URBAN RESILIENCE TO EXTREMES (UREXSRN)
CITY PROFILES: CLIMATE CHALLENGES

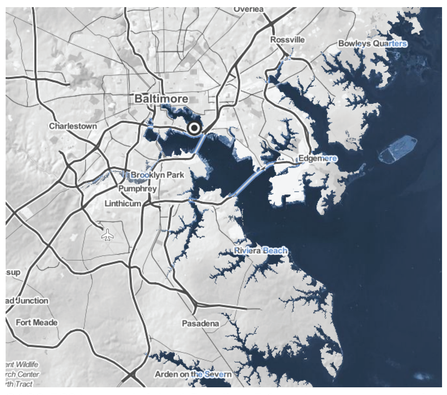
BALTIMORE

PROJECTED EXTREME EVENTS

- River related precipitation-driven storms
- Extreme heat
- Tidal flooding and storm surges associated with hurricanes

BACKGROUND: EXTREME EVENTS

- River related, precipitation-driven storms (e.g. August 1971 an extreme thunder storm brought 11 inches in 10 hours)
- Extreme heat events can occur nearly every summer
- If wind events also occur, major power outages and extreme heat
- Hurricanes (e.g. Agnes in 1972 most extreme flooding)
- Severe droughts (5 in the last century; 75-100% of water needs are met with surface water)
- Hurricane Sandy didn't hit Baltimore but motivated new resilience planning



2100 50% annual risk of flooding 5 feet due to sea level rise
Surging Seas by Climate Central

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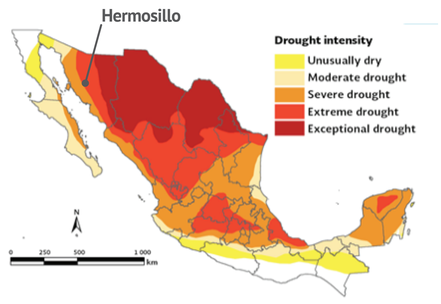
HERMOSILLO

PROJECTED EXTREME EVENTS

- Urban heat waves
- Urban runoff
- Drought

BACKGROUND: EXTREME EVENTS

- Population in the city is estimated at around 800,000
- Growth rate estimated at 2.5% per year in the last decade.
- Severe droughts in the 1990's and early 2000's
- Severe water shortages as a result of overexploitation of coastal aquifers
- Water conflicts as a result of inter basin transfers from the Yaqui River
- Flooding impacts every summer. No data on monetary losses. High vulnerability in peri-urban areas
- The impacts of climate change are not well understood



Sonora is one of the states most affected by drought, June 2011
Subgerencia de Pronóstico a Mediano y Largo Plazo, Coordinación General del Servicio Meteorologico Nacional, SMN, Feb 2012

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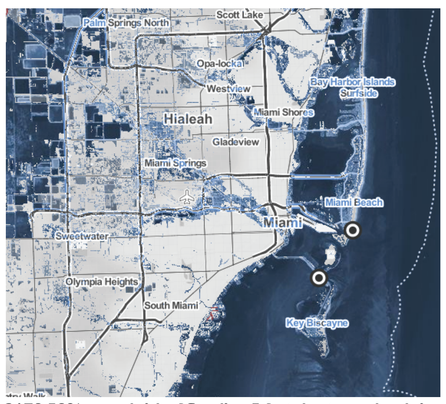
MIAMI

PROJECTED EXTREME EVENTS

- Tropical storms
- Urban flooding
- Coastal flooding
- Extreme heat
- Drought

BACKGROUND: EXTREME EVENTS

- Highly threatened by sea level rise, with up to $31 billion of property value threatened with 3 foot sea level rise
- High tides currently inundate coastal communities: June 2009 high tide levels were 6" to 2' above normal levels
- October 7, 2010: Ocean high tides reached the streets of downtown Miami
- High fluctuation in rainfall: November 2008 - April 2009 was second driest 6-month period on record, with the following May-July having heavier than average rainfall. June 5, 2009, 9.3" of rain fell within 3 hours creating severe flooding
- Temperature extremes: 2010 had the coldest 3 months in four decades followed by a summer with record breaking heat
- Florida is ranked number one in total damage costs from hurricanes and fourth for floods.



2170 50% annual risk of flooding 5 feet due to sea level rise
Surging Seas by Climate Central

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Miami-Dade County
Southeast Florida Regional Climate Compact
South Florida Water Management District
Florida Water & Climate Alliance
National Hurricane Center
American Institute of Architects, Miami Chapter
Sea Level Rise Task Force

NEW YORK

PROJECTED EXTREME EVENTS

- Surface flooding
- Coastal flooding
- Heat waves

BACKGROUND: EXTREME EVENTS

- Hurricane Sandy (2012) caused $60 billion regionally in damage: 250,000 cars lost, thousands of homes lost, millions without power, and more. Coastal and surface flooding was primary driver of infrastructure damage, but reverberated throughout urban system via cascading failures including damage to power supply, communications, transportation, fuel delivery, and food availability
- Notable extreme events during the first decade of the 21st century included flash floods, massive snowstorms, tornadoes, and Hurricanes Sandy and Irene.
- NOAA estimated a total of 656 storm events for NYC from 2005 to mid-2015 with a total of 123 deaths
- Responses to Sandy included assessments, adaptation and mitigation measures, and multiple agency plans, including roles of the Mayor's Office of Recovery and Resilience and public and private service providers

FEMA Flood Zone, 2020s Zone (11"), 2050s Zone (31") Sea Level Rise
National Oceanic & Atmospheric Administration

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New York City Mayor's Office of Recovery and Resiliency
New York City Department of Environmental Protection
New York City Deptartment of Parks & Recreation
WeACT
New York City Environmental Justice Alliance
The Nature Conservancy
Science and Resilience Institute at Jamaica Bay

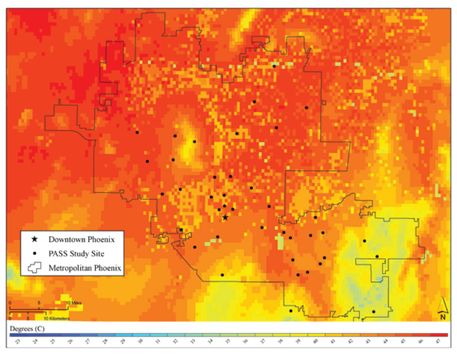
PHOENIX

PROJECTED EXTREME EVENTS

- Heat
- Drought
- Flooding
- Dust storms

BACKGROUND: EXTREME EVENTS

- Regular occurrence of extreme heat. Urban areas experiences around 80 heat related deaths per year and thousands of hospitalizations
- Urban flooding includes standing water in infrastructure as well as flash flooding
- September 2014, 10-15 centimeters of rainfall in less than 24 hours



Phoenix Map of Extreme Heat July 2005
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Maricopa County
City of Phoenix
The Nature Conservancy
Maricopa Flood Control District

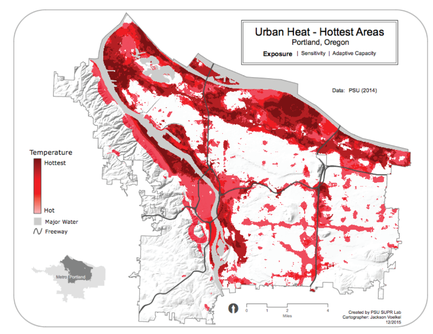
PORTLAND

PROJECTED EXTREME EVENTS

- Urban flooding
- Sedimentation of drinking water sources
- Combined sewage overflows
- Landslides
- Wildfire & air quality impacts

BACKGROUND: EXTREME EVENTS

- In 1993, developed first local climate action plan in the U.S.
- 25+ years of green infrastructure implementation
- Active climate change preparation strategy
- Aging population
- Housing/Homelessness State of Emergency declared in 2015
- Active gentrification
- 17.8% of population below the poverty level
- History of severe flooding (1948, 1996) December 2015: Portland's wettest month on record with 15.24" of rain
- Summer 2015: Portland's hottest summer on record with avg. temperature of 72.2°F and 28 days over 90°F



2015 Urban Heat Map
Sustaining Urban Places Research (SUPR) Lab, College of Urban and Public Affairs at Portland State University

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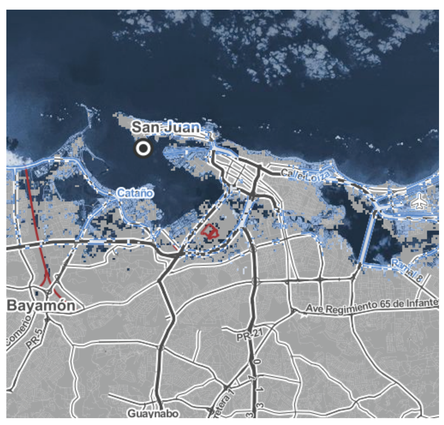
SAN JUAN

PROJECTED EXTREME EVENTS

- Coastal flooding
- Urban flooding
- Extreme Heat
- Drought

BACKGROUND: EXTREME EVENTS

- Severe droughts in the 1994, 2014 and 2015.
- Air surface temperature – New records occur every year and extreme heat events every summer
- 11 Presidential Disaster Declarations (1970- 2004) due to heavy rain, tropical storms and hurricanes
- 80 urban floods (2004-2014) 39% of the population lives in flood zones
- 22% (<5 years old and >65 years old)
- Most of the population concentrated 1km from the coastline
- Population in 2010 was 395,326
- Median household income below that of any State
- High unemployment, Shrinking economy
- Unseen emigration to the mainland
- Public health issues (obesity, asthma, vector-borne disease, etc.)



2170 50% annual risk of flooding 5 feet due to sea level rise
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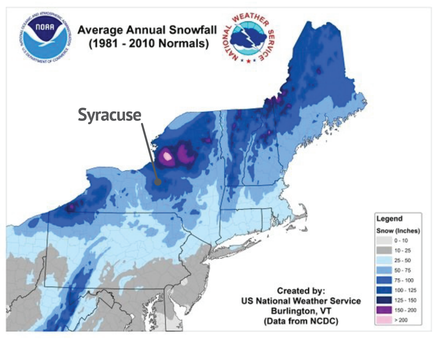
SYRACUSE

PROJECTED EXTREME EVENTS

- Ice storms
- Blizzards
- Microbursts
- Floods
- Extreme cold

BACKGROUND: EXTREME EVENTS

- Flooding, blizzards, massive snowfalls, ice storms, severe cold events
- Extreme events burden water, sewer, transport, mobility and energy infrastructures
- Storm water management is a major challenge
- Days with extreme precipitation and downpours are expected to increase (NPCC 2015)
- Climate projections include more frequent intense storms
- High rates of poverty in minority neighborhoods
- Declining and aging population 40% of city properties are non-taxable, eroding tax base, aging infrastructure
- Restoration of Onondaga Lake, green infrastructure investments



Average Annual Snowfall
National Oceanic & Atmospheric Administration

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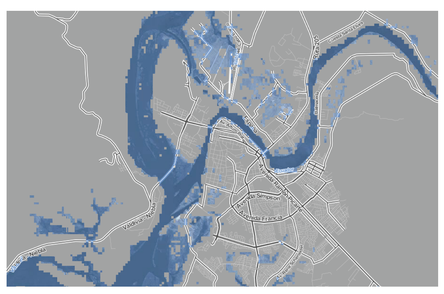
VALDIVIA

PROJECTED EXTREME EVENTS

- Urban flooding
- Extreme heat
- Drought
- Coastal flooding

BACKGROUND: EXTREME EVENTS

- 1960 earthquake extremely modified the geography "creating" several wetlands in the city
- Wetlands contribute to flood and heat mitigation, but are being infilled for housing and streets
- Generalized climate projections include more city flooding and drought, however public perception of most pressing issue is drought which occurs in summer when the population of Valdivia doubles due to tourism
- We do not have climate projections at the city scale (30 km2 aprox)
- Valdivia Sustainability Plan of Action (IDB, May 2015)



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