29th Annual RPUG Conference

Denver, CO November 14-17

Relationship between
repair situation
and roughness conditions
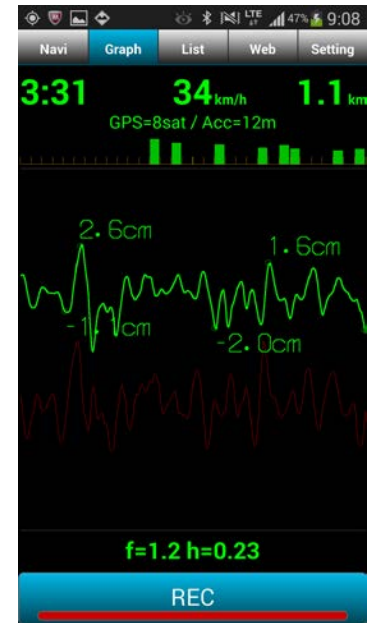
BumpRecorder

YAGI, Koichi

http://www.bumprecorder.com
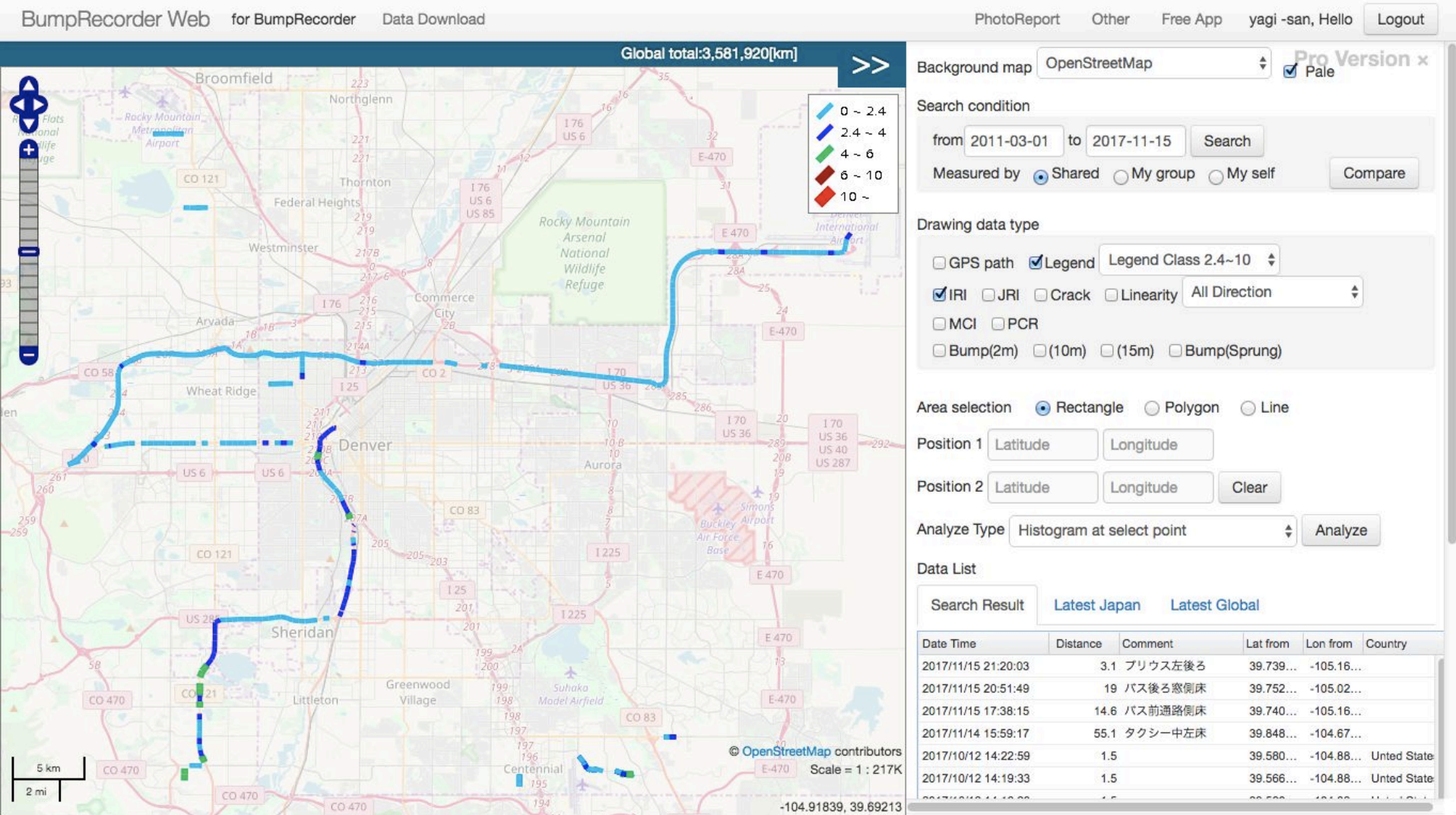info@bumprecorder.com

What is **BumpRecorder**

- **BumpRecoder** is a smartphone application which evaluate road condition IRI, cracking rate, and bump step locations.
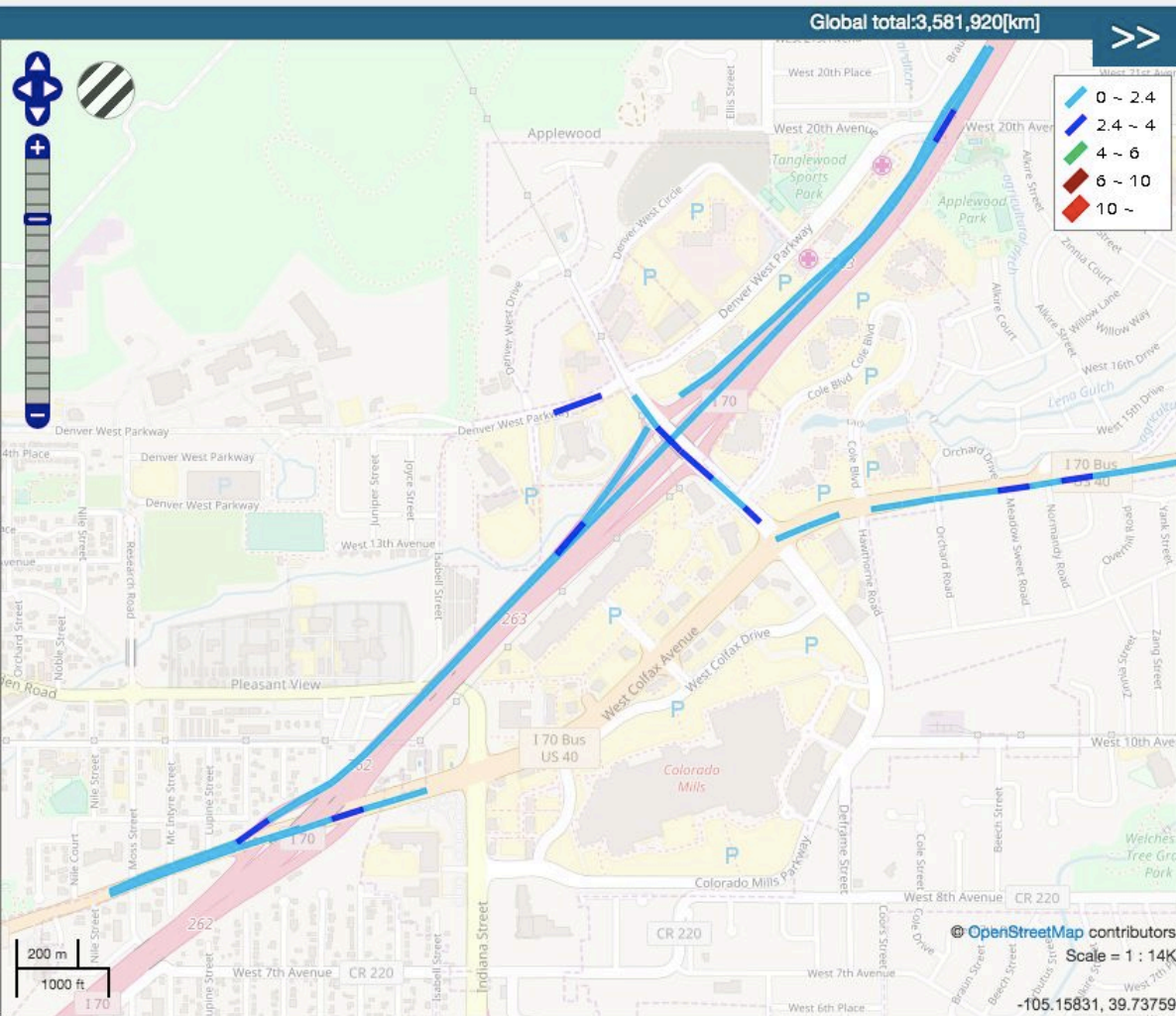
IRI situation on Denver

Data was collecting on Taxi and Bus.

IRI situation near Marriott

Cracking situation near Marriott

Bump step location near Marriott

BumpReocrder is IRI Class2

BumpRrecorder

Measure acceleration (a)

Suspension estimation (b)

Inverted QC simulation (c)

Calculate profile (d)

IRI Class 2

(3) Calculate IRI

(2) QC simulation

(1) Measure profile
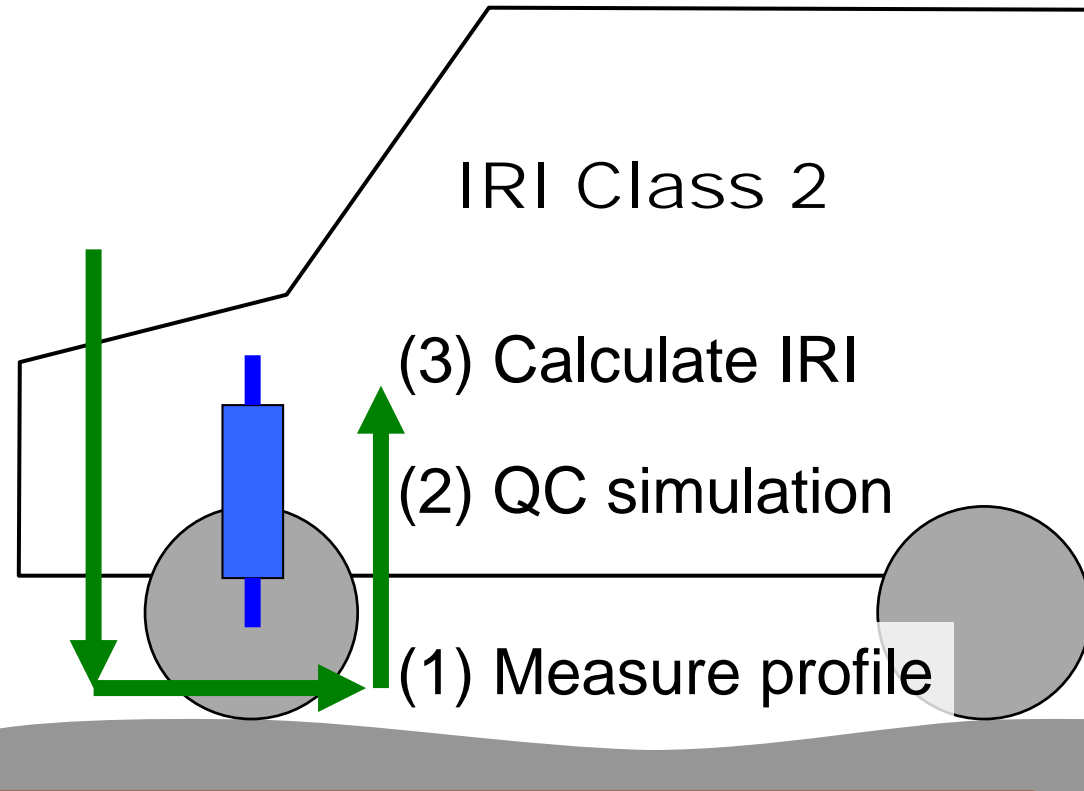
Auto calibration is done during measurement driving.
Good repeatability.

When no calibration...

Amplitude Shape Peak Location
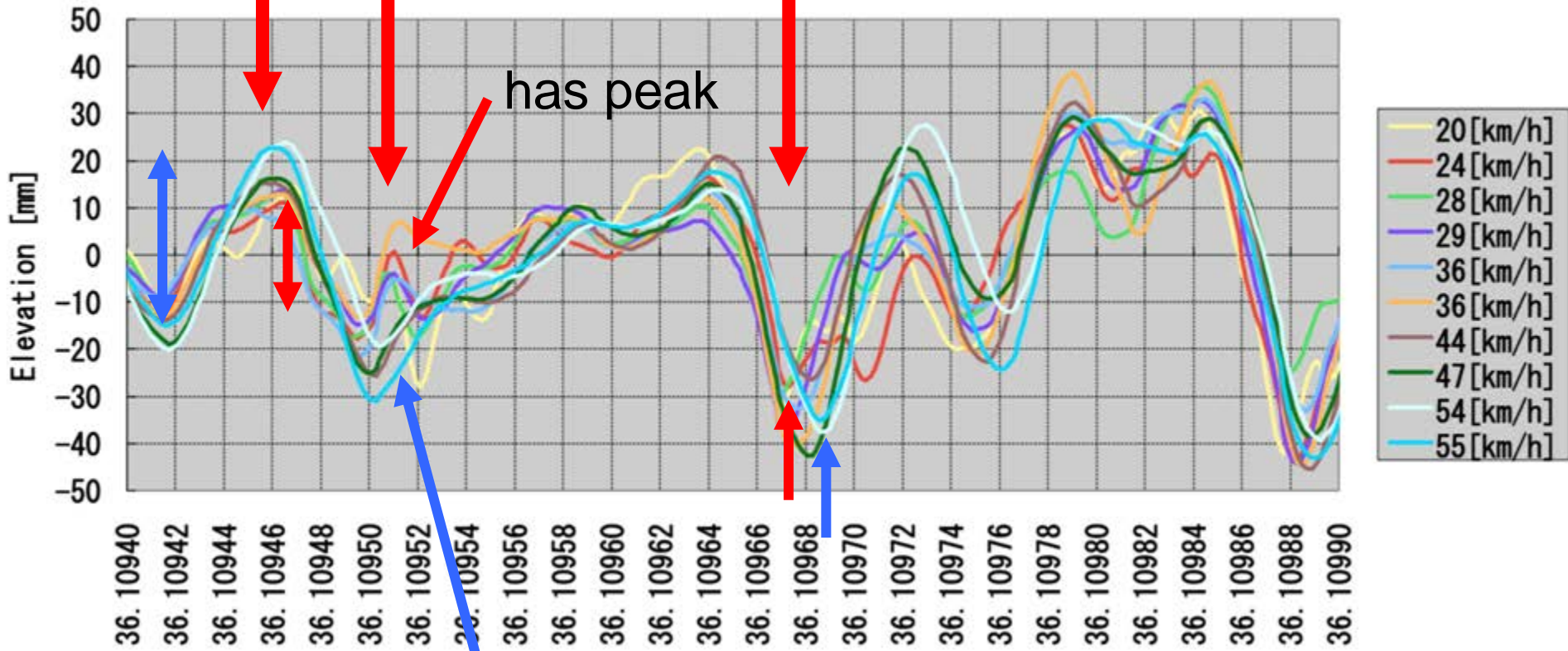
has peak

no peak

Low reliability

Suspension calibration effects
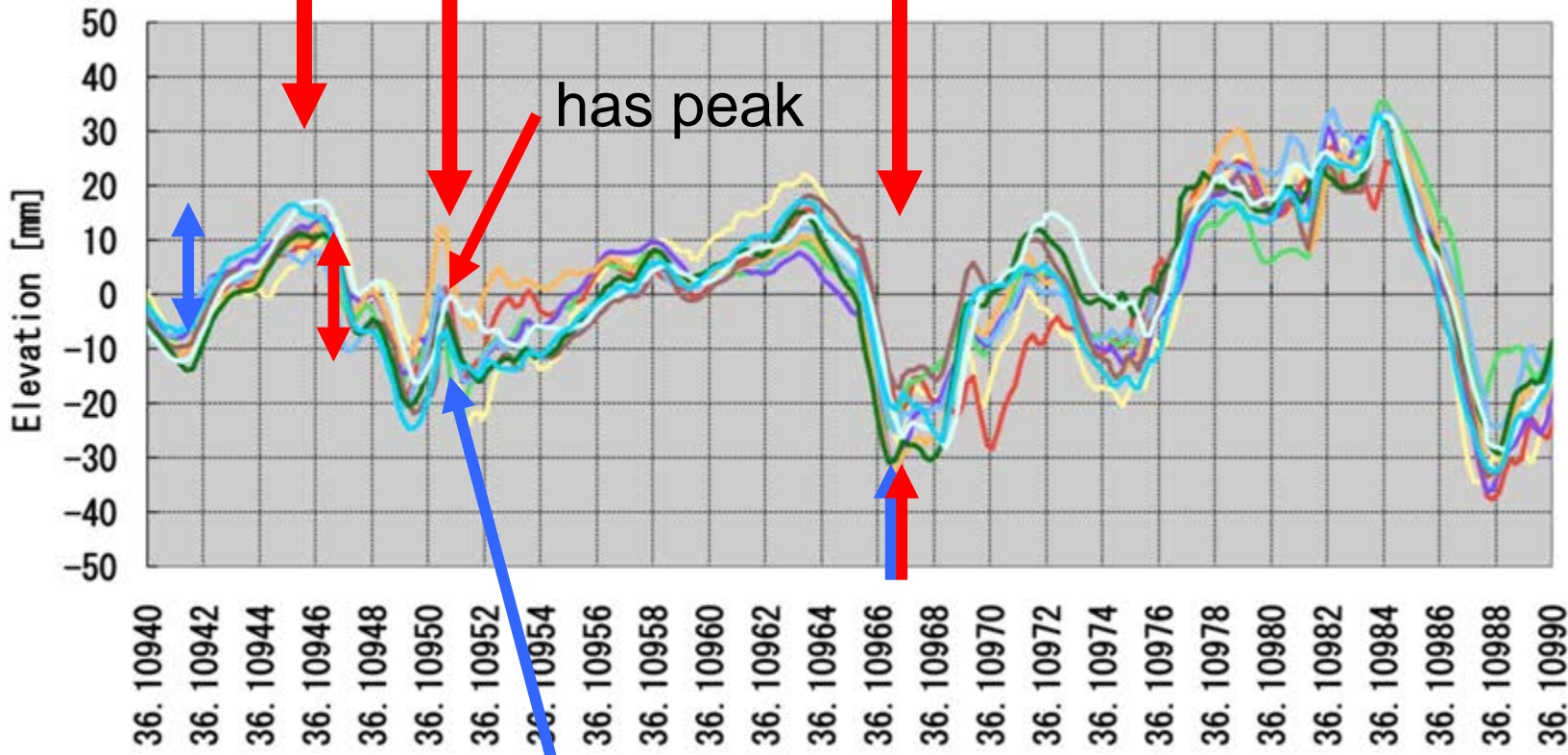
Tilt calibration
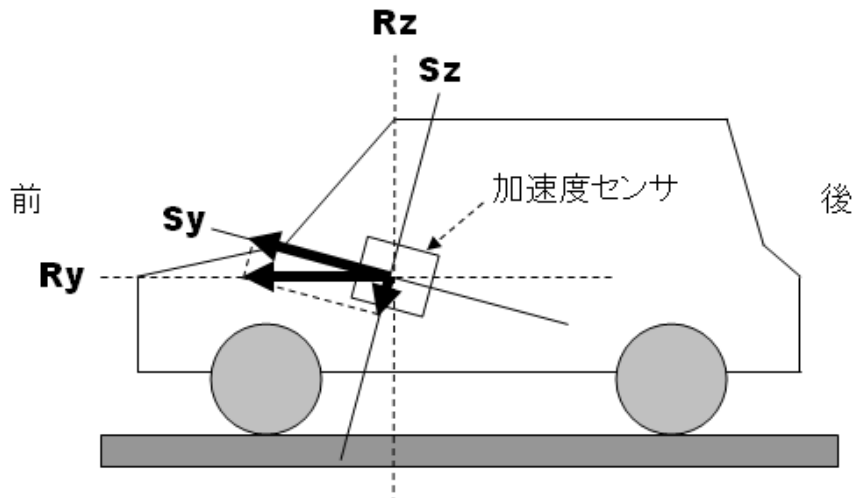
- When smartphone sensor has tilt, virtual vertical acceleration will be occured.
- Road has slope and cant, it is not easy to place completely horizontal angle.
- **BumpRecorder** estimate tilt angle automatically from relationship of 2 axis acceleration.
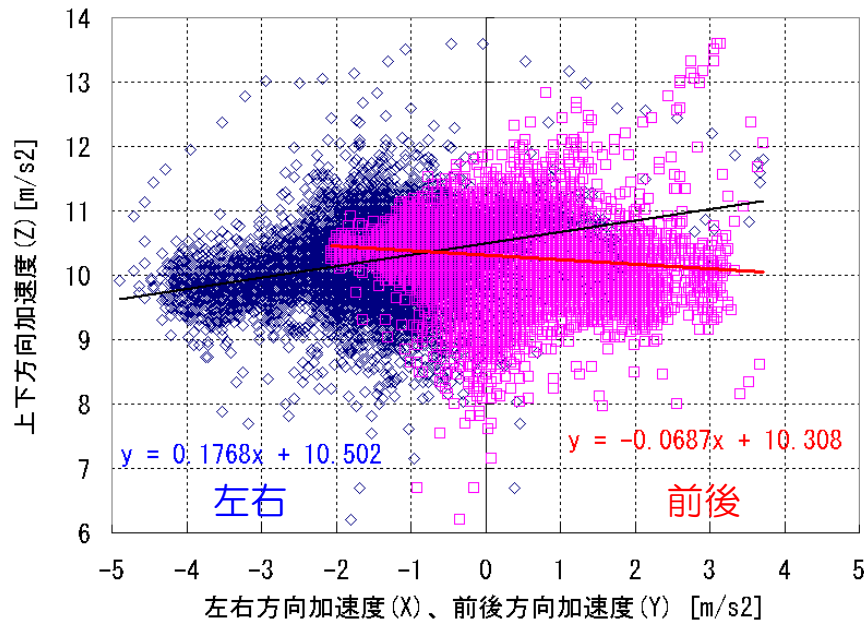
Tilt calibration effects

Stop & go
and turn
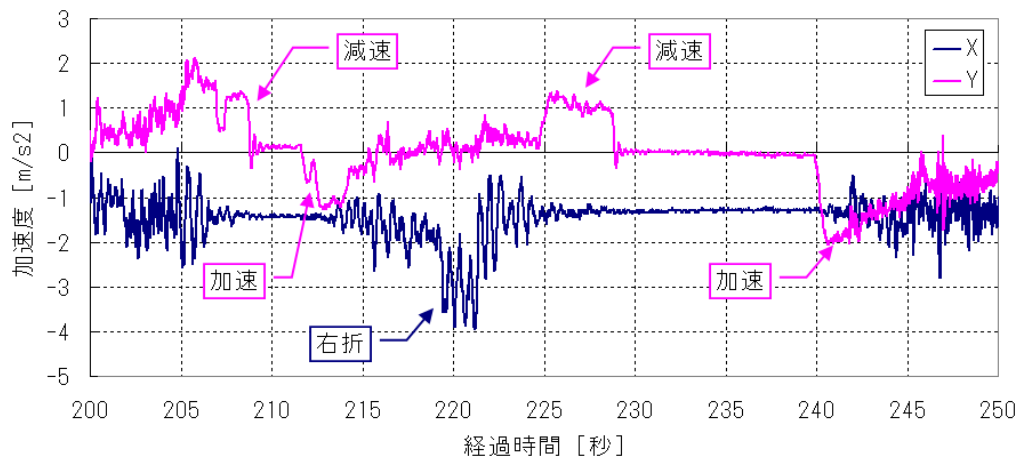
Original
vertical
acceleration
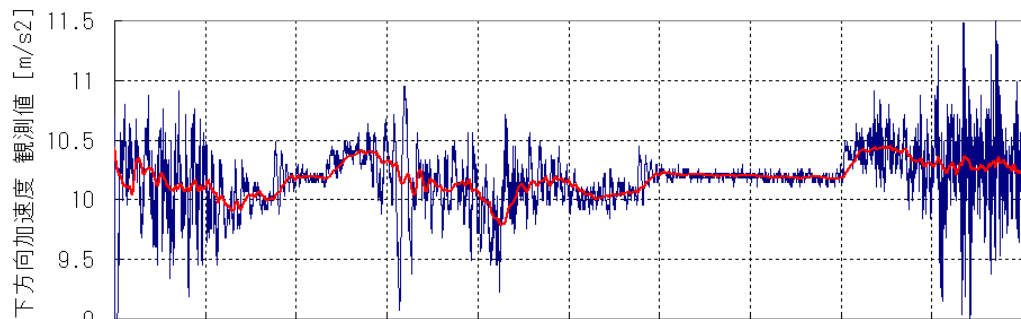
After
calibration
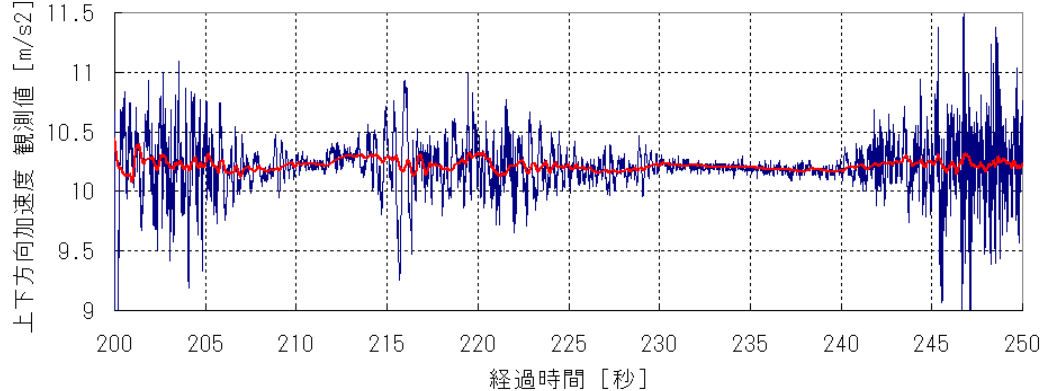
Comparison of longitudinal profile

Join "IRI common test" and compare with Class 1 profiler.

IRI Comparison
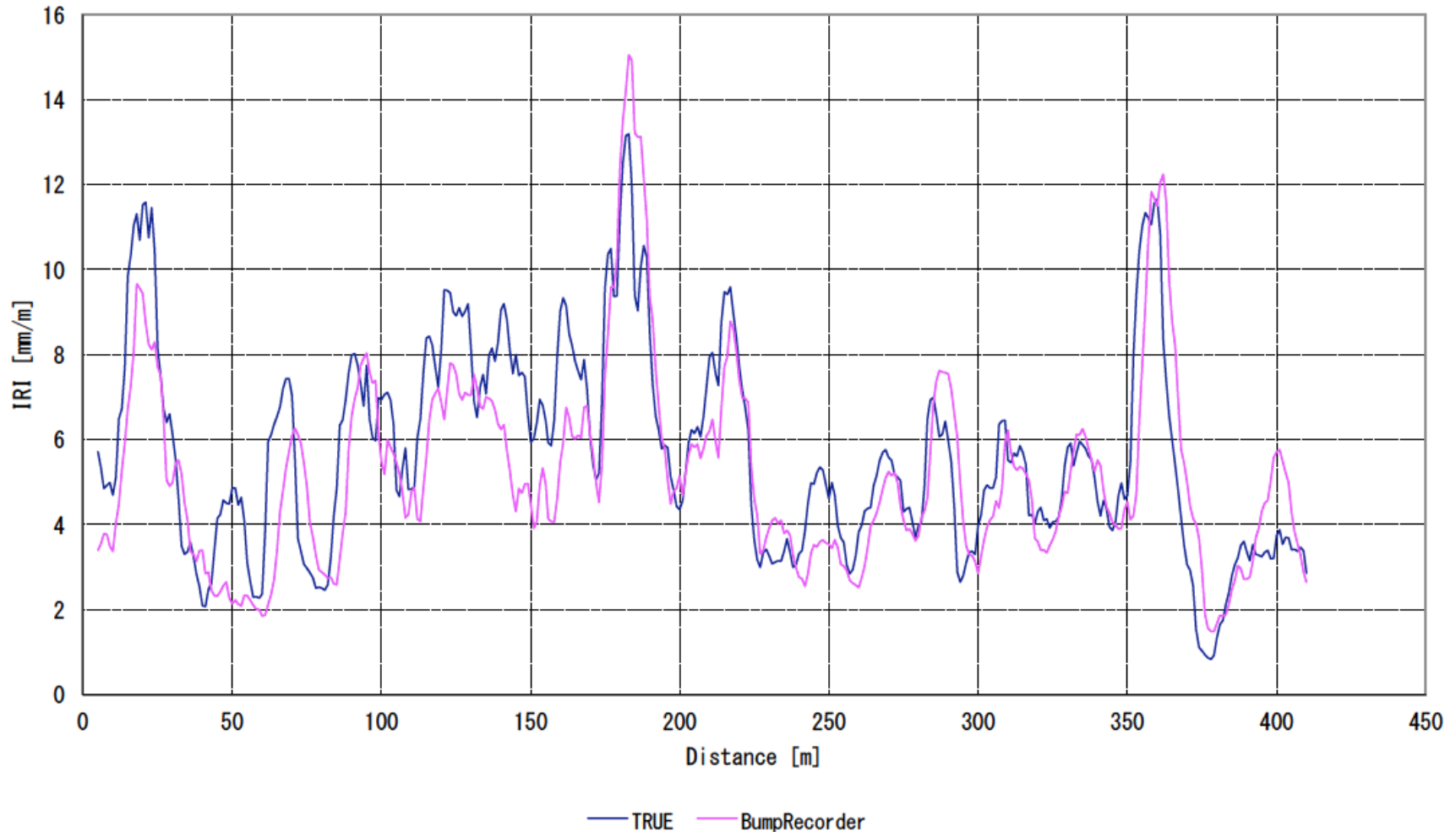
Today's topic

- Previously, Data collection spend much cost, so, road administrator make decision without data.

- Now, there are smartphone application.

- It is removing one the obstacle of cost side.

- In fact, many road administrator faced difficulties "how to use measurement data?"

Road conditions recording

- From before, the "Aizu-Wakamatu" city road administrators are doing regular patrol few times in a week for human visual inspections and quick repairs.

- Since January 2015, they are starting regular roughness measurement during this patrol on 20 vehicle by using Smartphone App "**BumpRecorder**".

- It not increasing man-hour cost.

They knows road conditions data.

Quick repair history recording

- Patrol result was hand writing on the notebook, previously.
- Since June 2016, by using smartphone, they are starting to record GPS location data, one word comment and/or site photo.
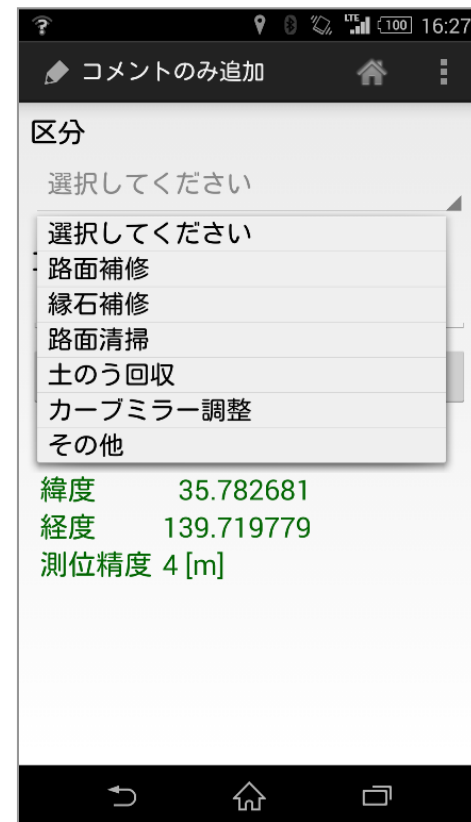
Daily Report

Purpose of recording is to reduce reporting time.
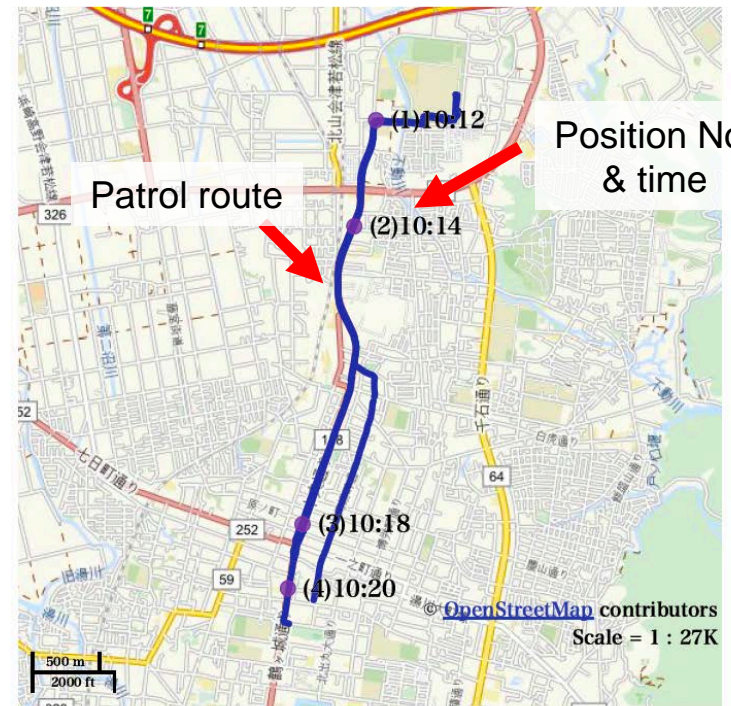
道路・河川巡視員業務日誌

平成 28年05月12日 木曜日

課長	G L	巡視員

Position No.

対応番号	Repair type 所見及び対応
(1)	路面補修
(2)	路面清掃 3箇所
(3)	カーブミラー調整 左方
(4)	その他
(5)	
(6)	
(7)	
(8)	

【記事】

路面補修 ヶ所	水門点検 ヶ所	その他 ヶ所	直営・業者施工要 件	常温合材使用量

道路・河川巡視員業務日誌(平成 28年05月12日 木曜日)

Patrol route

Position No. & time

(1)10:12
(2)10:14
(3)10:18
(4)10:20

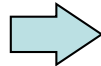© OpenStreetMap contributors
Scale = 1 : 27K

500 m
2000 ft

Purposes of this research

They have road condition data and quick repair results more than 1 years.
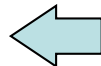
First Step

| Quick repair | → | road condition data |

Is there relationship?

Next Step

| Quick repair | ← | road condition data |

To evaluate repair possibility
and making repair planning

Trial city "Aizu-Wakamatsu"

Aizu-Wakamatsu is located at north place from Tokyo.
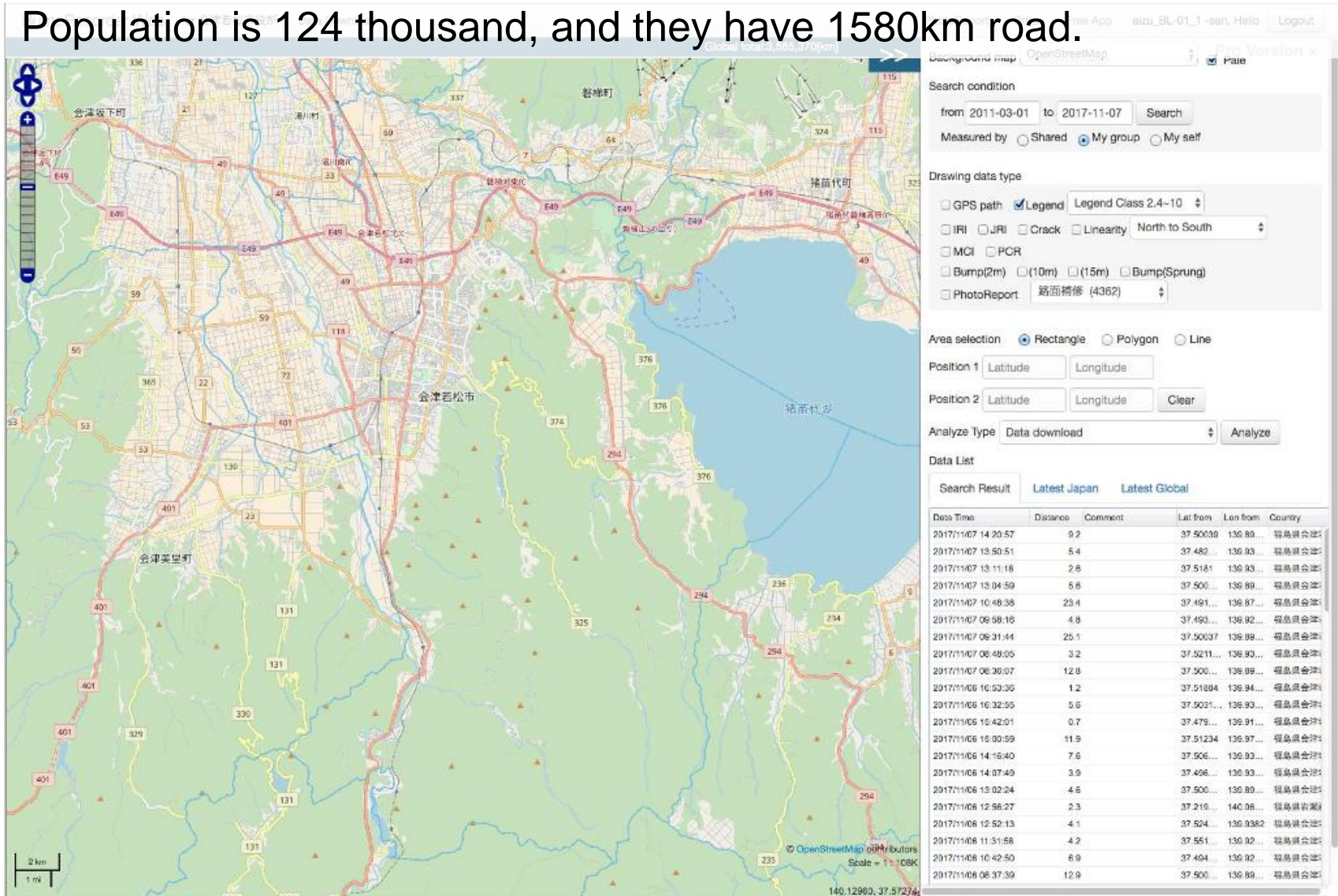
Trial city "Aizu-Wakamatsu"

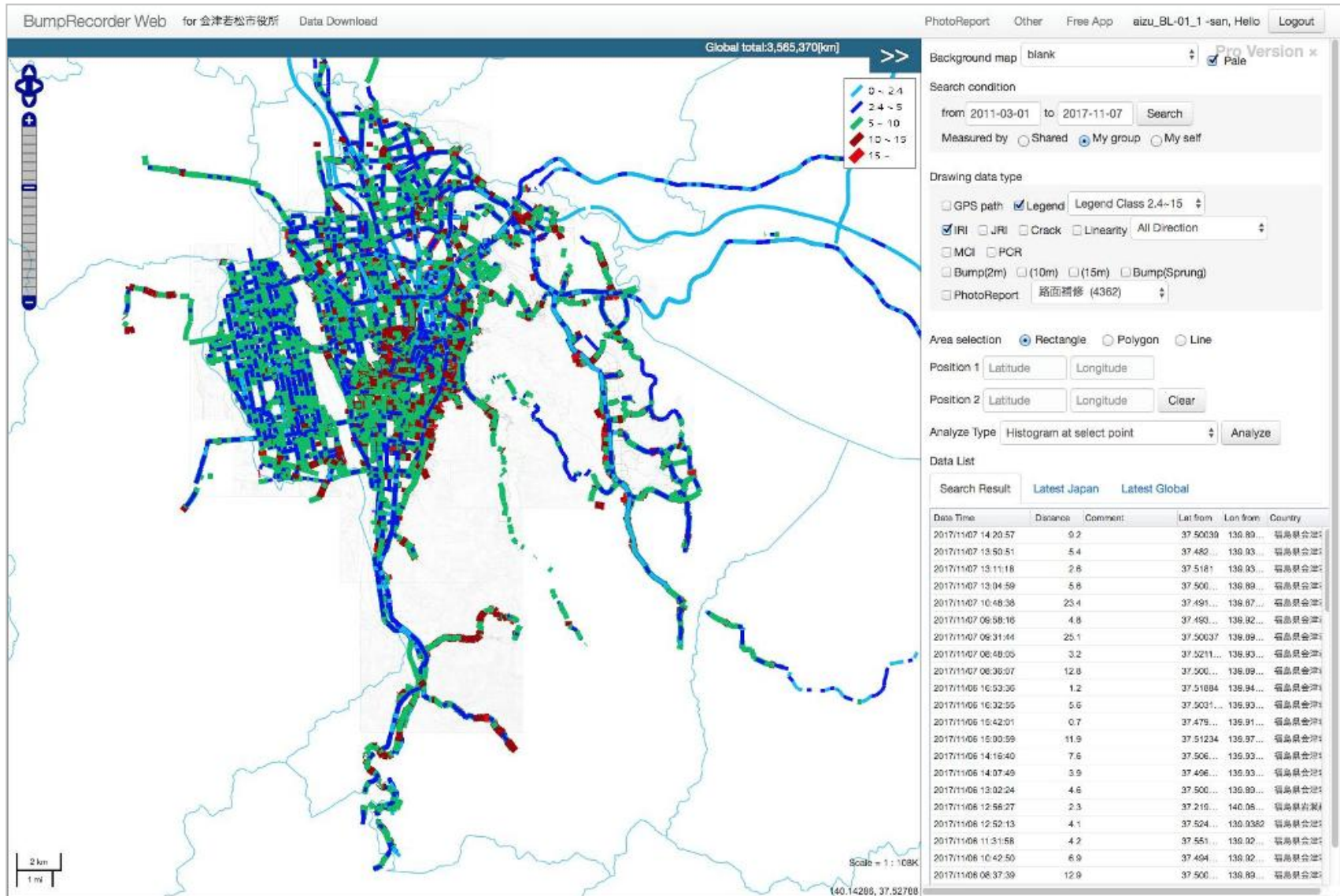They have downtown side, mountain side and lake side.

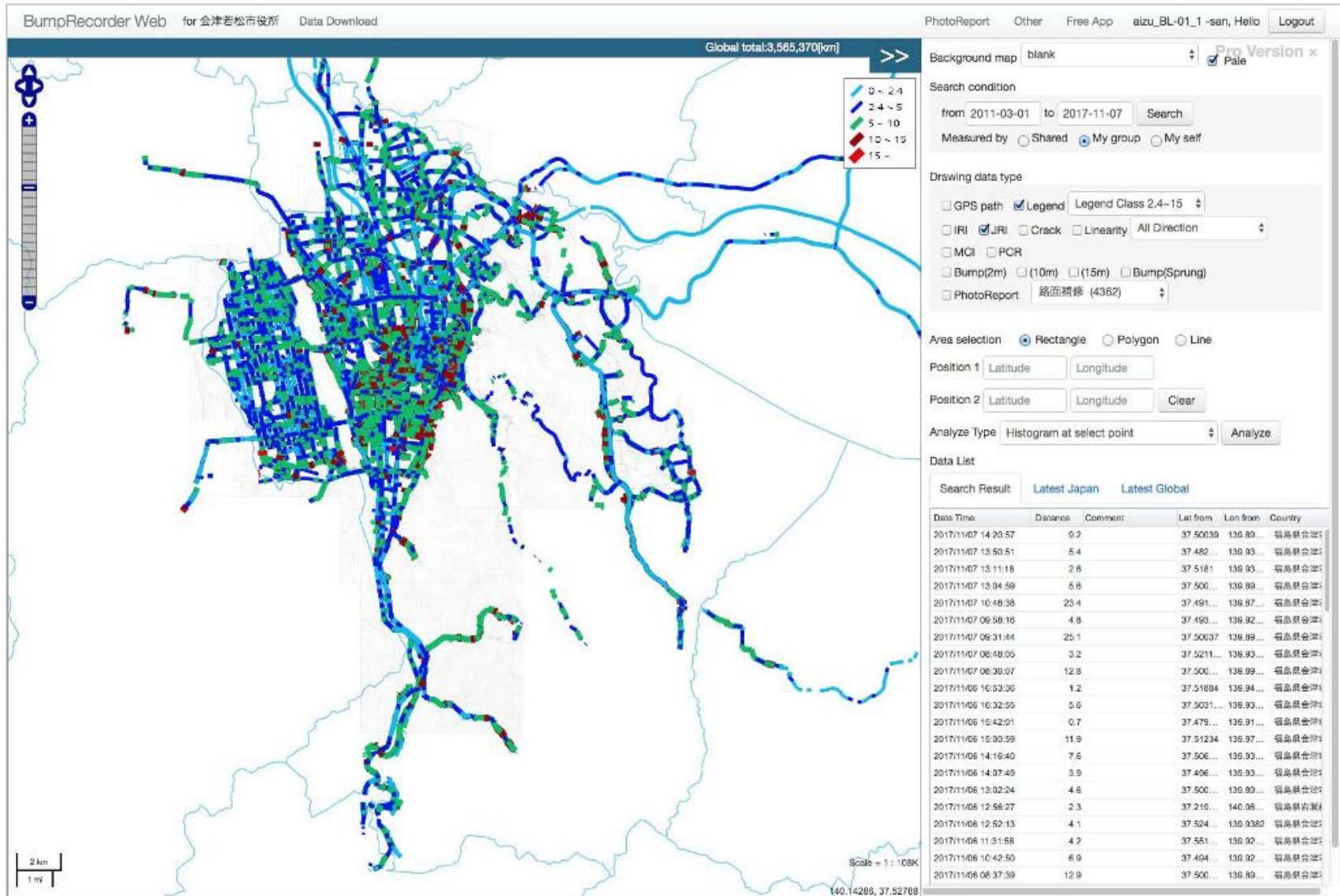Population is 124 thousand, and they have 1580km road.

Data collection : IRI

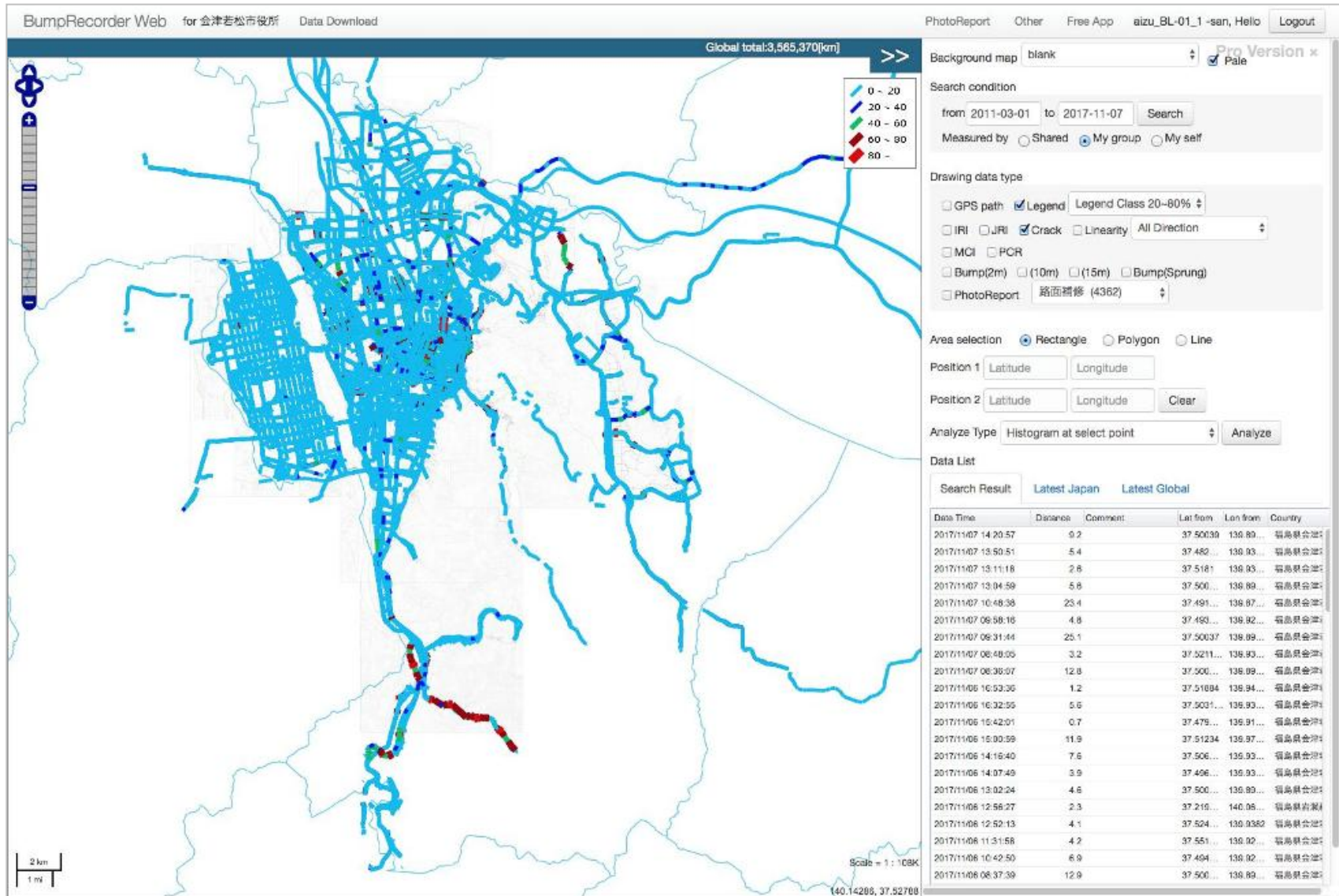Since 2015, regular data collection was starting. It collect few days in a week.

JRI : Japanese Roughness Index

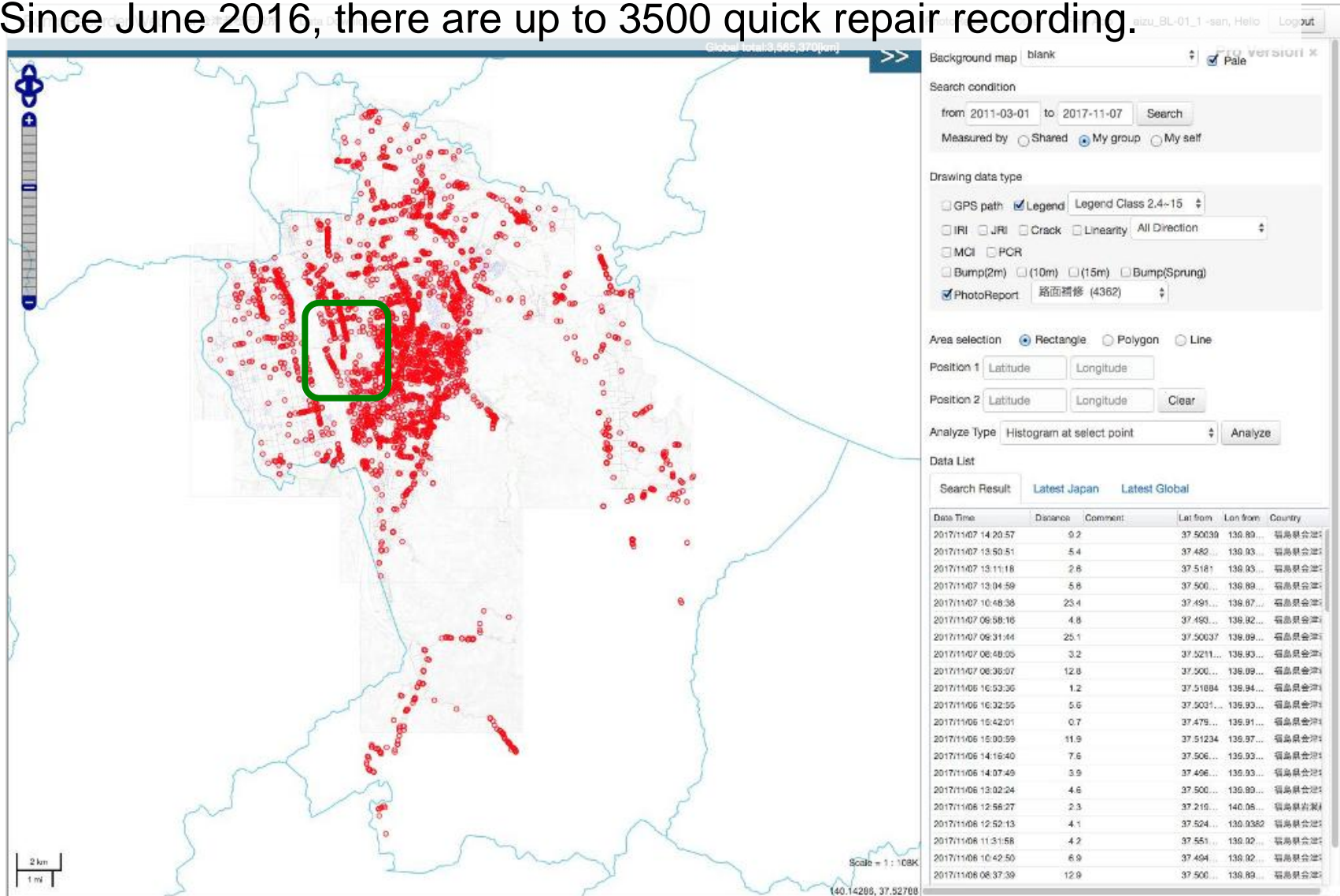JRI is the Japanese standard which reflect shorter wave length than IRI.

Cracking rate

Cracking rate also collect by using smartphone App "**BumpRecorder**".

Quick repair history

Repair history is recording by using smartphone during regular patrol.
Since June 2016, there are up to 3500 quick repair recording.

Close-up Downtown area

Red line : City main road, Blue line : Community road

Quick repair at Downtown area

M2-4 and M1-20 is neighboring road, but repair frequency is different.
On M1-10, repair density is not same for each sections.
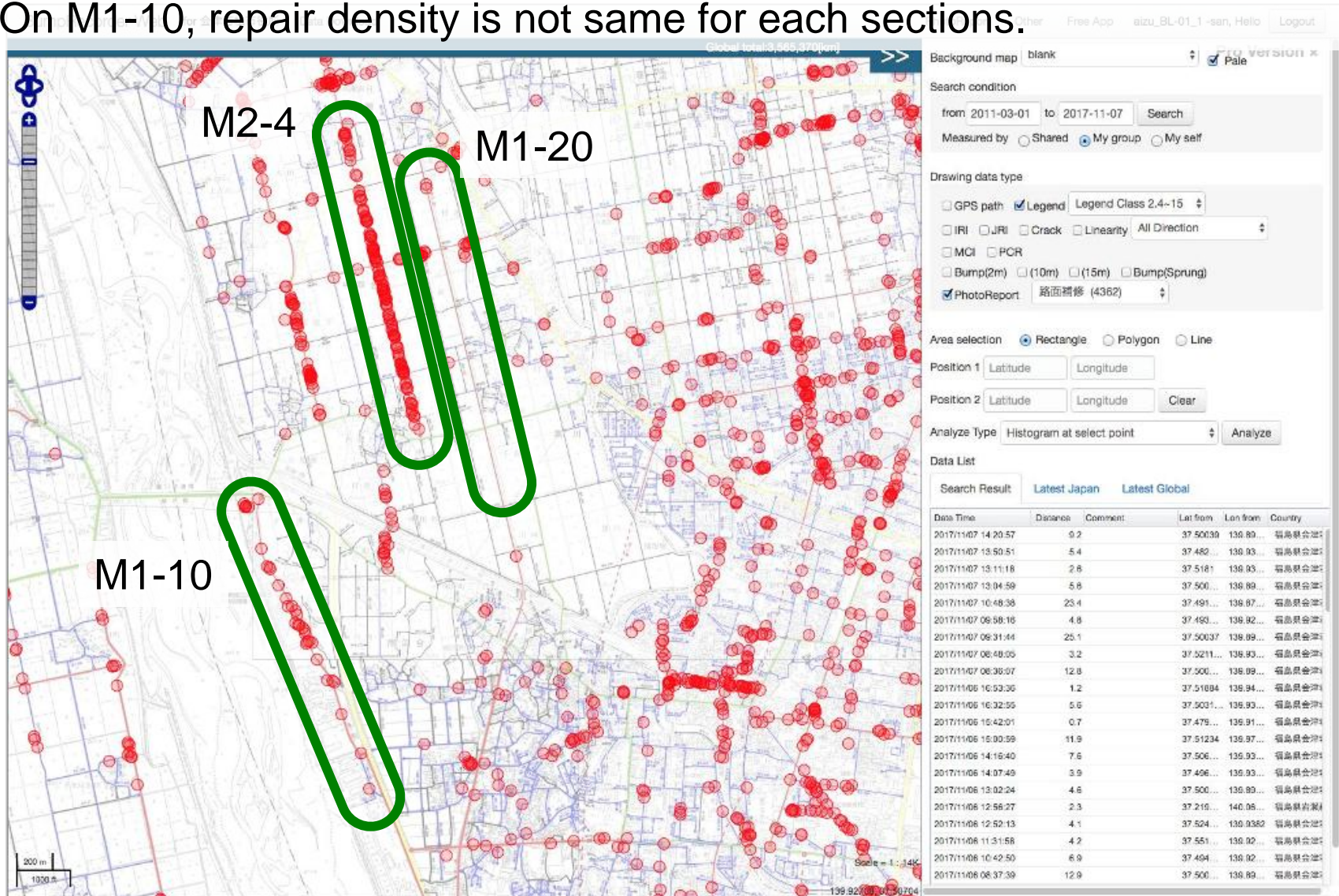
IRI conditions

IRI of (1) is bad than (2)
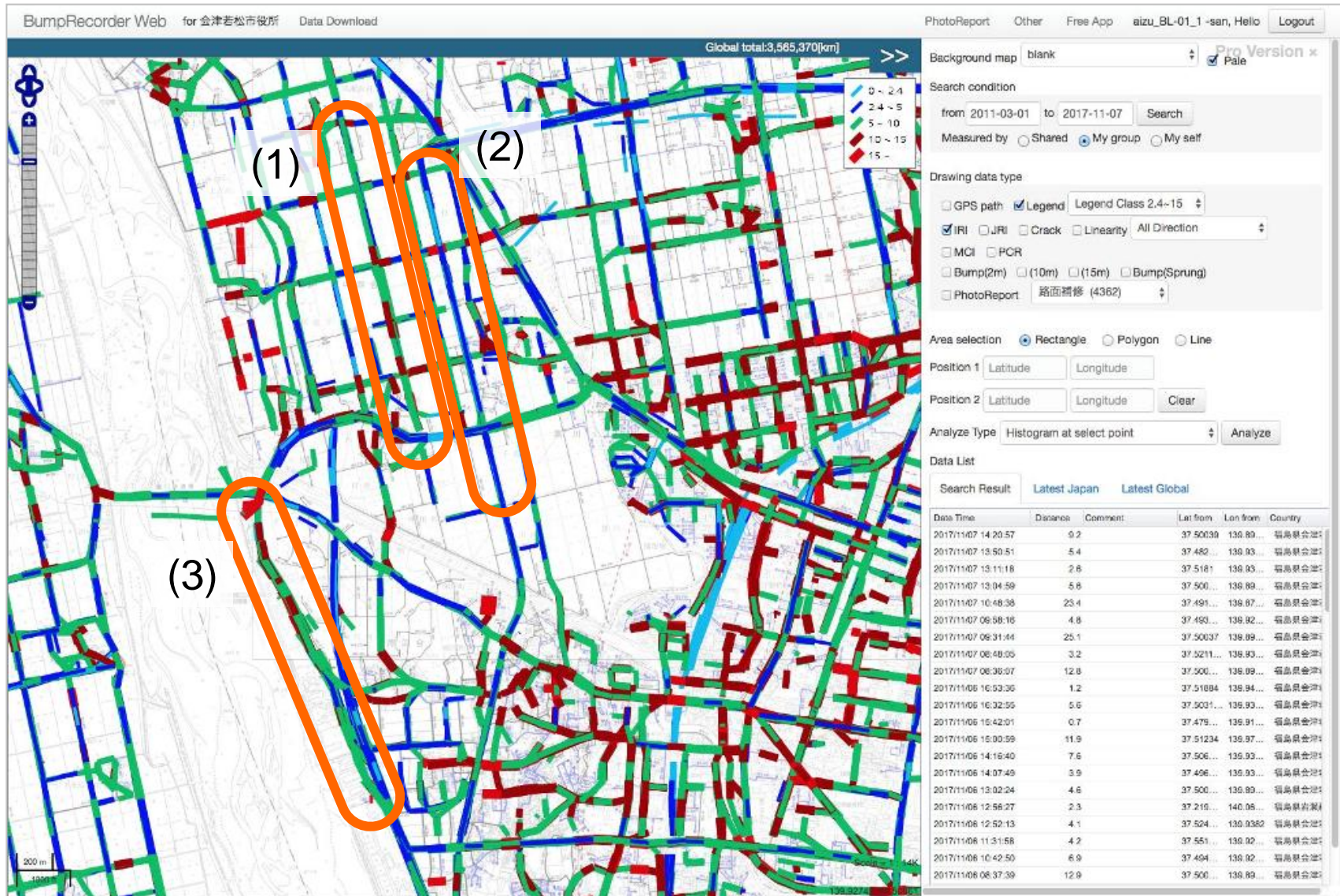
Contour plot of Main road (1)

Repair location has IRI > 4[mm/m]

IRI average is yellow = 6 [mm/m]
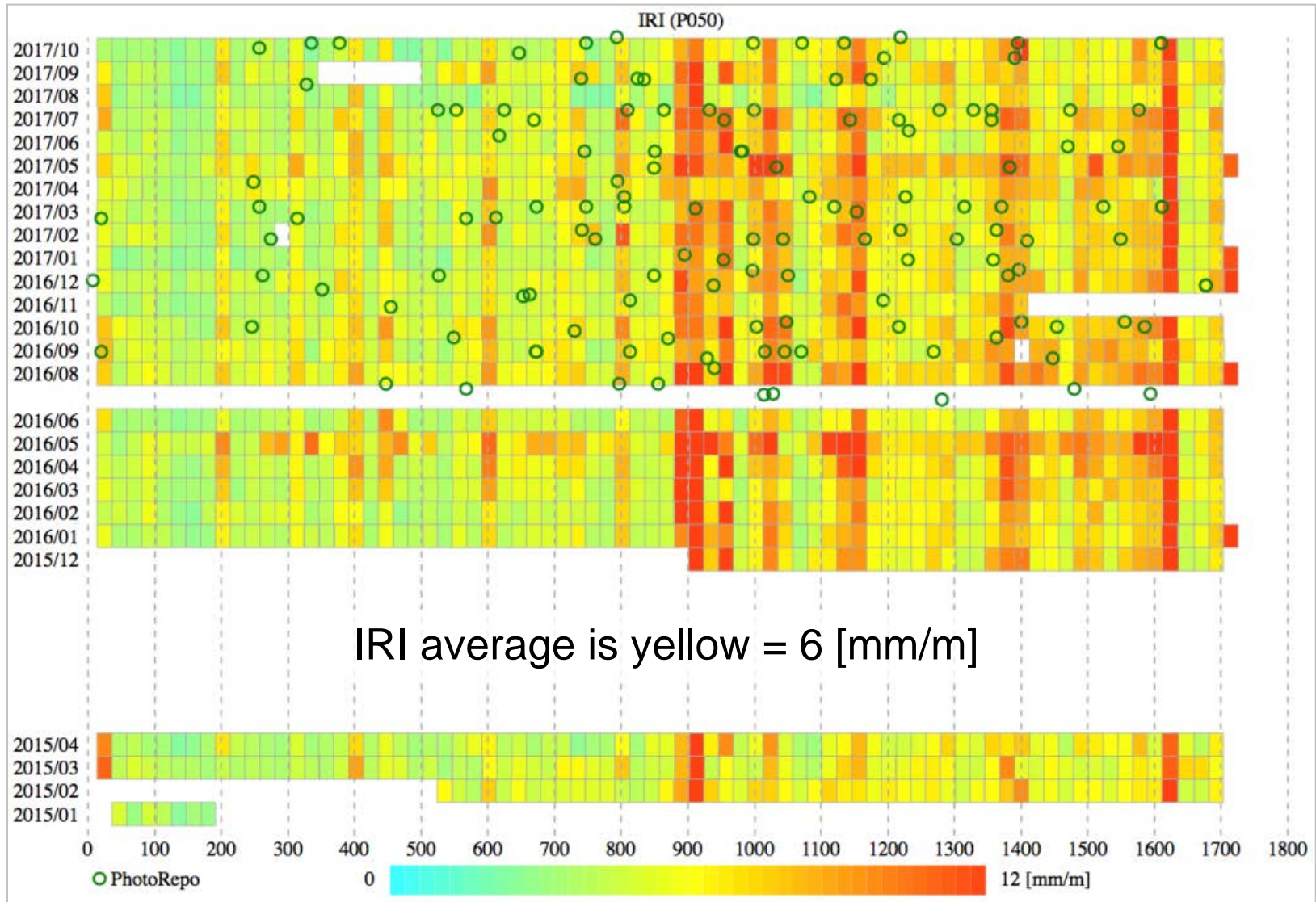
Contour plot of Main road (1)

Repair location has cracking rate > 10[%]

Cracking rate average is yellow = 12 [%]

Contour plot of Main road (2)

Almost no repair, and IRI < 5[mm/m]

IRI (P050)

Condition changed
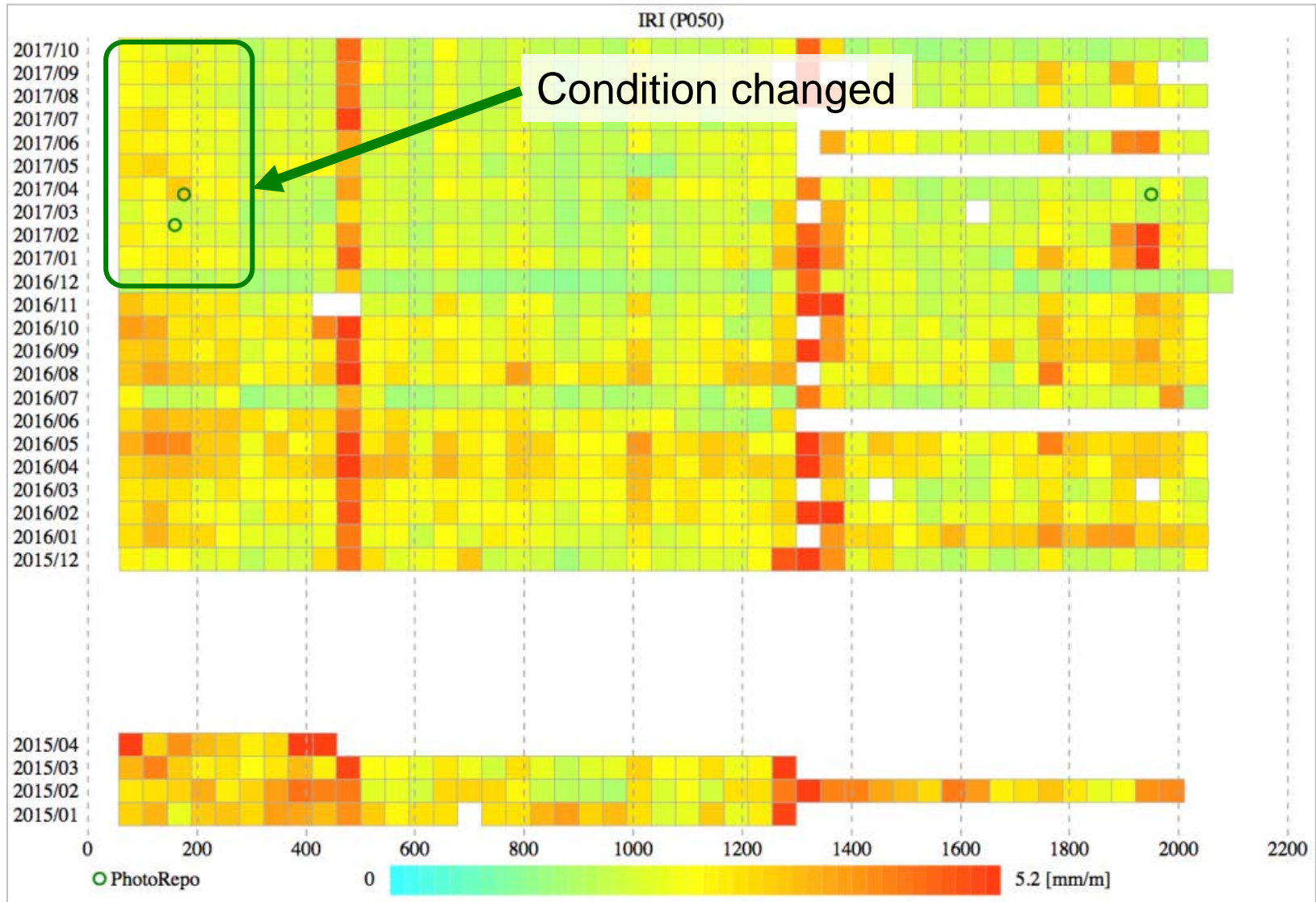
Contour plot of Main road (2)

Almost no repair, and cracking rate < 4[%]

Contour plot of Main road (3)

Almost no repair, and IRI < 5[mm/m]

Contour plot of Main road (3)

Almost no repair, and cracking rate < 4[%]

Seasonal variation?
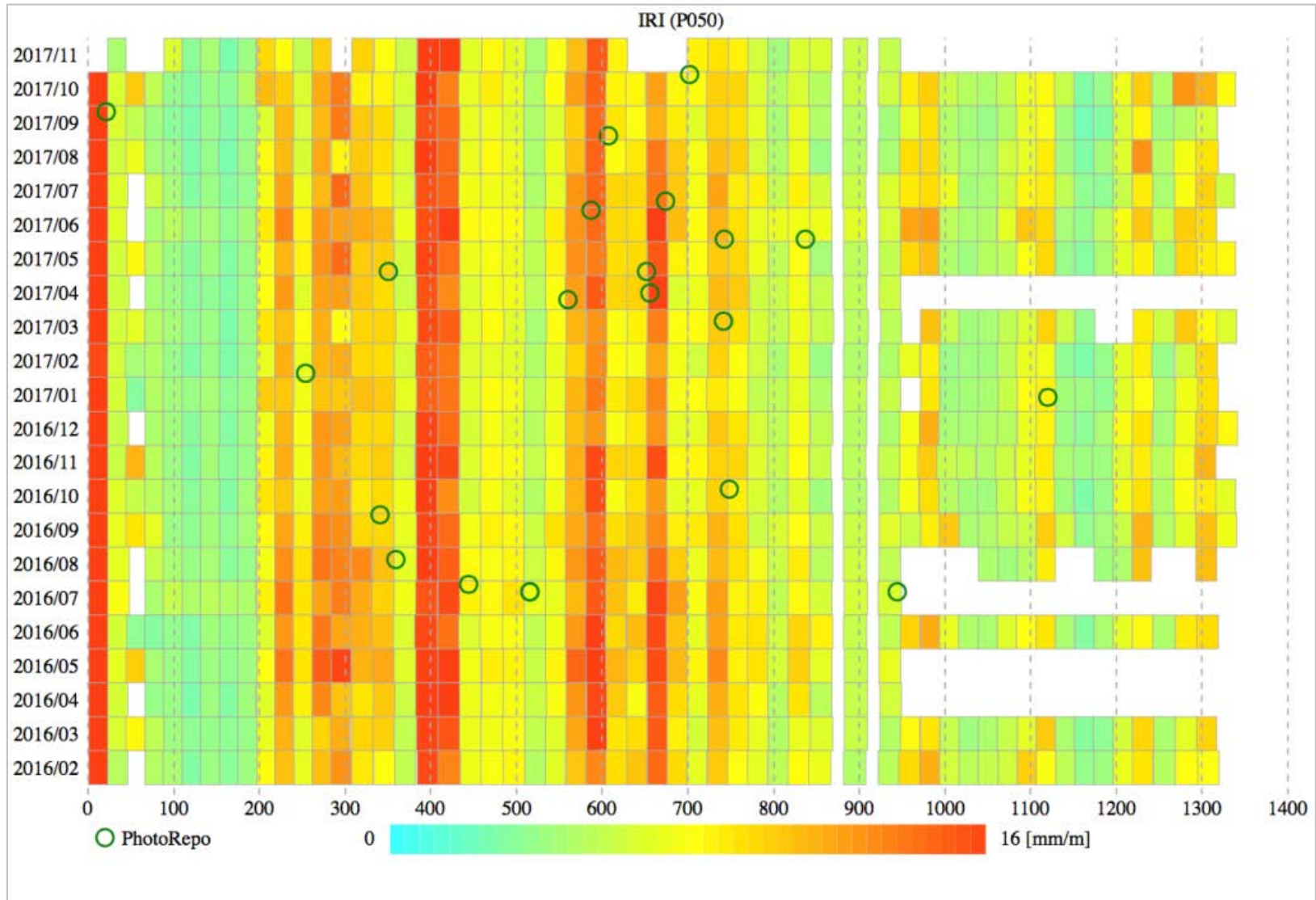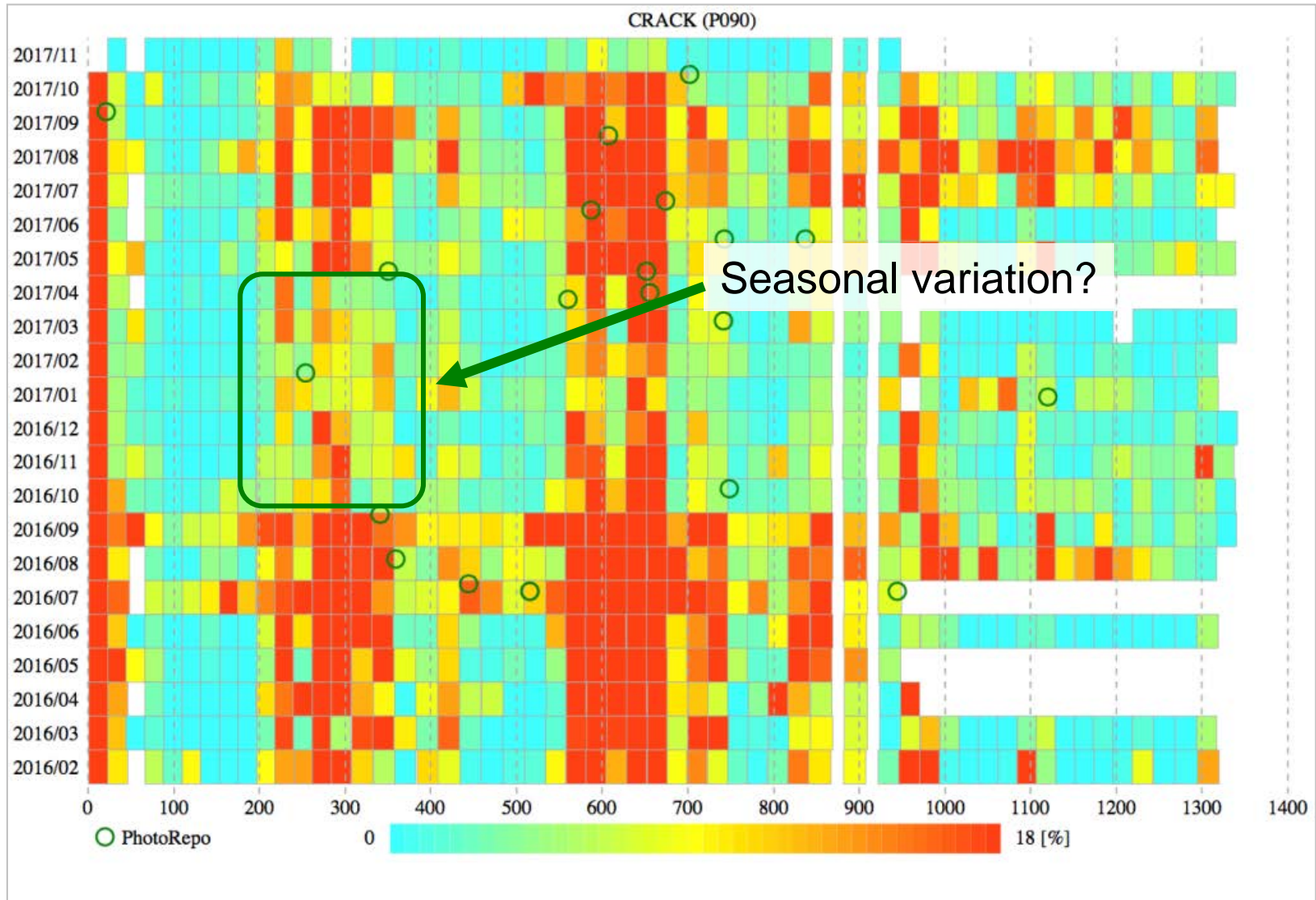
Conclusions

- This is first step to study relationship between repair history and road condition on several city main roads by using regular recording data.
- In this study, there are relationship and it found quick repair is increasing on IRI > 6[mm/m] and/or Cracking rate > 10[%].

Next step

- To confirm relationship on the other road.
- When it will find related parameters and thresholds, an automatic pick-up logic will be developed.
- In future time, by using road condition data, repair risk will be evaluated.

BumpRecorder

Additional Information

BumpRecorder New service will be start!

To increase measurement data usage,
1. IRI calculation price is 1USD / km. It proved on the
   BumpRecorder Web site from today
   http://map.bumprecorder.com/download

2. IRI calculation API will provide, when you post acceleration
   and GPS data to **BumpRecorder** server, you will get IRI
   data. This function will provide in the end of this year.

When you have an interesting, please contact
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or please visit TRB 2018 booth 474