

Cropland and Rangeland Activities

Big Sky Carbon Sequestration Partnership

David Brown

Washington State University - Pullman

Regional Carbon Sequestration Partnerships

Initiative Review Meeting

Pittsburgh, PA, Dec. 14, 2007

Terrestrial Partners & Contributors

Rick Lawrence, Perry Miller, Julianna Fessenden, Sam Clegg, Ross Bricklemyer, Jennifer Watts, George Vance, Jerry Schuman, Justin Derner, and Rick Engel

Terrestrial Carbon Sequestration **MMV**

Δ Land Management

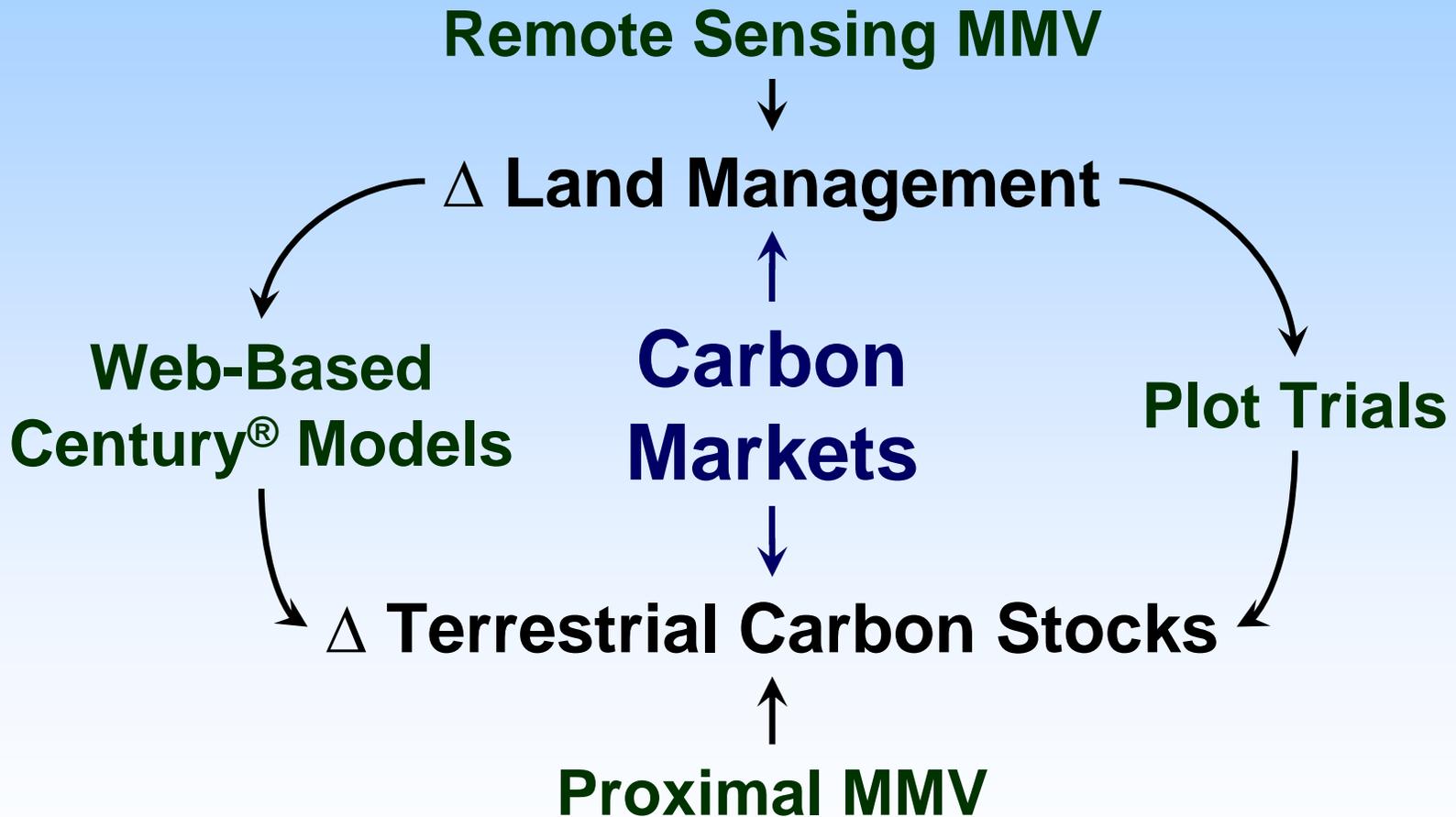


Amount – Certainty – Cost – Value

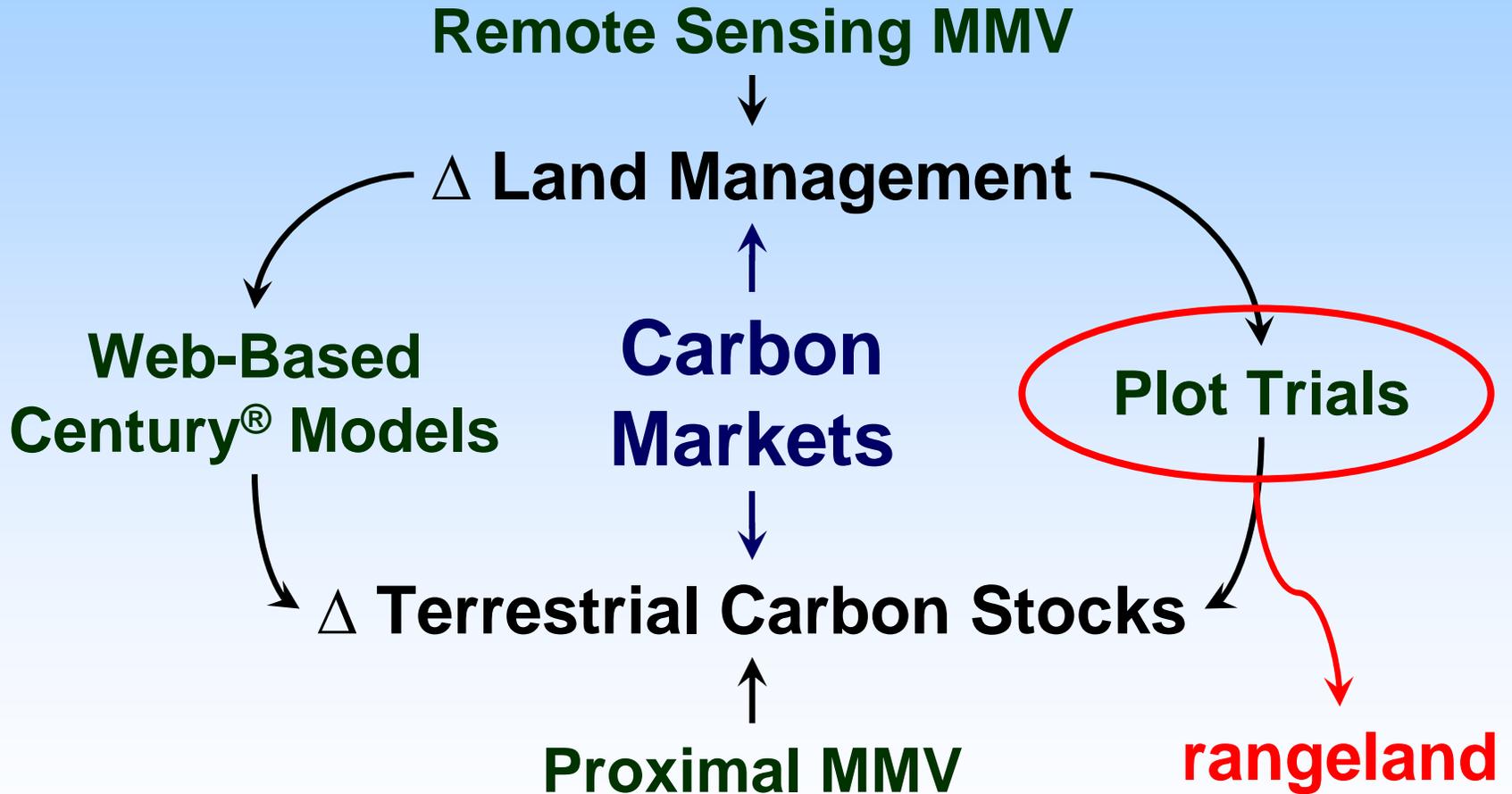


Δ Terrestrial Carbon Stocks

Terrestrial Carbon Sequestration MMV



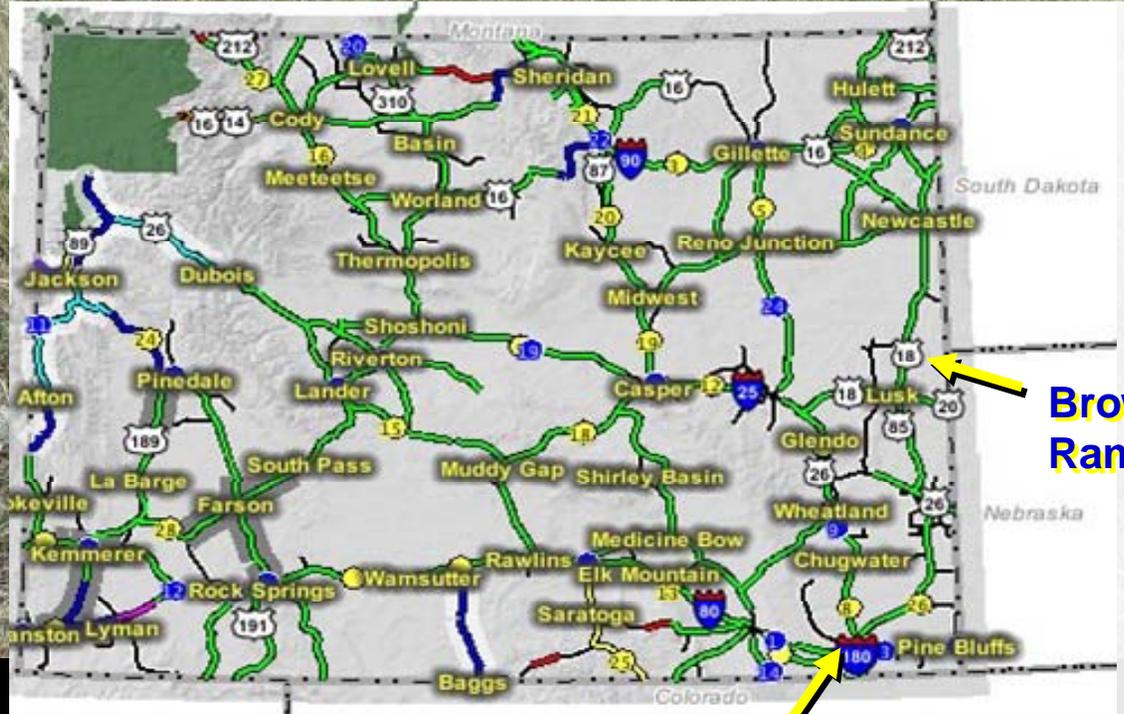
Terrestrial Carbon Sequestration MMV



Rangeland Carbon Sequestration Assessment



**George Vance,
Justin Derner, &
Jerry Schuman
(U of Wyoming)**



Browder Ranch

**High Plains Grasslands
Research Station**

Rangeland Soil Sampling Activities:

- 2006 → Grazing intensity
 - established 1982
 - 4 treatments, 320 soil samples
- 2008 → Rangeland Improvements
 - established 2003-04
 - 3 treatments, 120 soil samples
- 2009 → Grazing seasonality
 - established 2003
 - 5 treatments, 160 soil samples
- Vegetation C & forage quality for all

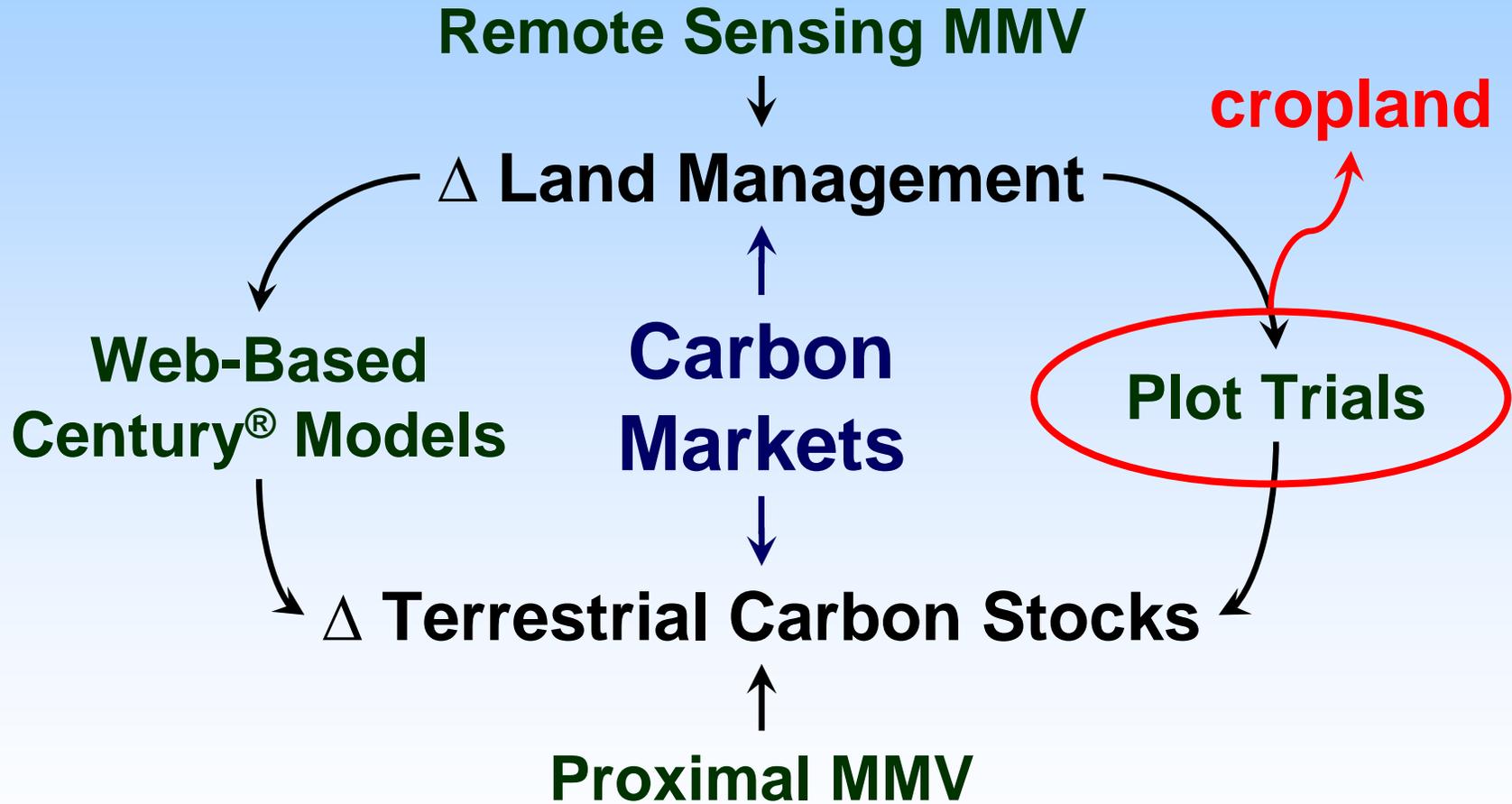
Rangeland Findings:

- Grazing intensity
 - 0-30 cm SOC
 - Light and heavy grazing > non-grazed
 - 58.0 and 58.3 vs. 47.9 Mg C/ha
 - Heavy grazing → plant community shift
 - cool-season perennial grasses to
warm-season blue grama
- **Climate influences long-term trends**
 - 2003, 2006, & 2007 SOC results not consistent

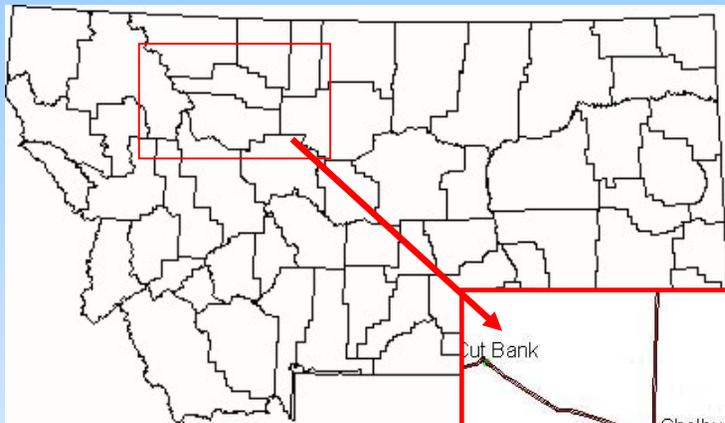
Rangeland Conclusions:

- No change in exclosure SOC content during year 1993 to 2006
- SOC content of both CL and CH treatments declined irrespective of soil depths during 1993 to 2006
 - **Attributed to drought conditions**
- In 2006, SOC was highly variable in the grazing treatments
 - **Under normal to wet conditions, changes in SOC may be rapid ?**

Terrestrial Carbon Sequestration MMV

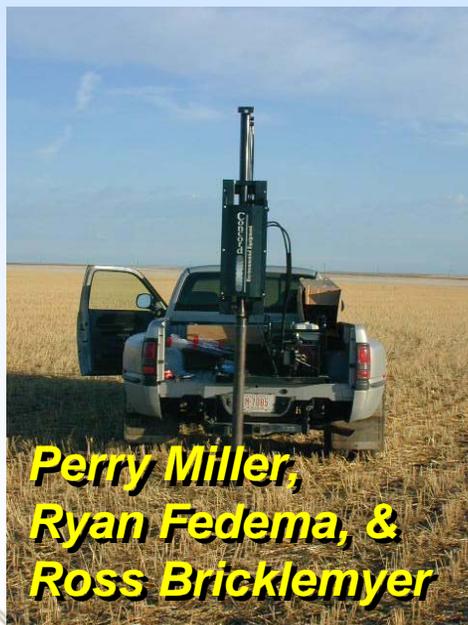
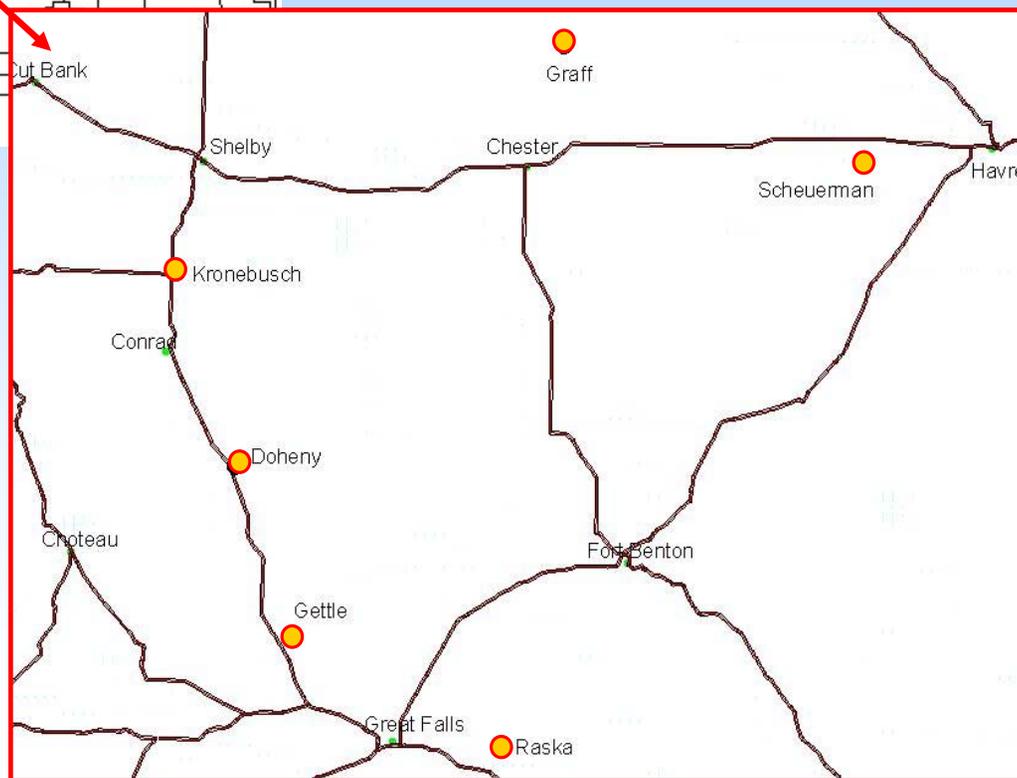


Cropland Controlled Test Sites



Treatments:

- Till vs. no-till
- Wheat-fallow vs. wheat-lentil



***Perry Miller,
Ryan Fedema, &
Ross Bricklemeyer***

Isotope Tracing of Carbon Movement and Storage

Tillage vs. no-till
Crop rotation



Soil Carbon Dynamics

- Estimate carbon loss as a function of ag practices
- Quantify young vs. old carbon lost to the atmosphere
- Quantify rainfall, snowmelt and seasonality factors
- Field measurements to constrain model (CQESTR)

Julianna Fessenden¹, Malu Cisneros¹ and Ryan Feddema²

¹ Earth & Environmental Sciences Division, Los Alamos National Laboratory

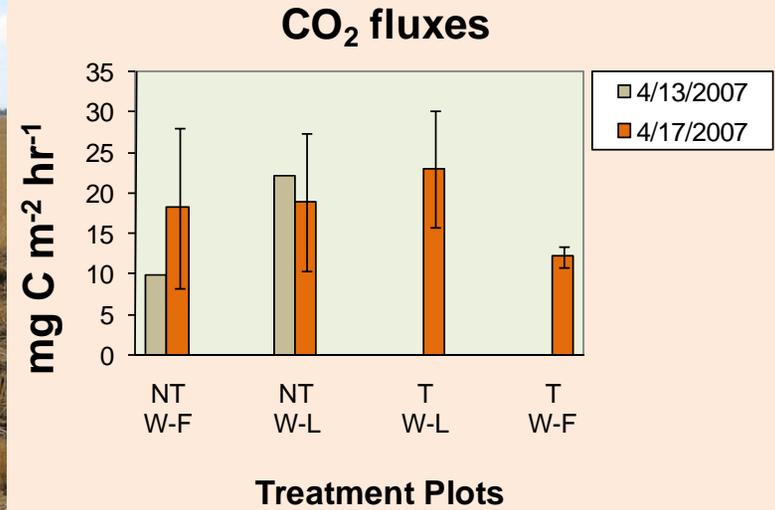
² Land Resources & Environmental Sciences, Montana State University

CO₂ fluxes measured on April 13th and 17th, 2007



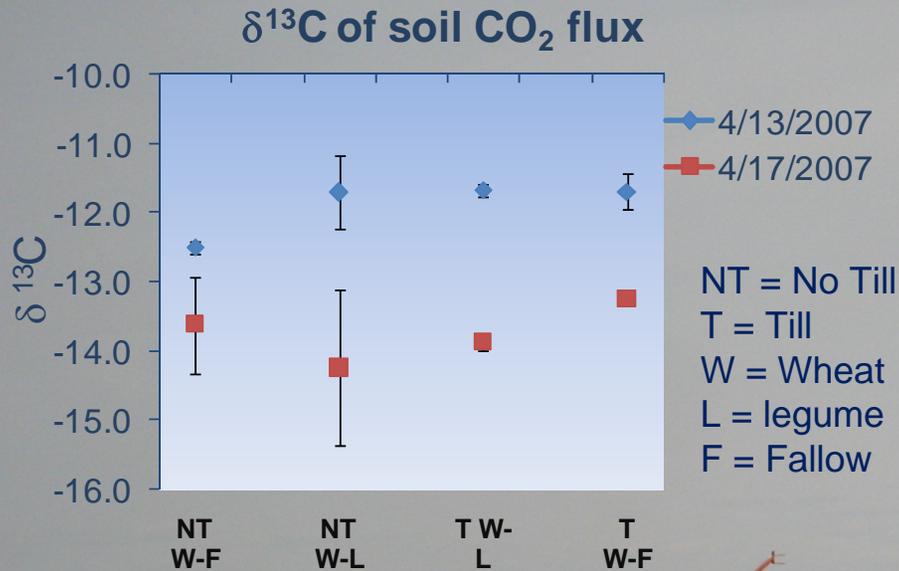
Collars installed 24 hours in advance

System for flux measurement and collection of a CO₂ sample



- **Fluxes low, heterogeneity**
- **No significant differences**
(3 years since start)
- **Higher fluxes expected later**
(warmer temperatures)

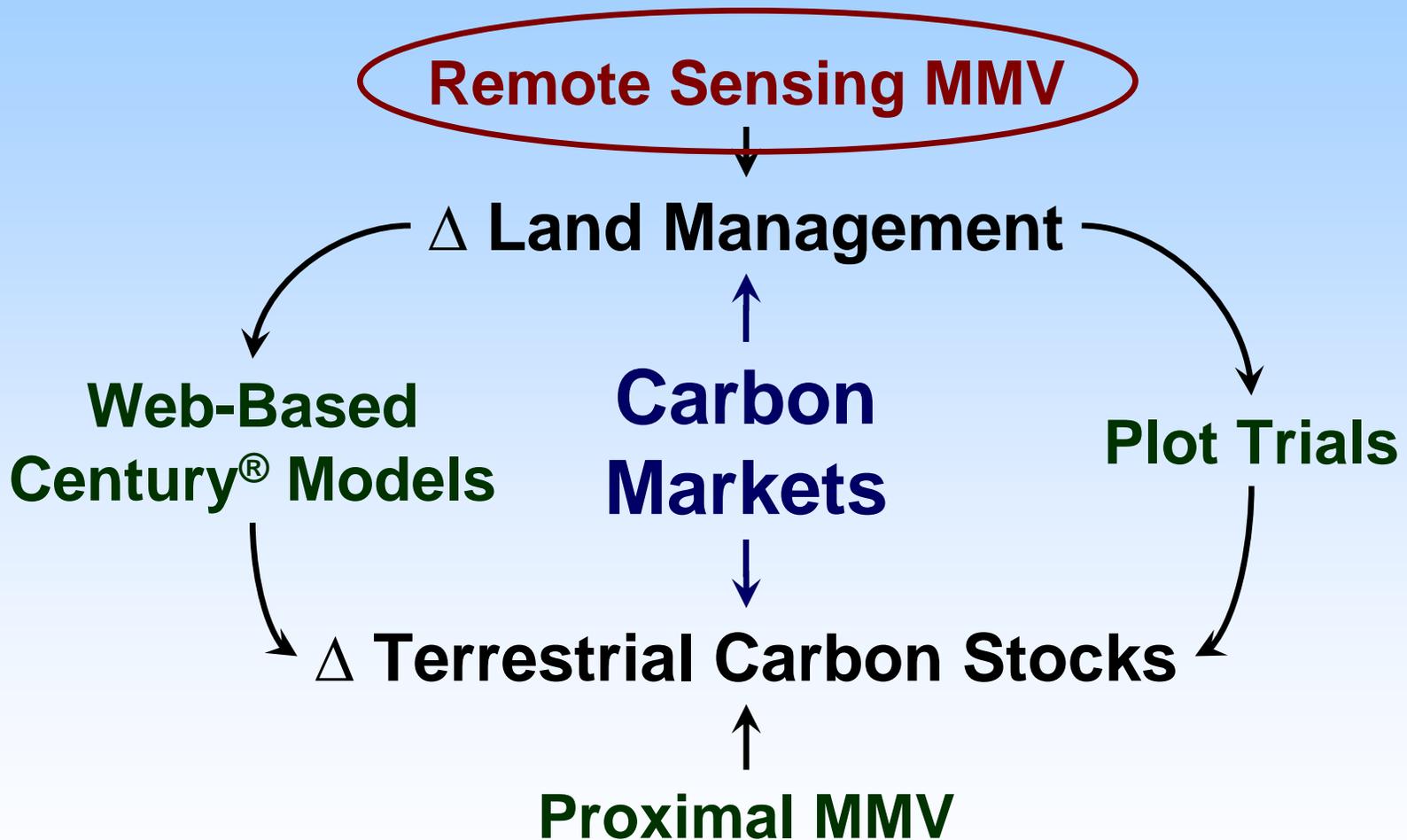
Instantaneous effect of tilling/seeding on carbon release



- **Tilled and seeded on 04/17/2007**
- **CO_2 flux $\delta^{13}\text{C}$ values shifts negative following tillage/seeding.**
Statistically sig. ($p < 0.05$) for “T W-L” plots (tilled-wheat-legume)
- **Disturbance facilitates diffusion of gases upward,**
particularly of the lighter isotope (^{12}C), $\delta^{13}\text{C} \rightarrow$ negative

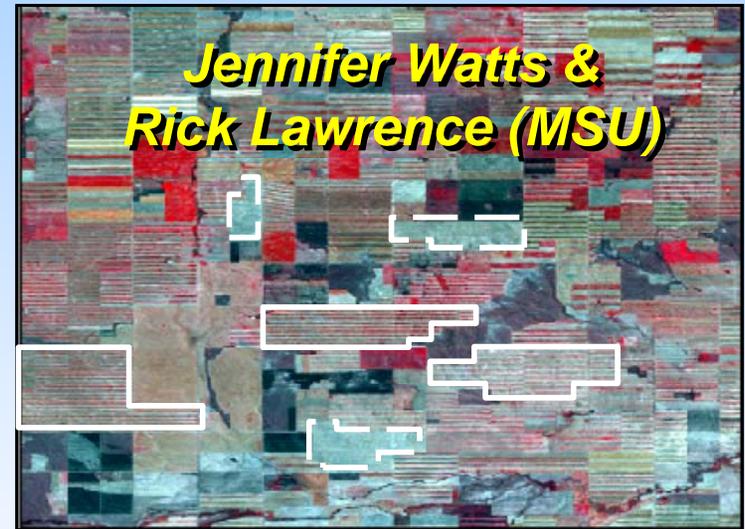


Terrestrial Carbon Sequestration MMV

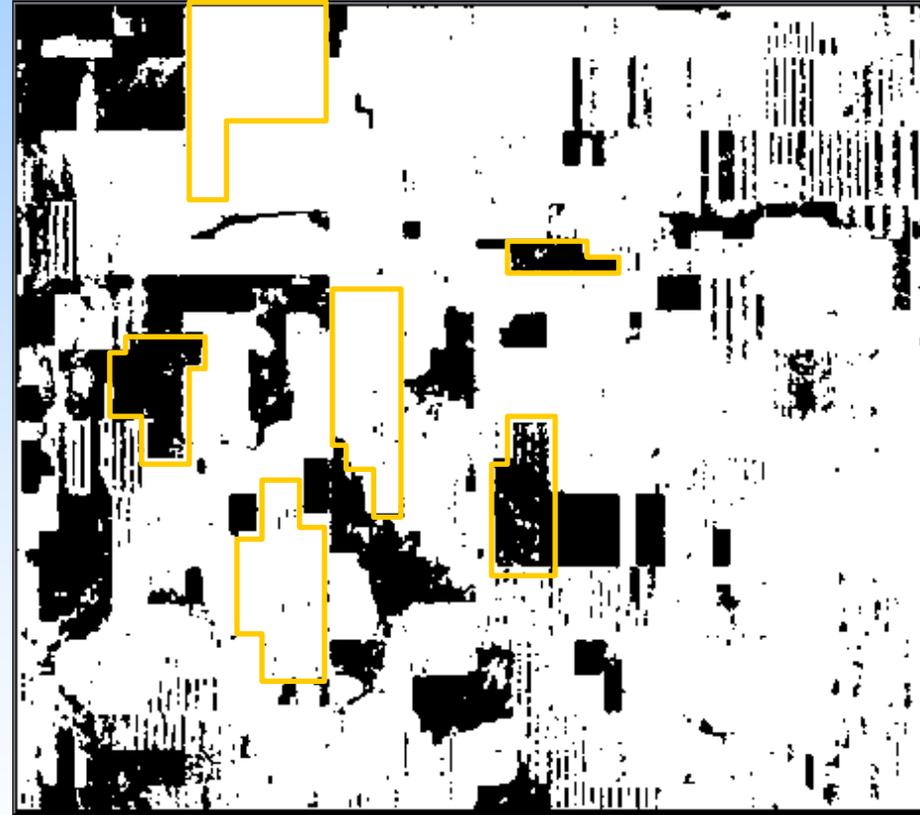


Remote Sensing MMV Objectives

- Map management practices in north central Montana
 - Tillage vs. no-till
 - Crop types & rotations
 - CRP
- Quantify adoption trends
 - Voluntary adoption trends for no-till
 - Current proportion of agriculture in alternative rotations

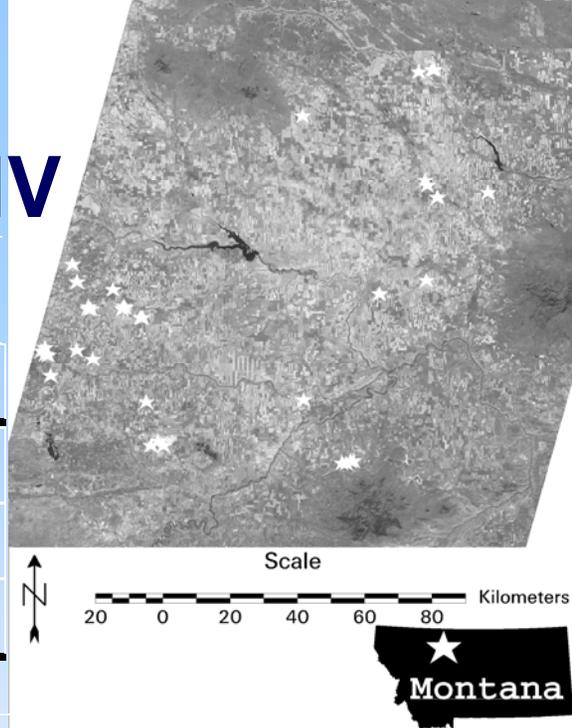


Remote Sensing MMV



Bricklemyer et al. 2002

Remote Sensing MMV



Logistic regression (N = 40181)

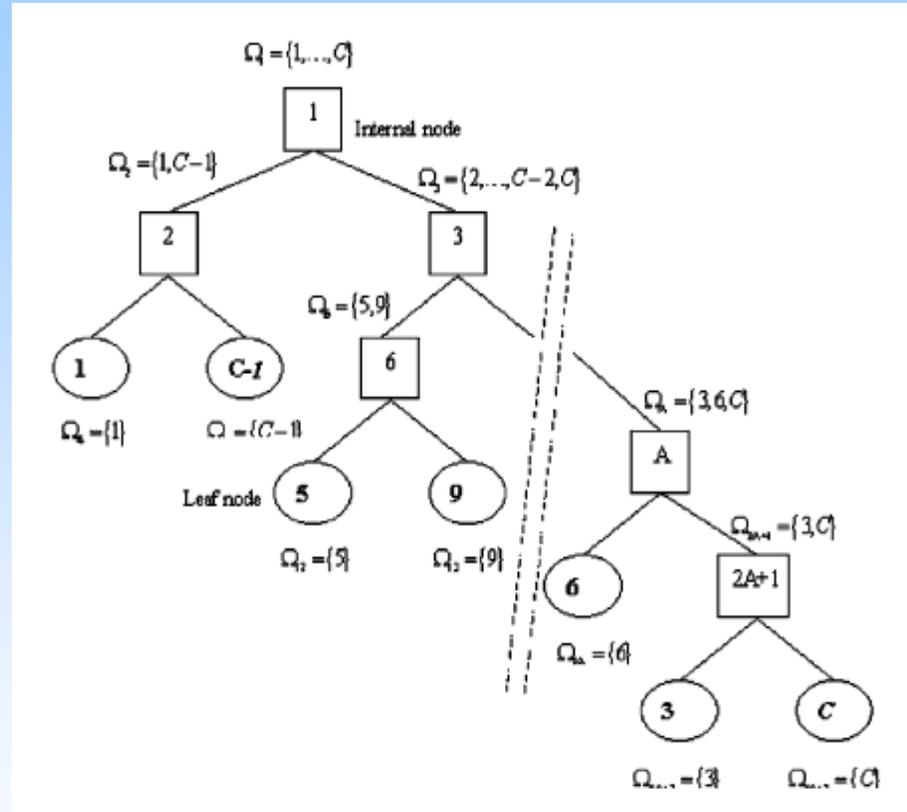
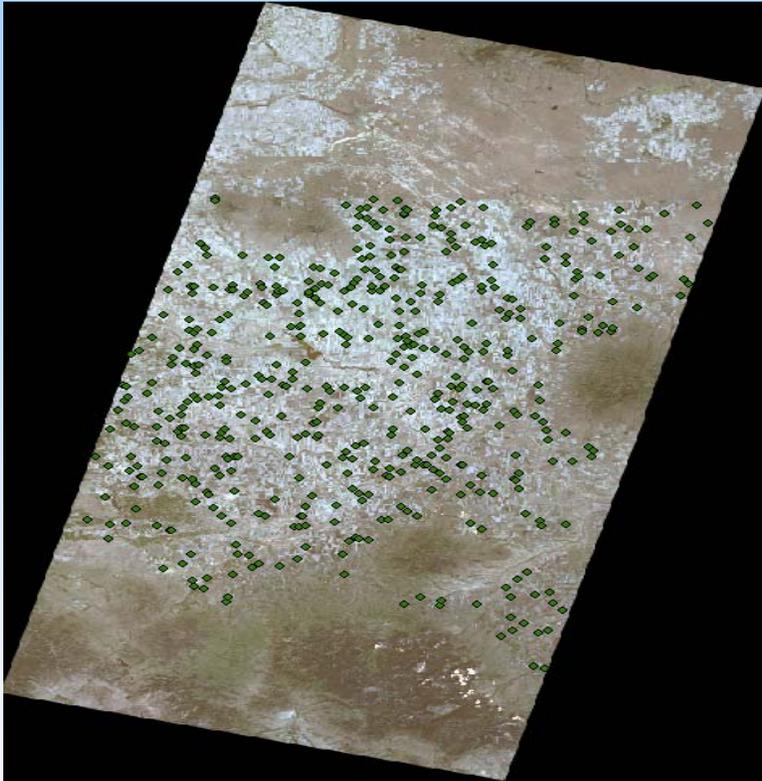
	No-till	Tillage
Producer's Accuracy (%)	99	29
User's Accuracy (%)	95	80
Overall Accuracy (%)	94	

Boosted classification trees (99 boosts, N = 35944)

	SW	WW	Bly	CRP	Len	Alf
Producer's Accuracy (%)	99	98	92	96	88	95
User's Accuracy (%)	97	99	96	99	91	97
Overall Accuracy (%)	97					

SW = spring wheat, WW = winter wheat, Bly = barley,
 Len = lentils, Alf = alfalfa

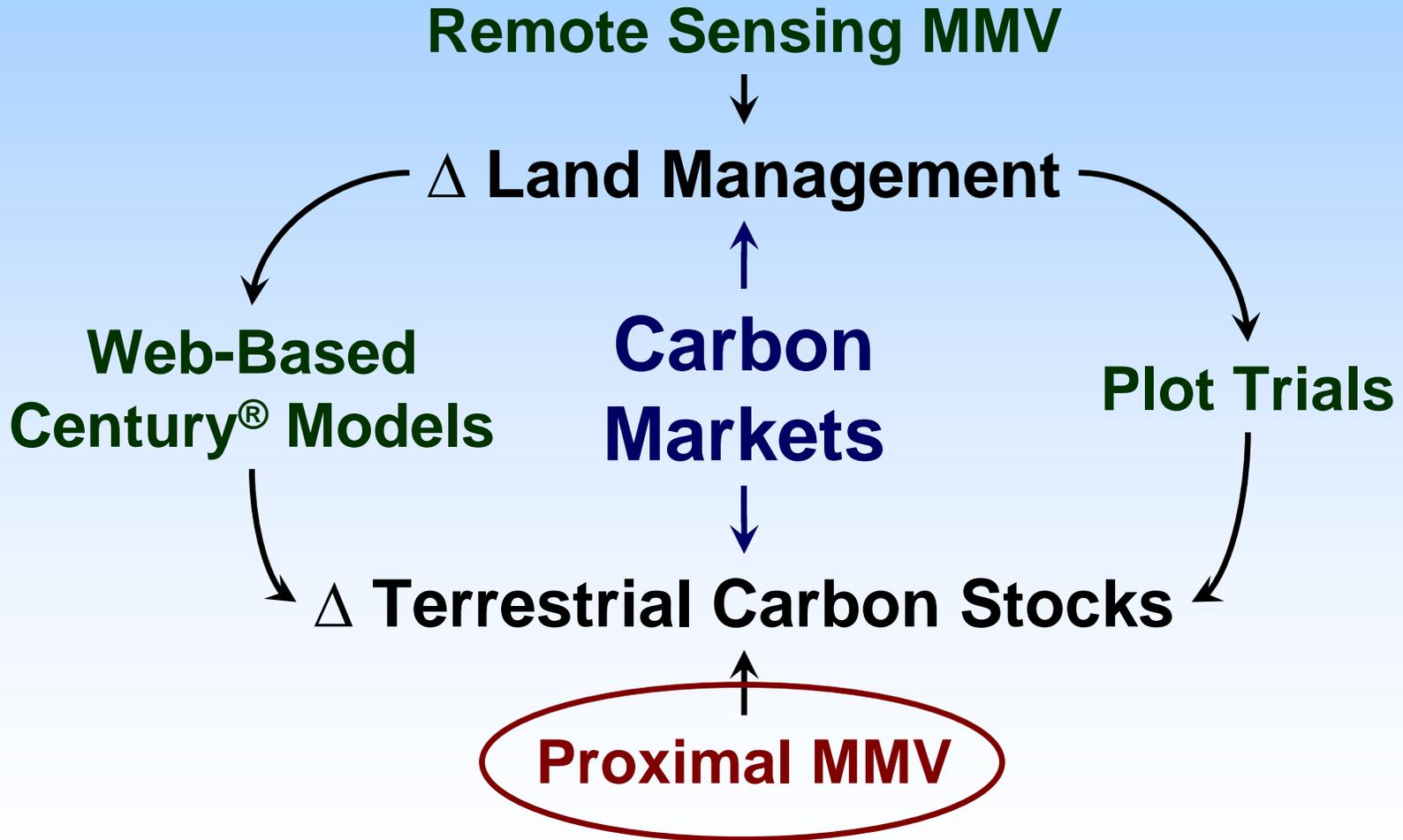
Remote Sensing MMV - Object-oriented



- Spatial & Spectral features
- Advanced classification techniques

Lawrence
& Watts,
MSU

Terrestrial Carbon Sequestration MMV



“On the fly” VisNIR spectroscopy



efficient
core
acquisition

- 9 fields scanned
- SOC/SIC completed (surface)

**“On the Fly”
VisNIR spectroscopy**

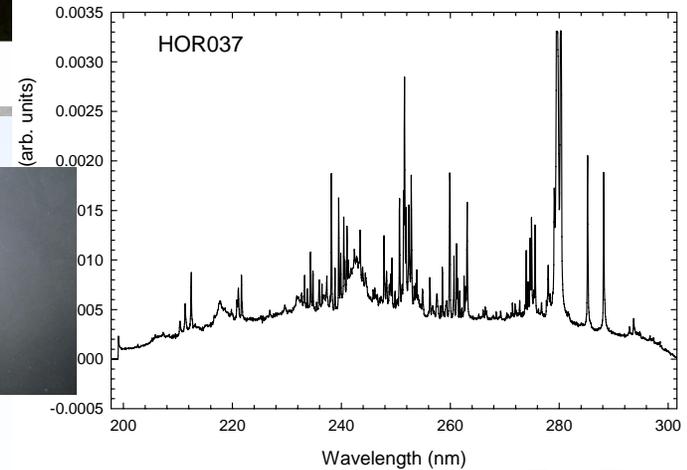
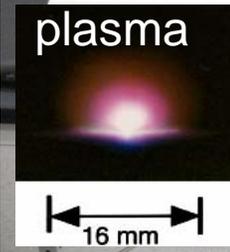
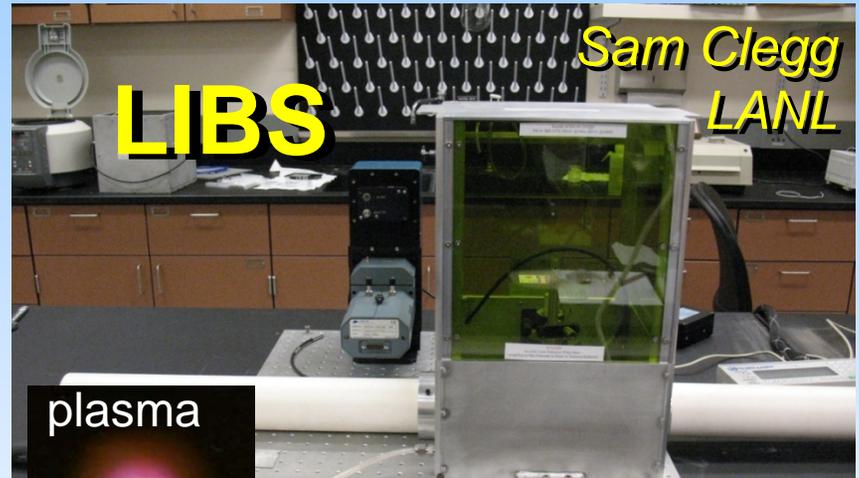
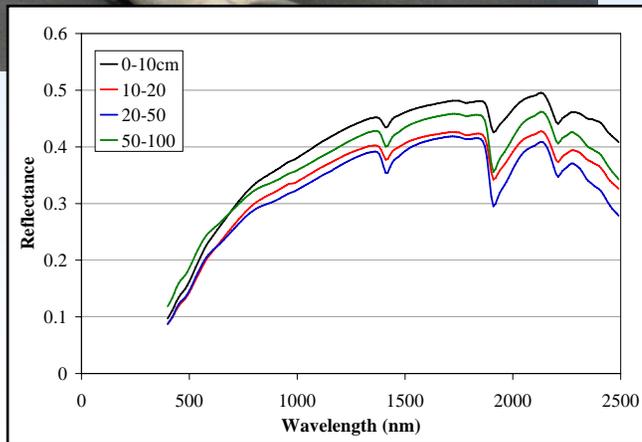
Colin Christy

Veris Technologies

BIG SKY CARBON
SEQUESTRATION PARTNERSHIP

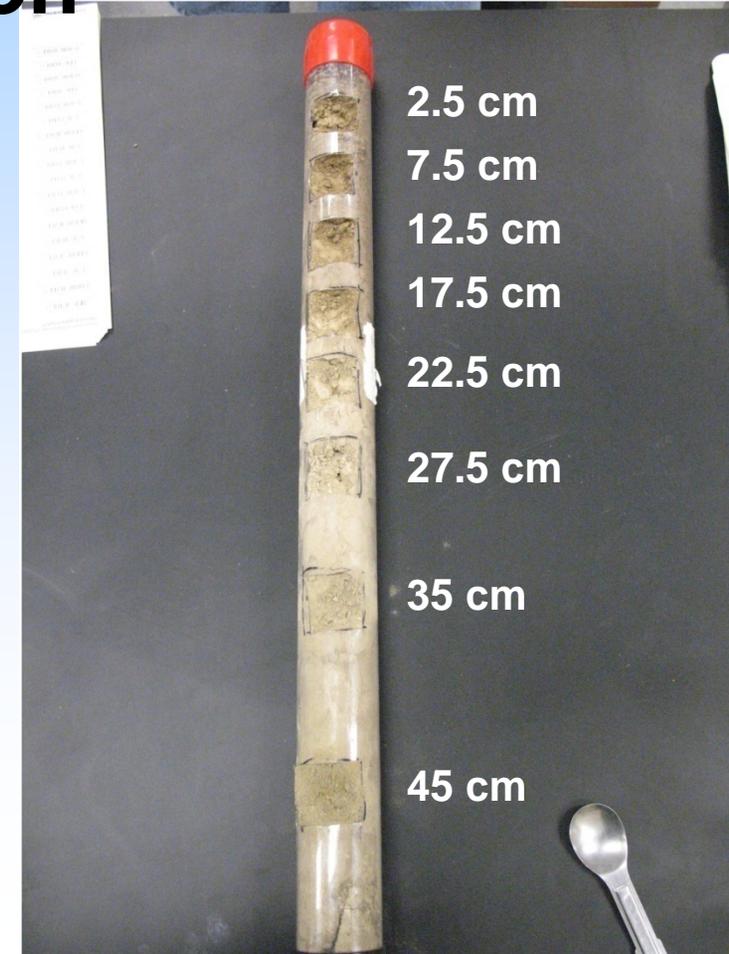
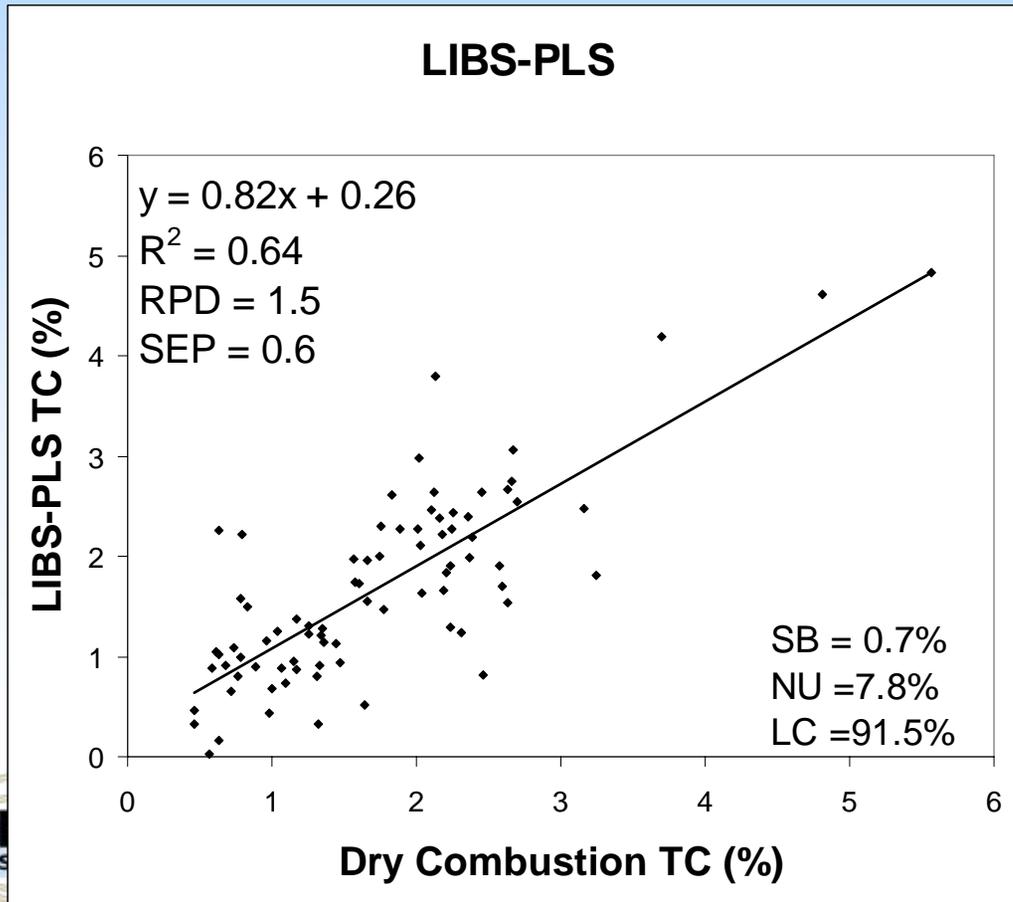


Soil Core Analysis



Soil Cores

- 61 cores for calibration
- 20 cores random validation



Terrestrial Carbon Sequestration MMV

Δ Land Management



Amount – Certainty – Cost – Value



Δ Terrestrial Carbon Stocks

Questions?

David Brown
Washington State University