CIRCA's Research Support for Phase III Projects

Phase III of Resilient Connecticut will develop location-specific projects on Ansonia, Branford, Danbury, Fair Haven, Fairfield, South Norwalk and Stratford. Consultant teams are developing scientifically informed adaptation strategies and scoping the engineering and infrastructure components to 30% conceptual design for the seven projects below. For each project, feasibility and implementation strategies will be evaluated, including historic and environmental permitting considerations, as well as cost estimates, funding pathways, and coordination and alignment with Federal and State climate resilience programs. CIRCA supports the Phase III projects with nearshore modeling work, and field measurements.

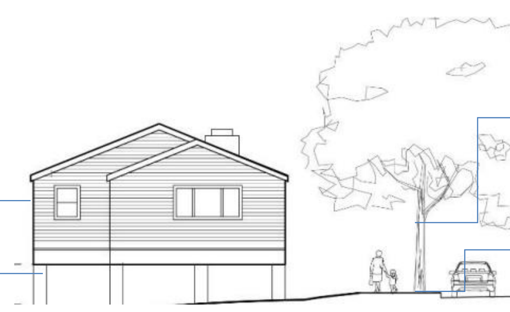
UCONN AVERY POINT

CIRCA Connecticut Institute for Resilience and Climate Adaptation

Nearshore Flood Modeling

Total Water Level
Accurate tide, surge and wave runup predictions

Sea Level Rise
Providing estimation of various surge scenarios with sea level rise impact



Validation
Accuracy comparisons with high water marks

Ground Elevation
Correct elevations from LIDAR and RTK measurements

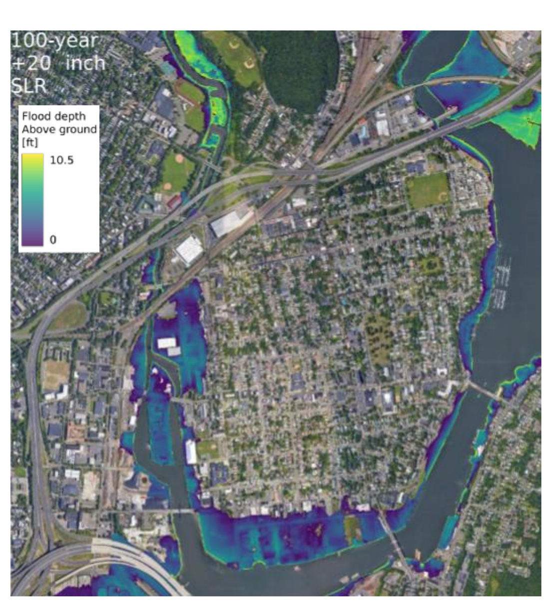
Flood hazard planning requires accurate estimations of total water elevation due to predicted tide, surge, and wave runup to design flood protection structures and improve coastal risk planning for severe storms. CIRCA has performed a set of high-resolution nearshore modeling studies to assess and estimate flood risk in Branford, Norwalk, Fair Haven, and Fairfield, under historical and future scenarios.

Model Highlights

Scan for full article to read about the methodology!

- Topography is combined from the LIDAR DEM on land and in shallow waters, and the USGS CoNED topobathymetric data product in deep waters.
- Open boundary forcing include wave and surge water level from a Long Island Sound model described by Liu et al. (2020).
- The elevations of bridges or underpasses are not indicated in the DEM data and are surveyed onsite with RTK GPS.
- Modeled maximum water level were compared with USGS high water mark (HWM) measurements during Superstorm Sandy.

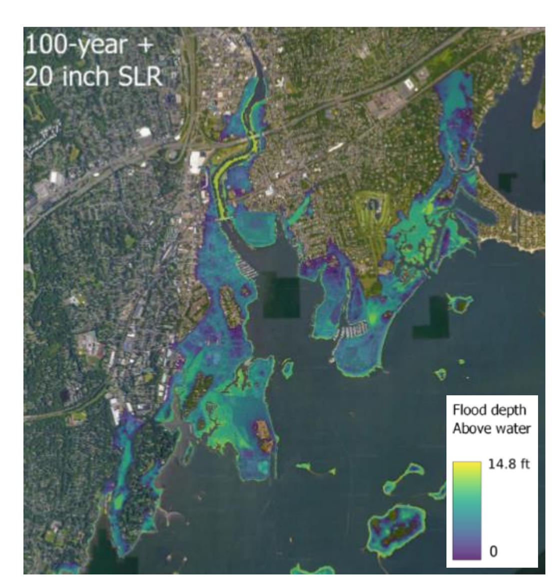
The Long Island Sound model estimates the return intervals of the wave and surge water levels by simulating 22 historical severe storm events and performing extremal analysis with these results. The nearshore model uses the boundary conditions from the Long Island Sound model. A total of 6 scenarios of current floods (10-,50- and 100-year) and future floods (10-, 50- and 100-year +20 inches sea level rise) are considered.

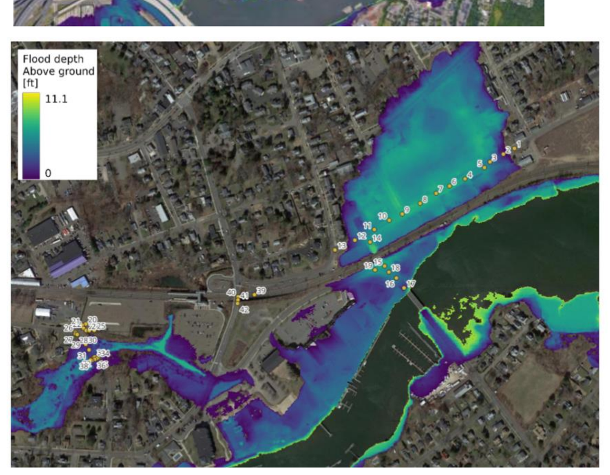


100 year surge & waves + 20 in Sea level

Fair Haven
ADCIRC-SWAN model supported with RTK measurements.

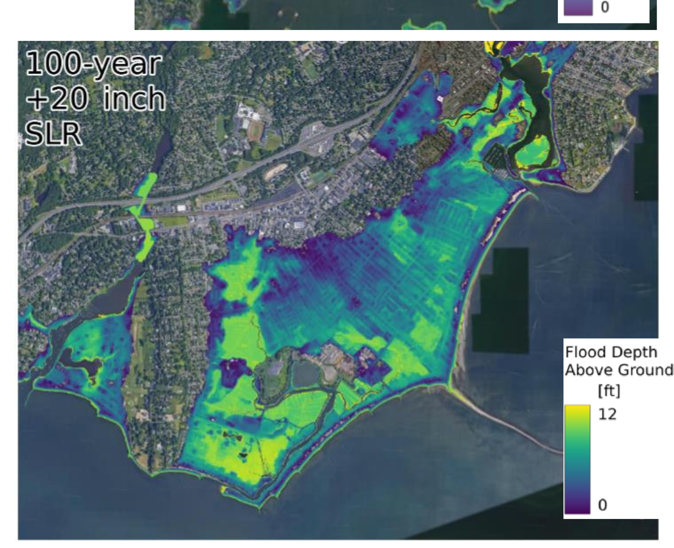
Norwalk
FUNWAVE-TVD model supported with RTK measurements around south Norwalk.





Branford
ADCIRC-SWAN model supported with RTK measurements.

Fairfield
ADCIRC-SWAN model supported with RTK measurements.

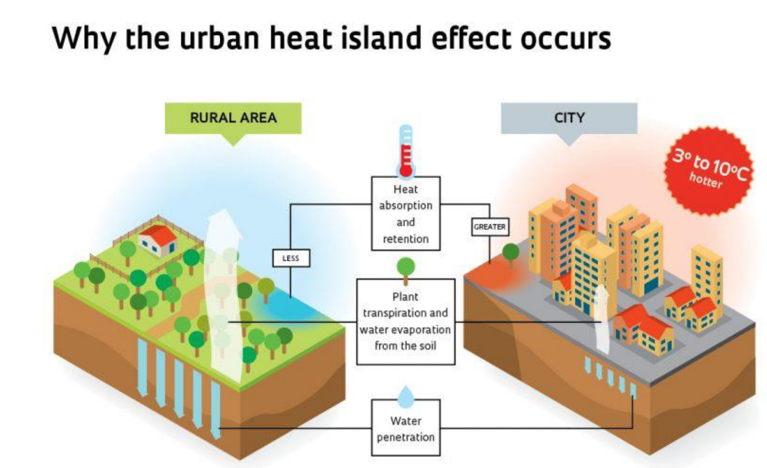


All the flood scenarios include total flood depth which includes storm surge and waves considering mean high high water level above ground level and NAVD88.

The nearshore model under the predicted 100-year scenario are compared using FUNWAVE with FEMA FIS, NACCS, and FVCOM-SWAVE. The comparison showed that the FEMA-suggested Base Flood Elevation maps overestimate the total water elevation, especially predict wave runup, with considerable disagreement with FUNWAVE due to its simplistic approach.

Neighborhood Scale Heat Index Variability

Most of the temperature estimates are based on numerical weather predictions using ground radar, weather balloons, aircraft, satellites, and ocean buoys. These instruments are not installed to measure how environmental conditions relevant to human heat stress vary across and within urban neighborhoods or with equity in mind. CIRCA deployed heat sensors in various locations in towns to map and identify vulnerable areas to heat and identify the contribution of the changes in heat to vulnerability.



Process

Scan for deployed locations for the sensors!

- Mapped unique install sites based on surrounding landscape typology, socio-economic factors, heat CCVI and town interest.
- Collaboration between City and private partners to ensure permissions and appropriateness of sites.
- CIRCA deploys the sensors on poles or trees and maintains the sensors. The sensors are deployed 8-10 ft above ground level.
- Continuous feedback about street-level climate on temperature, humidity and dew point temperature.

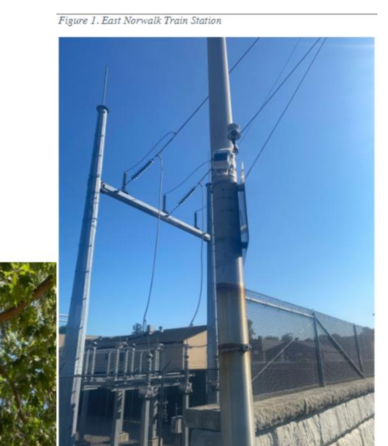
The sensors collect temperature, relative humidity, and dew point temperature at every 10 minutes. The dew point is the temperature the air needs to be cooled to (at constant pressure) to achieve a relative humidity of 100%. At this point, the air cannot hold any more water in the gas form. If the air were to be cooled, even more, water vapor would have to come out of the atmosphere in liquid form, usually as fog or precipitation. The higher the dew point rises, the greater the amount of moisture in the air. This directly affects how "comfortable" it will feel outside. The heat index, apparent temperature, is also computed from the data to explain the human-perceived equivalent of the temperature would be in the various parts of the town.

Identifying Sensor Locations

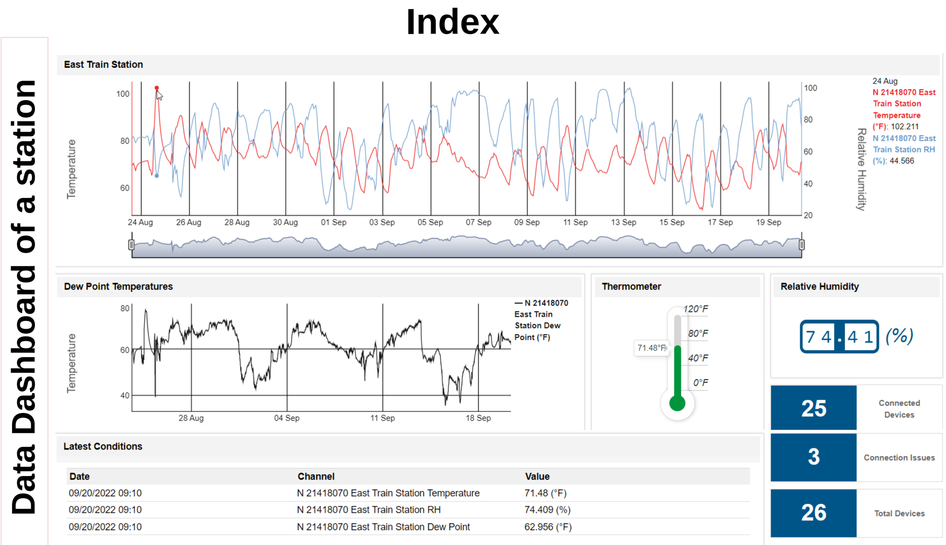
Local Climate Zones — Local Climate zones are classified using World Urban Database and Access Portal Tools, which is a machine learning approach that uses Google Earth Pro and SAGA GIS to develop LCZ classification based on aerial images (Google and LANDSAT 8).

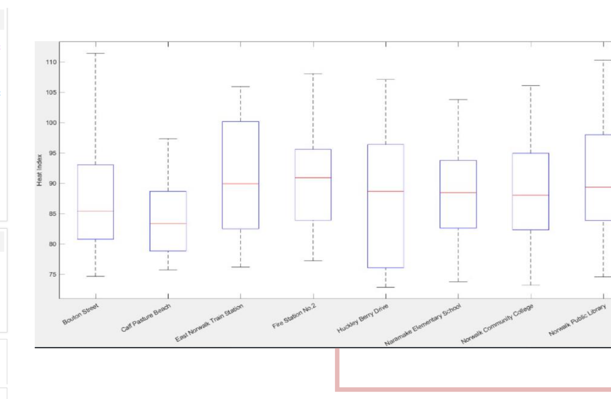
Demographic Characteristics — Socio-economic characteristics of the community are examined using social vulnerability index and Census Data.

Heat Vulnerability Index — Climate Change Vulnerability Index is examined to determine most vulnerable locations.



Data Dashboard of a station





The sensors are deployed in the City of Danbury and Norwalk for 2022 Summer.

The sample comparison box plot shows the average heat index (red horizontal line), The 10th and 90th percentile range of all the data (in a box), the highest and lowest points that each station reached (in horizontal lines), and the extend of the data range (in dashed lines) between June 6-22, 2022 in 8 Norwalk stations.

There is a significant variation in the datasets for temperature and humidity within these locations that can reach the differences of 5-10 F. These differences should be considered when developing adaptation solutions to extreme heat.