Catch the King

Project Summary and Findings

King Tide Volunteer Mapping - Pilot Project
October 27 - 30, 2019 | Hampton, NH

Catch the King: Overview

New Hampshire Sea Grant and UNH Extension received funding from the NH Coastal Program to pilot a project working with citizen science volunteers in coastal New Hampshire to collect real-time flooding data during a projected high "king" tide on Oct. 27-30, 2019. These dates were selected to coincide with local efforts to photograph coastal flooding (King Tide Photo Contest, NH Coastal Adaptation Working Group).

Project staff reviewed and examined a variety of mobile apps, including What's Your Water Level, Liquid Field Notes, My Coast, Collector for ArcGIS, Anecdata, ISeeChange, and WeatherCitizen. Assessing features such as ease of use, ability to collect point and line data, ability to collect photographs, and data sharing options, the team selected the SeaLevelRise app for the pilot project (see Sea Level Rise Solutions: Sidebar).

Sample Site Selection

Project staff met with employees from the Town of Hampton (emergency managers, police, Hampton Department of Public Works) on May 21, 2019 to discuss the project, identify data needs to improve decision-making, and to identify potential flooding hotspots that could be the focus of king tide mapping. Managers prioritized 4 locations on public property that flood regularly and would be accessible to volunteers on foot. In addition, managers expressed interest in connecting flood reach data to the water level data collected at Hampton Harbor tide gauge, used by emergency managers to communicate flood risk to community members. Comparing these data could help clarify to a wider audience the degree of variability between flood levels and tide height (e.g., a 10' foot tide at the tide gauge will have variability in where flooding actually occurs based on wind speed and direction, precipitation, etc.).

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Resources

- NH Coastal Adaptation Working Group
- Sea Level Rise Solutions
- Sampling Protocol
- Hampton Harbor Tide Gauge
- Isles of Shoals Buoy
- Community Collaborate Rain, Hail and Snow Network

After this input, the project team met to strategize about what kinds of data should be collected by citizen scientists during the pilot study and to test out the SeaLevelRise app. The team created a sampling chart with locations on one axis and October sampling dates/times on the second axis, with available signups for each location and date (total sampling points = 16). The team also developed a sampling protocol (see page 1 sidebar) to share with volunteers, outlining how to record a series of points along the edge of flooded areas, staying on public property, and making decisions based on safety (e.g. buddy system, don't wade in flood waters, etc.)

Training Methods

On September 30, 2019, fourteen (14) volunteers participated in a training workshop to become "Catch the King" citizen science volunteers. The workshop allowed volunteers to learn how to download the SeaLevelRise app, practice mapping flooded areas using their smartphones, and commit to mapping flooding during at least one time slot during the October 2019 King Tide. Available time slots were 60 minutes long, 30 minutes on either side of the projected day-time high tide, in order to catch the highest flood point. Volunteers could sign up to map at one or more of 4 sampling locations, chosen based on the flooding hot spots identified by town staff earlier in the season. Using a blue chalk-marked sample flood line in the parking lot, volunteers got hands-on experience practicing collection of data points with their smartphones while walking along the "water's edge." Volunteers signed up for all but one (1) of the available sampling slots, which got assigned to one of the project team members (W. Costello), enabling staff to experience sampling protocols along with trained volunteers.

Catch the King: Volunteer Data Collection

Volunteers deployed to four (4) field locations each day over the course of four (4) days, October 27-30, 2019. In some cases, volunteers teamed up, but many collected data by themselves. 100% of volunteers successfully collected flooding data through the SeaLevelRise app. Project staff member Wells Costello participated during the Oct. 30 sampling period for the Kings Highway South location.

Water level data were obtained from the Hampton Harbor tide gauge. The maximum water levels recorded during each 1-hour sampling period are presented in Table 1. Predictions of high tide for this event were accurate with respect to time so volunteer data collection included the highest water level recorded for each sampling event. The overall maximum water level recorded during the four-day project period (11.91 feet) coincided with volunteer data collection at 12:00pm on 10/28/2019. Wind direction and speed data were obtained from the Isles of Shoals buoy (Station IOSN3). Wind direction varied between east and northeast at the start of the sampling period to southeast and south at the end. Wind speed varied from 7-18 miles per hour (mph). Precipitation data were obtained for

Date	Time of Data Collection	Wind Speed (miles per hour)	Wind Direction	Total Precipitation (inches)	Max Water Level (feet)
10/27/2019	10:30 - 11:30 A.M.	9	East	0.93	11.2
10/28/2019	11:30 A.M. - 12:30 P.M.	18	North-Northeast	0.06	11.9
10/29/2019	12:30 - 1:30 P.M.	13	Southeast	0.00	11.2
10/30/2019	1:00 - 2:00 P.M.	7	South	0.06	11.0

Hampton (Station NH-RC-45) from the Community Collaborative Rain, Hail, and Snow Network, a citizen science program of volunteers collecting precipitation data. To assess data collection accuracy and validity, volunteers were asked to email photos from their data collection efforts to project team members as part of QA/QC efforts.

A total of 2,512 data points were collected by 8 volunteer teams over the 4-day sampling period. Twelve data points were excluded from the dataset that did not meet the accuracy standard of 5 meters or less. Accuracy of all data points collected are mapped in Figure 1. Data that met accuracy criteria are presented for all sites (Figure 2) and by individual sites surveyed (Figure 3 a-d).

Community Peer Review

On March 3, 2020, volunteers met with project staff for a "community review" of the data. Goals of this session included:

- Collect feedback on data validity and interpretation
- Collecting ideas for project improvements and lessons learned
- Thanking citizen science volunteers

From the volunteer feedback it became apparent that volunteer input was critical to interpreting the data collected and identifying improvements for future efforts. Recommendations are detailed in the following section ("Discussion and Lessons Learned").

Catch the King Volunteer Tide Mapping

All Data - October 27 - 30, 2019

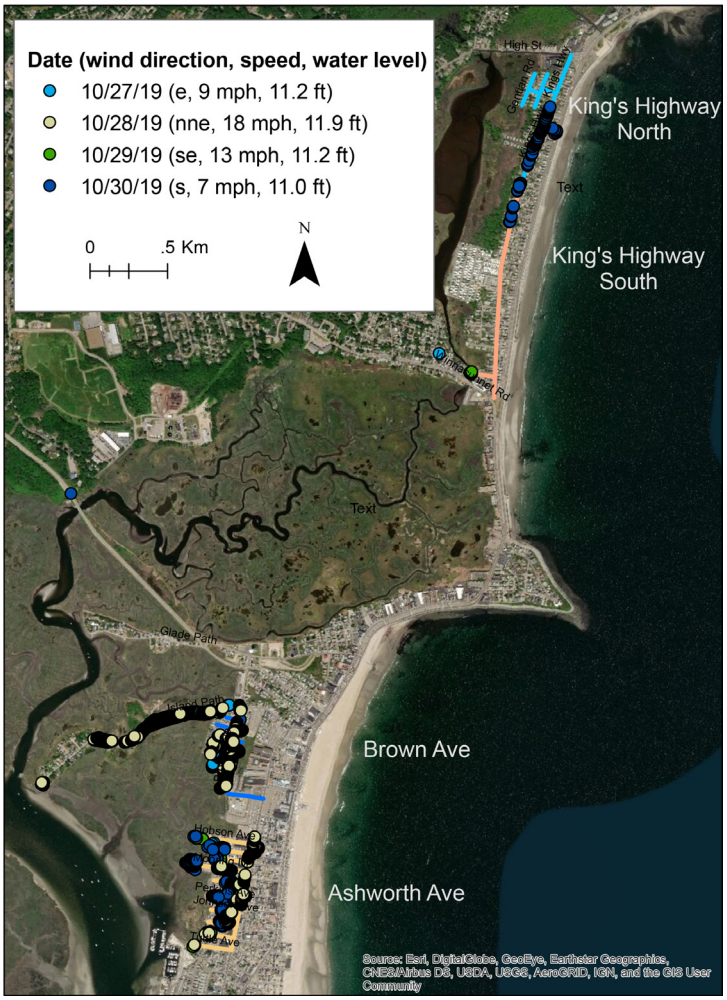


Figure 2: Accuracy

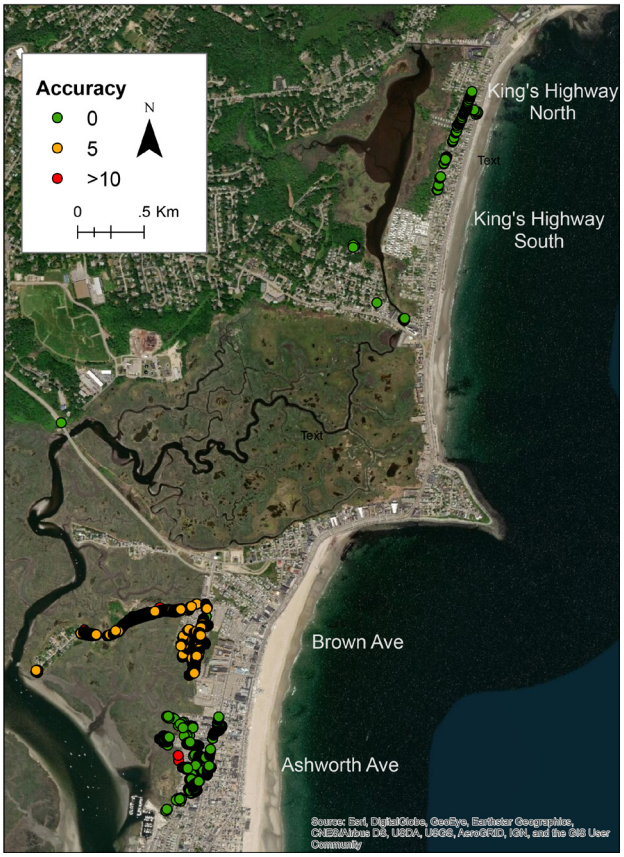


Figure 3a: West of Ashworth Ave

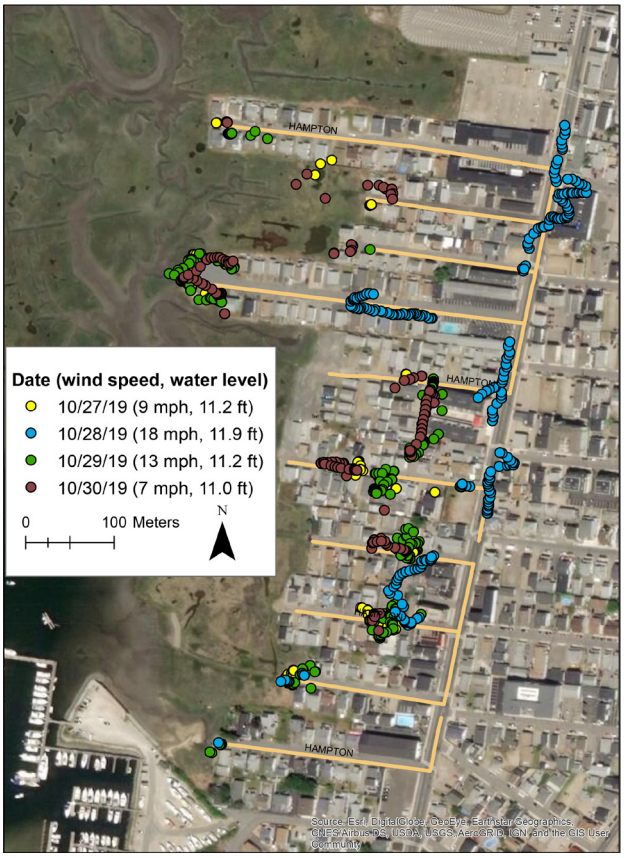
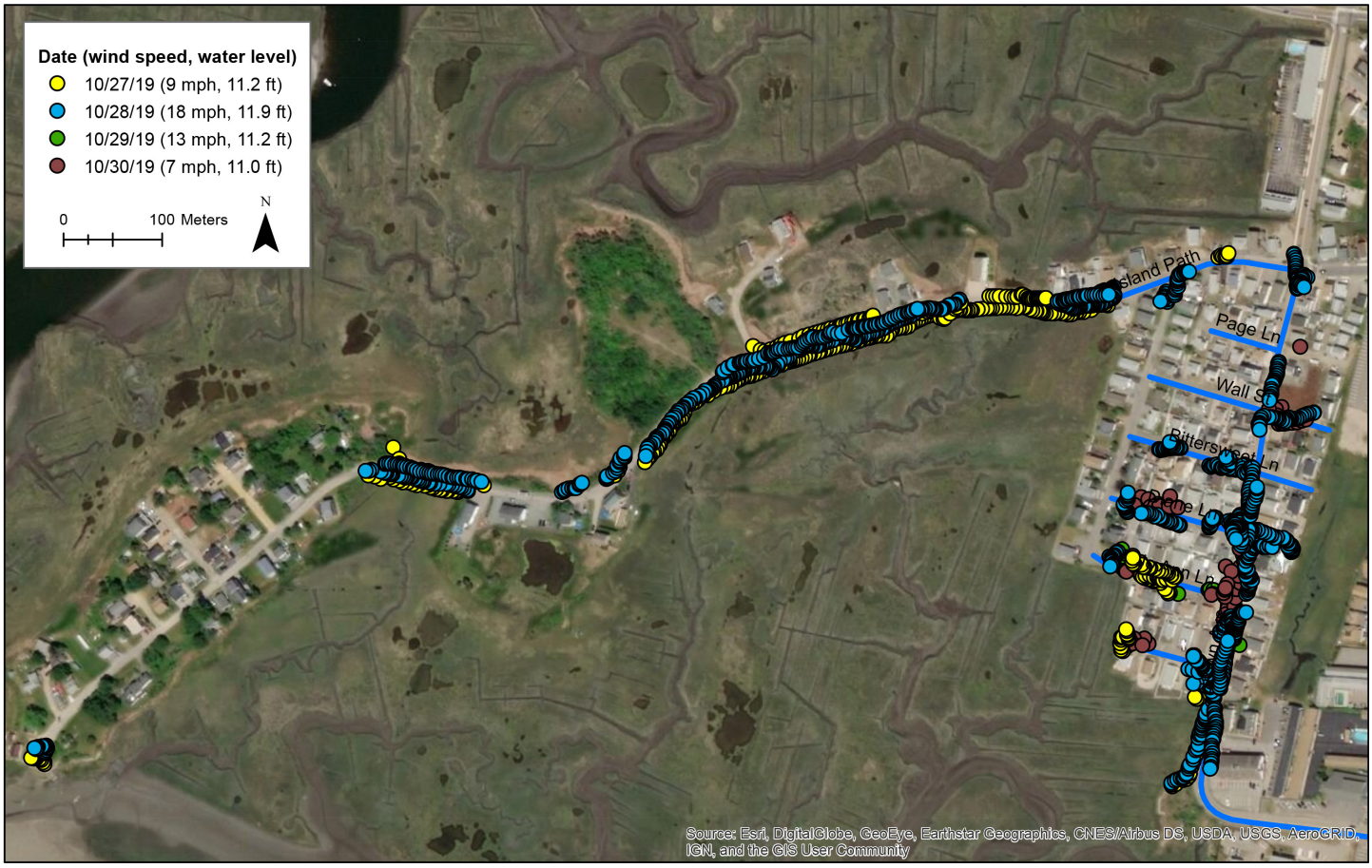


Figure 3b: King's Highway North

Figure 3c: King's Highway South

Figure 3d: Brown Ave and Island Path

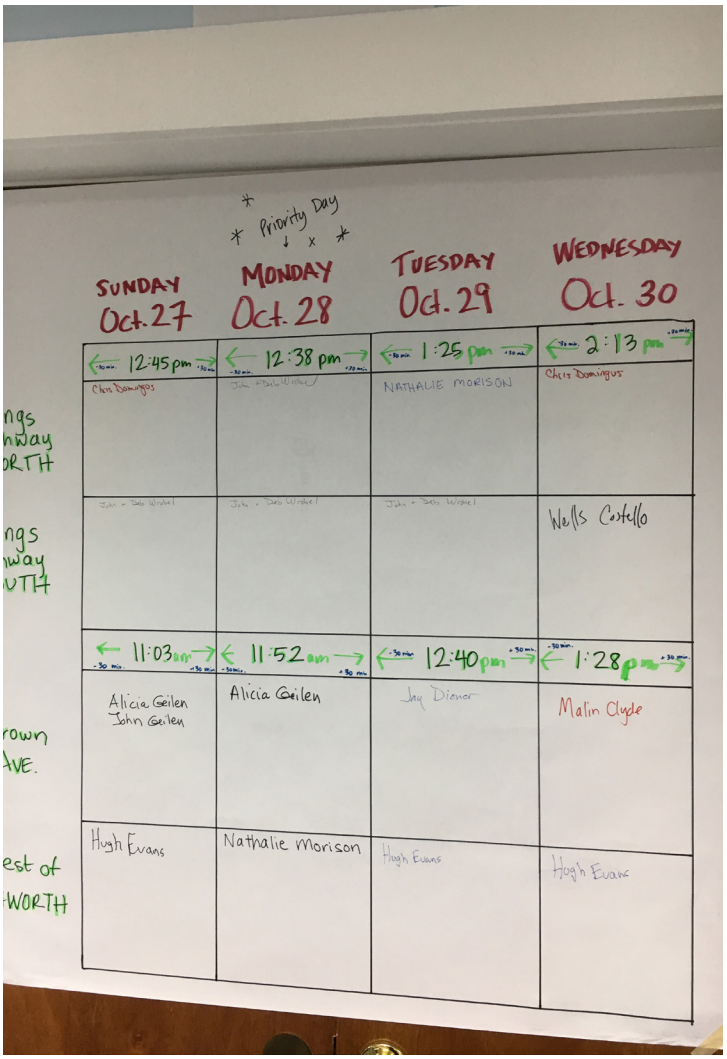


Discussion and Lessons Learned

The following are lessons learned from the pilot project, as collected by project staff and citizen scientists during follow up conversations and/or the Community Peer Review:

- **The process of accurately mapping flooded areas was challenging.** Volunteers questioned the accuracy of their results based on their experience in the field. When mapping on public roads or sidewalks, volunteers reported good delineation and accuracy. However, when flooding crossed into private lands (where volunteers were instructed not to go), data collection was disjointed. One volunteer reported, "It was difficult to map if the water went all over the place, with water flooding the sidewalk and going onto private property." A potential solution is to use LIDAR data to help connect data points to further estimate flooding extent.
- **Wet weather complicated mapping.** Volunteers described difficulty determining whether flooding was tidal or caused by ponding due to storm water. A potential solution might be to add the catch basin and outfall data from the Hampton Department of Public Works to assist in interpreting cause of areas of ponding, or possibly use the note function on the map to note "storm drain overflowing," for example.
- **Volunteer input was critical for interpreting mapping data.** In some areas with complicated flood scenarios (e.g. NE section of the Brown Ave.), it was unclear which points delineate flooding and which indicate dry areas. Future mapping could include different types of points that can be recorded in the field that indicate each point as "flooded" or "not flooded." GPS units or ArcGIS Collector could also be used and could possibly provide more accurate data and easier links to photos.

- **Keep sampling routes short.** Many of our sampling areas required at least 1 hour to map on foot, resulting in the flooding extent changing over time in previously mapped areas.
- **Start sampling at or after time of predicted highest tide.** As the tide recedes, the wet areas and wrack line may be used as an indicator of the high tide line that can be mapped.
- **Mapping during floods can be risky.** Despite training on safe practices to collect data, at least one volunteer reported feeling unsafe during data collection due to deep water or waves caused by cars driving through flooded areas. One volunteer ended up driving, not walking, their route due to long distances. Future efforts should encourage and/or provide knee boots for volunteers while also stressing volunteer safety.
- **SeaLevelRise app had benefits and limitations.**
  - » App is easy to use.
  - » Volunteers can only view their own data, not data for any other volunteers. For the SeaLevelRise data to be useable (visible to volunteers, made understandable to decision-makers), the project team had to download data into ArcGIS to create maps and spend considerable time to create user-friendly maps.
  - » Accuracy of data points may be problematic due to variation in the strength of smartphone cell signals. In analyzing data, only points with accuracy level of 1-5m were used (0.4% of data points deleted).
  - » There was no way to tell if locations without data collected were because volunteers did not show up, or because there was no flooding. The app has no "null data" function.
  - » Although the app includes a function to take a photo for each data collection effort, doing so caused the app to freeze. As a result, volunteers had to email photos from their smartphone separately to project coordinators. Given this added step, not all volunteers remembered to take (or to submit) photos, so QA/QC efforts were incomplete.
  - » One volunteer described app as "glitchy."
- **Adverse landowner reactions are possible.** Volunteers reported that neighborhood homeowners were surprised to see volunteers collecting data. In the future, it is recommended that volunteers have identification (vest or name badge) indicating their affiliation with the University or science organization.
- **Fall season was good time for data collection.** Volunteers noted that it was beneficial to conduct mapping during the tourist off-season, as high pedestrian traffic would have been a problem.



Next Steps

- Consider using ArcGIS online to make data available to all.
- Public/private lands issue is a serious limitation for volunteer flooding mapping, given the amount of private lands affected by flooding in Hampton.
- Need to compare other ways of collecting real-time flooding data, such as use of drones and fixed sensors. Data processing from both of these techniques will also pose a challenge.
- Explore Weather Citizen app which has more features to share data and maps or creating a project specific data collection interface in ArcGIS Collector
- Need to consider the public/private property locations; need to find “indicator” locations for consistent data collection over time (could get permission over long term from landowners)
- Sensor data could ground-truth volunteer delineations (maybe they could be combined?) and should consider use of LiDAR data as based.

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