Environmental pollutants and their health effects in Myanmar

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* Air pollution and health effects conducted in Myanmar

* Pilot collaborative research with National Institute of Environmental Studies (NIES), Japan

Health effect of air pollutants:
some Myanmar studies

* Some Myanmar researchers conducted studies on health effect of air pollutants.

* They focused on those exposed to dust or pollutants at the workplace.

Workers of Paper mill (Zaw Lin Thein, 2006)

Casella controlled flow personal sampler with Whatmann Glass Microfibre filter (37mm) attached to a worker

* Exposed to bamboo dust and paper dust (n=96)
* Total dust concentration (8-h TWA): **1.53 mg/m^3 to 28.193 mg/m^3** (TLV of 10 mg/m^3 for organic dust: ACGIH 2001)
* Respirable dust: **0.45 – 1.74 mg/m^3** (TLV of 5 mg/m^3 for organic dust: ACGIH 2001)
* Respiratory symptoms such as cough, phlegm and chronic bronchitis ++
* % of Predicted peak expiratory flow (PEF): lower than unexposed
* % of Predicted forced expiratory flow rate (25%-75%) (FEF25-75%): lower than unexposed

Small airway obstruction

Marble stone sculpture: Carving and Refining (Hein Min Latt, 2012)

* Workers exposed to dust (calcium carbonate) released from the process of stone sculpture (n=42)
* The process produces a great amount of fine dust particles.
* Working <15 years vs working >15 years:
  * FEV1/FVC and FEF25-75%: significantly reduced in latter group

Small airway obstruction

Pump men of compressed natural gas (CNG) stations (Si Thu Tun, 2011)

CNG (methane): gas < 2 μm
Acceptable limit: 7 ppm

Office staff at CNG station (n=30)
Ambient CNG concentration (ppm): **846 ppm** (mean)

Pump men exposed to CNG (n=30)
Ambient CNG concentration (ppm): **680 ppm** (mean)

* % of Predicted FVC : 71.16 ± 21.44 and 77.03 ± 21.31
* % of Predicted FEV1 : 63.41 ± 19.69 and 65.50 ± 18.59
* FEV1/FVC : above 80%

Restrictive type of lung function impairment

Battery workers : from battery factory and small scale industry (Zarli Thant, 2005)

* Exposed to lead contaminated air (n=36)
  * Blood lead level (BLL): **48.45 ± 19.96** µg/dL
  * 61.2%: BLL **> 40 µg/dL** (OSHA, 1995; WHO, 1995)

High lead exposure

* **Anaemia**: 25% of participants (BLL >40 µg/dL)

Lead-exposed battery workers (n=28):

Thazin Shwe, Thuya Tun Oo, Cherry Bo Htay, Ohnmar, 2016

Cognitive and psychomotor ability
Peripheral Sensory function
C-reactive protein, vitamin C and MDA

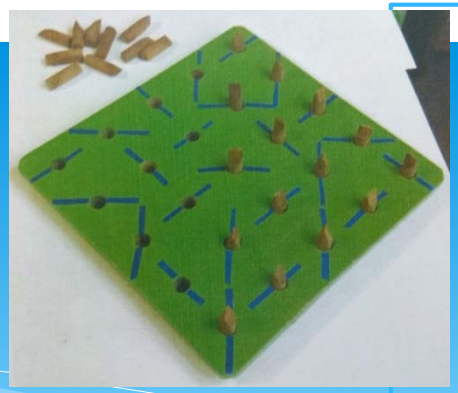
* Blood lead level (BLL):
  * Exposed subjects: **4.25 ± 3.87 µg/dL**

* CDC reference level = 5 µg/dL
* 92.85% of lead-exposed battery: lower than 5

Low lead exposure

Lead-exposed battery workers

- **Reduction in cognitive ability in attention, short-term memory and perceptual motor ability**
- **Early functional impairment in large myelinated sensory fibers**
- **Plasma MDA: increase**



* Total cognitive ability score: significantly lower than non-exposed (with lower score in digit span, and paired associate learning)
* Psychomotor ability tests: significantly lower than non-exposed (with lower score in Santa Ana dexterity)

* Peripheral sensory function
  * No neurological symptoms
  * Vibration perception threshold (VPT)
    * Hand: 4.20±2.29 volts vs 2.66 ± 0.71 volts
    * Foot: 8.36±4.81 volts vs 4.93 ± 2.62 volts

Collaborative research with NIES

Pilot project for air quality assessment in Yangon city

* **the most urbanized and most densely populated city in Myanmar: 7.4 million (2018)**

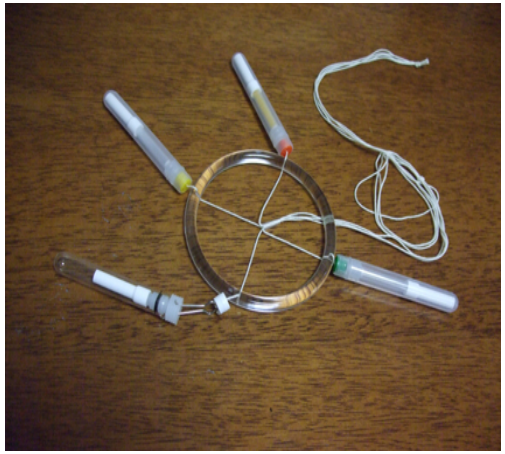
* **a growing number of vehicles in Yangon city:** over **870,000** vehicles in April 2018 (RTAD, 2018)

* **Outdoor air quality has been deteriorating because of increasing traffic and industrial development in suburban areas.**

Kilometers
0 1.5 3 6 9

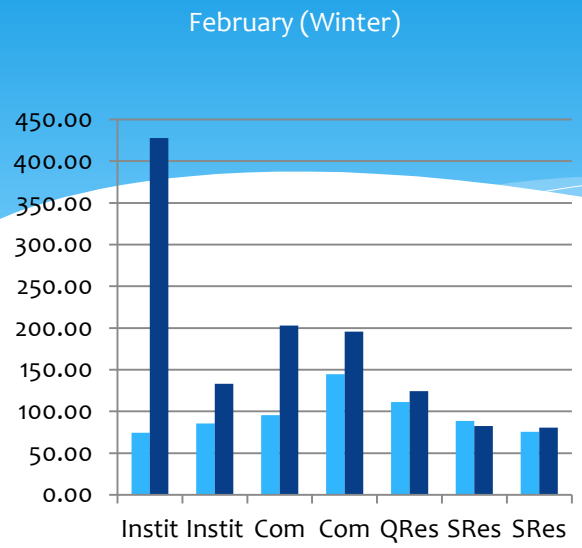
Phase I: Pilot project: Indoor and outdoor air quality assessment

Diffusive air samplers

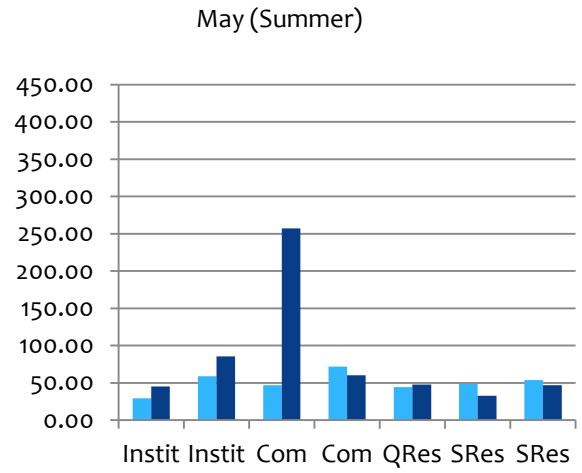


VOC-CX for VOCs
DSD-BEP/DNPH for ozone and carbonyl compounds
DSD-TEA for acid gases (NO_2, SO_2)
DSD-NH3 for basic gases (ammonia)

Volatile organic compounds

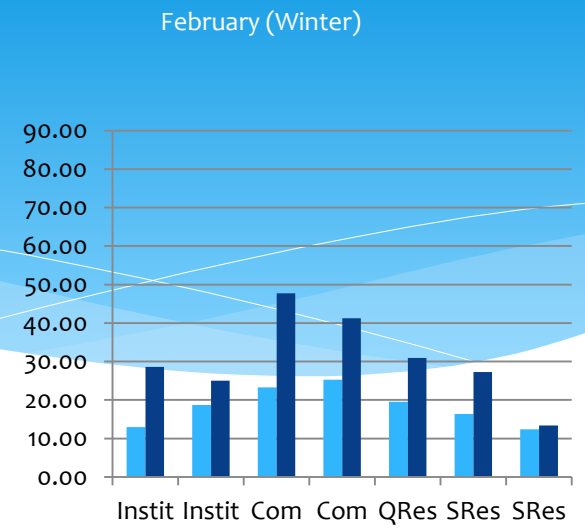


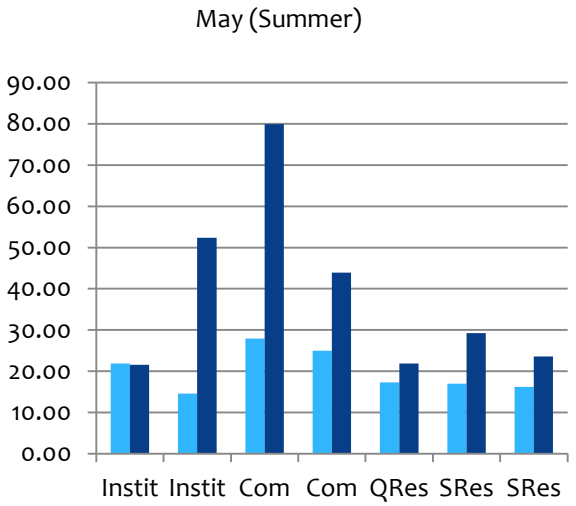
Outdoor << Indoor



Seasonal variation

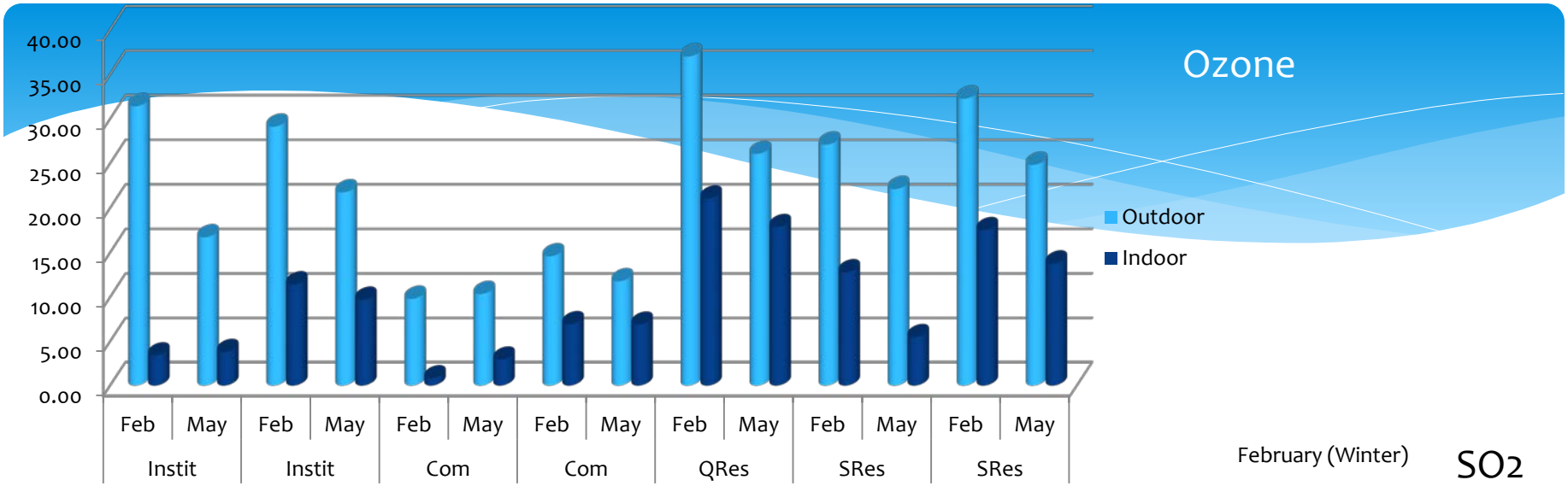
Total Carbonyls compounds



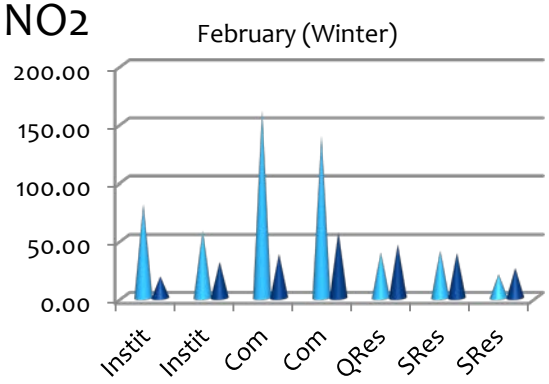


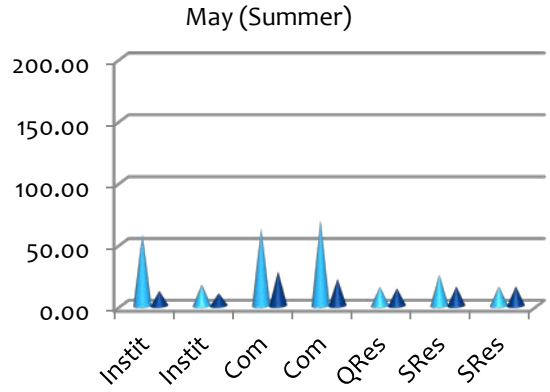
* **Toluene & hexane**

* **Formaldehyde & acetaldehyde**



NO2



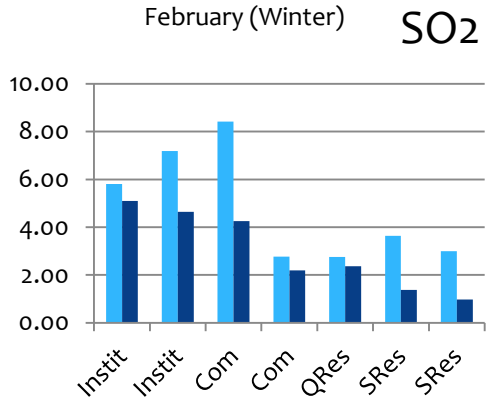


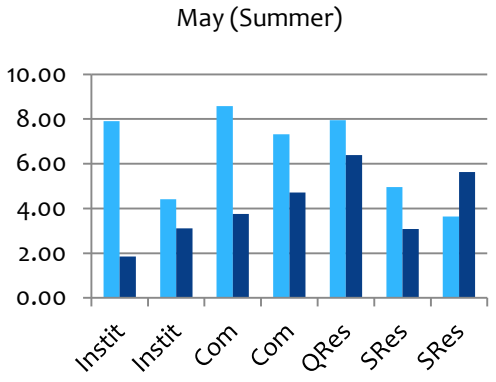
Mainly outdoor sources

Ozone
Acidic gases
NO2 and SO2

Seasonal variation

SO2





Basic gas: Ammonia

Outdoor	Instit	Instit	Com	Com	Qres	Sres	Sres
Winter	26.67	51.08	57.96	42.95	36.95	37.03	32.78
Summer	110.68	112.62	140.56	143.00	109.62	117.03	120.62
Indoor	Instit	Instit	Com	Com	Qres	Sres	Sres
Winter	98.81	53.86	92.55	81.50	48.58	30.84	81.36
Summer	272.40	165.99	228.98	159.23	135.19	160.35	215.70

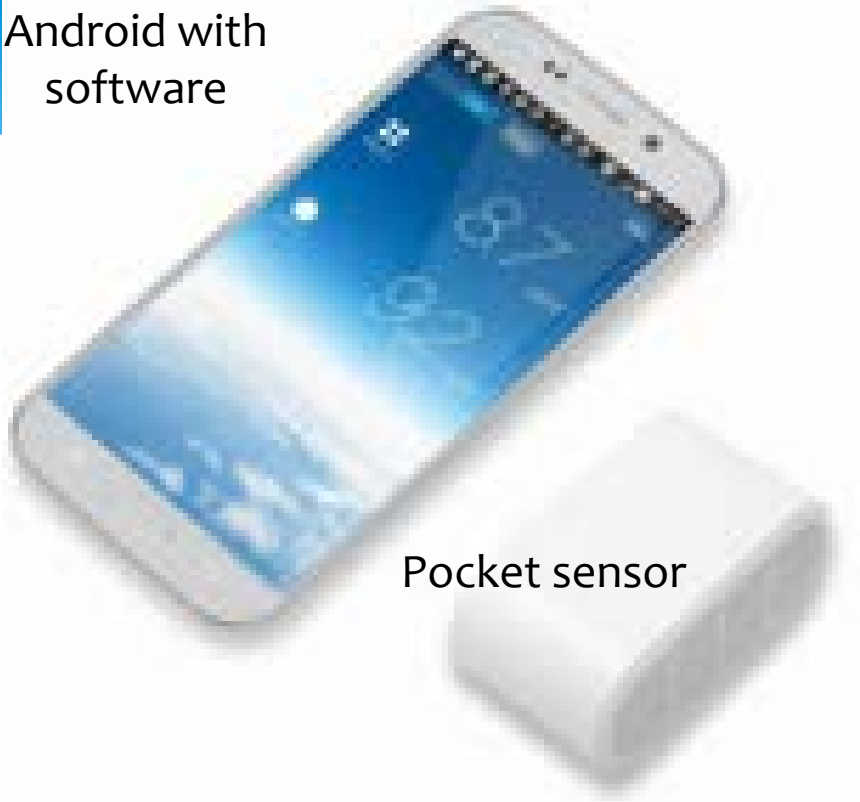
* Indoor > outdoor
* Sources: Animals, residents and household goods such as bathroom cleaner, floor cleaner and glass cleaner
* Summer > winter

Phase II

Pilot survey on $PM_{2.5}$ and PM_{10}

Temporal and Seasonal variation

Android with software



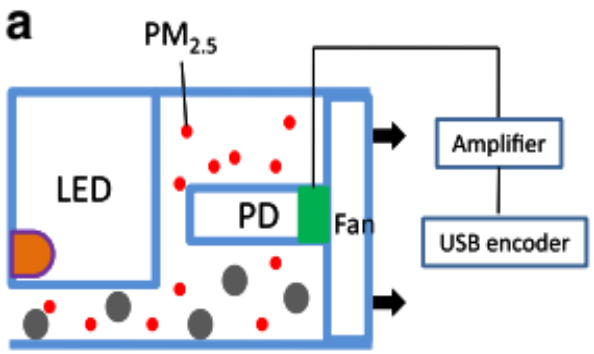
Pocket sensor

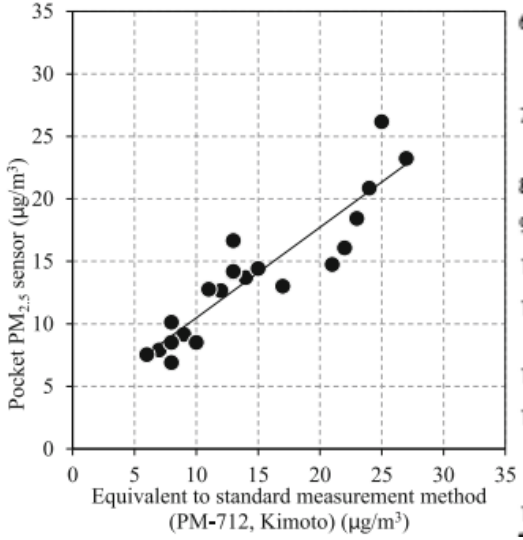
Colour variation showing different PMs levels

Table 1 Specification of Pocket $PM_{2.5}$ Sensor (Yaguchi Electric Corp.)

No	Item	Parameter
1	Measurement parameters	PM2.5,PM10
2	Measurement range	0.0–999.9 μg /m3
3	Rated voltage	5 V
4	Rated current	60 mA ± 10 mA
5	Sleep current	< 4 mA laser and fan sleep
6	Temperature range	Storage environment: – 10 – + 50 °C Work environment:– 20 – + 60 °C
7	Humidity range	Storage environment: max 90% Work environment: max 70%
8	Air pressure	86 KPa – 110 KPa
9	Corresponding time	1 s
10	Serial data output frequency	1 Hz
11	Minimum resolution of particle	< 0.3 μm
12	Counting yield	70%@0.3 μm 98%@0.5 μm
13	Relative error	Maximum of ± 15% and ± 10 μg/m3 25 °C, 50%RH
14	Product size	42.5 × 32 × 24.5 (mm)

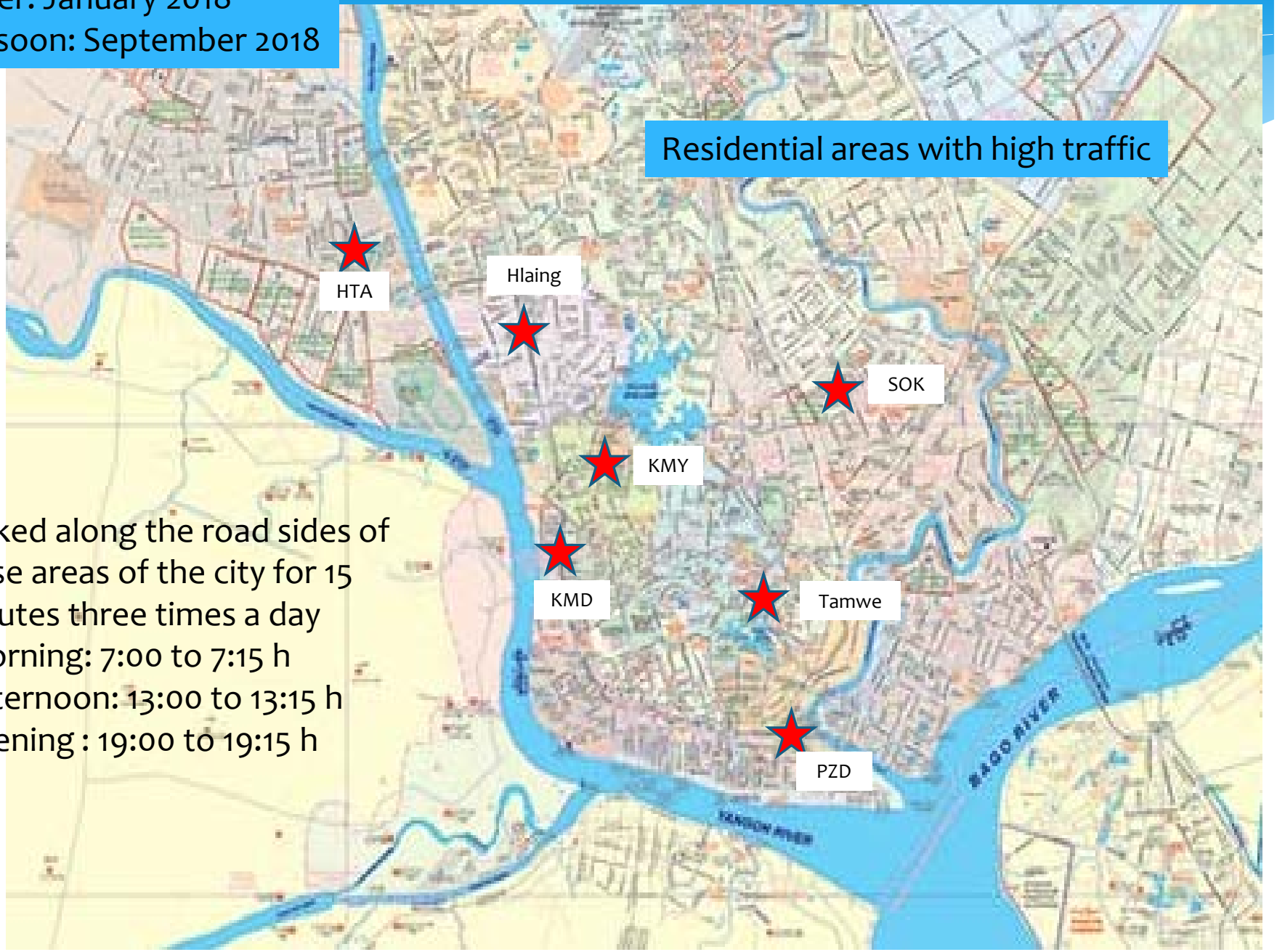
Principle of pocket sensor





Winter: January 2018
Monsoon: September 2018

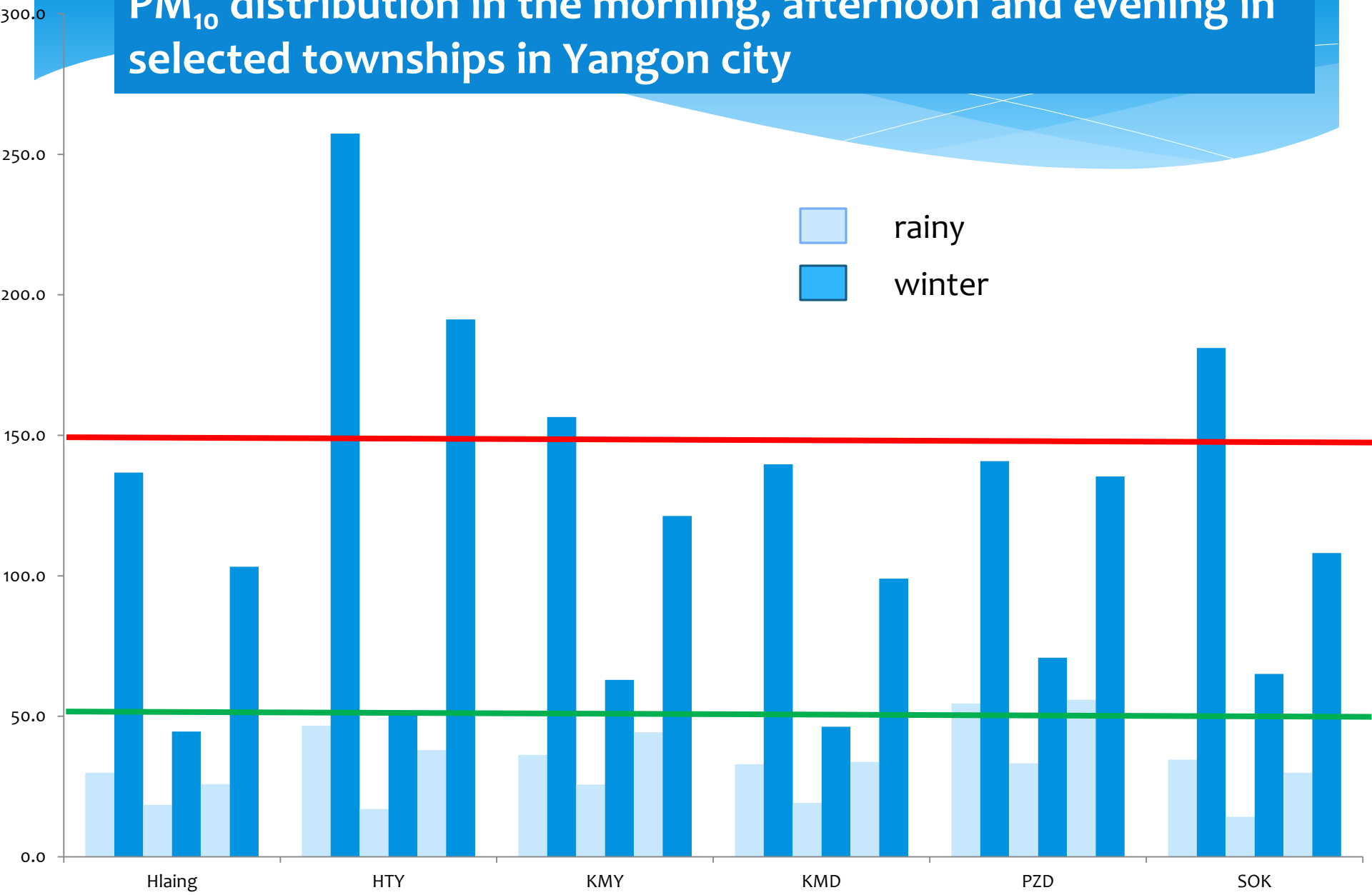
Residential areas with high traffic



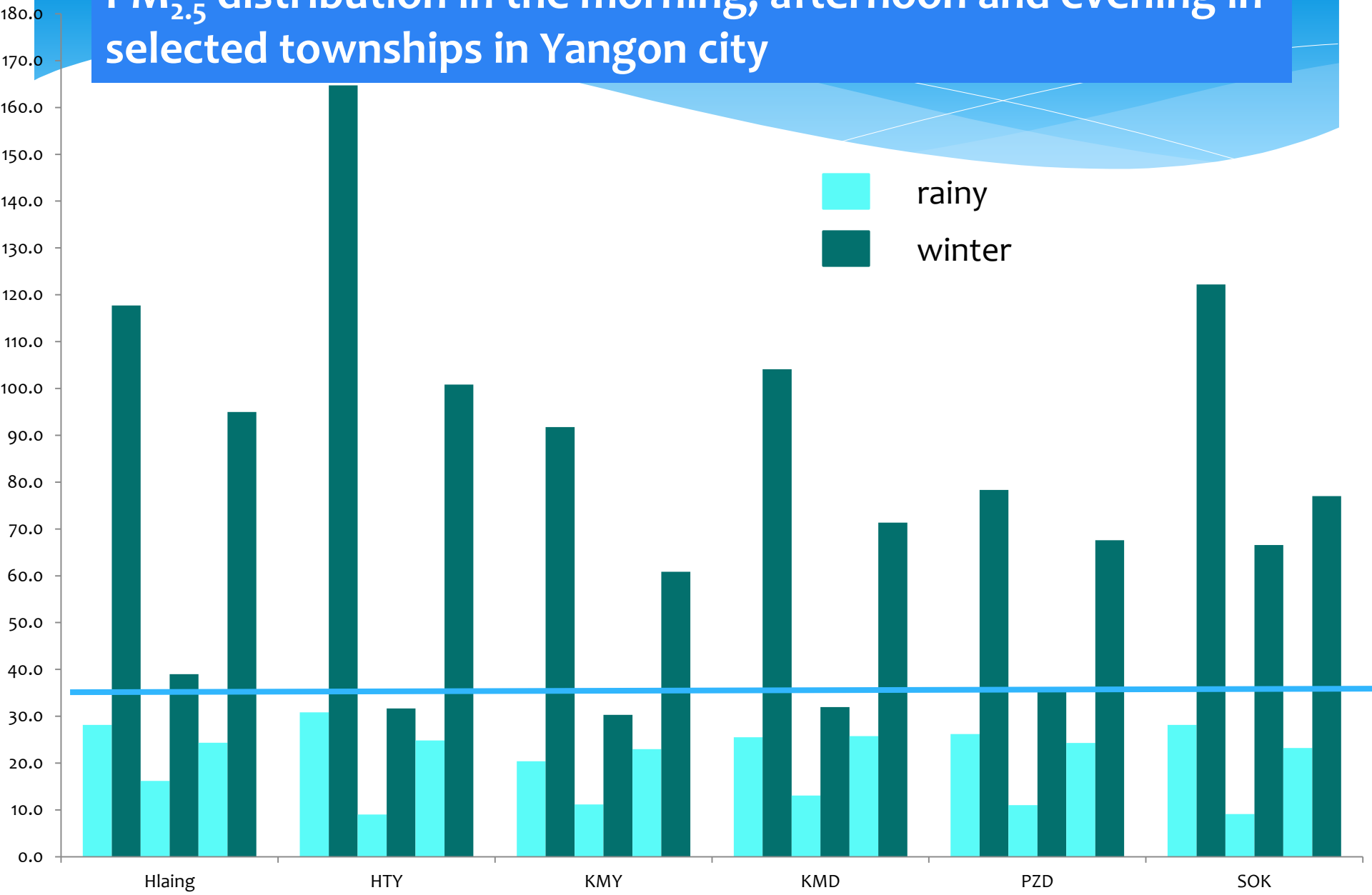
walked along the road sides of these areas of the city for 15 minutes three times a day

- Morning: 7:00 to 7:15 h
- Afternoon: 13:00 to 13:15 h
- Evening : 19:00 to 19:15 h

PM_{10} distribution in the morning, afternoon and evening in selected townships in Yangon city



$PM_{2.5}$ distribution in the morning, afternoon and evening in selected townships in Yangon city



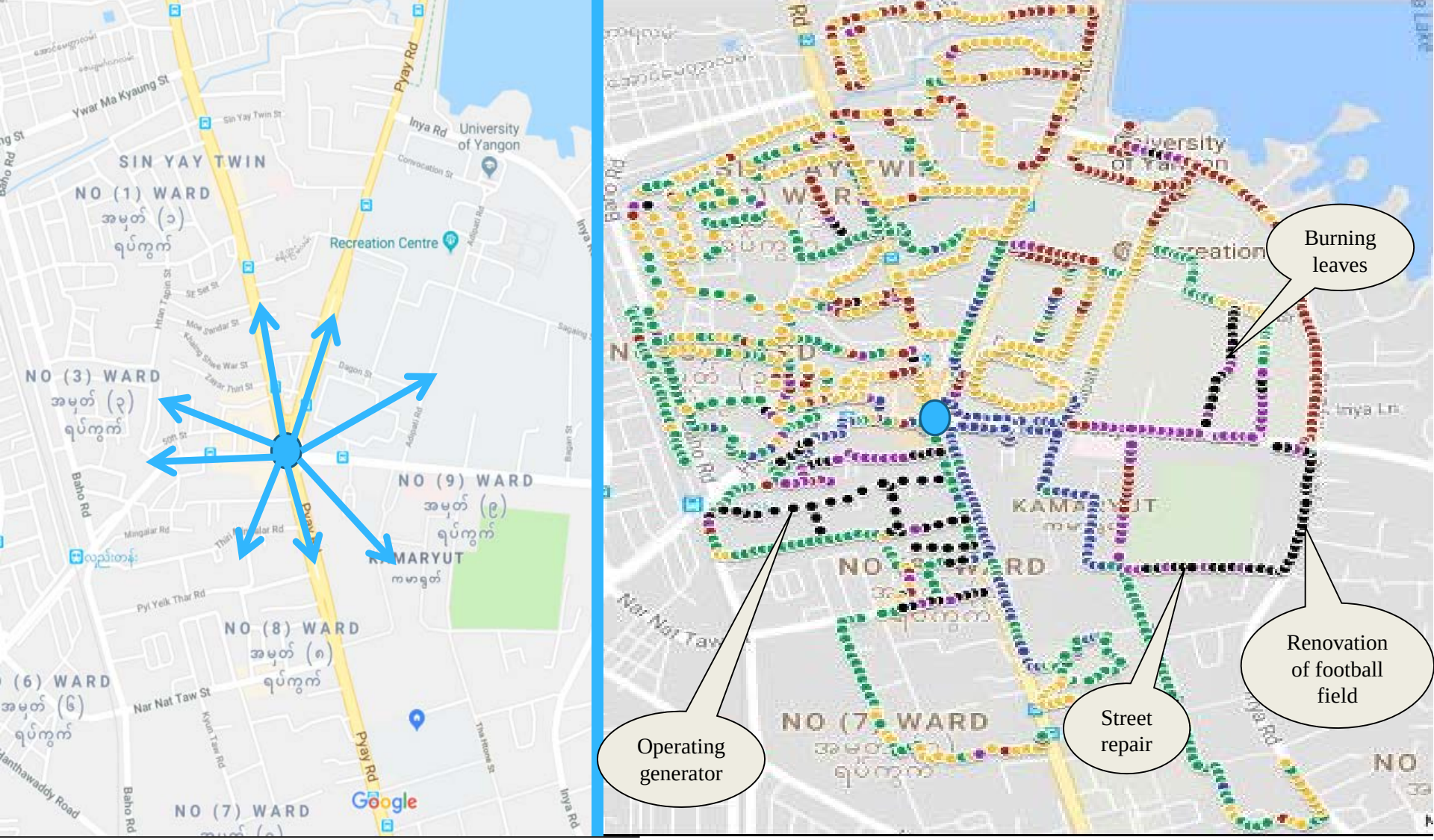
Temporal variation: $PM_{2.5}$ & PM_{10}

Both $PM_{2.5}$ and PM_{10} in the morning and in the evening during winter season (although 15 minute quality) are found to be much higher than 24-hour health based standards.

Pilot survey on $PM_{2.5}$ and PM_{10} in Yangon city

Real time assessment

with spatial variation



Location of sampling area (Hledan Junction) in Kamayut Township, Yangon, Myanmar.

Conclusion

* Outdoor air was being contaminated with traffic-related pollutants, resulting from the **greater traffic volume** in recent years.

Recent relaxation in vehicle import regulations causes noticeable influx of motor vehicles in Yangon;

registered vehicles has largely increased from approximately **480,000** vehicles in 2013(RTAD, 2013) to over **870,000** vehicles in April 2018 (RTAD, 2018).

Conclusion

* Indoor air quality varied with
  - indoor characteristics of the building
  - indoor human activities
  - ventilation.

* It is also noted that gases with health concern such as **toluene** and **formaldehydes** are identified in indoor air

Conclusion

* The PM_{10} and $PM_{2.5}$ level in Yangon city has reached the noticeable level, especially during rush hour in winter season.

* Within townships, air quality, particularly in relation to concentrations of $PM_{2.5}$ tends to be worse close to busy roads, and construction sites.

On-going research

- Indoor air quality: PCB (polychlorinated biphenyl)
  - in 5 locations using diffusive air sampler (DSD-CX)
  - monthly for one year (May 2018 to April 2019)
  - Sample collection: still in progress

- Outdoor air quality: O3 and NO2
  - in 3 locations:
    - Heavy traffic (Tamwe Tsp: Furniture shop),
    - Moderate traffic (KMY Tsp: um1)
    - Low traffic (HTY Tsp: FMI city),
  - for 5 days
  - Sample collection: completed
  - Analysis: still in progress

Our future plans

* To detect individual exposure screening of $PM_{2.5}$ concentration in highly contaminated area using pocket sensor

* To continue PM air quality assessment (with fixed station and mobile equipment)
  - for 24-hour average as well as annual data
  - in other locations in Yangon city
  - in other major cities in Myanmar

* To investigate whether association exists between $PM_{2.5}$ concentration and health risk in Myanmar.

* Individual exposure to some hazardous pollutants by using personal samplers

* Formaldehyde exposure to Faculty members working in Medical university

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THANK
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