Determination of environmental pollution caused by organic hazardous substances in Vietnam and the quality assurance during the analytical process correspondingly

Pham Hung Viet

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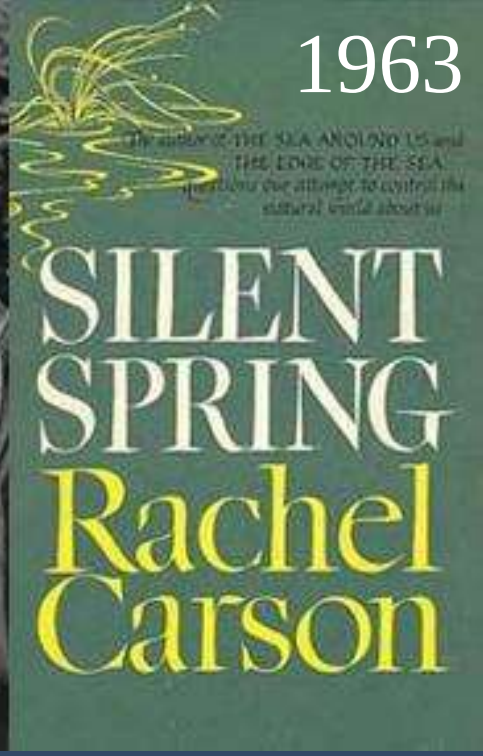
Danang – 11/2016

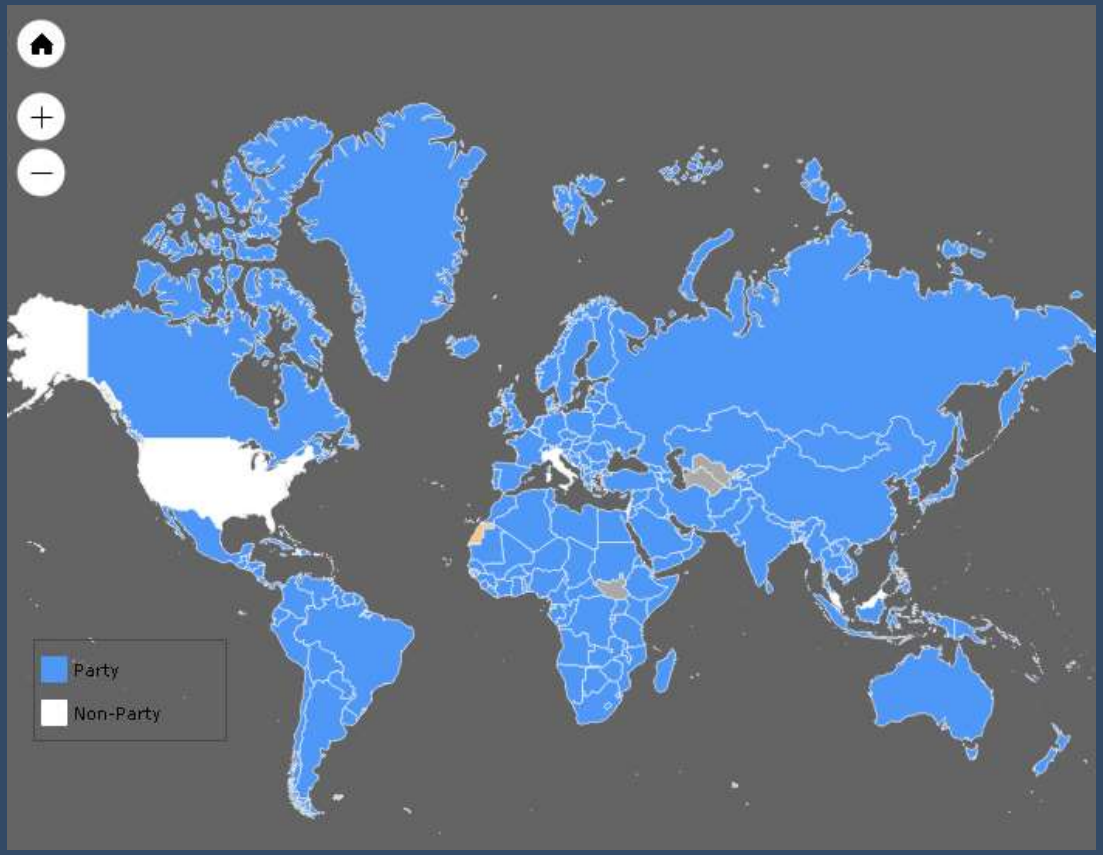
Persistent Organic Pollutants

- Persistent
- Bio-accumulative
- Toxic
- Transboundary movement

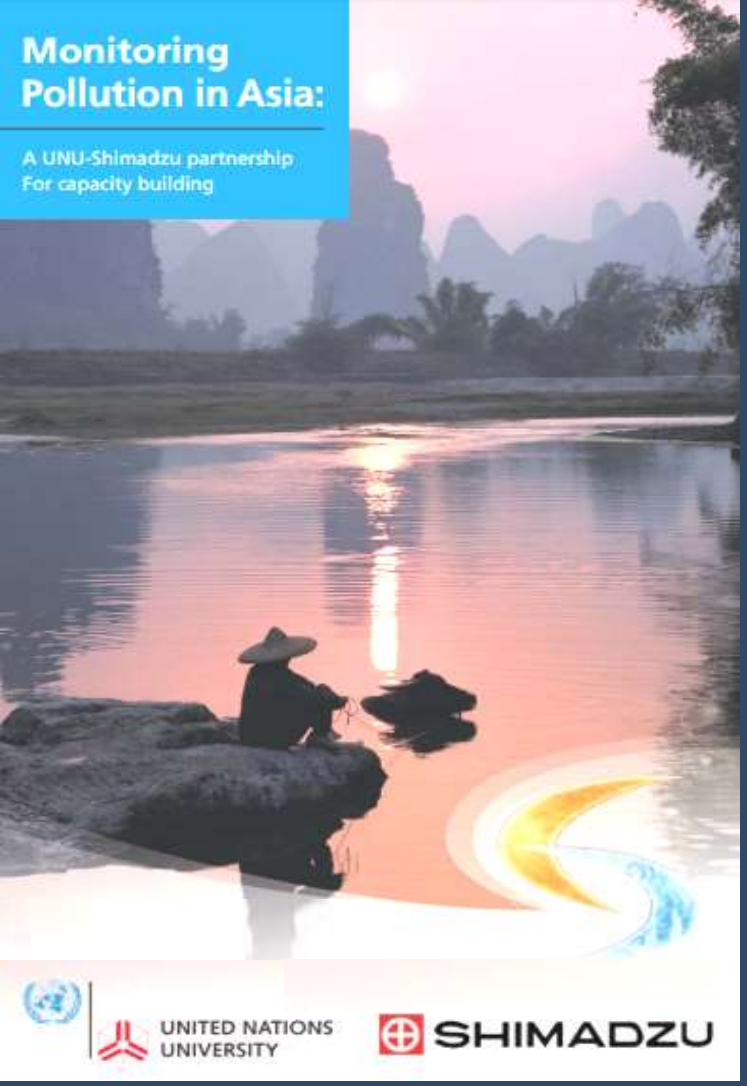


Signature of the Stockholm Convention May 2001

The status of the Stockholm Convention (2013)



Date of Adoption: 22/5/2001	**Place of Adoption:** Stockholm
Date of Entry into Force: 17/5/2004	**Registration:** No. 40214
Number of Signatories: 152	**Number of Parties:** 180



First Phase: 1996-1999

"Environmental Monitoring and Analysis in the East Asian Region"

1. Pesticides in rice and soil
2. VOCs in tapwater, tributhyl tin in fish
3. VOCs and aldehydes in air

Second Phase: 1999-2002

"Environmental Monitoring and Governance in the East Asian Coastal Hydrosphere"

1. POP pesticides in river water
2. Bisphenol A, Alkylphenols in river water
3. Phthalates in river water

Third Phase: 2002-2005

POP pesticides in river water and sediment

Fourth Phase: 2005-2008

POP pesticides in shrimp, fish, squid

Fifth Phase: 2008-2011

PCBs in shrimp
PBDEs in sediment

Sixth Phase: 2012 – 2015 – 2018

"Monitoring and Management of Persistent Organic Pollutants in Asia"

PFCs in water, in fish

First Phase: 2016 – 1999: Environmental Monitoring and Analysis in the East Asian Region

The United Nations University

Environmental Monitoring and Analysis in the East Asian Region

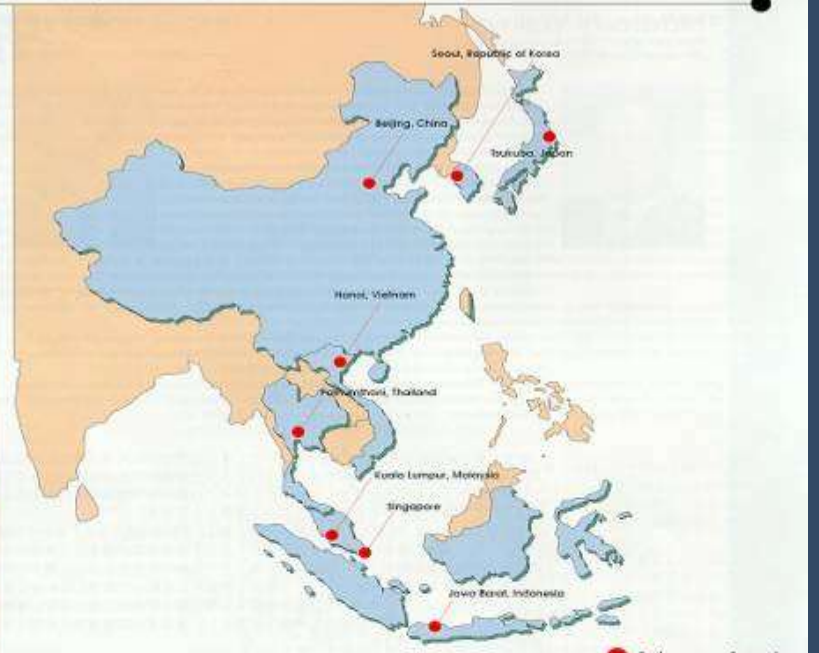
Technology Transfer and Environmental Governance

東アジア地域の環境監視と分析

技術移転と環境管理

1996 ····· 1997 ····· 1998 ····· 1999

PARTICIPATING LABORATORIES プロジェクト参加研究機関



Laboratory Locations

China
China-Japan Friendship Center for Environmental Protection Beijing, China

Indonesia
Environmental Management Center BAPEDAL Tangerang-Jawa Barat, Indonesia

Japan
National Institute for Environmental Sciences Tsukuba, Japan

Republic of Korea
National Institute of Environmental Research Seoul, Republic of Korea

Singapore
National University of Singapore Kent Ridge, Singapore

Thailand
Environmental Research & Training Center Pathumthani, Thailand

Vietnam
Center of Environme
Hanoi, Vietnam

Malaysia
University of Malay
Malaysia

4

UNU PROJECT

BEST PERFORMANCE 1996

2nd Phase- 5th Phase: 2016 – 1999: Environmental Monitoring and Governance in Coastal Hydrosphere

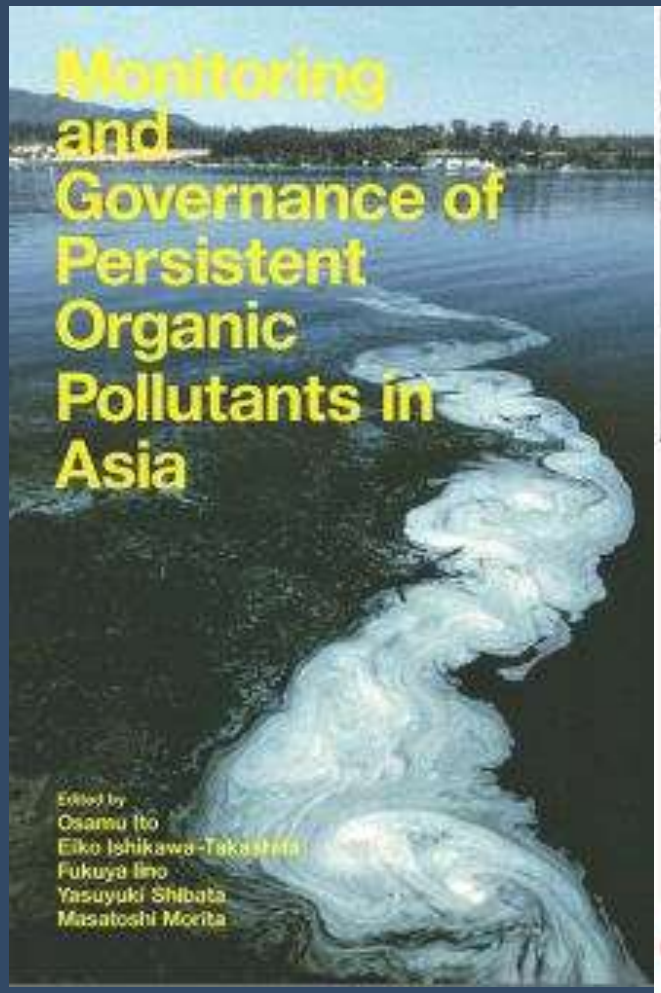
The United Nations University

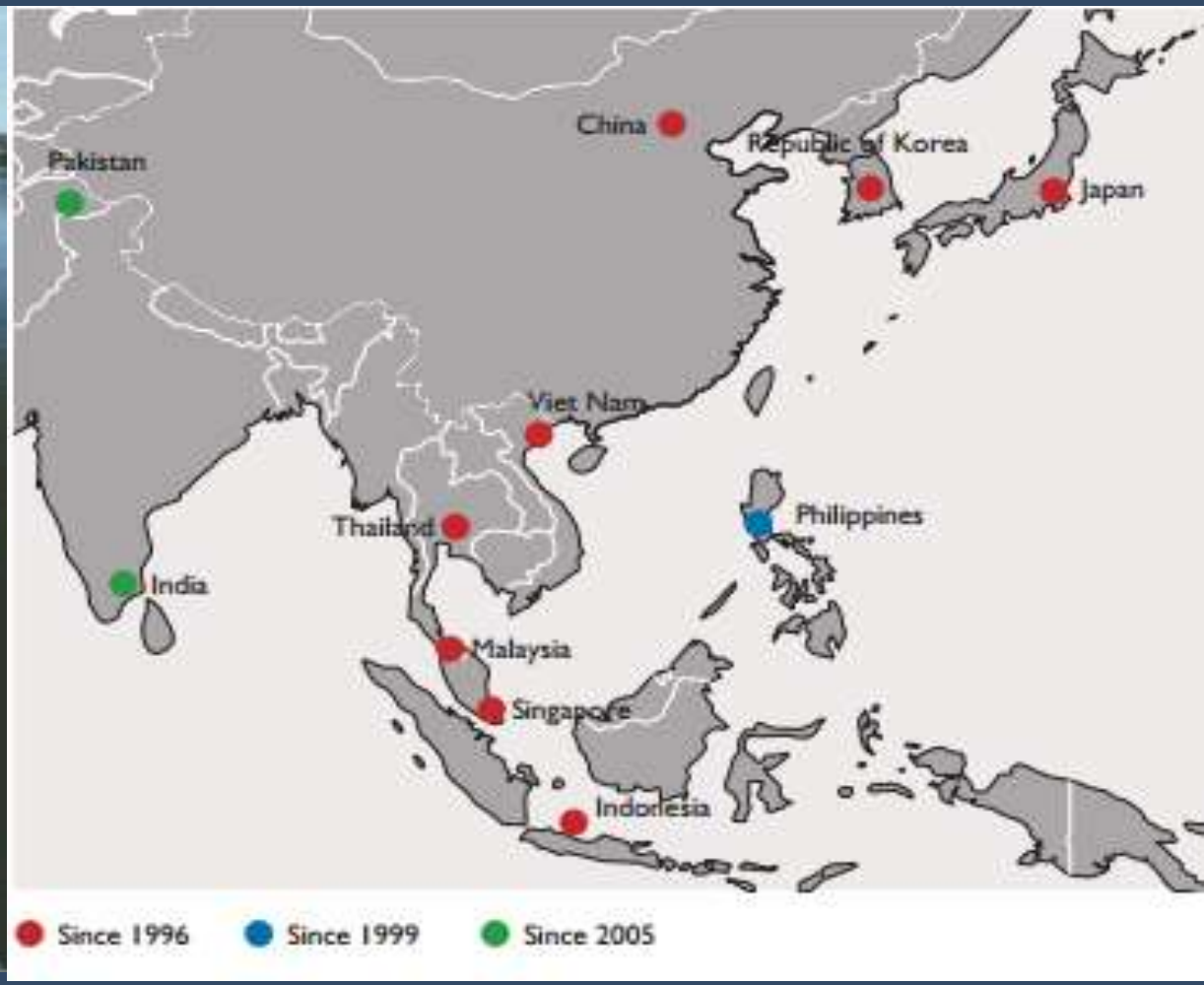
Environmental Monitoring and Governance in Coastal Hydroshpere

Partner Institutions

For EDC Pollution in the East Asian Coastal Hydroshpere

6th Phase: 2016 – 2018: Monitoring and Management of Persistent Organic Pollutants in Asia





Stockholm Convention on Persistent Organic Pollutants (POPs)

The initial 12 POPs

Annex A (Elimination)

- ● Aldrin
- ● Chlordane
- ● Dieldrin
- ● Endrin
- ● Heptachlor
- ●/▲ Hexachlorobenzene
- ● Mirex
- ● Toxaphene
- ▲ PCB

Annex B (Restriction)

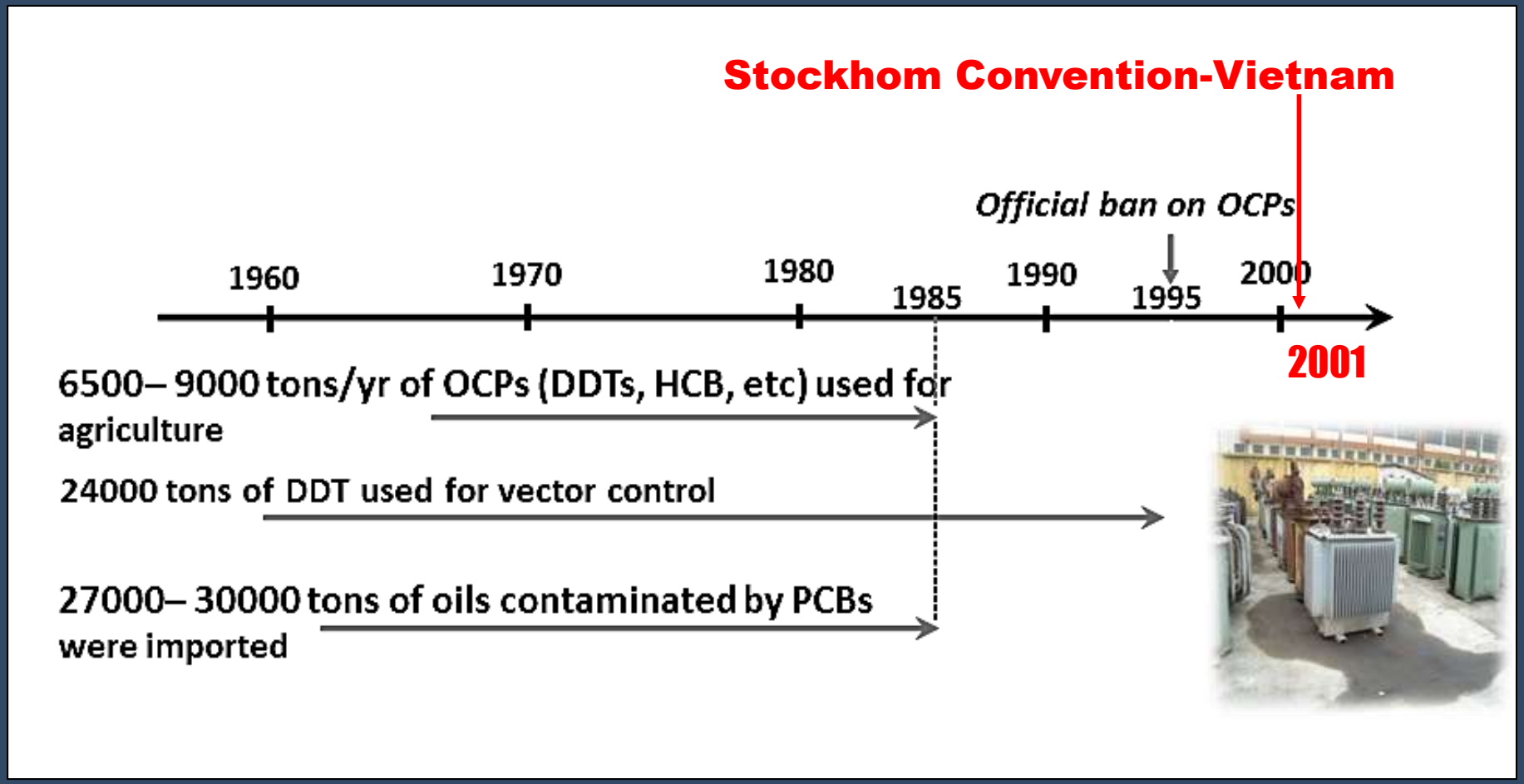
- ● DDT

Annex C (Unintentional production)

- ■ Polychlorinated dibenzo-*p*-dioxins and dibenzofurans
- ■ Hexachlorobenzene
- ■ PCB

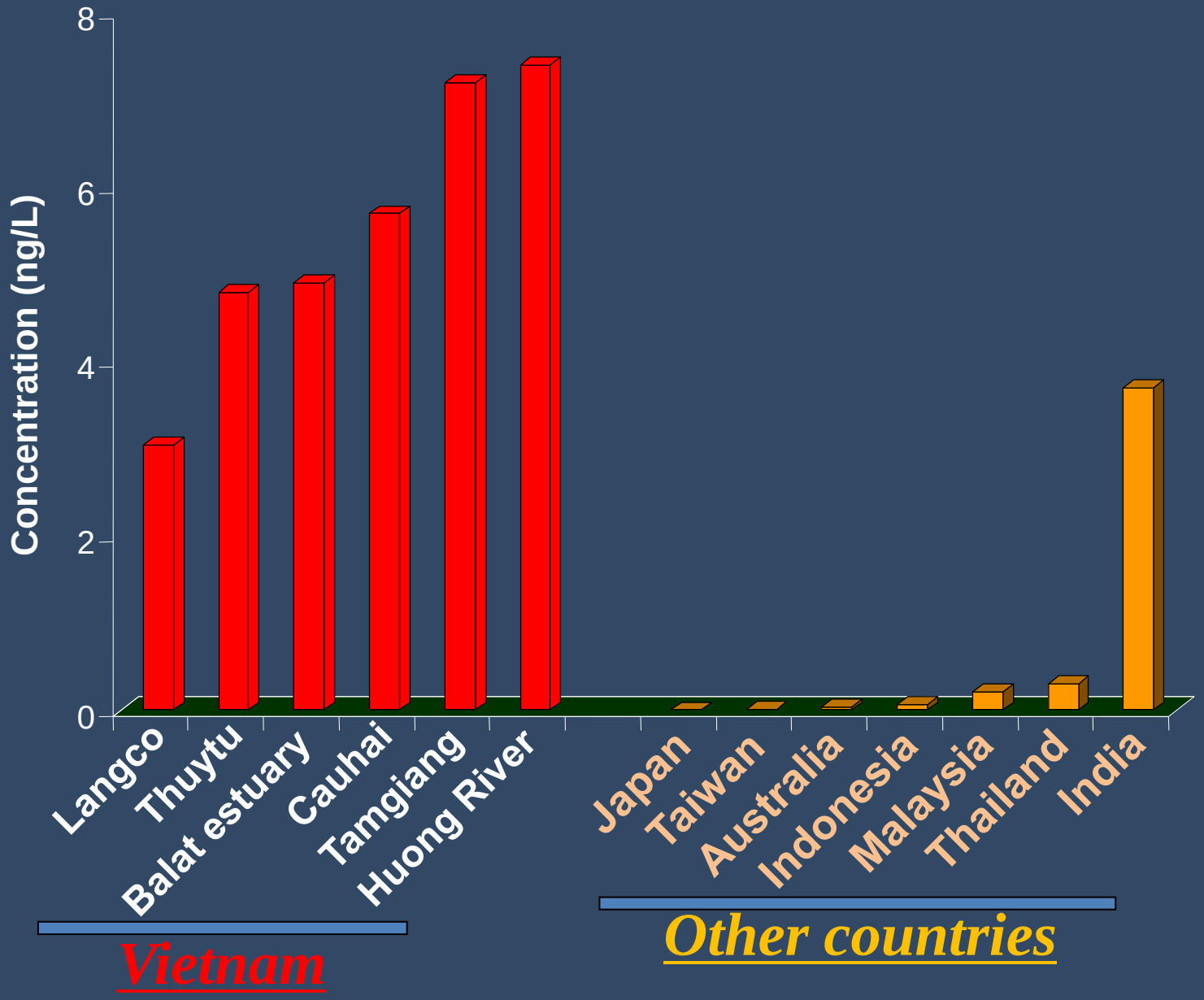
● Pesticides / ▲ Industrical chemicals / ■ By-products

The usage of POPs (OCPs and PCBs) in Vietnam

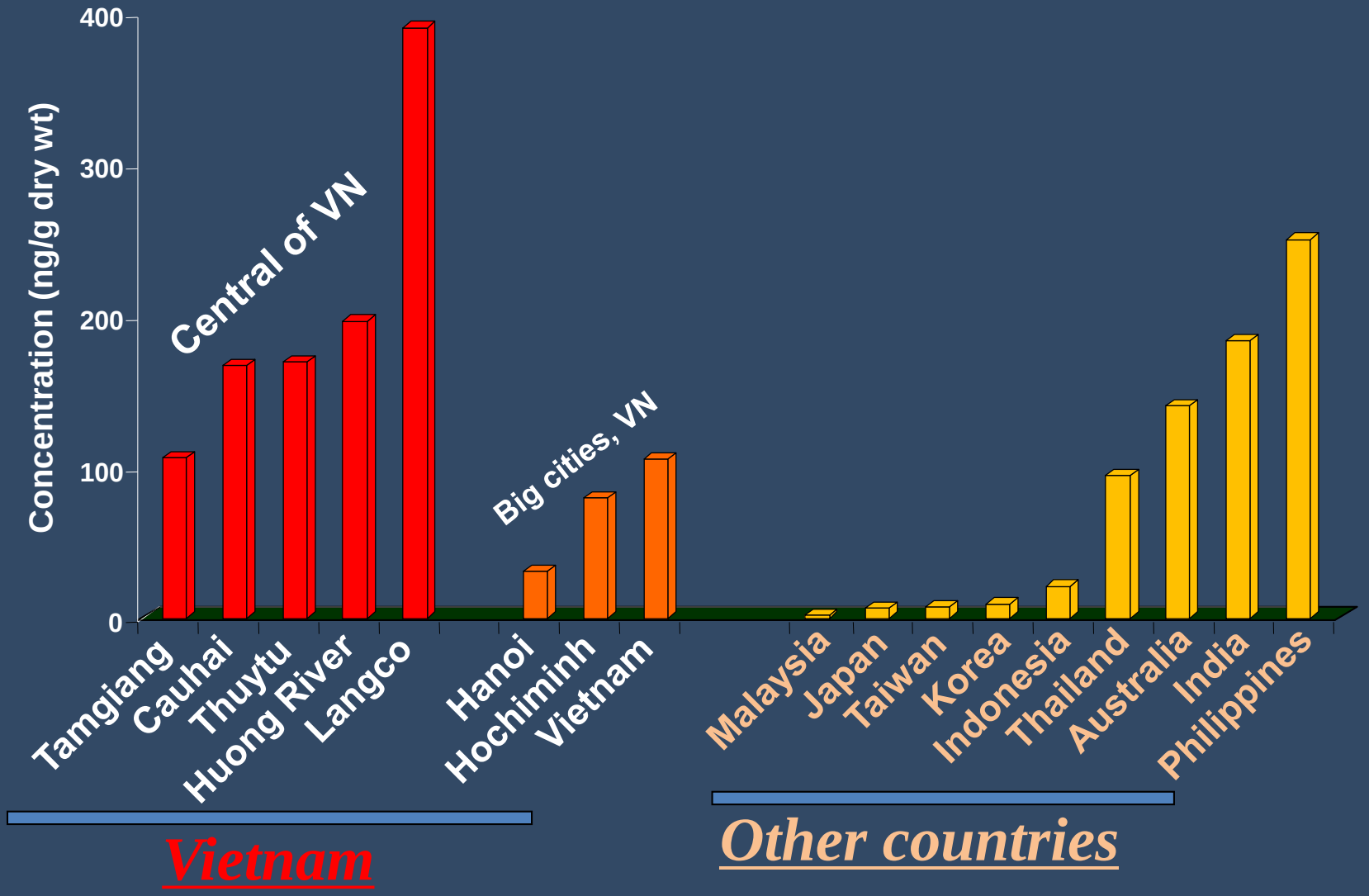


Data source:
Sinh et al., 1999. In UNEPRegional Workshop on Management of POPs, March 1999, Hanoi, Vietnam, MONRE 2006

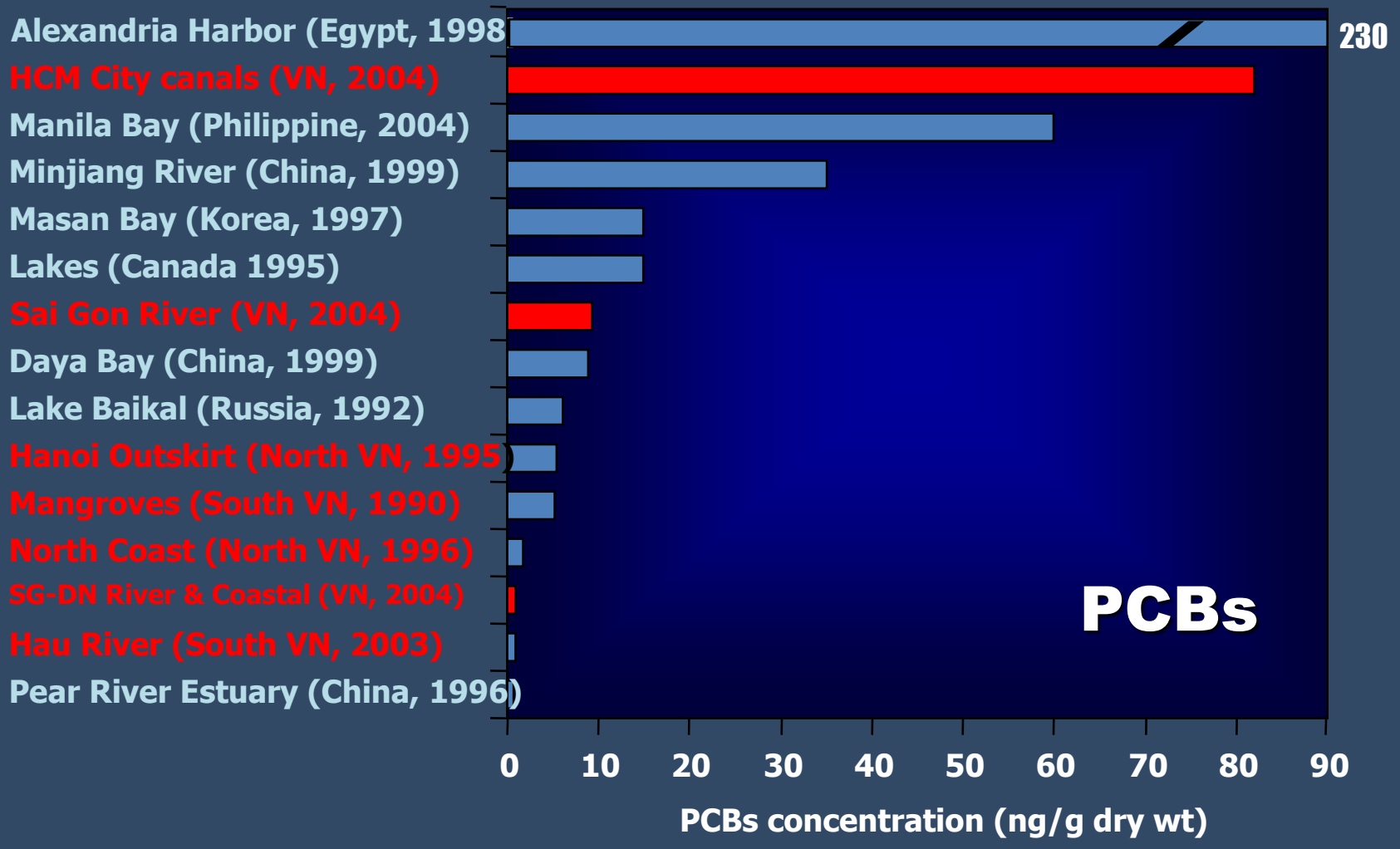
Comparison of p,p’-DDT concentrations in surface waters from Asia-Pacific countries



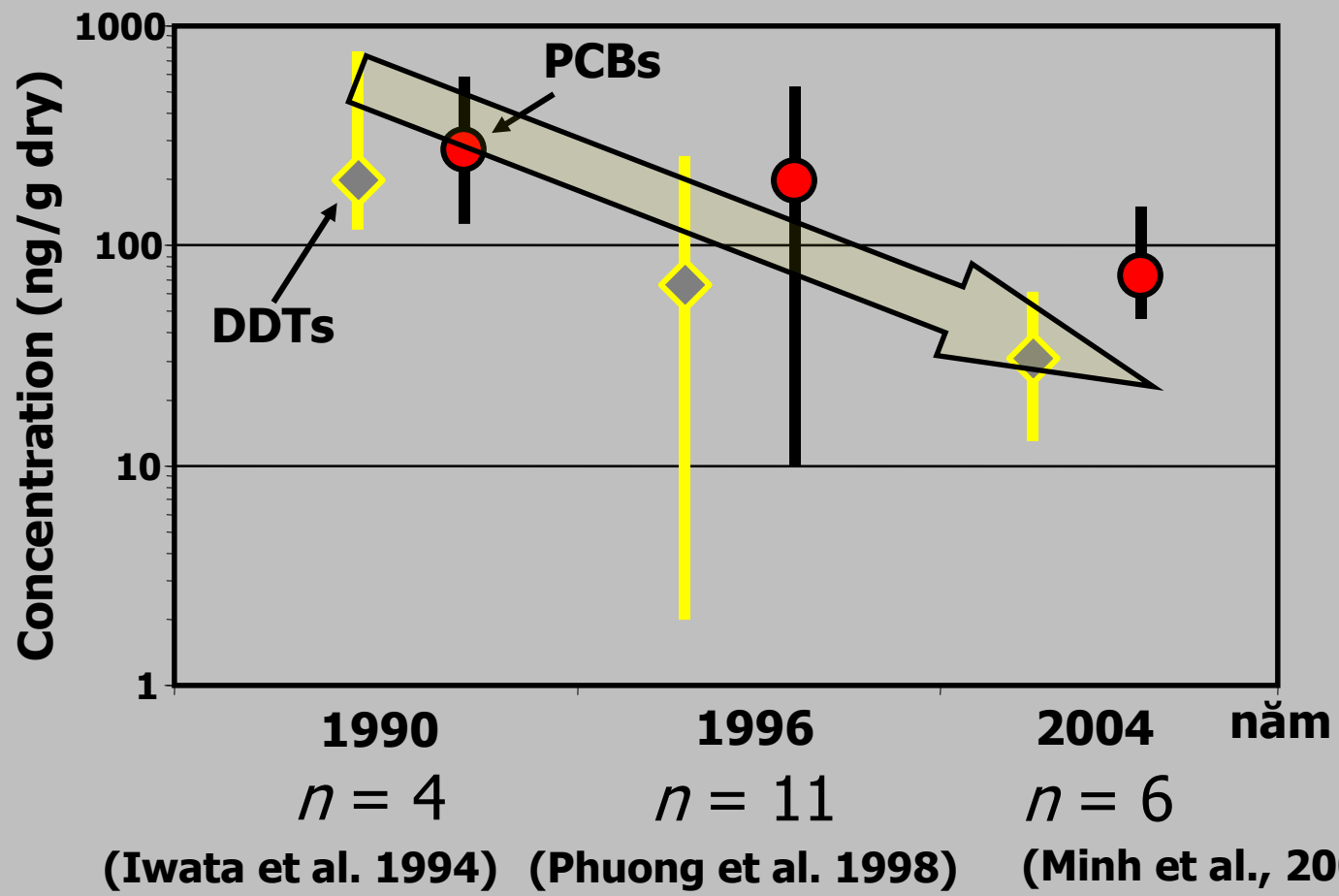
Comparison of total DDT concentrations in river and estuary sediments from Asia-Pacific countries



Comparison of total PCB concentrations in river and estuary sediments from several countries



Trend of Contamination of PCBs and DDTs in sediment samples collected at Hochiminh city canals



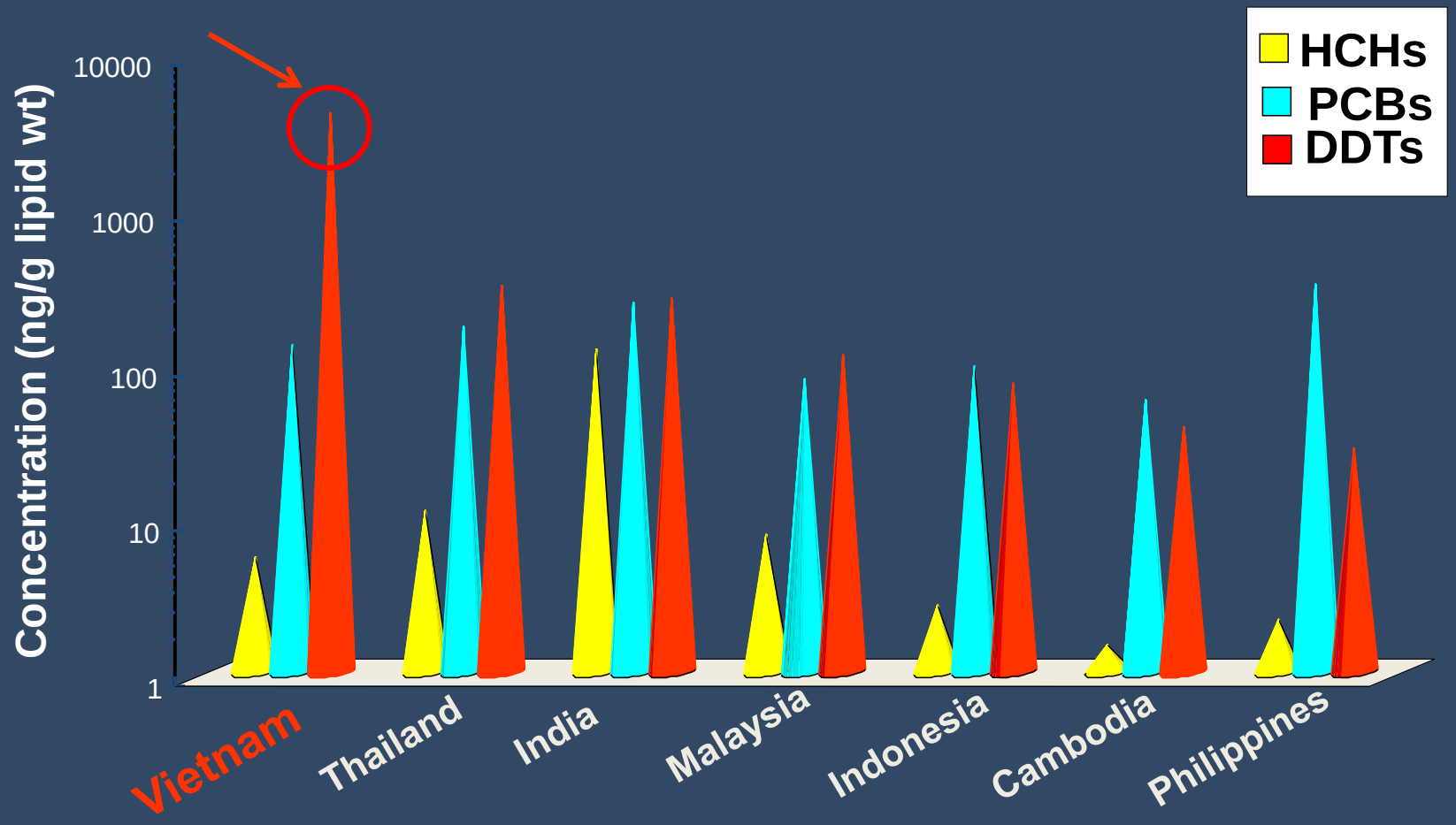
Estimated half-life time:

PCBs: ~ 8 years

DDTs: ~ 5 years

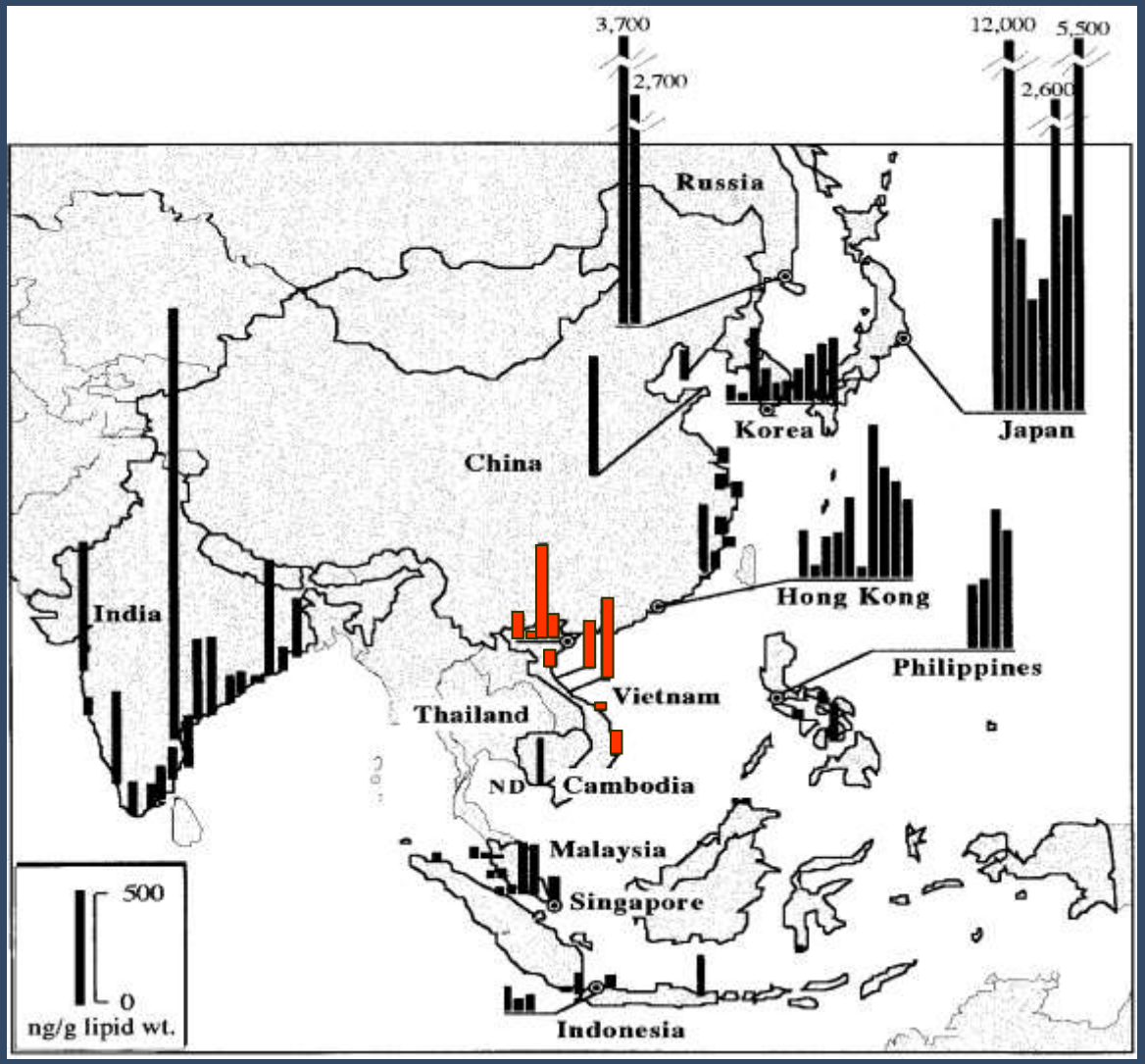
Magnitude of contamination of persistent organochlorines in mussels from Vietnam and in southeast Asian region

Asia-Pacific Mussels Watch Program



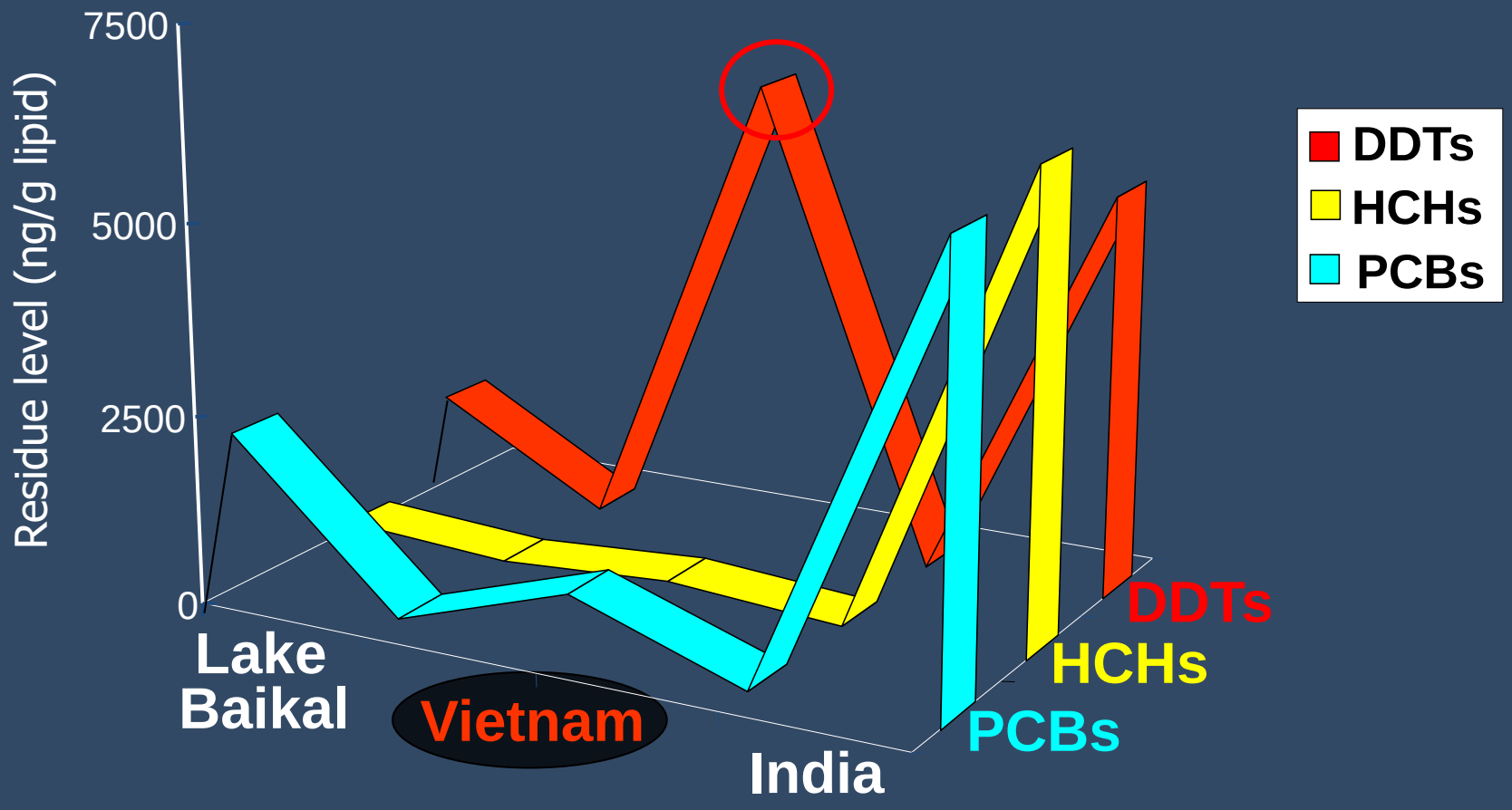
Data from Monirith et al., 2000; Minh et al., 2002

Magnitude of contamination of PCBs in mussels from Vietnam and in Asia-Pacific region



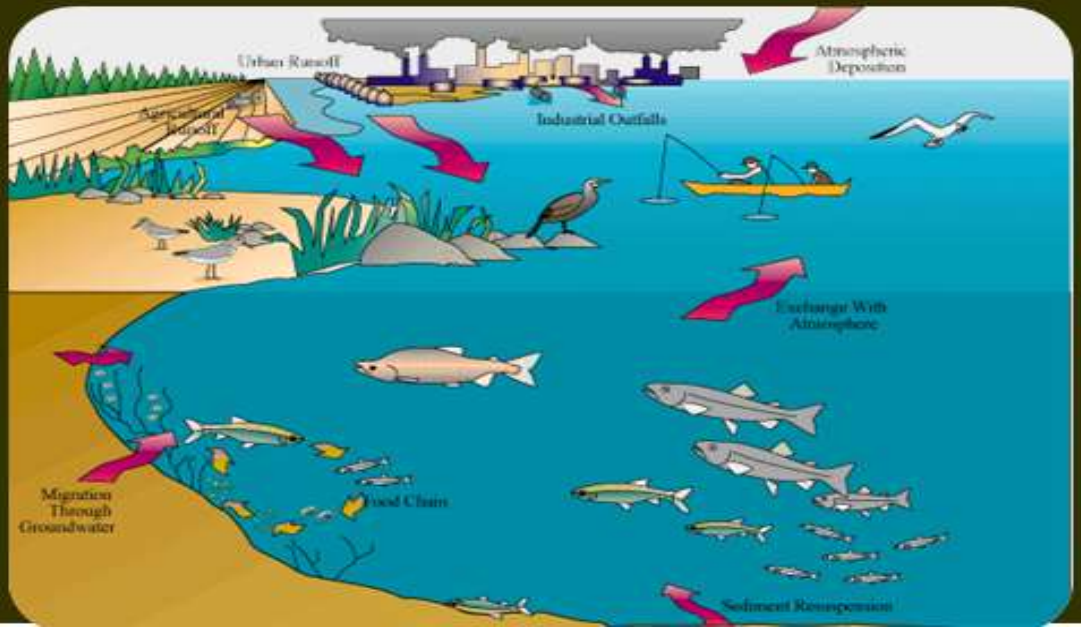
Monirith et al., 2003

Magnitude of contamination of persistent organochlorines in resident birds from Vietnam and in Asia-Pacific region



Data from Tanabe et al., 1998; Kunisue et al., 2002; Minh et al., 2002

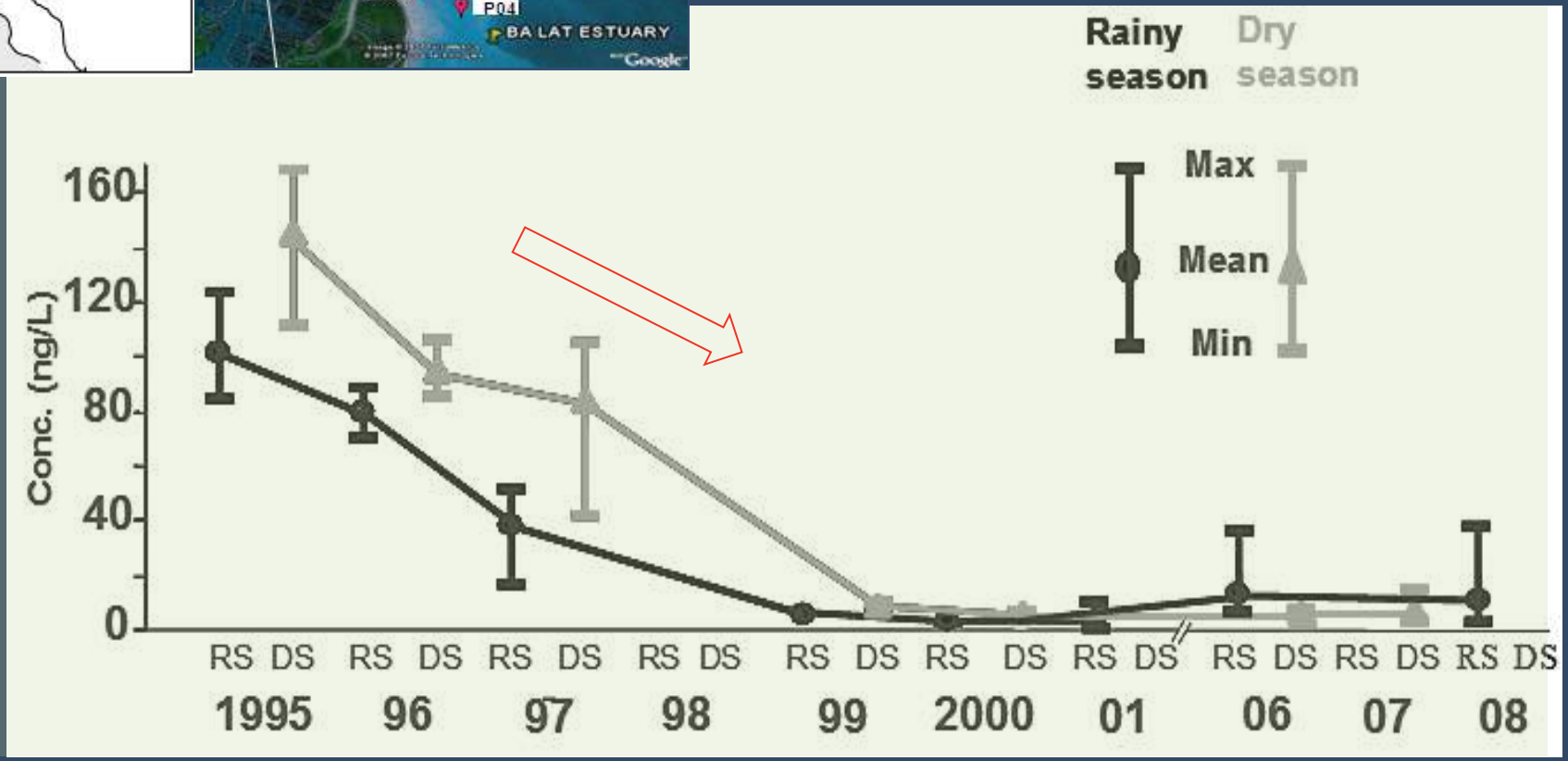
Case study: temporal trend of DDTs, PCBs in water, sediment from Balat estuary - Red River, Vietnam



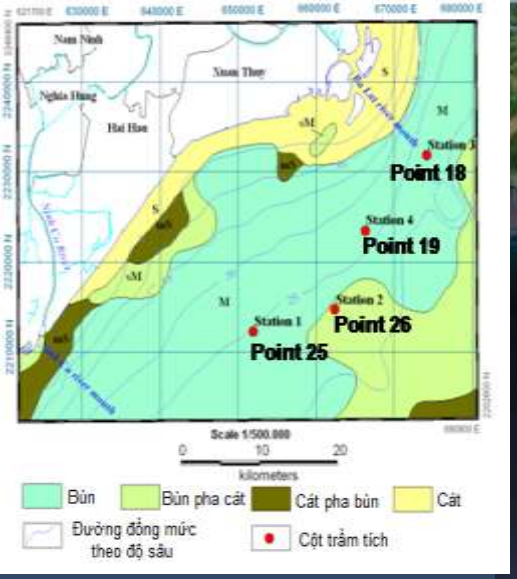
Pollution history?

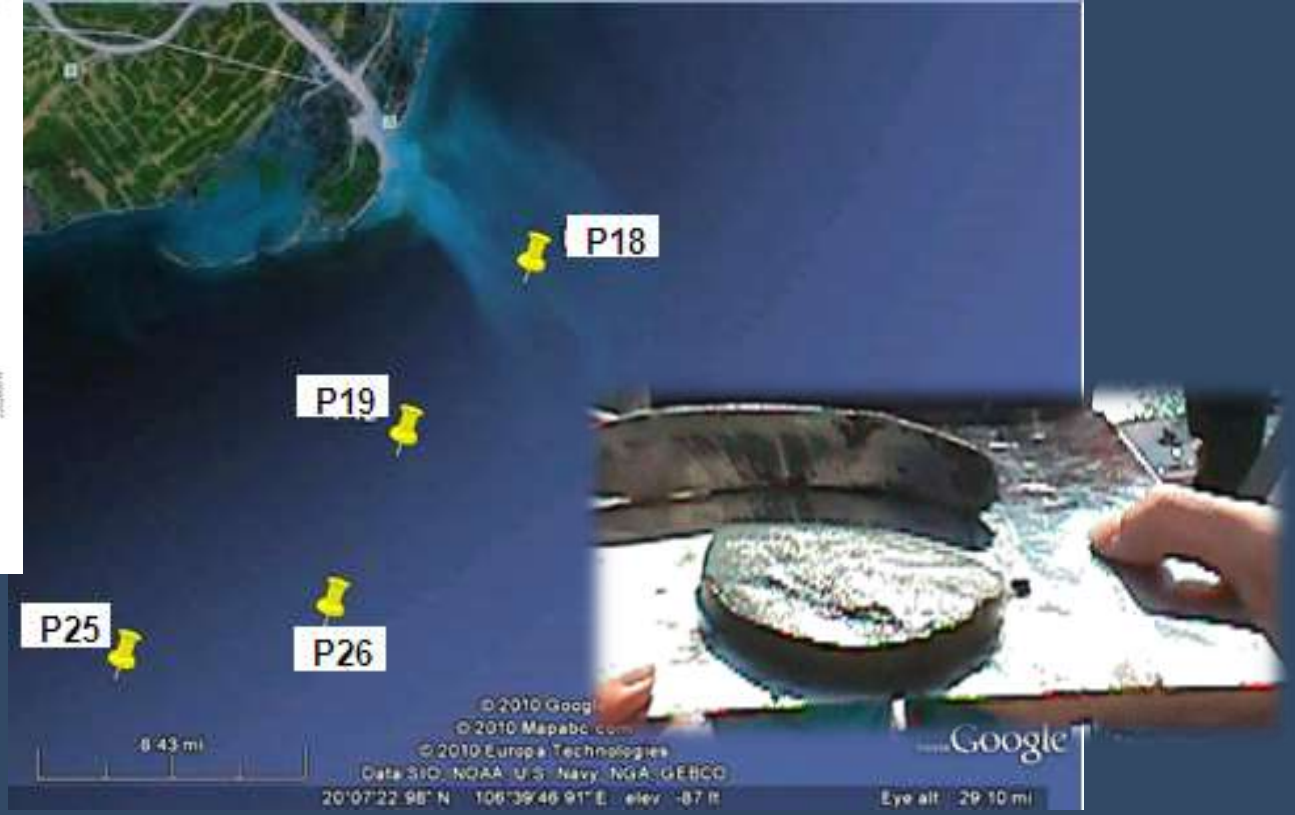
Sediment core

Level of DDTs in seawater of Ba Lat Estuary



Data from UNU Project (Viet P.H. et al. 2016)


Nam Ninh
Nghia Hung
Hai Hau
Point 18
Station 4
Point 19
Station 2
Point 26
Station 1
Point 25
Scale 1:500.000
0 10 20
kilometers
Bùn
Bùn pha cát
Cát pha bùn
Cát
Đường đồng mức theo độ sâu
Cột trầm tích


P18
P19
P25
P26
8.43 mi
© 2010 Europa Technologies
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
20°07'22.98" N 106°39'46.91" E elev -87 ft
Eye alt 29.10 mi
Google

DIOXIN 2009

Halogenated Persistent Organic Pollutants

29th International Symposium on Halogenated Persistent Organic Pollutants

August 23-28, 2009 Beijing, China

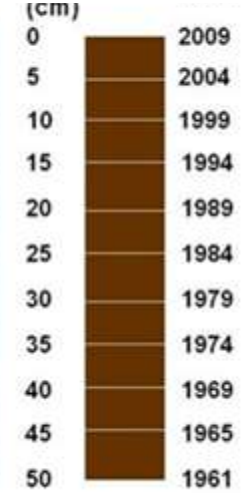
ORGANOCHLORINE PESTICIDES IN SEDIMENT CORES FROM BALAT - A MAJOR ESTUARY OF RED RIVER, NORTHERN VIETNAM: SPATIAL DISTRIBUTION AND DEPTH PROFILES

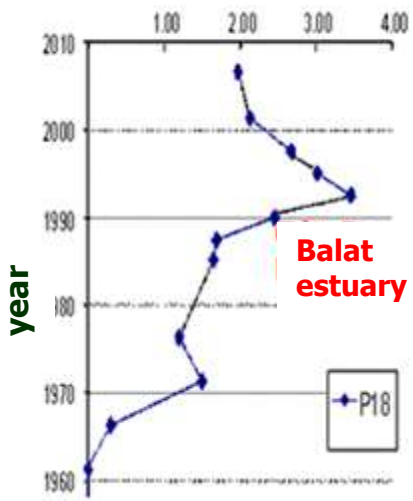
Nguyen N.T.T[1], Duong A.H.[1], Pham V. H[1], Takada H.[2]

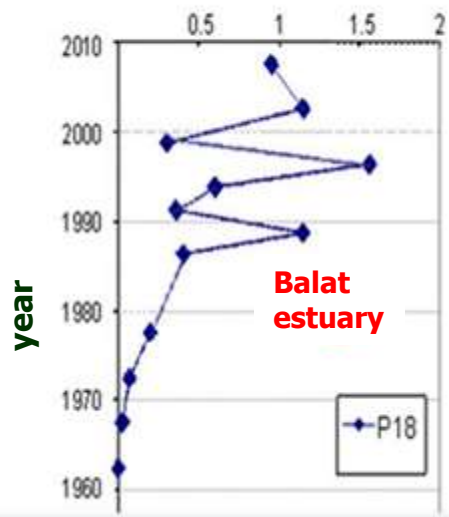
[1]Research Center for Environmental Technology and Sustainable Development, Hanoi University of Science, 334 Nguyen Trai, Thanh Xuan, Hanoi, Vietnam; [2]Laboratory of Organic Geochemistry, Tokyo University of Agriculture and Technology, Fuchu, Tokyo 183-8509, Japan.

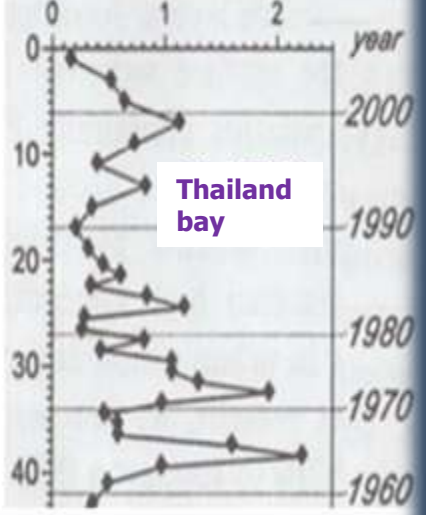
Abstract

We investigated spatial and vertical distributions of organochlorine pesticides (OCPs) in surface sediment and sediment cores from Ba Lat estuary, a major estuary of Red River, the biggest river in Northern Vietnam. Concentrations of dichlorodiphenyltricloroethanes (DDTs), hexachlorobenzene (HCB) and hexachlorohexanes (HCHs) were in range of 0.68 – 3.46, <0.05 – 0.69, <0.06 – 2.87 ng/g, respectively. Concentrations of DDTs were higher at station near the mouth of Red River. Vertical depth profile of DDTs in sediment cores reasonably reflects the history of DDT usage in Vietnam.

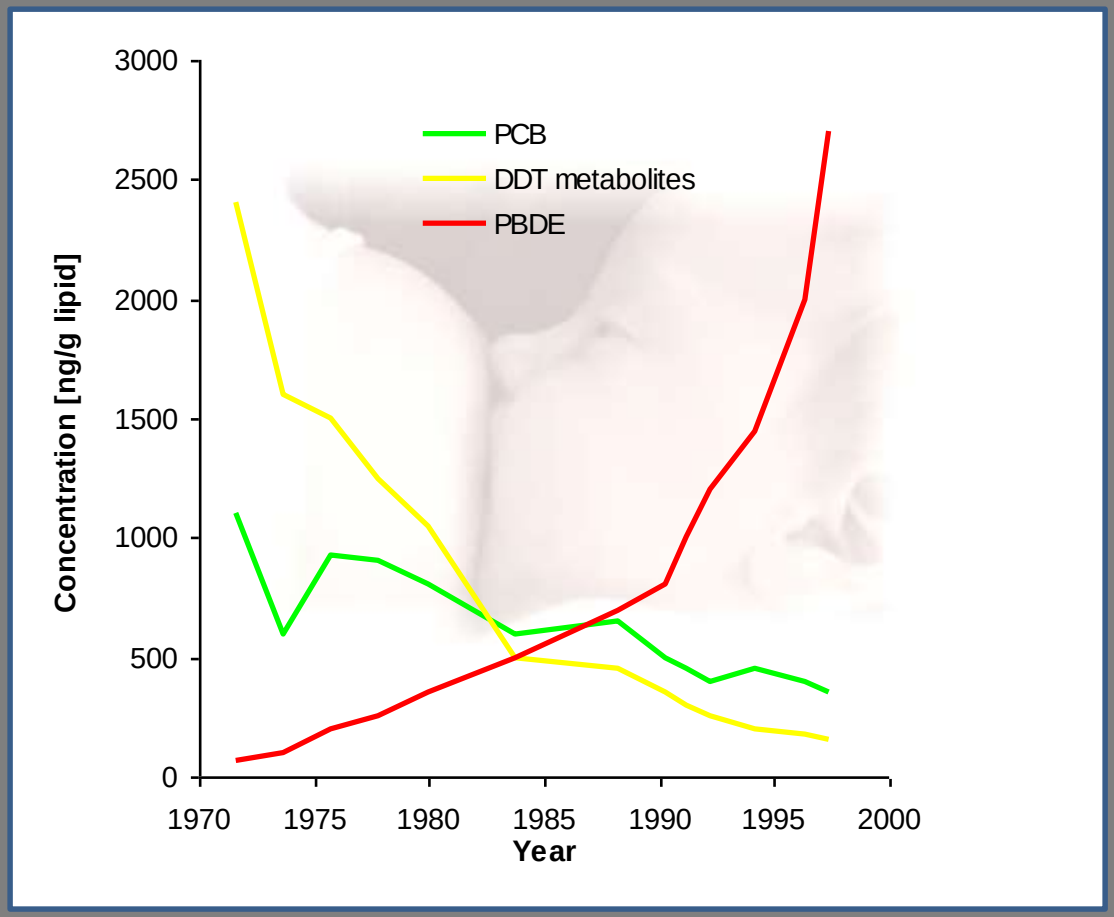








Temporal trends of new POPs vs classic POPs



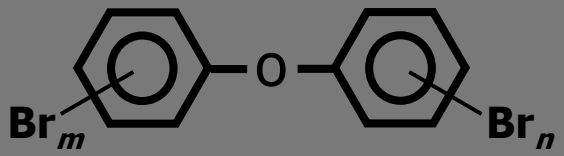
New listing of POPs – 2009

12 + 11 = 23 POPs

- Annex A (prohibited)
  - Pesticides: Lindane, alpha-HCH, beta-HCH, chlordecone, endosulfan
  - Industrial chemicals: hexabromobiphenyl, pentachlorobenzene, pentaBDE, octaBDE
- Annex B (Restricted)
  - Industrial chemicals: PFOS, its salts, and PFOS-F
- Annex C (Unitentional production)
  - By products: Pentachlorobenzene

Brominated Flame Retardants (BFRs)

- Emerging POPs
- Anti-inflammatory additives in polymers



Polybrominated diphenyl ethers (PBDEs)

Study Locations

E-waste Recycling Sites (EWRSs)

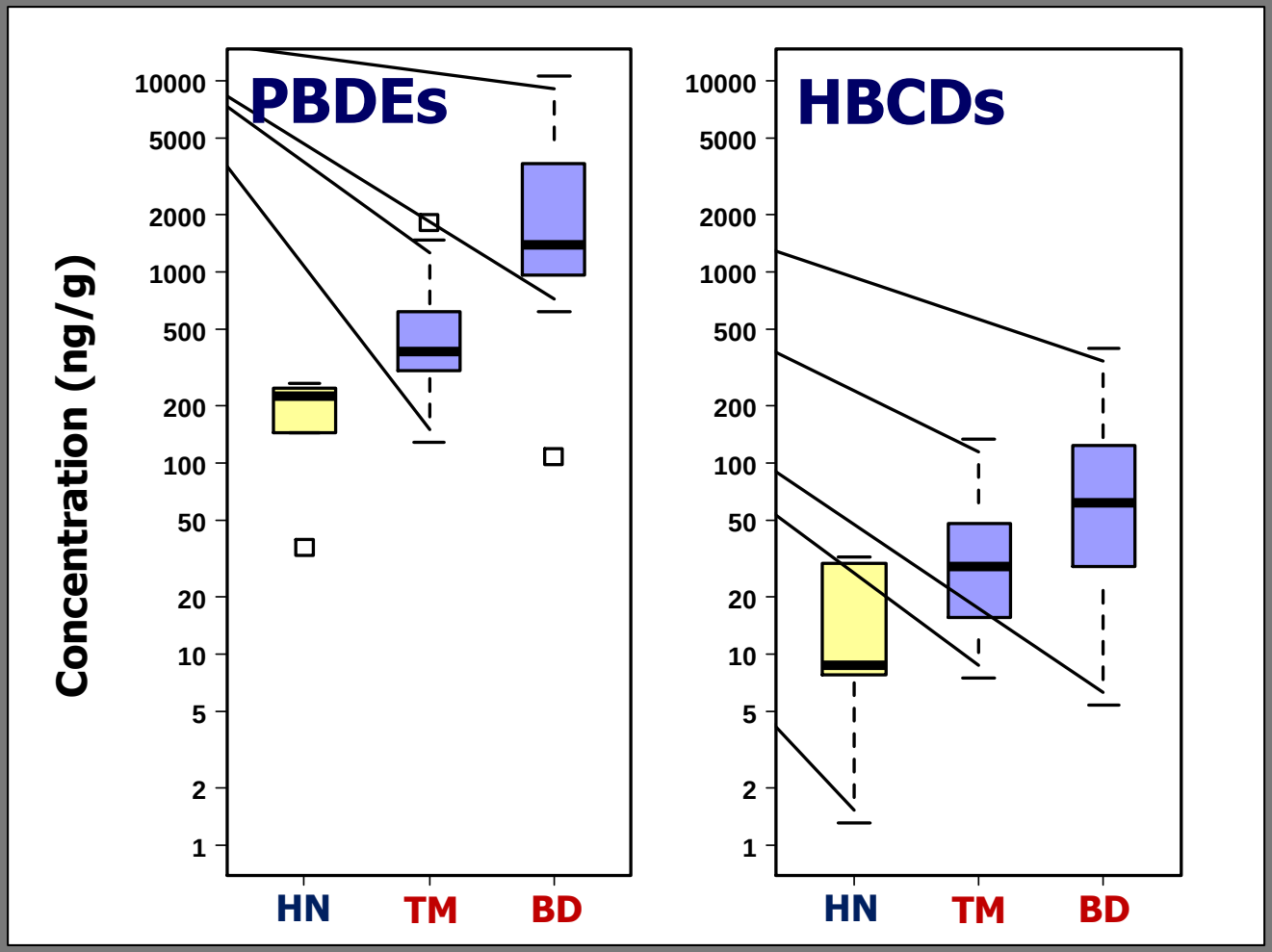
TM: Trang Minh (Hai Phong)

BD: Bui Dau (Hung Yen)

Reference

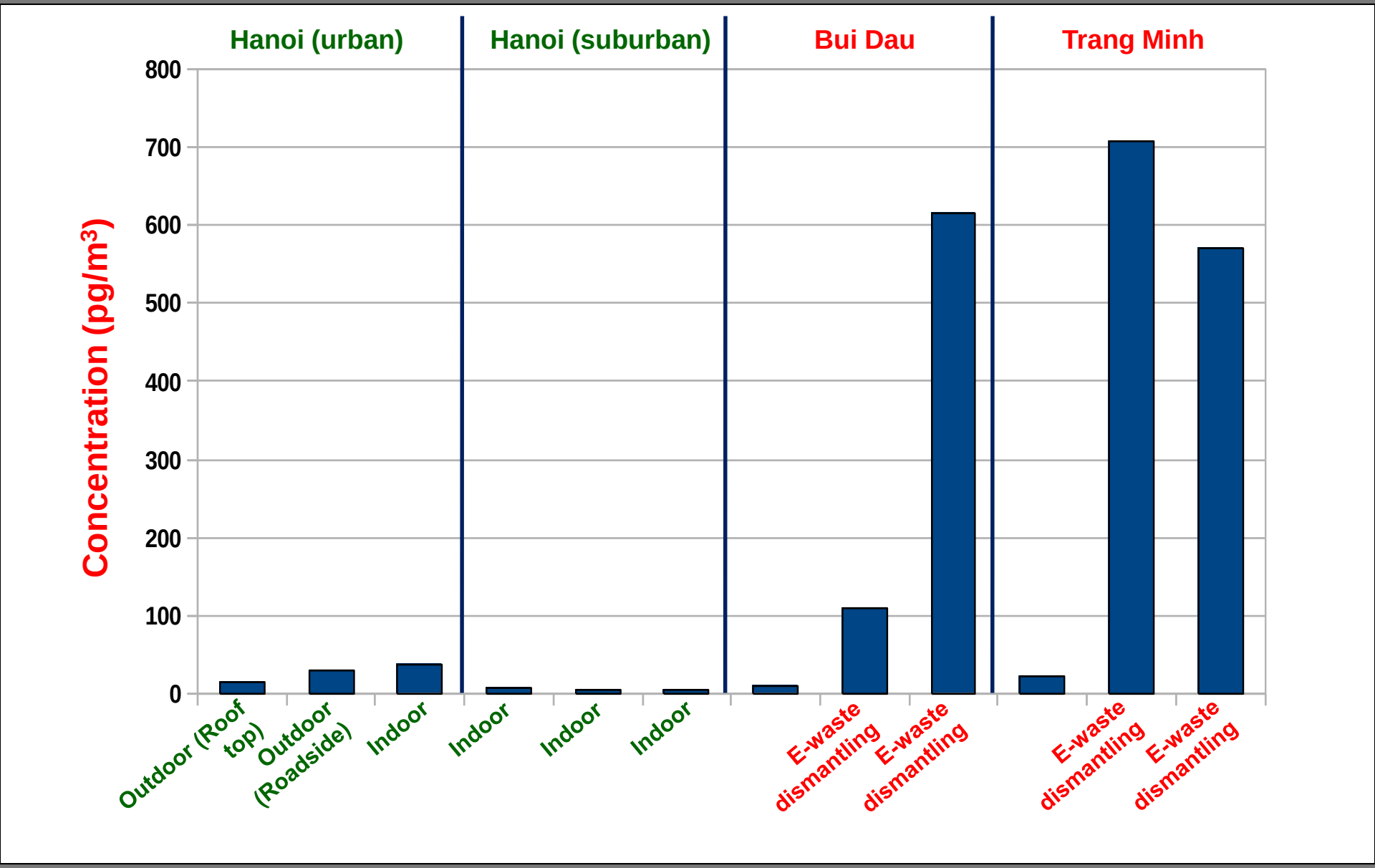
UB: Hanoi

Contamination by BFRs, HBCDs in House Dust



- E-waste recycling is a significant source of BFRs
- PBDEs are the most abundant contaminant in house dust

Air Contamination by PBDEs



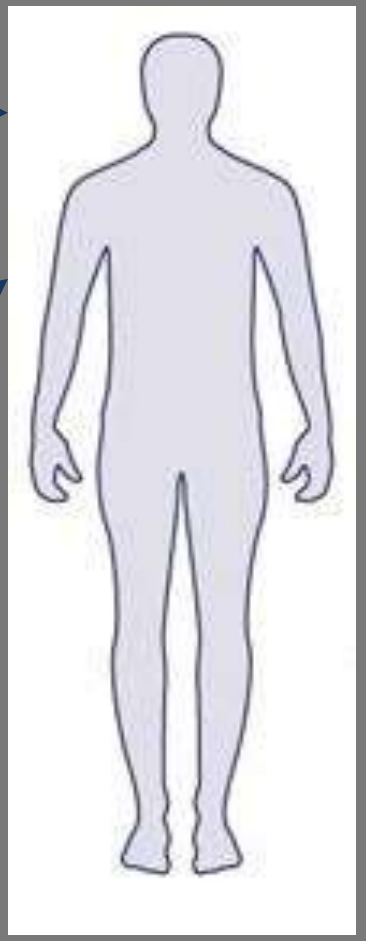
Assessment of Human Exposure Pathways of BFRs

Air (PUF samplers)

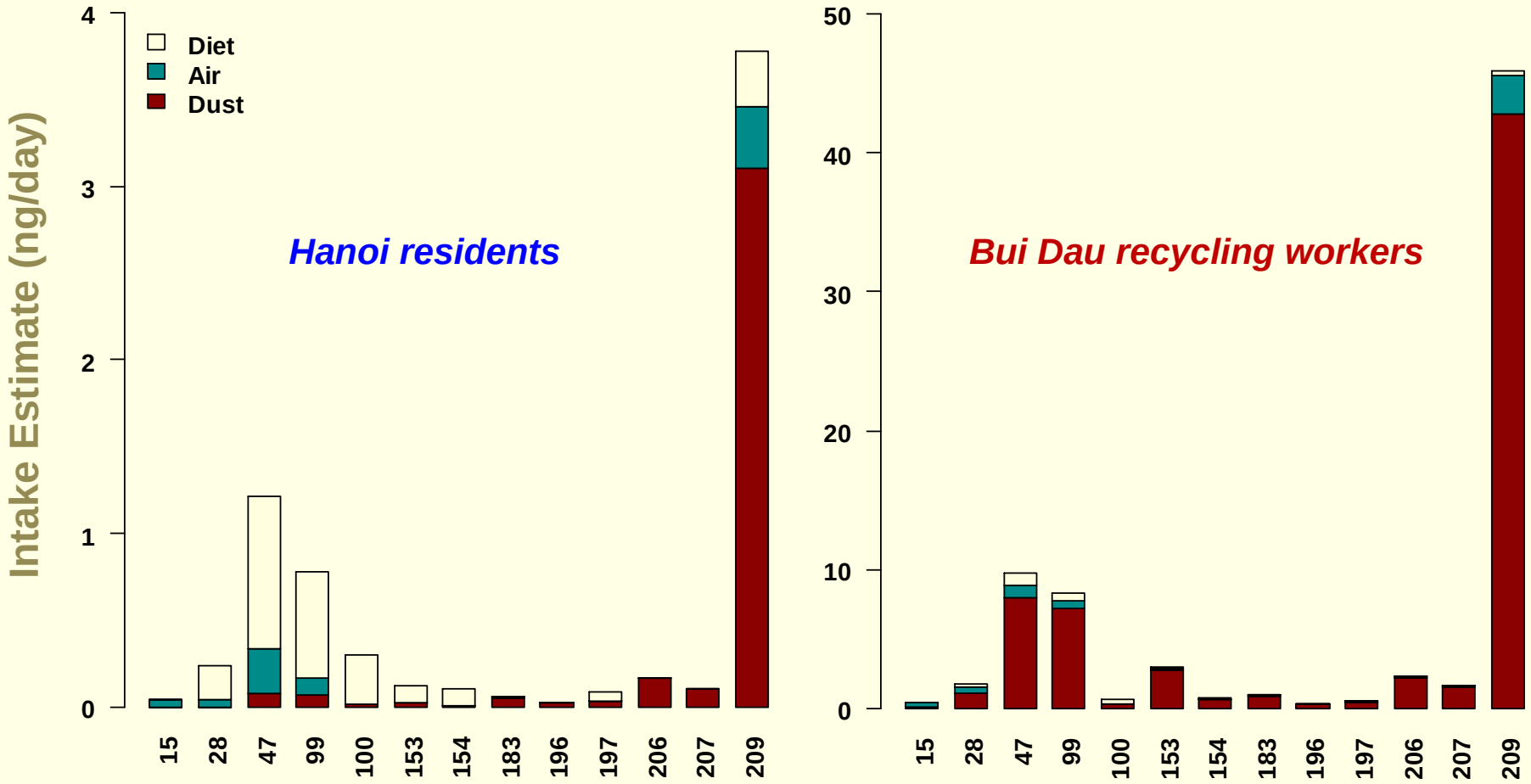
House Dust

Inhalation

Ingestion

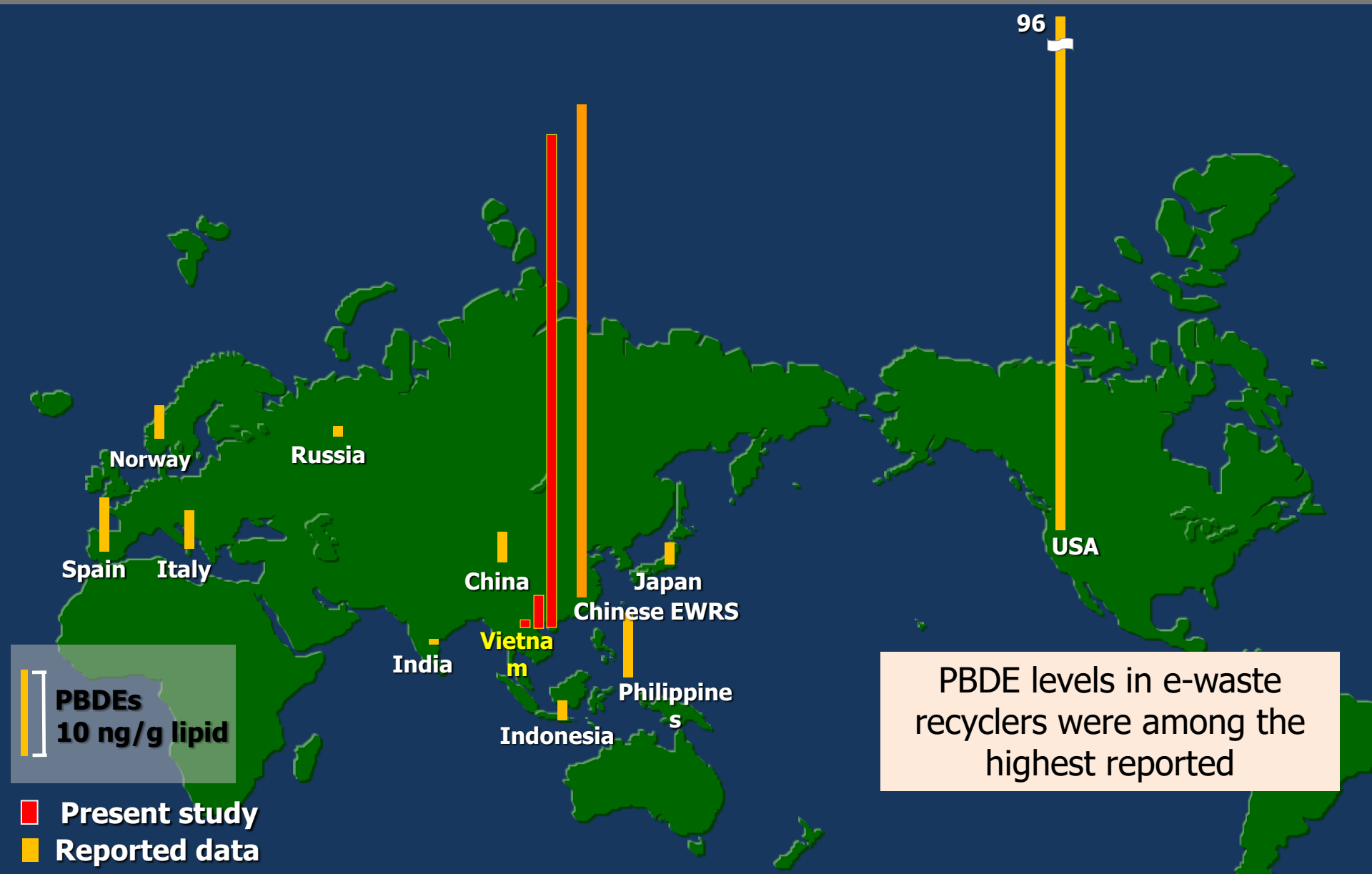


Estimated Human Daily Intake of PBDEs



High exposure to PBDEs from dust for e-waste recyclers in Bui Dau

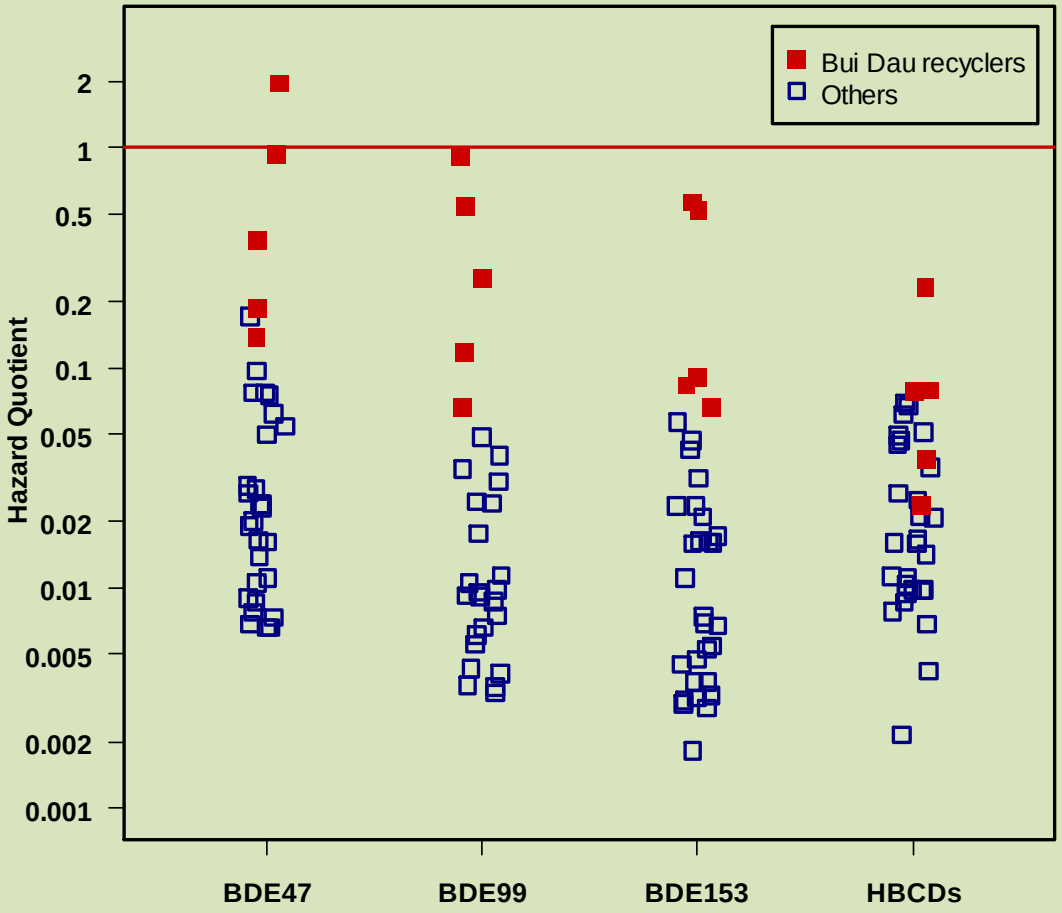
Global Comparison of PBDEs in Human Milk



PBDE levels in e-waste recyclers were among the highest reported

Data cited from Bi et al. (2007), Eslami et al. (2006), Gómara et al. (2007), Ingelido et al. (2007), Malarvannian et al. (2009), Polder et al. (2008), Sudaryanto et al. (2005), She et al. (2007)

Infant Health Risk from Breastfeeding



Calculated for a 5-kg infant consuming 700 g milk/day (Van Oostdam et al. 1999)

Hazard Quotient (HQ):

$$HQ = \frac{\text{Daily intake}}{\text{RfD}}$$

Reference Doses (RfD):

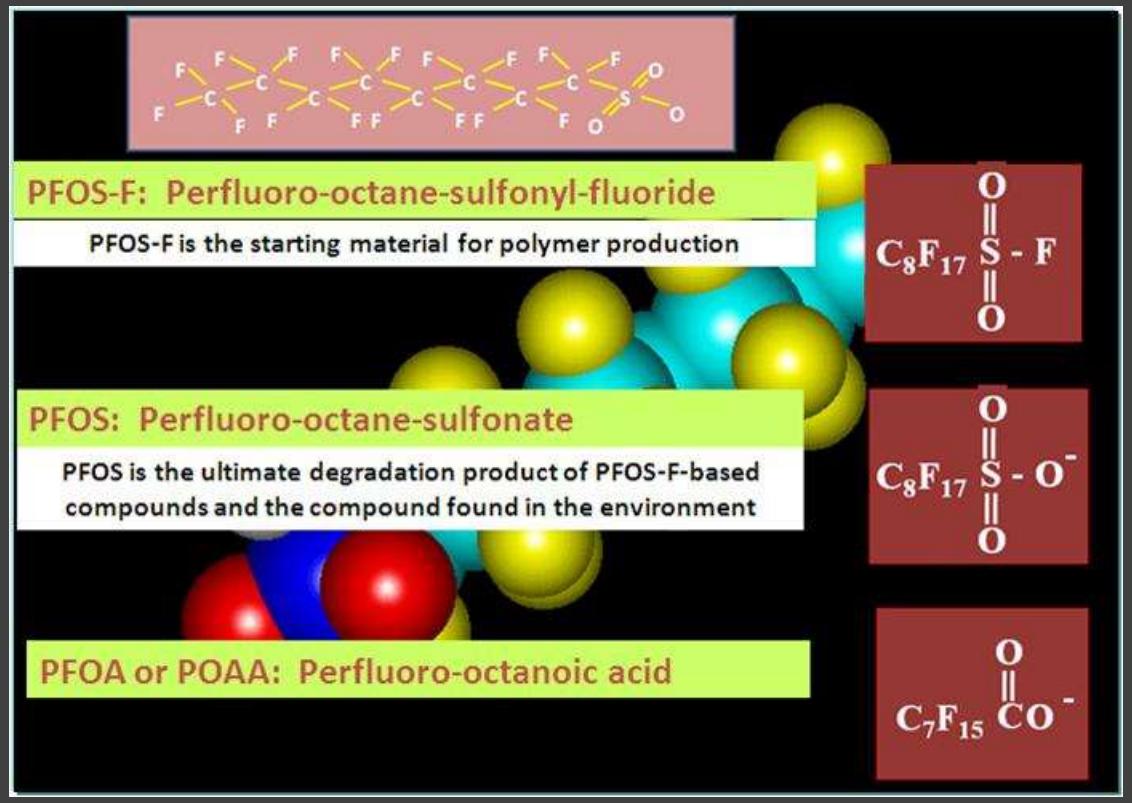
in µg/kg bw/day

BDE-47	0.1
BDE-99	0.1
BDE-153	0.2
HBCDs	0.2

(EPA 2008; ATSDR 2007)

High PBDE levels in breast milk of women involved in e-waste recycling may pose health risk to their infants

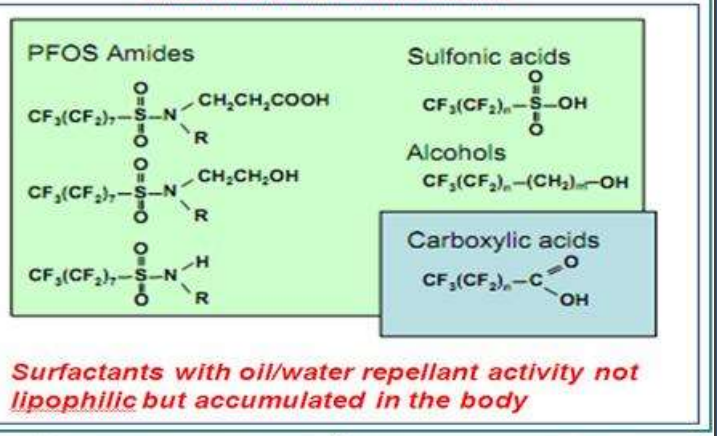
Perfluorochemicals (PFCs)



Some PFC Compounds of Interest

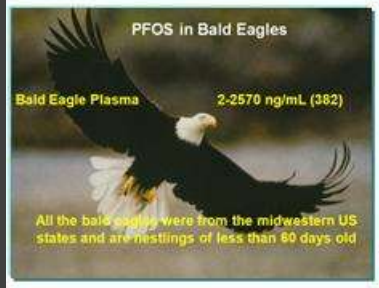
Compound	Formula
Tridecafluoroheptanoate (C7)	$C_6F_{13}COO^-$
Pentadecafluorooctanoate (C8; PFOA)	$C_7F_{15}COO^-$
Heptadecafluorononoate (C9)	$C_8F_{17}COO^-$
Nonadecafluorodecanoate (C10)	$C_9F_{19}COO^-$
Perfluoroundecanoate (C11)	$C_{11}F_{21}COO^-$
Perfluorododecanoate (C12)	$C_{12}F_{23}COO^-$
Perfluorooctane sulfonate (PFOS)	$C_8F_{17}SO_3^-$

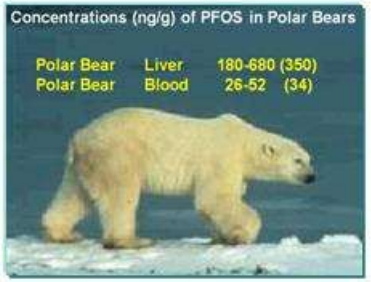
Perfluorosurfactants



Surfactants with oil/water repellant activity not lipophilic but accumulated in the body

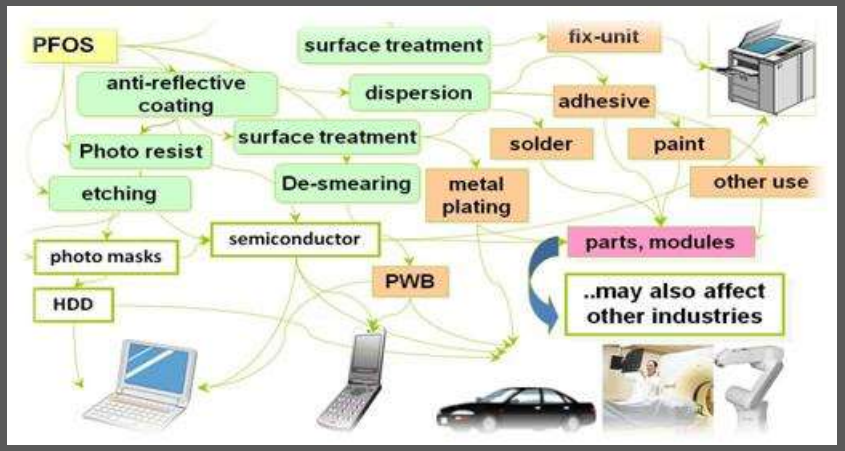
- Perfluorochemicals (PFCs) are a group of chemicals used to make fluoropolymer coatings and products that resist heat, oil, stains, grease, and water.
- PCFs are extremely heat stable and are resistant to breakdown in the environment
- PFCs have been found in rivers and lakes and in many types of animals on land and in the water.





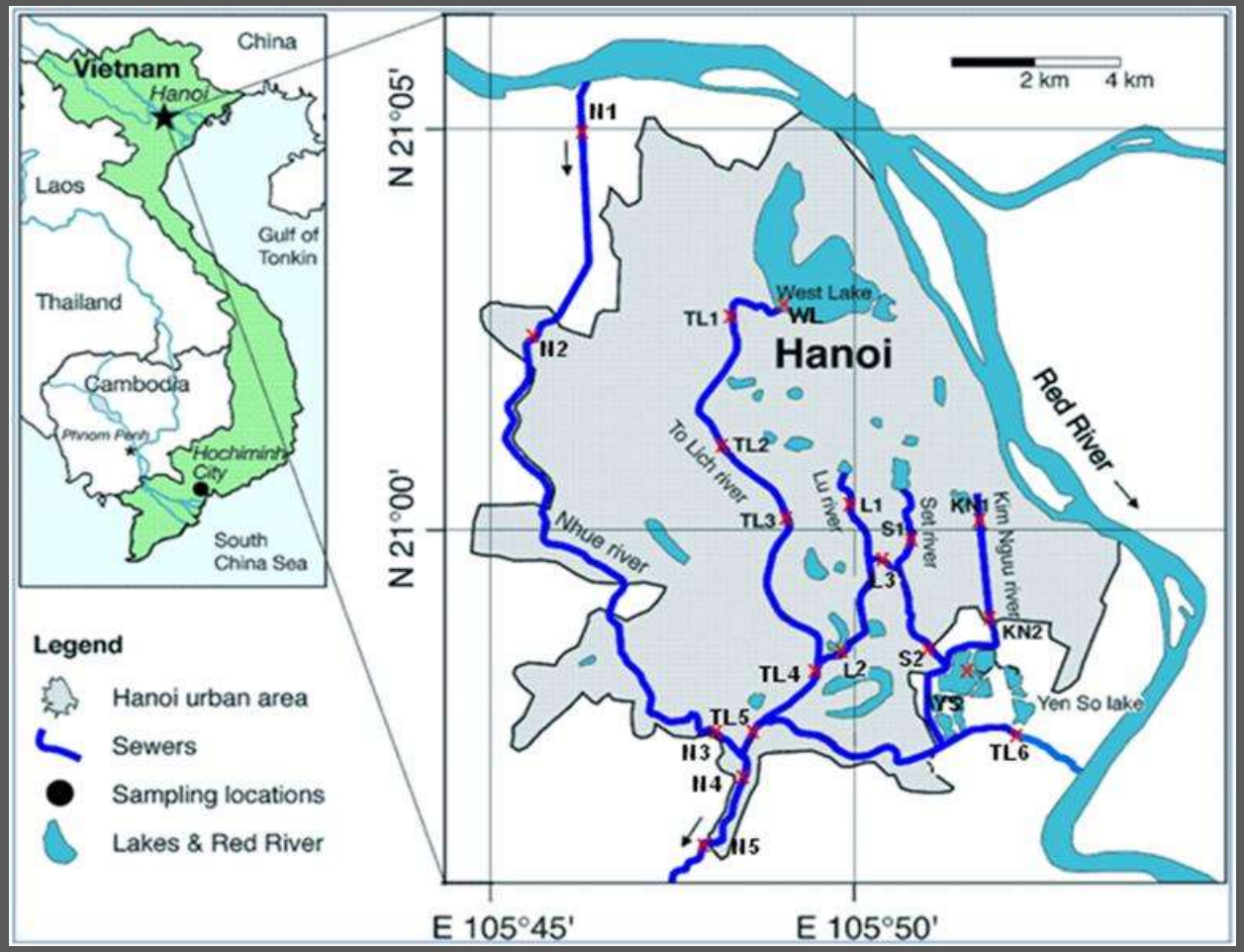
articles and products containing PFOS and its related substances on the consumer market

use of PFOS and its related substances in industrial sectors



fire fighting foams, aviation hydraulic fluids and insecticides

1. Sampling site in Hanoi drainage system



Hanoi city center

- ✓Total Area: 3,344 km2
- ✓Urban area: 186 km2
- ✓Population: more 7 million.

Hanoi drainage system in the urban including

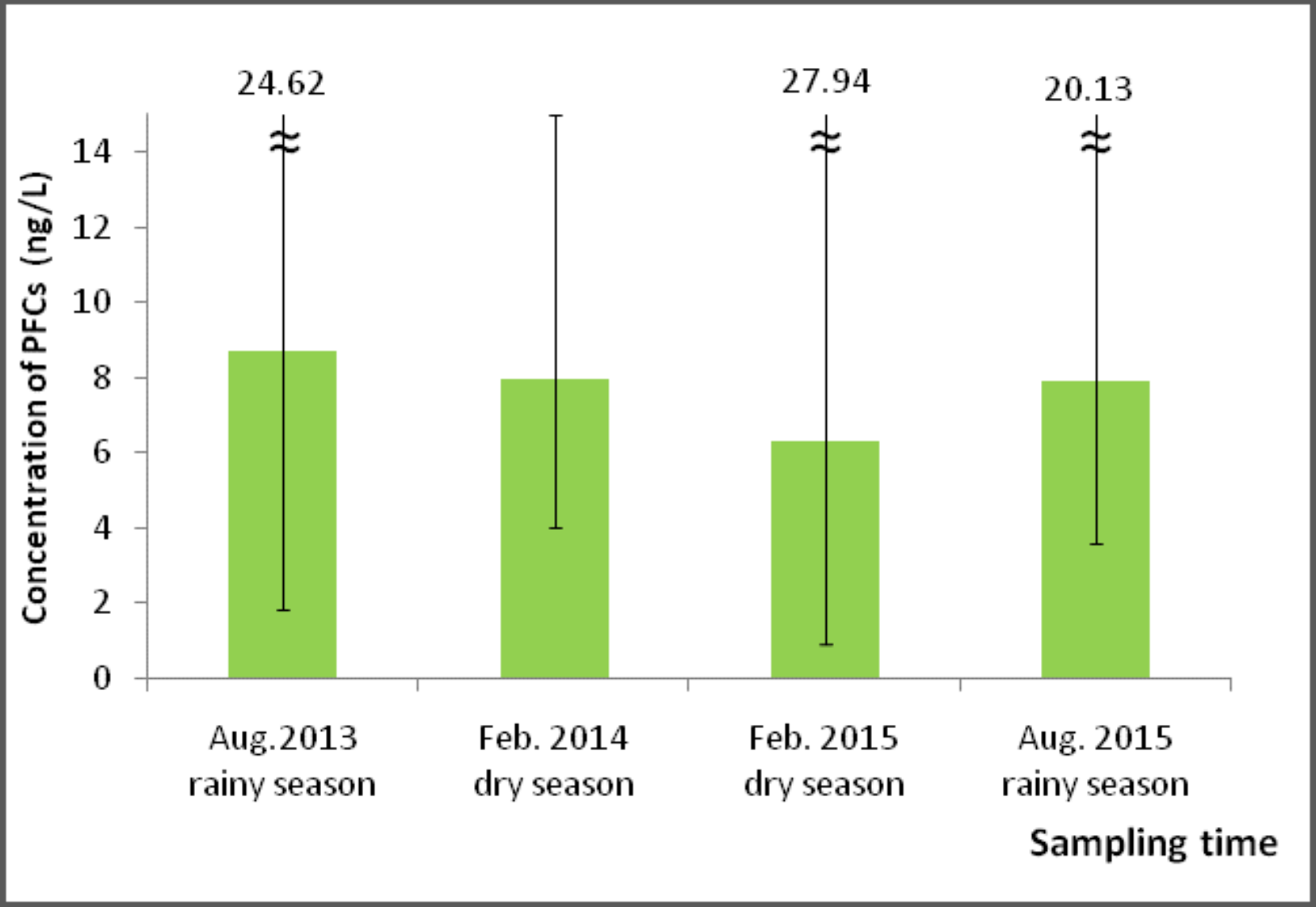
- ✓rivers: Nhue, To lich, Lu, Set, Kim Nguu
- ✓70 km length
- ✓Municipal waste water, rain water, …

Sampling:

- ✓Twenty locations
- ✓2013 (rainy season)
- ✓2014 (dry season)

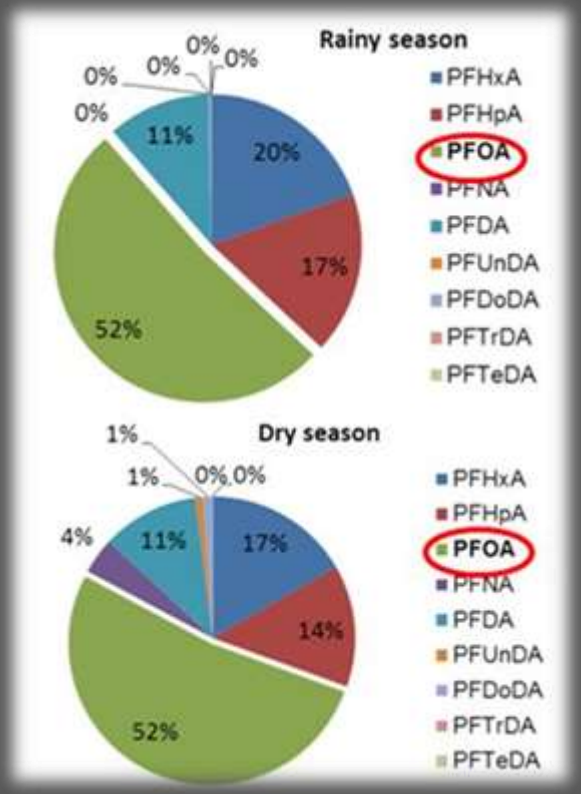
Data from UNU Project

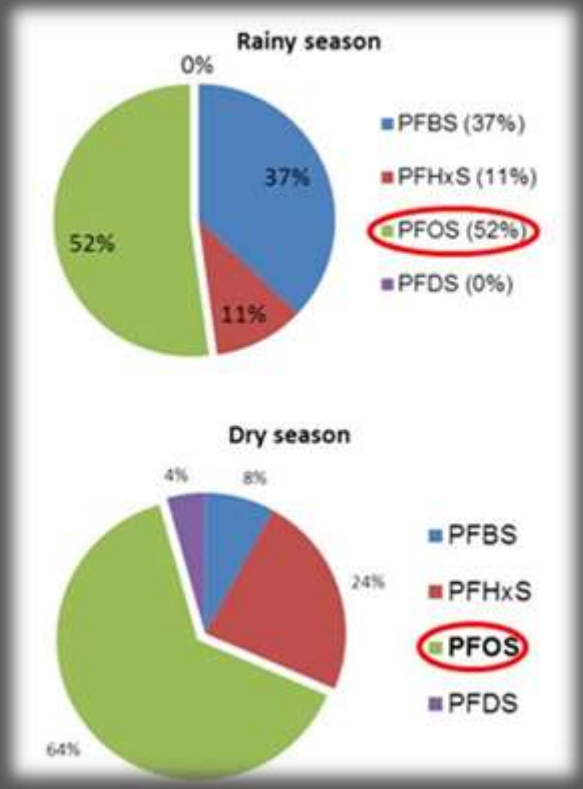
Profiles of PFCs in municipal wastewater from drainage system in Hanoi



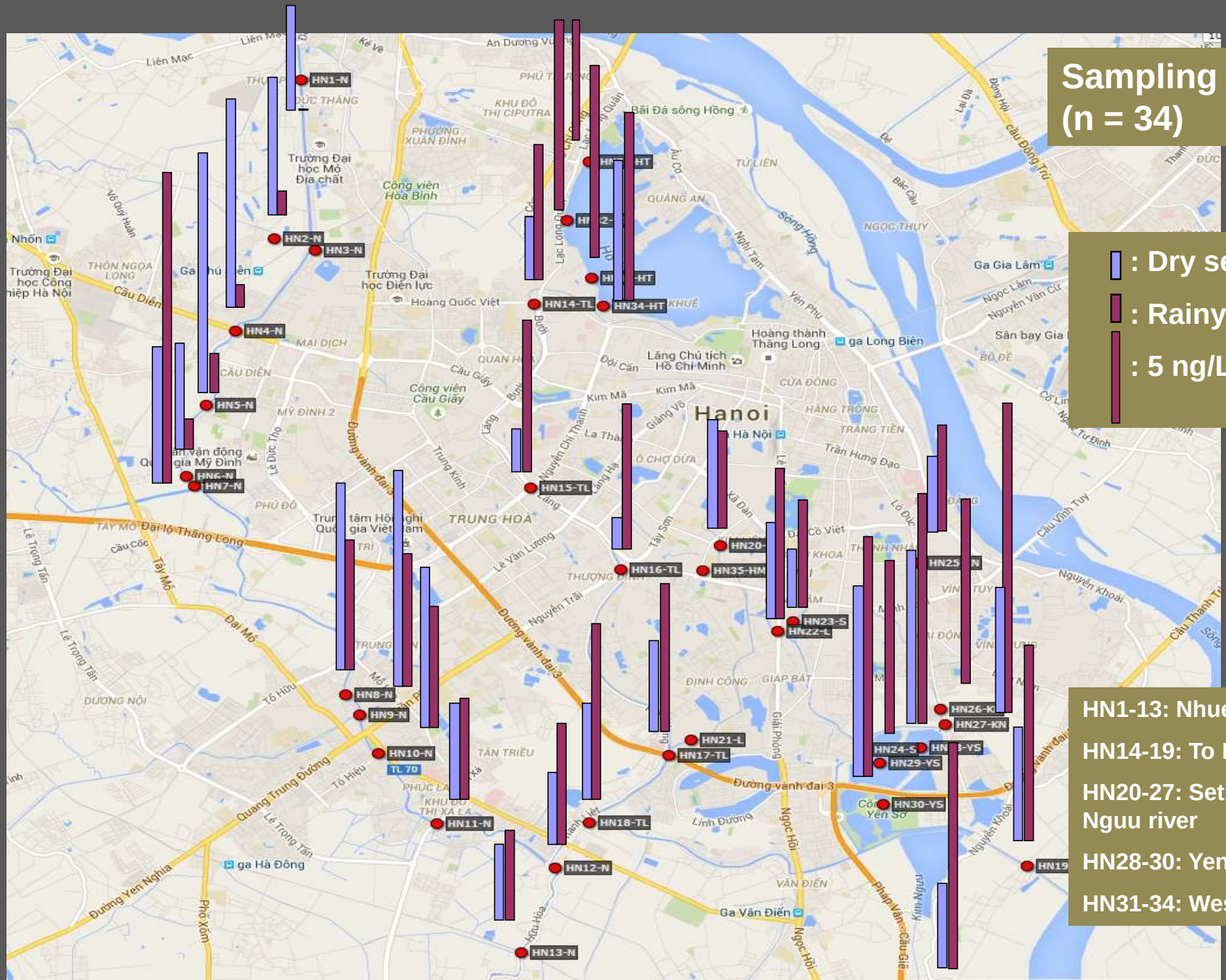
Profiles of PFCs in municipal wastewater from drainage system in Hanoi

	2013	2014	2015	2015
	Rainy season (n=20)	Dry season (n=20)	Dry season (n=30)	Rainy season (n=34)
PFAs	7.18 (1.66-21.66)	6.67 (3.47-12.09)	4.87 (0.93 - 15.30)	6.00 (2.61-13.66)
PFSs	1.54 (0.18-2.96)	1.30 (0.56-2.90)	1.44 (nd -12.64)	1.88 (0.98-6.47)
Sum PFCs	**8.72 ng/L**	**7.97 ng/L**	**6.31 ng/L**	**7.88 ng/L**





PFCs concentration in municipal wastewater from drainage system in Hanoi



2. Sampling around unused dumping site

Tay Mo Dumping site in Hanoi: 2015, dry season (January)
2015, wet season (August)

- ✓ Tay Mo dumping site is in the surrounding area of Hanoi city center
- ✓ All domestic waste of Hanoi was moved to Tay Mo dumgping site that had been used since 7/1997
- ✓ 9/1999: dumping site was closed because it was full
- ✓ 1 waste treatment plan belong to URENCO is working to treat urban compost

Data from UNU Project

PFCs concentration in unused dumping site in Hanoi

Sampling in 2015 (n = 8)

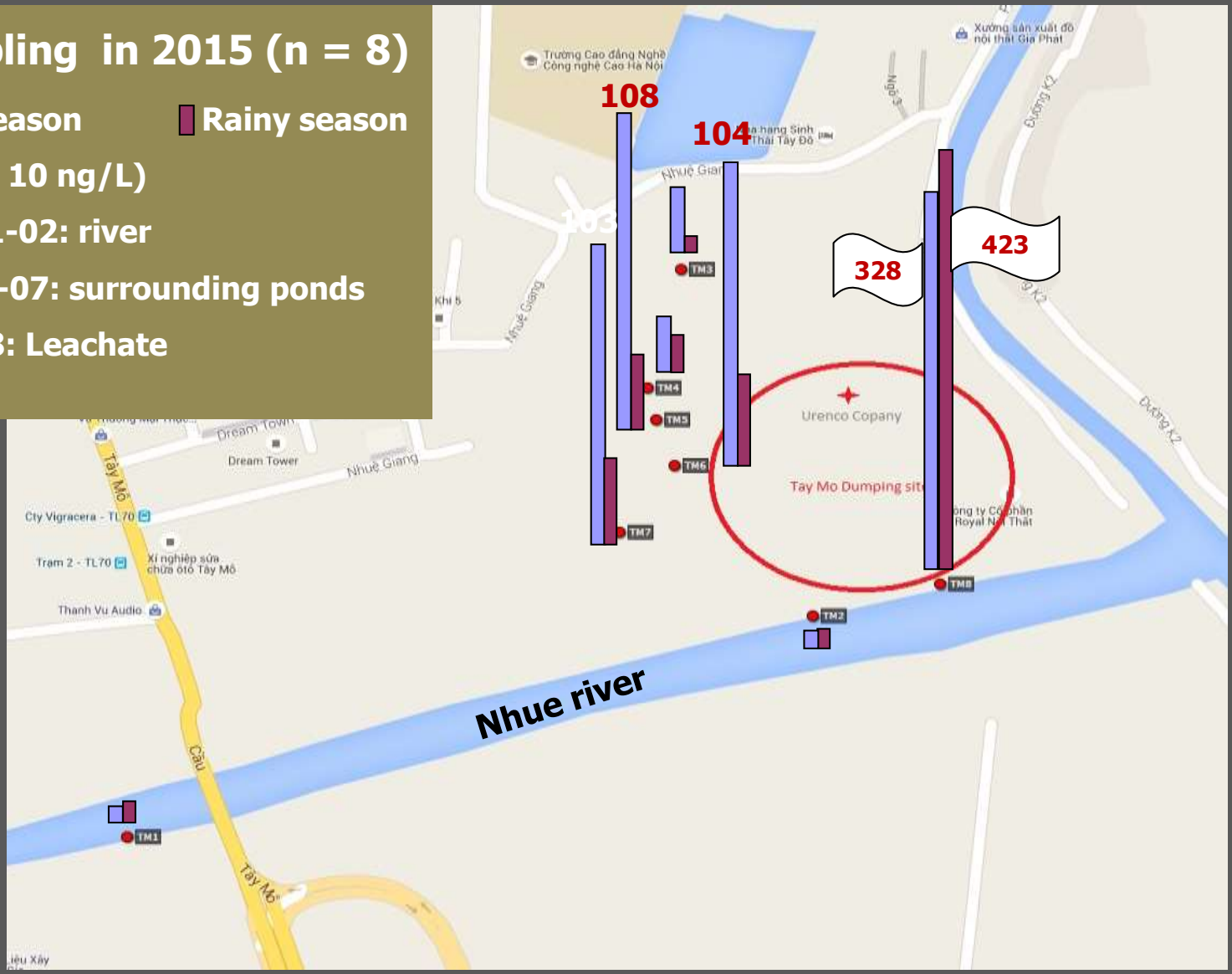
- Dry season
- Rainy season

(: 10 ng/L)

TM 01-02: river

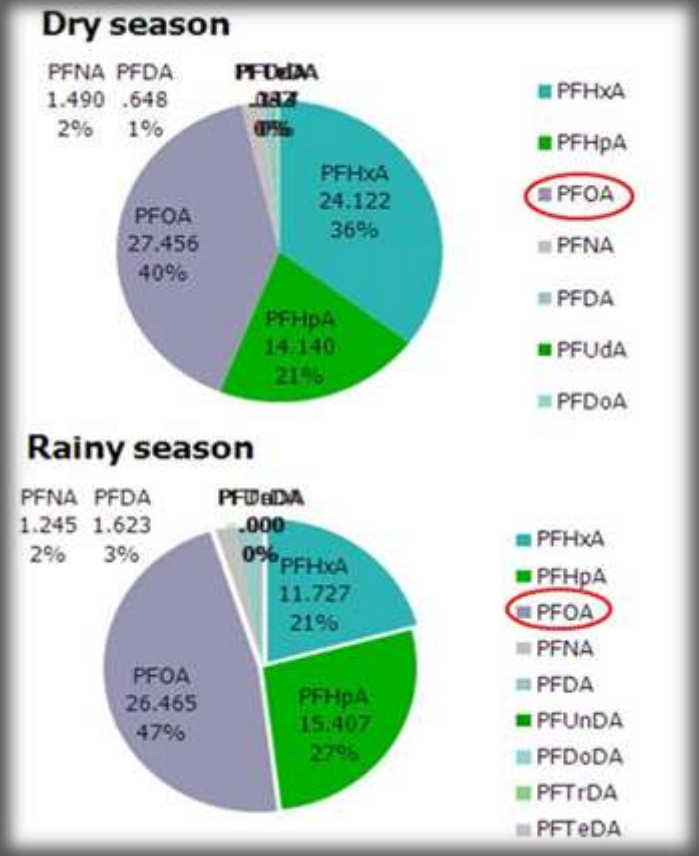
TM03-07: surrounding ponds

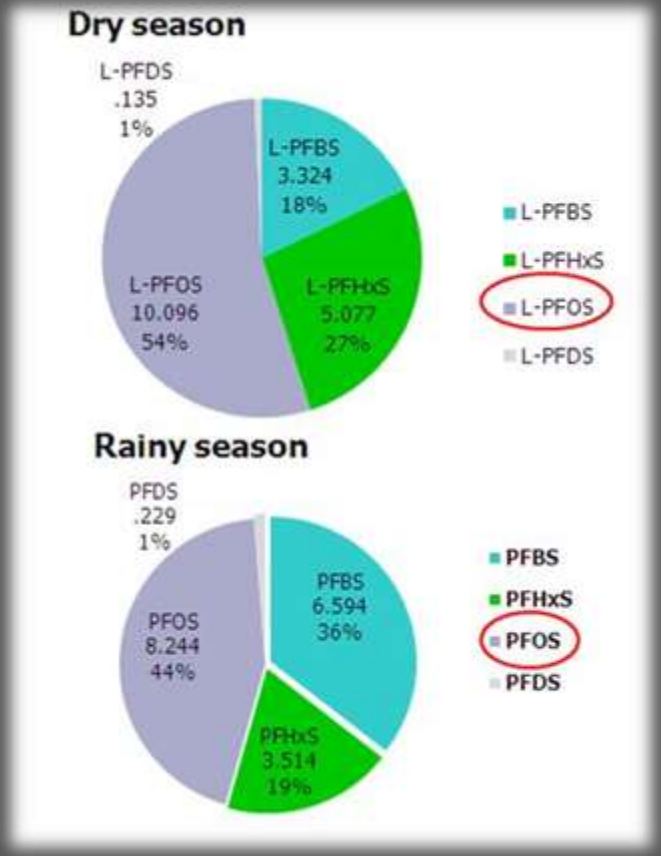
TM 08: Leachate



Profiles of PFCs in unused dumping site in Hanoi

	2015	2015
	Dry season (n=8)	**Rainy season** (n=8)
PFAs:	68.32 (3.03-267.24)	56.47 (3.75-347.52)
PFSs:	19.96 (0.26-67.89)	18.58 (0.69-105.56)
Sum PFCs:	**86.95 ng/L**	**75.05 ng/L**





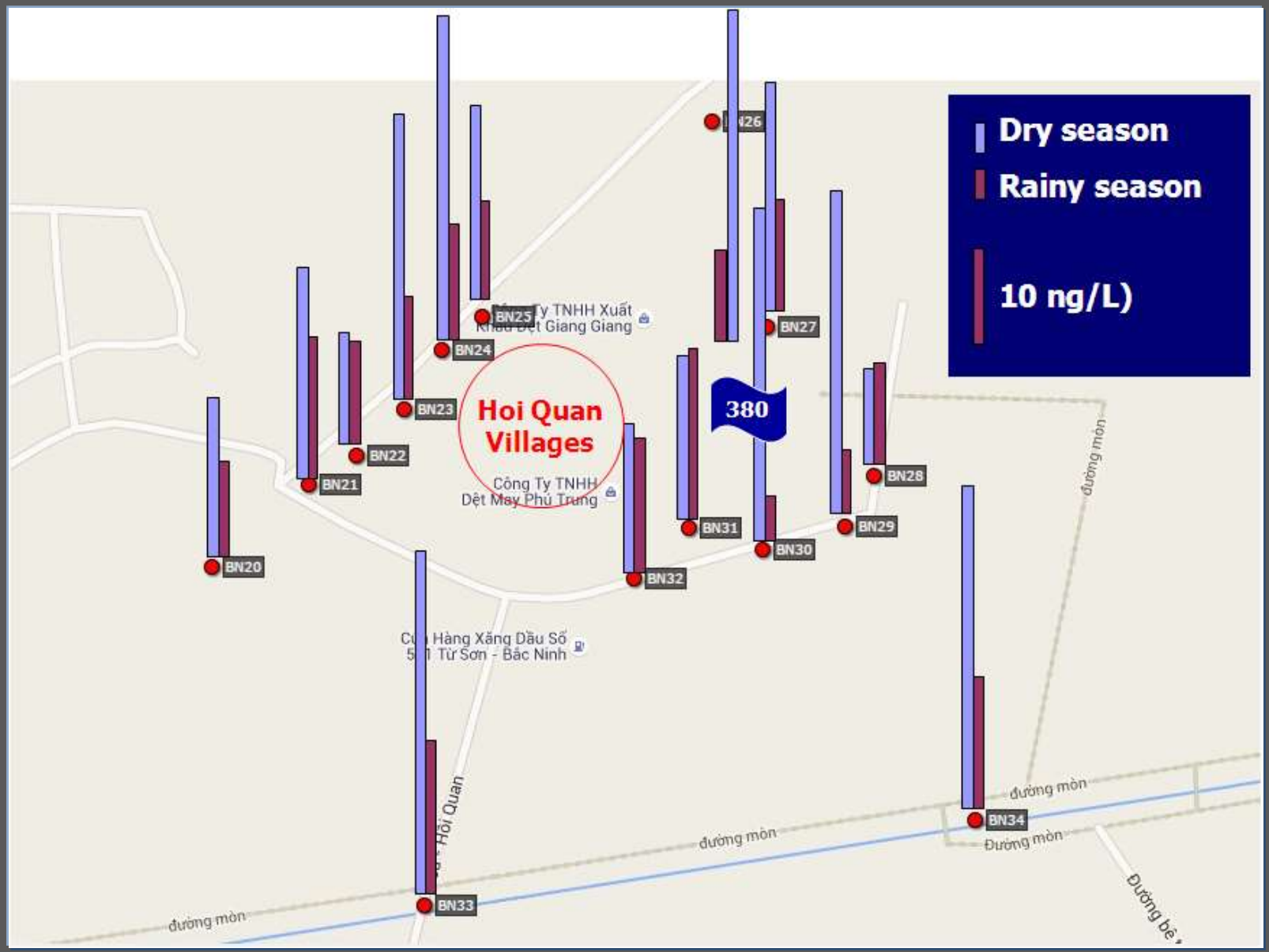
3. Sampling in Textile and dyeing village, Bac Ninh province

- Bac Ninh is 30km far from Hanoi. Hoi Quan is a village in Bac Ninh with population of 4,300 (~1.200 household)
- 60% of households are worked as textile and dyeing area. There are more 900 traditional looms and 200 sewing industrial machines .
- Village ‘s product is very diversified material including silk, wound for medicine , curtain material, wash cloth….

- ✓ **15 sampling points surrounding textile and dyeing village – Hoiquan, Bac Ninh**
- ✓ **2015, dry season (January)**
- ✓ **2015, wet season (August)**

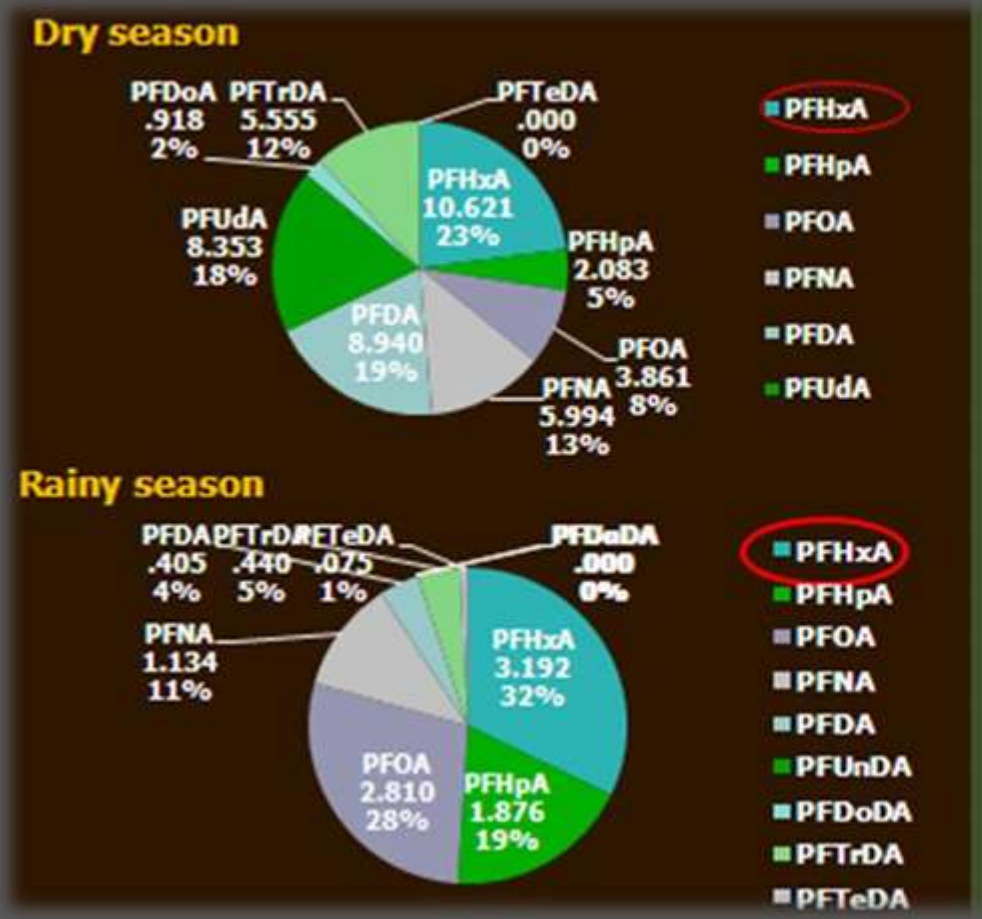
Data from UNU Project

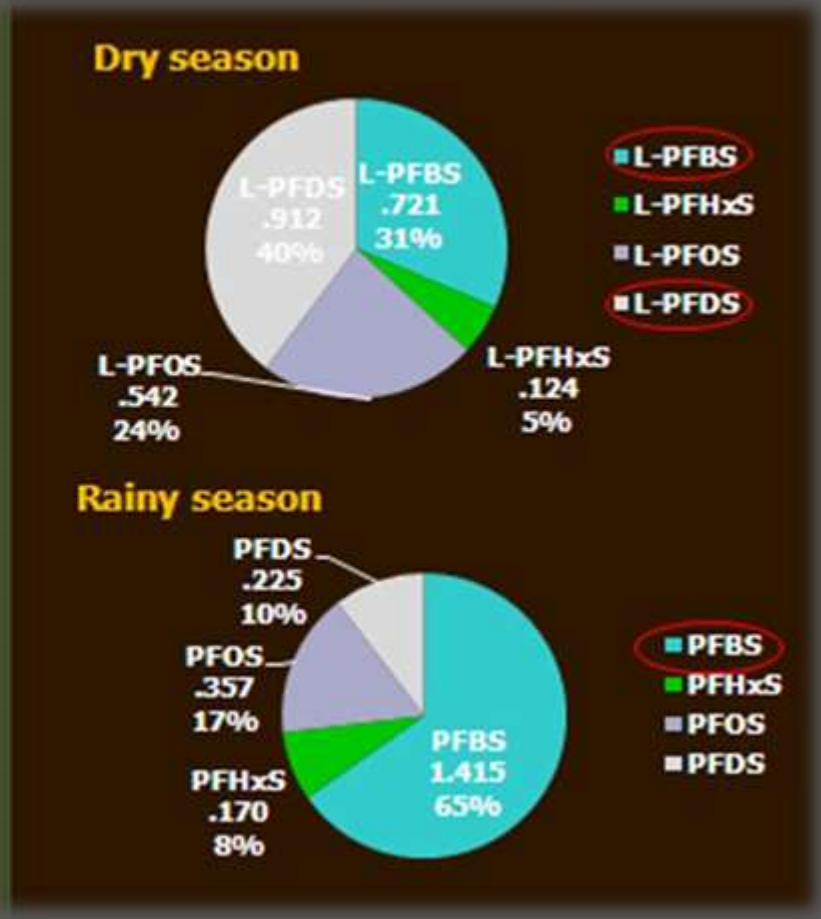
PFCs contaminated level in water from Textile and dyeing village in Hoi Quan, Bac Ninh



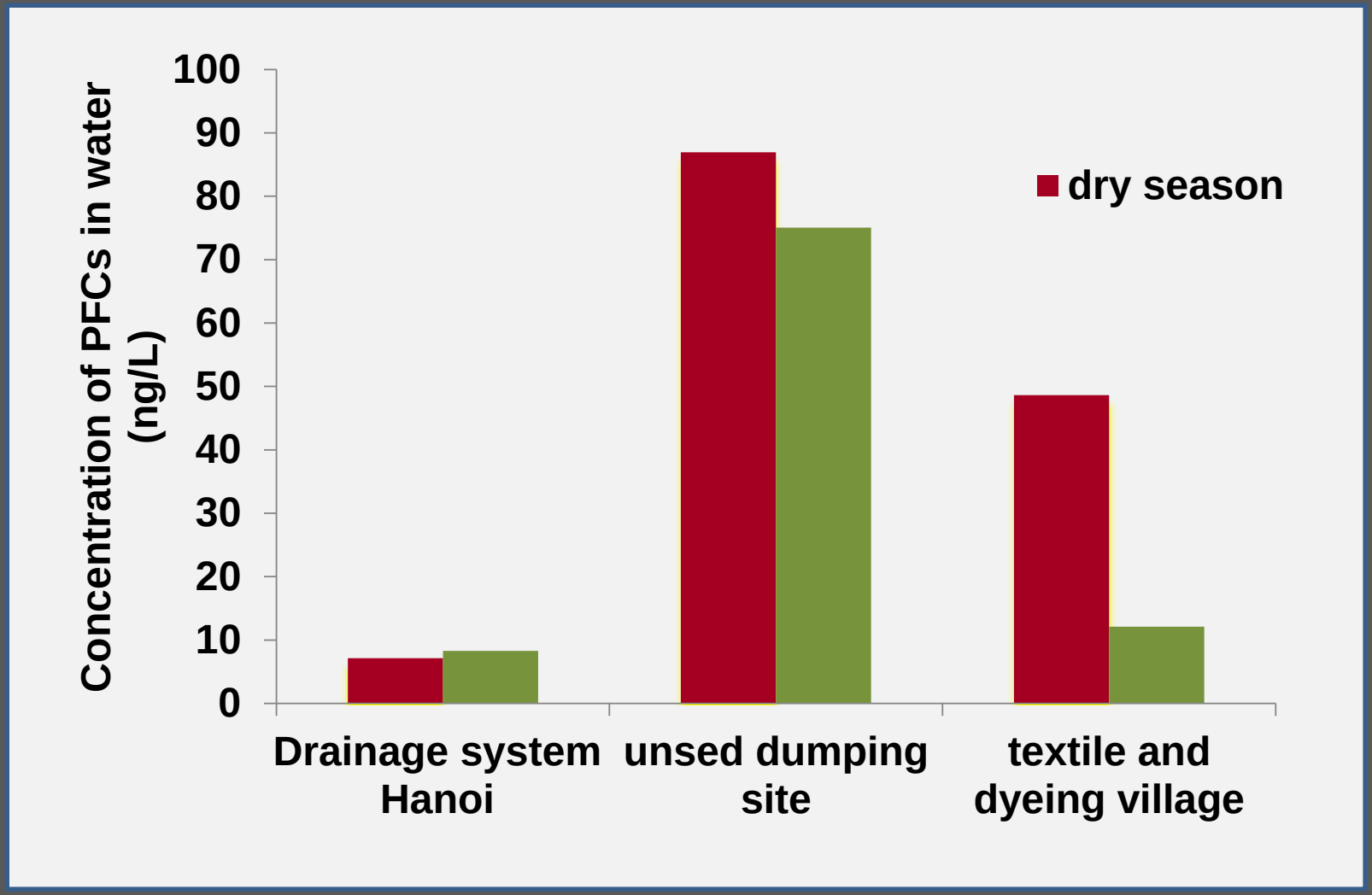
Profiles of PFCs in textile and dyeing village in Bac Ninh

	2015	2015
	dry season (n=15)	Rainy season (n=15)
PFAs:	46.33 (6.15-391.36)	9.93 (1.55-19.35)
PFSs:	2.30 (nd-15.04)	2.17 (0.76-6.09)
Sum PFCs:	**48.63 ng/L**	**12.10 ng/L**

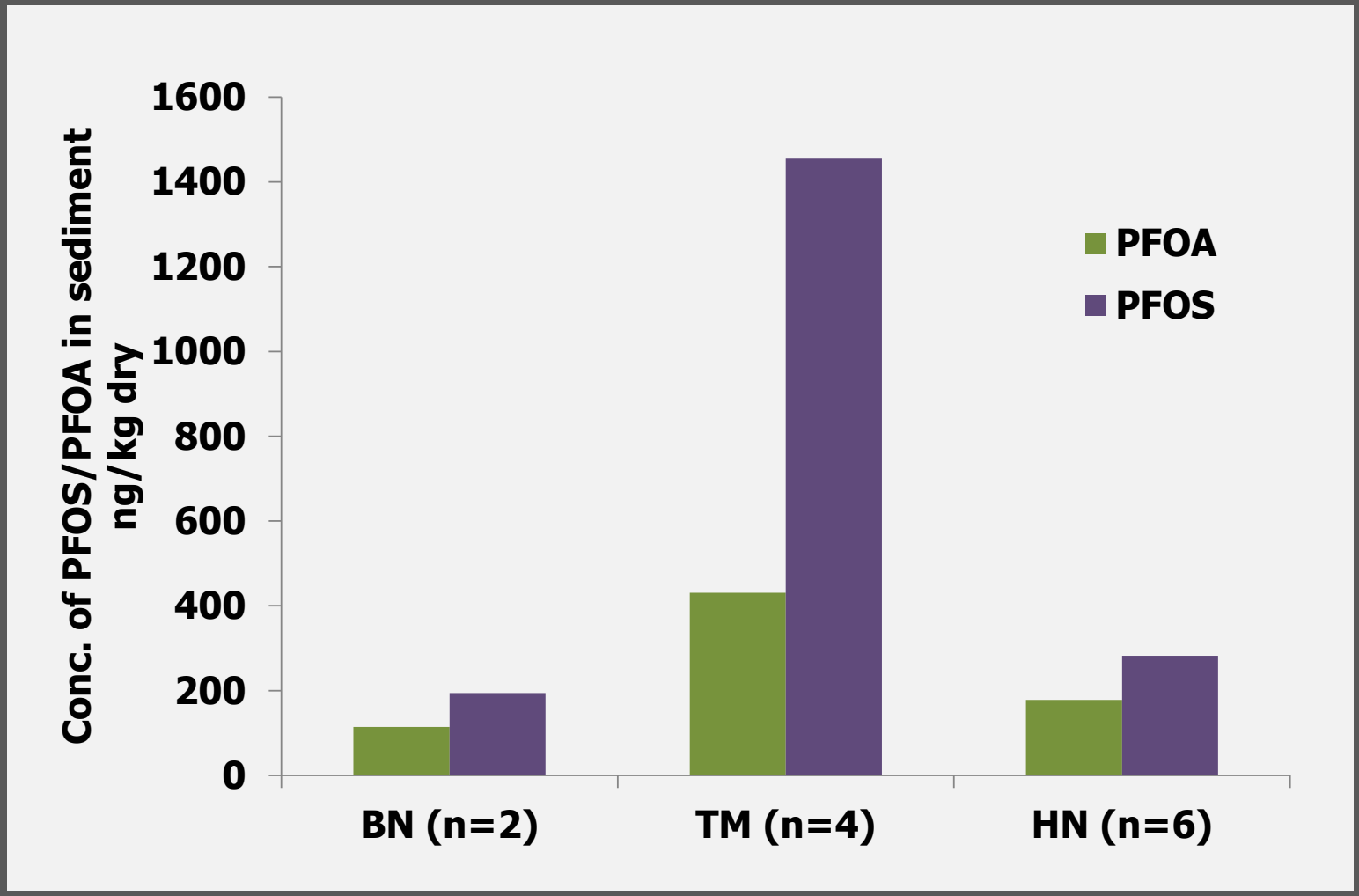




Average concentration of PFCs in water from various sites



PFOS and PFOA in sediment



PFCs contaminated level in water

1/Municipal wastewater from drainage system in Hanoi

- PFCs concentration was similar in 4 sampling campaigns including rainy and dry seasons (from 2013 to 2015) and approximately 7÷8 ng/L in water.
- PFCs contamination sources in drainage system of Hanoi was unmodified.

2/Dumping site in Hanoi

- Tay Mo dumping site had not been used for 15 years. The concentration of PFCs in around surface water was 87 ng/L in dry season and 75 ng/L in rainy season.
- The highest PFCs was 423 ng/L and 328 ng/L in rainy and dry seasons, respectively that is in the leachate of dumping site.
- PFOA and PFOS were dominated compounds in 13 PFCs analysed. This means that the PFCs contamination sources is similar of municipal wastewater from drainage system in Hanoi.

3/Textile and dyeing village (Bac Ninh province)

- PFCs concentration of waste water from textile and dyeing village was four times higher in dry season (49 ng/L) than rainy season (12ng/L).
- The contamination source of PFCs in the trade village was difference two sampling locations because the PFC dominated compounds were PFHxA, PFDS and PFBS.

Analytical methods of POPs

Sample preparation

- ✓ Liquid – liquid extraction
- ✓ Ultrasonic extraction, Soxhlet extraction, Pressurized Liquid Extraction/ Accelerated Solvent Extraction (PLE or ASE)…
- ✓ Solid phase extraction (SPE)…

Qualitative and Quantitative Analysis

- ✓ Gas chromatography: GC/ECD, GC/TQMS, GC/TOFMS, HRGCMS
- ✓ Liquid chromatography: LCMSMS

Quality assurance

- ✓ Internal standards, Surrogate, Blank correction, Recovery performance …
- ✓ Spiked samples, Certificate materials
- ✓ Internal-lab blind samples, Inter-laboratory crosscheck program

UNEP DATABANK OF LABORATORIES ANALYZING PERSISTENT ORGANIC POLLUTANTS
"POPS LABORATORY DATABANK"

- Select a Filter -

back to Previous | clear all

Selection criteria used

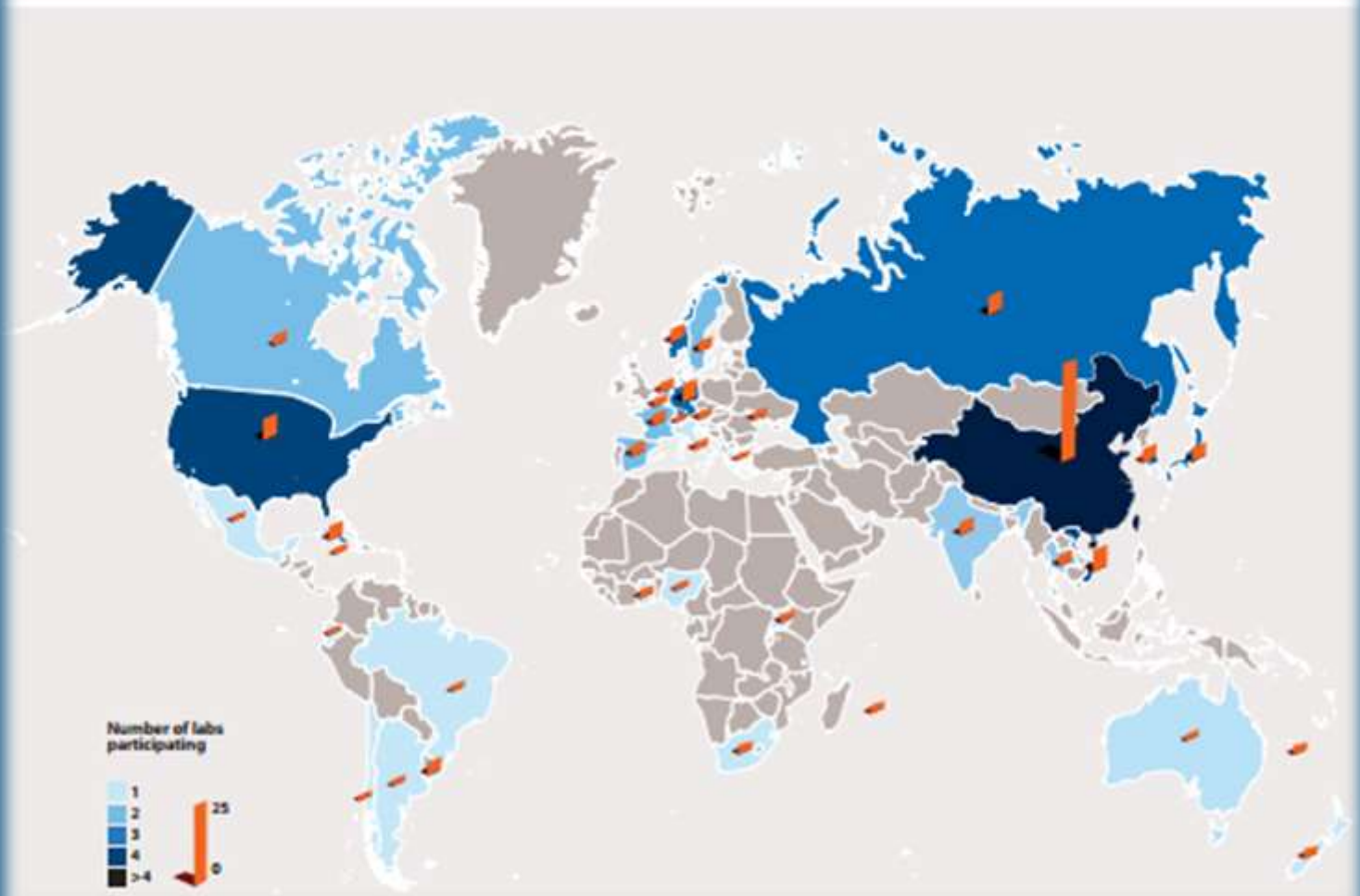
ID	ATTRIBUTE	VALUE
1	COUNTRIES	Viet Nam

7 Laboratories found

NAME	COUNTRY	PRINT
Dioxin Laboratory, Center for Environmental Monitoring, Vietnam Environment Administration	Viet Nam	
CETASD - Research Centre for Environmental Technology and Sustainable Development	Viet Nam	
The Environmental Testing Laboratory	Viet Nam	
Northern Pesticide Control Center	Viet Nam	
The Environment Monitoring Laboratory, Institute for Nuclear Science and Technology	Viet Nam	
Chemical and Environmental Department, Vietnam-Russia Tropical Centre	Viet Nam	
Marine Environmental Chemical Laboratory	Viet Nam	

7 elements

Bi-ennial Global Interlaboratory Assessment on Persistent Organic Pollutants



The 3rd inter-laboratory crosscheck program on analysing PCB in oils

for registered laboratories within the POP Analysis Laboratory Network

Project "Vietnam PCB Management"

Hanoi, 8 /2013

General information

1. Participants :

- ✓ 24 laboratories in the network registered (22 laboratories sent the results)
- ✓ 2 international laboratories:
  - + Bachema laboratories, Switzerland (assigned laboratory)
  - + EMPA laboratories, Switzerland

2. Set of samples and standards (prepared by the organization committee):

- 5 blind oil samples (PCB concentrations from ten ppm to thousands ppm)
- Standard 6-congener PCB indicator mixture (PCB 28, 52, 101, 138, 153 and 180), concentrations: 10 ng/µl.
- Standard 6-congener PCB indicator isotope mixture ($PCB^{13}C$: 28, 52, 101, 138, 153 và 180), concentrations: 1 ng/µl.
- Perylen d^{12} concentrations: 10 ng/µl

Data Analysis Method

Z score

Proficiency of laboratories is evaluated based on Z-score index (ISO 13258 : 2005, "Statistical methods for use in proficiency testing by inter-laboratory comparisons"):

$$Z\text{-score} = (x - x_a)/\sigma_p$$

In which:

- x analyzing result provided by participated laboratories
- x_a assigned value (provided by "expert" lab)
- σ_p fitness-for-purpose-based "standard deviation for proficiency assessment"

Assigned values and standard deviation used to determine inter-laboratories crosscheck performance on analyzing PCB in transformed oils- 2013

Oil samples	Unit	Assigned values (total PCBs) - x_a	Relative standard deviation	Standard deviation - σ_p
Oil – 01	mg/kg	42,100	12%	5,052
Oil – 02	mg/kg	91.0	18%	16.4
Oil – 03	mg/kg	1,170	12%	140
Oil – 04	mg/kg	11.8	24%	2.8
Oil – 05	mg/kg	91.0	18%	16.4

Evaluation

	$\lvert Z \rvert$	≤ 2.0	**satisfied results**
2.0 <	$\lvert Z \rvert$	**< 3.0**	questionable results, requiring another test
	$\lvert Z \rvert$	**≥ 3.0**	un satisfied results, requiring actions

Summary of PCBs analysis procedure in oil samples provided by laboratories

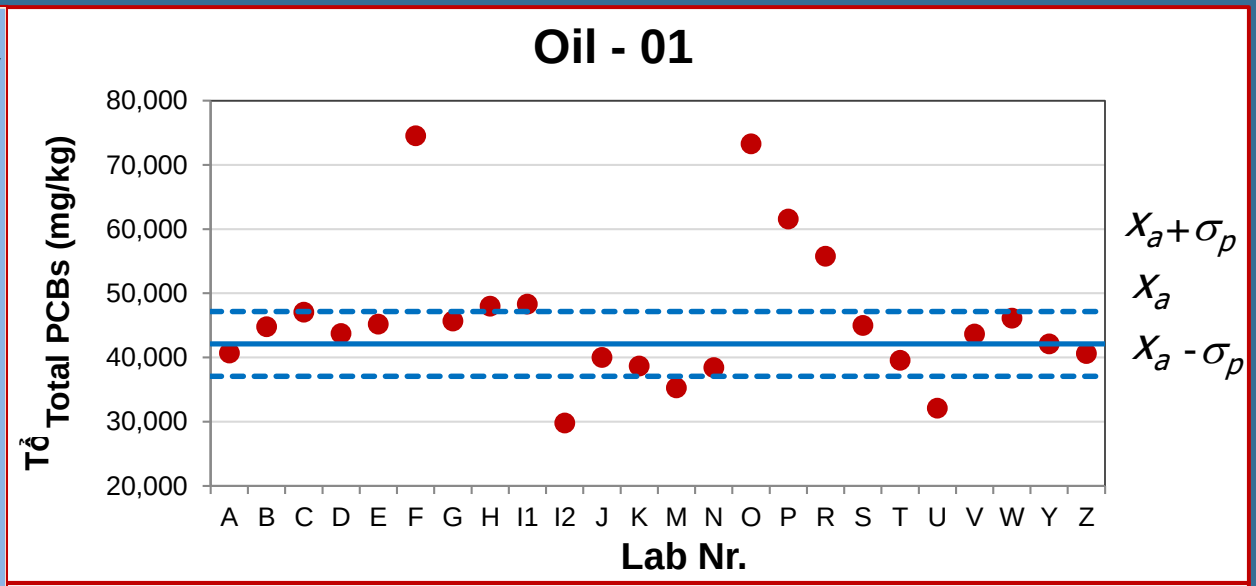
1. **Sample preparation:**
   - Dilution by solvent (nHexane, Cyclohexane, isooctane)
   - Acid Washing
   - Cleanup by SPE: Florisil (18), Silicagel (4),SAX/SCX (1), Multi-layer silicagel, alumina column (1)

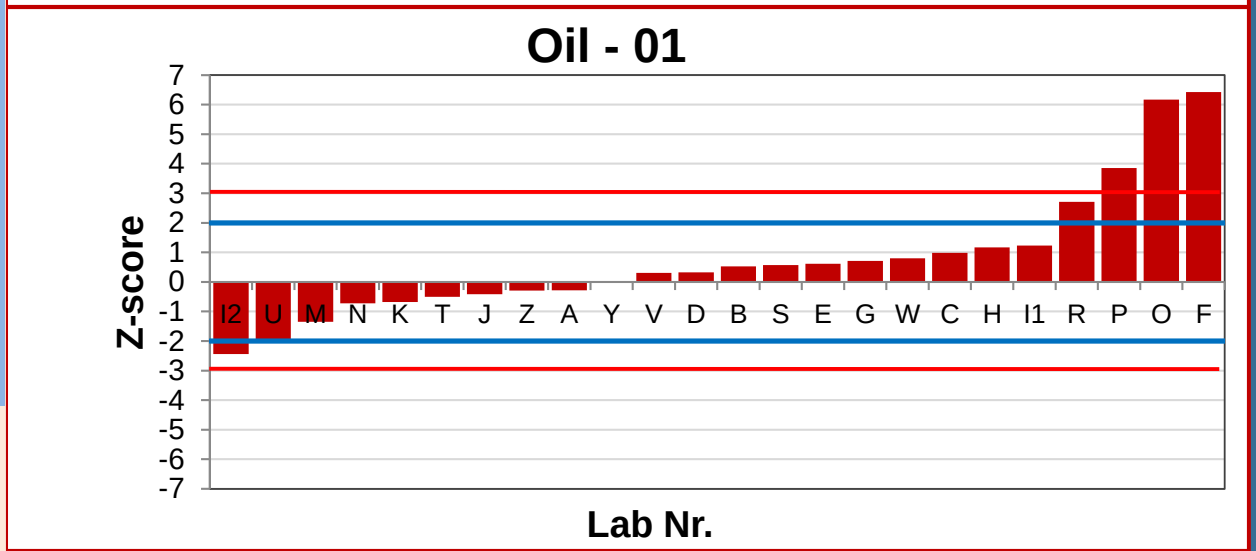
2. **Analysis:**
   - Detector: ECD (10), MS (13), HRMS (1)
   - Separation column DB5 and equivalence: 30m (20), 60m (2)
   - Internal Standards: NO (7), YES (16)
   - Surrogates: NO (8), YES (15)
   - Blank correction: NO (12), YES (11)
   - Recovery performance: NO (11), YES (12)
   - Total calculated PCBs: 6 congeners (22), Aroclor (2)

   - SOP: EPA 8082 (2), EPA 6013 (1) and in-lab methods

Assessment of the laboratories' proficiency: oil – 01 (x_a = 41.200 mg/kg)

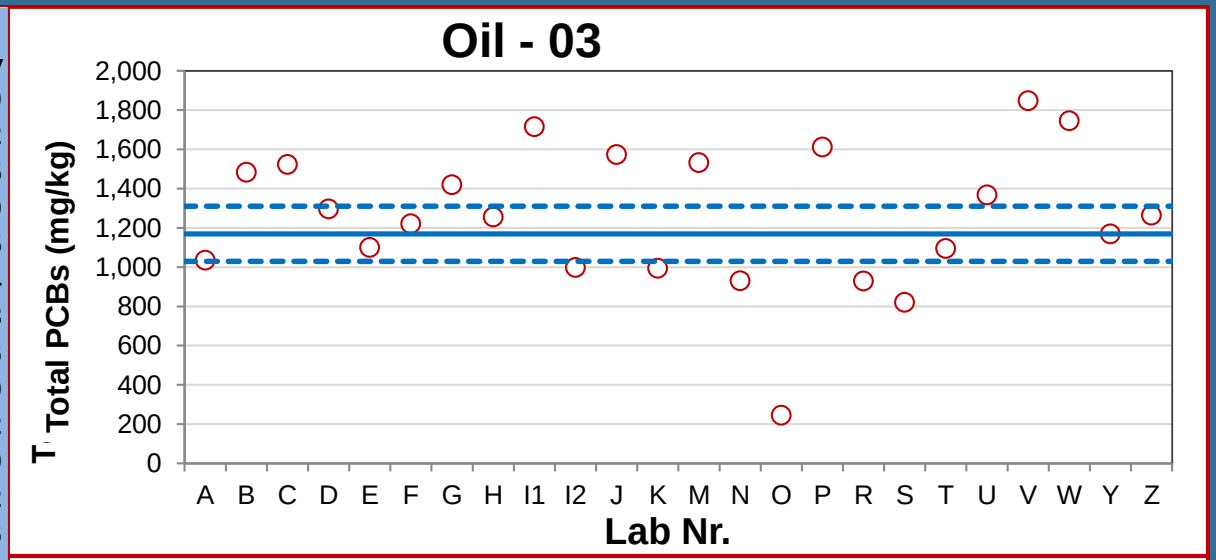
Oil 1	Tổng PCB mg/kg	Z-score (Bachema) 12% uncertainty
A	40.692	-0,3
B	44.780	0,5
C	47.071	1,0
D	43.745	0,3
E	45.194	0,6
F	74.542	6,4
G	45.699	0,7
H	47.997	1,2
I1	48.304	1,2
I2	29.788	-2,4
J	39.987	-0,4
K	38.649	-0,7
M	35.277	-1,4
N	38.437	-0,7
O	73.282	6,2
P	61.579	3,9
R	55.789	2,7
S	45.000	0,6
T	39.562	-0,5
U	32.082	-2,0
V	43.647	0,3
W	46.123	0,8
Y	42.100	0,0
Z	40.631	-0,3
Q	15.874	-5,2
Assigned value	42100	
Lower value	37048	
Upper value	47152	
Uncertainty	12%	

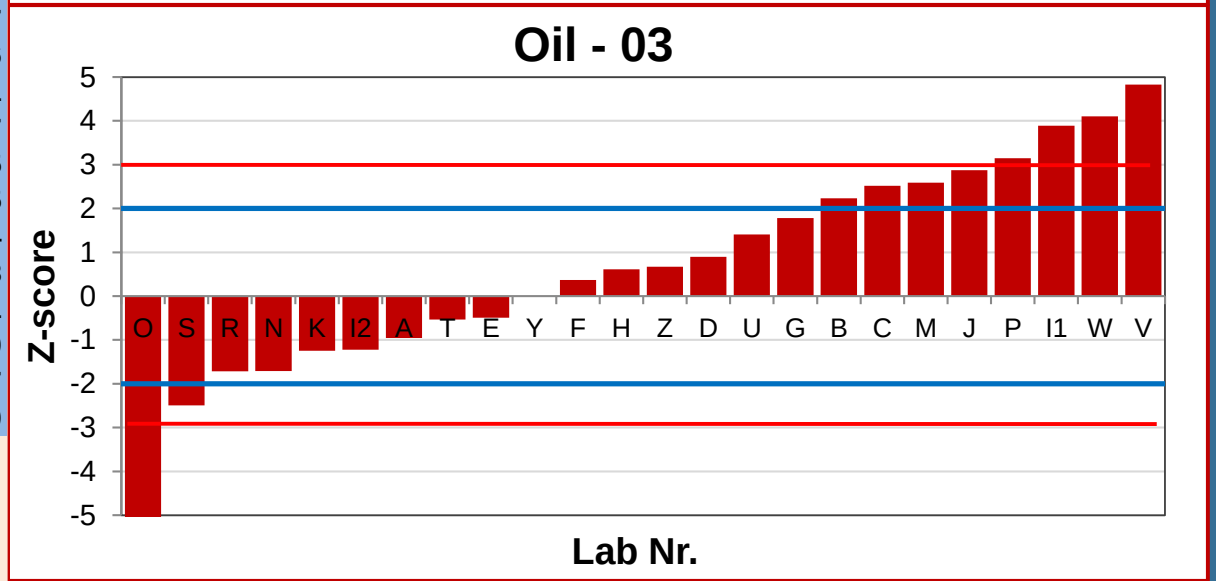




Assessment of the laboratories' proficiency: oil – 03 (x_a = 1.170 mg/kg)

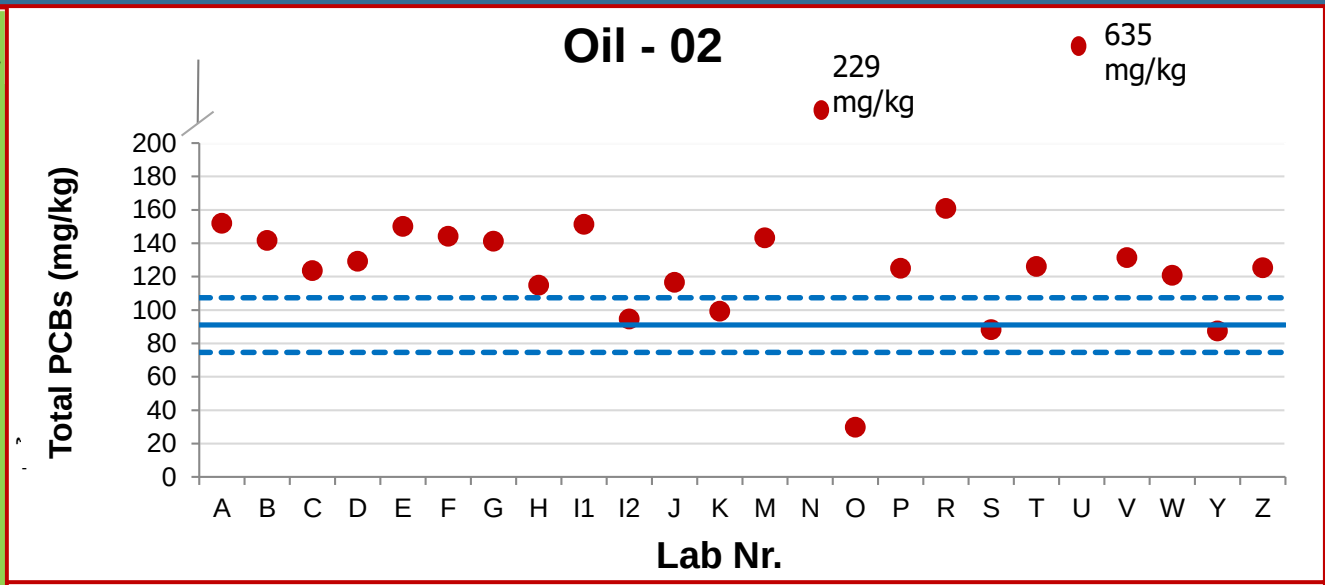
Oil 3	Tổng PCB mg/kg	Z-score (Bachema) 12% uncertainty
A	1.035	-1,0
B	1.483	2,2
C	1.524	2,5
D	1.296	0,9
E	1.101	-0,5
F	1.222	0,4
G	1.420	1,8
H	1.256	0,6
I1	1.716	3,9
I2	998	-1,2
J	1.574	2,9
K	995	-1,2
M	1.533	2,6
N	930	-1,7
O	246	-6,6
P	1.612	3,1
R	929	-1,7
S	820	-2,5
T	1.095	-0,5
U	1.368	1,4
V	1.848	4,8
W	1.746	4,1
Y	1.170	0,0
Z	1.265	0,7
Q	11.713	75,0
Assigned value	1.170	
Lower value	1030	
Upper value	1310	
Uncertainty	12%	

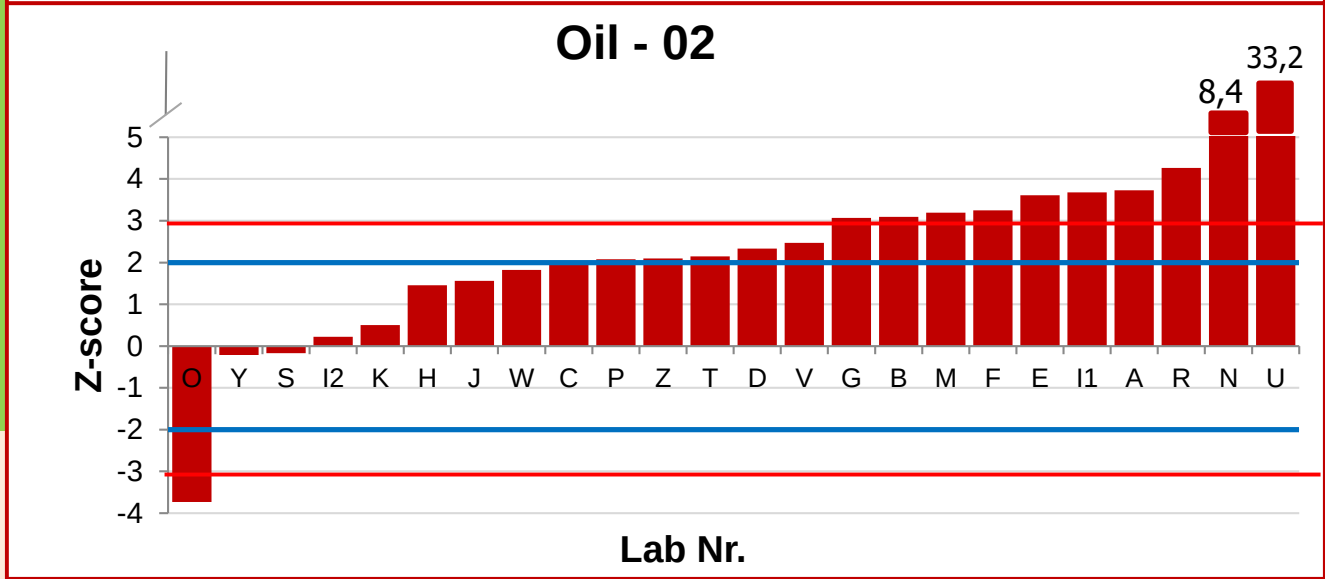




Assessment of the laboratories' proficiency: oil – 02 (x_a = 91,0 mg/kg)

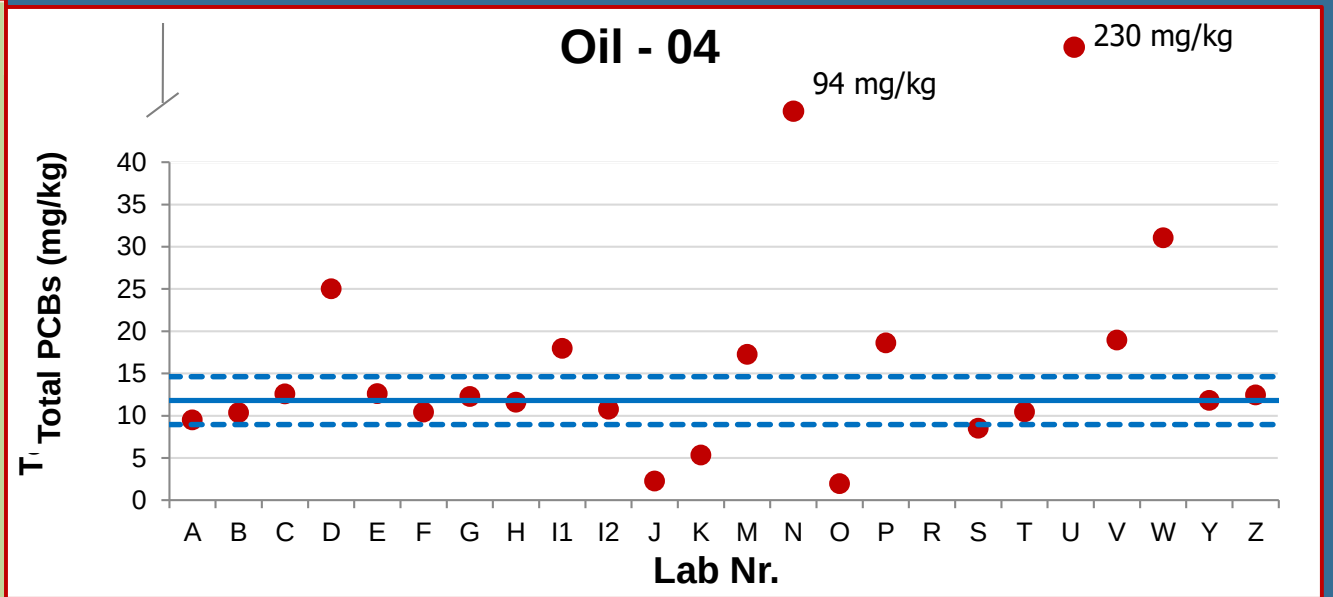
Oil 2	Tổng PCB mg/kg	Z-score (Bachema) 18% uncertainty
A	152	3,7
B	141,7	3,1
C	124	2,0
D	129	2,3
E	150,11	3,6
F	144	3,3
G	141,2	3,1
H	114,9	1,5
I1	151,29	3,7
I2	94,65	0,2
J	116,61	1,6
K	99,26	0,5
M	143,315	3,2
N	243,700	9,3
O	29,85	-3,7
P	125	2,1
R	160,812	4,3
S	88,2	-0,2
T	126,2	2,1
U	635	33,2
V	131	2,5
W	120,88	1,8
Y	87,5	-0,2
Z	125	2,1
Q	1.280,18	72,6
Assigned value	91,0	
Lower value	74,6	
Upper value	107,4	
Uncertainty	18%	

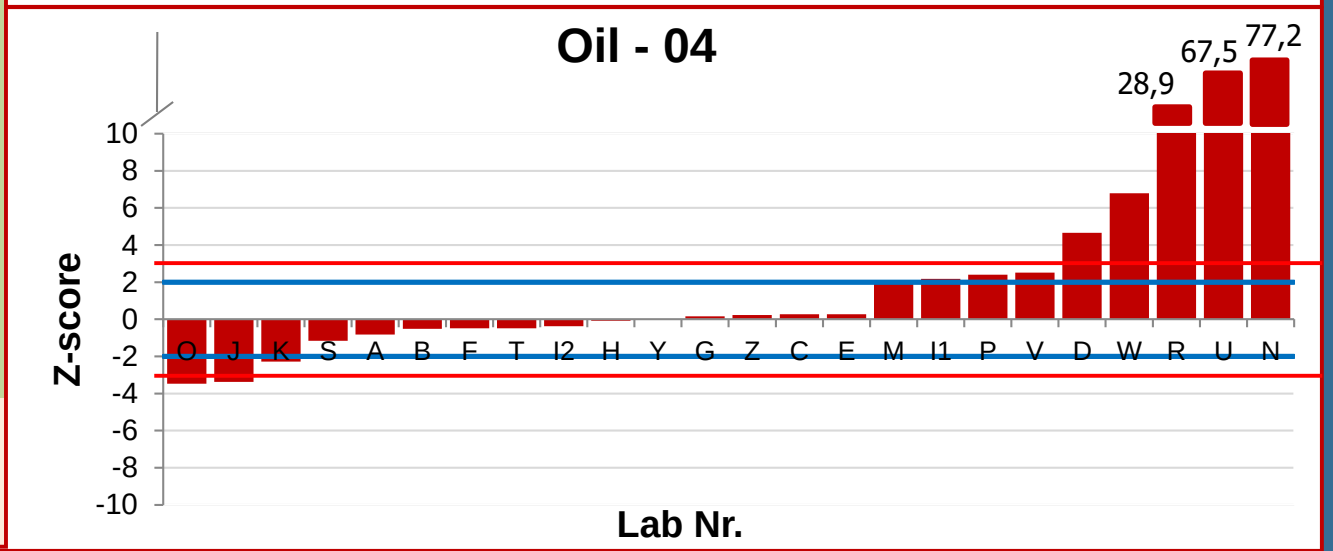




Assessment of the laboratories' proficiency: oil – 04 (x_a = 11,8 mg/kg)

Oil 4	Tổng PCB mg/kg	Z-score (Bachema) 24% uncertainty
A	9,5	-0,8
B	10,4	-0,5
C	12,6	0,3
D	25,0	4,7
E	12,6	0,3
F	10,4	-0,5
G	12,3	0,2
H	11,6	-0,1
I1	18,0	2,2
I2	10,8	-0,4
J	2,3	-3,4
K	5,3	-2,3
M	17,3	1,9
N	230,4	77,2
O	2,0	-3,5
P	18,6	2,4
R	93,6	28,9
S	8,5	-1,2
T	10,4	-0,5
U	203,0	67,5
V	18,9	2,5
W	31,0	6,8
Y	11,8	0,0
Z	12,4	0,2
Q	68,0	18,0
Assigned value	11,8	
Lower value	9,0	
Upper value	14,6	
Uncertainty	24%	





Summary on percentage of laboratories graded according to Z-score and concentration of PCBs

Sample size	Laboratory ratios (%)		
	IZI ≤ 2	2 < IZI < 3	IZI ≥ 3
Oil 1 - ten thousands ppm	**76%**	**8%**	**16%**
Oil 3 - thousands ppm	**60%**	**20%**	**20%**
Oil 2 & 5 - hundreds ppm	**36%**	**18%**	**46%**
Oil 4 - tens ppm	**42%**	**16%**	**32%**

Lab	Z score					Detector	6 cong.	Aroclor
	Oil - 01	Oil - 03	Oil - 02	Oil -05	Oil - 04			
I2	-2,4	-1,2	0,2	0,2	-0,4	ECD		x
S	0,6	-2,5	-0,2	0,0	-1,2	ECD		x
H	1,2	0,6	1,5	1,2	-0,1	MS	x	
K	-0,7	-1,2	0,5	0,1	-2,3	MS	x	
T	-0,5	-0,5	2,1	2,0	-0,5	MS	x	
Z	-0,3	0,7	2,1	1,5	0,2	HRMS	x	
BACHEMA						ECD	x	

- ***No difference between results achieved by determination of total PCB using 6-congener method or using Aroclor mixture among "good labs"***

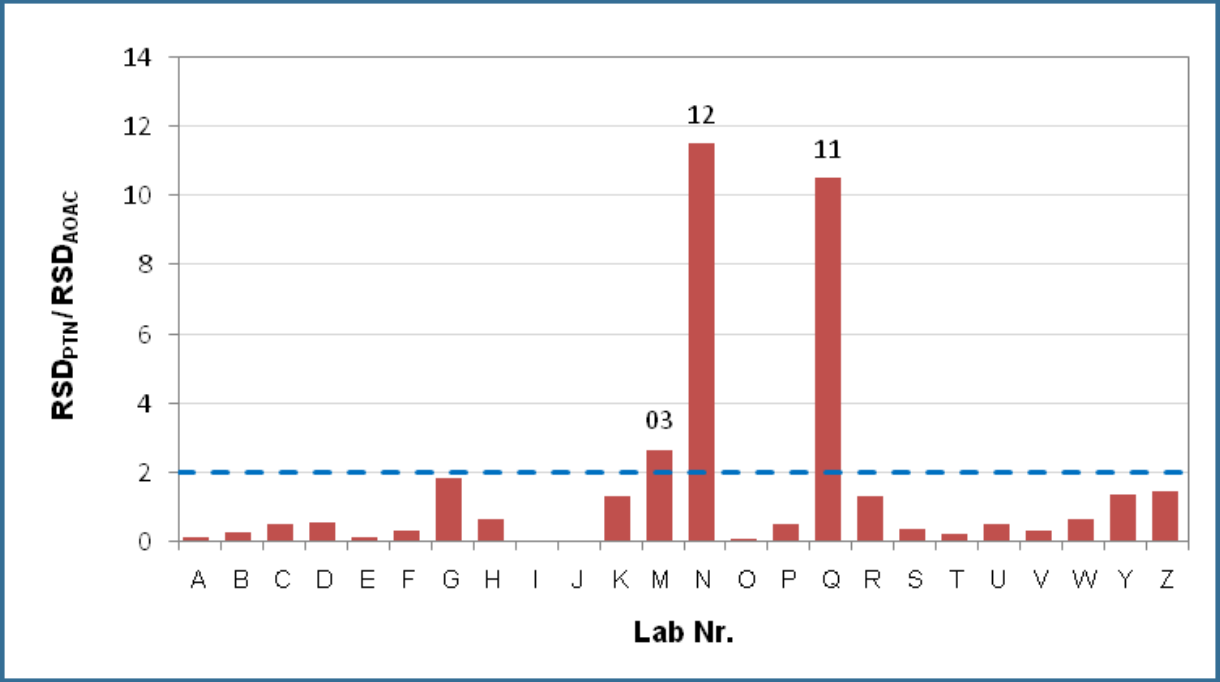
Assessment of the repeatability of analysis results in Oil-02 and Oil-05

Repeatability

Repeatability is evaluated based on the relative standard deviation (RSD) values of Oil-02 and Oil-05 analysis results provided by laboratories. These RSD_{lab} values are compared with the acceptable maximized relative standard deviation RSD_{AOAC} at the concentration of 100 mg/kg (mass fraction = 0.00010) according to the reference documents AOAC [*http://www.aoac.org/Official_Methods/slv_guidelines.pdf*]

$$RSD_{AOAC} = 0.00010^{-0.15} = 4$$

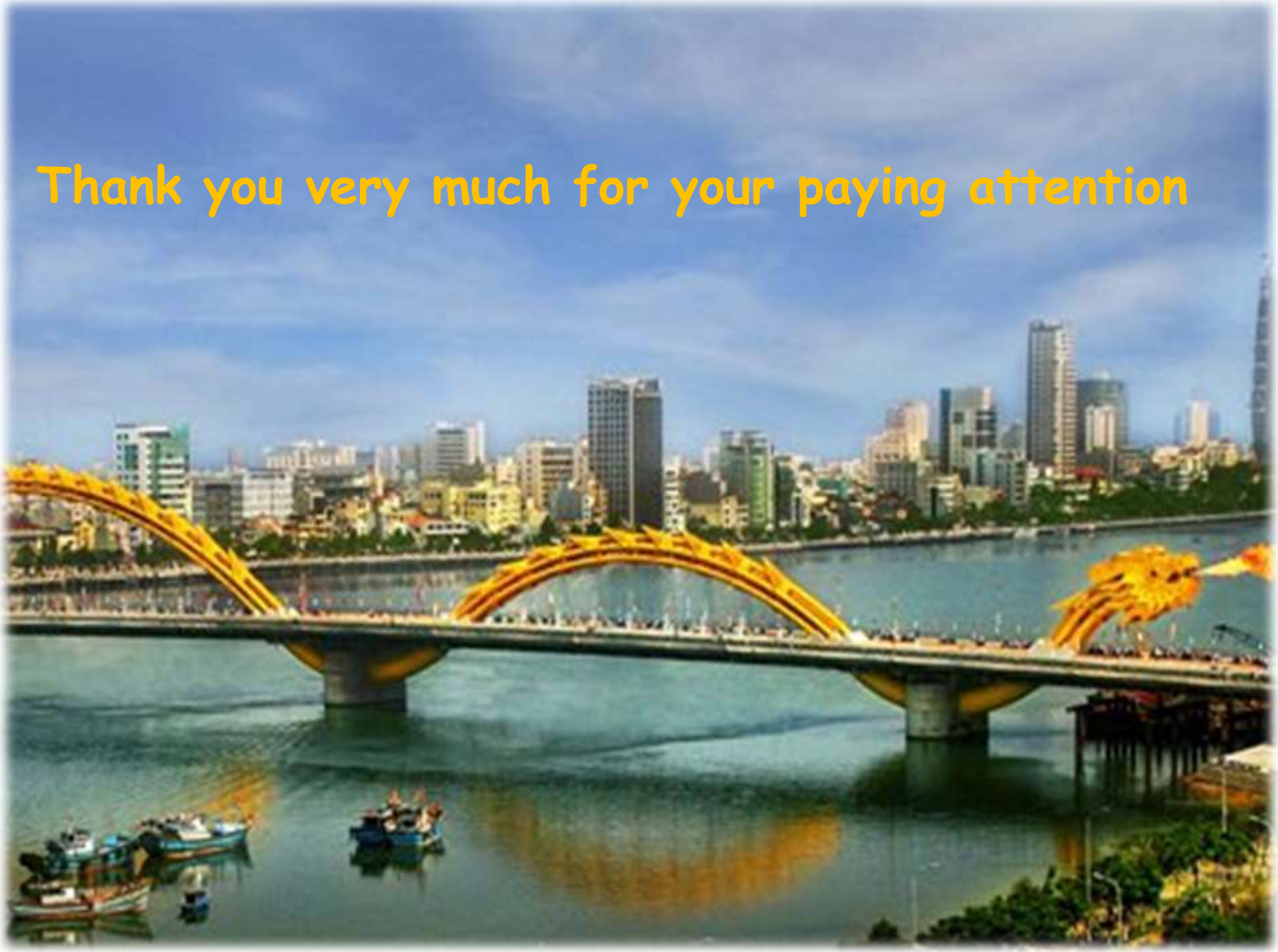
The repeatability of laboratories is satisfied if $RSD_{lab}/ RSD_{AOAC} < 2$



Acknowledgements

Financial support for studies on POPs:

- *UNU Project "Environmental Monitoring and Analysis in East Asian Region: Technology Transfer and Environmental Governance"*
- *Swiss Agency for Development and Cooperation (SDC) in the framework of the Swiss-Vietnamese Cooperation Project ESTNV (Environmental Science and Technology in Northern Vietnam)*
- *Vietnam National University (VNU, Hanoi)*
- *Core University Program between NCST and Japan Society for the Promotion for Science (JSPS)*
- *21st Century Center of Excellence (COE) and Global COE Programs from Ministry of Education, Culture, Sports, Science, and Technology (MEXT), Japan and JSPS*


Thank you very much for your paying attention

Parties:	States and/or regional economic integration organizations that have expressed their consent to be bound by the Convention by an act of ratification, acceptance, approval or formal confirmation.

Ratification, Acceptance, Approval:	Consent of a State and/or regional economic integration organization to become a Party and be bound by the Convention. Ratification, acceptance and approval all require 2 steps: (a) Execution of an instrument of ratification, acceptance or approval by the Head of State, Head of Government or Minister for Foreign Affairs, expressing the intent of the State to be bound by the Convention; and (b) Deposit of the instrument with the depositary.

Signature:	*Definitive signature (signature not subject to ratification)* Where a State expresses its consent to be bound by signing the treaty without the need for ratification, acceptance or approval. A State may definitively sign a treaty only when the treaty so permits. *Simple signature (signature subject to ratification)* Simple signature applies to most multilateral treaties. This means that when a State signs the treaty, the signature is subject to ratification, acceptance or approval. The State has not expressed its consent to be bound by the treaty until it ratifies, accepts or approves it. In that case, a State that signs a treaty is obliged to refrain, in good faith, from acts that would defeat the object and purpose of the treaty. Signature alone does not impose on the State obligations under the Convention.

Determining of Dates for sediment core

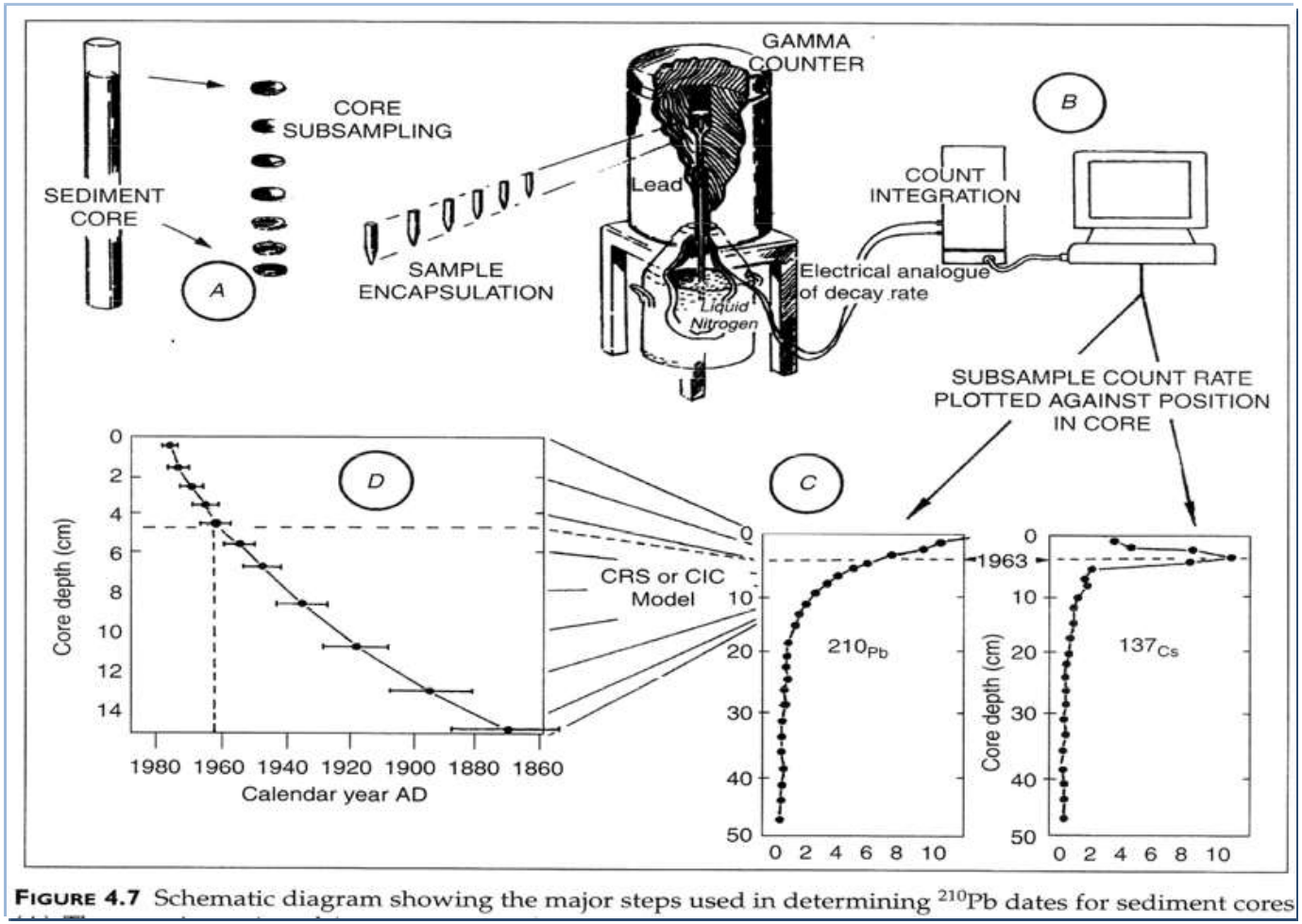
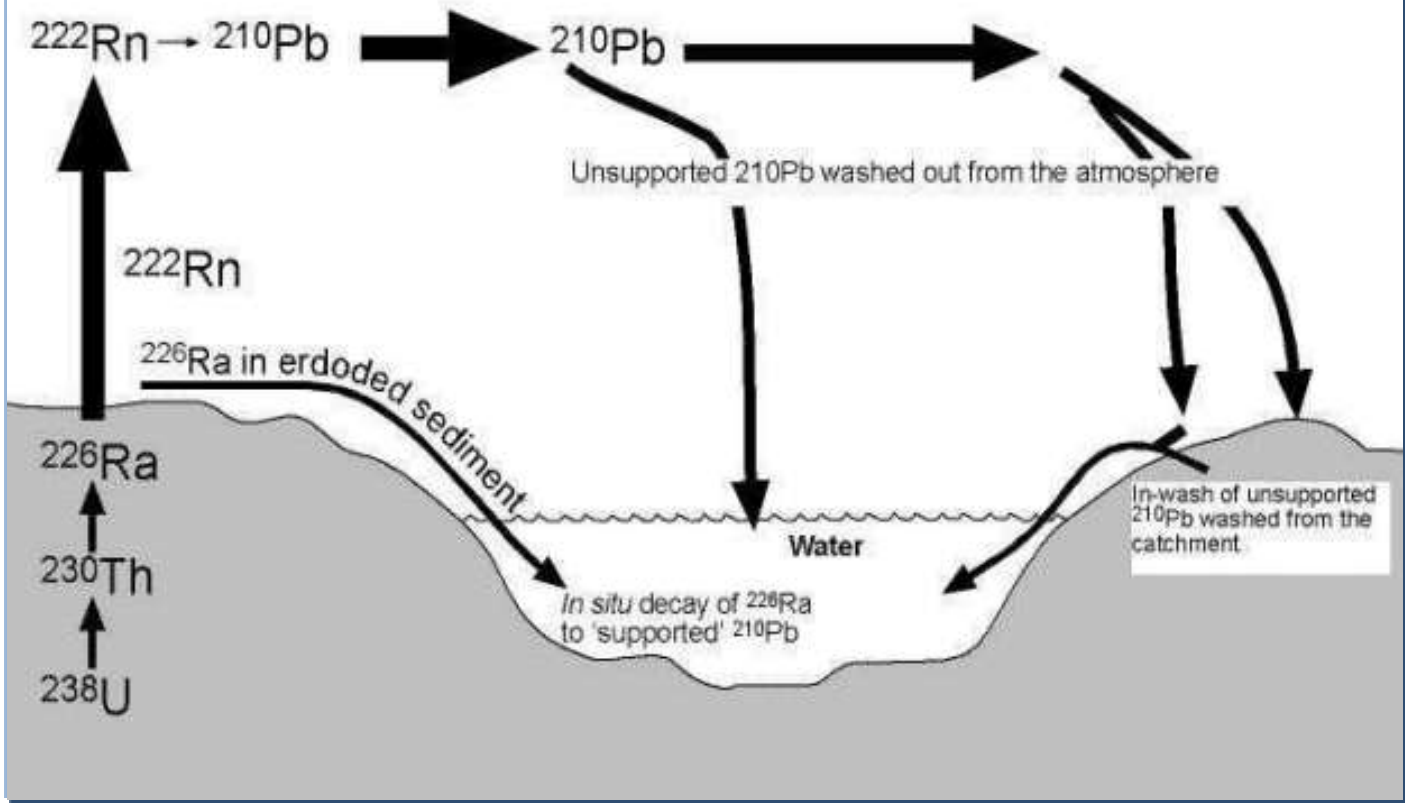


FIGURE 4.7 Schematic diagram showing the major steps used in determining ^{210}Pb dates for sediment cores

$$^{210}Pb \xrightarrow[22\ \text{years}]{\beta^-,0.61\text{MeV}} {}^{210}Bi \xrightarrow[5\ \text{days}]{\beta^-,1.17\text{MeV}} {}^{210}Po \xrightarrow[138\ \text{days}]{\alpha,5.3\text{MeV}} {}^{206}Ph\ (\text{stable isotope})$$

Potential sources of ^{210}Pb in marine sediments



CONSTANT RATE OF SUPPLY (CRS) MODEL FOR DETERMINING THE SEDIMENT ACCUMULATION RATES IN THE COASTAL AREA USING 210Pb

(1) $^{210}Pb_{Unsuported}$ is supplied at constant rate,
(2) the initial of ^{210}Pb concentration in sample is variable and
(3) the influx rate of sediment is variable

The age of deposit of depth z (year):

$$t = (1/\lambda) \ln (A_{tot}/A_z)$$

In which:

- A_{tot} is the total unsupported ^{210} Pb activity in sediment column ($Bq.cm^{-2}$)
- A_z is the total unsupported ^{210} Pb activity in sediment beneath depth z ($Bq.cm^{-2}$)
- λ decay constant of ^{210} Pb (0,03114 y^{-1})

Human health effects by chronic arsenic exposure

Source

Inorganic As
(As[III] and As[V])

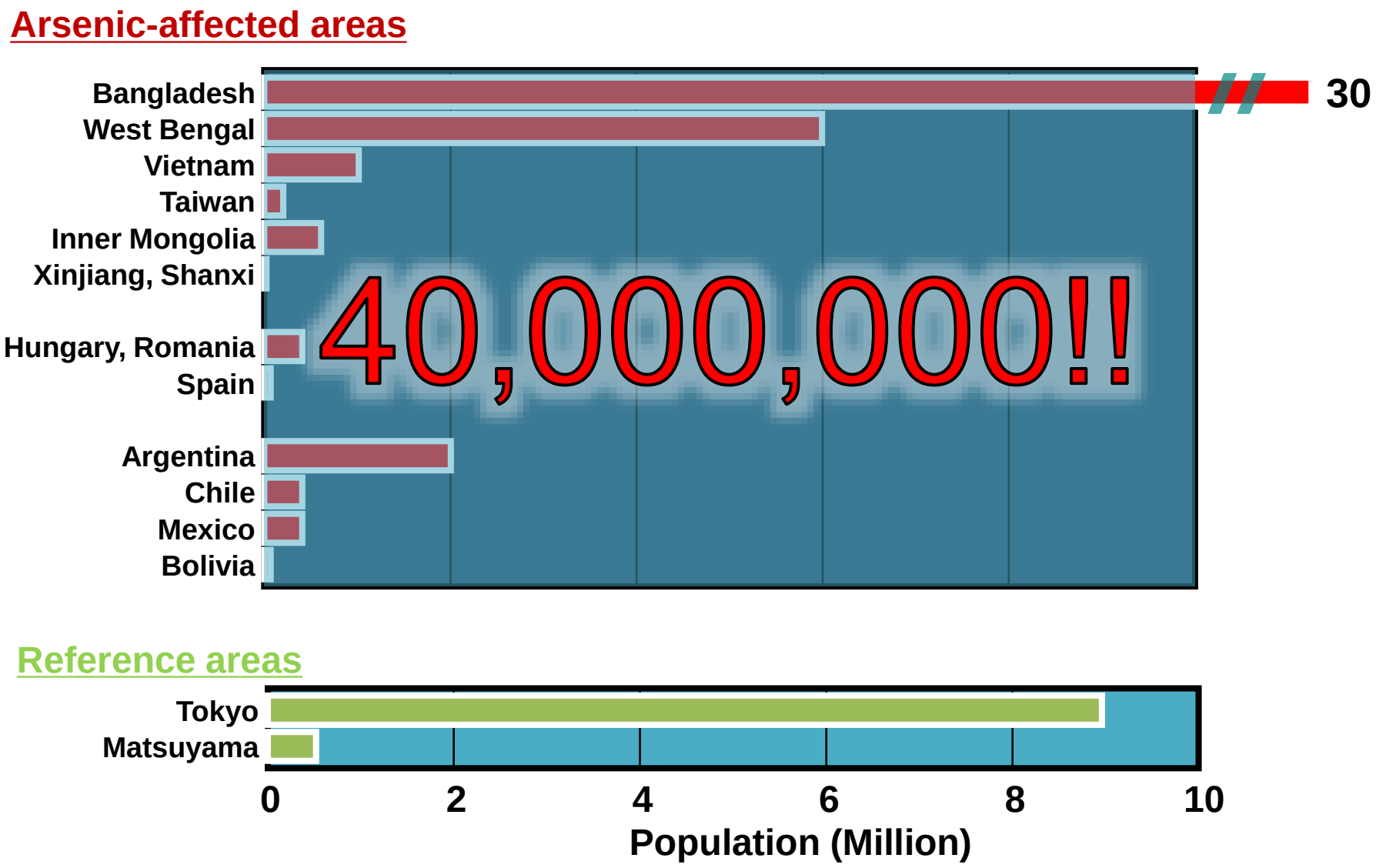
Health effects

Keratosis

Skin cancer

WHO, 2004

Potential arsenic-exposed population



Nordstrom, 2002

Contamination by arsenic in groundwater from the Red River Delta, Vietnam

1st study

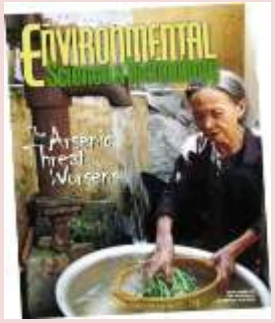
TABLE 1. Average Arsenic Concentrations Measured in Three Sample Series of Groundwaters from Private Tubewells in Rural Districts around Hanoi

district[a]		arsenic concn (μg/L)		
		n	average	range
Dong Anh	A	48	31	<1−220
Tu Liem	B	48	67	1−230
Gai Lam	C	55	127	2−3050
Thanh Tri	D	45	432	9−3010
	all	196	159	<1−3050

[a] The boundaries of the administrative districts A−D are shown in Figure 1a.

Berg et al., 2001

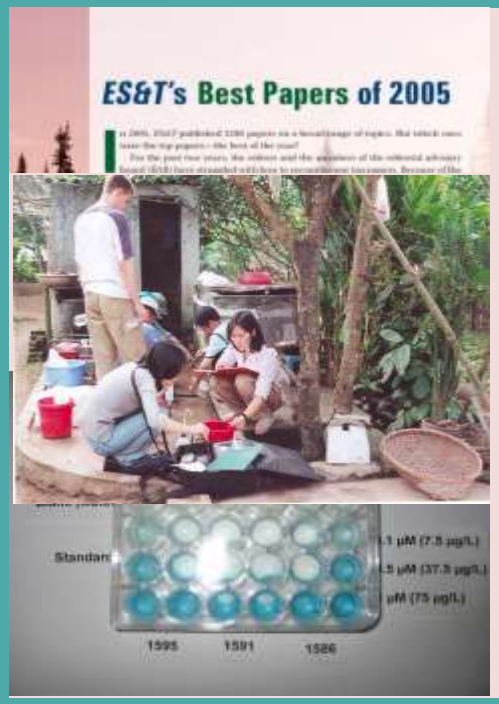
Arsenic contamination in groundwater (1998 - 2008)



Environmental Science &Technology, 2001, vol.35, no. 13, p. 2621-2626.

Citation: 675

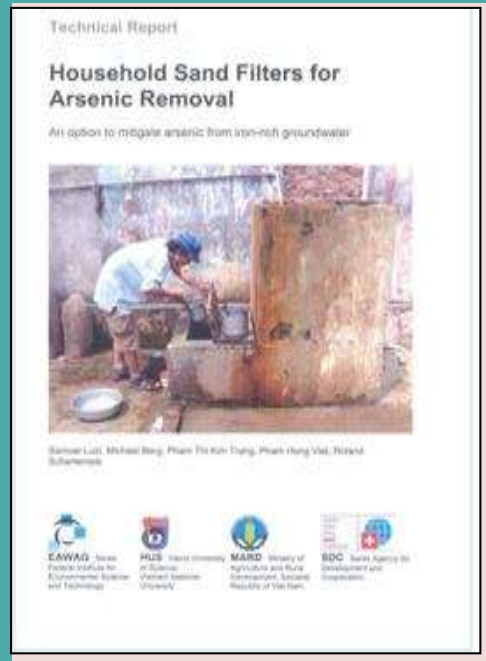
Development of biosensor for As (2002)



Environmental Science & Technology, 2005, vol. 39, p. 7625-7630

The Top paper 2005
Citation: 95

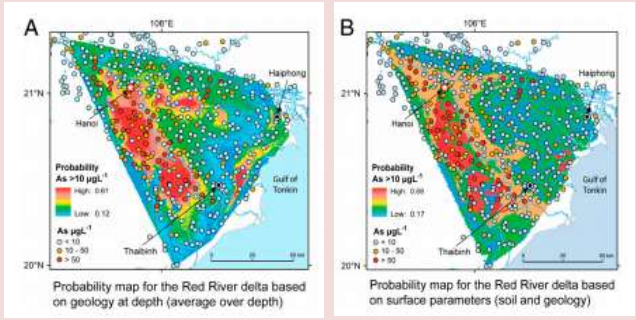
Arsenic removal technology (2004)



Environment International (IF: 6,248), 2008, vol. 34, p. 756-764

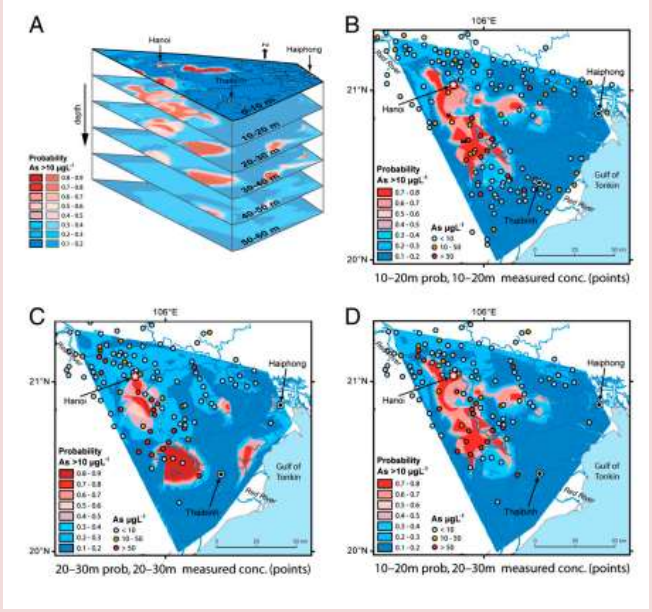
Citation: 88

Modeling of As pollution



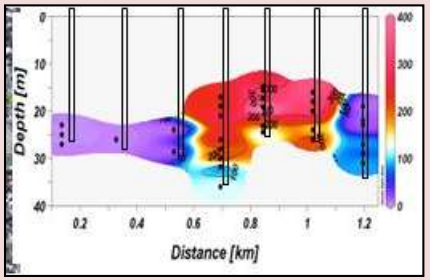
PNAS (IF 9,757), 2011, vol. 108, no. 4, p. 1246-1251,

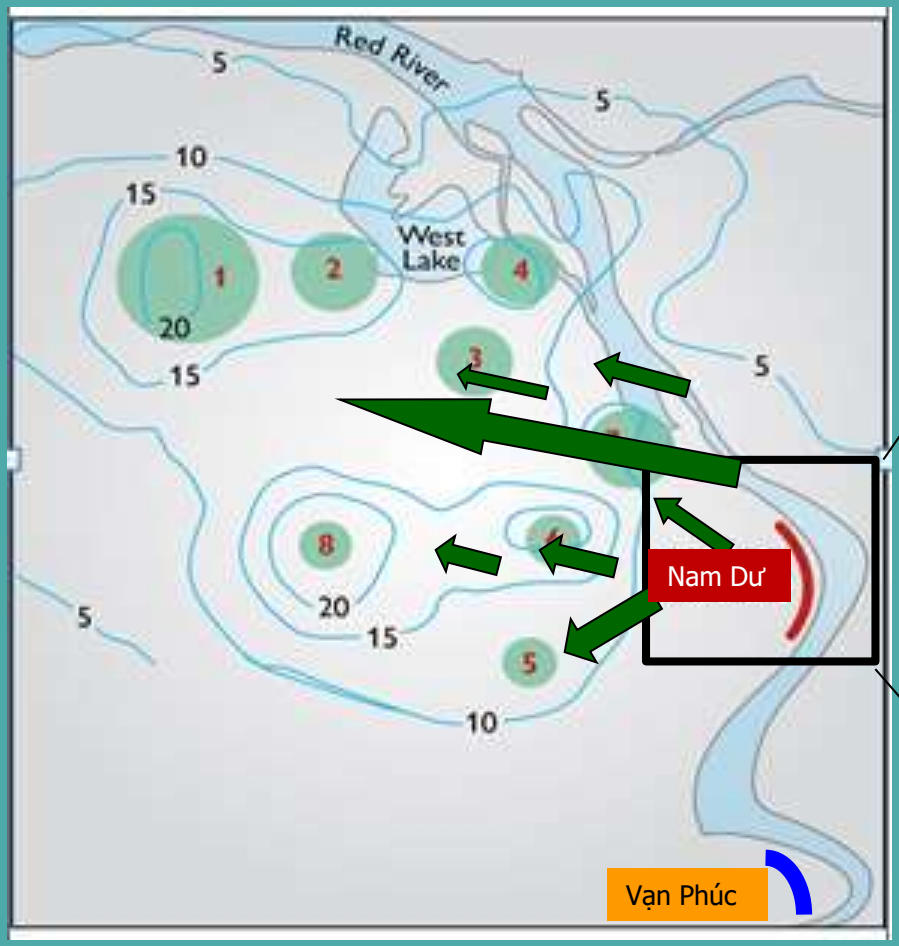
Citation: 47

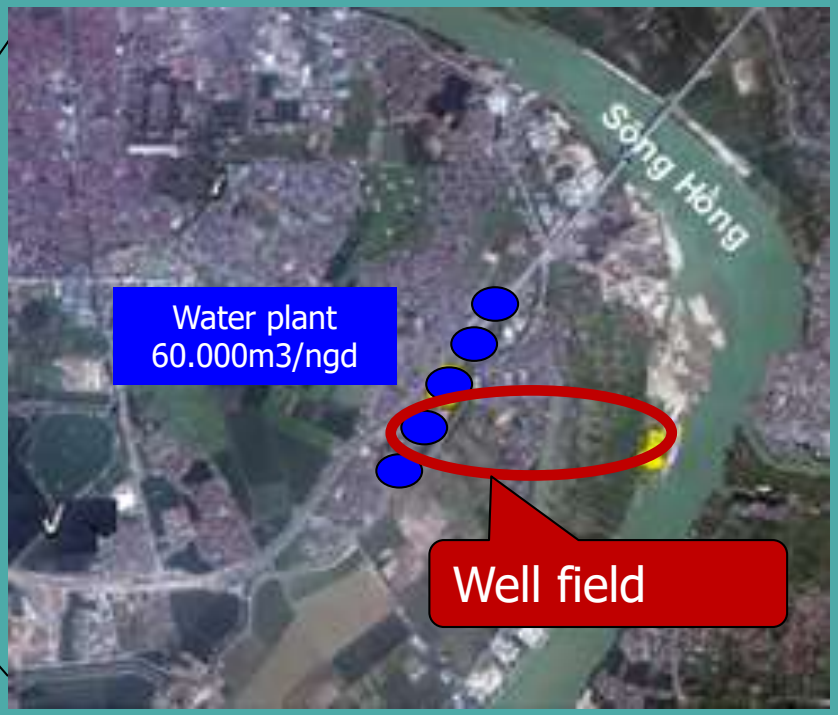


Hypothesis for arsenic mobilization

Nature Geoscience (IF:12.367) 2012, Vol. 5, p. 656–66113




Red River
West Lake
5
10
15
20
1
2
3
4
8
Nam Dư
Vạn Phúc


Sông Hồng
Water plant
60.000m3/ngd
Well field

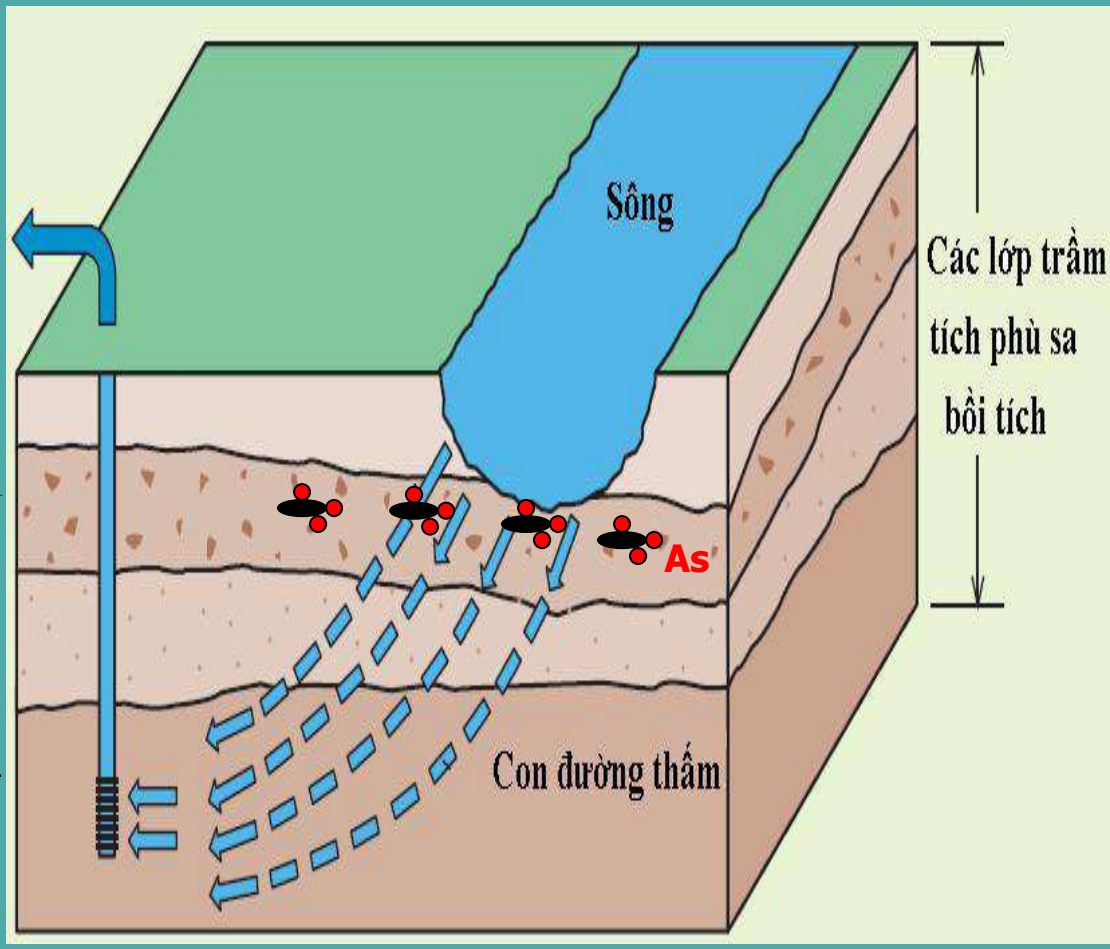
Water plant

Exploitation of groundwater from Pleistocene aquifer

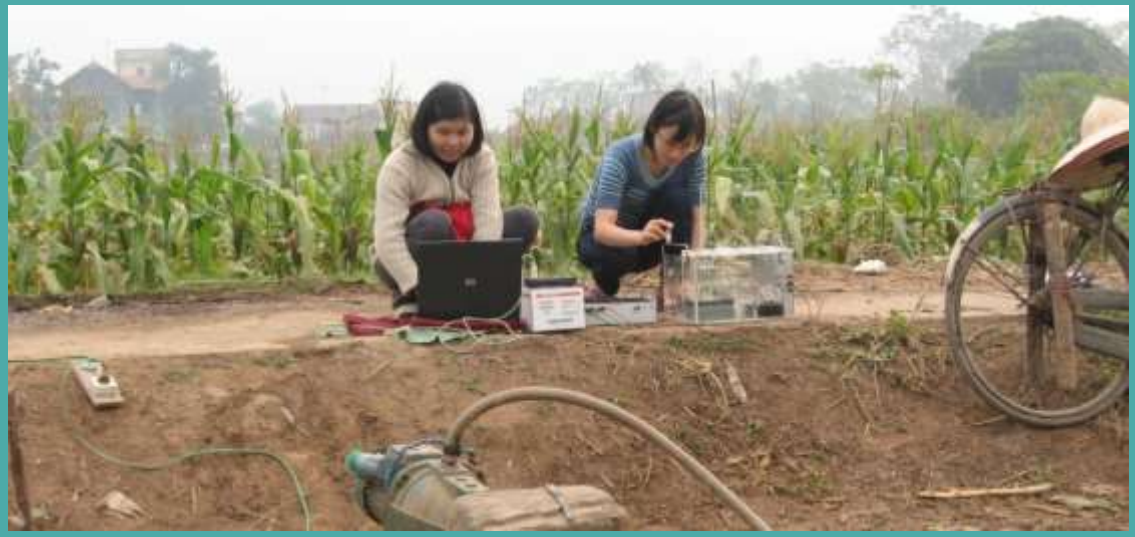
Holocene aquifer

Clay layer

Pleistocene aquifer






LETTER

doi:10.1038/nature12444

Retardation of arsenic transport through a Pleistocene aquifer

Alexander van Geen[1], Benjamin C. Bostick[1], Pham Thi Kim Trang[2], Vi Mai Lan[2], Nguyen-Ngoc Mai[2], Phu Dao Manh[2], Pham Hung Viet[2], Kathleen Radloff[1]†, Zahid Aziz[1]†, Jacob L. Mey[1,3], Mason O. Stahl[4], Charles F. Harvey[4], Peter Oates[5], Beth Weinman[6]†, Caroline Stengel[7], Felix Frei[7], Rolf Kipfer[7,8] & Michael Berg[9]

Groundwater drawn daily from shallow alluvial sands by millions of wells over large areas of south and southeast Asia exposes an estimated population of over a hundred million people to toxic levels of arsenic[1]. Holocene aquifers are the source of widespread arsenic poisoning across the region[2,3]. In contrast, Pleistocene sands deposited in this region more than 12,000 years ago mostly do not host groundwater with high levels of arsenic. Pleistocene aquifers are increasingly used as a safe source of drinking water[4] and it is therefore important to understand under what conditions low levels of arsenic can be maintained. Here we reconstruct the initial phase of contamination of a Pleistocene aquifer near Hanoi, Vietnam. We demonstrate that changes in groundwater flow conditions and the redox state of the aquifer sands induced by groundwater pumping caused the lateral intrusion of arsenic contamination more than 120 metres from a Holocene aquifer into a previously uncontaminated Pleistocene aquifer. We also find that arsenic adsorbs onto the aquifer sands and that there is a 16–20-fold retardation in the extent of the contamination relative to the reconstructed lateral movement of groundwater over the same period. Our findings suggest that arsenic contamination of Pleistocene aquifers in south and southeast Asia as a consequence of increasing levels of groundwater pumping may have been delayed by the retardation of arsenic transport.

River (Fig. 1b). Groundwater heads, and therefore the groundwater velocity field, within Van Phuc respond rapidly to the daily and seasonal cycles in the water level of the river (Supplementary Information). Before large-scale groundwater withdrawals, rainfall was sufficient to maintain groundwater discharge to the river, as is still observed elsewhere along the Red River[4]. In Van Phuc, however, the groundwater level was on average 40 cm below that of the water level of the Red River in 2010–11 and the hydraulic gradient nearly always indicated flow from the river into the aquifer. The reversal of the natural head gradient is caused by the large depression in groundwater level centred 10 km to the northwest that induces groundwater flow along the Van Phuc transect from the river towards Hanoi (Fig. 1a). This perturbation of groundwater flow is caused by massive pumping for the municipal water supply of Hanoi[9–11], which nearly doubled from 0.55 million to 0.90 million cubic metres per day between 2000 and 2010 owing to the rapid expansion of the city (Supplementary Fig. 1).

A change in the colour of a clay layer capping sandy sediment along the transect defines a geological boundary between the two portions of the Van Phuc aquifer. Up to a distance of 1.7 km from the river bank, the clay capping the aquifer is uniformly grey with the exception of a thin brown interval at the very surface (Fig. 2b). In contrast, a readily identifiable sequence of highly oxidized bright yellow, red and white

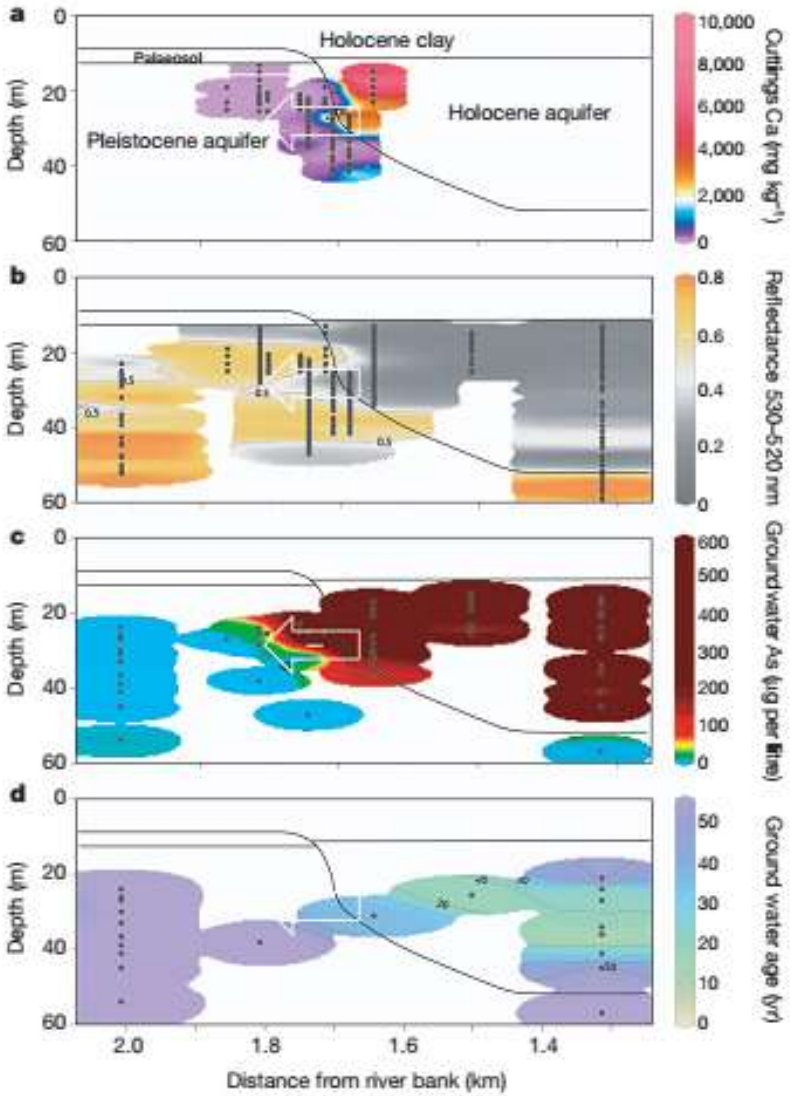


Figure 2 | Contoured sections of sediment and water properties based on data collected between 1.3 km and 2.0 km from the Red River bank. The

Van Geen et al., 2013 (Nature)

Chemical species database

Microsoft Excel - CETASDresult_RedriverDelta_June2005

File Edit View Insert Format Tools Data Window Help

A1: Red River delta -Vietnam

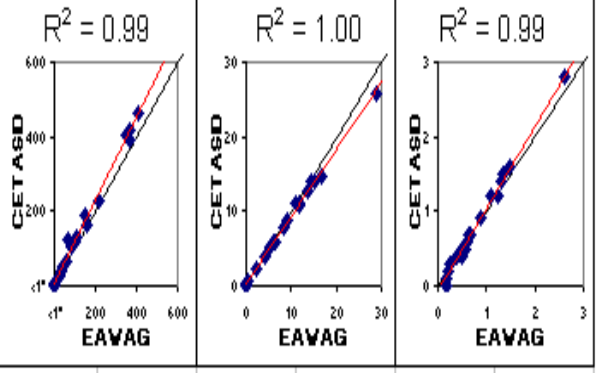
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
1	Red River delta -Vi			June	CETASD results													
2																		
3	Place	Depth	Province	Eh	As	Fe	Mn	Na	K	Ca	Mg	PO4-P	Si	HCO3-	F-	Cl-	Br-	SO4-
4	ID	m		mV	µg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
5	Red river delta-VN, private tubewells																	EAWAG
6	RD1	30	Hanoi	144.4	<1	<0.05	2.47	49.7	3.50	13.0	10.7	0.086	27.50	177.1	0.210	17.98	0.108	0.923
7	RD2	9	Hanoi	121.8	<1	<0.05	0.79	36.6	2.07	8.8	9.5	<0.01	19.98	177.1	0.151	4.23	0.038	9.062
8	RD3	30	Hanoi	116.7	<1	<0.05	0.34	12.8	4.78	37.6	44.6	<0.01	11.00	346.9	0.107	7.20	0.422	4.296
9	RD4	no inf	Ha Tay	-131.1	200.9	7.7	<0.05	29.2	1.51	53.2	15.6	1.571	23.82	472.4	0.167	5.77	0.132	0.289
10	RD5	45	Ha Tay	-127.7	51.5	2.3	0.11	29.8	1.68	57.5	13.4	0.458	12.74	324.8	0.347	8.54	0.089	0.287
11	RD6	27	Ha Tay	185.1	<1	<0.05	0.30	21.7	1.58	39.3	12.8	<0.01	13.10	228.8	0.228	11.75	0.047	0.826
12	RD7	24	Ha Tay	-159.5	166.7	14.9	0.21	37.5	2.23	156.0	27.2	0.615	12.27	546.2	0.108	72.13	0.113	16.669
13	RD8	30	Ha Tay	-147.7	187.1	9.5	0.28	11.3	1.71	145.6	25.8	0.464	13.05	531.4	0.076	25.54	0.051	1.670
14	RD9	35	Ha Tay	-165.5	143.1	3.2	0.17	17.4	2.16	31.3	12.8	0.472	6.83	280.5	0.677	3.79	0.037	0.281
15	RD10	40	Ha Tay	-13.0	12.4	3.3	2.53	33.1	1.02	39.2	14.5	0.025	6.35	206.7	0.175	54.07	0.148	11.530
16	RD11	25	Ha Tay	-18.8	1.2	0.1	1.48	22.5	1.36	16.6	5.4	0.003	11.67	184.5	0.352	3.72	0.193	0.981

Inter-laboratory crosscheck program on Arsenic analysis

ChemAs Feb 2003 CETASD and EAWAG results

Place ID	Sample no.	Sampling Date	Depth m	As µg/L EAWAG	As µg/L CETASD	Fe mg/L EAWAG	Fe mg/L CETASD	Mn mg/L EAWAG	Mn mg/L CETASD
Van Phuc									
VP20	520	15/2/03	40	216	229	6.4	5.7	0.50	0.50
VP21	521	15/2/03	65	35	39	<0.05*	0.1	0.64	0.70
VP22	522	15/2/03	99	3	7	28.8	25.9	0.40	0.40
VP23	523	15/2/03	21	43	50	15.1	13.9	0.61	0.60
			Min	1	1	<0.05*	0.1	0.2	<0.06*
			Max	410	460	28.8	25.9	2.6	2.8
			Median	70	106	6.4	5.8	0.6	0.7
			Average	121	140	7.9	7.4	0.8	0.8

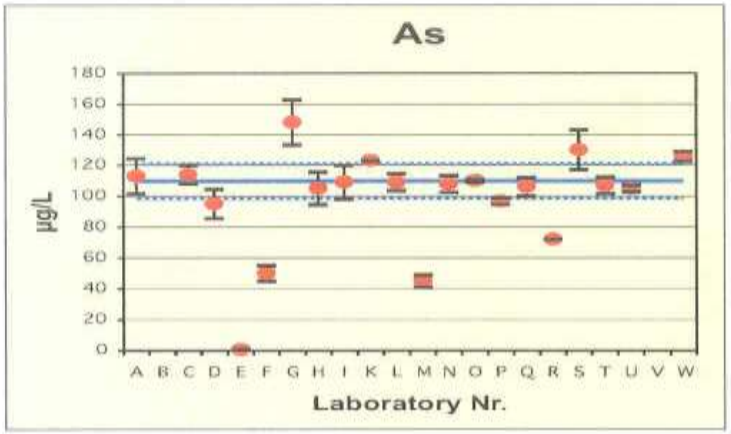
Cross-Check



ARS-13

Laboratory Nr.	conc. µg/L	max. µg/L	min. µg/L	uncer. (%)
A	113	124	102	10
B				
C	114	120	108	5.3
D	95	105	86	10
E	0.618	0.626	0.610	1.32
F	50	55	45	10
G	148	163	133	10
H	105	116	95	10
I	109	120	98	10
K	123	123.2	122.8	0.16
L	109	114	104	5
M	45	49	41	8.6
N	107.8	113.2	102.4	5
O	110	111	109	1.0
P	96.78	98.95	94.61	2.24
Q	106	112	100	5.63
R	72	72	72	
S	130	143	117	10
T	107	112	102	5
U	105	107	103	2
V				
W	125.84	128.92	122.76	2.45

Indicative value	110			
Confident. range		121	99	10%



VNU Key Laboratory of "Analytical Technology for Environmental Quality and Food Safety Control"

Director:	**Prof. Dr. Pham Hung Viet**
Address:	**T3 Building, 334 Nguyen Trai St, Thanh Xuan, Hanoi, Vietnam**
Tel:	**84.4.3858 7964 Fax: 84.4.3858 8152**
Staff members:	**23 full-time staffs & 8 part-time staffs (lecturers, researchers, technicians, administrative staffs) including 2 professors, 4 associate professors, 10 doctors, 8 masters**

Analytical Science and Technology

Journal of Analytical Science and Technology

Editor-in-Chief: Chaejoon **Cheong**
ISSN: 2093-3371 (electronic version)
Journal no. 40543

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***JAST* publishes original research and review articles on all aspects of analytical principles, techniques, methods, procedures, and equipment.**

In 2008 representatives from leading Dutch industry laboratories and academic analytical science and technology groups at universities recognized three major concerns for future innovation and economic growth in The Netherlands:

(1) a trend towards application-driven and sector-specific analytical R&D at Dutch universities and a concurrent decline of highly innovative fundamental analytical research,
(2) increasingly difficult recruitment, due to a lack of high-quality researchers and technicians at PhD, MSc and BSc (HBO) levels,
and (3) the limited sharing of and access to rare, high-end analytical instrumentation.

The sense of urgency for **COmprehensive Analytical Science and Technology** (COAST) was evident.

In the following, critical, step a group of ~60 large industrial companies, SMEs, institutes and university groups committed the initial funding for the development of the COAST Business Plan. This facilitated the formal established and registration of TI-COAST as an independent foundation in December 2008. The COAST business plan was presented in September 2009 to the national co-ordination body for chemistry ('RegieGroep Chemie', RGC). Following the support by the RCG, the Ministry of economic affairs and the national science foundation NWO granted the TA-COAST R&D program. This was the first step in the realization of the COAST business plan.

The lean-and-mean organization structure of TI-COAST is exclusively funded by its participants, who contribute an annual membership fee. In doing so, they emphasize their strong commitment to the COAST mission. Today, COAST is recognized as the analytical-science-and-technology partner and executes its integrated strategic agenda of R&D, education and infrastructure.

COAST is ready for the future. Obviously, analytical science and technology is of crucial interest to innovation in many topsectors, but COAST has found a home in the Top Sector Chemistry, where it is recognized as *Community of Innovation.* From there, COAST will establish and maintain contacts with other relevant topsectors, such as AgroFood, Life Science&Health, Water, Energy, etc. COAST is specifically mentioned in the cross-cutting Roadmap ICT for the topsectors.

JASIS 2015

JAIMA



International Conference Session 2015

Makuhari Messe, Chiba;
September 2-4, 2015

Royal Society of Chemistry Tokyo International Conference 2015*

Sep. 3▶4

- Analytical Technology Towards Life Innovation -

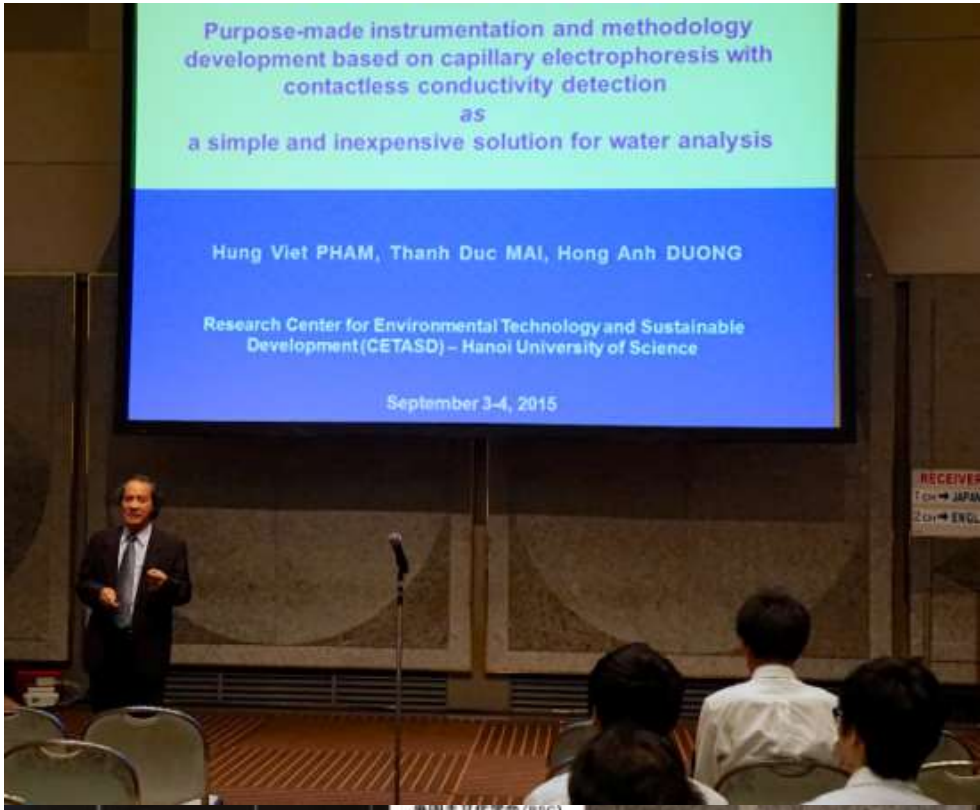
Registration Fee: Free

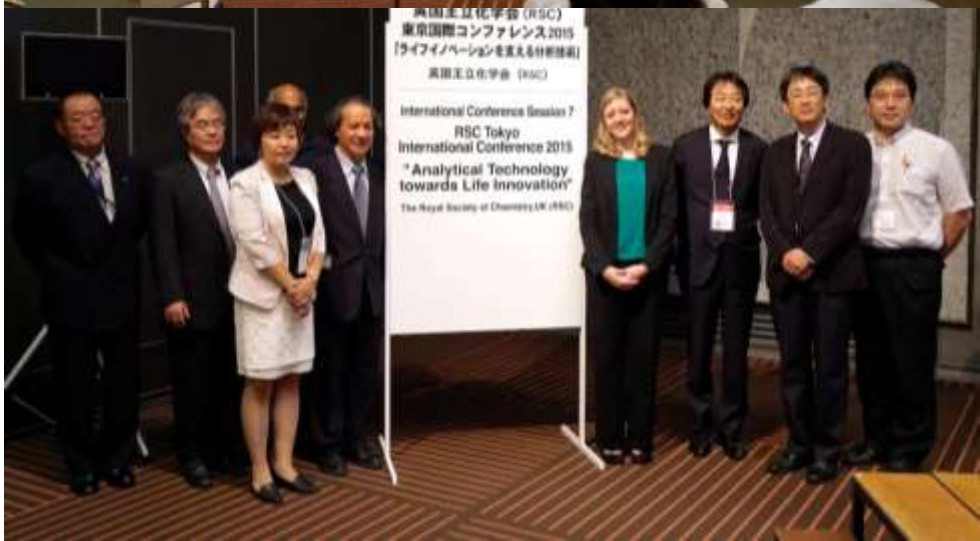
Plenary Lecture Session

Flash Presentation & Poster Session

Poster Prizes

***RSC-TIC 2015**
JASIS CONFERENCE





Research team of analytical sciences and application have been recognized as one of sixteen VNU strong research teams in 2014

1. Research branch of organic compounds (since 1994)
2. Research branch of environmental geochemistry (since 1998)
3. Research branch of development and application of analytical instrument (since 2005)
4. Research branch of toxicology and food safety (new branch)

VNU Key lab

Director
(Head of research team)

Research branches

1. Environ. Geochemistry

1 PhD,
1 PhD stu.,
2 MSc, 1 MSc Stu.

2. Organic Compounds

6 PhD, 2 MSc

3. Toxicology and Food safety

4 PhD, 2 MSc,
1 MSc Stu.

4. Development of analytical equip. & application

Head of research branch

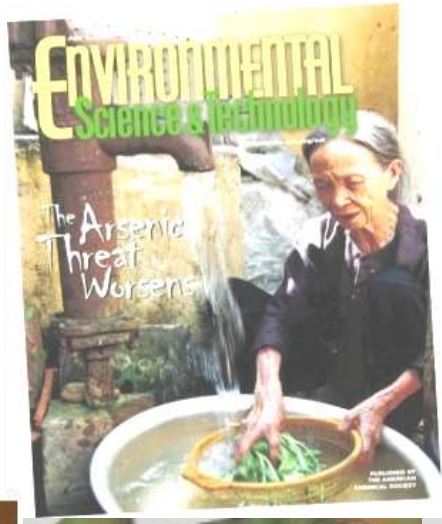
Key member

3 PhD, 2 PhD stu.
3MSc., 2 MSC stu.

Scientific achievements 2010- 2015

International publications:

In the period of 2010 – 2015, research team of analytical sciences and application published: 63 publications in internationally refereed journals (60 ISI papers), 46 publications in national journals and 31 published international conference contributions.



Measuring equipments and application procedures

(1) Manual Capillary Electrophoresis (CE) equipment
(2) Automated SIA-CE equipment (SIA - sequential injection analysis)
(3) Automated portable single-channel CE equipment
(4) Automated portable dual-channel CE equipment

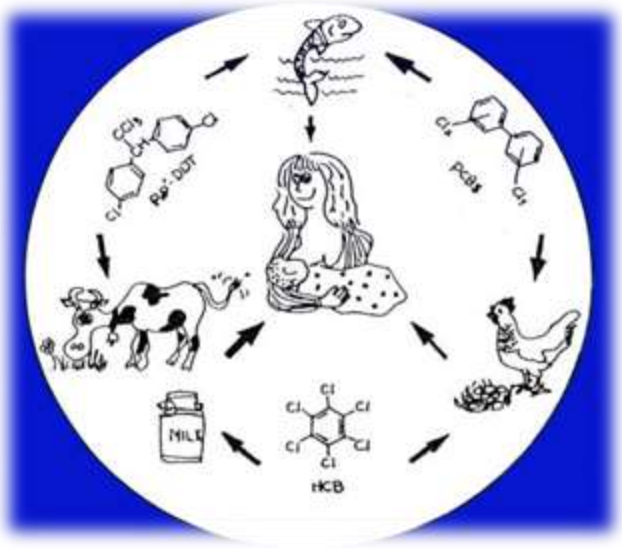
Two patent registrations have been accepting as valid applications

1

2

3

4



Priority targets

Analytical Sciences and Technology for Environmental Quality and Food Safety Control

VNU Key Laboratory of "Analytical Technology for Environmental Quality and Food Safety Control"

Vision:

Becoming an laboratory on analytical sciences and application had equal level as other laboratories in Southeast Asia.

Target:

- Short-term (05 years): becoming a national laboratory of food safety and analytical environment.
- Long-term: Development in products for the field of biomedical analysis.

Orientation of VNU Key laboratory:

- Becoming an outstanding centre in cooperation between VNU and Shimadzu Corporation, Japan (VNU-Shimadzu COE) following memorandum of understanding signed by Director of VNU and General director of Shimadzu Corporation on November 3rd, 2012 .
- Becoming an potential unit in development of national products on the field of fabricating sensor, measuring equipments being able to operate in fieldsite for environmental quality control and food safety.

AGREEMENT ON ESTABLISHMENT OF CENTRE OF EXCELLENCE
BETWEEN
VIETNAM NATIONAL UNIVERSITY, HANOI
AND
SHIMADZU CORPORATION

Vietnam National University Hanoi, Hanoi, Vietnam, and Shimadzu Corporation, Kyoto, Japan, sign this Agreement to affirm the wish to establish Centre of Excellence for teaching and researching in scientific fields between the two organizations (referred to hereafter as 'the two parties').

Article 1: Purpose
The Centre is established to teach and research in scientific fields of environmental analysis, food control and safety, materials testing and biomedical diagnosis. A place where creates advanced research products, the manpower of international standards. To enhance the reputation, position and brand for Vietnam National University, Hanoi and Shimadzu Corporation as well as the VNU-Shimadzu collaboration.

Article 2: Location and Operational Agreement
The VNU-Shimadzu COE shall be the next phase of VNU-Shimadzu Joint Laboratory (VSL) which showed an excellent and efficient cooperation between VNU Hanoi and Shimadzu Corporation as a proud tradition between both sides; and the legislation status and operational plan of the centre will be decided by Vietnam National University, Hanoi.
The Centre has the Steering Committee with the presence of the leadership of Vietnam National University, Hanoi and of Shimadzu Asia Pacific – on behalf of Shimadzu Corporation. Annual planned activities of the COE including development approaches, investment in equipment and infrastructure conditions will be discussed and approved during the Steering Committee meetings.

Article 3: Tasks
- Scientific research and development of new technologies in the areas of environment, earth, food, materials and biomedicine.
- Through researches, training outstanding young scientists in the selected areas.
- Services and consulting on outstanding interest issues.
- Expand cooperation and attract investment from government, industry, international organizations and non-governmental organizations.

Article 4: Amendment of the Agreement
The clause of this Agreement may be amended if either party proposes an amendment by written notice and both parties mutually agree upon the amendment.

Article 5: Dispute
If any dispute about the interpretation or application of this Agreement arises between the parties, both parties shall try to settle it in an amicable way through mutual consultation.

Article 6: Term of the Agreement
This Agreement shall be effective upon signature by the two parties and shall remain in force for a period of 3 (three) years. Thereafter it shall be automatically renewed from year to year.

Article 7: Others
Any matter not specified herein shall be stipulated separately upon consultation between two parties.

IN WITNESS HEREOF, the parties hereto have executed this Agreement in duplicate by placing their signatures thereon, and each party shall keep one copy of the originals in English.

Date: November 3rd, 2012

Mai Trong Nhuan
President
Vietnam National University, Hanoi

Date: November 3rd, 2012

Akira Nakamoto
President & Chief Executive Officer
Shimadzu Corporation, Japan

TRUNG TÂM NGHIÊN CỨU CÔNG NGHỆ MÔI TRƯỜNG VÀ PHÁT TRIỂN BỀN VỮNG

VIỆN KIỂM NGHIỆM AN TOÀN VỆ SINH THỰC PHẨM QUỐC GIA

Hà Nội, ngày 24 tháng 4 năm 2015

BIÊN BẢN GHI NHỚ

GIỮA TRUNG TÂM NGHIÊN CỨU CÔNG NGHỆ MÔI TRƯỜNG VÀ PHÁT TRIỂN BỀN VỮNG
(Đại học Khoa học tự nhiên - Đại học Quốc gia Hà Nội)
VÀ
VIỆN KIỂM NGHIỆM AN TOÀN VỆ SINH THỰC PHẨM QUỐC GIA
(Bộ Y tế)

Gi

Tr
đây gọi
Đại học
kết hợp
Cơ quan
học Phâ
Bán. Trâ
đóng góp
Khoa họ
chung. T
cứu tron
trình ngh
(Nature)
thạc sĩ đ
tiêu chu
trong lĩn
quốc tế.
tác trong

Vi
Viện) là
chất lượ

2. Hợp tác trong đào tạo, nghiên cứu khoa học và cung cấp dịch vụ

2.1. Nội dung hợp tác:

2.1.1. Hợp tác chặt chẽ trong nghiên cứu khoa học để phát huy thế mạnh của mỗi bên, đẩy mạnh nghiên cứu chung trong lĩnh vực an toàn thực phẩm mang tính chuyên sâu, hợp tác xây dựng các đề tài tiềm năng và tiến tới xây dựng đề tài cấp Nhà nước.

2.1.2. Xây dựng mối quan hệ giữa ha
công tác đào tạo trong lĩnh vực an toàn thực pl

2.2. Hình thức thực hiện:

2.2.1. Các hoạt động kết hợp giữa hai b
học và cung cấp dịch vụ được thể hiện trong
bên sẽ ký kết.

2.2.2. Hàng năm, Trung tâm và Phòng
tuyển thuộc Viện chủ động có văn bản thông
đào tạo, nghiên cứu khoa học và những đề xu

động của hai bên được lồng ghép với nhau một cách hợp lý, và cùng trao đổi, hợp tác theo từng hoạt động cụ thể.

2.2.3. Lãnh đạo hai bên xây dựng kế hoạch sử dụng tối đa công suất các trang thiết bị sẵn có của hai bên trong công tác đào tạo, nghiên cứu khoa học và cung cấp dịch vụ hợp tác.

2.3. Điều khoản thi hành:

2.3.1. Hiệu lực của những thỏa thuận ghi nhớ hai bên sẽ thực hiện trên cơ sở thống nhất về thời gian, nội dung đáp ứng yêu cầu thực tế. Mọi sự điều chỉnh bất kỳ một trong các điều khoản của Biên bản ghi nhớ này được thực hiện thông qua thông báo bằng văn bản của hai bên.

2.3.2. Biên bản ghi nhớ được làm thành 04 bản, có giá trị pháp lý như nhau. Mỗi bên giữ 02 bản./.

GIÁM ĐỐC TRUNG TÂM NGHIÊN CỨU CÔNG NGHỆ MÔI TRƯỜNG VÀ PHÁT TRIỂN BỀN VỮNG	VIỆN TRƯỞNG VIỆN KIỂM NGHIỆM AN TOÀN VỆ SINH THỰC PHẨM QUỐC GIA
GS.TS. Phạm Hùng Việt	**PGS.TS. Phạm Xuân Đà**

Orientation research and products in the period of 2016-2020

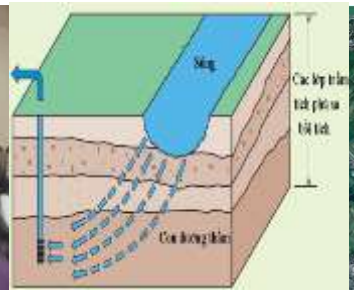
1. Research branch on environmental geochemistry

Research on geochemistry of groundwater (inorganic pollutants in groundwater, especially heavy metal such as arsenic, maganese, etc)

Research on arsenic transport in groundwater based on experiments using radioisotope.

- Publications in internationally refereed journals and education products




2. Research branch of organic compounds

- ✓ Research on organic polutants (POPs, PTSs) in environment, food and biomedical samples.

- ✓ Research on separation and structure elucidation of organic compounds owning biological activities in folk remedies using mordern intrumental mothods

- ❖ Analysis proceduces for new pollutants
- ❖ Natural product, support for the treatment of some diseases have been identified chemical structure and activities
- ❖ Patent registration
- ❖ Publications in internationally refereed journals and education products





3. Research branch of development and application of analytical equipment

- ✓ Development of automated multi-channel CE equipment coupled with C4D and UV-LED detector.
- ✓ Development of portable CE system with miniaturized flow system using micro-injector or microfluidic.
- ✓ Development of applications using the developed instruments for quality control of food, pharmaceutical and water environment.
- ✓ Participating in development and application of measurement equipment for methane generation potential to assess renewable energy sources.

- ❖ The miniaturized, automated equipment, which can be produced by 3D printing technology, coupled with electrochemical sensors and optical sensors for environmental monitoring and control of food safety, quality control of pharmaceutical and biofuel, patent registration.
- ❖ Publications in internationally refereed journals and education products




4. Research branch of toxicology and food safety (new branch)

Research on development cell lines carrying the gene expression for application in environmental analysis and food safety.

- ❖ New tools to determinate and evaluate compounds using biochemical methods for research on toxicology and food safety
- ❖ Publications in internationally refereed journals and education products