Red Rover, Red Rover, Let Windy Come Over

And other weather phenomena impacting American housing.

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Abstract

Insurance companies have performed risk assessments for decades, so the concept of identifying one's odds of a weather occurrence is nothing new. When one goes to purchase homeowners, renters, and/or automobile insurance a price listing is presented for your ala carte selection. Counties that are known to have a higher likelihood of an occurrence will have a higher premium, and vice versa. This project performs several queries are run to combine different datasets and perform analysis about the weather phenomenon in certain counties. Selecting the data from the weather tables (tornado, hail storms, and wind storms) and joining it to the United States Counties table. From there calculations for number of weather events per county and number of events per state, as an example. But should one go ahead and spend the money on the insurance despite the odds on the off chance of an event occurring again?

Here we show that despite the high premiums and a rising increase in the number of tornado, hail, and wind events, it is a frequent enough occurrence (1 in every 8 days, almost an average of once a week) in weather events that if one wishes to protect their physical and financial assets, it would be wise to purchase weather insurance. This study focuses on tornados, hail, and windstorms between 1955 and 2020. There are several counties and states that appear on in the top 10 lists for tornados, hail and/or windstorms. About tornados, Colorado, Florida, and Texas hold all the top spots. Hail is slightly different, Colorado and Kansas make up majority of top 10 counties, along with an appearance from Texas. For windstorms, the top 10 positions contain mostly a different set of states than tornado and hail; with Pennsylvania and Alabama have each have 2 counties in the top 10. The only state that also appears on the top 10 tornado or hail list is Texas, which again has Tarrant County taking 5th place.

After looking at 66,244 tornados, 370,766 hailstorms, and 462,478 windstorms between January 1955 and December 2020, some trends are apparent. One such trend is the steadily increasing number of weather events for Tarrant County Texas. There is an expectation that a person with property in Tarrant County should consider purchasing weather insurance despite the premium prices due to the frequency of weather events in the area. A few further analyses that could be made include increasing the types of weather covered or showing the results on a map.

Introduction

Cleverly named Windy by The Association in 1967 (Friedman, 1967), the song personifies Mother Nature, whom everyone agrees usually has an interesting way of announcing her moods.

"Who's reachin' out to capture a moment
Everyone knows it's Windy.
And Windy has stormy eyes
That flash at the sound of lies"

When Windy is upset, those stormy eyes are known to cause trouble. Temper tantrums are known to have wind sheers frequently relocating patio furniture and children's toys; outrage rains hail anywhere from the size of a pea to a softball is found pelting automobiles, shingles, and windows; and if the mood is infuriation, tornados are unleashed on the human filled terrarium we call home.

A popular American children's game, Red Rover, has children standing in two lines, or fronts, each team of children take turns chanting the taunt

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"Red Rover, Red Rover
Let {child's name} come over."

The chosen child then proceeds to run across the divide and break through the other team's front, if caught the child now belongs to that team (Wikipedia, 202). This study looks at wind, hail, and tornado locations across different counties within the United States since the 1950s. The purpose is to identify areas of high or low negative weather phenomena (wind, hail, tornado). Although the children's game is harmless fun, the question your house is asking you is: Red Rover, Red Rover, is Windy coming over?

Depending on where the weather front is in relation to your home, your friends, or your family the weather can be entirely different. It is possible to have a downpour at one house and across the street does not see even a drop. With this unpredictability, when looking for a family home, I want to have the correct insurance for when Windy comes to call. But should the homeowner purchase wind, hail, tornados, a mix of the bunch? Are there areas that are known hotspots or areas worse than others for certain weather conditions? Insurance companies have their algorithms but naturally, do not want to share the information with the general public. Even if a service is offered in the area is it worth it to purchase, if the weather condition is likely to appear only once in a blue moon?

As there are over 3,000 counties in the United States, focused studies will look at Tarrant County (home county of the author).

Research Context/Background

Insurance companies have performed risk assessments for decades, so the concept of identifying one's odds of a weather occurrence is nothing new. When one goes to purchase homeowners, renters, and/or automobile insurance a price listing is presented for your ala carte selection. Counties that are known to have a higher likelihood of an occurrence will have a higher premium, and vice versa. If a weather event occurs the insurance policy is used to offset the costs of repairs. In Florida, the 2005 hurricane season was so strong that insurance companies "substantially raised rates and decreased their exposures. While no severe hurricanes struck the United States in 2006 and 2007, market pressures remain strong given the high risk still facing coastal states" (Grace & Klein, 2009). What this means is despite having the premiums increase for a few years due to an active hurricane season, the prices have never gone back down. According to the Journal of Natural Hazzard Risk Assessment, it was found that "the sole use of past damage experience with traditional actuarial procedures does not consistently provide an adequate measure of present or future risk" (Friedman, 1984).

But should one go ahead and spend the money on the insurance despite the odds on the off chance of an event occurring again? This study focuses on tornados, hail, and windstorms between 1955 and 2020.

> *"Insurance data for tornado damages during 1949–2006 revealed 793 tornado events that each caused $1 million in losses. The average annual loss of these tornado catastrophes is $982 million, an amount that greatly exceeds the existing average of $462 million based on estimates from government records.*
>
> *Tornado catastrophes and losses were most frequent in Texas, Oklahoma, and Kansas, and relatively frequent in many Midwestern states"* (Changnon, 2009).

Along with hurricanes, which are out of scope for this project, tornados are at the top of the terrifying list of weather phenomena, especially for the midwestern states that live within the acclaimed "tornado alley". "These disasters present problems in property markets and insurance markets that have been investigated to some effect. ... While the storm path that spawns tornadoes may pass over many people and cover a wide swath of territory, any given tornado cuts a very concentrated path of damage within the territory" (Miller, Morgan, & Womack, 2002). However, tornados, although terrifying are not the most frequent plague to fall upon an area. It is much more likely that an area will be subject to a hailstorm. One study entitled High-resolution assessment of the hail hazard over complex terrain from radar and insurance data found that "Severe hailstorms that occur almost exclusively in the summer months carry a high risk for buildings, vehicles, and crops… nearly 40 % of the total damage to buildings between 1986 and 2008 are related to large hail, with the mean annual loss amounting to almost EUR 50 million" (Kunz & Puskeiler, 2010). In the case of the United States:

> *"A series of thunderstorms on 24 May 2011 produced significant hail in the Dallas–Fort Worth (DFW) metroplex, resulting in an estimated $876.8 million (U.S. dollars) in insured losses to property and automobiles, according to the Texas Department of Insurance. Insurance claims and policy-in-force data were obtained from five insurance companies for more than 67 000 residential properties located in 20 ZIP codes"* (Brown, Pogorzelski, & Giammanco, 2015).

Materials and Methods

Esri USA_Counties

Contains all the counties/parishes in the United States (50 states and DC).
Provider: Esri
Updated: January 4, 2022
Accessed: April 12, 2022
Metadata: Metadata Document (arcgis.com)
URL: https://hub.arcgis.com/datasets/esri::usa-counties

61 Attributes including:
County Name (name)
State Name (state_name)
Square Miles (sqmi)

1950-2020-torn-aspath

Contains data for all tornados in the United States (50 states and DC) from 1950-2020.
Provider: NOAA
Updated: March 15, 2022
Accessed: April 12, 2022
Metadata: http://www.spc.noaa.gov/wcm/#data
URL: Storm Prediction Center Severe Weather GIS (noaa.gov)

29 Attributes including:
Year (yr)
Rating (f)
Square Miles (sqmi)

1955-2020-hail-aspath

Contains data for all hail storms in the United States (50 states and DC) from 1955-2020.
Provider: NOAA
Updated: March 15, 2022
Accessed: April 12, 2022
Metadata: http://www.spc.noaa.gov/wcm/#data
URL: Storm Prediction Center Severe Weather GIS (noaa.gov)

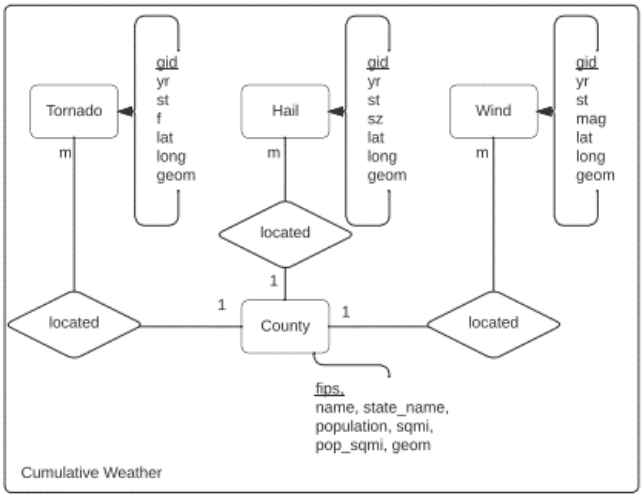
29 Attributes including:
Year (yr)
Rating (sz)
Square Miles (sqmi)

1955-2020-wind-aspath

Contains data for all wind storms in the United States (50 states and DC) from 1955-2020.
Provider: NOAA
Updated: March 15, 2022
Accessed: April 12, 2022
Metadata: http://www.spc.noaa.gov/wcm/#data
URL: Storm Prediction Center Severe Weather GIS (noaa.gov)

29 Attributes including:
Year (yr)
Rating (mag)
Square Miles (sqmi)

Data sources used are described on the left, and below are major attributes and relationships used for the analysis in the rest of the document.



The first step is to identify the location of each weather event. Joining the Esri's USA_Counties dataset to the 1950-2020-torn-aspath, 1955-2020-hail-aspath, and 1955-2020-wind-aspath (referred to as counties, tornado, hail, and wind datasets respectively) provides the state and county information per weather event. As the hail and wind datasets were only collected as of January 1955, the tornado dataset is restricted to the same timeframe.

```
CREATE TABLE county_tornado AS
    SELECT
      tor.*, cnty.name, cnty.state_name, cnty.cnty_fips, cnty.population,
        cnty.pop_sqmi, cnty.sqmi, cnty.shape_area
        FROM "1950-2020-torn-aspath" AS tor
        JOIN usa_counties AS cnty
        ON ST_Intersects(tor.geom, cnty.geom)
        WHERE yr >= 1955;
SELECT * FROM county_tornado;
```

Figure 1 Tornado Join County Query

```
CREATE TABLE county_hail AS
    SELECT
      hail.*, cnty.name, cnty.state_name, cnty.cnty_fips, cnty.population,
        cnty.pop_sqmi, cnty.sqmi, cnty.shape_area
        FROM "1955-2020-hail-aspath" AS hail
        JOIN usa_counties AS cnty
        ON ST_Intersects(hail.geom, cnty.geom);
SELECT * FROM county_hail;
```

Figure 3 Hail Join County Query

```
CREATE TABLE county_wind AS
    SELECT
      wind.*, cnty.name, cnty.state_name, cnty.cnty_fips, cnty.population,
        cnty.pop_sqmi, cnty.sqmi, cnty.shape_area
        FROM "1955-2020-wind-aspath" AS wind
        JOIN usa_counties AS cnty
        ON ST_Intersects(wind.geom, cnty.geom);
SELECT * FROM county_wind;
```

Figure 2 Wind Join County Query

The results of these queries are shown in Table 1, Table 2, and Table 3, of the Results section below.

As you can see in Figure 1, Figure 3, and Figure 2, the queries are almost identical for the data sets. Therefore, unless specified otherwise, all queries are identically repeated for tornado, hail and wind datasets and the one shown should be considered an example for all three from here out.

Common functions for weather phenomena

Next, run some analysis to see some details about each weather phenomena individually; before the data points are combined. Figure 4 to the right shows four different statistics that are of interest. The results of the queries are shown in the Results section below for Table 4 through Table 18.

```
1  /*County Weather Data Analysis and Facts*/
2  SELECT "name", state_name, count("name") AS "tornado"
3    FROM county_tornado
4    GROUP BY state_name, "name"
5    ORDER BY tornado DESC;
6
7  SELECT state_name, count(*) AS "hail", count(*)/sum(sqmi) AS "hail/sqmi"
8    FROM county_hail
9    GROUP BY state_name
10   ORDER BY hail DESC;
11 SELECT state_name, count(*) AS "hail", count(*)/sum(sqmi) AS "hail/sqmi"
12   FROM county_hail
13   GROUP BY state_name
14   ORDER BY "hail/sqmi" DESC;
15
16 SELECT yr, state_name, count(*) AS "wind/year", count(*)/sum(sqmi) AS "wind/sqmi"
17   FROM county_wind
18   GROUP BY yr, state_name
19   ORDER BY "wind/year" DESC;
20
21 SELECT state_name, count(*) AS wind,
22        CONCAT(LEFT(CAST(yr AS varchar(4)), 3), '0s') AS decade
23    FROM county_wind
24    GROUP BY LEFT(CAST(yr AS varchar(4)), 3), state_name
25    ORDER BY wind DESC;
```

Figure 4 County Weather Data Analysis and Facts

The first query (lines 2-5) counts the number of events per county and displays the county name, state, and total phenomena count descending from largest to smallest event. See Table 4 through Table 6 for result analysis.

Next is the number of weather events per square mile of the state. This removes any bias artificially inflating the ranking of states like Texas due to their large landmass. Lines 7-10 show this calculation sorted by largest number weather events, while lines 11-14 show the same calculation sorted by the number of incidents per square mile. See Table 7 through Table 11 for result analysis.

The query on lines 16-19 counts the number of weather events per year for each state and displays the states and years from largest to smallest number of occurrences. See Table 13 through Table 15 for result analysis.

The final query (lines 21-25) counts the number of events in each state per decade. The final values are then sorted by the number of weather events. See Table 16 through Table 18 for result analysis.

It is possible that all the events in a state happen in just a few counties, so break down the last query into the individual counties. Similar to the first query in Figure 4, this table creates a table with the individual county's weather count, but aggregates it for the decade. The

```
CREATE TABLE decade_hail AS
    SELECT "name", state_name, count("name") AS hail,
           CONCAT(LEFT(CAST(yr AS varchar(4)), 3), '0s') AS decade
       FROM county_hail
       GROUP BY LEFT(CAST(yr AS varchar(4)), 3), "name", state_name
       ORDER BY hail DESC;
SELECT * FROM decade_hail;
```

Figure 5 Number of Weather Events per Decade by County

third and fifth row of code contain a concatenation/casting statement. This tells the query to ignore the final yearly digit and groups all the years together, then reapplies the 0 for the label (example: 1961-1969 are trunkated to 196, merged toghether, then relabeled to the final format of 1960s). See Table 20 Table 21 on page 5 for the results.

Is seems to be some trends in the weather when looking at one type at a time, but is there a connection for all three? Grouping by decade, earliest to latest, the data joins the tornado data to the hail data to the wind data. This officially ends the duplicate tables. An example of the table created by this information is shown in Table 22.

```
/*Combine the decade tables to get total disasters*/
CREATE TABLE disasters AS
    SELECT
      torn.decade, torn.name, torn.state_name,torn.tornado,
        decade_hail.hail, decade_wind.wind
        FROM ((decade_tornado AS torn
        INNER JOIN decade_hail
            ON torn.name = decade_hail.name
            AND torn.state_name = decade_hail.state_name
            AND torn.decade = decade_hail.decade)
        INNER JOIN decade_wind
            ON torn.name = decade_wind.name
            AND torn.state_name = decade_wind.state_name
            AND torn.decade = decade_wind.decade)
            ORDER BY torn.decade ASC;
SELECT * FROM disasters;

SELECT decade, "name", state_name, SUM(tornado + hail + wind) AS disasters
    FROM disasters
    GROUP BY decade, "name", state_name
    ORDER BY disasters DESC;
```

Figure 6 All Weather per County by Decade

The next query combines the phenomena and accounts for them equally, as any one, regardless of category could cause damage and lead to an insurance claim. Table 23 shows this combined query ordered descending by total event count.

There are so many counties that looking at the full list provided in the previous query is hard to sort through and a bit daunting. Instead, the next query takes just the top 10 weather counts per decade. This leaves us with only 70 rows of data and the opportunity to analyze and identify any patterns. Table 24 Top 10 Counties with Weather Per Decade shows the full results of this query.

```
/*View the Top 10 Counties with highest disaster count per decade*/
CREATE TABLE top10 AS
    SELECT *
    FROM (
         select
            ROW_NUMBER() OVER (PARTITION BY D.decade ORDER BY SUM(tornado + hail + wind) DESC) AS year_rank,
            decade, "name", state_name, SUM(D.tornado + D.hail + D.wind) AS disasters
         FROM disasters AS D
        GROUP BY D.decade, D.name, D.state_name
         ) disasters
    WHERE disasters.year_rank <= 10;
SELECT * FROM top10;
```

Figure 7 Filtering Weather to Top 10 Counties per Decade

Tarrant County Texas

```
/*Tarrant County, Texas information over the years*/
CREATE TABLE tarrant AS
    SELECT decade, "name" AS county, state_name,
            SUM(tornado + hail + wind) AS weather_events
        FROM disasters
        WHERE state_name = 'Texas'
            AND ("name" = 'Tarrant County'
                OR "name" = 'Dallas County'
                OR "name" = 'Parker County'
                OR "name" = 'Wise County'
                OR "name" = 'Denton County'
                OR "name" = 'Hood County'
                OR "name" = 'Johnson County'
                OR "name" = 'Ellis County')
        GROUP BY decade, county, state_name;
SELECT * FROM tarrant;
```

Figure 8 Tarrant County Weather Phenomena

Fort Worth Texas, the largest city in Tarrant County that along with several suburban cities makes up a majority stake in the DFW metropolitan area. The weather does not care about the arbitrary county lines so let's also look at the 7 counties that share a boundary with Tarrant County. As with the previous queries, sort by decade oldest to newest. To view these results, see Table 25.

```
/*Total number of weather events in DFW per decade*/
SELECT decade, SUM(weather_events) AS weather_events
        FROM tarrant
        GROUP BY decade
        ORDER BY decade ASC;
```

Figure 9 Summarized Tarrant County Weather

Table 28 show the results of the county breakdown for the Tarrant County metropolitan area. This breakdown orders each county by the number of weather events in a decade. The partition totals each county's weather and allows for sorting by the year.

```
/*View top county per decade*/
CREATE TABLE tarrant_decade AS
    SELECT *
    FROM (
         SELECT
            ROW_NUMBER() OVER (PARTITION BY D.decade ORDER BY weather_events DESC) AS year_rank,
            decade, county, weather_events AS disasters
         FROM tarrant AS D
        GROUP BY D.decade, D.county, weather_events
         ) tarrant
    WHERE tarrant.year_rank <= 10;
SELECT * FROM tarrant_decade;
```

Figure 10 Ranked County Weather per Decade

Results

Table 1 County Tornado Data Results

gid	om	yr	mo	dy	date	time	tz	st	stf	stn	mag	inj	fat	loss	closs	slat	slon	elat	elon	len	wid	fc	geom	name	state_na	cnty_fips	populati	pop_sqm	sqmi	shape_ar
52631	565	2009	5	23	########	12:55:00	3	AL	1	0	0	0	0	0.01	0	32.6967	-86.4258	32.7003	-86.4306	0.37	50	0	01050000	Autauga	Alabama	1	58224	96.3	604.37	0.15026
54595	355901	2011	12	22	########	14:02:00	3	AL	1	144	0	0	0	0.065	0	32.6203	-86.5478	32.7019	-86.4059	10.18	100	0	01050000	Autauga	Alabama	1	58224	96.3	604.37	0.15026
54675	289678	2011	2	28	########	17:05:00	3	AL	1	6	0	0	0	0.077	0	32.5699	-86.4854	32.5546	-86.3329	8.94	200	0	01050000	Autauga	Alabama	1	58224	96.3	604.37	0.15026
22997	896	1983	12	6	########	2:51:00	3	AL	1	41	3	19	1	6	0	32.4	-87.07	32.55	-86.9	13	500	0	01050000	Autauga	Alabama	1	58224	96.3	604.37	0.15026
47086	518	2005	11	28	########	18:41:00	3	AL	1	79	0	0	0	0.03	0	32.43	-86.72	32.47	-86.63	5.4	150	0	01050000	Autauga	Alabama	1	58224	96.3	604.37	0.15026
54888	311699	2011	4	15	########	20:25:00	3	AL	1	48	1	0	0	0.085	0	32.3526	-86.8712	32.404	-86.7848	6.2	800	0	01050000	Autauga	Alabama	1	58224	96.3	604.37	0.15026
3616	735	1957	9	18	########	14:45:00	3	AL	1	24	0	0	0	4	0	32.4	-86.87	32.52	-86.72	11.9	100	0	01050000	Autauga	Alabama	1	58224	96.3	604.37	0.15026
6921	136	1963	4	29	########	17:30:00	3	AL	1	16	2	0	0	5	0	32.48	-86.77	32.6	-86.65	10.6	600	0	01050000	Autauga	Alabama	1	58224	96.3	604.37	0.15026
16039	37	1975	1	10	########	16:45:00	3	AL	1	9	1	0	0	4	0	32.47	-86.48	32.4701	-86.4799	0.1	10	0	01050000	Autauga	Alabama	1	58224	96.3	604.37	0.15026
24757	2	1985	1	31	########	16:52:00	3	AL	1	1	0	0	0	1	0	32.43	-86.53	32.4301	-86.5299	0.5	50	0	01050000	Autauga	Alabama	1	58224	96.3	604.37	0.15026
39976	304	1999	5	7	5/7/1999	12:06:00	3	AL	1	16	0	0	0	0.001	0	32.5	-86.45	32.5	-86.45	0.5	0	0	01050000	Autauga	Alabama	1	58224	96.3	604.37	0.15026
41784	542	2001	11	24	########	15:54:00	3	AL	1	45	1	0	0	0.04	0	32.48	-86.58	32.63	-86.52	9.8	50	0	01050000	Autauga	Alabama	1	58224	96.3	604.37	0.15026
45299	669	2004	11	24	########	6:24:00	3	AL	1	42	2	1	0	0.9	0	32.38	-86.67	32.47	-86.55	9.7	500	0	01050000	Autauga	Alabama	1	58224	96.3	604.37	0.15026
47886	295	2005	7	6	7/6/2005	12:27:00	3	AL	1	29	1	0	0	0.01	0	32.5	-86.67	32.5	-86.67	0.3	30	0	01050000	Autauga	Alabama	1	58224	96.3	604.37	0.15026
47887	301	2005	7	6	7/6/2005	12:36:00	3	AL	1	30	0	0	0	0.003	0	32.62	-86.68	32.62	-86.7	0.2	25	0	01050000	Autauga	Alabama	1	58224	96.3	604.37	0.15026
47892	296	2005	7	6	7/6/2005	13:56:00	3	AL	1	35	0	0	0	0.002	0	32.42	-86.55	32.42	-86.55	0.2	25	0	01050000	Autauga	Alabama	1	58224	96.3	604.37	0.15026
49447	43	2007	2	13	########	18:22:00	3	AL	1	7	1	0	0	0.01	0	32.47	-86.75	32.45	-86.74	1.1	200	0	01050000	Autauga	Alabama	1	58224	96.3	604.37	0.15026
50596	209	2008	2	17	########	14:58:00	3	AL	1	0	3	50	0	10.1	0	32.4	-86.48	32.58	-86.37	14.65	440	0	01050000	Autauga	Alabama	1	58224	96.3	604.37	0.15026
53389	1244	2010	11	30	########	9:57:00	3	AL	1	35	1	0	0	0.058	0	32.4281	-86.5065	32.4615	-86.4153	5.8	150	0	01050000	Autauga	Alabama	1	58224	96.3	604.37	0.15026
54890	311702	2011	4	15	########	20:29:00	3	AL	1	50	2	0	0	0.309	0	32.3882	-86.8329	32.5132	-86.7471	9.98	800	0	01050000	Autauga	Alabama	1	58224	96.3	604.37	0.15026
61149	615791	2017	10	7	########	18:31:00	3	AL	1	0	1	0	0	0	0	32.4015	-86.653	32.4471	-86.6933	3.93	625	0	01050000	Autauga	Alabama	1	58224	96.3	604.37	0.15026
62760	616979	2018	12	1	########	15:49:00	3	AL	1	0	0	0	0	0	0	32.6326	-86.7415	32.6326	-86.7371	0.26	100	0	01050000	Autauga	Alabama	1	58224	96.3	604.37	0.15026
62851	615921	2018	2	7	2/7/2018	7:04:00	3	AL	1	0	0	0	0	0	0	32.5603	-86.7174	32.566	-86.6842	1.97	150	0	01050000	Autauga	Alabama	1	58224	96.3	604.37	0.15026
63792	617039	2019	1	19	########	13:47:00	3	AL	1	0	1	0	0	0	0	32.3481	-86.9096	32.3981	-86.8233	6.13	75	0	01050000	Autauga	Alabama	1	58224	96.3	604.37	0.15026
63793	617040	2019	1	19	########	14:04:00	3	AL	1	0	1	2	0	0	0	32.4847	-86.7275	32.5467	-86.59	9.08	400	0	01050000	Autauga	Alabama	1	58224	96.3	604.37	0.15026
63885	617077	2019	3	3	3/3/2019	13:19:00	3	AL	1	0	0	0	0	0	0	32.471	-86.747	32.4762	-86.7385	0.62	70	0	01050000	Autauga	Alabama	1	58224	96.3	604.37	0.15026
14119	85	1973	3	16	########	7:30:00	3	AL	1	2	2	0	0	5	0	32.7	-86.5	32.8	-86.38	9.7	77	0	01050000	Autauga	Alabama	1	58224	96.3	604.37	0.15026
17813	79	1977	3	29	########	15:00:00	3	AL	1	2	2	2	0	5	0	32.58	-86.52	32.7	-86.2	20.5	50	0	01050000	Autauga	Alabama	1	58224	96.3	604.37	0.15026
21966	5	1982	1	3	1/3/1982	17:22:00	3	AL	1	2	2	12	0	5	0	32.68	-86.57	32.78	-86.48	8	80	0	01050000	Autauga	Alabama	1	58224	96.3	604.37	0.15026
21967	6	1982	1	3	1/3/1982	17:25:00	3	AL	1	3	1	0	0	3	0	32.67	-86.52	32.6701	-86.5199	1.5	77	0	01050000	Autauga	Alabama	1	58224	96.3	604.37	0.15026
16940	94	1976	3	12	########	20:30:00	3	AL	1	4	3	4	0	6	0	32.58	-86.92	32.57	-86.63	16.5	100	0	01050000	Autauga	Alabama	1	58224	96.3	604.37	0.15026
22107	223	1982	4	26	########	15:10:00	3	AL	1	16	1	0	0	5	0	32.55	-86.52	32.63	-86.32	12	200	0	01050000	Autauga	Alabama	1	58224	96.3	604.37	0.15026
40646	605	2000	12	16	########	16:55:00	3	AL	1	42	0	0	0	0	0	32.55	-86.43	32.55	-86.43	0.2	20	0	01050000	Autauga	Alabama	1	58224	96.3	604.37	0.15026
45296	256	2004	11	24	########	5:49:00	3	AL	1	40	2	0	0	0.63	0	32.6	-86.9	33	-86.18	49	1400	0	01050000	Autauga	Alabama	1	58224	96.3	604.37	0.15026
54884	310539	2011	4	15	########	19:48:00	3	AL	1	44	1	0	0	0.44	0	32.5095	-86.668	32.6037	-86.5918	7.88	200	0	01050000	Autauga	Alabama	1	58224	96.3	604.37	0.15026
54885	310540	2011	4	15	########	19:56:00	3	AL	1	45	1	0	0	0.458	0	32.5639	-86.6064	32.705	-86.4479	13.42	200	0	01050000	Autauga	Alabama	1	58224	96.3	604.37	0.15026
54886	310541	2011	4	15	########	20:06:00	3	AL	1	46	0	0	0	0.04	0	32.6144	-86.5121	32.6634	-86.4631	4.43	50	0	01050000	Autauga	Alabama	1	58224	96.3	604.37	0.15026
54893	311717	2011	4	15	########	21:47:00	3	AL	1	53	3	4	3	1.24	0	32.5803	-86.5818	32.6126	-86.4269	9.29	400	0	01050000	Autauga	Alabama	1	58224	96.3	604.37	0.15026
56586	374293	2012	3	2	3/2/2012	21:15:00	3	AL	1	0	1	0	0	0	0	32.5486	-87.1531	32.635	-86.8455	18.9	700	0	01050000	Autauga	Alabama	1	58224	96.3	604.37	0.15026
63870	617169	2019	3	14	########	19:44:00	3	AL	1	0	1	0	0	0	0	32.5282	-86.788	32.5665	-86.6841	7.09	250	0	01050000	Autauga	Alabama	1	58224	96.3	604.37	0.15026
48284	1036	2006	11	15	########	8:48:00	3	AL	1	53	0	0	0	0.05	0	31.07	-87.77	31.08	-87.75	1.14	50	0	01050000	Baldwin	Alabama	3	227660	139.4	1633.14	0.3984
6193	70	1962	3	31	########	8:00:00	3	AL	1	11	2	0	0	5	0	30.3	-87.7	30.37	-87.52	11.9	100	0	01050000	Baldwin	Alabama	3	227660	139.4	1633.14	0.3984
7268	693	1964	12	24	########	21:15:00	3	AL	1	23	2	3	0	4	0	30.5	-87.8	30.5001	-87.7999	2	100	0	01050000	Baldwin	Alabama	3	227660	139.4	1633.14	0.3984
8867	573	1966	11	10	########	11:10:00	3	AL	1	9	2	0	0	4	0	31	-87.8	31.05	-87.68	7.7	10	0	01050000	Baldwin	Alabama	3	227660	139.4	1633.14	0.3984
9443	854	1967	10	30	########	9:30:00	3	AL	1	15	2	1	0	4	0	30.25	-87.65	30.4	-87.78	13.1	10	0	01050000	Baldwin	Alabama	3	227660	139.4	1633.14	0.3984
9459	876	1967	12	10	########	4:10:00	3	AL	1	20	2	0	0	5	0	30.3	-87.77	30.33	-87.53	14.2	10	0	01050000	Baldwin	Alabama	3	227660	139.4	1633.14	0.3984
11510	388	1969	7	8	7/8/1969	17:30:00	3	AL	1	9	0	0	0	2	0	30.7	-87.8	30.7001	-87.7999	0.1	10	0	01050000	Baldwin	Alabama	3	227660	139.4	1633.14	0.3984
11539	529	1969	8	22	########	16:15:00	3	AL	1	11	1	0	0	1	0	30.7	-87.8	30.7001	-87.8999	0.1	10	0	01050000	Baldwin	Alabama	3	227660	139.4	1633.14	0.3984

Dataset has 31 attributes and 73,054 records. Query to generate is shown in Figure 1 Tornado Join County Query above on page 4.

Table 2 County Hail Data Results

gid	om	yr	mo	dy	date	time	tz	st	stf	stn	mag	inj	fat	loss	closs	slat	slon	elat	elon	len	wid	geom	name	state_nam	cnty_fips	populatio	pop_sqmi	sqmi	shape_area
10598	126	1971	4	23	4/23/1971	14:45:00	3	AL	1	14	2	0	0	0.00E+00	0.00E+00	32.5	-86.58	32.5001	-86.5799	0	0	01050000	Autauga C	Alabama	1	58224	96.3	604.37	0.150256142
14618	1441	1974	7	15	7/15/1974	15:45:00	3	AL	1	45	1	0	0	0.00E+00	0.00E+00	32.47	-86.48	32.4701	-86.4799	0	0	01050000	Autauga C	Alabama	1	58224	96.3	604.37	0.150256142
24729	492	1982	4	26	4/26/1982	15:00:00	3	AL	1	31	2	0	0	0.00E+00	0.00E+00	32.47	-86.48	32.4701	-86.4799	0	0	01050000	Autauga C	Alabama	1	58224	96.3	604.37	0.150256142
24737	500	1982	4	26	4/26/1982	16:10:00	3	AL	1	39	1.75	0	0	0.00E+00	0.00E+00	32.53	-86.72	32.5301	-86.7199	0	0	01050000	Autauga C	Alabama	1	58224	96.3	604.37	0.150256142
41989	803	1988	5	10	5/10/1988	7:20:00	3	AL	1	51	1.25	0	0	0.00E+00	0.00E+00	32.57	-86.48	32.5701	-86.4799	0	0	01050000	Autauga C	Alabama	1	58224	96.3	604.37	0.150256142
81626	751	1996	3	18	3/18/1996	18:02:00	3	AL	1	55	1.75	0	0	0	0.02	0.00E+00	32.47	-86.48	32.4701	-86.4799	0	0	01050000	Autauga C	Alabama	1	58224	96.3	604.37	0.150256142
81637	762	1996	3	18	3/18/1996	19:50:00	3	AL	1	66	0.75	0	0	0	0.01	0.00E+00	32.5	-86.48	32.5001	-86.4799	0	0	01050000	Autauga C	Alabama	1	58224	96.3	604.37	0.150256142
81641	766	1996	3	18	3/18/1996	20:18:00	3	AL	1	70	0.75	0	0	0	0.01	0.00E+00	32.47	-86.48	32.4701	-86.4799	0	0	01050000	Autauga C	Alabama	1	58224	96.3	604.37	0.150256142
83466	2491	1996	4	29	4/29/1996	12:55:00	3	AL	1	101	1.25	0	0	0	0.01	0.00E+00	32.47	-86.48	32.4701	-86.4799	0	0	01050000	Autauga C	Alabama	1	58224	96.3	604.37	0.150256142
84255	3864	1996	5	24	5/24/1996	15:15:00	3	AL	1	110	0.75	0	0	0	0.01	0.00E+00	32.47	-86.48	32.4701	-86.4799	0	0	01050000	Autauga C	Alabama	1	58224	96.3	604.37	0.150256142
98431	499	1998	2	17	2/17/1998	4:20:00	3	AL	1	13	0.75	0	0	0.00E+00	0.00E+00	32.47	-86.48	32.4701	-86.4799	0	0	01050000	Autauga C	Alabama	1	58224	96.3	604.37	0.150256142
99401	991	1998	3	8	3/8/1998	15:21:00	3	AL	1	44	0.75	0	0	0.00E+00	0.00E+00	32.47	-86.48	32.4701	-86.4799	0	0	01050000	Autauga C	Alabama	1	58224	96.3	604.37	0.150256142
100194	2950	1998	4	30	4/30/1998	15:03:00	3	AL	1	213	0.75	0	0	0.00E+00	0.00E+00	32.47	-86.48	32.4701	-86.4799	0	0	01050000	Autauga C	Alabama	1	58224	96.3	604.37	0.150256142
103043	3161	1998	5	3	5/3/1998	14:00:00	3	AL	1	222	0.88	0	0	0.00E+00	0.00E+00	32.52	-86.48	32.5201	-86.4799	0	0	01050000	Autauga C	Alabama	1	58224	96.3	604.37	0.150256142
111587	3521	1999	5	13	5/13/1999	12:08:00	3	AL	1	94	1	0	0	0.00E+00	0.00E+00	32.55	-86.83	32.5501	-86.8299	0	0	01050000	Autauga C	Alabama	1	58224	96.3	604.37	0.150256142
111601	3535	1999	5	13	5/13/1999	13:00:00	3	AL	1	97	1	0	0	0.00E+00	0.00E+00	32.47	-86.48	32.4701	-86.4799	0	0	01050000	Autauga C	Alabama	1	58224	96.3	604.37	0.150256142
111603	3537	1999	5	13	5/13/1999	13:01:00	3	AL	1	98	1	0	0	0.00E+00	0.00E+00	32.47	-86.48	32.4701	-86.4799	0	0	01050000	Autauga C	Alabama	1	58224	96.3	604.37	0.150256142
119018	271	2000	12	16	12/16/2000	16:45:00	3	AL	1	271	1.75	0	0	0	0.004	0.00E+00	32.5	-86.58	32.5001	-86.5799	0	0	01050000	Autauga C	Alabama	1	58224	96.3	604.37	0.150256142
119637	88	2000	3	10	3/10/2000	18:55:00	3	AL	1	88	1.25	0	0	0	0.003	0.00E+00	32.47	-86.48	32.4701	-86.4799	0	0	01050000	Autauga C	Alabama	1	58224	96.3	604.37	0.150256142
120503	39	2000	3	3	3/3/2000	18:38:00	3	AL	1	39	1.25	0	0	0	0.005	0.00E+00	32.47	-86.48	32.4701	-86.4799	0	0	01050000	Autauga C	Alabama	1	58224	96.3	604.37	0.150256142
121955	127	2000	4	2	4/2/2000	17:36:00	3	AL	1	127	0.88	0	0	0	0.005	0.00E+00	32.47	-86.48	32.4701	-86.4799	0	0	01050000	Autauga C	Alabama	1	58224	96.3	604.37	0.150256142
126933	198	2000	7	20	7/20/2000	17:10:00	3	AL	1	198	0.75	0	0	0.00E+00	0.00E+00	32.47	-86.48	32.4701	-86.4799	0	0	01050000	Autauga C	Alabama	1	58224	96.3	604.37	0.150256142
132346	49	2001	4	3	4/3/2001	4:30:00	3	AL	1	49	0.75	0	0	0.00E+00	0.00E+00	32.45	-86.78	32.4501	-86.7799	0	0	01050000	Autauga C	Alabama	1	58224	96.3	604.37	0.150256142
132362	30	2001	4	3	4/3/2001	6:20:00	3	AL	1	30	0.88	0	0	0.00E+00	0.00E+00	32.47	-86.48	32.4701	-86.4799	0	0	01050000	Autauga C	Alabama	1	58224	96.3	604.37	0.150256142
134217	83	2001	5	24	5/24/2001	19:30:00	3	AL	1	83	0.88	0	0	0.00E+00	0.00E+00	32.47	-86.48	32.4701	-86.4799	0	0	01050000	Autauga C	Alabama	1	58224	96.3	604.37	0.150256142
145691	63	2002	4	30	4/30/2002	12:41:00	3	AL	1	63	0.75	0	0	0.00E+00	0.00E+00	32.43	-86.67	32.4301	-86.6699	0	0	01050000	Autauga C	Alabama	1	58224	96.3	604.37	0.150256142
147918	103	2002	5	4	5/4/2002	12:00:00	3	AL	1	103	1.75	0	0	0	0.004	0.00E+00	32.47	-86.48	32.4701	-86.4799	0	0	01050000	Autauga C	Alabama	1	58224	96.3	604.37	0.150256142
153236	214	2002	8	20	8/20/2002	18:56:00	3	AL	1	214	0.75	0	0	0.00E+00	0.00E+00	32.47	-86.48	32.4701	-86.4799	0	0	01050000	Autauga C	Alabama	1	58224	96.3	604.37	0.150256142
155356	59	2003	3	14	3/14/2003	20:52:00	3	AL	1	59	0.75	0	0	0.00E+00	0.00E+00	32.47	-86.48	32.4701	-86.4799	0	0	01050000	Autauga C	Alabama	1	58224	96.3	604.37	0.150256142
156936	152	2003	4	25	4/25/2003	17:01:00	3	AL	1	152	1	0	0	0.00E+00	0.00E+00	32.38	-86.48	32.3801	-86.4799	0	0	01050000	Autauga C	Alabama	1	58224	96.3	604.37	0.150256142
171406	25	2004	4	7	4/7/2004	19:14:00	3	AL	1	25	1.75	0	0	0	0.02	0.00E+00	32.58	-86.72	32.5801	-86.7199	0	0	01050000	Autauga C	Alabama	1	58224	96.3	604.37	0.150256142
171416	27	2004	4	7	4/7/2004	22:04:00	3	AL	1	27	0.75	0	0	0.00E+00	0.00E+00	32.47	-86.48	32.4701	-86.4799	0	0	01050000	Autauga C	Alabama	1	58224	96.3	604.37	0.150256142
171417	28	2004	4	7	4/7/2004	22:23:00	3	AL	1	28	1.75	0	0	0	0.03	0.00E+00	32.47	-86.48	32.4701	-86.4799	0	0	01050000	Autauga C	Alabama	1	58224	96.3	604.37	0.150256142
183242	724	2005	3	22	3/22/2005	9:41:00	3	AL	1	93	0.75	0	0	0.00E+00	0.00E+00	32.55	-86.88	32.5501	-86.8799	0	0	01050000	Autauga C	Alabama	1	58224	96.3	604.37	0.150256142
183621	1103	2005	3	26	3/26/2005	18:27:00	3	AL	1	142	0.88	0	0	0.00E+00	0.00E+00	32.43	-86.67	32.4301	-86.6699	0	0	01050000	Autauga C	Alabama	1	58224	96.3	604.37	0.150256142
183658	1140	2005	3	27	3/27/2005	11:21:00	3	AL	1	154	0.75	0	0	0.00E+00	0.00E+00	32.47	-86.48	32.4701	-86.4799	0	0	01050000	Autauga C	Alabama	1	58224	96.3	604.37	0.150256142
184976	2775	2005	4	21	4/21/2005	14:50:00	3	AL	1	229	1	0	0	0.001	0.00E+00	32.47	-86.48	32.4701	-86.4799	0	0	01050000	Autauga C	Alabama	1	58224	96.3	604.37	0.150256142
185541	3342	2005	4	22	4/22/2005	18:42:00	3	AL	1	334	0.75	0	0	0.001	0.00E+00	32.47	-86.57	32.4701	-86.5699	0	0	01050000	Autauga C	Alabama	1	58224	96.3	604.37	0.150256142
188276	3705	2005	5	5	5/5/2005	17:40:00	3	AL	1	358	0.75	0	0	0.00E+00	0.00E+00	32.57	-86.72	32.5701	-86.7199	0	0	01050000	Autauga C	Alabama	1	58224	96.3	604.37	0.150256142
199225	5116	2006	4	19	4/19/2006	21:14:00	3	AL	1	228	1	0	0	0.00E+00	0.00E+00	32.58	-86.47	32.5801	-86.4699	0	0	01050000	Autauga C	Alabama	1	58224	96.3	604.37	0.150256142
199229	5120	2006	4	19	4/19/2006	21:28:00	3	AL	1	231	0.75	0	0	0.00E+00	0.00E+00	32.47	-86.48	32.4701	-86.4799	0	0	01050000	Autauga C	Alabama	1	58224	96.3	604.37	0.150256142
202117	3805	2006	4	8	4/8/2006	8:16:00	3	AL	1	122	1.75	0	0	0.00E+00	0.00E+00	32.47	-86.48	32.4701	-86.4799	0	0	01050000	Autauga C	Alabama	1	58224	96.3	604.37	0.150256142

Dataset has 30 attributes and 370,175 records. Query to generate is shown in Figure 3 Hail Join County Query above on page 4.

Table 3 County Wind Data Results

gid	om	yr	mo	dy	date	time	tz	st	stf	stn	mag	inj	fat	loss	closs	slat	slon	elat	elon	len	wid	mt	geom	name	state_nam	cnty_fips	populatio	pop_sqmi	sqmi	shape_area
6437	105	1964	4	13	4/13/1964	10:35:00	3	AL	1	5	0.00E+00	0	0	0.00E+00	0.00E+00	32.38	-86.5	32.3801	-86.4999	0	0	NULL	01050000	Autauga C	Alabama	1	58224	96.3	604.37	0.150256142
10401	1516	1968	12	28	12/28/1968	0:00:00	3	AL	1	57	0.00E+00	0	0	0.00E+00	0.00E+00	32.5	-86.58	32.5001	-86.5799	0	0	NULL	01050000	Autauga C	Alabama	1	58224	96.3	604.37	0.150256142
17886	244	1973	4	24	4/24/1973	17:30:00	3	AL	1	17	0.00E+00	0	0	0.00E+00	0.00E+00	32.65	-86.7	32.6501	-86.6999	0	0	NULL	01050000	Autauga C	Alabama	1	58224	96.3	604.37	0.150256142
18091	499	1973	5	23	5/23/1973	22:00:00	3	AL	1	50	0.00E+00	0	0	0.00E+00	0.00E+00	32.47	-86.47	32.4701	-86.4699	0	0	NULL	01050000	Autauga C	Alabama	1	58224	96.3	604.37	0.150256142
19629	41	1974	1	28	1/28/1974	12:04:00	3	AL	1	7	0.00E+00	0	0	0.00E+00	0.00E+00	32.47	-86.47	32.4701	-86.4699	0	0	NULL	01050000	Autauga C	Alabama	1	58224	96.3	604.37	0.150256142
30510	171	1979	4	9	4/9/1979	1:40:00	3	AL	1	19	0.00E+00	0	0	0.00E+00	0.00E+00	32.47	-86.48	32.4701	-86.4799	0	0	NULL	01050000	Autauga C	Alabama	1	58224	96.3	604.37	0.150256142
41471	4850	1983	12	3	12/3/1983	18:45:00	3	AL	1	184	0.00E+00	0	0	0.00E+00	0.00E+00	32.43	-86.67	32.4301	-86.6699	0	0	NULL	01050000	Autauga C	Alabama	1	58224	96.3	604.37	0.150256142
41512	4891	1983	12	6	12/6/1983	3:45:00	3	AL	1	196	0.00E+00	0	0	0.00E+00	0.00E+00	32.53	-86.63	32.5301	-86.6299	0	0	NULL	01050000	Autauga C	Alabama	1	58224	96.3	604.37	0.150256142
46210	3475	1984	11	10	11/10/1984	15:20:00	3	AL	1	152	0.00E+00	0	0	0.00E+00	0.00E+00	32.47	-86.48	32.4701	-86.4799	0	0	NULL	01050000	Autauga C	Alabama	1	58224	96.3	604.37	0.150256142
47687	1167	1984	5	3	5/3/1984	18:09:00	3	AL	1	86	0.00E+00	0	0	0.00E+00	0.00E+00	32.47	-86.48	32.4701	-86.4799	0	0	NULL	01050000	Autauga C	Alabama	1	58224	96.3	604.37	0.150256142
50465	401	1985	4	5	4/5/1985	18:15:00	3	AL	1	63	0.00E+00	0	0	0.00E+00	0.00E+00	32.67	-86.47	32.6701	-86.4699	0	0	NULL	01050000	Autauga C	Alabama	1	58224	96.3	604.37	0.150256142
50470	407	1985	4	5	4/5/1985	18:25:00	3	AL	1	65	0.00E+00	0	0	0.00E+00	0.00E+00	32.47	-86.48	32.4701	-86.4799	0	0	NULL	01050000	Autauga C	Alabama	1	58224	96.3	604.37	0.150256142
52717	3196	1985	8	16	8/16/1985	13:45:00	3	AL	1	172	0.00E+00	0	0	0.00E+00	0.00E+00	32.47	-86.58	32.4701	-86.5799	0	0	NULL	01050000	Autauga C	Alabama	1	58224	96.3	604.37	0.150256142
57958	4191	1987	12	15	12/15/1987	4:00:00	3	AL	1	110	0.00E+00	0	0	3	0.00E+00	32.47	-86.48	32.4701	-86.4799	0	0	NULL	01050000	Autauga C	Alabama	1	58224	96.3	604.37	0.150256142
59099	1255	1987	6	18	6/18/1987	14:25:00	3	AL	1	36	0.00E+00	0	0	0.00E+00	0.00E+00	32.47	-86.48	32.4701	-86.4799	0	0	NULL	01050000	Autauga C	Alabama	1	58224	96.3	604.37	0.150256142
60542	1676	1987	7	1	7/1/1987	13:20:00	3	AL	1	42	0.00E+00	0	0	0.00E+00	0.00E+00	32.47	-86.48	32.4701	-86.4799	0	0	NULL	01050000	Autauga C	Alabama	1	58224	96.3	604.37	0.150256142
62690	285	1988	4	23	4/23/1988	12:25:00	3	AL	1	26	0.00E+00	0	0	0.00E+00	0.00E+00	32.47	-86.48	32.4701	-86.4799	0	0	NULL	01050000	Autauga C	Alabama	1	58224	96.3	604.37	0.150256142
66689	178	1989	3	15	3/15/1989	21:15:00	3	AL	1	24	0.00E+00	0	0	0.00E+00	0.00E+00	32.43	-86.67	32.4301	-86.6699	0	0	NULL	01050000	Autauga C	Alabama	1	58224	96.3	604.37	0.150256142
68750	2653	1989	6	14	6/14/1989	13:40:00	3	AL	1	143	0.00E+00	0	0	0.00E+00	0.00E+00	32.43	-86.67	32.4301	-86.6699	0	0	NULL	01050000	Autauga C	Alabama	1	58224	96.3	604.37	0.150256142
72088	232	1990	2	10	2/10/1990	3:28:00	3	AL	1	45	0.00E+00	0	0	0.00E+00	0.00E+00	32.47	-86.48	32.4701	-86.4799	0	0	NULL	01050000	Autauga C	Alabama	1	58224	96.3	604.37	0.150256142
75910	3559	1990	7	2	7/2/1990	13:55:00	3	AL	1	226	0.00E+00	0	0	0.00E+00	0.00E+00	32.47	-86.48	32.4701	-86.4799	0	0	NULL	01050000	Autauga C	Alabama	1	58224	96.3	604.37	0.150256142
78525	701	1991	3	29	3/29/1991	6:30:00	3	AL	1	28	0.00E+00	0	0	0.00E+00	0.00E+00	32.63	-86.48	32.6301	-86.4799	0	0	NULL	01050000	Autauga C	Alabama	1	58224	96.3	604.37	0.150256142
80990	2280	1991	5	5	5/5/1991	14:00:00	3	AL	1	116	0.00E+00	0	0	0.00E+00	0.00E+00	32.47	-86.48	32.4701	-86.4799	0	0	NULL	01050000	Autauga C	Alabama	1	58224	96.3	604.37	0.150256142
84874	355	1992	3	18	3/18/1992	18:15:00	3	AL	1	44	0.00E+00	0	0	0.00E+00	0.00E+00	32.43	-86.67	32.4301	-86.6699	0	0	NULL	01050000	Autauga C	Alabama	1	58224	96.3	604.37	0.150256142
84877	358	1992	3	18	3/18/1992	18:30:00	3	AL	1	47	0.00E+00	0	0	0.00E+00	0.00E+00	32.7	-86.48	32.7001	-86.4799	0	0	NULL	01050000	Autauga C	Alabama	1	58224	96.3	604.37	0.150256142
92570	2314	1993	6	11	6/11/1993	14:30:00	3	AL	1	36	0.00E+00	0	0	0.00E+00	0.00E+00	32.67	-86.47	32.6701	-86.4699	0	0	NULL	01050000	Autauga C	Alabama	1	58224	96.3	604.37	0.150256142
107227	994	1995	4	11	4/11/1995	10:00:00	3	AL	1	46	0.00E+00	0	0	4	0.00E+00	32.47	-86.48	32.4701	-86.4799	0	0	NULL	01050000	Autauga C	Alabama	1	58224	96.3	604.37	0.150256142
117180	531	1996	3	6	3/6/1996	4:55:00	3	AL	1	31	50	0	0	0.00E+00	0.00E+00	32.35	-86.53	32.3501	-86.5299	0	0	NULL	01050000	Autauga C	Alabama	1	58224	96.3	604.37	0.150256142
125081	167	1997	1	24	1/24/1997	7:20:00	3	AL	1	26	52	0	0	0.00E+00	0.00E+00	32.47	-86.48	32.4701	-86.4799	0	0	NULL	01050000	Autauga C	Alabama	1	58224	96.3	604.37	0.150256142
126209	1471	1997	4	22	4/22/1997	15:25:00	3	AL	1	113	0.00E+00	0	0	0.00E+00	0.00E+00	32.47	-86.48	32.4701	-86.4799	0	0	NULL	01050000	Autauga C	Alabama	1	58224	96.3	604.37	0.150256142
142295	3482	1998	6	5	6/5/1998	15:10:00	3	AL	1	126	50	0	0	0.03	0.00E+00	32.52	-86.55	32.5201	-86.5499	0	0	NULL	01050000	Autauga C	Alabama	1	58224	96.3	604.37	0.150256142
150502	5618	1999	6	30	6/30/1999	16:00:00	3	AL	1	170	50	0	0	0.01	0.00E+00	32.47	-86.48	32.4701	-86.4799	0	0	NULL	01050000	Autauga C	Alabama	1	58224	96.3	604.37	0.150256142
157483	90	2000	3	19	3/19/2000	16:30:00	3	AL	1	90	55	0	0	0.01	0.00E+00	32.52	-86.63	32.5201	-86.6299	0	0	NULL	01050000	Autauga C	Alabama	1	58224	96.3	604.37	0.150256142
158531	122	2000	4	3	4/3/2000	13:49:00	3	AL	1	122	55	0	0	0.002	0.00E+00	32.43	-86.67	32.4301	-86.6699	0	0	NULL	01050000	Autauga C	Alabama	1	58224	96.3	604.37	0.150256142
163774	226	2000	7	20	7/20/2000	17:10:00	3	AL	1	226	58	0	0	0.02	0.00E+00	32.47	-86.48	32.4701	-86.4799	0	0	NULL	01050000	Autauga C	Alabama	1	58224	96.3	604.37	0.150256142
165214	317	2000	8	10	8/10/2000	17:30:00	3	AL	1	317	50	0	0	0.01	0.00E+00	32.43	-86.67	32.4301	-86.6699	0	0	NULL	01050000	Autauga C	Alabama	1	58224	96.3	604.37	0.150256142
165248	330	2000	8	10	8/10/2000	19:00:00	3	AL	1	330	50	0	0	0.00E+00	0.00E+00	32.52	-86.63	32.5201	-86.6299	0	0	NULL	01050000	Autauga C	Alabama	1	58224	96.3	604.37	0.150256142
170059	101	2001	3	15	3/15/2001	1:15:00	3	AL	1	101	55	0	0	0.00E+00	0.00E+00	32.47	-86.48	32.4701	-86.4799	0	0	NULL	01050000	Autauga C	Alabama	1	58224	96.3	604.37	0.150256142
175015	162	2001	6	4	6/4/2001	13:30:00	3	AL	1	162	50	0	0	0.00E+00	0.00E+00	32.7	-86.48	32.7001	-86.4799	0	0	NULL	01050000	Autauga C	Alabama	1	58224	96.3	604.37	0.150256142
175134	172	2001	6	5	6/5/2001	16:30:00	3	AL	1	172	50	0	0	0.00E+00	0.00E+00	32.5	-86.58	32.5001	-86.5799	0	0	NULL	01050000	Autauga C	Alabama	1	58224	96.3	604.37	0.150256142
180443	240	2002	11	11	11/11/2002	2:00:00	3	AL	1	239	60	0	0	0.08	0.00E+00	32.65	-86.53	32.6501	-86.5299	0	0	NULL	01050000	Autauga C	Alabama	1	58224	96.3	604.37	0.150256142
183564	65	2003	5	30	5/30/2003	12:15:00	3	AL	1	64	50	0	0	0.002	0.00E+00	32.65	-86.73	32.6501	-86.7299	0	0	NULL	01050000	Autauga C	Alabama	1	58224	96.3	604.37	0.150256142

Dataset has 31 attributes and 460,980 records. Query to generate is shown in Figure 2 Wind Join County Query on page 4.

Table 4 Tornado Events per County

name	state_name	tornado
Weld County	Colorado	283
Harris County	Texas	229
Washington County	Colorado	177
Palm Beach County	Florida	167
Polk County	Florida	166
Adams County	Colorado	164
Hillsborough County	Florida	140
Elbert County	Colorado	138
Hale County	Texas	133
Broward County	Florida	131
Miami-Dade County	Florida	124
Laramie County	Wyoming	123
Kit Carson County	Colorado	121
Oklahoma County	Oklahoma	121
Caddo County	Oklahoma	117
Pinellas County	Florida	114
Osage County	Oklahoma	110
McLean County	Illinois	109
Lincoln County	Nebraska	109
Tarrant County	Texas	106
Lee County	Florida	105
Arapahoe County	Colorado	105
Barton County	Kansas	103
Ford County	Kansas	103
Sherman County	Kansas	101
Custer County	Nebraska	101
Lincoln County	Colorado	101
Hinds County	Mississippi	100
Rankin County	Mississippi	99
Johnson County	Texas	98
Canadian County	Oklahoma	98
Dallas County	Texas	97
Yuma County	Colorado	97
Kiowa County	Colorado	96
Campbell County	Wyoming	96
Galveston County	Texas	96

The tornado dataset has 3 attributes and 3029 records. It is worth noting that the counties with the 10 highest resulting tornados (cumulative from 1955-2020) are all located in Colorado (1st, 3rd, 6th, and 8th), Florida (4th, 5th, 7th, and 10th), and Texas (2nd and 9th). Oklahoma considered the middle of "tornado alley" does not have a county listed until 14th. The 10 least frequented tornado counties are in North Carolina (3 of the 10), Virginia (2 of the 10), West Virginia (4 of the 10), and Oregon (1 of the 10). The first 28 counties all have a total tornado count of over 100, 322 counties have a total count over 50, and 812 counties recorded less than 10 (but at least 1) tornados from 1955-2020.

This list of occurrences per county includes all counties in the United States. Colorado, Texas, and Florida respectively are the first three states to appear in the list, while Rhode Island, D.C., and Alaska are the last three to appear in the list, with Alaska not having a county until the 2,982nd position. 9th place is held by Hale County, which ironically does not appear in the top 50 of the hail dataset.

Table 5 Hail Events per County

name	state_name	hail
El Paso County	Colorado	1577
Pennington County	South Dakota	1314
Sedgwick County	Kansas	1244
Lincoln County	Nebraska	997
Tarrant County	Texas	996
Weld County	Colorado	972
Oklahoma County	Oklahoma	971
Laramie County	Wyoming	947
Yuma County	Colorado	881
Ford County	Kansas	861
Tulsa County	Oklahoma	853

The hail dataset has 3 attributes and 3,097 records.

The counties with the 10 highest resulting hailstorms (cumulative from 1955-2020) are all located in Colorado (1st, 6th, and 9th), Kansas (3rd and 10th), and South Dakota, Nebraska, Texas, Oklahoma, and Wyoming respectively for the remaining 2nd through 8th place. The 10 least frequented hail counties are in 7 different states, only Oregon is on the

minimum list for both hail and tornados. The first 3 counties have a total number of hailstorms over 1,000; 57 counties have a total over 500; 1,291 counties all have a total hail count of over 100; 2,149 counties have a total count over 50; and 144 counties recorded less than 10 (but at least 1) hail from 1955-2020.

This list of occurrences per county includes all counties in the United States. Colorado and Texas both appear in the top 10 list for both tornado and hail counties, while Rhode Island, D.C., and Alaska are 3 of the last 5 to appear in the list for both tornado and hail, with Alaska again having the last spot and not having a county in the list until the 2,990th position.

The wind dataset has 3 attributes and 3,088 records. The counties with the 10 highest resulting windstorms (cumulative from 1955-2020) are all located in Pennsylvania (4th and 6th), Alabama (7th and 10th), and Arizona, Illinois, Kansas, Texas, Tennessee, and Oklahoma respectively for the remaining 1st through 9th place (Arizona is 1st). The 10 least frequented wind counties are California (5 of the 10), Colorado (2 of the 10), Washington (2 of the 10), and Alaska (1 of the 10, and last).

Table 6 Wind Events per County

name	state_name	wind
Maricopa County	Arizona	1084
Cook County	Illinois	911
Sedgwick County	Kansas	904
Allegheny County	Pennsylvania	815
Tarrant County	Texas	815
Westmoreland County	Pennsylvania	798
Lauderdale County	Alabama	778
Davidson County	Tennessee	763
Tulsa County	Oklahoma	734
Madison County	Alabama	715
Oklahoma County	Oklahoma	699

Only Arizona, having the county in 1st position has a total number of windstorms over 1,000; 47 counties have a total over 500; 1,943 counties all have a total windstorm count of over 100; 2,626 counties have a total count over 50; and 110 counties recorded less than 10 (but at least 1) windstorm from 1955-2020.

This list of occurrences per county includes all counties in the United States. Texas is the only state to appear in the top 10 county list for all 3 weather phenomena, while Alaska, as always, having the last spot and not having a county in the list until the 3046th position.

Table 7 Number of Tornados per State

state_name	tornado	tornado/sqmi
Texas	9442	0.000973538
Kansas	4678	0.0011821
Oklahoma	4433	0.001042067
Nebraska	3253	0.000928227
Florida	3244	0.000964466
Iowa	3088	0.001697152
Illinois	3086	0.001519238
Mississippi	2942	0.001612065
Missouri	2755	0.001580357
Alabama	2722	0.001227416
Louisiana	2418	0.001244336

The table on the left shows the number of tornados per state, and no surprise Texas, Kansas, and Oklahoma are the top 3 results (all are in "tornado alley"). However, looking at the number of tornados per square mile in each state, D.C., Rhode Island, and Kentucky have the most tornados per square mile than any other state.

Table 8 Number of Tornados per Square Mile

state_name	tornado	tornado/sqmi
District of Columbia	4	0.016212711
Rhode Island	12	0.003135992
Kentucky	1294	0.002620884
Virginia	887	0.002589126
New Jersey	170	0.002496029
Georgia	2167	0.002453352
Indiana	1807	0.002399488
Maryland	408	0.002246023
Ohio	1330	0.002074324
West Virginia	159	0.002044658
Tennessee	1510	0.001978079

Table 9 Number of Hailstorms per State

state_name	hail	hail/sqmi
Texas	46708	0.000927297
Kansas	36229	0.001186244
Oklahoma	27372	0.001033685
Nebraska	22072	0.000851694
Missouri	17952	0.001583535
South Dakota	14995	0.000663388
Iowa	13785	0.001675045
Minnesota	13294	0.000859124
Colorado	13019	0.000497714
Arkansas	10855	0.001374305
Illinois	10226	0.001545726

Table 10 Number of Hailstorms per Square Mile

state_name	hail	hail/sqmi
District of Columbia	31	0.016212711
Rhode Island	113	0.003205604
Kentucky	5978	0.002611107
Georgia	8283	0.002566026
New Jersey	950	0.002413767
Indiana	6760	0.002409361
Virginia	5447	0.002299514
Maryland	1378	0.002185163
Ohio	8209	0.00209784
West Virginia	2748	0.002035872
Tennessee	6113	0.001999631

The table on the left shows the number of hailstorms per state, and again Texas, Kansas, and Oklahoma are the top 3 results. Looking at the number of hailstorms per square mile in each state, D.C., Rhode Island, and Kentucky have again the most storms per square mile than any other state.

Table 11 Number of Windstorms per State

state_name	wind	wind/sqmi
Texas	30150	0.000993667
Kansas	21547	0.00119587
Oklahoma	18856	0.001036192
Ohio	18521	0.002089044
Georgia	18367	0.002435843
Pennsylvania	18048	0.001368389
Illinois	17395	0.001567012
Tennessee	17016	0.002071831
Missouri	16912	0.001594922
North Carolina	16570	0.001793461
Kentucky	16321	0.002710096

Table 12 Number of Windstorms per Square Mile

state_name	wind	wind/sqmi
District of Columbia	228	0.016212711
Rhode Island	263	0.003190127
Kentucky	16321	0.002710096
Georgia	18367	0.002435843
Indiana	13844	0.002417969
New Jersey	4596	0.002417861
Virginia	15515	0.002350151
Maryland	6268	0.002261998
West Virginia	5842	0.002178757
Ohio	18521	0.002089044
Tennessee	17016	0.002071831

The table on the left shows the number of windstorms per state, and again Texas, Kansas, and Oklahoma are the top 3 results. Looking at the number of windstorms per square mile in each state, D.C., Rhode Island, and Kentucky have again the most storms per square mile than any other state.

Texas appears in the top 10 weather phenomenon for each list, dominating in the number of tornados per year (8 of the 10 years). Kansas holds 6 of the top 10 hail years. Although no one state leads in yearly windstorms, Pennsylvania does hold the top two spots and for consecutive years in 2020 and 2019, possibly leading to a trend in increased storms.

Table 13 Tornados per State Sorted by Year

yr	state_name	tornado/year	tornado/sqmi
2015	Texas	263	0.000919029
1995	Texas	236	0.000978222
1967	Texas	236	0.001025169
1982	Texas	227	0.000964952
2007	Texas	218	0.000983225
2008	Kansas	218	0.001199749
2011	Alabama	211	0.001235236
1971	Texas	207	0.000980278
1992	Texas	204	0.000881457
1991	Texas	200	0.000959303
1997	Texas	196	0.000919852

Table 14 Hailstorms per State Sorted by Year

yr	state_name	hail/year	hail/sqmi
2008	Kansas	1800	0.001179823
2001	Kansas	1753	0.001173967
2002	Kansas	1700	0.001202382
2009	Texas	1641	0.00085023
2005	Texas	1581	0.000895753
2011	Kansas	1569	0.001209338
2004	Kansas	1568	0.001159677
2002	Texas	1513	0.00090052
2004	Texas	1512	0.000819852
2005	Kansas	1461	0.001212966
1995	Texas	1447	0.000981485

Table 15 Windstorms per State Sorted by Year

yr	state_name	wind/year	wind/sqmi
2020	Pennsylvania	1391	0.001465813
2019	Pennsylvania	1239	0.001403563
2019	Virginia	1195	0.002291924
2011	North Carolina	1150	0.001819015
2009	Texas	1113	0.001018608
2011	Virginia	1066	0.002184808
2011	South Carolina	1056	0.001390647
2019	Texas	1051	0.000974067
2010	Virginia	1038	0.002195439
2011	Alabama	1018	0.001319546
2015	Texas	994	0.000947083

Table 16 Tornados per State by Decade

state_name	tornados	decade
Texas	1745	1990s
Texas	1543	2000s
Texas	1525	1970s
Texas	1492	1980s
Texas	1283	2010s
Texas	1248	1960s
Kansas	1244	2000s
Oklahoma	965	2010s
Kansas	864	1990s
Kansas	854	2010s
Oklahoma	777	1990s

Table 17 Hailstorms per State by Decade

state_name	hail	decade
Kansas	14362	2000s
Texas	14340	2000s
Texas	11906	2010s
Texas	11534	1990s
Kansas	10172	2010s
Nebraska	8182	2000s
Oklahoma	8089	2000s
Oklahoma	8048	1990s
Missouri	7423	2000s
Kansas	7164	1990s
Nebraska	7160	2010s

Table 18 Windstorms per State by Decade

state_name	wind	decade
Texas	8164	2010s
Texas	7983	2000s
Virginia	7629	2010s
Kansas	7141	2010s
Texas	7025	1990s
North Carolina	6923	2010s
Kansas	6821	2000s
Pennsylvania	6745	2010s
Georgia	6636	2010s
Kentucky	6466	2010s
Ohio	6260	2010s

Barely loosing first place to Kansas and the only state to appear in the top 10 list for at least three decades, Texas holds an overwhelming occurrence in each of the tornado, hail, and wind storm lists for most occurrences per decade. Except for 1960s-1980s Texas tornados, all the results for any weather phenomenon are 1990s-2010s, leading to further analysis into the thought that the occurrences are increasing decade over decade. Texas and Kansas are the only two states to appear on all three lists.

Similarly, Table 4-Table 6, the work in the dataset is calculated by county, only this is cumulative per decade. For the hail decades, the top 22 spots are all held by the 2000 or 2010 decades, which hold 92% of the top 100 spots. A decade earlier than the 90s does not occur until the 376th position. Tornados tell a different story, The top ten decades are surprisingly not in tornado alley, but instead 70% are in Colorado, with two counties appearing multiple times. This means that the dates cover multiple decades and apart from 8th and 9th place (both a Colorado county), all the decades are between 1970 and 1990. Wind follows the pattern of hail, even more extreme. The first 18 positions are all held by the 2010s and 95% of the top 40 are also 2010, the remainder 2000. In fact, it is not until position 44 that a non-current millennium is listed, when 1990 appears in the list.

Table 20 Hail Count per County by Decade

name	state_name	hail	decade
El Paso County	Colorado	670	2010s
Pennington County	South Dakota	578	2010s
Sedgwick County	Kansas	462	2000s
Laramie County	Wyoming	445	2010s
El Paso County	Colorado	419	2000s
Sedgwick County	Kansas	416	2010s
Ford County	Kansas	398	2000s
Yuma County	Colorado	391	2000s
Weld County	Colorado	356	2010s
Pennington County	South Dakota	349	2000s
Lincoln County	Nebraska	346	2000s

Table 21 Tornado Count per County by Decade

name	state_name	tornado	decade
Weld County	Colorado	78	1990s
Weld County	Colorado	61	1980s
Harris County	Texas	59	1970s
Washington County	Colorado	59	1990s
Polk County	Florida	51	1990s
Harris County	Texas	50	1980s
Adams County	Colorado	47	1990s
Washington County	Colorado	47	2010s
Kiowa County	Colorado	45	2010s
Kit Carson County	Colorado	45	1990s
Weld County	Colorado	44	2000s

Table 19 Wind Count per County by Decade

name	state_name	wind	decade
Maricopa County	Arizona	436	2010s
Leon County	Florida	404	2010s
Davidson County	Tennessee	401	2010s
Lauderdale County	Alabama	396	2010s
Montgomery County	Maryland	375	2010s
Colleton County	South Carolina	373	2010s
Allegheny County	Pennsylvania	348	2010s
Greene County	Missouri	341	2010s
Richland County	South Carolina	333	2010s
Sedgwick County	Kansas	317	2010s
Cook County	Illinois	306	2010s

Table 22 All Weather per County by Decade

decade	name	state_name	tornado	hail	wind
1950s	Carroll County	Missouri	1	2	3
1950s	Custer County	Oklahoma	5	5	3
1950s	Wilkin County	Minnesota	3	2	1
1950s	Laramie County	Wyoming	5	7	2
1950s	Kay County	Oklahoma	16	4	5
1950s	Pontotoc County	Mississippi	2	1	1
1950s	Linn County	Iowa	1	2	6
1950s	Lamar County	Alabama	1	1	2
1950s	Otero County	New Mexico	2	2	2
1950s	Stafford County	Kansas	15	4	3
1950s	Macoupin County	Illinois	2	1	1
1950s	Barton County	Missouri	4	2	1
1950s	Lake County	South Dakota	2	2	2
1950s	Hale County	Texas	9	2	5
1950s	Corson County	South Dakota	2	1	1
1950s	Caldwell County	Missouri	1	3	1
1950s	Kendall County	Illinois	2	1	1
1950s	Custer County	Nebraska	11	8	3
1950s	Fulton County	Georgia	1	1	5
1950s	Phillips County	Colorado	1	2	3
1950s	Holmes County	Mississippi	1	1	1
1950s	Koochiching County	Minnesota	2	1	2
1950s	Howard County	Texas	5	5	4

This table although not impressive by itself, leads the way to ranking and analysis in the future. This is also the first table that shows all three weather types, tornado, hail, and wind together.

Table 23 Combined Weather Events per County by Decade

decade	name	state_name	disasters
2010s	Pennington County	South Dakota	825
2000s	Sedgwick County	Kansas	763
2010s	Sedgwick County	Kansas	744
2010s	El Paso County	Colorado	718
2000s	Ford County	Kansas	574
2010s	Lincoln County	Nebraska	558
2010s	Tarrant County	Texas	555
2010s	Greene County	Missouri	548
2010s	Laramie County	Wyoming	542
2000s	Butler County	Kansas	539
2010s	Cook County	Illinois	526
2010s	Butler County	Kansas	520
2010s	Davidson County	Tennessee	513
2000s	Polk County	Iowa	512
2010s	Allegheny County	Pennsylvania	510
2010s	Meade County	South Dakota	505
2000s	Cook County	Illinois	501
2010s	Maricopa County	Arizona	499
2000s	Yuma County	Colorado	495
2000s	Lincoln County	Nebraska	490
2010s	Cherry County	Nebraska	489

No surprise the top 20 weather phenomena count per county is newer than 2000. It is worth noting that when you combine tornados, hail, and windstorms the top county has 825 events in a decade. The top 17 total counts are above 500, 506 decades sit above 200 events.

It is worth noting that the 1950s only accounts for 1955-1959, so the lower numbers in comparison to the other decades are not unexpected. The 1980s through 2010s have all top 10 counties with values above 100, and despite the 2020s only including the year 2020 there is a high chance of the trend continuing. Out of the 70 values, 43 are unique counties with many counties appearing multiple times. Tarrant County (located in Fort Worth, Texas) holds the record, appearing on 7 of the 8 represented decades (3rd in 1950s, 10th in 1960s, 2nd in 1970s, 2nd in 1980s, 3rd in 1990s, 5th in 2010s, and 7th so far in 2020s).

Table 24 Top 10 Counties with Weather Per Decade

year_rank	decade	name	state_name	disasters	year_rank	decade	name	state_name	disasters
1	1950s	Oklahoma County	Oklahoma	36	1	1990s	Tulsa County	Oklahoma	480
2	1950s	Sedgwick County	Kansas	36	2	1990s	Osage County	Oklahoma	459
3	1950s	Tarrant County	Texas	32	3	1990s	Tarrant County	Texas	404
4	1950s	Dallas County	Texas	31	4	1990s	Dallas County	Texas	351
5	1950s	Cook County	Illinois	29	5	1990s	Caddo Parish	Louisiana	347
6	1950s	Tulsa County	Oklahoma	28	6	1990s	Weld County	Colorado	337
7	1950s	Ford County	Kansas	28	7	1990s	Oklahoma County	Oklahoma	336
8	1950s	Kiowa County	Oklahoma	28	8	1990s	Sedgwick County	Kansas	328
9	1950s	Lubbock County	Texas	27	9	1990s	El Paso County	Colorado	319
10	1950s	Grayson County	Texas	27	10	1990s	Harris County	Texas	300
1	1960s	Jackson County	Missouri	143	1	2000s	Sedgwick County	Kansas	763
2	1960s	Oklahoma County	Oklahoma	122	2	2000s	Ford County	Kansas	574
3	1960s	Cook County	Illinois	98	3	2000s	Butler County	Kansas	539
4	1960s	Sedgwick County	Kansas	90	4	2000s	Polk County	Iowa	512
5	1960s	Kay County	Oklahoma	83	5	2000s	Cook County	Illinois	501
6	1960s	Dallas County	Texas	80	6	2000s	Yuma County	Colorado	495
7	1960s	Wichita County	Texas	78	7	2000s	Lincoln County	Nebraska	490
8	1960s	Johnson County	Kansas	75	8	2000s	Reno County	Kansas	481
9	1960s	Hillsborough County	Florida	73	9	2000s	El Paso County	Colorado	469
10	1960s	Tarrant County	Texas	73	10	2000s	Randall County	Texas	468
1	1970s	Jefferson County	Alabama	147	1	2010s	Pennington County	South Dakota	825
2	1970s	Tarrant County	Texas	135	2	2010s	Sedgwick County	Kansas	744
3	1970s	Lubbock County	Texas	119	3	2010s	El Paso County	Colorado	718
4	1970s	Dallas County	Texas	114	4	2010s	Lincoln County	Nebraska	558
5	1970s	Harris County	Texas	114	5	2010s	Tarrant County	Texas	555
6	1970s	Sedgwick County	Kansas	111	6	2010s	Greene County	Missouri	548
7	1970s	Jackson County	Missouri	101	7	2010s	Laramie County	Wyoming	542
8	1970s	Oklahoma County	Oklahoma	98	8	2010s	Cook County	Illinois	526
9	1970s	Hillsborough County	Florida	95	9	2010s	Butler County	Kansas	520
10	1970s	Shelby County	Tennessee	88	10	2010s	Davidson County	Tennessee	513
1	1980s	Oklahoma County	Oklahoma	302	1	2020s	Lauderdale County	Alabama	125
2	1980s	Tarrant County	Texas	200	2	2020s	Cook County	Illinois	99
3	1980s	Weld County	Colorado	192	3	2020s	Montgomery County	Pennsylvania	98
4	1980s	Caddo County	Oklahoma	185	4	2020s	Allegheny County	Pennsylvania	77
5	1980s	Pulaski County	Arkansas	180	5	2020s	Ocean County	New Jersey	76
6	1980s	Dallas County	Texas	178	6	2020s	Colbert County	Alabama	75
7	1980s	Caddo Parish	Louisiana	175	7	2020s	Tarrant County	Texas	73
8	1980s	Canadian County	Oklahoma	172	8	2020s	Bucks County	Pennsylvania	71
9	1980s	Bowie County	Texas	147	9	2020s	Weld County	Colorado	68
10	1980s	Harris County	Texas	143	10	2020s	Coffee County	Alabama	65

Table 25 Tarrant County Total Weather by Decade

decade	weather_events
1950s	104
1960s	246
1970s	467
1980s	890
1990s	1802
2000s	1597
2010s	2080
2020s	118

As with other tables previously discussed, 1990-2010s are the highest values each topping 1500 compared to the few hundred of the other decades. There is an overall upward trend in events (the 2020s is excluded as the decade is not complete)

In case one county in the area has majority of the results and skews the results, a breakdown of each county is shown below. There is a variation in the numbers but overall, the counties follow the same pattern and no major outliers.

Table 27 Graph of Weather Events per County

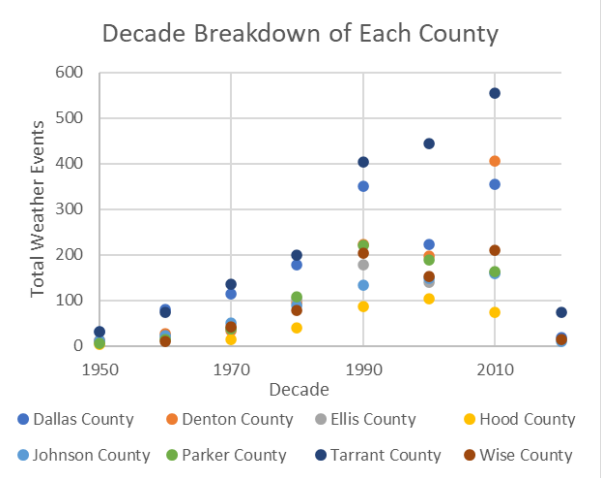


Table 26 Weather Events per County

decade	county	state_name	weather_events
1950s	Dallas County	Texas	31
1950s	Denton County	Texas	12
1950s	Ellis County	Texas	8
1950s	Hood County	Texas	4
1950s	Johnson County	Texas	12
1950s	Parker County	Texas	5
1950s	Tarrant County	Texas	32
1960s	Dallas County	Texas	80
1960s	Denton County	Texas	28
1960s	Ellis County	Texas	18
1960s	Johnson County	Texas	22
1960s	Parker County	Texas	14
1960s	Tarrant County	Texas	73
1960s	Wise County	Texas	11
1970s	Dallas County	Texas	114
1970s	Denton County	Texas	34
1970s	Ellis County	Texas	38
1970s	Hood County	Texas	15
1970s	Johnson County	Texas	51
1970s	Parker County	Texas	38
1970s	Tarrant County	Texas	135
1970s	Wise County	Texas	42
1980s	Dallas County	Texas	178
1980s	Denton County	Texas	96
1980s	Ellis County	Texas	103
1980s	Hood County	Texas	40
1980s	Johnson County	Texas	88
1980s	Parker County	Texas	108
1980s	Tarrant County	Texas	200
1980s	Wise County	Texas	77
1990s	Dallas County	Texas	351
1990s	Denton County	Texas	222
1990s	Ellis County	Texas	179

year_rank	decade	county	disasters
1	1950s	Tarrant County	32
2	1950s	Dallas County	31
3	1950s	Johnson County	12
4	1950s	Denton County	12
5	1950s	Ellis County	8
6	1950s	Parker County	5
7	1950s	Hood County	4
1	1960s	Dallas County	80
2	1960s	Tarrant County	73
3	1960s	Denton County	28
4	1960s	Johnson County	22
5	1960s	Ellis County	18
6	1960s	Parker County	14
7	1960s	Wise County	11
1	1970s	Tarrant County	135
2	1970s	Dallas County	114
3	1970s	Johnson County	51
4	1970s	Wise County	42
5	1970s	Parker County	38
6	1970s	Ellis County	38
7	1970s	Denton County	34
8	1970s	Hood County	15
1	1980s	Tarrant County	200
2	1980s	Dallas County	178
3	1980s	Parker County	108
4	1980s	Ellis County	103
5	1980s	Denton County	96
6	1980s	Johnson County	88
7	1980s	Wise County	77
8	1980s	Hood County	40

year_rank	decade	county	disasters
1	1990s	Tarrant County	404
2	1990s	Dallas County	351
3	1990s	Denton County	222
4	1990s	Parker County	221
5	1990s	Wise County	204
6	1990s	Ellis County	179
7	1990s	Johnson County	134
8	1990s	Hood County	87
1	2000s	Tarrant County	445
2	2000s	Dallas County	222
3	2000s	Denton County	197
4	2000s	Parker County	189
5	2000s	Wise County	153
6	2000s	Johnson County	148
7	2000s	Ellis County	139
8	2000s	Hood County	104
1	2010s	Tarrant County	555
2	2010s	Denton County	405
3	2010s	Dallas County	354
4	2010s	Wise County	209
5	2010s	Parker County	164
6	2010s	Ellis County	161
7	2010s	Johnson County	158
8	2010s	Hood County	74
1	2020s	Tarrant County	73
2	2020s	Dallas County	19
3	2020s	Wise County	15
4	2020s	Johnson County	11

Out of the eight counties, Tarrant County is ranked 1st every decade except for the 1960s, which it ranked 2nd behind Dallas County.

Table 28 Ranked Counties by Decade

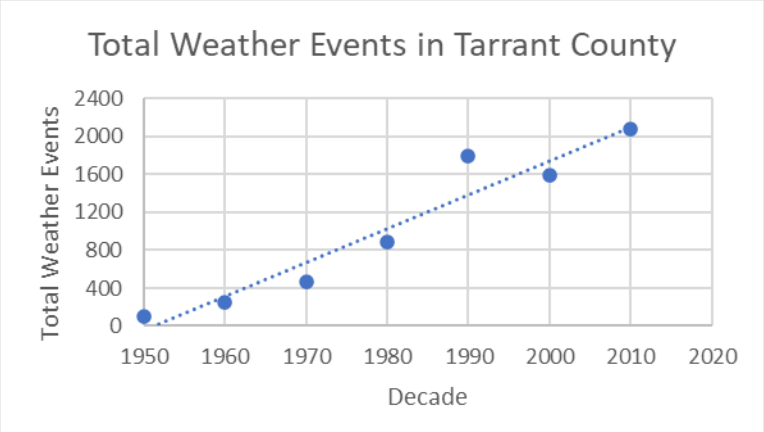
Discussion

There are several counties and states that appear on in the top 10 lists for tornados, hail and/or windstorms. About tornados, tracked from January 1955 through December 2020, Colorado, Florida, and Texas hold all the top spots. As with hail and wind, Alaska is one of the last three state to have a county in the frequency list. Hail is slightly different, Colorado (again) and Kansas make up majority of top 10 counties for hailstorms for January 1955 through December 2020; but Texas's Tarrant County also makes another appearance in 5th place. For windstorms, the top 10 positions contain mostly a different set of states than tornado and hail, but Pennsylvania and Alabama have each have 2 counties in the top 10. The only state that also appears on the top 10 tornado or hail list is Texas, which again has Tarrant County taking 5th place.

Texas appearing in the top 10 list for all three weather phenomena is not all that surprising considering its size and central location. If we remove the state's size from the picture and calculate each county's weather events based on the number of events per square mile, the results are all weather conditions and counties is less than 0.02 events per square foot. With so many states and events, a full analysis requires further breakdown, and visualization with graphing would help aid in the interpretations. One way to reduce the complexity of the data size is to look at a specific county.

The one theme that was consistent was Texas, and for hail and wind Tarrant County is the only Texas state to appear in the top 10 and is in 20th position on the tornado list. This suggests that Tarrant County is a high weather location. For the Tarrant County metroplex (8 counties comprised of Dallas, Denton, Ellis, Hood, Johnson, Parker, Tarrant and Wise), the cumulative tornado, hail, and windstorm activity overall has an increasing trend from decade to decade, with the 2020s being on trend to be the highest decade yet.

Table 29 Graph of Total Weather Events



Even breaking down the Tarrant County area into the individual counties, the results of Tarrant County are almost always the highest (only the 1960s with Dallas County barely surpassing Tarrant County). In the case of the 1990s and later, the values of Tarrant County are about a hundred events higher than the next competitor.

Besides the obvious next steps of increasing the types of weather covered in the analysis, next steps include mapping the results. To enhance the experience, color coding per the ranking of the year, or for values within a range. Further analysis of each of the other counties, or maybe even a more granular breakdown of each city would help reinforce the goal of identifying the areas that are likely to have a weather phenomenon.

Conclusion

After looking at 66,244 tornados, 370,766 hailstorms, and 462,478 windstorms between January 1955 and December 2020, some trends are apparent. Every one of the 50 United States (plus Washington D.C.) appears on each weather list, but despite the 3,143 counties in the United States, only 90% of them have a weather event on at least one of the phenomena lists.

The one county that is listed in the top 20 for all three weather phenomena is Tarrant County (North Central Texas). Comparing the number of weather events per decade, Tarrant County is at the top of every list. Texas, located in tornado alley and having frequent wind speeds high enough to rearrange your patio furniture no surprise is at the top of the tornado and wind storm lists. In an area that has frequent 3-digit temperatures and little rainfall over half of the year, it is a bit of a surprise is the county sitting near the top of the hail storm list; but a 50% overlap in tornado and hailstorm events may explain the reason for the high hail storms in the area if they fall just short of having enough wind and rotation to become a tornado.

So, should a house in Tarrant County purchase weather insurance? Despite the high premiums and a rising increase in the number of tornado, hail, and wind events, it is a frequent enough occurrence (1 in every 8 days, almost an average of once a week) in weather events that if one wishes to protect their physical and financial assets, it would be wise to purchase weather insurance.

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