Smart Pavement Inspection

Co., Ltd.

25th Feb. 2021

www.bumprecorder.com
info@bumprecorder.com

Company Profile

Co., Ltd.

Start up : Oct. 23rd 2013 (7 years)

Funder & CEO : YAGI, Koichi

Office : Akabane, Tokyo, Japan

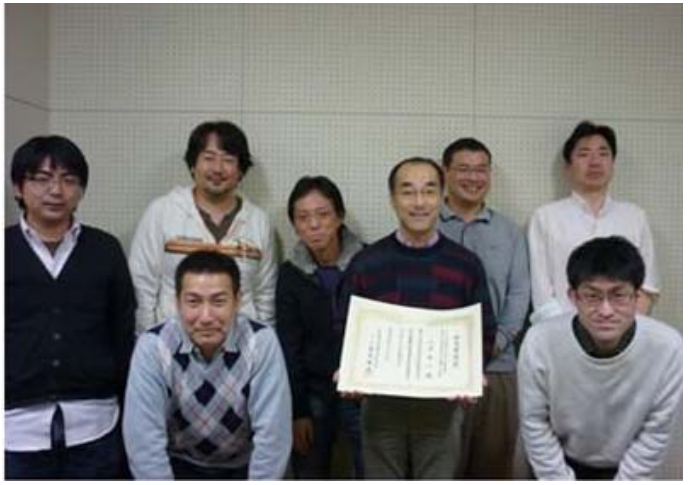
Main service

- : Pavement inspection application
  It was developed since 2007. (13 years)
- Photo report : Human visual inspection supporting tool

Won many awards!

Android Application Award 2011

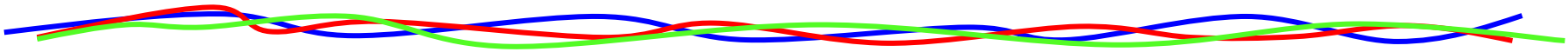
JSTE Research Award 2011



Japan e-Land Map Award 2014

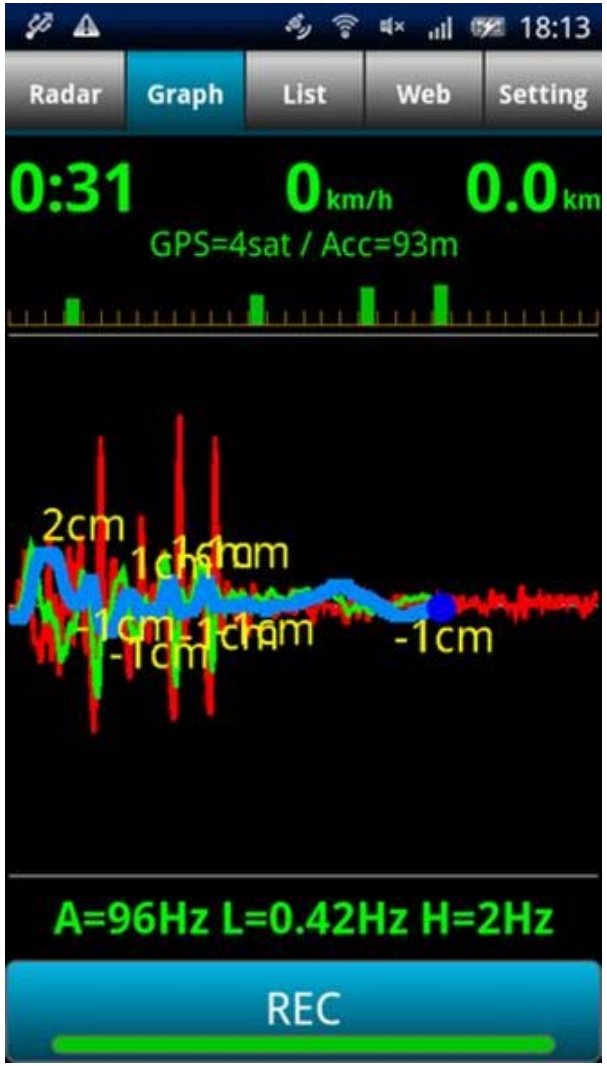
Tokyo Venture Technology Award 2015

overview



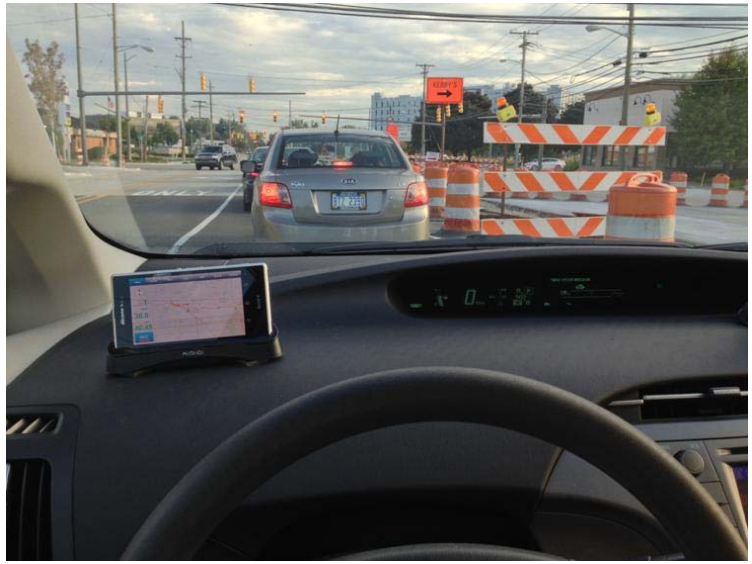
for data inspection

Viblation data is collected under the driving by Smartphone App.



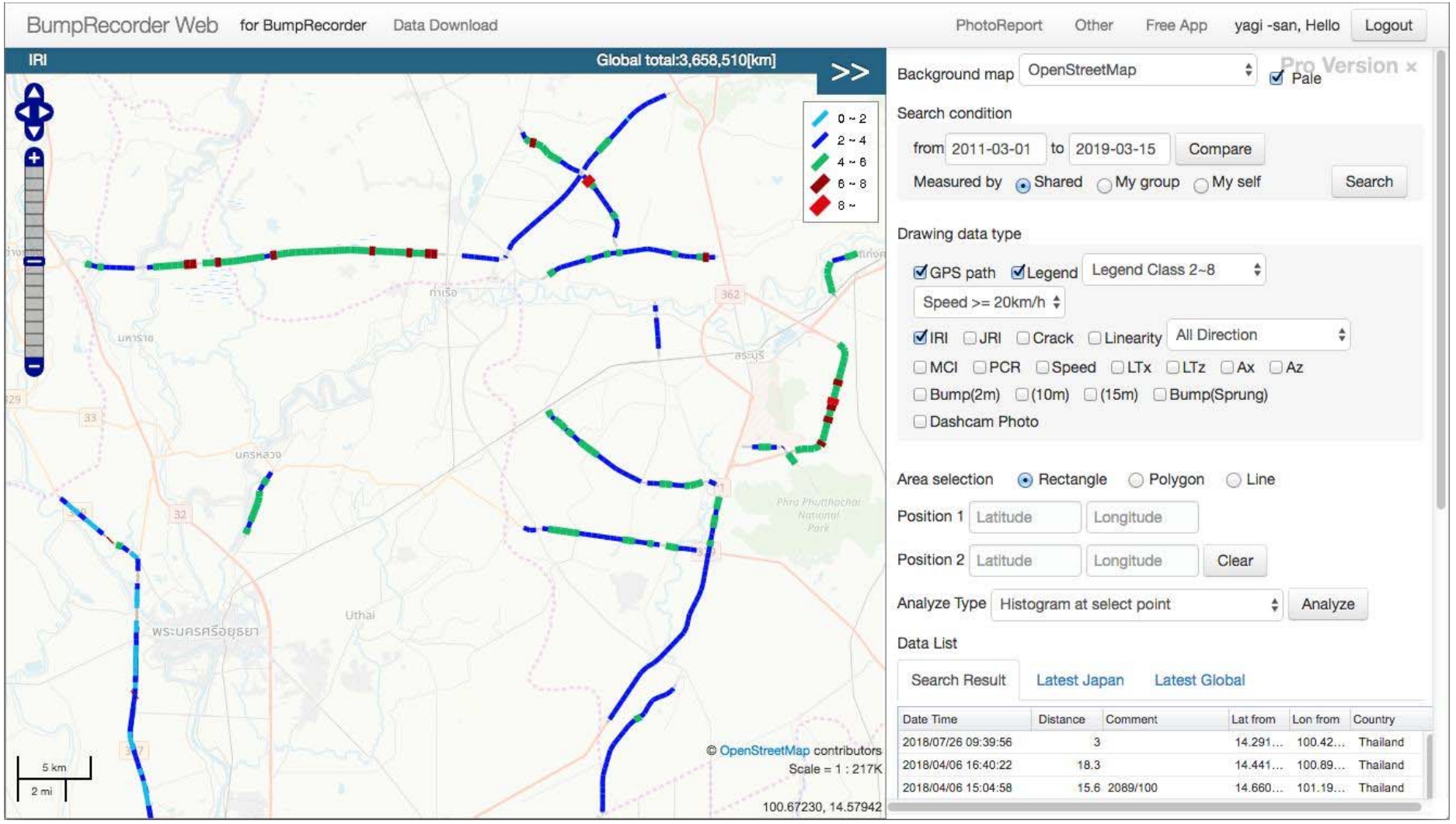
Smartphone app

Smartphone is placed on hard surface tightly, like dashboard, arm lest.



Web GIS

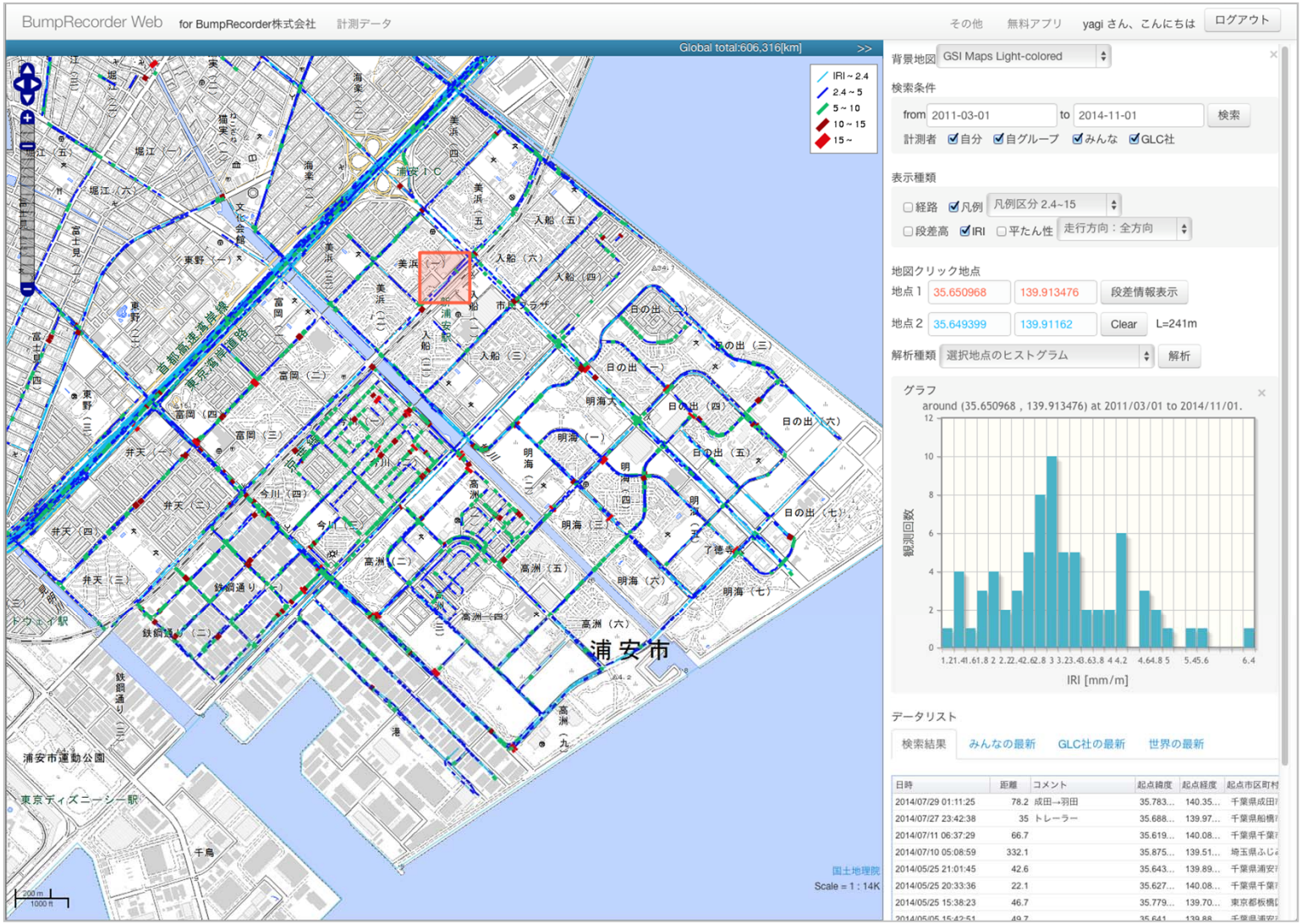
Result will be shown on web map soon.



BumpRecorder

for data inspection

Measurement result can be shown on the map online.



Our belief

Simple, speedy, low cost

BumpRecorder

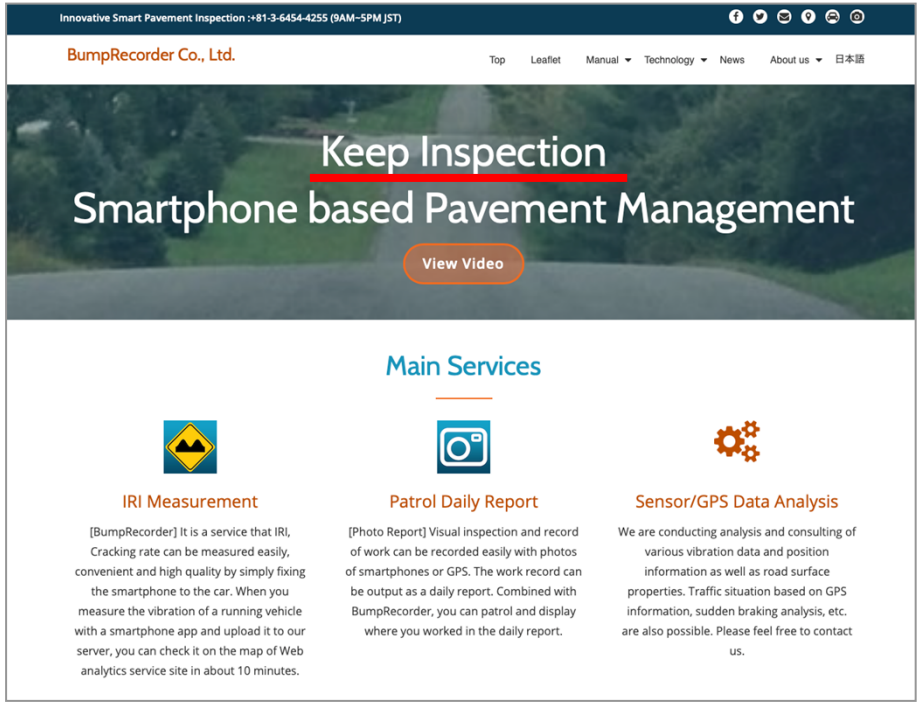
Pavement Roughness Measurement
Smartphone Application
BumpRecorder

Pavement Maintenance Management
Cloud service
BumpRecorder Web

Simple・Speedy・Low cost
Next Generation Maintenance Management Service

Winning Tokyo Venture Technology Award 2015,
the Special Award 2014

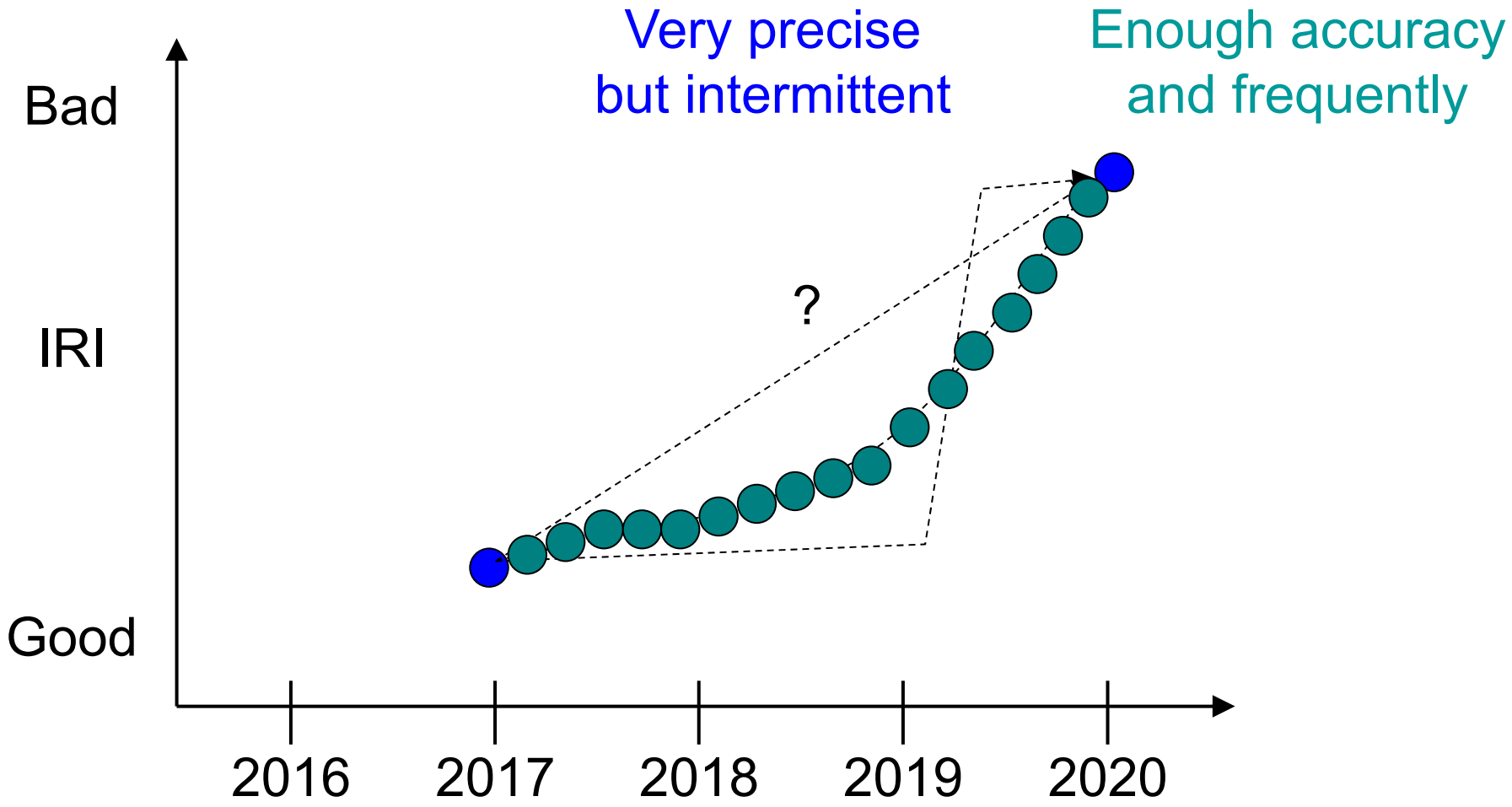
Keep inspection



https://www.bumprecorder.com/en/

Not require special skill,
it can use continuously.

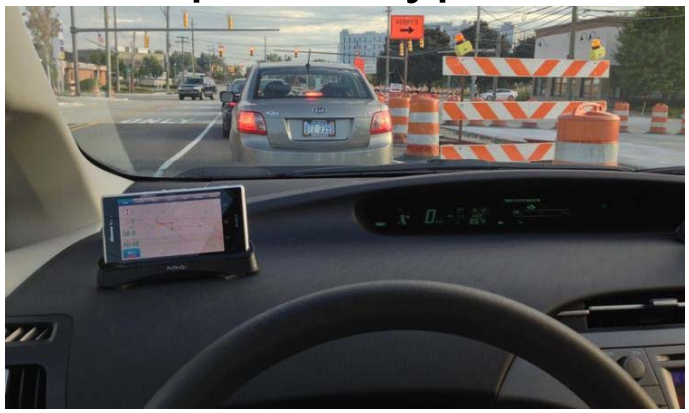
What is right monitoring?



What is right monitoring?

Pavement health monitoring

Smartphone type



Low cost

Inertial profiler

Very precise

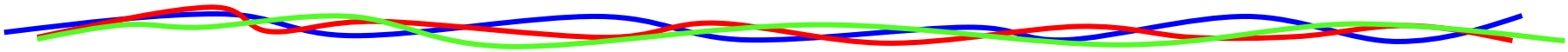
Human health monitoring

Body temp, Blood pressure

CT scanner

BumpRecorder

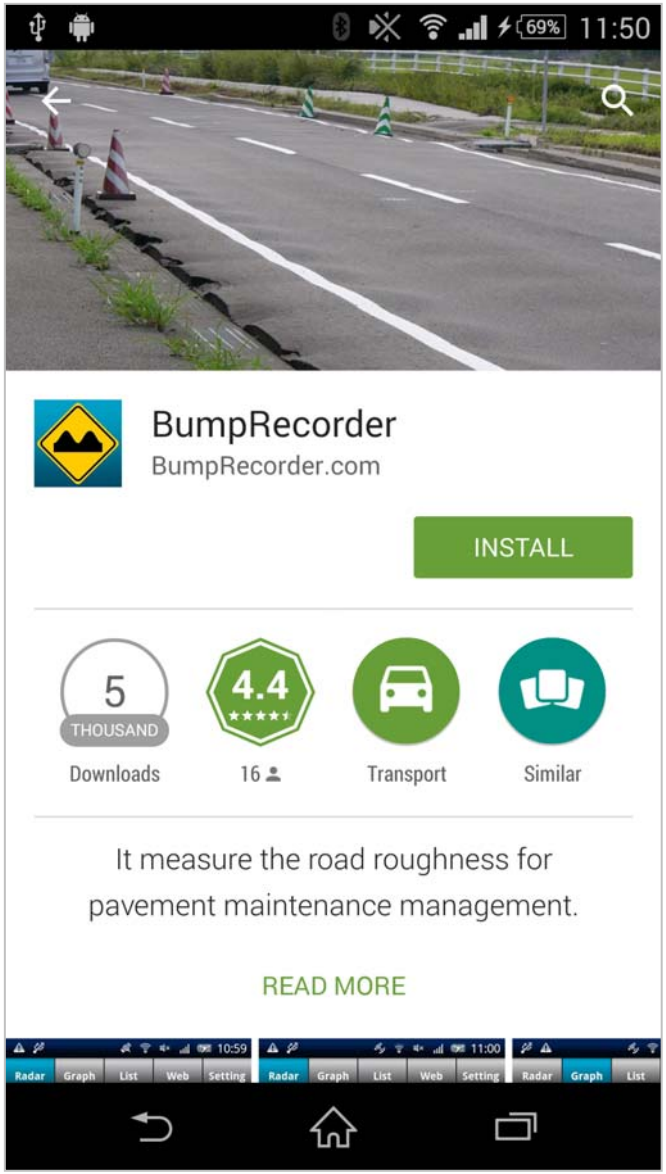
How to use ?



Please visit web page to get manual

https://www.bumprecorder.com/

Install on your Smartphone



BumpRecorder is installed from Google Play. It can search or Bump Navi.

Place on the dashboard tightly

Any tilt angle is okay, but must placed tightly

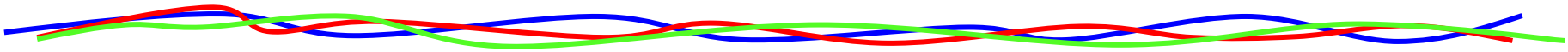
Not only fixed at left and right, but also bottom side.

It use sticky sheet on the bottom side.

NOT recommend

It is easy vibrate itself

Accuracy



IRI is classified 4 class

Some document explained “response type is class 3”.
But I said is class 2.

This is the key point of our technology!

High accuracy ->

Other smartphone app ->

Low accuracy ->

Classification of Roughness Measuring Devices

World Bank sponsored International Road Roughness Experiments (IRRE) conducted in Brazil in 1982, categorised the related equipments into 4 classes, namely Class I, II, III and IV.

-> Class I: *Gives higher standard of accuracy which enable precision measurement of pavement surface profile.*
- *Rod and Level, TRRL beam, Dipstick, Merlin and Walking Profiler*

Class II: *Profile is measured as the basis of direct computation of international roughness index (IRI), very less accuracy compared to class I measurement.*
- *APJ Trailer etc.*

Class III: *Response Type Road Roughness Measuring System (RTRRMS)*
- *Automatic Road Unevenness Recorder / Bump Integrator / Roughometer, Car Axle Mounted Bump Integrator, Mays Meter etc.*

Class IV: *Methods used in situations where higher accuracy is not essential.*
- *Ride experience, Visual inspection*

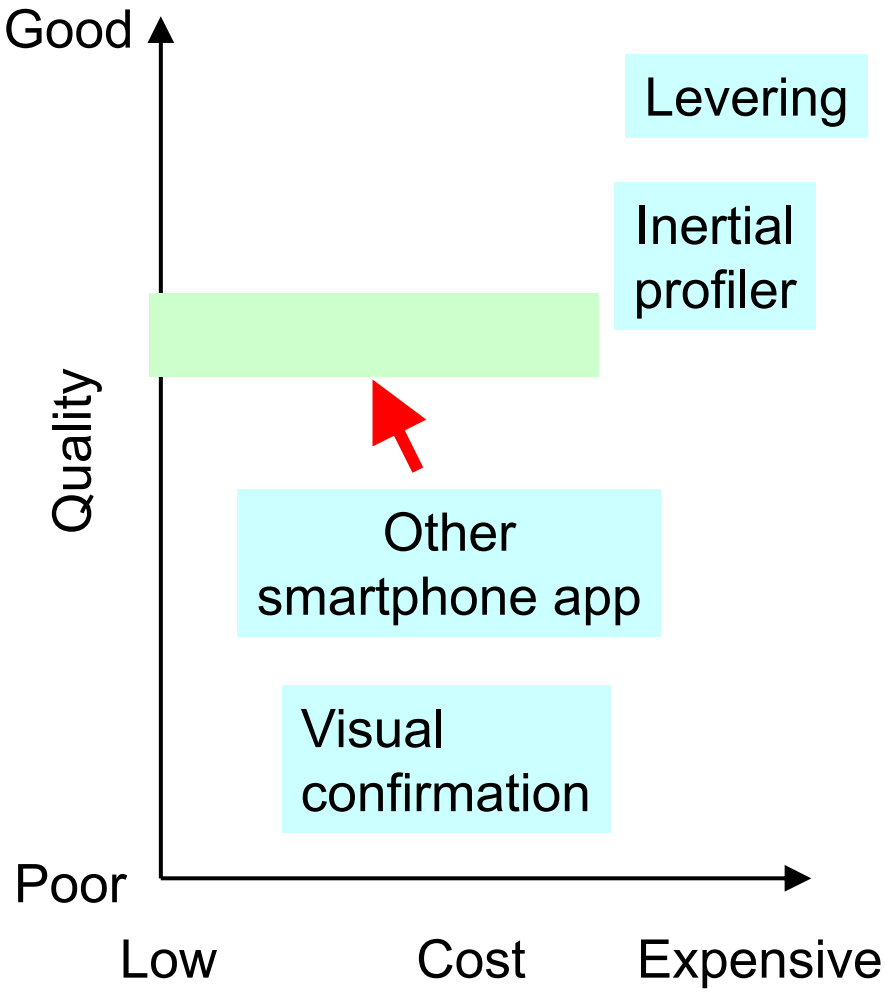
CSIR CRRI

http://www.academia.edu/9039390/ROAD_ROUGHNESS_MEASUREMENT_TECHNIQUES_AND_STATNDARDISATION_OF_RTRRMS_DEVICES

Position of

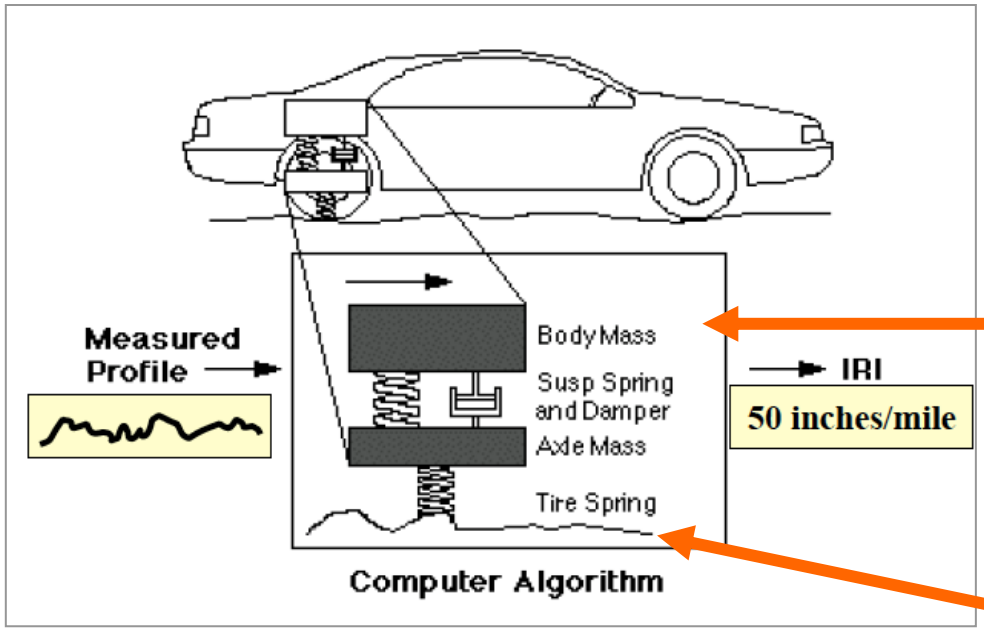
is more precise and lower cost for IRI measurement.

Class 1 Precise Static method	Profilometric QC simulation
Class 2 Other method	
Class 3 Correlation equations	No QC simulation
Class 4 Subjective ratings	No verifiable



IRI computation

IRI is suspension movement average under 80km/h.
- average of suspension expansion and compression-



(3) Calculate average length of suspension expansion and contraction, that is IRI.

(2) QC simulation is applied to calculate suspension movement.

(1) Measuring longitudinal profile.

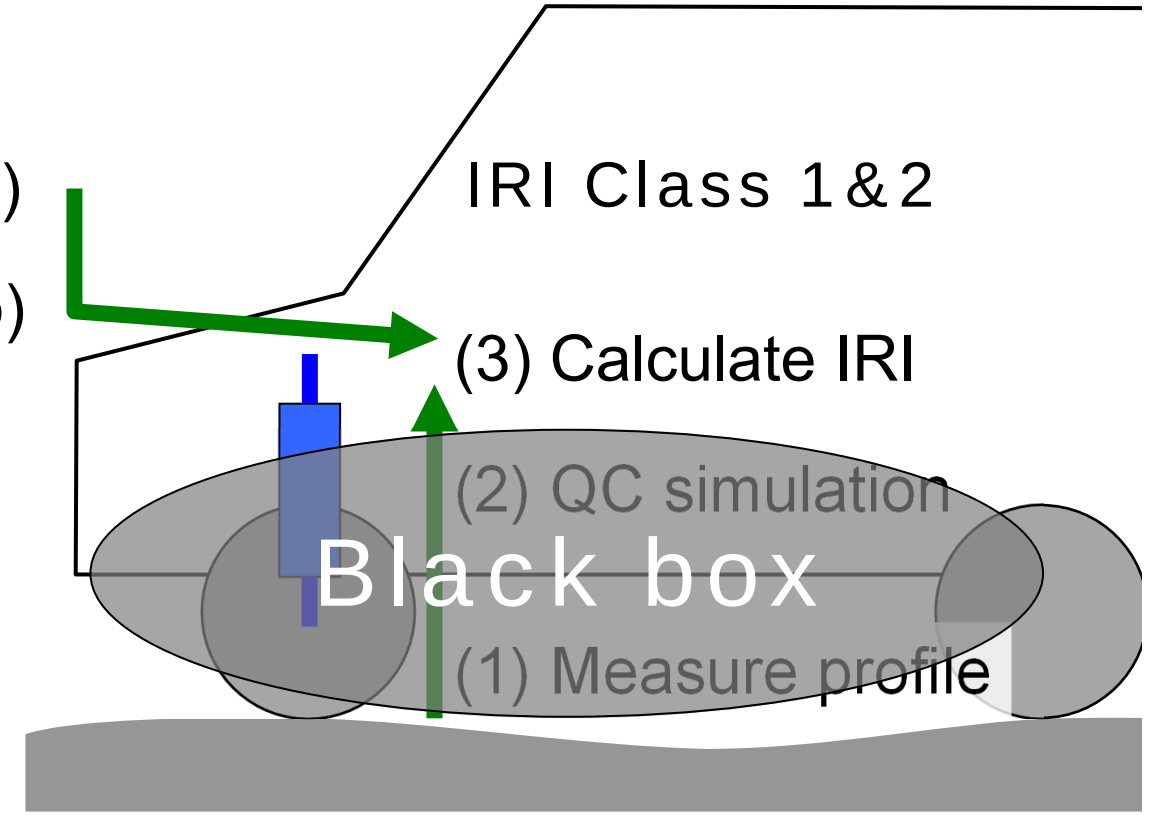
http://www.dot.state.mn.us/materials/smoothnessdocs/IRIIntroduction.pdf

Other response type is IRI Class 3

IRI Class 3

Dashboard acceleration (a)

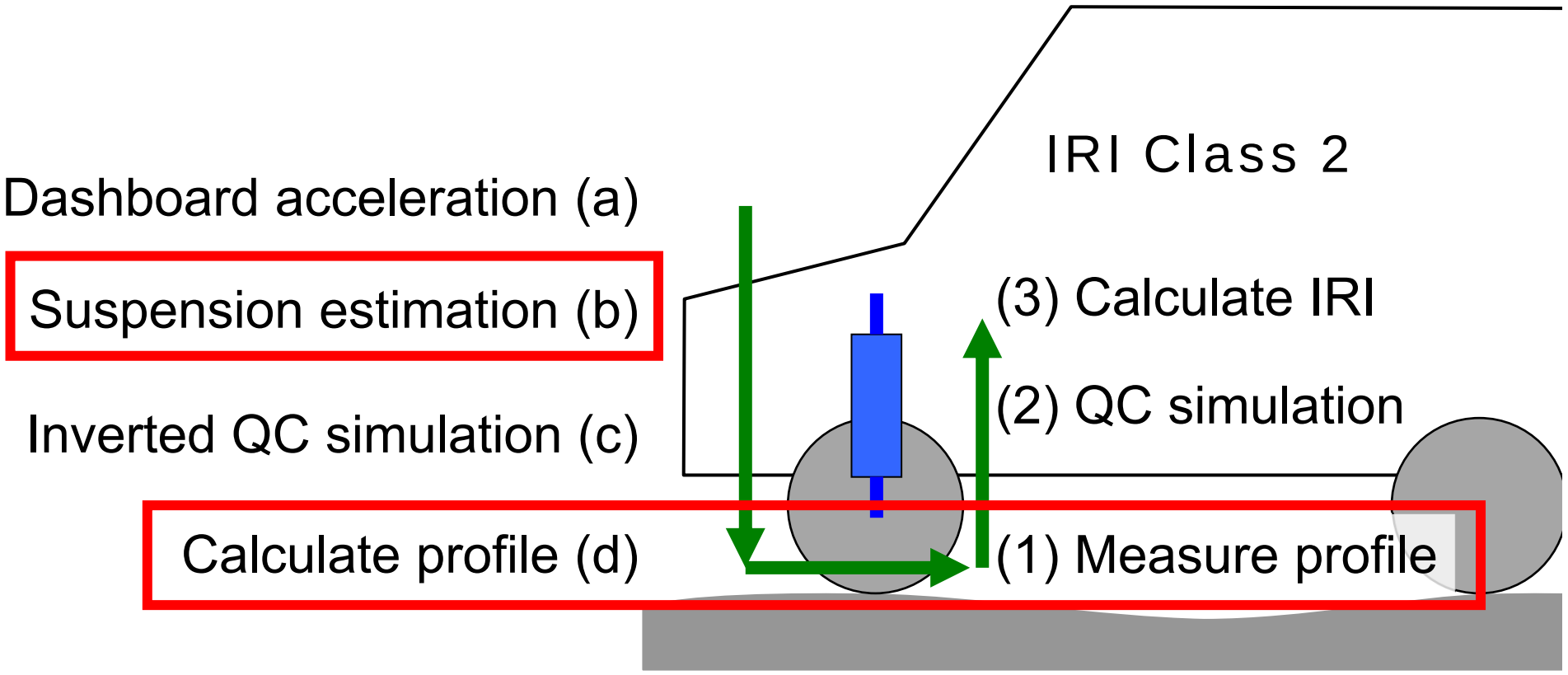
Correlation formula (b)



Calibration driving is needed.

Low repeatability.

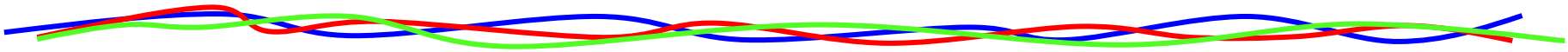
is IRI Class 2



Auto calibration is done during measurement driving.

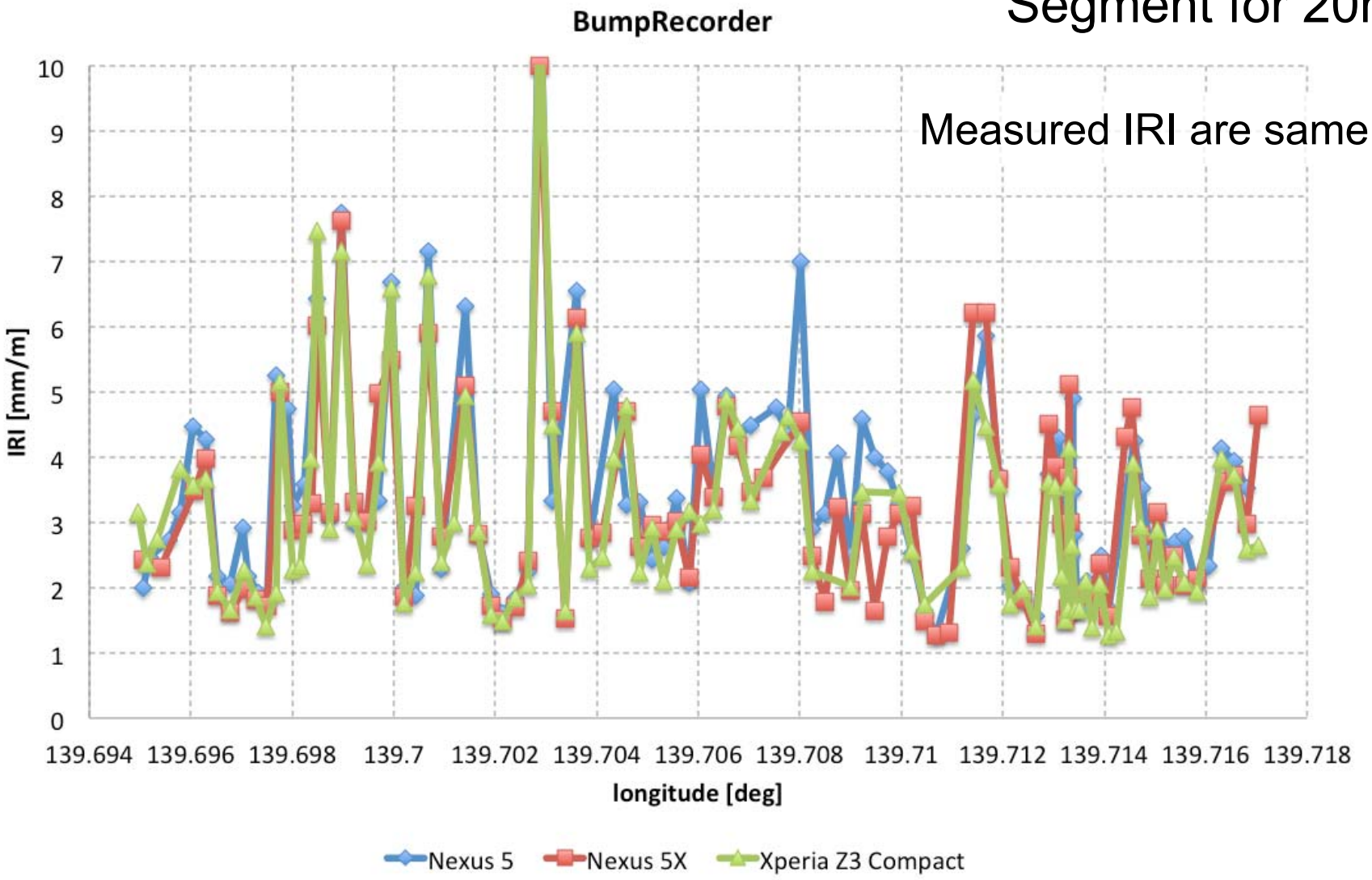
Good repeatability.

Verification Result Reliability



Using different smartphone model

Segment for 20m



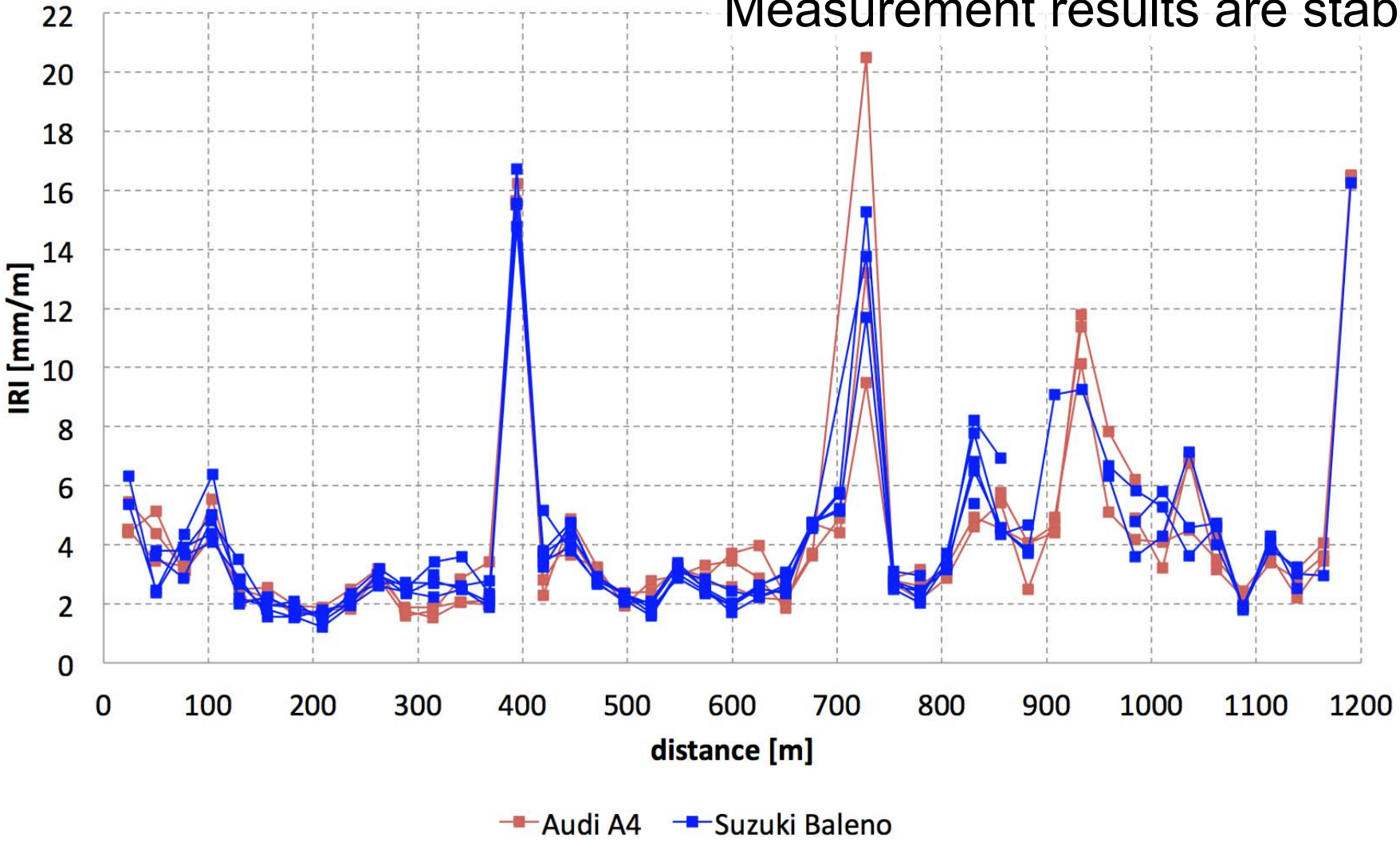
Measured IRI are same.

Using different vehicle type

It measured 3 times

車種依存確認

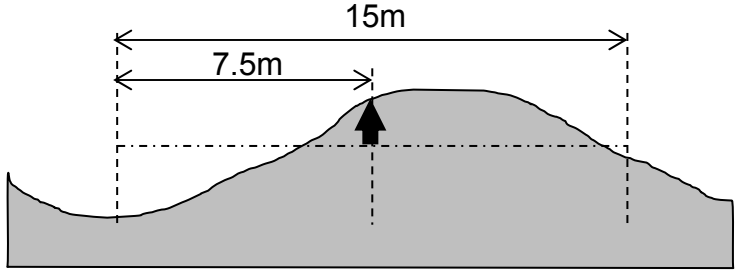
Measurement results are stable



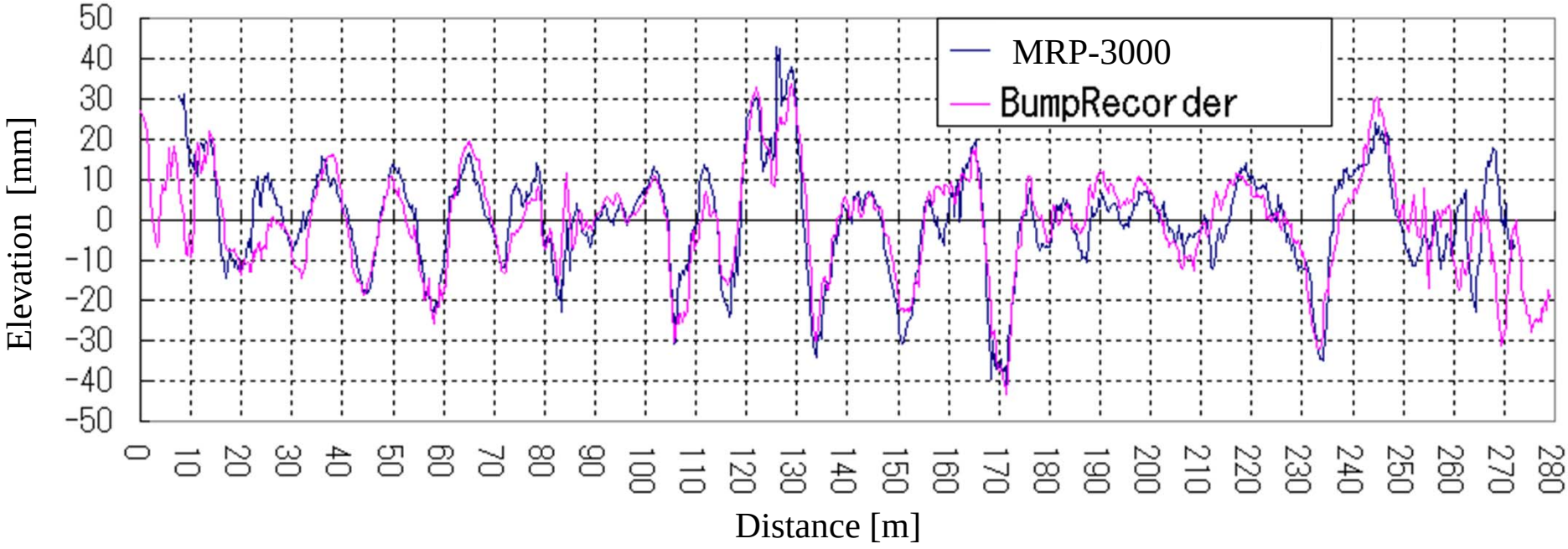
Comparison with KUMATAKA MRP-3000

Comparison : Relative height in 15[m] long

Calculating relative height in 15[m] long
for MRP-3000 and BumpRecorder.
Then comparing this two values.



Trend was consistent.
Position gap was not so large.

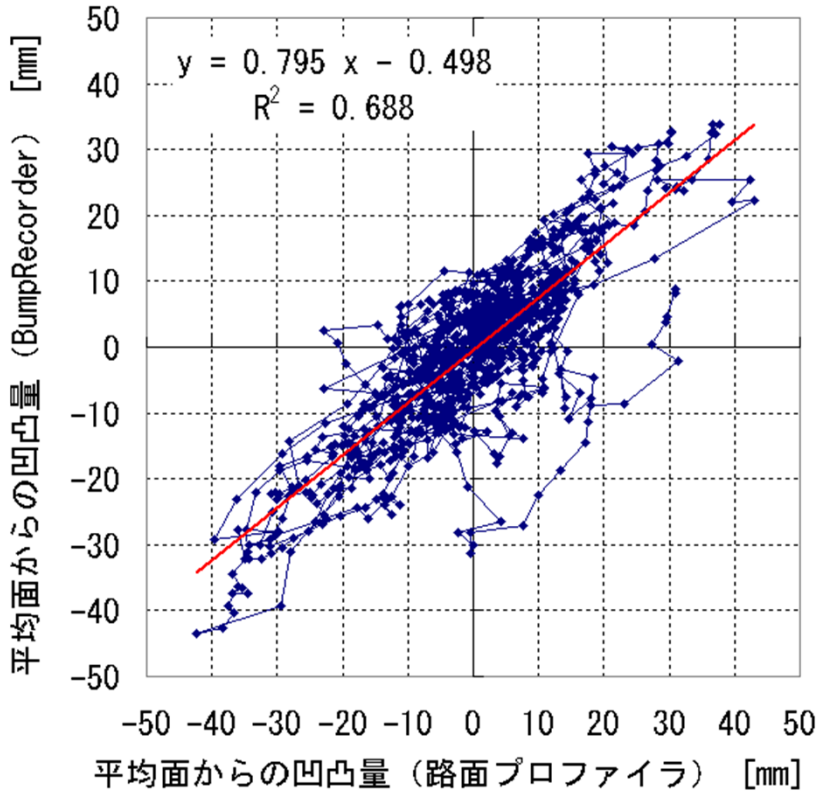


Comparison : Relative height in 15[m] long

Liner regression was done,
by using result of MRP-3000
and BumpRecorder

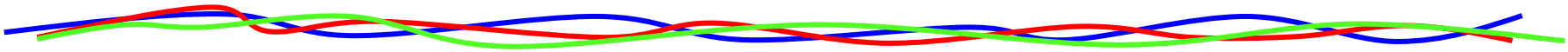
- Contribution Ratio : 0.688

= Correlation coefficient : 0.829



Relative height by MRP-3000 [mm]

Available indexes



evaluate indexes

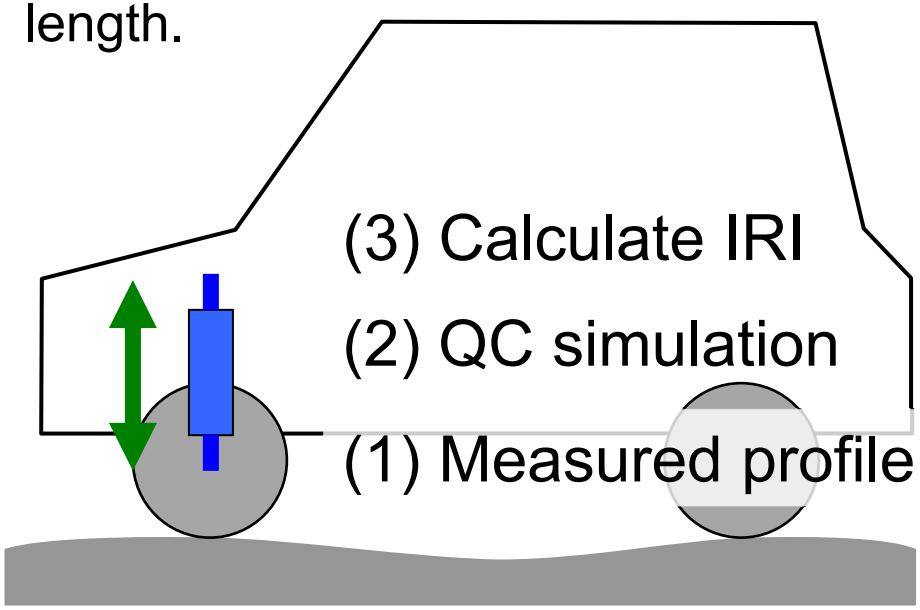
	Road standard				Railway standard
	Global	Japan	India	Original	
Roughness	IRI	JRI	*BI*		
	Boeing Bump Index				longitudinal level irregularity *
Crack	Surface cracking ratio *			Wheel path cracking ratio	
Rut *	Rut depth *				
Combination	PCR *PSI*	MCI		*Repair priority*	
Ride comfort vertical & transverse					Maximum acceleration
					LT index (ISO 2631-4)

supported future plan N/A * : not support

Roughness

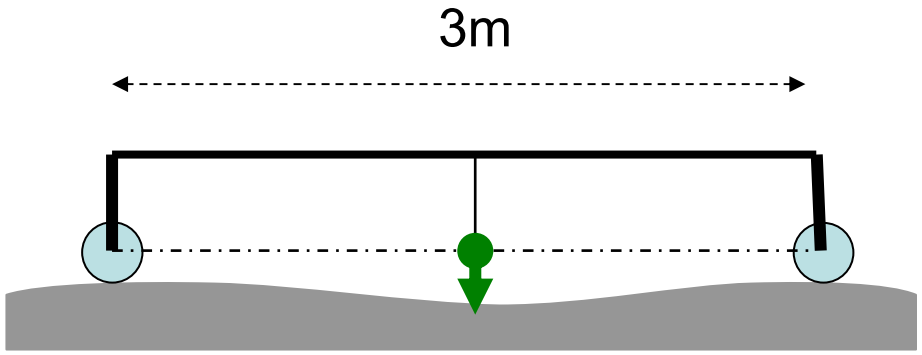
IRI - International Roughness Index

Average of suspension expansion & compression under 80km/h driving situation. It includes longer wave length.



JRI - Japanese Roughness Index

Standard deviation of 3m profilometer measurement value. It indicate shorter wave length situation.



BI - Bump Index

BI converted from IRI by correlation formula.

BI = 630 x (IRI^1.12)

Similar to PI : Profile Index

Boeing Bump Index

IRI / JRI - Roughness

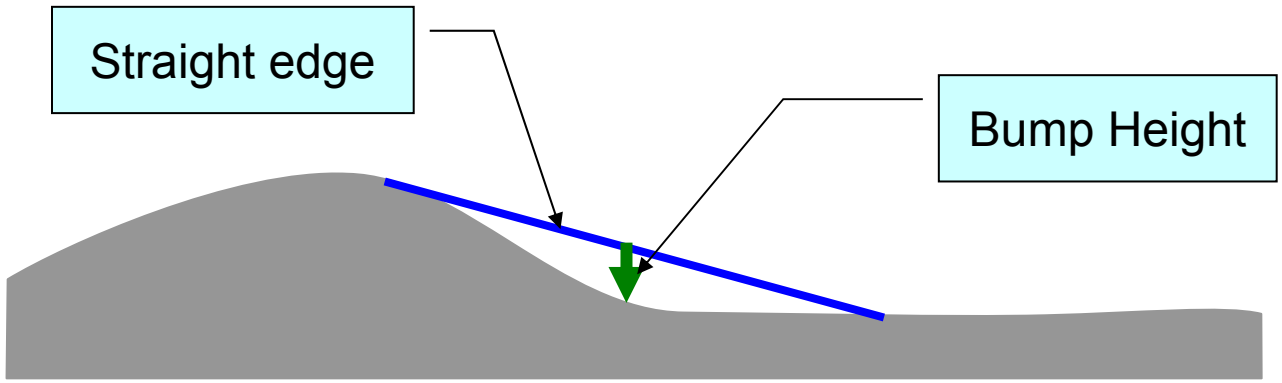
Representative value on the segment.

BBI - Boeing Bump Index

Point information of the bump size and location.

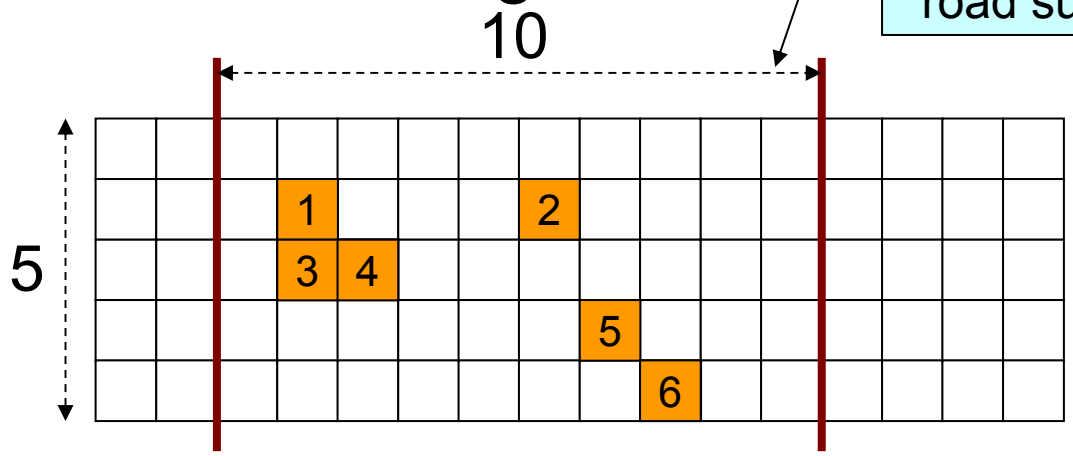
2m/10m/15m straight edge is used,

and deepest depth is defined Bump Height.



Cracking rate

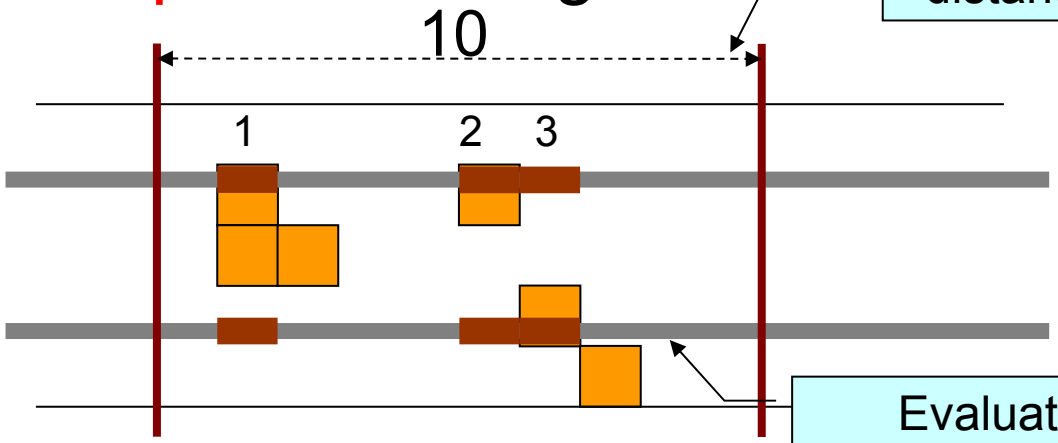
Surface cracking rate



Square measure rate between road surface and cracking area

$$\frac{6}{10\text{x}5} = 12\%$$

Wheel path cracking rate



Distance rate between running distance and cracking distance

$$\frac{3}{10} = 30\%$$

Evaluate on wheel path
(not include other surface)

Combination Index

PCR (Pavement Condition Rating)

PCR = (0.60 * SCR) + (0.40 * RCI) Pavement Condition Rating
RCI = 160 * (2.718282 ^ (-0.259776 * IRI)) Roughness Condition Index
SCR = 100 - [Cracking rate] Surface Condition Rating

0 (bad) ~ 100 (good)

MCI (Maintenance Condition Index) Japanese Standard

$MCI = 10 - 1.48C^{0.3} - 0.29D^{0.7} - 0.47\sigma^{0.2}$
$MCI0 = 10 - 1.51C^{0.3} - 0.30D^{0.7}$
$MCI1 = 10 - 2.23C^{0.3}$
$MCI2 = 10 - 0.54D^{0.7}$

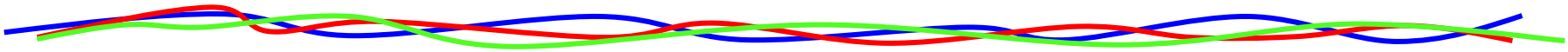
smallest value is used.

C =Cracking rate [%]
D =Rut depth [mm]
σ=JRI [mm]

0 (bad) ~ 10 (good)

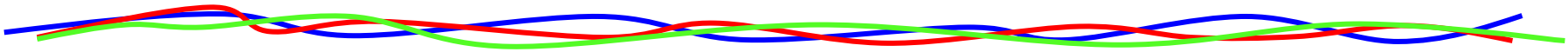
Wheel path cracking rate is used for above formula.

Web display samples



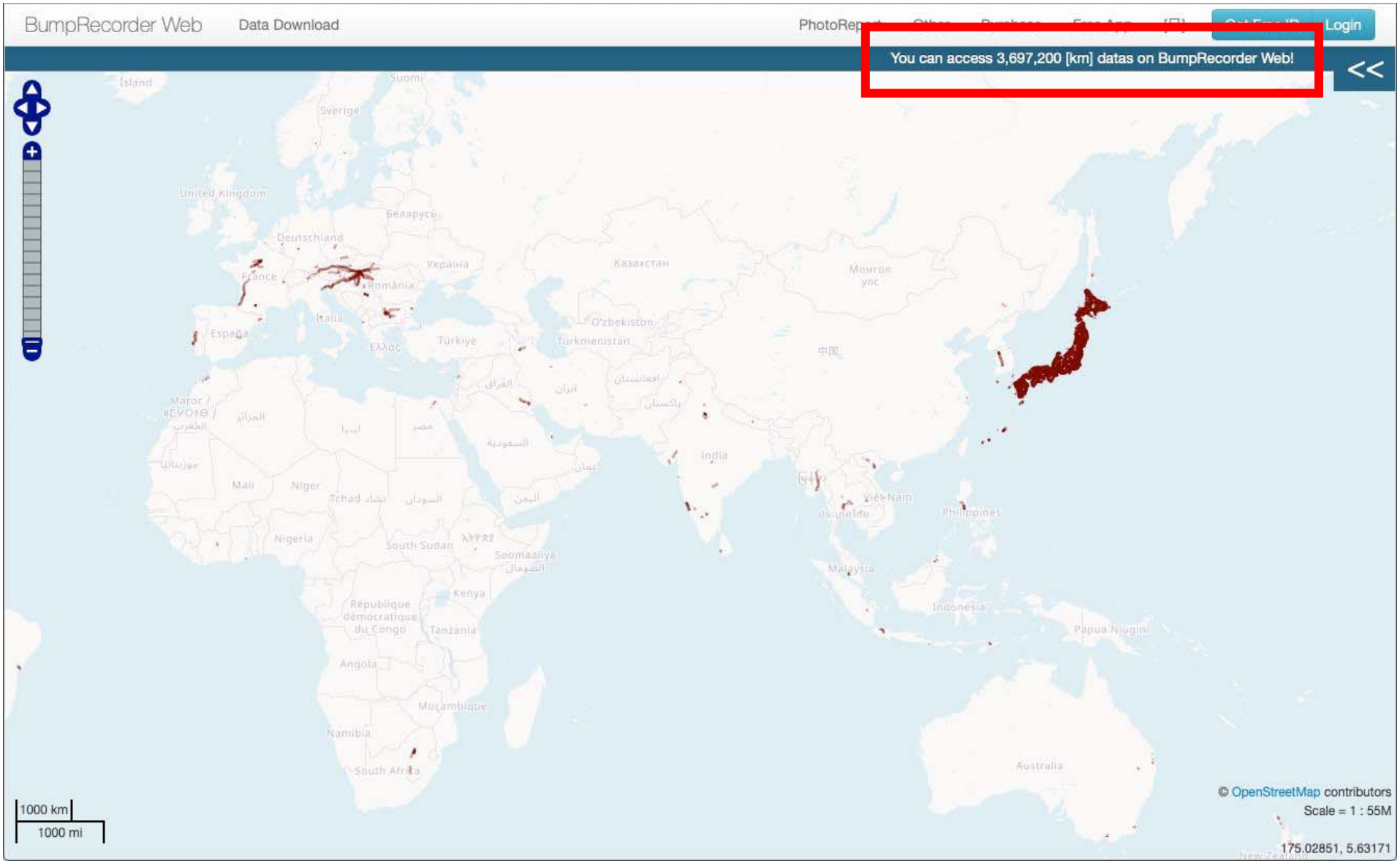
https://map.bumprecorder.com/

has
3,809,790km data in global

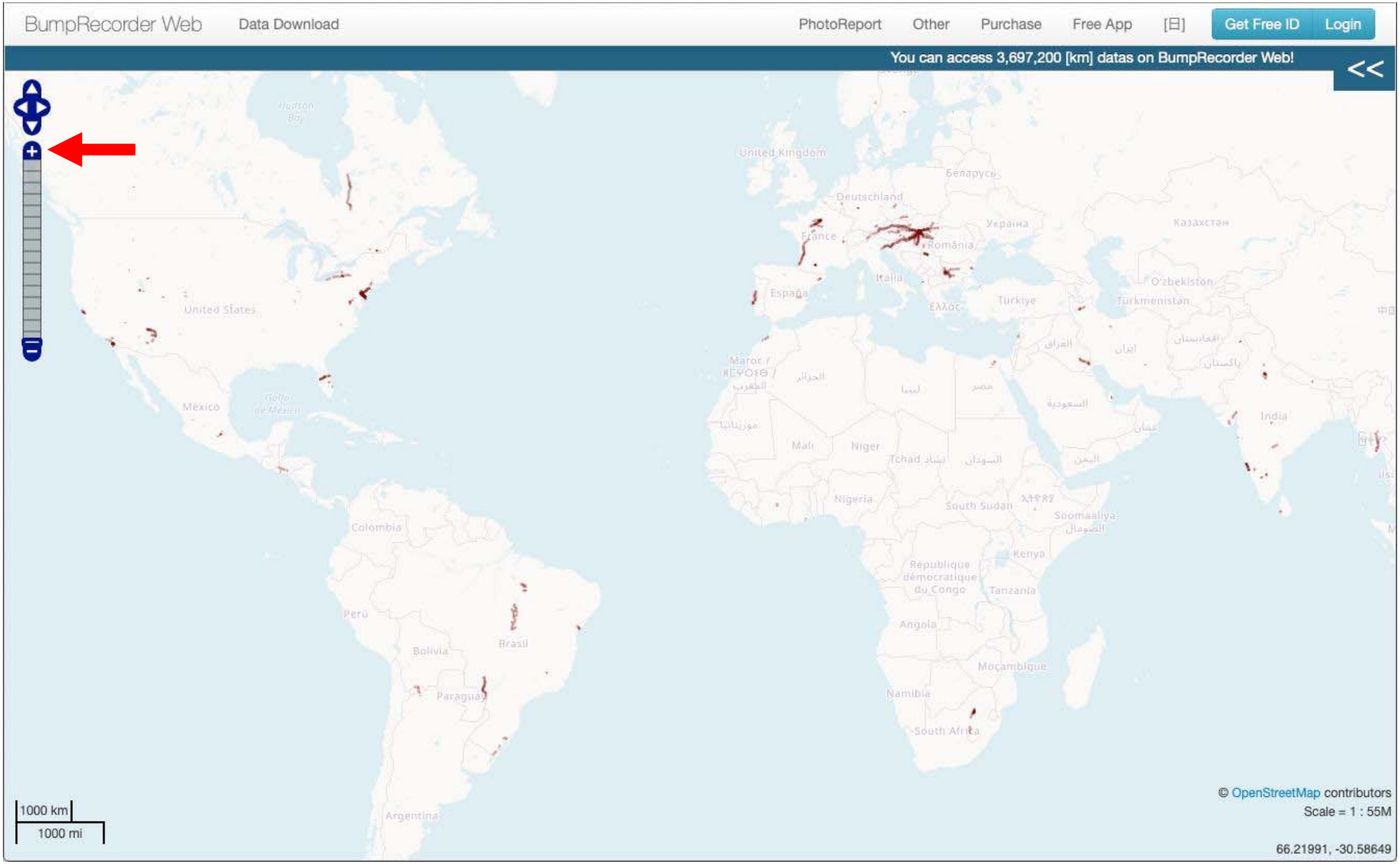


We have much experience!

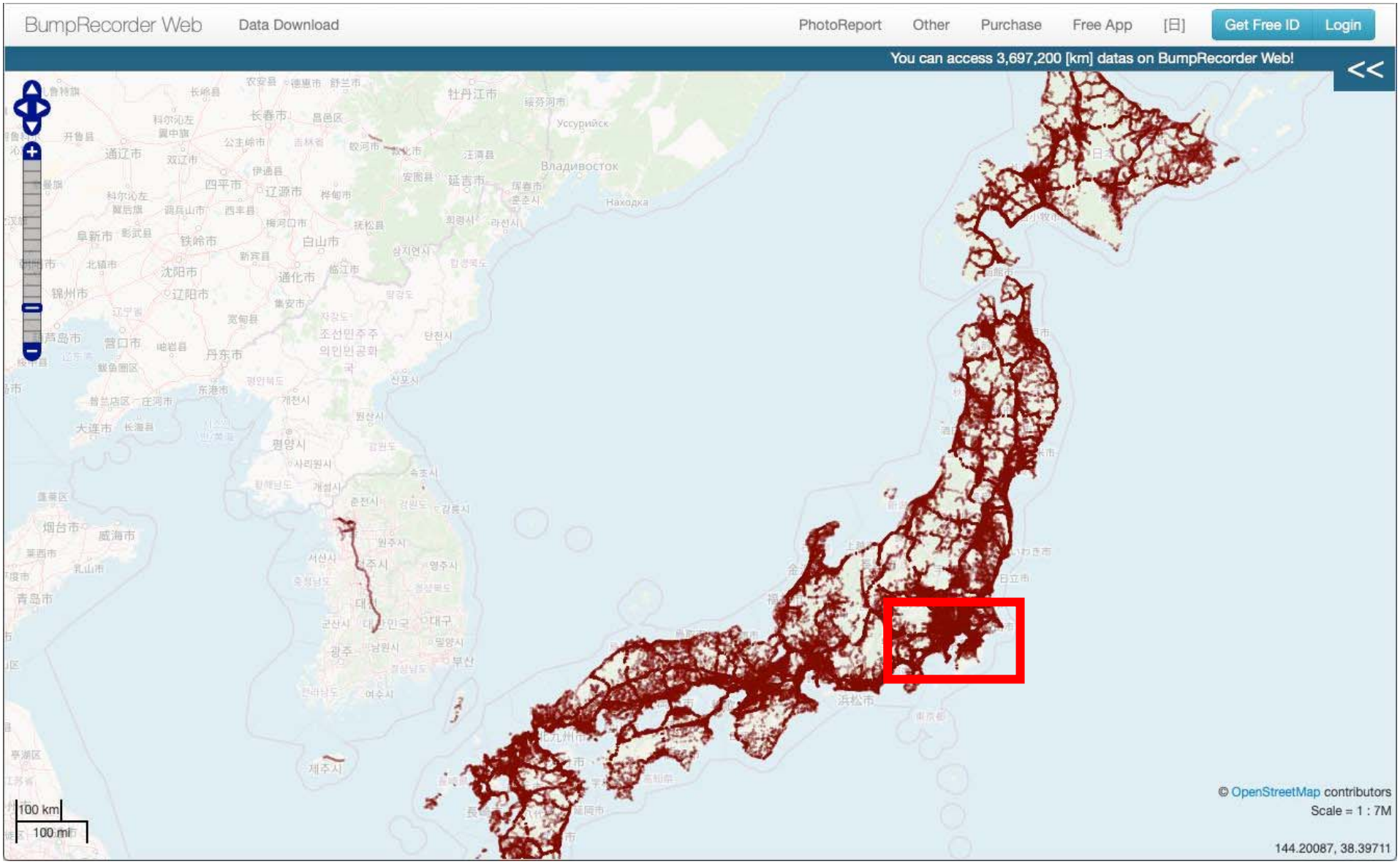
Whole Japan and many courtiers!



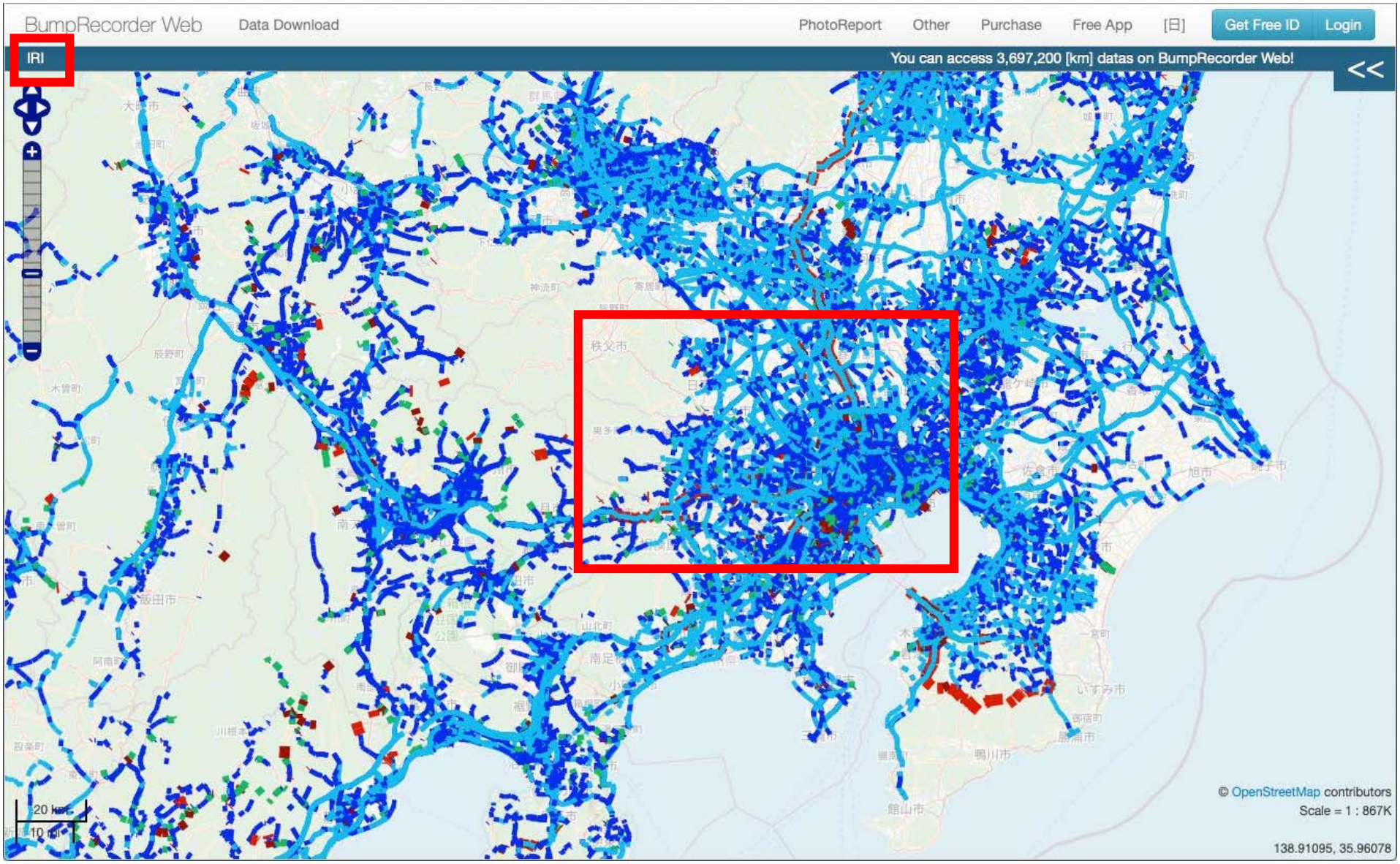
American continent too



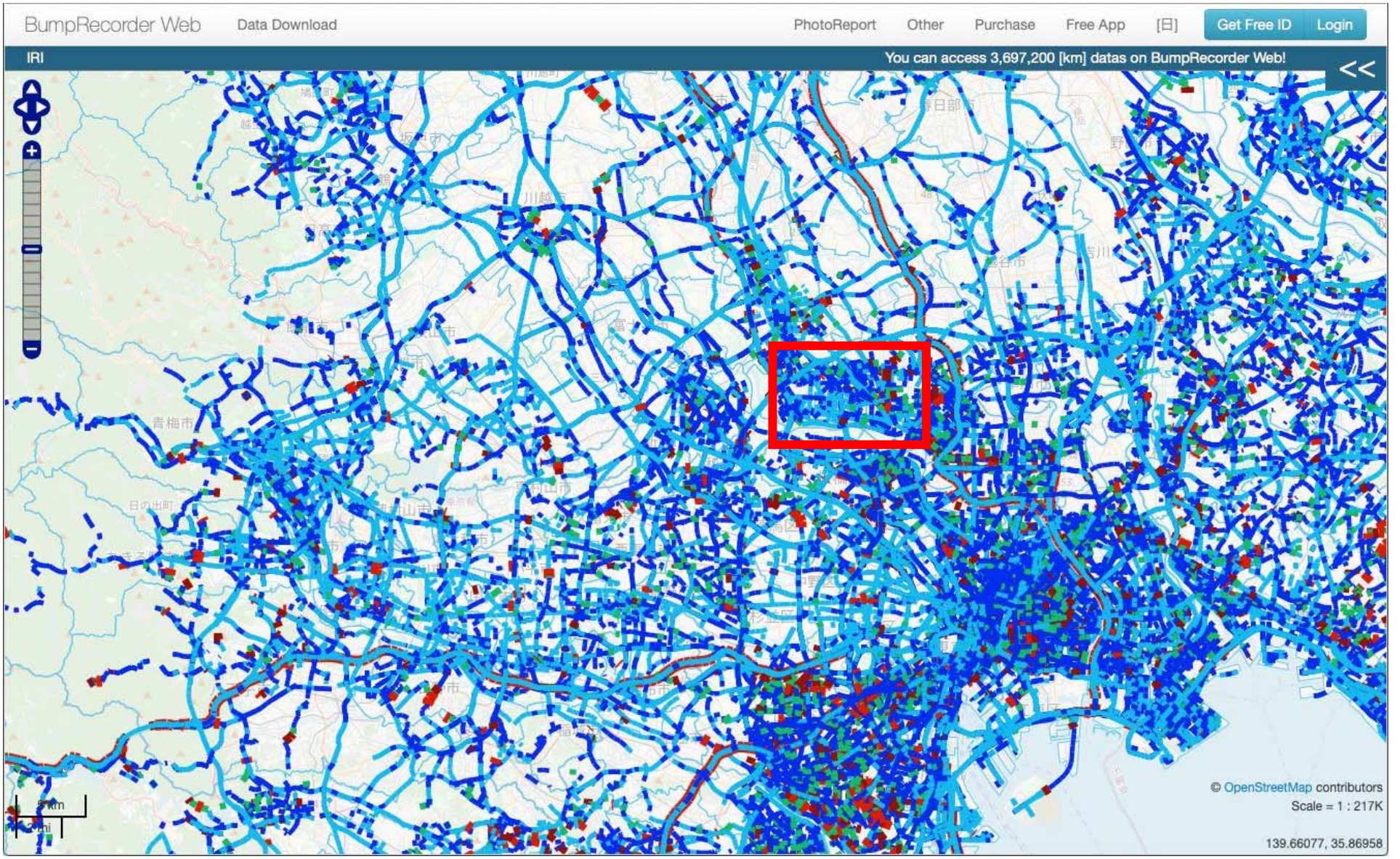
Close up Japan



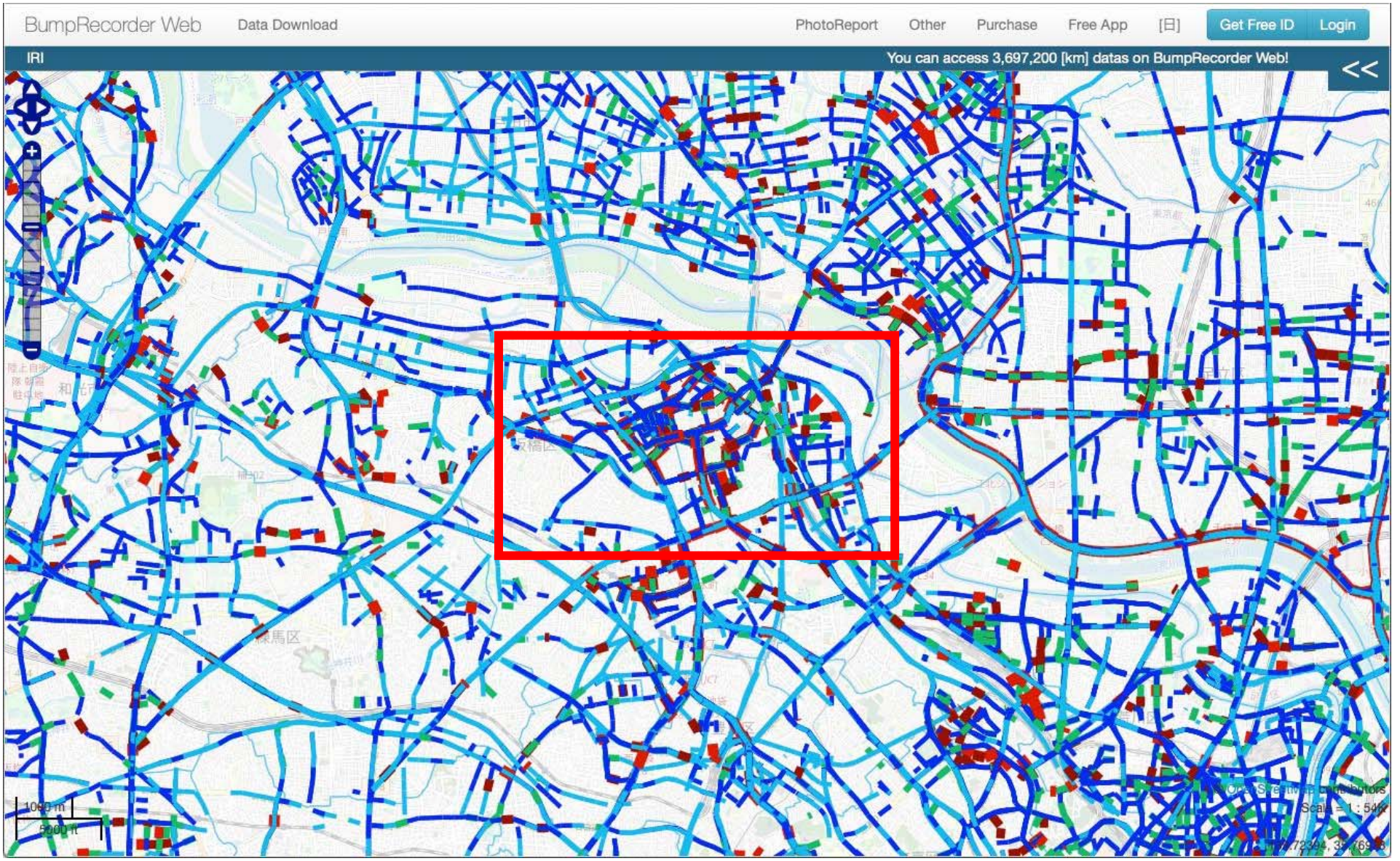
Close up Tokyo area



Close up more



and more


BumpRecorder Web
Data Download
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Purchase
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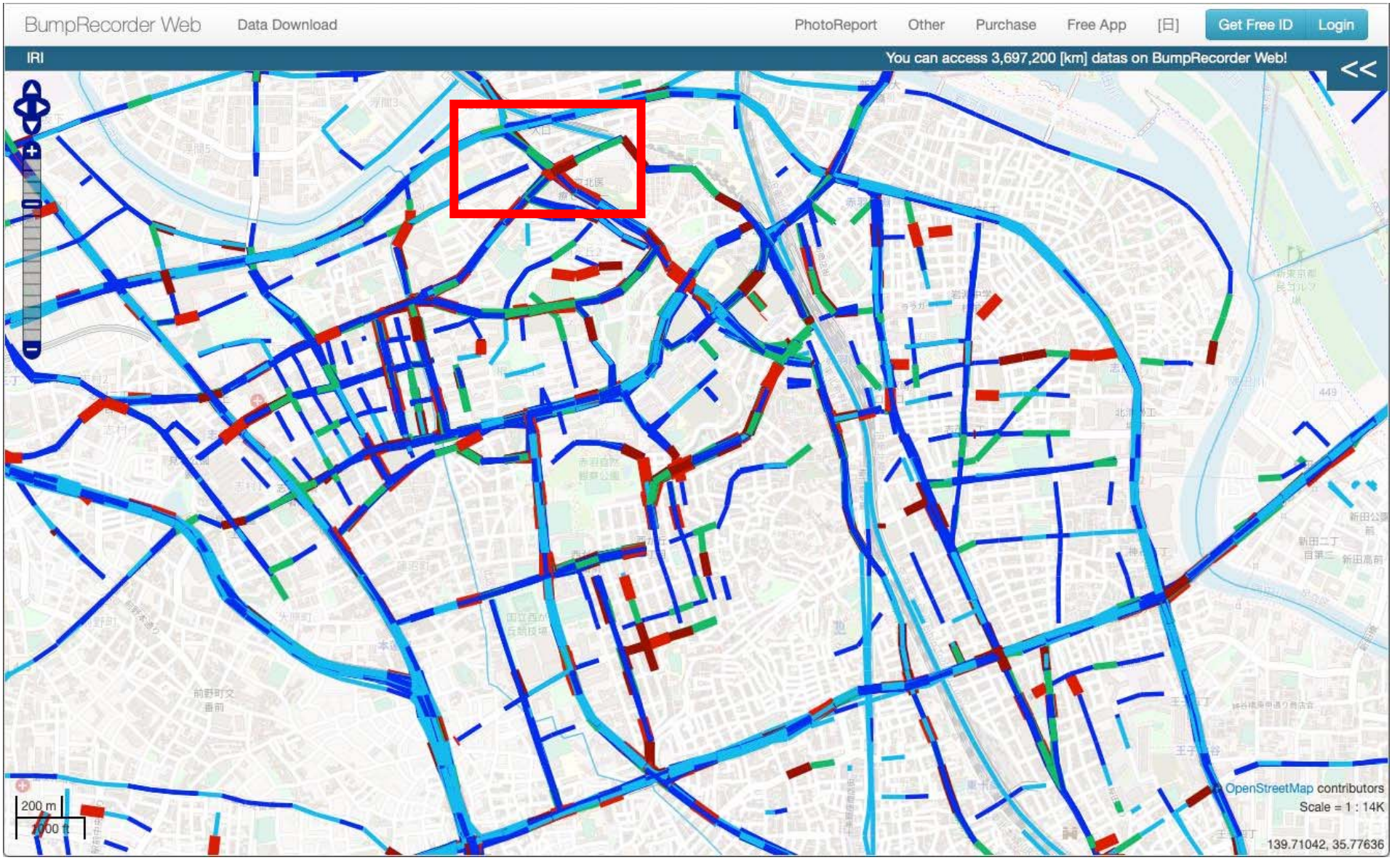
Get Free ID
Login
IRI
You can access 3,697,200 [km] datas on BumpRecorder Web!
<<

and more


BumpRecorder Web
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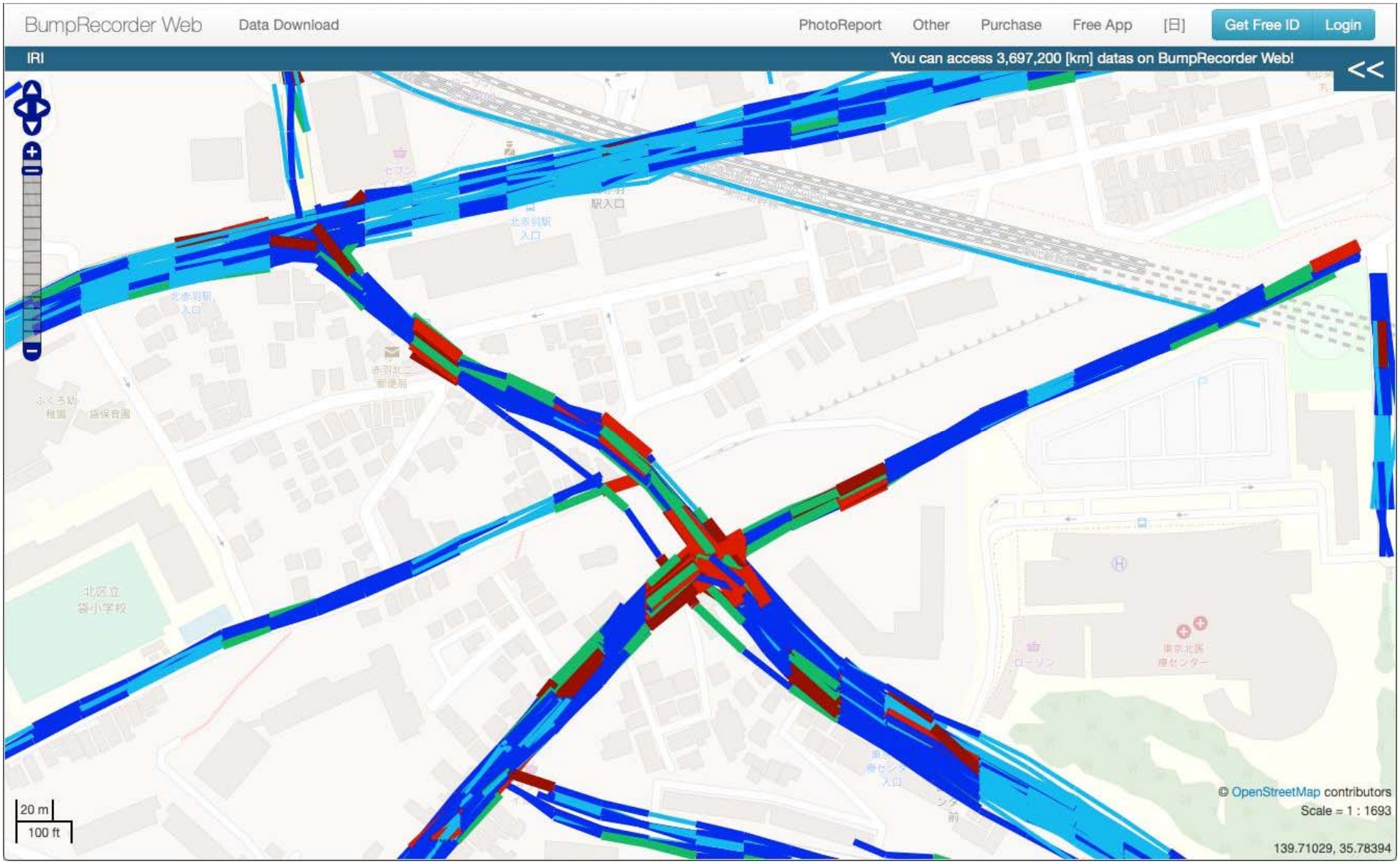
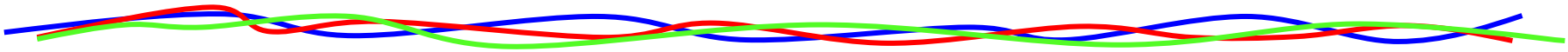
You can access 3,697,200 [km] datas on BumpRecorder Web!
<<
200 m
OpenStreetMap contributors
Scale = 1 : 14K
139.71042, 35.77636

Available from Network level to Project level

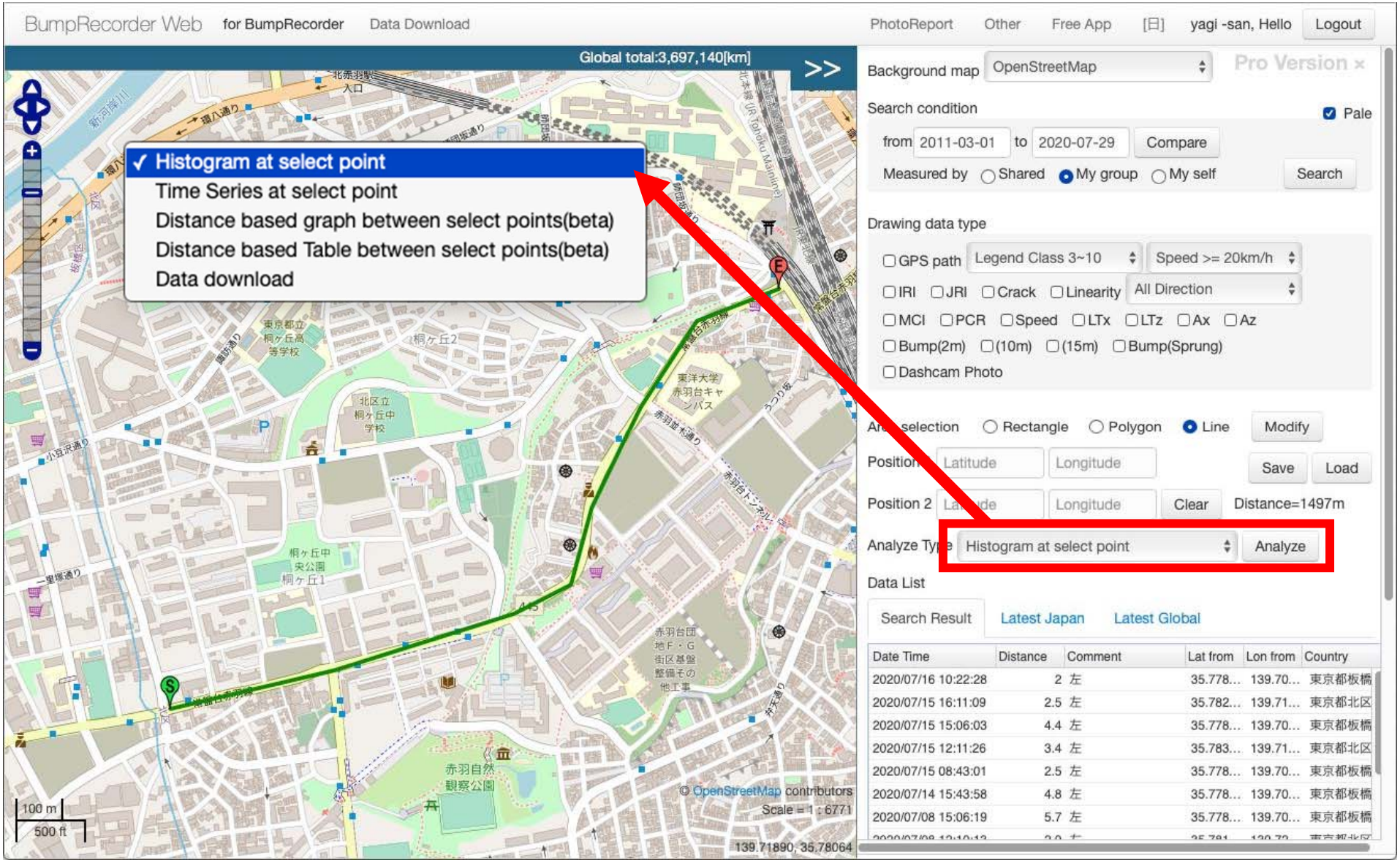


Simple PMMS functions

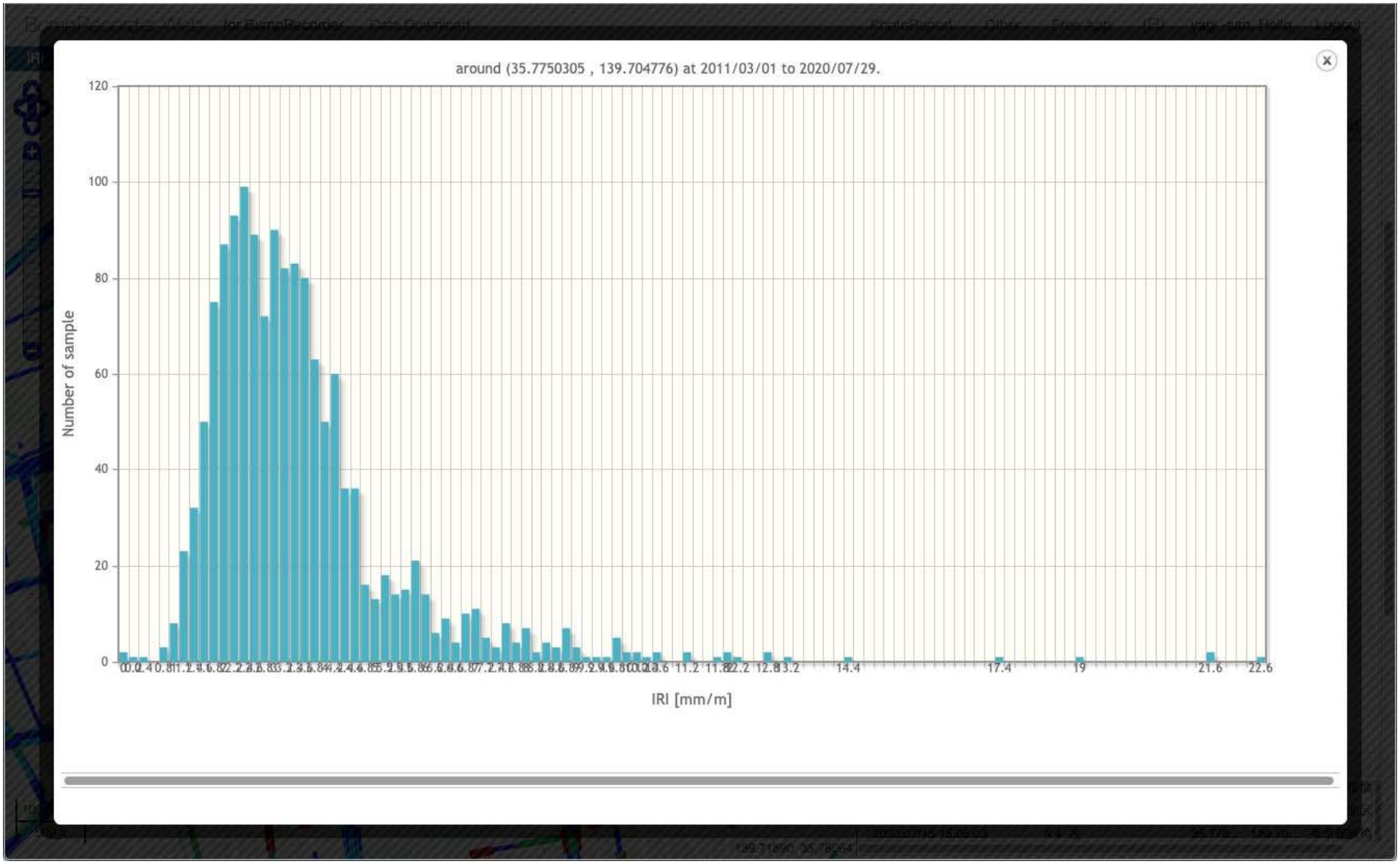
-Pavement Maintenance Management System-



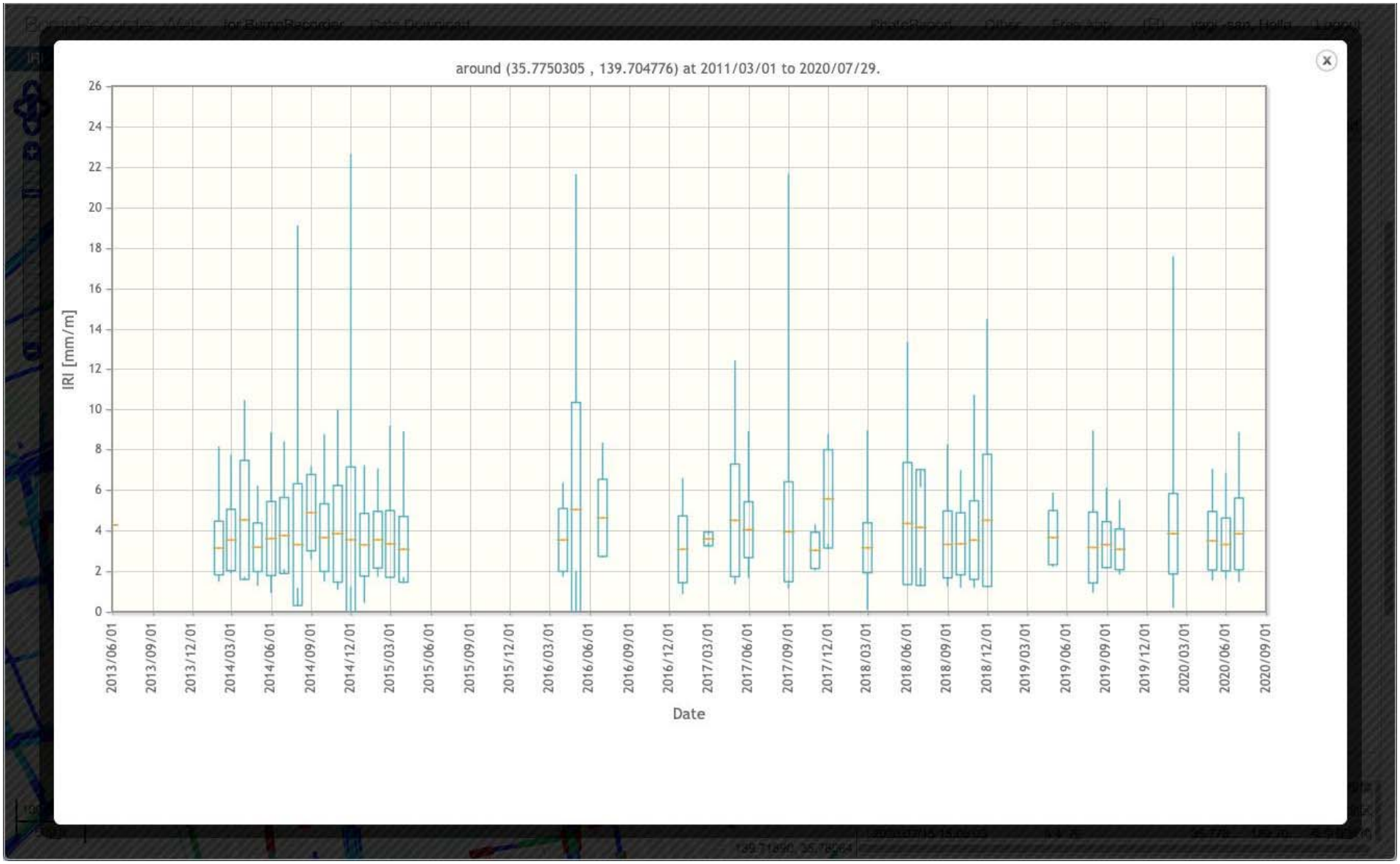
Draw statistic graph



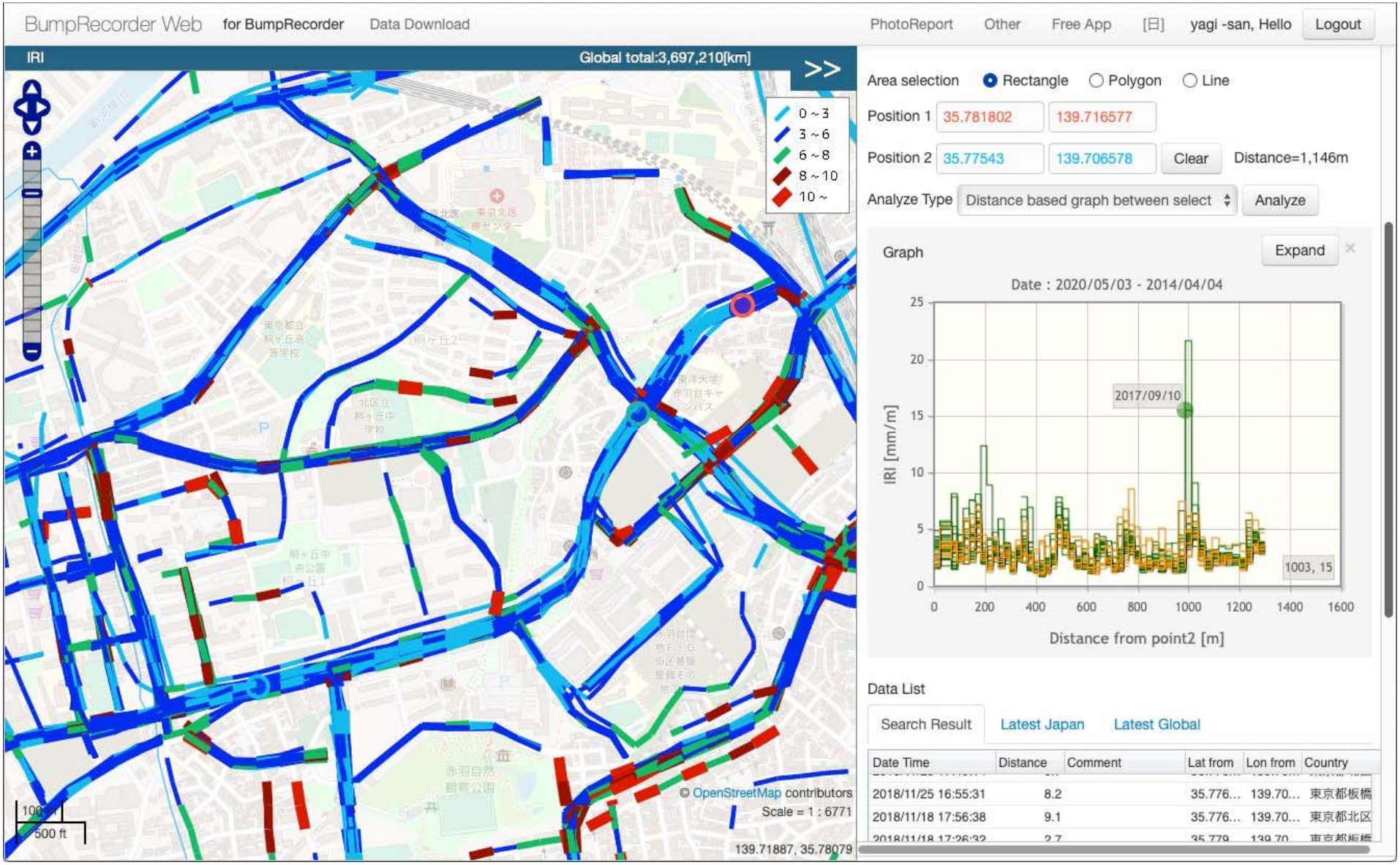
Histogram


around (35.7750305 , 139.704776) at 2011/03/01 to 2020/07/29.
Number of sample
120
100
80
60
40
20
0
14.4
17.4
19
21.6
22.6
IRI [mm/m]

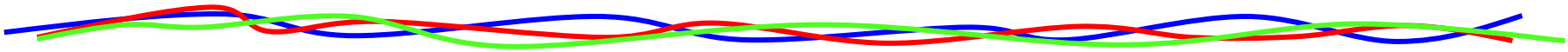
Time series


around (35.7750305 , 139.704776) at 2011/03/01 to 2020/07/29.
IRI [mm/m]
0
2
4
6
8
10
12
14
16
18
20
22
24
26
2013/06/01
2013/09/01
2013/12/01
2014/03/01
2014/06/01
2014/09/01
2014/12/01
2015/03/01
2015/06/01
2015/09/01
2015/12/01
2016/03/01
2016/06/01
2016/09/01
2016/12/01
2017/03/01
2017/06/01
2017/09/01
2017/12/01
2018/03/01
2018/06/01
2018/09/01
2018/12/01
2019/03/01
2019/06/01
2019/09/01
2019/12/01
2020/03/01
2020/06/01
2020/09/01
Date

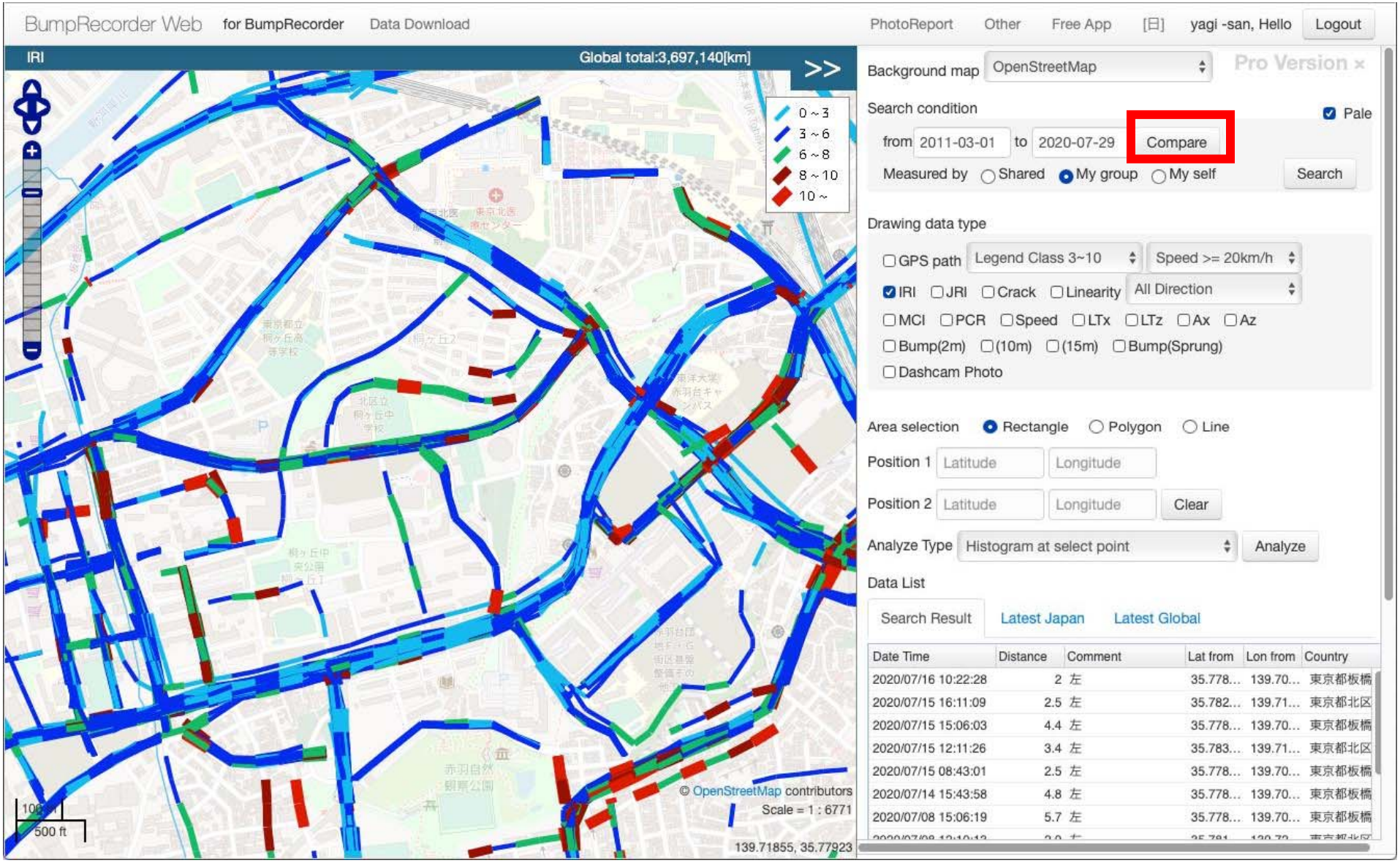
Distance base



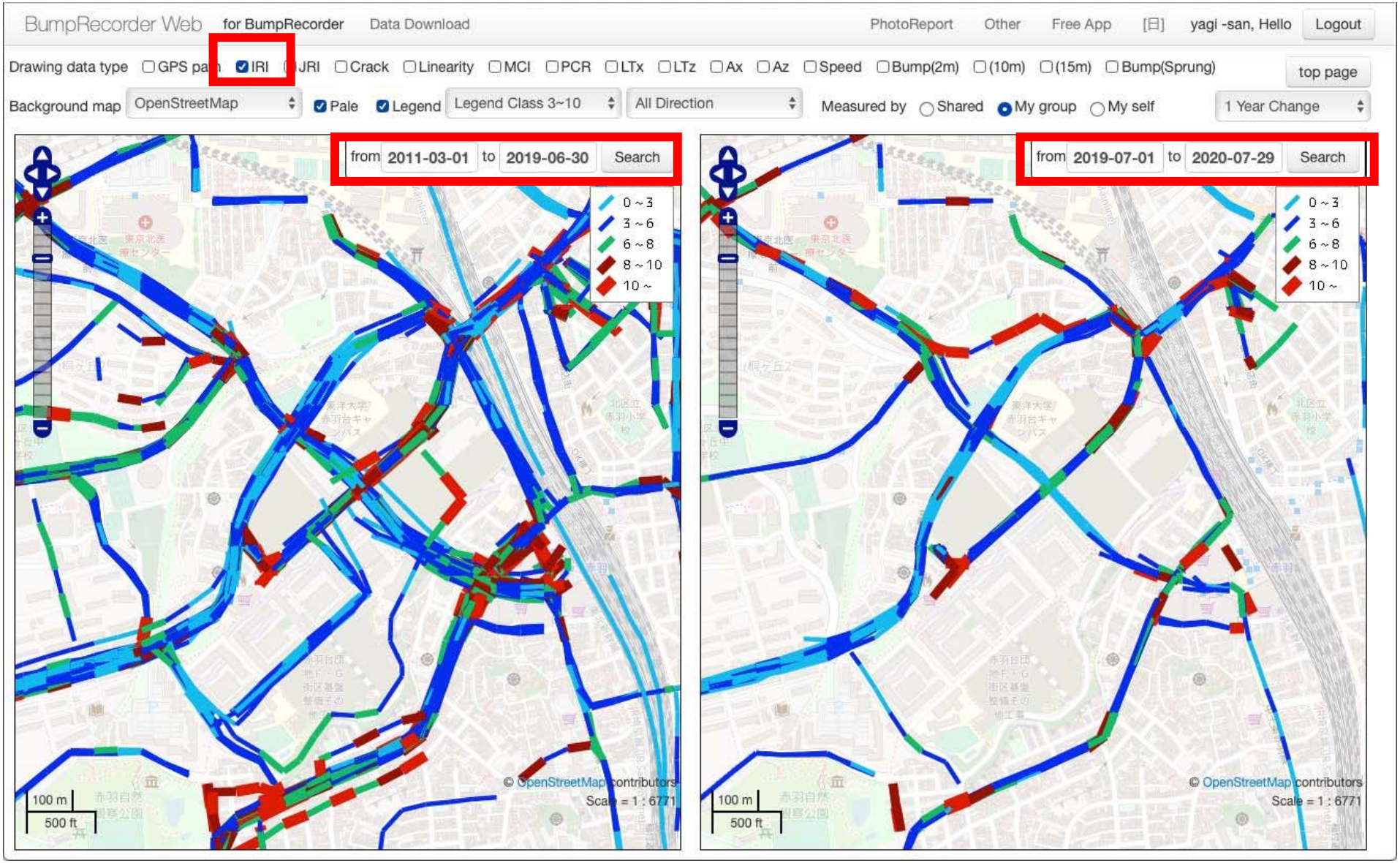
Data comparison function



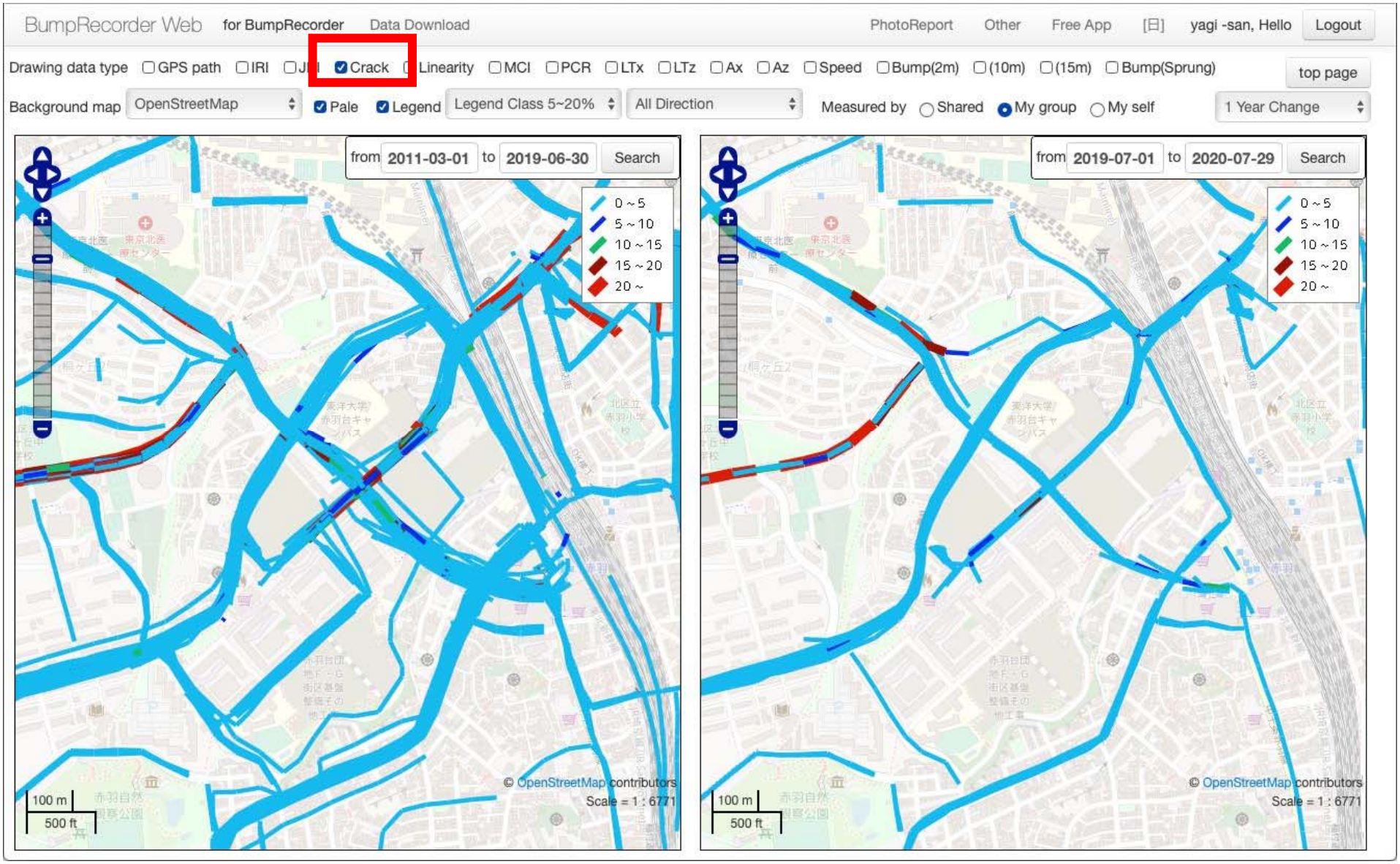
Move to Comparison function



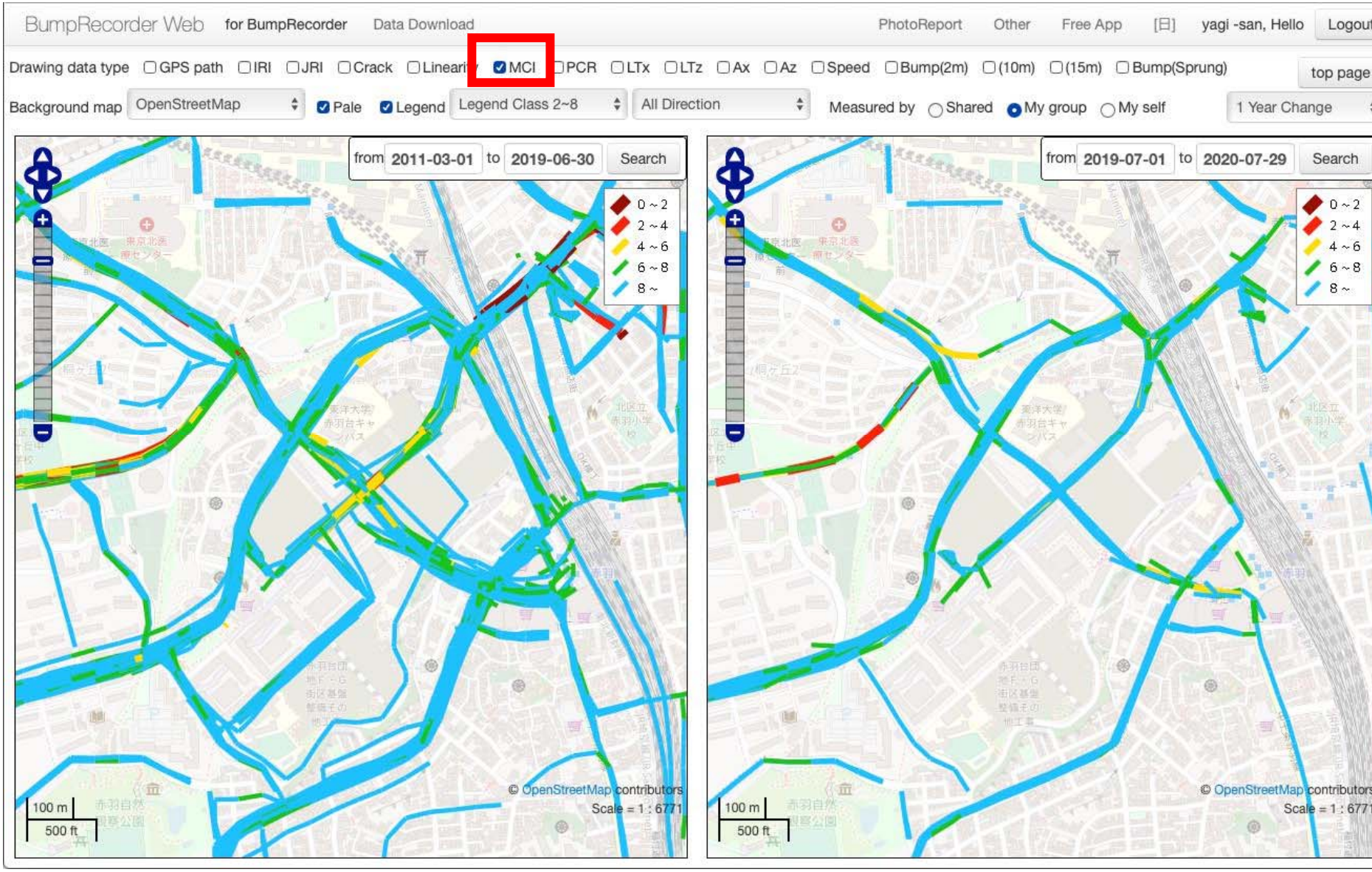
Same location, different period



Crack


BumpRecorder Web
for BumpRecorder
Data Download
PhotoReport
Other
Free App
[日]
yagi -san, Hello
Logout
Drawing data type
GPS path
IRI
Crack
Linearity
MCI
PCR
LTx
LTz
Ax
Az
Speed
Bump(2m)
(10m)
(15m)
Bump(Sprung)
top page
Background map
OpenStreetMap
Pale
Legend
Legend Class 5~20%
All Direction
Measured by
Shared
My group
My self
1 Year Change
from 2011-03-01 to 2019-06-30 Search
from 2019-07-01 to 2020-07-29 Search
0 ~ 5
5 ~ 10
10 ~ 15
15 ~ 20
20 ~
© OpenStreetMap contributors
Scale = 1 : 6771
100 m
500 ft

MCI


BumpRecorder Web
for BumpRecorder
Data Download
PhotoReport
Other
Free App
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Logout
Drawing data type
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IRI
JRI
Crack
MCI
PCR
LTx
LTz
Ax
Az
Speed
Bump(2m)
(10m)
(15m)
Bump(Sprung)
top page
Background map
OpenStreetMap
Pale
Legend
Legend Class 2~8
All Direction
Measured by
Shared
My group
My self
1 Year Change
from 2011-03-01 to 2019-06-30 Search
from 2019-07-01 to 2020-07-29 Search
0 ~ 2
2 ~ 4
4 ~ 6
6 ~ 8
8 ~
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Scale = 1 : 6771
100 m
500 ft

Any Questions? Requests?

We are always welcome your contact!

Co., Ltd.
CEO YAGI, Koichi (Mr.)
email : yagi@bumprecorder.com

TOA Road Corp.
MURAKAMI, Kenji
email : kenji_murakami@toadoro.co.jp