

# Damage Review - Hurricane Harvey

## Background and Scope

**Hurricane Harvey** was a devastating Category 4 hurricane that made landfall on Texas and Louisiana in August 2017, causing catastrophic flooding and many deaths. It was the first major hurricane to make landfall in the United States since Wilma in 2005, ending a record 12-year span in which no hurricanes made landfall at the intensity of a major hurricane throughout the country. In a four-day period, many areas received more than 40 inches (1,000 mm) of rain as the system slowly meandered over eastern Texas and adjacent waters, causing unprecedented flooding.ins

Let us begin by importing the data.

## Import the Data

```
stormData = importfile("StormEvents_2017_finalProject.csv")
```

```
stormData = 57005x24 table
```

...

	EpisodeID	Event_ID	State	Year	Month	Event_Type	CZ_Name
1	113355	678791	NEW JER...	2017	April	Thunderstorm...	GLOUCES...
2	113459	679228	FLORIDA	2017	April	Tornado	LEE
3	113448	679268	OHIO	2017	April	Thunderstorm...	GREENE
4	113697	682042	OHIO	2017	April	Flood	CLERMONT
5	113683	682062	NEBRASKA	2017	April	Hail	CASS
6	114718	688082	INDIANA	2017	April	Flash Flood	SWITZER...
7	114834	688895	VIRGINIA	2017	April	Thunderstorm...	WESTMOR...
8	121068	724772	GULF OF...	2017	October	Marine Thund...	ATCHAFA...
9	114489	686560	OHIO	2017	April	Flash Flood	CLERMONT
10	113683	682156	NEBRASKA	2017	April	Thunderstorm...	BURT

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Extracting only Data which relates to Hurricane Harvey,

```
stormData = stormData(ismember(stormData.Episode_Narrative,{'As Hurricane Harvey struck southeaste...
```

```
stormData = 151x24 table
```

...

	EpisodeID	Event_ID	State	Year	Month	Event_Type	CZ_Name
1	118750	713329	MISSISS...	2017	September	Strong Wind	LOWNDES
2	119821	718430	KENTUCKY	2017	September	Flash Flood	TODD
3	119821	718431	KENTUCKY	2017	September	Flood	MUHLENB...
4	118746	713318	MISSISS...	2017	August	Thunderstorm...	LAMAR

	EpisodeID	Event_ID	State	Year	Month	Event_Type	CZ_Name
5	118746	713320	MISSISS...	2017	August	High Wind	WASHING...
6	118746	713322	MISSISS...	2017	August	Strong Wind	GRENADA
7	120460	721724	TENNESSEE	2017	September	Heavy Rain	ROBERTSON
8	120460	721725	TENNESSEE	2017	September	Heavy Rain	MONTGOM...
9	120460	721726	TENNESSEE	2017	September	Heavy Rain	ROBERTSON
10	118746	713323	MISSISS...	2017	August	Flood	LAMAR
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Making a few changes to the Dataset for easy usage, by removing NaN values from Damage\_Property and Property\_Cost

```
stormData.Property_Cost(ismissing(stormData.Property_Cost)) = 0;
stormData.Damage_Property(ismissing(stormData.Damage_Property)) = 0;
stormData = sortrows(stormData, 'Property_Cost', 'descend')
```

stormData = 151x24 table

...

	EpisodeID	Event_ID	State	Year	Month	Event_Type	CZ_Name
1	119859	718519	TEXAS	2017	August	Hurricane	ARANSAS
2	119859	720925	TEXAS	2017	August	Hurricane	NUECES
3	119859	720923	TEXAS	2017	August	Hurricane	SAN PAT...
4	119859	720951	TEXAS	2017	August	Hurricane	REFUGIO
5	119859	720926	TEXAS	2017	August	Storm Surge/...	NUECES
6	119859	720927	TEXAS	2017	August	Hurricane	CALHOUN
7	119859	718740	TEXAS	2017	August	Storm Surge/...	ARANSAS
8	119859	721006	TEXAS	2017	August	Hurricane	VICTORIA
9	120216	798846	TEXAS	2017	August	Flood	FAYETTE
10	119859	720932	TEXAS	2017	August	Storm Surge/...	CALHOUN
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```
groupedStates = groupsummary(stormData, "State", "sum", "Property_Cost");
groupedStates = sortrows(groupedStates, 'sum_Property_Cost', 'descend')
```

groupedStates = 10x3 table

	State	GroupCount	sum_Property_Cost
1	TEXAS	60	4.7633e+09
2	MISSISS...	18	456000
3	KENTUCKY	13	400000
4	TENNESSEE	29	392000

	State	GroupCount	sum_Property_Cost
5	ARKANSAS	2	7000
6	INDIANA	3	2000
7	ALABAMA	6	0
8	GULF OF...	10	0
9	LOUISIANA	3	0
10	OKLAHOMA	7	0

## Two States Most Impacted by Harvey

Here, we find the states which have maximum Property\_Cost Damage.

```
state1 = groupedStates(1,:).State
```

```
state1 = categorical
        TEXAS
```

```
state2 = groupedStates(2,:).State
```

```
state2 = categorical
        MISSISSIPPI
```

## Table of Events for Two Most Impacted States

Here we create a table of Events, for the two states found in the above step

```
eventsState1 = stormData(stormData.State == state1,:)
```

```
eventsState1 = 60x24 table
```

...

	EpisodeID	Event_ID	State	Year	Month	Event_Type	CZ_Name
1	119859	718519	TEXAS	2017	August	Hurricane	ARANSAS
2	119859	720925	TEXAS	2017	August	Hurricane	NUECES
3	119859	720923	TEXAS	2017	August	Hurricane	SAN PAT...
4	119859	720951	TEXAS	2017	August	Hurricane	REFUGIO
5	119859	720926	TEXAS	2017	August	Storm Surge/...	NUECES
6	119859	720927	TEXAS	2017	August	Hurricane	CALHOUN
7	119859	718740	TEXAS	2017	August	Storm Surge/...	ARANSAS
8	119859	721006	TEXAS	2017	August	Hurricane	VICTORIA
9	120216	798846	TEXAS	2017	August	Flood	FAYETTE
10	119859	720932	TEXAS	2017	August	Storm Surge/...	CALHOUN

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```
eventsState2 = stormData(stormData.State == state2,:)
```

eventsState2 = 18x24 table

...

	EpisodeID	Event_ID	State	Year	Month	Event_Type	CZ_Name
1	118746	713315	MISSISS...	2017	August	Tornado	FORREST
2	118746	713314	MISSISS...	2017	August	Tornado	LAMAR
3	118746	713322	MISSISS...	2017	August	Strong Wind	GRENADA
4	118746	713321	MISSISS...	2017	August	Strong Wind	ATTALA
5	118746	713316	MISSISS...	2017	August	Tornado	JEFFERS...
6	118746	713318	MISSISS...	2017	August	Thunderstorm...	LAMAR
7	118750	713329	MISSISS...	2017	September	Strong Wind	LOWNDES
8	118746	713328	MISSISS...	2017	August	Thunderstorm...	LOWNDES
9	118746	713326	MISSISS...	2017	August	Thunderstorm...	LOWNDES
10	118746	713327	MISSISS...	2017	August	Thunderstorm...	LOWNDES

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## Visualizations

### Figure of Event Types

Let us consider the first state.

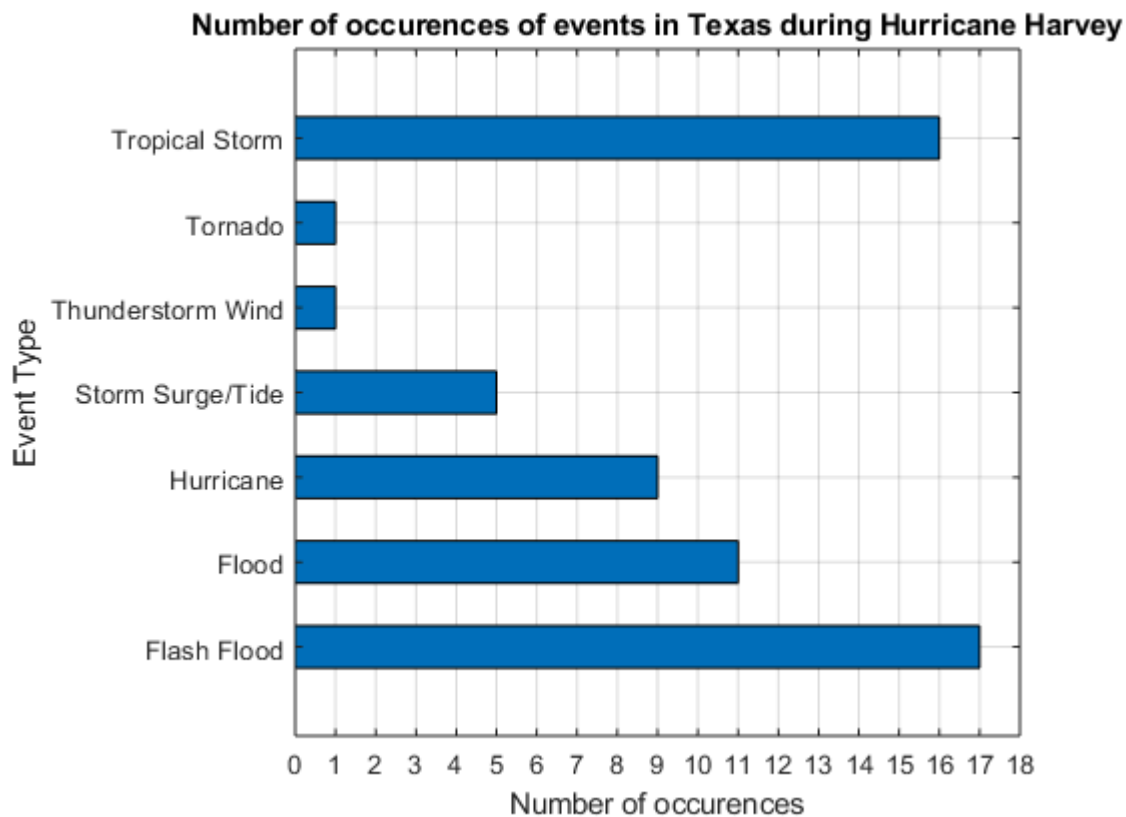
```
eventsState1;  
eventSummary1 = groupsummary(eventsState1, 'Event_Type');  
eventSummary1.Event_Type = string(eventSummary1.Event_Type)
```

eventSummary1 = 7x2 table

	Event_Type	GroupCount
1	"Flash Flood"	17
2	"Flood"	11
3	"Hurricane"	9
4	"Storm Surge..."	5
5	"Thunderstor..."	1
6	"Tornado"	1
7	"Tropical Storm"	16

```
barh(eventSummary1.GroupCount, 'BarWidth',0.5)  
grid on  
xticks(0:1:20)  
xlabel('Number of occurences')  
ylabel('Event Type')  
set(gca, 'yticklabel', {eventSummary1.Event_Type(1), eventSummary1.Event_Type(2), eventSummary1.Event_Type(3), eventSummary1.Event_Type(4), eventSummary1.Event_Type(5), eventSummary1.Event_Type(6), eventSummary1.Event_Type(7)})
```

```
title('Number of occurrences of events in Texas during Hurricane Harvey')
```



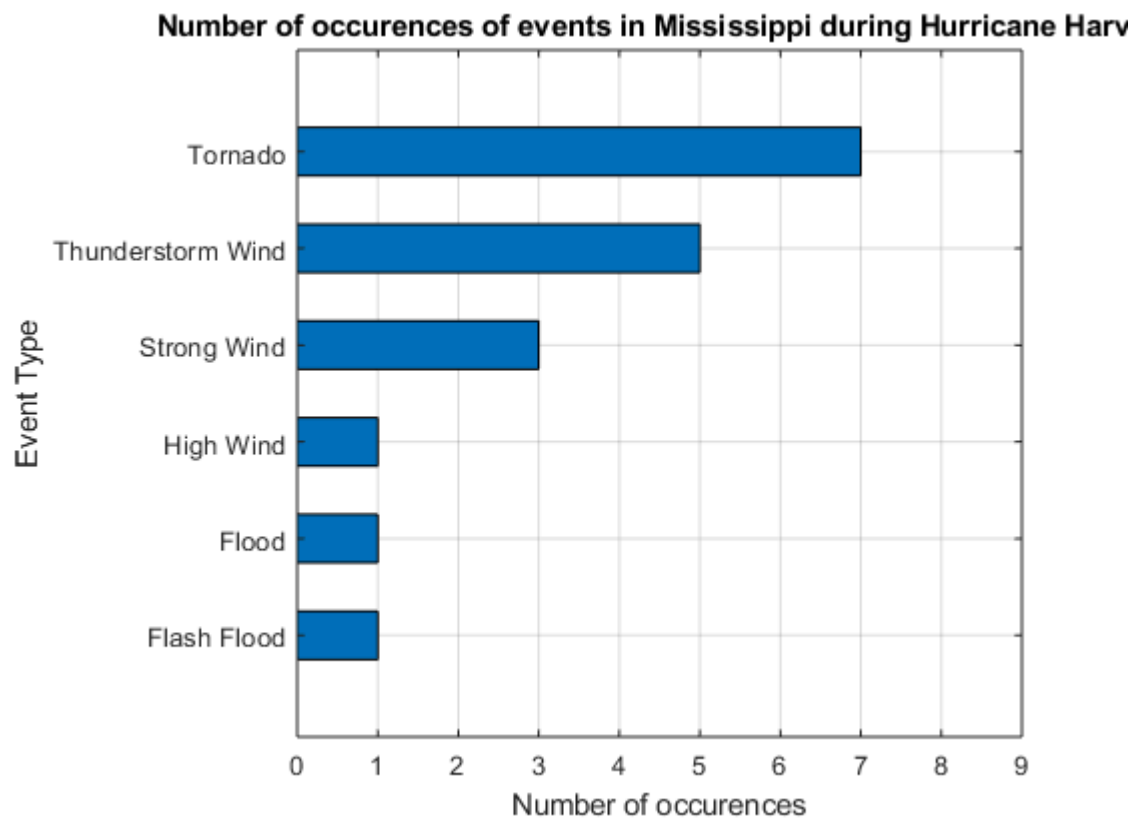
Let us consider the second State

```
eventsState2;
eventSummary2 = groupsummary(eventsState2, 'Event_Type');
eventSummary2.Event_Type = string(eventSummary2.Event_Type)
```

eventSummary2 = 6x2 table

	Event_Type	GroupCount
1	"Flash Flood"	1
2	"Flood"	1
3	"High Wind"	1
4	"Strong Wind"	3
5	"Thunderstor..."	5
6	"Tornado"	7

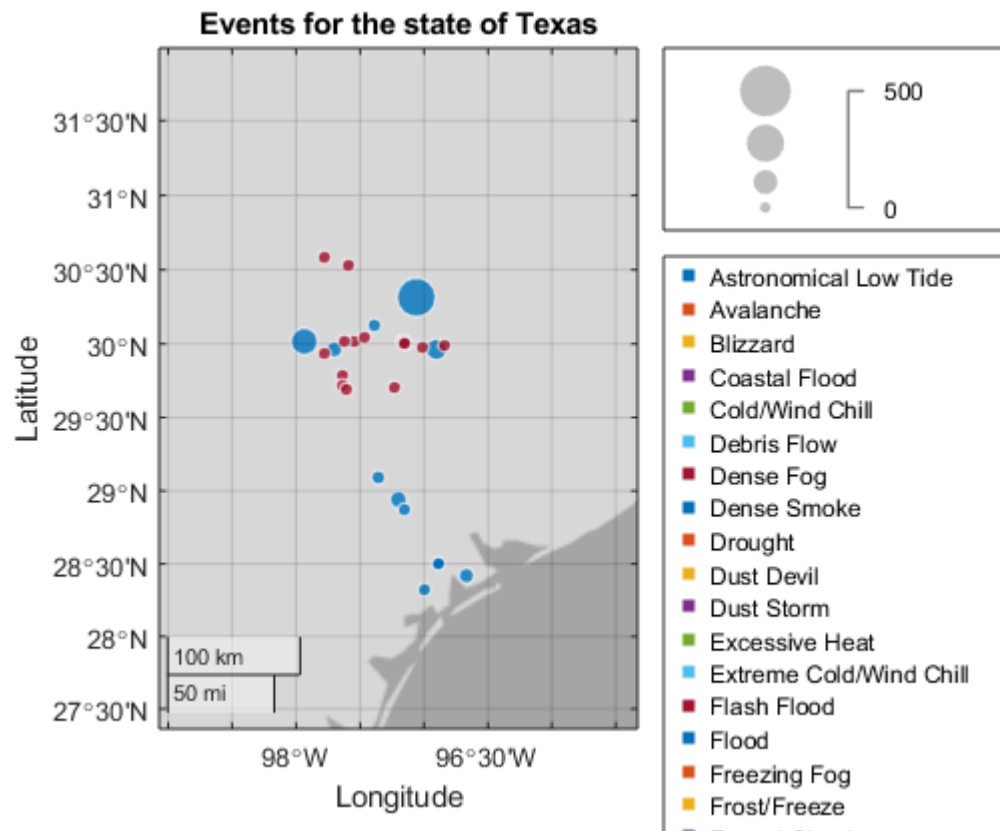
```
barh(eventSummary2.GroupCount, 'BarWidth',0.5)
grid on
xlim([0 9])
xlabel('Number of occurrences')
ylabel('Event Type')
set(gca,'yticklabel',{eventSummary2.Event_Type(1),eventSummary2.Event_Type(2),eventSummary2.Event_Type(3),eventSummary2.Event_Type(4),eventSummary2.Event_Type(5),eventSummary2.Event_Type(6)})
title('Number of occurrences of events in Mississippi during Hurricane Harvey')
```



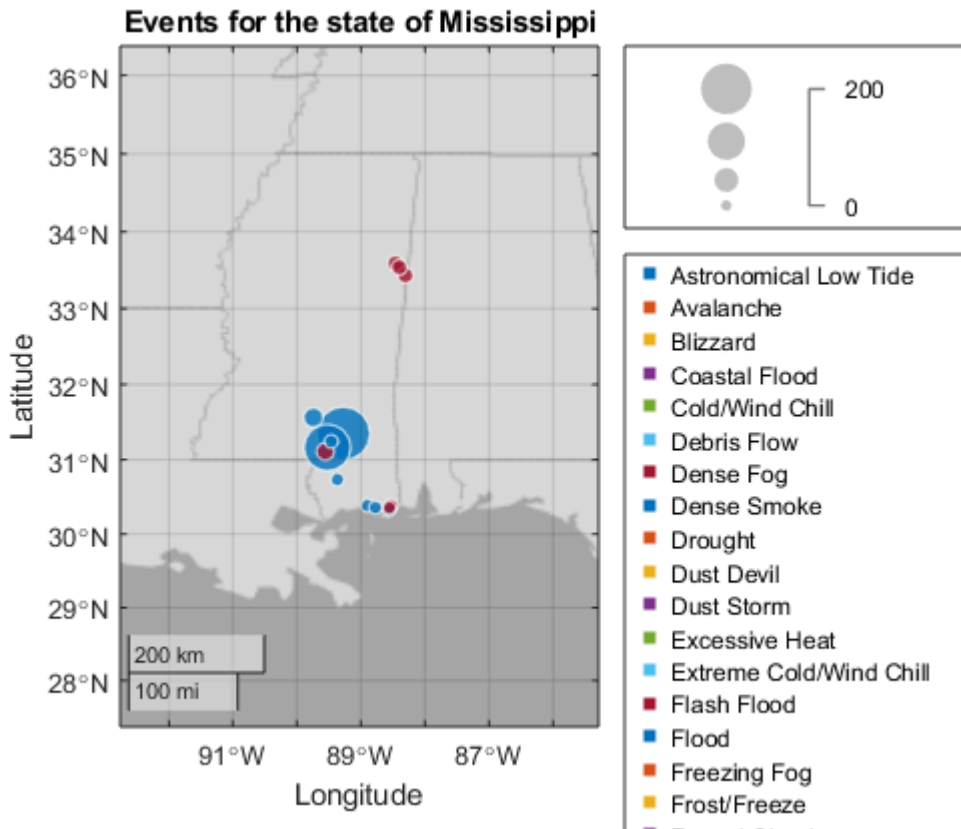
## Figure of Event Locations

Here we show the geoplots of the Events in the different state

```
geobubble(eventsState1.Begin_Lat,eventsState1.Begin_Lon,eventsState1.Damage_Property,eventsState1.Damage_Property)
geolimits([27.68 31.95],[-98.69 -95.24])
legend
title('Events for the state of Texas')
geolimits([28.06 31.31],[-99.07 -95.33])
```



```
geobubble(eventsState2.Begin_Lat,eventsState2.Begin_Lon,eventsState2.Damage_Property,eventsState2.Damage_Value)
title('Events for the state of Mississippi')
geolimits([28.75 35.09],[-92.76 -85.29])
legend show
```



## Analysis

Let us get the data for Texas and Mississippi.

For Texas,

```
counties1 = groupsummary(eventsState1,'CZ_Name','sum','Property_Cost');
counties1MaxCost = sortrows(counties1,'sum_Property_Cost','descend')
```

counties1MaxCost = 27×3 table

	CZ_Name	GroupCount	sum_Property_Cost
1	ARANSAS	2	1.9500e+09
2	NUECES	2	1.3000e+09
3	SAN PAT...	2	502000000
4	REFUGIO	3	500020000
5	CALHOUN	5	281010000
6	VICTORIA	3	160000000
7	FAYETTE	4	500000000
8	CALDWELL	7	12850000
9	DE WITT	2	3100000
10	BASTROP	9	1500000



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```
counties1MaxEvents = sortrows(counties1,'GroupCount','descend')
```

counties1MaxEvents = 27×3 table

	CZ_Name	GroupCount	sum_Property_Cost
1	BASTROP	9	1500000
2	CALDWELL	7	12850000
3	CALHOUN	5	281010000
4	FAYETTE	4	50000000
5	REFUGIO	3	500020000
6	VICTORIA	3	160000000
7	ARANSAS	2	1.9500e+09
8	DE WITT	2	3100000
9	GONZALES	2	100000
10	HAYS	2	100000

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For Mississippi,

```
counties2 = groupsummary(eventsState2,'CZ_Name','sum','Property_Cost');
counties2MaxCost = sortrows(counties2,'sum_Property_Cost','descend')
```

counties2MaxCost = 10×3 table

	CZ_Name	GroupCount	sum_Property_Cost
1	FORREST	1	200000
2	LAMAR	3	161000
3	GRENADA	1	45000
4	LOWNDES	4	20000
5	ATTALA	1	15000
6	JEFFERS...	1	15000
7	HARRISON	1	0
8	JACKSON	4	0
9	PEARL R...	1	0
10	WASHING...	1	0

```
counties2MaxEvents = sortrows(counties2,'GroupCount','descend')
```

counties2MaxEvents = 10×3 table

	CZ_Name	GroupCount	sum_Property_Cost
1	JACKSON	4	0

	CZ_Name	GroupCount	sum_Property_Cost
2	LOWNDES	4	20000
3	LAMAR	3	161000
4	ATTALA	1	15000
5	FORREST	1	200000
6	GRENADA	1	45000
7	HARRISON	1	0
8	JEFFERS...	1	15000
9	PEARL R...	1	0
10	WASHING...	1	0

Therefore, we can arrive at the following results below.

### Three Counties with Most Events in State 1

```
countiesState1MaxEvents = string(counties1MaxEvents.CZ_Name(1:3,:))
```

```
countiesState1MaxEvents = 3x1 string array
"BASTROP"
"CALDWELL"
"CALHOUN"
```

### Three Counties with Most Events in State 2

```
countiesState2MaxEvents = string(counties2MaxEvents.CZ_Name(1:3,:))
```

```
countiesState2MaxEvents = 3x1 string array
"JACKSON"
"LOWNDES"
"LAMAR"
```

### Three Counties with Highest Property Cost in State 1

```
countiesState1MaxCost = string(counties1MaxCost.CZ_Name(1:3,:))
```

```
countiesState1MaxCost = 3x1 string array
"ARANSAS"
"NUECES"
"SAN PATRICIO"
```

### Three Counties with Highest Property Cost in State 2

```
countiesState2MaxCost = string(counties2MaxCost.CZ_Name(1:3,:))
```

```
countiesState2MaxCost = 3x1 string array
"FORREST"
"LAMAR"
"GRENADA"
```

## Conclusions and Recommendations

In Summary, we can say that the states of Texas and Mississippi are the most affected states in the Hurricane Harvey.

Also in those regions, the above mentioned counties are the most affected.

It is recommended to send people to Texas and Mississippi immediately to assess the damage and provide relief.