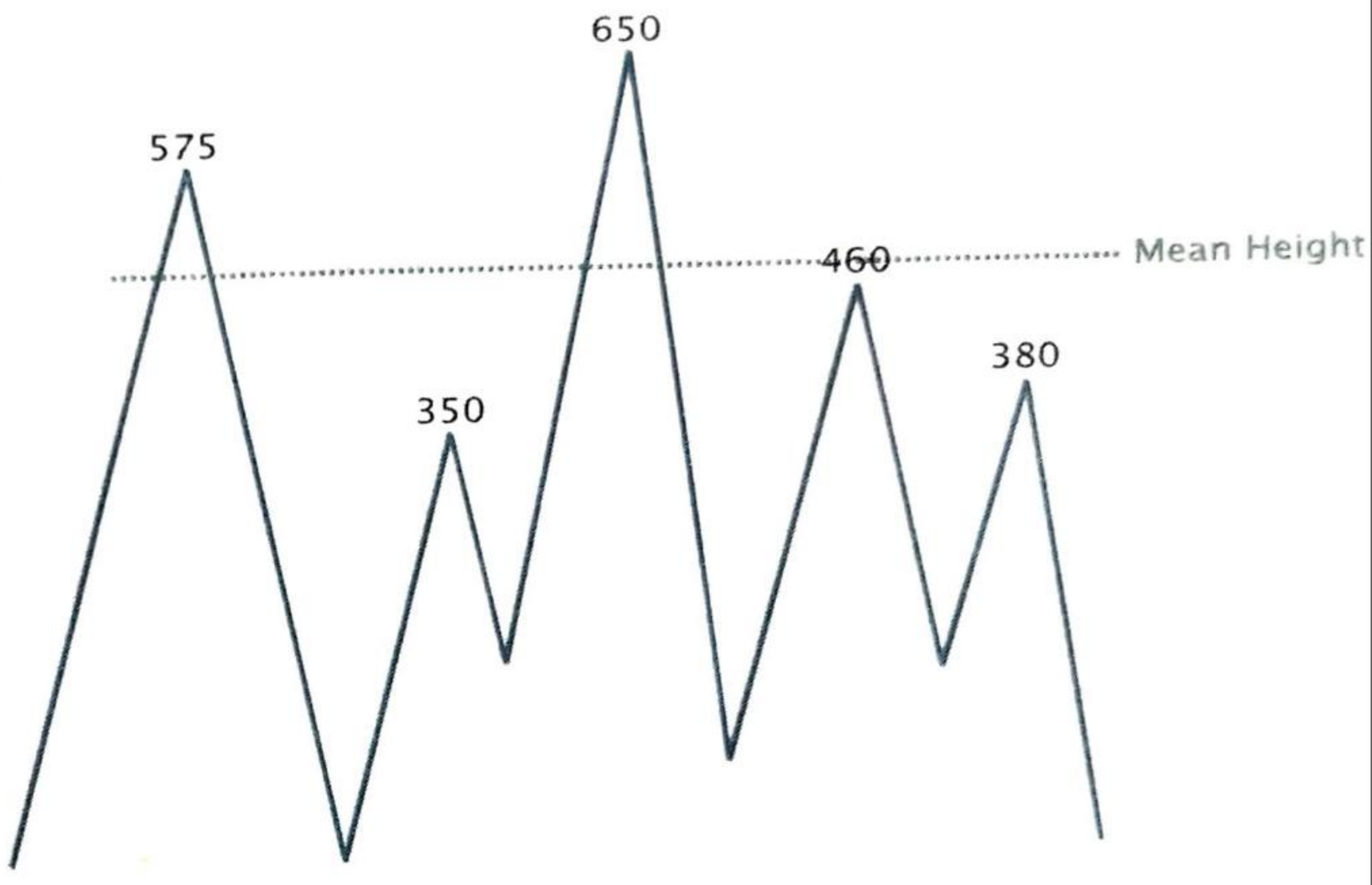
STUDENT WORKSHEET - LEVEL 1

CALCULATING THE MEAN SEA LEVEL

Sea Surface Height Measurements 2085

1. <u>Calculate the Mean:</u>

   Using the 'sample' data to the right, complete the table and compute the mean height.



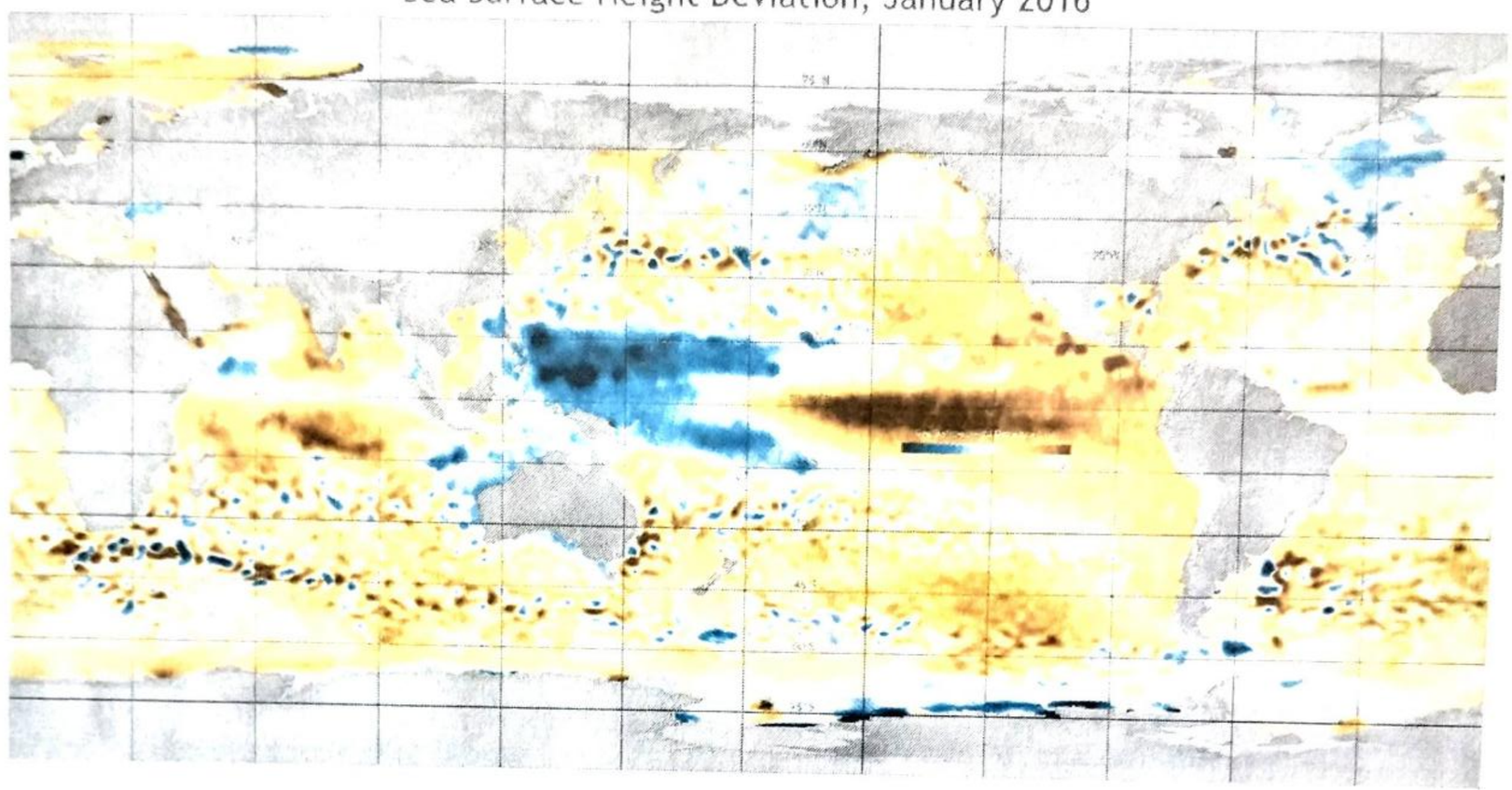
2. <u>Calculate the Deviation:</u> Once you have the mean, calculate how much each data point deviates from that mean. To do this, subtract the mean from each height measurement recorded. Write the results in the column marked Deviation.

Measurement	Height	(- Mean)	Deviation
1	575	417	158
2	350	417	-67
3	650	417	233
4	460	417	43
5	380	417	-37
TOTAL	2085		
MEAN	417		

STUDENT WORKSHEET - LEVEL 2

Interpreting Global Sea Level Data

Sea Surface Height Deviation, January 2016



Instructions: Examine the map above. Use the color bar at right to help with your interpretation.

Answer the following questions:

Question 1: The yellow and orange colors on the map represent areas where:

A) the sea surface height is roughly the same as the historical mean height
B) the water is warmer than normal
C) sea levels are rising
D) the sea surface height is higher than the historical mean height

Question 2: In January 2016, what was the approximate SSHD off the coast of Los Angeles, USA?

A) 0.2 meters
B) 0.1 meters
C) -0.1 meters
D) -0.4 meters

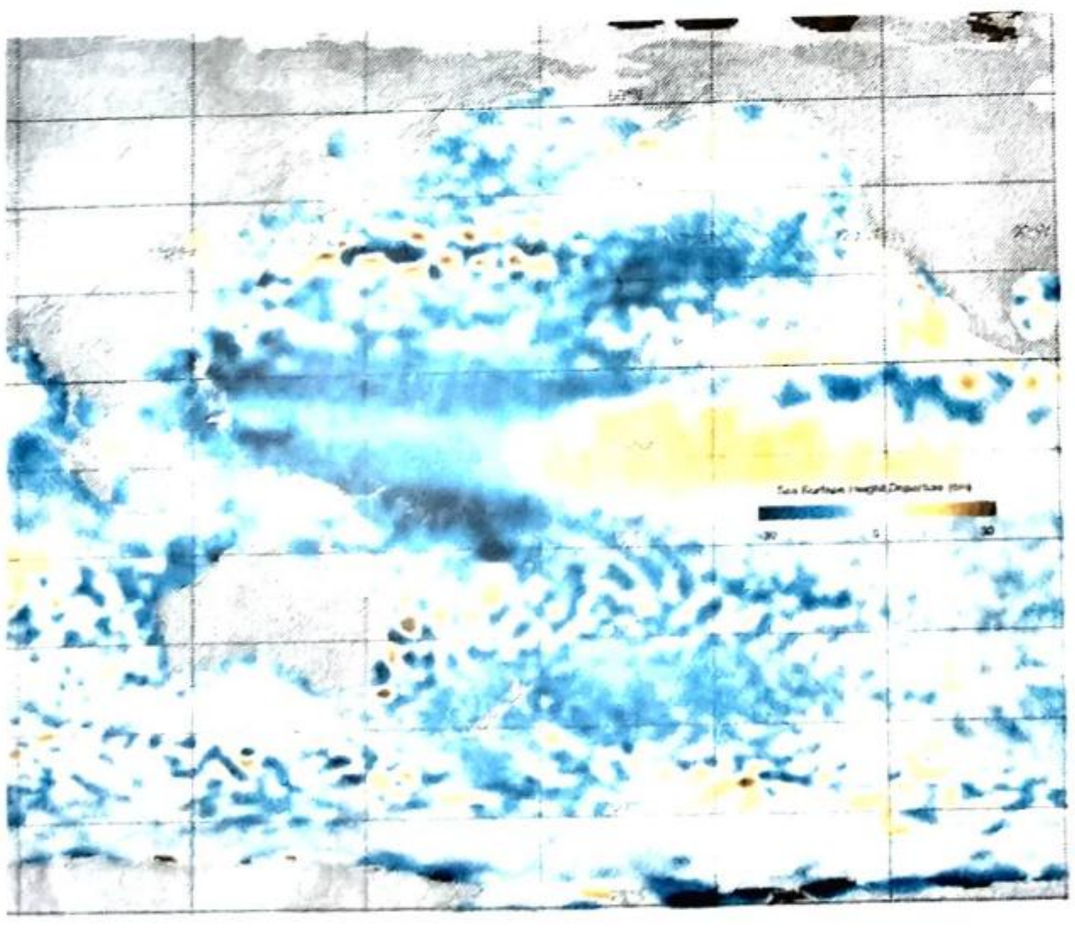
Question 3: Is the sea level in the Western Pacific generally higher or lower than the mean sea level? Lower

Question 4: Propose an explanation for the differences in sea surface height between the Eastern and Western Pacific in September 2016.

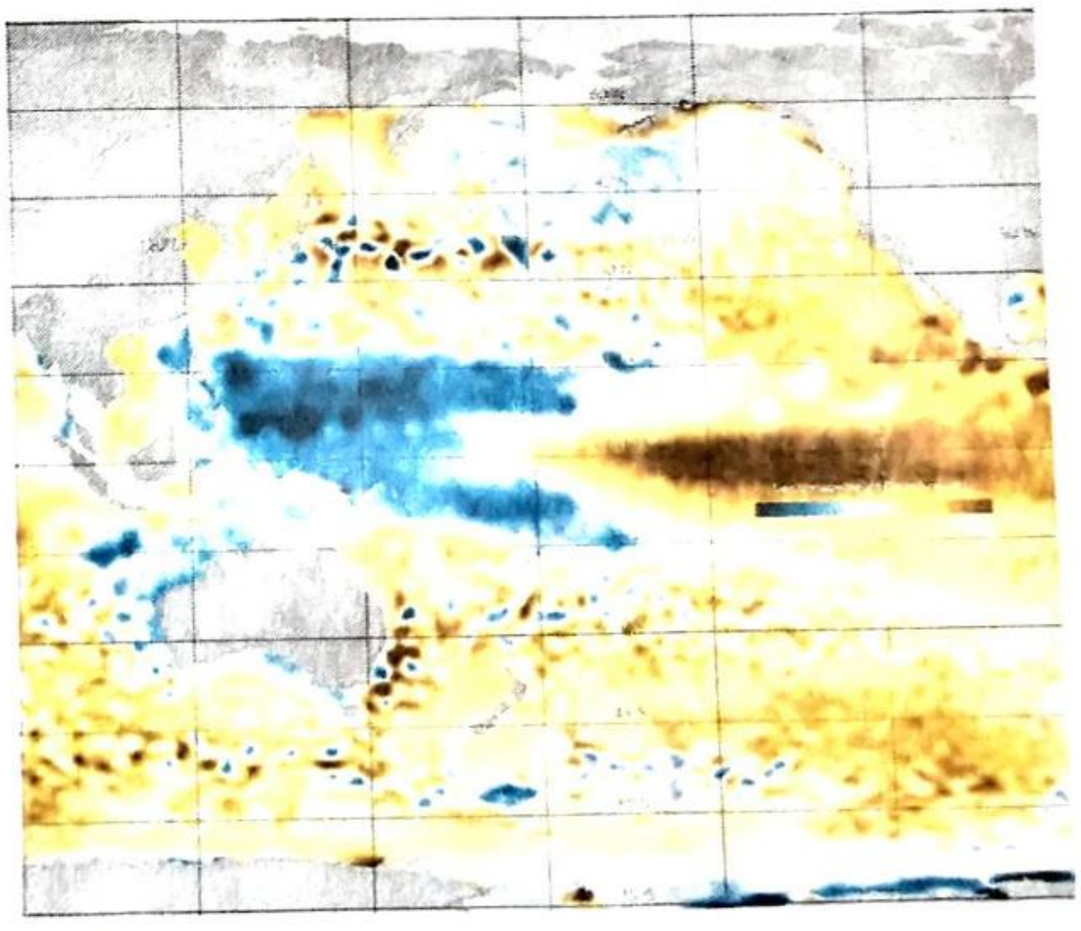
The water in the Western Pacific was cooler than in the Eastern Pacific in Septeber 2016.

Question 5: Next, compare the data maps below from December 1993 and December 2016. What is a major difference between the two maps? Propose an explanation.

The map in 1993 shows a low deviation and the 2016 map shows a high deviation. There was probably a heat phenomenon in the Pacific in 2016.



Sea Surface Height Deviation, January 1993

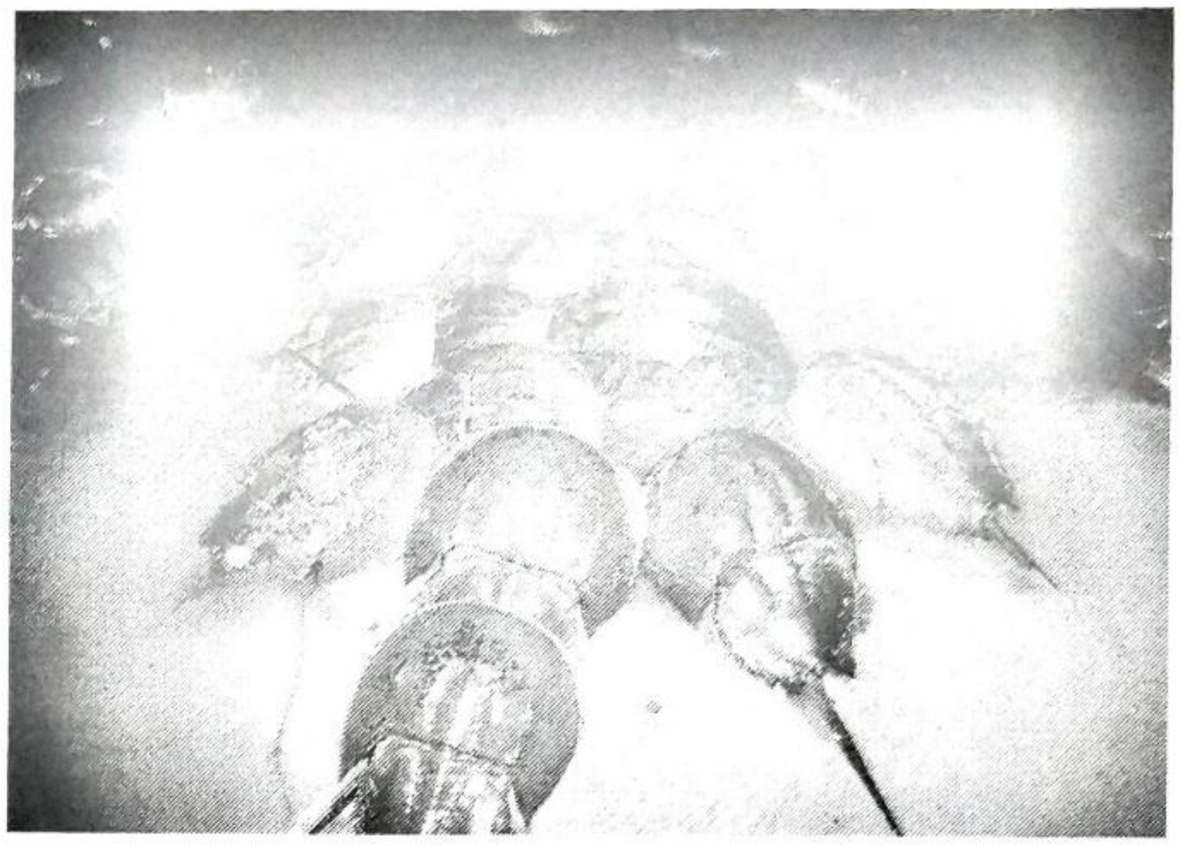


Sea Surface Height Deviation, January 2016

STUDENT WORKSHEET - LEVEL 3

ANSWERING A QUESTION WITH TIDE DATA

Your mission: Travel back in time to May 2016. You are taking a trip to Delaware to see the largest concentration of spawning horseshoe crabs in the world. Spawning is highest during the new and full moons, and you've learned that often the highest numbers of crabs are present during the nighttime high tides.



Each spring, horseshoe crabs come ashore to spawn.

Question: What's likely the BEST date and time to see horseshoe crab spawning in May 2016?

Get the Data: To answer this question, use the tide data tool to create a tide chart.

- Using the map features, zoom into the area around Delaware Bay.
- Select (click) one of the colored markers along the edges of Delaware Bay.
- Inside the small pop-up window, click 'More info' and you will be taken to a new website.
- Scroll down the page and change the date range: From May 1 To May 31
- Click the 'Plot' button. A tide chart should appear.
- Find the legend located directly beneath the chart. Inside the legend, click 'Predictions.' The blue line should disappear, leaving only the 'verified' tide data visible on the chart. Save or print the chart, if desired.

Interpret the data: Using your tide chart, answer the questions below.

1. Approximately, when did the most extreme 'spring' tides occur in May 2016?

   From May 5 To May 11

2. Approximately, what time was the NIGHTTIME high tide, during the above period?

   Note that 00:00 is midnight, 1 AM is 01:00, and 11 PM is 23:00.

   9:30 PM

3. What was the moon phase during these extreme tides?

   a. Full moon
   b. Quarter moon
   c. Waxing Gibbous
   d. Either full or new moon

Draw a Conclusion: The *likely* best time to see horseshoe crab spawning in May 2016.....

Around May 9th @ 9:30 PM

Going further: *On a separate sheet of paper, make a diagram of the approximate orientation of the Moon relative to the Earth and Sun on the date in your conclusion above. Color a blue tidal bulge around the earth, indicating an approximate spring tide or neap tide. Label your diagram.*

STUDENT WORKSHEET - LEVEL 3

CALCULATING MEAN TIDAL RANGE

Question: What was the mean tidal range in Delaware Bay from May 7-9, 2016?

Get the Data: To answer this question, use the tide data tool to create a new tide chart.

- Using the map features, zoom into the area around Delaware Bay.
- Select (click) one of the colored markers along the edges of Delaware Bay.
- Inside the small pop-up window, click 'More info.'.
- Scroll down the page and change the date range to the following:
  From May 7, 2016 To May 8, 2016
- Click the 'Plot' button. A tide chart should appear.
- Find the legend located directly beneath the chart. Inside the legend, click 'Predictions.' The blue line should disappear, leaving only the 'verified' tide data visible on the chart. Save or print the chart, if desired.

Calculate the mean tidal range: Complete the table on the next page. Instructions and an example table is below.

1. Record the height of the *first low tide* and the *first high tide* in your table.
2. Calculate the difference in height between the first low and high tide.
3. Record the height of the next consecutive high and low tides, completing the table.
4. Calculate the mean tidal range.

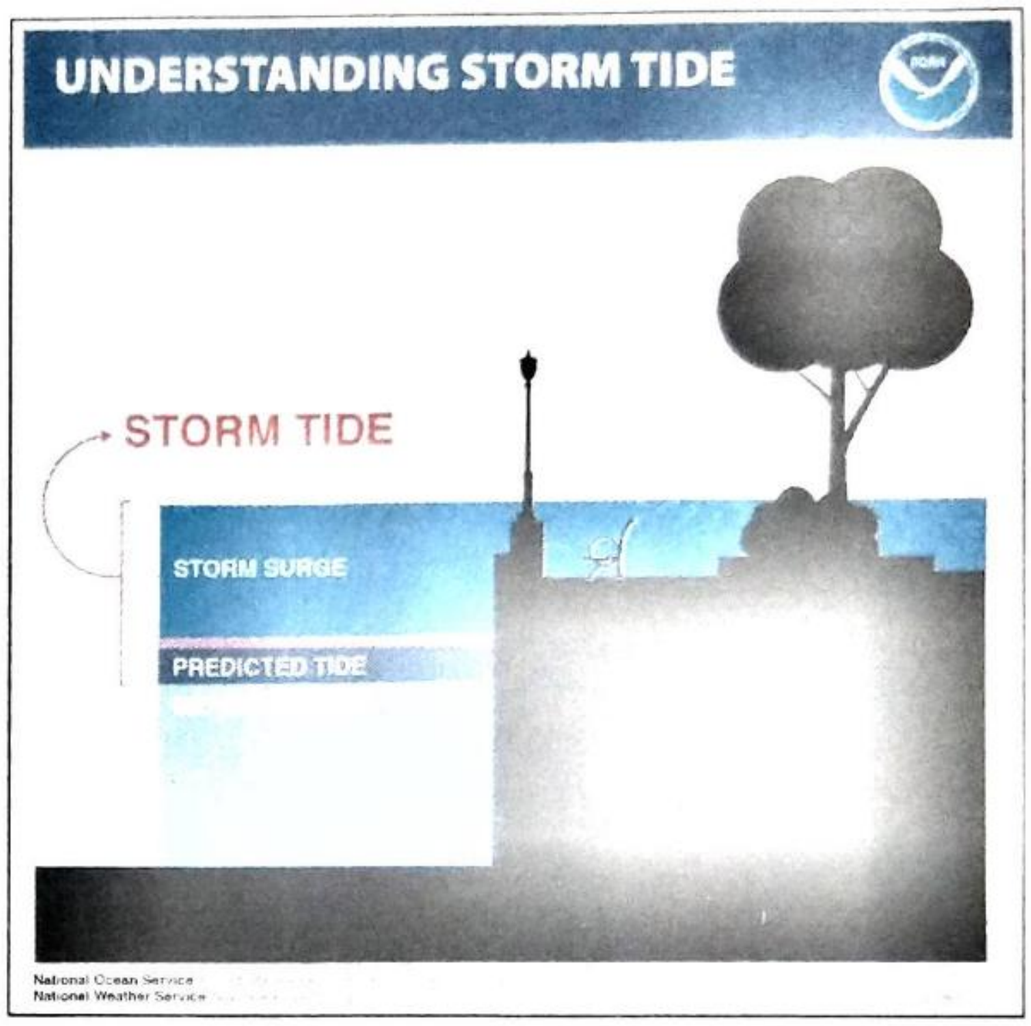
Table: Example using tide data from Lewes, DE

Date	Low tide or high tide?	Tide height (ft)	Tidal Range (high tide height - low tide height)
05/06/2016	High	6.87	
05/06/2016	Low	1.26	6.87 - 1.26 = 5.61 ft
05/06/2016	High	6.20	6.20 - 1.26 = 4.94 ft

Table: Mean tidal height

Date	Low tide or high tide?	Tide height (ft)	Tidal Range (high tide height - low tide height)
5-7	High	5.9	
5-7	Low	-.8	5.1
5-7	High	7.2	
5-7	Low	-.7	6.5
5-8	High	5.7	
5-8	Low	-.7	5.0
5-8	High	7.0	
5-8	Low	-.6	6.4
		TOTAL	23.0
		MEAN TIDAL RANGE	5.75

RESEARCH PROJECT: DETERMINING STORM SURGE HEIGHT



Your mission: You are joining a team of scientists who are studying the effects of storms along the U.S. coast. Your task is to pick a storm event for a coastal location and design a research plan to help you gather data about the water height before, during, and after the storm. You already know something about the typical or average water height in the area due to tides. Your goal now is to determine the additional effect a storm can have on water height. Once your plan is accepted, you are to carry out your data collection, analyze it, and report your findings to the team.

Which Storm?

- Use the internet and search for news stories using keywords such as 'flooding,' and 'storm tides.' Include the location you are interested in, such as 'Miami, Florida.'
- Once you have found a storm to study, record the date(s) when flooding occurred:

  August 29, 2005

- Record the location(s), coastal cities or beaches where the flooding occurred:

  Gulf of Mexico Coast from New Orleans to Biloxi.

Form Your Question: Write your research question in the space below.

Example: How did Winter Storm Jonas impact water levels in Baltimore, MD?

How did Hurricane Katrina impact water levels in New Orleans?

Get the Data: To answer your question, use the data tool to create a tide chart.

- Using the map features in Level 4, zoom into the area near the storm.
- Select (click) one of the colored markers closest to the area you are studying.
- Inside the small pop-up window, click 'More info.'
- Scroll down the page and change the date range to include the dates around the time of the storm. Include at least 2 days before and after the storm occurred.
- Click the 'Plot' button. Save or print the chart, if desired.

Interpret the data: Using your tide chart, answer the questions below.

1. On the tide chart, is there evidence that the sea levels were higher than expected during the storm? If yes, how can you tell?

   Yes. The high tides seemed to average around 5', but during Katrina surged to 25'

2. What was the height of the highest storm tide? 27'

3. At the time of the highest storm tide, how much did the sea level rise above the predicted sea level?

   22'

4. What was the approximate moon phase during the storm *(use the online moon phase calendar)*?

   a. Full or new moon (b.) Gibbous or Crescent c. Quarter moon

5. What effect could moon phase have on flooding due to a storm?

The moon can rise the tides before the storm comes.

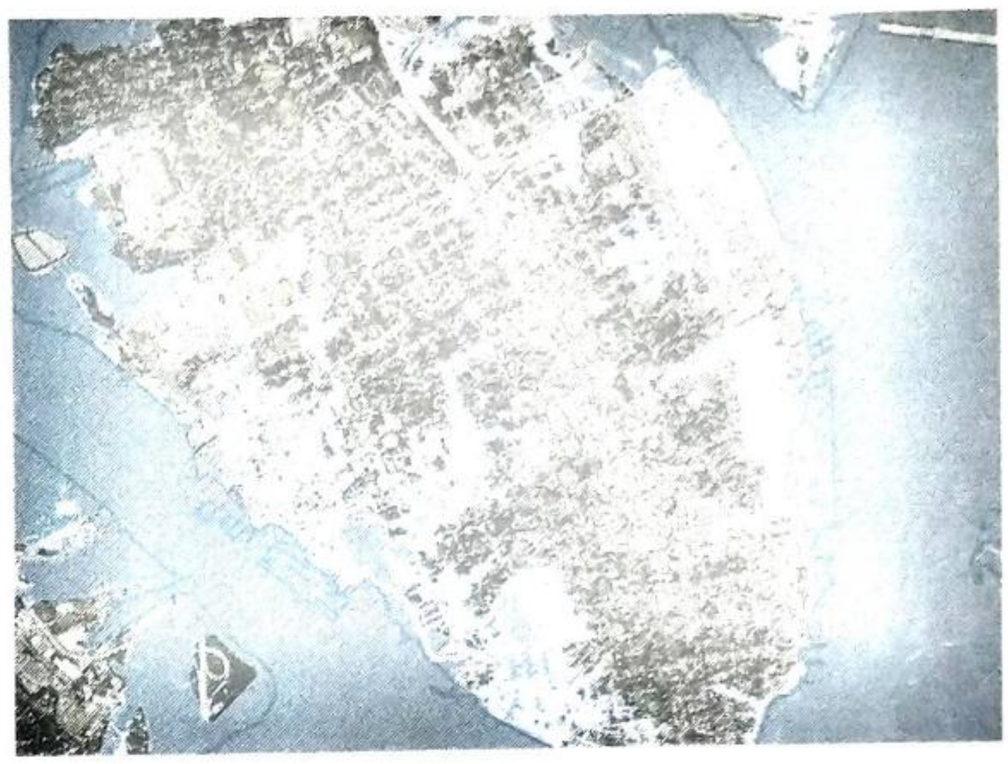
Draw a Conclusion: What is the answer to your question? Use evidence and data to support your conclusion.

The moon Was in a Waning Crescent phase so the tides were building up to be at their most extreme. This, along with rain and wind caused extrenely high and volitile tides.

DESIGN YOUR OWN INVESTIGATION

Develop Your Question:

What was the [redacted] mean variation in New Orleans in June 2020?



Make a Plan: Make a list below of the specific data you will need to answer the question.

Data Set	Date	Map or Graph?
Example: Sea surface height deviation	December 2015	map
Observed Water Levels	June 2020	Graph

Other than the data listed above, what other information (if any) will you need to answer your question?

Need to figure out high tides vs low tides then find variation, then calculate the mean.

Get the data: Use the website to download the data you will need.

Interpret the data: What does your data show? Be specific and descriptive.

I was able to go into the tides + currents website from the NOAA. I found the high + low tides each day from a data listing for last month. From there I took the difference to find the daily variation, then calculated the mean. The average variation was 1.242.

Draw a Conclusion: What is the answer to your question? Use evidence and data to support your conclusion.

The full moon ~~bed~~ was on the 5th and had high tides of 4.32 ft and a variation of 2.38. These were much higher than the mean variation. The month began and ended with a waxing gibbous moon that had the tides much lower than the mean and a variation of less than 1.0 which is well below the mean.