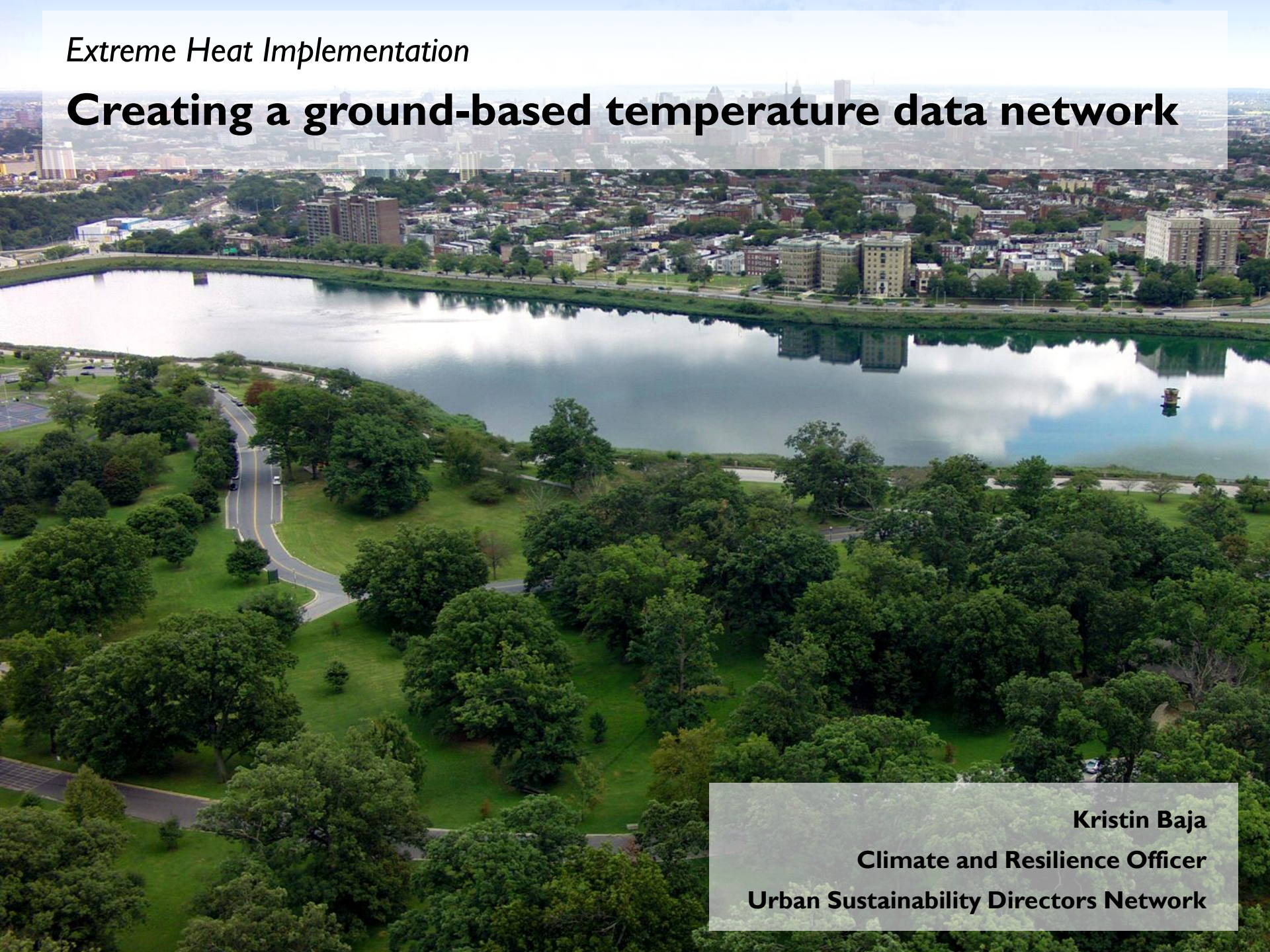
Extreme Heat Implementation

Creating a ground-based temperature data network



Kristin Baja

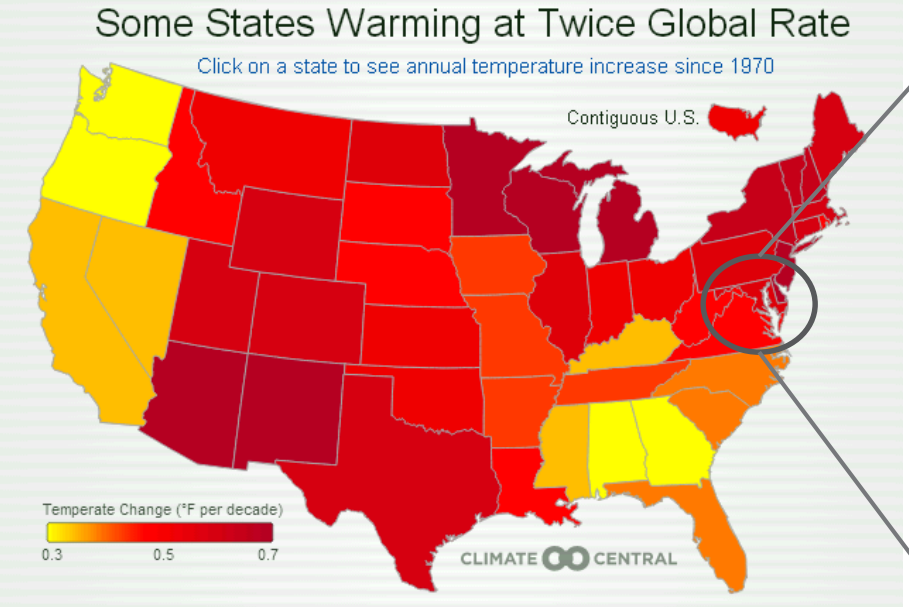
Climate and Resilience Officer

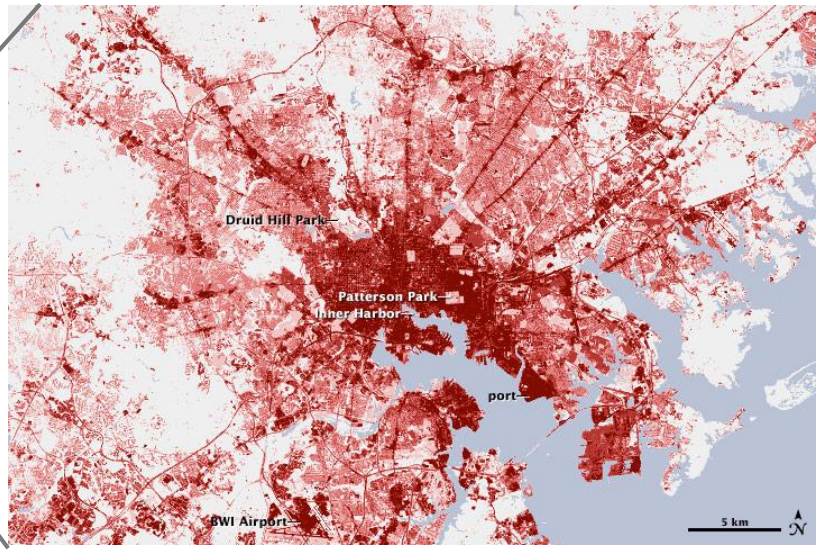
Urban Sustainability Directors Network

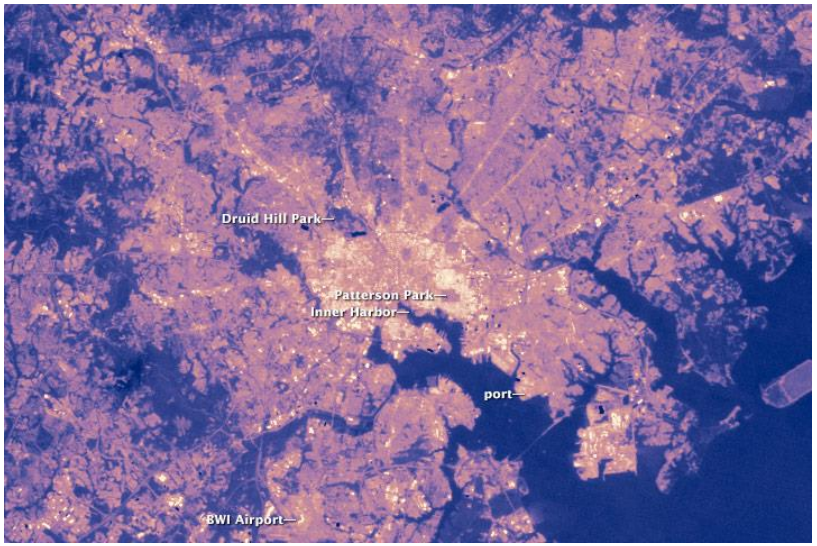
Overview

- Brief Background
- Approach
- Partners
- Implementation
- Engagement
- Next Steps

Extreme Heat in Baltimore







The number of days with air temperatures exceeding 90 F is projected to double (and could even triple) by the end of the century.

Risk Assessment

Risk Assessment

Hazard Identification

- Hazard Identification
- Review Historical Impacts
- Conduct an Asset Inventory

Vulnerability Assessment

- Determine likelihood
- Determine economic, social, legal & environmental consequence

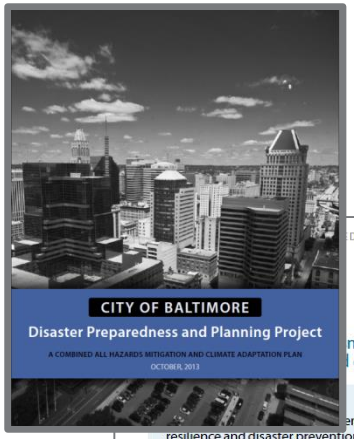
Impacts Assessment

- HAZUS Modeling
- Integrate projected climate conditions
- Identify weaknesses

Plan Development

- Vision, Goals, Strategies, Actions
- Prioritization
- Integration
- Plan for implementation & monitoring

Disaster Preparedness Plan



Adopted unanimously in October, 2013

ment that evaluates and improves all pipes' ability to withstand
l cold

em is dated and in need of upgrades. It is important to build extreme weather resilience and disaster prevention into water and wastewater systems by using both adaptation and mitigation actions. Additionally, structural and infrastructural upgrades must be made to reduce loss of water supply from the distribution system.

Baltimore Water Pipe *Source: BaltimoreSun*

1. Replace old and malfunctioning pipes with new pipes or retrofit existing pipes with new lining

   Pipes that have already begun experiencing problems, or older pipes which are more vulnerable to the impacts of hazards, should be upgraded using the best available technology.

2. Evaluate and utilize new technology that allows for greater flexibility in pipes as they are replaced

   It is essential to prepare for future changes in hazard events and proactively upgrade pipe systems to prevent cracking and bursting.

IMPLEMENTATION GUIDELINES	
Lead Agency	DPW
Stakeholders	DOT, DPW, Water and Wastewater Utilities
Alignment with Goals	Goal 3
Connection with Existing Efforts	CAP; CRS; MD DNR; ESF-3; ESF-4
Timeframe	

STORMWATER

IN-16 Enhance and expand stormwater infrastructure and systems

Future changes in precipitation frequency and intensity may require reconsideration of the design of existing stormwater infrastructure systems.

Increase resiliency and disaster prevention measures related to stormwater systems by enhancing drainage systems in stream corridors and improving and repairing stormwater conveyance popes and outfalls.

1. Implement the requirements of Baltimore's MS4 (separate stormwater and sewer system) permit (S)

   The City of Baltimore operates under a Municipal Separate Stormwater and Sewer System (MS4) permit, which protects water-quality and requires that Baltimore prevents pollution as much as possible. It is critical that the requirements of these permits are fully met.

2. Prioritize storm drain upgrades and replacement in areas with reoccurring flooding (S)

   While proximity to a floodplain or floodway can increase vulnerability to flooding, certain measures can reduce this vulnerability. Inadequate or older pipes, which cannot accommodate the excessive amounts of stormwater, should be upgraded so as to handle extreme rainfall and storm surge events.

3. Install backflow-prevention devices or other appropriate technology along waterfront to reduce flood risk (M-L)

   Backflow-prevention devices are used to ensure that water does not flow back through drainage infrastructure. Through the installation of backflow-prevention devices, the City can improve the performance of the drainage network and prevent risk of flooding impact along the waterfront.

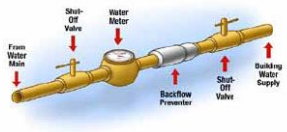
4. Preserve and protect natural drainage corridors (S)

   It is important to utilize natural drainage corridors and green infrastructure to capture more stormwater runoff and enhance the ability of the existing infrastructure to cope with environmental changes.

5. Review and revise storm drain design on a continuous basis, to accommodate projected changes in intense rainfall (O)

   The City's storm drains will require continual revision to incorporate new and projected changes in intense rainfall. This will ensure that the storm drains maintain adequate capacity.

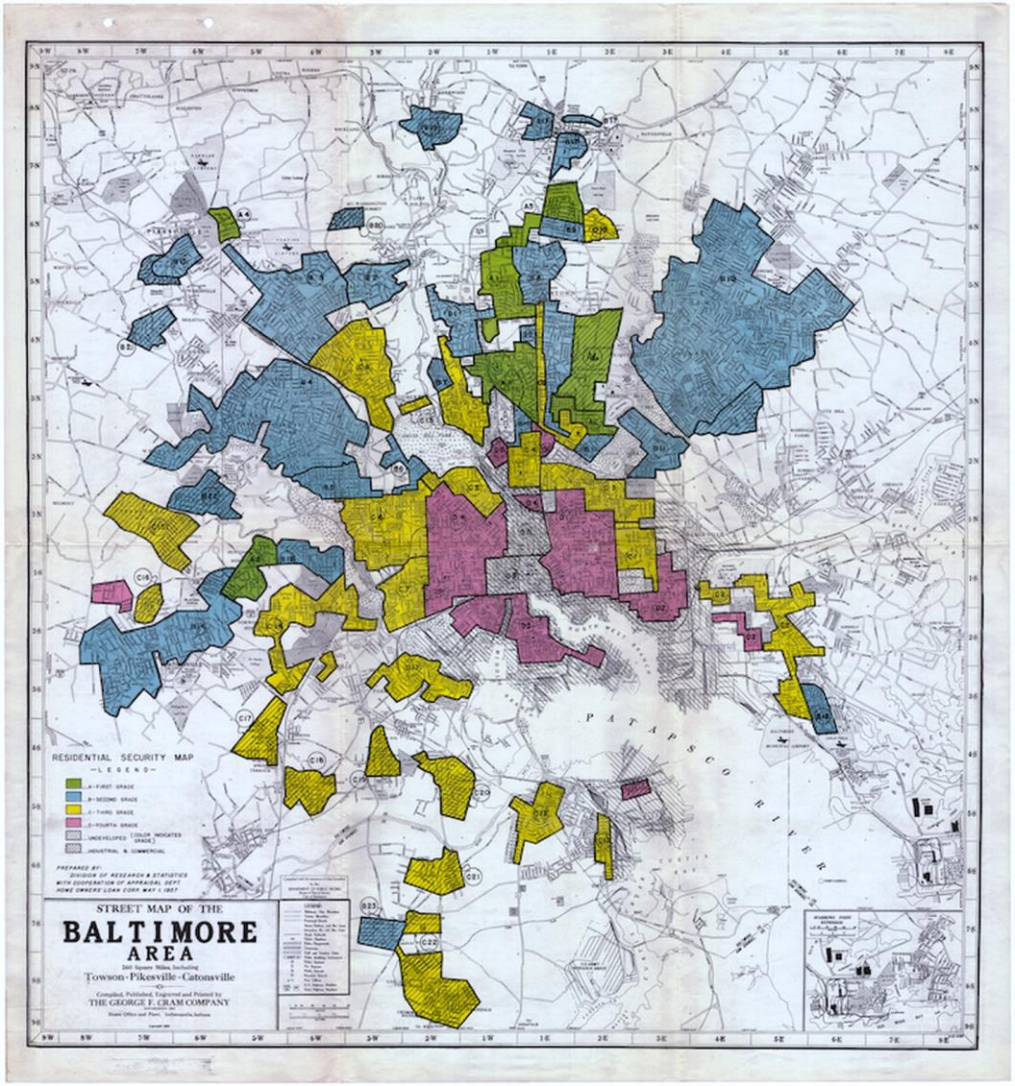
IMPLEMENTATION GUIDELINES	
Lead Agency	DPW
Stakeholders	Community Groups, DOT, DPW, MOEM, MDNR, NGOs, Private Developers, Stormwater Utility
Alignment with Goals	Goals 1, 3, and 6
Connection with Existing Efforts	CRS; MD DNR
Timeframe	



Backflow Preventer *Source: DemarPlumbingNYC*

Equity

- Historic planning practices. Honestly acknowledge racism within policies and practices
- From 1951 to 1971 80-90% of the 25,000 families displaced to build new highways, schools and housing were black



Equity as a Lens

- Prioritize neighborhoods with highest vulnerability and historic disinvestment
- Provide job training and green job opportunities as part of most initiatives
- Build trust and relationships
- Highlight economic and health benefits such as lower electricity costs

Partners and Project Team

- The City needed a team of experts to assist with data collection and assessment
- Approached Johns Hopkins University (JHU) and the Maryland Institute College of Art (MICA)
- Strong core project team developed in 2014

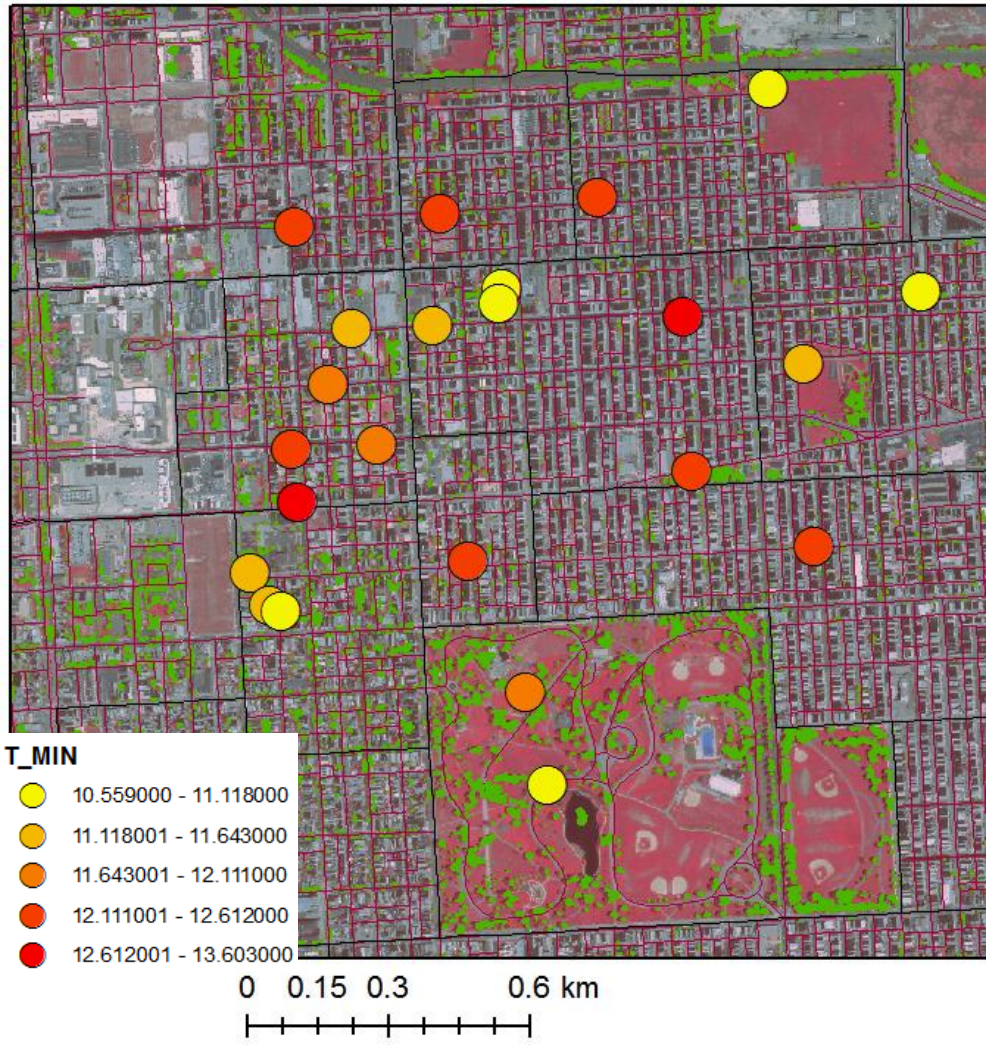
Left to right: Ben Zaitchik, Asha Jordan, Anna Scott, D'Ann Williams, (bottom) Meredith McCormack (JHU). Katie O'Meara, Clara Hickman, Sophie Storkel (MICA).

Bmore Cool Project

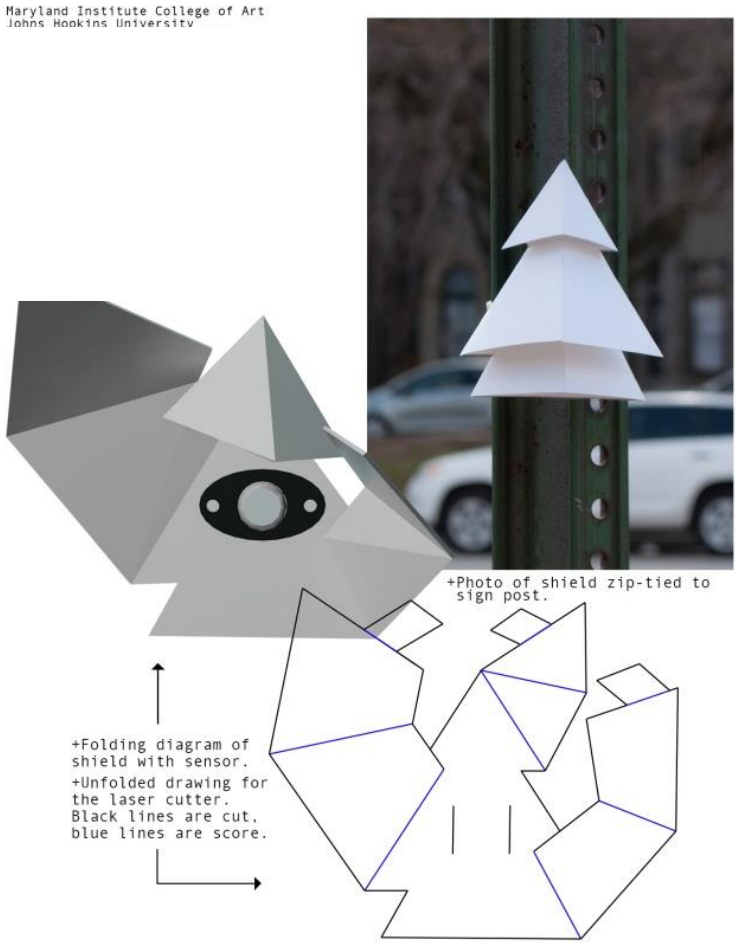
Goals:

- To improve our understanding of the heat burden in underserved neighborhoods
- To identify ways to reduce heat impacts through awareness, warnings, and heat island mitigation.
- To generate science-based analysis of heat vulnerabilities in order to inform heat warning and heat island mitigation activities.

Minimum Temperature (^{O}C)



Temp and Humidity Sensors



Thermometer/hygrometer and radiation shield. Design and figure courtesy Sophie Stoerkel, Clara Hickman, Katie O'Meara, MICA.

The team developed a network of low-cost temperature and humidity sensors.

The sensors are deployed each summer across heat vulnerable neighborhoods in the city.

The sensors are composed of an iButton hygrometer and a radiation shield designed at MICA, are used to monitor local variations in heat.

Sensor Distribution

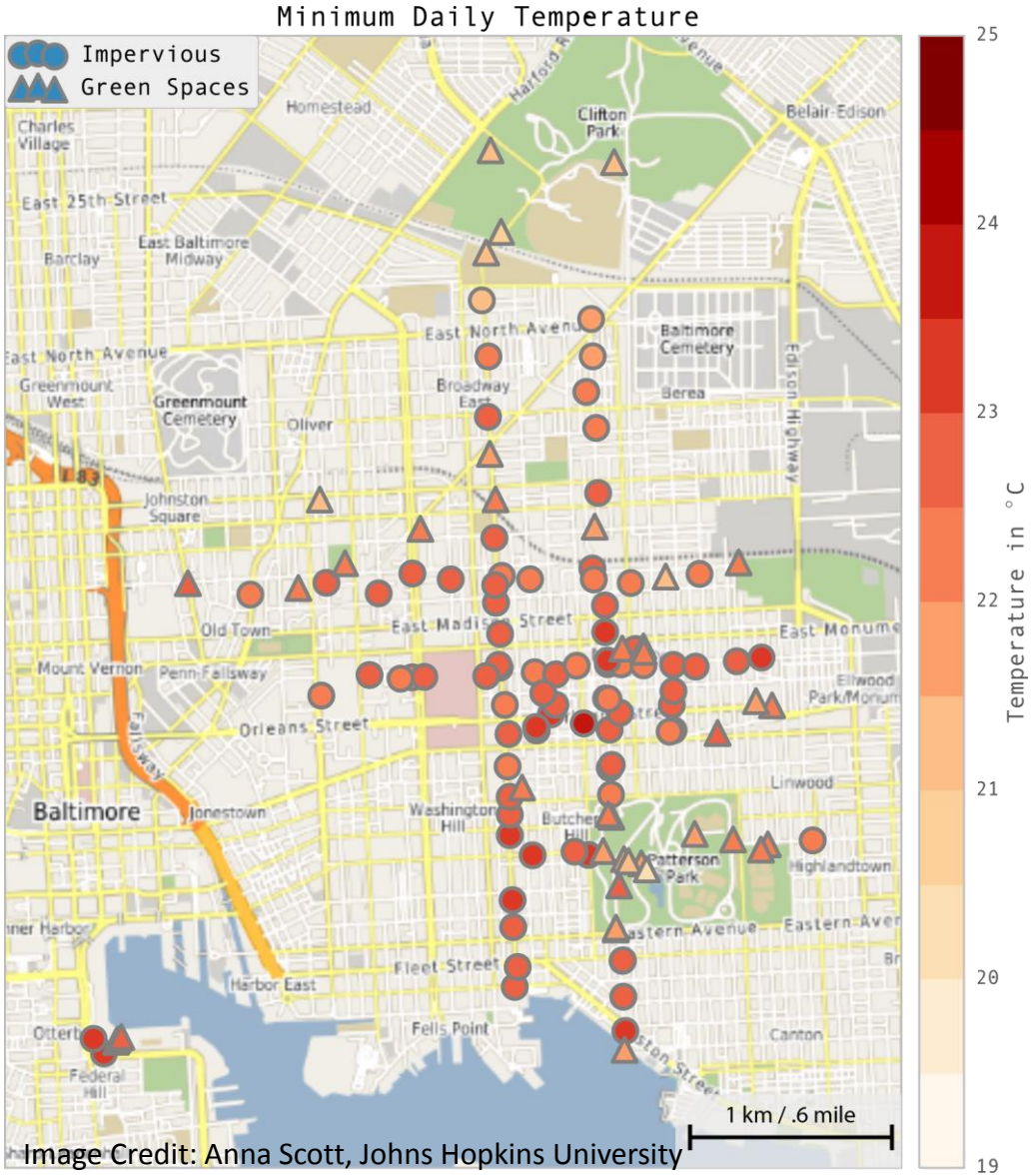
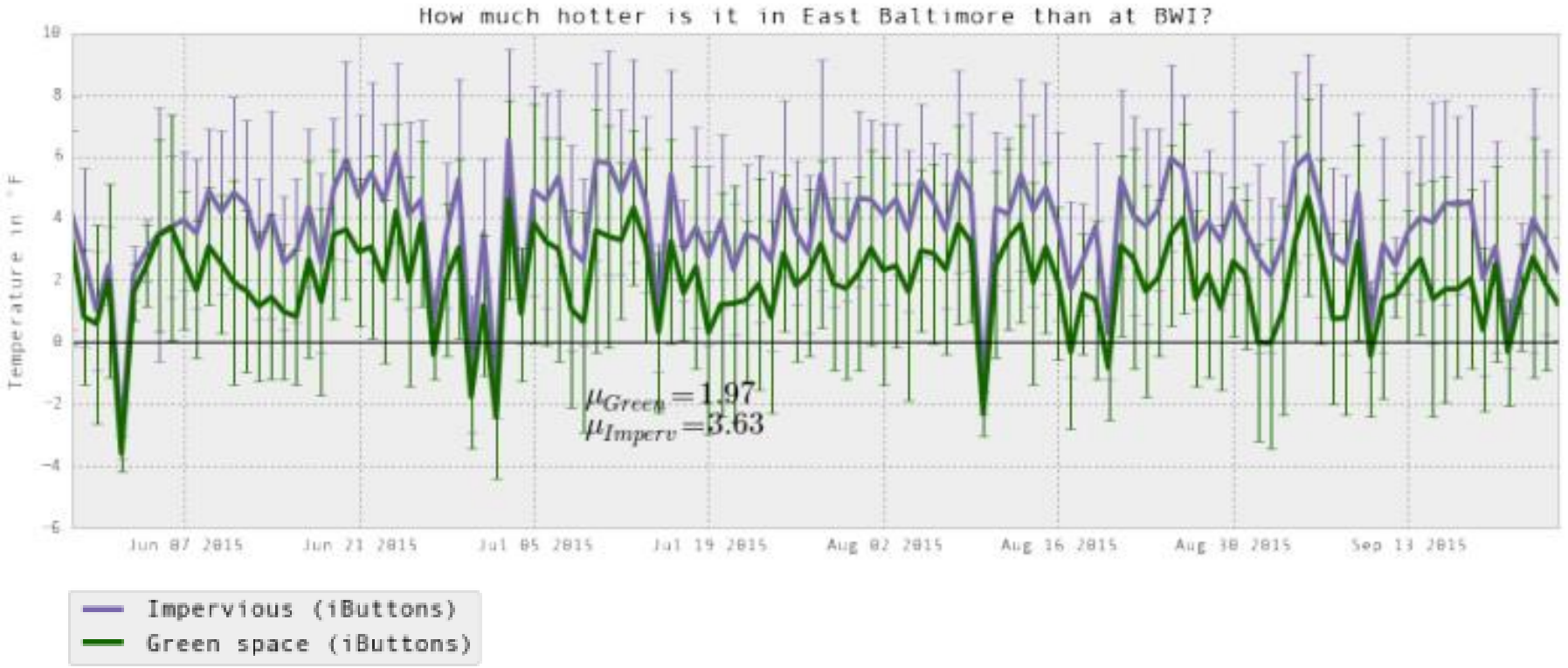


Image Credit: Anna Scott, Johns Hopkins University

Combine the network measurements with satellite-derived Earth observations including skin temperature from Landsat, ASTER and MODIS sensors, high-resolution satellite estimates of vegetation cover, albedo, and topography, and GIS information on infrastructure and human demographics.

Data Collection



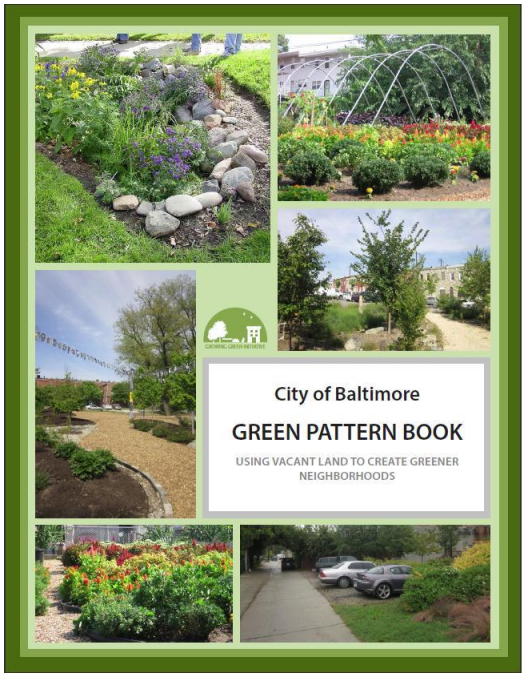
There is a need to capture heterogeneities in the UHI at neighborhood and sub-neighborhood scale, such that city offices with responsibility for health, emergency management, housing, and sustainability can effectively target acute interventions for vulnerable populations

Accomplishments to date

- Just completed third year of monitoring outdoor air temperature using 150 monitors throughout Baltimore City
- Published research on night-time air temperature variability in Baltimore (Scott et al 2016, JAMC), indoor temperature & health (McCormack et al 2016, An. Am. Thoracic Soc.)
- Presented results at scientific meetings

City- Greening Initiatives

Utilize the UHI data to focused on re-using vacant land to green neighborhoods, reduce stormwater runoff, grow food, and create community spaces that mitigate the negative impacts of vacant properties



Prioritize Plantings

TreeBaltimore

- Goal of 40% tree canopy cover by 2030
- Partner with individual homeowners as well as communities, schools, and businesses
- Data used for prioritizing plantings in areas with highest UHI

TreeKeepers

- Data used in classes that teach citizens about climate change and how to care for their trees and environment

Weed Warriors

- Data used to inform removal of invasive species by trained environmental stewards

Data- Tree Species Database

Database of Trees

- Predicted climate conditions
- Species that thrive
- Maintenance and soil requirements
- Planting specifications

Spatial Analysis Tool

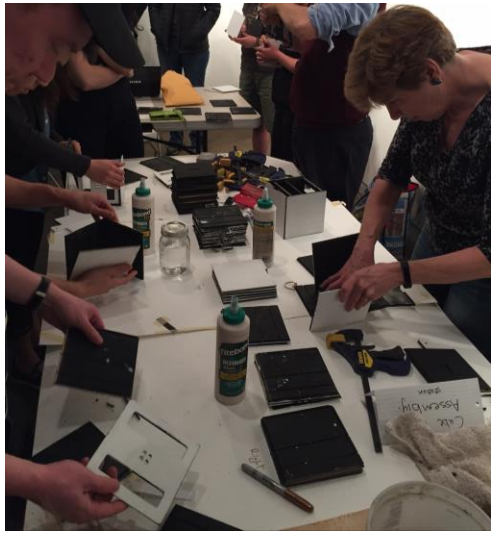
- Overlay areas at risk
- Overlay soils, demographic information, water/salt water info and heat data
- Develop list of trees best for those conditions

Engagement

Next Steps

Greater Baltimore Open Air Project

- Sensors that monitor air quality and urban heat
- 300 air quality monitors assembled a local nonprofit Civic Works
- Involves more project partners including the Maryland Department of the Environment and Community Based Organizations
- Extensive Community Engagement and Involvement



Thank you to my awesome Bmore Cool Project team!

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