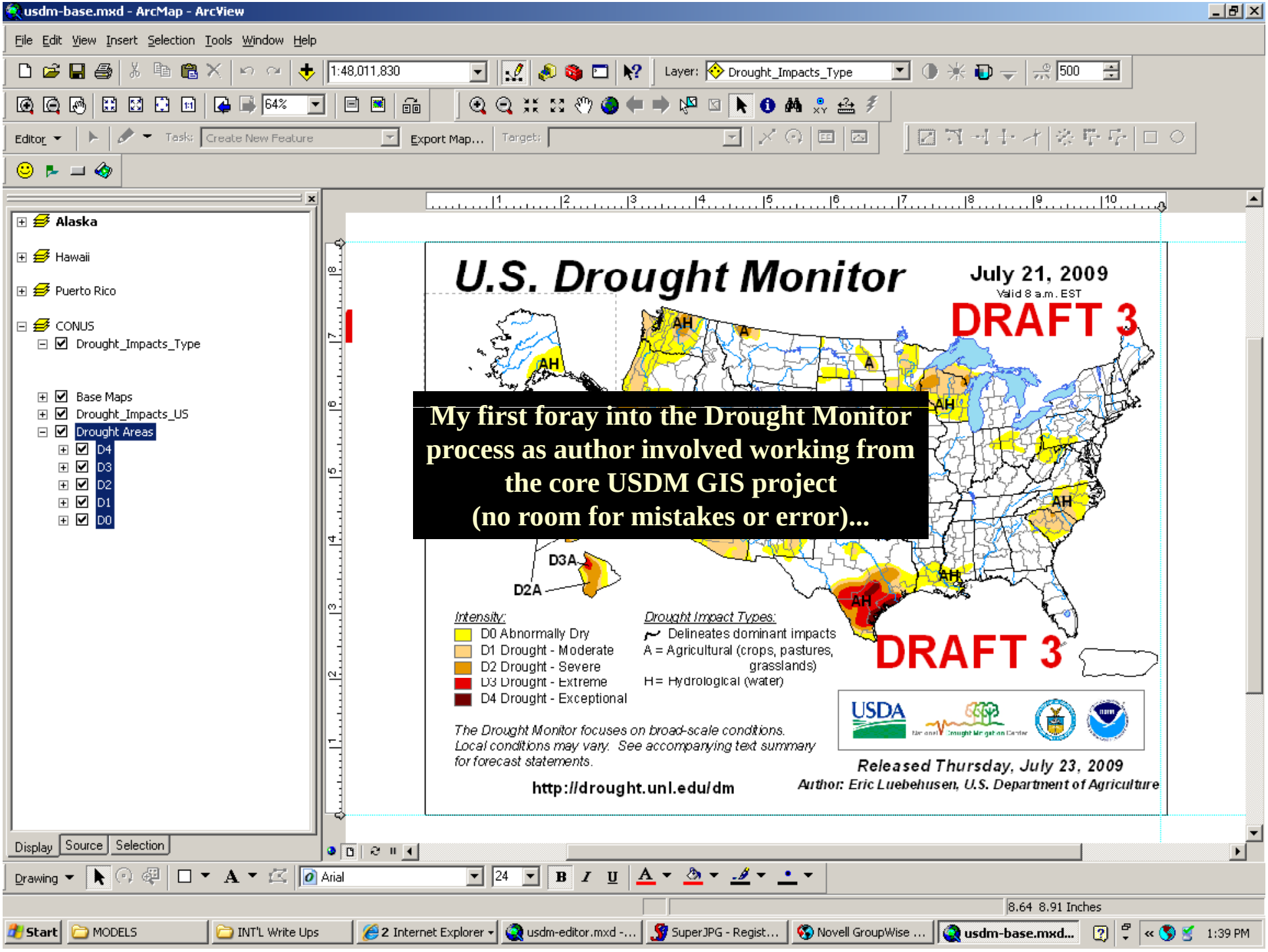
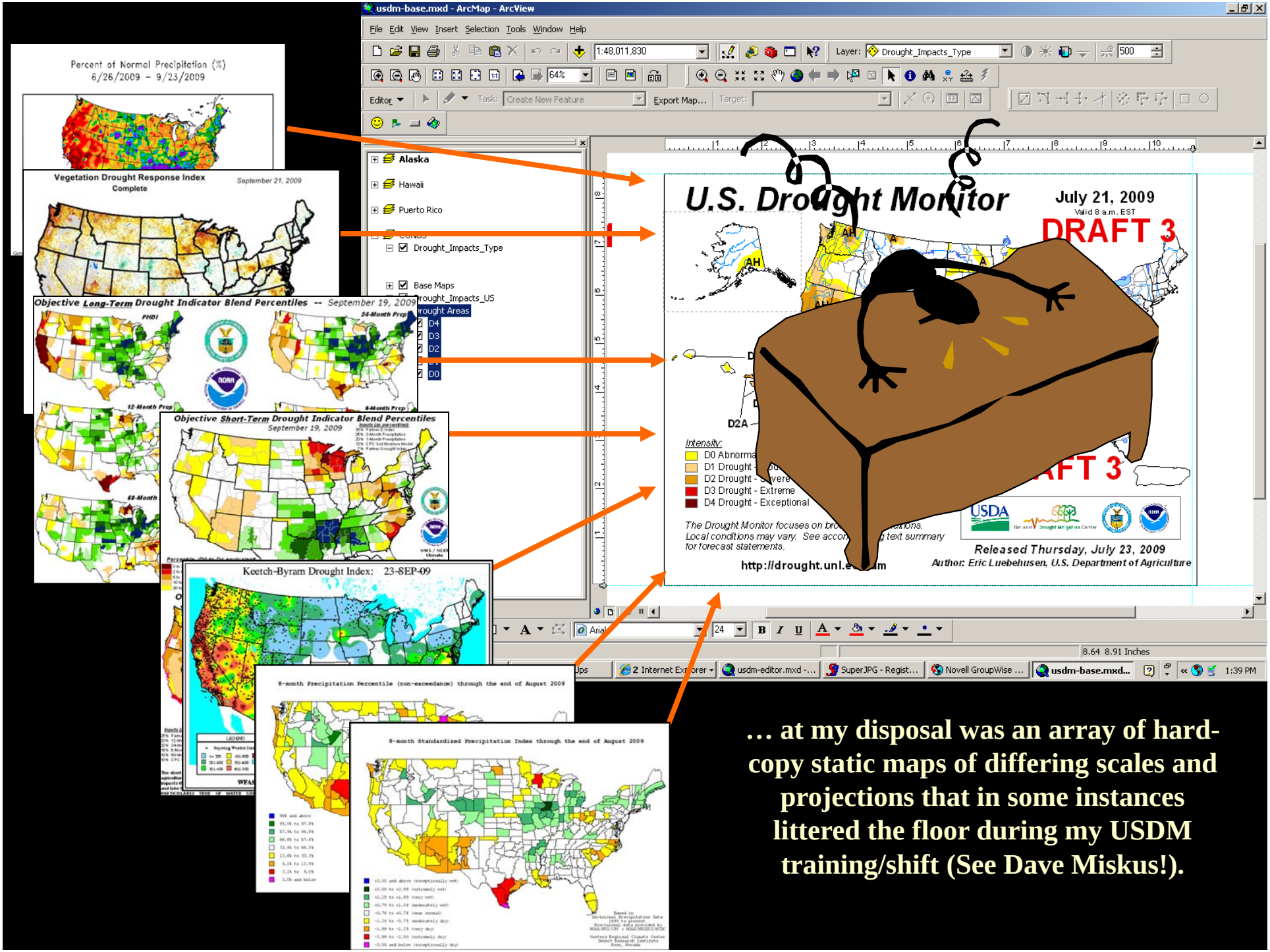
U.S. Drought Monitor Forum
Austin, Texas
October 7-9, 2009

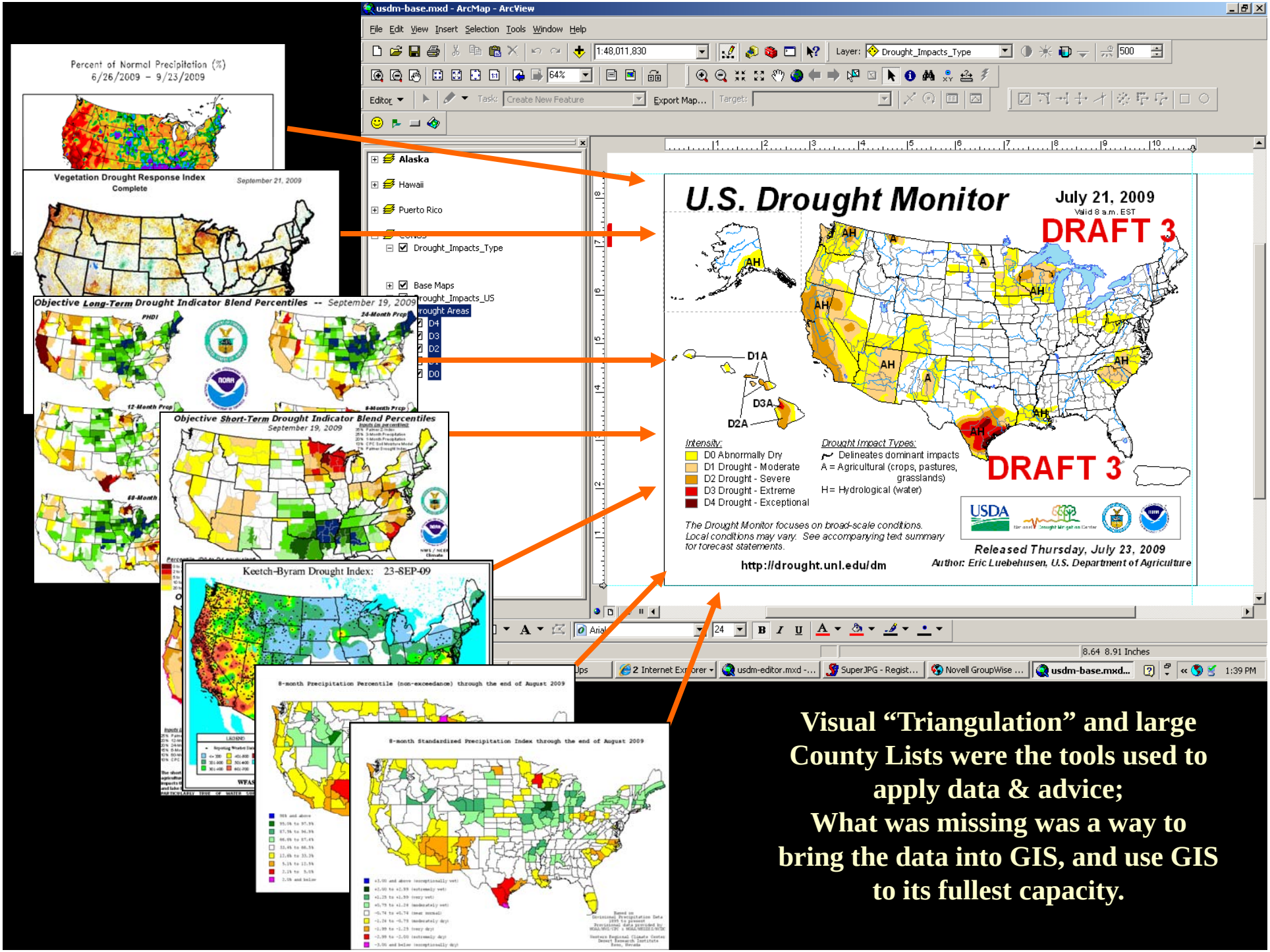
GIS data for U.S. Drought Assessment: Current Uses and Needs

Eric Luebehusen
Meteorologist & USDM Author
USDA – World Agricultural Outlook Board

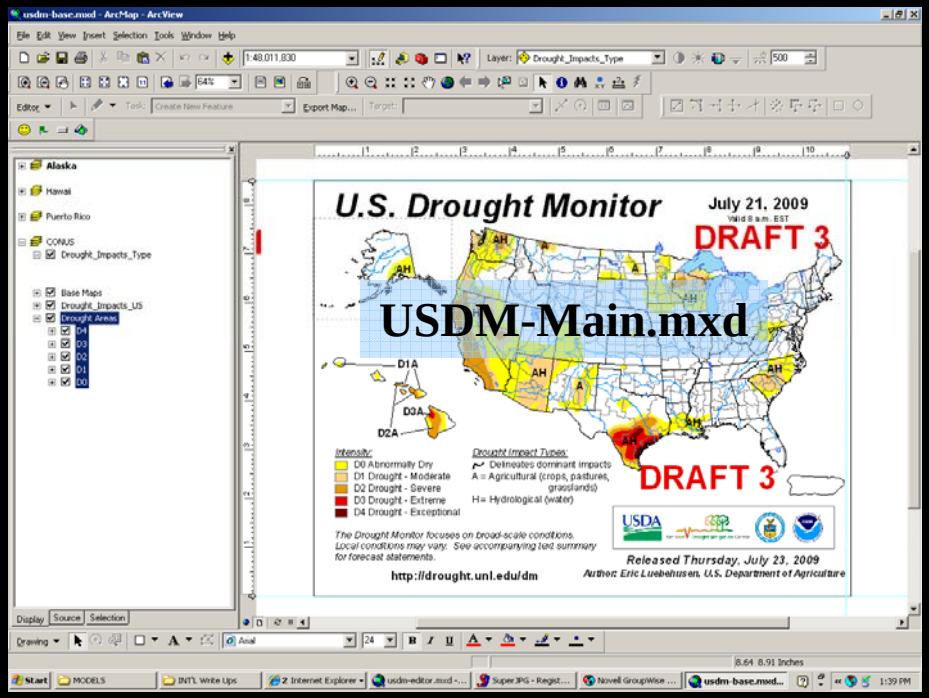

usdm-base.mxd - ArcMap - ArcView
File Edit View Insert Selection Tools Window Help
1:48,011,830
Layer: Drought_Impacts_Type
Editor
Task: Create New Feature
Export Map...
Target:
Alaska
Hawaii
Puerto Rico
CONUS
Drought_Impacts_Type
Base Maps
Drought_Impacts_US
Drought Areas
D4
D3
D2
D1
D0
Display
Source
Selection
U.S. Drought Monitor
July 21, 2009
Valid 8 a.m. EST
DRAFT 3
My first foray into the Drought Monitor process as author involved working from the core USDM GIS project (no room for mistakes or error)...
D3A
D2A
Intensity:
D0 Abnormally Dry
D1 Drought - Moderate
D2 Drought - Severe
D3 Drought - Extreme
D4 Drought - Exceptional
Drought Impact Types:
Delineates dominant impacts
A = Agricultural (crops, pastures, grasslands)
H = Hydrological (water)
DRAFT 3
USDA
The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.
http://drought.unl.edu/dm
Released Thursday, July 23, 2009
Author: Eric Luebehusen, U.S. Department of Agriculture
Drawing
Arial
24
8.64 8.91 Inches
Start
MODELS
INT'L Write Ups
2 Internet Explorer
usdm-editor.mxd -...
SuperJPG - Regist...
Novell GroupWise ...
usdm-base.mxd...
1:39 PM

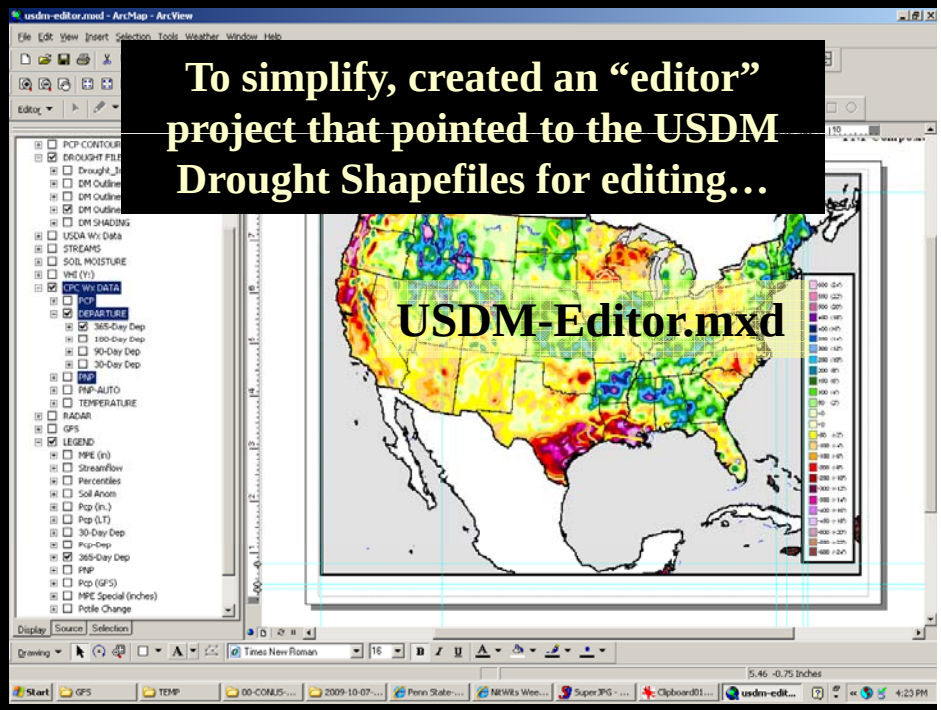


… at my disposal was an array of hard-copy static maps of differing scales and projections that in some instances littered the floor during my USDM training/shift (See Dave Miskus!).

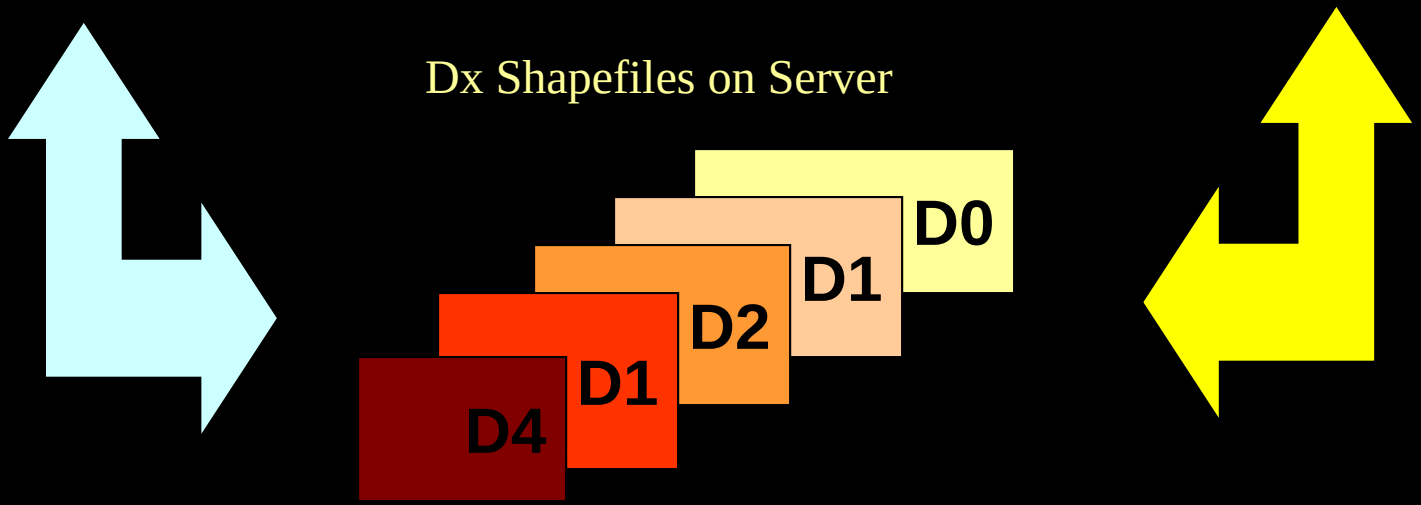


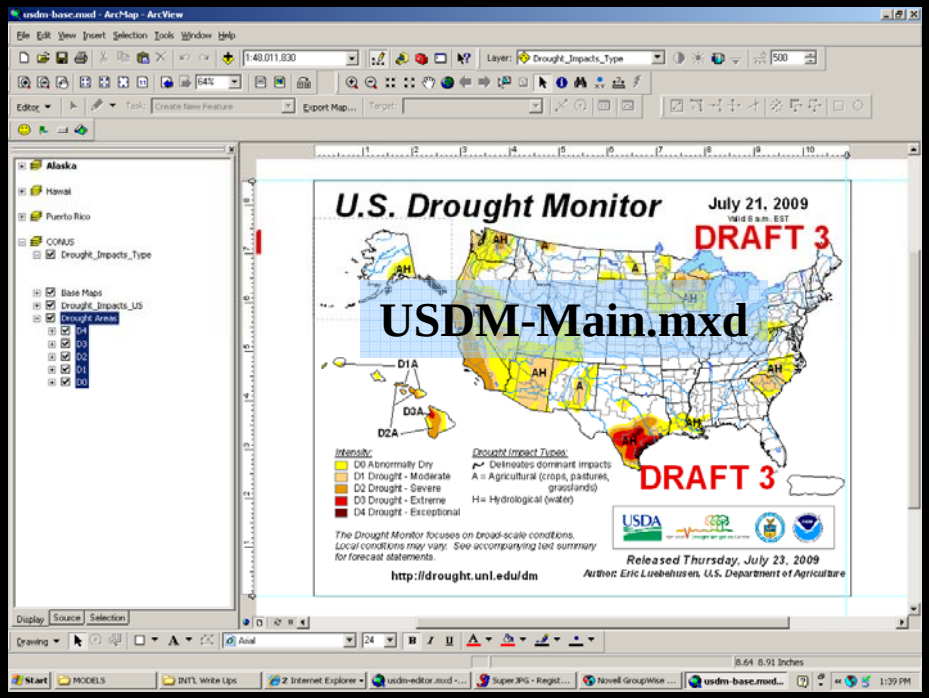
Visual "Triangulation" and large County Lists were the tools used to apply data & advice;
What was missing was a way to bring the data into GIS, and use GIS to its fullest capacity.

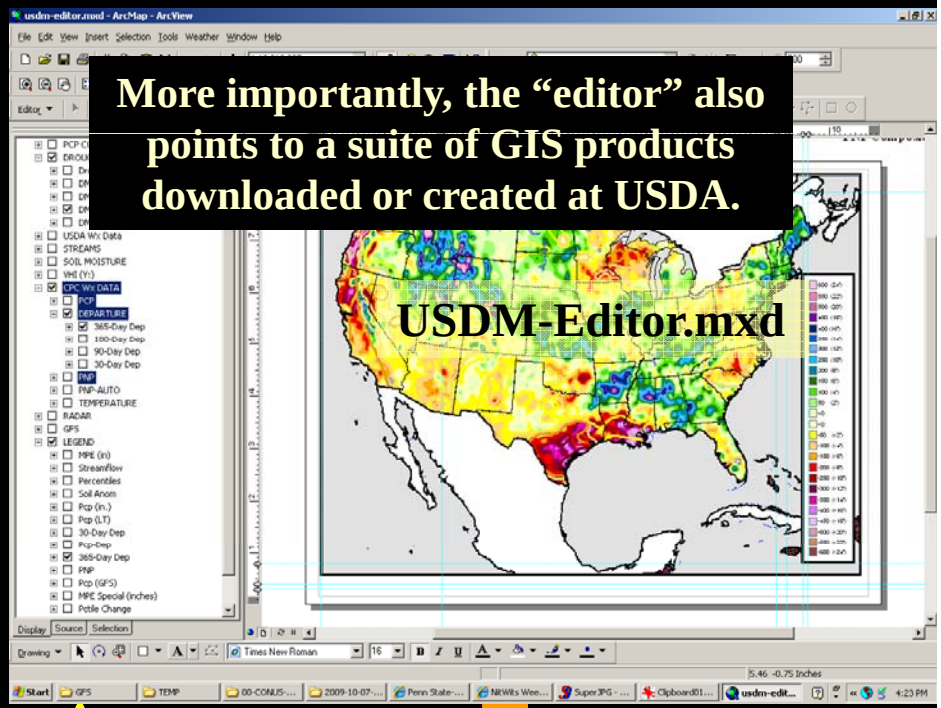


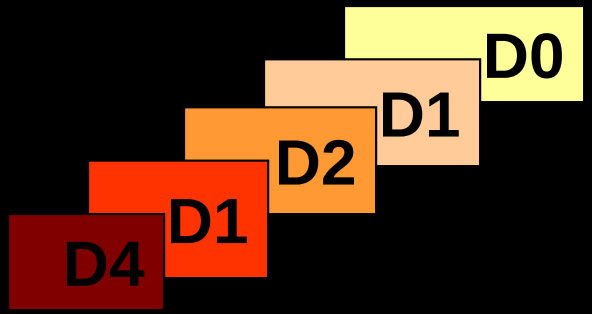


Dx Shapefiles on Server

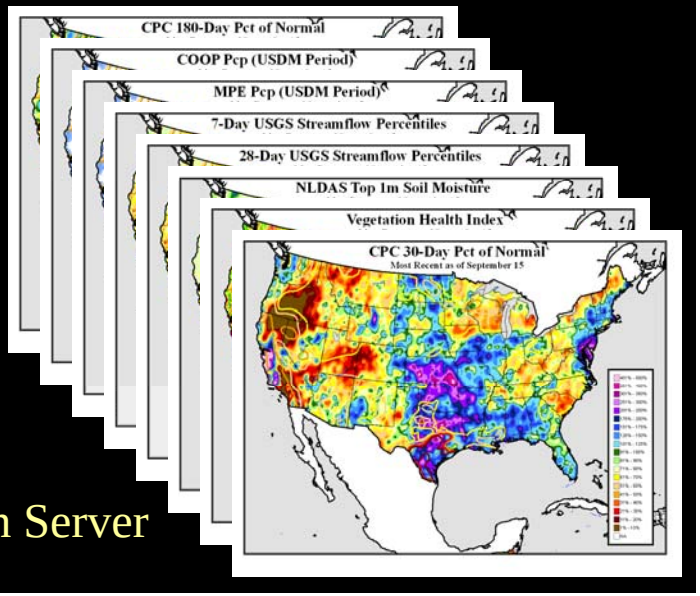




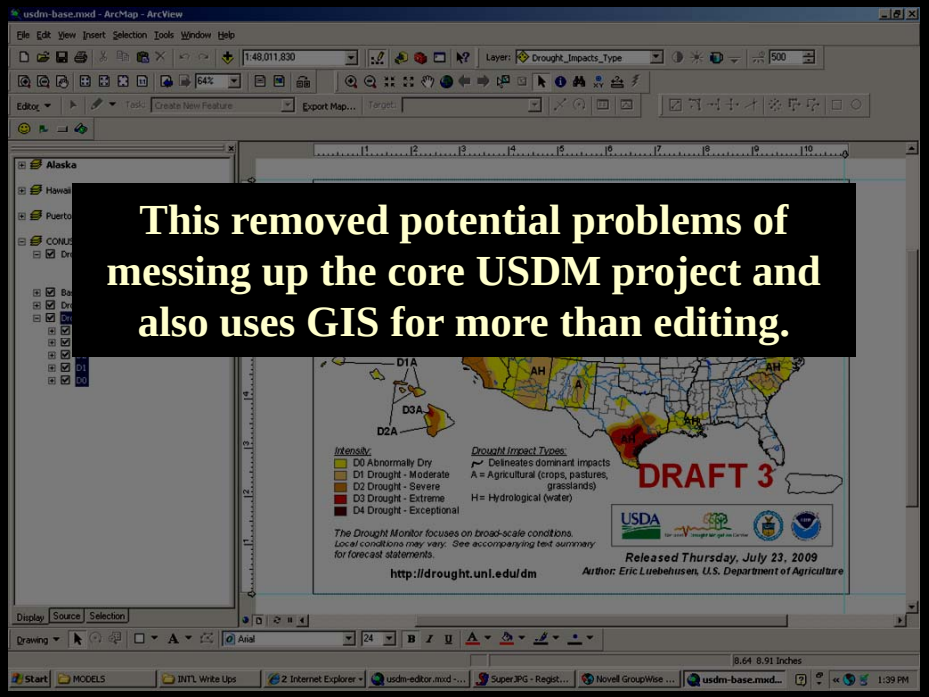




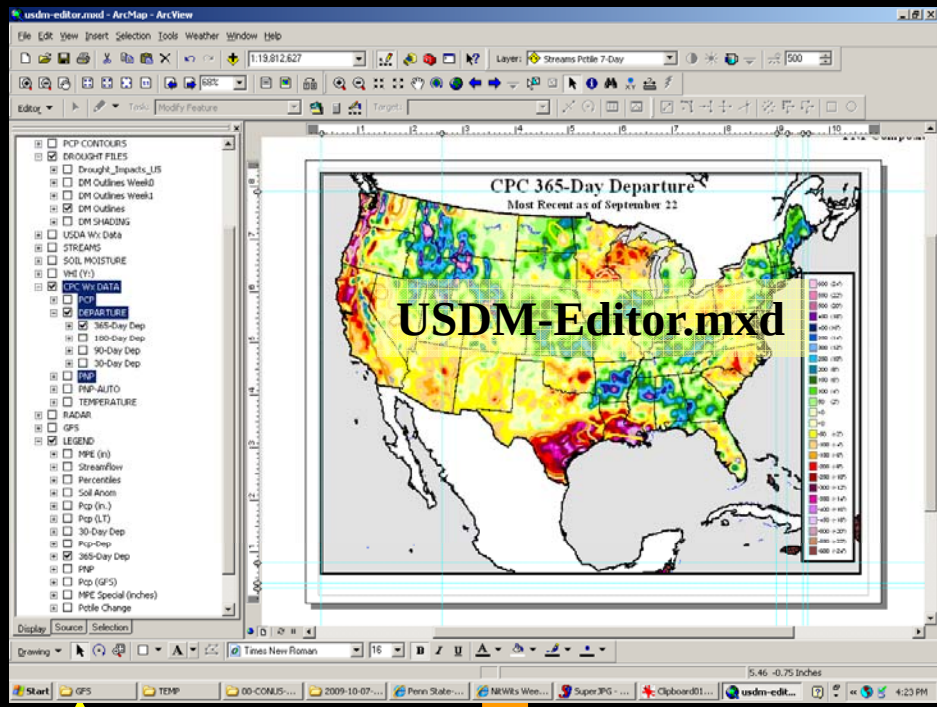
Dx Shapefiles on Server

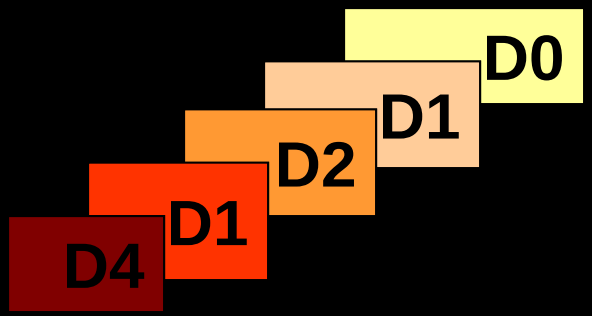


GIS Wx Data on Server

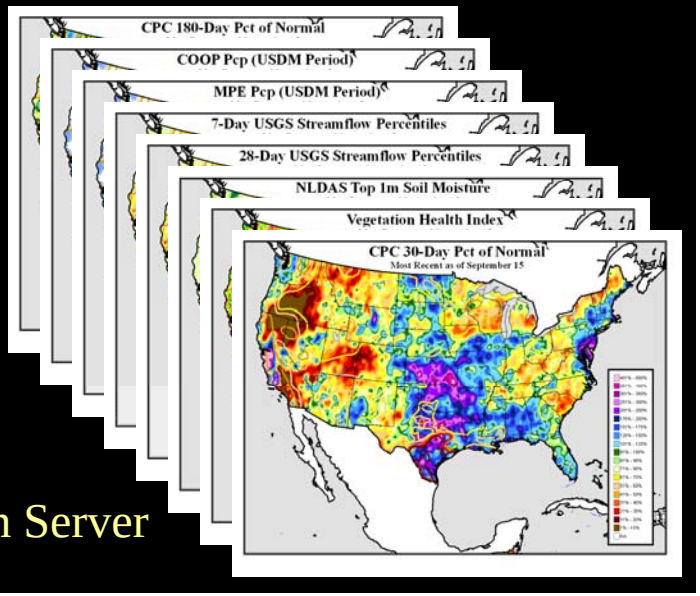


This removed potential problems of messing up the core USDM project and also uses GIS for more than editing.

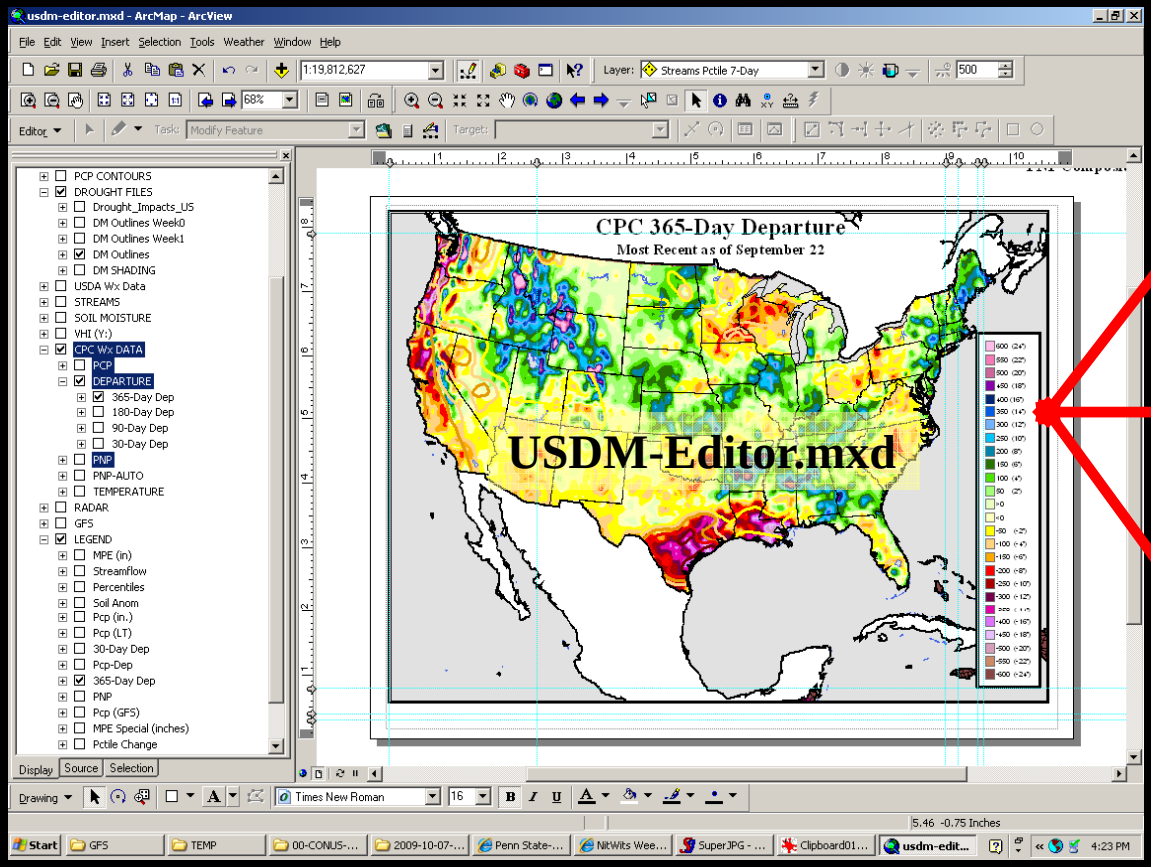


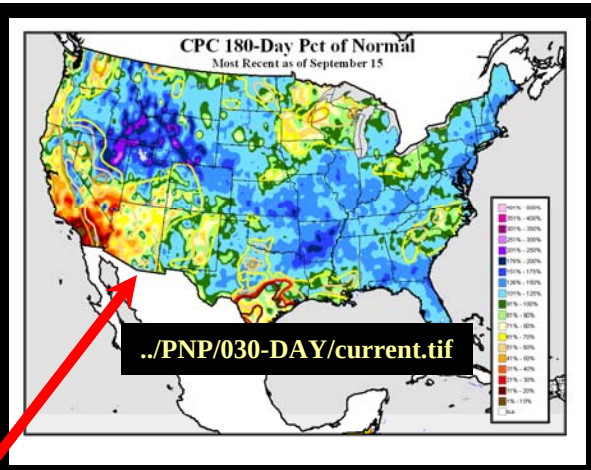


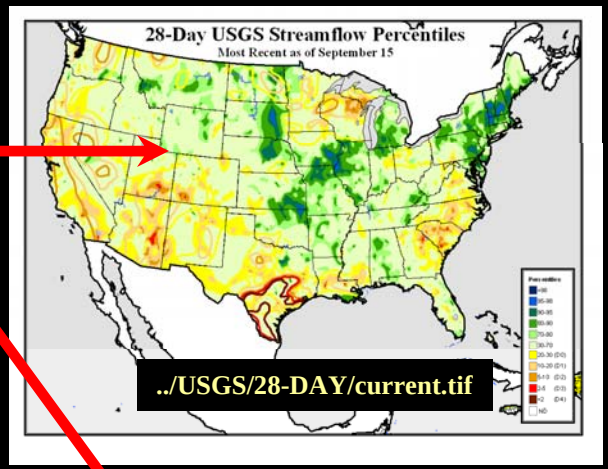
Dx Shapefiles on Server

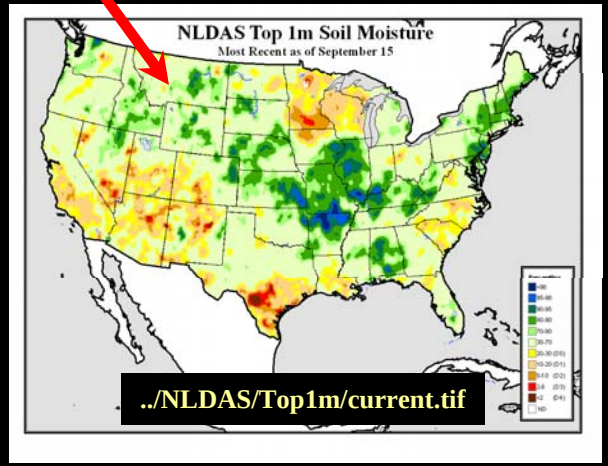


GIS Wx Data on Server

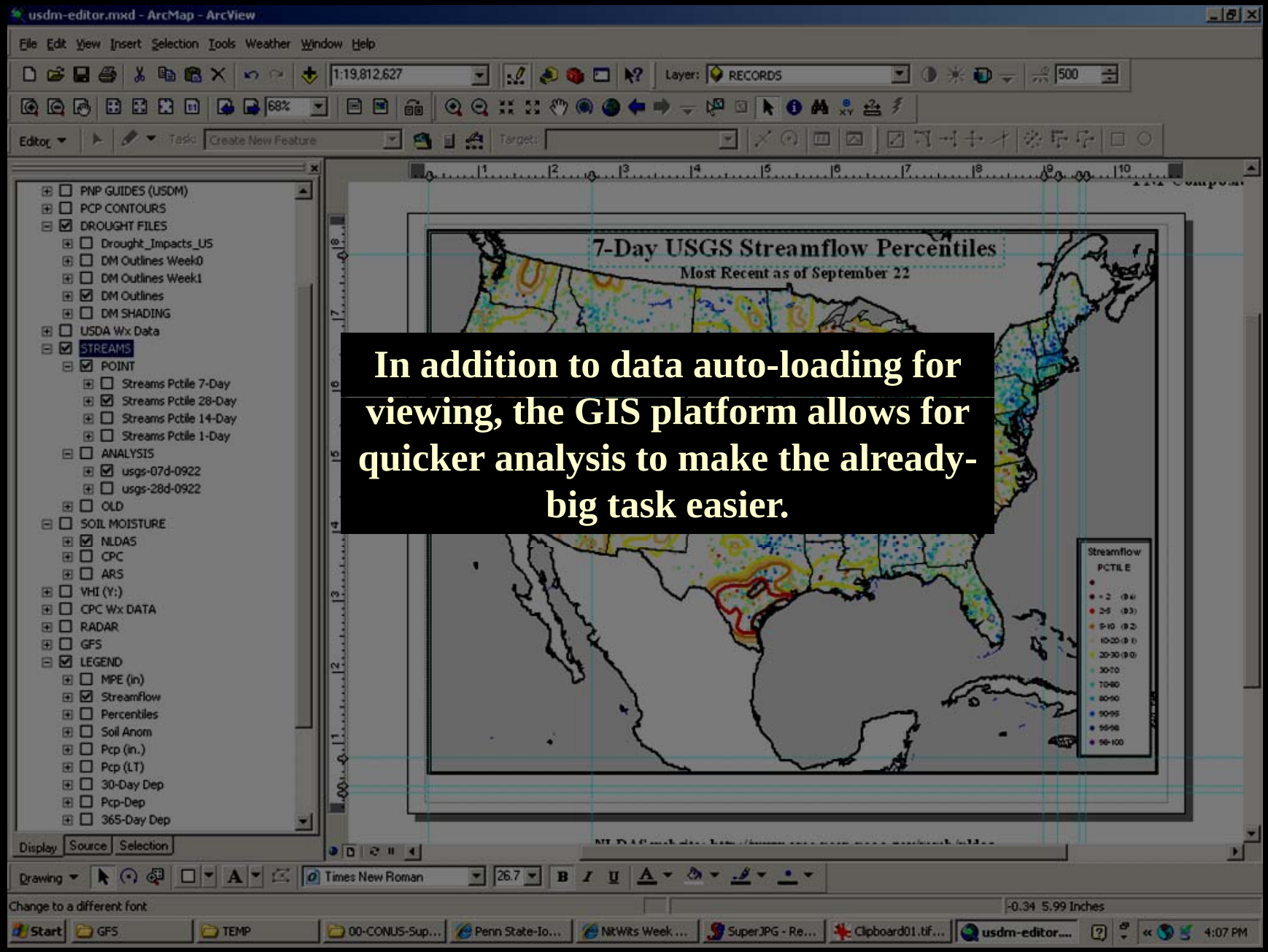




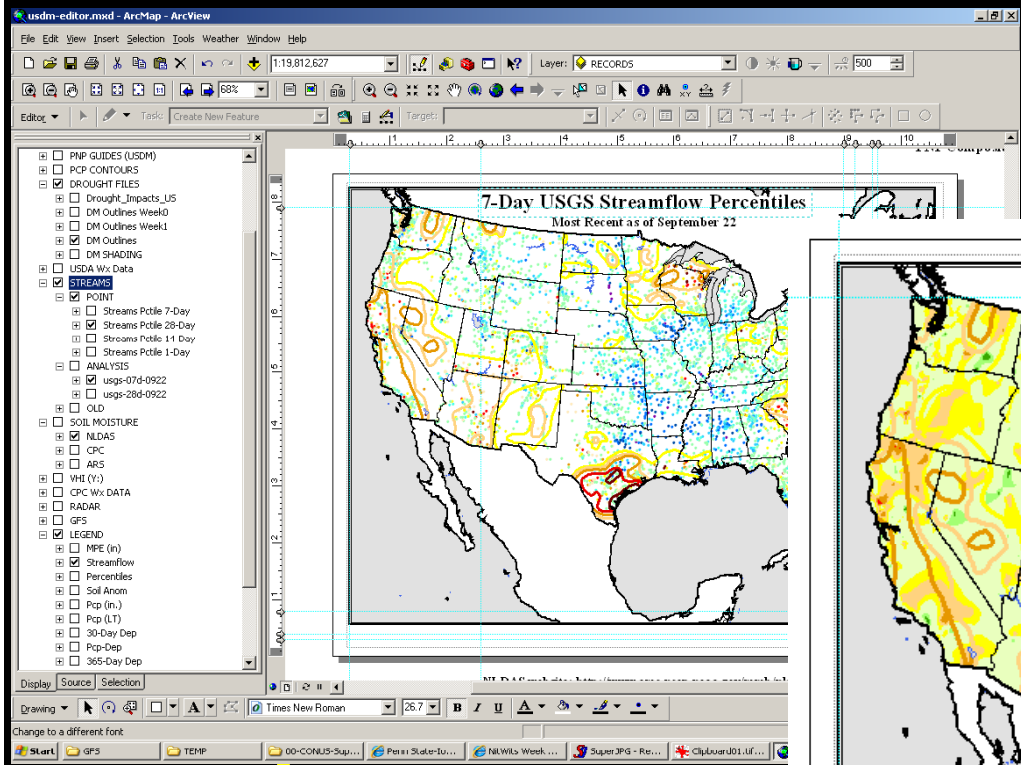


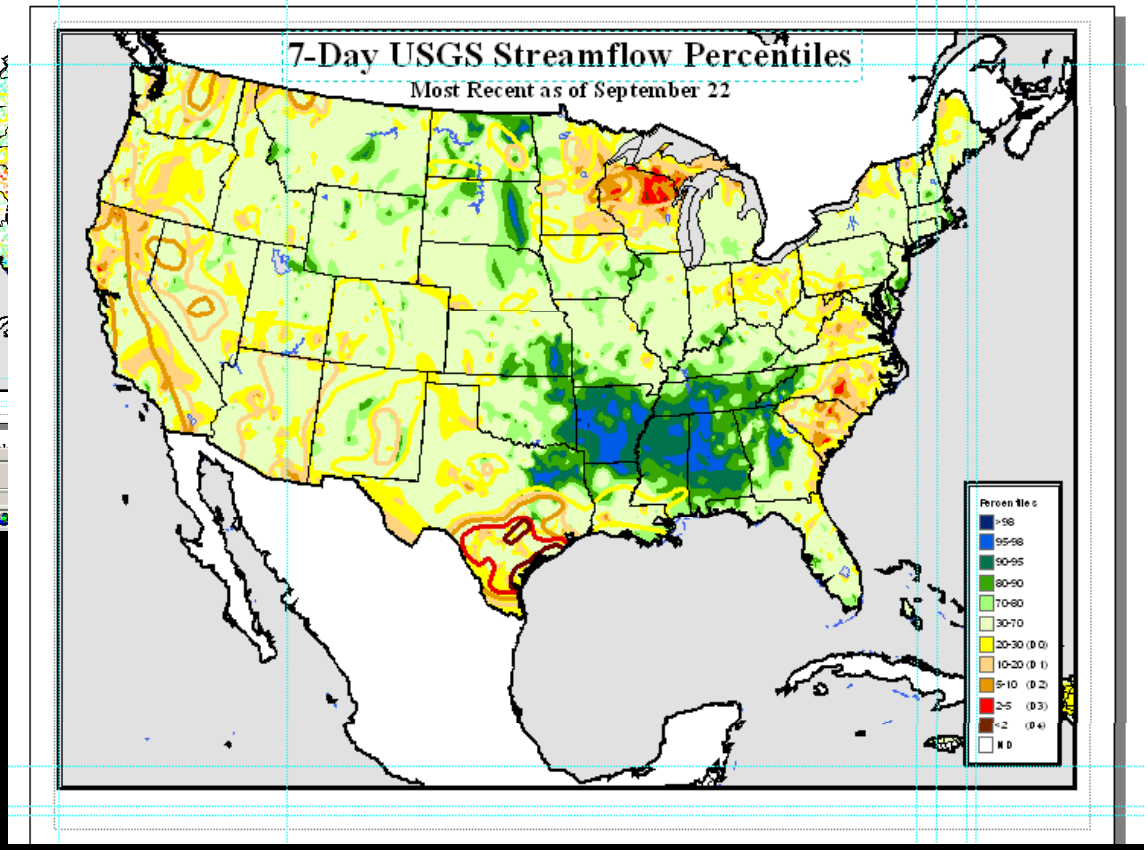


An automatic download of the data (renamed to "current.tif" and a "yyyymmdd.tif" archive) saves time not only on data acquisition, but on the GIS end too (data is dynamically linked); Open the project, & the data awaits.

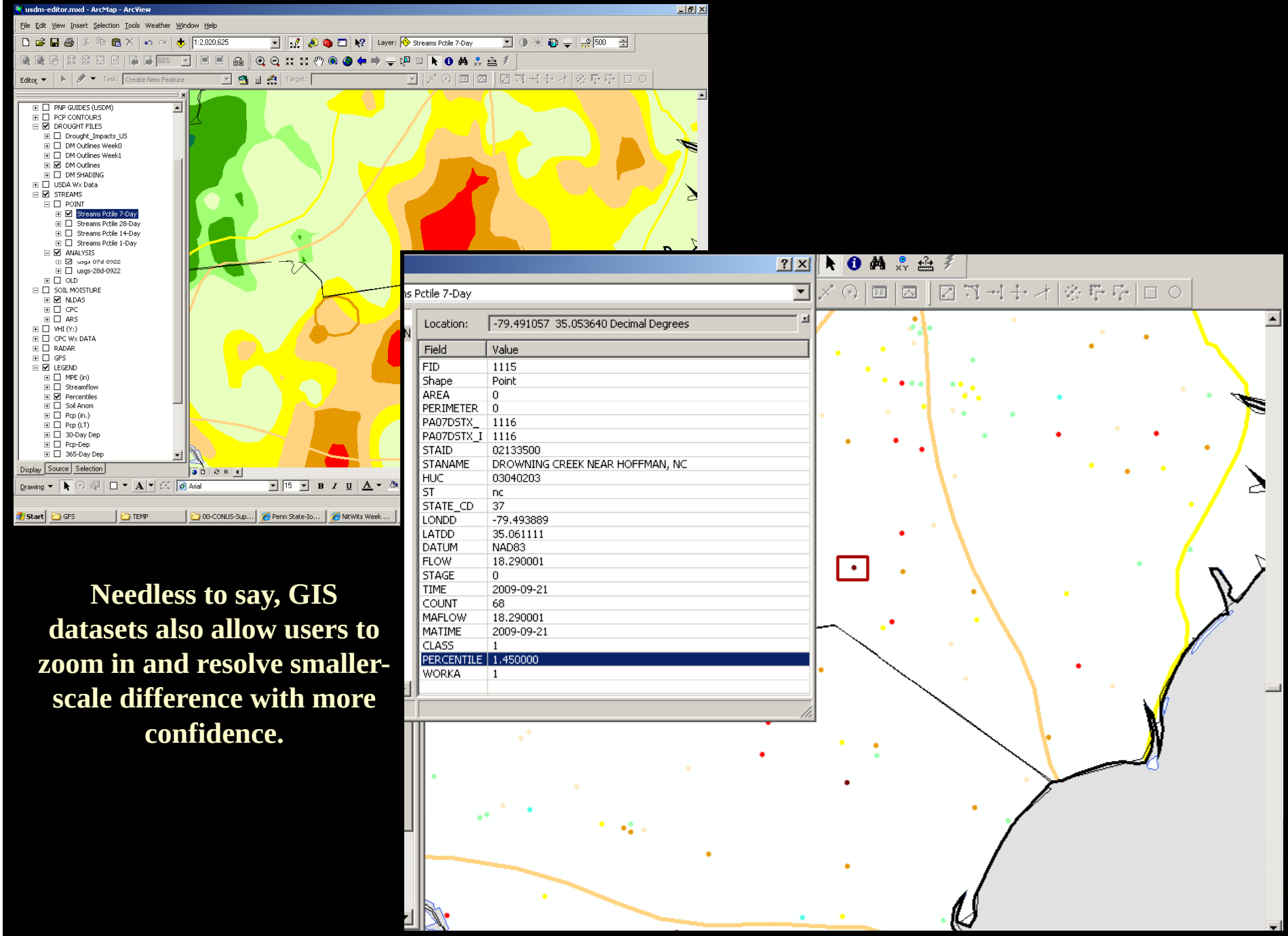


In addition to data auto-loading for viewing, the GIS platform allows for quicker analysis to make the already-big task easier.

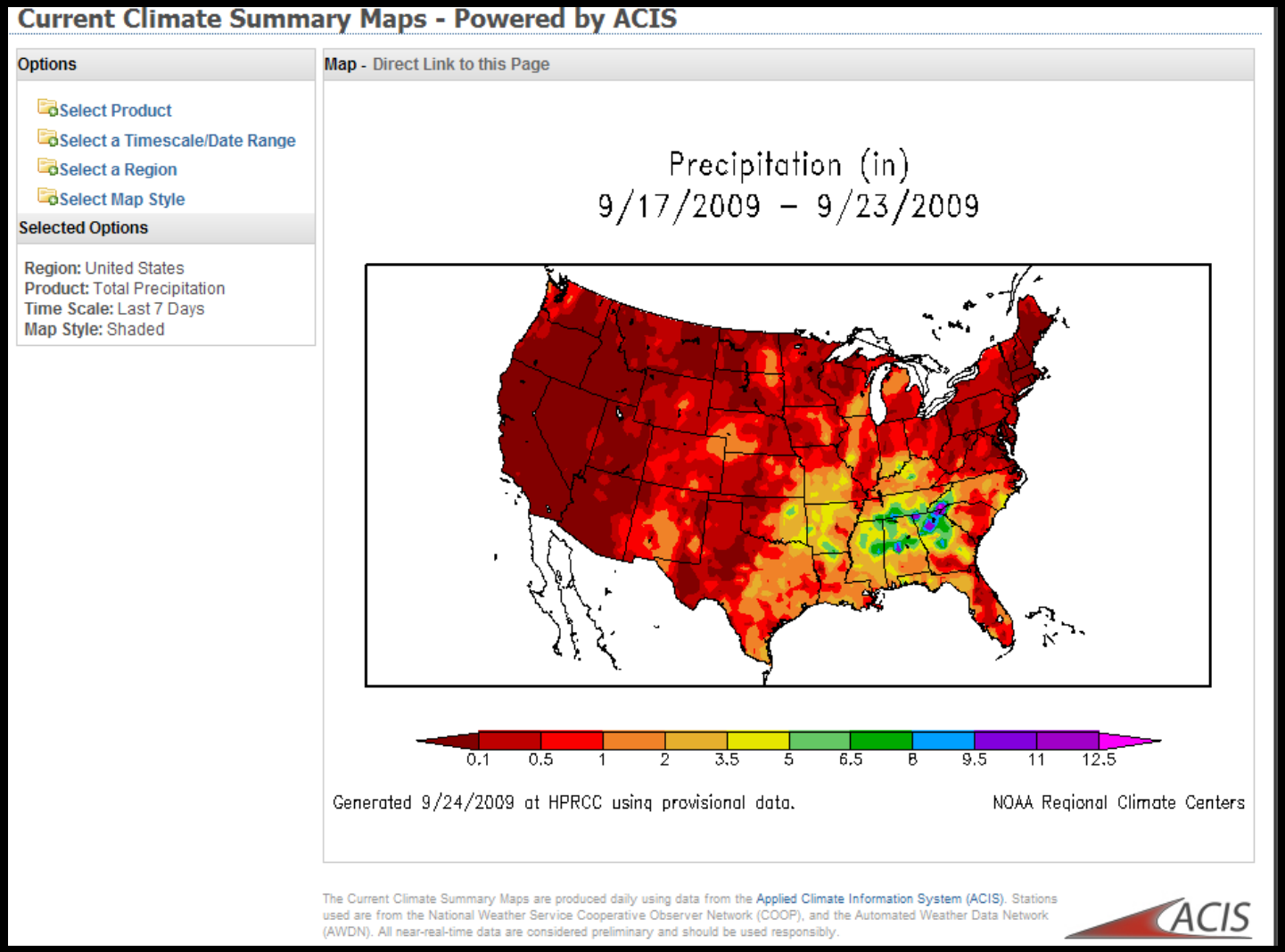




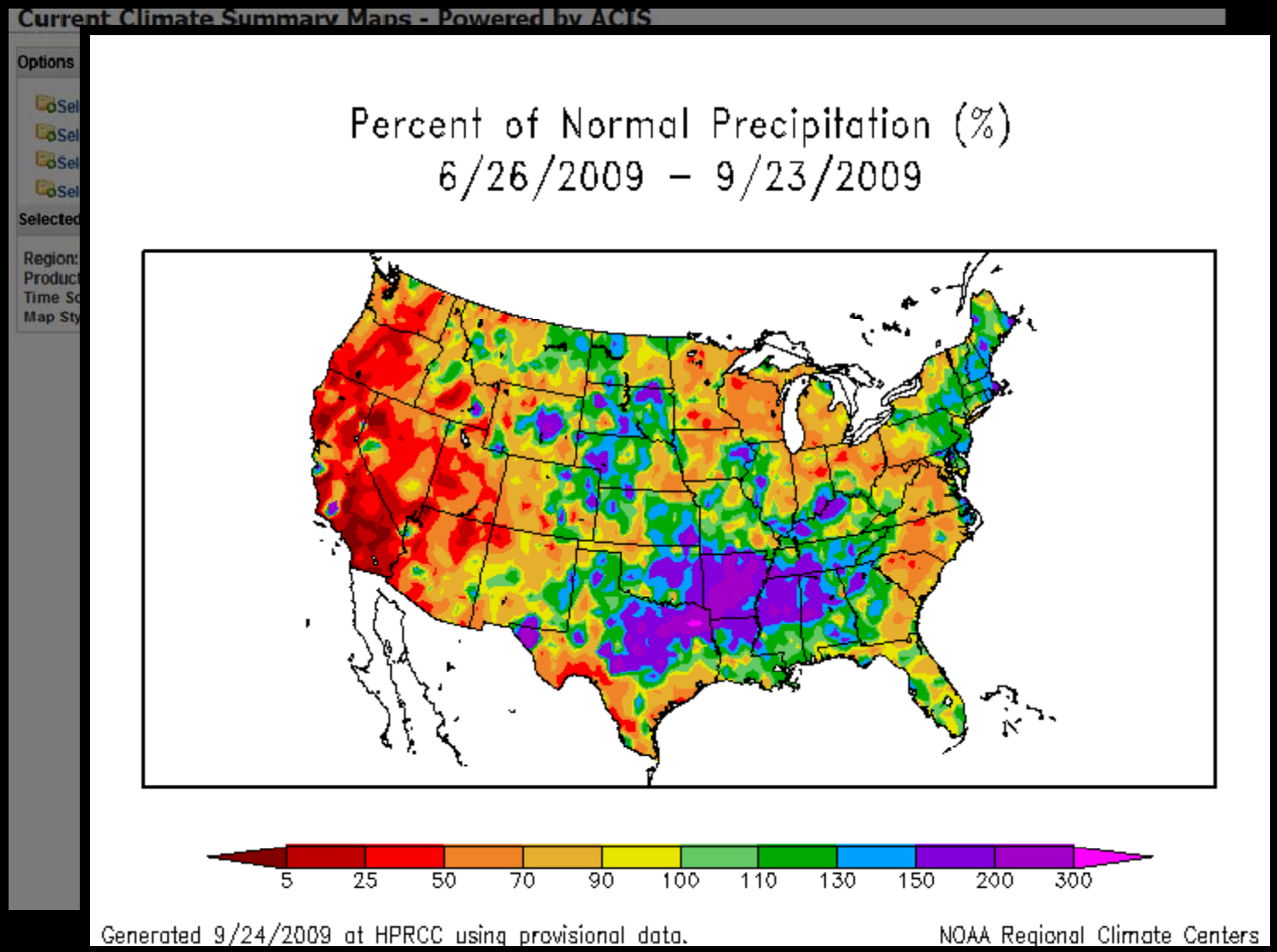
For example, GIS-point streamflow data from USGS are easily queried and/or interpolated to create maps such as this 7-Day streamflow surface, which uses the Dx Colors.



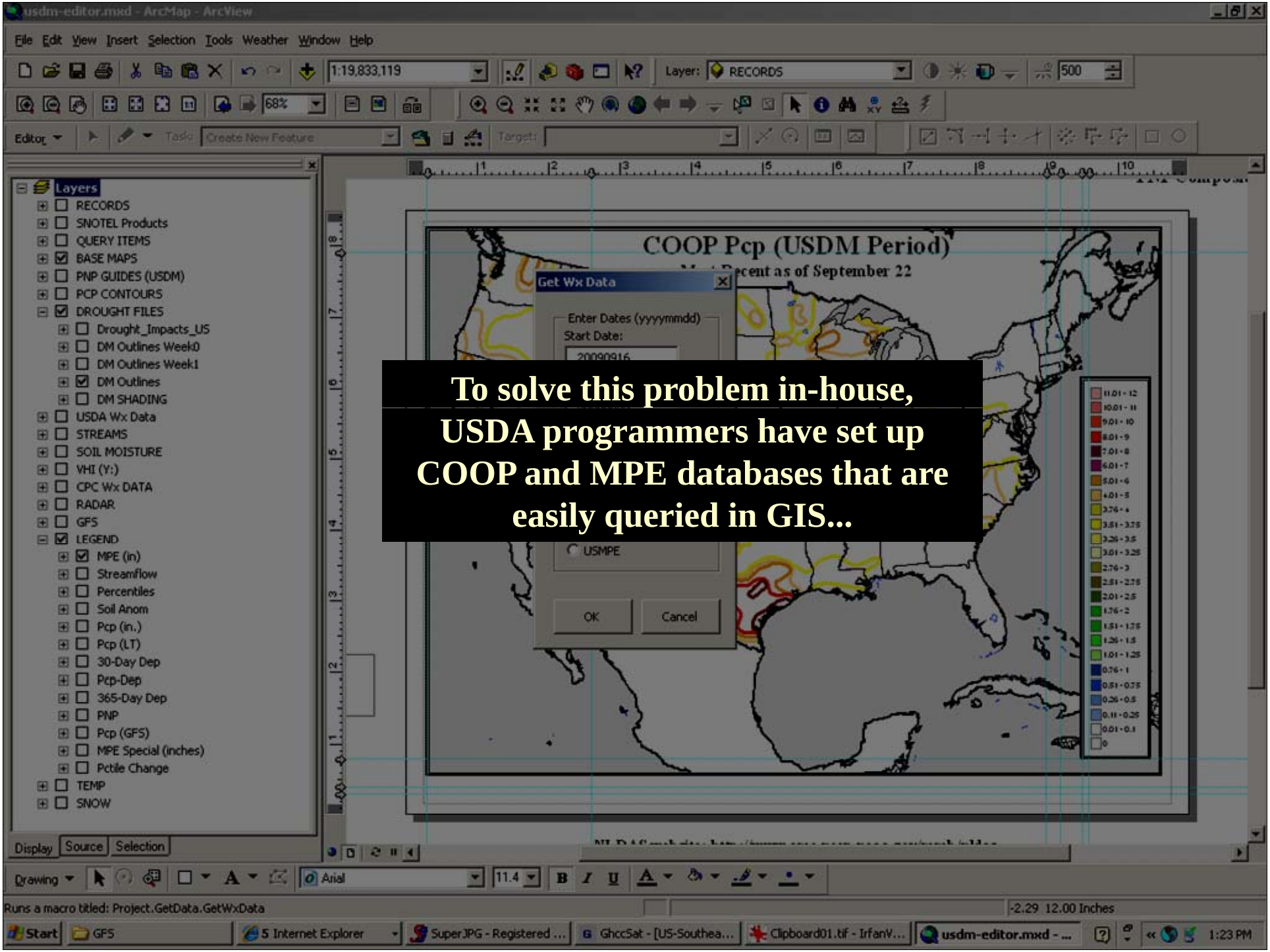
Needless to say, GIS datasets also allow users to zoom in and resolve smaller-scale difference with more confidence.



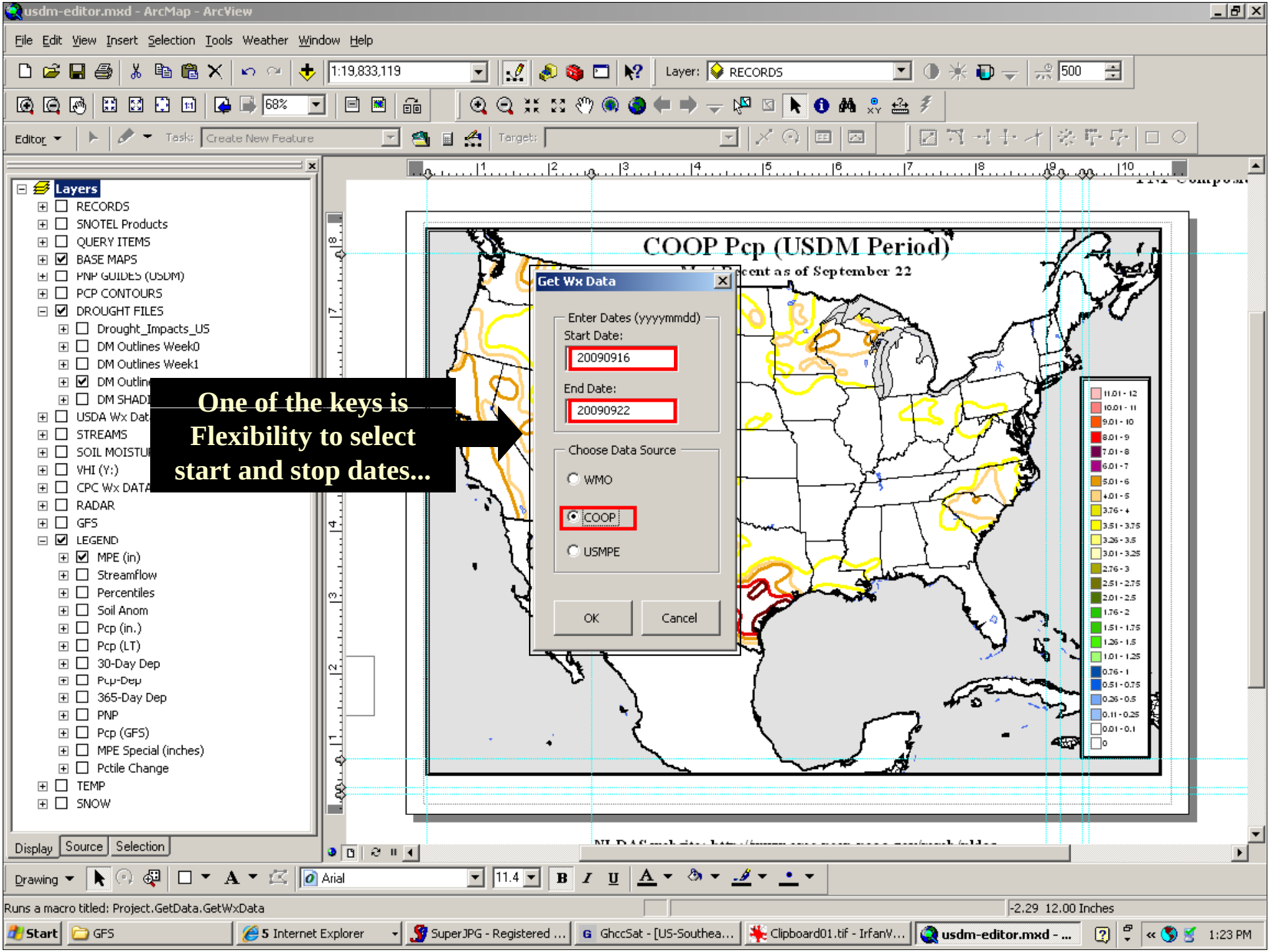
GIS authors frequently use (or are sent) products created on ACIS (*High Plains Regional Climate Center*).



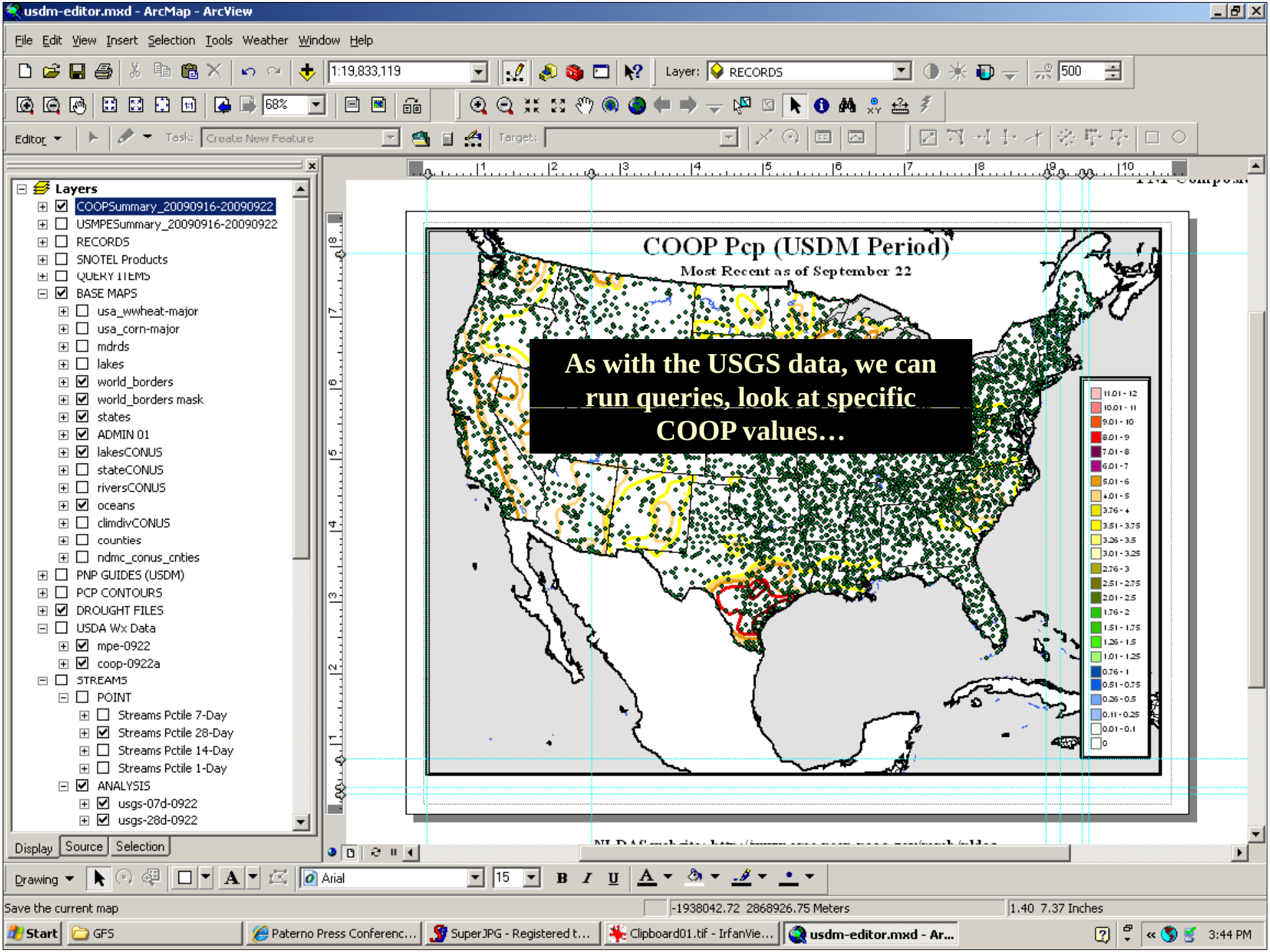
The problem is, these products are static and very difficult to bring into GIS, the platform in which the USDM is edited and created.

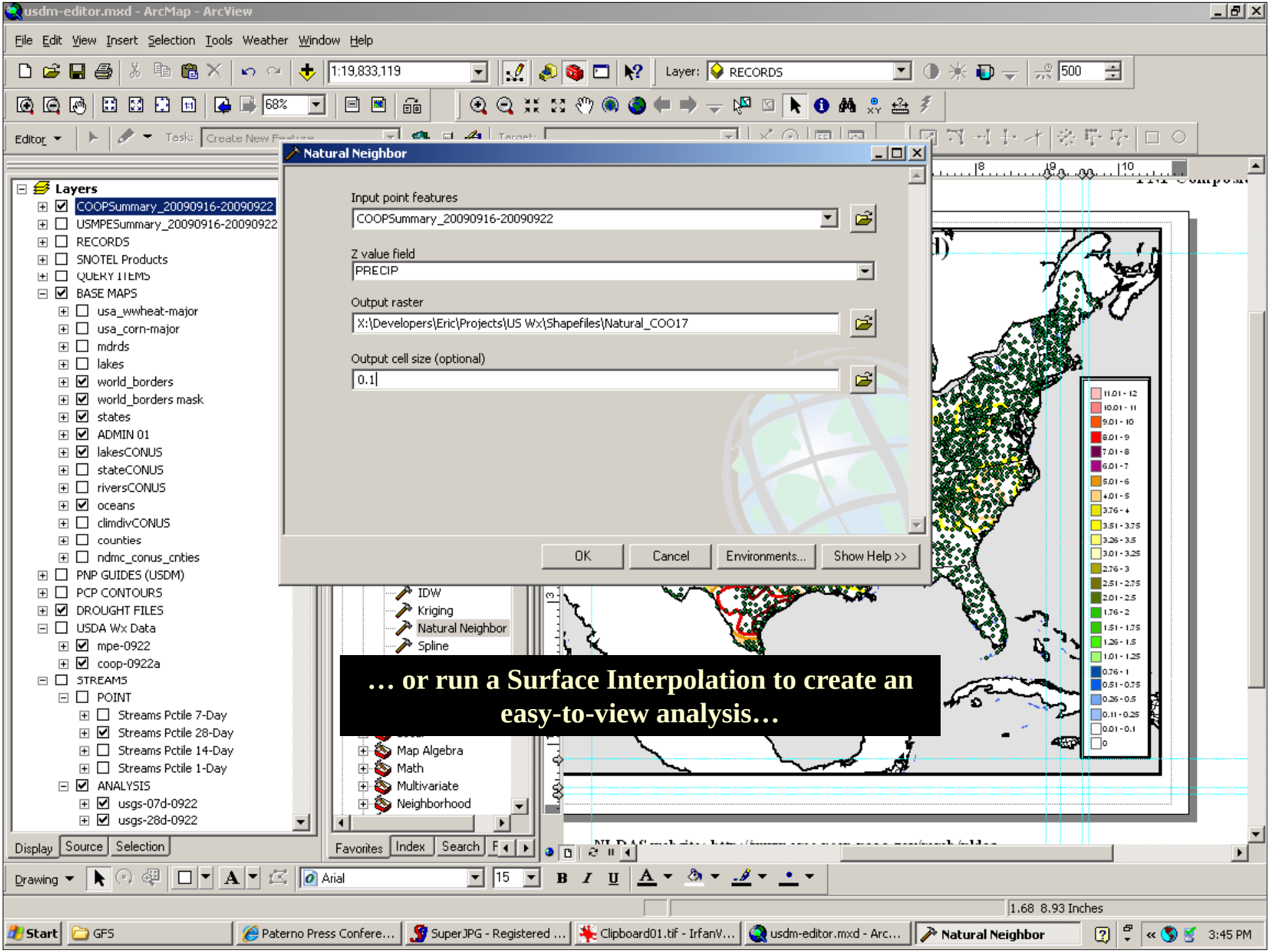


To solve this problem in-house, USDA programmers have set up COOP and MPE databases that are easily queried in GIS...

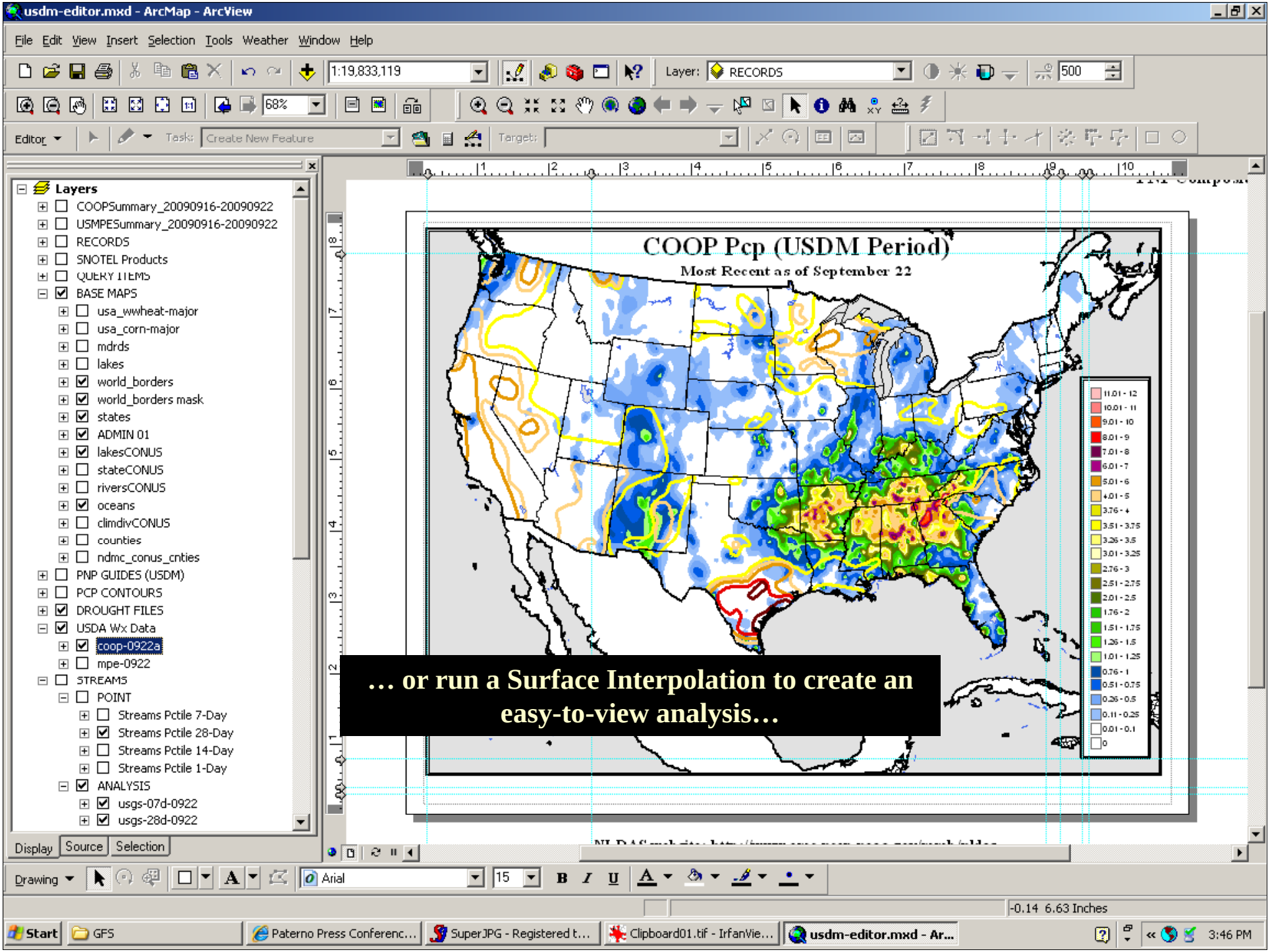


One of the keys is Flexibility to select start and stop dates...


usdm-editor.mxd - ArcMap - ArcView
File Edit View Insert Selection Tools Weather Window Help
1:19,833,119
Layer: RECORDS
500
68%
Editor
Task: Create New Feature
Target:
Layers
COOPSummary_20090916-20090922
USMPESummary_20090916-20090922
RECORDS
SNOTEL Products
QUERY ITEMS
BASE MAPS
usa_wwheat-major
usa_corn-major
mdrds
lakes
world_borders
world_borders mask
states
ADMIN 01
lakesCONUS
stateCONUS
riversCONUS
oceans
climdivCONUS
counties
ndmc_conus_cnties
PNP GUIDES (USDM)
PCP CONTOURS
DROUGHT FILES
USDA Wx Data
mpe-0922
coop-0922a
STREAMS
POINT
Streams Pctile 7-Day
Streams Pctile 28-Day
Streams Pctile 14-Day
Streams Pctile 1-Day
ANALYSIS
usgs-07d-0922
usgs-28d-0922
Display
Source
Selection
COOP Pcp (USDM Period)
Most Recent as of September 22
As with the USGS data, we can run queries, look at specific COOP values…
Drawing
Arial
15
Save the current map
-1938042.72 2868926.75 Meters
1.40 7.37 Inches
Start
GFS
Paterno Press Conferenc...
SuperJPG - Registered t...
Clipboard01.tif - IrfanVie...
usdm-editor.mxd - Ar...
3:44 PM



… or run a Surface Interpolation to create an easy-to-view analysis…



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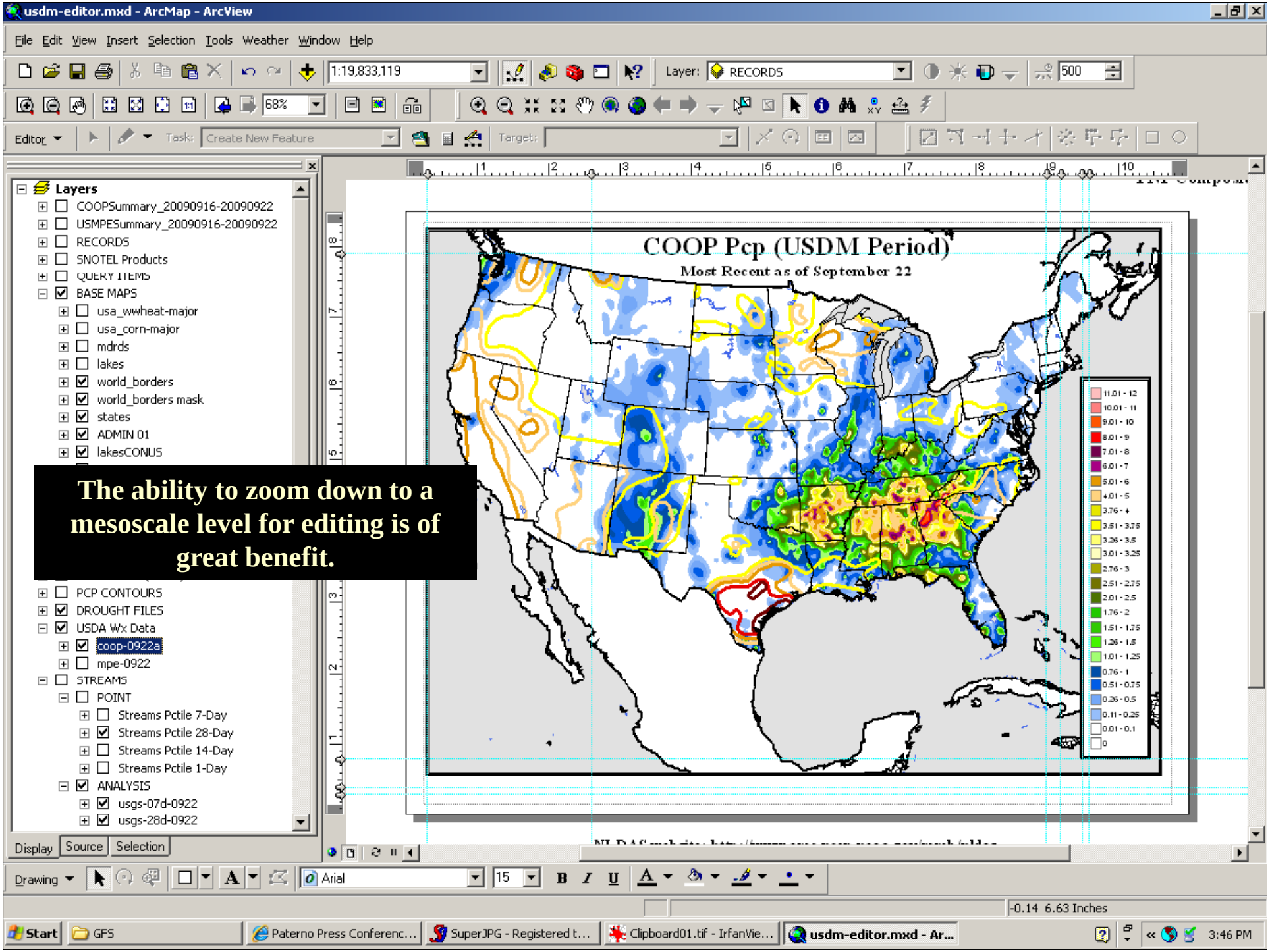
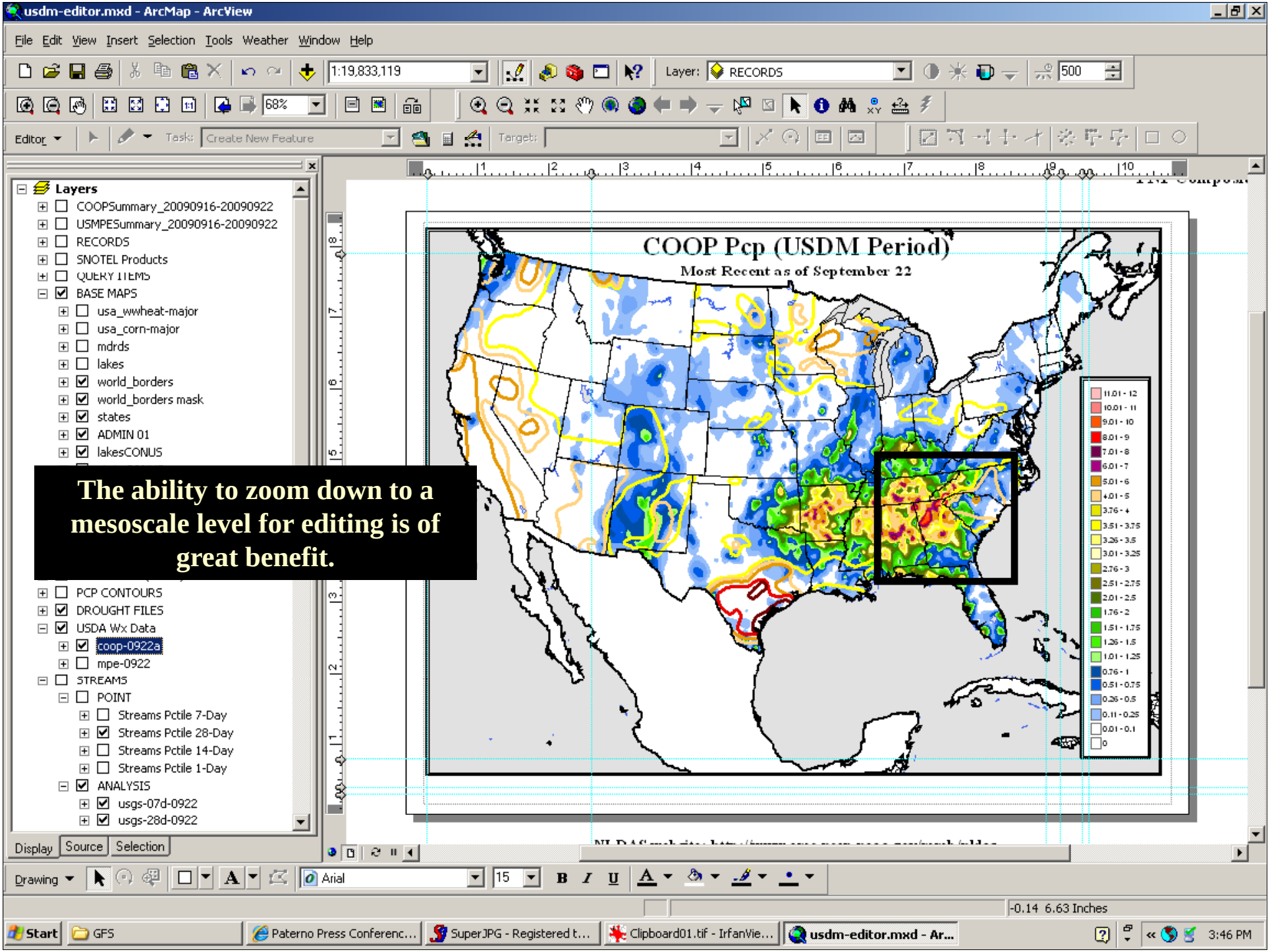


The ability to zoom down to a mesoscale level for editing is of great benefit.



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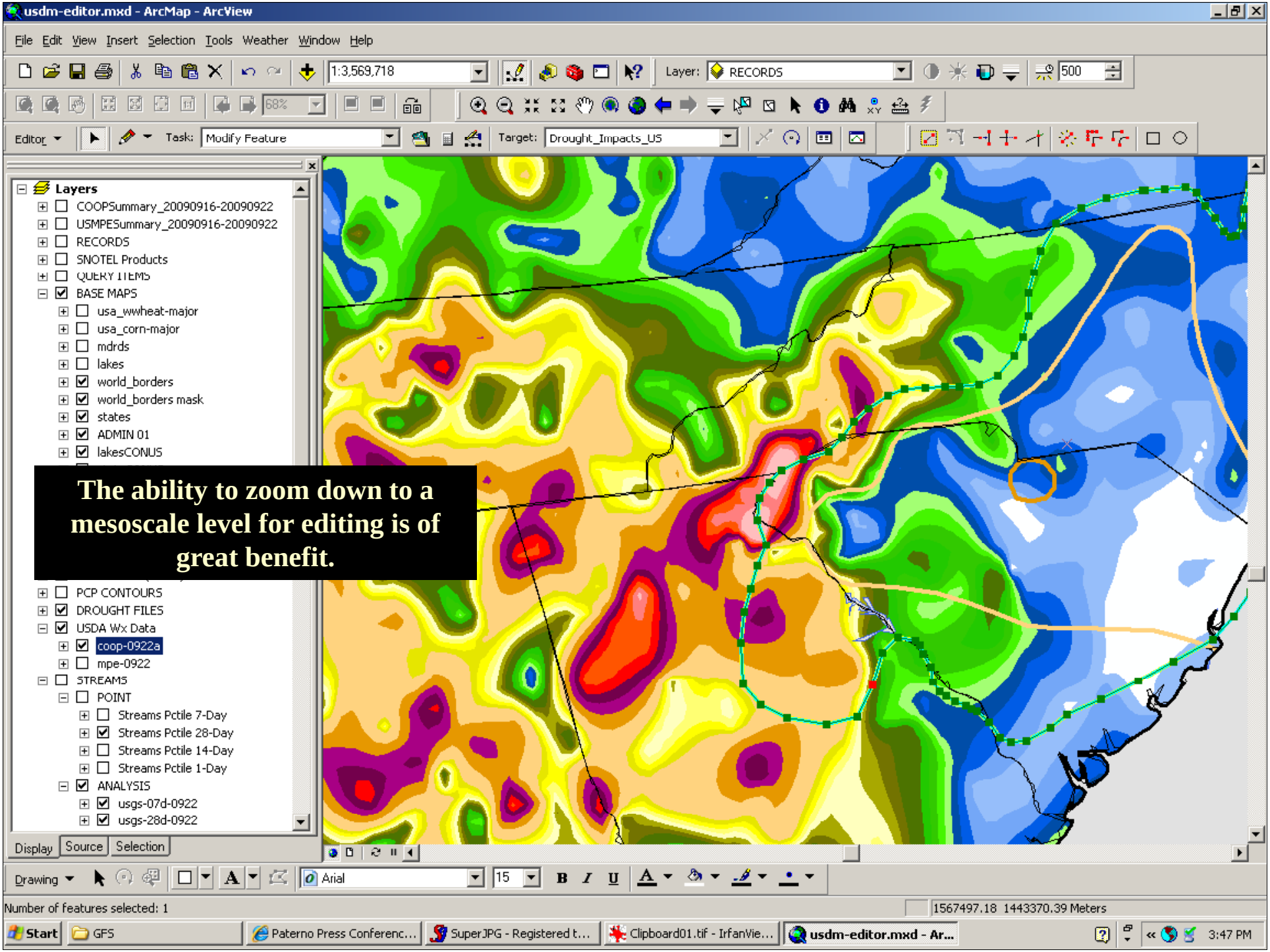

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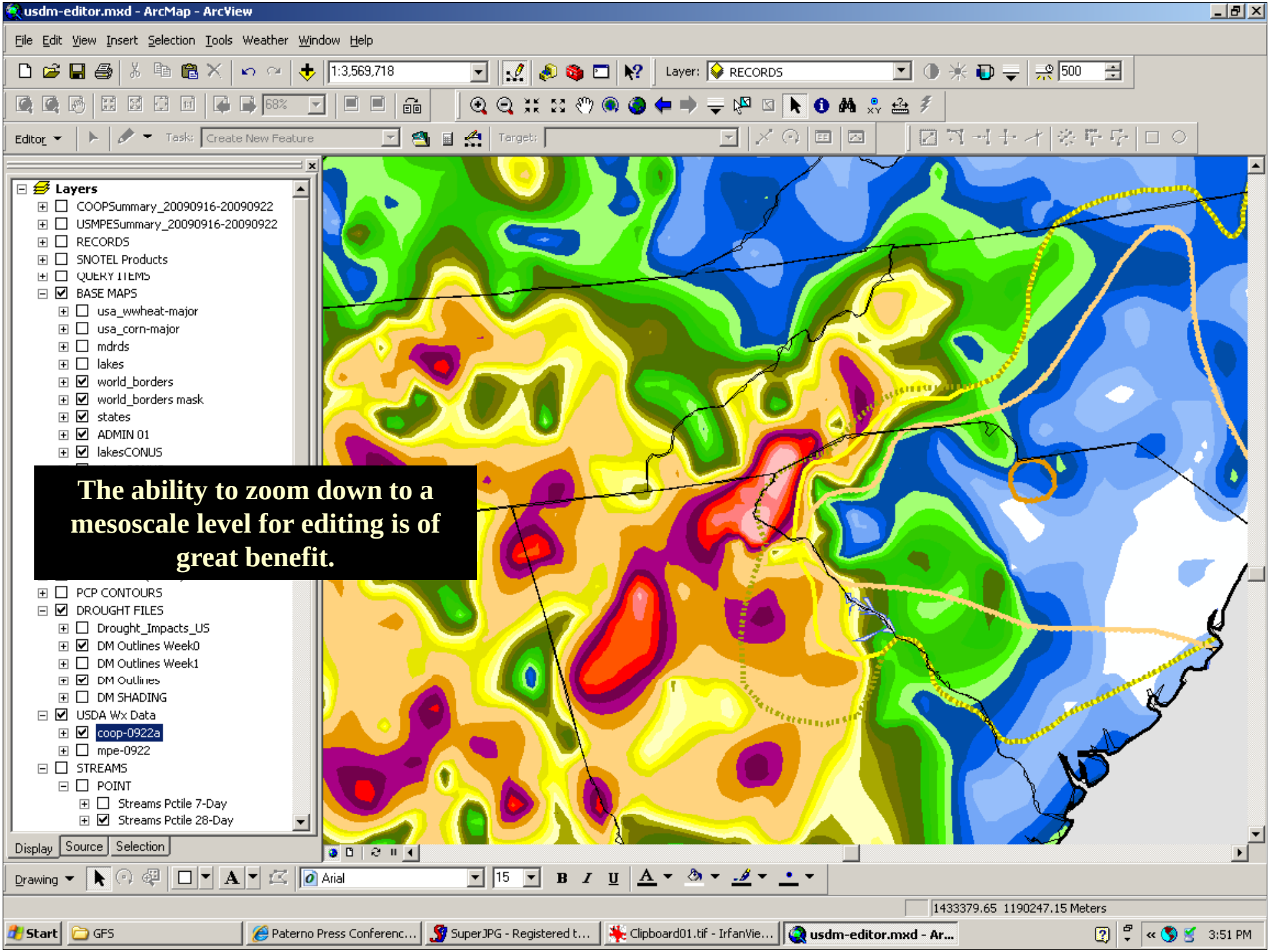
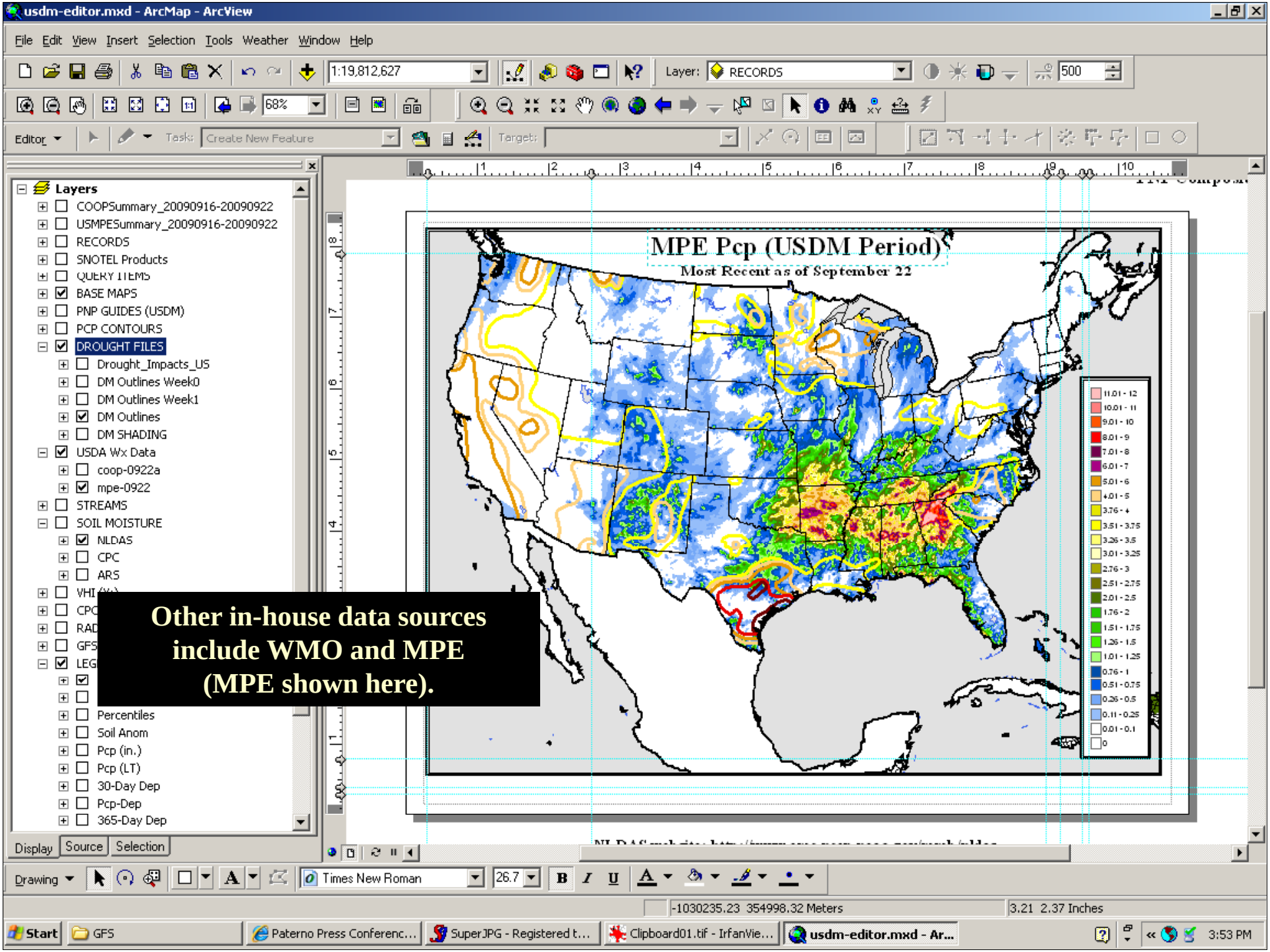
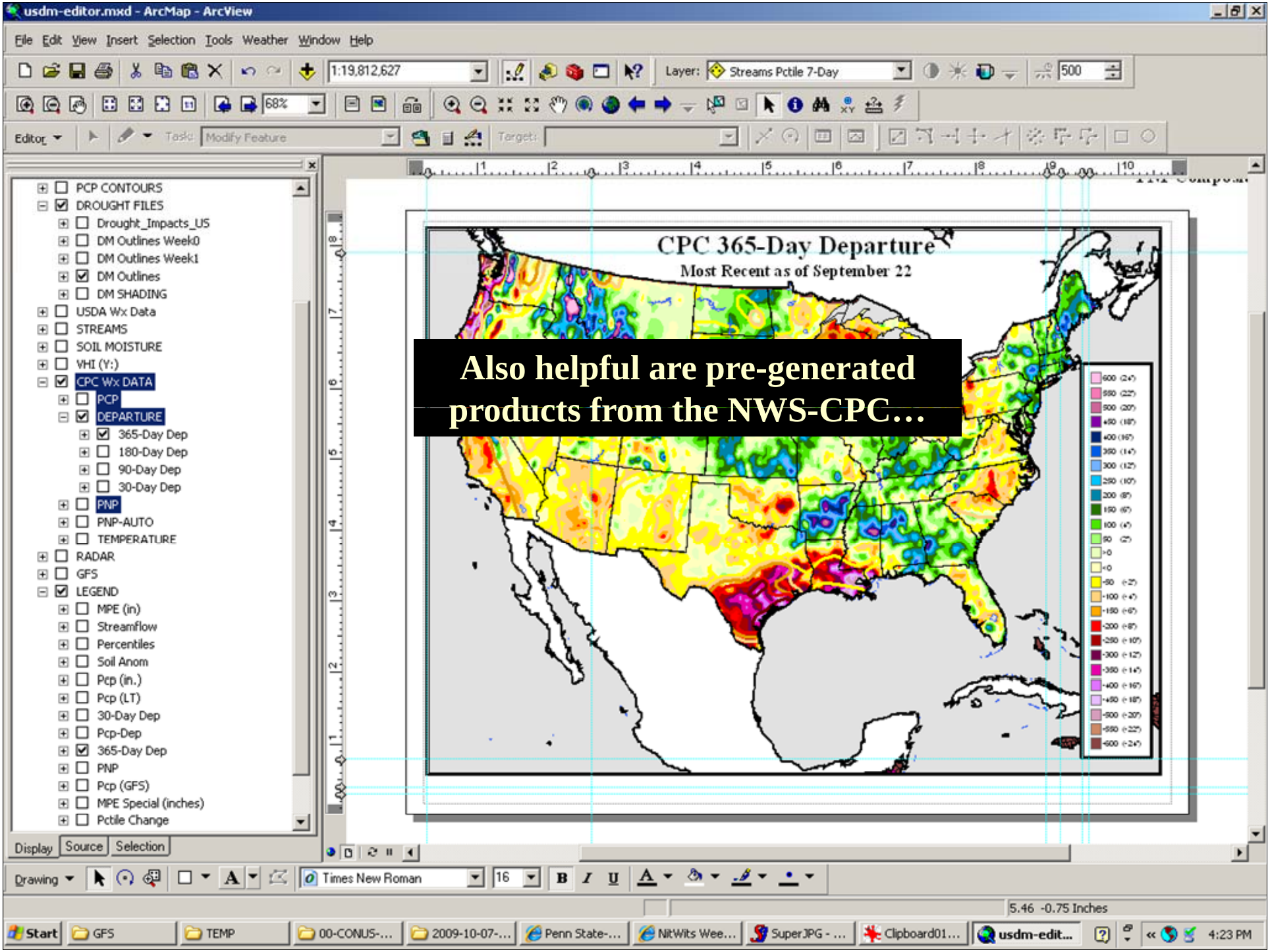


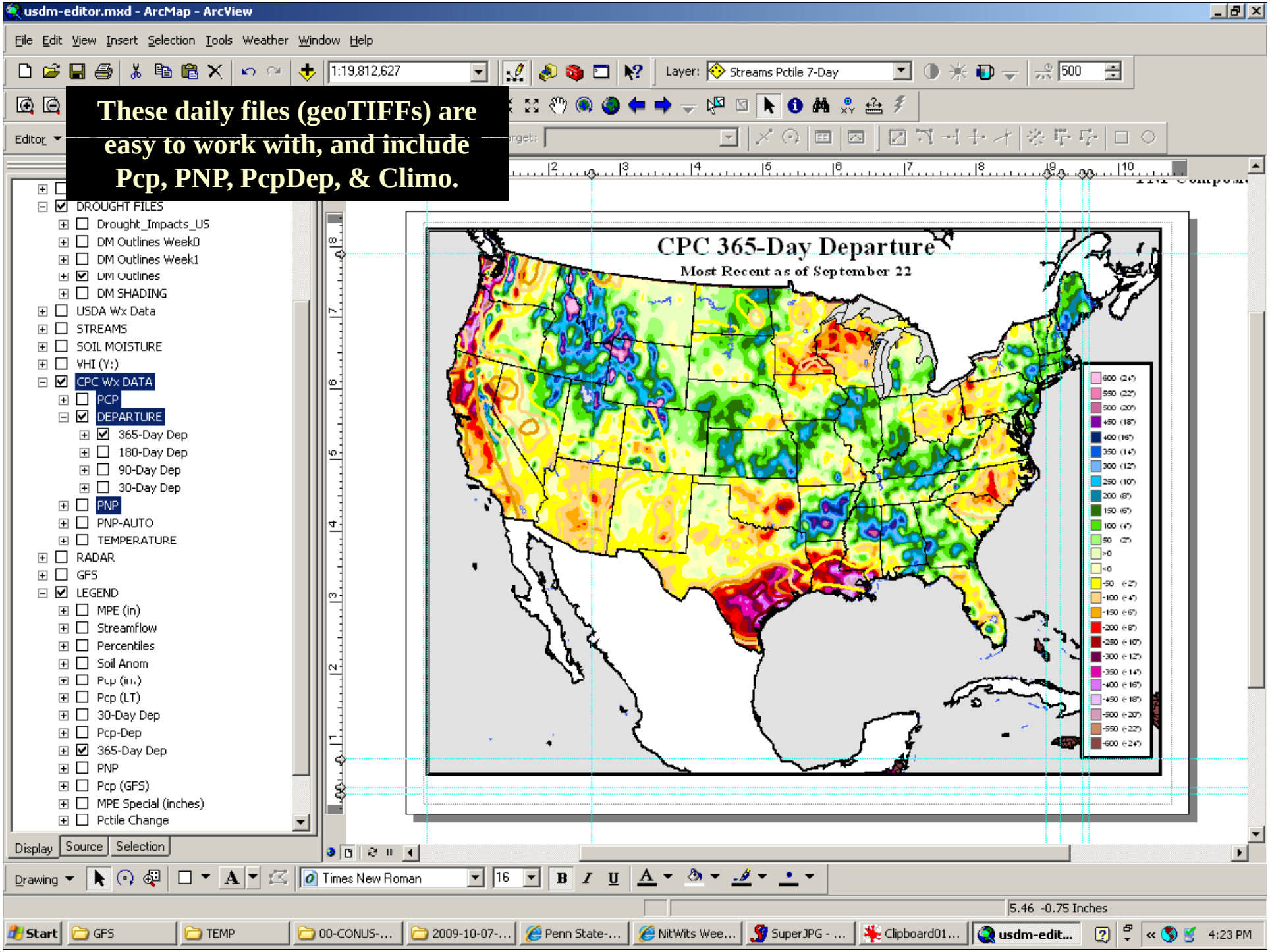
The ability to zoom down to a mesoscale level for editing is of great benefit.

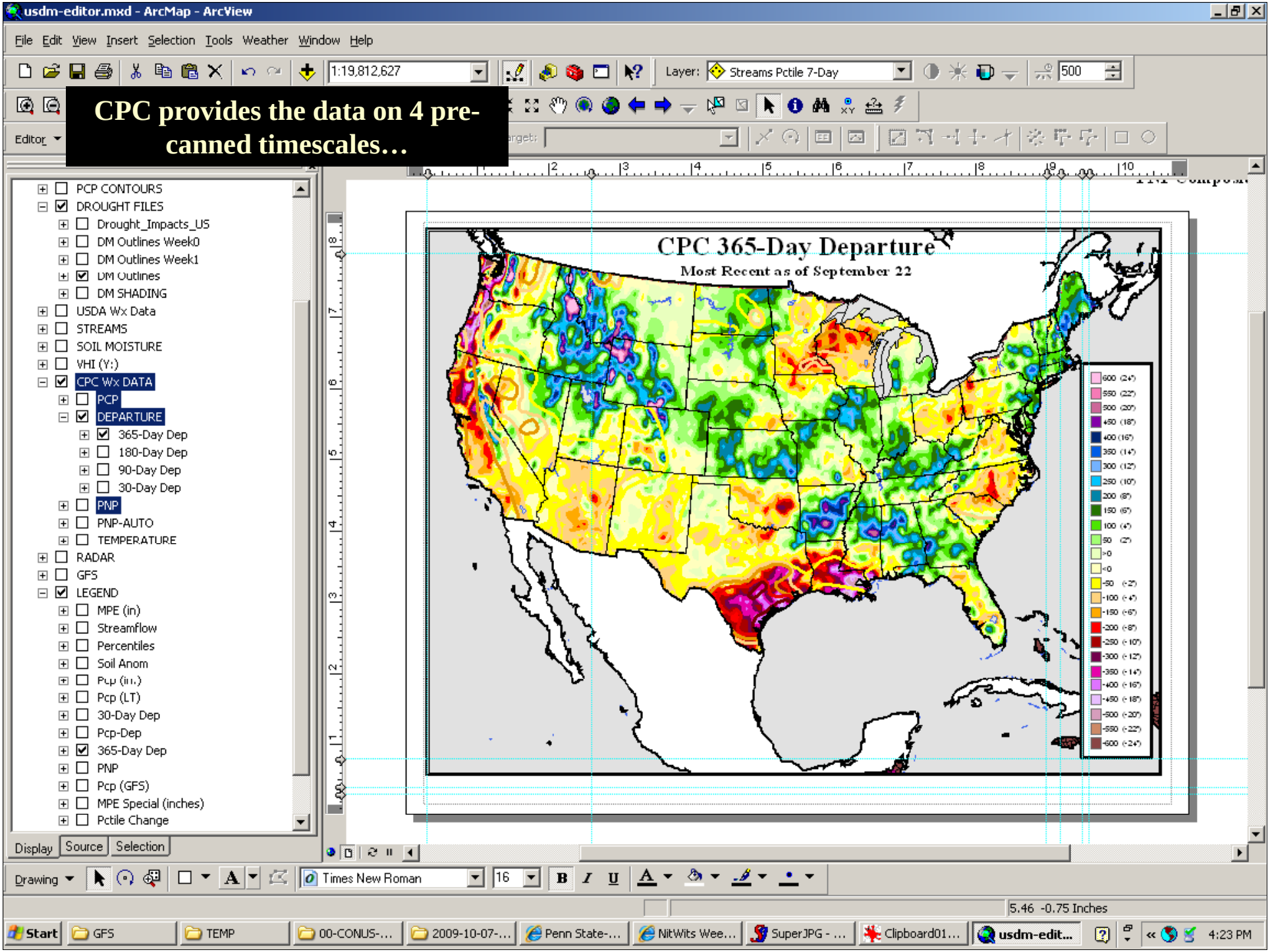


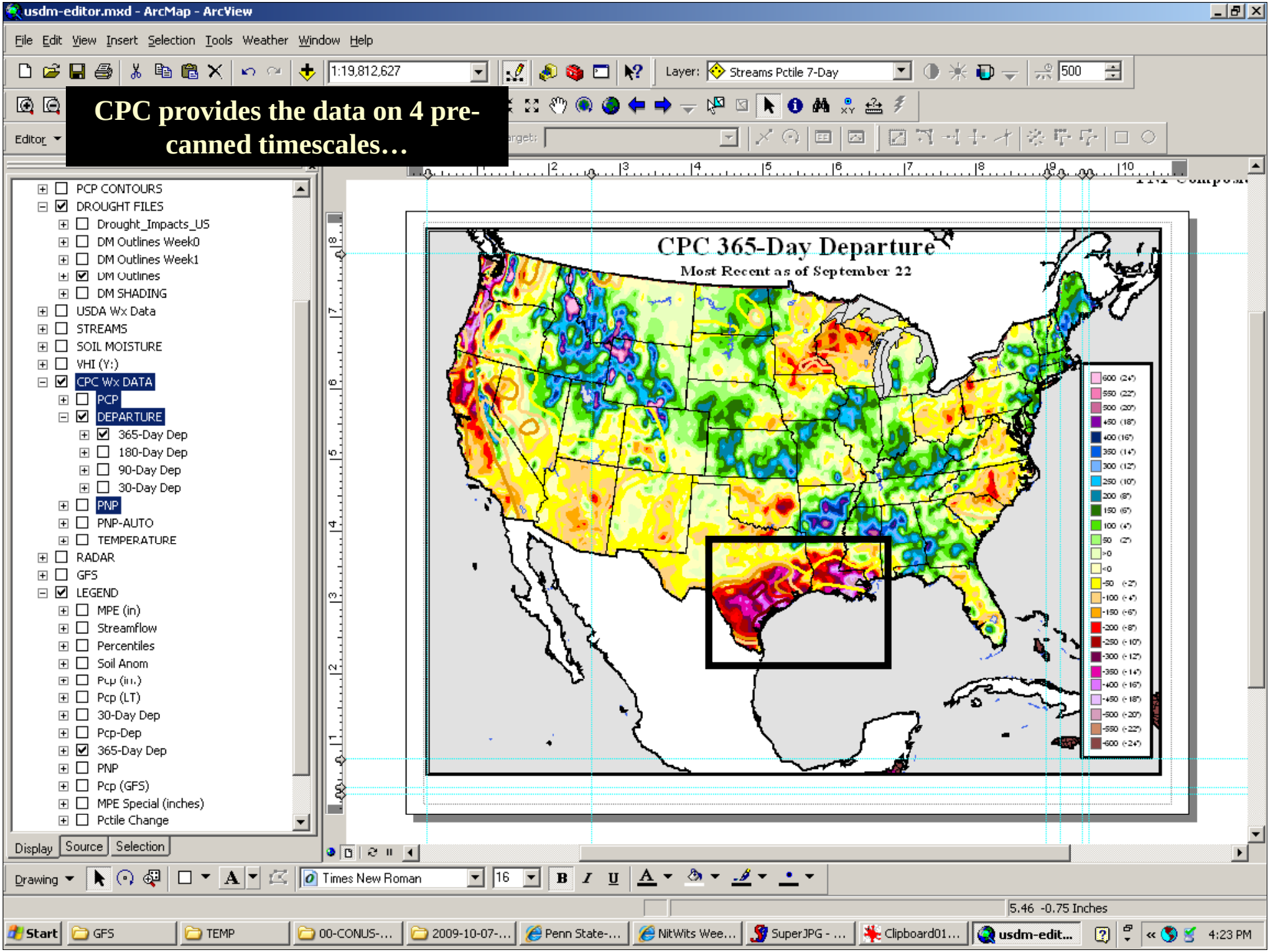
Other in-house data sources include WMO and MPE (MPE shown here).



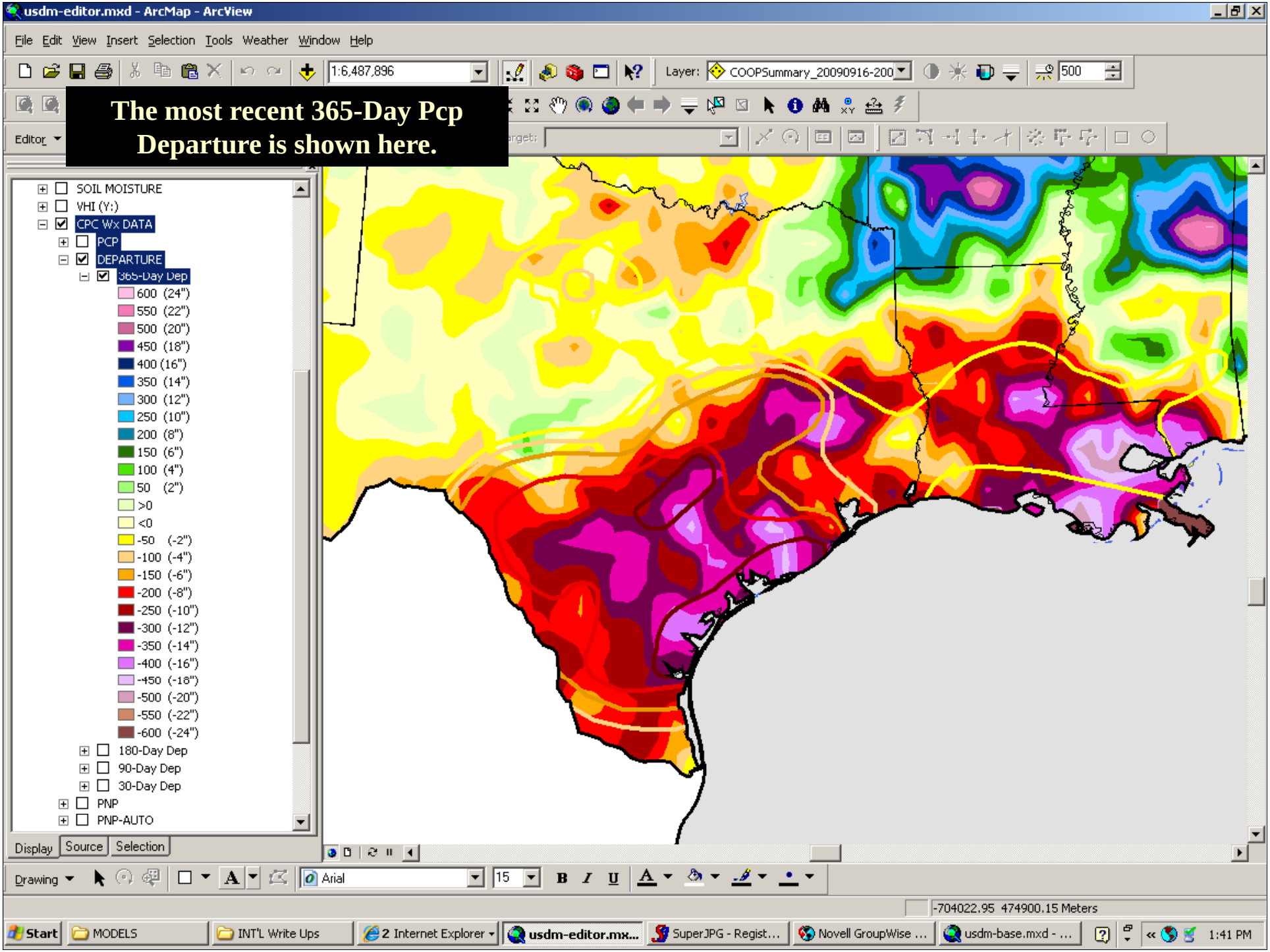
Also helpful are pre-generated products from the NWS-CPC…

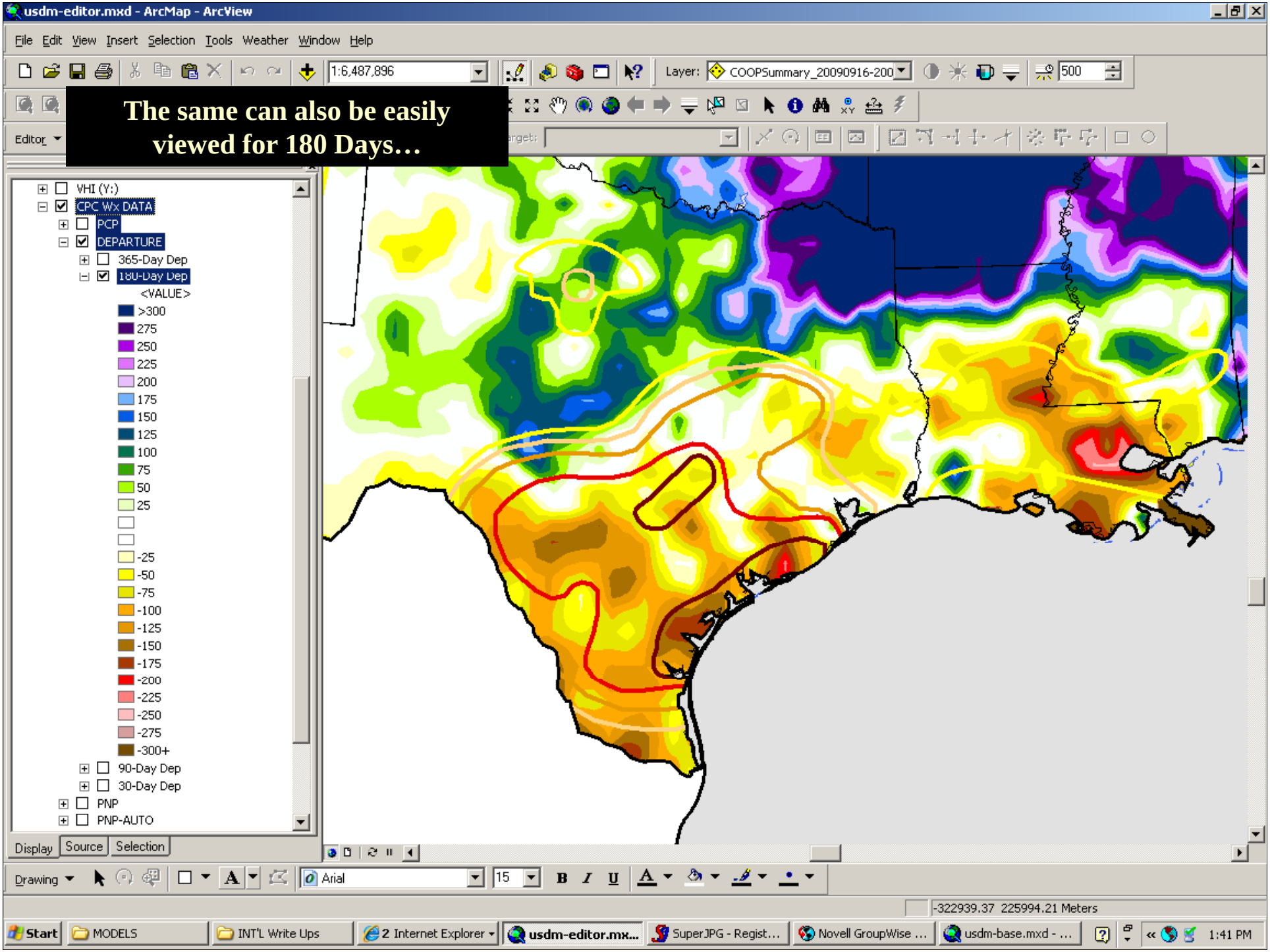

usdm-editor.mxd - ArcMap - ArcView
File Edit View Insert Selection Tools Weather Window Help
1:19,812,627
Layer: Streams Pctile 7-Day
500
Editor
These daily files (geoTIFFs) are easy to work with, and include Pcp, PNP, PcpDep, & Climo.
DROUGHT FILES
Drought_Impacts_US
DM Outlines Week0
DM Outlines Week1
DM Outlines
DM SHADING
USDA Wx Data
STREAMS
SOIL MOISTURE
VHI (Y:)
CPC Wx DATA
PCP
DEPARTURE
365-Day Dep
180-Day Dep
90-Day Dep
30-Day Dep
PNP
PNP-AUTO
TEMPERATURE
RADAR
GFS
LEGEND
MPE (in)
Streamflow
Percentiles
Soil Anom
Pcp (in.)
Pcp (LT)
30-Day Dep
Pcp-Dep
365-Day Dep
PNP
Pcp (GFS)
MPE Special (inches)
Pctile Change
Display
Source
Selection
CPC 365-Day Departure
Most Recent as of September 22
Drawing
Times New Roman
16
5.46 -0.75 Inches
Start
GFS
TEMP
00-CONUS-...
2009-10-07-...
Penn State-...
NitWits Wee...
SuperJPG - ...
Clipboard01...
usdm-edit...
4:23 PM


usdm-editor.mxd - ArcMap - ArcView
File Edit View Insert Selection Tools Weather Window Help
1:19,812,627
Layer: Streams Pctile 7-Day
500
Editor
CPC provides the data on 4 pre-canned timescales…
PCP CONTOURS
DROUGHT FILES
Drought_Impacts_US
DM Outlines Week0
DM Outlines Week1
DM Outlines
DM SHADING
USDA Wx Data
STREAMS
SOIL MOISTURE
VHI (Y:)
CPC Wx DATA
PCP
DEPARTURE
365-Day Dep
180-Day Dep
90-Day Dep
30-Day Dep
PNP
PNP-AUTO
TEMPERATURE
RADAR
GFS
LEGEND
MPE (in)
Streamflow
Percentiles
Soil Anom
Pcp (in.)
Pcp (LT)
30-Day Dep
Pcp-Dep
365-Day Dep
PNP
Pcp (GFS)
MPE Special (inches)
Pctile Change
Display
Source
Selection
CPC 365-Day Departure
Most Recent as of September 22
Drawing
Times New Roman
16
5.46 -0.75 Inches
Start
GFS
TEMP
00-CONUS-...
2009-10-07-...
Penn State-...
NitWits Wee...
SuperJPG - ...
Clipboard01...
usdm-edit...
4:23 PM



CPC provides the data on 4 pre-canned timescales…


usdm-editor.mxd - ArcMap - ArcView
File Edit View Insert Selection Tools Weather Window Help
1:6,487,896
Layer: COOPSummary_20090916-200
500
Editor
The most recent 365-Day Pcp Departure is shown here.
SOIL MOISTURE
VHI (Y:)
CPC Wx DATA
PCP
DEPARTURE
365-Day Dep
600 (24")
550 (22")
500 (20")
450 (18")
400 (16")
350 (14")
300 (12")
250 (10")
200 (8")
150 (6")
100 (4")
50 (2")
>0
<0
-50 (-2")
-100 (-4")
-150 (-6")
-200 (-8")
-250 (-10")
-300 (-12")
-350 (-14")
-400 (-16")
-450 (-18")
-500 (-20")
-550 (-22")
-600 (-24")
180-Day Dep
90-Day Dep
30-Day Dep
PNP
PNP-AUTO
Display Source Selection
Drawing
Arial
15
-704022.95 474900.15 Meters
Start
MODELS
INT'L Write Ups
2 Internet Explorer
usdm-editor.mx...
SuperJPG - Regist...
Novell GroupWise ...
usdm-base.mxd - ...
1:41 PM


usdm-editor.mxd - ArcMap - ArcView
File Edit View Insert Selection Tools Weather Window Help
1:6,487,896
Layer: COOPSummary_20090916-200
500
Editor
The same can also be easily viewed for 180 Days…
VHI (Y:)
CPC Wx DATA
PCP
DEPARTURE
365-Day Dep
180-Day Dep
<VALUE>
>300
275
250
225
200
175
150
125
100
75
50
25
-25
-50
-75
-100
-125
-150
-175
-200
-225
-250
-275
-300+
90-Day Dep
30-Day Dep
PNP
PNP-AUTO
Display
Source
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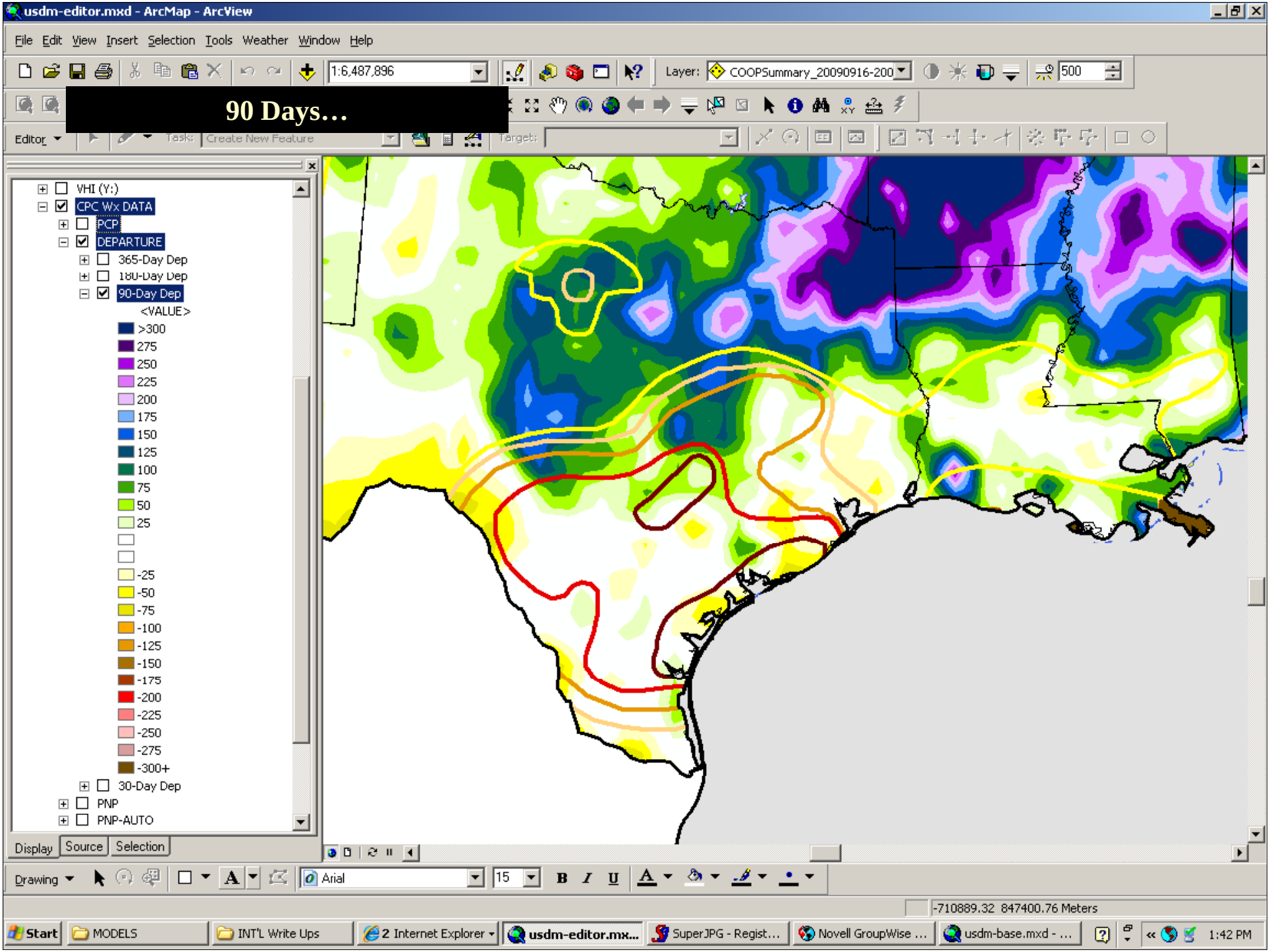
Novell GroupWise ...
usdm-base.mxd - ...
1:41 PM


usdm-editor.mxd - ArcMap - ArcView
File Edit View Insert Selection Tools Weather Window Help
1:6,487,896
Layer: COOPSummary_20090916-200
500
90 Days…
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Task: Create New Feature
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>300
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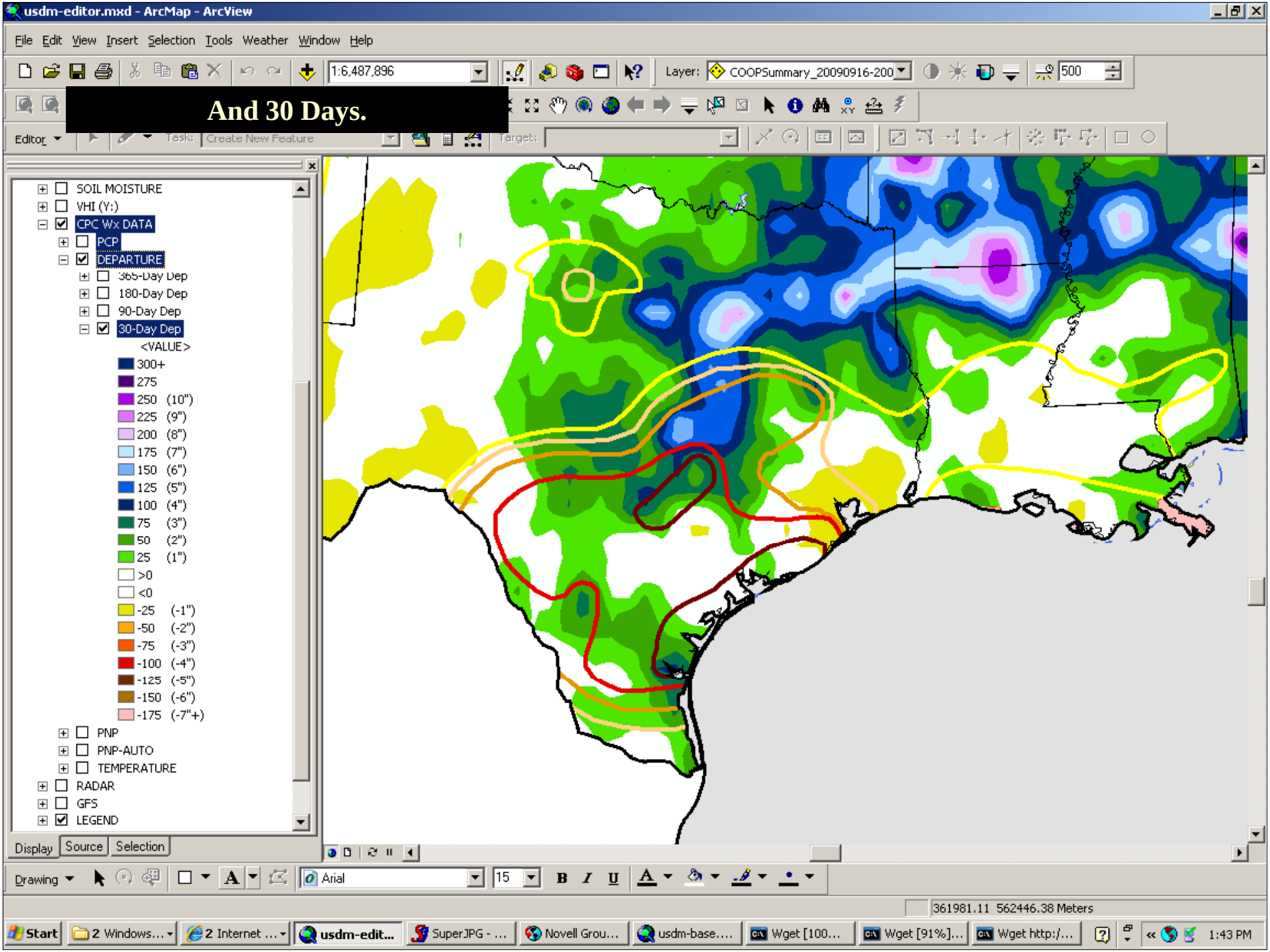
usdm-editor.mxd - ArcMap - ArcView
File Edit View Insert Selection Tools Weather Window Help
1:6,487,896
Layer: COOPSummary_20090916-200
500
And 30 Days.
Editor
Task: Create New Feature
Target:
SOIL MOISTURE
VHI (Y:)
CPC Wx DATA
PCP
DEPARTURE
365-Day Dep
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175 (7")
150 (6")
125 (5")
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75 (3")
50 (2")
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>0
<0
-25 (-1")
-50 (-2")
-75 (-3")
-100 (-4")
-125 (-5")
-150 (-6")
-175 (-7"+)
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Novell Grou...
usdm-base....
Wget [100...
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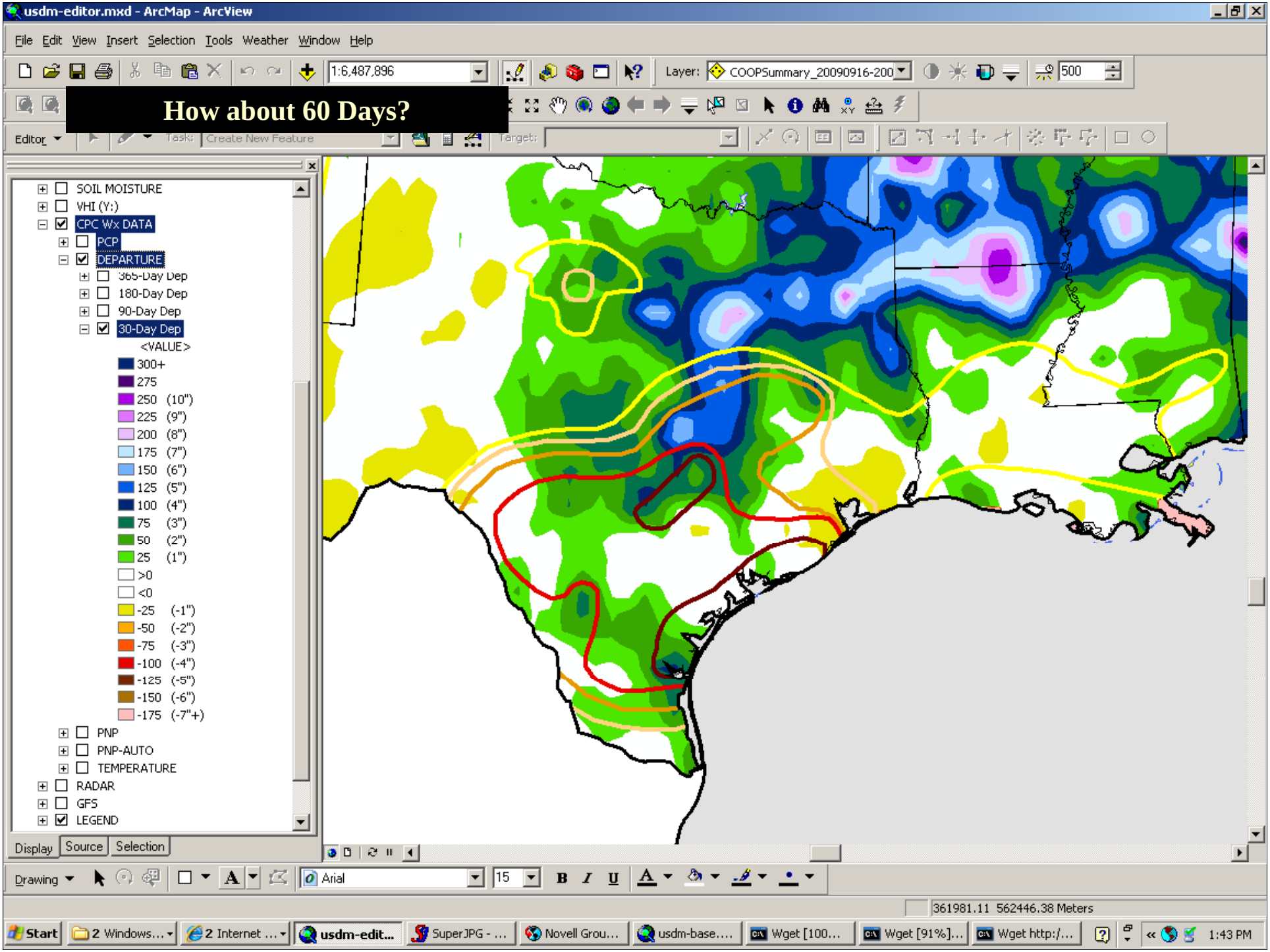
How about 60 Days?
usdm-editor.mxd - ArcMap - ArcView
File Edit View Insert Selection Tools Weather Window Help
1:6,487,896
Layer: COOPSummary_20090916-200
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Editor
Task: Create New Feature
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SOIL MOISTURE
VHI (Y:)
CPC Wx DATA
PCP
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180-Day Dep
90-Day Dep
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SuperJPG - ...
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usdm-base....
Wget [100...
Wget [91%]...
Wget http:/...
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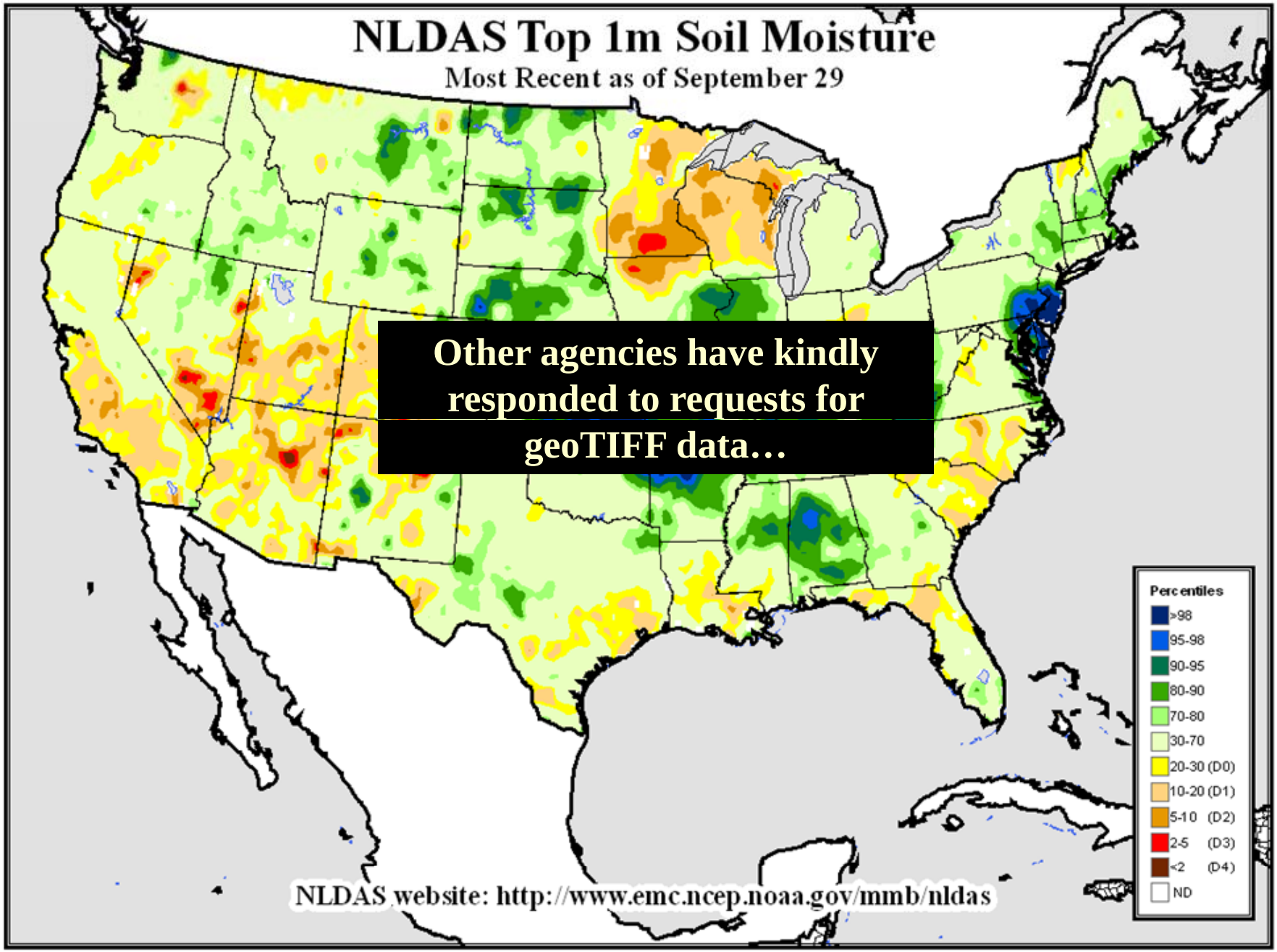
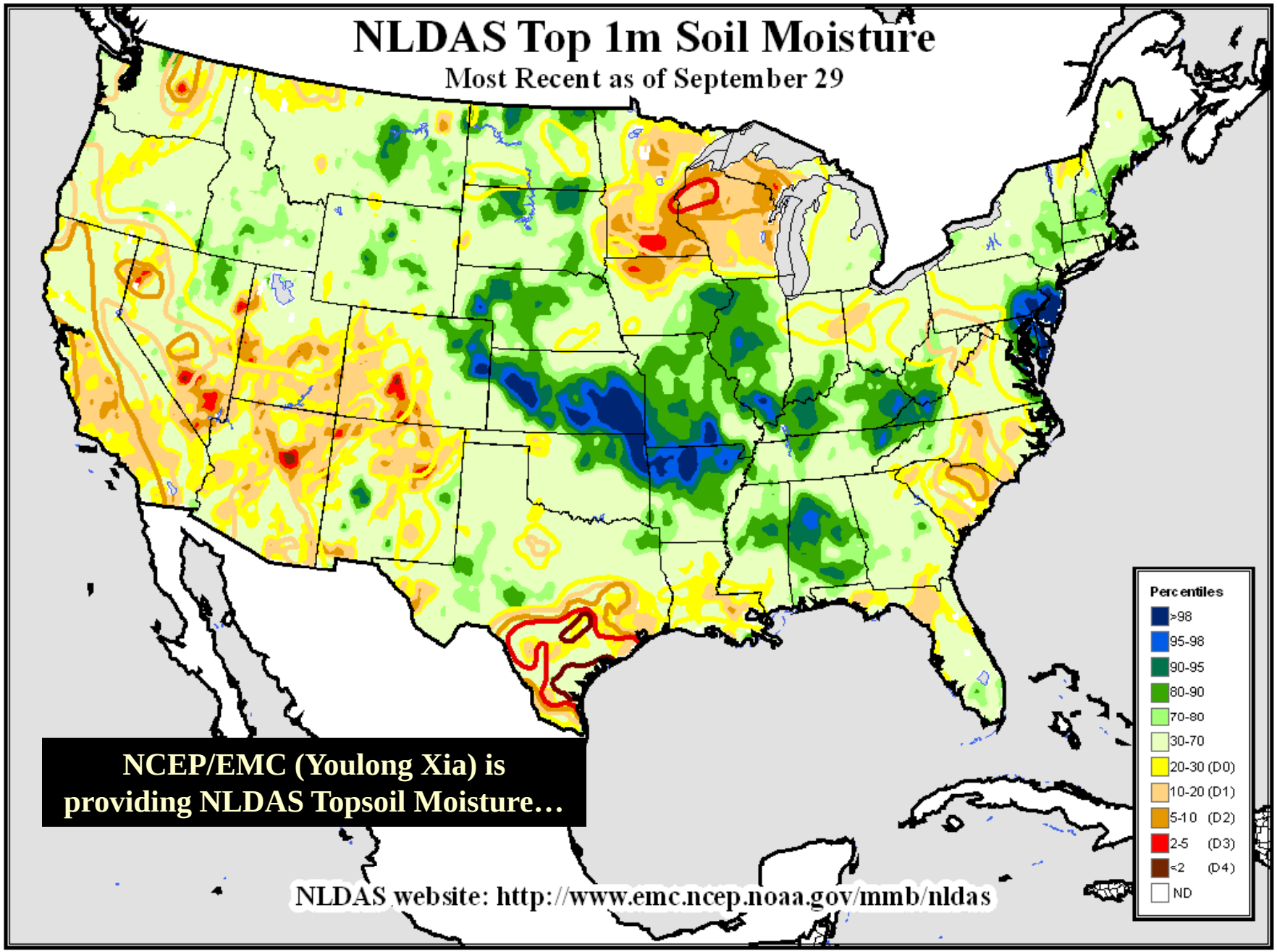
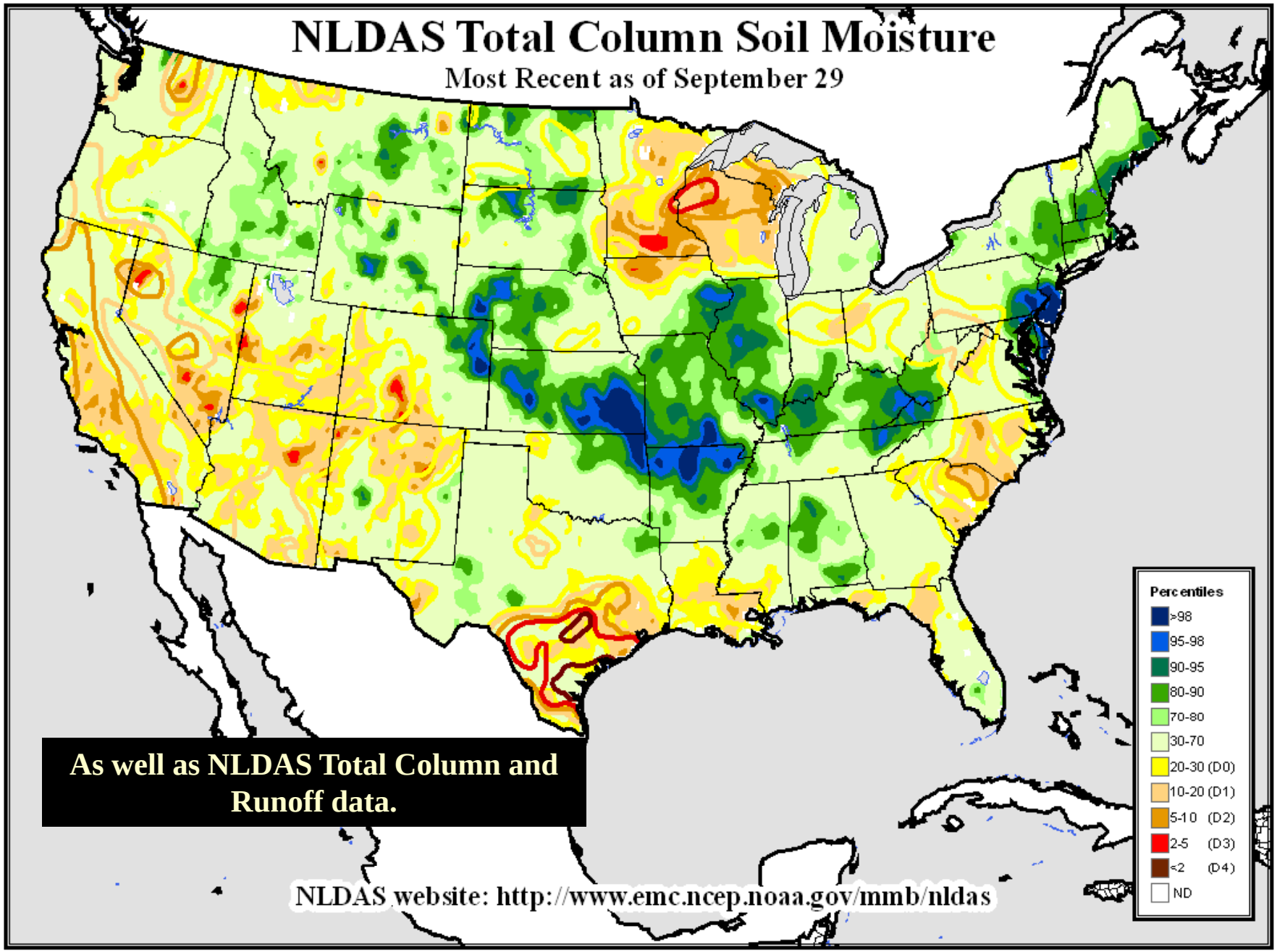
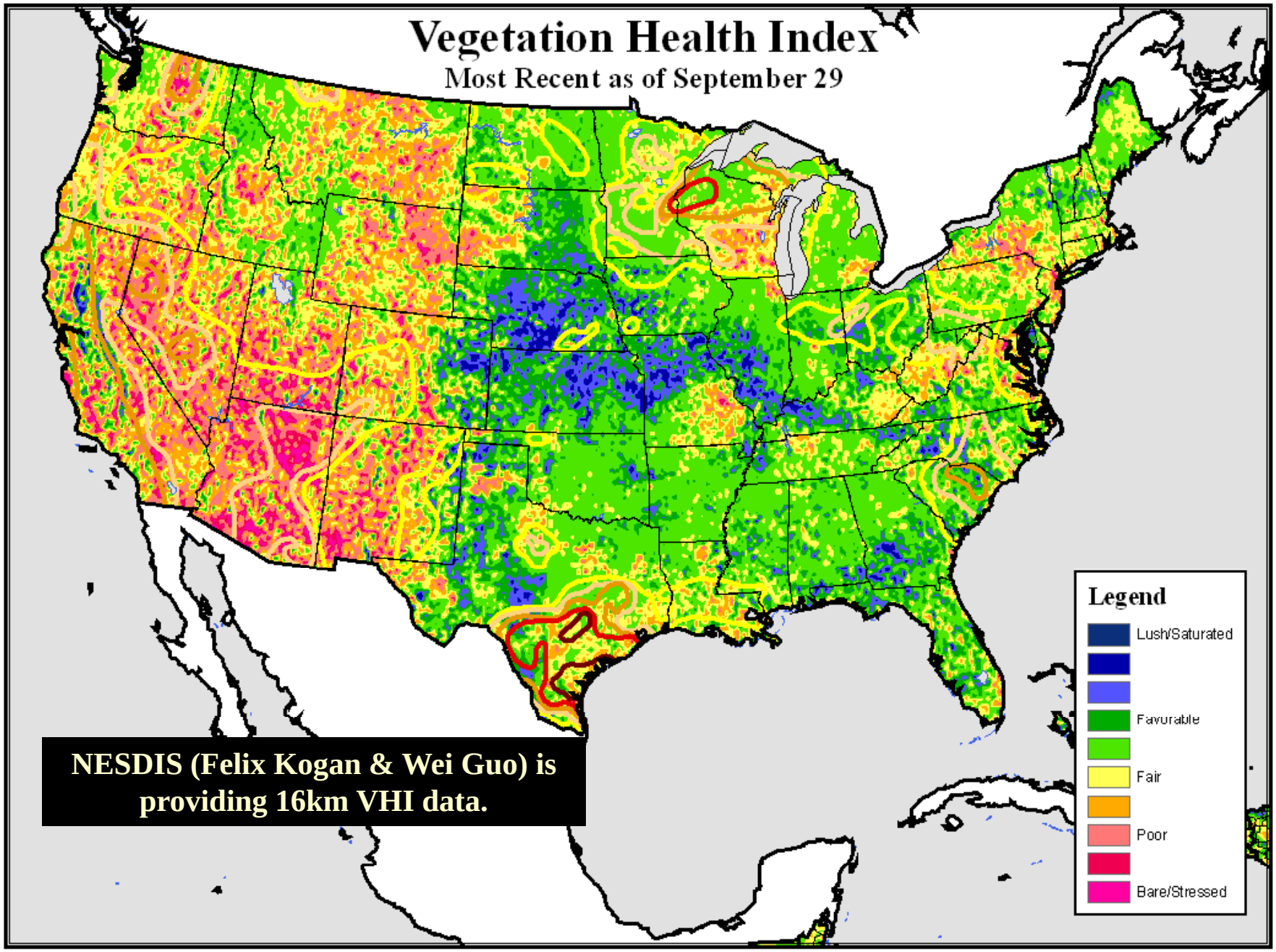


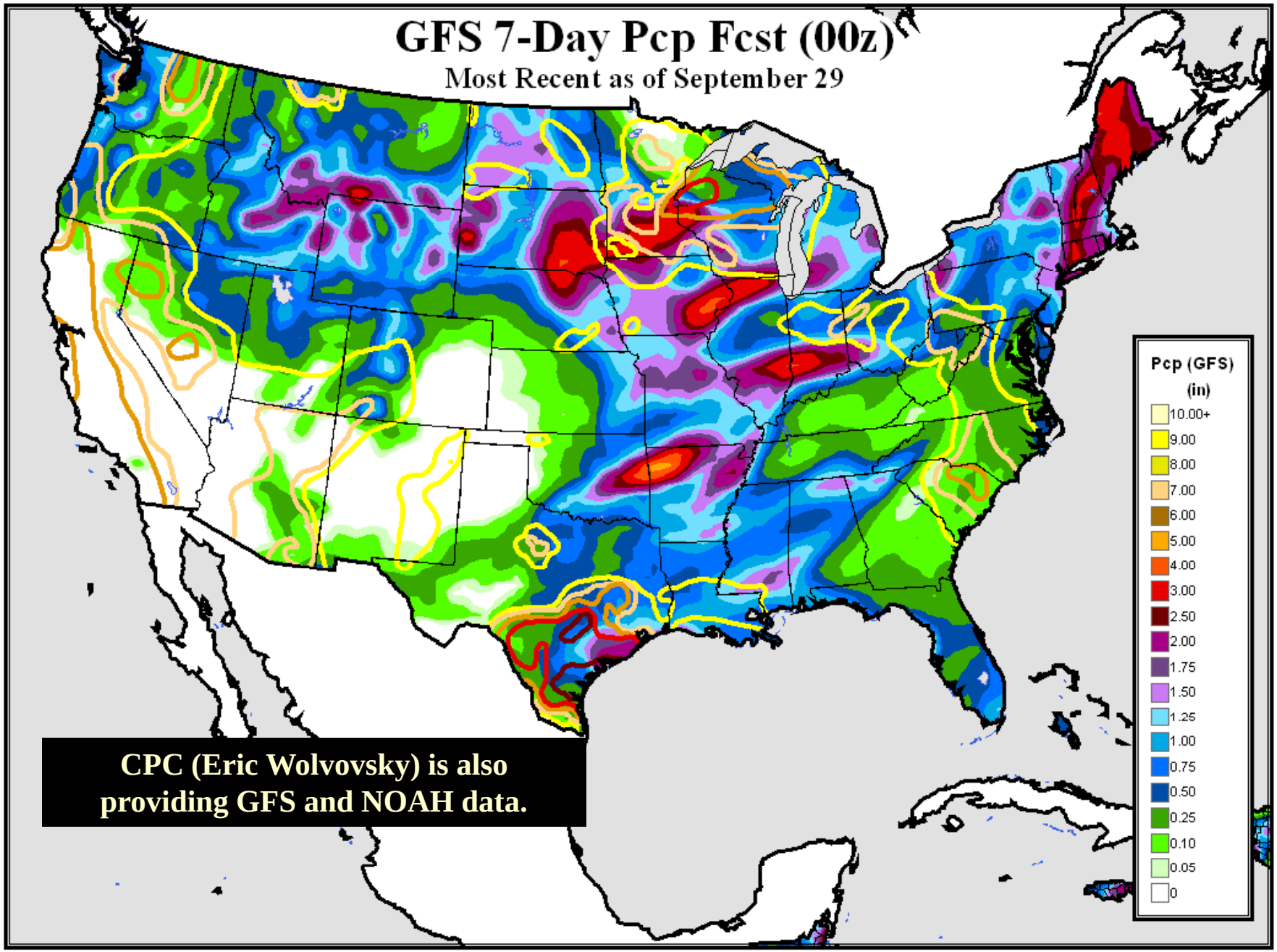
Other agencies have kindly responded to requests for geoTIFF data…


NLDAS Top 1m Soil Moisture
Most Recent as of September 29
Percentiles
>98
95-98
90-95
80-90
70-80
30-70
20-30 (D0)
10-20 (D1)
5-10 (D2)
2-5 (D3)
<2 (D4)
ND
NCEP/EMC (Youlong Xia) is providing NLDAS Topsoil Moisture…
NLDAS website: http://www.emc.ncep.noaa.gov/mmb/nldas

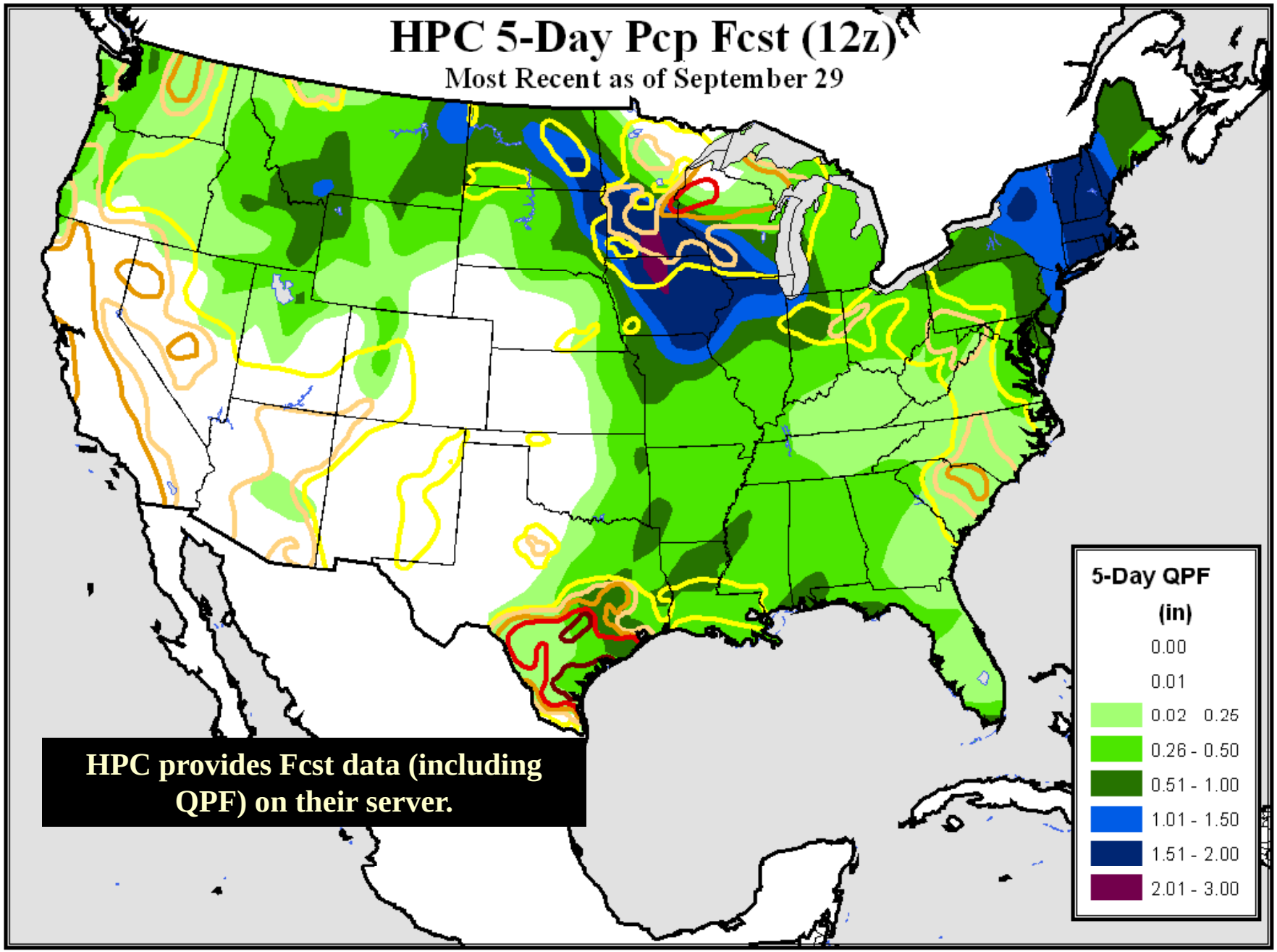

NLDAS Total Column Soil Moisture
Most Recent as of September 29
Percentiles
>98
95-98
90-95
80-90
70-80
30-70
20-30 (D0)
10-20 (D1)
5-10 (D2)
2-5 (D3)
<2 (D4)
ND
As well as NLDAS Total Column and Runoff data.
NLDAS website: http://www.emc.ncep.noaa.gov/mmb/nldas



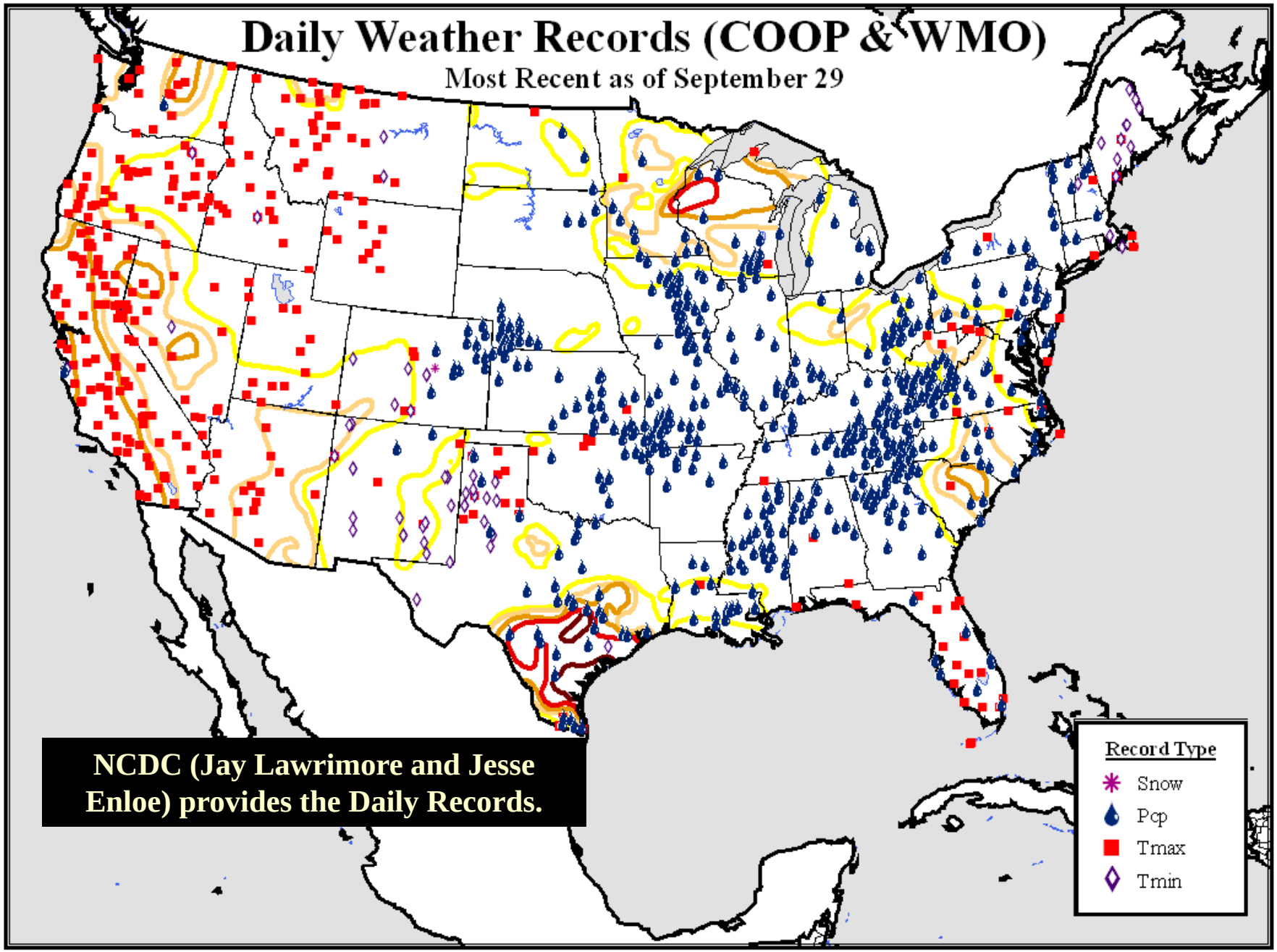
NESDIS (Felix Kogan & Wei Guo) is providing 16km VHI data.



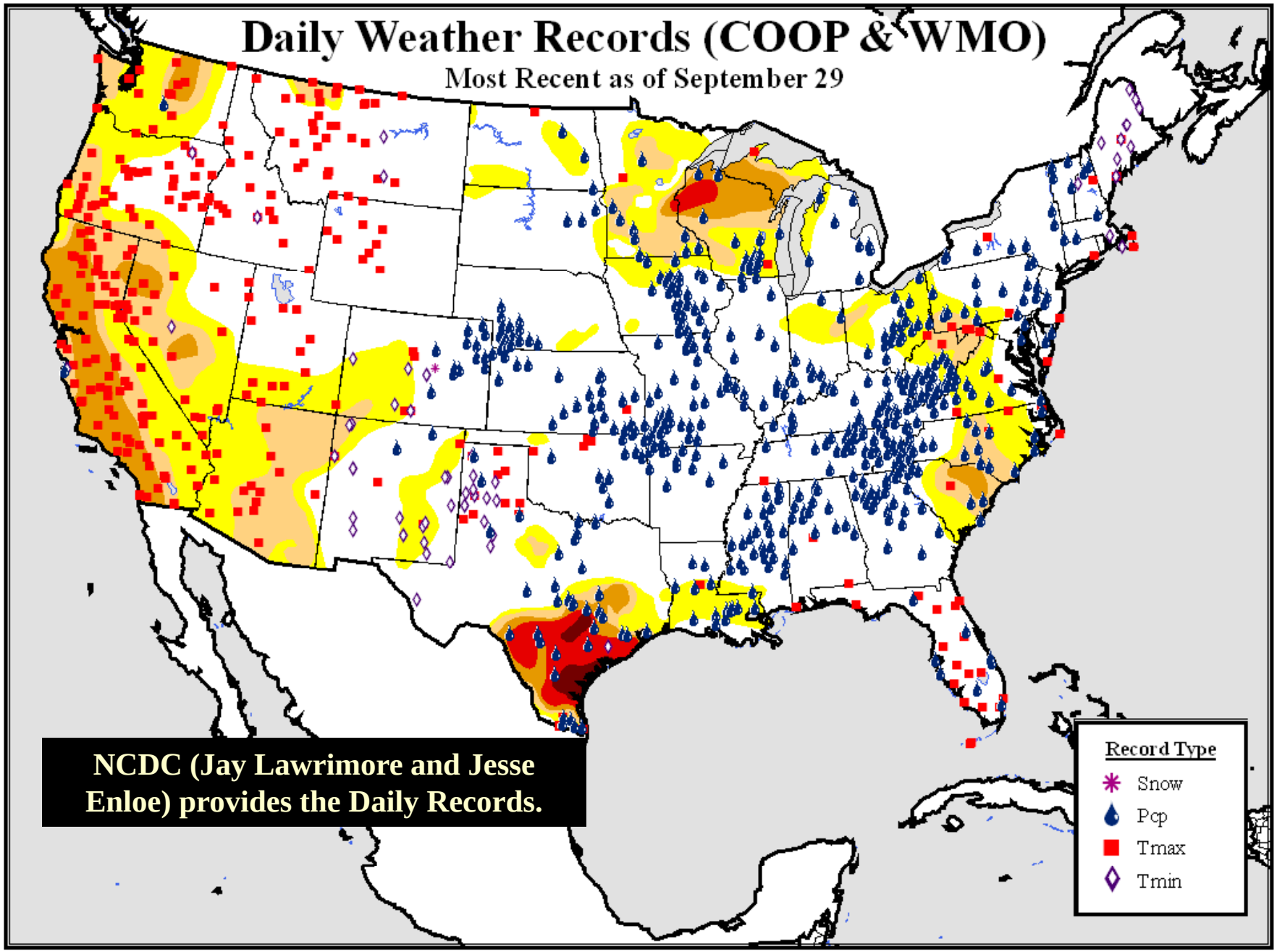
CPC (Eric Wolvovsky) is also providing GFS and NOAH data.



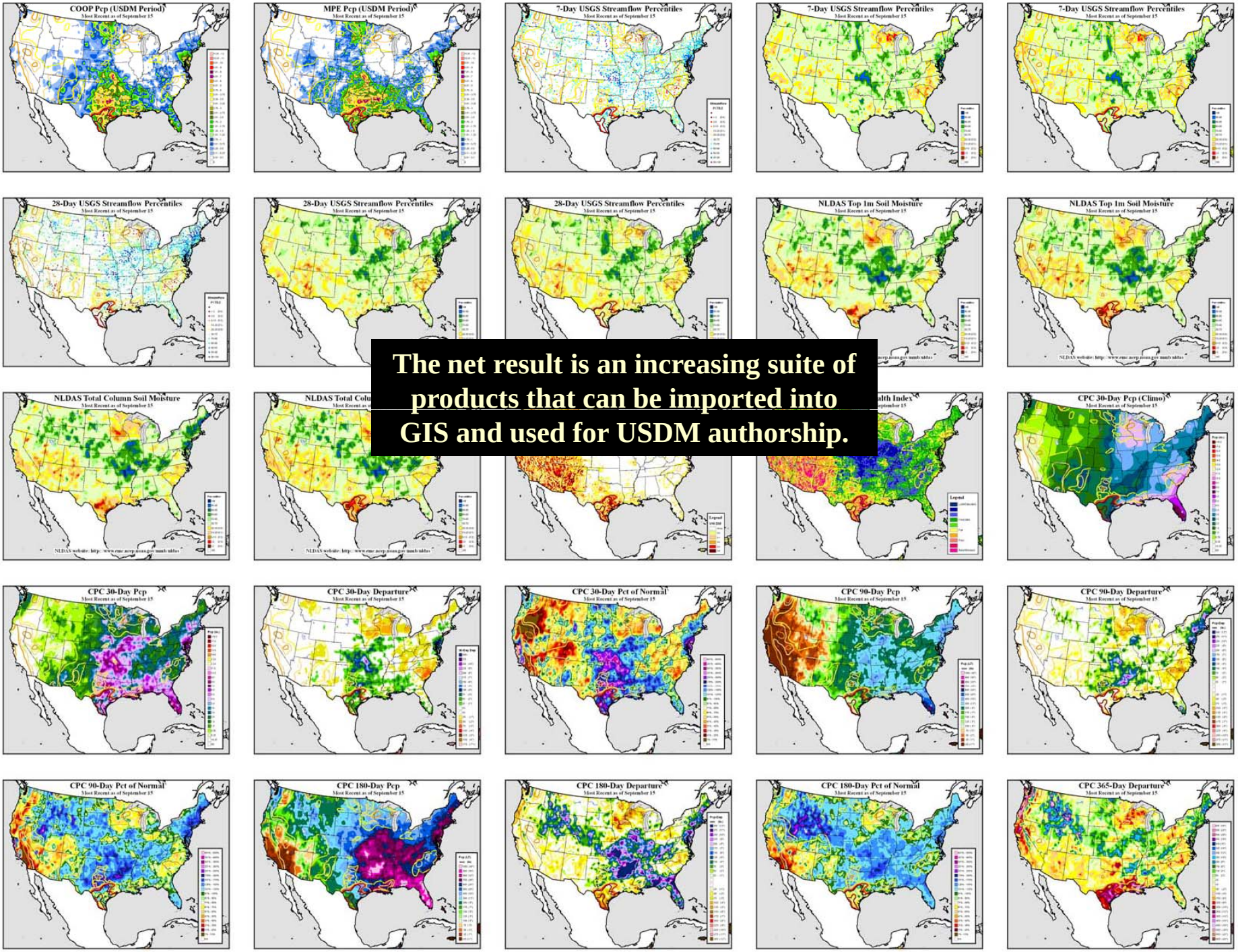
HPC provides Fcst data (including QPF) on their server.



NCDC (Jay Lawrimore and Jesse Enloe) provides the Daily Records.



NCDC (Jay Lawrimore and Jesse Enloe) provides the Daily Records.



The net result is an increasing suite of products that can be imported into GIS and used for USDM authorship.

Other global web resources are adding GIS as an export option as well…

GPCC VISUALIZER - Windows Internet Explorer

http://orias.dwd.de/GPCC/GPCC_Visualizer

GPCC (Global Precipitation Climatology Center) offers ASCII and an ARCVIEW Grid as export options for their data.

Deutscher Wetterdienst

GPCC - VISUALIZER

DATASET	GPCC Landsurface First Guess Product 1.0°	COASTLINES	LOWRES
PRODUCT	PRECIP. PERCENTAGE OF NORMALS	OUTPUT	GIF (GIF, PNG, POSTSCRIPT, PDF, ASCII, ARCVIEW GRID)
PERIOD	AUGUST	GIF-SCALE	
YEAR	2009 (for winter 86/87 eg. select 1987)	SHOW	
Menu / AREA / Userdefined	GLOBAL (-180°/+180°); LON_min -180. LON_max +180. LAT_min -90. LAT_max +90. ZOOM-Window	COLOR	COLOR
		PROJECTION	LAT/LON

START VISUALISATION

Download GPCC data | GPCC Product Info | Customer Feedback

By Peter Finger and GrADS , Copyright © DWD/WZN (GPCC), 1996/2005 Go Back

IEM | GIS Homepage - Windows Internet Explorer

http://mesonet.agron.iastate.edu/GIS/

File Edit View Favorites Tools Help

IEM | GIS Homepage

Iowa Environmental Mesonet
Iowa State University Department of Agronomy

Over 1 billion observations collected

Archive | Current | Climatology | Info | IEM Networks | GIS | Roads

Browse Data | NEXRAD Data | OGC Webservices | Rainfall Data | RadMap API

Iowa State University's Department of Agronomy has a wealth of GIS data.

IEM GIS Information

Geographic Information System (GIS) is a system for manipulating spatially referenced data. Since the IEM contains many spatially referenced datasets, it would only seem natural to integrate IEM data into GIS applications.

Presentations & Docs:

- *28 Jul 2003:* NEXRAD + Mapserver HOWTO
  A HowTo on generating NEXRAD composite images with GEMPAK and serving them out with Mapserver.
- IEM Presentation Archive
  The IEM has given a number of GIS related talks. You can browse an archive of presentations.

Web Applications:

- NEXRAD w/ warnings
- COOP Daily Extremes and Averages
- Dynamic Plotting
- IEM Site Locator

Links:

- US Drought Monitor GIS data
  Download current and historical drought monitor products in GIS formats
- GIS Severe Weather reports

GIS READY! You may have noticed this image appearing on IEM webpages. It signifies that the data link is ready for most GIS systems.

IEM GIS Projects

- GOES Satellite GIS Products
  Current and archived GIS products from NOAA's GOES satellites
- Open GIS Web Services
  A listing of OGC web services offered by the IEM
- Iowa Climate Summaries
  GIS ready data files of monthly and yearly climate summaries dating back to 1951.
- IEM Freeze
  Web mapping application to support winter weather nowcasting.
- IEM Radview
  Our effort to provide NEXRAD information in realtime to GIS systems.
- IEM Rainfall
  Gridded rainfall estimates in GIS formats dating back to 2002 for Iowa.
- IEM Iowa Road Conditions

Internet 100%

Start | IEM | GIS Hom... | play.it Radio Play... | SuperJPG - Regist... | Luebehusen-USD... | Presentation7 | Presentation8 | usdm-editor.mxd ... | 3:36 PM

percentile [NOAA NCEP CPC CAMS_OPI v0208 anomaly (prcp * 30.)] / [(NOAA NCEP CPC CAMS_OPI - Windows Internet Explorer

http://iridl.ldeo.columbia.edu/expert/ds:/SOURCES/.NOAA/.NCEP/.CPC/.CAMS_OPI/.v0208/.anomaly/.prcp/30/mul/SOURCES/.UEA/.CRU/.New/.CRU05

File Edit View Favorites Tools Help

NCEP CPC CAMS_OPI v0208 anomaly prcp } , 0 , 0)] dataset

help

The International Research Institute (IRI) offers 2 GIS-readable formats for their global weather files (2-D Table and LAN Image).

netCDF (network Common Data Form)	A commonly suppo

Partial Information Formats

These files contain only some of the available metadata.

Columnar Table	A table with separate columns of numbers for each independent variable (i.e., grids) and for the data. This columnar table is available in a variety of file and column formats here. Note: By setting the helper for mime-type *text/tab-separated-values*, you can have this loaded directly into your favorite spreadsheet. This file will be approximately 96768 bytes, with 3 columns of 8064 numbers.
2-Dimensional Tab-Separated Tables Y X Table X Y Table	Tab-separated-values (tsv) file with information about the independent variables (i.e., grids). The list to the left allows you to specify the format of the table. Note: The variable running across the top of the table (identifing columns) is listed first and the variable running down the side of the table (identifing rows) is listed second.

GIS-Compatible Formats

There are three GIS-compatible formats available.

2-Dimensional Table	A 2-dimensional ascii file that includes an ArcInfo Header.
IDA Image	File(s) in the Image Display and Analysis format. Typically used with WinDisp.
LAN Image	File(s) in the ERDAS LAN format. Typically used with various GIS programs, including ArcView and HealthMapper.

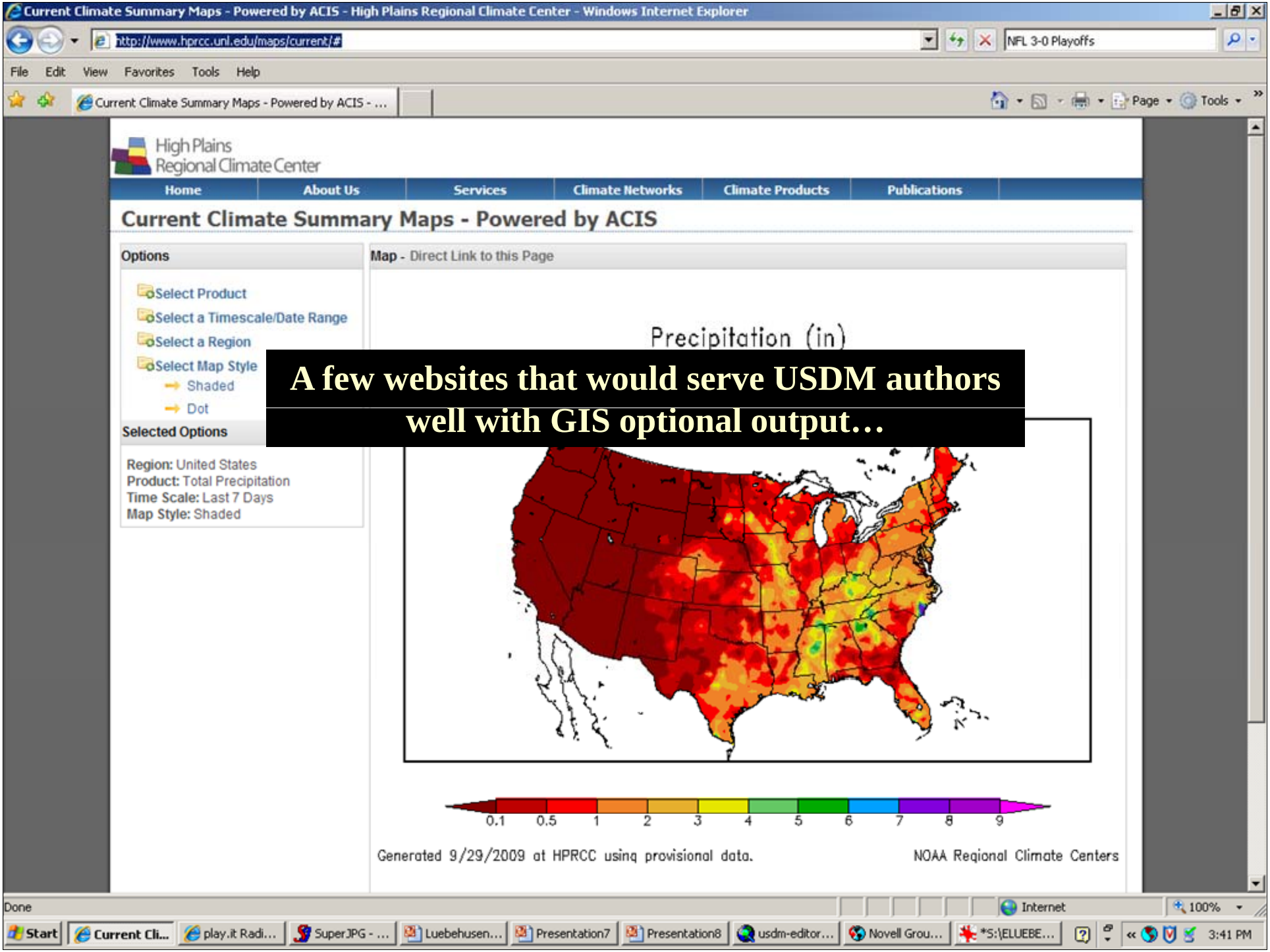
Data Only Formats

These files contain just the data without any of the available metadata.

Binary direct access	A big-endian, ieee single-precision file in floating-point format. Also known as a binary random access file. This is a random-access file; it is purely data with no record-structuring information. The data is structured to correspond to the independent variables (i.e., grids) in X Y order, with the first grid varying the fastest.
DEC ALPHA direct access	Same as the binary random/direct access format above except that it is byte-swapped for DEC ALPHA's and PC's (little-endian).
Binary FORTRAN sequential access	A big-endian, ieee, single-precision file in floating-point format. This is a sequential-access file with each record containing one point. It **must** be read using FORTRAN sequential access. Records correspond to X Y, with the first grid varying the fastest.
DEC ALPHA sequential access	Same as the binary sequential access format above except that it is byte-swapped for DEC ALPHA's and PC's (little-endian).
	Text file where data values corresponding to different **X** are separated by tabs and data values corresponding to different **Y** are on different lines. This is

Done, but with errors on page. Internet 100%

Start | percentile [... | play.it Radio P... | SuperJPG - Re... | Luebehusen-U... | Presentation7 | Presentation8 | usdm-editor.m... | *S:\ELUEBEHU... | 3:34 PM



A few websites that would serve USDM authors well with GIS optional output…

Current Climate Summary Maps - Powered by ACIS - High Plains Regional Climate Center - Windows Internet Explorer

http://www.hprcc.unl.edu/maps/current/#

File Edit View Favorites Tools Help

High Plains Regional Climate Center

Home | About Us | Services | Climate Networks | Climate Products | Publications

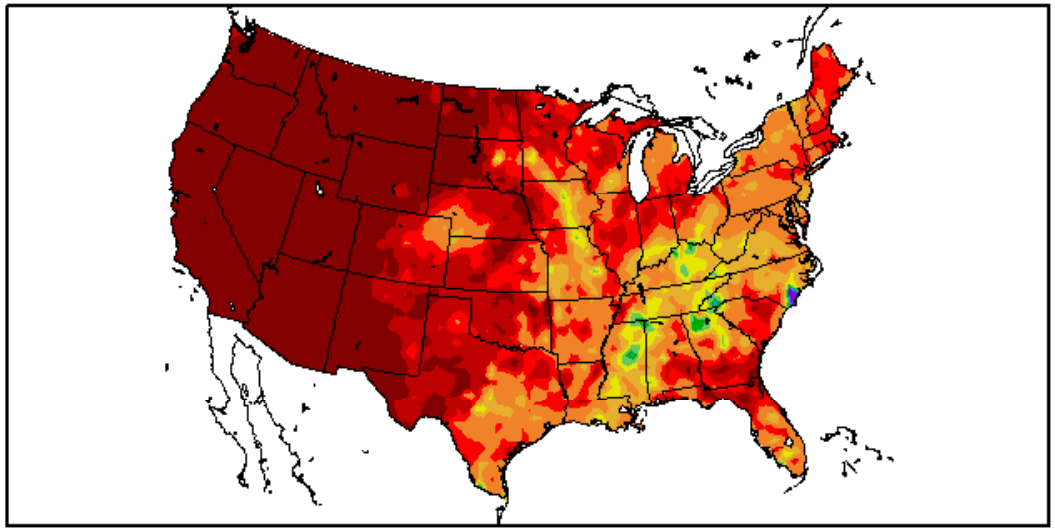
The High Plains Regional Climate Center's ACIS site is frequently used by Drought Exploder folks as a reference; if authors can bring this data into GIS, it would save us a great deal of time.

Select Map Style
- Shaded
- Dot

Selected Options

Region: United States
Product: Total Precipitation
Time Scale: Last 7 Days
Map Style: Shaded

cipitation (in)
9/22/2009 – 9/28/2009



0.1 0.5 1 2 3 4 5 6 7 8 9

Generated 9/29/2009 at HPRCC using provisional data.

NOAA Regional Climate Centers

CoCoRaHS - Community Collaborative Rain, Hail & Snow Network - Windows Internet Explorer

http://www.cocorahs.org/Maps/ViewMap.aspx?state=usa

File Edit View Favorites Tools Help

CoCoRaHS - Community Collaborative Rain, Hail & Sn...

COMMUNITY COLLABORATIVE RAIN, HAIL & SNOW NETWORK

"Because every drop counts"

Home | States | View Data | Maps My Data Entry | Login

Maps : Daily Precipitation

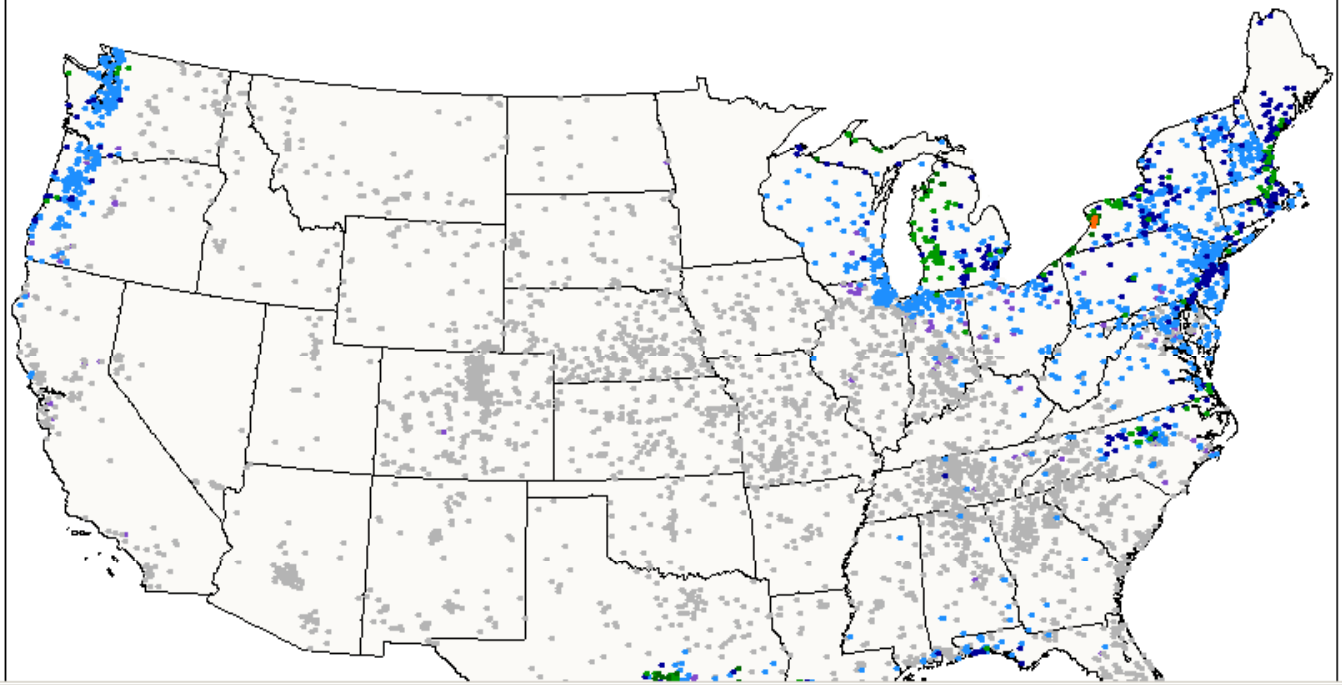
The ever-expanding CoCoRaHS network would be even more useful for the USDM if data periods could be extracted as an ASCII table for GIS.

Map Type	Map Location		Date
Precipitation	National	No State Selected	9/29/2009

Daily Precipitation (inches x.xx), for the 24 hour period ending ~7:00 am

USA 9/29/2009

0.0 | Trace | 0.01 - 0.27 | 0.28 - 0.54 | 0.55 - 1.34 | 1.35 - 3.22 | 3.23 - 4.83 | 4.84 - 5.36



Internet 100%

Start | CoCoRaHS - Commu... | play.it Radio Player - ... | SuperJPG - Registered ... | 3 Microsoft Office Po... | usdm-editor.mxd - Arc... | Novell GroupWise - Mail... | 3:46 PM

Daily SPI - Gridded Maps - NDMC - Windows Internet Explorer

http://www.drought.unl.edu/monitor/spi-dailygridded.html

Monitoring Drought

Daily Gridded Standard Precipitation Index

My Kingdom for SPI in GIS!!!!
If I ask reeeeaaaaallllly nice...

What is Drought?
Planning for Drought
Monitoring Drought
Drought Risk and Impacts
Mitigating Drought

About the NDMC
Contact Information
What's New
Site Map
Search the Site
Publications
Photo Gallery

NDMC Home Page

Quick Links:

NDMC's Drought Impact Reporter
U.S. Drought Monitor
Drought for Kids
For Media
Other Drought-related Sites

Select a map from one of the following lists:

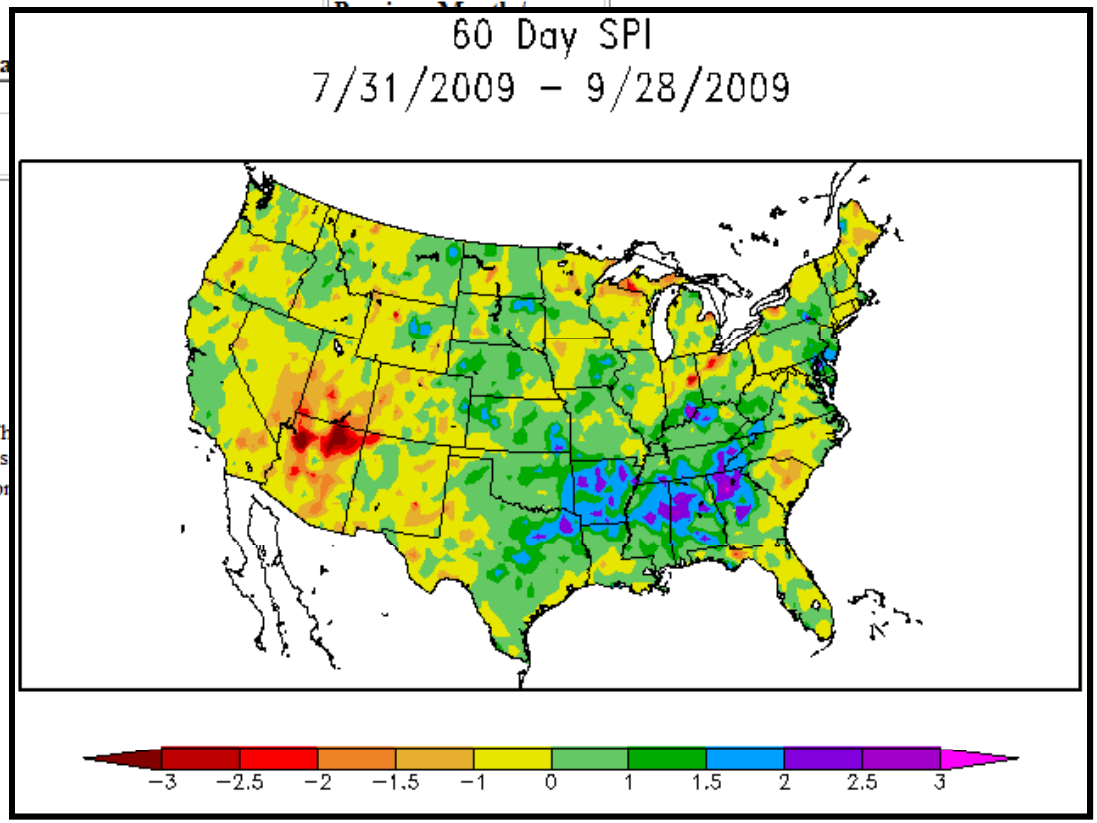
Updated Daily
60-Day SPI

Select an area: United States

Select map type: Shaded

View Map | Clear

This is an **Experimental Climate Product!** Th
limited quality control is performed on provis
best available data is incorporated as it becor



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Basin Snow Water Content Map (SNOTEL) - Windows Internet Explorer

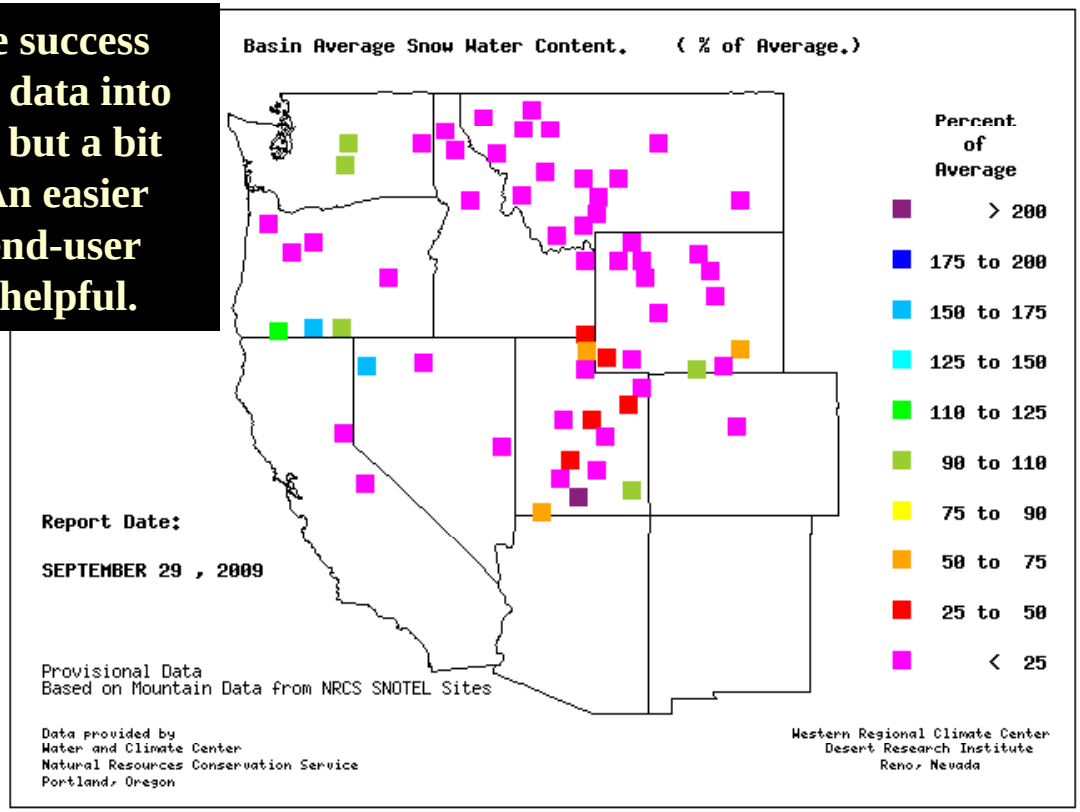
http://www.wrcc.dri.edu/snotelanom/basinswe.html

File Edit View Favorites Tools Help

Basin Snow Water Content Map (SNOTEL)

SNOTEL - River Basin Snow Water Content

I have had some success getting SNOTEL data into GIS; it's doable but a bit cumbersome. An easier option for the end-user would be most helpful.



Tabular Report --- Basin Snow Water Content Map (Numeric)
Basin Precipitation Map --- Basin Precipitation Map (Numeric)

... back to Home Page.

Western Regional Climate Center, wrcc@dri.edu

Done Internet 100%

Start | Basin Snow Wat... | play.it Radio Playe... | SuperJPG - Regist... | 3 Microsoft Offic... | usdm-editor.mxd -... | Novell GroupWise ... | *S:\ELUEBEHUSEN... | 3:50 PM

USGS
science for a changing world

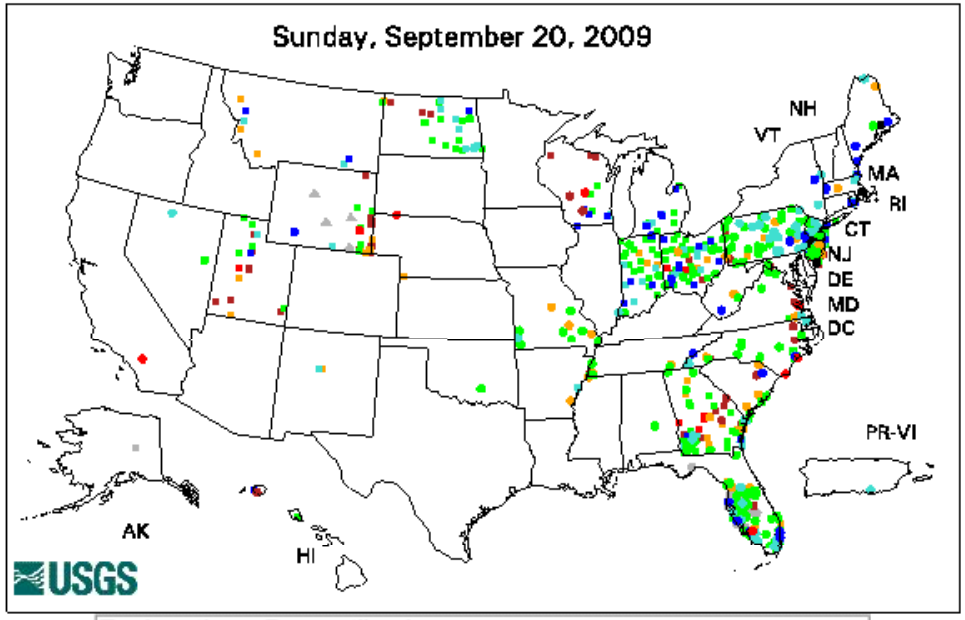
USGS Home
Contact USGS
Search USGS

Groundwater Watch

Long-Term Groundwater Data Network

Use the buttons above the map to select the data frequency and length of record.
NOTE: Javascript must be enabled for the map to work correctly.

○ Annual Data	◉ Monthly Data	○ Daily Data
◉ 20 Years or More	○ 30 Years or More	○ 50 Years or More



Explanation - Percentile classes (symbol color based on most recent measurement)

New Low	<10 Much Below Normal	10-24 Below Normal	25-75 Normal	76-90 Above Normal	>90 Much Above Normal	New High	Not Ranked

Map generated 9/20/2009 10:12:51 PM
Long-Term Groundwater Data Network Well Count: 722

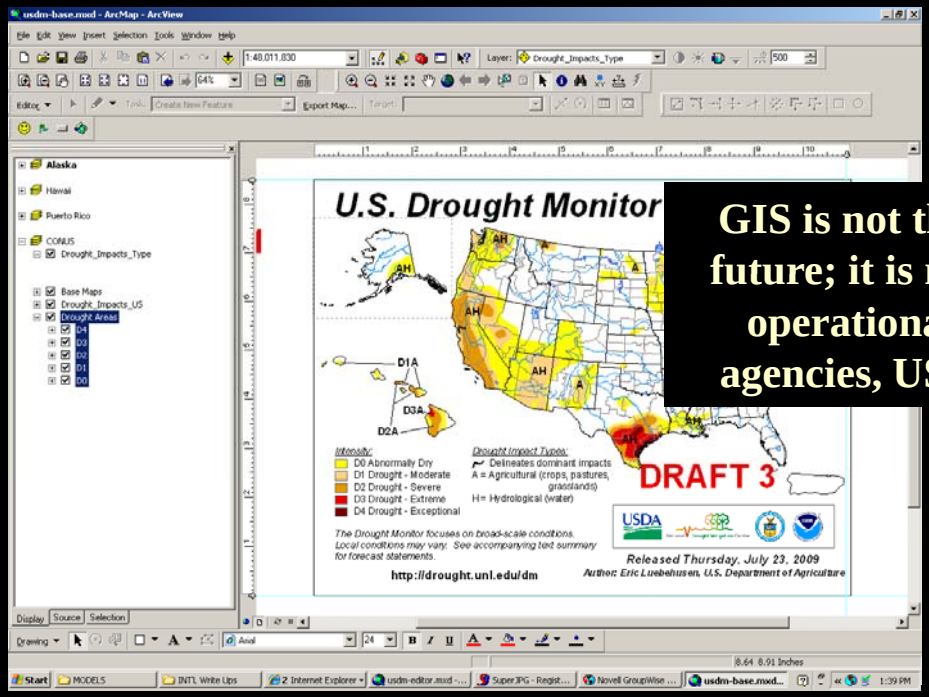
Groundwater Watch Help Page

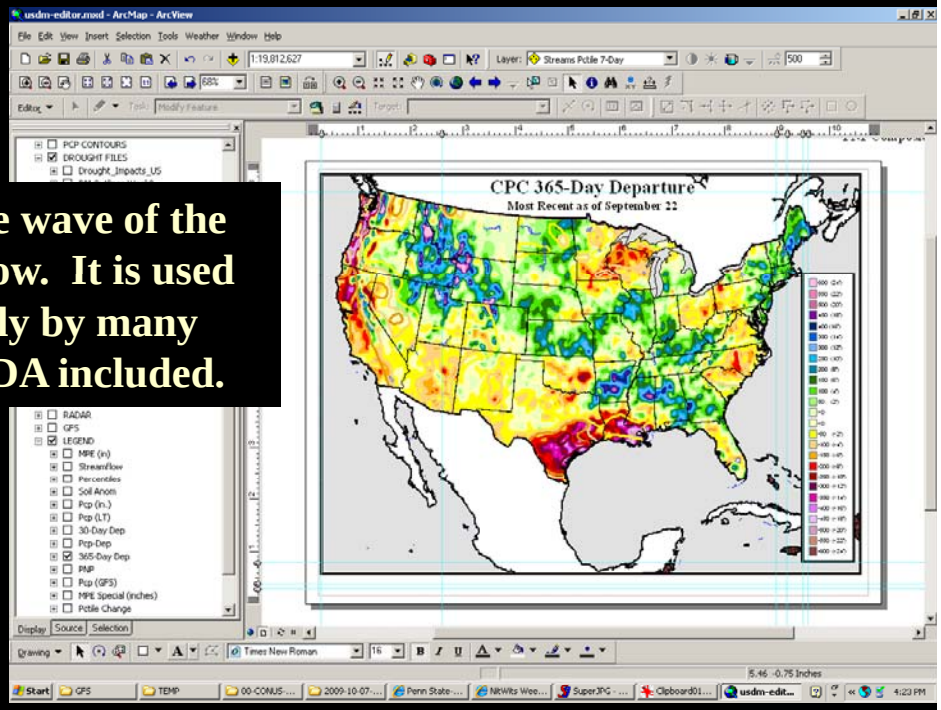
Download Google Earth Version

USGS supplies streamflow in shapefile format; Groundwater data would be a big help.

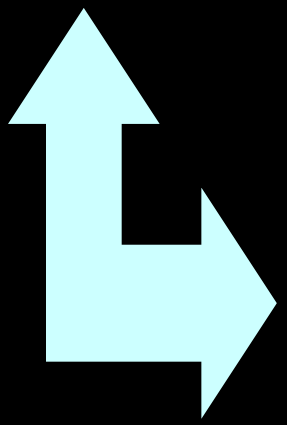
Internet 100%

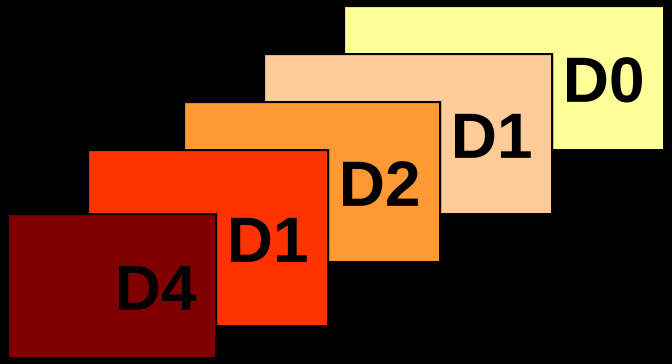
Summary

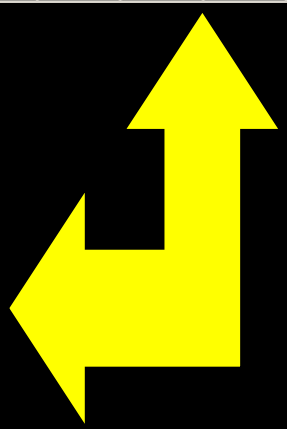




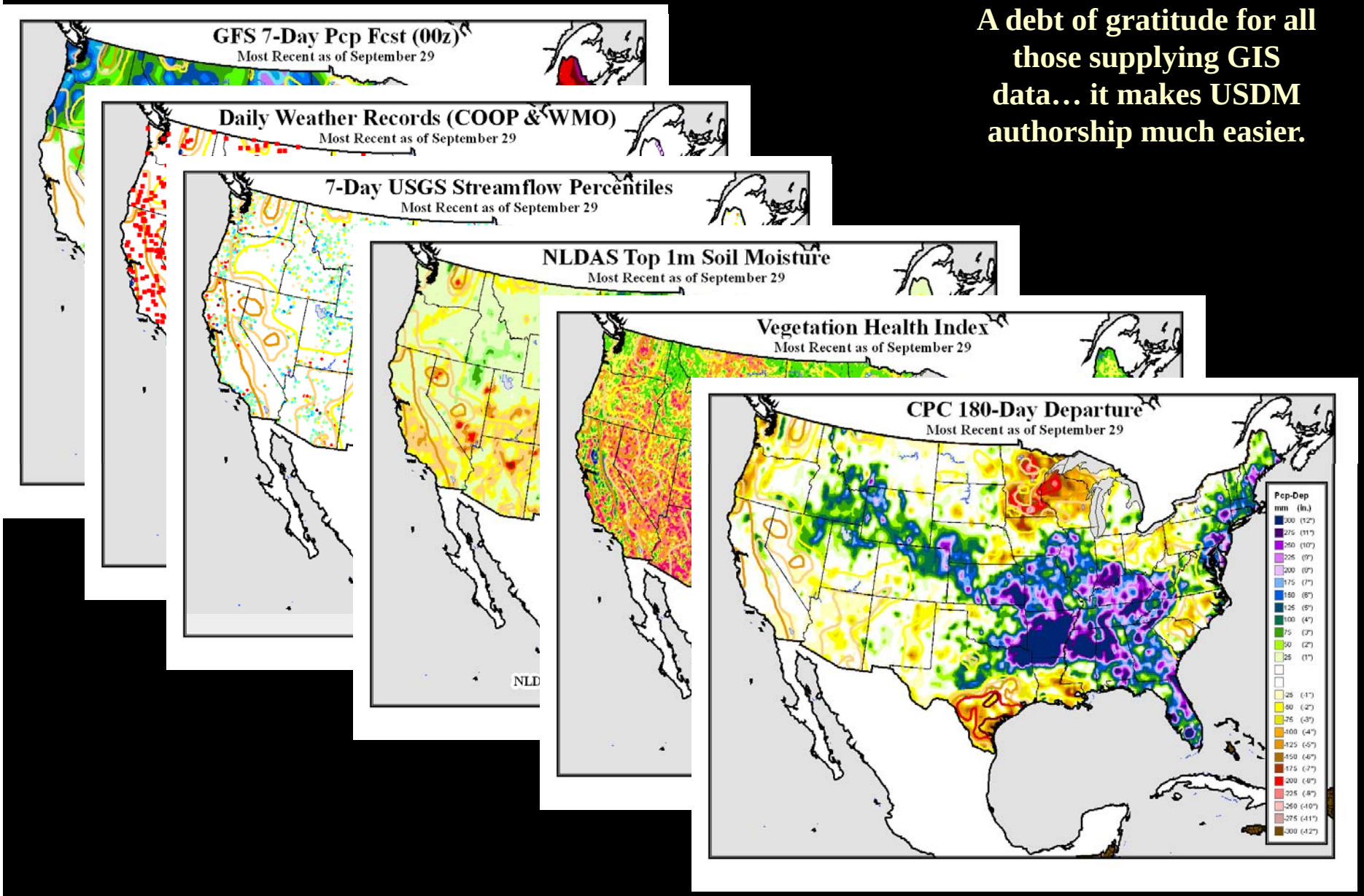
GIS is not the wave of the future; it is now. It is used operationally by many agencies, USDA included.





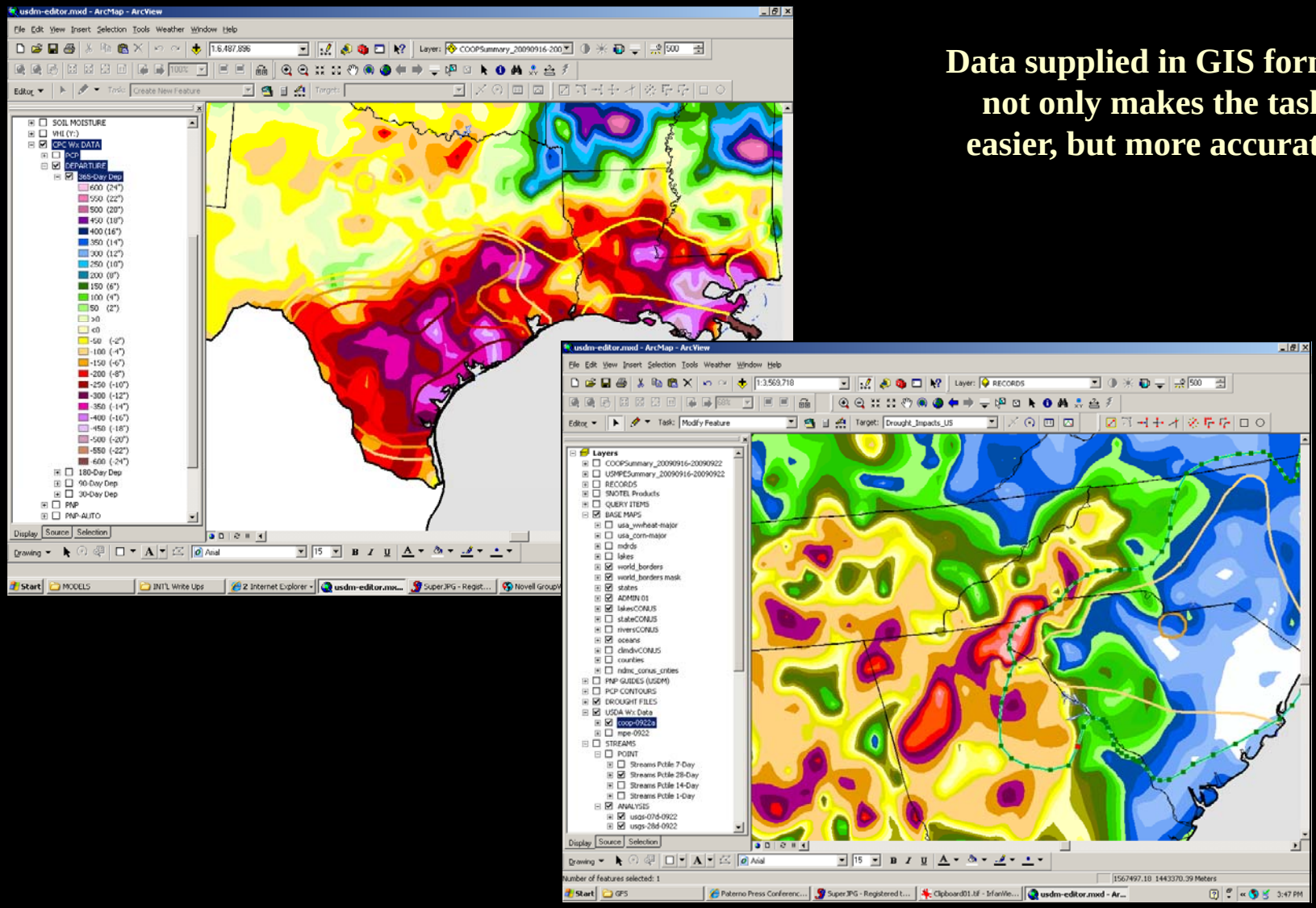


Summary



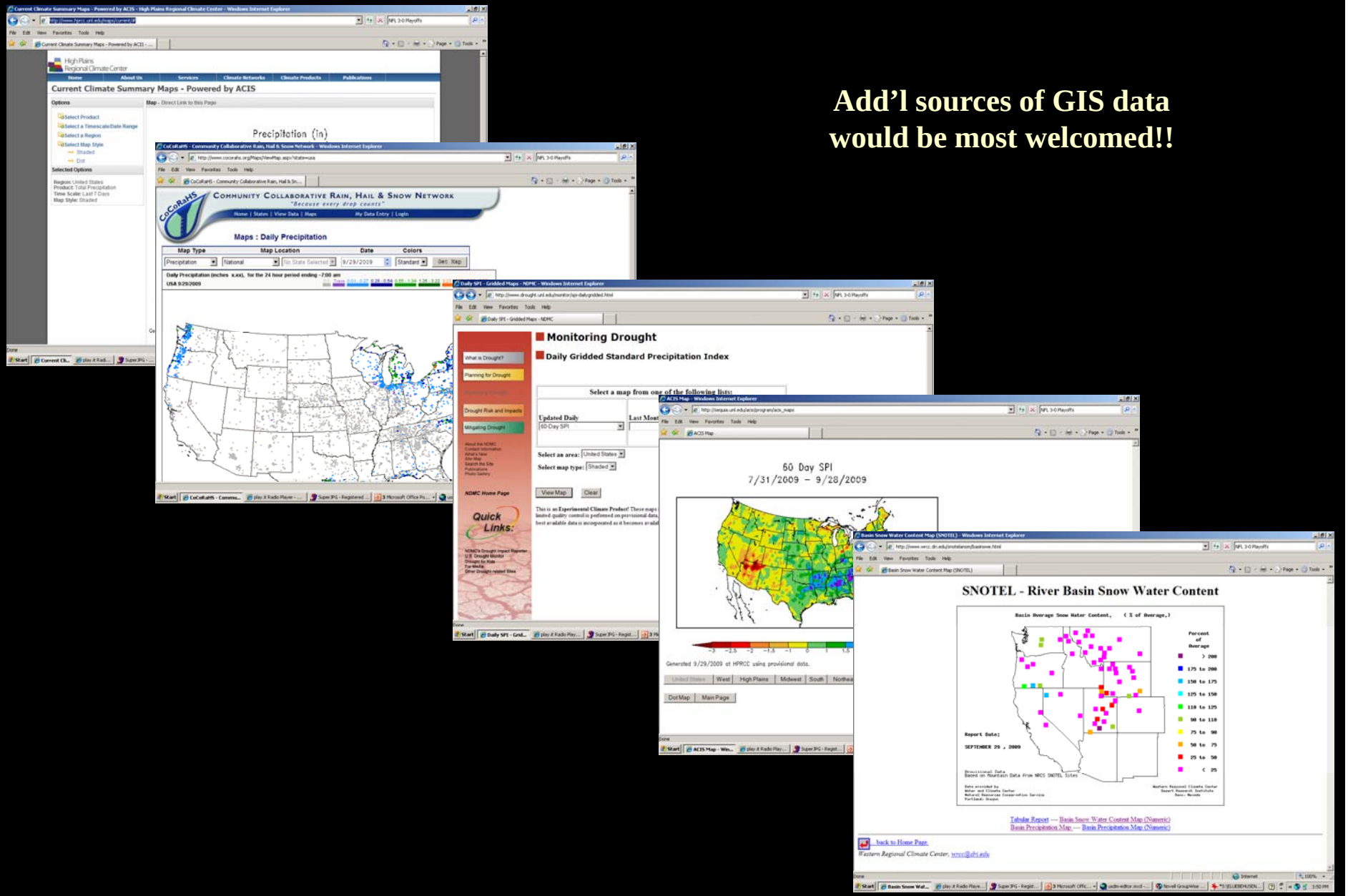
A debt of gratitude for all those supplying GIS data… it makes USDM authorship much easier.

Summary



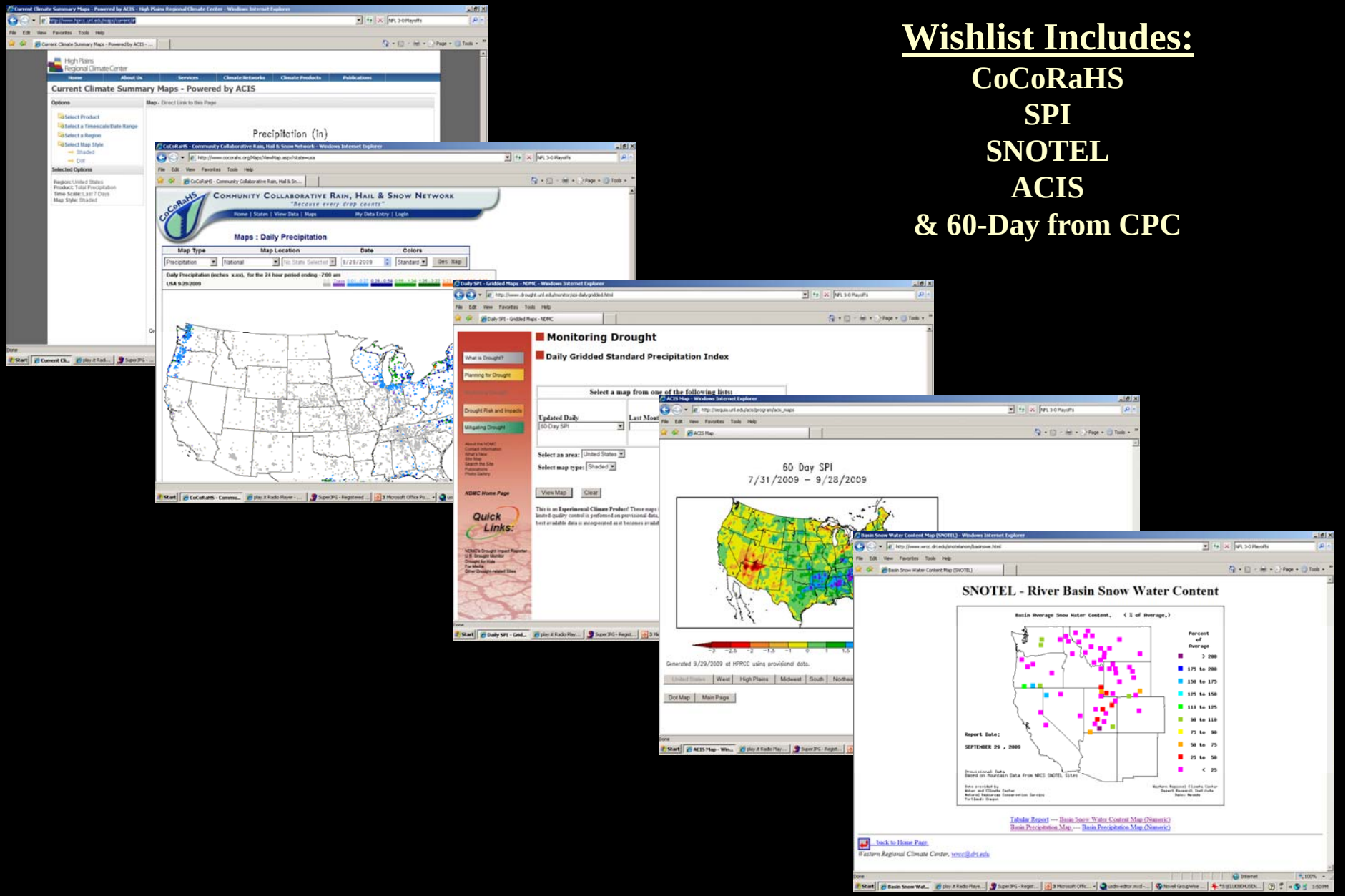
Data supplied in GIS format not only makes the task easier, but more accurate.

Summary



Add'l sources of GIS data would be most welcomed!!

Summary



<u>Wishlist Includes:</u>

CoCoRaHS
SPI
SNOTEL
ACIS
& 60-Day from CPC

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Questions?

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