Exploration of 2013 Storm Events

Table of Contents

Introduction

The data file contains a list of weather events that occurred in the United States in 2013. The events have been categorized by type and the state in which they occurred. There is also information about

- damage costs,
- number of resulting injuries,
- and location of some of the events.

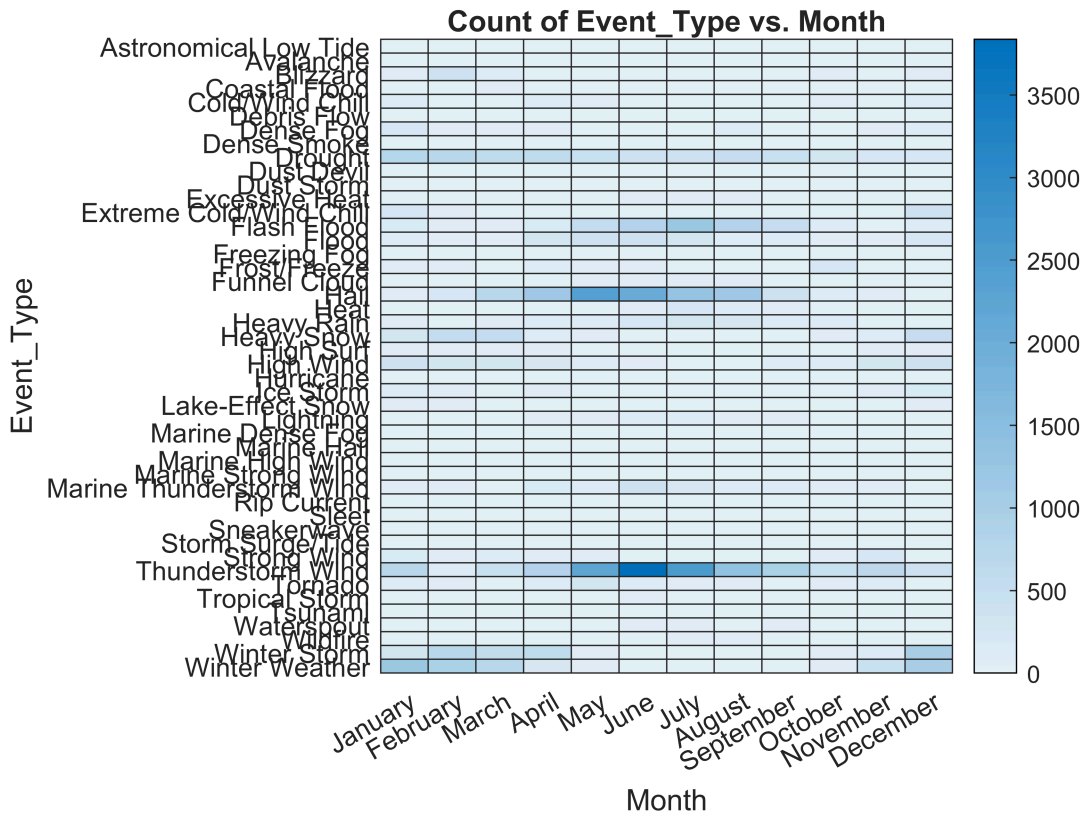
```
StormEvents2013 = importStormData("StormEvents_2013.csv");

% Reorder months
month = ["January","February","March","April","May","June","July","August","September","October
StormEvents2013.Month = reordercats(StormEvents2013.Month,month);
head(StormEvents2013);
```

Visualize raw data

Create a heat map to look at the frequency of each event type by month.

```
% Count of events by type and month
heatmap(StormEvents2013,"Month","Event_Type");
```

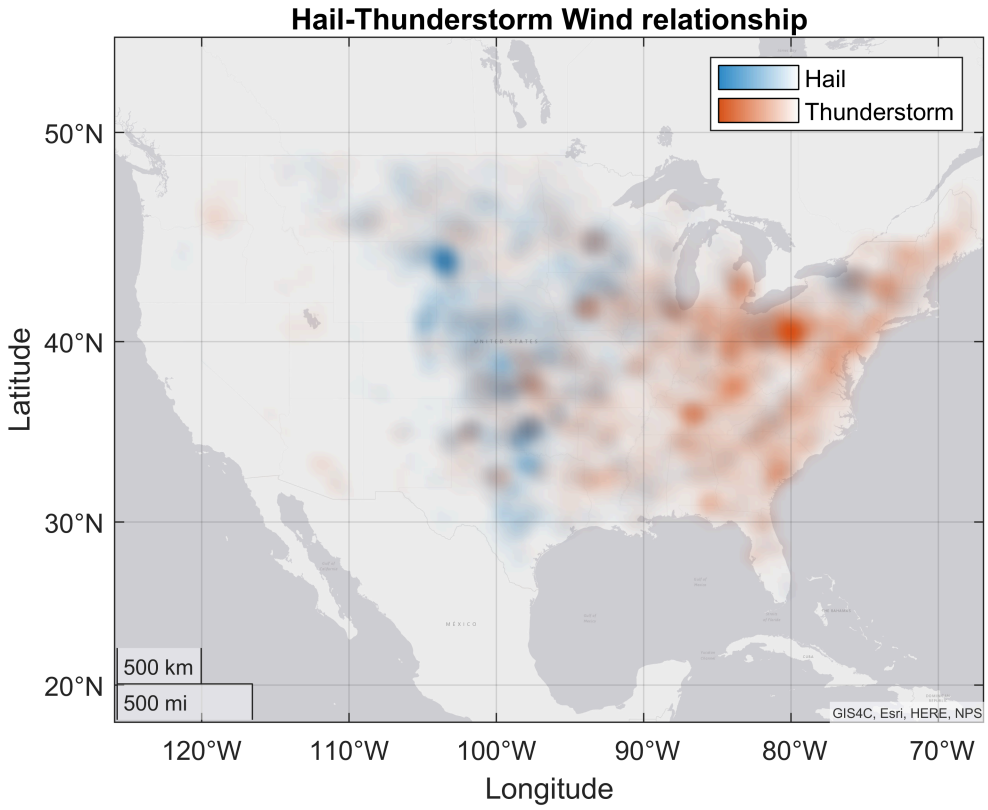


Explore Hail and Thunderstorm Wind

There is a higher occurrence of Hail and Thunderstorm Wind in the summer months. Further analysis will see if there is a relationship between these two events.

```
% Creating a new plot - geodensity
Hind = StormEvents2013.Event_Type=="Hail";
geodensityplot(StormEvents2013.Begin_Lat(Hind),StormEvents2013.Begin_Lon(Hind))
% Just show continental US
geolimits([17.0 55.2],[-128.0 -65.6])

% Add Thunderstorm Wind to see if they are related.
hold on
TWind = StormEvents2013.Event_Type=="Thunderstorm Wind";
```




```
geodensityplot(StormEvents2013.Begin_Lat(TWind),StormEvents2013.Begin_Lon(TWind)hold off

% When looking across all states, there does not appear to be a relationship between hail and t
```

Texas

The geodenisty plot shows some potential overlapping hail and thunderstorm wind events in Texas.

```
% Creating a new plot - geodensity
Hind = StormEvents2013.Event_Type=="Hail" & StormEvents2013.State=="TEXAS";
geodensityplot(StormEvents2013.Begin_Lat(Hind),StormEvents2013.Begin_Lon(Hind))

% Add Thunderstorm Wind to see if they are related.
hold on
TWind = StormEvents2013.Event_Type=="Thunderstorm Wind" & StormEvents2013.State=="TEXAS";
geodensityplot(StormEvents2013.Begin_Lat(TWind),StormEvents2013.Begin_Lon(TWind))
hold off

% While it appears most of the events are unrelated, some of the events do overlap. The large c
```

Amarillo, TX

Both hail and thunderstorm wind events contain latitude and longitude values. Use this to select events that occurred within a specified distance of Amarillo. The coordinates for Amarillo, TX were obtained online.

```
amarilloTX = [35.221996 -101.831299]; % [latitude longitude]
```

Distance from Amarillo can be computed using the Haversine formula:

$$a = \sin^2\left(\frac{\Delta \text{lat}}{2}\right) + \cos(\text{lat}_1) * \cos(\text{lat}_2) * \sin^2\left(\frac{\Delta \text{lon}}{2}\right)$$

$$c = 2 \cdot a\tan^2(\sqrt{a}, \sqrt{(1-a)})$$

$$d = R \cdot c$$

```
dLat = StormEvents2013.Begin_Lat - amarilloTX(1);
dLon = StormEvents2013.Begin_Lon - amarilloTX(2);

% Haversine formula
R = 6371; % earth's radius, kilometers
a = sind(dLat/2).^2 + cosd(StormEvents2013.Begin_Lat).*cosd(StormEvents2013.End_Lat).*sind(dLon
c = 2*atan2(sqrt(a),sqrt(1-a));

% Add distance to data table
StormEvents2013.Dist_m = R*c; % kilometers

% Select all hail and thunderstorm wind events that occurred within 8 km (~5 miles) of Amarillo
dist = 8; % kilometers
events = StormEvents2013((StormEvents2013.Event_Type=="Hail" | ...
    StormEvents2013.Event_Type=="Thunderstorm Wind") & ...
    StormEvents2013.Dist_m < dist,:);
head(events);

events.Event_Type = removecats(events.Event_Type); % remove empty categories
heatmap(events,"Event_Type","Begin_Date_Time");
% So far, the analysis has only used location to identify a potential relationship between hail
```

Conclusion

The main contributing factor in the formation of hail is wind. It would therefore be reasonable to expect some relationship between hail and thunderstorm wind events. This preliminary investigation into these two events would suggest that, at least in this data set, there is not a strong relationship.

A comparison of the events by concentration shows most hail events occur in the central United States while most thunderstorm wind events occur in the east. There are exceptions, but it is necessary to look at individual storms to identify potential relationships.

One such storm was found to hit the Amarillo, Texas area on May 28, 2013. Eight thunderstorm wind events were recorded between 16:16 and 17:11. Then starting at 22:35, nine hail events were recorded, with the last one starting at 23:14.

Additional work is necessary to determine if the thunderstorm wind events did in fact contribute to the hail events.