The History of Introducing IRI for Expressways in Japan

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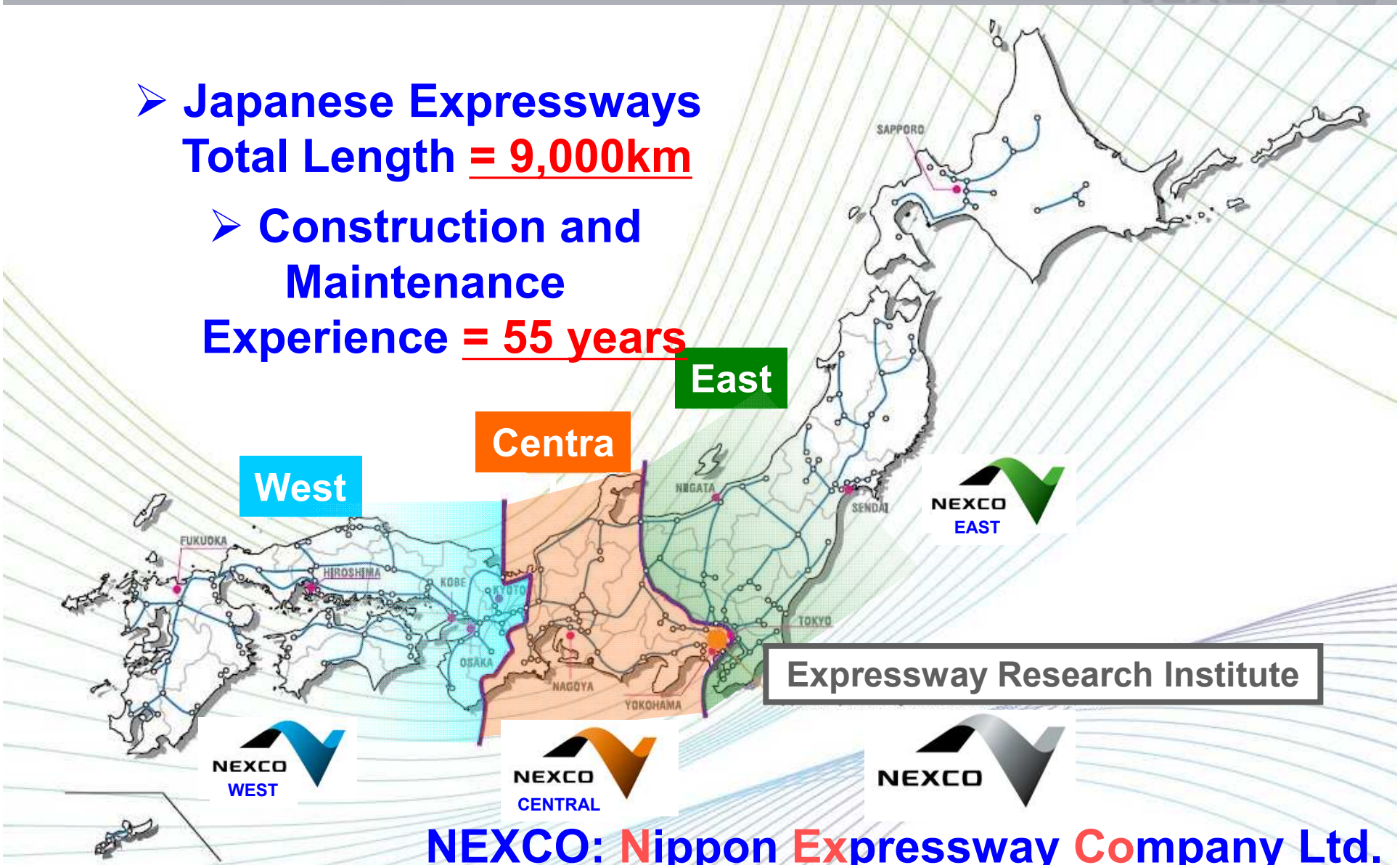
Japanese Expressway Network

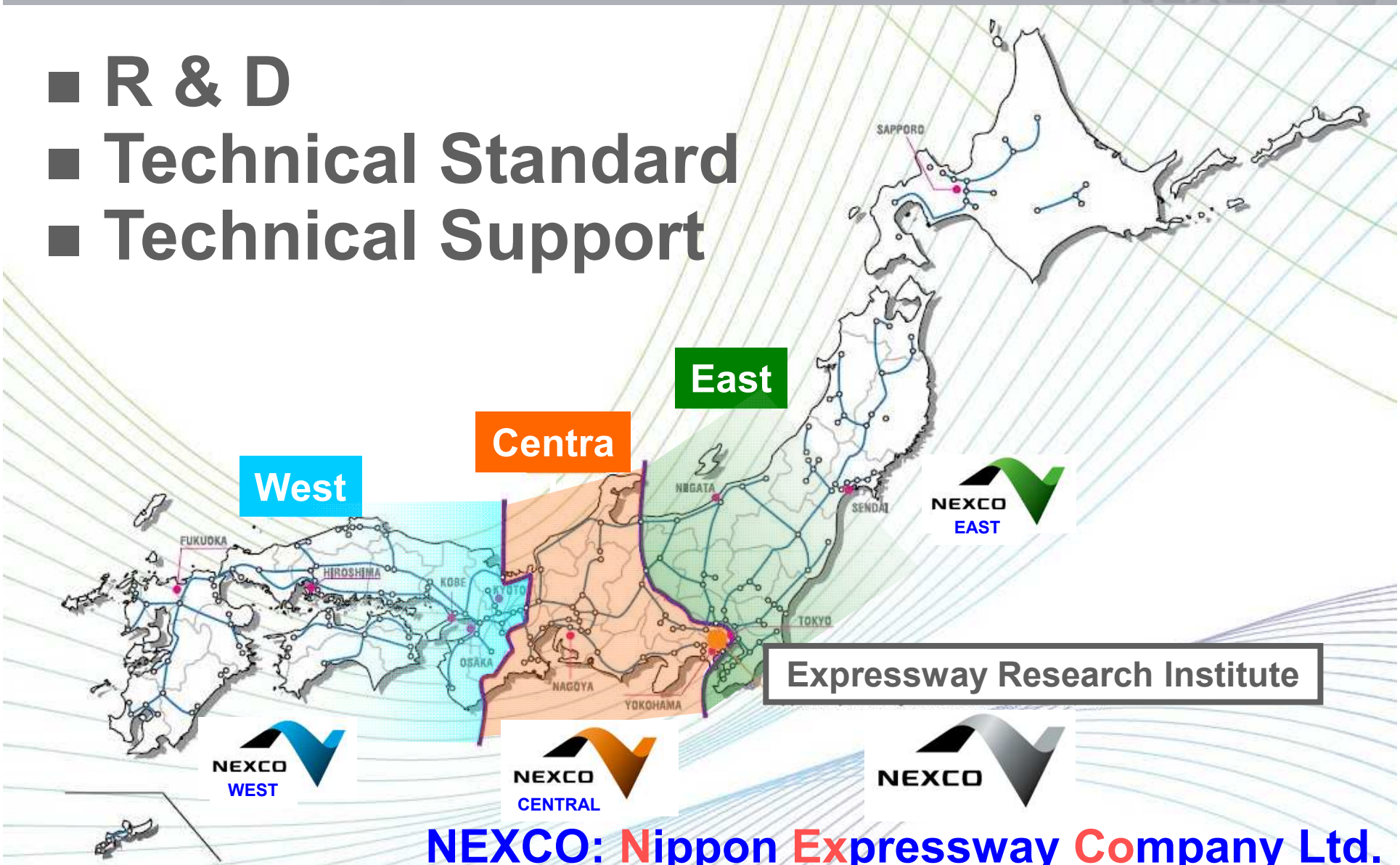
- **Japanese Expressways Total Length = 9,000km**
- **Construction and Maintenance Experience = 55 years**



NEXCO: Nippon Expressway Company Ltd.

Japanese Expressway Network

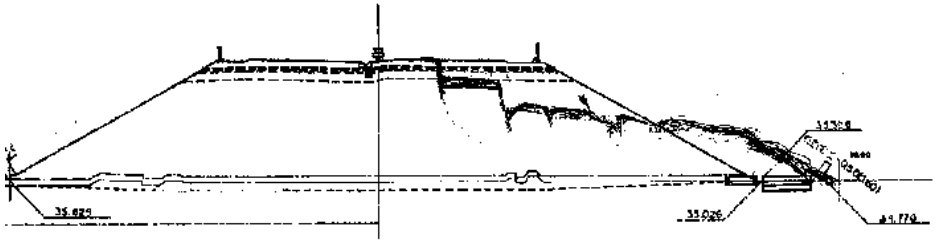
- R & D
- Technical Standard
- Technical Support



NEXCO: Nippon Expressway Company Ltd.

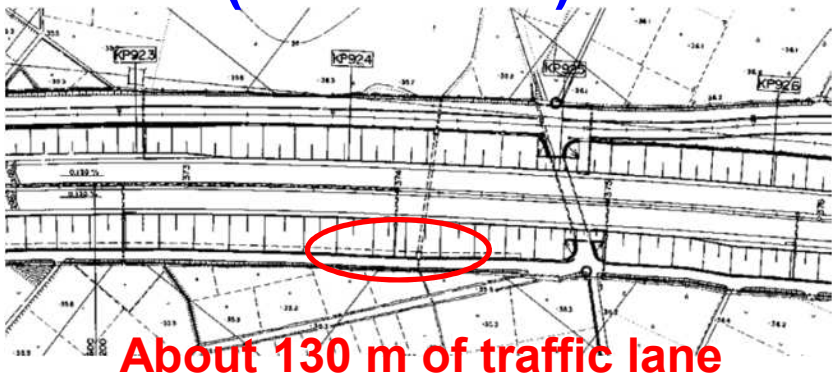
Great East Japan Earthquake

(Cross-section)



1 stage embankment collapsed over a total length of about 130 m with corrugated road surface embankment collapse

(Plain view)



About 130 m of traffic lane collapsed

2011.3.12 photo

Photo: NEXCO East

Quick Recovery

Emergency restoration was done in 6 days through day and night working.

Country Information

25 Million People

Texas

Austin
882 mm

696,000 km²

128 Million People

Tokyo
1500 mm

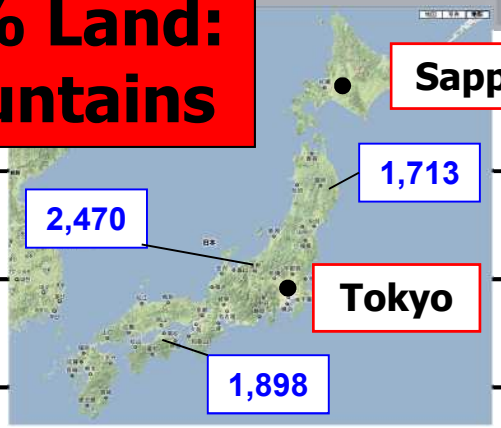
378,000 km²

Forest 249,000 km²

Source: Wikipedia, Ministry of International Affairs Communications

Annual Rainfall

70% Land: Mountains

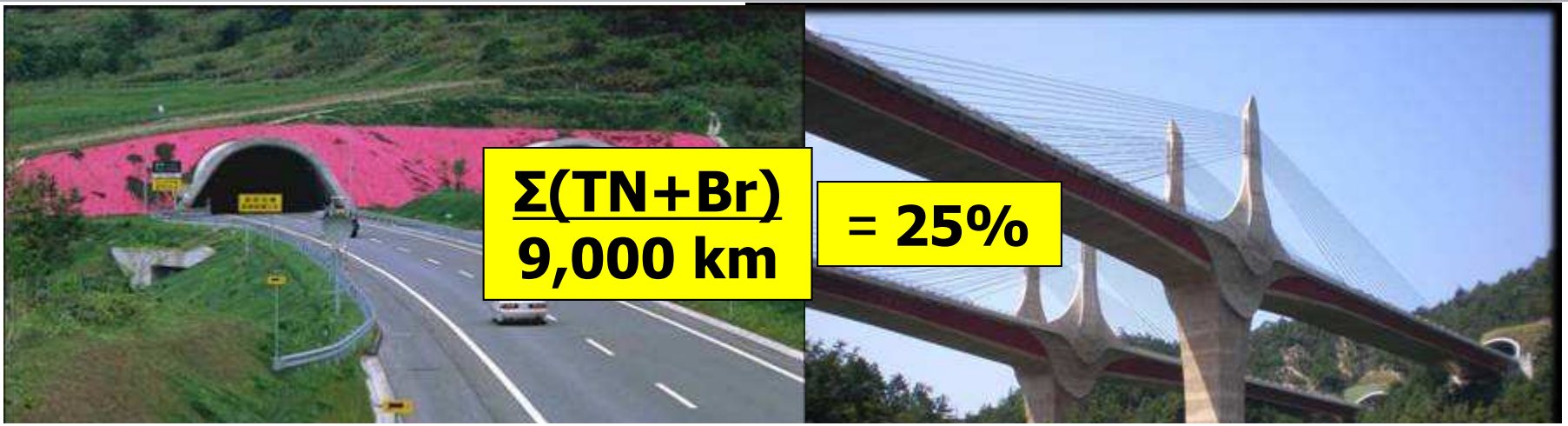


Annual Average Rainfall (mm)

3000
2500
2000
1500
1000
500
0

Paris
Rome
Munich
TX Austin
Sydney
Sapporo
Zurich
New York
Shanghai
Mexico City
Seoul
Tokyo
Hanoi
Manila
Singapore
Kuala Lumpur

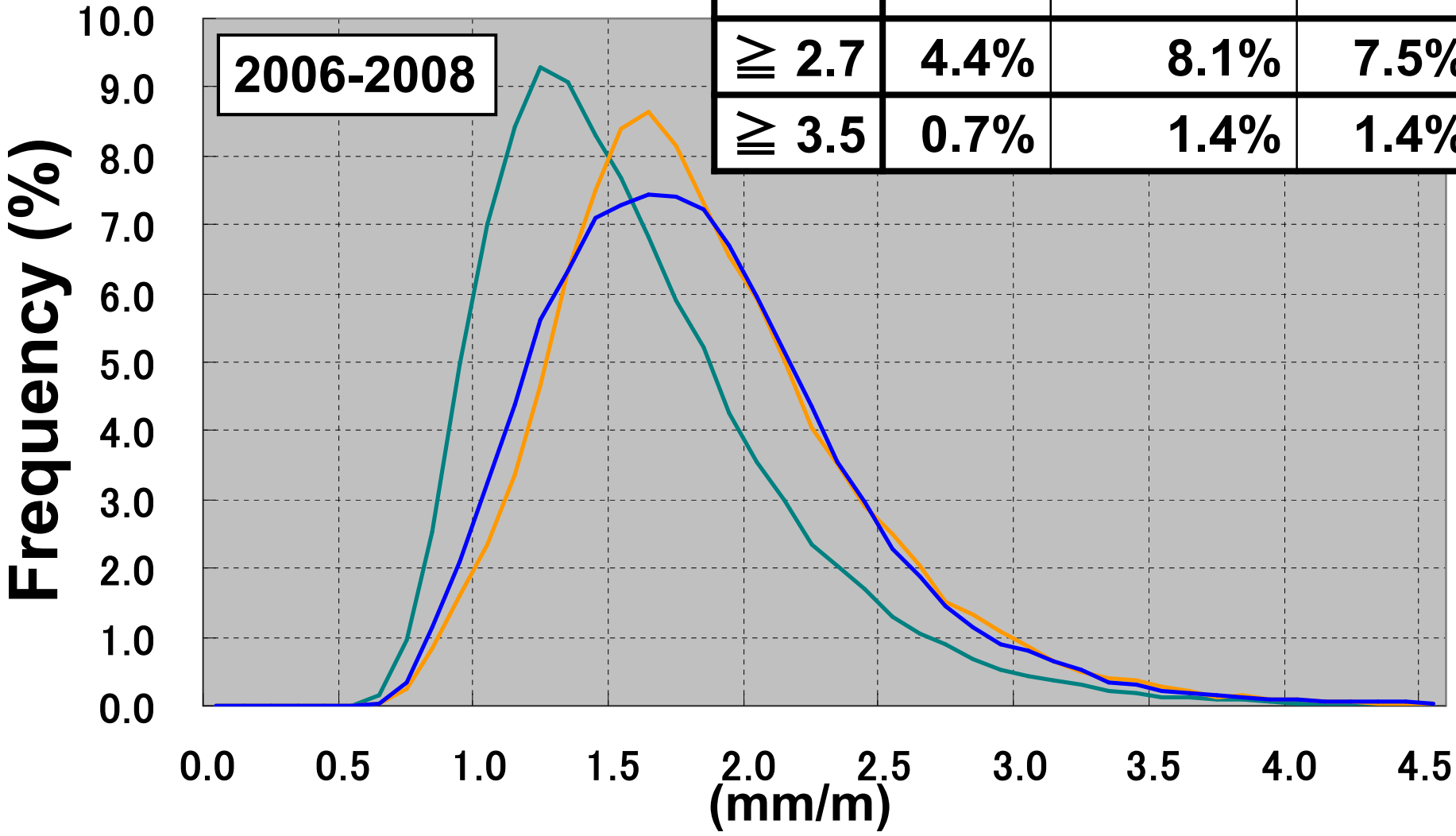
High Structures Ratio



1,445 km - 1,545 Tunnels 1,250 km - 13,500 bridges

IRI Distribution

IRI	East	Central	West
≧ 2.7	4.4%	8.1%	7.5%
≧ 3.5	0.7%	1.4%	1.4%



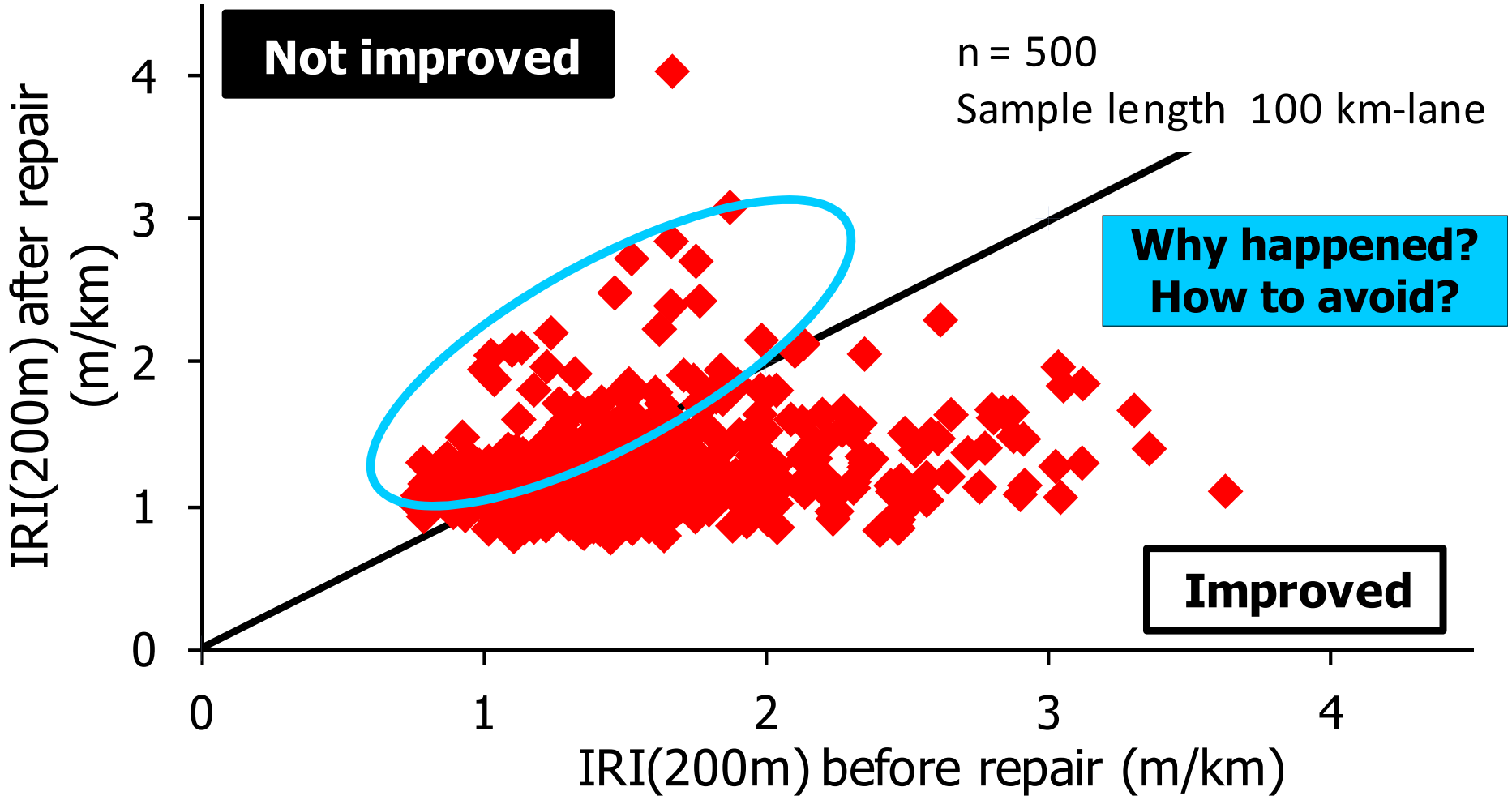
History of IRI Adoption

- Major changes at NEXCO - 主な技術基準

Objective	Previous Index	Current Index	Adopted
Repair judgement on in-service roads - 補修目標値	σ = 3.5 mm by 3-meter profiler	IRI(200m) = 3.5 mm/m	2007.8
Criterion for newly built projects - 出来形基準(建設)	Profile Index ≤ 5 10-cm/km on earthwork section; ≤ 8 10-cm/km on concrete structure by 8-meter profiler	On average IRI(200m) ≤ μ+1σ = 1.6 mm/m At maximum IRI(200m) ≤ μ+3σ = 2.4 mm/m	2015.7
Criterion for repair projects - 出来形基準(補修)	σ = 1.3 mm by 3-meter profiler	On average IRI(200m) ≤ μ+1σ = 2.0 mm/m At maximum IRI(200m) ≤ μ+3σ = 3.0 mm/m	2017.7

IRIs before & after repair

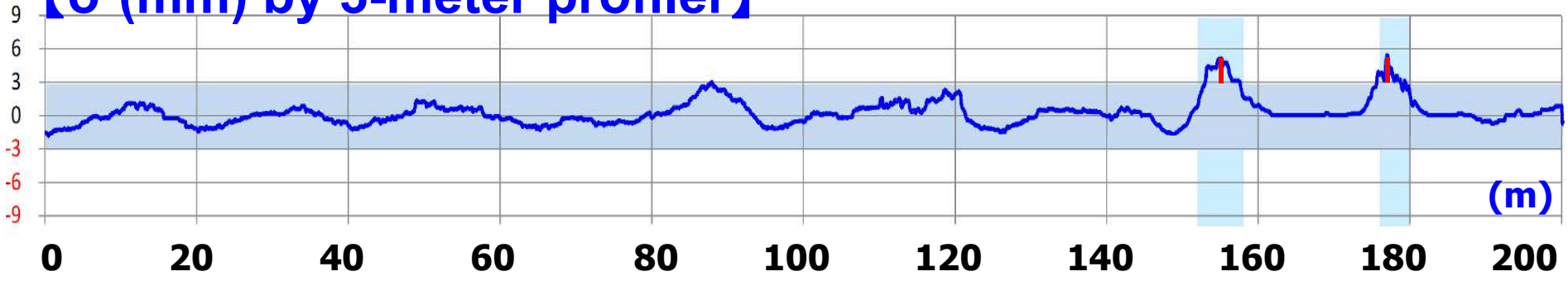
Conventional σ caused unreasonable problems.



IRI-σ Incompatibility

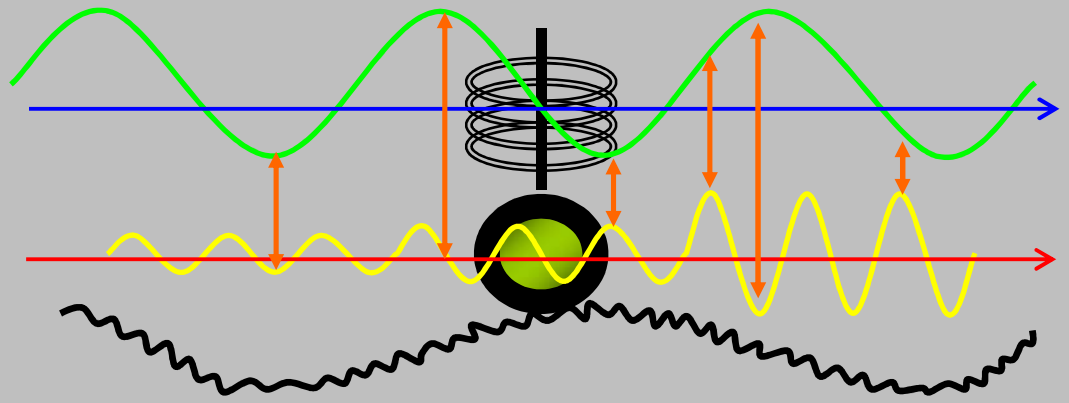
IRI's criterion had to be developed independently from that of σ.

【σ (mm) by 3-meter profiler】

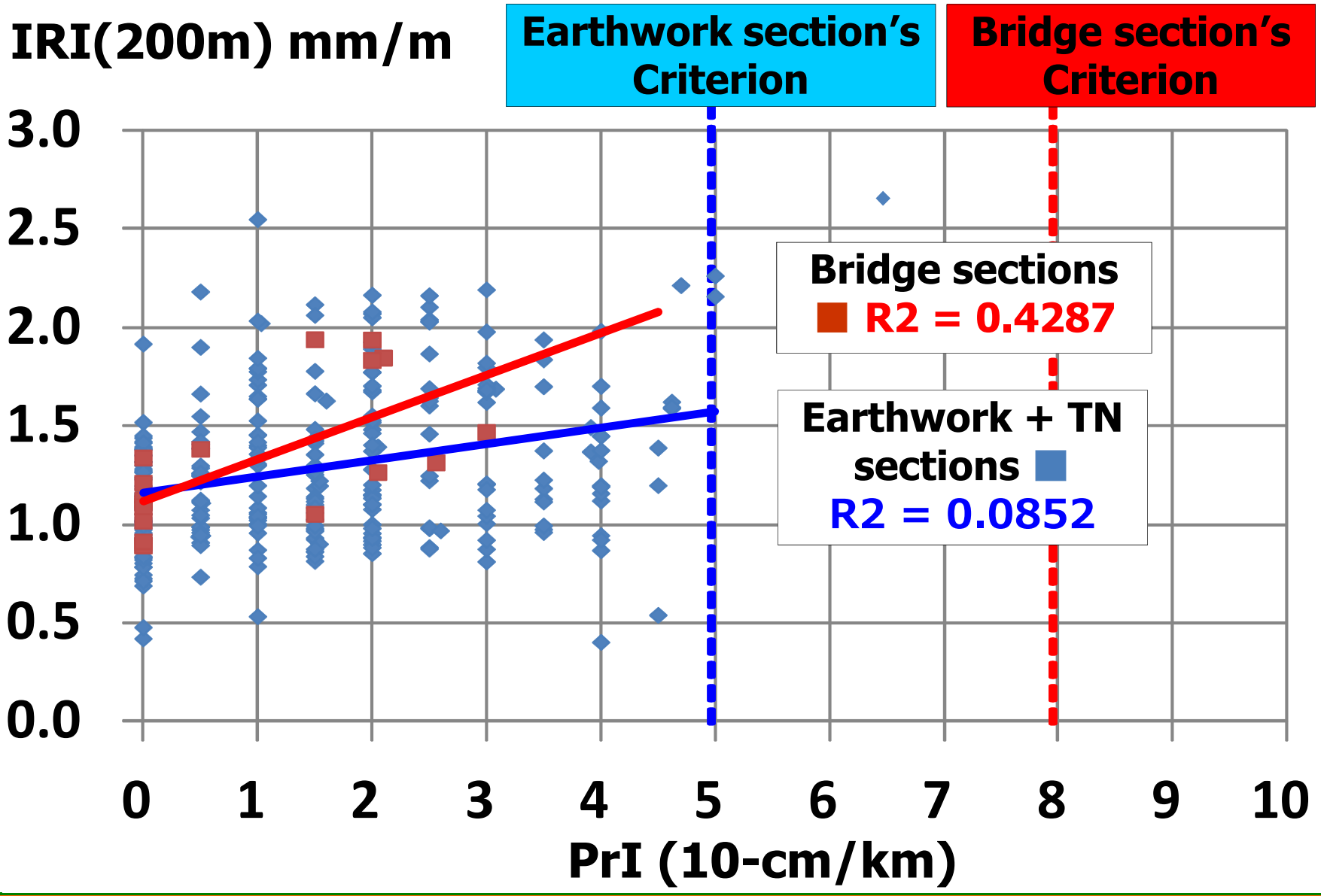


【IRI using Quarter-car simulation】

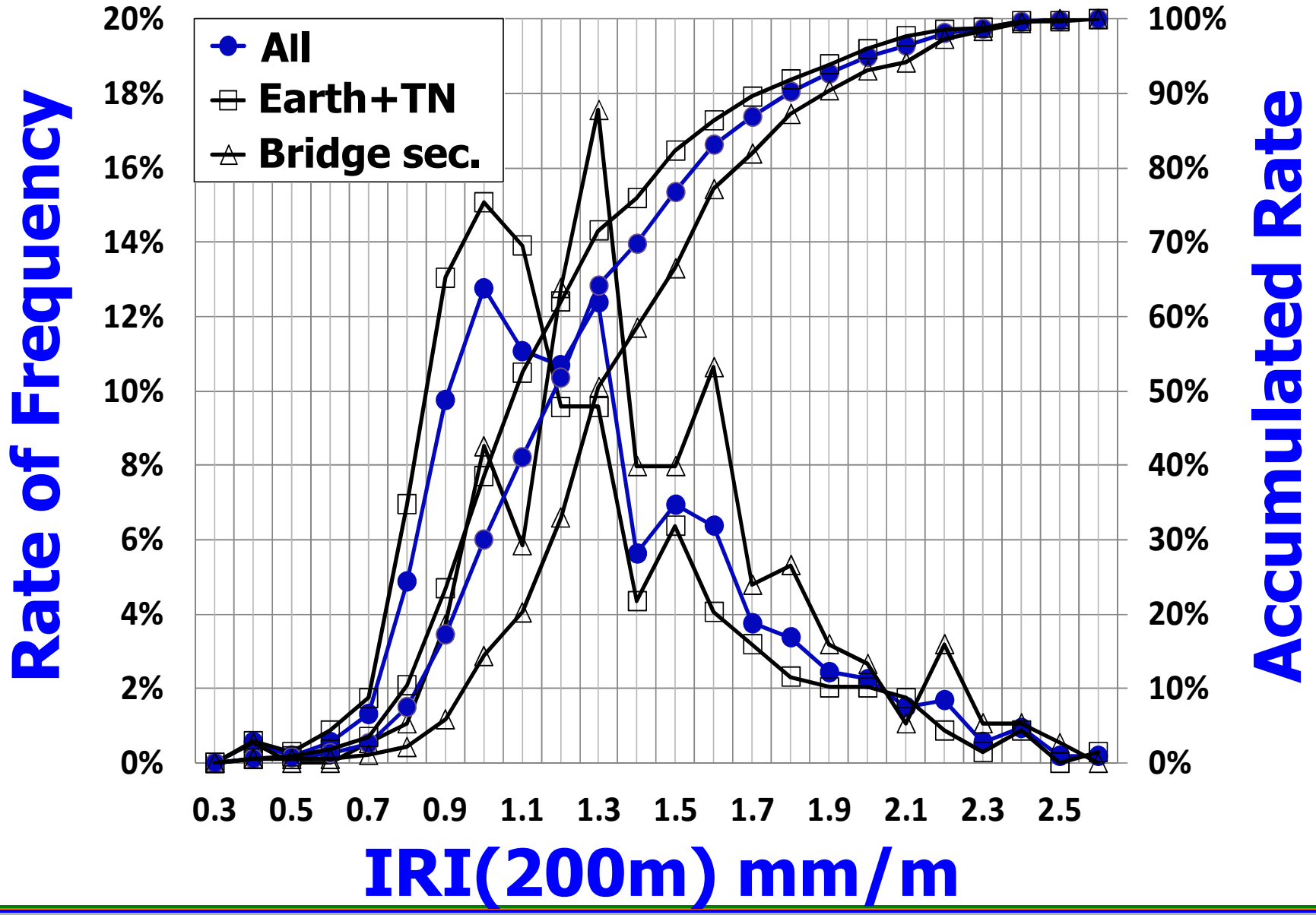
IRI の出来形基準は σとは無関係とした。



IRI vs. Profile Index



New Projects IRI (2014)



Criterion for New Projects

- Results of from 2014 new projects

  IRI(200m):

Structure	Average	Ave+1σ	Ave +3σ
All sections	1.3 mm/m	1.7 mm/m	2.4 mm/m
Earthwork+TN sections	1.2 mm/m	1.6 mm/m	2.4 mm/m
Bridge sections	1.4 mm/m	1.8 mm/m	2.5 mm/m

- Average IRI(200m) ≤ 1.6 mm/m and,

  Maximum IRI(200m) ≤ 2.4 mm/m

However, quite naturally, repair projects are controversial and needed more deliberation.

Repair Procedures

1990s

At NEXCO

Lane-basis and time-limited

Midnight repairs are quite usual in heavy traffic.

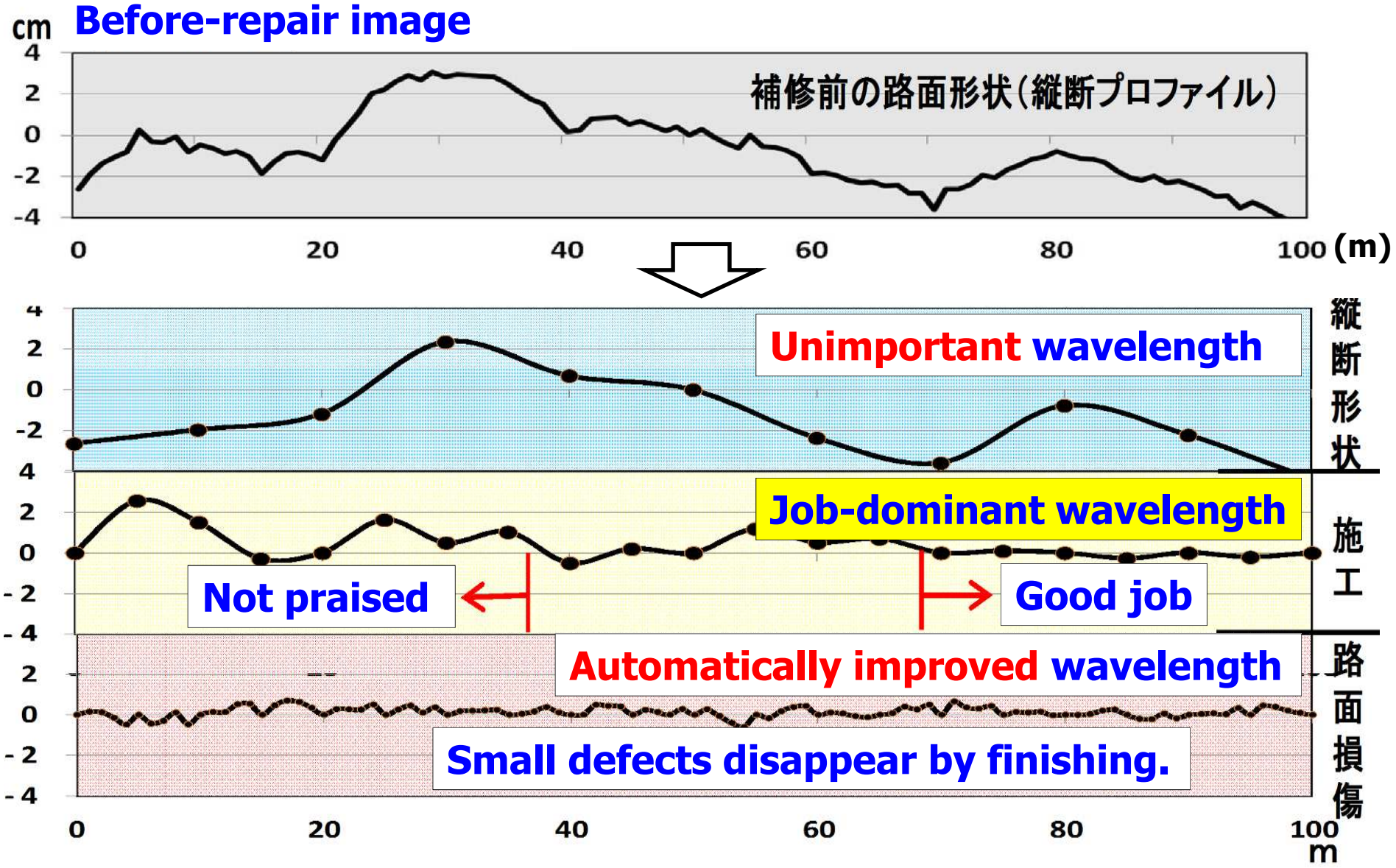
2007

A9 Berlin-Munich

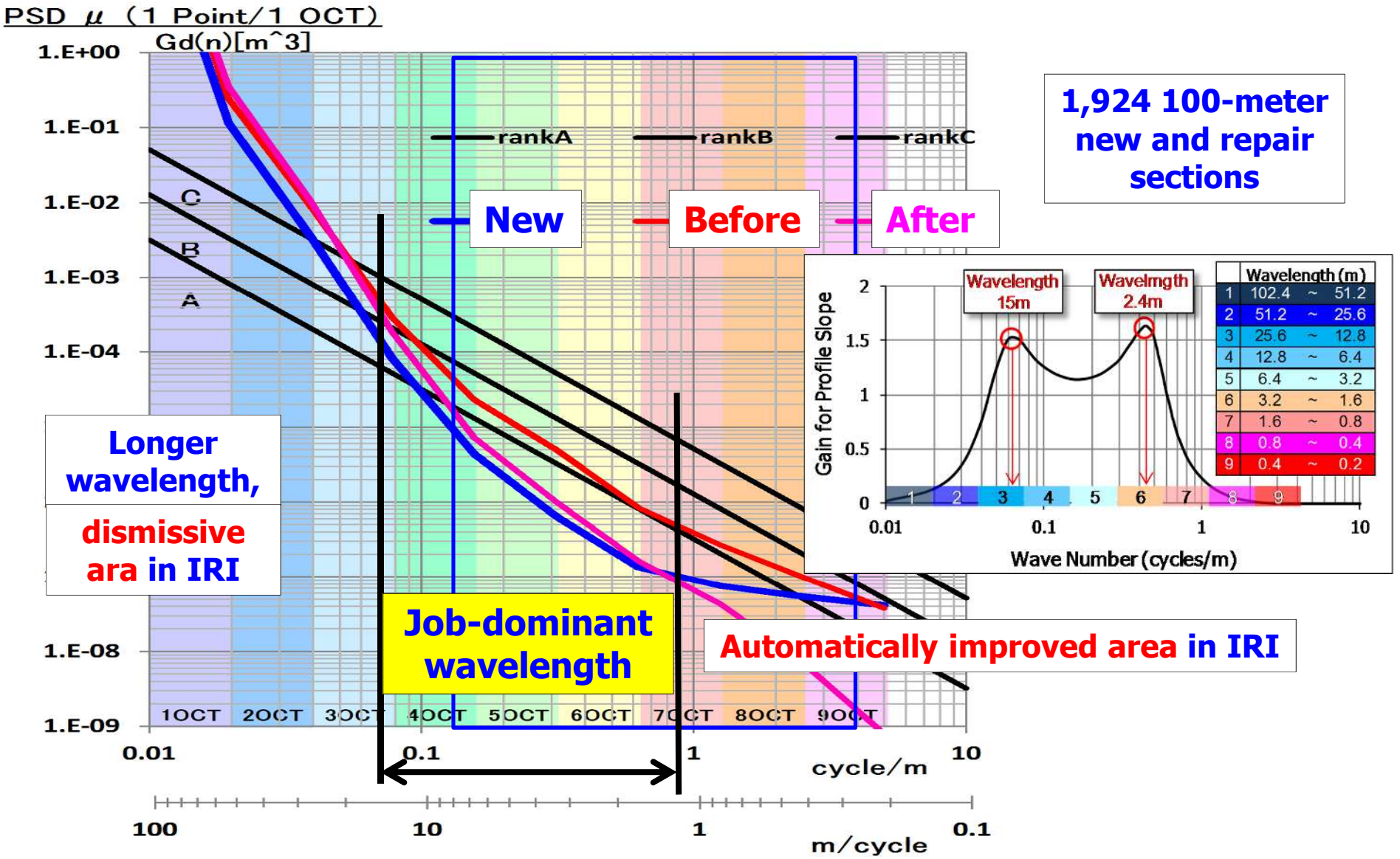
An entire 3-lane direction was closed for long days.

2007

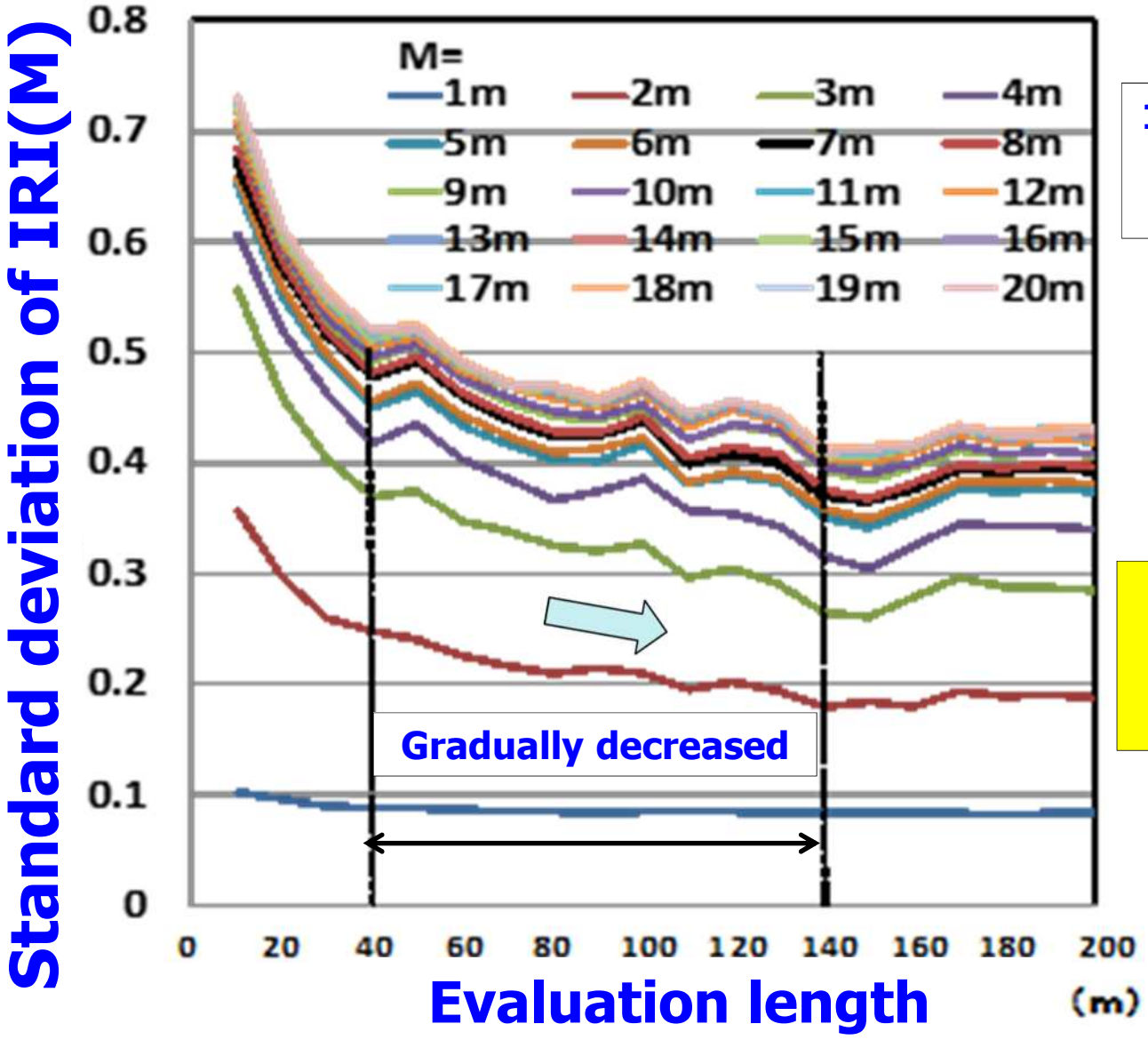
Longitudinal profile analysis



Practical data at NEXCO



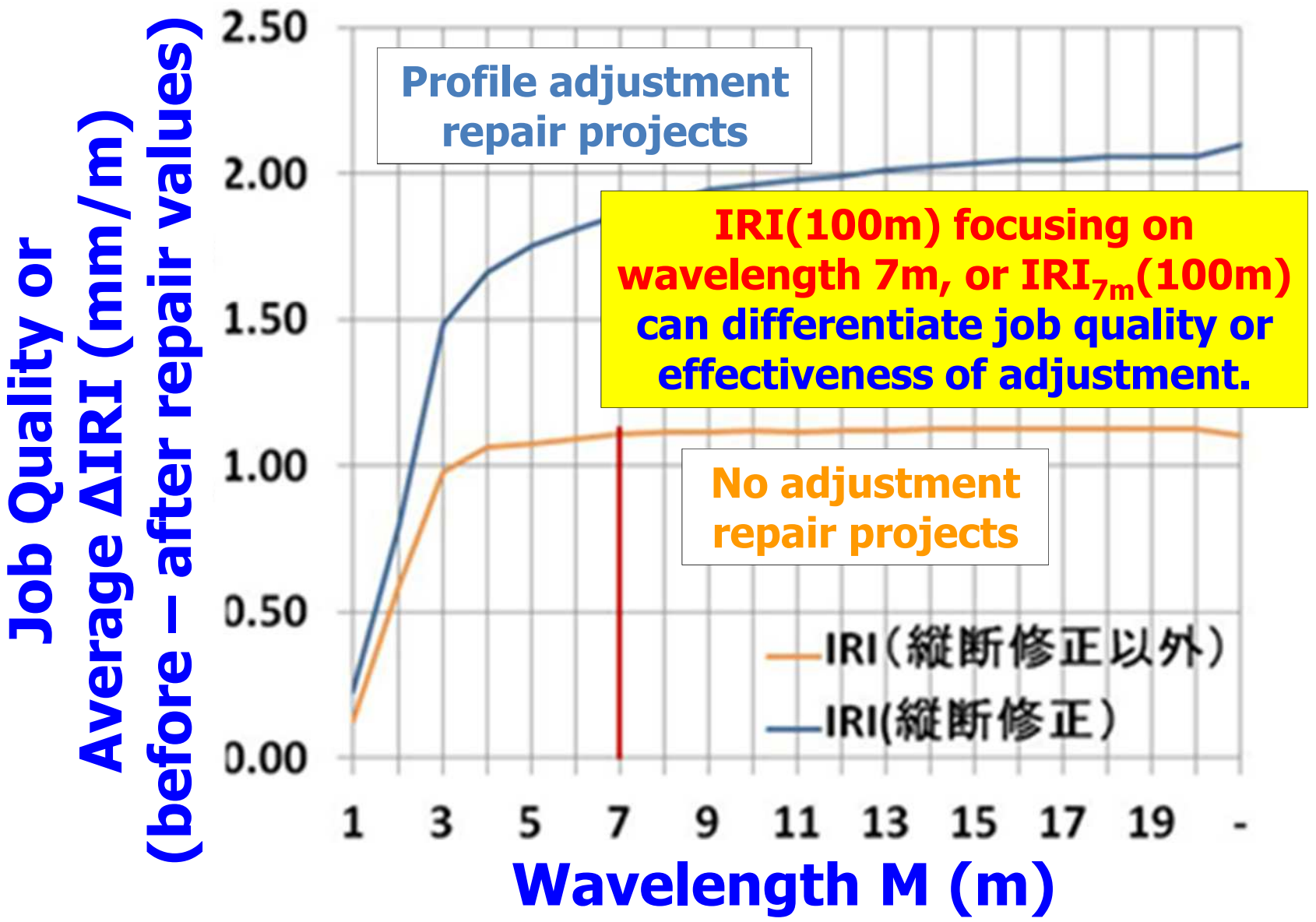
Evaluation length to stabilize IRI



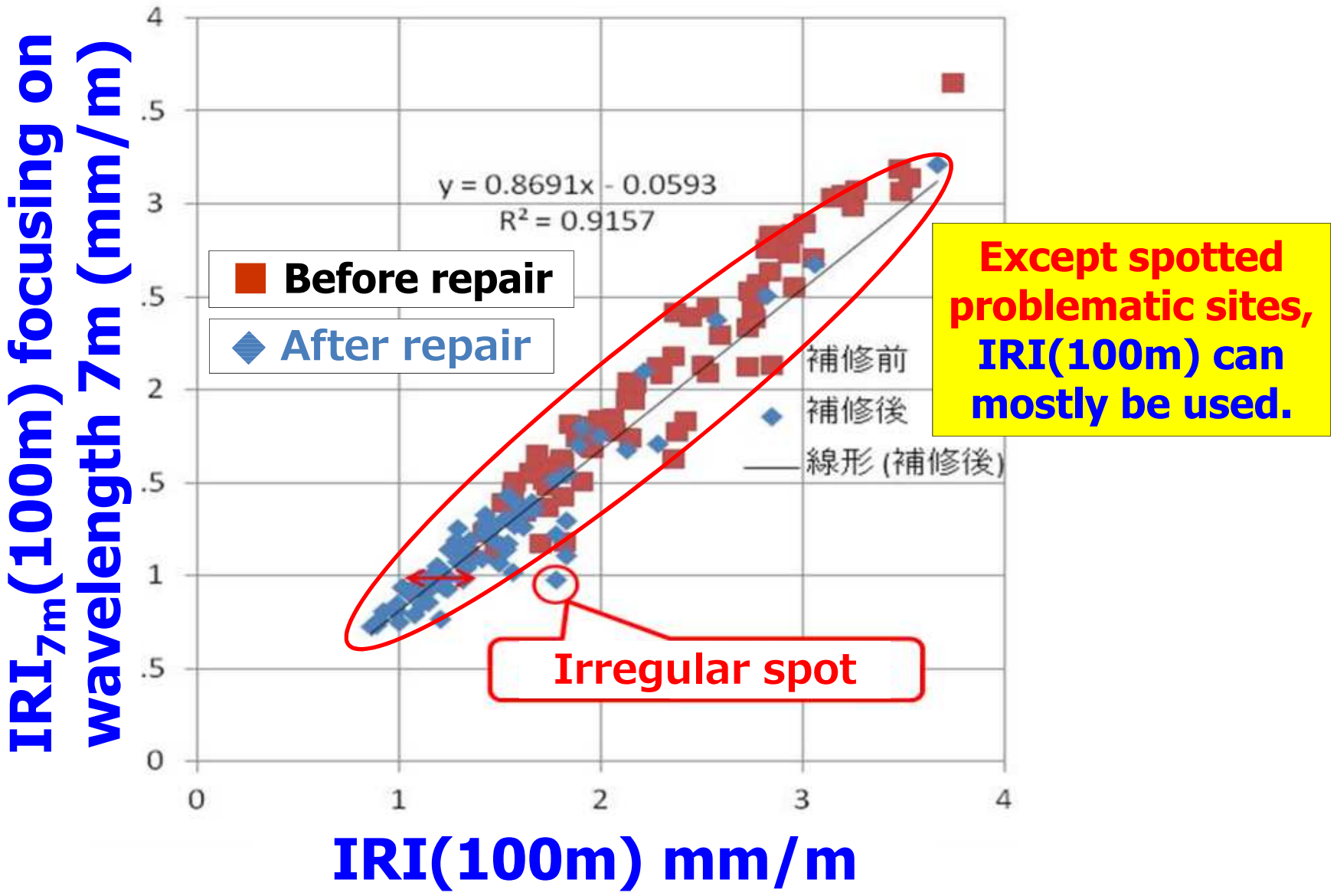
1,924 100-meter new and repair sections

IRI(100m) can be valued from practicality.

Wavelength to focus Job Quality

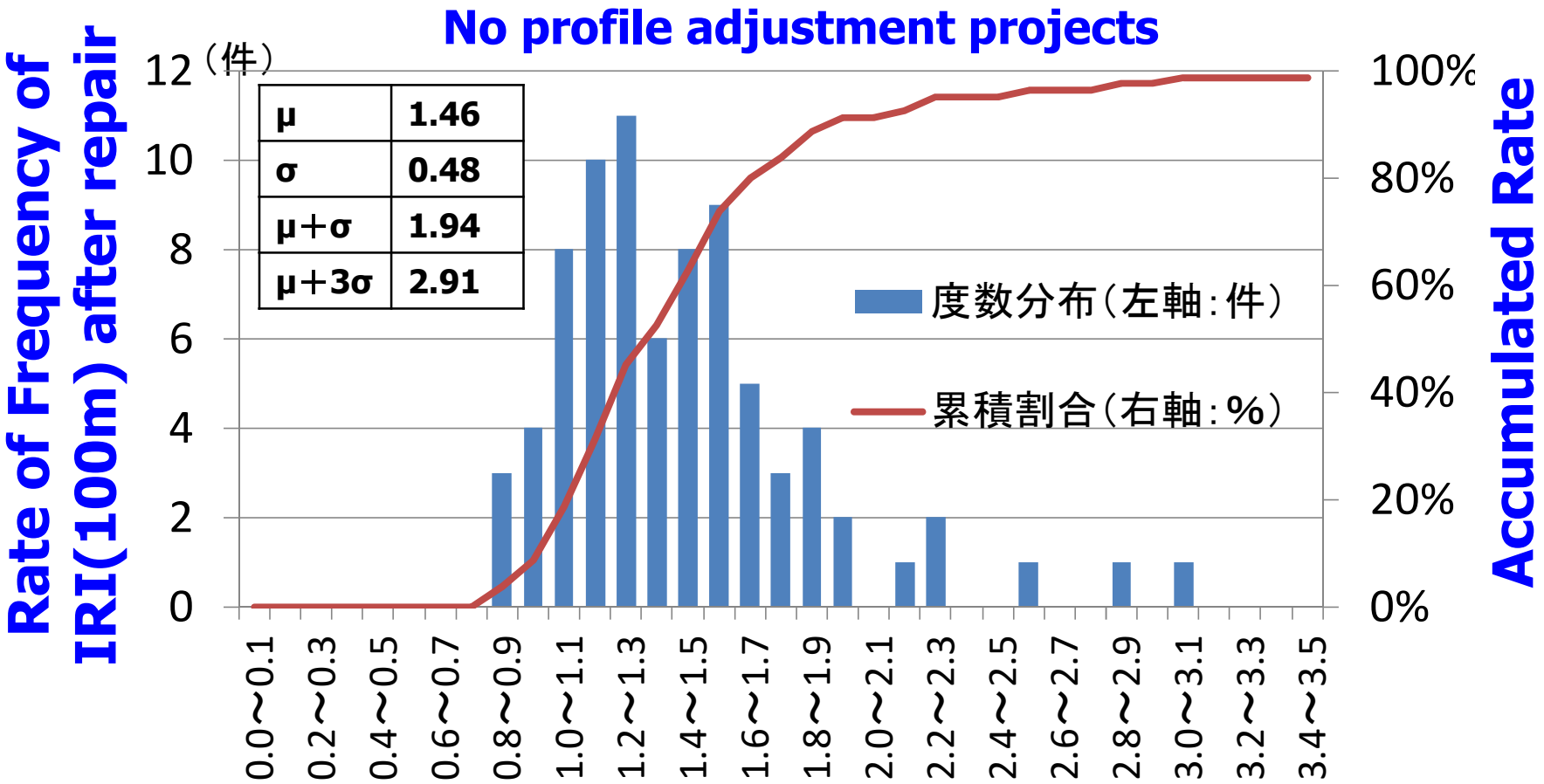


IRI_{7m}(100m) and IRI(100m)



Minimum repair length

Criterion for repair projects



- **Average IRI(100m) ≦ 2.0 mm/m and, Maximum IRI(100m) ≦ 3.0 mm/m; However, if repair length ≦ 100m, max IRI is only to apply.**

Requirement to profilers

- Accuracy requirements of a low-speed profiler to be used for contracting inspection in terms of IRI evaluation:
  - #1 Profile agreement with Class-1 reference to at least 0.95 (overall range) and 0.9 (wavelength range 1.6-25 meter)
  - #2 IRI error no greater than 2.5%, and
  - #3 a gain error no more than 5% (wavelength range 1.6-50 meter)

Thank you for your attention!