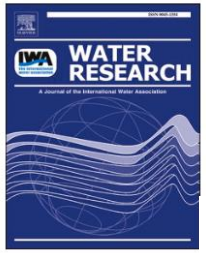
FloodNet: Hyperlocal, street-level flood monitoring in New York City

NYU
ADVANCED SCIENCE RESEARCH CENTER
THE GRADUATE CENTER
CITY UNIVERSITY OF NEW YORK
NYCOTI
NYC Mayor's Office of Climate & Environmental Justice
NYC Environmental Protection
SCIENCE+ RESILIENCE INSTITUTE JAMAICA BAY · NYC

Motivation – Many Needs for Quantitative Flood Data

Community Members	Government Agencies	Researchers
Advocacy	Infrastructure, transportation, resiliency planning + monitoring	Validate flood predictions from H&H models
Day-to-day decision making	Emergency response (faster and more localized)	Monitor changes to flooding over time
Validate community reported flood events	Inform road closures	Inform water sampling
	Post-flood assistance and impact cataloging	Impact-based forecasting

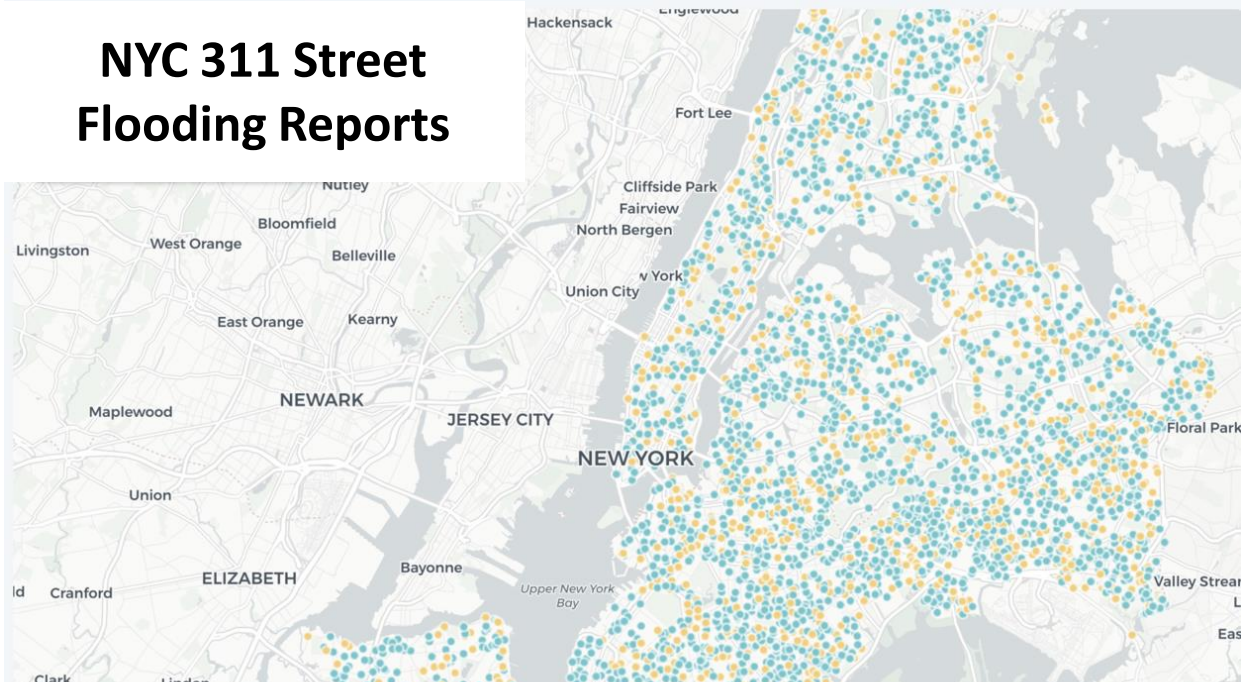


Making waves: Uses of real-time, hyperlocal flood sensor data for emergency management, resiliency planning, and flood impact mitigation

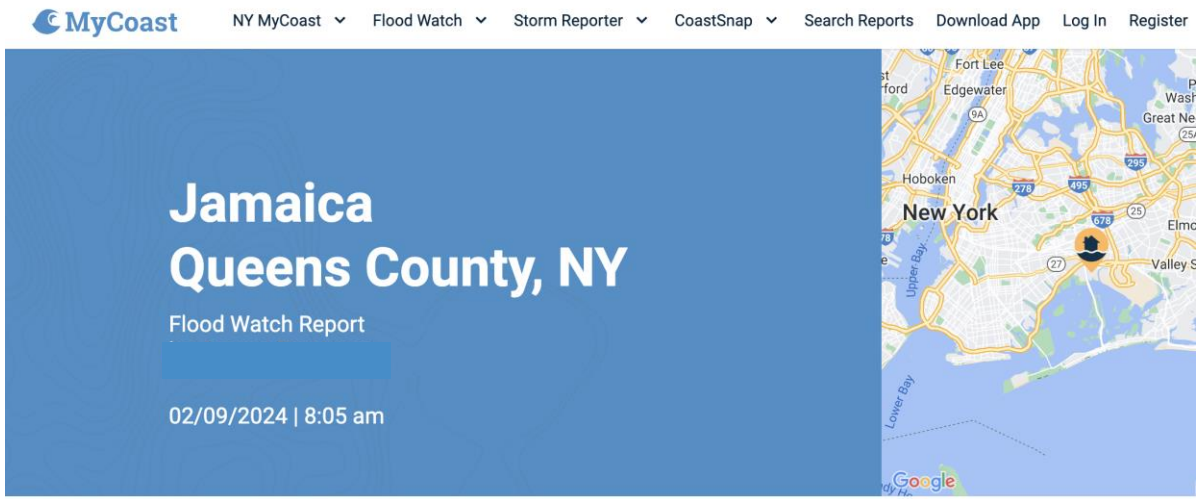
Andrea I. Silverman [a,*], Tega Brain [b], Brett Branco [c,d], Praneeth sai venkat Challagonda [e], Petra Choi [a], Rebecca Fischman [f], Kathryn Graziano [g], Elizabeth Hénaff [b], Charlie Mydlarz [e], Paul Rothman [h], Ricardo Toledo-Crow [i]

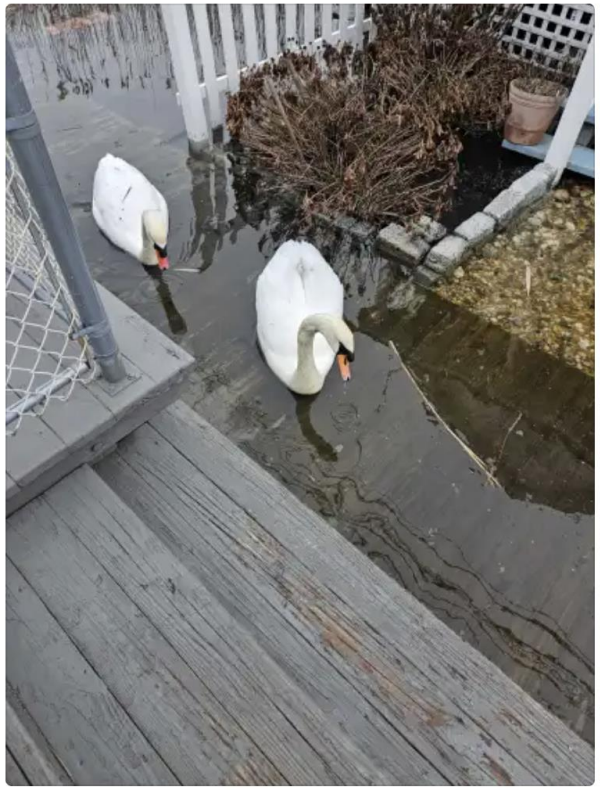
Water Research 220 (2022) 118648

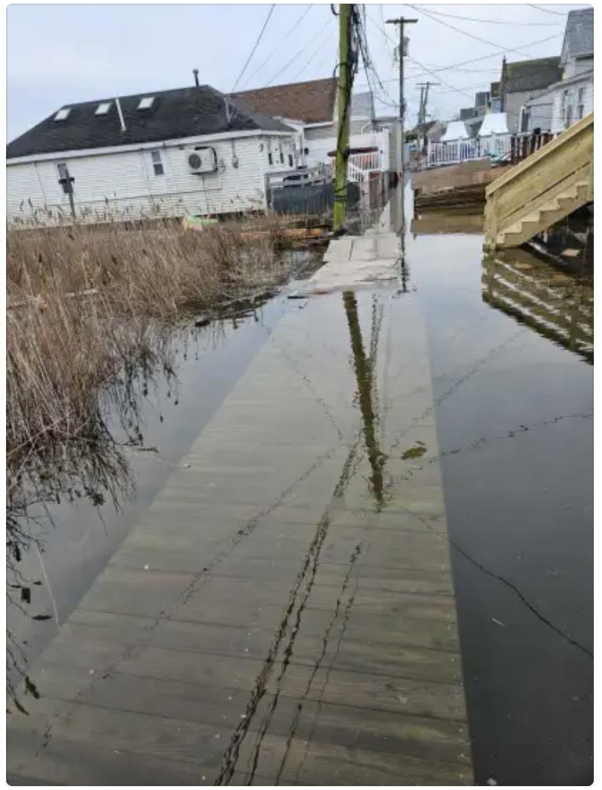
NYC 311 Street Flooding Reports



NYC Community Flood Watch Project





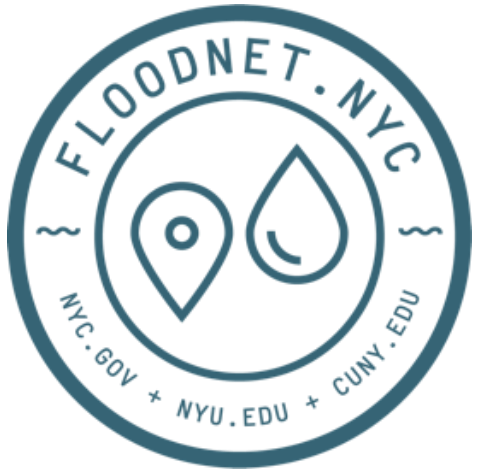


How can we collect **real-time**, **quantitative** data on urban street-level flooding, and provide data to various stakeholders?

FloodNet's mission is to develop tools for real-time urban flood monitoring, implement these tools to measure flooding in New York City, and make flood data and monitoring tools available in a manner that is accessible and useful to stakeholders including residents, community-based organizations, government agencies, and researchers.

- Design, build, and deploy low-cost, robust **sensor network**
- Produce **data products** to contextualize/communicate data
- **Community engagement** to meaningfully share data with stakeholders and gain feedback for project implementation

FloodNet



- New York University (NYU)
- City University of New York (CUNY)
- Science and Resilience Institute at Jamaica Bay (SRIJB)
- NYC Office of Technology & Innovation (OTI)
- NYC Mayor's Office of Climate & Environmental Justice (MOCEJ)
- Funding from NYC Department of Environmental Protection (DEP)

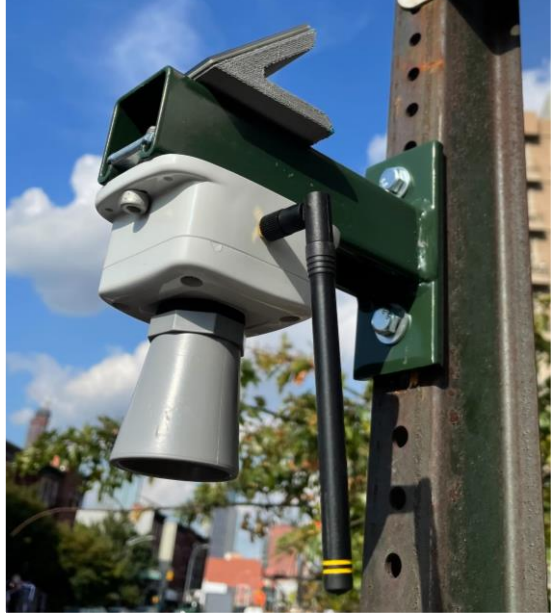
Work with community groups, including:

- Citizens Committee of New York City
- Sixth Street Community Center
- Little Haiti BK
- Little Caribbean (CaribBEING)
- Brooklyn Movement Center
- Brinkerhoff Action Association
- The Campaign Against Hunger
- El Puente Bushwick Leadership Center
- Canarsie Community Development Inc.
- Wyckoff Farmhouse Museum
- City Island Rising
- Pleasant Village Community Garden
- Edgemere Community Civic Association
- Far Rockaway Arverne Nonprofit Coalition
- Cunningham Park Farmers Market (Down to Earth)
- Gowanus Canal Conservancy
- Meyers Emergency Management Group
- Hamilton Beach Civic Association
- Red Hook Initiative
- Pioneer Works
- Rockaway Initiative for Sustainability and Equity (RISE)
- Bronx River Alliance
- South Beach Civic Association
- Nonprofit Staten Island (SI COAD)
- Community Emergency Response Team
- Queens Memory Project
- Queens Library at East Elmhurst
- Waterfront Alliance (Rise to Resilience)
- Van Cortland Park Alliance
- Together We Can Community Resource Center

FloodNet Hardware

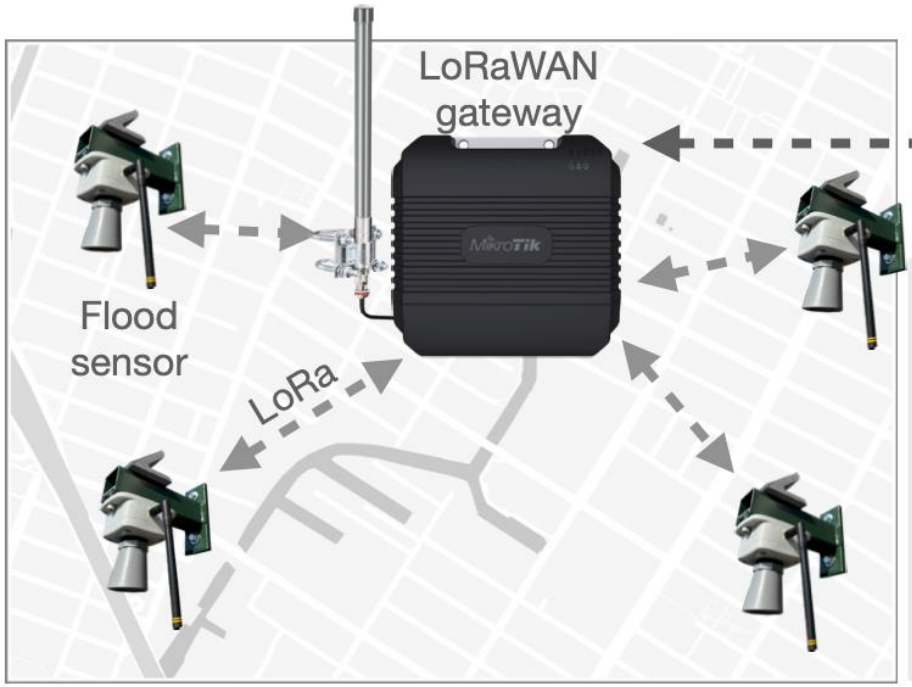
- Sense water depth with accuracy of ±5 mm
- Collect and transmit measurements every 1 min
- Operate independent of existing power and networking infrastructure
- Operate autonomously in environment for long periods time
- Comprise low-cost components for sensor network scalability (~$250)

All design files open-source on github




Friday
11:30am - 1pm


FLOODNET.NYC
NYC.GOV + NYU.EDU + CUNY.EDU
Local Flood Sensor
Sensor de Inundación de Barrio
This sensor monitors flooding at this location. The information is used to better understand the problem and identify potential solutions.
No identifying information is being collected.
Two city agencies and two academic institutions are responsible for this device, and the data it collects.
NYC
NYCCTO
NYU
To learn more, visit floodnet.nyc or email info@floodnet.nyc



TCP/IP SSL

THE THINGS NETWORK

Project server

Node-RED

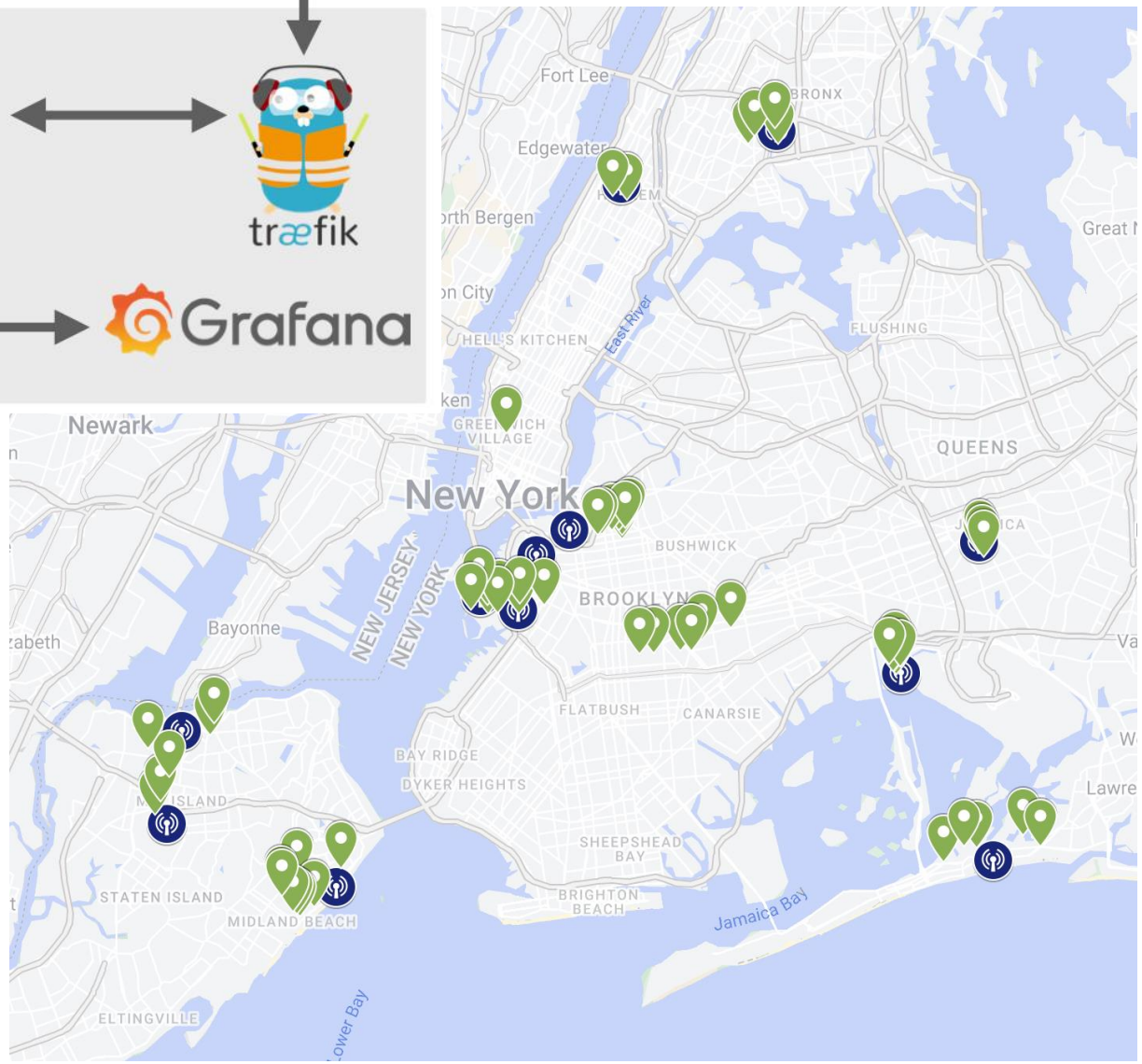
træfik

influxdb

Grafana

FLOODNET.NYC

FloodNet Dashboard



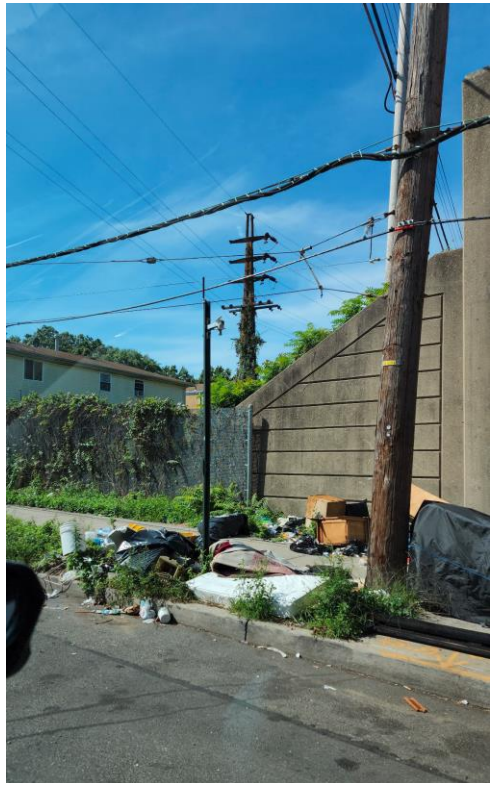
Gateway/LoRa Challenges:

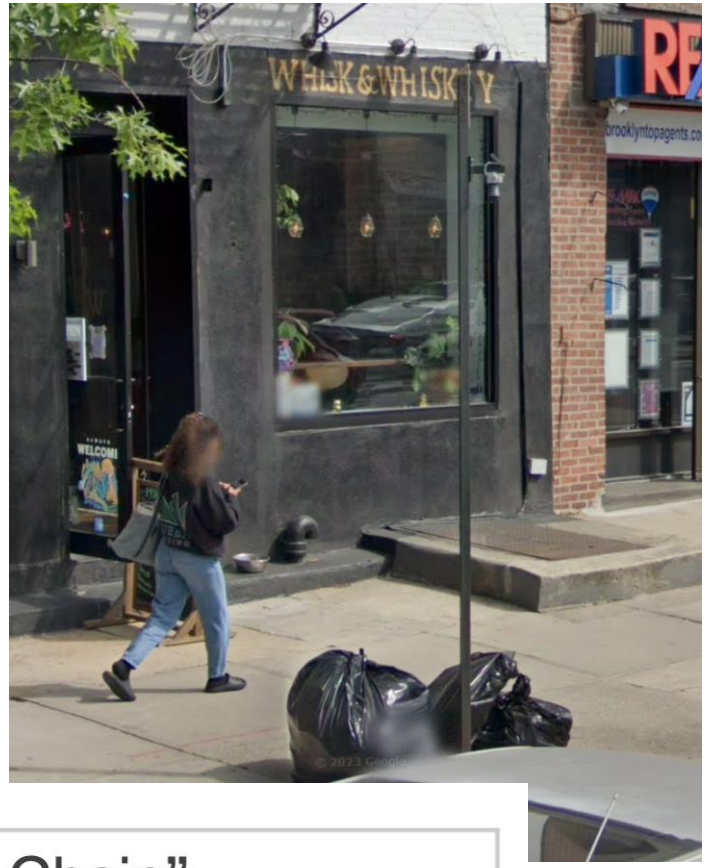
- identify/gain permissions for gateway installs
- clustering of sensors
- potential poor connectivity
- gateway downtime

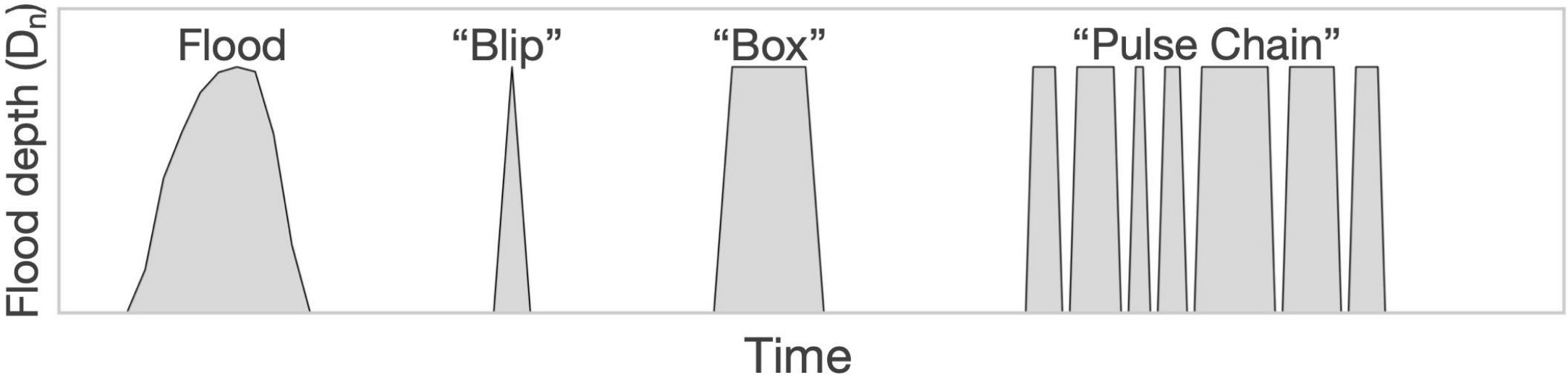
Transitioning to cellular connected sensor that is designed for manufacturing

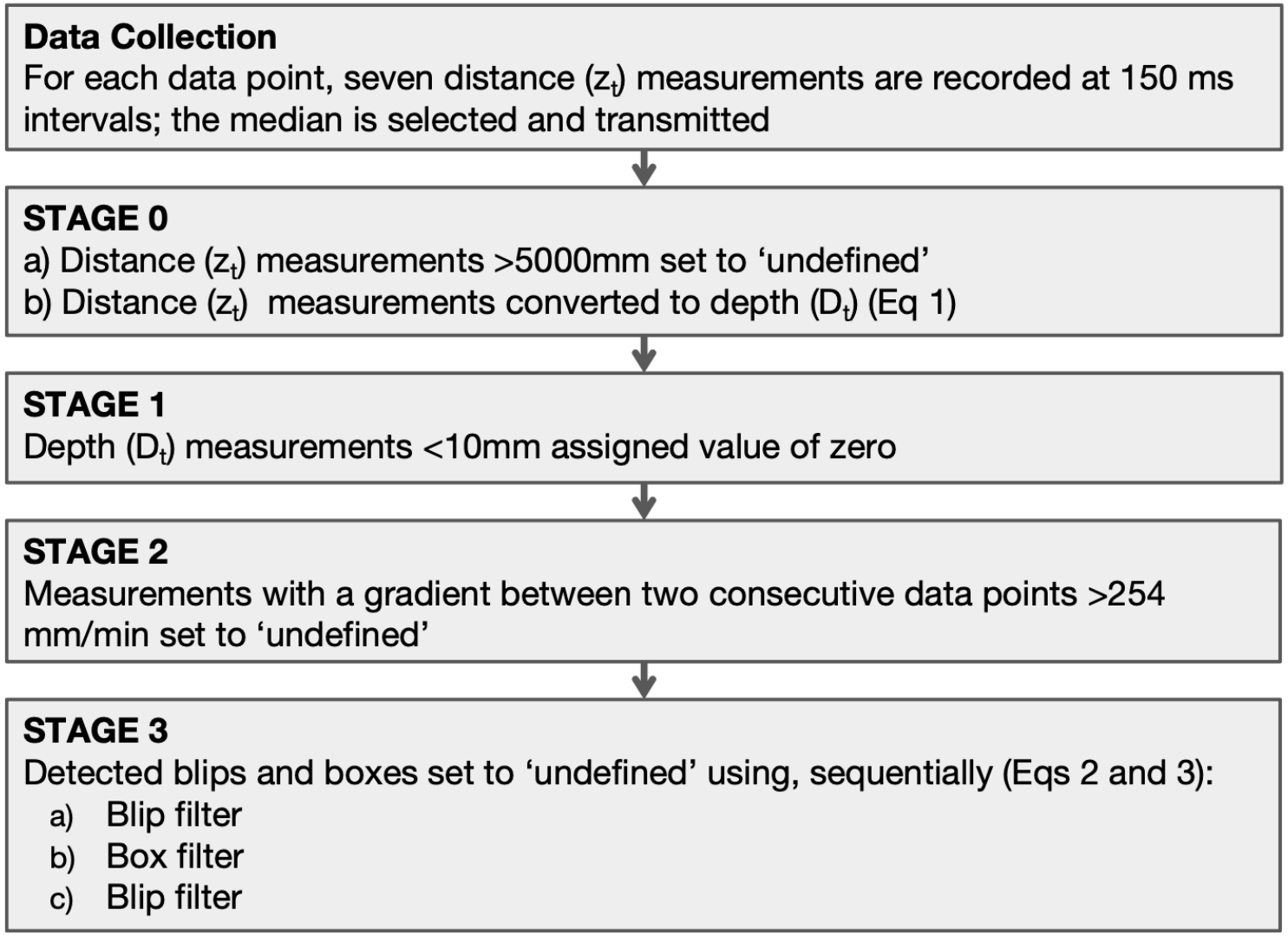
Data Processing

Clean data needed to:
- Avoid false identification of floods by data users
- Minimize false flood alerts sent out by automated alert system





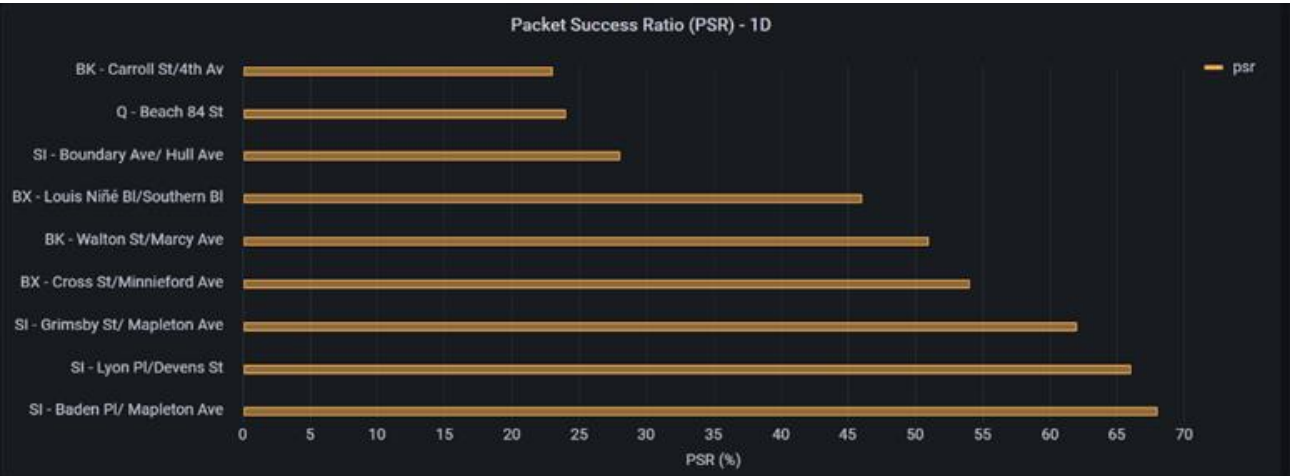


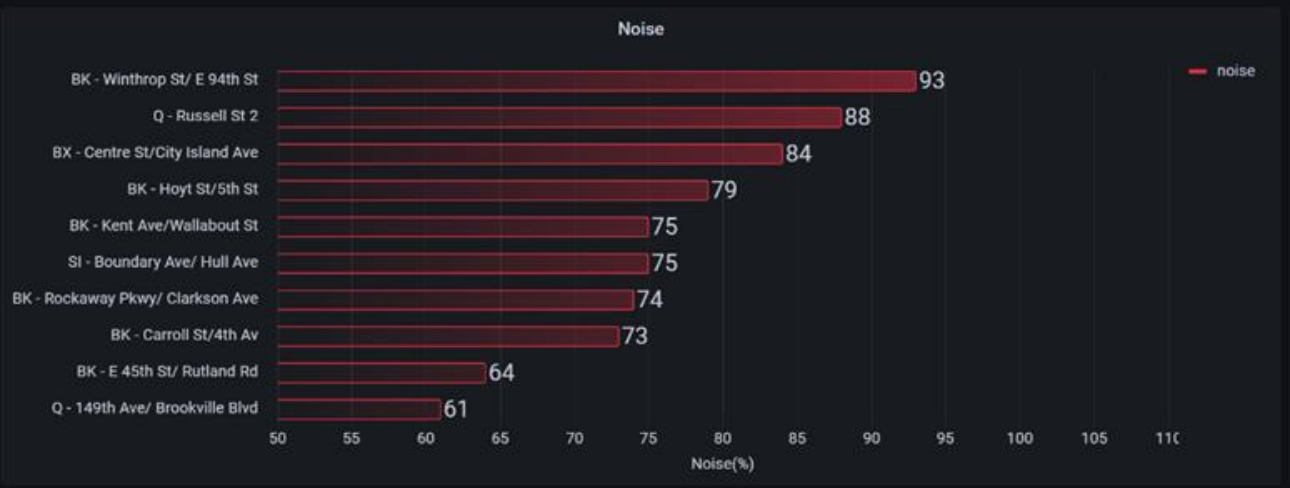


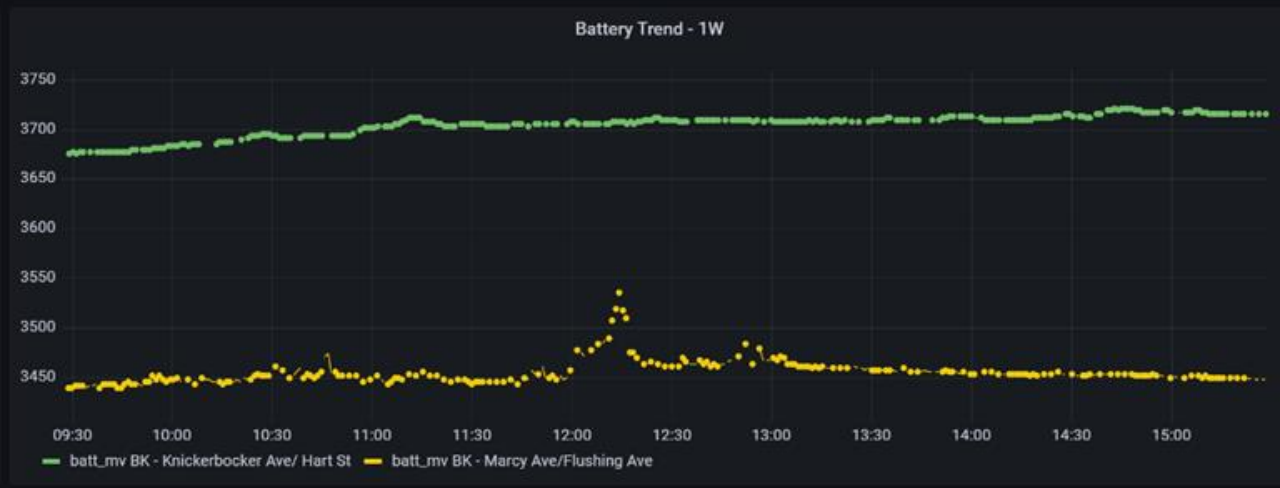
Work in progress

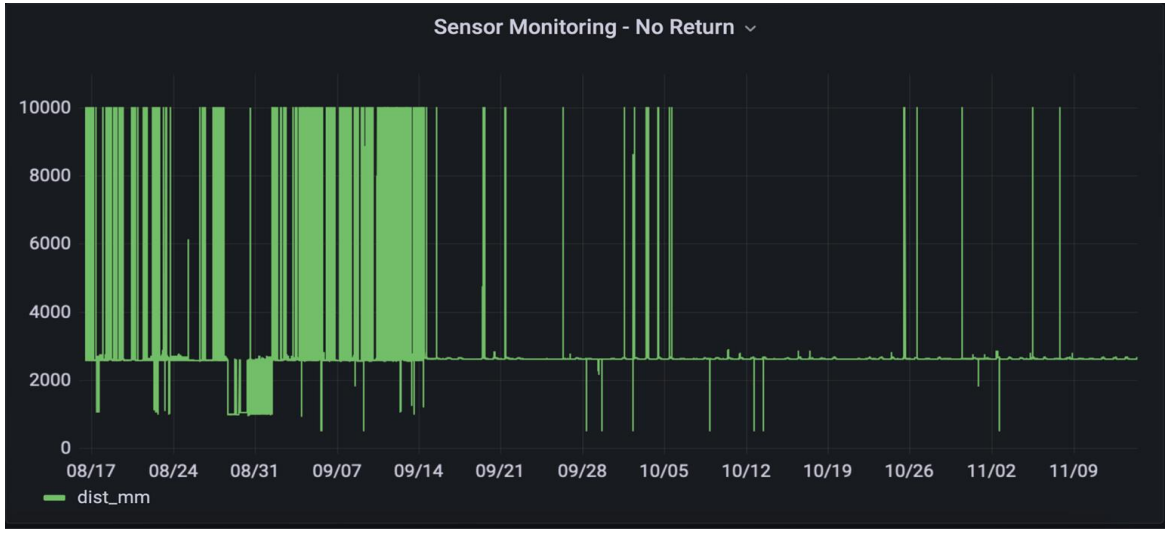
- Machine learning models to recognize flood versus noise + clean data
- Evaluating needs for real-time data filters versus data cleaning post-hoc
- Data pipeline to create event-based dataset from time series data - automatically recognize floods and determine summary statistics (depth, duration, etc)

Sensor Maintenance








Sensor Monitoring - No Return
10000
8000
6000
4000
2000
0
08/17
08/24
08/31
09/07
09/14
09/21
09/28
10/05
10/12
10/19
10/26
11/02
11/09
dist_mm


EMERGENCY EXIT


NO STANDING
Mon - Friday
7am
7pm

Sensor Installation Locations

Sensor placement informed by:

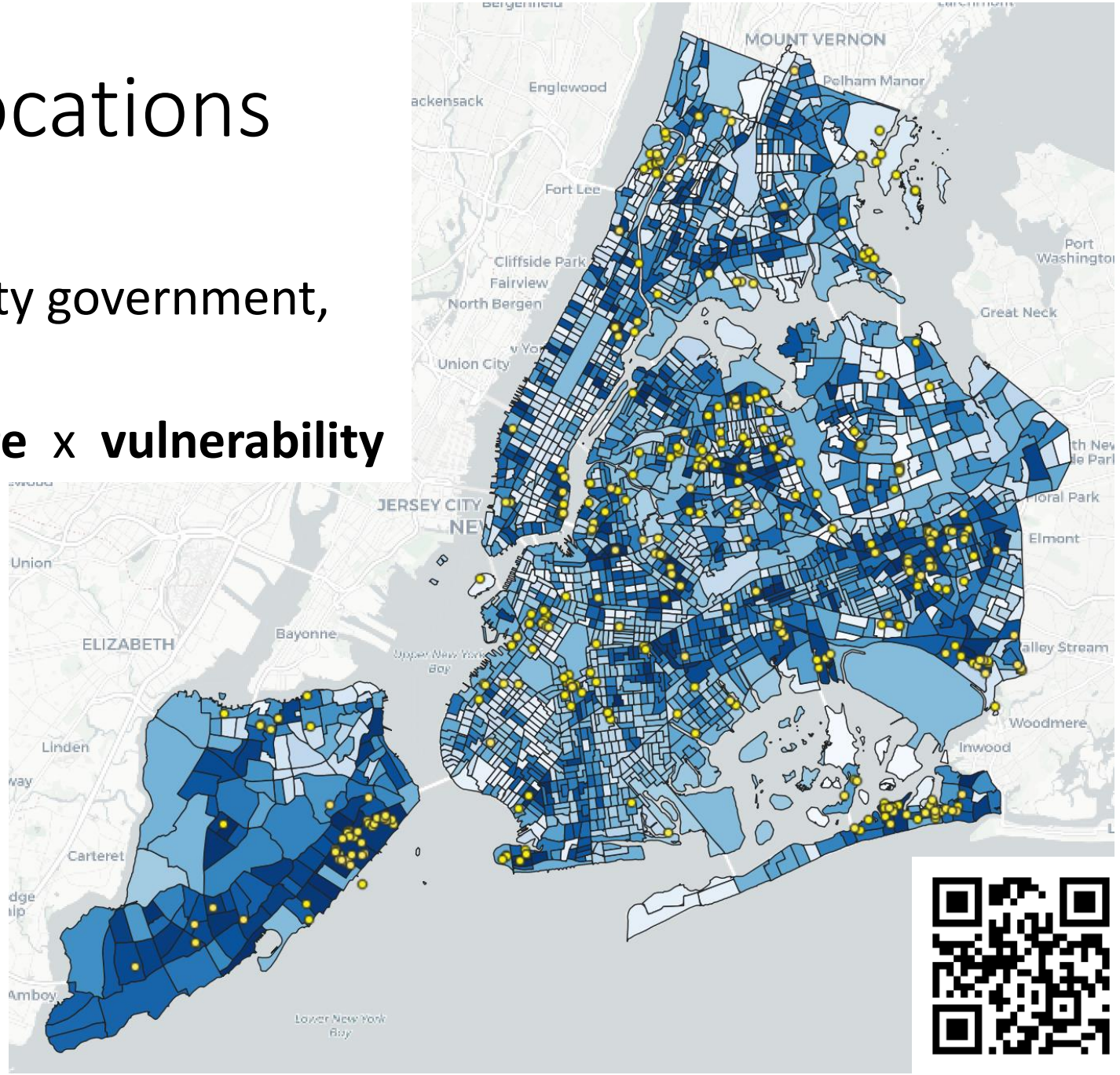
(1) Requests from NYC residents, city government, and researchers

(2) Index = flood **hazard** x **exposure** x **vulnerability**

Hazard: total flooded area in each census tract - moderate scenario NYC Stormwater Flood Map or NYC Flood Hazard Mapper high tide 2080s middle estimate (29 inches SLR)

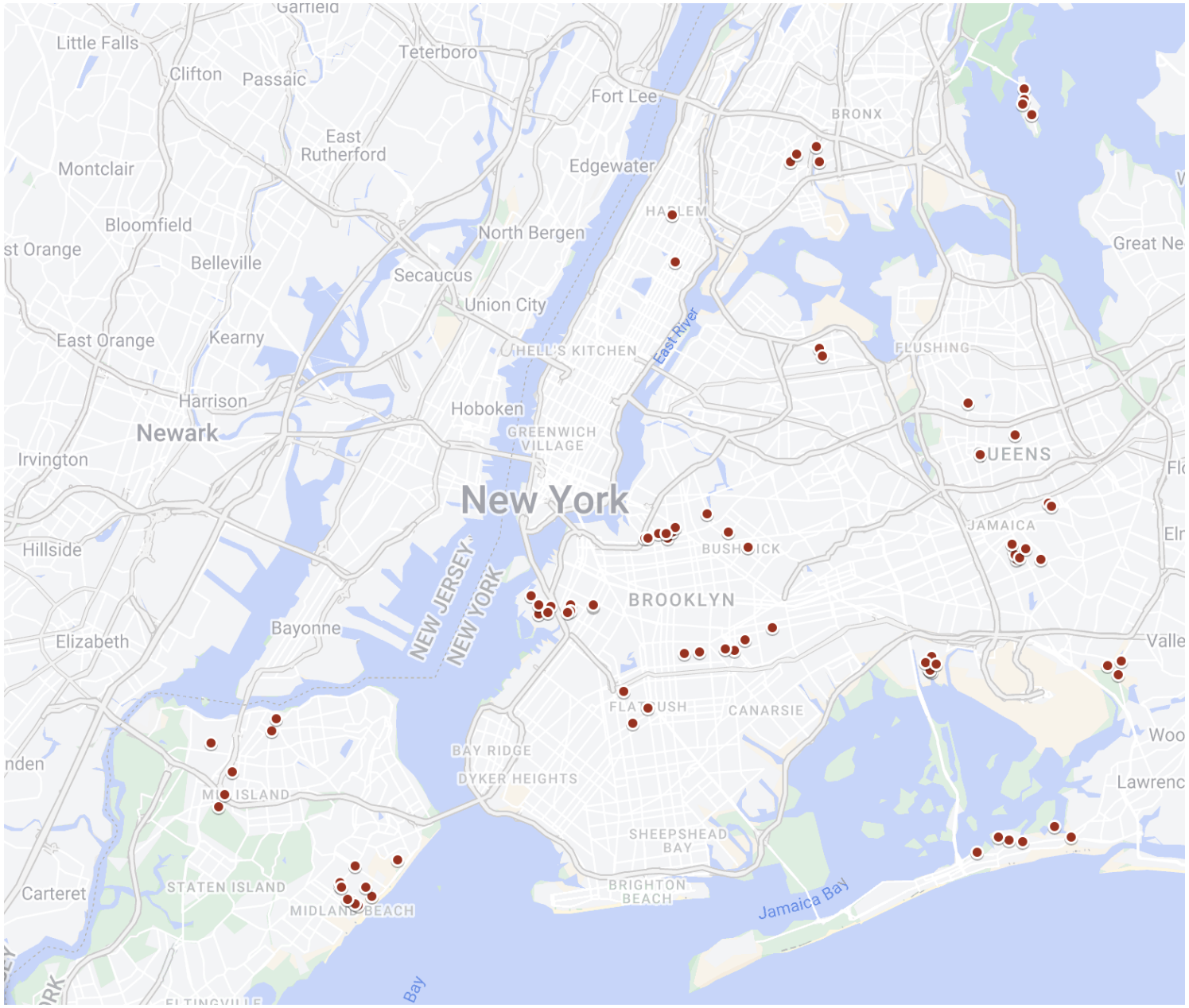
Exposure: census tract population density

Vulnerability - flood vulnerability index (VIA – MOCEJ et al.)



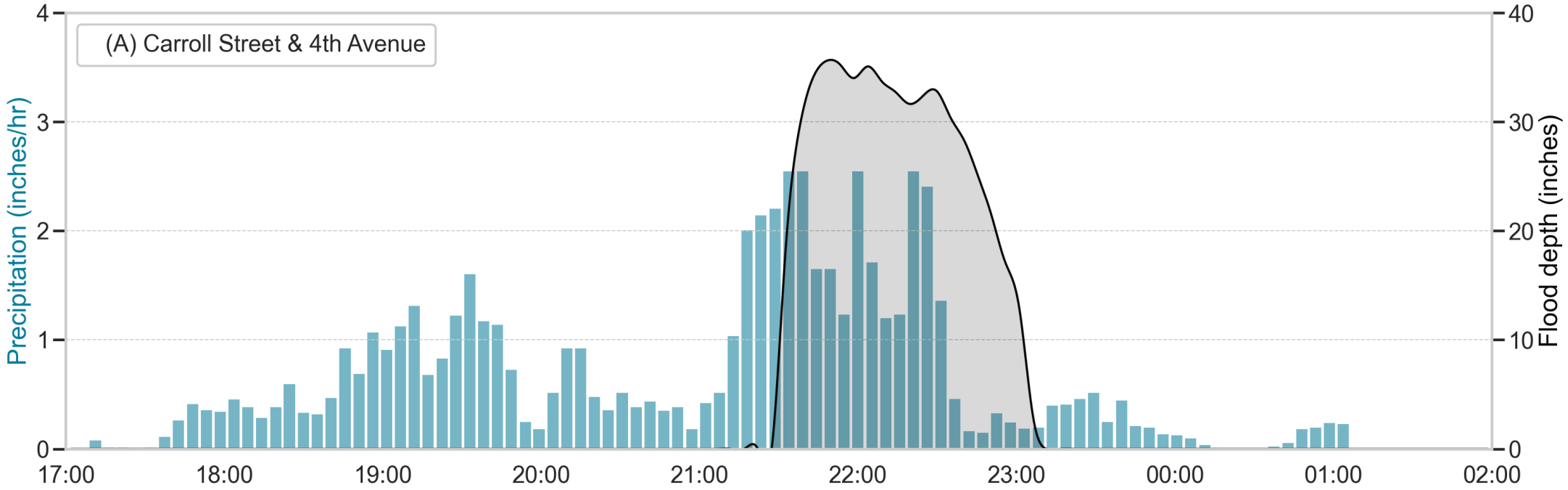
87 Sensors Currently Installed

Goal of 500 Sensors

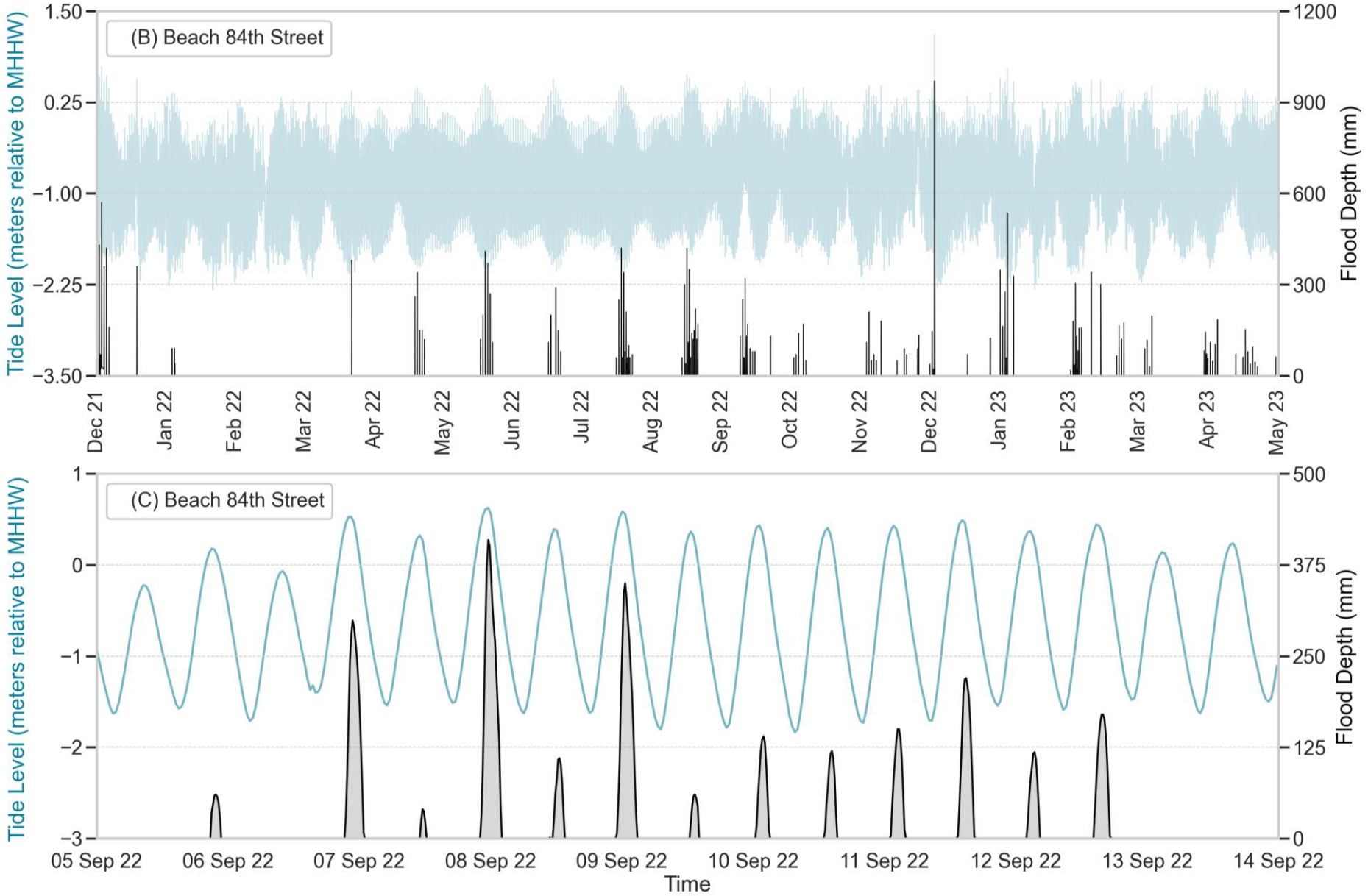


Data Examples

Hurricane Ida (1 Sept 2021)



Data Examples – Tidal Flooding



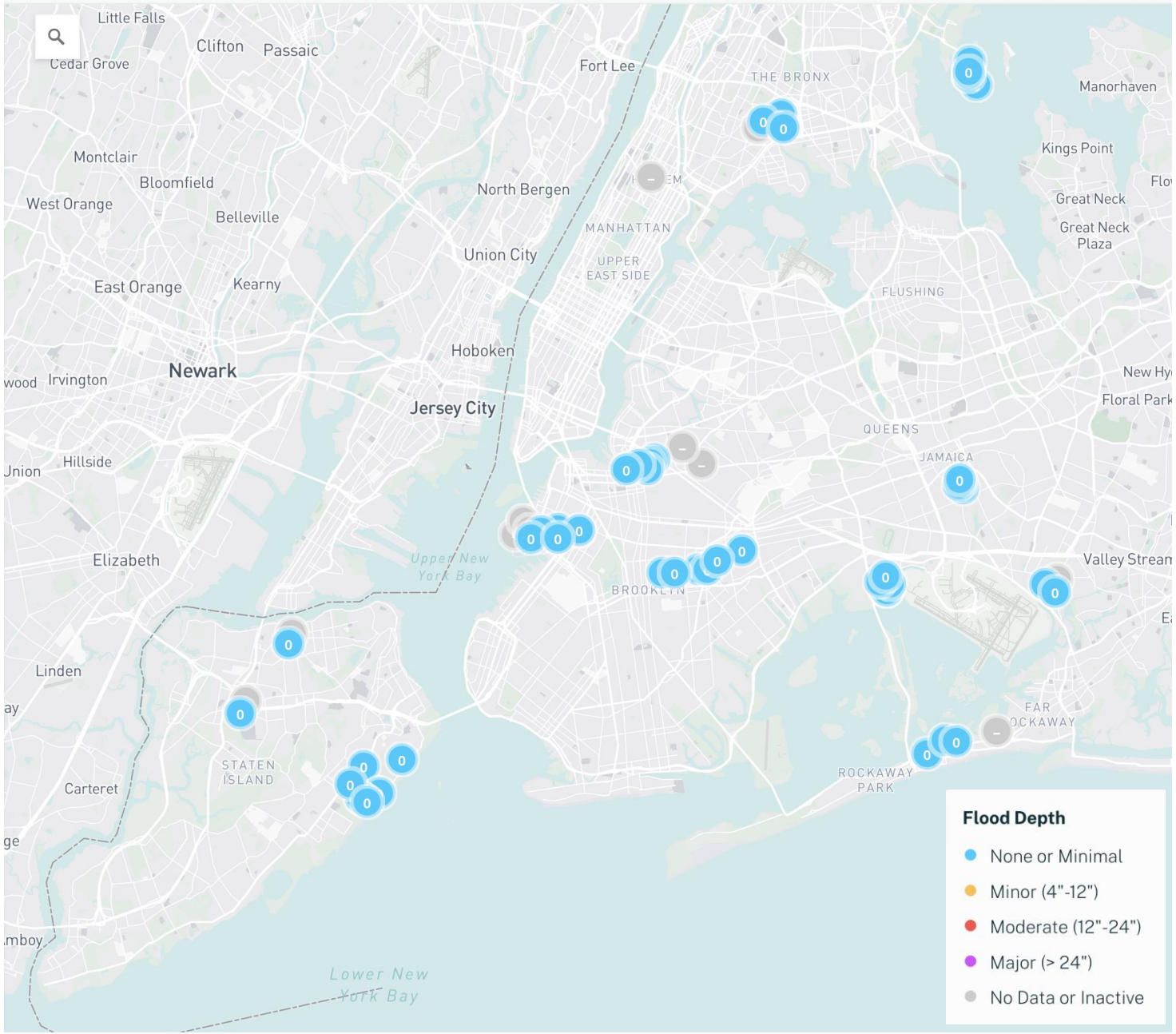
Flood Sensor Data Interfaces

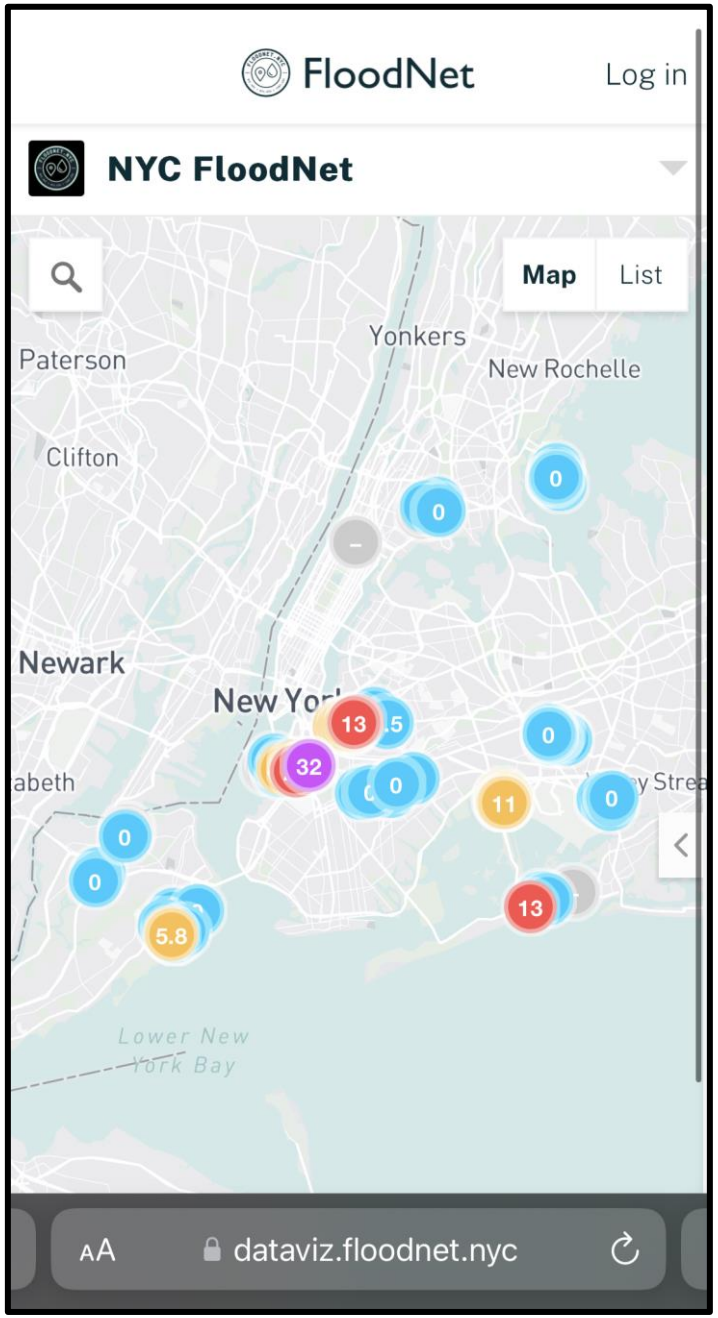
- Online Data Dashboard
- Printed Neighborhood Reports
- Flood Alerts
- API for Data Ingestion

NYC FloodNet Project Info, Methodology & Data Sources >
FloodNet is a collaboration between NYC, CUNY, and NYU.
Submit a Flood Photo Report

https://www.floodnet.nyc/

29 Sept 2023 – 8:25 am





< Back to Sensor Map

Data View

Add Chart

Share

BK - Carroll St/4th Av

Gowanus, Brooklyn

Deployed on July 15, 2021 by FloodNet

Last Seen 11/3/2022, 19:54

◀ 15 of 22 ▶

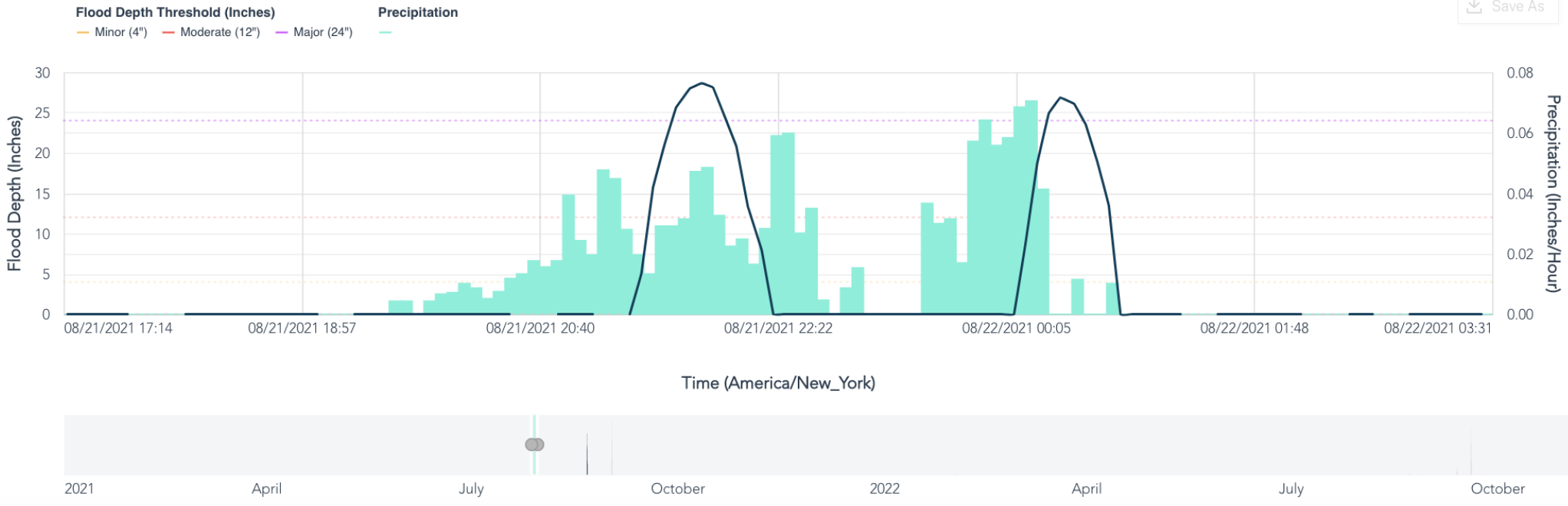
View By: Day Week 2 Week Month Year All 08/21/21 08/22/21

BK - Carroll St/4th Av | Flood Depth | Remove

BK - Carroll St/4th Av | Precipitation | Remove

Time Series

Save As



< Back to Sensor Map

Data View

Add Chart

Share

Q - Beach 84 St

Far Rockaway , Queens

Deployed on December 10, 2021 by FloodNet

Last Seen 11/3/2022, 20:08

19 of 23

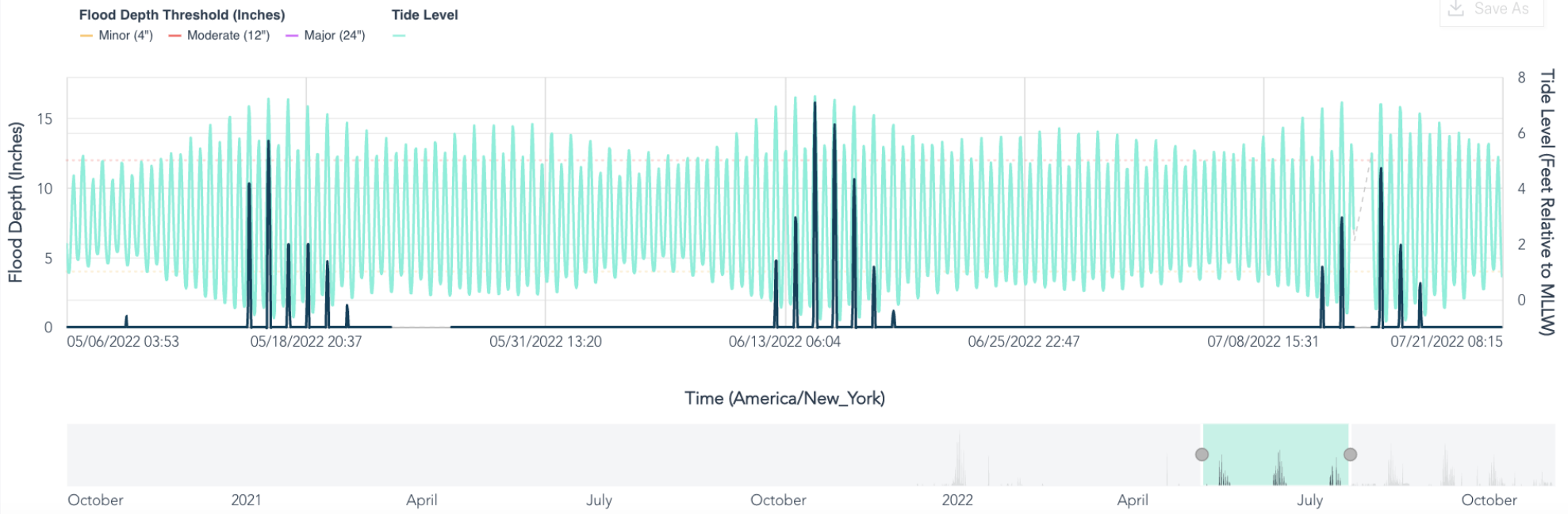
View By: Day Week 2 Week Month Year All 05/06/22 07/21/22

Q - Beach 84 St | Flood Depth | Remove

Q - Beach 84 St | Tide Level | Remove

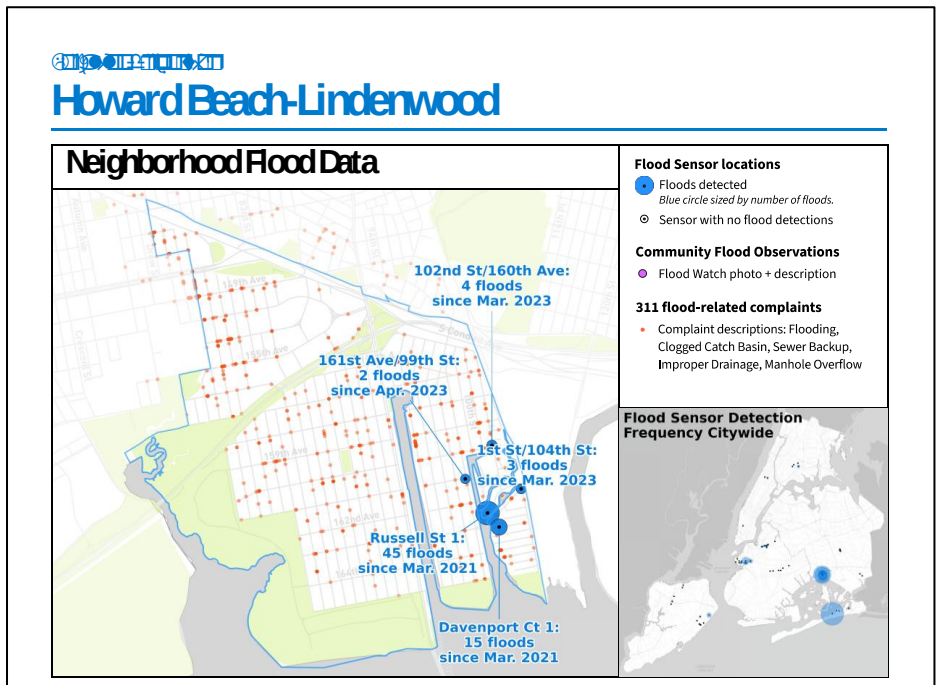
Time Series

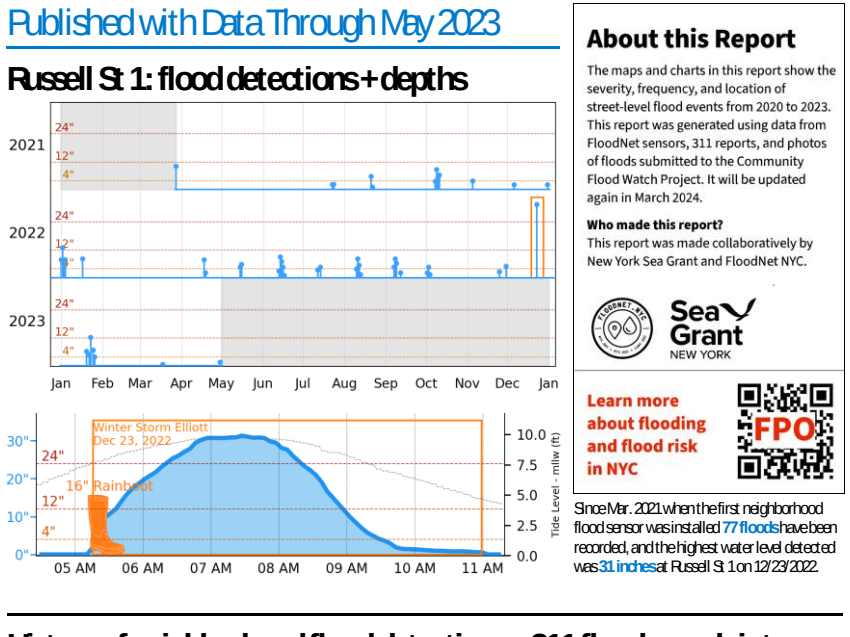
Save As



Printed Neighborhood Reports

Collaborators: NY Sea Grant, SRIJB, Sara Eichner, Can Sucuoglu





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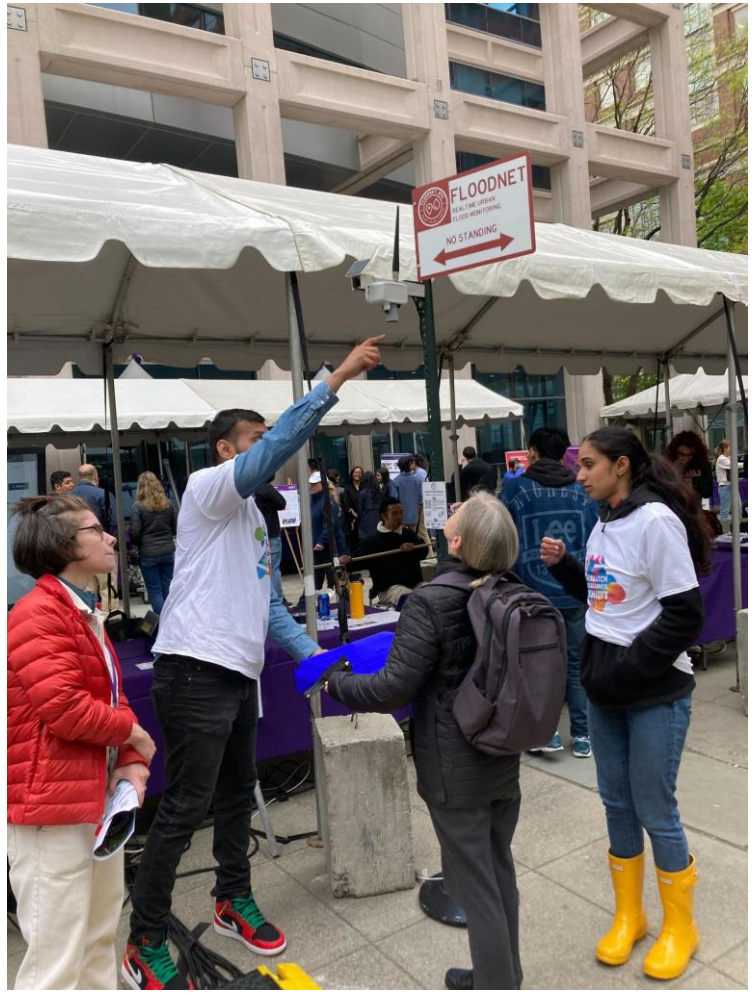
Community engagement

Véronëque Ignace – presentation tomorrow afternoon



Funding Sources

NYC Environmental Protection

Alfred P. Sloan Foundation

C2SMART Connected Cities with Smart Transportation

New York State of Opportunity. Empire State Development

CUNY Office of Research

NYU Marron Institute of Urban Management

Thank you to our community partners

New York University

Andrea Silverman, Charlie Mydlarz, Elizabeth Henaff, Tega Brain, Amanpreet Kaur, Bea Steers, Prafull Moona

CUNY Advanced Science Research Center

Ricardo Toledo-Crow, Praneeth sai venkat Challagonda, Kendra Krueger

Science and Resilience Institute at Jamaica Bay (Brooklyn College) + New York Sea Grant

Brett Branco, Polly Pierone, Véronëque Ignace, Sofia Maryamis, Hannah Burnett

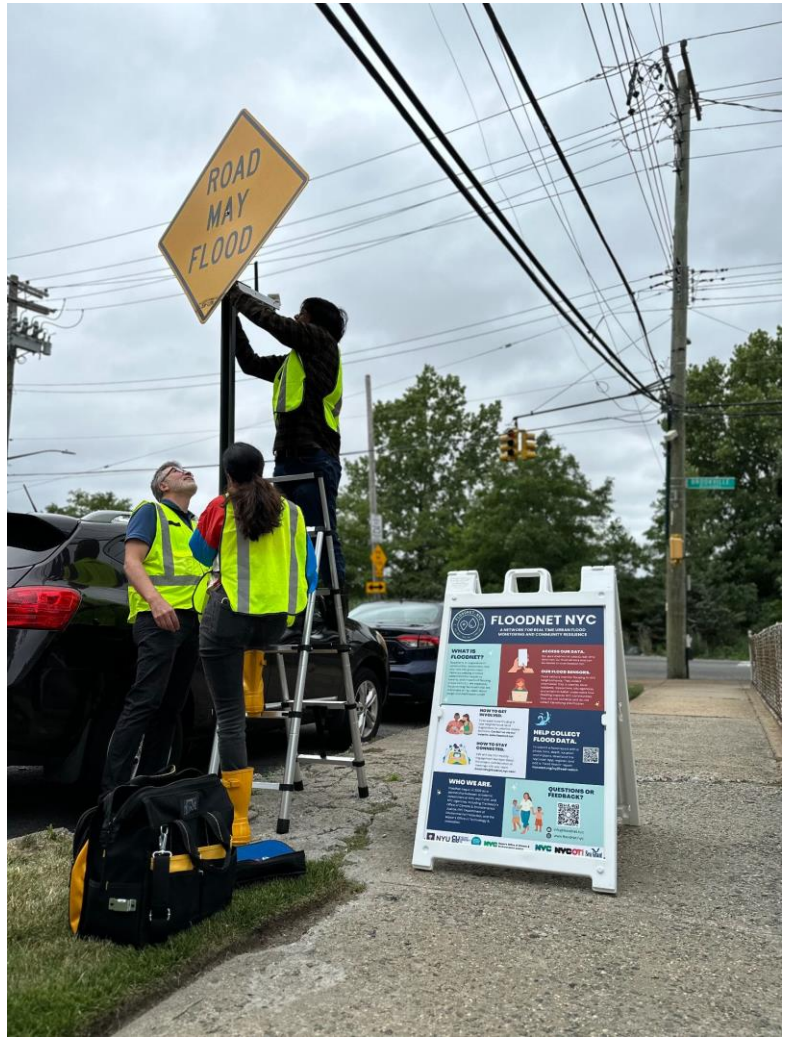
NYC Mayor's Office of Climate & Environmental Justice

Hayley Elszasz

NYC Office of Technology & Innovation

Paul Rothman

+ student researchers at NYU and CUNY



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NYC.GOV + NYU.EDU + CUNY.EDU

https://www.floodnet.nyc/