Testing low-cost flood & tidal sensor technologies to identify installation sites for inland flooding in coastal communities of Queens, NYC

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Introduction

Floods often take place due to an overwhelming amount of water from intensive rainfall, making it very hard for drains and sewers to properly remove this liquid from an area. Additionally, flooding can take place in areas due to ‘land subsidence, and the loss of natural barriers’ (National Oceanic and Atmospheric Association [NOAA], 2018, para. 1). However, flooding can occur when no rainfall takes place. This is known as nuisance flooding (sunny-day flooding), where tides may affect the amount of liquid on land. Nuisance flooding is detrimental in the way that it causes erosion. With a recent example of this being the collapse of a Miami residential building in June of 2021 (Partlow et al., 2021). This type of infrastructure erosion not only leads to financial burdens, but can also lead to deaths. In an effort to gain a better understanding on flooding and its risks, past tracking methods such as aerial flood watch, computer vision datasets, and radars were used. However, these methods were inefficient in some capacity. But with sensors and community engagement, researchers, communities, and New York City government agencies could understand and improve the frequency and severity of flooding in New York City.

Goals & Hypotheses

This project has three main objectives:
(a) Determine if low cost technology is effective in comparison to past tracking methods.
(b) Determine if tide sensors and Community Flood Watch can help find a flood prone area.
(c) Find patterns in the experiences of Rockaway residents through a survey

This project has two hypotheses:
(a) Low cost sensors will show reliable flood and tide data compared to other methods.
(b) Inland flooding events can be connected with high and low tide data from the sensors.

Methods

Flood Sensor

The CUNY Community Sensor Lab and FloodNet designed an arduino based sensor which uses an ultrasonic detector to measure the height of water. The sensors were installed by the RISE students at Marina 59 down the street from RISE Headquarters. The sensors will be first used to track the tides which will determine the accuracy and effectiveness of the technology. This data will be compared to tide data from NOAA sensors near JFK.

Flood Survey

In an effort to gain more information in regards to flooding in the Rockaway Peninsula, we constructed a survey, and shared it through RISE’s social media platforms and newsletter. This survey was inspired by a similar survey created by Community Flood Watch. This survey, however, included more about recurrence, education and advocacy.

Inland Flood Scouting

Team members also scouted the rockaway area looking for inland flood prone areas. These locations were photographed at different times to see if correlations existed with high and low tide.

References


Results

SurveyMonkey

How often Rockaway residents experience flooding, via Survey Monkey

Tide Sensor and NOAA Comparison

Fig. 2 This image shows the sensor used for this project. It’s components are: (1) the battery, (2) the radio transmitter, (3) the antenna, and (4) the device’s computer.

Fig. 7. This graph shows the frequency of which Rockaway residents experience flooding based on their answers on Survey Monkey. The category as are follows: once a day; once a week; once every 4-6 weeks; no response.

Fig. 4. This graph shows the level of interest Rockaway residents had with learning about flooding based on their answers on Survey Monkey. The category as are follows: very uninterested, uninterested, indifferent, somewhat interested, and very interested.

Fig. 5. The NOAA tide table for July 29, 2021 with a 7:41 P.M low tide prediction.

Fig. 3. This image shows the sensor used for this project. It's components are: (1) the camera, (2) the radio transmitter, (3) the antenna, and (4) the device’s computer.

Fig. 8. On July 30, 2021, the Rockaway Marina 59 tidal sensor pinpoints the second high tide event of the day at approximately 2:26 P.M. NOAA predicts high tide at 2:03 P.M, which is 23 minutes before the actual time high tide occurs.

Fig. 6. The NOAA tide table for July 30, 2021 with a 2:03 P.M high tide prediction.

Fig. 9. The NOAA tide table for August 2, 2021 with a 7:41 A.M low tide prediction.

Fig. 10. This is a photo taken at 5:18 P.M on July 30th 2021. For this day, high tide was predicted to be at 2:26 P.M. A huge puddle of water on the right hand side of the photo, but there are no other signs of flooding in sight. Additionally, the location for this photo is different in comparison to Fig 1.

Low & High Tide Images

Fig. 11. This is a photo taken at 5:16 P.M on August 2, 2021. The NOAA tide table predicts high tide at 5:17 P.M. However, the high tide was observed at 5:16 P.M.

Fig. 12. This is a photo taken at 5:16 P.M on August 2, 2021. The NOAA tide table predicts high tide at 5:17 P.M. However, the high tide was observed at 5:16 P.M.

Fig. 13. This is a photo taken at 5:16 P.M on August 2, 2021. The NOAA tide table predicts high tide at 5:17 P.M. However, the high tide was observed at 5:16 P.M.

Fig. 14. This is a photo taken at 5:16 P.M on August 2, 2021. The NOAA tide table predicts high tide at 5:17 P.M. However, the high tide was observed at 5:16 P.M.

Discussion

SurveyMonkey Results

Most community members experience flooding every 4-6 weeks, which means that it may be caused by weather events rather than tide events.

Many people may not have enough information about flooding given how interested people are with learning about flooding.

Floods are most seen in Jamaica Bay, however, and it may be caused by weather events rather than tide events.

Survey data also revealed how community members were frustrated with a lack of support from government agencies and local agencies when it comes to flooding. NOAA Tide Tables vs. Tide Sensors

While the tide table predicted low/high tide close to the actual Marina 59 sensor, it was not as accurate with 10+ minute differences for both low and high tide.

NOAA Tide Table data comes from J.F.K. Airport, which may account for the delay of high and low tides.

Due to confounding variables such as rain and road damage, the conclusion that inland flooding events can be connected with high and low tide data from tide sensors couldn’t be reached. More data is needed for a clear consensus to be determined.

Next Steps

In the future, pictures should be taken consistently to exclude any confounding variables.

Install a flood sensor in Jamaica Bay to better understand the severity of flooding, and obtain resources to improve this part of Rockaway.

More infrastructure policies on the maintenance and improvement of roadways/transportation are placed in the Rockaway community.

Local organizations, agencies, and programs that aid and invest in sustainable water management and hydrology technology need to be better funded by public/private sectors.

Elect local officials that support infrastructure repair, and are passionate about improving flooding problems in a particular area.