

**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

Why cropland / Why Iowa ?

Changes in
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Why cropland / Why Iowa ?

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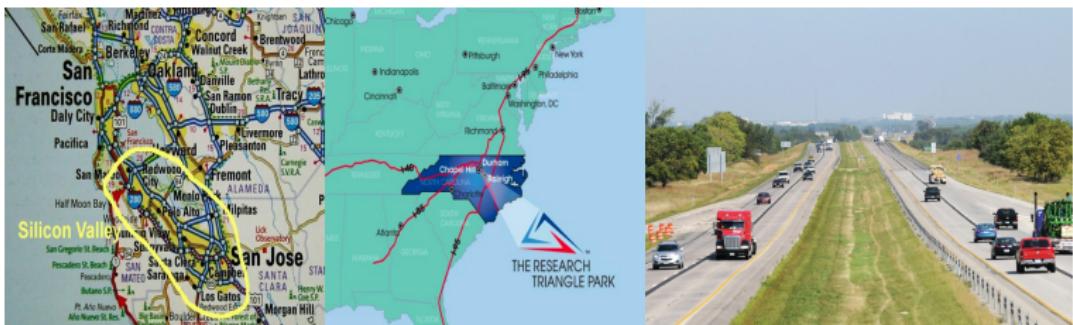


Why cropland / Why Iowa ?

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<http://www.cultivationcorridor.org/>

National Resources Inventory (NRI)

Changes in
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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
- study data: 2003-2007, frame designed in 2003

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

Publicly available data

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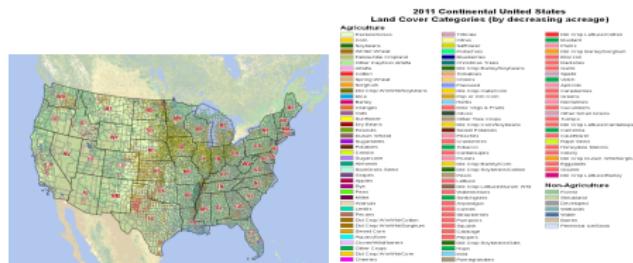
Data

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State of Iowa Census Tracts - Current ACS3 - Data as of January 1, 2013

STATE	CD	GRDP	INCOME	PERCAPITA	SOCR	UNEMPLOYMENT	BLDUD	BLDUDS	BLDUDT	BLDUDX	BLDUDY	BLDUDZ		
IOWA	102	39531842	39500000	101	4600	962	Cesa-TechC	CT	B	100580	1208	-112448	-14789	-84326
IOWA	103	39531843	39500000	101	4600	962	Cesa-TechC	CT	B	100608	1081	-112457	-14786	-84340
IOWA	104	39531847	39500000	101	4600	962	Cesa-TechC	CT	B	100647	751	-112578	-14783	-84329
IOWA	105	39531848	39500000	101	4600	962	Cesa-TechC	CT	B	100664	2671	-112579	-14783	-84329
IOWA	106	39531849	39500000	101	4600	962	Cesa-TechC	CT	B	100684	4963	-112579	-14783	-84329
IOWA	107	39531850	39500000	101	4600	962	Cesa-TechC	CT	B	100704	2210	-112579	-14783	-84329
IOWA	108	39531851	39500000	101	4600	962	Cesa-TechC	CT	B	100724	4779	-112579	-14783	-84329
IOWA	109	39531852	39500000	101	4600	962	Cesa-TechC	CT	B	100744	15791	-112579	-14783	-84329
IOWA	110	39531853	39500000	101	4600	962	Cesa-TechC	CT	B	100764	3943	-112579	-14783	-84329
IOWA	111	39531854	39500000	101	4600	962	Cesa-TechC	CT	B	100784	34849	-112579	-14783	-84329
IOWA	112	39531855	39500000	101	4600	962	Cesa-TechC	CT	B	100804	10351	-112579	-14783	-84329
IOWA	113	39531856	39500000	101	4600	962	Cesa-TechC	CT	B	100824	39551	-112579	-14783	-84329
IOWA	114	39531857	39500000	101	4600	962	Cesa-TechC	CT	B	100844	49402	-112579	-14783	-84329

Publicly available data

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[INRS DATA DOWNLOAD](#)

New Cropland Plus Data Download

Complete statewide file generated with embedded metadata

Select 'BLM FILE' or download

Log-in PLM Data Download by state or by individual county
snapshot
Continue to use the LSP Map Viewer to download individual
counties and use the BLM File download to generate basemap (SICB)
points and lines.

<http://ftp.lgs.iowa.edu/gis/library/basins/>

Index of /gis_library/basins/

Name	Size	Date Modified
[DIR] gis_library		
Apple_Plan	12.8 MB	7/4/2009 7:43:00 PM
Bear_Wyoming	12.8 MB	7/4/2009 7:43:00 PM
Big_Papago_Mesquite	12.8 MB	7/4/2009 7:43:00 PM
Black_Hills	12.8 MB	7/4/2009 7:43:00 PM
Blackfoot_Soldier	12.8 MB	7/5/2009 7:51:00 PM
Blue_Earth	12.8 MB	7/5/2009 7:53:00 PM
Boise	12.8 MB	7/5/2009 7:53:00 PM
Chelan_Cover	12.8 MB	7/5/2009 8:03:00 PM
Chelan_Middle	12.8 MB	7/5/2009 8:03:00 PM
Cedar_Upper	12.8 MB	7/5/2009 8:10:00 PM
Chelan_Upper	12.8 MB	7/5/2009 8:11:00 PM
Cheyenne_Basin	12.8 MB	7/5/2009 8:13:00 PM
Cheyenne_Dakota	12.8 MB	7/5/2009 8:14:00 PM
Dak_Mont_Lower	12.8 MB	7/5/2009 8:18:00 PM
Dak_Mont_Middle	12.8 MB	7/5/2009 8:18:00 PM
Des_Mines_Upper	12.8 MB	7/5/2009 8:22:00 PM
East_Fox_Des_Mines	12.8 MB	7/5/2009 8:24:00 PM
Elkhorn_Basin	12.8 MB	7/5/2009 8:26:00 PM
Fox_Henderson	12.8 MB	7/5/2009 8:26:00 PM
Floyd	12.8 MB	7/5/2009 8:30:00 PM
Grand_Lower	12.8 MB	7/5/2009 8:30:00 PM



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/docs/CDL_2013_crosswalk.htm

USDA NA3S Cropland Data Layer - category codes, class names, and colors. Consistent and standardized for all states and all years.

The 1987-2010 CDLs were revised 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/Hetaceous (code 171), and Pasture/Hay (code 181). This was done to eliminate confusion among these similar land cover types which were not always classified deformationally consistent from state to state or year to year and frequently had poor classifier accuracies. This follows the recycling 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/changes2>.

Codes	Current Class Names	Old Class Names	Summary of Revision
0	Background	Background	
1	Corn	Corn	
2	Cotton	Cotton	
3	Rice	Rice	
4	Sorghum	Sorghum	
5	Soybeans	Soybeans	
6	Sunflower	Sunflower	
7			
8			
9			
10	Peanuts	Peanuts	
11	Tobacco	Tobacco	
12	Sweet Corn	Sweet Corn	
13	Pop or Orn. Corn	Pop or Orn. Corn	
24	Mint	Mint	
25			
26			

RGB values for Erdas Imagine

Index	Red	Green	Blue
0	0.0000	0.0000	0.0000
1	1.0000	0.8279	0.0000
2	1.0000	0.1495	0.3406
3	0.0000	0.6589	0.0000
4	1.0000	0.6291	0.0471
5	0.3490	0.4413	0.0000
6	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	0.4392	0.6475	0.0000
11	0.0000	0.6863	0.2986
12	0.9867	0.6471	0.0471
13	0.9867	0.6471	0.0471
24	0.4940	0.3275	1.0000
25	0.0000	0.0000	0.0000
26	0.0000	0.0000	0.0000

RGB values for ESRI ArcGIS

Index	Red	Green	Blue
0	0	0	0
1	255	212	0
2	255	38	38
3	0	169	239
4	255	158	15
5	38	115	0
6	255	255	0
7	0	0	0
8	0	0	0
9	0	0	0
10	112	168	0
11	0	175	77
12	224	166	15
13	224	166	15
24	128	212	235
25	0	0	0
26	0	0	0

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>

to me ▾

Mar 15

This is an automated notification to inform you that you are nearing your CyFiles quota. You are currently using 4.83 GB of 5.00 GB or 96% of your total space. If your usage reaches 100% you will no longer be able to save new files or modify existing files until you increase your quota or delete files.

You can increase your quota by visiting the following site:
<https://aws.iastate.edu/cgi-bin/acropolis/user/cyquota>

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

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.

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

Processing CDL data

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Results

Conclusions

- *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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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

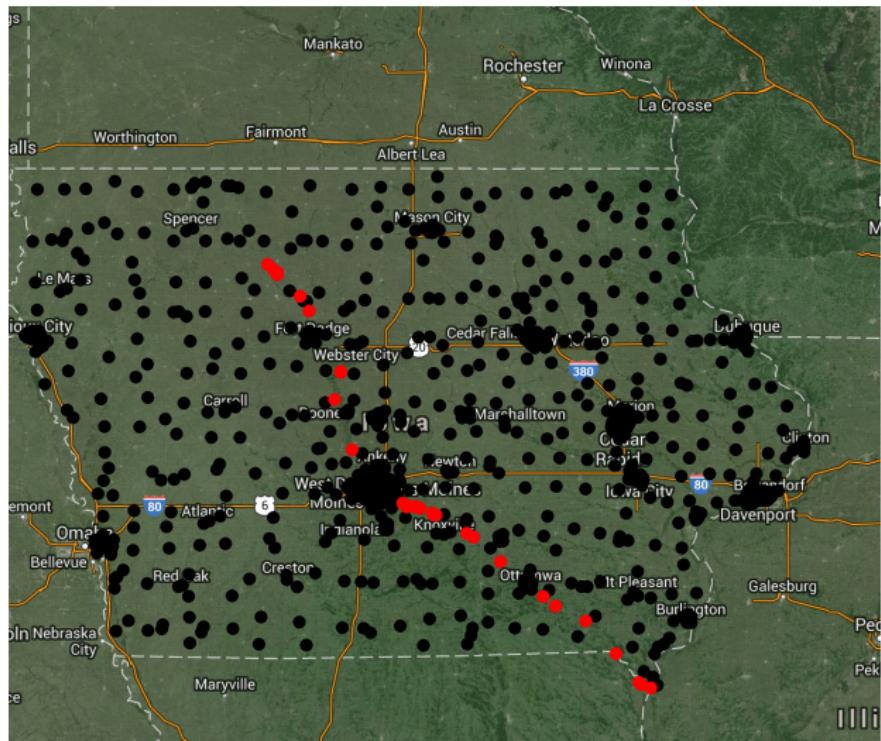
CEAP sample

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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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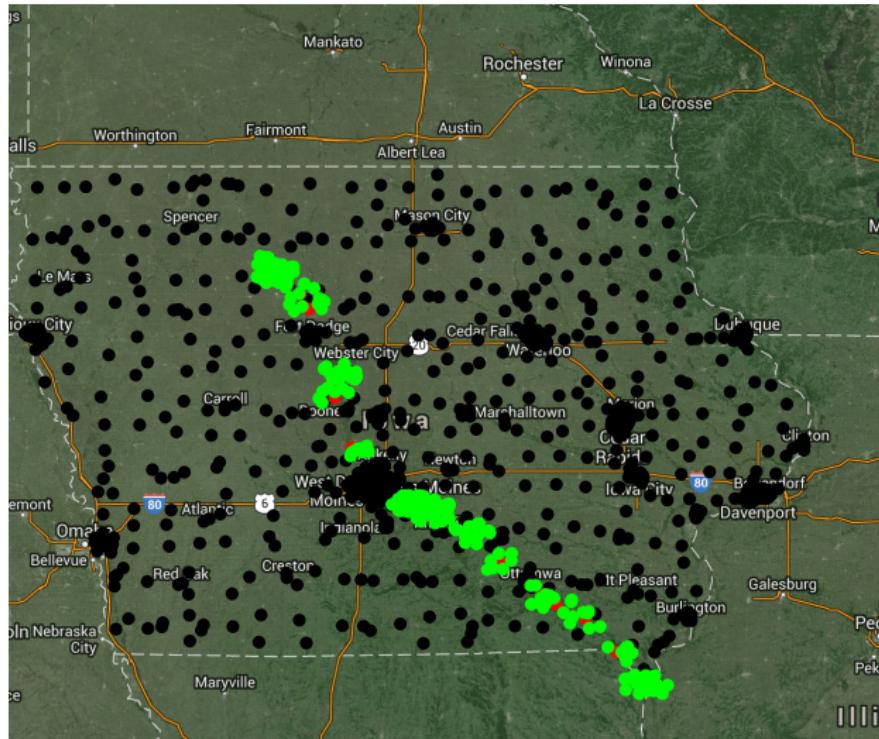
CEAP sample

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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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Conclusions

- *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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• unstructured source code

```
view-source:www.nass.usda.gov/research/Cropland/docs/CDL_2013_crosswalk.htm
1000 <td class="x111115710" style="border:none; border-left:none; border-right:none; border-top:none; border-bottom:none;>RGB values for ESRI ArcGIS</td>
1001 <td class="x110918710" style="border:none; border-left:none; border-right:none; border-top:none; border-bottom:none;>
1002 <td class="x111015710" style="border:none; border-left:none; border-right:none; border-top:none; border-bottom:none;>
1003 <td class="x110818710" style="border:none; border-left:none; border-right:none; border-top:none; border-bottom:none;>
1004 <td class="x111115710" height="21" style="height:21; width:8px;">
1005 <td class="x110818710" style="border:none; border-left:none; border-right:none; border-top:none; border-bottom:none;>Codebook</td>
1006 <td class="x1112215710" style="border:none; border-left:none; border-right:none; border-top:none; border-bottom:none;>Summary Class Names</td>
1007 <td class="x1110915710" style="border:none; border-left:none; border-right:none; border-top:none; border-bottom:none;>List Class Names</td>
1008 <td class="x1110818710" style="border:none; border-left:none; border-right:none; border-top:none; border-bottom:none;>Summary of Explanations</td>
1009 <td class="x111115710" style="border:none; border-left:none; border-right:none; border-top:none; border-bottom:none;>
1010 <td class="x110818710" style="border:none; border-left:none; border-right:none; border-top:none; border-bottom:none;>Ends Green</td>
1011 <td class="x1110915710" style="border:none; border-left:none; border-right:none; border-top:none; border-bottom:none;>Ends Blue</td>
1012 <td class="x111115710" style="border:none; border-left:none; border-right:none; border-top:none; border-bottom:none;>ESRI RGB</td>
1013 <td class="x1110915710" style="border:none; border-left:none; border-right:none; border-top:none; border-bottom:none;>ESRI Green</td>
1014 <td class="x1110818710" style="border:none; border-left:none; border-right:none; border-top:none; border-bottom:none;>ESRI Blue</td>
1015 <td class="x111115710" style="border:none; border-left:none; border-right:none; border-top:none; border-bottom:none;>ESRI Open</td>
1016 <td class="x110918710" style="border:none; border-left:none; border-right:none; border-top:none; border-bottom:none;>
1017 <td class="x111115710" style="border:none; border-left:none; border-right:none; border-top:none; border-bottom:none;>Height 10 pixels</td>
1018 <td class="x110818710" style="border:none; border-left:none; border-right:none; border-top:none; border-bottom:none;>Height 15 pixels</td>
1019 <td class="x111115710" style="border:none; border-left:none; border-right:none; border-top:none; border-bottom:none;>Height 20 pixels</td>
1020 <td class="x1110915710" style="border:none; border-left:none; border-right:none; border-top:none; border-bottom:none;>Height 30 pixels</td>
1021 <td class="x111115710" style="border:none; border-left:none; border-right:none; border-top:none; border-bottom:none;>Border 1px solid black</td>
1022 <td class="x1110915710" style="border:none; border-left:none; border-right:none; border-top:none; border-bottom:none;>Border 2px solid black</td>
1023 <td class="x111115710" style="border:none; border-left:none; border-right:none; border-top:none; border-bottom:none;>Border 3px solid black</td>
1024 <td class="x1110915710" style="border:none; border-left:none; border-right:none; border-top:none; border-bottom:none;>Border 4px solid black</td>
1025 <td class="x111115710" style="border:none; border-left:none; border-right:none; border-top:none; border-bottom:none;>Border 5px solid black</td>
1026 <td class="x1110915710" style="border:none; border-left:none; border-right:none; border-top:none; border-bottom:none;>Border 6px solid black</td>
1027 <td class="x111115710" style="border:none; border-left:none; border-right:none; border-top:none; border-bottom:none;>Border 7px solid black</td>
1028 <td class="x111115710" style="border:none; border-left:none; border-right:none; border-top:none; border-bottom:none;>Border 8px solid black</td>
1029 <td class="x111115710" style="border:none; border-left:none; border-right:none; border-top:none; border-bottom:none;>Border 9px solid black</td>
1030 <td class="x111115710" style="border:none; border-left:none; border-right:none; border-top:none; border-bottom:none;>Border 10px solid black</td>
```

• 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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Results

Conclusions

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

Changes in
cultivated
cropland land
in Iowa

Andreea L.
Erdulescu

NRI - CEAP

Data

CEAP sample

Crop
codes/classes

Results

Conclusions

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

The end...

**Changes in
cultivated
cropland land
in Iowa**

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Thank you for your attention!