

FEMA Disaster Declaration Raw Dataset

The original FEMA Dataset retrieved for the purposes of this project was the "OpenFEMA" Dataset: Disaster Declarations Summaries - v2". It consisted of 28 columns and 67361 rows with the majority of older data being manually entered or transferred from written spreadsheets. FEMA declarations go as far back as the 1950's and have experienced changes in labeling over the decades. There are a lot of columns that, in their original state, were unreadable or lacked comprehension due to their abbreviated meanings or government based definitions.

Declaration Type:

- FM = Fire Mgmt
- DR = Major Disasters
- EM = Emergency Disasters

Fed. Relief Program:

- ih = Individuals & Households
- ia = Individual Assistance
- pa = Public Assistance
- hm = Hazard Mitigation

FIPS Codes:

- Federal Information Processing System (States and Counties)
- Uniquely identify geographic areas

Original DataFrame

This is not readable - shown here for emphasis on raw format and necessary transformations



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1	FM-5529-OR	5529	CR	FM 2024-08-09T00:00:00.000Z	2024	Fire	LEE FALLS FIRE		0	1 2	1 2024-08-08700:00:00.0002	NaN	NaN	0	41	67	99067	Washington (County)	24122	NaN 2024081001	10	R 2024-08-27T18:22:14.80F	OZ as87cf3c6ed795015b714af7166c7c295b2b67	.7c7 OSe3181a-Se16-4p72-b317-1c64e0cfaSF
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3	FM-6527-OR	5527	CR	FM 2024-08-02T00:00:00:000Z	2024	Fire M'	MILE MARKER 132 FIRE	0	0	1 2	1 2024-08-02700:00:00.0002	NaN	NaN	0	41	17	99017	Deschutes (County)	24111	NaN 2024080301	10	R 2024-08-27T18:22:14.80F	OZ 2521d90c06bc64b0d4121aa3f18d852bcb4b1	11a 8d 3edf0-bc2f-496b-8d9f-b2e73da832z
4	FM-5522-CA	5522	CA	FM 2024-07-27T00:00:00.000Z	2024	Fire	BOREL FIRE	0	0	1.	1 2024-07-25T00:00:00:000Z	NaN	NaN	0	6	29	99029	Kern (County)	24102	NaN 2024072701	9	R 2024-08-27T18:22:14.80F	CZ 51ec819011c936f287ecF10b9d5839b35419ca	a95 9b73e19b-d326-4992-8da1-7e558d97507
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67352	DR-8-IA		14.	DR 1953-06-11T00:00:00.000Z	1953	Flood	FLOOD		1	1 2	1 1953-06-11700:00:00.000Z 1963-06-11700	/00:00:00.000Z 1955-1	11-01T00:00:00.000Z	0	19	0	0	Statewide	53008	NaN 53008	7	NaN 2024-09-27T18:22:14.90F	OZ a051cd99c34a0ec2485d0f9b5b11c4c93509ad	d88 f103b5c1-0f3f-4c3d-ad3c-50040e98edF
67353	DR-7-MA	7	M4	DR 1953-06-11T00:00:00.000Z	1953	Tornado	TORNADO	0	1	1 /	1 1953-06-11T00:00:00:000Z 1963-06-11T00	/00:00:00:000Z 1956-P	J5-01T00:00:00.000Z	0	25	0	0	Statewide	53009	NaN 53009	1	NaN 2024-08-27T18:22:14.8002	OZ b720724cfb17afaba95e73a92fdf09b1fc6d0	Bedf fca83efc-524a-45a0-ac86-2643b954a5e
67354	DR-2-TX	2	TK	DR 1953-65-15T00:60:00.000Z	1953	Tornado TORNAD	ADD & HEAVY RAINFALL		1	1 /	1 1953-05-15T00:00:00.000Z 1953-05-15T00	/00:00:00:000Z 1958-P	d1-81T00:90:08.000Z	0	48	0	0	Statewide	53003	NaN 53833	6	W 2024-08-27T18:22:14.80F	00Z 8a8bc885c003cb873c201bb6s3a2771a6c84er	erb1 #821327-6190-4246-b19f-ff5c40258a
67355	DR-1-GA	1	GA.	OR 1953-05-02T00:00:00.000Z	1903	Tornado	TORNADO	0	1	1	1 1953-05-02700:00:00.0002 1953-05-02700	(00:00:00:00:00Z 1954-P	35-01T00:00:00.000Z	0	13	0	0	Statewide	53013	NaN 53013	4	NaN 2024-08-27T18:22:14.8003	00Z 413/f808d79f08a6710/6b78f361d5a7de69827	2711 8943dfcF-9786-4651-8589-d52014034bis

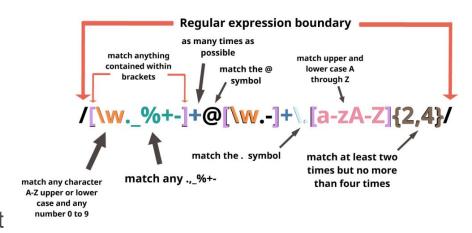
FEMA Data - Initial Filtering

Filter 1: Basic - Parsing, Merging,

- Dates included times @ midnight -> Remove times
- Geographic codes (ie. FIPS) deemed less helpful -> Remove FIPS codes
- Created DataFrame with only desired incident types to merge with original
- Drop columns that are mostly NaN

Filter 2: Advanced (Regex) - Areas

- 'designatedArea' -> Separated by `()' to create area and area types
- 'areaType' containing more area info ->
 Cleaned and duplicated with new areas
- Match `areaType` by keywords for accuracy and then by bins to create granularity in data (26 types originally)
- Granularity was not used for project, but with theoretical repurposing in mind



The Geoapify API Call...

Is actually just the concept of geocoding that we've all done as a class already!

Geoapify was given freeform location info in the form of an area name, and the state it's in. It was also restricted to finding coordinate pairs only in the US and its territories within a given rectangle.

This is how we retrieved the coordinate pairs for every incident and then filtered the resultant DataFrame to only rows that had coordinates.

The intricacies are found in how the call was performed...
Limitations were:

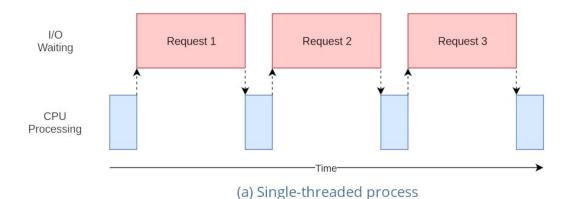
- 5 calls/second
- 3000 calls/day
- 3427 data points

→ 38 minutes, 38 seconds (runtime)

By integrating my call with the "concurrent.futures" library I was able to utilize the 9 keys I acquired to create **9 different threads**, all of which made API calls every 0.2 seconds

→ 4 minutes, 20 seconds (runtime)

Multi-Threading Conceptually



Request 1 Request 1 1/0 1/0 Request 2 Request 2 Waiting Waiting Request 3 Request:3 Thread 1 CPU CPU Thread 2 2 Processing Processing Thread 3 -Time -Time (b) Multi-threaded process (c) Single-threaded process with GIL acquired by current thread with asyncio

Final & Summary DataFrames

Final DF

	disasterNumber	declarationRequestNumber	declarationTitle	area	areaType	state	incidentType	declarationType	declarationDate	incidentBeginDate	latitude	longitude	tribalRequest	ihProgramDeclared	iaProgramDeclared	paProgramDeclared	hmProgramDeclared
0	5530	24123	GOLD RANCH FIRE	Washoe	County	NV	Fire	FM	2024-08-12	2024-08-11	40.584905	-119.613161	0	0	0	1	1
1	5529	24122	LEE FALLS FIRE	Washington	County	OR	Fire	FM	2024-08-09	2024-08-08	45.560188	-123.058791	0	0	0	1	1
2	5528	24116	ELK LANE FIRE	Jefferson	County	OR	Fire	FM	2024-08-06	2024-08-04	44.722434	-123.007389	0	0	0	1	1
3	5527	24111	MILE MARKER 132 FIRE	Deschutes	County	OR	Fire	FM	2024-08-02	2024-08-02	44.156923	-121.258700	0	0	0	1	1
4	5522	24102	BOREL FIRE	Kern	County	CA	Fire	FM	2024-07-27	2024-07-25	35.314570	-118.753822	0	0	0	1	1
	***						***	***					***				
58138	1967	11042	TSUNAMI WAVES	Honolulu	County	н	Tsunami	DR	2011-04-08	2011-03-11	21.304547	-157.855676	0	0	0	1	1
58139	1967	11042	TSUNAMI WAVES	Maui	County	н	Tsunami	DR	2011-04-08	2011-03-11	20.758059	-156.310523	0	0	0	1	1
58140	1964	11029	TSUNAMI WAVE SURGE	Coos	County	OR	Tsunami	DR	2011-03-25	2011-03-11	43.218414	-124.109621	0	0	0	1	1
58141	1964	11029	TSUNAMI WAVE SURGE	Curry	County	OR	Tsunami	DR	2011-03-25	2011-03-11	41.858425	-74.581269	0	0	0	1	1
58142	1964	11029	TSUNAMI WAVE SURGE	Lincoln	County	OR	Tsunami	DR	2011-03-25	2011-03-11	42.108750	-122.403078	0	0	0	1	1

	isaster Number	Title	Number of Requests	Declaration Request Number	Incident Type	Incident Begin Date (First)	Incident Begin Date (Last)	Declaration Date (First)	Declaration Date (Last)	Latitude	Longitude
0	1	TORNADO	1	53013	Tornado	1953-05-02	1953-05-02	1953-05-02	1953-05-02		-84.200199
1	7-	TORNADO & HEAVY RAINFALL		53003	Tornado	1953-05-15	1953-05-15	1953-05-15			-94.917548
2	3	FLOOD	1	53005	Flood	1953-05-29	1953-05-29	1953-05-29	1953-05-29	32.787346	-91.904878
3	4	TORNADO	1	53004	Tornado	1953-06-02	1953-06-02	1953-06-02	1953-06-02	42.233092	-84.327177
4	5	FLOODS	1	53006	Flood	1953-06-06	1953-06-06	1953-06-06	1953-06-06	46.540855	-111.946345
4713	5547	JENNINGS CREEK FIRE	1	24199	Fire	2024-11-08	2024-11-08	2024-11-15	2024-11-15	41.539816	-74.098199
4714	5548	FRANKLIN FIRE	1	24204	Fire	2024-12-09	2024-12-09	2024-12-10	2024-12-10	34.053691	-118.242766
4715	5549	PALISADES FIRE	1	25002	Fire	2025-01-07	2025-01-07	2025-01-07	2025-01-07	34.053691	-118.242766
4716	5550	EATON FIRE		25003	Fire	2025-01-07	2025-01-07	2025-01-08	2025-01-08	34.053691	-118.242766
4717	5551	HURST FIRE	1	25004	Fire	2025-01-07	2025-01-07	2025-01-08	2025-01-08	34.053691	-118.242766

Summary DF



File Organization

CSV Breakdown:

- Original
- Cleaned Using Basic Methods
- Geocoded File gained from API
- Cleaned Using Regex and validated with geocoding
- Summary

Assets:

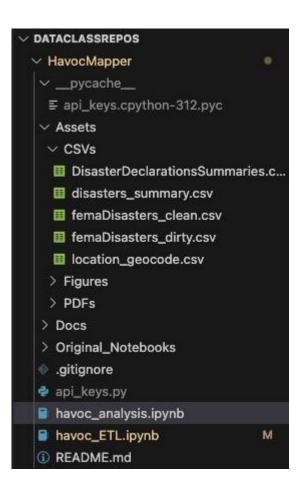
- CSVs
- Figures (exported images by Name)
- PDFs (resources)

Docs:

For source linking and additional documentation

Original Notebooks:

- Each collaborator's individual notebook



Data Engineering Rabbit Holes

- Learning to use Regex and vectorized function for DataFrames
- 'areaType' pitfall of cleaning data that wasn't needed/used
- Deciding on API and how to use
- Encountering heavy limits on API and runtime issues/long wait time
- Deciding on group workflow



The fearsome rabbit from Monty <u>Python</u> and the Holy Grail

Federal Emergency Management Agency (FEMA) Data Statistical Analysis - summary

Natural Disasters Focused on the FEMA data-set

- Severe Storms 18,399
- Hurricane 13,721
- Flood 11,093
- Fire 3759
- Snowstorms 3707
- Severe Ice Storms 2942
- Tornado 1623
- Drought 1292
- Tropical Storm 1047

- Coastal Storm 637
- Freezing 301
- Earthquake 228
- Typhoon 130
- Winter storm 117
- Volcanic Eruption 51
- Mud/Landslide 43
- Tsunami 9
- Straight-Line Winds 2

Declaration Types

- Major Disasters 41,116
- Emergency Declarations 15,991
- Fire Management 1994

Total Number of Natural Disasters

Declared over the last 72 years is

59,101







Most Common and Least Common Natural Disasters Declared

- Most Common Natural Disaster Declared
 - Severe Storms
 - Hurricane
 - Flood

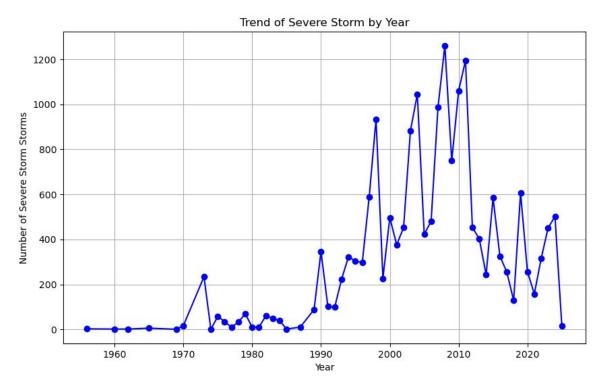
- Least Common Natural Disaster Declared
 - Straight line winds
 - Tsunami
 - Mud/Landslides



Severe Storms - Trends Over the last Seven Decades

Trends:

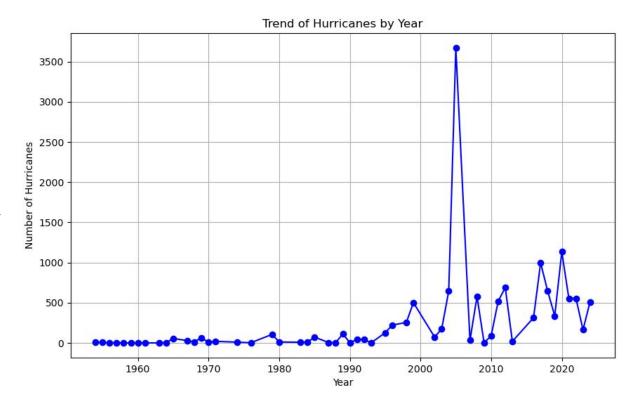
- Average Storms per year is 342.1
- Most number of Severe storms in a given year was 1263
- Least number of storms in a given Year was 1
- 2008 had the highest number of storms
- In general there was a spike in the number of storms between 2000 2010



Hurricanes - Trends Over the last Seven Decades

Trends:

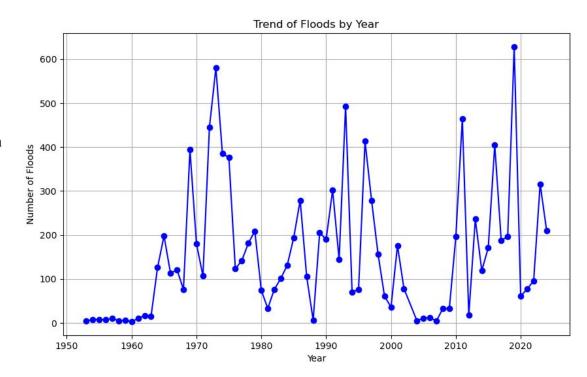
- Average Hurricanes per year is 254 09
- Most number of Severe storms in a given year was 3714
- Least number of Hurricanes in a given Year was 1
- 2005 had the highest number of storms
- Overall there was a consistent increase in hurricanes after 2006 with no major spikes



Floods - Trends Over the last Seven Decades

Trends:

- Average Floods per year is 124.1
- Most number of Floods in a given year was 3714
- Least number of Floods in a given Year was 1
- Floods have been consistent throughout the last seven decades with two spikes in the early 70's and late 2010's
- 1950's and 1960's were two decades that had the least amount of Floods.



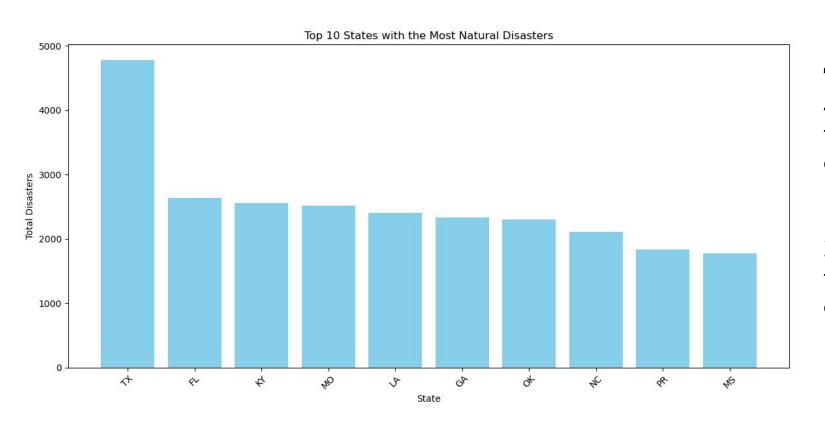
Geographical Data

Question: What US locations experience the most natural

disasters? Why?



Graphs Based on FEMA Disaster Declaration Data Set



TX: 4,779 total disasters

FL: 2,635 total disasters

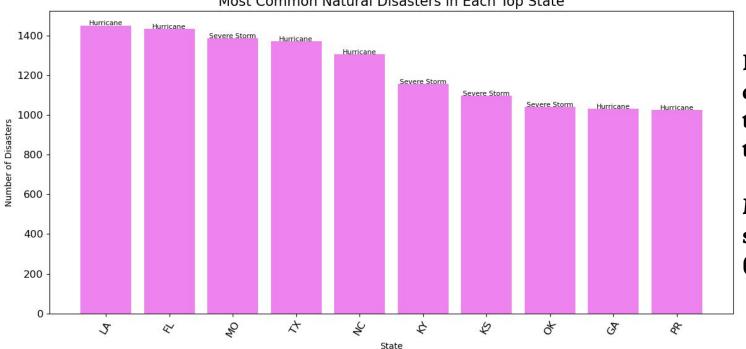
Top 10 Most Frequent Disaster Types

Disaster Type

Hood

He





LA: most hurricanes declared out of all the states (1,450 total)

MO: most severe storms declared (1,387 total)

Why?

• Texas:

- Broad coastline, making it more vulnerable to hurricanes and severe storms.
- It is a very big state with lots of land that covers multiple climate zones.

• Florida:

- Situated between the Gulf of Mexico, Atlantic Ocean, and the Straits of Florida, making the state susceptible to hurricanes from many directions.
- Low elevation can increase the risk of floods.

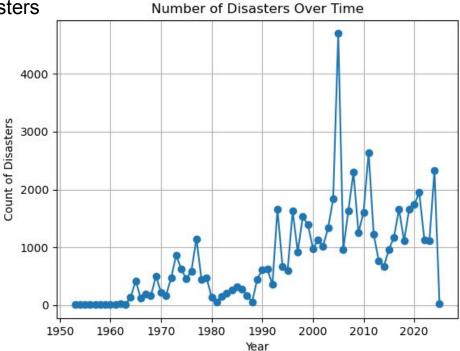
• Southeast Regions (LA, GA, KY):

- Highly exposed to Atlantic hurricanes and storms.
- Moisture from the Gulf of Mexico can lead to frequent thunderstorms.

Natural Disaster Impact trend Analysis

Year 2005 had 41 natural disasters

38.99% change over time of natural disasters



YOY Trend Analysis

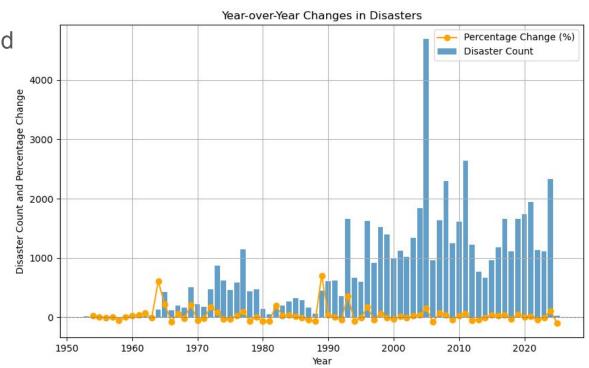
 Hurricane Katrina and Rita impacted large spike in 2005 in LA and TX

- Spring: 22636

- Fall: 17310

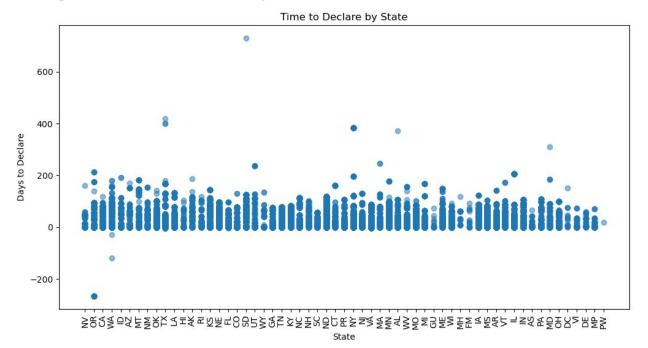
- Summer: 15721

Winter: 11689



Time to Declare by State

- PR and FL are the states that take the shortest time to declare a disaster with about ~ 8 days
- AK the longest at about 52 days



Additional Sources

- https://www.ncei.noaa.gov/
- https://www.spc.noaa.gov/publications/
- https://www.fema.gov/openfema-data-page/disaster-declarations-summaries-v2 (Main Dataset)
- https://www.fema.gov/flood-maps/products-tools/national-risk-index
- https://www.usgs.gov/programs/natural-hazards
- <u>https://www.fema.gov/openfema-data-page/fima-nfip-redacted-claims-v2</u>