The Soils of Iowa

C. Lee Burras

Iowa State University

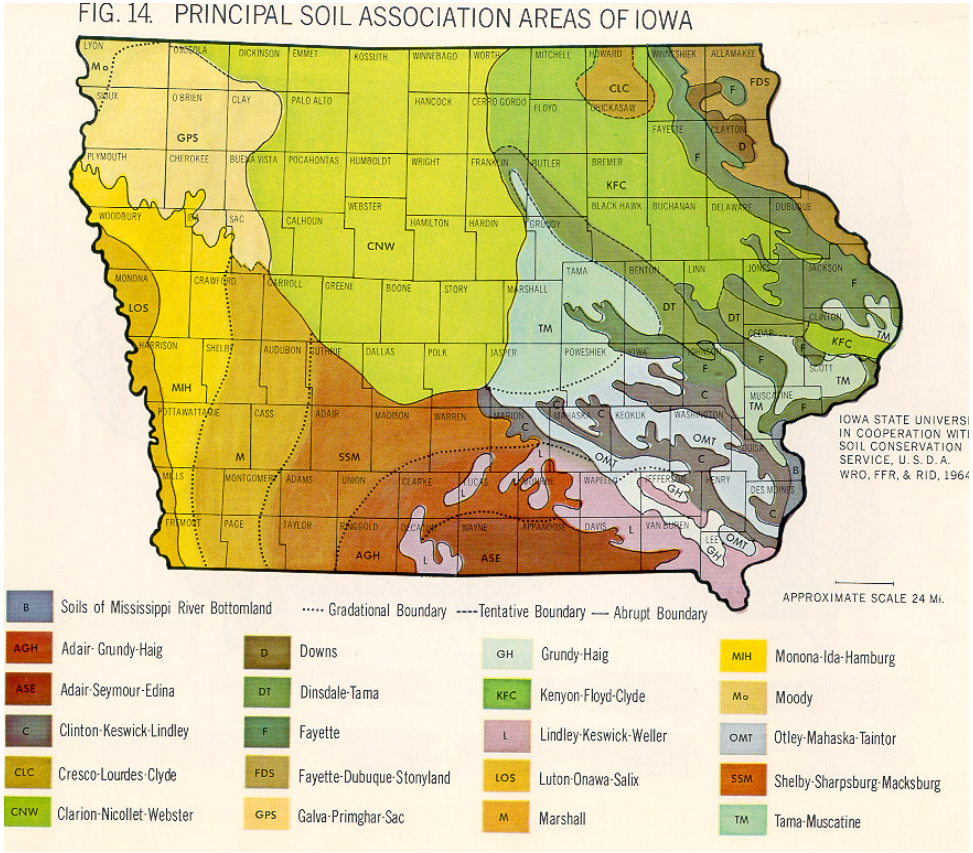
January 18, 2018

I am honored to be here with PFI today! Thank you for inviting me, Dr. Gailans.

I am a flexible so if you have a burning question while I am speaking, please interrupt me.

Our goal is to understand the formation, distribution and productivity of Iowa's soils.

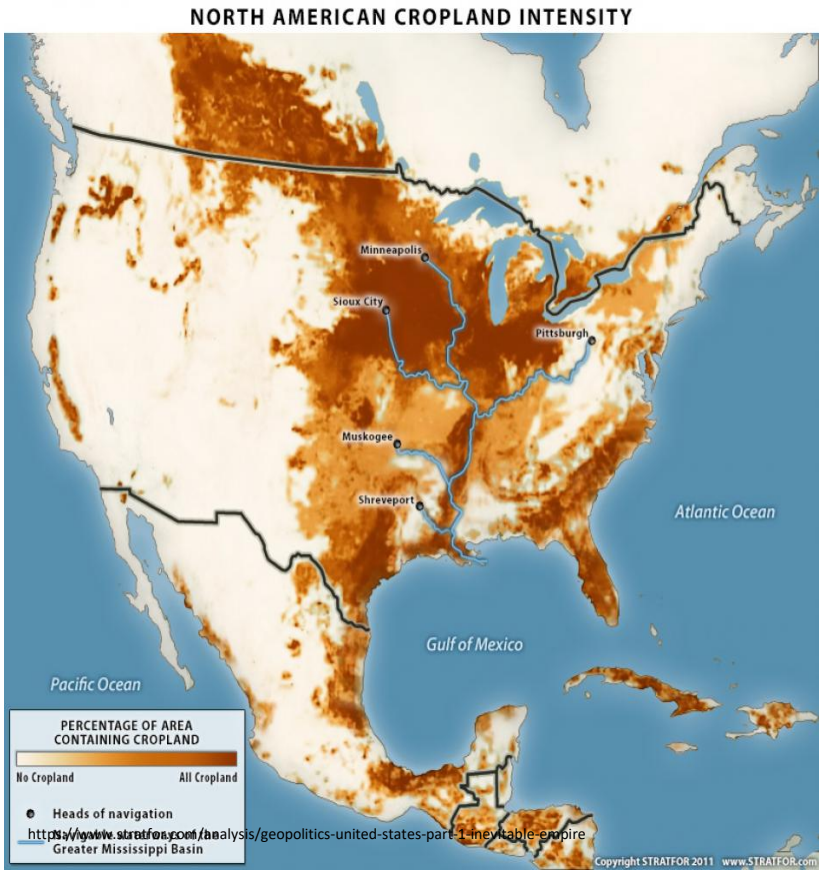
1. Overview of Iowa
2. Soil Formation
3. Soil Distribution
4. Soils & plants
5. Summary



A few possibly useful URL's.

Key Words	URL	"Value"
Web soil survey (WSS)	http://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm	Official soil maps for the USA and their interpretations
California soil resource lab	http://casoilresource.lawr.ucdavis.edu	Speedy UC Davis site w/ Apps
Iowa Geographic Server	http://ortho.gis.iastate.edu (as an example)	Historical & current information
GoogleEarth		Satellite images, etc.
ISPAID Iowa Land	http://www.extension.iastate.edu/soils/	Iowa facts, maps, CSR2
SoilsGrid	https://soilgrids.org	World wide soil maps
European soil maps	http://eusoils.jrc.ec.europa.eu/esdb_archive/EuDASM/EUDASM.htm	Soil maps for most countries of the world.
WOSSAC soil maps	http://www.wossac.com	Soil digital data for the world
NRCS world soil maps	http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/edu/college/?cid=nrcs142p2_054010	USDA-developed maps of the world
Iowa Land Use	http://www.extension.iastate.edu/soils/	Variety of information
Soil Health	https://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/	Portal for soil health USA

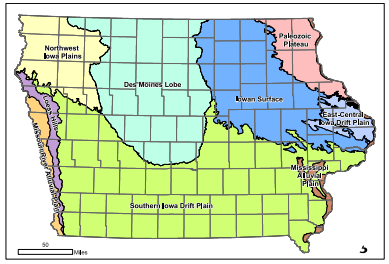
Iowa = North American Central Lowlands, Central Plains, Mississippi River Watershed, Prairie Province, Chernozems, Black Soils, Mollisols.



http://www.stratfor.com/analysis/geopolitics-united-states-part-1-inevitable-empire

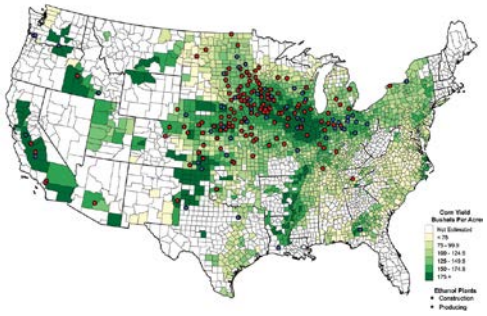
Iowa – a few facts

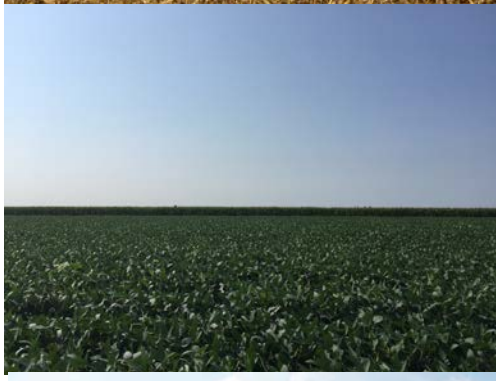
Area = 56,000 mi^2 = 36 million ac.
Population = 3.1 million.
50 people/mi^2
55% urban, 45% rural.
40% Iowans live in six counties.
26% urban & 16% rural college degrees.
12% poverty.



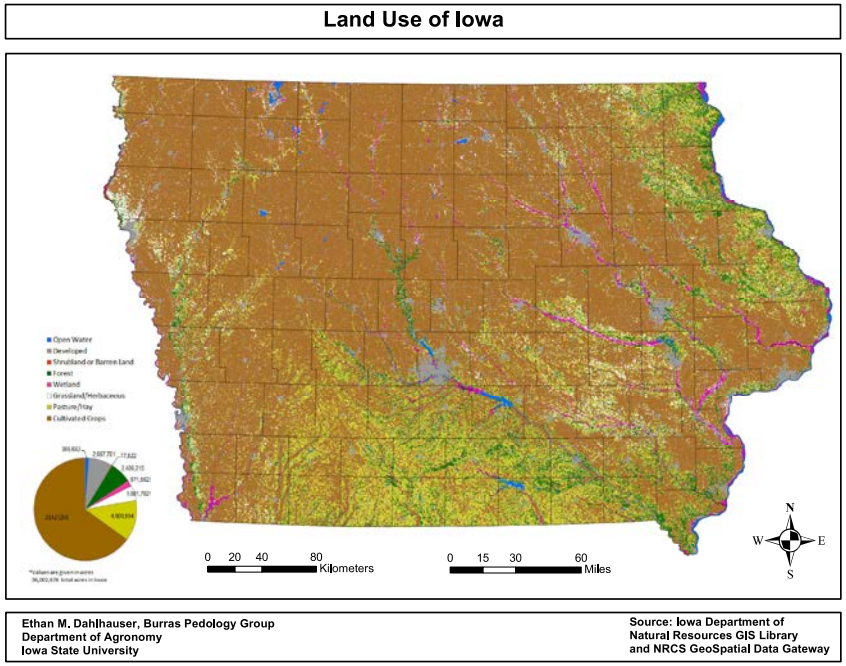
Iowa – a few facts

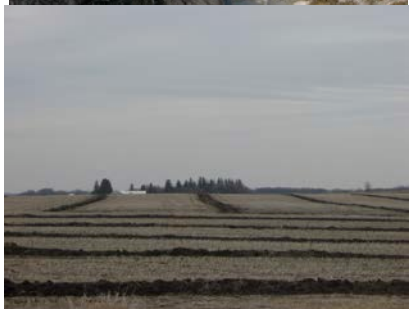
Land area = 90% is farmed.
About 90,000 farms that average 350 ac.
Corn: 14 million ac; mean yield = 12 t/ha.
Soybeans: 10 million ac; mean yield = 4 t/ha.
Pasture, forages & forest: 10 million ac.
Farmland value is $4,000 to $12,000/ac.





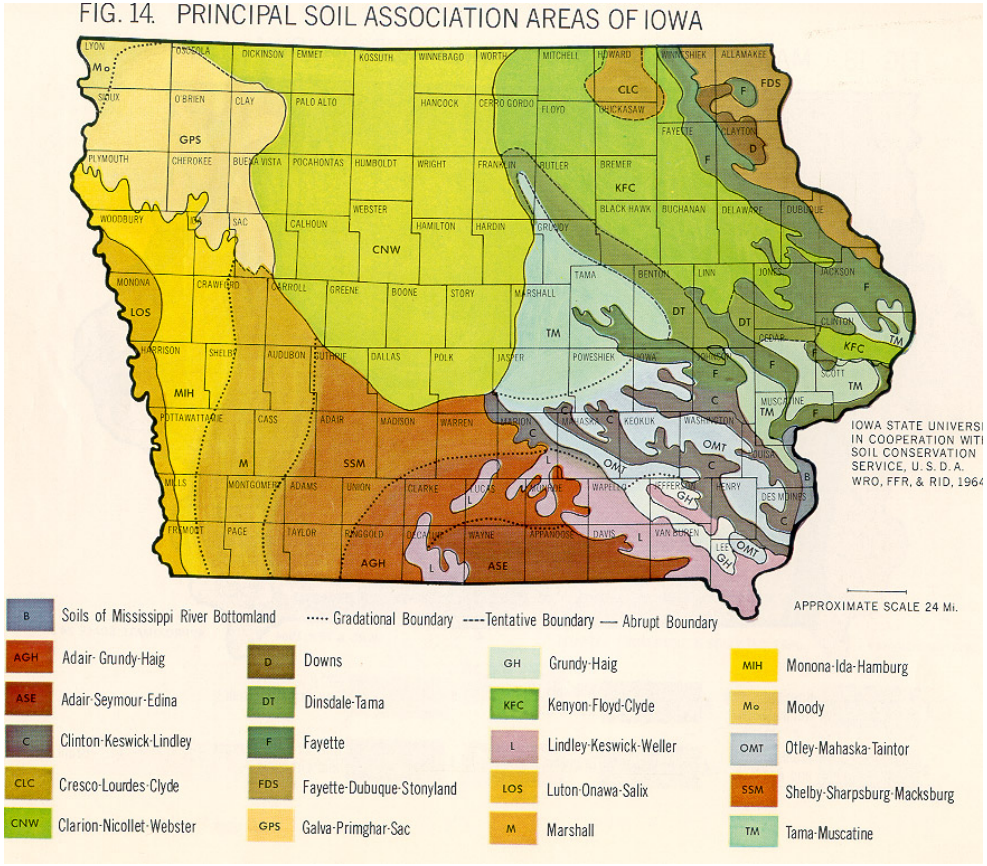
Iowa is 90% farmed because of our natural soils & our weather, & our management.





Key soil issues have been and are drainage, fertilization and erosion.

Pedology of Iowa

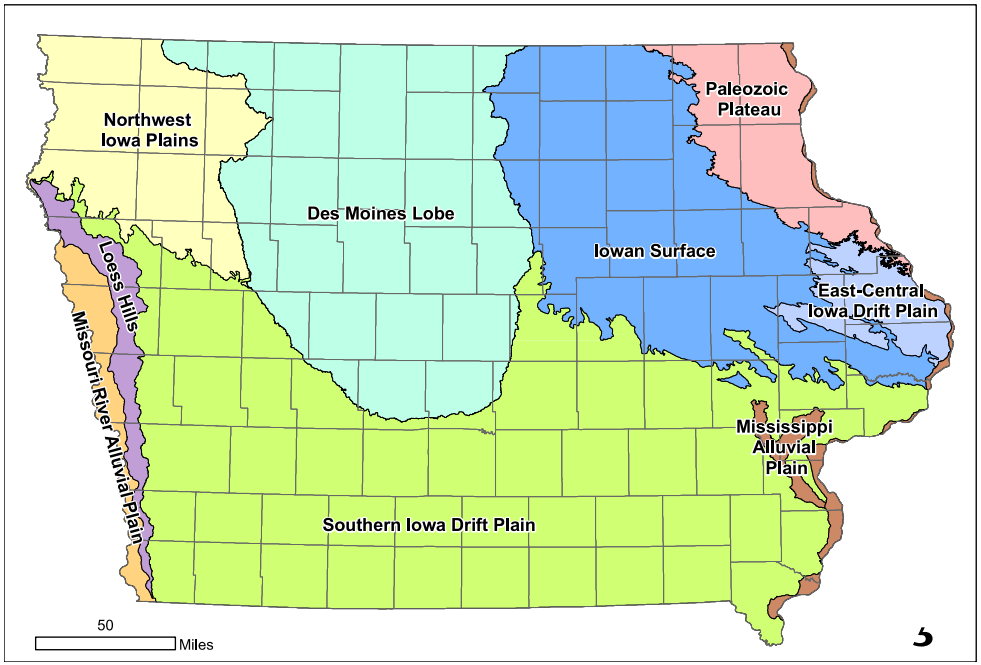


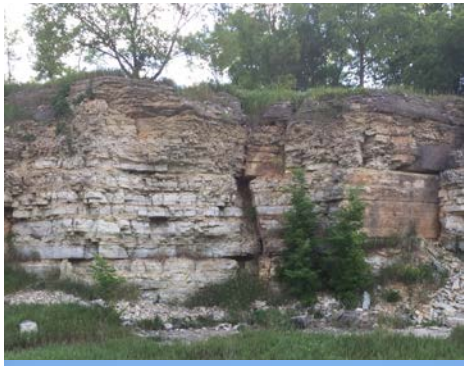
Iowa has 507 soil series. They differ based upon:

Parent material
Time
Climate
Biota
Relief

Hans Jenny (1941)

Parent material regions of Iowa.





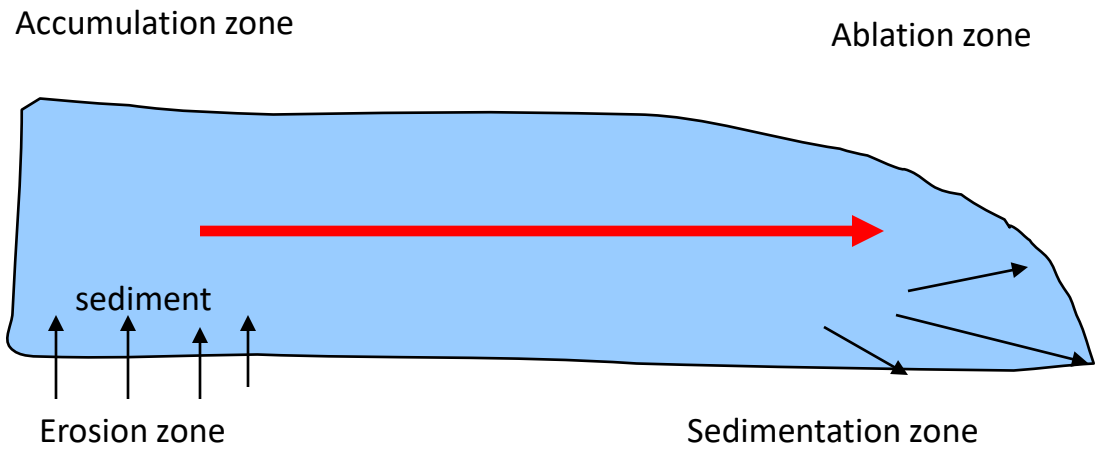
Parent materials and pedology starts with glaciers.

Larsen Ice Sheet, Antarctica (NASA photo).

Glaciers are HUGE!

They have shaped our world.

Glaciers = akin to a river with turbulent current



Over the past 2 million years….

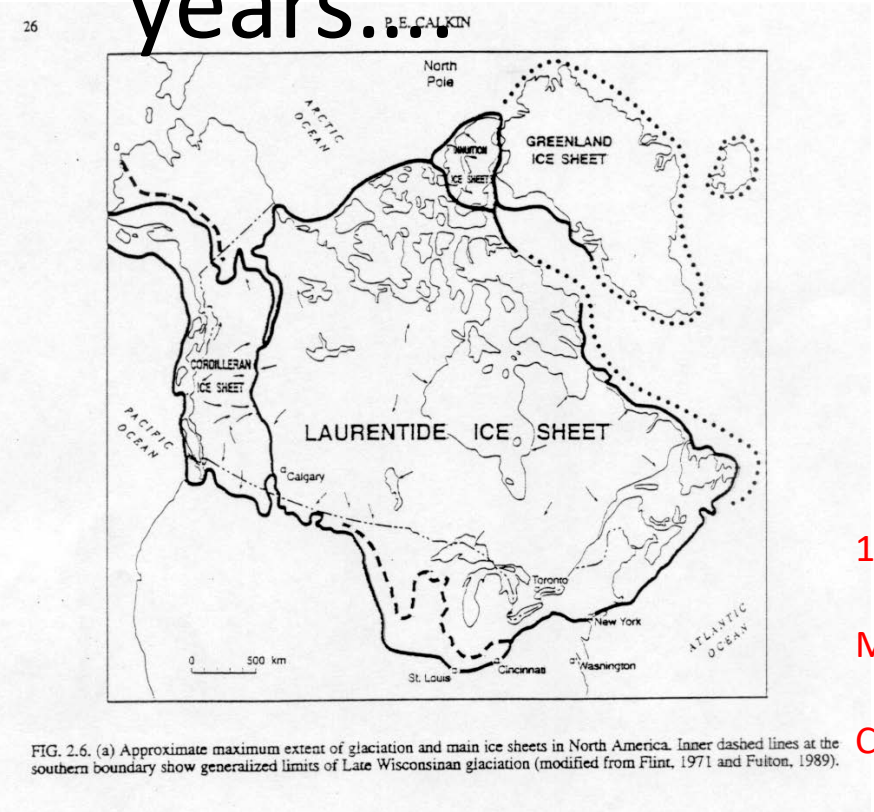
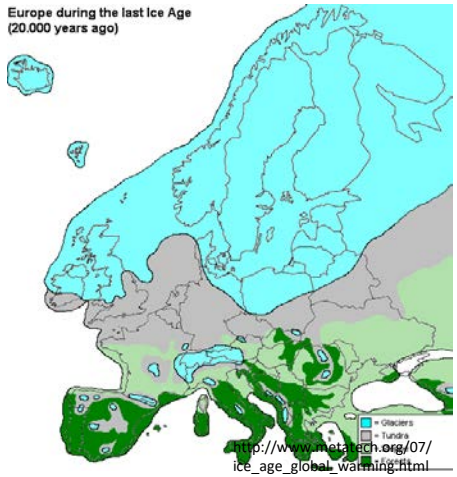


FIG. 2.6. (a) Approximate maximum extent of glaciation and main ice sheets in North America. Inner dashed lines at the southern boundary show generalized limits of Late Wisconsinan glaciation (modified from Flint, 1971 and Fulton, 1989).

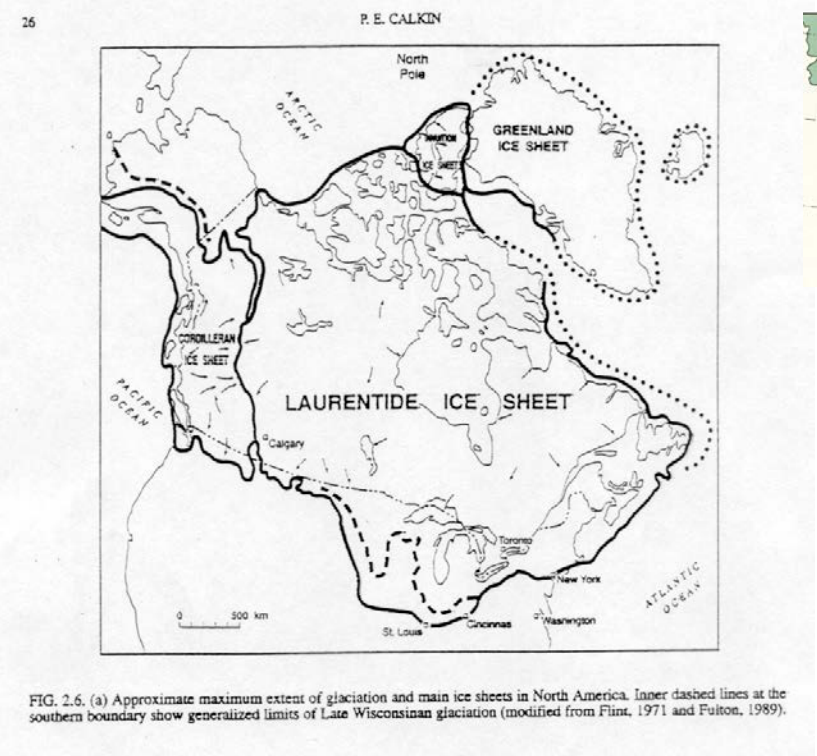


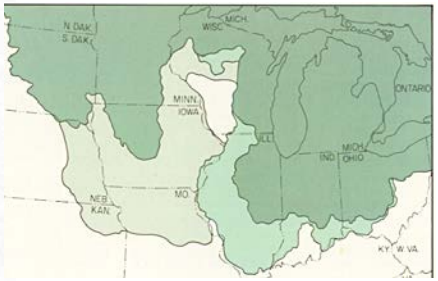
16 or so major glacial advances

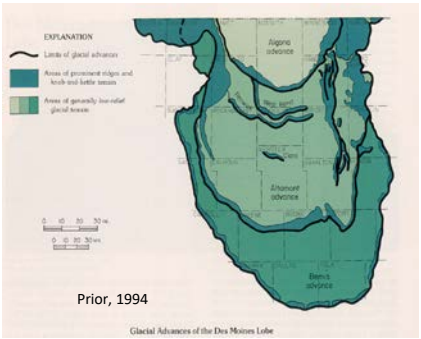
Moved trillion of tons of sediment

Connected/disconnected land masses

“Our” Des Moines Lobe was a tiny bit of ice

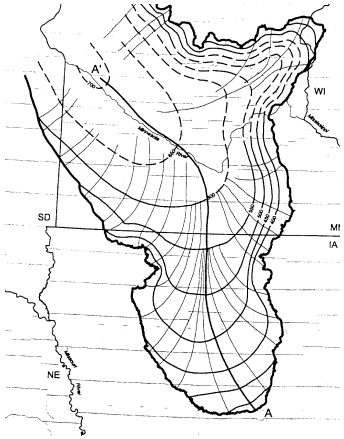


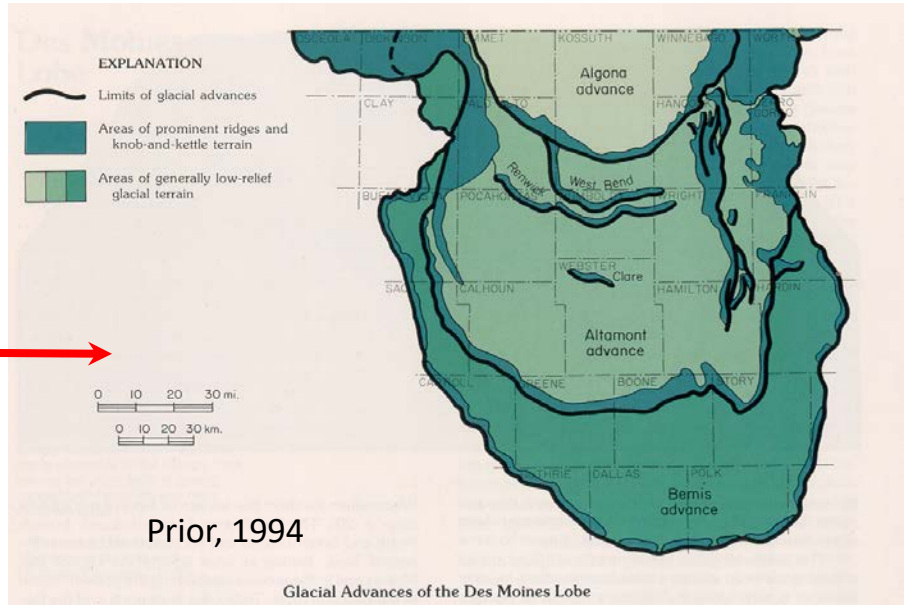




Prior, 1994

But it's huge from a single human perspective.

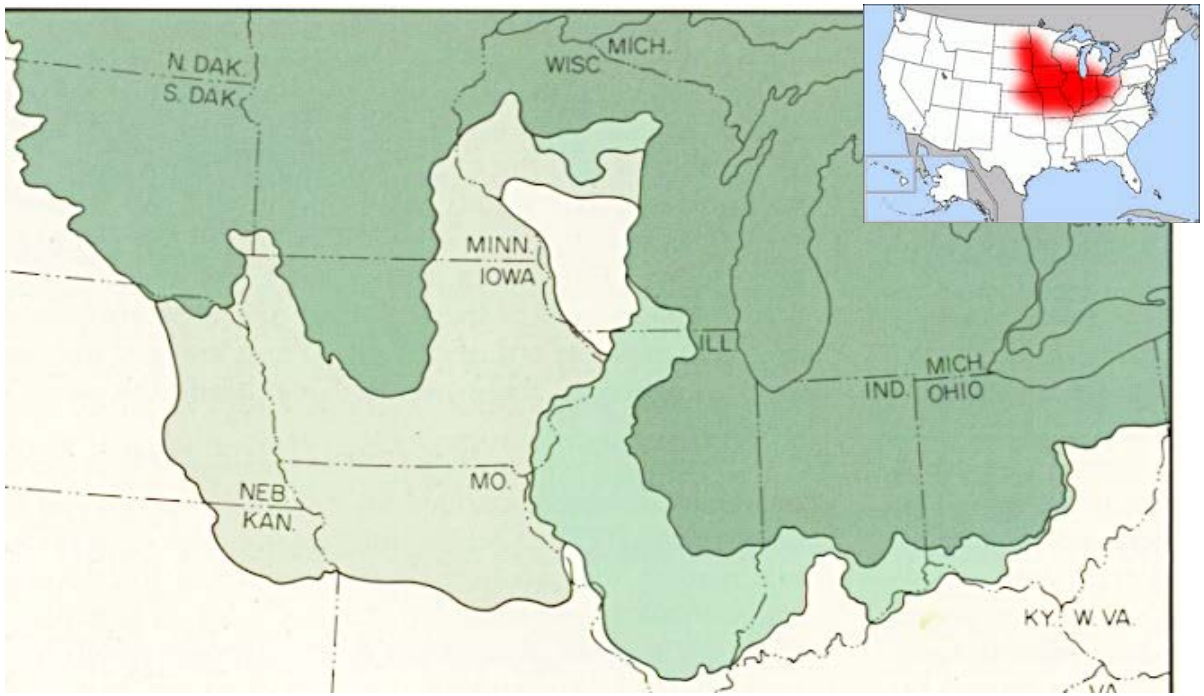




Des Moines Lobe in Iowa = 30,000 km^2 =, >30 m thick in places

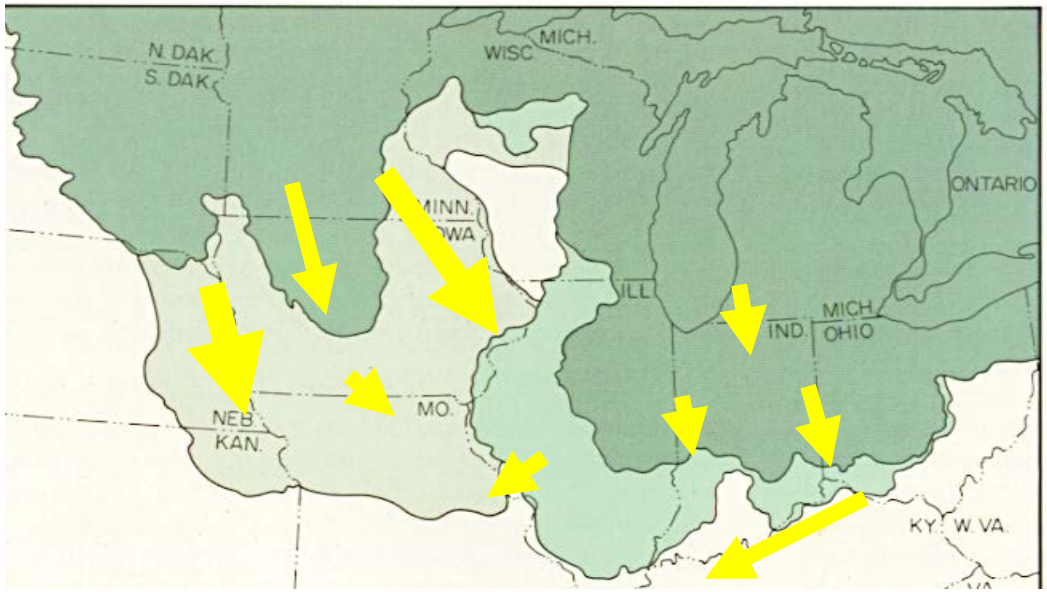
Assume average 15 m thick, Iowa part weighs **800 billion tons**

Glacial tills almost outline the USA corn belt.



Why did they stop here?

Off-glacier = What goes on?



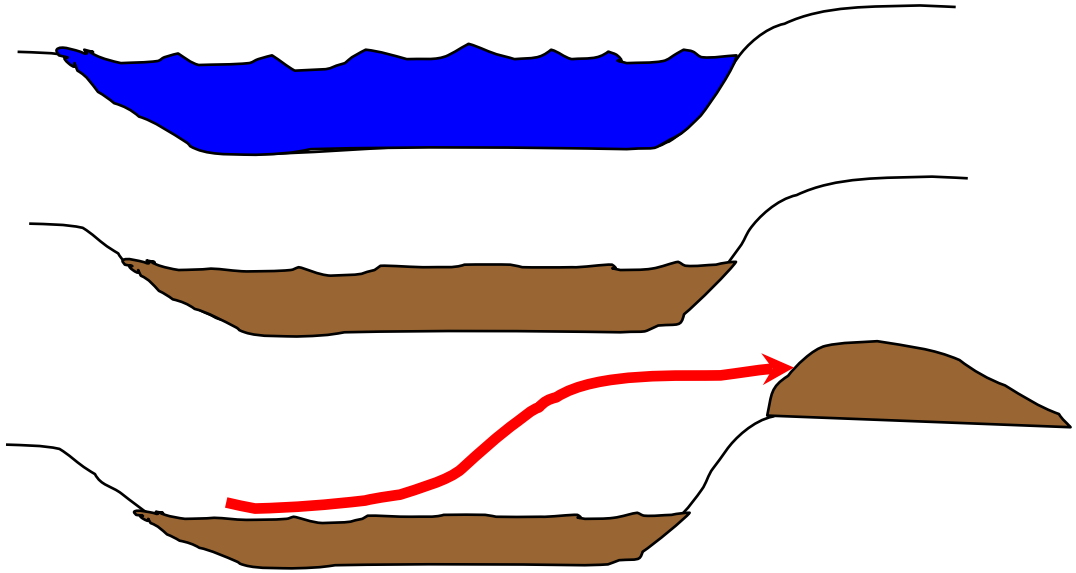
(1) Lots of ice = sea level change (100 m lower)

(2) Huge discharge every summer = Outwash

Glacial streams have incredible seasonal Q.

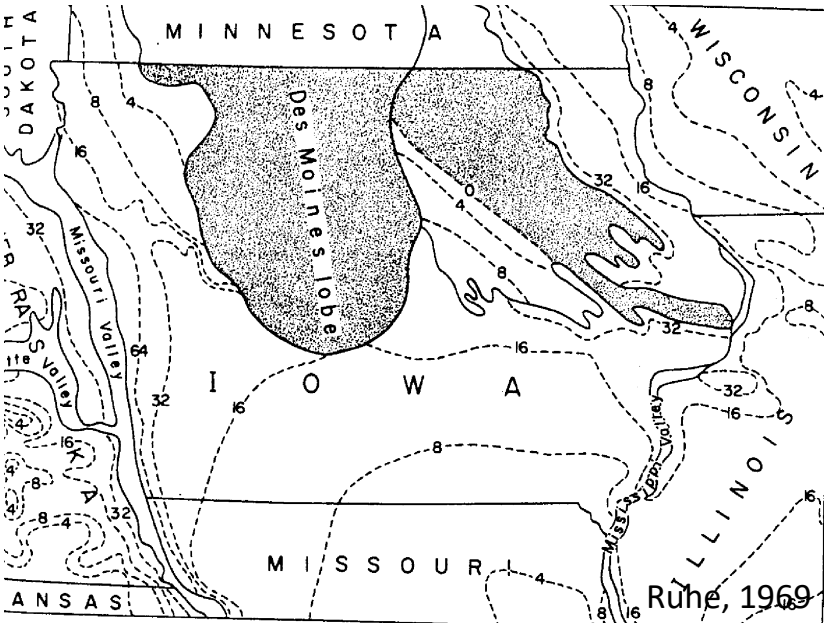
Summers lots water ⇒ Outwash = sands & gravels fill valleys.

During winter, little Q; intense winds whip across valleys ⇒ loess on uplands.



Loess in Iowa

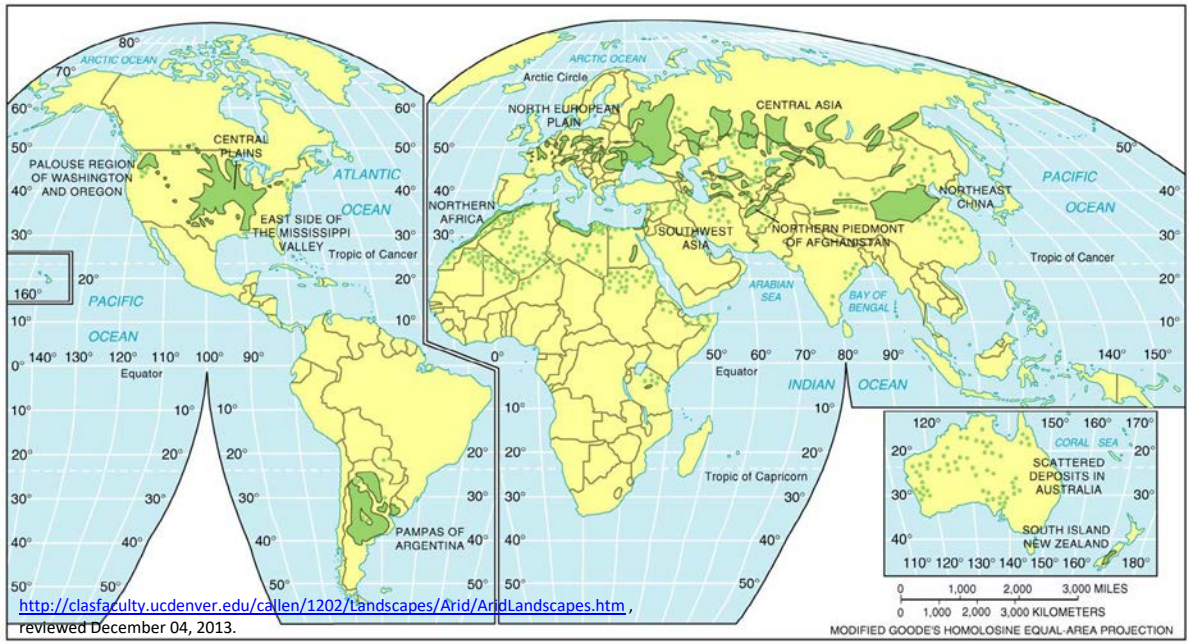
75,000 km^2, 5 m thick = **600 billion tons**



Why is loess thickest in western Iowa & eastern Nebraska?

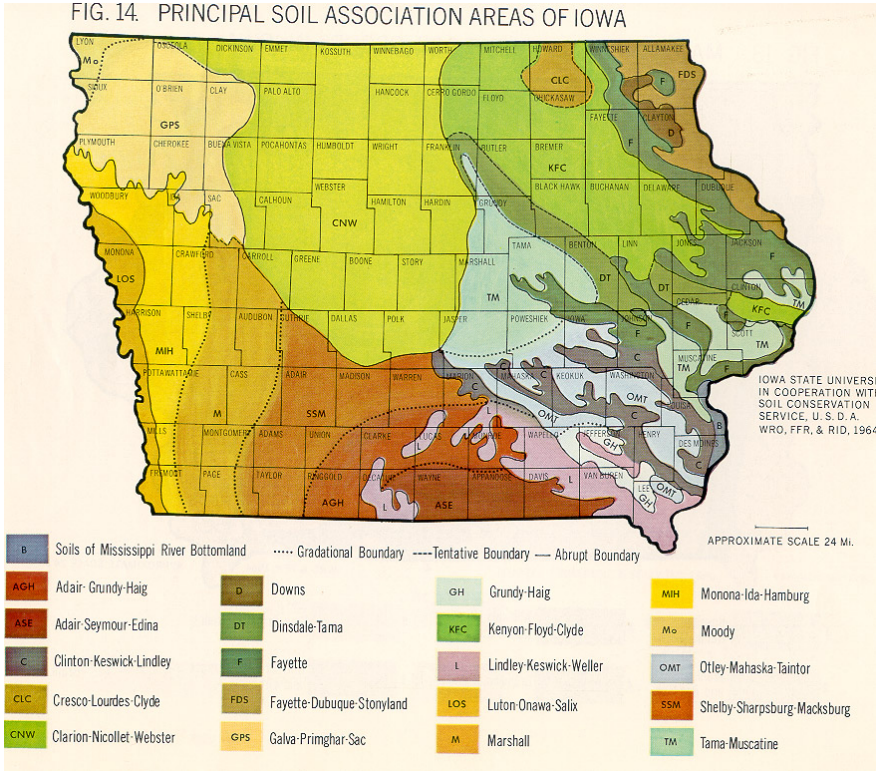
Is all of the loess in the central USA?

To get loess, need exposed sediment & wind.



http://clasfaculty.ucdenver.edu/callen/1202/landscapes/Arid/AridLandscapes.htm , reviewed December 04, 2013.

Parent material regions of Iowa



CNW = glacial till
Des Moines Lobe = 600 billion tons

MIH, M = deep loess
Loess hills = 300 billion tons

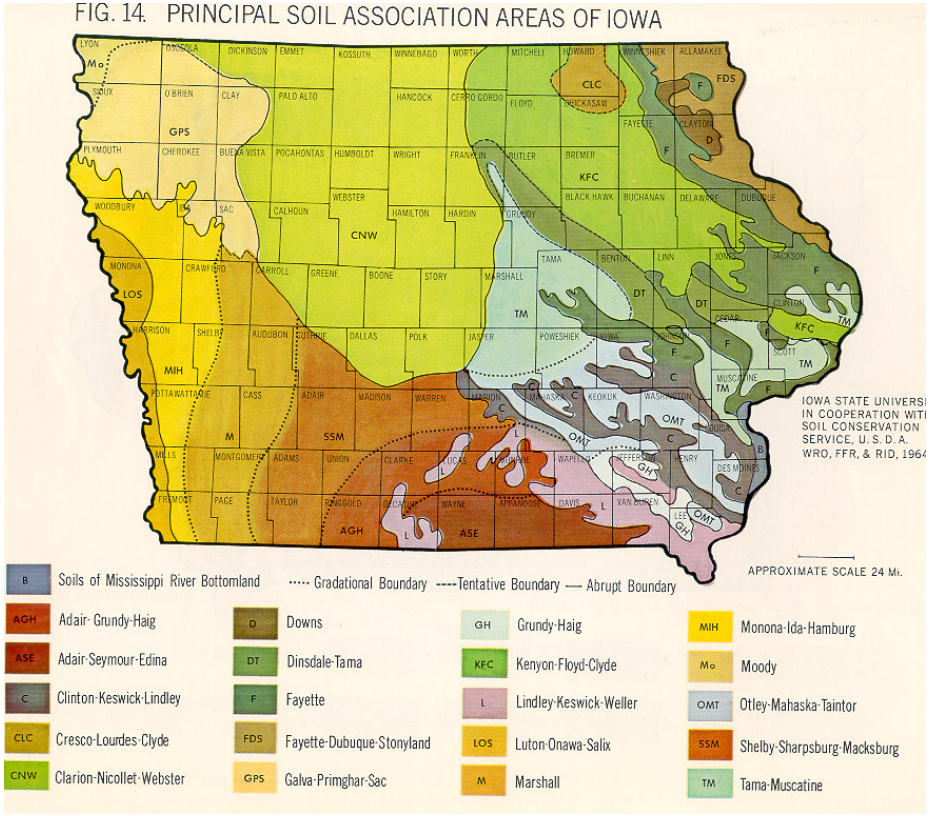
SSM, AGH, ASE, L, OMT = clayey loess over paleosol

TM, GPS = loess

KFC = pedisediment
Iowan Surface

LOS = alluvium
Missouri River Valley

Pedology of Iowa



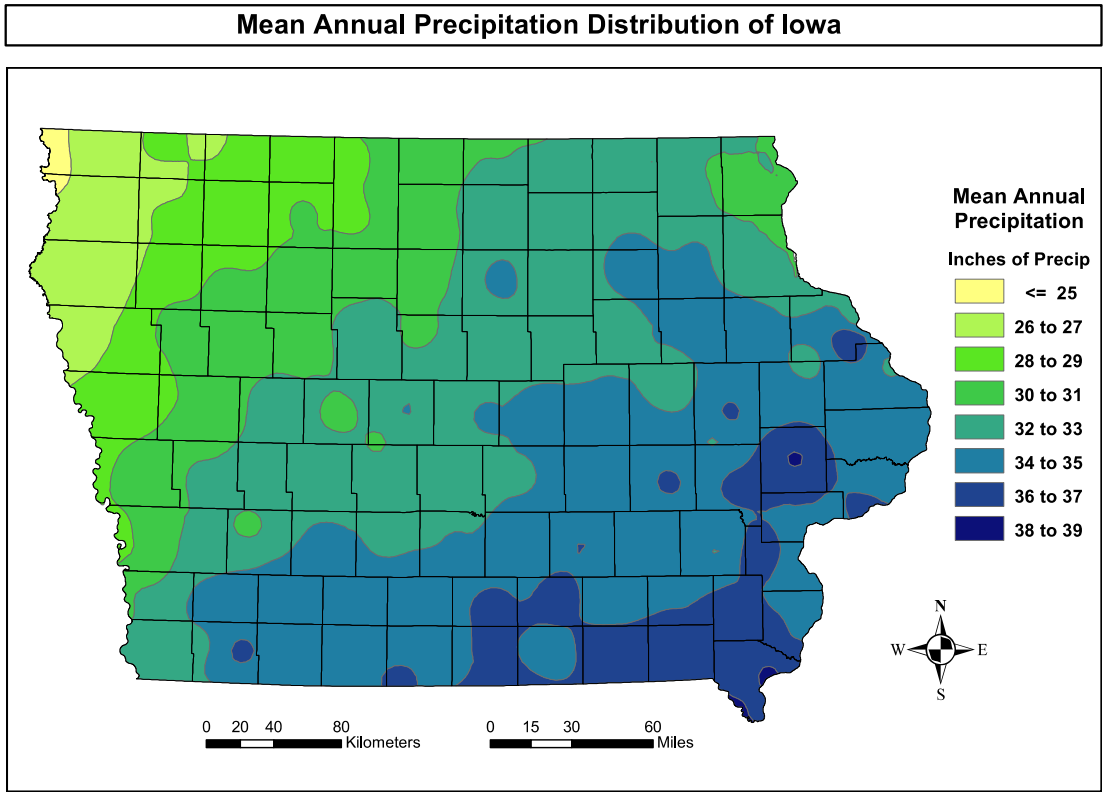
Different soils form according to differences in

Parent material
Time
Climate
Biota
Relief

Jenny (1941)

2018 PFI Revival - Cultivating a Deeper Understanding – Burras – Iowa, a pedologist's perspective – January 18, 2018

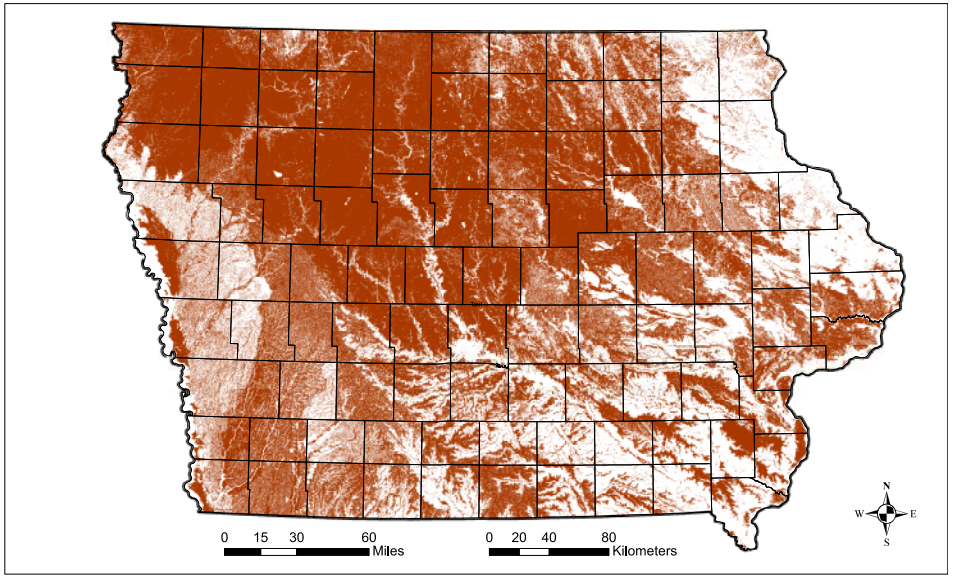
MAP = 33 inches, MAT = 50° F

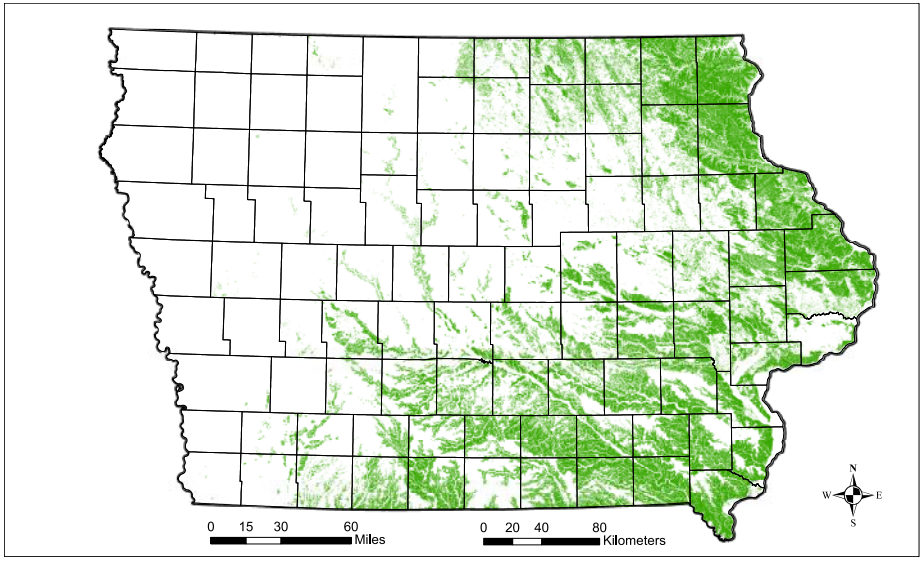


urce: Iowa Department of
Natural Resources GIS Library

Ecology & climate

Prairie, Forest, Savannah, Wetlands.

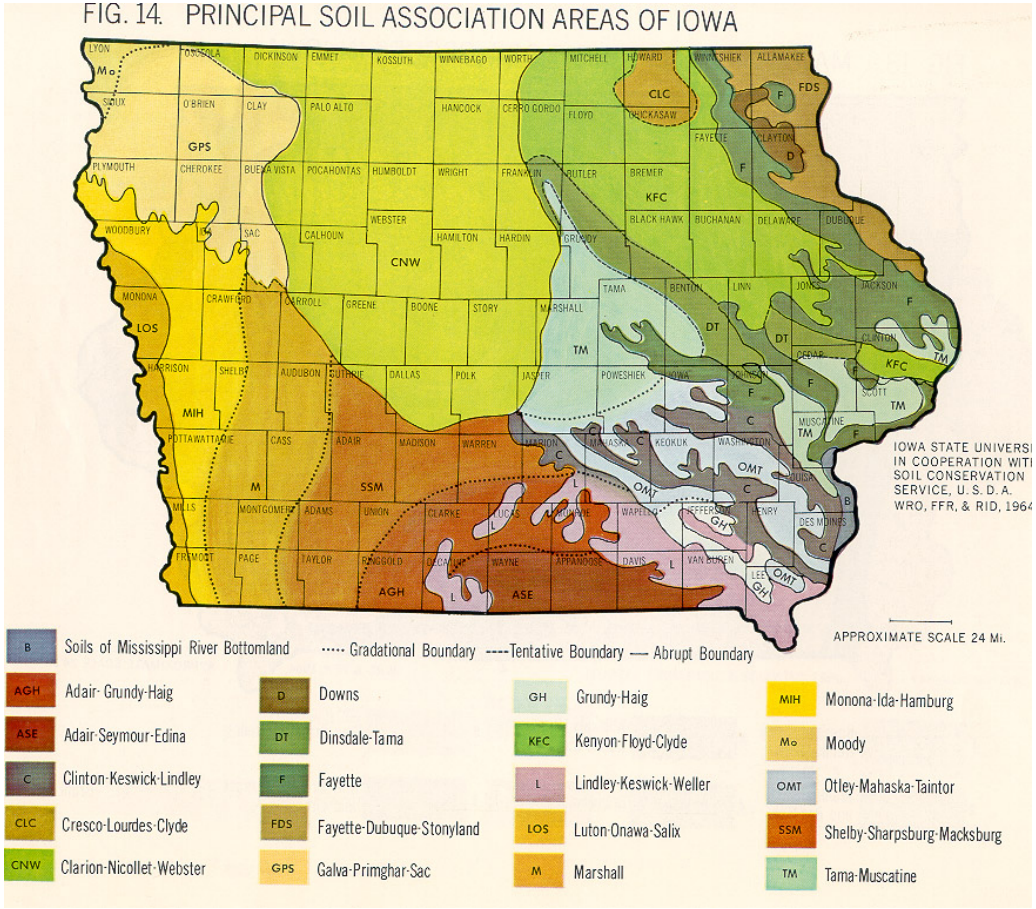




ervation Service (2013)
and Iowa Soil Properties and Interpretations Database (7.3)

3)

Climate & native biota



SE = 950 mm precipitation
NW =650 mm precipitation

East = forest
West = prairie

F, FDS, L, C = forest
Alfisol

DT, ASE, AGH = savannah
Alfisol, Mollisol

Rest of Iowa = prairie
Mollisols

Definition

Black Soils = Mollisols

Mollisol =

1. Mollic Epipedon

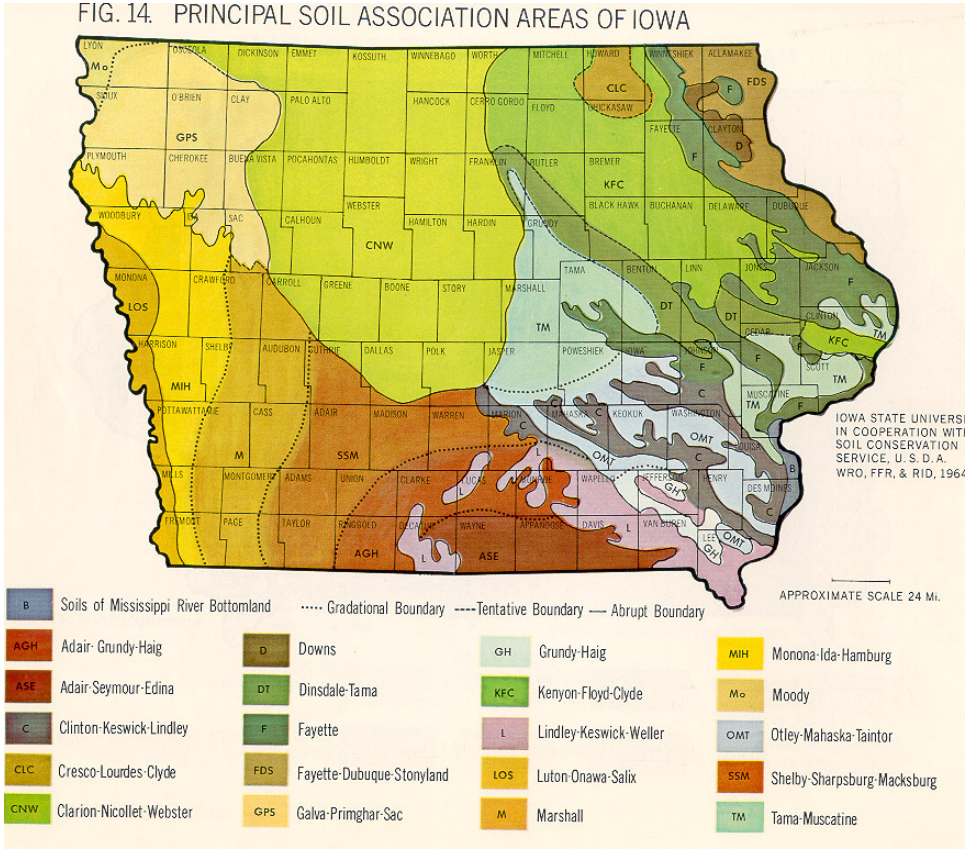
   ≥25 cm thick with structure, ≤3/3, ≥0.6% SOC

2. Solum

   ≥ 50% BS to ≥125 cm.

From: ftp://ftp-fc.sc.egov.usda.gov/NSSC/pub/orders/mollisol.jpg

Mollisols in Iowa = 98,000 km^2 = 68%



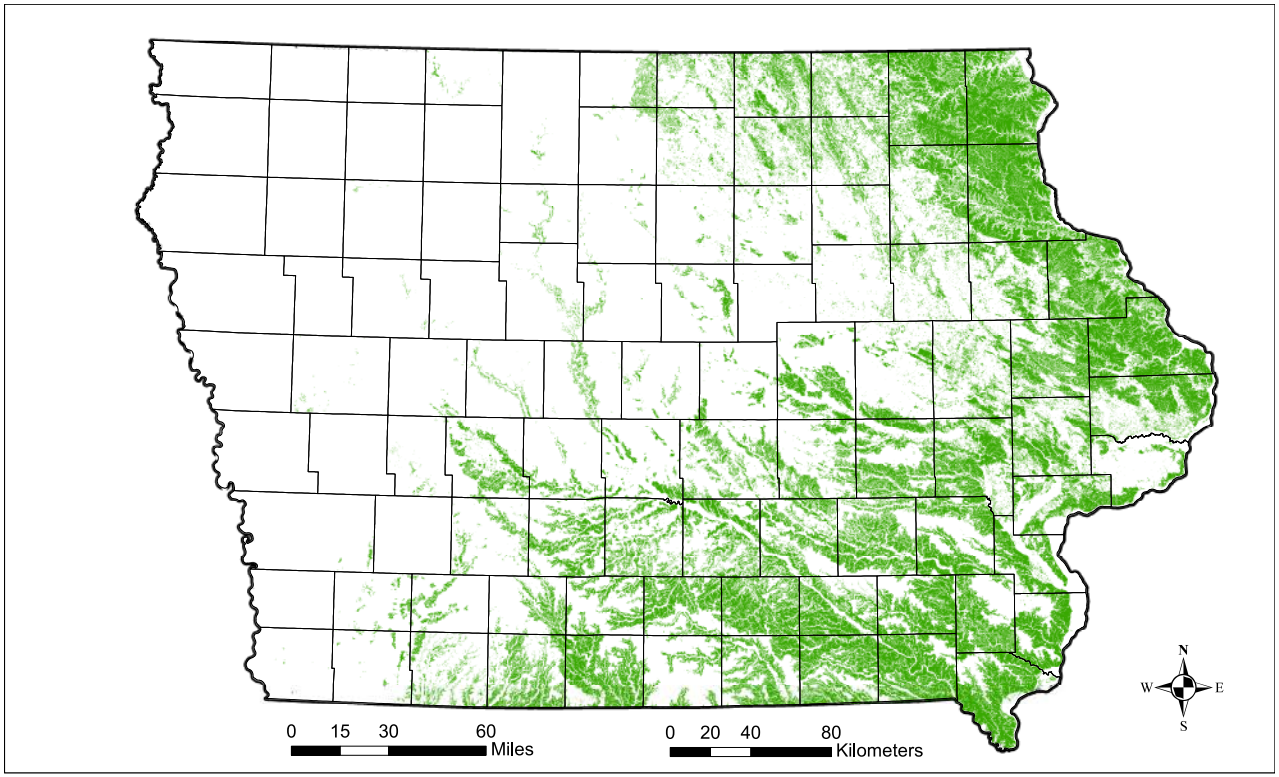
Argiudolls east & south

Hapludolls north & west

Endoaquolls throughout

Alfisols account for another 25% or so of Iowa. The rest are Inceptisols, Entisols, Vertisols and Histisols.

“Forested” Eastern Iowa = Alfisols



ervation Service (2013)
and Iowa Soil Properties and Interpretations Database (7.3)

Alfisol

Alfisol =

1. Thin Epipedon

   <25 cm thick with structure

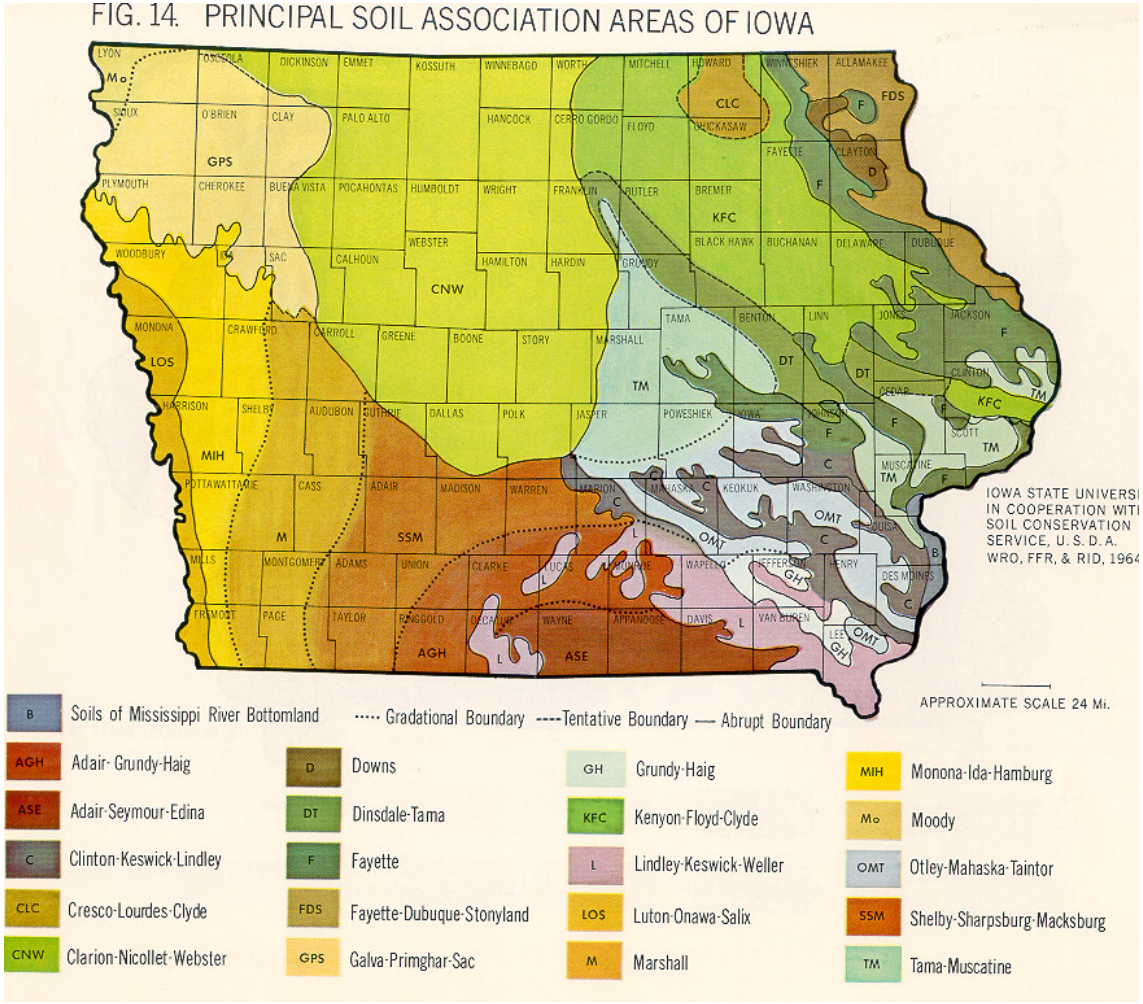
2. Solum

   Argillic horizon

   ≥ 35% BS at 125 cm.

From: ftp://ftp-fc.sc.egov.usda.gov/NSSC/pub/orders/alfisol.jpg

Relief = soils differ across landscapes.



Different soils form according to differences in

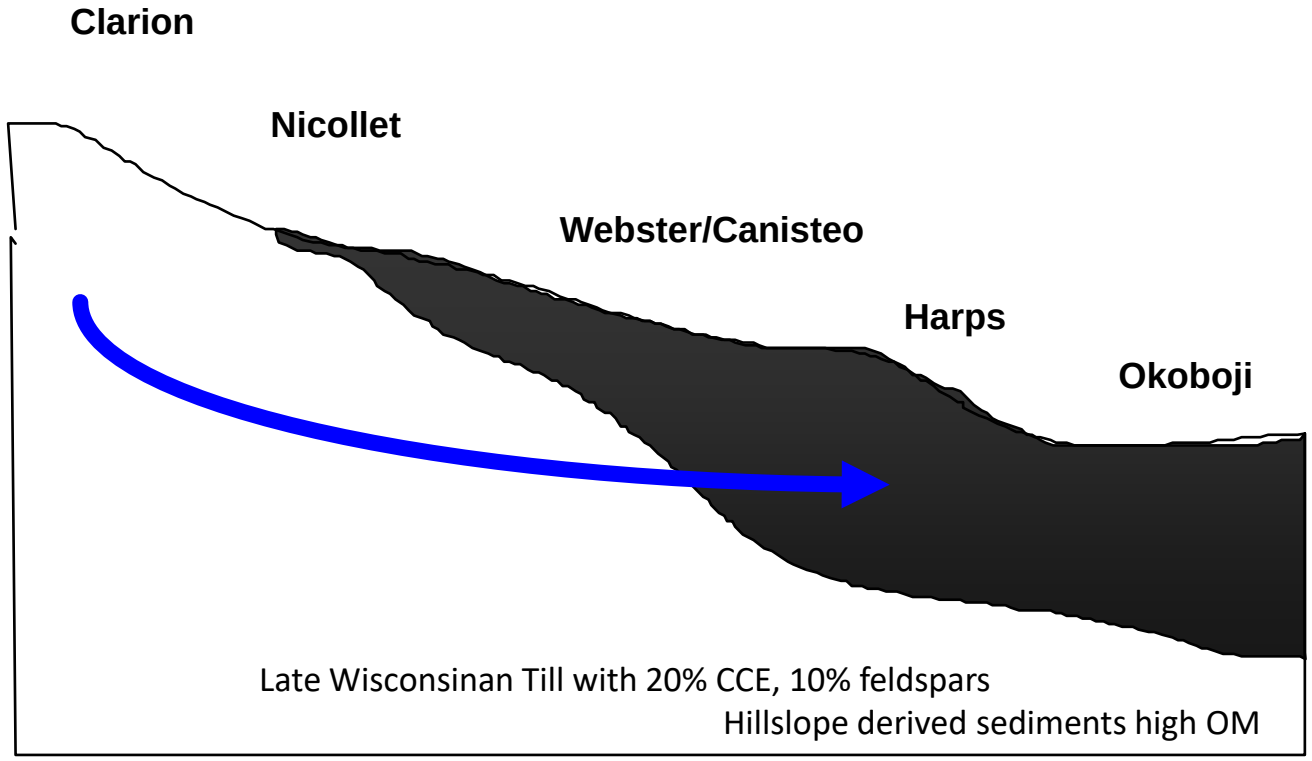
Parent material
Time
Climate
Biota
Relief

Jenny (1941)

Mollisol catena in north-central Iowa

Udolls

Aquolls

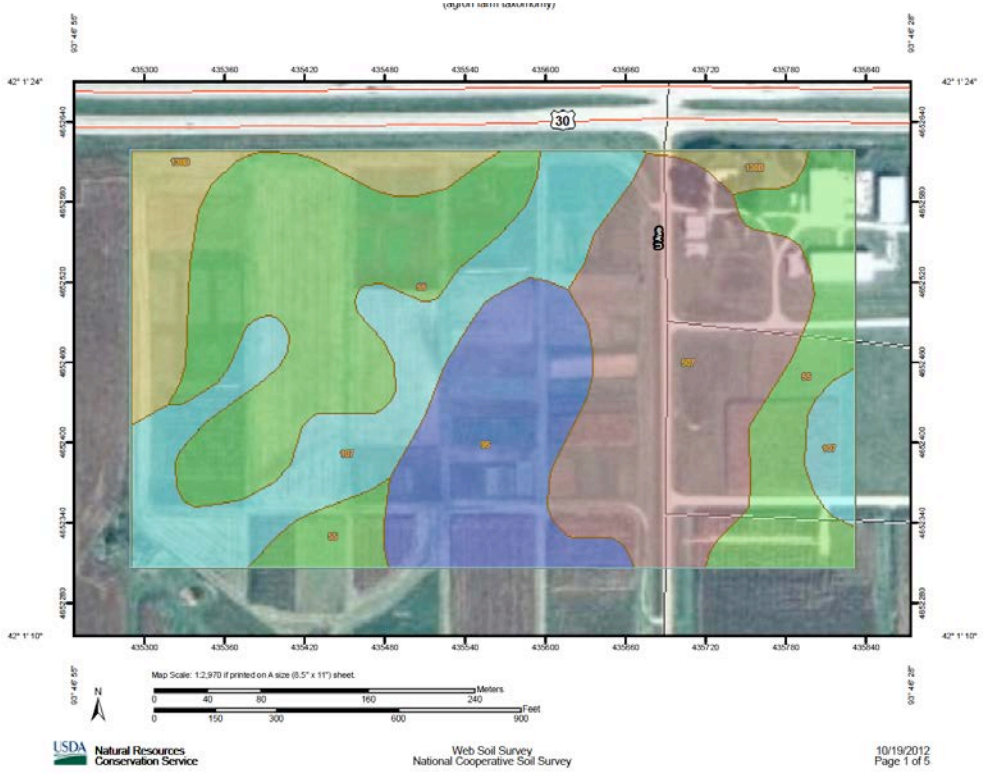


Tallgrass prairie
1.5 m water table depth

Sedges and other hydrophytes
0.0 m water table depth

Relief = catena.

Maps showing this detail available.



Please see “web soil survey”
http://websoilsurvey.nrcs.usda.gov/app/HomePage.htm

Or GoogleEarth

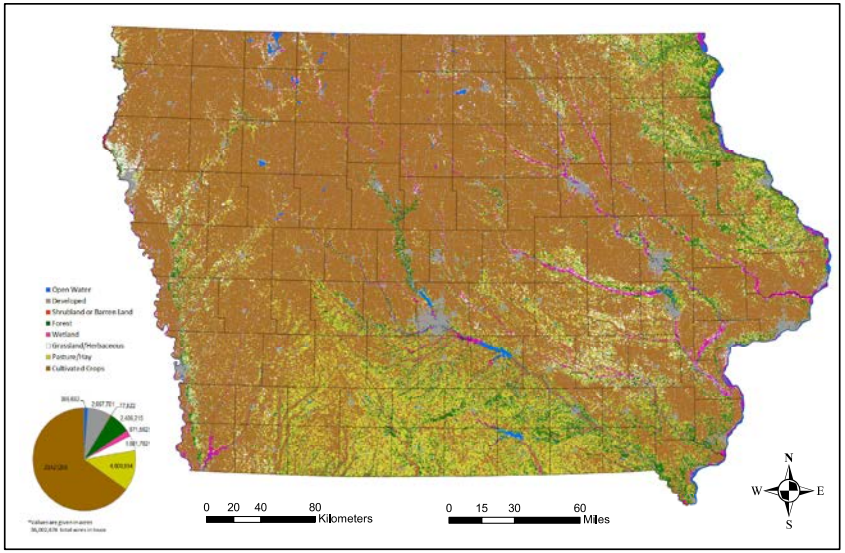
Or ISPAID

Map Unit Legend

Boone County, Iowa (IA015)			
Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
55	Nicollet loam, 1 to 3 percent slopes	14.1	33.8%
95	Harps loam, 0 to 2 percent slopes	6.1	14.6%
107	Webster silty clay loam, 0 to 2 percent slopes	8.1	19.3%
138B	Clarion loam, 2 to 5 percent slopes	3.6	8.6%
507	Canisteo silty clay loam, 0 to 2 percent slopes	9.9	23.7%
Totals for Area of Interest		41.8	100.0%

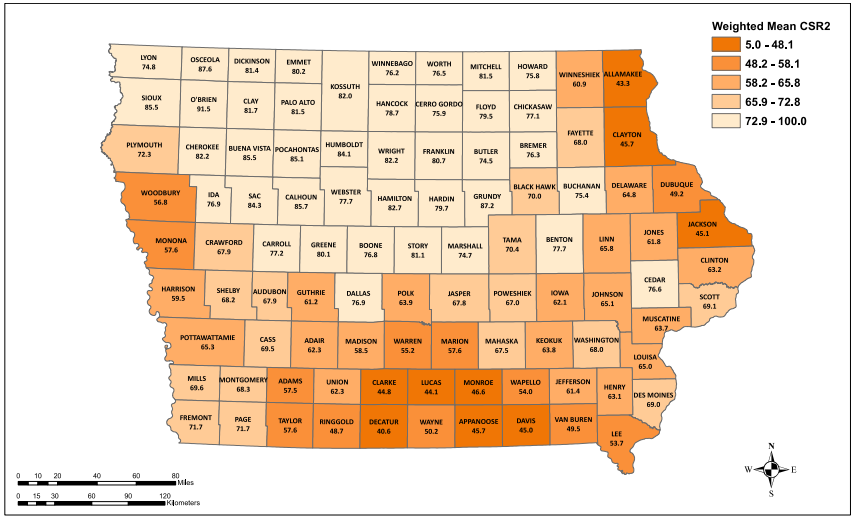
Pedology and Agronomy – what does the 21st century hold for us?

Land Use of Iowa

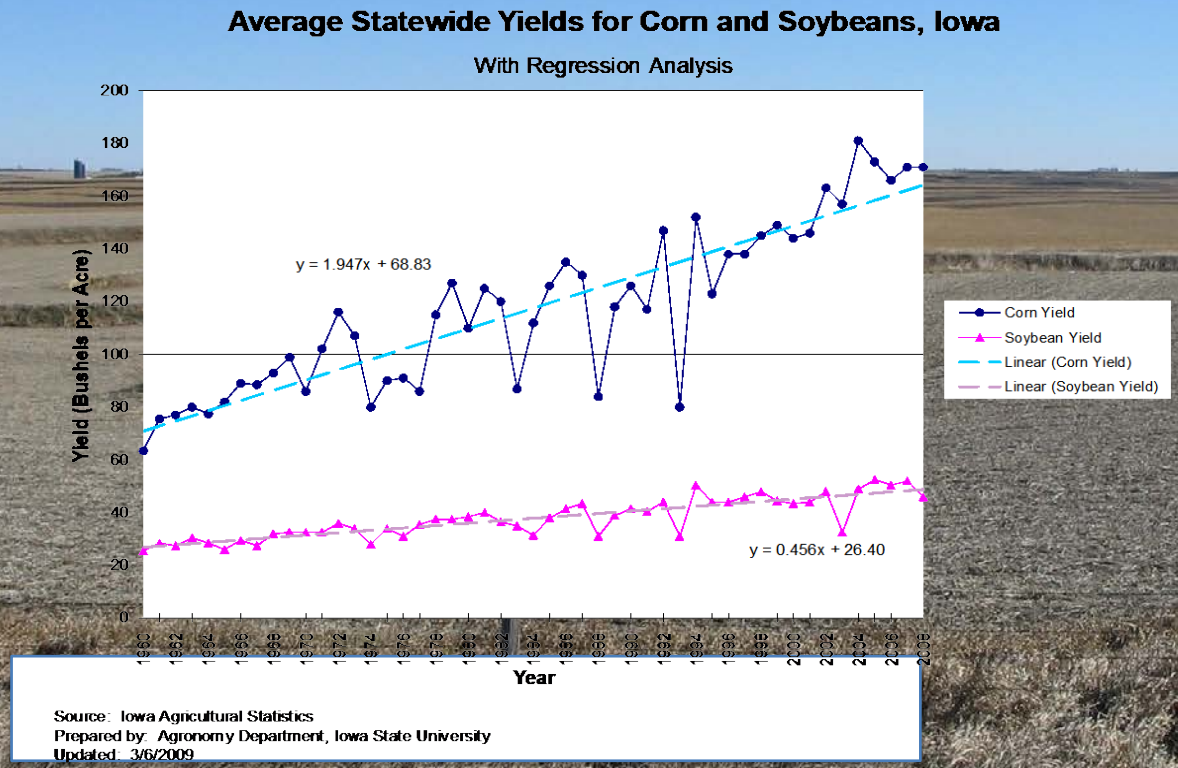


Ethan M. Dahlhauser, Burras Pedology Group
Department of Agronomy
Iowa State University

Source: Iowa Department of Natural Resources GIS Library and NRCS GeoSpatial Data Gateway



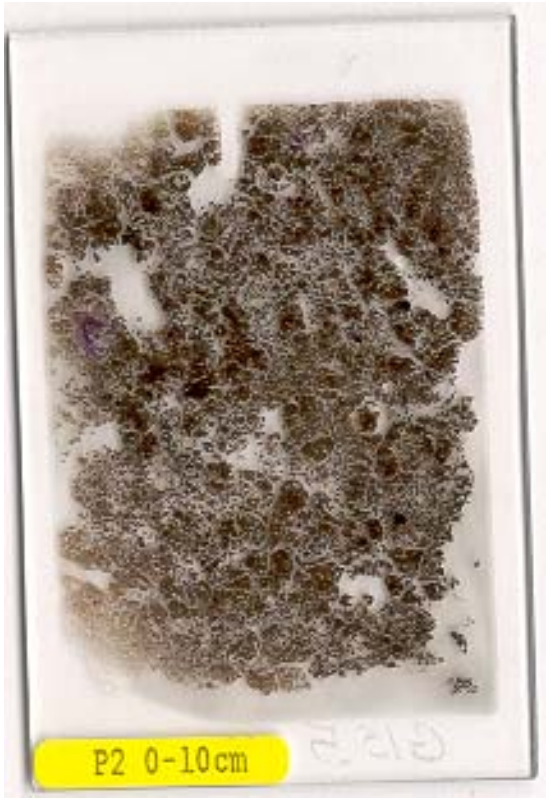
We are going to farm more intensely.



As a result, we will need to better manage root productivity

- Water - infiltrate, store, drain
- Nutrients – 12/17
- Gas Exchange - CO_2 & O_2
- Support/Anchor
- Waste Disposal
- Nursery
- Symbiosis

We will also take into account soil change.



With the biggest payoff coming from improved management for soil quality & health!

Summary 1

1. The pedology of Iowa is straightforward but important.
2. There are 10 major landform regions with the two main parent materials being loess and glacial drift.
3. Prairie-derived Mollisols are the most common soil but in eastern Iowa there are considerable areas of forest-derived Alfisols.
4. There are 500 series in Iowa. Detailed information on their properties and uses is found in Web Soil Survey and/or GoogleEarth.

Summary 2

Iowa is a beautiful place with fascinating history -- both natural hand human.

Iowa's future will be based upon on continued, intensified use of our soils – and that will require better understanding of soil-root relationships!

Questions, comments, insights?

Thank you.