Evaluation of Changes in IRI Along the Center of Lane to Assess the Effect of Environmental Factors on IRI

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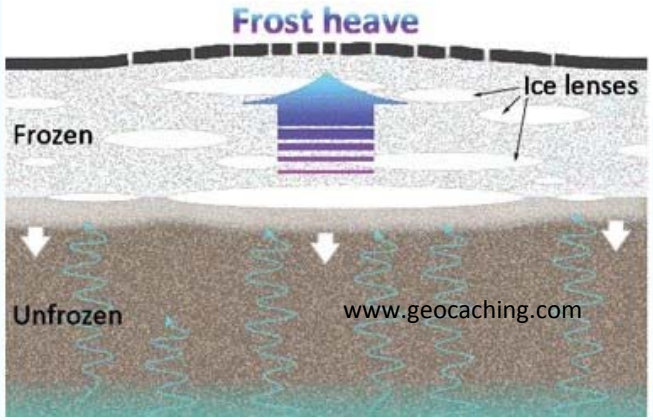
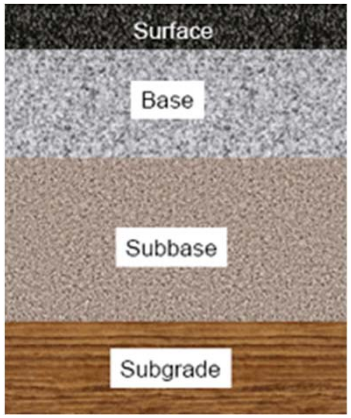
What Factors Cause Pavement Roughness?

Traffic



Frost Heave



Shrink/Swell Subgrade/Subsurface

Environmental Related Cracking

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LTPP Profilers

Collecting Profile Data Along the Two Wheelpaths and Center of the Lane since 1996

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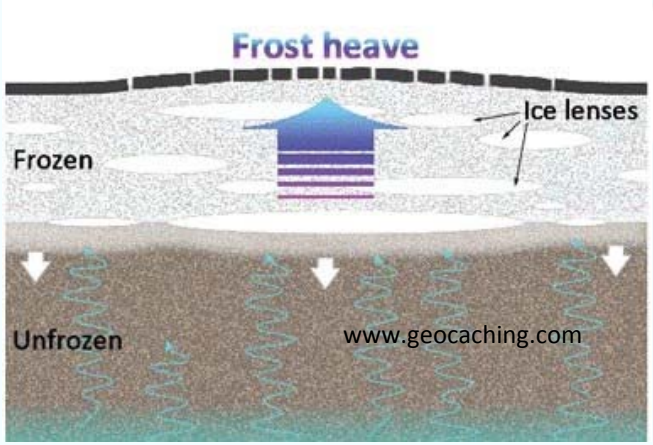
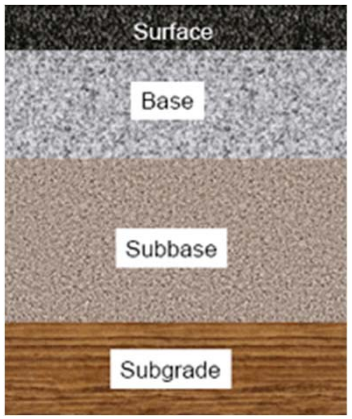
Roughness Changes Along Center of the Lane

Roughness Changes Along Center of Lane Expected to be Primarily Influenced by Environmental Effects



Frost Heave



Shrink/Swell Subgrade/Subsurface

Environmental Related Cracking

Project Objective

- Evaluate changes in Center of Lane IRI (CLIRI) to assess impact of environmental effects on IRI for flexible pavements (Asphalt Concrete).

- Use data from LTPP SPS-1 Experiment for the analysis.

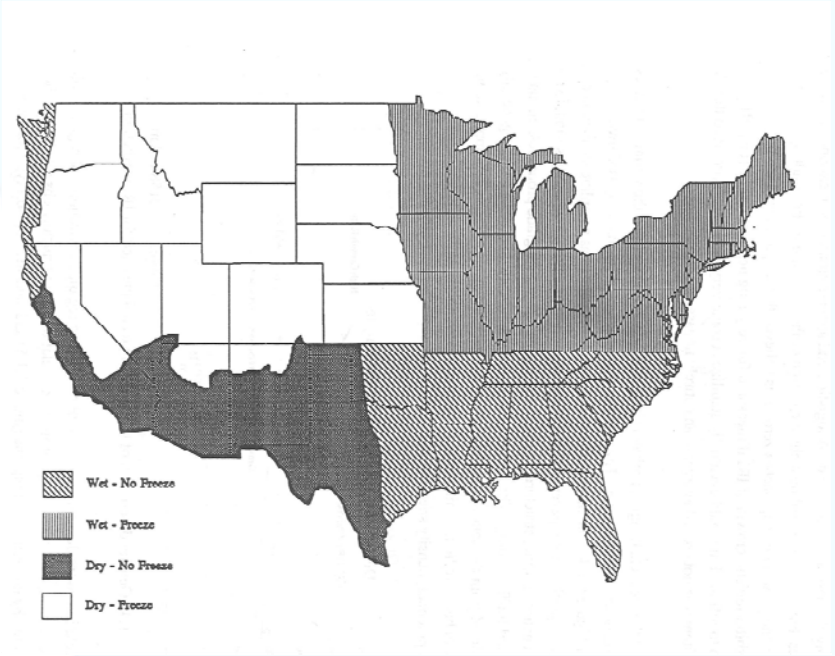
LTPP SPS-1 Experiment

- Twelve test sections constructed at a site.
- Structural factors evaluated in study: asphalt thickness, base type, base thickness, provision of drainage.
- Eighteen projects constructed throughout United States.

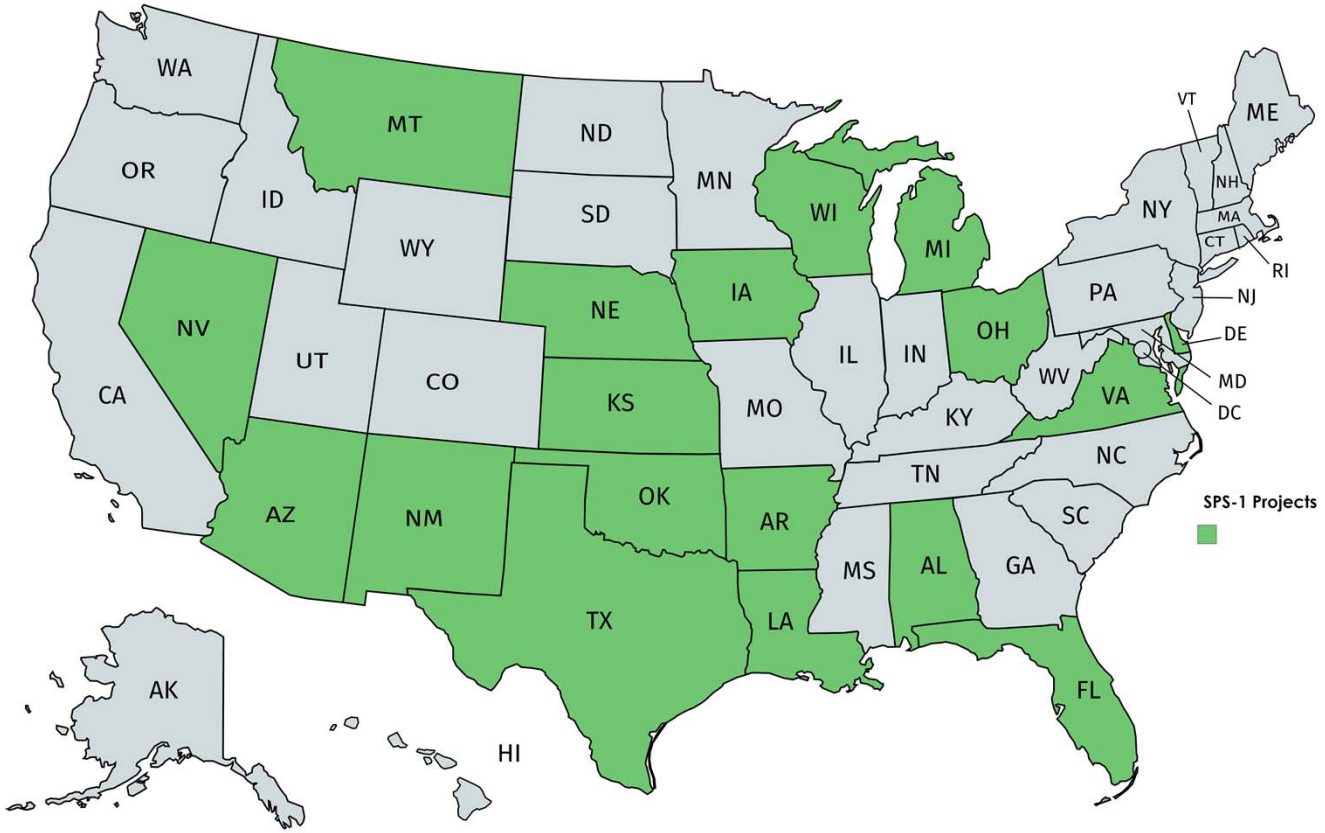
LTPP SPS-1 Experiment

- Subgrade Types: Fine (Clay/Silt) and Coarse (Sand).

- Environmental Regions: Dry No-Freeze, Dry Freeze, Wet No-Freeze, Wet-Freeze



SPS-1 Project Locations



SPS-1 Projects

Project Location	Environmental Zone	Subgrade Type
Alabama	Wet No-Freeze	Fine-Grained
Arizona	Dry No-Freeze	Coarse-Grained
Arkansas	Wet No-Freeze	Coarse-Grained
Delaware	Wet No-Freeze	Coarse-Grained
Florida	Wet No-Freeze	Coarse-Grained
Iowa	Wet-Freeze	Fine-Grained
Kansas	Wet-Freeze	Coarse-Grained
Louisiana	Wet No-Freeze	Fine-Grained
Michigan	Wet-Freeze	Fine-Grained
Montana	Dry-Freeze	Coarse-Grained
Nebraska	Wet-Freeze	Fine-Grained
Nevada	Dry-Freeze	Coarse-Grained
New Mexico	Dry No-Freeze	Fine-Grained
Ohio	Wet-Freeze	Fine-Grained
Oklahoma	Wet No-Freeze	Coarse-Grained
Texas	Wet No-Freeze	Coarse-Grained
Virginia	Wet No-Freeze	Coarse-Grained
Wisconsin	Wet-Freeze	Coarse-Grained

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SPS-1 Test Sections

Test Section Number	Asphalt Thickness (in)	Layer 2		Layer 3	
		Material	Thickness (in)	Material	Thickness (in)
1	7"	DGAB	8"	-	-
2	4"	DGAB	12"	-	-
3	4"	ATB	8"	-	-
4	7"	ATB	12"	-	-
5	4"	ATB	4"	DGAB	4"
6	7"	ATB	8"	DGAB	4"
7	4"	PATB	4"	DGAB	4"
8	7"	PATB	4"	DGAB	8"
9	7"	PATB	4"	DGAB	12
10	7"	ATB	4"	PATB	4"
11	4"	ATB	8"	PATB	4"
12	4"	ATB	12"	PATB	4"
DGAB: Dense-Graded Aggregate Base					
ATB: Asphalt Treated Base					
PATB: Permeable Asphalt Treated Base					

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SPS-1 Test Sections

Test Section Number	Asphalt Thickness (in)	Layer 2		Layer 3	
		Material	Thickness (in)	Material	Thickness (in)
13	4"	DGAB	8"	-	-
14	7"	DGAB	12"	-	-
15	7"	ATB	8"	-	-
16	4"	ATB	12"	-	-
17	7"	ATB	4"	DGAB	4"
18	4"	ATB	8"	DGAB	4"
19	7"	PATB	4"	DGAB	4"
20	4"	PATB	4"	DGAB	8"
21	4"	PATB	4"	DGAB	12"
22	4"	ATB	4"	PATB	4"
23	7"	ATB	8"	PATB	4"
24	7"	ATB	12"	PATB	4"

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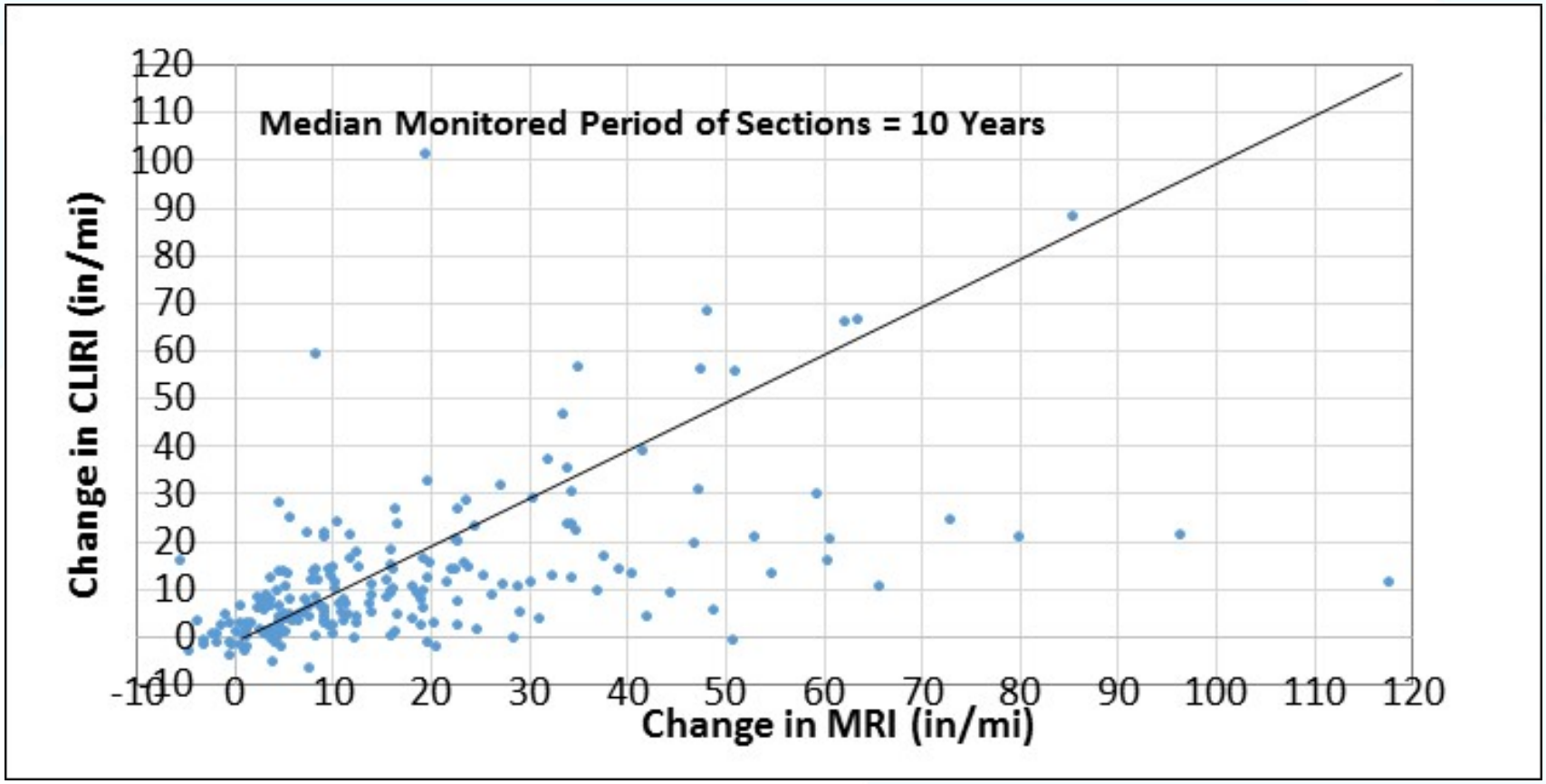
CLIRI vs MIRI



Change in CLIRI > Change in MIRI at 35% of Sections

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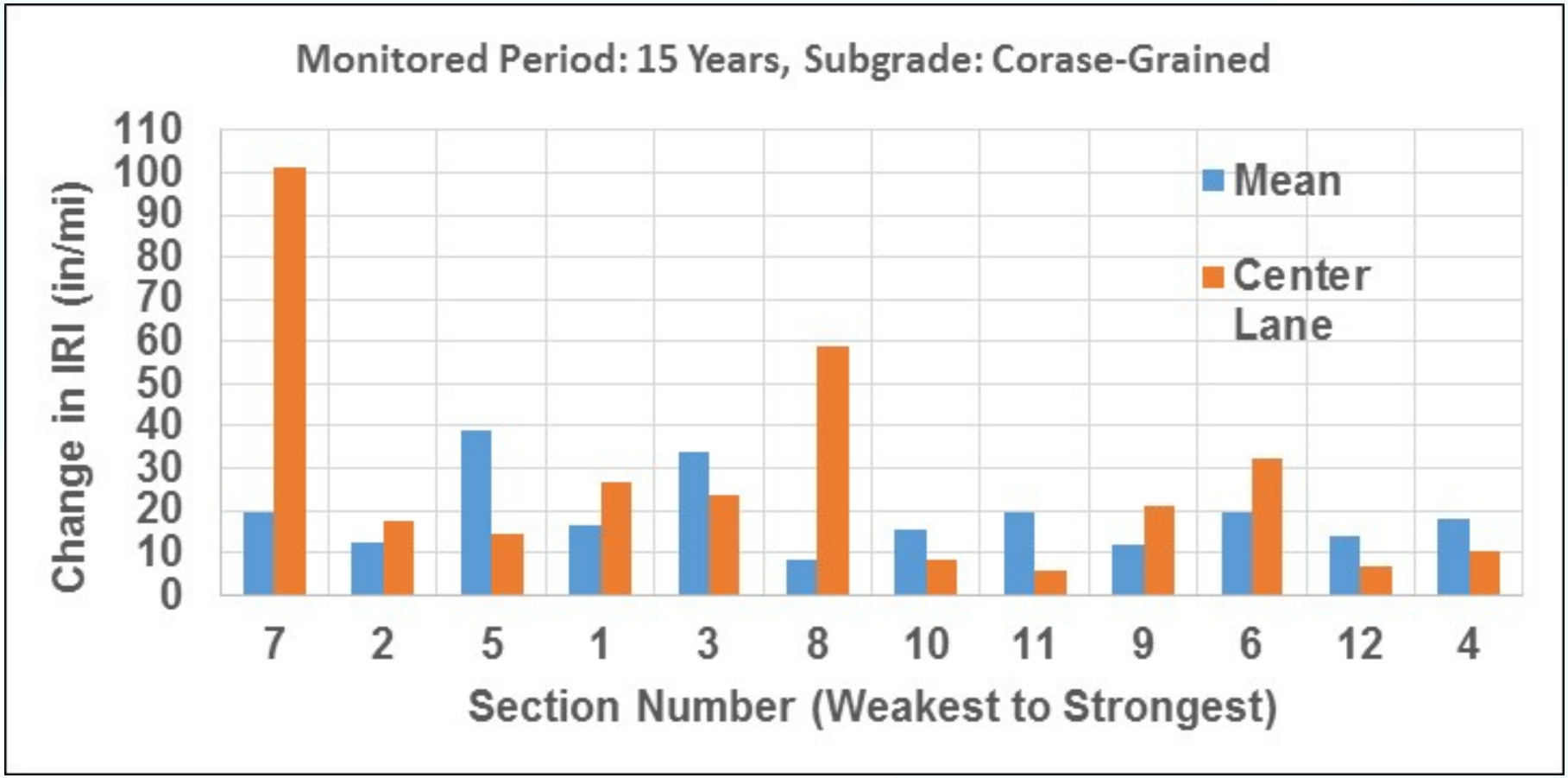
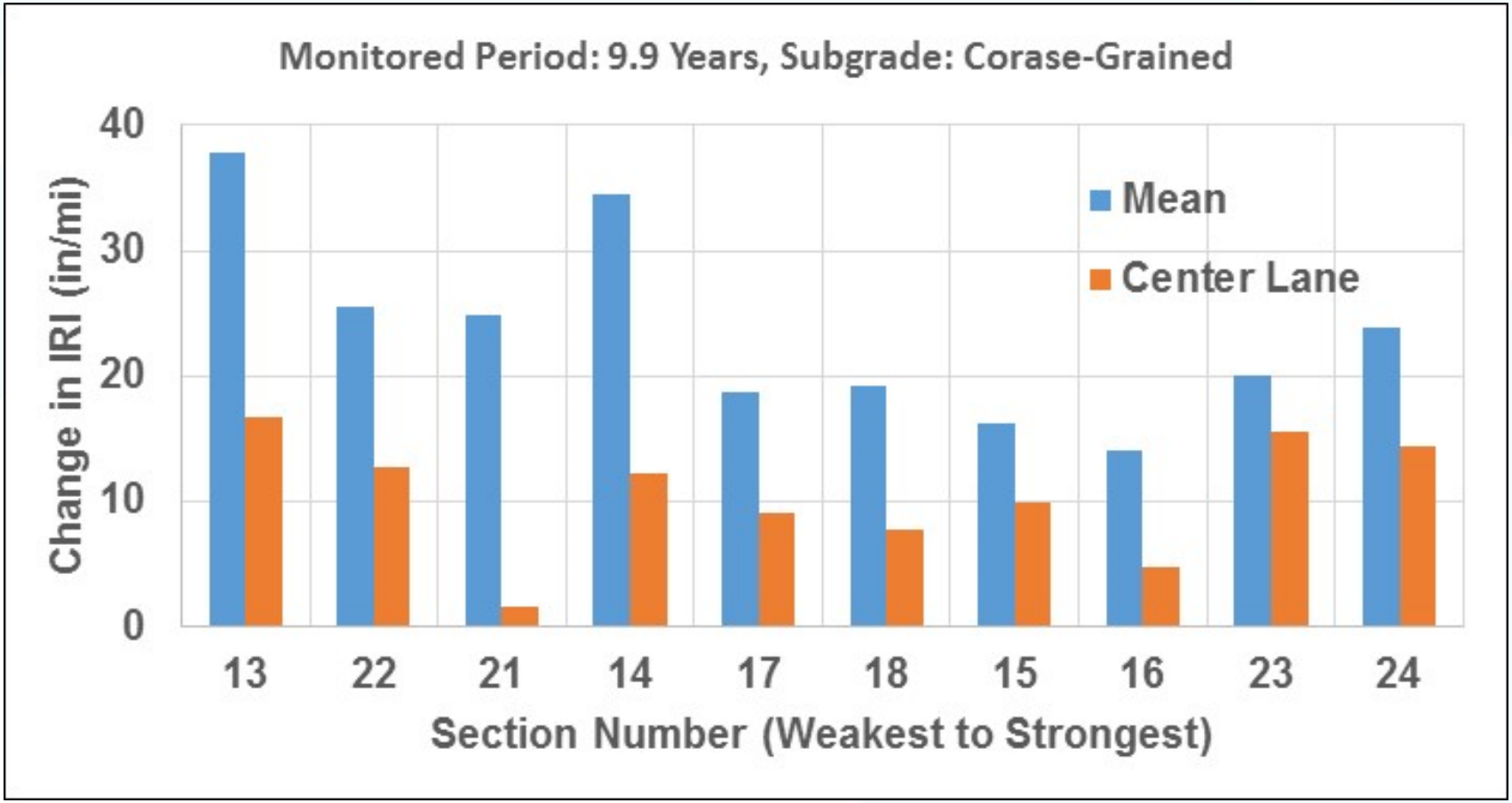
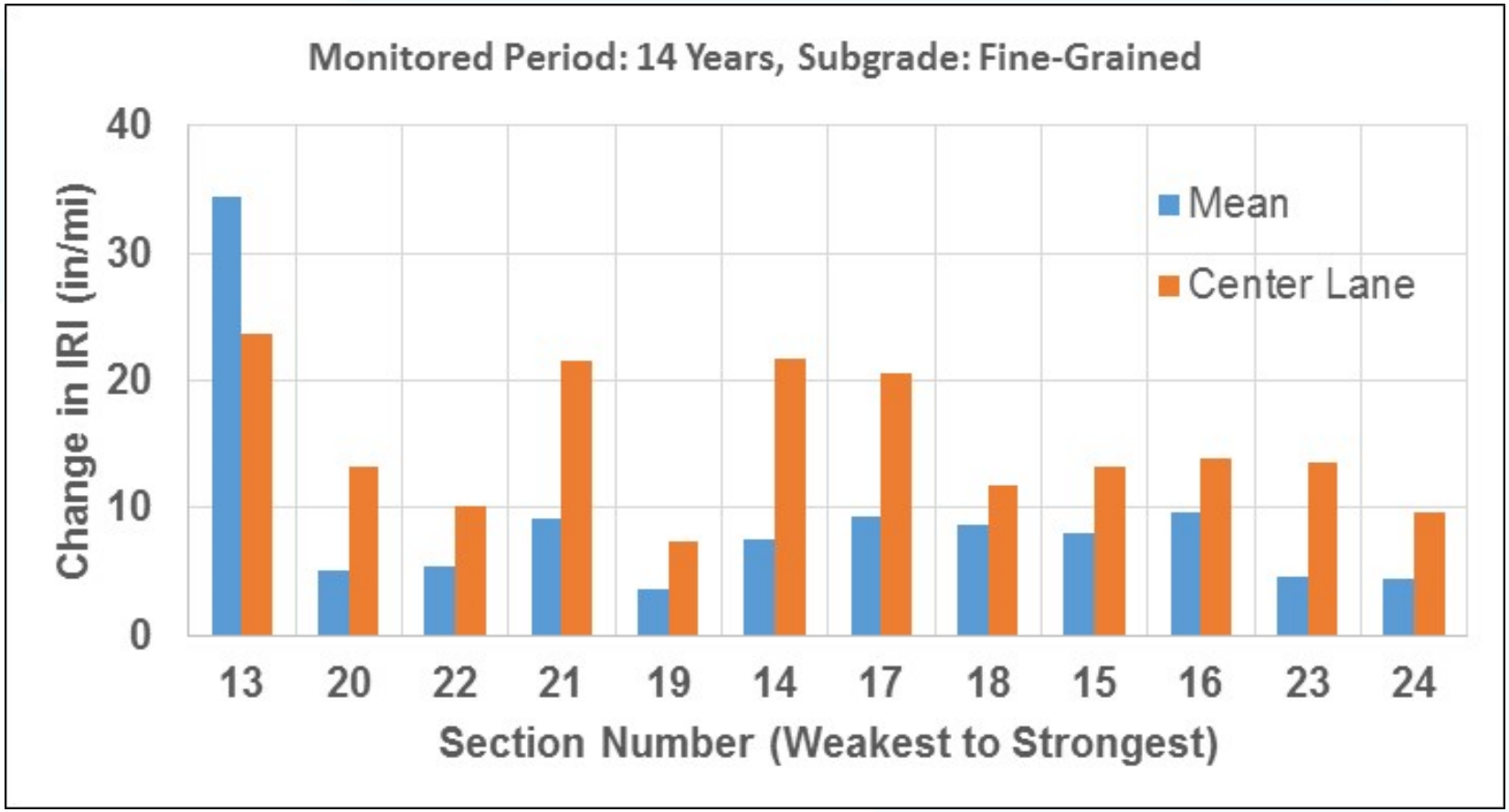
Florida, Change in CLIRI and MIRI



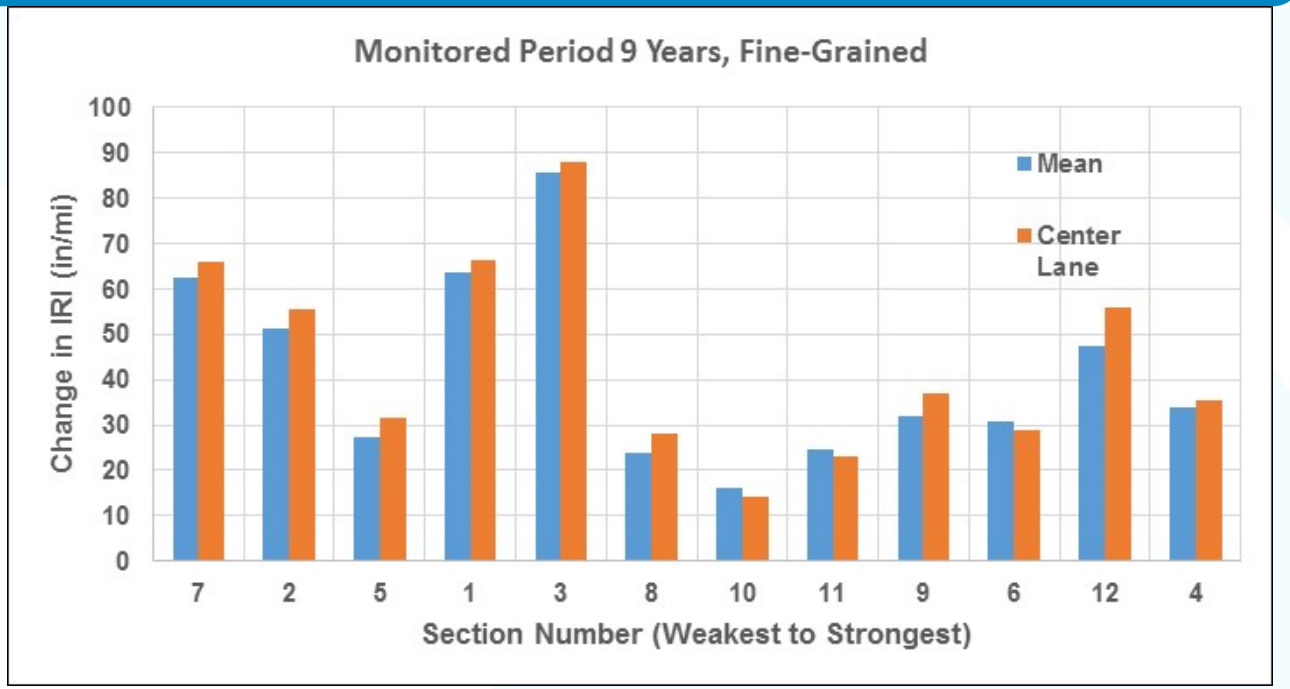
Arkansas, Change in CLIRI and MIRI



Louisiana, Change in CLIRI and MIRI

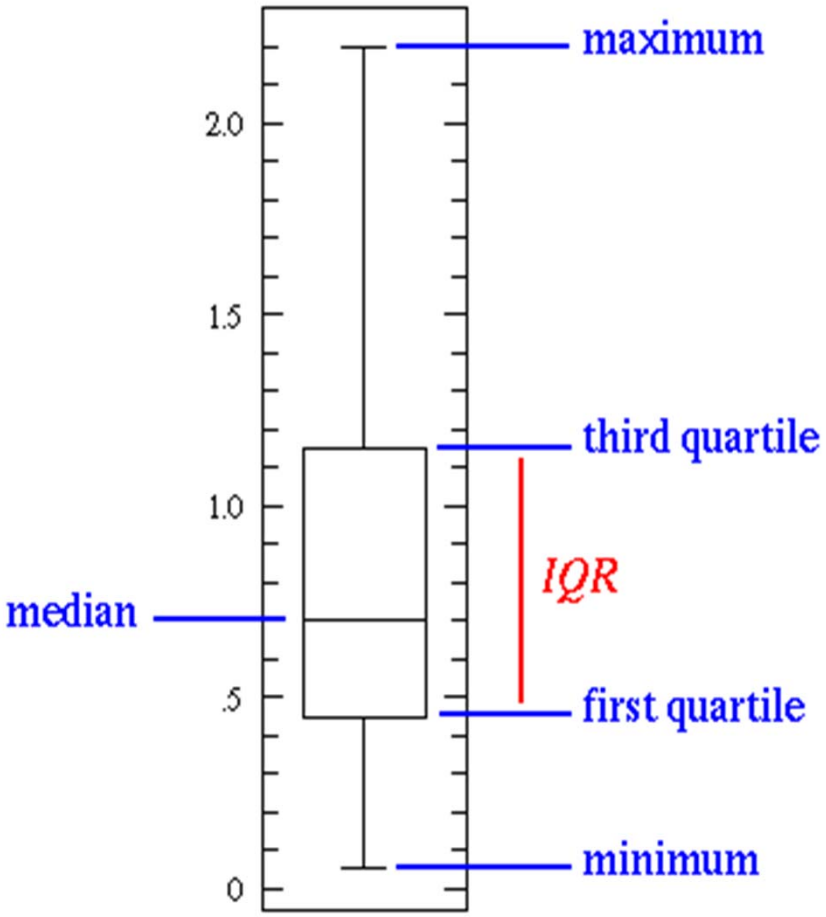


New Mexico, Change in CLIRI and MIRI



Overall Observations

Box and Whisker Plot

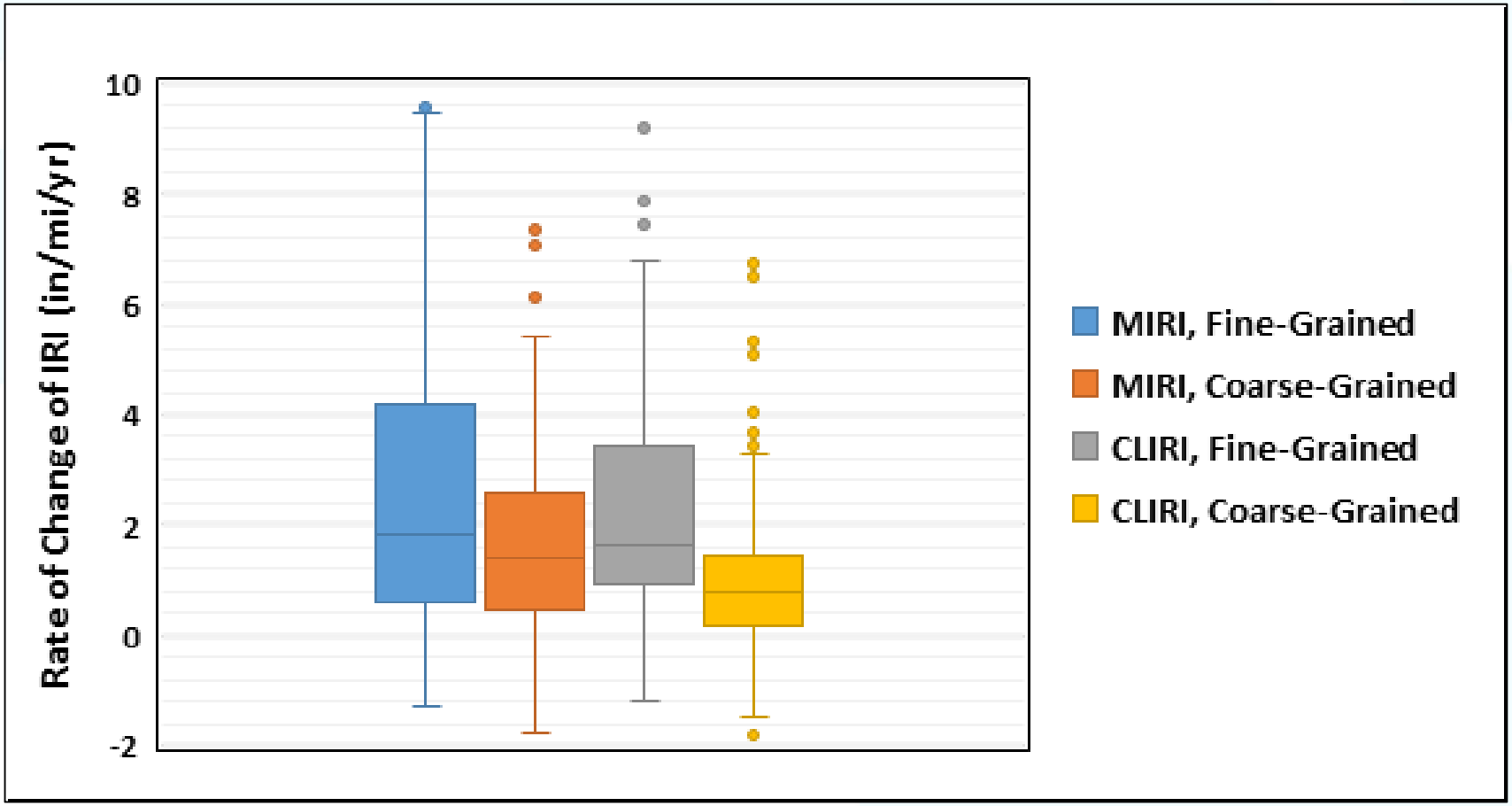


← 75 percent

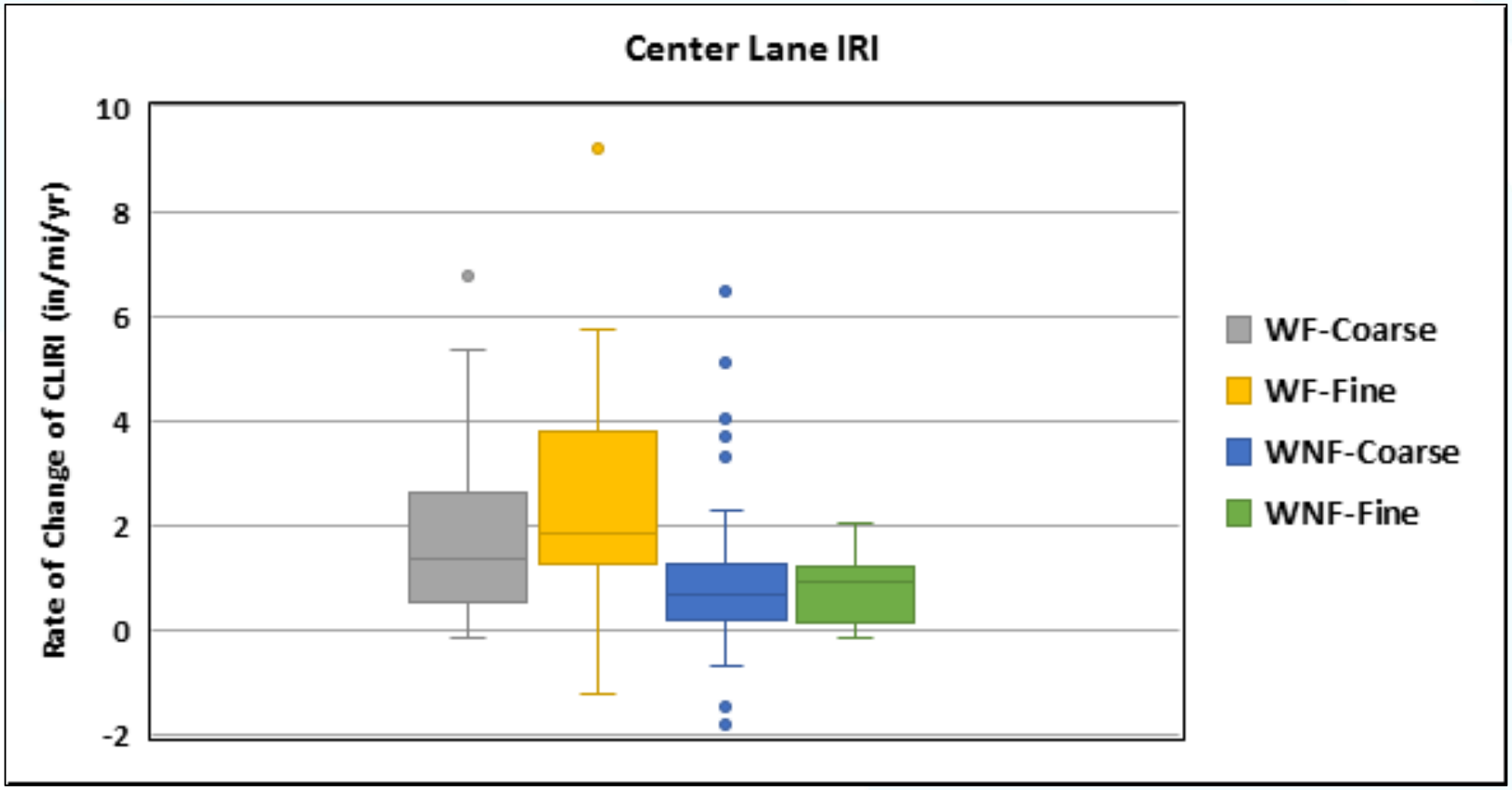
← 25 percent

Source: physics.csbsju.edu

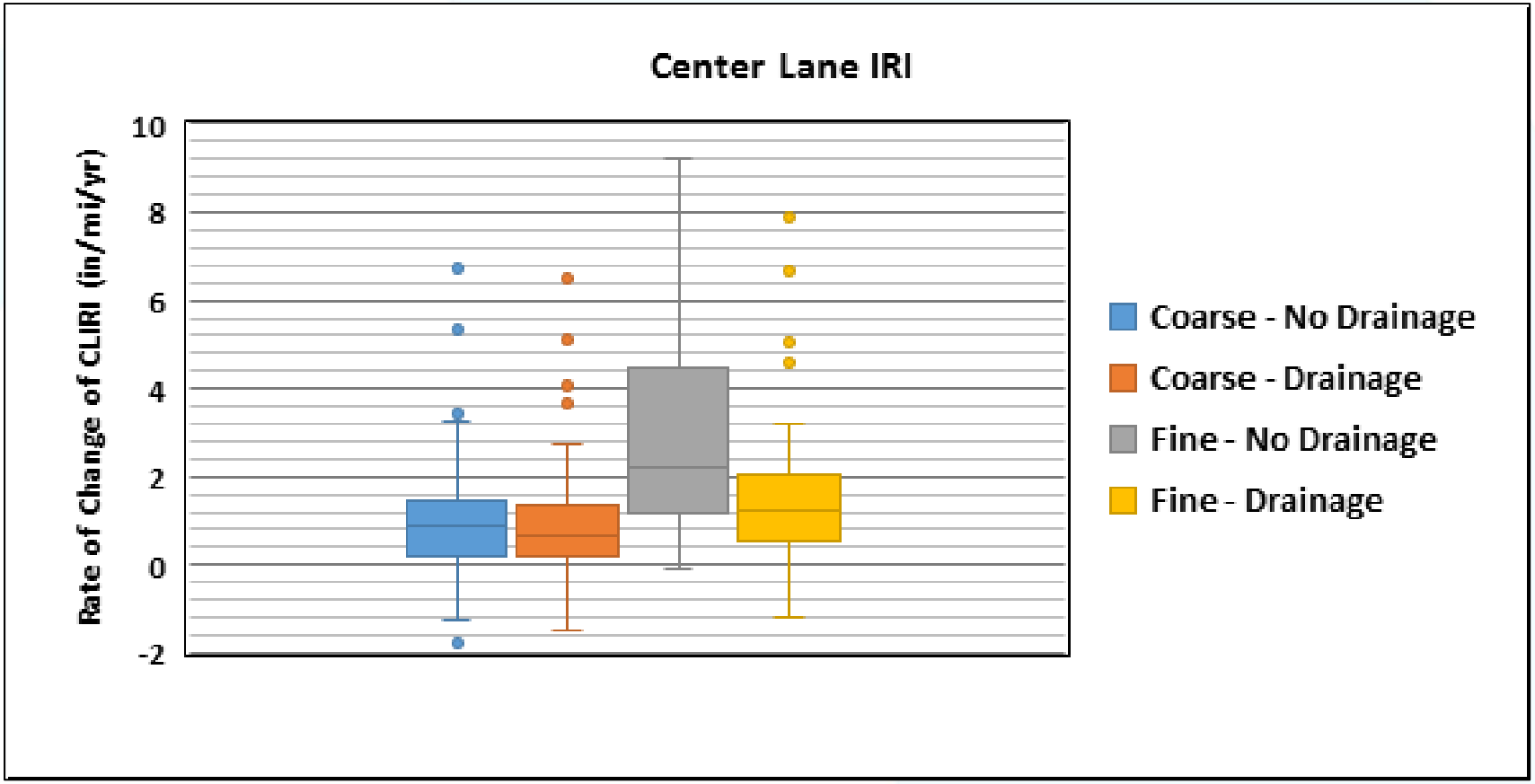
Rate of Change of MIRI and CLIRI, All Environmental Zones: Subgrade Type



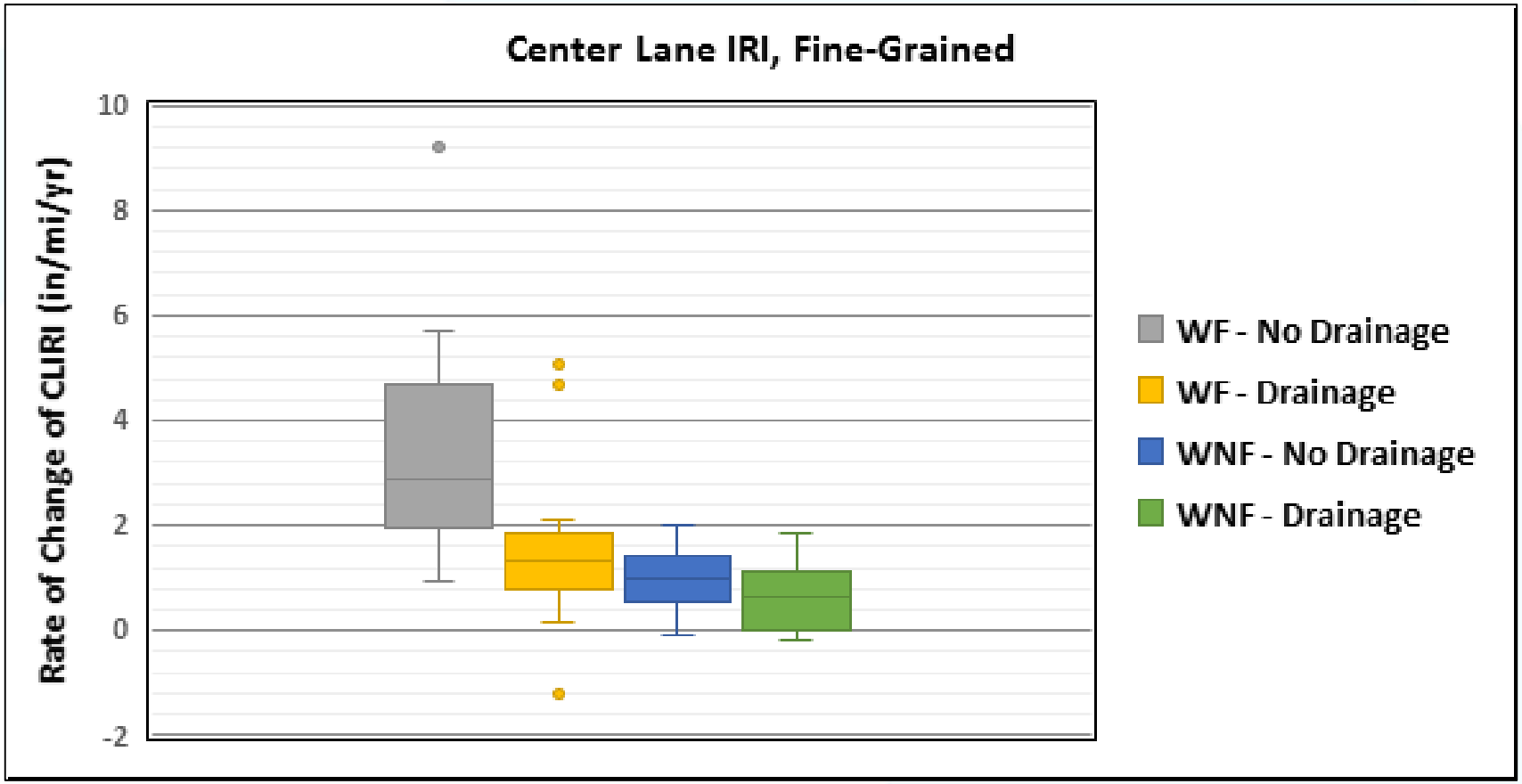
Rate of Change of CLIRI, WF and WNF, Subgrade Type



Rate of Change of CLIRI, All Environmental Zones, Effect of Drainage



Rate of Change of CLIRI, Effect of Drainage on Fine-Grained Subgrade

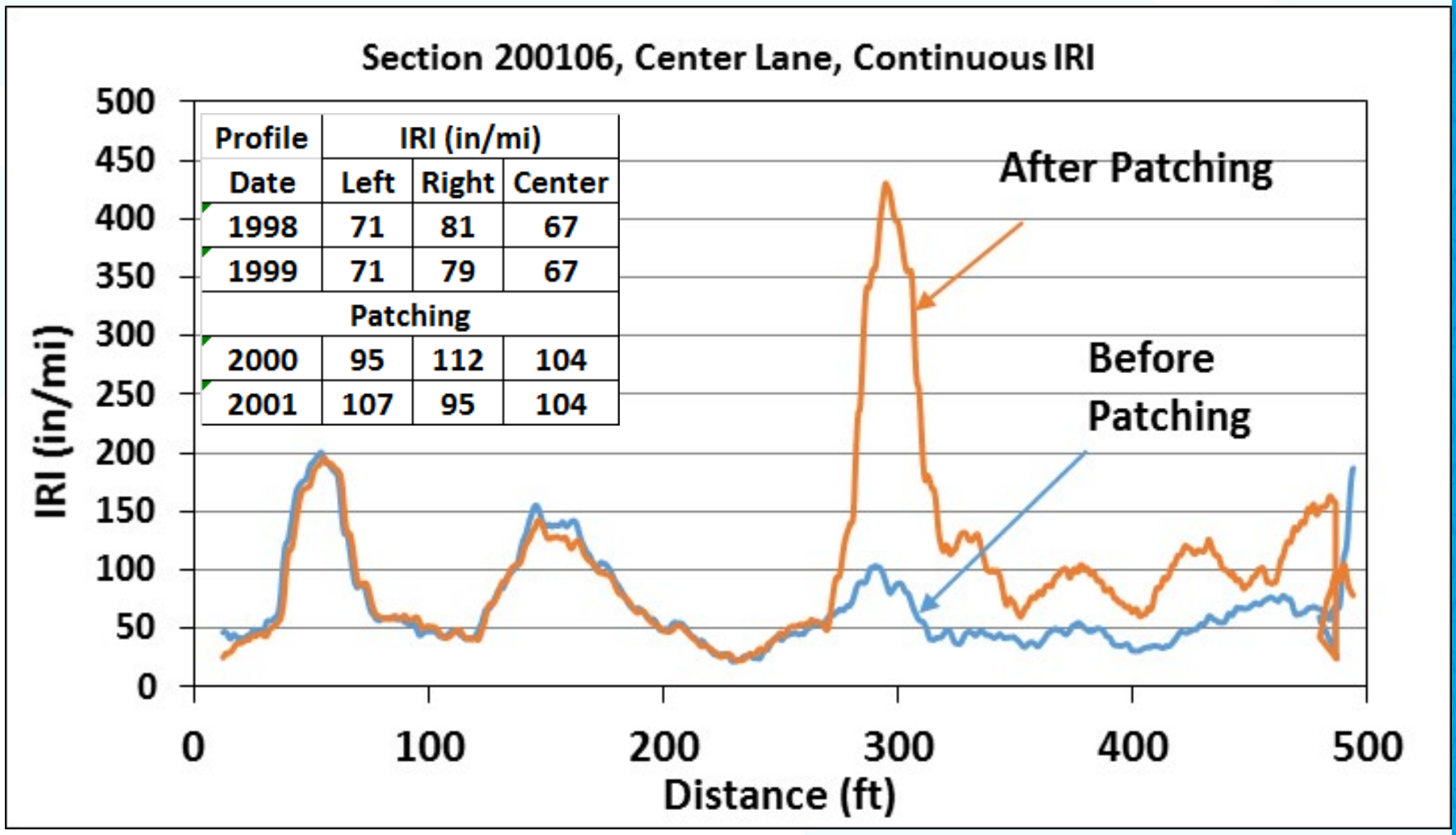


Observations

- Interaction of environmental effects and subgrade type affects roughness progression.
- Provision of drainage was shown to have a major impact on roughness increase for pavements on fine-grained subgrade in the wey-freeze zone.

Effect of Patching (Pavement Repairs)

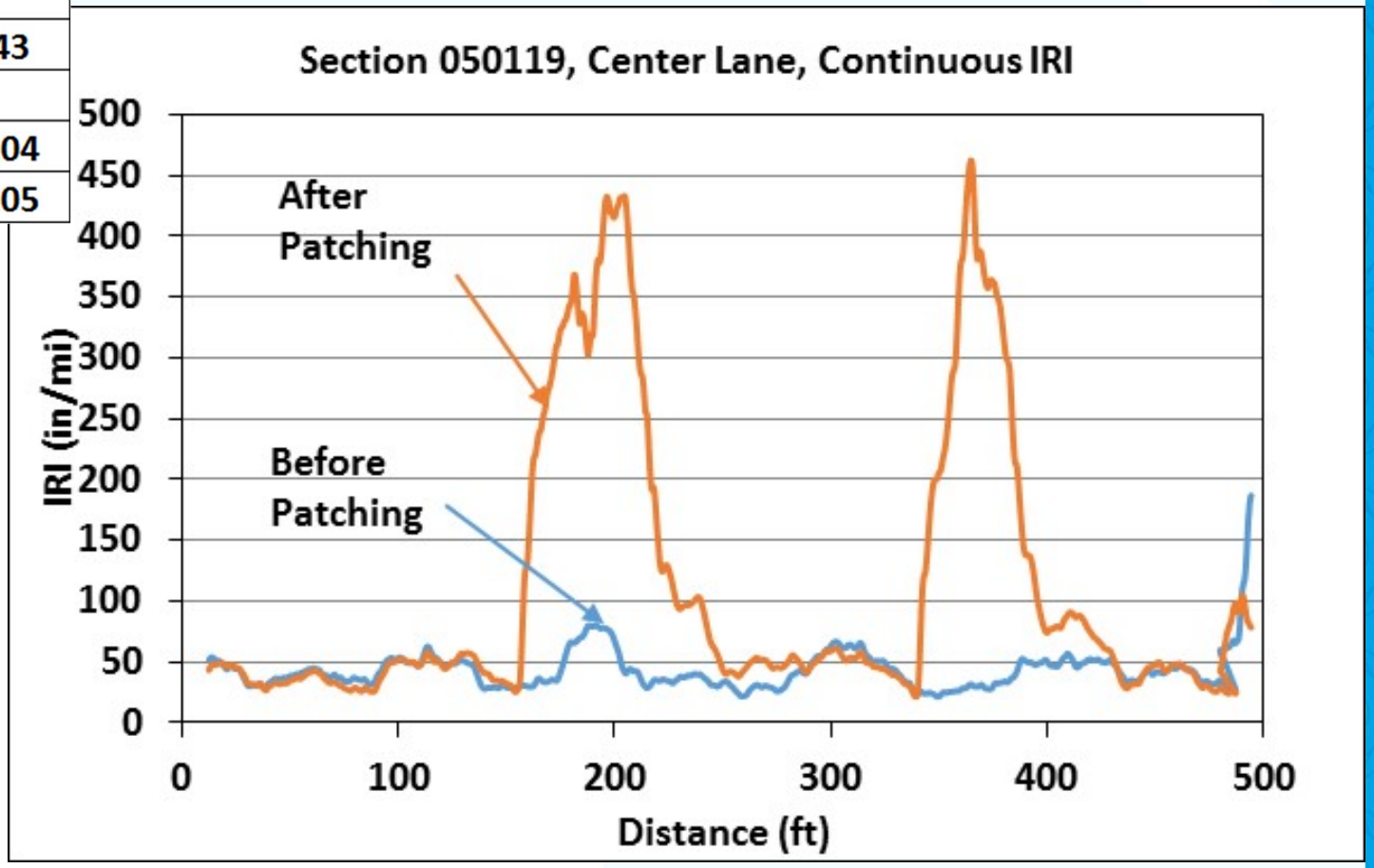
200106, Center Lane



Profile	IRI (in/mi)		
Date	Left	Right	Center
1998	71	81	67
1999	71	79	67
Patching			
2000	95	112	104
2001	107	95	104

050119, Center Lane

Profile	IRI (in/mi)		
Date	Left	Right	Center
1997	53	51	43
1999	Patching		
2001	120	85	104
2002	121	85	105



Summary

- Collecting profile data along center of lane can provide information on how environmental effects/subgrade conditions affect the IRI.
- Can be used to improve pavement design procedures to reduce effect of environmental factors on increase in IRI.
- Pay attention to pavement smoothness when doing patching.

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FHWA COR: Larry Wiser

Thank You!!