

# Using Python, SQL, ASP.NET and ArcGIS to Process Custom Map Requests

**Jeff Nothwehr**

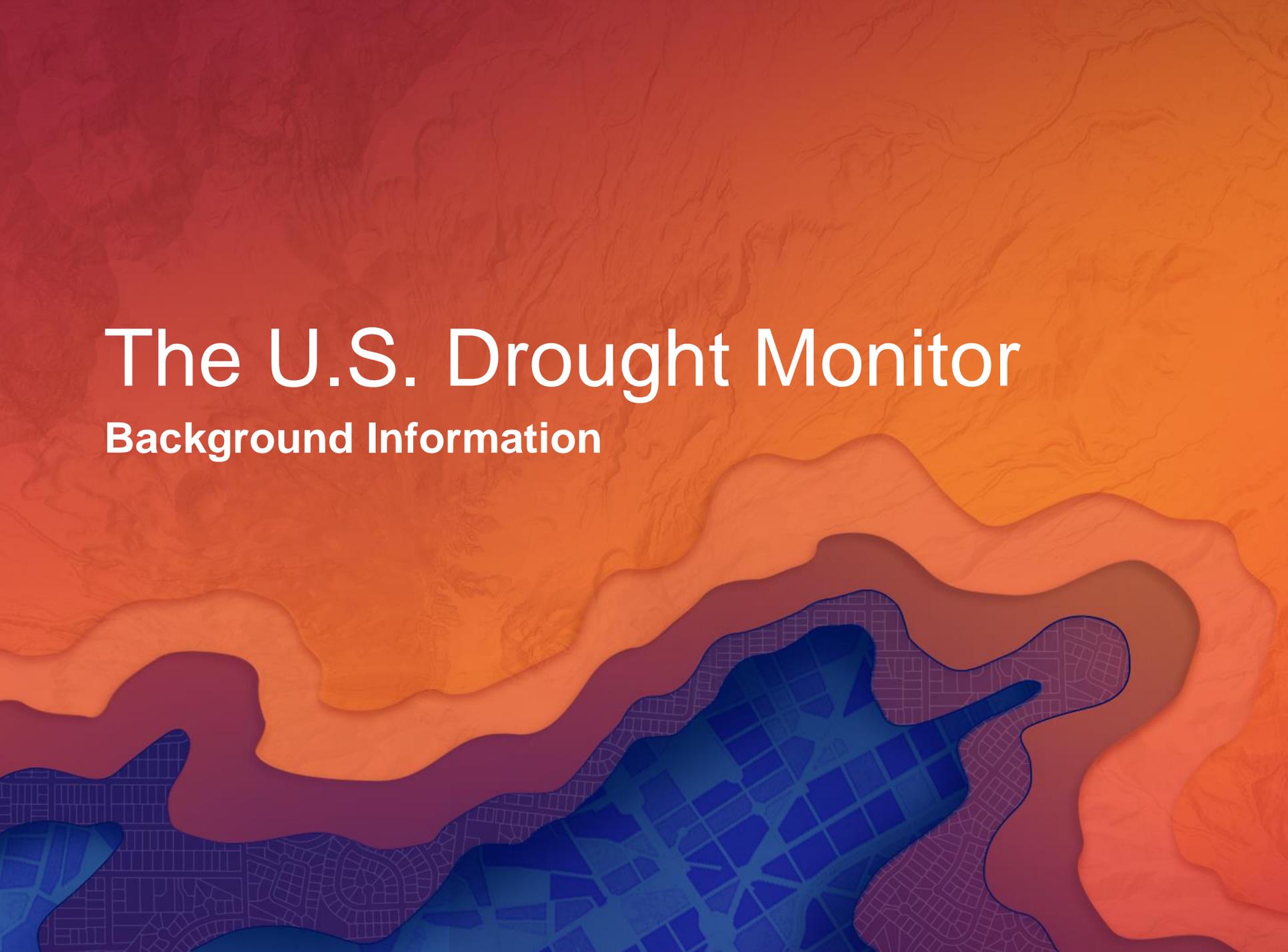
*National Drought Mitigation Center*

*University of Nebraska-Lincoln*



# Overview

- U.S. Drought Monitor background
- Custom map challenges
- Solution
  - How it works
  - Pieces
- Step-by-step through the process
- Improvements

The background features a vertical gradient from dark red at the top to bright orange at the bottom. In the lower half, there are abstract, layered shapes in shades of blue and purple, some containing a faint grid pattern, resembling a stylized map or topographic relief.

# The U.S. Drought Monitor

## Background Information

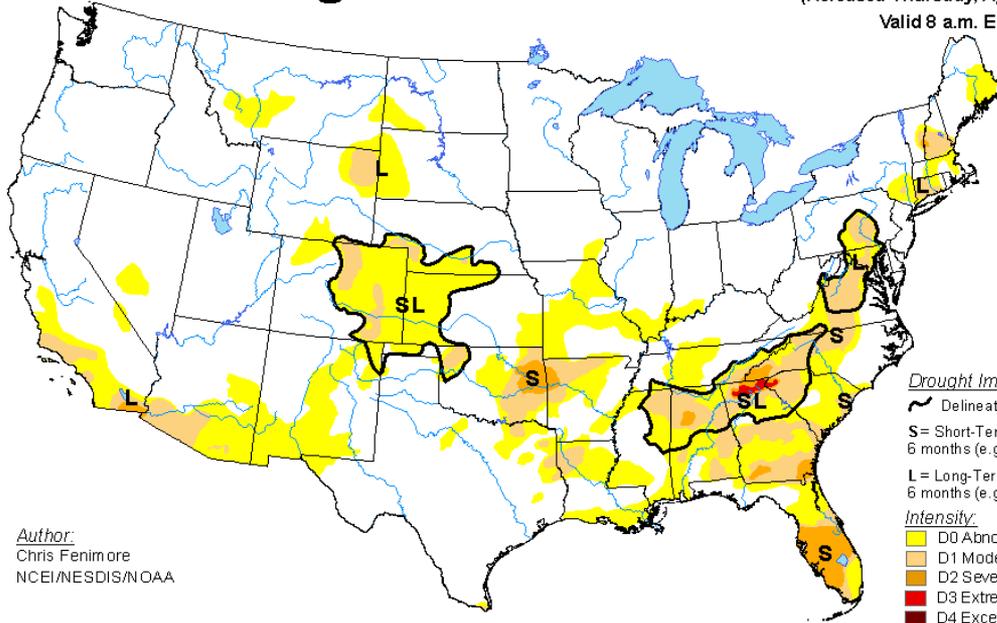
# U.S. Drought Monitor

- U.S. Map Depicting Drought Conditions
- Covers 50 states and Puerto Rico
  - Soon to be expanded to U.S. Virgin Islands and Pacific possessions

# U.S. Drought Monitor

## U.S. Drought Monitor

April 18, 2017  
(Released Thursday, Apr. 20, 2017)  
Valid 8 a.m. EDT



Author:  
Chris Fenimore  
NCEI/NESDIS/NOAA

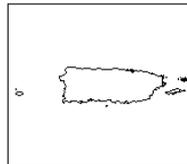
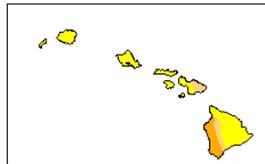
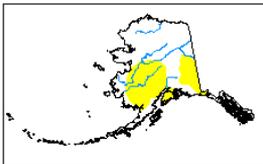
### Drought Impact Types:

- ~ Delineates dominant impacts
- S = Short-Term, typically less than 6 months (e.g. agriculture, grasslands)
- L = Long-Term, typically greater than 6 months (e.g. hydrology, ecology)

### Intensity:

- D0 Abnormally Dry
- D1 Moderate Drought
- D2 Severe Drought
- D3 Extreme Drought
- D4 Exceptional Drought

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.



<http://droughtmonitor.unl.edu/>

# U.S. Drought Monitor

- Produced on a weekly basis
- Data compiled by one author each week
- Author edits shapefiles in ArcMap

# U.S. Drought Monitor

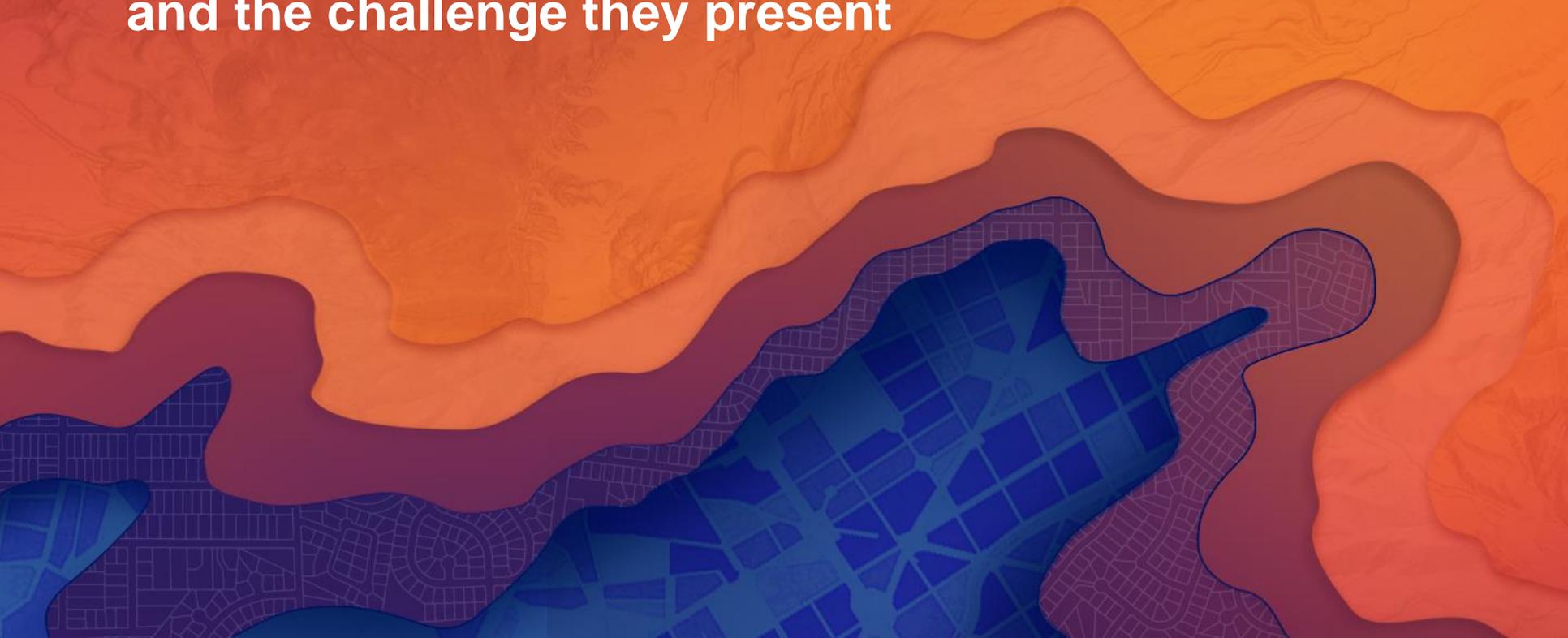
- Data are processed by the NDMC on Wednesday afternoon/evening
  - Process currently happens in Python
- Data are released on Thursday morning at 8:30 a.m. Eastern Time

# U.S. Drought Monitor

- Almost **3,300** map files produced
- Areas mapped:
  - National
  - State
  - Other areas (regions, 2-digit HUCS, etc.)

# Custom Map Requests

and the challenge they present



# Mapping Challenges

- Large number of maps produced
  - Over **3,200** files
  - Over **1 GB** of data
- Doesn't seem like a lot but...
  - over **900 weeks** of data

# Mapping Challenges

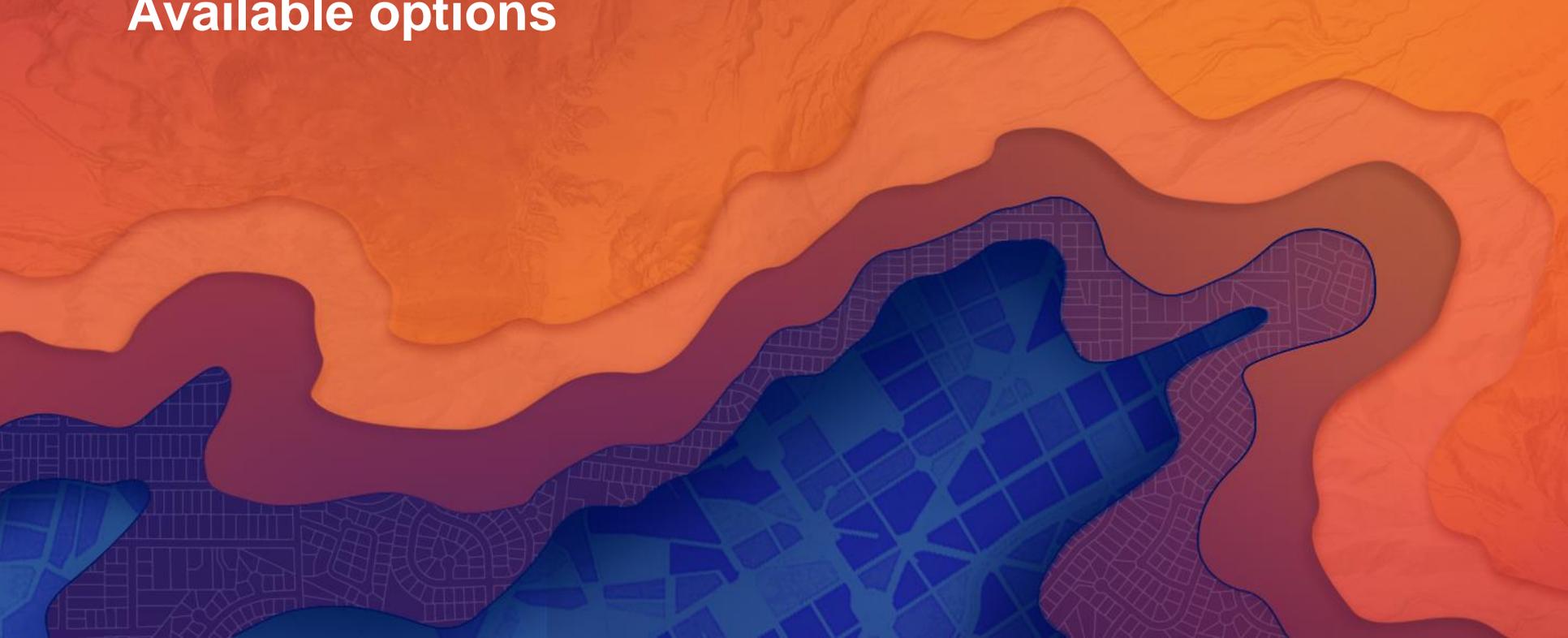
- Limited time to produce maps
  - **16 hours** between final edits and data release
- Process happens during “non-business” hours
  - Between 5 p.m and 7 a.m. Central Time

# Mapping Challenges

- Requests for maps of areas that are not part of the process
- Can't map everything due to the time and resource limitations

# Solving the Mapping Conundrum

Available options



# Option Number One

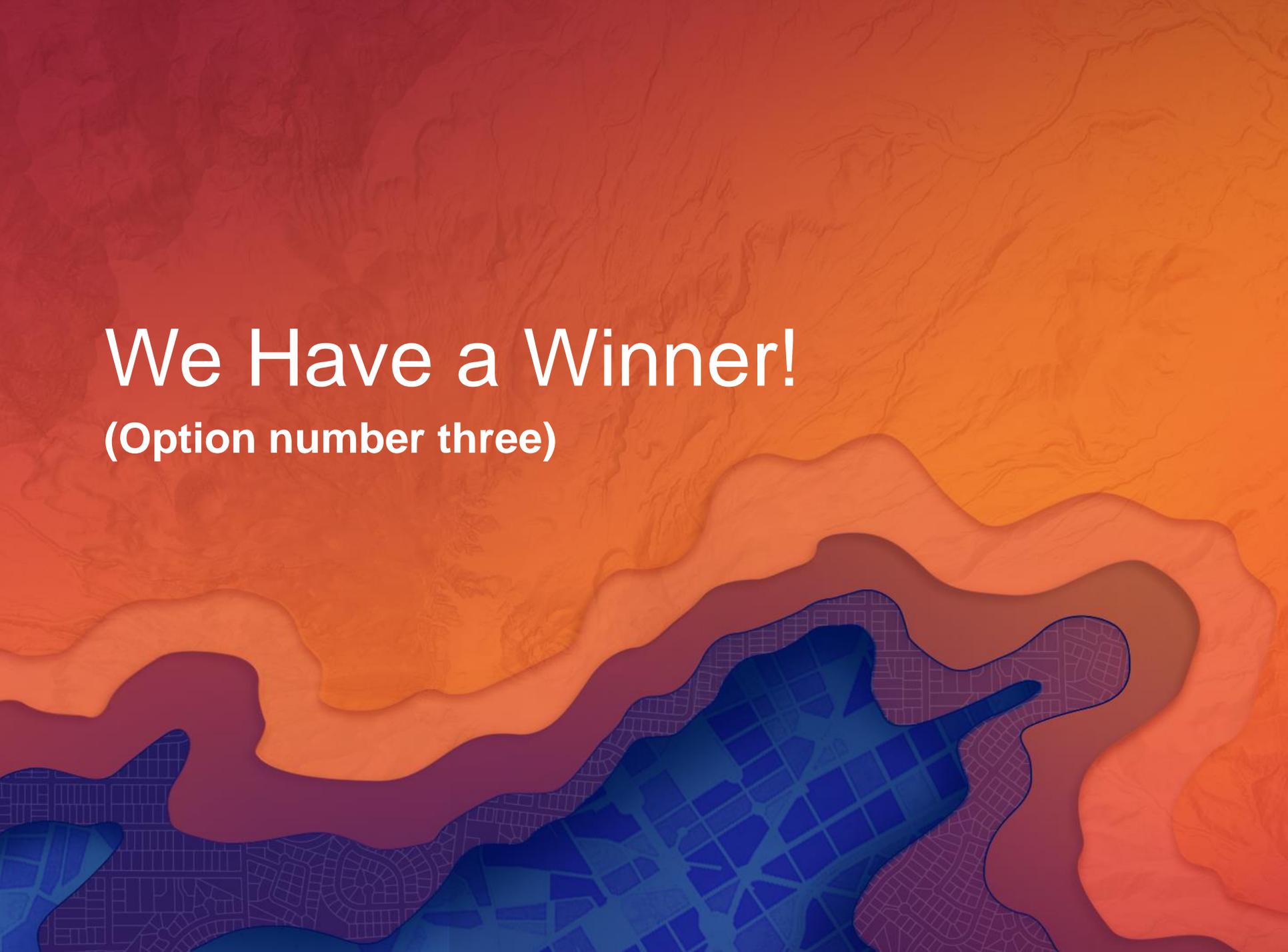
- Produce custom map requests manually
  - Time consuming
  - Need to store a number of files (mxds, layers, etc.)
  - Possibility for map inconsistencies
- Basically the potential for **chaos!!!**

# Option Number Two

- Add more maps as part of normal process
  - Processing time constraints
  - Disk space constraints
  - Opens the door for more and more requests

# Option Number Three

- Create a custom map request tool
  - Allow users to request maps at their convenience
  - Handle processing automatically upon request

The background features a vertical gradient from dark red at the top to bright orange at the bottom. In the lower portion, there are layered, wavy shapes in shades of blue and purple, some containing a faint grid pattern resembling a city map.

# We Have a Winner!

(Option number three)

# Solution

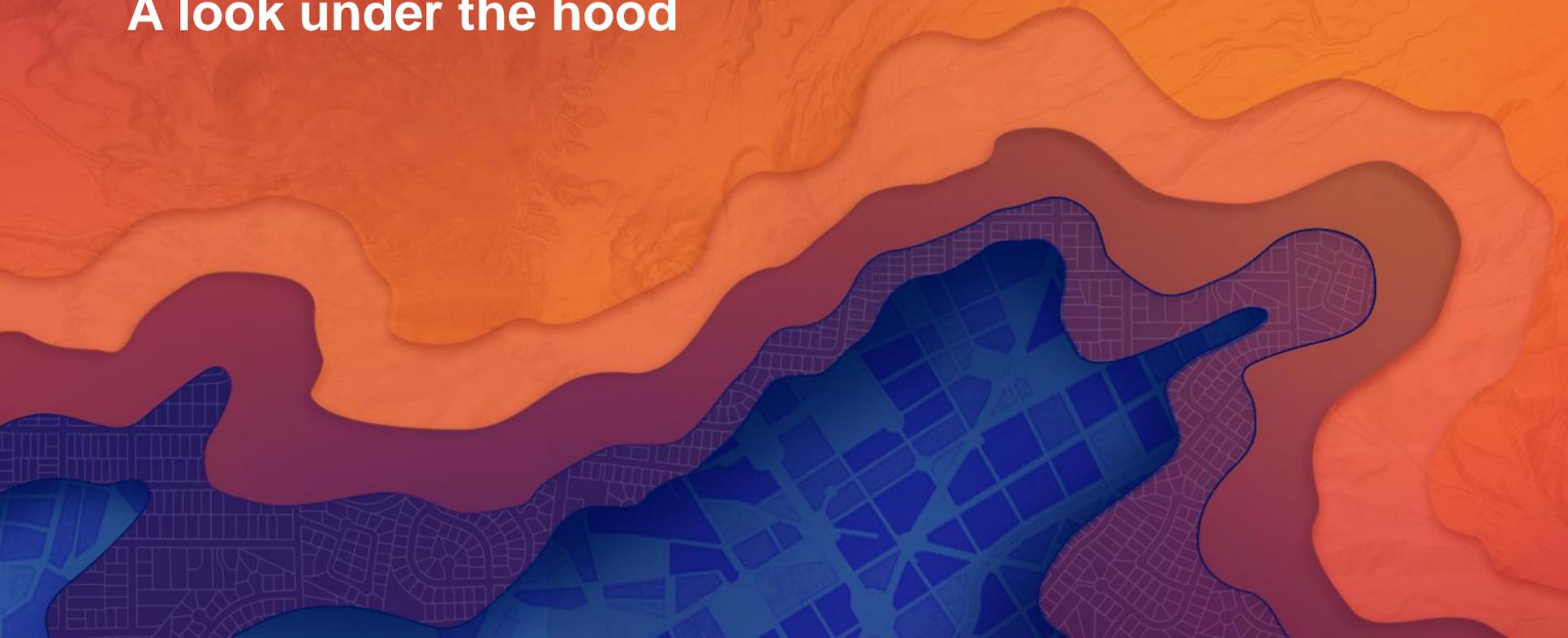
- On-demand custom map request module/process
  - Maps generated automatically upon user data submission
  - Minimal use of storage space and staff resources

# Solution

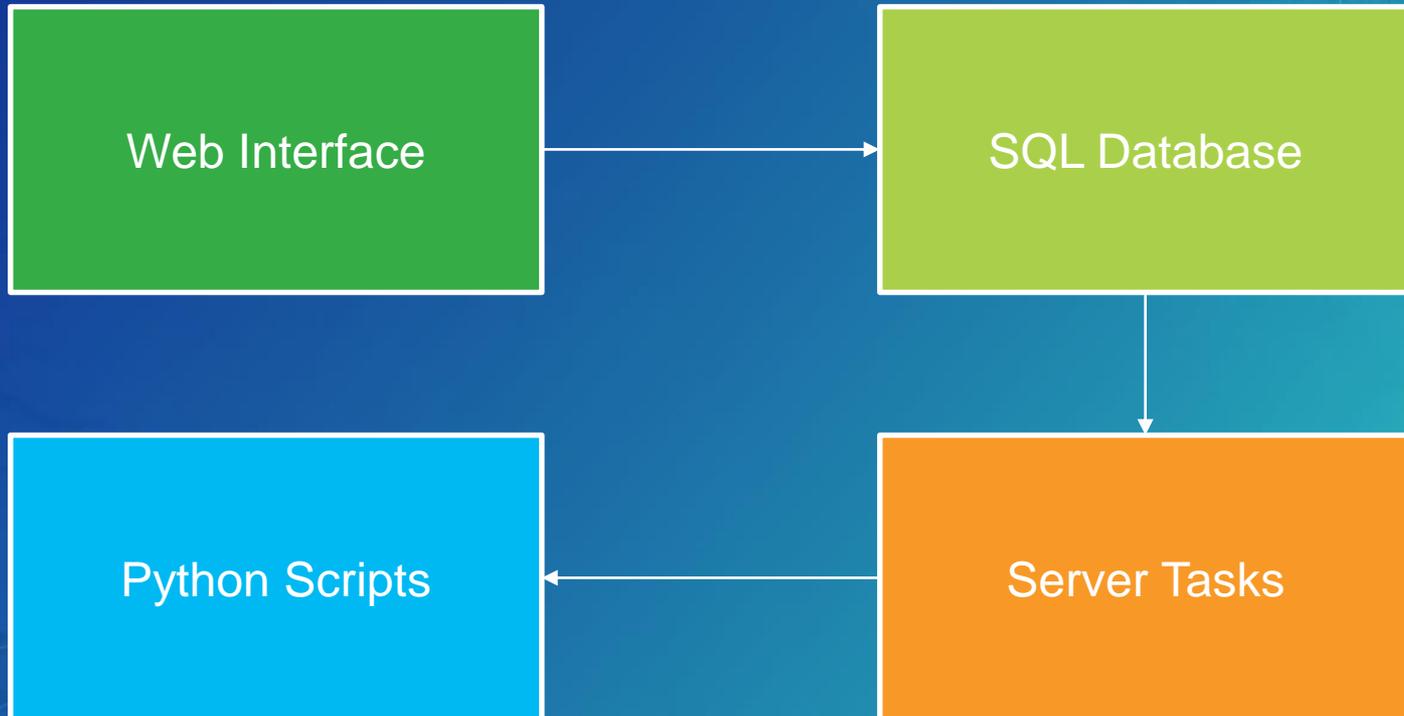
- Allows users to request maps as needed
  - Can provide maps of areas that are not part of current process
  - Users can specify some map options that are not part of current process

# How does it Work?

A look under the hood



# How it Works



# Web Interface

- ASP.NET page which writes to the SQL database
  - Site built in DNN content management system

# Web Interface

- Multiple selection options
  - Area
  - Map Type
  - File Format
  - Resolution (if applicable)

# Web Interface

- User submits a valid email address
- Request is written in the SQL database as a new record

# Web Interface

The screenshot shows a web browser window with the URL `droughtmonitordev.unl.edu/Maps/CustomMap.aspx`. The page title is "United States Drought Monitor" and the breadcrumb is "Maps / Custom Map". The navigation menu includes "Home", "Maps", "Data", "Narrative", "About USDM", and "Current Conditions and Outlooks".

**Custom Map Request Form**

This tool lets you generate a custom map. Once you make your choices and submit them, we'll email the map within 15 minutes.

**Select a Map Date**  
Choose a U.S. Drought Monitor map date:  
April 18, 2017

**Select a Map Format**  
Select a file format for the map:  
PNG

**Select an Area Type**  
Choose the type of area from the list below:  
National

**Select a Specific Area**  
Select a specific area from the list below:  
CONUS

**Select a Map Type**  
Choose the type of map to create:  
No Text

**Enter a Map Resolution**  
Enter a map resolution between 70 and 600:  
96 dpi

Note that 96 dpi is ideal for images displayed on the web, while 300 dpi or greater is necessary for print materials.

**Enter a Valid Email Address**  
Enter an email address where the finished map file can be sent:

Submit

# SQL Database

- Table inside the USDM database to handle requests

# SQL Database

	customMapReqId	areaType	specArea	mapType	mapFormat	mapRes	emailAddress	mapSent	dmReleaseId	fileName
1	1	urban	16264	text	png	96	jnothwehr2@unl.edu	1	869	20151208_16264_text.png
2	2	urban	49933	text	png	100	jnothwehr2@unl.edu	1	931	20170214_49933_text.png
3	3	national	total	usdm	pdf	0	jnothwehr2@unl.edu	1	936	20170321_total_usdm.pdf
4	4	fema	4	text	pdf	0	jnothwehr2@unl.edu	1	937	20170328_4_text.pdf
5	5	huc4	1101	trd	pdf	0	jnothwehr2@unl.edu	1	937	20170328_1101_trd.pdf
6	6	huc4	0714	trd	pdf	0	jnothwehr2@unl.edu	1	938	20170404_0714_trd.pdf
7	7	huc4	1806	text	pdf	0	jnothwehr2@unl.edu	1	869	20151208_1806_text.pdf
8	8	county	48237	date	png	96	jnothwehr2@unl.edu	1	936	20170321_48237_date.png
9	9	fema	7	text	png	96	jnothwehr2@unl.edu	1	294	20050215_7_text.png
10	10	huc4	1810	trd	pdf	0	jnothwehr2@unl.edu	1	938	20170404_1810_trd.pdf
11	11	climdiv	106	text	pdf	0	cpoulsen2@unl.edu	1	932	20170221_106_text.pdf
12	12	climdiv	106	text	pdf	0	cpoulsen2@unl.edu	1	932	20170221_106_text.pdf
13	13	climdiv	106	text	pdf	0	cpoulsen2@unl.edu	1	932	20170221_106_text.pdf
14	14	climdiv	106	text	pdf	0	cpoulsen2@unl.edu	1	932	20170221_106_text.pdf
15	15	climdiv	106	text	pdf	0	cpoulsen2@unl.edu	1	932	20170221_106_text.pdf
16	16	climdiv	106	text	pdf	0	cpoulsen2@unl.edu	1	932	20170221_106_text.pdf
17	17	climdiv	106	text	pdf	0	cpoulsen2@unl.edu	1	932	20170221_106_text.pdf
18	18	climdiv	106	text	pdf	0	cpoulsen2@unl.edu	1	324	20050913_106_text.pdf
19	19	fema	6	text	pdf	0	jnothwehr2@unl.edu	1	938	20170404_6_text.pdf

# SQL Database

- Several columns hold map parameters
  - Area type
  - Area ID number
  - Map type
  - Map resolution

# SQL Database

- Email address stored
- Map file name recorded
  - Combination of date and map parameters
- Parameter to indicate whether or not map has been emailed

# Python Script: Mapping

- Script handles the mapping process
  - Uses parameters from the data request
- Creates map to a folder on the server

# Python Script: Mapping

- Searches database for records that have no file name listed
  - Creates a map for each record
  - Uses parameters submitted to the database to create the map
  - Writes the filename to the database
  - Exports the map to a folder on a server

# Python Script: Email

- Second script handles the email
  - Sends a canned email response with the newly created map as an attachment

# Python Script: Email

- Script checks the database for records that have parameter value of 0
  - Locates the file name listed for each record
  - Sends the automated email to the address listed in the record
  - Attaches the map file to the email

# Server Scheduled Tasks

- Two scheduled tasks run every 15 minutes
  - First task runs the mapping script
  - Second task runs the email script

# Other Pieces

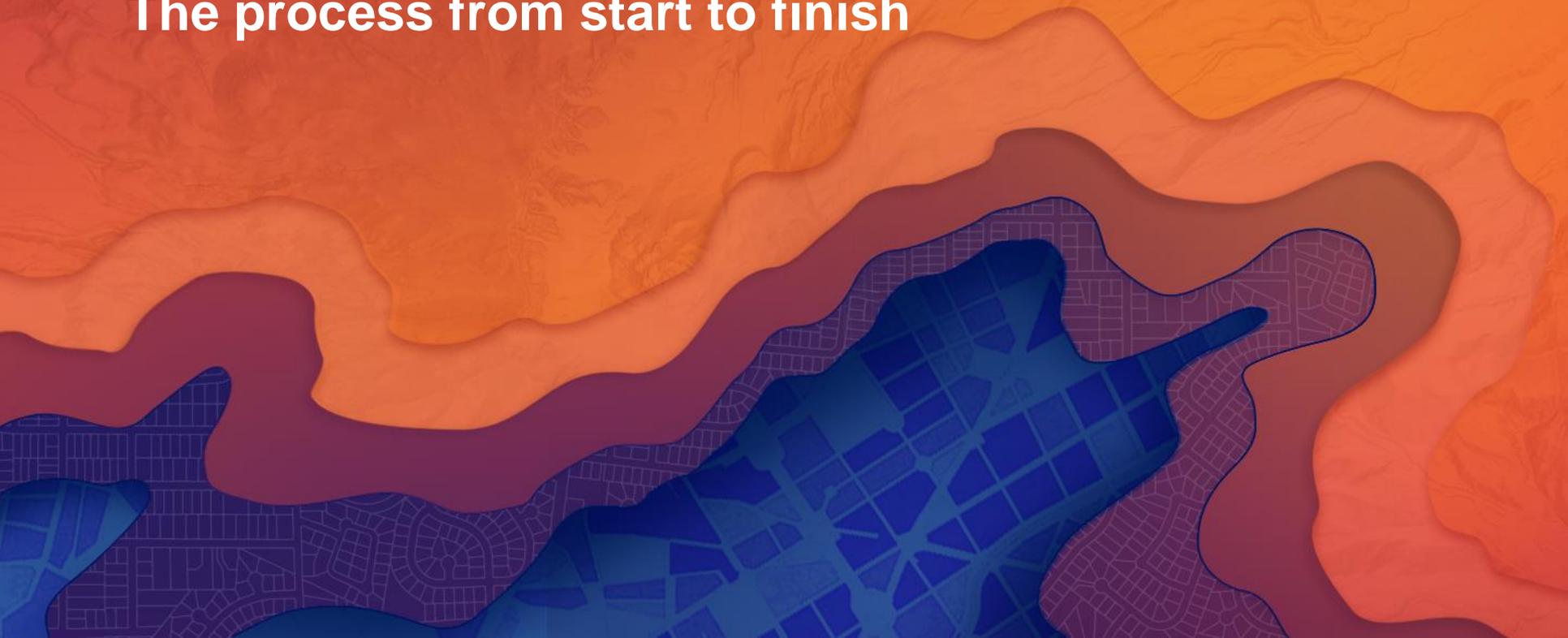
- MXD files containing map templates
  - Used by the Python Scripts
  - Same MXDs that are used the regular production process

# Other Pieces

- Layer files with symbology for maps
- Accessible location on the sever for map storage

# Step by Step Example

The process from start to finish



# Submit my Information

Custom Map Request Form Maps / Custom Map

This tool lets you generate a custom map. Once you make your choices and submit them, we'll email the map within 15 minutes.

**Select a Map Date**  
Choose a U.S. Drought Monitor map date:

**Select a Map Format**  
Select a file format for the map:

**Select an Area Type**  
Choose the type of area from the list below:

**Select a Map Resolution**  
Enter a map resolution between 70 and 600:  
 dpi

Note that 96 dpi is ideal for images displayed on the web, while 300 dpi or greater is necessary for print materials.

**Select a Specific Area**  
Select a specific area from the list below:

**Select a Map Type**  
Choose the type of map to create:

**Enter a Valid Email Address**  
Enter an email address where the finished map file can be sent:

The National Drought Mitigation Center  
University of Nebraska-Lincoln  
3310 Holdrege Street  
P.O. Box 830988  
Lincoln, NE 68583-0988  
phone: (402) 472-6707  
fax: (402) 472-2946  
Contact Us | Web Policy

USDA NDMC

The U.S. Drought Monitor is produced through a partnership between the National Drought Mitigation Center at the University of Nebraska.

# Submit my Information

Custom Map Request Form

Home Maps Data Narrative About USDM Current Conditions and Outlooks

Maps / Custom Map

Your information has been successfully submitted. Expect your map file to be delivered to the email address provided within the next 15 minutes.

This tool lets you generate a custom map. Once you make your choices and submit them, we'll email the map within 15 minutes.

**Select a Map Date**  
Choose a U.S. Drought Monitor map date:  
April 18, 2017

**Select a Map Format**  
Select a file format for the map:  
PNG

**Select an Area Type**  
Choose the type of area from the list below:  
National

**Select a Specific Area**  
Select a specific area from the list below:  
Total U.S.

**Select a Map Type**  
Choose the type of map to create:  
Map with Impacts

**Enter a Map Resolution**  
Enter a map resolution between 70 and 600:  
300 dpi

Note that 96 dpi is ideal for images displayed on the web, while 300 dpi or greater is necessary for print materials.

**Enter a Valid Email Address**  
Enter an email address where the finished map file can be sent:  
jnothwehr2@unl.edu

Submit

The National Drought Mitigation Center  
University of Nebraska-Lincoln  
3310 Holdrege Street  
P.O. Box 830988  
Lincoln, NE 68583-0988  
phone: (402) 472-6707

USDA NDMC UNIVERSITY OF NEBRASKA-LINCOLN NOAA

# Record Added to Database

	customMapReqId	areaType	specArea	mapType	mapFormat	mapRes	emailAddress	mapSent	dmReleaseId	fileName
7	7	huc4	1806	text	pdf	0	jnothwehr2@unl.edu	1	869	20151208_1806_text.pdf
8	8	county	48237	date	png	96	jnothwehr2@unl.edu	1	936	20170321_48237_date.png
9	9	fema	7	text	png	96	jnothwehr2@unl.edu	1	294	20050215_7_text.png
10	10	huc4	1810	trd	pdf	0	jnothwehr2@unl.edu	1	938	20170404_1810_trd.pdf
11	11	climdiv	106	text	pdf	0	cpoulsen2@unl.edu	1	932	20170221_106_text.pdf
12	12	climdiv	106	text	pdf	0	cpoulsen2@unl.edu	1	932	20170221_106_text.pdf
13	13	climdiv	106	text	pdf	0	cpoulsen2@unl.edu	1	932	20170221_106_text.pdf
14	14	climdiv	106	text	pdf	0	cpoulsen2@unl.edu	1	932	20170221_106_text.pdf
15	15	climdiv	106	text	pdf	0	cpoulsen2@unl.edu	1	932	20170221_106_text.pdf
16	16	climdiv	106	text	pdf	0	cpoulsen2@unl.edu	1	932	20170221_106_text.pdf
17	17	climdiv	106	text	pdf	0	cpoulsen2@unl.edu	1	932	20170221_106_text.pdf
18	18	climdiv	106	text	pdf	0	cpoulsen2@unl.edu	1	324	20050913_106_text.pdf
19	19	fema	6	text	pdf	0	jnothwehr2@unl.edu	1	938	20170404_6_text.pdf
20	20	national	total	usdm	png	300	jnothwehr2@unl.edu	0	940	NULL



# Email Sent

The screenshot shows an Outlook window titled "Custom USDM Map Request 20 - Message (Plain Text)". The interface includes a ribbon with "FILE" and "MESSAGE" tabs, and a ribbon menu with various actions like Ignore, Delete, Reply, Forward, Meeting, etc. The email content is as follows:

Mon 4/24/2017 2:35 PM  
NDMC Data  
Custom USDM Map Request 20  
To: Jeffrey Nothwehr  
Message 20170418\_usdm.png (378 KB)

Hello,

The U.S. Drought Monitor map you have requested is attached to this email. Please contact me if you have any questions.

Chris Poulsen  
-----  
National Drought Mitigation Center  
GIS Manager  
(402) 472-8828  
[cpoulsen2@unl.edu](mailto:cpoulsen2@unl.edu)  
-----

Click a photo to see recent emails and social updates.

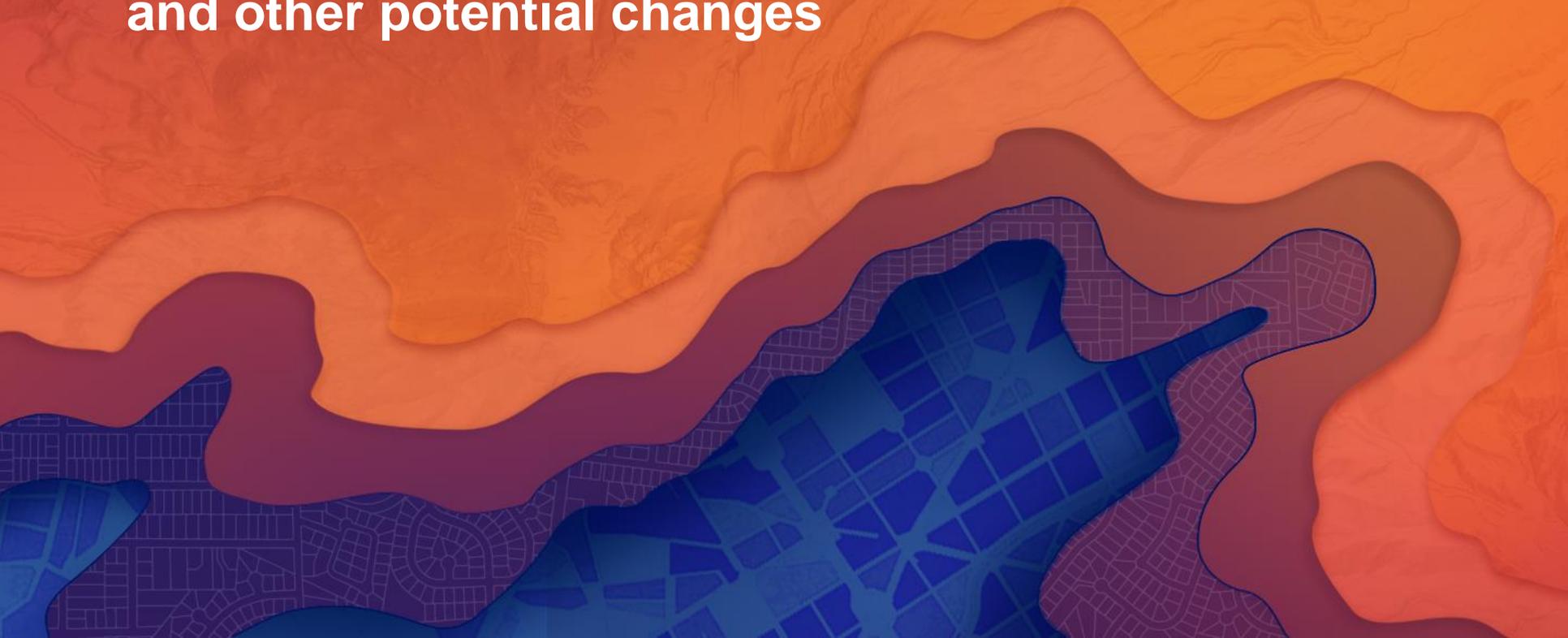
Unable to log in to: SharePoint. [Click here to log in.](#)

NDMC Data      Jeffrey Nothwehr  
GIS Manager      GIS/WEB Spec II

# Database Updated

	customMapReqId	areaType	specArea	mapType	mapFormat	mapRes	emailAddress	mapSent	dmReleaseId	fileName
7	7	huc4	1806	text	pdf	0	jnothwehr2@unl.edu	1	869	20151208_1806_text.pdf
8	8	county	48237	date	png	96	jnothwehr2@unl.edu	1	936	20170321_48237_date.png
9	9	fema	7	text	png	96	jnothwehr2@unl.edu	1	294	20050215_7_text.png
10	10	huc4	1810	trd	pdf	0	jnothwehr2@unl.edu	1	938	20170404_1810_trd.pdf
11	11	climdiv	106	text	pdf	0	cpoulsen2@unl.edu	1	932	20170221_106_text.pdf
12	12	climdiv	106	text	pdf	0	cpoulsen2@unl.edu	1	932	20170221_106_text.pdf
13	13	climdiv	106	text	pdf	0	cpoulsen2@unl.edu	1	932	20170221_106_text.pdf
14	14	climdiv	106	text	pdf	0	cpoulsen2@unl.edu	1	932	20170221_106_text.pdf
15	15	climdiv	106	text	pdf	0	cpoulsen2@unl.edu	1	932	20170221_106_text.pdf
16	16	climdiv	106	text	pdf	0	cpoulsen2@unl.edu	1	932	20170221_106_text.pdf
17	17	climdiv	106	text	pdf	0	cpoulsen2@unl.edu	1	932	20170221_106_text.pdf
18	18	climdiv	106	text	pdf	0	cpoulsen2@unl.edu	1	324	20050913_106_text.pdf
19	19	fema	6	text	pdf	0	jnothwehr2@unl.edu	1	938	20170404_6_text.pdf
20	20	national	total	usdm	png	300	jnothwehr2@unl.edu	1	940	20170418_usdm.png

# Improvements and other potential changes



# Potential Improvements

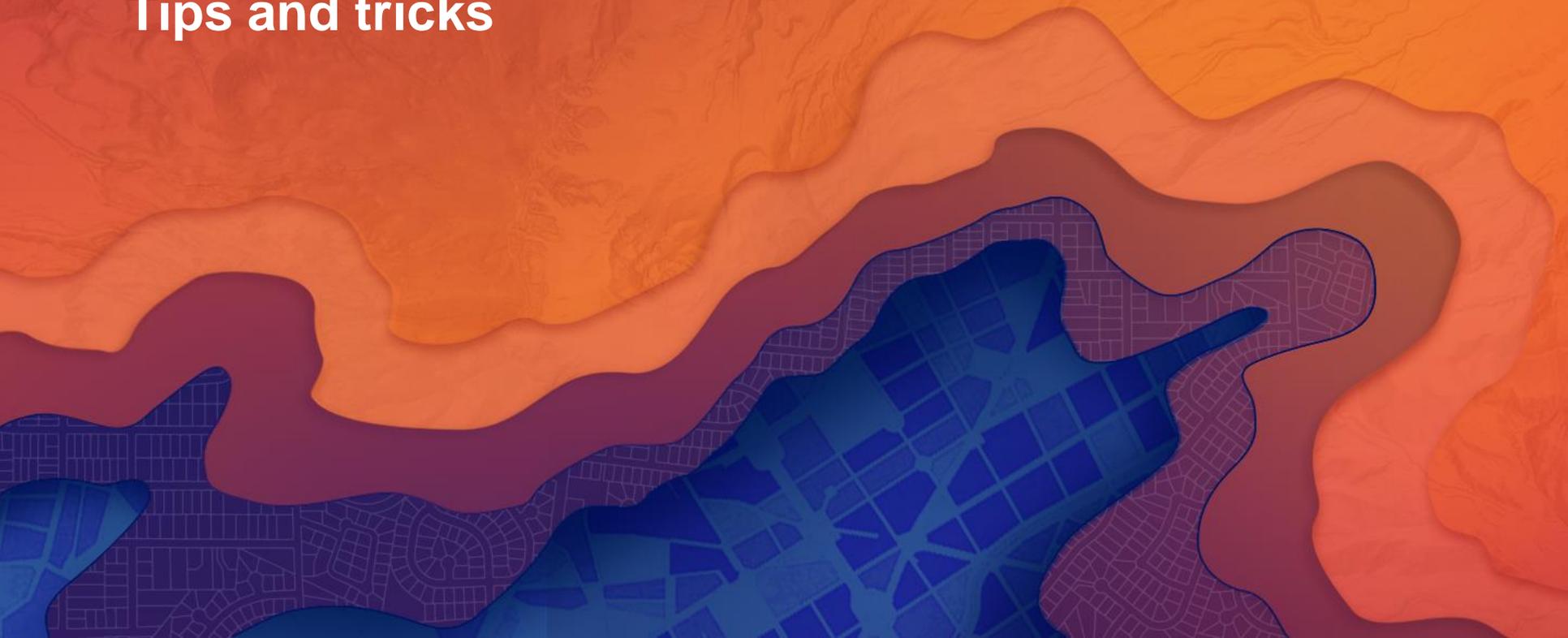
- More error checking
  - Check validity of email
  - Captcha or some other spam prevention

# Potential Improvements

- Process to clean up map files after they are sent
  - Delete files in order to save space

# Do it Yourself

Tips and tricks



# Web Form

- Any type of web form should work
- Need to be able to write to a database
- Indicate that user's email will not be shared with anyone else

# SQL Database

- Use Boolean variables to record when events happen
  - Used to determine that map has been emailed in this example

# Python Scripts

- Used **pyodbc** to write to database
  - Free add in which must be installed
  - Simple way to interact with databases

# Python Scripts

- Make sure scripts successfully change check variables
  - Prevent tasks from running endlessly
  - Prevents duplicate emails to users

# Python Scripts

- Use “**try**” and “**except**” statements to handle errors
- Set up an email script to alert someone if errors occur

# Scheduled Tasks

- Can run at longer or shorter intervals
  - 15 minutes used in this example
- Indicate to users how much wait time is possible

# Other

- Make sure your symbology layers have a **valid data source**
  - Layers with a missing data source won't work

# Other

- As with anything, test thoroughly before deploying
  - Don't want maps with errors going to users

# Questions?

Contact:

[jnothwehr2@unl.edu](mailto:jnothwehr2@unl.edu)