

MY COMMUNITY, OUR EARTH

MIAMI

VISUALIZING SEA LEVEL RISE AT THE DEERING ESTATE, MIAMI, FLORIDA, USA

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Problem Statement: How would creating tangible elevation contours on land enable the visualization of sea level rise at the Deering Estate?

Abstract

South Florida is topographically flat with an elevation that ranges from sea level to about 25 feet and is therefore threatened by an increase in sea level rise and storm surges from hurricanes. The Deering Estate is an historically significant site in South Florida and will be inundated as the ocean level increases and has already been a victim of a massive storm surge. To help better visualize what the Deering Estate will experience as the water level rises, students created elevation contour lines on the lawn of the Deering Estate.

Global Warming Concerns

Global warming is real and it poses a threat to historical sites in South Florida. The world's mean temperature has risen 1.4°F during the last 100 years, and most of it has occurred during the last few decades. Although there are many consequences of global warming including changes in local climate, the spread of vector-borne diseases, and ocean acidification, the two most immediate concerns to Florida are rising sea level and the threat of stronger storms.

Worldwide, sea level rise is occurring and per satellite imagery, sea level rise is accelerating. It is expected that by 2100, sea level could rise between 3 feet and 6 feet. Higher sea level rise could occur if the Greenland and West Antarctica ice sheets melt more quickly than originally thought, as some scientists are predicting. Florida is especially susceptible to the impacts of sea level rise



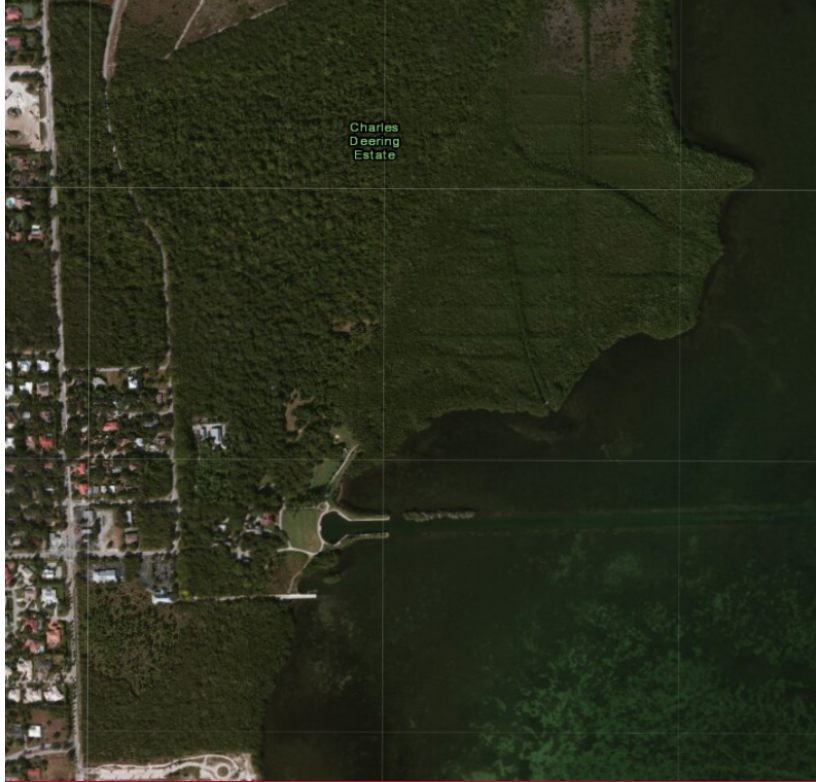
The Richmond House

due to its flat terrain. In fact about 9 percent of the state is within 5 feet of the current sea level.

Climate scientists are still debating the effect of global warming on the formation of hurricanes and other storms, but most agree that the increase in worldwide temperatures will result in a higher number of stronger storms. The recent storm Sandy that devastated the northeast is an example of a strong storm that some attribute, in part, to global warming. New Orleans experienced the strength and destruction of Katrina, and South Florida dealt with the damage of Andrew. Although global warming may not have been responsible for the formation of any of these storms, it is thought global warming may have played a role in maintaining their existence rather than dying out due to cooler water and temperature.

The Deering Estate

Florida has many historical landmarks, one of them being the Deering Estate. The Deering Estate was the home of Charles Deering, born in 1852 and through several business deals be-



MyCOE map image of the Deering Estate

came co-founder and chairman of International Harvester Company. In 1913 he began his acquisition of what would eventually become known as the Deering Estate. Amongst its many structures the estate has a remarkable three-floor wooden house known as the Richmond House as well as an impressive three-floor stone mansion referred to as the Stone House. After the death of Deering’s last heir the estate was sold to the State of Florida and Miami-Dade County in 1985. The Deering Estate is placed on the National Register of Historic Places.

In total, the current estate covers 444 acres and not only contains the historical buildings of Deering’s home, but also has a variety of ecosystems including mangrove forests, sea-grass beds, sand bars, rocky debris, tidal flats, island sand dunes, and is also acclaimed to have the largest tropical hardwood hammock in the continental United States. The site is also known for its archeological richness and contains evidence that the area was home to people 10,000 years ago making the Deering Estate one of the most archaeologically significant sites in the Eastern United States.

The MyCOE map shows an aerial view of the

Deering estate. To the north mangrove forests are visible, and the roofs of the main buildings are seen at the southern end. An ocean channel and boat dock are prominent in the water. In the extreme lower left are roofs of buildings that are not part of the Deering Estate.

Additionally, included are photos of the two best known structures on the estate, the wooden Richmond House and the Stone House.

The entire 444 acre estate ranges in elevation from sea level to a maximum of just under 16 feet. There is a narrow ridge on the property that runs somewhat parallel to the shoreline on which some historical structures and archeological artifacts are located, but Charles Deering built his residence on slightly lower ground. The Stone House mansion sits on ground that starts at around 7 feet to maximum of 11 feet, while the wooden Richmond House sits on ground that ranges from 9 feet to 11 feet. Half of the property is only 1-4 feet above sea level. Such a low elevation poses a flooding hazard during normal periods of high tides and storms, but the hazard becomes more severe with the combined threats of sea level rise and strong hurricanes as may happen due to global warming.

On August 24, 1992, Hurricane Andrew, a category 5 storm, hit South Florida and the Deering Estate. The north end of the eye wall touched the estate, resulting in much damage and or destruction. Flood waters reached 16.6 feet and waves from the storm



The Stone House

surge damaged the second floor of the Stone House. The Deering Estate was closed for 8 years as renovations took place. As global warming assists in the formation of stronger storms the De-ering Estate will probably experience a similar storm in its future.

Sea Level Rise Contour Lines

To visualize the impact of sea level rise at the Deering Estate, students from Felix Varela Senior High visited the grounds and created visible 1-foot contour intervals using plastic yellow tape to show the encroachment of the sea as the water level rises. To prepare for the activity, several students researched the elevation points at the Deering Estate using a combination of MyCOE maps and Google Earth maps. The MyCOE map showed the Deering Estate at a lower resolution, but the Google Earth map was taken on a day when there was a special event at the site; tables, tents and tables are seen in the image. However, since the Goggle Earth map provided more detail it was selected to be used as the basemap. Students drew contour lines on top of the basemap using 1-foot intervals. Below is the Google Earth map with the contour lines.

To set up the yellow tape as contour lines, it was decided to only place lines on the yard in front of the Stone and Richmond Houses; the rest of the property had too much vegetation to allow the tape to be laid down easily and the vegetation would have made the lines difficult to be seen. It was noted the 1-foot contour line was along the inner ocean wall of the boat docking area, making it very tricky to lay down yellow tape at the estate, and the 2-foot contour was next to the dock edge and far away from the 3-foot contour line, which was much closer to the houses. Therefore, it was decided to only lay down the contour lines for the 3-7 foot contours. Using the Google Earth contour map students located the 3-7 foot elevation points and started to lay down the yellow tape. However, there was a strong wind and even though the students had weights to hold down the tape, the wind was strong and the tape would start to blow away. As the morning progressed, the wind became stronger, so only the 4-7 foot contours were laid down; by the time the 4th contour line was completed, the others were having to be redone. None-the-less, the results were impressive.

A photo of the Deering Estate with the contour lines.





Students are standing on a line indicating with their fingers the elevation of their line.

Increase in Sea Level	Anticipated Year
0.5 feet	2018 - 2024
1 foot	2031 - 2042
2 foot	2048 - 2066
3 foot	2063 - 2085
4 foot	2074 - 2100
5 foot	2084 - 2112
6 foot	2094 - 2122

Above is the predicted timeframe for when the shoreline will reach each of the contour lines

Results

Although it may be easy to understand that land will become submerged as sea level rises, it is more impressive to actually see where the shoreline will be in the future. A map of sea level rise might be thought-provoking, but to stand where surf will be crashing onshore is much more moving. When Charles Deering built his Stone House he built it far enough away from the shoreline as to feel safe from high tide and most storms, and he certainly was not aware that by the year 2050 his house would have the ocean touching his porch.

The pictures of lines where the shoreline will be as the water rises 4-feet, or 5-feet, or 6-feet is moving. It is also moving to realize the contours indicate the average location of the water between high and low tide – it does not consider what occurs during a storm. Hurricane Andrew is a reminder of how much higher water may rise.

References

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