

Soil Variability & Human-Induced Pedological Change across Iowa

C. Lee Burras, Thanos Papanicolaou, Jessica Veenstra,
Yury Chendev & Mike Sucik

Iowa State University

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Objective

Overview three cooperative soil survey projects

Outline

- Context
- Background on Iowa
- Research at Clear Creek on Ksat variability
- Updating of CSR to CSR2
- Research into changes in representative pedons

My approach is to question assumptions because, otherwise, with time they become treated as proven.

Context

My goal is to know what's in the field today.

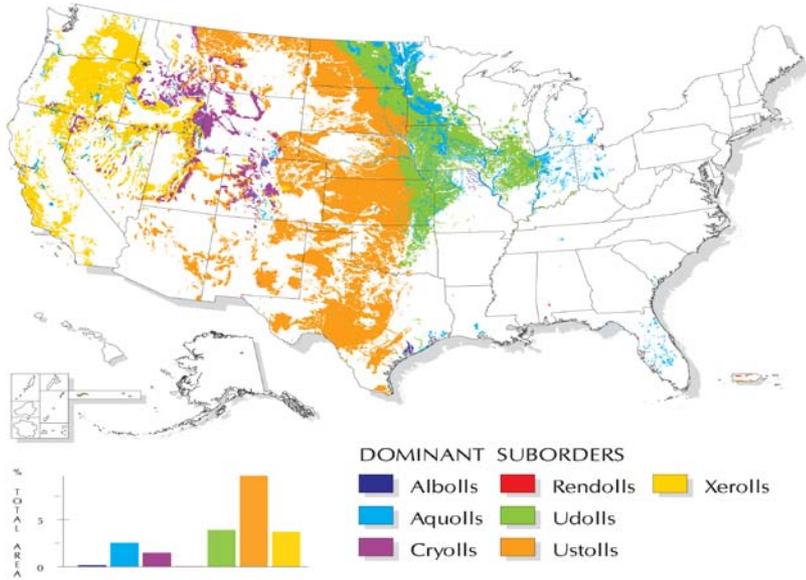
Director Golden reminded us yesterday that Congress' charge to soil survey is

1. Inventorying the soils of the USA,
2. Keeping that inventory current,
3. Providing interpretations for the soils,
4. Insuring access & use of that information.

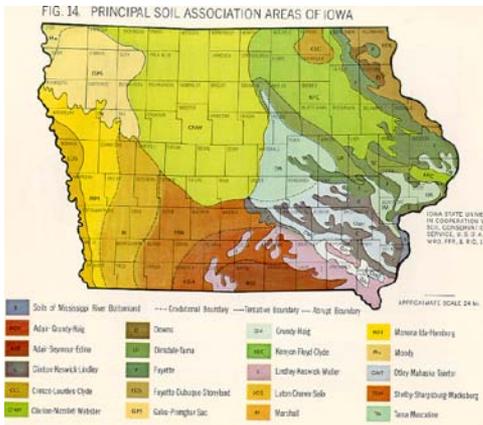
His goal is we “harmonize concepts” through stronger cooperative use of knowledge.

Iowa is 68% Mollisols

MOLLISOLS



From: http://ftp-fc.sc.gov.usda.gov/NSSC/pub/orders/mollisol_map.jpg



From: <http://ftp-fc.sc.gov.usda.gov/NSSC/pub/orders/mollisol.jpg>

Soil use in Iowa = 91% farms

- Iowa area is 144,000 km².
- About 85,000 farms with average area about 150 ha.
- Maize grown on 5 million ha; mean yield = 12 t/ha.
- Soybeans grown on 4 million ha; mean yield = 3.5 t/ha.
- Harvested maize & soybeans worth about \$15,000,000,000.
- Pasture and forages are grown on the remaining 4 million ha.

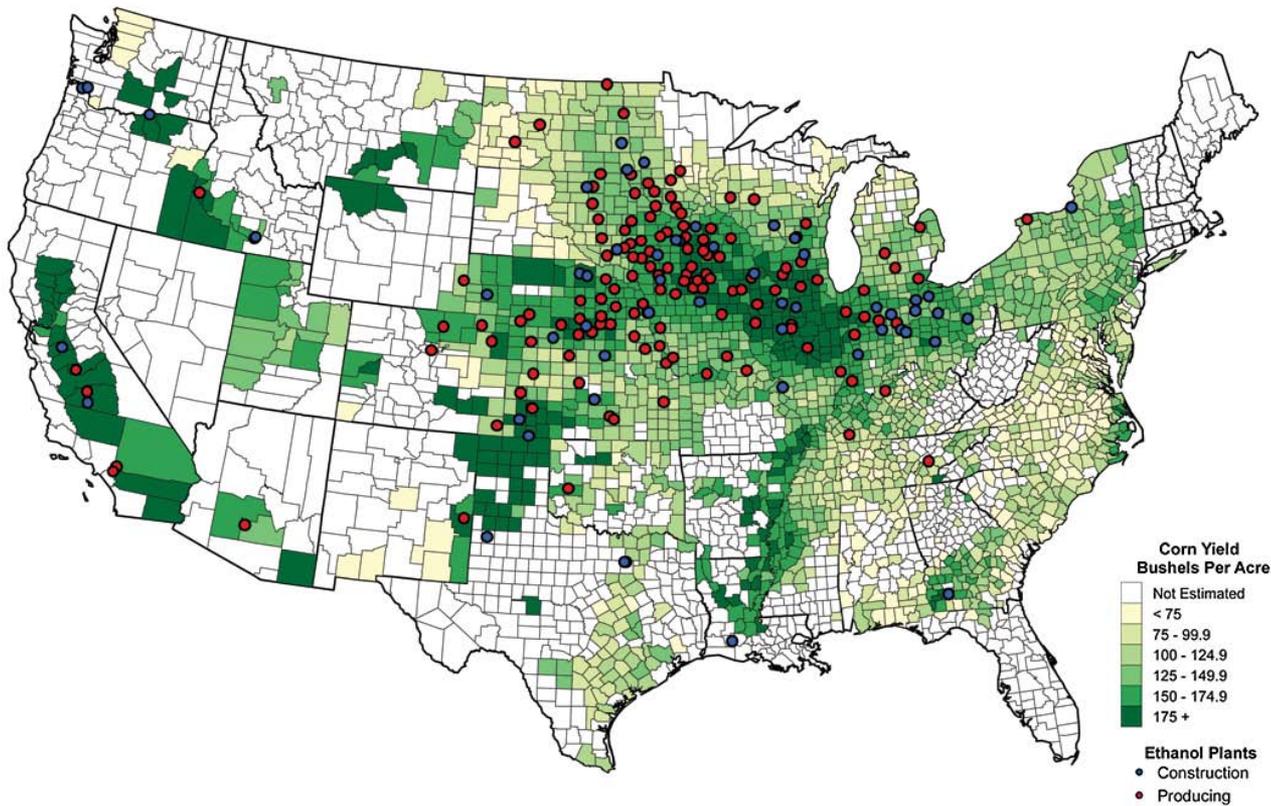
- The most productive soils are Mollisols, especially Aquic Hapludolls, Typic Hapludolls, Typic Argiudolls, and Cumulic Hapludolls.
- They are nearly 100% used to grow maize, soybeans and houses.

- Total value of cropland is around \$200,000,000,000.
- Cropland sells for \$7000/ha to \$20000/ha.

Soil use for agriculture is intense & intensifying

90% of several counties growing maize or soybean today.

1,500,000 km of tile; therefore, Aquolls \cong Udolls yields.



USA & Iowa concerns are:

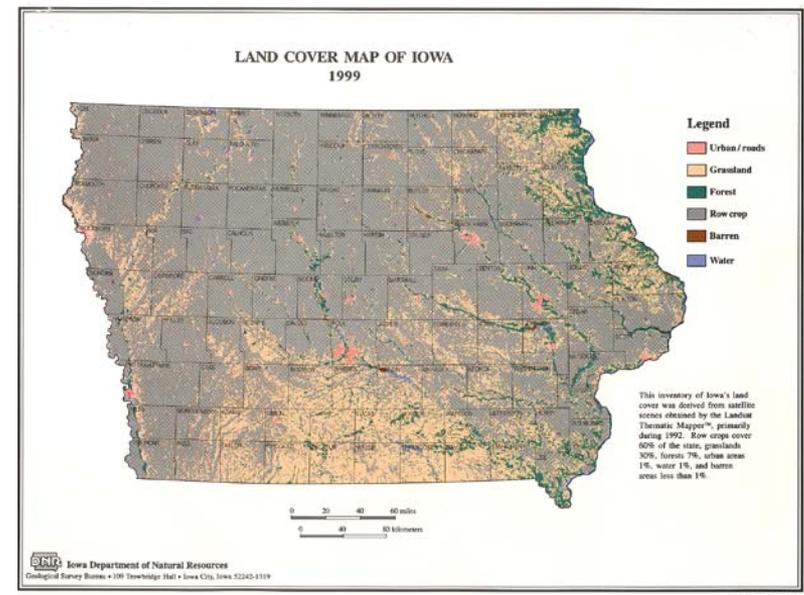
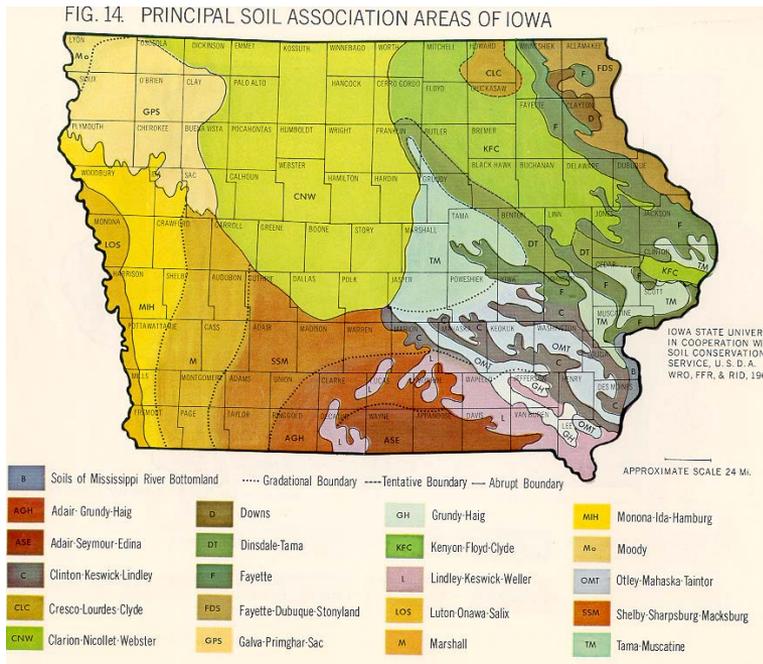
- Erosion & sedimentation,
- Loss of SOC,
- Loss of ecological functions,
- Loss of watershed functions,
- Loss of yield potential,
- Loss of the soil.



Objective

Overview of three projects

- Clear Creek Ksat variability
- CSR to CSR2
- Changes in representative pedons



PREDICTIONS OF SATURATED HYDRAULIC CONDUCTIVITY (K_{sat}) DYNAMICS IN A MIDWESTERN AGRICULTURAL WATERSHED IN IOWA

Thanos Papanicolaou & Lee Burras & teams



Objectives

- Development of a modeling framework for the understanding and predictions of K_{sat}
- Selection of pedotransfer functions (PTFs) and watershed models
- Predictions of K_{sat} dynamics

Baseline (K_b) : Intrinsic factors (Spatial)



Soil properties

Bare (K_{br}) : Extrinsic factors (Spatial + Temporal)



Soil properties

Climate and agricultural practices

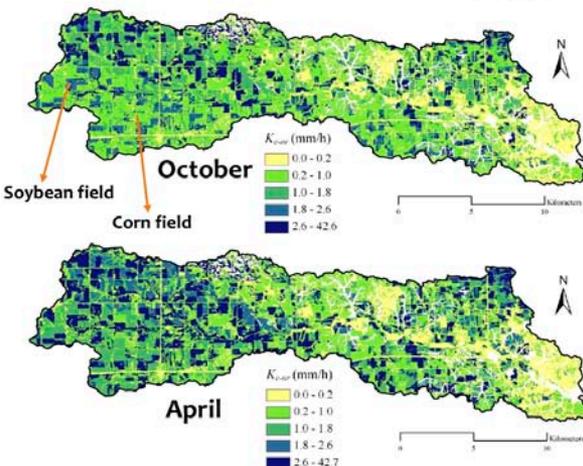
Effective (K_e) : Extrinsic factors (Spatial + Temporal)

Soil properties

Climate, agricultural practices, and land cover

K_{sat} Dynamics Distribution in the CCW

- Effective saturated hydraulic conductivity without storm effects (K_{e-nr})



$$K_{e-nr} = \zeta_{br} \left(1 - \zeta_{TE} \right)$$

K_{e-nr} : Inversely proportional to C_{TE} in that it has the similar effect with crust which provides a protection layer on the field surface.

Recommendations

- Higher resolution of input data (e.g., rainfall, land uses and soil properties) will provide more detailed K_{sat} distribution maps.
- Updated soil survey and land use databases will provide a better representation of the current state of K_{sat} , which varies temporally.
- Different PTFs and watershed models may be applicable for different areas; therefore, selecting a suitable PTF and watershed model through calibrations is required to apply the methodology that is used in this study.

Corn Suitability Rating 2

$$CSR2 = S-M-F-C \pm EJ$$

Where:

S is the taxonomic subgroup class of the soil series

M is the family particle size class

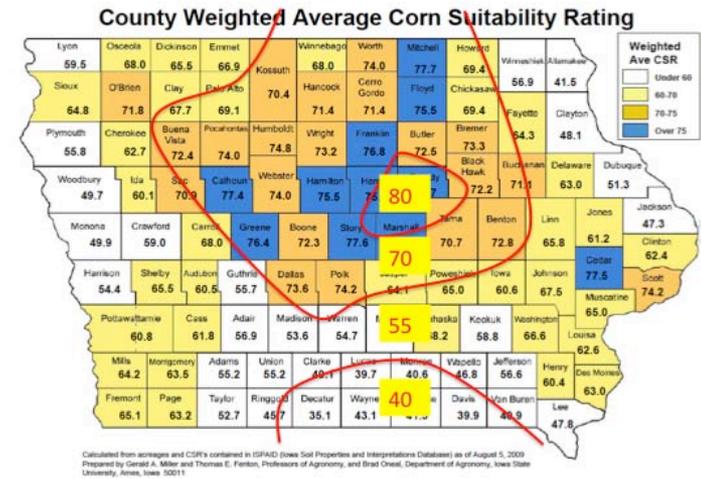
F is the field conditions of a particular SMU

D is the soil depth factor, which is tied to USLE T

C refers to the county's climate

EJ is an expert judgment correction factor

Published points are assigned to each of the above



Chendev, Burras & Sauer (2009)

Alfisol \Rightarrow Mollisol

Structure improved, horizonation shifted downward, more burrowing, bigger Fe & Mn features



Veenstra (2010) resampled pedons

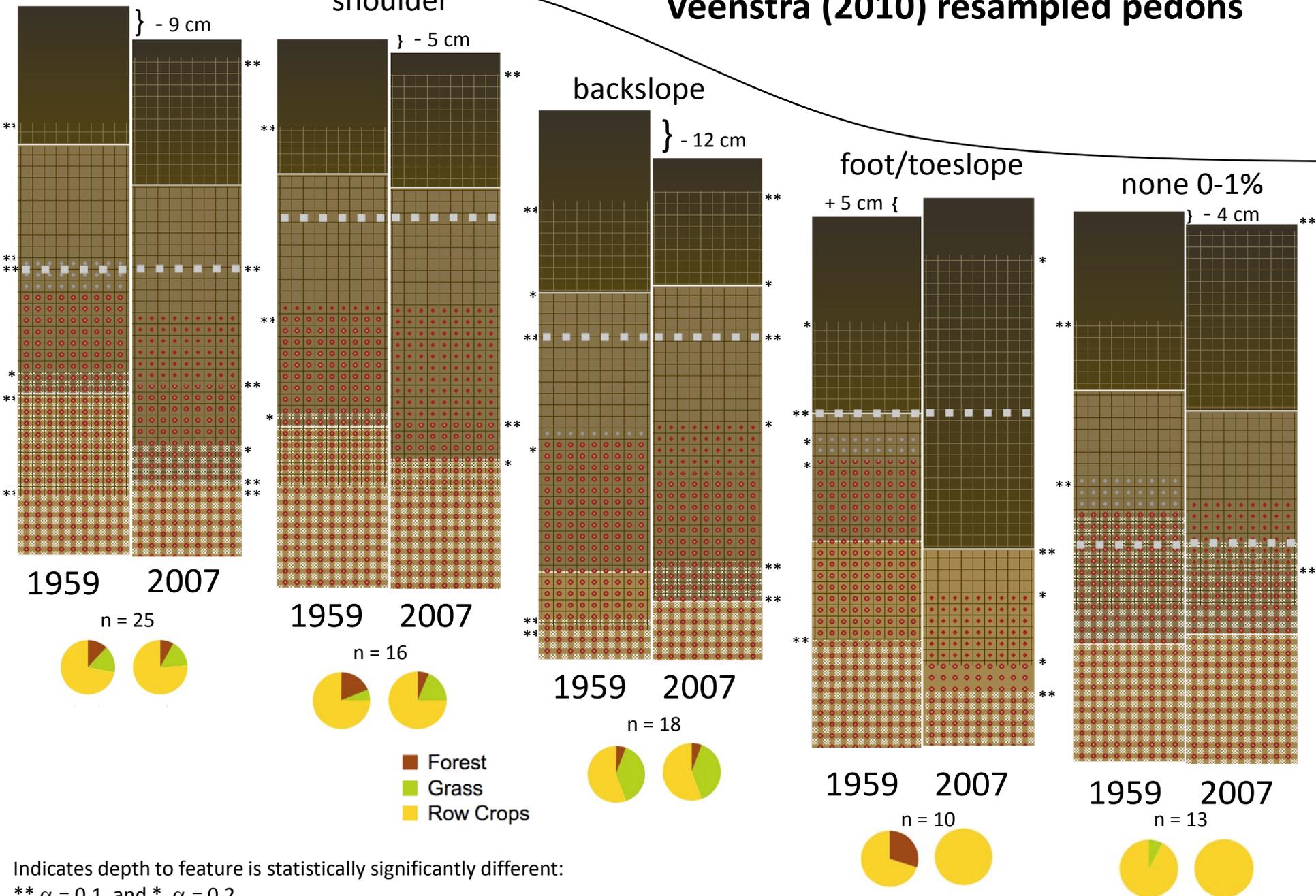
summit

shoulder

backslope

foot/toeslope

none 0-1%



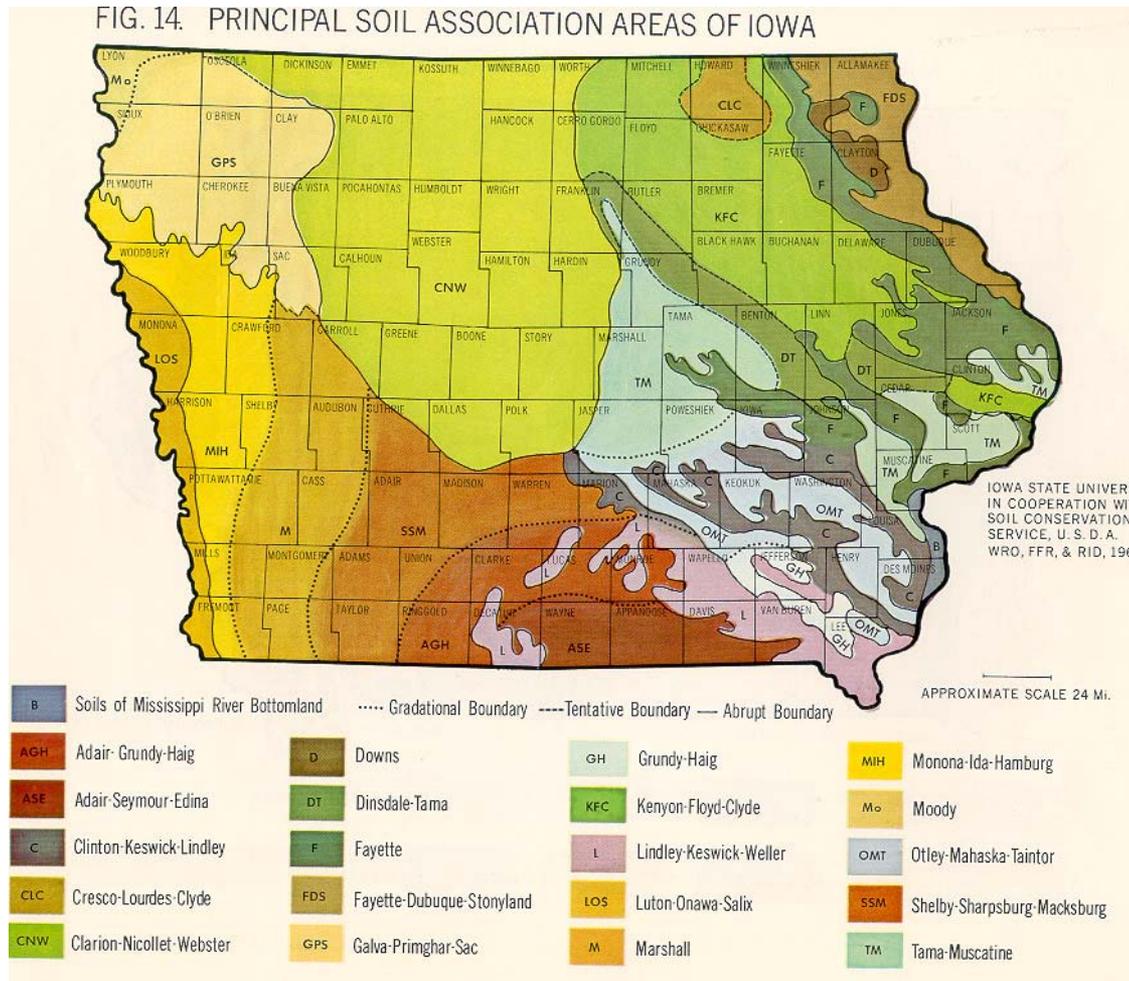
Veenstra & Burras (2010)

Percent of pedons that show a change in soil classification after approximately 50 years of agricultural land use (n = 82)

	Canadian Taxonomy	US Taxonomy	FAO-WRB	
Order	15%	19%	RSG	32%
Suborder	N/A	26%	Prefix	47%
Great Group	49%	32%	Suffix	37%
Subgroup	62%	56%		
Family	66%	60%	At least one change	67%



The bottom line is Iowa's soils have changed.



Different soils occur according to differences in

Geology

Climate

Biota

Relief

Time

MANAGEMENT

Summary

- Improved predictability of properties and interpretations across space and time is occurring with models such as Papanicolaou's for Ksat.
- Increased reliance on soil survey databases is occurring with models such as CSR2.
- But the question is: Do we really know what soils are in the field today?

Questions, comments, insights?

Thank you.

