Polycyclic aromatic hydrocarbons in road dusts collected from Myanmar, Japan and Taiwan and their exposure risks in human

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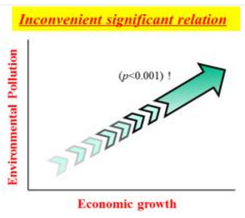
Background

Fig. Economic growth rates (%) of Myanmar and other Asian countries[1)]

No	Country	Value	No	Country	Value
1	Libya	55.1	7	Bangladesh	7.1
2	Macao SAR	13.4	8	Djibouti	7.0
3	Ethiopia	8.5	9	Cambodia	6.9
4	Cote d'Ivoire	7.6	10	Laos	6.9
5	Nepal	7.5	11	China	6.8
6	Myanmar	7.2	12	Senegal	6.8

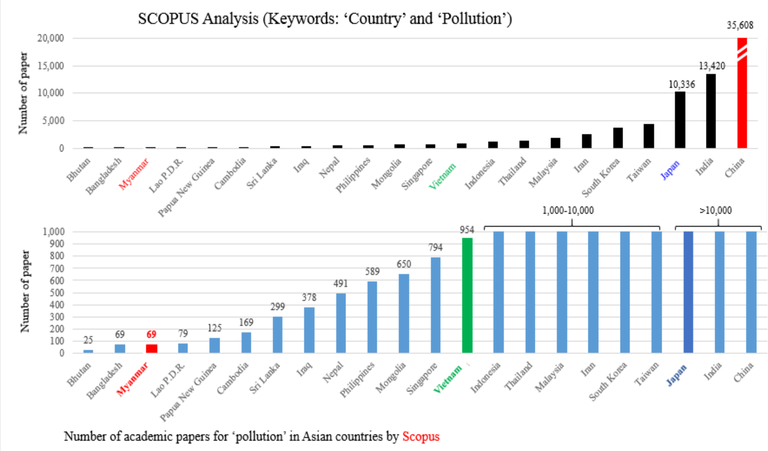
Ranking of economic growth rate in the world (2017)[2)]

- Economic growth rate of Myanmar increase compared to other countries.
- The rank of Myanmar is 6th.



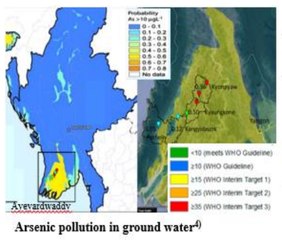
Air, water and garbage pollutions in China, Vietnam Indonesia Bangladesh and other economically growing countries in Asia.[3)]

- Environmental pollution and economic growth are generally paralleled.
- Air, water and garbage pollutions in the Asian countries.

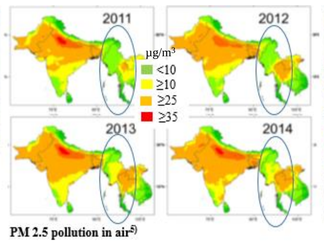


Number of academic papers for 'pollution' in Asian countries by Scopus

- Little information on environmental pollution in Myanmar is available.



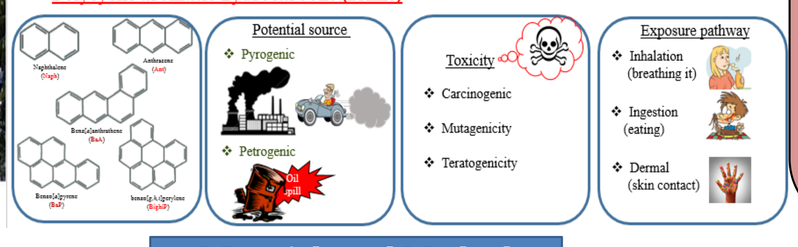
Arsenic pollution in ground water[4)]



PM 2.5 pollution in air[5)]

- Arsenic [As] pollution in ground water of Myanmar, especially for Ayeyarwaddy division.
- PM 2.5 concentrations in air pollution in Myanmar is becoming increased year by year.

Polycyclic aromatic hydrocarbons (PAHs)



Objectives

- To identify PAHs pollutions and distributions in road dusts from Myanmar, Japan and Taiwan.
- To estimate the sources of PAHs in the road dusts.
- To evaluate exposure risk of PAHs in human.

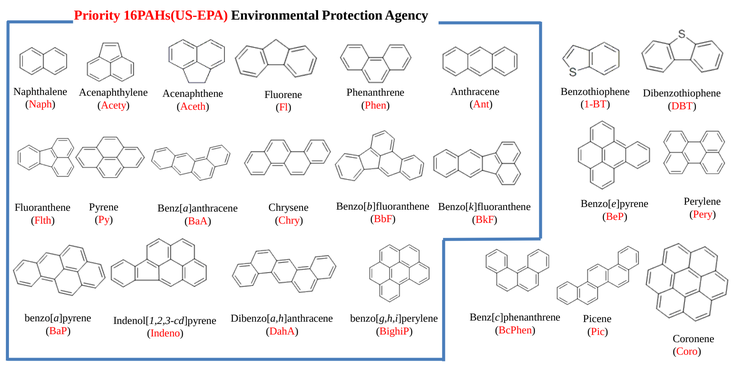
Conclusions

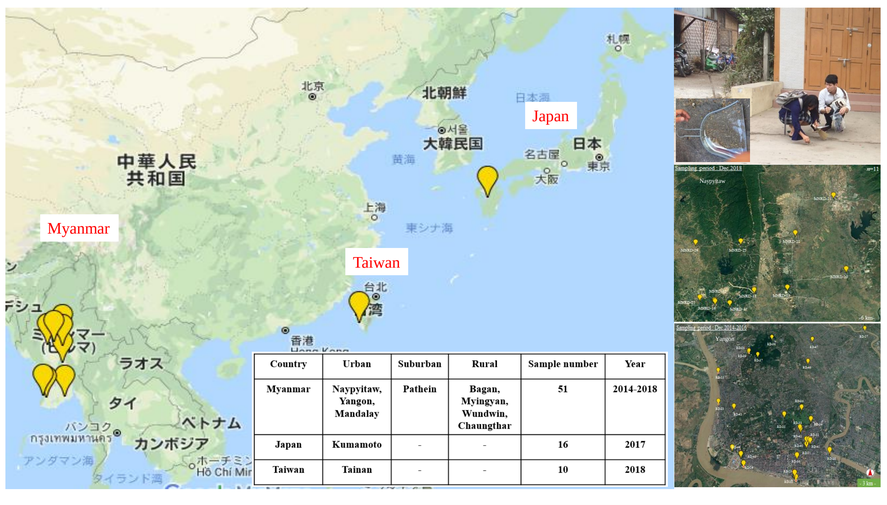
- PAHs concentration were higher in Taiwan road dusts than in Myanmar and Japan.
- Combination of petrogenic and pyrogenic sources in Myanmar, and japan.
- Myanmar and Taiwan road dusts have a little potential risk of PAHs exposure to human.

Materials and Method

Target analytes

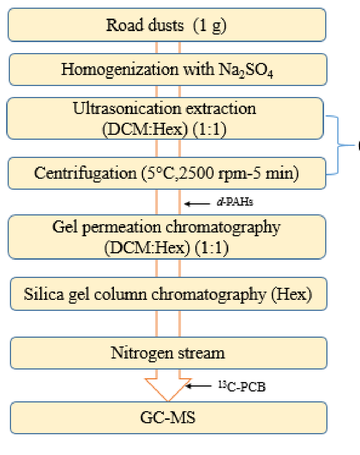
Parent PAHs (Par-PAHs) 23 compounds





Country	Urban	Suburban	Rural	Sample number	Year
Myanmar	Naypyitaw, Yangon, Mandalay	Pathein	Bagan, Myingyan, Wundwin, Chaungthar	51	2014-2018
Japan	Kumamoto	-	-	16	2017
Taiwan	Tainan	-	-	10	2018

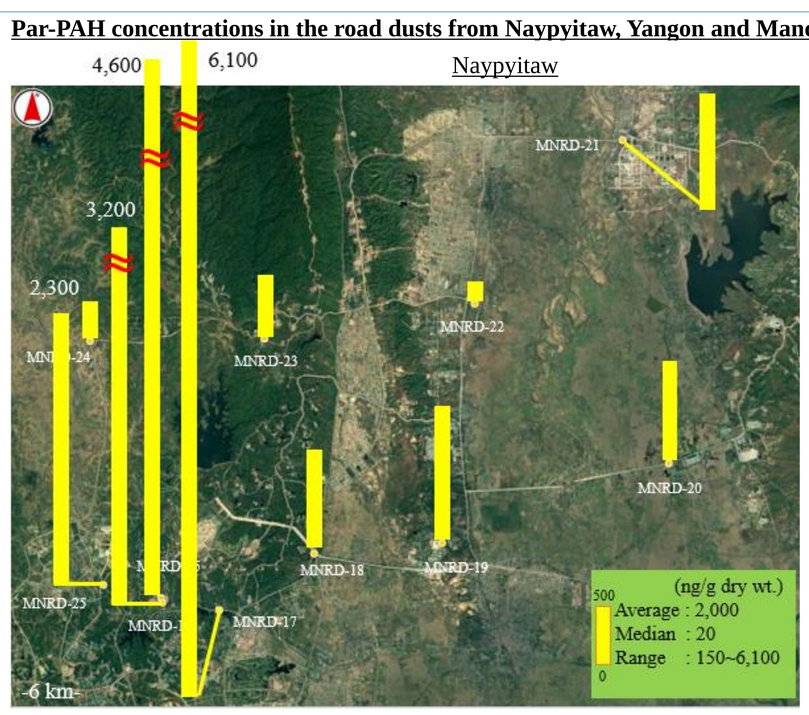
Analytical Method

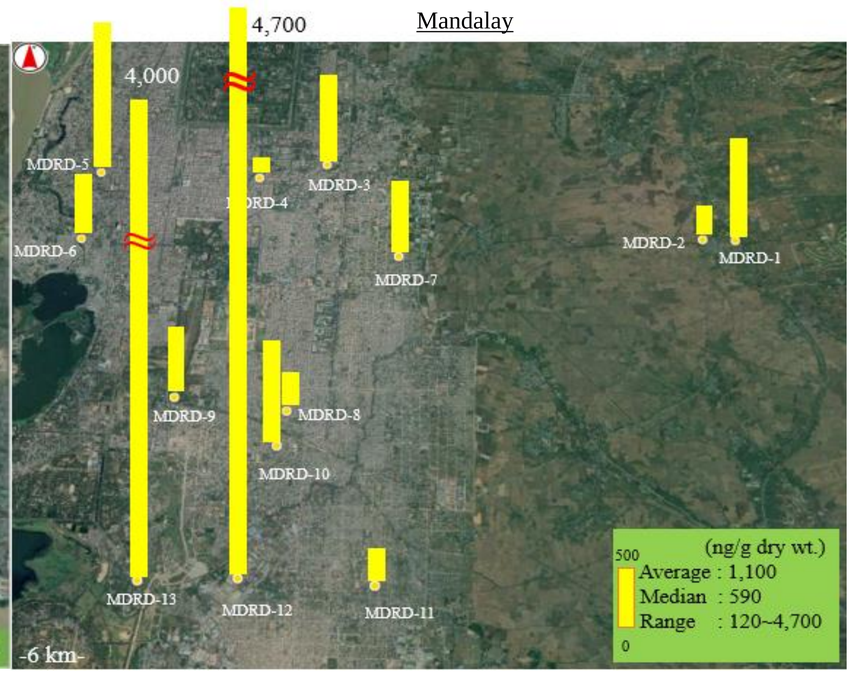


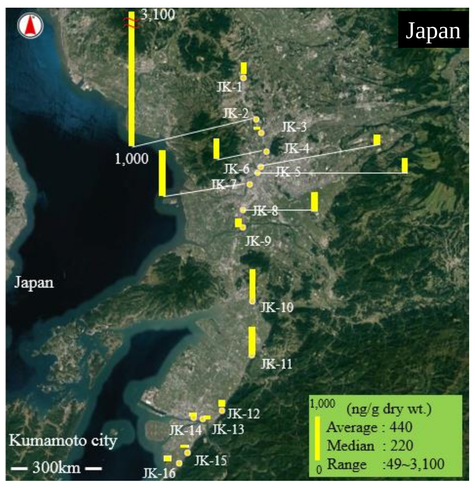
Agilent Technology 7693 Series- GC-Agilent Technology 5977B MSD (EI mode)	
Column	BPX-5,60 m × 0.25 mm i.d. x 0.25 μm
Temperature graduation	80°C(1 min)-[20°C/min]-160°C (0 min)-[3°C/min]-310°C (40 min)
Injection mode	Splitless mode
Injection volume	2 μl
Injection temperature	270°C
Transfer line temperature	280°C
Carrier gas	He (99.999%),1 mL/min (constant flow mode)
Ion energy	70 eV
MS acquisition mode	Selected Ion Mode (SIM)

Results and Discussion

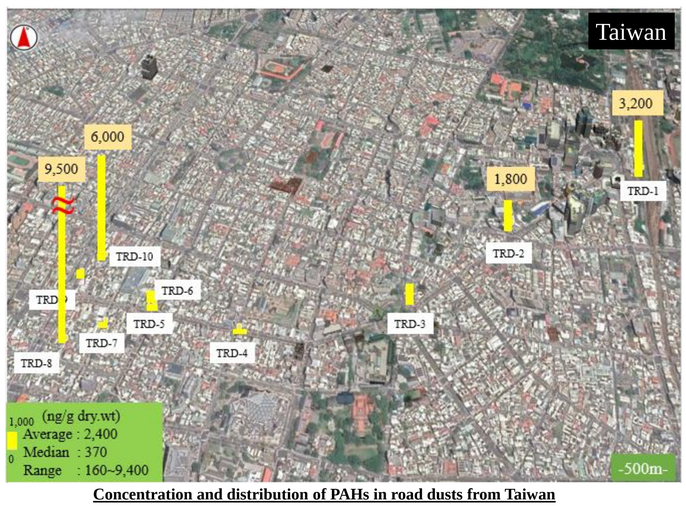
Par-PAH concentrations in the road dusts from Naypyitaw, Yangon and Mandalay



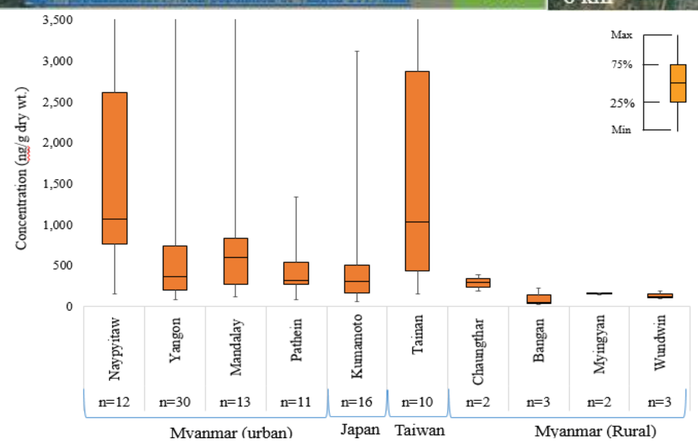




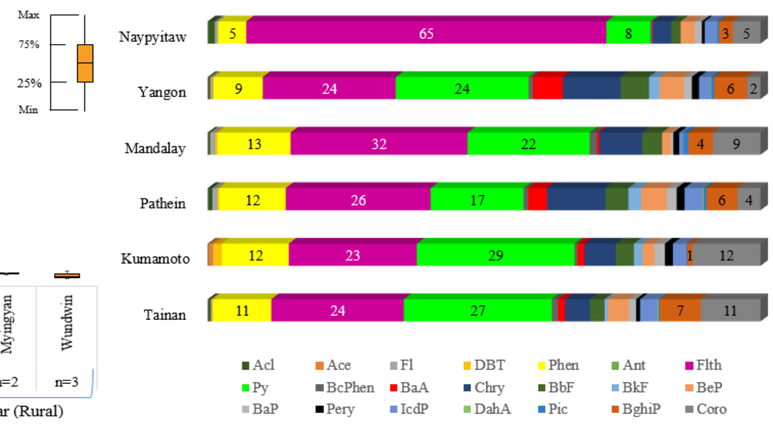
Concentration and distribution of PAHs in road dusts from Japan



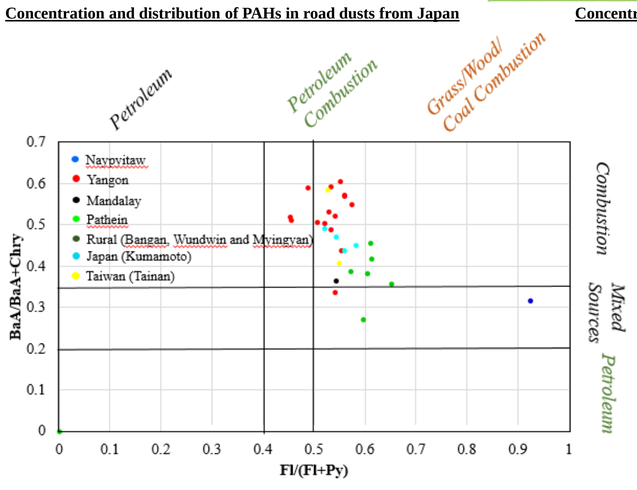
Concentration and distribution of PAHs in road dusts from Taiwan



Comparsion of PAH concentration in road dusts from different areas



Compositions of PAHs in road dusts from Myanmar, Japan and Taiwan road dusts



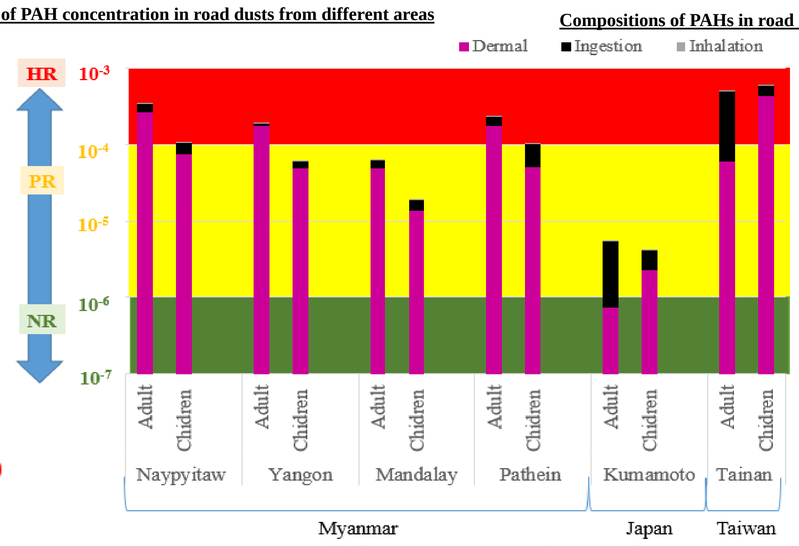
Potential source of PAHs in road dusts

$$ILCRs_{ingestion} = \frac{CS \times \left(CSF_{ingestion} \times \frac{\sqrt[3]{BW}}{70}\right) \times IR_{ingestion} \times EF \times ED}{BW \times AT \times 10^6}$$

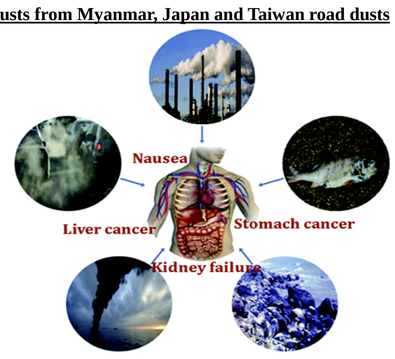
$ILCRs_{ingestion}$	=	**Incremental Lifetime Cancer Risk.**
CS	=	B[a]P-equivalent concentration of PAHs in road dust (ng/g).
$CSF_{ingestion}$	=	Carcinogenic slope factors of B[a]P (7.3 mg/kg).
BW	=	Body weight (57.7 and 16.8 kg for adult and children).
$IR_{ingestion}$	=	Dusts intake rate (50 and 100 mg/day).
EF	=	Exposure frequency (180 days/year).
ED	=	Exposure duration.
AT	=	Average life span (70 years).

$\leq 10^{-6}$	: Negligible risk
10^{-6} to 10^{-4}	: Potential risk
$>10^{-4}$	: High risk

Calculation of Incremental Lifetime Cancer risk (ILCRs) of PAHs



Comparison of ILCRs values in Myanmar, Japan and Taiwan



1) Date: IMF (http://www.imf.org/external/datamapper/NGDP_RPCH@WEO/OEMDC/ADVEC/WEOWORLD)
2) http://www.imf.org/external/datamapper/NGDP_RPCH@WEO/OEMDC/ADVEC/WEOWORLD
3) https://www.cnbc.com/2017/02/24/10-powerful-images-that-show-the-effects-of-pollution-around-the-world.html#slide=1
4) Yunker *et al.*, (2002)
5) L.H.Tuyen *et al.*, (2014)
6) PAHs+effects+on+human+health&sxsrf=ACYBGNSdgKqyt83XASm3qwtBksCPE8soew:1568344283978&tbm=isch&source=iu&ictx=1&fir=JcHhKqEx9tOSCM%253A%252C5cZlnUTZszB2sM%252C_&vet=1&usg=AI4_-kSEccALFLm1V2yQ0BjXvFjgDHgsGw&sa=X&ved=2ahUKEwiKkLrf6czkAhWSA4gKHRuiDVoQ9QEwAXoECAUQAw#imgrc=GJpwvkSHZzlKmM:&vet=1