Cool Policy Review

Cool Roof Rating Council Membership Meeting

June 19, 2014

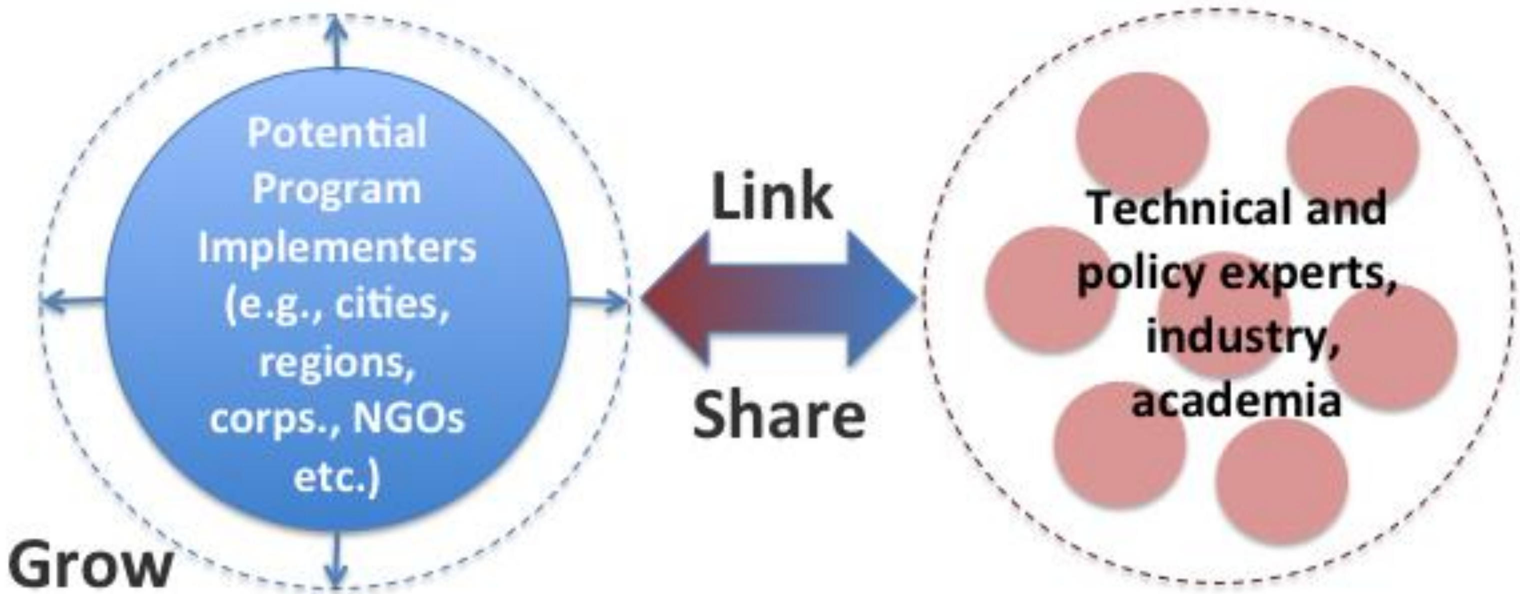
Global
Cool Cities
ALLIANCE

Global Cool Cities Alliance

1. **Introduction**
2. U.S. Cool Policy and Codes Overview
3. Cool Roofs International Policy Roundup
4. Snapshot: Mexico
5. Snapshot: South Africa
6. Heat Vulnerability Study

Global Cool Cities Alliance (GCCA)

The Global Cool Cities Alliance is dedicated to advancing policies and actions that reduce excess urban heat in order to cool buildings, cool cities, and to mitigate the effects of climate change through global cooling.



Board

Hashem Akbari – Concordia University

Dian Grueneich – Dian Grueneich Consulting (former CPUC Commissioner)

Catherine Hunt – Dow Corp. (retired)

Gregory Kats – Good Energies

Laurie Kerr – NRDC (former Deputy Director for Energy Efficiency for New York City)

Ronnen Levinson - LBNL

Art Rosenfeld – LBNL, former CA Energy Commissioner

Stephen Wiel – Collaborative Labeling and Appliance Standards Program

John Wilson – Energy Foundation

Staff

Kurt Shickman – Executive Director

Washington, DC

Amy Dickie
Deputy Director
San Francisco, CA

Karen Murphy
Communications Director
Washington, DC

The Cool Roofs and Pavements Toolkit
www.CoolRoofToolKit.org

- Science, costs, and benefits of cool surfaces
- Global best practices for program and policy implementation
- Sample materials and relevant organizations.
- A comprehensive “knowledge base”
- New: Networking Forum

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Cool Roofs in the Codes

Trend is moving from credits and trade-offs with insulation to requirements

ASHRAE 90.1, 1999
- credit

IECC 2003
- allows compliance via ASHRAE

ASHRAE 90.1, 2010
- requirement, with exemptions

IECC 2012
- requirement

1999

2006

2013

California Title 24 2001 - credit

Florida State 2001 – credit

City of Chicago 2001 - requirement

California Title 24 2005 - requirement

Washington, DC 2008 – green code

Houston 2008

Dallas 2008

Miami 2009

Florida 2010

Philadelphia 2010

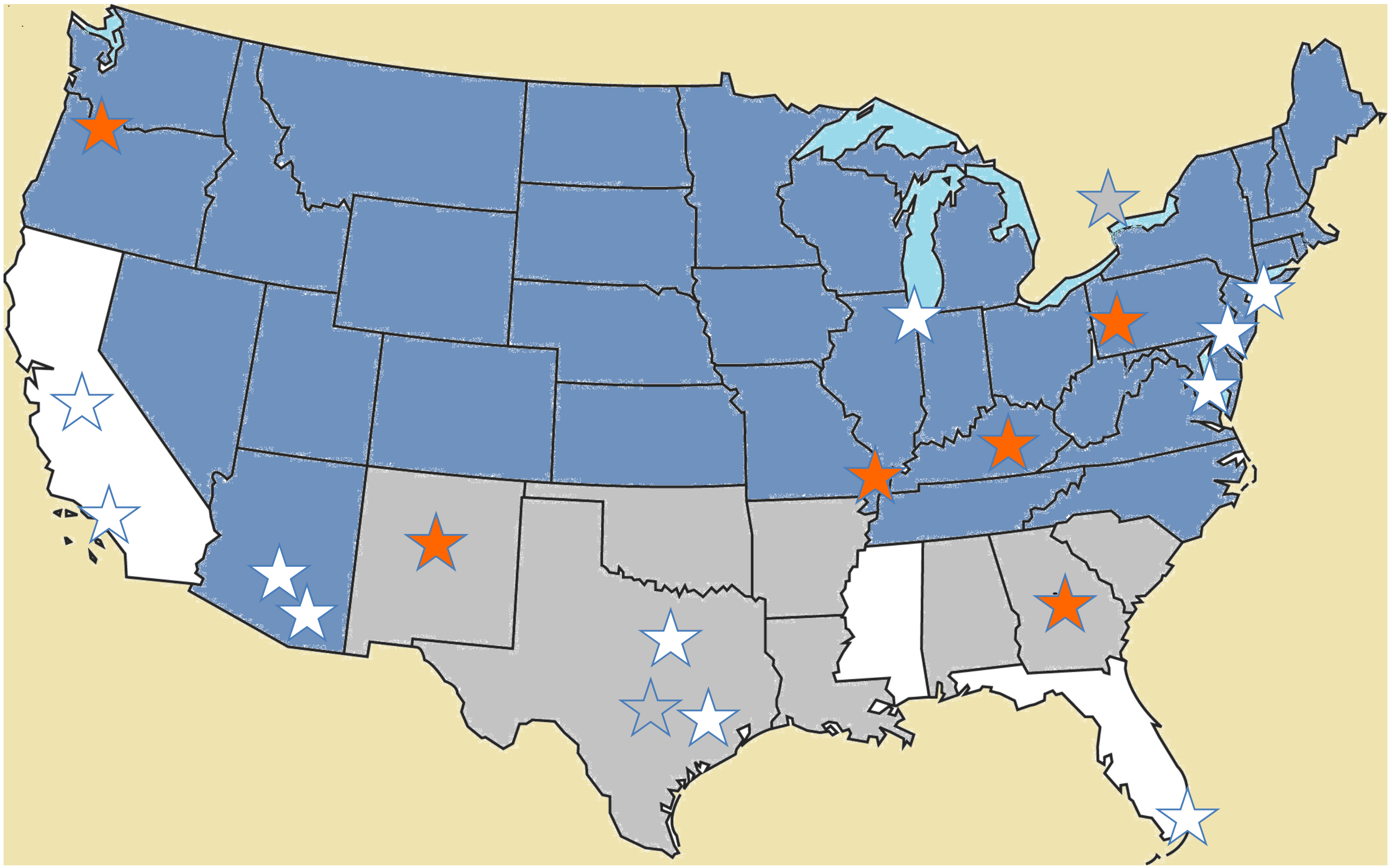
New York City 2012

Phoenix 2013

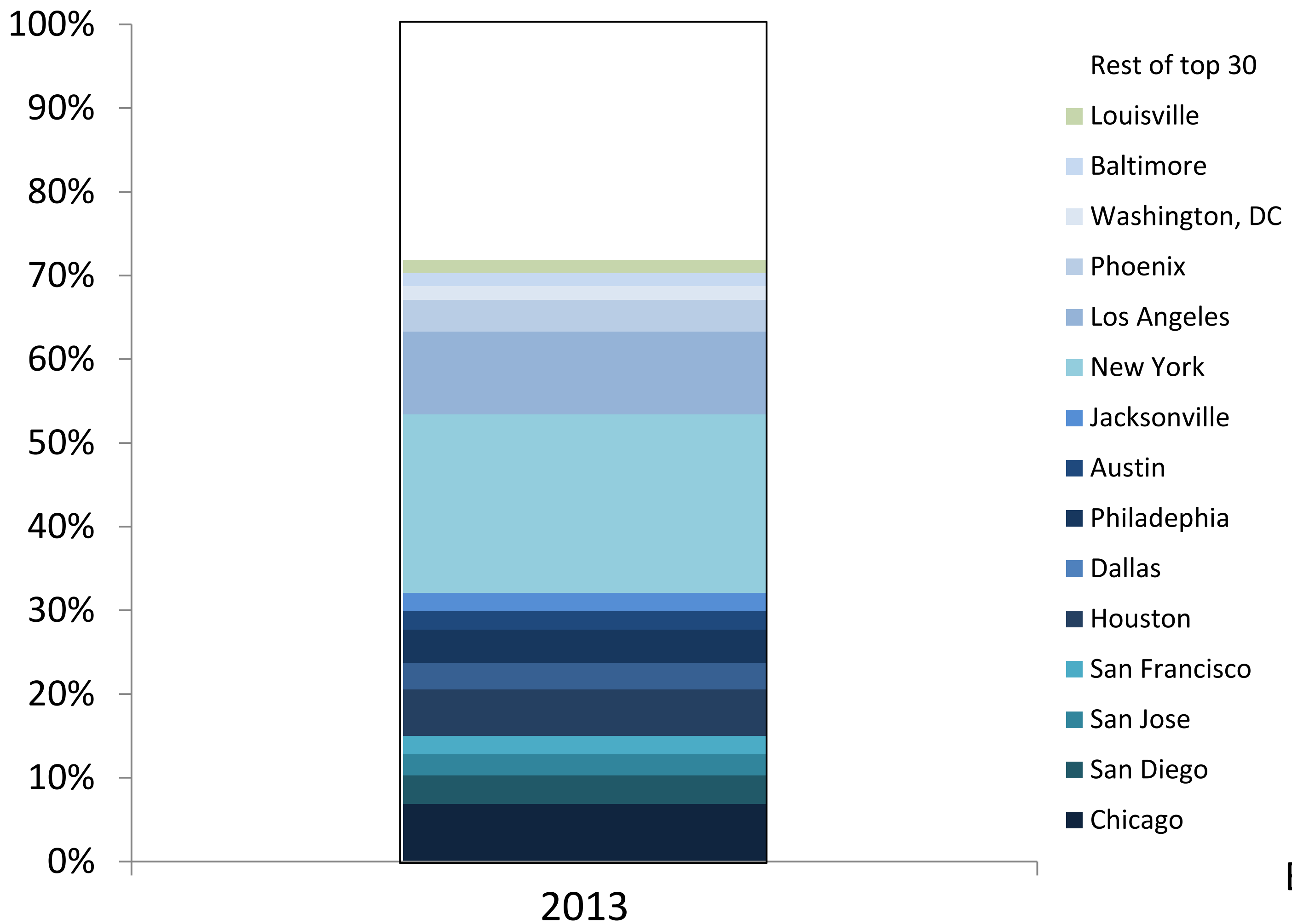
Los Angeles 2013

Washington, DC 2013

Where are Cool Roof Programs/Laws in Effect?



Cool Roofs in the Largest US Cities



By population

Where are the codes heading?

IECC 2015 – Incorporates the CRRC-1 standard and some clarifying language. No stringency changes from 2012.

IgCC – Development Committee approved an increase in required roof reflectivity for compliance with Chapter 4 (UHI) and a "jurisdictional elective" that turns Chapter 4 into an opt-in.

Efforts to expand cool roof requirements into Climate Zone 4a and 4b have not been successful so far in ASHRAE (189.1, 90.1, 90.2) or the I-Codes (IECC, IgCC).

UHI City Survey

- ACEEE and GCCA surveyed 26 North American cities to better understand what they are doing to address excess urban heat. Report released on June 18th.

Key findings

- **Health Angle:** Half of the cities surveyed cited climate adaptation or public health and resilience as the key reasons they adopted UHI reduction programs.
- **Event Driven**: Half of the cities started to incorporate heat mitigation into their city policies after a natural disaster.
- **Diffuse Ownership**: UHI mitigation strategies are managed by a broad set of city agencies and mandates. Some cities attempt to coordinate with a central body, often based in the mayor's office.

Global Cool Cities ALLIANCE

Findings at a Glance

Cities	Climate Zone (1–7)		Goals	Strategies: Policies and Programs — Mandatory	Voluntary
POPULATION 3M+					
Los Angeles	3	Natural Disaster Response	Vegetative Roofs, Stormwater Management, Urban Canopy, Other*	Cool Procurement Policies, Reflective Roofs, Other*	Reflective Roofs
New York	4	Natural Disaster Response	Reflective Roofs, Stormwater Management, Urban Canopy, Other*	Cool Procurement Policies, Reflective Roofs, Urban Canopy	Reflective Roofs, Vegetative Roofs, Stormwater Management
POPULATION <3M					
Houston	2	Natural Disaster Response	Vegetative Roofs, Urban Canopy	Cool Procurement Policies, Reflective Roofs	Other*
Phoenix	2		Light-colored Pavements, Stormwater Management, Urban Canopy, Other*	Cool Procurement Policies	Reflective Roofs, Urban Canopy
Dallas	3		Stormwater Management, Urban Canopy, Other*	Cool Procurement Policies, Reflective Roofs, Stormwater Management, Other*	Urban Canopy, Other*
Philadelphia	4	Natural Disaster Response	Reflective Roofs, Vegetative Roofs, Stormwater Management, Urban Canopy, Other*	Cool Procurement Policies, Reflective Roofs	Reflective Roofs, Stormwater Management, Urban Canopy
Chicago	5	Natural Disaster Response	Vegetative Roofs, Urban Canopy, Other*	Reflective Roofs, Stormwater Management, Urban Canopy	Cool Procurement Policies, Reflective Roofs, Vegetative Roofs, Stormwater Management

KEY

- Cool Procurement Policies
- Other*
- Reflective Roofs
- Stormwater Management
- Urban Canopy
- Vegetative Roofs
- Light-colored Pavements
- Natural Disaster Response

* Other includes the following list of goals and strategies. Goals: GHG emissions reduction, energy use reduction, disaster preparedness, urban agriculture, air quality, green building standard implementation, reducing hospitializations, and reducing VMT. Strategies: Green Building techniques, educational campaigns, energy efficiency, and energy use reduction.

Cities	Climate Zone	Natural Disaster Response	Goals	Strategies: Policies and Programs — Mandatory	Strategies: Policies and Programs — Voluntary
POPULATION <1M					
Austin	2	⚠	Stormwater Management, Urban Canopy, Other*	Reflective Roofs, Urban Canopy	Vegetative Roofs, Other*
New Orleans	2	⚠	Reflective Roofs, Vegetative Roofs, Light-colored Pavements, Stormwater Management, Urban Canopy, Other*	Stormwater Management	Other*
Atlanta	3	⚠	Stormwater Management, Urban Canopy, Other*	Stormwater Management, Other*	Cool Procurement Policies, Reflective Roofs
Charlotte	3	⚠	Urban Canopy		
Chula Vista	3		Light-colored Pavements, Stormwater Management, Urban Canopy	Cool Procurement Policies, Reflective Roofs, Light-colored Pavements, Stormwater Management, Urban Canopy	Other*
Las Vegas	3		Vegetative Roofs, Stormwater Management, Urban Canopy		Other*
Sacramento	3		Reflective Roofs, Vegetative Roofs, Light-colored Pavements, Stormwater Management, Urban Canopy, Other*	Cool Procurement Policies, Reflective Roofs, Urban Canopy	Reflective Roofs, Urban Canopy
Albuquerque	4		Reflective Roofs, Vegetative Roofs, Stormwater Management, Other*		Other*
Baltimore	4	⚠	Reflective Roofs, Stormwater Management, Urban Canopy, Other*	Stormwater Management	Urban Canopy

KEY

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- Other*
- Reflective Roofs
- Stormwater Management
- Urban Canopy
- Vegetative Roofs
- Light-colored Pavements
- ⚠ Natural Disaster Response

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Cities POPULATION 3M+	Climate Zone (1–7)		Goals	Strategies: Policies and Programs Mandatory	Voluntary
Cincinnati	4	Natural Disaster Response	Reflective Roofs, Vegetative Roofs, Light-colored Pavements, Stormwater Management, Urban Canopy, Other*	Urban Canopy	Cool Procurement Policies, Vegetative Roofs, Other*
Louisville	4	Natural Disaster Response	Stormwater Management, Urban Canopy, Other*		Cool Procurement Policies, Stormwater Management, Other*
Portland	4	Natural Disaster Response	Vegetative Roofs, Light-colored Pavements, Stormwater Management, Urban Canopy	Cool Procurement Policies, Vegetative Roofs	Vegetative Roofs, Stormwater Management, Urban Canopy
St. Louis	4		Stormwater Management, Urban Canopy, Other*	Urban Canopy	Reflective Roofs, Urban Canopy, Other*
Vancouver	4		Stormwater Management, Urban Canopy, Other*	Vegetative Roofs	
Washington DC	4	Natural Disaster Response	Reflective Roofs, Vegetative Roofs, Stormwater Management, Urban Canopy	Cool Procurement Policies, Reflective Roofs, Light-colored Pavements, Stormwater Management, Other*	Vegetative Roofs, Stormwater Management, Other*
Boston	5	Natural Disaster Response	Stormwater Management, Urban Canopy, Other*	Stormwater Management	Cool Procurement Policies, Urban Canopy
Denver	5	Natural Disaster Response	Urban Canopy, Other*	Cool Procurement Policies, Other*	Other*
Omaha	5		Vegetative Roofs, Urban Canopy, Other*		Other*
Toronto	5		Urban Canopy, Other*	Cool Procurement Policies, Vegetative Roofs, Other*	Reflective Roofs, Vegetative Roofs, Stormwater Management, Urban Canopy

KEY

- Cool Procurement Policies
- Other*
- Reflective Roofs
- Stormwater Management
- Urban Canopy
- Vegetative Roofs
- Light-colored Pavements
- Natural Disaster Response

* Other includes the following list of goals and strategies. Goals: GHG emissions reduction, energy use reduction, disaster preparedness, urban agriculture, air quality, green building standard implementation, reducing hospitializations, and reducing VMT. Strategies: Green Building techniques, educational campaigns, energy efficiency, and energy use reduction.

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Cool Roof and UHI Strategies Worldwide

- **London** – Heat vulnerability mapping, extensive UHI and roof research
- **Paris** – heat vulnerability mapping
- **Melbourne** – Cool roofs guide, extensive UHI research
- **Australia** – Building Code allowances for lower R-value with higher reflectance
- **New Delhi** – Cool roof requirement for new buildings, cool roofs guide
- **India** – Includes cool roof/site requirement in ECBC and GRIHA

Cool Roof and UHI Strategies Worldwide (cont.)

- **Tokyo** – UHI mapping and monitoring, cool pavements pilots
- **Changwon** – Encouraging commercial/industrial adoption, considering a rebate
- **Toronto** – EcoRoof Incentive for cool roofs
- **European Cool Roofs Council** – research and advocacy. Developing a rating system.
- Voluntary programs with international uptake **– Green Globes, LEED, RoofPoint**

Global Superior Energy Performance Partnership

- Initiative of the Clean Energy Ministerial and International Partnership for Energy Efficiency Cooperation (IPEEC).
- National governments are official members: India, Japan, Mexico, South Africa, and U.S. Active participation from private sector, academics, and technical experts.
- Countries agree to an Action Plan that includes developing CRRC-like institutions, studying national impact of cool surfaces, organizing local actors, pilot projects, and launching voluntary industry standards.

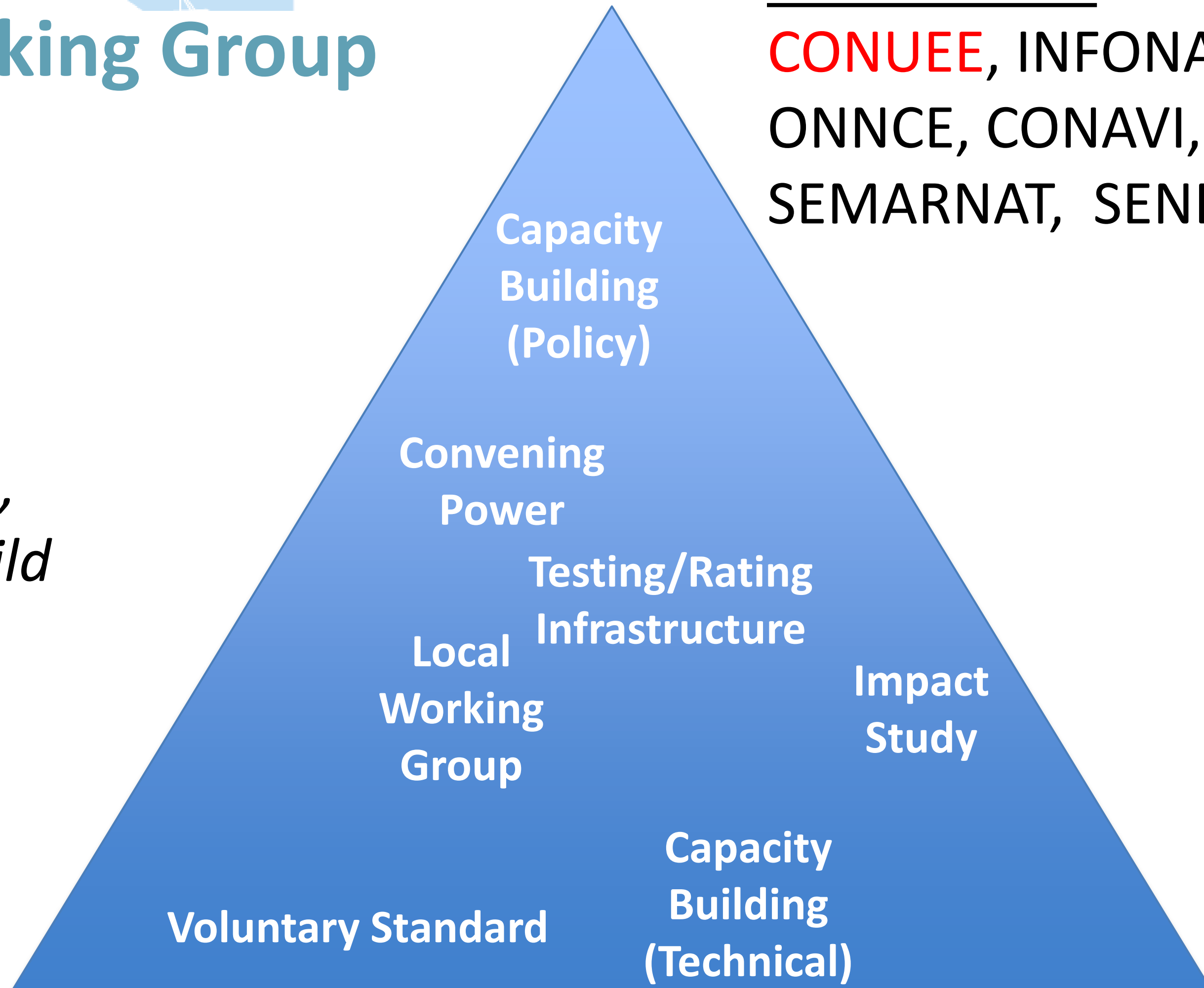
First Cool Roofs Working Group meeting, September 2011

GSEP Working Group in Mexico

Support from US DOE, LBNL, GCCA, WinBuild and others.

Government

CONUEE, INFONAVIT ONNCE, CONAVI, SEMARNAT, SENER



Industry

ANAFAPyT, AEAEE

Technical

CENIDET, CIMAV

Cool Roofs Action Plan

Adopted by CONUEE in 2012

1. Study impact of cool roofs – **DONE**

2. Create voluntary industry standard for testing and performance – **ONGOING**

3. Move voluntary standards into building codes – **ONGOING**

4. Capacity building – **DONE**

5. Form a local working group to drive progress - **DONE**

Impact Study

Research led by CENIDET Institute with technical and financial support from GSEP Working Group

7 major cities in all 6 of Mexico's climate zones

Energy savings, GHG emissions, and economic payback from increasing roof reflectance (SR 0.1 through SR 0.9)

Building models assumed code-compliant residential and non-residential buildings (first recreation of such models)

http://www.coolrooftoolkit.org/knowledgebase/assessing-energy-savings-from-cool-roofs-on-residential-and-non-residential-buildings-in-mexico/

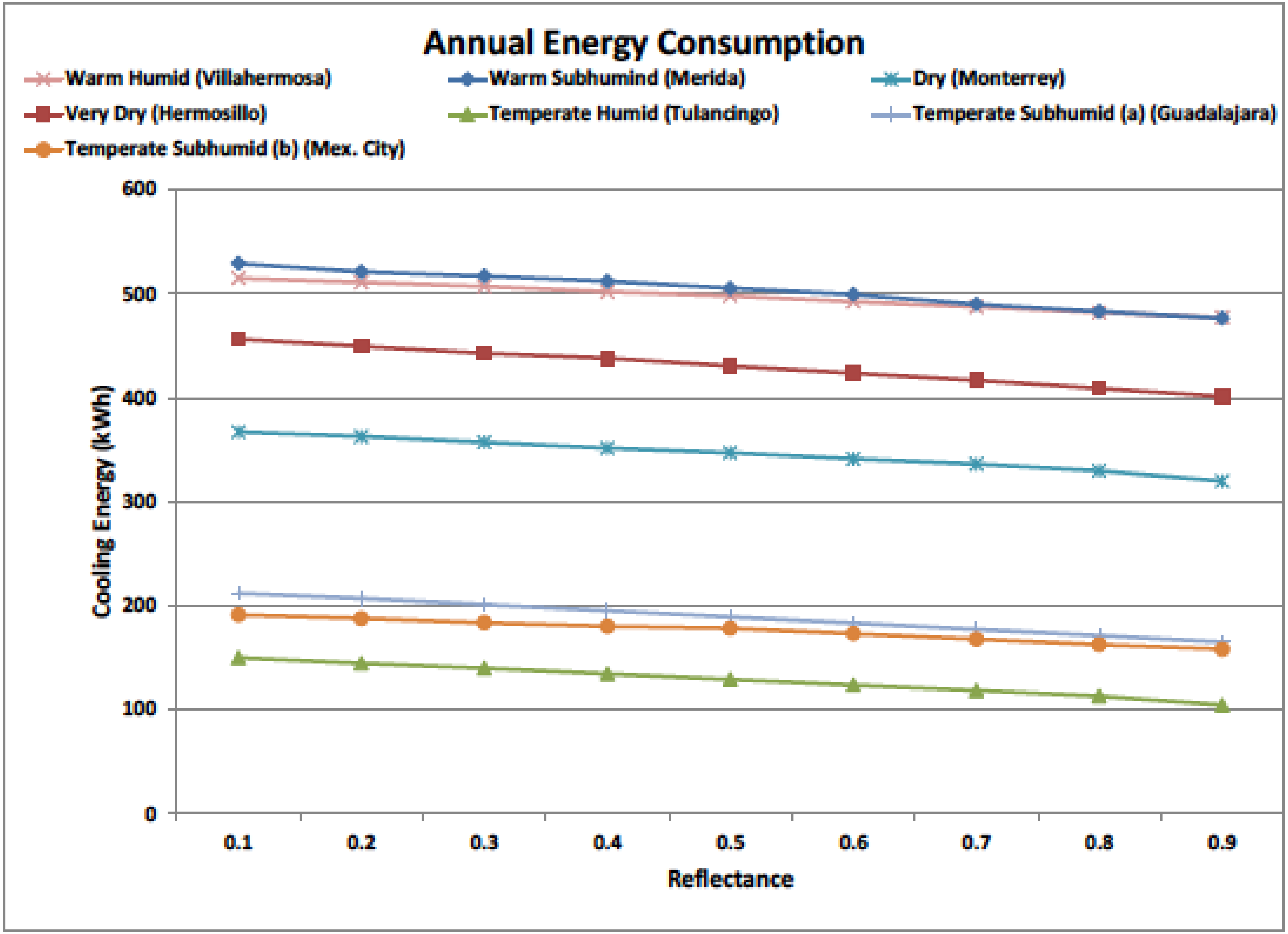

GROUPS AND SUBGROUPS
OF CLIMATES IN MEXICO
WARM
1. WARM HUMID
a.- Villahermosa
2. WARM SUBHUMID
b.- Merida
Dry
3. DRY
c.- Monterrey
4. VERY DRY
d.- Hermosillo
TEMPERATE
5. TEMPERATE SUBHUMID
f.- Guadalajara
g.- Mexico City
6. TEMPERATE HUMID
h.- Tulancingo
d
c
b
e
g
f
a
GOLFO DE MÉXICO
OCÉANO PACÍFICO
MAR CARIBE
ESTADOS UNIDOS DE AMÉRICA
GUATEMALA
BELICE
TRÓPICO DE CÁNCER
GRUPOS Y SUBGRUPOS
DE CLIMAS DE MÉXICO
INEGI
INSTITUTO NACIONAL DE ESTADÍSTICA
GEOGRAFÍA E INFORMÁTICA
ESCALA GRAFICA

Key Findings

Payback in 3 years or less across Mexico for non-residential, 1 year or less for residential.

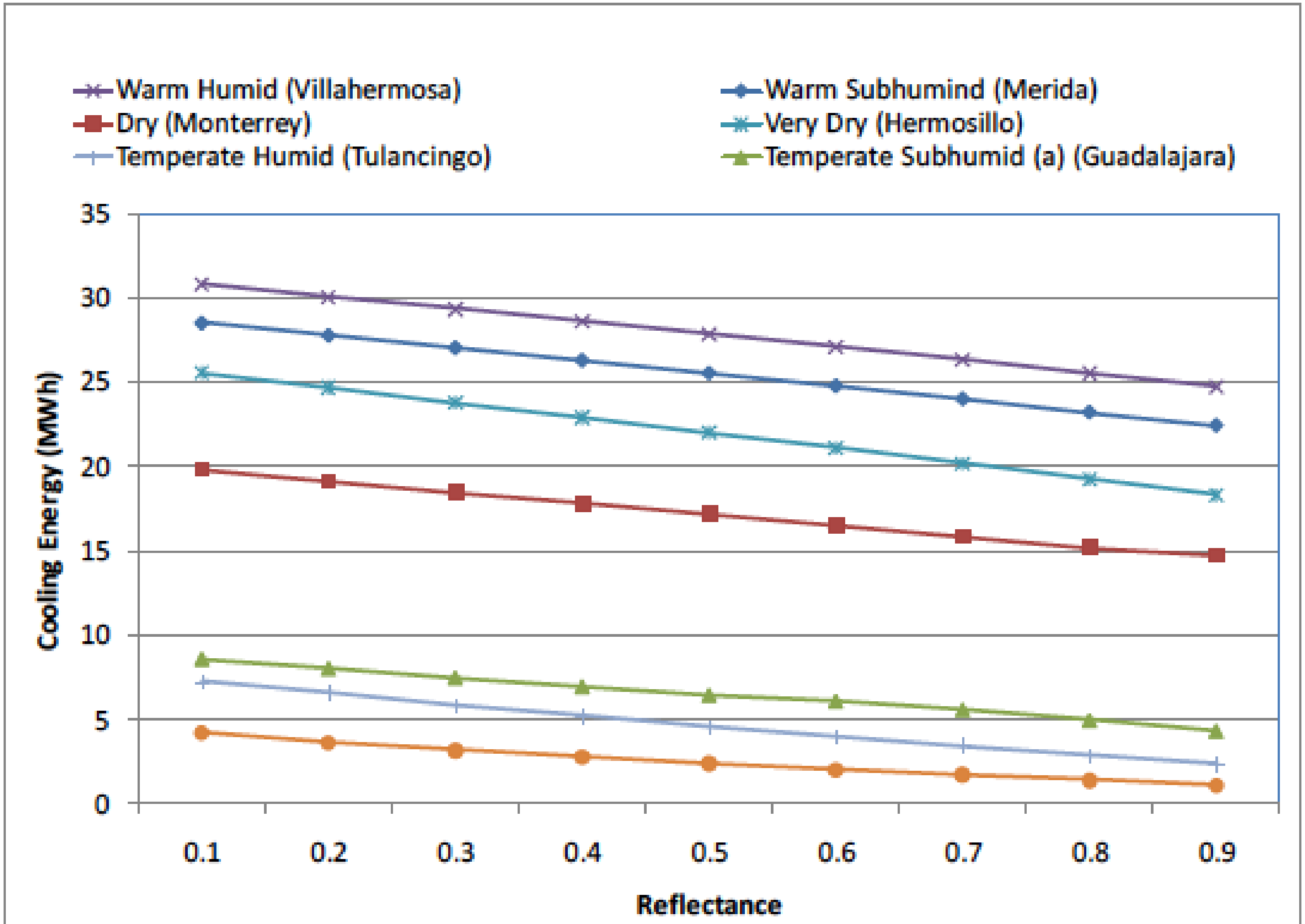
Energy savings of 5-21% and 15-60% for non-residential and residential, respectively.

Emissions reduction equivalent of taking 118K cars off the road in Monterrey alone (~7%).



Annual Energy Consumption
Warm Humid (Villahermosa)
Warm Subhumind (Merida)
Dry (Monterrey)
Very Dry (Hermosillo)
Temperate Humid (Tulancingo)
Temperate Subhumid (a) (Guadalajara)
Temperate Subhumid (b) (Mex. City)
600
500
400
300
200
100
0
Cooling Energy (kWh)
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
Reflectance

Residential Energy Savings



Shown: Case A, which includes no insulation

Table 6.1.4.3. Payback period of the investment from increasing the roof reflectance from 0.3 to 0.6, 0.7 and 0.8 in non-residential buildings.

Reflectance	Investment payback /bimonthly	Investment payback /annual	Total savings (MX) Life time 5 years
Mérida (Warm sub-humid)			
0.6	2	0.3	$48,559.75
0.7	6	1.0	$49,672.22
0.8	9	1.5	$46,372.43
Monterrey (Dry)			
0.6	3	0.5	$23,39.75
0.7	10	1.7	$20,472.22
0.8	14	2.3	$23,252.43
Hermosillo (Very dry)			
0.6	3	0.5	$24,319.75
0.7	10	1.7	$22,632.22
0.8	13	2.2	$27,252.43
Mexico City (Temperate sub-humid)			
0.6	4	0.7	$15,599.75
0.7	12	2.0	$15,992.22
0.8	18	3.0	$13,812.43
Tulancingo (Temperate humid)			
0.6	3	0.5	$24,639.75
0.7	10	1.7	$23,352.22
0.8	14	2.3	$23,412.43

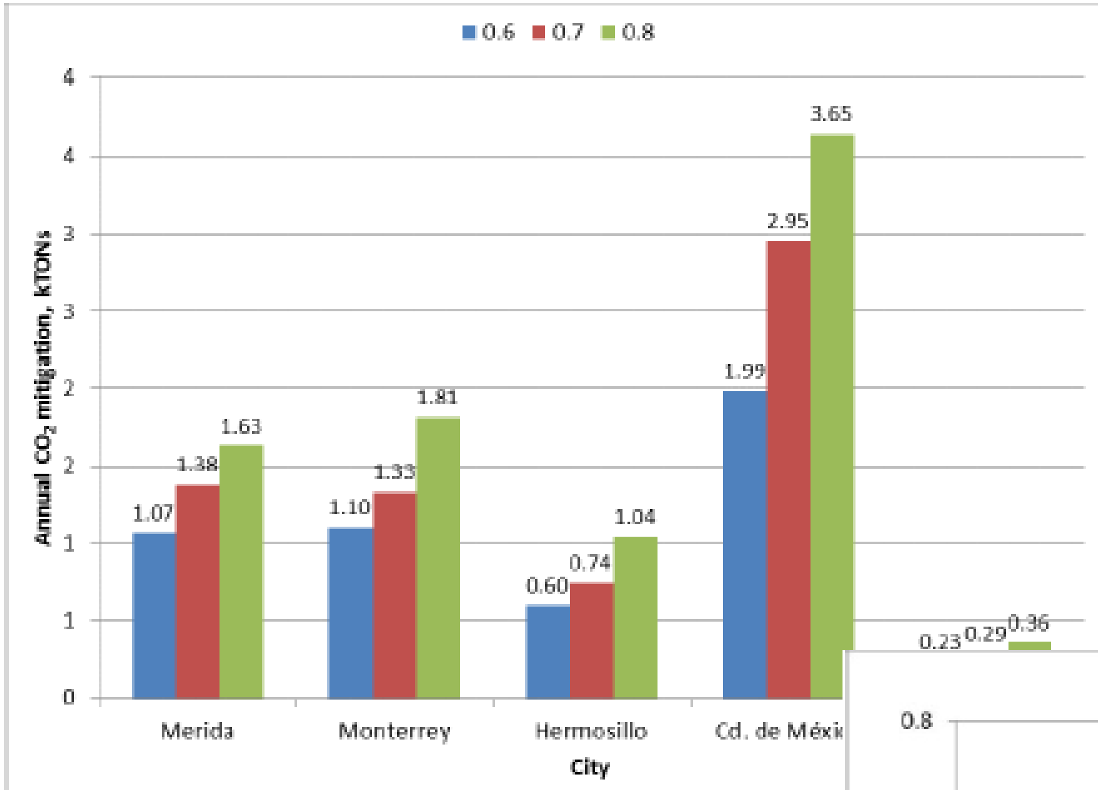
*Investment: R=0.6 ($2,000.25 MX); R=0.7 ($10,087.78 MX); R=0.8 ($18,427.57 MX)

Table 6.2.4.4. . Payback period of the investment from increasing the roof reflectance from 0.3 to 0.6, 0.7 and 0.8 in residential buildings.

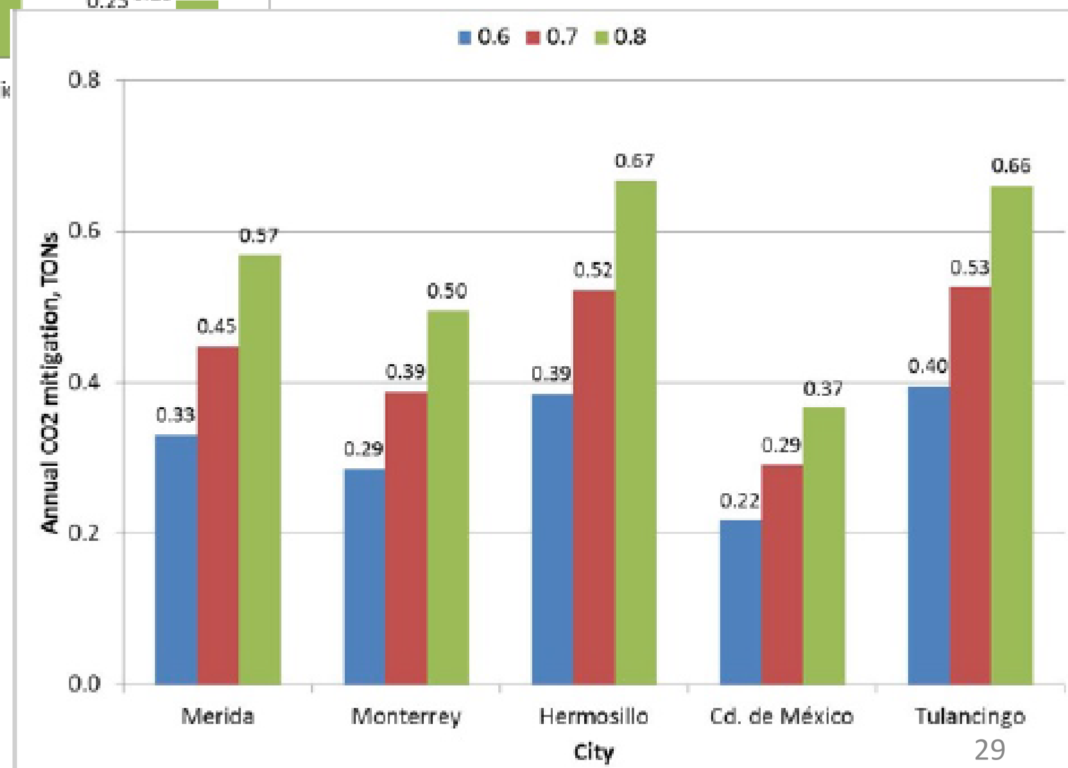
Investment	$2,000.25 (R=0.6)	$10,087.78 (R=0.7)	$18,427.57 (R=0.8)
Reflectance R	Investment payback /bimonthly	Investment payback /annual	Total savings Life time 5 years
	Mérida (Warm sub-humid)		
0.6	2	0.3	$6,383.81
0.7	3	0.5	$7,971.29
0.8	4	0.7	$9,699.02
	Monterrey (Dry)		
0.6	2	0.3	$5,600.4
0.7	4	0.7	$6,801.10
0.8	5	0.8	$8,167.90
	Hermosillo (Very dry)		
0.6	2	0.3	$6,560.81
0.7	3	0.5	$9,445.62
0.8	4	0.7	$13,435.57
	Cd. de México (Temperate sub-humid)		
0.6	2	0.3	$4,080.83
0.7	4	0.7	$4,886.20
0.8	7	1.2	$5,651.08
	Tulancingo (Temperate humid)		
0.6	1	0.2	$7,597.07
0.7	3	0.5	$9,517.22
0.8	4	0.7	$11,471.68

Fewer GHG Emissions

Non-Res, 2.5” insulation, base roof SR = 0.3



Res, 2” insulation (1” in MXC), base roof SR = 0.3



Per building

Voluntary Standard

Drafted by industry groups/companies convened by ANAFAPyT

Defines low sloped "cool roofing" as having an initial SR of 0.84, initialTE of 0.80, and an initial SRI of 105 (in line with Title 24 and CalGreen). Steep slope cool roofing has an initial SRI of 43.

Dirt pick up testing (delta whiteness index <20%) instead of field aging

Requires a minimum product warranty of 5 years.

Establishes a testing procedure based largely on the CRRC-1 Standard

The standard will start a public comment period this summer.

Getting Involved

- Commenting on voluntary standard – ensuring CRRC-1 best practices are incorporated

- Participating in GSEP meetings

- Participating in ANAFAPyT working group meetings

Contact me and I will connect you accordingly.
kurt@globalcoolcities.org

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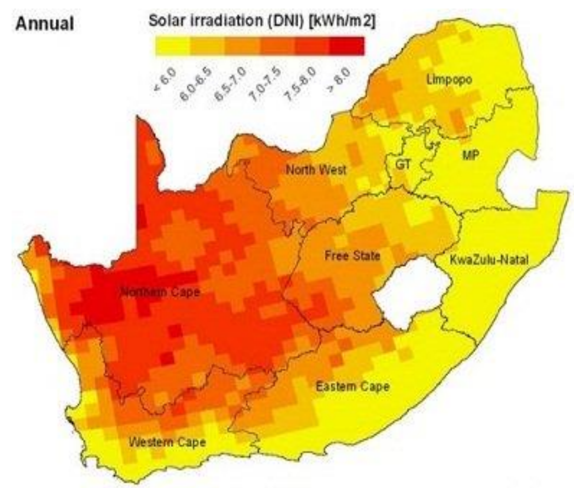
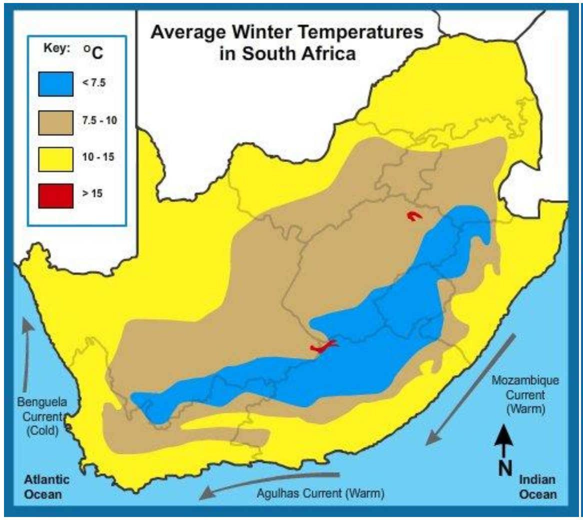
Global Cool Roofs: South Africa

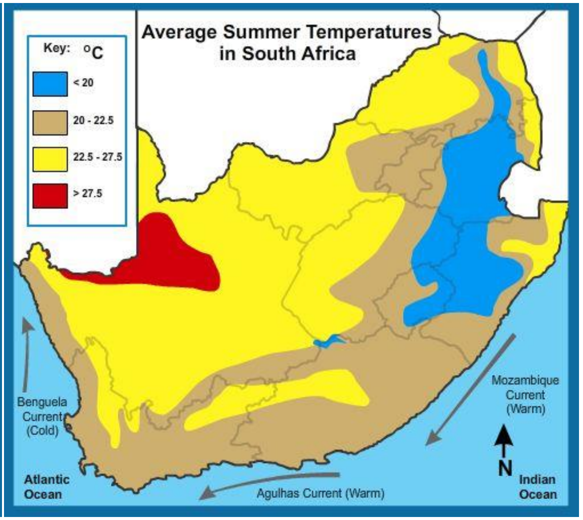
Joined the GSEP Cool Roofs and Pavements Working Group in January 2013.

Adopted an Action Plan similar to Mexico's, focusing on testing infrastructure, forming a local working group, impact study, and demonstrations on low-income dwellings.



DOE EERE project to grow market for U.S. products features cool surfaces.





SACSA – A New Cool Surfaces Organization

Co-founded by AAAMSA, a large organization representing a wide set of building trades and SANEDI.

Membership organization that will host a cool roof testing facility. Current plan is to adopt the CRRC-1 standard and modify as needed.

SACSA

South African Cool Surfaces Association

Global Cool Cities Alliance

Promoting U.S. Cool Roofing Materials in South Africa

2 year DOE EERE initiative, led by GCCA

Partnered with LBNL, NFRC, University of South Florida, WinBuild, SANEDI (SA Govt), AAAMSA (SA Industry), and PEER Africa (Flagship affordable community developer)

Demonstrate technologies, training services, and advises team on South Africa market and policy.

Getting Involved

- Demonstrating products
- Growing market share and finding local partners
- Participating in GSEP meetings
- Joining SACSA

Contact me and I will connect you accordingly.
kurt@globalcoolcities.org

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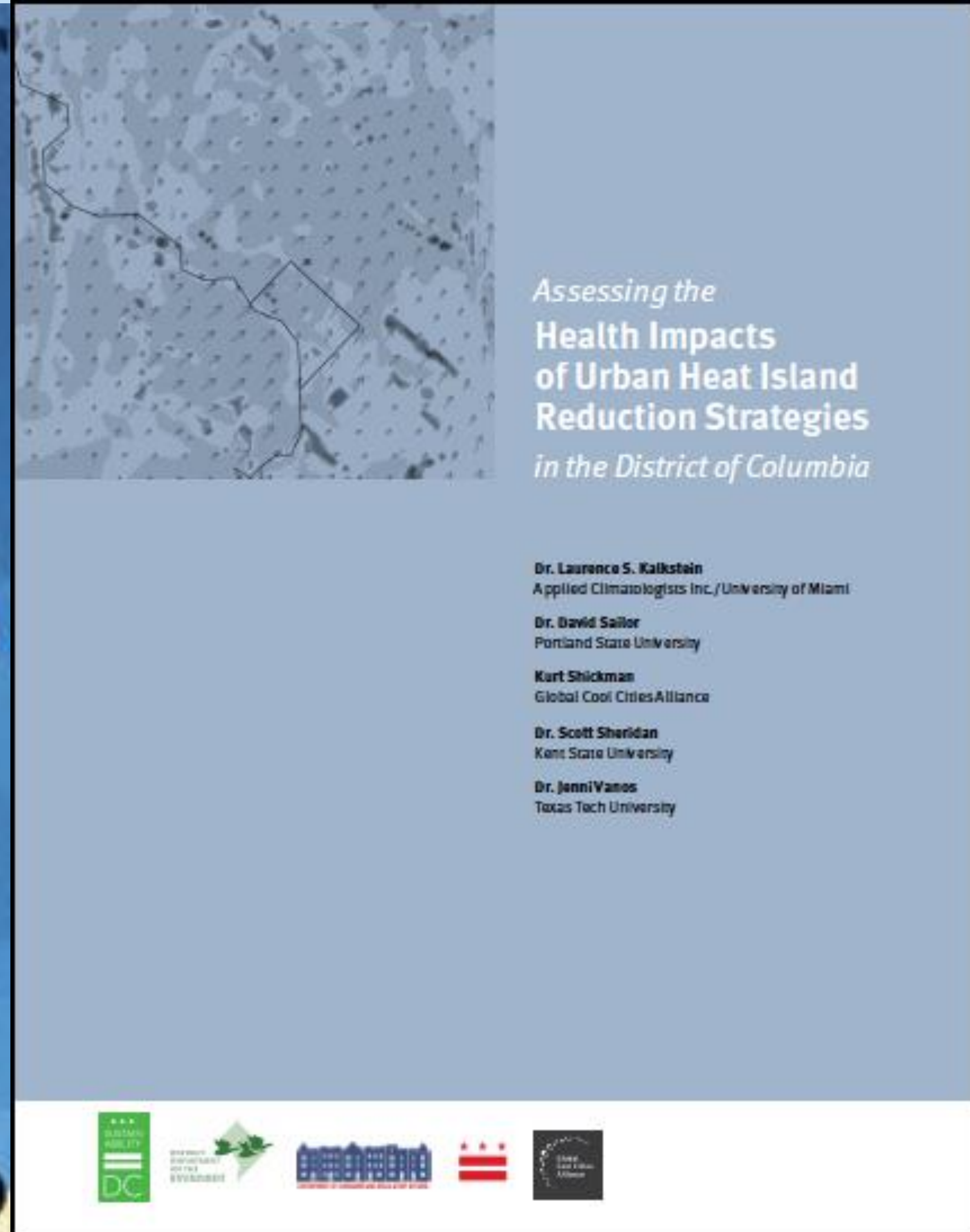
MONTY PYTHON'S
AND NOW FOR SOMETHING COMPLETELY DIFFERENT
THE BEST OF MONTY PYTHON'S FLYING CIRCUS
DVD
12



Assessing the
Health Impacts of Urban Heat Island Reduction Strategies
in the District of Columbia
Dr. Laurence S. Kalkstein
Applied Climatologists Inc./University of Miami
Dr. David Sailor
Portland State University
Kurt Shickman
Global Cool Cities Alliance
Dr. Scott Sheridan
Kent State University
Dr. Jenni Vanos
Texas Tech University

Can Cool Roofs and Vegetation Save Lives During Heat Waves?

1. Do UHI strategies cool cities during extreme heat events?

2. Are those changes apparent to urban populations (i.e., what is the impact of UHI when changes in humidity are considered)?

3. Are those changes in temperature meaningful enough to reduce deaths during heat waves?

Primary Authors

Dr. Larry Kalkstein of the Miller School of Medicine at the University of Miami and President of Applied Climatologists Inc. (ACI). ACI pioneered the use of air mass characteristics to predict expected mortality and has implemented heat advisory systems in 35 cities around the world, including the District.

Dr. David Sailor ran the climate models used in this study. He is the founding director of the Green Building Research Lab at Portland State University. His research ranges from energy analysis of individual buildings to measurements and modeling of the urban climate system.

Cities in the Study

- Studied 4 cities: Baltimore, Los Angeles, New York City, and Washington DC

- These cities represent a variety of densities, existing vegetated cover, and building types

- Some similarities:
    - Climates in Baltimore, DC, and NYC are comparable.
    - Weather in Baltimore, NYC, and LA are impacted by nearby bodies of water.

Methodology Overview

ID Heat Waves	Validate and Model Scenarios	Determine Mortality Impact	Map Results
Identify multi-day heat waves (4 per city)	Downscale WRF climate model	Identify anomalous actual morality for base case	Map findings to identify where cooling is greatest.
Gather weather data at 4 points each day	Validate against actual results	Use city-specific heat mortality algorithms for scenarios	Overlay with existing vulnerability analyses (if any)
Characterize the air masses	Run UHI scenarios		

What is an Air Mass?

Air mass is determined for each day based on 24 distinct variables (6 variables 4 times per day) – Temperature, dew point, wind, cloud cover, air pressure, diurnal range

The air masses are spatially cohesive.

They lend themselves well to health-based applied studies since "offensive" air masses are statistically linked to negative health outcomes.

They are the primary input for National Weather Service heat-health warning systems in 35 cities around the world.

Offensive Air Masses Result in Higher Mortality

City (% frequency JJA)	DT Mortality (% Inc)	MT+ Mortality (% Inc)
Baltimore (11%)	**+0.9 (4%)**	**+1.7 (7%)**
Los Angeles	**+8.4 (5%)**	**+8.4 (5%)**
New Orleans (2%)	None	+3.7% (9%)
New York (11%)	**+16.6 (7%)**	**+16.9% (7%)**
Phoenix (1%)	+2.7[b] (7%)	None
Rome (11%)	+6.2 (14%)	+5.0 (12%)
Seattle (6%)	+3.7 (8%)	+4.7[a] (10%)
Shanghai (11%)	None	+42.4 (10%)
Toronto (7%)	+4.2 (11%)	+4.0 (10%)

Offensive Days on the Rise

	Baltimore		Los Angeles		New York		Washington	
	Average Summer Days	Percent	Average Fall Days	Percent	Average Summer Days	Percent	Average Summer Days	Percent
1950-1959	11.2	12.2	7.6	8.4	10.9	11.8	9.7	10.5
1960-1969	7.1	7.7	7.9	8.7	8.4	9.1	7.4	8.0
1970-1979	6.5	7.1	7.6	8.4	5.2	5.7	13.9	15.1
1980-1989	12.5	13.6	7.7	8.5	10.5	11.4	14.4	15.7
1990-1999	14.2	15.4	5.9	6.5	14.1	15.3	15.6	17.0
2000-2009	9.3	10.1	6.8	7.5	16.0	17.4	16.2	17.6
2010-2012	18.0	19.6	7.3	8.0	22.8	24.7	29.3	31.9

Derived from The Spatial Synoptic Classification.
http://sheridan.geog.kent.edu/ssc.html

The Scenarios are Achievable in Real Life

- Urban heat island mitigation included reflective roofs, vegetated roofs, increased vegetated cover/shade trees, lighter-colored pavements, and permeable/pervious pavement.
- A 0.1 increase in urban surface reflectivity is achieved by raising the reflectivity from 0.15 to 0.55 on 25% of roofs. Conservative – 0.55 is at or below aged reflectivity requirements in many codes.
- DC - A 10% increase in vegetation would add 2.5 square miles of greenery to the city's current total of 25 square miles.

General Findings

- Increasing reflectivity results in modest reductions in temperature during heat waves.
- Increasing vegetation occasionally increased the dew point temperature (humidity).
- All reductions in temperature led to a drop in mortality, most significantly when the day dropped out of an “oppressive” air mass.
- Except for Baltimore, about 50% of heat waves had changes in air mass and significant reductions in mortality. The other 50% saw minor changes in mortality.

Estimated Mortality Reductions

Scenario	Washington	Baltimore	Los Angeles	New York City
A 10-percentage point increase in urban surface reflectivity	6%	1%	1%	9%
A 10-percentage point increase in urban surface reflectivity and a 10 percent increase in vegetative cover	7%	2%	1%	9%
A 20 percentage point increase in urban surface reflectivity	4%	5%	21%	10%

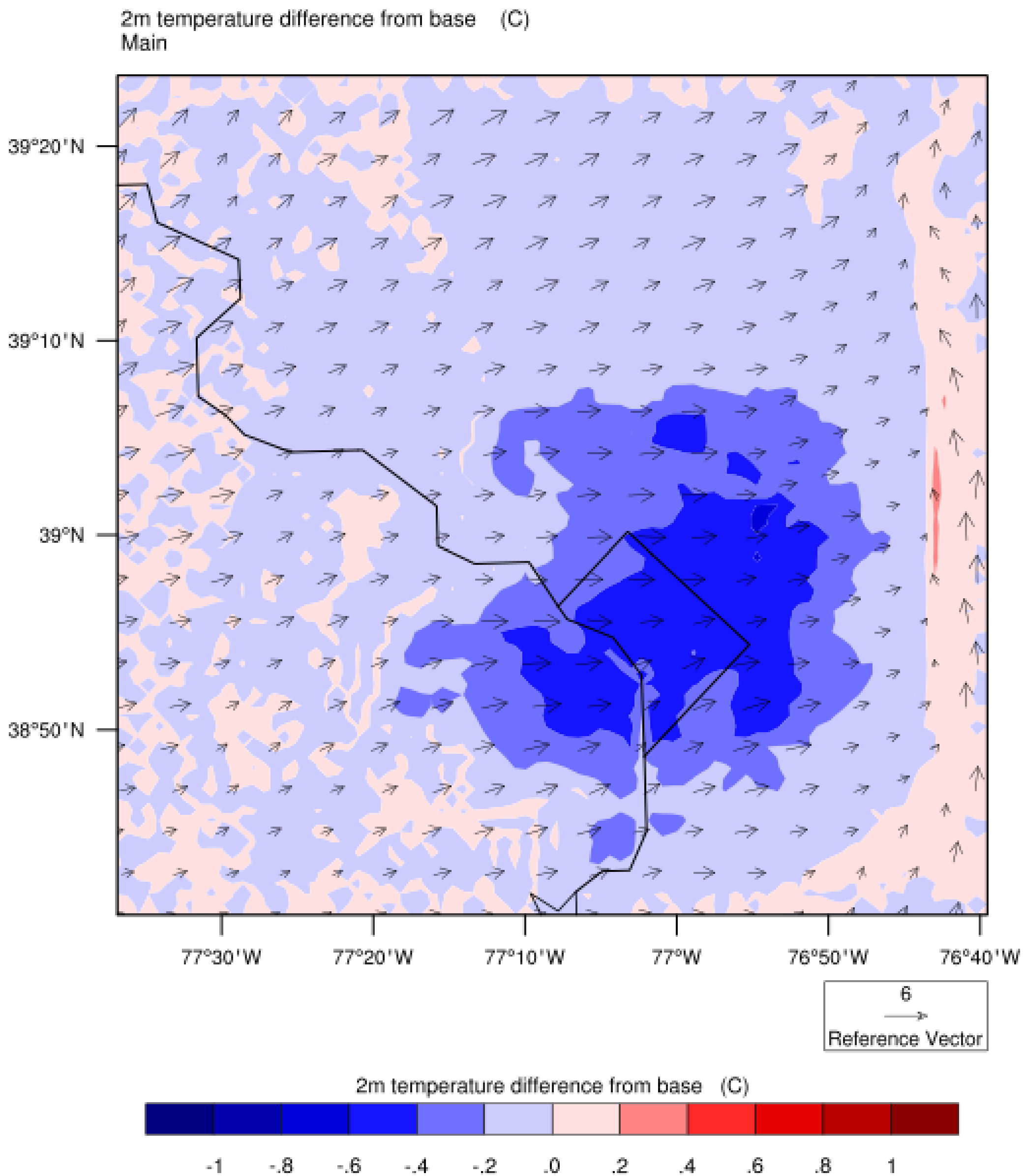
Mapping the Changes in Each Heat Wave

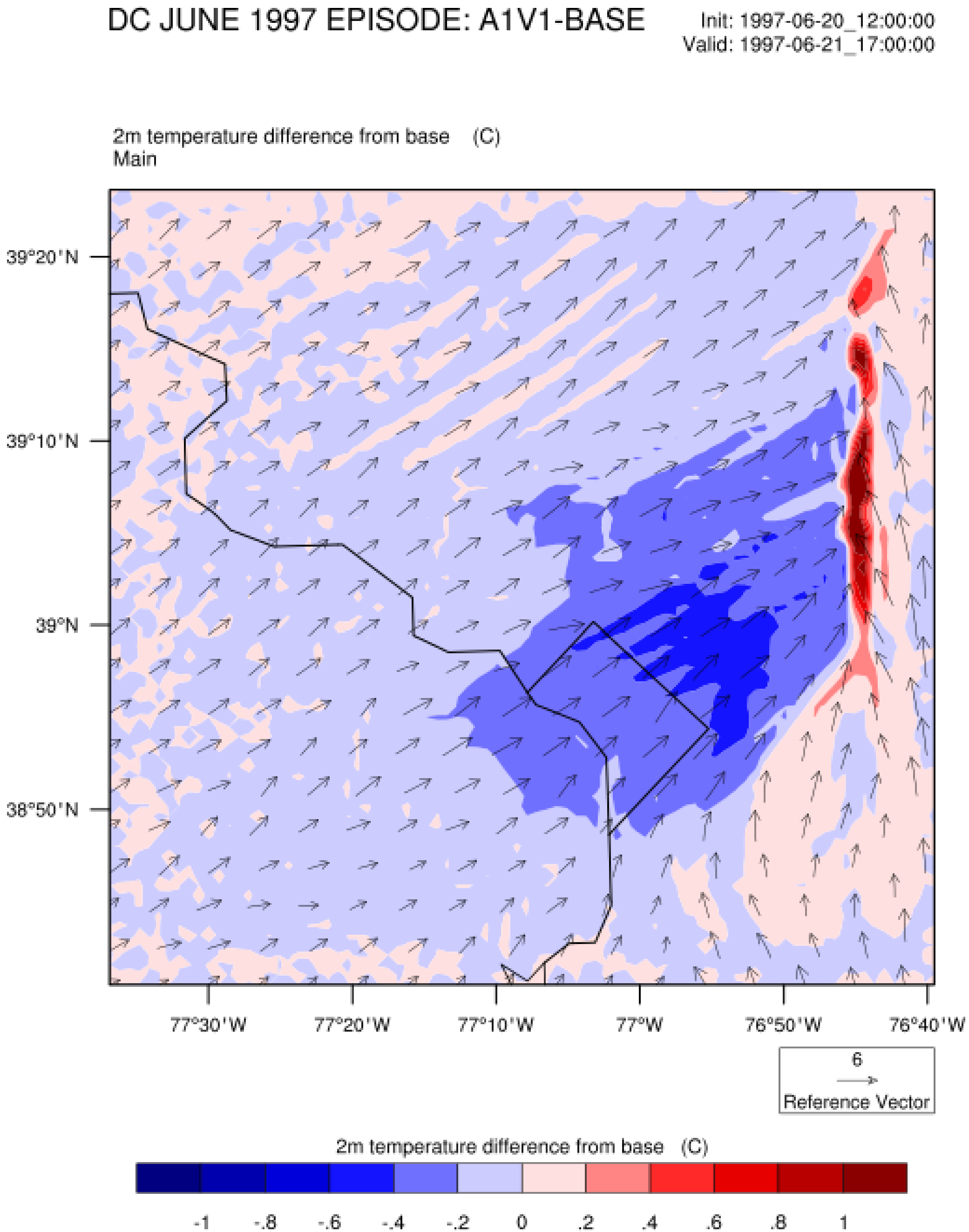
- June 21st, 1997 (first day of the heat wave)
- Maps plot temperature difference between actual conditions and conditions assuming DC was 0.1 more reflective and 10% more vegetated
- Wind speed and direction indicated by arrows

DC JUNE 1997 EPISODE: A1V1-BASE

Init: 1997-06-20_12:00:00
Valid: 1997-06-21_13:00:00

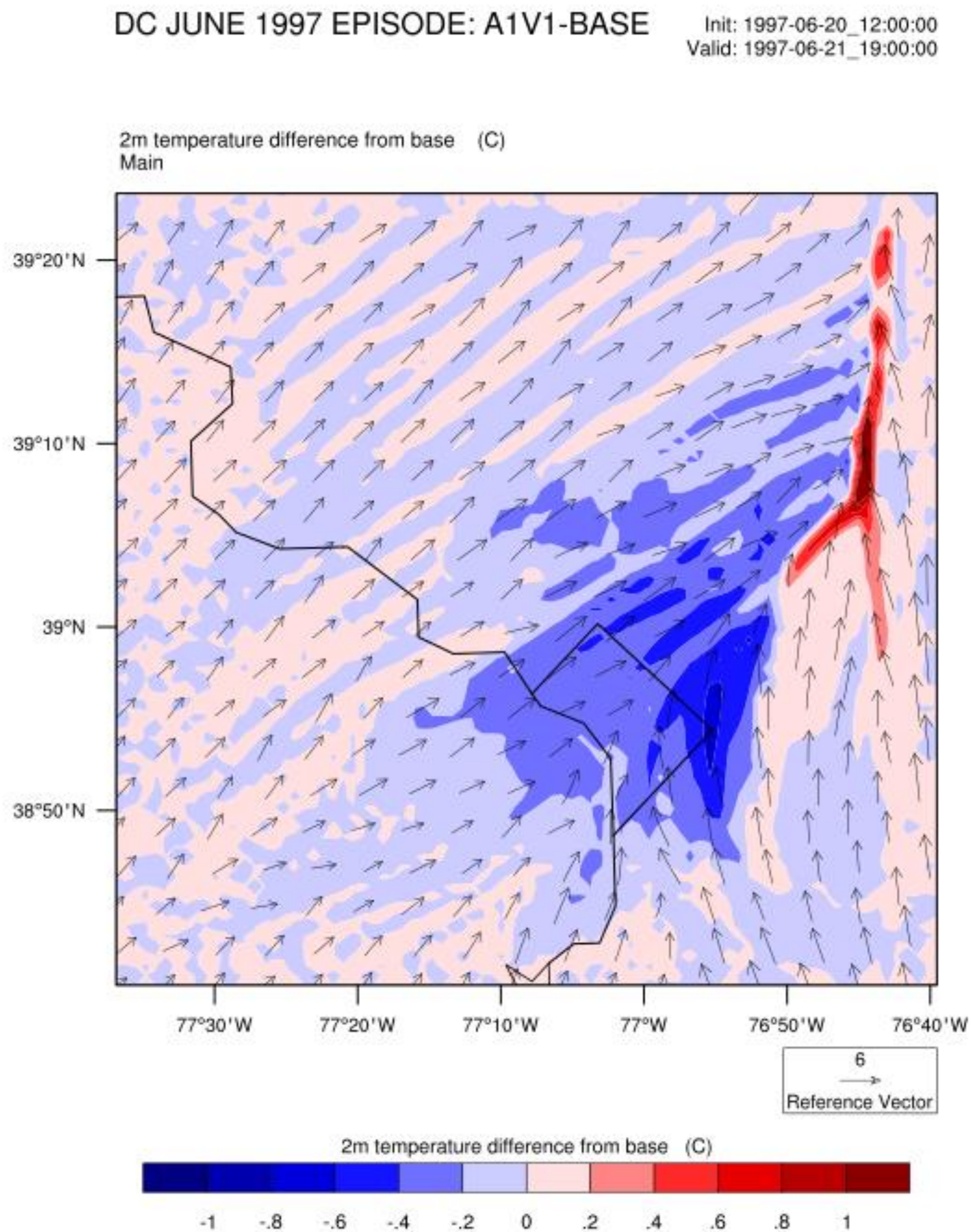
9am

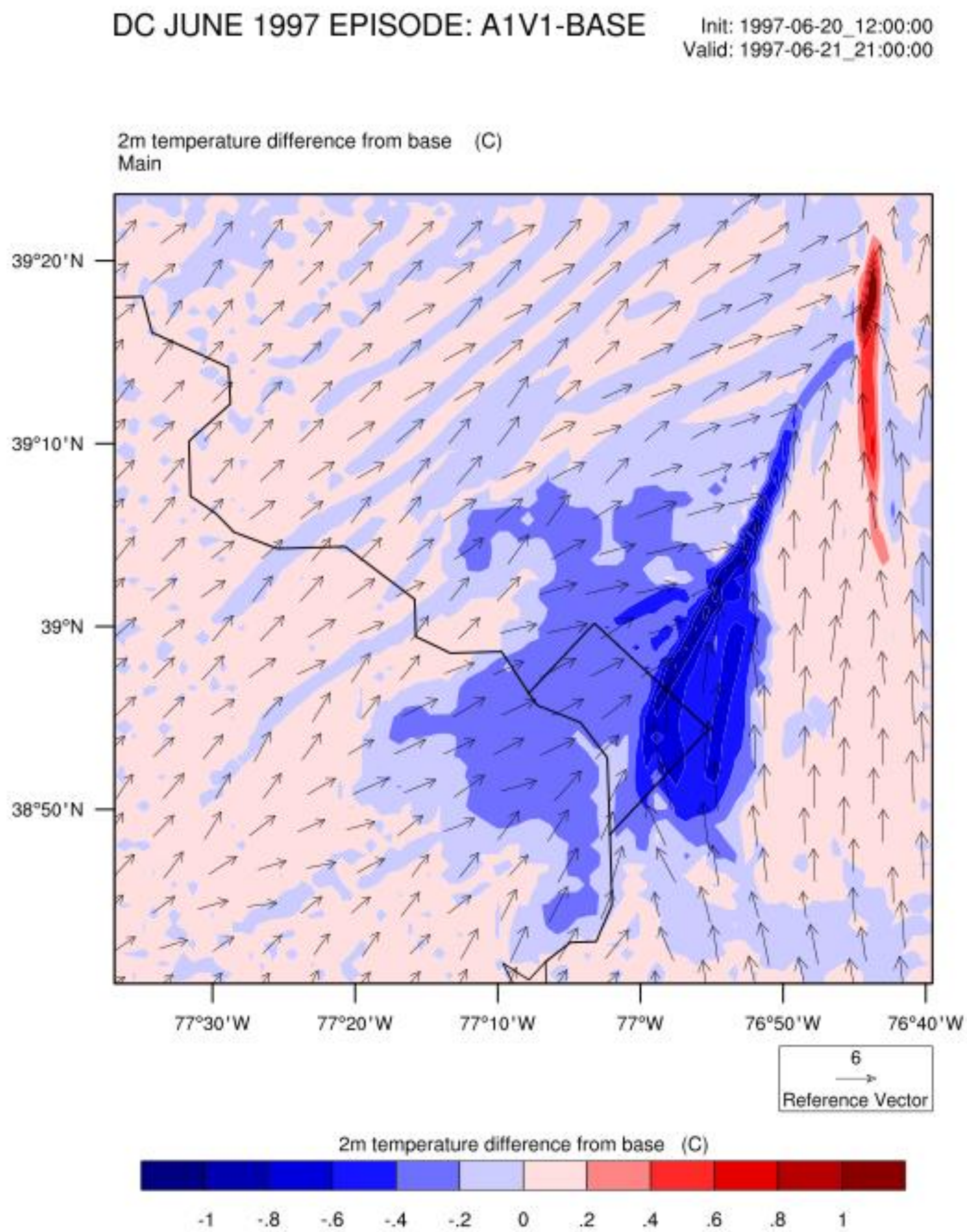



DC JUNE 1997 EPISODE: A1V1-BASE
Init: 1997-06-20_12:00:00
Valid: 1997-06-21_17:00:00
2m temperature difference from base (C)
Main
39°20'N
39°10'N
39°N
38°50'N
77°30'W
77°20'W
77°10'W
77°W
76°50'W
76°40'W
6
Reference Vector
2m temperature difference from base (C)
-1
-.8
-.6
-.4
-.2
0
.2
.4
.6
.8
1

1pm

3pm


DC JUNE 1997 EPISODE: A1V1-BASE
Init: 1997-06-20_12:00:00
Valid: 1997-06-21_19:00:00
2m temperature difference from base (C)
Main
39°20'N
39°10'N
39°N
38°50'N
77°30'W
77°20'W
77°10'W
77°W
76°50'W
76°40'W
6
Reference Vector
2m temperature difference from base (C)
-1
-.8
-.6
-.4
-.2
0
.2
.4
.6
.8
1


DC JUNE 1997 EPISODE: A1V1-BASE
Init: 1997-06-20_12:00:00
Valid: 1997-06-21_21:00:00
2m temperature difference from base (C)
Main
39°20'N
39°10'N
39°N
38°50'N
77°30'W
77°20'W
77°10'W
77°W
76°50'W
76°40'W
6
Reference Vector
2m temperature difference from base (C)
-1
-.8
-.6
-.4
-.2
0
.2
.4
.6
.8
1

5pm

Thanks for your time!

Questions?

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