Investigating Hurricanes

Part A: 2005 Hurricane Season

1: Generalizing from the information in this video, describe where most hurricanes form and how they move across the Atlantic Ocean basin. Does there seem to be anything particular about those places that helps hurricanes to form?

2: Come up with four questions about things from the video that you didn't understand.

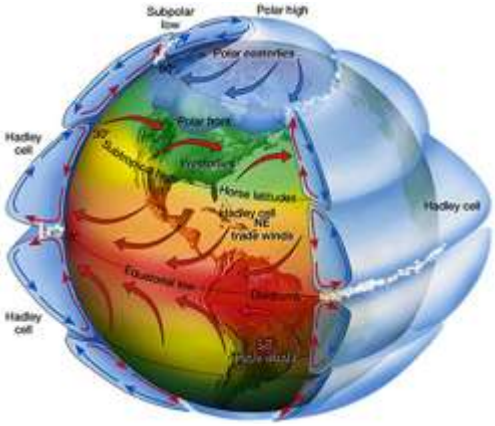
1)

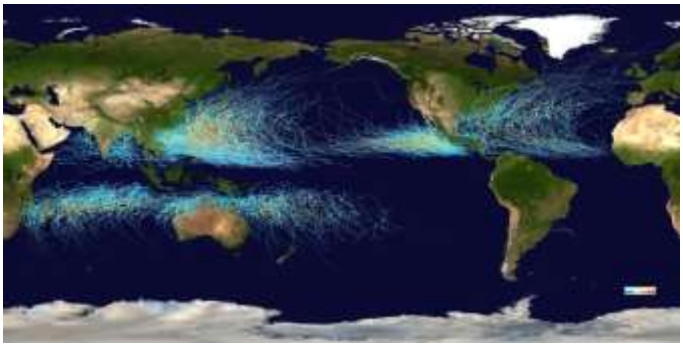
2)

3)

4)

Part B: Patterns of Hurricanes





3: Based on these two images, is there a connection between global wind patterns and the movement patterns of hurricanes? In your own words, describe how global wind patterns illustrated in the first image influence the overall patterns you see in the second image.

4: There are a few areas on the second image where there is little to no hurricane activity. The most prominent one of these is the empty stripe running along the equator. In the 20 years covered by this data, not a single hurricane has been seen to cross through this region from one hemisphere to the other. Based on what you've learned so far, hypothesize as to why we might expect this to be the case.

5: Does the absence of equator crossing storms in the second image mean that such events do not happen? Justify your answer.

Part C: Scale of a Hurricane

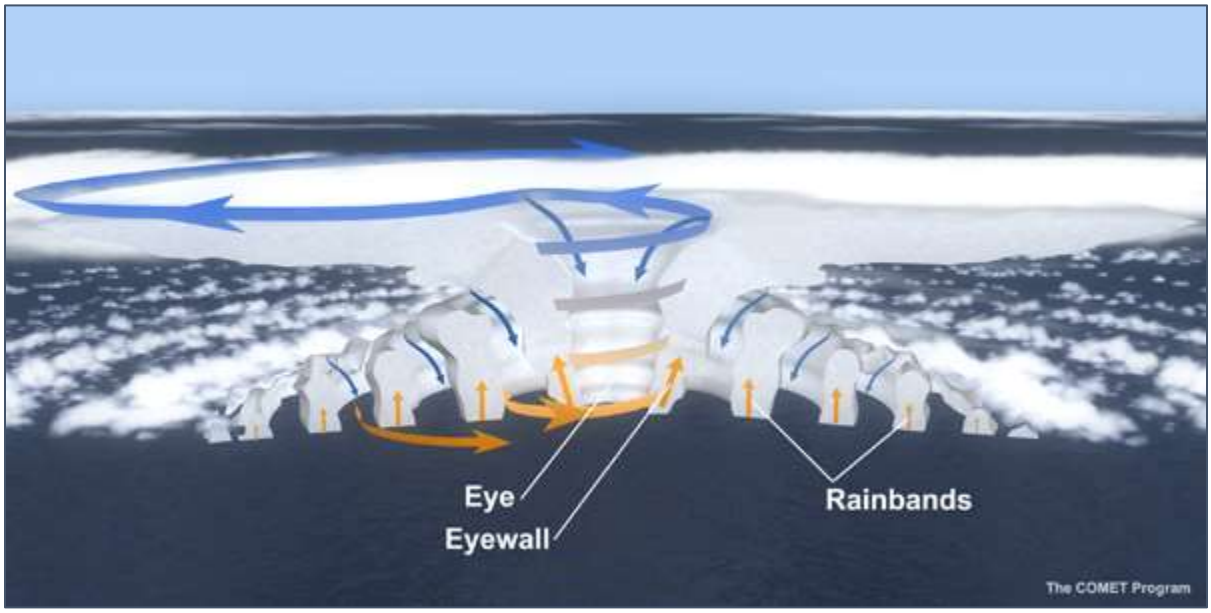
1. The amount of rain that fell during Hurricane Isabel's lifetime was 400 trillion tons of water. Knowing that the density of water is 1 ton per cubic meter and 1 kilometer is 1000 meters, how many cubic kilometers of water condensed as rain out of Hurricane Isabel?

2. How does your answer compare to the volume of Lake Superior which contains 12,100 cubic kilometers of water?

3. Using the numbers that you calculated, determine the total amount of heat released by the condensing water. You need to know that the energy released in the condensation of 1 kg of steam into 1 kg of liquid water is 2,260 kJ.

4. The largest nuclear device ever detonated was a 58-megaton bomb tested by the Soviet Union in 1961 which released 2.4×10^{14} kJ of energy. How does this compare to the heat energy released by Hurricane Isabel over its lifespan? Show your math and then interpret the results in your own words.

Part D: Under the Hood



Step 1: Internal Structure

1: There isn't a legend to explain it, but what does the color of the arrows denote in the image?

2. The air rushing into the core of the storm turns under the influence of the Coriolis force. In what direction does it rotate?

3. The air at the top of the storm spreads out from the core of the storm. This outflow is affected by the Coriolis Force, but it is flowing away from rather than towards the center. Which direction does the diagram show the outflowing air rotate?

Part E: North and South

1. The term "storm surge" refers to water that is pushed up to higher-than-normal levels at the shore by the winds of a storm. If the storm surge occurs at high tide, then the coast experiences a worst case situation. The spiraling nature of winds in cyclones result in winds on one side of the storm blowing on-shore (towards the land) in the same direction as the storm's motion. In the Northern Hemisphere, the storm surge occurs on

the right side of the eye (using the direction of motion as facing forward) because that is where the winds and storm motion reinforce each other. On the other side, where winds are blowing offshore (away from the land) there is no storm surge and in fact most times the water level is lower than normal. Which side of a Southern Hemisphere cyclone will experience the higher storm surge? Draw a diagram of a hypothetical storm to illustrate how you came to your conclusion. Label the relevant parts of the storm as well as the wind and motion directions.

2. Watch the brief animation of Cyclone George making landfall at the north coast of Australia in March of 2007. Based on your answer to **#1**, was the storm surge from Cyclone George to the East of the eye or to the West when it came ashore?

3. Below are satellite photos of Hurricane Katrina on August 29, 2005 (left) and Hurricane Catarina on March 28, 2004 (right). Katrina was the costliest storm to hit the United States; Catarina was the only hurricane ever recorded in the South Atlantic.

Based on these two images and descriptions, compare and contrast these two storms.

4: Catarina was on the borderline between Category 1 and 2. Despite its relatively weak status, the storm damaged or destroyed about 26% of all the buildings in the region of Brazil where it came ashore. The storm caused about $25 million in damages. Based on what you've learned, formulate an explanation for how a relatively weak storm could cause so much damage.