GSB-LACAf Environmental Project
Penn State Potential Contributions

CENA – 27 August 2014

Piracicaba, SP

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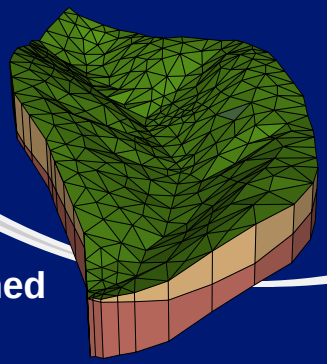
Research Across Scales

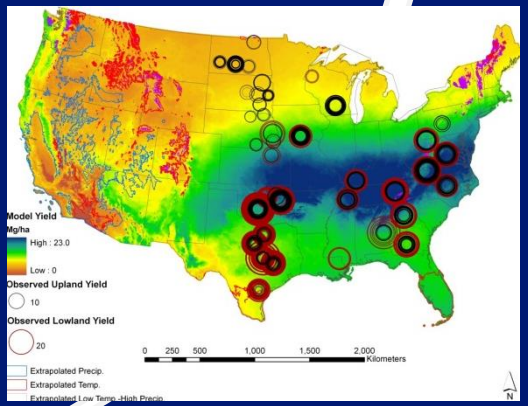
Crop x Soil x Climate x Management

A field in Pennsylvania

A Texas landscape



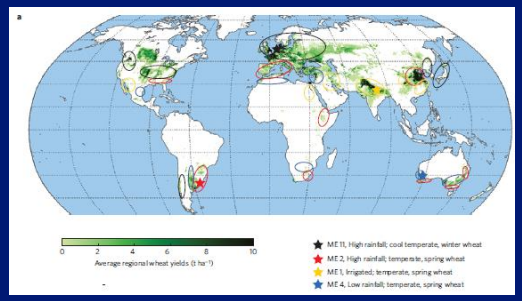
A Watershed



Region

Multi-Region

Global



What we do Research

Scale	Experiments	Models (PIHM-CYCLES-CROPSYST)
Crop Growth and Water Use	✓ Plot scale ✓ Eddy covariance ✓ Plant competition	✓ Water Use Efficiency Theory ✓ Coupled photosynthesis and transpiration models ✓ Plant competition ✓ *Cycles and CropSyst*
Soil Carbon and N cycling	✓ Plot scale (^{13}C, ^{15}N) ✓ Hillslope scale (N_2O)	✓ Yes
Farm Scale - Climate Change		✓ Agronomic and economic modeling at regional scale
Watershed Scale Biogeochemical Models	✓ Critical Zone Observatory	✓ *Penn State Integrated Hydrological Model* ✓ *Cycles*

What we do C and N Experiments

Soil Biology & Biochemistry 75 (2014) 273–281

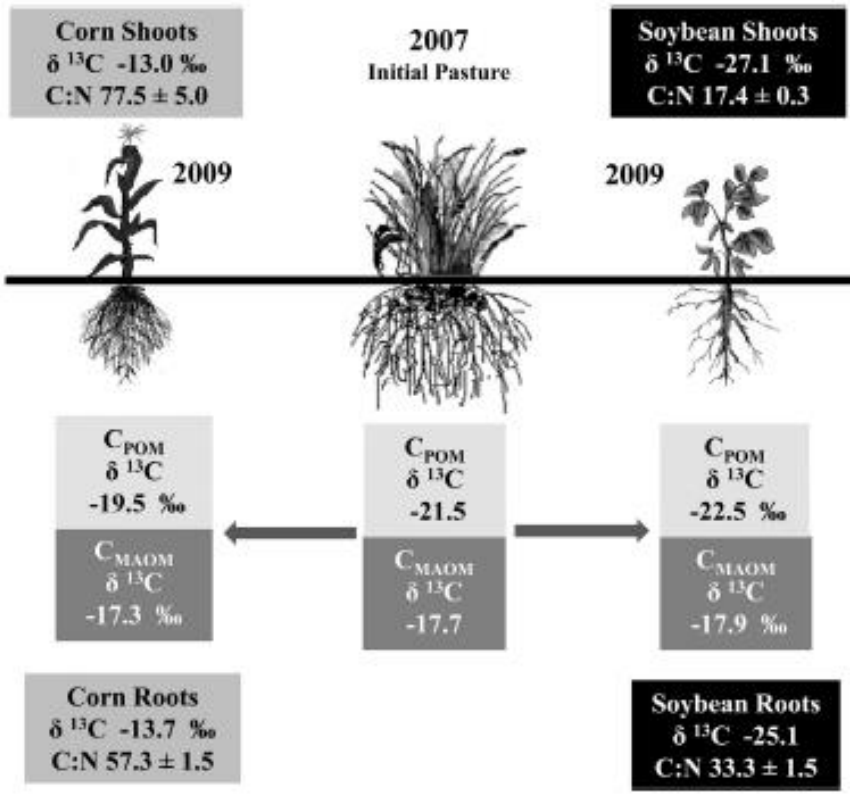
Contents lists available at ScienceDirect

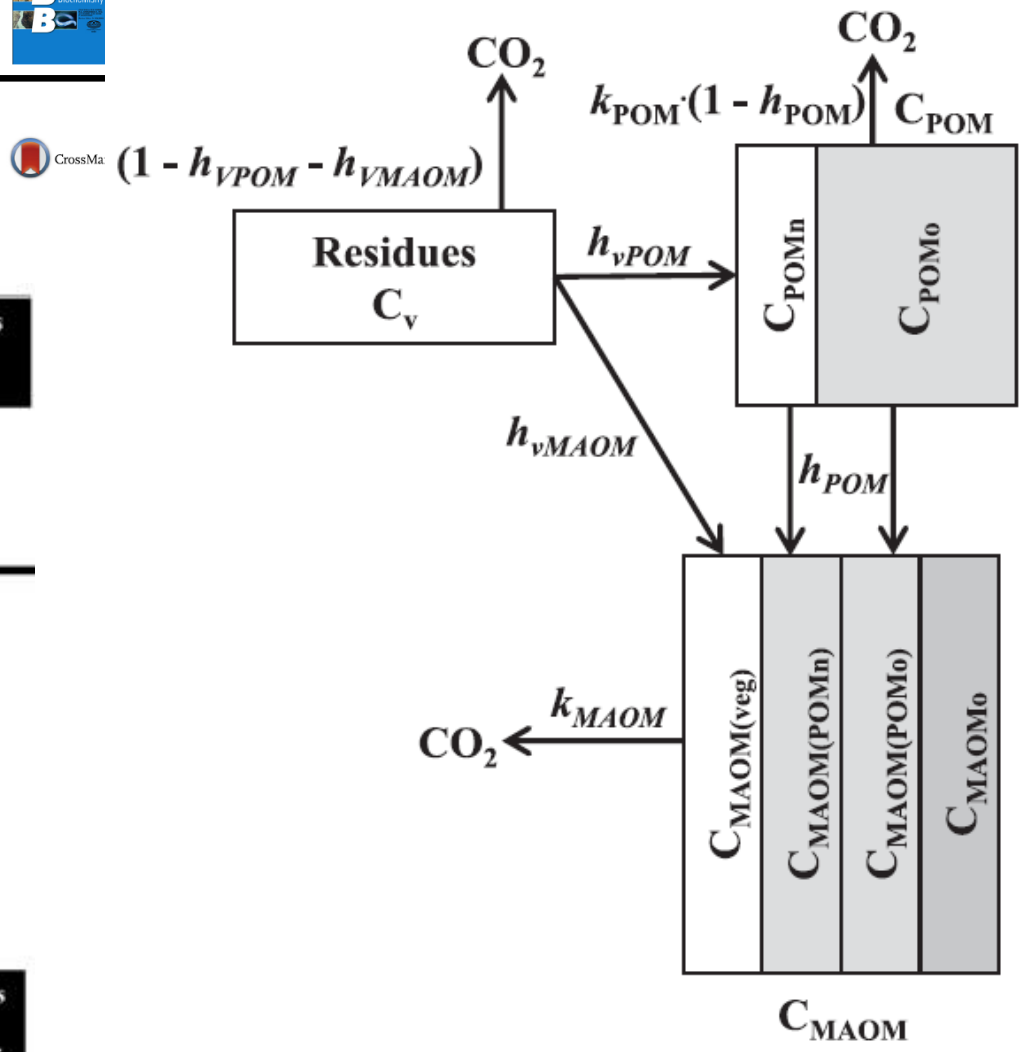
Soil Biology & Biochemistry

journal homepage: www.elsevier.com/locate/soilbio

Priming of soil organic carbon decomposition induced by corn compared to soybean crops

Sebastián R. Mazzilli [a,*], Armen R. Kemanian [b], Oswaldo R. Ernst [a], Robert B. Jackson [c], Gervasio Piñeiro [d]





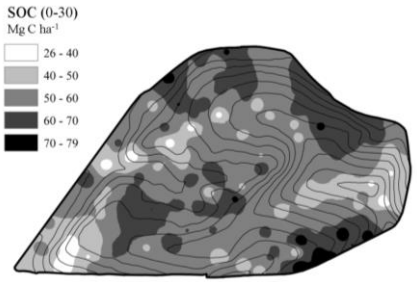
What we do

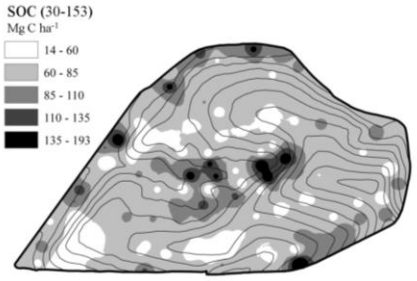
Eddy covariance, maize and willow

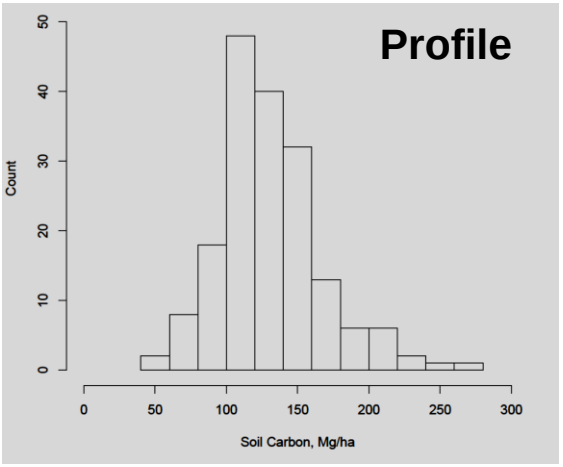
Data

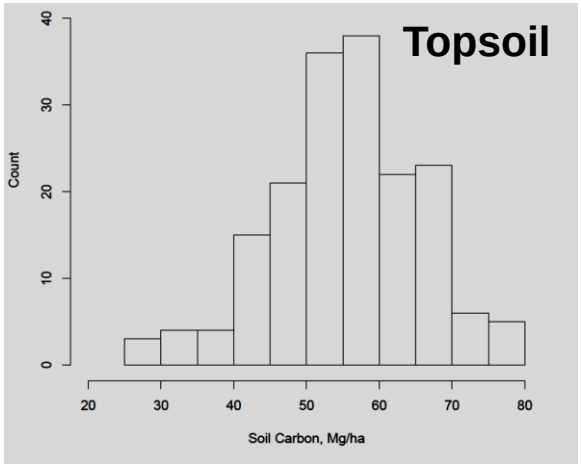
Frequency distribution of C_s

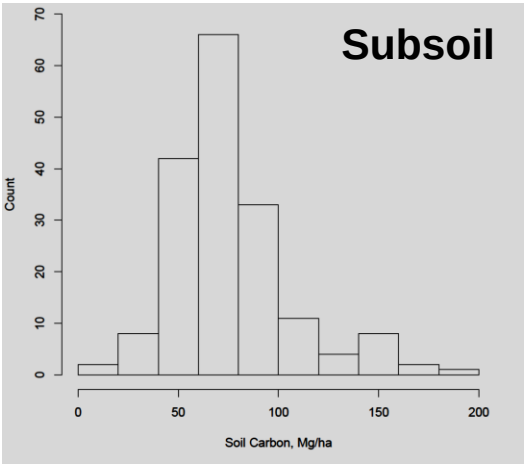
Some semblance with Shale Hills (and any landscape with slope)







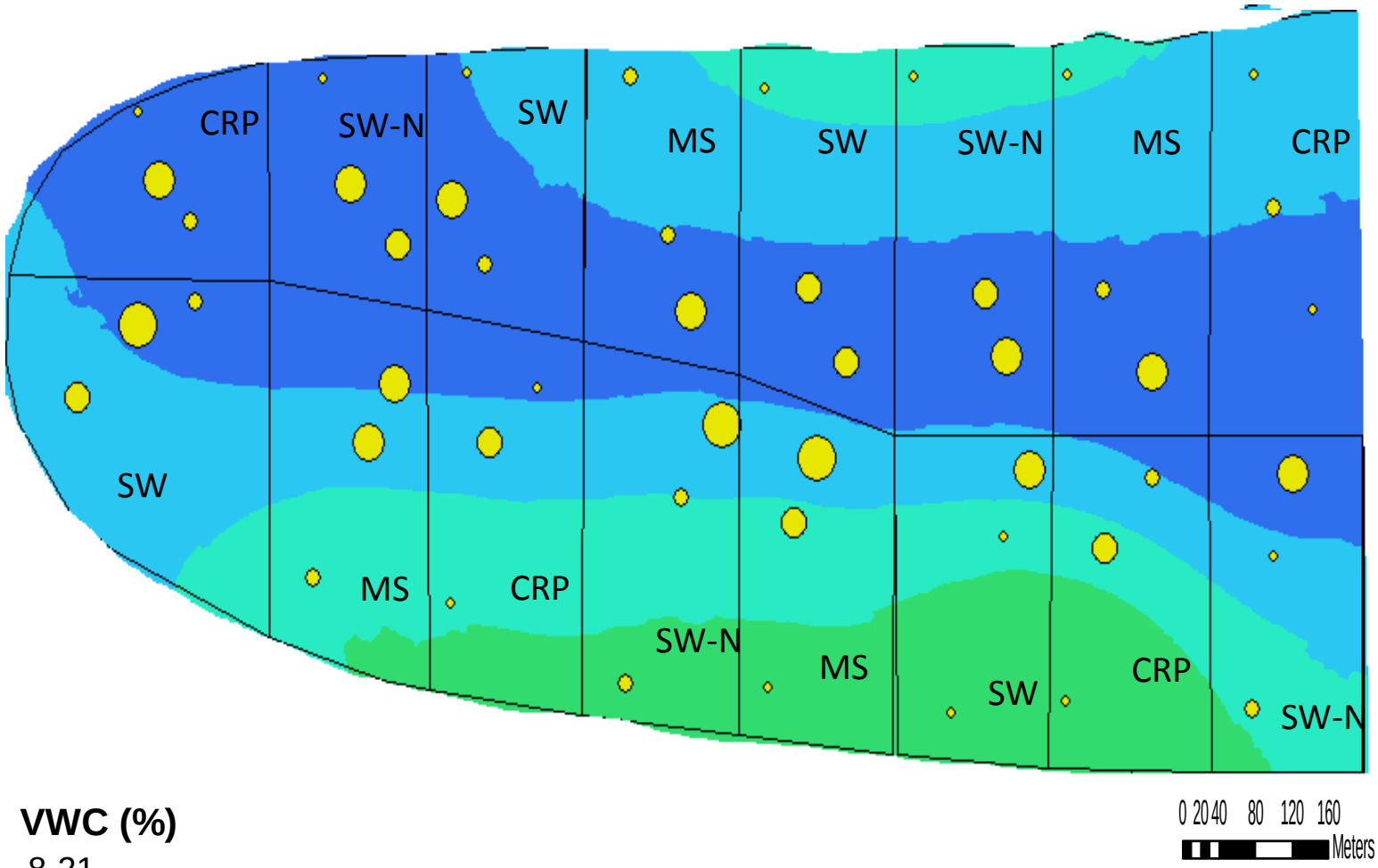




Frequency distribution of soil organic carbon in the profile (left panel), the top 0.3-m of the profile (middle panel) and between 0.3 and 1.5 m in the Cook Agronomy Farm in eastern Washington (n = 177).

Leck Kill Bioenergy Research (2013)
Team:
P. Adler, P. Kleinman, B. Rau … (ARS)
A. Kemanian, J. Kaye, D. Saha (PSU)

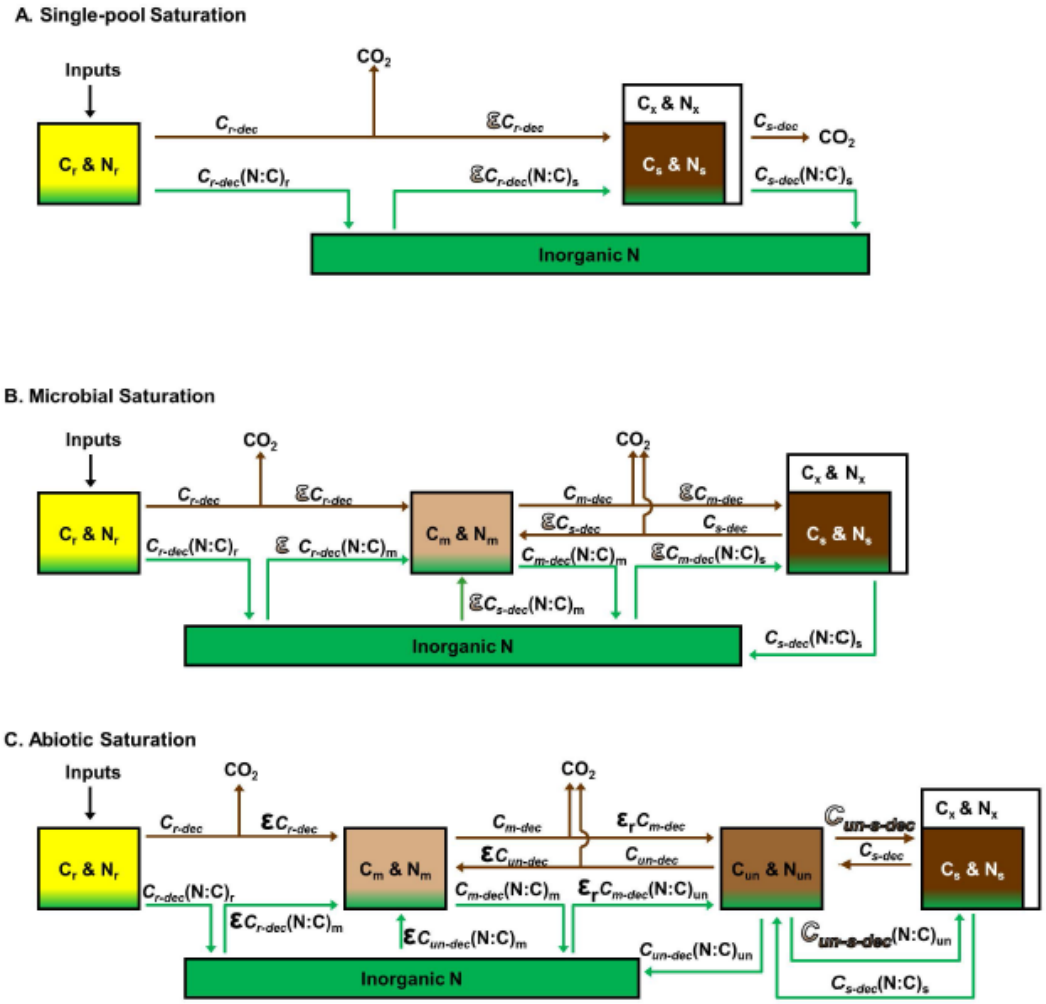
Differential soil water dynamics and N_2O flux in the landscape



Wetting front after a rain event

Credit. D. Saha
Data not for distribution

What do we C and N modeling

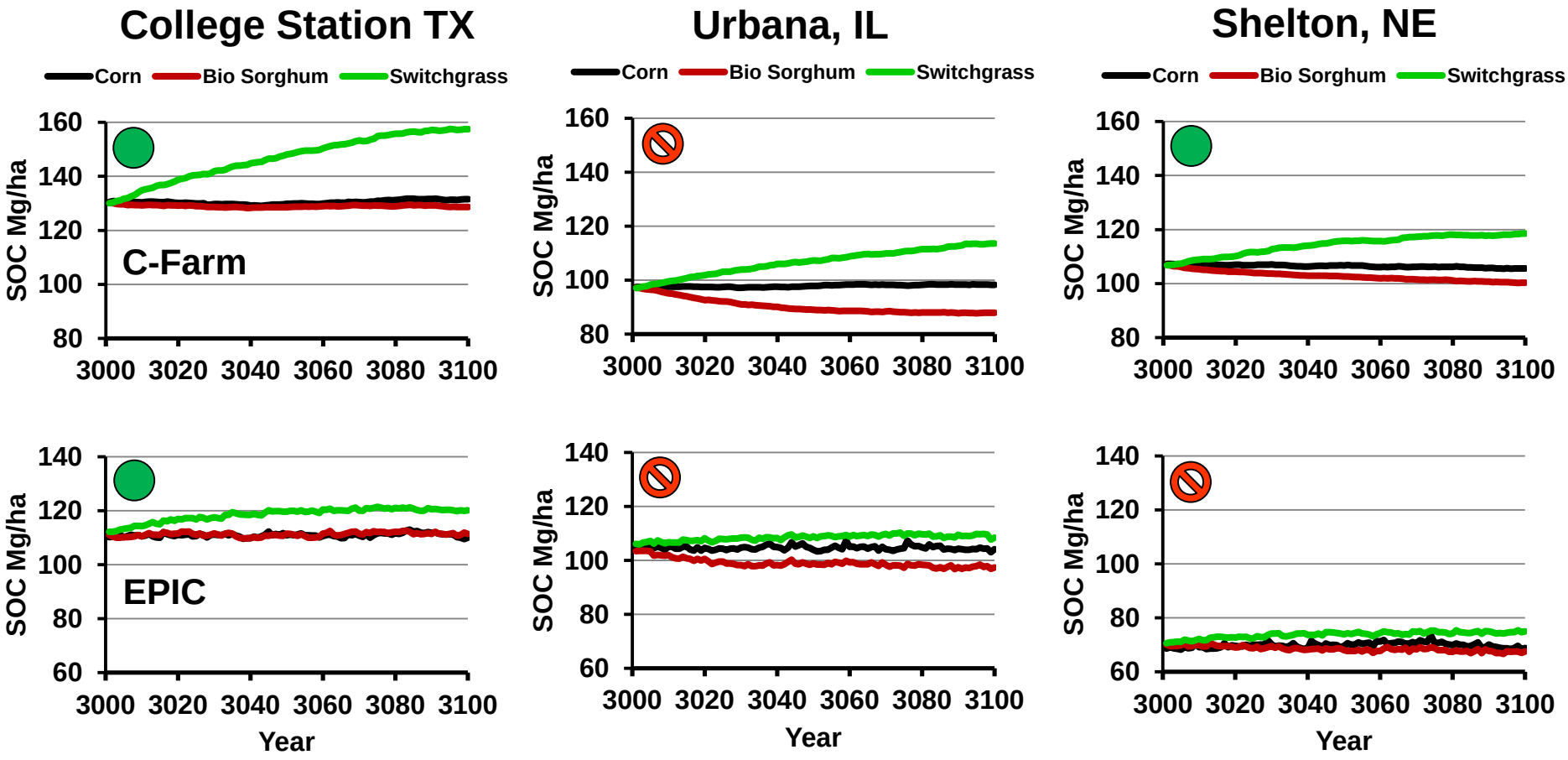


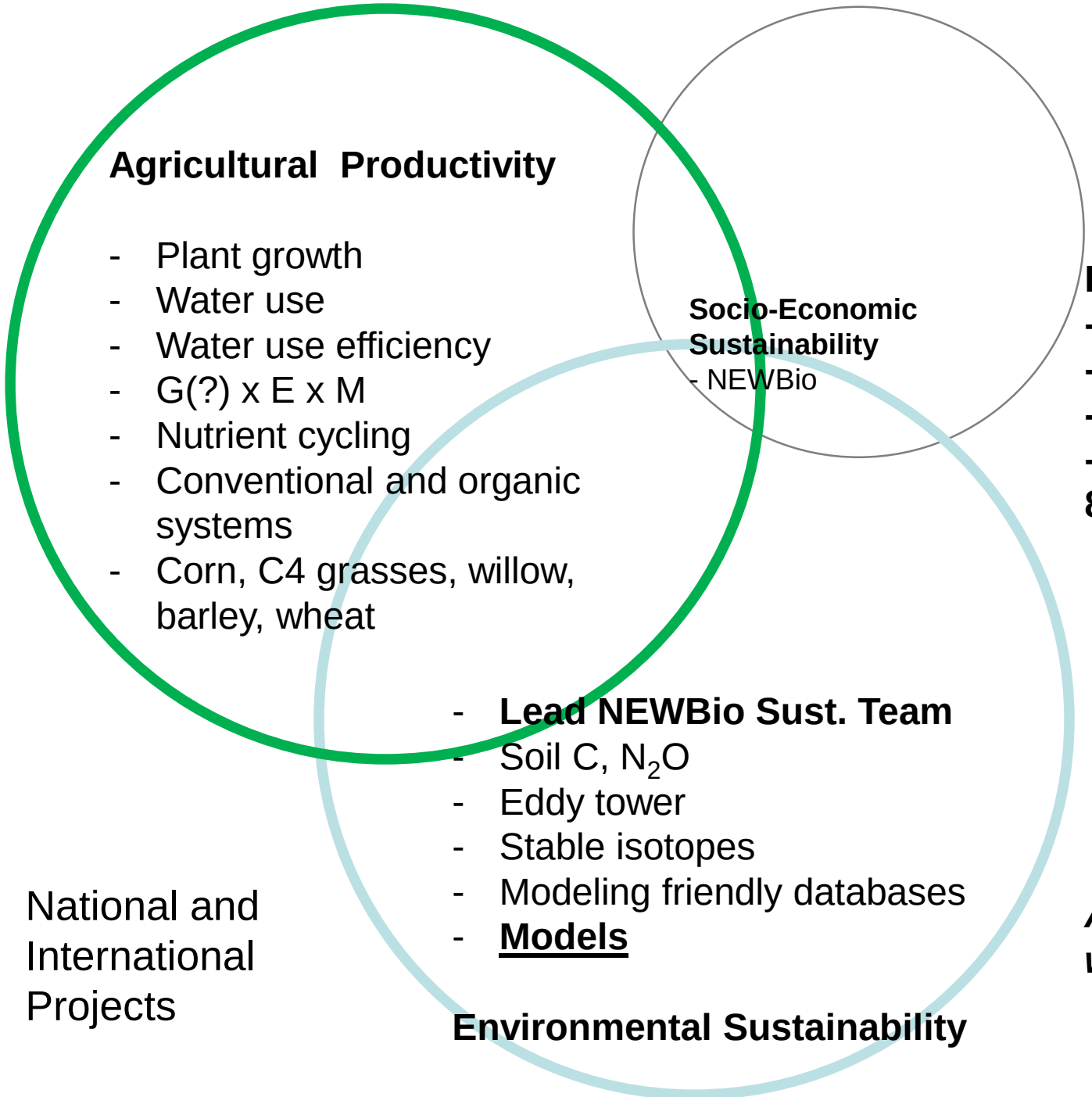
Biogeosciences Discuss., 11, 9667–9695, 2014
www.biogeosciences-discuss.net/11/9667/2014/
doi:10.5194/bgd-11-9667-2014

Models

Do different models give different outputs?

Total SOC – 100 years





Funding:
-USDA
-EPA
-DOT
-NSF
8 ongoing projects

National and International Projects

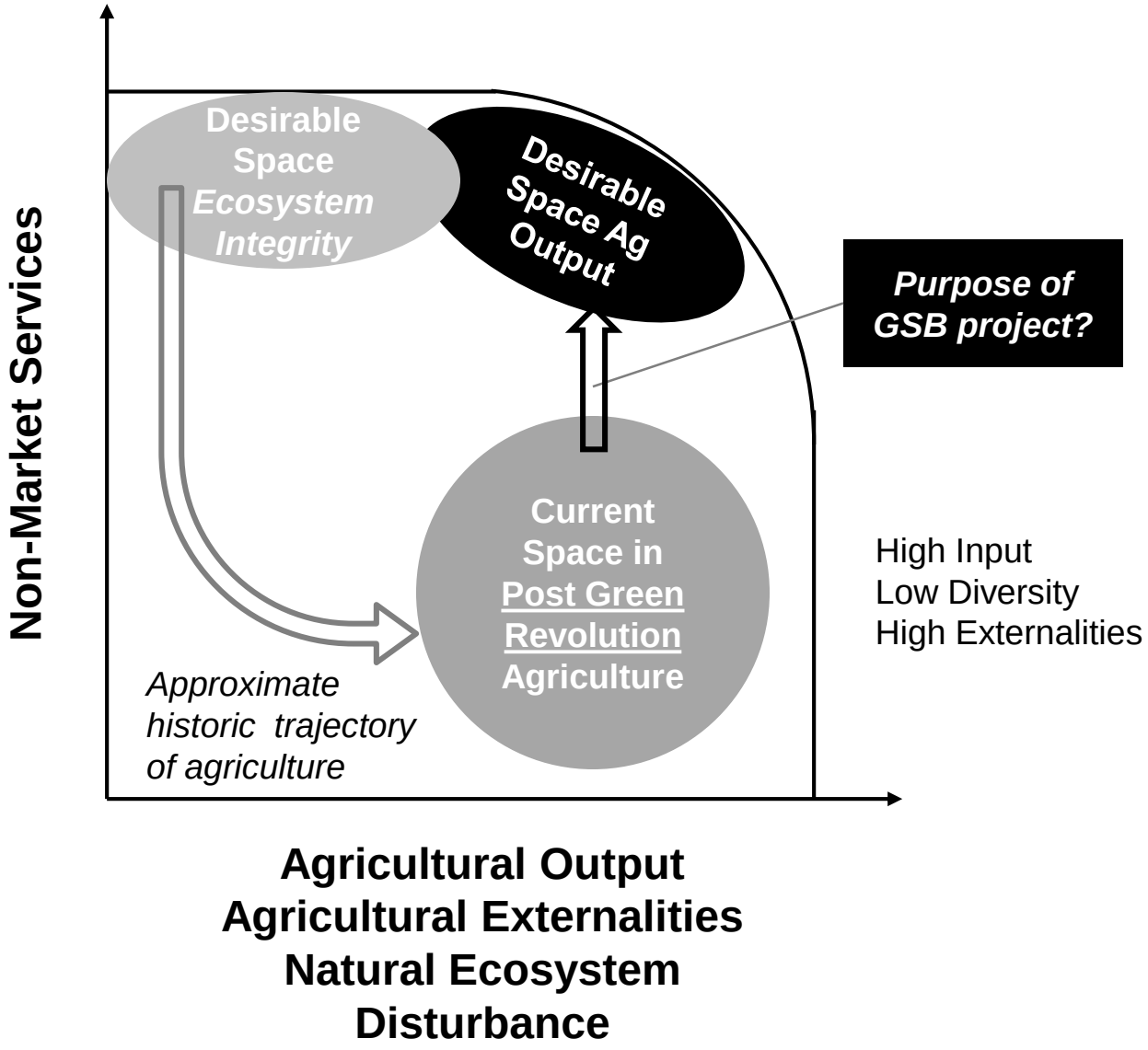
Administrative work too!

What we do Team

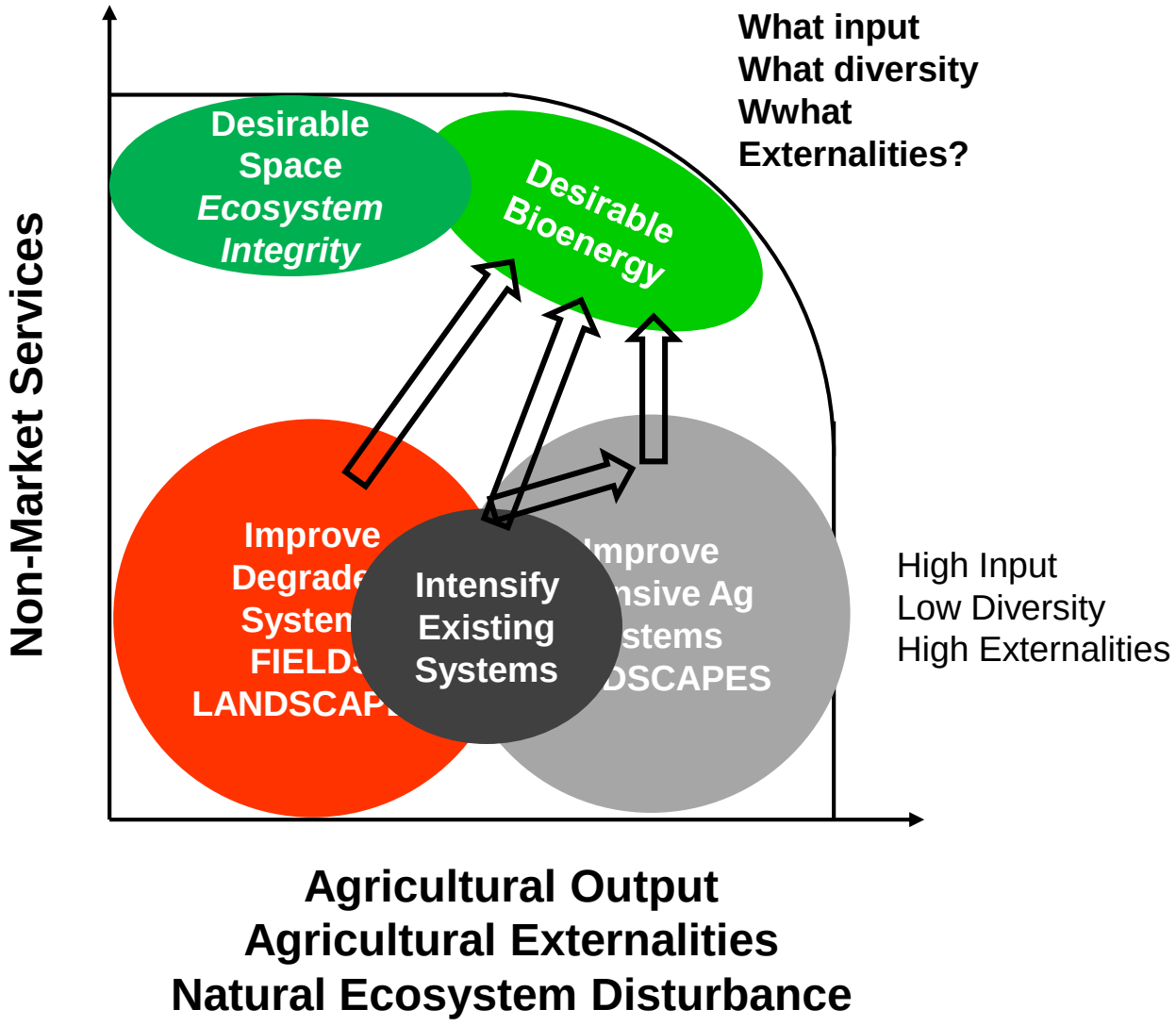
Faculty	Graduate Students	Postdoc and Research Associate	"Foster Kids"
A. Kemanian	5 PhD 2 MSc	1 postoc 1 RA	*9 students*
E. Smithwick	4 PhD	1 RA	(Sabbatical)
M. Jacobson	2 PhD		(Sabbatical)
T. Richard	3 PhD		(Sabbatical)
C. Duffy	3 PhD	1 RA	(Sabbatical)

Borrowing from Martinelli:

Norman Borlaug (2002) stated: "*Poets — and city folks — love to romanticize agriculture, portraying it as some sort of idyllic state of harmony between humankind and nature. How far this is from the truth! Since Neolithic man — or most probably woman — domesticated the major crop and animal species some 10–12 millennia ago,* ***agriculture has been a struggle between the forces of natural biodiversity and the need to produce food under increasingly intensive production systems***".


Non-Market Services
Desirable Space Ecosystem Integrity
Desirable Space Ag Output
Purpose of GSB project?
Current Space in Post Green Revolution Agriculture
High Input
Low Diversity
High Externalities
Approximate historic trajectory of agriculture
Agricultural Output
Agricultural Externalities
Natural Ecosystem
Disturbance

Starting Point



What's Next

Crops need to be highly productive

This requires high nutrient availability

Nutrients available for the crop are also available for losses

Can bioenergy mitigate current externalities?
Can bioenergy trigger a virtuous cycle?

What's Next

- **Contribute to field experiments**
- **Contribute in biogeochemical and hydrological modeling**