

**Changes in  
cultivated  
cropland land  
in Iowa**

Andreea L.  
Erciulescu

NRI - CEAP

Data

CEAP sample

Crop  
codes / classes

Results

Conclusions

# STAT 585X - Final Project

## Changes in cultivated cropland in CEAP

Andreea L. Erciulescu

April 23, 2014

# National Resources Inventory (NRI)

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- annual survey conducted collaboratively by USDA NRCS (Natural Resources Conservation Services) and ISU Center for Survey Statistics and Methodology (CSSM)
- to provide status and trend estimates for natural resources on nonfederal lands in US
  - Example of such estimates are soil erosion estimates in relation to land characteristics and programs.

# Conservation Effects Assessment Project (CEAP)

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- series of surveys intended to quantify environmental effects of conservation practices and programs by hydrologic unit codes (HUCs)
- CEAP sample is a subset of the NRI points classified as cultivated cropland
  - Farmer interviews about on-farm practices
  - Hydrologic, climate and soil databases
  - APEX model

# United States territory division into HUCs

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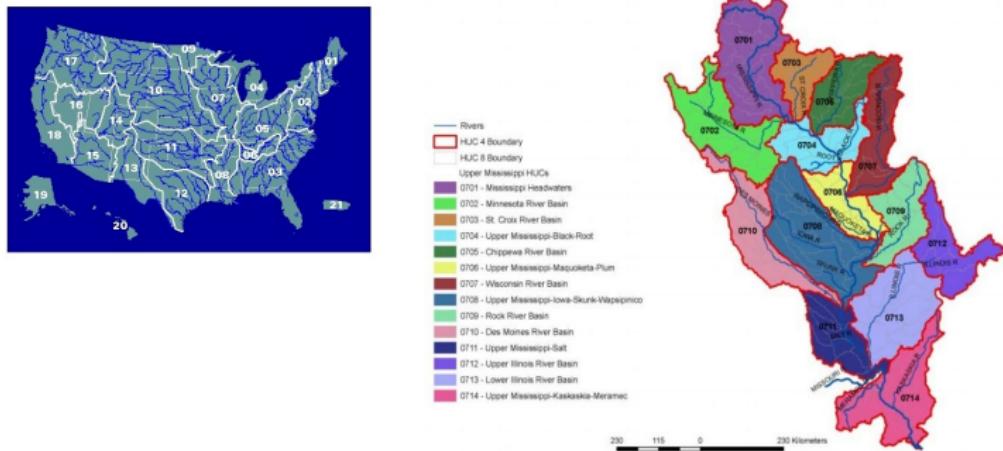
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Local concerns regarding the existence of nitrates in drinking water,  
particularly in Des Moines



# Publicly available data

Changes in cultivated cropland land in Iowa

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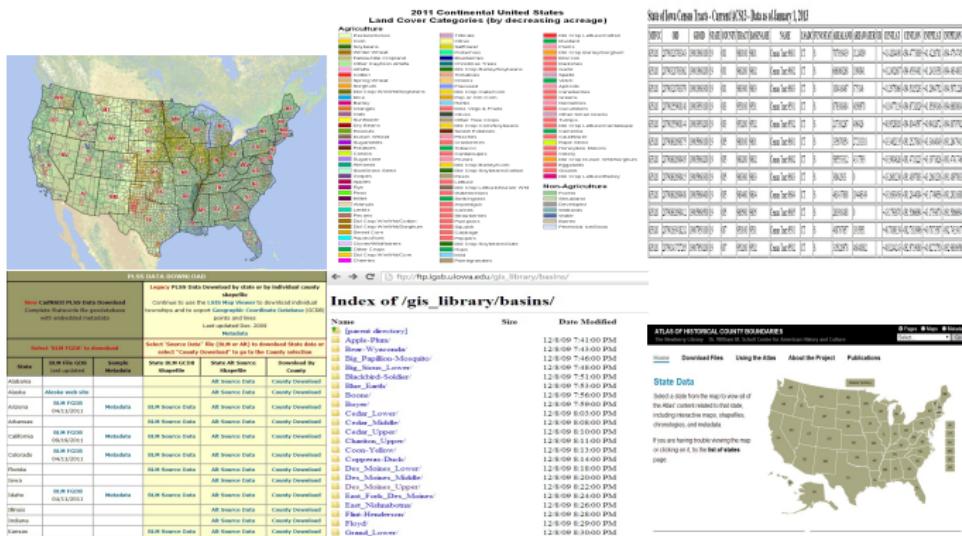
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# Crop Data Layer (CDL)



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- Tagged Image File (.tif) Format
- pixel counts for different categories of cropland - codes

The screenshot shows a table titled "Iowa MARS CroplandData Layer - Category Codes - Crop, State, and Year". The table lists various crop codes and their corresponding descriptions. The first few rows are as follows:

Category/Code	On Disk Name	Description/Definition	Old name for this code	New name for this code
General	background			
Grain	corn		10000	10000
Grain	rice		10000	10000
Grain	barley		10000	10000
Grain	oats		10000	10000
Grain	durum		10000	10000
Grain	sorghum		10000	10000
Grain	soybeans		10000	10000
Grain	wheat		10000	10000
Grain	rye		10000	10000
Grain	millet		10000	10000
Grain	grain sorghum		10000	10000
Grain	other grain		10000	10000
Grain	peas		10000	10000
Grain	lentils		10000	10000
Grain	peas, lentils		10000	10000
Grain	other legume		10000	10000
Grain	other		10000	10000
Forage	hay		10000	10000
Forage	silage		10000	10000
Forage	silage, hay		10000	10000
Forage	other		10000	10000
Vegetables	potatoes		10000	10000
Vegetables	onions		10000	10000
Vegetables	carrots		10000	10000
Vegetables	radishes		10000	10000
Vegetables	turnips		10000	10000
Vegetables	other		10000	10000
Fruit	apples		10000	10000
Fruit	pears		10000	10000
Fruit	citrus		10000	10000
Fruit	grapes		10000	10000
Fruit	other		10000	10000
Other	grass		10000	10000
Other	other		10000	10000

- download Iowa and years 2003-2007, approx. 750,000 KB

# Processing CDL data

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- *Raster* package in R, S4 methods
- coordinate reference system (CRS)

```
cdl.ia03 <- raster("data/CDL_2003_19.tif")
cdl.ia04 <- raster("data/CDL_2004_19.tif")
cdl.ia05 <- raster("data/CDL_2005_19.tif")
cdl.ia06 <- raster("data/CDL_2006_19.tif")
cdl.ia07 <- raster("data/CDL_2007_19.tif")
cdl.ia03

## class       : RasterLayer
## dimensions : 11672, 17796, 207714912 (nrow, ncol, ncell)
## resolution : 30, 30  (x, y)
## extent     : -52065, 481815, 1938165, 2288325 (xmin, xmax, ymin, ymax)
## coord. ref. : +proj=aea +lat_1=29.5 +lat_2=45.5 +lat_0=23 +lon_0=-96
## data source : U:\stat585\STAT585X-Project\data\CDL_2003_19.tif
## names       : CDL_2003_19
## values      : 0, 255 (min, max)
```

# GIS, PLSS, AtlasHCB

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- smaller dimensions (except for PLSS)
- polygons information, shapefiles
- different territory coverages, not applicable for our problem
  - GIS: full river basin, universal transverse mercador (UTM) format
  - PLSS: state and county level, no hydrologic level
  - AtlasHCB: historical records, county level
- *maptools* in *R*

# Census Tigerweb

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- big data, storage not a problem because web scrapping
- national, regional and hydrologic levels
- extract Iowa and Des Moines River data from hydrologic data

# Processing Census Tigerweb

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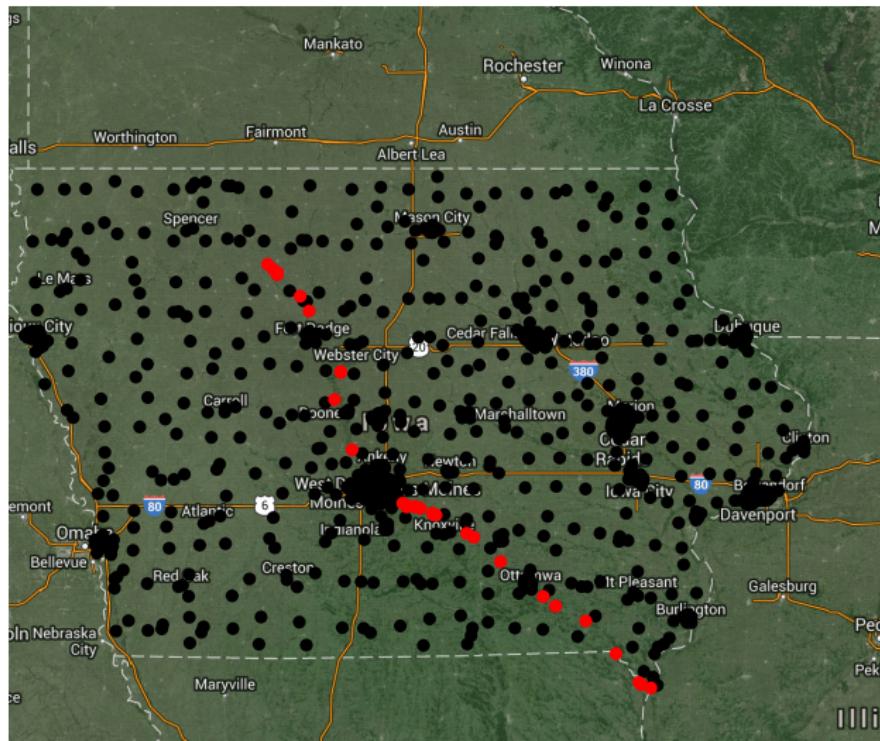
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- XML library in *R*
- pull point coordinates for Iowa and for Des Moines river



# Constructing the sample for the Des Moines river watershed

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Data

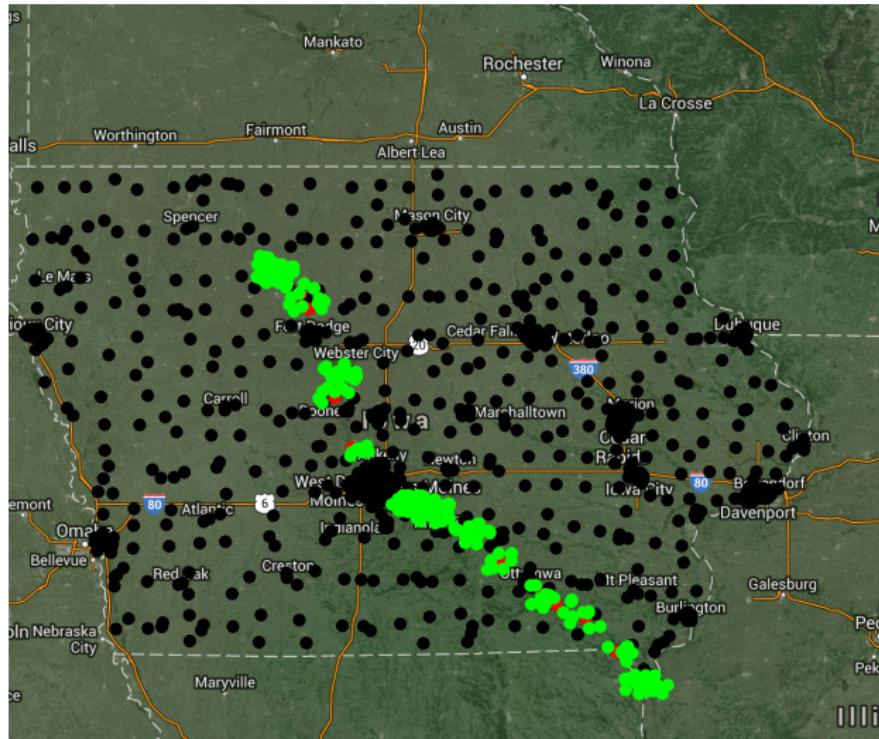
CEAP sample

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Conclusions

- add noise to each point using *jitter* to mimic CEAP sample
- *plyr* package



# Extract CDL data for the region

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- *cellFromXY* function to extract the pixel count information from CDL
- 224 points, crop codes
- web scrape code/class data from NASS website
- merge codes and classes

# The CODES challenge

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## • unstructured source code



The screenshot shows a web browser window with the URL [www.nrcs.usda.gov/research/Cropland/docs/CDL\\_2015\\_crosswalk.htm](http://www.nrcs.usda.gov/research/Cropland/docs/CDL_2015_crosswalk.htm). The page contains a large amount of XML-like unstructured source code. At the top left, there is a table titled "CDL Class Names" with columns: CDL Class Name, NRI Class Name, Definition of Cropland. The table lists various crop classes such as Background, Corn, Soybean, Wheat, Alfalfa, Barley, Oats, Rye, Sorghum, Sunflowers, and Sunflowers. The table has 10 rows.

CDL Class Name	NRI Class Name	Definition of Cropland
Background	Background	
Corn	Corn	
20Cotton	Cotton	
Wheat	Wheat	
Alfalfa	Alfalfa	
Barley	Sorghum	
Oats	Soybeans	
Rye	Sunflowers	
Sorghum	Sunflowers	

Below the table, the page continues with more unstructured source code, including definitions for "Background", "Corn", "Soybean", "Wheat", "Alfalfa", "Barley", "Oats", "Rye", "Sorghum", "Sunflowers", and "Sunflowers". The code uses XML tags like <code>, <def>, <value>, <list>, and <list-item>.

## • list of unequal length elements

Total	2003	2004	2005	2006	2007
21	10	13	11	13	8

Table: Number of crop classes by year

## • similar crop classes, *Developed* and *Developed/Low Intensity* or *Developed/Open Space*

# Results

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Crop Code	2003	2004	2005	2006	2007
Alfalfa	2.439	2.9268	1.4634	2.439	27.8049
Corn	23.9024	0.4878	0.4878	27.3171	12.6829
Developed	2.439	0.9756	25.3659	14.6341	9.7561
Fallow/Idle Cropland	6.3415	28.7805	1.9512	0.4878	22.439
Forest	4.3902	2.9268	2.9268	3.9024	0.9756
Grass/Pasture	23.9024	2.9268	13.6585	1.9512	5.3659
Oats	0.4878	11.2195	21.4634	16.0976	18.0488
Other Small Grains	1.4634	19.5122	1.4634	0.9756	2.9268
Soybeans	30.7317	0.4878	0.4878	0.4878	NA
Water	3.9024	0.4878	26.3415	0.4878	NA
Christmas Trees	NA	1.9512	4.3902	4.3902	NA
Clouds/No Data	NA	22.439	NA	25.3659	NA
Nonag/Undefined	NA	4.878	NA	1.4634	NA
Other Crops	NA	NA	NA	NA	NA
Deciduous Forest	NA	NA	NA	NA	NA
Developed/Low Intensity	NA	NA	NA	NA	NA
Developed/Open Space	NA	NA	NA	NA	NA
Herbaceous Wetlands	NA	NA	NA	NA	NA
Mixed Forest	NA	NA	NA	NA	NA
Open Water	NA	NA	NA	NA	NA
Woody Wetlands	NA	NA	NA	NA	NA

Table: Proportion of land by crop class, by year.

# Conclusions

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*The following conclusions hold only for the region we have described in the previous section. Whether they still hold for the real CEAP data needs future investigation.*

- big data
- coordinates in different measurement system
- missing crop classes for all/some the years
- significant proportions of missing records in 2004 and 2006 due to clouds and to undefined records
- significant changes in some important crops over the years, for example corn and soybeans
  - corn proportion of land is low in 2004 and 2005
  - soybean proportion of land is low in all years but 2003, missing in 2007
  - possible frame problem

# Future work

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- analyze changes in the real CEAP data
- investigate CDL data as source of covariates in CEAP small area models
- shiny app

# The end...

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Thank you for your attention!