
# *2014 Emissions Modeling Platform Spatial Surrogate Documentation*

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# Contents

## Acknowledgements

Eastern Research Group, Inc. (ERG) contributed to this work through the development of the Gulf of Mexico platform and support vessel density Shapefile and through the development of oil and gas production Shapefiles and Surrogates.

# 1 Introduction

This memo describes the collection, processing, and development of updated geospatial data for calculating spatial surrogates to be used in EPA emissions modeling platforms.

Spatial surrogates are used to allocate county level emission inventories into the rectangular grid cells used by urban and regional scale air quality models. Spatial surrogates are based on data at resolutions different from the county-level, such as census tracts or road locations, and can therefore be used to allocate the emissions more specifically than assuming they are uniformly distributed throughout the county. For example, motor vehicle emissions from interstate highways can be placed into the grid cells that intersect the highways themselves, and dry cleaning emissions can be allocated to areas of the county that have higher population, or the areas that have more dry cleaners - if data are available on specific locations of dry cleaners. Spatial surrogates consist of values between 0 and 1.0 that specify the fraction of the county emissions that should be allocated to each grid cell that intersects the county. The spatial surrogate fractions for each county sum to 1.0, except for counties that intersect the edge of a modeling grid and are not completely contained within the modeling domain. The emissions for a specific county within a grid cell are computed by multiplying the surrogate fraction for that county and grid cell by the total emissions for the county (Eyth et al., 2007). Figure 1 illustrates how spatial surrogates impact the emissions levels within the grid cells of a county.

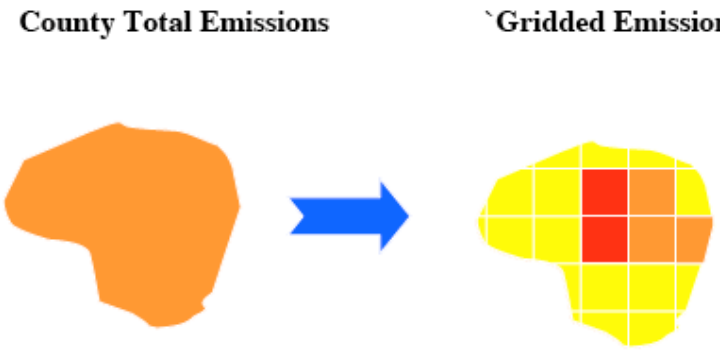


**Figure 1. Spatial surrogate schematic**

Spatial surrogates have three components:

1. Weight Shapefile – geospatial dataset used for allocating (or weighting) county-level emission inventory sources to a modeling grid. Examples include roadways, population density, or the point locations of marine ports. This memo describes the weight Shapefile updates completed under this Work Assignment.
2. Data Shapefile – geospatial dataset that corresponds to the administrative unit boundaries of the emission inventory. For this Work Assignment, the data Shapefile defines U.S. county boundaries. EPA specified that the year 2014 county boundaries from the U.S. Census be used as the data Shapefile for this Work Assignment.
3. Output grid or polygon – definition of the modeling grid(s) or polygon(s) upon which the spatial surrogates map emission inventories. For this Work Assignment, two output grids include continental U.S. modeling grids at resolutions of 12-km and 4-km.

The U.S. EPA surrogate database was last updated in 2014 for use with the 2011 National Emissions Inventory (UNC-IE, 2014). Those surrogates incorporated new data for most of the weight shapefiles and included several completely new surrogates. Under the current work assignment, UNC-IE updated the spatial surrogates for use with the 2014 National Emissions Inventory (NEI). These updates include the use of 2014 county boundaries and new weight data that have become available since the 2011 NEI surrogate updates. The data and configurations used to update these surrogates are described here. The surrogates described in this memo were generated using a combination of the Surrogate Tool[1] of the Spatial Allocator (SA)[2] and a new, forthcoming PostgreSQL/PostGIS utility.

UNC-IE generated spatial surrogates on the CONUS domain at resolutions of 12-km and 4-km. All of the surrogates were generated on a Lambert Conformal Conic projection (lat_0 = 40° north, lon_0 = 97° west, true_lat1 = 33° north, true_lat2 = 45° north) assuming a spherical earth with a radius of 6,370,000 m. The grid definitions of the three surrogate domains are provided in Table 1.

**Table 1. Surrogate domain definitions**

| Parameter | 12km | 4km |
|---|---|---|
| X-orig | -2,736,000 m | -2,736,000 m |
| Y-orig | -2,088,000 m | -2,088,000 m |
| columns | 444 | 1332 |
| rows | 336 | 1008 |

UNC-IE used the gapfilling, normalization, and quality assurance (QA) tools of the SA to ensure completeness and quality of the surrogates. Normalizing the surrogates eliminates surrogate values that do not equal 1.0, which can result from rounding errors in the surrogate calculations. The QA steps check for surrogates that do not equal 1.0, missing surrogates, and surrogates that are gapfilled. In addition to these tabulated QA summaries, UNC-IE produced spatial plots of the surrogates on each of the CONUS domains. The QA tables, spatial plots, and a README file

[1] http://www.cmascenter.org/sa-tools/documentation/4.0/html/srgtool/SurrogateToolUserGuide_4_0.htm

[2] http://www.cmascenter.org/sa-tools/

describing the surrogates are packaged in a "QA" directory in the 2014 NEI spatial surrogate Linux tar archives. The surrogates, shapefiles, and accompanying QA data are available from the U.S. EPA CHIEF[3] website as part of the OAQPS 2014 emissions modeling platform and from the CMAS Center Data Clearinghouse[4].

UNC-IE collected, created, and prepared several GIS shapefiles for generating the 2014 spatial surrogates. The American Community Survey (ACS) of the U.S. Census includes annual 5-year average estimates that are released between the decadal census. The 2010-2014 ACS (U.S. Census Bureau, 2014) provided the basis for the population and housing surrogates, including the home heating surrogates. Year 2013 roadway data modeling onroad mobile sources came from the U.S. Department of Transportation Highway Performance Monitoring System (HPMS; U.S. DOT, 2013). Rail data came from the 2014 National Transportation Atlas Database (NTAD; U.S. BTS, 2014) and the U.S. Census 2014 TIGER/Line Files (U.S. Census Bureau, 2014). Landcover data from the 2011 National Landcover Database (NLCD; Homer et al., 2015) were used to create several surrogates related to built and natural features. The FEMA HAZUS-MH v2.0, which was released in September 2011, contains building square footage data that were used to identify the locations of different types of built features. The U.S. Forest Service 2016 Planned and Accomplished Timber Harvest was used to create a surrogate for logging equipment and the 2011 USGS Mineral Resources System was used to update the mining equipment surrogate (USGS, 2005). Year 2015 data on energy system commodities from the Energy Information Administration (EIA) were used to create a new surrogate for refineries and tank farms. The Points of Interest (POI) Factory, public golf course shapefile was used to create a new golf course surrogate for use with commercial turf maintenance equipment. Eastern Research Group, Inc. aggregated basin-level HPDI production and activity data to the continental scale for upstream oil and gas sources (Reference).

Several new surrogates were created to support the processing of MOVES mobile sources. The Urban/Rural Restricted/Unrestricted road miles and Annual Average Daily Traffic (AADT) data from HPMS were processed using Federal Highway Administration (FHWA) urban and rural distinctions[5] that are consistent with the roadway classifications in MOVES. UNC-IE updated the Extended Idle Locations shapefile that is used for MOVES rate per hour (RPH) sources.

The NLCD data were leveraged to create several new surrogates that are based on different levels of development intensity. UNC-IE worked with the U.S. EPA on identifying surrogates that reached a middle ground between the non-specific total population (100) surrogate and the overly prescriptive FEMA building square footage surrogates (5**). In creating combinations of the NLCD development intensity landcover categories (e.g. low+medium intensity), we tried to capture the locations of non-point emissions activities in a way that does not concentrate emissions into false hot spots.

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[3] http://www.epa.gov/chief/

[4] http://www.cmascenter.org/download/data.cfm

[5] https://www.fhwa.dot.gov/planning/processes/statewide/related/highway_functional_classifications/section06.cfm

The list of GIS Shapefiles used for the updated spatial surrogates and details of how these data were preprocessed for generating surrogates are provided in Section 2. A Google Spreadsheet (https://docs.google.com/spreadsheets/d/1byvKzcSmuHmzjbRYE8KTmhhAIH2oY9OjKtYBx5eILFg/edit?usp=sharing) that accompanies this document includes the detailed specifications of the Shapefiles and surrogates that were collected and updated under this Work Assignment. All of the shapefiles used to develop the 2014 spatial surrogates were processed in their native projections.

# 2 Shapefile Database

## *2.1 U.S. Census-based Surrogates*

### 2.1.1 Population and Housing

The 2010-2014 TIGER/Line database contains American Community Survey (ACS) 5-year estimates of population and housing unit counts at the Census block level for each state. UNC-IE calculated urban and rural areas using Census block groups. Urban was defined as Census block groups that have a population density of at least 1,000 people per square mile and everything else was defined as rural. In addition, Census block groups are classified based on the number of housing units per square kilometers (housing unit density [HUD]) and the attribute HUD_CODE is assigned to census block groups with the following conditions:

1. Urban: HUD >= 1000
2. Suburban: HUD >= 125 and HUD < 1000
3. Exurban: HUD >= 6 and HUD < 125
4. Rural: HUD < 6

The attributes in the file used to compute surrogates include:

- POP2014 – 2014 population
- HU2014 – 2014 housing units
- HUD_CODE – census block group codes; 1=urban, 2=suburban, 3=exurban, 4=rural

*Shapefile Name:* ACS_2014_5HR_PopHousing

*Shapefile Type:* Polygon

*Year*: 2010-2014 5-year average

*Spatial Coverage:* All U.S. States and territories

*Attributes:* STATEFP,COUNTYFP,TRACTCE,BLKGRPCE,GEOID,NAMELSAD,MTFCC,FUNCSTAT,ALAND,AWATER,INTPTLAT,INTPTLON,Shape_Leng,Shape_Area,GEOID_Data,FIPSSTCO,HU2014,UTIL_GAS,LP_GAS,ELEC,FUEL_OIL,COAL,WOOD,SOLAR,TOTAREA,POPDENS,HUDENS,POP2014,HUCH14_10,POPCH14_10,POP2010,HU2010,POP2000,HU2000,POPD10,HUD14_KM2,HUD_CODE,UACE10,GEOID10,NAME10,LSAD10,MTFCC10,UATYP10,ALAND10,AWATER10,POPD_CODE

*Projection:* Geographic

*Datum:* NAD83

*Spheroid:* Normal Sphere with radius 6,370,000 meters

*Derived Surrogates:* 100, 110, 131, 132, 134, 137, 140

### 2.1.2 Home Heating Fuels

The American Community Survey (ACS) is a U.S. Census project that collects yearly demographic and housing information from randomly selected households throughout the U.S. The data are aggregated in 5 and 10-year increments to provide Census tract estimates for the statistics collected during the survey. Home heating fuel type from the ACS was used to develop spatial surrogates for home heating sources (i.e. residential wood combustion) in the nonpoint inventory. The ACS 5-year 2014 survey results that were released in 2015 represent data collected from 2001-2014. These data were used to create home heating surrogates.

The attributes in the file used to compute surrogates include:

- UTIL_GAS - number of housing units using Utility Gas for primary heating
- WOOD - number of housing units using Wood for primary heating
- FUEL_OIL - number of housing units using Fuel Oil for primary heating
- COAL - number of housing units using Coal for primary heating
- LP_GAS - number of housing units using Bottled Gas for primary heating

*Shapefile Name:* ACS_2014_5HR_PopHousing

*Shapefile Type:* Polygon

*Year*: 2010-2014 5-year average

*Spatial Coverage:* All U.S. States and territories

*Attributes:* STATEFP,COUNTYFP,TRACTCE,BLKGRPCE,GEOID,NAMELSAD,MTFCC,FUNCSTAT,ALAND,AWATER,INTPTLAT,INTPTLON,Shape_Leng,Shape_Area,GEOID_Data,FIPSSTCO,HU2014,UTIL_GAS,LP_GAS,ELEC,FUEL_OIL,COAL,WOOD,SOLAR,TOTAREA,POPDENS,HUDENS,POP2014,HUCH14_10,POPCH14_10,POP2010,HU2010,POP2000,HU2000,POPD10,HUD14_KM2,HUD_CODE,UACE10,GEOID10,NAME10,LSAD10,MTFCC10,UATYP10,ALAND10,AWATER10,POPD_CODE

*Projection*: Geographic

*Datum:* NAD83

*Spheroid:* Normal Sphere with radius 6,370,000 meters

*Derived Surrogates*: 150, 160, 170, 180, 190

## *2.2 Transportation Surrogates*

### 2.2.1 Roadways

UNC-IE aggregated state-level 2013 HPMS Shapefile data to create a national file with urban and rural roadways. UNC-IE projected the data to a U.S. national Lambert Conformal Conic projection on a normal sphere. FHWA urban and rural roadway classifications encoded in the HPMS data were used to distinguish between urban and rural roadways. The HMPS F_System codes (Table 2) were used to distinguish the different road types (DOT, 2013).

**Table 2. HMPS F_System codes**

| Code | Description | |
|---|---|---|
| | Rural | Urban |
| 1 | Interstate | Interstate |
| 2 | Other Principal Arterial | Other Freeways and Expressways |
| 3 | Minor Arterial | Other Principal Arterial |
| 4 | Major Collector | Minor Arterial |
| 5 | Minor Collector | Collector |
| 6 | Local | Local |

The MOVES 2014 road types (EPA, 2016: Table 2-4) (Table 3) were then mapped to the HPMS F_System codes using the FHWA urban/rural codes that are also included in the HPMS database.

**Table 3. MOVES2014 road type codes.**

| roadTypeID | Description | FHWA Functional Types |
|---|---|---|
| 1 | Off Network | Off Network |
| 2 | Rural Restricted Access | Rural Interstate |
| 3 | Rural Unrestricted Access | Rural Principal Arterial, Minor Arterial, Major Collector, Minor Collector & Local |
| 4 | Urban Restricted Access | Urban Interstate & Urban Freeway/Expressway |
| 5 | Urban Unrestricted Access | Urban Principal Arterial, Minor Arterial, Collector & Local |
| 6 | Rural Restricted without Ramps | |
| 7 | Urban Restricted without Ramps | |
| 8 | Rural Restricted only Ramps | |
| 9 | Urban Restricted only Ramps | |
| 100 | Nonroad | |

We created the road type (RDTYPE) attribute in the HPMS shapefiles to use for creating surrogates for the MOVES onroad mobile emissions data. The attributes in the HPMS shapefile used to compute surrogates include:

| RDTYPE | Description | HPMS F_System Code |
|---|---|---|
| 2 | Rural Restricted | 1 + rural |
| 3 | Rural Unrestricted | 2, 3, 4, 5 + rural |
| 4 | Urban Restricted | 1, 2 + urban |
| 5 | Urban Unrestricted | 3, 4, 5 + urban |

An additional attribute for annual average daily traffic (aadt) is used to weight the road types by average activity on each road link.

*Shapefile Names*: hpms2013_2014_roads_surrogate_rdtype2, hpms2013_2014_roads_surrogate_rdtype3, hpms2013_2014_roads_surrogate_rdtype4, hpms2013_2014_roads_surrogate_rdtype4

*Shapefile Type:* Line

*Year*: 2013-2014

*Spatial Coverage:* Conterminous U.S.

*Attributes:*

*Projection:* Geographic

*Datum:* NAD83

*Spheroid:*

*Derived Surrogates:* 201, 202, 211, 212, 221, 222, 231, 232, 239, 240, 241, 242, 243, 244

### 2.2.2 Rail Length

UNC-IE used the national 2014 TIGER/Line Shapefile data to create a national railway network file. The TIGER/Line MTFCC codes R1052, R1051, and R1011 were used to define the different classes of rail lines.

The attributes in the file used to compute surrogates include:

- MTFCC – rail classes; 1011=class 1; 1051=class 2; 1052=class 3

*Shapefile Name*: TIGER_2014_Rail

*Shapefile Type:* Line

*Year*: 2014

*Spatial Coverage:* All U.S. States and territories

*Attributes:* LINEARID, FULLNAME, MTFCC

*Projection:* Geographic

*Datum:* NAD83

*Spheroid:* GRS80

*Derived Surrogates:* 260, 280

### 2.2.3 Rail Freight Density

UNC-IE used the 2014 National Transportation Atlas Database (NTAD) freight densities to weight the line Shapefile of rail activity locations. The attribute DENS defines freight densities in Millions of Gross Tons (MGT) for each rail link. The original NTAD database includes freight density categories with the attribute DEN11CODE. UNC-IE mapped the density categories to integer densities for use in the surrogate calculations. Table 4 shows the mapping from the DEN11CODE categories to DENS.

**Table 4. NTAD rail density code mapping**

| DEN11CODE Category | DENS (MGT) |
|---|---|
| Unknown | 1 |
| <5 MGT | 5 |
| 5-10 MGT | 10 |
| 10-50 MGT | 25 |
| 50-100 MGT | 75 |

| | |
|---|---|
| >100 MGT | 100 |

The NTAD RAILTYPE codes were used to define the different classes of rail lines.

The attributes in the file used to compute surrogates include:

- DENS – rail link freight density (MGT); see Table 4
- RAILTYPE – rail classes; 1=class 1,2,3 rail; 2=Amtrak; 3=Commuter rail

*Shapefile Name*: NTAD_2014_Rail

*Shapefile Type:* Line

*Year*: 2014

*Spatial Coverage:* All U.S. States, no territories

*Attributes* FRAARCID,MILES,STATEAB,STATEFIPS,CNTYFIPS,STCNTYFIPS, FRAREGIONS, RROWNER1,RROWNER2,RROWNER3,TRKRGHTS1,TRKRGHTS2, TRKRGHTS3, TRKRGHTS4,TRKRGHTS5,TRKRGHTS6,TRKRGHTS7,TRKRGHTS8, TRKRGHTS9,STRACNET,SIGSYS,TRACKS,SUBDIV,FRFRANODE,TOFRANODE,NET, PASSNGR,YARDS,INT_TYPE,DEN11CODE,DENS,RAILTYPE

*Projection:* Geographic

*Datum:* WGS84

*Spheroid:* WGS84

*Derived Surrogates:* 261, 271, 272, 273

### 2.2.4 Rail Yards

Michelle Bergin and Byeong Kim of GA DNR provided a spreadsheet of rail yard locations and emissions collected as part of the Eastern Regional Technical Advisory Committee (ERTAC) railway inventory development and improvement effort (Bergin et al., 2009). UNC-IE converted this spreadsheet to a point Shapefile for generating a rail yard surrogate for the U.S. The surrogate is based on the sum of the NOx and PM2.5 emissions at the rail yard locations in the ERTAC rail yard inventory.

The attributes in the file used to compute surrogates include:

- NOXPMTOT – total of NOx and PM2.5 emissions at each rail yard

*Shapefile Name*: ERTAC_railyard_WRF

*Shapefile Type:* Point

*Year*: 2012

*Spatial Coverage:* All U.S. States, no territories

*Attributes* OBJECTID, OWNER1, OWNER2, OWNER3, STATE, FIPS, YARDNAME, LON, LAT, NOX, PM25, NOXPMTOT,

*Projection:* Lambert Conformal Conic ($X_0$=-97.0, $Y_1$=33.0, $Y_2$=45.0, $Y_0$=40.0)

*Datum:* NAD83

*Spheroid:* Normal Sphere with radius 6,370,000 meters

*Derived Surrogates:* 275

### 2.2.5 Bus Terminals

2014 U.S. locations for transportation terminals from the National Transportation Atlas Intermodal Passenger Connectivity Database. This Shapefile was used to define the locations of intercity and transit bus stations for allocating off-network MOVES emissions to modeling grids. This point Shapefile of transportation terminals was obtained from the online National Transportation Atlas Database.

The attributes in the file used to compute surrogates include:

- BUS_INTERC – point locations of intercity bus terminals
- BUS_TRANSI – point locations of transit bus terminals

*Shapefile Name*: NTAD_2014_ipcd

*Shapfile Type:* Point

*Year*: 2014

*Spatial Coverage:* All U.S. states, no territories

*Attributes:* Point_ID, CITY, STATE, METRO_AREA, Lon, Lat, FERRY_TRAN, FERRY_INTE, BUS_TRANSI, BUS_INTERC, BUS_CODE, BUS_SUPPLE, RAIL_INTER, RAIL_COMMU, RAIL_HEAVY, RAIL_LIGHT, AIR_SERVICE, INTERCITY_, TRASIT_SE, CBSA_CODE, CBSA_TYPE, MODES_SRV, MODE_BUS, MODE_AIR, MODE_RAIL, MODE_FERRY

*Projection:* Geographic

*Datum:* WGS84

*Spheroid:* WGS84

*Derived Surrogates:* 258, 259

### 2.2.6 Extended Idle Locations

Locations of extended idle emissions for tractor-trailers. The base parking area shapefile was provided by EPA and it included 7 different classes of parking locations:

1. State Department of Transportation (DOT) visitor centers
2. DOT welcome centers
3. DOT rest areas
4. DOT weigh stations
5. DOT parking areas
6. Private truck stops
7. Private retail locations, including Walmart and McDonalds

Along with the latitude-longitude coordinates of the parking locations, the database includes attributes indicating the number of parking spots at each location to use for weighting a spatial

surrogate. The attributes for the number of parking spots for the different types of locations were pulled from multiple data sources. The EPA database included the number of parking spots for many of the private truck stops but did not include the number of spots for most of the DOT or private retail locations. The following steps were followed to mine parking spot data to develop a complete database of extended idle locations.

State DOT Locations

Nationwide request from all state DOTs for the number of parking spots at state-run locations returned data from the WV, IN, MO, WI, NC, CT, ME, UT, VA, GA, and FL. Many of these states reviewed the default data pulled from the web and updated these data with new information. We reconciled the data provided by the states with the national data provided by EPA. Manual matching was done using Bing satellite imagery for locations in which the parking area exit ramp coordinates were provided rather than the actual parking lot location. The matching yielded a fairly complete database of coordinates and the number (or range) of truck parking spots at DOT locations.

Private Truck Stops

Data downloaded from Pilot, Petro, and TA truck stop company websites include the coordinates and number of truck parking spots at all locations nationally. Merged these data with the EPA database using a 300 meter buffer to exclude duplicates. These data appeared more reliable than the number of parking spot attributes in the EPA database based on manual comparisons with Bing satellite imagery.

Private Retail Locations

The EPA database included coordinates and number of parking spots for some retail and food service areas. Walmarts composed the largest number of private retail locations in the database and did not include any information on the number of truck parking spots at any of the locations.

Gapfilling the Number of Parking Spots

After creating an inventory of the truck parking spot locations from the collected data and merging these data into the EPA database, we used the following rules to fill in the number of truck parking spots:

- If number of spots listed as "<20", set to 20
- If number of spots listed as "20-69", set to 45
- If number of spots listed as ">70", set to 70
- If retail locations listed the number of spots as "unknown", set to 2
- Weigh stations and parking areas all listed the number of spots as "unknown", set to 2
- For rest areas with missing truck parking spots, calculated 1$^{st}$ quartile, median, and 3$^{rd}$ quartile from all known DOT rest area data and used these as low, medium, and high attributes for the number of spots; results: low = 14, median = 18, high = 31
- For truck stops with missing truck parking spots, calculated 1$^{st}$ quartile, median, and 3$^{rd}$ quartile from all known truck stop data and used these as low, medium, and high attributes for the number of spots; results: low = 80, median = 123, high = 188

Develop Shapefile

Created a shapefile from the modified/gapfilled EPA database by converting the point locations to an NAD83 datum and Lambert Conformal Conic projection. The shapefile includes the attributes truckpark_low, truckpark_med, and truckpark_high to use for weighting spatial surrogates. If the number of truck parking spots at a location was known in the database and there was no need to gapfill, these low/med/high attributes were set to all equal the number of spots at the location.

Updates for 2016

Several updates to the extended idling location shapefile were incorporated for the 2014 modeling surrogates:

- Idling location data from the Maricopa Association of Governments were used to replace all of the previous data for Maricopa County, AZ
- The coordinates for one truck stop in St. Louis County, MO were corrected to place truck stop in the correct location
- Locations for the Loves Truck Stop chain were added to the database
- Locations for public and private truck stops in the Chicago area, including state travel plazas, were added to the database.
- Missing Walmart locations were added to the database.

The attributes in the shapefile used to compute surrogates include:

- trucks_med – median number of truck parking spaces at potential idling locations

*Shapefile Name*: 2016_PIL_16Aug

*Shapfile Type:* Point

*Year*: 2016

*Spatial Coverage:* Conterminous U.S.

*Attributes:* truck_park, name, address, city, state, zip, latitude, longitude, site_cat, source, directions, alt_source, trucks_low, trucks_med, trucks_high

*Projection:* Geographic

*Datum:* WGS84

*Spheroid:* WGS84

*Derived Surrogates:* 205

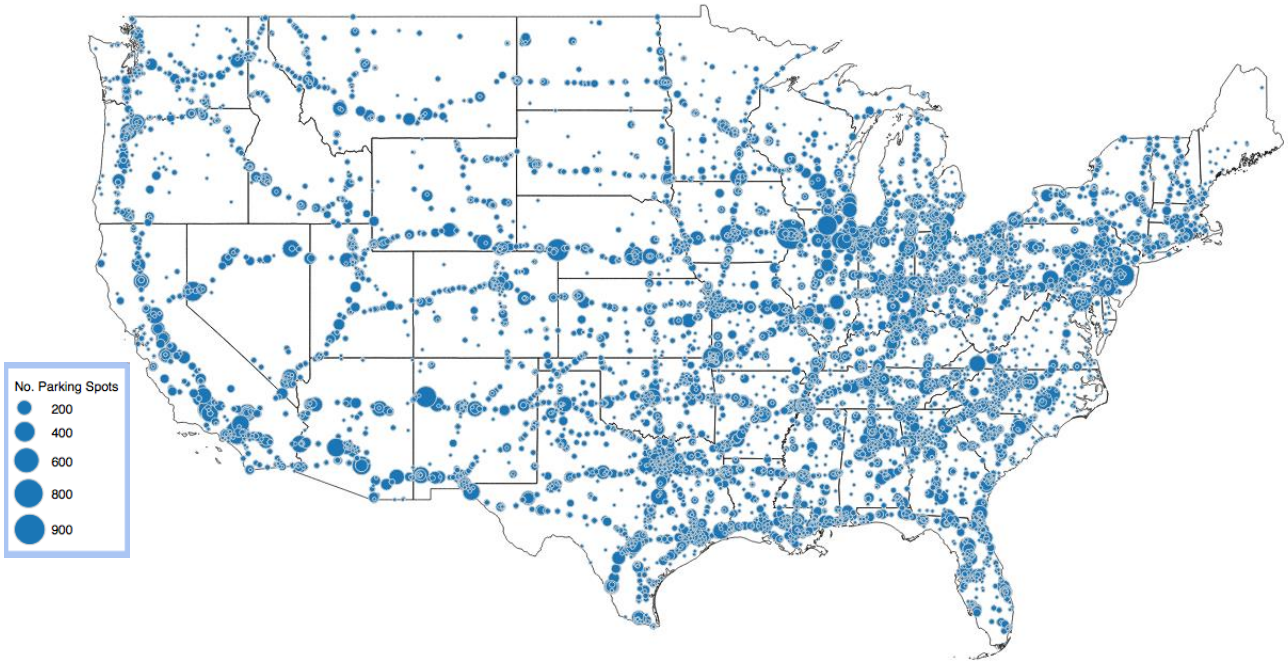


**Figure 2. 2016 Potential idling locations**

## *2.3 Shipping and Port Surrogates*

### 2.3.1 Waterways

2014 National Transportation Atlas Database (NTAD) data for waterway lengths.

The attributes in the file used to compute surrogates include:

- LENGTH – navigable waterway lengths

*Shapefile Name*: NTAD_2014_Waterway

*Shapefile Type:* Line

*Year*: 2011

*Spatial Coverage:* All U.S. states and territories

*Attributes:* LENGTH, FEATUREID, ANODE, BNODE, LINKNAME, RIVERNAME, AMILE, BMILE, LENGTH1, LENTH_SRC, LINKTYPE, CTRL_DEPTH, WATERWAY, GEO_CLASS, FUNC_CLASS, WTWY_TYPE, CHART_ID, NUM_PAIRS, WHO_MOD, DATE_MOD, HEADING, STATE, FIPS, FIPS2, NONUS, VERSION

*Projection:* Geographic

*Datum:* WGS84

*Spheroid:* WGS84
*Derived Surrogates:* 807

### 2.3.2 Marine Ports

2014 marine port areas weighted by NEI2014 activity in KW.

The attributes in the file used to compute surrogates include:

- Area_sqmi – port areas in miles$^2$
- ACTIVITYKW – annual KW activities for port vessels from the NEI2014

*Shapefile Name*: Ports_2014NEI

*Shapefile Type:* polygon

*Year*: 2014

*Spatial Coverage:* All U.S. states and territories

*Attributes: XLongitude,YLatitude,ShapeID,FIPS,NAME,Area_sqmi,PortID, ShapeType,ACTIVITYKW,TYPE*

*Projection:* Equidistant Conic ($X_0$=-96.0, $Y_0$=40.0, $Y_1$=20.0, $Y_2$=60.0)

*Datum:* NAD83

*Spheroid:* GRS80

*Derived Surrogates:* 801, 820

### 2.3.3 Gulf of Mexico Platforms

ERG, Inc. estimated the locations of class 1 and 2 commercial shipping vessels in the Gulf of Mexico and associated these locations with the density of shipping activity surrounding oil and gas platforms (Figure 3). A Shapefile that defines the fraction of total Gulf activity density around the energy development platforms was used to create a Gulf Shipping Lanes surrogate.

The attributes in the file used to compute surrogates include:

- Fraction – fraction of Gulf-wide activity associated with individual oil and gas platforms

*Shapefile Name*: GulfofMexico_SupportVessels_Density_WRF

*Shapefile Type:* Polygon

*Year*: 2010

*Spatial Coverage:* Gulf of Mexico

*Attributes*: GRIDCODE, Area, Fraction

*Projection:* Lambert Conformal Conic ($X_0$=-97.0, $Y_1$=33.0, $Y_2$=45.0, $Y_0$=40.0)

*Datum:* NAD83

*Spheroid:* Normal Sphere with radius 6,370,000 meters

*Derived Surrogates:* 802

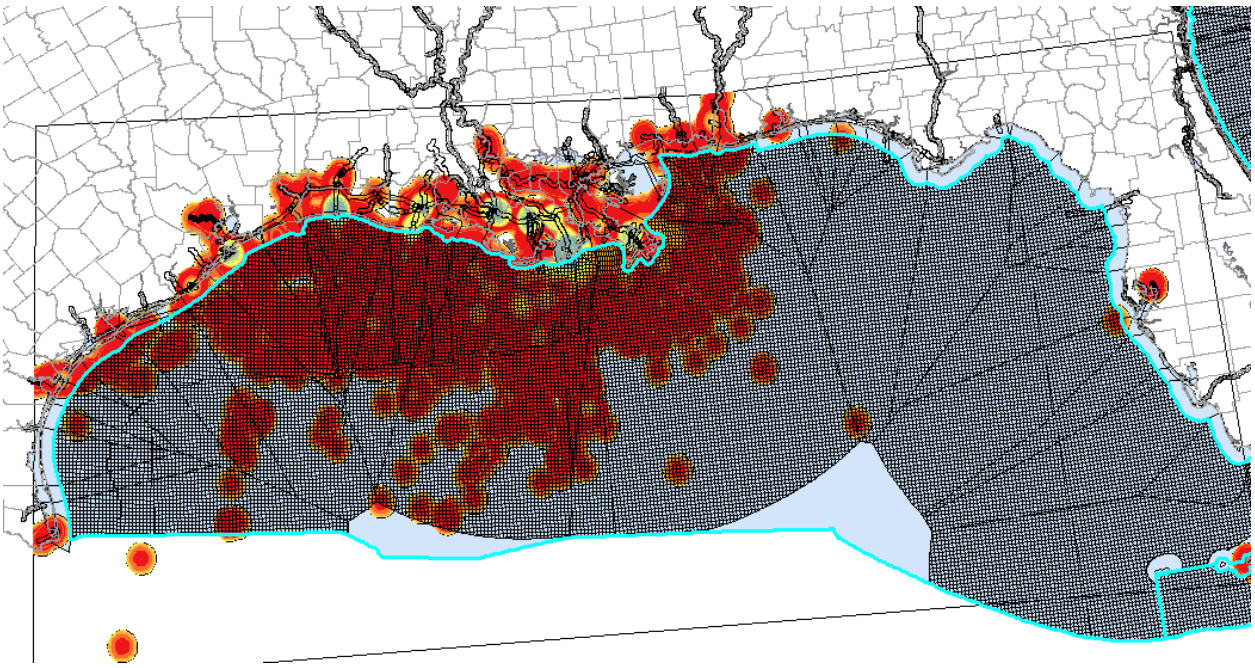

**Figure 3. Gulf of Mexico oil and gas platform support vessel densities**

### 2.3.4 Offshore Commercial Shipping

Offshore shipping lane areas for the Pacific, Atlantic, Gulf of Mexico, and Great Lakes weighted by activity from the NEI2014.

The attributes in the file used to compute surrogates include:

- Area_sqmi – port areas in miles$^2$
- ACTIVITYKW – annual KW activities for C1/C2 vessels from the NEI2014

*Shapefile Name*: ShippingLanes_2014NEI

*Shapefile Type:* Polygon

*Year*: 2014

*Spatial Coverage:* Conterminous U.S.

*Attributes*: Area_sqmi,ShapeID,FIPS,ActivityKW

*Projection:* Equidistant Conic ($X_0$=-96.0, $Y_0$=40.0, $Y_1$=20.0, $Y_2$=60.0)

*Datum:* NAD83

*Spheroid:* GRS80

*Derived Surrogates:* 802, 805, 806

## 2.4 FEMA Building Footprints

HAZUS is a nationally standardized methodology that contains models for estimating potential losses from natural disasters. A key component of the HAZUS database is information on building locations, sizes, and classifications. These geospatial data on buildings are useful for allocating inventory data to modeling grids because they contain details on the locations and sizes of different building types. The Federal Emergency Management Agency HAZUS-MH version 2 was released in September 2011 and contains square footage data for different types of buildings throughout the U.S. The building square footage data are used to identify building classifications (i.e. commercial, residential, industrial, institutional) for allocating non-point inventory sources to modeling grids. UNC-IE merged Census-block level data in state Shapefiles into a national Shapefile for select database attributes.

The attributes in the file used to compute surrogates include:

- COM# - commercial building square footage
- IND# - industrial building square footage
- RES# - residential building square footage
- EDU# - educational building square footage
- REL# - religious building square footage
- GOV# - government building square footage

*Shapefile Name*: fema_bsf_2002bnd

*Shapefile Type:* Polygon

*Year*: 2011

*Spatial Coverage:* All U.S. states, no territories

*Attributes*: COM#, IND#, RES#, EDU#, REL#, GOV#

*Projection:* Lambert Conformal Conic ($X_0$=-97.0, $Y_1$=33.0, $Y_2$=45.0, $Y_0$=40.0)

*Datum:* NAD83

*Spheroid:* Normal Sphere with radius 6,370,000 meters

*Derived Surrogates:* 500, 505, 506, 510, 512, 515, 520, 525, 526, 527, 535, 540, 545, 555, 560, 575, 580, 585, 590, 595, 596

## 2.5 Landcover Surrogates

2011 National Land Cover Database (NLCD) land cover data were used to create this shapefile. UNC-IE first dissolved the original 30-meter resolution NLCD raster data to 500-meter resolution using the dominant land use class. The raster data were then converted to a vector polygon file and a spatial join was performed to combine the Continental U.S. and Alaska land cover data into a single shapefile. The attribute “GRIDCODE” in the Shapefile is used to identify

the different landuse categories. The surrogates for different land cover categories were generated by filtering the data based on the GRIDCODE.

The attributes in the file used to compute surrogates are listed in Table 5.

**Table 5. NLCD 2011 surrogate attributes**

| GRIDCODE | NLCD categories | Surrogate ID | Surrogate Name |
|---|---|---|---|
| 22 | Developed, Low Intensity | 300 | NLCD Low Intensity Development |
| 23 | Developed, Medium Intensity | 301 | NLCD Med Intensity Development |
| 24 | Developed, High Intensity | 302 | NCLD High Intensity Development |
| 21 | Developed, Open Space | 303 | NLCD Open Space |
| 21, 22 | | 304 | NLCD Open + Low |
| 22, 23 | | 305 | NLCD Low + Med |
| 23, 24 | | 306 | NLCD Med + High |
| 21, 22, 23, 24 | | 307 | NLCD All Development |
| 22, 23, 24 | | 308 | NLCD Low + Med + High |
| 21, 22, 23 | | 309 | NLCD Open + Low + Med |
| 81, 82 | | 310 | NLCD Total Agriculture |
| 81 | Pasture/Hay | 318 | NLCD Pasture Land |
| 82 | Cultivated Crops | 319 | NLCD Crop Land |
| 41, 42, 43 | Deciduous Forest (41), Evergreen Forest (42), Mixed Forest (43) | 320 | NLCD Forest Land |
| 21, 31, 41, 42, 43, 52, 71 | Developed, Open Space (21), Barren Land (31), Forest, Shrub/Scrub, Grassland | 321 | NLCD Recreational Land |
| ! = 11 | Everything but water | 340 | Land |
| 11 | Water | 350 | Water |

*Shapefile Name*: CONUS_AK_NLCD_2011_500m_WGS

*Shapefile Type:* Polygon

*Year*: 2011

*Spatial Coverage:* Conterminous U.S.

*Attributes*: GRIDCODE

*Projection:* Geographic

*Datum:* WGS84

*Spheroid:* WGS84

*Derived Surrogates:* See Table 5

## *2.6 Oil and Gas Production*

### 2.6.1 Eastern Research Group, Inc. Oil and Gas Production Data (HPDI Database)

The primary activity data source that ERG used for developing oil and gas spatial surrogates were data from Drilling Info (DI) Desktop's HPDI database (ERG, 2016). This database contains well-level location, production, and exploration statistics at the monthly level. Due to a proprietary agreement with DI Desktop, individual well locations and ancillary production data cannot be made publicly available, but aggregated statistics are allowed. The HPDI data represented approximately 94% of the activity data used for these surrogates.

For the remaining 6% of the activity, ERG supplemented the HPDI with additional data from Oil and Gas Commission (OGC) websites. In many cases, the correct surrogate parameter was not available (e.g., feet drilled), but an alternative surrogate parameter was available (e.g., number of spudded wells) and used for generating the spatial surrogates.

In total, ERG compiled over 1.43 million unique well locations from the above data sources. The well locations cover 34 states and 1,158 counties. Each well was uploaded into ArcGIS, and assigned to 2-km and 4-km Continental U.S. grid identifiers. Well locations are presented in Figure 4.

As the HPDI data collected by ERG are proprietary and cannot be redistributed, a set of de-identified Shapefiles that include the number of wells or production units in 2-km to 4-km grid cells (polygons) will be made available to the public. The surrogates developed from these public Shapefiles will use the number of production units in each grid cell as the weighting attribute. Although it will not be possible to exactly reproduce the oil and gas production surrogates in the EPA modeling platform without the proprietary Shapefile data, the de-identified production Shapefiles will provide a close approximation of these data to use for the development of surrogates on customized modeling domains.

For additional details on these Shapefiles and spatial surrogates see ERG (2016).

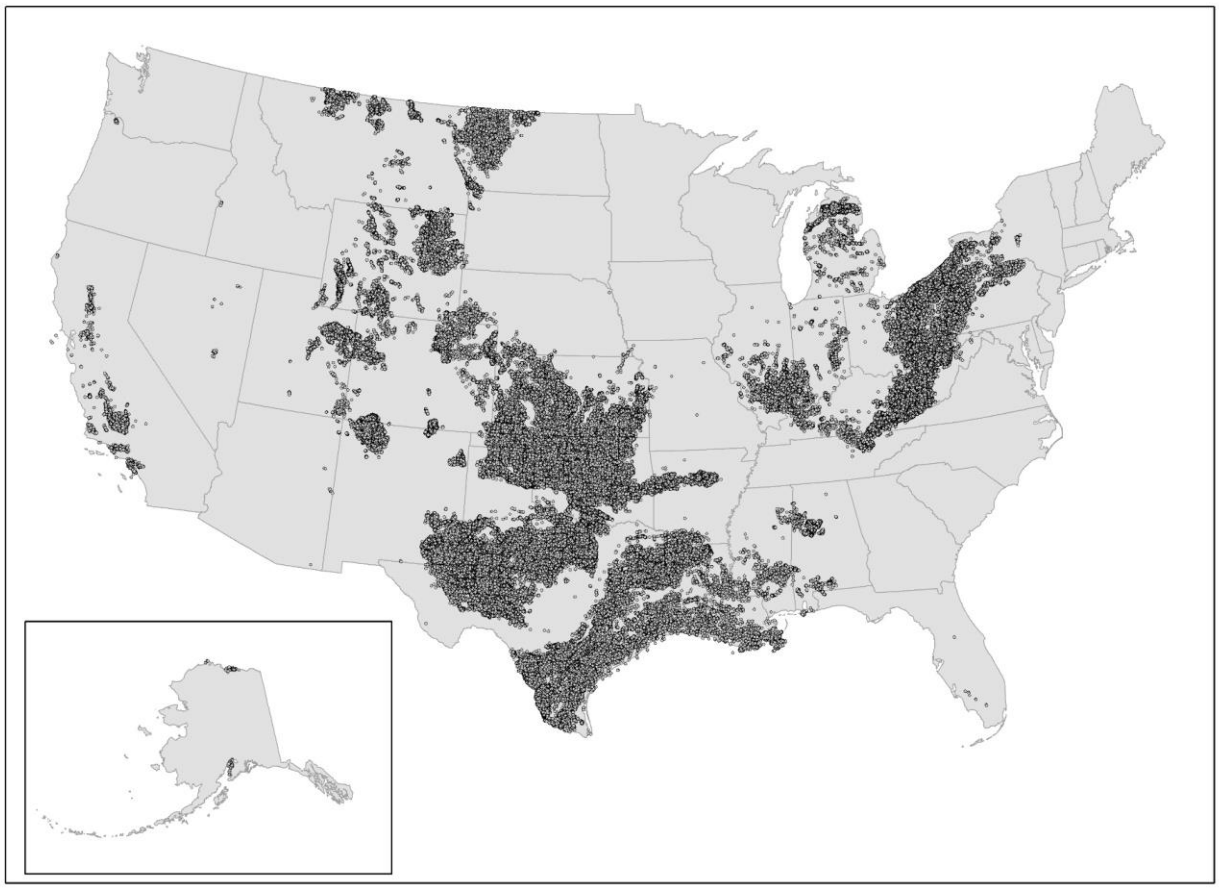

**Figure 4. 2015 active oil and gas well locations.**

The shapefile names and attributes in the ERG/HPDI files used to compute the surrogates are listed in Table 6.

**Table 6. HPMS Oil and gas surrogate codes**

| Surrogate Name | Surrogate ID | Shapefile Name | Weight Attribute |
|---|---|---|---|
| Spud Count - CBM Wells | 670 | SpudCount_CBM | SPUD_COU_1 |
| Spud Count - Gas Wells | 671 | SpudCount_Gas | SPUD_COU_1 |
| Gas Production at Oil Wells | 672 | AssocGasProduction | ASSOCIAT_1 |
| Oil Production at CBM Wells | 673 | CondensateCBMProd | CONDENSA_1 |
| Unconv. Well Completion Counts | 674 | SpudCount_HF | SPUD_HF_21 |
| Well Count - All Producing | 676 | AllProductionWells | TOTAL_PR_1 |
| Well Count - All Exploratory | 677 | AllExloratoryWells | TOTAL_EX_1 |
| Completions at Gas Wells | 678 | Completions_Gas | COMPLETI_1 |
| Completions at CBM Wells | 679 | Completions_CBM | COMPLETI_1 |
| Spud Count - Oil Wells | 681 | SpudCount_Oil | SPUD_COU_1 |
| Produced Water at All Wells | 683 | ProducedWater_All | PRODUCED_1 |
| Completions at Oil Wells | 685 | Completions_Oil | COMPLETI_1 |
| Completions at All Wells | 686 | Completions_All | COMPLETI_1 |
| Feet Drilled at All Wells | 687 | FeetDrilled_All | FEET_DRI_1 |

| | | | |
|---|---|---|---|
| Well Counts - CBM Wells | 691 | CBMWell_Counts | CBM_WELLS1 |
| Spud Count - All Wells | 692 | SpudCount_All | SPUD_COU_1 |
| Well Count - All Wells | 693 | AllWells | TOTAL_WE_1 |
| Oil Production at Oil Wells | 694 | OilProduction | OIL_PROD_1 |
| Well Count - Oil Wells | 695 | OilWell_Counts | OIL_WELL_1 |
| Gas Production at Gas Wells | 696 | GasProduction | GAS_PROD_1 |
| Oil Production at Gas Wells | 697 | CondensateGasProd | CONDENSA_1 |
| Well Count - Gas Wells | 698 | GasWell_Counts | CBM_WELLS1 |
| Gas Production at CBM Wells | 699 | CBMProduction | CBM_PROD_1 |

*Type:* Polygon

*Year*: 2015

*Spatial Coverage:* Conterminous U.S.

*Attributes*: The attributes are different for each Shapefile. See ERG (2016) for details about the Shapefiles and the derived surrogates

*Projection:* Lambert Conformal Conic ($X_0$=-97.0, $Y_1$=33.0, $Y_2$=45.0, $Y_0$=40.0)

*Datum:* Unknown

*Spheroid:* Unknown

*Derived Surrogates:* 670-699

## *2.7 Other Industrial and Commercial Activities*

### 2.7.1 Refineries and Tank Farms

Energy Information Administration 2015/16 locations of downstream liquid petroleum processing and storage facilities. UNC-IE downloaded and joined (spatial) the following datasets from the EIA website[6]: Product Terminals, Refineries, LNG Import/Export Terminals, and Crude Oil Rail Terminals.

The attributes in the file used to compute surrogates include:

- NONE – point locations of the commodities used to derive the surrogate

*Shapefile Name*: EIA_2015_US-Oil

*Shapefile Type:* Point

*Year*: 2015-16

*Spatial Coverage:* All U.S. states, no territories

*Attributes*: Site_Name,CITY,STATE,PADD,STATION_TY,FACILITY_T,HANDLING, LONGITUDE,LATITUDE,Source,Company,Corp,Site,AD_Mbpd,VDist_Mbpd,CaDis_Mbpd,V

[6] https://www.eia.gov/maps/layer_info-m.php

Redu_Mbpd,CaRef_Mbpd,Isal_Mbpd,HDS_Mbpd,Cokin_Mbpd,Asph_Mbpd,Period_,Data_perio,Facility,Owner,Operator,County,ImpExp,Period,Cap_Bcfd,Liq_Bcfd,Stora_MMcf,

*Projection:* Geographic

*Datum:* WGS84

*Spheroid:* WGS84

*Derived Surrogates:* 650

### 2.7.2 Mines

2011 USGS Mineral Resources Data System (MRDS) point locations of metallic and nonmetallic mineral resources.

The attributes in the file used to compute surrogates include:

- DEV_STAT: development status; DEV_STAT = producer was used for the surrogate calculation

*Shapefile Name*: USGS_2011_mines

*Shapefile Type:* Point

*Year*: 2011

*Spatial Coverage:* All U.S. states, no territories

*Attributes*: DEP_ID, SITE_NAME,DEV_STAT,URL,CODE_LIST,

*Projection:* Geographic

*Datum:* WGS84

*Spheroid:* WGS84

*Derived Surrogates:* 860

### 2.7.3 Commercial Timber

2016 U.S. Forest Service activities accomplished as a part of the timber harvest program of work. It is important to note that this layer does not contain all timber harvest activities because the spatial portion of the activity description is not required and is self-reported by Forest Service units

The attributes in the file used to compute surrogates include:

- NONE – locations of the harvest activities were used to generate the surrogate

*Shapefile Name*: USFS_2016_TimberHarvest

*Shapefile Type:* Polygon

*Year*: 2016

*Spatial Coverage:* All U.S. states, no territories

*Attributes*: ADMIN_FORE,ADMIN_REGI,ADMIN_FO_1,PROCLAIMED,ADMIN_DIST,ADMIN_DI_1,HOME_ORG,ACTIVITY_U,SUID,FACTS_ID,SUBUNIT,SUBUNIT_CN,SUB

UNIT_NA,SUBUNIT_SI,SALE_NAME,ACTIVITY_C,ACTIVITY_1,ACTIVITY_2,ACTIVITY_N,TREATMENT_,NBR_UNITS_,UOM,NBR_UNITS1,DATE_PLANN,DATE_ACCOM,DATE_COMPL,FY_PLANNED,FY_ACCOMPL,FY_COMPLET,FUND_CODES,COST_PER_U,NEPA_PROJE,NEPA_DOC_N,NEPA_PRO_1,METHOD_COD,METHOD_DES,EQUIPMENT_,EQUIPMENT1,IMPLEMENTA,IMPLEMEN_1,IMPLEMEN_2,WORK_AGENT,LAND_SUITA,LAND_SUI_1,PRODUCTIVI,PRODUCTI_1,OWNERSHIP_,OWNERSHIP1,ASPECT,ELEVATION,SLOPE,STATE_ABBR,WATERSHED_,SUBUNIT_UO,STAGE,STAGE_DESC,DATA_SOURC,DATA_SOU_1,ACCURACY,CRC_VALUE,UK,EDW_INSERT,ETL_MODIFI,REV_DATE,GIS_ACRES,SHAPE_AREA,SHAPE_LEN

*Projection:* Geographic

*Datum:* NAD83

*Spheroid:* GRS80

*Derived Surrogates:* 860

### 2.7.4 Golf Courses

The Point of Interest (POI) Factory is a crowd-sourced GIS data resource. The GolfCourses-USA Shapefile was submitted on June 7, 2010 and is updated continually by the POI user community. The dataset was compiled from the website locator on www.golflinks.com. Some of the coordinates were obtained using the Google Earth streetview and GPS visualizer.

The attributes in the file used to compute surrogates include:

- NONE – the surrogate was generated using the point locations of the golf courses

*Shapefile Name*: POI-Factory_2015_GolfCourses

*Shapefile Type:* Point

*Year*: 2015

*Spatial Coverage:* All U.S. states, no territories

*Attributes*: lon,lat,name,type,address,city,state,phone

*Projection:* Lambert Conformal Conic ($X_0$=-97.0, $Y_1$=33.0, $Y_2$=45.0, $Y_0$=40.0)

*Datum:* NAD83

*Spheroid:* GRS80

*Derived Surrogates:* 850

### 2.7.5 Airport Point Emissions

Locations of U.S. airports weighted by NEI 2008 total emissions

The attributes in the file used to compute surrogates include:

- TOTAL_EMIS – total emissions of all sources at each airport location reported in the NEI2008v2 inventory

*Shapefile Name*: US_Airports_NEI08v2_WRF

*Shapefile Type:* Point

*Year*: 2008

*Spatial Coverage:* Conterminous U.S.

*Attributes*: FIPS,NAME,LAT,LON,TOTAL_EMIS,YEAR

*Projection:* Lambert Conformal Conic ($X_0$=-97.0, $Y_1$=33.0, $Y_2$=45.0, $Y_0$=40.0)

*Datum:* NAD83

*Spheroid:* Normal Sphere with radius 6,370,000 meters

*Derived Surrogates:* 710

### 2.7.6 Airport Area

Spatial areas of U.S. airports in 199.

The attributes in the file used to compute surrogates include:

- TOTAL_EMIS – total emissions of all sources at each airport location reported in the NEI2008v2 inventory

*Shapefile Name*: airport_area

*Shapefile Type:* Polygon

*Year*: 1999

*Spatial Coverage:* Conterminous U.S.

*Attributes*: AREA,PERIMETER,AIRPORT_AR,AIRPORT__1,NAME,FCC,LOC_ID,USE, OWNERNAME,FIPSSTCO,STATE,COUNTY

*Projection:* Lambert Conformal Conic ($X_0$=-97.0, $Y_1$=33.0, $Y_2$=45.0, $Y_0$=40.0)

*Datum:* NAD83

*Spheroid:* Normal Sphere with radius 6,370,997 meters

*Derived Surrogates:* 711

# 3 Known Issues and Future Work

While the Shapefiles and surrogates documented here and in the accompanying spreadsheet represent the best available information for allocating non-point emissions to modeling grids, there are some caveats to these data and issues that should be addressed in the future.

- The total agriculture surrogate (310) is not specific enough for livestock sources and could be improved using a point Shapefile of confined animal feeding operations (CAFOs). Although we were not able to find a national Shapefile of CAFO locations, these data are available from some states. State departments of water quality track CAFO locations for monitoring runoff and water permitting purposes. It will be worthwhile to collect data from as many states as possible for developing a national CAFO surrogate to use for allocating non-point livestock inventories to model grids.

- The mines surrogate (860) is missing many of the coal mines in the U.S. Shapefiles available from state mining commissions are a better source of coal mining data and should be used to augment the national data.
- Data are available from LADCO on shipping lanes in the Great Lakes. These data should be used in the calculation of the commercial shipping (802) surrogate.

# 4 Surrogate Revision History

# 5 REFERENCES

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# Appendix A – Surrogate Specifications

**Table 7. Primary surrogate specifications**

| ID | Surrogate Name | Weight Shapefile | Attribute | Weight/Filter Function |
|---|---|---|---|---|
| 100 | Population | ACS_2014_5YR_PopHousing | POP2014 | |
| 110 | Housing | ACS_2014_5YR_PopHousing | HU2014 | |
| 131 | Urban Housing | ACS_2014_5YR_PopHousing | NONE | HUD_CODE=1 |
| 132 | Suburban Housing | ACS_2014_5YR_PopHousing | NONE | HUD_CODE=1 |
| 134 | Rural Housing | ACS_2014_5YR_PopHousing | NONE | HUD_CODE=4 |
| 137 | Housing Change | ACS_2014_5YR_PopHousing | HUCH14_10 | |
| 140 | Housing Change and Population | NA | NA | 0.5*Housing Change+0.5*Population |
| 150 | Residential Heating - Natural Gas | ACS_2014_5YR_PopHousing | UTIL_GAS | |
| 160 | Residential Heating - Wood | ACS_2014_5YR_PopHousing | WOOD | |
| 170 | Residential Heating - Distillate Oil | ACS_2014_5YR_PopHousing | FUEL_OIL | |
| 180 | Residential Heating - Coal | ACS_2014_5YR_PopHousing | COAL | |
| 190 | Residential Heating - LP Gas | ACS_2014_5YR_PopHousing | LP_GAS | |
| 201 | Urban Restricted Road Miles | | NONE | RDTYPE=04 |
| 202 | Urban Restricted AADT | | aadt | RDTYPE=04 |
| 205 | Extended Idle Locations | 2016_PIL_16Aug | trucks_med | |
| 211 | Rural Restricted Road Miles | | NONE | RDTYPE=02 |
| 212 | Rural Restricted AADT | | aadt | RDTYPE=02 |
| 221 | Urban Unrestricted Road Miles | | NONE | RDTYPE=05 |
| 222 | Urban Unrestricted AADT | | aadt | RDTYPE=05 |
| 231 | Rural Unrestricted Road Miles | | NONE | RDTYPE=03 |
| 232 | Rural Unrestricted AADT | | aadt | RDTYPE=03 |
| 239 | Total AADT | | aadt | RDTYPE=02,03,04,05 |
| 240 | Total Road Miles | | NONE | RDTYPE=02,03,04,05 |

| | | | | |
|---|---|---|---|---|
| 241 | Total Restricted Road Miles | | NONE | RDTYPE=02,04 |
| 242 | All Restricted Road AADT | | aadt | RDTYPE=02,04 |
| 243 | Total Unrestricted Road Miles | | NONE | RDTYPE=03,05 |
| 244 | All Unrestricted Road AADT | | aadt | RDTYPE=03,05 |
| 258 | Intercity Bus Terminals | NTAD_2014_ipcd | NONE | BUS_INTERC = 1 |
| 259 | Transit Bus Terminals | NTAD_2014_ipcd | NONE | BUS_TRANSI = 1 |
| 260 | Total Railroad Miles | TIGER_2014_Rail | NONE | |
| 261 | NTAD Total Railroad Density | NTAD_2014_Rail | DENS | RAILTYPE=1,2,3 |
| 271 | NTAD Class 1 2 3 Railroad Density | NTAD_2014_Rail | DENS | RAILTYPE="1" |
| 272 | NTAD Amtrak Railroad Density | TIGER_2014_Rail | DENS | RAILTYPE="2" |
| 273 | NTAD Commuter Railroad Density | NTAD_2014_Rail | DENS | RAILTYPE="3" |
| 275 | ERTAC Rail Yards | ERTAC_railyard_WRF | NOXPMTOT | |
| 280 | Class 2 and 3 Railroad Miles | TIGER_2014_Rail | NONE | MTFCC=R1051,R1052 |
| 300 | NLCD Low Intensity Development | CONUS_AK_NLCD_2011_500m_WGS | NONE | GRIDCODE=22 |
| 301 | NLCD Med Intensity Development | CONUS_AK_NLCD_2011_500m_WGS | NONE | GRIDCODE=23 |
| 302 | NLCD High Intensity Development | CONUS_AK_NLCD_2011_500m_WGS | NONE | GRIDCODE=24 |
| 303 | NLCD Open Space | CONUS_AK_NLCD_2011_500m_WGS | NONE | GRIDCODE=21 |
| 304 | NLCD Open + Low | CONUS_AK_NLCD_2011_500m_WGS | | GRIDCODE=21,22 |
| 305 | NLCD Low + Med | CONUS_AK_NLCD_2011_500m_WGS | | GRIDCODE=22,23 |
| 306 | NLCD Med + High | CONUS_AK_NLCD_2011_500m_WGS | | GRIDCODE=23,24 |
| 307 | NLCD All Development | CONUS_AK_NLCD_2011_500m_WGS | | GRIDCODE=21,22,23,24 |
| 308 | NLCD Low + Med + High | CONUS_AK_NLCD_2011_500m_WGS | | GRIDCODE=22,23,24 |
| 309 | NLCD Open + Low + Med | CONUS_AK_NLCD_2011_500m_WGS | | GRIDCODE=21,22,23 |
| 310 | NLCD Total Agriculture | CONUS_AK_NLCD_2011_500m_WGS | NONE | GRIDCODE=81,82 |
| 318 | NLCD Pasture Land | CONUS_AK_NLCD_2011_500m_WGS | NONE | GRIDCODE=81 |
| 319 | NLCD Crop Land | CONUS_AK_NLCD_2011_500m_WGS | NONE | GRIDCODE=82 |
| 320 | NLCD Forest Land | CONUS_AK_NLCD_2011_500m_WGS | NONE | GRIDCODE=41,42,43 |

| | | | | |
|---|---|---|---|---|
| 321 | NLCD Recreational Land | CONUS_AK_NLCD_2011_500m_WGS | NONE | GRIDCODE=21,31,41,42,43,52,71 |
| 340 | NLCD Land | CONUS_AK_NLCD_2011_500m_WGS | NONE | GRIDCODE!=11 |
| 350 | NLCD Water | CONUS_AK_NLCD_2011_500m_WGS | NONE | GRIDCODE=11 |
| 500 | Commercial Land | fema_bsf_2002bnd | NA | |
| 505 | Industrial Land | fema_bsf_2002bnd | NA | |
| 506 | Education | fema_bsf_2002bnd | NA | |
| 507 | Heavy Light Construction Industrial Land | fema_bsf_2002bnd | NA | |
| 510 | Commercial plus Industrial | fema_bsf_2002bnd | NA | |
| 515 | Commercial plus Institutional Land | fema_bsf_2002bnd | NA | |
| 520 | Commercial plus Industrial plus Institutional | fema_bsf_2002bnd | NA | |
| 525 | Golf Courses plus Institutional plus Industrial plus Commercial | NA | NA | 0.5*Commercial plus Industrial plus Institutional+0.5*Golf Courses |
| 526 | Residential - Non-Institutional | fema_bsf_2002bnd | NA | |
| 527 | Single Family Residential | fema_bsf_2002bnd | RES1 | |
| 535 | Residential + Commercial + Industrial + Institutional + Government | fema_bsf_2002bnd | NA | |
| 540 | Retail Trade (COM1) | fema_bsf_2002bnd | COM1 | |
| 545 | Personal Repair (COM3) | fema_bsf_2002bnd | COM3 | |
| 555 | Professional/Technical (COM4) plus General Government (GOV1) | fema_bsf_2002bnd | NA | |
| 560 | Hospital (COM6) | fema_bsf_2002bnd | COM6 | |
| 575 | Light and High Tech Industrial (IND2 + IND5) | fema_bsf_2002bnd | NA | |
| 580 | Food, Drug, Chemical Industrial (IND3) | fema_bsf_2002bnd | IND3 | |
| 585 | Metals and Minerals Industrial (IND4) | fema_bsf_2002bnd | IND4 | |
| 590 | Heavy Industrial (IND1) | fema_bsf_2002bnd | IND1 | |

| | | | | |
|---|---|---|---|---|
| 595 | Light Industrial (IND2) | fema_bsf_2002bnd | IND2 | |
| 596 | Industrial plus Institutional plus Hospitals | fema_bsf_2002bnd | | |
| 650 | Refineries and Tank Farms | EIA_2015_US-Oil | NONE | |
| 670 | Spud Count - CBM Wells | SpudCount_CBM | SPUD_COU_1 | |
| 671 | Spud Count - Gas Wells | SpudCount_Gas | SPUD_COU_1 | |
| 672 | Gas Production at Oil Wells | AssocGasProduction | ASSOCIAT_1 | |
| 673 | Oil Production at CBM Wells | CondensateCBMProd | CONDENSA_1 | |
| 674 | Unconventional Well Completion Counts | SpudCount_HF | SPUD_HF_21 | |
| 676 | Well Count - All Producing | AllProductionWells | TOTAL_PR_1 | |
| 677 | Well Count - All Exploratory | AllExloratoryWells | TOTAL_EX_1 | |
| 678 | Completions at Gas Wells | Completions_Gas | COMPLETI_1 | |
| 679 | Completions at CBM Wells | Completions_CBM | COMPLETI_1 | |
| 681 | Spud Count - Oil Wells | SpudCount_Oil | SPUD_COU_1 | |
| 683 | Produced Water at All Wells | ProducedWater_All | PRODUCED_1 | |
| 685 | Completions at Oil Wells | Completions_Oil | COMPLETI_1 | |
| 686 | Completions at All Wells | Completions_All | COMPLETI_1 | |
| 687 | Feet Drilled at All Wells | FeetDrilled_All | FEET_DRI_1 | |
| 691 | Well Counts - CBM Wells | CBMWell_Counts | CBM_WELLS1 | |
| 692 | Spud Count - All Wells | SpudCount_All | SPUD_COU_1 | |
| 693 | Well Count - All Wells | AllWells | TOTAL_WE_1 | |
| 694 | Oil Production at Oil Wells | OilProduction | OIL_PROD_1 | |
| 695 | Well Count - Oil Wells | OilWell_Counts | OIL_WELL_1 | |
| 696 | Gas Production at Gas Wells | GasProduction | GAS_PROD_1 | |
| 697 | Oil Production at Gas Wells | CondensateGasProd | CONDENSA_1 | |
| 698 | Well Count - Gas Wells | GasWell_Counts | CBM_WELLS1 | |

| | | | | |
|---|---|---|---|---|
| 699 | Gas Production at CBM Wells | CBMProduction | CBM_PROD_1 | |
| 710 | Airport Points | US_Airports_NEI08v2_WRF | TOTAL_EMIS | |
| 711 | Airport Areas | airport-area | AREA | |
| 801 | Port Areas | Ports_2014NEI | Area_sqmi | |
| 802 | Commercial Shipping | | | |
| 803 | Gulf Shipping Lanes | | | |
| 805 | Offshore Shipping Area | ShippingLanes_2014NEI | Area_sqmi | |
| 806 | Offshore Shipping NEI2014 Activity | ShippingLanes_2014NEI | ACTIVITYKW | |
| 807 | Navigable Waterway Miles | NTAD_2014_Waterway | LENGTH | |
| 820 | Ports NEI2014 Activity | Ports_2014NEI | ACTIVITYKW | |
| 850 | Golf Courses | POI-Factory_2015_GolfCourses | NONE | |
| 860 | Mines | USGS_2011_mines | NONE | DEV_STAT=Producer |
| 890 | Commercial Timber | USFS_2016_TimberHarvest | NONE | |

## Table 8. Surrogate gapfilling specifications

| ID | Surrogate Name | Secondary | Tertiary | Quaternary |
|---|---|---|---|---|
| 100 | Population | | | |
| 110 | Housing | Population | | |
| 131 | Urban Housing | Housing | Population | NLCD Land |
| 132 | Suburban Housing | Housing | Population | NLCD Land |
| 134 | Rural Housing | Housing | Population | NLCD Land |
| 137 | Housing Change | Housing | Population | NLCD Land |
| 140 | Housing Change and Population | Population | | |
| 150 | Residential Heating - Natural Gas | Housing | | |
| 160 | Residential Heating - Wood | Housing | | |
| 170 | Residential Heating - Distillate Oil | Housing | | |
| 180 | Residential Heating - Coal | Housing | | |
| 190 | Residential Heating - LP Gas | Housing | | |
| 201 | Urban Restricted Road Miles | Total Road Miles | | |
| 202 | Urban Restricted AADT | Total Road Miles | | |
| 205 | Extended Idle Locations | Total Road Miles | | |

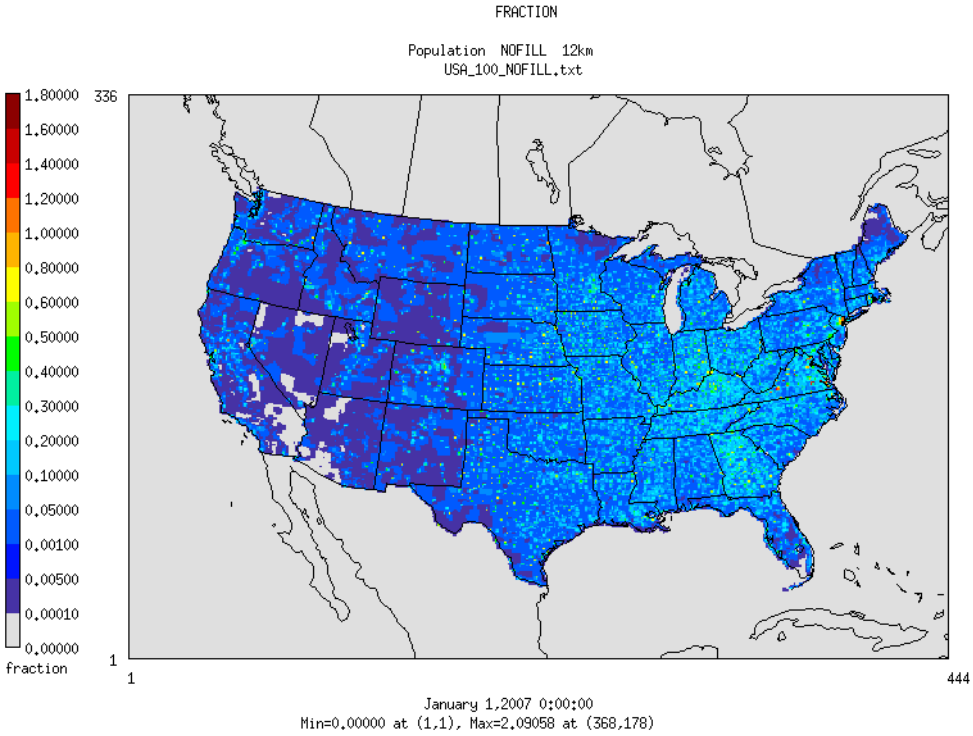
| | | | | |
|---|---|---|---|---|
| 211 | Rural Restricted Road Miles | Total Road Miles | | |
| 212 | Rural Restricted AADT | Total Road Miles | | |
| 221 | Urban Unrestricted Road Miles | Total Road Miles | | |
| 222 | Urban Unrestricted AADT | Total Road Miles | | |
| 231 | Rural Unrestricted Road Miles | Total Road Miles | | |
| 232 | Rural Unrestricted AADT | Total Road Miles | | |
| 239 | Total AADT | Total Road Miles | | |
| 240 | Total Road Miles | | | |
| 241 | Total Restricted Road Miles | Total Road Miles | | |
| 242 | All Restricted Road AADT | Total Road Miles | | |
| 243 | Total Unrestricted Road Miles | Total Road Miles | | |
| 244 | All Unrestricted Road AADT | Total Road Miles | | |
| 258 | Intercity Bus Terminals | Commercial plus Industrial | Population | NLCD Land |
| 259 | Transit Bus Terminals | Commercial plus Industrial | Population | NLCD Land |
| 260 | Total Railroad Miles | Total Road Miles | Population | |
| 261 | NTAD Total Railroad Density | Total Railroad Miles | Total Road Miles | Population |
| 271 | NTAD Class 1 2 3 Railroad Density | NTAD Total Railroad Density | Total Railroad Miles | Total Road Miles |
| 272 | NTAD Amtrak Railroad Density | NTAD Total Railroad Density | Total Railroad Miles | Total Road Miles |
| 273 | NTAD Commuter Railroad Density | NTAD Total Railroad Density | Total Railroad Miles | Total Road Miles |
| 275 | ERTAC Rail Yards | NTAD Total Railroad Density | Total Railroad Miles | Population |
| 280 | Class 2 and 3 Railroad Miles | Total Railroad Miles | Total Road Miles | Population |
| 300 | NLCD Low Intensity Development | Rural Housing | Population | NLCD Land |
| 301 | NLCD Med Intensity Development | Suburban Housing | Population | NLCD Land |
| 302 | NLCD High Intensity Development | Population | NLCD Land | |
| 303 | NLCD Open Space | Rural Housing | Population | NLCD Land |
| 304 | NLCD Open + Low | Suburban Housing | Population | NLCD Land |
| 305 | NLCD Low + Med | Urban Housing | Population | NLCD Land |
| 306 | NLCD Med + High | Urban Housing | Population | NLCD Land |
| 307 | NLCD All Development | Urban Housing | Population | NLCD Land |
| 308 | NLCD Low + Med + High | Urban Housing | Population | NLCD Land |
| 309 | NLCD Open + Low + Med | Rural Housing | NLCD Land | |

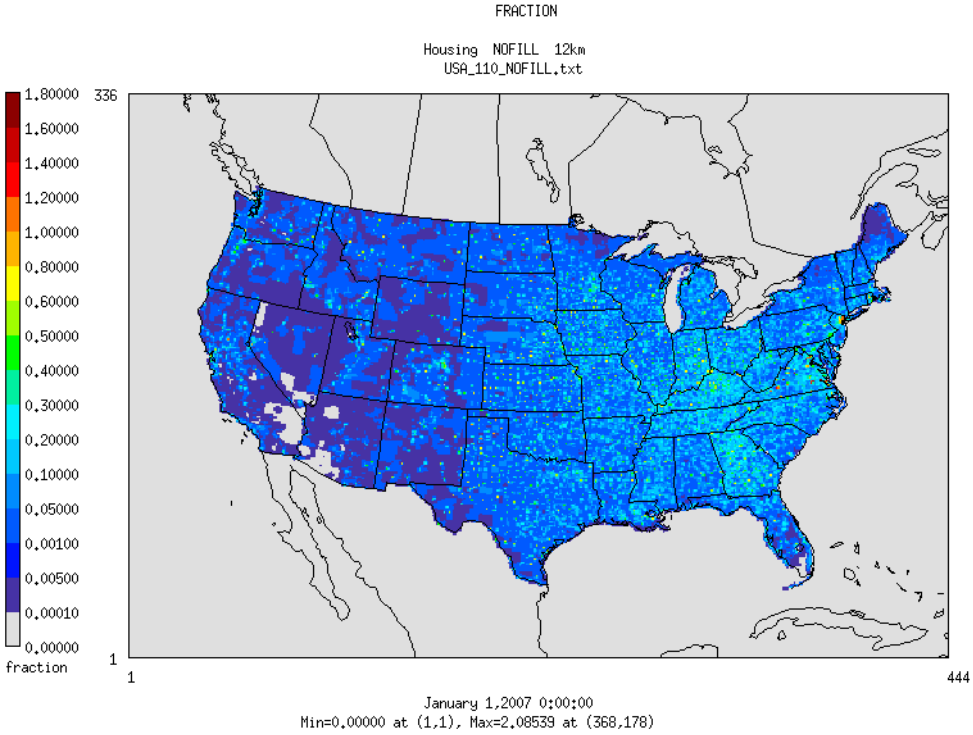
| | | | | |
|---|---|---|---|---|
| 310 | NLCD Total Agriculture | Rural Housing | NLCD Land | |
| 318 | NLCD Pasture Land | Rural Housing | NLCD Land | |
| 319 | NLCD Crop Land | Rural Land Area | NLCD Land | |
| 320 | NLCD Forest Land | Rural Land Area | NLCD Land | |
| 321 | NLCD Recreational Land | | | |
| 340 | NLCD Land | | | |
| 350 | NLCD Water | Population | NLCD Land | |
| 500 | Commercial Land | Population | NLCD Land | |
| 505 | Industrial Land | Population | NLCD Land | |
| 506 | Education | Population | NLCD Land | |
| 507 | Heavy Light Construction Industrial Land | Population | NLCD Land | |
| 510 | Commercial plus Industrial | Population | NLCD Land | |
| 515 | Commercial plus Institutional Land | Population | NLCD Land | |
| 520 | Commercial plus Industrial plus Institutional | Population | NLCD Land | |
| 525 | Golf Courses plus Institutional plus Industrial plus Commercial | Golf Courses | Commercial plus Industrial plus Institutional | Population |
| 526 | Residential - Non-Institutional | Housing | Population | |
| 527 | Single Family Residential | Housing | Population | NLCD Land |
| 535 | Residential + Commercial + Industrial + Institutional + Government | Population | NLCD Land | |
| 540 | Retail Trade (COM1) | Personal Repair (COM3) | Commercial Land | Population |
| 545 | Personal Repair (COM3) | Commercial Land | Population | NLCD Land |
| 555 | Professional/Technical (COM4) plus General Government (GOV1) | Commercial Land | Residential + Commercial + Industrial + Institutional + Government | Population |
| 560 | Hospital (COM6) | Commercial Land | Population | |
| 575 | Light and High Tech Industrial (IND2 + IND5) | Industrial Land | Population | NLCD Land |
| 580 | Food, Drug, Chemical Industrial (IND3) | Industrial Land | Population | NLCD Land |
| 585 | Metals and Minerals Industrial (IND4) | Industrial Land | Population | NLCD Land |
| 590 | Heavy Industrial (IND1) | Industrial Land | Population | NLCD Land |
| 595 | Light Industrial (IND2) | Industrial Land | Population | NLCD Land |
| 596 | Industrial plus Institutional plus Hospitals | Population | NLCD Land | |
| 650 | Refineries and Tank Farms | Industrial Land | Population | NLCD Land |

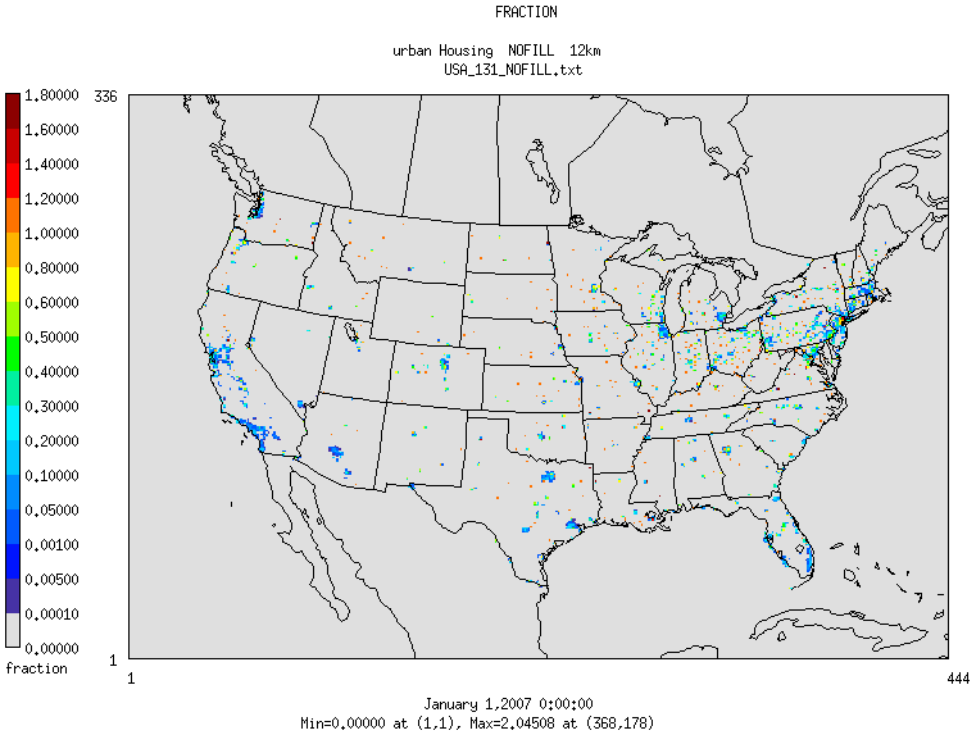
| | | | | |
|---|---|---|---|---|
| 670 | Spud Count - CBM Wells | Industrial Land | Population | NLCD Land |
| 671 | Spud Count - Gas Wells | Industrial Land | Population | NLCD Land |
| 672 | Gas Production at Oil Wells | Industrial Land | Population | NLCD Land |
| 673 | Oil Production at CBM Wells | Industrial Land | Population | NLCD Land |
| 674 | Unconventional Well Completion Counts | Industrial Land | Population | NLCD Land |
| 676 | Well Count - All Producing | Industrial Land | Population | NLCD Land |
| 677 | Well Count - All Exploratory | Industrial Land | Population | NLCD Land |
| 678 | Completions at Gas Wells | Industrial Land | Population | NLCD Land |
| 679 | Completions at CBM Wells | Industrial Land | Population | NLCD Land |
| 681 | Spud Count - Oil Wells | Industrial Land | Population | NLCD Land |
| 683 | Produced Water at All Wells | Industrial Land | Population | NLCD Land |
| 685 | Completions at Oil Wells | Industrial Land | Population | NLCD Land |
| 686 | Completions at All Wells | Industrial Land | Population | NLCD Land |
| 687 | Feet Drilled at All Wells | Industrial Land | Population | NLCD Land |
| 691 | Well Counts - CBM Wells | Industrial Land | Population | NLCD Land |
| 692 | Spud Count - All Wells | Industrial Land | Population | NLCD Land |
| 693 | Well Count - All Wells | Industrial Land | Population | NLCD Land |
| 694 | Oil Production at Oil Wells | Industrial Land | Population | NLCD Land |
| 695 | Well Count - Oil Wells | Industrial Land | Population | NLCD Land |
| 696 | Gas Production at Gas Wells | Industrial Land | Population | NLCD Land |
| 697 | Oil Production at Gas Wells | Industrial Land | Population | NLCD Land |
| 698 | Well Count - Gas Wells | Industrial Land | Population | NLCD Land |
| 699 | Gas Production at CBM Wells | Industrial Land | Population | NLCD Land |
| 710 | Airport Points | Population | NLCD Land | |
| 711 | Airport Areas | Airport Points | Population | NLCD Land |
| 801 | Port Areas | Navigable Waterway Miles | NLCD Water | |
| 802 | Commercial Shipping | | | |
| 803 | Gulf Shipping Lanes | | | |
| 805 | Offshore Shipping Area | | | |
| 806 | Offshore Shipping NEI2014 Activity | Offshore Shipping Area | Navigable Waterway Miles | NLCD Water |
| 807 | Navigable Waterway Miles | NLCD Water | | |
| 820 | Ports NEI2014 Activity | Port Areas | Navigable Waterway Miles | NLCD Water |

| | | | | |
|---|---|---|---|---|
| 850 | Golf Courses | Housing | Population | NLCD Land |
| 860 | Mines | Rural Housing | NLCD Land | |
| 890 | Commercial Timber | NLCD Forest Land | Rural Housing | Population |

# Appendix B – 12km Surrogate Plots




FRACTION
urban Housing NOFILL 12km
USA_131_NOFILL.txt
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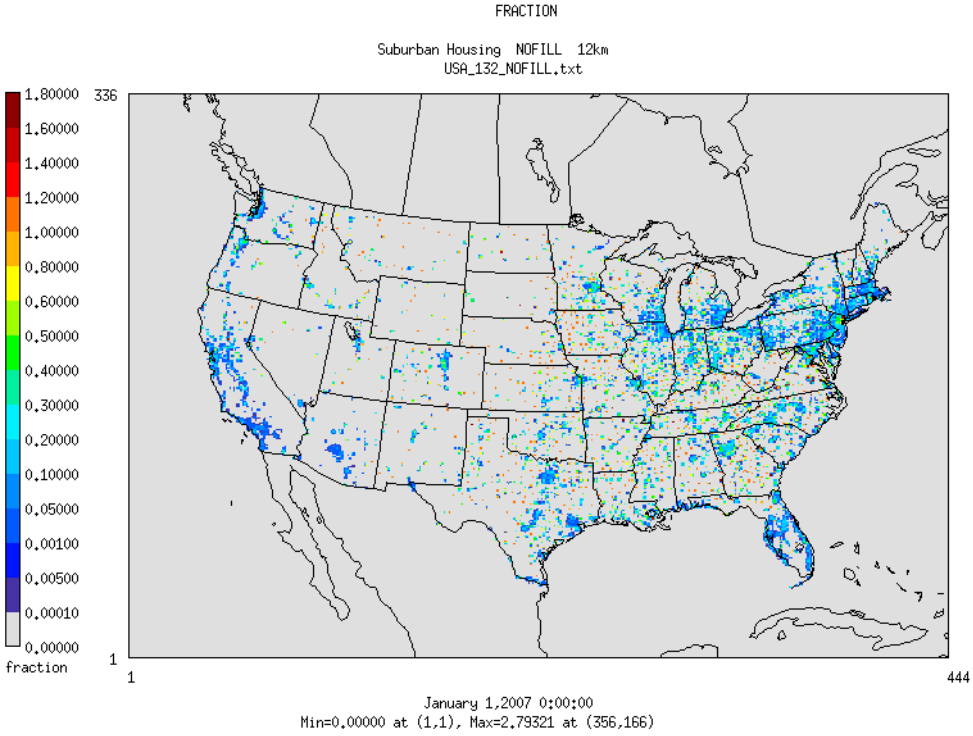
1.40000
1.20000
1.00000
0.80000
0.60000
0.50000
0.40000
0.30000
0.20000
0.10000
0.05000
0.00100
0.00500
0.00010
0.00000
fraction
336
1
1
444
January 1,2007 0:00:00
Min=0.00000 at (1,1), Max=2.04508 at (368,178)


FRACTION
Suburban Housing NOFILL 12km
USA_132_NOFILL.txt
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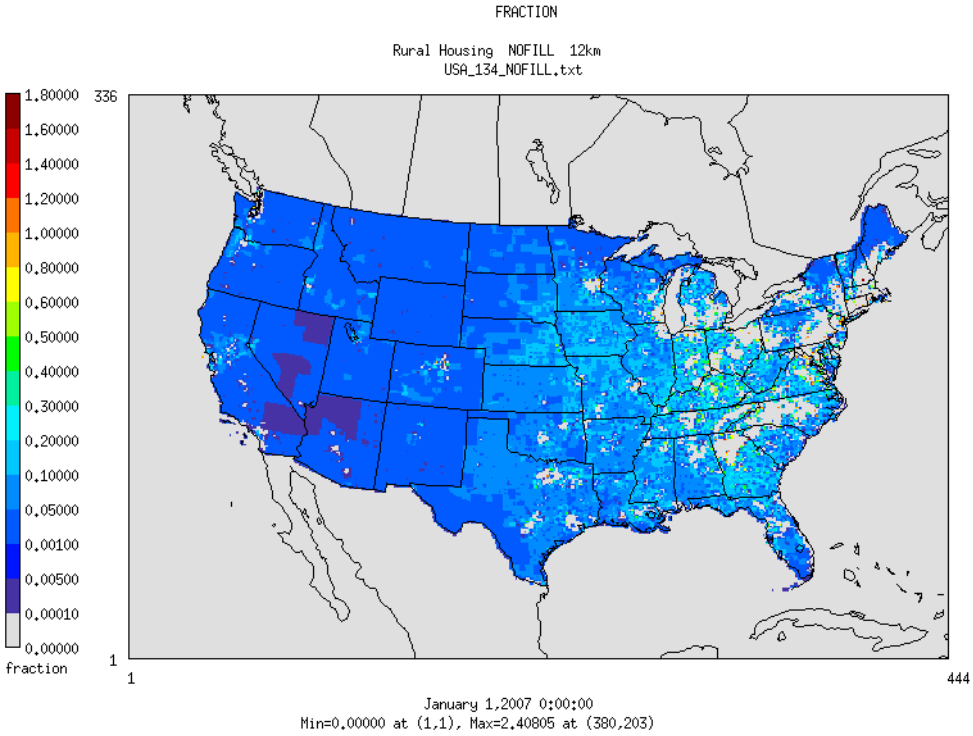
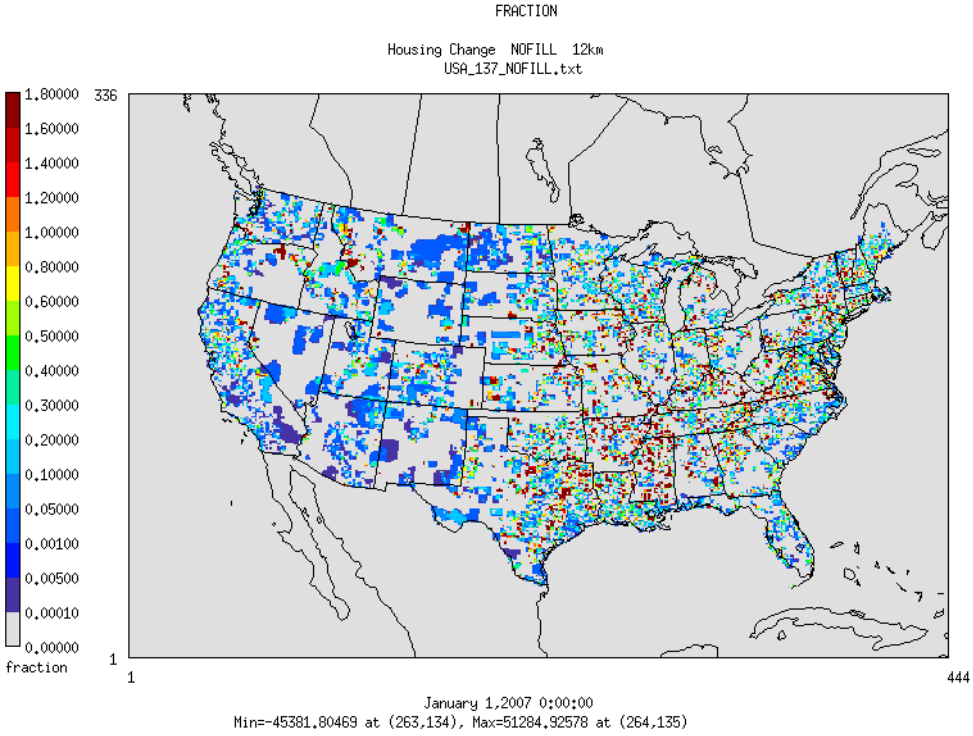
1.60000
1.40000
1.20000
1.00000
0.80000
0.60000
0.50000
0.40000
0.30000
0.20000
0.10000
0.05000
0.00100
0.00500
0.00010
0.00000
fraction
336
1
1
444
January 1,2007 0:00:00
Min=0.00000 at (1,1), Max=2.79321 at (356,166)


FRACTION
Rural Housing NOFILL 12km
USA_134_NOFILL.txt
1.80000
1.60000
1.40000
1.20000
1.00000
0.80000
0.60000
0.50000
0.40000
0.30000
0.20000
0.10000
0.05000
0.00100
0.00500
0.00010
0.00000
fraction
336
1
1
444
January 1,2007 0:00:00
Min=0.00000 at (1,1), Max=2.40805 at (380,203)


FRACTION
Housing Change NOFILL 12km
USA_137_NOFILL.txt
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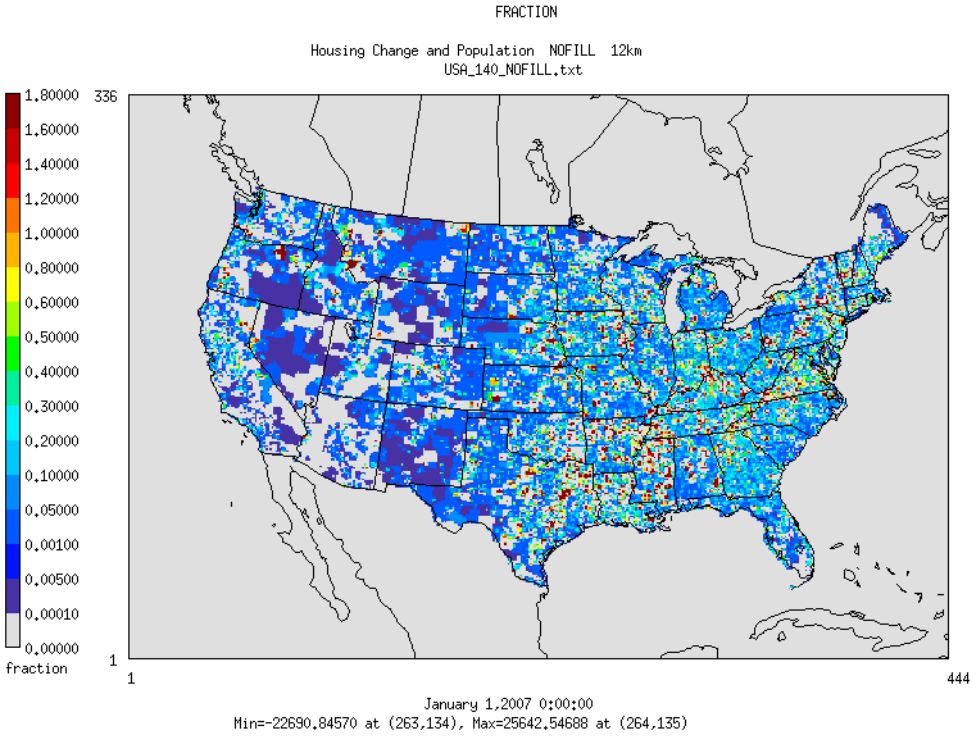
1.40000
1.20000
1.00000
0.80000
0.60000
0.50000
0.40000
0.30000
0.20000
0.10000
0.05000
0.00100
0.00500
0.00010
0.00000
fraction
336
1
1
444
January 1,2007 0:00:00
Min=-45381.80469 at (263,134), Max=51284.92578 at (264,135)


FRACTION
Housing Change and Population NOFILL 12km
USA_140_NOFILL.txt
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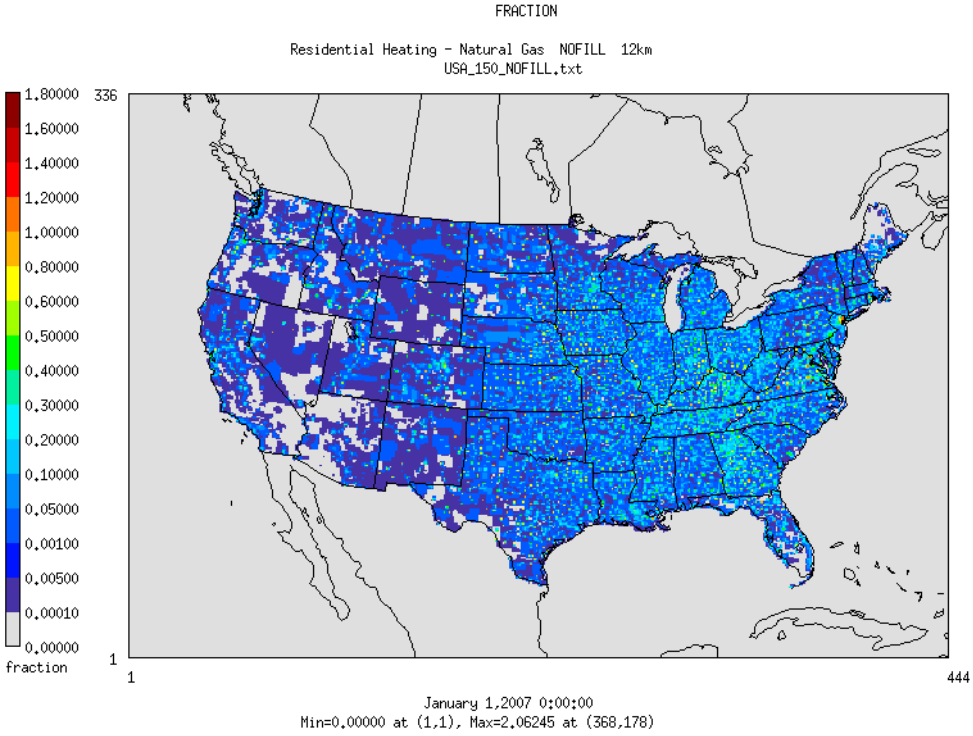
1.40000
1.20000
1.00000
0.80000
0.60000
0.50000
0.40000
0.30000
0.20000
0.10000
0.05000
0.00100
0.00500
0.00010
0.00000
fraction
336
1
1
444
January 1,2007 0:00:00
Min=-22690.84570 at (263,134), Max=25642.54688 at (264,135)


FRACTION
Residential Heating - Natural Gas NOFILL 12km
USA_150_NOFILL.txt
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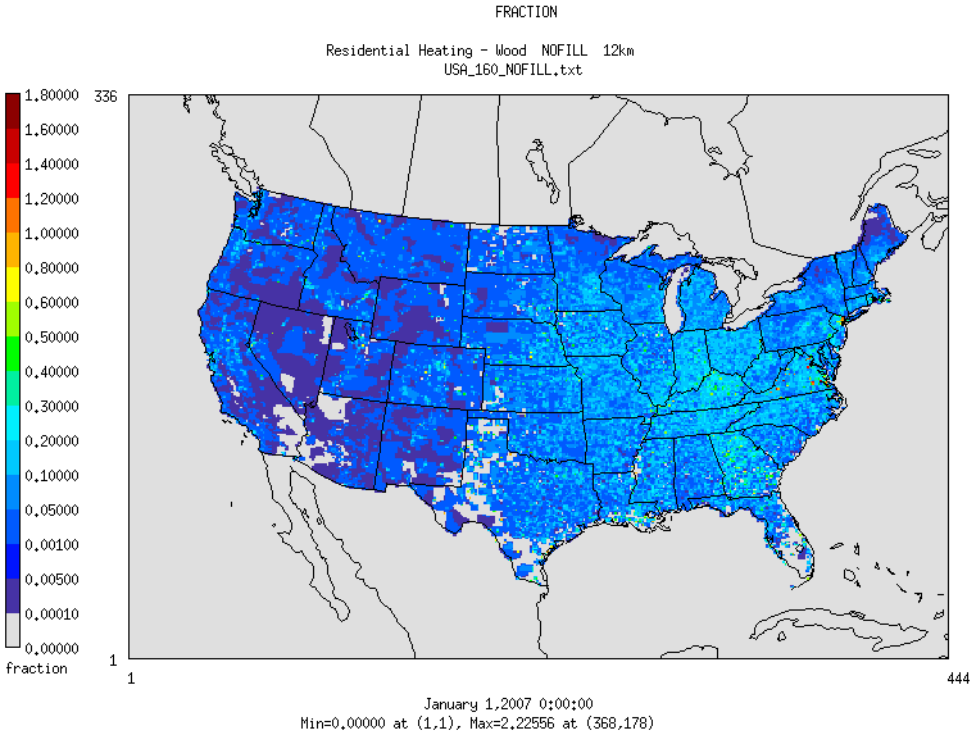
1.60000
1.40000
1.20000
1.00000
0.80000
0.60000
0.50000
0.40000
0.30000
0.20000
0.10000
0.05000
0.00100
0.00500
0.00010
0.00000
fraction
336
1
1
444
January 1,2007 0:00:00
Min=0.00000 at (1,1), Max=2.06245 at (368,178)


FRACTION
Residential Heating - Wood NOFILL 12km
USA_160_NOFILL.txt
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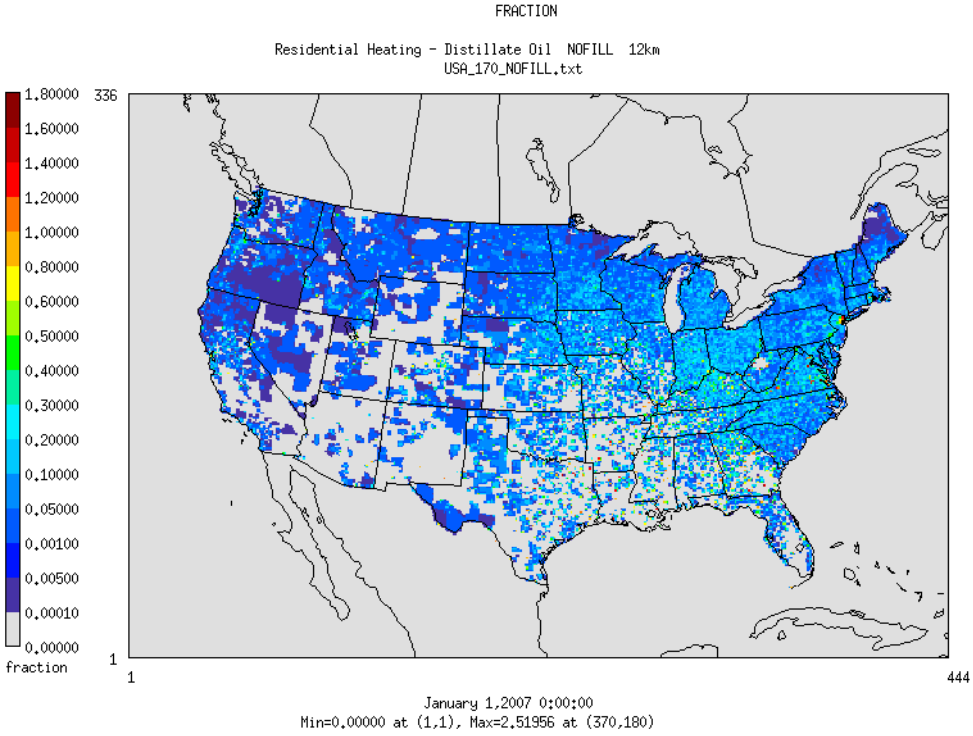
1.60000
1.40000
1.20000
1.00000
0.80000
0.60000
0.50000
0.40000
0.30000
0.20000
0.10000
0.05000
0.00100
0.00500
0.00010
0.00000
fraction
336
1
1
444
January 1,2007 0:00:00
Min=0.00000 at (1,1), Max=2.22556 at (368,178)


FRACTION
Residential Heating - Distillate Oil NOFILL 12km
USA_170_NOFILL.txt
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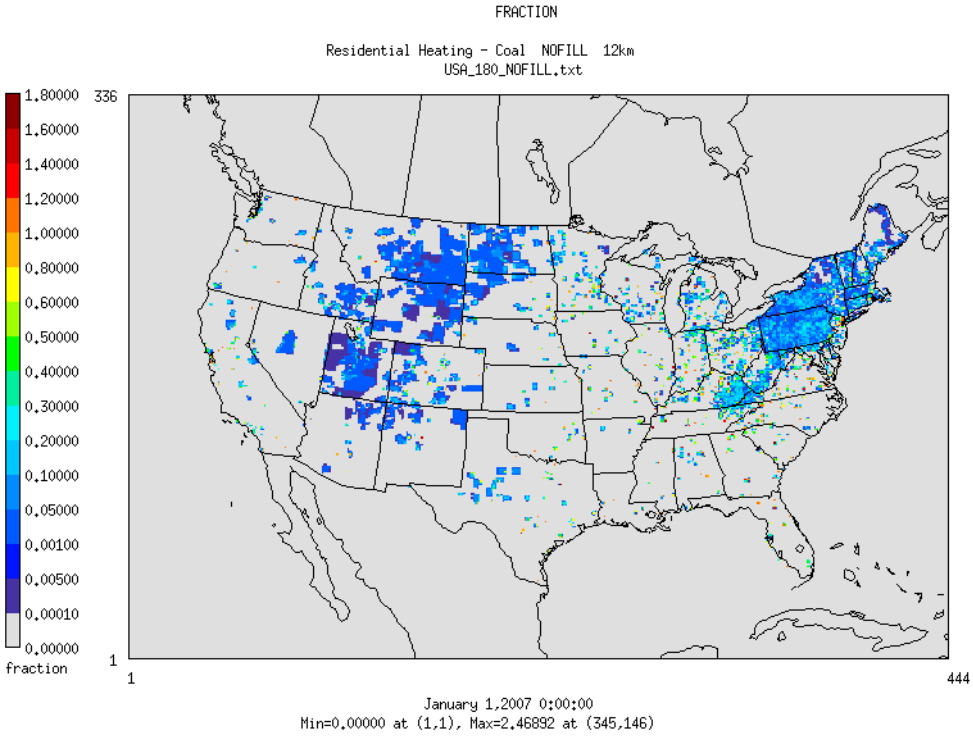
1.60000
1.40000
1.20000
1.00000
0.80000
0.60000
0.50000
0.40000
0.30000
0.20000
0.10000
0.05000
0.00100
0.00500
0.00010
0.00000
fraction
336
1
1
444
January 1,2007 0:00:00
Min=0.00000 at (1,1), Max=2.51956 at (370,180)


FRACTION
Residential Heating - Coal NOFILL 12km
USA_180_NOFILL.txt
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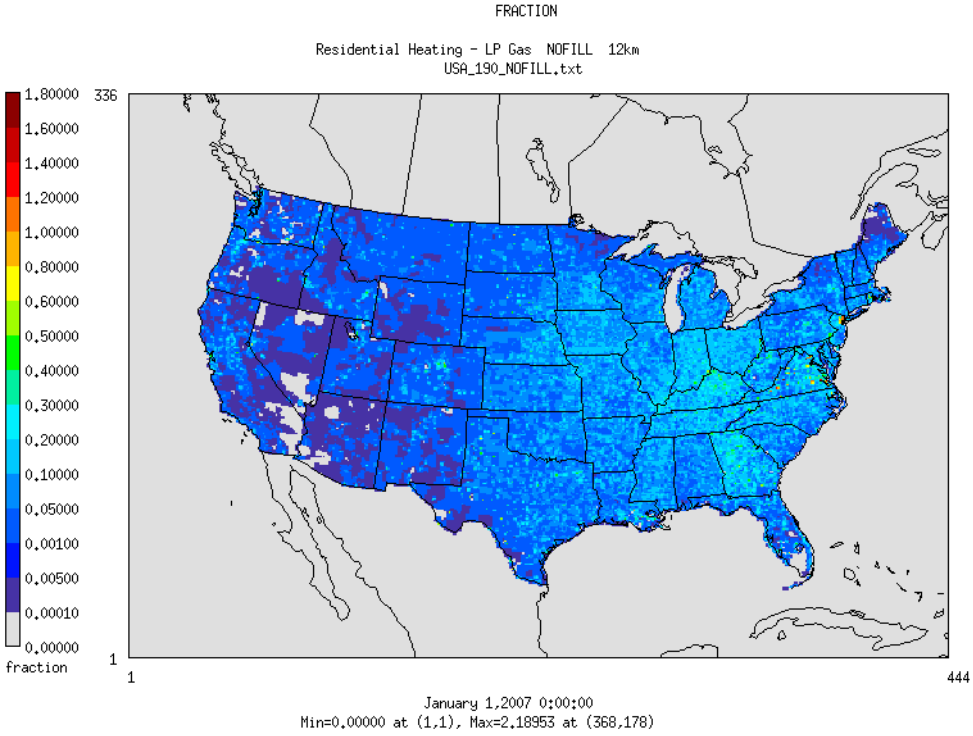
1.40000
1.20000
1.00000
0.80000
0.60000
0.50000
0.40000
0.30000
0.20000
0.10000
0.05000
0.00100
0.00500
0.00010
0.00000
fraction
336
1
1
444
January 1,2007 0:00:00
Min=0.00000 at (1,1), Max=2.46892 at (345,146)


FRACTION
Residential Heating - LP Gas NOFILL 12km
USA_190_NOFILL.txt
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1.40000
1.20000
1.00000
0.80000
0.60000
0.50000
0.40000
0.30000
0.20000
0.10000
0.05000
0.00100
0.00500
0.00010
0.00000
fraction
336
1
1
444
January 1,2007 0:00:00
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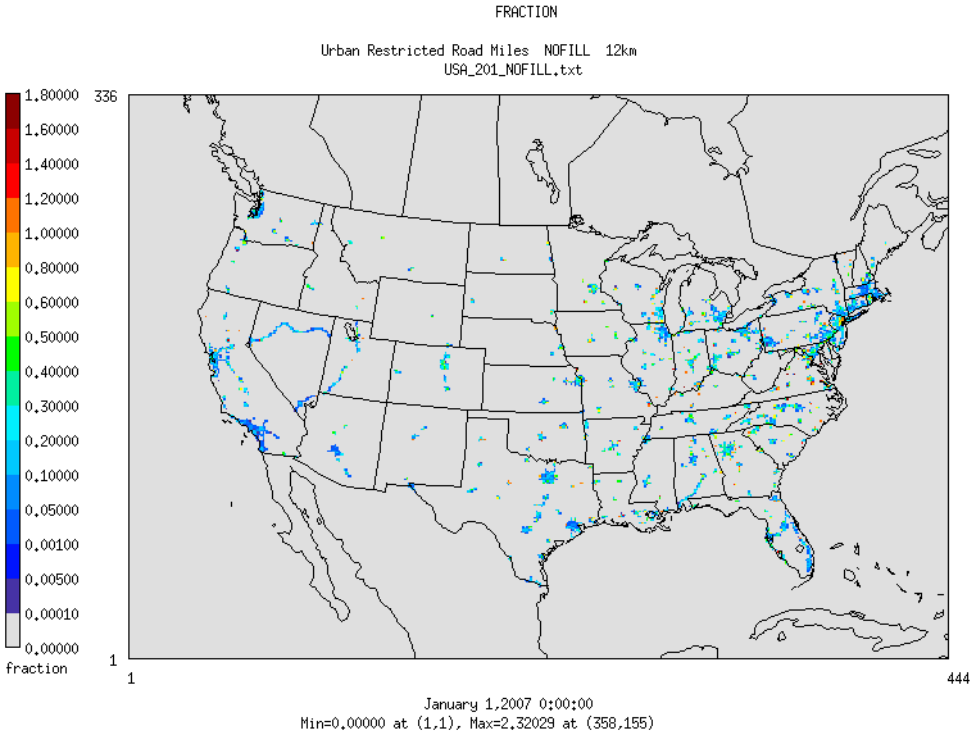
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Urban Restricted Road Miles NOFILL 12km
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1.20000
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0.60000
0.50000
0.40000
0.30000
0.20000
0.10000
0.05000
0.00100
0.00500
0.00010
0.00000
fraction
336
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1
444
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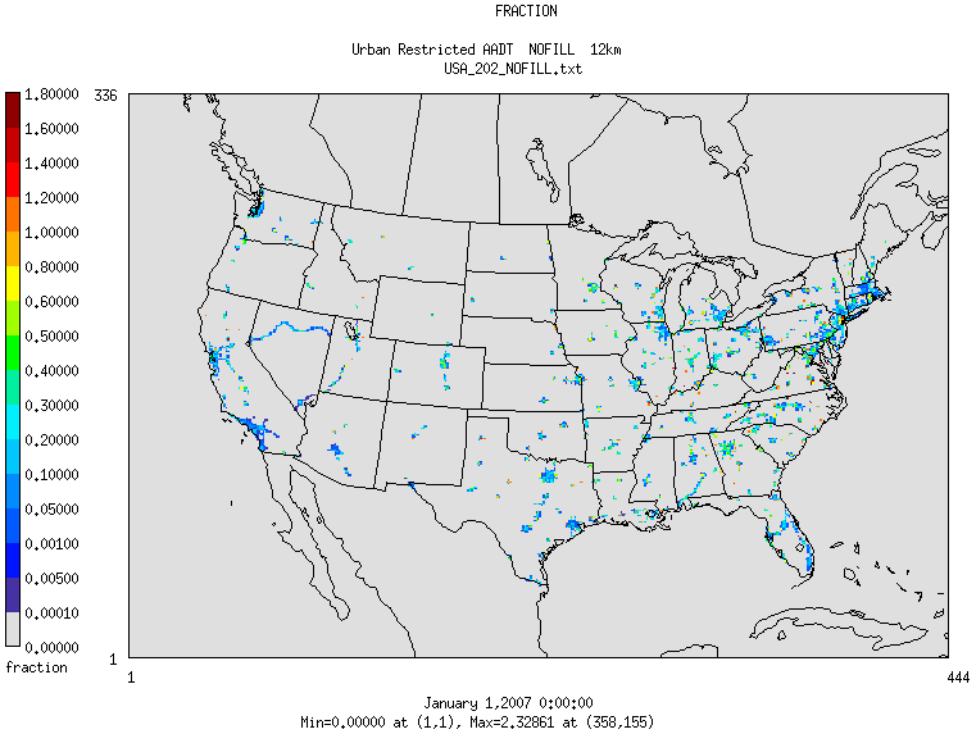
Min=0.00000 at (1,1), Max=2.32029 at (358,155)


FRACTION
Urban Restricted AADT NOFILL 12km
USA_202_NOFILL.txt
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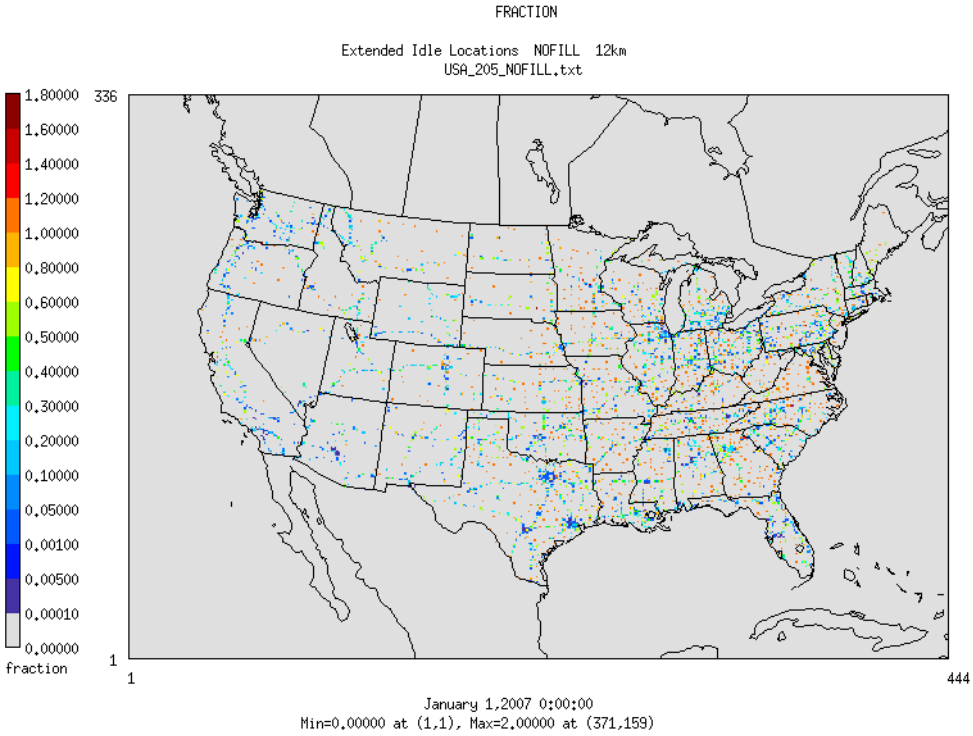
1.20000
1.00000
0.80000
0.60000
0.50000
0.40000
0.30000
0.20000
0.10000
0.05000
0.00100
0.00500
0.00010
0.00000
fraction
336
1
1
444
January 1,2007 0:00:00
Min=0.00000 at (1,1), Max=2.32861 at (358,155)


FRACTION
Extended Idle Locations NOFILL 12km
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1.20000
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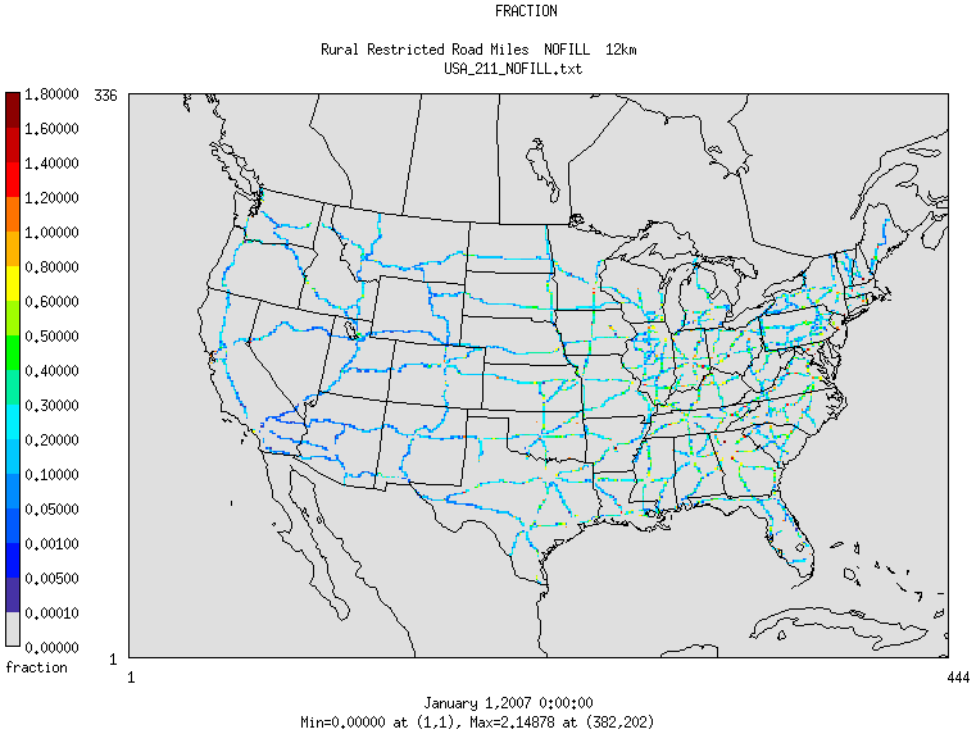
0.60000
0.50000
0.40000
0.30000
0.20000
0.10000
0.05000
0.00100
0.00500
0.00010
0.00000
fraction
336
1
1
444
January 1,2007 0:00:00
Min=0.00000 at (1,1), Max=2.00000 at (371,159)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1.20000
1.00000
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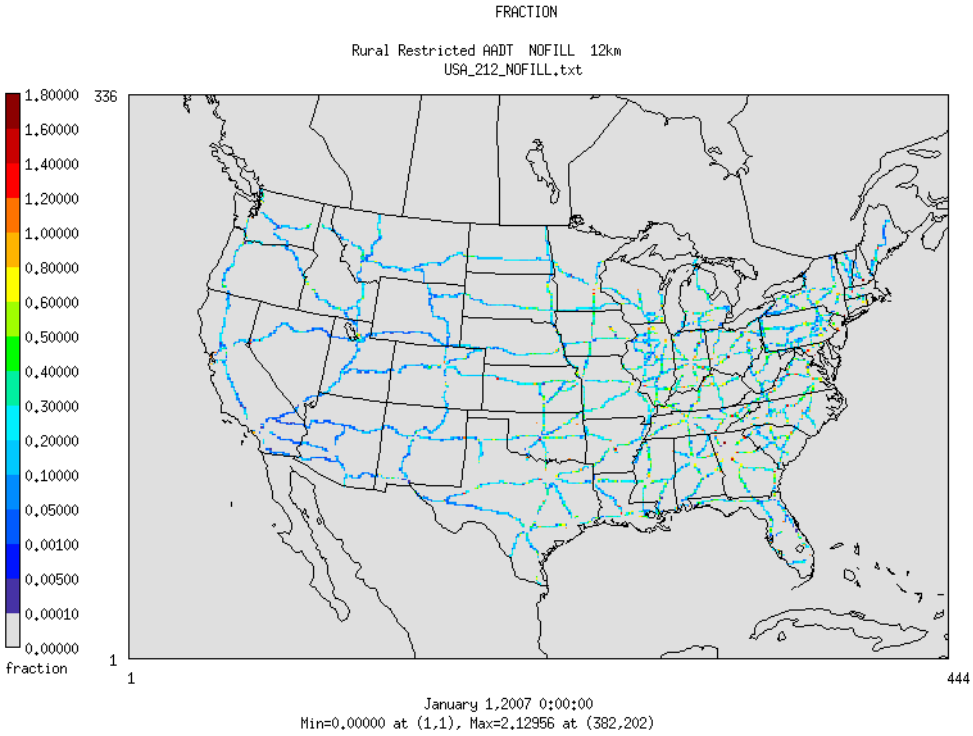
0.60000
0.50000
0.40000
0.30000
0.20000
0.10000
0.05000
0.00100
0.00500
0.00010
0.00000
fraction
336
1
1
444
January 1,2007 0:00:00
Min=0.00000 at (1,1), Max=2.14878 at (382,202)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Rural Restricted AADT NOFILL 12km
USA_212_NOFILL.txt
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1.00000
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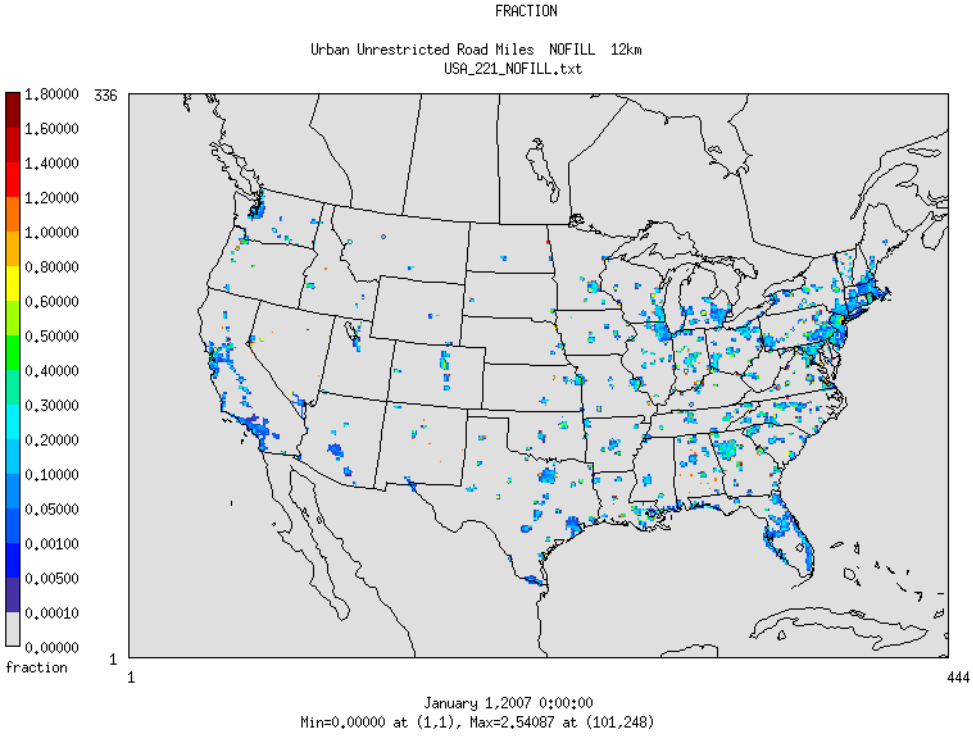
0.60000
0.50000
0.40000
0.30000
0.20000
0.10000
0.05000
0.00100
0.00500
0.00010
0.00000
fraction
336
1
1
444
January 1,2007 0:00:00
Min=0.00000 at (1,1), Max=2.12956 at (382,202)


FRACTION
Urban Unrestricted Road Miles NOFILL 12km
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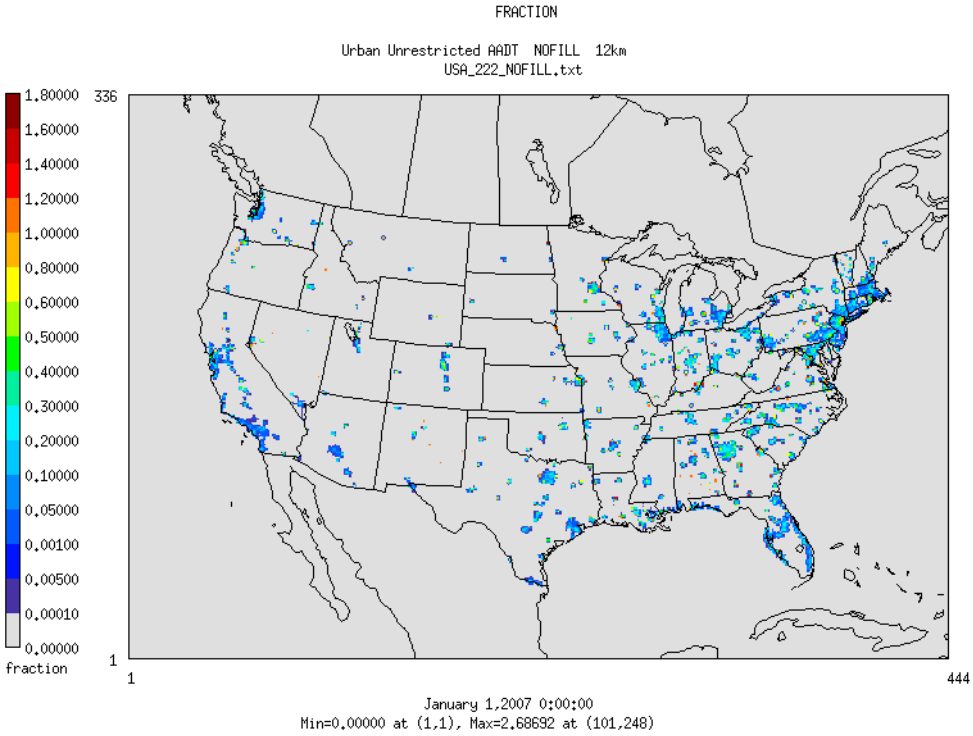
1.20000
1.00000
0.80000
0.60000
0.50000
0.40000
0.30000
0.20000
0.10000
0.05000
0.00100
0.00500
0.00010
0.00000
fraction
336
1
1
444
January 1,2007 0:00:00
Min=0.00000 at (1,1), Max=2.54087 at (101,248)


FRACTION
Urban Unrestricted AADT NOFILL 12km
USA_222_NOFILL.txt
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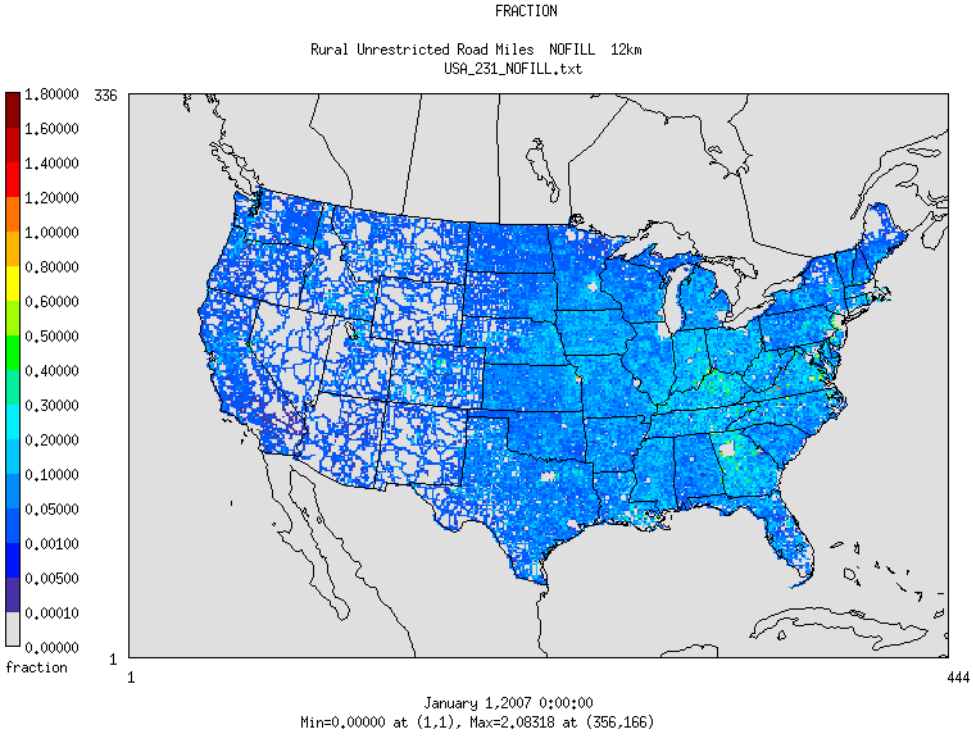
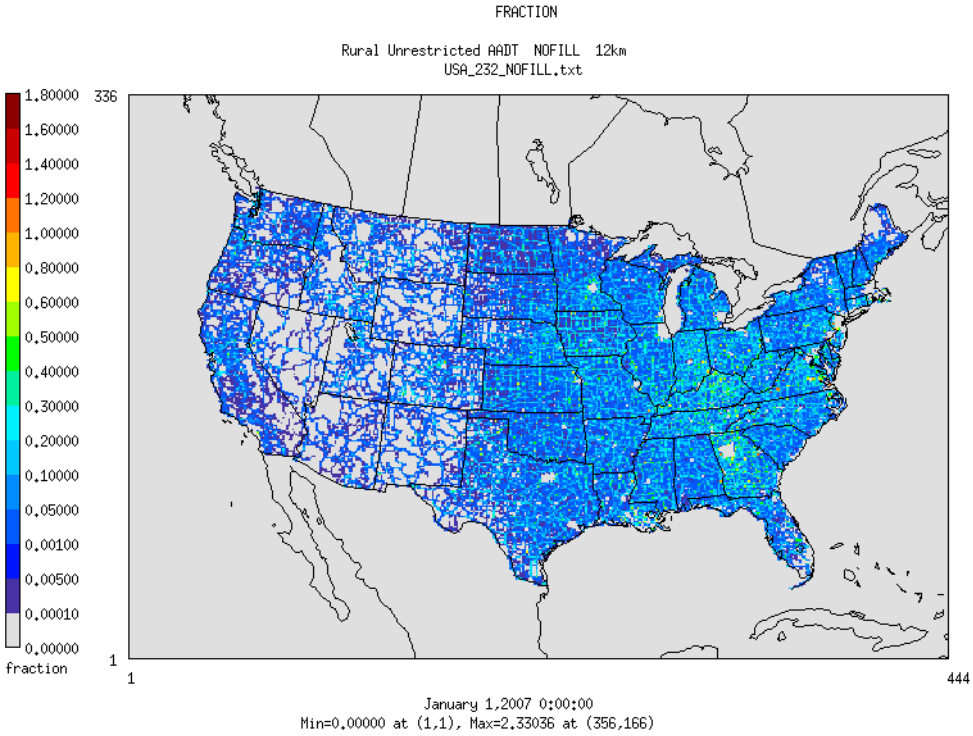
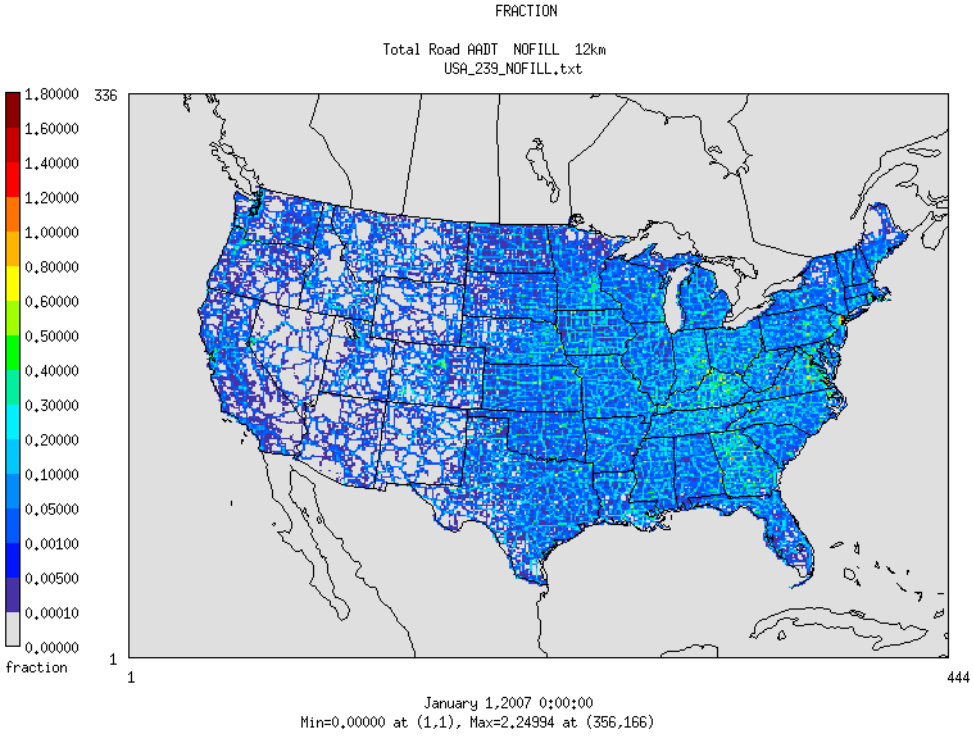
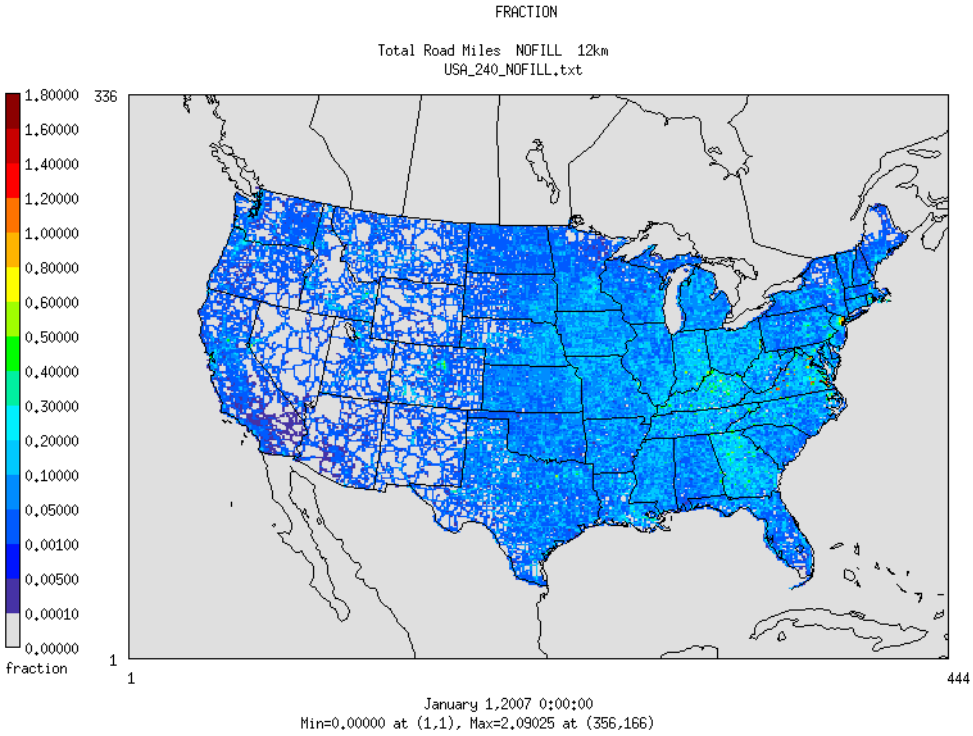
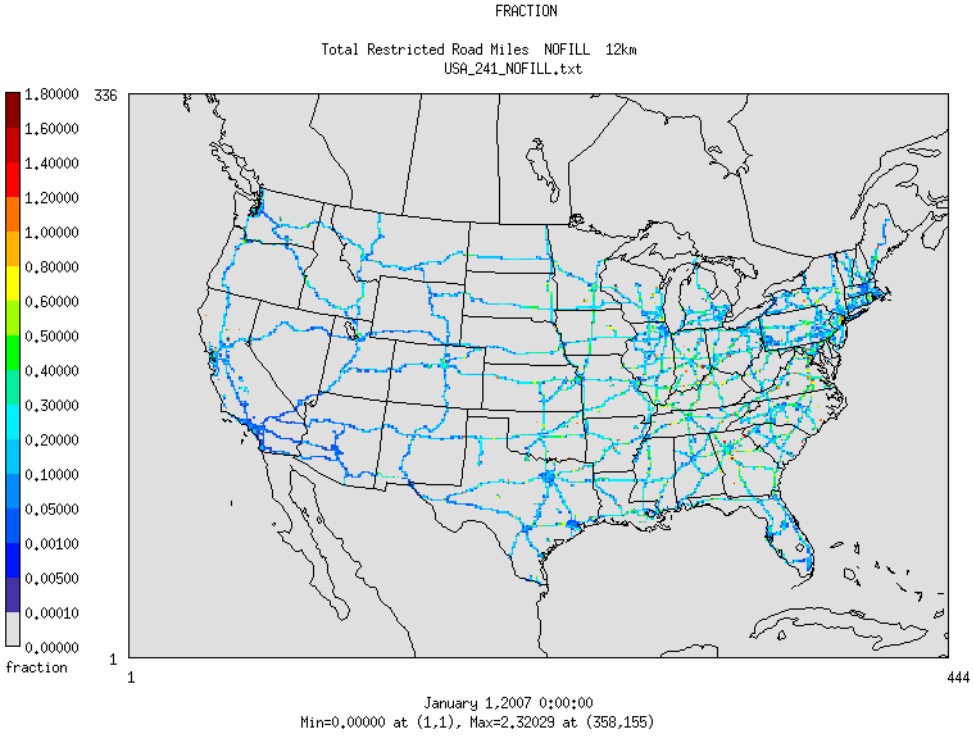
1.40000
1.20000
1.00000
0.80000
0.60000
0.50000
0.40000
0.30000
0.20000
0.10000
0.05000
0.00100
0.00500
0.00010
0.00000
fraction
336
1
1
444
January 1,2007 0:00:00
Min=0.00000 at (1,1), Max=2.68692 at (101,248)

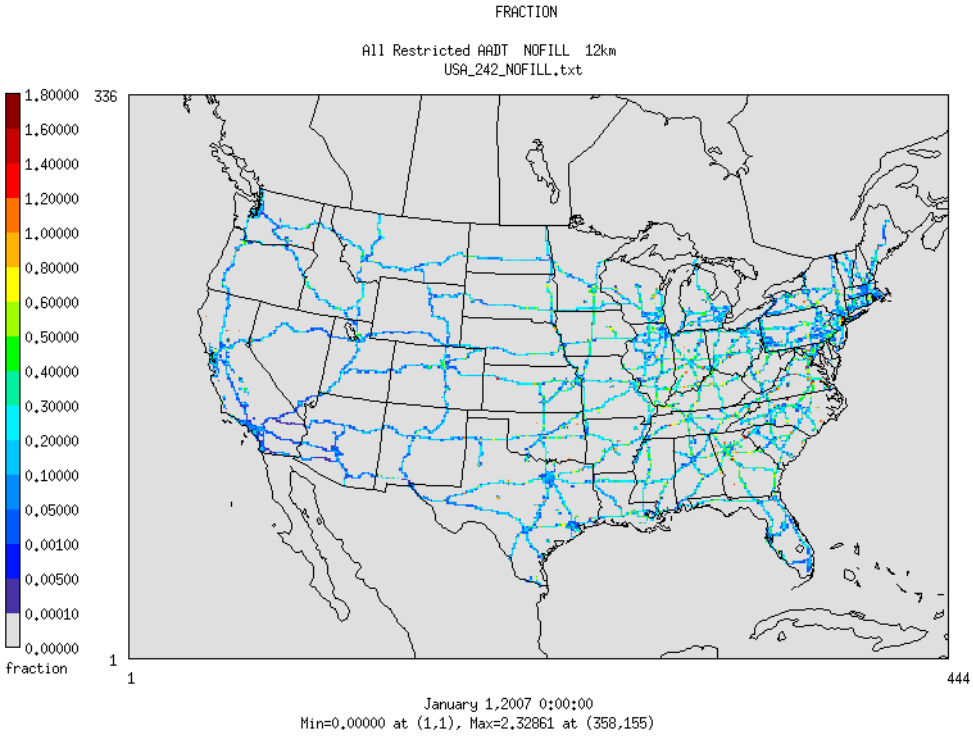

FRACTION
Rural Unrestricted Road Miles NOFILL 12km
USA_231_NOFILL.txt
1.80000
1.60000
1.40000
1.20000
1.00000
0.80000
0.60000
0.50000
0.40000
0.30000
0.20000
0.10000
0.05000
0.00100
0.00500
0.00010
0.00000
fraction
336
1
1
444
January 1,2007 0:00:00
Min=0.00000 at (1,1), Max=2.08318 at (356,166)

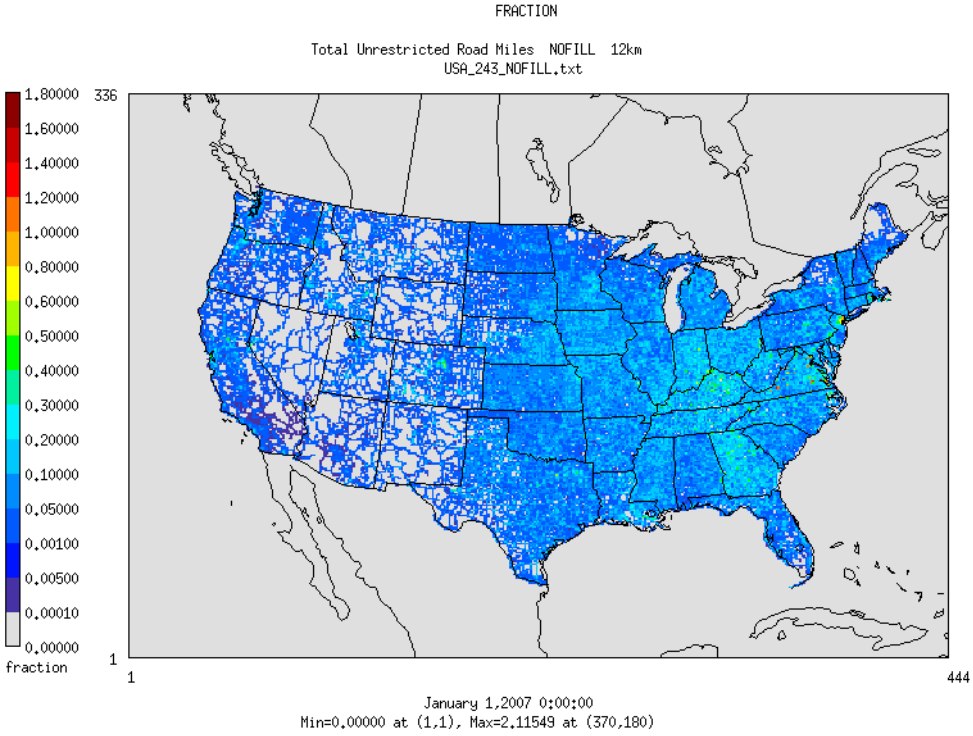

FRACTION
Rural Unrestricted AADT NOFILL 12km
USA_232_NOFILL.txt
1.80000
1.60000
1.40000
1.20000
1.00000
0.80000
0.60000
0.50000
0.40000
0.30000
0.20000
0.10000
0.05000
0.00100
0.00500
0.00010
0.00000
fraction
336
1
1
444
January 1,2007 0:00:00
Min=0.00000 at (1,1), Max=2.33036 at (356,166)

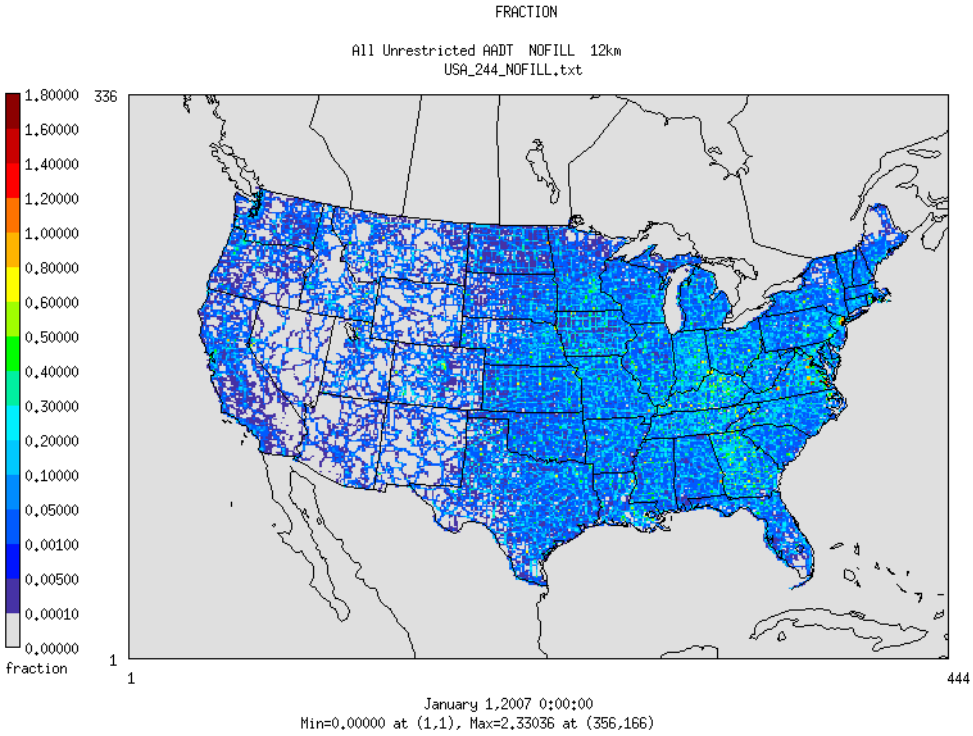

FRACTION
Total Road AADT NOFILL 12km
USA_239_NOFILL.txt
1.80000
1.60000
1.40000
1.20000
1.00000
0.80000
0.60000
0.50000
0.40000
0.30000
0.20000
0.10000
0.05000
0.00100
0.00500
0.00010
0.00000
fraction
336
1
1
444
January 1,2007 0:00:00
Min=0.00000 at (1,1), Max=2.24994 at (356,166)

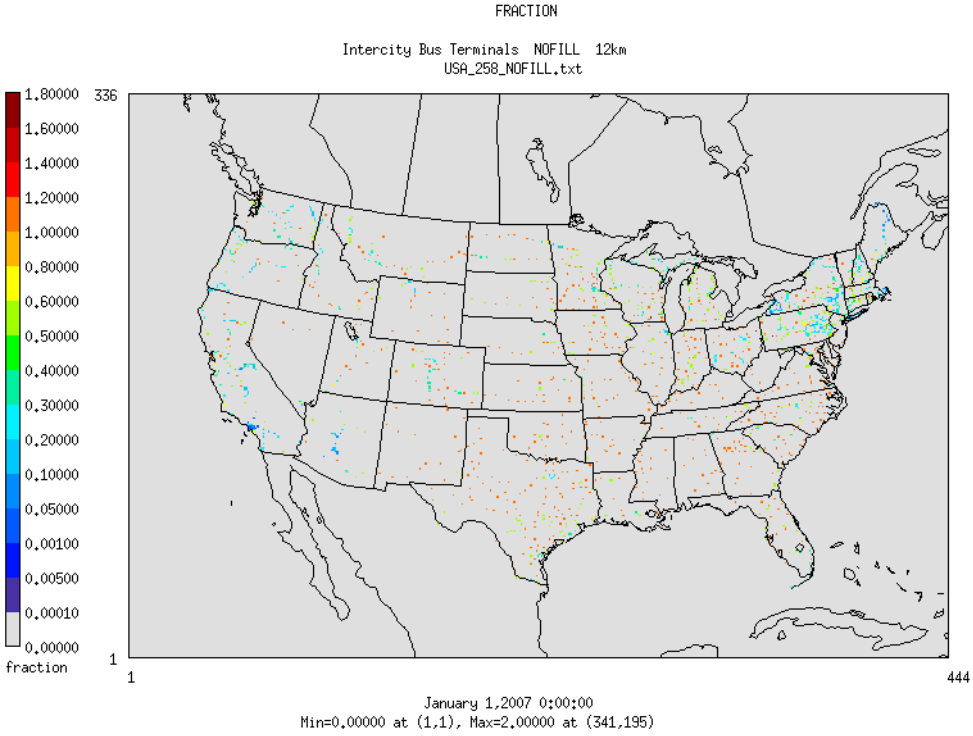

FRACTION
Total Road Miles NOFILL 12km
USA_240_NOFILL.txt
1.80000
1.60000
1.40000
1.20000
1.00000
0.80000
0.60000
0.50000
0.40000
0.30000
0.20000
0.10000
0.05000
0.00100
0.00500
0.00010
0.00000
fraction
336
1
1
444
January 1,2007 0:00:00
Min=0.00000 at (1,1), Max=2.09025 at (356,166)

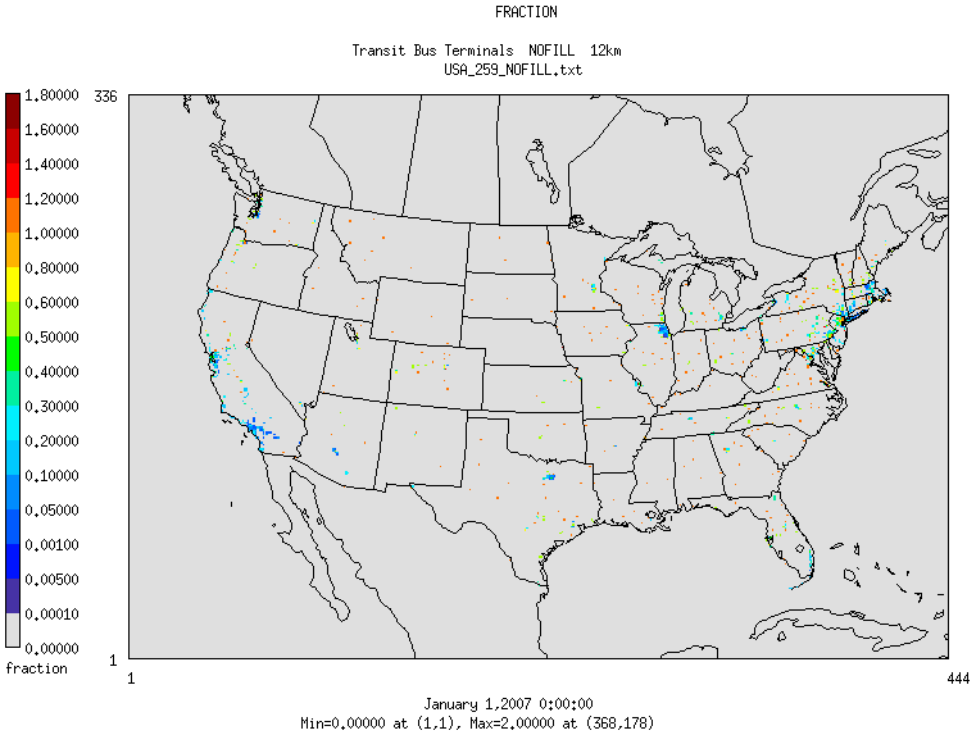

FRACTION
Total Restricted Road Miles NOFILL 12km
USA_241_NOFILL.txt
1.80000
1.60000
1.40000
1.20000
1.00000
0.80000
0.60000
0.50000
0.40000
0.30000
0.20000
0.10000
0.05000
0.00100
0.00500
0.00010
0.00000
fraction
336
1
1
444
January 1,2007 0:00:00
Min=0.00000 at (1,1), Max=2.32029 at (358,155)

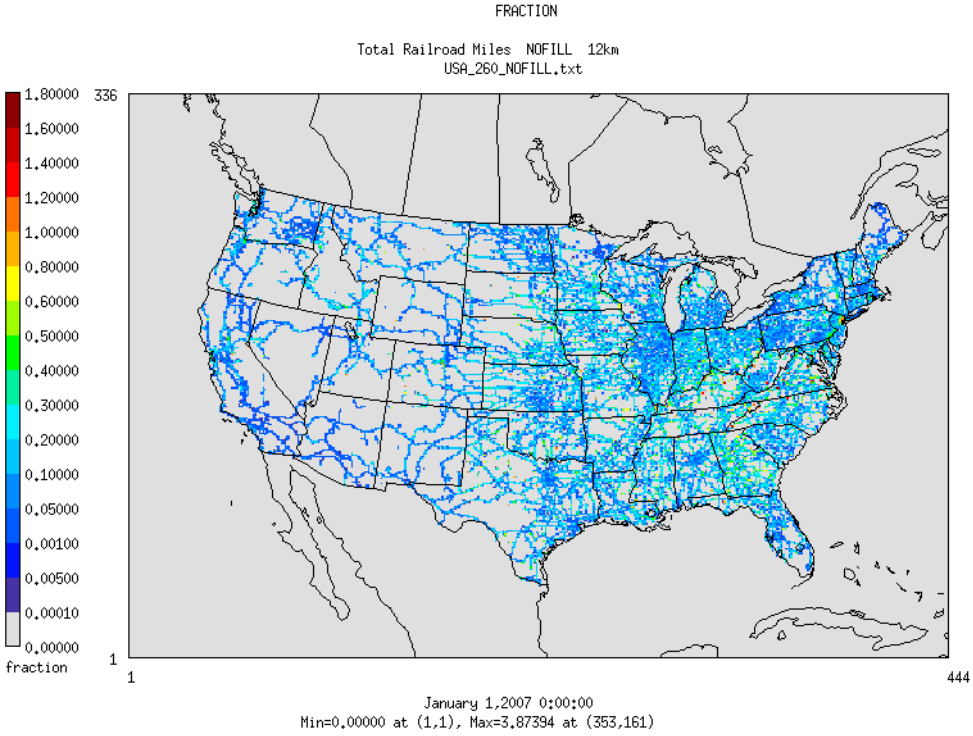

FRACTION
All Restricted AADT NOFILL 12km
USA_242_NOFILL.txt
1.80000
1.60000
1.40000
1.20000
1.00000
0.80000
0.60000
0.50000
0.40000
0.30000
0.20000
0.10000
0.05000
0.00100
0.00500
0.00010
0.00000
fraction
336
1
1
444
January 1,2007 0:00:00
Min=0.00000 at (1,1), Max=2.32861 at (358,155)

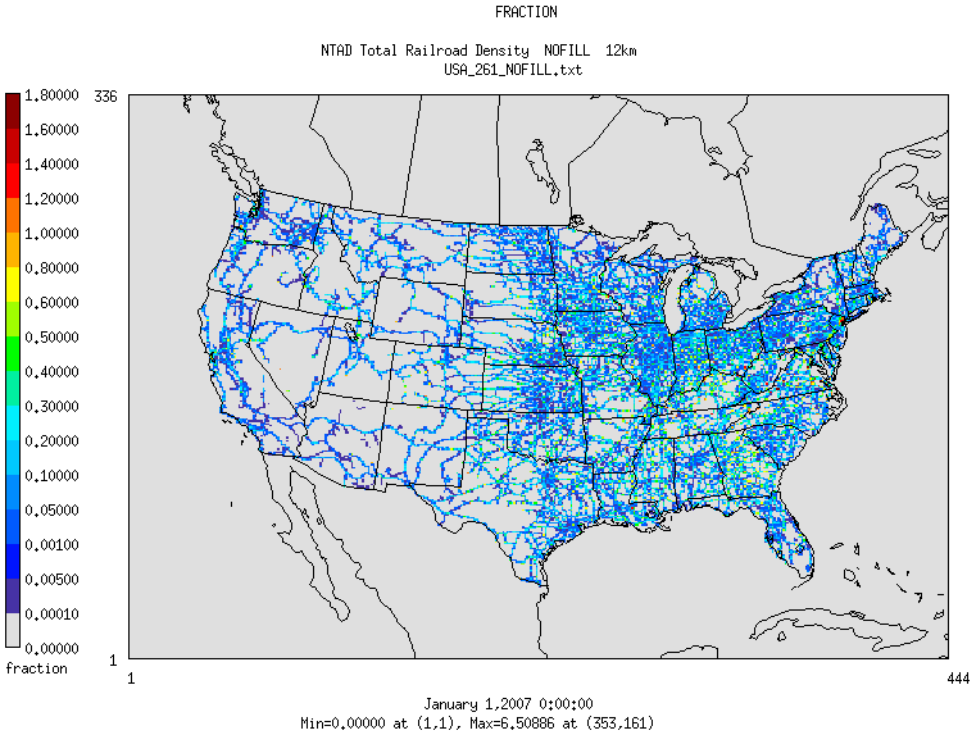

FRACTION
Total Unrestricted Road Miles NOFILL 12km
USA_243_NOFILL.txt
1.80000
1.60000
1.40000
1.20000
1.00000
0.80000
0.60000
0.50000
0.40000
0.30000
0.20000
0.10000
0.05000
0.00100
0.00500
0.00010
0.00000
fraction
336
1
1
444
January 1,2007 0:00:00
Min=0.00000 at (1,1), Max=2.11549 at (370,180)

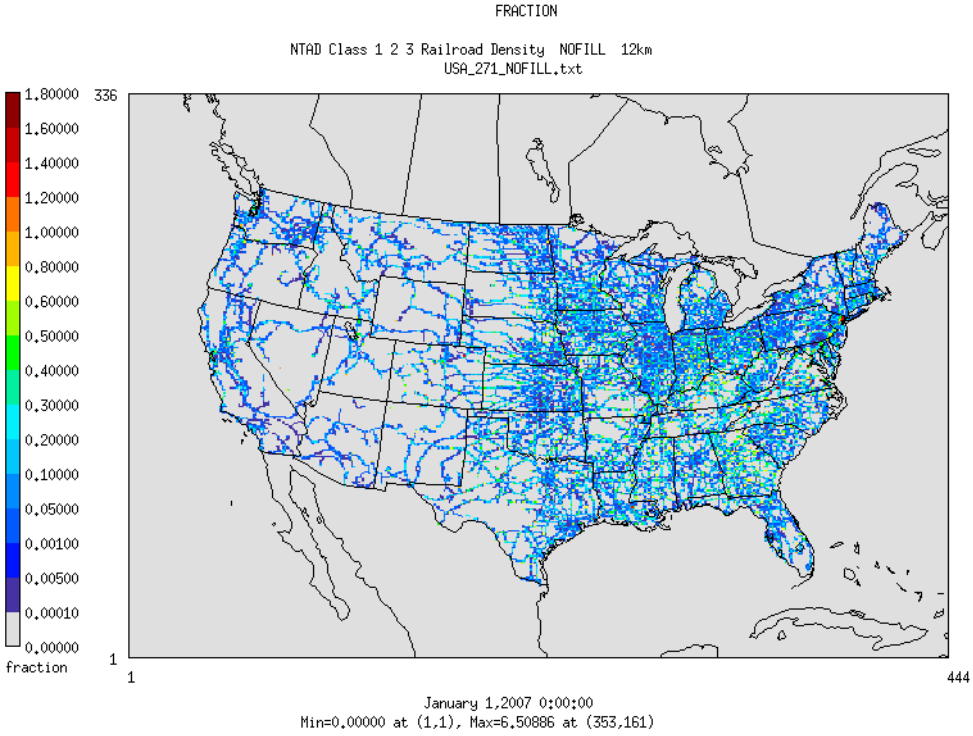

FRACTION
All Unrestricted AADT NOFILL 12km
USA_244_NOFILL.txt
1.80000
1.60000
1.40000
1.20000
1.00000
0.80000
0.60000
0.50000
0.40000
0.30000
0.20000
0.10000
0.05000
0.00100
0.00500
0.00010
0.00000
fraction
336
1
1
444
January 1,2007 0:00:00
Min=0.00000 at (1,1), Max=2.33036 at (356,166)

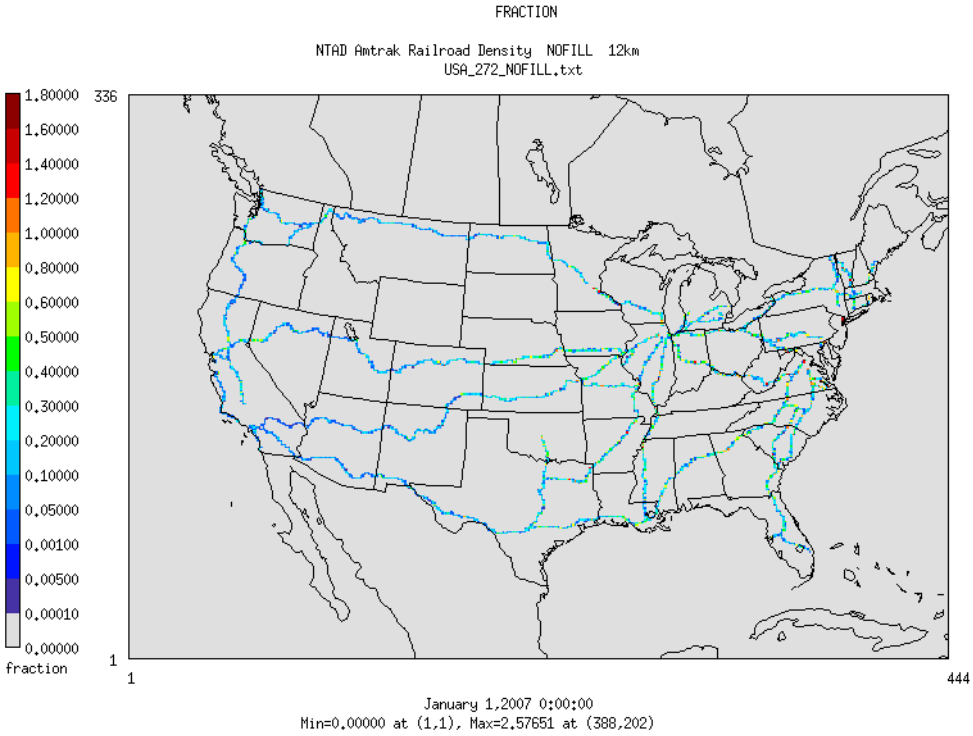

FRACTION
Intercity Bus Terminals NOFILL 12km
USA_258_NOFILL.txt
1.80000
1.60000
1.40000
1.20000
1.00000
0.80000
0.60000
0.50000
0.40000
0.30000
0.20000
0.10000
0.05000
0.00100
0.00500
0.00010
0.00000
fraction
336
1
1
444
January 1,2007 0:00:00
Min=0.00000 at (1,1), Max=2.00000 at (341,195)

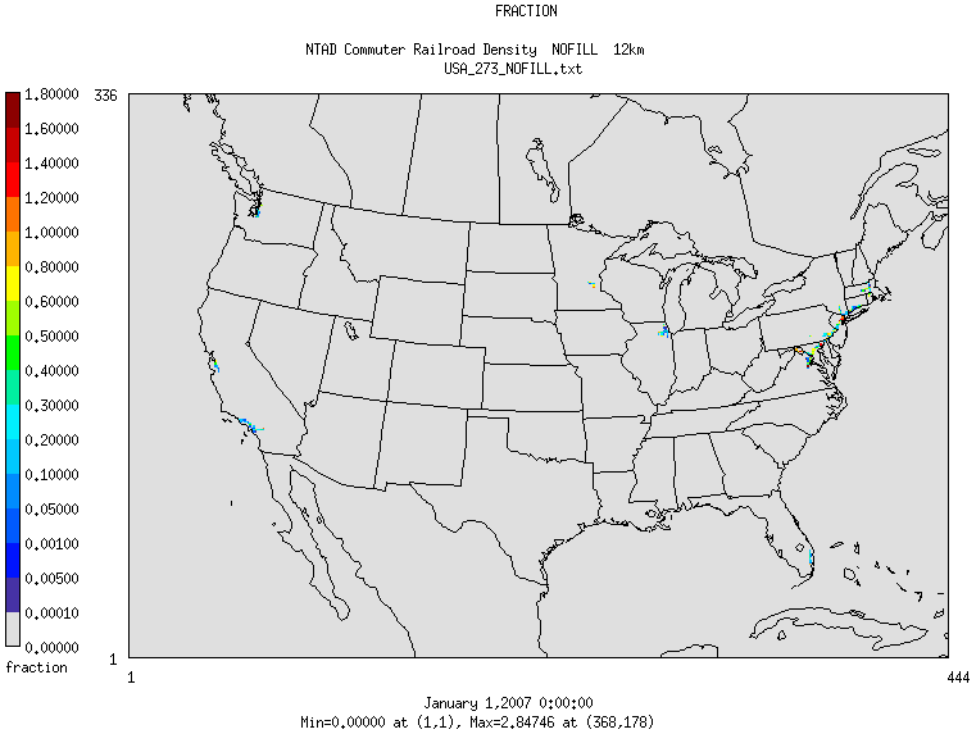

FRACTION
Transit Bus Terminals NOFILL 12km
USA_259_NOFILL.txt
1.80000
1.60000
1.40000
1.20000
1.00000
0.80000
0.60000
0.50000
0.40000
0.30000
0.20000
0.10000
0.05000
0.00100
0.00500
0.00010
0.00000
fraction
336
1
1
444
January 1,2007 0:00:00
Min=0.00000 at (1,1), Max=2.00000 at (368,178)

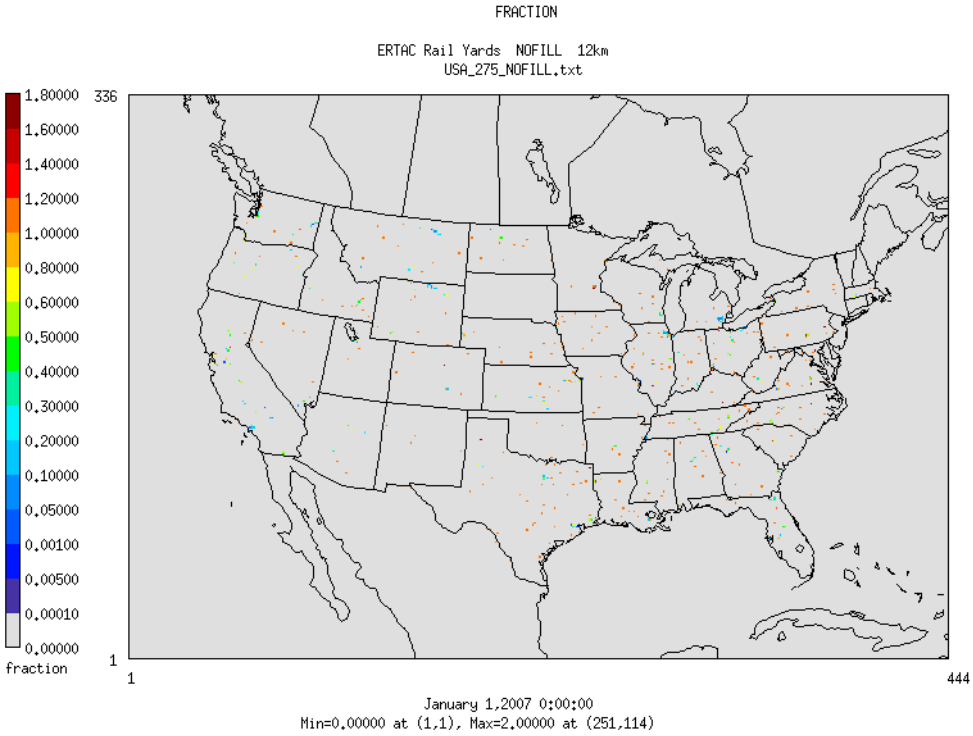

FRACTION
Total Railroad Miles NOFILL 12km
USA_260_NOFILL.txt
1.80000
1.60000
1.40000
1.20000
1.00000
0.80000
0.60000
0.50000
0.40000
0.30000
0.20000
0.10000
0.05000
0.00100
0.00500
0.00010
0.00000
fraction
336
1
1
444
January 1,2007 0:00:00
Min=0.00000 at (1,1), Max=3.87394 at (353,161)

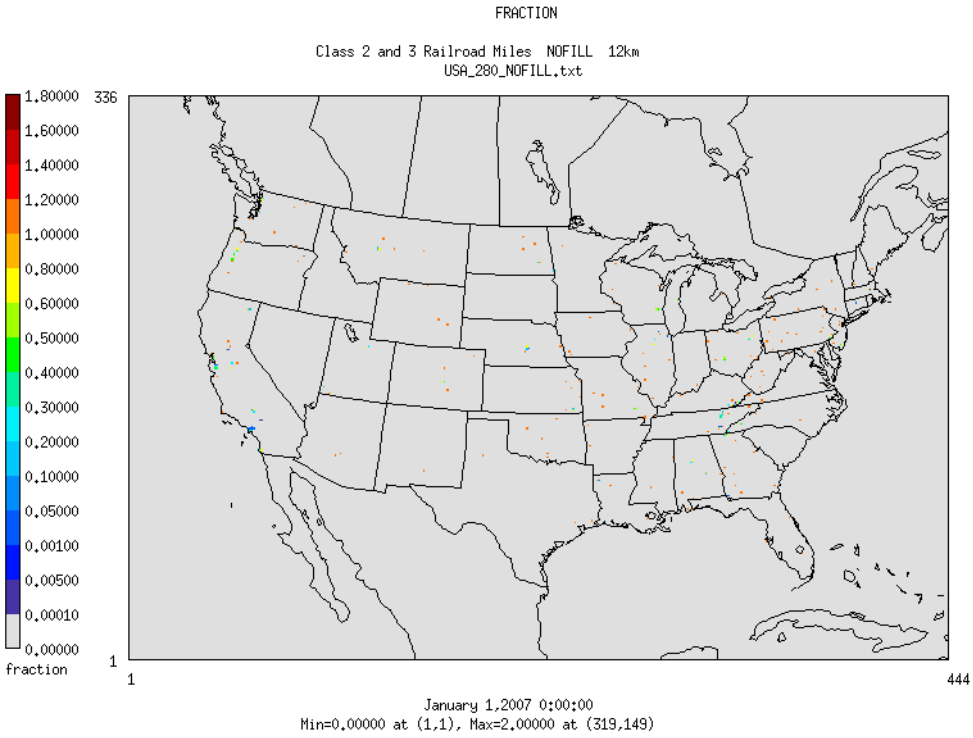

FRACTION
NTAD Total Railroad Density NOFILL 12km
USA_261_NOFILL.txt
1.80000
1.60000
1.40000
1.20000
1.00000
0.80000
0.60000
0.50000
0.40000
0.30000
0.20000
0.10000
0.05000
0.00100
0.00500
0.00010
0.00000
fraction
336
1
1
444
January 1,2007 0:00:00
Min=0.00000 at (1,1), Max=6.50886 at (353,161)

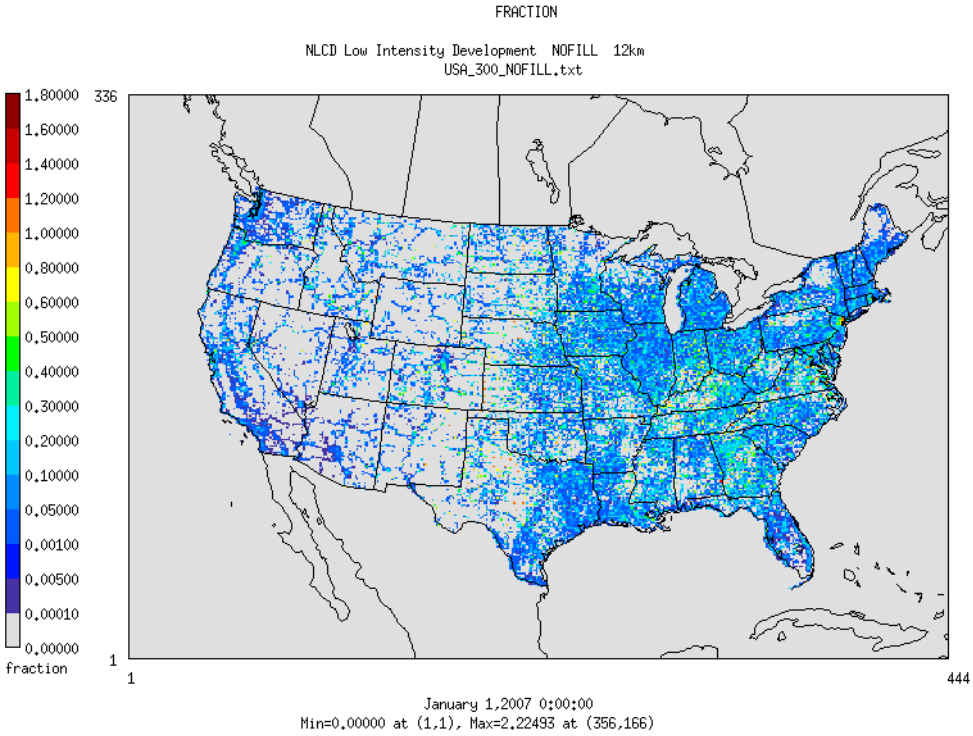

FRACTION
NTAD Class 1 2 3 Railroad Density NOFILL 12km
USA_271_NOFILL.txt
1.80000
1.60000
1.40000
1.20000
1.00000
0.80000
0.60000
0.50000
0.40000
0.30000
0.20000
0.10000
0.05000
0.00100
0.00500
0.00010
0.00000
fraction
336
1
1
444
January 1,2007 0:00:00
Min=0.00000 at (1,1), Max=6.50886 at (353,161)

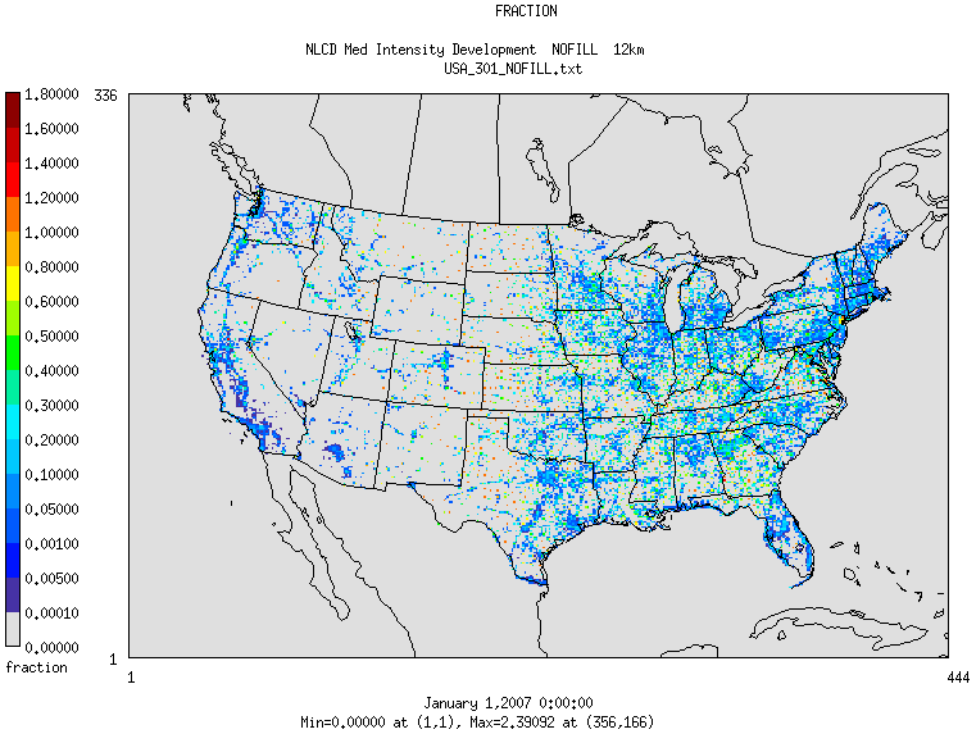

FRACTION
NTAD Amtrak Railroad Density NOFILL 12km
USA_272_NOFILL.txt
1.80000
1.60000
1.40000
1.20000
1.00000
0.80000
0.60000
0.50000
0.40000
0.30000
0.20000
0.10000
0.05000
0.00100
0.00500
0.00010
0.00000
fraction
336
1
1
444
January 1,2007 0:00:00
Min=0.00000 at (1,1), Max=2.57651 at (388,202)

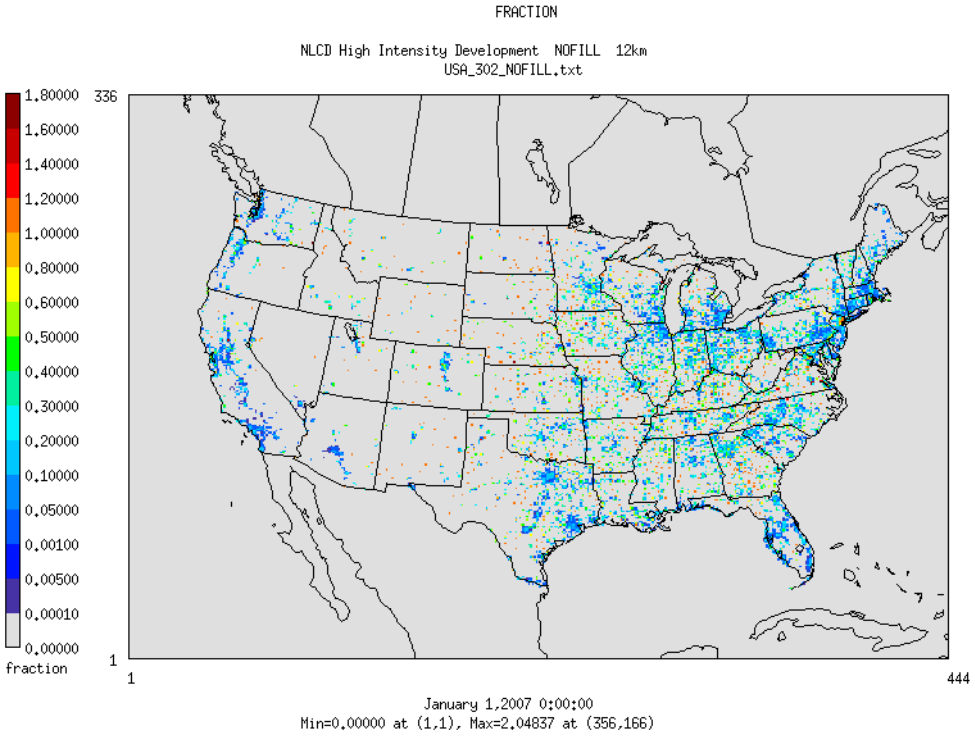

FRACTION
NTAD Commuter Railroad Density NOFILL 12km
USA_273_NOFILL.txt
1.80000
1.60000
1.40000
1.20000
1.00000
0.80000
0.60000
0.50000
0.40000
0.30000
0.20000
0.10000
0.05000
0.00100
0.00500
0.00010
0.00000
fraction
336
1
1
444
January 1,2007 0:00:00
Min=0.00000 at (1,1), Max=2.84746 at (368,178)

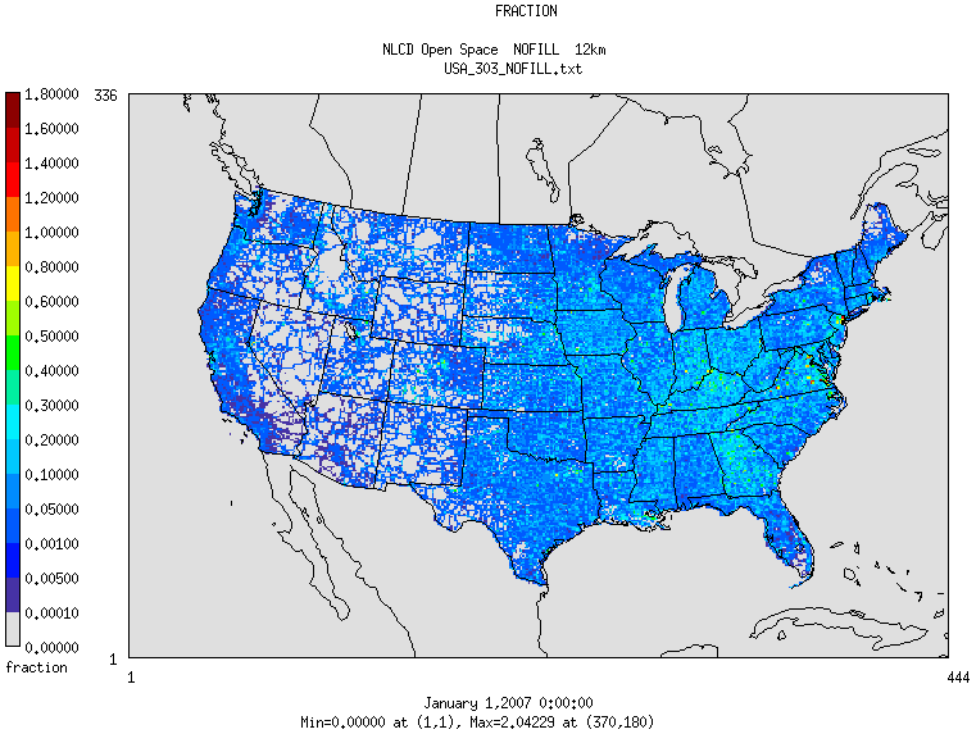

FRACTION
ERTAC Rail Yards NOFILL 12km
USA_275_NOFILL.txt
1.80000
1.60000
1.40000
1.20000
1.00000
0.80000
0.60000
0.50000
0.40000
0.30000
0.20000
0.10000
0.05000
0.00100
0.00500
0.00010
0.00000
fraction
336
1
1
444
January 1,2007 0:00:00
Min=0.00000 at (1,1), Max=2.00000 at (251,114)

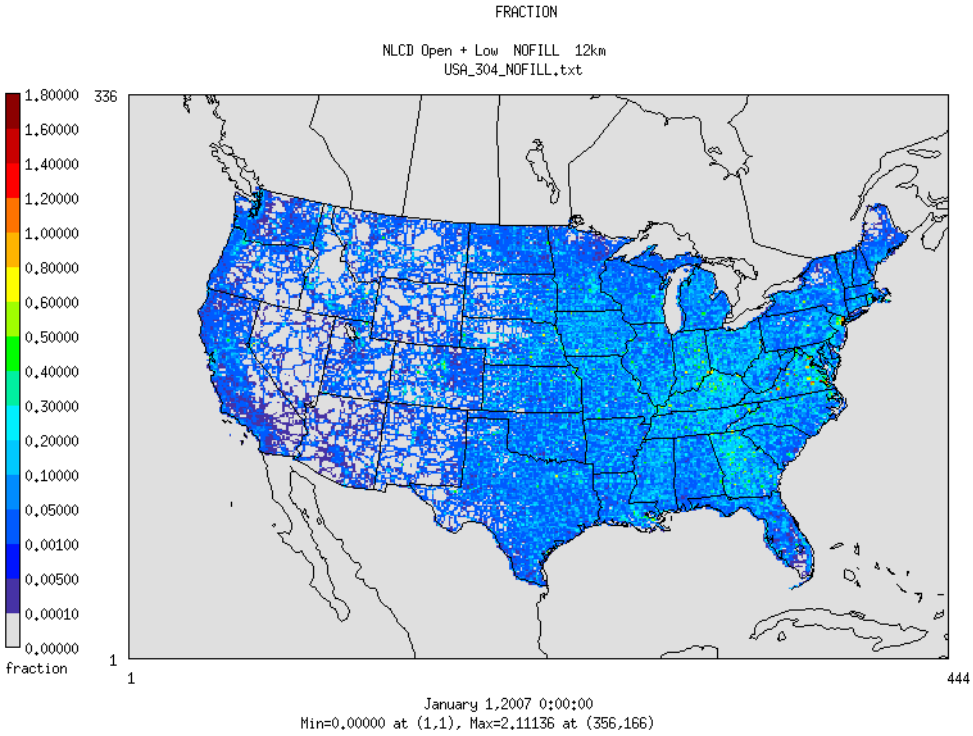

FRACTION
Class 2 and 3 Railroad Miles NOFILL 12km
USA_280_NOFILL.txt
1.80000
1.60000
1.40000
1.20000
1.00000
0.80000
0.60000
0.50000
0.40000
0.30000
0.20000
0.10000
0.05000
0.00100
0.00500
0.00010
0.00000
fraction
336
1
1
444
January 1,2007 0:00:00
Min=0.00000 at (1,1), Max=2.00000 at (319,149)

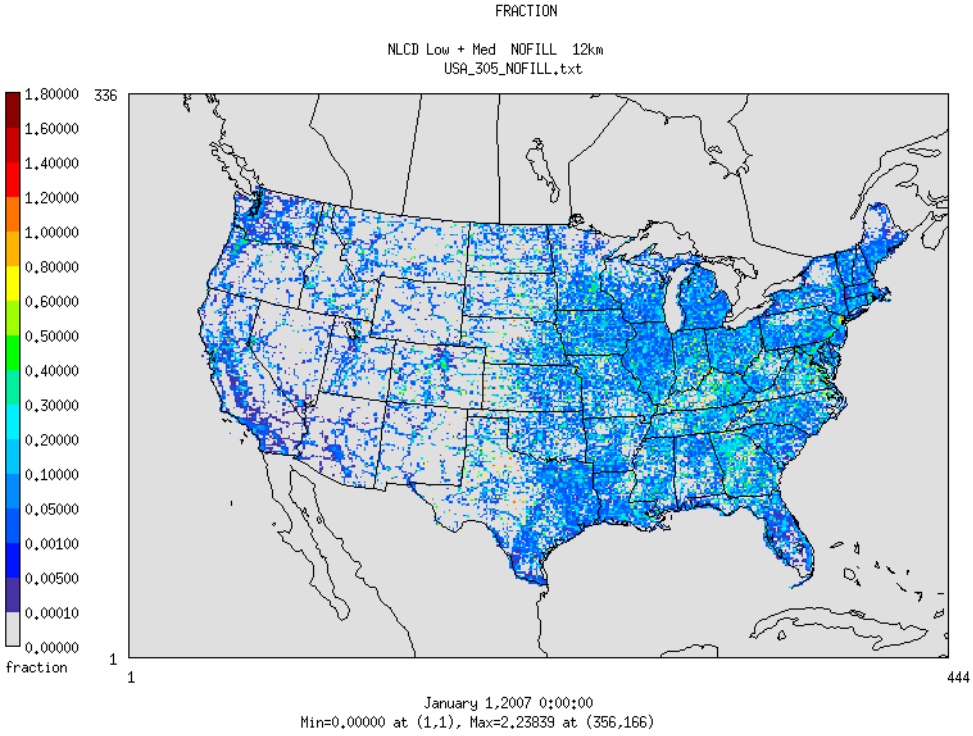

FRACTION
NLCD Low Intensity Development NOFILL 12km
USA_300_NOFILL.txt
1.80000
1.60000
1.40000
1.20000
1.00000
0.80000
0.60000
0.50000
0.40000
0.30000
0.20000
0.10000
0.05000
0.00100
0.00500
0.00010
0.00000
fraction
336
1
1
444
January 1,2007 0:00:00
Min=0.00000 at (1,1), Max=2.22493 at (356,166)

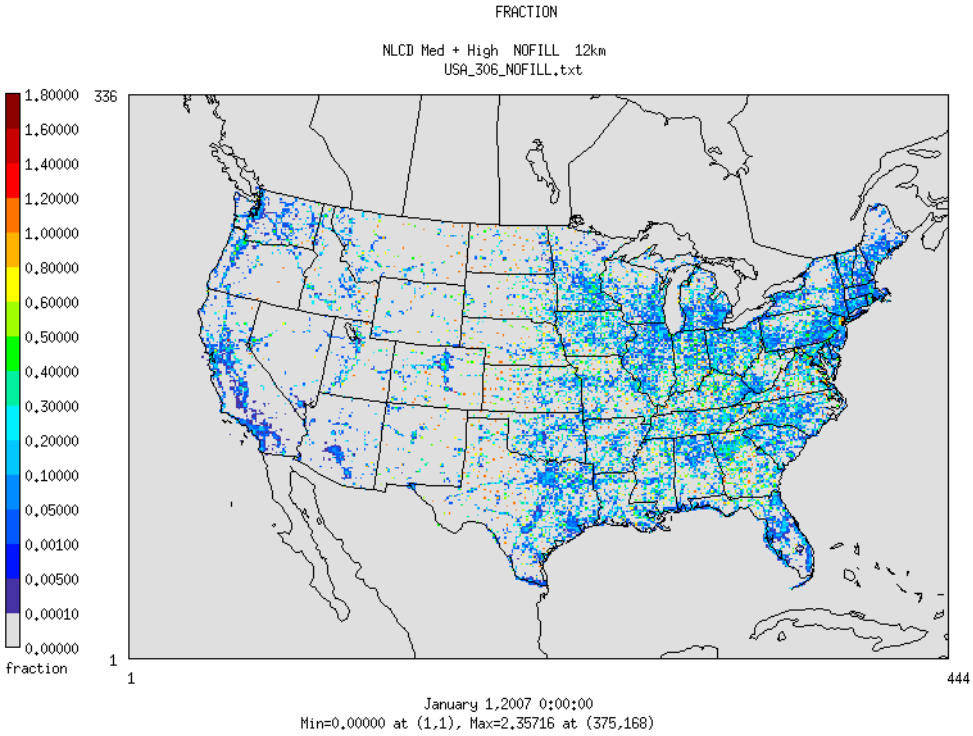

FRACTION
NLCD Med Intensity Development NOFILL 12km
USA_301_NOFILL.txt
1.80000
1.60000
1.40000
1.20000
1.00000
0.80000
0.60000
0.50000
0.40000
0.30000
0.20000
0.10000
0.05000
0.00100
0.00500
0.00010
0.00000
fraction
336
1
1
444
January 1,2007 0:00:00
Min=0.00000 at (1,1), Max=2.39092 at (356,166)

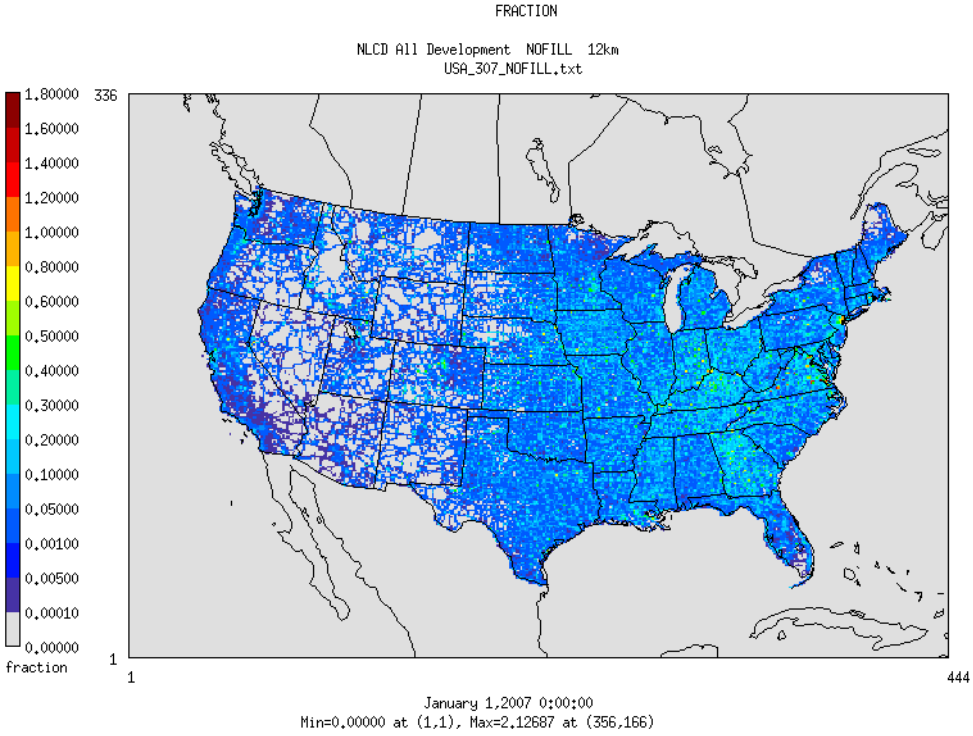

FRACTION
NLCD High Intensity Development NOFILL 12km
USA_302_NOFILL.txt
1.80000
1.60000
1.40000
1.20000
1.00000
0.80000
0.60000
0.50000
0.40000
0.30000
0.20000
0.10000
0.05000
0.00100
0.00500
0.00010
0.00000
fraction
336
1
1
444
January 1,2007 0:00:00
Min=0.00000 at (1,1), Max=2.04837 at (356,166)

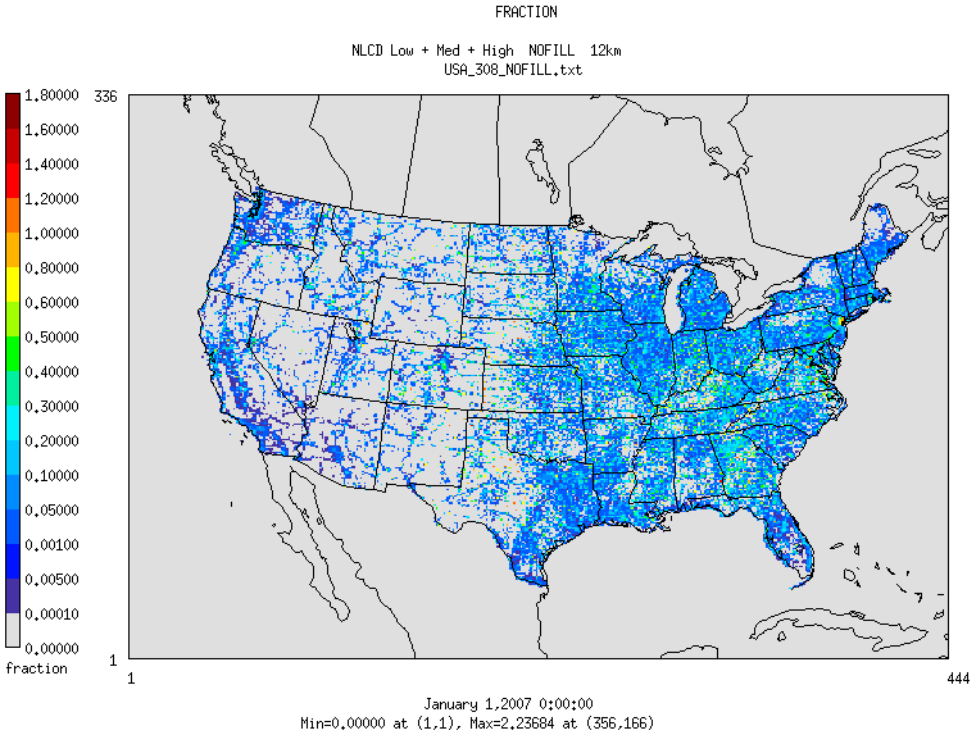

FRACTION
NLCD Open Space NOFILL 12km
USA_303_NOFILL.txt
1.80000
1.60000
1.40000
1.20000
1.00000
0.80000
0.60000
0.50000
0.40000
0.30000
0.20000
0.10000
0.05000
0.00100
0.00500
0.00010
0.00000
fraction
336
1
1
444
January 1,2007 0:00:00
Min=0.00000 at (1,1), Max=2.04229 at (370,180)

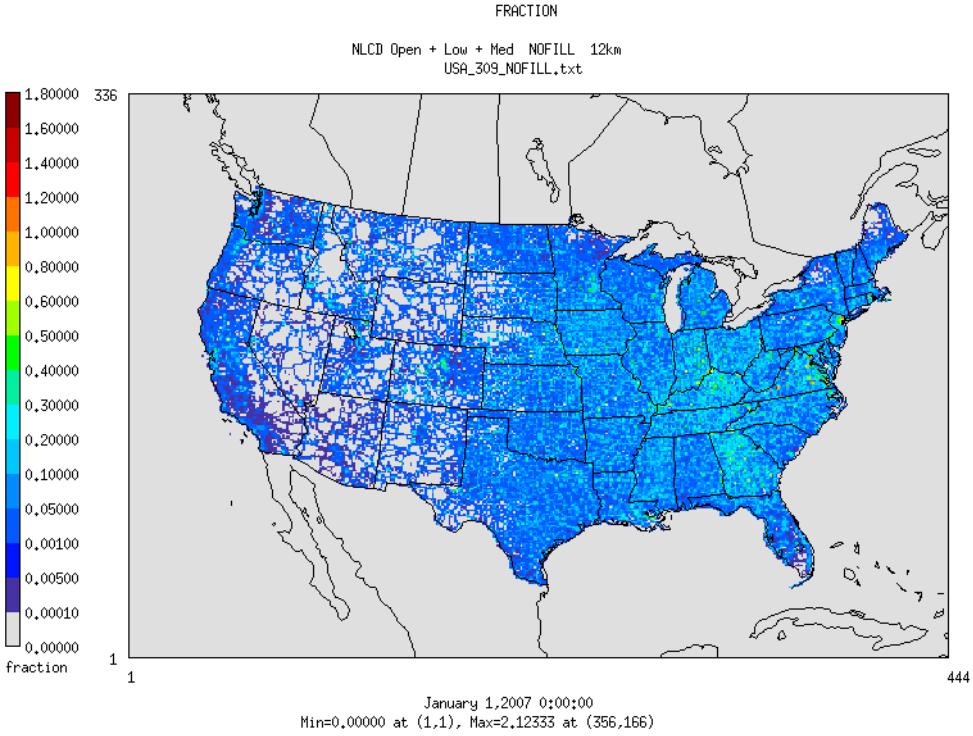

FRACTION
NLCD Open + Low NOFILL 12km
USA_304_NOFILL.txt
1.80000
1.60000
1.40000
1.20000
1.00000
0.80000
0.60000
0.50000
0.40000
0.30000
0.20000
0.10000
0.05000
0.00100
0.00500
0.00010
0.00000
fraction
336
1
1
444
January 1,2007 0:00:00
Min=0.00000 at (1,1), Max=2.11136 at (356,166)

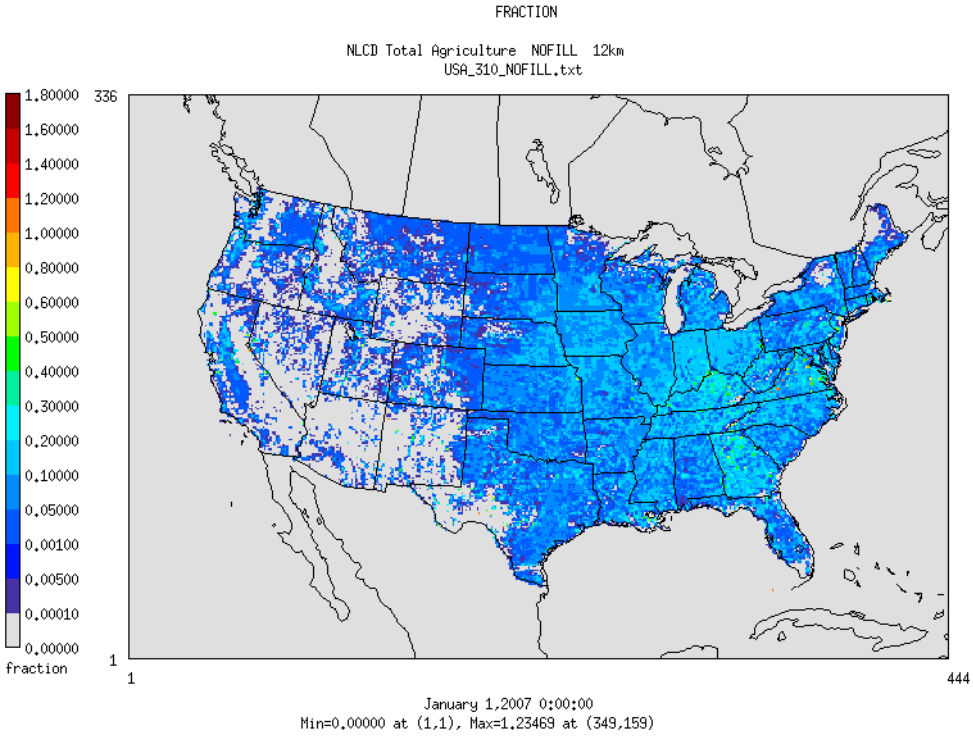

FRACTION
NLCD Low + Med NOFILL 12km
USA_305_NOFILL.txt
1.80000
1.60000
1.40000
1.20000
1.00000
0.80000
0.60000
0.50000
0.40000
0.30000
0.20000
0.10000
0.05000
0.00100
0.00500
0.00010
0.00000
fraction
336
1
1
444
January 1,2007 0:00:00
Min=0.00000 at (1,1), Max=2.23839 at (356,166)

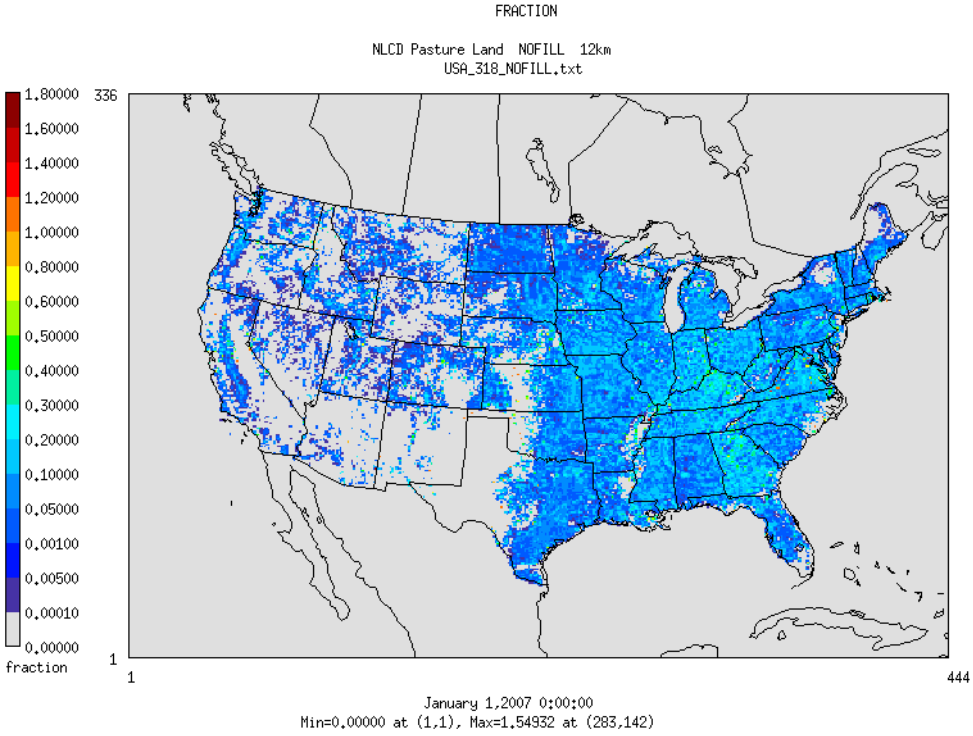

FRACTION
NLCD Med + High NOFILL 12km
USA_306_NOFILL.txt
1.80000
1.60000
1.40000
1.20000
1.00000
0.80000
0.60000
0.50000
0.40000
0.30000
0.20000
0.10000
0.05000
0.00100
0.00500
0.00010
0.00000
fraction
336
1
1
444
January 1,2007 0:00:00
Min=0.00000 at (1,1), Max=2.35716 at (375,168)

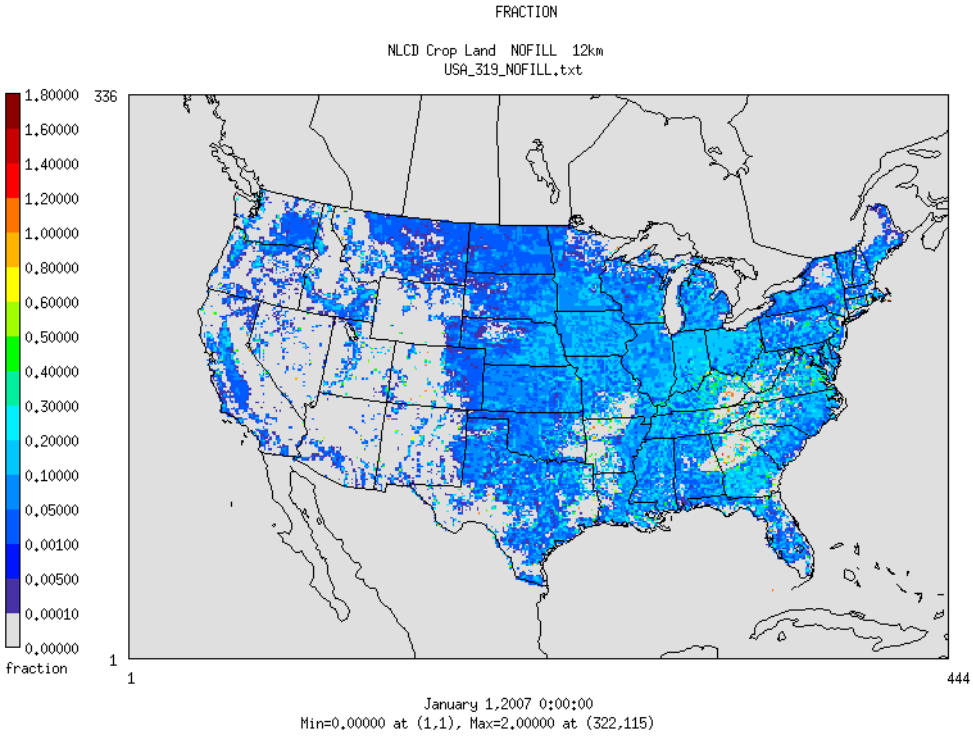

FRACTION
NLCD All Development NOFILL 12km
USA_307_NOFILL.txt
1.80000
1.60000
1.40000
1.20000
1.00000
0.80000
0.60000
0.50000
0.40000
0.30000
0.20000
0.10000
0.05000
0.00100
0.00500
0.00010
0.00000
fraction
336
1
1
444
January 1,2007 0:00:00
Min=0.00000 at (1,1), Max=2.12687 at (356,166)

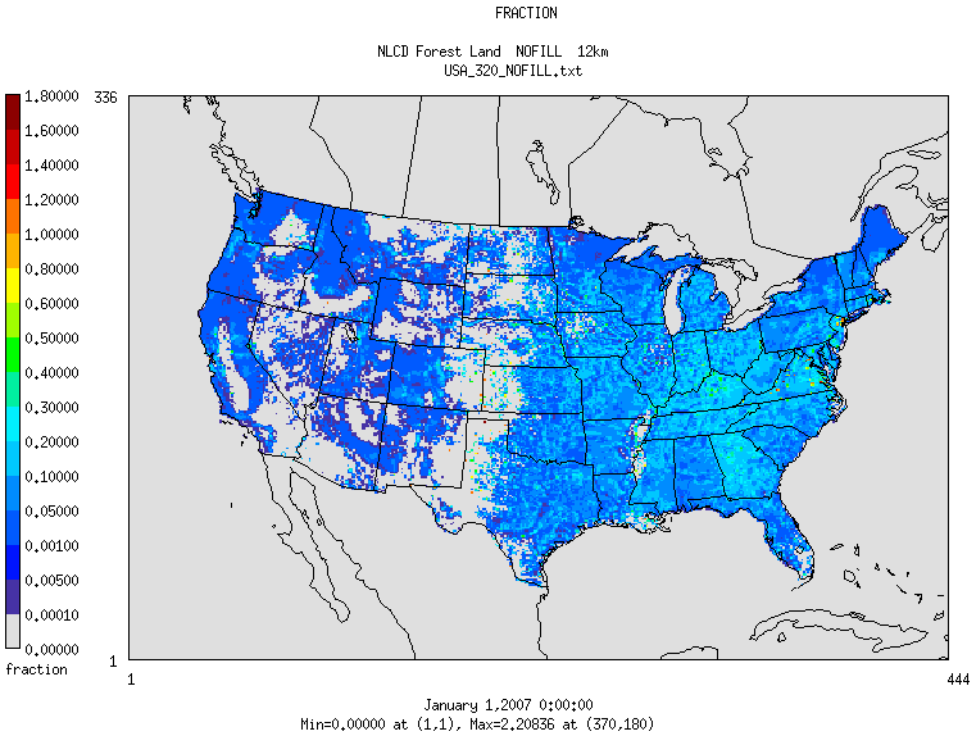

FRACTION
NLCD Low + Med + High NOFILL 12km
USA_308_NOFILL.txt
1.80000
1.60000
1.40000
1.20000
1.00000
0.80000
0.60000
0.50000
0.40000
0.30000
0.20000
0.10000
0.05000
0.00100
0.00500
0.00010
0.00000
fraction
336
1
1
444
January 1,2007 0:00:00
Min=0.00000 at (1,1), Max=2.23684 at (356,166)

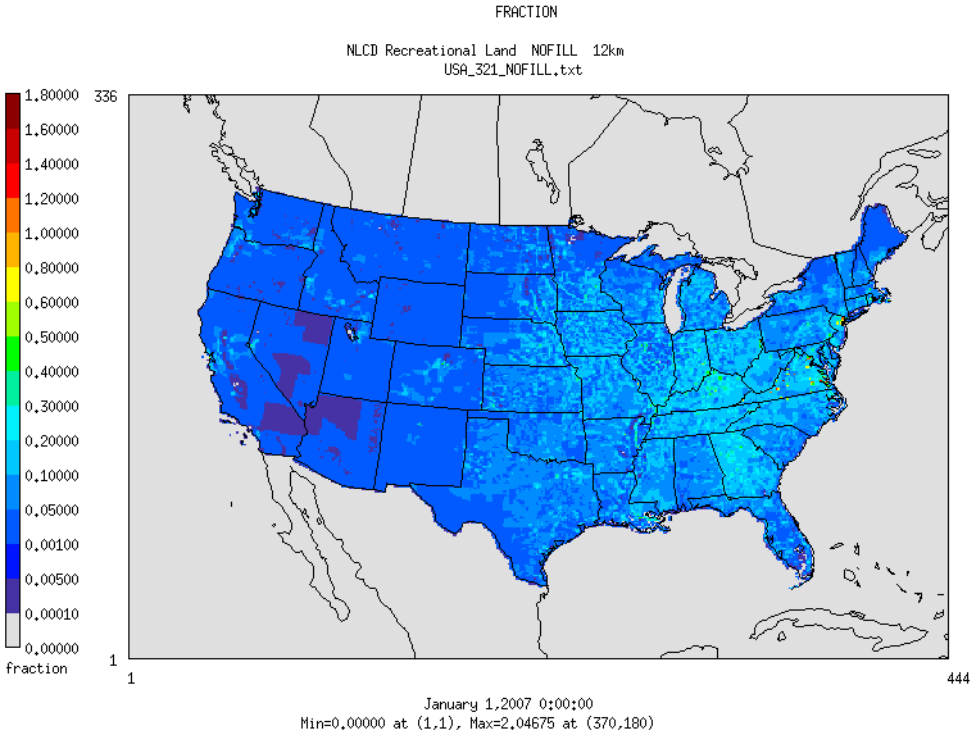

FRACTION
NLCD Open + Low + Med NOFILL 12km
USA_309_NOFILL.txt
1.80000
1.60000
1.40000
1.20000
1.00000
0.80000
0.60000
0.50000
0.40000
0.30000
0.20000
0.10000
0.05000
0.00100
0.00500
0.00010
0.00000
fraction
336
1
1
444
January 1,2007 0:00:00
Min=0.00000 at (1,1), Max=2.12333 at (356,166)

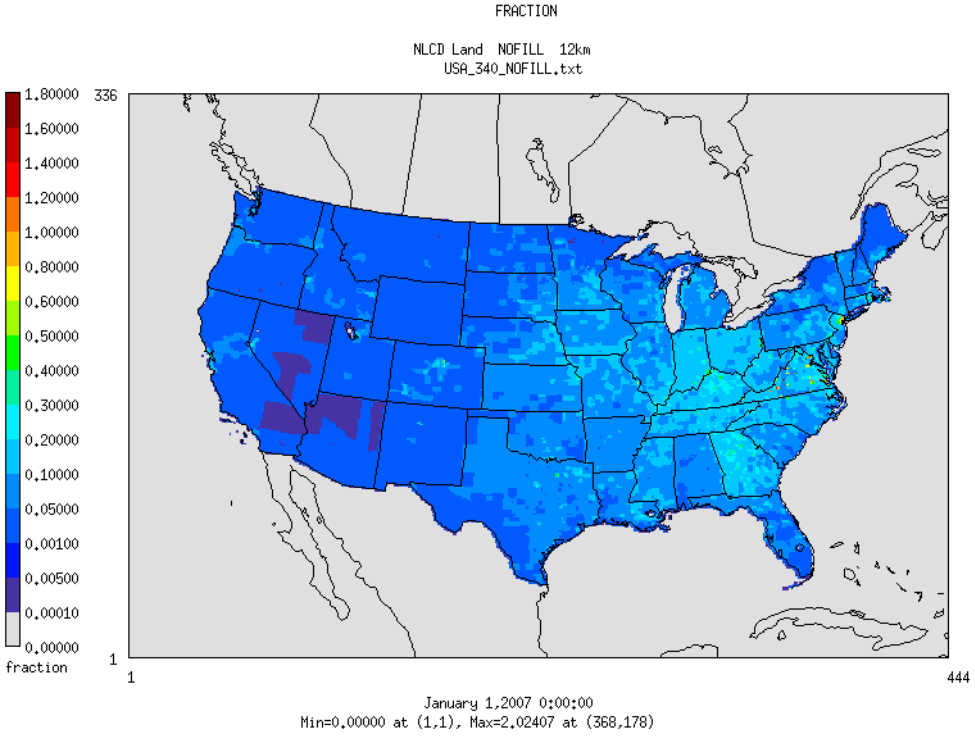

FRACTION
NLCD Total Agriculture NOFILL 12km
USA_310_NOFILL.txt
1.80000
1.60000
1.40000
1.20000
1.00000
0.80000
0.60000
0.50000
0.40000
0.30000
0.20000
0.10000
0.05000
0.00100
0.00500
0.00010
0.00000
fraction
336
1
1
444
January 1,2007 0:00:00
Min=0.00000 at (1,1), Max=1.23469 at (349,159)

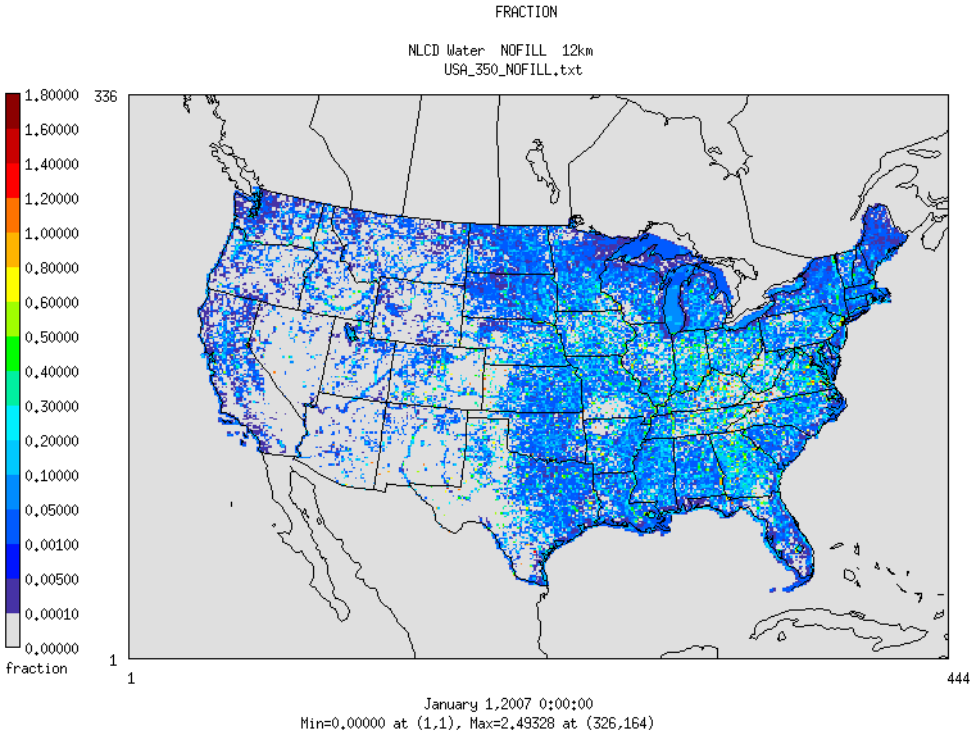

FRACTION
NLCD Pasture Land NOFILL 12km
USA_318_NOFILL.txt
1.80000
1.60000
1.40000
1.20000
1.00000
0.80000
0.60000
0.50000
0.40000
0.30000
0.20000
0.10000
0.05000
0.00100
0.00500
0.00010
0.00000
fraction
336
1
1
444
January 1,2007 0:00:00
Min=0.00000 at (1,1), Max=1.54932 at (283,142)

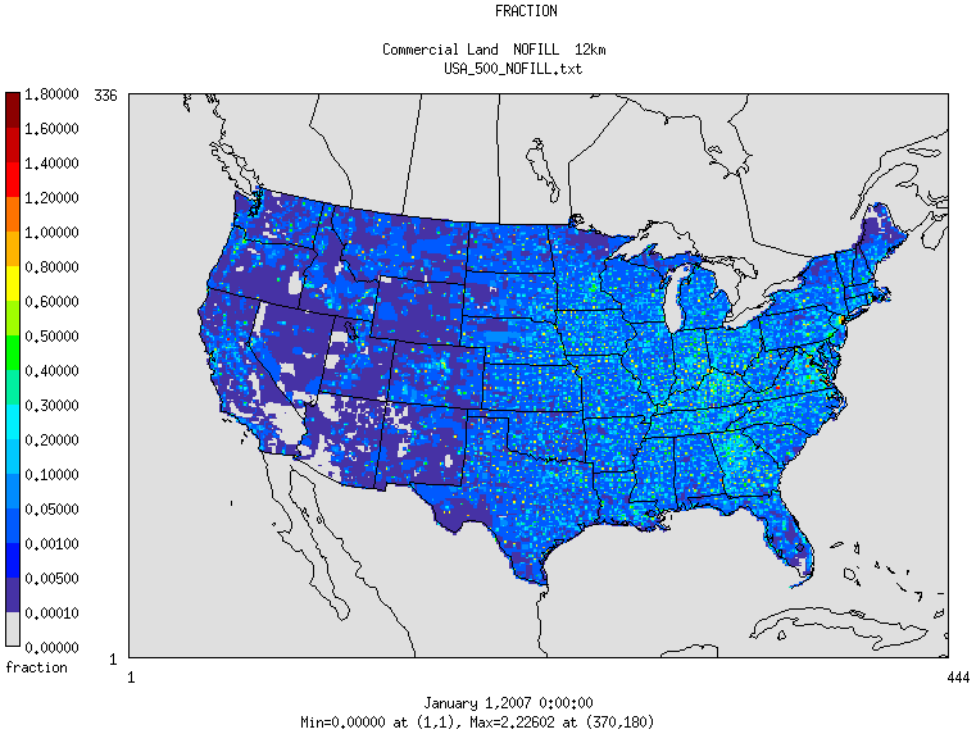

FRACTION
NLCD Crop Land NOFILL 12km
USA_319_NOFILL.txt
1.80000
1.60000
1.40000
1.20000
1.00000
0.80000
0.60000
0.50000
0.40000
0.30000
0.20000
0.10000
0.05000
0.00100
0.00500
0.00010
0.00000
fraction
336
1
1
444
January 1,2007 0:00:00
Min=0.00000 at (1,1), Max=2.00000 at (322,115)

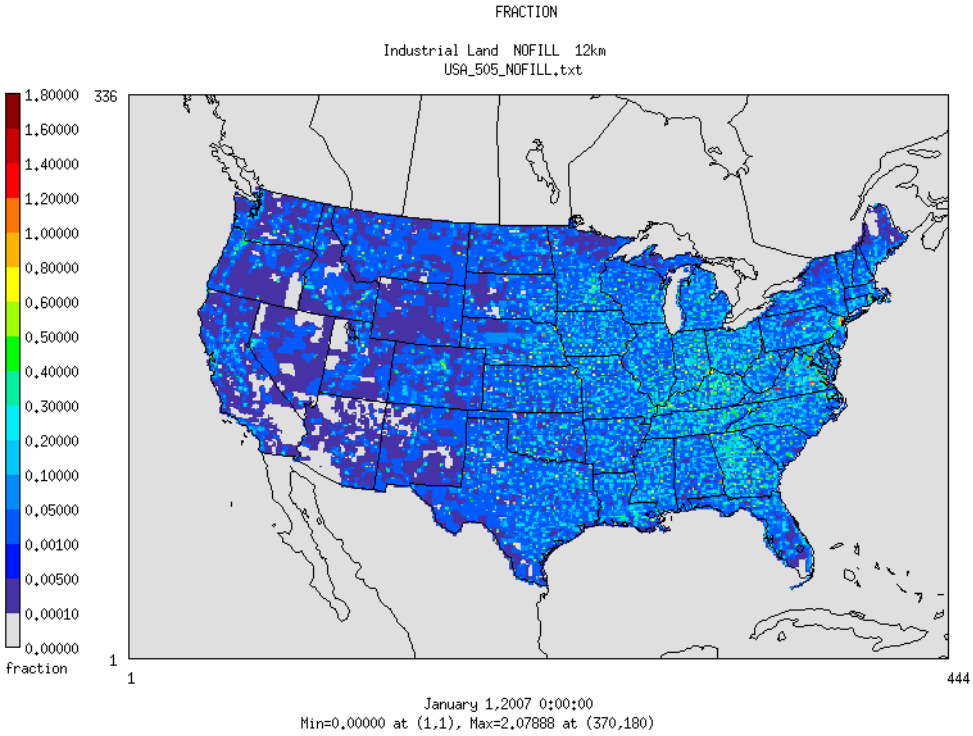

FRACTION
NLCD Forest Land NOFILL 12km
USA_320_NOFILL.txt
1.80000
1.60000
1.40000
1.20000
1.00000
0.80000
0.60000
0.50000
0.40000
0.30000
0.20000
0.10000
0.05000
0.00100
0.00500
0.00010
0.00000
fraction
336
1
1
444
January 1,2007 0:00:00
Min=0.00000 at (1,1), Max=2.20836 at (370,180)

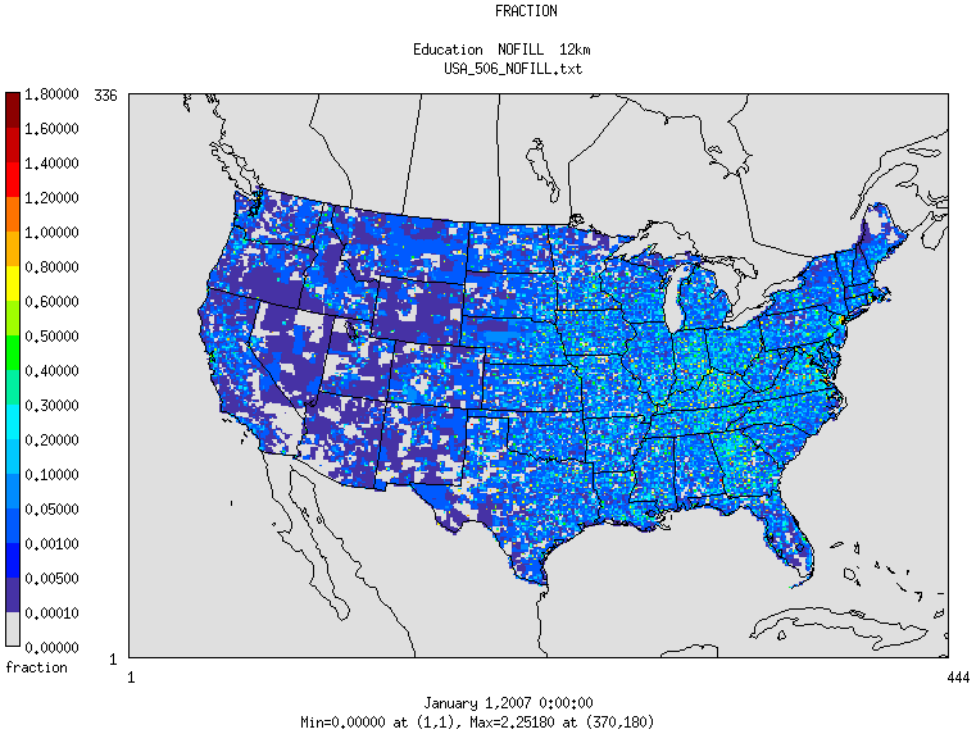

FRACTION
NLCD Recreational Land NOFILL 12km
USA_321_NOFILL.txt
1.80000
1.60000
1.40000
1.20000
1.00000
0.80000
0.60000
0.50000
0.40000
0.30000
0.20000
0.10000
0.05000
0.00100
0.00500
0.00010
0.00000
fraction
336
1
1
444
January 1,2007 0:00:00
Min=0.00000 at (1,1), Max=2.04675 at (370,180)

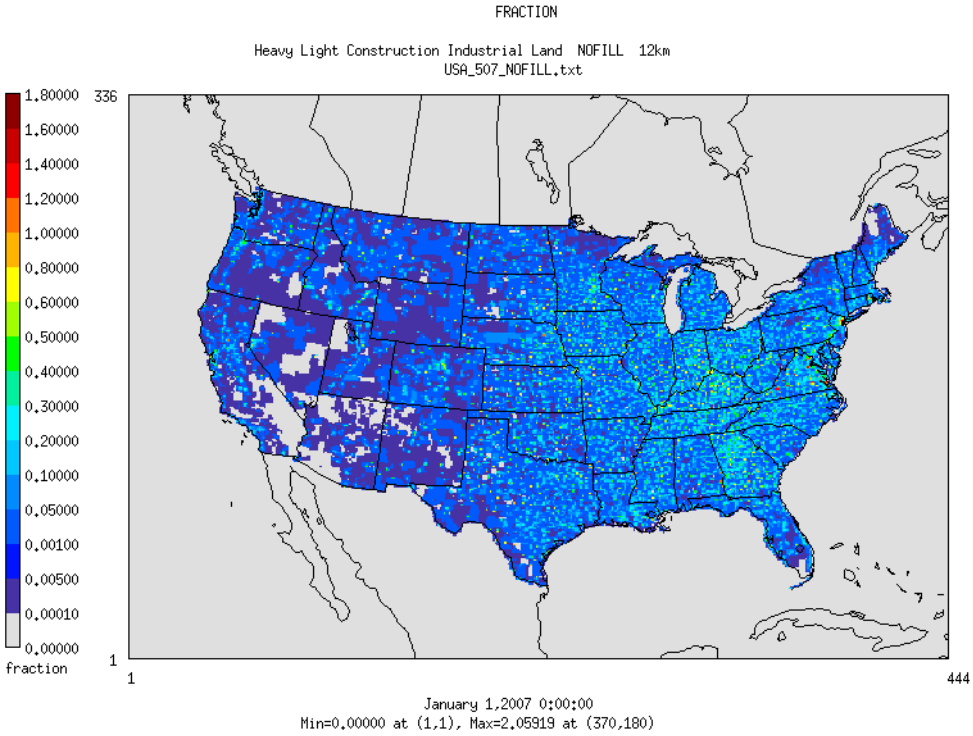

FRACTION
NLCD Land NOFILL 12km
USA_340_NOFILL.txt
1.80000
1.60000
1.40000
1.20000
1.00000
0.80000
0.60000
0.50000
0.40000
0.30000
0.20000
0.10000
0.05000
0.00100
0.00500
0.00010
0.00000
fraction
336
1
1
444
January 1,2007 0:00:00
Min=0.00000 at (1,1), Max=2.02407 at (368,178)

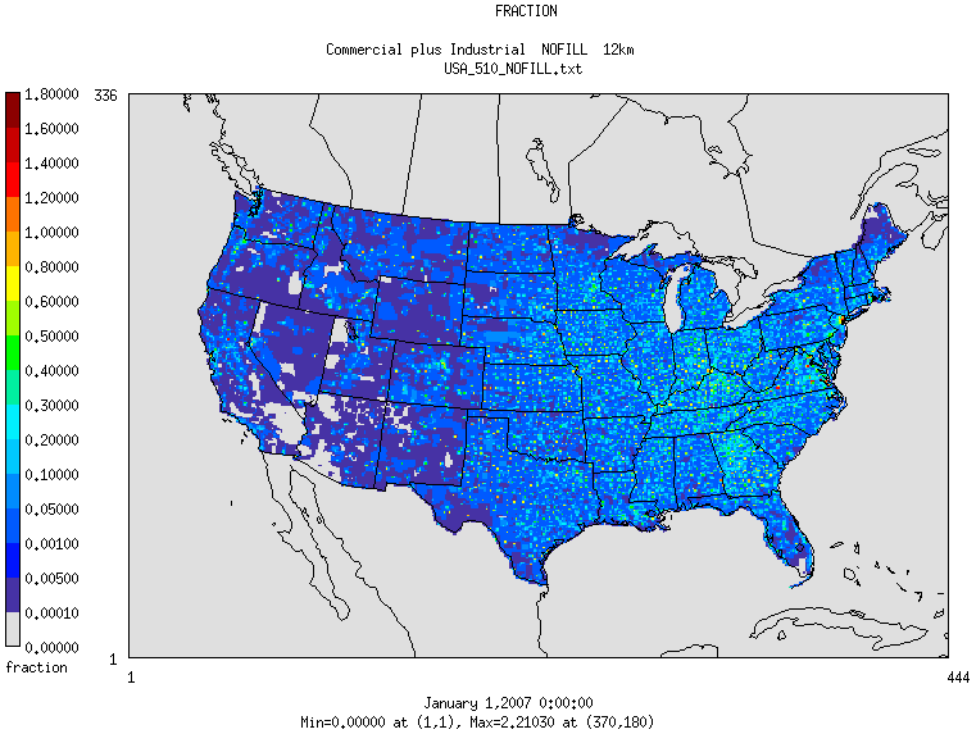

FRACTION
NLCD Water NOFILL 12km
USA_350_NOFILL.txt
1.80000
1.60000
1.40000
1.20000
1.00000
0.80000
0.60000
0.50000
0.40000
0.30000
0.20000
0.10000
0.05000
0.00100
0.00500
0.00010
0.00000
fraction
336
1
1
444
January 1,2007 0:00:00
Min=0.00000 at (1,1), Max=2.49328 at (326,164)

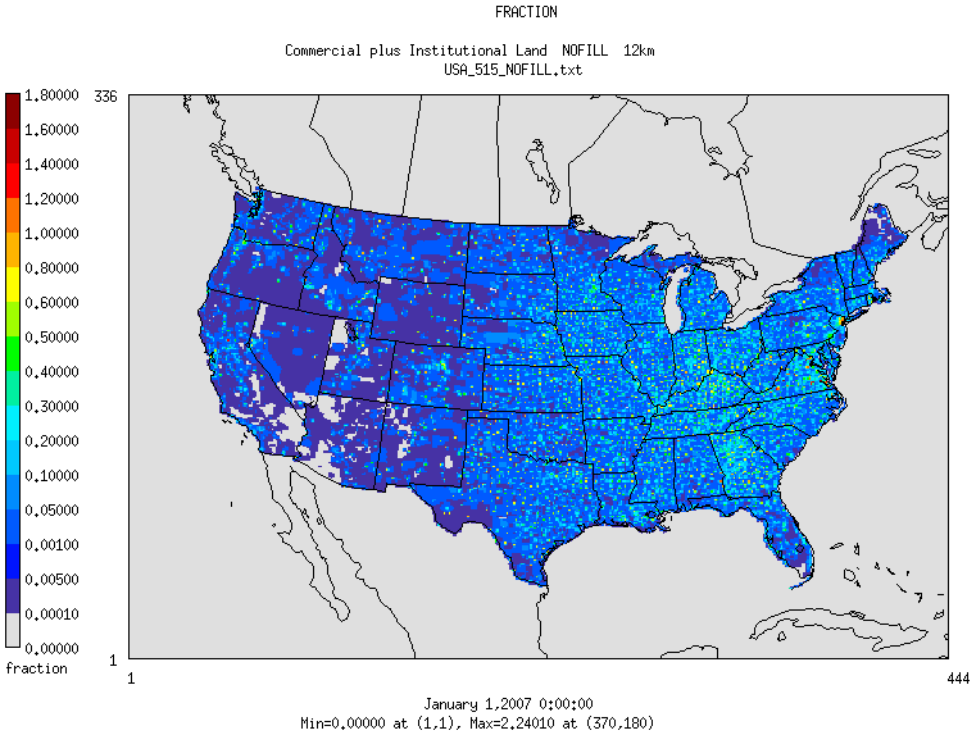

FRACTION
Commercial Land NOFILL 12km
USA_500_NOFILL.txt
1.80000
1.60000
1.40000
1.20000
1.00000
0.80000
0.60000
0.50000
0.40000
0.30000
0.20000
0.10000
0.05000
0.00100
0.00500
0.00010
0.00000
fraction
336
1
1
444
January 1,2007 0:00:00
Min=0.00000 at (1,1), Max=2.22602 at (370,180)

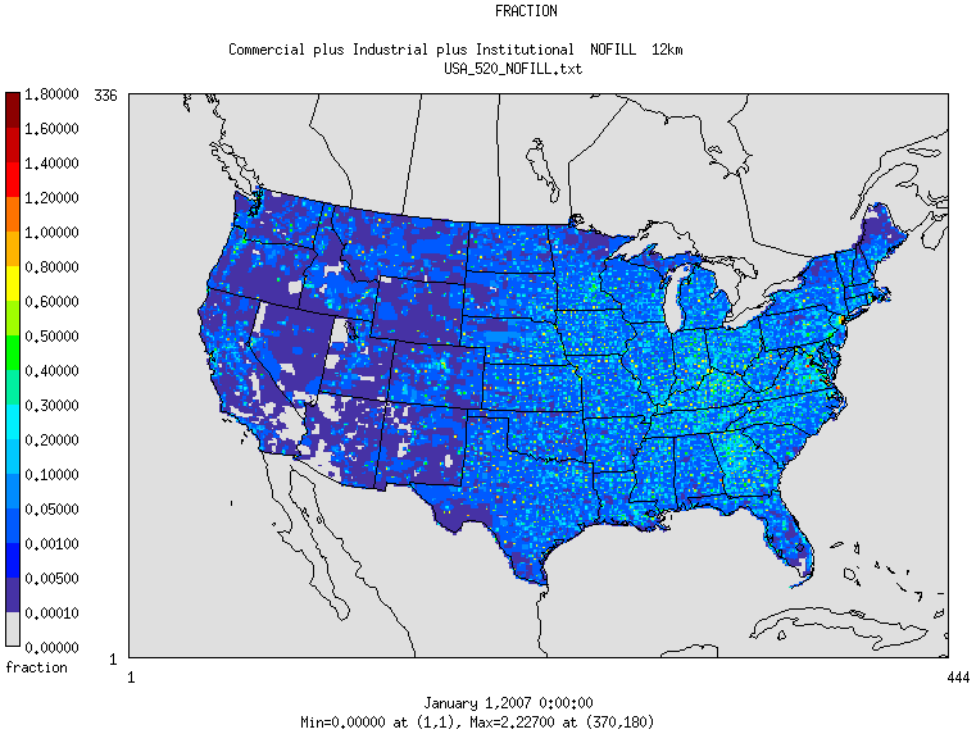

FRACTION
Industrial Land NOFILL 12km
USA_505_NOFILL.txt
1.80000
1.60000
1.40000
1.20000
1.00000
0.80000
0.60000
0.50000
0.40000
0.30000
0.20000
0.10000
0.05000
0.00100
0.00500
0.00010
0.00000
fraction
336
1
1
444
January 1,2007 0:00:00
Min=0.00000 at (1,1), Max=2.07888 at (370,180)

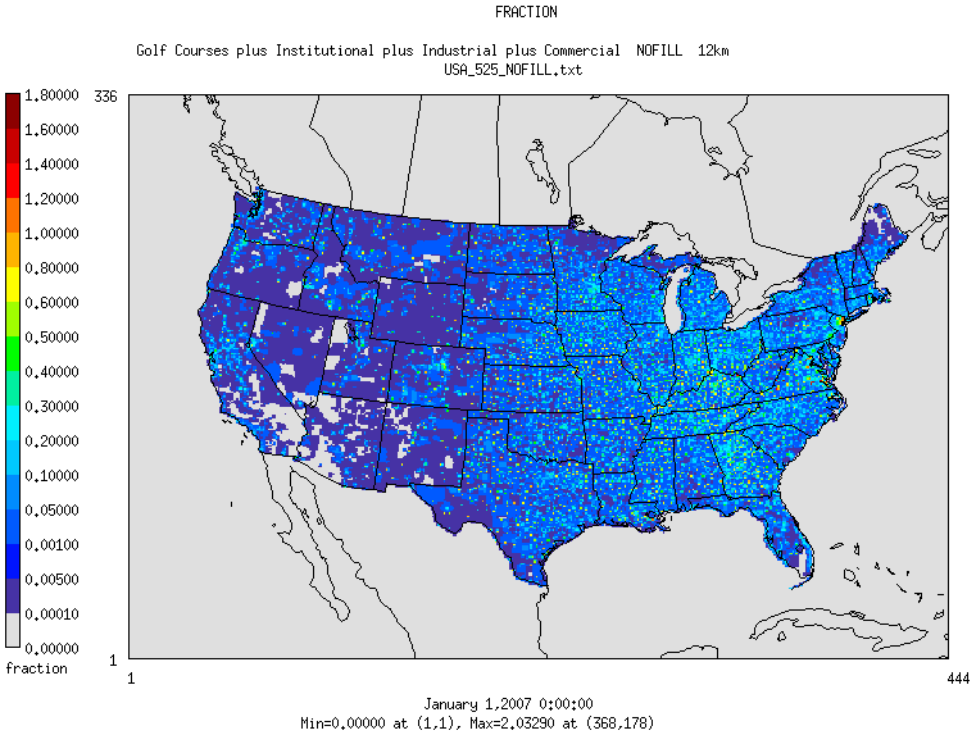

FRACTION
Education NOFILL 12km
USA_506_NOFILL.txt
1.80000
1.60000
1.40000
1.20000
1.00000
0.80000
0.60000
0.50000
0.40000
0.30000
0.20000
0.10000
0.05000
0.00100
0.00500
0.00010
0.00000
fraction
336
1
1
444
January 1,2007 0:00:00
Min=0.00000 at (1,1), Max=2.25180 at (370,180)

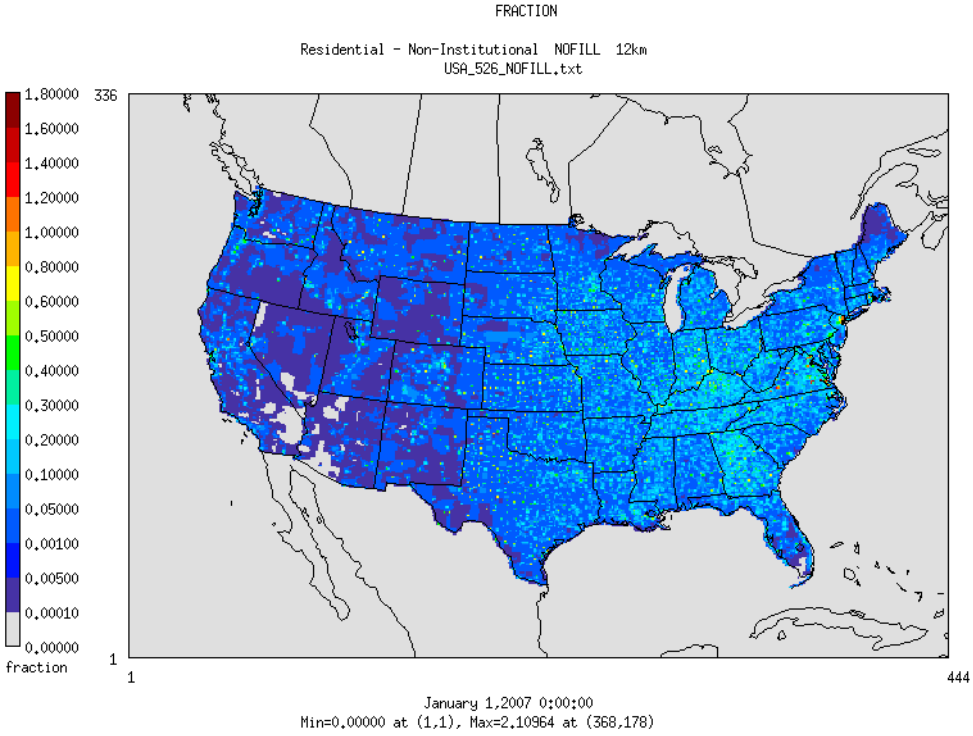

FRACTION
Heavy Light Construction Industrial Land NOFILL 12km
USA_507_NOFILL.txt
1.80000
1.60000
1.40000
1.20000
1.00000
0.80000
0.60000
0.50000
0.40000
0.30000
0.20000
0.10000
0.05000
0.00100
0.00500
0.00010
0.00000
fraction
336
1
1
444
January 1,2007 0:00:00
Min=0.00000 at (1,1), Max=2.05919 at (370,180)

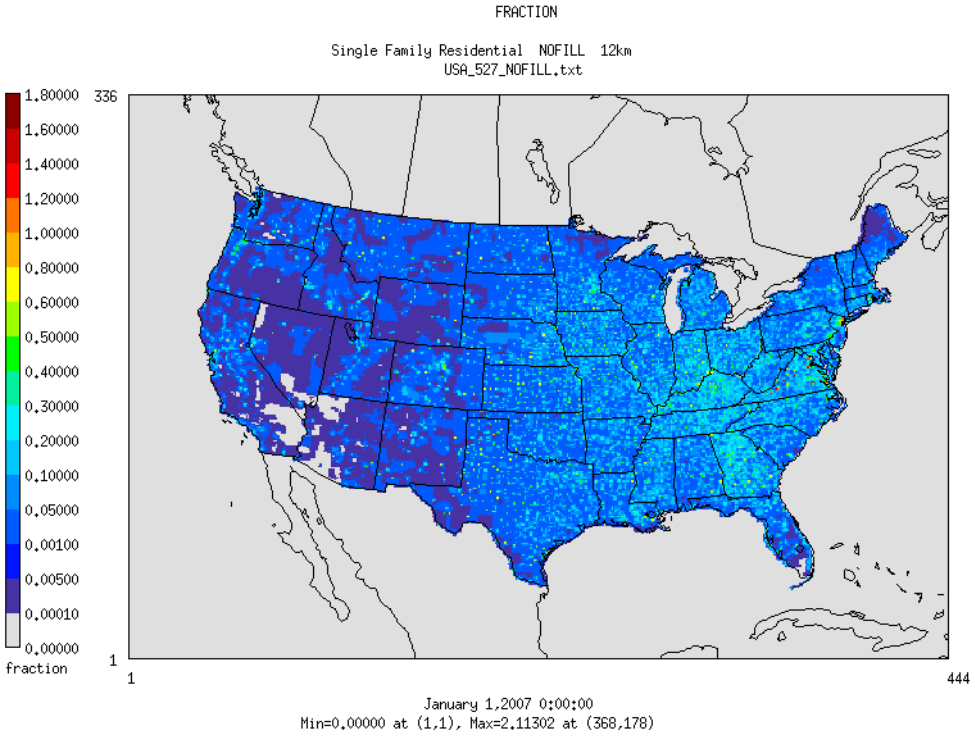

FRACTION
Commercial plus Industrial NOFILL 12km
USA_510_NOFILL.txt
1.80000
1.60000
1.40000
1.20000
1.00000
0.80000
0.60000
0.50000
0.40000
0.30000
0.20000
0.10000
0.05000
0.00100
0.00500
0.00010
0.00000
fraction
336
1
1
444
January 1,2007 0:00:00
Min=0.00000 at (1,1), Max=2.21030 at (370,180)

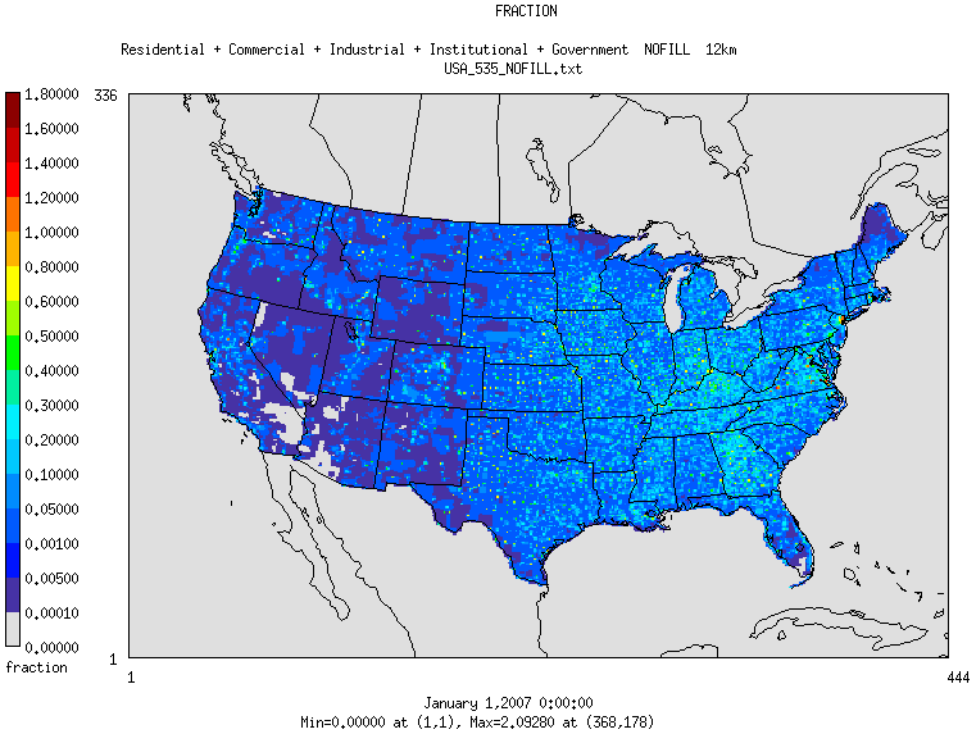

FRACTION
Commercial plus Institutional Land NOFILL 12km
USA_515_NOFILL.txt
1.80000
1.60000
1.40000
1.20000
1.00000
0.80000
0.60000
0.50000
0.40000
0.30000
0.20000
0.10000
0.05000
0.00100
0.00500
0.00010
0.00000
fraction
336
1
1
444
January 1,2007 0:00:00
Min=0.00000 at (1,1), Max=2.24010 at (370,180)

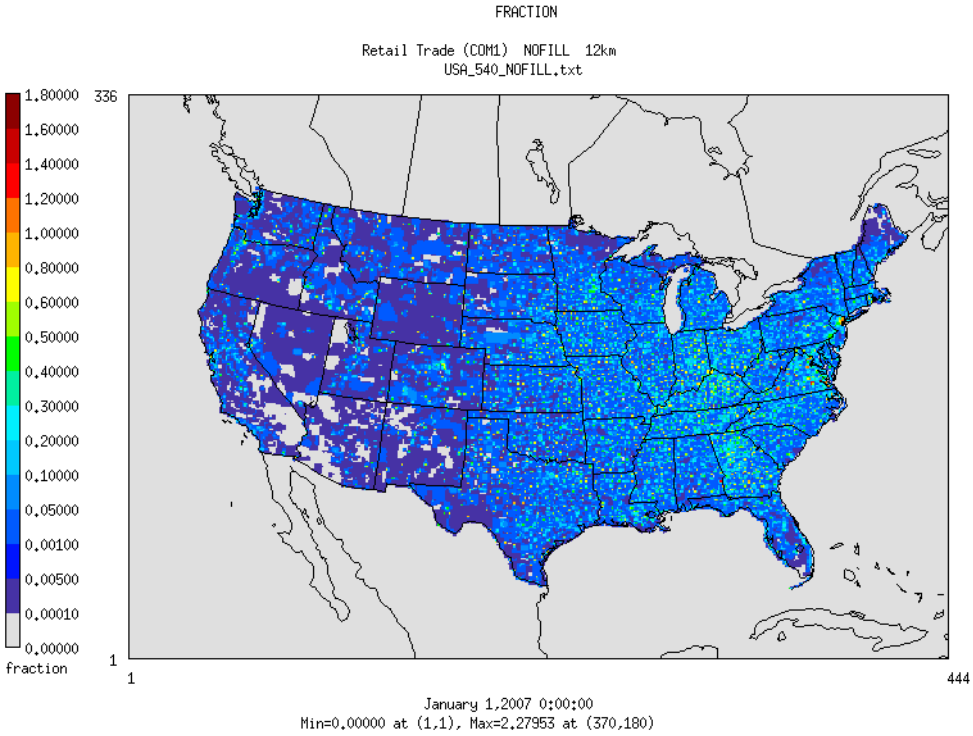

FRACTION
Commercial plus Industrial plus Institutional NOFILL 12km
USA_520_NOFILL.txt
1.80000
1.60000
1.40000
1.20000
1.00000
0.80000
0.60000
0.50000
0.40000
0.30000
0.20000
0.10000
0.05000
0.00100
0.00500
0.00010
0.00000
fraction
336
1
1
444
January 1,2007 0:00:00
Min=0.00000 at (1,1), Max=2.22700 at (370,180)

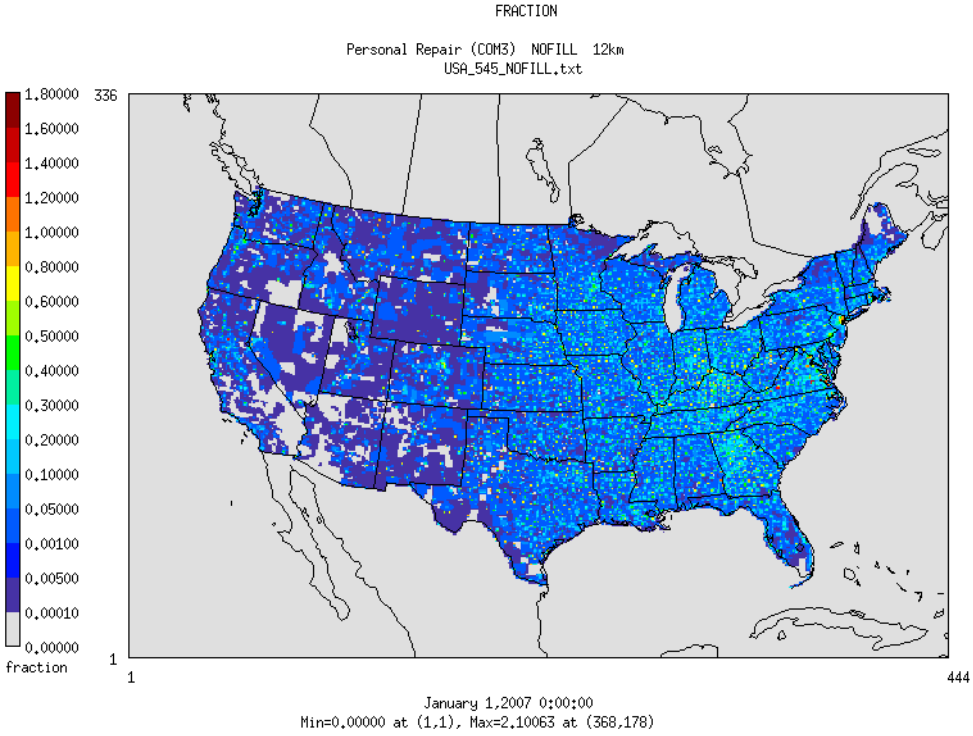

FRACTION
Golf Courses plus Institutional plus Industrial plus Commercial NOFILL 12km
USA_525_NOFILL.txt
1.80000
1.60000
1.40000
1.20000
1.00000
0.80000
0.60000
0.50000
0.40000
0.30000
0.20000
0.10000
0.05000
0.00100
0.00500
0.00010
0.00000
fraction
336
1
1
444
January 1,2007 0:00:00
Min=0.00000 at (1,1), Max=2.03290 at (368,178)

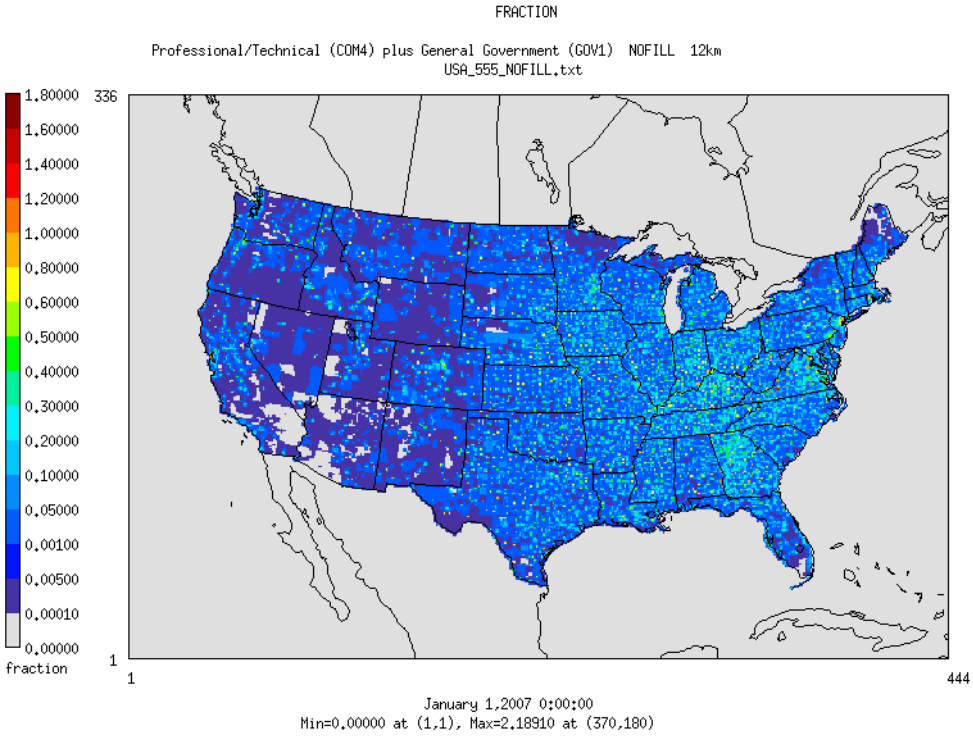

FRACTION
Residential - Non-Institutional NOFILL 12km
USA_526_NOFILL.txt
1.80000
1.60000
1.40000
1.20000
1.00000
0.80000
0.60000
0.50000
0.40000
0.30000
0.20000
0.10000
0.05000
0.00100
0.00500
0.00010
0.00000
fraction
336
1
1
444
January 1,2007 0:00:00
Min=0.00000 at (1,1), Max=2.10964 at (368,178)

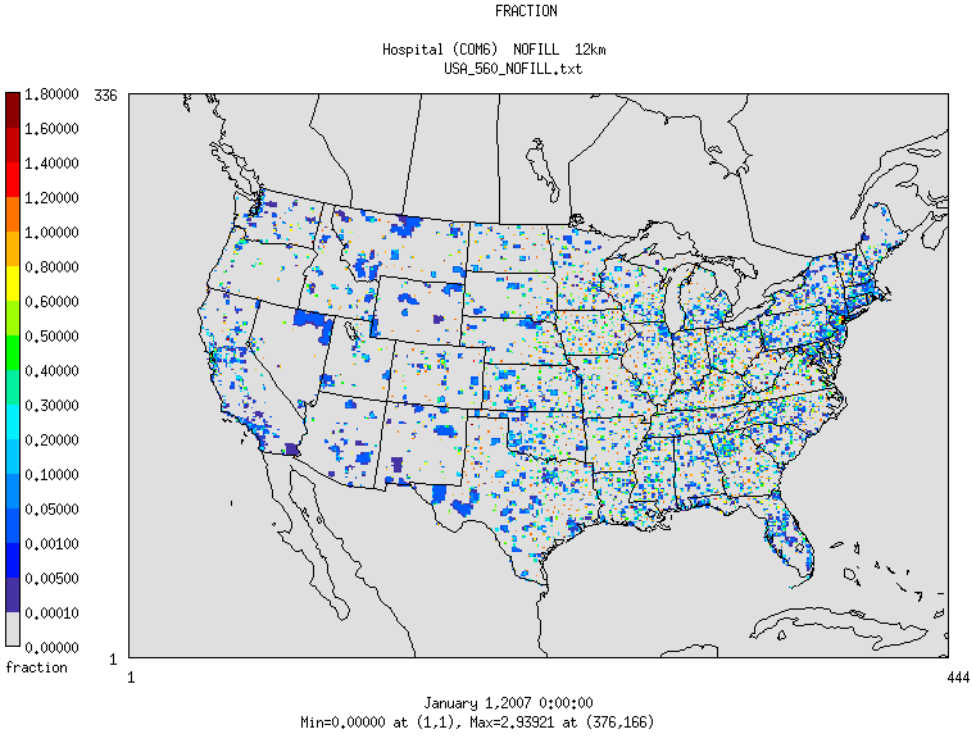

FRACTION
Single Family Residential NOFILL 12km
USA_527_NOFILL.txt
1.80000
1.60000
1.40000
1.20000
1.00000
0.80000
0.60000
0.50000
0.40000
0.30000
0.20000
0.10000
0.05000
0.00100
0.00500
0.00010
0.00000
fraction
336
1
1
444
January 1,2007 0:00:00
Min=0.00000 at (1,1), Max=2.11302 at (368,178)

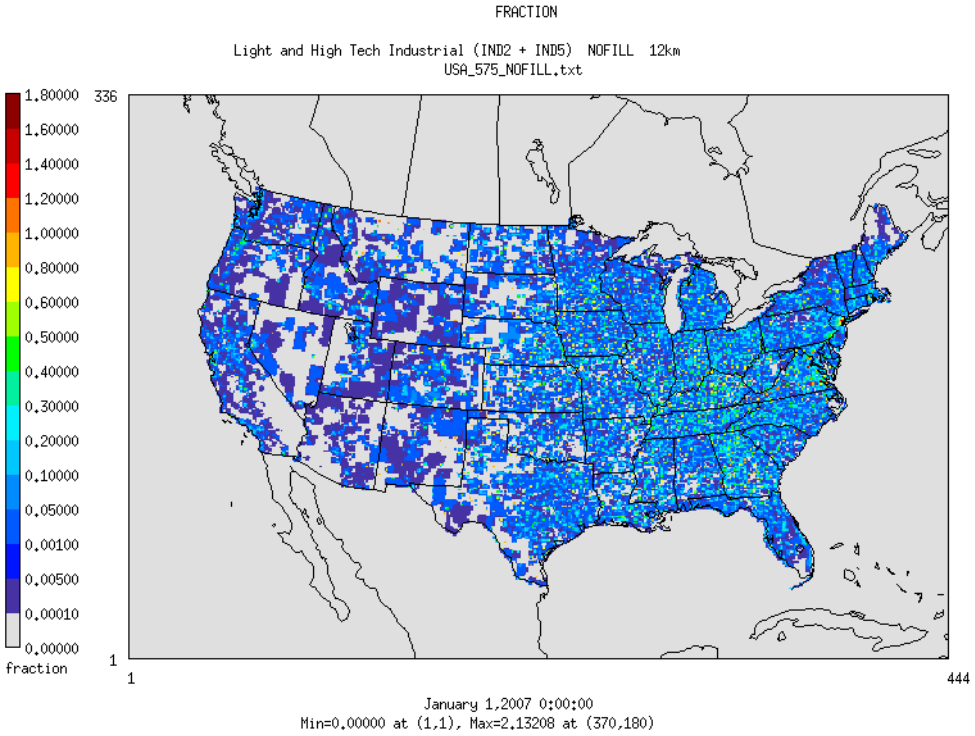

FRACTION
Residential + Commercial + Industrial + Institutional + Government NOFILL 12km
USA_535_NOFILL.txt
1.80000
1.60000
1.40000
1.20000
1.00000
0.80000
0.60000
0.50000
0.40000
0.30000
0.20000
0.10000
0.05000
0.00100
0.00500
0.00010
0.00000
fraction
336
1
1
444
January 1,2007 0:00:00
Min=0.00000 at (1,1), Max=2.09280 at (368,178)

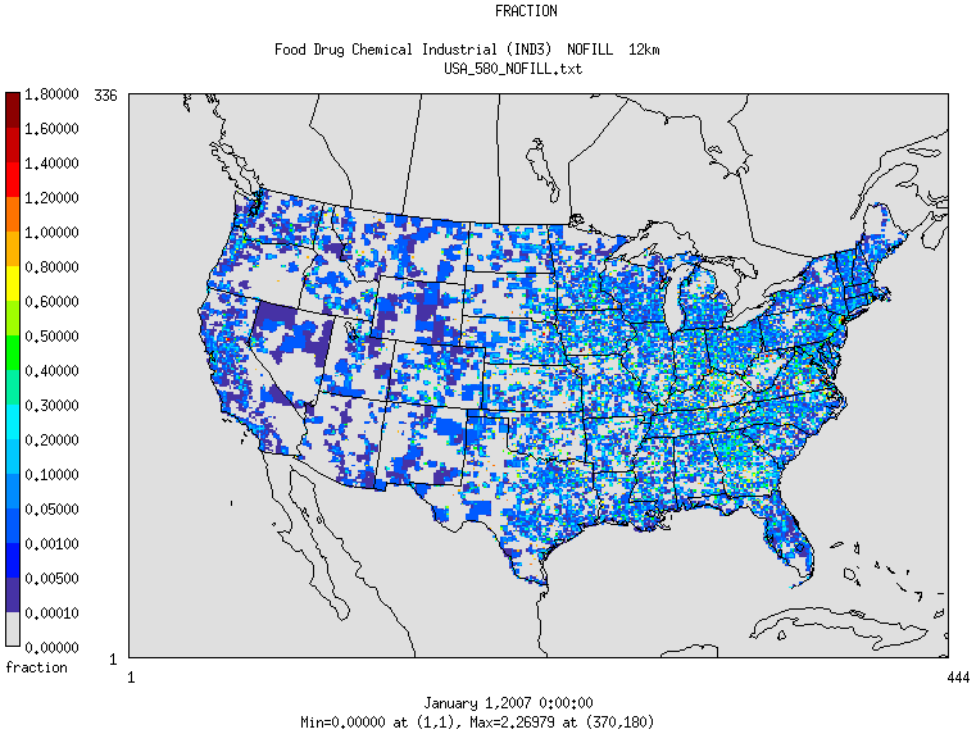

FRACTION
Retail Trade (COM1) NOFILL 12km
USA_540_NOFILL.txt
1.80000
1.60000
1.40000
1.20000
1.00000
0.80000
0.60000
0.50000
0.40000
0.30000
0.20000
0.10000
0.05000
0.00100
0.00500
0.00010
0.00000
fraction
336
1
1
444
January 1,2007 0:00:00
Min=0.00000 at (1,1), Max=2.27953 at (370,180)

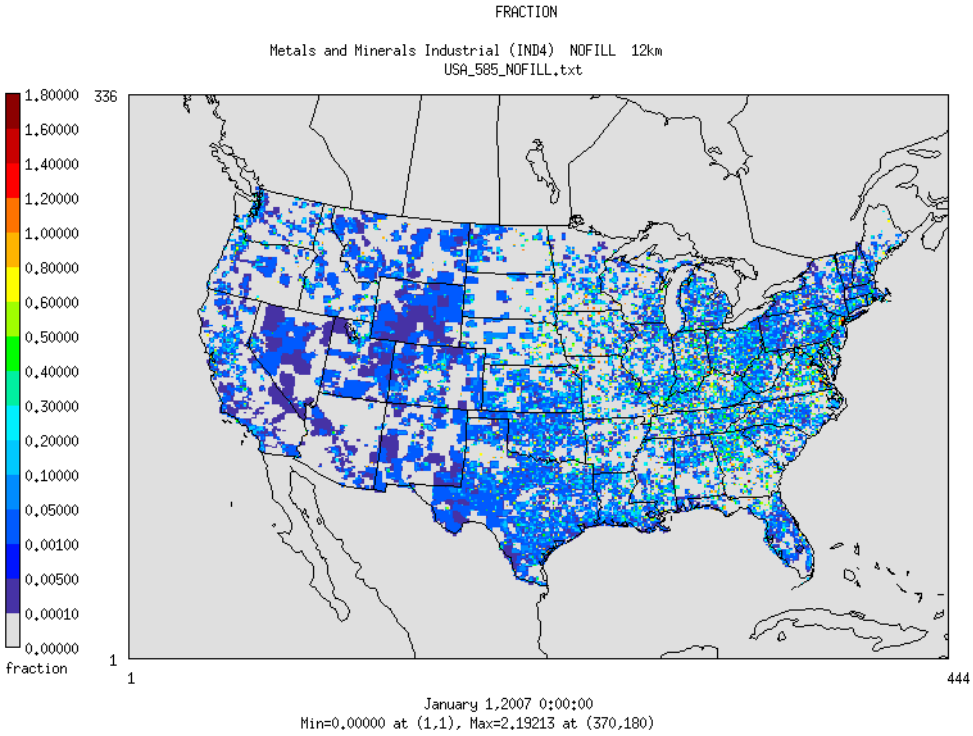

FRACTION
Personal Repair (COM3) NOFILL 12km
USA_545_NOFILL.txt
1.80000
1.60000
1.40000
1.20000
1.00000
0.80000
0.60000
0.50000
0.40000
0.30000
0.20000
0.10000
0.05000
0.00100
0.00500
0.00010
0.00000
fraction
336
1
1
444
January 1,2007 0:00:00
Min=0.00000 at (1,1), Max=2.10063 at (368,178)

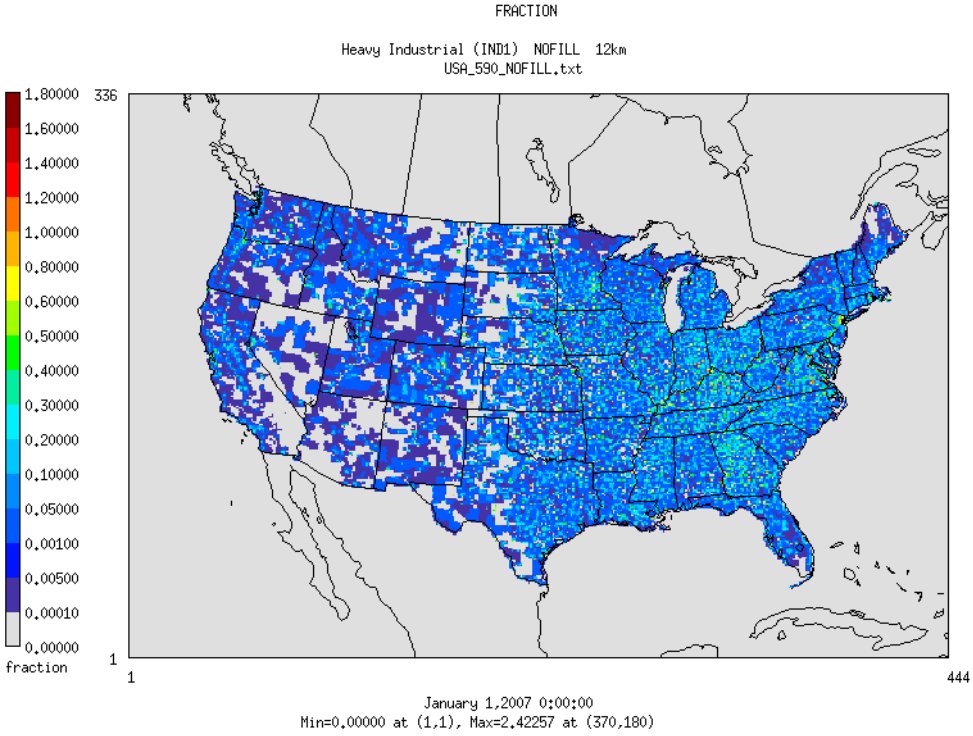

FRACTION
Professional/Technical (COM4) plus General Government (GOV1) NOFILL 12km
USA_555_NOFILL.txt
1.80000
1.60000
1.40000
1.20000
1.00000
0.80000
0.60000
0.50000
0.40000
0.30000
0.20000
0.10000
0.05000
0.00100
0.00500
0.00010
0.00000
fraction
336
1
1
444
January 1,2007 0:00:00
Min=0.00000 at (1,1), Max=2.18910 at (370,180)

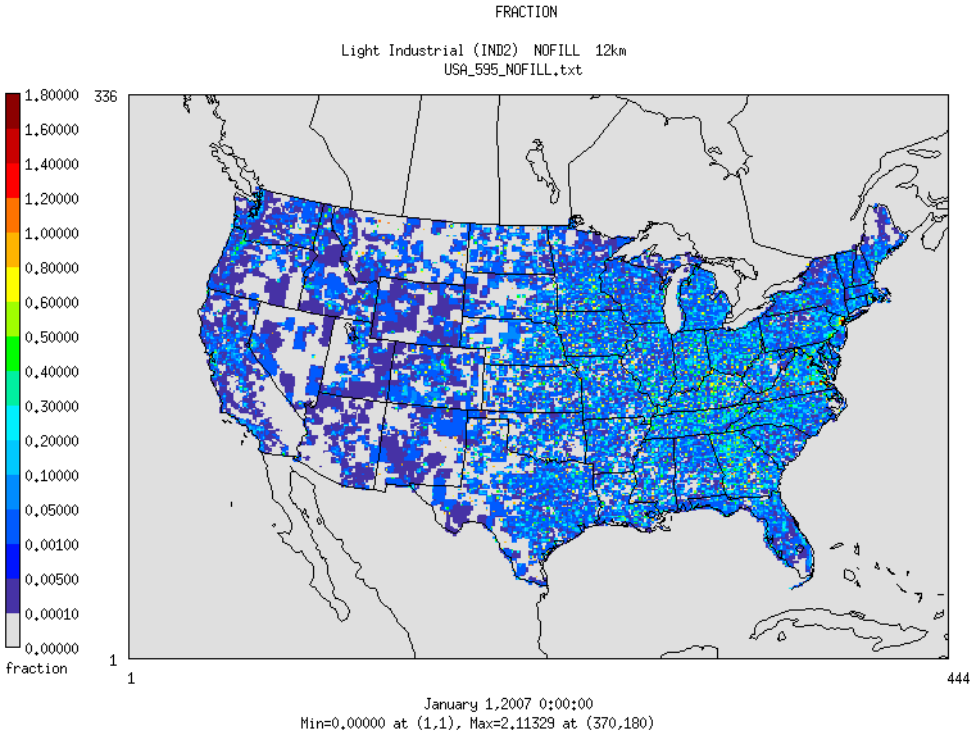

FRACTION
Hospital (COM6) NOFILL 12km
USA_560_NOFILL.txt
1.80000
1.60000
1.40000
1.20000
1.00000
0.80000
0.60000
0.50000
0.40000
0.30000
0.20000
0.10000
0.05000
0.00100
0.00500
0.00010
0.00000
fraction
336
1
1
444
January 1,2007 0:00:00
Min=0.00000 at (1,1), Max=2.93921 at (376,166)

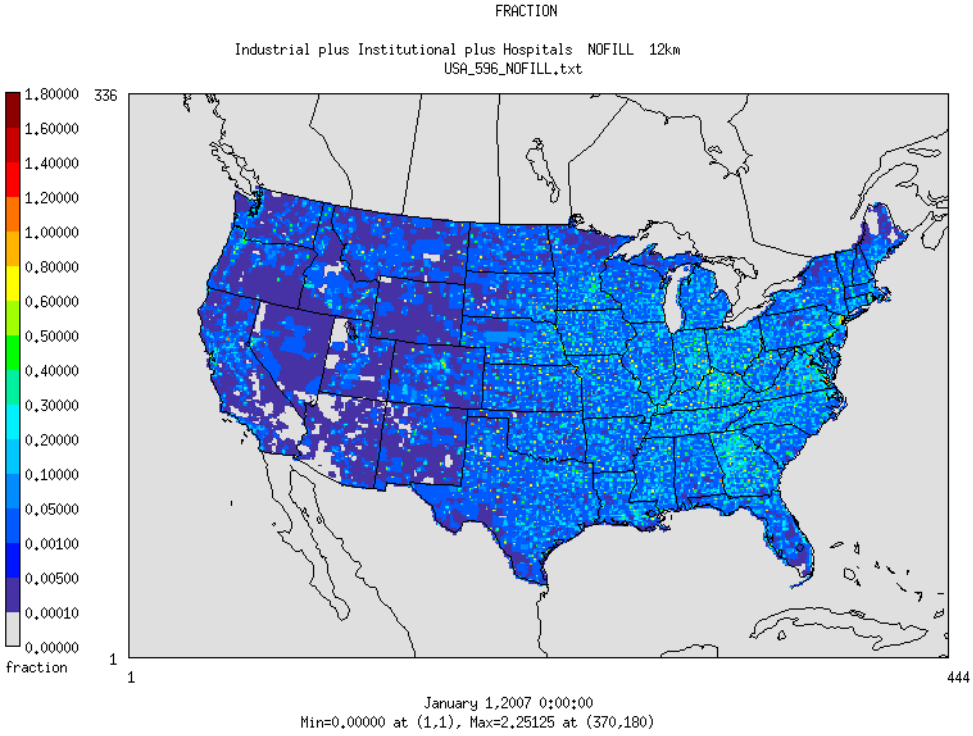

FRACTION
Light and High Tech Industrial (IND2 + IND5) NOFILL 12km
USA_575_NOFILL.txt
1.80000
1.60000
1.40000
1.20000
1.00000
0.80000
0.60000
0.50000
0.40000
0.30000
0.20000
0.10000
0.05000
0.00100
0.00500
0.00010
0.00000
fraction
336
1
1
444
January 1,2007 0:00:00
Min=0.00000 at (1,1), Max=2.13208 at (370,180)

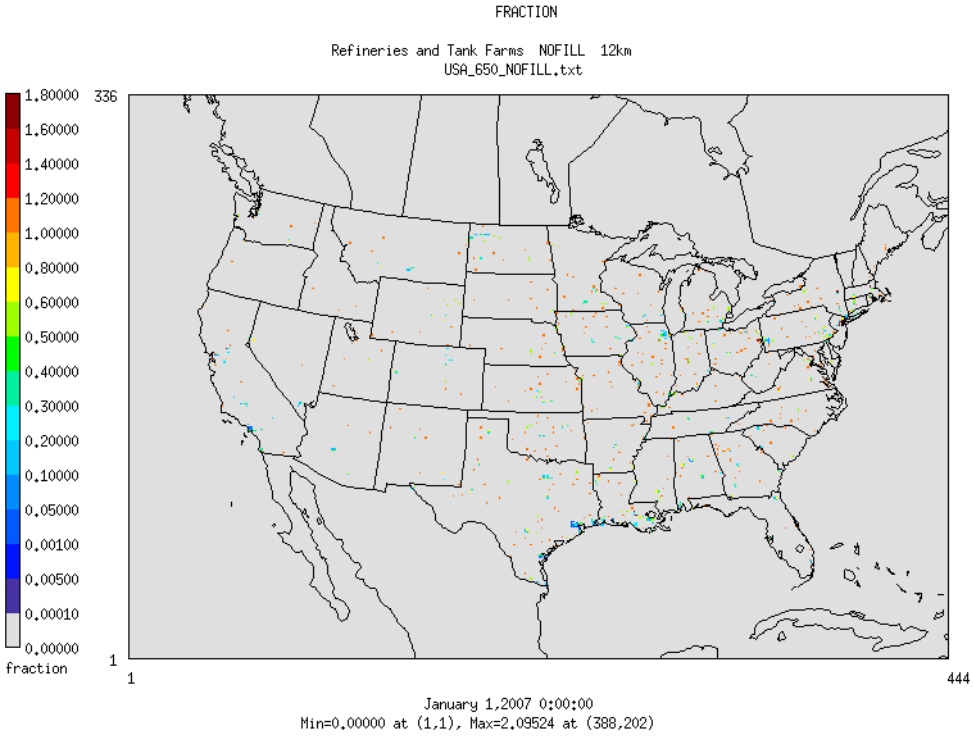

FRACTION
Food Drug Chemical Industrial (IND3) NOFILL 12km
USA_580_NOFILL.txt
1.80000
1.60000
1.40000
1.20000
1.00000
0.80000
0.60000
0.50000
0.40000
0.30000
0.20000
0.10000
0.05000
0.00100
0.00500
0.00010
0.00000
fraction
336
1
1
444
January 1,2007 0:00:00
Min=0.00000 at (1,1), Max=2.26979 at (370,180)

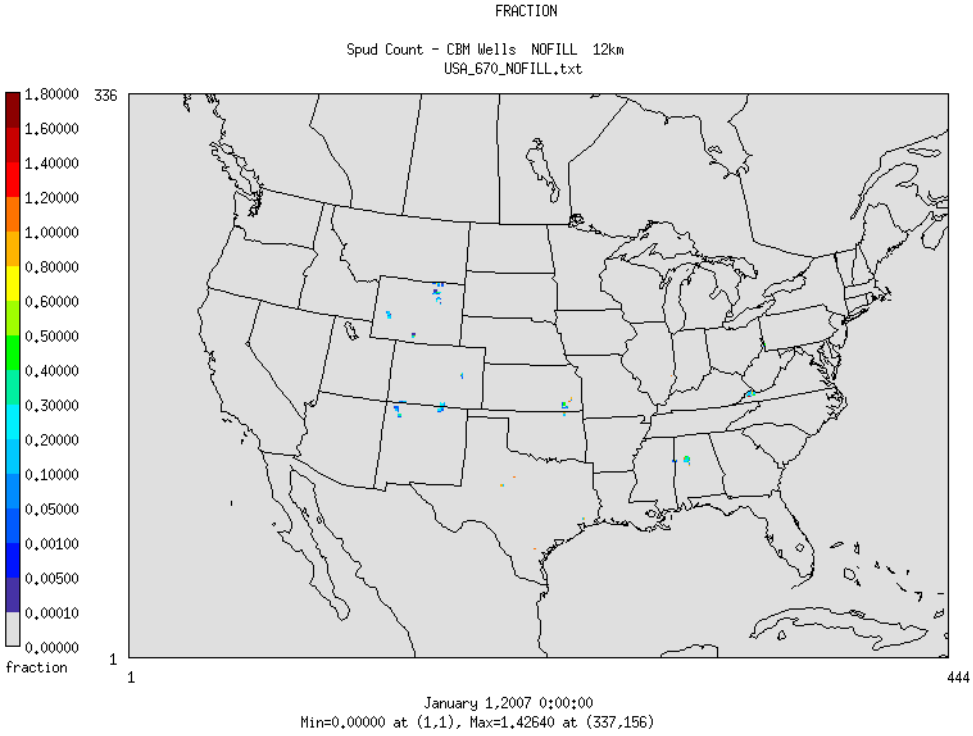

FRACTION
Metals and Minerals Industrial (IND4) NOFILL 12km
USA_585_NOFILL.txt
1.80000
1.60000
1.40000
1.20000
1.00000
0.80000
0.60000
0.50000
0.40000
0.30000
0.20000
0.10000
0.05000
0.00100
0.00500
0.00010
0.00000
fraction
336
1
1
444
January 1,2007 0:00:00
Min=0.00000 at (1,1), Max=2.19213 at (370,180)

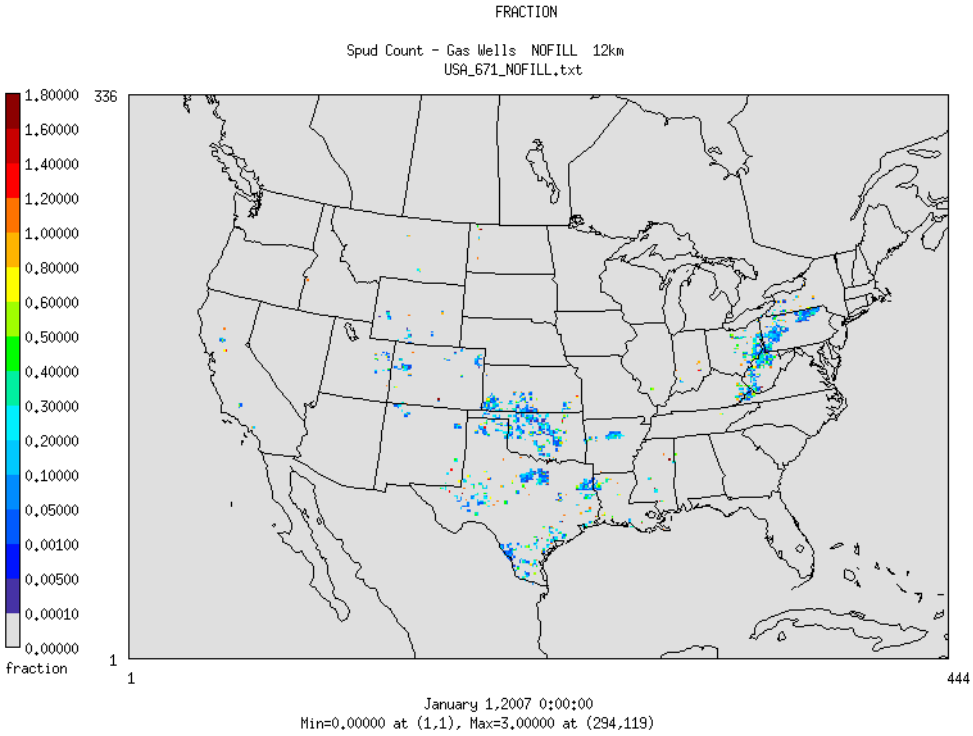

FRACTION
Heavy Industrial (IND1) NOFILL 12km
USA_590_NOFILL.txt
1.80000
1.60000
1.40000
1.20000
1.00000
0.80000
0.60000
0.50000
0.40000
0.30000
0.20000
0.10000
0.05000
0.00100
0.00500
0.00010
0.00000
fraction
336
1
1
444
January 1,2007 0:00:00
Min=0.00000 at (1,1), Max=2.42257 at (370,180)

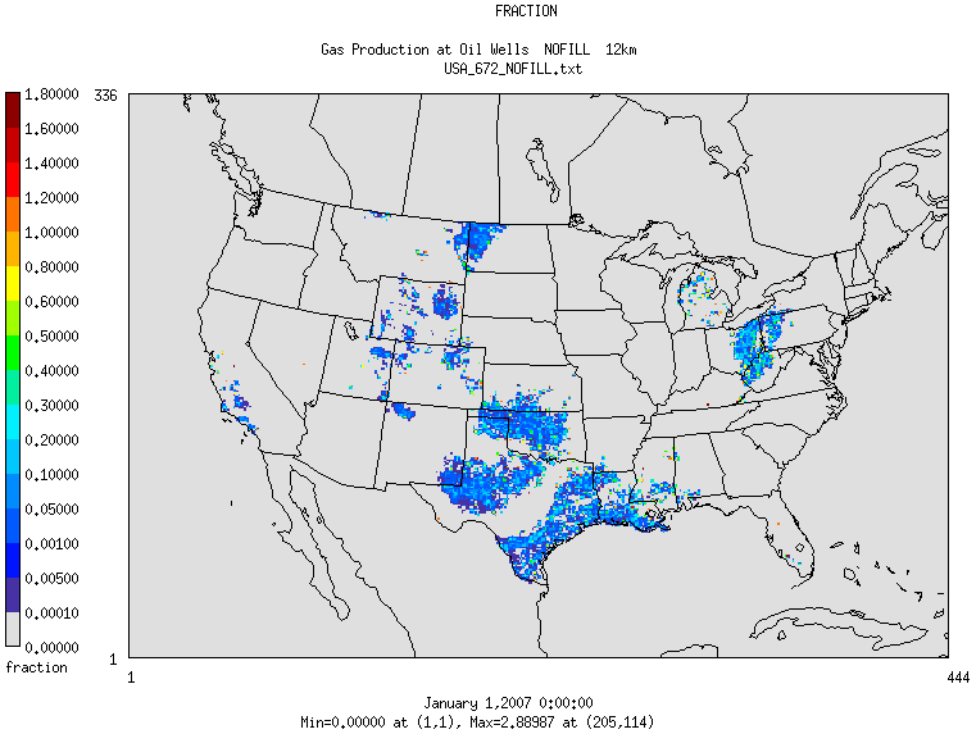

FRACTION
Light Industrial (IND2) NOFILL 12km
USA_595_NOFILL.txt
1.80000
1.60000
1.40000
1.20000
1.00000
0.80000
0.60000
0.50000
0.40000
0.30000
0.20000
0.10000
0.05000
0.00100
0.00500
0.00010
0.00000
fraction
336
1
1
444
January 1,2007 0:00:00
Min=0.00000 at (1,1), Max=2.11329 at (370,180)

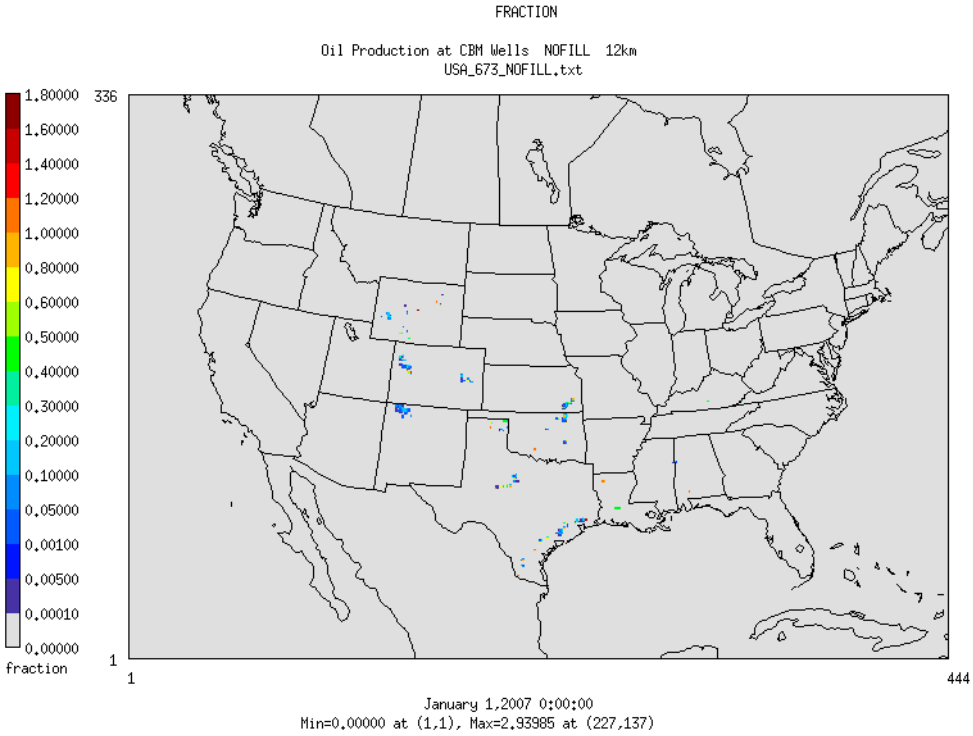

FRACTION
Industrial plus Institutional plus Hospitals NOFILL 12km
USA_596_NOFILL.txt
1.80000
1.60000
1.40000
1.20000
1.00000
0.80000
0.60000
0.50000
0.40000
0.30000
0.20000
0.10000
0.05000
0.00100
0.00500
0.00010
0.00000
fraction
336
1
1
444
January 1,2007 0:00:00
Min=0.00000 at (1,1), Max=2.25125 at (370,180)

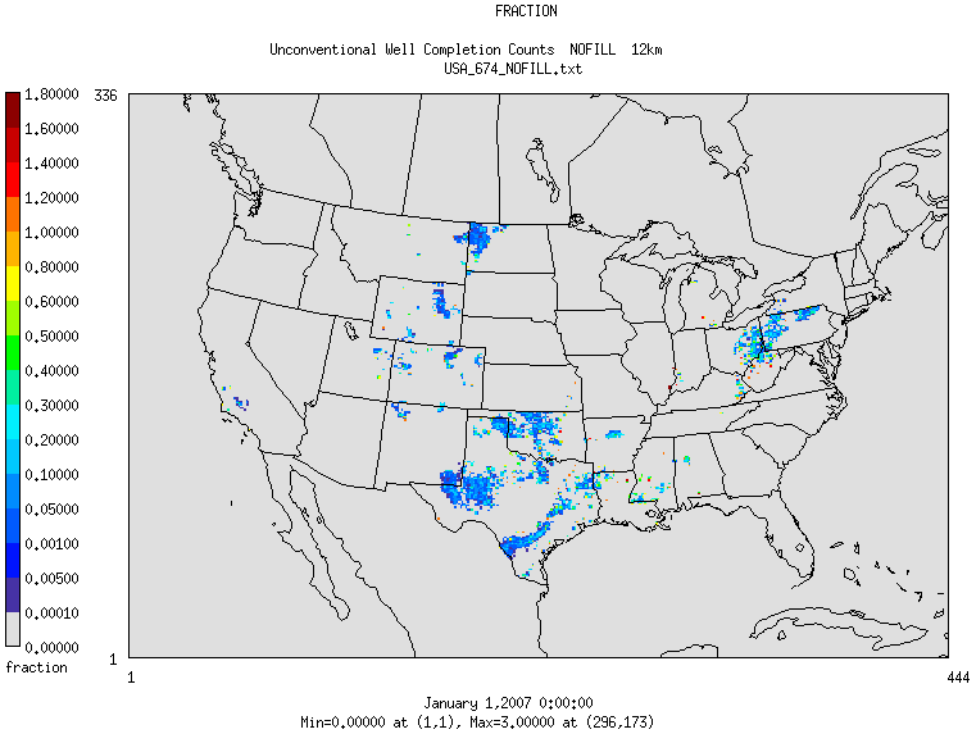

FRACTION
Refineries and Tank Farms NOFILL 12km
USA_650_NOFILL.txt
1.80000
1.60000
1.40000
1.20000
1.00000
0.80000
0.60000
0.50000
0.40000
0.30000
0.20000
0.10000
0.05000
0.00100
0.00500
0.00010
0.00000
fraction
336
1
1
444
January 1,2007 0:00:00
Min=0.00000 at (1,1), Max=2.09524 at (388,202)

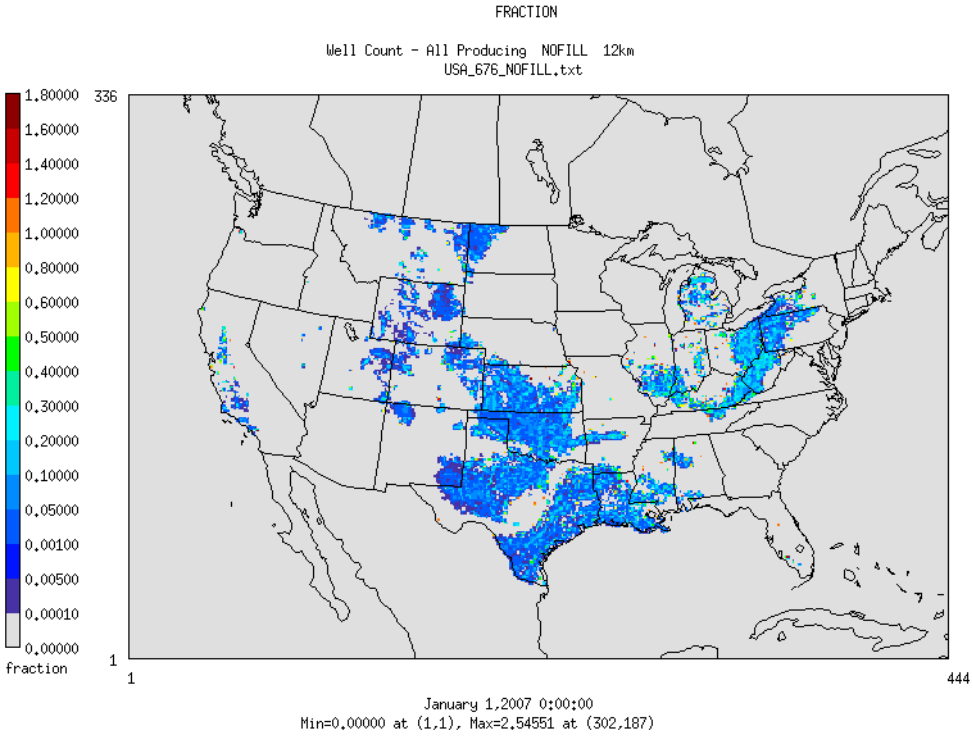

FRACTION
Spud Count - CBM Wells NOFILL 12km
USA_670_NOFILL.txt
1.80000
1.60000
1.40000
1.20000
1.00000
0.80000
0.60000
0.50000
0.40000
0.30000
0.20000
0.10000
0.05000
0.00100
0.00500
0.00010
0.00000
fraction
336
1
1
444
January 1,2007 0:00:00
Min=0.00000 at (1,1), Max=1.42640 at (337,156)

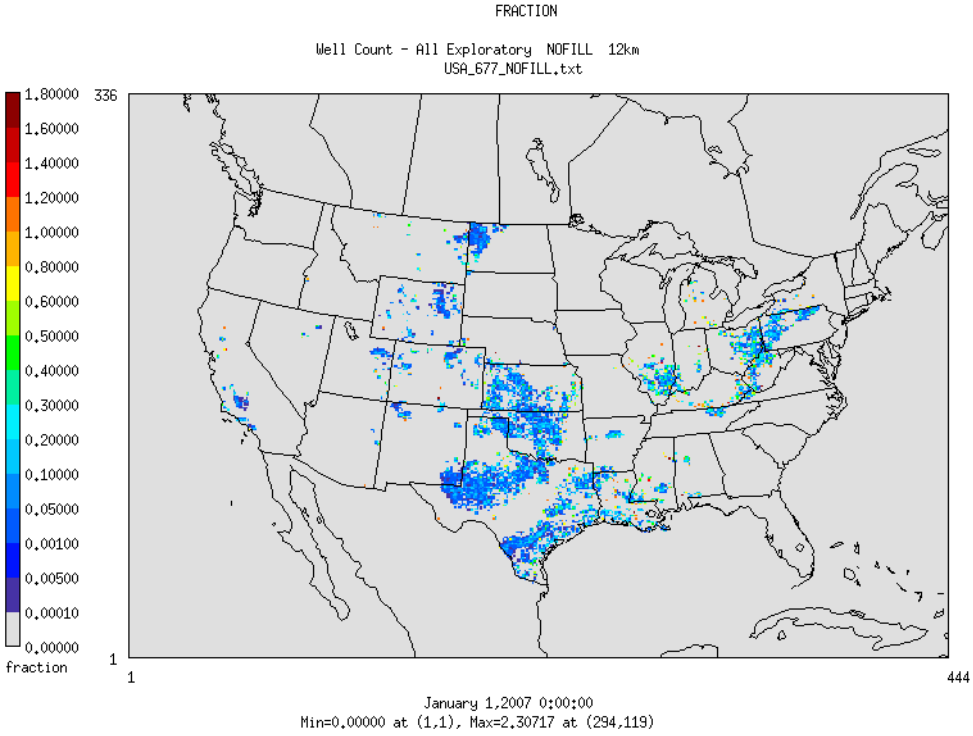

FRACTION
Spud Count - Gas Wells NOFILL 12km
USA_671_NOFILL.txt
1.80000
1.60000
1.40000
1.20000
1.00000
0.80000
0.60000
0.50000
0.40000
0.30000
0.20000
0.10000
0.05000
0.00100
0.00500
0.00010
0.00000
fraction
336
1
1
444
January 1,2007 0:00:00
Min=0.00000 at (1,1), Max=3.00000 at (294,119)

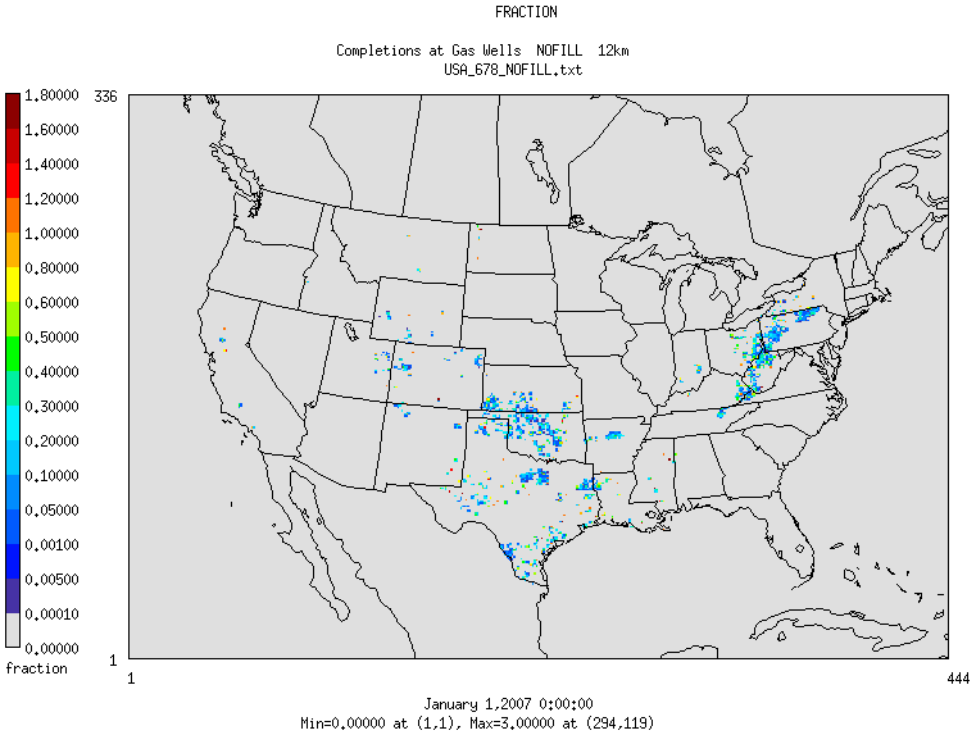

FRACTION
Gas Production at Oil Wells NOFILL 12km
USA_672_NOFILL.txt
1.80000
1.60000
1.40000
1.20000
1.00000
0.80000
0.60000
0.50000
0.40000
0.30000
0.20000
0.10000
0.05000
0.00100
0.00500
0.00010
0.00000
fraction
336
1
1
444
January 1,2007 0:00:00
Min=0.00000 at (1,1), Max=2.88987 at (205,114)

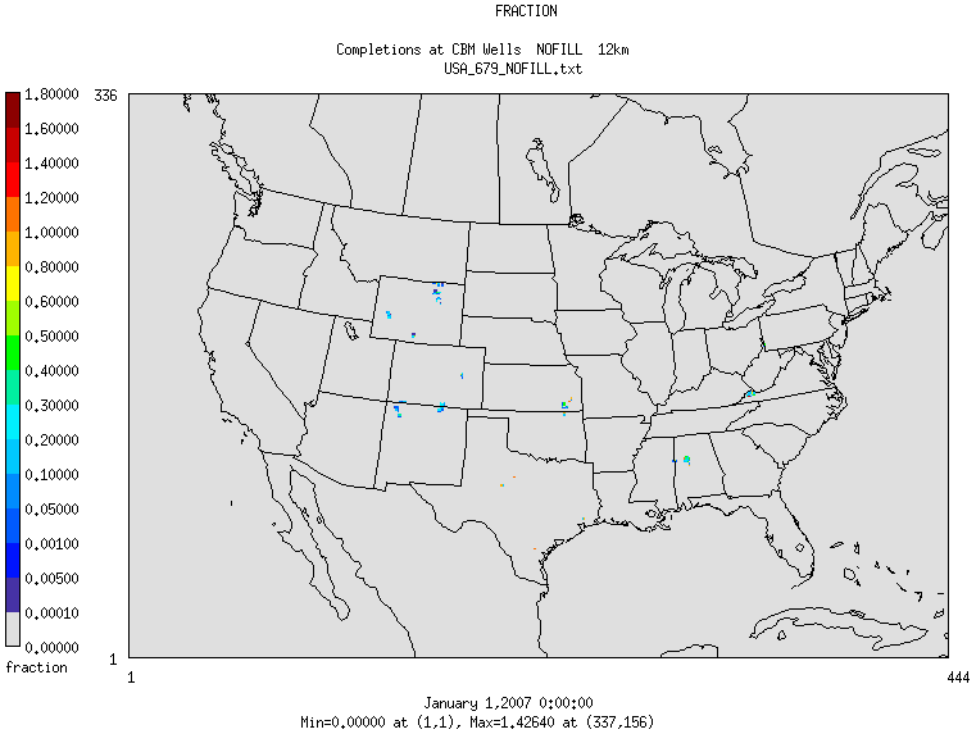

FRACTION
Oil Production at CBM Wells NOFILL 12km
USA_673_NOFILL.txt
1.80000
1.60000
1.40000
1.20000
1.00000
0.80000
0.60000
0.50000
0.40000
0.30000
0.20000
0.10000
0.05000
0.00100
0.00500
0.00010
0.00000
fraction
336
1
1
444
January 1,2007 0:00:00
Min=0.00000 at (1,1), Max=2.93985 at (227,137)

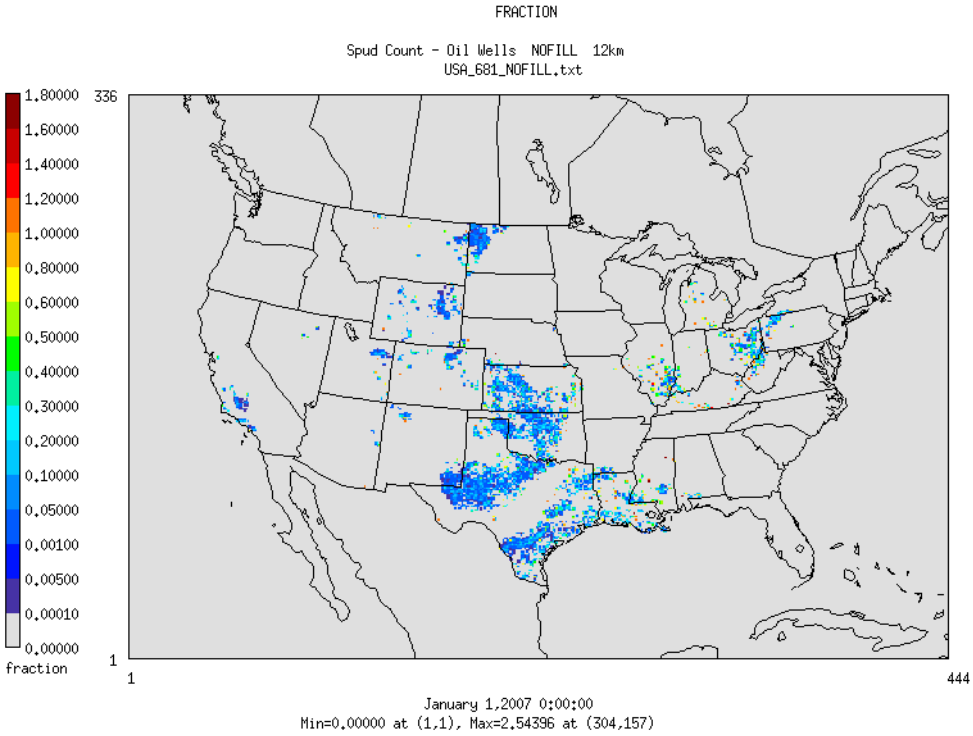

FRACTION
Unconventional Well Completion Counts NOFILL 12km
USA_674_NOFILL.txt
1.80000
1.60000
1.40000
1.20000
1.00000
0.80000
0.60000
0.50000
0.40000
0.30000
0.20000
0.10000
0.05000
0.00100
0.00500
0.00010
0.00000
fraction
336
1
1
444
January 1,2007 0:00:00
Min=0.00000 at (1,1), Max=3.00000 at (296,173)

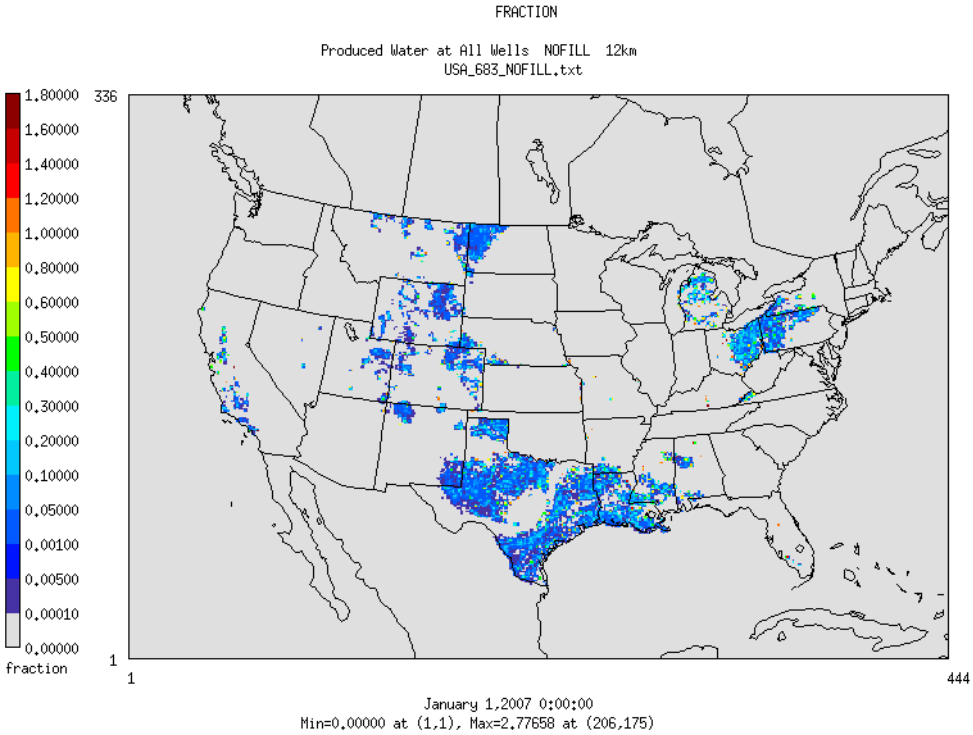

FRACTION
Well Count - All Producing NOFILL 12km
USA_676_NOFILL.txt
1.80000
1.60000
1.40000
1.20000
1.00000
0.80000
0.60000
0.50000
0.40000
0.30000
0.20000
0.10000
0.05000
0.00100
0.00500
0.00010
0.00000
fraction
336
1
1
444
January 1,2007 0:00:00
Min=0.00000 at (1,1), Max=2.54551 at (302,187)

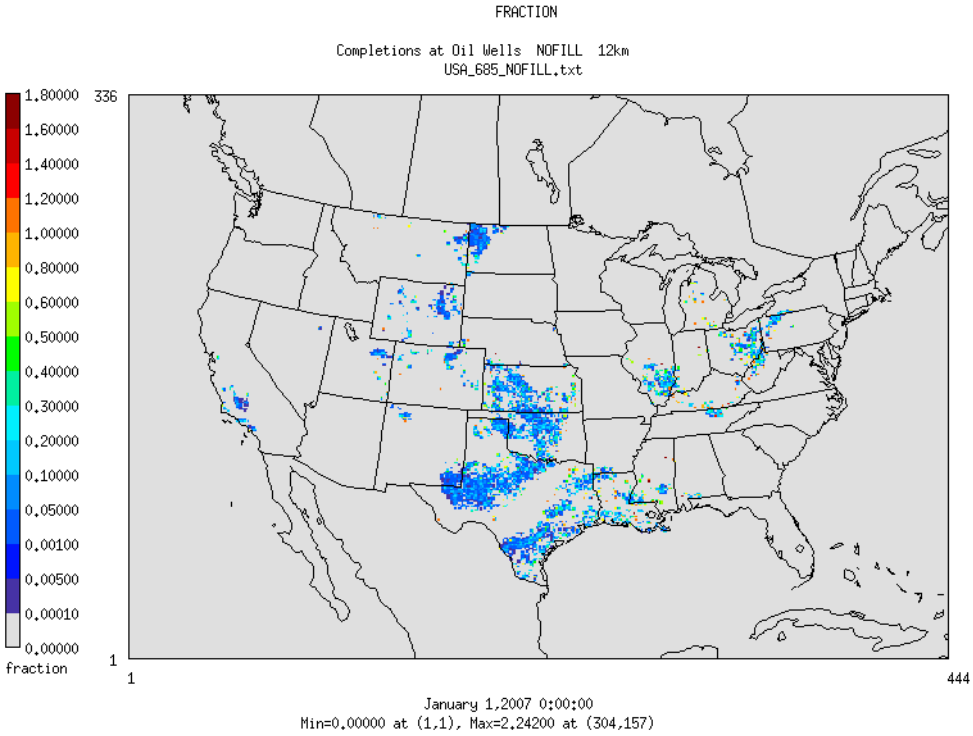

FRACTION
Well Count - All Exploratory NOFILL 12km
USA_677_NOFILL.txt
1.80000
1.60000
1.40000
1.20000
1.00000
0.80000
0.60000
0.50000
0.40000
0.30000
0.20000
0.10000
0.05000
0.00100
0.00500
0.00010
0.00000
fraction
336
1
1
444
January 1,2007 0:00:00
Min=0.00000 at (1,1), Max=2.30717 at (294,119)

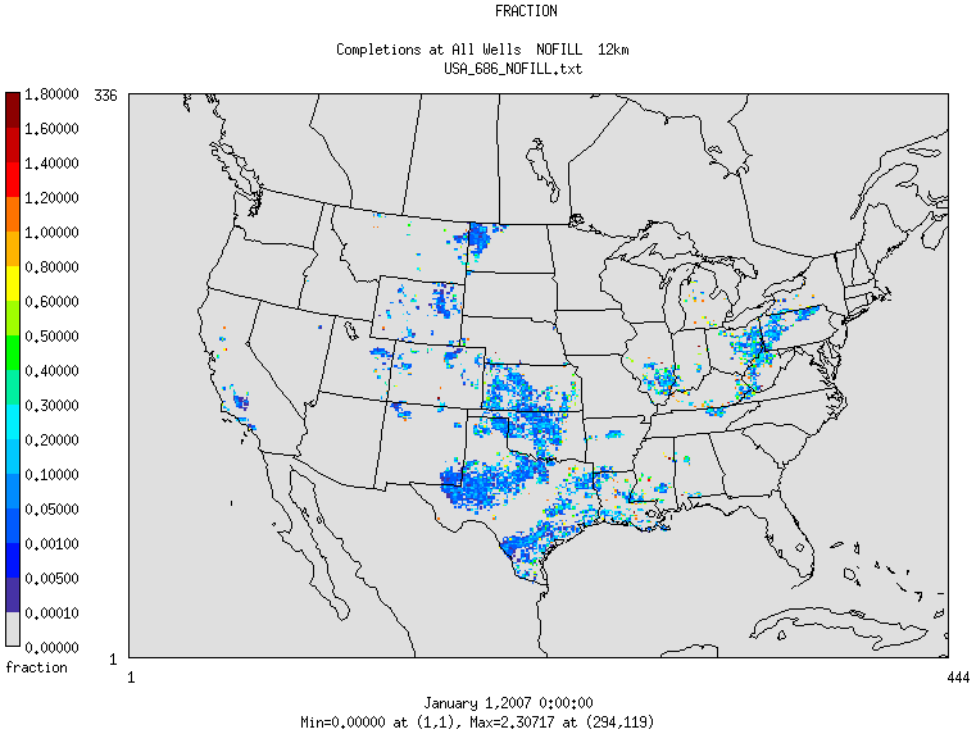

FRACTION
Completions at Gas Wells NOFILL 12km
USA_678_NOFILL.txt
1.80000
1.60000
1.40000
1.20000
1.00000
0.80000
0.60000
0.50000
0.40000
0.30000
0.20000
0.10000
0.05000
0.00100
0.00500
0.00010
0.00000
fraction
336
1
1
444
January 1,2007 0:00:00
Min=0.00000 at (1,1), Max=3.00000 at (294,119)

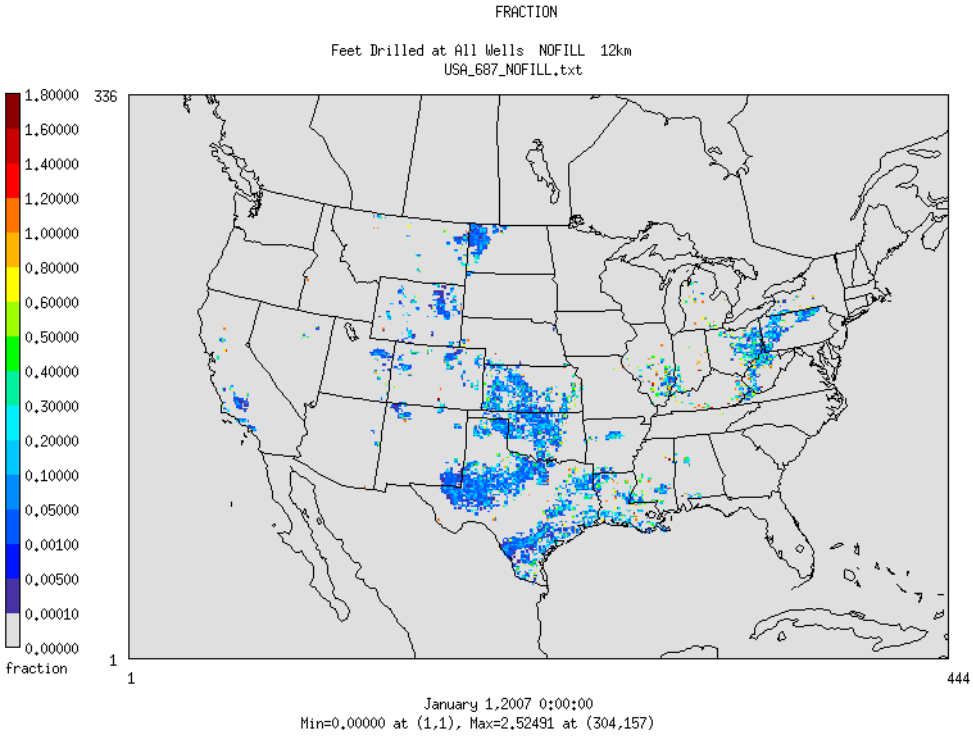

FRACTION
Completions at CBM Wells NOFILL 12km
USA_679_NOFILL.txt
1.80000
1.60000
1.40000
1.20000
1.00000
0.80000
0.60000
0.50000
0.40000
0.30000
0.20000
0.10000
0.05000
0.00100
0.00500
0.00010
0.00000
fraction
336
1
1
444
January 1,2007 0:00:00
Min=0.00000 at (1,1), Max=1.42640 at (337,156)

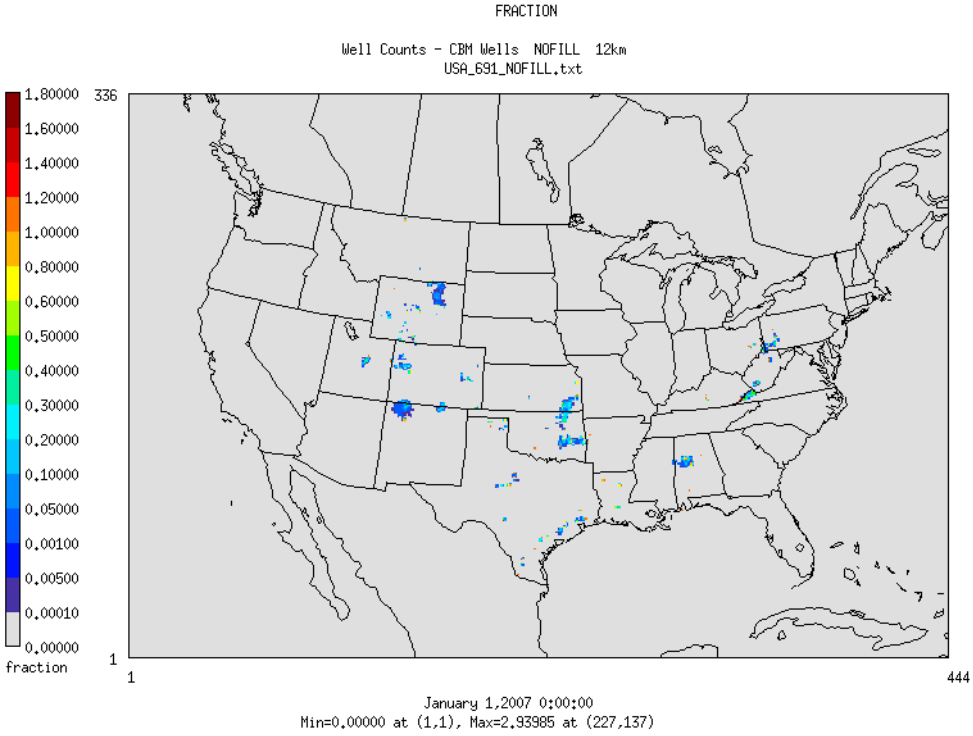

FRACTION
Spud Count - Oil Wells NOFILL 12km
USA_681_NOFILL.txt
1.80000
1.60000
1.40000
1.20000
1.00000
0.80000
0.60000
0.50000
0.40000
0.30000
0.20000
0.10000
0.05000
0.00100
0.00500
0.00010
0.00000
fraction
336
1
1
444
January 1,2007 0:00:00
Min=0.00000 at (1,1), Max=2.54396 at (304,157)

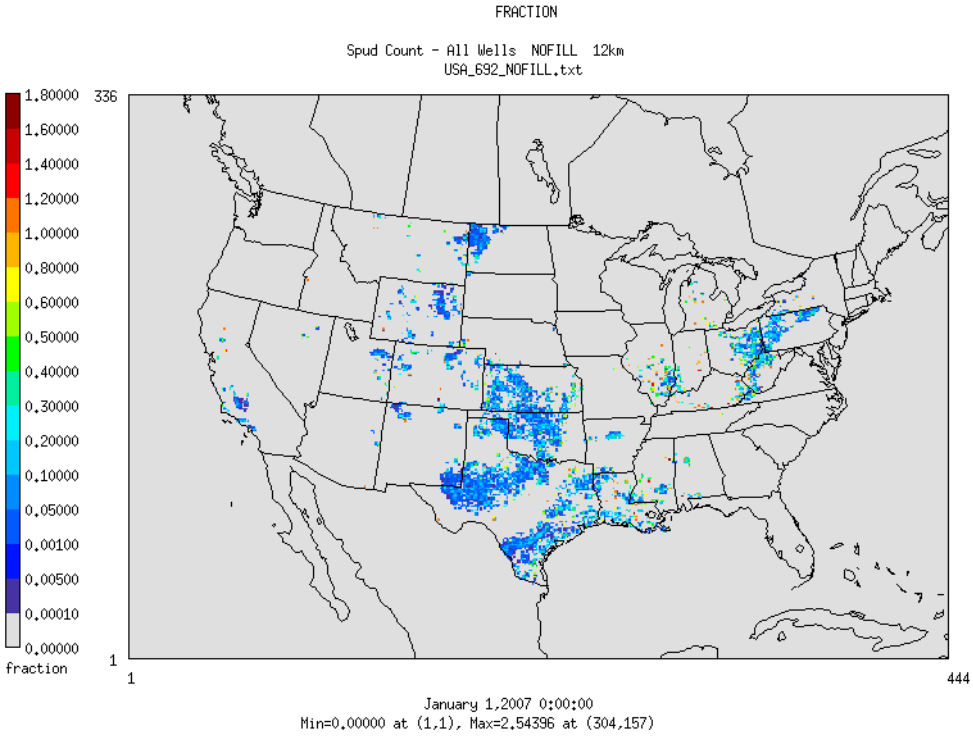

FRACTION
Produced Water at All Wells NOFILL 12km
USA_683_NOFILL.txt
1.80000
1.60000
1.40000
1.20000
1.00000
0.80000
0.60000
0.50000
0.40000
0.30000
0.20000
0.10000
0.05000
0.00100
0.00500
0.00010
0.00000
fraction
336
1
1
444
January 1,2007 0:00:00
Min=0.00000 at (1,1), Max=2.77658 at (206,175)

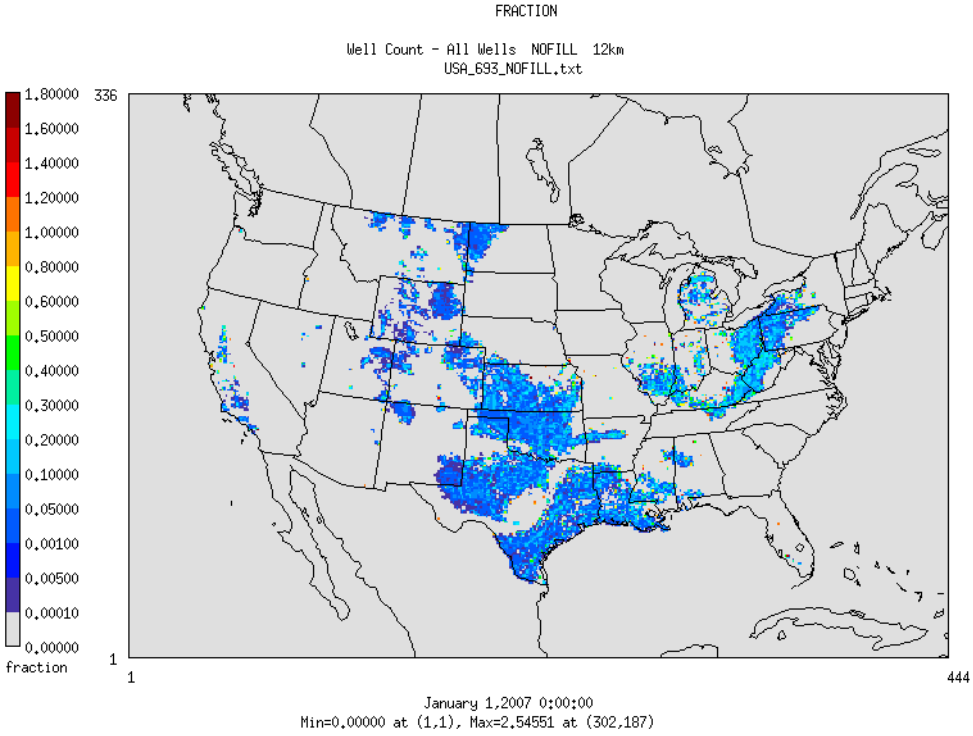

FRACTION
Completions at Oil Wells NOFILL 12km
USA_685_NOFILL.txt
1.80000
1.60000
1.40000
1.20000
1.00000
0.80000
0.60000
0.50000
0.40000
0.30000
0.20000
0.10000
0.05000
0.00100
0.00500
0.00010
0.00000
fraction
336
1
1
444
January 1,2007 0:00:00
Min=0.00000 at (1,1), Max=2.24200 at (304,157)

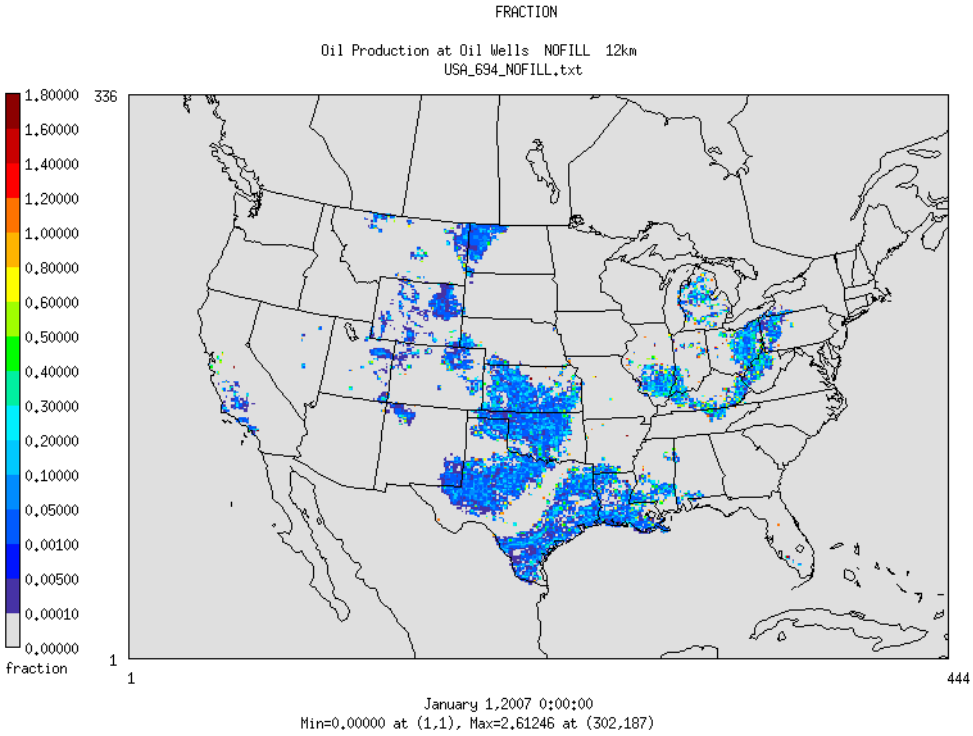

FRACTION
Completions at All Wells NOFILL 12km
USA_686_NOFILL.txt
1.80000
1.60000
1.40000
1.20000
1.00000
0.80000
0.60000
0.50000
0.40000
0.30000
0.20000
0.10000
0.05000
0.00100
0.00500
0.00010
0.00000
fraction
336
1
1
444
January 1,2007 0:00:00
Min=0.00000 at (1,1), Max=2.30717 at (294,119)

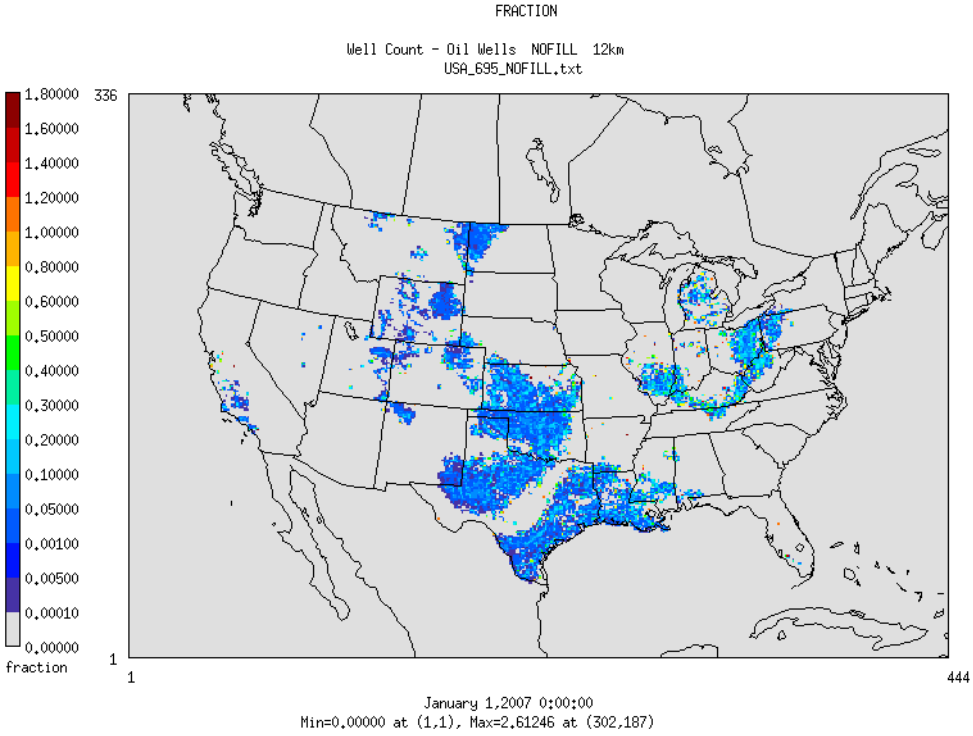

FRACTION
Feet Drilled at All Wells NOFILL 12km
USA_687_NOFILL.txt
1.80000
1.60000
1.40000
1.20000
1.00000
0.80000
0.60000
0.50000
0.40000
0.30000
0.20000
0.10000
0.05000
0.00100
0.00500
0.00010
0.00000
fraction
336
1
1
444
January 1,2007 0:00:00
Min=0.00000 at (1,1), Max=2.52491 at (304,157)

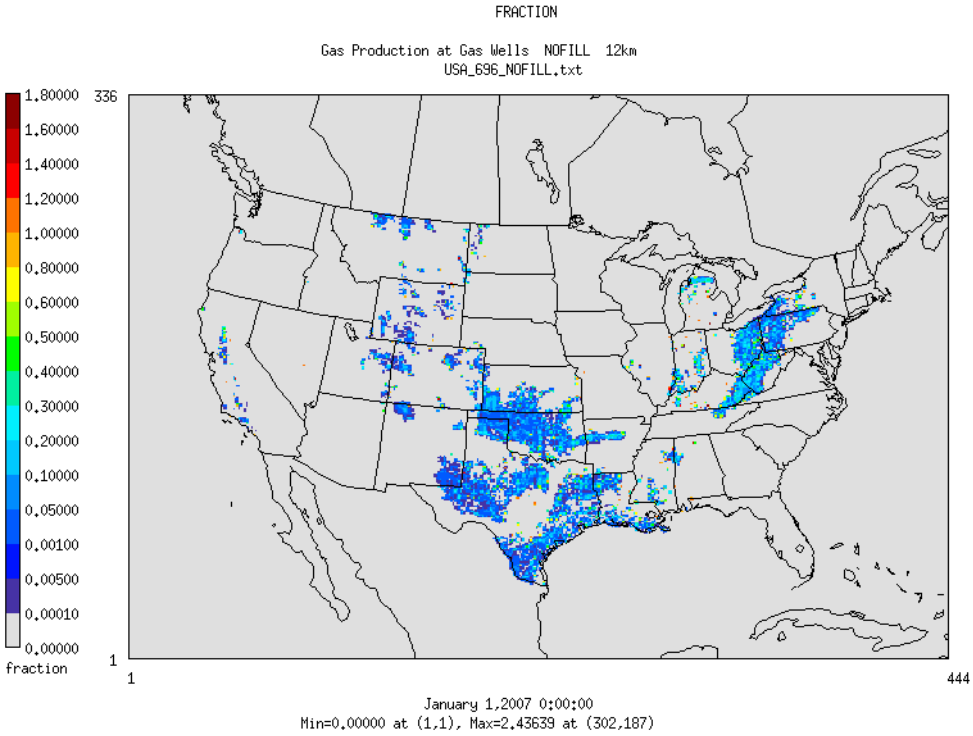

FRACTION
Well Counts - CBM Wells NOFILL 12km
USA_691_NOFILL.txt
1.80000
1.60000
1.40000
1.20000
1.00000
0.80000
0.60000
0.50000
0.40000
0.30000
0.20000
0.10000
0.05000
0.00100
0.00500
0.00010
0.00000
fraction
336
1
1
444
January 1,2007 0:00:00
Min=0.00000 at (1,1), Max=2.93985 at (227,137)

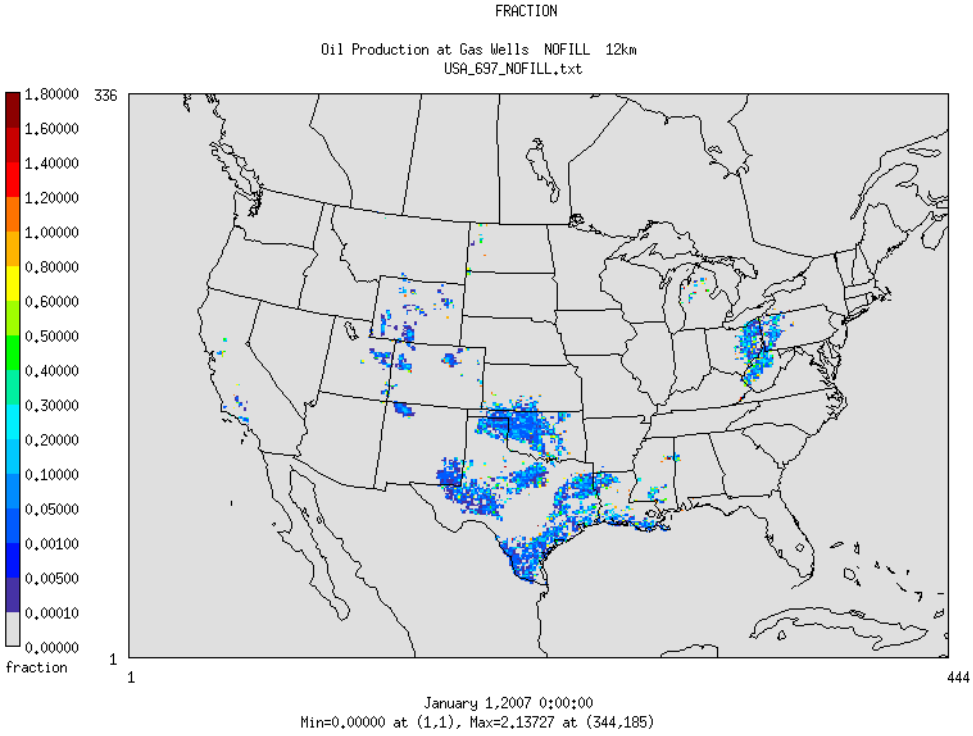

FRACTION
Spud Count - All Wells NOFILL 12km
USA_692_NOFILL.txt
1.80000
1.60000
1.40000
1.20000
1.00000
0.80000
0.60000
0.50000
0.40000
0.30000
0.20000
0.10000
0.05000
0.00100
0.00500
0.00010
0.00000
fraction
336
1
1
444
January 1,2007 0:00:00
Min=0.00000 at (1,1), Max=2.54396 at (304,157)

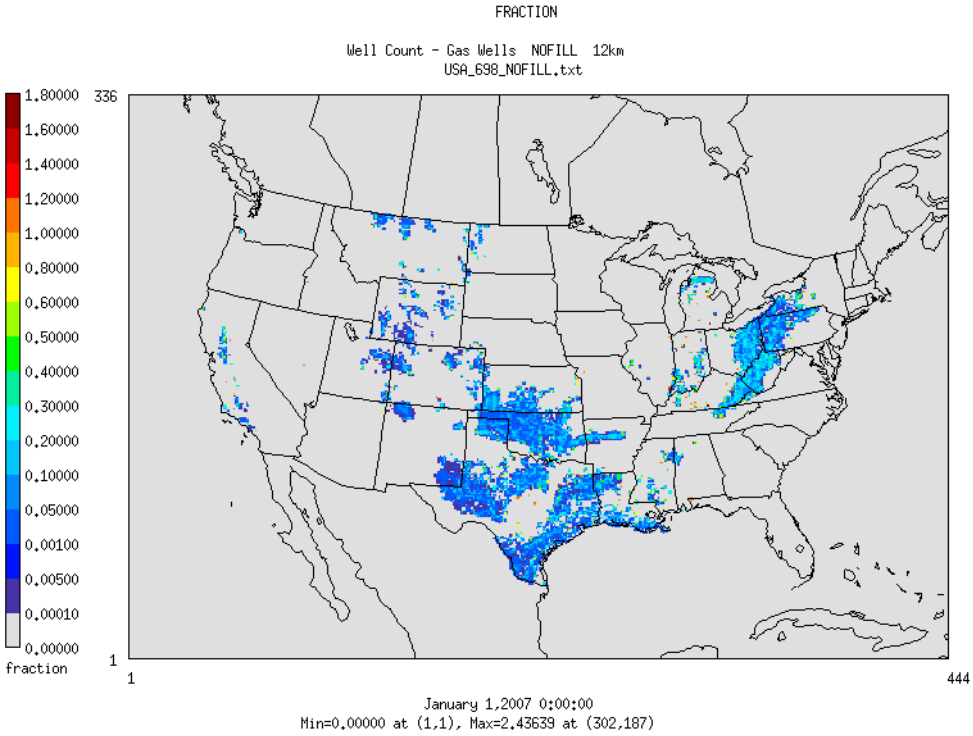

FRACTION
Well Count - All Wells NOFILL 12km
USA_693_NOFILL.txt
1.80000
1.60000
1.40000
1.20000
1.00000
0.80000
0.60000
0.50000
0.40000
0.30000
0.20000
0.10000
0.05000
0.00100
0.00500
0.00010
0.00000
fraction
336
1
1
444
January 1,2007 0:00:00
Min=0.00000 at (1,1), Max=2.54551 at (302,187)

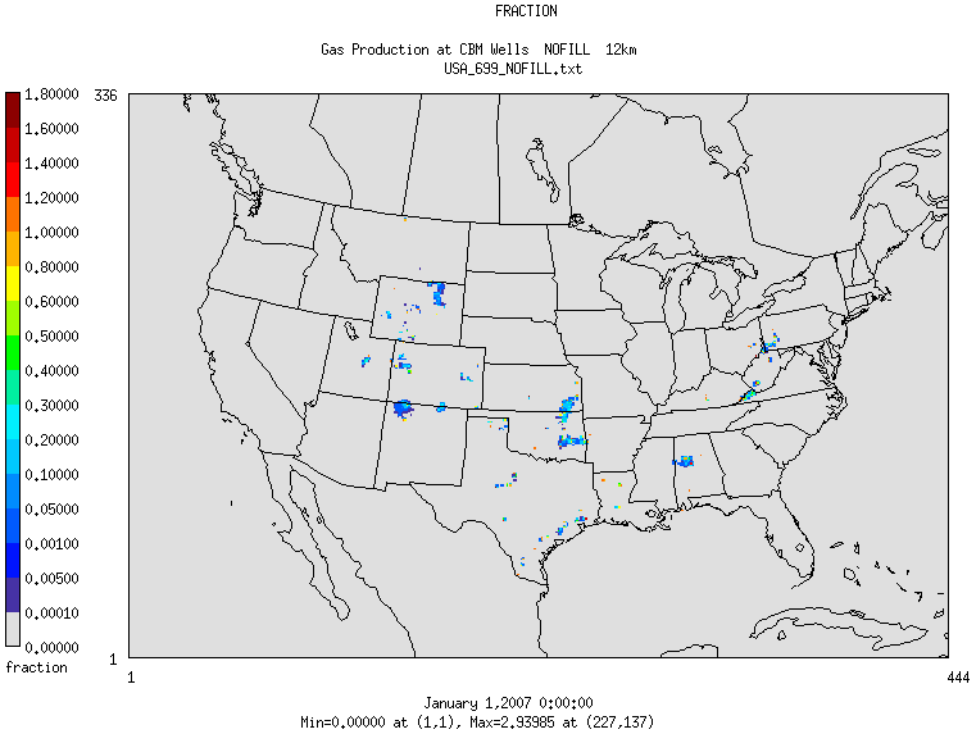

FRACTION
Oil Production at Oil Wells NOFILL 12km
USA_694_NOFILL.txt
1.80000
1.60000
1.40000
1.20000
1.00000
0.80000
0.60000
0.50000
0.40000
0.30000
0.20000
0.10000
0.05000
0.00100
0.00500
0.00010
0.00000
fraction
336
1
1
444
January 1,2007 0:00:00
Min=0.00000 at (1,1), Max=2.61246 at (302,187)

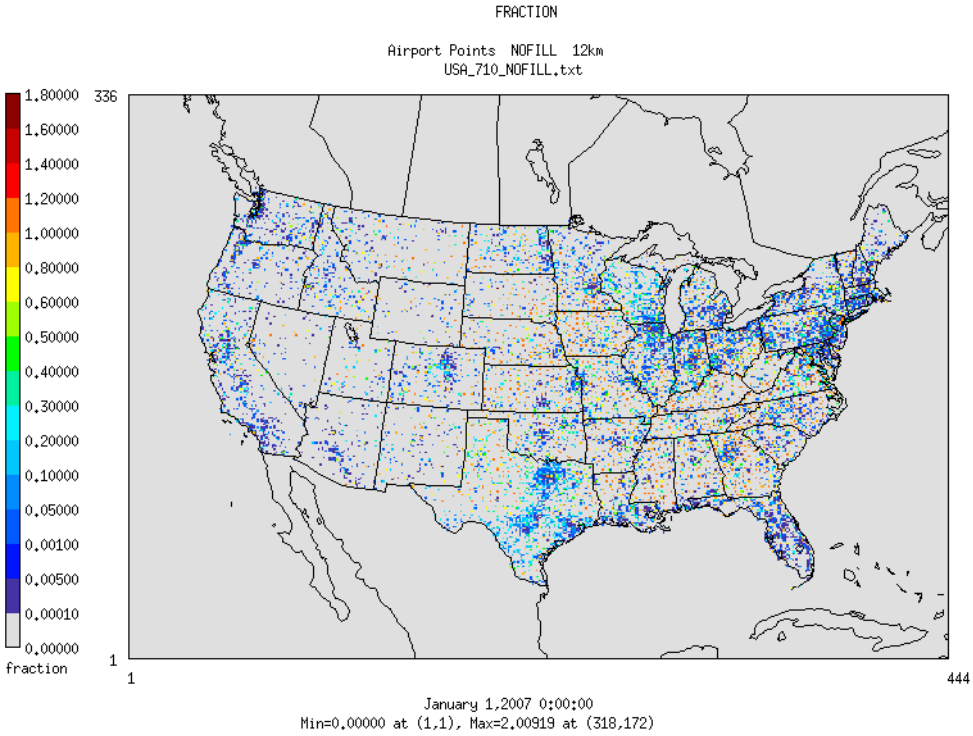

FRACTION
Well Count - Oil Wells NOFILL 12km
USA_695_NOFILL.txt
1.80000
1.60000
1.40000
1.20000
1.00000
0.80000
0.60000
0.50000
0.40000
0.30000
0.20000
0.10000
0.05000
0.00100
0.00500
0.00010
0.00000
fraction
336
1
1
444
January 1,2007 0:00:00
Min=0.00000 at (1,1), Max=2.61246 at (302,187)

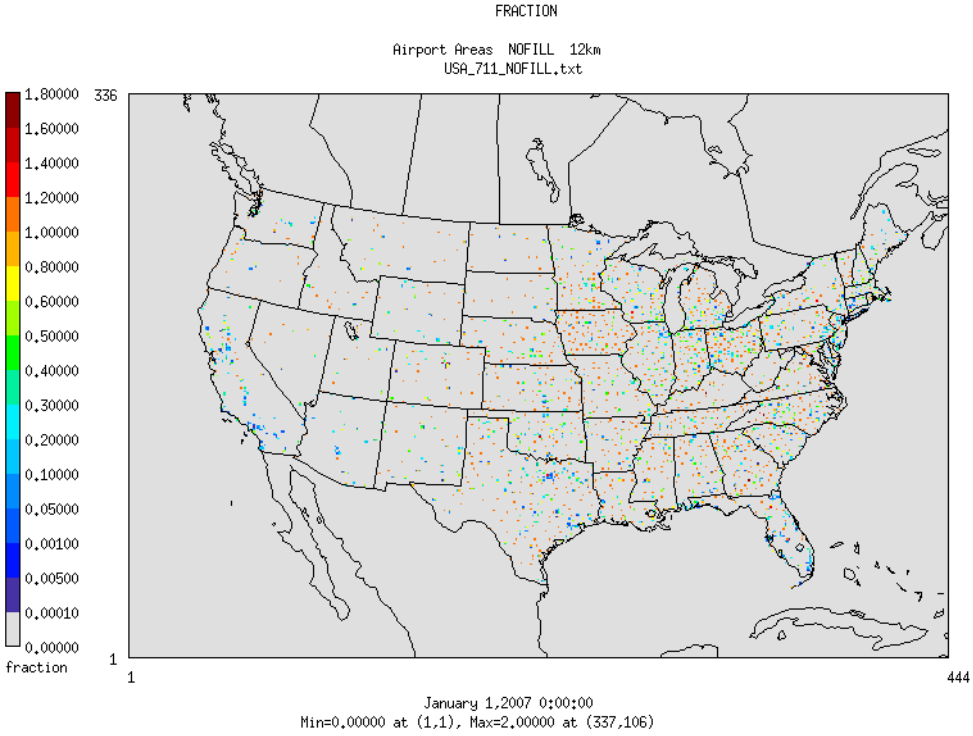

FRACTION
Gas Production at Gas Wells NOFILL 12km
USA_696_NOFILL.txt
1.80000
1.60000
1.40000
1.20000
1.00000
0.80000
0.60000
0.50000
0.40000
0.30000
0.20000
0.10000
0.05000
0.00100
0.00500
0.00010
0.00000
fraction
336
1
1
444
January 1,2007 0:00:00
Min=0.00000 at (1,1), Max=2.43639 at (302,187)

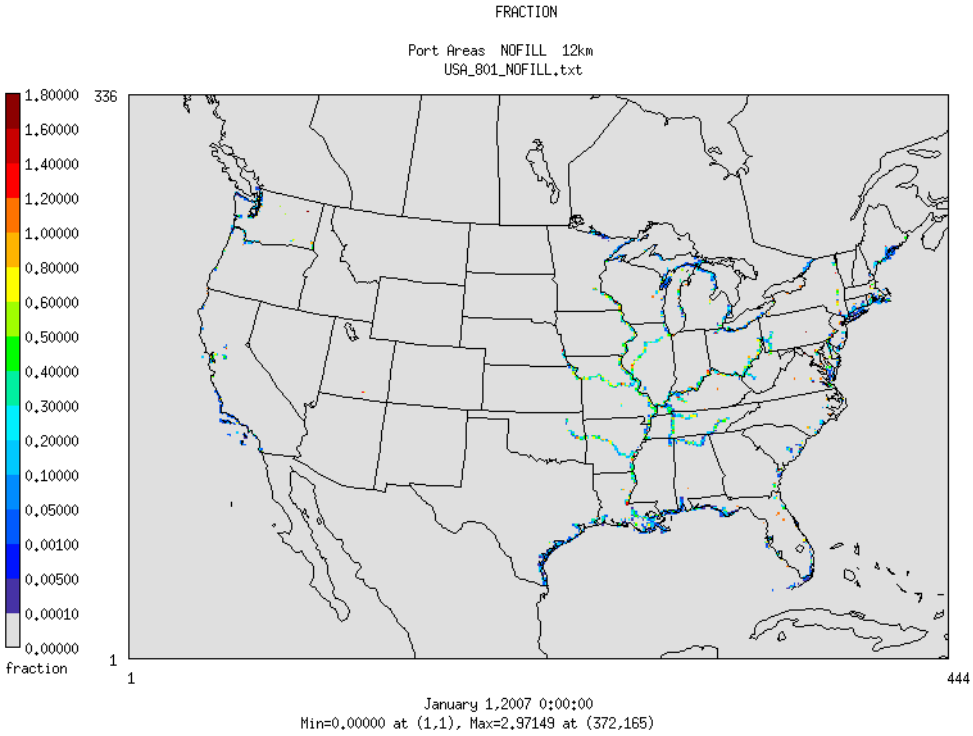

FRACTION
Oil Production at Gas Wells NOFILL 12km
USA_697_NOFILL.txt
1.80000
1.60000
1.40000
1.20000
1.00000
0.80000
0.60000
0.50000
0.40000
0.30000
0.20000
0.10000
0.05000
0.00100
0.00500
0.00010
0.00000
fraction
336
1
1
444
January 1,2007 0:00:00
Min=0.00000 at (1,1), Max=2.13727 at (344,185)

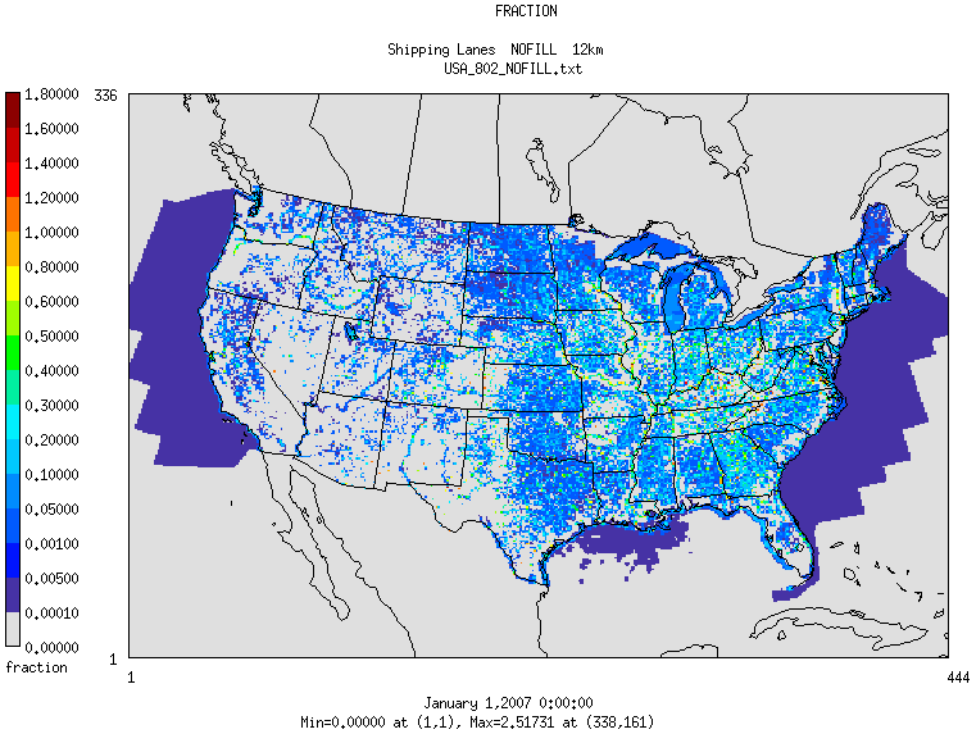

FRACTION
Well Count - Gas Wells NOFILL 12km
USA_698_NOFILL.txt
1.80000
1.60000
1.40000
1.20000
1.00000
0.80000
0.60000
0.50000
0.40000
0.30000
0.20000
0.10000
0.05000
0.00100
0.00500
0.00010
0.00000
fraction
336
1
1
444
January 1,2007 0:00:00
Min=0.00000 at (1,1), Max=2.43639 at (302,187)

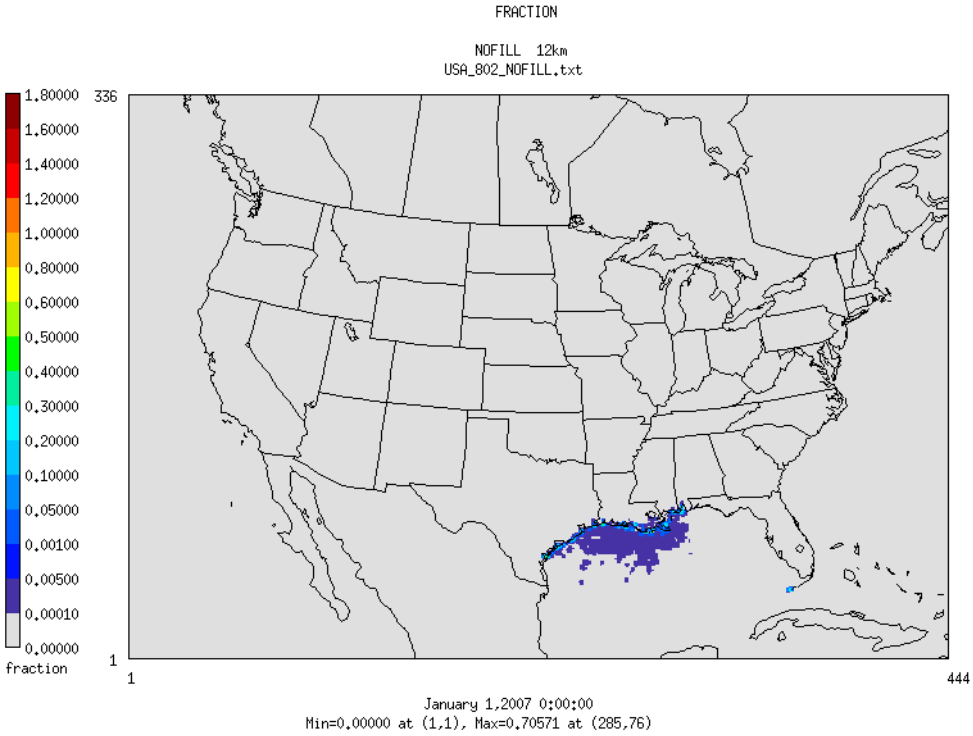

FRACTION
Gas Production at CBM Wells NOFILL 12km
USA_699_NOFILL.txt
1.80000
1.60000
1.40000
1.20000
1.00000
0.80000
0.60000
0.50000
0.40000
0.30000
0.20000
0.10000
0.05000
0.00100
0.00500
0.00010
0.00000
fraction
336
1
1
444
January 1,2007 0:00:00
Min=0.00000 at (1,1), Max=2.93985 at (227,137)

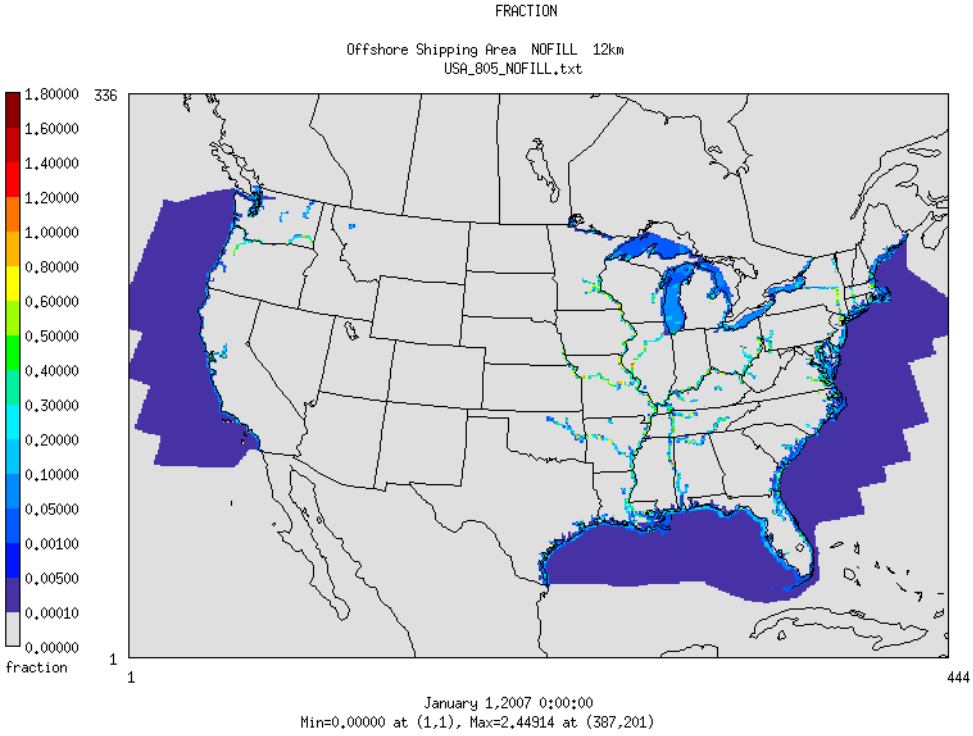

FRACTION
Airport Points NOFILL 12km
USA_710_NOFILL.txt
1.80000
1.60000
1.40000
1.20000
1.00000
0.80000
0.60000
0.50000
0.40000
0.30000
0.20000
0.10000
0.05000
0.00100
0.00500
0.00010
0.00000
fraction
336
1
1
444
January 1,2007 0:00:00
Min=0.00000 at (1,1), Max=2.00919 at (318,172)

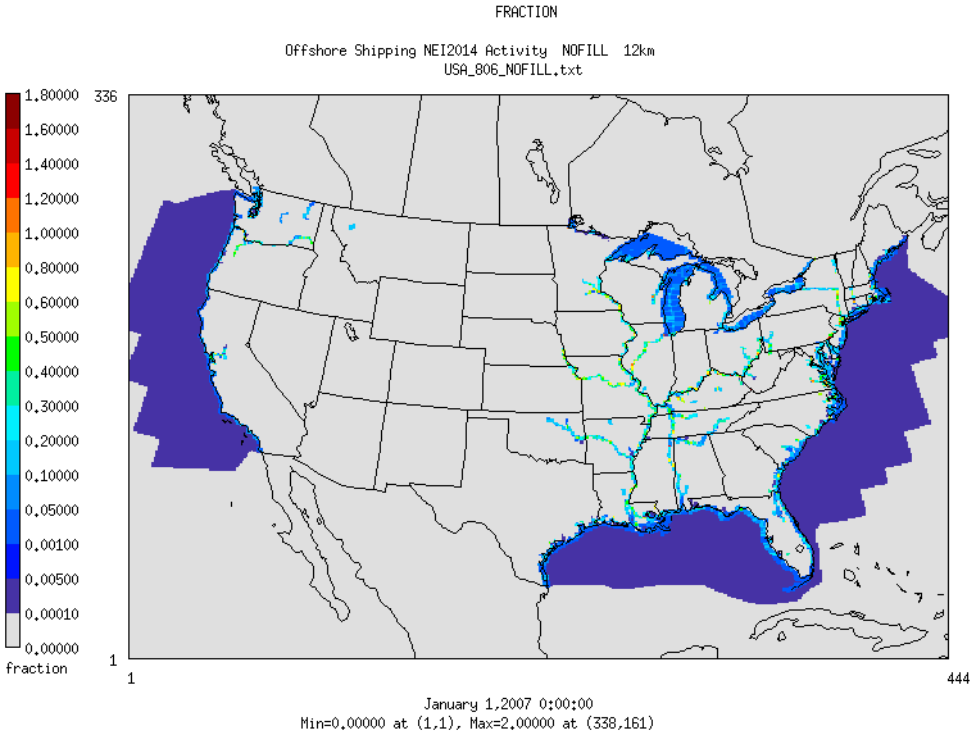

FRACTION
Airport Areas NOFILL 12km
USA_711_NOFILL.txt
1.80000
1.60000
1.40000
1.20000
1.00000
0.80000
0.60000
0.50000
0.40000
0.30000
0.20000
0.10000
0.05000
0.00100
0.00500
0.00010
0.00000
fraction
336
1
1
444
January 1,2007 0:00:00
Min=0.00000 at (1,1), Max=2.00000 at (337,106)

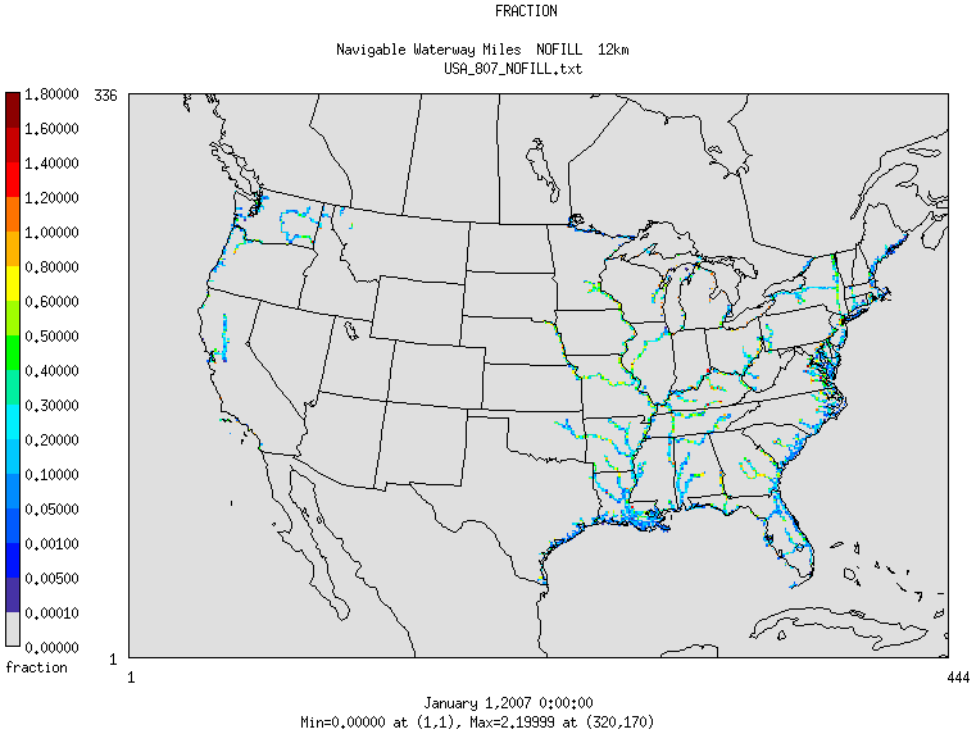

FRACTION
Port Areas NOFILL 12km
USA_801_NOFILL.txt
1.80000
1.60000
1.40000
1.20000
1.00000
0.80000
0.60000
0.50000
0.40000
0.30000
0.20000
0.10000
0.05000
0.00100
0.00500
0.00010
0.00000
fraction
336
1
1
444
January 1,2007 0:00:00
Min=0.00000 at (1,1), Max=2.97149 at (372,165)

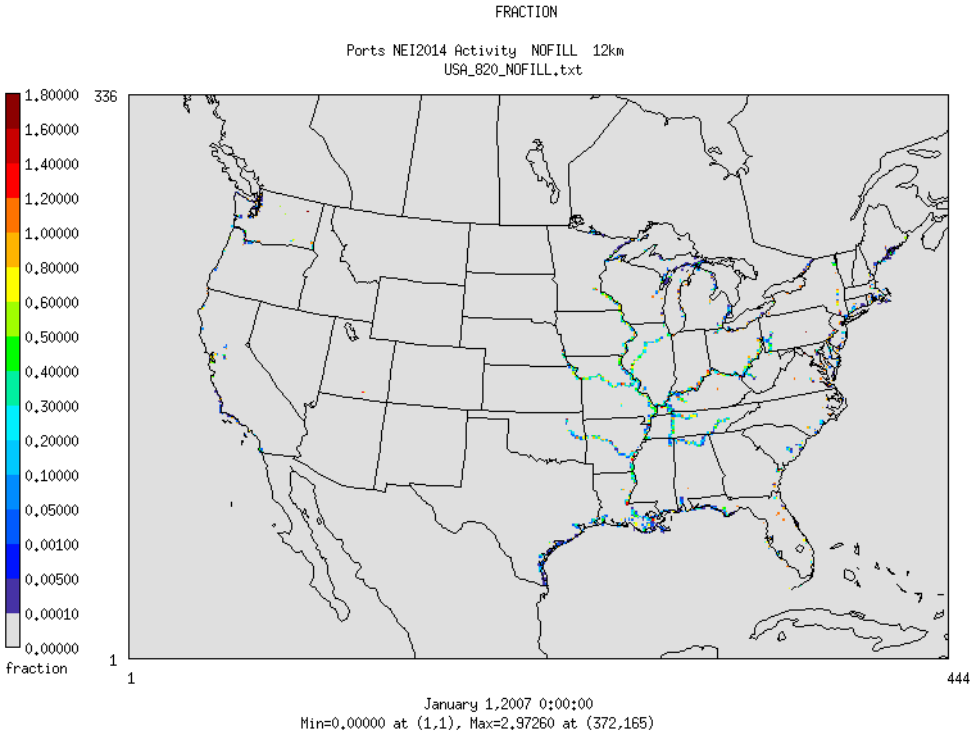

FRACTION
Shipping Lanes NOFILL 12km
USA_802_NOFILL.txt
1.80000
1.60000
1.40000
1.20000
1.00000
0.80000
0.60000
0.50000
0.40000
0.30000
0.20000
0.10000
0.05000
0.00100
0.00500
0.00010
0.00000
fraction
336
1
1
444
January 1,2007 0:00:00
Min=0.00000 at (1,1), Max=2.51731 at (338,161)

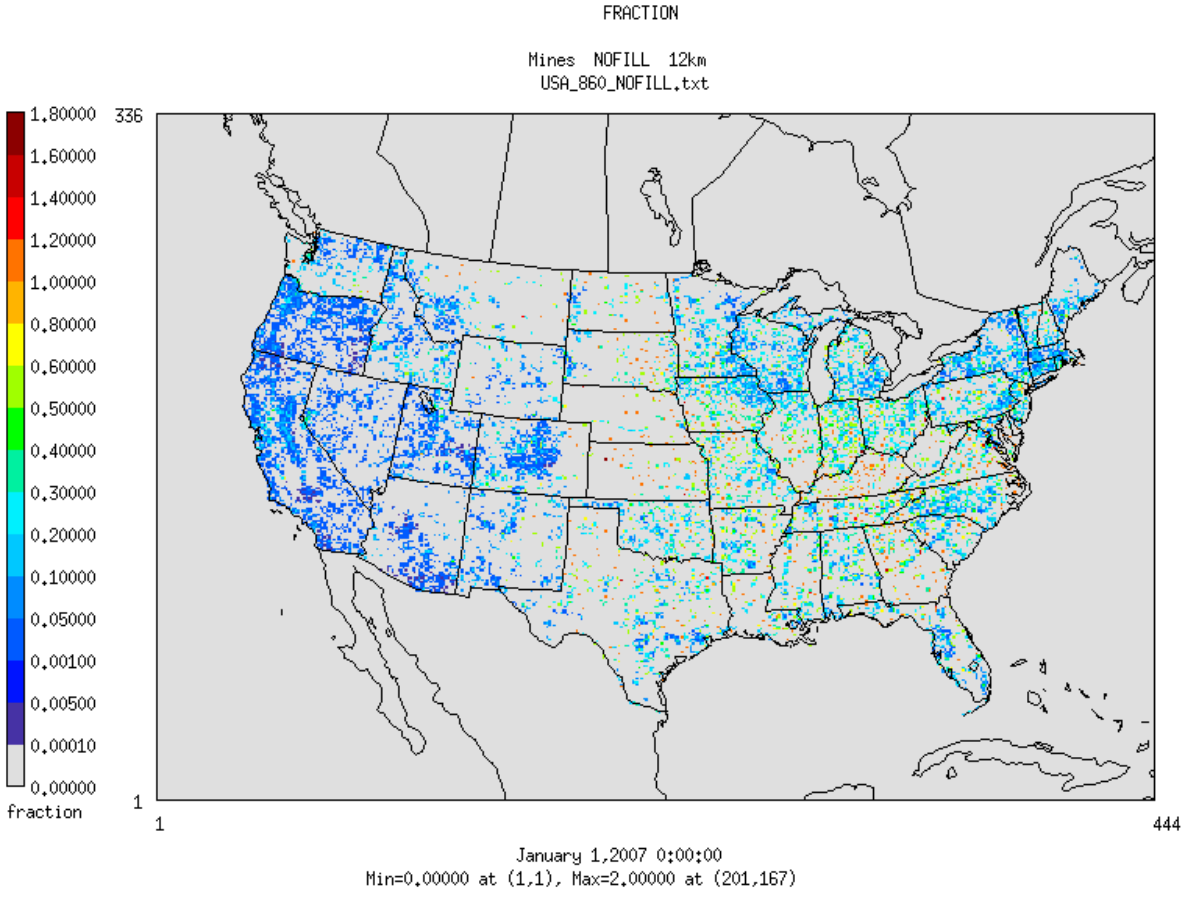

FRACTION
NOFILL 12km
USA_802_NOFILL.txt
1.80000
1.60000
1.40000
1.20000
1.00000
0.80000
0.60000
0.50000
0.40000
0.30000
0.20000
0.10000
0.05000
0.00100
0.00500
0.00010
0.00000
fraction
336
1
1
444
January 1,2007 0:00:00
Min=0.00000 at (1,1), Max=0.70571 at (285,76)

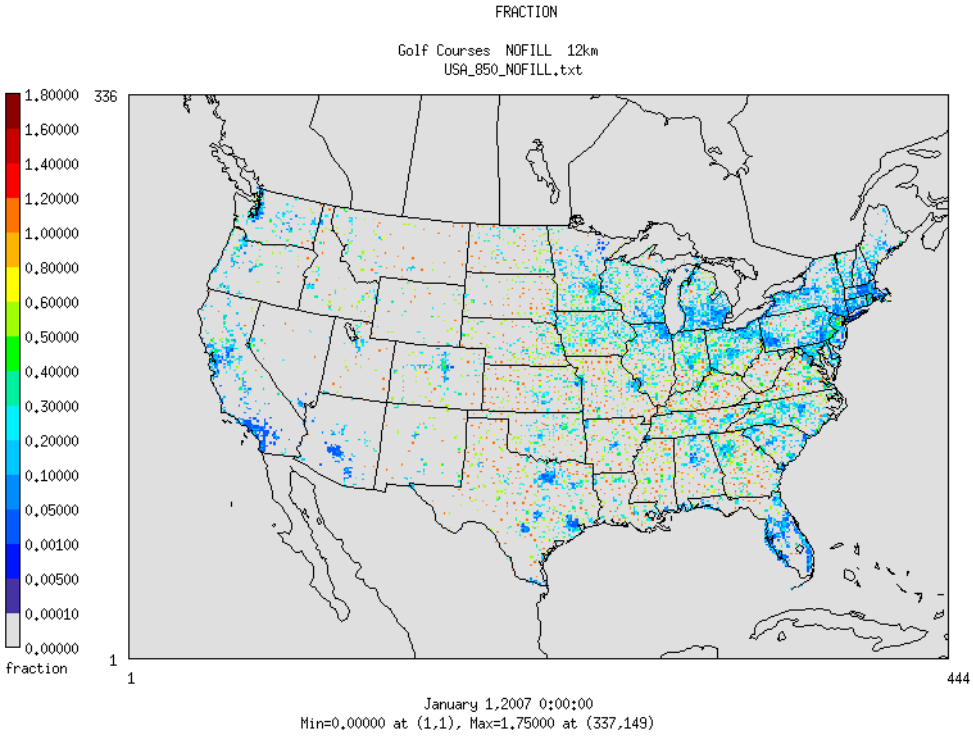

FRACTION
Offshore Shipping Area NOFILL 12km
USA_805_NOFILL.txt
1.80000
1.60000
1.40000
1.20000
1.00000
0.80000
0.60000
0.50000
0.40000
0.30000
0.20000
0.10000
0.05000
0.00100
0.00500
0.00010
0.00000
fraction
336
1
1
444
January 1,2007 0:00:00
Min=0.00000 at (1,1), Max=2.44914 at (387,201)

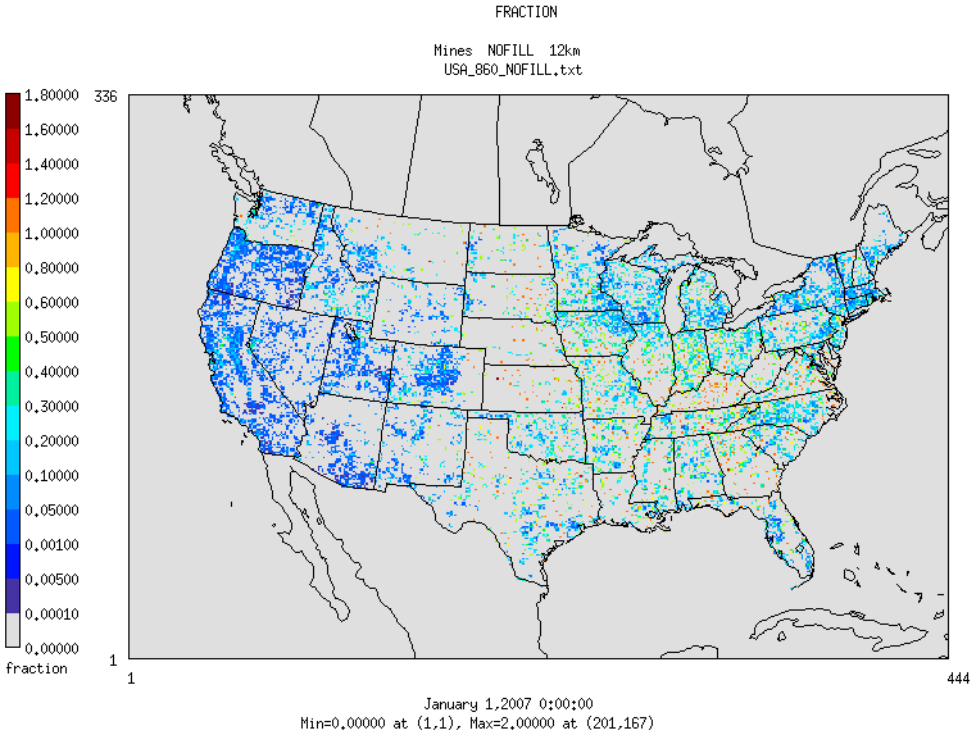

FRACTION
Offshore Shipping NEI2014 Activity NOFILL 12km
USA_806_NOFILL.txt
1.80000
1.60000
1.40000
1.20000
1.00000
0.80000
0.60000
0.50000
0.40000
0.30000
0.20000
0.10000
0.05000
0.00100
0.00500
0.00010
0.00000
fraction
336
1
1
444
January 1,2007 0:00:00
Min=0.00000 at (1,1), Max=2.00000 at (338,161)

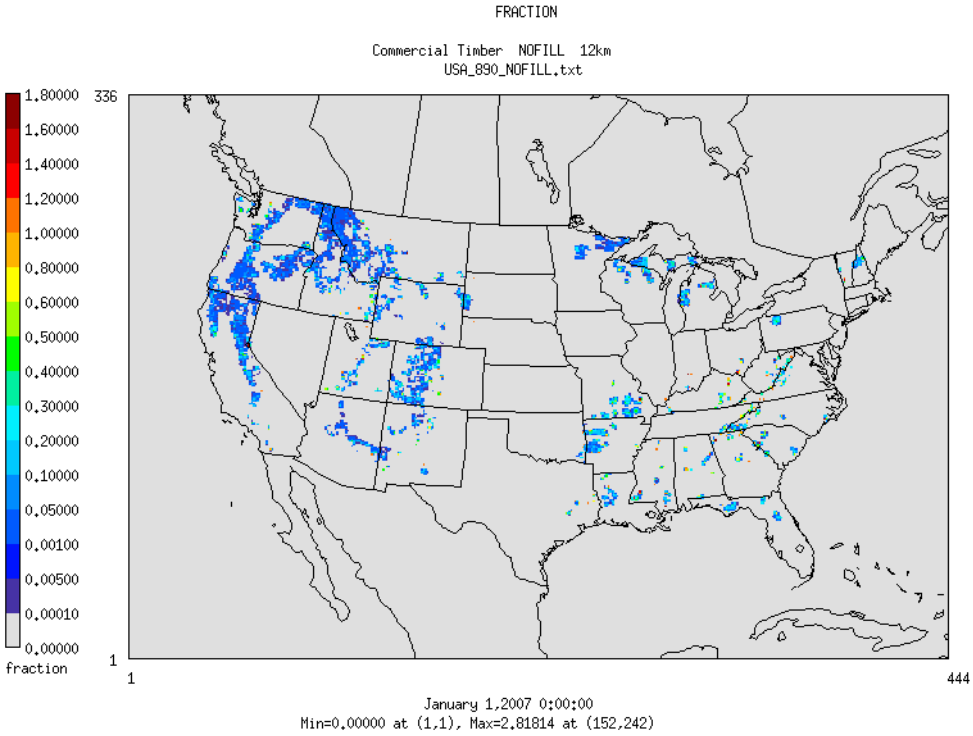

FRACTION
Navigable Waterway Miles NOFILL 12km
USA_807_NOFILL.txt
1.80000
1.60000
1.40000
1.20000
1.00000
0.80000
0.60000
0.50000
0.40000
0.30000
0.20000
0.10000
0.05000
0.00100
0.00500
0.00010
0.00000
fraction
336
1
1
444
January 1,2007 0:00:00
Min=0.00000 at (1,1), Max=2.19999 at (320,170)


FRACTION
Ports NEI2014 Activity NOFILL 12km
USA_820_NOFILL.txt
1.80000
1.60000
1.40000
1.20000
1.00000
0.80000
0.60000
0.50000
0.40000
0.30000
0.20000
0.10000
0.05000
0.00100
0.00500
0.00010
0.00000
fraction
336
1
1
444
January 1,2007 0:00:00
Min=0.00000 at (1,1), Max=2.97260 at (372,165)


FRACTION
Mines NOFILL 12km
USA_860_NOFILL.txt
1.80000
1.60000
1.40000
1.20000
1.00000
0.80000
0.60000
0.50000
0.40000
0.30000
0.20000
0.10000
0.05000
0.00100
0.00500
0.00010
0.00000
fraction
336
1
1
444
January 1,2007 0:00:00
Min=0.00000 at (1,1), Max=2.00000 at (201,167)


FRACTION
Golf Courses NOFILL 12km
USA_850_NOFILL.txt
1.80000
1.60000
1.40000
1.20000
1.00000
0.80000
0.60000
0.50000
0.40000
0.30000
0.20000
0.10000
0.05000
0.00100
0.00500
0.00010
0.00000
fraction
336
1
1
444
January 1,2007 0:00:00
Min=0.00000 at (1,1), Max=1.75000 at (337,149)


FRACTION
Mines NOFILL 12km
USA_860_NOFILL.txt
1.80000
1.60000
1.40000
1.20000
1.00000
0.80000
0.60000
0.50000
0.40000
0.30000
0.20000
0.10000
0.05000
0.00100
0.00500
0.00010
0.00000
fraction
336
1
1
444
January 1,2007 0:00:00
Min=0.00000 at (1,1), Max=2.00000 at (201,167)


FRACTION
Commercial Timber NOFILL 12km
USA_890_NOFILL.txt
1.80000
1.60000
1.40000
1.20000
1.00000
0.80000
0.60000
0.50000
0.40000
0.30000
0.20000
0.10000
0.05000
0.00100
0.00500
0.00010
0.00000
fraction
336
1
1
444
January 1,2007 0:00:00
Min=0.00000 at (1,1), Max=2.81814 at (152,242)