# IMPORTANCE OF SETTING-UP ATMOSPHERIC MONITORING NETWORK OF PERSISTENT ORGANIC POLLUTANTS (POPS) IN ARID ZONE OF NORTHWEST CHINA

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## ABSTRACT

Persistent Organic Pollutants (POPs) as a group of emerging pollutants have raised the attended of researchers all around the world for several decades. Very little research has been undertaken on POPs in the arid zone of northwest China. Research at several sites including Peacock River, Shihezi, Kanas and Hami, indicated that POPs were contributed to by both local emissions and long-term atmospheric transport and that these may pose risks to human health and the ecosystem.

A year round monitoring programme for atmospheric POPs (including organochlorine pesticides (OCPs) and polycyclic aromatic hydrocarbons (PAHs)) based on (a) polyurethane foam (PUF) passive air samplers and (b) soil samples was conducted in Kaidu-Peacock River system in Xinjiang.

Results for OCPs indicated that the hexachlorocyclohexanes (HCHs) were mainly transported outside of this region and no new usage of Lindane. Soil-air exchanges of OCPs changed during the different seasons, indicating the soil could be a local source of OCPs. The results indicated that it is necessary to set up a long-term monitoring network for atmospheric POPs and air-soil exchange in Northwest of China.

**Keywords:** Persistent Organic Pollutants (POPs), Atmospheric Monitoring Network, Xinjiang

## 1. Introduction

Persistent organic pollutants (POPs) are organic compounds of anthropogenic origin that resist degradation and accumulate in the food-chain. They can be transported over long distances in the atmosphere, resulting in widespread distribution across the earth, including regions where they have never been used. Owing to their toxicity, they can pose a threat to humans and the environment. Many POPs are currently or were in the past used or accompanied by industry production, such as Organochlorine Pesticides (OCPs), Polychlorinated Biphenyl (PCBs) and polychlorinated dibenzop-dioxins and dibenzofurans (PCDD/Fs). They have been observed to persist in the environment, to be capable of long-range transport, bioaccumulate in human and animal tissue, biomagnify in food chains, and to have potential significant impacts on human health and the environment. The historical producing and using of OCPs in China were mainly among 1950s to 1980s, when 33% HCHs and 20% DDTs of each world total yield were produced in China (Fu, 2003). Due to the environmental behaviours of POPs, the concentrations of HCHs and DDTs residues in China are still at high levels though they were banned since 1982 (Jiang *et al*., 2009).

In past decades, much research concerning pollution by POPs in different environmental sectors has been conducted in China and other areas of the world. Most studies have focused

on the level and distribution of POPs in water, soil, sediments, atmosphere and biota. Usually, investigations in China were located in industrial and developed areas where human impact is high. It is easy to recognize that most of the research sites are: (1) located in industrial and relatively developed areas and (2) are in the monsoon climatic zone or near the sea that has high humidity levels (Cai *et al*, 2008). Very few studies have been conducted inland (Huang *et al*, 2014) where the dominant climate is a continental desert—extremely arid and rainless, such as the Kaidu-Peacock River Drainage Basin in China, part of the arid desert zone of Central Asia. Although, considerable research on the levels and distributions of POPs has been conducted worldwide, to our knowledge, there are no available data that indicate the degree of contamination by POPs in the Kaidu-Peacock River. Therefore, a current POPs pollution level study of the Peacock River is both important and valuable in providing a base line for future monitoring.

The objectives of this research were to: (1) survey the levels and distribution of OCPs in the atmospheric and soil in this region as an example of POPs; (2) discuss soil-atmospheric exchange and possible sources of certain important OCPs and (3) try to explain the importance of setting-up the atmospheric monitoring network in this region.

## 2. Materials and methods

The climate of Xinjiang is the typical continental desert climate, which is extremely arid and rainless. In summer, the weather is so sweltering (the temperature in the day can reach 50 ℃ or above), and in winter is very cold (the average temperature in the coldest month may be below 0 ℃). The difference in temperature is great both in the year and day. The time of sunlight is very long so that the radiancy is great.

The Peacock River in Bosten Lake valley of the Bayingolmongol Autonomous Area in Xinjiang, is located in about 41°25´N–42°30´N, 85°45´E–87°30´E. The topography, climate and runoff changes greatly (Zhang, 2003): There are high mountains, oasis, and basins; the climate changes greatly both in different aclinic areas and vertical space; water loss from the Kaidu River and Bosten Lake will affect the water flow of the Peacock River.

During the period from 2011 August to 2012 August, polyurethane foam (PUF) passive air samples and soil samples were collected for a year round (Figure 1). The PUF samplers were changed for the PUF every 3 months and the soil samples were collected when changing the PUF All the samples were collected in polyethylene clean bags and stored at about –20 ℃ in the dark until analysis.

Soxhlet extraction: 5 μg of both TCmX and PCB-209 were injected into the samples as surrogate standards. During extraction, samples were absorbed by elemental Cu for sulfur and other inorganic oxidant. All extracts were first collected with Bunsen flasks, evaporated to 10 mL and subsequently eluted through a $SiO_2$ & $Al_2O_3$ column. After rotary vacuum evaporation to 0.5 mL, the extracts were put into a 2 mL bottle, and rinsed with 1.5 mL mixture of hexane: dichloromethane (3: 2). Then the extracts were concentrated into 0.2 mL by $N_2$-blowing.

Gas chromatography: 2 *μ*L extracts from each sample into injected the HP7890A gas chromatography–electron capture detection (GC-ECD), at an initial temperature of 100 ℃. After 54.33 min the sampling temperature was 290 ℃. One pure hexane sample, six standard samples (200 ppb, 150 ppb, 100 ppb, 50 ppb, 20 ppb and 10 ppb of OCP-28), nine samples waiting for analysis and one blank sample were analyzed.

Different types of procedures are used for Quality Assessment (QA)/Quality Control (QC). They are method blank control, parallel sample control, and basic matter control.

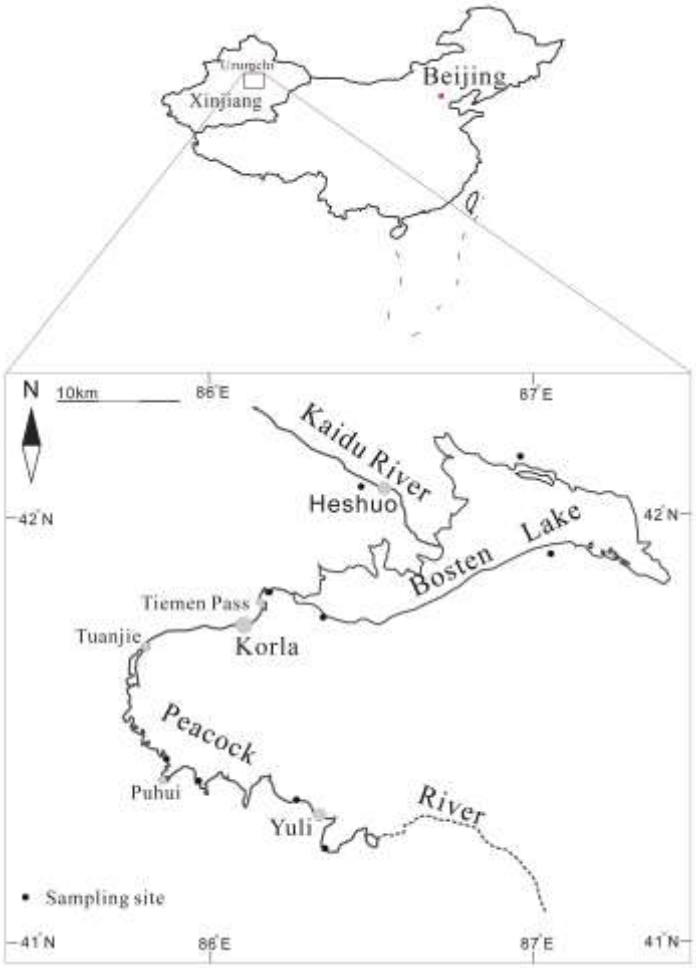


**Figure 1:** Research region and sampling sites.

## 3. Results and discussions

### 3.1. Pre-study of OCPs in Kaidu-Peacock River

Pre-study in 2006 (Chen *et al*, 2011), in the same region showed that all the organochlorine pesticides (OCPs) except *o*,*p'*-DDT were detected in sediments from the Peacock River; but in the water samples, only *β*-HCH, HCB, *p*,*p'*-DDD and *p*,*p'*-DDT were detected at some sites. The ranges for total OCPs in the water and sediments were from N.D. to 195 ng $l^{-1}$ and from 1.36 ng $g^{-1}$ to 24.60 ng $g^{-1}$, respectively.

The only existing HCH isomer in the water, *β*-HCH, suggested that the contamination by HCHs could be attributed to erosion of the weathered agricultural soils containing HCHs compounds. Composition analyses showed that no technical HCH, technical DDT, technical chlordanes, endosulfans and HCB had been recently used in this region. However, there was new input of *γ*-HCH (lindane) into the Peacock River. The most possible source was water flowing from Bosten Lake and/or agricultural tailing water that was returned directly into the Peacock River. DDT compounds in the sediments may be derived mainly from DDT-treated aged and weathered agricultural soils, the degradation condition was aerobic and the main product was DDE. HCB in the sediment might be due to the input from Bosten Lake and the lake may act as an atmospheric deposition zone.

### 3.2. Soil-atmospheric exchange of OCPs

Preliminary results on one year monitoring on atmosphere and soil were listed below and some more detailed research will be conducted and reported soon. Based on the results obtained, it could be found that the HCHs were dominant components in the atmosphere and DDTs were in the soil. Chlordanes and endosulfans were also detectable in both air and soil. The Composition

analyses indicated that the source of OCPs in atmosphere could be complex which both contributed by both local source and long-term atmospheric transport. The role of soil for source and sink could be shifted at different sites and seasons.

## 4. Conclusions

The pre-study indicated that the POPs were large extent existing in the Kaidu-Peacock River region. And the HCHs and DDTs were still the main components of OCPs. And soil erosion may be an important source of DDTs and atmospheric transport could be a source of HCHs in the air.

One year monitoring on atmosphere and soil in Kaidu-Peacock River region indicated the complex source of OCPs in this region. And the role of soil for source and sink could be shifted at different sites and seasons.

It is important to set up an atmospheric monitoring network in this region, because POPs were contributed to by both local emissions and long-term atmospheric transport and that these may pose risks to human health and the ecosystem.

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