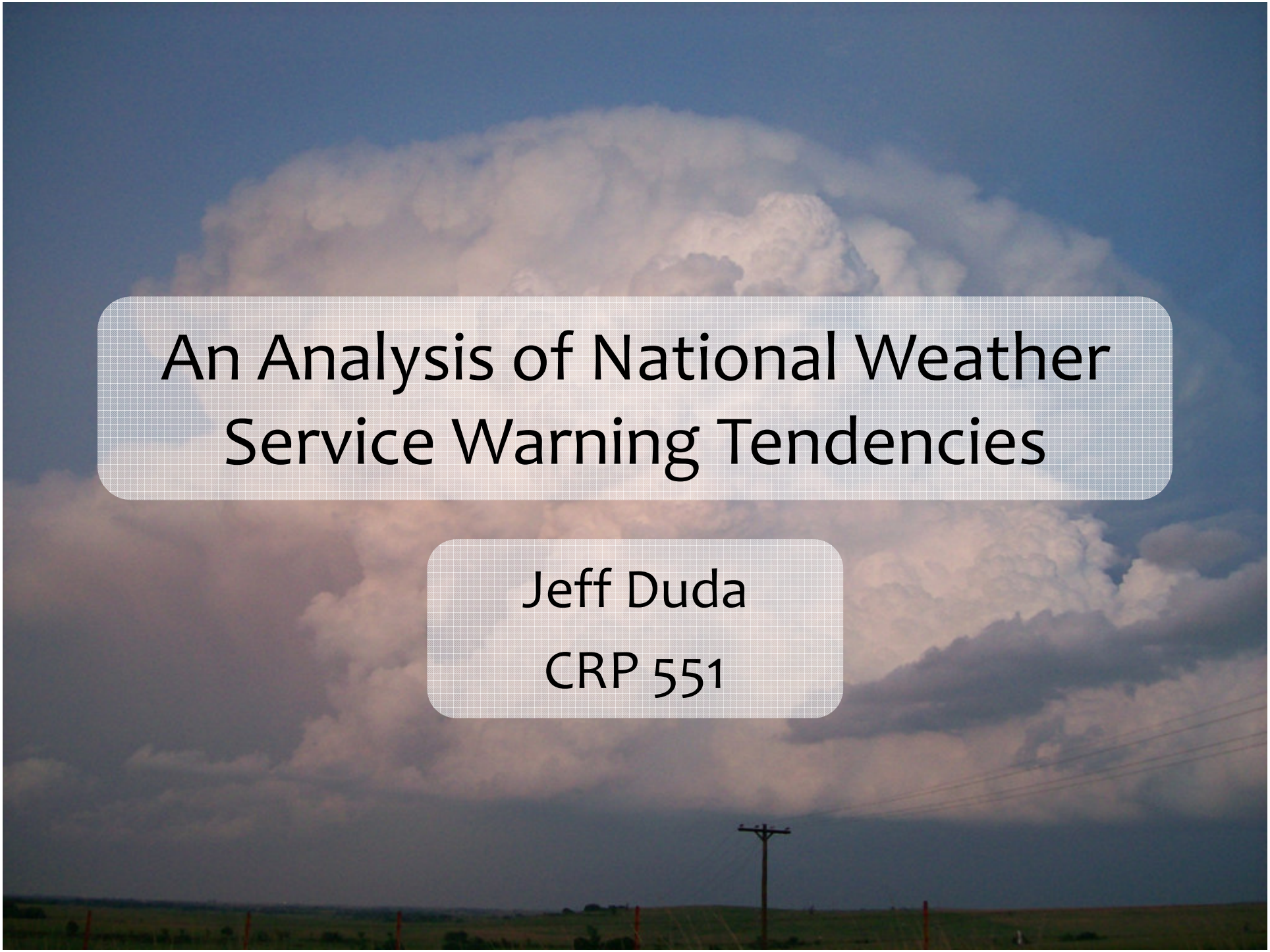


An Analysis of National Weather Service Warning Tendencies

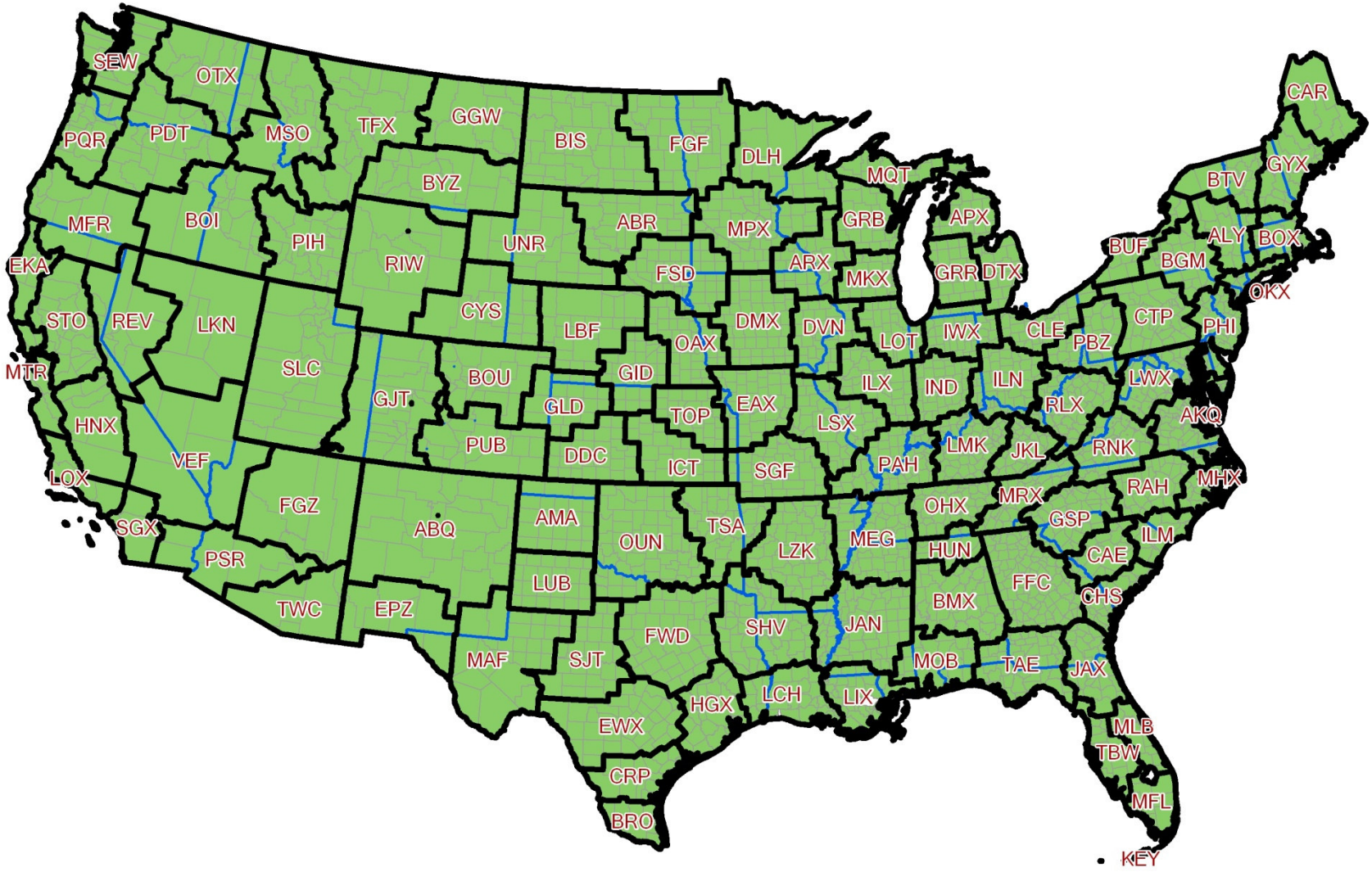
Jeff Duda

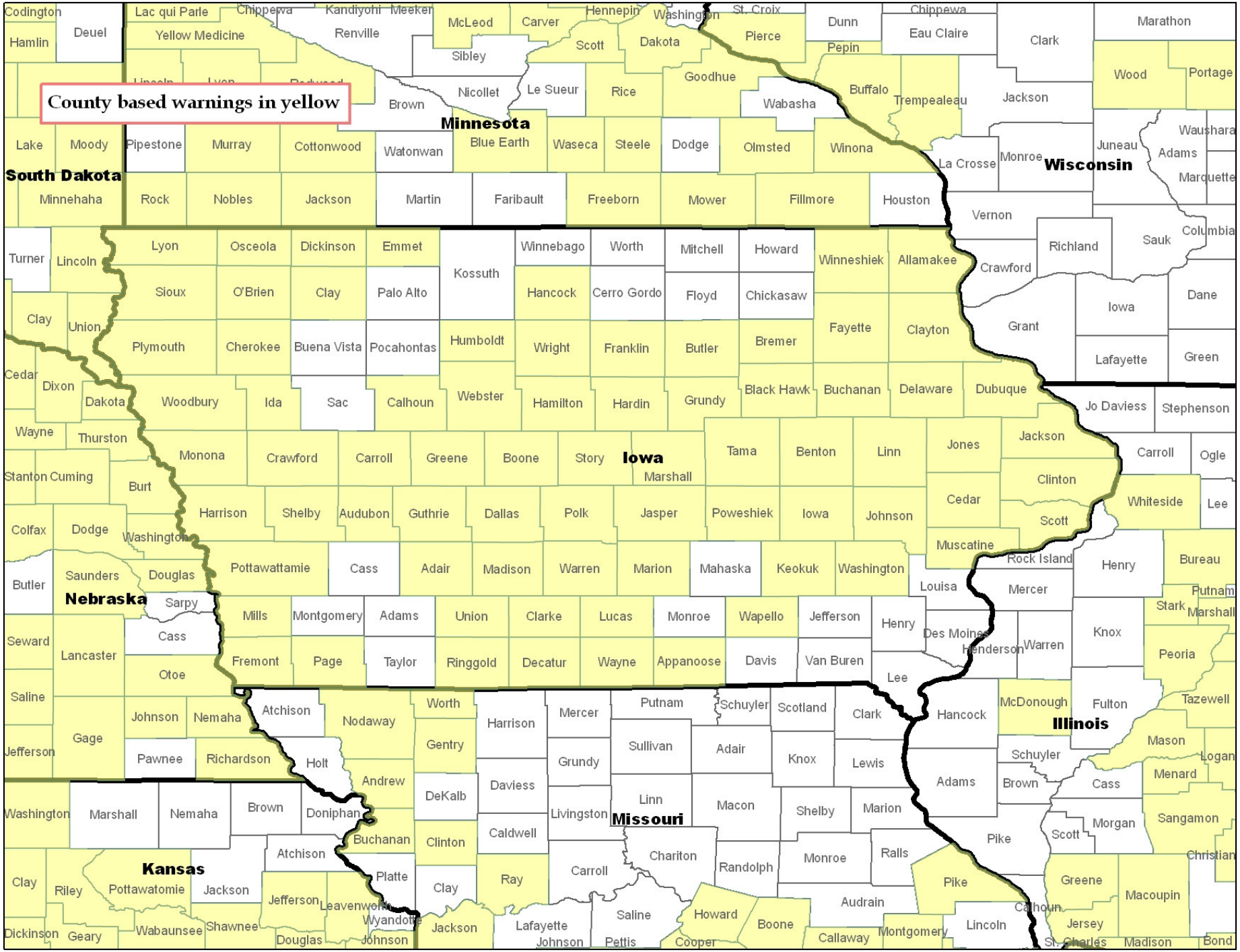
CRP 551

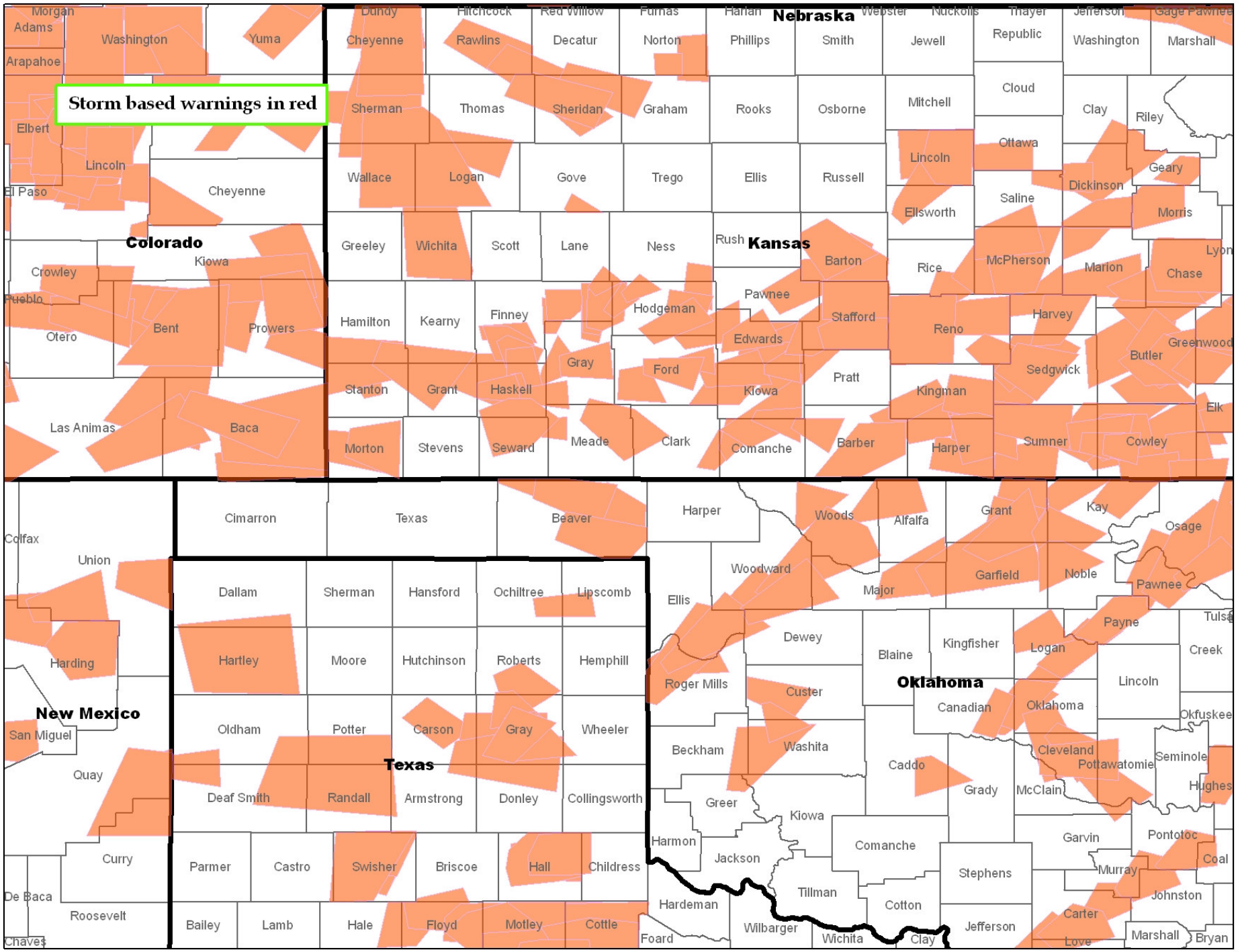
Background

- National Weather Service
  - Responsible for issuing severe weather warnings
    - Tornado
    - Severe Thunderstorm
  - Issues warnings by county or by “polygon”
    - Storm based warnings
  - 116 weather forecast offices (WFO) in the lower 48
  - Each WFO oversees a county warning area (CWA)
    - Responsible for issuing warnings for counties within CWA

National Weather Service County Warning areas and Weather Forecast Offices




County based warnings in yellow
Minnesota
South Dakota
Wisconsin
Iowa
Nebraska
Kansas
Missouri
Illinois
Codington
Deuel
Hamlin
Lac qui Parle
Yellow Medicine
Chippewa
Kandiyohi
Meeker
Renville
McLeod
Carver
Hennepin
Washington
St. Croix
Sibley
Scott
Dakota
Pierce
Dunn
Chippewa
Eau Claire
Clark
Marathon
Pepin
Wood
Portage
Nicollet
Le Sueur
Rice
Goodhue
Wabasha
Buffalo
Trempealeau
Jackson
Brown
Lake
Moody
Pipestone
Murray
Cottonwood
Watonwan
Blue Earth
Waseca
Steele
Dodge
Olmsted
Winona
La Crosse
Monroe
Juneau
Waushara
Adams
Marquette
Minnehaha
Rock
Nobles
Jackson
Martin
Faribault
Freeborn
Mower
Fillmore
Houston
Vernon
Richland
Sauk
Columbia
Crawford
Turner
Lincoln
Lyon
Osceola
Dickinson
Emmet
Kossuth
Winnebago
Worth
Mitchell
Howard
Winneshiek
Allamakee
Sioux
O'Brien
Clay
Palo Alto
Hancock
Cerro Gordo
Floyd
Chickasaw
Fayette
Clayton
Iowa
Dane
Clay
Union
Plymouth
Cherokee
Buena Vista
Pocahontas
Humboldt
Wright
Franklin
Butler
Bremer
Grant
Lafayette
Green
Cedar
Dixon
Dakota
Woodbury
Ida
Sac
Calhoun
Webster
Hamilton
Hardin
Grundy
Black Hawk
Buchanan
Delaware
Dubuque
Jo Daviess
Stephenson
Wayne
Thurston
Monona
Crawford
Carroll
Greene
Boone
Story
Marshall
Tama
Benton
Linn
Jones
Jackson
Carroll
Ogle
Stanton
Cuming
Burt
Clinton
Harrison
Shelby
Audubon
Guthrie
Dallas
Polk
Jasper
Poweshiek
Iowa
Johnson
Cedar
Whiteside
Lee
Colfax
Dodge
Washington
Scott
Muscatine
Rock Island
Henry
Bureau
Butler
Saunders
Douglas
Pottawattamie
Cass
Adair
Madison
Warren
Marion
Mahaska
Keokuk
Washington
Louisa
Mercer
Putnam
Stark
Marshall
Sarpy
Mills
Montgomery
Adams
Union
Clarke
Lucas
Monroe
Wapello
Jefferson
Henry
Knox
Seward
Lancaster
Cass
Fremont
Page
Taylor
Ringgold
Decatur
Wayne
Appanoose
Davis
Van Buren
Lee
Des Moines
Henderson
Warren
Peoria
Otoe
Saline
Johnson
Nemaha
Gage
Atchison
Nodaway
Worth
Harrison
Mercer
Putnam
Schuyler
Scotland
Clark
Hancock
McDonough
Fulton
Tazewell
Jefferson
Pawnee
Richardson
Holt
Gentry
Grundy
Sullivan
Adair
Knox
Lewis
Adams
Schuyler
Brown
Cass
Mason
Logan
Menard
Andrew
DeKalb
Daviess
Linn
Macon
Shelby
Marion
Washington
Marshall
Nemaha
Brown
Doniphan
Livingston
Missouri
Caldwell
Pike
Scott
Morgan
Sangamon
Buchanan
Clinton
Atchison
Chariton
Monroe
Ralls
Christian
Clay
Riley
Pottawatomie
Jackson
Platte
Clay
Ray
Carroll
Randolph
Pike
Greene
Macoupin
Kansas
Jefferson
Leavenworth
Wyandotte
Audrain
Calhoun
Jersey
Dickinson
Geary
Wabaunsee
Shawnee
Douglas
Johnson
Jackson
Lafayette
Saline
Howard
Boone
Lincoln
Montgomery
Madison
Bond
Johnson
Pettis
Cooper
Callaway
St. Charles

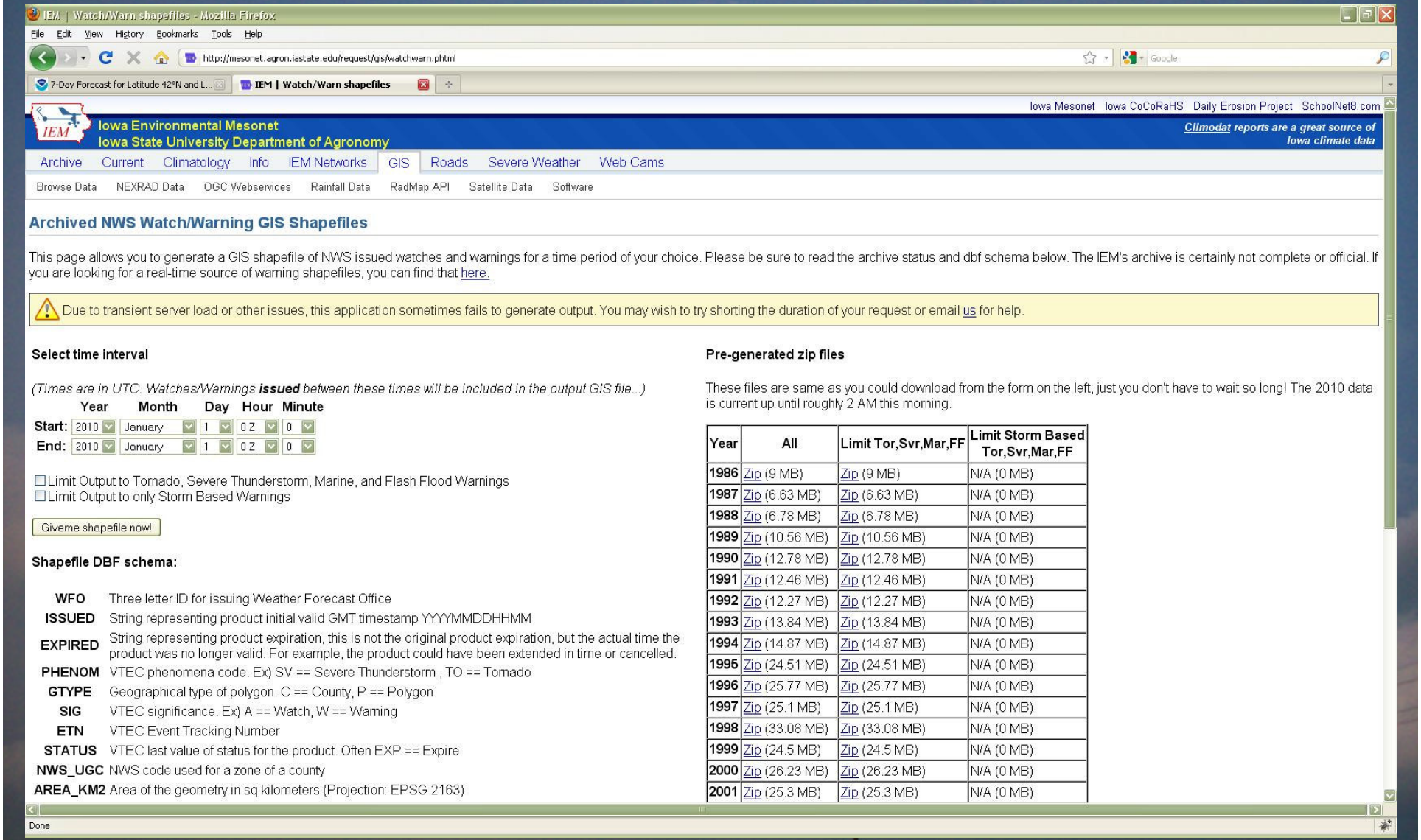

Storm based warnings in red
Nebraska
Colorado
Kansas
Oklahoma
New Mexico
Texas
Morgan
Adams
Washington
Yuma
Arapahoe
Elbert
Lincoln
El Paso
Cheyenne
Kiowa
Crowley
Pueblo
Otero
Bent
Prowers
Las Animas
Baca
Dundy
Hitchcock
Red Willow
Furnas
Harlan
Webster
Nuckolls
Thayer
Jefferson
Gage
Pawnee
Republic
Washington
Marshall
Cheyenne
Rawlins
Decatur
Norton
Phillips
Smith
Jewell
Cloud
Clay
Riley
Sherman
Thomas
Sheridan
Graham
Rooks
Osborne
Mitchell
Ottawa
Wallace
Logan
Gove
Trego
Ellis
Russell
Lincoln
Geary
Dickinson
Saline
Ellsworth
Morris
Greeley
Wichita
Scott
Lane
Ness
Rush
Barton
Rice
McPherson
Marion
Chase
Lyon
Hamilton
Kearny
Finney
Hodgeman
Pawnee
Edwards
Stafford
Reno
Harvey
Butler
Greenwood
Sedgwick
Stanton
Grant
Haskell
Gray
Ford
Kiowa
Pratt
Kingman
Elk
Morton
Stevens
Seward
Meade
Clark
Comanche
Barber
Harper
Sumner
Cowley
Colfax
Union
Cimarron
Texas
Beaver
Harper
Woods
Alfalfa
Grant
Kay
Osage
Woodward
Garfield
Noble
Pawnee
Major
Ellis
Payne
Tulsa
Creek
Dewey
Blaine
Kingfisher
Logan
Lincoln
Roger Mills
Custer
Canadian
Oklahoma
Okfuskee
Harding
Dallam
Sherman
Hansford
Ochiltree
Lipscomb
Hartley
Moore
Hutchinson
Roberts
Hemphill
Beckham
Washita
Caddo
Cleveland
Pottawatomie
Seminole
Hughes
Oldham
Potter
Carson
Gray
Wheeler
Grady
McClain
Greer
Kiowa
Harmon
Jackson
Comanche
Garvin
Pontotoc
Coal
Deaf Smith
Randall
Armstrong
Donley
Collingsworth
Tillman
Cotton
Stephens
Murray
Johnston
Quay
San Miguel
Curry
Roosevelt
De Baca
Chaves
Parmer
Castro
Swisher
Briscoe
Hall
Childress
Hardeman
Wilbarger
Wichita
Clay
Jefferson
Carter
Love
Marshall
Bryan
Foard
Bailey
Lamb
Hale
Floyd
Motley
Cottle

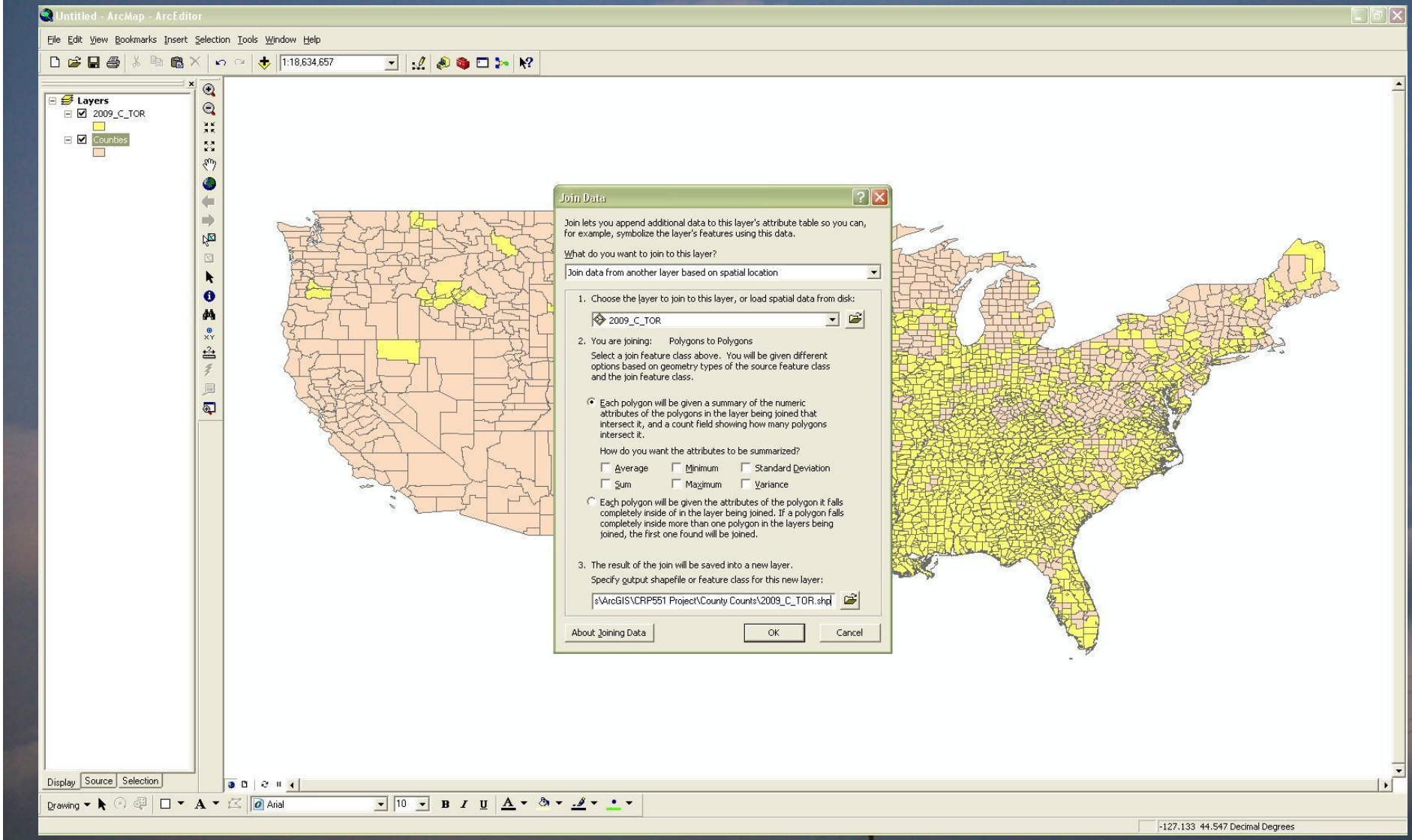
Objective

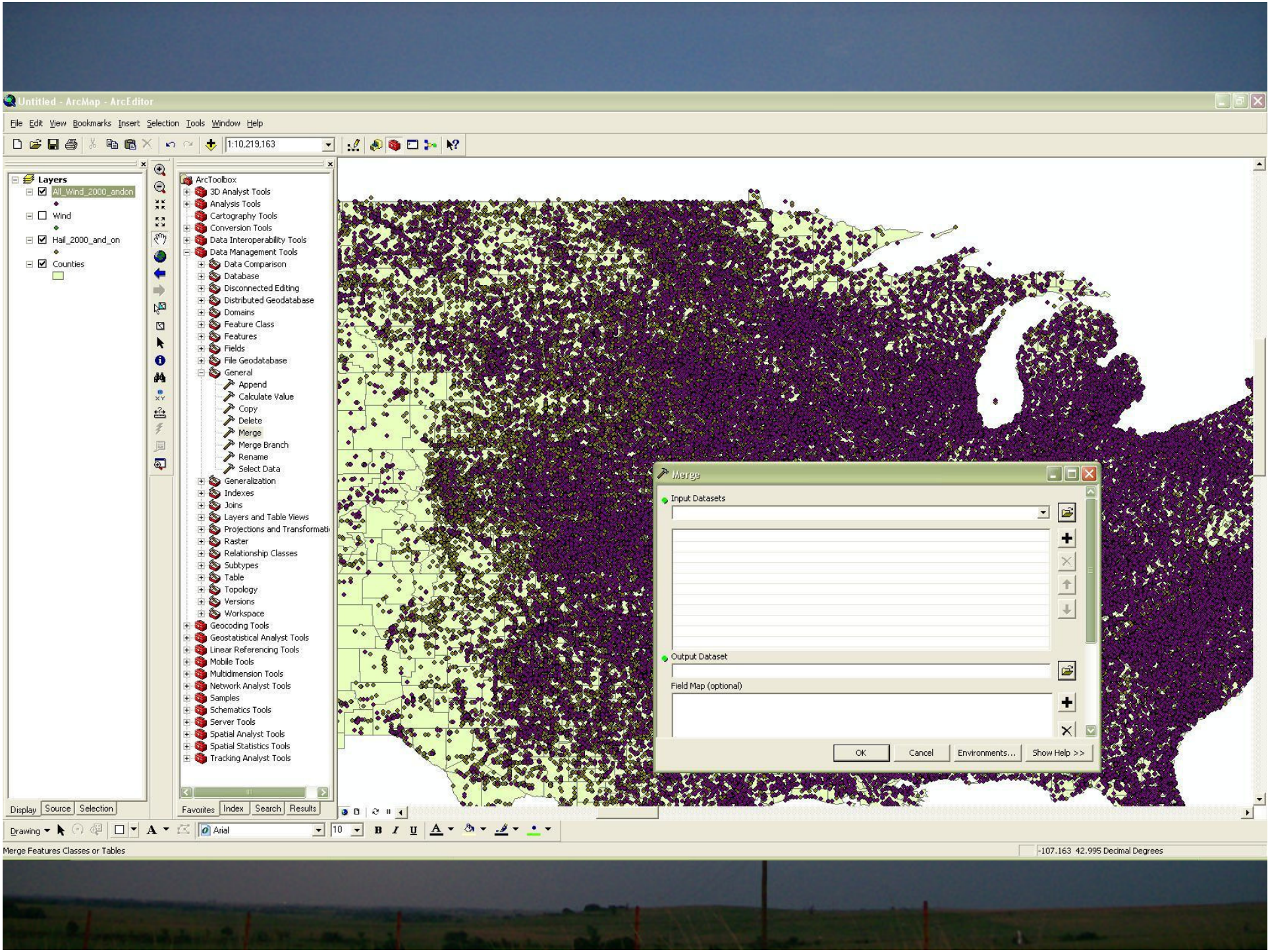
- Analyze warning issuing tendencies of WFOs
  - Size of warning polygons
  - Number of warnings
- Analyze severe weather climatology by county
  - Warning frequency
- Focused on 2000 – 2009 or a subset
  - 2002 – 2009
  - 1 Oct 2007 – end of 2009

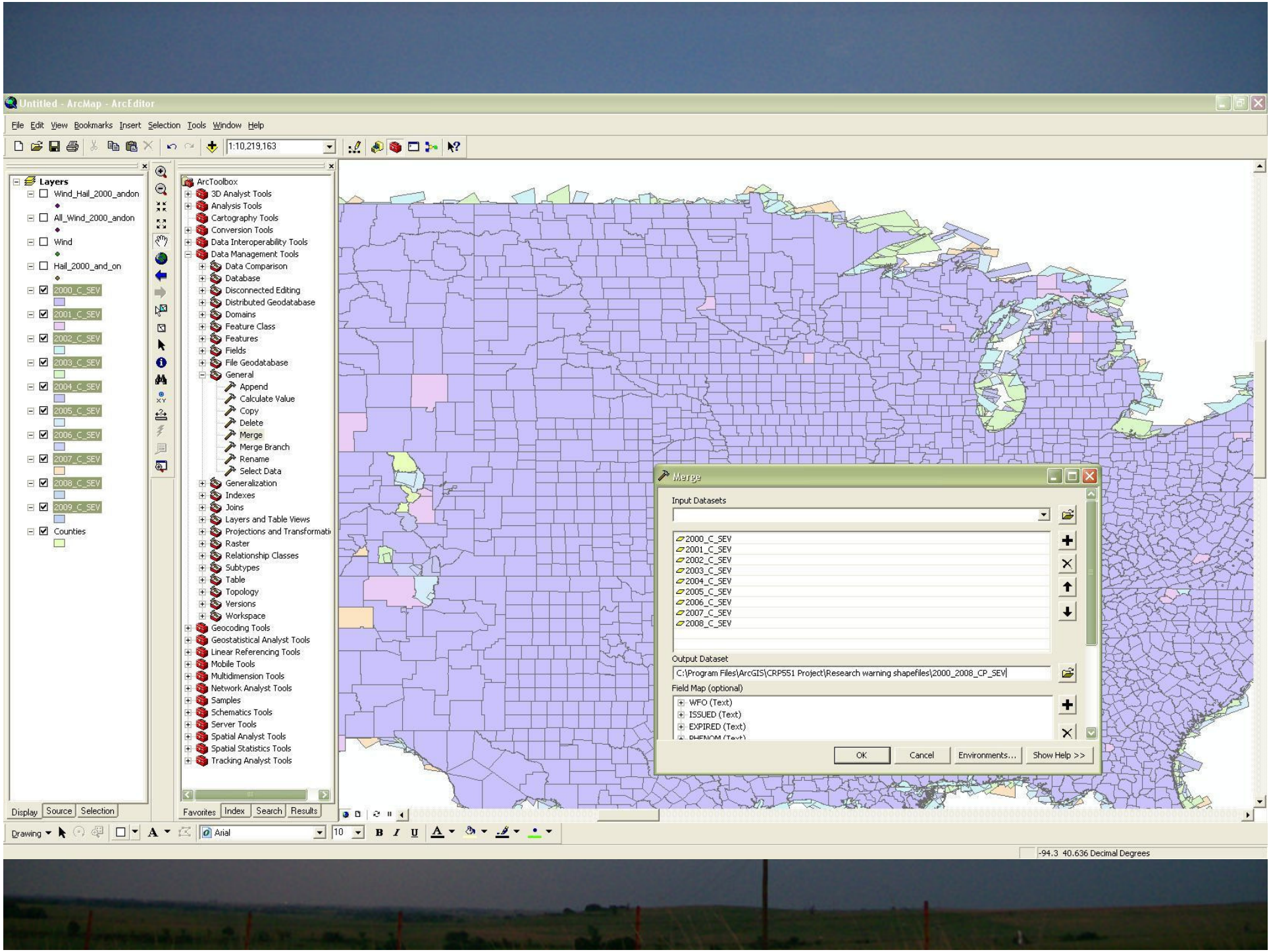
GIS

- Geoprocessing tools used
  - Select by attributes ➞ export as shapefile
  - Spatial join
  - Merging
  - Buffering
  - Editing of polygon shapefiles
  - Computation of area

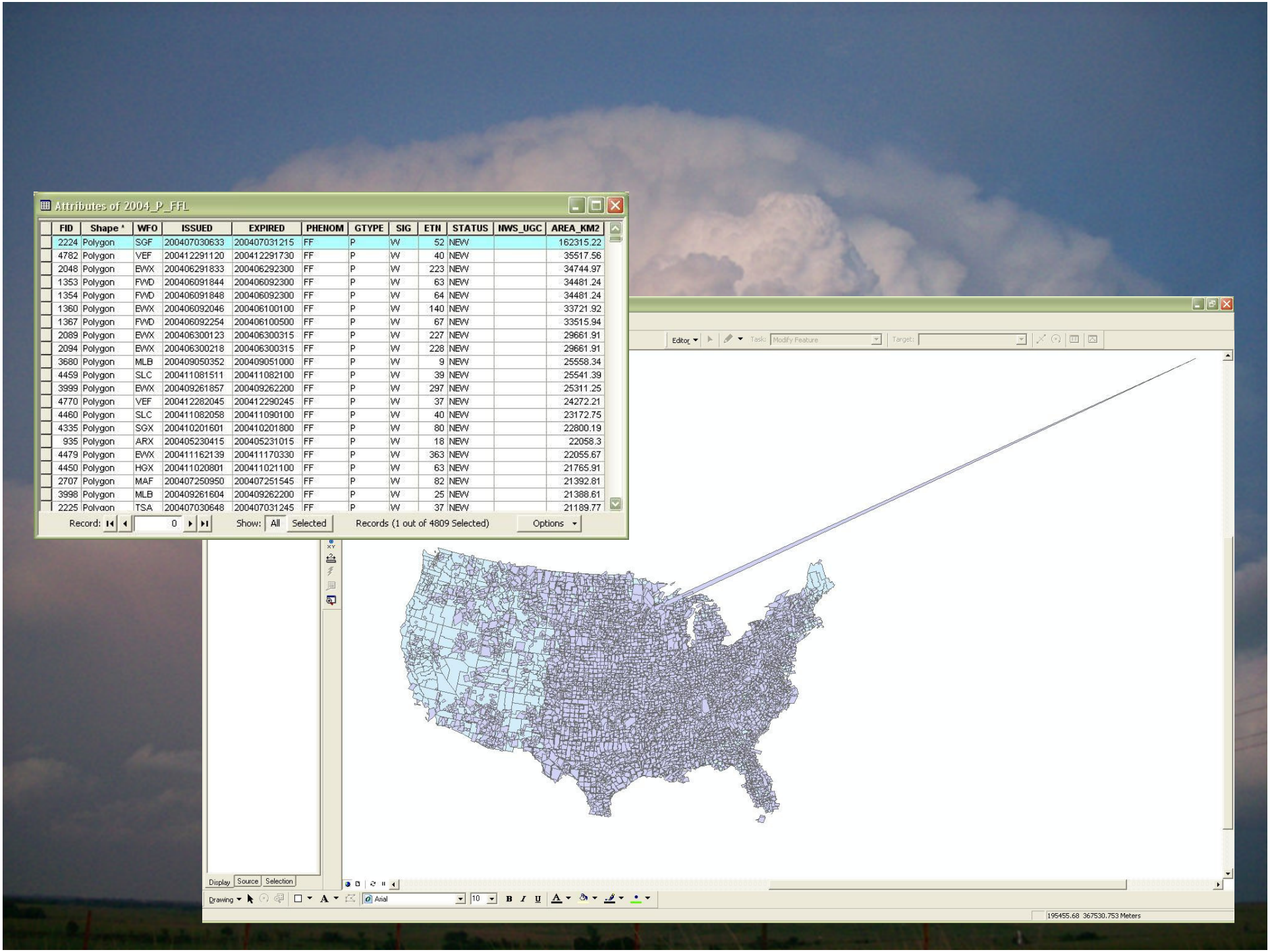

IEM | Watch/Warn shapefiles - Mozilla Firefox
File Edit View History Bookmarks Tools Help
http://mesonet.agron.iastate.edu/request/gis/watchwarn.phtml
7-Day Forecast for Latitude 42°N and L...
IEM | Watch/Warn shapefiles
Iowa Mesonet Iowa CoCoRaHS Daily Erosion Project SchoolNet8.com
Iowa Environmental Mesonet
Iowa State University Department of Agronomy
Climodat reports are a great source of Iowa climate data
Archive Current Climatology Info IEM Networks GIS Roads Severe Weather Web Cams
Browse Data NEXRAD Data OGC Webservices Rainfall Data RadMap API Satellite Data Software
Archived NWS Watch/Warning GIS Shapefiles
This page allows you to generate a GIS shapefile of NWS issued watches and warnings for a time period of your choice. Please be sure to read the archive status and dbf schema below. The IEM's archive is certainly not complete or official. If you are looking for a real-time source of warning shapefiles, you can find that here.
Due to transient server load or other issues, this application sometimes fails to generate output. You may wish to try shorting the duration of your request or email us for help.
Select time interval
(Times are in UTC. Watches/Warnings issued between these times will be included in the output GIS file...)
Year Month Day Hour Minute
Start: 2010 January 1 0 Z 0
End: 2010 January 1 0 Z 0
Limit Output to Tornado, Severe Thunderstorm, Marine, and Flash Flood Warnings
Limit Output to only Storm Based Warnings
Giveme shapefile now!
Shapefile DBF schema:
WFO Three letter ID for issuing Weather Forecast Office
ISSUED String representing product initial valid GMT timestamp YYYYMMDDHHMM
EXPIRED String representing product expiration, this is not the original product expiration, but the actual time the product was no longer valid. For example, the product could have been extended in time or cancelled.
PHENOM VTEC phenomena code. Ex) SV == Severe Thunderstorm , TO == Tornado
GTYPE Geographical type of polygon. C == County, P == Polygon
SIG VTEC significance. Ex) A == Watch, W == Warning
ETN VTEC Event Tracking Number
STATUS VTEC last value of status for the product. Often EXP == Expire
NWS_UGC NWS code used for a zone of a county
AREA_KM2 Area of the geometry in sq kilometers (Projection: EPSG 2163)
Pre-generated zip files
These files are same as you could download from the form on the left, just you don't have to wait so long! The 2010 data is current up until roughly 2 AM this morning.
Year | All | Limit Tor,Svr,Mar,FF | Limit Storm Based Tor,Svr,Mar,FF
1986 Zip (9 MB) Zip (9 MB) N/A (0 MB)
1987 Zip (6.63 MB) Zip (6.63 MB) N/A (0 MB)
1988 Zip (6.78 MB) Zip (6.78 MB) N/A (0 MB)
1989 Zip (10.56 MB) Zip (10.56 MB) N/A (0 MB)
1990 Zip (12.78 MB) Zip (12.78 MB) N/A (0 MB)
1991 Zip (12.46 MB) Zip (12.46 MB) N/A (0 MB)
1992 Zip (12.27 MB) Zip (12.27 MB) N/A (0 MB)
1993 Zip (13.84 MB) Zip (13.84 MB) N/A (0 MB)
1994 Zip (14.87 MB) Zip (14.87 MB) N/A (0 MB)
1995 Zip (24.51 MB) Zip (24.51 MB) N/A (0 MB)
1996 Zip (25.77 MB) Zip (25.77 MB) N/A (0 MB)
1997 Zip (25.1 MB) Zip (25.1 MB) N/A (0 MB)
1998 Zip (33.08 MB) Zip (33.08 MB) N/A (0 MB)
1999 Zip (24.5 MB) Zip (24.5 MB) N/A (0 MB)
2000 Zip (26.23 MB) Zip (26.23 MB) N/A (0 MB)
2001 Zip (25.3 MB) Zip (25.3 MB) N/A (0 MB)
Done

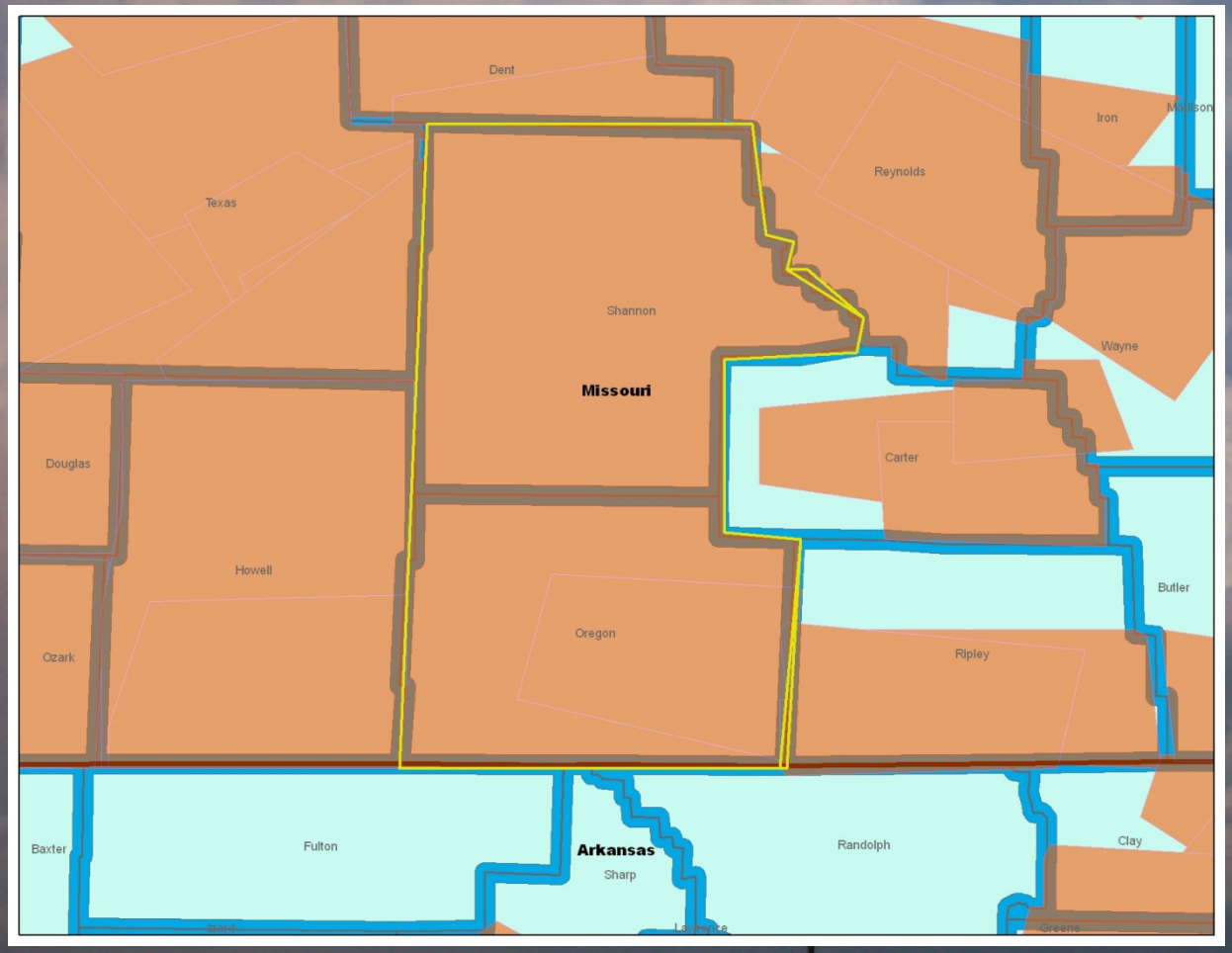

Untitled - ArcMap - ArcEditor
File Edit View Bookmarks Insert Selection Tools Window Help
1:18,634,657
Layers
2009_C_TOR
Counties
Join Data
Join lets you append additional data to this layer's attribute table so you can, for example, symbolize the layer's features using this data.
What do you want to join to this layer?
Join data from another layer based on spatial location
1. Choose the layer to join to this layer, or load spatial data from disk:
2009_C_TOR
2. You are joining: Polygons to Polygons
Select a join feature class above. You will be given different options based on geometry types of the source feature class and the join feature class.
Each polygon will be given a summary of the numeric attributes of the polygons in the layer being joined that intersect it, and a count field showing how many polygons intersect it.
How do you want the attributes to be summarized?
Average
Minimum
Standard Deviation
Sum
Maximum
Variance
Each polygon will be given the attributes of the polygon it falls completely inside of in the layer being joined. If a polygon falls completely inside more than one polygon in the layers being joined, the first one found will be joined.
3. The result of the join will be saved into a new layer.
Specify output shapefile or feature class for this new layer:
s\ArcGIS\CRP551 Project\County Counts\2009_C_TOR.shp
About Joining Data
OK
Cancel
Display
Source
Selection
Drawing
Arial
10
-127.133 44.547 Decimal Degrees

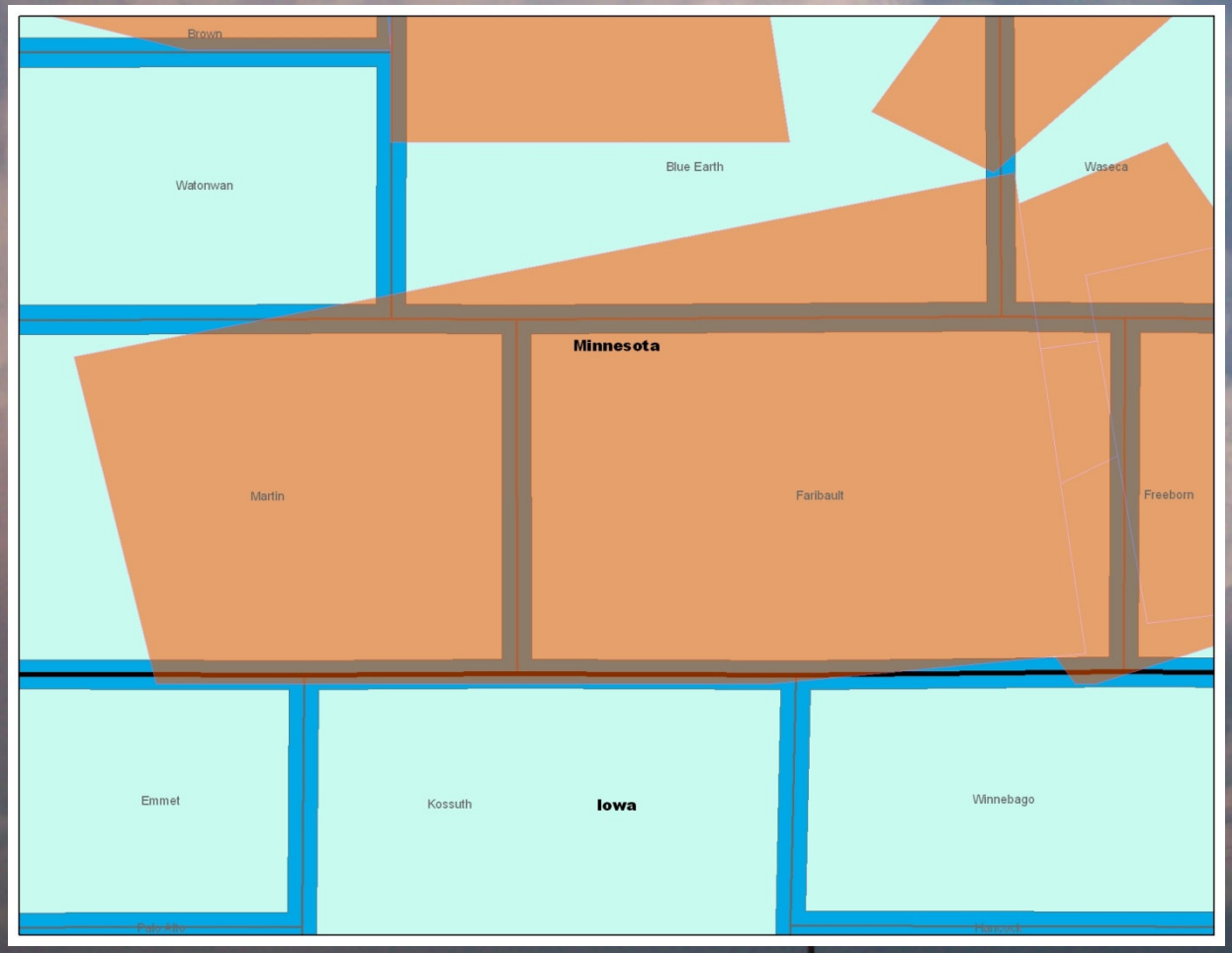

Untitled - ArcMap - ArcEditor
File Edit View Bookmarks Insert Selection Tools Window Help
1:10,219,163
Layers
All_Wind_2000_andon
Wind
Hail_2000_and_on
Counties
ArcToolbox
3D Analyst Tools
Analysis Tools
Cartography Tools
Conversion Tools
Data Interoperability Tools
Data Management Tools
Data Comparison
Database
Disconnected Editing
Distributed Geodatabase
Domains
Feature Class
Features
Fields
File Geodatabase
General
Append
Calculate Value
Copy
Delete
Merge
Merge Branch
Rename
Select Data
Generalization
Indexes
Joins
Layers and Table Views
Projections and Transformati
Raster
Relationship Classes
Subtypes
Table
Topology
Versions
Workspace
Geocoding Tools
Geostatistical Analyst Tools
Linear Referencing Tools
Mobile Tools
Multidimension Tools
Network Analyst Tools
Samples
Schematics Tools
Server Tools
Spatial Analyst Tools
Spatial Statistics Tools
Tracking Analyst Tools
Merge
Input Datasets
Output Dataset
Field Map (optional)
OK
Cancel
Environments...
Show Help >>
Display Source Selection
Favorites Index Search Results
Drawing
Arial
10
Merge Features Classes or Tables
-107.163 42.995 Decimal Degrees


Untitled - ArcMap - ArcEditor
File Edit View Bookmarks Insert Selection Tools Window Help
1:10,219,163
Layers
Wind_Hail_2000_andon
All_Wind_2000_andon
Wind
Hail_2000_and_on
2000_C_SEV
2001_C_SEV
2002_C_SEV
2003_C_SEV
2004_C_SEV
2005_C_SEV
2006_C_SEV
2007_C_SEV
2008_C_SEV
2009_C_SEV
Counties
Display Source Selection
ArcToolbox
3D Analyst Tools
Analysis Tools
Cartography Tools
Conversion Tools
Data Interoperability Tools
Data Management Tools
Data Comparison
Database
Disconnected Editing
Distributed Geodatabase
Domains
Feature Class
Features
Fields
File Geodatabase
General
Append
Calculate Value
Copy
Delete
Merge
Merge Branch
Rename
Select Data
Generalization
Indexes
Joins
Layers and Table Views
Projections and Transformati
Raster
Relationship Classes
Subtypes
Table
Topology
Versions
Workspace
Geocoding Tools
Geostatistical Analyst Tools
Linear Referencing Tools
Mobile Tools
Multidimension Tools
Network Analyst Tools
Samples
Schematics Tools
Server Tools
Spatial Analyst Tools
Spatial Statistics Tools
Tracking Analyst Tools
Favorites Index Search Results
Merge
Input Datasets
2000_C_SEV
2001_C_SEV
2002_C_SEV
2003_C_SEV
2004_C_SEV
2005_C_SEV
2006_C_SEV
2007_C_SEV
2008_C_SEV
Output Dataset
C:\Program Files\ArcGIS\CRP551 Project\Research warning shapefiles\2000_2008_CP_SEV
Field Map (optional)
WFO (Text)
ISSUED (Text)
EXPIRED (Text)
OK
Cancel
Environments...
Show Help >>
Drawing
Arial
10
-94.3 40.636 Decimal Degrees

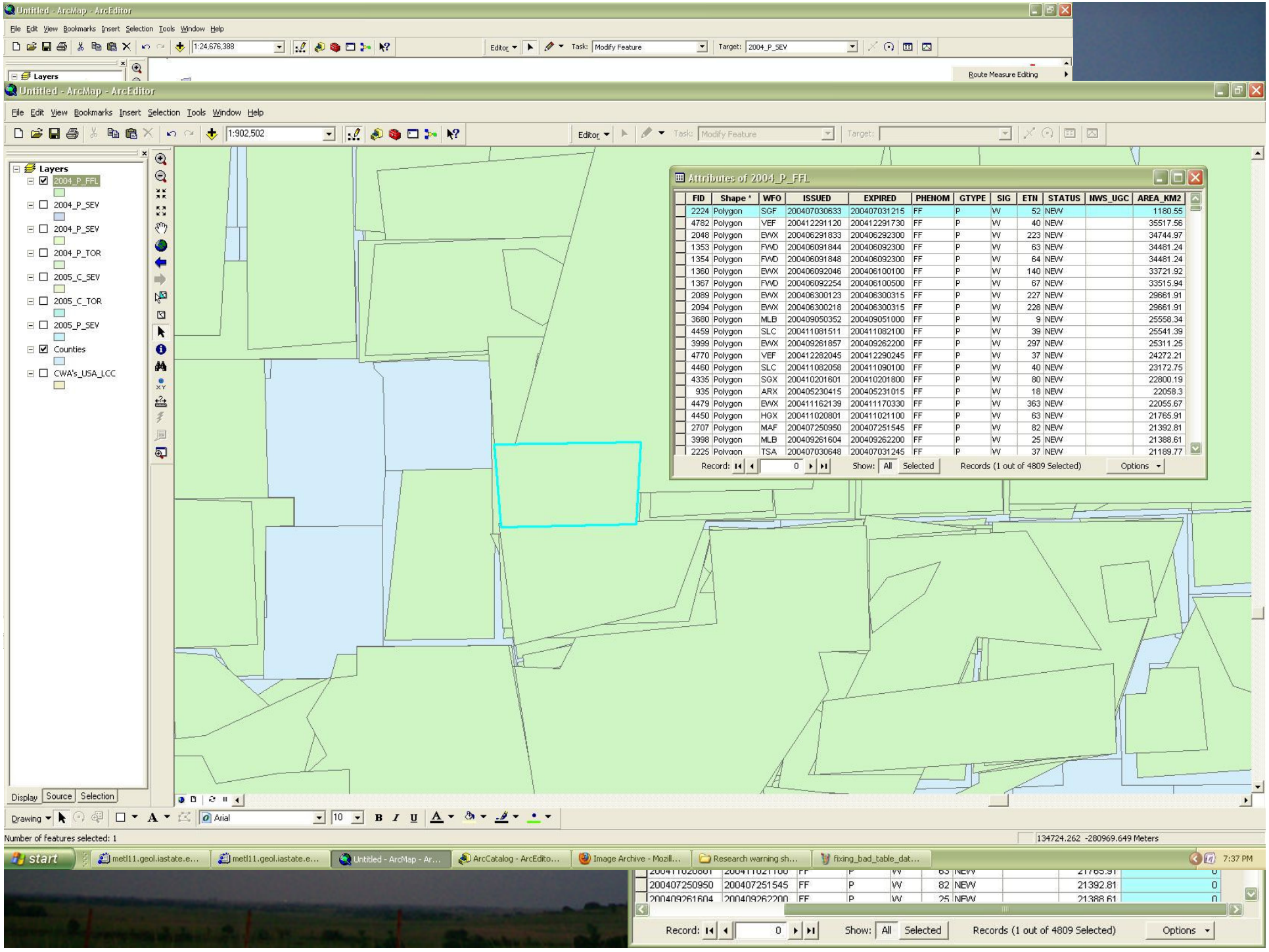
Problems/Issues

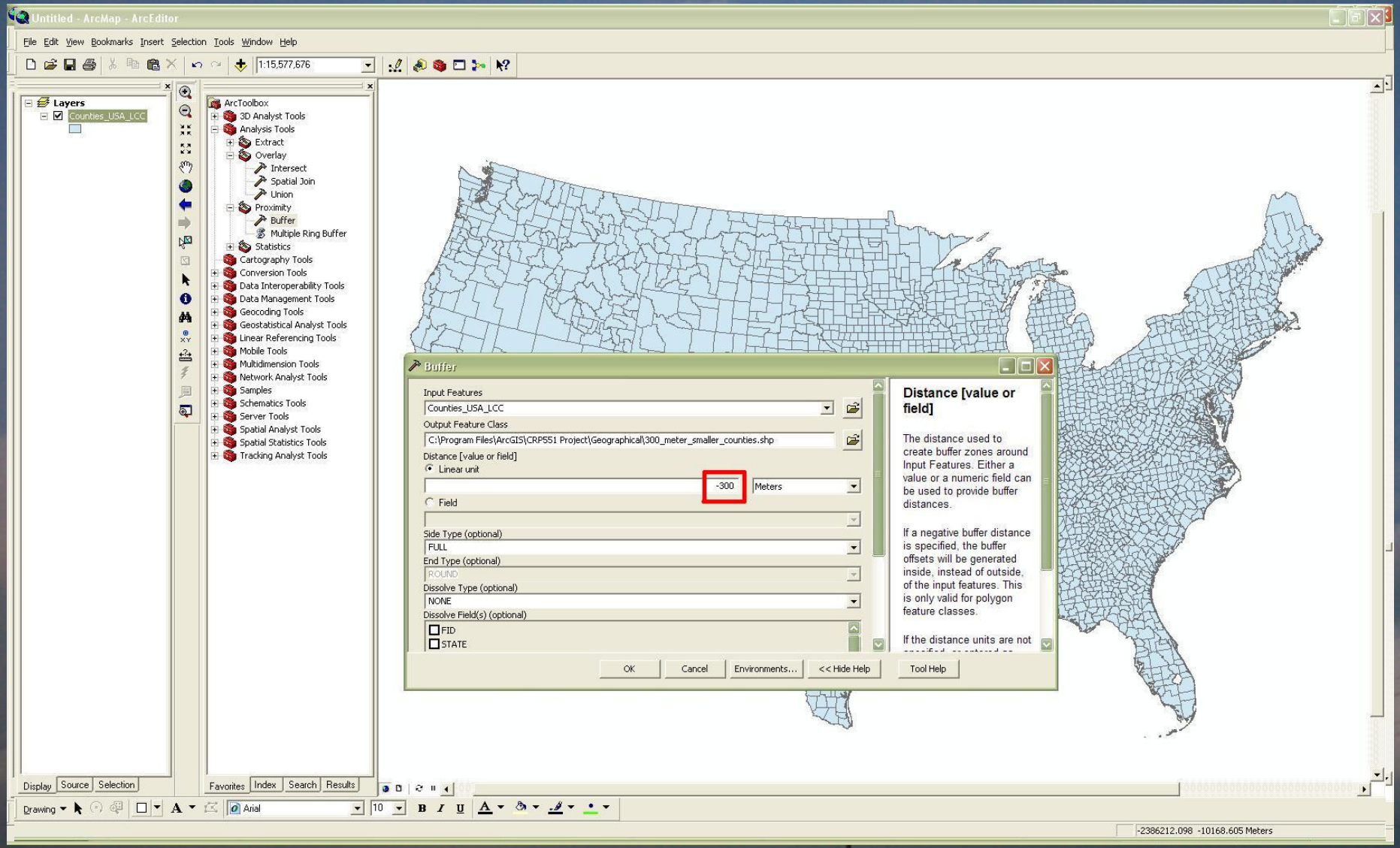

Attributes of 2004_P_FFL
FID | Shape * | WFO | ISSUED | EXPIRED | PHENOM | GTYPE | SIG | ETN | STATUS | NWS_UGC | AREA_KM2
2224 | Polygon | SGF | 200407030633 | 200407031215 | FF | P | W | 52 | NEW | | 162315.22
4782 | Polygon | VEF | 200412291120 | 200412291730 | FF | P | W | 40 | NEW | | 35517.56
2048 | Polygon | EWX | 200406291833 | 200406292300 | FF | P | W | 223 | NEW | | 34744.97
1353 | Polygon | FWD | 200406091844 | 200406092300 | FF | P | W | 63 | NEW | | 34481.24
1354 | Polygon | FWD | 200406091848 | 200406092300 | FF | P | W | 64 | NEW | | 34481.24
1360 | Polygon | EWX | 200406092046 | 200406100100 | FF | P | W | 140 | NEW | | 33721.92
1367 | Polygon | FWD | 200406092254 | 200406100500 | FF | P | W | 67 | NEW | | 33515.94
2089 | Polygon | EWX | 200406300123 | 200406300315 | FF | P | W | 227 | NEW | | 29661.91
2094 | Polygon | EWX | 200406300218 | 200406300315 | FF | P | W | 228 | NEW | | 29661.91
3680 | Polygon | MLB | 200409050352 | 200409051000 | FF | P | W | 9 | NEW | | 25558.34
4459 | Polygon | SLC | 200411081511 | 200411082100 | FF | P | W | 39 | NEW | | 25541.39
3999 | Polygon | EWX | 200409261857 | 200409262200 | FF | P | W | 297 | NEW | | 25311.25
4770 | Polygon | VEF | 200412282045 | 200412290245 | FF | P | W | 37 | NEW | | 24272.21
4460 | Polygon | SLC | 200411082058 | 200411090100 | FF | P | W | 40 | NEW | | 23172.75
4335 | Polygon | SGX | 200410201601 | 200410201800 | FF | P | W | 80 | NEW | | 22800.19
935 | Polygon | ARX | 200405230415 | 200405231015 | FF | P | W | 18 | NEW | | 22058.3
4479 | Polygon | EWX | 200411162139 | 200411170330 | FF | P | W | 363 | NEW | | 22055.67
4450 | Polygon | HGX | 200411020801 | 200411021100 | FF | P | W | 63 | NEW | | 21765.91
2707 | Polygon | MAF | 200407250950 | 200407251545 | FF | P | W | 82 | NEW | | 21392.81
3998 | Polygon | MLB | 200409261604 | 200409262200 | FF | P | W | 25 | NEW | | 21388.61
2225 | Polygon | TSA | 200407030648 | 200407031245 | FF | P | W | 37 | NEW | | 21189.77
Record: 0
Show: All Selected
Records (1 out of 4809 Selected)
Options
Editor
Task: Modify Feature
Target:
Display
Source
Selection
Drawing
Arial
10
195455.68 367530.753 Meters


Dent
Iron
Madison
Reynolds
Texas
Shannon
Wayne
Missouri
Douglas
Carter
Howell
Butler
Oregon
Ozark
Ripley
Baxter
Fulton
Arkansas
Randolph
Clay
Sharp


Brown
Watonwan
Blue Earth
Waseca
Minnesota
Martin
Faribault
Freeborn
Emmet
Kossuth
Iowa
Winnebago

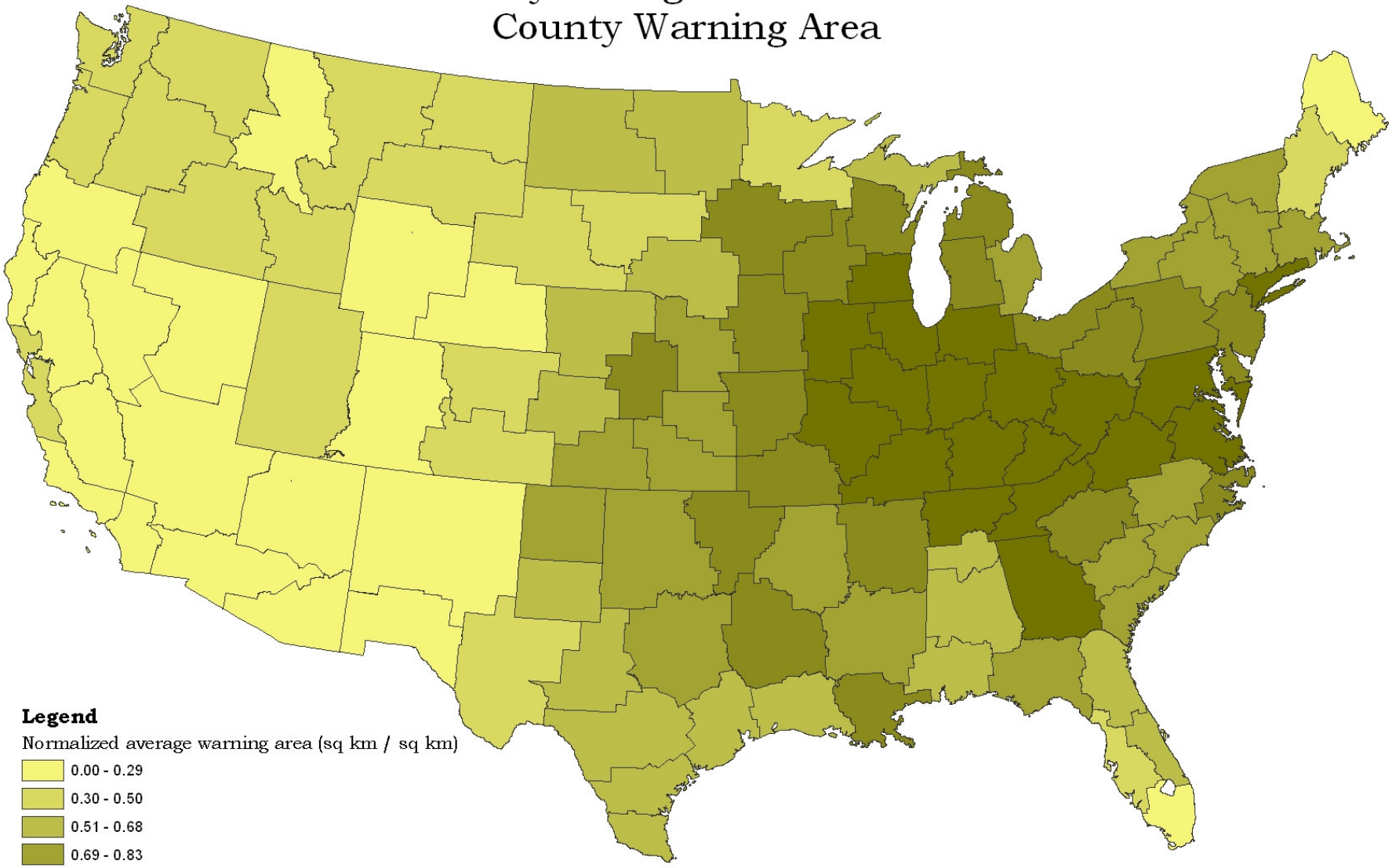
Solutions


Untitled - ArcMap - ArcEditor
File Edit View Bookmarks Insert Selection Tools Window Help
Layers
2004_P_FFL
2004_P_SEV
2004_P_SEV
2004_P_TOR
2005_C_SEV
2005_C_TOR
2005_P_SEV
Counties
CWA's_USA_LCC
Display Source Selection
Attributes of 2004_P_FFL
FID Shape * WFO ISSUED EXPIRED PHENOM GTYPE SIG ETN STATUS NWS_UGC AREA_KM2
2224 Polygon SGF 200407030633 200407031215 FF P W 52 NEW 1180.55
4782 Polygon VEF 200412291120 200412291730 FF P W 40 NEW 35517.56
2048 Polygon EWX 200406291833 200406292300 FF P W 223 NEW 34744.97
1353 Polygon FWD 200406091844 200406092300 FF P W 63 NEW 34481.24
1354 Polygon FWD 200406091848 200406092300 FF P W 64 NEW 34481.24
1360 Polygon EWX 200406092046 200406100100 FF P W 140 NEW 33721.92
1367 Polygon FWD 200406092254 200406100500 FF P W 67 NEW 33515.94
2089 Polygon EWX 200406300123 200406300315 FF P W 227 NEW 29661.91
2094 Polygon EWX 200406300218 200406300315 FF P W 228 NEW 29661.91
3680 Polygon MLB 200409050352 200409051000 FF P W 9 NEW 25558.34
4459 Polygon SLC 200411081511 200411082100 FF P W 39 NEW 25541.39
3999 Polygon EWX 200409261857 200409262200 FF P W 297 NEW 25311.25
4770 Polygon VEF 200412282045 200412290245 FF P W 37 NEW 24272.21
4460 Polygon SLC 200411082058 200411090100 FF P W 40 NEW 23172.75
4335 Polygon SGX 200410201601 200410201800 FF P W 80 NEW 22800.19
935 Polygon ARX 200405230415 200405231015 FF P W 18 NEW 22058.3
4479 Polygon EWX 200411162139 200411170330 FF P W 363 NEW 22055.67
4450 Polygon HGX 200411020801 200411021100 FF P W 63 NEW 21765.91
2707 Polygon MAF 200407250950 200407251545 FF P W 82 NEW 21392.81
3998 Polygon MLB 200409261604 200409262200 FF P W 25 NEW 21388.61
2225 Polygon TSA 200407030648 200407031245 FF P W 37 NEW 21189.77
Record: 0 Show: All Selected Records (1 out of 4809 Selected) Options
Number of features selected: 1
134724.262 -280969.649 Meters
start
7:37 PM

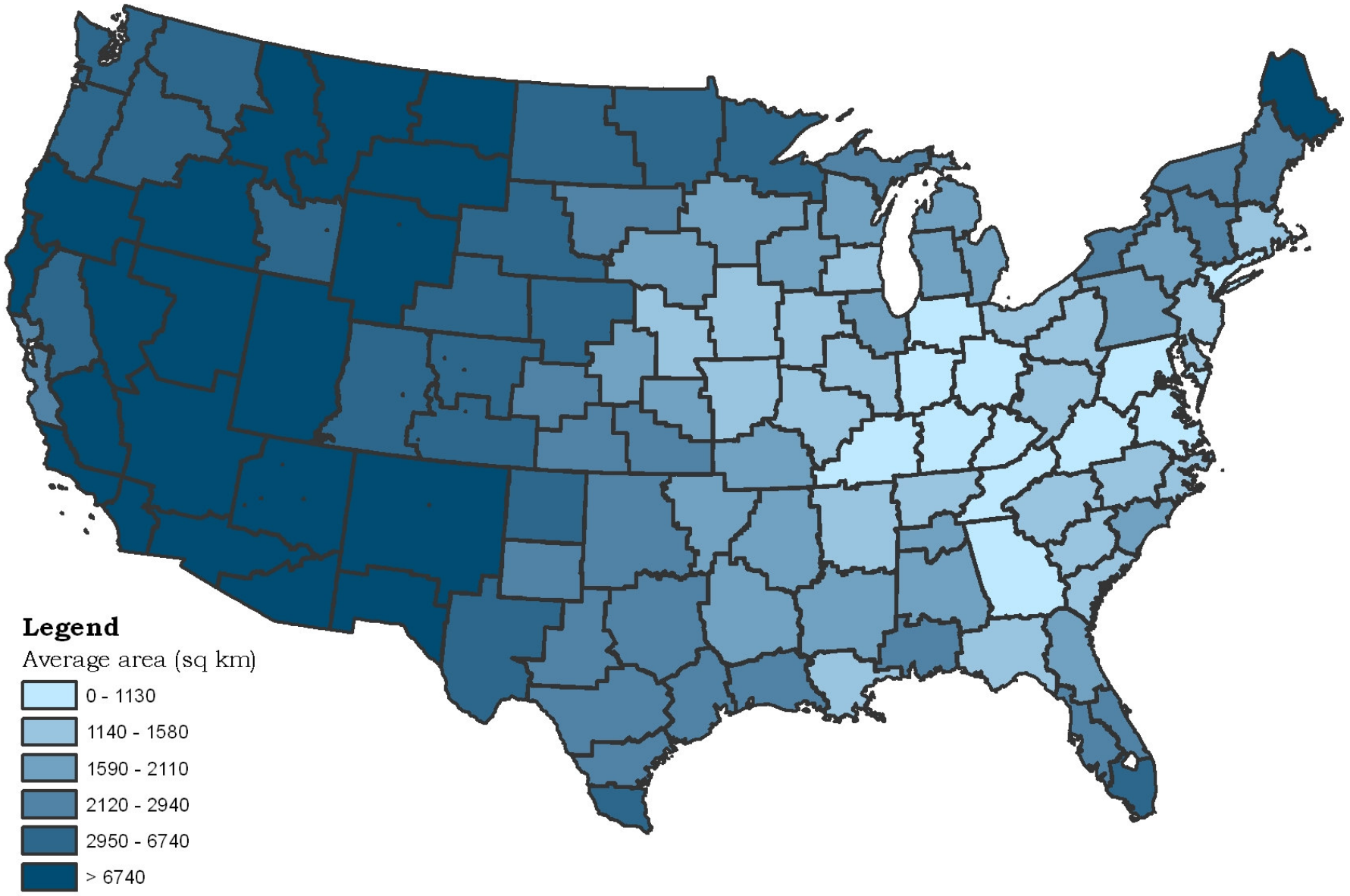

Untitled - ArcMap - ArcEditor
File Edit View Bookmarks Insert Selection Tools Window Help
1:15,577,676
Layers
Counties_USA_LCC
ArcToolbox
3D Analyst Tools
Analysis Tools
Extract
Overlay
Intersect
Spatial Join
Union
Proximity
Buffer
Multiple Ring Buffer
Statistics
Cartography Tools
Conversion Tools
Data Interoperability Tools
Data Management Tools
Geocoding Tools
Geostatistical Analyst Tools
Linear Referencing Tools
Mobile Tools
Multidimension Tools
Network Analyst Tools
Samples
Schematics Tools
Server Tools
Spatial Analyst Tools
Spatial Statistics Tools
Tracking Analyst Tools
Display Source Selection
Favorites Index Search Results
Drawing
Arial
10
Buffer
Input Features
Counties_USA_LCC
Output Feature Class
C:\Program Files\ArcGIS\CRP551 Project\Geographical\300_meter_smaller_counties.shp
Distance [value or field]
Linear unit
-300
Meters
Field
Side Type (optional)
FULL
End Type (optional)
ROUND
Dissolve Type (optional)
NONE
Dissolve Field(s) (optional)
FID
STATE
Distance [value or field]
The distance used to create buffer zones around Input Features. Either a value or a numeric field can be used to provide buffer distances.
If a negative buffer distance is specified, the buffer offsets will be generated inside, instead of outside, of the input features. This is only valid for polygon feature classes.
If the distance units are not
OK
Cancel
Environments...
<< Hide Help
Tool Help
-2386212.098 -10168.605 Meters

Results

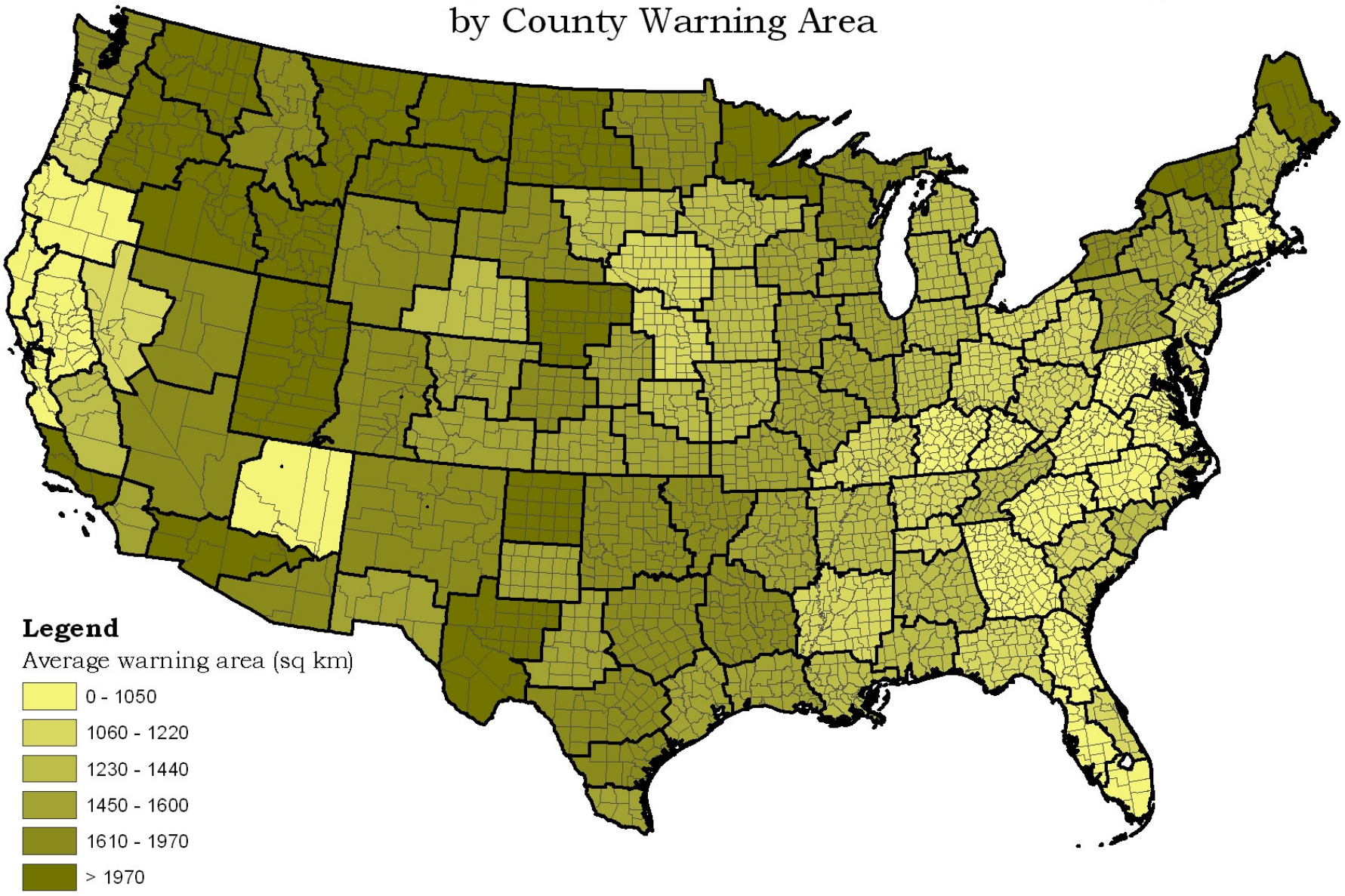
2002 - 2009 Average Severe Thunderstorm Warning Size Normalized by Average Area of the Counties in a County Warning Area



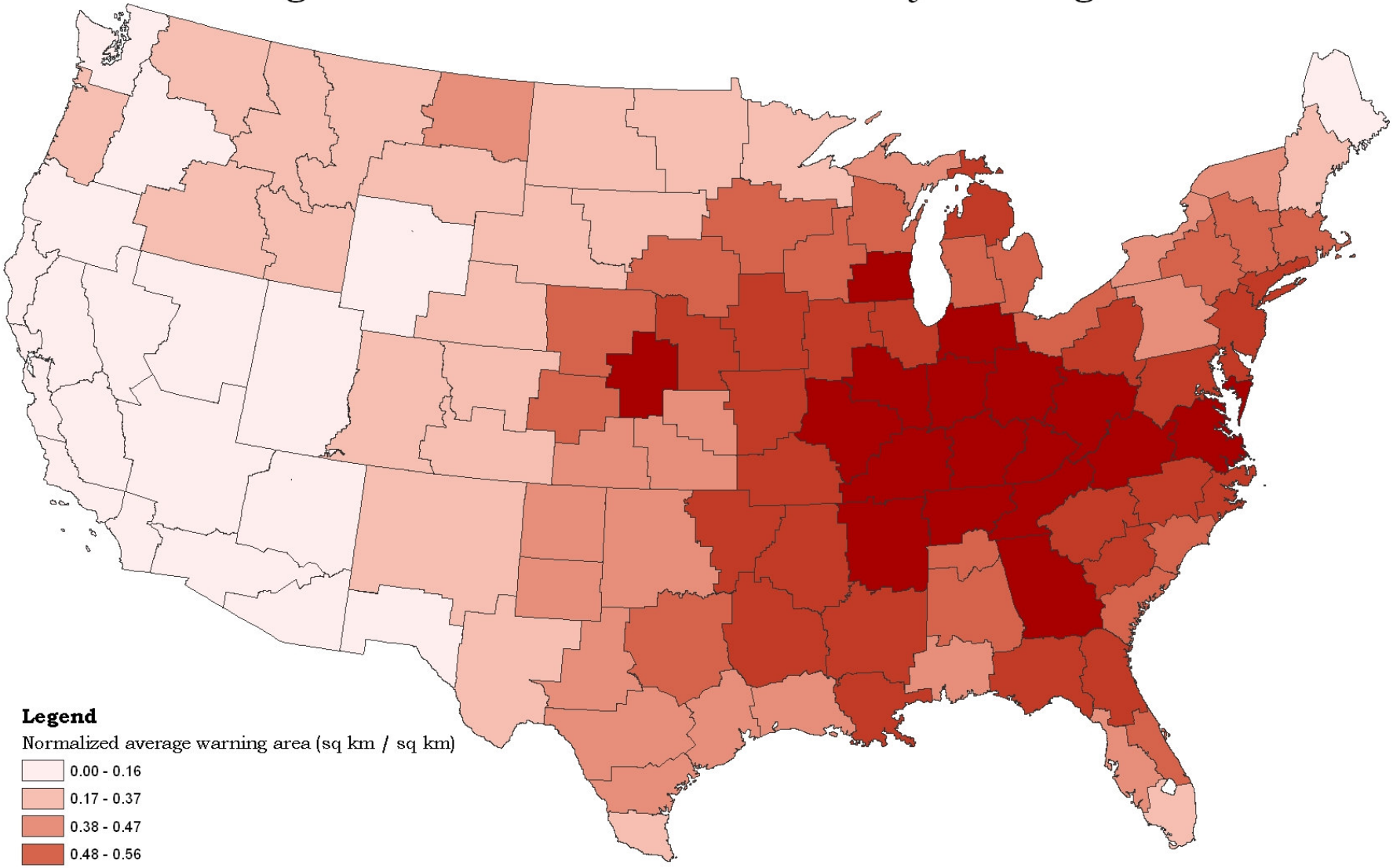
Average Area of Counties by County Warning Area



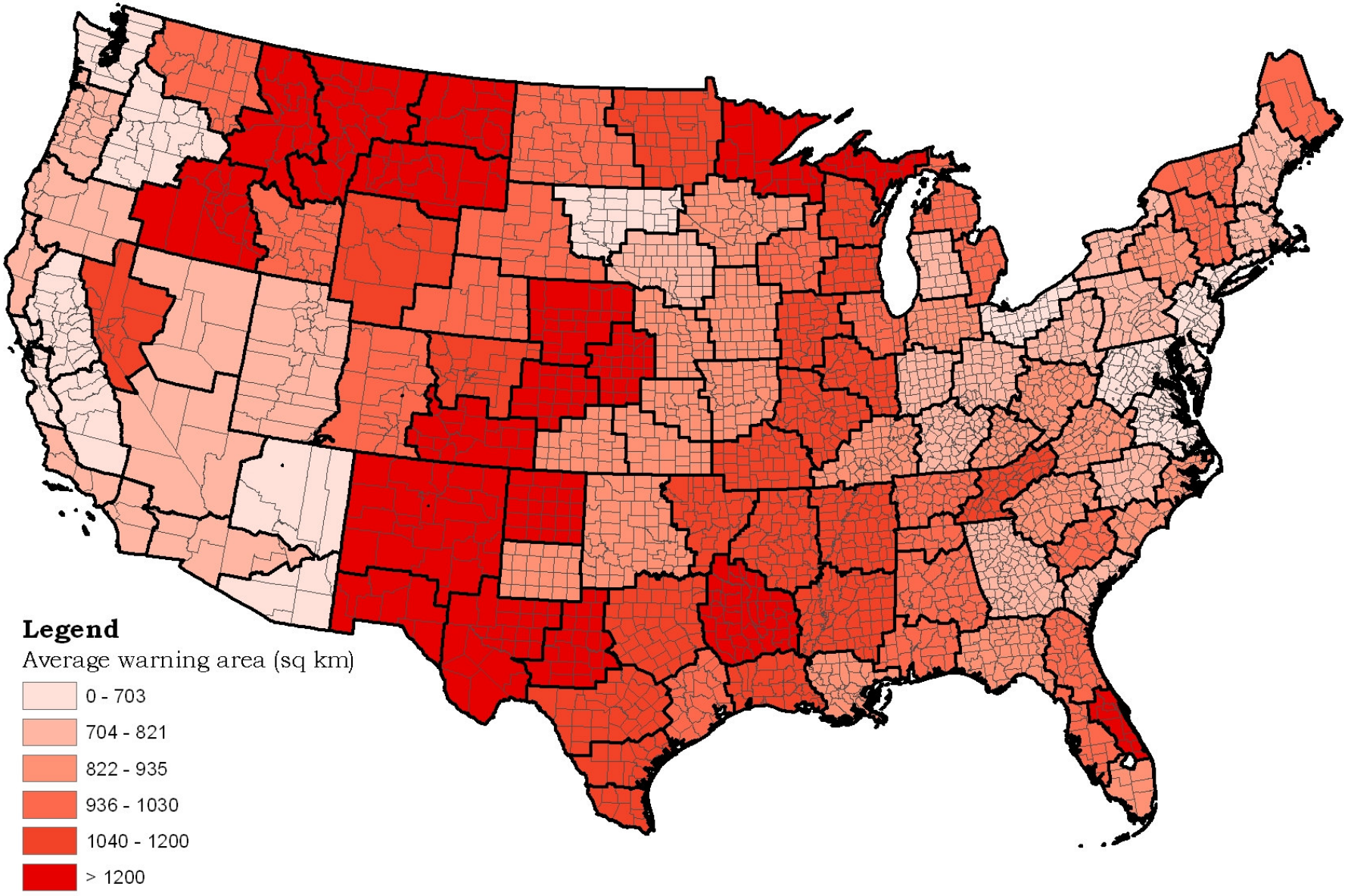
2002 - 2009 Average Area of Severe Thunderstorm Warnings by County Warning Area



2002 - 2009 Average Tornado Warning Size Normalized by Average Area of the Counties in a County Warning Area

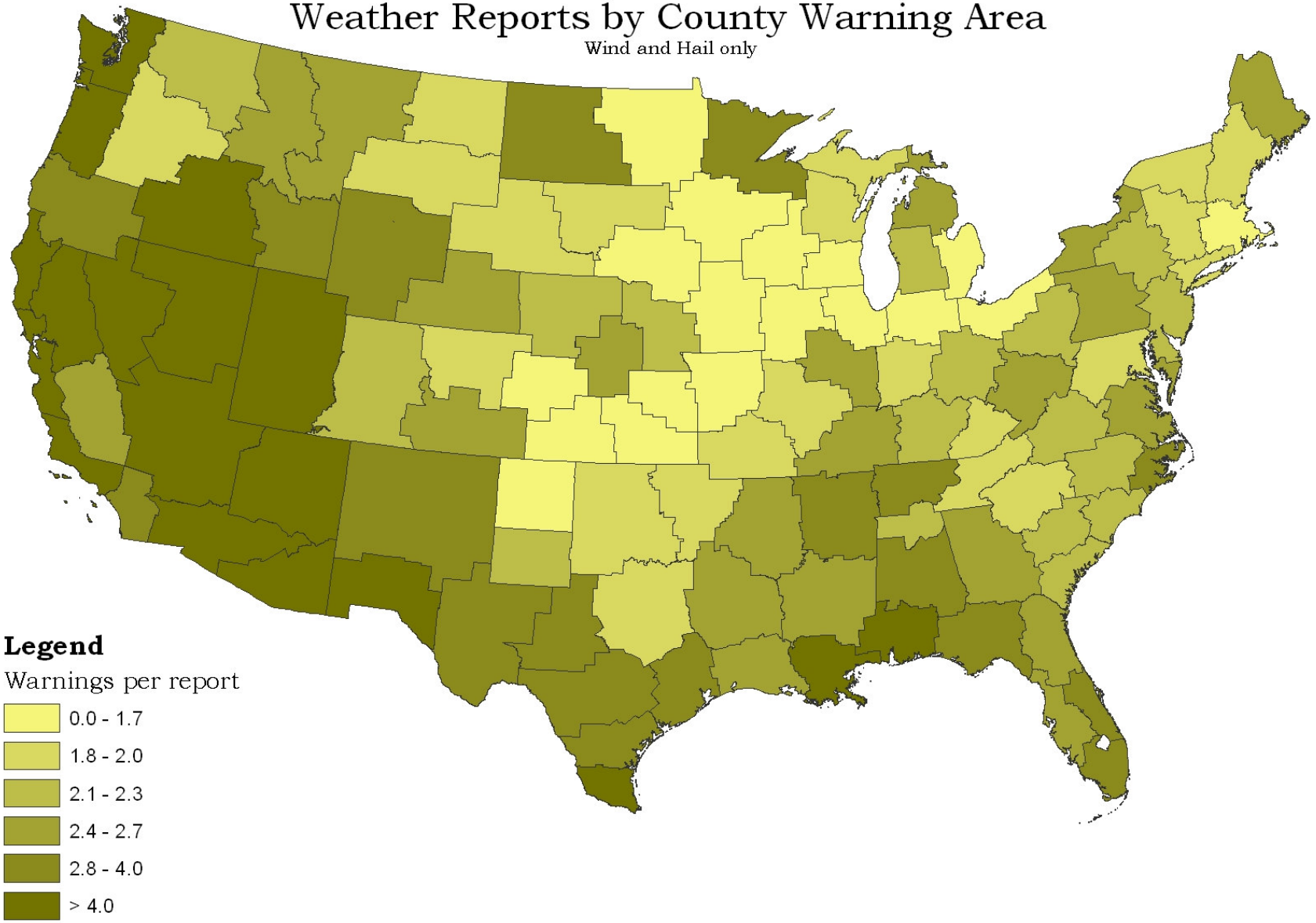


2002 - 2009 Average Area of Tornado Warnings by County Warning Area

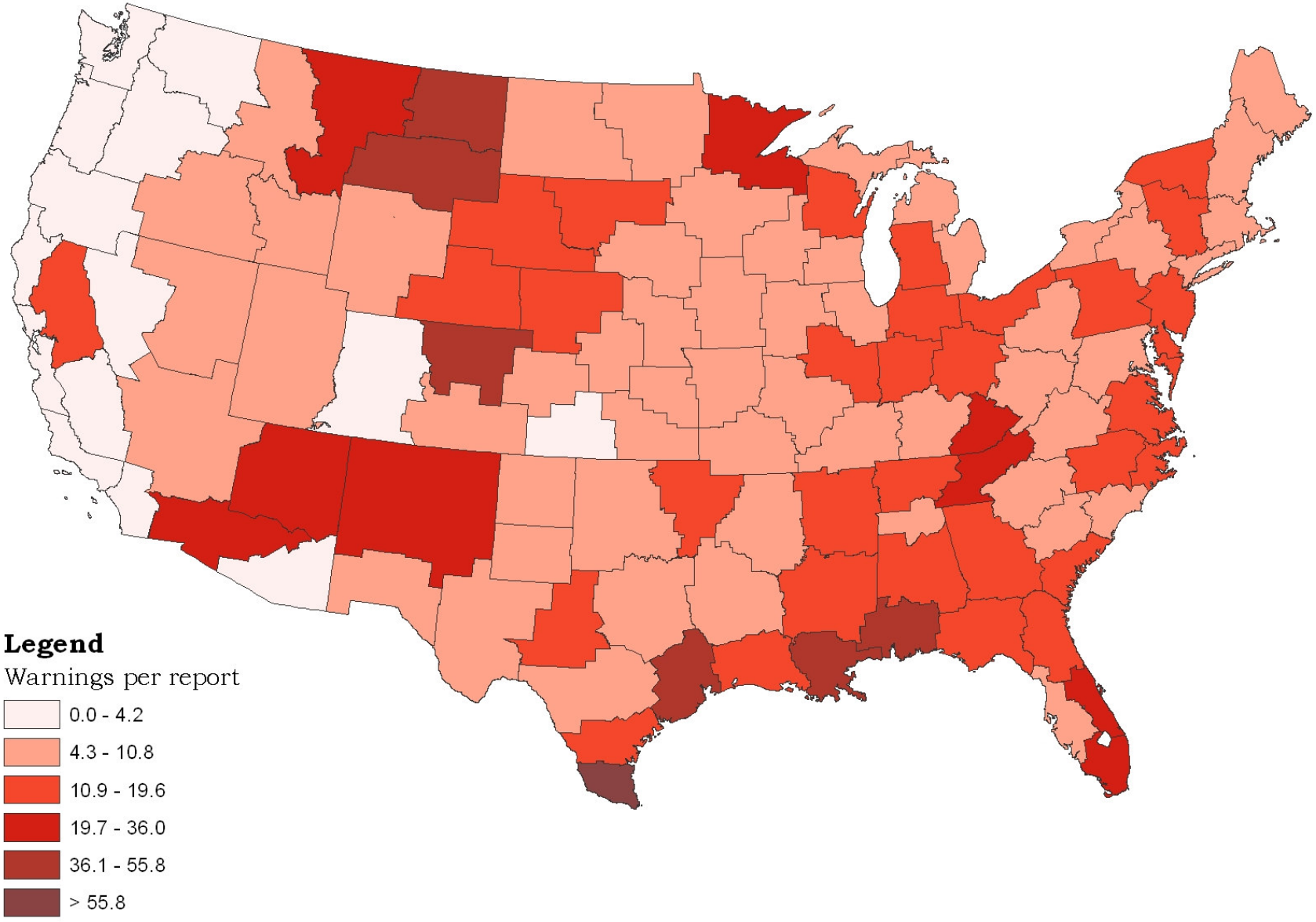


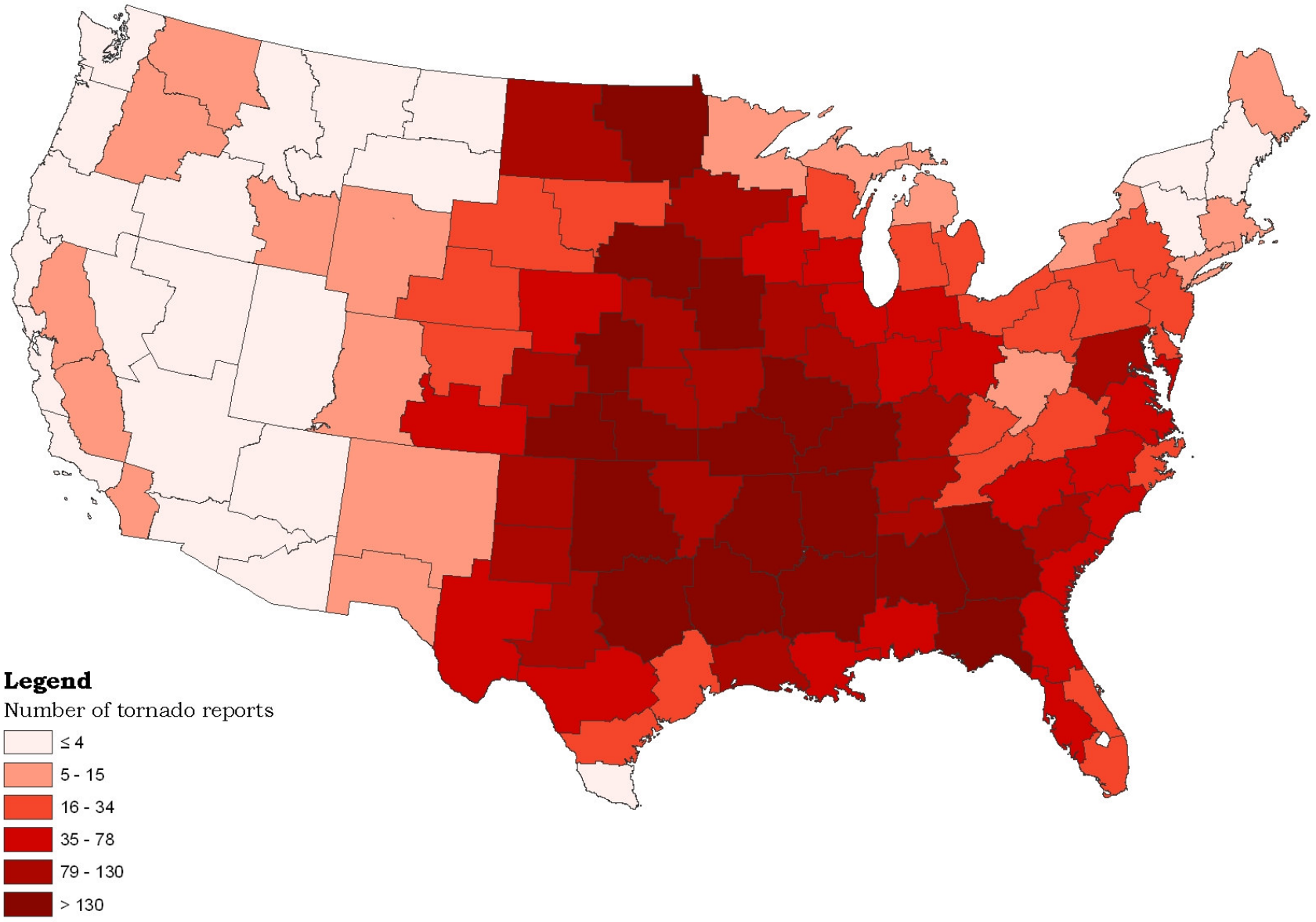
2000 - 2009 Severe Thunderstorm Warnings and Severe Weather Reports by County Warning Area

Wind and Hail only

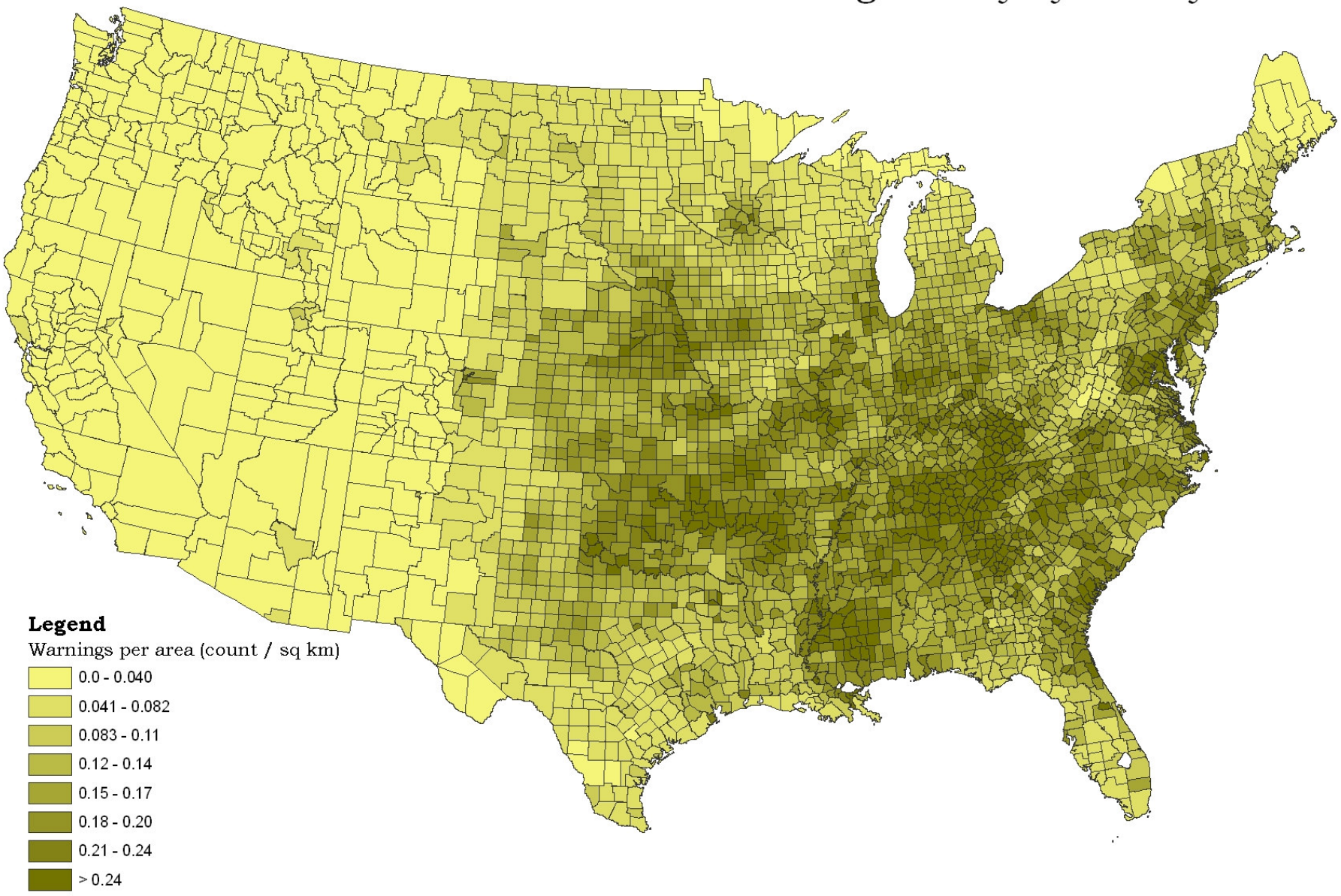


2000 - 2009 Tornadoes and Tornado Reports by County Warning Area

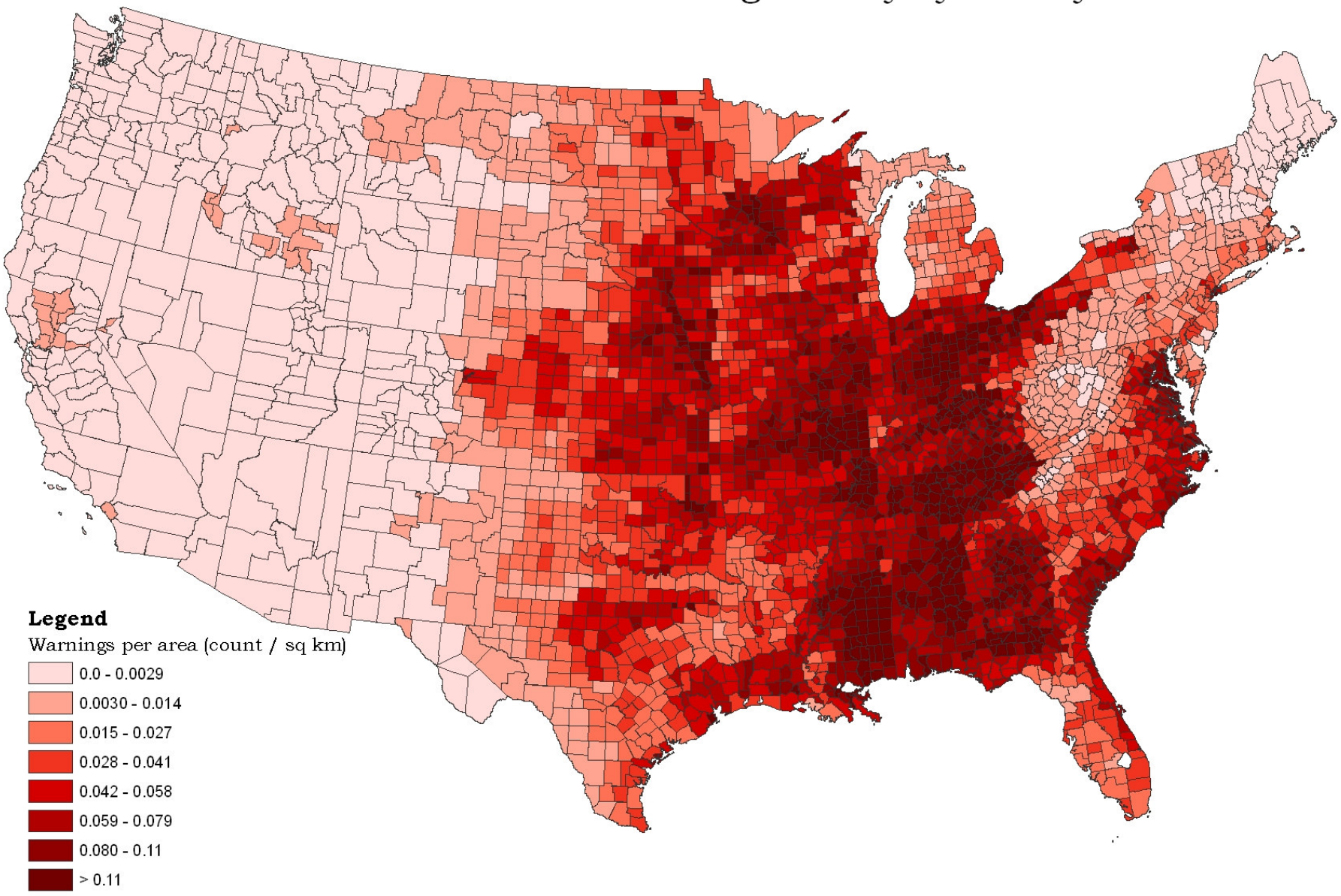



Legend
Number of tornado reports
≤ 4
5 - 15
16 - 34
35 - 78
79 - 130
> 130

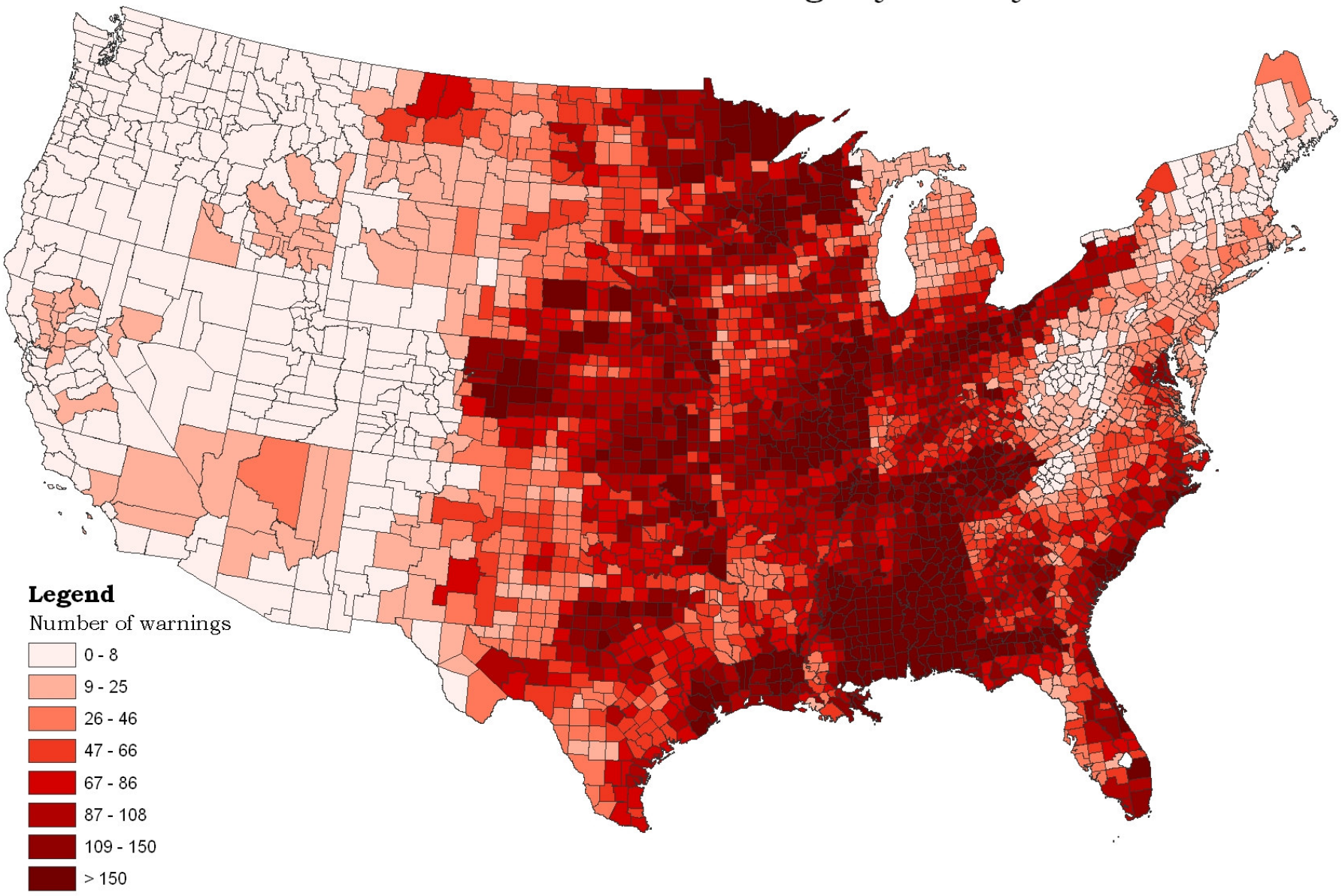
2000 - 2009 Severe Thunderstorm Warning Density by County



2000 - 2009 Tornado Warning Density by County



2000 - 2009 Tornado Warnings by County



End
Thanks for listening!