



A STUDY ON THE ANALYSIS OF THE ROAD TRAFFIC SERVICE CHARACTERISTIC CORRESPONDING TO SNOWFALL AND ON THE ESTIMATION METHOD OF BENEFITS BY SNOW REMOVAL

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2. Background
3. Method
4. Analysis of QVK characteristics
5. Relationship between running speed and travel speed
6. Basic knowledge of benefit calculation

1. INTRODUCTION



1. INTRODUCTION

Description

Clarify the relationship between snow accumulation and road traffic in winter.

Present basic knowledge of estimating method of road network benefits of snow removal based on changes in road traffic conditions.

2. BACKGROUND

2. BACKGROUND

- Falling tax income
- Harsh opinions of investment in public works
- The weakening of the construction industry
- An aging of society
- Residents need for snow removal is changing

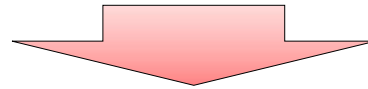


It is essential to improve methods
of managing roads in winter

2. BACKGROUND

In order to improve winter road management

- Efficient snow removal
- Effective road selection methods



Method of estimating the snow removal benefits
for road traffic

3. METHOD



3. METHOD

Research Flow

The QVK characteristics at the fixed observation points are analyzed by snow accumulation depth



Speed-flow relation are set by road conditions and by snow accumulation depth



The relationship between running speed and travel speed is grasped



The basic knowledge of estimate benefits of road network is presented

3. METHOD

Data Used

Kind of observation data	Items	Location
Fixed point observation data	Traffic volume Running speed	Fixed point
Probe car data (Floating Car Data)	Travel speed	Each section of network
Meteorological data	Snow depth	Fixed point

3. METHOD

Region and Period Studied

Region

- 3 of 47 prefectures
(NIIGATA, TOYAMA, ISHIKAWA)

Period

- period of snow accumulating : January and February
- period of not accumulating : September and October

4. QVK CHARACTERISTICS



4. QVK CHARACTERISTICS

- V_f (free flow speed)
- K_0 (critical density)

using hourly data of traffic volume and running speed

- V_0 (critical speed)
- Q_0 (basic capacity)

based on the Drake Equation using V_f , K_0 .

$$V_0 = V_f \times e^{-\frac{1}{2}} \qquad Q_0 = K_0 \times V_0$$

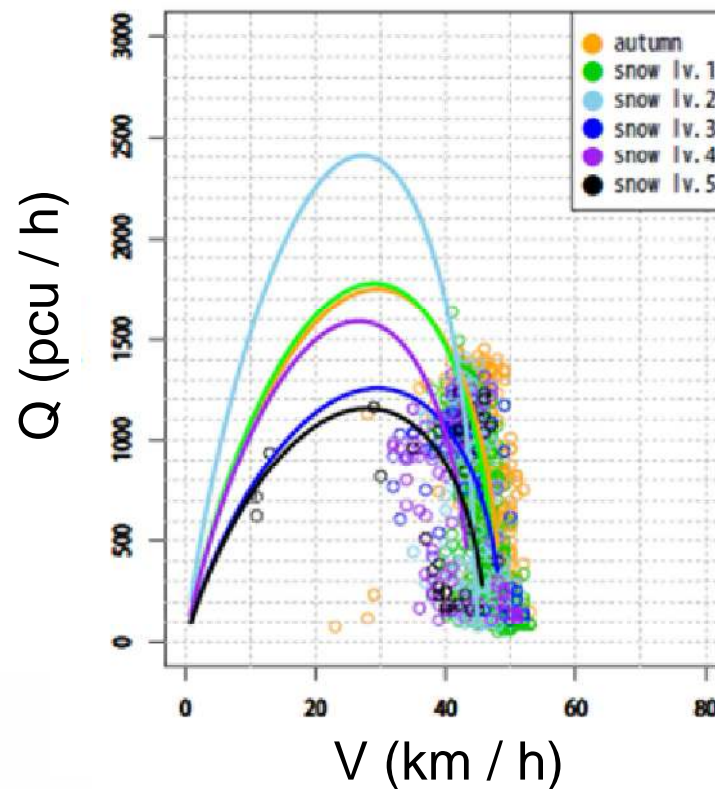
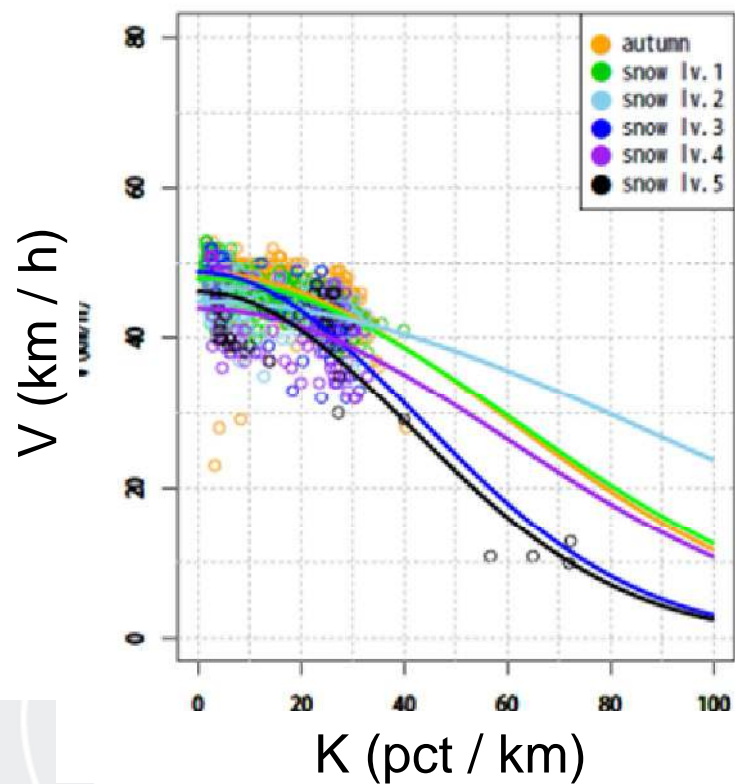
4. QVK CHARACTERISTICS

Hourly Snow Accumulation Rank

Rank	Hourly Snow Accumulation	Months
Autumn	None	September - October
Rank 1	0cm	January - February
Rank 2	Over 0cm - under 2cm	
Rank 3	Over 2cm - under 5cm	
Rank 4	Over 5cm - under 10cm	
Rank 5	Over 10cm	

4. QVK CHARACTERISTICS

Example of Results



4. QVK CHARACTERISTICS

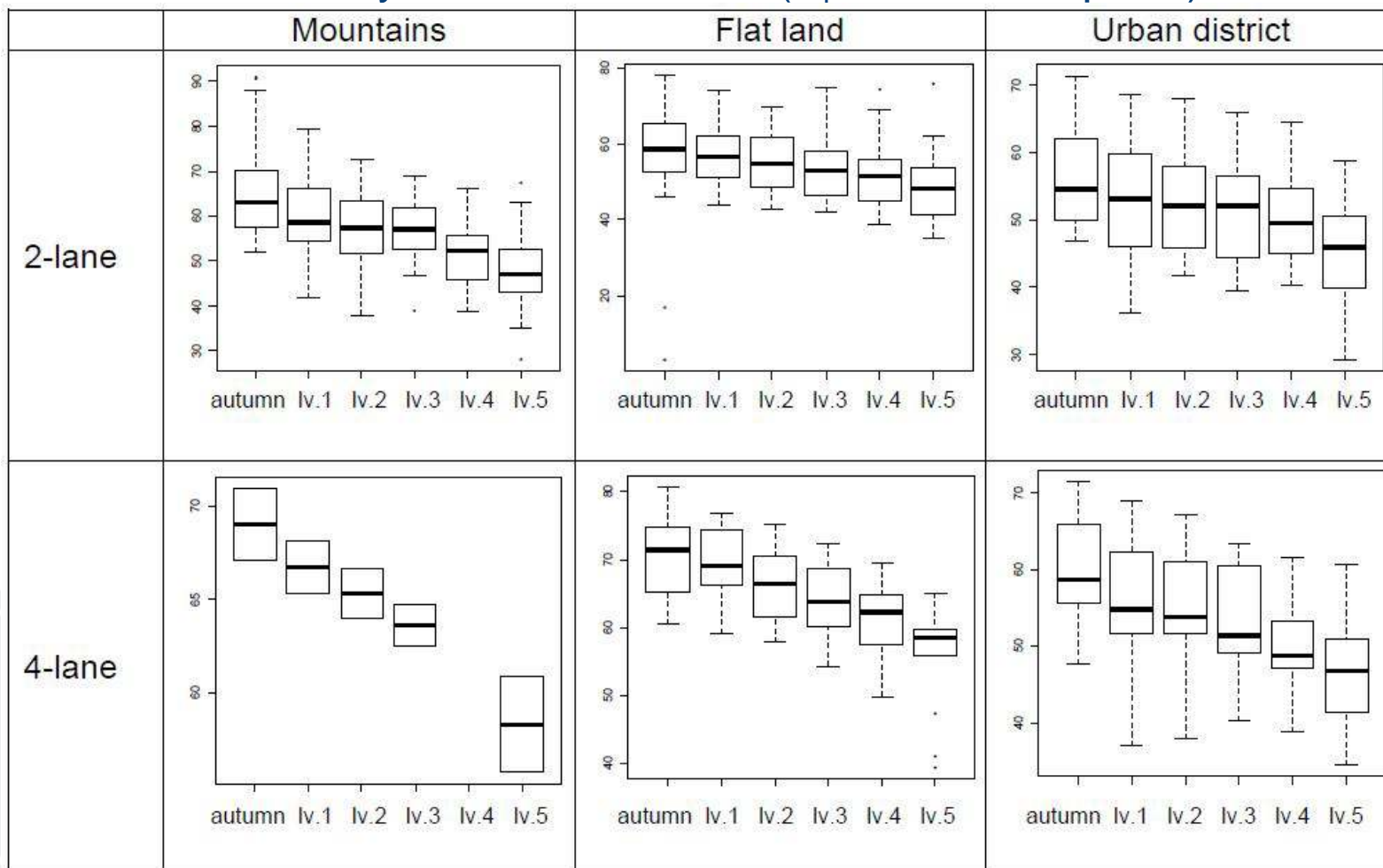
Category and rank of points

Categories of Road Conditions

Category	Items
Roadside condition	Mountains, flat land (excluding urban districts), urban districts
Number of traffic lanes	2-lane, 4-lane

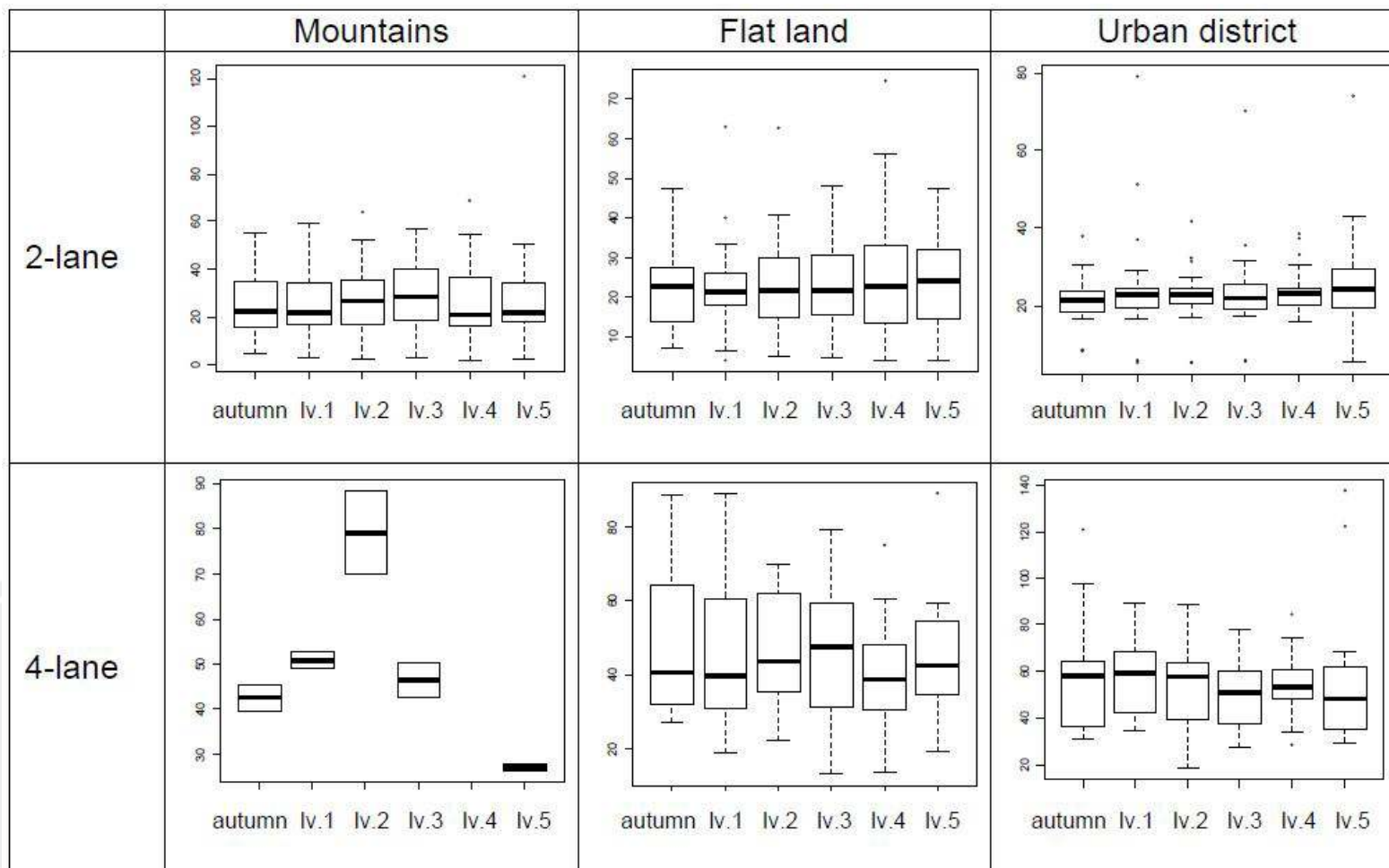
4. QVK CHARACTERISTICS

QVK Characteristics by Road Conditions (V_f : free flow speed)



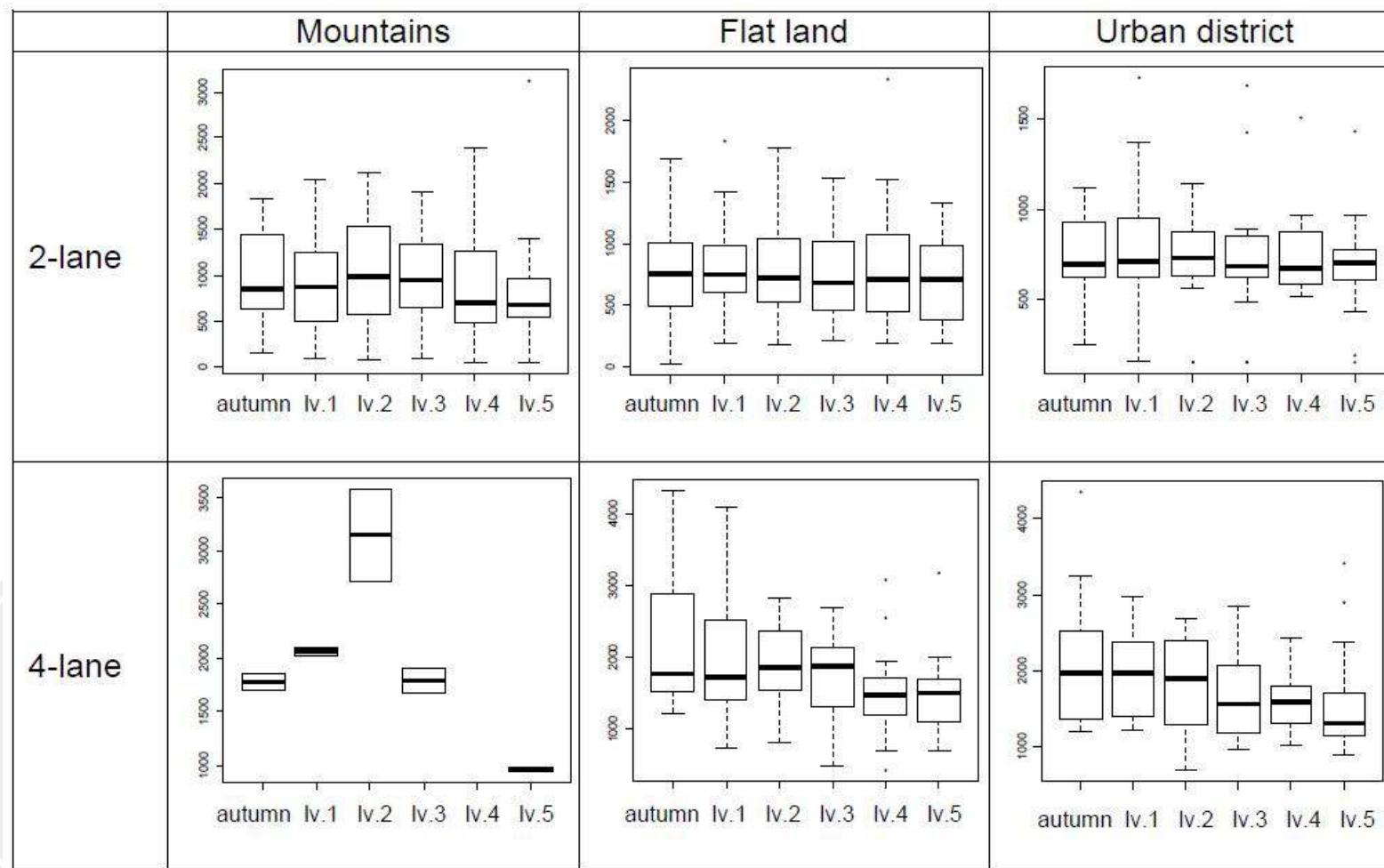
4. QVK CHARACTERISTICS

QVK Characteristics by Road Conditions (K_0 : critical density)



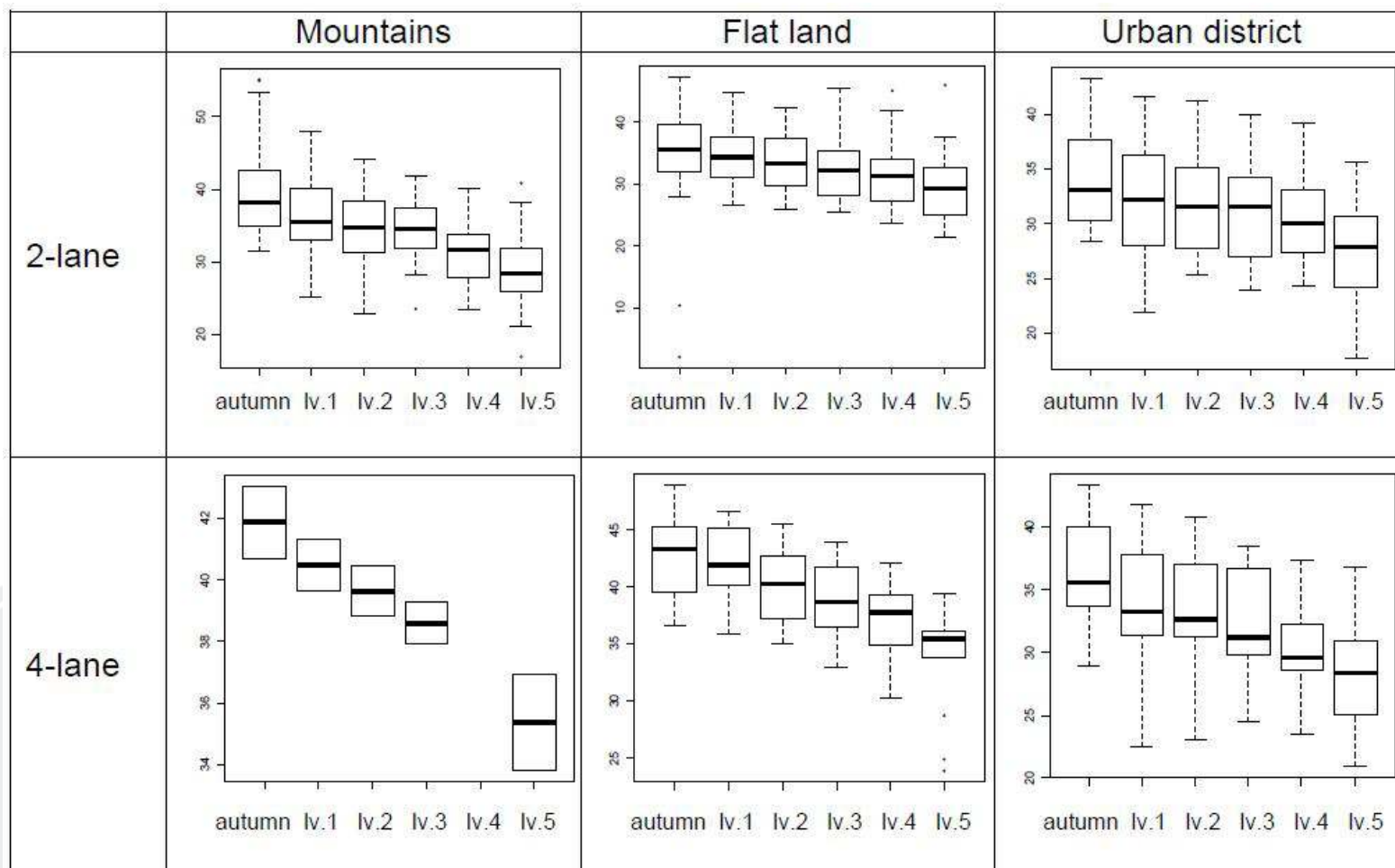
4. QVK CHARACTERISTICS

QVK Characteristics by Road Conditions (Q_0 : basic capacity)



4. QVK CHARACTERISTICS

QVK Characteristics by Road Conditions (V_0 :critical speed)



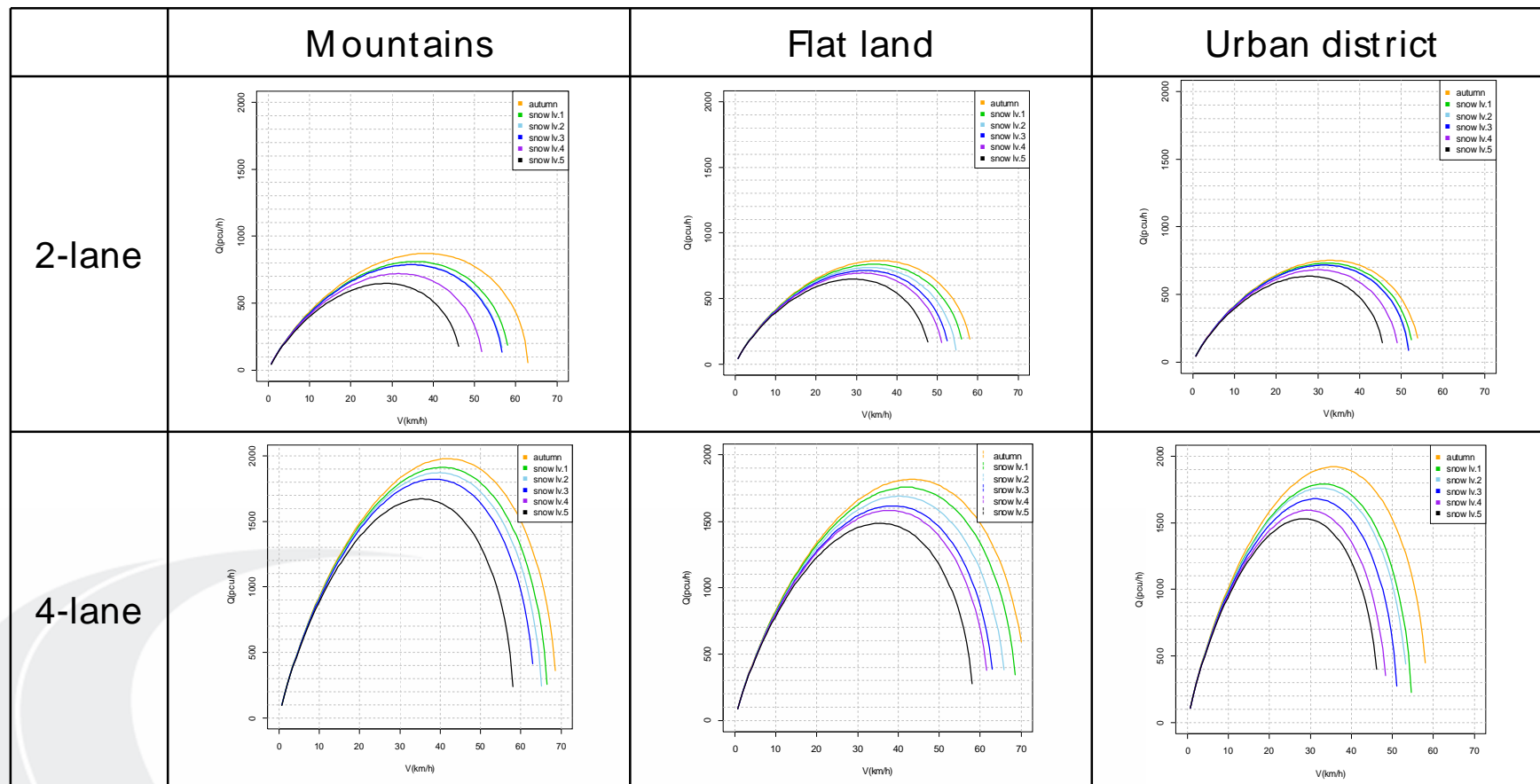
4. QVK CHARACTERISTICS

QVK Characteristics are different
by road conditions
by snow accumulation

The impact of hourly snow accumulation

- Higher in relation to the speed
- Lower in relation to the traffic density

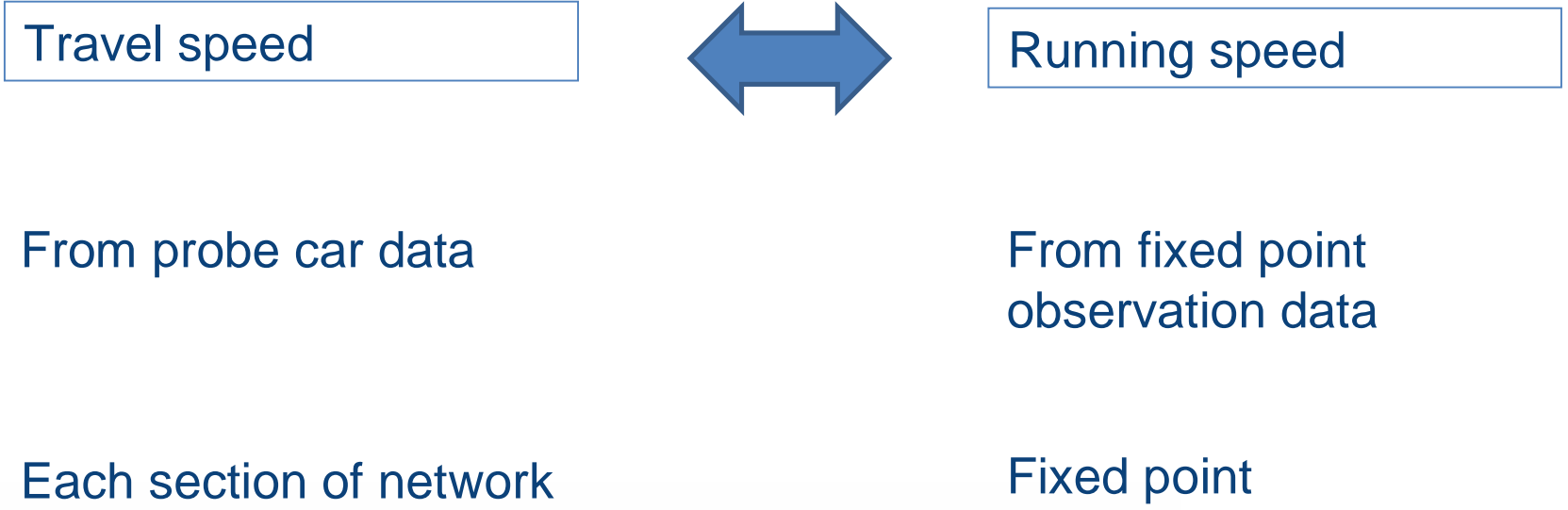
4. QVK CHARACTERISTICS



5. RELATIONSHIP BETWEEN RUNNING SPEED AND TRAVEL SPEED

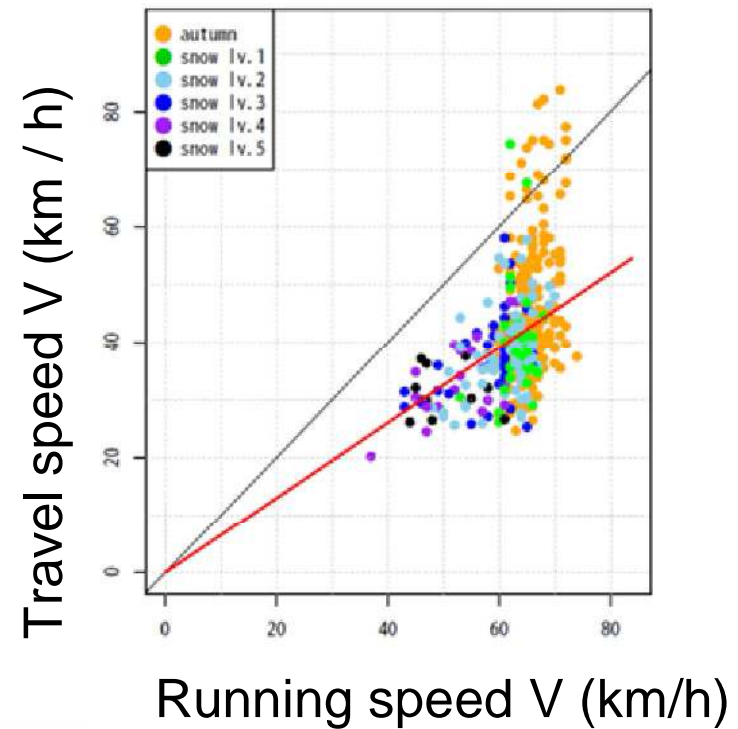
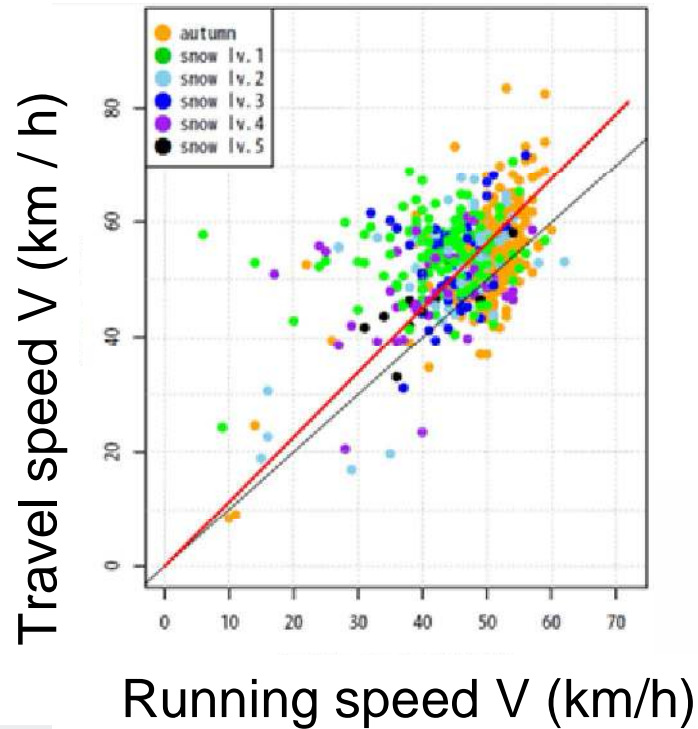


5. RELATIONSHIP BETWEEN RUNNING SPEED AND TRAVEL SPEED



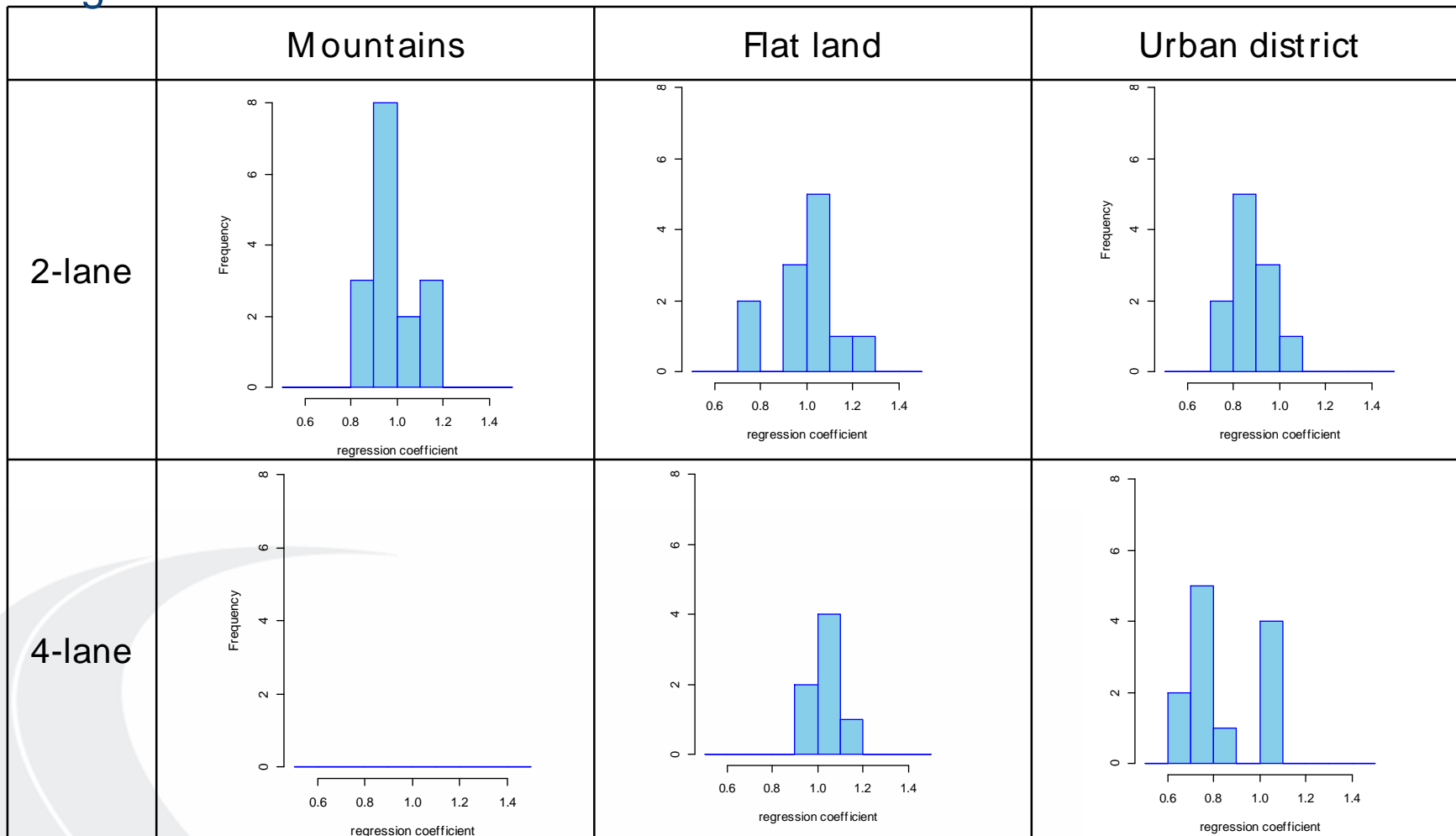
5. RELATIONSHIP BETWEEN RUNNING SPEED AND TRAVEL SPEED

Examples of relationship



5. RELATIONSHIP BETWEEN RUNNING SPEED AND TRAVEL SPEED

Regression coefficient



5. RELATIONSHIP BETWEEN RUNNING SPEED AND TRAVEL SPEED

Equation

	Mountains	Flat land	Urban district
2-lane	$\text{Running speed} = \text{Travel speed}$	$\text{Running speed} = \text{Travel speed}$	$\text{Running speed} = \text{Travel speed} / 0.8$
4-lane	$\text{Running speed} = \text{Travel speed}$	$\text{Running speed} = \text{Travel speed}$	$\text{Running speed} = \text{Travel speed} / 0.8$

6. BASIC KNOWLEDGE OF BENEFIT CALCULATION

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STEP 1

Calculating total driving time

STEP 2

Calculating the driving time benefits of snow removal

6. BASIC KNOWLEDGE OF BENEFIT CALCULATION

STEP 1 Calculating Total Driving Time

$$TotalDrivingTime = \sum \left(\frac{SectionLength}{AverageTravelSpeed} \times TrafficVolume \right)$$

From probe car data

From probe car data

Using relationship between running speed and travel speed

Using speed-flow relations

according to road conditions and hourly snow accumulation rank in the section

6. BASIC KNOWLEDGE OF BENEFIT CALCULATION



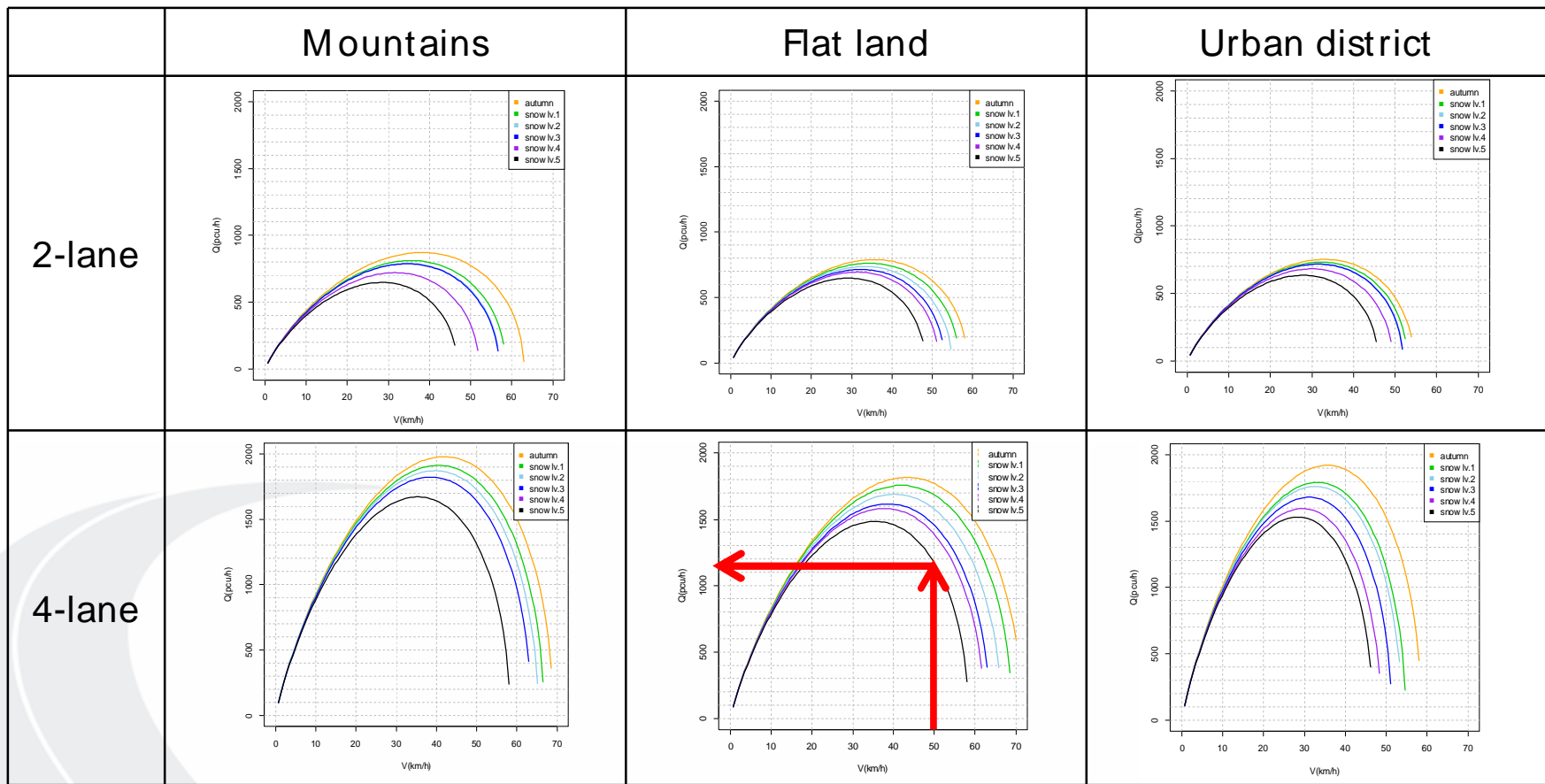
	Mountains	Flat land	Urban district
2-lane	Running speed = Travel speed	Running speed = Travel speed	Running speed = Travel speed / 0.8
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6. BASIC KNOWLEDGE OF BENEFIT CALCULATION

Running speed



Traffic volume



6. BASIC KNOWLEDGE OF BENEFIT CALCULATION

STEP 2 Calculating the driving time benefits of snow removal

$$\text{Benefits} = \text{TotalDrivingTime} (LV .5) - \text{TotalDrivingTime} (LV .n)$$

Assuming non snow removal

$$= \sum \left(\frac{\text{SectionLength}}{\text{AverageTravelSpeed} (LV .5)} \times \text{TrafficVolume} \right)$$

Gathering the data of LV.5 (Assuming non snow removal)

$$- \sum \left(\frac{\text{SectionLength}}{\text{AverageTravelSpeed}} \times \text{TrafficVolume} \right)$$

Calculating at STEP1

Same value

SUMMARY

This study estimates speed-flow relation and relationship between travel speed and running speed, using observation data. And the calculating method of snow removal benefits of road network from data of probe car are presented.

To calculate benefits more exactly, it is necessary to analyze the traffic characteristics according to more detailed road conditions.