Scientists Warn of Rising Oceans From Polar Melt

Engaging Context Data Integration

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NASA Endeavor Science Teaching Certificate Project

June, 2014

Abstract

This paper documents the results of a ten day data collection of ocean levels in two areas of the United States that were seriously damaged during Hurricane Katrina in 2005 and Hurricane Sandy in 2012. The purpose of this study is to provide evidence to answer the question, "Is there a correlation between the irreversible melting of the Antarctic Ice Sheet, rising sea level trends and the devastating water damage incurred in the aftermath of these devastating storms?" Additionally, this investigation is being conducted as a viable basis for a lesson plan that adheres to The Next Generation Science Standards (NGSS), and the tenets of the Nature of Science (NOS) and the Nature of Math (NOM). This lesson plan seeks to fulfill the four subject areas, Science, Technology, Engineering and Math being discussed during the NASA Endeavor STEM Methods course in May through July, 2014.

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Is there a correlation between the irreversible melting of the Antarctic Ice Sheet, rising sea level trends and the devastating water damage incurred in the aftermath of Hurricane Katrina in 2005 and Hurricane Sandy in 2012? In order to provide evidence to answer this question, the author created a spreadsheet using Apple's Numbers software (see Figure 1). A collection of sea level data was recorded over a period of ten days beginning on May 30, 2014 through June 8, 2014 using the National Oceanic and Atmospheric Administration's Observed Water Levels at Sandy Hook NJ (NOAA, 2014) and Shell Beach LA (NOAA, 2014). Additionally, a baseline reading of water levels for both locations as documented by NOAA on June 1, 2013 was recorded as a means of comparison.

Ten Day Data Collection - MLLW - Sandy Hook NJ and Shell Beach LA

Date	Sandy Hook NJ	Shell Beach LA
6/1/13	0.419	0.341
5/30/14	3.44	2.67
5/31/14	5.06	2.14
6/1/14	3.96	2.24
6/2/14	4.68	2.17
6/3/14	5.0	1.78
6/4/14	3.63	1.8
6/5/14	2.35	1.5
6/6/14	4.832	1.69
6/7/14	4.809	1.398
6/8/14	5.389	1.322

Figure 1

Based on the data in Figure 1, two charts were created to provide graphical representations to facilitate the interpretation of data. A 3D Stacked Chart (see Figure 2) and a 3D Bar Chart (see Figure 3) provide tangible evidence of sea level readings.

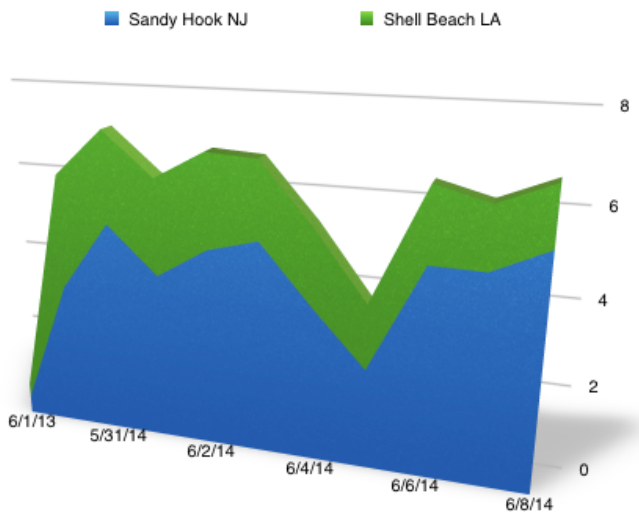

Figure 2

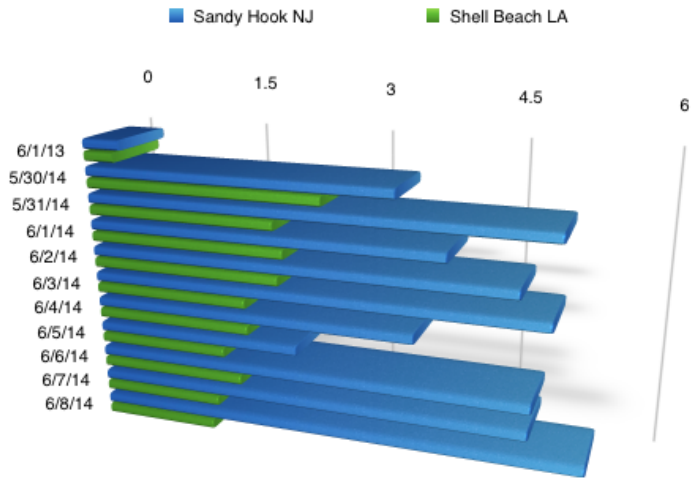

Figure 3

During the analysis of this data, it became remarkably evident that the baseline reading observed one year ago reveals compelling evidence that there has been a sustained rise in sea levels for both Sandy Hook, NJ and Shell Beach LA. Fluctuations in the ten day span of readings can be attributed to daily high and low tides. A modification should be made to the criteria of data collection to be consistent with either high tide readings or low tide readings. The data was collected at approximately six p.m. each day. Since NOAA provides an open database of sea level observations, then data collection can be safely made in retrospect. A maximum reading can be observed by keying in date criteria and observing the resulting chart for the highest sea level recorded on that date.

More data can be recorded and graphed for the same date range for several years. An indicative change in data collection would be to record sea levels from May 30 through June 8 during 2004, one year preceding Katrina, and the same time period during 2005. The same date range could be recorded to examine Sandy Hook data for May 30 through June 8 of 2011 and the same date range in 2012 to discover trends.

The NSTA Framework document outlines Scientific and Engineering Practices. This data-driven exercise of collecting sea level data fits well within the category of planning and carrying out investigations. Pratt states, "A major practice of scientists is planning and carrying out systematic scientific investigations that require identifying variables and clarifying what counts as data" (Pratt, 2012). This concept works within my proposed integrated lesson plan that will have the students investigate real-world solutions to the management of water levels in communities. Pratt suggests, "Engineering investigations are conducted to gain data essential for specifying criteria or parameters and to test proposed designs" (Pratt, 2012).

As I reflect on the merits of this data-driven exercise, I am compelled to find more supporting evidence and models to present to my students in the fall during our web design course. The lesson plan that I am developing around this topic culminates in the "E" of STEM whereby my students will make design proposals for a community in danger of rising sea levels. National Geographic provides a haunting interactive website entitled, "Rising Seas Interactive:If All the Ice Melted"(Folger, 2013). By clicking on each continent, the user can view the former coastline and the resulting land area after a dramatic polar melt. A proposed Superstorm 2100 is represented on a National Geographic webpage that postulates a Hurricane Sandy-like storm and the resulting map of Manhattan (National Geographic, 2014). The Urban Green-Blue Grids website provides a design tool that proposes solutions for "sustainable and resilient cities"(Urban Green-Blue, 2014). Existing amphibious homes in Maasbommel, The Netherlands are documented on the website Urban Green-Blue. These homes adjust based on the level of surrounding water (Potz & Bleuze, 2009).

The "S" of STEM is adequately covered by the original New York Times article that was the genesis of this lesson plan. The first tenet of the Nature of Science Matrix is, "Science Investigations Use a Variety of Methods" (Next Generation Science Standards, 2013). The New York Times article provides the reader with the conclusions of two groups of scientists. Gillis and Chang state, "Two scientific papers released on Monday by the journals Science and Geophysical Research Letters came to similar conclusions by different means" (Gillis & Chang, 2014). One paper published by the University of California, employed satellite images and air measurements. There is an active link within the article that displays the actual report for the

student to view. The second paper mentioned in the article utilizes computer modeling with measurements of ice flow to substantiate their findings.

The "T" of STEM will be manifested in the production of a webpage that is designed by each student to represent the answer to the original question, "Is there a correlation between the irreversible melting of the Antarctic Ice Sheet, rising sea level trends and the devastating water damage incurred in the aftermath of Hurricane Katrina in 2005 and Hurricane Sandy in 2012?" This webpage will be produced in HTML5 which recognizes mobile client devices and is designed using cascading style sheets.

The "M" of STEM is manifested in the collection of data, producing graphical representations and then interpreting the data. Comparison to historical data benchmarks makes current data more relevant. This analysis is a good exercise in fulfilling the Common Core State Standards Initiative High School: Statistics Interpreting Categorical and Quantitative Data. (Next Generation Science Standards, 2013)

Conclusions and Further Study

The data-driven investigations are valuable to incorporate into STEM planning. Real world issues and proposed solutions are engaging topics for students. By providing authentic data to students, the classroom becomes a think-tank where students can be producers rather than consumers of technology. Deep understanding can be achieved by analysis of data, models provided by experts in the field and student-proposed solutions to a real world problem.

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