ID=0037

Evaluating the Degree of Visibility Deterioration Perceived by Drivers during Snowstorms

16th International Road Weather Conference
Helsinki Finland 23 – 25 May, 2012

Masaru Matsuzawa* and Hirotaka Takechi*
*Civil Engineering Research Institute for Cold Region, PWRI, Japan

Introduction

Back Ground

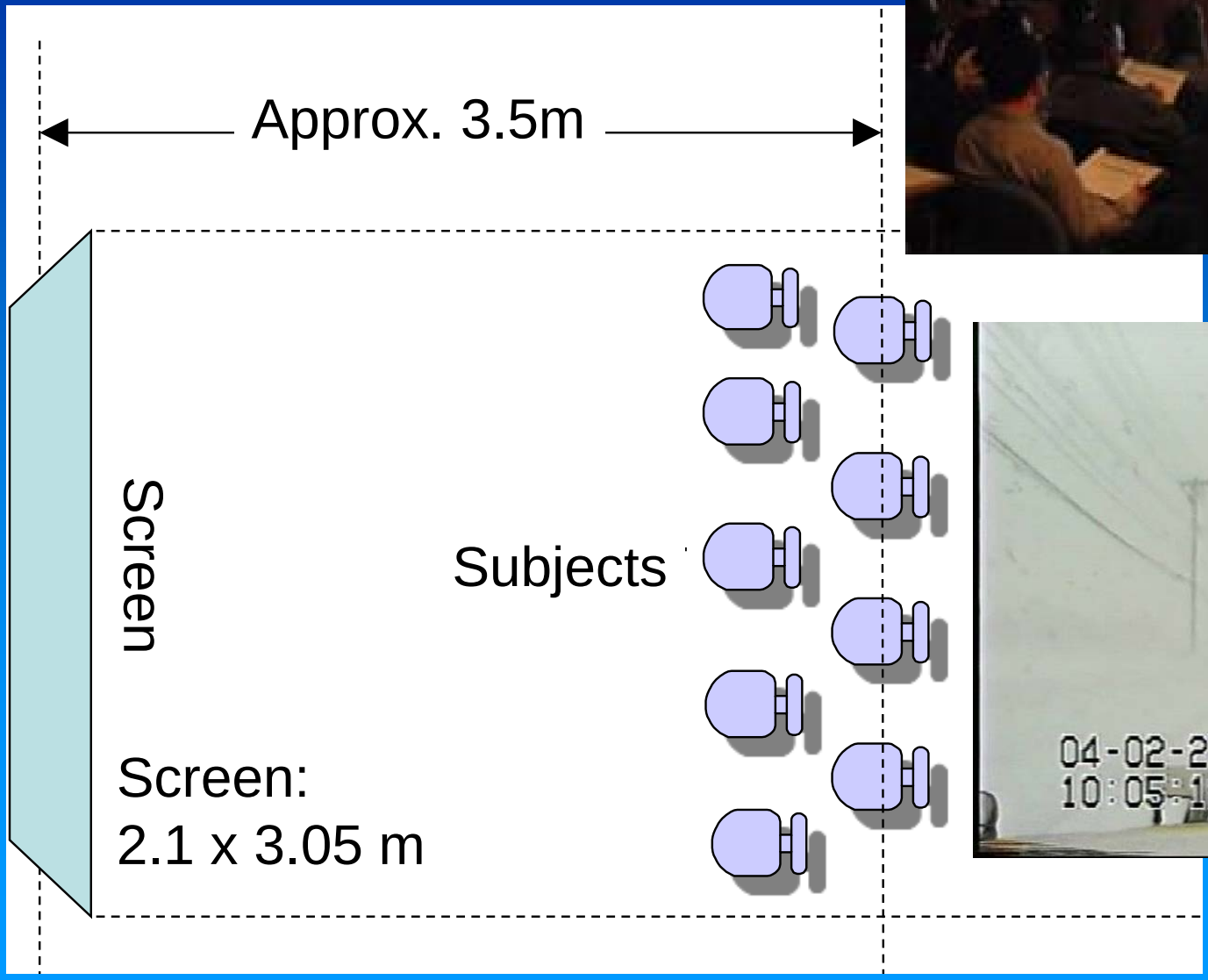
- Road closures and multi-vehicle collisions often result from visibility deterioration caused by snowstorms.
- Currently, visibility meters are used to measure visibility based on MOR (meteorological optical range.)
- Visibility perceived by drivers may vary with facilities or road side conditions along routes, even for the same MOR.

Purposes of the Survey

- Relationship between MOR and perceived visibility
- A method for the evaluating visibility deterioration

→ Human subject experiments on perceived visibility by viewing videos

Method for the Experiments



Northern Road Research

Method for the Experiments (cont.)

- **Videos were recorded from a vehicle traveling in a snowstorm**
- **Visibility was simultaneously measured.**
- **Roadside conditions or facilities were identified from the videos.**

1. Delineating facilities (fixed-post delineators, delineators)
2. Snow control facilities (collector snow fences, blower snow fences)
3. Continuous woods along routes
4. Roadside barriers
5. Roadside houses
6. Utility poles

172 ten-second videos

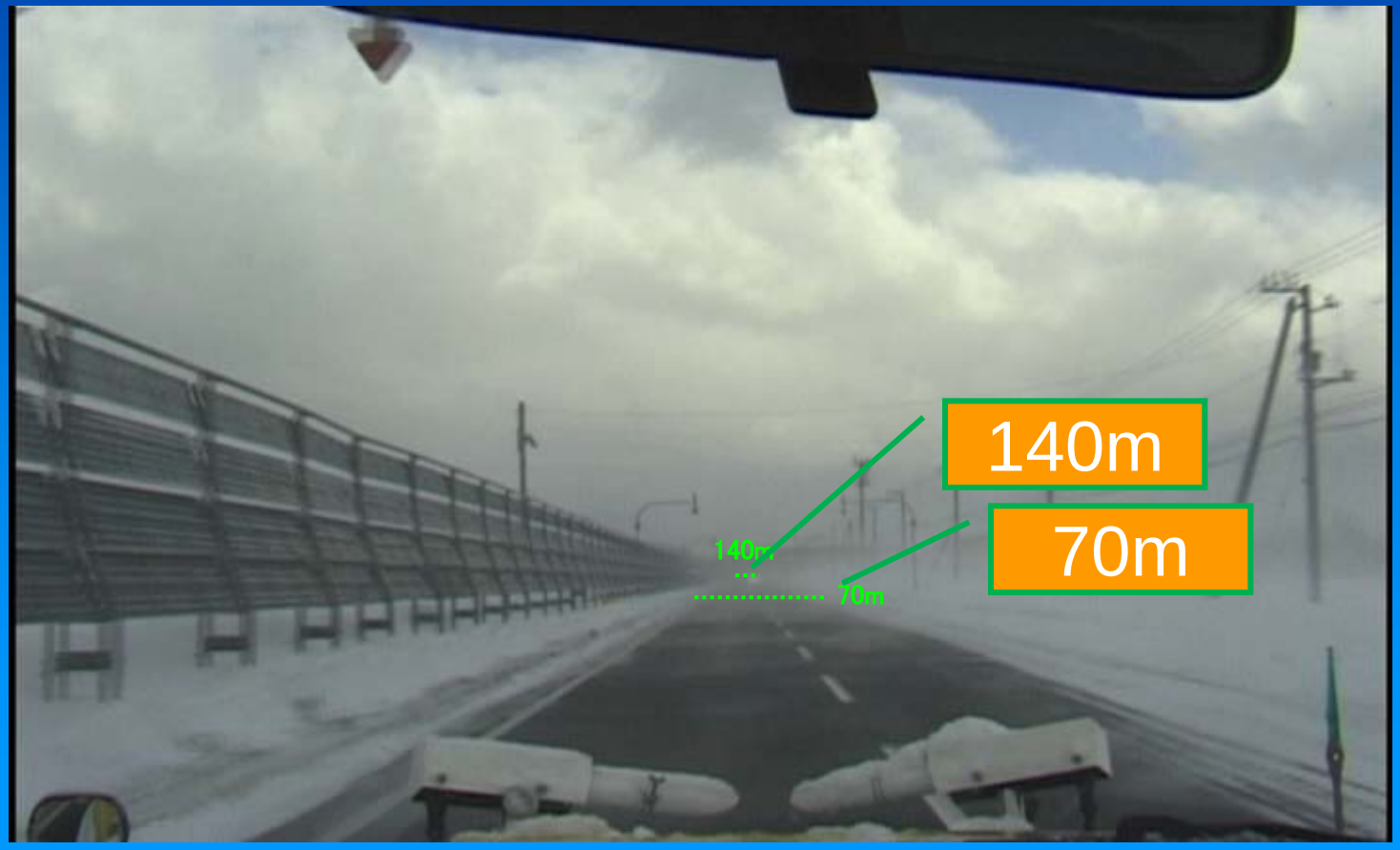
Fixed-post delineators with arrow-shaped pointers

Delineators

Blower snow fence

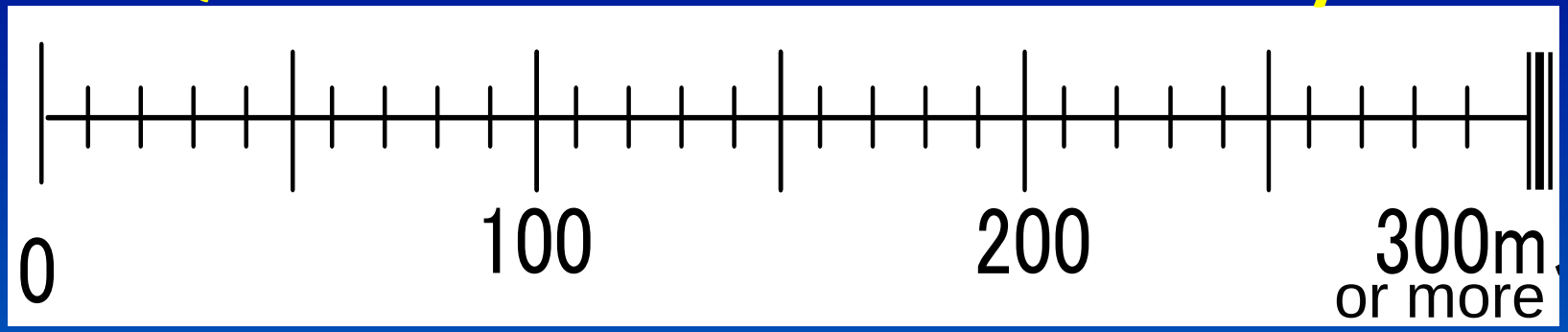
Method for the Experiments (cont.)

- Before the test videos were played, following sample was shown to the subjects to help them evaluate distances on roads.




2008-02-13 16:34:30
移動観測01

Question No. 1: Perceived Visibility



Question No. 2: Driving Intention

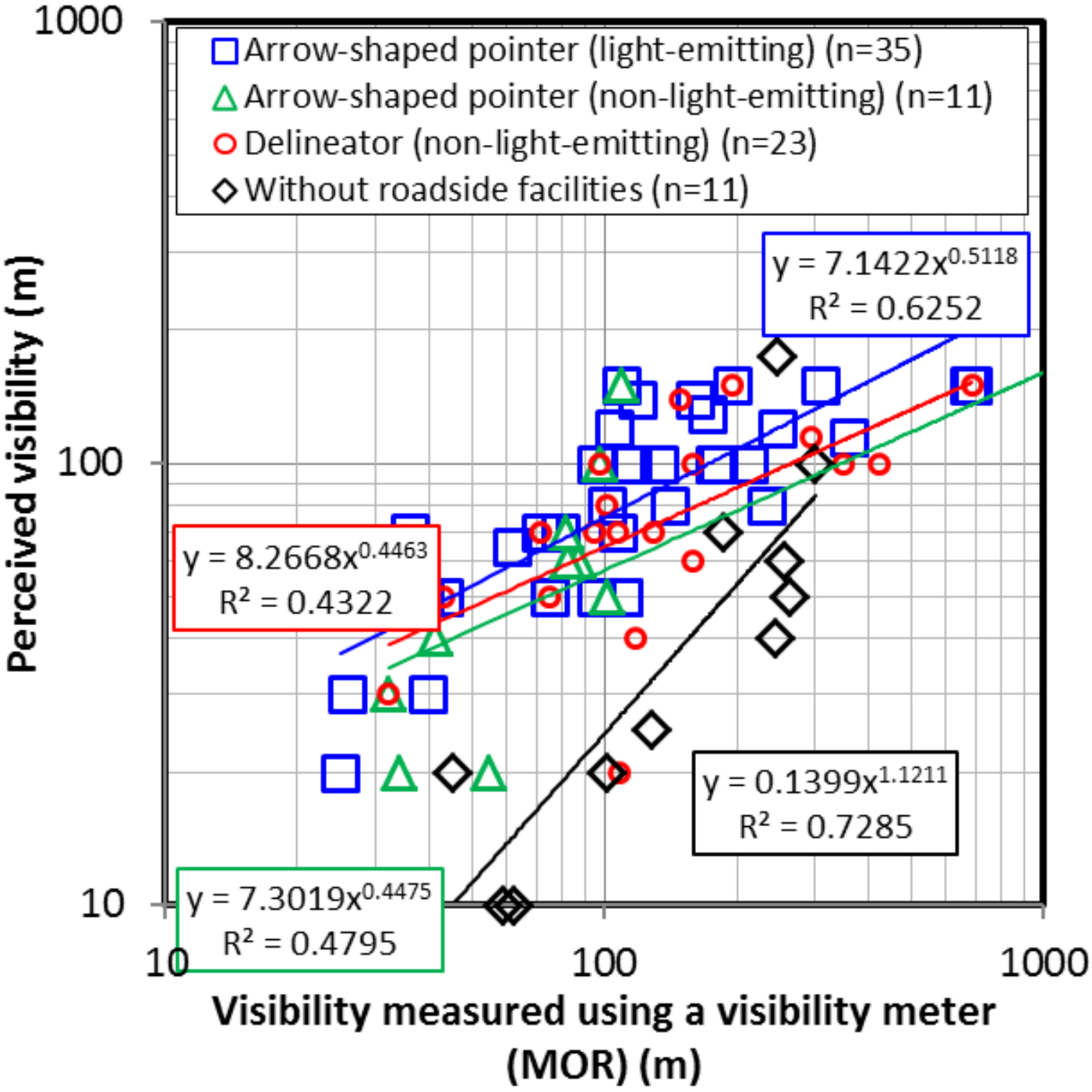
Ranks	Driving behaviour the subject would choose based on the road conditions shown in the video
5	I'd keep driving at normal speed because visibility is relatively good.
4	I'd keep driving slowly due to poor visibility.
3	Driving would barely be possible, but I'd stop the car if there was a convenience store, a gas station or some other place to park.
2	I'd rather pull over because it would be difficult to drive, but I think I'd have to keep driving.
1	I'd pull over because it would be impossible to drive.

Subject's attributes

		No. of respondents to the question on Q1, perceived visibility	No. of respondents to the question on Q2, driving intentions
Gender	Male	178	73
	Female	190	88
Age	20s	82	40
	30s	135	53
	40s	78	36
	50s	37	15
	60s +	36	17
Total		368	161

Results

Relationship between perceived visibility and MOR: comparison of conditions with and without delineating facilities



Quantitative determination for the effects of roadside and meteorological factors on perceived visibility through multivariate analysis

Explanatory variables

- Fixed-post delineators with arrow-shaped pointers
- Delineators
- Snow control and other facilities (snow fences, woods along routes and roadside barriers)
- Utility poles
- Houses
- Visibility (MOR) measured using a visibility meter
- Visibility fluctuation (Equation 1)
- Snowfall

$$I = \frac{\sqrt{\overline{\left(\overline{V} - V\right)^2}}}{\overline{V}} \cdot 100 \quad \cdots\cdots\cdots\cdots\cdots\cdots \quad (1)$$

Where,

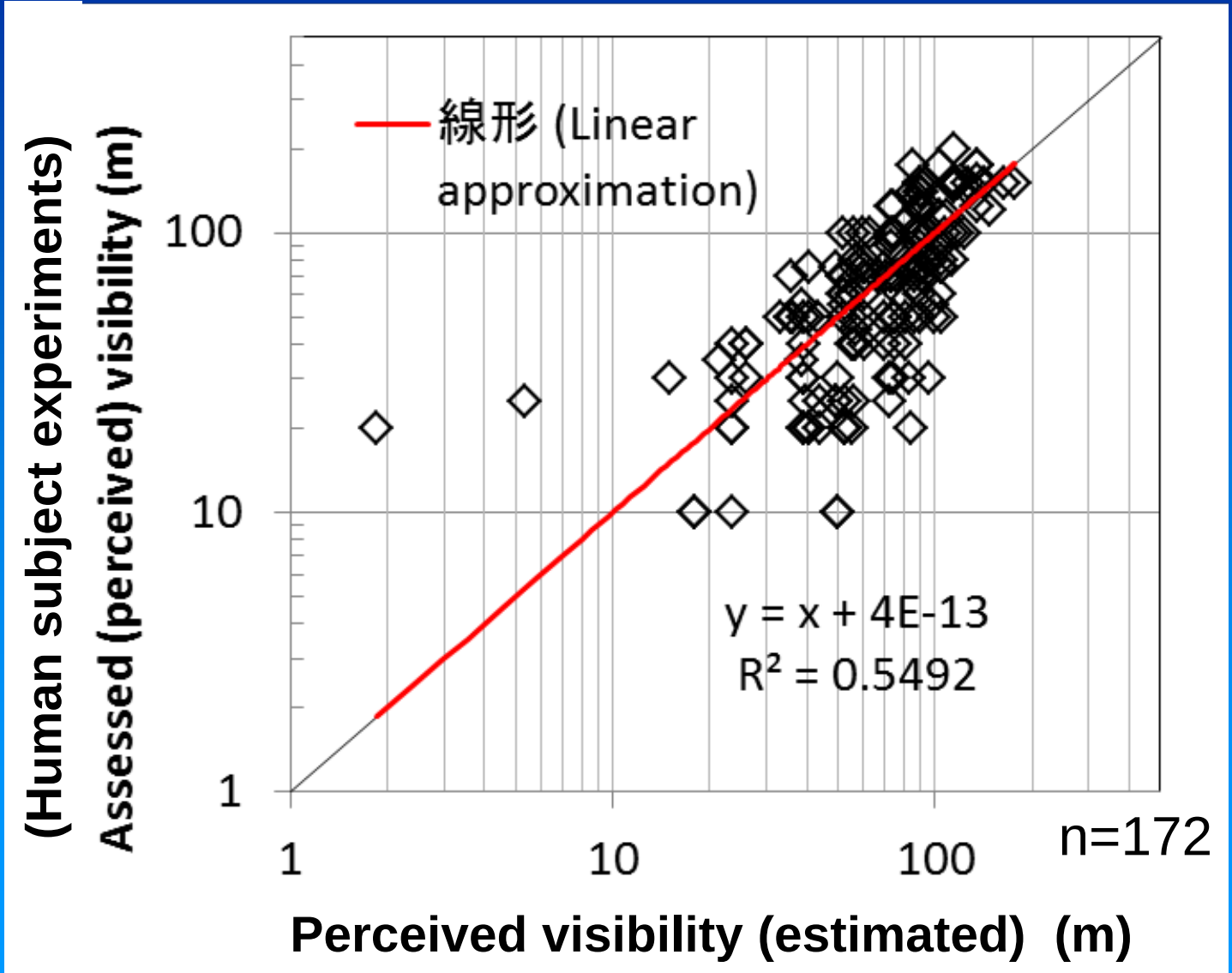
I: Visibility fluctuation (%),

V: Visibility (m)

Perceived visibility evaluation sheet

Items (Explanatory variables)	Rating standard	Score	
a. Visibility measured using a visibility meter (average for the survey period)	< 50m	-34	
	50-100m	-17	
	100-200m	17	
	>=200m	40	
b. Visibility fluctuation	<50%	2	
	>=50%	-2	
c. Snowfall	Yes	-4	
	No	24	
d. Fixed-post delineator with arrow-shaped pointers	Yes	7	
	No	-6	
e. Snow control and other facilities (snow fences, woods…)	Yes	12	
	No	-9	
f. Utility poles	Yes	9	
	No	9	
g. Houses	Yes	13	
	No	-8	
h:Total (=a+b+c+d+e+f+g)			
Perceived Visibility (=h+73) (m) (estimated value)			

Comparison of visibility:
assessed in the experiment vs. estimation



Rating of snowstorm-induced visibility deterioration

Rank	Perceived Visibility (m) (Estimation)	Driving difficulty
A	125 or more	Driving at normal speed is possible.
B	60 - 125	Driving at low/reduced speed is possible.
C	30 - 60	Driving is barely possible and risky.
D	15 - 30	Driving is difficult and extremely risky.
E	Less than 15	Driving is extremely difficult.

Summary

- Visibility as perceived by drivers tended to be less than MOR value.
- Perceived visibility tended to be better when roadside facilities were present to provide visual targets.
- Method for evaluating visibility deterioration on a five-level scale based on perceived visibility and driving intension was proposed.

Thank you for your attention
Kiitos!

Snow and Ice Research Team
Civil Engineering Research Institute
for Cold Region, Japan

www2.ceri.go.jp

mailto:snow@ceri.go.jp
masaru@ceri.go.jp