Advancing Precision Agriculture and Soil Health Research with AI: Collaborative Opportunities

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My CV

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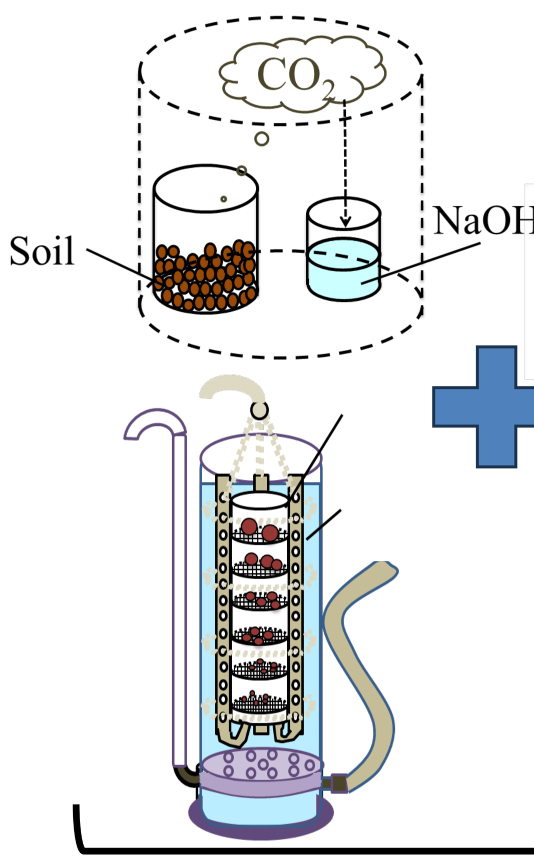
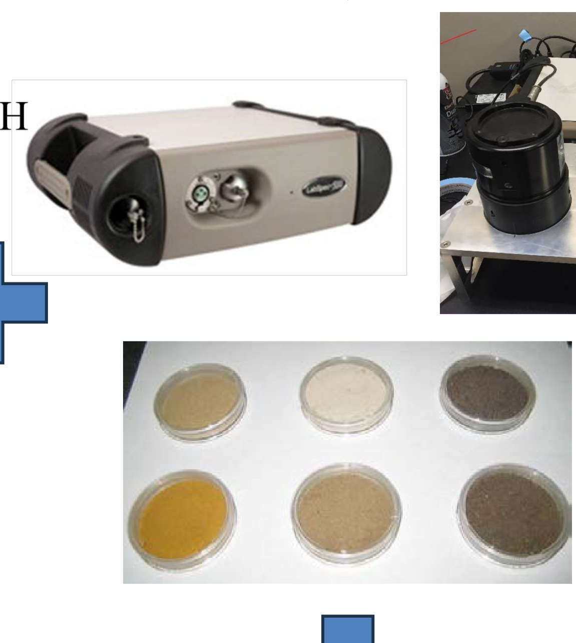
Laboratory

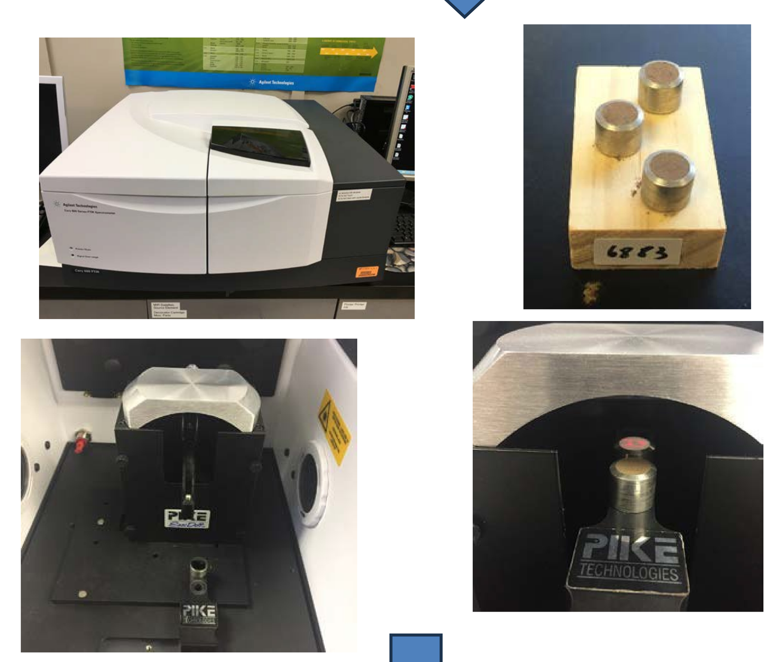
Lab data
Analytical measurements of soil attributes (traditional lab methods)



Visible/near-infrared (VNIR) diffuse reflectance spectroscopy (350~2,500 nm)



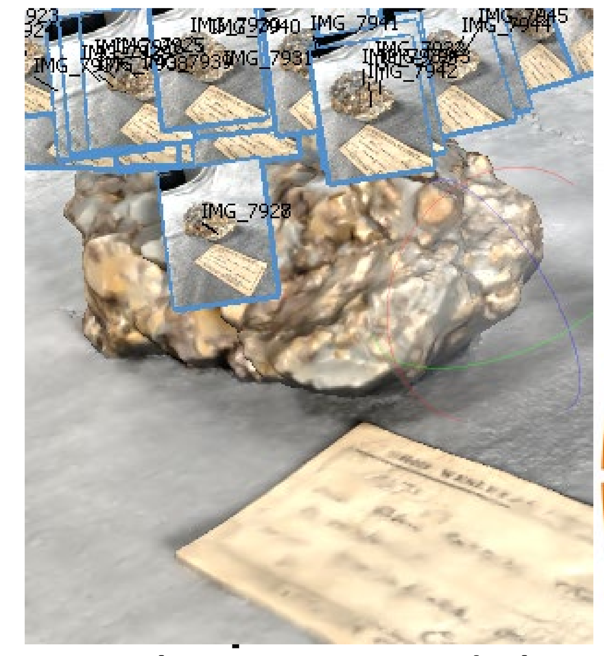
Mid-infrared (MIR) diffuse reflectance spectroscopy (2,500-25,000 nm)



Develop a rapid, cheap and accurate method to diagnose soil health and nutrient status for crops/grasses.

Q. The effects of moisture on prediction readings?
Q. Prediction accuracy for plant available soil nutrients?
Q. Standard protocol of spectral diagnosis for soil nutrients in KY?

3-D Model Development



Develop 3-D model of historic rock/soil monolith museum

Pedo-Econometrics

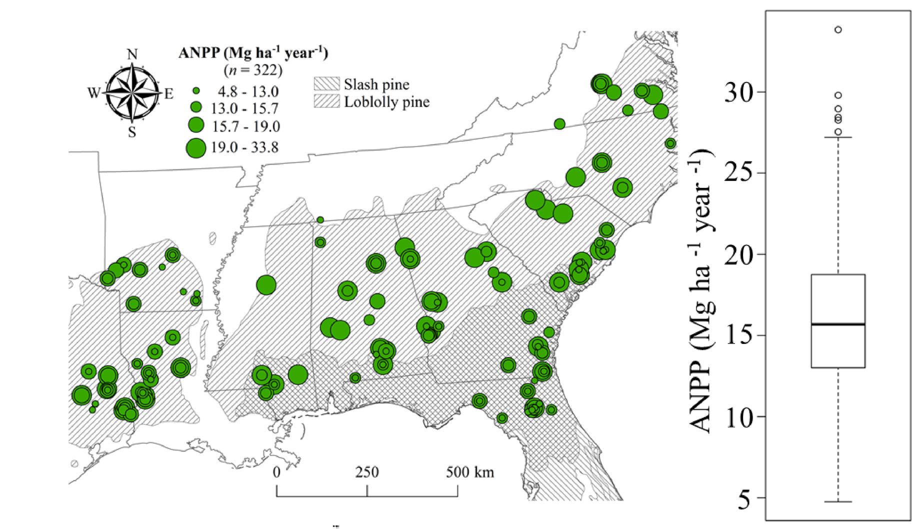
Pedology (Soil Science) → Econom(etr)ics → Math/Stats

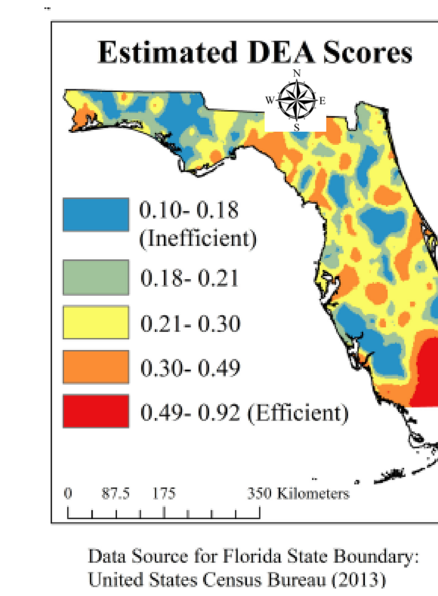
Grunwald et al (2011)

Variable Selection → Manageable Inputs / Target Soil-/ Env. Functions/Services → Soil/Ecosystem Health Index Calculation → Index Scores

Uses data-driven optimization approach (e.g., Data Envelopment Analysis, DEA)

State Scale and Beyond



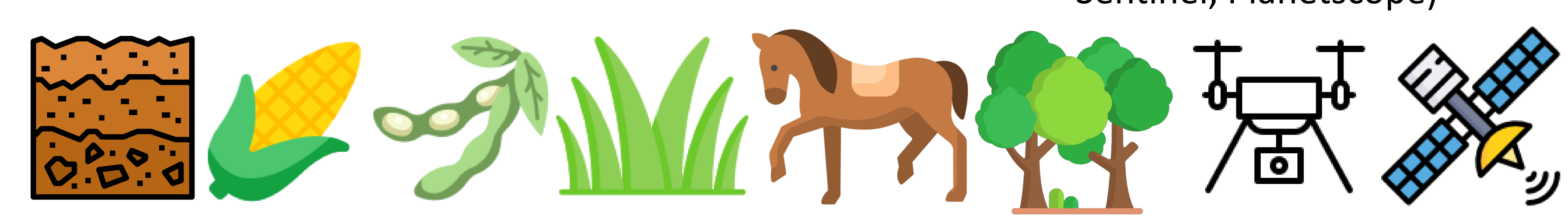


Soil C seq. capability index in Florida and Ecological health in southeastern US (Mizuta et al. 2021, 2022)

Remote Sensing (RS): Various satellites (e.g., SPOT, Landsat, Sentinel, Planetscope)

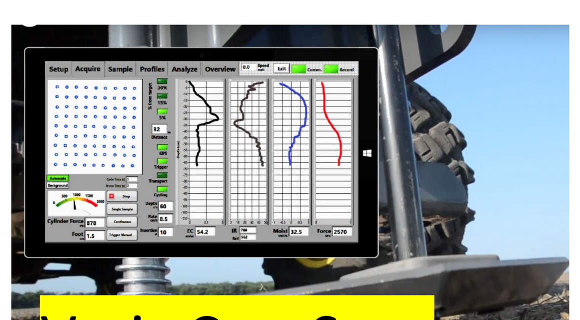
Q. The most efficient soil C seq. capability county in KY?
Q. What does a RS-based 3D-mapping of soil organic carbon look like in KY?
Q. Adoption rates of soil health practices in KY?
Q. Adoption rates of precision agriculture technologies in KY?
Q. Land use/cover changes in Kentucky since 2007

Test — Assess — Validate — Apply



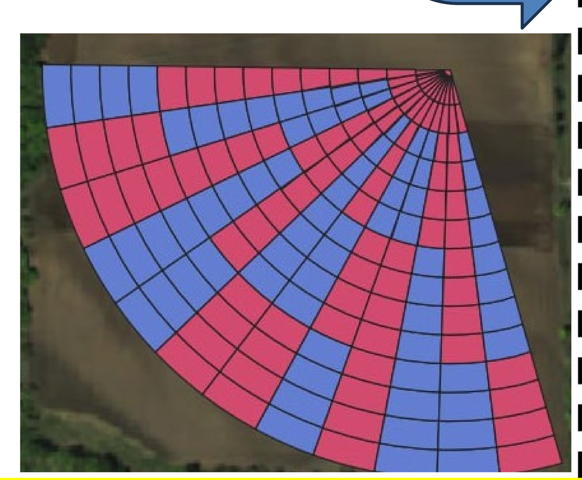
Small-Plot

EarthOptics



Veris CoreScan

Digital Soil Core



Variable-rate irrigation x fertilizer x seeding rate with various soil health practices

GPR

pXRF

UAV (hyperspectral camera)

etc

Understand the mechanisms of agroecological phenomena through data-intensive approaches, focusing on soil health practices

Q. Soil health = Yield?
Q. The effect of spatial heterogeneity of bulk density on laboratory-recommended fertilizer rates?
Q. a mixed-effects, process-based, an artificial intelligence-based, or integral model to assess the effect of soil and topographic heterogeneity in space on yield under soil health practices (e.g., cover crop, no-till...etc)?
Q. The effect of various soil amendments on soil health indicators over space/time?

On-Farm

Develop the most profitable and sustainable data-driven management practice

Q. Simulate the optimal in-season fertilizer and irrigation application?
Q. How can we develop a data-driven management practice that enhances soil health, profitability for farmers, sustainability, and scale it for adoption in Kentucky?
Q. Visualize botanical compositions of grasses at a farm scale, botanical composition, detecting tall fescue, and analyzing the levels of endophyte and ergovaline toxicities using AI?

Table. Evaluation of agronomic, economic, and environmental benefits of satellite-based in-season precision nitrogen management practices for corn

N application strategy	Total N rate	Grain yield		Urea cost	UAN (32% N) cost	Net return		Profit rank
	--lb/ac--	--bu/ac--	*	--------------$/ac--------------			*	
100% FNR[1]	144	**202**	a	$49.96	$0.00	**$1,159.00**	a	1
130% FNR	181	187	a	$63.73	$0.00	$1,060.00	a	6
35% FNR + 65% FNR	150	189	a	$17.79	$28.55	$1,090.00	a	4
35% FNR + CS	142	**171**	a	$17.42	$24.78	**$985.00**	a	7
35% FNR + Granular	151	190	a	$17.73	$29.13	$1,091.00	a	2
35% FNR + RS-ML	146	189	a	$17.07	$28.21	$1,087.00	a	5
70% FNR + CS	131	189	a	$33.07	$9.56	$1,090.00	a	3

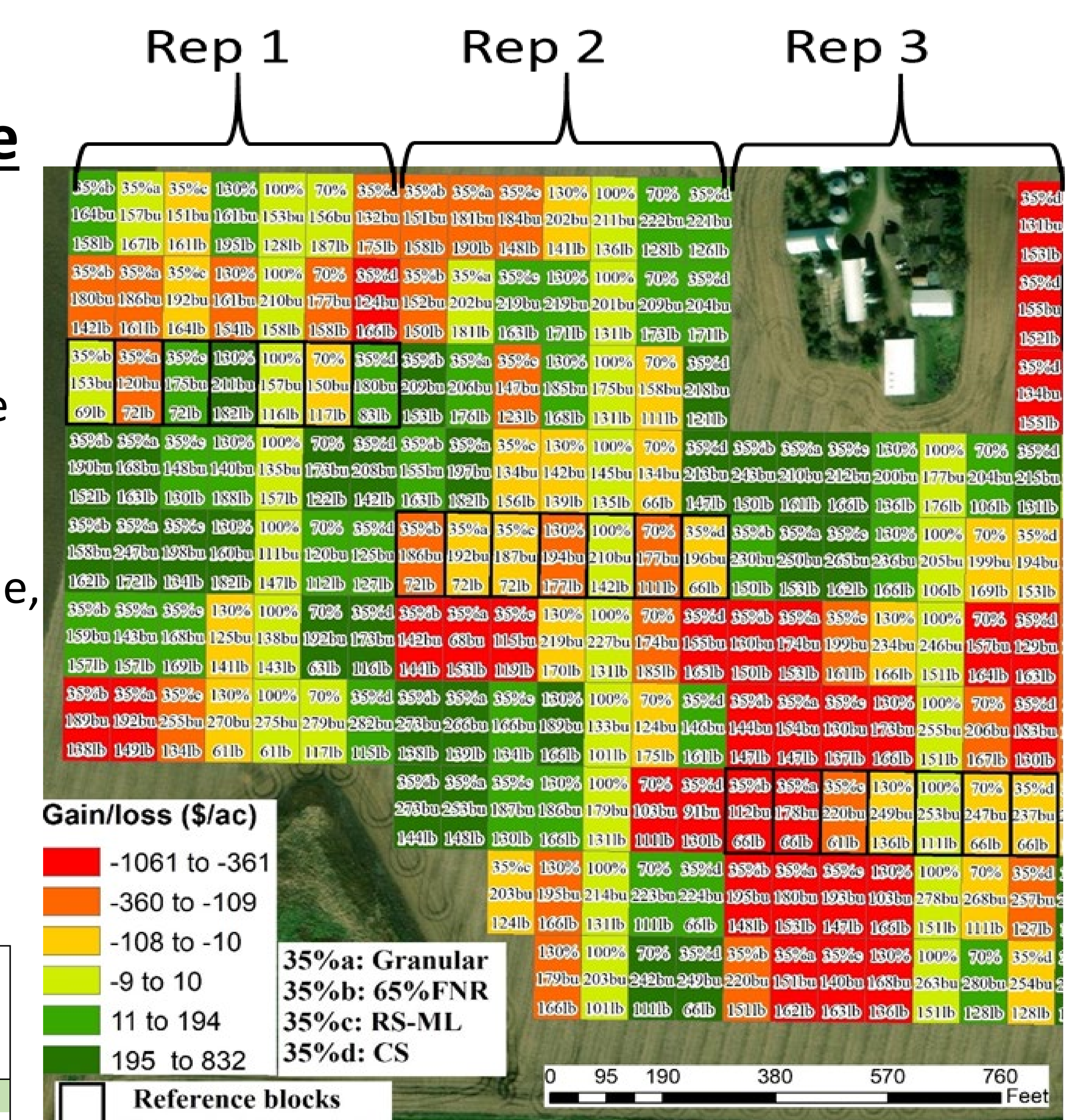


Figure. Evaluation of the spatial profit gain/loss of remote sensing-based precision agriculture management in on-farm trials