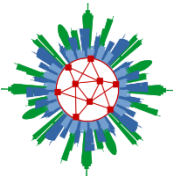


# Polycyclic aromatic hydrocarbons associated with PM 10 among Ger districts in Ulaanbaatar, Mongolia

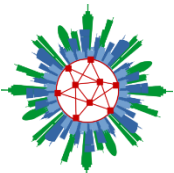
**KHULAN Tsermaa, Soyol-Erdene Tseren-Ochir, Günter  
Bambauch, Ulrich Vogt, Amarsanaa Badгаа**

**tsermaahulan@gmail.com**

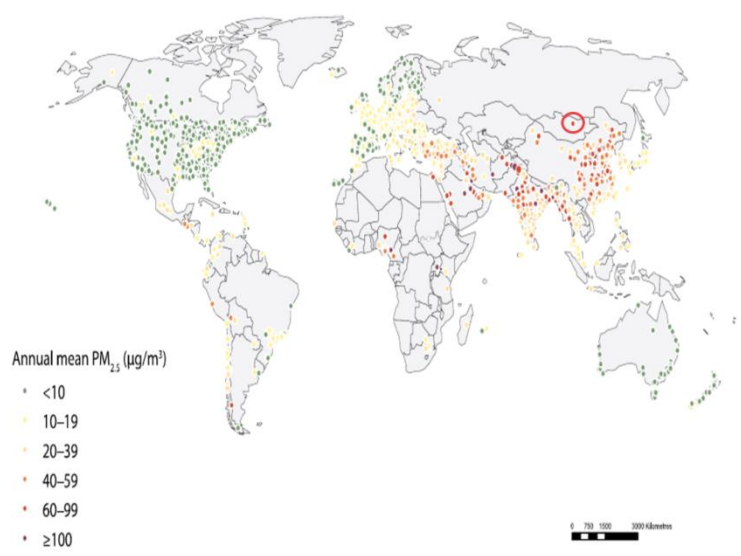


# Outline

- Background and Introduction
- Material and Methods
  - Sampling sites and techniques of PM 10
  - Analysis of PAHs associated with PM 10
- Results and Discussion
  - Concentration of PM 10 and PAHs among Ger districts
  - Distribution and Source apportionment of PAHs
  - Cancer risks assesment of PAHs
- Conclusion



# Background and Introduction

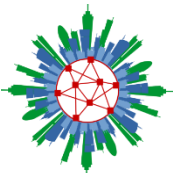


- Winter time - **#1 polluted** capital
- Particle Pollution 7-10 times higher than WHO guidelines

!!! PEAK VALUES **>>100** TIMES

## SMOG

- Vehicles, power plants, soil resuspension – 20%
  - 80% from apprx. 200,000 coal burning stoves
- + Geographical and meteorological conditions**



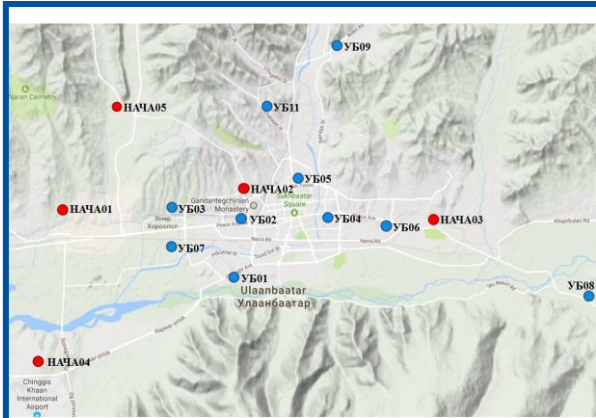
# Background and Introduction

## AIR POLLUTANTS

Criteria pollutants  
NO<sub>x</sub>, SO<sub>2</sub>, CO, PM, O<sub>3</sub>...

Greenhouse gases:  
CO<sub>2</sub>

**HAZARDOUS AIR  
POLLUTANTS**

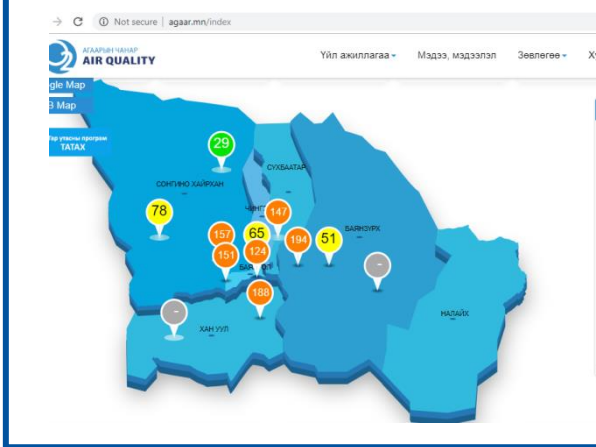


### Air Quality monitoring stations

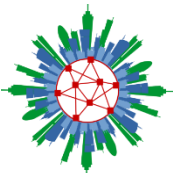
5 Municipality  
10 State  
1 US embassy



- Lack of capability,
- Complexity of analysis
  - ultra- trace analysis



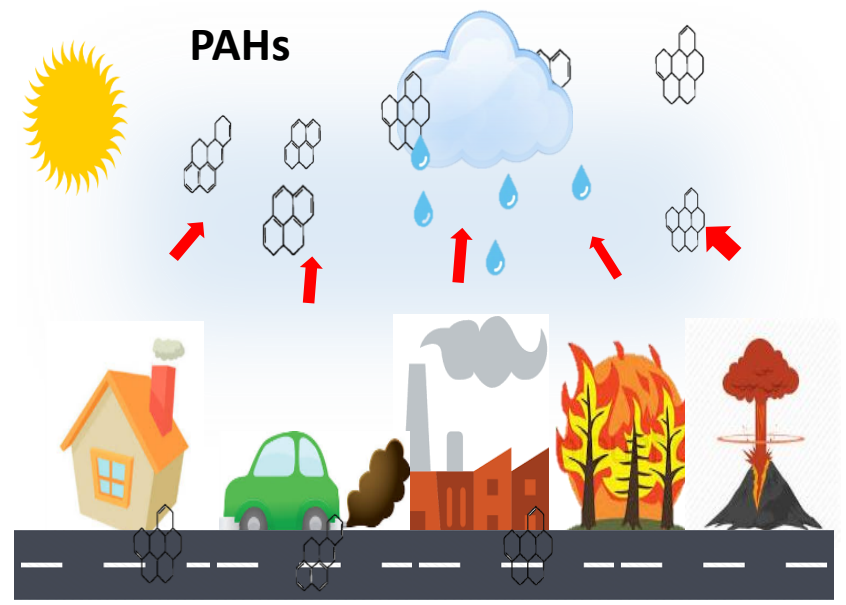
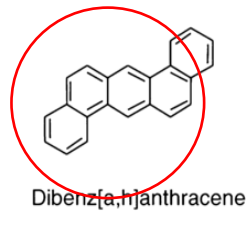
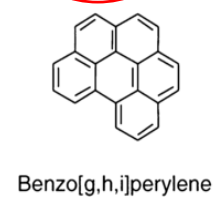
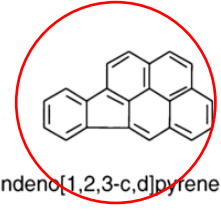
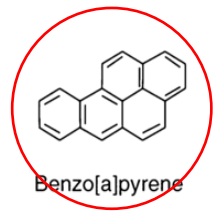
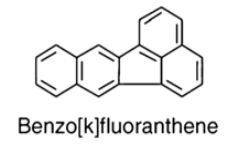
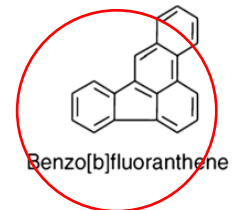
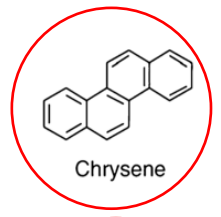
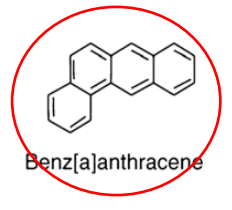
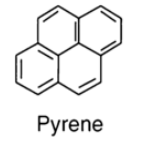
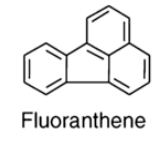
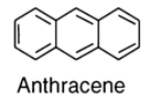
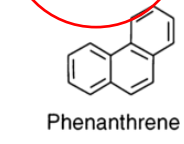
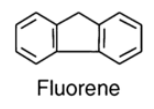
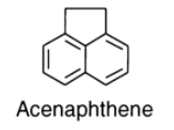
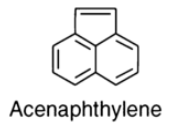
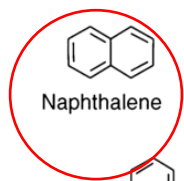
- [www.agaar.mn](http://www.agaar.mn)
- [www.air.ub.gov.mn](http://www.air.ub.gov.mn)
- [www.aqicn.org](http://www.aqicn.org)
- [www.openaq.org](http://www.openaq.org)
- [www.tsag-agaar.mn](http://www.tsag-agaar.mn)
- O<sub>2</sub> mobile app



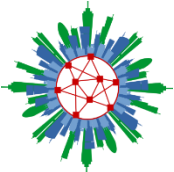
# Polycyclic aromatic hydrocarbons

## PAHs

- 16 of them listed Priority pollutants by USEPA controlled by EU and ECFS
- CARCINOGENIC/MUTAGENIC/TERATOGENIC



Main source Incomplete combustion  
Absorbed on air particulates



# Study goal and objectives

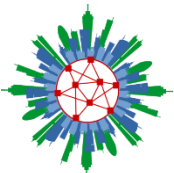
## **AIM of this study:**

To determine particulate PAHs' concentration, distribution and cancer risk assessment in ambient air among Ger districts of Ulaanbaatar

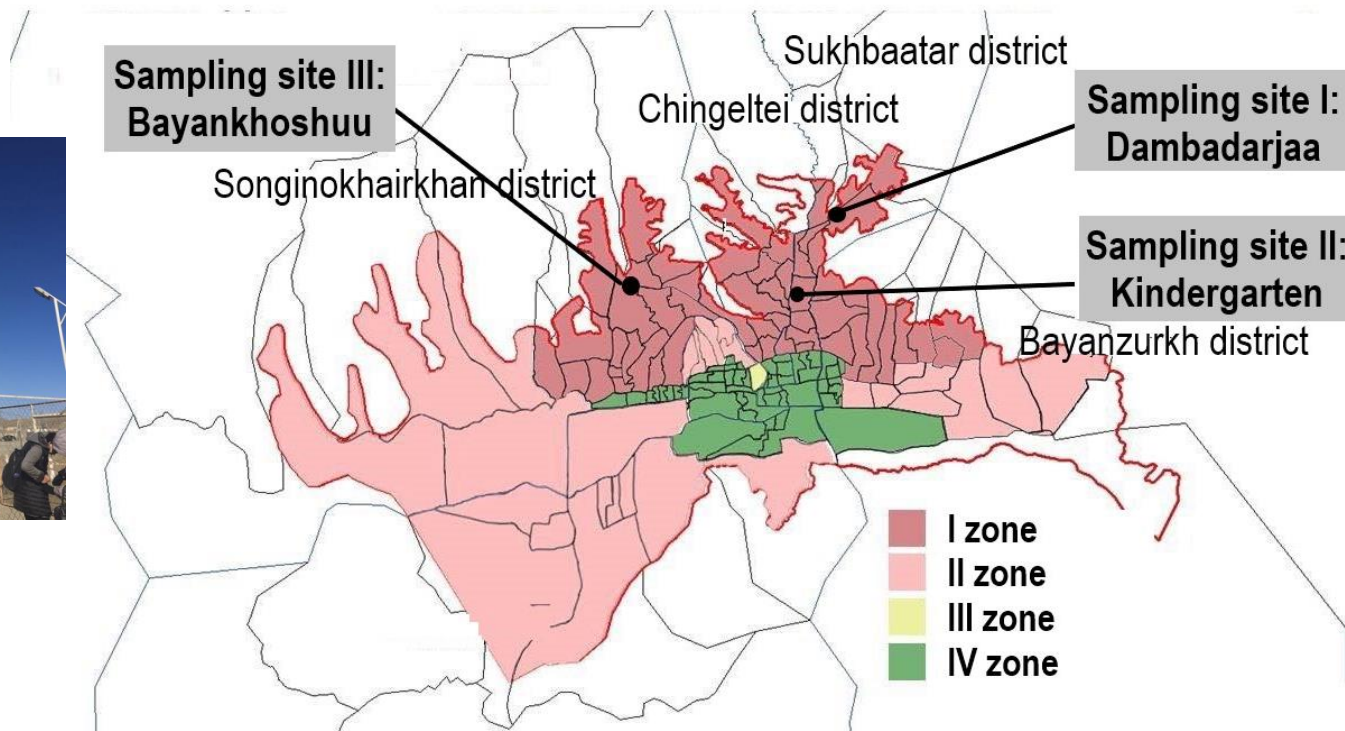
## **Objectives to achieve aim:**

- To develop determination method for the particulate PAHs
- Evaluate pollution level of particulate PAHs
- Calculate source apportionment and cancer risk assessment

# Material and Methods



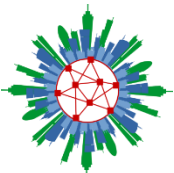
# Sampling sites and techniques of PM 10



Site name	Latitude	Longitude
SI: Dambadarjaa	47°58'54.91"N	106°56'25.84"E
SII: Kindergarten	47°57'14.72"N	106°55'12.61"E
SIII: Bayankhoshuu	47°57'26.88"N	106°49'22.14"E

Feb-March/2019  
24- 72 hour sampling  
Low volume sampler  
FR: 16.7 l/min





# Analysis of PAHs associated with PM 10

## Major steps of Analysis

1

Mass concentration of sampled PM10 :

\* parts per million



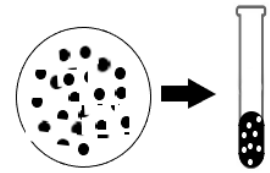
2

Sample treatment:

- Phase extraction
- Pre- Concentration



Instrumental analysis



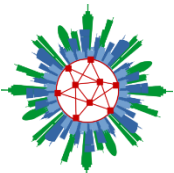
3

Instrumental analysis

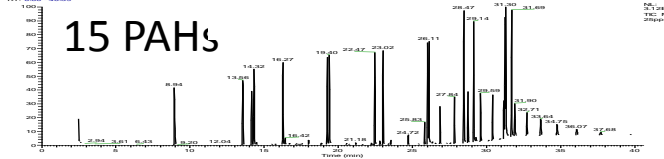


Gas chromatography model	Thermo Fisher Trace 1310
Detector type	Mass spectrometry
Column	30 m × 0.25 mm × 0.25 μm
Oven program	65°C hold 5' / up to 140°C by 25°C/min and hold 5' / up to 325°C by 10°C/min and hold 9' / 41' in total
Carrier gas/flow rate	Argon/ 1 ml/min
Injection mode/volume	Spitless/1μl

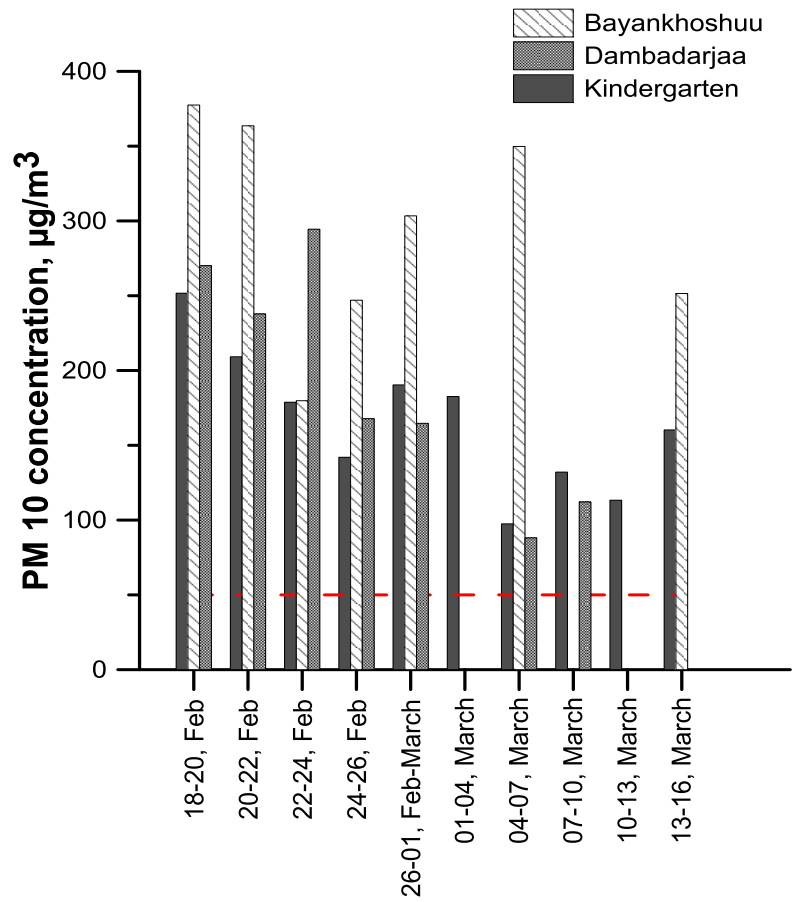
# Results and Discussion



# Pollution level of PM 10 and PAHs

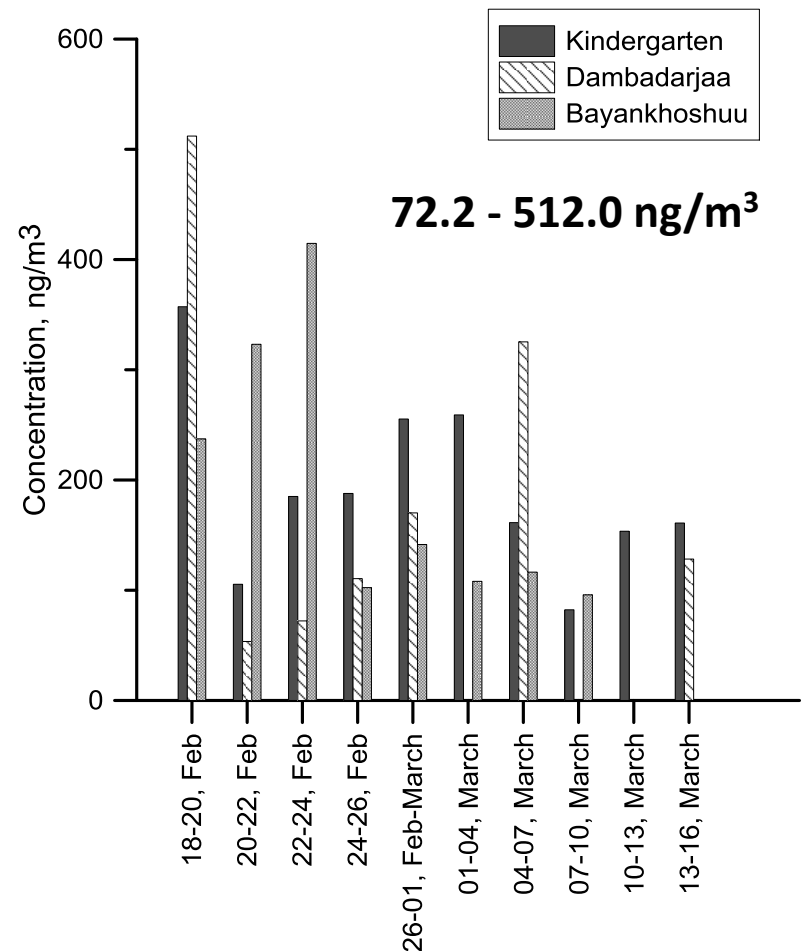


**PM 10 concentration at 3 sites**

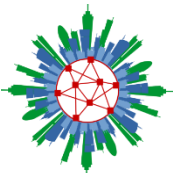


Baynkhoshuu: 179.8 – 377.5 µg/m<sup>3</sup>  
 Dambadarjaa: 88.1 – 294.5 µg/m<sup>3</sup>  
 Kindergarten: 97.5 – 251.7 µg/m<sup>3</sup>

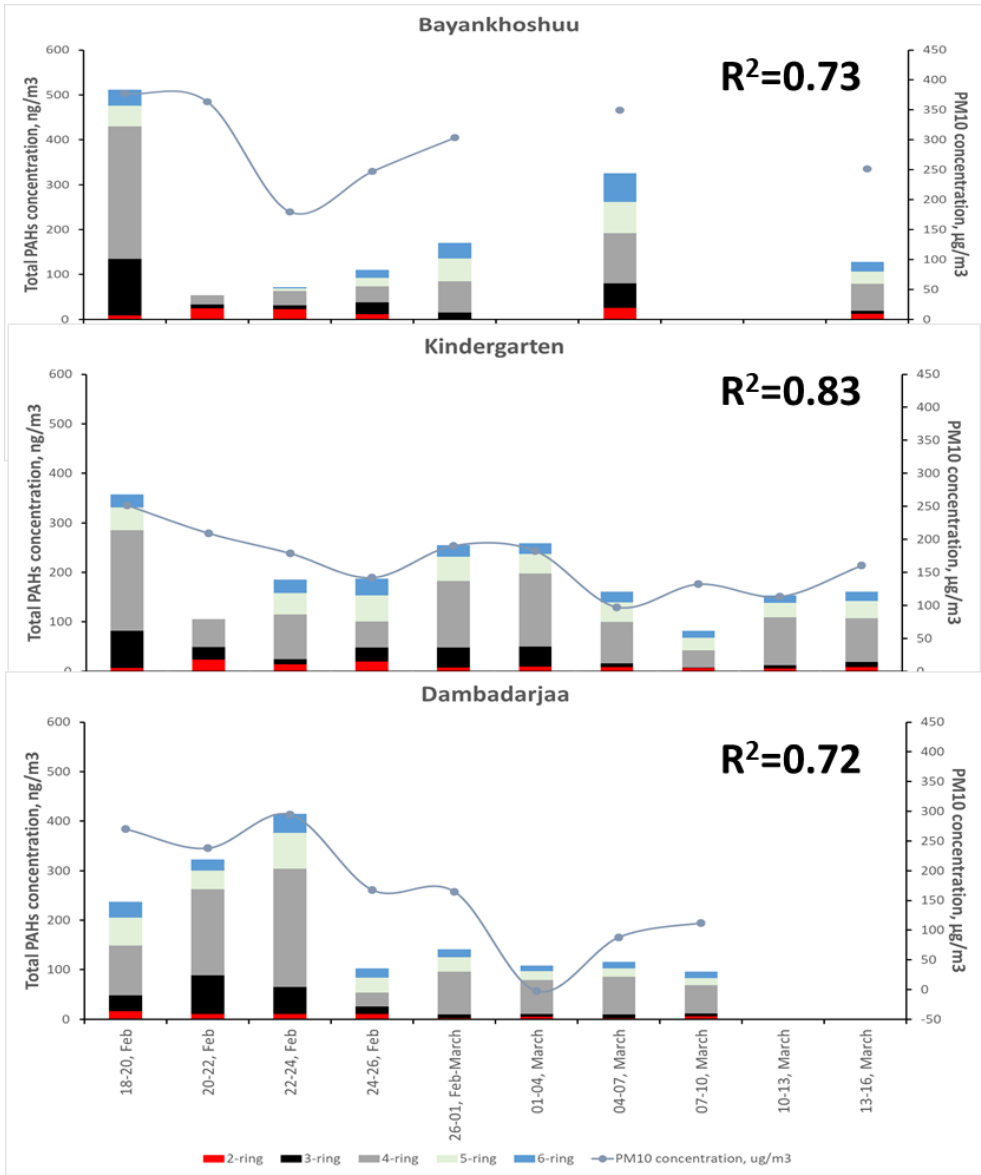
**Total 15 PAHs concentration at 3 sites**



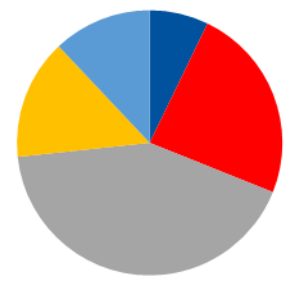
Baynkhoshuu: 179.8 – 377.5 µg/m<sup>3</sup>  
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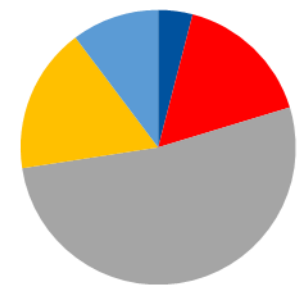
# Distribution of particulate PAHs



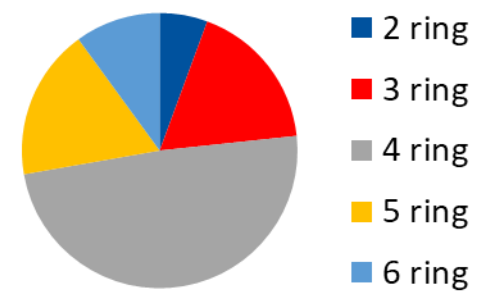
**Bayankhoshuu**

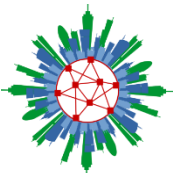


**Dambadarjaa**

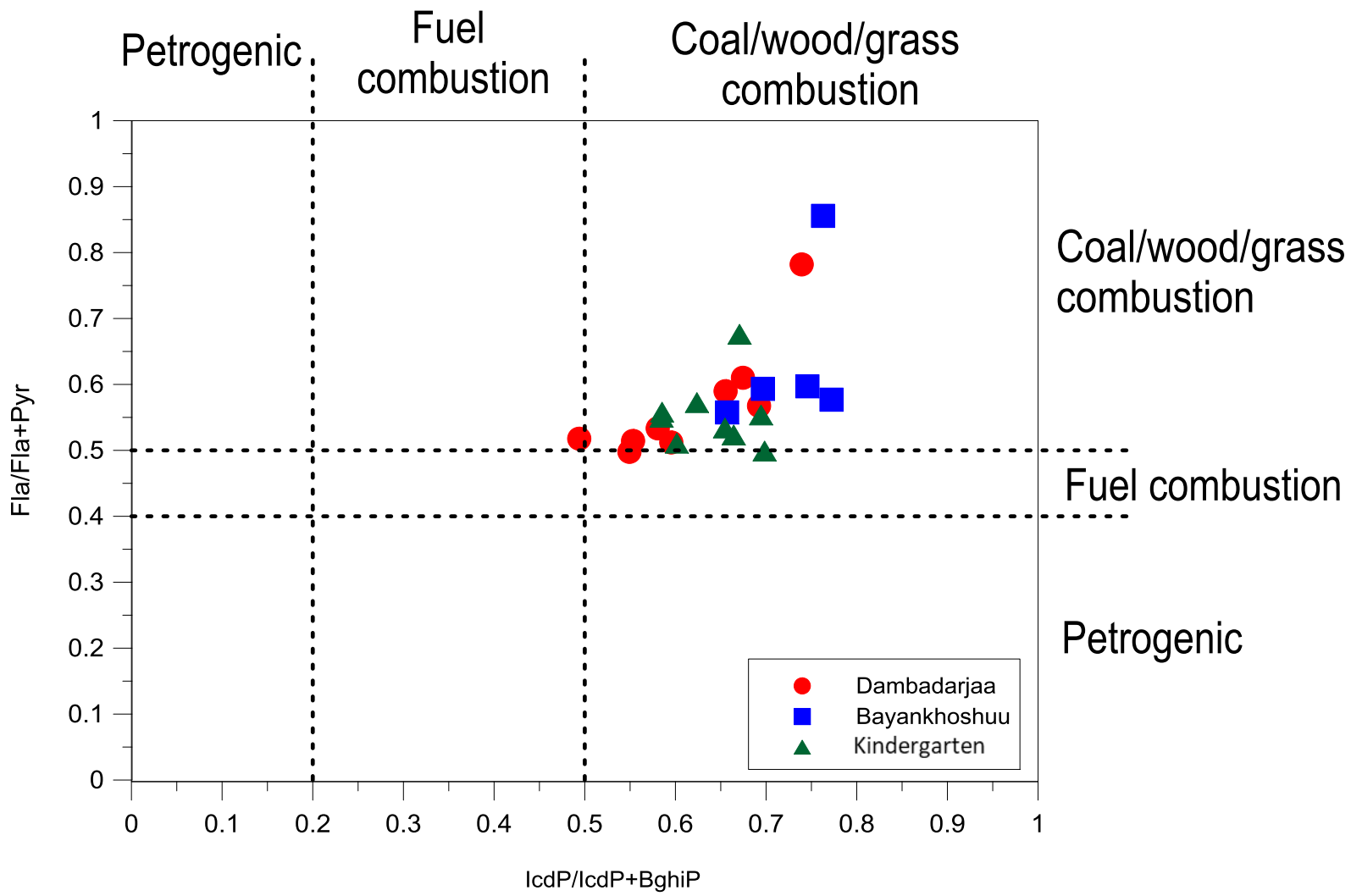


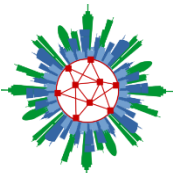
**Kindergarten**



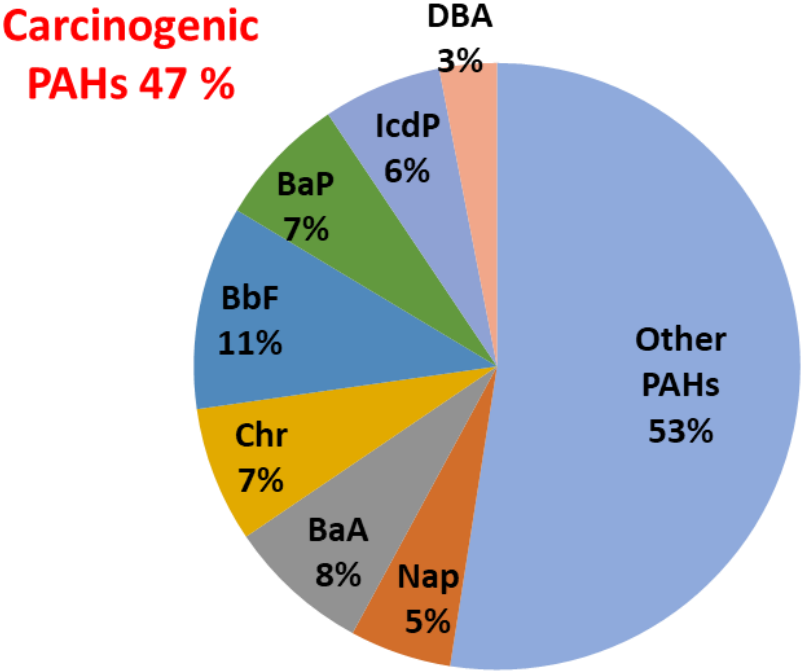


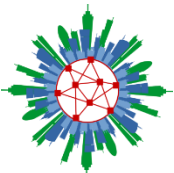
# Source apportionment of PAHs



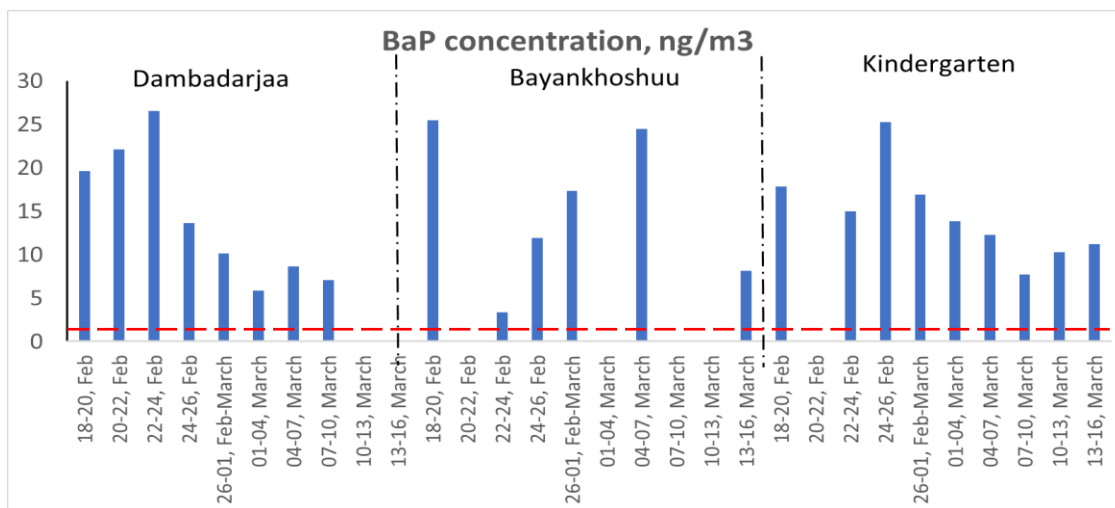


# Carcinogenic PAHs and Cancer risks assessment of PAHs





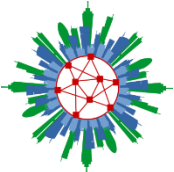
# Carcinogenic PAHs and Cancer risks assessment of PAHs



1 ng/m<sup>3</sup>

Location	BaPeq (ng/m <sup>3</sup> )	Period	Source
Ulaanbaatar, Mongolia	32±17	2019.2-2019.3	This study
Tianjin, China	29.7±15.1	2014.3	Jing et al. 2018
Tianjin, China	38.8±11.3	2008.4 - 2009.1	Shi et al., 2010
Dettenhausen, Germany	2.6	2005.11–2006.3	Bari et al. 2010
Nagasaki, Japan	1.3	1997/1998	Wada et al. 2001
Apin	2.0	1996 оны өвөл	Marino et al. 2000
Bangkok	2.1	2002.11–2003.04	Norramit et al. 2005
Roman	2.5	1996/1997	Menichini et al. 1999
Copenhagen	6.3	1992.01-1992.03	Nielsen et al. 1996

$$BaPeq = \sum (C_i \times TEF_i)$$



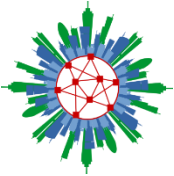
## Conclusion

Identification of 15 PAHs contained in PM10 particles in the regions of the embryos

2019.02.18-2019.03.19 Total PAHs 49 - 439 ng/m<sup>3</sup>

- For internal distribution PAHs, 4 and 5 ringed PAHs were dominant in the samples and they can have coal and biomass combustion sources according to source apportionment by PAHs ratios.
- Carcinogenic PAHs is making up almost half of total PAHs (47%) and the cancer risk factor was estimated that in range of of  $32 \pm 17$
- Carcinogen causing benzo[a]pyrene was exceeded by 3.3 – 26 times compared with the national standard 1 ng/m<sup>3</sup>
- In the future, this study will be useful in assessing the effects of air pollution as well as the effectiveness of measures to mitigate environmental pollution, as it relates to several locations in Ulaanbaatar.





# Thank you for your attention

## **Acknowledgement**

*„This project has been carried out in cooperation with the Advisory Assistance Programme for environmental protection in the countries of Central and Eastern Europe, a program of the German Federal Ministry for Environment, Nature Conservation, Building and Nuclear Safety.“*

- *Stuttgart University, Prof Günter Baumbach & Prof. Ulrich Vogt*
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- *Institute of Chemistry and Chemical Technology, MAS*
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- *CLEM, Mr. Barkhasragchaa, Mr. Tumendemberel*
- *Municipal AAAQ, Dr. Tsatsral , Ms. Sanchirbayar, Ms. Narmandakh*



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