Exploring Louisiana Coastal Flooding

Objective:

In this activity you will look at data to determine a pattern to the occurrence of flooding events at the Marine Center. You will then use some online resources to see if you can make a prediction about when the Marine Center will have a flooding event and how severe the flooding event will be. You'll make your prediction and then see how accurate your prediction was using the LUMCON tower cameras and environmental monitoring data.

Introduction:

The Louisiana Universities Marine Consortium (LUMCON) is based at the DeFelice Marine Center in Cocodrie, Louisiana, located approximately 85 miles southwest of New Orleans. The Marine Center is surrounded by wetlands on the delta of the Mississippi River. This location is ideal for a marine laboratory because it provides easy access to the Atchafalaya and Mississippi River systems. These two river systems have state, national, and global significance. The ability to access field sites to preform scientific research is vital to understanding Louisiana's changing landscape and the resulting impacts to plants, animals, people, and the physical environment.

In recent years, the Marine Center staff have been affected more and more by impacts related to land loss, climate change and sea-level rise. The most pressing challenge to the operations at the Marine Center is the frequency, duration, and severity of flooding events. At the Marine Center a flooding event is defined as an event that submerges some part of the property that the Marine Center sits on that would not, under normal circumstances, be submerged. These flooding events can cause interruptions in operations at the Marine Center by limiting staff access to the facility, occurrences of the loss of power and other utilities, and damage to some physical infrastructure (docks, boardwalks, and the building).

Flooding events have occurred in Cocodrie for a very long time. It is not that these events occur that is the problem. The concern is with how these events have been increasing in frequency and severity over time. This is a trend that is certain to continue as the climate changes, global sea-level rises, there is an increase in the occurrence of hurricanes and tropical storms, wind and weather patterns change, and more land is lost because of the subsidence and erosion of Louisiana's coast. The reasons for flooding at the Marine Center are complex and interwoven; no single issue can be the sole cause for the increase in the frequency and severity of these events. Many things, including the actual location near the ocean, and environmental changes at the local, regional, and global scale have led to this.

Part 1: Becoming familiar with areas around the Marine Center that are most vulnerable to flooding.

In this part of the activity, you'll look at data collected at the Marine Center that documents the number of days that part of the property was flooded per year.

Flooding at the Marine Center is monitored in many ways. One method is the tracking of the number of days per year certain locations of the property get flooded. Remember these are areas that under "normal conditions" would be dry. LUMCON staff members selected monitoring sites based on their elevation and importance to the operations at the Marine Center.

Step 1: Look at the map and table provided below. The map indicates where each monitoring location is located. The table shows the location name and water depth in the bayou that corresponds to the flooding of each location. The water depth in the bayou is measured by a pressure sensor on an EXO2 Sonde, which is one component of the LUMCON environmental monitoring station.

Location Name	Water depth in the bayou (ft)
Water submerges the marsh site	5.98
Water flows into parking lot through the Boat Ramp Drain	6.4
Parking Lot becomes flooded	7.4
Water comes in the main lobby of the ground floor	8.0
Highway 56 becomes submerged	8.0
Acadiana Dock becomes submerged	8.2

Step 2: Now let's look at how many days per year those locations have been flooded between 2016 and 2020. We have also included the number of days that the Marine Center was closed because of the severity of the flooding. These data do not include closures during hurricanes or tropical storms.

Number of Days Flooded / Year					
Location Name	2016	2017	2018	2019	2020
Water submerges the marsh site	313	288	331	352	307
Water flows into parking lot through the Boat Ramp Drain	188	189	222	298	277
Parking Lot becomes flooded	14	23	21	43	51
Water comes in the main lobby of the ground floor	0	8	3	9	14
Highway 56 becomes submerged	0	8	3	9	14
Acadiana Dock becomes submerged	0	4	2	3	14
Days Marine Center closed due to flooding	0	7*	4**	8***	14****

Includes closures during Tropical Storms Cindy and Harvey
*** Includes closures during Tropical Storm Michael*
****Included closures during Hurricane Barry*
***** Includes closures during Tropical Storms Cristobal and Hanna and Hurricanes Laura, Sally, Beta, Delta, and Zeta*

Questions: Answer the following questions on a separate piece of paper.

1. Draw a bar graph or line graph showing the data in Table #2. Remember to include titles, labels, and a legend on your graph.
2. Describe any relationships or trends you notice in these data.
3. Which locations have historically flooded more often?
4. Which location or locations have seen the greatest increase in flooding events over time? Why do you think this is happening?

Part 2: Identifying and understanding the wind and tide relationship.

In this part of the activity, you'll use data to help understand patterns and relationships that will help you make predictions about the timing and severity of flooding we may have at the Marine Center. Using other online tools, you'll be able to see if your predictions were correct.

The wind speed, wind direction, and high tide relationship:

For LUMCON staff members that work at the Marine Center, predicting when the parking lot will flood has become second nature. They have learned through observation that when wind speed, wind direction, and high tide combine in just the right way flooding will occur. Everyone brings their boots to work every day in case water is high when they arrive.

Let's look at some data to see if it supports what staff members are observing. Answer each of the questions below about these data.

Date	Wind speed (mph)	Wind direction	High Tide Height (ft)	Water Depth at LUMCON Bayou (ft)	Notes
3.01.2019	10	NW	1.4	4.7	Water is high in the boat basin and the back yard around the volleyball court is flooded.
3.12.2019	7	N	0.99	3.4	Lot is dry.
6.18.2019	34	S	1.35	8.1	Water is way up everywhere. Water in the Lobby of the building.
6.27.2019	9	S	1.47	4.5	Lot is dry.
7.3.2019	17	SE	1.49	7.4	Parking lot was completely covered by water. Water all around the volleyball court and back driveway.
7.11.2019	10	S	1.1	5.9	Water in the boat basin and bayou are up. Marsh is submerged at the

					back dock but no flooding of the lot.
7.18.2019	19	SE	1.22	5.3	Water is up in the basin, but no flooding in the parking lot. There are wet spots around the volleyball court.
8.12.2019	14	SE	1.4	6.1	Water is coming up in the boat basin drain. The back driveway has some significant puddling but no flooding of significant areas.
9.17.2019	7	NE	0.97	4.3	Lot is dry.
10.25.2019	2	N	0.94	3.9	Lot is dry.
11.02.2019	8	NW	1.42	3.8	Water starting to come up in the boat basin. There are significant areas of flooding in the back.
11.13.2019	13	N	1.3	2.3	Lot is dry.
12.05.2019	15	NE	0.82	3.1	Lot is dry.

Use the data above to complete the questions below. By completing the checklist you should be able to determine if there is a relationship in these data.

1. **How many days were "dry"? _____**
   a. **What were the wind speeds like on these days?**

   ☐ Wind speeds were relatively low (between 0 and 10 mph).

   ☐ Wind speeds were relatively high (between 11 and 20 mph).

   ☐ Wind speeds were really high (higher than 21 mph).

   b. **What direction was the wind most often coming from on these days?**

   ☐ From the N, NE, or NW

   ☐ From the S, SE, or SW

   c. **What was high tide like on these days?**

   ☐ High tide height was low (between 0.8 and 1.0 ft).

   ☐ High Tide height was high (between 1.1 and 1.5 feet).

2. **How many days was there high water but no flooding reported in the notes? _____**

a. **What were the wind speeds like on these days?**

☐ Wind speeds were relatively low (between 0 and 10 mph).

☐ Wind speeds were relatively high (between 11 and 20 mph).

☐ Wind speeds were really high (higher than 21 mph).

b. **What direction was the wind most often coming from on these days?**

☐ From the N, NE, or NW

☐ From the S, SE, or SW

c. **What was high tide like on these days?**

☐ High tide height was low (between 0.8 and 1.0 ft).

☐ High Tide height was high (between 1.1 and 1.5 feet).

3. **How many days was water reported somewhere on the LUMCON property? _____**
   a. **What were the wind speeds like on these days?**

☐ Wind speeds were relatively low (between 0 and 10 mph).

☐ Wind speeds were relatively high (between 11 and 20 mph).

☐ Wind speeds were really high (higher than 21 mph).

b. **What direction was the wind most often coming from on these days?**

☐ From the N, NE, or NW

☐ From the S, SE, or SW

c. **What was high tide like on these days?**

☐ High tide height was low (between 0.8 and 1.0 ft).

☐ High Tide height was high (between 1.1 and 1.5 feet).

4. **How many days was there water reported in the building? _____**
   a. **What were the wind speeds like on these days?**

☐ Wind speeds were relatively low (between 0 and 10 mph).

☐ Wind speeds were relatively high (between 11 and 20 mph).

☐ Wind speeds were really high (higher than 21 mph).

    b. What direction was the wind most often coming from on these days?

☐ From the N, NE, or NW

☐ From the S, SE, or SW

    c. What was high tide like on these days?

☐ High tide height was low (between 0.8 and 1.0 ft).

☐ High Tide height was high (between 1.1 and 1.5 feet).

5. **After completing the checklist did you notice any patterns start to emerge?**

6. **Describe the pattern you observed.**

7. **Were there any data that seemed unusual when compared to the other data?**

8. **On what date did was that data recorded?**

9. **What was unusual about the data?**

10. What is a possible explanation for what could have been occurring when this data was recorded?

Part 3: Predicting flooding events at the Marine Center.

In this section you'll use some online resources to make a prediction about whether conditions at the Marine Center will cause flooding.   You will need resources that provide forecasts for wind speed and direction, and tide times and heights.

There are many online resources where you can get the information you need to make a prediction. We are going to use some that are favorites among the staff, but you should feel free to do research and find resources that work best for you.

Tide height and time forecast

To get information about tides we suggest using tide-forecast.com. Using this resource, you can see what days are forecasted to have high tides that will have higher water heights verses days that will have high tides with lower water heights associated with them.

Tide chart for Cocodrie, Terrebonne Bay

Showing low and high tide times for the next 30 days. Tide Times are CST (UTC -6.0hrs).

View Cocodrie,
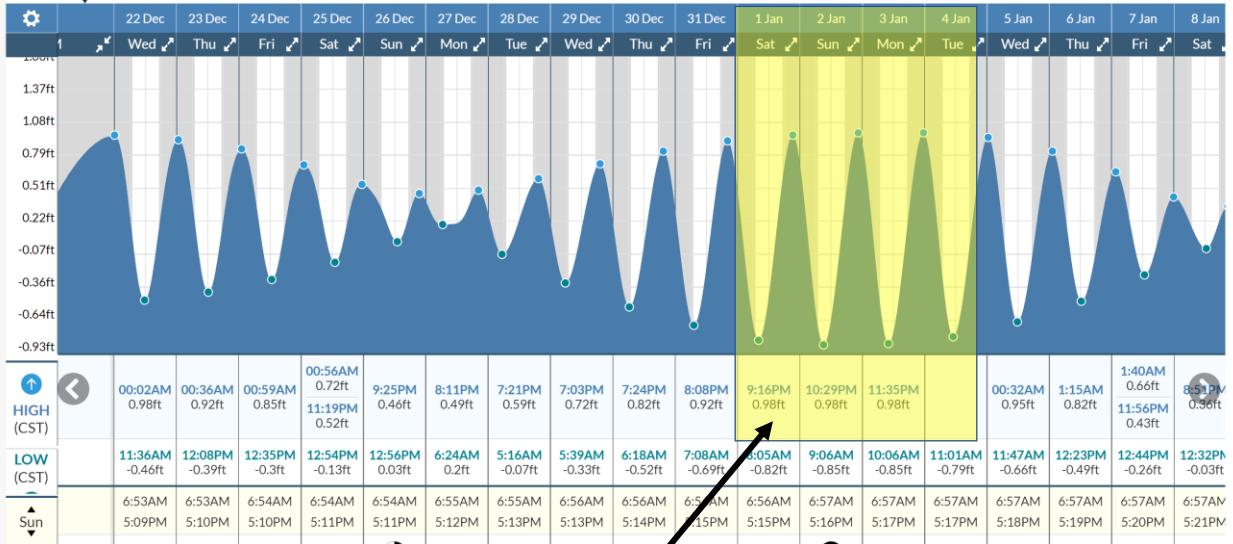Terrebonne Bay 7 Day
Tide Chart Image.
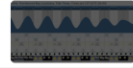
Old Tide Chart — New 30 Day Tide Chart

Print: 7 Days — 30 Days   Print Tide Table

Click ⤢ to expand the day into detailed view,
Click any ⊙ to view the height and time.

	22 Dec	23 Dec	24 Dec	25 Dec	26 Dec	27 Dec	28 Dec	29 Dec	30 Dec	31 Dec	1 Jan	2 Jan	3 Jan	4 Jan	5 Jan	6 Jan	7 Jan	8 Jan
	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed	Thu	Fri	Sat
HIGH (CST)	00:02AM 0.98ft	00:36AM 0.92ft	00:59AM 0.85ft	00:56AM 0.72ft / 11:19PM 0.52ft	9:25PM 0.46ft	8:11PM 0.49ft	7:21PM 0.59ft	7:03PM 0.72ft	7:24PM 0.82ft	8:08PM 0.92ft	9:16PM 0.98ft	10:29PM 0.98ft	11:35PM 0.98ft		00:32AM 0.95ft	1:15AM 0.82ft	1:40AM 0.66ft / 11:56PM 0.43ft	8:51PM 0.36ft
LOW (CST)	11:36AM -0.46ft	12:08PM -0.39ft	12:35PM -0.3ft	12:54PM -0.13ft	12:56PM 0.03ft	6:24AM 0.2ft	5:16AM -0.07ft	5:39AM -0.33ft	6:18AM -0.52ft	7:08AM -0.69ft	8:05AM -0.82ft	9:06AM -0.85ft	10:06AM -0.85ft	11:01AM -0.79ft	11:47AM -0.66ft	12:23PM -0.49ft	12:44PM -0.26ft	12:32PM -0.03ft
Sun	6:53AM 5:09PM	6:53AM 5:10PM	6:54AM 5:10PM	6:54AM 5:11PM	6:54AM 5:11PM	6:55AM 5:12PM	6:55AM 5:13PM	6:56AM 5:13PM	6:56AM 5:14PM	6:5_AM 5:15PM	6:56AM 5:15PM	6:57AM 5:16PM	6:57AM 5:17PM	6:57AM 5:17PM	6:57AM 5:18PM	6:57AM 5:19PM	6:57AM 5:20PM	6:57AM 5:21PM

In this example we can see that this date range will have high tides that will have higher water heights than other days. This will help us determine what dates we should concentrate on when looking at wind forecasts.

Wind forecast

To find forecasts for the wind speed and direction we suggest using Windy.com.
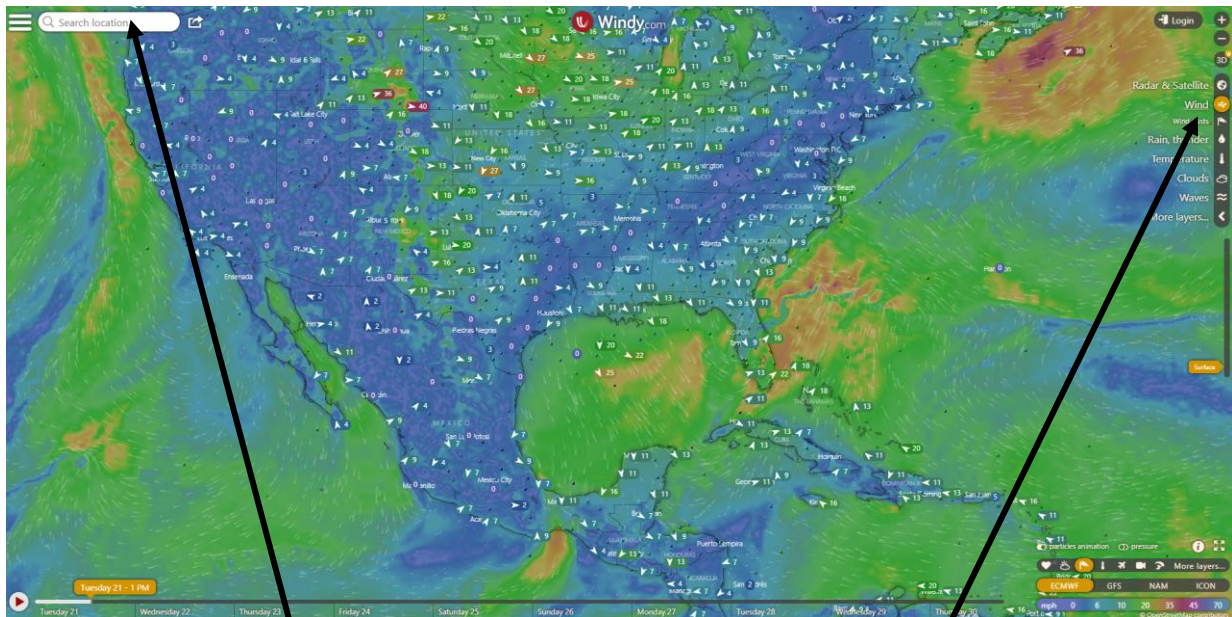
Choosing a location can be done in two ways.

You can type the name of the location into the search box. For this activity you would type in "Cocodrie, LA".

or

You can click on the area on the map. You can use your mouse to zoom in or out and drag the map.

The menu on the right gives you access to the available layers within the app. Make sure that you select the wind layer for this activity.
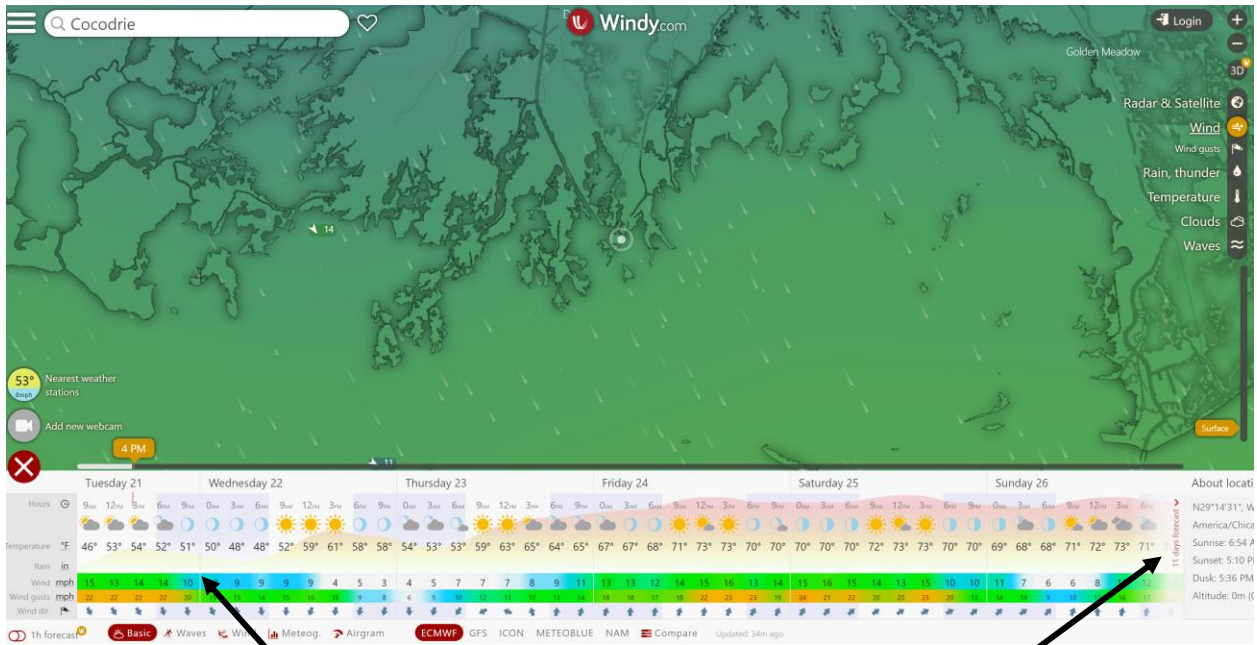
Once the location is selected, this table displays forecast data for the location. The forecast is shown hour by hour.

Click and drag the timeline to see forecasts up to 11 days ahead of the current day.

Make your prediction

Using the online resources that we suggested, determine if there are any days in the next 11 days that are forecasted to have conditions that may cause high water or flooding at the Marine Center. Fill out the table below with dates that you predict conditions will be right for a flooding event.

Date of predicted flooding	Forecasted wind direction	Forecasted wind speed	Forecasted high tide height	Forecasted time of high tide	Notes

Test your prediction

Now you can test your predictions to see if you were able to predict when water would be high at the Marine Center. There are two ways to do this. Feel free to use either method.

Method 1: Look at the LUMCON environmental monitoring data. Go to LUMCON's [environmental monitoring station page](#) and scroll down to the water depth graph and see if the water height recorded for the day you are interested in reached any of the benchmark water heights that would result in some flooding at the Marine Center.

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1. **Were you able to predict a flooding event?**

2. **If yes, how severe was the event and what locations at the Marine Center do you think had some flooding?**

3. **If no, what conditions or events might have resulted in stopping or lessening the amount of flooding at the Marine Center?**

Method 2: Look at the LUMCON observation tower cameras. LUMCON has a series of cameras on the observation tower of the Marine Center. You can visit the LUMCON website and use the [cameras](#) to track the conditions at the Marine Center in real time. If any of your predictions occur during the day time you may even see flooding happening. The parking lot is best viewed from the East camera, the Acadiana Dock can be seen on the South camera, and the back lot and volleyball court can be seen on the West camera.

4. **Were you able to predict a flooding event?**

5. **If yes, how severe was the event and what locations at the Marine Center do you think had some flooding?**

6. **If no, what conditions or events might have resulted in stopping or lessening the amount of flooding at the Marine Center?**