

Wildfires!

Lazouich Ford

**BLACK
PYTHON
DEVS**



Objectives

- A high-level understanding of wildfire terminology and data
- A broad sense of the capabilities of GeoPandas
- The basics of mapping with Folium

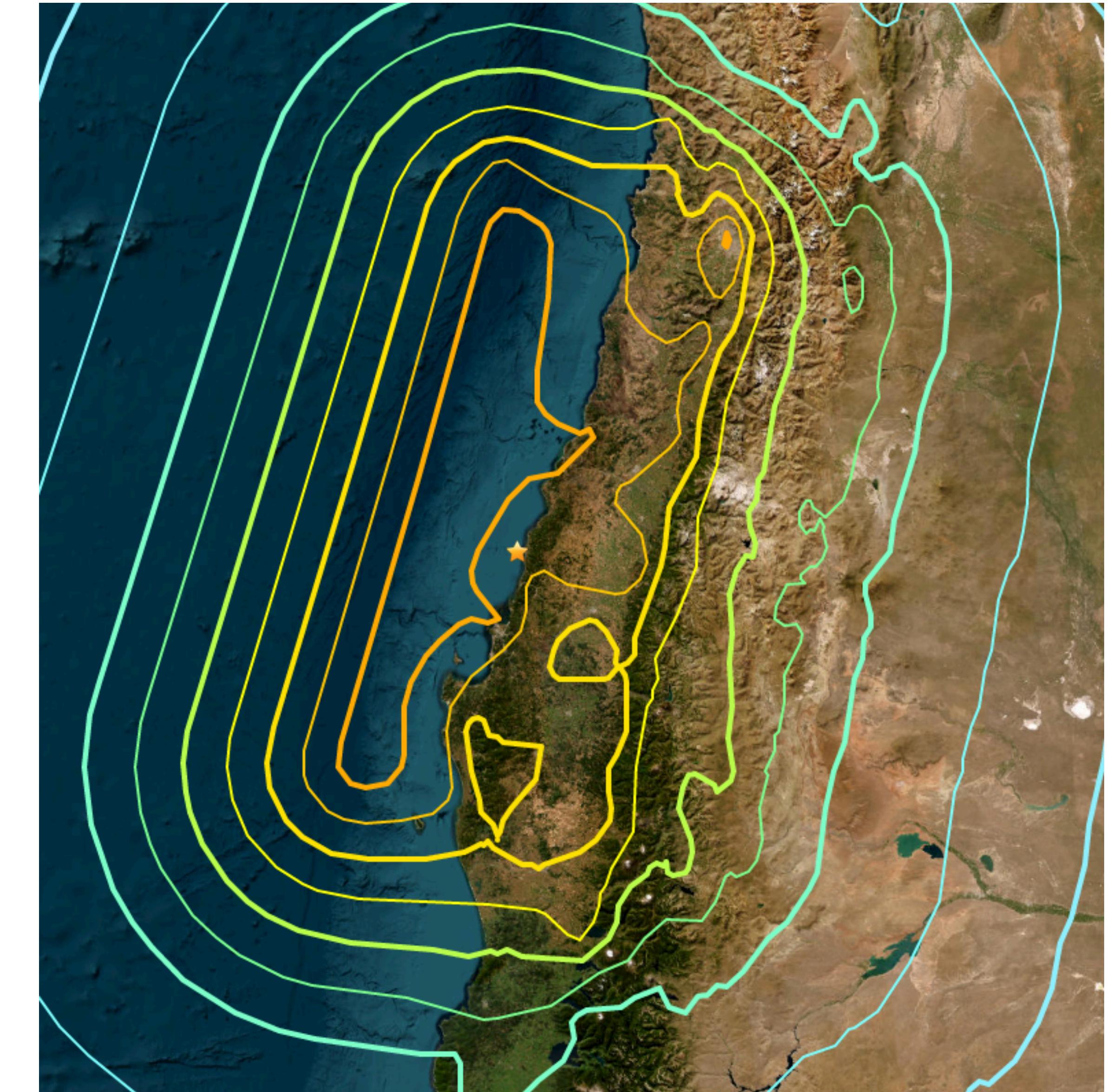


Geospatial Data

Geospatial Data

What is geospatial data?

- Data with a component that relates to a location on Earth

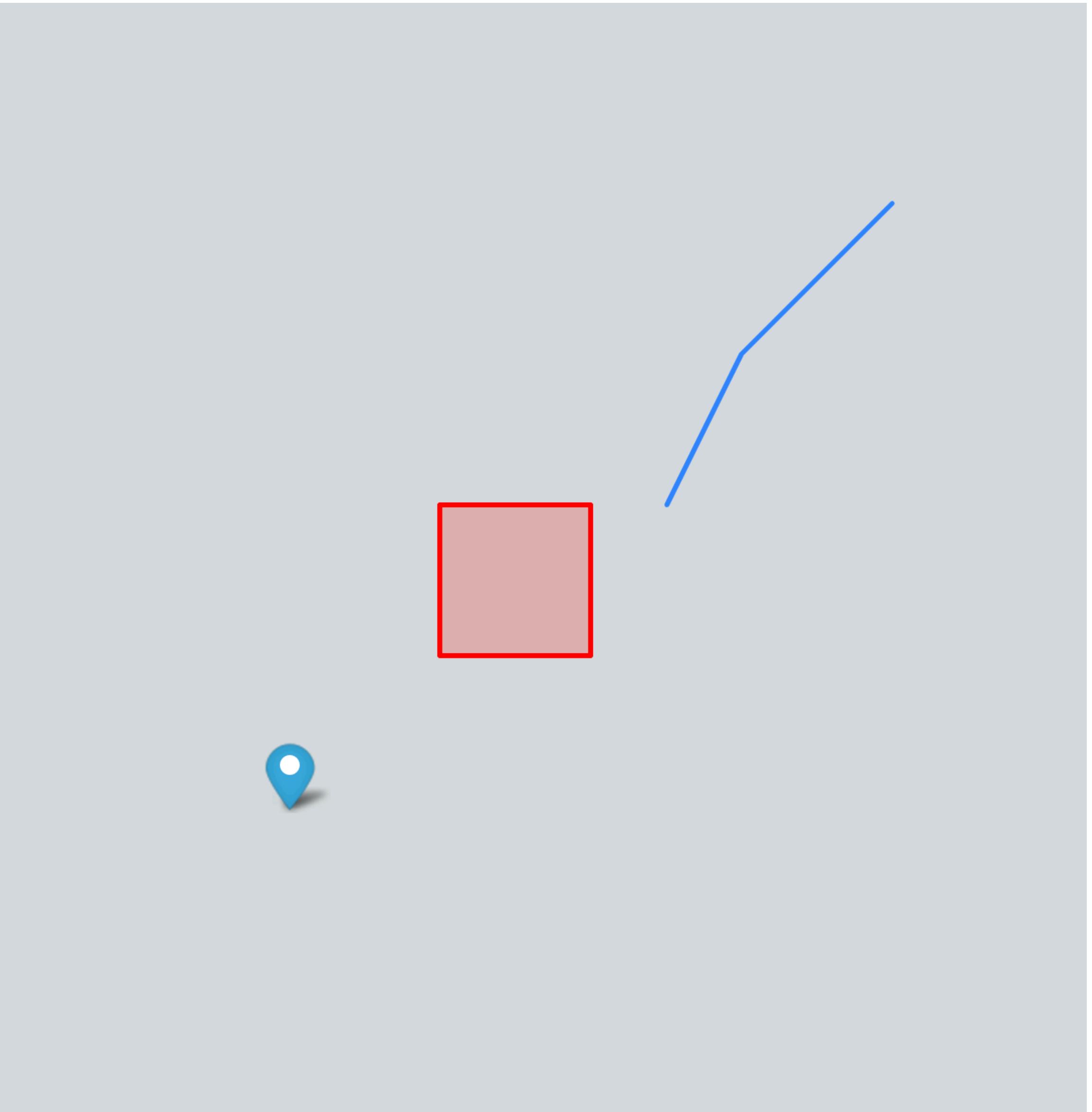


USGS ShakeMap 2010 Earthquake Chile

Geospatial Data

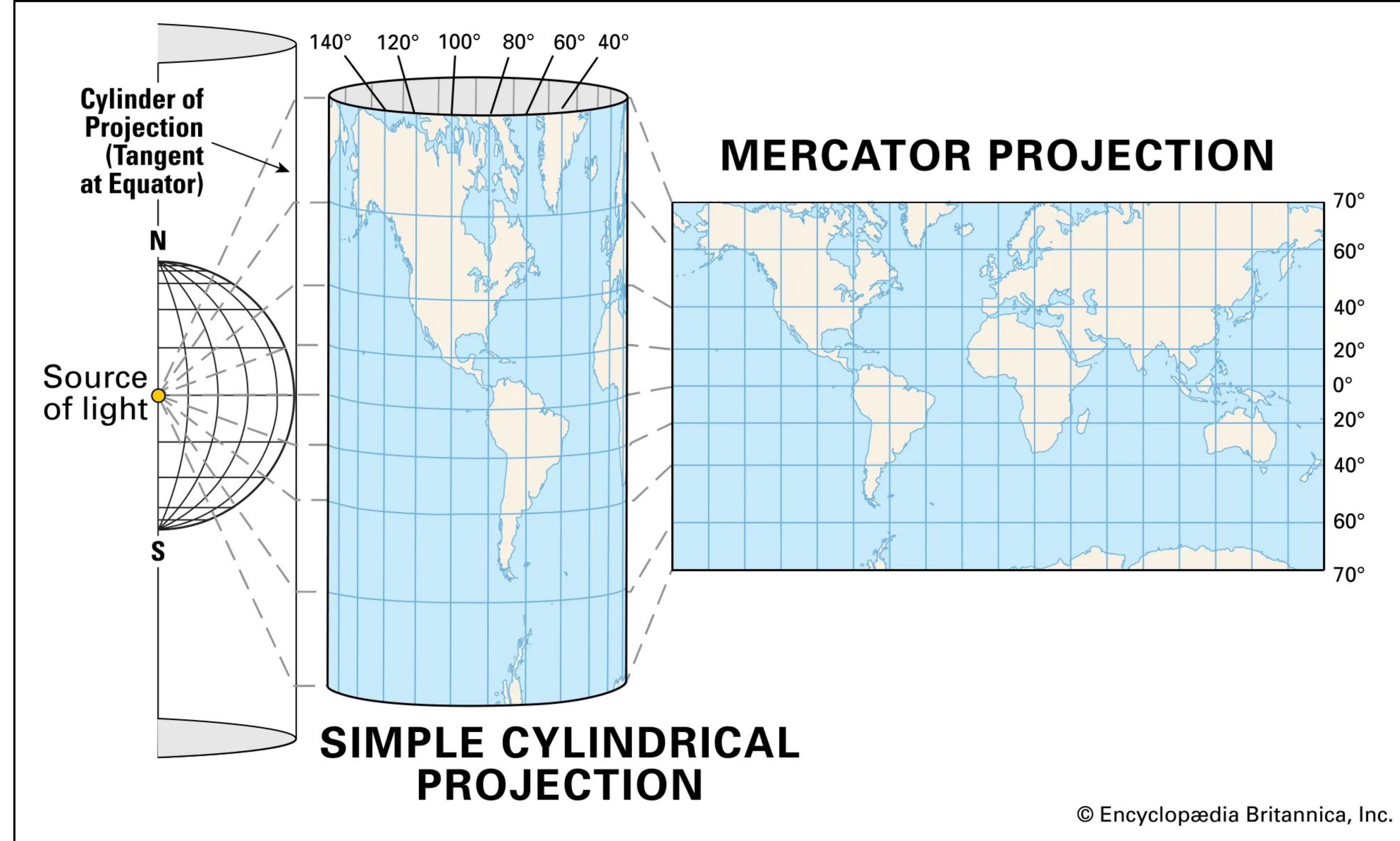
Geometries

- Point
- Linestring
- Polygon
- Collections
 - Multipolygon
 - Multipoint
 - ect.



**“The earth is not flat, and there is no simple way
of putting it down on a flat paper map (or
computer screen)...”**

- PostGIS contributors



There is not a one-size fits all projection.

See: <https://www.usgs.gov/publications/map-projections>

Geospatial Data

Spatial Reference System

- Describes where a geometry is located on the Earth's surface
- Common reference system is EPSG:4326 - World Geodetic System 1984
 - Latitude/Longitude used by GPS

Wildfires

Wildfires

Perimeter

- The outer boundary of a wildfire.



Wildfires

Acreage

- A measure of the land area affected by a wildfire.



Wildfires

Containment

- Limiting the spread of a wildfire through natural or man-made barriers (fire breaks)
- The fire is still active.
- A fire is considered **contained** when it is no longer expected to spread past the control line



Wildfires

Controlled

- Fire is within its control line and hotspots have been extinguished



Wildfires

IRWIN

IRWIN is software that allows data to be shared between applications so that there's a single data source for every incident. Hundreds of different online systems play a role in managing incidents like wildfires. Since most were developed at different times for different federal or state agencies, they don't necessarily talk to one another.

-U.S. Department of the Interior. "Hello, My Name Is IRWIN."

Wildfires

IRWINID

- Unique identifier assigned to each incident record in IRWIN



Wildfire Perimeter Data

Wildfire Perimeter Data

NIFC

- **National Interagency Fire Center** (NIFC) will be our focus for as a data source.





WFIGS 2025 Interagency Fire Perimeters to Date

Authoritative

NIFC Authoritative Content
National Interagency Fire Center

[View Map](#) [Download](#) [More ▾](#)

Summary

Best available perimeters for all reported wildland fires in the United States in the current year to date

The Wildland Fire Interagency Geospatial Services (WFIGS) Group provides authoritative geospatial data products under the interagency Wildland Fire Data Program. Hosted in the National Interagency Fire Center ArcGIS Online Organization (The NIFC Org), WFIGS provides both internal and public facing data, accessible in a variety of formats.

This service includes perimeters for [wildland fire incidents](#) that meet the following criteria:

[Read More ▾](#)

Looking for something else? See other datasets nearby →

Attributes

poly_SourceOID

poly_IncidentName

poly_FeatureCategory

poly_MapMethod

poly_GISAcres

poly_DeleteThis

poly_FeatureAccess

[Learn about charts ▾](#)



I want to...

Create a Map
Start a map with this data



data-nifc.opendata.arcgis.com/datasets/nifc::wfigs-2025-interagency-fire-perimeters-to-date/about

National Interagency Fire Center

2025 Wildland Fires Historical Wildland Fires WFIGS FAQs

 **WFIGS 2025 Interagency Fire Perimeters to Date**
NIFC Authoritative Content

authoritative shape is used.

Esri, USGS | Esri, FAO, NOAA, USGS

Powered by Esri

Attributes and their definitions can be found below. More detail about the NWCG Wildland Fire Event Polygon standard can be found [here](#).

Attributes:

poly_SourceOID

The OBJECTID value of the source record in the source dataset providing the polygon.

poly_IncidentName

The incident name as stored in the polygon source record.

poly_MapMethod

The mapping method with which the polygon was derived.

poly_GISAcres

The acreage of the polygon as stored in the polygon source record.

poly_CreateDate

System generated date for the date time the source polygon record was created (stored in UTC).

poly_DateCurrent

System generated date for the date time the source polygon record was last edited (stored in UTC).

poly_PolygonDateTime

Represents the date time that the polygon data was captured.

poly_IRWINID

IRWIN ID stored in the polygon record.

poly_FORID

FORID stored in the polygon record.

poly_Acres_AutoCalc

System calculated acreage of the polygon

(geodesic WGS84 acres).

poly_SourceGlobalID

The GlobalID value of the source record in the source dataset providing the polygon.

poly_Source

The source dataset providing the polygon.

attr_SourceOID

The OBJECTID value of the source record in the source dataset providing the attribution.

attr_ABCDMisc

A FireCode used by USDA FS to track and compile cost information for emergency initial attack fire suppression expenditures. for A, B, C & D size class fires on FS lands.

attr_AdSPermissionState

Indicates the permission hierarchy that is currently being applied when a system utilizes the UpdateIncident operation.

attr_ContainmentDateTime

The date and time a wildfire was declared contained.

attr_ControlDateTime

The date and time a wildfire was declared under control.

attr_CreatedBySystem

ArcGIS Server Username of system that created the IRWIN Incident record.

attr_IncidentSize

Reported for a fire. The minimum size is 0.1.

attr_DiscoveryAcres

An estimate of acres burning upon the discovery of the fire. More specifically when the fire is first reported by the first person that calls in the fire.

The estimate should include number of acres within the current perimeter of a specific, individual incident, including unburned and unburnable islands.

attr_DispatchCenterID

A unique identifier for a dispatch center responsible for supporting the incident.

attr_EstimatedCostToDate

The total estimated cost of the incident to date.

I want to...

 **Create a Map**

Start a map with this data

 **Create a Story**

Open in ArcGIS StoryMaps

 **View API Resources**

Try out the API Explorer

 **View Data Source**

Select to open in a new tab

 **View All Metadata**

Select to open in a new tab

 **Open in ArcGIS Online**

Select to open in a new tab

Showing 75 of 4,231 rows

[Close Table](#)

	poly_SourceOID	poly_IncidentName	poly_FeatureCategory	poly_MapMethod	poly_GISAcres	poly_DeleteThis	poly_FeatureAccess	poly_FeatureStatus	poly_IsVisible	poly_CreateDate	poly_DateCurrent	poly_PolygonD
	138	Daggett Brook	Wildfire Daily Fire Perimeter	Auto-generated for InFORM	0.25	No	Public	Approved	Yes	1/7/2025, 8:39 AM	1/7/2025, 9:42 AM	1/7/2025, 8:39 AM
	170	Cattle	Wildfire Daily Fire Perimeter	Auto-generated for InFORM	48	No	Public	Approved	Yes	1/7/2025, 8:13 PM	1/8/2025, 11:43 AM	1/7/2025, 10:36 PM
	171	Ranch	Wildfire Daily Fire Perimeter	Auto-generated for InFORM	65	No	Public	Approved	Yes	1/7/2025, 10:47 PM	1/8/2025, 12:04 PM	1/8/2025, 4:54 PM
	172	PALISADES	Wildfire Daily Fire Perimeter	IR Image Interpretation	23,448	No	Public	Approved	Yes	1/7/2025, 11:00 PM	1/21/2025, 4:43 PM	1/8/2025, 7:31 PM
	211	Beaver Creek	Wildfire Daily Fire Perimeter	Hand Sketch	0.14	No	Public	Approved	Yes	1/8/2025, 2:23 PM	1/8/2025, 2:25 PM	1/6/2025, 1:45 PM
	615	Eaton	Wildfire Daily Fire Perimeter	Mixed Methods	14,021.109	No	Public	Approved	Yes	1/18/2025, 4:33 PM	1/20/2025, 5:18 PM	
	312	Hurst	Wildfire Daily Fire Perimeter	Mixed Methods	799.818	No	Public	Approved	Yes	1/10/2025, 8:23 PM	1/10/2025, 8:25 PM	
	26,526	Roter	Wildfire Final Fire Perimeter	GPS-Walked	1.259	No	Public	Approved	Yes	1/10/2025, 8:11 AM	1/10/2025, 8:11 AM	1/10/2025, 8:11 AM
	391	Labor in Vain	Wildfire Daily Fire Perimeter	Hand Sketch	0.05	No	Public	Approved	Yes	1/13/2025, 1:08 PM	1/13/2025, 1:08 PM	1/13/2025, 1:08 PM
	380	East Hartford	Wildfire Daily Fire Perimeter	Mixed Methods	2.98	No	Public	Approved	Yes	1/13/2025, 9:39 AM	1/13/2025, 9:39 AM	
	16	MONUMENT	Wildfire Daily Fire Perimeter	GPS-Walked	17.586	No	Public	Approved	Yes	1/2/2025, 6:01 PM	1/13/2025, 4:56 PM	1/8/2025, 9:28 AM
	26,569	Mud Lake	Wildfire Final Fire Perimeter	Auto-generated for InFORM	2	No	Public	Approved	Yes	1/14/2025, 8:43 AM	1/14/2025, 8:43 AM	1/14/2025, 8:43 AM
	26,568	West Easment	Wildfire Final Fire Perimeter	Auto-generated for InFORM	2	No	Public	Approved	Yes	1/14/2025, 8:42 AM	1/14/2025, 8:42 AM	1/14/2025, 8:42 AM
	26,570	Mudd Bayou SW	Wildfire Final Fire Perimeter	Auto-generated for InFORM	0.5	No	Public	Approved	Yes	1/14/2025, 8:45 AM	1/14/2025, 8:45 AM	1/14/2025, 8:45 AM
	510	FREDDY	Wildfire Daily Fire Perimeter	GPS-Walked	6.53	No	Public	Approved	Yes	1/15/2025, 4:22 PM	1/15/2025, 4:26 PM	1/8/2025, 1:39 PM
	26,740	Rawhide	Wildfire Final Fire Perimeter	Auto-generated for InFORM	1	No	Public	Approved	Yes	1/17/2025, 9:57 AM	1/17/2025, 9:57 AM	1/17/2025, 9:57 AM
	26,774	Wedding	Wildfire Final Fire Perimeter	Mixed Methods	28.6	No	Public	Approved	Yes	1/22/2025, 8:58 AM	1/22/2025, 8:58 AM	1/22/2025, 8:58 AM
	823	Laguna	Wildfire Daily Fire Perimeter	Mixed Methods	66.507	No	Public	Approved	Yes	1/23/2025, 10:33 AM	6/26/2025, 7:31 PM	
	26,814	Salt Lake Pond	Wildfire Final Fire Perimeter	Auto-generated for InFORM	14	No	Public	Approved	Yes	1/23/2025, 11:53 AM	1/23/2025, 11:53 AM	1/23/2025, 11:53 AM
	26,830	MA Cas Johnson	Wildfire Final Fire Perimeter	Mixed Methods	0.1	No	Public	Approved	Yes	1/24/2025, 9:38 AM	1/24/2025, 9:38 AM	1/24/2025, 9:38 AM
	665	PRESLEY RD	Wildfire Daily Fire Perimeter	Auto-generated for InFORM	114	No	Public	Approved	Yes	1/20/2025, 7:14 PM	1/24/2025, 10:46 AM	1/21/2025, 10:30 PM
	26,843	NV COVE RX	Wildfire Final Fire Perimeter	Auto-generated for InFORM	14	No	Public	Approved	Yes	1/24/2025, 11:59 AM	1/24/2025, 11:59 AM	1/24/2025, 11:59 AM
	605	Indian Creek	Wildfire Daily Fire Perimeter	IR Image Interpretation	10.936	No	Public	Approved	Yes	1/18/2025, 1:54 PM	1/27/2025, 8:38 AM	1/27/2025, 7:01 PM
	26,869	Bell Springs	Wildfire Final Fire Perimeter	Phone/Tablet	0.1	No	Public	Approved	Yes	1/27/2025, 12:01 PM	1/27/2025, 12:01 PM	1/27/2025, 12:01 PM
	1,101	Arikara	Wildfire Daily Fire Perimeter	Auto-generated for InFORM	5	No	Public	Approved	Yes	1/28/2025, 12:16 PM	1/28/2025, 1:01 PM	1/28/2025, 12:20 PM
	26,898	Rincon	Wildfire Final Fire Perimeter	GPS-Walked	3.017	No	Public	Approved	Yes	1/29/2025, 11:08 AM	1/29/2025, 11:08 AM	1/29/2025, 11:08 AM
	530	EVP Block F Rx 0115	Prescribed Fire	Auto-generated for InFORM	47	No	Public	Approved	Yes	1/16/2025, 11:57 AM	1/30/2025, 6:18 AM	1/20/2025, 7:10 AM

data-nifc.opendata.arcgis.com/datasets/7c81ab78d8464e5c9771e49b64e834e9_0/explore?location=34.749235%2C-118.421990%2C9.58

National Interagency Fire Center

WFIFS 2025 Interagency Fire Perimeters to Date

Authoritative

 NIFC Authoritative Content
National Interagency Fire Center

Summary

Best available perimeters for all reported wildland fires in the United States in the current year to date

[View Full Details](#)

[Download](#)

Details

 Dataset Feature Layer

 March 14, 2023 at 12:00:00 AM MDT
Info Updated

 July 19, 2025 at 3:44:13 PM MDT
Data Updated

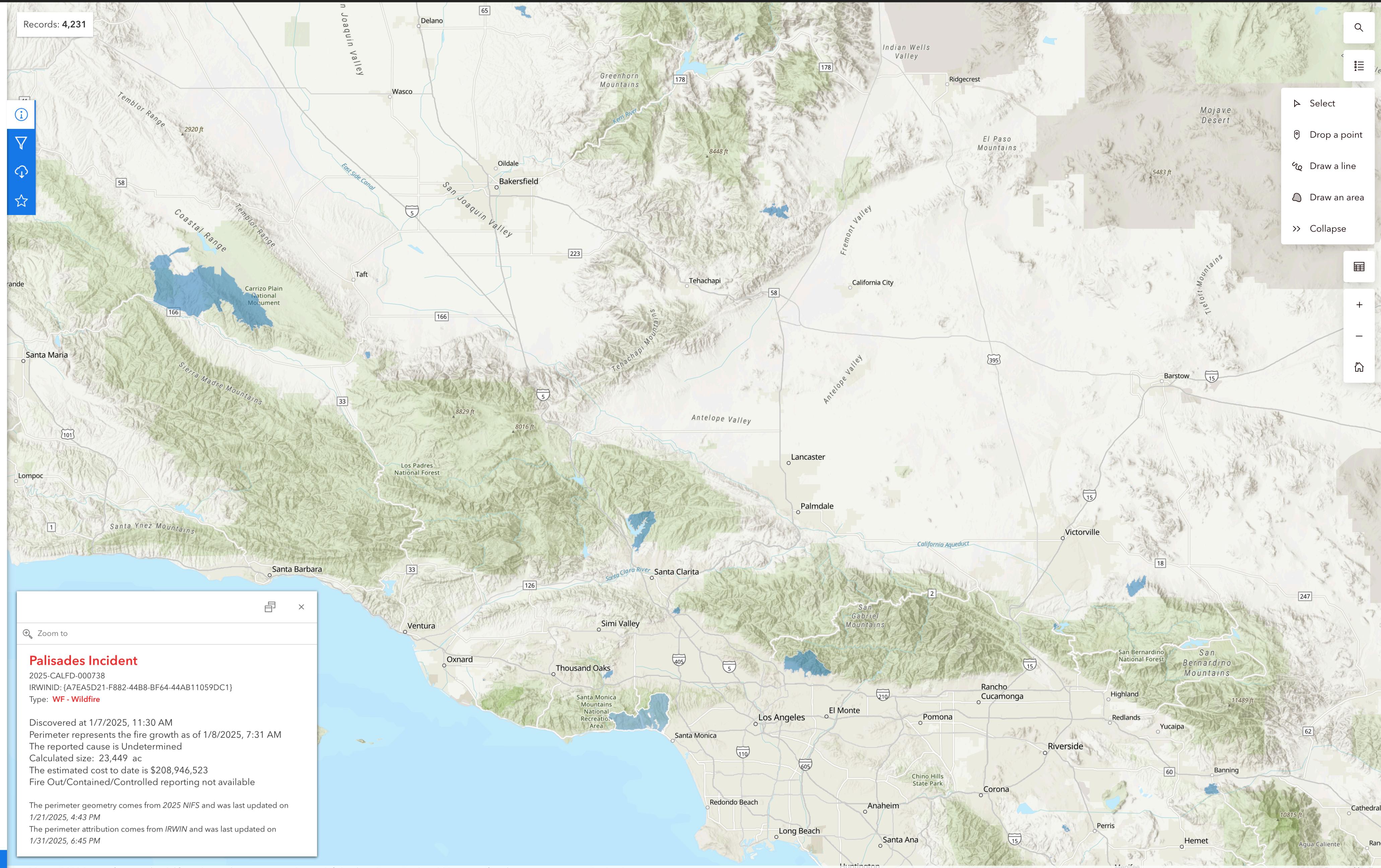
 February 14, 2023 at 3:56:04 PM MST
Published Date

 Records: 4,231
[View data table](#)

 Public
Anyone can see this content

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Records: 4,231



Palisades Incident
2025-CALFD-000738
IRWINID: (A7EA5D21-F882-44B8-BF64-44AB11059DC1)
Type: WF - Wildfire

Discovered at 1/7/2025, 11:30 AM
Perimeter represents the fire growth as of 1/8/2025, 7:31 AM
The reported cause is Undetermined
Calculated size: 23,449 ac
The estimated cost to date is \$208,946,523
Fire Out/Contained/Controlled reporting not available

The perimeter geometry comes from 2025 NIFS and was last updated on 1/21/2025, 4:43 PM
The perimeter attribution comes from IRWIN and was last updated on 1/31/2025, 6:45 PM

[I want to use this](#)

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GeoPandas

GeoPandas

What is it?

- Extension of Pandas library to add geospatial support
- DataFrame → GeoDataFrame

GeoPandas

Data

- Our data is downloaded directly from NIFC site as GeoJSON

GeoJSON Example:

```
{  
  "_id": "alaska",  
  "type": "Feature",  
  "properties": {  
    "name": "Alaska",  
    "abbreviation": "AK",  
    "capital": "Juneau",  
    "city": "Anchorage",  
    "population": 735132  
  },  
  "geometry": {  
    "coordinates": [  
      [  
        [  
          [-162.255031,  
           54.978353],  
          [-162.249682,  
           54.9759]  
        ]...  
      ]...  
    ]...  
  ]...  
}
```

GeoPandas

Loading Data

```
# Load data using GeoPandas

import geopandas as gpd

wf_perims_raw = gpd.read_file('WFIGS_Interagency_Perimeters.geojson')
wf_perims_raw.head()

Out[]:
  OBJECTID ...                               geometry
0    36832 ...  POLYGON ((-118.54464 34.07542, -118.54464 34.0...
1    42087 ...  POLYGON ((-81.74249 29.43366, -81.74251 29.433...
2    37062 ... MULTIPOLYGON (((-90.29272 44.11252, -90.2927 4...
```

GeoPandas

Viewing Columns

```
# View the columns in this GeoDataFrame  
  
wf_perims_raw.columns.tolist()  
  
Out[]:  
['OBJECTID',  
 'poly_SourceOID',  
 'poly_IncidentName',  
 'poly_FeatureCategory',  
 'poly_MapMethod',  
 'poly_GISAcres',  
 'poly_DeleteThis',  
 ...  
 'geometry']
```

GeoPandas

Cleaning Data

```
# Make new GeoDataFrame with columns of interest

cols = [
    "attr_IncidentName",
    "attr_EstimatedCostToDate",
    "poly_IRWINID",
    "poly_GISAcres",
    "geometry",
]
wf_perims = wf_perims_raw[cols].copy() # Deep copy
```

GeoPandas

Cleaning Data

```
# Replace missing values with zeros  
  
wf_perims["attr_EstimatedCostToDate"] = \  
wf_perims.attr_EstimatedCostToDate.fillna(value=0)  
  
wf_perims["poly_GISAcres"] = wf_perims["poly_GISAcres"].fillna(value=0)
```

GeoPandas

Cleaning Data

```
# Check for valid geometries  
  
wf_perims.geometry.is_valid  
wf_perims.geometry.is_valid_reason
```

GeoPandas

Cleaning Data

```
# Filter on acreage and cost  
  
wf_perims = wf_perims[wf_perims["poly_GISAcres"] >= 20]  
wf_perims = wf_perims[wf_perims["attr_EstimatedCostToDate"] >= 100_000]  
wf_perims.head()
```

attr_IncidentName	poly_GISAcres	attr_EstimatedCostToDate	poly_IRWINID	geometry
Palisades	23448.0	208946523.0	{A7EA5D21-F882-44B8-BF64-44AB11059DC1}	...
EATON	14021.108712	96100000.0	{72660ADC-B5EF-4D96-A33F-B4EA3740A4E3}	...
HURST	799.817638	3123000.0	{F4E810AD-CDF3-4ED4-B63F-03D43785BA7B}	...
COTTONWOOD CANYON	2011.362258	455000.0	{9EEE9EDD-914F-4622-AB9F-6BA9476548AF}	...

Folium

Folium

Let's Map

- **Folium** - Library that uses Leaflet.js for making maps

```
import folium
```

Folium

Let's Map

```
# Create our base map

import folium

map1 = folium.Map(
    location=[37.406, -100.110],
    tiles="CartoDB.DarkMatter",
    zoom_start=5
)
```



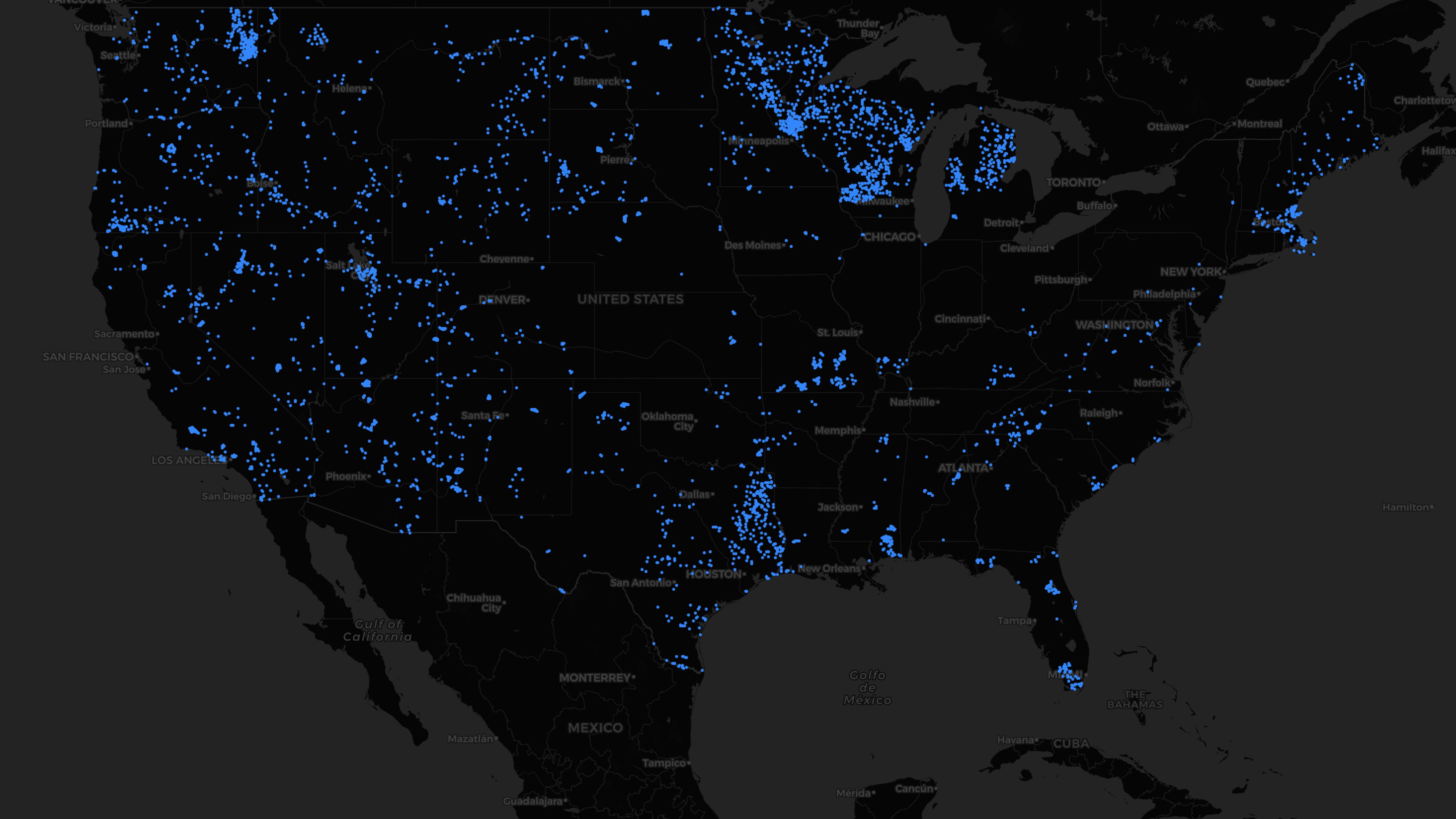
Folium

Let's Map

```
# Add the fire perimeters

map1 = folium.Map(
    location=[37.406, -100.110],
    tiles="CartoDB.DarkMatter",
    zoom_start=5
)

folium.GeoJson(
    wf_perims,
).add_to(map1)
```



Folium

Let's Map

```
# Add styling to the fire perimeters

folium.GeoJson(
    wf_perims,
    style_function=lambda x: {
        "fillColor": "red",
        "color": "red",
    }
).add_to(map1)
```

Folium

Let's Map

```
# Add dynamic styling to the fire perimeters

folium.GeoJson(
    wf_perims,
    style_function=lambda x: {
        "fillColor": colormap_size(x["properties"]["poly_GISAcres"]),
        "color": colormap_size(x["properties"]["poly_GISAcres"]),
    }
).add_to(map1)
```

Folium

Let's Map

```
# Create a color gradient for fire size

import branca

colormap_size = branca.colormap.LinearColormap(
    colors=["green","yellow","orange","red"],
    vmin=wf_perims["poly_GISAcres"].quantile(0.0),
    vmax=wf_perims["poly_GISAcres"].quantile(0.9),
    caption="Acres Burned",
)
```


Folium

Let's Map

```
# Create a popup

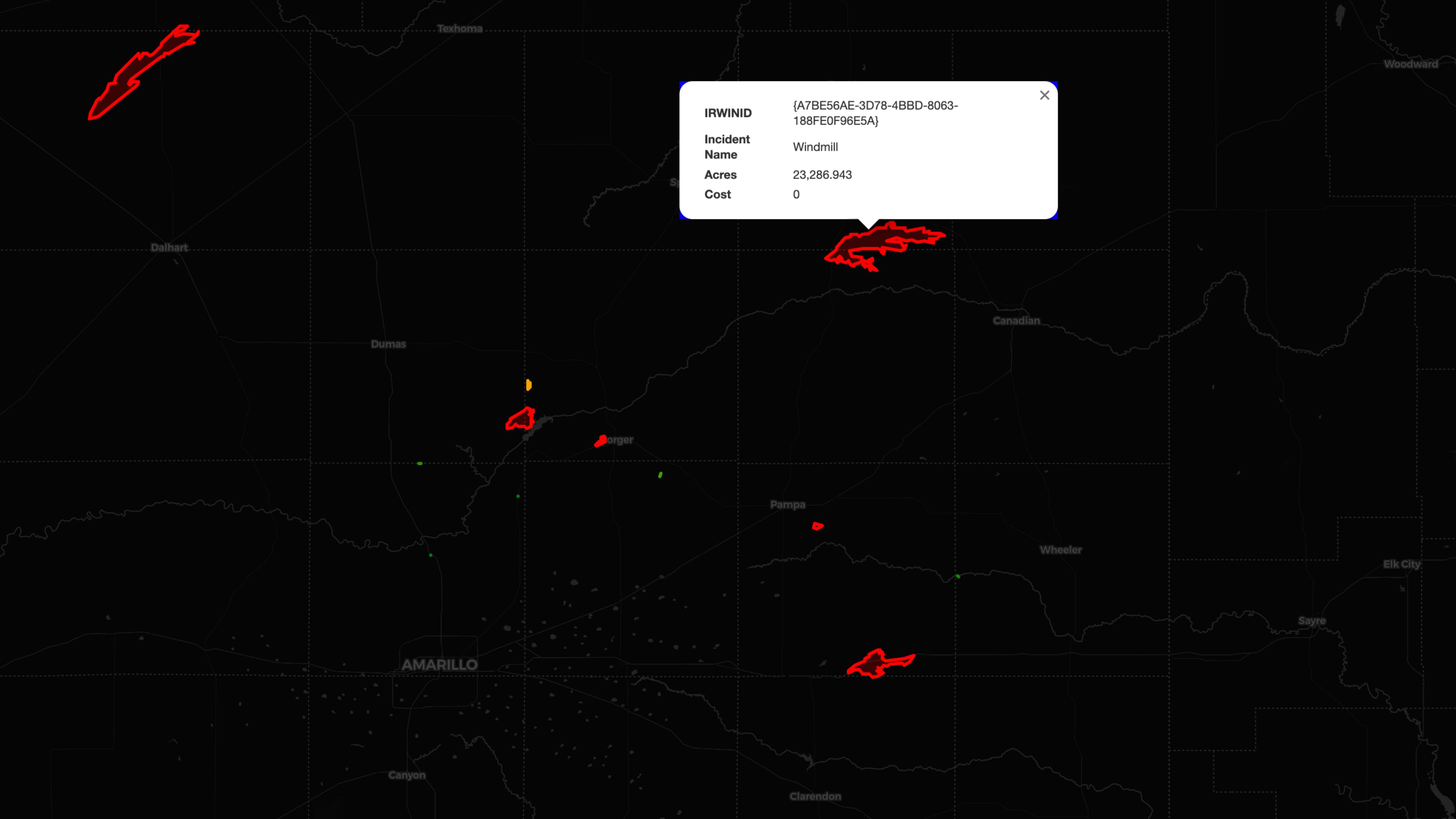
popup = folium.GeoJsonPopup(
    fields=[
        "attr_IncidentName",
        "poly_GISAcres",
        "attr_EstimatedCostToDate",
        "poly_IRWINID",
    ],
    aliases=["Incident Name", "Acres", "Cost", "IRWINID"],
)
```

Folium

Let's Map

```
# Add a popup when a fire perimeter is clicked

folium.GeoJson(
    wf_perims,
    style_function=lambda x: {
        "fillColor": colormap_size(x["properties"]["poly_GISAcres"]),
        "color": colormap_size(x["properties"]["poly_GISAcres"]),
    },
    popup=popup,
).add_to(map1)
```



Folium

More Geospatial

```
# Load state boundary data

state_data = gpd.read_file(
    "https://raw.githubusercontent.com/python-visualization/folium-example-data/main/us_states.json"
)

| id | name      | geometry
|----|-----|-----
| AL | Alabama   | POLYGON ((-87.3593 35.00118, -85.60668 34.9847...
| AK | Alaska     | MULTIPOLYGON (((-131.60202 55.11798, -131.5691...
```

Folium

More Geospatial

```
# Filter wildfire perimeters based on states  
  
target_states = state_data[state_data["id"].isin(["CA", "TX", "AK"])]  
  
filtered_wf_perims = \  
wf_perims[wf_perims.geometry.intersects(target_states.union_all())]
```

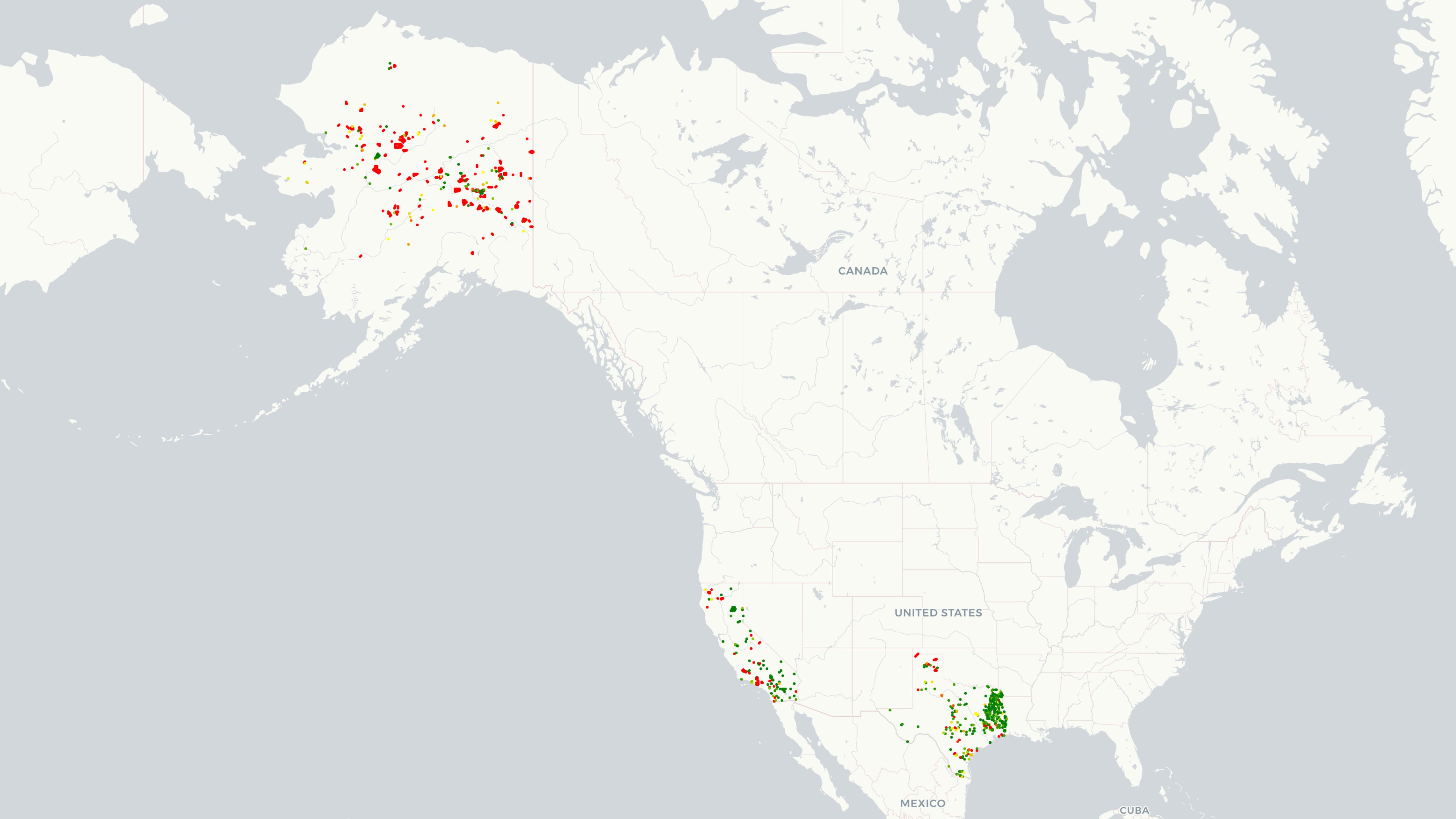
Folium

Let's Map

```
# Add the new filtered fire perimeters

map_light = folium.Map(... tiles="CartoDB Positron...")

folium.GeoJson(
    filtered_wf_perims,
    style_function=lambda x: {
        "fillColor": colormap_size(x["properties"]["poly_GISAcres"]),
        "color": colormap_size(x["properties"]["poly_GISAcres"]),
    },
).add_to(map_light)
```



Demo

Thank You



Backup Slides

Something Went Wrong ^\(\ツ)\/-

```
# Load state boundary data

state_data = gpd.read_file(
    "https://raw.githubusercontent.com/python-visualization/folium-example-data/main/us_states.json"
)
```

Backup Slides

Something Went Wrong ^\(\times\)^

```
# Create a base map

map4 = folium.Map(location=[34, -110], tiles="CartoDB Positron",
zoom_start=4)
```

Backup Slides

Something Went Wrong ^\(\times\)^

```
# Add a new column with the count of fires in each state  
  
state_data["fire_count"] = state_data.geometry.apply(  
    lambda x: wf_perims.geometry.intersects(x).sum()  
)
```

Backup Slides

Something Went Wrong ^\(\times\)^

```
# Create a color gradient for fire counts

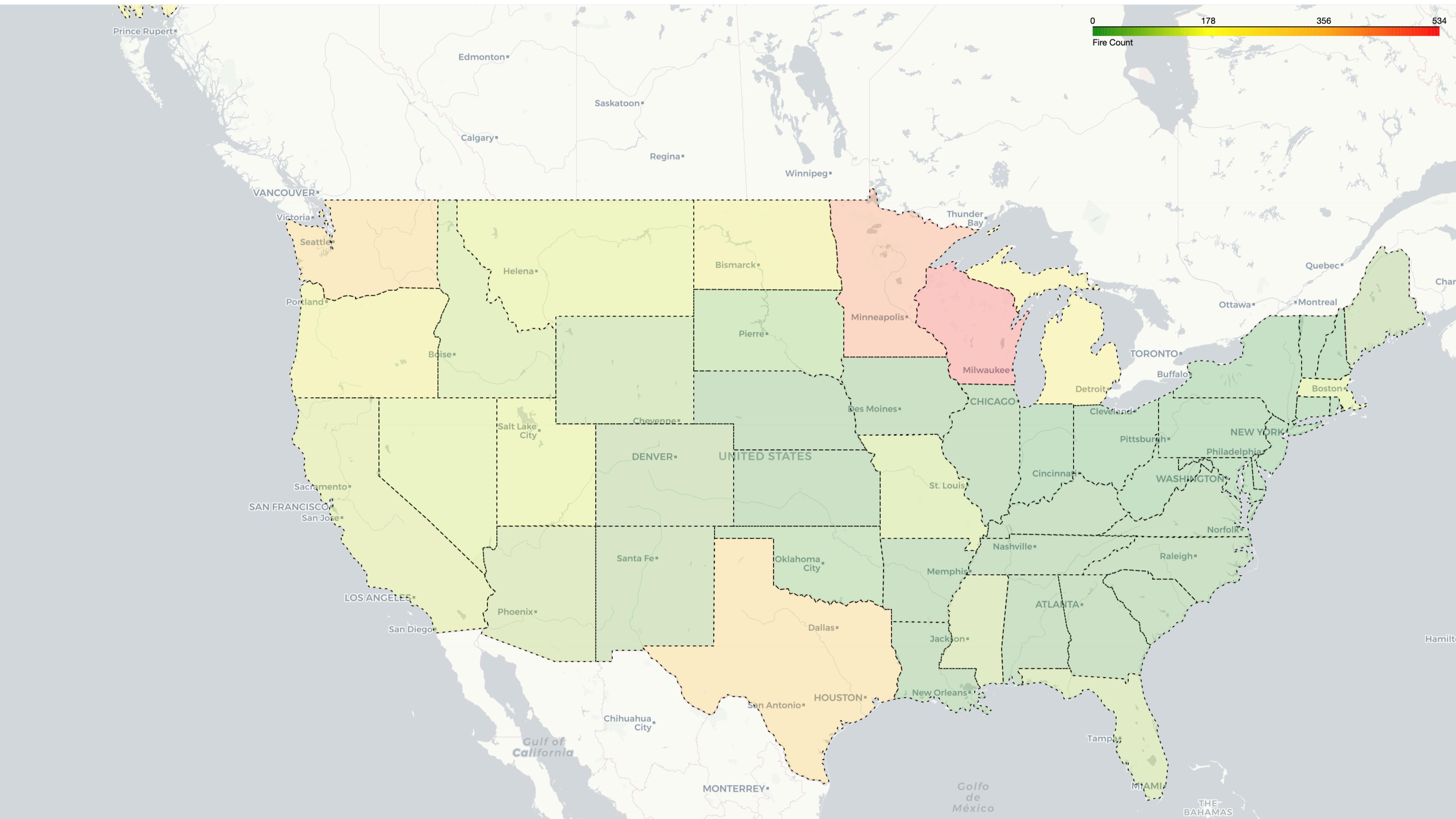
fire_count_colormap = branca.colormap.LinearColormap(
    colors=["green", "yellow", "orange", "red"],
    vmin=0,
    vmax=state_data["fire_count"].max(),
    caption="Fire Count",
)
```

Backup Slides

Something Went Wrong ^\(\times\)^

```
# Add state boundaries with colors based on fire count

folium.GeoJson(
    state_data,
    style_function=lambda x: {
        "fillColor": fire_count_colormap(x["properties"]["fire_count"]),
        "color": "black",
        "dashArray": "2,5",
    },
).add_to(map4)
```



Backup Slides

Something Went Wrong ^\(\ツ)\/-

```
# Add a popup when a fire perimeter is clicked

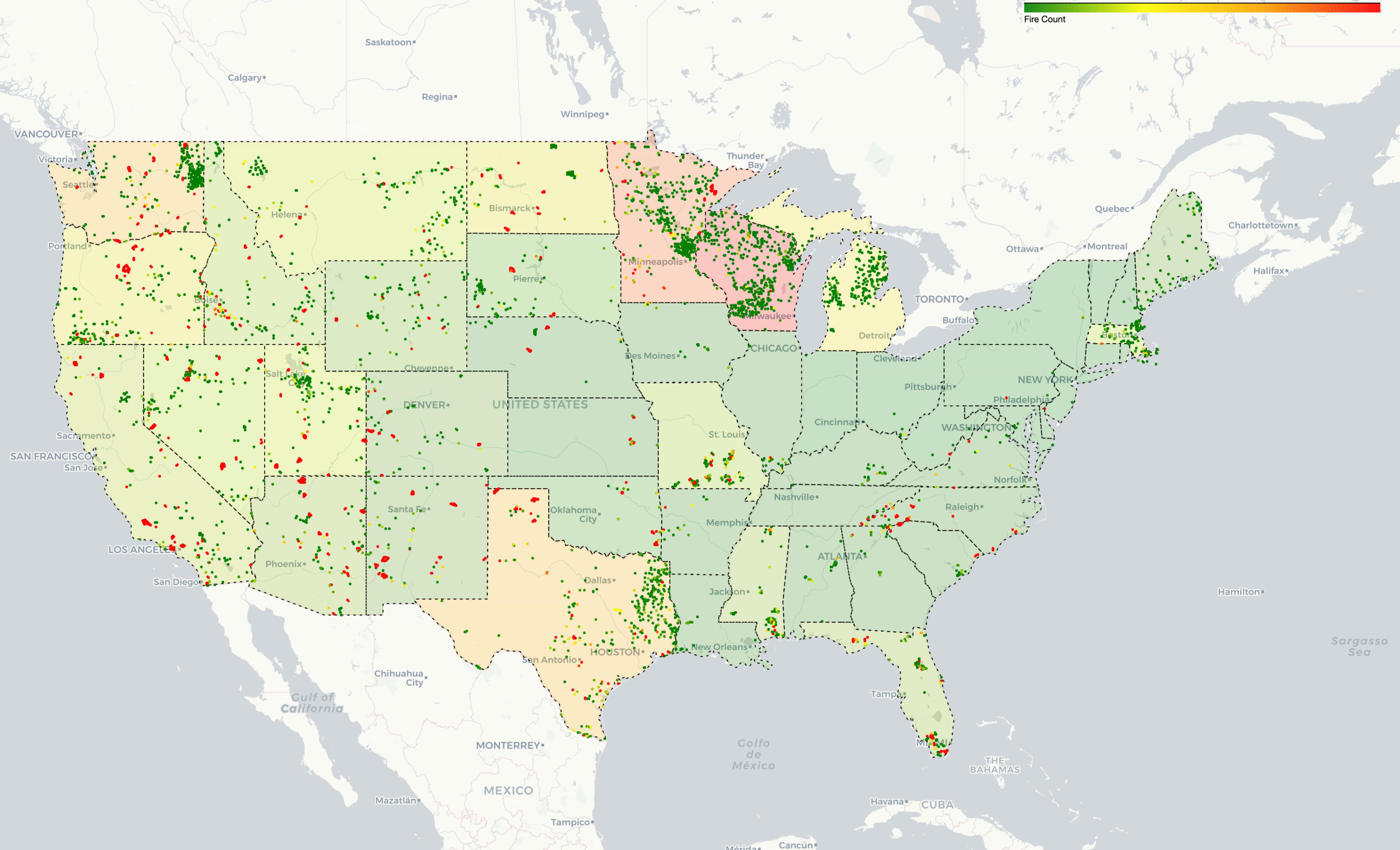
popup = folium.GeoJsonPopup(
    fields=["attr_IncidentName", "poly_GISAcres", "attr_EstimatedCostToDate"],
    aliases=["Incident Name", "Acres", "Cost"],
    localize=True,
    labels=True,
    style="background-color: blue;",
)
```

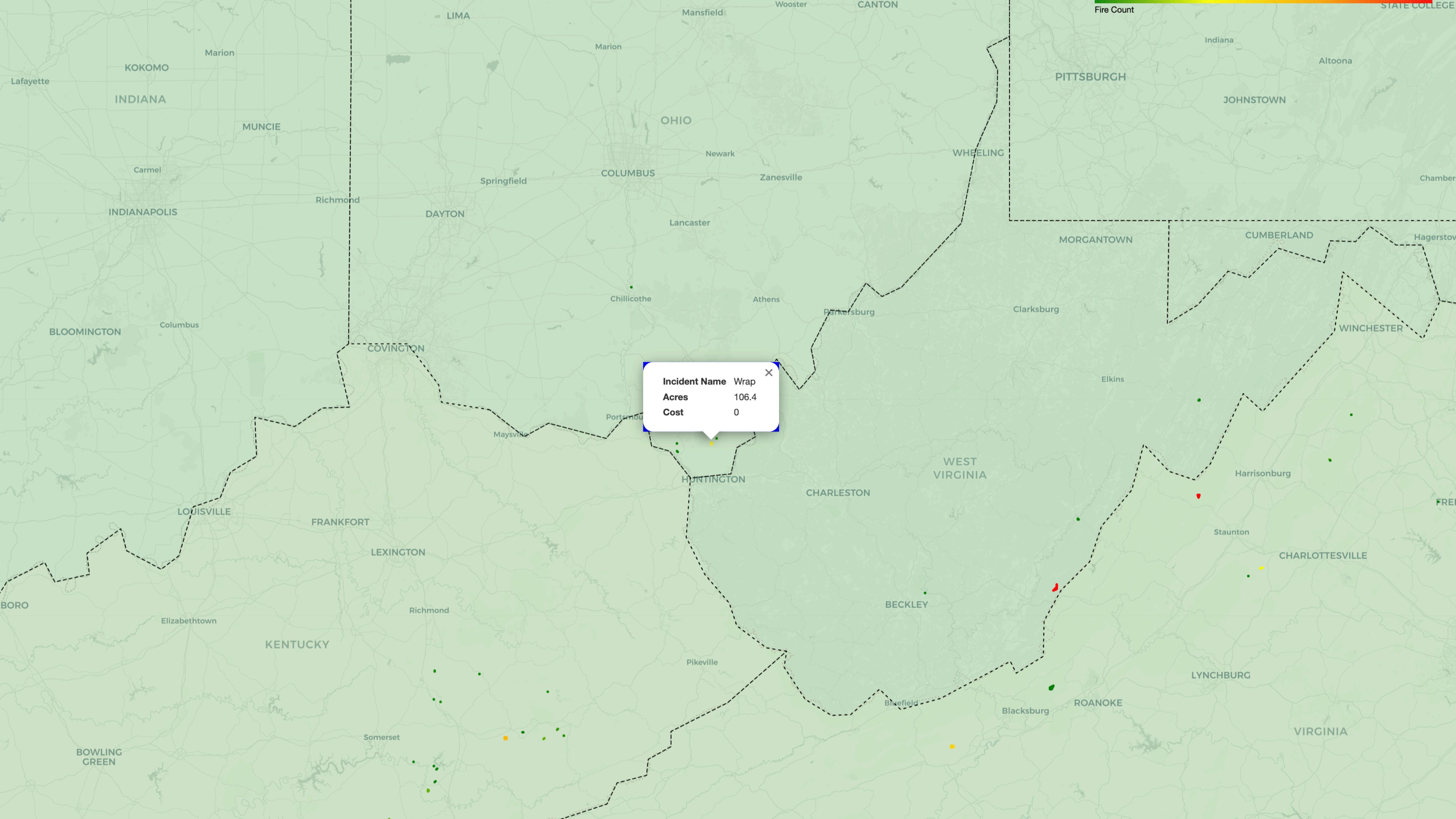
Backup Slides

Something Went Wrong ^\(\times\)^

```
# Add wildfire perimeters with color based on size

folium.GeoJson(
    wf_perims,
    style_function=lambda x: {
        "fillColor": colormap_size(x["properties"]["poly_GISAcres"]),
        "color": colormap_size(x["properties"]["poly_GISAcres"]),
    },
    popup=popup,
).add_to(map4)
```





Backup Slides

Something Went Wrong ^\(\ツ)\^

```
# Add state boundaries popup based on fire count

folium.GeoJson(
    state_data,
    style_function=lambda x: {
        ...
    },
    popup=folium.GeoJsonPopup(fields=["fire_count"]),
).add_to(map4)
```

