Carbon Assessment Tools:

The Need for Field Validation and Verification

(COMET-VR and SCI)

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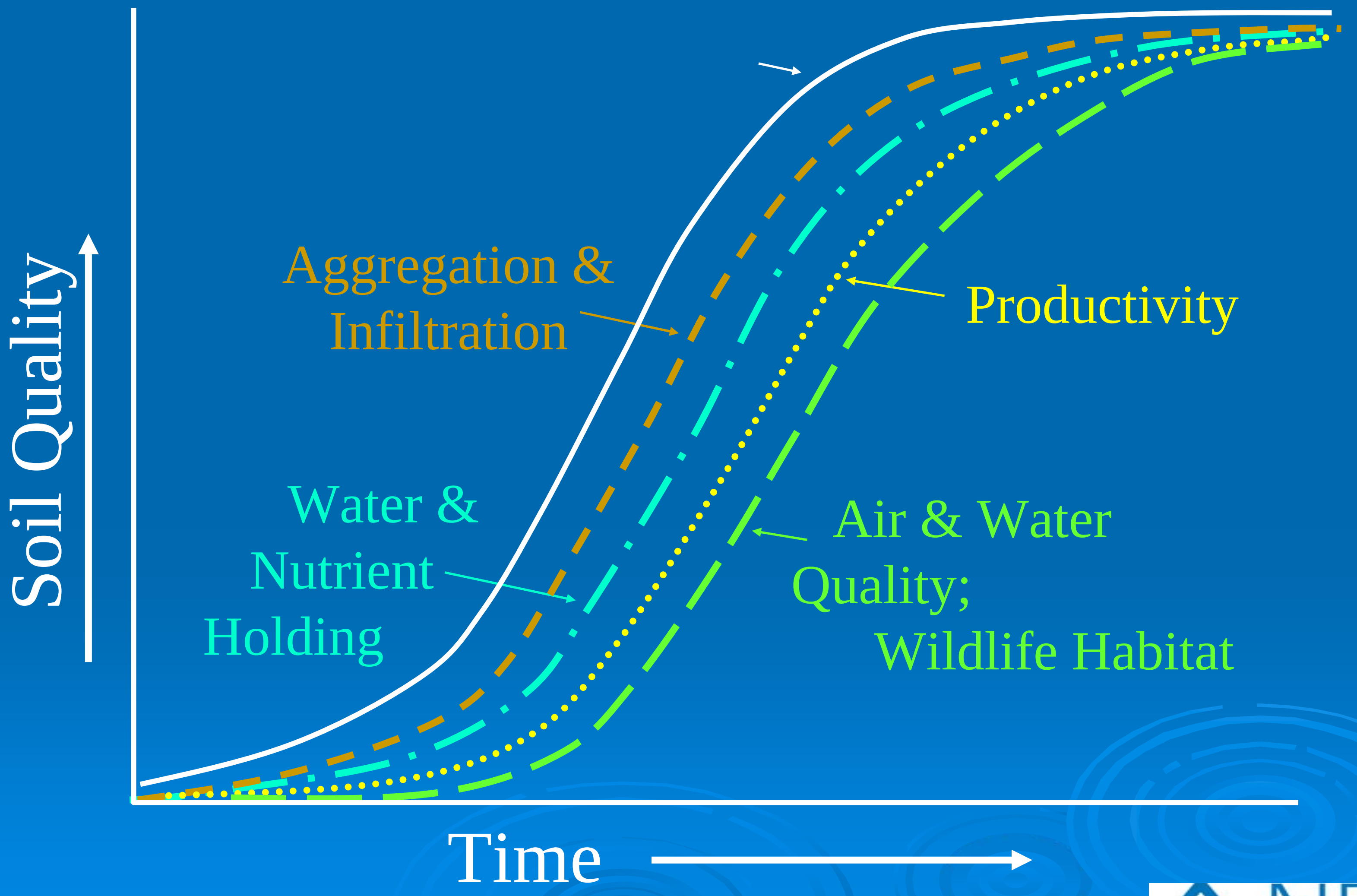
NRCS

Benefits of Soil Carbon



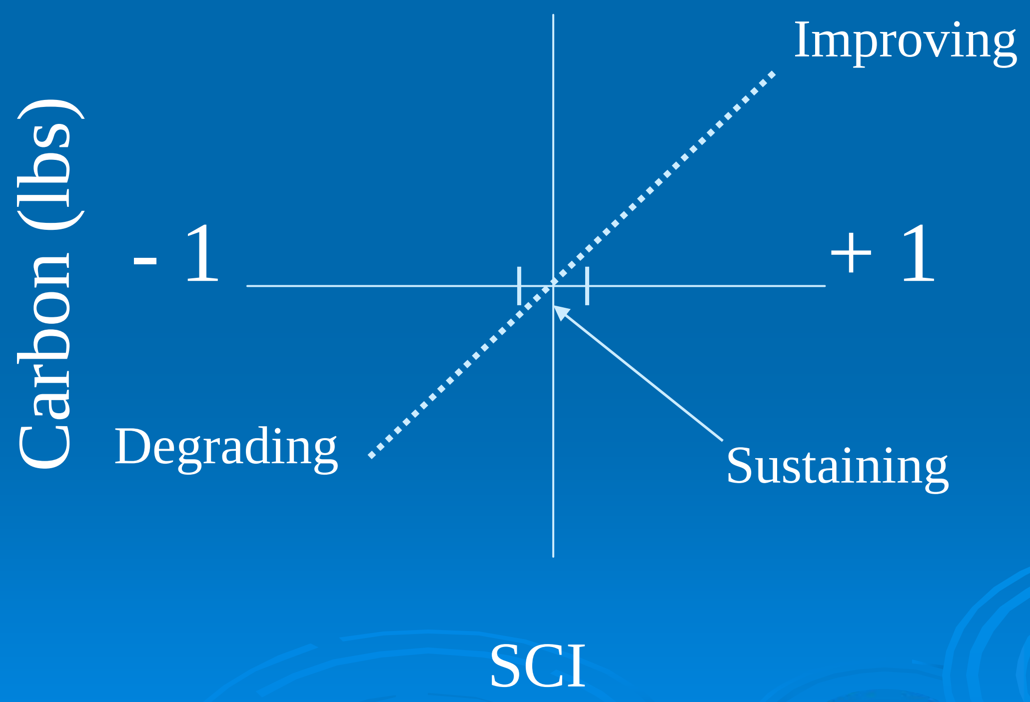
The Soil Conditioning Index (SCI):

- Expresses the effects of the system on organic matter trends as a primary indicator of soil condition.

- Provides a means to evaluate and design conservation systems that maintain or improve soil condition

Soil Conditioning Index

(SCI = Soil Disturbance + Plant Production + Erosion)



SCI Summary

- Tool for estimating soil quality condition
- Validated using long term research data
- Used for conservation assessment in CSP & CEAP
- Part of RUSLE2 output

COMET-VR

CarbOn Management Evaluation Tool for Voluntary Reporting

- Released on March 23, 2005
  - REPORTING CRITERIA
    - **Accuracy**
    - **Reliability**
    - **Verifiability**
- Interagency Initiative
  - DOE, USDA, EPA, NASA….
- Universities

COMET-VR Inputs

- **MODEL REQUIREMENTS**

  - **Location**

  - **Field or Parcel information**

  - **Soil Information - Texture**

  - **Management/**
    - **Cropping history**
    - **Tillage**

COMET-VR SCENARIOS

- Historic
  - Pre 70's: grazing
  - 1970-1990s: CS under CT
- Current :
  - 1990-present (same as 70's-90s)
- Reporting Period:
  - Rotation: (CS/CSWW)
  - Tillage: (CT/ MT/ NT)

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Objectives

- Compare SCI and COMET-VR as soil carbon assessment tools
- Determine the principal factors contributing to differences in model outcomes
- Assess regional differences, if any

Approach

- **Rotations**
  - Corn-soybean
  - Corn-soybean-winter wheat
  - Wheat Potato
  - Wheat 4-yr Alfalfa

- **Tillage**
  - Conventional till
  - Mulch-till
  - No-till

- **Soil Texture** (textural gradient)
  - Loamy sand
  - Sandy loam
  - Silt loam
  - Clay loam
  - Silty-clay loam

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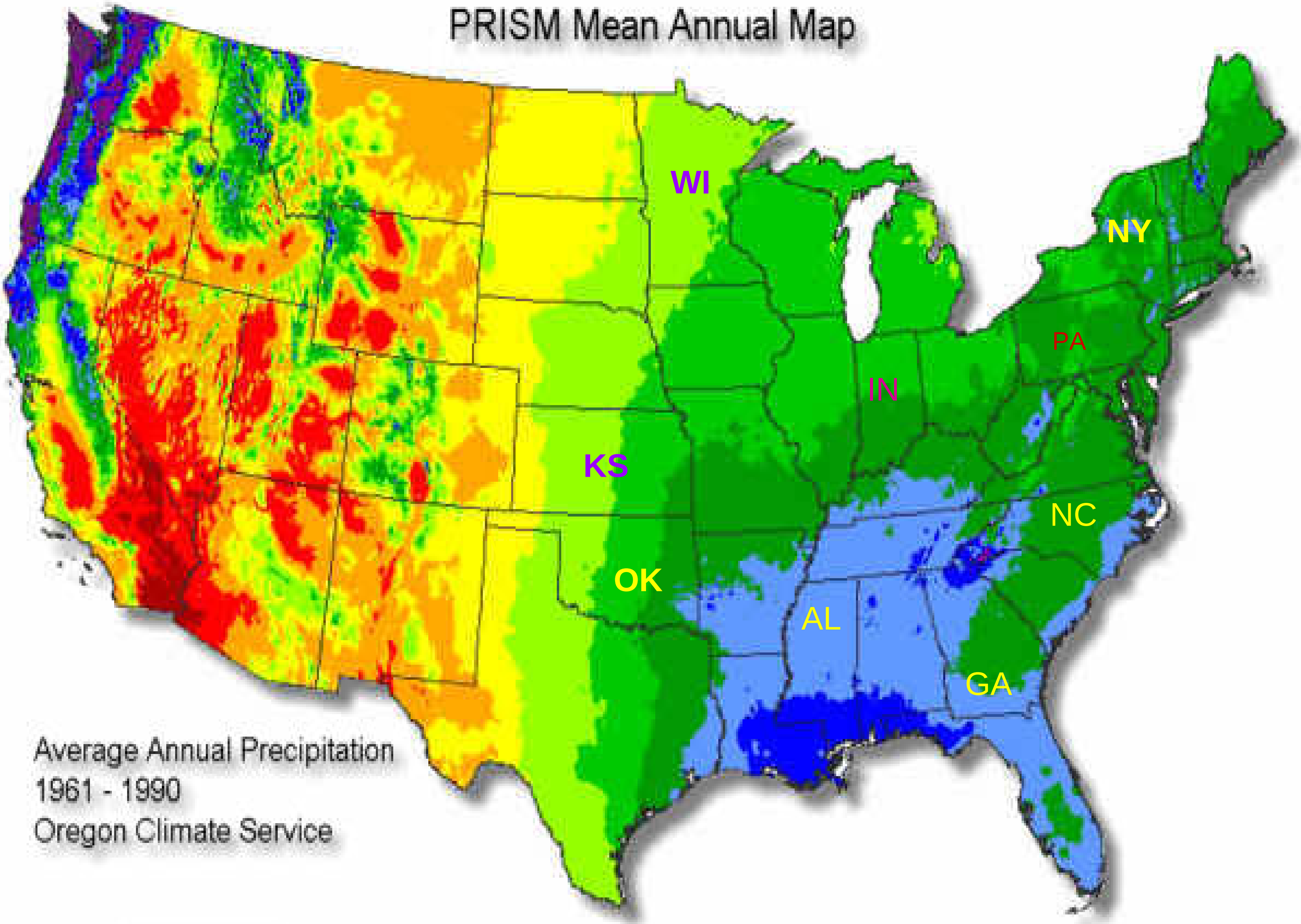
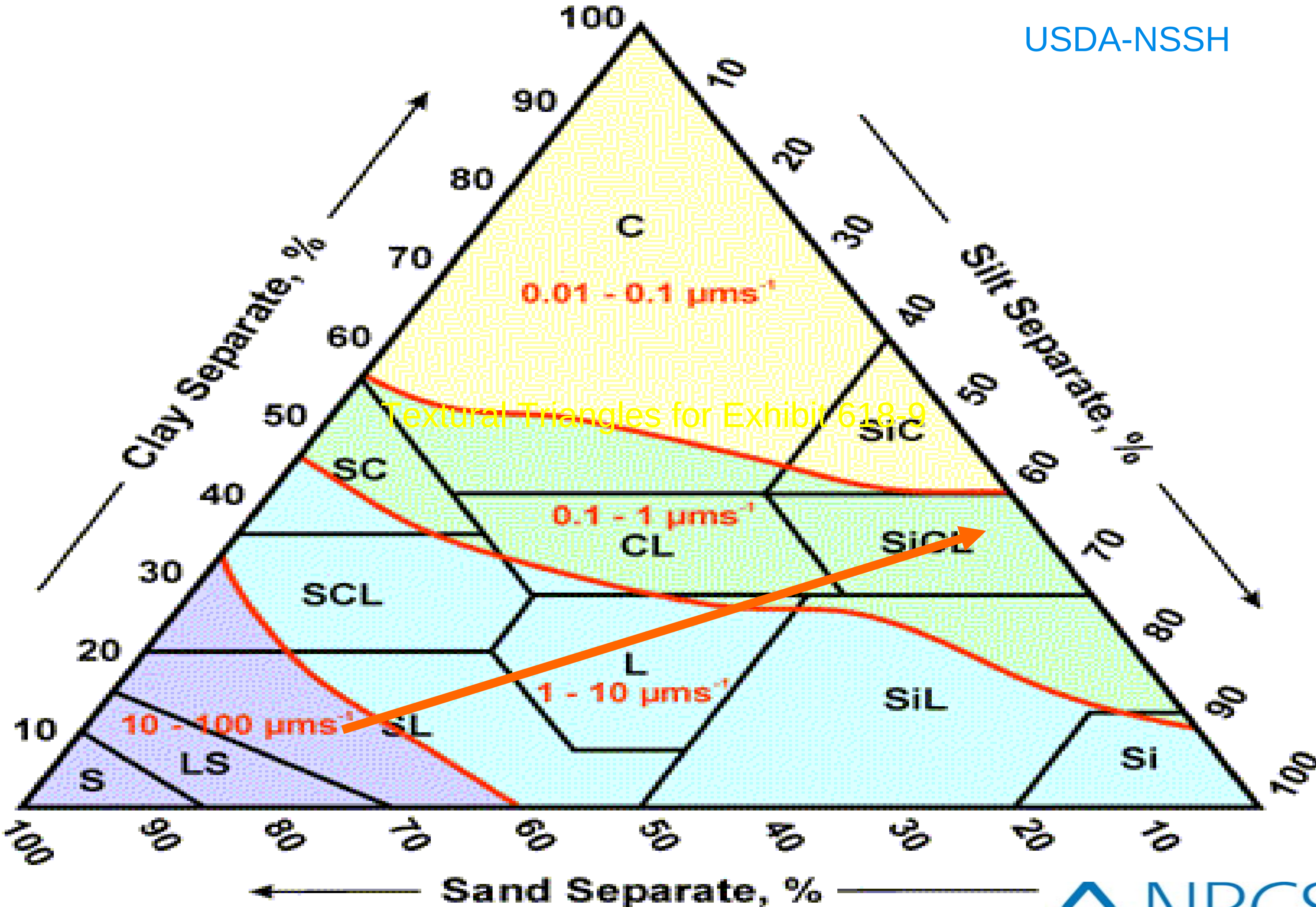

PRISM Mean Annual Map
WI
NY
PA
IN
KS
NC
OK
AL
GA
Average Annual Precipitation
1961 - 1990
Oregon Climate Service

Ksat for Medium Bulk Density

USDA-NSSH



Results

Effect of Tillage on Soil Organic Carbon across rotations and texture for for the CS-CSWW

State:	OK	NC	NY	KS	GA	AL	IN	WI	PA
County:	Adair	Alamance	Albany	Anderson	Grady	Madison	Marion	Pierce	York

Kg C ha^{-1} yr^{-1}

COMET-VR

Tillage	OK	NC	NY	KS	GA	AL	IN	WI	PA
NT	66.3a	216.4a	97.9a	93.1a	199.1a	59.1a	93.6a	105.1a	60.9a
MT	-32.5b	144.0b	68.1b	-2.9b	124.3b	-15.4b	-6.9b	-4.3b	-40.3b
CT	-76.8c	-18.6c	-98.7c	-27.1c	-18.8c	-54.7c	-32.3c	.30.0c	-86.9c

SCI

Tillage	OK	NC	NY	KS	GA	AL	IN	WI	PA
NT	213.9a	231.7a	292.9a	235.7a	167.2a	288.8a	401.7a	394.4a	363.6a
MT	20.3b	-101.0b	132.3b	68.1b	123.4b	77.8b	229.1b	211.8b	200.9b
CT	-141.9c	-275.1c	15.7c	-44.4c	-306.0c	-94.2c	76.3c	69.7c	22.1c

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Effects of Rotation on Soil Organic Carbon Pooled across Tillage and Texture for CS-CSWW

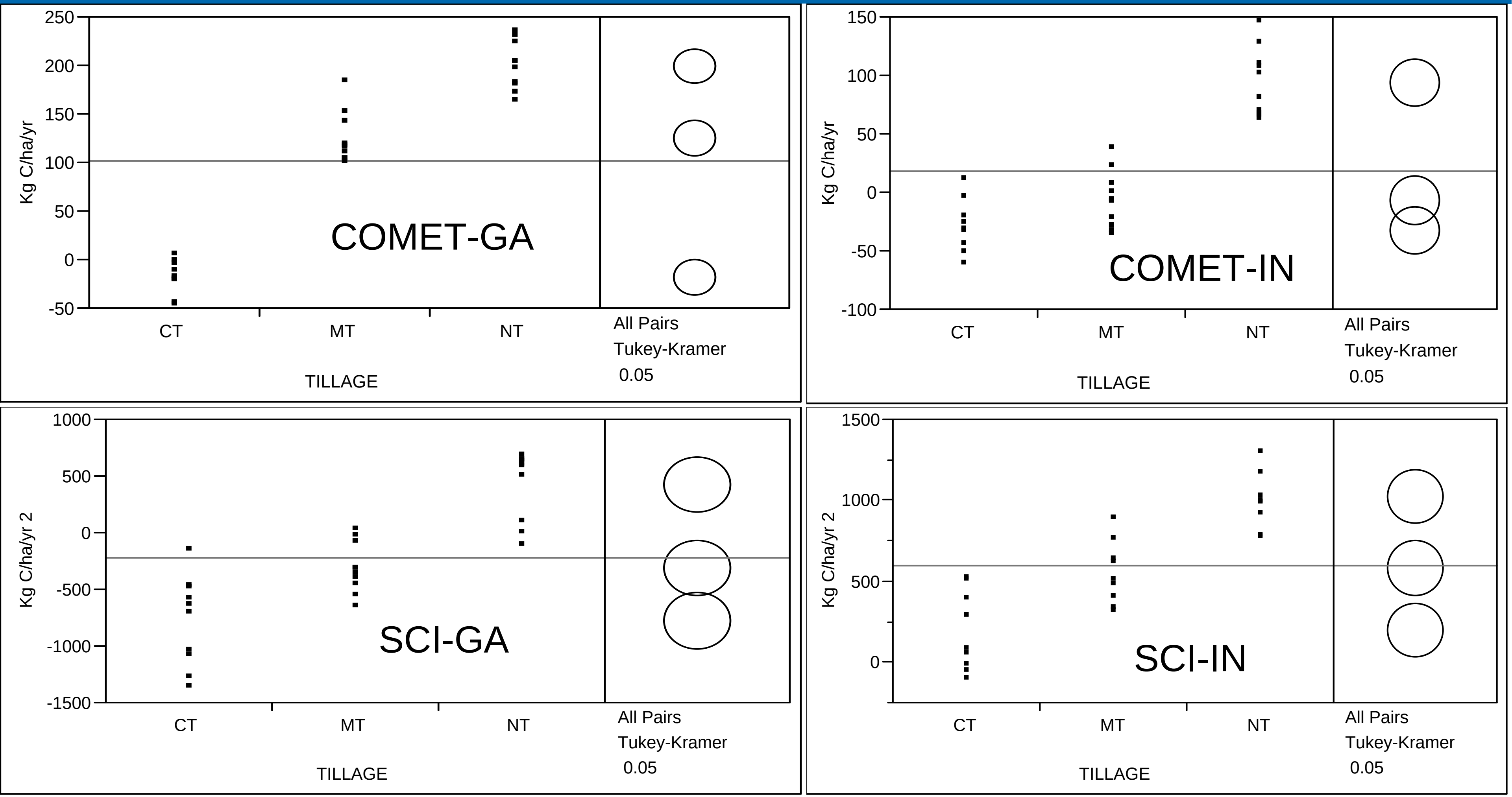
State	OK	NC	NY	KS	GA	AL	IN	WI	PA
County	Adair	Alamance	Albany	Anderson	Grady	Madison	Marion	Pierce	York
				Kg C ha^{-1} yr^{-1}					
				COMET-VR					
Rotation									
CS	-58.5b	106.6b	64.5a	45.5a	98.9b	-38.1b	38.5a	42.4a	-59.1b
CSWW	29.9a	121.3a	-19.7b	-3.4b	104.2a	30.8a	-2.2b	4.8b	14.9a
				SCI					
CS	20.6b	-28.6a	153.6b	47.4b	-158.5b	21.1b	168.6b	134.8b	119.1ba
CSWW	40.9a	-67.7b	200.3a	125.5a	-16.5a	160.4a	302.9a	3159.a	272.0a

Effects of Texture on Soil Organic Carbon pooled across Tillage and Rotations for the CS-CSWW

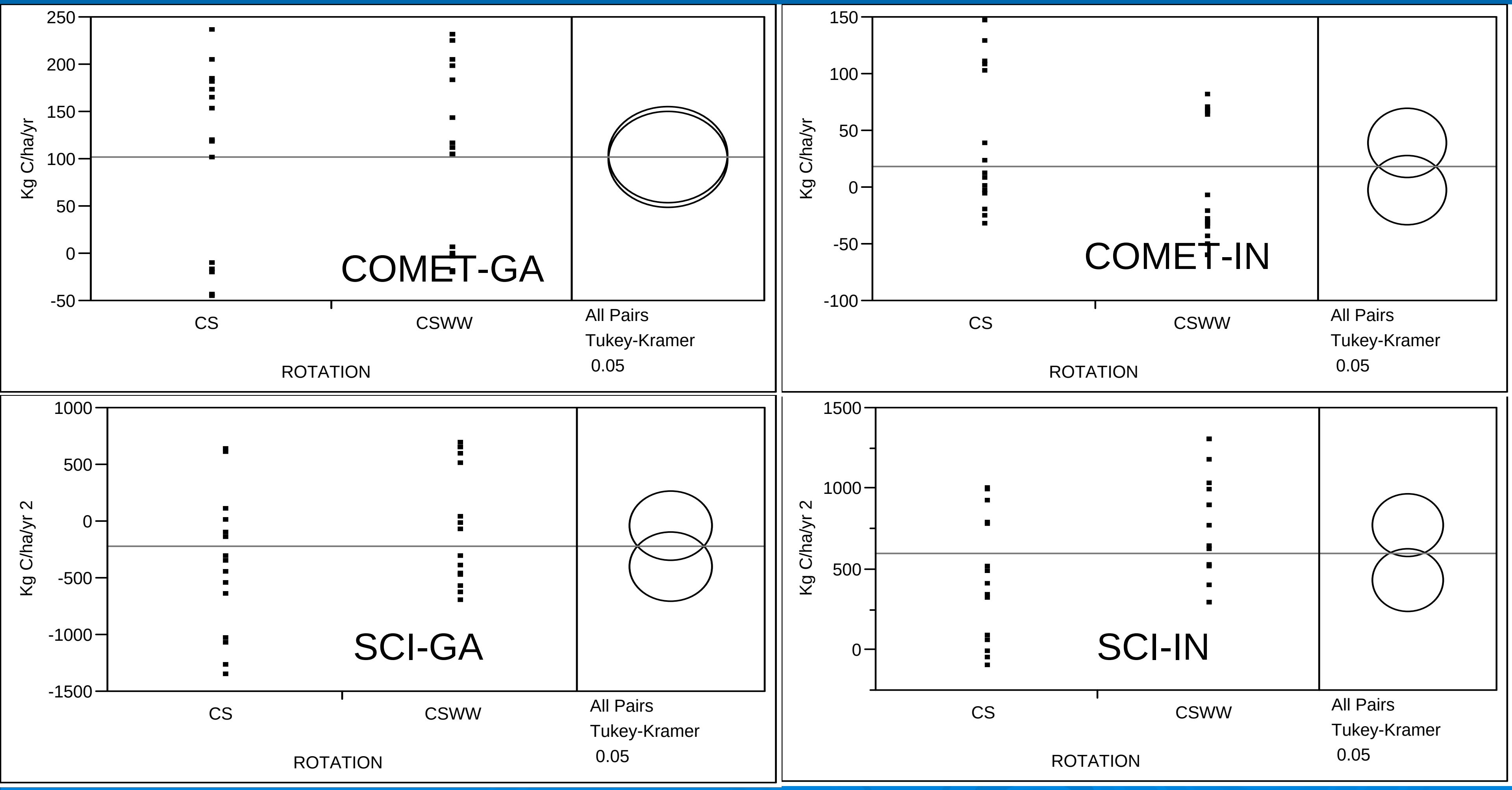
State	OK	NC	NY	KS	GA	AL	IN	WI	PA
County	Adair	Alamance	Albany	Anderson	Grady	Madison	Marion	Pierce	York
	Kg C ha^{-1} yr^{-1}								
	COMET-VR								
Texture									
SiCL	- 22.8c	88.5a	9.3c	11.9d	80.3a	21.3d	4.5d	18.3b	-35.1c
CL	-12.3b	102.3a	13.1c	18.7c	96.0a	-11.9c	3.c	20.9b	-22.8b
SiL	-53.0d	106.4a	31.4b	12.7cd	91.1a	-20.9d	9.7c	19.4b	-51.9d
SL	-11.9b	124.3a	10.8c	27.6b	116.1a	4.1b	24.3b	27.6a	-22.4b
LS	28.4a	148.2a	47.4a	34.3a	124.3a	31.7a	39.2a	31.7a	21.7a
	SCI								
SiCL	21.0bc	-54.3a	143.7c	99.a	-112.7a	98.1ab	275.6b	268.3a	247.8a
CL	58.0a	-33.0a	188.3a	94.2a	-92.2a	122.5a	282.0a	252.4ab	236.4a
SiL	-2.6c	-78.3a	123.7c	62.0a	-73.7a	51.2b	191.2d	213.1c	164.7c
SL	39.9ab	-38.8a	158.8b	79.9a	-8.24a	96.2ab	237.1c	227.6bc	178.0b
LS	37.5ab	-36.4a	118.3e	96.2a	-6.5a	85.9ab	192.7d	165.2d	150.8d

Means within each location followed by the same letter are not significantly different
SiCL= silty clay loam; CL = clay loam; SiL = silt Loam; SL = Sandy loam; and SL = Loamy sand

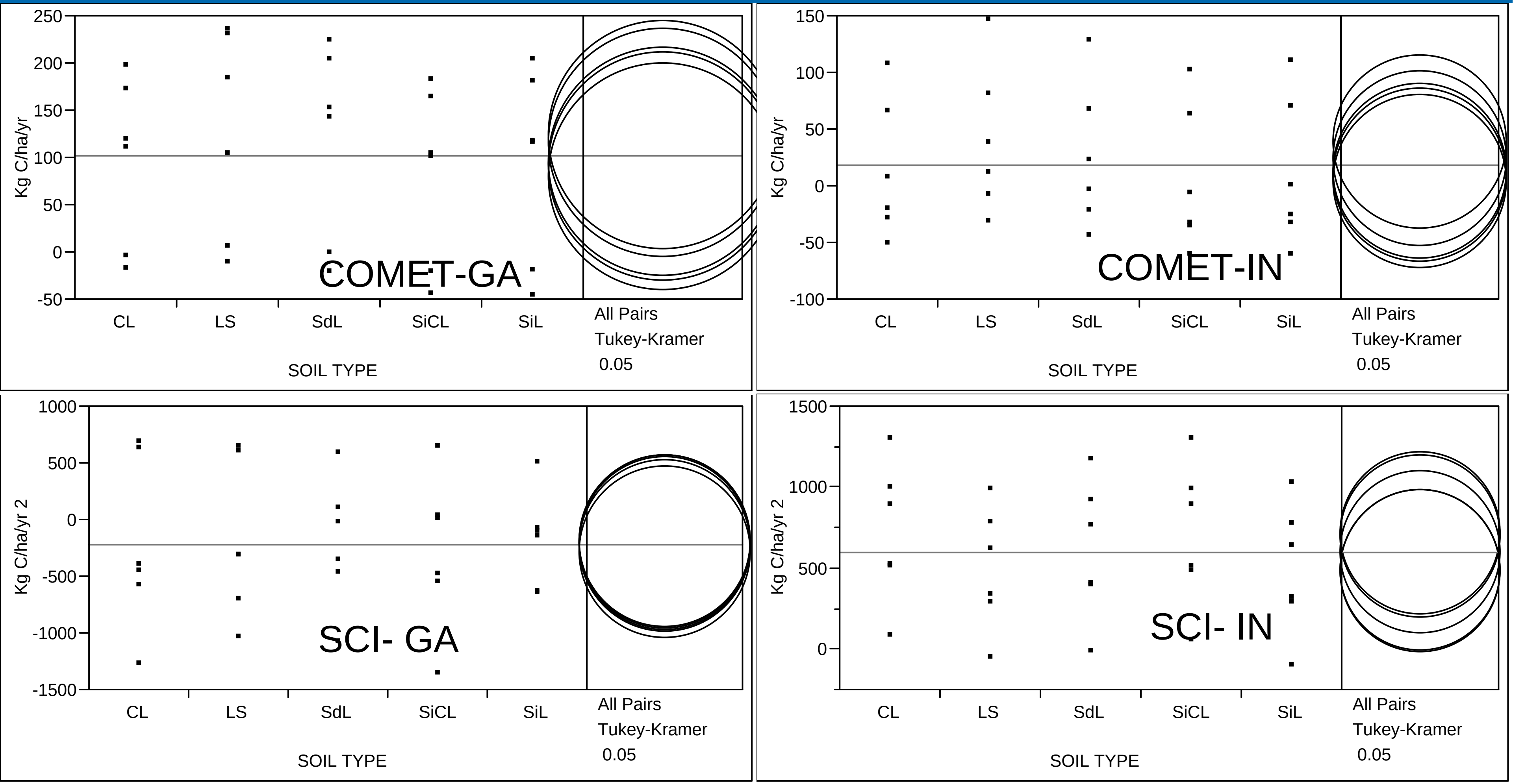
Effect of Tillage on Soil Carbon for Georgia and Indiana

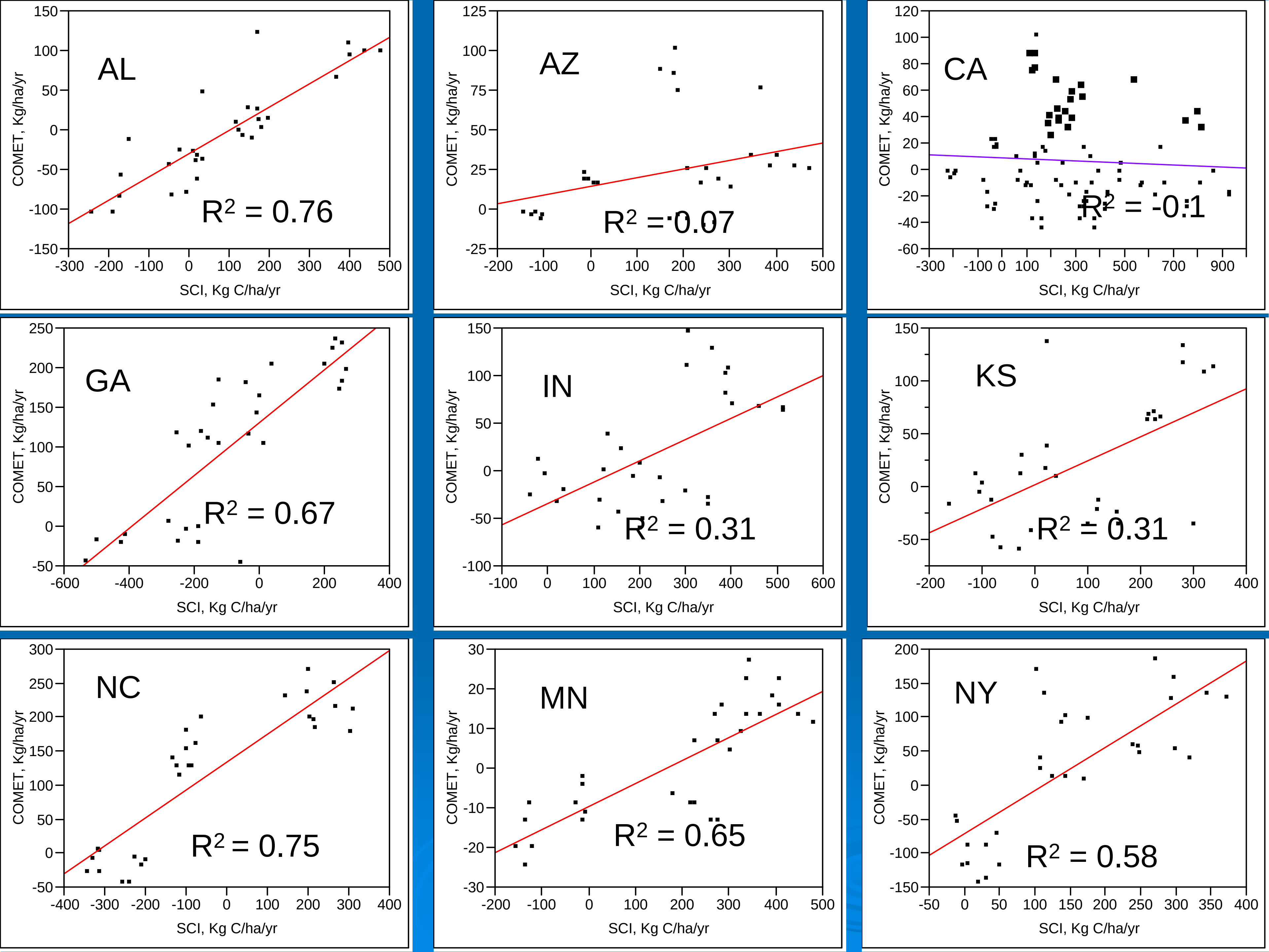


Effect of Crop Rotation on Soil Carbon for Georgia and Indiana



Effect of Soil Texture on Soil Carbon for Georgia and Indiana




AL
$R^2 = 0.76$
AZ
$R^2 = 0.07$
CA
$R^2 = -0.1$
GA
$R^2 = 0.67$
IN
$R^2 = 0.31$
KS
$R^2 = 0.31$
NC
$R^2 = 0.75$
MN
$R^2 = 0.65$
NY
$R^2 = 0.58$
COMET, Kg/ha/yr
SCI, Kg C/ha/yr

Conclusions-Tillage

- COMET-VR and SCI predicted highly significant tillage effects on SOC for all locations ($p<0.0001$)

The ranking for tillage was: NT > MT > CT

- **No net SOC loss for NT for all locations**
- **Mulch-till lost carbon at some locations but not others**
- **CT lost SOC for all locations except IN, NY, PA and WI for SCI**

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Conclusions-Rotations

COMET-VR and SCI predicted highly significant rotation effects on SOC for all locations except COMET in GA and Imperial, CA.

- The rankings were:

COMET-VR

- **CSWW > CS (MS, NC, OK, PA)**
- **CS > CSWW (IN, KS, NY, WI)**

SCI

- **CSWW > CS for all locations except NC**

Conclusions-Texture

- **COMET-VR and SCI predicted significant texture effects on SOC for some locations but NOT along a textural gradient**
  - COMET-VR predicted higher SOC levels in coarse textured soils most of the time
  - SCI predicted higher SOC in fine textured soils most of the time

Conclusions Interactions

Both models predicted significant tillage*texture, tillage*rotation and texture*rotation interactions for some locations

- Outcomes were similar for the tillage*texture interaction for 5 out of 9 locations
- For the tillage*rotation interaction both models predicted similar outcomes for 7 out of 9 locations
- For the rotation*texture interaction both models predicted similar outcomes in in 7 out of 9 locations

General Conclusions

- Models are useful tools for soil carbon prediction under various management scenarios

- Agreement between models range from good to poor

- Rapid in-field Carbon assessment tools are thus needed to verify model predictions

Related websites

- http://cometvr.colostate.edu/

http://fargo.nserl.purdue.edu/rusle2_dataweb/RUSLE2_Index.htm

http://soils.usda.gov/sqi/

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