

INTEGRATING PUBLIC HEALTH, SERVICE DELIVERY, HEALTH EQUITY AND CLIMATE ADAPTATION PLANNING



Action funded by the
EUROPEAN UNION

Ephrat Yovel

Workshop on Climate Adaptation
12 Feb, 2021

1

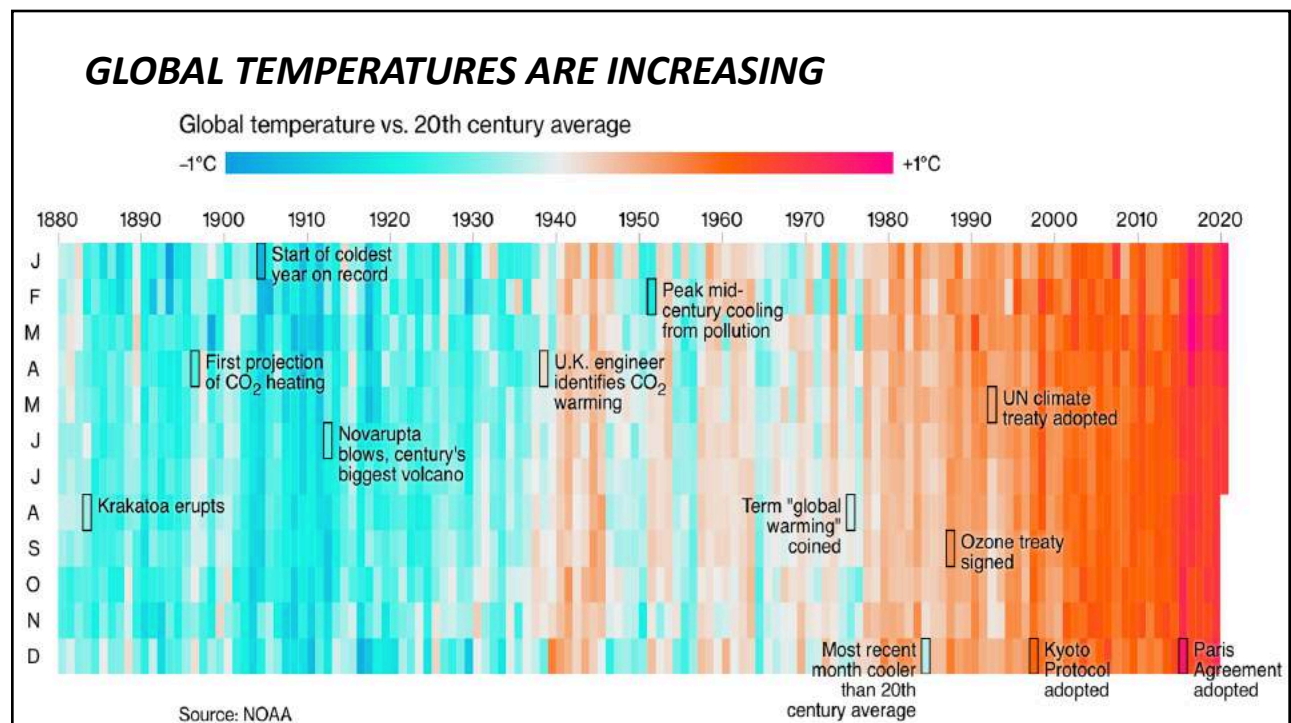
DISCUSSION

- Shared understanding
- WHO Frameworks for integrating climate considerations
- Public health issues related to climate change
- Social vulnerability / at-risk populations
- Extreme heat
- Urban heat islands

2

A SHARED UNDERSTANDING

3



4

WE HAVE A GOOD IDEA OF HOW CERTAIN TYPES OF CLIMATE EVENTS ARE BEING AFFECTED



Stronger and more frequent heat waves



Stronger rainfall and winter storms



Rising sea level and stronger hurricanes



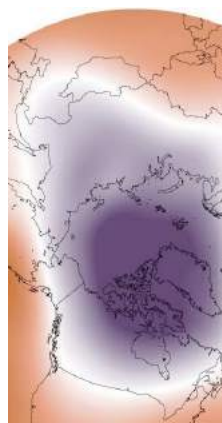
Larger wildfires in the West

5

OTHERS, WE'RE STILL FIGURING OUT



Droughts: stronger, but more or less frequent?



Polar Vortex: related to Arctic warming?



Derechos: Hard enough to predict, let alone project!



Tornadoes, hailstorms: stronger, but more or less frequent?

6

CHANGING CLIMATE IS A RISK MULTIPLIER



Uncertain impacts
on existing systems



Uncertain politics
and social
reactions



Changing
composition of
populations

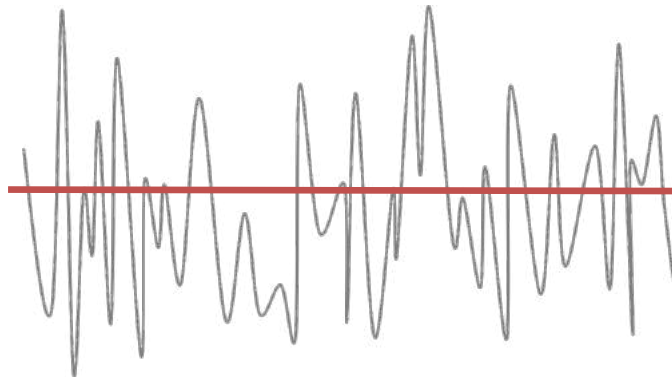


Uncertainty of
changing costs
and funding flows

7

IMPACTS ARE HERE. TIME TO PREPARE

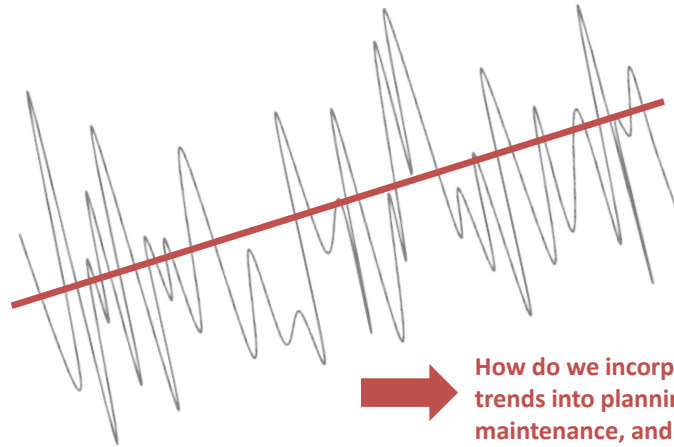
We used to assume that the long-term climate will remain stable and can be predicted based on past climate normals



8

IMPACTS ARE HERE. TIME TO PREPARE

Today, climate is manifestly non-stationary: Past is no longer a reliable indicator of present or future conditions

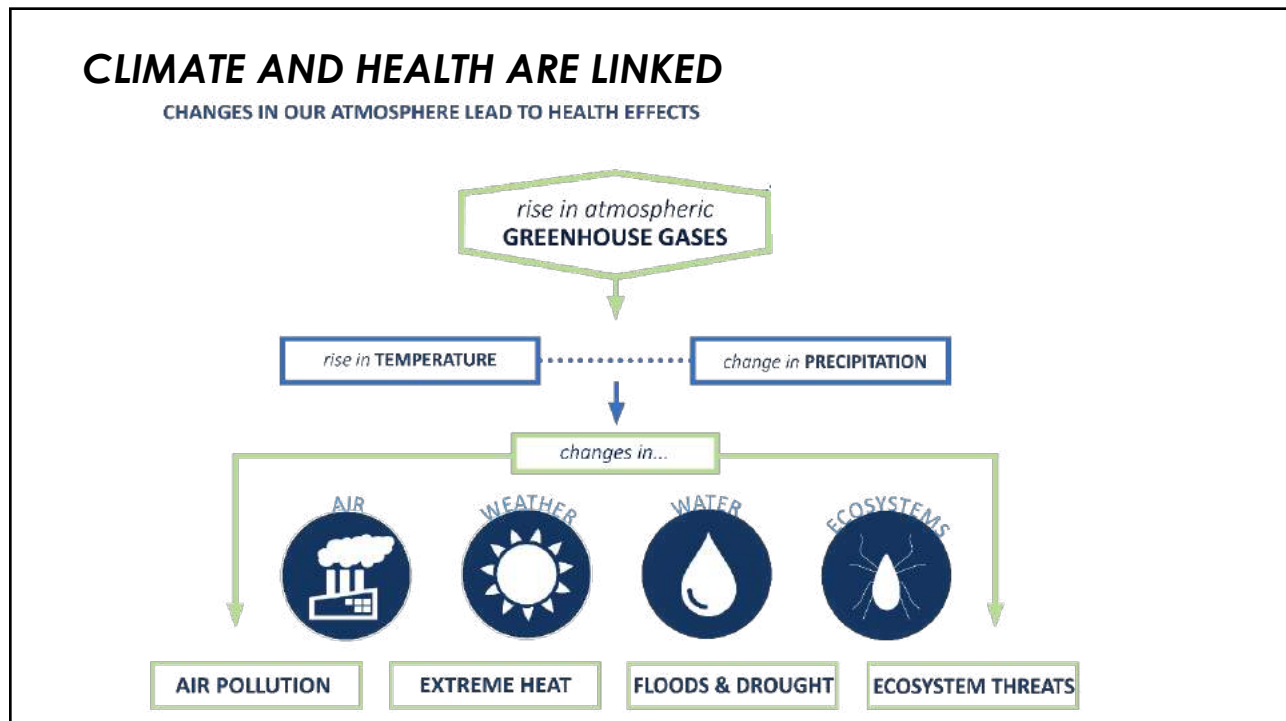


How do we incorporate changing climate trends into planning for operations, maintenance, and design?

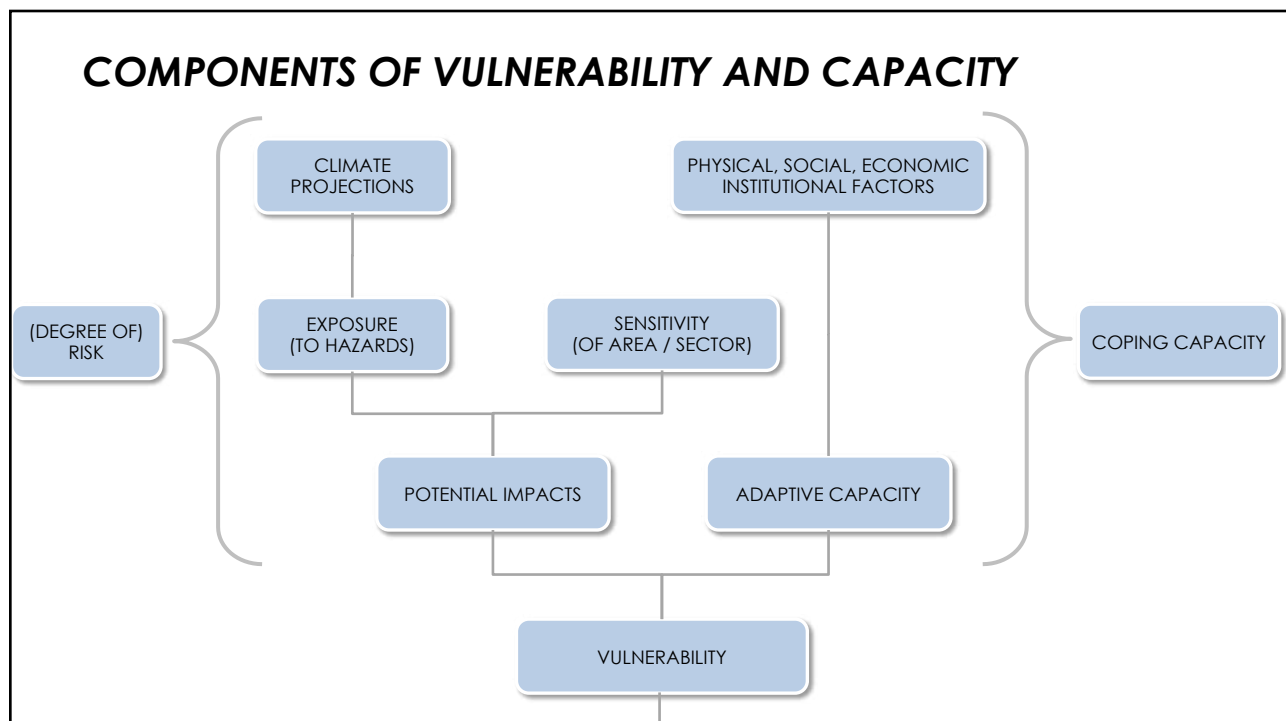
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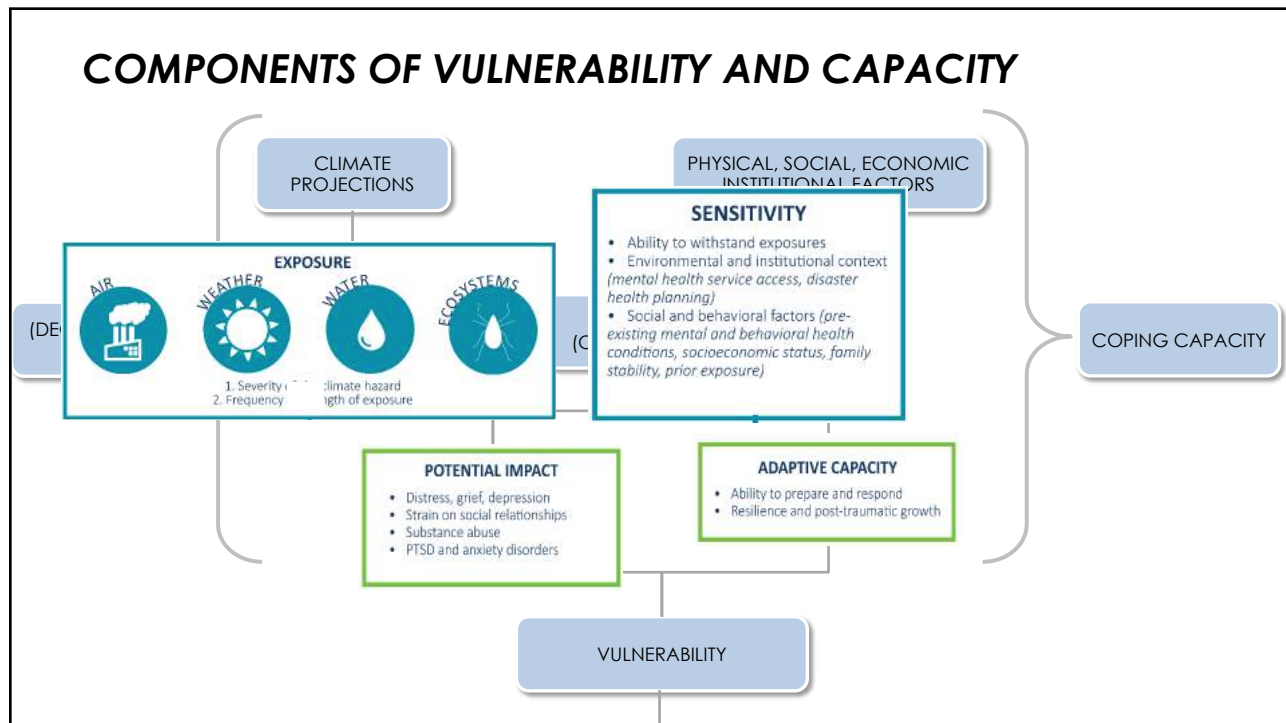
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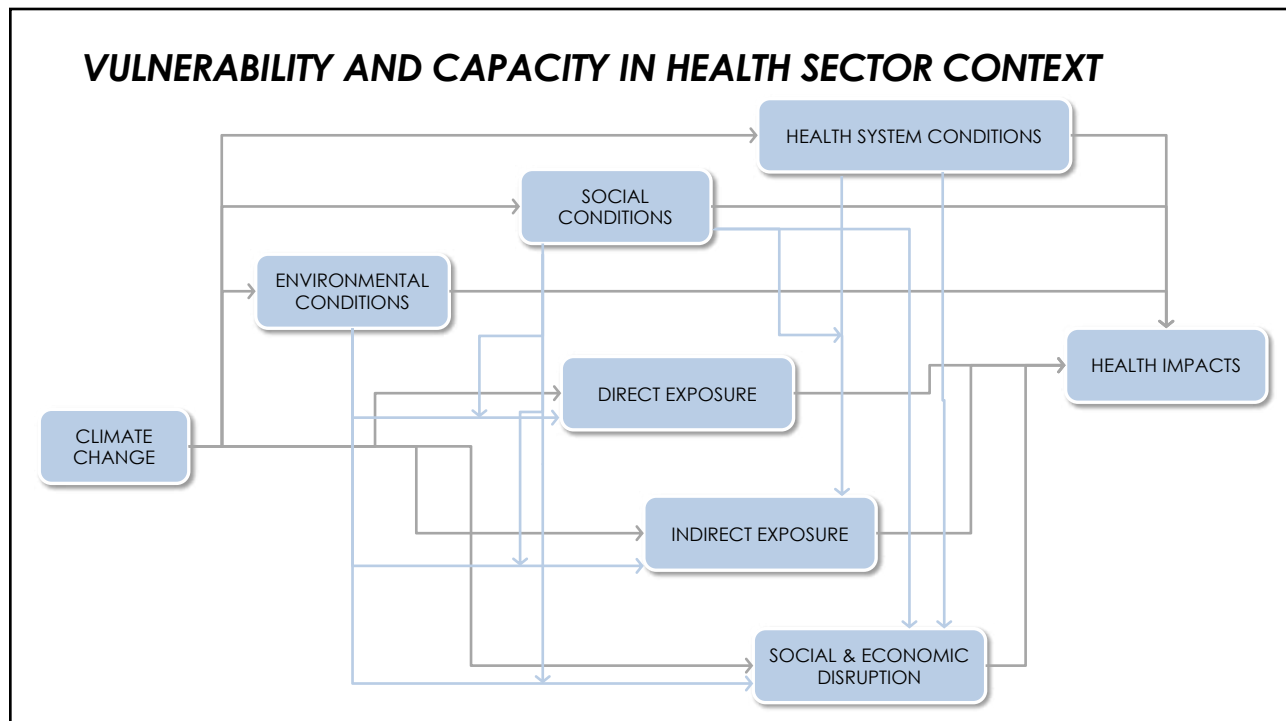
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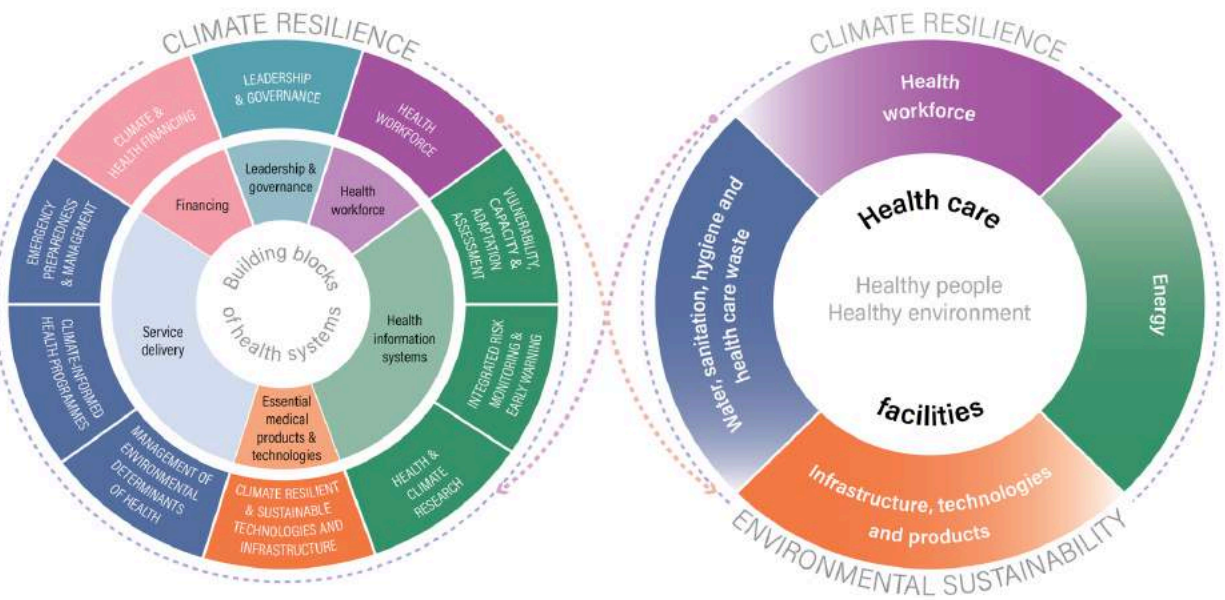


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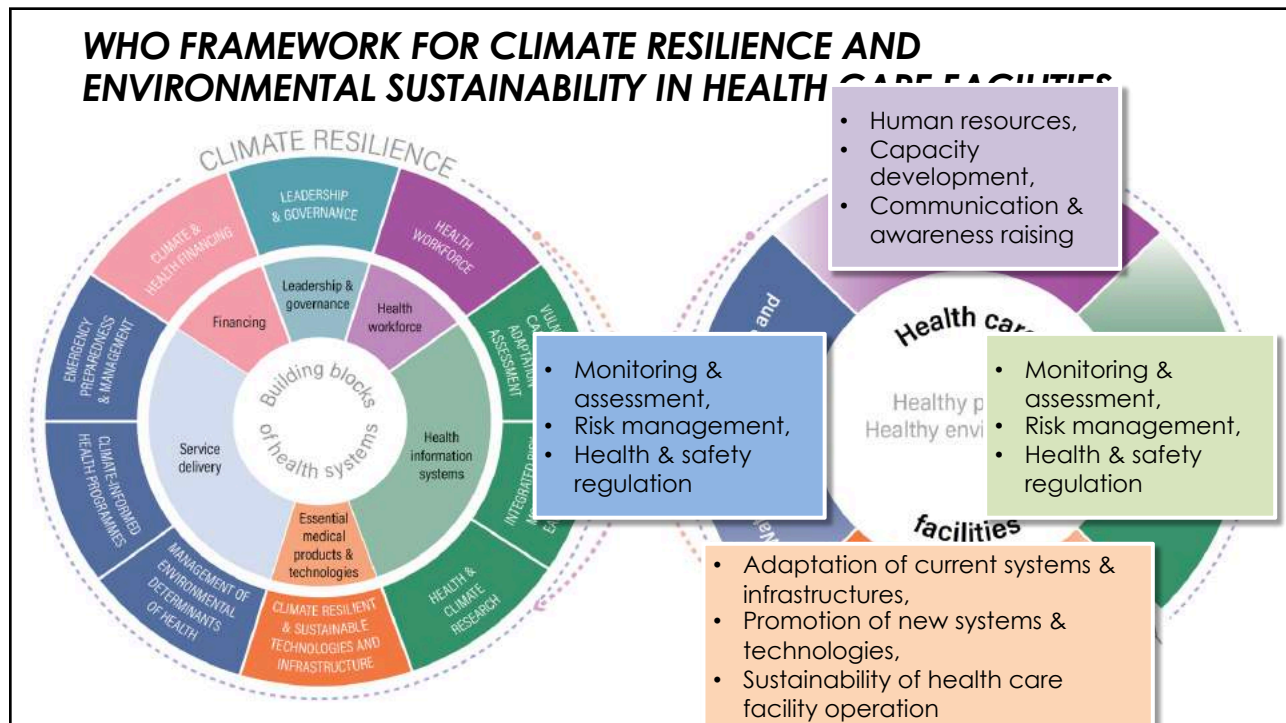
WHO FRAMEWORK FOR INTERACTION OF HUMAN HEALTH AND CLIMATE CHANGE

15

WHO FRAMEWORK FOR CLIMATE RESILIENCE AND ENVIRONMENTAL SUSTAINABILITY IN HEALTH CARE FACILITIES



16



17

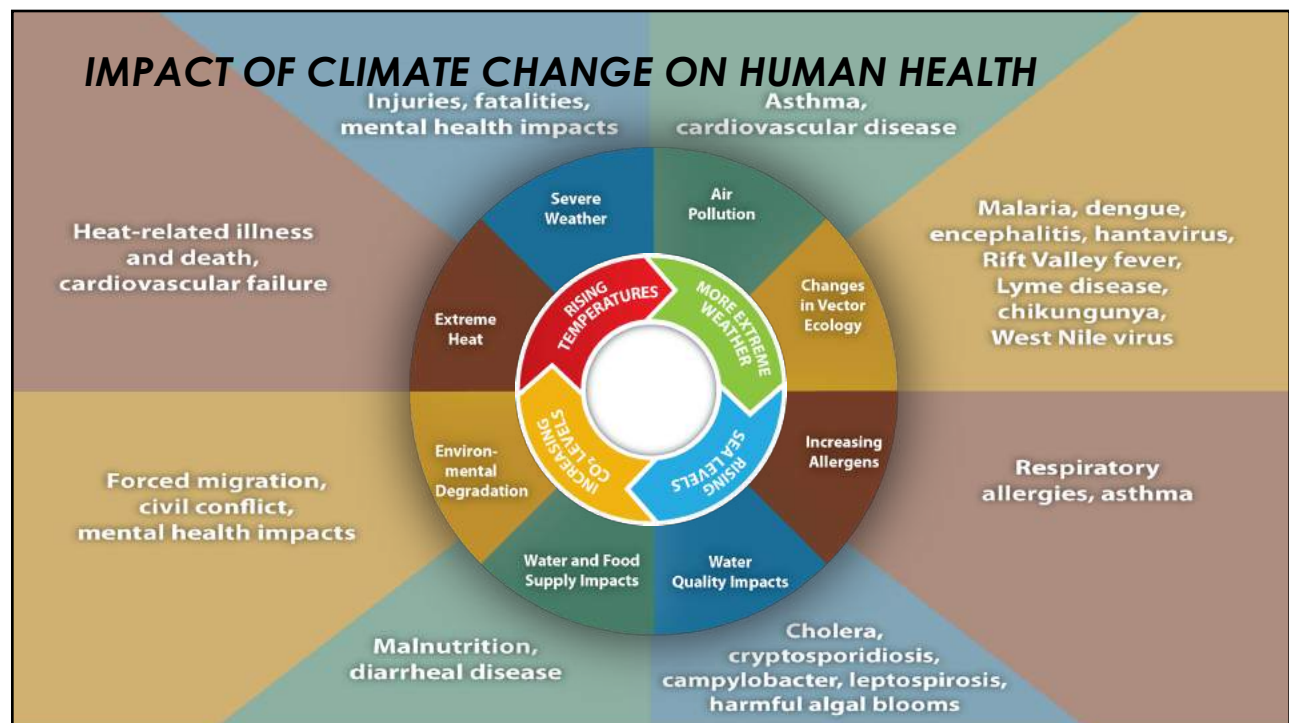


Naria Upazila Health Complex building in Shariatpur district (Bangladesh) falls

18

PUBLIC HEALTH ISSUES RELATED TO CLIMATE CHANGE

19



20

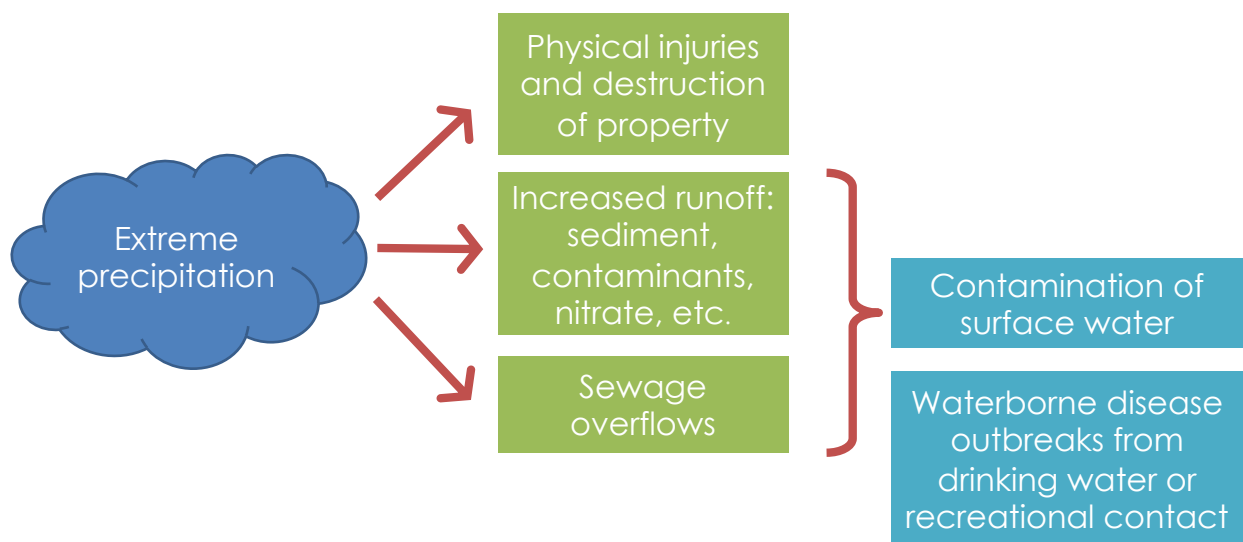
INCREASES IN WATER: FLOODING

- Changes in precipitation can lead to increases in:
 - Physical injuries (including drowning)
 - Allergies (mold)
 - Food and water-borne illnesses
 - e.g. *Salmonellosis*
 - e.g. *Cryptosporidium* and *Giardia*
 - Food security
 - Displacement
 - Mental health issues
 - Anxiety disorders
 - Depression
 - Psychological effects
 - Interruption of emergency services and health care (due to damage to infrastructure)



21

PUBLIC HEALTH ISSUES: INCREASES IN WATER



22

INCREASES IN WATER: FLOODING

1993 Milwaukee Cryptosporidium Outbreak

- 1.61 million people were affected
- 400,000+ people with significant symptoms
- 100 people died
- Illness lasted 9 days on average
- 31.7 million USD in medical costs
- 64.6 million USD in lost productivity



23

INCREASES IN WATER: EXTREME HEAT AND HUMIDITY

- Human health issues:
 - Heat rash
 - Heat exhaustion
 - Heat stroke
 - The dew point measures water vapor in the air. The higher the dew point, the more difficult it is for people's sweat to evaporate
 - The heat index (HI) combines air temperature and dew point (or relative humidity) to describe how they are perceived by the human body
- Death
- Stressed livestock
- Algae blooms
- Mold
- Enhance vector and microorganism populations



24

DECREASES IN WATER

- Surface water levels are being negatively impacted by evaporation and precipitation, while reliance on groundwater is rising
 - Reduced soil moisture, groundwater, lakes, wetlands, and stream flows
 - Potential concentration of pollutants
 - Decreasing water supply for drinking water and agriculture
 - Adversely affects food supply
 - Wildfire dangers



25

INCREASES IN WATER TEMPERATURE

- Changes in fish populations and mercury
 - Warmer waters can harm fish populations and biological activity of cold aquatic ecosystems
 - Warmer waters and increased rainfall intensity may be contributing to an increase in mercury concentrations in fish
 - Increased methylmercury production and export are associated with flooding events
 - Climate change factors could alter either the conversion of elemental mercury into methylmercury (more toxic form that enters the food chain) or the transport of methylmercury from the watershed. Increased temperature could enhance mercury bioaccumulation by increasing fish metabolism leading to higher uptake rates.



26

INCREASES IN WATER TEMPERATURE

- Increased pollution and temperatures
 - Increased harmful algae blooms and bacteria
 - Reduced dissolved oxygen
- Changes in vector populations
- Climate changes may lead to changes in mosquito and tick populations
 - Vector-borne disease risks will change too (some may increase, others may decrease)
- Climate change may favor invasive aquatic species with repercussions for public health and food security

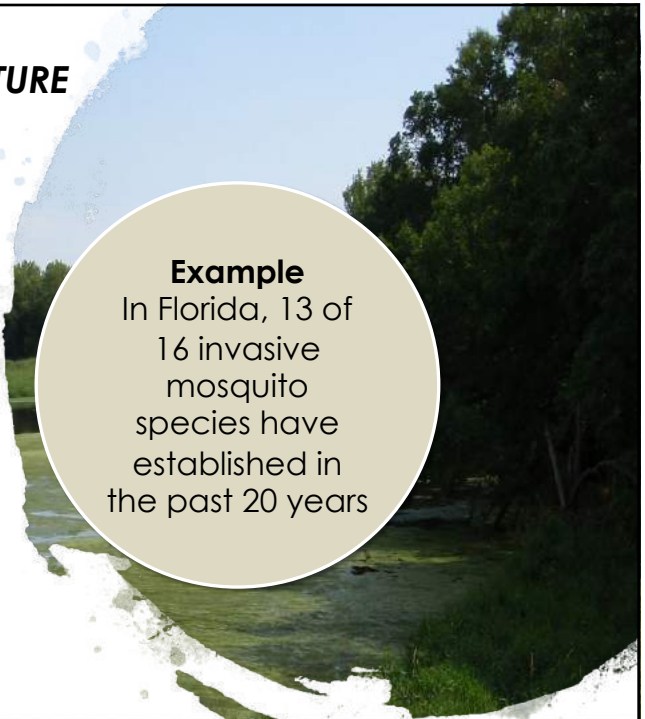


27

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Example
In Florida, 13 of
16 invasive
mosquito
species have
established in
the past 20 years



28

HEALTH OUTCOMES: DISTRESS

- The **threat and perception** of climate change can be a key psychological and emotional stressor and negatively impact a person's level of distress and state of wellbeing
 - Emotional reactions include: anxiety, depression, grief, helplessness, and resignation
 - Well-being impacts of climate change, especially from extreme weather events, can lead to serious mental health consequences, such as Post-Traumatic Stress Disorder (PTSD)
 - Drought conditions disrupt livelihoods and has been linked to an increase of **suicide among male farmers**



29

HEALTH OUTCOMES: RELATIONSHIP STRAIN

- Climate change can **strain relationships**, impacting how individuals interact with each other and within their communities
 - Decreased community cohesion
 - Disrupted sense of continuity and belonging
 - Changes the dynamics of the social relationships inside family units
 - Among Hurricane Katrina survivors, rates of suicide attempts are 78.6 times higher, and suicide completion rates are 14.7 times higher



30

HEALTH OUTCOMES: RELATIONSHIP STRAIN

- As temperature rises, so does the potential for **increased violence**
 - Increased violence and crime
 - When the heat index was 36.6°C, rates of violent crime were 9% higher compared to days when the temperature was 13.8°C degrees
 - Increased social instability
 - Increased interpersonal aggression and domestic abuse
- Climate change can lead to increases in high-risk coping behaviors, such as alcohol consumption



31

HEALTH OUTCOMES: AIR QUALITY

- Climate change may affect exposures to air pollutants and allergens by:
 - Creating both more windiness and more air stagnation events
 - Increasing temperatures
 - Lengthening the growing season
 - Longer pollen season
 - Increased production and potency of pollen
 - Increased proliferation of weedy plant species that produce allergenic pollen
 - Introduction of new allergen-producing plant species
 - Allergens can worsen asthma and other respiratory problems by interacting with other air pollutants
 - When ozone levels are high, it takes less pollen to trigger an asthmatic or allergic response



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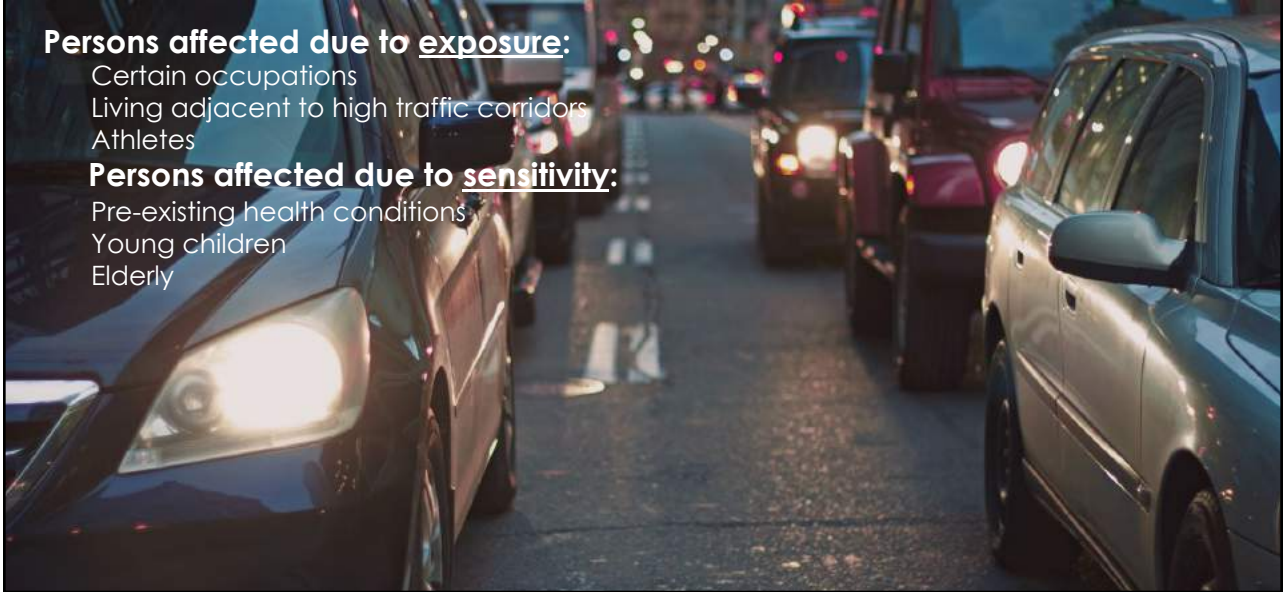
AIR QUALITY AND PUBLIC HEALTH

Persons affected due to exposure:

Certain occupations
Living adjacent to high traffic corridors
Athletes

Persons affected due to sensitivity:

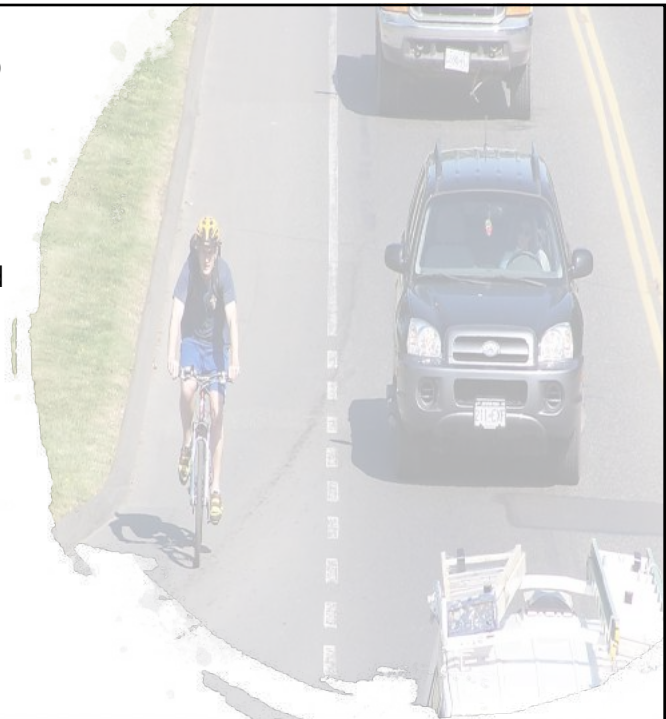
Pre-existing health conditions
Young children
Elderly



33

HEALTH OUTCOMES: GROUND LEVEL OZONE

- Climate change is likely to increase ground-level ozone, especially during the summer and downwind of urban areas
 - Particulate matter can increase allergic response by extending how long the allergens stay in the body



34

HEALTH OUTCOMES: MOLD

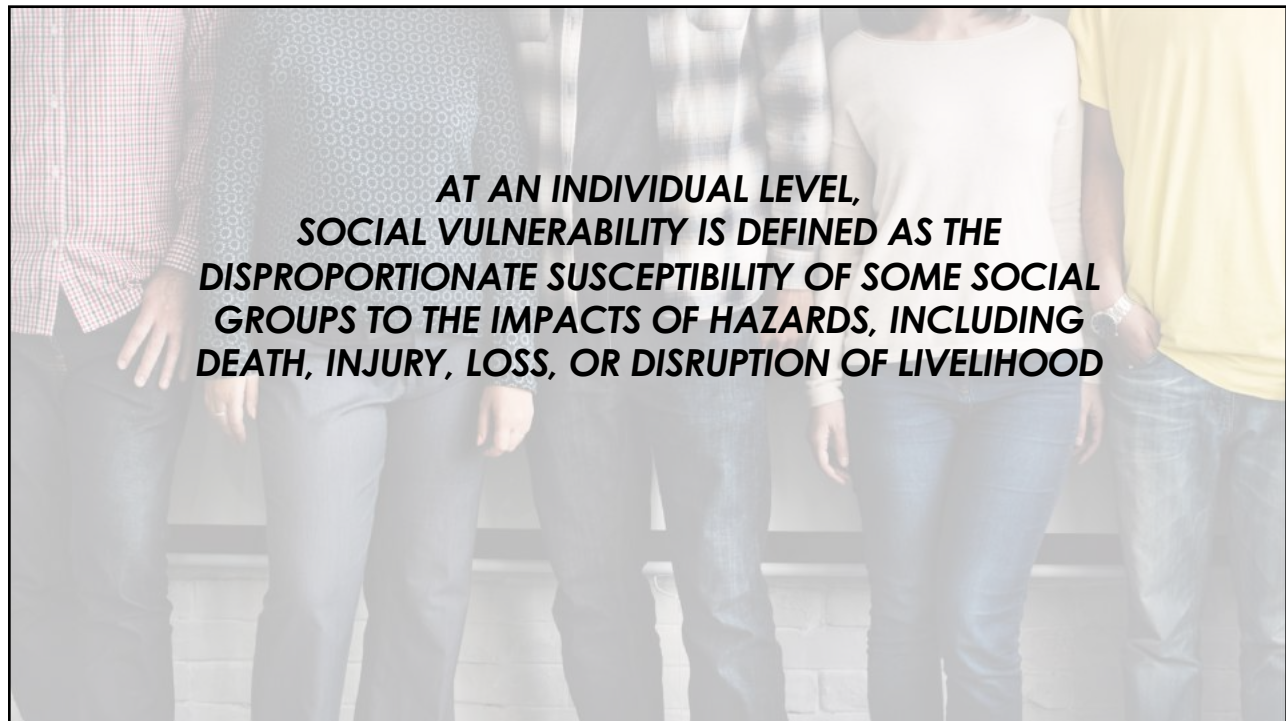
- Mold growth is enhanced by:
 - Precipitation/floods
 - High temperature or humidity
 - Increase in plant decay
 - Improper installation or management of air conditioning
- Mold can cause:
 - Coughing, wheezing
 - Aggravated respiratory conditions, like asthma
 - Weakened immune systems



35

SOCIAL VULNERABILITY / AT-RISK POPULATIONS

36



37



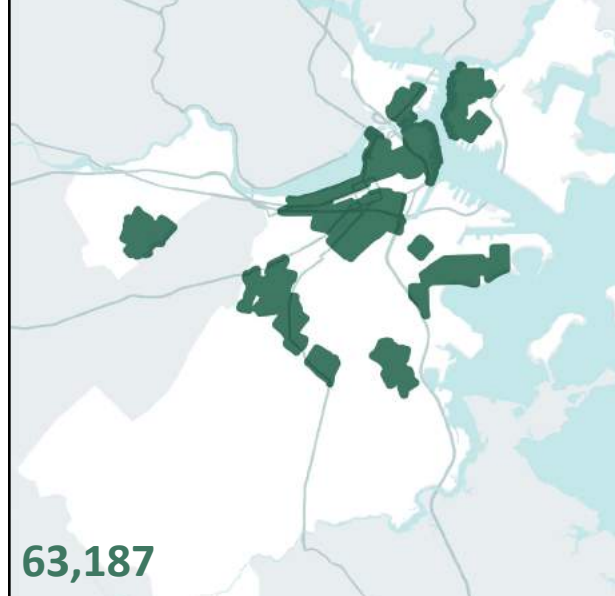
38

GENERALIZATIONS ABOUT CLIMATE CHANGE VULNERABILITY OF HUMAN POPULATIONS

- Vulnerability will be greater in **highly dense populations**
- Vulnerability will be greatest in areas of **low resources for health care**
- Vulnerability will be greatest in areas of **low resources for disaster and emergency response**
- Vulnerability will be greatest in areas of **over allocated, polluted, and inadequate water supplies**
- Vulnerability will be greatest in areas of **substandard housing and sanitation**
- Vulnerability will be greatest in areas of **low diversity of agricultural cropping systems**
- Vulnerability will be greatest in areas of **high proportion of women and children in the population**
- Greater vulnerability for **populations with serious existing problems**

39

CONCENTRATIONS OF SOCIALLY VULNERABLE POPULATIONS



63,187

OLDER ADULTS

**PEOPLE AREN'T
AFFECTED BY
CLIMATE CHANGE
EQUALLY**

40

COMMUNITY RISK FACTORS: GOVERNANCE CHALLENGES AND RESOURCES LIMITATIONS

- Communities that are particularly vulnerable include disaster-prone areas (river flooding, high wildfire risk, repeated drought) and communities that are economically dependent on climate and the environment (forestry, fishing, agriculture)

41

USING VULNERABILITY ANALYSIS TO ASSESS COMMUNITY VULNERABILITY

CASE STUDY – ECOSYSTEM-BASED ADAPTATION POTENTIAL OF MANGROVE FORESTS NEAR VULNERABLE COASTAL COMMUNITIES, TIMOR-LESTE

42

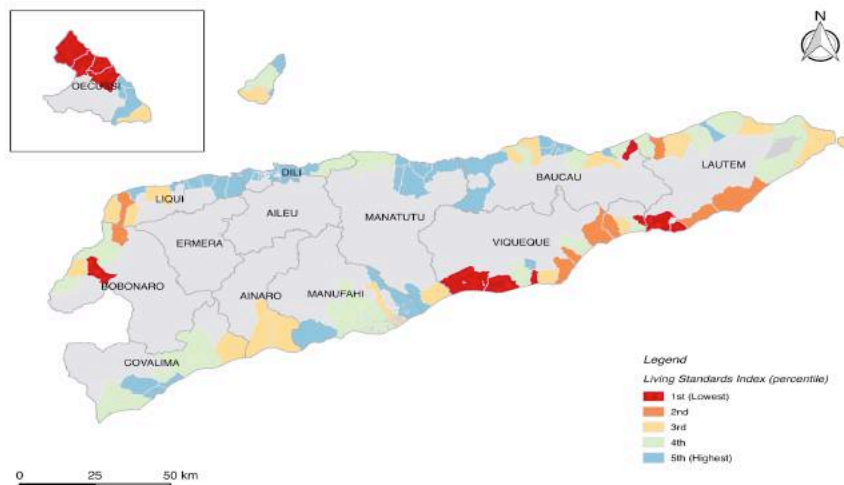
WHAT IS SOCIO-ECONOMIC VULNERABILITY OF COMMUNITIES?

- Tribal tenure-based settlements
 - No individual ownership
- Socio-economic vulnerability determined through an index of living standards indicators
 - Gender
 - Dependency ratio
 - Literacy ratio
 - Access to basic infrastructure (share of households with electricity, improved water, and improved sanitation)
 - Asset ownership (vehicles, boats, livestock, etc.)

43

WHAT IS SOCIO-ECONOMIC VULNERABILITY OF COMMUNITIES?

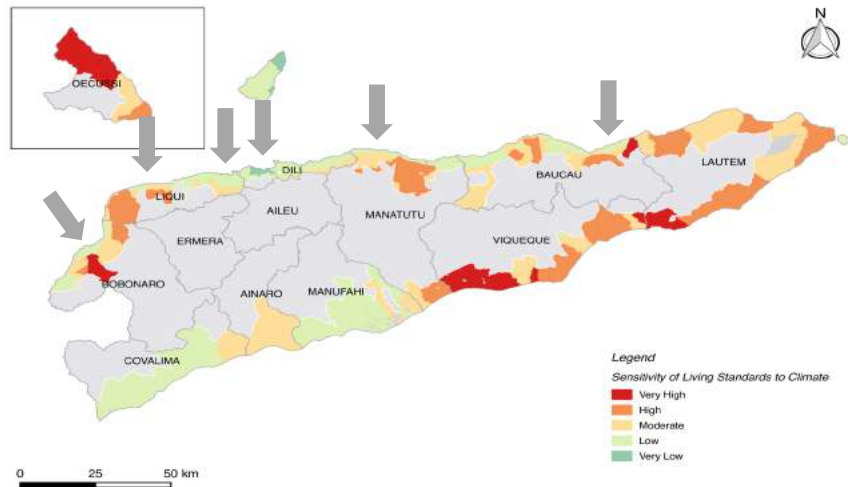
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44

WHAT IS SOCIO-ECONOMIC VULNERABILITY OF COMMUNITIES?

- What happens to living standards when we account for climate change?



45

EXTREME HEAT

46

RISING TEMPERATURES

WINTER TEMPERATURES ARE RISING
ABOUT TWICE AS FAST AS ANNUAL AVERAGE TEMPERATURES

MINIMUM OR 'OVERNIGHT LOW' TEMPERATURES ARE RISING
FASTER THAN MAXIMUM OR 'DAYTIME HIGH' TEMPERATURES

**Climate change is causing a
shift in the probability of
both average and extreme temperatures**



47



2003 HEAT WAVE IN EUROPE

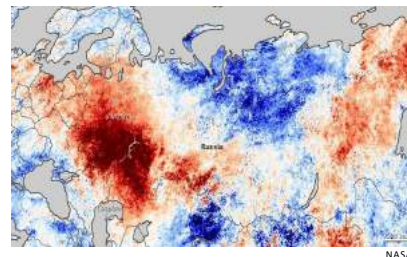
Country	Casualties
France	14 082
Germany	7 000
Spain	4 200
Italy	4 000
UK	2 045
Netherlands	1 400
Portugal	1 300
Belgium	150

INSERM: "Surmortalité liée à la canicule de l'été 2003", AP September 25, 2003

A death toll **exceeding 30,000**, the heat wave was the deadliest natural disaster in Europe for the last 100 years... elderly people were most impacted







2010 HEATWAVE IN RUSSIA



A reported death toll **of 55,756**, with 700 deaths per day in Moscow from combination of heat and smog

48

HEAT INDEX ABOVE 32°C	HEAT INDEX ABOVE 37.7°C	HEAT INDEX ABOVE 40°C	HEAT INDEX OFF THE CHARTS
			
Outdoor workers become more susceptible to illness	Undetermined, any level of exposure extremely dangerous, for all people and will likely result in illness	Anyone at risk of heat related illness, or death, as a result of prolonged exposure	Undetermined, any level of exposure extremely dangerous, for all people and will likely result in illness

49

RISK FACTORS TO EXTREME HEAT

- Lack of air conditioners in homes
- Low socioeconomic status (income and poverty)
- Living in urban areas (due to the urban heat island effect)
- Living in topmost floor
- Living in nursing homes or being bedridden
- Living alone or lack of social or family ties
- Age
- Underlying medical conditions / mental illness
- Prolonged exposure to sun
- Drinking alcohol
- Access to health care and cooling facilities



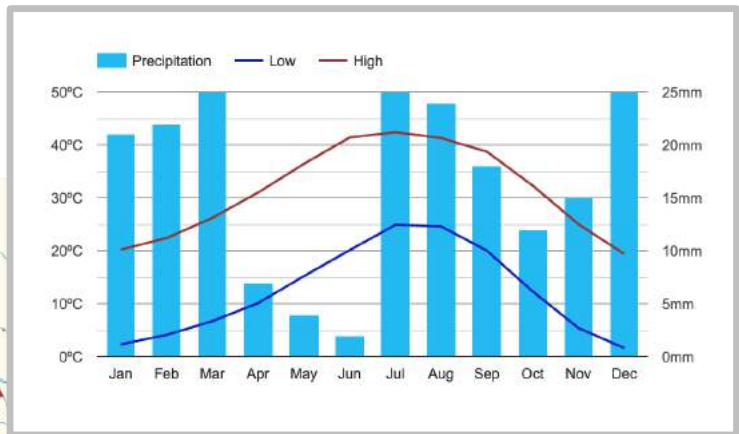
50

USING VULNERABILITY ANALYSIS TO ASSESS POLICY IMPLICATIONS

CASE STUDY – CONVERGENCE OF HEAT, HEALTH AND HOUSING VULNERABILITIES OF MOBILE HOME RESIDENTS IN MARICOPA COUNTY, ARIZONA, USA

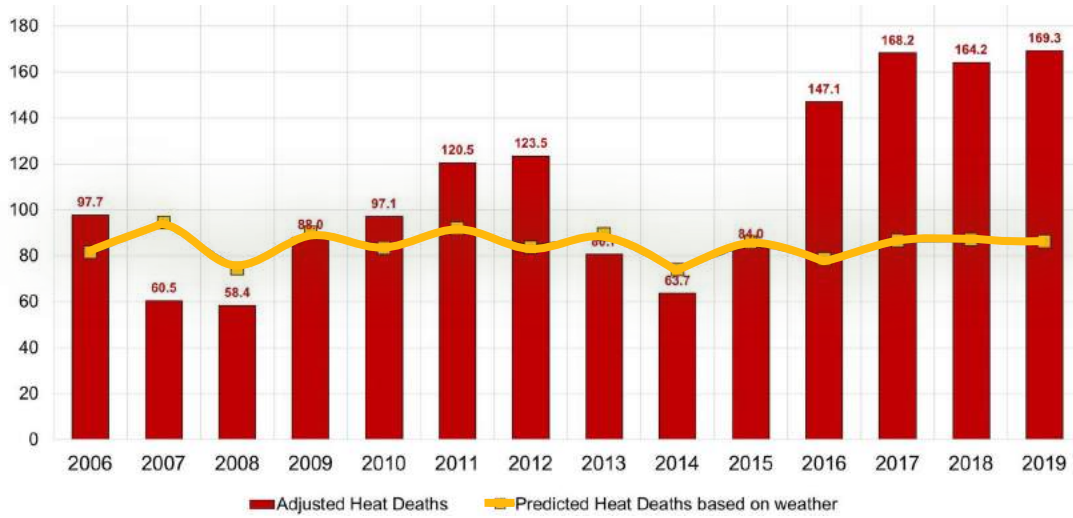
51

CONTEXT



52

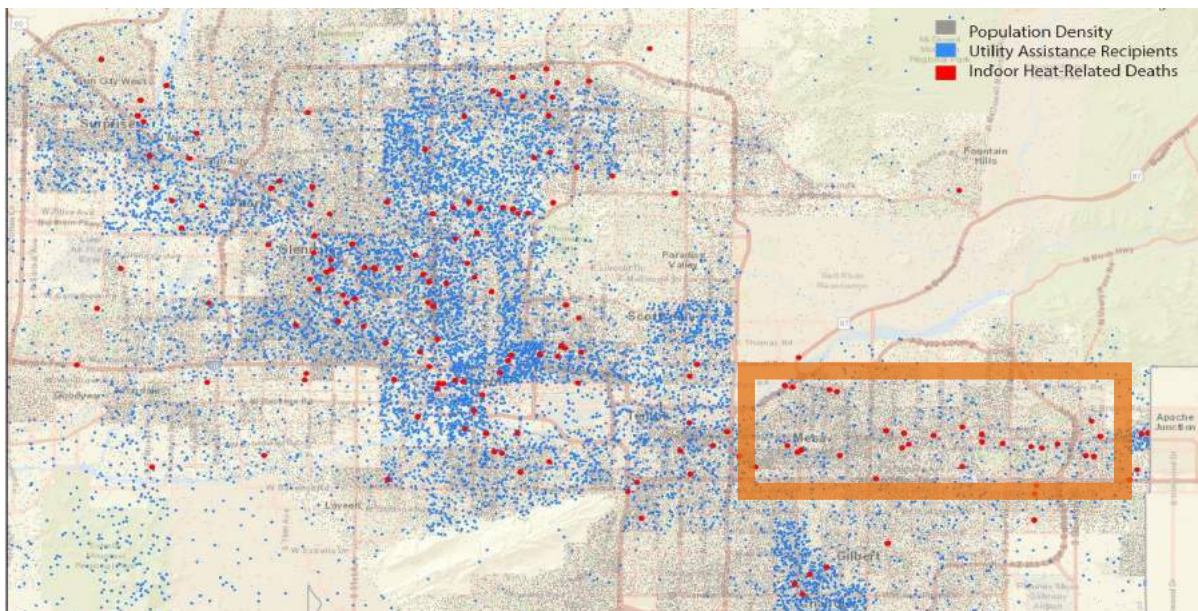
PREDICTED MORTALITY ESTIMATES ARE NOT EXPLAINED BY WEATHER PATTERNS



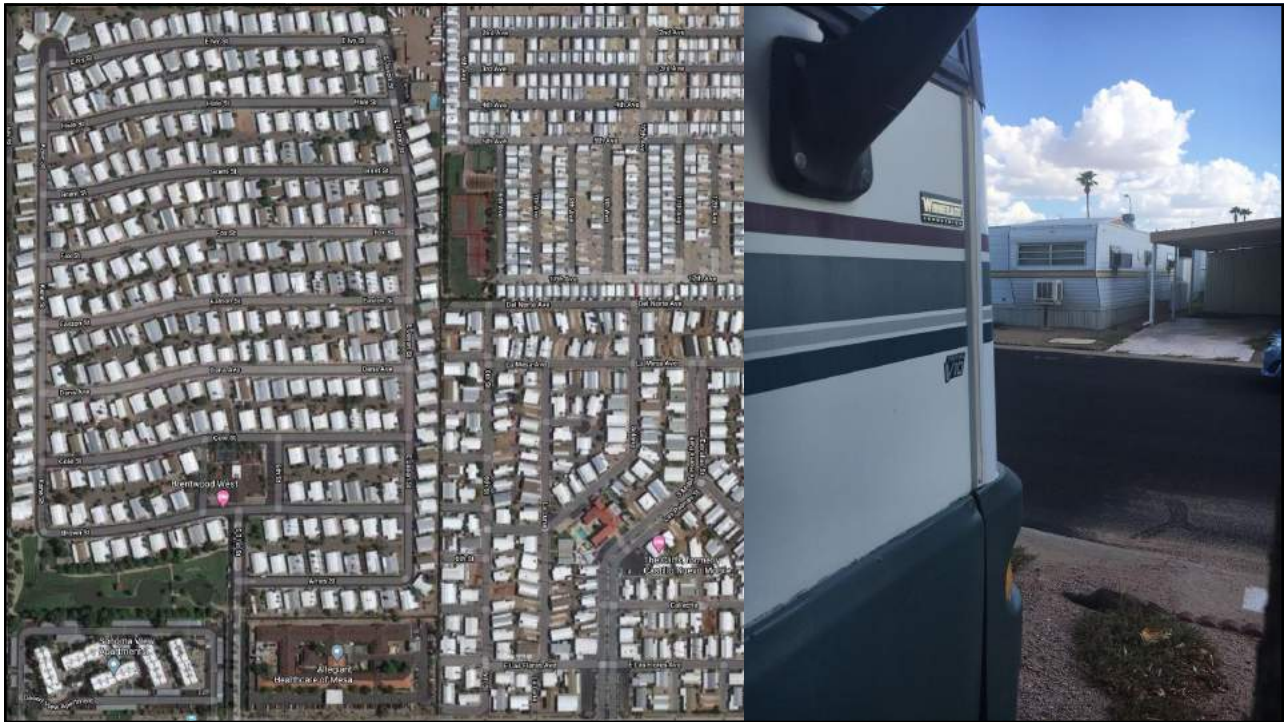
Heat related deaths in Maricopa County 2006–2019

53

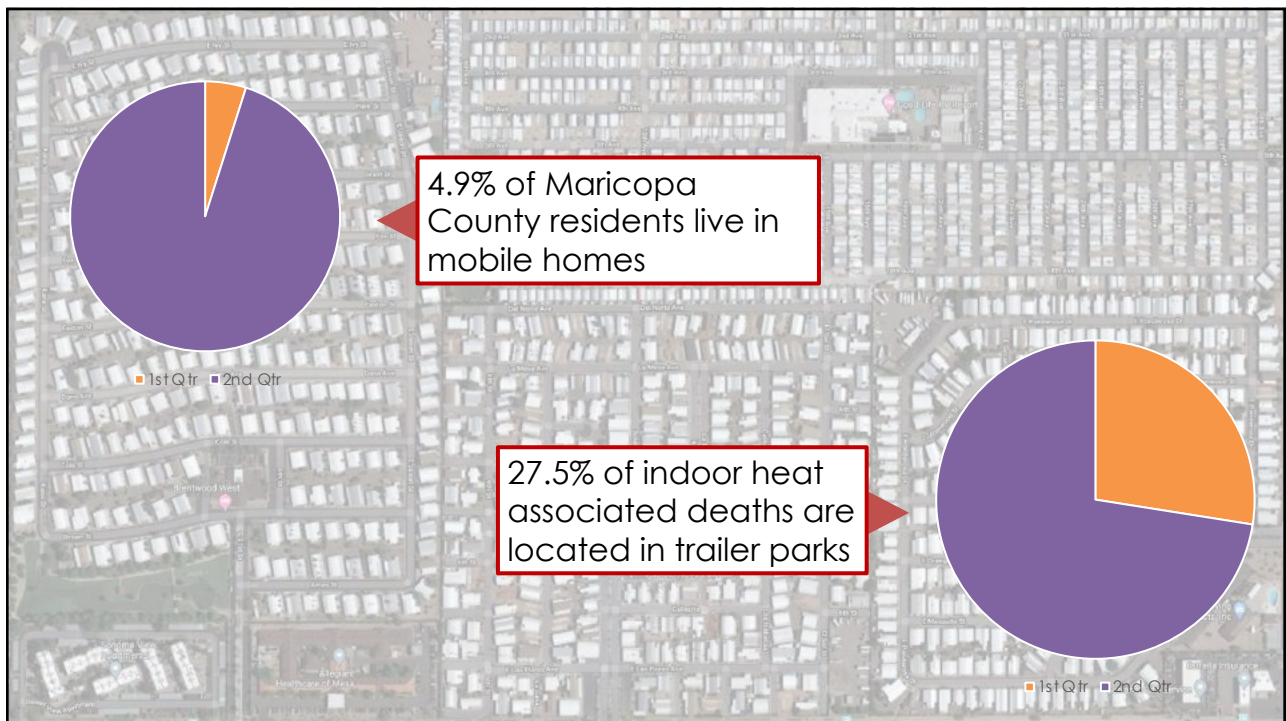
THE PATTERN OF HEAT-RELATED DEATHS DOES NOT CORRESPOND TO UTILITY ASSISTANCE PROGRAMS



54



55



56

INDOOR HEAT-RELATED DEATHS IN TRAILERS ARE TWICE AS LIKELY WHEN AIR-CONDITIONING IS NOT PRESENT, MOST OFTEN BECAUSE OF NO ELECTRICITY

ALL INDOOR DEATHS

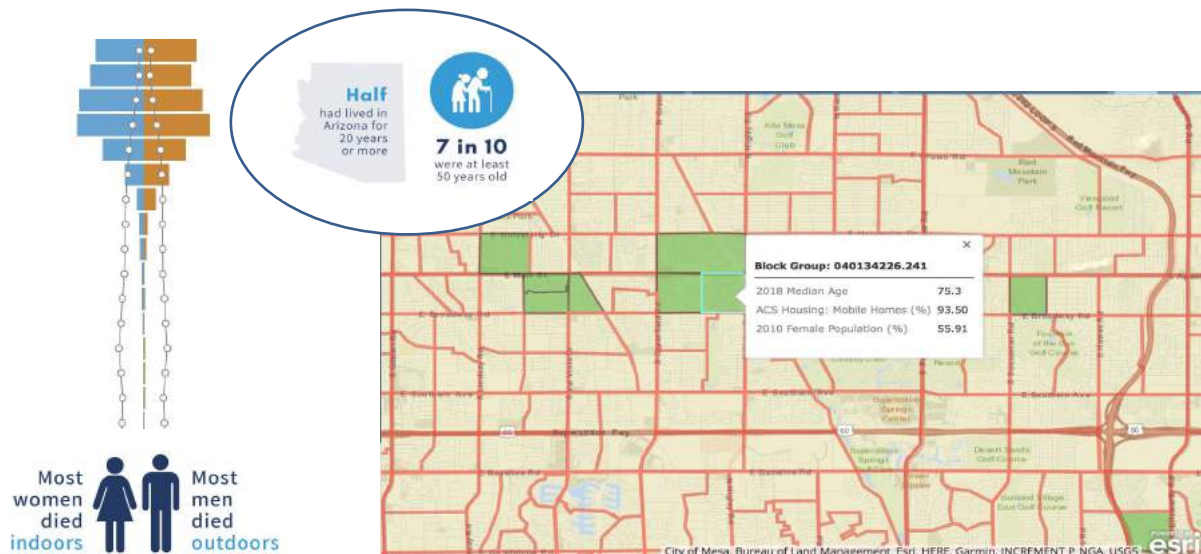
Air Conditioning Status	Indoor Deaths	Deaths in Trailers	Percent of Indoor Deaths in Trailers	Deaths not in Trailers	Percent of Indoor Deaths not in Trailers
Not Present	74	23	31%	51	15%
Present*	342	96	28%	246	73%
Unknown	51	11	22%	40	12%
Total	467	130	28%	337	100%

*Among Indoor Deaths with AC Present and Known Reason

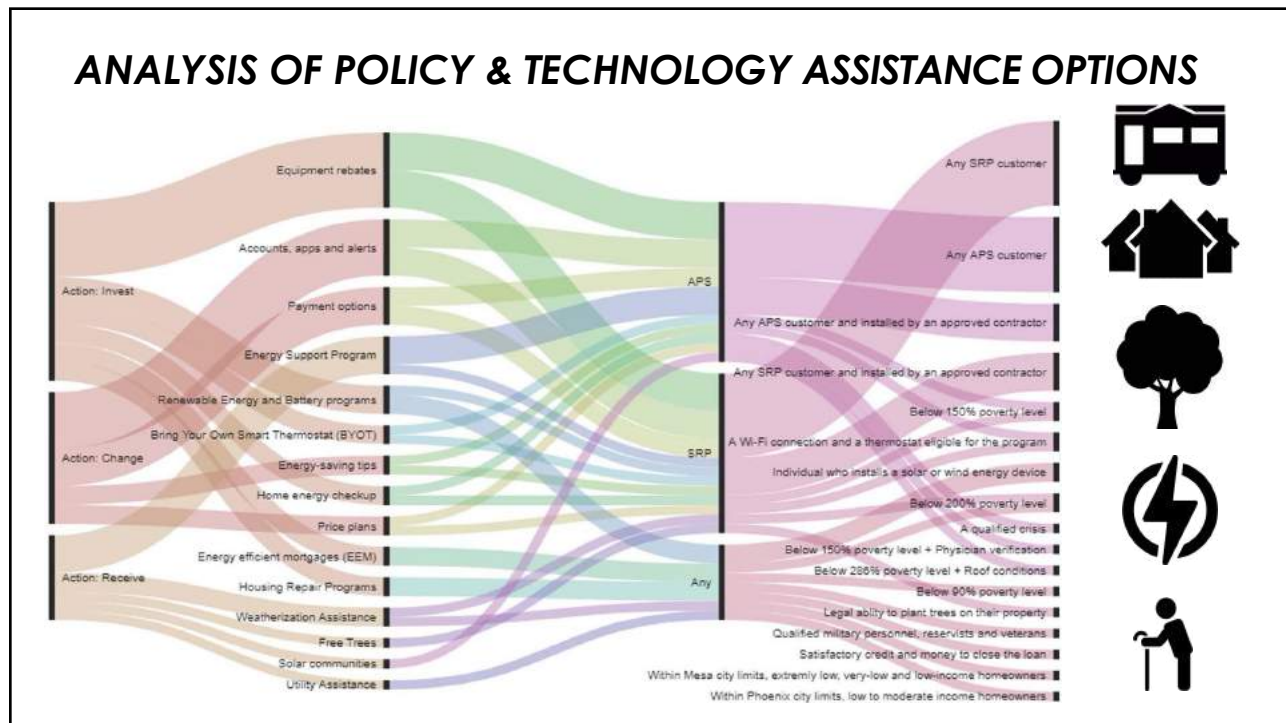
Reason for no AC	Indoor Deaths	Deaths in Trailers	Percent of Indoor Deaths in Trailers	Deaths not in Trailers	Percent of Indoor Deaths not in Trailers
Non-Functioning	191	55	29%	136	60%
No Electricity	34	11	32%	23	10%
Not in Use	87	21	24%	66	29%
Total	312	87	28%	225	100%

57

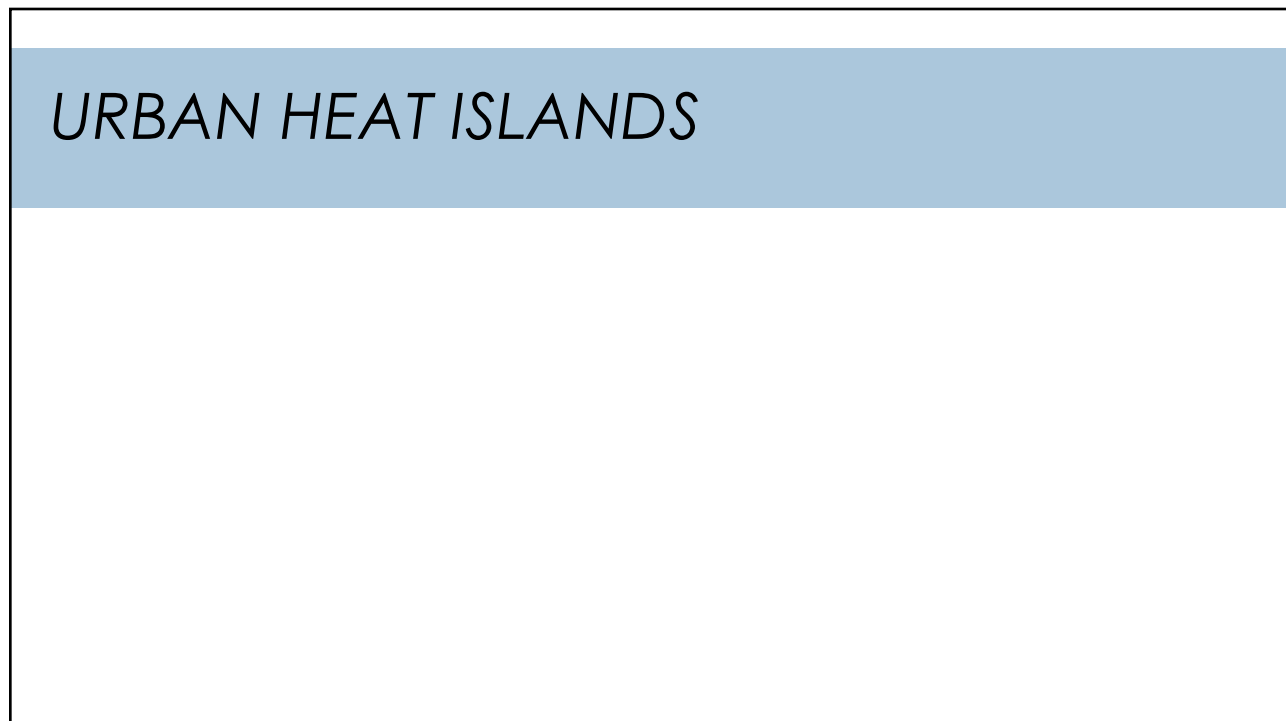
MANY PEOPLE IN THESE 'BLOCK GROUPS' ARE DISPROPORTIONATELY ELDERLY AND FEMALE, LIVING ALONE



58



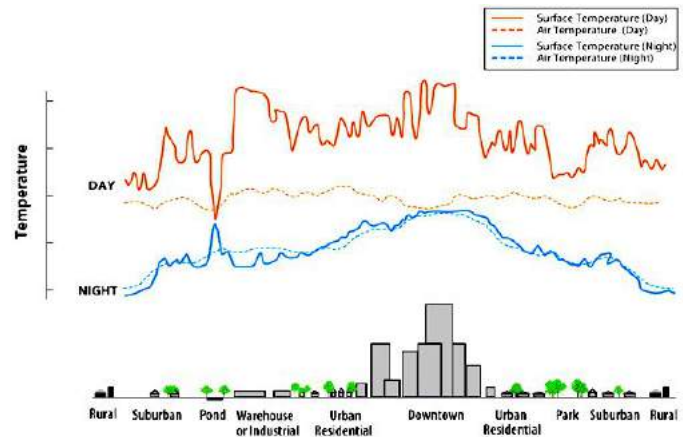
59



60

WHAT ARE URBAN HEAT ISLANDS?

- *Urban heat island effect* is a measurable increase in ambient urban air temperatures resulting primarily from the replacement of vegetation with buildings, roads, and other heat-absorbing infrastructure
 - Areas in and around cities are generally warmer than comparable rural areas.
 - Urban development reduces vegetative cover and adds heat absorbing surfaces such as rooftops, buildings, and paving.
 - Heat is also added from other sources in cities such as fuel combustion and air conditioning units



61

THREE TYPES OF URBAN HEAT ISLANDS

- **Surface** heat islands
 - Higher surface temperatures in urban areas compared with rural areas, illustrated with thermal images
- **Atmospheric** heat islands
 - Warmer air in urban areas compared with rural areas, illustrated with isotherm maps or graphs
 - **Canopy layer** heat islands are present in the air layer where we live – from ground level to the tops of trees or buildings
 - **Boundary layer** heat islands are in the area above rooftops and trees extending upwards as much as one mile

62

URBAN HEAT ISLANDS (UHI)

Year-Round Consequences

- Cost of cooling buildings
- Lack of low winter temps.
- Increased severe weather
- 30% downwind precipitation increase
- Air pollutant production (ground-level ozone)
- Worse heat waves in urban areas
- Overall effect urban ecosystems

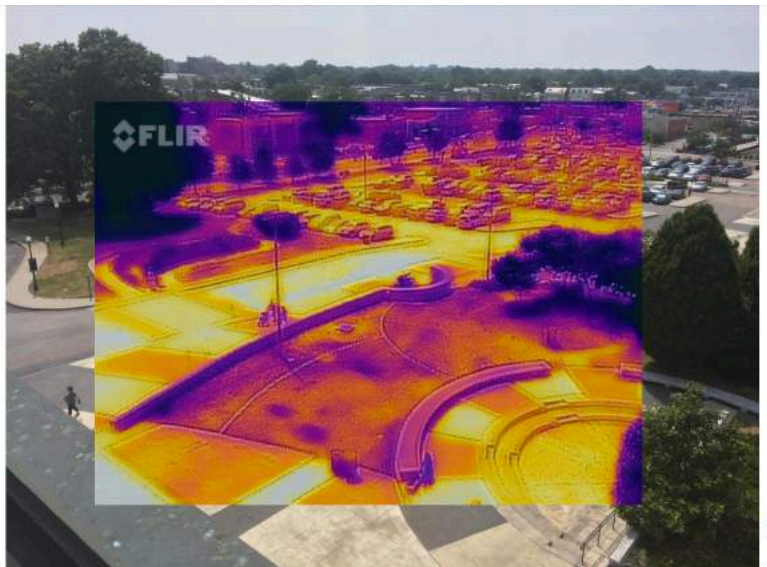


63

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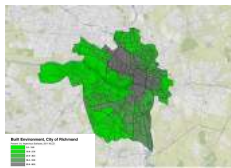
64

**USING VULNERABILITY ANALYSIS TO
IMPROVE HEALTH AND QUALITY OF LIFE**

**CASE STUDY –
HEAT ISLANDS AND HEALTH SERVICE
RESPONSES, RICHMOND, VA, USA**

65

URBAN HEAT VULNERABILITY =



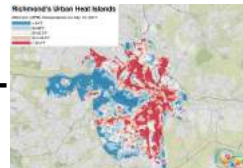
ASPHALT

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TREES

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HEAT

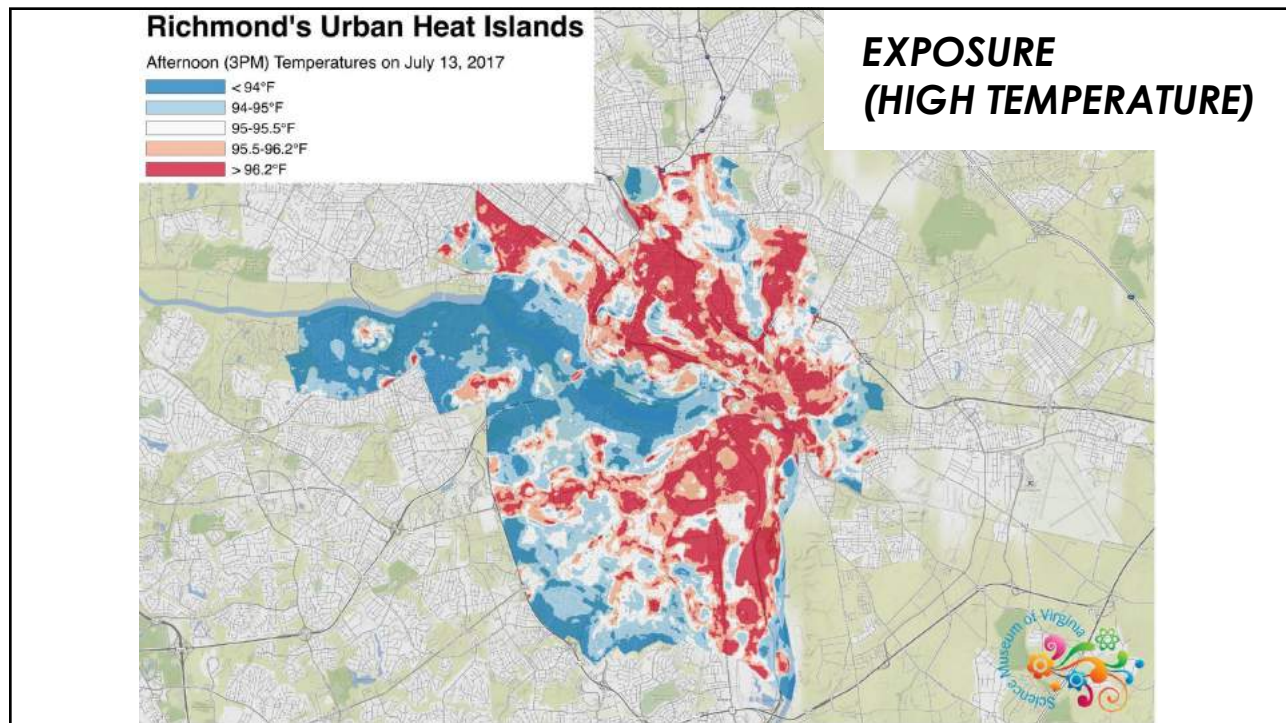
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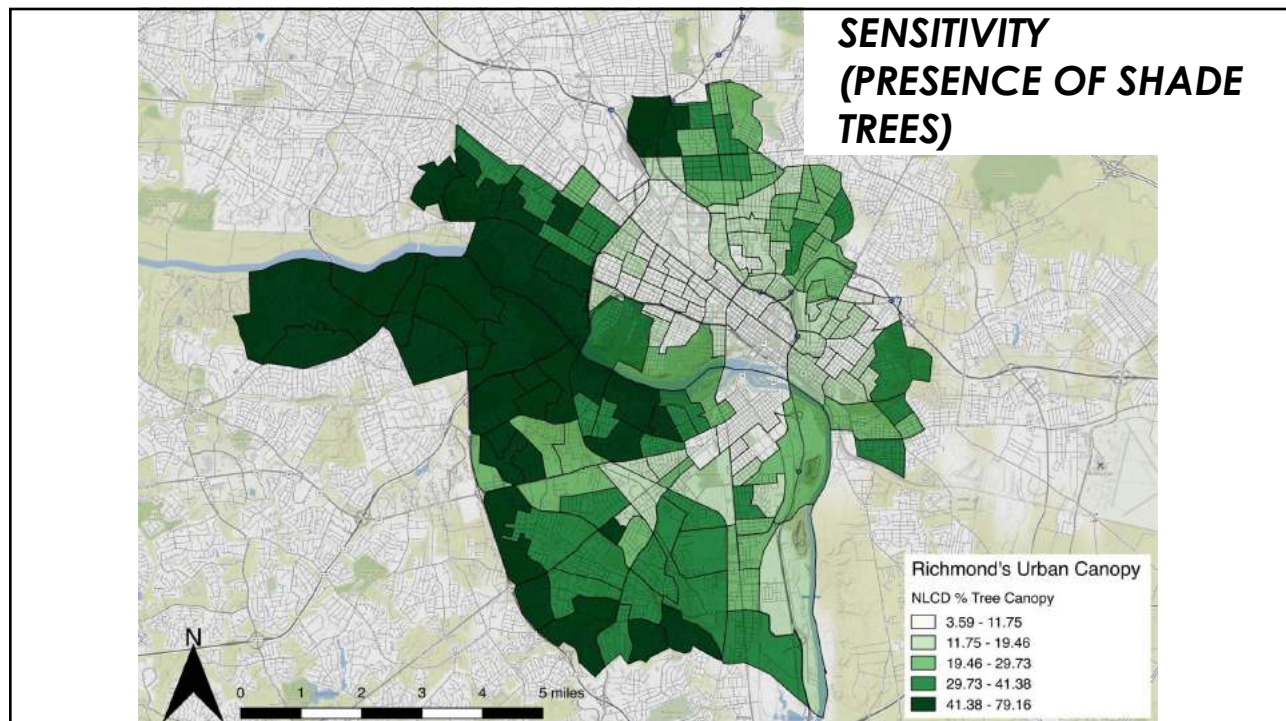
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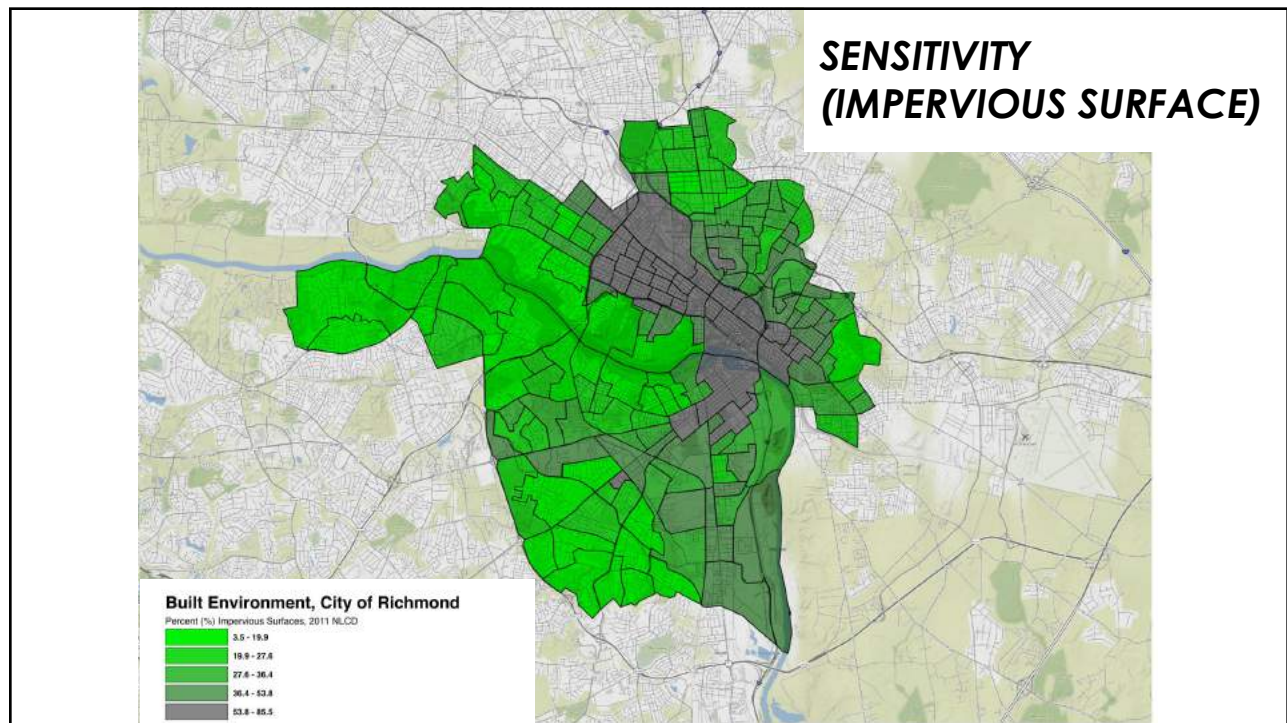
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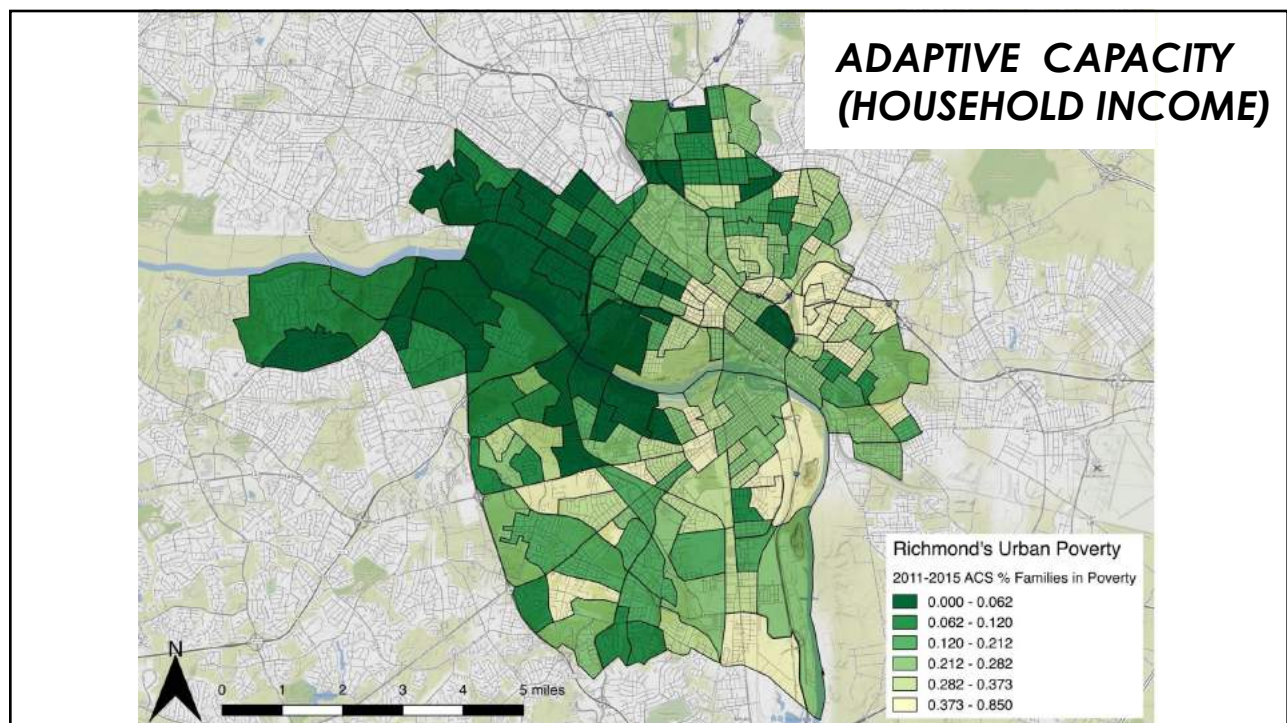
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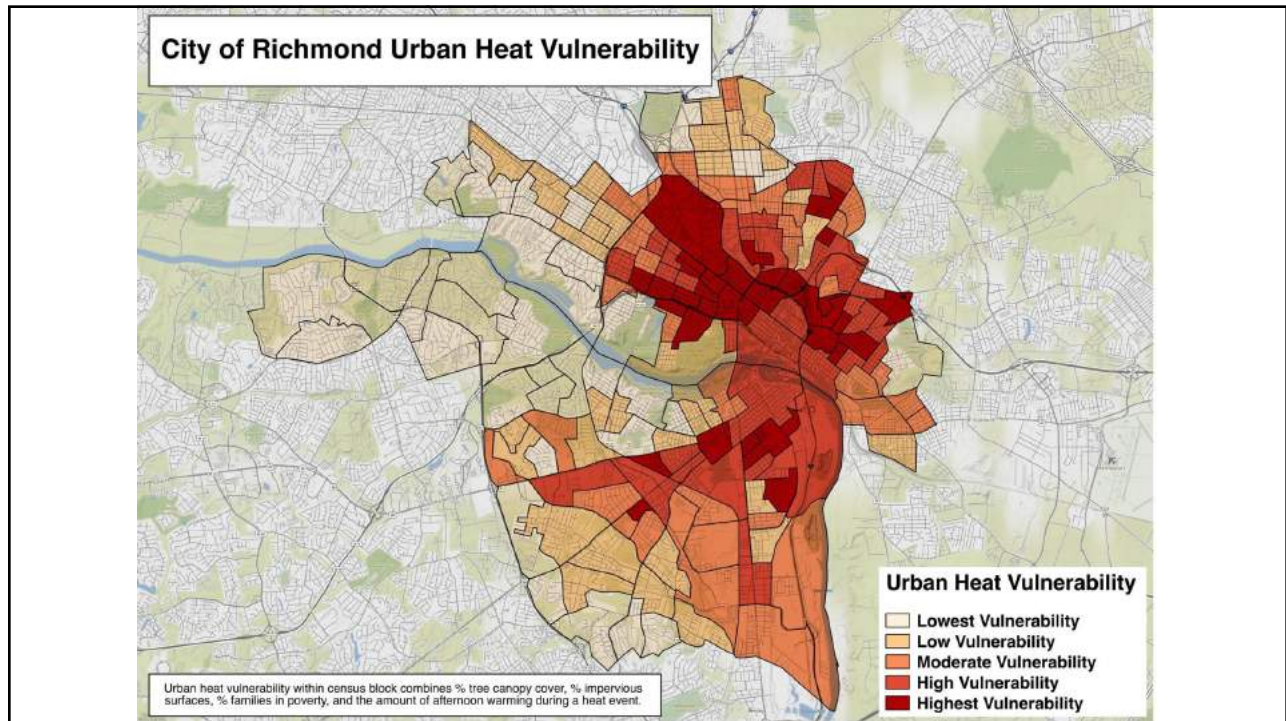
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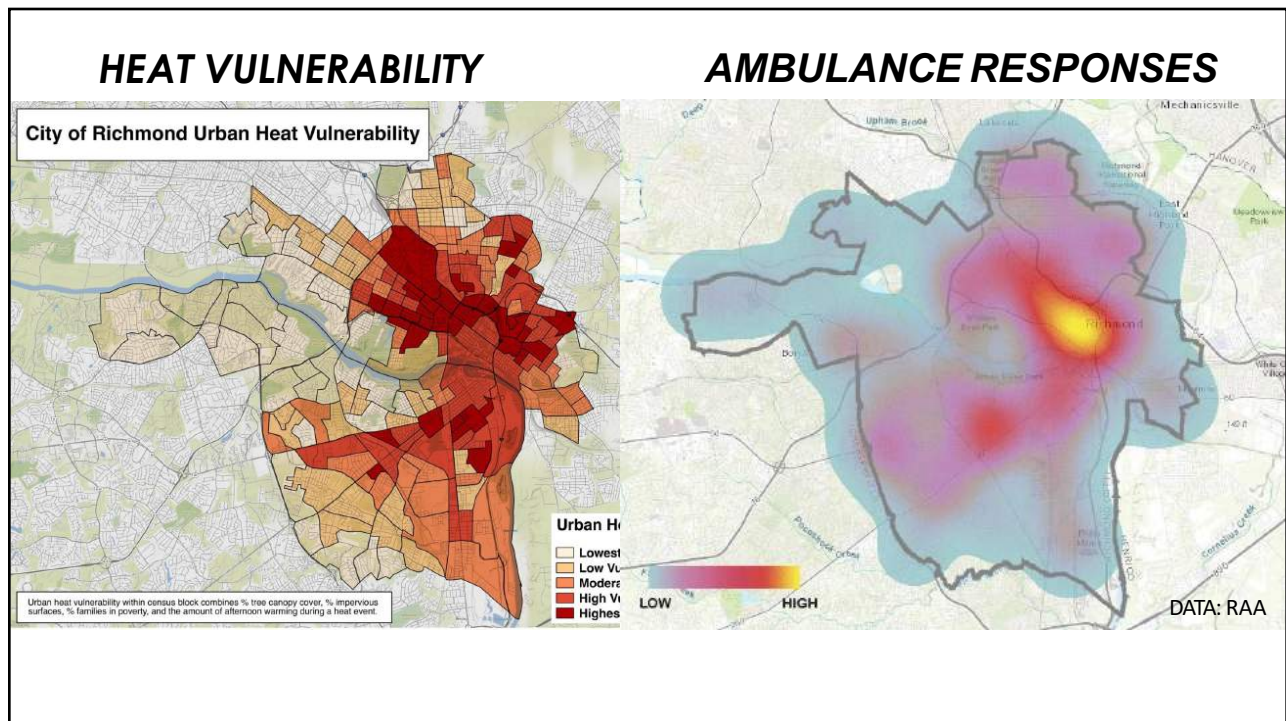
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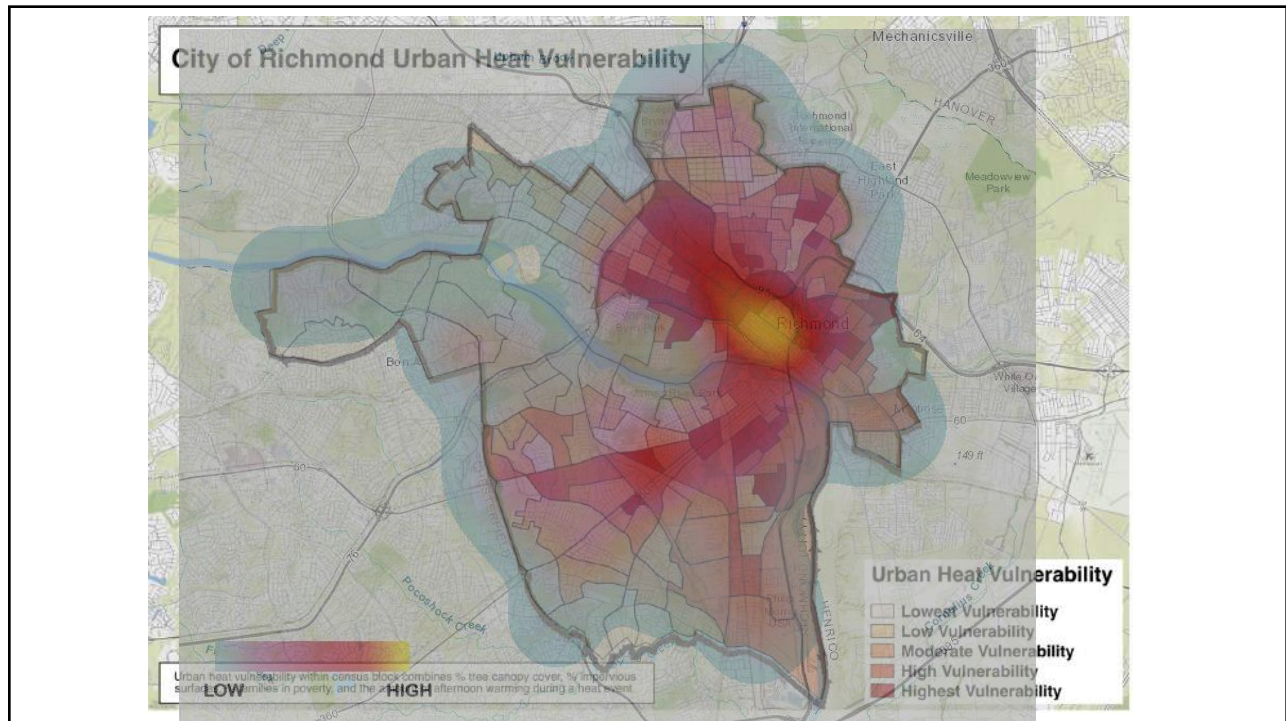
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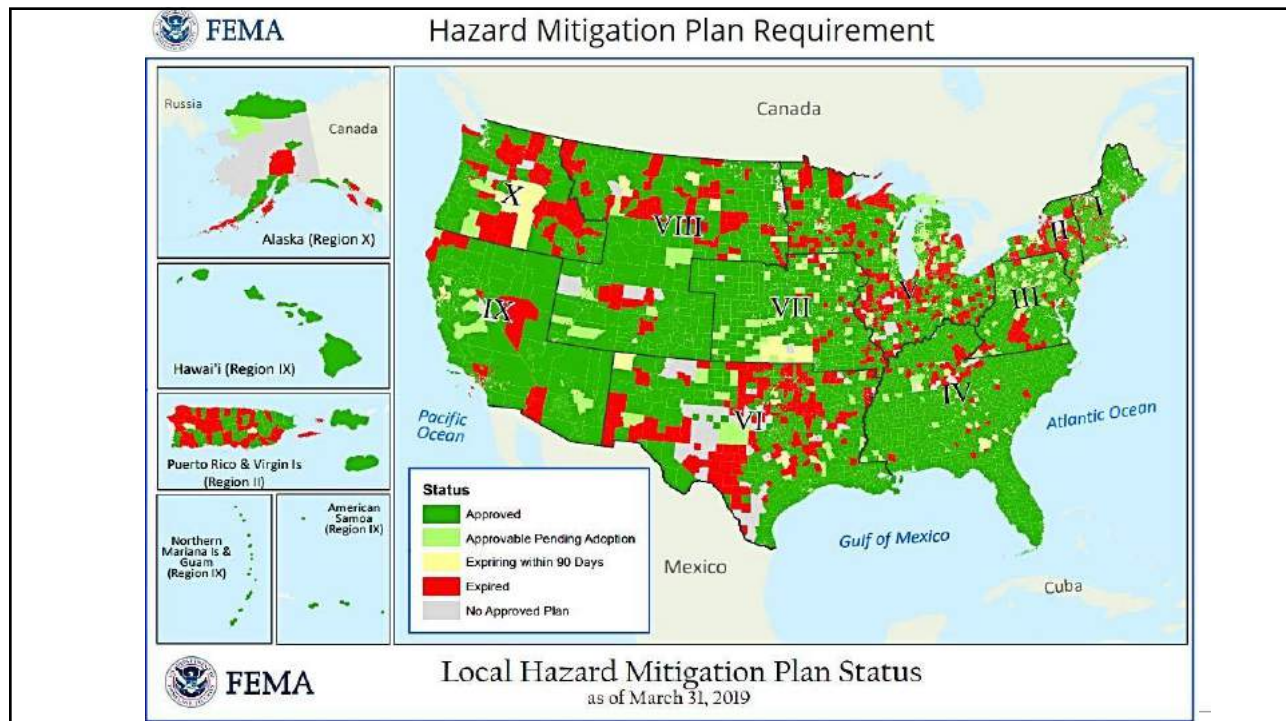
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PRELIMINARY RESPONSE PLAN

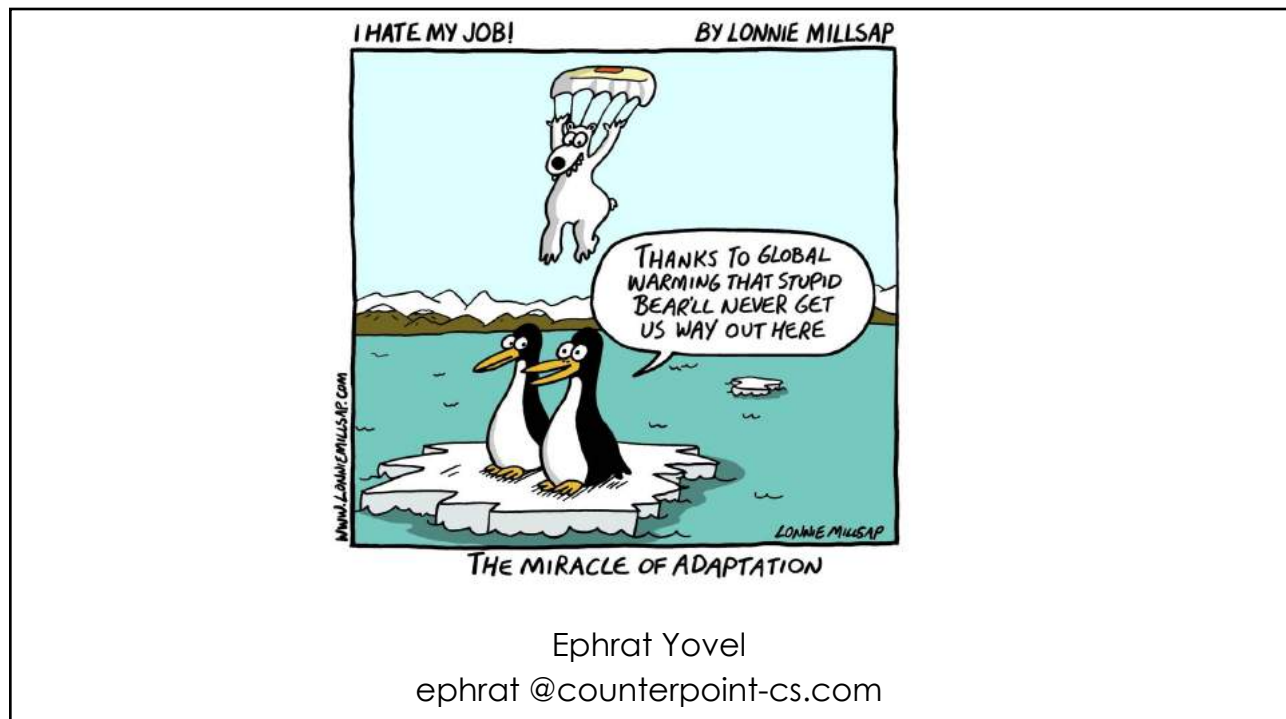
- In coordination with RAA, develop plan to prioritize ambulance response times in heat vulnerable areas
- Improve heat and shade mapping
- Tree planting
- Promote the development of community-scale adaptation
 - Tree planting program
 - Citizen social welfare program



74



75



76