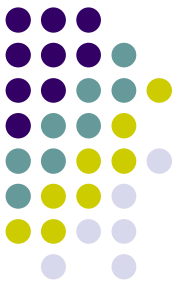


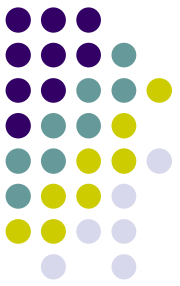
# Monitoring & Distribution of Persistent Toxic Substances (PTS) in Marine Environment of China



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**Division of Quality Assurance Technology**  
**National Marine Environmental Monitoring Center**  
**(NMEMC)**

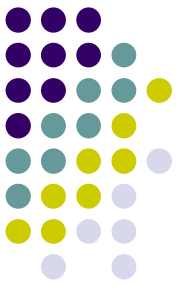
**E-mail: [xdma@nmemc.gov.cn](mailto:xdma@nmemc.gov.cn)**

# Outline



1. What are Persistent Toxic Substance?
2. Monitoring programs of marine environment in China
3. Case study
4. Data gaps

# 1 What are Persistent toxic substances (PTS)

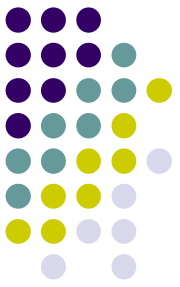


- ✦ organic (including organometallic) substances
- ✦ slowly degraded in the environment
- ✦ accumulating in biota, and
- ✦ toxic.

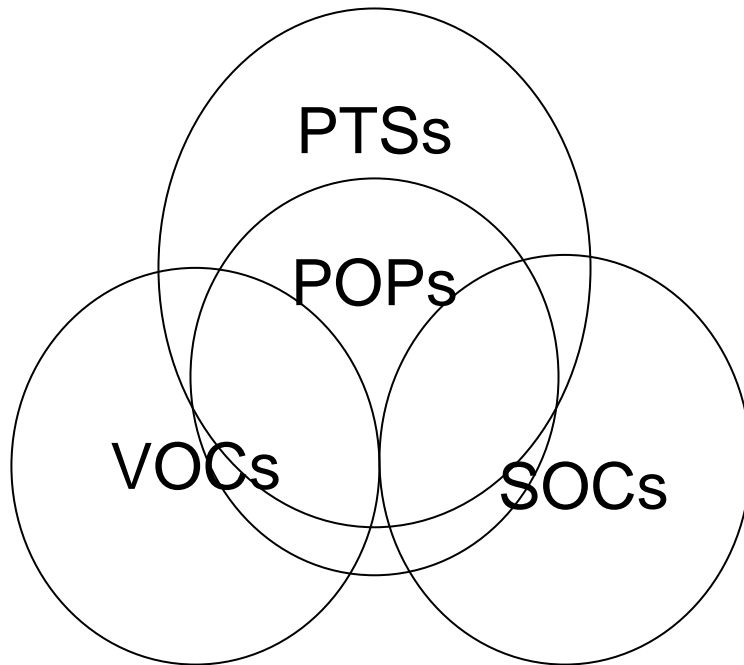
---by UNEP/GEF *“Guidance Document for the Collection, Assembly and Evaluation of Data on Sources, Environmental Levels and Impacts of Persistent Toxic Substances”* (UNEP, 2000)

- ✦ manufactured substances for use in various sectors of industry, pesticides, or by-products of industrial processes and combustion

# PTS *or* POPs



## Persistent Organic Pollutants---POPs



**VOCs** = Volatile organic chemicals

**SOCs** = semivolatile organic chemicals

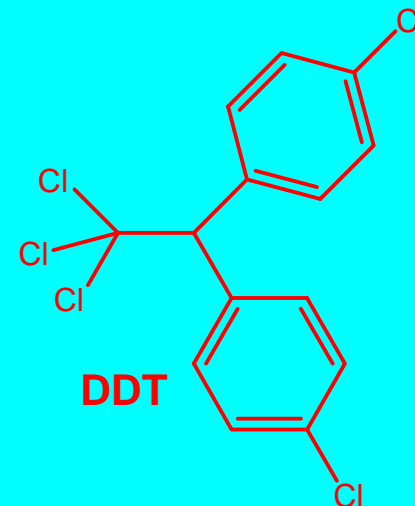
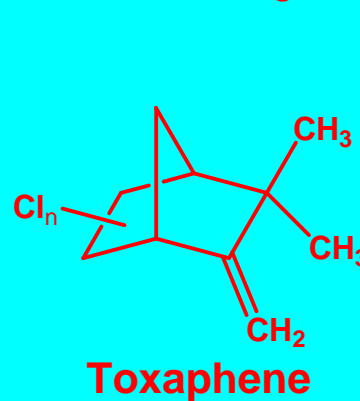
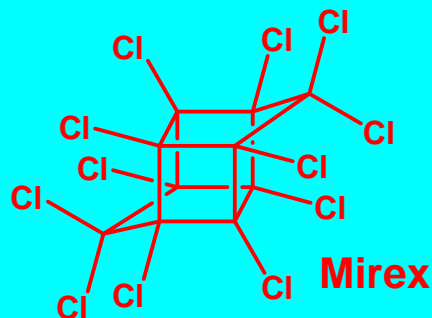
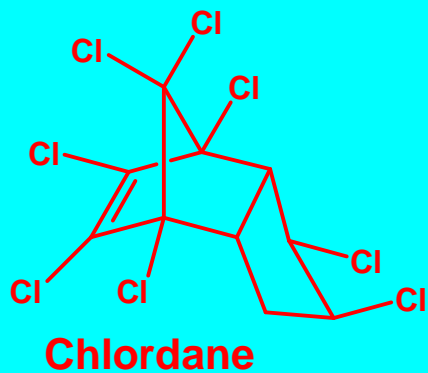
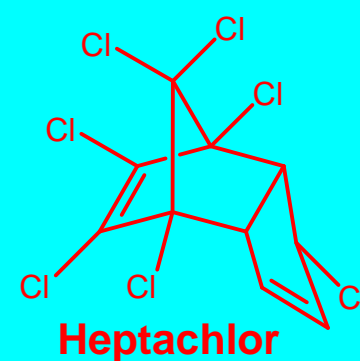
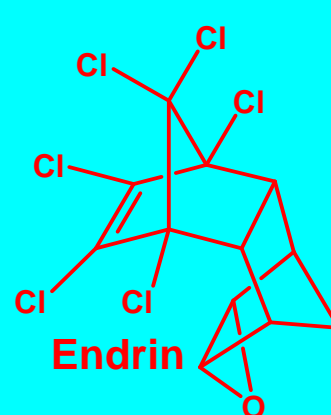
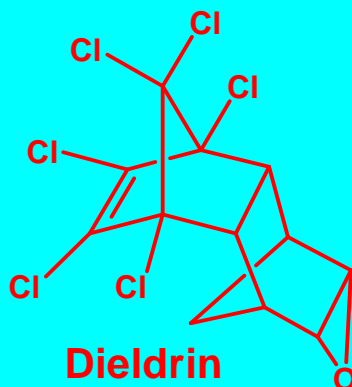
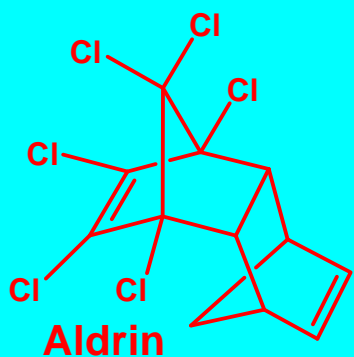
**POPs** = Persistent Organic Pollutants

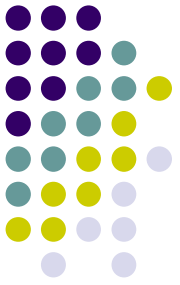
**PTSs** = Persistent Toxic Substances



# POPs – Compound Profiles

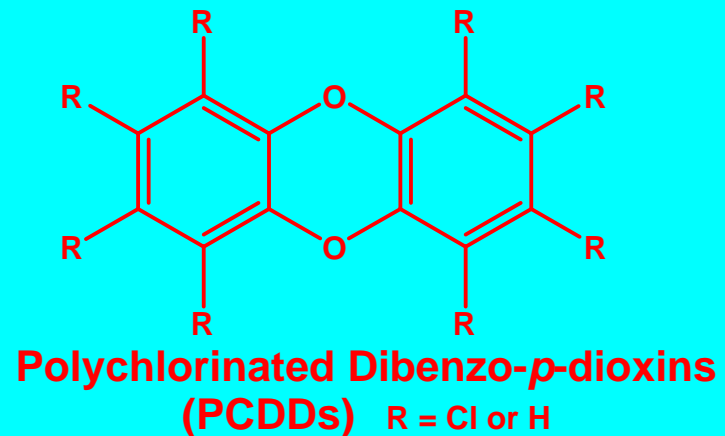
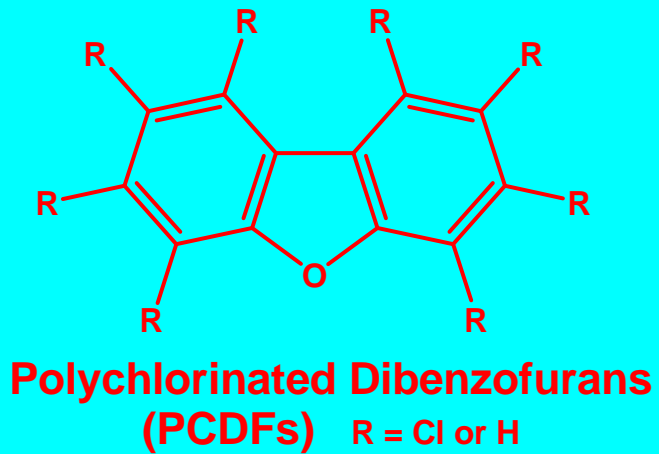
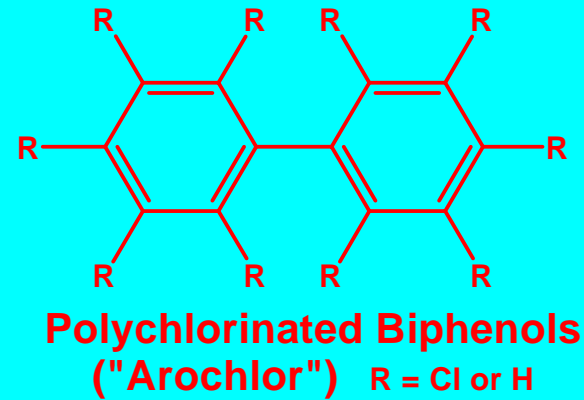
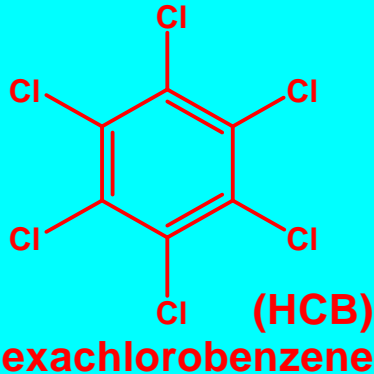
First generation organochlorine insecticides

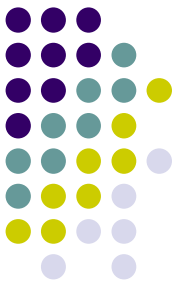




# POPs – Compound Profiles

Industrial chemical products and by-products





## 2. Review of Monitoring program in marine environment of China

- Sources investigation
- Distribution and trend survey

# POPs Sources Investigation Program

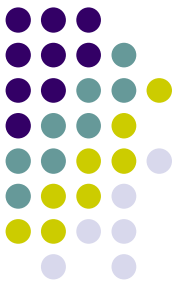
---by Ministry of Environmental Protection of PR China



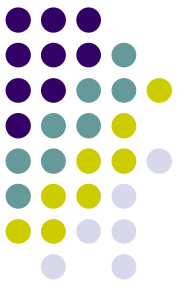
- Started in 2006
- National scale
- Focused on 17 kinds of industrial sources
- Targets: Stockholm “Dirty dozen”
- Aims:
  1. Mainly industrial discharge sources
  2. Production, storage and disposal status of POPs in China
  3. Production and usage of some insecticides
  4. Monitoring and investigation of POPs in main environmental matrices in some demo regions

# Coastal zone and outlet discharge investigation

---by State Oceanic Administration (SOA) of China



- Started in 1998
- Matrices:
  - Mussel and oyster
  - Sediment
  - Outlet discharge (from 2004)
- Targets:
  - PAHs
  - PCBs and OCPs
  - PBDEs、 Alkylphenol compounds et al.

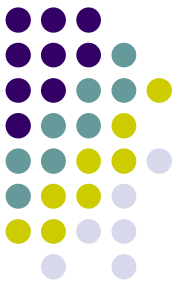


## 3. Case study

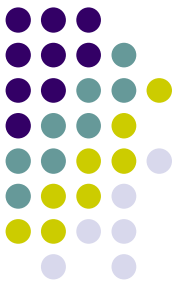
- PAHs
  - Inefficient combustion or natural sources (volcano, forest fire)
- PCBs
  - Industrial by-product
- OCPs
  - Pesticides, HCHs, DDTs
- TBT
  - Antifouling paint
- PBDEs
  - Flame retardants

# Polycyclic aromatic hydrocarbons

## ---PAHs

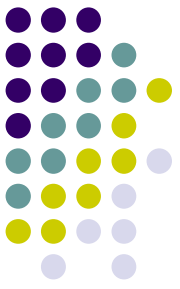


- PAHs are organic pollutants which exist in marine environment widely.
- On a national basis, PAHs levels in atmosphere were relatively high, especially in north. Furthermore, surface water was universally polluted by PAHs in some areas.
- The concentration of PAHs in sediments tended to be a low risk in most areas, while distribution profile in sediment cores showed a tendency of rapidly increase with economic development.



# PAHs in sediment of coastal areas

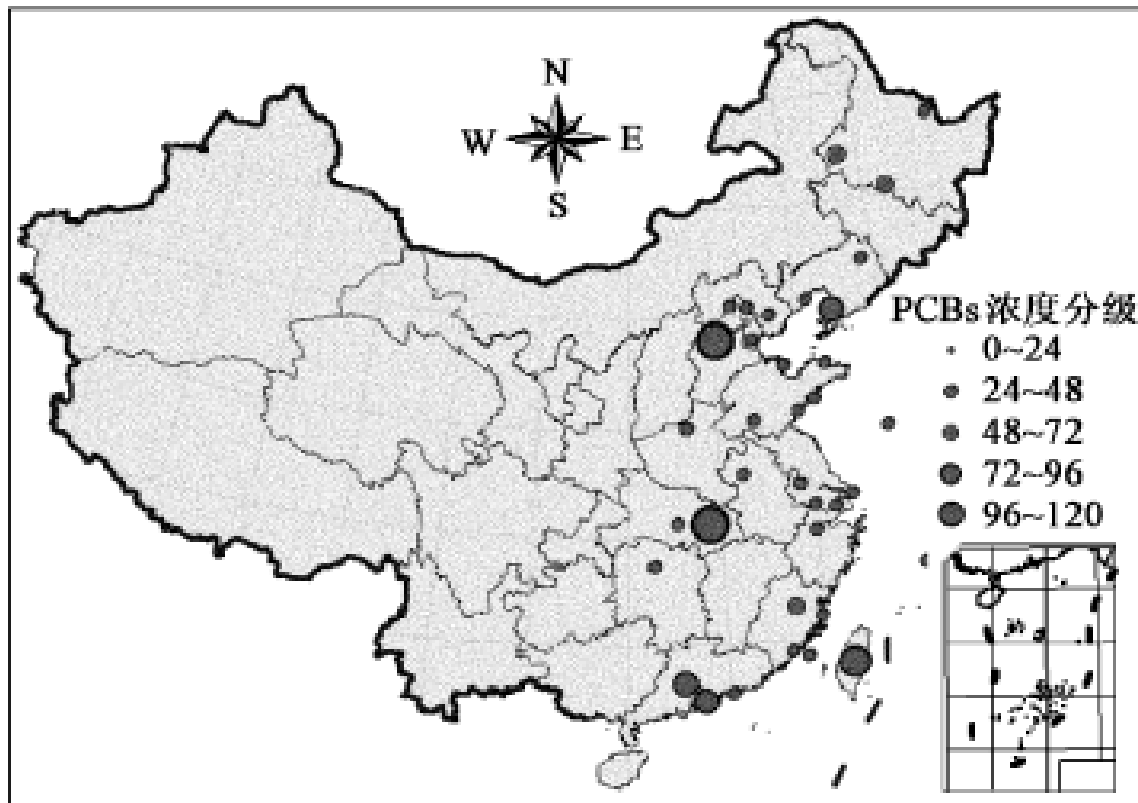
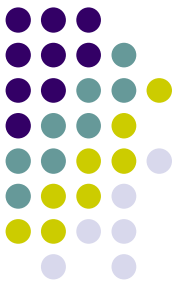
	Position	PAH isomers	Range (ng/g)	Average (ng/g)	Time
1	TaiHu Lake	15	253.6~643.6	410.9	Yuan (2004)
2	Liaohe River	17	27.45~198.26	86.8	Xu (2000)
3	Changjiang River	17	213.8~550.3	405.6	Xu (2000)
4	Zhujiang Estuary	16	156.32~9219.8 1	862.0	Mai (2000)
5	Dalian Bay	11	32.7~35588.9	1152.1	Liu (2001)
6	Laizhou Bay	10	24.7~139.2	55.0	Lin (2001)
7	Jiaozhou Bay	23	82~4567	1000.0	Yang (2003)
8	Meizhou Bay	16	196.7~229.7	256.1	Lin (2003)
9	North Yellow Sea	17	222.1~776 .3	423.5	Li (2005)



# PCBs

- Normally, **no regional** distribution map was established in China
- **Point source** pollution was the common pattern of contamination
- Songhua River and Dalian Bay in Northeast, two Lakes in central area, and Pearl River and Taiwan Province in Southeast of China have relatively high level of PCBs , while most other regions have lower concentrations
- Serious pollution of PCBs is found in some harbors and industrial areas, most of which existed **improper disposal of and leakage from PCB containers**

# Average concentrations of PCBs in sediment in China (dry weight, ng/ g)



\* Xing et al (2006)

# OCPs

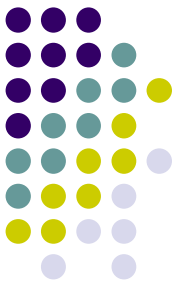


Table 1  
Status of OCP application in China in the last four decades (in tons)

Year	HCHs	DDTs	Gross pesticides
1950	–	–	213
1960	68,310	8100	81,415
1970	171,672	18,992	227,314
1980	241,613	16,428	348,847
1990	–	–	163,586



**Pesticides mainly used now are:  
Organophosphous pesticides,  
N-methylcarbamate pesticides**

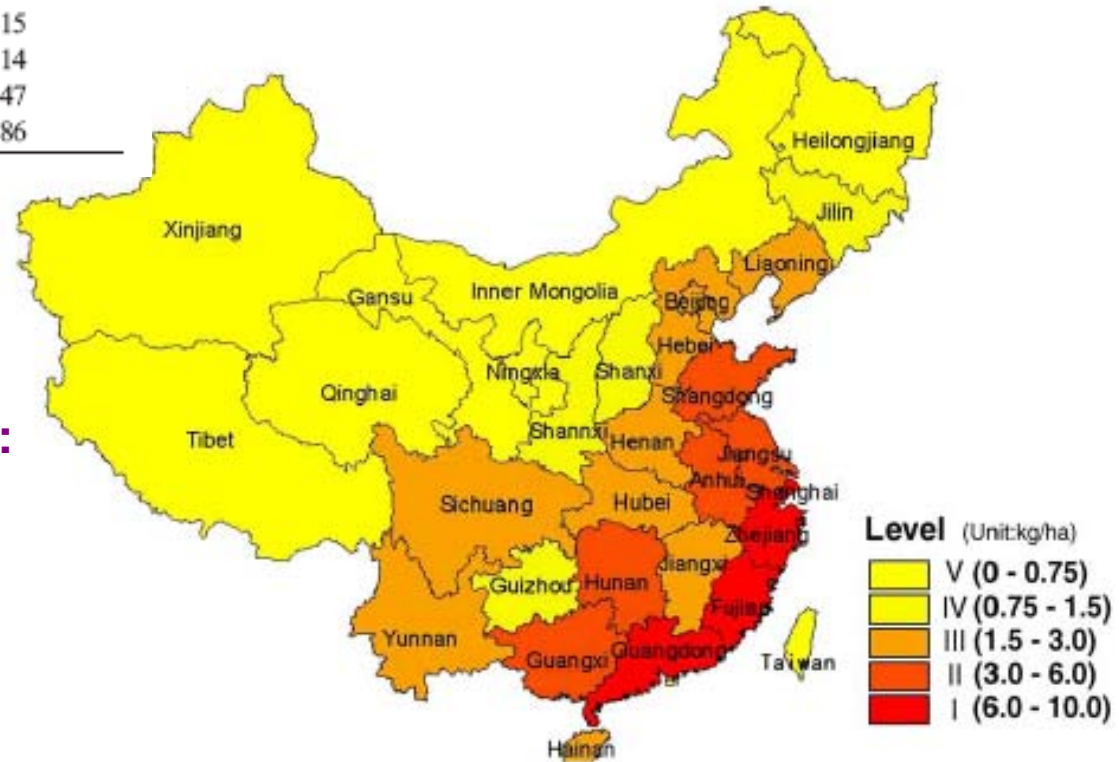


Fig. 1. Classification of pesticide application in different areas of China in 1996.

*From Wang et al Environ Intern (2005)*

# PCBs, HCHs and DDTs level in sediment of coastal zone in China (dry weight, ng/g)



N



S

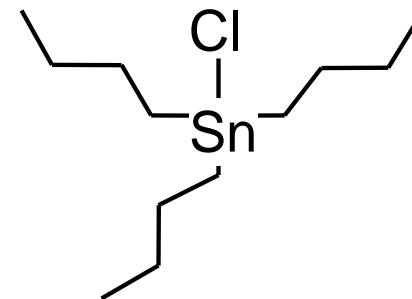
Site	PCBs (ave.)	BHCs (ave.)	DDTs (ave.)	Reference
<b>Dalian Bay</b>	1.02–153(19.1)	7.54–92.30(21.25)	20.12–72.3(21.75)	Li (1998)
<b>Jinzhou Bay</b>	0.6–32.56(3.84)	5.77–323.07(58.61)	0.97–154.87(23.85)	Li (1998)
<b>Jiaozhou Bay</b>	0.65–32.9(4.86)			Yang(2003)
<b>Yangtze River</b>	0.39–1.13	0.18–1.14	0.21–4.50	Xu (2001)
<b>Yangtze Estuary</b>	nd–18.95	nd–30.40	nd–0.57	Liu (2003)
<b>Xiamen Harbor</b>	0.05–7.24(1.74)	0.14–1.12(0.45)	4.45–311(42.8)	Hong 1995)
<b>Victoria Harbor</b>	3.2–81(7.9)	0.1–2.3(0.51)	1.38–30.3(9.1)	Hong 1995)
<b>Pearl Estuary</b>	11.54–485.45	0.14–17.04	2.6–1628.81	Mai (2000)

The areas with high level of OCPs were mostly in southeast of china.

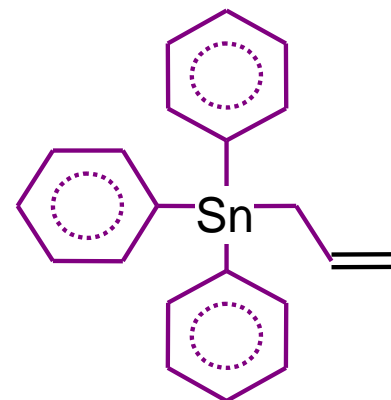
Distribution was parallel with the application of OCPs.

# Organotin compounds

- Marine pollution by organotin compounds (mainly TBT) has been of great concern in many countries, because of the wide existence
- Always the hotspot of environment because of its extremely high toxicity to marine organisms at low concentration levels in seawater
- According to the previous research, wide existence of TBT was found in samples from Chinese coastal water and sediment



TBT sodium hydrate



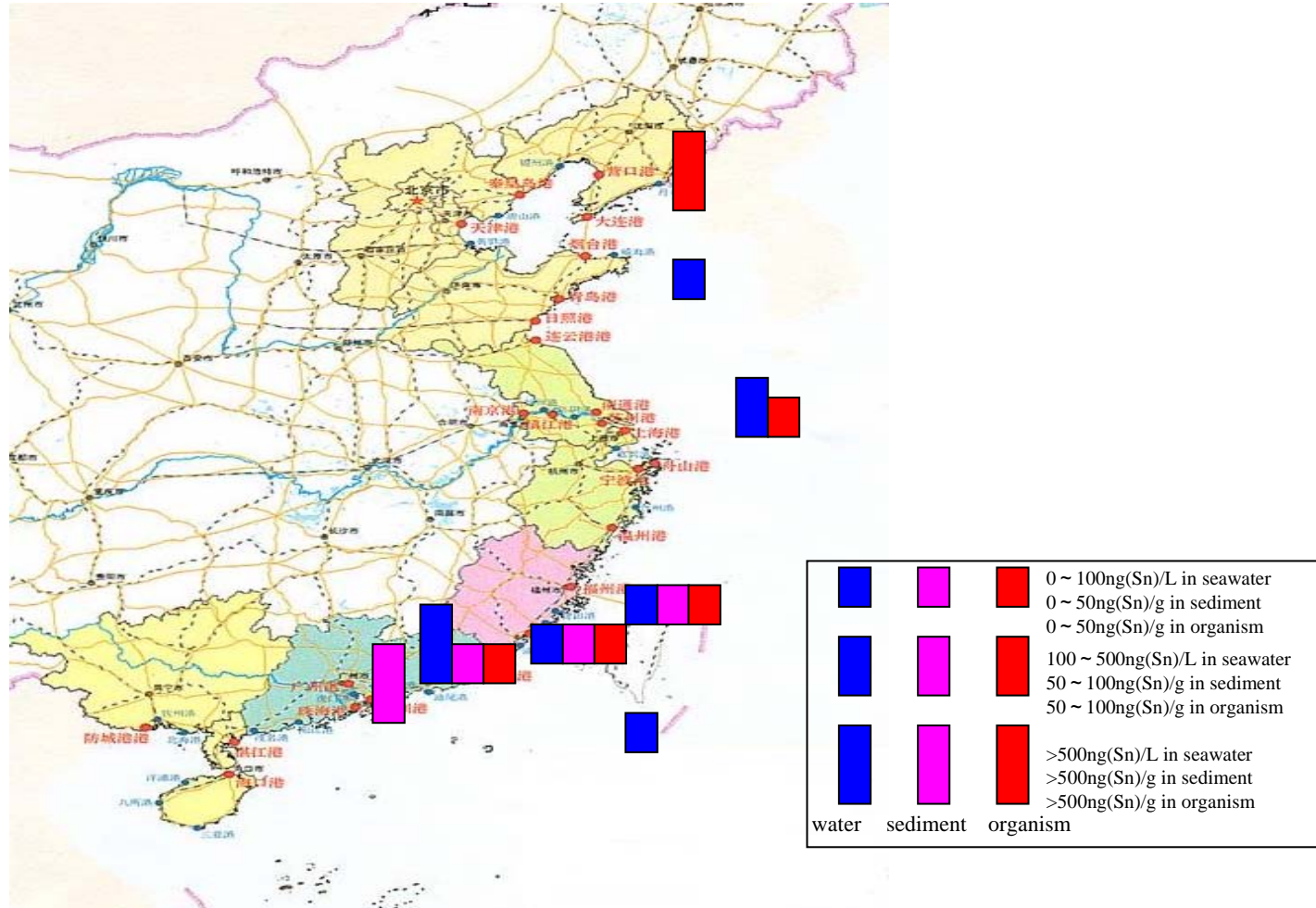
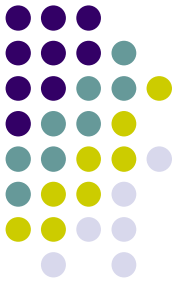
TPhT (Derivatized)

# Concentration of Organotins in different matrices in coastal provinces of China

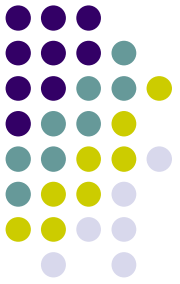


	Sea water	sediment	organism (wet)	References
<b>Dalian</b>			nd ~ 407.5 ng(Sn)/g	Li(2003)
<b>Qingdao</b>	26.17~132.10 ng/L			Yuan(2007)
<b>Shanghai</b>	483.3 ng/L (Mean)		nd ~ 42.9 ng(Sn)/g	Jiang(2001); Li(2003)
<b>Fujian</b>	n.d.~ 54.75 ng(Sn)/L	0.24 – 32.78 ng(Sn)/g	nd ~ 51.3 ng(Sn)/g	Yuan(2001); Li(2003)
<b>Shantou</b>	338.8 ng/L (Mean)	81.7 ng/g (Mean)	47.4 ng/g (Mean)	Huang(2005)
<b>Huiyang</b>	3290.2 ng/L (Mean)	19.6 ng/g (Mean)	44.6ng/g (Mean)	
<b>South of Taiwan</b>	50.4±4.3 ng(Sn)/L			Liu(2002)
<b>Pearl River estuary</b>		43.8– 514.8 ng/g		Yan(2000)

# Contamination map of TBT

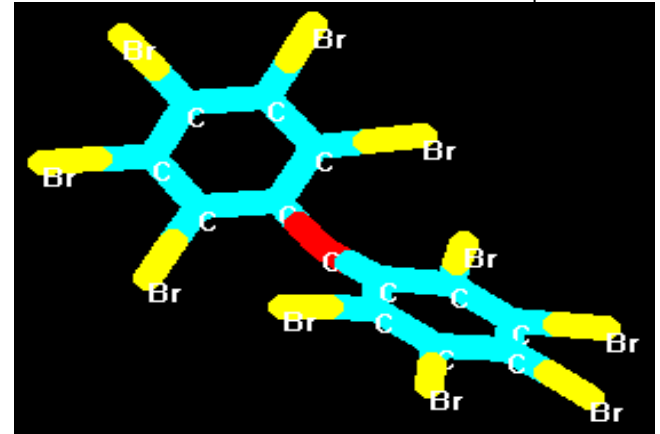


# PBDEs



- **Flame retardants**

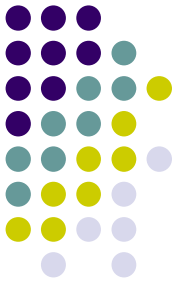
- PentaBDE
  - Foam in furniture, automobile seats
  - 8,000 tons/year worldwide.
- OctaBDE
  - Plastics in electronics (e.g. TVs, computers)
  - 4,000 tons/year worldwide
- DecaBDE
  - Plastics in electronics (e.g. TVs, computers), wire and cable insulation, textiles
  - 62,000 tons/year worldwide



(\* industry data for 2001)

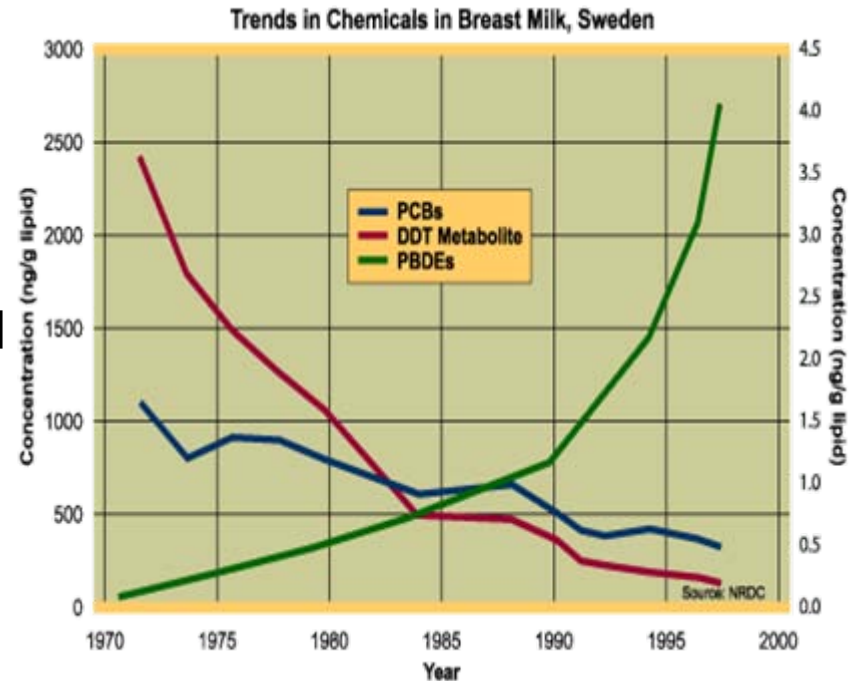
**In china, 2 000 tons PBDEs used in 1995 and  
13 500 tons in 2001 (Xia et al., 2005)**

# Why are we concerned?



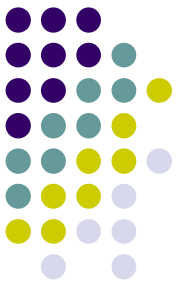
- Persistence
  - Presence in humans, environment and biota
- Bioaccumulation
  - Rapidly increasing concentrations in mammals and birds
- Toxicity
  - Varies from high to low
- **Unknowns**
  - **Unknown degradation products & metabolites**
  - **Unknown toxicity**

*adapted from materials by Tom McDonald, CAL EPA*

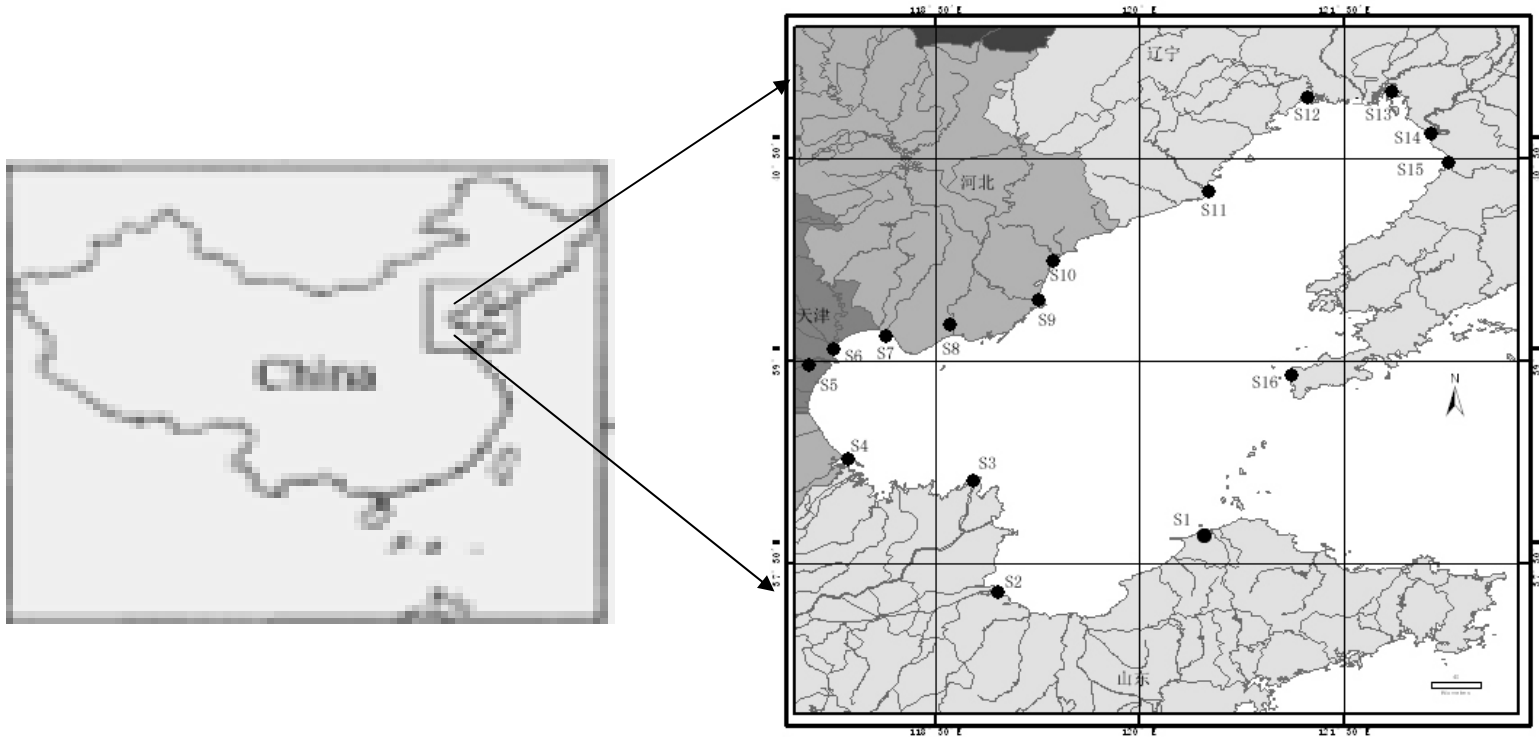


The only POPs with the increasing trend in environment

*From Meironyte et al (2001)*

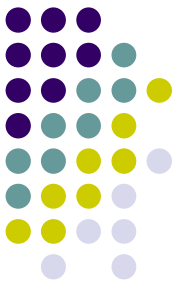


In 2006-2007, we conducted the investigation of PBDEs in sediment and biota sample along Bohai Sea coastal zone.



Sample stations along Bohai Sea coastal zone

# PBDEs level in sediment of coastal zone in China (dry weight, ng/g)

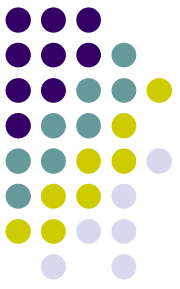


	<b>Region</b>	<b><math>\Sigma</math>PBDEs</b>	<b>BDE209</b>	<b>References</b>
1	Nearshore Qingdao	1.4		Yang (2005)
2	Pearl Estuary	3.1	18.5	Chen (2005)
3	South China Sea	0.46	2.7	Chen (2005)
4	Nearshore Hongkong	1.7-53.6		Liu (2005)
5	Marco Harbor	10.2	43.8	Mai (2005)
6	XiaMen Harbor	0.1-2.06		Ou (2006)
7	Bohai coastal zone	0.497	12.73	Ma (2007)



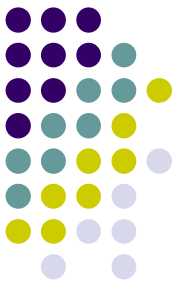
# PBDEs in mussel around world

Time	Species	Location	Concentration (ng/g)
2002	blue mussel	Lofoten (Svolvær)	0.06~0.19 ww
2000	blue mussel	Southern Greenland	0.11 ww
2003	blue mussel	Norway	0.06~0.25 ww
2003	mussel	Stockholm, Sweden	0.4~0.79 ww
		North Sea	4.95 dw
	mussel	Atlantic (Pen Bé)	0.25~1.47 dw
	mussel	English Channel (Villerville)	4.96~27.73 dw
2004	mussel	Hong Kong, China	27.0~83.7 dw
2002	blue mussel	Yellow Sea , China	0.753 dw
2006	mussel	BoHai Sea , China	0.31~2.73 dw



# Results

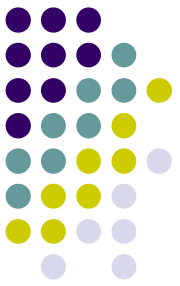
- PBDE concentrations in sediment around the Bo Sea are correspondingly lower than other regions of china and the entire residue level of china is higher than other areas of the world
- BDE-209 is the predominant congener in sediment, suggesting the deca-BDE mixture has been the major source of PBDEs
- The main pollutant monomers are low PBDEs in organism



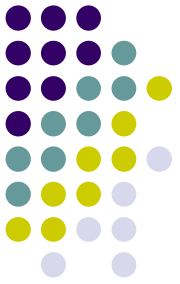
## 4 Data Gaps

- Available data were obtained from various labs, no uniform QA/QC methods;
  - The lack of standardized methodologies makes it difficult to compare and use existing data to provide exact conclusions on spatial and temporal trends.
- Most of the data available based on limited studies or focus on some “hot spots” along coastal zones of China.

# References:



- **Regionally Based Assessment of Persistent Toxic Substances: Central and North east Asia.**
  - *By UNEP Chemicals, GEF, 2002*
- **Persistent Organic Pollutants in Asia: Sources, Distributions, Transport, and Fate.**
  - *By An Li, Shinsuke Tanabe, Guibin Jiang, John P. Giesy, Paul KS Lam., Elsevier Science Ltd 2007*



Thanks for your attention!