

Exploring ArcIMS Services to Deliver National Weather Service Datasets in Support of Decision-Makers

**2007 ESRI Federal User Conference
Washington, DC – January 10, 2007**

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Fort Worth, Texas

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NOAA/NWS

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The Pennsylvania State University

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PS Institutes of Energy & the Environment
The Pennsylvania State University

Overview

- National Weather Service (NWS) Structure and tie to Decision-Makers
- Exploratory NWS Collaborative GIS/IMS Efforts
- Lessons Learned from PSU Serving NWS NDFD via ArcIMS

Department of Commerce (DOC)

www.doc.gov

**National Oceanic and
Atmospheric Administration
(NOAA)**

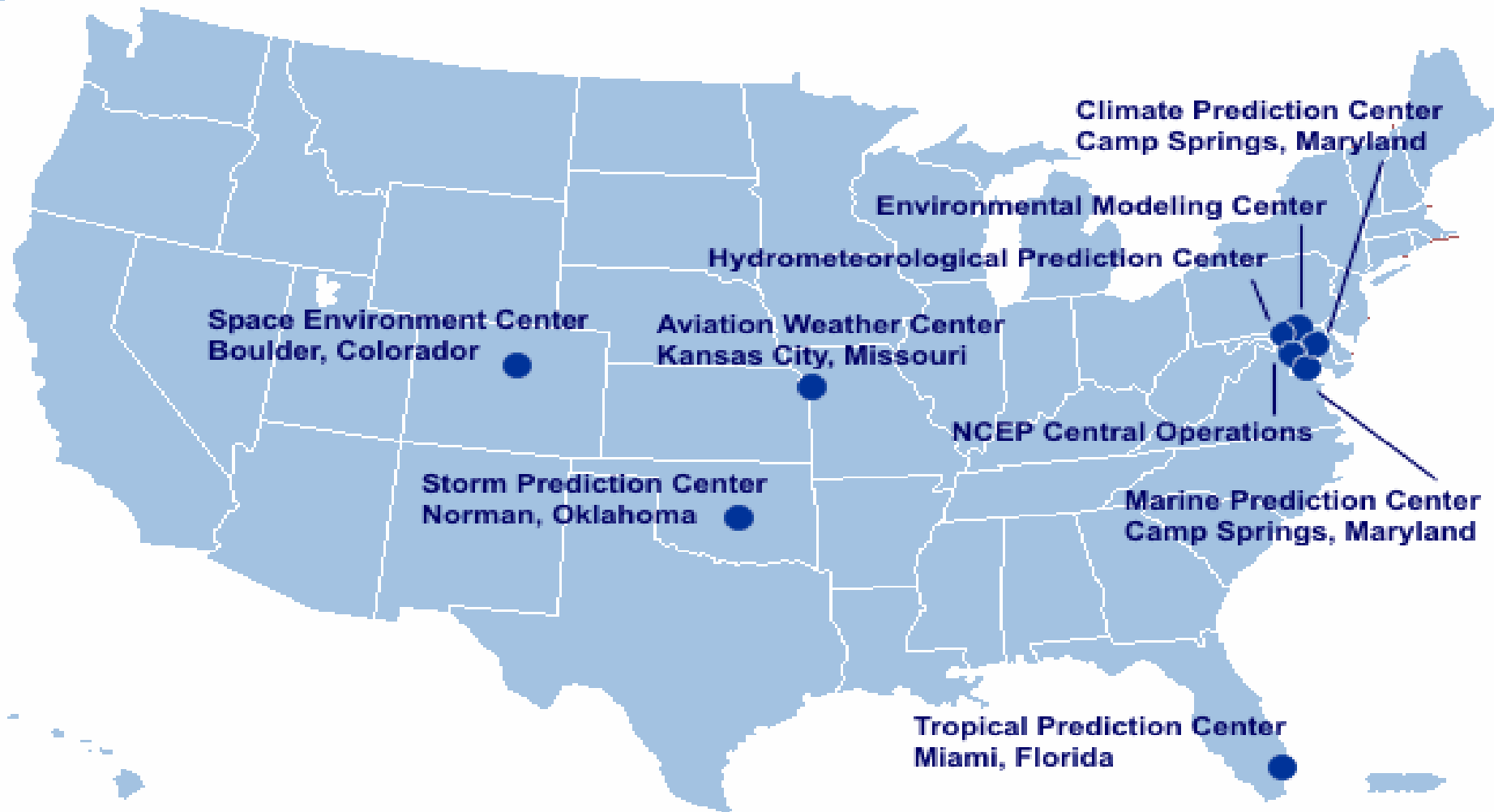
www.noaa.gov

Booth 617



National Weather Service Structure

National Centers for Environmental Prediction



National Weather Service Regions

Alaska Region HQ
Anchorage, Alaska

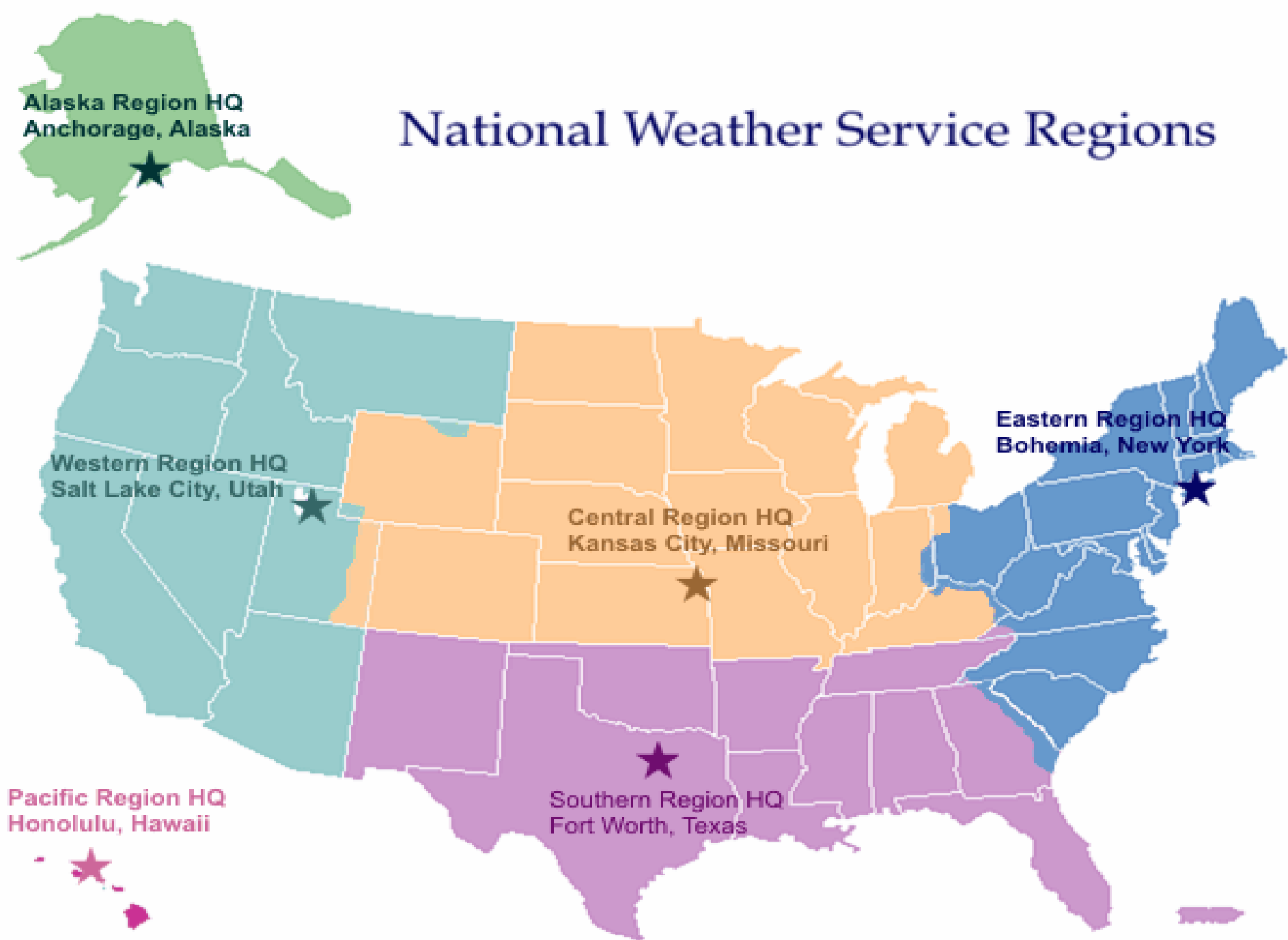
Western Region HQ
Salt Lake City, Utah

Central Region HQ
Kansas City, Missouri

Eastern Region HQ
Bohemia, New York

Southern Region HQ
Fort Worth, Texas

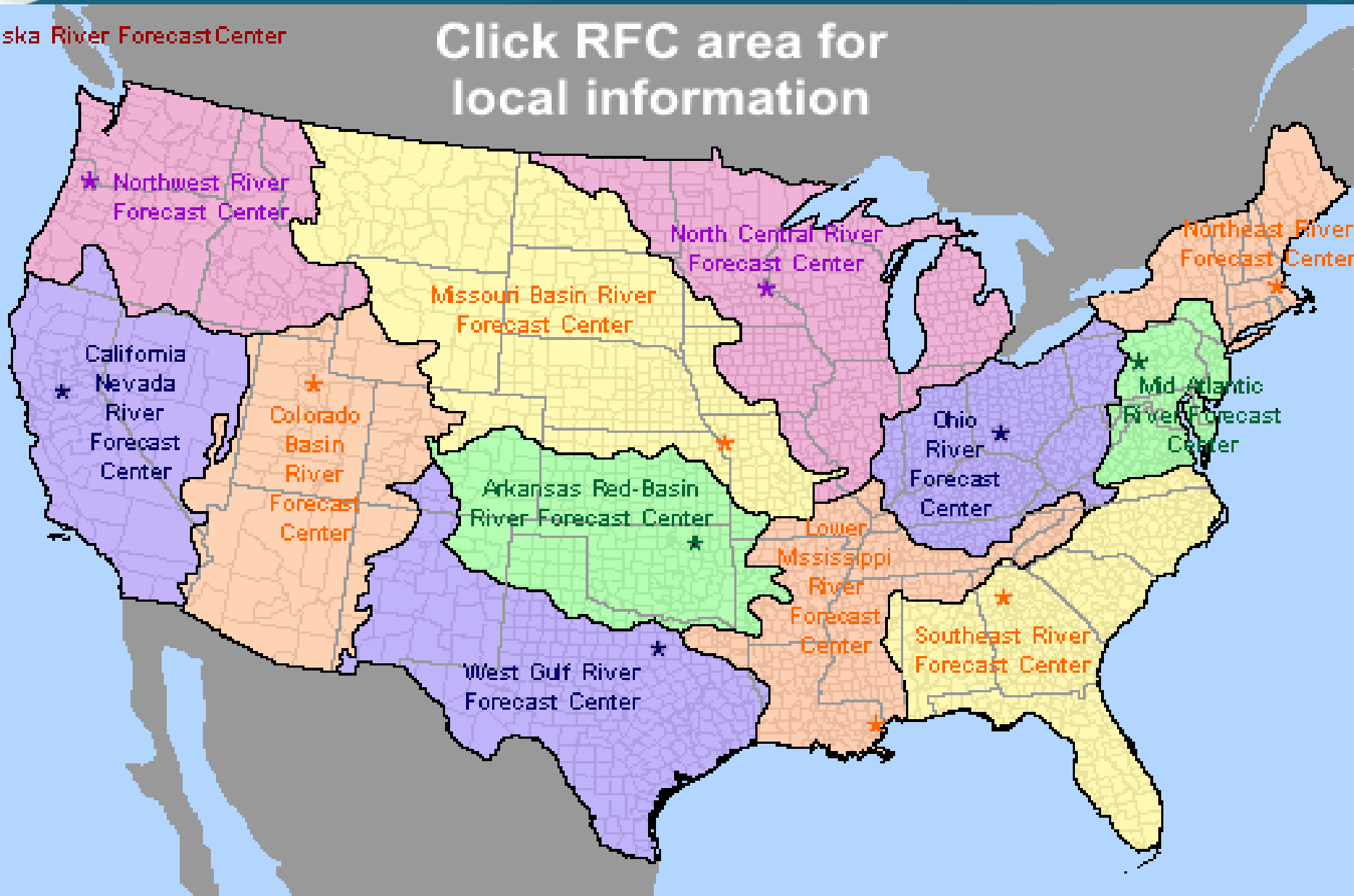
Pacific Region HQ
Honolulu, Hawaii



13 River Forecast Centers

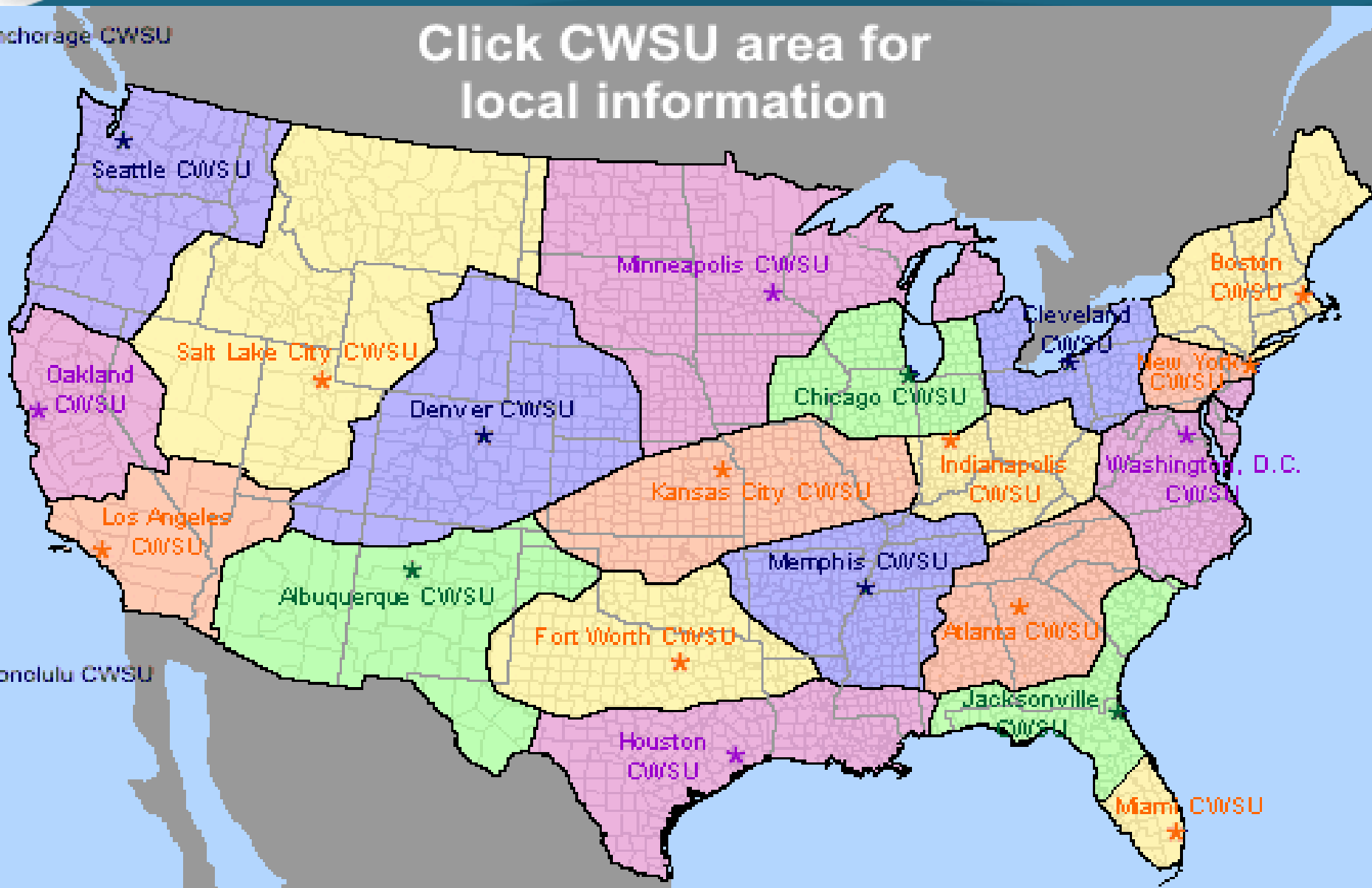
Alaska River Forecast Center

Click RFC area for local information



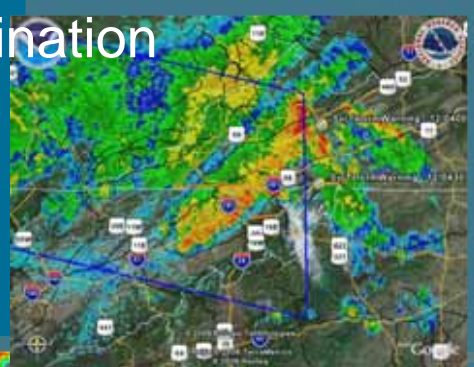
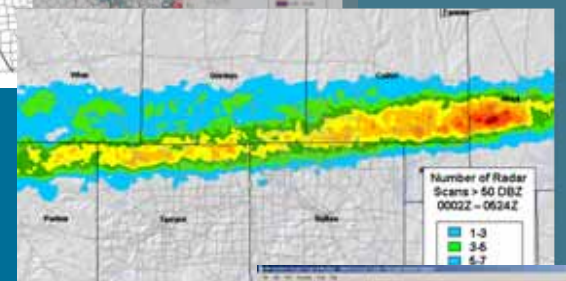
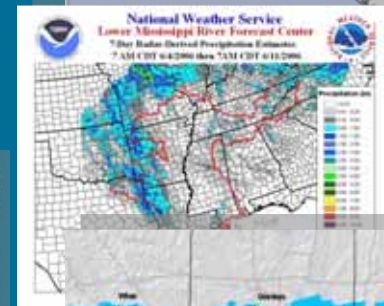
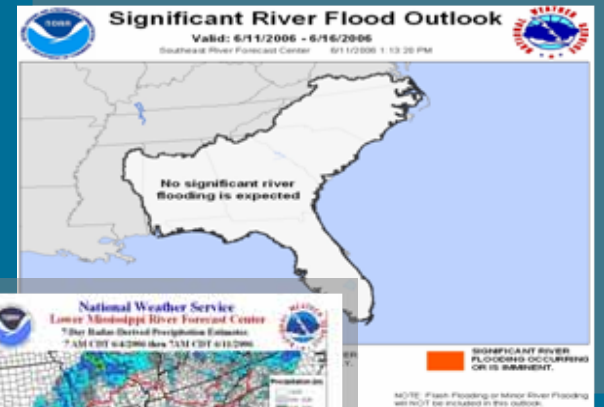
21 Center Weather Service Units

Click CWSU area for local information



What Can the NWS (and others) do with GIS-encoded weather information?

- Customized Projects/Products/Data Analysis and Display
- Research, Analysis and Verification
- Real – Time SA
- Centralize Storage and Standardized Dissemination





Exploratory National Weather Service Collaborative GIS/IMS Efforts

NOAA/NWS/EMHURR IMS

NOAA's National Weather Service Experimental EM Hurricane Site - Microsoft Internet Explorer

File Edit View Favorites Tools Help

Address <http://nwsqgis.nws.noaa.gov/website/emhurr/viewer.htm> Go Links Customize Links EMRS Google

NOAA's National Weather Service Experimental EM Hurricane Site

Zoom In Zoom Out Full Extent Last Extent Pan Identify Print Help Feedback Quick Help

Refresh Map

Legend

- Atlantic and Caribbean**
 - TROPICAL STORM CHRIS
 - Storm Path
 - Cone of Uncertainty
- Eastern and Central Pacific**
 - TROPICAL DEPRESSION GILMA
 - Storm Path
 - Cone of Uncertainty
- Satellite/Radar**
 - Radar
 - 55 DBZ
 - 50 DBZ
 - 45 DBZ
 - 40 DBZ
 - 30 DBZ
 - 15 DBZ
- GOES IR**
- Base Maps**
 - Cities
 - State/Country Labels
 - Counties
 - latlong

NOAA's National Weather Service

This tool allows you to view a smaller area in greater detail.

1. Click and hold down your left mouse button.
2. Drag a box over a location of interest on the map.
3. Release the left mouse button.

Map: -103.53, 25.31 -- Image: 350, 301 -- ScaleFactor: 0.06167896739308096

Internet

Start HURREVAC 2000 for Wi... M:\Settelmaier\esriconf2... Microsoft PowerPoint - [S... NOAA's National Weat... 8:28 PM

NOAA/NOS/NowCOAST IMS

nowCOAST: GIS Mapping Portal to Real-Time Environmental Observations and NOAA Forecasts - Microsoft Internet Explorer

File Edit View Favorites Tools Help

Address <http://nowcoast.noaa.gov/> Go Links Customize Links EMRS

Google nowcoast

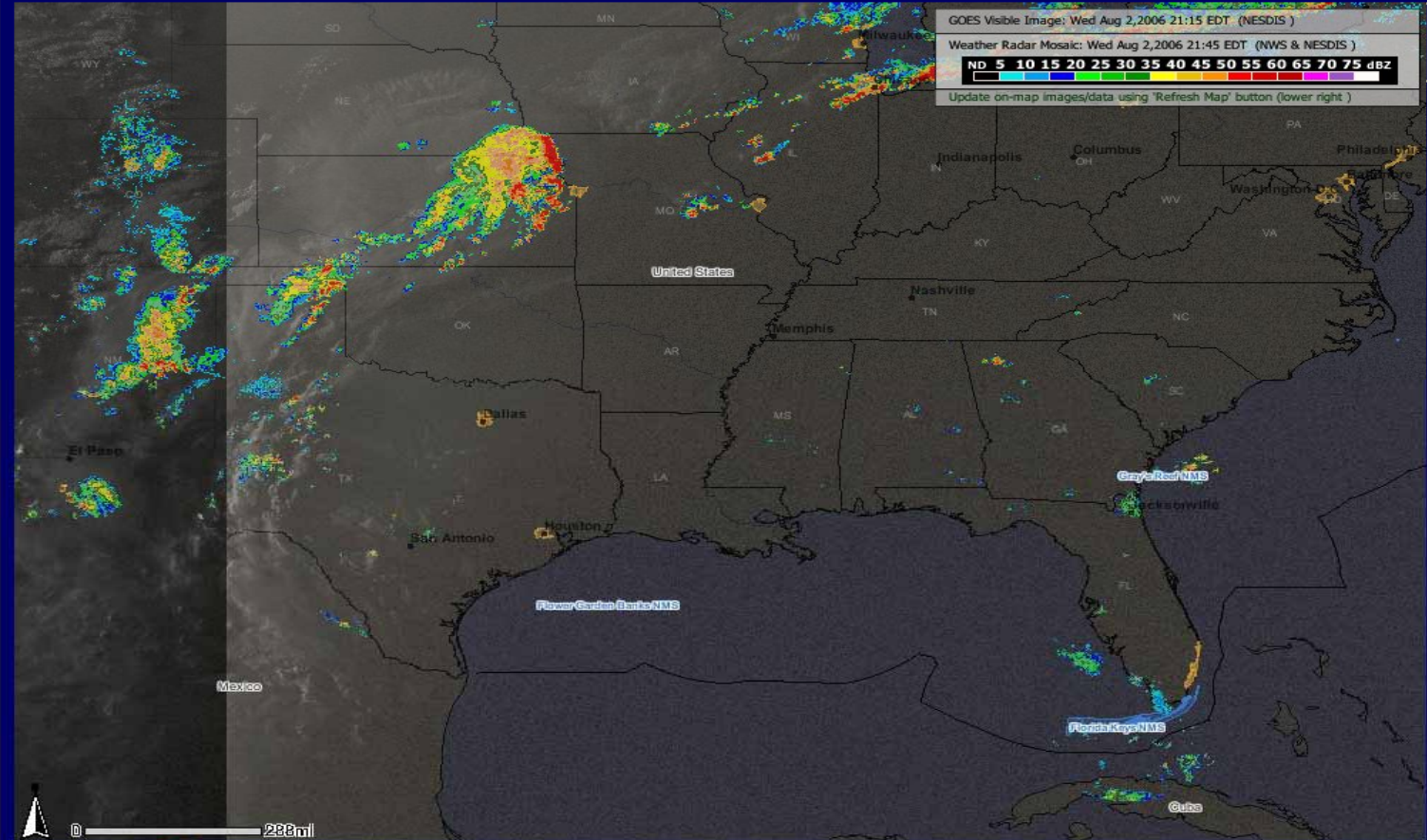
More Information Instructions On/Off Send Email

Classroom Lesson Plan



1) LOCATION → 2) INFORMATION → 3) VARIABLE → 4) TIME → 5) GO

-Select Location- -Select Map Layer- -Select Variable- -Real Time-



Map Layers Controls: Display Active

Active Layer: Meteorological
(Click on individual layer names below for more info on each)

- On-Map Data, Imagery, Forecasts:**
- Observations - In-Situ Stations:**
- Surface Meteorological/Ocean
 - Station ID
 - 76 Air Temp (deg F)
 - 72 Dew Point Temp (deg F)
 - Wind (knots)
 - 0172 Mean Sea Level Pressure (mb)
 - 4.4 Visibility (miles)
 - 85 Sea Surface Temp (deg F)
 - 34 Significant Wave Height (feet)
- Observations - Remote Sensors:**
- Weather Radar Mosaic
 - GOES Visible Image
 - GOES IR Image

- Geo-Referenced Links:**
- Observations - In-Situ Stations:**
- Meteorological
 - Oceanographic
 - River
 - Water Quality
- Observations - Remote Sensors:**
- Weather Radars
 - Boundary Layer Profiles
 - Upper Air Soundings
 - HF Radar Surface Currents
 - Web Cameras
- Predictions:**
- Astronomical Tidal
- Forecast Model Guidance:**
- [refresh map](#)

Map Tools tool help

The Zoom In/Out and Pan tools are used to navigate the map to a particular scale and location. After selecting location, use the Map Layers list to toggle on and off individual layers, then use the Link to Data tool to click on a station or forecast point to display data.

Active Tool: Pan

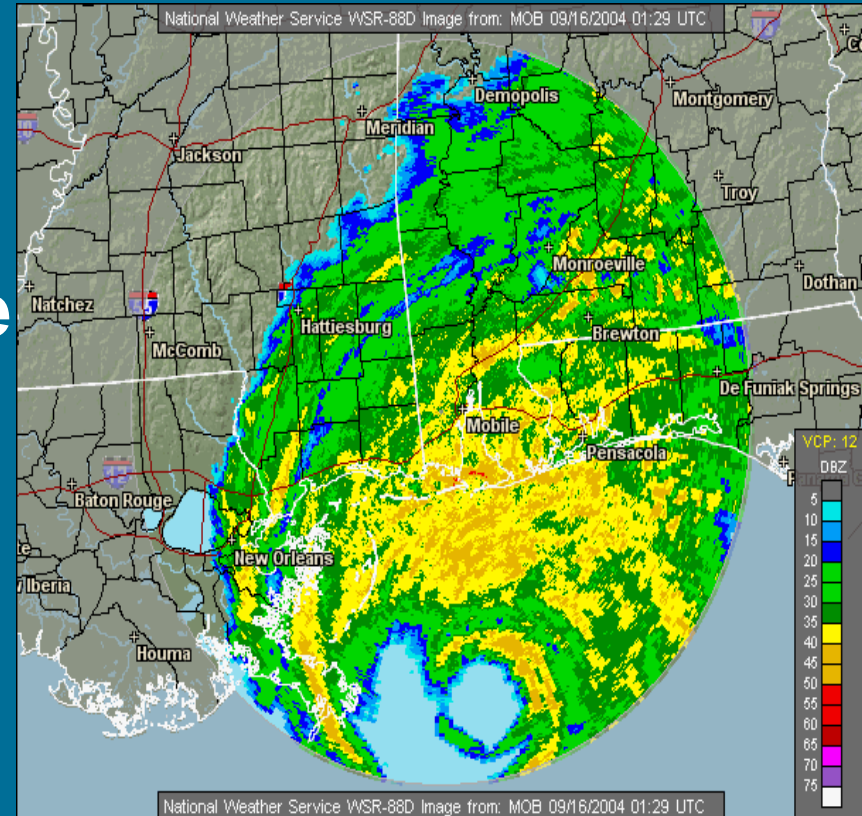
Zoom In Zoom Out Pan Select by Rectangle Identify Print
 Full Extent Zoom Last Zoom to Lat/Lon Clear Selected Query Open Databrowser Link to Data

Refresh Map Automatically

DOC > NOAA > NOS > DCS
Privacy Policy

New GIS-ready Radar Imagery

- Available as time loops for Weather Service Radars
- New GIS Topographic Base Map
- Provides real time storm, movement, precipitation and now, *velocity* data!



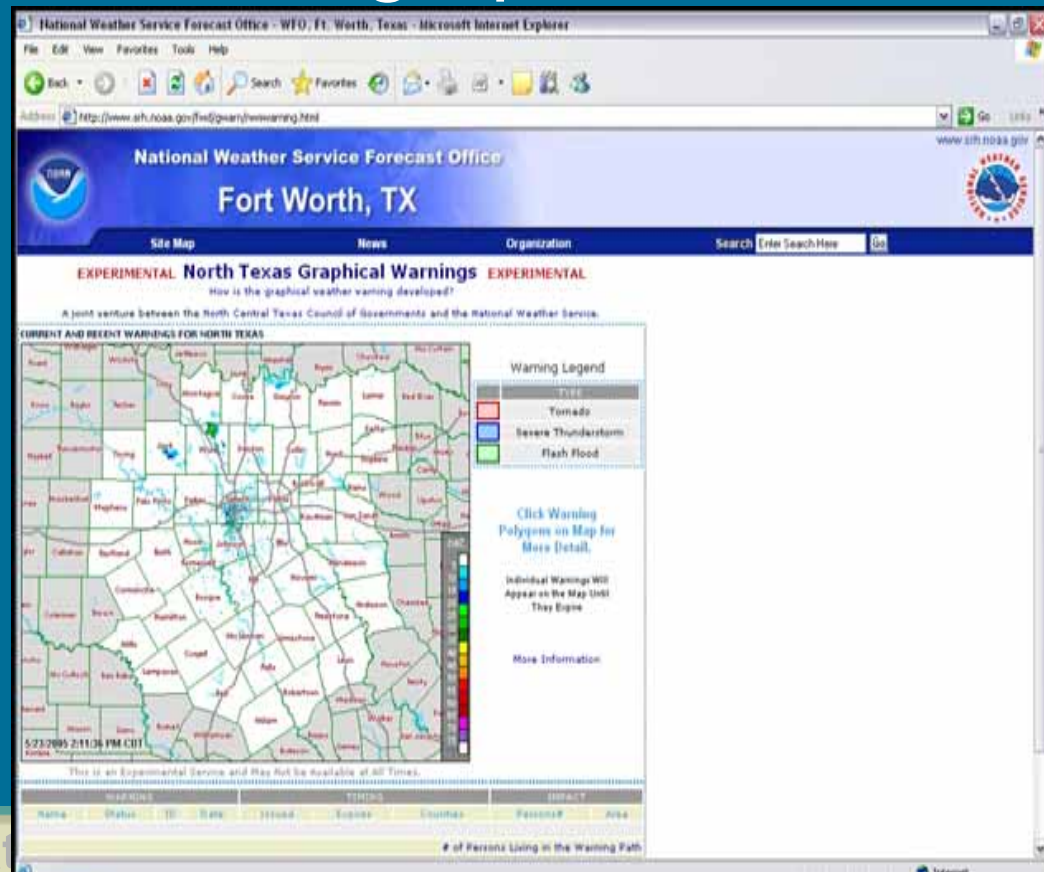
www.srh.weather.gov/ridge

Paul.Kirkwood@noaa.gov

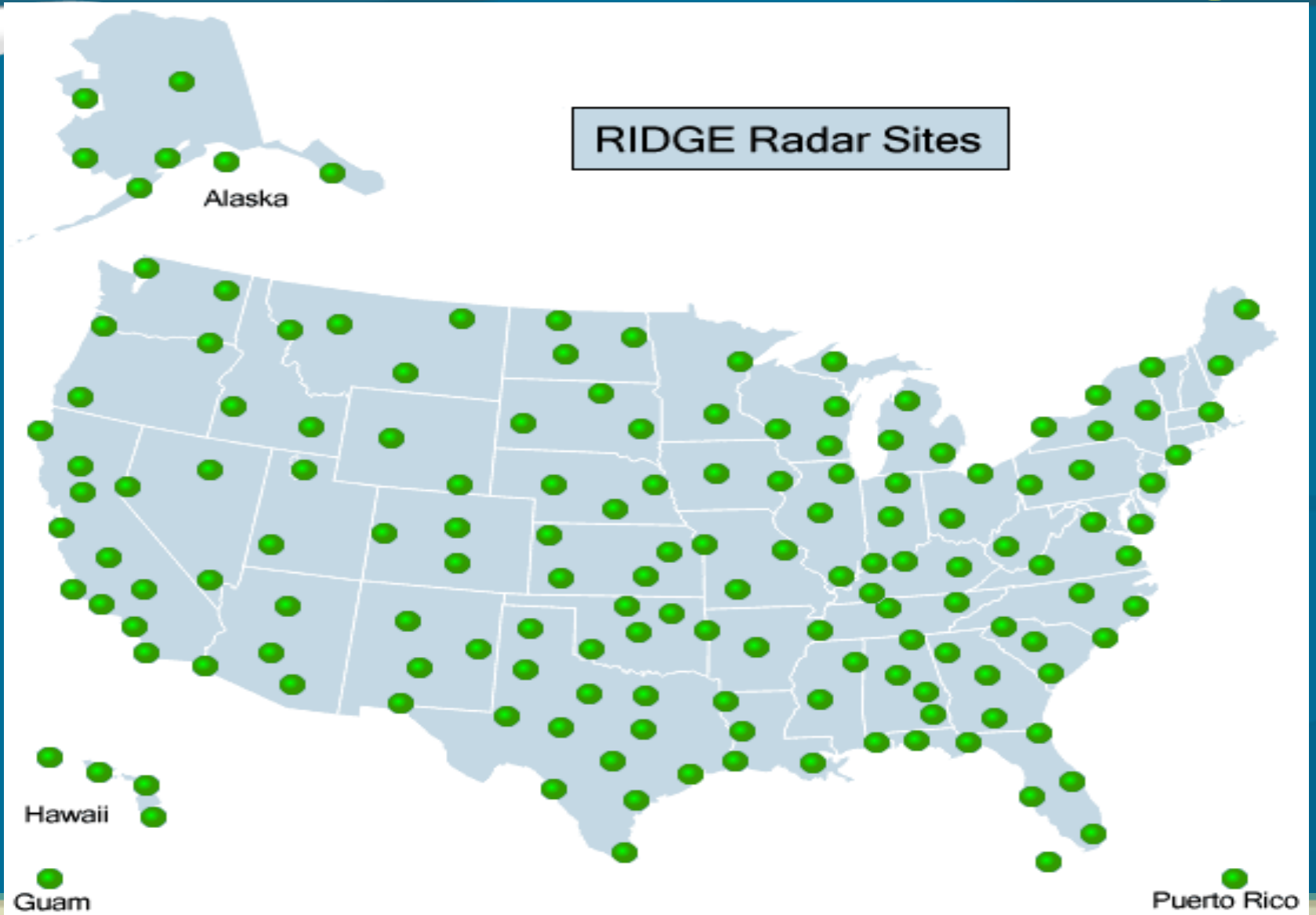
Keith.Stellman@noaa.gov

RIDGE (Radar Integrated Display with Geospatial Elements)

- Collaborative Effort with NCTCOG using technology found in FWD graphical warning project.



Georeferenced Radar Images



Old vs New Radar Imagery

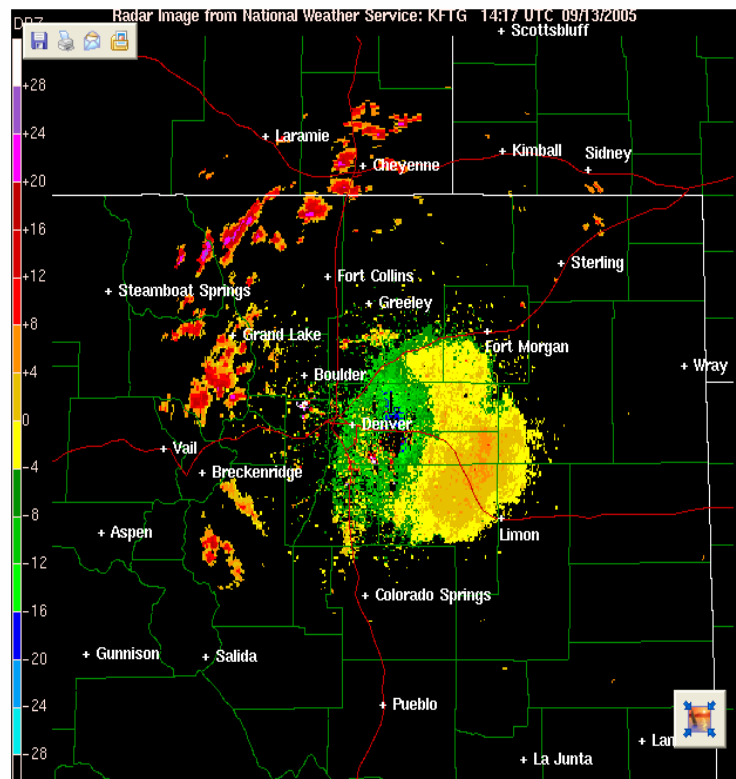
http://www.crh.noaa.gov/radar/images/DS.p19r0/SI.kftg/latest.gif - Microsoft Internet Explorer

File Edit View Favorites Tools Help

Back Forward Stop Home Search Favorites Media

Address http://www.crh.noaa.gov/radar/images/DS.p19r0/SI.kftg/latest.gif

Google ncar Search New 0 blocked ABC Check AutoLink Autofill Options



National Weather Service Experimental Radar from Denver/Boulder, CO - Microsoft Internet Explorer

File Edit View Favorites Tools Help

Back Forward Stop Home Search Favorites Media

Address http://www.srh.noaa.gov/ridge/ftg.shtml

Google Search New 0 blocked ABC Check AutoLink Autofill Options

National Weather Service WSR-88D Image from: FTG 09/13/2005 14:17 UTC (8:17 AM MDT)

Wheatland Lorrington Alliance

Scottsbluff

Oshkosh

Laramie Cheyenne Kimball Sidney

Steamboat Springs Fort Collins Greeley Sterling

Grand Lake Fort Morgan

Boulder Denver

Vail Breckenridge Limon

Aspen Colorado Springs

Gunnison Salida Pueblo

Alamosa Lamar

WVP: 32

DBZ

28

24

20

16

12

8

4

-4

-8

-12

-16

-20

-24

-28

Warnings:

Tomado

Severe

Flash Flood

Marine

National Weather Service WSR-88D Image from: FTG 09/13/2005 14:17 UTC (8:17 AM MDT)

Topo Radar Counties Rivers Highways Cities Warnings Legend

Short Range Images

Base Reflectivity: Loop

Composite Refl Loop

Short Range Loop

Velocity:

Storm Relative Loop

Base Loop

Rainfall:

1-Hour Total Loop

Storm Total Loop

MouseOver Off

Long Range Images

Reflectivity: Loop

Base Loop

U.S. Views

Reflectivity: Loop

National Loop

Alaska Loop

Hawaii Loop

Guam Loop

Puerto Rico Loop

Radars by State

Additional Info:

Radar Information

GIS Users

Credits

Contact us:

Email

This is a WSR-88D radar image from station FTG. The map shows a large area of high reflectivity (yellow and red) centered over Denver, Colorado, extending towards the northwest. Other smaller areas of reflectivity are visible around the region. The map includes labels for various cities and towns in the area. A vertical watermark on the right side reads 'National Weather Service - Since 1870'. The bottom of the image contains a navigation menu with various options like 'Topo', 'Radar', 'Counties', 'Rivers', 'Highways', 'Cities', 'Warnings', and 'Legend'. There is also a 'Short Range Images' section with various options like 'Base Reflectivity', 'Composite Refl', 'Short Range', 'Velocity', 'Storm Relative', 'Base', 'Rainfall', '1-Hour Total', 'Storm Total', 'Long Range Images', 'Reflectivity', 'Base', 'U.S. Views', 'Reflectivity', 'National', 'Alaska', 'Hawaii', 'Guam', 'Puerto Rico', 'Radars by State', 'Additional Info', 'Radar Information', 'GIS Users', 'Credits', 'Contact us', 'Email'.



National Weather Service Southern Region Headquarters

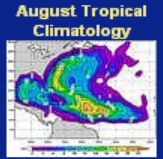


Go to: [Tropical Weather Home](#)

Local weather forecast by "City, St" Go

Tropical Cyclone Forecast Tracks - Tropical Storm CHRIS

Current Active Storms: [Tropical Storm CHRIS](#)



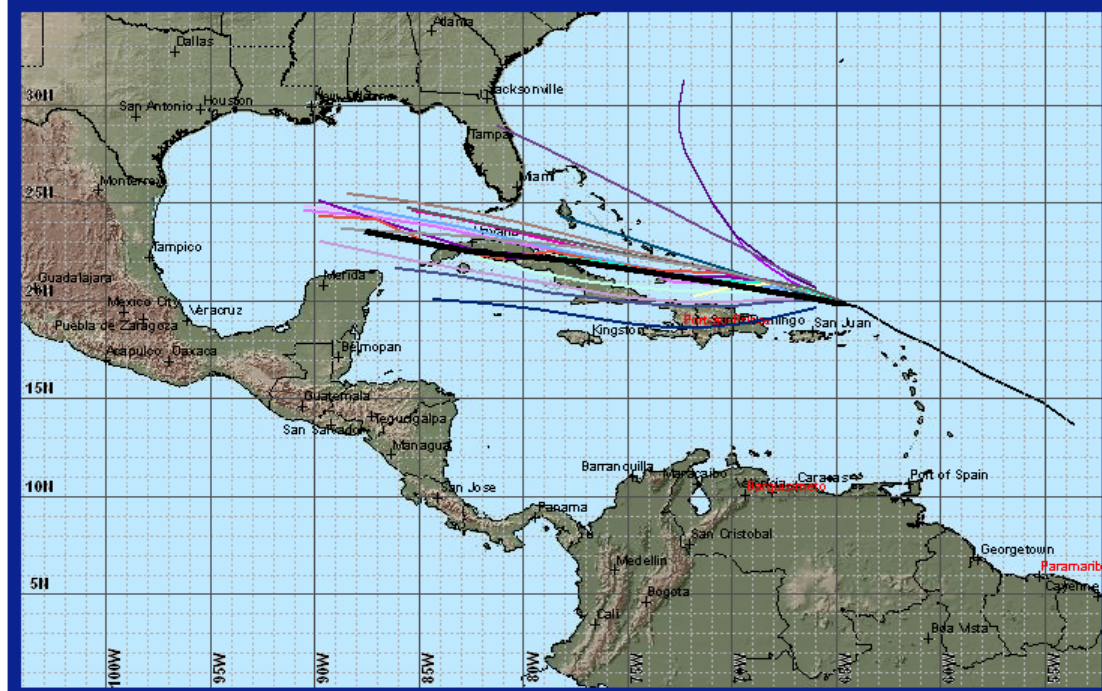
[Tropical Discussion Atlantic](#) | [Alt. link Pacific](#) | [Alt. link](#)

[Tropical Outlook Atlantic](#) | [Alt. link En Español Pacific](#) | [Alt. link 2006 Atlantic Season](#)

[Hurricane U. Tropical Training Are You Prepared? Hurr. Intensity Scale Past Hurr. Tracks](#)

[Hurricane Centers National Central Pacific](#)

[Additional Info Satellite Imagery Local Radars More links SR Tropical Home SR Homepage](#)



Model Runs
08/03/2006-00Z
Go

Forecast Tracks
 Official Forecast
 HPC Forecast
 Previous Fcst.

Models
 Dynamic #1
 Dynamic #2
 GFS Ensembles
 Climo - Statistical

Views
 Atlantic Ocean
 Central Atlantic
 Western Atlantic
 Gulf of Mexico
 Caribbean

- Topography
- Storm History
- State/Country
- Lat/Long
- Cities/Highways

Dynamical Models #1	
A9UK	
AC00	
AVN0	GFS model
CGUN	Average of GDFI, UKMI, NGPI and GFSI
CMC	
COA2	
	Decay SHIPS - SHIPS intensity

Dynamical Models #2	
CONU	
DSNS	
ICON	Average of GDFI and DSHIP intensity forecasts
MRCL	Wind radii clipper (McCadie - Atlantic Ocean)
NGM	
NGPS	NOGAPS - Navy global model

GFS Ensembles	
AEMN	GFS Ensemble Mean, adjusted to current storm position
AP01	GFS Ensemble Member
AP02	GFS Ensemble Member
AP03	GFS Ensemble Member
AP04	GFS Ensemble Member
AP05	GFS Ensemble Member
AP06	GFS Ensemble Member

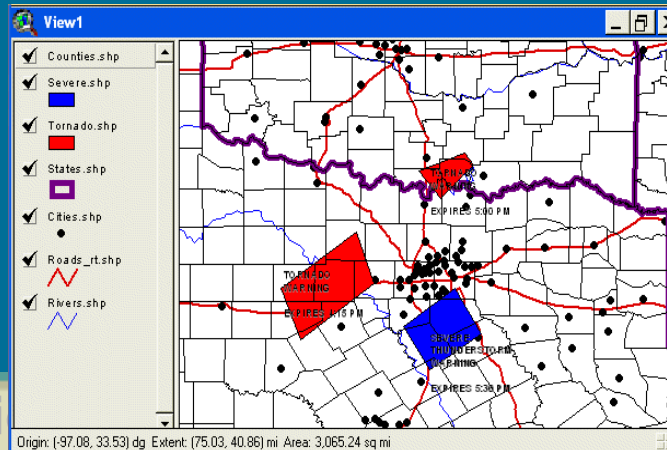
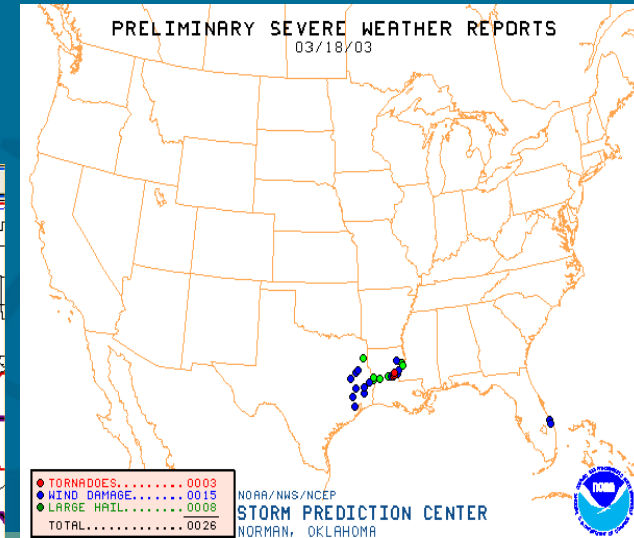
Climo/Statistical	
A90E	An obsolete statistical-dynamic model
A98E	Current statistical-dynamic model
DRCL	Recently integrated wind radii CLIPER model (DRCL)
BAMD	Beta and Advection Model (deep layer)
	Beta & Advection Model

National Weather Service - Since 1870

Severe Weather Prototype

Live IMS for Severe Weather Season
2004 (geared towards emergency
managers)

- Expected Nationwide Coverage
- Radar and Satellite Data
- Severe Weather (wind, hail, tornado)
watches/warnings
- Observed Severe Weather Reports



NOAA/NOS/NowCOAST IMS

nowCOAST: GIS Mapping Portal to Real-Time Environmental Observations and NOAA Forecasts - Microsoft Internet Explorer

File Edit View Favorites Tools Help

Back Forward Stop Home Refresh

Address <http://nowcoast.noaa.gov/> Go

Links Customize Links EMRS

Google nowcoast



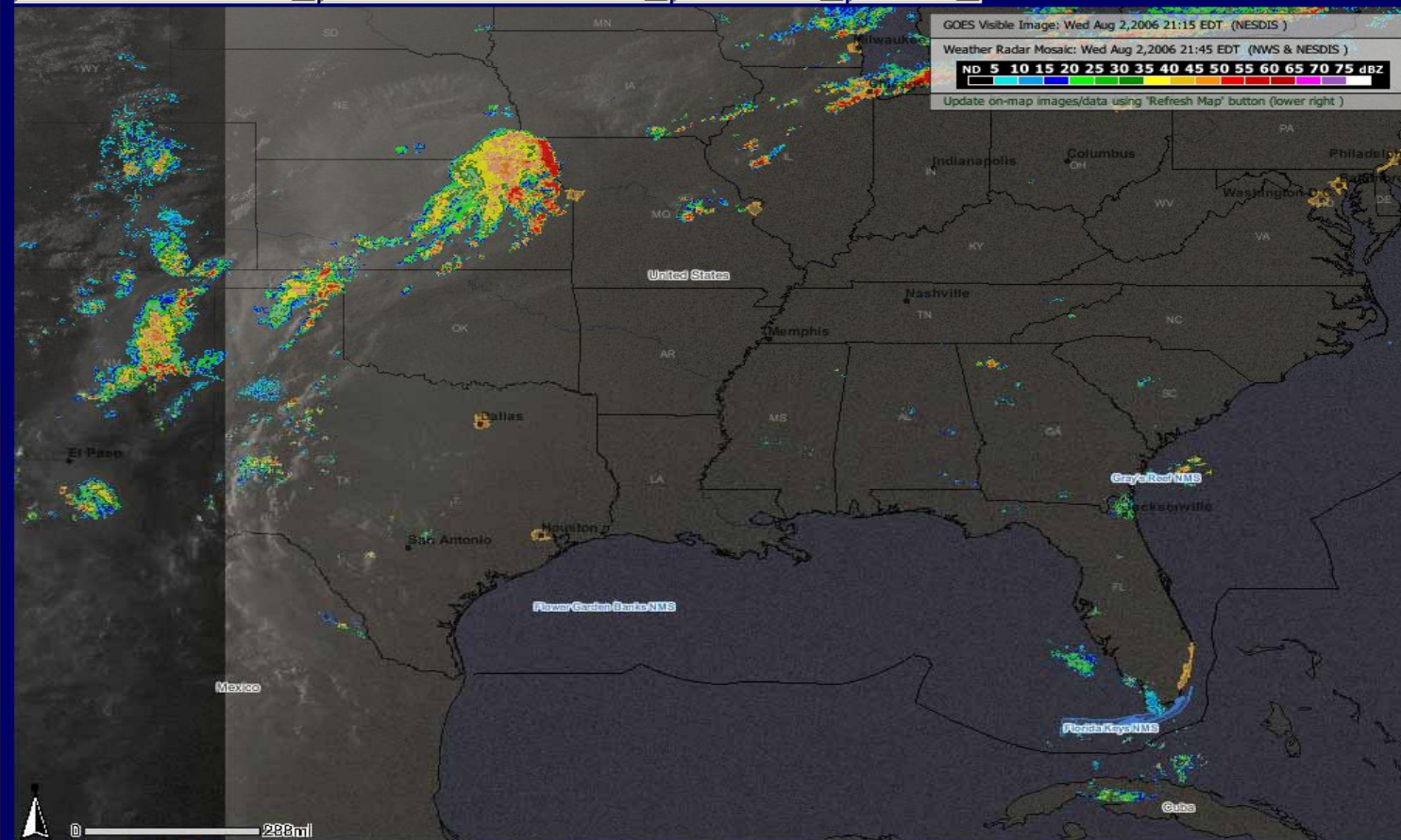
noaa's **nowCOAST**
Web Mapping Portal to Real-Time Coastal Observations and NOAA Forecasts

More Information Instructions On/Off Send Email

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Forecast Model Guidance:

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DOC > NOAA > NOS > DCS
Privacy Policy

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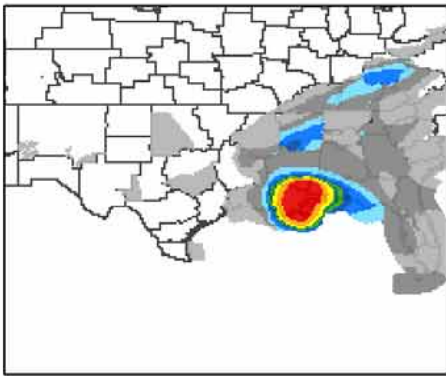
- Zoom In
- Zoom Out
- Pan
- Zoom to Lat/Lon
- Full Extent
- Zoom Last
- Zoom to Lat/Lon
- Select by Rectangle
- Clear Selected
- Identify
- Query
- Print
- Open Databrowser
- Link to Data

The background of the slide is a solid blue color. In the top-left corner, there is a white, stylized graphic that looks like a piece of paper or a flag. In the bottom-right corner, there is a faint, light blue graphic of a globe with latitude and longitude lines.

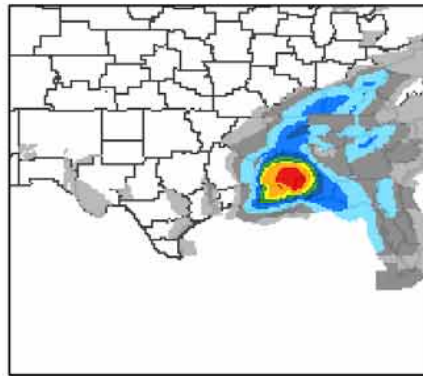
Automated Geoprocessing as a Tool to Assess NWS Forecast Quality

Benefits

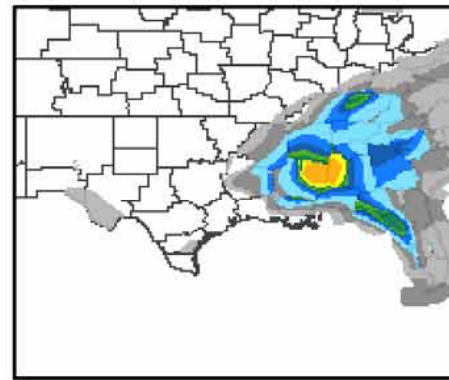
- Geospatial Depiction of Gridded PoP/QPF Forecasts
- Tabular Summaries/Statistics of Data
- Useful for Generating Post-event Recaps
- Encourages GIS Usage/Exploration
- Helps Sell Need for Enterprise Solution Across NOAA



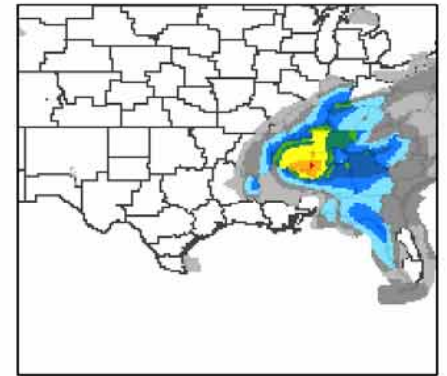
1200-1800



1800-0000



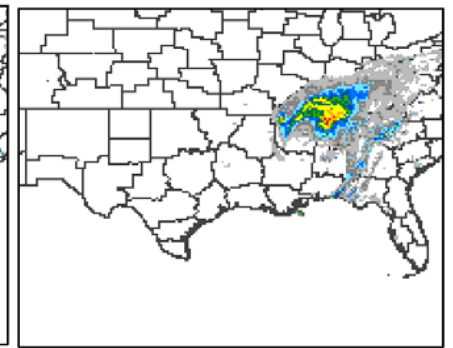
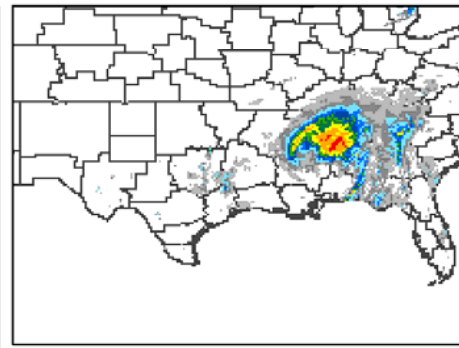
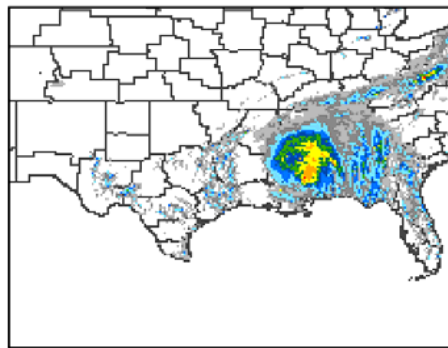
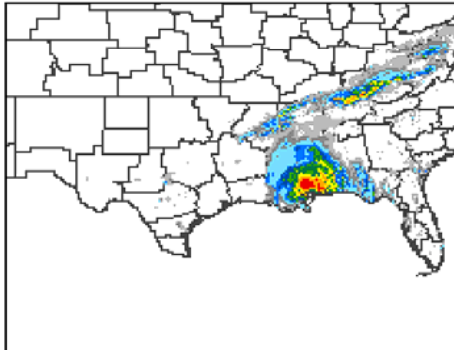
0000-0600



0600-1200

NDFD QPF

NPVU QPE

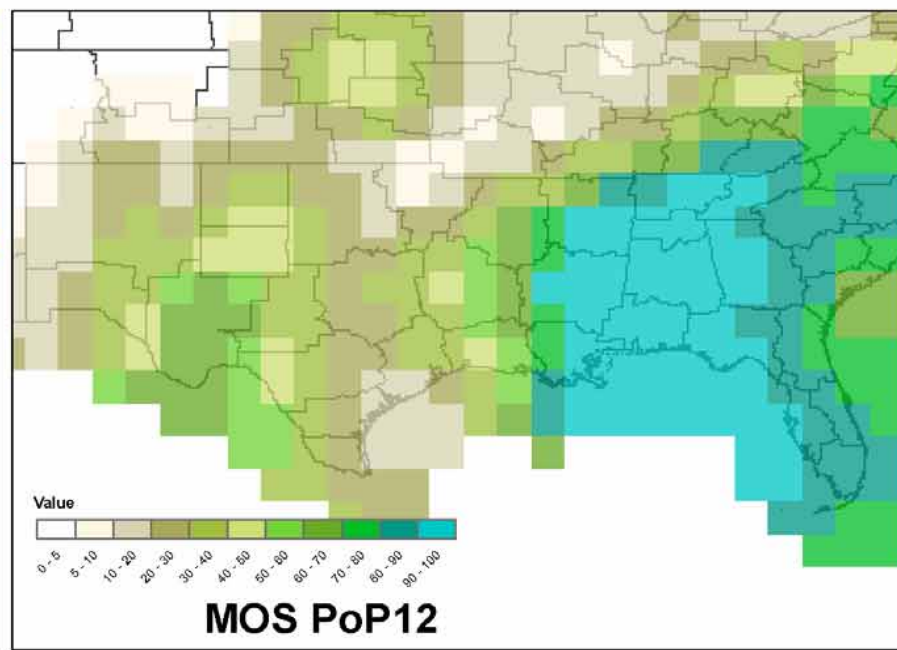
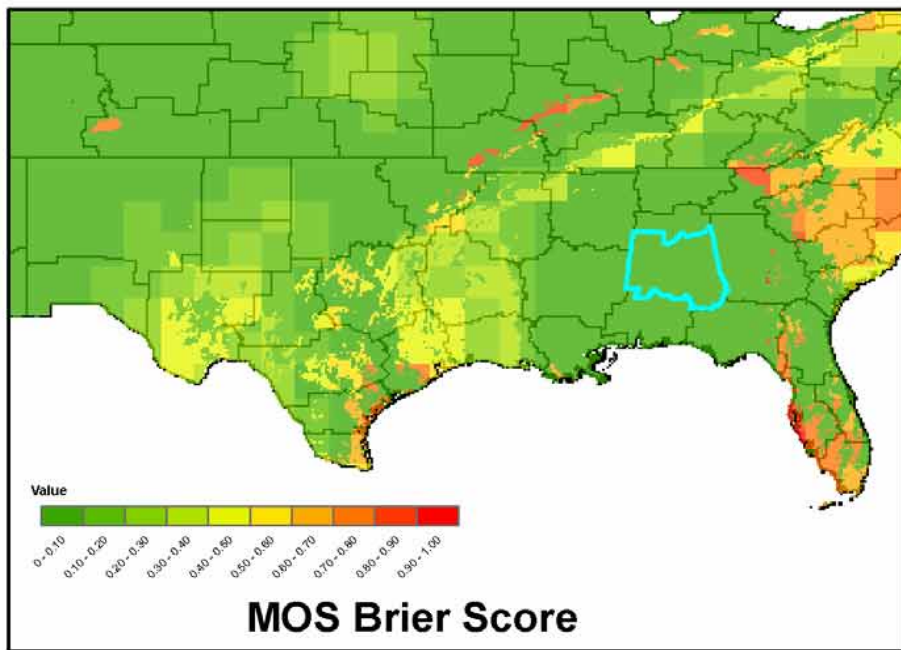


24hr Period Ending 12Z August 30, 2005

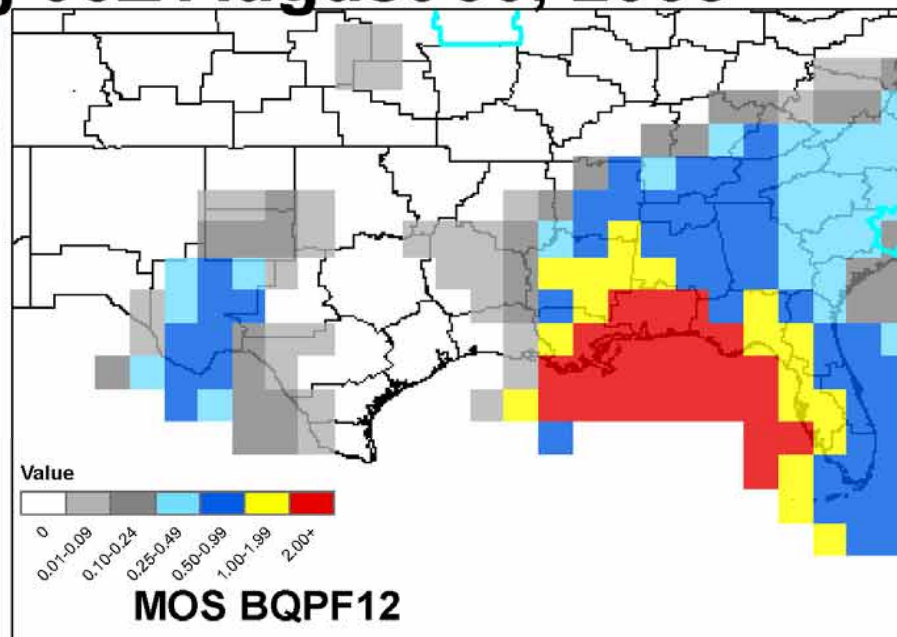
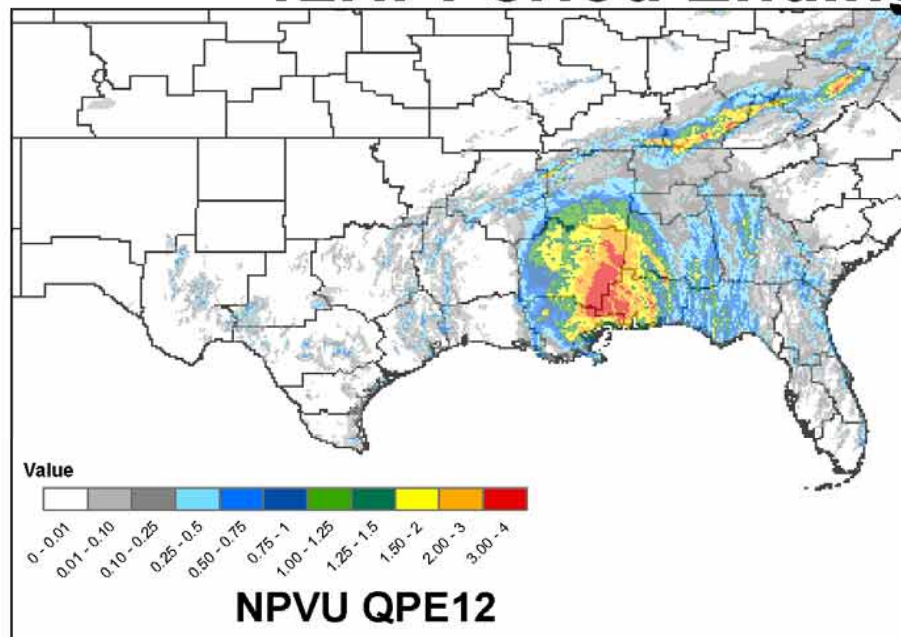
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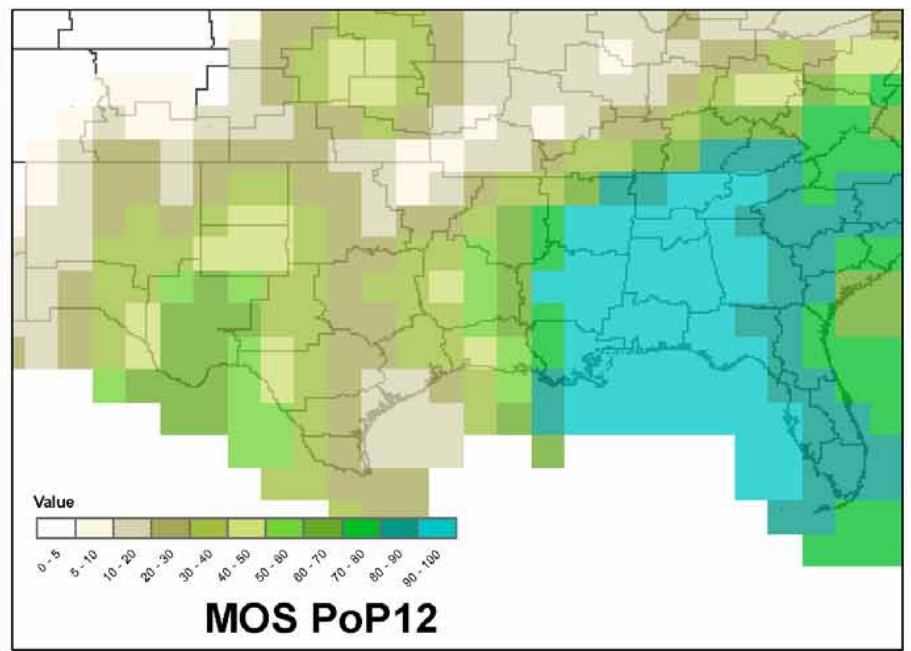
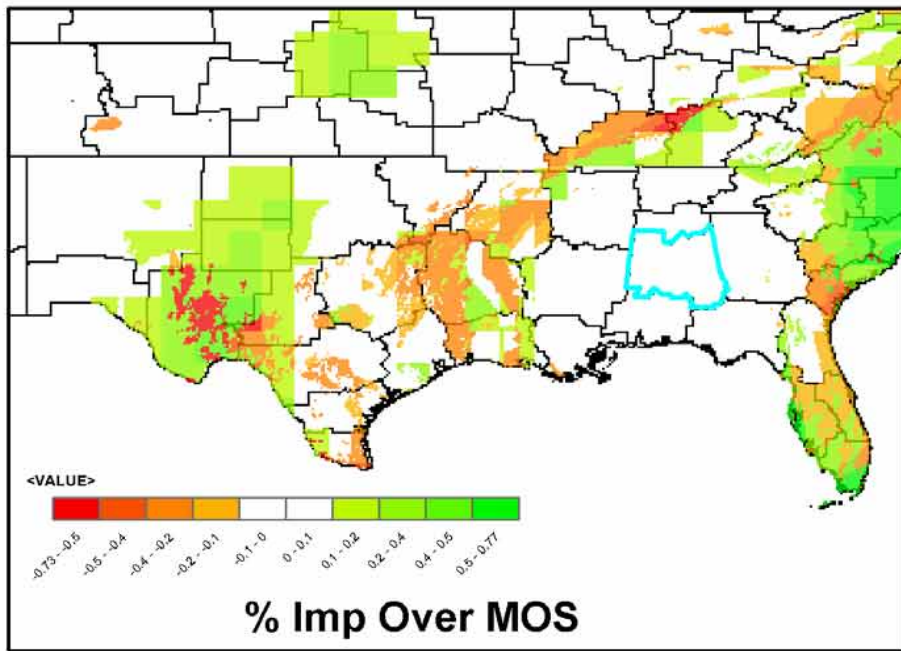


0 - 0.01
 0.01 - 0.10
 0.10 - 0.25
 0.25 - 0.5
 0.50 - 0.75
 0.75 - 1
 1.00 - 1.25
 1.25 - 1.5
 1.50 - 2
 2.00 - 3
 3.00 - 4

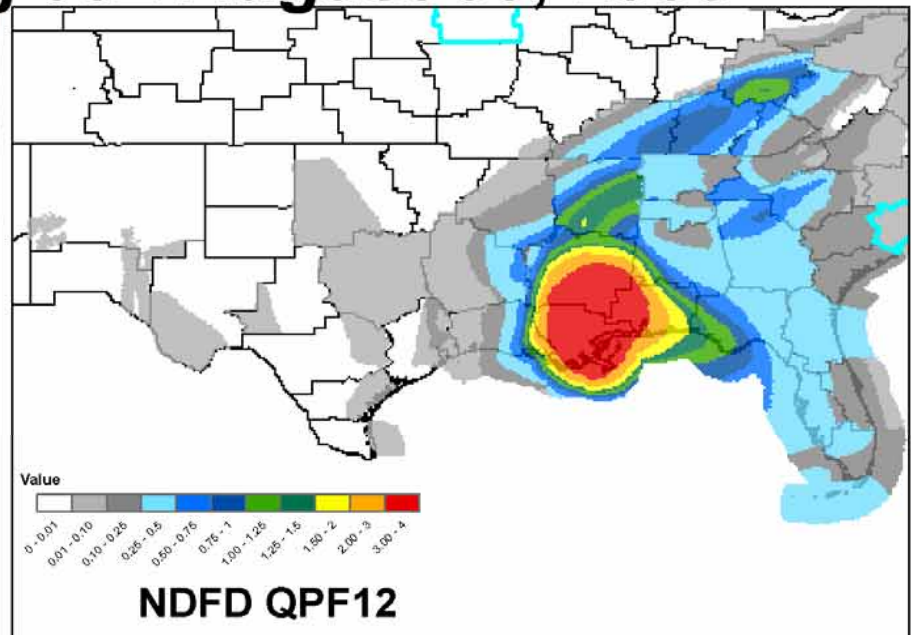
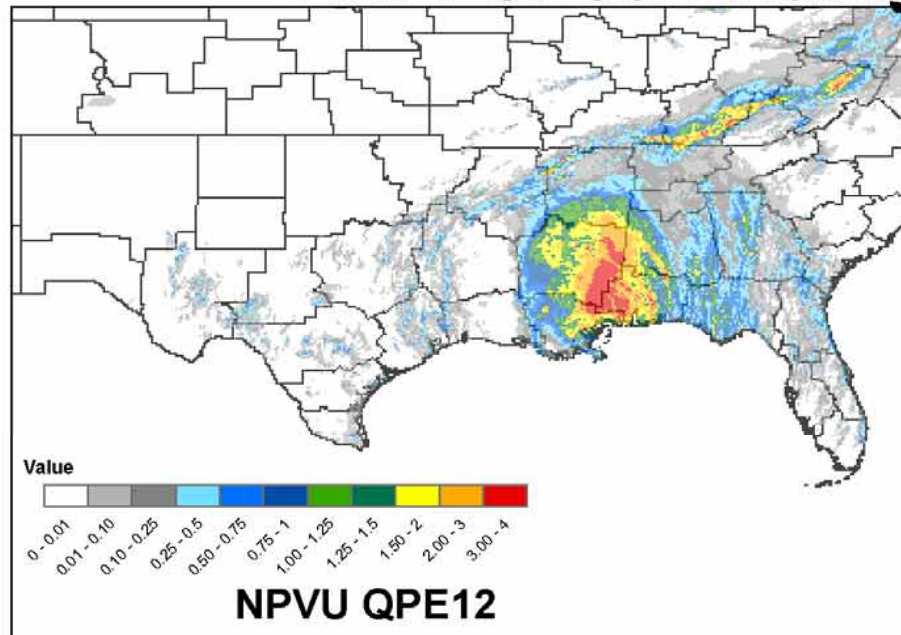


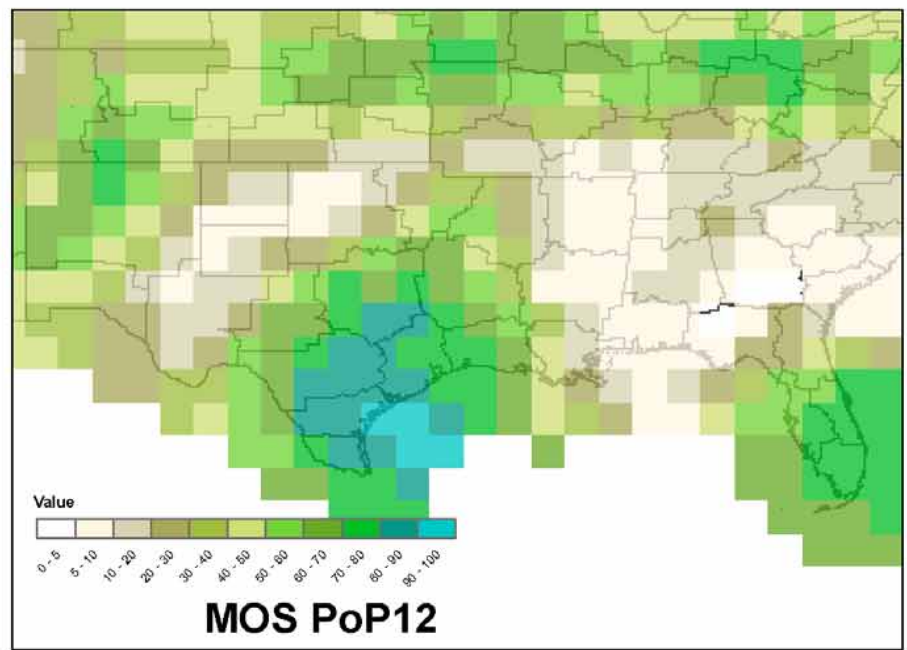
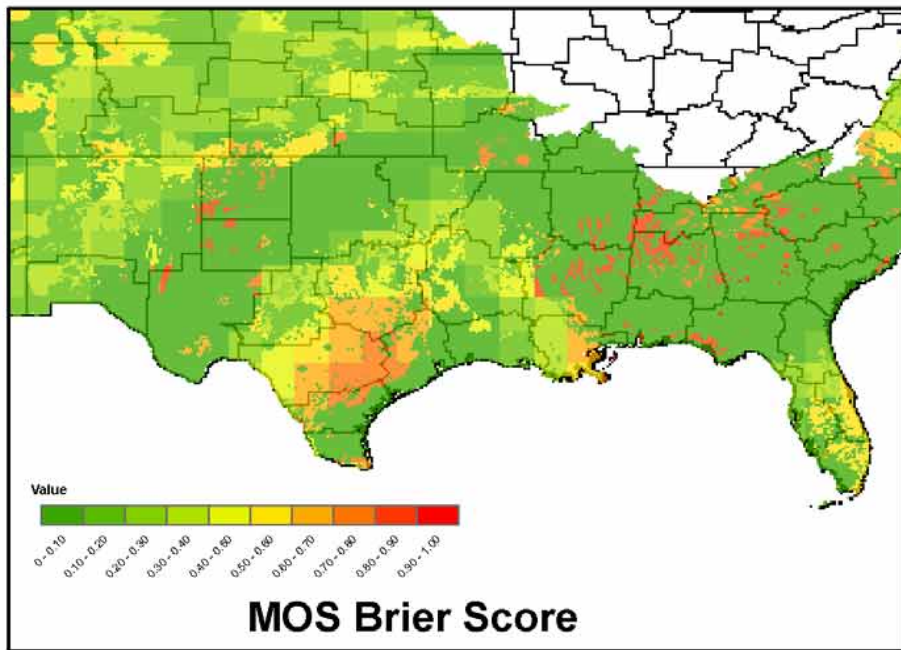
12Hr Period Ending 00Z August 30, 2005



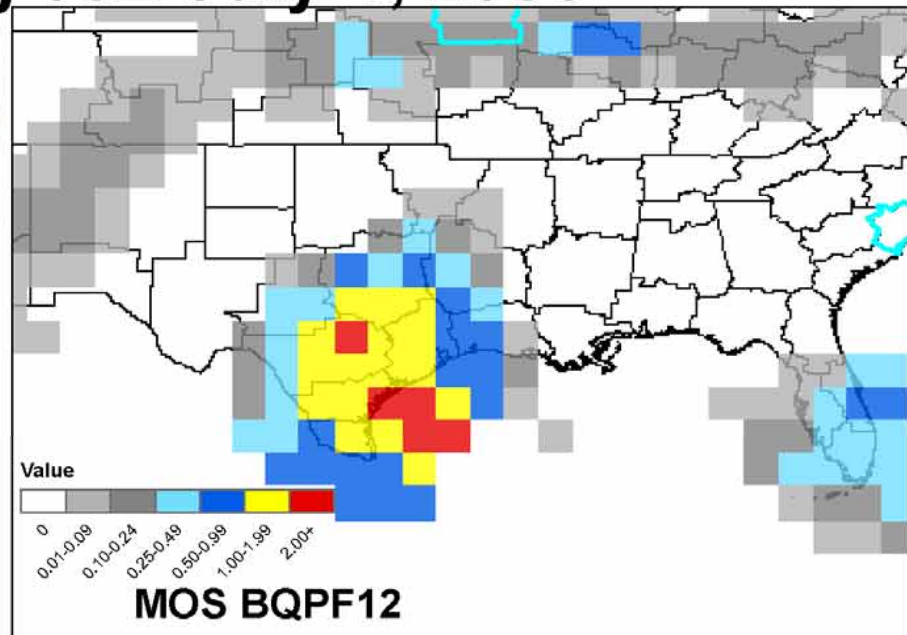
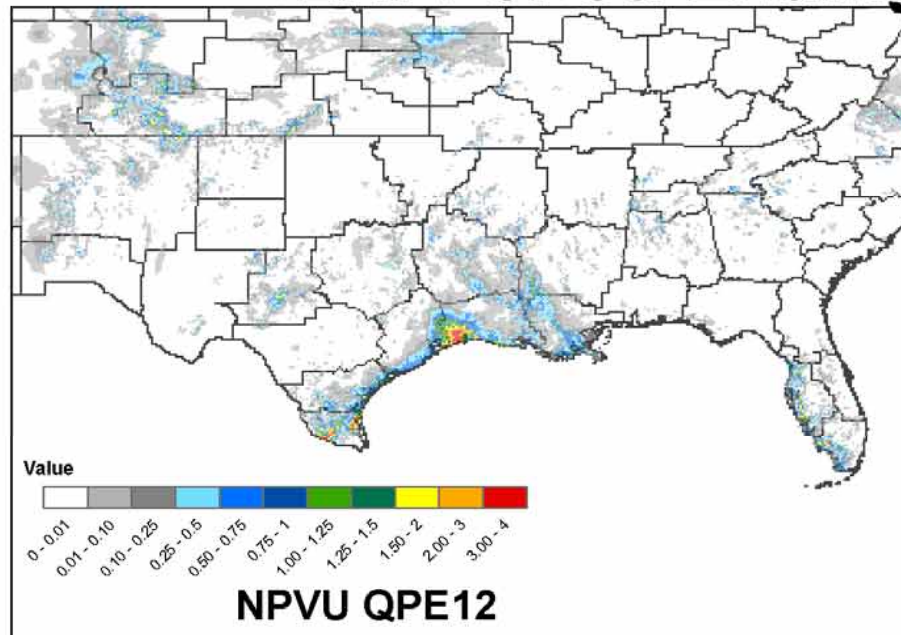


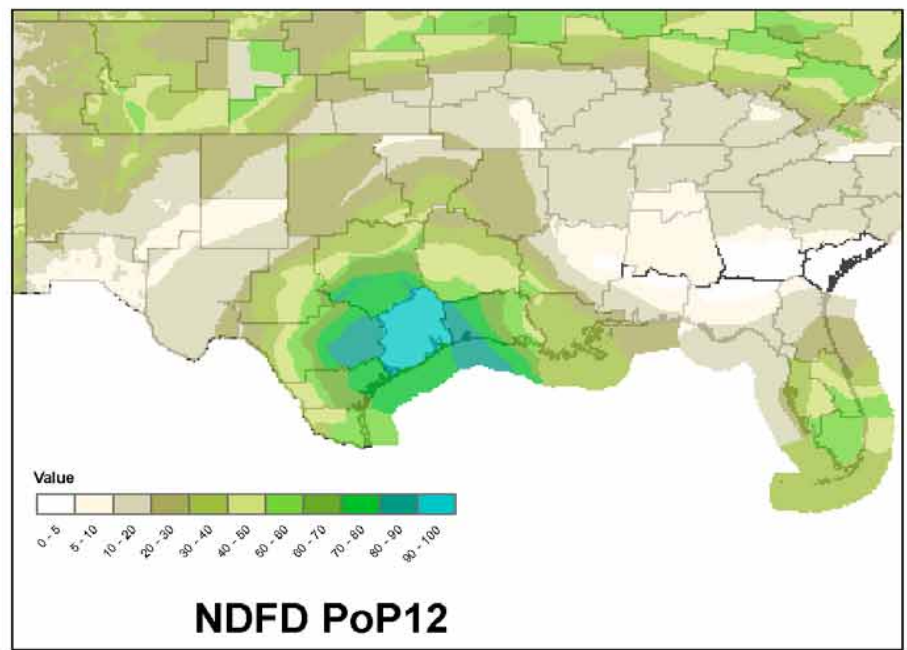
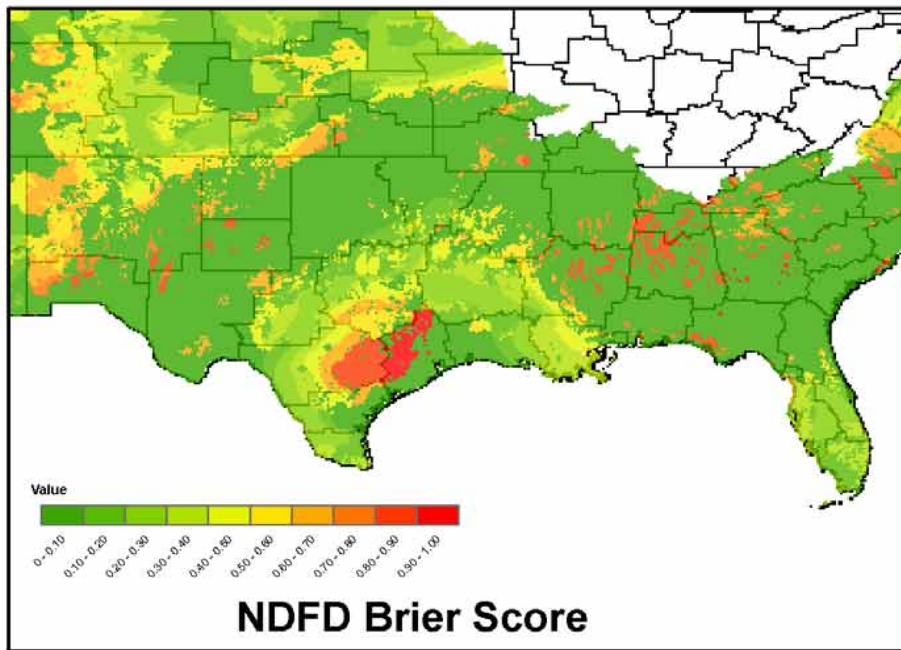
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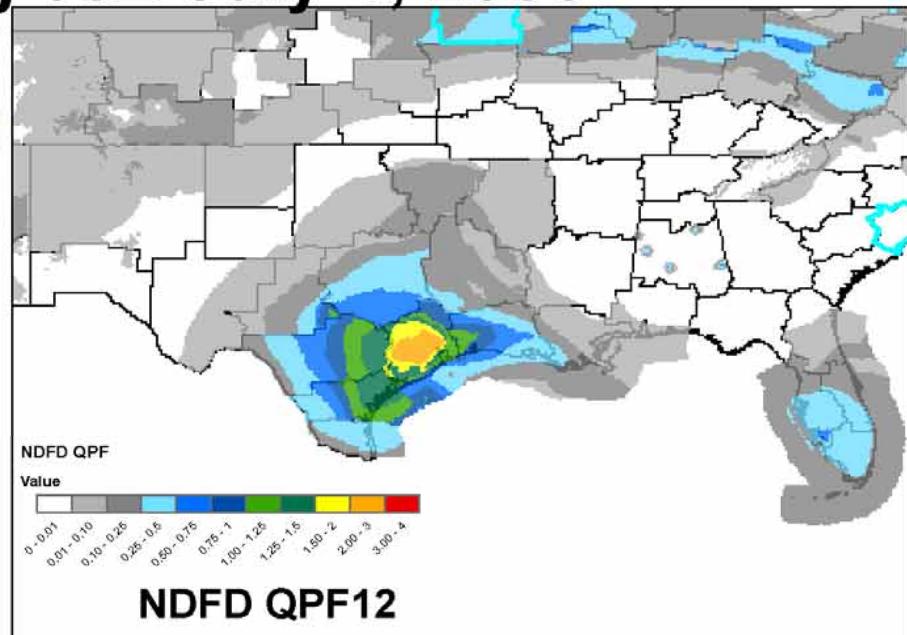
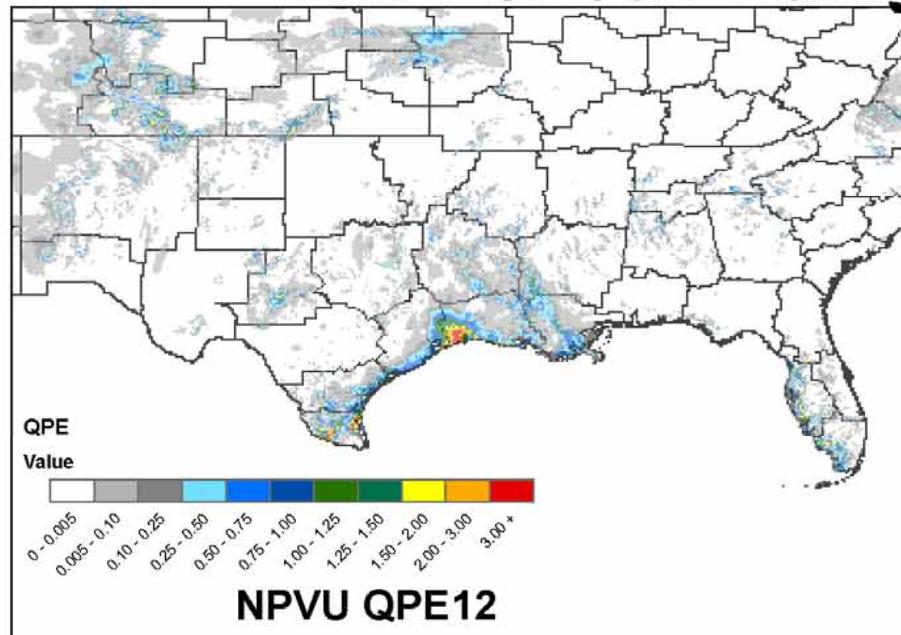


12Hr Period Ending 00Z July 4, 2006



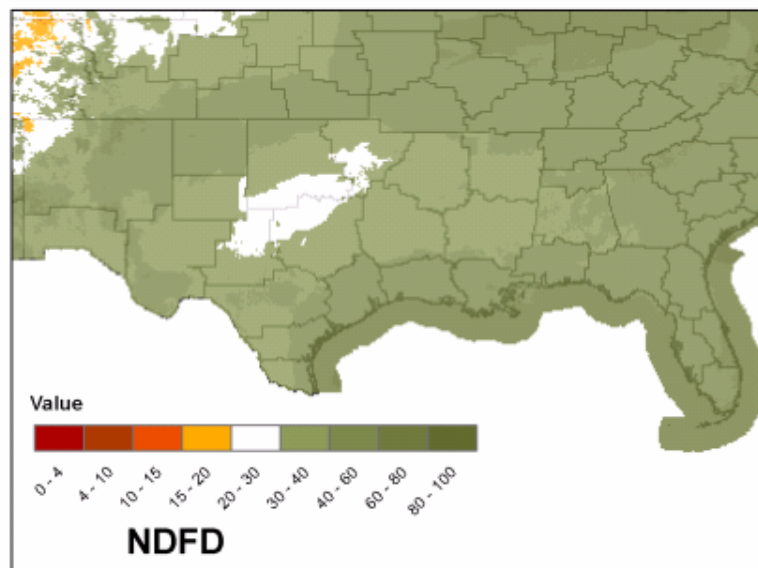
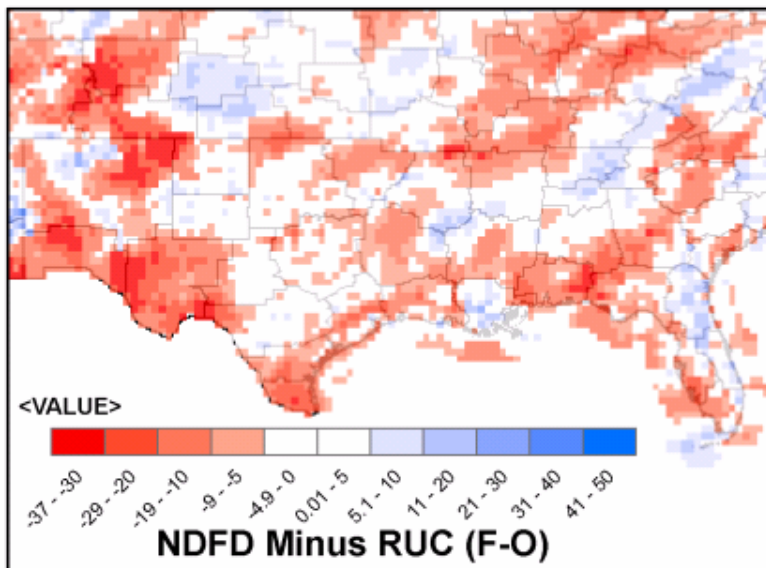


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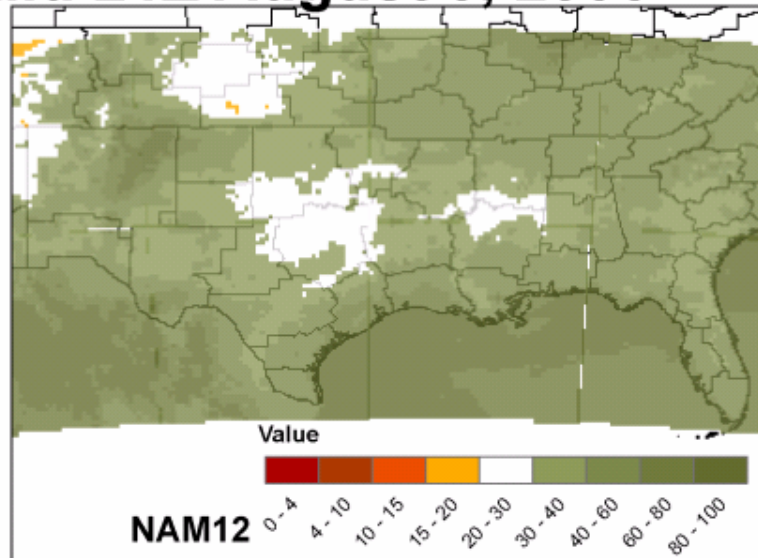
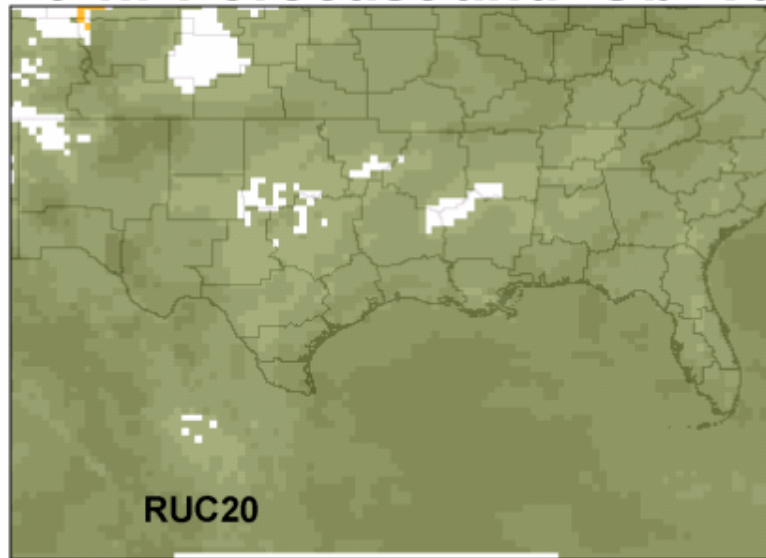


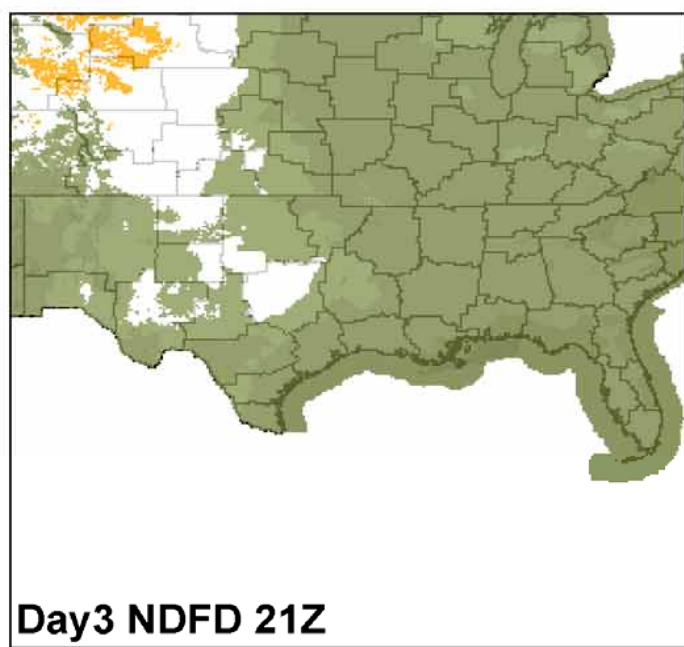
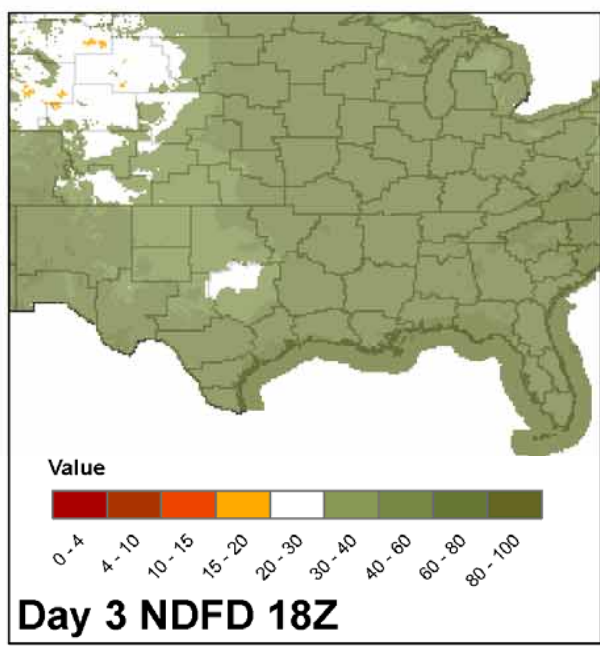
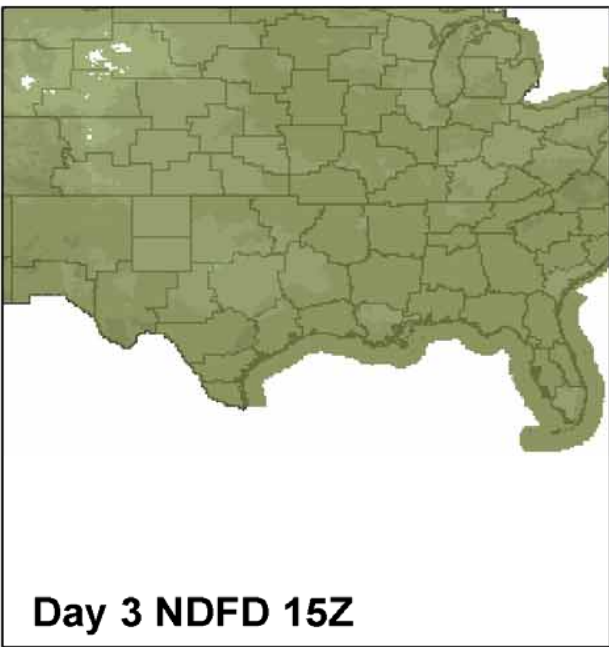
A2 HGX

	A	B	C	D	E	F	G	H	I	J	K	L
1	CWA	ZONE_COI	COUNT	AREA	MIN	MAX	RANGE	MEAN	STD	SUM		
2	HGX	109	978	4.9301000000	0.3600000000	2.7600000000	2.4000000000	1.6129500000	0.5384060000	#####		
3	CRP	111	782	3.9420600000	0.2200000000	1.4100000000	1.1900000000	0.8737210000	0.3876310000	#####		
4	EWX	110	1711	8.6251500000	0.1600000000	1.7700000000	1.6100000000	0.7455170000	0.3979530000	#####		
5	LCH	66	957	4.8242400000	0.0800000000	1.3100000000	1.2300000000	0.5786310000	0.2811090000	#####		
6	MKX	115	678	3.4178000000	0.2000000000	0.5700000000	0.3700000000	0.4076990000	0.0474048000	#####		
7	TBW	30	569	2.8683300000	0.0800000000	0.6000000000	0.5200000000	0.3637080000	0.1362020000	#####		
8	GRB	114	1025	5.1670300000	0.0900000000	0.4300000000	0.3400000000	0.3585950000	0.0589367000	#####		
9	FWD	108	1947	9.8148300000	0.0300000000	0.9200000000	0.8900000000	0.3500260000	0.2029300000	#####		
10	MFL	32	495	2.4953000000	0.1000000000	0.6000000000	0.5000000000	0.3247480000	0.0786161000	#####		
11	BRO	106	411	2.0718500000	0.1200000000	0.4600000000	0.3400000000	0.2904140000	0.0758798000	#####		
12	RLX	63	1176	5.9282200000	0.0000000000	0.6600000000	0.6600000000	0.2587250000	0.1759210000	#####		
13	MLB	31	426	2.1474700000	0.0900000000	0.5000000000	0.4100000000	0.2550470000	0.0977139000	#####		
14	LOT	51	797	4.0176800000	0.0800000000	0.5600000000	0.4800000000	0.2068010000	0.1015690000	#####		
15	DMX	40	1580	7.9647800000	0.0700000000	0.4400000000	0.3700000000	0.2060320000	0.0792928000	#####		
16	CLE	97	805	4.0580000000	0.0100000000	0.6900000000	0.6800000000	0.1974160000	0.1917150000	#####		
17	IND	54	864	4.3554200000	0.0000000000	0.5200000000	0.5200000000	0.1796990000	0.1672730000	#####		
18	SJT	105	1305	6.5785100000	0.0100000000	1.0400000000	1.0300000000	0.1697780000	0.1992900000	#####		
19	DVN	39	1125	5.6711200000	0.0700000000	0.5800000000	0.5100000000	0.1644890000	0.0794416000	#####		
20	ILN	55	1095	5.5199000000	0.0000000000	0.3900000000	0.3900000000	0.1617170000	0.1168180000	#####		
21	IWX	53	891	4.4915300000	0.0600000000	0.5300000000	0.4700000000	0.1588220000	0.0420686000	#####		
22	MQT	71	856	4.3151000000	0.0600000000	0.4000000000	0.3400000000	0.1482480000	0.0516817000	#####		
23	ILX	50	1052	5.3031300000	0.0100000000	0.6800000000	0.6700000000	0.1415780000	0.1483660000	#####		
24	OAX	41	1212	6.1096900000	0.0200000000	0.3000000000	0.2800000000	0.1407760000	0.0528063000	#####		
25	SHV	8	1759	8.8671200000	0.0200000000	0.5200000000	0.5000000000	0.1367030000	0.0671751000	#####		
26	PUB	23	1749	8.8167100000	0.0100000000	0.2400000000	0.2300000000	0.1347340000	0.0645342000	#####		
27	CTP	102	1275	6.4272800000	0.0300000000	0.3000000000	0.2700000000	0.1308470000	0.0954925000	#####		
28	PBZ	67	1043	5.2577600000	0.0200000000	0.3000000000	0.2800000000	0.1181500000	0.0159436000	#####		
29	ARX	42	1127	5.6812100000	0.0600000000	0.4600000000	0.4000000000	0.1120590000	0.0367855000	#####		
30	LBF	88	1872	9.4367500000	0.0100000000	0.2500000000	0.2400000000	0.1118000000	0.0715833000	#####		
31	TSA	7	1316	6.6339600000	0.0000000000	0.2200000000	0.2200000000	0.1078420000	0.0620819000	#####		
32	PHI	29	834	4.2041900000	0.0300000000	0.1400000000	0.1100000000	0.1078420000	0.0209348000	#####		
33	EYW	34	6	0.0302460000	0.1000000000	0.1000000000	0.0000000000	0.1000000000	0.0000000000	0.6000000000		
34	ESD	43	1631	8.2218700000	0.0200000000	0.2000000000	0.1800000000	0.0989761000	0.0649170000	#####		

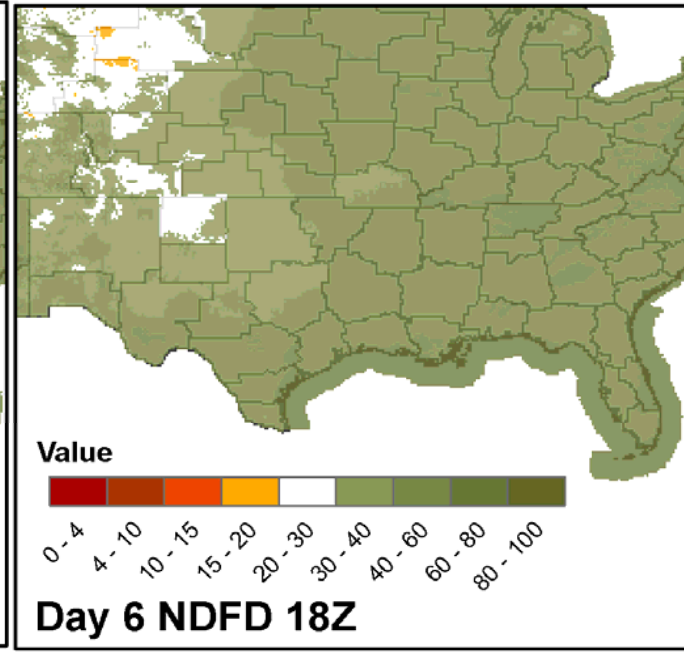
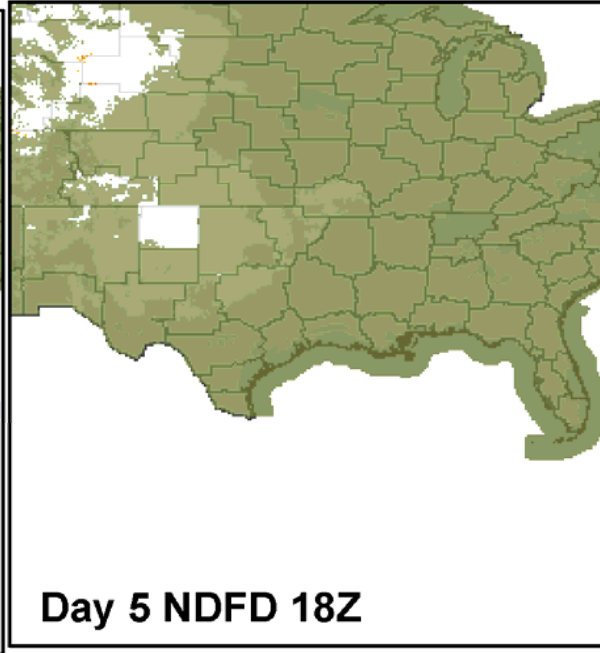
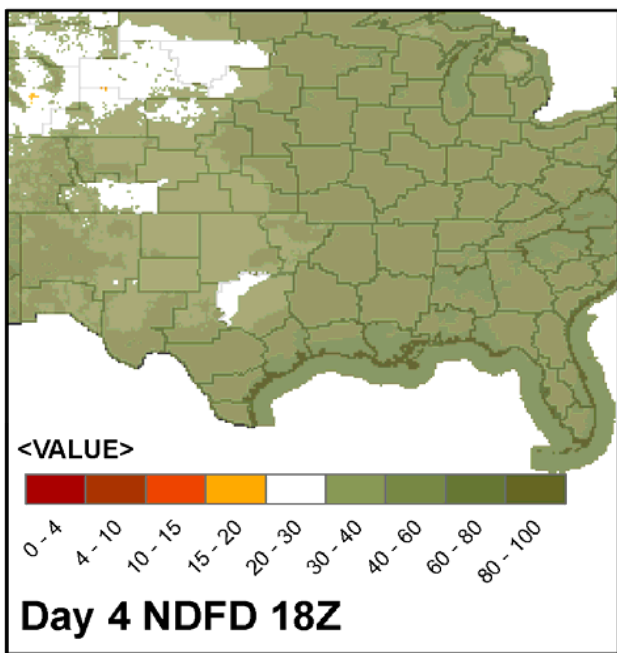


9-hr Forecast and 'Ob' Valid 21Z August 3, 2006

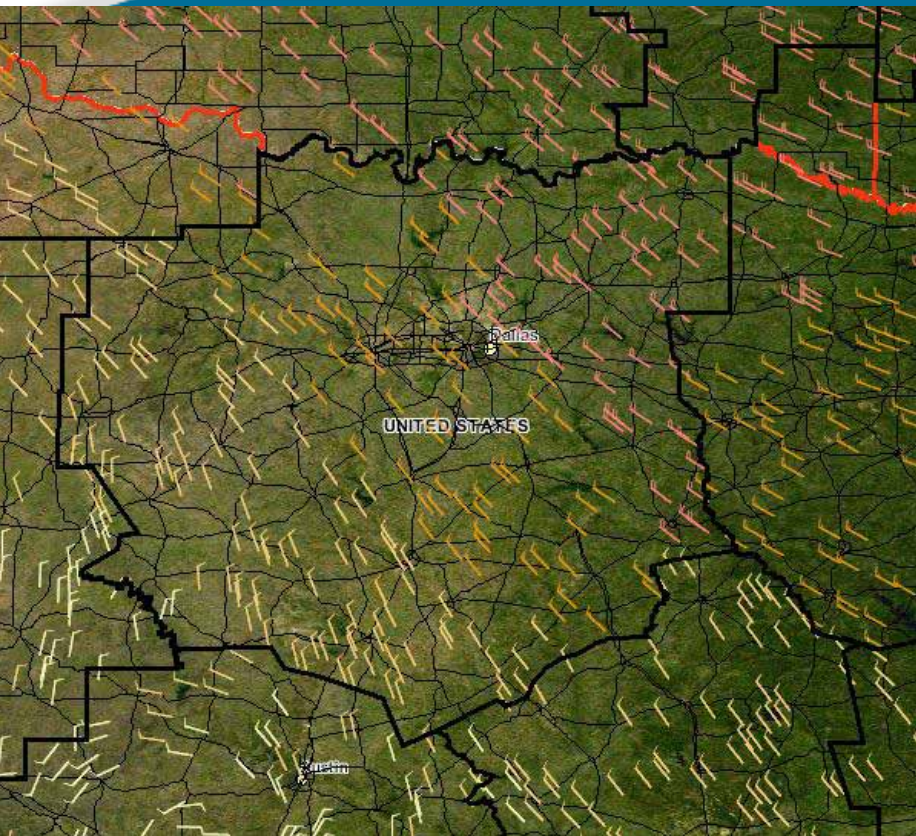




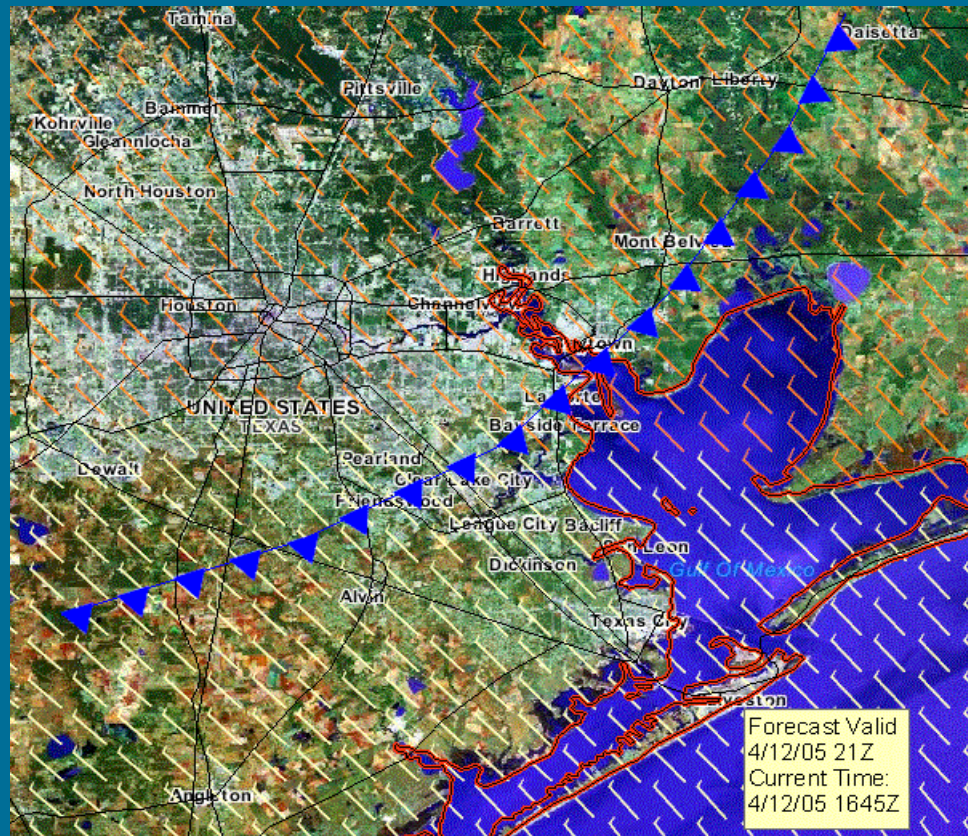
Extended (Days 3-6) NDFD RH Forecasts August 6, 2006 to August 9, 2006



National Digital Forecast Database (NDFD)



NDFD surface winds



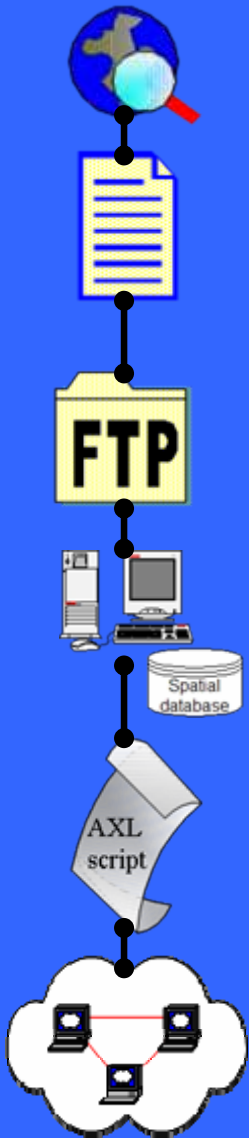
Winds with annotation

What Can't the NWS do with GIS?

SERVE IT!

What can PSU (and others?) do with weather data in GIS?

Segue to PSU portion on
Serving NDFD via IMS



Developing Internet Map Services with NDFD (NOAA/NWS)

- **Dr. Bernd J. Haupt**, *Earth & Environmental Systems Institute*
- **Maurie Caitlin Kelly**, *PS Institutes of Energy & the Environment*
 - **Ryan E. Baxter**, *PS Institutes of Energy & the Environment*
 - **James F. Spayd**, *PS Institutes of Energy & the Environment*

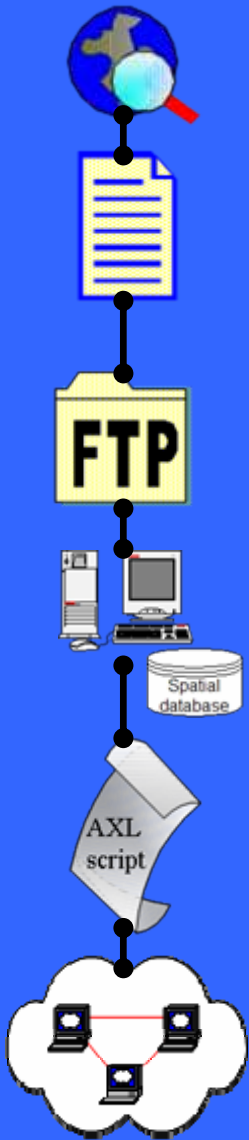
The Pennsylvania State University



In collaboration with

Jack Settelmaier (*NOAA/NWS*), Ken Waters (*NOAA/NWS*)

Presentation for ESRI Federal Users Conference, January 10, 2007



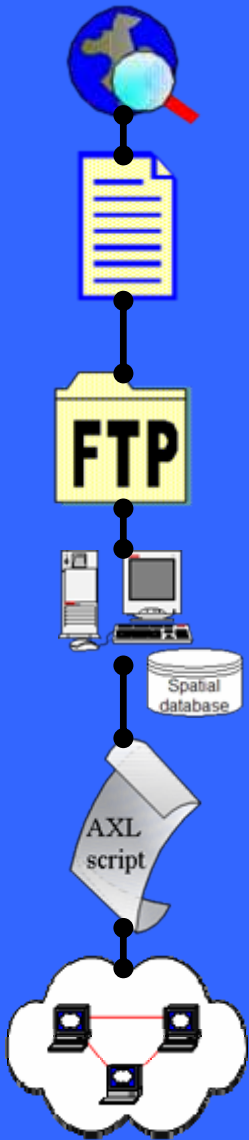
Who We Are...

- PSIEE & EESI faculty collaborate on several GIS related projects.
- Project team works with Federal agencies such as the US Geological Survey (USGS); state agencies such as the PA Office of Information Technology, and non profit organizations such as the American Fisheries Society.
- Currently, project team members manage spatial databases that houses approximately 8 terabytes of data and imagery.
- Project team members manage the Pennsylvania Geospatial Data Clearinghouse, PASDA, <http://www.pasda.psu.edu>, and the geospatial component of the Mid-Atlantic Information Node, MAIN, <http://main.nbii.org>.
- *Initial funding was provided from the Penn State University GIS Council to develop proof of concept for climate and weather data.*

Framework for Pilot Project ... (Why do we need it?)

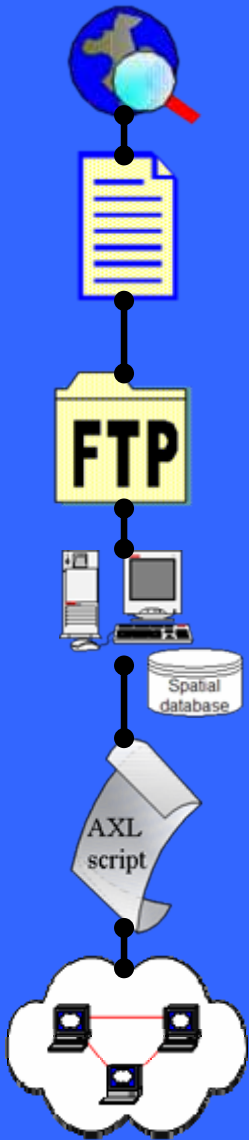
The NDFD (National Digital Forecast Data) Pilot project was developed by PSIEE and EESI faculty for the following reasons:

- Most users are unfamiliar with the NDFD data or the types of data formats that weather data come in.
- Most users do not have the processing capabilities or knowledge to acquire and convert and store this data for their own use.
- *We have developed a way for users to incorporate this data into their desktop GIS with a click of a button. This eliminates the need for them to process this data themselves.*
- Emergency managers and response support agencies need this vital information to cope with potential emergency situations. In Pennsylvania, flooding is the primary natural disaster with which emergency managers cope with.

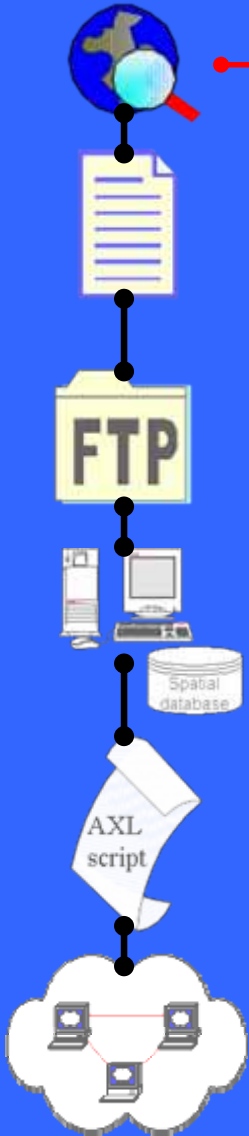


Process Steps... (6 in total) Overview

- Identify sources of spatial and temporal data from agencies, organizations, or academic institutions.
- Develop partnership with data provider.
- Acquire data from provider or from public access site such as an FTP site (Automate this process where possible).
- QA/QC data for completeness; convert to GIS format; create metadata; load into ArcSDE (spatial data engine).
- Create ArcIMS Image and Feature Services which are updated when data is updated in database. (new AXL files with new datasets).
- Users can bring Image and Feature services directly into their desktop GIS software.



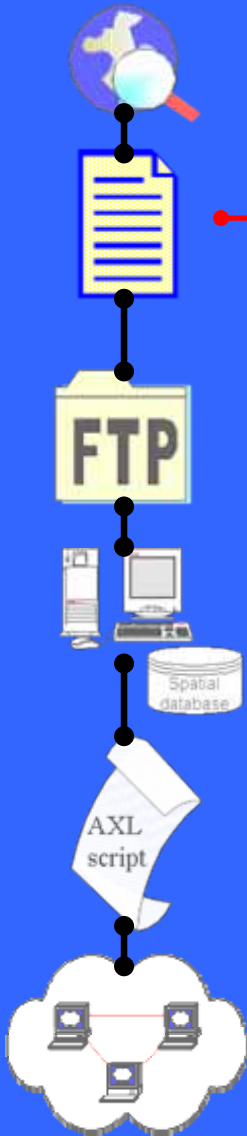
Process Steps... (step 1)



- Identify sources of spatial and temporal data from agencies, organizations, or academic institutions.
- Develop partnership with data provider.
- Acquire data from provider or from public access site such as an FTP site (Automate this process where possible).
- QA/QC data for completeness; convert to GIS format; create metadata; load into ArcSDE (spatial data engine).
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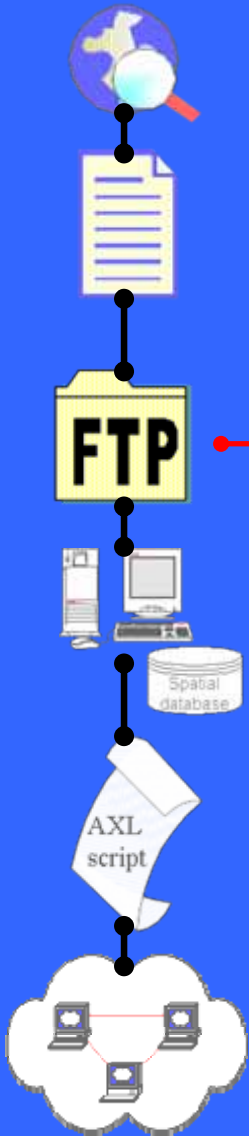
Process Steps... (step 2)

- Identify sources of spatial and temporal data from agencies, organizations, or academic institutions.
- **Develop partnership with data provider.**
- Acquire data from provider or from public access site such as an FTP site (Automate this process where possible).
- QA/QC data for completeness; convert to GIS format; create metadata; load into ArcSDE (spatial data engine).
- Create ArcIMS Image and Feature Services which are updated when data is updated in database. (new AXL files with new datasets).
- Users can bring Image and Feature services directly into their desktop GIS software.



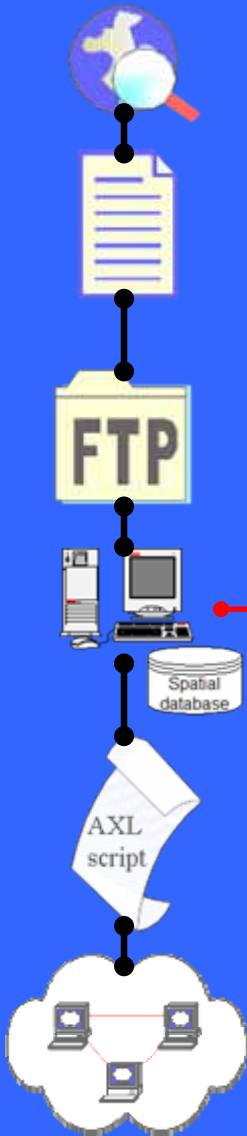
Process Steps... (step 3)

- Identify sources of spatial and temporal data from agencies, organizations, or academic institutions.
- Develop partnership with data provider.
- **Acquire data from provider or from public access site such as an FTP site (Automate this process where possible).**
- QA/QC data for completeness; convert to GIS format; create metadata; load into ArcSDE (spatial data engine).
- Create ArcIMS Image and Feature Services which are updated when data is updated in database. (new AXL files with new datasets).
- Users can bring Image and Feature services directly into their desktop GIS software.



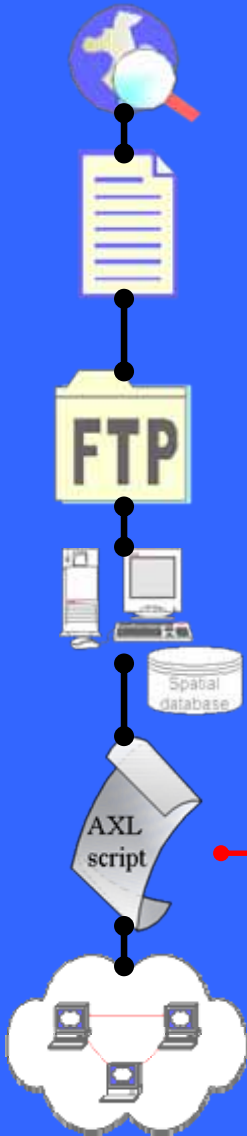
Process Steps... (step 4)

- Identify sources of spatial and temporal data from agencies, organizations, or academic institutions.
- Develop partnership with data provider.
- Acquire data from provider or from public access site such as an FTP site (Automate this process where possible).
- QA/QC data for completeness; convert to GIS format; create metadata; load into ArcSDE (spatial data engine).
- Create ArcIMS Image and Feature Services which are updated when data is updated in database. (new AXL files with new datasets).
- Users can bring Image and Feature services directly into their desktop GIS software.



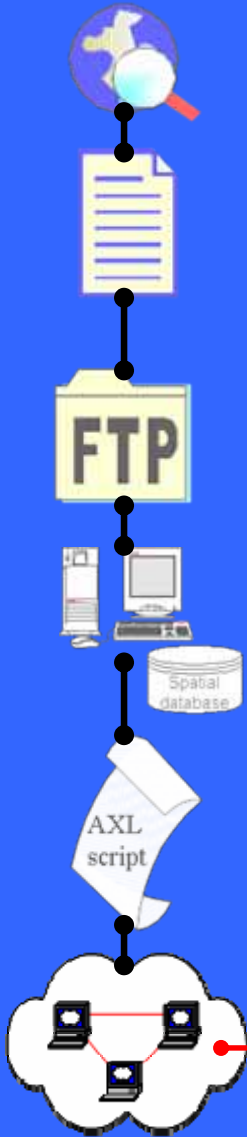
Process Steps... (step 5)

- Identify sources of spatial and temporal data from agencies, organizations, or academic institutions.
- Develop partnership with data provider.
- Acquire data from provider or from public access site such as an FTP site (Automate this process where possible).
- QA/QC data for completeness; convert to GIS format; create metadata; load into ArcSDE (spatial data engine).
- **Create ArcIMS Image and Feature Services which are updated when data is updated in database. (new AXL files with new datasets).**
- Users can bring Image and Feature services directly into their desktop GIS software.



Process Steps... (step 6)

- Identify sources of spatial and temporal data from agencies, organizations, or academic institutions.
- Develop partnership with data provider.
- Acquire data from provider or from public access site such as an FTP site (Automate this process where possible).
- QA/QC data for completeness; convert to GIS format; create metadata; load into ArcSDE (spatial data engine).
- Create ArcIMS Image and Feature Services which are updated when data is updated in database. (new AXL files with new datasets).



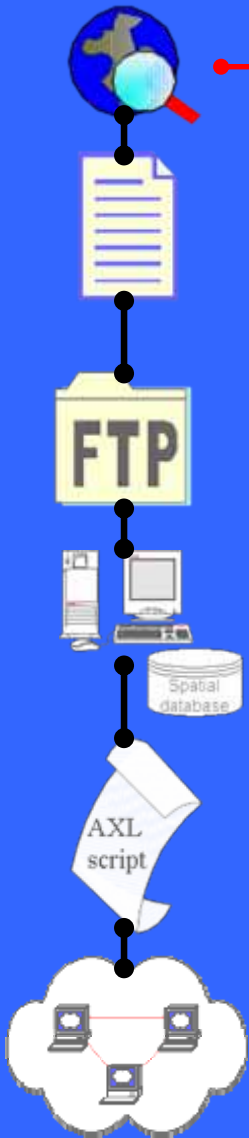
Users can bring Image and Feature services directly into their desktop GIS software.

Process Steps... (step 1a)

Identify sources of spatial and temporal data from agencies, organizations, or academic institutions.

There are plenty of temporal data available from various sources like:

- National Oceanic & Atmospheric Administration (NOAA)
 - *National Weather Service (NOAA/NWS) ⇔ today's example*
- US Geological Service (USGS)
- National Biological Information Infrastructure (NBII)
- Multi-State Aquatic Resources Information System (MARIS)
- Universities
- Government
- ...
- Today, we'll use NOAA/NWS NDFD data as one possible example (NDFD = National Digital Forecast Data; <http://www.weather.gov/ndfd>).



Process Steps... (step 1b)

Identify sources of spatial and temporal data from agencies, organizations, or academic institutions.

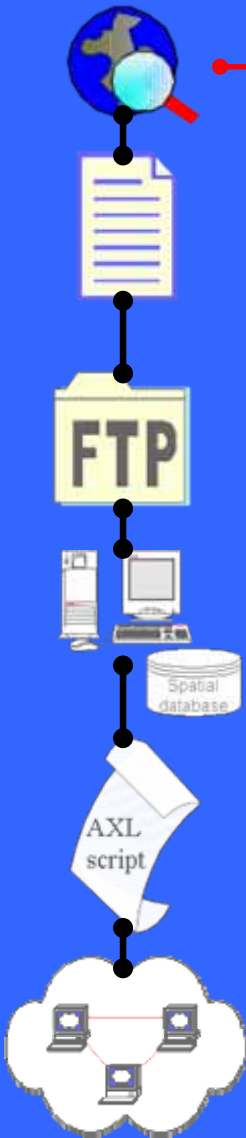
- The National Digital Forecast Database (NDFD) broke the CONUS (Continental United States) into sixteen geographic sub-sectors.



Available variables we are currently serving to the GIS community are:

min. & max. temp., 12-hour probability of precipitation, temp., dewpoint, quantitative precipitation forecast (QPF), snow amount, wind direction & speed, significant wave height, sky cover, apparent temp., rel. humidity, wind gust

More variables provided by NOAA/NWS and others are hopefully coming soon (depends on interest and time available -- non-funded enterprise)



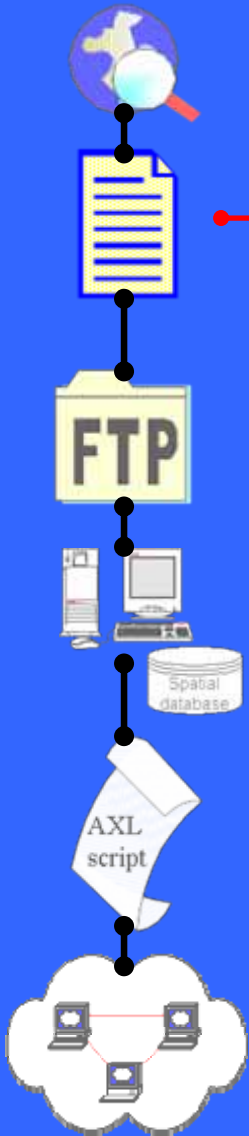
Process Steps... (step 2)

Develop partnership with data provider.

Developing a relationship with a data provider gives the project a more sustainable base, allows data to be updated more readily, and encourages further cooperation should additional data become available.

The following step should be made once a dataset has been identified:

- The data provider should be contacted to ensure that he/she agrees to the distribution of his/her data by another institution.
- Appropriate credit should be given in the metadata to the data provider.
- Disclaimer and use constraints can also be included in the metadata where applicable.

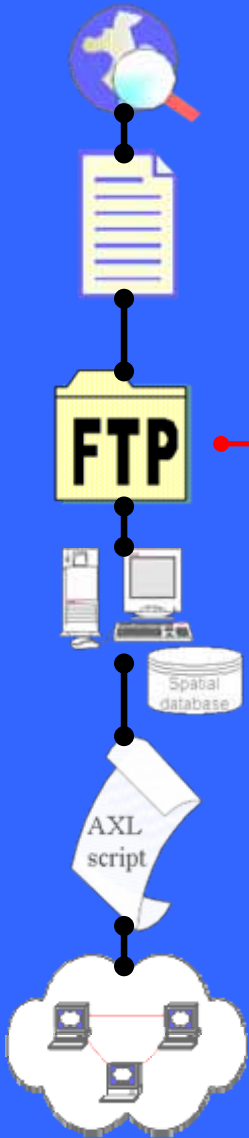


Process Steps... (step 3)

Acquire data from provider or from public access site such as an FTP site (Automate this process where possible).

Some details that the normal user will not get to see and does not have to worry about:

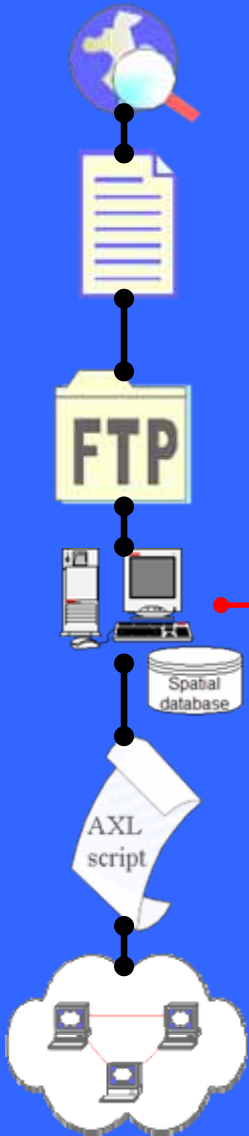
- Data (e.g., NDFD; ~ 75 MB -- compressed) will be downloaded from the data provider at *predetermined time intervals (e.g., every 1-3 hours)* via either anonymous FTP or HTTP (Unix, Linux, Cygwin).
- Parallel downloads immensely speed up data transfer (frequently datasets are split into chunks, which is preferable; note: datasets need to be concatenated to become usable).
- Avoid sequential data downloads
- If downloads require a username and password other than an anonymous login, *make sure that files are read and write protected, especially on multi-user systems.*



Process Steps... (step 4)

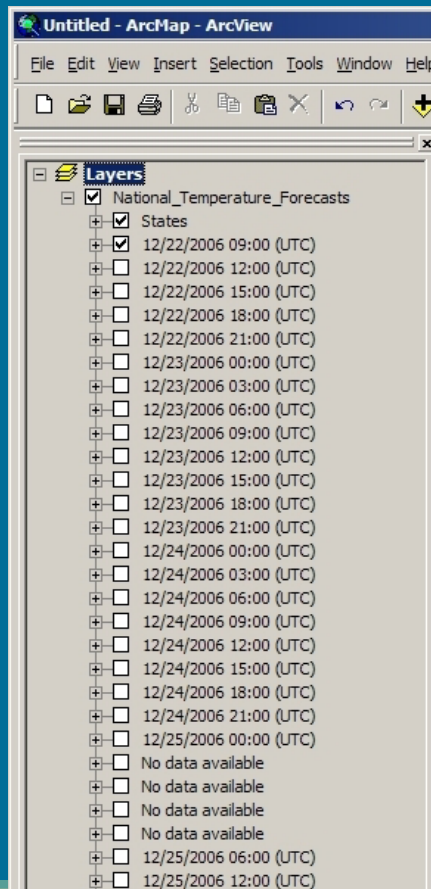
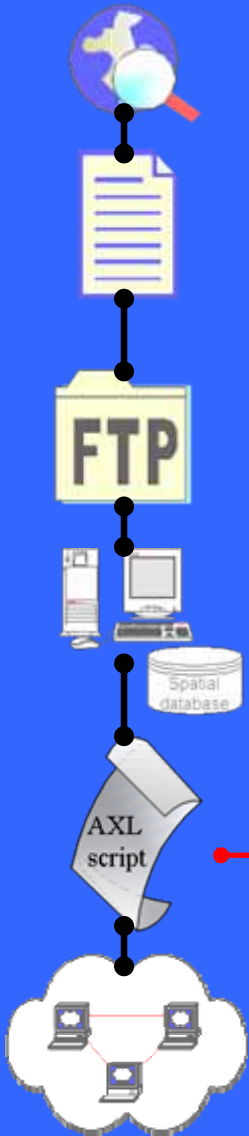
• QA/QC data for completeness; convert to GIS format; create metadata; load into ArcSDE (spatial data engine).

- Check data for completeness
- Data come in compressed format => “Degrib” data and convert to ESRI shape files (GRIB2 is the second version of the World Meteorological Organization’s (WMO) standard for distributing gridded data).
- Upload ESRI shape files/layers into “Spatial Database”, e.g., 40 forecast layers for “temperature” (26 x every 3h = 78h; then 14 x 6h = 84h; forecast for about 1 week)
- Repeat for all other variables



Process Steps... (step 5a)

Create ArcIMS Image and Feature Services which are updated when data is updated in database. (new AXL files with new datasets).



- Update time stamp (BONUS; tricky; wait for next slide)
- Usually timestamps say, e.g. 3, 6, 9, ... , 150 hours from now; *ours* do show real times.
- Problem: A users saves a map and reopens it without remembering the time he saved the map → ideally the timestamp should show the forecast time.

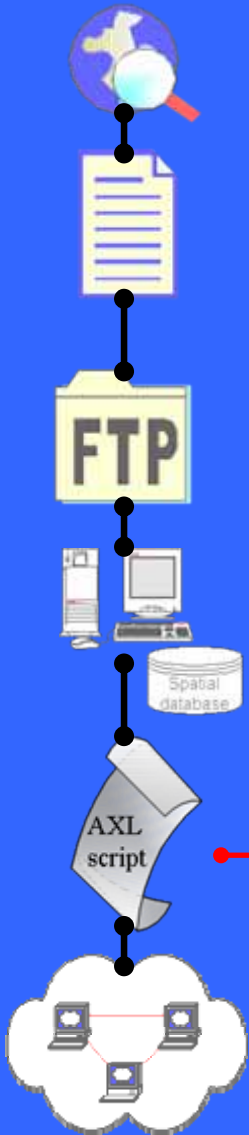
Process Steps... (step 5b)

Create ArcIMS Image and Feature Services which are updated when data is updated in database. (new AXL files with new datasets).

```
cygdrive/d/noaa.conus/data-archive/2007010301/conus
$ degrib vp004-007/ds.temp.bin -I
MsgNum, Byte, GRIB-Version, elem, level, reference(UTC), valid(UTC), Proj(hr)
1.0, 0, 2, T="Temperature [K]", 0-SFC, 01/03/2007 06:00, 01/06/2007 06:00, 72.00
2.0, 255958, 2, T="Temperature [K]", 0-SFC, 01/03/2007 06:00, 01/06/2007 12:00, 78.00
3.0, 511415, 2, T="Temperature [K]", 0-SFC, 01/03/2007 06:00, 01/06/2007 18:00, 84.00
4.0, 767703, 2, T="Temperature [K]", 0-SFC, 01/03/2007 06:00, 01/07/2007 00:00, 90.00
5.0, 1027690, 2, T="Temperature [K]", 0-SFC, 01/03/2007 06:00, 01/07/2007 06:00, 96.00
6.0, 1285997, 2, T="Temperature [K]", 0-SFC, 01/03/2007 06:00, 01/07/2007 12:00, 102.00
7.0, 1544605, 2, T="Temperature [K]", 0-SFC, 01/03/2007 06:00, 01/07/2007 18:00, 108.00
8.0, 1800934, 2, T="Temperature [K]", 0-SFC, 01/03/2007 06:00, 01/08/2007 00:00, 114.00
9.0, 2061530, 2, T="Temperature [K]", 0-SFC, 01/03/2007 06:00, 01/08/2007 06:00, 120.00
10.0, 2323549, 2, T="Temperature [K]", 0-SFC, 01/03/2007 06:00, 01/08/2007 12:00, 126.00
11.0, 2586626, 2, T="Temperature [K]", 0-SFC, 01/03/2007 06:00, 01/08/2007 18:00, 132.00
12.0, 2845848, 2, T="Temperature [K]", 0-SFC, 01/03/2007 06:00, 01/09/2007 00:00, 138.00
13.0, 3108526, 2, T="Temperature [K]", 0-SFC, 01/03/2007 06:00, 01/09/2007 06:00, 144.00
14.0, 3371488, 2, T="Temperature [K]", 0-SFC, 01/03/2007 06:00, 01/09/2007 12:00, 150.00
```

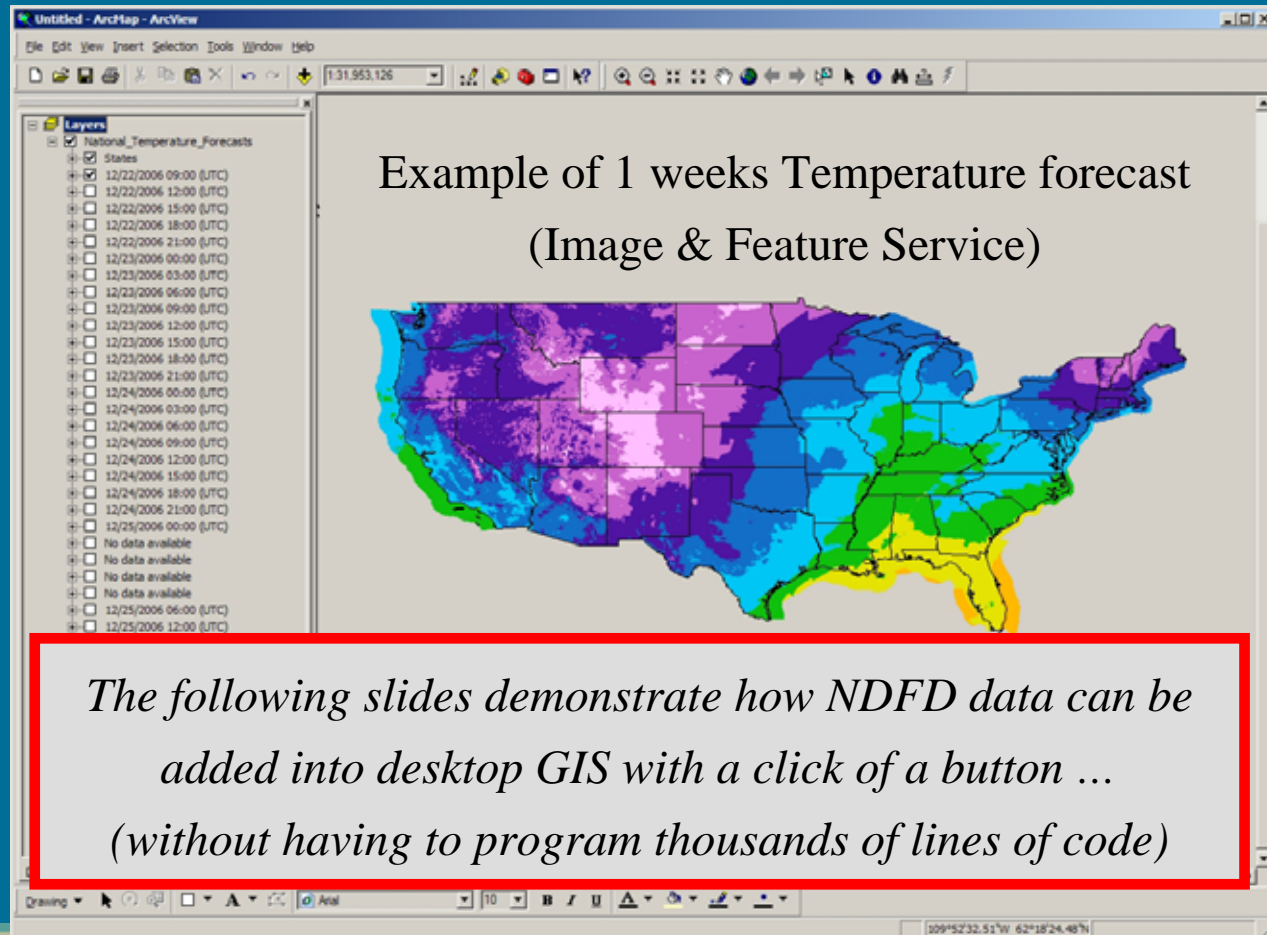
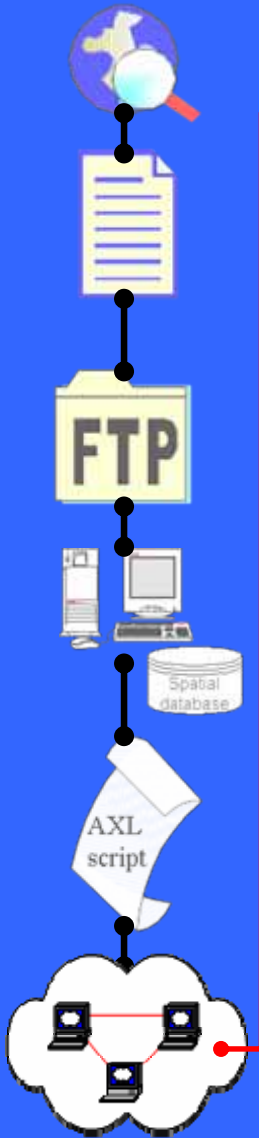
Example of metadata
• degrib ds.temp.bin -I

- Here is how we *update the time stamp* ...
 1. Extract timestamp from data archive/metadata
 2. Update AXL file with the “real” time information
 3. Stop Feature and Image Service
 4. Replace old AXL file with new updated file
 5. Restart Feature and Image Service
 6. Repeat for all other variables
 7. DONE



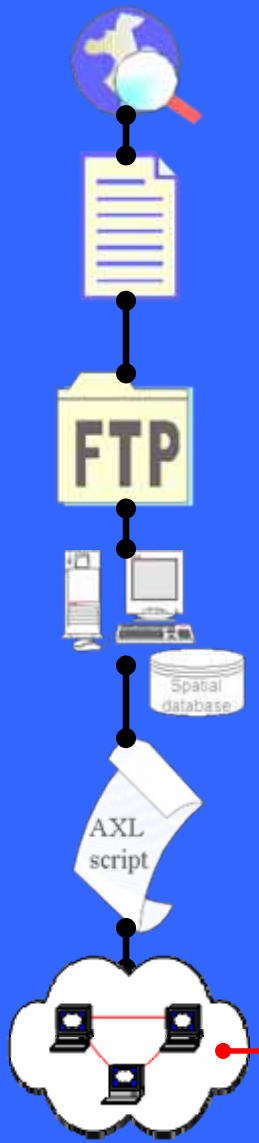
Process Steps... (step 6a)

Users can bring Image and Feature services directly into their desktop GIS software.



Process Steps... (step 6b)

Users can bring Image and Feature services directly into their desktop GIS software.

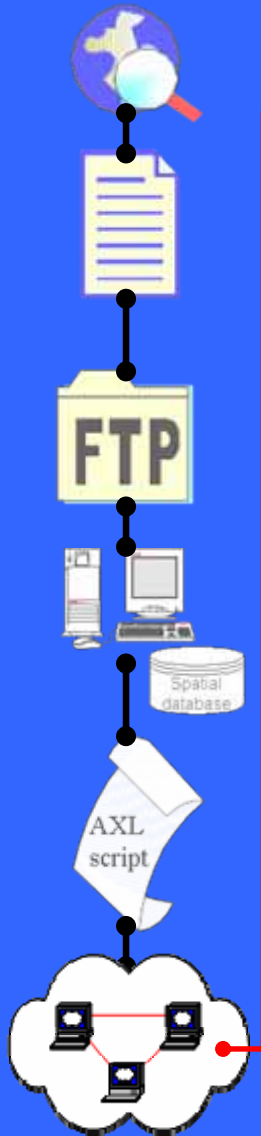


GIS weather data with a click of a button!

PASDA is funded by the Geospatial Technologies Office of the PA Office for Information Technology

Process Steps... (step 6c)

Users can bring Image and Feature services directly into their desktop GIS software.



PASDA - Access Data - Netscape Browser

File Edit View Go Bookmarks Tools Help

http://www.pasda.psu.edu/access/index

PASDA - Access Data

PASDA
PENNSYLVANIA SPATIAL
DATA ACCESS

Access Data
Explore PA
Outreach

GIS Community
About PASDA
Help

Access Data

NEW! **NEW!**

Data Access Wizard

- Simplified interface -
- Add datasets to your *Data Cart* -
- Clip, reproject and download multiple datasets at the same time -

NEW! **NEW!**

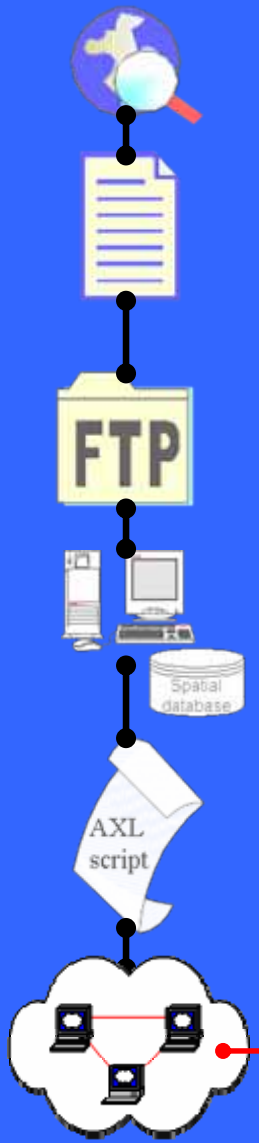
FTP Site & Search Options

- ◆ [Direct to FTP Site](#)---NOTE: Our FTP site has been streamlined and updated. If you are unable to find the data you need, use the Data Wizard.
- ◆ [Keyword Search](#)
- ◆ [Search by County](#)
- ◆ [Search by Quadrangle](#)
- ◆ [Search by Watershed](#)

Transferring data from www.pasda.psu.edu... No Full Scan

Process Steps... (step 6d)

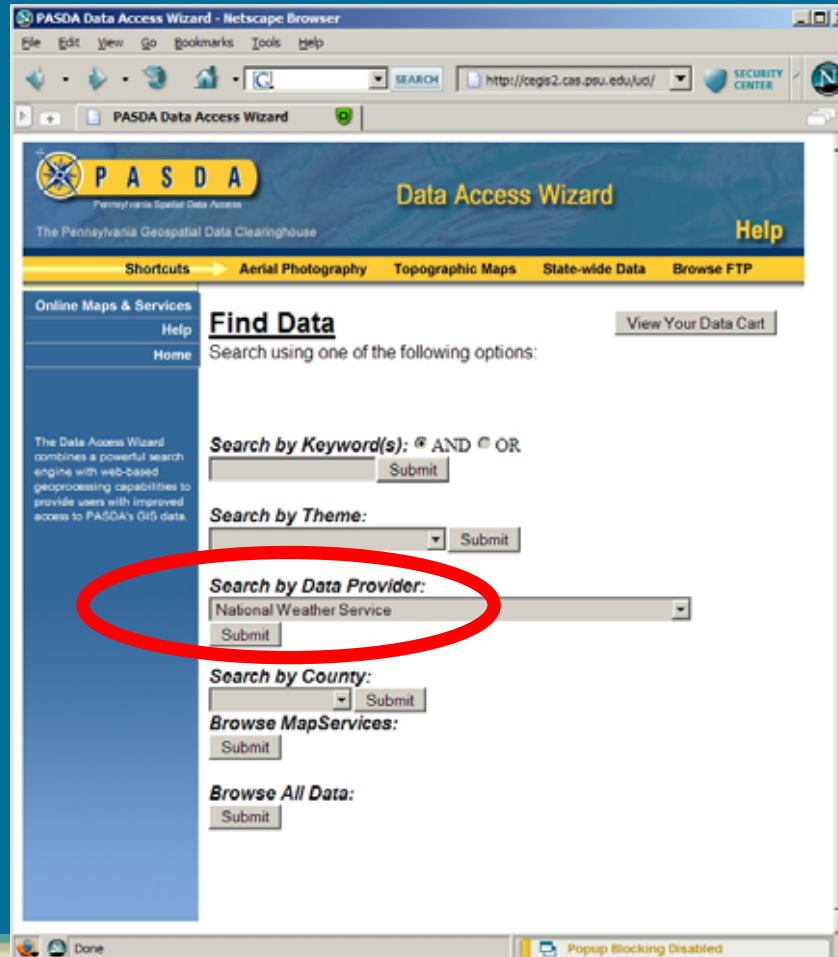
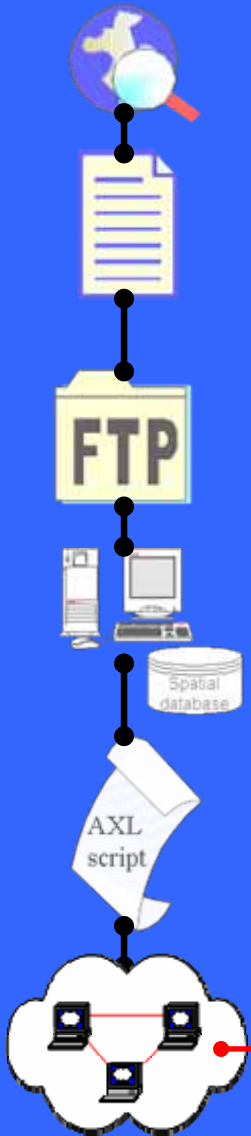
Users can bring Image and Feature services directly into their desktop GIS software.



Today's example:
NOAA/NWS

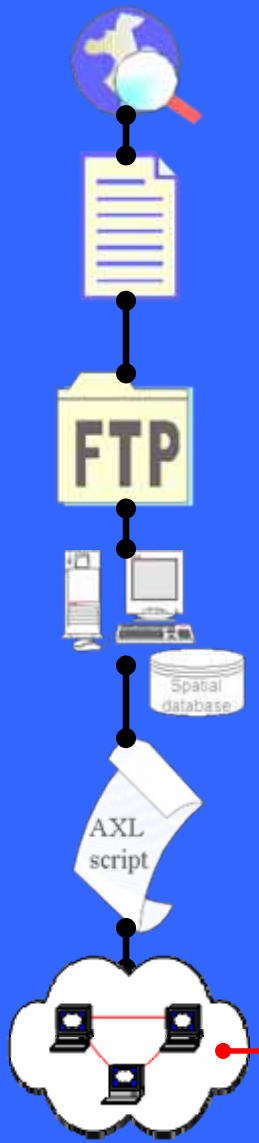
Process Steps... (step 6e)

Users can bring Image and Feature services directly into their desktop GIS software.



Process Steps... (step 6f)

Users can bring Image and Feature services directly into their desktop GIS software.



PASDA Data Access Wizard - Netscape Browser

17 Total Results.

Search Results

Return to Search Page
View Your Data Cart

FTP Download
Data Applications & Viewers
Add To Your Data Cart For Download
MapServices (ArcMap/GoogleEarth/WMS)

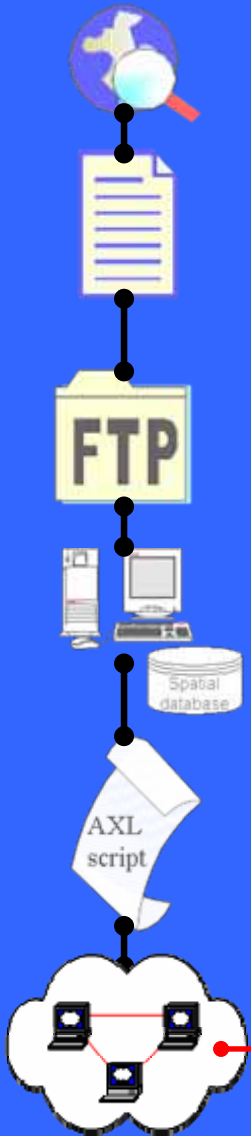
Title	Originator	Year	Download
Latest National Infrared Satellite Image	National Weather Service	2006	⚡
Latest National Radar Image	National Weather Service	2006	⚡
Latest National Visible Satellite Image	National Weather Service	2006	⚡
National Apparent Temperature Forecasts	National Weather Service	2006	⚡
National Dew Point Temperature Forecasts	National Weather Service	2006	⚡
National Maximum Temperature Forecasts	National Weather Service	2006	⚡
National Minimum Temperature Forecasts	National Weather Service	2006	⚡
National Precipitation Amount Forecasts	National Weather Service	2006	⚡
National Probability of Precipitation Forecasts	National Weather Service	2006	⚡
National Relative Humidity Forecasts	National Weather Service	2006	⚡
National Sky Cover Forecasts	National Weather Service	2006	⚡
National Snow Amount Forecasts	National Weather Service	2006	⚡
National Temperature Forecasts	National Weather Service	2006	⚡
National Wave Height Forecasts	National Weather Service	2006	⚡
National Wind Direction Forecasts	National Weather Service	2006	⚡
National Wind Gust Forecasts	National Weather Service	2006	⚡
National Wind Speed Forecasts	National Weather Service	2006	⚡

14 + 3 = 17 variables

- 3 temporal images
- 14 NDFD datasets

Process Steps... (step 6g)

Users can bring Image and Feature services directly into their desktop GIS software.



MetadataDisplay - Netscape Browser
http://cegs2.cas.psu.edu
P A S D A Data Access Wizard
The Pennsylvania Geospatial Data Clearinghouse
Help

Online Maps & Services
Help Home

Metadata Summary

National Weather Service - National Temperature Forecasts

Title:National Weather Service - National Temperature Forecasts
Originator:National Weather Service
Publication Date:2006

Abstract:
This datasets contains 40 maps representing temperature forecasts for times occurring every three hours during the next seven day period. The model is run every three hours, so these forecast projections are relative to real-time, plus or minus three hours. TEMPERATURE is the expected temperature valid for the indicated hour. The National Digital Forecast Database (NDFD) contains a seamless mosaic of digital forecasts from NWS field offices working in collaboration with the National Centers for Environmental Prediction (NCEP). The database is made available to all customers and partners from the public, private and academic sectors. Those customers and partners may use this data to create a wide range of text, graphic, gridded and image products of their own. Over time, NWS will offer a wider array of gridded forecast elements and a larger set of graphical presentations.

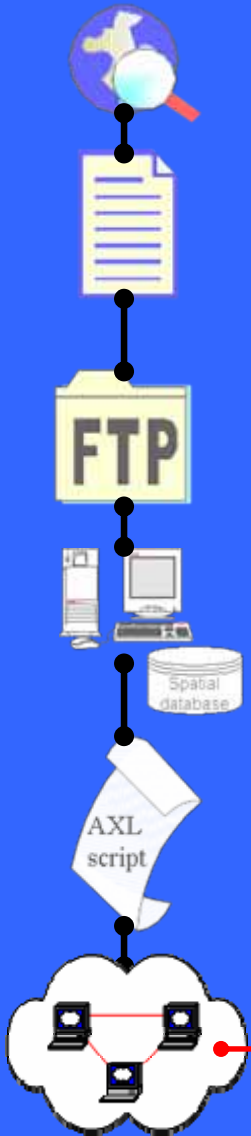
[View Full Metadata Document](#)
[Download Full XML Metadata Document \(Right-click and save...\)](#)

MapServices (ArcMap/GoogleEarth/WMS)

Keep slide in mind,
we'll return to it.

Process Steps... (step 6h)

Users can bring Image and Feature services directly into their desktop GIS software.



Metadisplay - Netscape Browser

http://cegis2.cas.psu.edu/ucj/FulMeta

National Weather Service - National Temperature Forecasts

- [Identification Information](#)
- [Spatial Data Organization Information](#)
- [Spatial Reference Information](#)
- [Entry and Attribute Information](#)
- [Distribution Information](#)
- [Metadata Reference Information](#)

Identification Information:

Citation:

Citation Information:

Originator: National Weather Service
Publication Date: 2006
Title: National Weather Service - National Temperature Forecasts
Geospatial Data Presentation Form: vector digital data
Publication Information:
Publication Place: University Park, Pennsylvania
Publisher: The Pennsylvania State University
Online Linkage: <http://gis1.pasda.psu.edu>
Online Linkage: <http://www.weather.gov/ndfd>

Description:

Abstract:

This datasets contains 40 maps representing temperature forecasts for times occurring during the National Digital Forecast Database (NDFD) contains a seamless mosaic of digital data.

Purpose:

Many technological advances and scientific breakthroughs have allowed NWS weather forecasting to become more accurate and timely.

Time Period of Content:

Time Period Information:

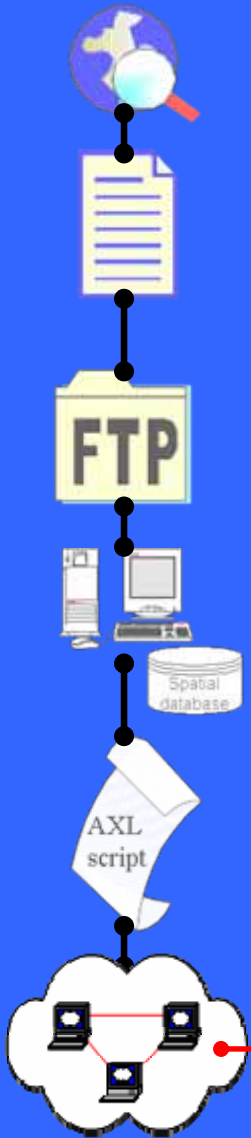
Single Date Time:
Calendar Date: 2006

Currentness Reference:

Provide appropriate credit

Process Steps... (step 6i)

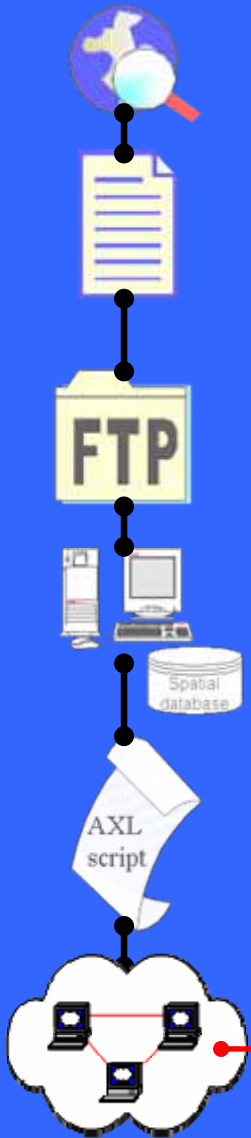
Users can bring Image and Feature services directly into their desktop GIS software.



MetadataDisplay - Netscape Browser
http://cegs2.cas.psu.edu
PASDA
Data Access Wizard
Help
Online Maps & Services
Help
Home
Metadata Summary
National Weather Service - National Temperature Forecasts
Title: National Weather Service - National Temperature Forecasts
Originator: National Weather Service
Publication Date: 2006
Abstract:
This datasets contains 40 maps representing temperature forecasts for times occurring every three hours during the next seven day period. The model is run every three hours, so these forecast projections are relative to real-time, plus or minus three hours. TEMPERATURE is the expected temperature valid for the indicated hour. The National Digital Forecast Database (NDFD) contains a seamless mosaic of digital forecasts from NWS field offices working in collaboration with the National Centers for Environmental Prediction (NCEP). The database is made available to all customers and partners from the public, private and academic sectors. Those customers and partners may use this data to create a wide range of text, graphic, gridded and image products of their own. Over time, NWS will offer a wider array of gridded forecast elements and a larger set of graphical presentations.
[View Full Metadata Document](#)
[Download Full XML Metadata Document \(Right-click and save...\)](#)
[MapServices \(ArcMap/GoogleEarth/WMS\)](#)

Process Steps... (step 6j)


- Users can bring Image and Feature services directly into their desktop GIS software.



PASDA Data Access Wizard
The Pennsylvania Spatial Data Clearinghouse

MapService Details

Title: National Temperature Forecasts
Originator: National Weather Service
Date: 2006



[Preview Data](#)
[View in Google Earth](#)

ArcIMS Image Service: [Add to ArcMap](#)
Server Name: gis1.pasda.psu.edu
Service Name: National_Temperature_Forecasts

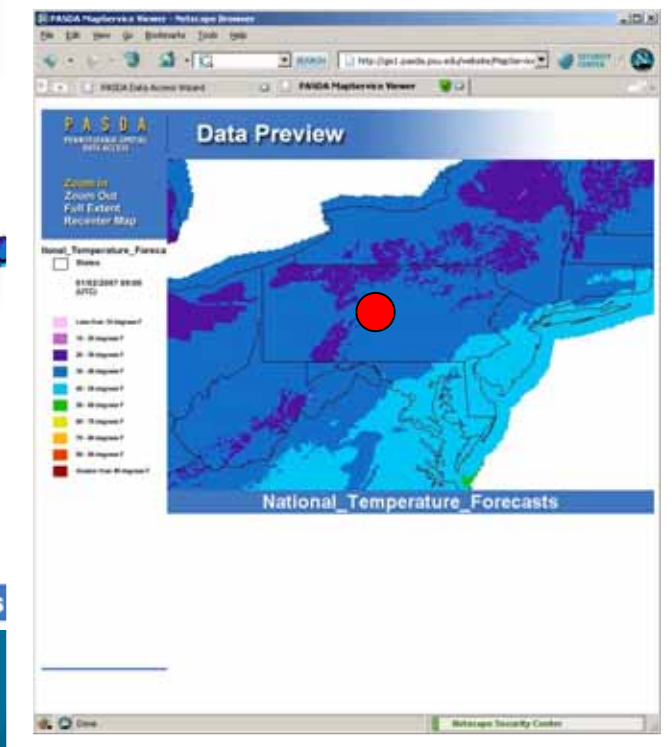
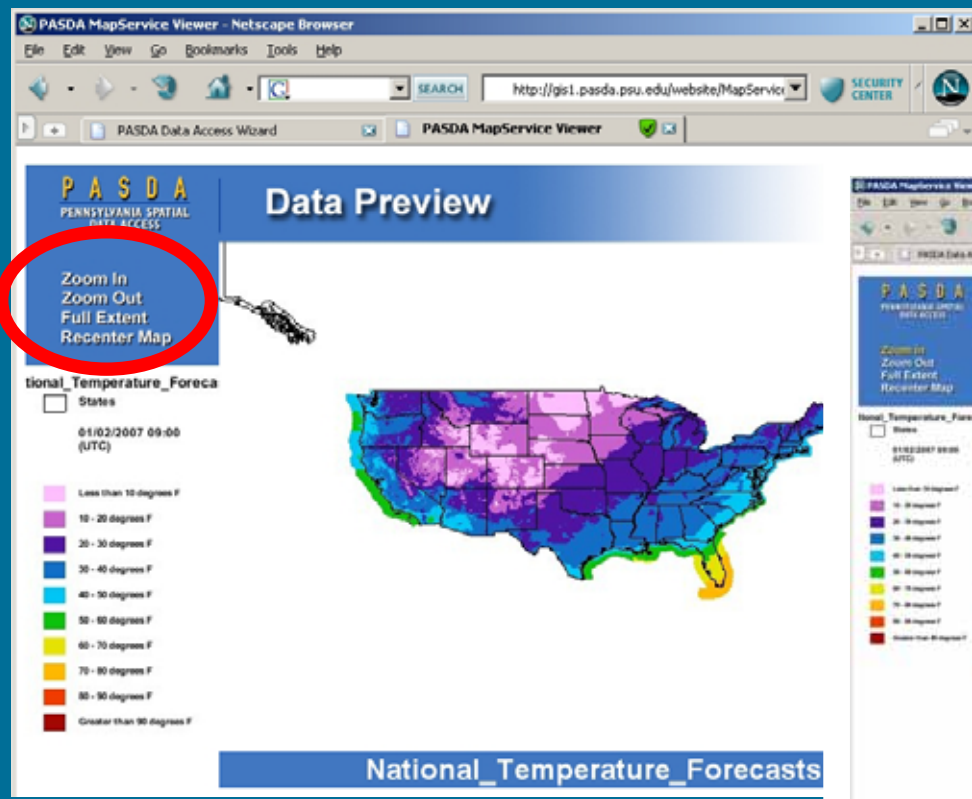
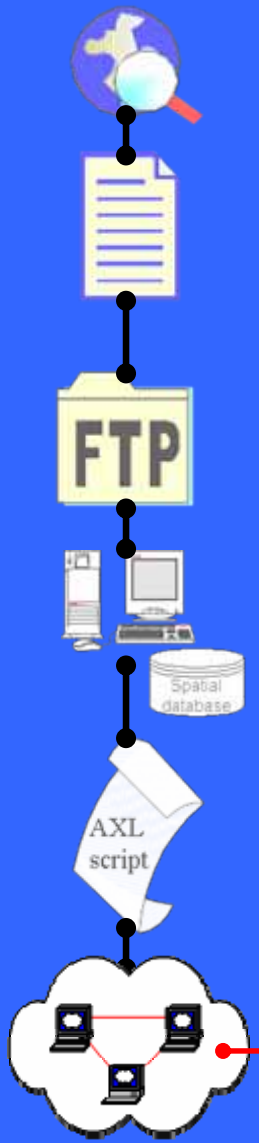
WMS Service:
Map Server
URL: http://gis1.pasda.psu.edu/servlet/com.esri.ogc.wms.WMSServlet?Servicename=National_Temperature_Forecasts

ArcIMS Feature Service: [Add to ArcMap](#)
Server Name: gis1.pasda.psu.edu
Service Name: National_Temperature_Forecasts_feature

Keep slide in mind,
we'll return to it.

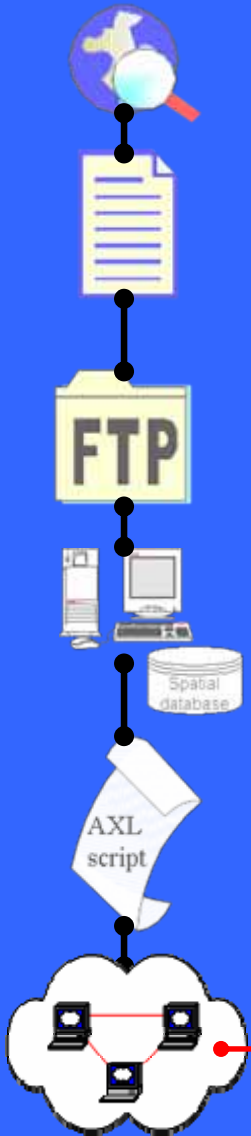
Process Steps... (step 6k)

Users can bring Image and Feature services directly into their desktop GIS software.



Process Steps... (step 6l)

Users can bring Image and Feature services directly into their desktop GIS software.



PASDA Data Access Wizard
The Pennsylvania Geospatial Data Clearinghouse

MapService Details

Title: National Temperature Forecasts
Originator: National Weather Service
Date: 2006

[Preview Data](#)
[View in Google Earth](#)

ArcIMS Image Service: [Add to ArcMap](#)
Server Name: gis1.pasda.psu.edu
Service Name: National_Temperature_Forecasts

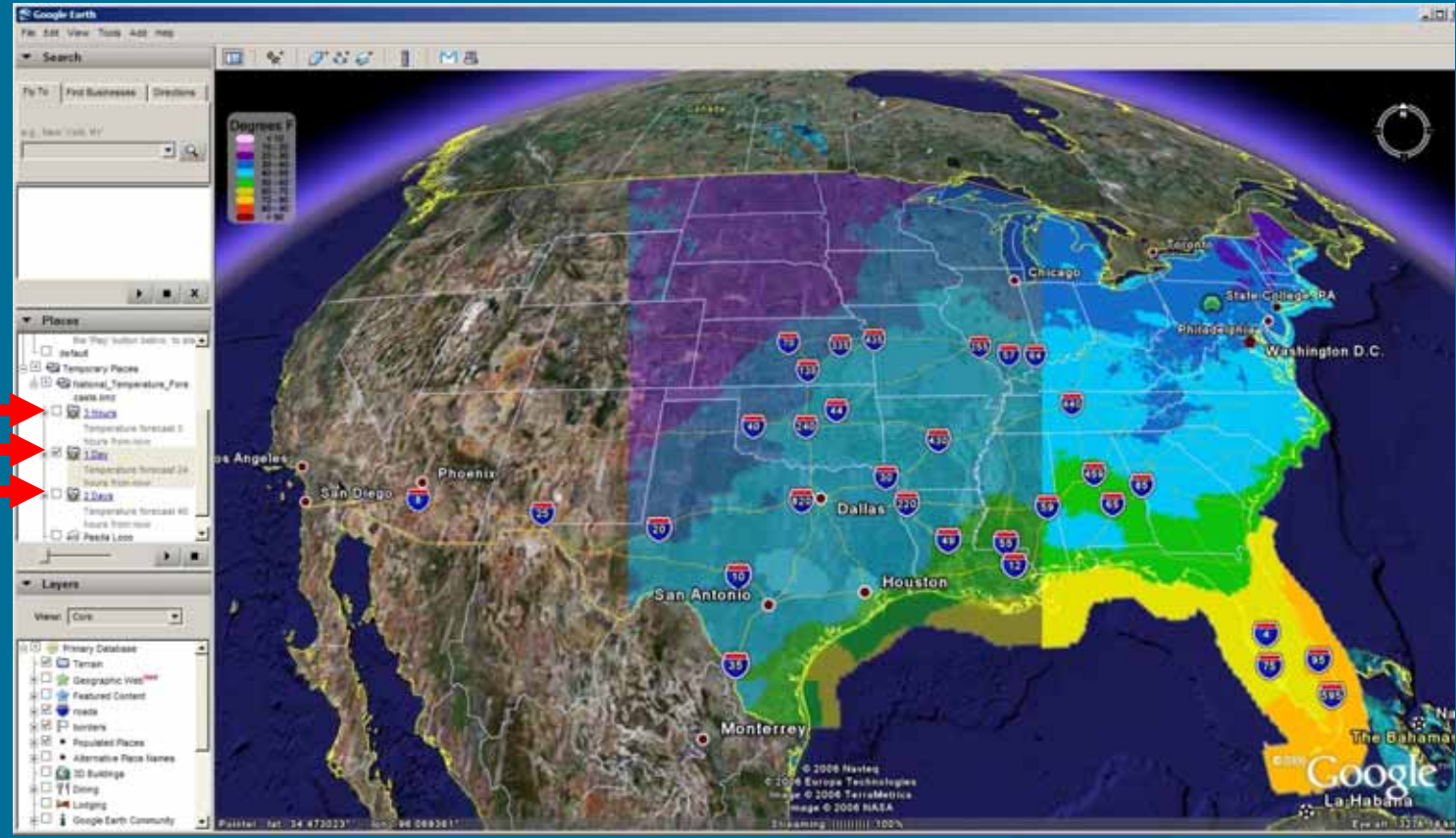
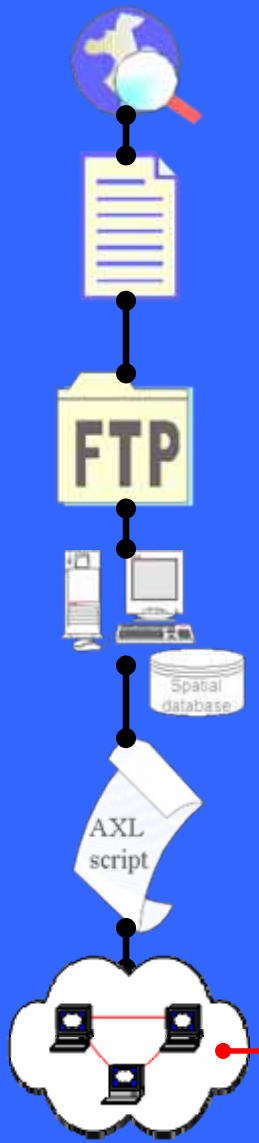
WMS Service:
Map Server
URL: http://gis1.pasda.psu.edu/servelet/com.esri.ogc.wms.WMSServlet?Servicename=National_Temperature_Forecasts

ArcIMS Feature Service: [Add to ArcMap](#)
Server Name: gis1.pasda.psu.edu
Service Name: National_Temperature_Forecasts_feature

Keep slide in mind,
we'll return to it.

Process Steps... (step 6m)

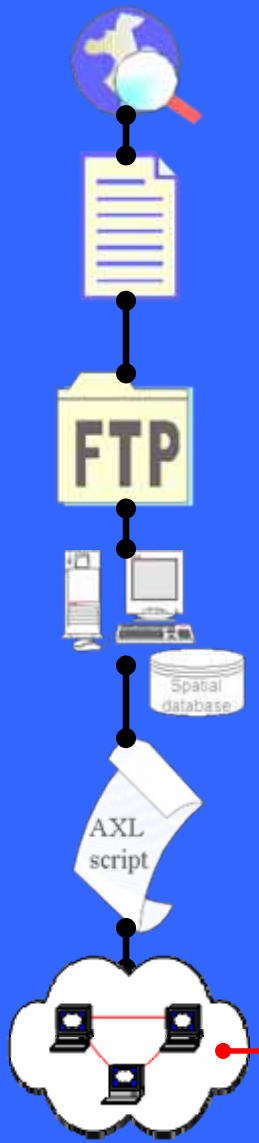
Users can bring Image and Feature services directly into their desktop GIS software.



Three NDFD forecast layers are available for each variable at 3h, 1d, & 2d
NOAA/National Weather Service Southern Region

Process Steps... (step 6n)

Users can bring Image and Feature services directly into their desktop GIS software.



PASDA Data Access Wizard
The Pennsylvania Geospatial Data Clearinghouse

MapService Details

Title: National Temperature Forecasts
Originator: National Weather Service
Date: 2006

[Preview Data](#)
[View in Google Earth](#)

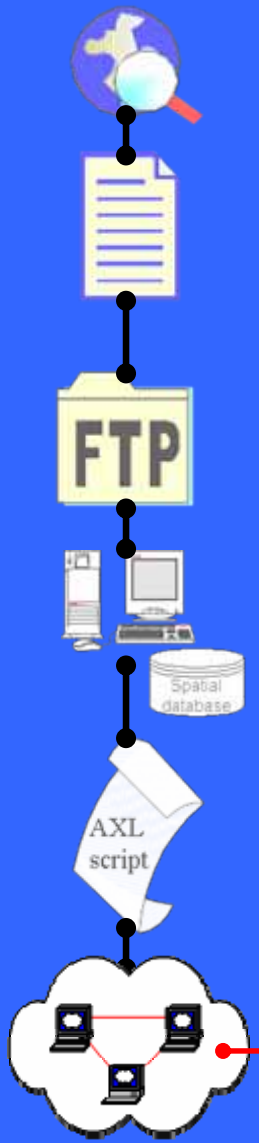
ArcIMS Image Service: [Add to ArcMap](#)
Server Name:gis1.pasda.psu.edu
Service Name:National_Temperature_Forecasts

WMS Service:
Map Server
URL:http://gis1.pasda.psu.edu/servelet/com.esri.ogc.wms.WMSServlet?Servicename=National_Temperature_Forecasts

ArcIMS Feature Service: [Add to ArcMap](#)
Server Name:gis1.pasda.psu.edu
Service Name:National_Temperature_Forecasts_feature

Process Steps... (step 60)

Users can bring Image and Feature services directly into their desktop GIS software.

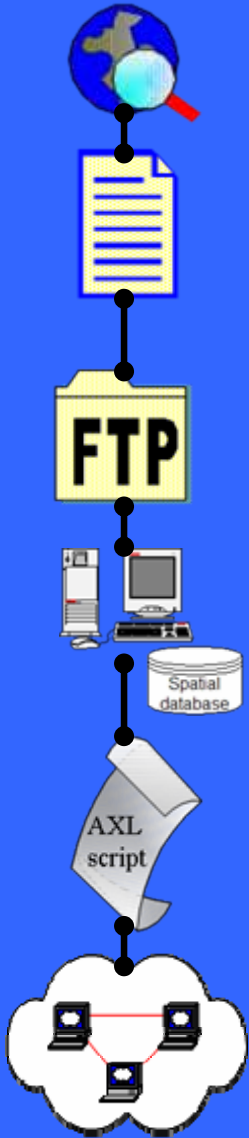


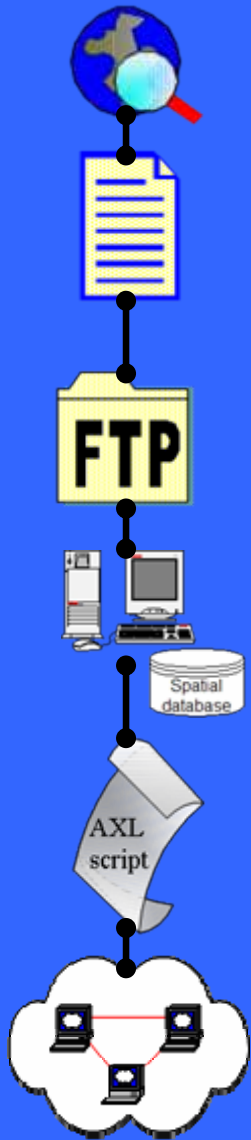
Example of 1 weeks Temperature forecast
(Image & Feature Service)

*Data are available with
a click of a mouse!*

Conclusions

- PSIEE & EESI (PSU) team communicates and collaborates with NOAA/NWS on GIS projects.
- Together, we, PSIEE, EESI, and NOAA/NWS can grow together for a greater benefit to anyone tapping in →
- We provide continuously updated NOAA/NWS weather data *in GIS format* to emergency managers and response support agencies as well as the general public.
- *With a click of a mouse users can bring our Image and Feature services directly into their desktop GIS software.*





Conclusions II

- Collaboration works!!
- Further exploration/resources needed
 - <http://www.weather.gov/gis>
 - <http://www.pasda.psu.edu>

Questions & Comments

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