Hurricane Research Project

Name _____
Period _____
Lab # _____

Challenge Statement: You are a senior science advisor for Lousiana's environmental agency. Due to the recent damaging and deadly hurricanes during 2005 (i.e., Hurricane Katrina) through 2008, you, along with your team of climatologists, meteorologists, and environmental impact experts have been tasked to study the danger of future tropical storms. Specifically, you will investigate the potential for future deadly and damaging hurricanes to impact the Gulf Coast area. Your research could help to save thousands of lives and billions of dollars in property damage – good luck!

Required Software: Google Earth (if needed, it can be downloaded here: http://earth.google.com/)

Your Goals:
1) Review the factors that influence hurricane development.
2) Research if trends are present in atmospheric and oceanic conditions which may affect future hurricane frequency and/or intensity.
3) After answering #2 above, you will split up into scientist subgroups (made up of 3 – 4 students) to research a specific "Environment of Concern". Refer to the "Group Work" section below for further details.
4) Create a summary discussing what steps should be taken, if any, to mitigate the danger of future hurricanes in your specific Environment of Concern based on your answer to Goal #2.

Important Note: The questions below are numbered according to the goals stated above. The website resource(s) listed with each question must be completed and read *before* attempting to answer the accompanying questions.

Vocabulary Review

Hurricane:

Tropical Storm:

Frequency:

Intensity:

Air Mass:

Evaporation:

Condensation:

Latent Heat:

Wind:

Feedback Cycle:

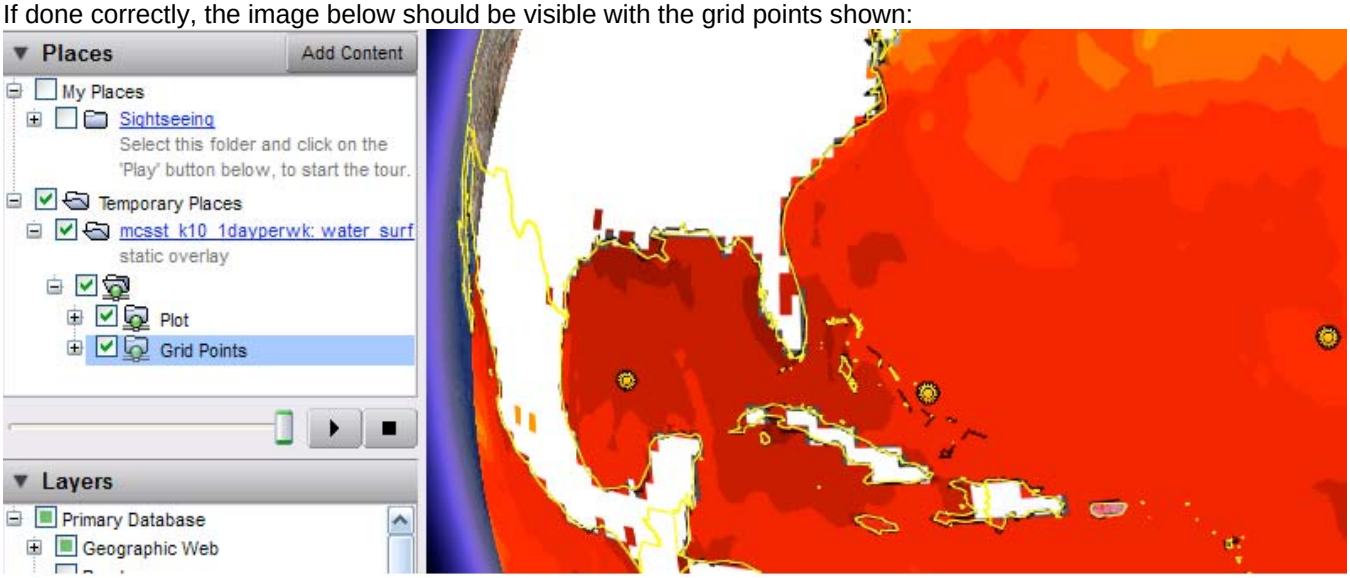
Goal #1: Hurricane Development

1) Go this website: http://mynasadata.larc.nasa.gov/las/servlets/constrain?var=193
Leave all fields as they are shown (the defaults) except for the following pull-down options:

- Select Output: "Plot to Google Earth"
- Set the area of the map for plotting to 50° N Latitude; 5° S Latitude; 110° W Longitude; 5° W Longitude
- Scroll down to "Select Time". Select August 29, 2005.
- Then click "next".

You will be prompted to either save, or open the ocean temperature data file – select "open with Google Earth". In Google Earth, turn all of the buttons under "Temporary Places" on.

If done correctly, the image below should be visible with the grid points shown:



2a) What is represented by the red colors over the oceans in this Google Earth overlay?

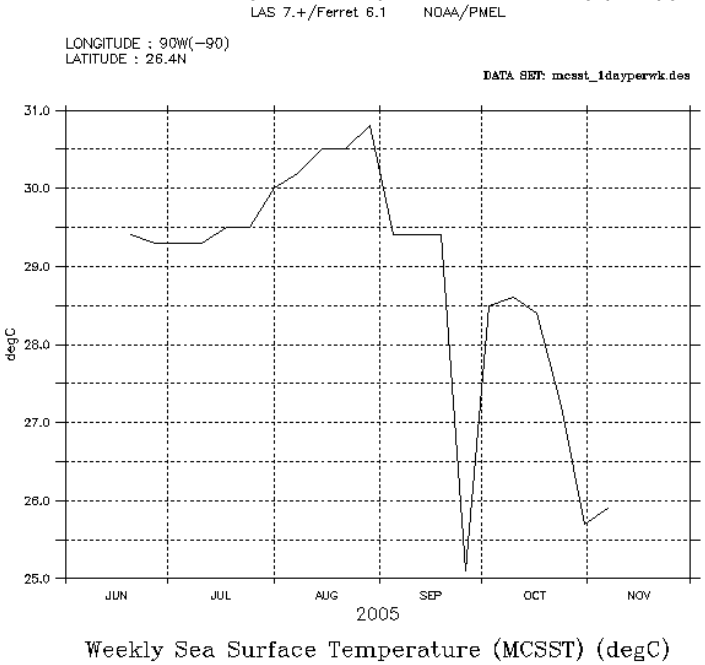
_____

2b) How does the shading over the ocean relate to its surface temperature?

_____

3) Focusing on the dark red in the Gulf of Mexico, what temperature value is shown? _____

Click on the western most observation station located in the Gulf of Mexico. Click on “time series plot”. You should see a graph display for Time vs. Sea Surface Temperature (SST) data. (You should see later summer 2005 dates on the x-axis to confirm you did step 1 above correctly.) Copy and paste that graph in the space below:

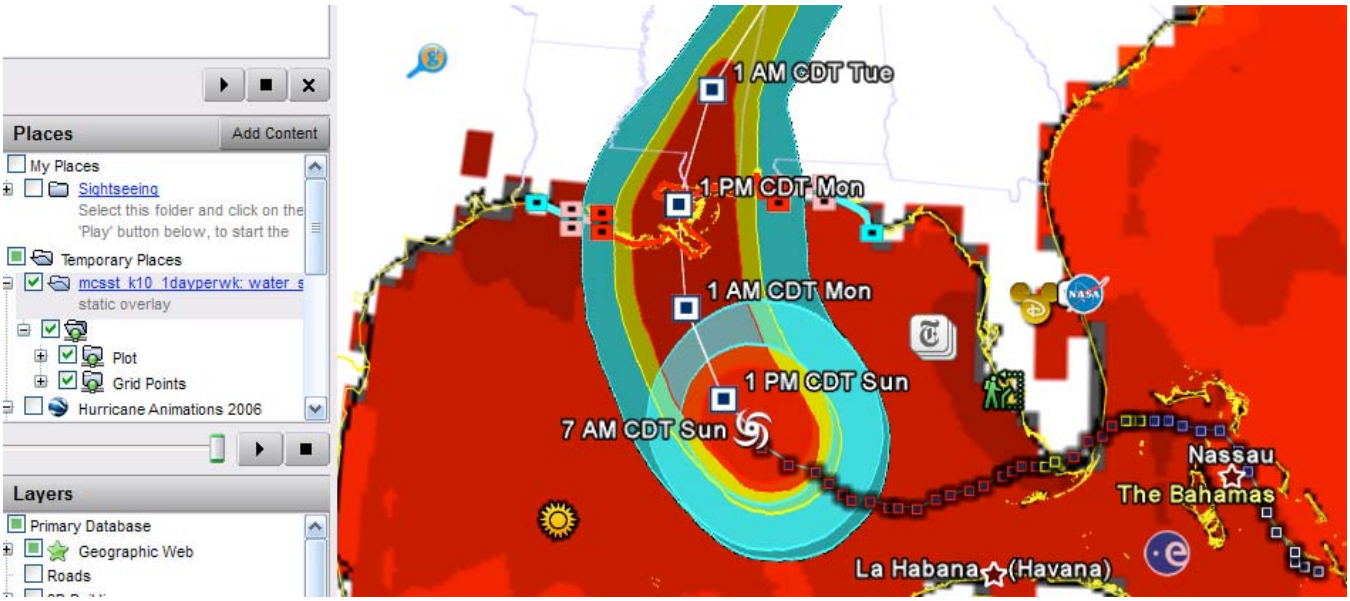


4) What maximum recorded ocean temperature value is shown on the graph (be sure to include units)? _____

5) At what approximate date(s) did this maximum ocean temperature value occur? _____

6) Using your ESRTs p. 13, convert the Celsius temperature value from question 5 above, to Fahrenheit _____

7) Open the following file to load hurricane Katrina data in Google Earth:
http://hurricanemapping.com/data/Katrina22_2005.kmz
Be sure to leave the ocean temperature placemark (titled "mcsst_k10_1dayperwk….") highlighted.



The image above should be visible after opening up the hurricane Katrina Google Earth file. The boxes shown indicate the advisory locations for real-time data collection during the the storm by either reconnaissance hurricane hunter aircraft, or from buoys sending data remotely via satellites. Click on these advisory boxes starting in the southeast and note the storm's classification and its wind speed as the storm moved toward the northwest selecting approximately every 5-8 advisories. Continue this exercise until you reach the hurricane symbol shown as "7 AM CDT Sun".

8) What category hurricane was Katrina at #22? _____ what was the wind speed then?
_____

9) What relationship do you see about ocean surface temperature and hurricane intensity?

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Watch this video click: http://svs.gsfc.nasa.gov/vis/a000000/a003300/a003354/27StormsFull_ipod.m4v
(You may wish to watch this twice paying careful attention to the storms' direction and changing intensity.)

10) What is the single most important ingredient necessary for a hurricane to form? (Support your answer with details on one or more storms from the 2005 Hurricane Season.)

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11) Using Google Earth, examine advisory 10A closely. What inference can be made as to why Hurricane Katrina was temporarily downgraded from a hurricane to tropical storm? *(Hint: Consider your answer question 10 above.)*

12) Other than your answer to #1 above, what other single condition was present for the record breaking hurricane development during the 2005 hurricane season? *(Hint: You may have to watch the 1st half of the video again "27 storms" video again.)*

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Read the following hurricane summary to answer the questions below:
http://earthobservatory.nasa.gov/Features/HurricaneHeart/heart_2.php
Consider the following questions considering the above website reading.

13) Hurricanes often strengthen over warm ocean water. Discuss below how the processes occurring inside a hurricane can "feed the hurricane" in the form a positive feedback cycle?

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Conclusion: Write a paragraph below discussing the factors that influence hurricane formation *and* the cause of hurricanes' tremendous destructive wind speeds (hint: Consider both the atmospheric "ingredients" and oceanic factors.)

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Goal #2: Hurricane Research

You are now to perform research on the current scientific understanding of future hurricane intensity and frequency. Use the websites below to help you perform this work.

Watch the video shown here:
http://www.pbs.org/wgbh/nova/sciencenow/3302/07.html

The website of the MIT professor interviewed in the above video:
http://wind.mit.edu/~emanuel/home.html

An update on the research of the MIT professor referenced in the above link:
http://www.chron.com/disp/story.mpl/tech/news/5693436.html

Read the information in this website:
http://www.gfdl.noaa.gov/~tk/glob_warm_hurr_webpage.html#section1

Research Nasa conclusions here:
http://www.nasa.gov/mission_pages/hurricanes/multimedia/AtlanticHurricanesWithJeff.html

National Geographic Article:
http://news.nationalgeographic.com/news/2005/08/0804_050804_hurricanewarming_2.html

Hurricanes, Climate, and Katrina: Research, Reviews, and Articles from Science Online
www.sciencemag.org/sciext/katrina/

Hurricanes and Global Warming - Q&A
http://www.pewclimate.org/hurricanes.cfm

Analyzing the data
Create a graph summarizing the data found here:
http://wind.mit.edu/~emanuel/Atlantic_SST_PDI_1949-2007.xls

This will be *much* easier if you use excel to do the work for you! If you are unfamiliar with creating graphs in Excel, directions can be found here:
http://www.ehow.com/how_4474239_make-graph-using-excel.html

Once done with your graph, paste your graph (electronic or hard copy sized appropriately) in the space below:

Research Conclusion: Based on your research above, write 1 – 2 paragraphs summarizing what trends, if any, are present in future hurricanes. Be sure to differentiate between the scientific hurricane "intensity" and "frequency".

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Goal #3: Environment of Concern – Group Work

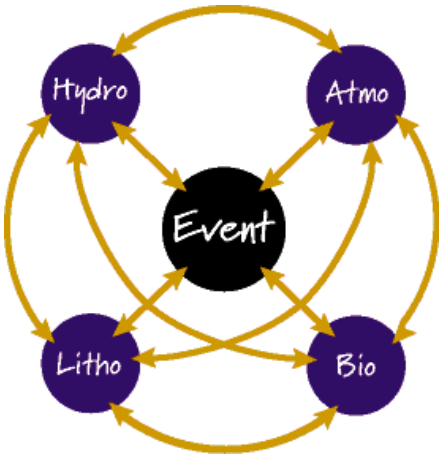
In this section you will be drawing connections between your previous understanding of hurricanes (Goal 1), and scientific data for future hurricanes (Goal 2). Specifically, you will discuss the interaction between a specific "sphere" and the "event". Refer to the group lists for your "sphere of influence" assignments. If needed for review, refer to your textbook definitions of the terms below:

Hydro = Hydrosphere:

Atmo = Atmosphere:

Litho = Lithosphere

Bio = Biosphere



Reread the Challenge Statement from the beginning of this activity. You will now create a summary of how the event – an Atlantic Ocean Hurricane – affects your specific "sphere", or the "environment of concern" (EOC). For example, if your group is assignment the Biosphere environment, then your job is to determine all possible pathways that a hurricane could impact all living matter. The Biosphere could include plants, trees, and wetland areas etc.

Goal #4: The Report/Summary of Findings

What to hand in: Your report will address the following two main topics: (a) what impacts a hurricane would have your environment of concern (see goal 3 above), and (b) what steps, if any, could be taken to mitigate this potential impact.
Note: You should be sure to include citations and explanations for your conclusions. Additionally, you should explain the basic background behind your scientific relationships. For example, if you explain the affects of storm surge on wetland coastal areas, then you should describe the basic science of how storm surges form, as well as, what are wetland coastal areas. You may accomplish Goal 4 by:

A) Writing a 2-3 page (not counting graphs, pictures, or any non-text visual) summary paper

OR

B) Creating an interactive presentation (i.e., Google Earth Tour)

OR

c) A visual presentation (poster, powerpoint, etc.)

**You may use resources listed in Goal 2 to help you with your research.

Rubric:

Evidence of Hurricane Processes (Goal 1)				
4	**3**	**2**	**1**	**Rationale**
Clear and complete explanations discussing cause and effect relationships.	Explanations contain relevant hurricane and meteorology terms, but clarity and cause and effect relationships missing at times	Explanations contain little relevant hurricane and meteorology terms, and cause and effect relationship explanations are missing.	Little relevant meteorological vocabulary is included or used properly. Summary of ideas is lacking and incomplete.	
Data Presentation (Applies to all Goals)				
4	**3**	**2**	**1**	**Rationale**
All graphs, tables, and data presentations are for the correct in terms of time interval, data variables, and labeling (i.e., graphs)	Graphs and tables are included, but lack clear labeling of axes, or time frame is incorrectly shown for Goal 1 (Question 3)	Graphs and tables are missing when required, or data included does not match the web-referenced data sets.	Graphs and tables are missing or missing major components.	
Hurricane Research Summary (Goal 2)				
4	**3**	**2**	**1**	**Rationale**
Clear explanation of hurricane trends is present and includes original ideas is supported by citations.	Explanation of hurricane trends is present but lacking supporting evidence. Citations are missing.	Explanation of hurricane trends is incomplete and missing supporting citations.	No explanation or appropriate citations are present.	
Independent Environment (Sphere) of Concern Research & Presentation (Goals 3 & 4)				
4	**3**	**2**	**1**	**Rationale**
Group research is clear, investigations a variety of impacts to appropriate “sphere”, and includes a variety of citations (peer reviewed websites, books, journals, etc)	Group research requires clarifying, only 2-3 impacts to appropriate “sphere” are included, and a only 2-3 citations are present.	Group research requires clarifying, only 2-3 impacts to appropriate “sphere” are included, and a only 2-3 citations are present.	Only one part of “sphere” work is complete: research or presentation. If presentation is present, no research or citations are included.	
Identify your personal contribution to your group				
4	**3**	**2**	**1**	**Rationale**
Active participation in all areas of the PBL. Collaboratively worked with group members to assign and fulfill roles.	Participated in most of the areas of the PBL. Worked with group members.	Limited work done, or chose to work on area not assigned to you, or not involved in group role assignment.	No work done	