

**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

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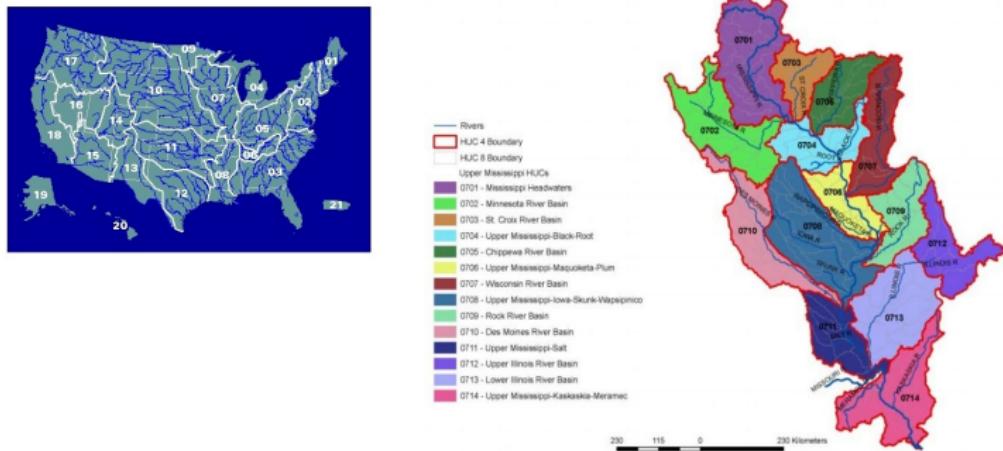
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Local concerns regarding the existence of nitrates in drinking water,
particularly in Des Moines



Publicly available data

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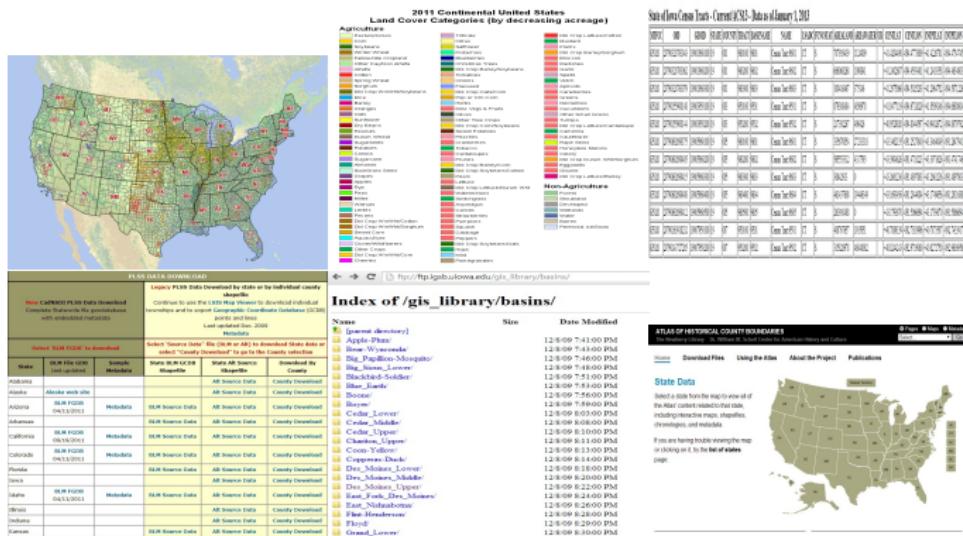
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Crop Data Layer (CDL)



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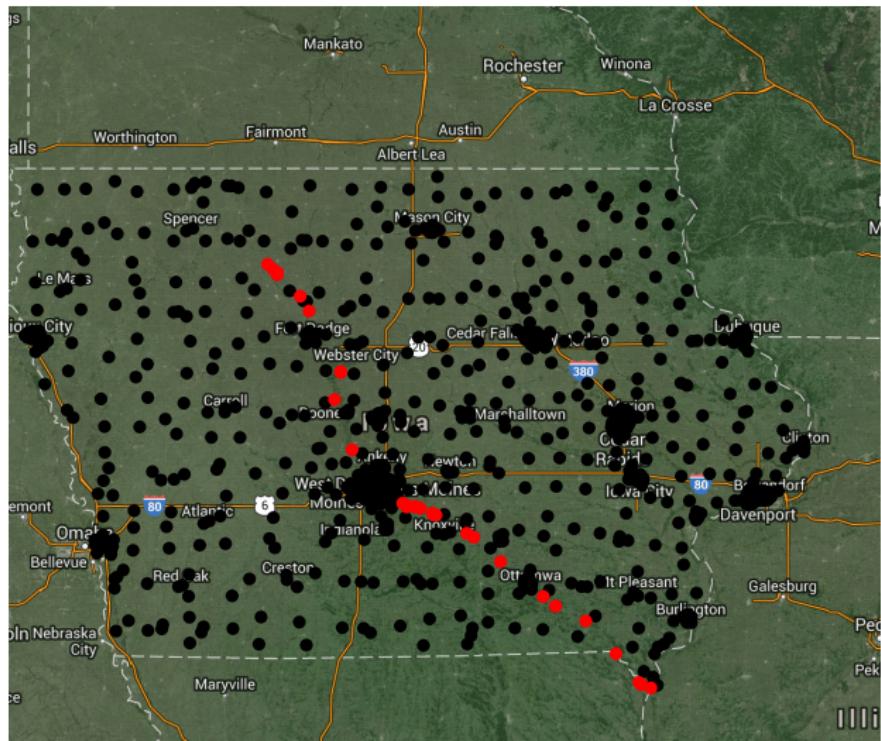
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- XML library in *R*
- pull point coordinates for Iowa and for Des Moines river



Constructing the sample for the Des Moines river watershed

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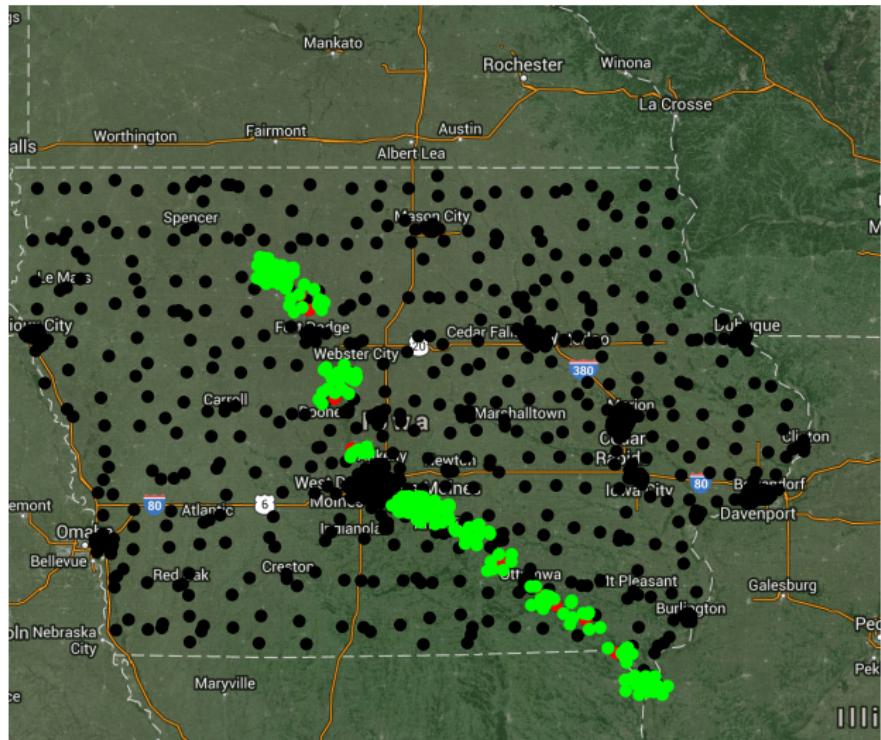
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- add noise to each point using *jitter* to mimic CEAP sample
- *plyr* package



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

USA-NASS Cropland Data Layer - category codes, class names, and colors. Consistent and standardised for all states and all years.	
The 1970-2012 USA-NASS crop land was extracted at January 2013 to better represent past agricultural capacity. Area	
category names have been updated to reflect the categories defined in USA-NASS. Categories are: Crops, Rangeland, Wetlands, Irrigated, Non-Irrigated, Pasture, and Residential.	
Crops (17) includes all crops. This is the most common land use type found across all state boundaries and is the largest category.	
Rangeland (18) includes all rangeland. This is the second most common land use type found across all state boundaries and is the second largest category.	
Wetlands (19) includes all wetlands. This is the third most common land use type found across all state boundaries and is the third largest category.	
Irrigated (20) includes all irrigated land. This is the fourth most common land use type found across all state boundaries and is the fourth largest category.	
Pasture (21) includes all pasture land. This is the fifth most common land use type found across all state boundaries and is the fifth largest category.	
Residential (22) includes all residential land. This is the sixth most common land use type found across all state boundaries and is the sixth largest category.	
The listing of the area (in acres) for each category shows the total area of each category in the USA-NASS dataset.	
For more information about the USA-NASS dataset, please visit the website at http://www.nass.usda.gov/ .	

- 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*

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

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

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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
- proportions of missing records in 2004 and 2005 due to clouds and to undefined records
- changes in some important crops over the years, for example corn and soybeans
 - corn proportion of land is lower in 2003 and 2005
 - soybean proportion of land is higher in 2003
 - possible frame coverage 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!