

Influential factors and dry deposition of polychlorinated biphenyls (PCBs) in atmospheric particles at an isolated island (Pingtan Island) in Fujian Province, China

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Text S1 Details of the Sample Pretreatment and Analysis

Unless otherwise stated, all organic reagents are HPLC grade. PCB internal standards (PCB30 and PCB209) and the surrogate standard were purchased from AccuStandard, USA.

Before extraction, the GFFs were removed from the freezer and placed in a dry-box to warm at room temperature for 24–48 h. The GFFs were cut into quarters for extraction by an accelerated solvent extraction instrument (ASE 200, Dionex, US) spiked with 60 μL of the surrogate standard and using 1:1 dichloromethane/hexane as the extraction solvent at 100°C and 1000–1500 psi ($6.9\text{--}10.3 \times 10^6$ Pa) for a 3-min heating process followed by a 5-min static extraction process. This procedure was repeated 2 times with fresh solvent. The extract was concentrated to 1 mL using a rotary evaporation, and then, the concentrated extract was transferred to chromatography column (anhydrous sodium sulfate +4g silica gel + anhydrous sodium sulfate) and eluted with 100 mL hexane/dichloromethane (v/v 1:1). Finally, the eluate was concentrated to 0.1 mL under a gentle stream of nitrogen and transferred into hexane for determination.

In total, 28 PCB congeners (PCB-8, 18, 28, 52, 44, 66, 101, 81, 77, 123, 118, 114, 153, 105, 138, 126, 187, 128, 167, 156, 157, 180, 169, 170, 189, 195, 206 and 209) were detected using gas chromatography/electron capture detection (GC/ECD) (Agilent 7890A with Ni63 ECD) equipped with a DB-5 MS column ($60\text{ m} \times 0.25\text{ mm} \times 0.25\text{ }\mu\text{m}$ film thickness). The temperature of the injector and detector was 270 °C and 300 °C, respectively. Splitless injection was used, and 1 μL of the extract was injected. The oven temperature was initially set at 80 °C, increased to 210 °C at a rate of 10 °C min^{-1} , then to 250 °C at 0.8 °C min^{-1} and held for 1 min, and at last reached 290 °C at a rate of 10 °C min^{-1} and held for 12 min. High-purity nitrogen (99.999%) was used as the carrier gas with a flow rate of 30 mL min^{-1} .

A portion of the filter samples was analysed by elemental analysis isotope mass spectrometry (Flash EA 1112 HT-Delta V Advantages, Thermo) to determine the TOC and $\delta^{13}\text{C}$. The carrier gas flow rate was 90 mL min^{-1} , and the temperature of the combustion tube and chromatographic column was 960 °C and 45 °C.

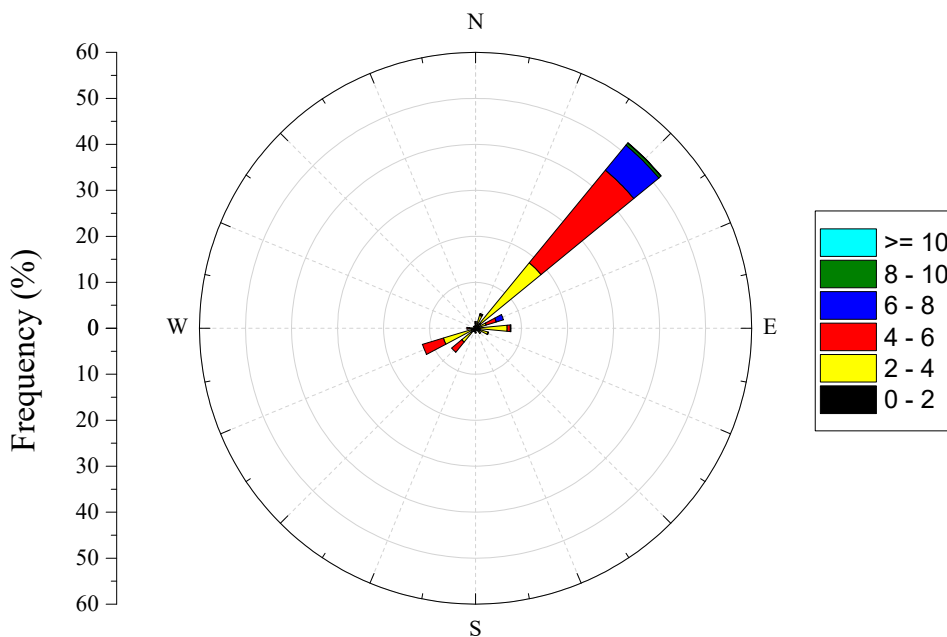


Figure S1. Frequency of wind direction at Pingtan Island from January 2006 to November 2007.

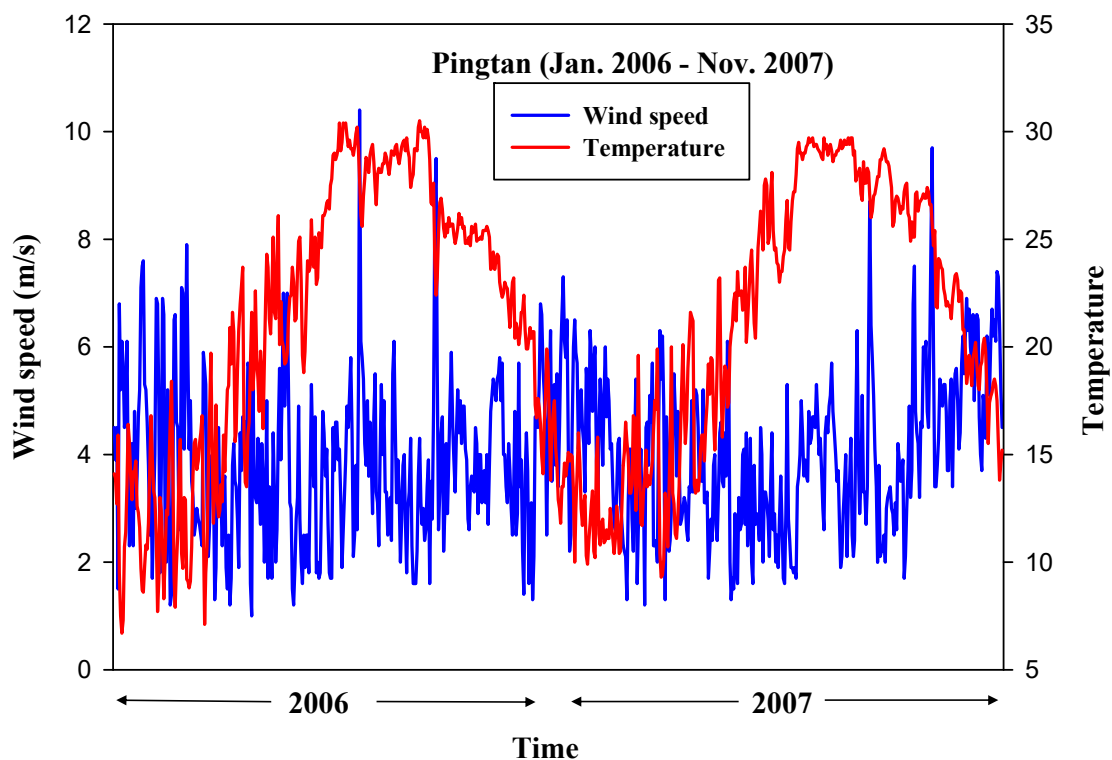


Figure S2. Temporal variations of wind speed and ambient air temperature at Pingtan Island during the sampling periods.

Table S1 The number of chlorines for the various congeners.

Congeners	Number of chlorine atoms	Congeners	Number of chlorine atoms	Congeners	Number of chlorine atoms	Congeners	Number of chlorine atoms
PCB-8	2	PCB-81	4	PCB-138	6	PCB-180	7
PCB-18	3	PCB-77	4	PCB-126	5	PCB-169	6
PCB-28	3	PCB-123	5	PCB-187	7	PCB-170	7
PCB-52	4	PCB-118	5	PCB-128	6	PCB-189	7
PCB-44	4	PCB-114	5	PCB-167	6	PCB-195	8
PCB-66	4	PCB-153	6	PCB-156	6	PCB-209	9
PCB-101	5	PCB-105	5	PCB-157	6	PCB-209	10

Table S2 Monthly average concentrations of PCBs in the atmospheric particulates of Pingtan Island in 2006. Concentrations are pg m⁻³.

PCBs(pg/m ³)	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Sept.	Oct.	Nov.	Dec.
Non-ortho PCBs											
81	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00
77	0.56 ± 0.75	0.22 ± 0.14	0.22 ± 0.29	0.62 ± 0.44	0.32 ± 0.17	0.54 ± 0.32	2.22 ± 19.2	3.51 ± 2.06	2.06 ± 2.93	8.34 ± 8.02	8.39 ± 5.08
126	0.80 ± 2.53	0.28 ± 0.48	0.00 ± 0.00	2.25 ± 7.41	0.31 ± 0.43	0.00 ± 0.00	0.01 ± 0.04	0.14 ± 0.25	0.15 ± 0.55	0.21 ± 0.42	0.00 ± 0.00
169	0.07 ± 0.13	0.00 ± 0.00	0.01 ± 0.05	0.00 ± 0.00	0.14 ± 0.20	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.08 ± 0.15	0.02 ± 0.06	0.06 ± 0.20
Mono-ortho PCBs											
105	0.09 ± 0.16	0.02 ± 0.04	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.25 ± 0.43	0.01 ± 0.03	0.00 ± 0.00	0.69 ± 1.24
114	0.26 ± 0.65	0.09 ± 0.10	0.09 ± 0.17	0.33 ± 0.24	0.39 ± 0.48	0.02 ± 0.03	0.02 ± 0.05	0.14 ± 0.24	0.01 ± 0.02	0.01 ± 0.22	0.10 ± 0.18
118	0.01 ± 0.02	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.01 ± 0.05	0.15 ± 0.27	0.00 ± 0.00
123	0.35 ± 0.22	0.36 ± 0.28	0.15 ± 0.18	0.26 ± 0.27	0.11 ± 0.05	0.03 ± 0.06	0.42 ± 0.52	0.13 ± 0.23	0.24 ± 0.57	0.19 ± 0.37	0.00 ± 0.00
156	0.75 ± 1.21	0.39 ± 0.28	0.15 ± 0.24	0.45 ± 0.27	0.03 ± 0.05	0.01 ± 0.03	0.09 ± 0.22	0.04 ± 0.07	0.17 ± 0.27	0.64 ± 0.58	0.56 ± 0.71
157	0.99 ± 1.44	0.29 ± 0.19	0.26 ± 0.48	0.34 ± 0.23	0.01 ± 0.02	0.05 ± 0.05	0.17 ± 0.19	0.46 ± 0.80	1.41 ± 4.41	0.55 ± 0.60	0.44 ± 0.47
189	3.67 ± 3.73	3.78 ± 2.48	5.10 ± 9.12	7.54 ± 13.94	2.61 ± 2.95	1.12 ± 1.65	0.52 ± 0.56	0.88 ± 0.79	1.28 ± 1.37	3.32 ± 3.86	3.50 ± 3.81
Indicator PCBs											
28	0.06 ± 0.19	0.01 ± 0.04	0.02 ± 0.07	0.52 ± 0.67	0.70 ± 0.89	0.01 ± 0.02	0.00 ± 0.00	0.12 ± 0.11	0.13 ± 0.45	0.00 ± 0.00	0.04 ± 0.12
52	5.85 ± 14.14	0.16 ± 0.16	1.40 ± 4.74	0.01 ± 0.04	0.00 ± 0.00	0.06 ± 0.10	0.11 ± 0.30	0.23 ± 0.39	0.45 ± 0.79	0.31 ± 0.43	0.63 ± 0.71
101	0.15 ± 0.46	0.00 ± 0.00	0.03 ± 0.07	0.01 ± 0.03	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.23 ± 0.40	0.29 ± 1.01	1.14 ± 2.69	0.00 ± 0.00
153	0.09 ± 0.27	0.01 ± 0.02	0.00 ± 0.01	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.33 ± 1.17	0.00 ± 0.00	0.00 ± 0.00
138	8.90 ± 8.50	6.25 ± 5.12	4.12 ± 3.73	7.37 ± 2.79	1.05 ± 0.58	0.33 ± 0.15	0.54 ± 0.46	0.57 ± 0.44	1.67 ± 1.17	4.56 ± 3.21	7.96 ± 7.06
180	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.10 ± 0.11	0.18 ± 0.16	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.01 ± 0.03	0.02 ± 0.06	0.00 ± 0.00
Other											
8	0.23 ± 0.32	0.02 ± 0.06	0.20 ± 0.27	0.58 ± 0.57	0.35 ± 0.49	1.44 ± 0.84	0.82 ± 0.86	0.49 ± 0.17	0.45 ± 0.35	1.16 ± 1.42	0.50 ± 0.32
18	0.08 ± 0.12	0.01 ± 0.02	0.01 ± 0.03	0.03 ± 0.07	0.01 ± 0.01	0.06 ± 0.06	0.04 ± 0.06	0.00 ± 0.00	0.16 ± 0.41	0.12 ± 0.22	0.20 ± 0.27
44	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00
66	0.15 ± 0.23	0.04 ± 0.09	0.02 ± 0.08	0.14 ± 0.44	0.08 ± 0.11	0.00 ± 0.00	0.13 ± 0.23	0.26 ± 0.32	0.17 ± 0.22	0.21 ± 0.34	0.30 ± 0.52
187	1.02 ± 1.02	1.14 ± 0.71	0.46 ± 0.53	1.26 ± 0.46	0.21 ± 0.10	0.11 ± 0.10	0.27 ± 0.36	0.18 ± 0.16	0.08 ± 0.15	0.34 ± 0.53	0.71 ± 1.29
128+167	0.07 ± 0.09	0.15 ± 0.18	0.00 ± 0.01	0.06 ± 0.15	0.21 ± 0.30	0.00 ± 0.00	0.01 ± 0.04	0.00 ± 0.00	0.01 ± 0.02	0.06 ± 0.12	0.03 ± 0.07
170	0.38 ± 0.45	0.27 ± 0.21	0.02 ± 0.07	0.30 ± 0.41	0.10 ± 0.10	0.04 ± 0.06	0.44 ± 0.78	0.25 ± 0.23	0.22 ± 0.26	0.52 ± 0.58	0.41 ± 0.37
195	0.40 ± 0.23	0.27 ± 0.28	0.15 ± 0.22	0.45 ± 0.32	0.12 ± 0.08	0.01 ± 0.03	0.01 ± 0.03	0.02 ± 0.04	0.15 ± 0.26	0.26 ± 0.20	0.37 ± 0.26
206	0.25 ± 0.13	0.31 ± 0.22	0.33 ± 0.77	0.21 ± 0.17	0.08 ± 0.01	0.02 ± 0.05	0.20 ± 0.28	0.00 ± 0.00	0.01 ± 0.05	0.25 ± 0.38	0.24 ± 0.41
209	0.03 ± 0.05	0.09 ± 0.25	0.00 ± 0.00	0.03 ± 0.04	0.00 ± 0.00	0.02 ± 0.05	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.03 ± 0.08
Σ DL-PCBs	7.54 ± 5.89	5.43 ± 2.77	5.98 ± 8.88	11.78 ± 20.70	3.92 ± 4.22	1.77 ± 1.42	3.46 ± 1.95	5.55 ± 3.39	5.42 ± 8.14	13.53 ± 8.75	13.75 ± 6.79
Σ indicator PCBs	15.05 ± 16.27	6.42 ± 5.12	5.57 ± 6.88	8.01 ± 3.17	1.93 ± 1.63	0.40 ± 0.24	0.65 ± 0.65	1.15 ± 0.40	2.87 ± 3.21	6.03 ± 4.01	8.63 ± 7.37
Σ 28 PCBs	25.20 ± 20.43	14.16 ± 7.56	12.74 ± 12.27	22.85 ± 21.31	7.01 ± 7.03	3.87 ± 1.26	6.04 ± 3.43	7.91 ± 4.36	9.54 ± 11.28	22.48 ± 12.5	25.18 ± 13.75

Table S3 Monthly average concentrations of PCBs in the atmospheric particulates of Pingtan Island in 2007. Concentrations are pg m^{-3} .

PCBs(pg/m^3)	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug	Oct.	Nov.
Non-ortho PCBs										
81	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00
77	4.44 ± 3.44	3.28 ± 3.99	0.62 ± 0.48	4.08 ± 4.14	1.52 ± 1.31	0.94 ± 1.50	0.29 ± 0.31	0.43 ± 0.56	1.86 ± 0.48	2.47 ± 0.88
126	0.05 ± 0.17	0.04 ± 0.12	0.00 ± 0.00	0.00 ± 0.00	0.02 ± 0.07	0.05 ± 0.15	0.00 ± 0.00	0.06 ± 0.19	0.00 ± 0.00	0.00 ± 0.00
169	0.08 ± 0.13	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.01 ± 0.03	0.00 ± 0.00	0.01 ± 0.04	0.03 ± 0.10	0.00 ± 0.00	0.00 ± 0.00
Mono-ortho PCBs										
105	0.24 ± 0.23	0.12 ± 0.25	0.02 ± 0.08	0.02 ± 0.09	0.01 ± 0.04	0.14 ± 0.15	0.09 ± 0.18	0.02 ± 0.06	0.00 ± 0.00	0.00 ± 0.00
114	0.04 ± 0.08	0.14 ± 0.29	0.00 ± 0.00	0.09 ± 0.13	0.04 ± 0.11	0.00 ± 0.00	0.00 ± 0.00	0.02 ± 0.06	0.04 ± 0.07	0.08 ± 0.14
118	0.00 ± 0.00	0.14 ± 0.32	0.21 ± 0.67	0.00 ± 0.00	0.03 ± 0.10	0.28 ± 0.45	0.44 ± 0.66	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00
123	0.12 ± 0.34	0.19 ± 0.42	0.03 ± 0.11	0.00 ± 0.00	0.07 ± 0.16	0.00 ± 0.00	0.28 ± 0.75	0.00 ± 0.67	0.00 ± 0.00	0.00 ± 0.00
156	1.25 ± 1.22	0.60 ± 0.54	0.45 ± 0.59	0.11 ± 0.09	0.18 ± 0.18	0.29 ± 0.30	0.20 ± 0.51	0.35 ± 0.48	0.10 ± 0.11	0.40 ± 0.36
157	0.69 ± 0.42	0.48 ± 0.35	0.24 ± 0.32	0.15 ± 0.17	0.16 ± 0.13	0.35 ± 0.46	0.70 ± 1.42	0.28 ± 0.30	0.11 ± 0.10	0.31 ± 0.08
189	5.87 ± 2.14	2.84 ± 3.11	1.29 ± 1.02	0.85 ± 0.80	2.41 ± 6.09	0.44 ± 0.29	0.40 ± 0.34	1.14 ± 1.87	0.83 ± 0.35	2.06 ± 1.55
Indicator PCBs										
28	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.01 ± 0.03	0.01 ± 0.02	0.00 ± 0.00	0.02 ± 0.07	0.02 ± 0.08	0.03 ± 0.05	0.14 ± 0.12
52	0.23 ± 0.24	0.30 ± 0.34	0.00 ± 0.00	0.01 ± 0.05	0.00 ± 0.00	0.10 ± 0.12	0.11 ± 0.23	0.10 ± 0.30	0.17 ± 0.19	0.25 ± 0.23
101	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.02 ± 0.04	0.00 ± 0.00	0.02 ± 0.06	0.00 ± 0.00	0.00 ± 0.00
153	0.00 ± 0.00	0.00 ± 0.00	0.05 ± 0.16	0.01 ± 0.03	0.00 ± 0.00	0.04 ± 0.10	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00
138	13.26 ± 6.95	8.41 ± 6.59	2.24 ± 1.52	2.20 ± 1.65	1.63 ± 1.12	0.71 ± 0.65	0.99 ± 0.87	0.97 ± 0.87	2.18 ± 0.74	3.95 ± 1.59
180	0.01 ± 0.05	0.01 ± 0.02	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.04 ± 0.08	0.03 ± 0.09	0.00 ± 0.00	0.00 ± 0.00
Other										
8	0.78 ± 0.50	1.80 ± 1.51	0.57 ± 0.47	0.79 ± 0.59	1.03 ± 1.06	6.57 ± 9.43	3.66 ± 6.33	2.50 ± 3.01	0.42 ± 0.22	0.88 ± 0.58
18	0.29 ± 0.48	0.03 ± 0.07	0.02 ± 0.06	0.13 ± 0.16	0.08 ± 0.09	0.21 ± 0.34	0.04 ± 0.07	0.11 ± 0.17	0.20 ± 0.35	0.27 ± 0.26
44	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.06	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00
66	0.09 ± 0.27	0.00 ± 0.00	0.04 ± 0.14	0.04 ± 0.10	0.55 ± 0.71	0.19 ± 0.17	0.10 ± 0.22	0.03 ± 0.07	0.20 ± 0.35	0.15 ± 0.13
187	0.16 ± 0.57	0.03 ± 0.08	0.09 ± 0.23	0.17 ± 0.25	0.32 ± 0.17	0.04 ± 0.10	0.09 ± 0.25	0.04 ± 0.08	0.42 ± 0.15	0.67 ± 0.20
128+167	0.05 ± 0.12	0.04 ± 0.10	0.04 ± 0.12	0.00 ± 0.00	0.01 ± 0.02	0.02 ± 0.06	0.08 ± 0.15	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00
170	0.61 ± 0.42	0.45 ± 0.57	0.20 ± 0.33	0.31 ± 0.36	0.10 ± 0.12	0.24 ± 0.29	0.20 ± 0.24	0.27 ± 0.26	0.02 ± 0.04	0.20 ± 0.09
195	0.57 ± 0.25	0.32 ± 0.29	0.12 ± 0.12	0.12 ± 0.14	0.05 ± 0.08	0.02 ± 0.05	0.05 ± 0.08	0.08 ± 0.11	0.07 ± 0.07	0.19 ± 0.06
206	0.16 ± 0.14	0.07 ± 0.12	0.04 ± 0.11	0.00 ± 0.00	0.00 ± 0.00	0.08 ± 0.21	0.10 ± 0.21	0.03 ± 0.06	0.41 ± 0.71	0.05 ± 0.05
209	0.01 ± 0.05	0.02 ± 0.06	0.01 ± 0.04	0.03 ± 0.05	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.05 ± 0.09
Σ DL-PCBs	12.78 ± 4.59	7.82 ± 4.99	2.86 ± 2.60	5.31 ± 4.56	4.44 ± 5.70	2.50 ± 2.18	2.42 ± 2.48	2.61 ± 2.49	2.94 ± 0.68	5.32 ± 1.94
Σ indicator PCBs	13.5 ± 7.02	8.72 ± 6.79	2.29 ± 1.47	2.23 ± 1.65	1.63 ± 1.12	0.86 ± 0.60	1.16 ± 1.08	1.13 ± 0.88	2.38 ± 0.51	4.33 ± 1.47
Σ 28 PCBs	29.01 ± 10.68	19.28 ± 10.94	6.27 ± 4.35	9.12 ± 5.79	8.21 ± 5.28	10.74 ± 8.93	7.90 ± 9.94	6.81 ± 4.15	7.06 ± 1.65	12.10 ± 2.25

Table S4 PCBs deposition fluxes reported in literature from different sites

Location	Environment type	Number of chlorine atoms	Dry deposition fluxes[ng m ⁻² d ⁻¹]	References
Thau lagoon, France	coastal	18	0.40	[1]
Island of Crete, Greece	coastal	54	0.1-1.1	[2]
Southern Taiwan	Urban/industrial	12	0.29-1.01 in fall 0.29-0.86 in spring	[3]
Izmir, Turkey	industrial	41	349 in summer 469 in winter	[4]
Chicago, USA	urban	43	190	[5]
Pingtang Island, China	coastal	28	3.94 in 2006 2.94 in 2007	This study

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