



# Wave Rider Buoy

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## Introduction

- Sunny day flooding
  - Tides 2ft higher than the average high tide during King Tide events
  - Damages property and infrastructure
  - Often unexpected
- Rising sea levels
  - Due to global warming
  - Floods will happen more frequently and cause more damage
- Wave buoy
  - Collect data on wave conditions
  - Wave height and period
  - Establish baseline for calm conditions
  - Data from buoy will contribute to predictive methods for flooding frequency and severity for coastal areas
    - Hampton, NH

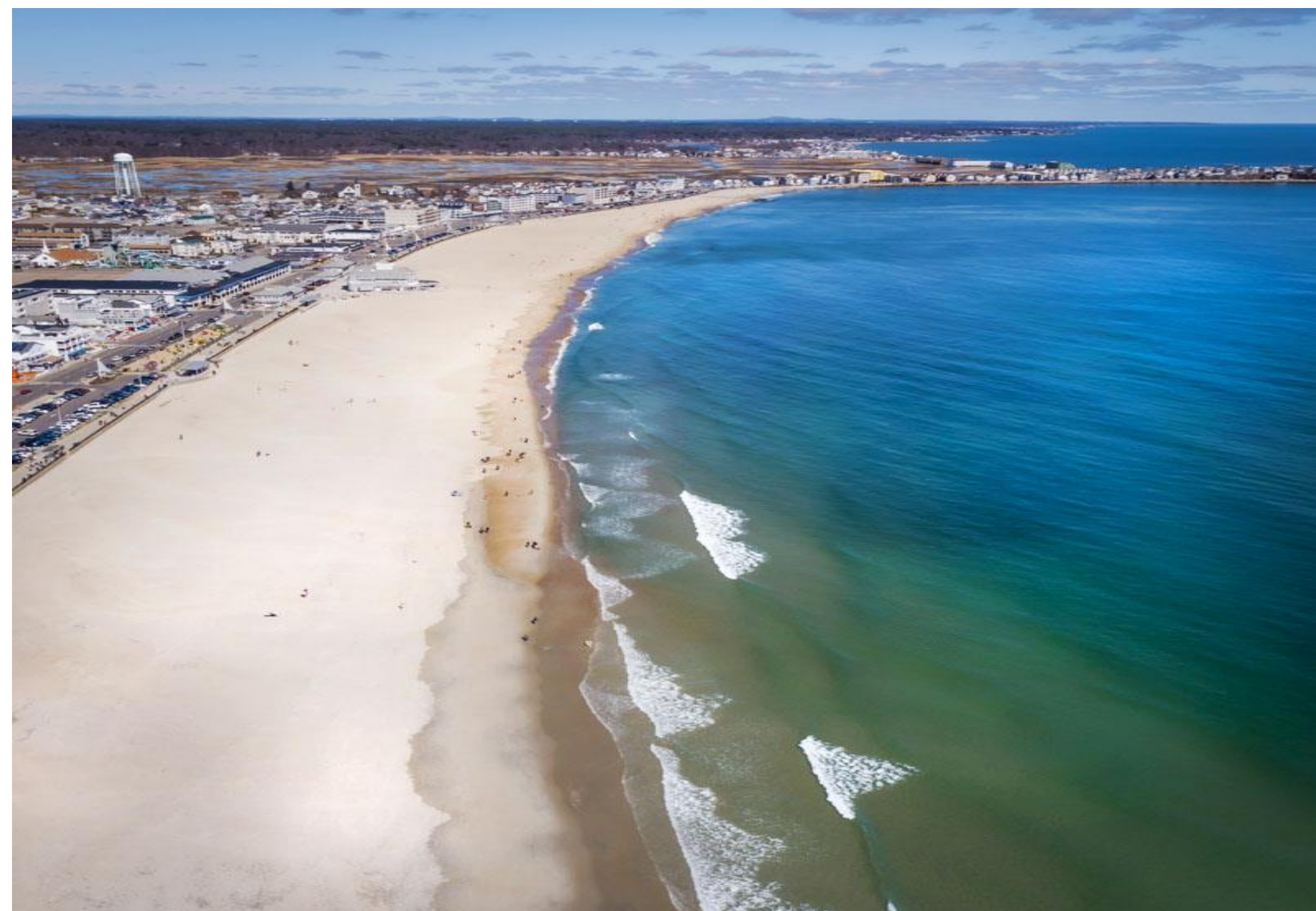


Figure 1: Aerial view of Hampton Beach, NH

## Data

4/8/2022,15:35:39,-2.85,2.38,0.33,-0.22,-0.01,0.99,-0.15,0.25,-0.07  
 4/8/2022,15:35:40,-2.88,2.60,0.49,-0.22,-0.01,0.99,-0.15,0.25,-0.06  
 4/8/2022,15:35:41,-2.41,3.45,0.72,-0.22,-0.01,0.97,-0.15,0.25,-0.07  
 4/8/2022,15:35:42,-3.24,2.38,0.46,-0.22,-0.01,0.99,-0.15,0.24,-0.06  
 4/8/2022,15:35:43,-3.36,2.41,0.45,-0.22,-0.01,0.98,-0.14,0.25,-0.07  
 4/8/2022,15:35:44,-2.98,2.52,0.54,-0.22,-0.01,0.98,-0.14,0.25,-0.07  
 4/8/2022,15:35:46,-1.55,-41.60,9.21,-0.22,0.15,1.05,-0.24,0.24,0.02  
 4/8/2022,15:35:47,-61.61,69.38,108.25,0.00,-0.22,0.52,0.18,0.49,-0.12  
 4/8/2022,15:35:48,-14.35,-95.60,-140.98,0.13,-0.08,0.98,0.33,0.44,-0.10  
 4/8/2022,15:35:49,18.16,28.25,-0.72,-0.23,0.01,0.93,-0.06,0.51,-0.11

Figure 2: Data output off on-board buoy components during test

- With such large amounts of data collected, functions must be written to process acceleration values to wave amplitude and bearing
- Future plans are made to improve ease of data analysis
- With these, data can be beneficial and easily interpreted by the residents of Hampton

## Design

- Components included
  - Real time clock
    - Records current date and time, even when disconnected from power
    - Planning on associating our data with other groups' instruments in real time
      - Weather station, flood elevation sensor
    - Greater diversity in data allows for predictive capabilities for wave conditions during flooding in the future
  - Accelerometer
    - Measures raw acceleration values in X, Y and Z axes
  - MicroSD datalogger
    - Records date/time, acceleration values and outputs to a microSD for simple data collection

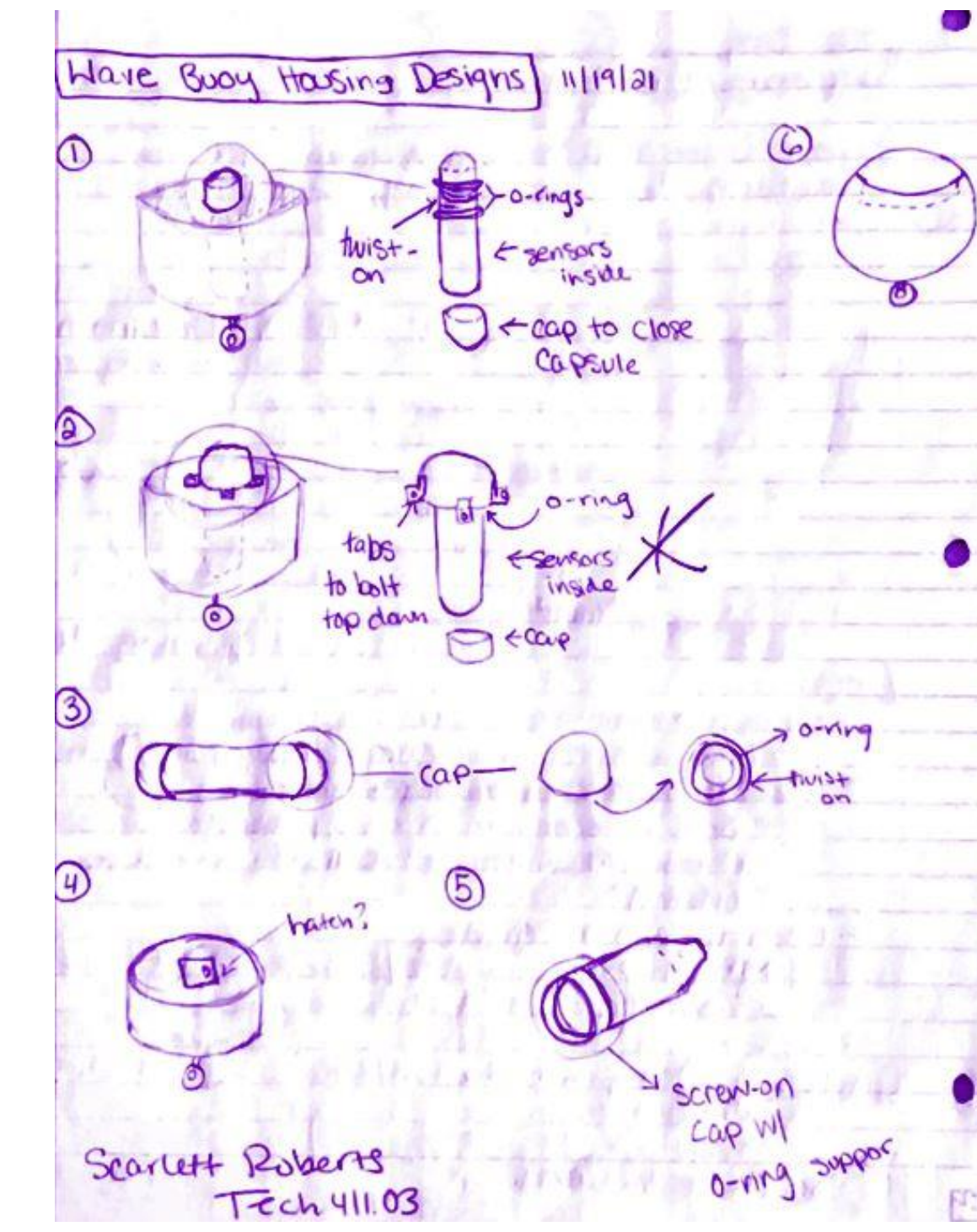


Figure 3: Previous design iterations of buoy housing

## Pictures

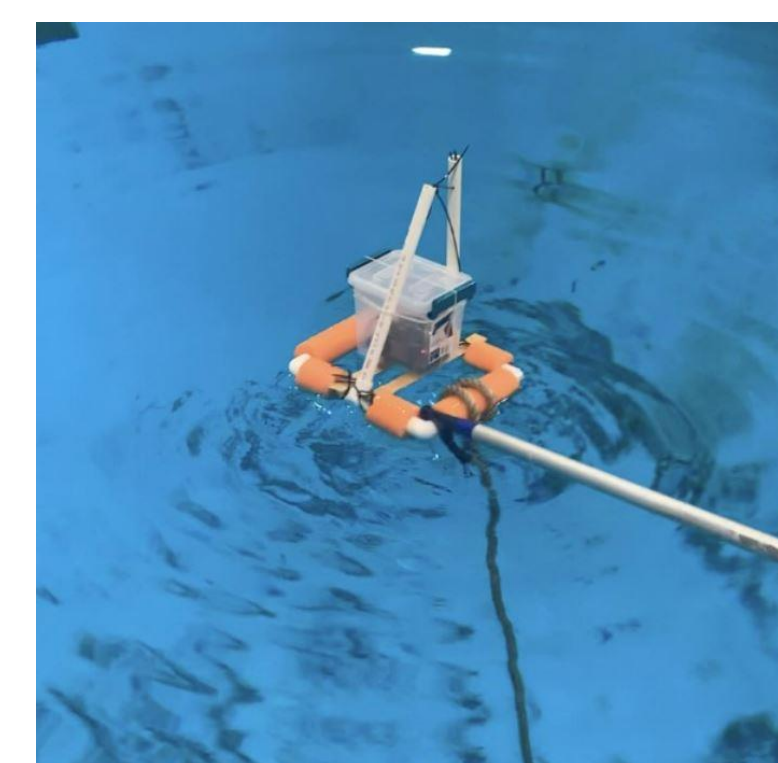


Figure 4: Testing Circuitry in Wave Tank



Figure 5: Wave buoy housing

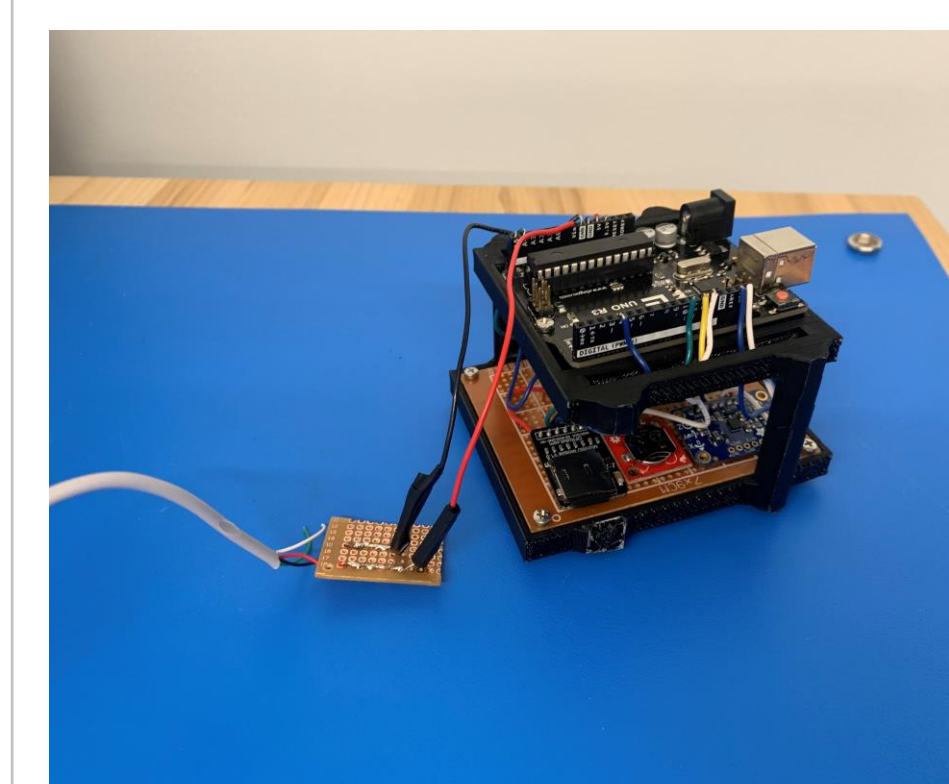


Figure 6: Arduino UNO Sensor hub

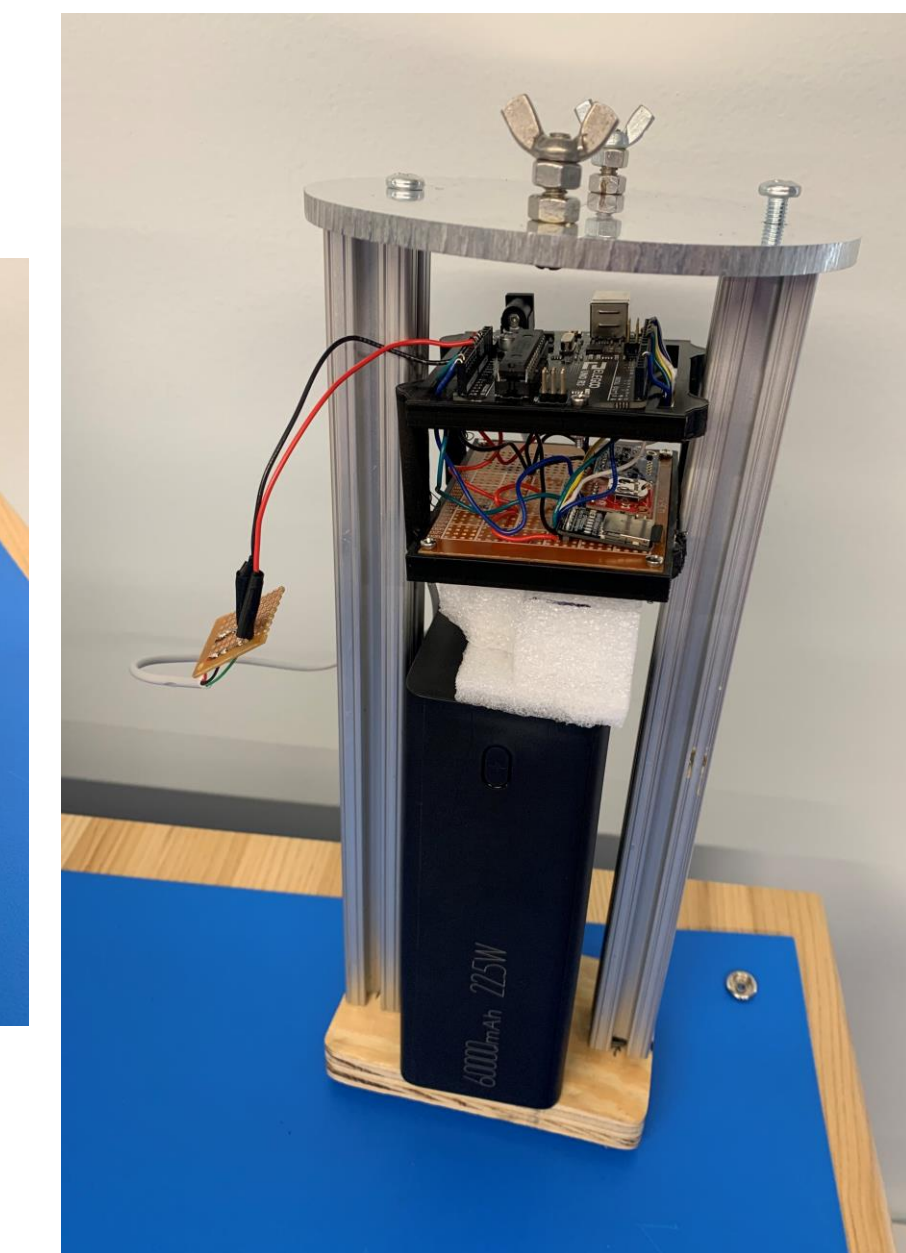


Figure 7: Sensor hub, battery in "cage"

## Graphs

- Acceleration data from the wave tank located in Chase Laboratory
  - Tested sensor response by placing circuitry in wave tank and creating waves around it with a rod
  - Graphs below show the results from that test

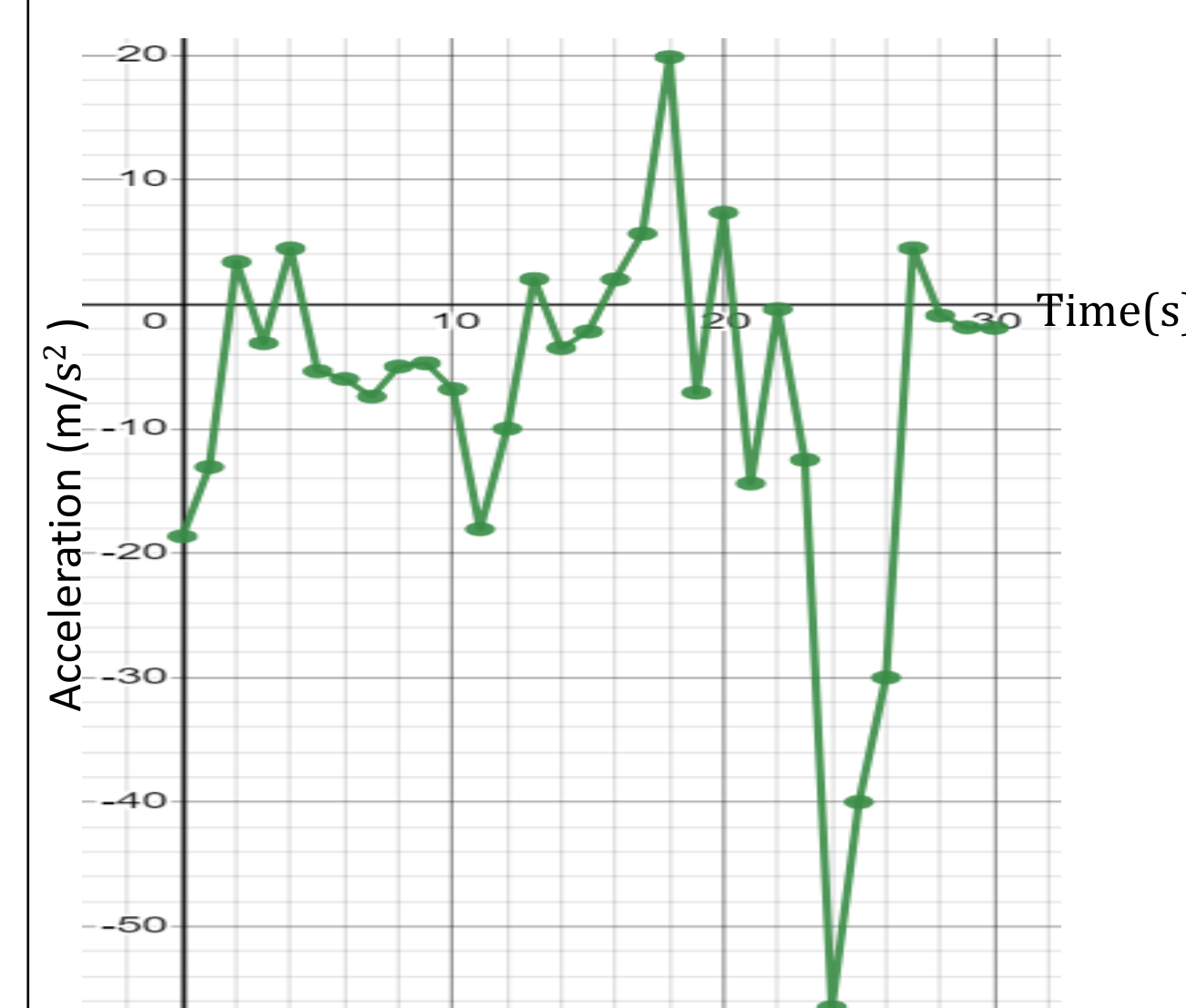


Figure 8: Raw acceleration values in the x direction

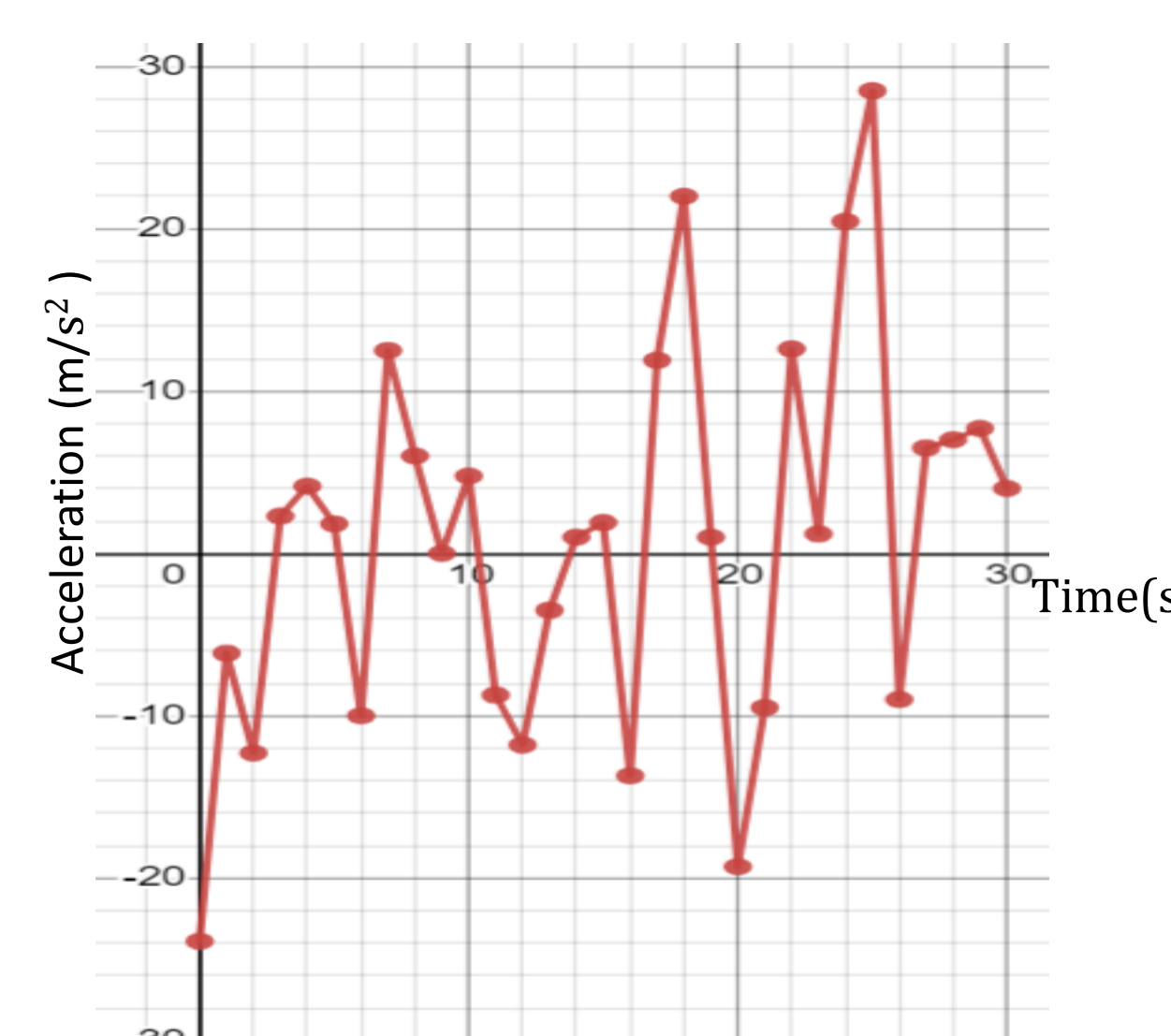


Figure 9: Raw acceleration values in the y direction

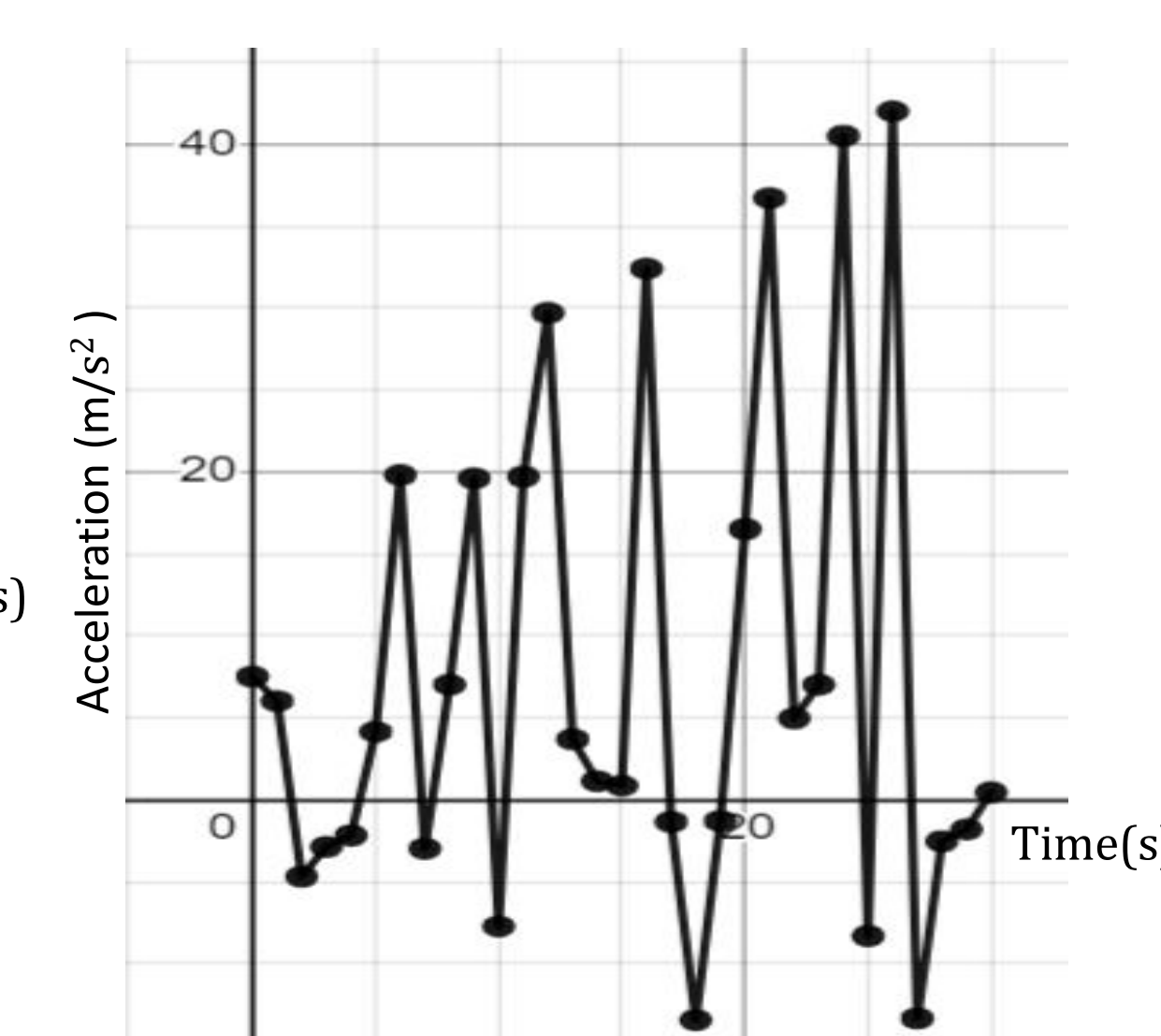


Figure 10: Raw acceleration values in the z direction

## Conclusion

In conclusion, we were able to create a functioning wave buoy with waterproof housing and circuitry that can measure acceleration and wave amplitude. We were able to collect data in the wave tank in Chase Laboratory. Our next steps would be to place our buoy in the Hampton estuary to gather real-life data that would be useful to Hampton residents.



Figure 11: Wave Tank located in Chase Laboratory UNH

## Future Plans

- Further Testing
  - Further conduct controlled testing in the UNH wave and engineering tank
  - Analyze sample data to set a baseline for field data
- Deployment
  - Obtain community approval for deployment
  - Deploy wave buoy in Hampton Harbor
  - First deployment: 1 week (to ensure proper function)
  - Deployments following: 2-3 weeks (to obtain a large range of data that will show obvious trends in the data)
- Data Analysis
  - Convert acceleration data from deployments into wave height and period
  - Compare data and analysis to other groups in cohort to detect correlations or discrepancies
  - Make data accessible to the community and easy to understand

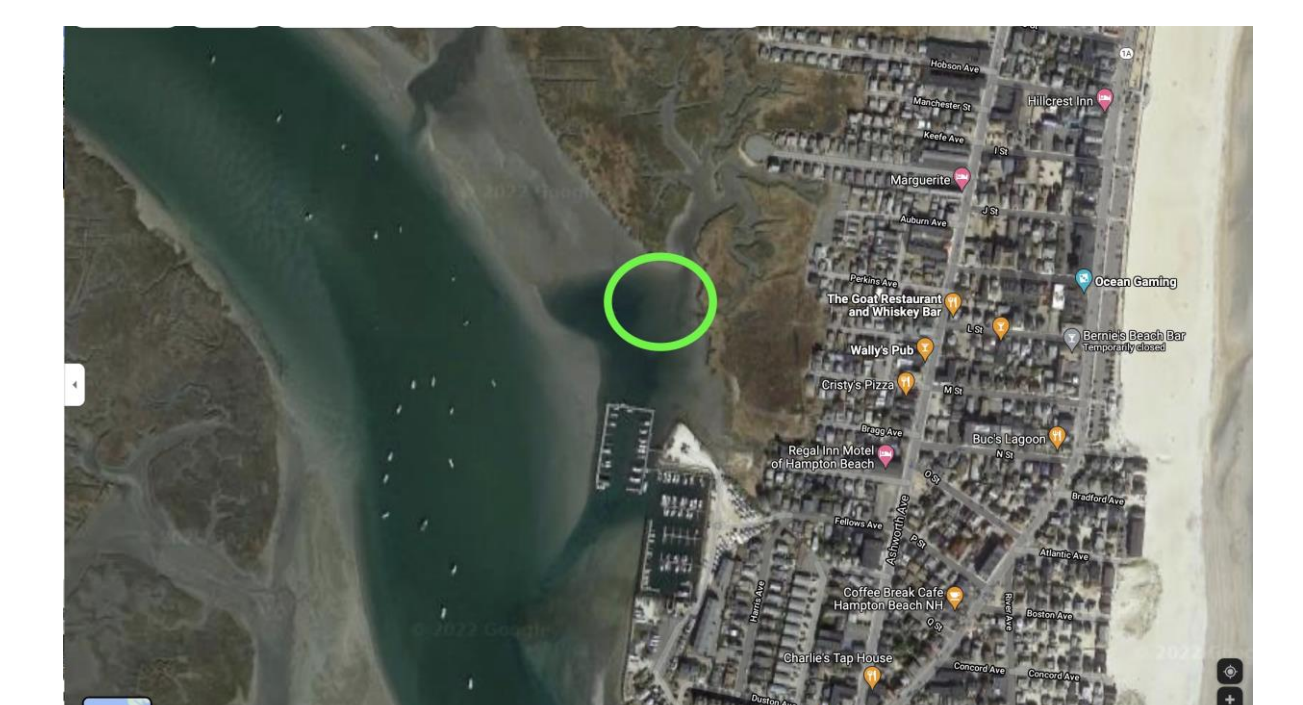


Figure 12: Intended deployment location (marked by green circle)

## Acknowledgements

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