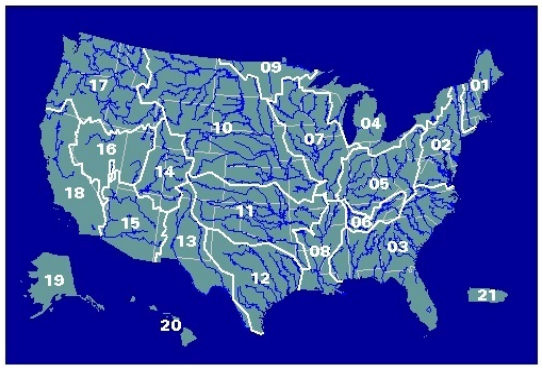
STAT 585X - Final Project
Changes in cultivated cropland in CEAP

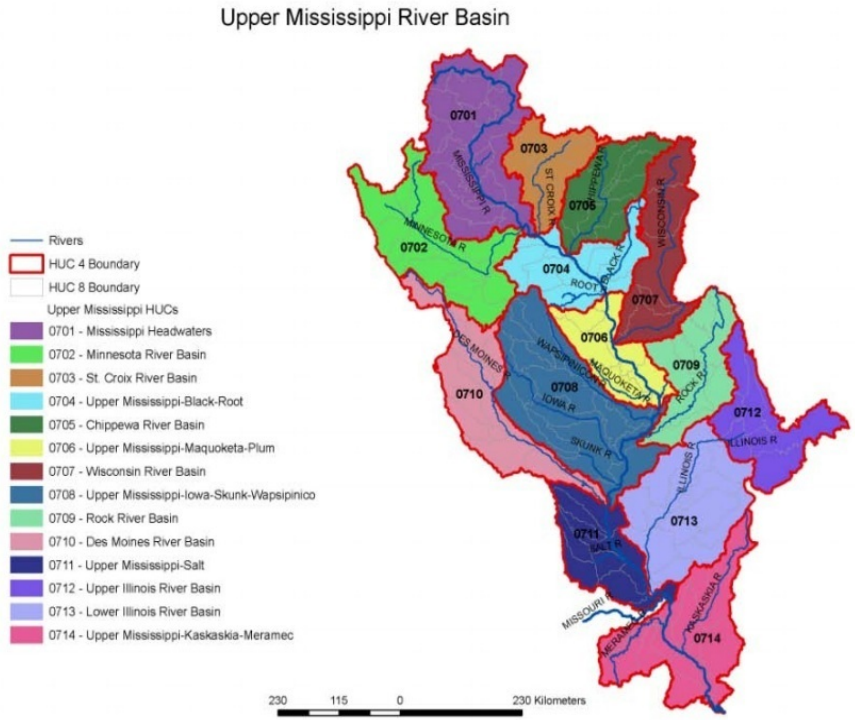
Andreea L. Erciulescu

April 30, 2014

Conservation Effects Assessment Project (CEAP)

- Series of surveys intended to quantify environmental effects of conservation practices and programs by hydrologic unit codes (HUCs)





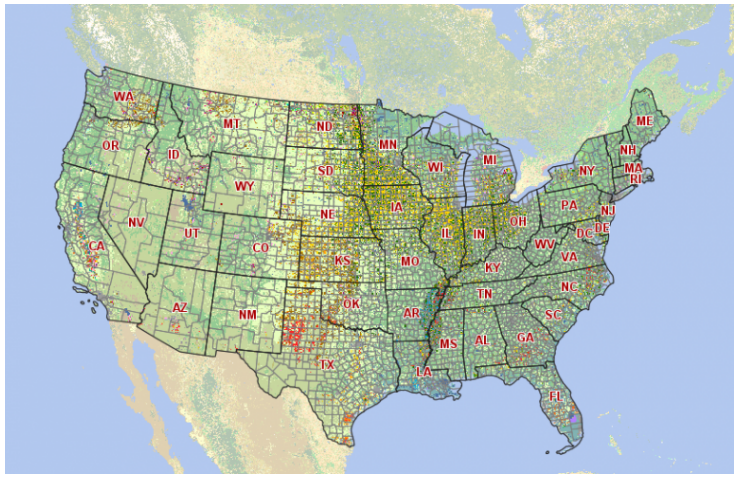
- Local concerns regarding the existance of nitrates in drinking water, particularly in Des Moines

CEAP study data and project goal

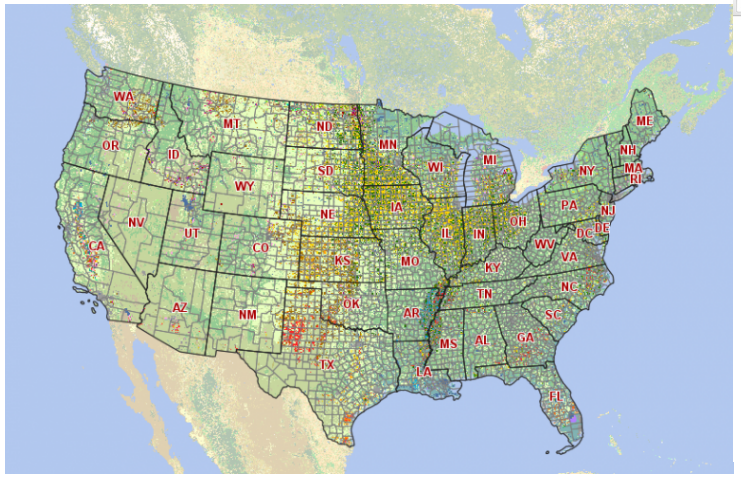
- CEAP sample is a set of cultivated cropland points
- Center for Survey Statistics and Methodology (CSSM) study data: 2003-2007
- Frame designed in 2003

The question of interest: Do changes in land characteristics over time match the CEAP survey design and data collection?

Publicly available data



Publicly available data



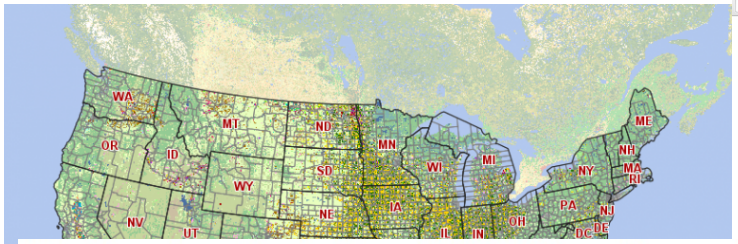
www.nass.usda.gov/research/Cropland/docs/CDL_2013_crosswalk.htm

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

The 1997-2013 CDLs were recoded 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 Herbaceous (code 171), and Pasture/Hay (code 181). This was done to eliminate confusion among these similar land cover types which were not always classified definitionally consistent from state to state or year to year and frequently had poor classification 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 (FAQ's) section at <http://www.nass.usda.gov/research/Cropland/sarsfaqs2>.

Codes	Current Class Names	*Old Class Names*	*Summary of Revisions*	RGB values for Erdas Imagine			RGB values for ESRI ArcGIS		
				Erdas Red	Erdas Green	Erdas Blue	ESRI Red	ESRI Green	ESRI Blue
0	Background	Background		0.0000	0.0000	0.0000	0	0	0
1	Corn	Corn		1.0000	0.8275	0.0000	255	212	0
2	Cotton	Cotton		1.0000	0.1490	0.1490	255	38	38
3	Rice	Rice		0.0000	0.6588	0.8980	0	169	230
4	Sorghum	Sorghum		1.0000	0.6196	0.0471	255	158	15
5	Soybeans	Soybeans		0.1490	0.4431	0.0000	38	115	0
6	Sunflower	Sunflower		1.0000	1.0000	0.0000	255	255	0
7				0.0000	0.0000	0.0000	0	0	0
8				0.0000	0.0000	0.0000	0	0	0
9				0.0000	0.0000	0.0000	0	0	0
10	Peanuts	Peanuts		0.4392	0.6471	0.0000	112	168	0
11	Tobacco	Tobacco		0.0000	0.6863	0.2980	0	175	77
12	Sweet Corn	Sweet Corn		0.8667	0.6471	0.0471	224	166	15
13	Pop or Orn Corn	Pop or Orn Corn		0.8667	0.6471	0.0471	224	166	15
14	Mint	Mint		0.4980	0.8275	1.0000	128	212	255
15				0.0000	0.0000	0.0000	0	0	0
16				0.0000	0.0000	0.0000	0	0	0

Publicly available data



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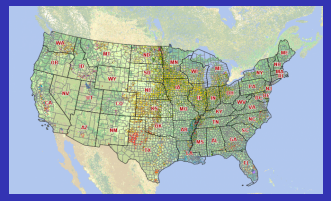
Codes	Current Class Names	Old Class Names	Summary of Revisions	RGB values for Erdas Imagine: Erdas Red	Erdas Green	Erdas Blue	RGB values for ESRI ArcGIS: ESRI Red	ESRI Green	ESRI Blue
0	Background	Background		0.0000	0.0000	0.0000	0	0	0
1	Corn	Corn		1.0000	0.8275	0.0000	255	212	0
2	Cotton	Cotton		1.0000	0.1490	0.0000	255	38	38
3	Rice	Rice		0.6588	0.9020	0.6588	169	230	169
4	Sorghum	Sorghum		0.8000	0.4824	0.0000	158	15	158
5	Soybeans	Soybeans		0.4510	0.0000	0.4510	115	0	115
6	Sunflower	Sunflower		1.0000	0.0000	1.0000	255	0	255
10	Peanuts	Peanuts		0.6510	0.4824	0.1922	0	0	0
11	Tobacco	Tobacco		0.0000	0.8000	0.8000	0	0	0
12	Sweet Corn	Sweet Corn		0.0000	0.8000	0.8000	0	0	0
13	Pop or Orn Corn	Pop or Orn Corn		0.0000	0.8000	0.8000	0	0	0
14	Mint	Mint		0.5020	0.8000	0.8000	168	0	168
21	Barley	Barley		0.8000	0.6510	0.0000	175	77	175
22	Durum Wheat	Durum Wheat		0.6510	0.4824	0.1922	166	15	166
23	Spring Wheat	Spring Wheat		0.6510	0.4824	0.1922	166	15	166
24	Winter Wheat	Winter Wheat		0.6510	0.4824	0.1922	212	255	212
25	Other Small Grains	Other Small Grains		0.6510	0.4824	0.1922	0	0	0
26	Dbl Crop WinWht/Soybeans	Dbl Crop WinWht/Soybeans		0.6510	0.4824	0.1922	0	0	0
27	Rye	Rye		1.0000	0.6588	0.3294			
28	Oats	Oats		1.0000	0.6588	0.3294			
29	Millet	Millet		1.0000	0.6588	0.3294			
30	Speltz	Speltz		1.0000	0.6588	0.3294			
31	Canola	Canola		0.3216	0.3216	0.6392			
32	Flaxseed	Flaxseed		0.3216	0.3216	0.6392			
33	Safflower	Safflower		0.3216	0.3216	0.6392			
34	Rape Seed	Rape Seed		0.3216	0.3216	0.6392			
35	Mustard	Mustard		0.3216	0.3216	0.6392			
36	Alfalfa	Alfalfa		1.0000	0.6510	0.8902			
37	Other Hay/Non Alfalfa	Other Hay/Non Alfalfa		0.6510	0.4824	0.1922			
38	Camelina	Camelina		0.3216	0.3216	0.6392			
39	Buckwheat	Buckwheat		0.3216	0.3216	0.6392			
41	Sugarbeets	Sugarbeets		0.6588	0.0000	0.4510			
42	Dry Beans	Dry Beans		0.6588	0.0000	0.4510			
43	Potatoes	Potatoes		0.6588	0.0000	0.4510			
44	Other Crops	Other Crops		0.6588	0.0000	0.4510			
45	Sugarcane	Sugarcane		0.6588	0.0000	0.4510			
46	Sweet Potatoes	Sweet Potatoes		0.6588	0.0000	0.4510			
47	Misc Vegs & Fruits	Misc Vegs & Fruits		0.6588	0.0000	0.4510			
48	Watermelons	Watermelons		0.6588	0.0000	0.4510			
49	Onions	Onions		0.6588	0.0000	0.4510			
50	Cucumbers	Cucumbers		0.6588	0.0000	0.4510			
51	Chick Peas	Chick Peas		0.6588	0.0000	0.4510			
52	Lentils	Lentils		0.6588	0.0000	0.4510			
53	Peas	Peas		0.6588	0.0000	0.4510			
54	Tomatoes	Tomatoes		0.6588	0.0000	0.4510			
55	Caneberries	Caneberries		0.6588	0.0000	0.4510			
56	Hops	Hops		0.6588	0.0000	0.4510			
57	Herbs	Herbs		0.6588	0.0000	0.4510			
58	Clover/Wildflowers	Clover/Wildflowers		0.6588	0.0000	0.4510			
59	Sod/Grass Seed	Sod/Grass Seed		0.6588	0.0000	0.4510			
60	Switchgrass	Switchgrass		0.6588	0.0000	0.4510			
61	Fallow/Idle Cropland	Fallow/Idle Cropland		0.8824	0.9412	0.6588			
62	Pasture/Grass	Pasture/Grass		0.6588	0.9020	0.6588			
63	Forest	Forest		0.3216	0.6392	0.3216			
64	Shrubland	Shrubland		0.6588	0.7294	0.4275			
65	Barren	Barren		0.8000	0.9490	0.9490			
66	Cherries	Cherries		1.0000	0.0000	0.8000			
67	Peaches	Peaches		1.0000	0.0000	0.8000			
68	Apples	Apples		1.0000	0.0000	0.8000			
69	Grapes	Grapes		1.0000	0.0000	0.8000			
70	Christmas Trees	Christmas Trees		1.0000	0.0000	0.8000			
71	Other Tree Crops	Other Tree Crops		1.0000	0.0000	0.8000			
72	Citrus	Citrus		1.0000	0.0000	0.8000			
74	Pecans	Pecans		1.0000	0.0000	0.8000			
75	Almonds	Almonds		1.0000	0.0000	0.8000			
76	Walnuts	Walnuts		1.0000	0.0000	0.8000			
77	Pears	Pears		1.0000	0.0000	0.8000			
81	Clouds/No Data	Clouds/No Data		0.8824	0.9412	0.6588			
82	Developed	Developed		0.5294	0.5294	0.5294			
83	Water	Water		0.0000	0.0000	0.4510			
87	Wetlands	Wetlands		0.7098	0.8000	0.9412			
88	Nonag/Undefined	Nonag/Undefined		0.8824	0.9412	0.6588			
92	Aquaculture	Aquaculture		0.0000	0.0000	0.4510			
111	Open Water	Open Water		0.0000	0.0000	0.4510			
112	Perennial Ice/Snow	Perennial Ice/Snow		0.8196	0.8196	0.8196			
121	Developed/Open Space	Developed/Open Space		0.5294	0.5294	0.5294			
122	Developed/Low Intensity	Developed/Low Intensity		0.5294	0.5294	0.5294			
123	Developed/Med Intensity	Developed/Med Intensity		0.5294	0.5294	0.5294			
124	Developed/High Intensity	Developed/High Intensity		0.5294	0.5294	0.5294			
131	Barren	Barren		0.8000	0.9490	0.9490			
141	Deciduous Forest	Deciduous Forest		0.3216	0.6392	0.3216			
142	Evergreen Forest	Evergreen Forest		0.3216	0.6392	0.3216			
143	Mixed Forest	Mixed Forest		0.3216	0.6392	0.3216			
152	Shrubland	Shrubland		0.6588	0.7294	0.4275			
176	Grass/Pasture	Grass/Pasture		0.6588	0.9020	0.6588			
190	Woody Wetlands	Woody Wetlands		0.7098	0.8000	0.9412			
195	Herbaceous Wetlands	Herbaceous Wetlands		0.7098	0.8000	0.9412			
204	Pistachios	Pistachios		1.0000	0.0000	0.8000			
205	Triticale	Triticale		0.6510	0.4824	0.1922			
206	Carrots	Carrots		0.6588	0.0000	0.4510			
207	Asparagus	Asparagus		0.6588	0.0000	0.4510			
208	Garlic	Garlic		0.6588	0.0000	0.4510			
209	Cantaloupes	Cantaloupes		0.6588	0.0000	0.4510			
210	Prunes	Prunes		1.0000	0.0000	0.8000			
211	Olives	Olives		1.0000	0.0000	0.8000			
212	Oranges	Oranges		1.0000	0.0000	0.8000			
213	Honeydew Melons	Honeydew Melons		0.6588	0.0000	0.4510			
214	Broccoli	Broccoli		0.6588	0.0000	0.4510			
215	Peppers	Peppers		0.6588	0.0000	0.4510			
216	Pomegranates	Pomegranates		1.0000	0.0000	0.8000			
217	Nectarines	Nectarines		1.0000	0.0000	0.8000			
218	Greenhouse	Greenhouse		0.6588	0.0000	0.4510			
219	Lettuce	Lettuce		0.6588	0.0000	0.4510			
220	Plums	Plums		1.0000	0.0000	0.8000			
221	Strawberries	Strawberries		1.0000	0.0000	0.8000			
222	Squash	Squash		0.6588	0.0000	0.4510			
223	Apricots	Apricots		1.0000	0.0000	0.8000			
224	Vetch	Vetch		0.6510	0.4824	0.1922			
225	Dbl Crop WinWht/Corn	Dbl Crop WinWht/Corn		0.6510	0.4824	0.1922			
226	Dbl Crop Oats/Corn	Dbl Crop Oats/Corn		0.6510	0.4824	0.1922			
227	Lettuce	Lettuce		0.6588	0.0000	0.4510			
228	Dbl Crop Triticale/Corn	Dbl Crop Triticale/Corn		0.6510	0.4824	0.1922			
229	Pumpkins	Pumpkins		0.6588	0.0000	0.4510			
230	Dbl Crop Lettuce/Durum Wht	Dbl Crop Lettuce/Durum Wht		0.6588	0.0000	0.4510			
231	Dbl Crop Lettuce/Cantaloupe	Dbl Crop Lettuce/Cantaloupe		0.6588	0.0000	0.4510			
232	Dbl Crop Lettuce/Cotton	Dbl Crop Lettuce/Cotton		0.6588	0.0000	0.4510			
233	Dbl Crop Lettuce/Barley	Dbl Crop Lettuce/Barley		0.6588	0.0000	0.4510			
234	Dbl Crop Durum Wht/Sorghum	Dbl Crop Durum Wht/Sorghum		0.6510	0.4824	0.1922			
235	Dbl Crop Barley/Sorghum	Dbl Crop Barley/Sorghum		0.6510	0.4824	0.1922			
236	Dbl Crop WinWht/Sorghum	Dbl Crop WinWht/Sorghum		0.6510	0.4824	0.1922			
237	Dbl Crop Barley/Corn	Dbl Crop Barley/Corn		0.6510	0.4824	0.1922			
238	Dbl Crop WinWht/Cotton	Dbl Crop WinWht/Cotton		0.6510	0.4824	0.1922			
239	Dbl Crop Soybeans/Cotton	Dbl Crop Soybeans/Cotton		0.4510	0.0000	0.4510			
240	Dbl Crop Soybeans/Oats	Dbl Crop Soybeans/Oats		0.4510	0.0000	0.4510			
241	Dbl Crop Corn/Soybeans	Dbl Crop Corn/Soybeans		0.4510	0.0000	0.4510			
242	Blueberries	Blueberries		1.0000	0.0000	0.8000			
243	Cabbage	Cabbage		0.6588	0.0000	0.4510			
244	Cauliflower	Cauliflower		0.6588	0.0000	0.4510			
245	Celery	Celery		0.6588	0.0000	0.4510			
246	Radishes	Radishes		0.6588	0.0000	0.4510			
247	Turnips	Turnips		0.6588	0.0000	0.4510			
248	Eggplants	Eggplants		0.6588	0.0000	0.4510			
249	Gourds	Gourds		0.6588	0.0000	0.4510			
250	Cranberries	Cranberries		1.0000	0.0000	0.8000			

State of Iowa Census Tracts - Current/ACS13 - Data as of January 1, 2013

MTFCC	OID	GEOID	STATE	COUNTY	TRACT	BASENAME	NAME	LSADC	FUNCSTAT	AREALAND	AREAWATER	UR	CENTLAT	CENTLON	INTPTLAT	INTPTLON
G5020	20790328763043	19001960100	19	001	960100	9601	Census Tract 9601	CT	S	707919439	1124009		+41.4204490	-094.4773809	+41.4226701	-094.4754745
G5020	20790328763062	19001960200	19	001	960200	9602	Census Tract 9602	CT	S	666068268	1098841		+41.2402687	-094.4593481	+41.2403358	-094.4634803
G5020	20790328763079	19001960300	19	001	960300	9603	Census Tract 9603	CT	S	100416467	375146		+41.2975066	-094.5025203	+41.2964752	-094.5071226
G5020	20790155900148	19003950100	19	003	950100	9501	Census Tract 9501	CT	S	879308484	4856978		+41.0477119	-094.6732029	+41.0509146	-094.6680804
G5020	20790155900144	19003950200	19	003	950200	9502	Census Tract 9502	CT	S	217392267	496426		+40.9528920	-094.8044597	+40.9482672	-094.8079792
G5020	20790692090375	19005960100	19	005	960100	9601	Census Tract 9601	CT	S	335670054	27231318		+43.3462135	-091.2527640	+43.3464049	-091.2647941
G5020	20790692090405	19005960200	19	005	960200	9602	Census Tract 9602	CT	S	565553312	4317593		+43.3904626	-091.4718223	+43.3971626	-091.4741746
G5020	20790692090415	19005960300	19	005	960300	9603	Census Tract 9603	CT	S	30642913	0		+43.2661236	-091.4897803	+43.2661236	-091.4897803
G5020	20790692090408	19005960400	19	005	960400	9604	Census Tract 9604	CT	S	461437608	19446349		+43.1693456	-091.2844084	+43.1749656	-091.2911688
G5020	20790692090412	19005960500	19	005	960500	9605	Census Tract 9605	CT	S	261910488	0		+43.1793670	-091.5066694	+43.1793670	-091.5066694
G5020	20790163918232	19007950100	19	007	950100	9501	Census Tract 9501	CT	S	408767657	1915051		+40.7889139	-092.7383996	+40.7873507	-092.7433917
G5020	20790143727285	19007950200	19	007	950200	9502	Census Tract 9502	CT	S	315828978	46040082		+40.8244243	-092.9719060	+40.8272750	-092.9636956

Crop Data Layer (CDL)



- Tagged Image File (.tif) Format
- pixel counts for different categories of cropland - codes
- download Iowa and years 2003-2007, approx. 750,000 KB

Working off of U: drive wasn't a good idea...

[CyFiles] Your CyFiles is 96% Full Misc x

IT Services <its@iastate.edu> Mar 15

to me

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://asw.iastate.edu/cgi-bin/acropolis/user/cyquota

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https://asw.iastate.edu/cgi-bin/acropolis/user/cynotify

Or you can also manage your CyFiles sharing access by visiting this site:
https://asw.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 or solution@iastate.edu.

Information Technology Services
195 Durham Center
Iowa State University
solution@iastate.edu
515-294-4000

Processing CDL data

- *Raster* package, 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
```

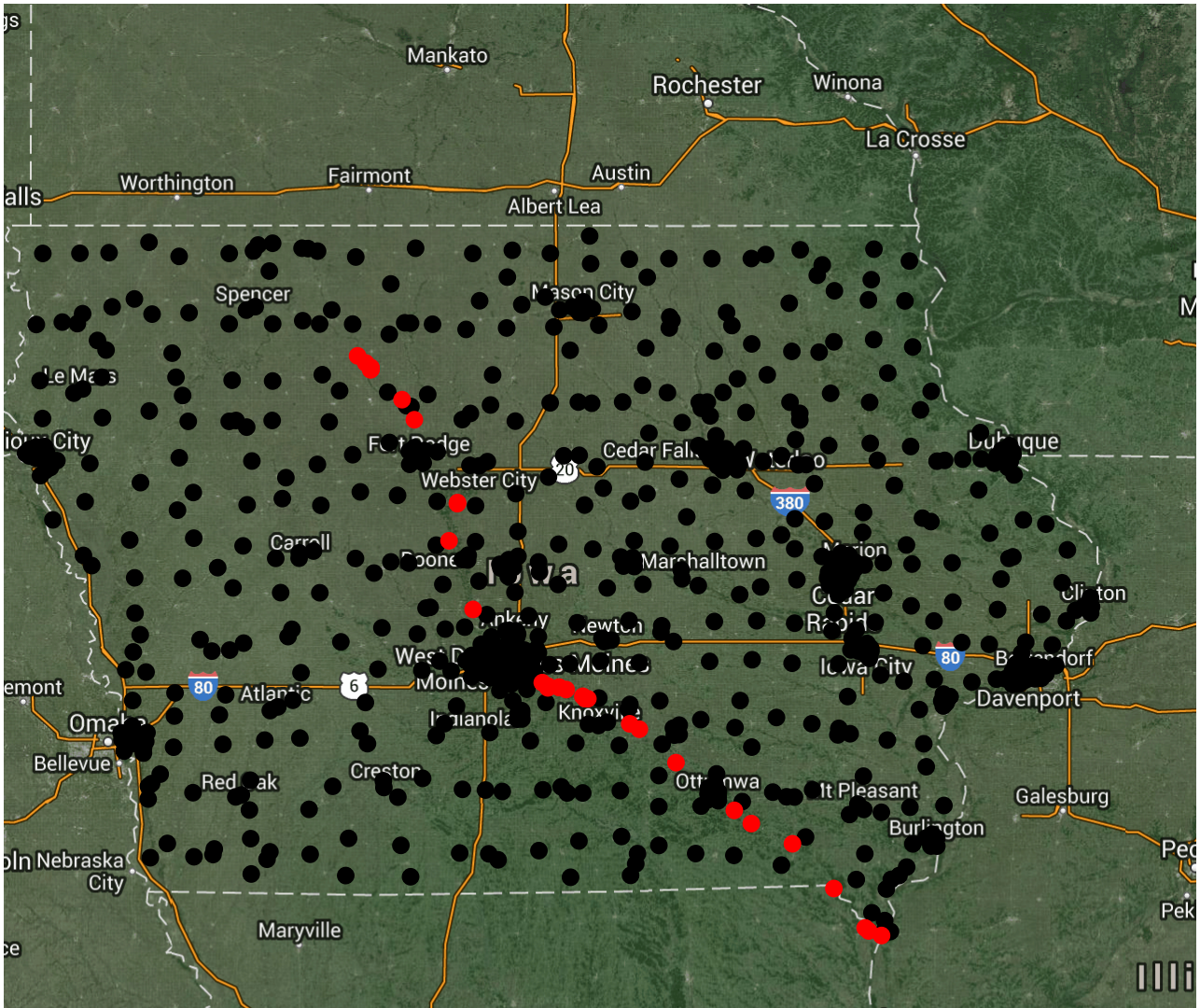
```
## class       : RasterLayer
## dimensions  : 11672, 17796, 207714912  (nrow, ncol, ncell)
## resolution  : 30, 30  (x, y)
## extent      : -52065, 481815, 1938165, 2288325  (xmin, xmax, ymin, ym
## coord. ref. : +proj=aea +lat_1=29.5 +lat_2=45.5 +lat_0=23 +lon_0=-96
## data source : U:\stat585\STAT585X-Project\data\CDL_2003_19.tif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

Census Tigerweb

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

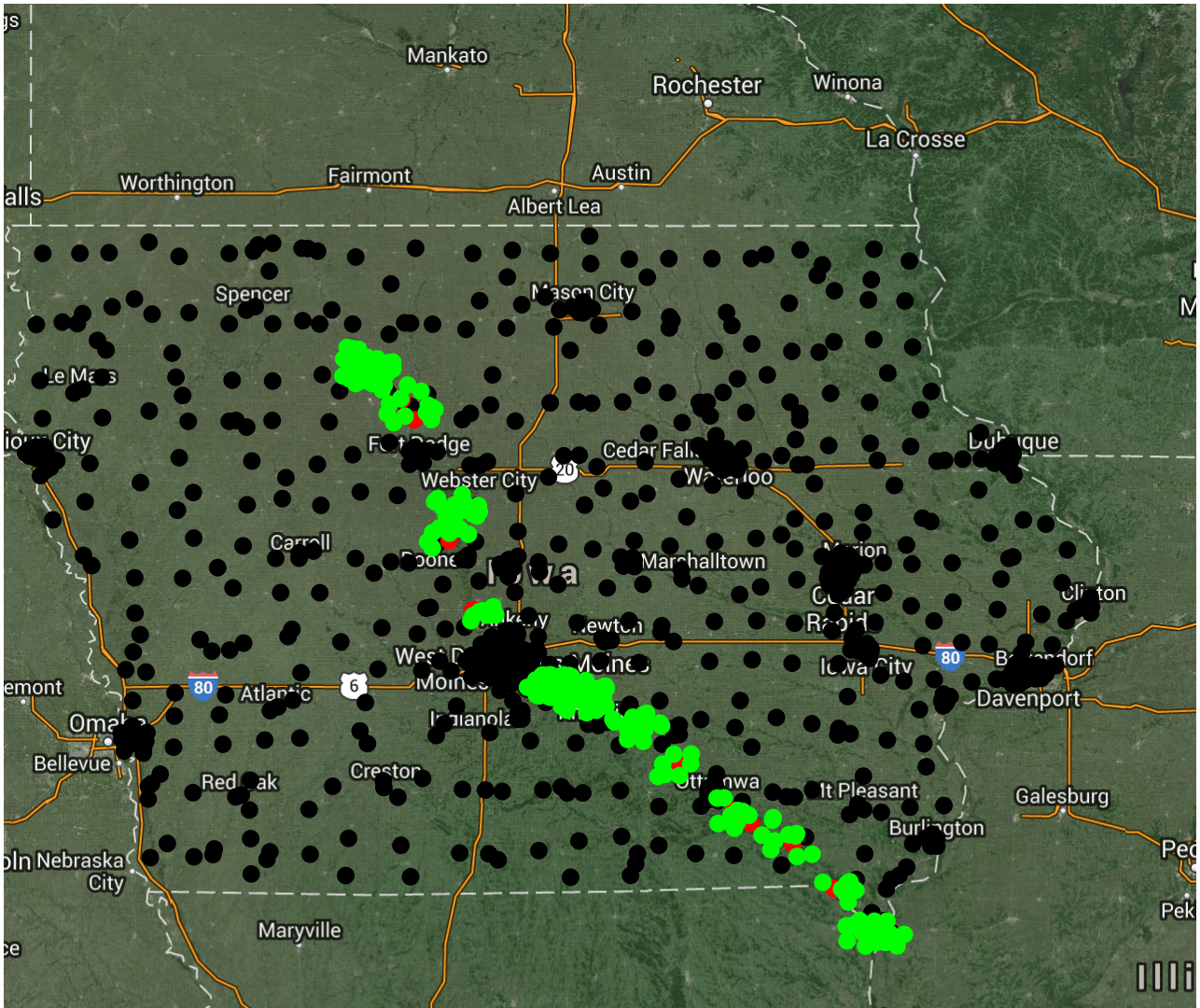
Processing Census Tigerweb

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



Constructing the sample for the Des Moines river watershed

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



Extract CDL data for the region

- *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

- *XML* library
- unstructured source code


```
<td class=xl11115710></td>
<td class=xl11215710 colspan=3>RGB values for ESRI ArcGIS</td>
<td class=xl10915710></td>
</tr>
<tr class=xl16915710 height=21 style='height:15.75pt'>
<td height=21 class=xl10615710 style='height:15.75pt'>Codes</td>
<td class=xl10515710 style='border-left:none'>Current Class Names</td>
<td class=xl12215710 style='border-left:none'>Old Class Names</td>
<td class=xl12015710 style='border-left:none'>Summary of Revisions</td>
<td class=xl7615710></td>
<td class=xl9615710>Erdas Red</td>
<td class=xl9715710 style='border-left:none'>Erdas Green</td>
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<td class=xl7715710></td>
<td class=xl10215710>ESRI Red</td>
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<td class=xl10415710 style='border-left:none'>ESRI Blue</td>
<td class=xl6915710></td>
</tr>
<tr height=20 style='height:15.0pt'>
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<td class=xl10815710 style='border-left:none'>Background</td>
<td class=xl10815710 style='border-left:none'>Background</td>
<td class=xl11415710 style='border-left:none'> </td>
<td class=xl7515710></td>
<td class=xl9315710 align=right>0.0000</td>
<td class=xl9415710 align=right style='border-left:none'>0.0000</td>
<td class=xl9515710 align=right style='border-left:none'>0.0000</td>
<td class=xl6815710></td>
<td class=xl9915710 align=right>0</td>
<td class=xl10015710 align=right style='border-left:none'>0</td>
<td class=xl10115710 align=right style='border-left:none'>0</td>
<td class=xl11515710></td>
</tr>
<tr height=21 style='height:15.75pt'>
<td height=21 class=xl9015710 align=right style='height:15.75pt;border-top:
none'>1</td>
<td class=xl7115710 style='border-top:none;border-left:none'>Corn</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

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

Results

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

- Data processing
  - different data types/sources
  - large spatial, image data
  - coordinates in different measurement systems
  - regular expressions

  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.
- Results
  - missing crop classes for all/some the years
  - missing records is some years
  - changes in crops over the years
  - possible frame coverage problem

Future work

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

The end...

Thank you for your attention!
Questions?