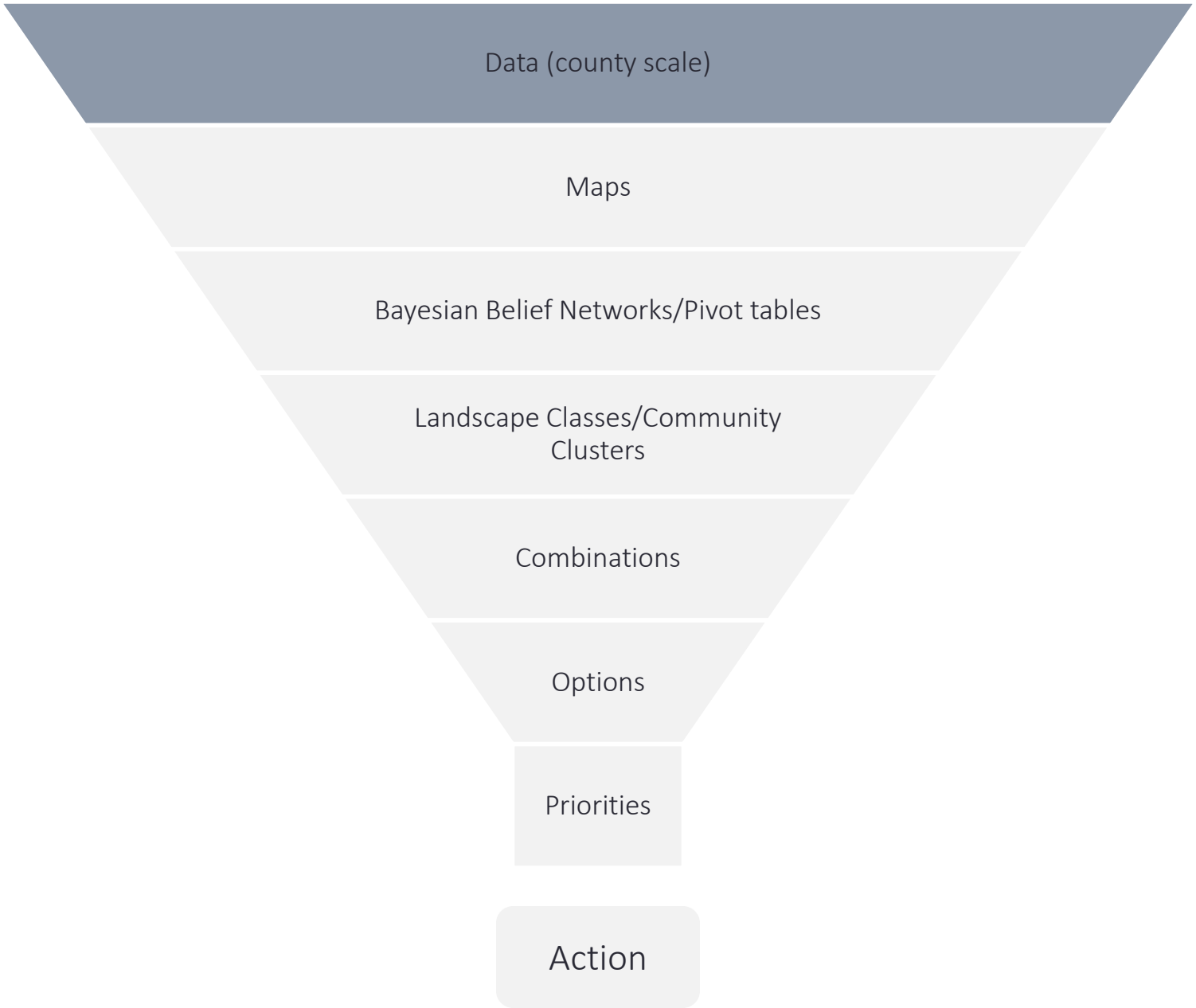
Preparing Data for Analysis

National Cohesive Wildland Fire Management Strategy

Science Analysis Report: Application to the Southeast Region

January, 2014

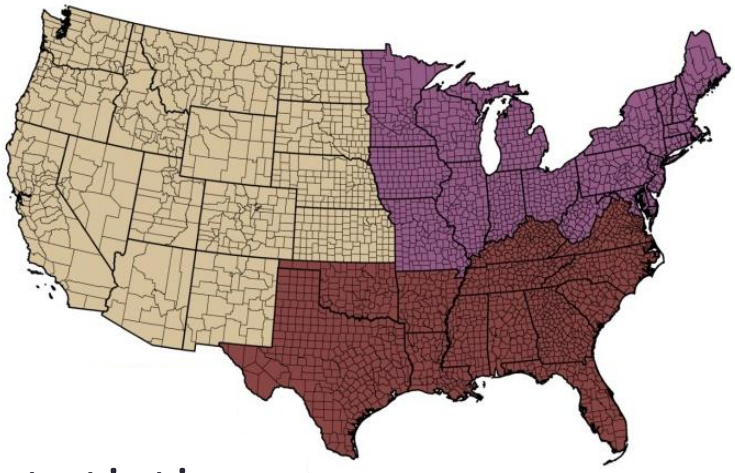

Data (county scale)
Maps
Bayesian Belief Networks/Pivot tables
Landscape Classes/Community Clusters
Combinations
Options
Priorities
Action

Analytical Approach

Every state, county, management unit, or community can claim its own unique fire regime, history and special circumstances.

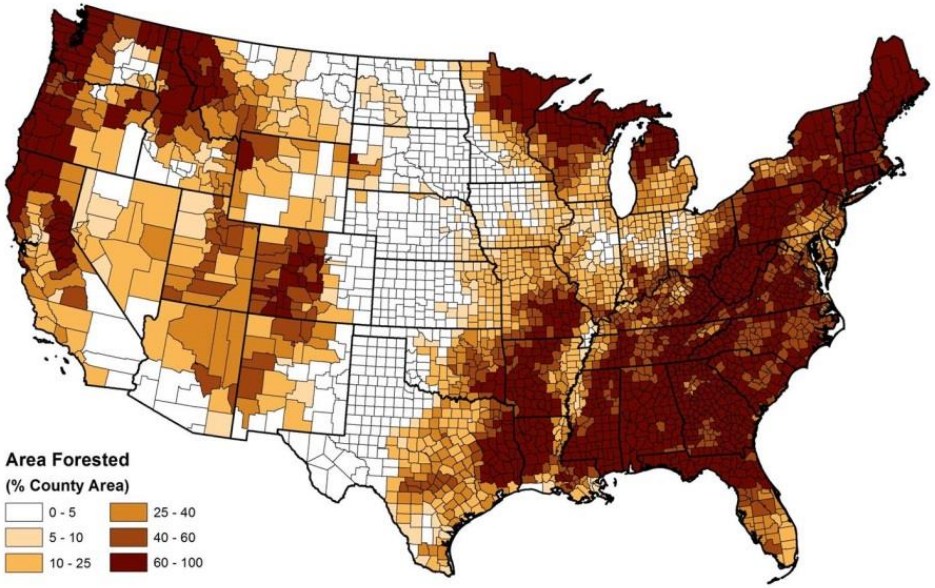
One of the challenges within a national analysis is finding an adequate level of both generalization and specification that highlights important differences while also recognizing commonalities.

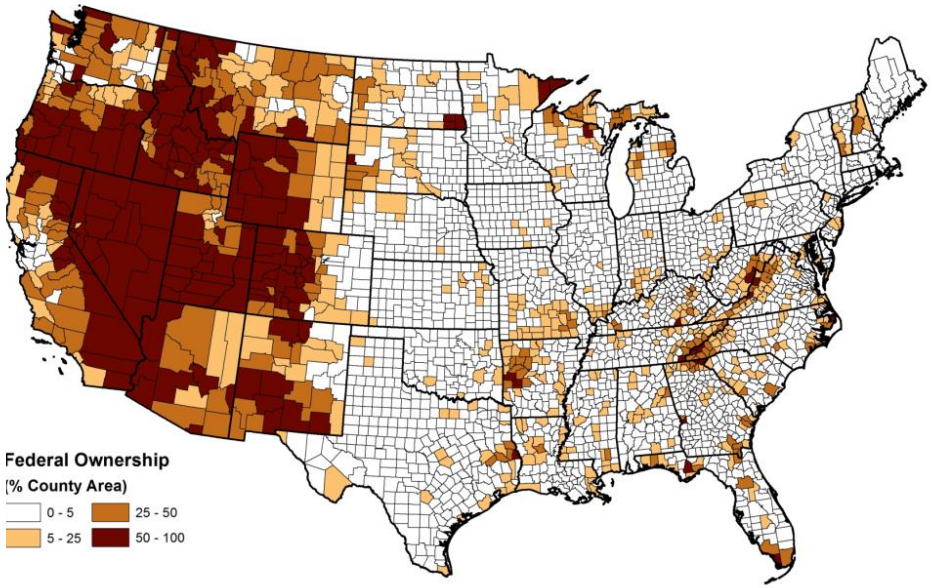
County-level Analysis



- Data spanning a broad spectrum of environmental, socioeconomic, and fire-related statistics
- County level to provide a comparable unit of analysis across data sets
  - 3,109 counties in the conterminous United States
- Spatial Scale that captures broad landscape-scale interactions and that informs policy and management options

Exploring data spatially (maps)





There are 3109 counties in the conterminous United States and each one has its own unique story.

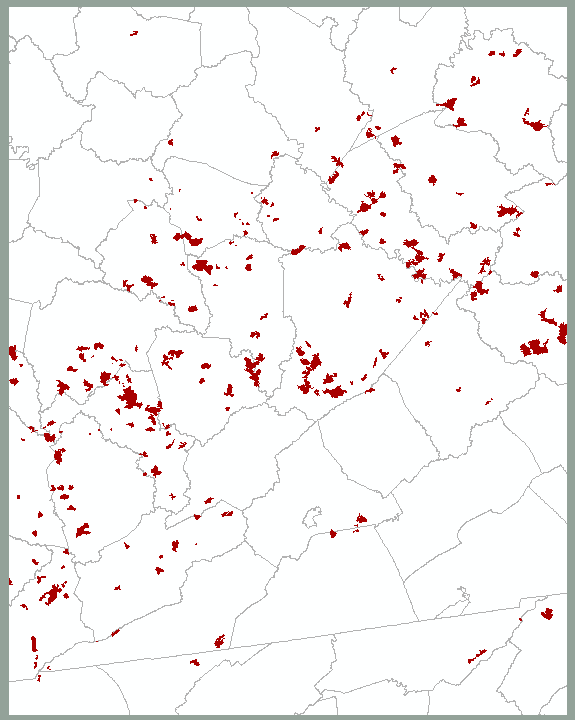
Over 300 maps were generated to view trends in data across the United States.

Data Variable Categories (final primary variables)

- **Fire Statistic** (19)
  - Area Burned, 2001-2011 (MTBS/GEOMAC), Fire Reports (NFIRS, NASF)
- **Fire Response** (12)
  - Response arrival, duration, buildings involved (NFIRS); Structures lost (209 Reports); Fire stations and personnel (DHS)
- **Landcover** (25)
  - Vegetation type and treatment potential; Biophysical attributes; Landcover type; WUI statistics (Silvis)
- **Social/Demographic** (14)
  - Population; Income and Poverty rates; Timber-related productivity and jobs
- **Jurisdictional** (4)
  - Conservation Partners (PADUS); Federal land management

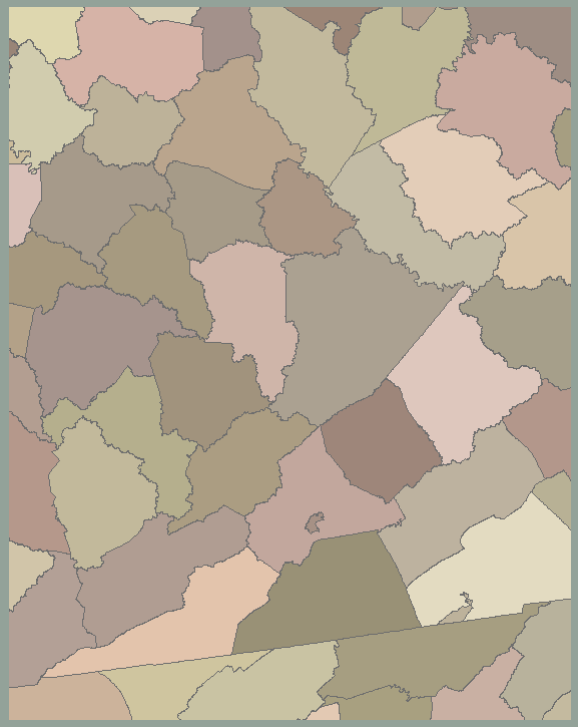
Original Data Resolutions (Spatial Data)

Below County



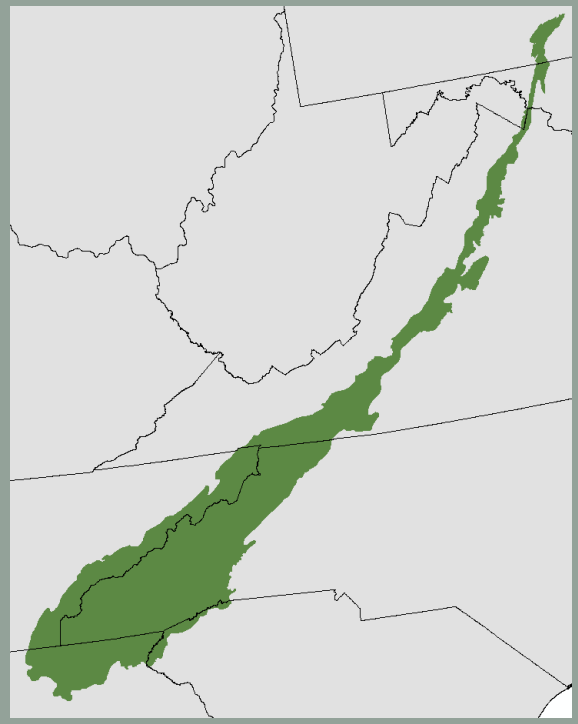
Area Burned
Protected Areas
Landcover Type

County



Population and Census Data
Timber Jobs
Forest Productivity

Above County

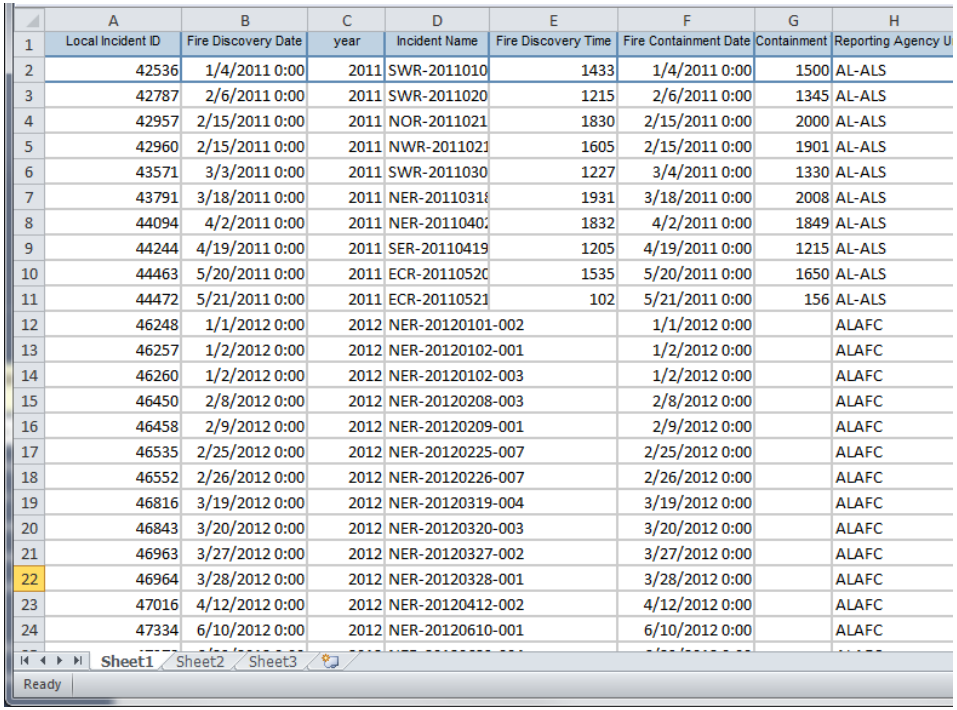


Ecoregions

Records and Reporting Systems

- Federal
  - Fire Occurrence (FPA)
  - National Fire Plan Operations and Reporting System (NFPORS)
- State and Local
  - National Association of State Foresters (NASF)
  - National Fire Incident Reporting System (NFIRS)

Example of a few NASF Records



	A	B	C	D	E	F	G	H
1	Local Incident ID	Fire Discovery Date	year	Incident Name	Fire Discovery Time	Fire Containment Date	Containment	Reporting Agency U
2	42536	1/4/2011 0:00	2011	SWR-2011010	1433	1/4/2011 0:00	1500	AL-ALS
3	42787	2/6/2011 0:00	2011	SWR-2011020	1215	2/6/2011 0:00	1345	AL-ALS
4	42957	2/15/2011 0:00	2011	NOR-2011021	1830	2/15/2011 0:00	2000	AL-ALS
5	42960	2/15/2011 0:00	2011	NWR-2011021	1605	2/15/2011 0:00	1901	AL-ALS
6	43571	3/3/2011 0:00	2011	SWR-2011030	1227	3/4/2011 0:00	1330	AL-ALS
7	43791	3/18/2011 0:00	2011	NER-20110318	1931	3/18/2011 0:00	2008	AL-ALS
8	44094	4/2/2011 0:00	2011	NER-2011040	1832	4/2/2011 0:00	1849	AL-ALS
9	44244	4/19/2011 0:00	2011	SER-20110419	1205	4/19/2011 0:00	1215	AL-ALS
10	44463	5/20/2011 0:00	2011	ECR-20110520	1535	5/20/2011 0:00	1650	AL-ALS
11	44472	5/21/2011 0:00	2011	ECR-20110521	102	5/21/2011 0:00	156	AL-ALS
12	46248	1/1/2012 0:00	2012	NER-20120101-002		1/1/2012 0:00		ALAFC
13	46257	1/2/2012 0:00	2012	NER-20120102-001		1/2/2012 0:00		ALAFC
14	46260	1/2/2012 0:00	2012	NER-20120102-003		1/2/2012 0:00		ALAFC
15	46450	2/8/2012 0:00	2012	NER-20120208-003		2/8/2012 0:00		ALAFC
16	46458	2/9/2012 0:00	2012	NER-20120209-001		2/9/2012 0:00		ALAFC
17	46535	2/25/2012 0:00	2012	NER-20120225-007		2/25/2012 0:00		ALAFC
18	46552	2/26/2012 0:00	2012	NER-20120226-007		2/26/2012 0:00		ALAFC
19	46816	3/19/2012 0:00	2012	NER-20120319-004		3/19/2012 0:00		ALAFC
20	46843	3/20/2012 0:00	2012	NER-20120320-003		3/20/2012 0:00		ALAFC
21	46963	3/27/2012 0:00	2012	NER-20120327-002		3/27/2012 0:00		ALAFC
22	46964	3/28/2012 0:00	2012	NER-20120328-001		3/28/2012 0:00		ALAFC
23	47016	4/12/2012 0:00	2012	NER-20120412-002		4/12/2012 0:00		ALAFC
24	47334	6/10/2012 0:00	2012	NER-20120610-001		6/10/2012 0:00		ALAFC

Sheet1 Sheet2 Sheet3

Ready

Data Processing

County-level aggregation or summaries were made for each dataset in order for it to be used in the National Analysis

Aggregating at the County level

- Records need to have a County association
- Events or records can be totaled (i.e. # of Fires/County)
- Total area can be calculated from spatial data
- Modal values can help to describe a County's condition

Normalizing for comparable unit of analysis

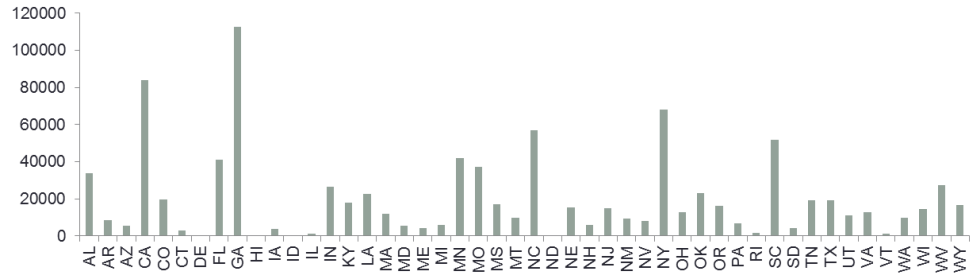
- Values converted to rates or units/area
- Percentages used to make counties comparable

Example: Federal, State, and Local Reporting Systems

County level summaries from record systems

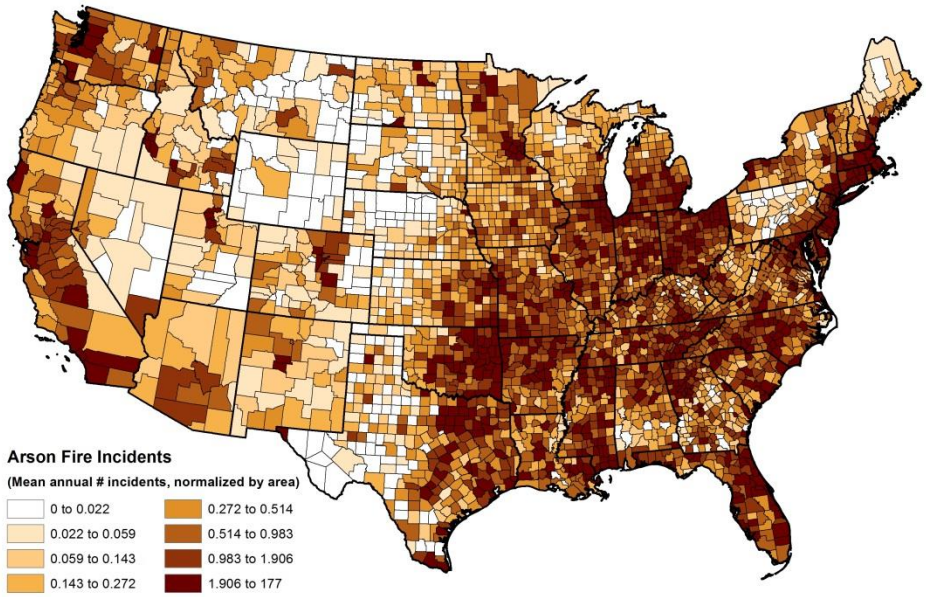
Dataset in its original format

	A	B	C	D	E	F	G	H	I	J	K
1	Local Incident ID	Fire Discovery Date	year	Incident Name	Fire Discovery Time	Fire Containment Date	Containment	Reporting Agency U	State	State FIPS	County
2	42536	1/4/2011 0:00	2011	SWR-2011010	1433	1/4/2011 0:00	1500	AL-ALS	AL	00	Baldwin
3	42787	2/6/2011 0:00	2011	SWR-2011020	1215	2/6/2011 0:00	1345	AL-ALS	AL	00	Baldwin
4	42957	2/15/2011 0:00	2011	NOR-2011021	1830	2/15/2011 0:00	2000	AL-ALS	AL	00	Jackson
5	42960	2/15/2011 0:00	2011	NWR-2011021	1605	2/15/2011 0:00	1901	AL-ALS	AL	00	Walker
6	43571	3/3/2011 0:00	2011	SWR-2011030	1227	3/4/2011 0:00	1330	AL-ALS	AL	00	Marengo
7	43791	3/18/2011 0:00	2011	NER-2011031	1931	3/18/2011 0:00	2008	AL-ALS	AL	00	Randolph
8	44094	4/2/2011 0:00	2011	NER-2011040	1832	4/2/2011 0:00	1849	AL-ALS	AL	00	Saint Clair
9	44244	4/19/2011 0:00	2011	SER-20110419	1205	4/19/2011 0:00	1215	AL-ALS	AL	00	Pike
10	44463	5/20/2011 0:00	2011	ECR-2011052	1535	5/20/2011 0:00	1650	AL-ALS	AL	00	Tallapoos
11	44472	5/21/2011 0:00	2011	ECR-20110521	102	5/21/2011 0:00	156	AL-ALS	AL	00	Russell
12	46248	1/1/2012 0:00	2012	NER-20120101-002		1/1/2012 0:00		ALAFC	AL	01	Saint Clair
13	46257	1/2/2012 0:00	2012	NER-20120102-001		1/2/2012 0:00		ALAFC	AL	01	Saint Clair
14	46260	1/2/2012 0:00	2012	NER-20120102-003		1/2/2012 0:00		ALAFC	AL	01	Saint Clair
15	46450	2/8/2012 0:00	2012	NER-20120208-003		2/8/2012 0:00		ALAFC	AL	01	Saint Clair



*This shows an example of some records from the NASF reporting system

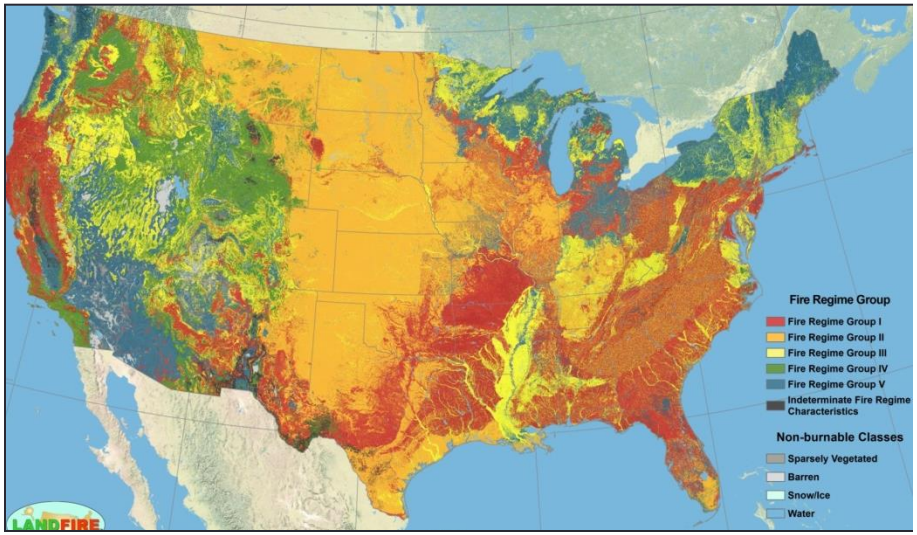
County-level summary of Arson reports



Example: Historical Fire Regime Group (LANDFIRE)

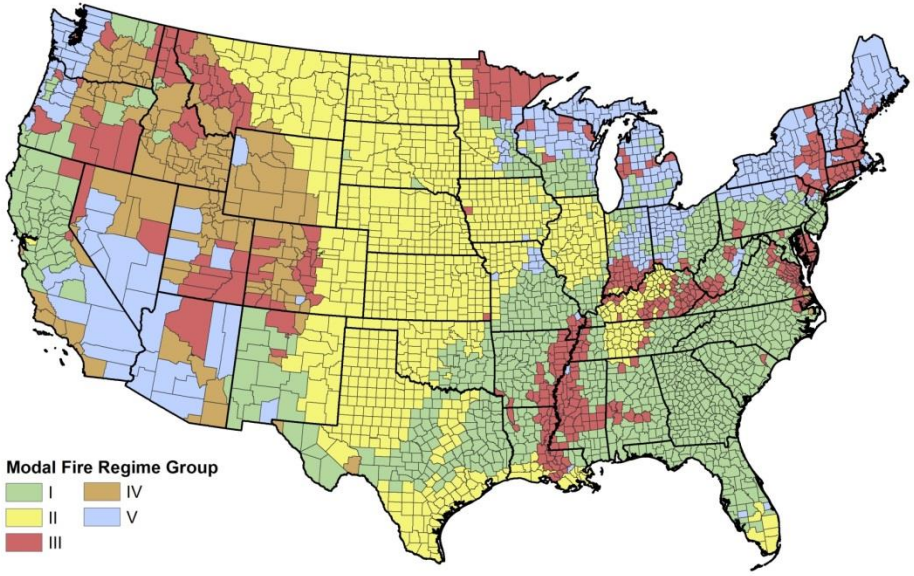
County level aggregation from raster dataset

Dataset in its original resolution



Credit: LANDFIRE

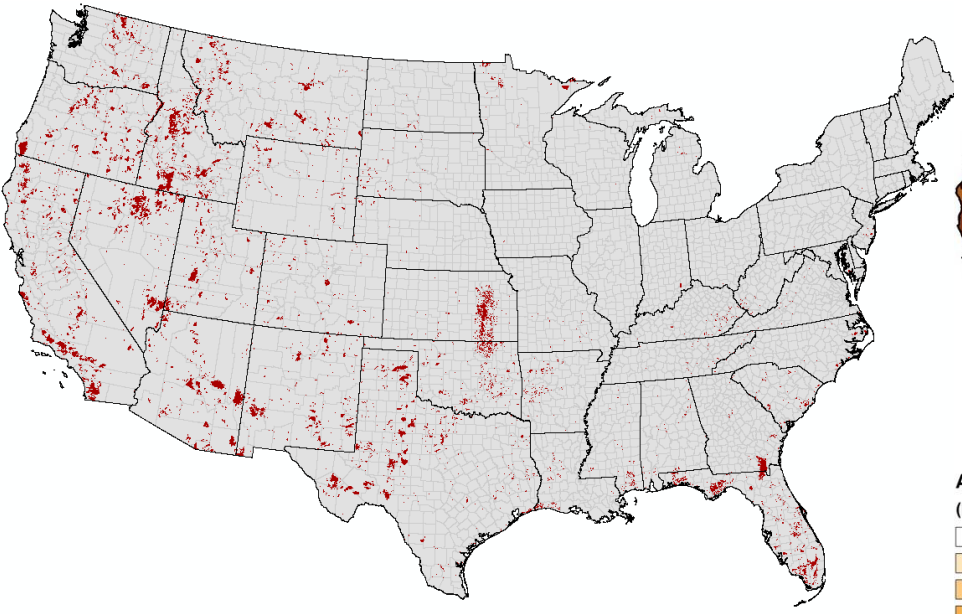
County-level summary of modal value for each county



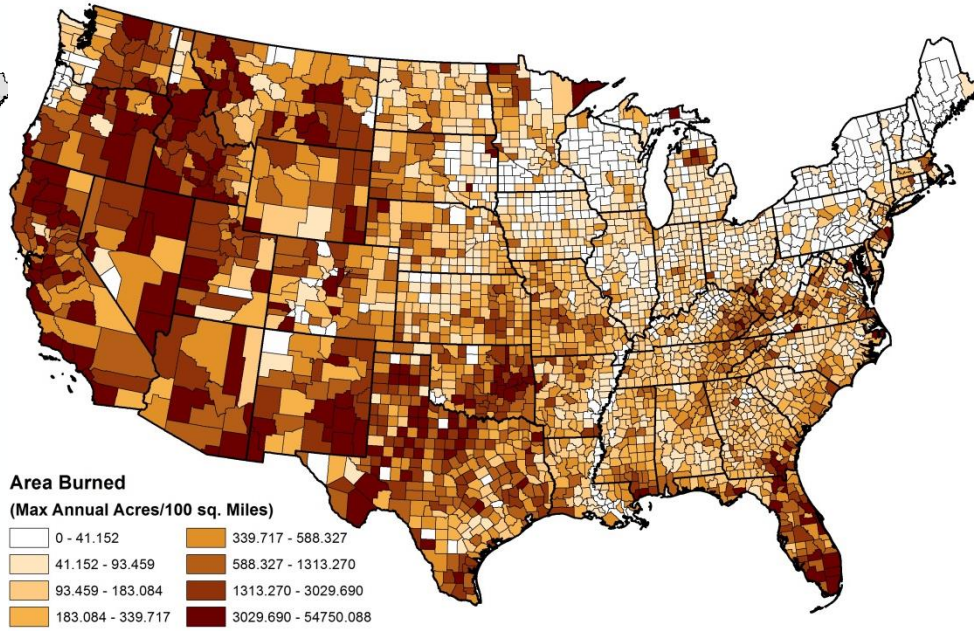
Example: Area Burned 2001-2011 (MTBS/GEOMAC)

County level area summation from below county spatial data

Dataset in its original resolution



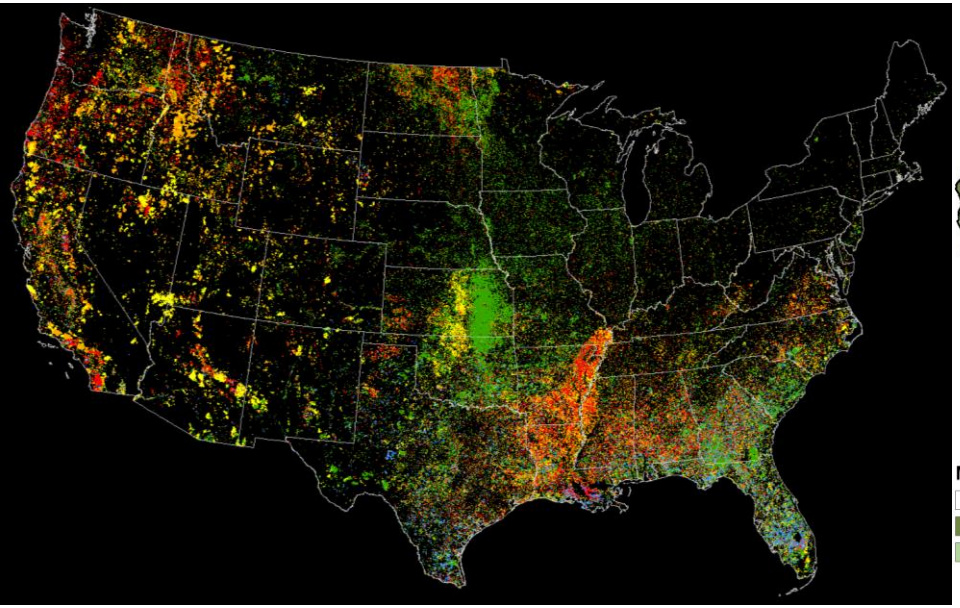
County-level summary of normalized area for each county



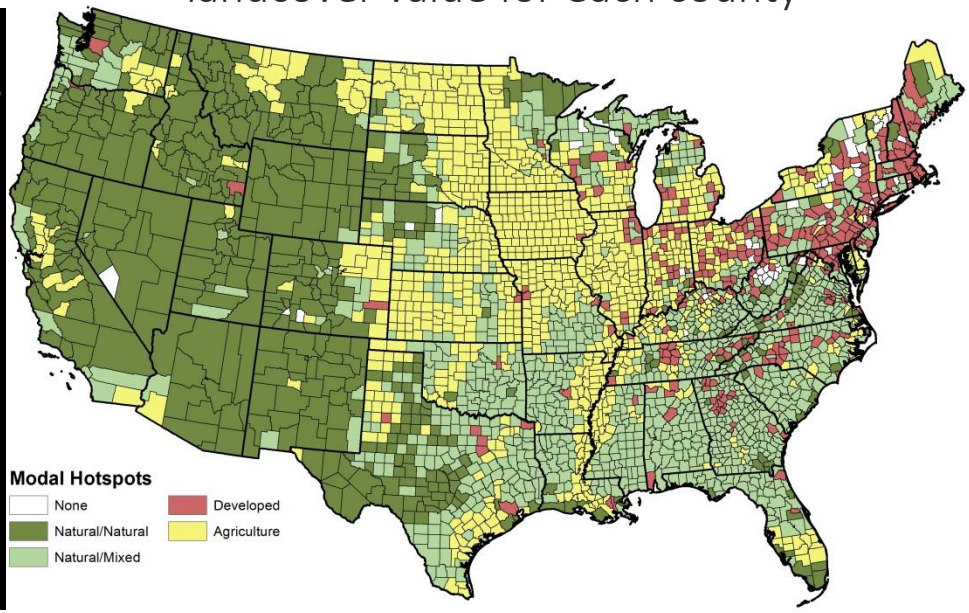
Example: MODIS Hotspots 2001-2011

County level summary of modal values from raster dataset

Dataset in its original resolution



County-level summary of modal landcover value for each county



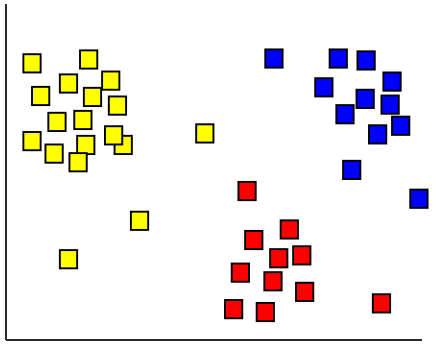
Credit: Steve Norman

Dimensional Reduction Techniques

Statistical methods for dealing with the complexity of many data variables and the variation of conditions across the Nation

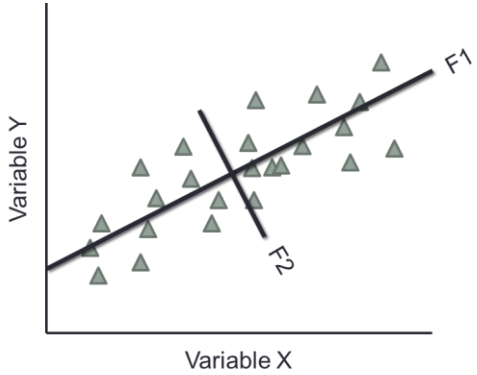
Statistical Clustering

- Grouping counties with similar attributes or conditions



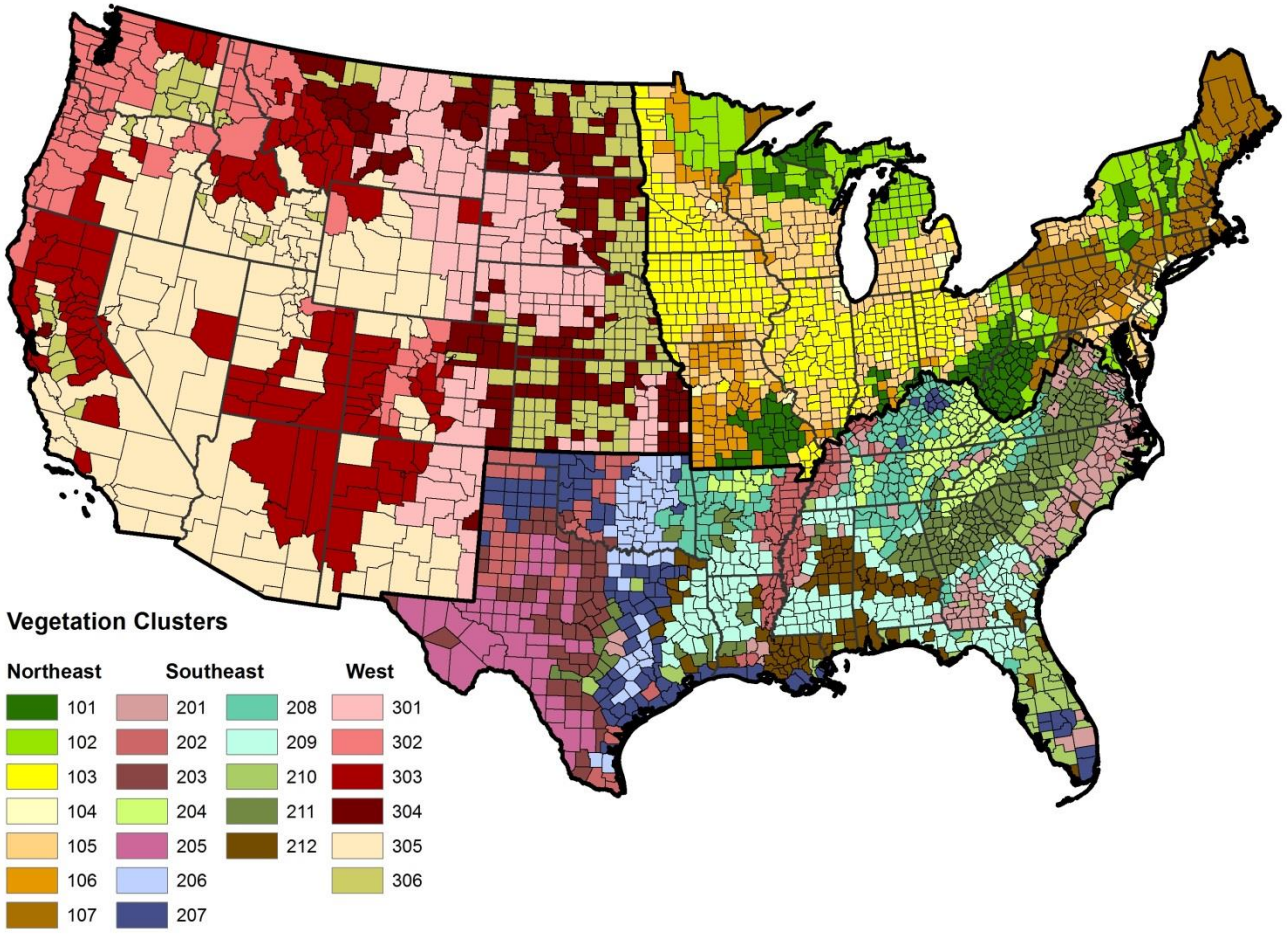
Factor Score Analysis

- Describing multiple factors in a single variable



Clustering Analysis Example: Vegetation Groups

Statistical clustering of LANDFIRE's Existing Vegetation Types, grouped by U.S. NVCS Subclass

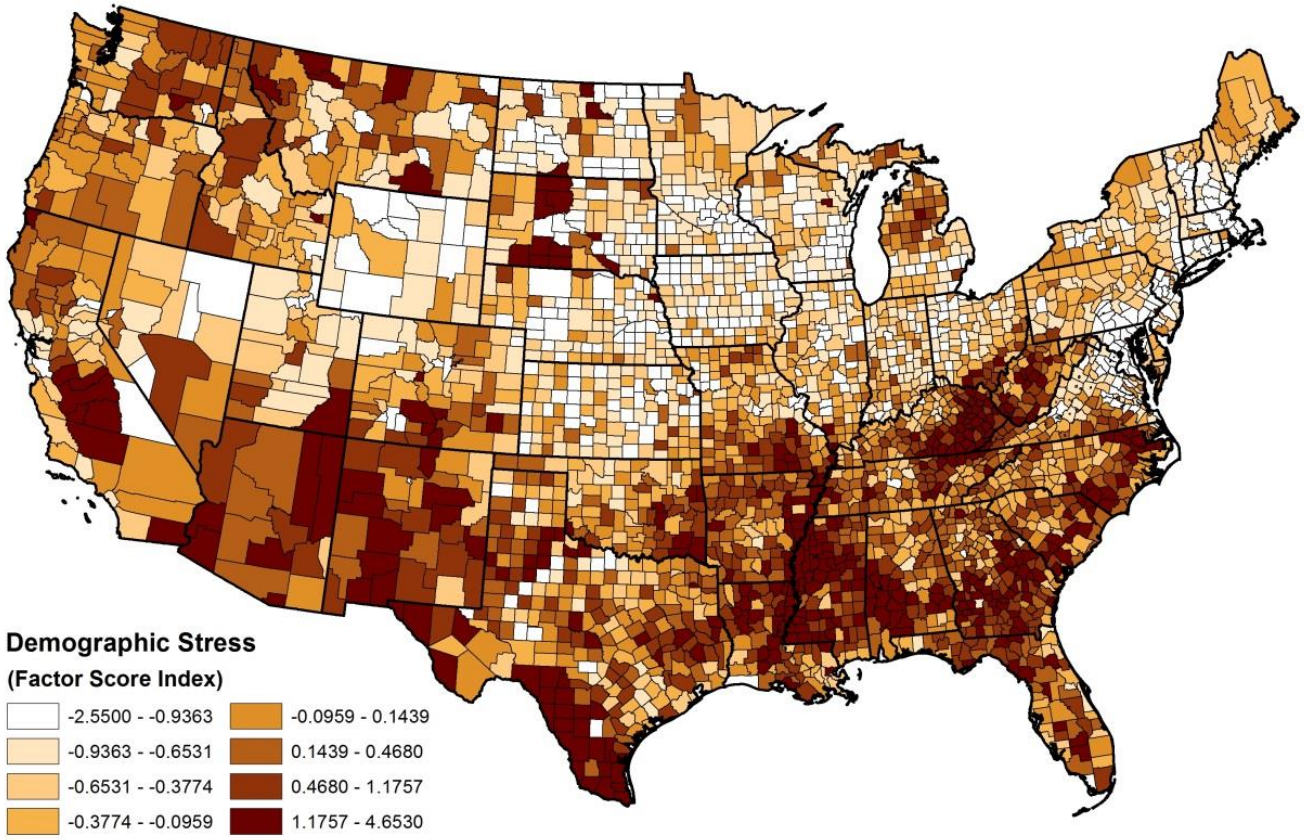


Factor Score Analysis Example: Demographic Stress

Data Inputs:

- Total Population
- Population Growth
- Poverty Rates (for Households and Children)
- Household Income
- Educational Attainment

The Factor Score Analysis analyzes the combination of variables to determine the overall score index



NSAT Science Products Using Dimensional Reduction

Clustering Analysis

- Vegetation Groups (NVCS)
- Surface Fuels (NVCS)
- Community Clusters

Factor Score Analysis

- Demographic
  - Stress
  - Advantage
- WUI
  - Area
  - Home Density
- Biophysical
  - Wetness (Precipitation)
  - Warmness (Temperature)
  - Terrain

NSAT Fuel Treatment Availability Products

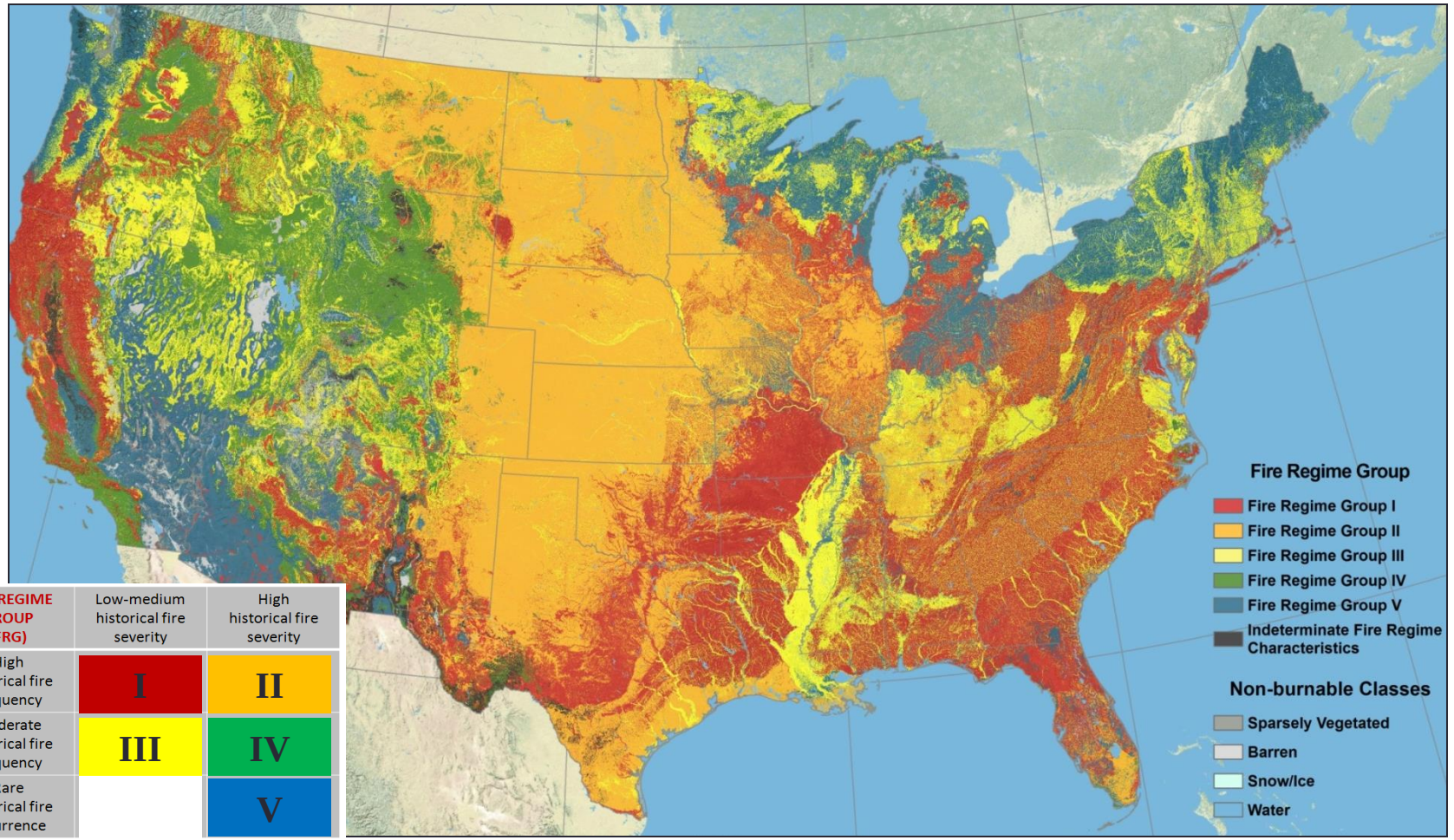
Summary of process and filters used

1. Areas with historical occurrence of wildfire
   - LANDFIRE Fire Regime Groups I, II and III, some IV
2. Areas with “burnable” fuels
   - LANDFIRE burnable fuel models (not: FM91 urban/developed; FM92 snow/ice; FM93 agriculture; FM98 water; FM99 barren)
3. Areas of Natural Vegetation
   - Riitters’ Landcover: “Natural” vegetation (this further excludes agriculture and developed dominated areas)
4. Forested and non-forested areas were mapped separately

NSAT Fuel Treatment Availability Products

1. Areas with historical occurrence of wildfire

- LANDFIRE Fire Regime Groups I, II and III, some IV

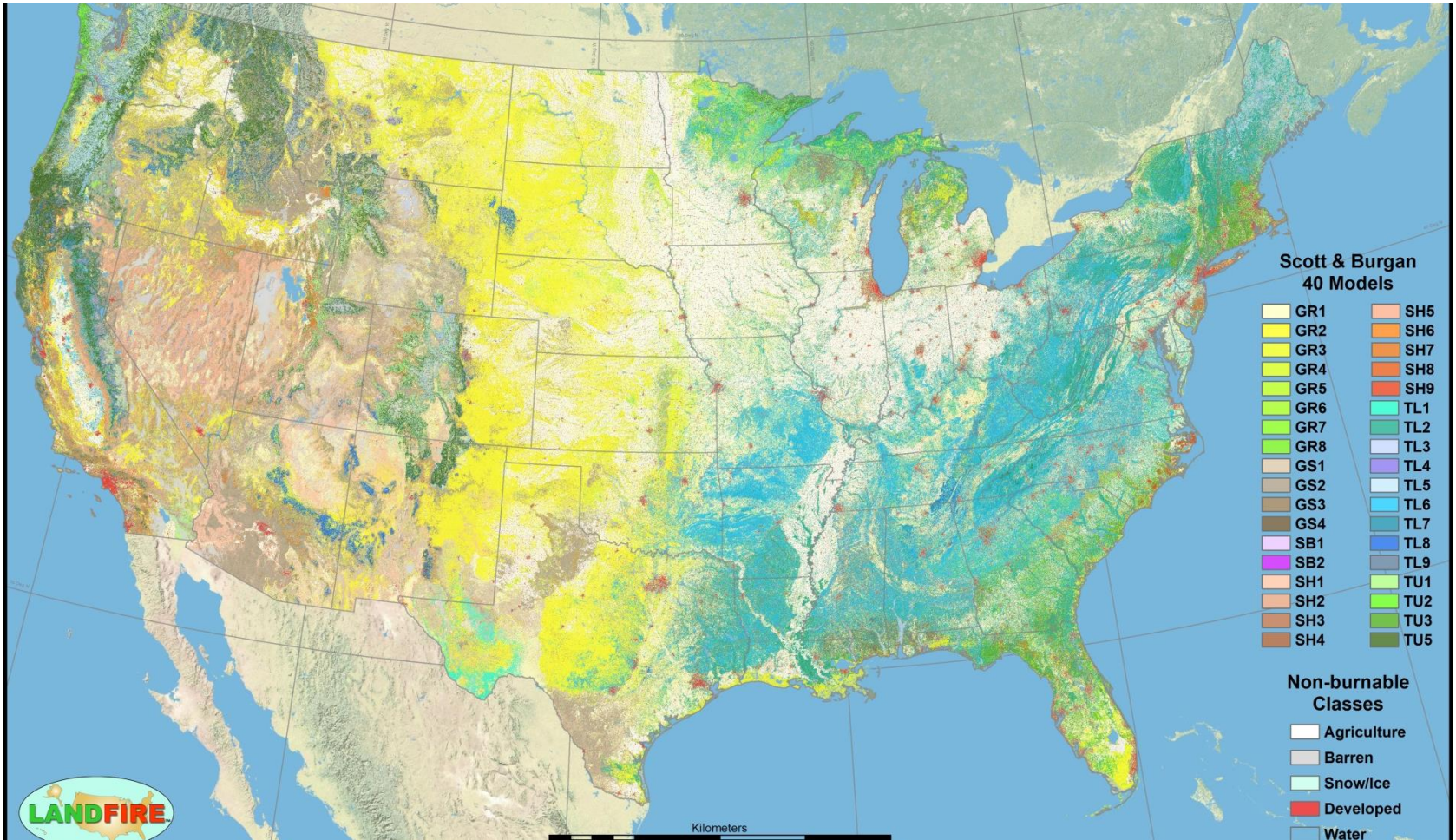


FIRE REGIME GROUP (FRG)	Low-medium historical fire severity	High historical fire severity
High historical fire frequency	I	II
Moderate historical fire frequency	III	IV
Rare historical fire occurrence		V

NSAT Fuel Treatment Availability Products

2. Areas with “burnable” fuels

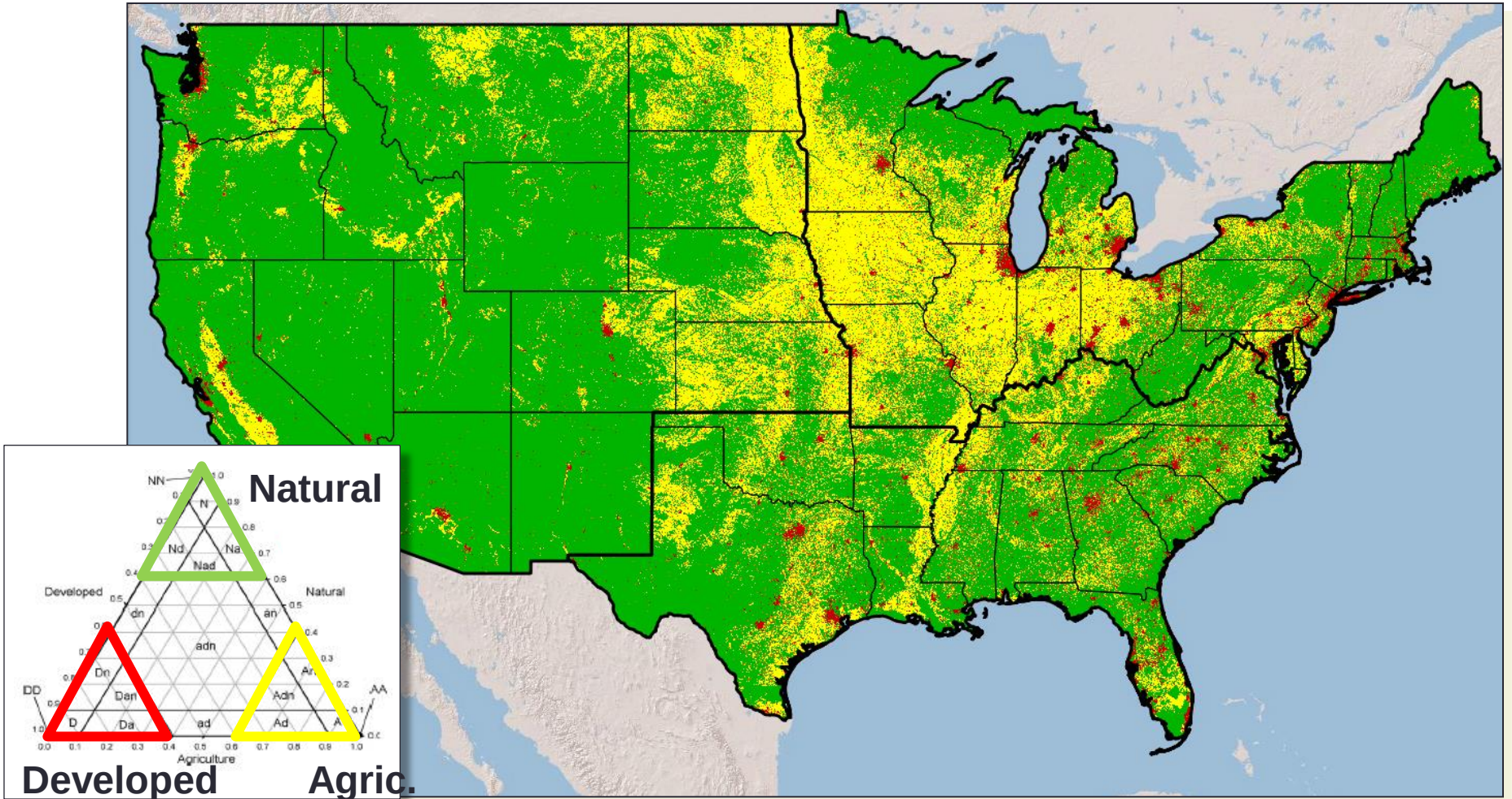
- LANDFIRE burnable fuel models (not: developed, snow/ice, ag, barren)



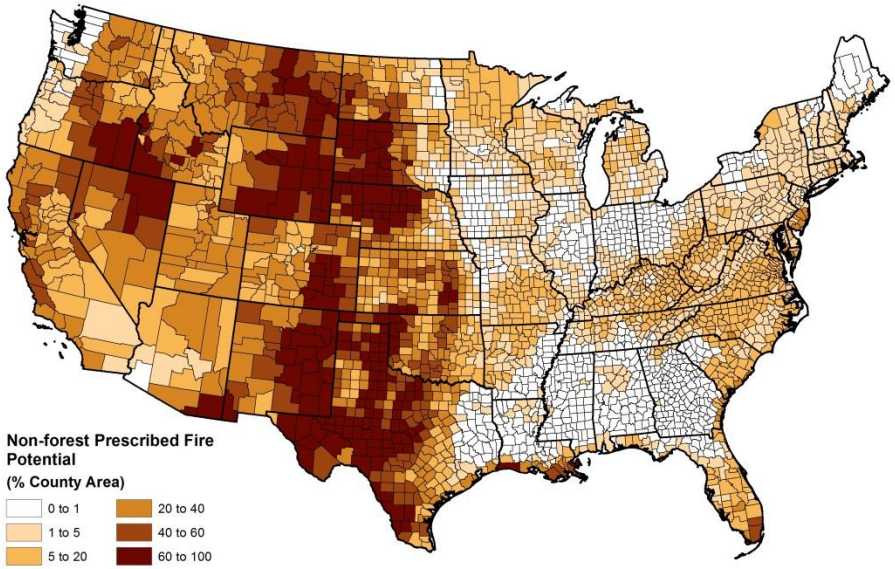
NSAT Fuel Treatment Availability Products

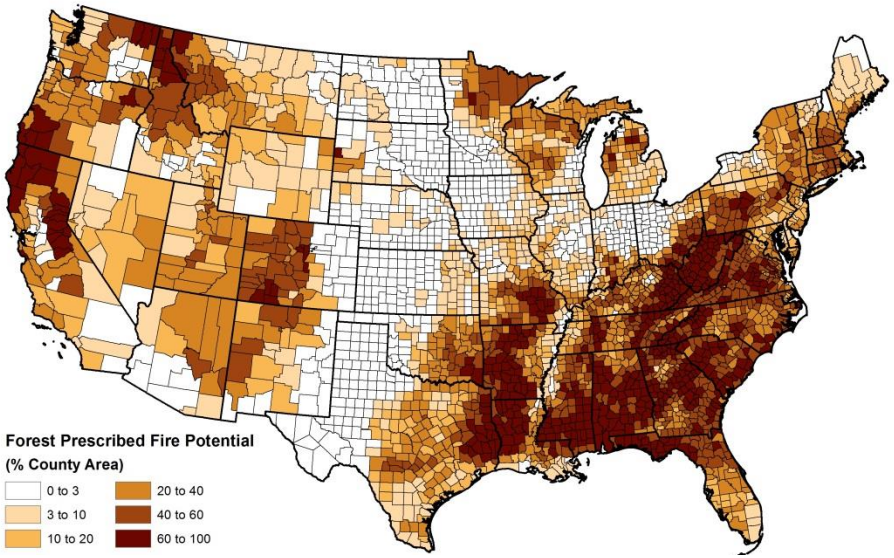
3. Areas of Natural Vegetation

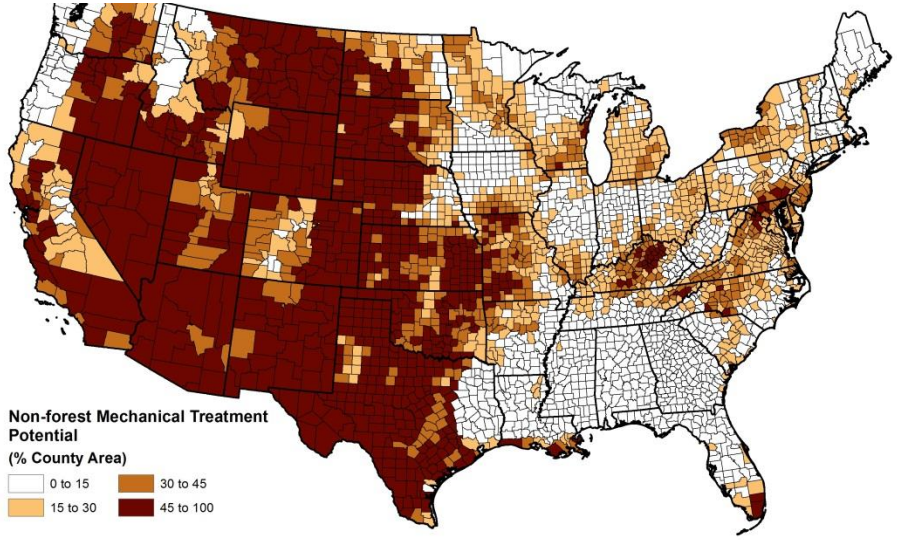
- Riitters' Landcover: "Natural" vegetation

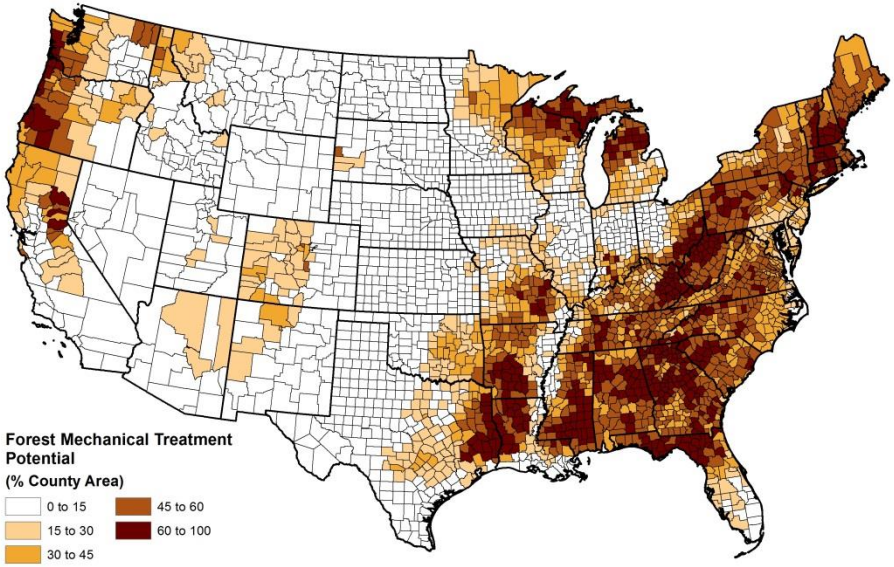


Fuel Treatment Availability Products



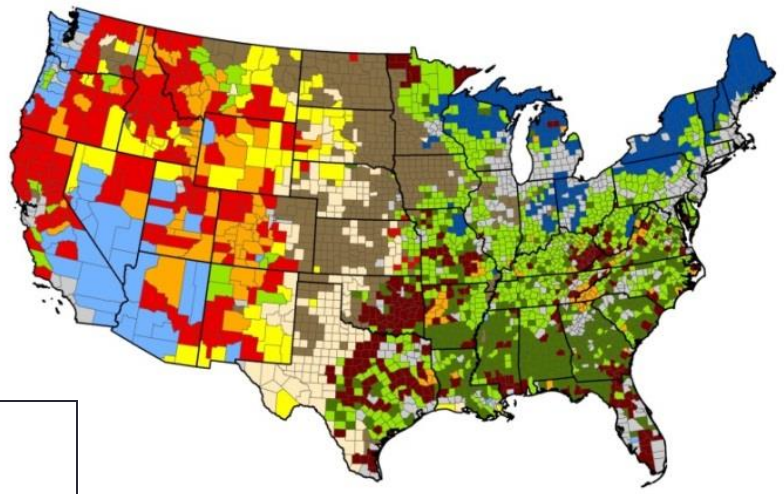


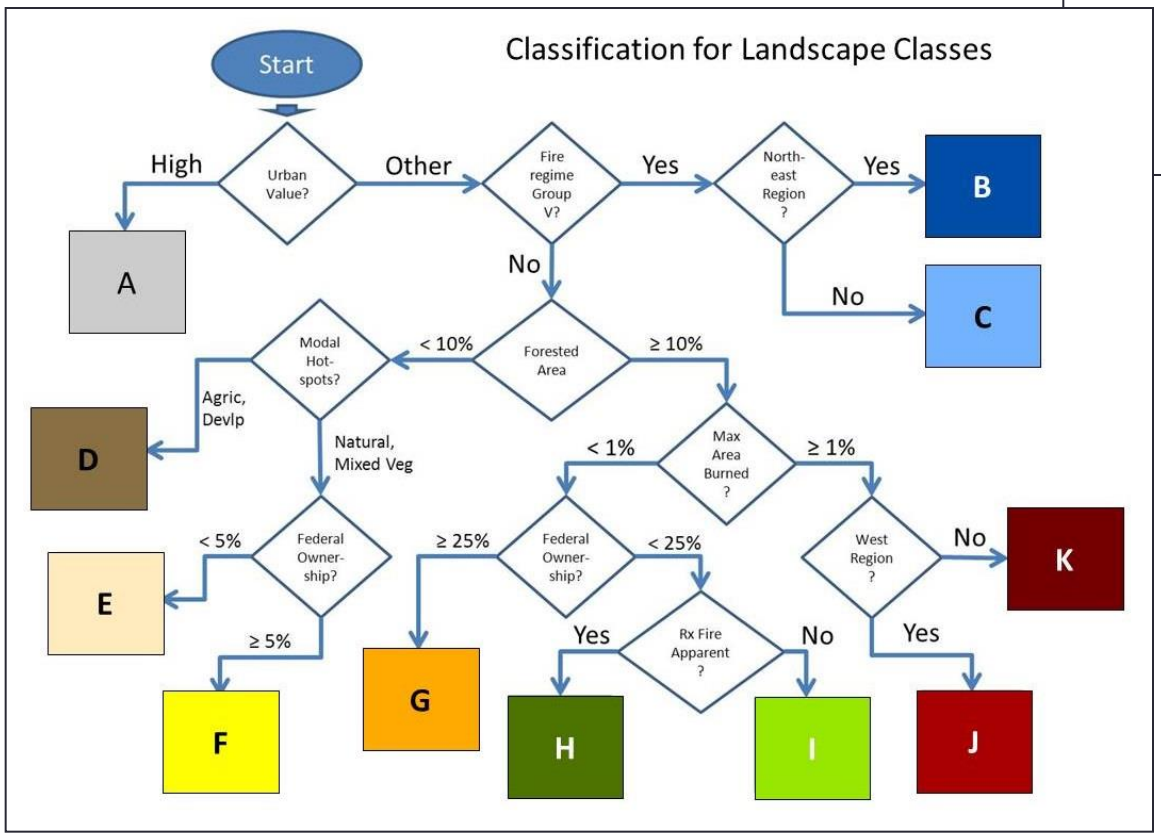




National Characterization

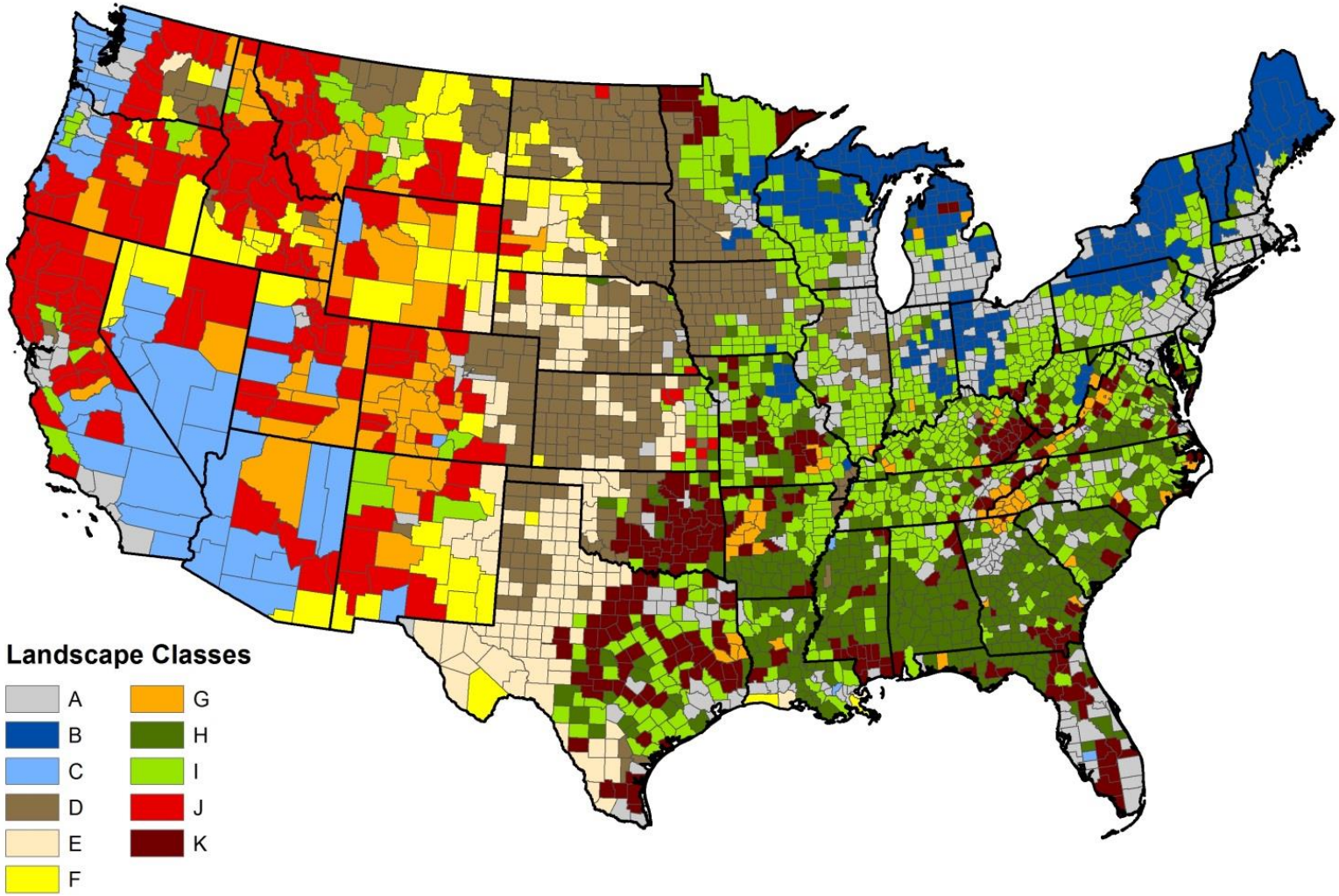
Landscape **Classes**



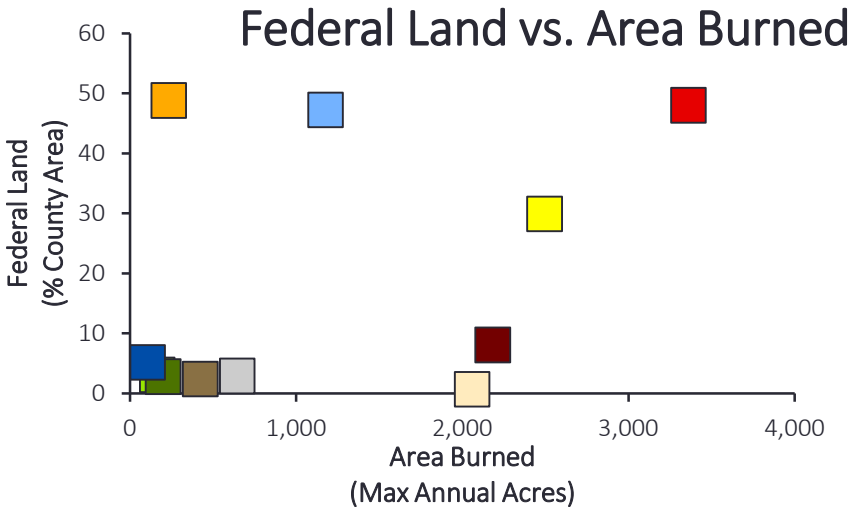


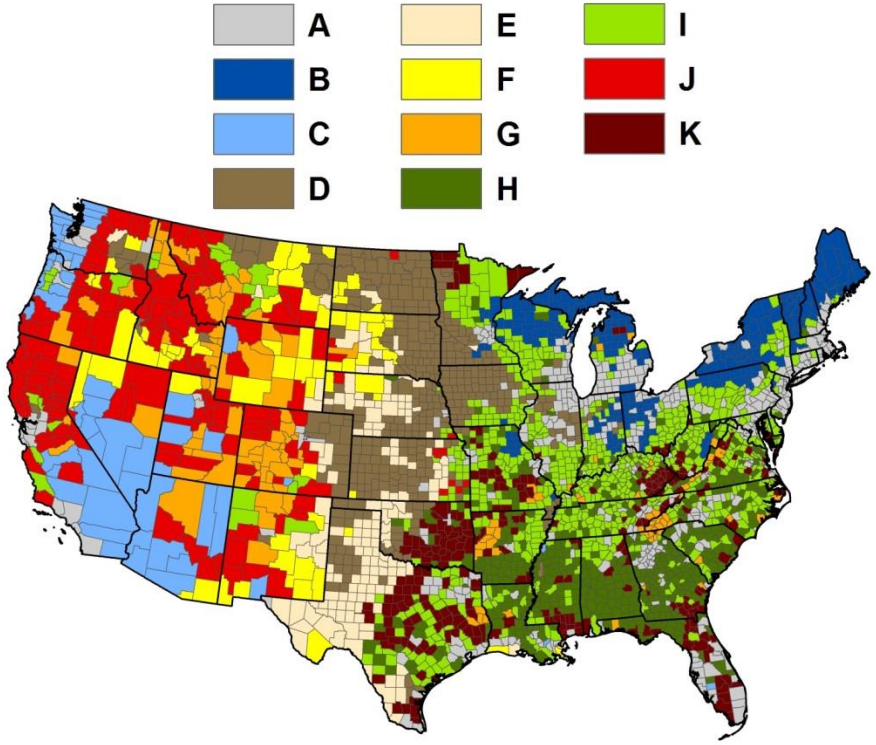
The classification system designed and used in the analysis divides counties into landscape classes where similar conversations about land management objectives and resiliency might occur, using county-level attributes.

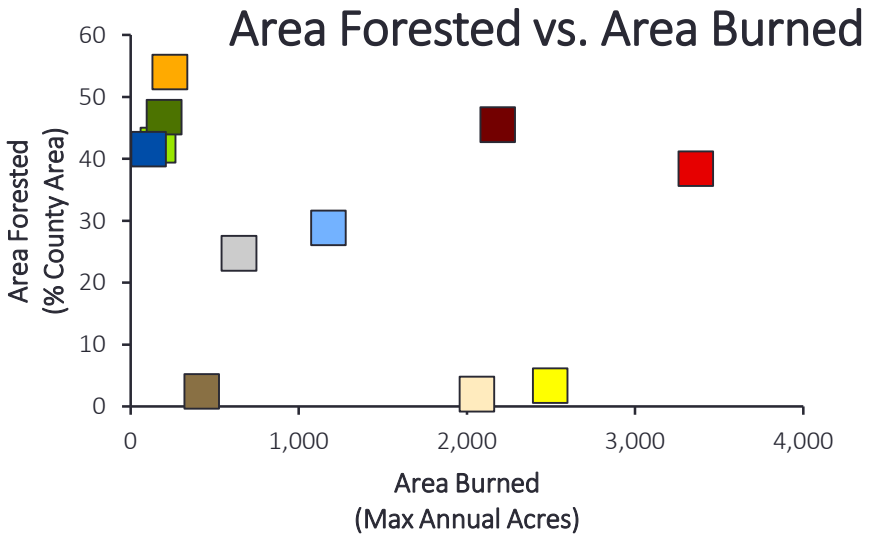
Landscape Classes

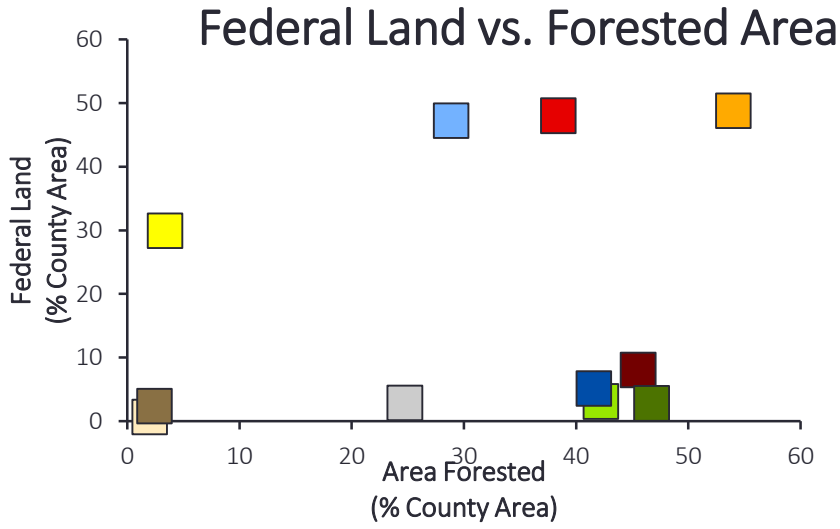


Map of the geographical distribution of the eleven landscape classes across the conterminous United States


Federal Land vs. Area Burned
Federal Land
(% County Area)
0
10
20
30
40
50
60
0
1,000
2,000
3,000
4,000
Area Burned
(Max Annual Acres)

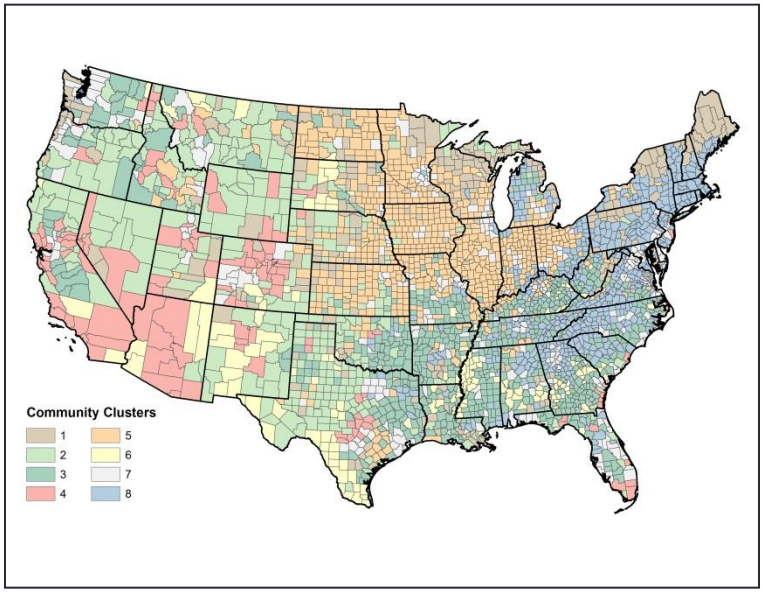

A
B
C
D
E
F
G
H
I
J
K


Area Forested vs. Area Burned
Area Forested
(% County Area)
0
10
20
30
40
50
60
0
1,000
2,000
3,000
4,000
Area Burned
(Max Annual Acres)


Federal Land vs. Forested Area
Federal Land
(% County Area)
0
10
20
30
40
50
60
0
10
20
30
40
50
60
Area Forested
(% County Area)

National Characterization

Community Clusters



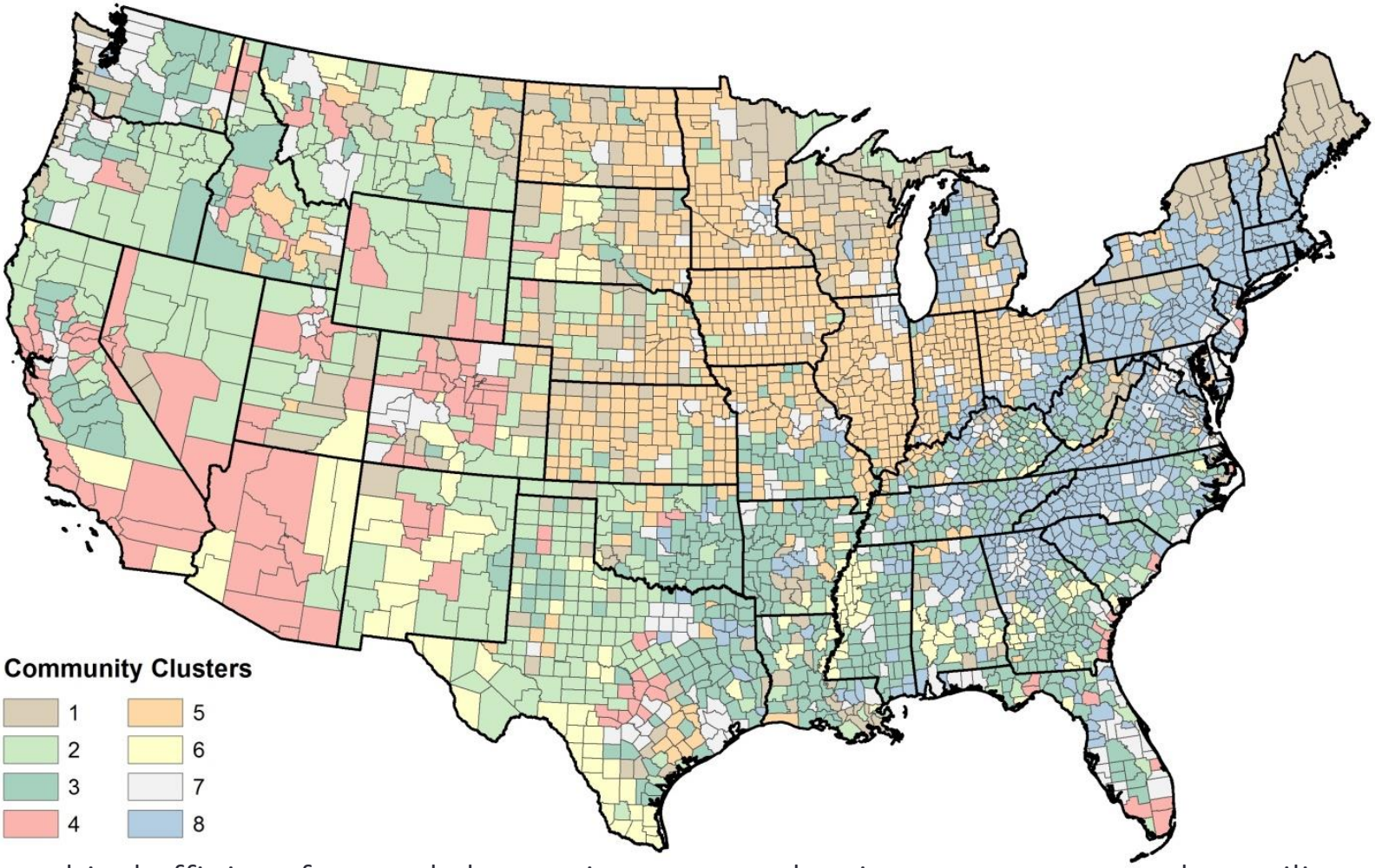
Variables used :

- Amount of area in the **Wildland Urban Interface** and the density of homes within it
- **Demographic** measures of household stress and economic advantage
- Measures of **area burned** by wildfires
- **Ignition density**

The wildfire risk to communities and values can be viewed as the intersection of three principal elements:

- **Wildfire occurrence and extent**
- **Homes and communities**
- **Social and economic resources**

Community Clusters



Geographical affinity of several clusters is apparent, but is not as strong as the resiliency classes. This result highlights the fact that there are counties with similar fire histories, WUI patterns, and socioeconomic attributes scattered throughout the country.

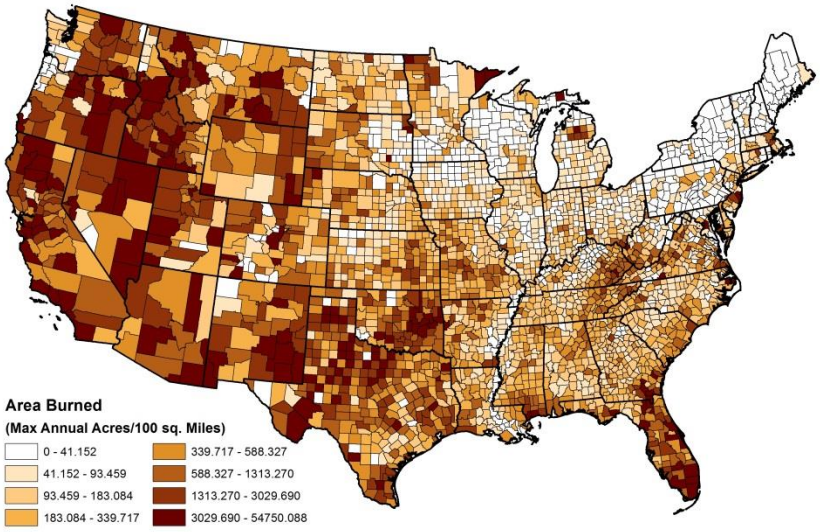
County-level Data Assembled

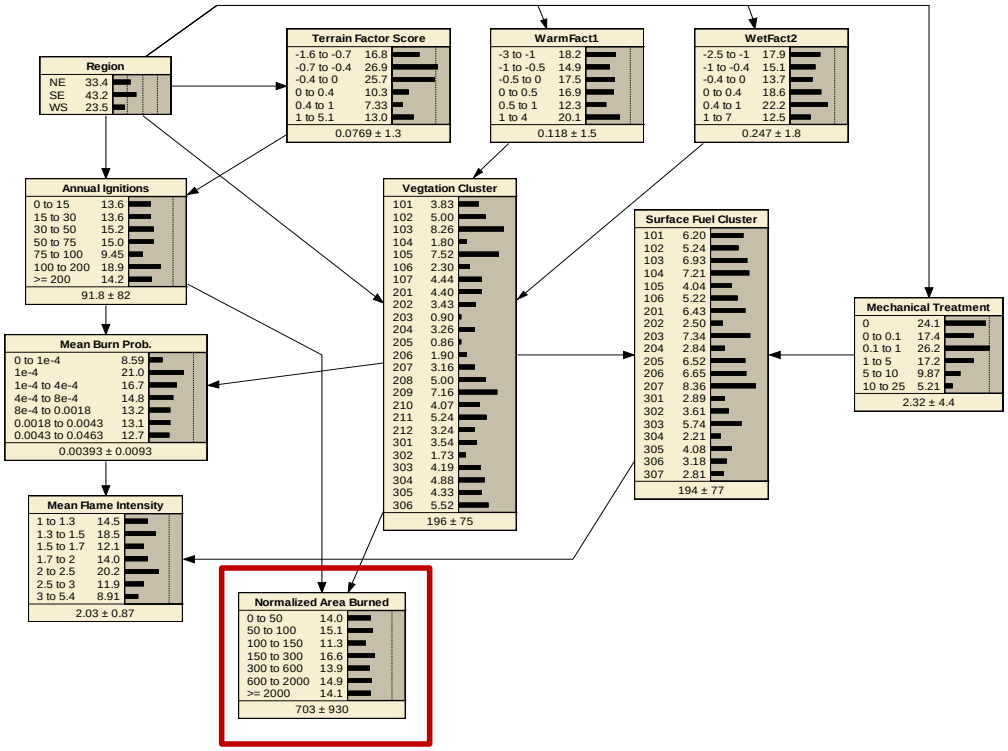
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
1	IDnum	NumCases	resilclass	commclus8	combo_class	region	FIPS5	STATE	COUNTY	stateabv	SQMI	D_Mchn_pct	Dom_PAD	Log_All_Prds	rdbuff_pct	tot_dstb_pct	tot_pct_fed	Tot_Pct_PAD	fmech_35	nfmech_35	Ecoregion	FuelClusR
2	1001	604	H	7	7H	SE	1001	1	1	AL	604	8.964	State	4.194	79.55	8.96	0	2.75	59.03	0.15	231	203
3	1003	1654	I	7	7I	SE	1003	1	3	AL	1653.6	8.684	State	4.152	67.41	9	1.96	10.18	42.61	1.63	232	207
4	1005	905	H	6	6H	SE	1005	1	5	AL	904.5	10.894	State	4.349	67.86	10.94	0.7	5.26	51.91	0.02	231	203
5	1007	626	H	3	3H	SE	1007	1	7	AL	626.2	12.774	USFS	4.061	76.84	12.81	15.94	19.81	68.33	1.03	231	201
6	1009	651	I	8	8I	SE	1009	1	9	AL	650.6	4.822	State	3.838	90.9	4.82	0	0.09	61.61	2.57	231	203
7	1011	626	H	6	6H	SE	1011	1	11	AL	626.1	6.429	State	4.076	59.86	6.43	0	0.75	47.26	0.04	231	203
8	1013	778	H	3	3H	SE	1013	1	13	AL	777.8	13.282	None	4.225	70.89	13.28	0	0	60.09	0.00	231	201
9	1015	612	H	8	8H	SE	1015	1	15	AL	612.3	3.564	USFS	3.355	86.94	3.57	16.55	19.2	61.51	0.82	231	203
10	1017	603	H	1	1H	SE	1017	1	17	AL	603	10.78	OGov	3.912	82.92	10.78	0	0.08	68.62	0.15	231	201
11	1019	600	K	3	3K	SE	1019	1	19	AL	600	7.027	OGov	3.922	81.39	7.65	2.65	10.68	52.86	1.73	231	203
12	1021	701	H	8	8H	SE	1021	1	21	AL	700.7	8.36	USFS	4.018	83.05	8.36	5.09	5.98	65.42	0.08	231	203
13	1023	921	H	3	3H	SE	1023	1	23	AL	920.9	16.611	DODE	4.545	62.83	16.61	0.6	1.26	56.61	0.04	231	201
14	1025	1252	H	6	6H	SE	1025	1	25	AL	1252.4	16.311	State	4.723	56.49	16.31	0	4.22	50.64	0.14	231	201
15	1027	606	H	3	3H	SE	1027	1	27	AL	606	7.731	USFS	3.974	83.84	12.03	18.09	18.69	75.35	0.11	231	201
16	1029	561	K	3	3K	SE	1029	1	29	AL	561	9.153	USFS	3.93	76.29	9.16	35.72	36.63	66.88	0.18	231	201
17	1031	680	H	8	8H	SE	1031	1	31	AL	680.4	7.743	DODE	4.023	84.9	7.74	2.99	2.99	56.69	0.00	232	203
18	1033	624	I	5	5I	SE	1033	1	33	AL	623.5	6.257	State	3.663	69.69	6.8	2.22	16.27	40.38	1.31	231	203
19	1035	853	H	6	6H	SE	1035	1	35	AL	852.7	17.522	State	4.327	67.25	17.52	0	0	56.78	0.00	232	203
20	1037	666	H	3	3H	SE	1037	1	37	AL	666.4	13.733	State	4.082	69.81	13.73	0	11.28	62.29	0.18	231	201
21	1039	1044	H	1	1H	SE	1039	1	39	AL	1043.8	10.23	USFS	4.292	83.01	10.23	8.22	11.5	62.02	0.00	232	203
22	1041	611	H	3	3H	SE	1041	1	41	AL	610.9	10.176	State	4.245	77.79	10.18	0	0.14	60.63	0.01	231	201
23	1043	755	I	8	8I	SE	1043	1	43	AL	754.9	4.929	OGov	3.673	94.22	4.93	0	1.73	56.14	2.48	231	203
24	1045	563	H	1	1H	SE	1045	1	45	AL	562.8	6.557	DODE	3.666	85.64	6.56	12.01	12.01	59.78	0.01	231	203
25	1047	994	H	6	6H	SE	1047	1	47	AL	993.8	7.937	OGov	4.18	71.92	7.94	0.35	1.71	49.15	0.37	231	203
26	1049	779	K	8	8K	SE	1049	1	49	AL	778.5	3.371	NPS	3.795	95.8	4.15	1.72	1.92	58.53	0.88	231	203
27	1051	657	H	8	8H	SE	1051	1	51	AL	657.1	4.068	OGov	3.773	87.37	4.07	0	5.08	61.31	0.12	231	203
28	1053	953	H	3	3H	SE	1053	1	53	AL	953.1	15.835	USFS	4.154	71.66	15.84	4.76	5.09	55.84	0.14	232	207
29	1055	549	A	8	8A	SE	1055	1	55	AL	548.8	4.537	OGov	3.571	92.7	4.54	0	2.14	60.23	1.83	231	203
30	1057	629	H	1	1H	SE	1057	1	57	AL	629.3	12.505	State	4	80.77	12.5	0	0.88	70.11	0.58	231	201
31	1059	647	I	3	3I	SE	1059	1	59	AL	646.5	8.632	OFed	3.818	83.4	8.63	3.74	3.88	62.42	0.88	231	201
32	1061	579	H	3	3H	SE	1061	1	61	AL	579	3.269	State	3.91	88.63	3.27	0	1.94	46.18	0.00	232	206
33	1063	660	H	6	6H	SE	1063	1	63	AL	660	11.652	OGov	4.158	63.39	11.65	0.88	2.46	47.15	0.26	231	203
34	1065	657	H	3	3H	SE	1065	1	65	AL	656.5	8.611	USFS	4.193	71.84	8.61	6.96	9.09	49.12	0.10	231	203
35	1067	568	H	1	1H	SE	1067	1	67	AL	568.4	7.781	None	3.925	76.71	7.78	0	0	47.53	0.00	231	203
36	1069	582	H	3	3H	SE	1069	1	69	AL	581.5	2.919	Prvt	3.682	89.44	2.92	0	0	40.18	0.00	232	206
37	1071	1127	I	3	3I	SE	1071	1	71	AL	1126.9	2.935	State	4.005	64.9	3.28	4.64	15.37	40.69	1.28	221	203
38	1073	1124	A	8	8A	SE	1073	1	73	AL	1123.8	6.024	OGov	3.761	85.27	6.02	0	0.51	52.57	3.24	231	203
39	1075	606	H	1	1H	SE	1075	1	75	AL	605.5	13.362	State	3.995	85.38	13.36	0	2.75	74.21	0.00	231	201
40	1077	719	I	3	3I	SE	1077	1	77	AL	718.6	2.089	OGov	3.513	88.21	2.38	3.05	12.9	47.11	0.38	231	203

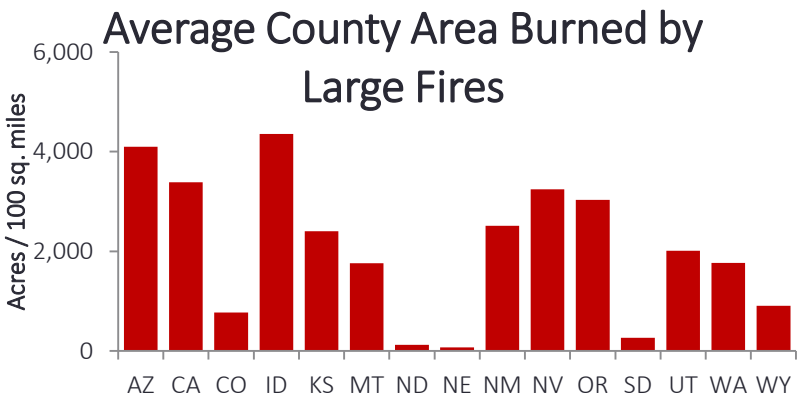
Environmental, socioeconomic, and fire related data.

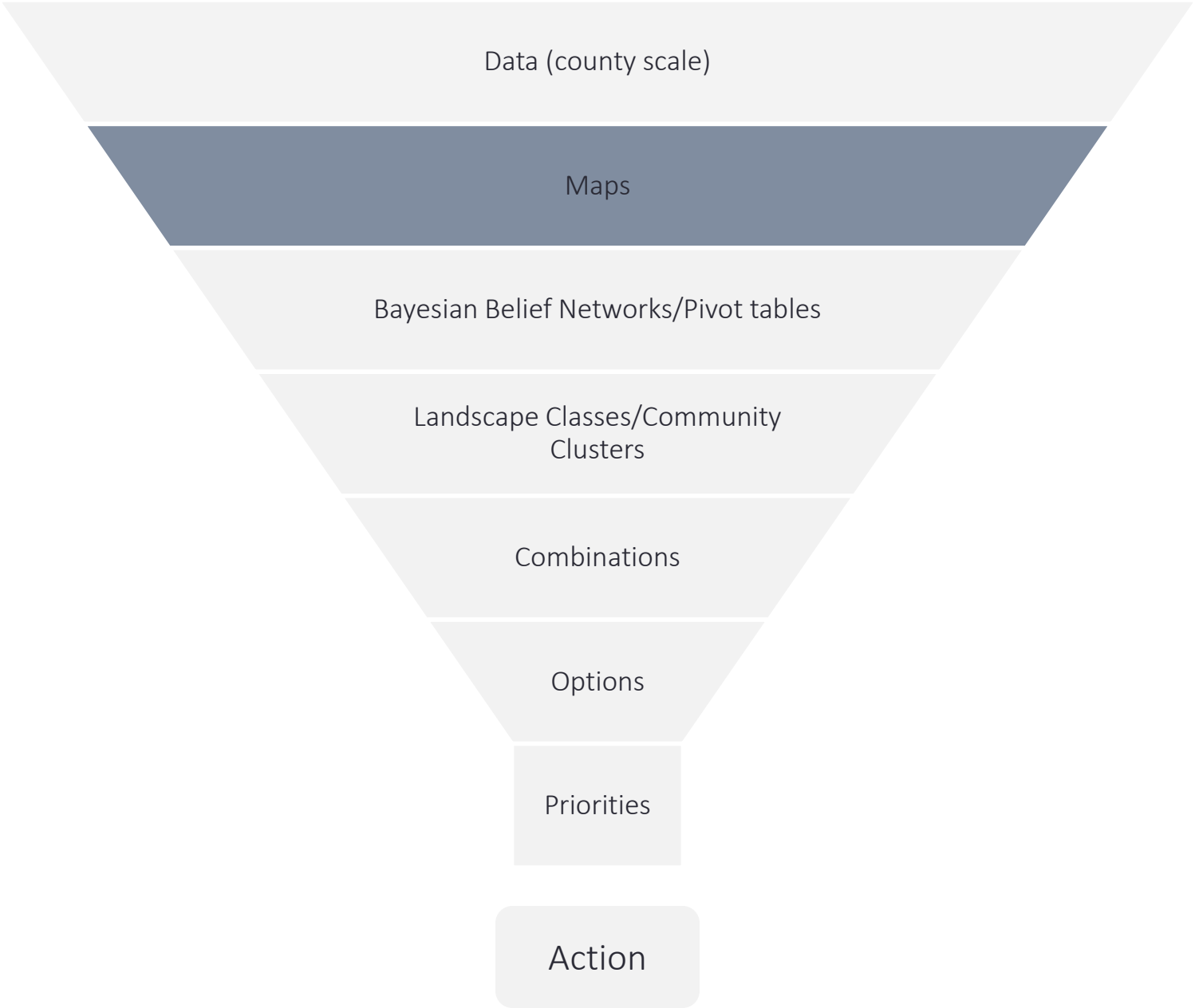
These data have been summarized and consolidated into the COUNTY level in order to provide a comparable unit of analysis across data sets.

Different methods for exploring data

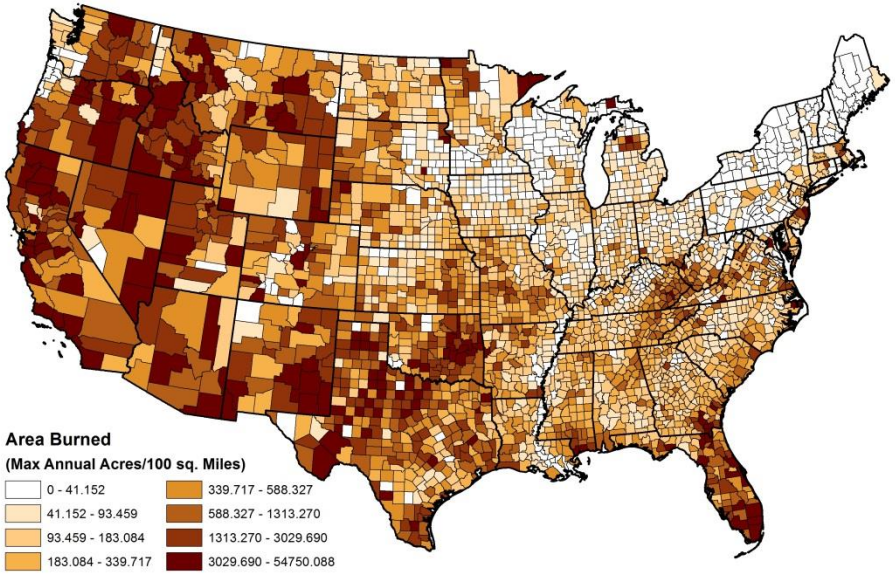


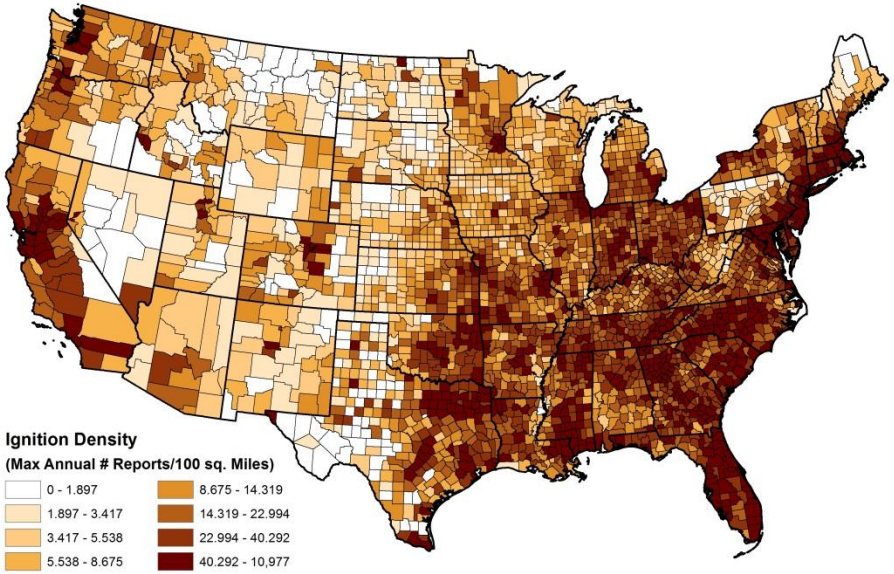


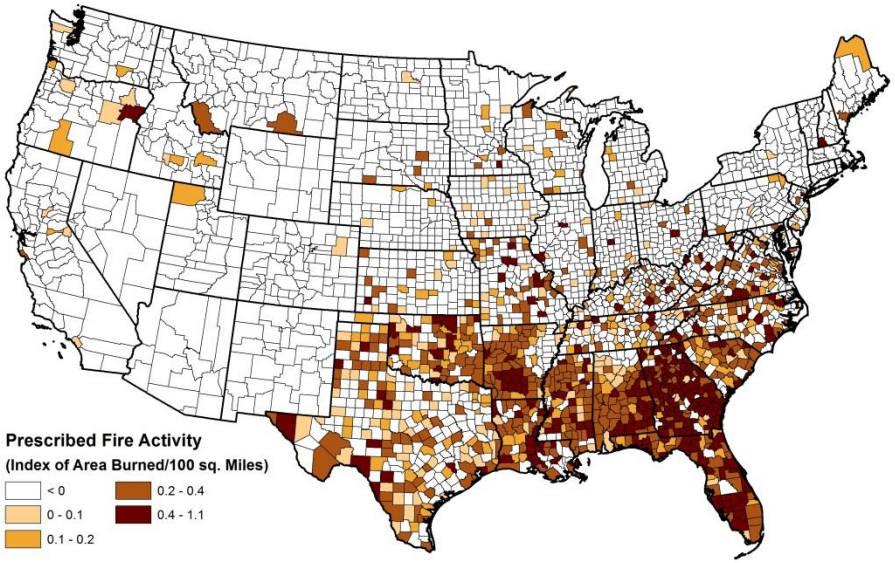


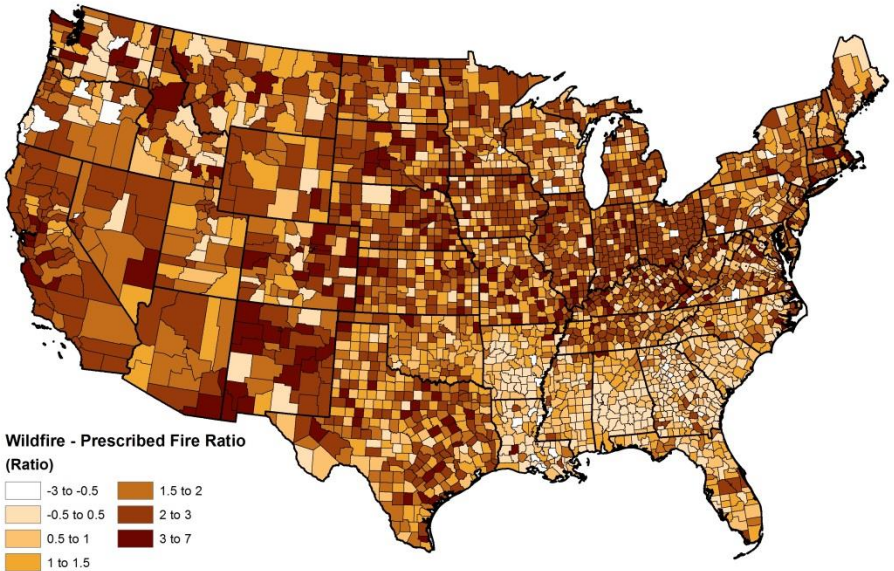

Data (county scale)
Maps
Bayesian Belief Networks/Pivot tables
Landscape Classes/Community Clusters
Combinations
Options
Priorities
Action

Fire Statistics

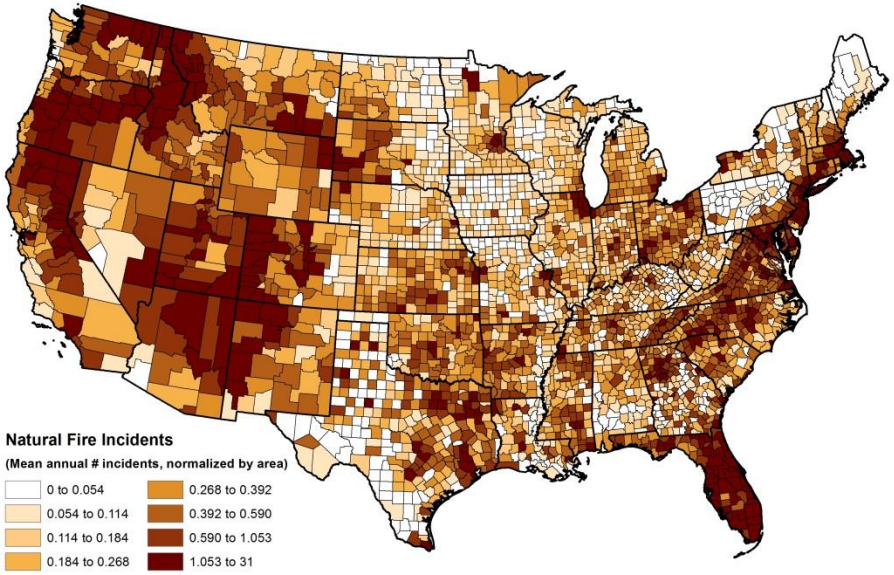


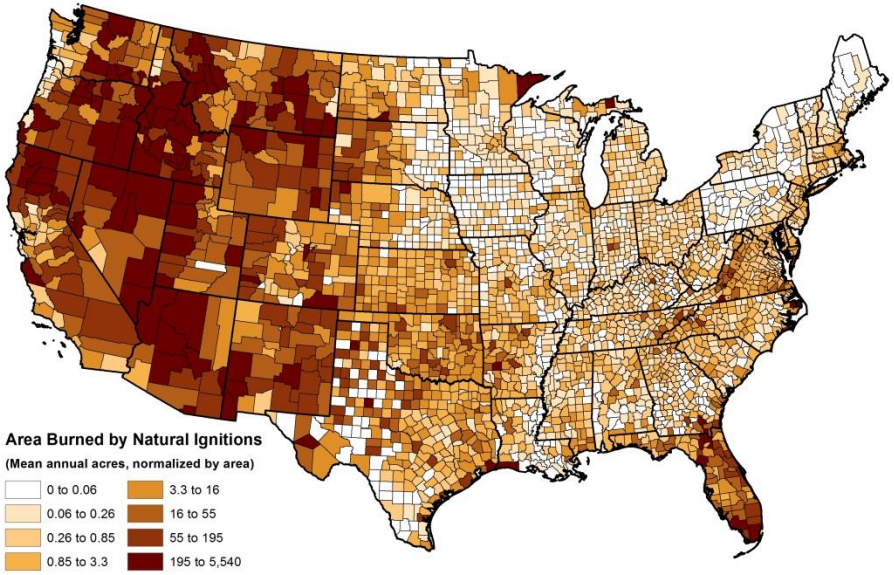


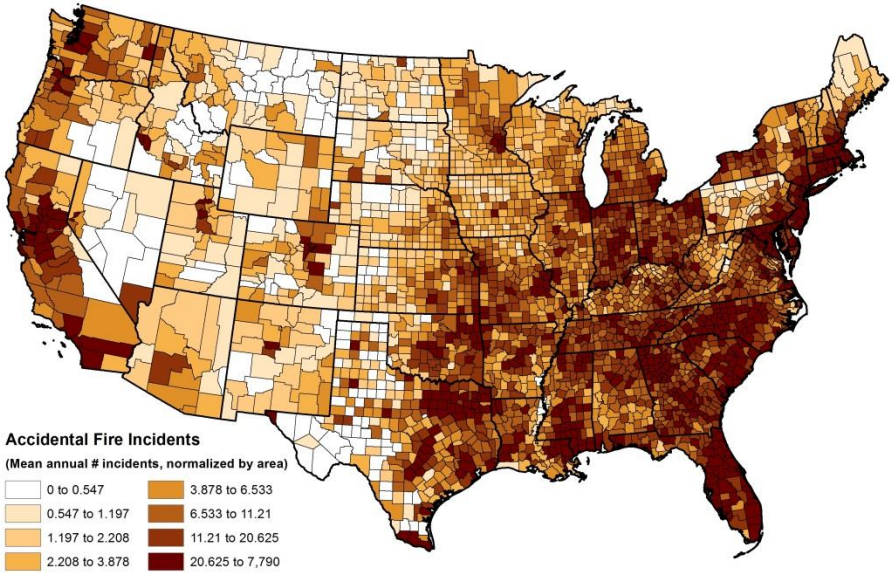


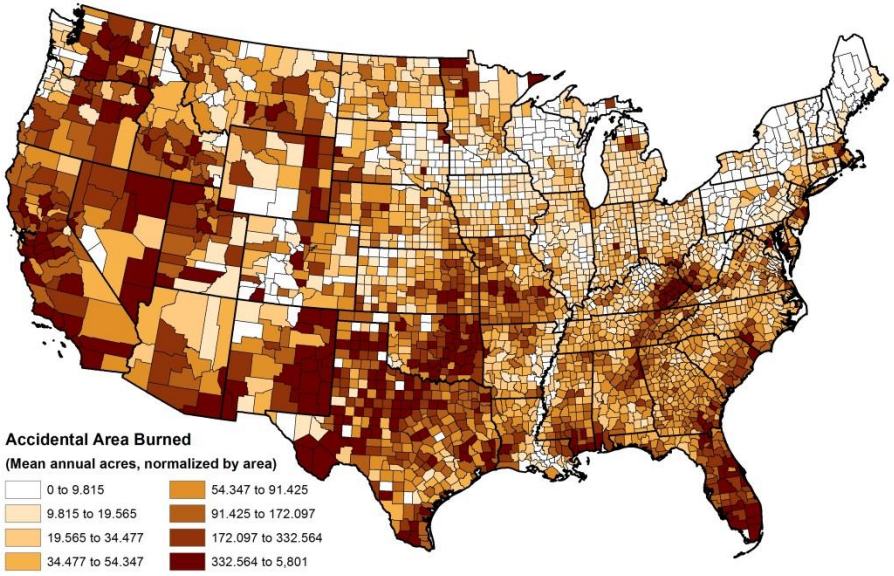


Fire Statistics

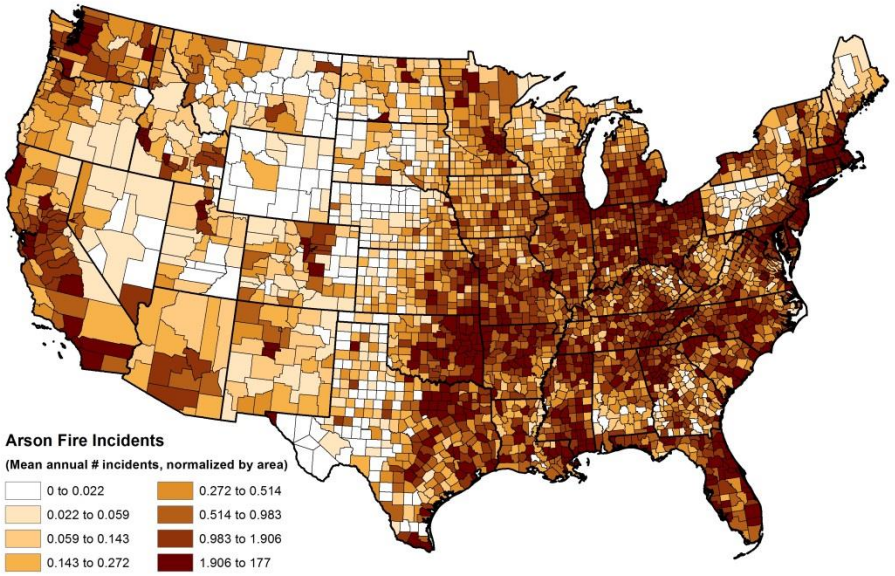


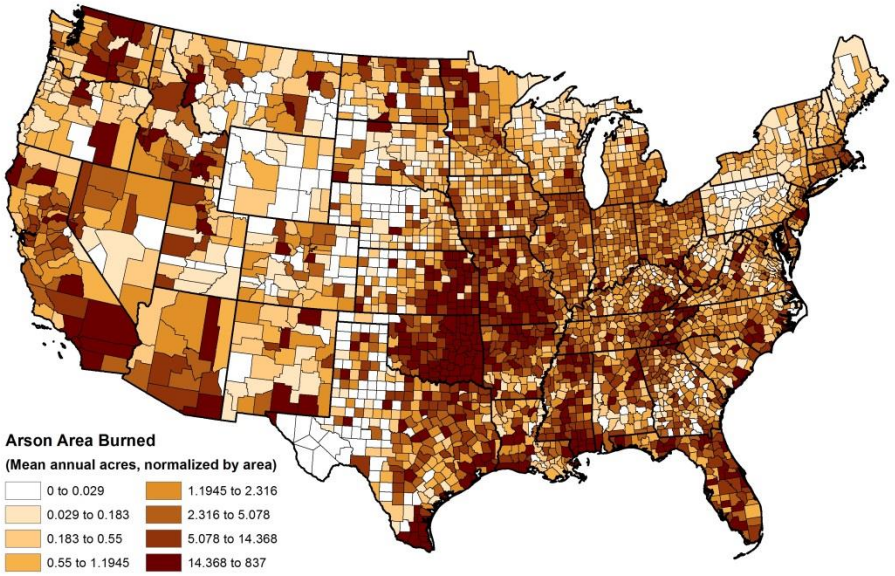


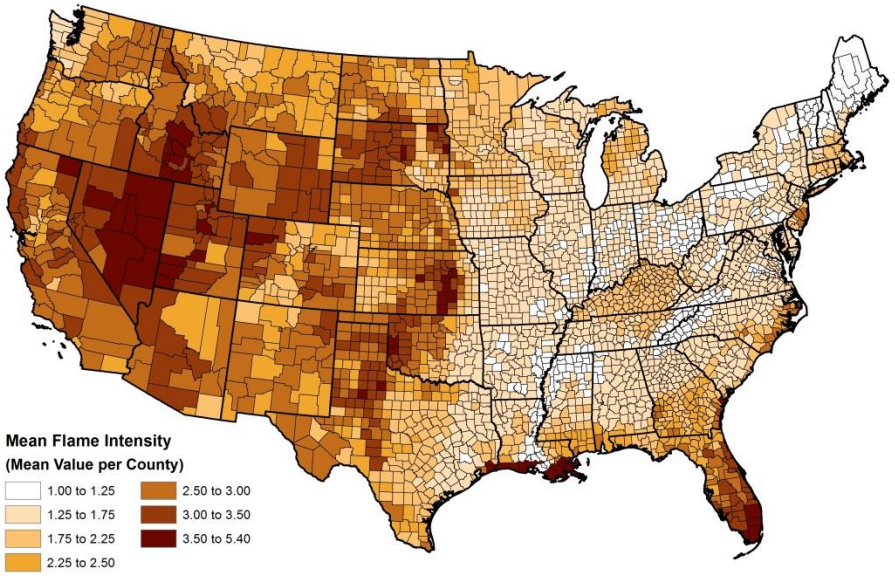


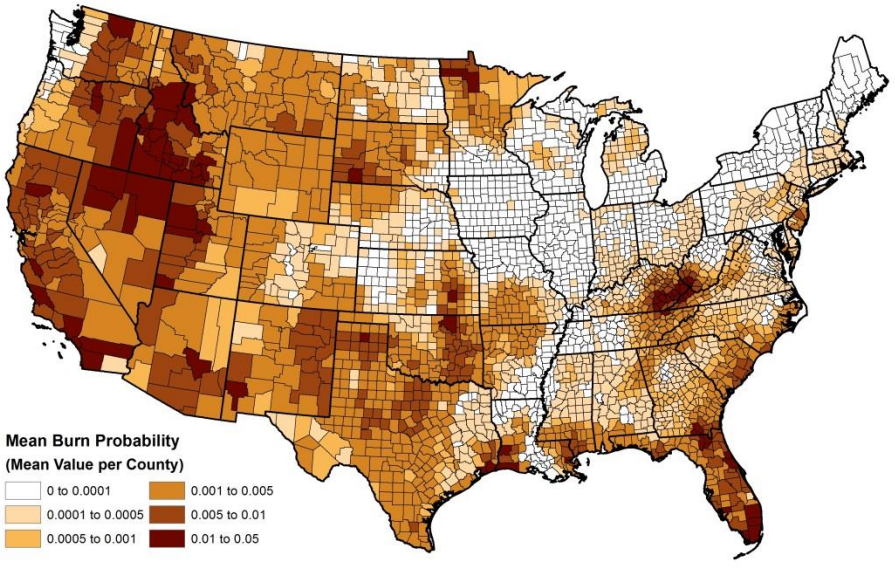


Fire Statistics

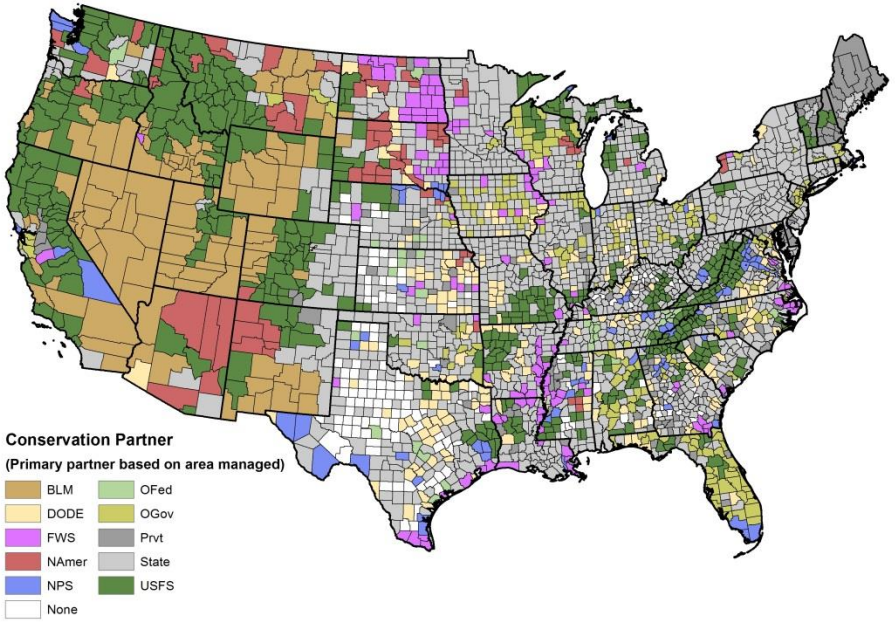


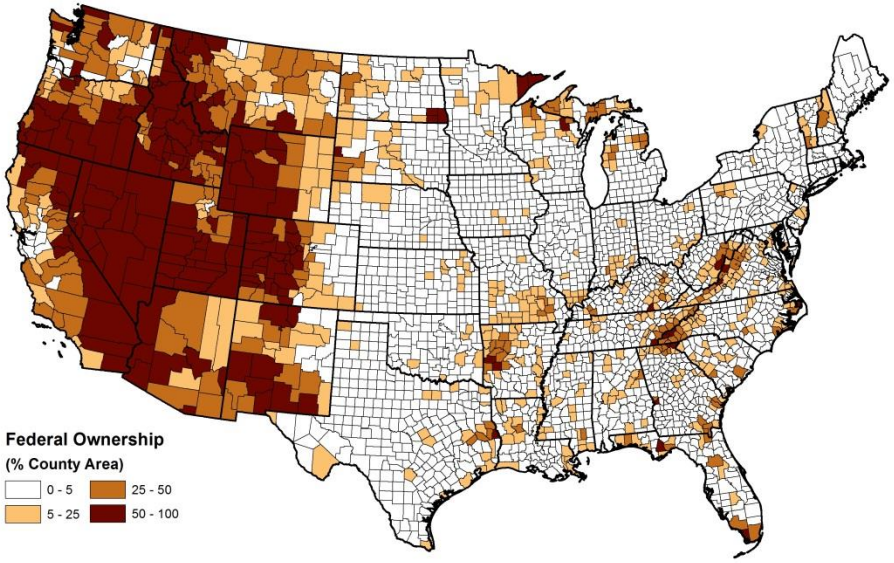


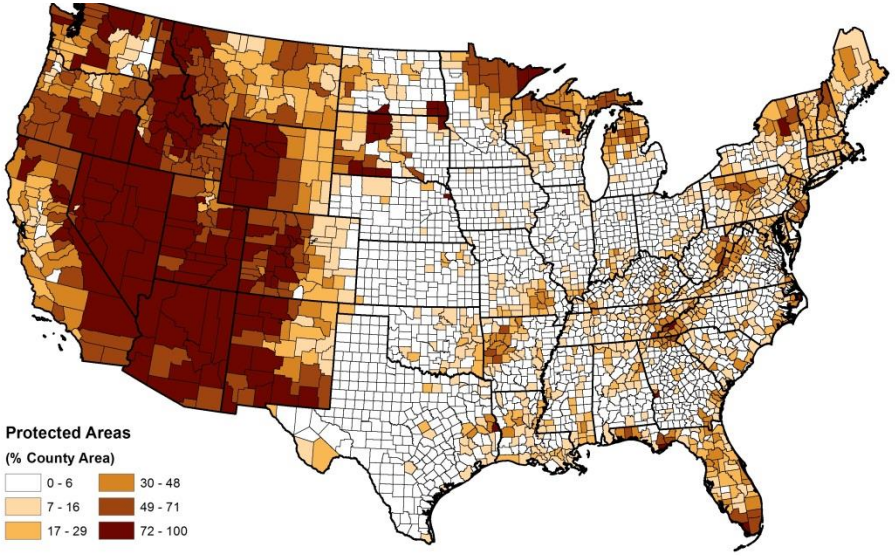


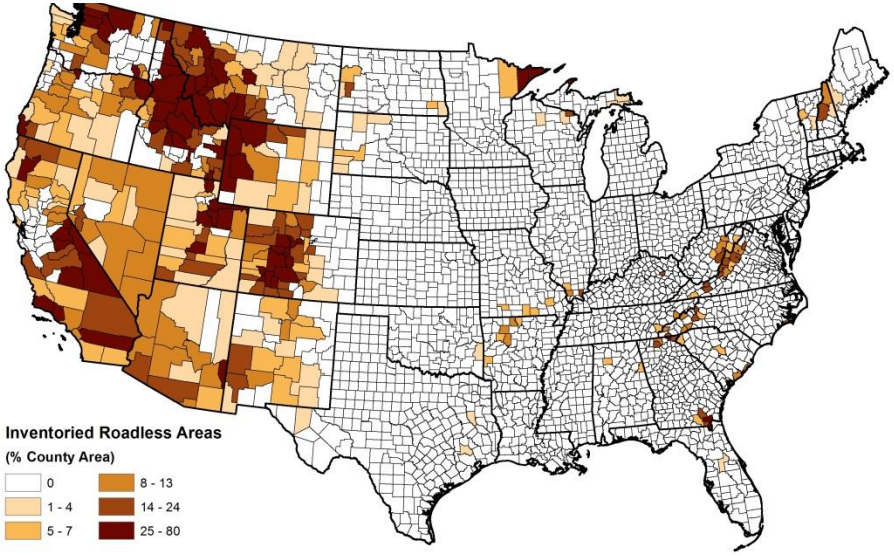


Jurisdictional Variables

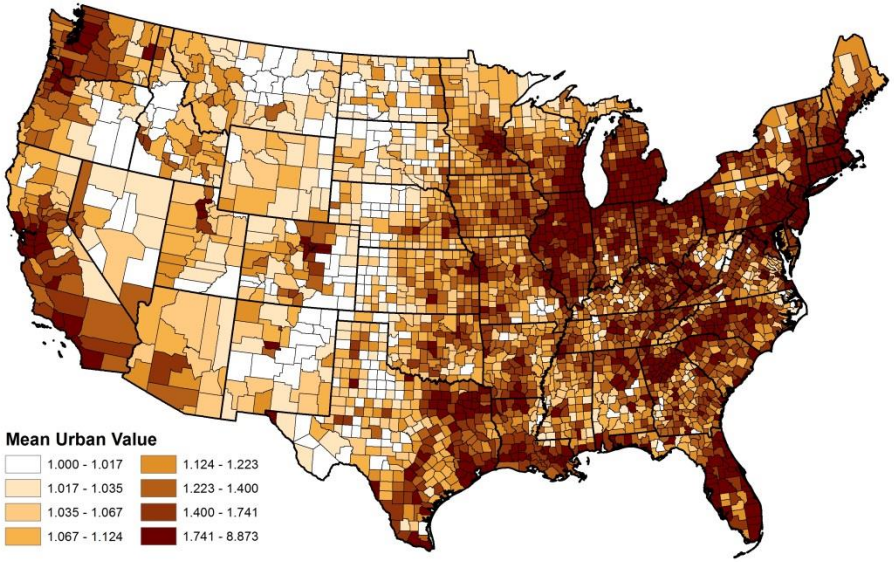


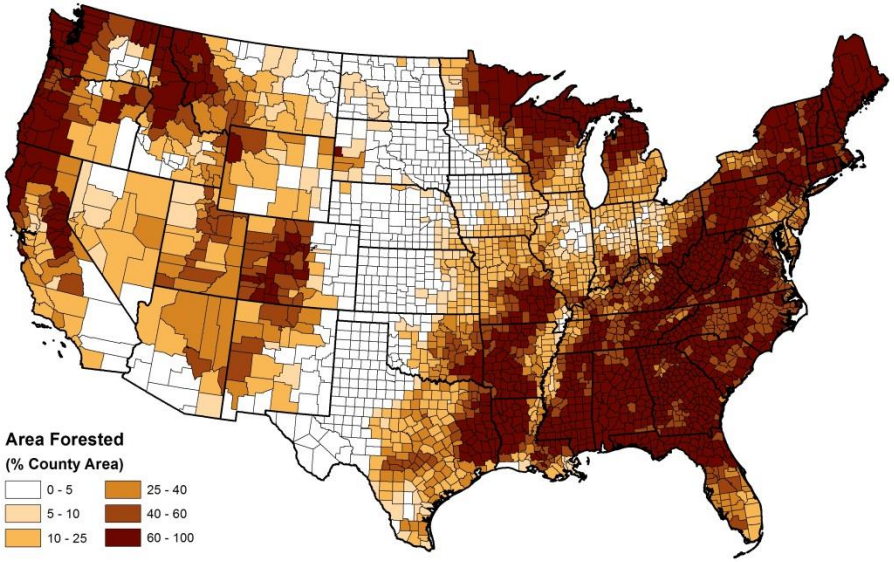


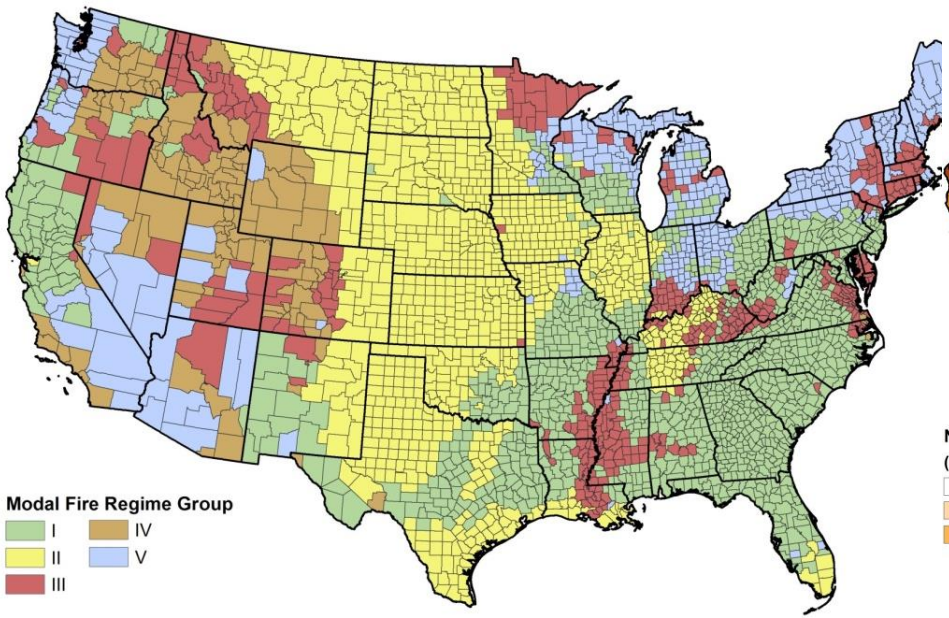


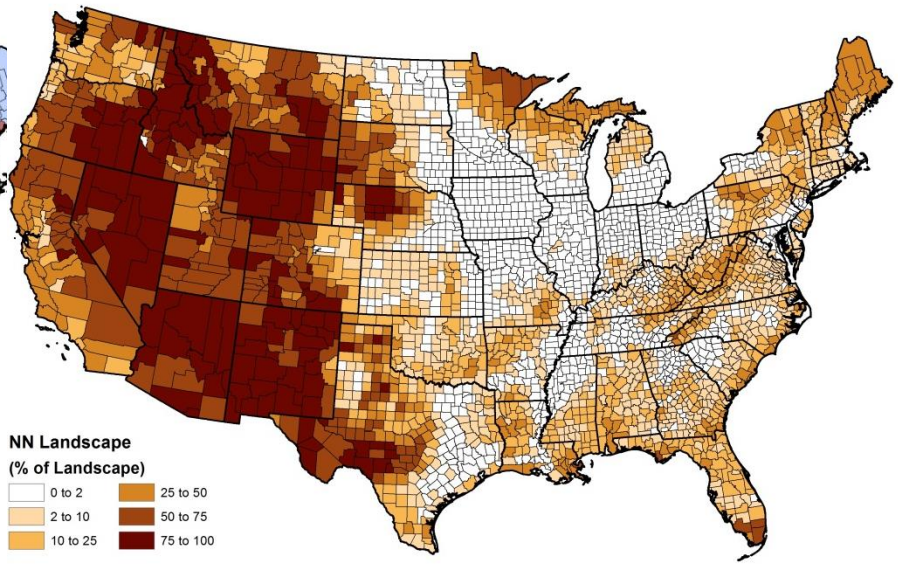


Landcover Variables

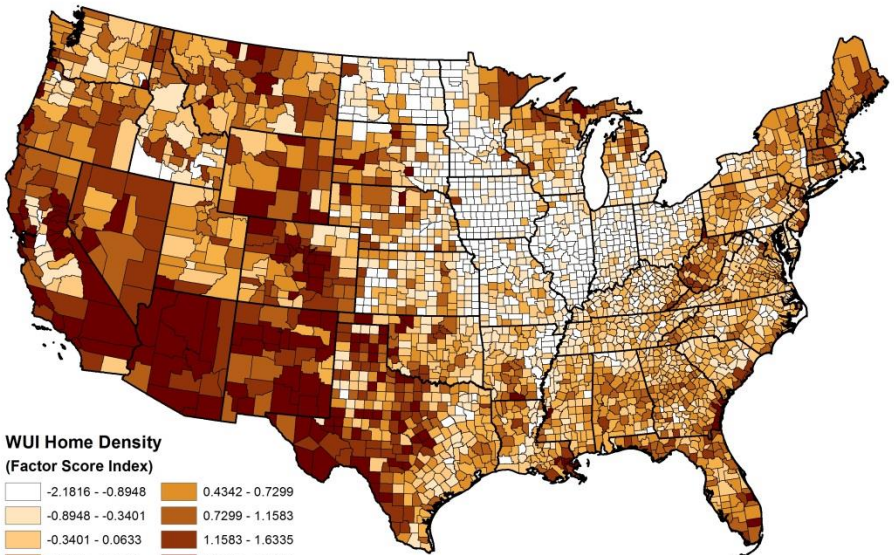


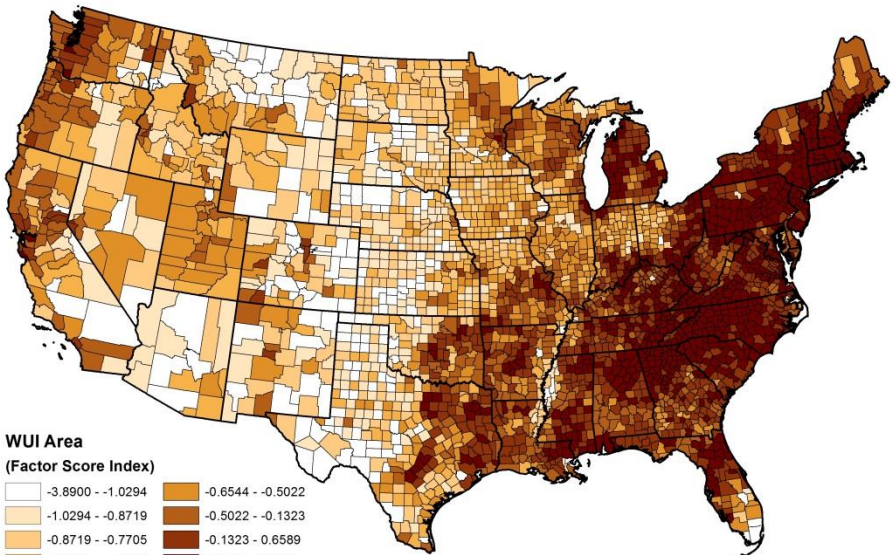


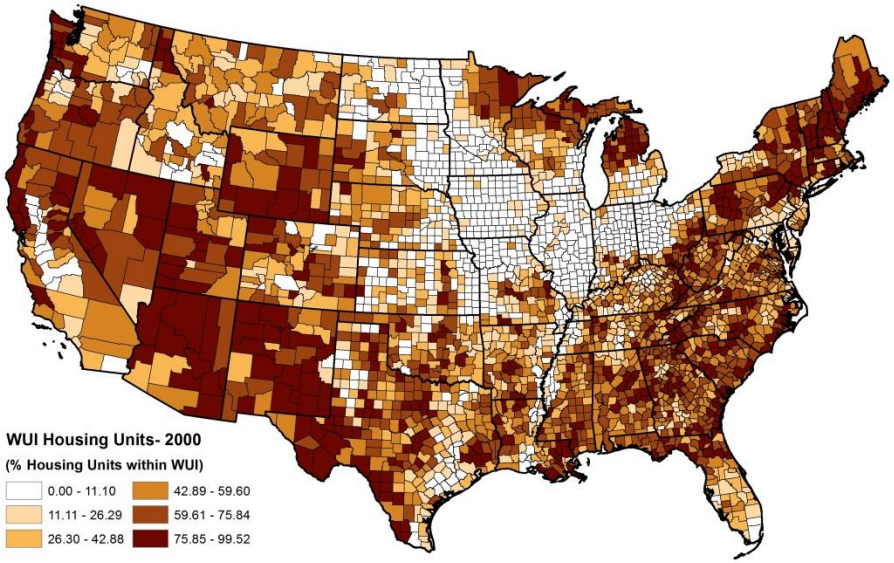


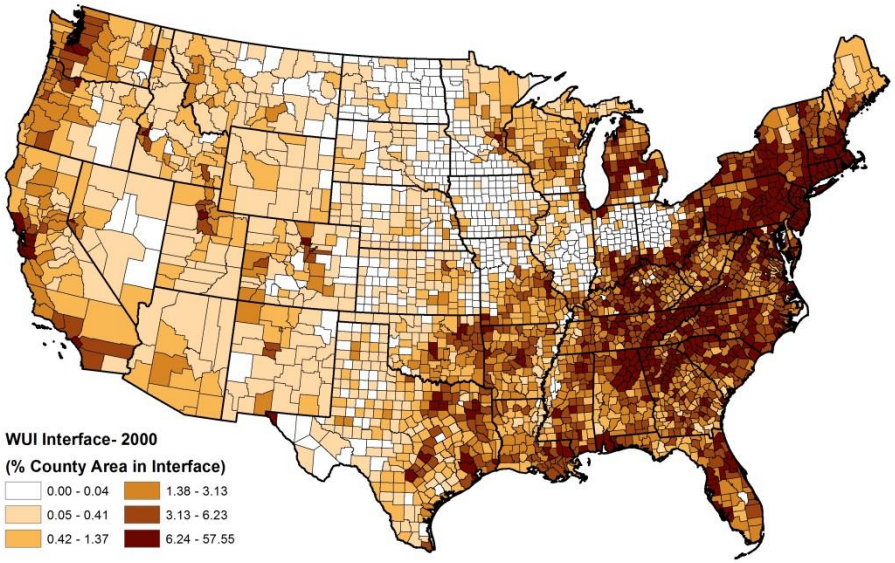


WUI Landcover Variables

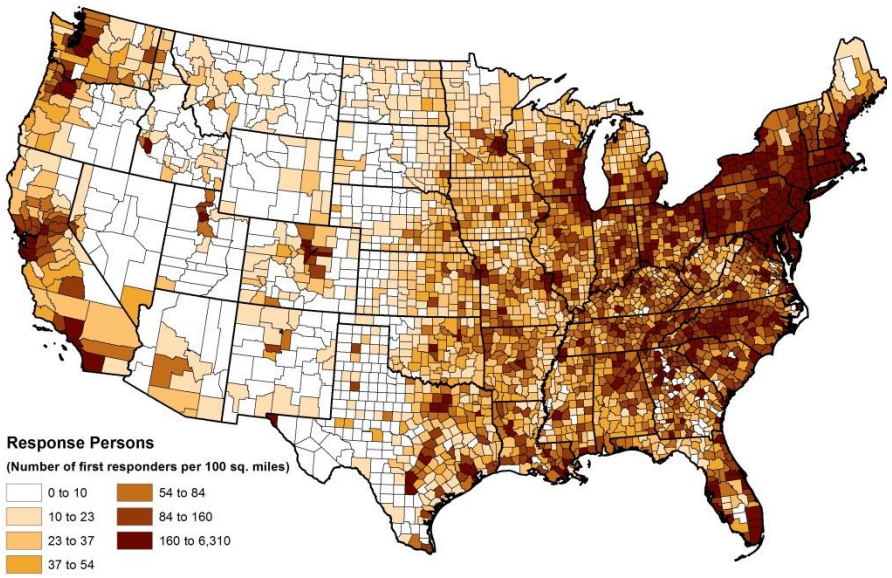


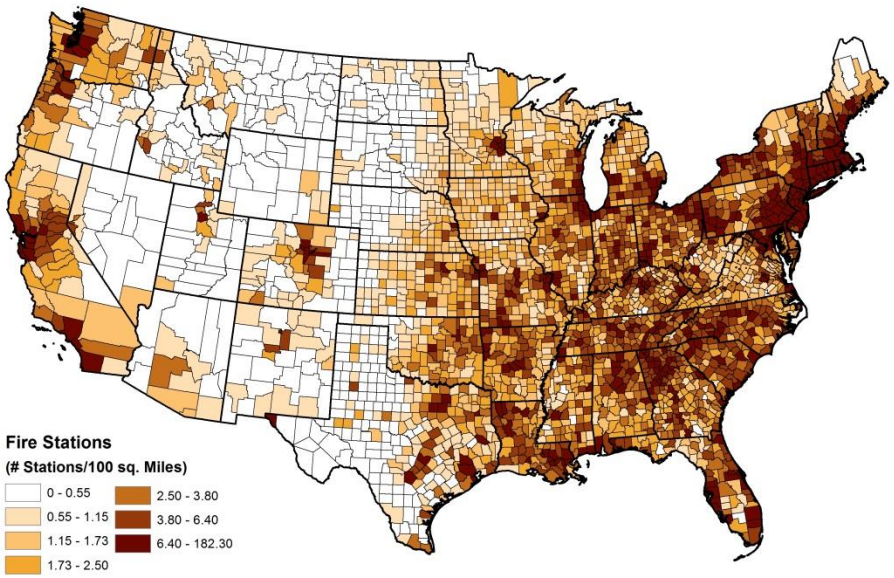


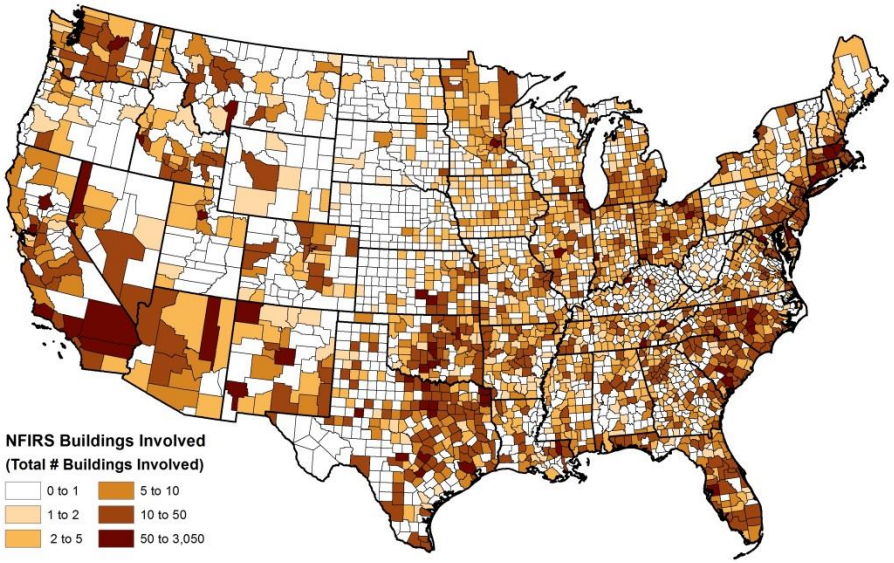


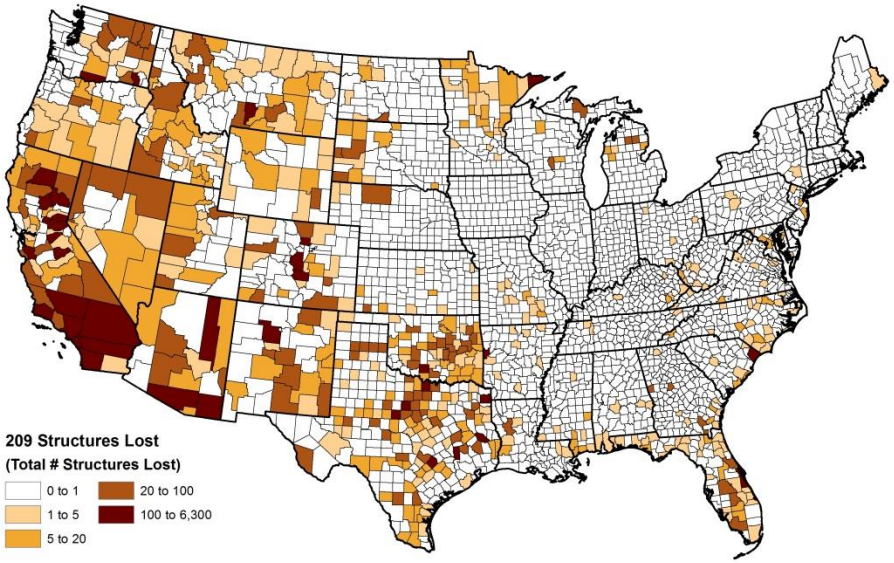


Response Variables

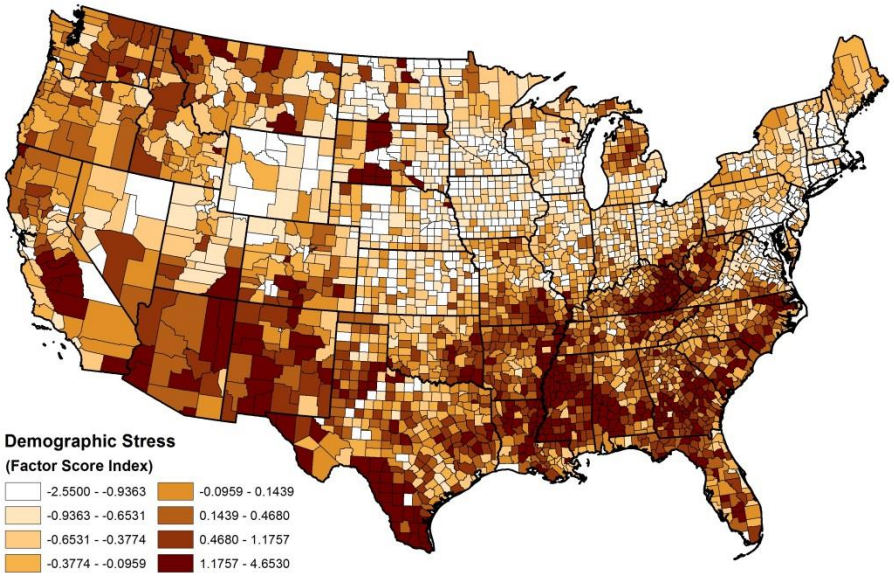


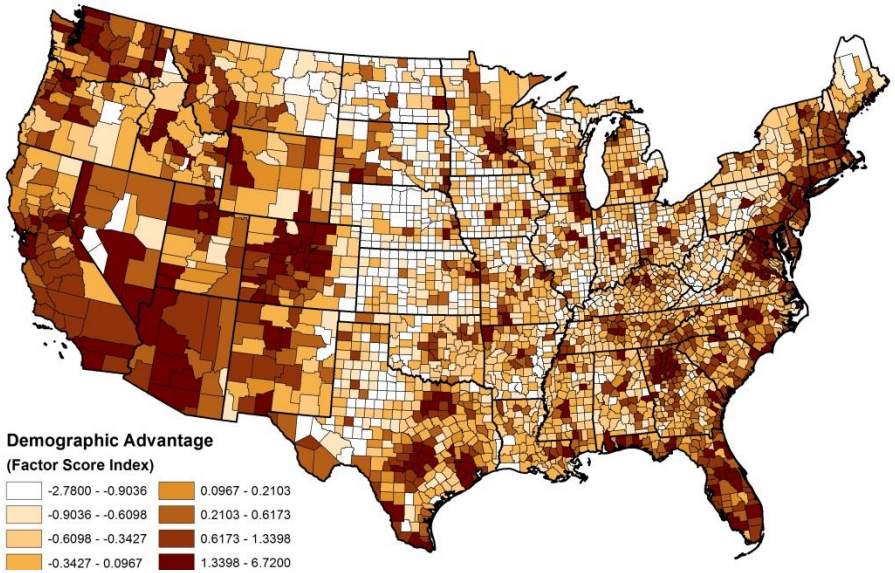


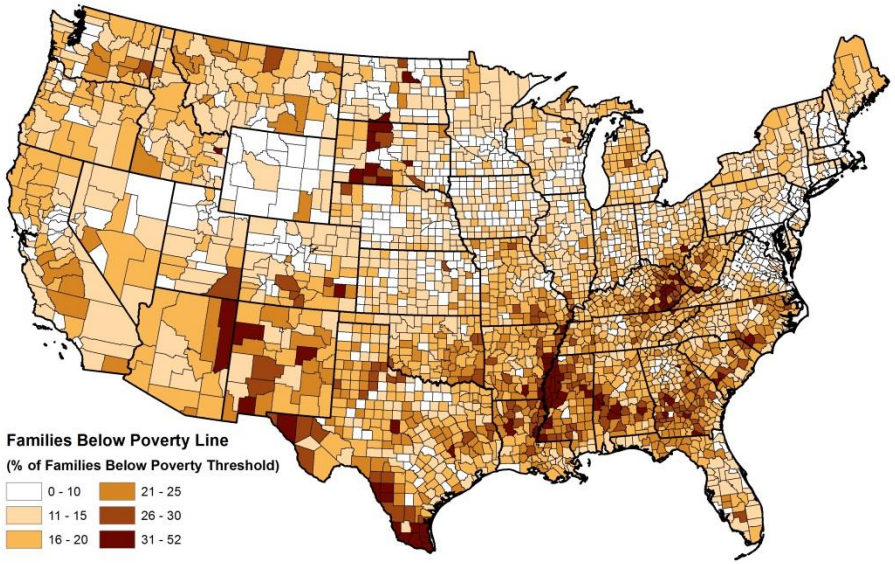


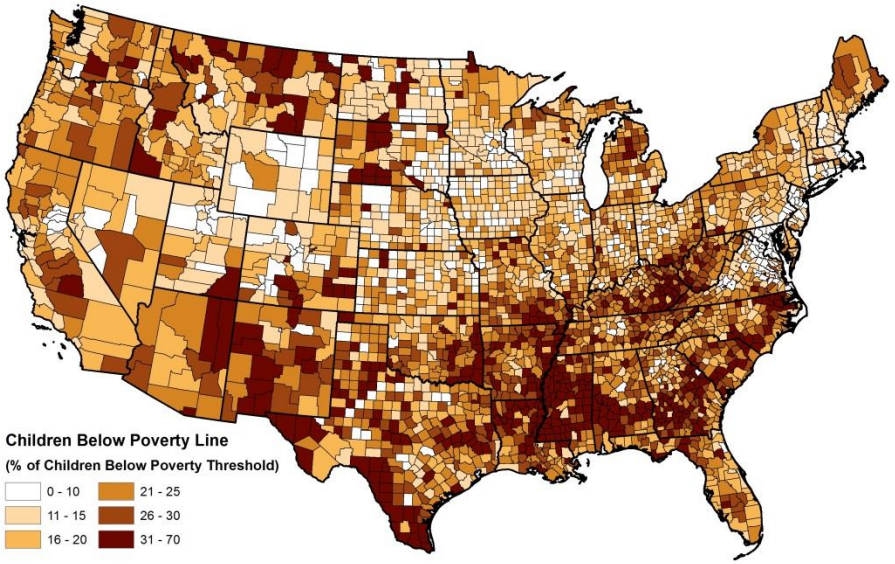


Socioeconomic/Demographic Variables









Economic Variables