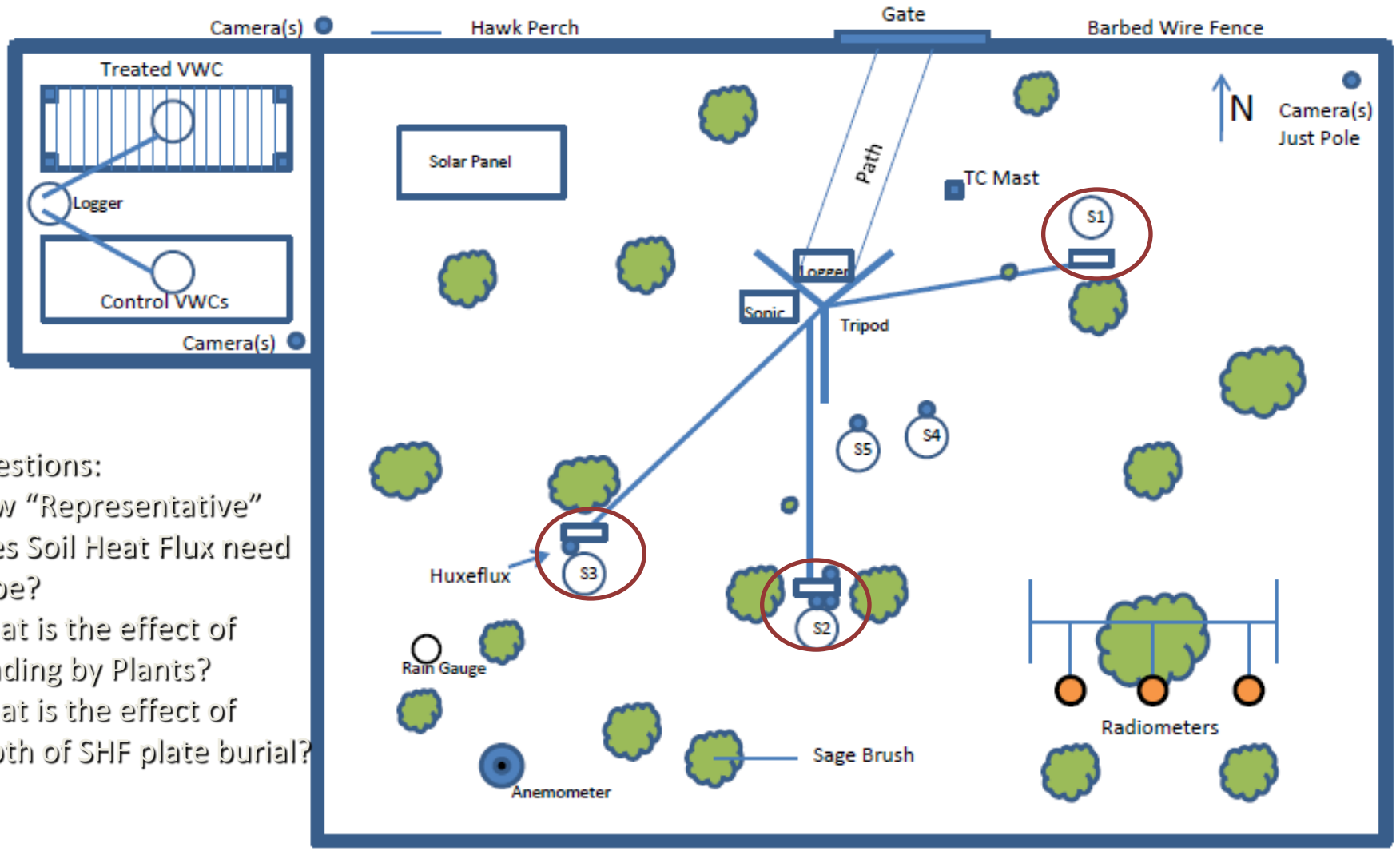
Experimental Program to Stimulate Competitive Research


2 3-D sonic anenometers
2 LiCor 7500 H20/CO2 Infrared A.
7 Net radiometers
1 Scintec BLS900 Scintillometer
24 Soil Heat Flux Sensors
48 Soil Temperature Sensors
32 Soil Water Content Sensors
2 Rain Gages
2 Sonic Snow Depth Sensors
2 Infrared Temperature Sensors

Hollister Sage Brush site – Installed Feb. 2010

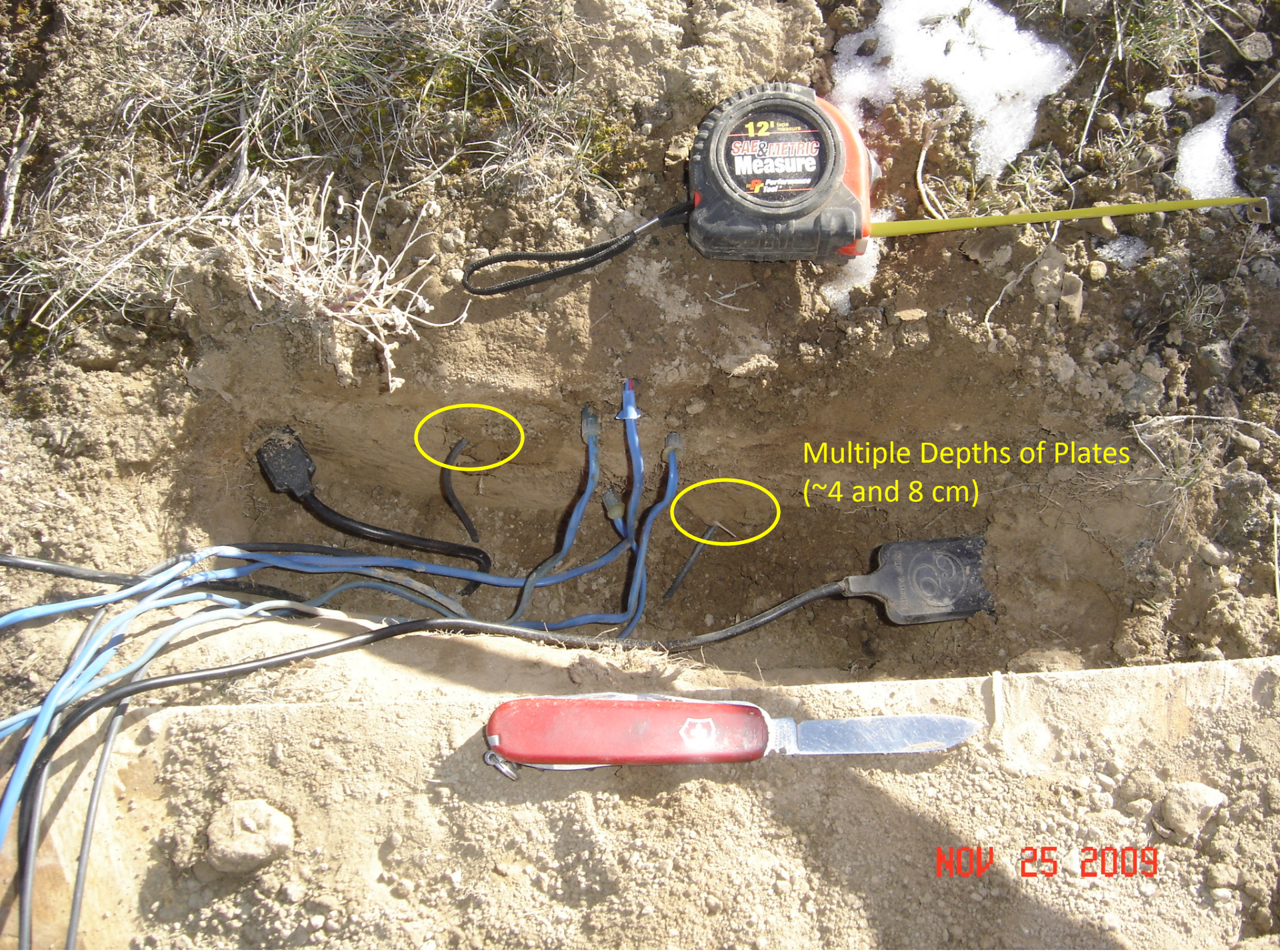
3	3-D sonic anenometers
1	LiCor 7500 H20/CO2 Infrared A.
3	Net radiometers
1	Scintec BLS900 Scintillometer
16	Soil Heat Flux Sensors
32	Soil Temperature Sensors
20	Soil Water Content Sensors
7	Soil Water Potential Sensors
2	Rain Gages
2	Infrared Temperature Sensors

EPSCOR Hollister Eddy Covariance Site 1 (North)



Questions:
How "Representative" does Soil Heat Flux need to be?
What is the effect of Shading by Plants?
What is the effect of depth of SHF plate burial?

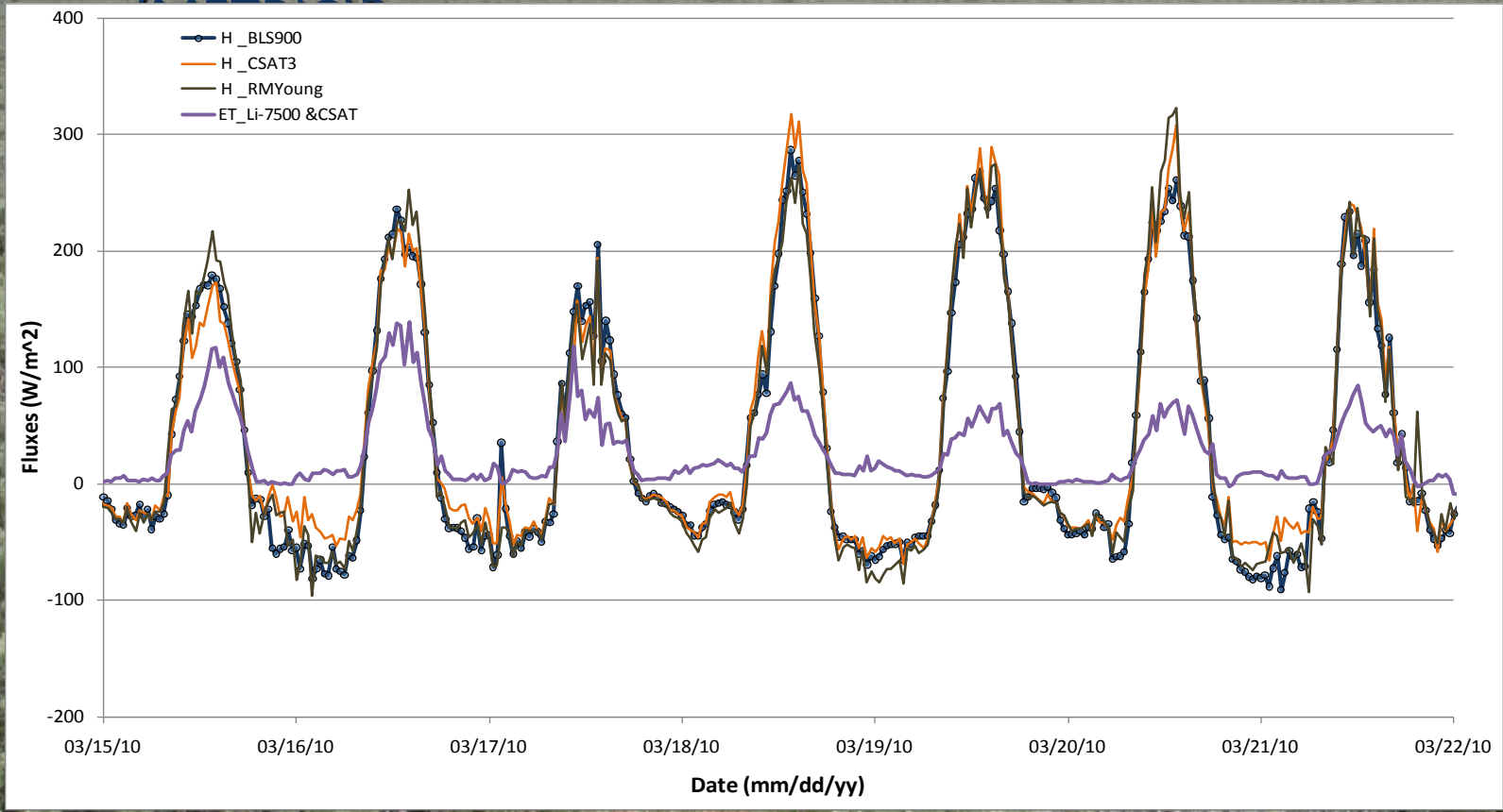
Installed 11/24/09 (Soil Sensors)
S1 = Northside of Sagebrush – soil heat flux
S2 = Open Area (Bear Soil, sparse clumps of grass) – soil heat flux
S3 = Southside of Sagebrush – Soil heat flux
S4 and S5 = ECHO probe at ~35-40cm (above caliche)


12' tape measure
SAE & METRIC
Measure
Multiple Depths of Plates
(~4 and 8 cm)
NOV 25 2009

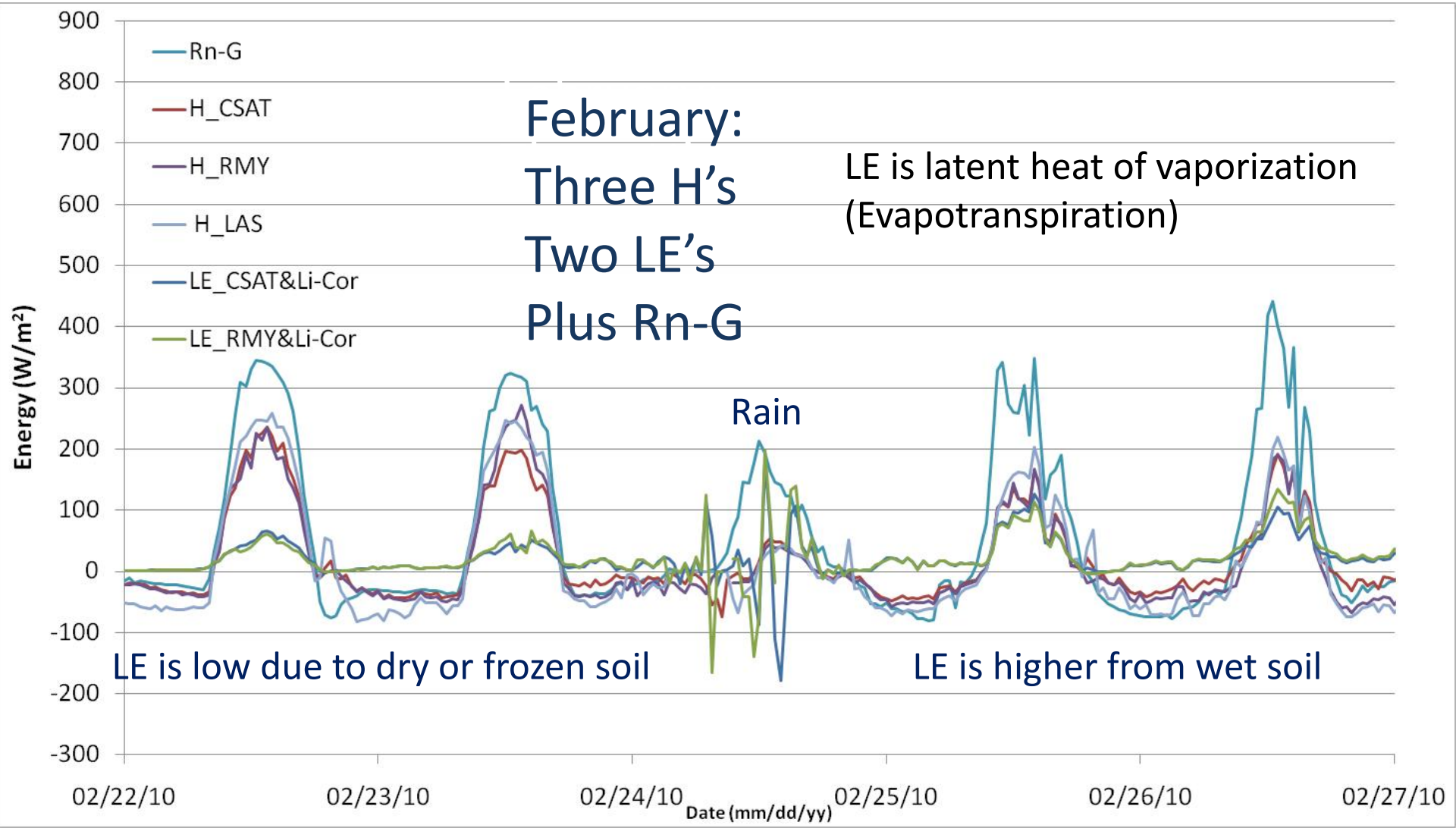

Placement on North Side of Sagebrush
NOV 25 2009

Hollister Site: Sagebrush

1. How 'fast' do Sagebrush Systems Meter out Stored Precipitation as Transpiration?
2. How can we better estimate spatial ET of these systems using Satellite-based Energy balance?



Hollister Sage Brush Flux Site



Hollister Sage Brush Flux Site

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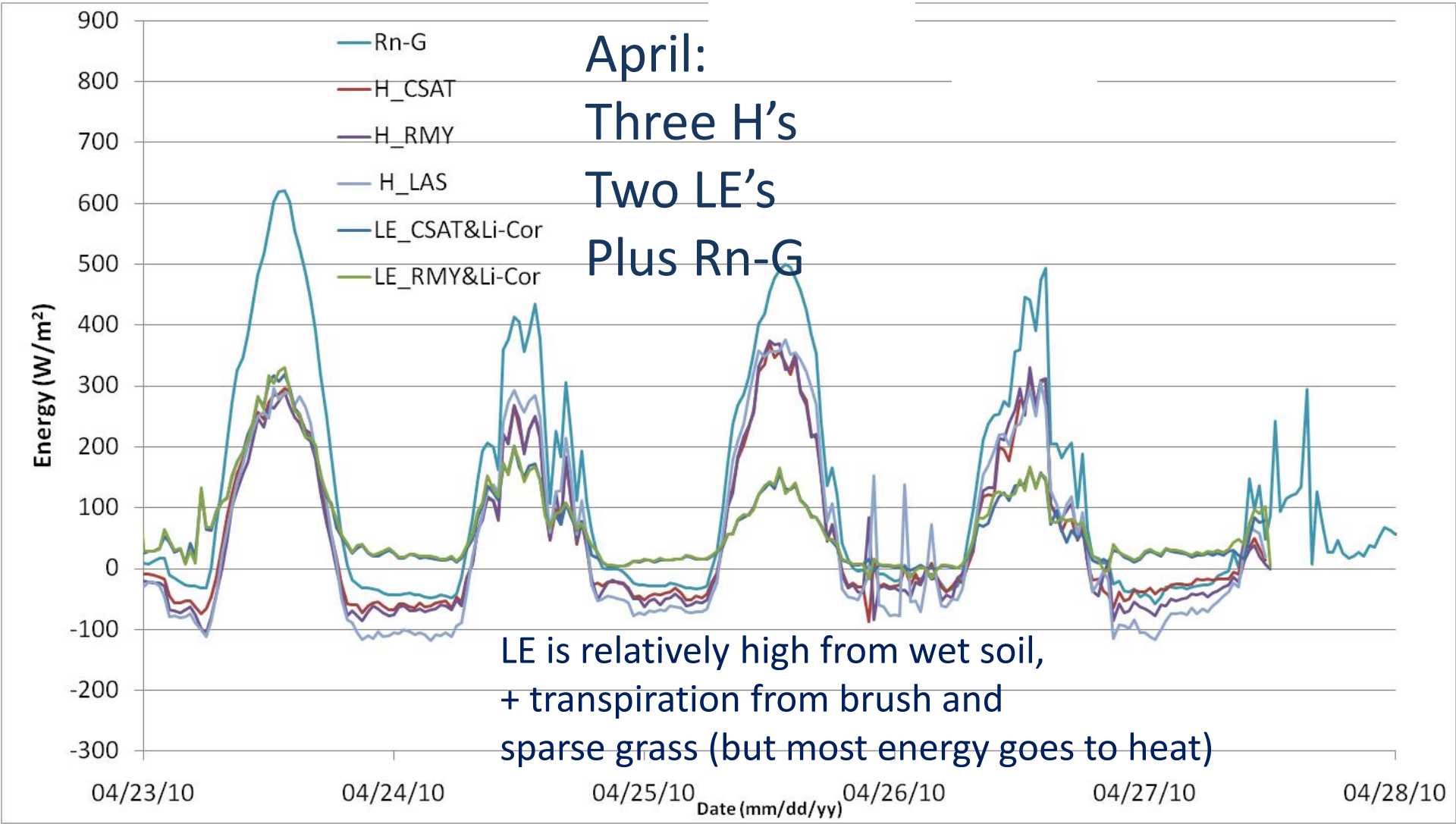
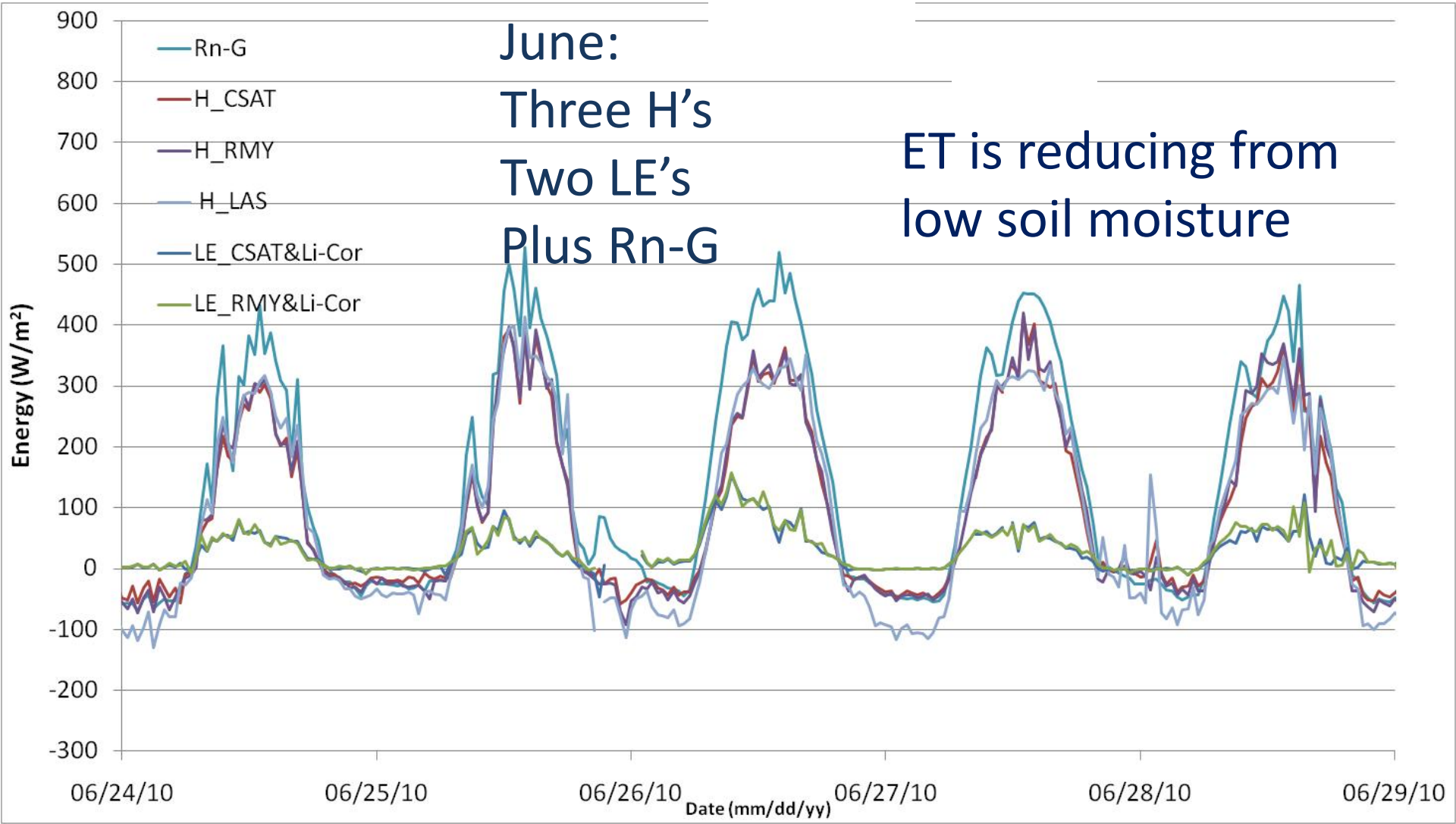


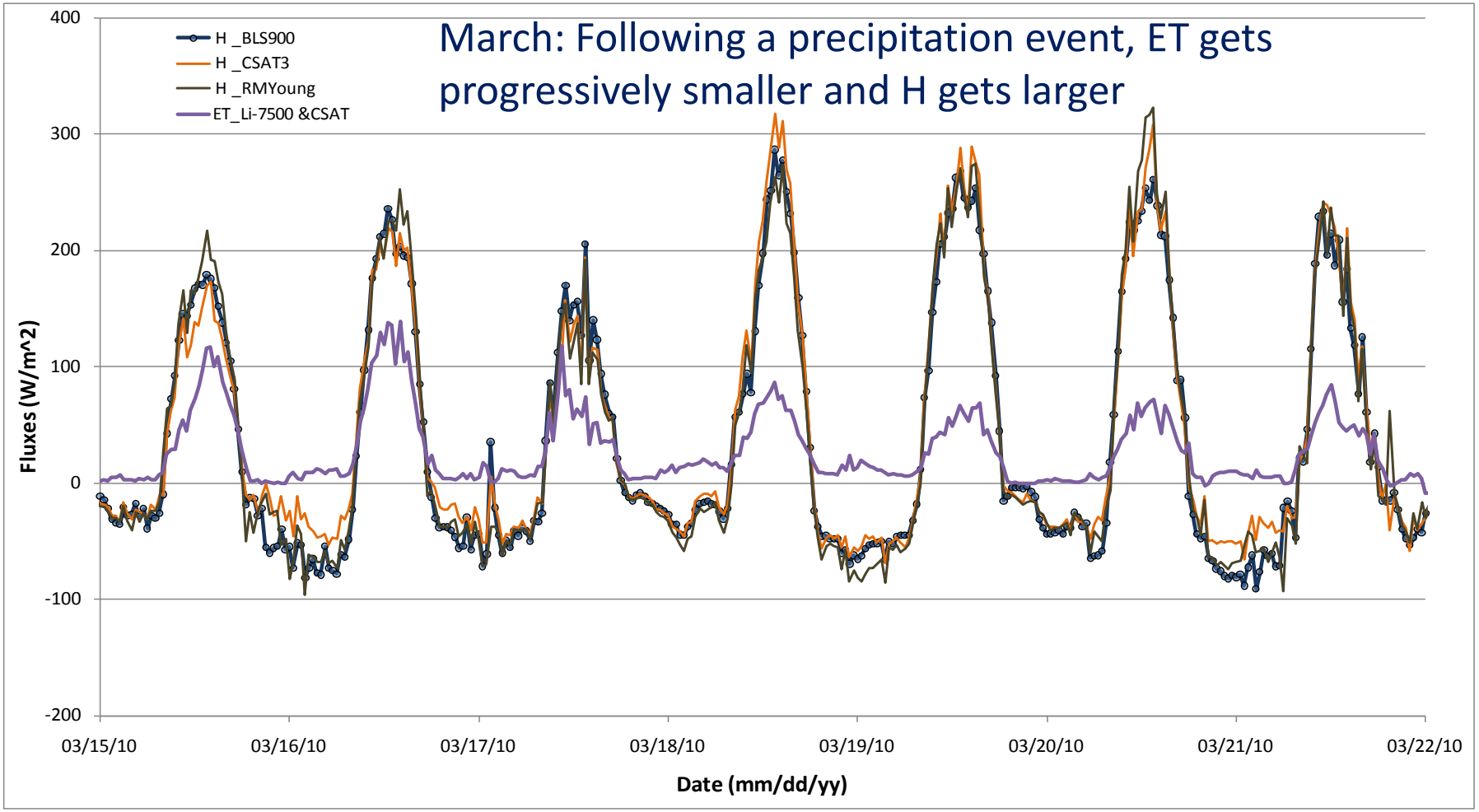
Hollister Sage Brush Flux Site



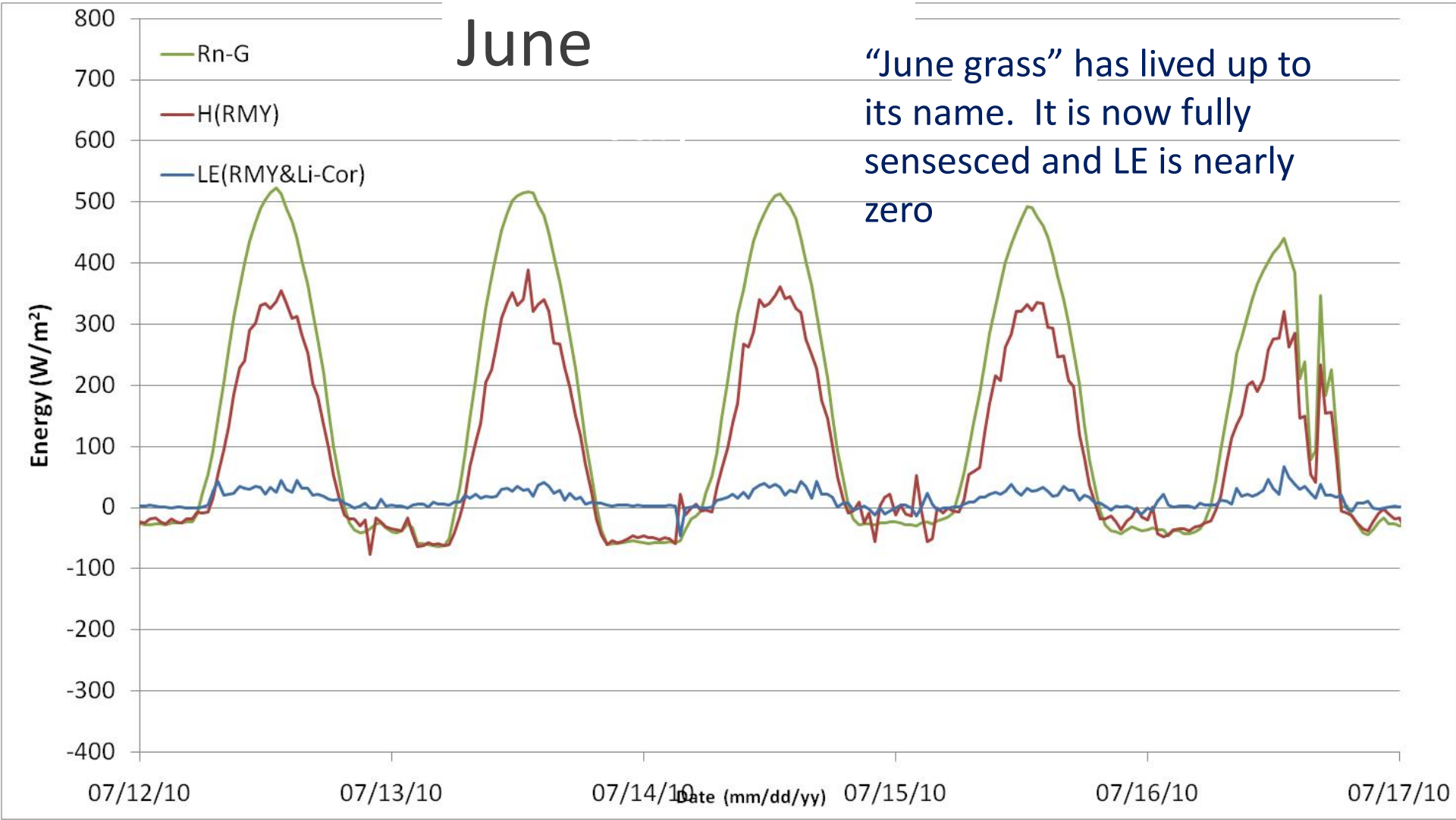
Raft River Cheatgrass site – Installed Nov. 2009

2	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

Raft River Cheatgrass Flux Site

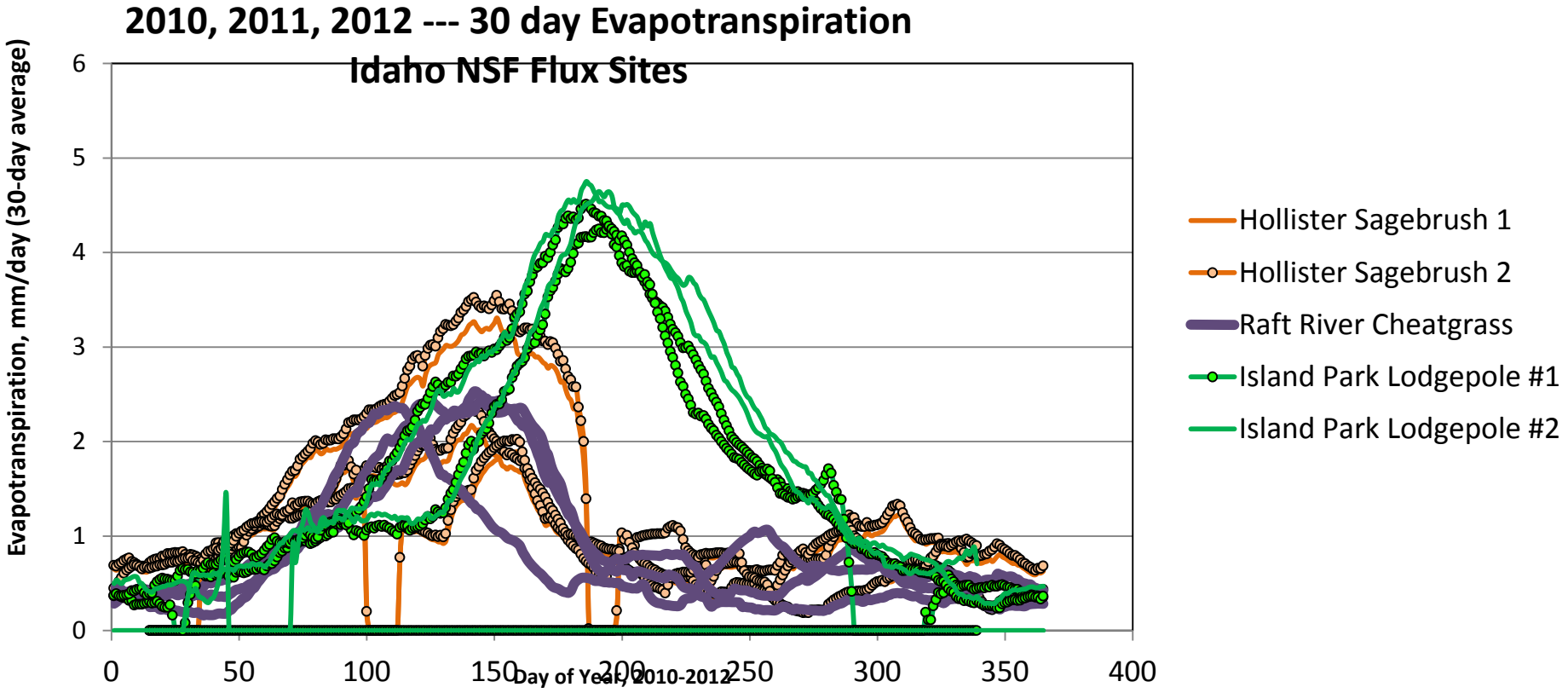


Raft River Cheatgrass Flux Site



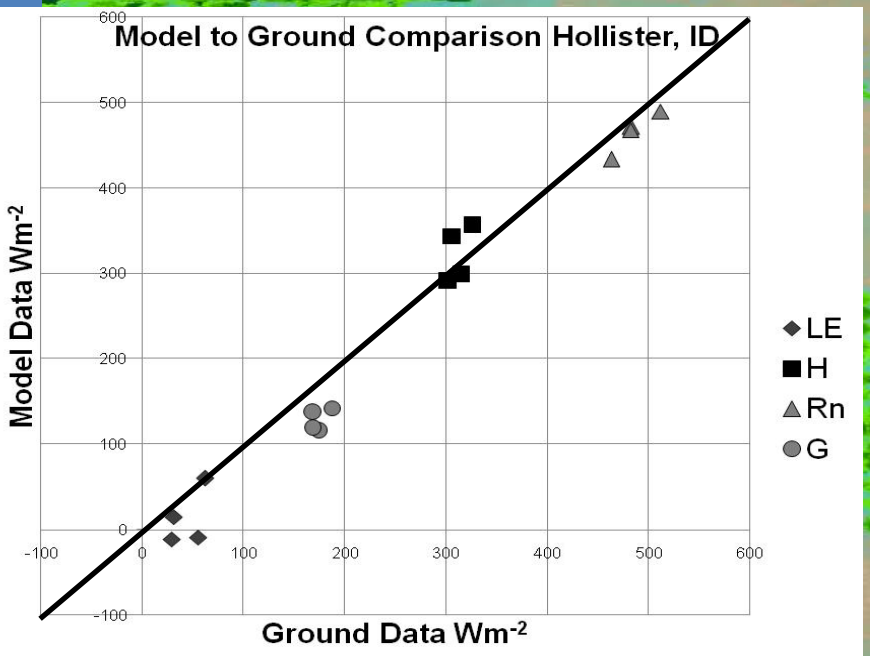
"June grass" has lived up to its name. It is now fully sensesced and LE is nearly zero

Summary of ET data



Comment: Cheat grass has earlier, but lower peak than sagebrush. Lodgepole is later and higher due to more rainfall. **Substantial differences among years.**

Research Niche - Remote Sensing of Surface Energy



Four Landsat Dates during 2010 – Sagebrush

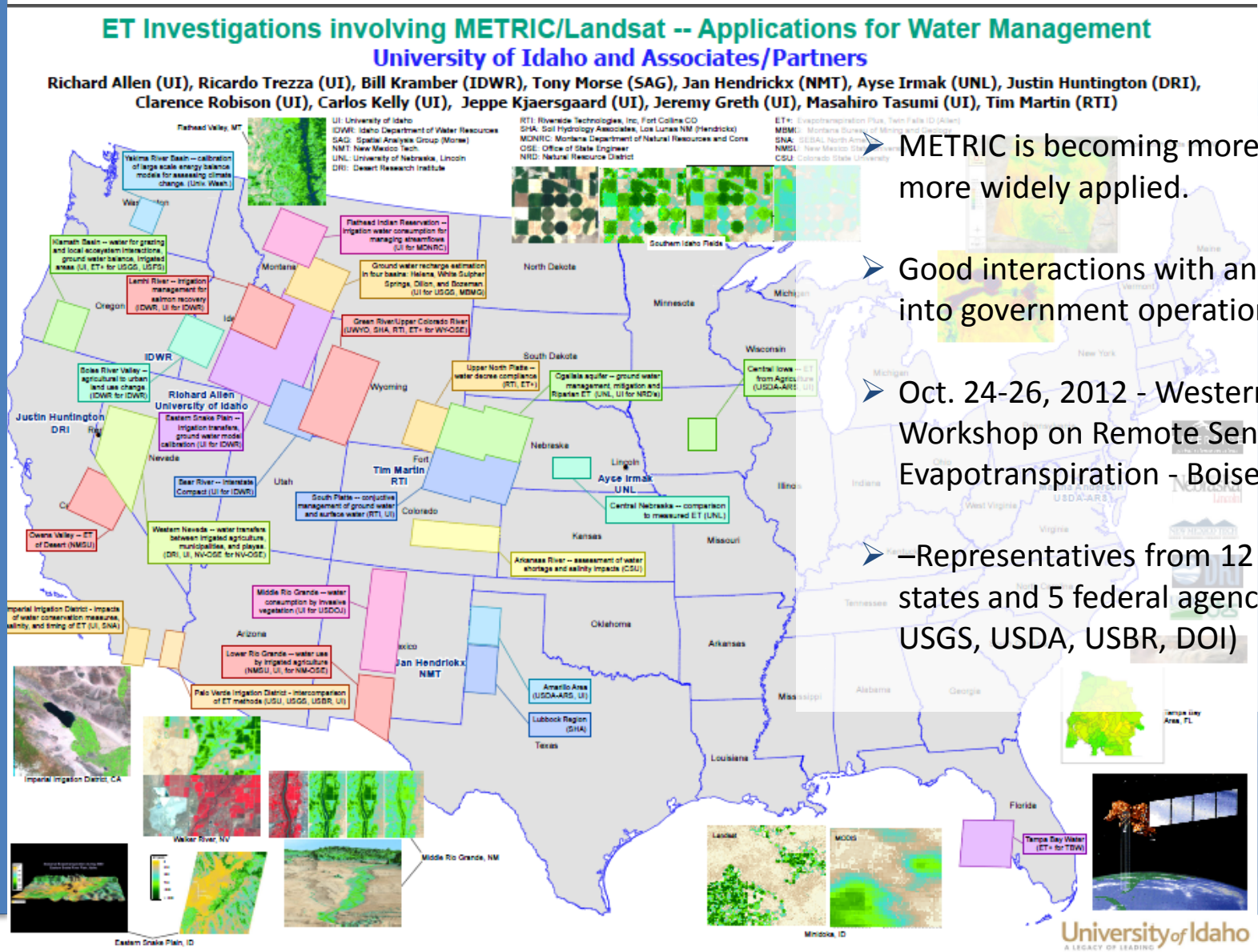
April – September ET from METRIC

- Comparison with satellite-based surface energy balance (UI METRIC model) to improve modeling for natural systems

Hydroclimate

Research Niche - Remote Sensing of Surface Energy

Hydroclimate



- METRIC is becoming more robust and more widely applied.
- Good interactions with and extension into government operations:
- Oct. 24-26, 2012 - Western States Workshop on Remote Sensing of Evapotranspiration - Boise
- –Representatives from 12 western states and 5 federal agencies (NASA, USGS, USDA, USBR, DOI)

Highlights

Idaho Nat'l Lab Ecohydrology Study

- 20 years running, 72 large plots
- 3 **precip regimes**
- 2 vegetation types
  - Key exotic incl.
- 4 soil types
- Well instrumented
- Many contributors

- Climate effects on sagebrush

Conclusions

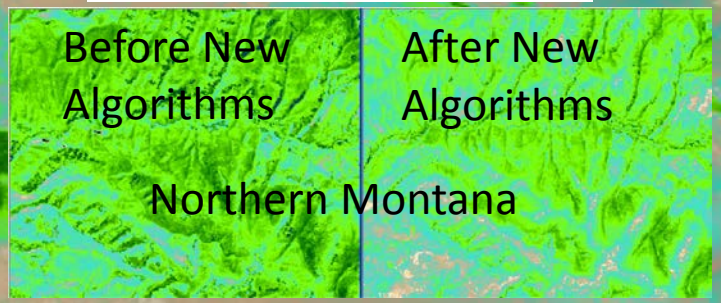
Hydroclimate

- Flux site data are improving our understanding of energy partitioning in desert systems and how to best measure
- Measurements are feeding improvements in METRIC and other hydrologic system models
- We welcome partnering with ecological modeling applications

Aerodynamic Functions

$$z_{om\_terrain} = z_{om\_terrain\_max} \sin\left(\frac{\pi}{2} \frac{\min(SDE_3, 200)}{200}\right)^3$$

$$U_{200\_adj\_1} = U_{200} \max\left(1,\ 1 + C_u\, RE_3 \left(\frac{SDE_3 - 30}{50 - 30}\right)\right)$$



Allen, R.; Trezza, R.; Kilic, A.; Tasumi, M.; Hongjun L. (2012) Sensitivity of Landsat-scale energy balance to aerodynamic variability in mountains and complex terrain. *Journal of the Am. Water Resources Assoc.* (in press).

Data


Firefox
www.kimberly.uidaho.edu/epscor/index.html
dropbox
Most Visited
Getting Started
Latest Headlines
Idaho Transportation ...
(3988 unread) - rick_all...
KAYAK Search Results
University of Idaho Ki...
Find My iPhone
Google Scholar
Bookmarks
Mozilla Firef...
(977 unread...
US Airways |...
Citrix Online
tr21 usda - ...
5a. Charles ...
La Quinta In...
Google Cale...
Expert Back...
EPSCoR I...
5157 DEEBO...
5157 Deebo...
Experimental Program to Stimulate Competitive Research in Idaho
Strengthening Idaho by Investing in Discovery, Learning, and Research Infrastructure
Site Selection
IDAHO NSF - EPSCoR
Helpful Links
Hollister site –Sagebrush (Artemisia tridentata)
Site Description (Hol)
Raft River site -- invasive cheatgrass (bromus tectorum) with some bunch grass
Site Description (RR)
Climate Change Impacts Project -- Flux Measurement
Moscow EPSCoR Climate Change Site
Idaho NSF EPSCoR website
CUAHSI data server
Kimberly ID, Research Center
NSF info on
7:44 AM