

**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 30, 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

# United States territory division into HUCs

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Upper Mississippi River Basin

- Rivers
- HUC 4 Boundary
- HUC 8 Boundary
- Upper Mississippi HUCs
- 0701 - Mississippi Headwaters
- 0702 - Minnesota River Basin
- 0703 - St. Croix River Basin
- 0704 - Upper Mississippi-Black-Rio
- 0705 - Chippewa River Basin
- 0706 - Upper Mississippi-Maquoketa-Plum
- 0707 - Wisconsin River Basin
- 0708 - Upper Mississippi-Iowa-Skunk-Wapsipinico
- 0709 - Rock River Basin
- 0710 - Des Moines River Basin
- 0711 - Upper Mississippi-Salt
- 0712 - Upper Illinois River Basin
- 0713 - Lower Illinois River Basin
- 0714 - Upper Mississippi-Kaskaskia-Meramec



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



# Crop Data Layer (CDL)



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

[www.nass.usda.gov/research/Cropland/index/CDL\\_2013\\_crosswalk.htm](http://www.nass.usda.gov/research/Cropland/index/CDL_2013_crosswalk.htm)

USDA NA5S Cropland Data Layer - category codes, class names, and colors. Consistent and standardized for all states and all years.  
 The 1997-2010 CDLs were re-coded and re-released in January 2014 to better represent pasture and grass-related categories. A new category named Grass/Pasture (code 176) collapses the following historical CDL categories: Pasture/Grass (code 62), Grassland/Hayaceous (code 171), and Pasture/Hay (code 181). This was done to eliminate confusion among these similar land cover types which were not always classified definitively consistent from state to state or year to year and frequently had poor classifier accuracies. This follows the recoding of the entire CDL archive in January 2012 to better align the historical CDLs with the current product. For a detailed list of the category name and code changes, please visit the Frequently Asked Questions (FAQs) section at <http://www.nass.usda.gov/research/Cropland/faqs.htm>.

Codes	Current Class Names	Old Class Names	Summary of Revisions	RGB values for Erdas Imagine	RGB values for ESRI ArcGIS	
				Red	Green	Blue
0	Background	Background		0.0000	0.0000	0.0000
1	Corn	Corn		1.0000	0.8275	0.0000
2	Cotton	Cotton		1.0000	0.1495	0.3406
3	Rice	Rice		0.0000	0.6591	0.0000
4	Sorghum	Sorghum		1.0000	0.6294	0.0417
5	Soybeans	Soybeans		0.3480	0.4413	0.0000
6	Sunflower	Sunflower		1.0000	1.0000	0.0000
7				0.0000	0.0000	0.0000
8				0.0000	0.0000	0.0000
9				0.0000	0.0000	0.0000
10	Peanuts	Peanuts		0.4392	0.6475	0.0000
11	Tobacco	Tobacco		0.0000	0.6863	0.2986
12	Sweet Corn	Sweet Corn		0.0667	0.6475	0.0470
13	Pop or Orn. Corn	Pop or Orn. Corn		0.0667	0.6475	0.0470
14	Mint	Mint		0.4940	0.3275	1.0000
15				0.0000	0.0000	0.0000
16				0.0000	0.0000	0.0000

# Crop Data Layer (CDL)



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

[CyFiles] Your CyFiles is 96% Full Mac x



IT Services <its@iastate.edu>

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Mar 15

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You can increase your quota by visiting the following site:  
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You can also change your notification settings by visiting this site:  
<https://aws.iastate.edu/cgi-bin/acropolis/user/cynotify>

Or you can also manage your CyFiles sharing access by visiting this site:  
<https://aws.iastate.edu/cgi-bin/acropolis/user/cyaccess>

Your CyFiles Information:

Current Usage: 4.83 GB

Current Quota: 5.00 GB

Current Usage Percent: 96%

CyFiles Windows Path: [cyfiles.iastate.edu/24/28/andreeae](http://cyfiles.iastate.edu/24/28/andreeae)

CyFiles Mac SMB Path: <smb://cyfiles.iastate.edu/24/28/andreeae>

For more information regarding CyFiles go to <http://it.iastate.edu/services/storage/cyfiles>

For any questions or comments, please contact the IT Services Solution Center at [515-294-4000](tel:515-294-4000) or [solution@iastate.edu](mailto:solution@iastate.edu).

Information Technology Services  
195 Durham Center  
Iowa State University  
[solution@iastate.edu](mailto:solution@iastate.edu)  
[515-294-4000](tel:515-294-4000)

# 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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Conclusions

- smaller dimensions, except for Public Land Survey System (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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codes/classes

Results

Conclusions

- 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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Data

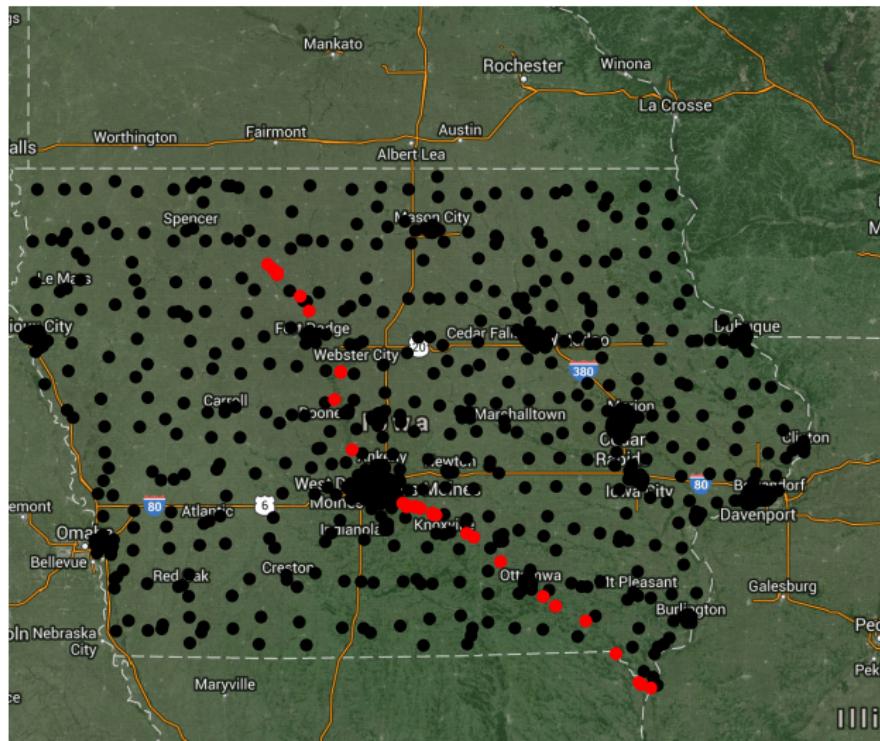
CEAP sample

Crop  
codes / classes

Results

Conclusions

- 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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NRI - CEAP

Data

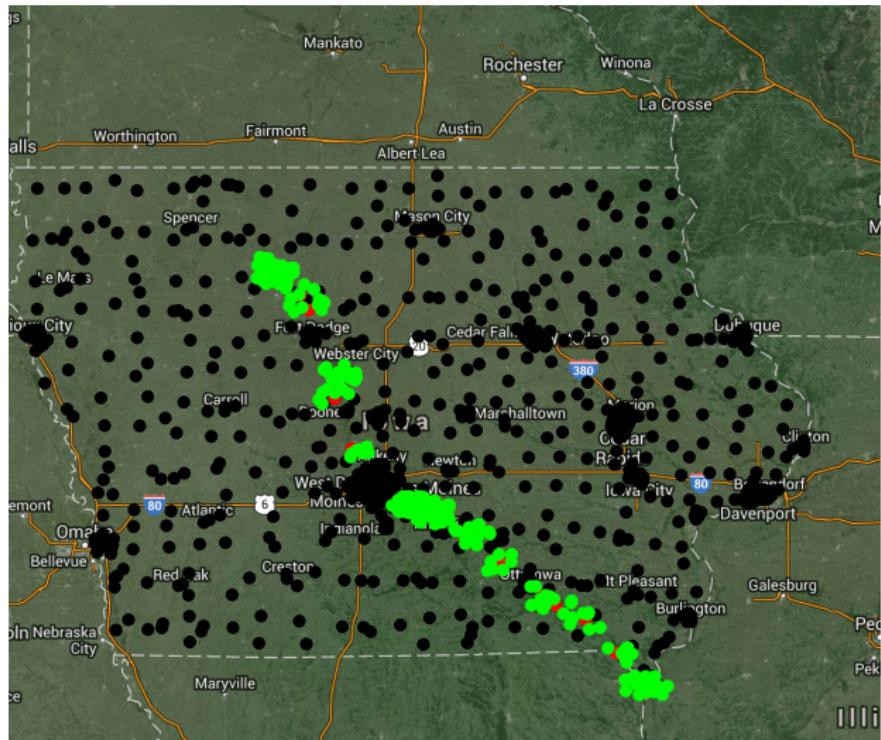
CEAP sample

Crop  
codes / classes

Results

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, overlapping the region of interest

```
# get the coordinates in CRS
loc.newcoords <- project(cbind(add.poly.coords[, 2], add.poly.coord
    proj = "+proj=aea +lat_1=29.5 +lat_2=45.5 +lat_0=23 +lon_0=-96

# gets the values of the pixels
cdl.pts3 <- cdl.ia03[cellFromXY(cdl.ia03, loc.newcoords)]
cdl.pts4 <- cdl.ia04[cellFromXY(cdl.ia04, loc.newcoords)]
cdl.pts5 <- cdl.ia05[cellFromXY(cdl.ia05, loc.newcoords)]
cdl.pts6 <- cdl.ia06[cellFromXY(cdl.ia06, loc.newcoords)]
cdl.pts7 <- cdl.ia07[cellFromXY(cdl.ia07, loc.newcoords)]
table(cdl.pts3)/length(cdl.pts3[-which(is.na(cdl.pts3))]) * 100

## cdl.pts3
##      1      5     25     28     36     61     63     82
## 23.9024 30.7317  1.4634  0.4878  2.4390  6.3415  4.3902  2.4390
##      176
## 23.9024
```

- web scrape code/class data from NASS website
- merge codes and classes

## The *CODES* challenge

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## CEAP sample

## Crop codes / classes

## Results

### **Conclusions**

- unstructured source code

```
cd C:\view-source\www.nasa.usda.gov\research\copland\docs\CDL_2013_crosswalk.htm
1000 <td>
1001 class="x11111111715" style="border:none; width:300px; value="" for="EIR_Arc015</td>
1002 </tr>
1003 <tr>
1004 <td>
1005 class="x11111111715" style="height:15.75px;"><br></td>
1006 <td>
1007 class="x11111111715" style="height:15.75px;"><br></td>
1008 <td>
1009 class="x11111111715" style="border-left:none;">Old Class Name</td>
1010 <td>
1011 class="x11111111715" style="border-left:none;">Summary of Revisions</td>
1012 </tr>
1013 <tr>
1014 <td>
1015 class="x11111111715" style="border-left:none;">For: </td>
1016 <td>
1017 class="x11111111715" style="border-left:none;">XData Screen</td>
1018 <td>
1019 class="x11111111715" style="border-left:none;">XData Blue</td>
1020 <td>
1021 class="x11111111715" style="border-left:none;">XERI Green</td>
1022 <td>
1023 class="x11111111715" style="border-left:none;">XERI Blue</td>
1024 </tr>
1025 </table>
1026 <table border="0" style="width:100%; border-collapse: collapse; margin-top: 10px;">
1027 <tr>
1028 <td>
1029 class="x11111111715" style="height:15.0px;">
1030 <td>
1031 class="x11111111715" style="height:15.0px;"><br></td>
1032 <td>
1033 class="x11111111715" style="border-left:none;">Background</td>
1034 <td>
1035 class="x11111111715" style="border-left:none;">Background</td>
1036 </tr>
1037 <tr>
1038 <td>
1039 class="x11111111715" align="right" style="border-left:none; padding-right: 10px;">
1040 <td>
1041 class="x11111111715" align="right" style="border-left:none; padding-left: 10px;">0.0000</td>
1042 <td>
1043 class="x11111111715" align="right" style="border-left:none; padding-right: 10px;">0.0000</td>
1044 <td>
1045 class="x11111111715" align="right" style="border-left:none; padding-left: 10px;">0.0000</td>
1046 <td>
1047 class="x11111111715" align="right" style="border-left:none; padding-right: 10px;">0.0000</td>
1048 <td>
1049 class="x11111111715" align="right" style="border-left:none; padding-left: 10px;">0.0000</td>
1050 </tr>
1051 </table>
1052 <table border="0" style="width:100%; border-collapse: collapse; margin-top: 10px;">
1053 <tr>
1054 <td>
1055 class="x11111111715" style="height:15.75px; align:right;"><br></td>
1056 <td>
1057 class="x11111111715" style="border:none; border-top:none; border-left:none;">XData</td>
1058 <td>
1059 class="x11111111715" style="border:none; border-top:none; border-left:none;">XERI</td>
1060 <td>
1061 class="x11111111715" style="border:none; border-top:none; border-left:none;">XERI</td>
1062 <td>
1063 class="x11111111715" style="border:none; border-top:none; border-left:none;">XERI</td>
1064 </tr>
1065 </table>
```

- 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*

# The CODES challenge defeated

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- matching the existent crop classes and adding the missing ones for each year
- using regular expressions: *grep*, *identical*
- debugging
- sorting by crop classes

# Results

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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.

# 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.*

- different data types/sources
- large spatial, image data
- coordinates in different measurement systems
- regular expressions
- missing crop classes for all/some the years
- missing records in some years
- changes in crops over the years
- possible frame coverage problem

# Future work

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Conclusions

- analyze changes in the real CEAP data
- investigate CDL data as source of covariates
- shiny application

# The end...

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Thank you for your attention!