Geospatial Challenges in the Asia-Pacific Region

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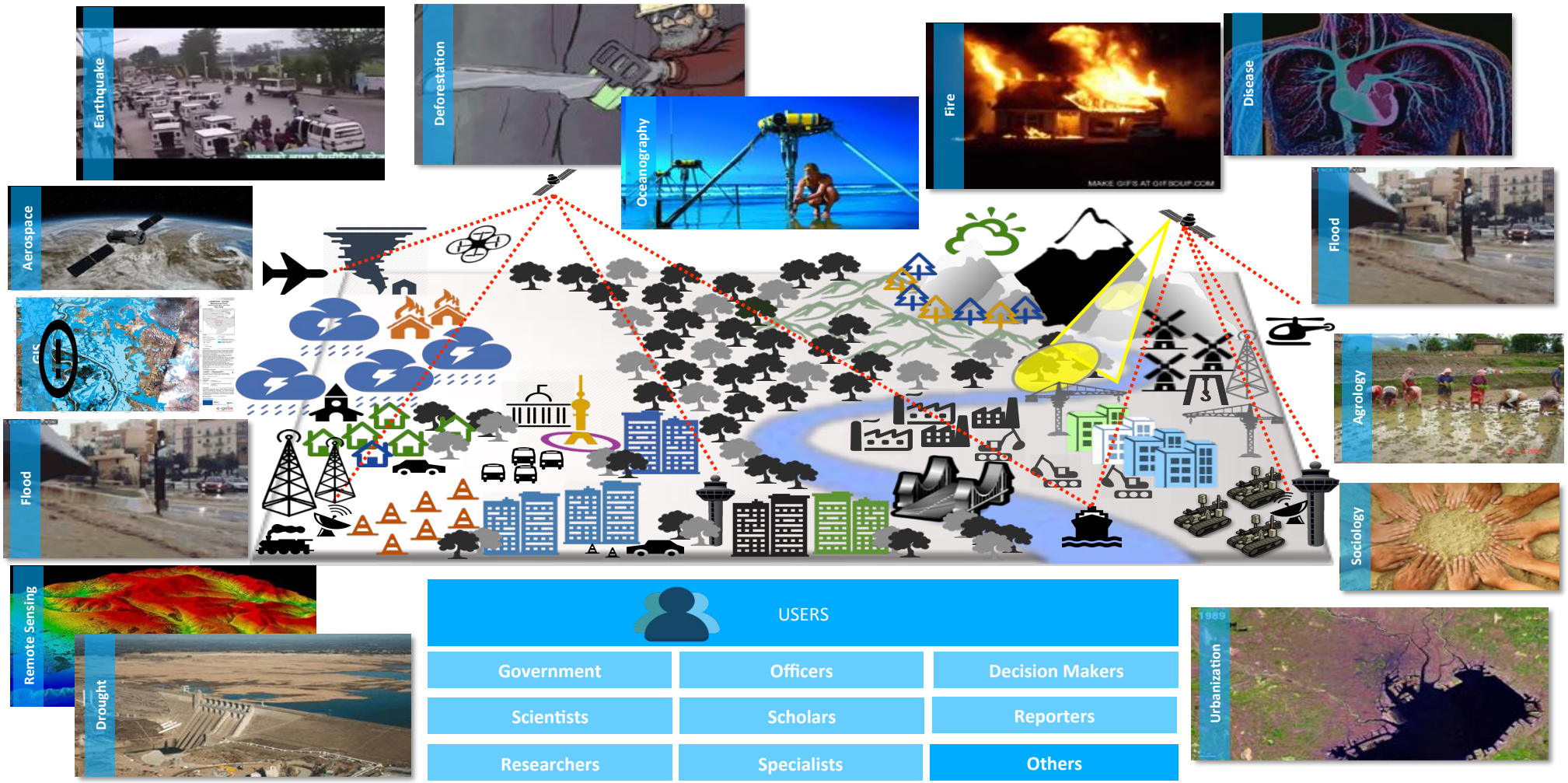
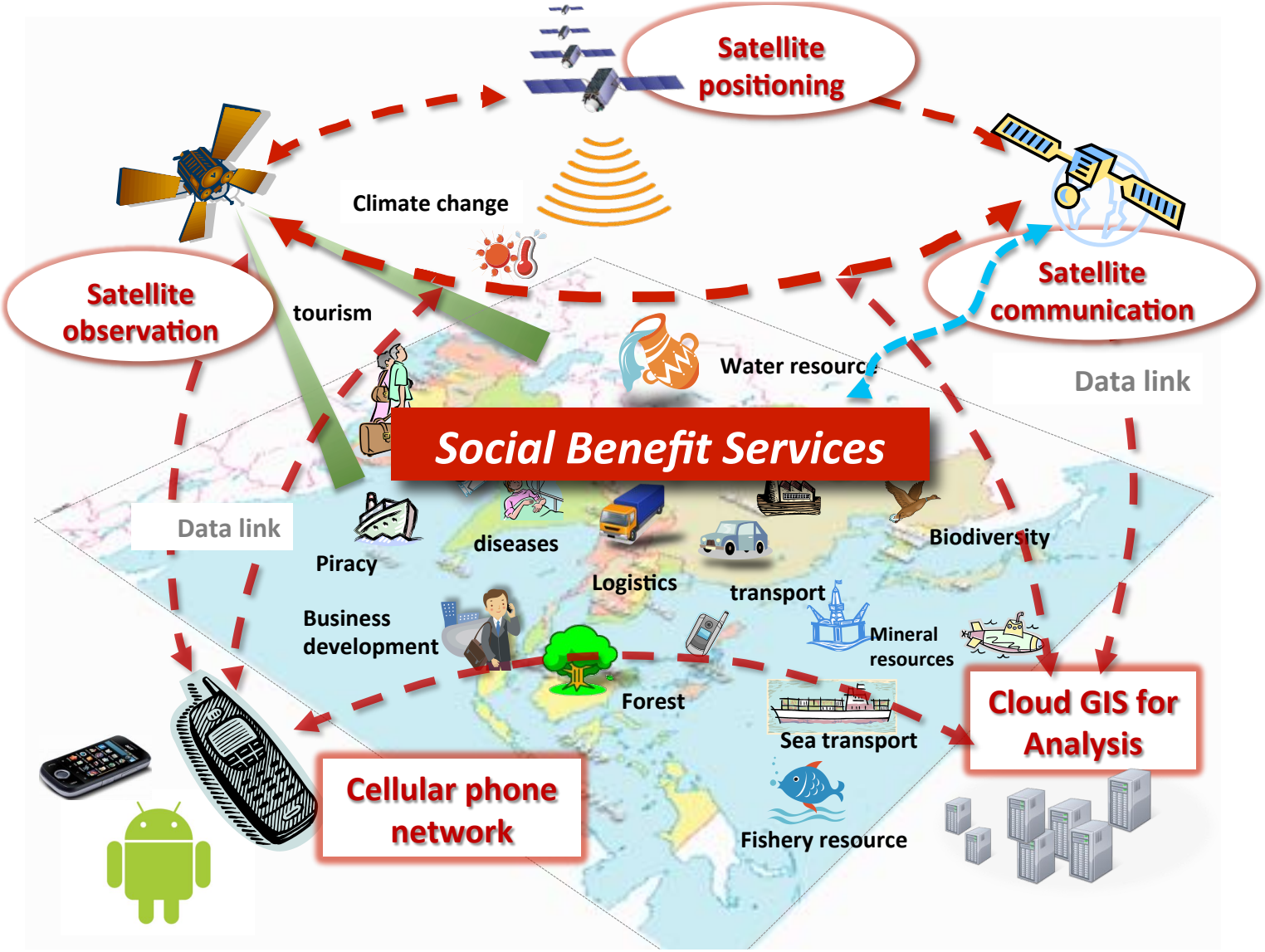
THE UNIVERSITY OF TOKYO

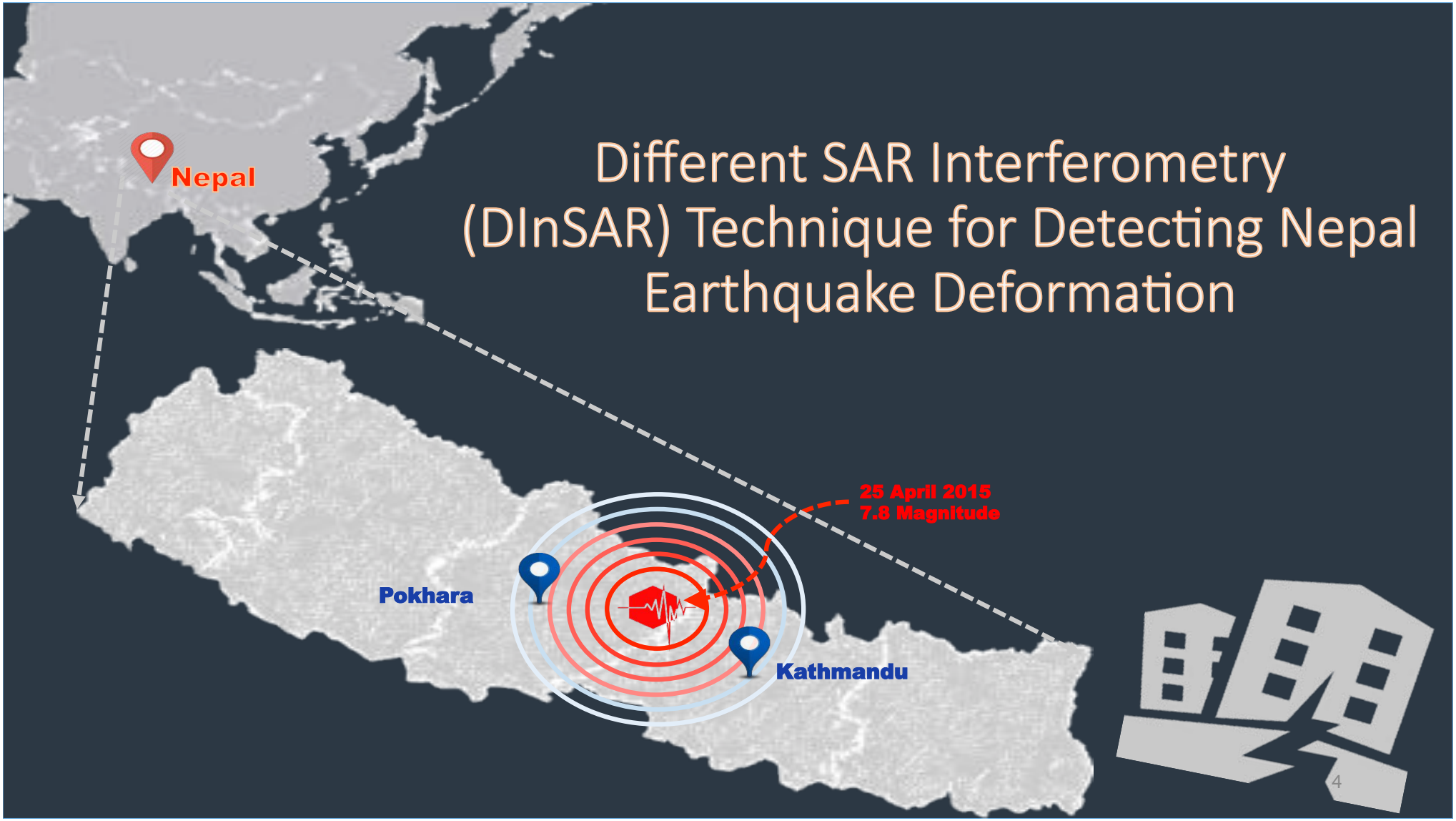
Challenges in the Asia-Pacific Region
Date: Wednesday 9 December, 2015


Earthquake
Deforestation
Oceanography
Fire
Disease
Aerospace
Flood
Flood
Agrology
Sociology
Remote Sensing
Drought
Urbanization
USERS
Government
Officers
Decision Makers
Scientists
Scholars
Reporters
Researchers
Specialists
Others

GESTISS

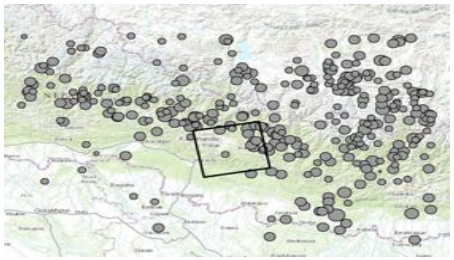
GEospatial and Space Technology concortium for Innovative Social Service



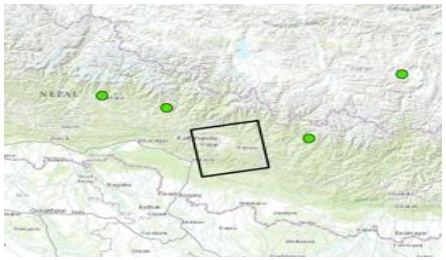

Different SAR Interferometry (DInSAR) Technique for Detecting Nepal Earthquake Deformation
Nepal
25 April 2015
7.8 Magnitude
Pokhara
Kathmandu

DInSAR and ALOS2 images

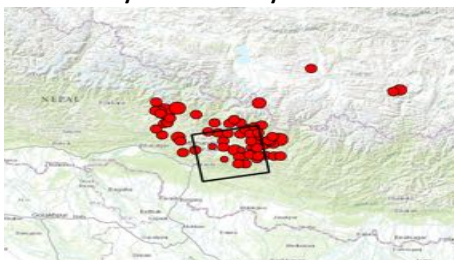
1970 - 03 October 2014



04 October 2014 – 20 February 2015



21 February 2015 – 02 May 2015



IRIS

SENTINEL ASIA

2014			2015					
Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun

25 April 2015
EQ 7.8 Mw

12 May 2015
EQ 7.2 Mw

More Images

Image 1 on 2014/10/04

Image 2 on 2015/02/21

Image 3 on 2015/05/02

InSAR Pre-Seismic

DEM

Pre-seismic

HH DInSAR

HV DInSAR

InSAR Co-Seismic

DEM

Co-seismic

HH DInSAR

HV DInSAR

InSAR Co-Seismic

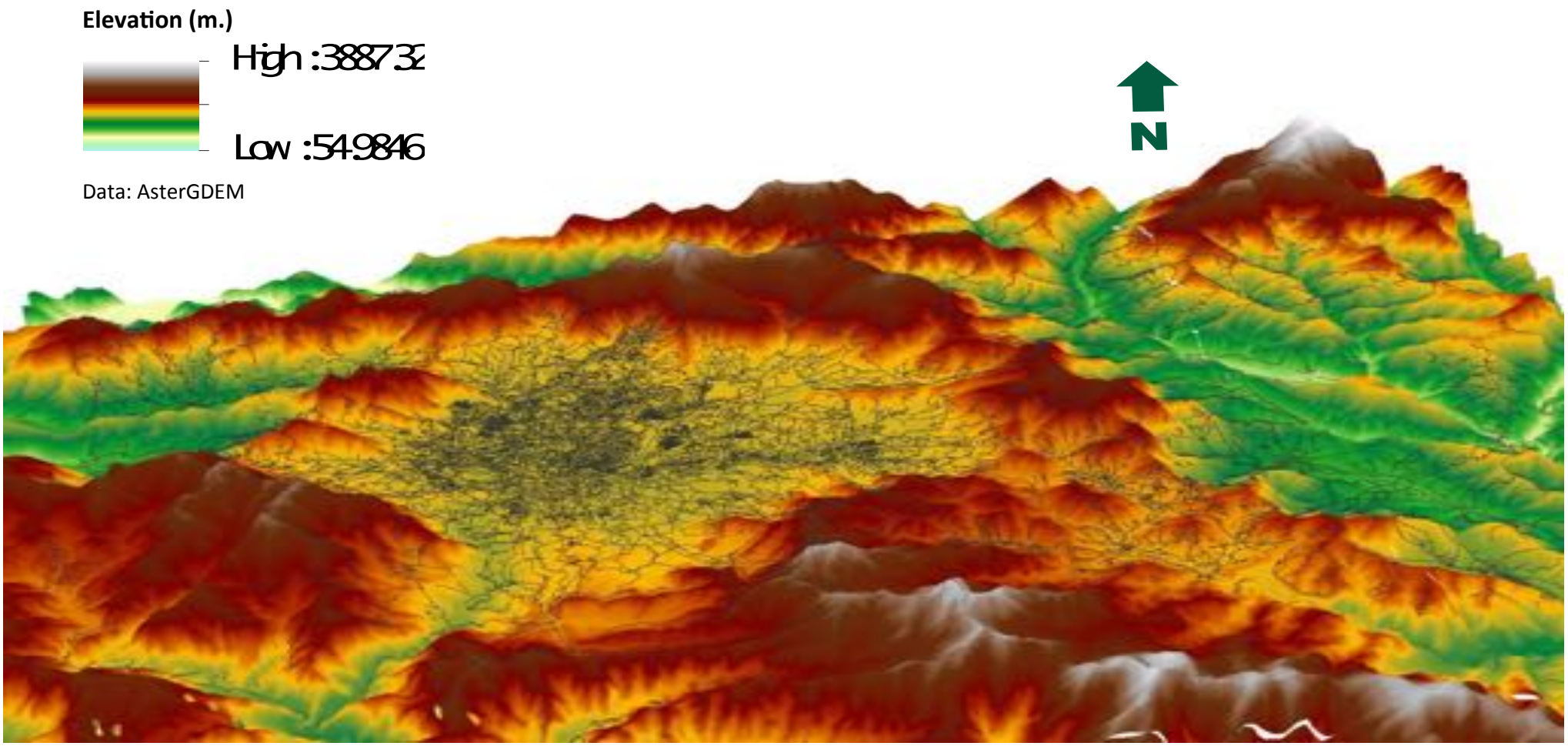
DEM

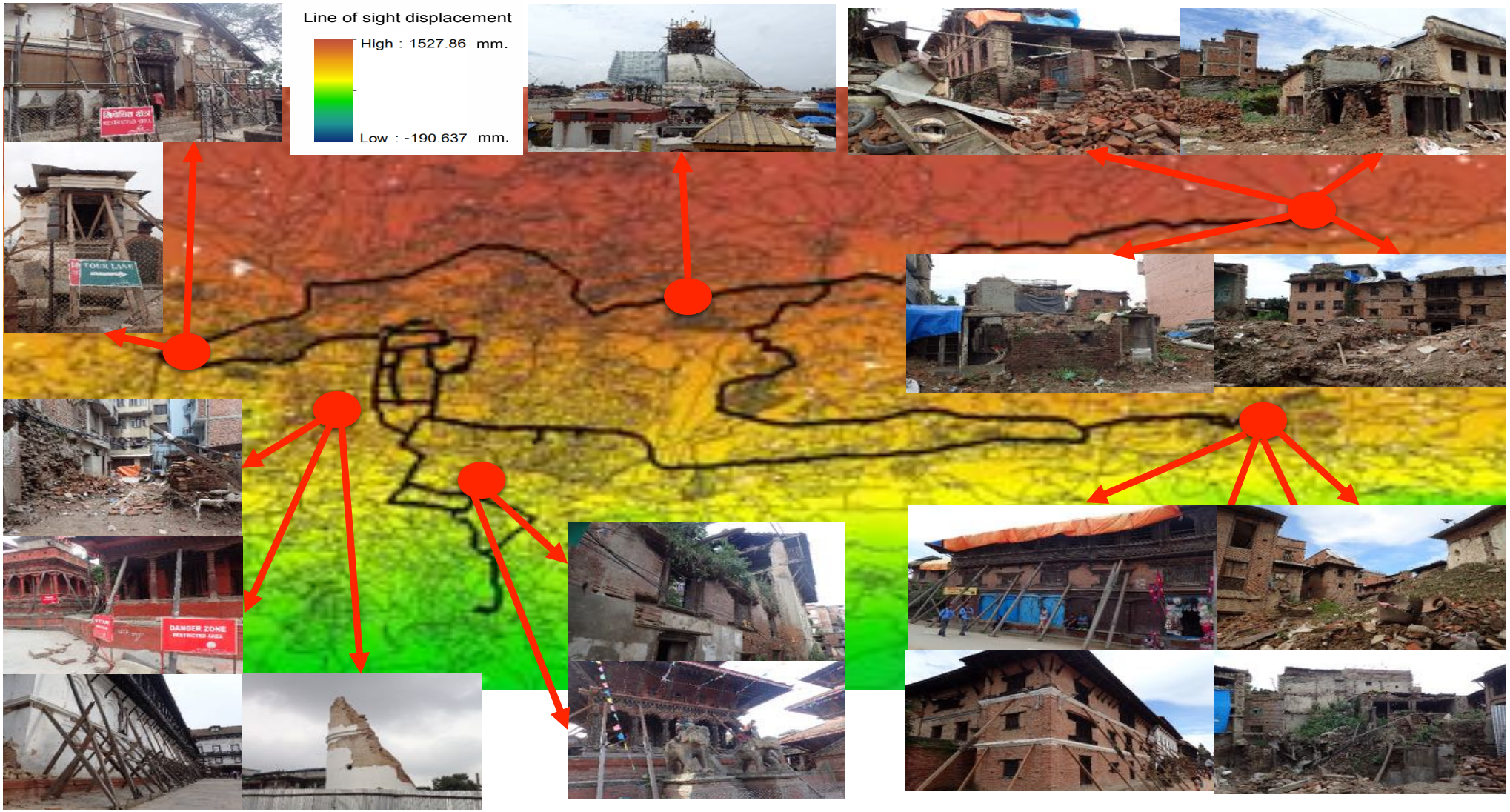
Co-seismic

HH DInSAR

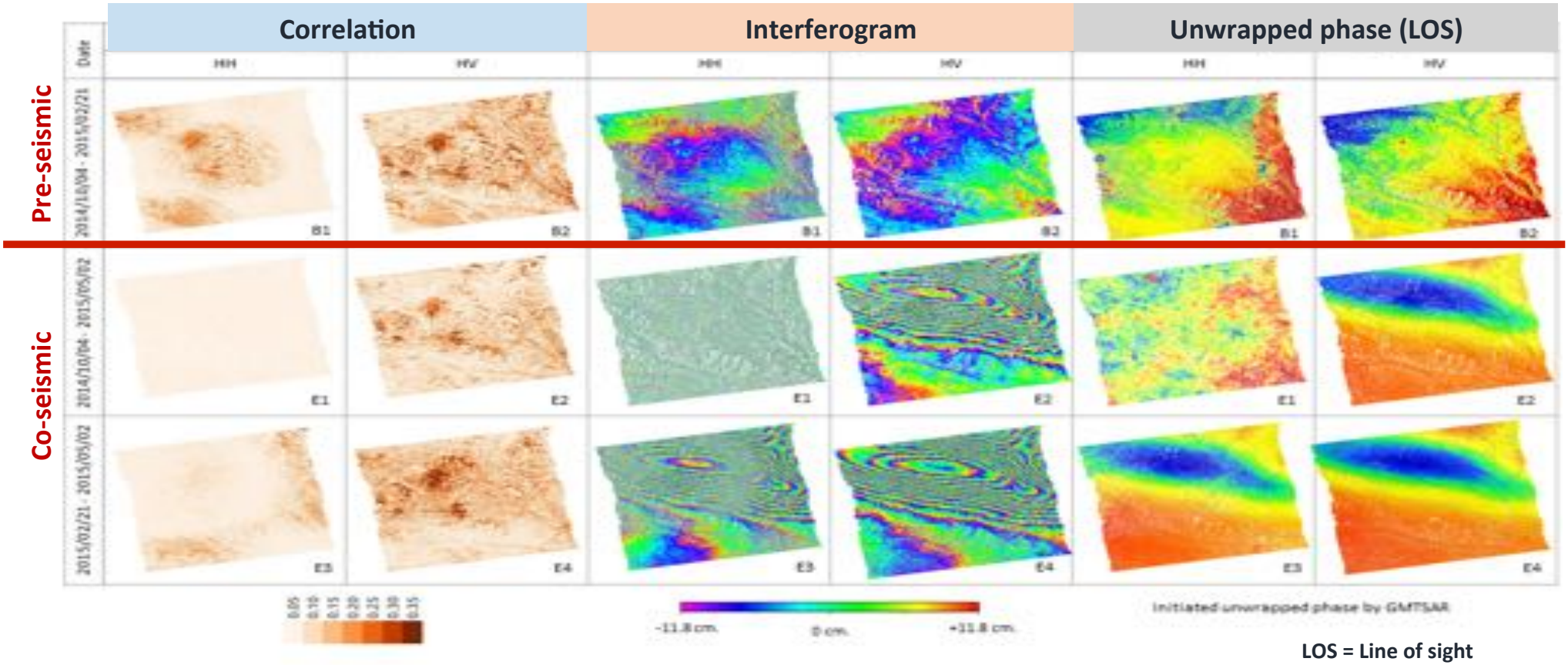
HV DInSAR

Topography of Kathmandu Valley




Line of sight displacement
High : 1527.86 mm.
Low : -190.637 mm.
TOUR LANE
DANGER ZONE

Summary of DInSAR results



LOS = Line of sight

Accuracy Assessment

1. **Comparison of LOS co-seismic with GPS co-seismic**

   GPS co-seismic information from NASA

   Reference:
   http://aria-share.jpl.nasa.gov/events/20150425-Nepal_EQ/GPS/20150425Nepal_ARIA_Rapid_Offsets_v1.txt

2. **Comparison of LOS co-seismic with fitting curve**

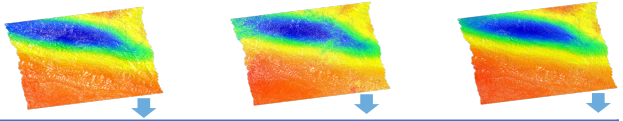
   R-square measures of how close of observed points and fitting curve as coefficient of determination

1) Comparison of LOS co-seismic with GPS co-seismic

- The LOS results were compared to GPS in vertical dimension. The results showed difference between vertical dimension of GPS and LOS was less than 20 cm. The interferogram of HV image and short time interval was the closest value less than 13 cm different between GPS and LOS

GPS co-seismic	East(cm)	North(cm)	Vertical (cm)
KKN4 station (Lat 27.800709681, Lon 85.278802098)	-44.60	-183.00	127.00
NAST station (Lat 27.656675624, Lon 85.327724872)	-31.50	-129.00	62.30

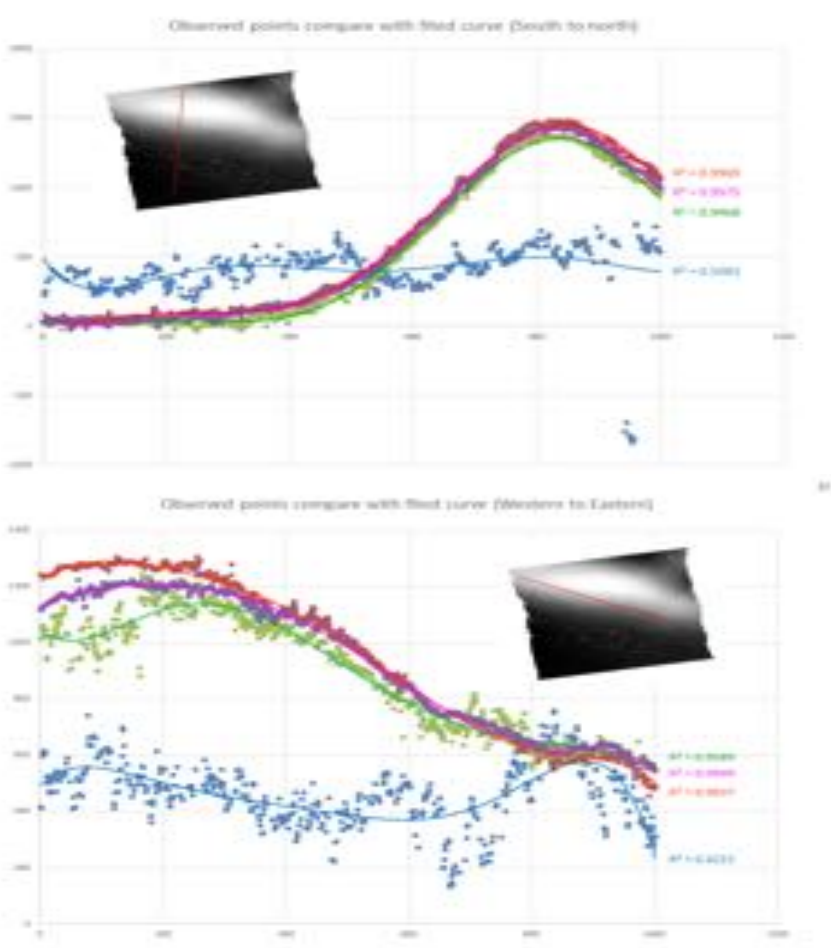
GPS stations



compare

InSAR co-seismic		InSAR E2	InSAR E3	InSAR E4
Line of sight (LOS)	KKN4	139.84	132.91	140.40
	NAST	71.18	70.78	77.71
Vertical height of LOS	KKN4	113.94	108.28	114.39
	NAST	57.90	57.57	63.21
Different between GPS and LOS in vertical dimension	KKN4	13.06	18.72	12.61
	NAST	4.40	4.73	-0.91

2) Comparison of LOS co-seismic with fitting curve



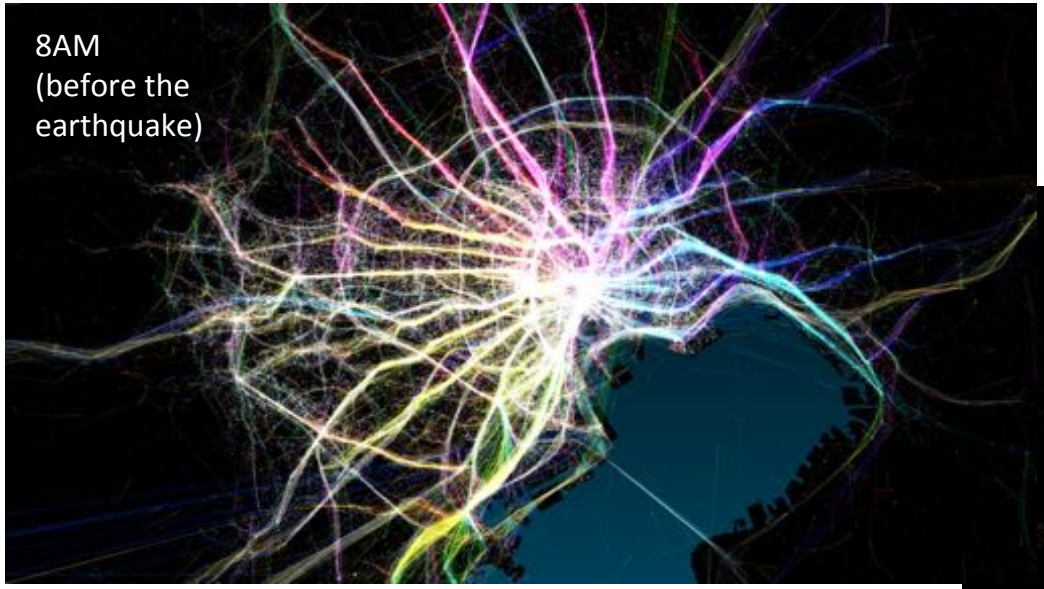
Co-seismic interferograms with correlation and R^2 of line of sight

Co-Seismic interferograms		Average correlation	R^2		
			S to N	W to E	
Img1HH - Img3HH - DEM	E1	0.0527	0.1092	0.4215	210 days
Img1HV - Img3HV - DEM	E2	0.1107	0.9969	0.9937	210 days
Img2HH - Img3HH - DEM	E3	0.0740	0.9968	0.9589	70 days
Img2HV -Img3HV - DEM	E4	0.1275	0.9975	0.9947	70 days

Based on GMTSAR using cross correlation algorithm (*xcorr) for registration. "xcorr" uses* window size of 64 pixels and has never failed to provide accurate co-registration even in cases where the interferometric coherence is close to zero.

Use polynomial 6 orders to fit curve

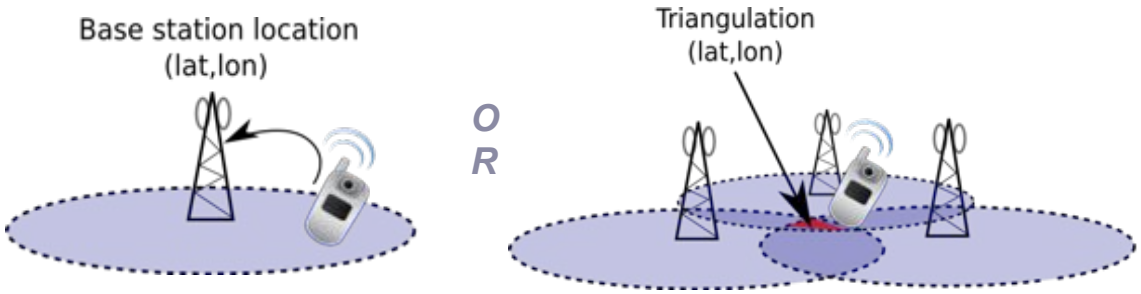
Mobile GPS Log on 11 March, at Tokyo



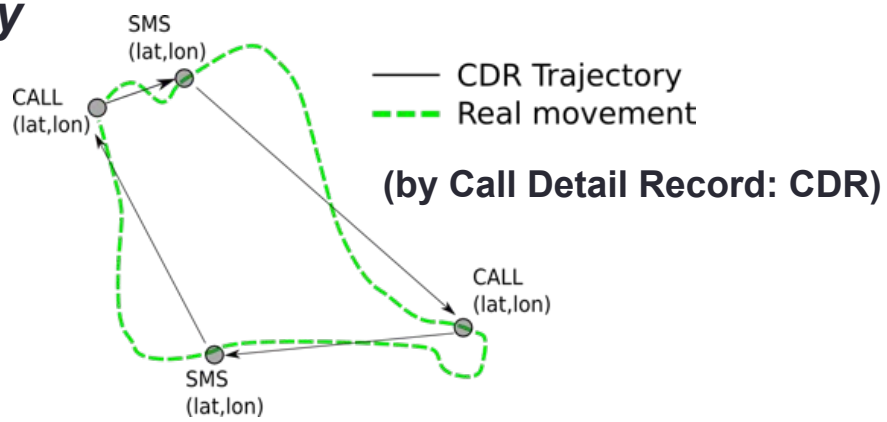
Data is provided by 混雑統計(R)　　ZENRIN DataCom CO., LTD

How to Measure the Location of and Track Mobile Phone Users?

1) Localizaton by cell towers



2) Trajectory



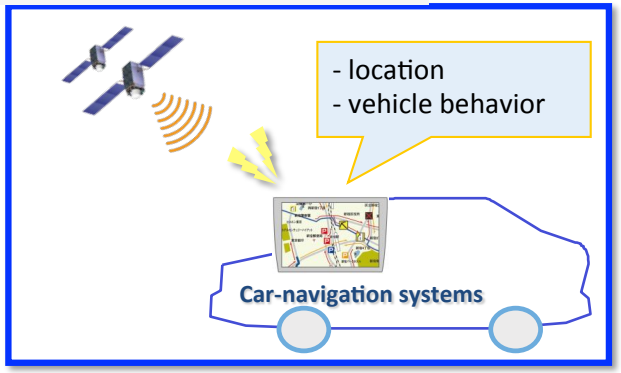
(by Call Detail Record: CDR)

Bangkok Taxi Probe's Big Data Processing for Traffic Hotspot Analysis and Visualization

Probe vehicles is equipped with GPS device and data communication device to monitor traffic situation.

- Obtain an accurate position of Vehicle
- Not need Road-side sensor
- Low cost for innovating a system

Very easy and cheap



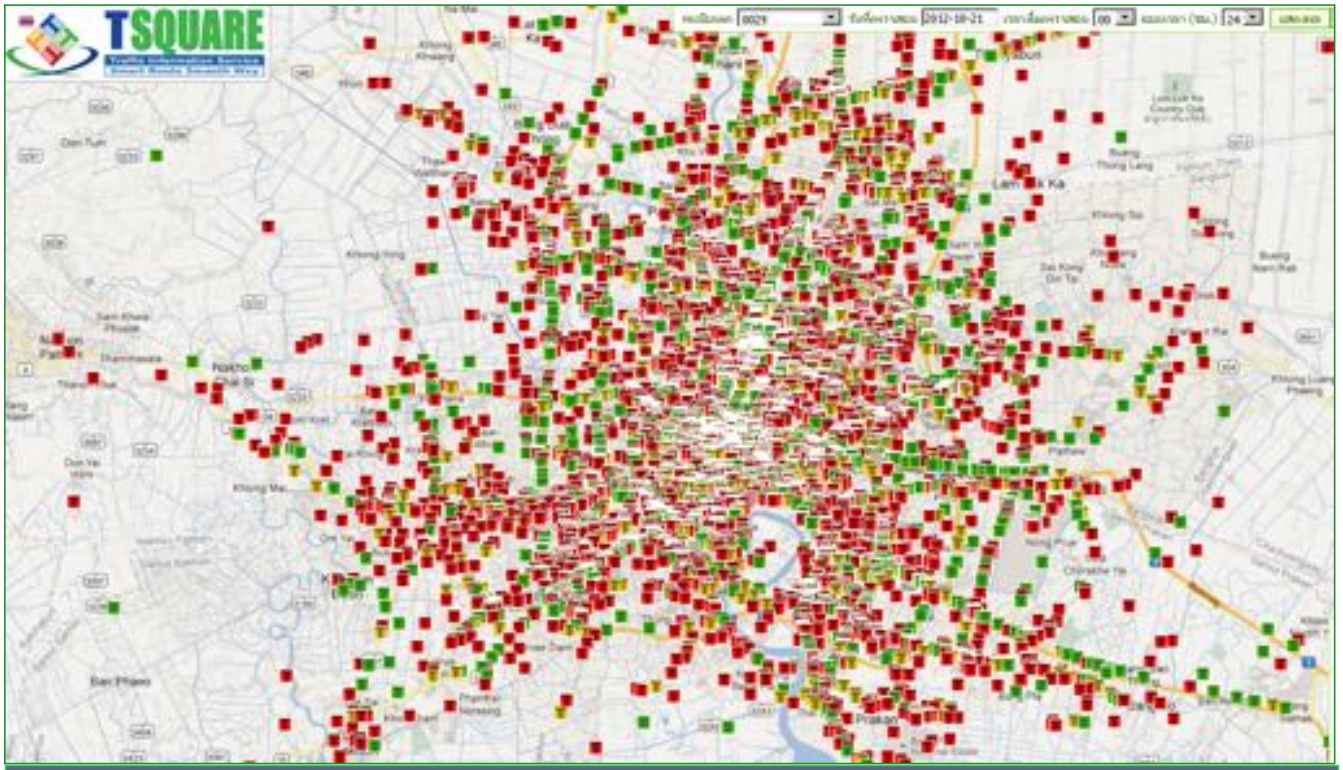
Trajectory Information

Taxi in "TSQUARE" Group

© Ranjit and Nagai, AIT

© Project : Toyota Tsusho Electronic Thailand Co. Ltd

“TSQUARE” VICS/RTIC traffic service in Thailand



Utilize GPS data from taxis as the main source. Capture data every 3 ~ 5 seconds.
Traffic conditions can be monitored accurately even for narrower streets.

GPS TSQUARE www.rtic-thai.info HOWA TRAFFIC SERVICE

© Project : Toyota Tsusho Electronic Thailand Co. Ltd

“TSQUARE” VICS/RTIC traffic service in Thailand

GPS data from taxis (Taxi Probe Data) can monitor traffic condition of detailed streets.

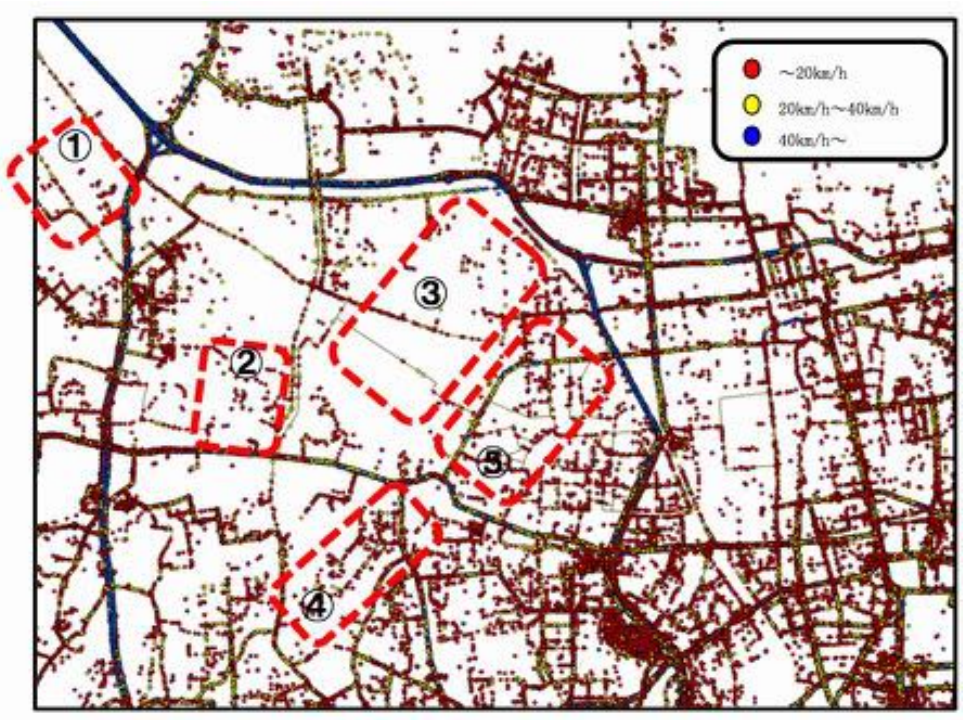
GPS TSQUARE www.rtic-thai.info HOWA TRAFFIC SERVICE

© Project : Toyota Tsusho Electronic Thailand Co. Ltd

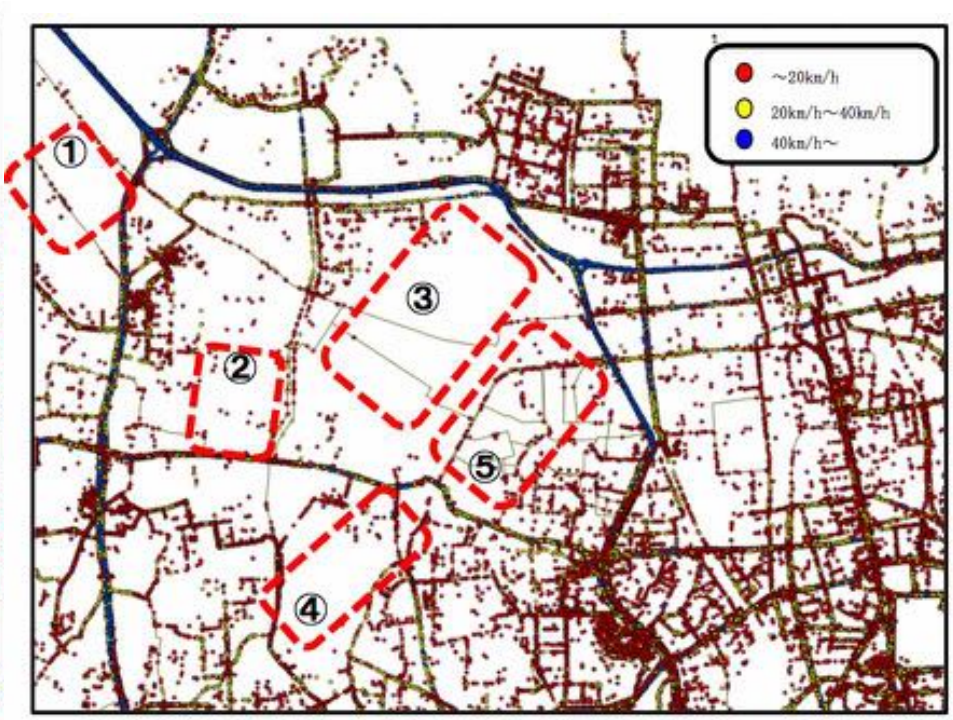
“Taxi Probe” data for “Flood”

© Project : Toyota Tsusho Electronic Thailand Co. Ltd

Comparison between Normal and Flood



Normal: 19/03/2014



Flood: 22/01/2014

© Project : NTT Data, the University of Tokyo, Toyota Tsusho Electronic Thailand Co. Ltd

Water coverage in Thailand

(2005/01/01～2015/01/17)

Detection of Road Height

- At present the most accurate collection of terrain data over large geographic areas is done with airborne LiDAR
- High quality DEM (Digital Elevation Model) is requisite for urban
  - Data is available but not accurate
- Urban Canyon and many different type of occlusion, Airborne LiDAR cant be used
- Mobile Mapping Systems(MMS) can provide a solution in creating a precise DEM in Urban areas

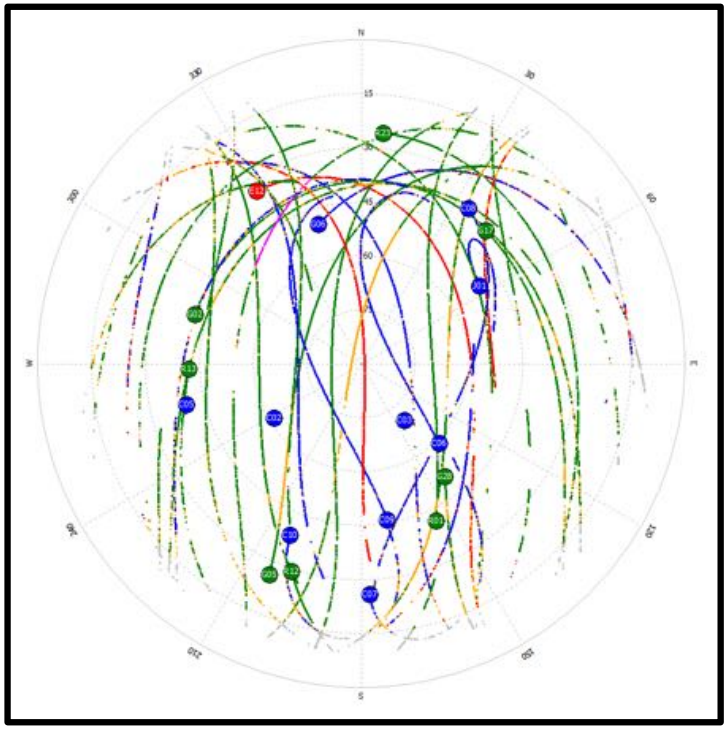
GNSS Experiment in Bangkok

- Baseline was upto 13 km
- Total area planned was 75.5 km and surveyed was 90 km
- Receivers used (Specification)
  - Trimble NetR9 (GPS, GLONASS, GALELIO, QZSS and BEIDOU)
  - Javad Sigma (GPS and GLONASS)
  - GoPro Video camera
  - Broadcom WICED™ Sense Bluetooth Smart Sensor Development Kit
    - Humidity
    - Temperature

SkyPlot and Satellite Visibility

- Elevation Mask angle: 15 degree
- 19 valid visible Satellites

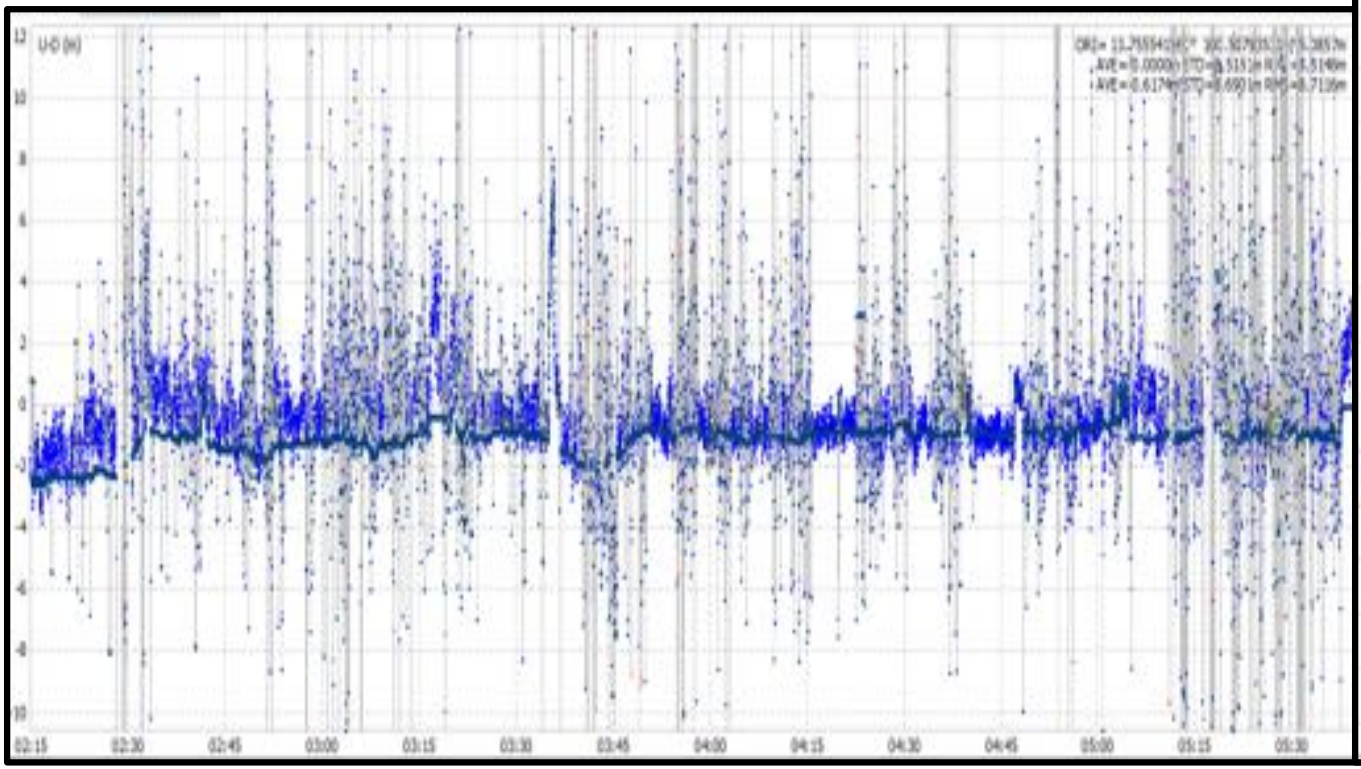
Satellite Constellations	Visible number
GPS	5
GLONASS	4
GALELIO	1
QZSS	1
BeiDou	8



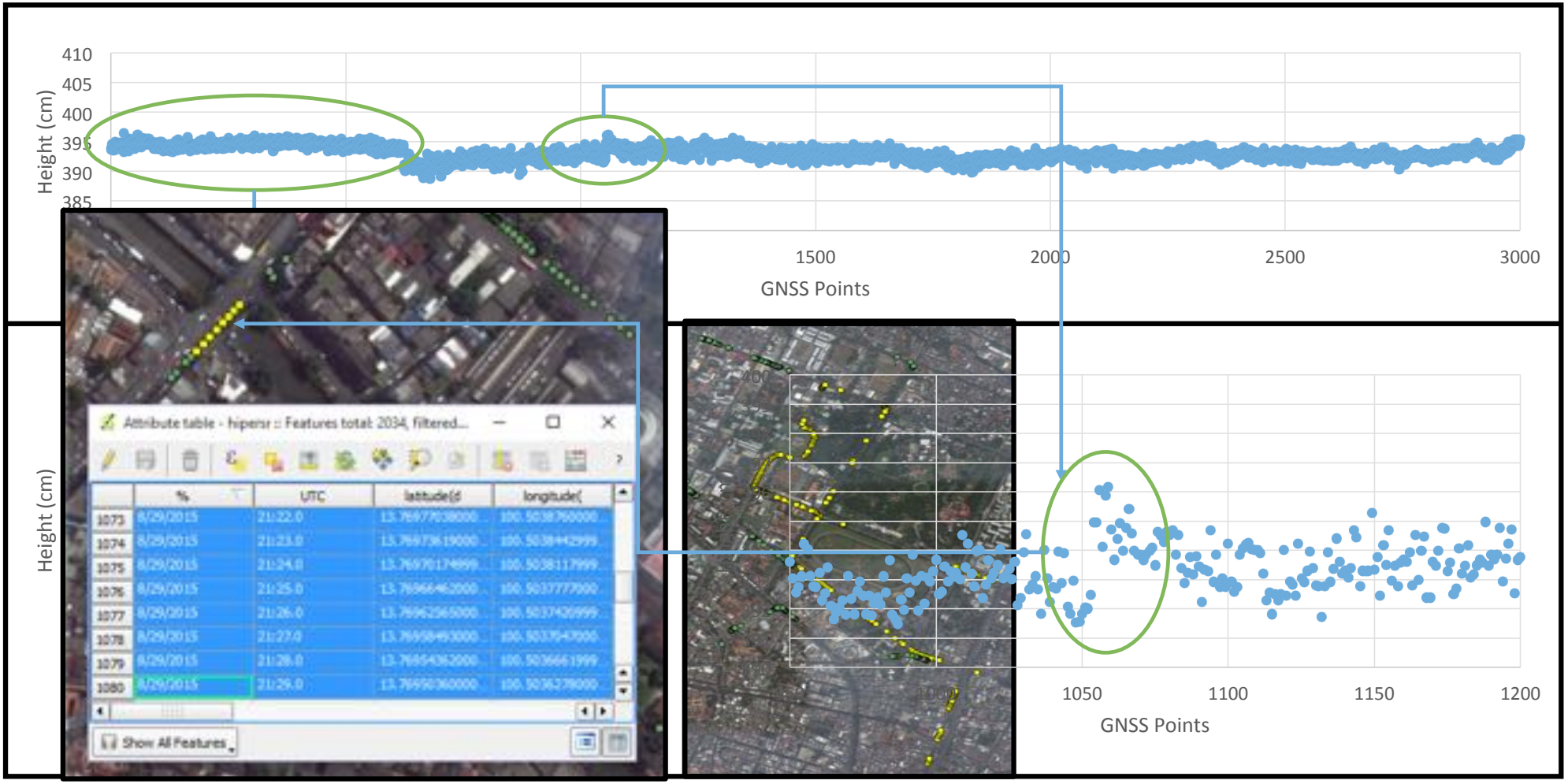
Comparison between Positioning Modes

- Elevation Mask angle: 15 degree
- 19 valid visible Satellites

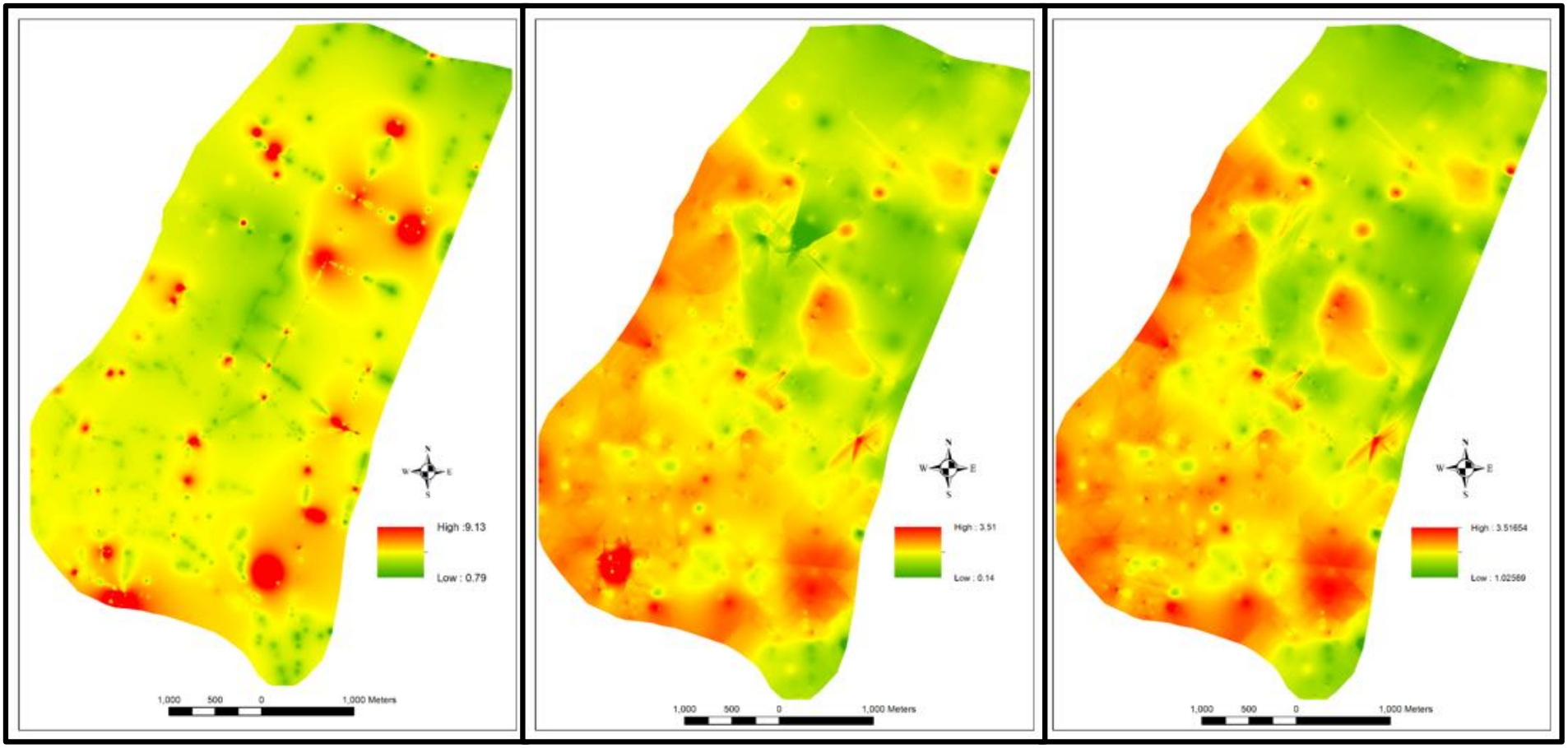
Positioning Mode	Fix Rtae (%)
Kinematic	96
DGNSS	98.8



Algorithm Results



DEM generated from GNSS data



Without filter

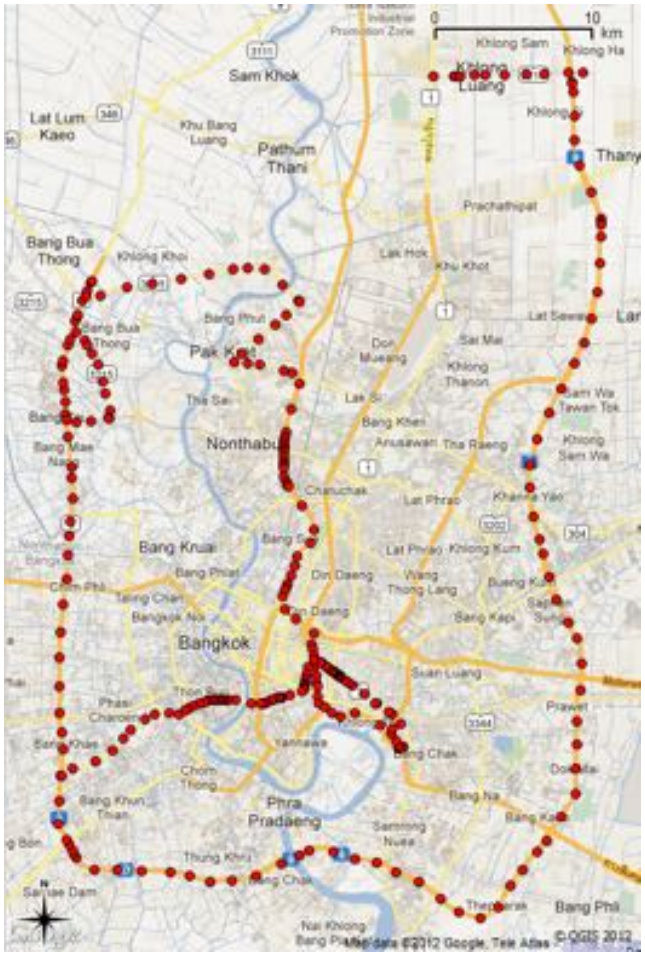
With filter

With additional setting in filter

Set up CO_2 sensor on vehicle

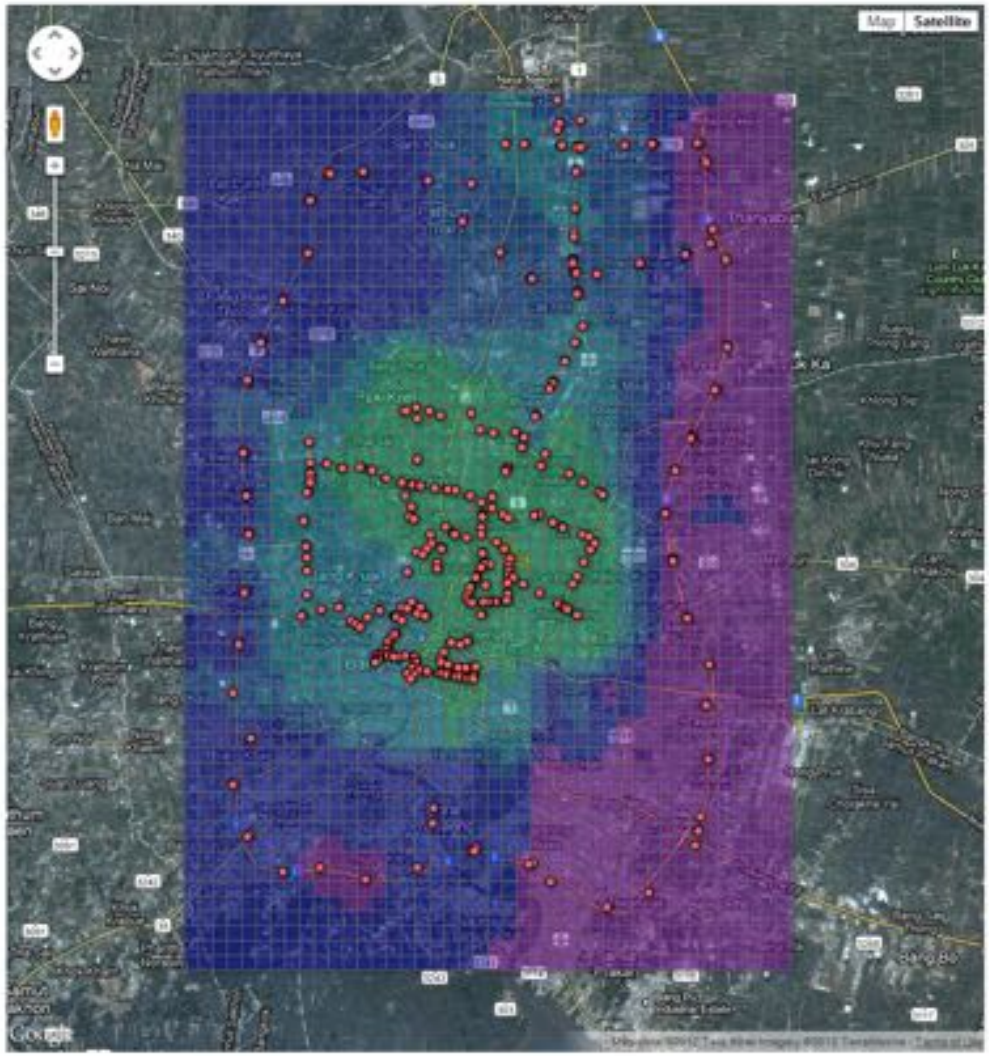
The portable will be set up in front and on the roof top of the vehicle, above the ground level about 1.5 meters.

Time : May 16, 2012 5:07:58 AM
CO2 amount : 2612 ppm
Latitude : 14.07963141
Longitude : 100.61229217
Count : 16
NumPoint : 1



Recording data

- The application is set to record data every 2 minutes.
- If drive car with a constant speed at 30 km/h, that means the application will record data every 1 km.



Mobile Environmental Monitoring

Interpolation Method:

- (•) *Inverse Distance Weighted (IDW)*
- ( ) *Kriging*

Grid Size:

- (•) *1x1 km*
- ( ) *2x2 km*

Submit Reset

- Point of measurement
- 0 - 200 ppm
- 200 - 400 ppm
- 400 - 600 ppm
- 600 - 800 ppm
- 800 - 1000 ppm
- 1200 - 1400 ppm
- 1400 - 1600 pm
- 1600 - 1800 ppm
- 1800 - 2000 ppm
- 2000 - 2200 ppm
- 2200 - 2400 ppm

Transportation Modes Detection in Bangkok Using GPS Logger Data and GIS Data

There are various modes of transportation in Bangkok

© Kritiyutanont and Nagai, AIT

GPS Logger

GPS working system

8/25/2014	07:24:02	13.869617	100.487228	-76.66
8/25/2014	07:26:35	13.869617	100.487228	-76.66
8/25/2014	07:26:40	13.869616	100.487244	-69.36
8/25/2014	07:26:45	13.869601	100.487251	-56.84
8/25/2014	07:26:50	13.869609	100.487228	-53.98
8/25/2014	07:26:55	13.869639	100.487206	-49.46
8/25/2014	07:27:00	13.869677	100.487175	-53.01
8/25/2014	07:27:05	13.869717	100.487144	-58.07
8/25/2014	07:27:10	13.869774	100.48716	-68.44
8/25/2014	07:27:15	13.869799	100.487129	-65.58

Record detailed routes

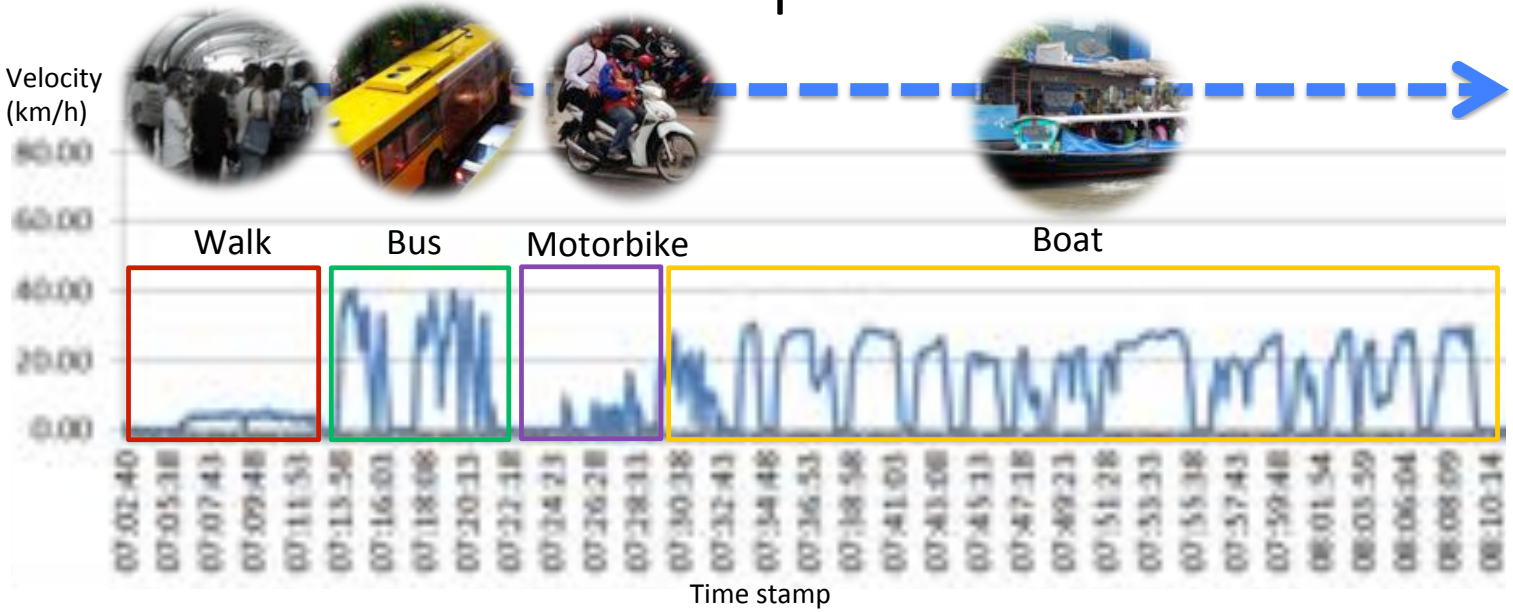
I –got U GT 600

5 seconds interval
1 week records
Motion detection

80 Students from
4 Universities

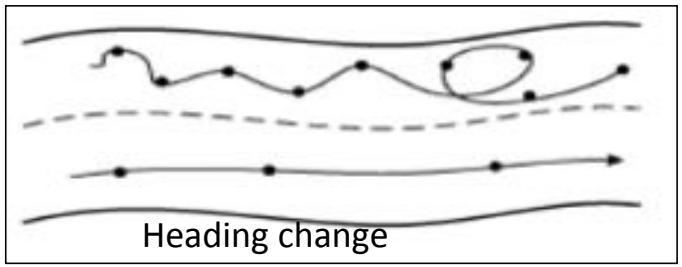
Multiple ways for attachment

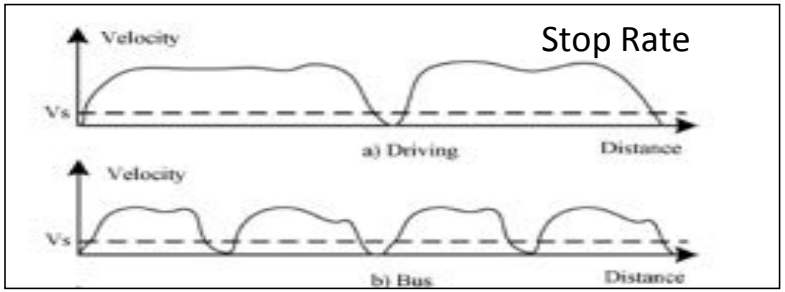
Characteristic of GPS Trip Data



id	userid	sampleid	deviceno	time_stamp	latitude	longitude	altitude	elapsed_time	distance(m)	velocity(m/s)	velocity(km/h)	bearing(deg)
1	cu02	2	165609	2014-09-30 00:00:01	13.903672	100.655083	14.21	NULL	NULL	NULL	NULL	NULL
2	cu02	2	165609	2014-09-30 00:00:06	13.903664	100.655121	15.15	5	4.2	0.84	3.02	102.24
3	cu02	2	165609	2014-09-30 00:00:11	13.903646	100.655174	20.77	5	6.06	1.21	4.36	109.28
4	cu02	2	165609	2014-09-30 00:00:16	13.90361	100.655205	26.48	5	5.22	1.04	3.76	140.11
5	cu02	2	165609	2014-09-30 00:00:21	13.903586	100.655251	34.86	5	5.64	1.13	4.06	118.26
6	cu02	2	165609	2014-09-30 00:00:26	13.903571	100.655228	31.33	5	2.99	0.6	2.15	236.1
7	cu02	2	165609	2014-09-30 00:00:32	13.903547	100.655174	21.2	6	6.41	1.07	3.85	245.4
8	cu02	2	165609	2014-09-30 00:00:37	13.903547	100.655174	21.2	5	0	0	0	0
9	cu02	2	165609	2014-09-30 00:00:42	13.903547	100.655174	21.2	5	0	0	0	0
10	cu02	2	165609	2014-09-30 00:00:47	13.903547	100.655174	21.2	5	0	0	0	0
11	cu02	2	165609	2014-09-30 00:00:52	13.903547	100.655174	21.2	5	0	0	0	0

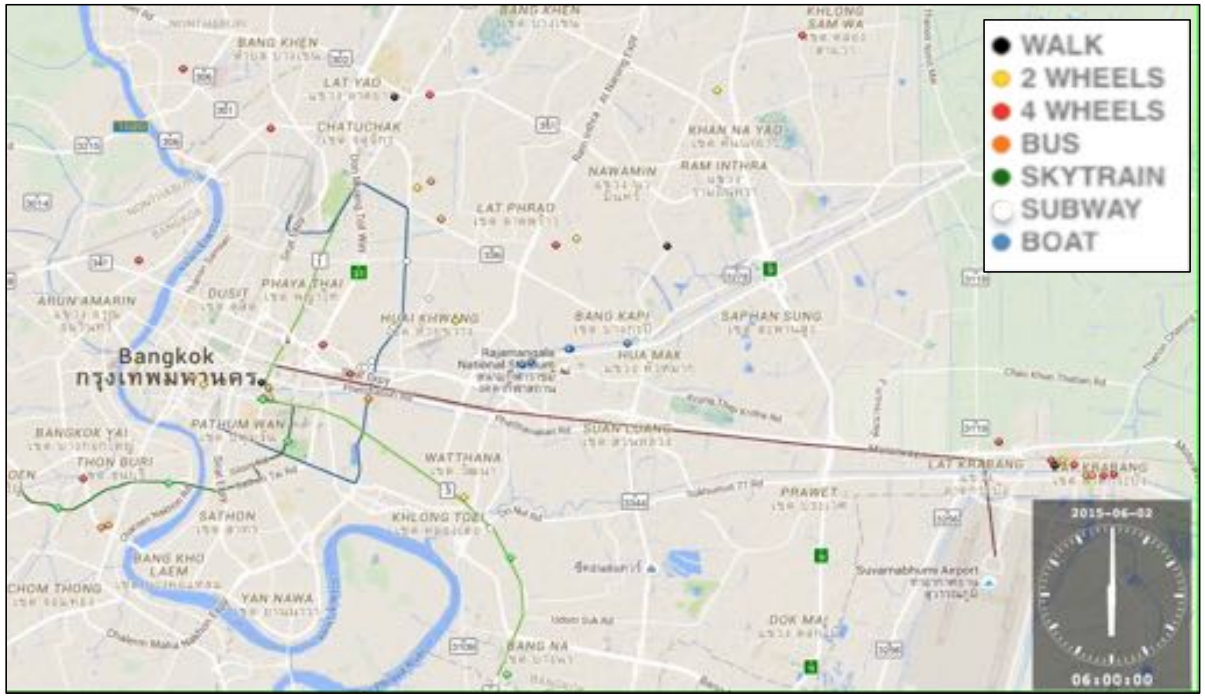
Classification Features

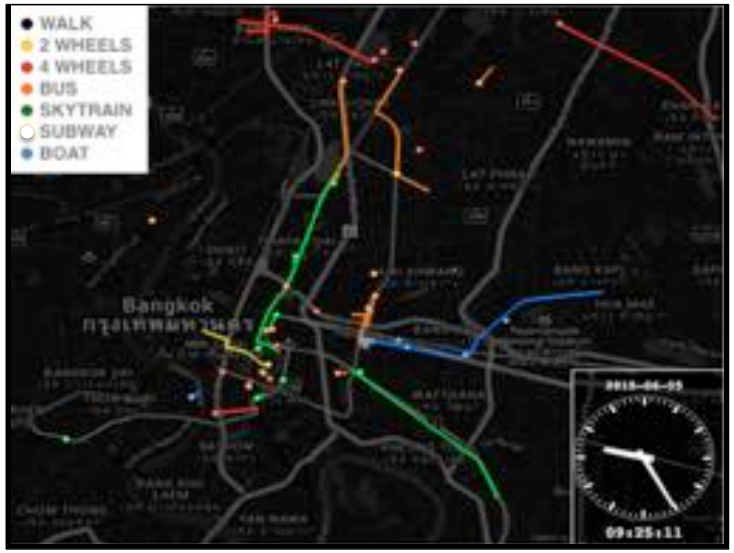




Category	Features	Significance
Basic Features	Distance	Distance of a segment
	MaxVi	The maximal velocity of a segment
	MaxAi	The maximal acceleration of a segment
	AV	Average velocity of a segment
	Time	Travel time of each segment
	Point	Total point of each segment
Advanced Features	HCR	Heading Change Rate
	SR	Stop Rate
Spatial Features	PiT	Point in Subway entrances
	PiR	Point in River and Canal
	PiL	Point in Sky train line
	PiP	Point in Sky train platform

Transportation Modes Detected Data

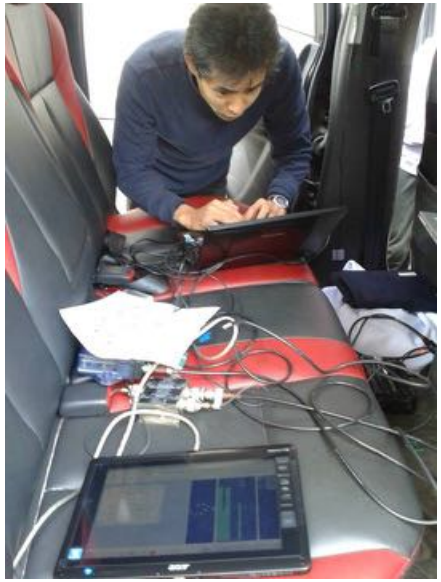




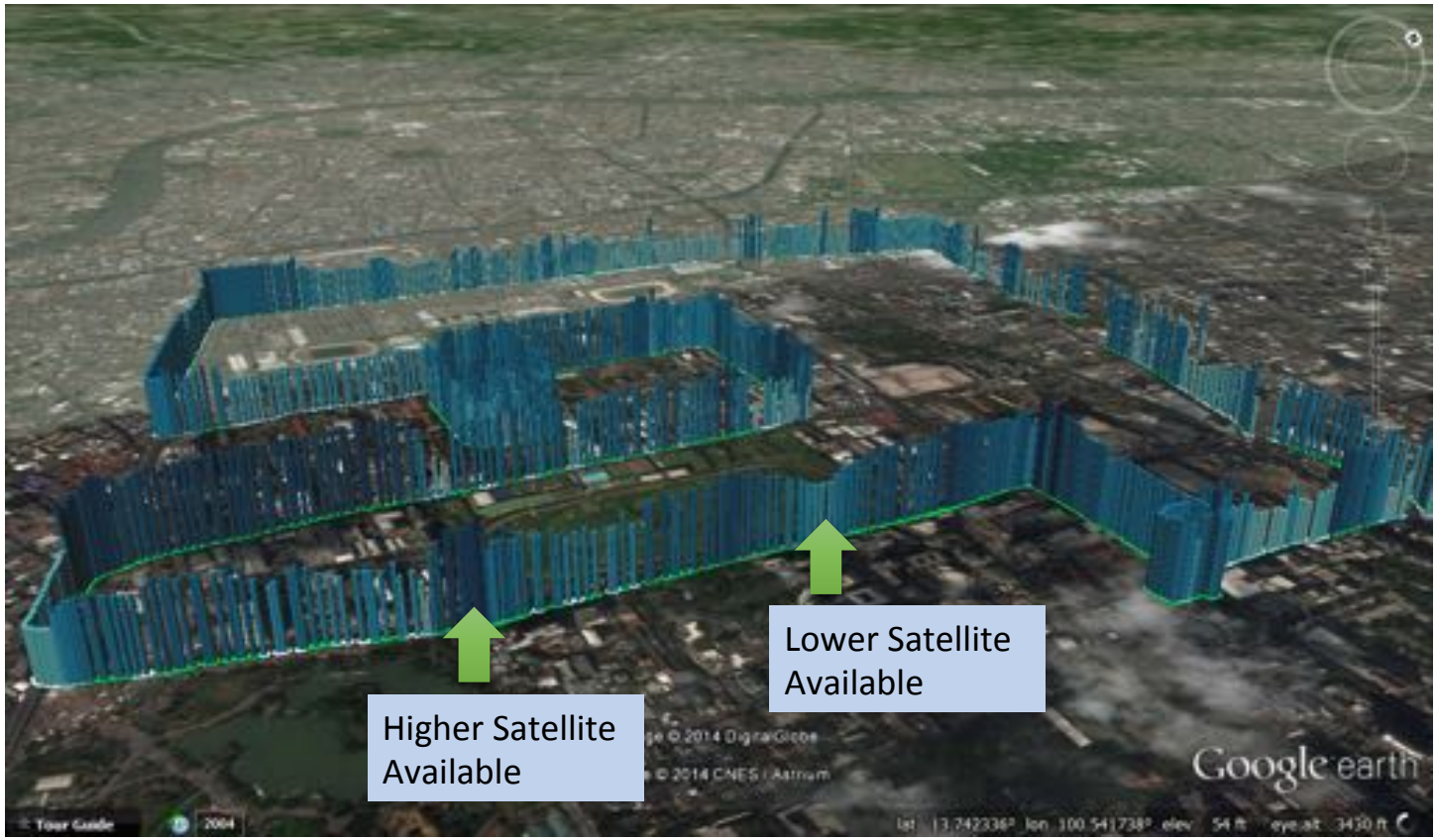
Estimated transportation modes used

Each color represents each mode
The colors are changed when people change their transportation modes

Field experiment in Bangkok



Satellite Availability



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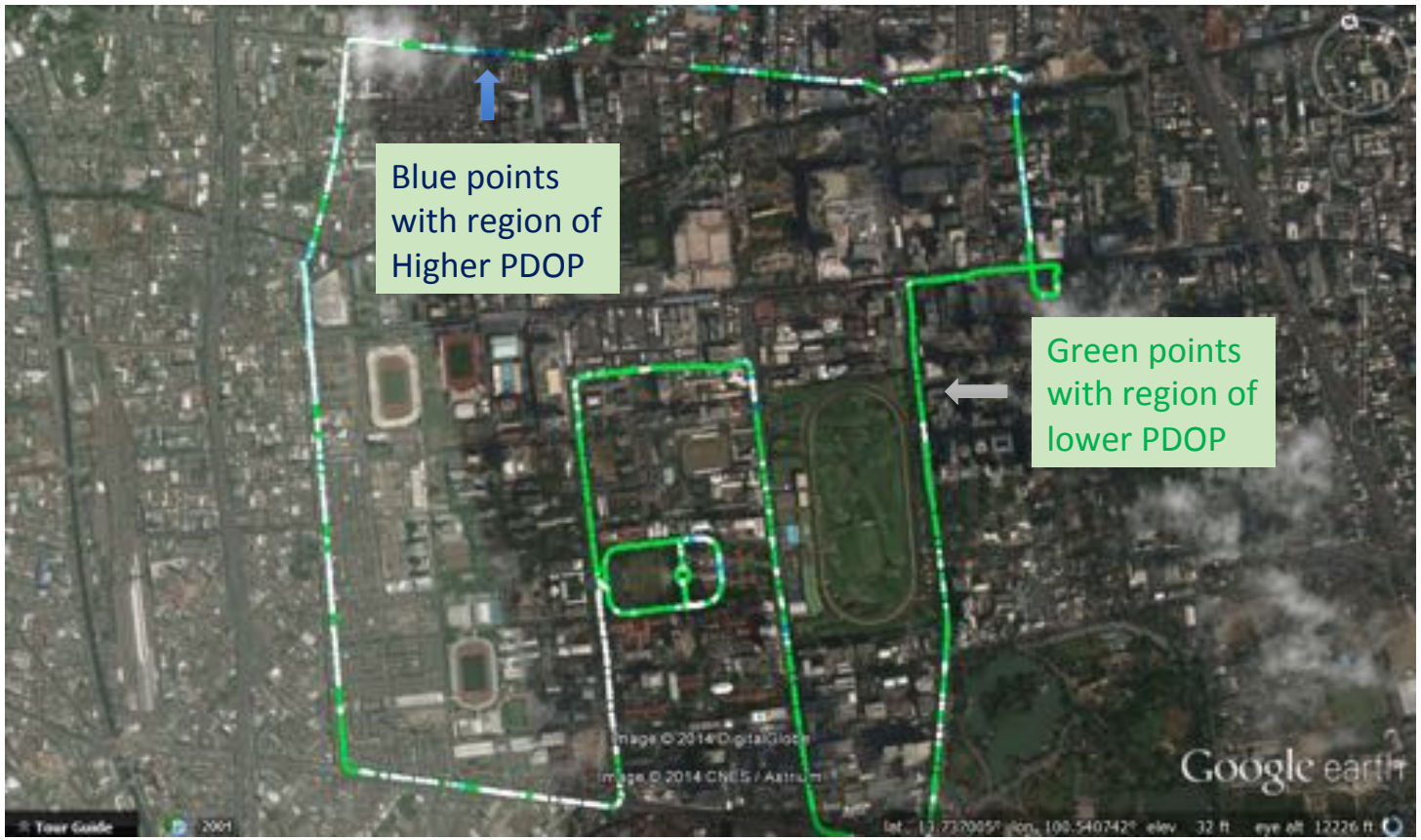
PDOP on the Experiment



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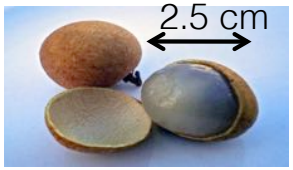
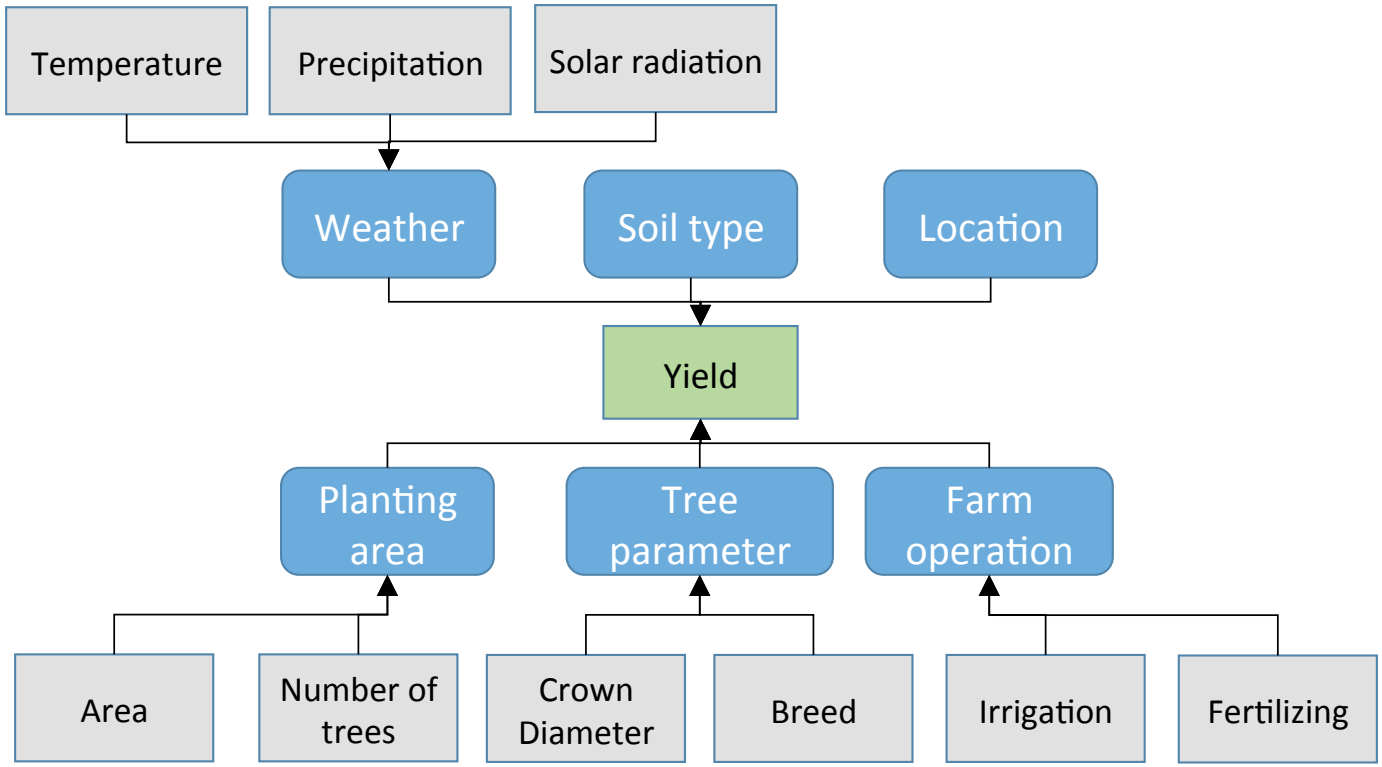
Managmet of Orchard, Longan



- Longan is medium-size evergreen tree
- Graft and pruning is required at young plantation stage
- The yield of a tree is from 60 kg to 200 kg[FAO corporate document repository]
- The yield is affected rain fall in the flower season
- Planting interval is 8-12 m due to best production[Longancenter maejo, 2011]
- The fruit bearing age is 7 years olds, and gerontic stage is more than 30 years old[agriculture Research Development Agency,]

Yield factors of plantation trees

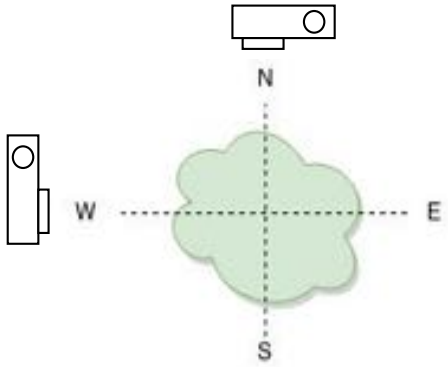


Field survey

Crown size measurement

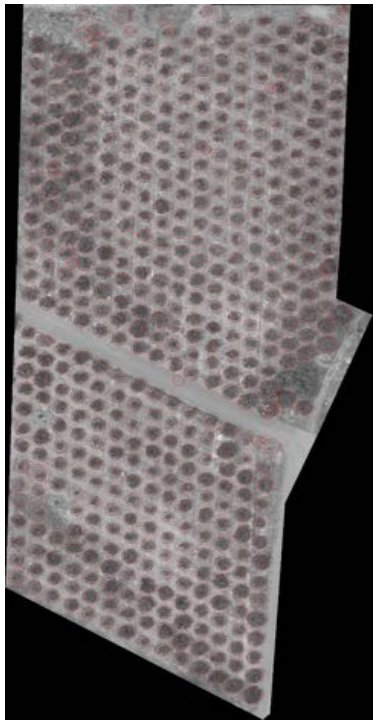
A crown is measured by tape measurement in N-S and E-W direction.

A camera is used taking photos in the same direction as crown size measurement.

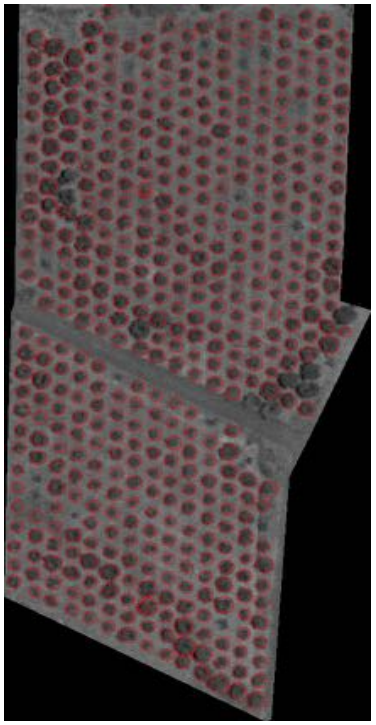


Detection of Number of Tree

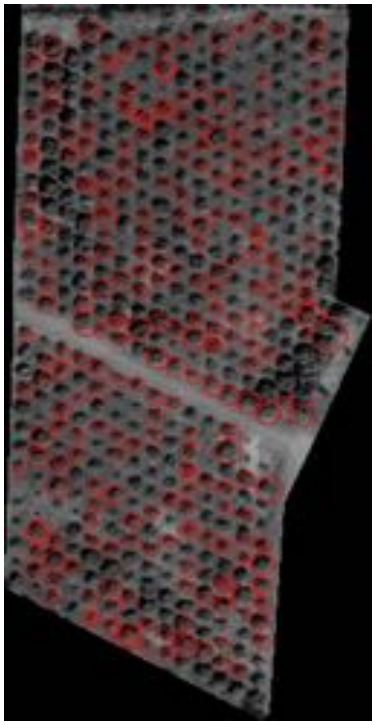
UAV



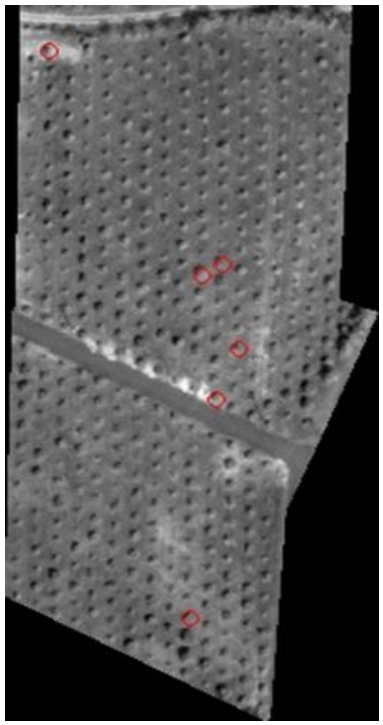
Google Earth



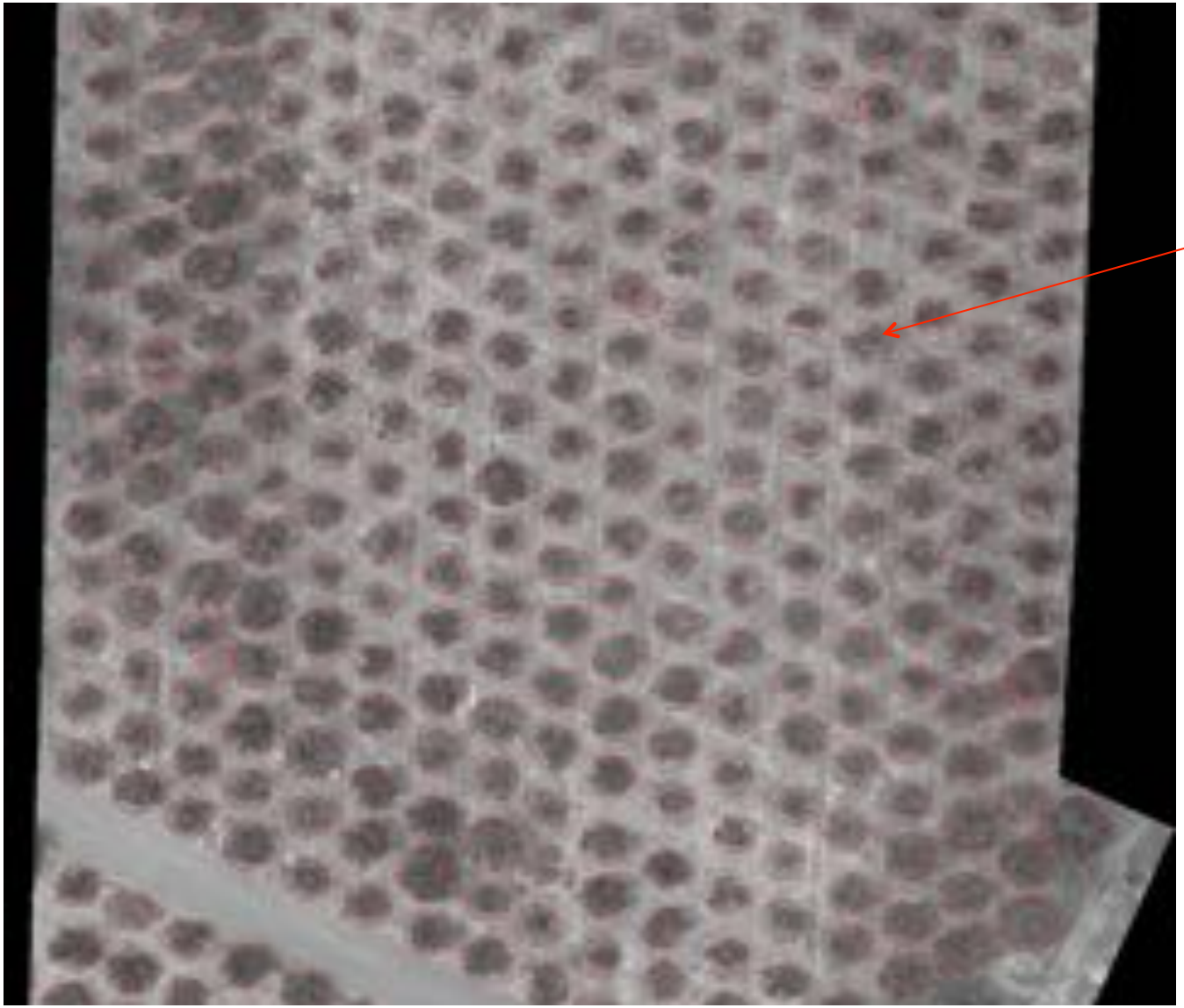
GeoEye-1



QuickBird

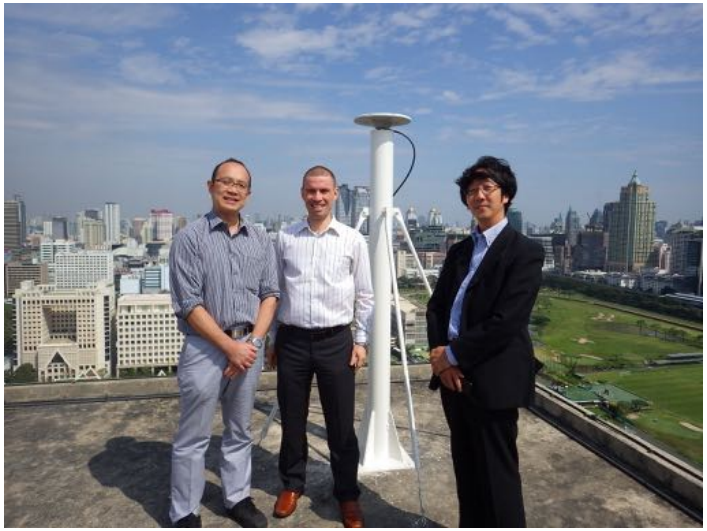


Detection of Tree Parameters



Precise Location
Information is required.

- ID
- Date
- Management data
- Tree Parameter
- Yield data
- Etc.



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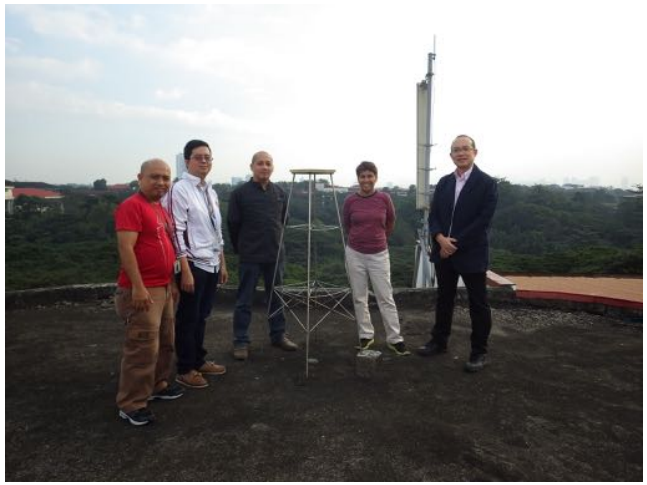

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