Building MEPDG Climate Files

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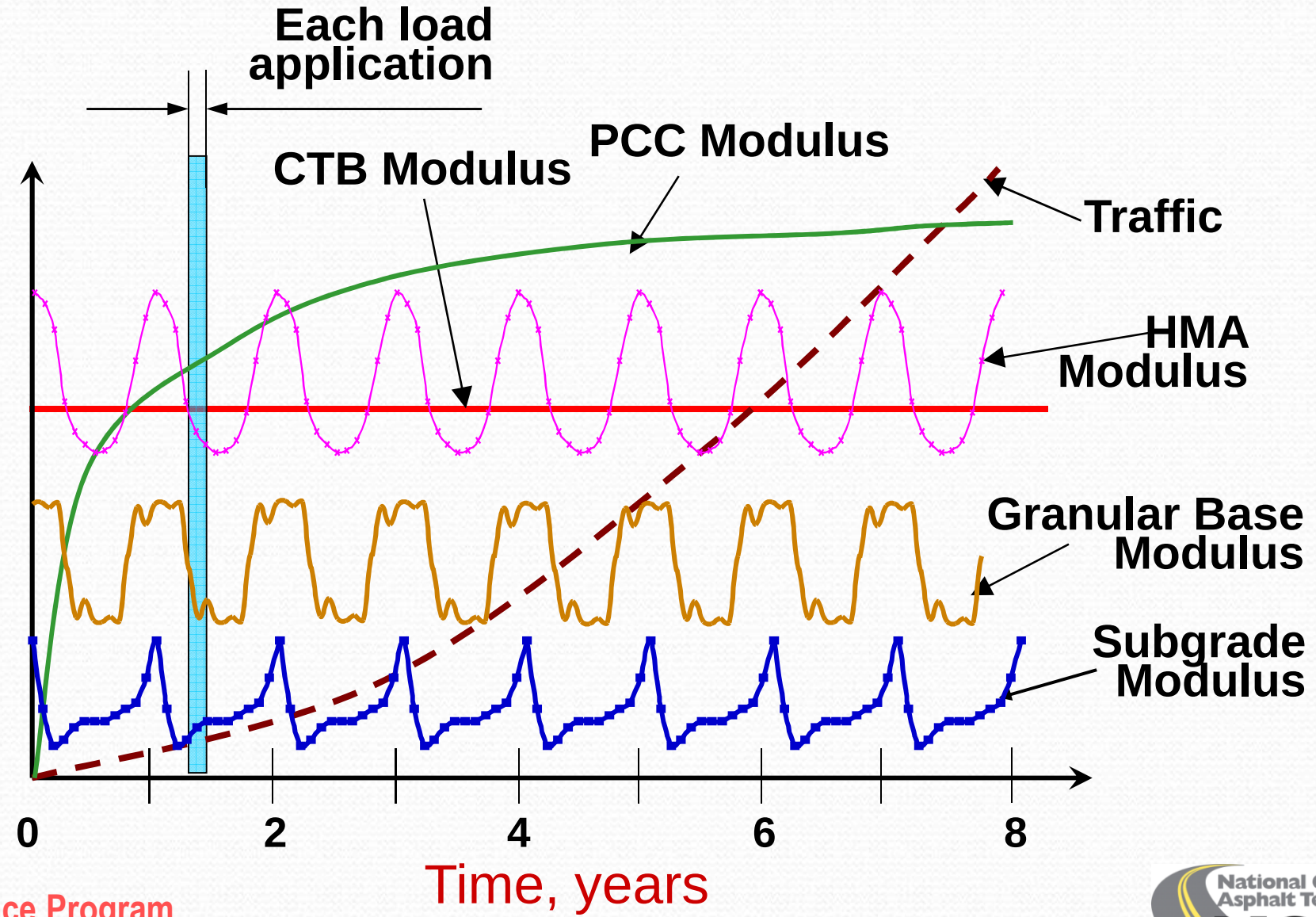
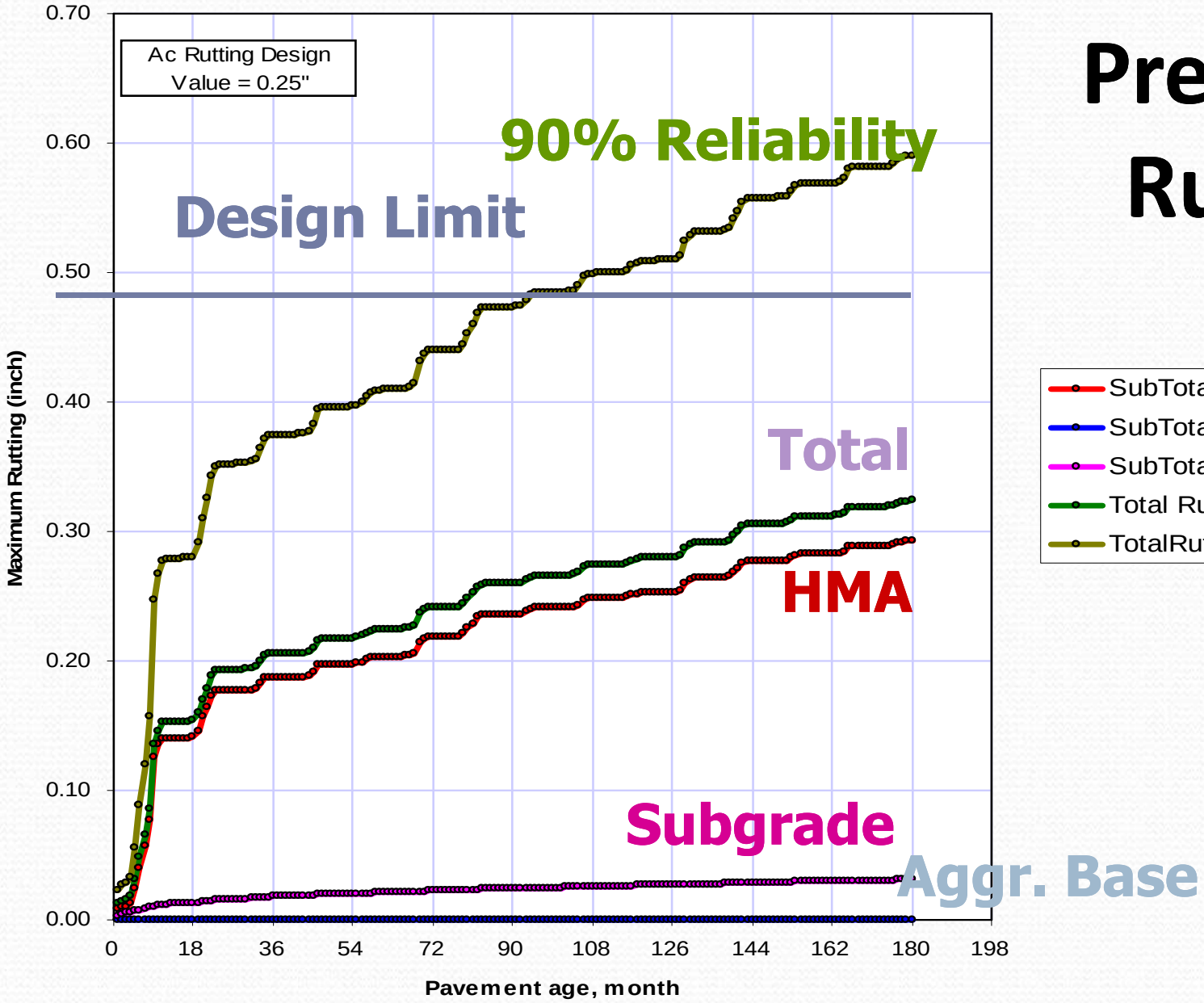
In this presentation….

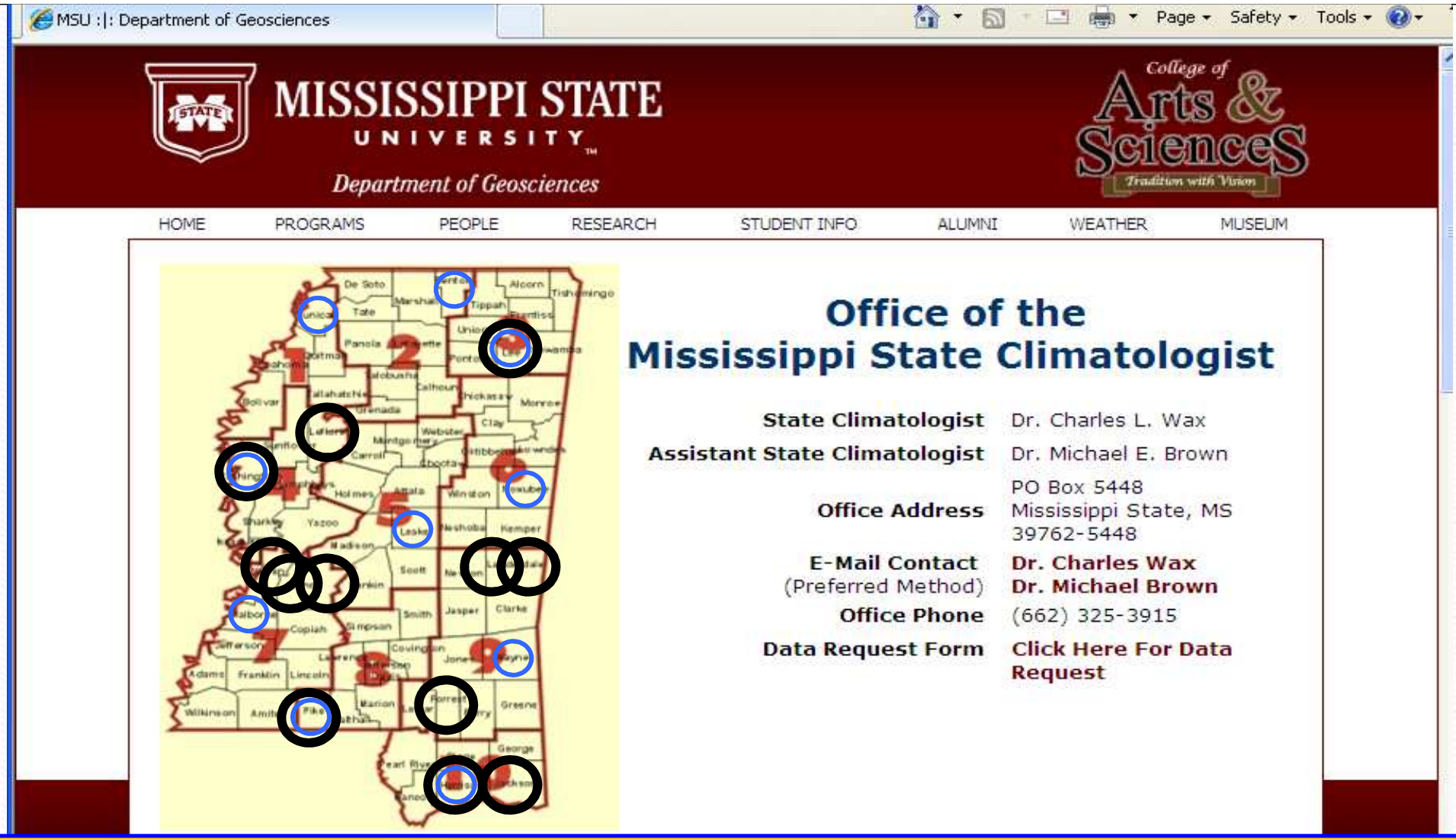
- Why is climate input important
- Building historic climate files
- Building future climate files
- Impact on predicted pavement performance

Pavement Design Variables



Predicted Rutting

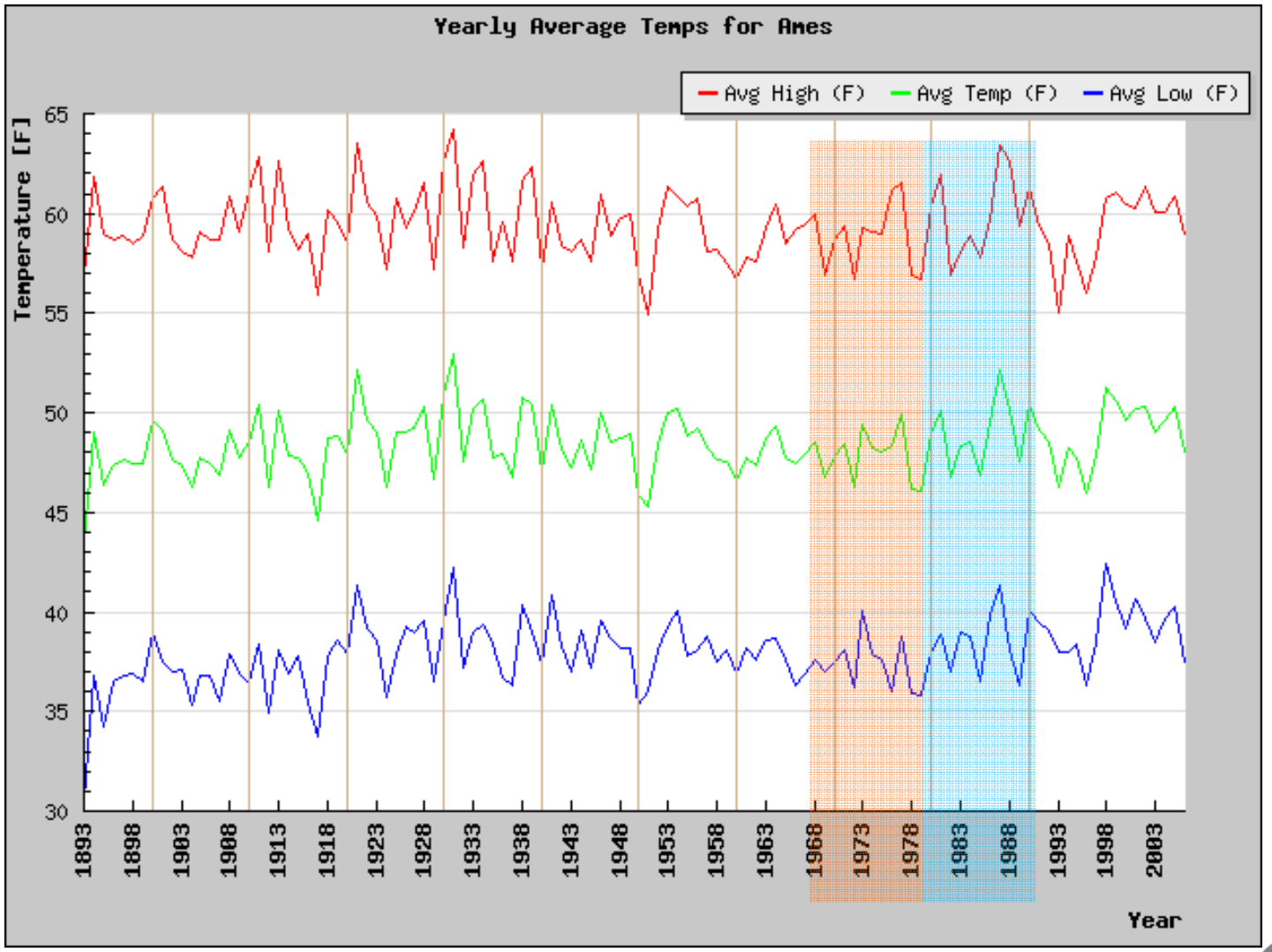




Only 12 MEPDG climate files in Mississippi

- 4 sites with 5-6 years of climate data (very limited)
- 8 with 8-10 years of climate data (limited)
- Starting with mid 1990s

Ames Temperature Trends



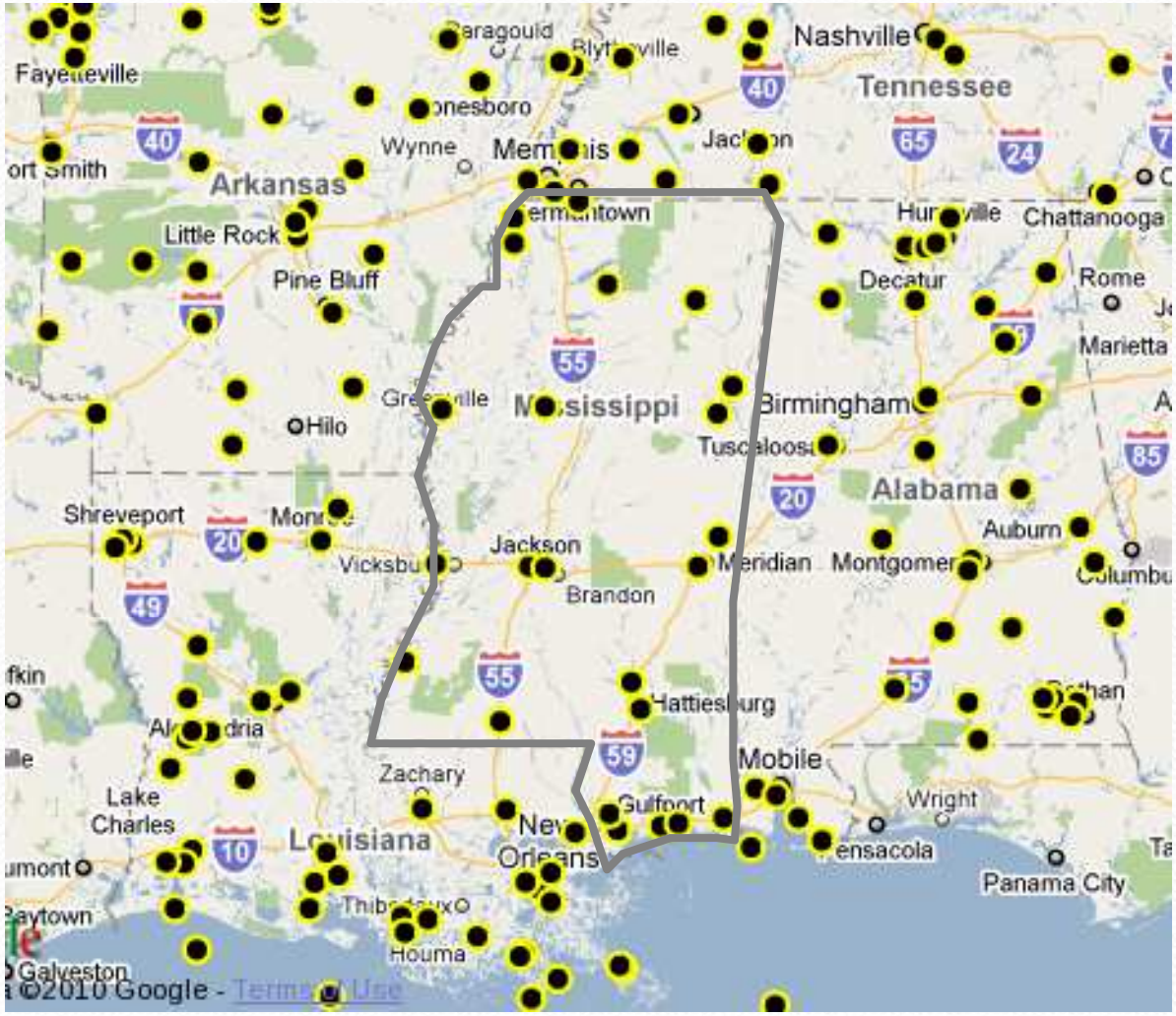
Iowa Averages and Extremes

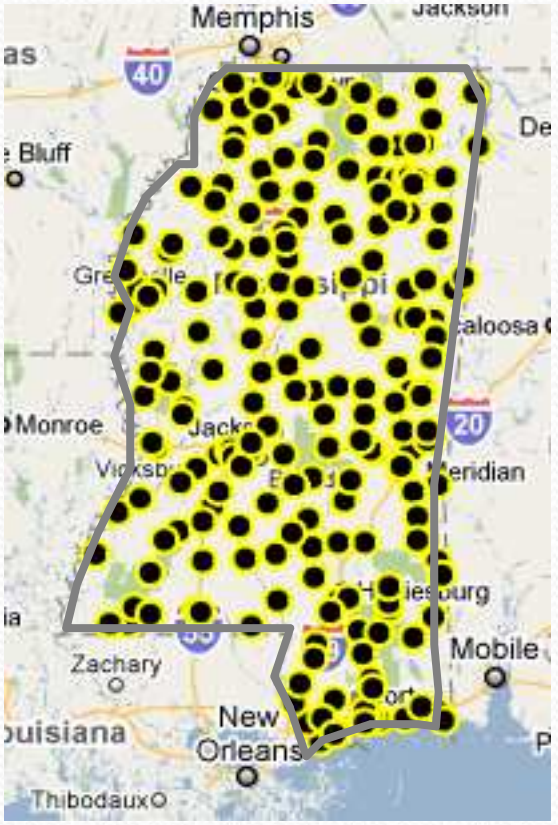
Decade	Avg High	Avg Low	100°+ events (days / weather station)
1970s	58.9	37.4	6
1980s	59.6	38.1	21
1990s	58.4	38.3	2

What 10-year period do you want to use for pavement performance prediction?

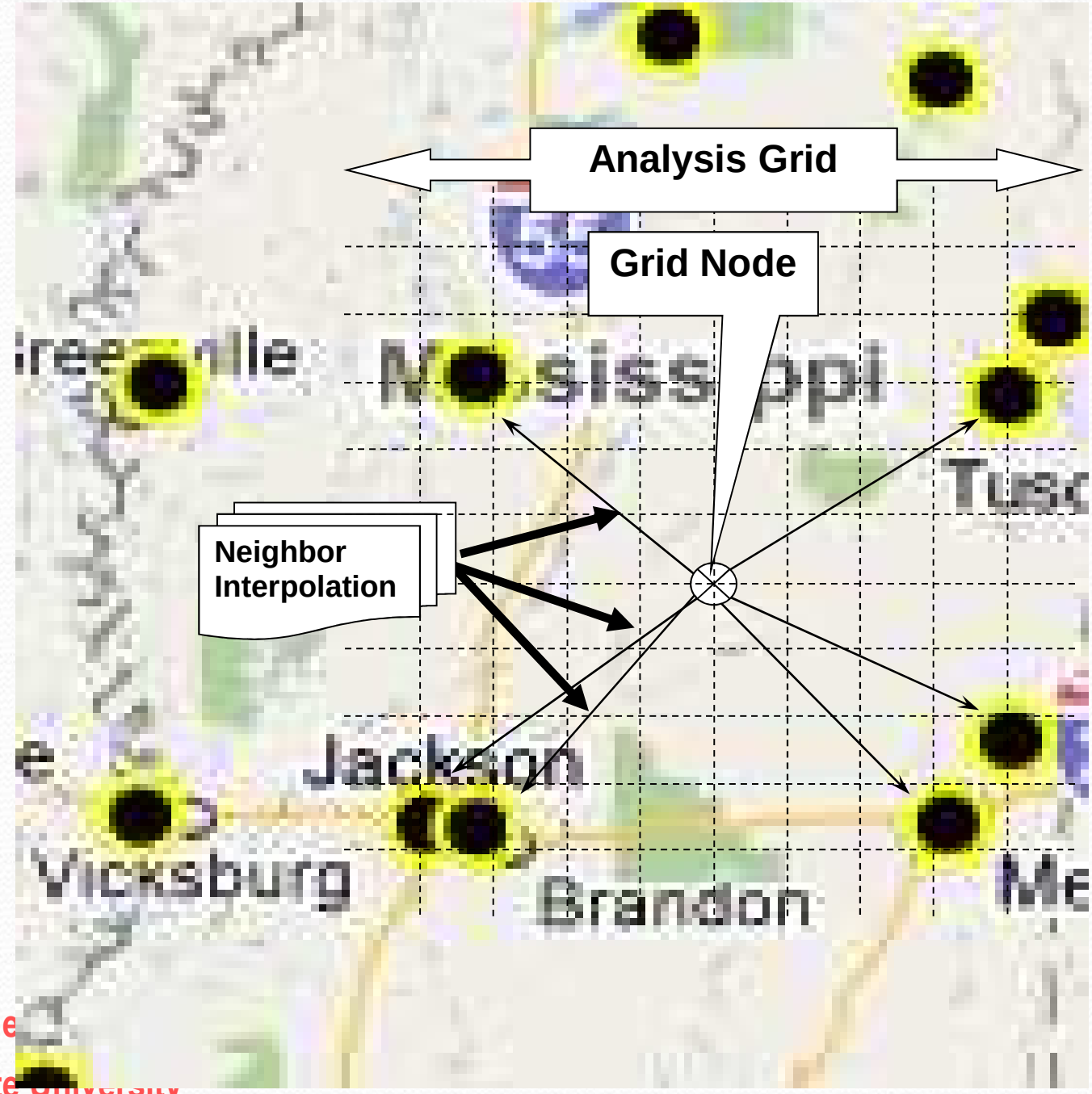
Development of Climate Data Input Files for the MEPDG

- Build complete 40-year historic climate files from county measurements
- Build 40-year future climate files from global and regional models





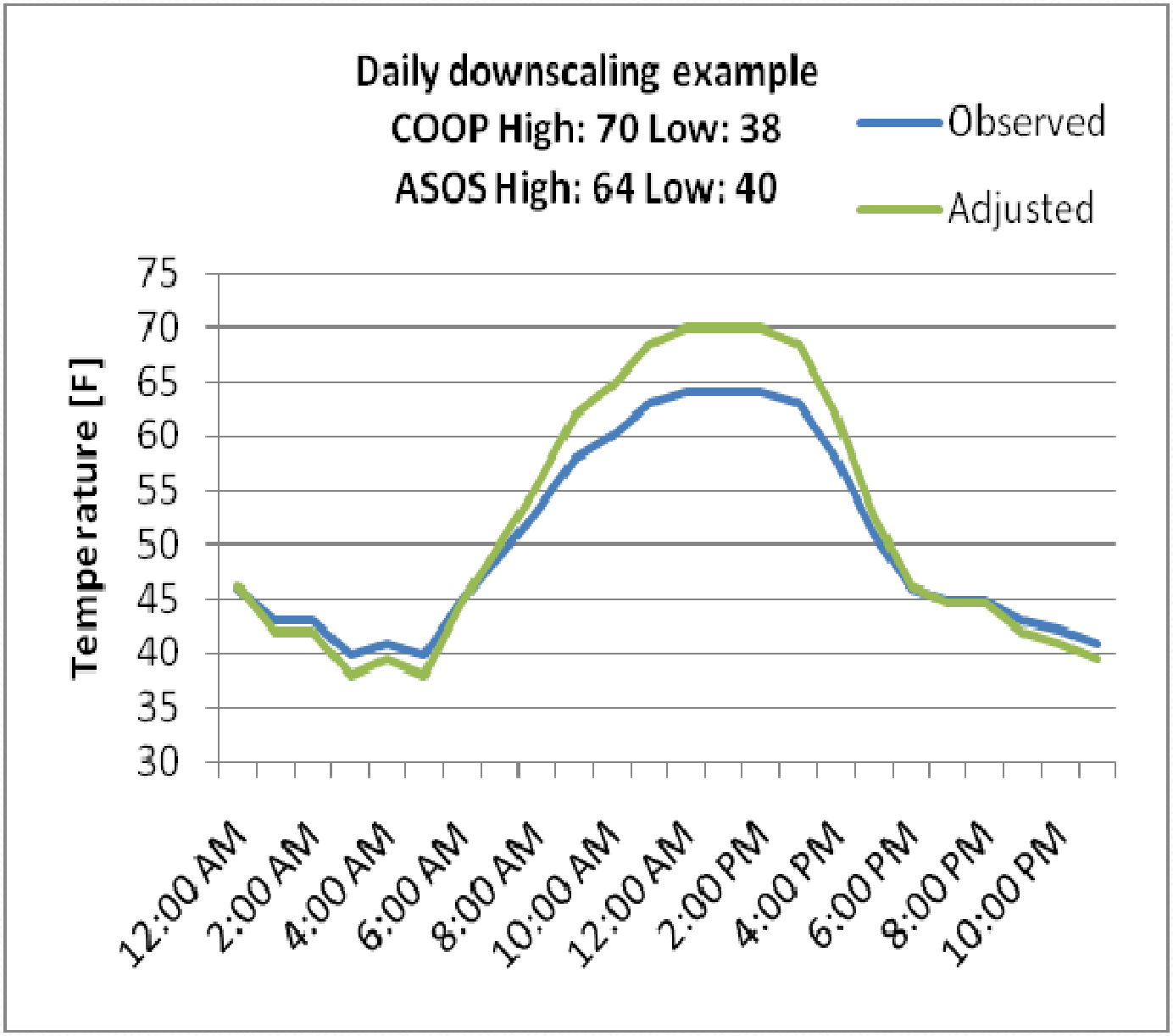
ASOS/AWOS **COOP**



Climate Scie

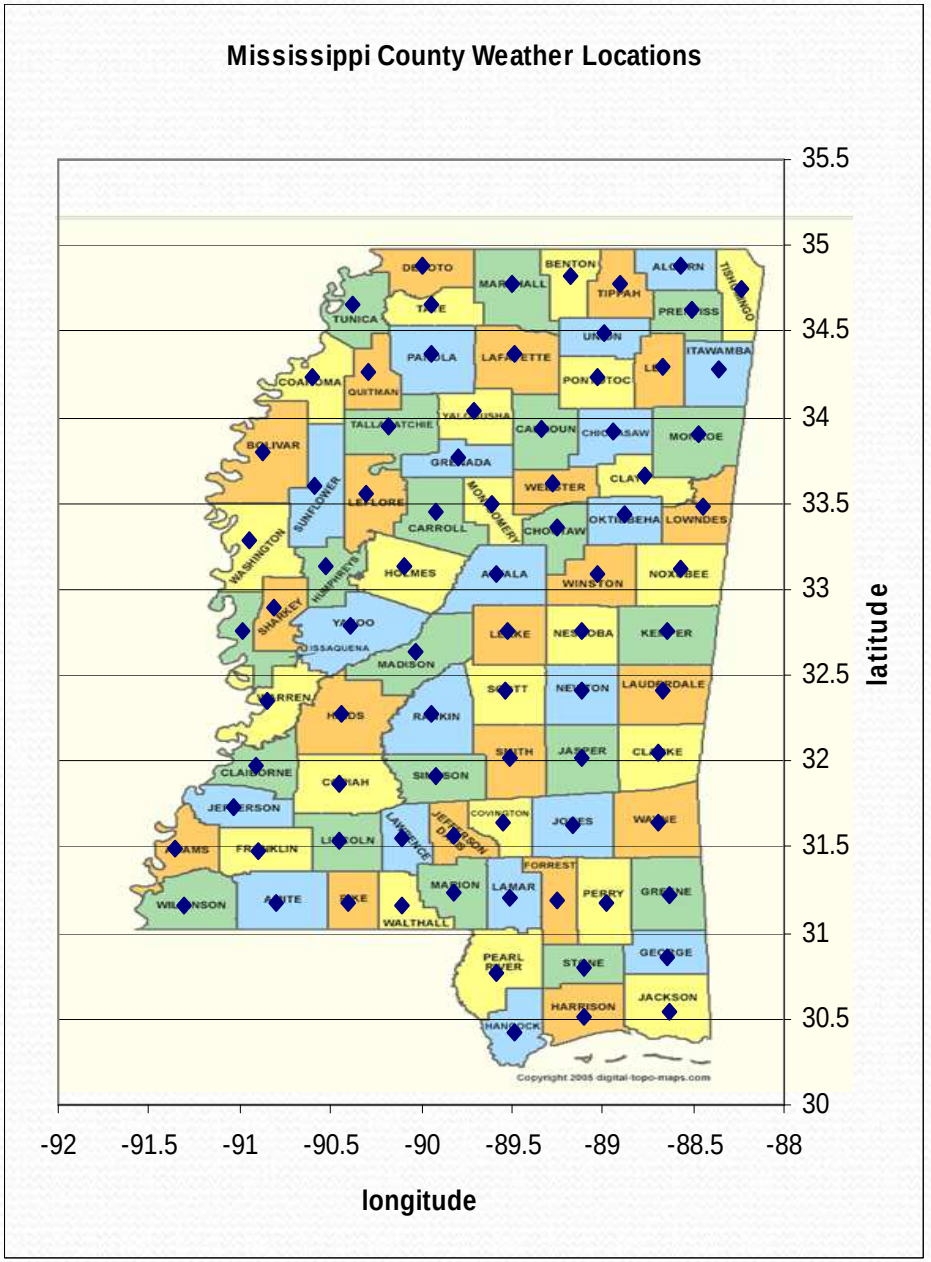
Iowa State University

National Center for Asphalt Technology
NCAT
at AUBURN UNIVERSITY

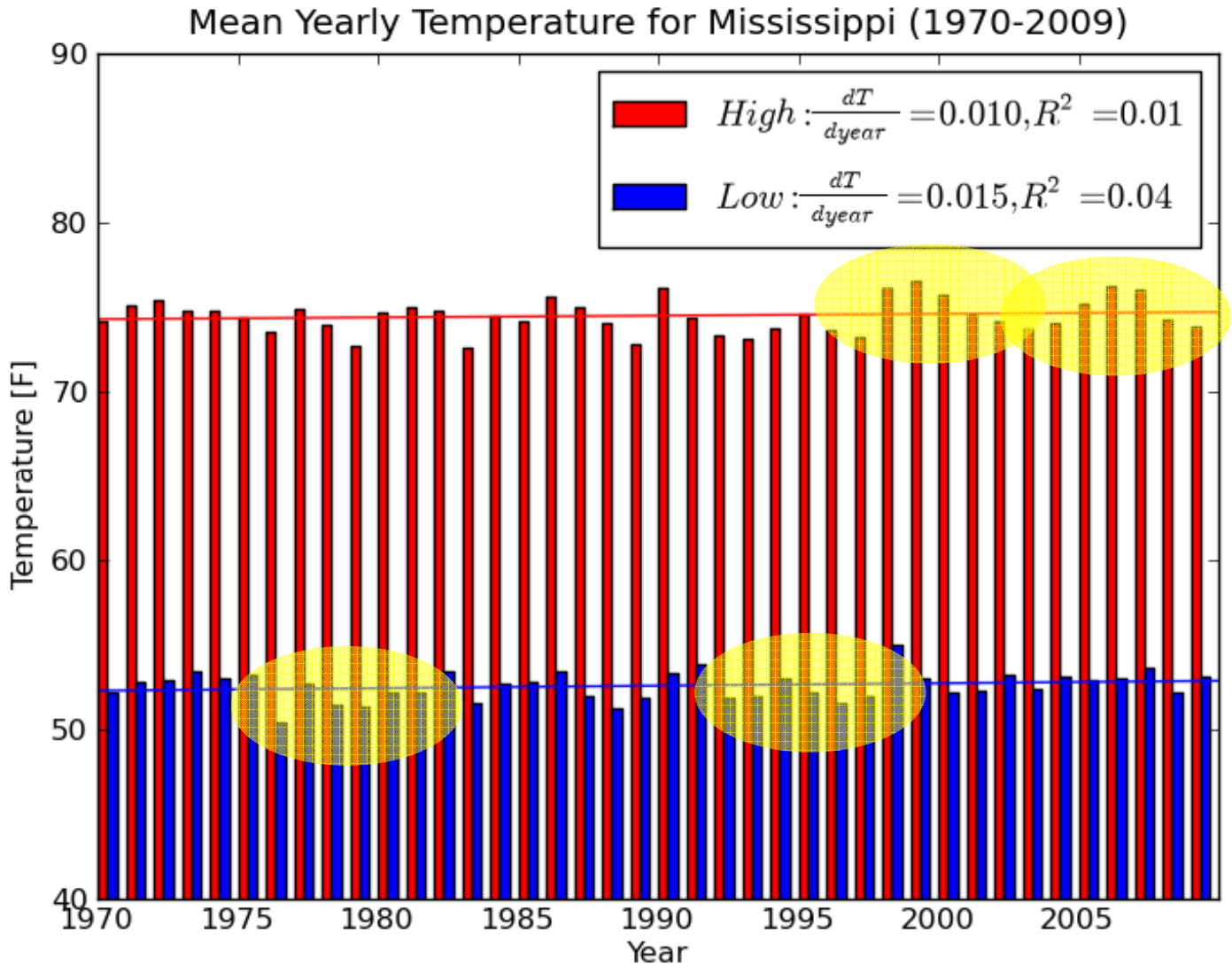

Daily downscaling example
COOP High: 70 Low: 38
ASOS High: 64 Low: 40
Observed
Adjusted
Temperature [F]
75
70
65
60
55
50
45
40
35
30
12:00 AM
2:00 AM
4:00 AM
6:00 AM
8:00 AM
10:00 AM
12:00 AM
2:00 PM
4:00 PM
6:00 PM
8:00 PM
10:00 PM

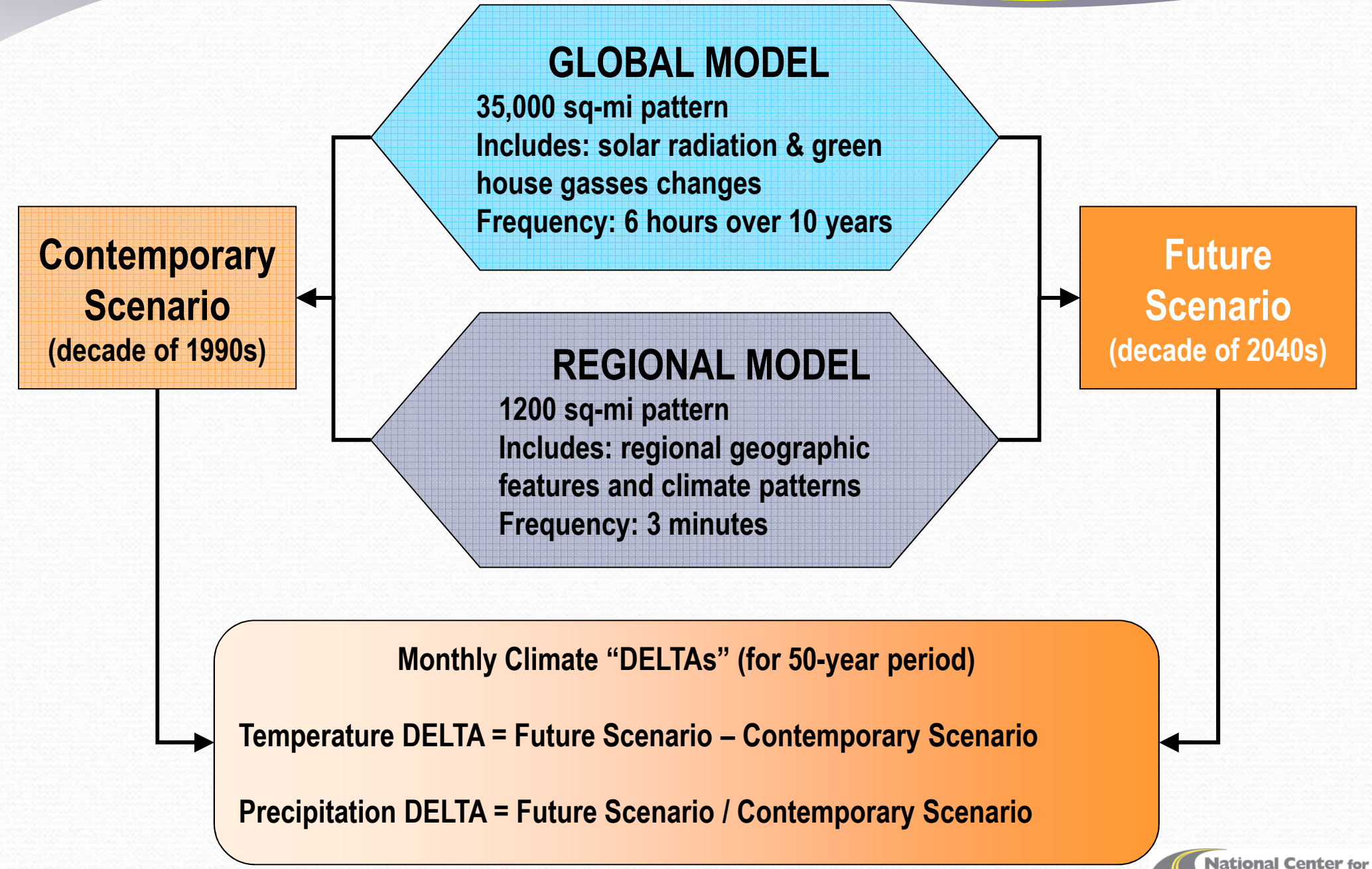
Complete Historic Files

- 40-year files (1970-2010)
- Each county in the State (82)

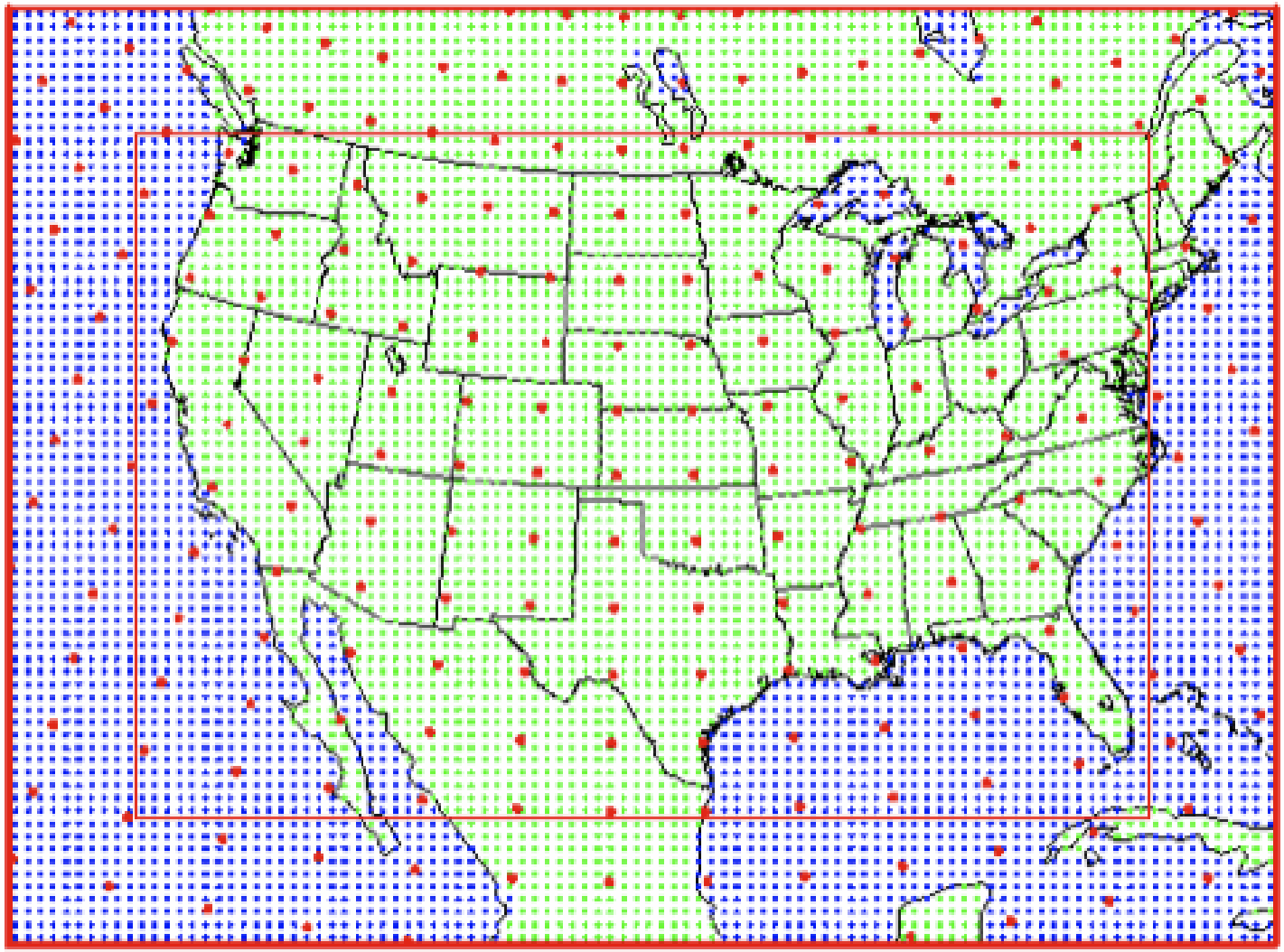


How should future climate files be built?




GLOBAL MODEL
35,000 sq-mi pattern
Includes: solar radiation & green house gasses changes
Frequency: 6 hours over 10 years
Contemporary Scenario
(decade of 1990s)
Future Scenario
(decade of 2040s)
REGIONAL MODEL
1200 sq-mi pattern
Includes: regional geographic features and climate patterns
Frequency: 3 minutes
Monthly Climate "DELTAs" (for 50-year period)
Temperature DELTA = Future Scenario – Contemporary Scenario
Precipitation DELTA = Future Scenario / Contemporary Scenario

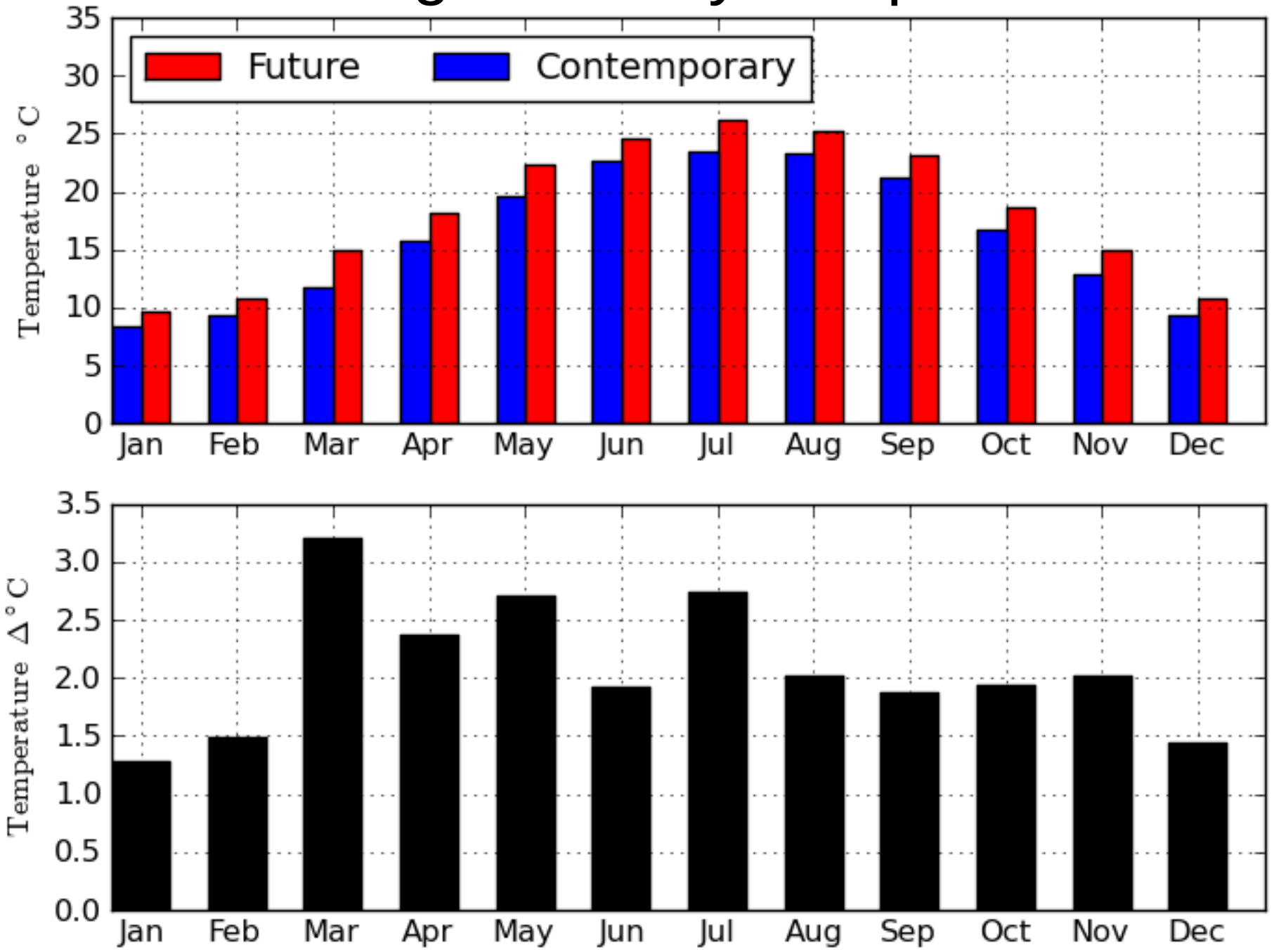
RegCM2 Simulation Domain



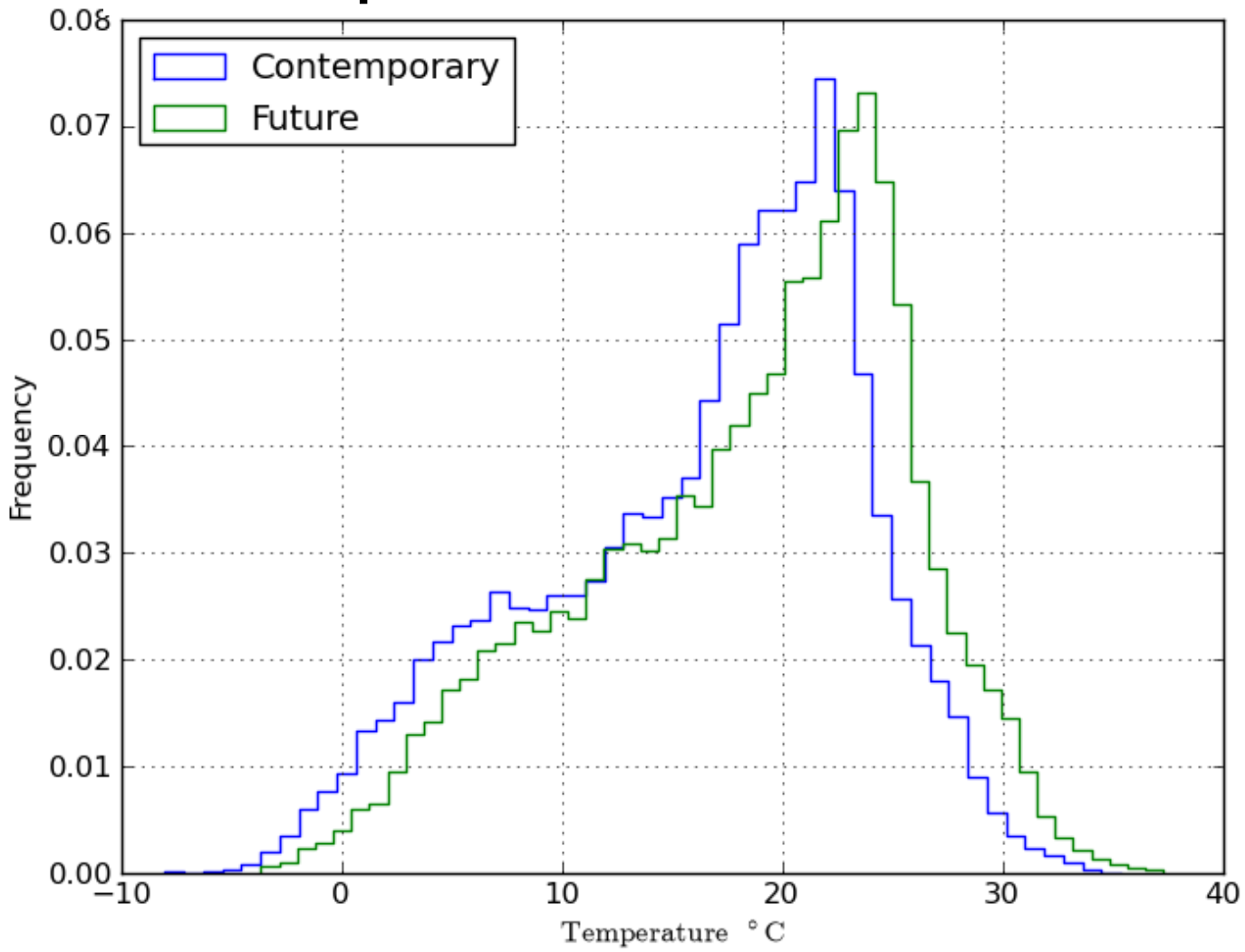
Red = global model grid point

Green/blue = regional model grid points

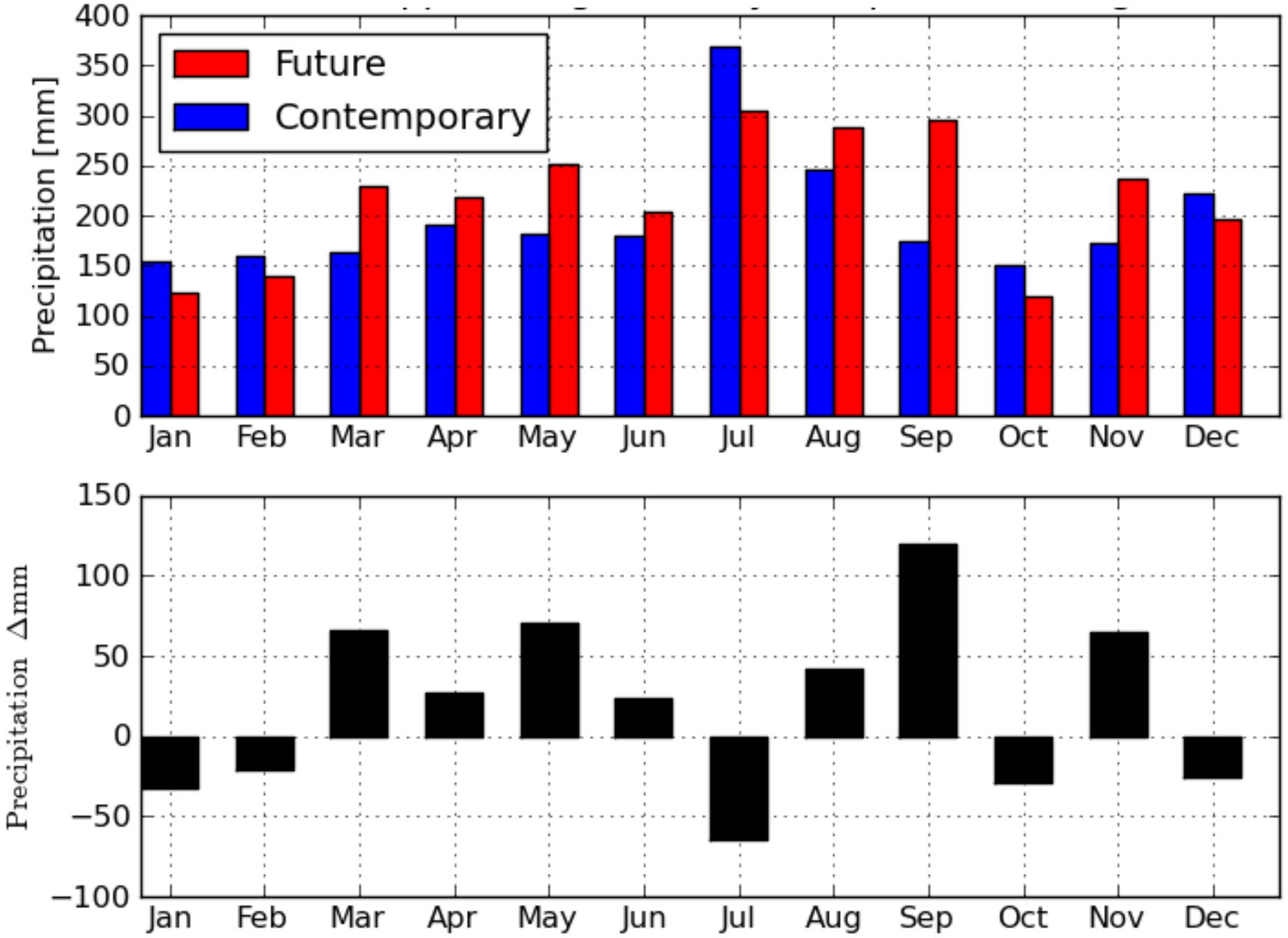
Average Monthly Temperature



Temperature Distribution

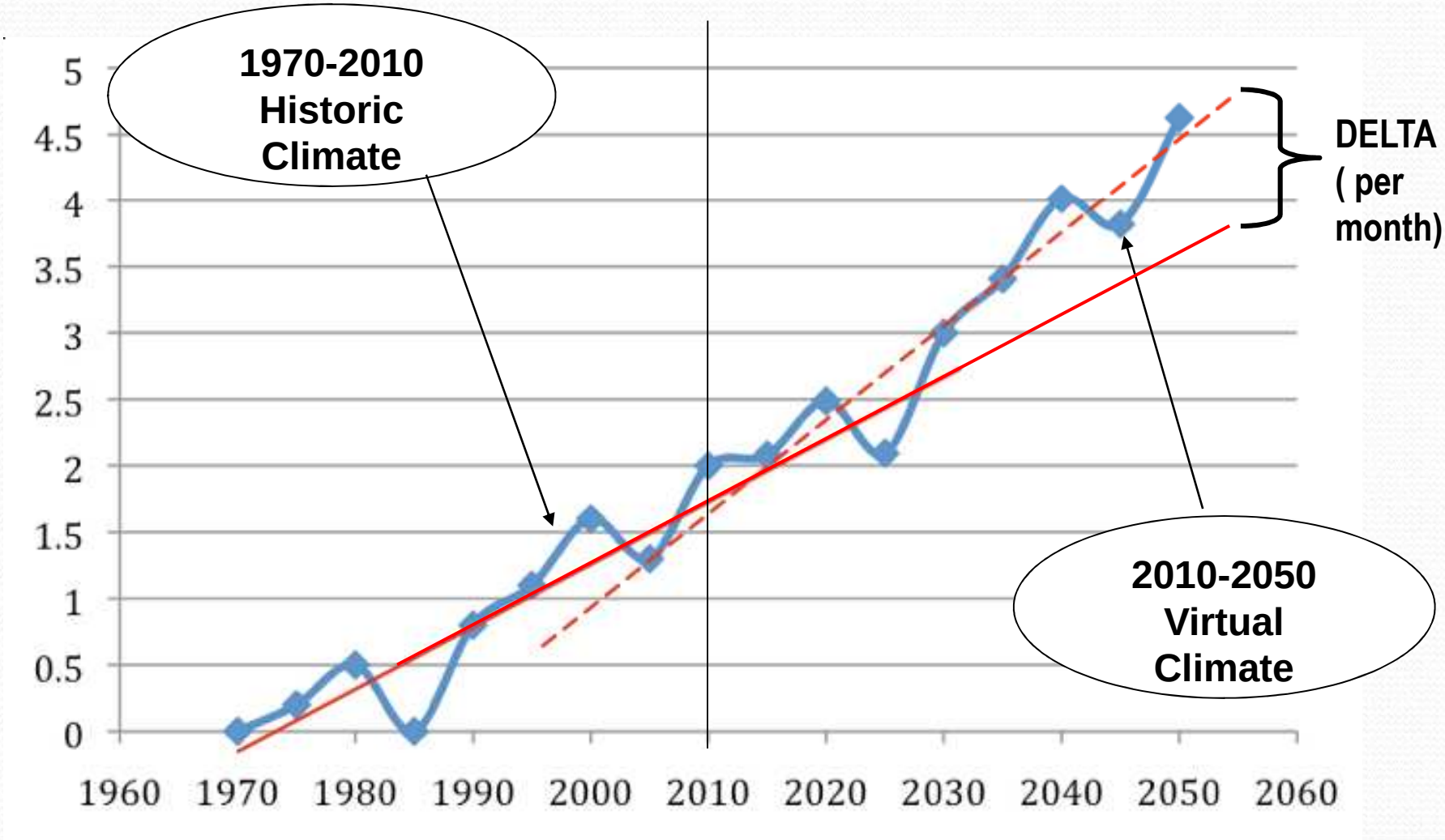


Average Monthly Precipitation



50-year DELTA's

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
T [C]	1.3	1.5	3.2	2.4	2.7	1.9	2.8	2.0	1.7	1.9	2.0	1.4
P [%]	-21	-13	40	14	39	13	-17	17	68	-20	37	-11



What is the impact of more accurate climate files?

9.3-in JPCP

20 ft joint spacing

tied PCC shoulder

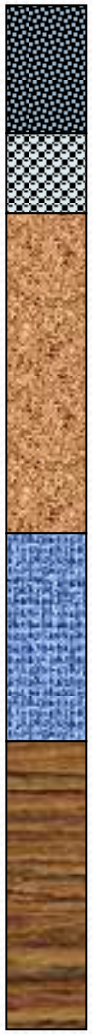
5.7-in lime stab base

A-2-4 subgrade

12.5-in HMA

AC-30

A-6 subgrade



4.5-in HMA, AC-30

3.0-in AC perm base

12-in A-2-4 base

8-in lime stab subgrade

A-6 subgrade

Complete Historic Files

- 40-year files (1970-2010)
- Each county in the State (82)

Critical for calibration

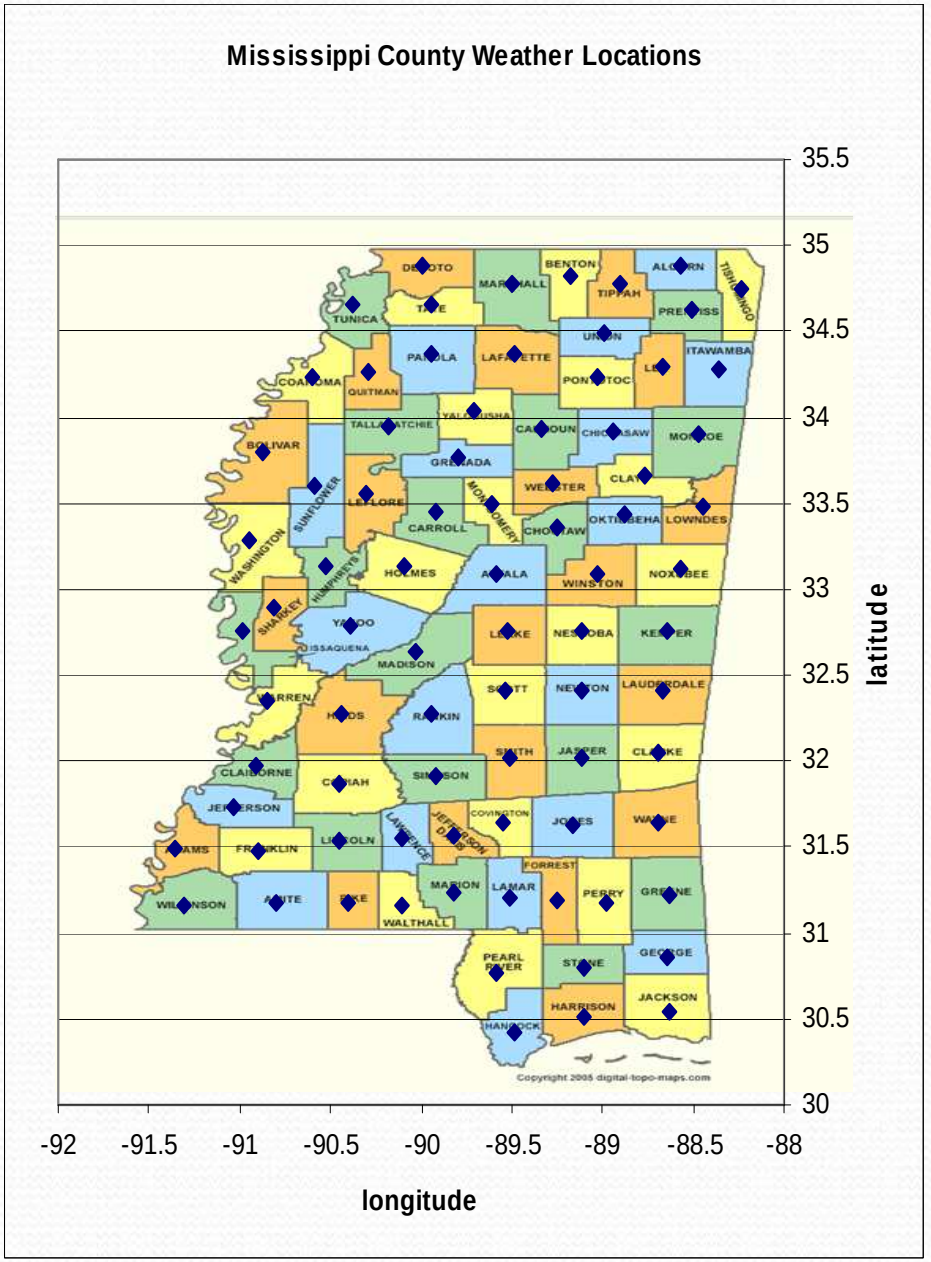
1985-2000 pavement

- 5-yr MEPDG climate

1995-2000 climate (3x)

- HISTORIC climate

1985-2000 climate



Complete Future Files

- 40-year climate files
- each climate region (10)

Critical for predicting performance

2010-2030 design

- 5-yr MEPDG climate

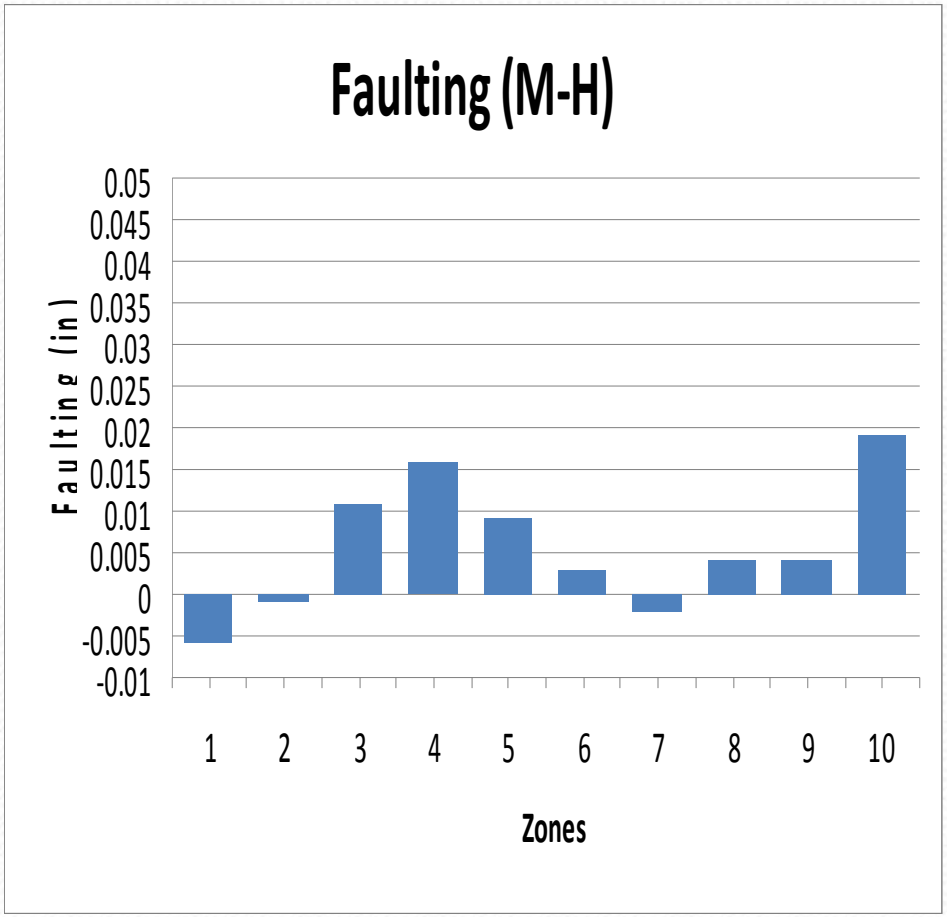
1995-2000 climate (4x)

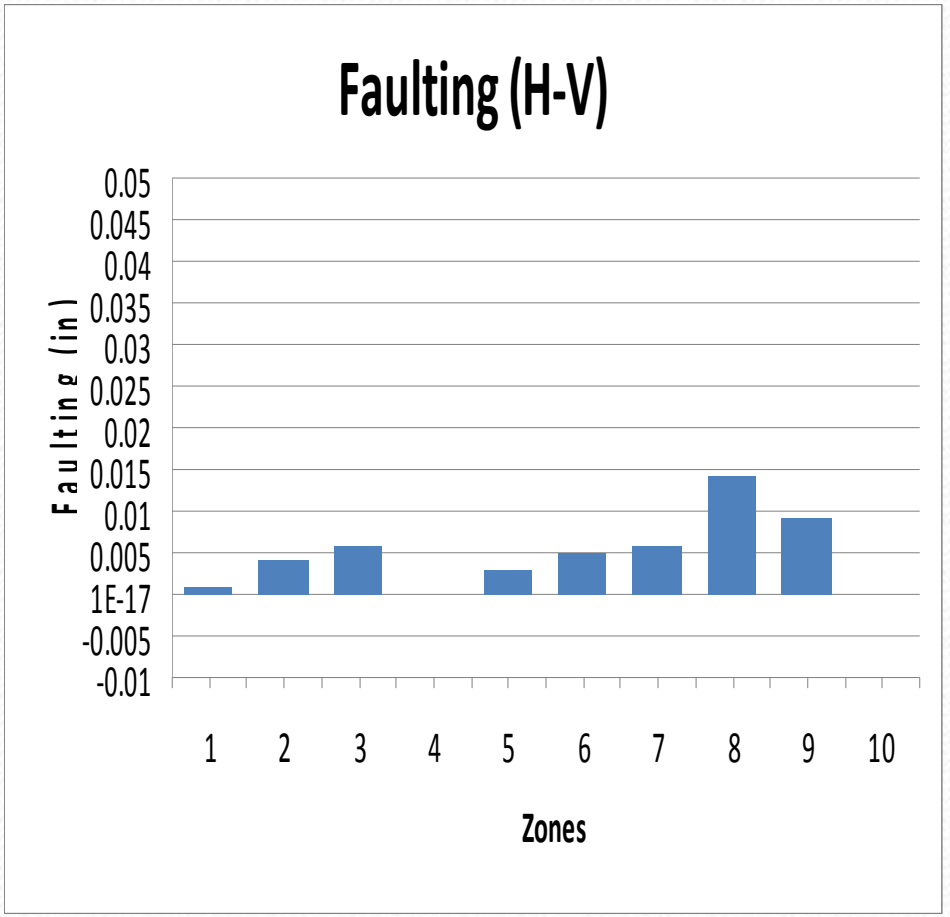
- FUTURE climate

2010-2030 virtual climate

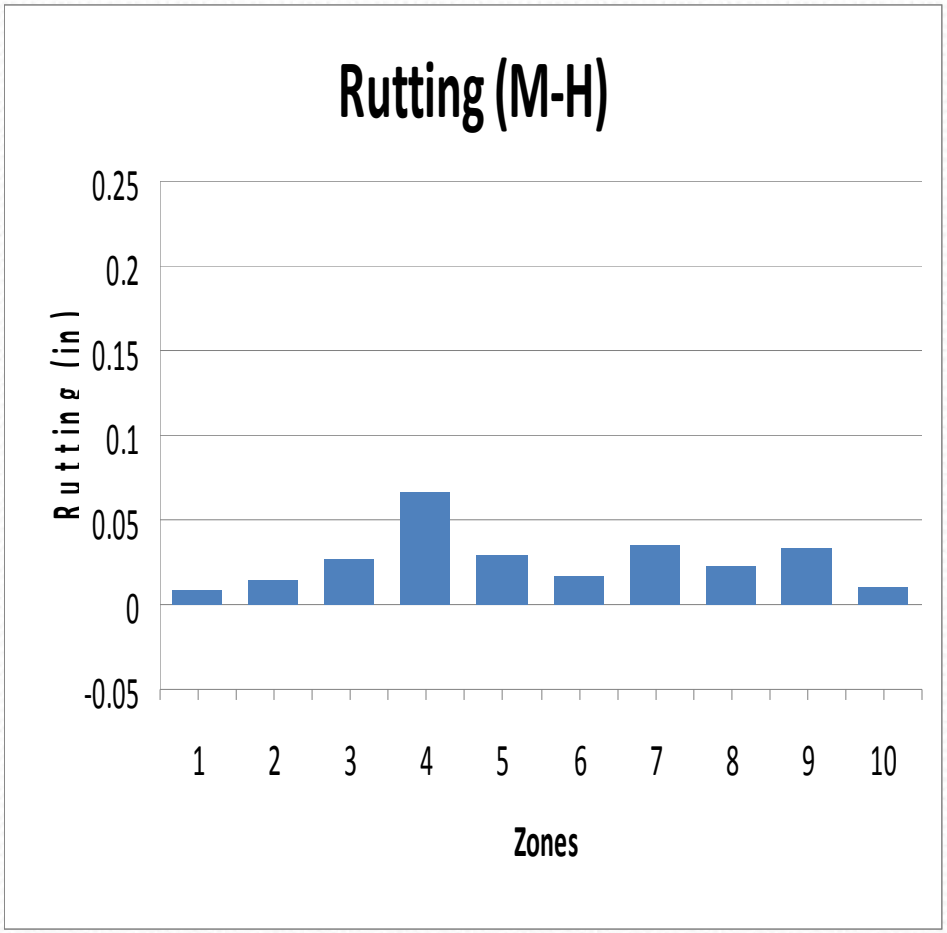
PVMT TYPE	PAVEMENT PERFORMANCE	CLIMATE COMPARISON	Mississippi Climate Zone									
			1	2	3	4	5	6	7	8	9	10
PCC	FAULT	MEDPG-Historic										
		MEPDG-Virtual										
		Historic-Virtual										
PCC	RIDE	MEDPG-Historic										
		MEPDG-Virtual										
		Historic-Virtual										
HMA1	RUTTING	MEDPG-Historic			S	S	S		S		S	
		MEPDG-Virtual				S	S		S		S	
		Historic-Virtual										
HMA1	RIDE	MEDPG-Historic				S						
		MEPDG-Virtual				S						
		Historic-Virtual										
HMA2	RUTTING	MEDPG-Historic			S	S	S	S	S	S	S	
		MEPDG-Virtual			S	S	S		S		S	
		Historic-Virtual										
HMA2	RIDE	MEDPG-Historic			S	S	S		S		S	
		MEPDG-Virtual			S	S	S		S		S	
		Historic-Virtual										

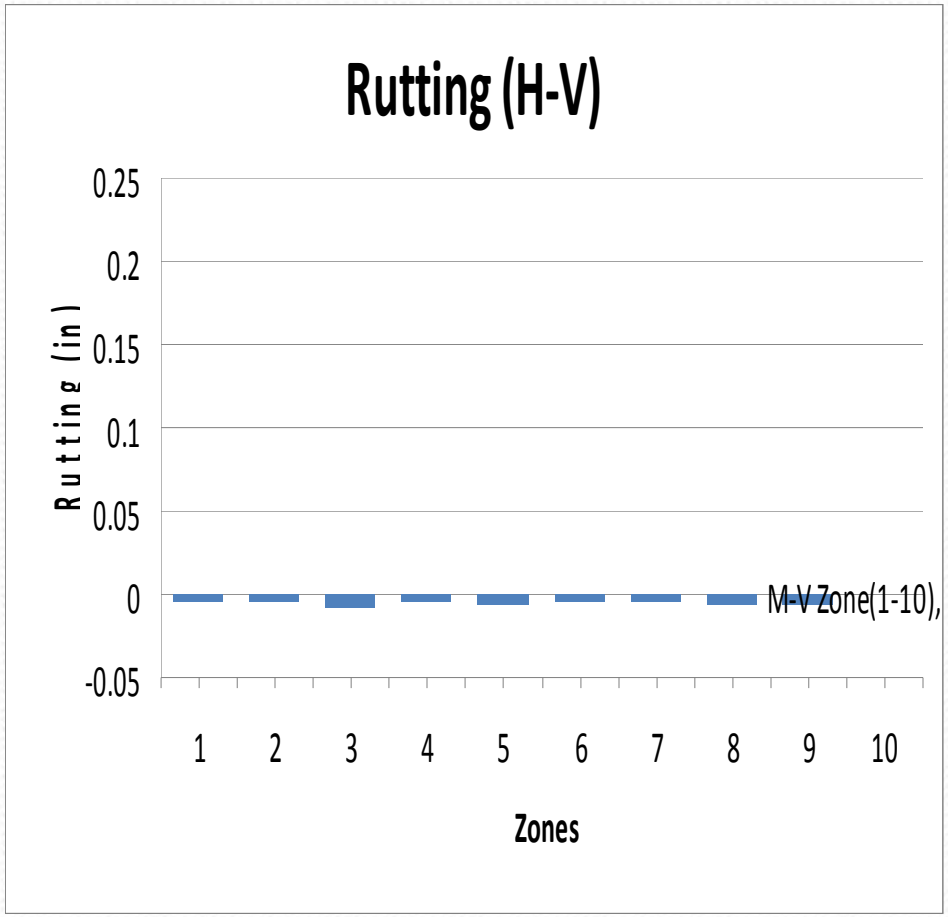
9.3-in JPCP


Faulting (M-H)
Faulting (in)
0.05
0.045
0.04
0.035
0.03
0.025
0.02
0.015
0.01
0.005
0
-0.005
-0.01
1
2
3
4
5
6
7
8
9
10
Zones

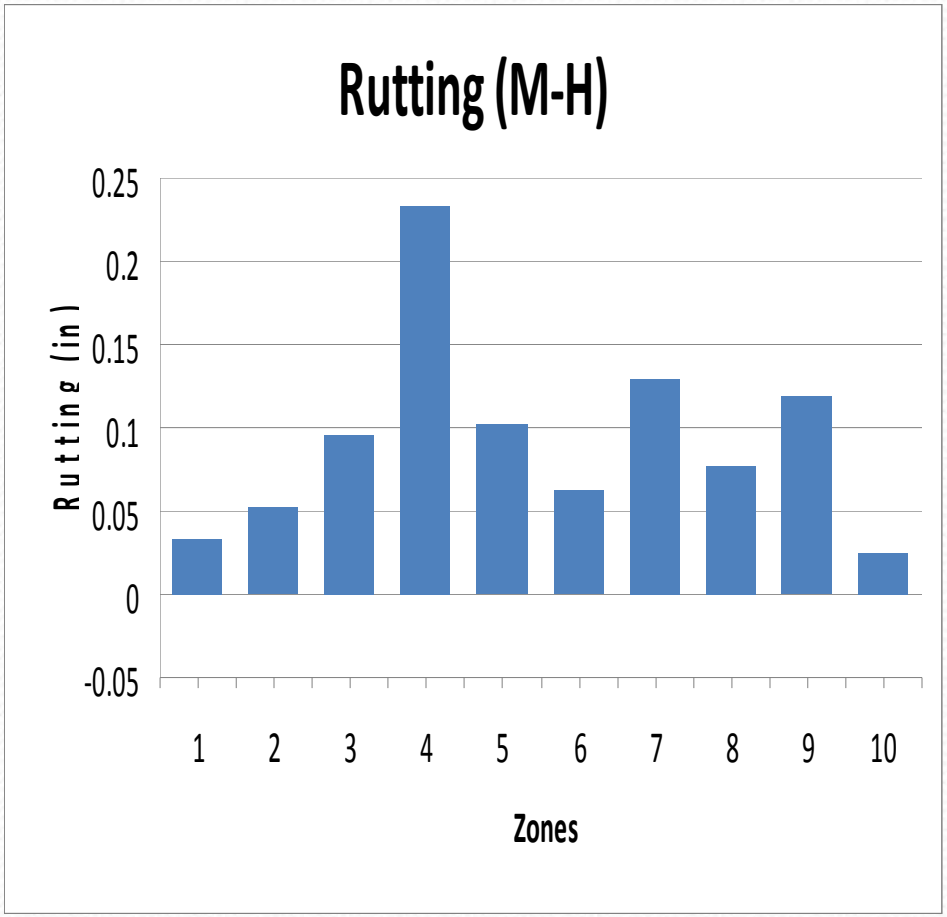

Faulting (H-V)
Faulting (in)
0.05
0.045
0.04
0.035
0.03
0.025
0.02
0.015
0.01
0.005
1E-17
-0.005
-0.01
1
2
3
4
5
6
7
8
9
10
Zones

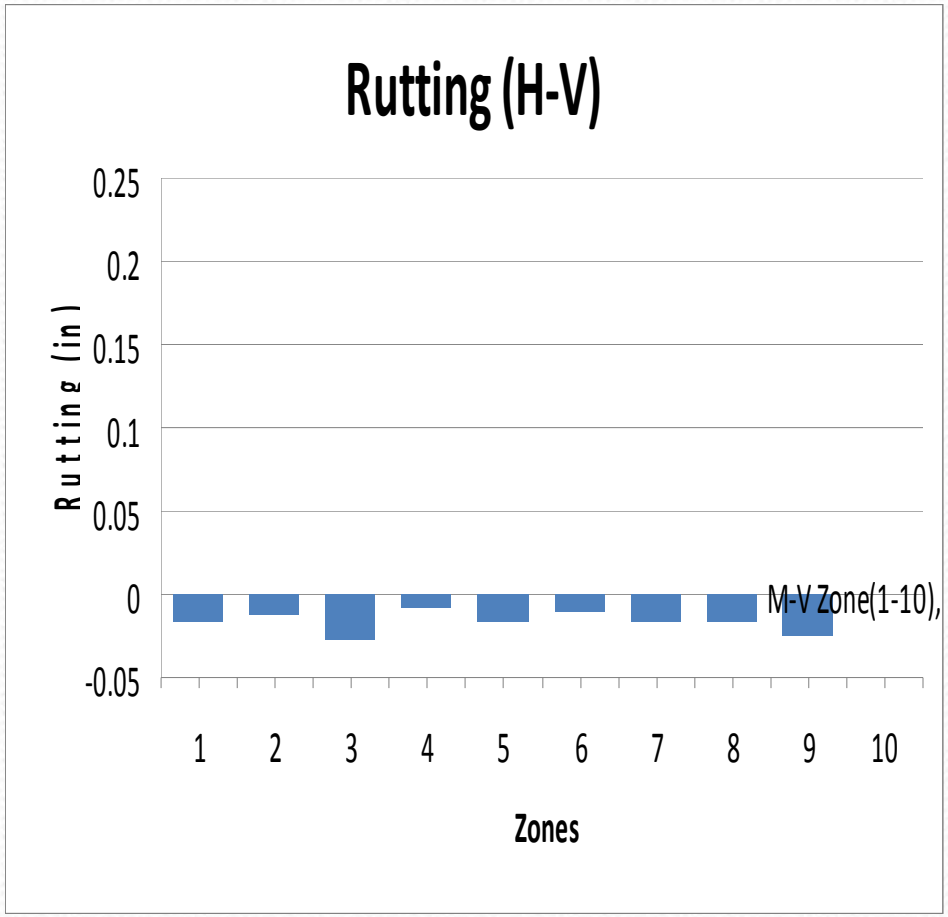
12.5-in HMA


Rutting (M-H)
Rutting (in)
0.25
0.2
0.15
0.1
0.05
0
-0.05
1
2
3
4
5
6
7
8
9
10
Zones

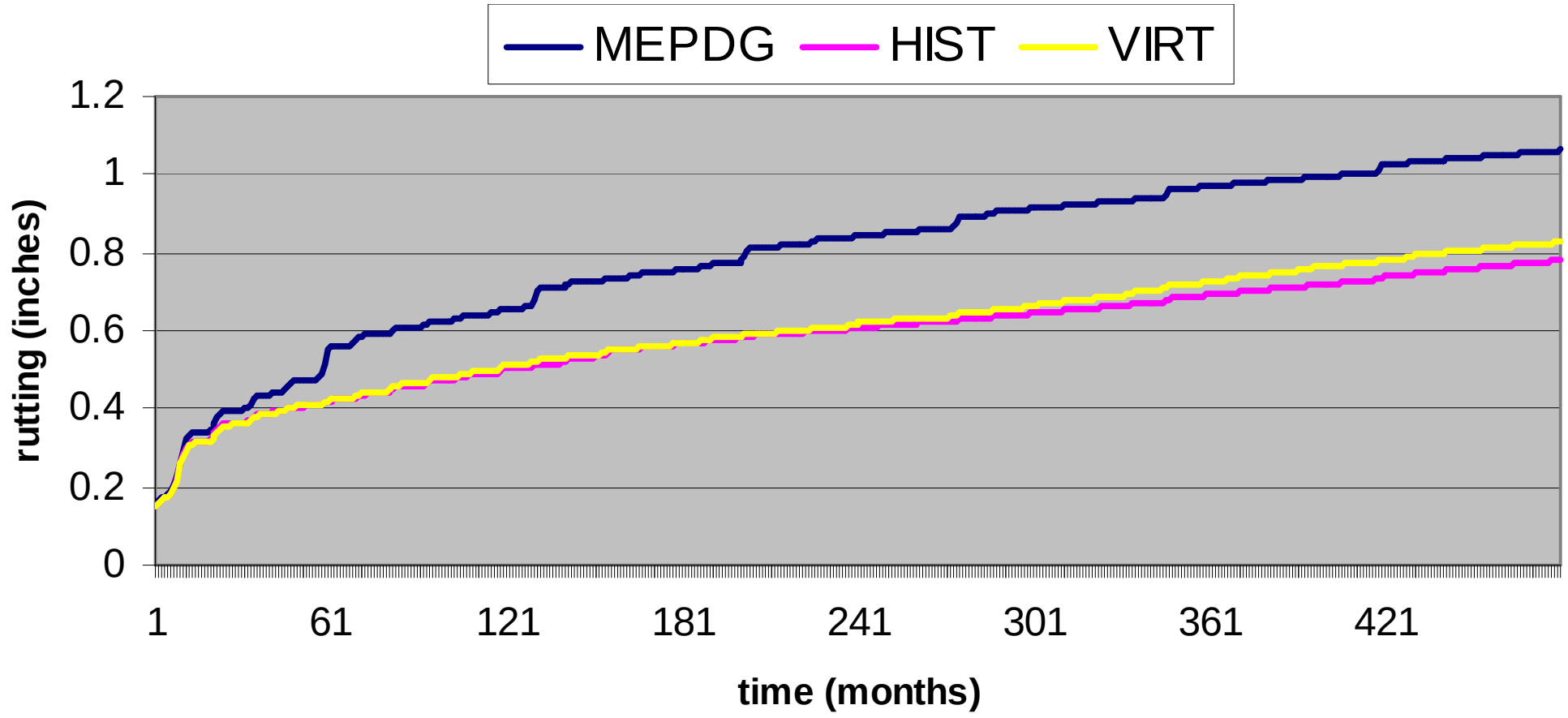

Rutting (H-V)
Rutting (in)
0.25
0.2
0.15
0.1
0.05
0
-0.05
M-V Zone(1-10),
1
2
3
4
5
6
7
8
9
10
Zones

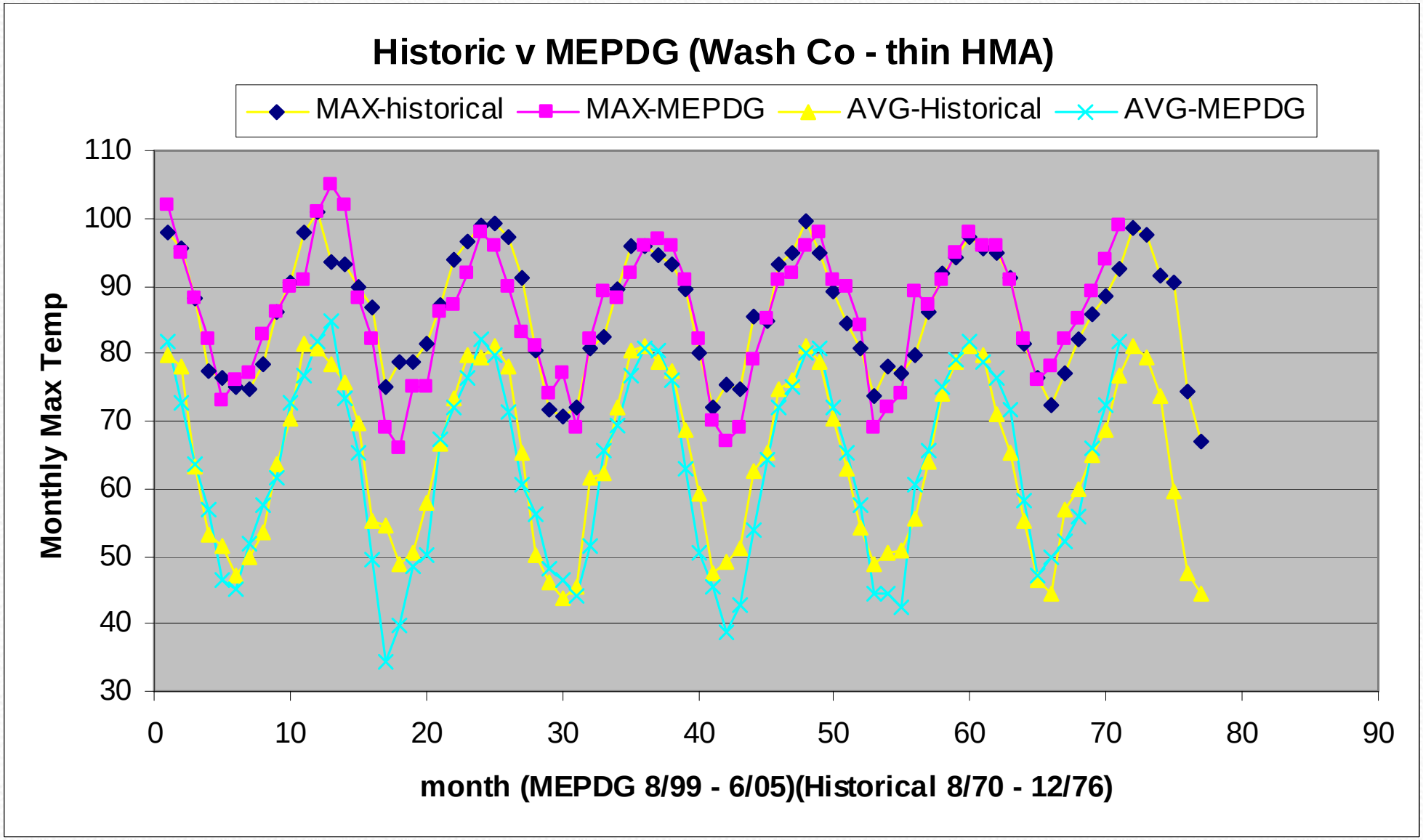
4.5-in HMA


Rutting (M-H)
Rutting (in)
0.25
0.2
0.15
0.1
0.05
0
-0.05
1
2
3
4
5
6
7
8
9
10
Zones


Rutting (H-V)
Rutting (in)
0.25
0.2
0.15
0.1
0.05
0
-0.05
M-V Zone(1-10),
1
2
3
4
5
6
7
8
9
10
Zones

Zone 4 Rutting Thin HMA



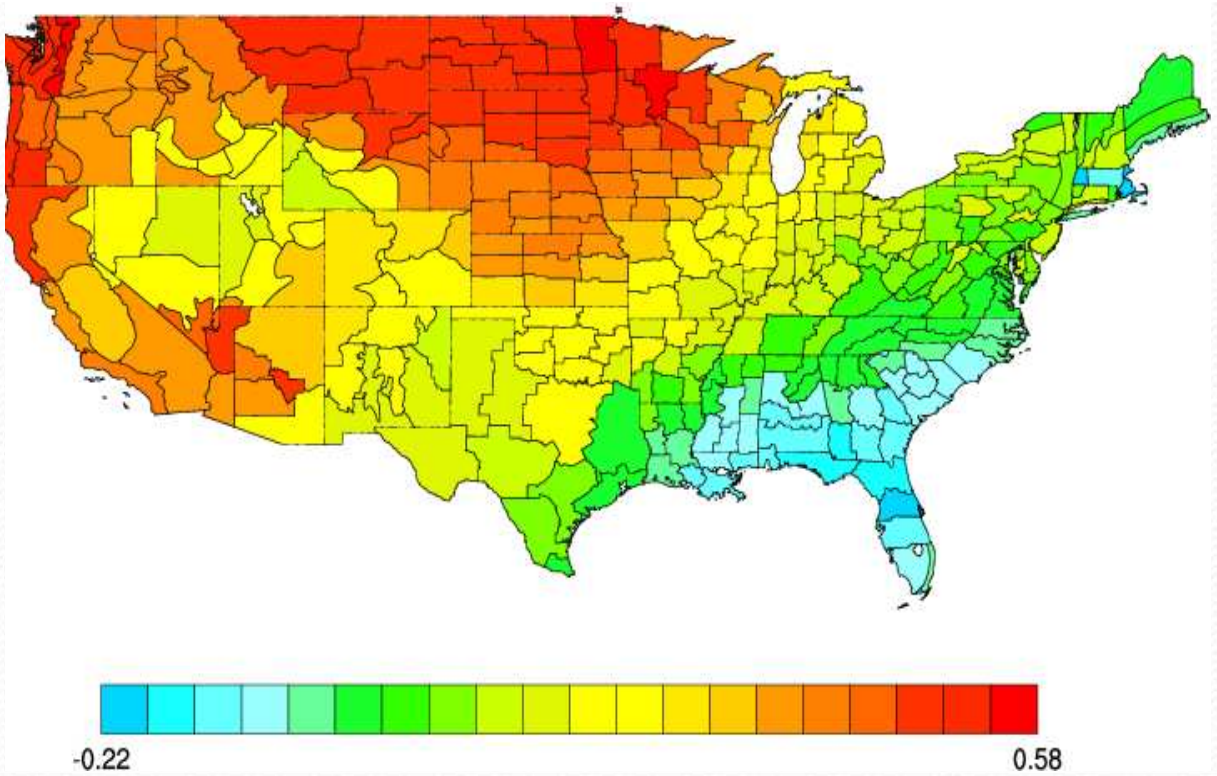

Historic v MEPDG (Wash Co - thin HMA)
MAX-historical
MAX-MEPDG
AVG-Historical
AVG-MEPDG
Monthly Max Temp
110
100
90
80
70
60
50
40
30
0
10
20
30
40
50
60
70
80
90
month (MEPDG 8/99 - 6/05)(Historical 8/70 - 12/76)

Current MEPDG 10-year climate files may adversely impact pavement performance predictions

- The fix is accurate and improves MEPDG model calibration

Future climate may be different from historic climate and change pavement performance predictions

- There are accepted scientific models to build future climate files



Climate Science Program

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