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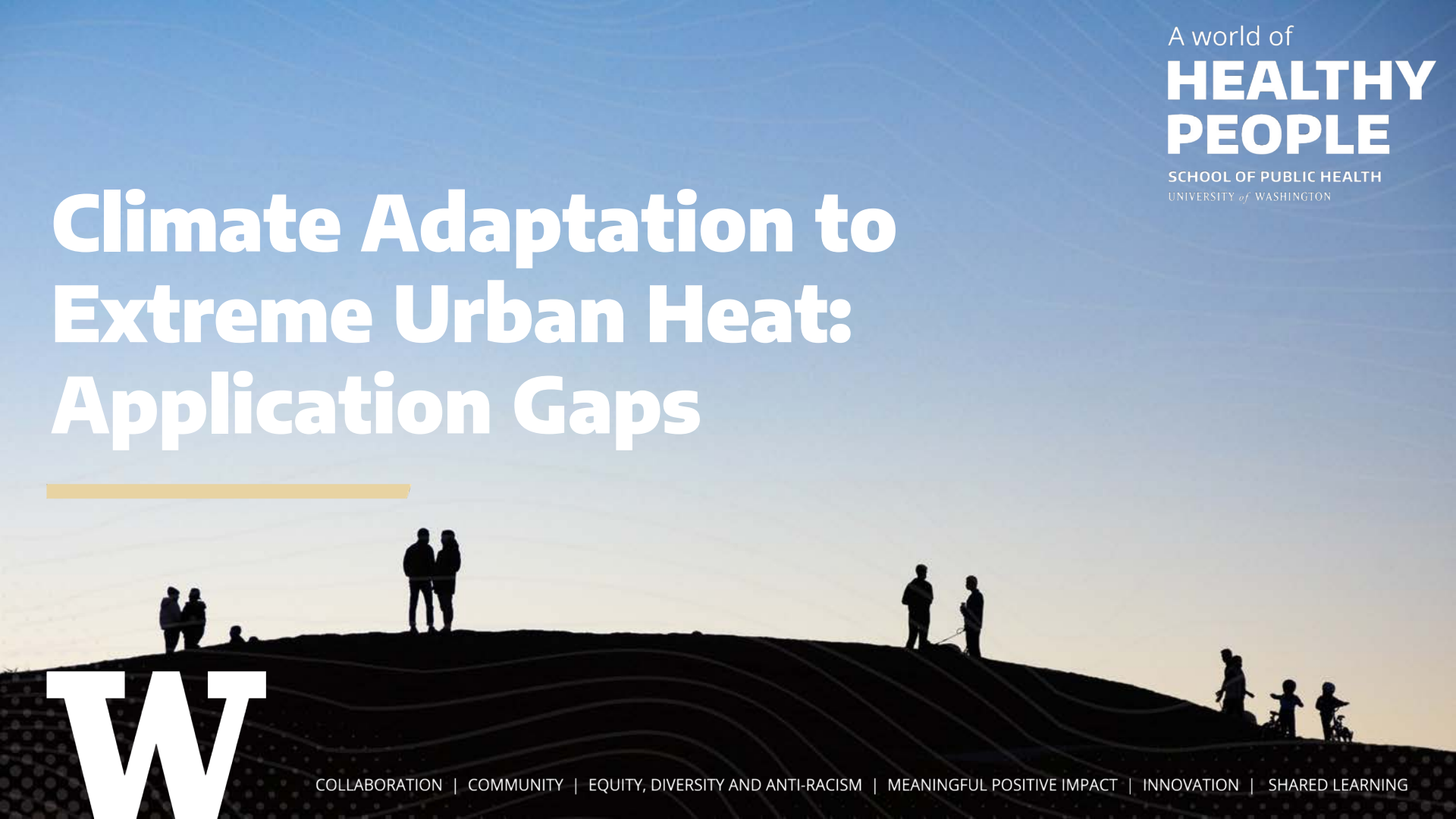
Climate Adaptation to Extreme Urban Heat: Application Gaps



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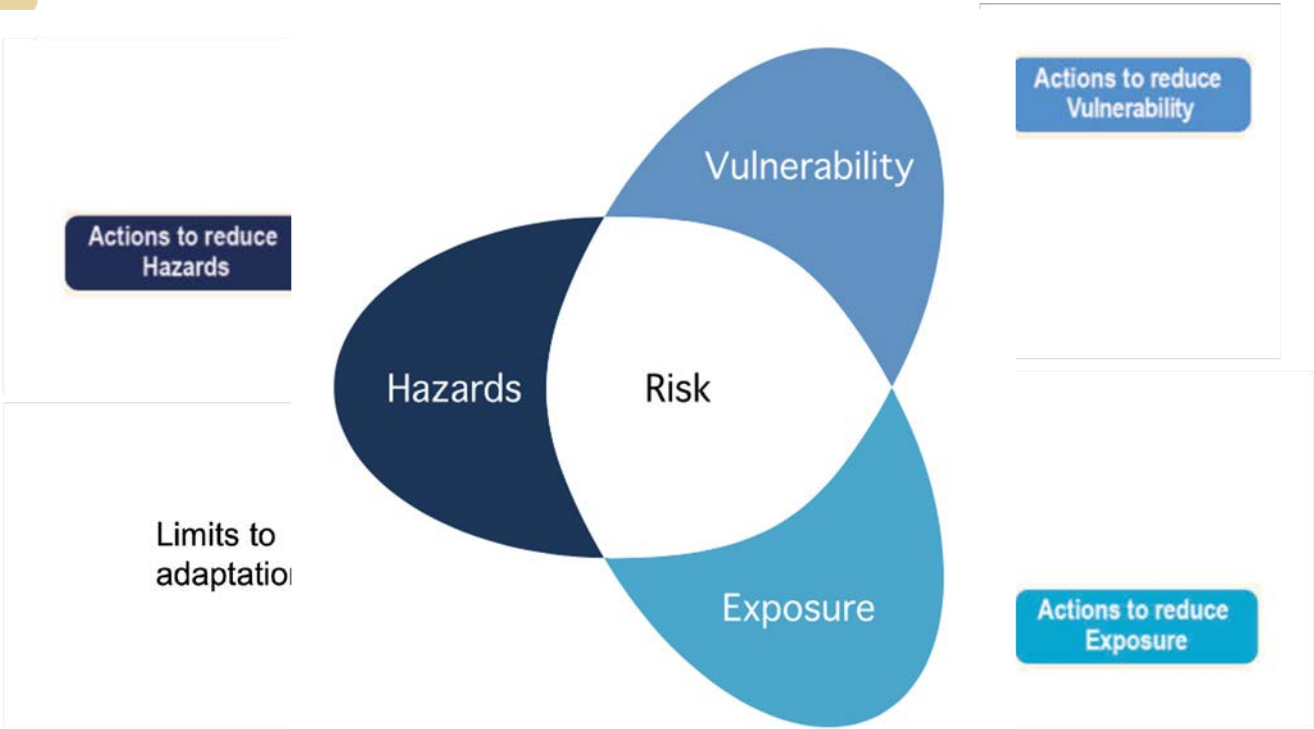
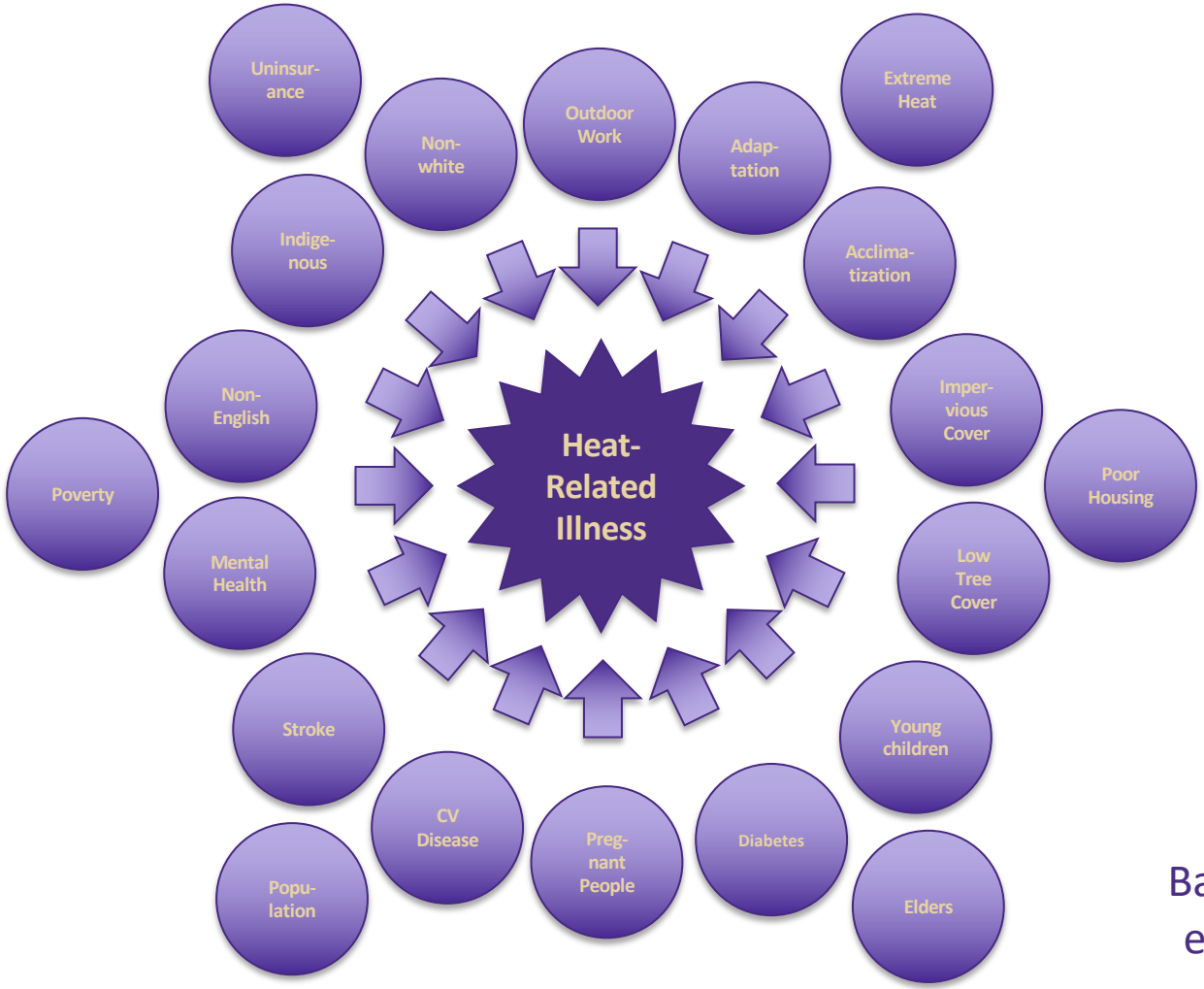
Overview

> Heat-health risk framework and drivers
> Evidence-based adaptation practice
> Relevant gaps
> Decision horizons and decision supports
> Ways forward

Risk Framework





Based on Yu et al. 2021

Points of Leverage

- **Vulnerability**
  - Widespread and latent
  - Multiple drivers
  - Certain common patterns
- **Exposure**
  - Somewhat concentrated
  - Variable modifiability
- **Hazard**
  - Worsening
  - Modified by built environment

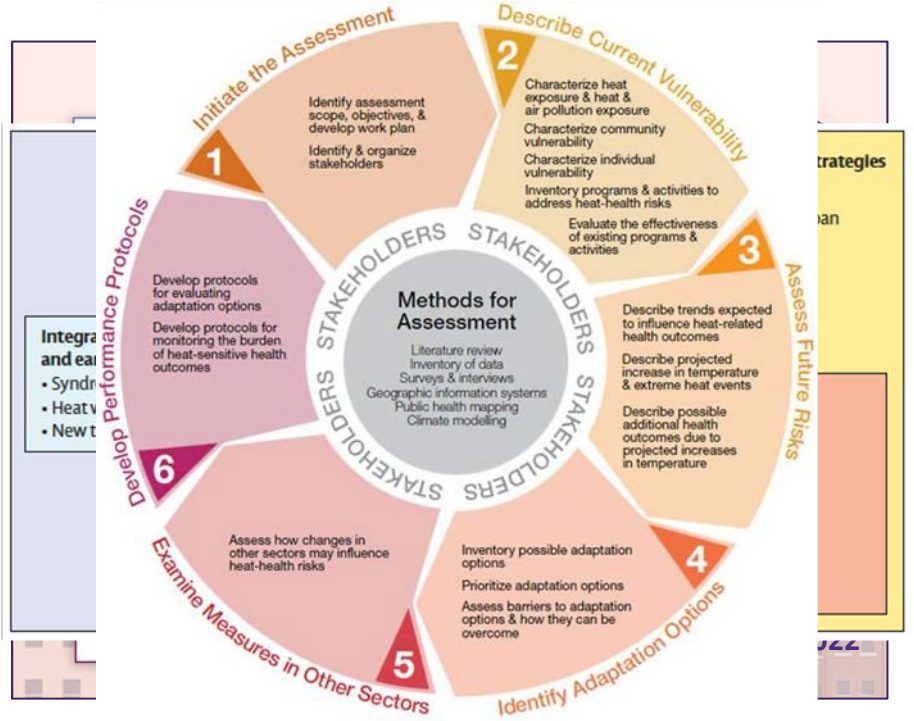
Evidence-based Practice

Adaptation after the Heat Dome

We know a lot about the risks of extreme heat, and potential solutions, to save lives. What's missing is coordinated efforts to take action before an event occurs.

The Challenge

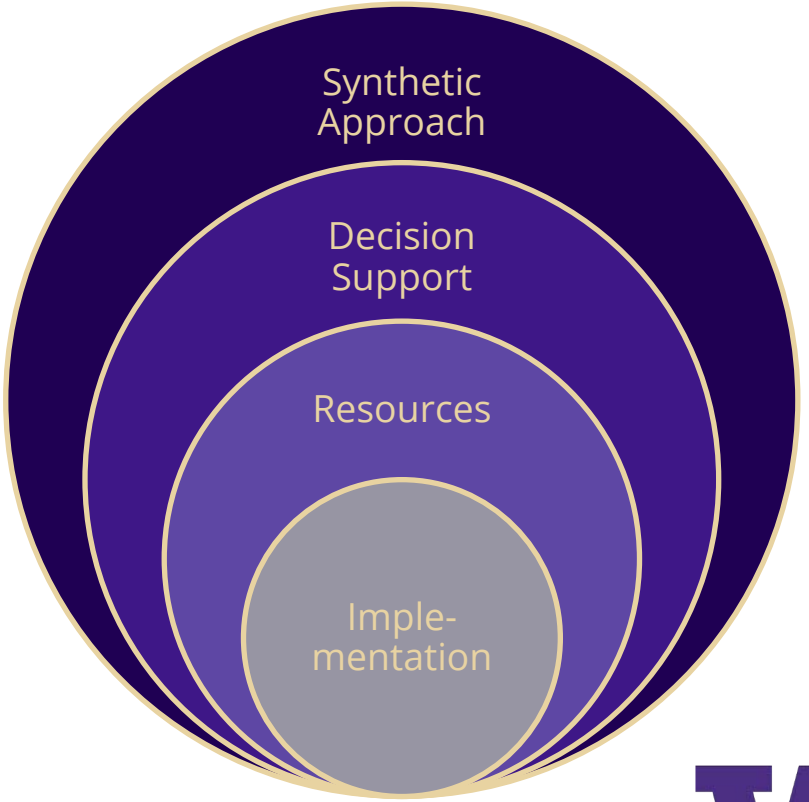
- We know what, in general, drives risk, and…
- We know what, in general, protects health, but…
- Communities have specific risk profiles, priorities, and needs



Health Canada 2011

Relevant Gaps

- Holistic approach to problems and their management
- Decision-oriented supports for communities and practitioners
- Financial resources for interventions at scale
- Implementation science-based supports to increase uptake and promote iterative management



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Strengthening Weak Links

- Health protections for heat are linked and frequently contingent
- The full impact of advances in forecasting depends on connecting forecasts with effective risk reduction measures
- Short- and medium-term risk interventions need to be coordinated

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Practitioner & Community Expertise

Households

Community-based Organizations

Faith-based Organizations

City/County Health or Regional Health District

City/County Emergency Management

Legislators

Governor's and/or Mayor's Office

Municipal building code, planners

Municipal/Regional parks

Washington State Building Code Council

Washington State Department of Commerce

Washington State Department of Health

Washington State Department of Ecology

Washington State Department of Labor & Industries

Washington State Department of Natural Resources

Washington State Emergency Management Division

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Decision Support

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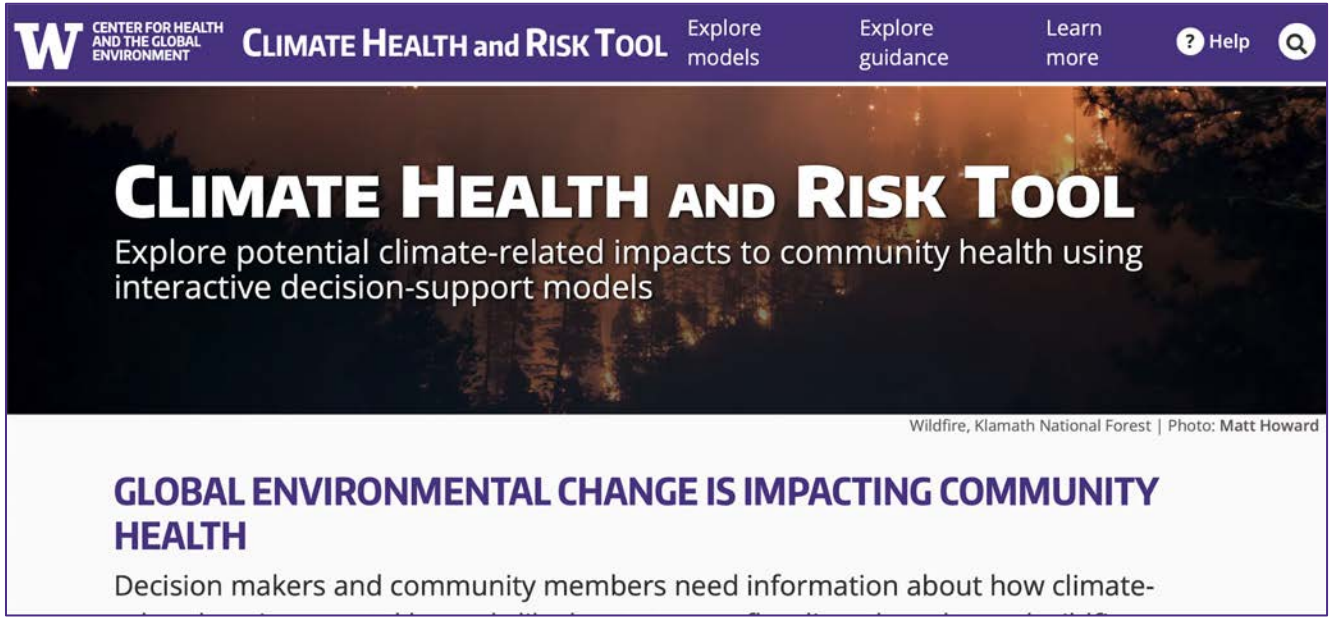
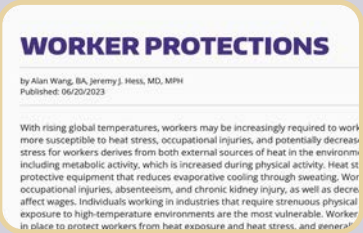
1 to 15 years

Our Decision Support Tool



https://climatesmarthealth.org

Structure


WORKER PROTECTIONS

by Alan Wang, BA, Jeremy J. Hess, MD, MPH
Published: 06/20/2023

With rising global temperatures, workers may be increasingly required to work
more susceptible to heat stress, occupational injuries, and potentially decreas
stress for workers derives from both external sources of heat in the environm
including metabolic activity, which is increased during physical activity. Heat st
protective equipment that reduces evaporative cooling through sweating. Wor
occupational injuries, absenteeism, and chronic kidney injury, as well as decre
affect wages. Individuals working in industries that require strenuous physical
exposure to high-temperature environments are the most vulnerable. Worker
in place to protect workers from heat exposure and heat stress, and general

Place-based Risk & Drivers

- High resolution
- Transparent
- Comprehensive
- Multiple hazard scenarios

Risk Reduction Opportunities

- Strategies
- Effectiveness
- Cost
- Timing

Synthesis

- Many points of entry
- Insights to advance discussions

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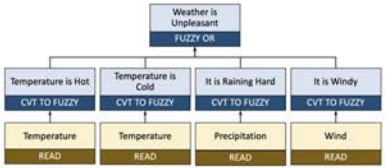
Fuzzy Logic Modeling

Fuzzy modeling

Fuzzy modeling is a tool for combining logical propositions using a hierarchical structure. For example, a proposition such as "Where is the weather most unpleasant" can be evaluated using the combination of other logical propositions, such as "Where is temperature the hottest?" and "Where is it most windy?".

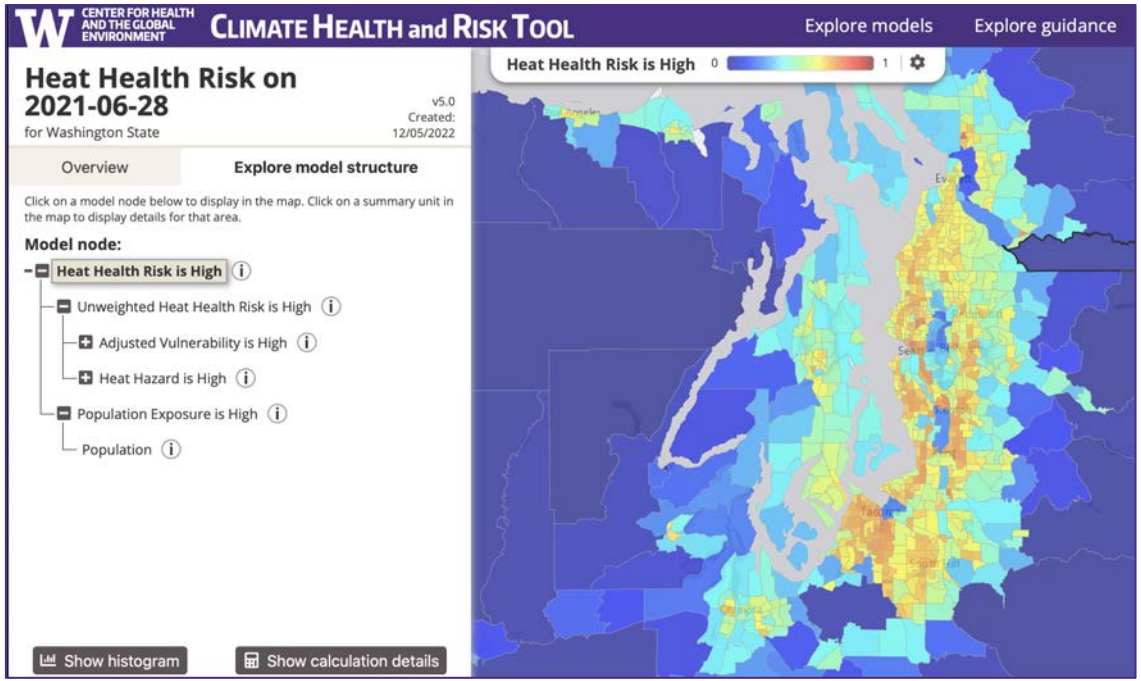
Fuzzy modeling starts by transforming a each charactistic that impacts each proposition in the model from its absolute value range , such as raw population count, to its fuzzy value range, such as Falsest to Truest for the proposition "population is high".

These propositions are then combined within a model to get to progressively higher-order propositions and eventually contribute toward the overall conclusion of the model.



Learn more about fuzzy modeling

Top Level Risk Estimates



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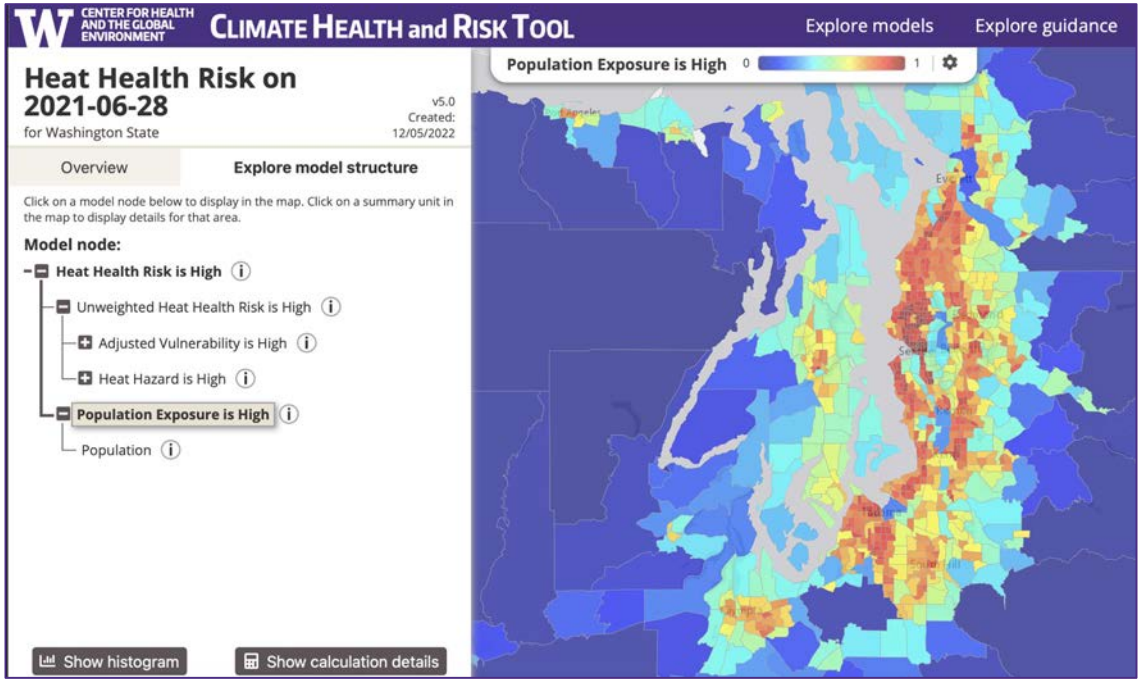
Population Exposure



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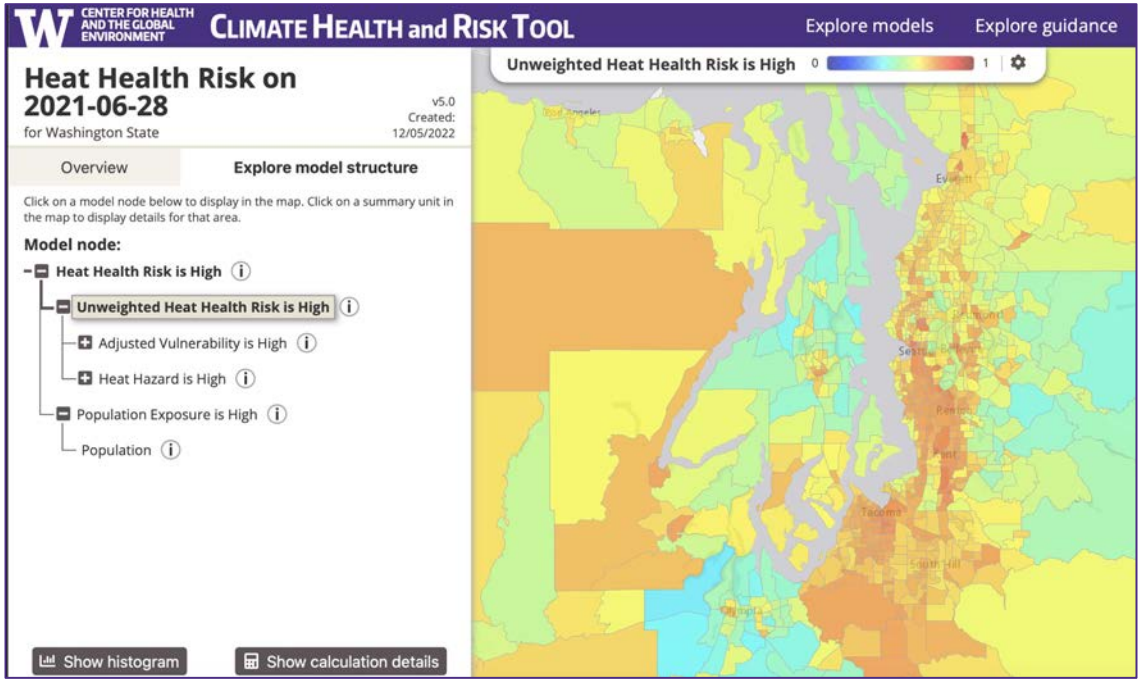
Risk Without Population Weighting



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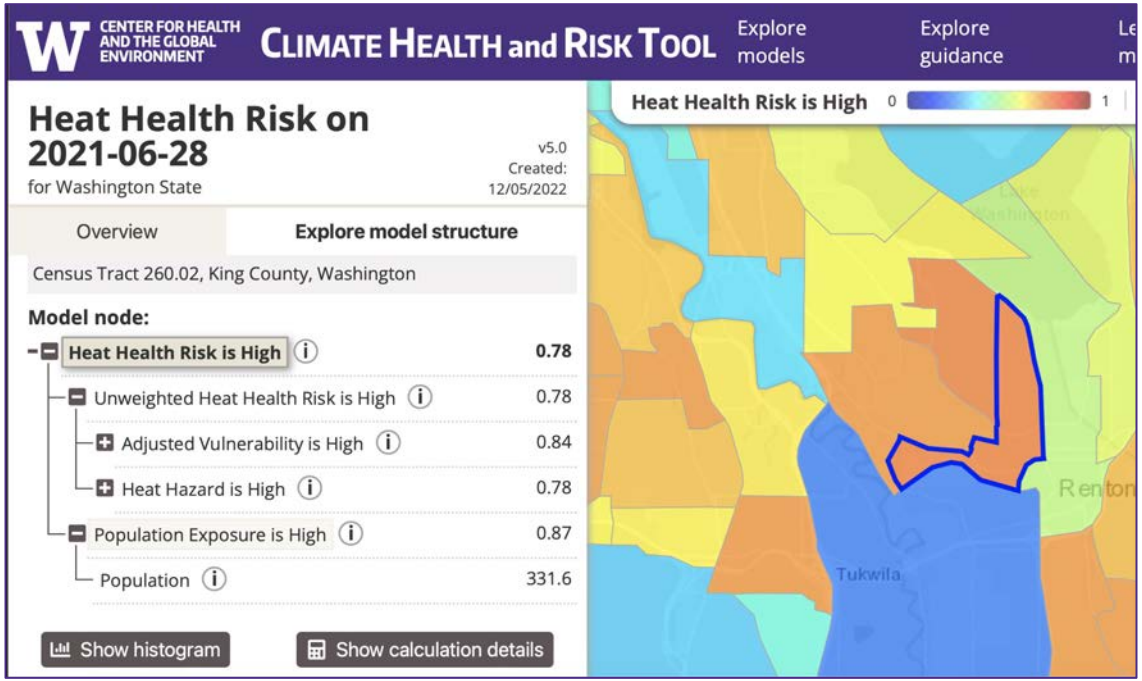
Zooming In



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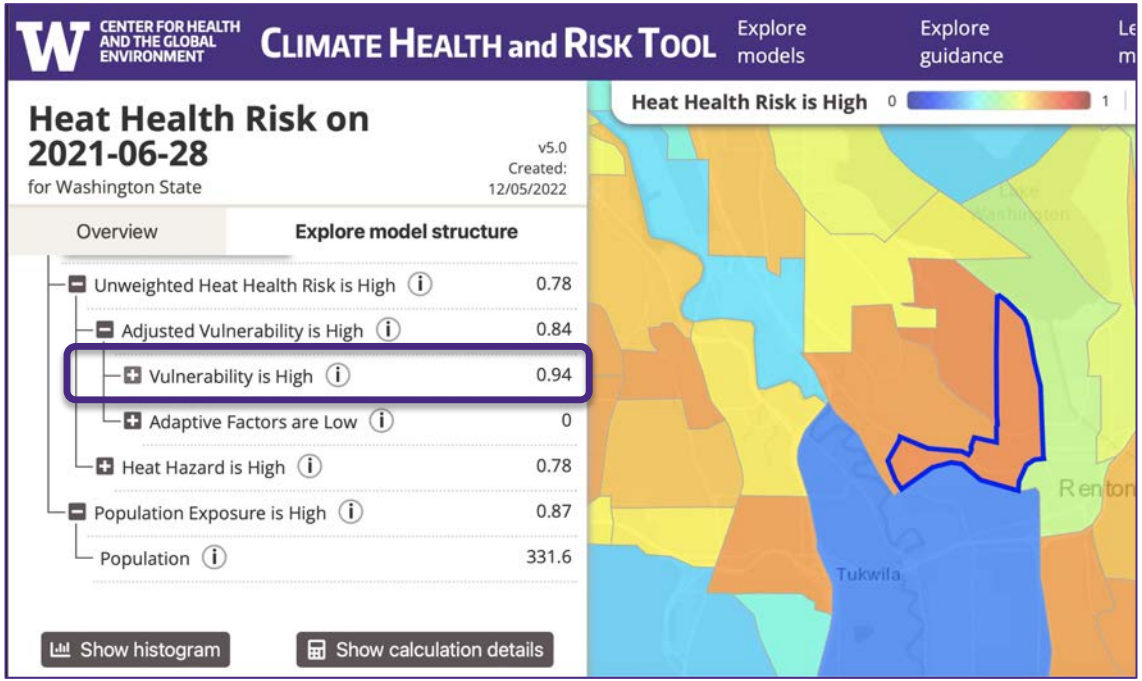
Vulnerability



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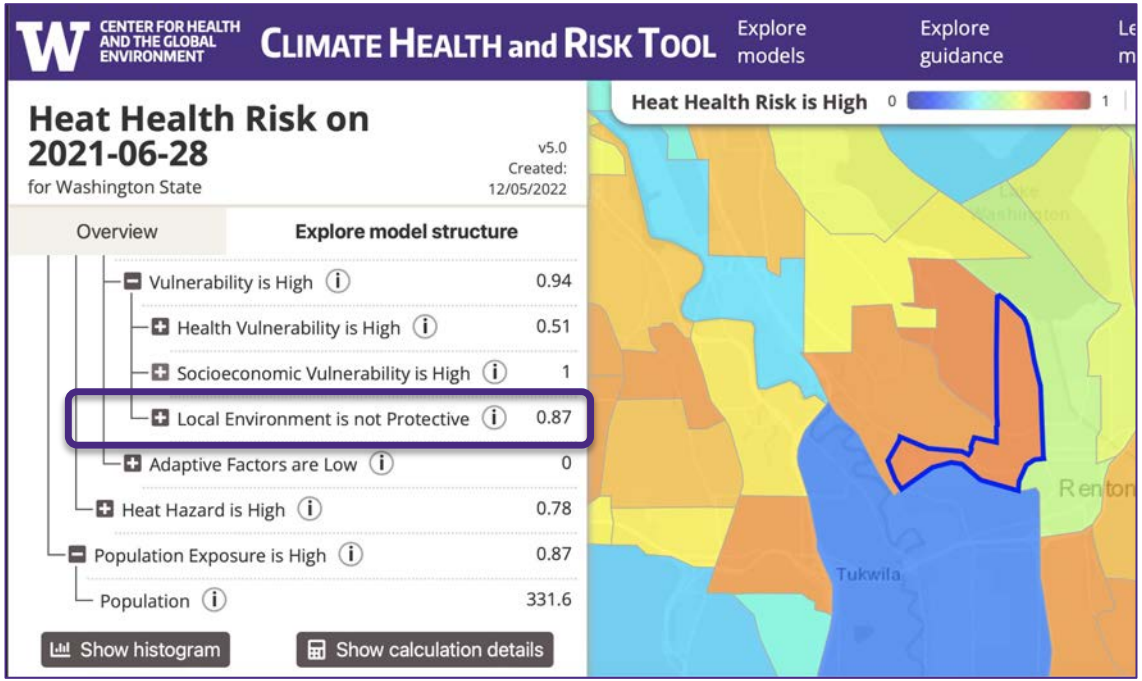
Diving Deeper



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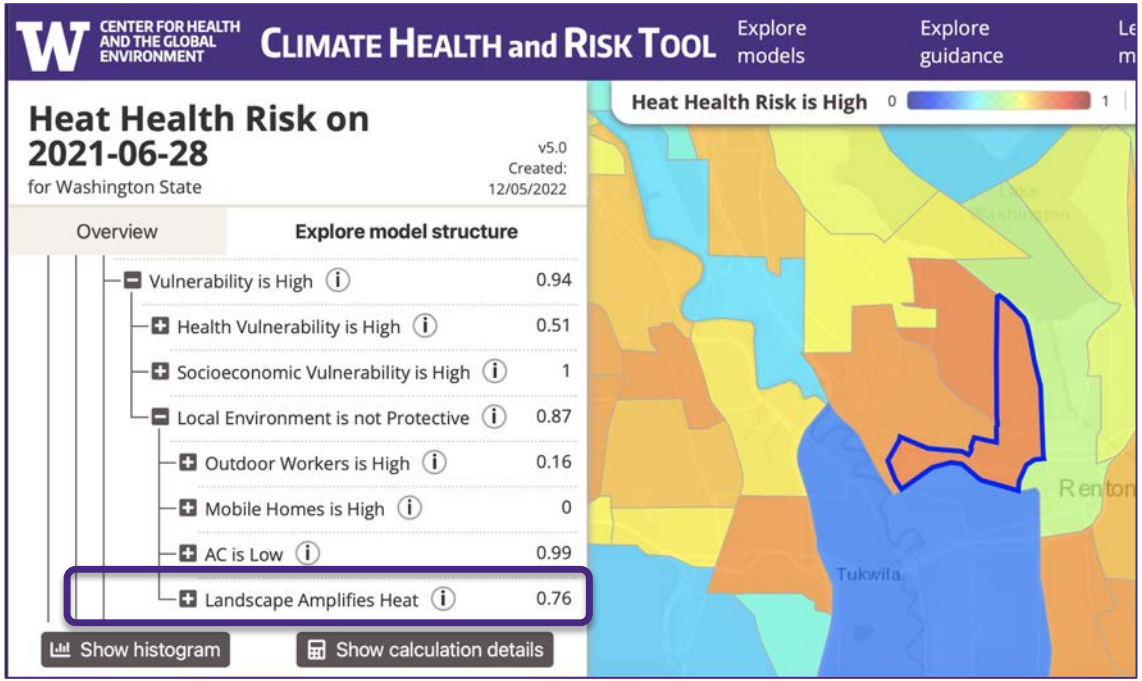
Areas for Potential Intervention



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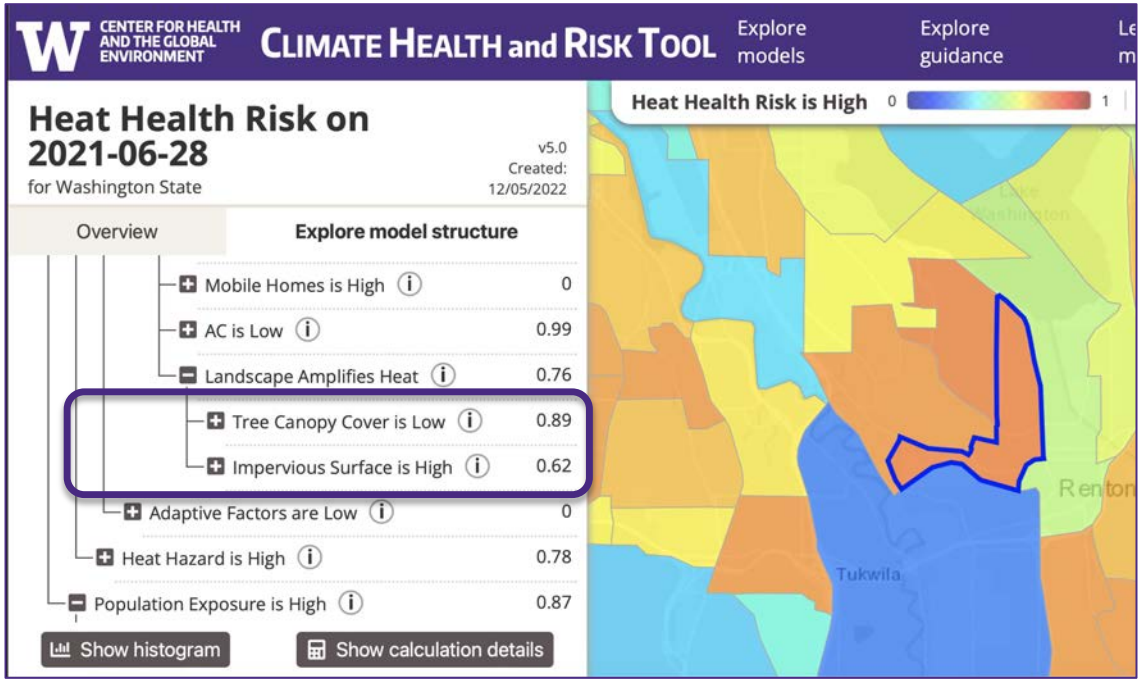
Landscape Amplifies Heat



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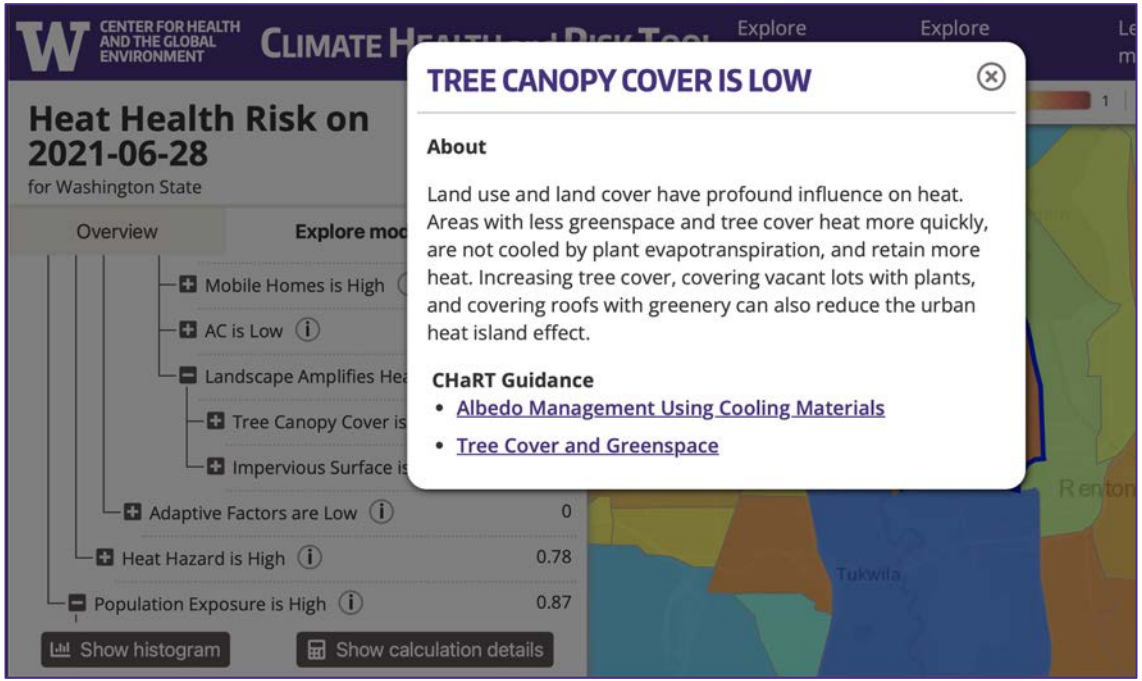
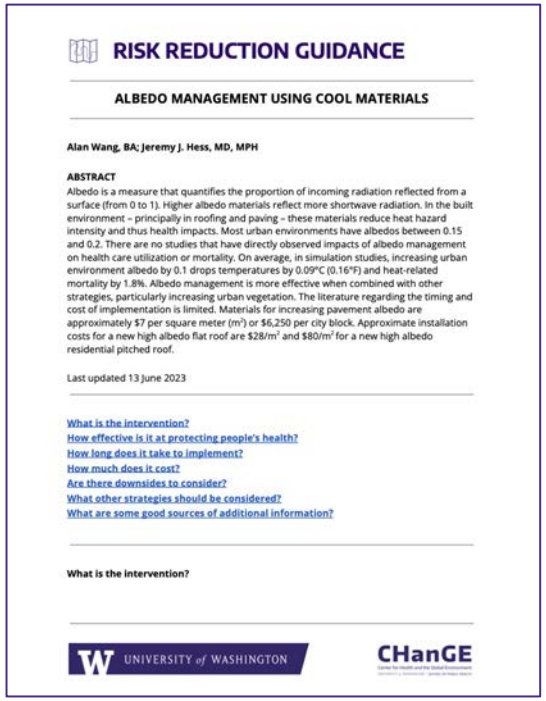
Decision Guidance



Albedo Management & Tree Cover



RISK REDUCTION GUIDANCE

ALBEDO MANAGEMENT USING COOL MATERIALS

Alan Wang, BA; Jeremy J. Hess, MD, MPH

ABSTRACT

Albedo is a measure that quantifies the proportion of incoming radiation reflected from a surface (from 0 to 1). Higher albedo materials reflect more shortwave radiation. In the built environment – principally in roofing and paving – these materials reduce heat hazard intensity and thus health impacts. Most urban environments have albedos between 0.15 and 0.2. There are no studies that have directly observed impacts of albedo management on health care utilization or mortality. On average, in simulation studies, increasing urban environment albedo by 0.1 drops temperatures by 0.09°C (0.16°F) and heat-related mortality by 1.8%. Albedo management is more effective when combined with other strategies, particularly increasing urban vegetation. The literature regarding the timing and cost of implementation is limited. Materials for increasing pavement albedo are approximately $7 per square meter ($m^2$) or $6,250 per city block. Approximate installation costs for a new high albedo flat roof are $28/$m^2$ and $80/$m^2$ for a new high albedo residential pitched roof.

Last updated 13 June 2023

What is the intervention?

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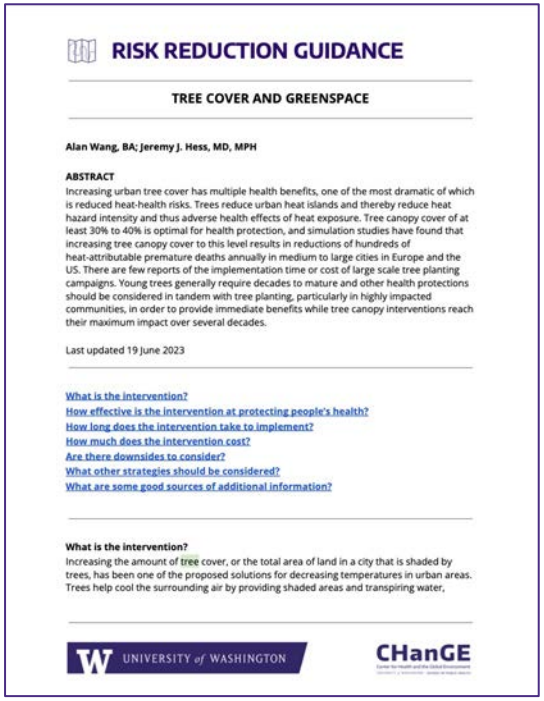

RISK REDUCTION GUIDANCE

TREE COVER AND GREENSPACE

Alan Wang, BA; Jeremy J. Hess, MD, MPH

ABSTRACT

Increasing urban tree cover has multiple health benefits, one of the most dramatic of which is reduced heat-health risks. Trees reduce urban heat islands and thereby reduce heat hazard intensity and thus adverse health effects of heat exposure. Tree canopy cover of at least 30% to 40% is optimal for health protection, and simulation studies have found that increasing tree canopy cover to this level results in reductions of hundreds of heat-attributable premature deaths annually in medium to large cities in Europe and the US. There are few reports of the implementation time or cost of large scale tree planting campaigns. Young trees generally require decades to mature and other health protections should be considered in tandem with tree planting, particularly in highly impacted communities, in order to provide immediate benefits while tree canopy interventions reach their maximum impact over several decades.

Last updated 19 June 2023

What is the intervention?

Increasing the amount of tree cover, or the total area of land in a city that is shaded by trees, has been one of the proposed solutions for decreasing temperatures in urban areas. Trees help cool the surrounding air by providing shaded areas and transpiring water,

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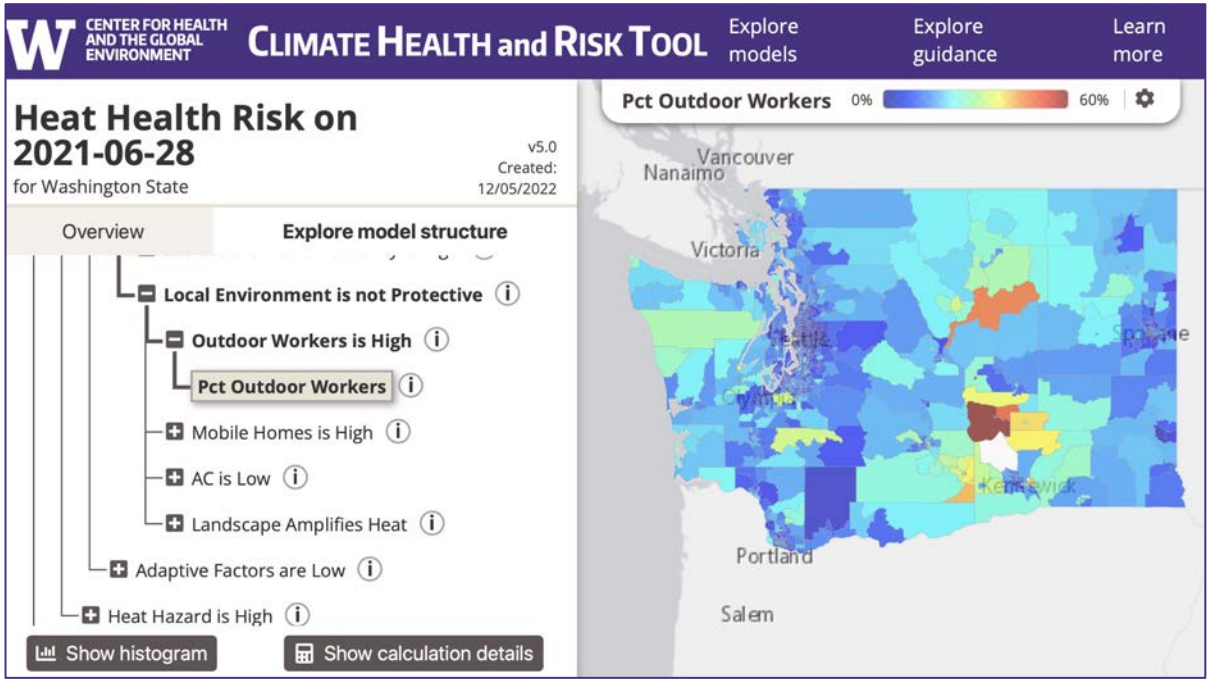
Guidance

- What is the intervention?
- How effective is the intervention at protecting people's health?
- How long does the intervention take to implement?
- How much does the intervention cost?
- Are there downsides to consider?
- What other strategies should be considered?
- What are some good sources of additional information?

Planning at Other Levels



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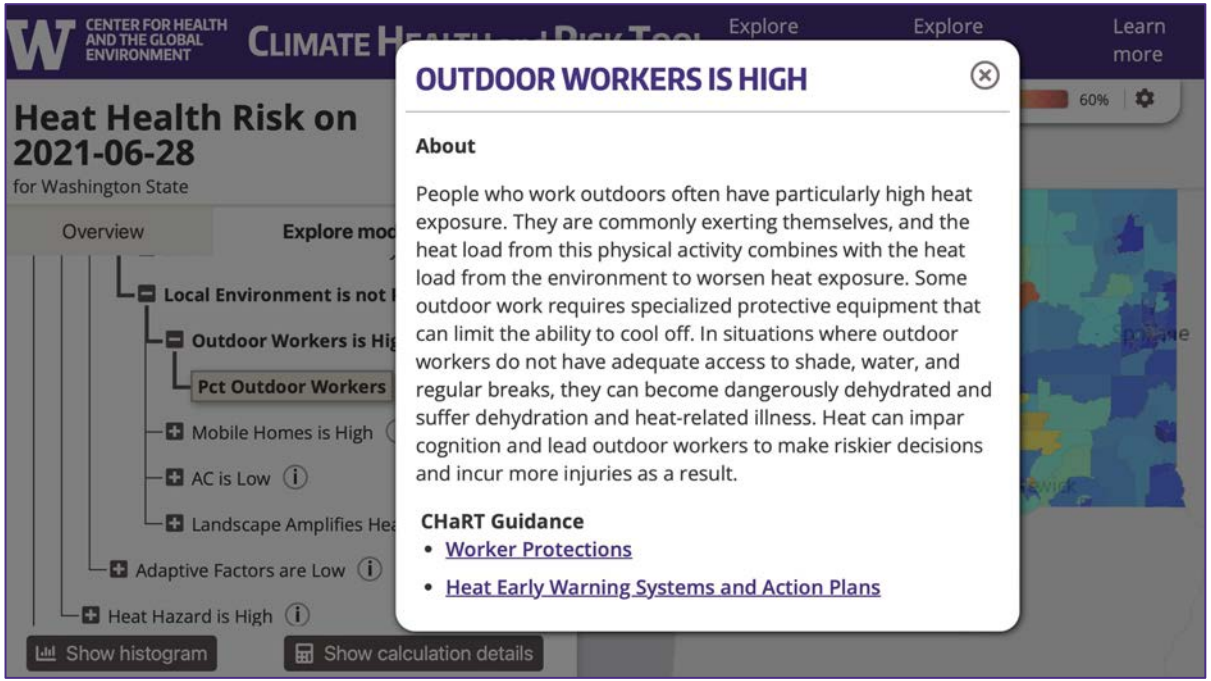
Linkage to Guidance



Evidence-based Practice

Opportunities for Enhancement

- Upstream supports
  - Linkage between heat mapping and vulnerability and risk assessment
  - Linkage with seasonal outlooks and forecasts
  - Development and integration of regional and local sociodemographic projections
- Internal supports
  - Leadership positions for managing climate-sensitive hazards and adaptations
  - Linkage with climate mitigation investments and infrastructure investments
  - Facilitated development of heat action plans and other policies
- Downstream supports
  - Investments to support implementation at scale
  - Support for interventions related to social determinants of health
  - Standardized surveillance and effectiveness measures

Thank You!

jjhess@uw.edu

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