

Information on Ambient Air Quality Monitoring Activities in INDONESIA

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INTRODUCTION



1. Indonesia is the largest archipelago in the world with a population of about 250 million. It consists of five major islands (Sumatera, Jawa, Kalimantan, Sulawesi, and Papua) and about 17.000 island. The archipelago is on a crossroad between two oceans, the Pacific and the Indian, and bridges two continents, Asia and Australia. The Capital city is: Jakarta

2. Air pollution is the chronic problem in main city in Indonesia like Jakarta city since 1990 (Word Bank, JICA etc)
3. ASEAN city of Air pollution (comparing between Asean City)

AMBIENT AIR QUALITY BETWEEN ASEAN CITIES

Country	City	PM-10	SO ₂	NO ₂	O ₃
		($\mu\text{g}/\text{m}^3$)	($\mu\text{g}/\text{m}^3$)	($\mu\text{g}/\text{m}^3$)	($\mu\text{g}/\text{m}^3$)
Indonesia	Jakarta (2011)	58.7	18.4	41	54.06
Malaysia	Kuala Lumpur (1997)	55	25	45	0.014 (ppm)
Philippines	Manila (2003)	46.9	35	30	
Singapore	Singapore(1998)		20	30	
Thailand	Bangkok (2011)	34.5	11	21.5	7.3

Back Ground of

- Air Quality Monitoring in Indonesia:
 - Act No. 32/ 2009, regarding to protection and management of environment.
 - Mandates dissemination of information of the quality of the environment to the public (Article 65, paragraph 2: Everyone is entitled to access environmental information, education, access to participation and access to justice in fulfilling the right to good environment and healthy)
 - National Ambient Air Quality Standards published as an appendix in Governmental Decree No.41/1999
 - NAAQS regulated SO₂, NO₂, O₃, CO, particulate matters, Hydrocarbons, Lead
 - Particulate matters AAQS consist of TSP, PM-10 and PM-2.5
 - International cooperation in the framework of:
 - Acid deposition monitoring (EANET)/APEC
 - Persistent Organic Pollutants (POP'S)/ UNU-United Nation University
 - Heavy Metal component in Ambient Air/ (RCA-IAEA)/Regional Cooperation Agreement)
- Management of environmental should be supported by data monitoring results are valid and scientifically reliable.

The monitoring activities in Indonesia consist of:

- Monitoring of ambient air by automatic system at 10 cities.
 - Sulfur Dioxide (SO₂), Nitrogen Dioxide (NO₂), Particulate Matter – 10 um (PM-10), Ozone (O₃) and Carbon Monoxide (CO).
 - Wind speed, wind direction, temperature, relative humidity and global radiation
- Monitoring of ambient air by passive system at 288 Province and local cities.
 - Sulfur Dioxide (SO₂), Nitrogen Dioxide (NO₂).
- Monitoring of acid deposition (wet, dry and inland aquatic)
- Monitoring of Poly Aromatic Hydrocarbon (PAH) in the ambient air by passive sampler.
- Monitoring of heavy metal in ambient air by Gent Sampler and X-Ray Fluorescence

INTEGRATED SYSTEM OF AMBIENT AIR QUALITY IN 10 CITIES BY AUTOMATICALLY (AQMS)

ON-LINE MONITORING FOR 10 MAJOR CITIES IN THE REPUBLIC OF INDONESIA



Fix Station

Mobile Station

Display ISPU

Regional/Main Center



Local Level:

3 fixed monitoring stations (FMS)
1 mobile monitoring station (MMS)
3 data displays (DD)

Local Level:

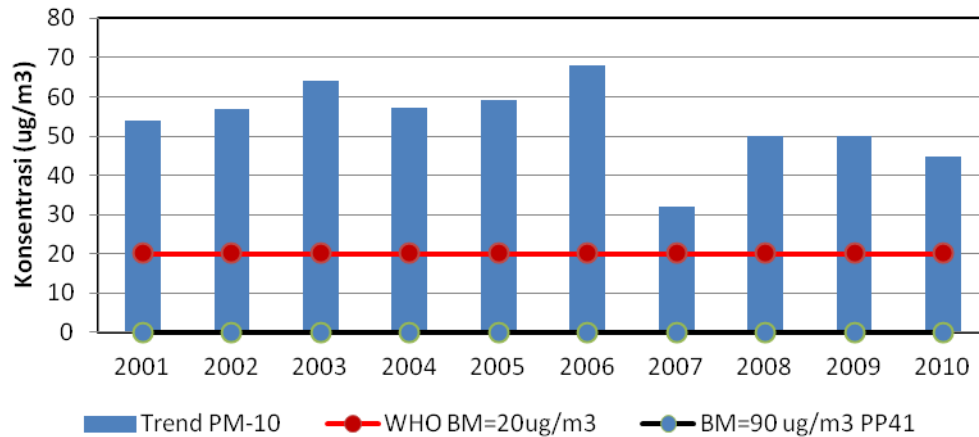
5 fixed monitoring stations (FMS)
1 mobile monitoring station (MMS)
5 data displays (DD)

Quality Control/Quality Assurance

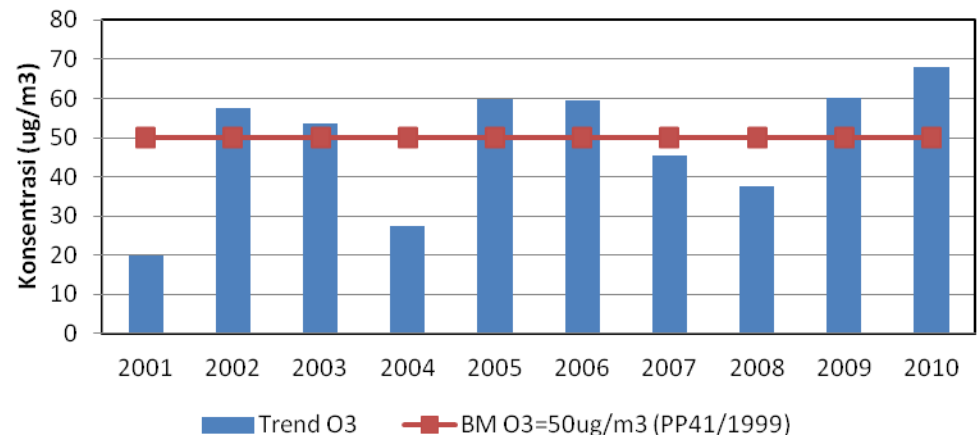
- Pusarpedal–Ministry of Environment prepared standard operational procedure (SOP) for each monitoring instrument
- Calibration System
- Data management by: Automatic data processing system

Annually Monitoring Result (PM-10 and Ozone) VS WHO Standard

Trend annual average PM-10 concentration (2001-2010)
DKI Jakarta

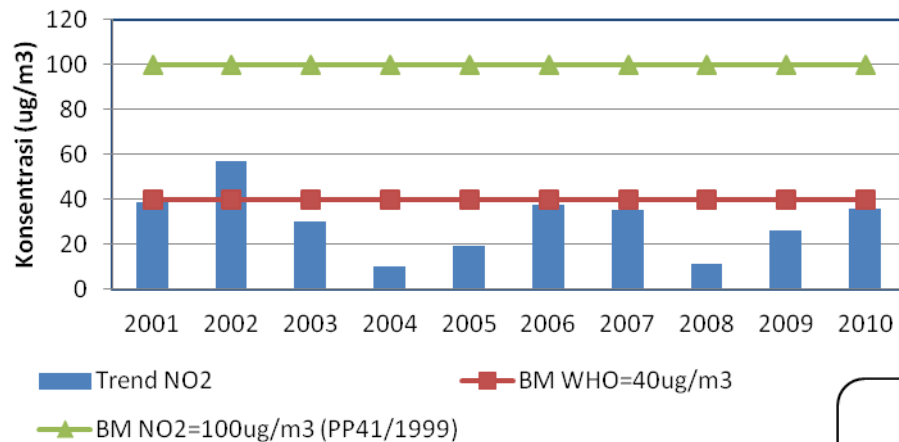


Trend annual average O3 concentration (2001-2010)
DKI Jakarta

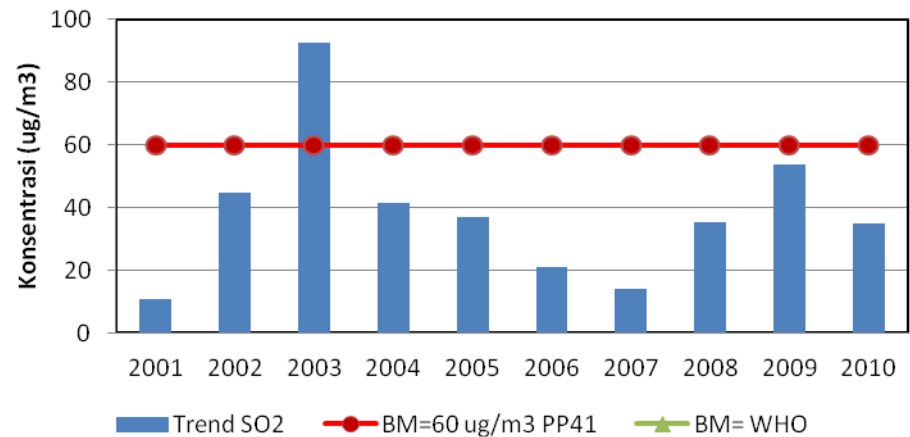


Annually Monitoring Result (NO2 and SO2) VS WHO Standard

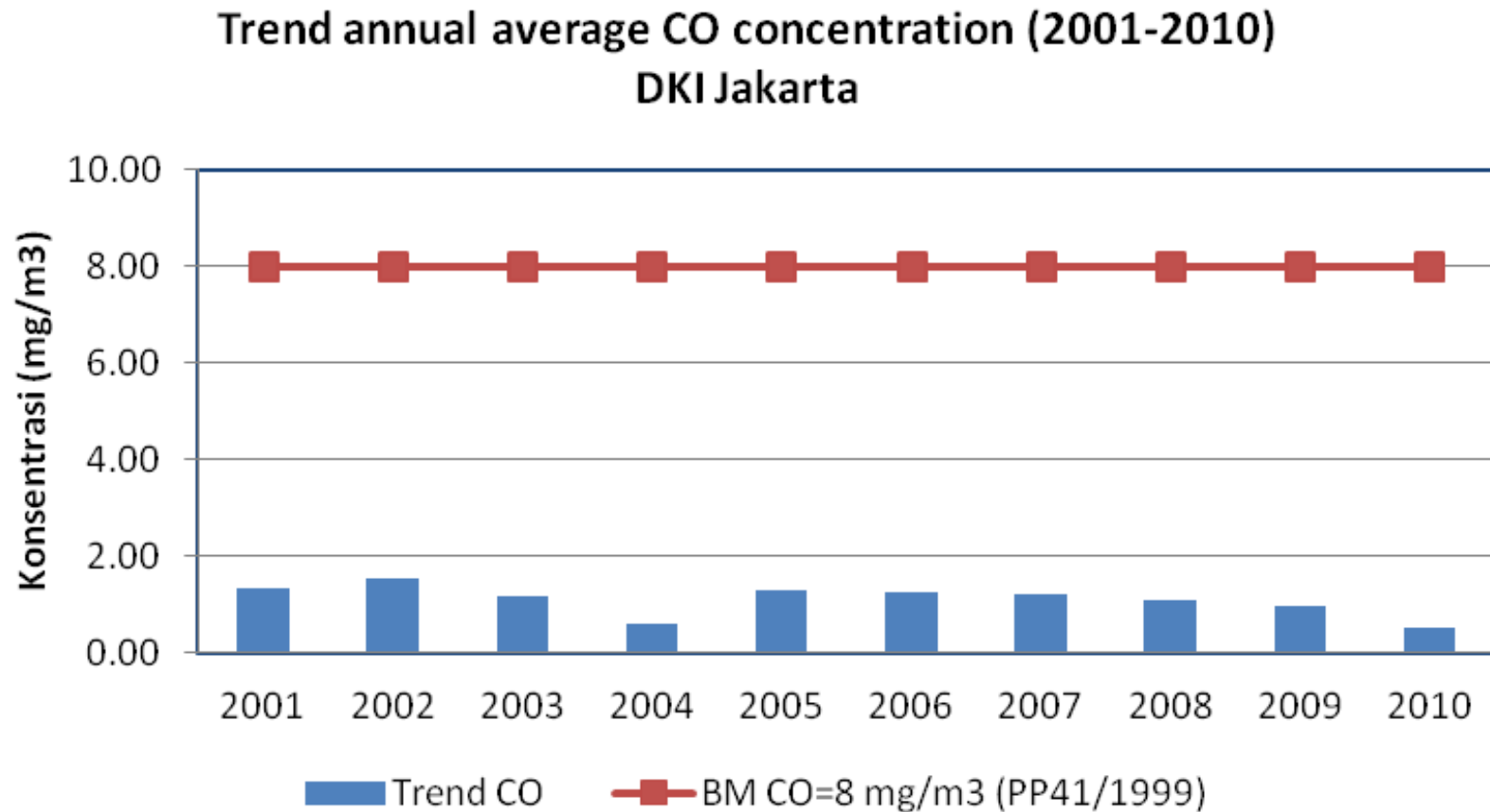
Trend annual average NO2 concentration (2001-2010)
DKI Jakarta



Trend annual average SO2 concentration (2001-2010)
DKI Jakarta



Annually Monitoring Result (CO) VS WHO Standard



Passive Monitoring

- Parameter: Sulfur Dioxide (SO_2) and Nitrogen Dioxide (NO_2)
- Sampling location: 288 location (Province, regencies and Cities)
- Sampling point:
 - Transportation
 - Industry
 - Residential
 - Commercial/Office

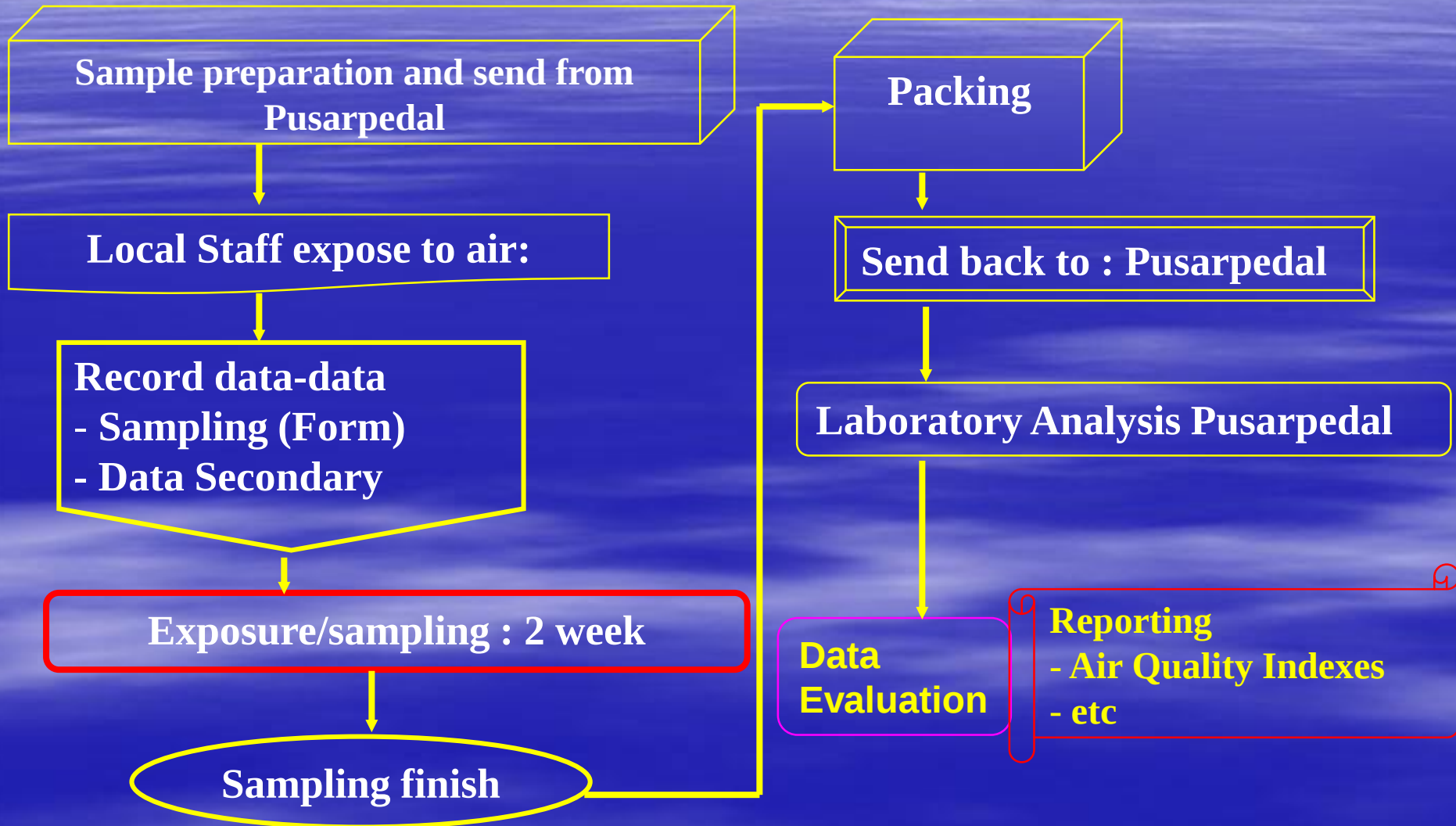
Ambient Air Quality Monitoring Network (Passive Method)



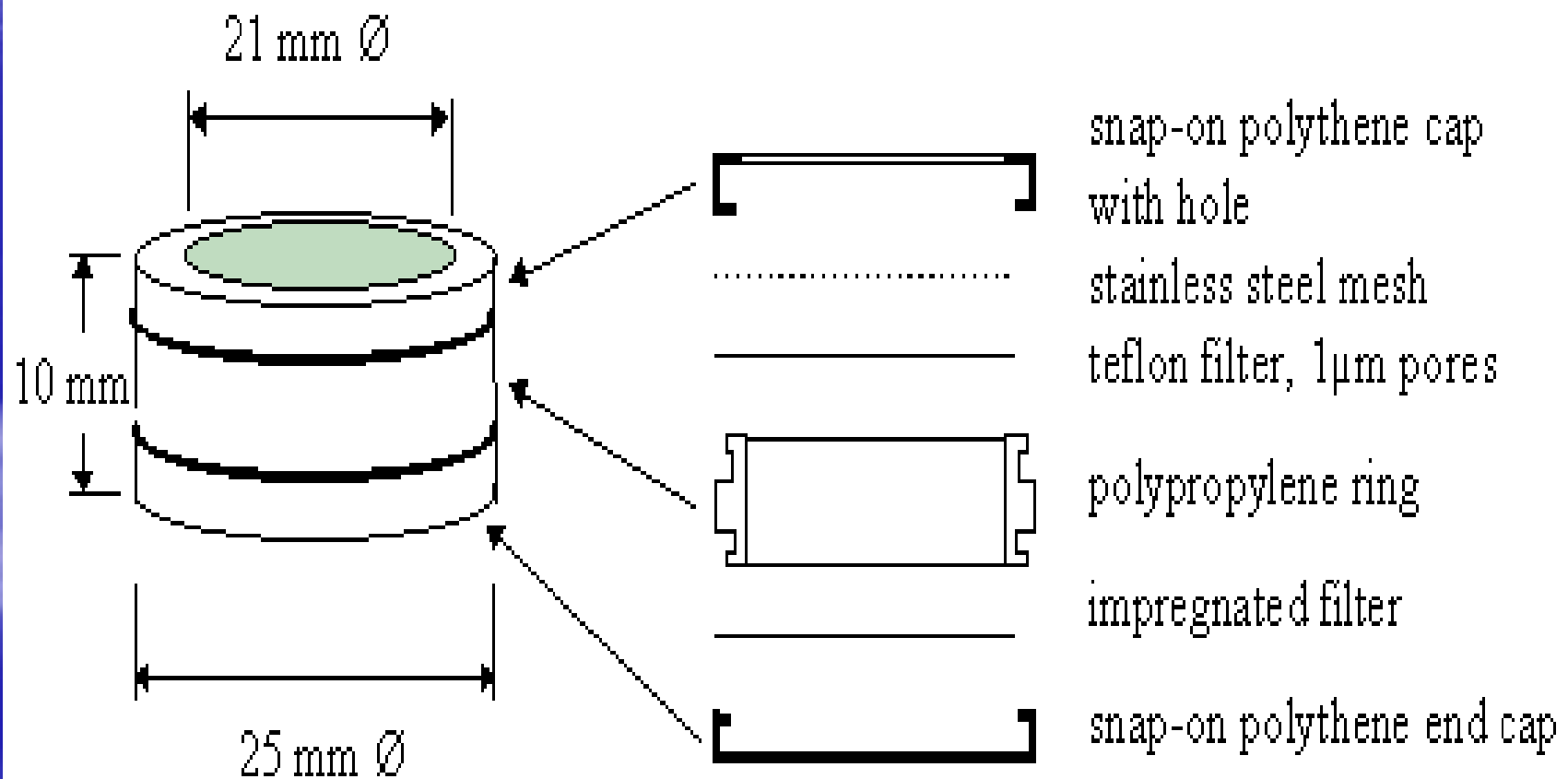
- Sampling Location:
1. Residential
 2. Industry
 3. Transportation
 4. Commercial



Monitoring Implementation Mechanism:



C-SIRO (AUSTRALIA) PASSIVE SAMPLER APPLIED IN THIS MONITORING ACTIVITIES



PASSIVE SAMPLER IN THE FIELD

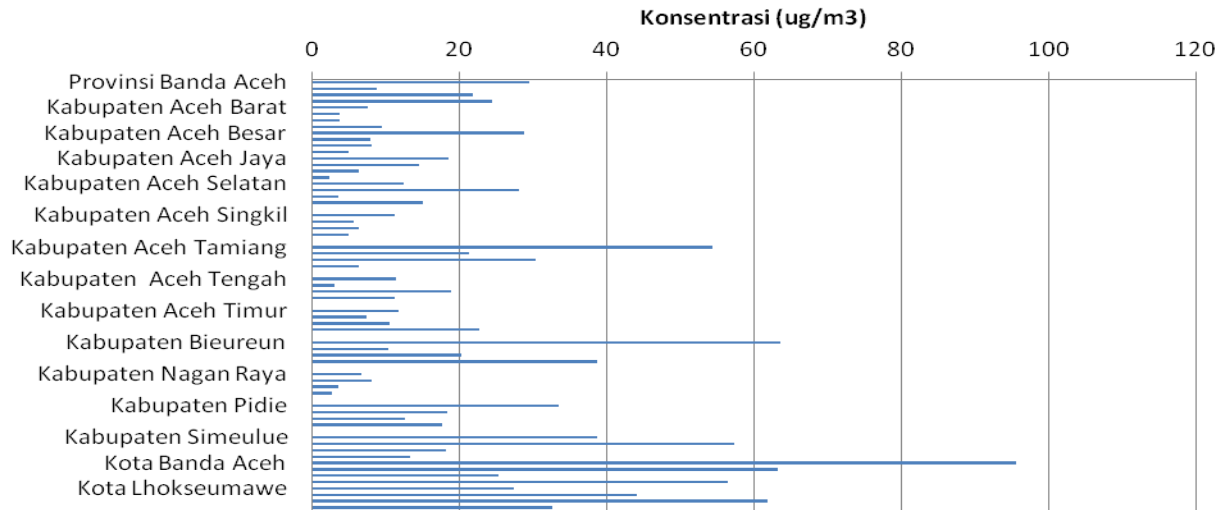


Quality Control/Quality Assurance

- Pusarpedal–Ministry of Environment prepared:
 - Prepare Standard Operational Procedure (SOP) including field form
 - Technical guidance on sampling and analysis
 - Laboratory analysis: standard calibration
 - Preparation for blank (transportation blank)
 - Conducting data management to be used in support of decision making
- Local government carry out :
 - Sampling (Sample expose to air)
 - Field Data collection
 - Send back sample to Pusarpedal

Example: Monitoring Result 2011

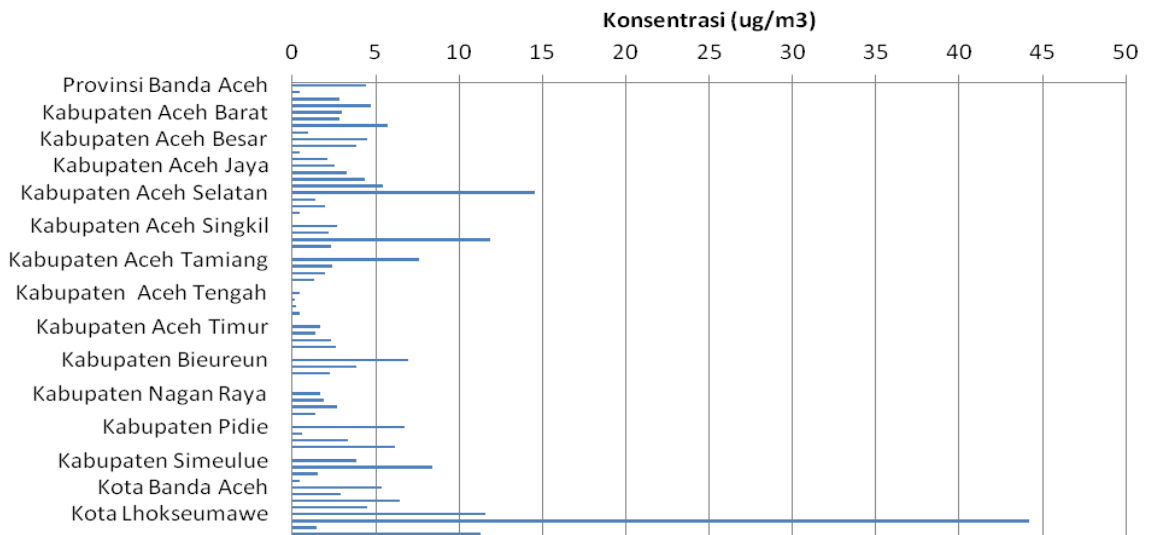
Konsentrasi NO2 di Prov. Aceh Tahun 2011



Air Quality Standard
NO2 Govn Reg PP.
No.41/1999 (100
ug/m³)
BM WHO: 40
ug/m³)

Air Quality Standard SO2
(Annually) Govn Reg: PP.
No.41/1999 (60 ug/m³)
sudah mendekati nilai BM
tersebut

Konsentrasi SO2 di Prov. Aceh Tahun 2011



PASSIVE AIR SAMPLER FOR PAH

EMC



Activities

- Cooperation UNU and AMETEX (APEC Marine Environmental Training and Education center) to monitor POPs/PAH in ambient air
- *Passive Air Sampling (PAS) with Poly Urethane Foam (PUF)*
- Monitoring stations of PAH is: Jakarta (Urban), Serpong (Rural)

Quality Control/Quality Assurance

- Pusarpedal–Ministry of Environment carry out:
 - Sampling (Sample expose to air)
 - Field Data collection
 - Send back sample to Ametec Korea for analysis
- Ametec prepared:
 - Prepare Standard Operational Procedure (SOP) including field form
 - Technical guidance on sampling and analysis
 - Laboratory analysis: standard calibration
 - Preparation for blank (transportation blank)
 - Conducting data management to be used in support of decision making

Upper and lower bowls
are joined by a hinge
on one side

PUF disk

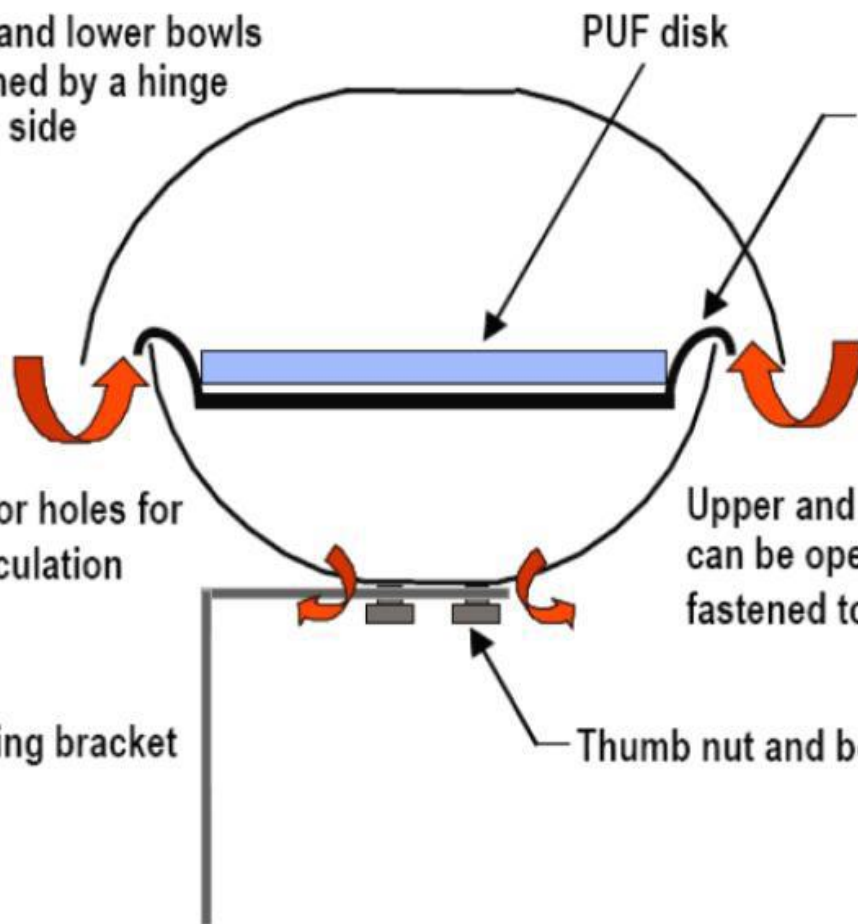
Stainless steel
support bracket

Gaps or holes for
air circulation

Upper and lower bowls
can be opened up or
fastened together with **cotter pin**

Mounting bracket

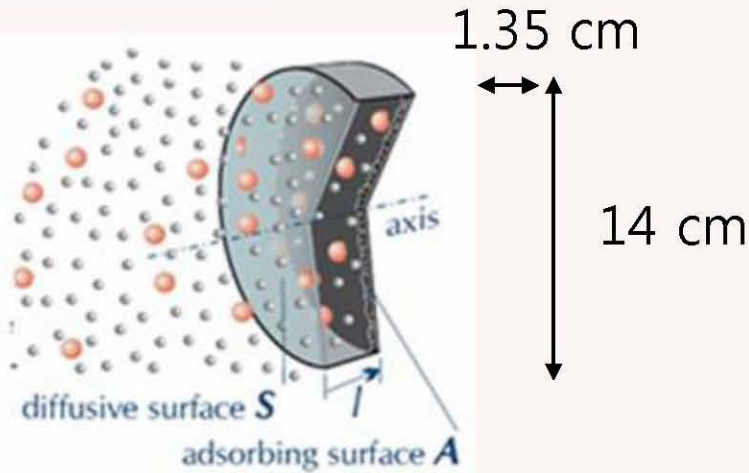
Thumb nut and bolt





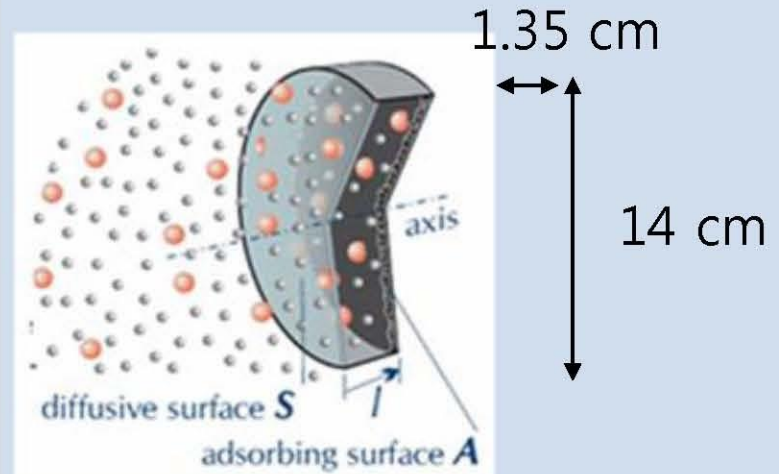
Polyurethane foam (PUF) disk

Harner type



- Diameter: 14 cm
- Thickness: 1.35 cm
- Surface area: 365 cm²
- Volume: 207 cm³
- Effective thickness: 0.567 cm
- Mass: 4.40 g
- Density: 0.0213 g/cm³

AMETEC



- Diameter: 14 cm
- Thickness: 1.35 cm
- Surface area: 367 cm²
- Volume: 208 cm³
- Effective thickness: 0.566 cm
- Mass: 6.08 g
- Density: 0.0293 g/cm³

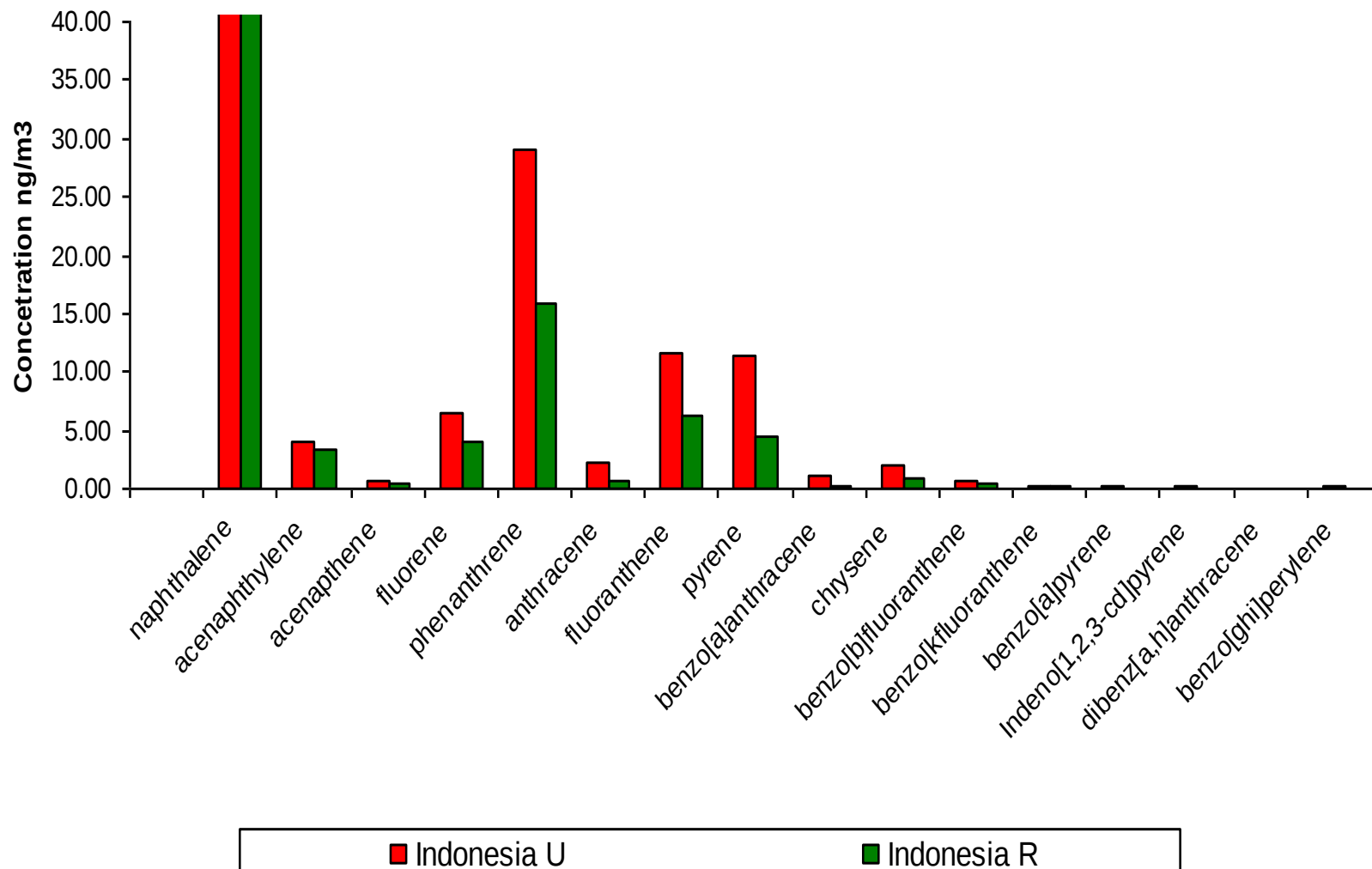
Implementation

- *Precleaned* PUF by KORDI trace organik laboratory
- Store PUF in frezeer before sampling (Pusarpedal).
- Expose to air 1 (one) month, (Pusarpedal (Background) and BPLHD Jakarta-Urban)
- Measure meteorology
- PUF sample already exposed 1 month collect and pack stainless steel
- Send to Korea for analysis (freezer)

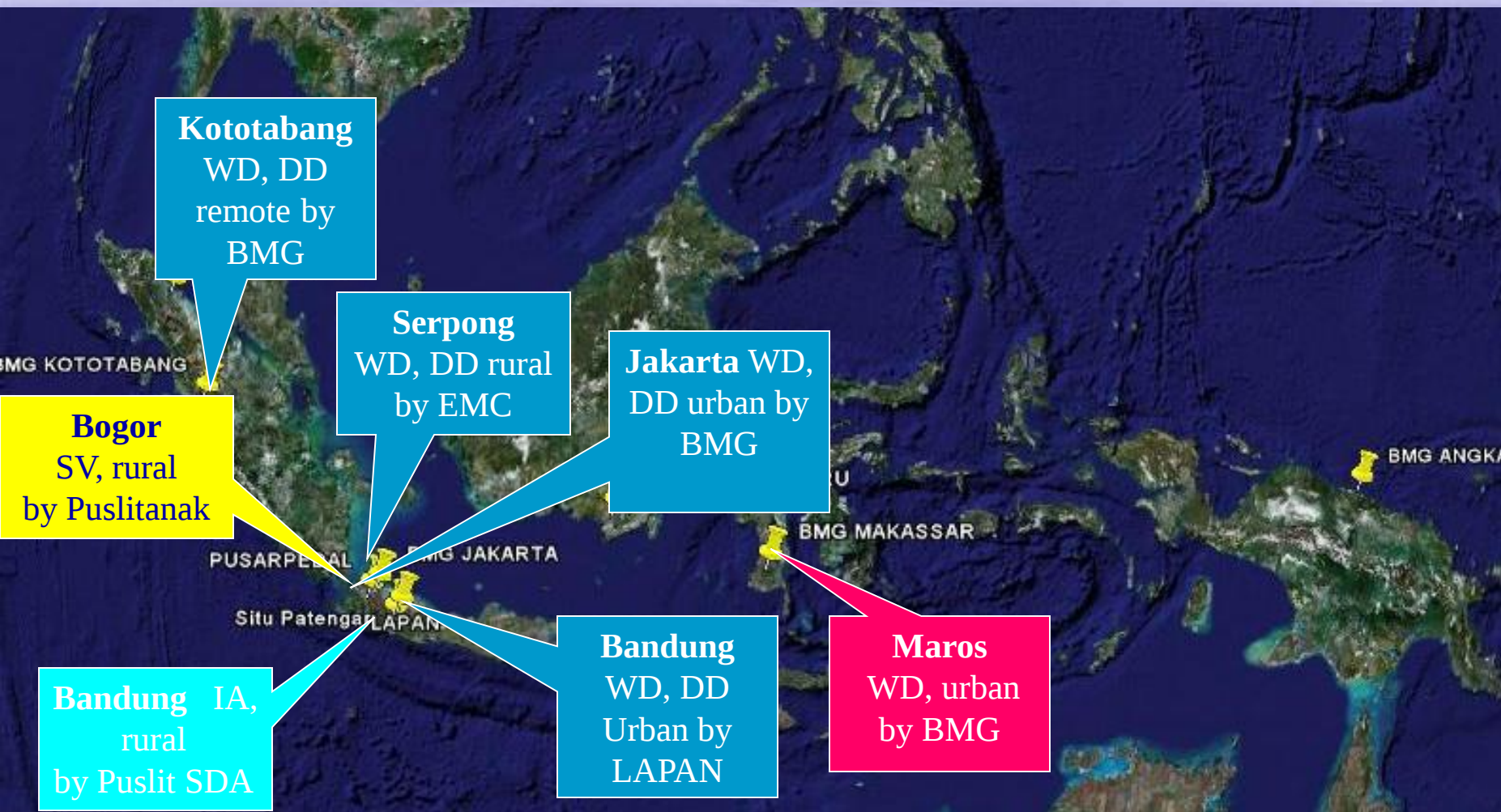
Continue'.....

- Prevent contamination PUF from the finger by used stainless steel pinset
- Sampler PUF exposed send to trace organik laboratory KORDI for analysis and parameter analysis PAH
- Conduct analysis by GCMS
- Canclute PAH concentration in the air

Analysis result of PAHs in ambient air at EMC(Serpong Rural) and BPLHD (Jakarta-Urban) 2010



Deposition Monitoring Sites



Acid Deposition Monitoring Activities

Acid deposition monitoring was conducted on:

- 1. Wet deposition in Serpong and Sukabumi;*
- 2. Dry deposition in Serpong, Jakarta, Bogor, Bandung, Maros and Kototabang*
- 3. Surface water in Situ Gunung Patengan Bandung and Sukabumi,*
- 4. Soil and vegetation in the Forest Research Dramaga Bogor.*
- 5. There has also been carried out activities of inter laboratory comparison*

Monitoring Site and Instrument

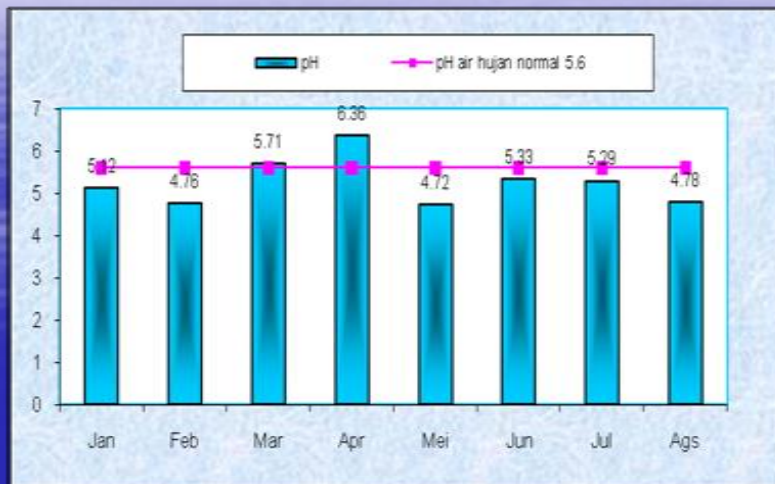


Monitoring Site in Indonesia (Jakarta)

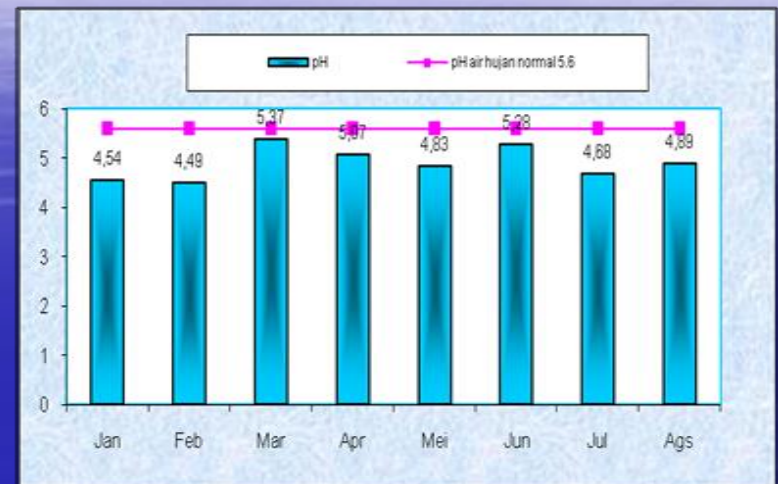
Sampling sites



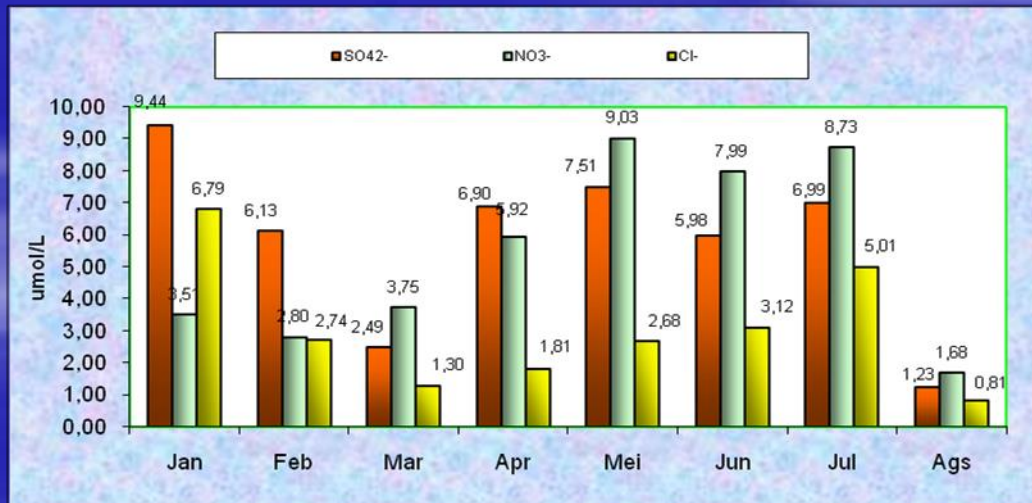
Monitoring result



pH rain water Serpong 2010



pH rain water Serpong 2011



Concentration of Anion rain water Serpong 2011

Summary Monitoring Result 2011

Acid Deposition

- Acid deposition monitoring activities in Serpong in 2011 can be concluded:
 - pH of rain water ranged from 4.49 to 5.37;
 - Total precipitation ranges from 4–363 mm,
 - EC from 0.10 to 0.63 mS / m.
 - Lowest levels of anions and cations in March with the highest rainfall of 363 mm.
 - Ammonia concentration (NH_3) in dry deposition in Serpong, Jakarta, Bogor, Bandung, Kototabang and Maros still higher than other gases like: SO_2 , HNO_3 and HCl .

Monitoring of Heavy metal in ambient air (Coarse and fine particle)

- Parameter to be monitored:

Sodium (Na)	Magnesium (Mg)	Aluminium (Al)	Phosphorus (P)	Sulfur (S)
Potassium (K)	Calcium (Ca)	Scandium (Sc)	Titanium (Ti)	Vanadium (V)
Manganese (Mn)	Ferrum (Fe)	Cobalt (Co)	Nickel (Ni)	Copper (Cu)
Gallium (Ga)	Germanium (Ge)	Arsenic (As)	Selenium (Se)	Bromine (Br)
Strontium (Sr)	Yttrium (Y)	Zirconium (Zr)	Niobium (Nb)	Molybdenum (Mo)
Barium (Ba)	Mercury (Hg)	Lead (Pb)	Chloride (Cl)	Chromium (Cr)
Zinc (Zn)	Rubidium (Rb)	Iodine (I)		

Gent sampler

Stacked filter unit consists of a holder for two sequential Nuclepore filters. Sampler was operated at rate 15 – 17 L/min

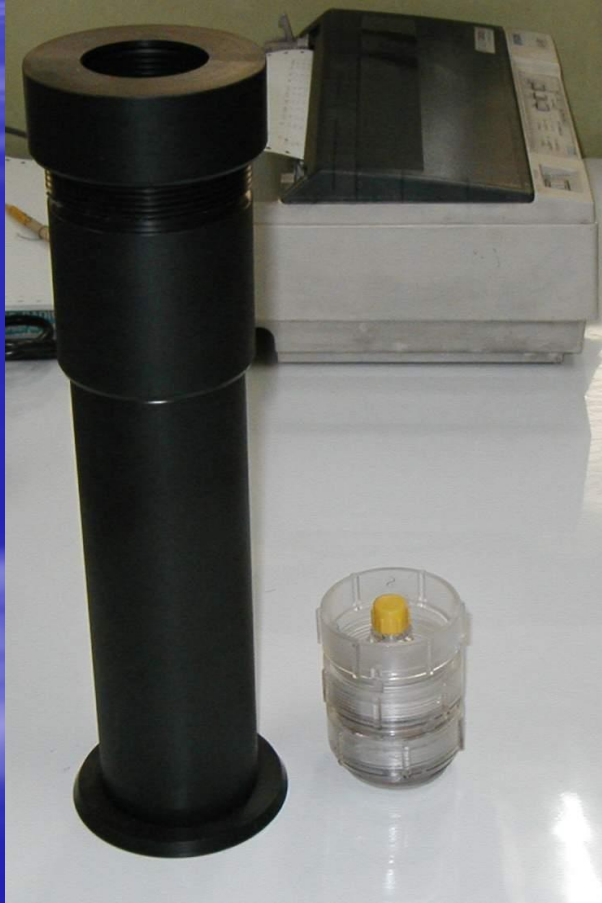


Vaccum pomp of sampler



Black container

Gent sampling head and exposed filters

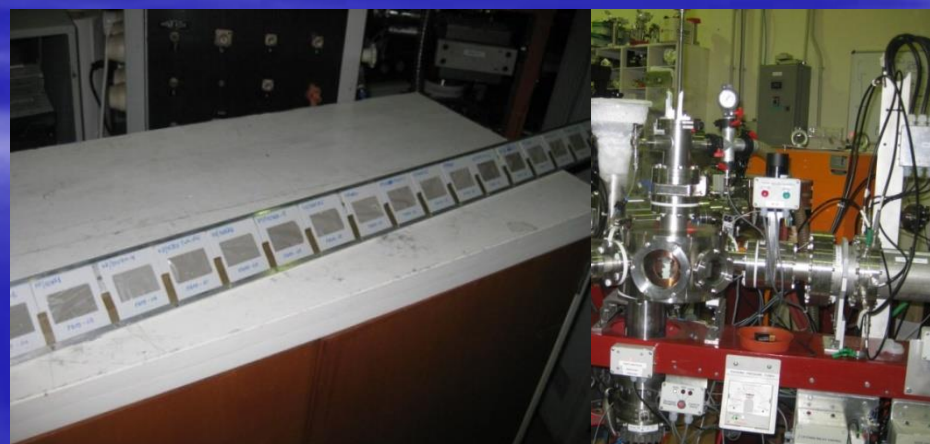


Elemental analysis



- The particulate matter mass of each fine fractions was determined by gravimetric.
- The concentration of black carbon (BC) in the samples was determined by reflectance measurement using an EEL model 43D Smoke Stain Reflectometer

- Sample filters were put in sample changer (each 20 filters) for measurement in PIXE, Ion beam analysis facility in New Zealand



Analysis Airborne Particulate Matter



Sampling Udara
(Gent Stacked
Filter Sampler)



Measurement PM



Black carbon Measurement

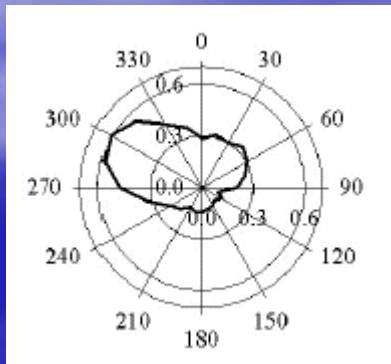


Sample Preparation /Standard

data

$$x_j = \sum_{k=1}^p g_k f_{kj} + e_j$$

$$X = GF^t + E$$



Analysis

Receptor Model

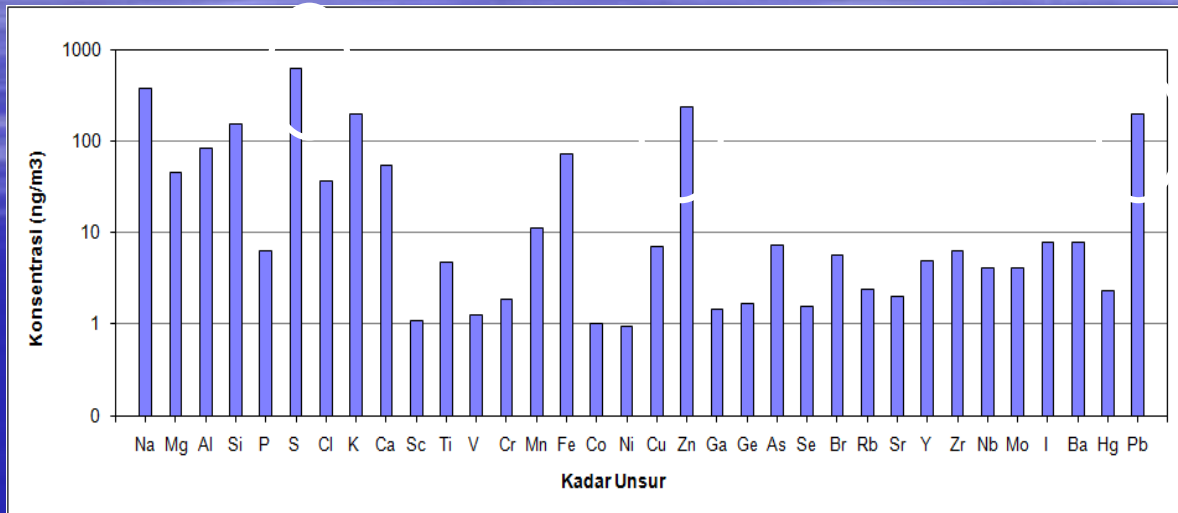
Measurement



AAN

Iradiasi dan Counting

Example: Monitoring result elemental concentration measurement by PIXE

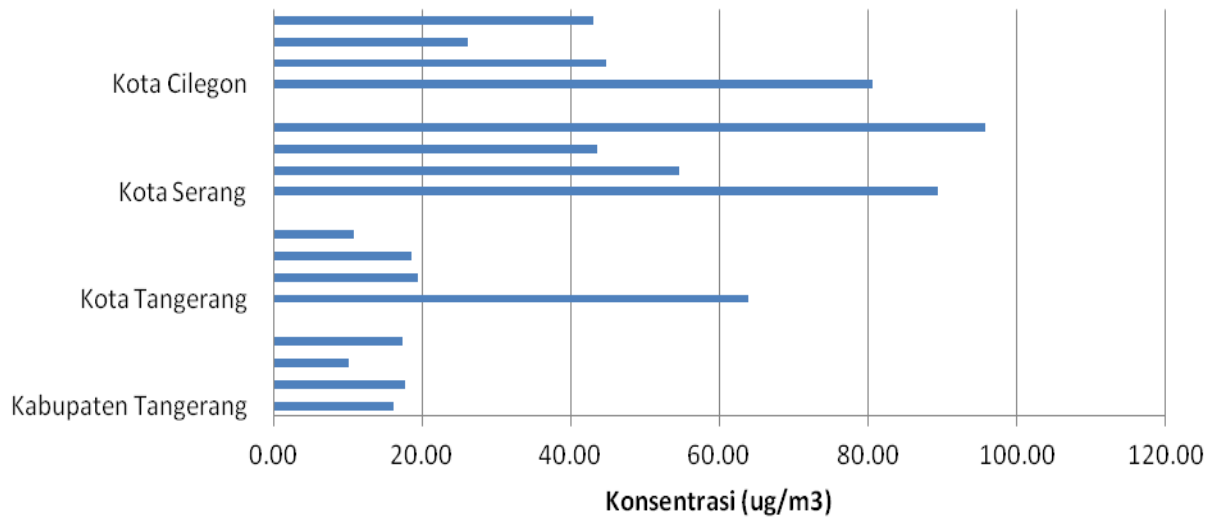


	Fine particulate matter			Coarse particulate matter		
	Mean	Stddev	Max	Mean	Stddev	Max
Na	379.12	183.35	2057.8	631.03	333.45	3328.2
Mg	45.67	18.93	184.3	111.36	96.38	1103.5
Al	83.17	76.82	887.5	565.30	868.63	9704.6
Si	154.35	155.89	1751.7	1356.17	1944.30	21586.7
P	6.22	9.09	85.8	33.44	25.11	268.6
S	631.91	368.92	4024.4	283.50	189.83	1992.7
Cl	36.97	57.40	547.9	324.11	271.90	1586.1
K	197.87	114.06	1193.0	185.09	127.23	1412.7
Ca	54.02	42.32	424.7	659.53	532.89	5648.7
Sc	1.07	1.53	5.5	5.35	6.99	72.0
Ti	4.76	6.74	69.1	58.46	82.29	911.3
V	1.23	1.69	12.8	1.80	2.54	21.9
Cr	1.88	2.13	18.7	4.48	8.51	84.9
Mn	11.33	23.89	255.4	29.55	45.65	377.6
Fe	72.39	77.50	849.0	667.69	1067.41	11909.0
Co	1.01	1.56	8.8	0.88	1.96	9.3
Ni	0.96	1.08	4.7	1.85	3.93	40.9
Cu	7.04	6.97	37.7	10.99	8.07	60.4
Zn	235.47	279.00	2128.9	285.34	336.04	2602.9
Ga	1.45	4.36	44.8	1.22	2.64	13.6
Ge	1.68	2.66	13.5	3.19	4.40	20.4
As	7.23	11.49	81.1	4.74	8.12	47.1
Se	1.54	3.29	14.8	1.57	2.85	10.9
Br	5.68	7.54	45.8	4.93	9.04	80.0
Rb	2.39	5.77	27.1	2.04	5.66	27.0
Sr	1.98	5.64	26.5	3.94	9.23	41.4
Y	4.87	18.86	187.6	2.34	7.38	38.3
Zr	6.22	12.71	54.2	9.94	20.51	149.7
Nb	4.05	11.19	42.1	3.81	18.40	179.0
Mo	4.11	14.56	84.2	7.07	19.28	94.6
I	7.74	12.49	105.2	3.74	10.01	70.2
Ba	7.76	9.76	55.4	8.23	10.17	38.2
Hg	2.30	4.91	18.6	2.77	5.51	21.8
Pb	197.05	456.80	3303.9	122.23	362.78	3066.6

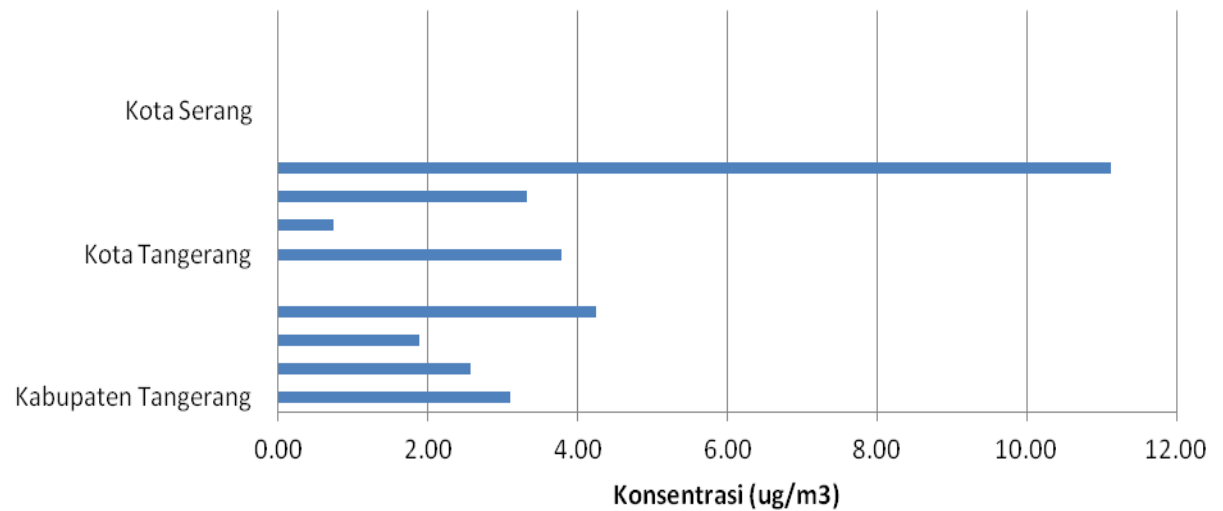
In general Lead concentration relative high, with average concentration 122, and maximum ~3000 ng/m³

Thank you very much for your kind attentions

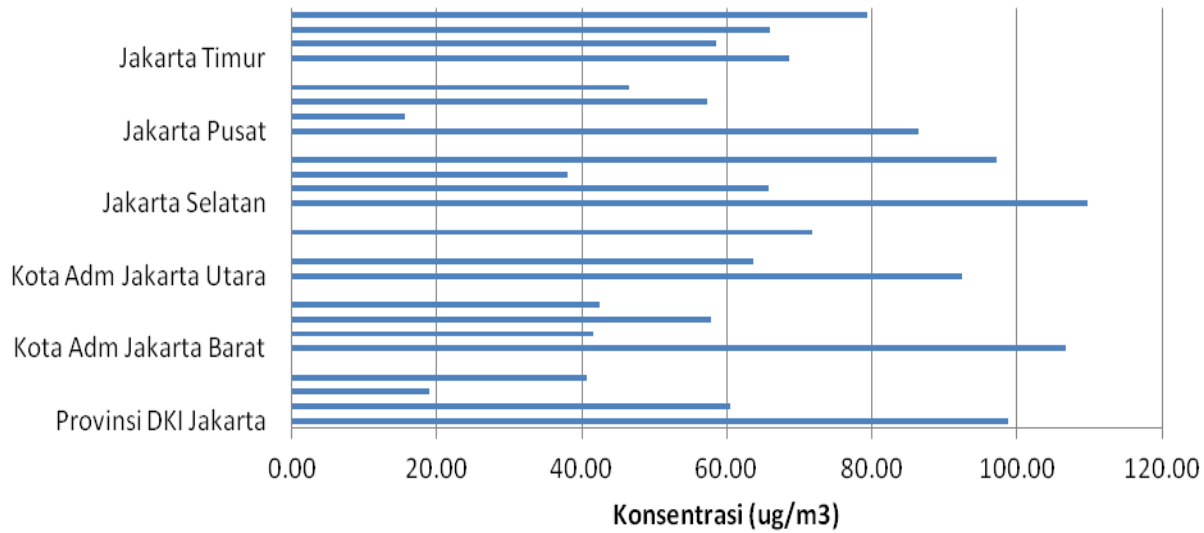
Konsentrasi NO2 di Banten Tahun 2011



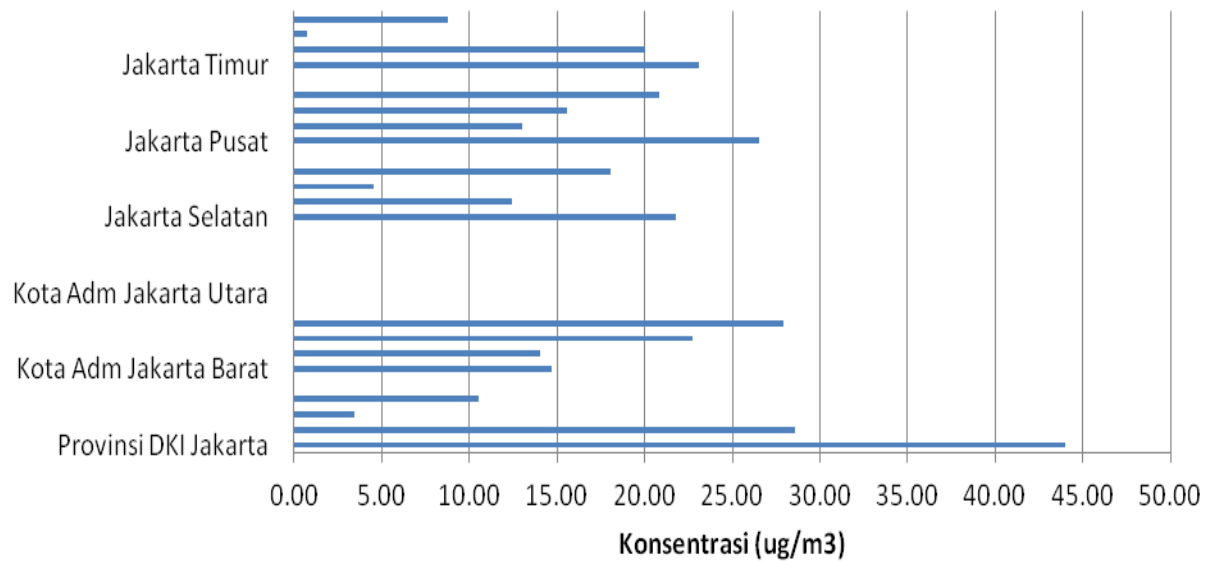
Konsentrasi SO2 di Banten Tahun 2011



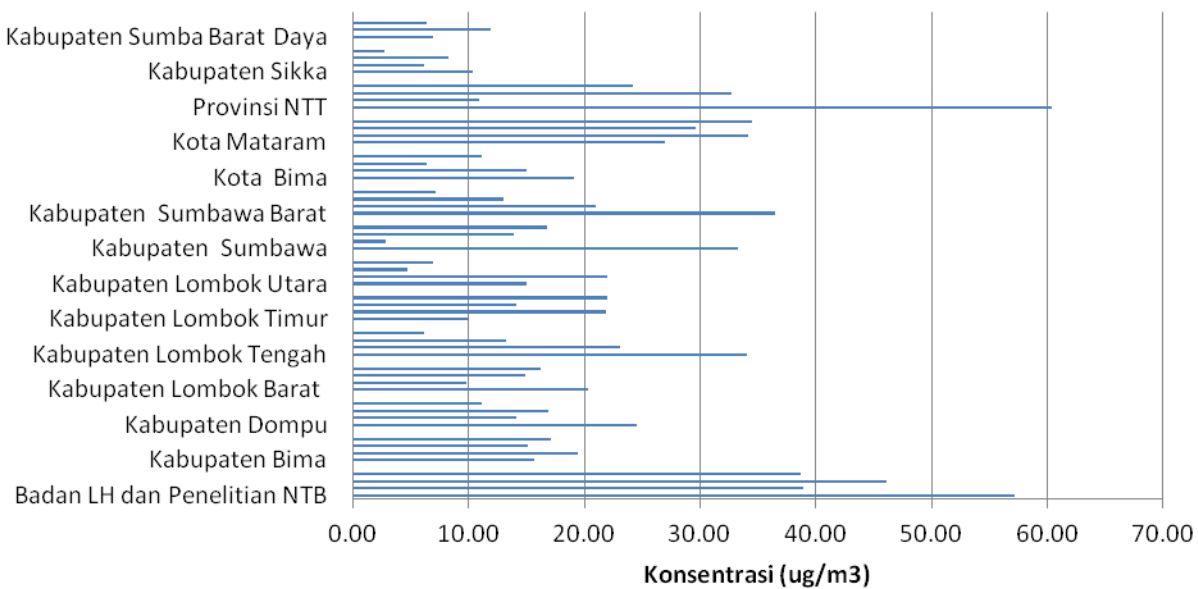
Konsentrasi NO2 di Prov.DKI-jakarta Tahun 2011



Konsentrasi SO2 di Prov. DKI-Jakarta Tahun 2011



Konsentrasi NO2 di Prov. NTB dan NTT Tahun 2011



Konsentrasi SO2 di Prov. NTB dan NTT Tahun 2011

