*Supplement of*

# Atmospheric processes of persistent organic pollutants over a remote lake of the central Tibetan Plateau: Implications for regional cycling

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## Introduction

[This supplement file includes the details about climate of sampling site, methods on the extraction and analysis of samples, detection limits and QA/QC results. Dataset of concentrations for each target compounds in this study and comparisons with literature values from other remote regions are also presented. Furthermore, method on air-water exchange calculation, localized physical-chemical properties of POPs and derived degradation fluxes are also detailed here. In total, this supplement includes six texts (Text S1 to S6), five figures (Figure S1 to S5) and seventeen tables (Table S1 to S17). They are listed in the order of appearance in the manuscript; please see the summary table below.]

## Summary of the number of pages, figures, and tables

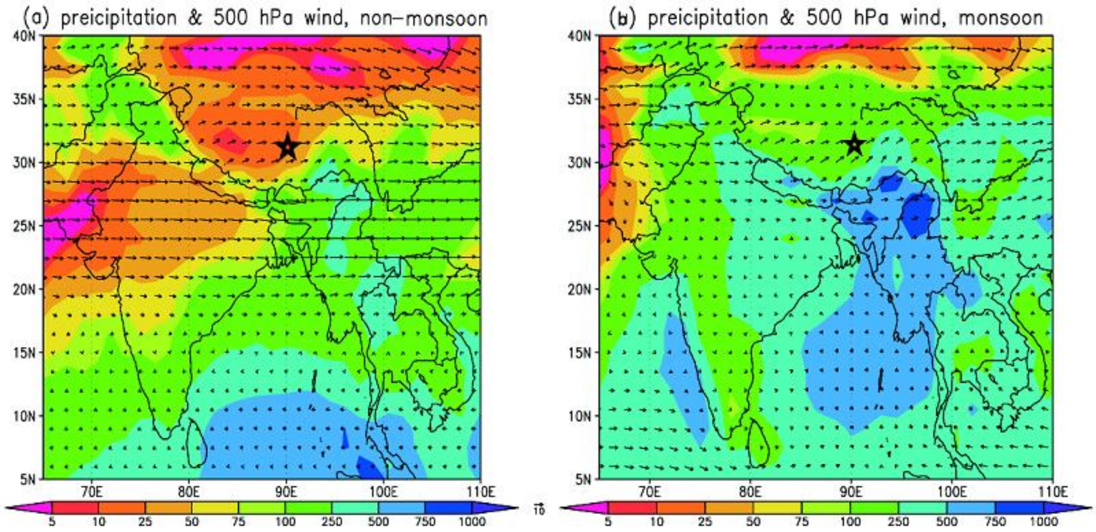


**Figure S1. The dominated air circulation in Nam Co region for monsoon and non-monsoon season (average from 1980-2010). The star is the location of Nam Co Monitoring and Research Station.**

(Cited from Zhang et al., 2013: A study of Zhadang glacier energy and mass balance and its hydrological process, in NamCo basin, central Tibetan Plateau, Doctoral Dissertation)

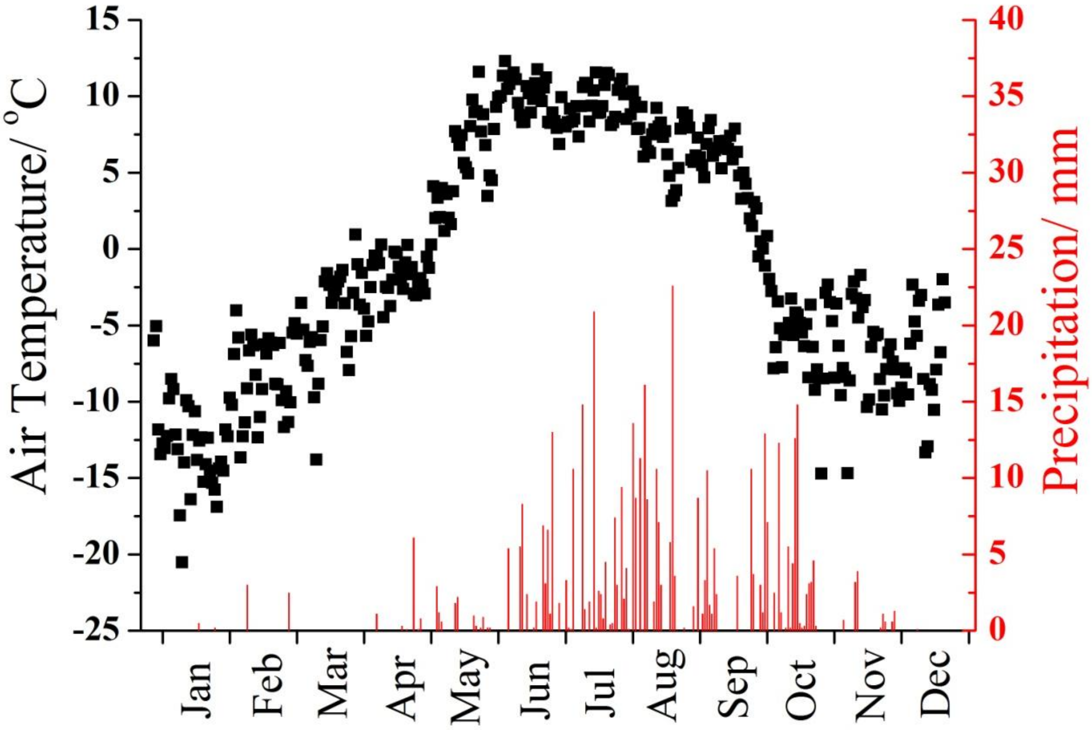


**Figure S2. Temporal variations of air temperature and precipitation in Nam Co station in 2012.**

The meteorological parameters were measured by an automatic weather station in the Nam Co station, and the data were downloaded in the website of High-cold Region Observation and Research Network for Land Surface Processes & Environment of China (HORN, http://www.horn.ac.cn/)

42 **Table S1. Air temperature and wind speed during the sampling period**

| Start Date Y/M/D | End Date Y/M/D | Temperature ($^oC$) | Wind speed (m/s) |
|---|---|---|---|
| 2012.09.03 | 2012.09.15 | 6.7 | 3.0 |
| 2012.09.16 | 2012.09.20 | 6.4 | 3.1 |
| 2012.10.01 | 2012.10.15 | -0.7 | 3.5 |
| 2012.10.24 | 2012.10.31 | -5.5 | 3.0 |
| 2012.11.01 | 2012.11.15 | -7.2 | 4.3 |
| 2012.11.16 | 2012.11.30 | -5.9 | NA |
| 2012.12.01 | 2012.12.15 | -8.3 | NA |
| 2012.12.16 | 2012.12.31 | -6.6 | NA |
| 2013.01.03 | 2013.01.15 | -12.6 | 3.3 |
| 2013.01.16 | 2013.01.31 | -13.0 | 2.9 |
| 2013.02.06 | 2013.02.16 | -8.9 | 3.6 |
| 2013.02.21 | 2013.03.01 | -8.7 | 3.0 |
| 2013.03.02 | 2013.03.15 | -6.1 | 2.2 |
| 2013.03.15 | 2013.03.31 | -5.4 | 3.2 |
| 2013.04.01 | 2013.04.15 | -3.2 | 3.5 |
| 2013.04.15 | 2013.04.30 | -1.1 | 3.2 |
| 2013.05.01 | 2013.05.15 | -0.2 | 3.1 |
| 2013.05.15 | 2013.06.04 | 5.2 | 3.3 |
| 2013.06.06 | 2013.06.15 | 8.0 | 2.8 |
| 2013.06.15 | 2013.06.30 | 9.7 | 3.2 |
| 2013.07.01 | 2013.07.19 | 10.0 | 2.8 |
| 2013.07.19 | 2013.08.03 | 8.5 | 3.0 |
| 2013.08.04 | 2013.08.15 | 8.6 | 2.4 |
| 2013.08.15 | 2013.08.31 | 8.9 | 2.9 |
| 2013.09.01 | 2013.09.15 | 5.2 | 2.7 |
| 2013.09.15 | 2013.09.30 | 4.9 | 2.9 |
| 2013.10.01 | 2013.10.15 | -0.7 | 3.5 |
| 2013.10.15 | 2013.10.30 | -5.5 | 3.0 |
| 2013.11.01 | 2013.11.15 | -8.3 | 3.7 |
| 2013.11.15 | 2013.11.30 | -9.7 | 3.0 |
| 2013.12.01 | 2013.12.15 | -12.6 | 3.1 |
| 2013.12.16 | 2013.12.30 | -9.1 | 4.1 |
| 2014.01.05 | 2014.01.31 | -12.6 | 3.3 |
| 2014.02.01 | 2014.02.15 | -8.7 | 3.7 |
| 2014.02.15 | 2014.02.28 | -9.1 | 3.8 |
| 2014.03.01 | 2014.03.15 | -6.1 | 2.2 |
| 2014.03.15 | 2014.03.31 | -5.4 | 3.2 |
| 2014.04.01 | 2014.04.15 | -2.4 | 3.2 |
| 2014.04.15 | 2014.04.30 | -1.0 | 3.6 |
| 2014.05.01 | 2014.05.15 | 2.3 | 3.4 |
| 2014.05.15 | 2014.05.28 | 5.2 | 3.2 |

| | | | |
|---|---|---|---|
| 2014.06.02 | 2014.06.15 | 8.0 | 2.8 |
| 2014.06.22 | 2014.06.30 | 9.7 | 3.2 |
| 2014.07.01 | 2014.07.15 | 10.0 | 2.8 |
| 2014.07.15 | 2014.07.31 | 9.2 | 2.7 |
| 2014.08.01 | 2014.08.15 | 9.3 | 2.5 |
| 2014.08.15 | 2014.08.31 | 6.8 | 2.5 |
| 2014.09.02 | 2014.09.15 | 7.9 | 2.8 |
| 2014.09.15 | 2014.09.30 | 4.5 | 3.1 |

NA: not available

**Table S2. Information about the water samples.**

The information include water temperature, pH, electric conductivity, salinity, dissolved oxygen and contents of suspended particulate matter (SPM).

| **Spatial sample** | **T ( ℃)** | **pH** | **Electric conductivity (ms cm$^{-1}$)** | **Salinity (ppt)** | **Dissolved Oxygen (mg L$^{-1}$)** | **SPM (mg L$^{-1}$)** |
|---|---|---|---|---|---|---|
| S1 | 14.5 | 9.48 | 1.96 | 1.1 | 9.2 | 11.0 |
| S2 | NA | 9.51 | 1.92 | 1.0 | 9.0 | 3.2 |
| S3 | 15.6 | 9.39 | 1.85 | 1.1 | 8.6 | 5.5 |
| S4 | NA | NA | NA | NA | NA | 5.7 |
| S5 | 14.4 | 9.48 | 1.76 | 1.0 | 9.3 | 7.0 |
| S6 | 12.7 | 9.56 | 1.92 | 1.1 | 10.2 | 1.7 |
| S7 | 11.7 | 9.44 | 1.54 | 0.8 | 9.4 | 5.3 |
| S8 | 12.4 | 9.56 | 1.86 | 1.0 | 9.9 | 7.2 |
| S9 | 12.4 | 9.56 | 1.93 | 1.1 | 9.6 | 6.7 |
| S10 | 8.5 | 9.63 | 1.99 | 1.1 | 9.7 | 2.1 |
| S11 | 8.1 | 9.49 | 2.02 | 1.1 | 8.9 | 6.1 |
| S12 | 14.8 | 9.50 | 1.86 | 1.1 | 10.1 | 3.2 |
| S13 | 14.6 | 9.40 | 1.83 | 1.1 | 10.2 | 5.2 |
| S14 | 14.9 | 9.34 | 1.93 | 1.0 | 9.5 | 11.7 |
| S15 | 14.8 | 9.38 | 0.74 | 1.0 | NA | 8.2 |
| **Seasonal sample** | **T ( ℃)** | **PH** | **Electric conductivity (ms cm$^{-1}$)** | **Salinity (ppt)** | **Dissolved Oxygen (mg L$^{-1}$)** | **SPM (mg L$^{-1}$)** |
| May-1 | 8.2 | 8.98 | 1.92 | 1.0 | 9.8 | 2.6 |
| May-2 | 8.5 | 9.01 | 1.91 | 1.1 | 11.2 | 2.2 |
| May-3 | 8.9 | 9.03 | 1.89 | 1.2 | 12.6 | 3.0 |
| June-1 | 10.1 | 9.13 | 1.9 | 1.2 | 11.7 | 0.9 |
| June-2 | 10.3 | 9.14 | 1.88 | 1.1 | 10.3 | 2.2 |
| June-3 | 10.9 | 9.14 | 1.86 | 1.0 | 8.9 | 0.8 |
| July-1 | 16.7 | 9.16 | 1.83 | 0.8 | 17.3 | 2.5 |
| July-2 | 15.9 | 9.10 | 1.82 | 0.9 | 17.8 | 4.0 |
| July-3 | 12.8 | 9.16 | 1.83 | 0.9 | 12.6 | 1.9 |
| Aug-1 | 15.6 | 9.25 | 1.75 | 0.8 | 20.0 | 2.4 |
| Aug-2 | 14.0 | 9.27 | 1.80 | 1.0 | 20.0 | 0.4 |
| Aug-3 | 13.2 | 9.28 | 1.85 | 1.1 | NA | 0.5 |
| Sep-1 | 12.4 | 9.16 | 1.82 | 0.8 | 13.4 | 1.0 |
| Sep-2 | 12.2 | 9.18 | 1.82 | 1.0 | 11.9 | 2.0 |
| Sep-3 | 12.3 | 9.17 | 1.82 | 0.9 | 12.7 | 0.6 |

NA: not available

## Text S1. Preparation, extraction and cleanup method for different samples

***Preparation.*** Polyurethane foam (PUF) and glass fiber filter (GFF 0.7 μm, Whatman) were used to absorb the gas and particulate phase POPs in air, respectively; while GFFs and XAD-2 resin were used to accumulate the POPs in suspended particulate matter (SPM) and dissolved phases in water, respectively. Prior to field sampling, PUF and XAD resin was pre-cleaned by Soxhlet extraction using dichloromethane (DCM) for 16 h; GFF were pre-combusted at 450 ℃ for 4 h. Glass adsorption column (internal diameter of 2.5 cm and length of 30 cm) was prepared and each one was filled with about 200 $cm^3$ of XAD resin.

***Extraction.*** Each collected sample was spiked with a mixture of 2, 4, 6-trichlorobiphenyl (PCB 30), Mirex and perylene-D12 as recovery surrogates before extraction. Different extraction methods were used for XAD-resin and other samples, but the procedure for cleanup is the same. The XAD column after passing through the water samples was first eluted with 100 mL of DCM. Then XAD resin was transferred to conical flask and mixed with enough anhydrous sodium sulfate for dehydration. Ultrasonically extraction was repeated for 3 times (20 min with 50 mL DCM for each time) to extract remaining chemicals. For the PUF and GFF filters, Soxhlet extraction was conducted using DCM at 48 ℃ for 16 h.

***Cleanup.*** Extracts of the above samples were all concentrated to 1 mL by a rotary evaporator, solvent exchanged to hexane and then cleanup. The samples were loaded on a chromatography column (from the bottom to top: 3 g of 6% deactivated silica gel, 2 g of 3% deactivated alumina and 1 g of anhydrous sodium sulfate) and eluted with 30 mL of a mixture of hexane/DCM (1:1 v/v). The elute was further cleaned on gel-permeation chromatography (GPC, containing 6 g of Biobeads SX3) with hexane/DCM (1:1). The first 16 mL was discarded and the subsequent 30 mL fraction was collected. After the cleanup, all samples were finally concentrated to 100 μL containing a known quantity of pentachloronitrobenzene (PCNB), decachlorobiphenyl (PCB 209), pryene-D10 and benzo[g,h,i]perylene-D12 as internal standards.

**Text S2. Details about the chromatographic conditions**

The POPs concentrations in all samples were analyzed on the gas chromatograph-mass spectrometer (GC-MS, Finnigan Trace GC/PolarisQ); however different chromatographic column and temperature program were used for OCPs, PCBs and PAHs. Additionally, the enantiomers of α-HCH were analyzed separately.

***OCPs and PCBs.*** The GC-MS was operated with a CP-Sil 8CB capillary column (50 m × 0.25 mm, film thickness 0.25 μm) and under single-ion monitoring (SIM) mode. Helium was used as the carrier gas at 1 mL $min^{-1}$ under constant-flow mode. The oven temperature began at 100 ℃ for 2 min and was increased at a rate of 20 ℃ $min^{-1}$ to 140 ℃, then increased at a rate of 4 ℃ $min^{-1}$ to 200 ℃, held for 10 min, and finally increased at a rate of 4 ℃ $min^{-1}$ to 300 ℃ and held for 17 min.

***PAHs.*** PAHs were analyzed on GC-MS system with a DB-5MS column (60 m × 0.25 mm, film thickness 0.25 μm). The carrier gas and SIM mode are the same as OCPs and PCBs. The oven temperature began at 50 ℃ for 2 min and was increased at a rate of 20 ℃ $min^{-1}$ to 180 ℃, then increased at a rate of 3 ℃ $min^{-1}$ to 250 ℃, then increased at a rate of 2 ℃ $min^{-1}$ to 300 ℃ and held for 10 min, and finally increased at a rate of 10 ℃ $min^{-1}$ to 310 ℃ and held for 5 min.

***Chiral analysis for α-HCH.*** Determination of enantiomeric compositions of α-HCH was performed on an Agilent 6890 gas chromatography equipped with a micro-cell $^{63}$Ni electron capture detector (μ-ECD) at State Key Laboratory of Environmental Chemistry and Ecotoxicology, Research Center of Eco-Environment Sciences, Chinese Academy of Sciences. Separation for enantiomers of α-HCH was carried out using a BGB-172 chiral column (30 m×0.25 mm i.d., 0.25 μm film thickness, BGB Analytik AG, Switzerland). The carrier gas was nitrogen with a flow of 0.7 mL/min. The injector and detector temperatures were 250 ℃ and 300 ℃, respectively. The temperature program was: 90 ℃ held for 1 min, increased to 140 ℃ at a rate of 15 ℃/min, followed by 2 ℃/min to 210 ℃, held for 5 min and then 20 ℃/min to 240 ℃, held for 10 min. According to the previous study (Ding et al., 2007a), the elution order of α-HCH on BGB column was (−)-α-HCH and (+)-α-HCH.

## Table S3. Concentrations of POPs in the field blanks and procedural blanks.

### Part 1. OCPs and PCBs in the field blanks:

| **Field blank Air (pg m$^{-3}$)** | **α-HCH** | **β-HCH** | **γ-HCH** | **HCB** | ***o,p'*-DDE** | ***p,p'*-DDE** | ***o,p'*-DDT** | ***p,p'*-DDT** | **PCB-28** | **PCB-52** | **PCB-101** | **PCB-153** | **PCB-138** | **PCB-180** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PUF field blank 1 | 0.10 | ND[a] | 0.06 | 1.97 | ND | 0.44 | ND | ND | ND | 0.02 | ND | ND | ND | ND |
| PUF field blank 2 | 0.10 | ND | 0.03 | 1.84 | ND | 0.15 | ND | ND | ND | 0.04 | ND | ND | ND | ND |
| PUF field blank 3 | 0.10 | ND | 0.03 | 1.50 | ND | 0.28 | ND | ND | ND | 0.03 | ND | ND | ND | ND |
| PUF field blank 4 | 0.13 | ND | 0.04 | 0.9 | ND | 0.38 | ND | ND | ND | 0.05 | ND | ND | ND | ND |
| PUF field blank 5 | 0.25 | ND | 0.03 | 1.14 | ND | 0.47 | ND | ND | ND | 0.07 | ND | ND | ND | ND |
| PUF field blank 6 | 0.15 | ND | 0.09 | 1.43 | ND | 0.36 | ND | ND | ND | 0.05 | ND | ND | ND | ND |
| Blank average | 0.14 | 0 | 0.05 | 1.46 | 0 | 0.35 | 0 | 0 | 0 | 0.04 | 0 | 0 | 0 | 0 |
| **Field blank Water (pg L$^{-1}$)** | **α-HCH** | **β-HCH** | **γ-HCH** | **HCB** | ***o,p'*-DDE** | ***p,p'*-DDE** | ***o,p'*-DDT** | ***p,p'*-DDT** | **PCB-28** | **PCB-52** | **PCB-101** | **PCB-153** | **PCB-138** | **PCB-180** |
| XAD field blank 1 | 0.79 | 1.31 | 1.08 | 1.05 | 0.57 | 0.27 | 0.19 | 0.34 | 0.14 | 0.18 | 0.15 | 0.05 | 0.01 | 0.09 |
| XAD field blank 2 | 0.44 | 1.20 | 0.93 | 1.03 | 0.58 | 0.44 | 0.22 | 0.30 | 0.08 | 0.16 | 0.27 | 0.15 | 0.07 | 0.03 |
| XAD field blank 3 | BDL | 0.53 | 0.05 | 0.85 | 0.30 | 0.34 | 0.14 | 0.17 | BDL | 0.05 | 0.18 | 0.04 | 0.02 | BDL |
| Blank average | 0.61 | 1.01 | 0.69 | 0.98 | 0.48 | 0.35 | 0.18 | 0.27 | 0.11 | 0.13 | 0.20 | 0.08 | 0.03 | 0.06 |

[a] ND=chemical was not detected in blank.

## Part 2. PAHs in the field blanks:

| **Field blank Air (pg m$^{-3}$)** | **Acel** | **Ace** | **Phe** | **Flu** | **Ant** | **Fla** | **Pyr** | **BaA** | **Chr** | **Bbf** | **Bkf** | **BaP** | **IcdP** | **DahA** | **BghiP** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PUF field blank 1 | 0.95 | 0.21 | 0.76 | ND | 0.24 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| PUF field blank 2 | 0.87 | 0.19 | 0.34 | ND | 0.15 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| PUF field blank 3 | 0.73 | 0.45 | 0.12 | ND | 0.46 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| PUF field blank 4 | 0.61 | 0.54 | 0.56 | ND | 0.31 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| PUF field blank 5 | 0.92 | 0.23 | 0.92 | ND | 0.36 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| PUF field blank 6 | 0.59 | 0.52 | 0.43 | ND | 0.27 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| Blank average | 0.78 | 0.36 | 0.52 | 0 | 0.30 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

| **Field blank Water (pg L$^{-1}$)** | **Acel** | **Ace** | **Flu** | **Phe** | **Ant** | **Fla** | **Pyr** | **BaA** | **Chr** | **Bbf** | **Bkf** | **Bap** | **IcdP** | **DahA** | **BghiP** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| XAD field blank 1 | 8.7 | 12.2 | 87.0 | 348.0 | 350.6 | 111.5 | 80.3 | 7.3 | 15.6 | ND | ND | ND | ND | ND | ND |
| XAD field blank 2 | 2.8 | 3.4 | 52.9 | 244.4 | 41.1 | 105.8 | 59.5 | 4.1 | 9.1 | ND | ND | ND | ND | ND | ND |
| XAD field blank 3 | 4.1 | 6.2 | 24.1 | 73.2 | 218.9 | 4.0 | 14.8 | 2.3 | 4.6 | ND | ND | ND | ND | ND | ND |
| Blank average | 5.2 | 7.3 | 54.7 | 221.9 | 203.5 | 73.8 | 51.5 | 4.6 | 9.7 | ND | ND | ND | ND | ND | ND |

## Part 3. OCPs, PCBs and PAHs in the procedural blanks (ng sample$^{-1}$):

| (ng sample$^{-1}$) | α-HCH | γ-HCH | HCB | *o,p'*-DDE | *p,p'*-DDE | *o,p'*-DDT | *p,p'*-DDT | PCB-28 | PCB-52 | PCB-101 | PCB-153 | PCB-138 | PCB-180 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| procedural blank 1 | 0.07 | 0.02 | 0.78 | ND | 0.16 | ND | ND | ND | 0.03 | ND | ND | ND | ND |
| procedural blank 2 | 0.10 | 0.02 | 0.91 | ND | 0.23 | ND | ND | ND | 0.02 | ND | ND | ND | ND |
| procedural blank 3 | 0.08 | 0.04 | 0.64 | ND | 0.20 | ND | ND | ND | 0.02 | ND | ND | ND | ND |
| procedural blank 4 | 0.08 | 0.04 | 1.04 | ND | 0.16 | ND | ND | ND | 0.02 | ND | ND | ND | ND |
| procedural blank 5 | 0.07 | 0.04 | 0.86 | ND | 0.14 | ND | ND | ND | 0.02 | ND | ND | ND | ND |
| procedural blank 6 | 0.11 | 0.03 | 0.89 | ND | 0.28 | ND | ND | ND | 0.04 | ND | ND | ND | ND |
| average | 0.08 | 0.03 | 0.85 | 0 | 0.20 | 0 | 0 | 0 | 0.02 | 0 | 0 | 0 | 0 |
| **(ng sample$^{-1}$)** | **Acel** | **Ace** | **Phe** | **Flu** | **Ant** | **BaA** | **Chr** | **Bbf** | **Bkf** | **BaP** | **IcdP** | **DahA** | **BghiP** |
| procedural blank 1 | 0.24 | 0.13 | 0.29 | ND | 0.14 | ND | ND | ND | ND | ND | ND | ND | ND |
| procedural blank 2 | 0.28 | 0.38 | 0.38 | ND | 0.27 | ND | ND | ND | ND | ND | ND | ND | ND |
| procedural blank 3 | 0.13 | 0.38 | 0.43 | ND | 0.08 | ND | ND | ND | ND | ND | ND | ND | ND |
| procedural blank 4 | 0.19 | 0.26 | 0.40 | ND | 0.17 | ND | ND | ND | ND | ND | ND | ND | ND |
| procedural blank 5 | 0.05 | 0.07 | 0.14 | ND | 0.07 | ND | ND | ND | ND | ND | ND | ND | ND |
| procedural blank 6 | 0.25 | 0.37 | 0.41 | ND | 0.31 | ND | ND | ND | ND | ND | ND | ND | ND |
| average | 0.19 | 0.27 | 0.34 | 0 | 0.17 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

## Text S3. The ways to define method detection limits (MDLs) and treat with the concentrations below MDLs

The MDLs were derived as the mean blank concentration plus 3 times its standard deviation; when a target compound was not detected in the blanks, the concentration of the lowest calibration standard was substituted for the MDL. Based on 600 $m^3$ and 200 L, the corresponding MDLs for air and water samples were calculated respectively and presented in Table S4.

If the concentration of a compound after blank correction was below the MDL, the concentration was substituted with 1/2 MDL in cases where greater than 70% of data were greater than the MDL (Antweiler and Taylor, 2008); otherwise it will be marked with “BDL”.

**Table S4. Detection frequency and MDLs for individual compound in each kind of samples**

| | Air-gas phase | | | Air-particulate phase | | | Water-dissolved phase | | | Water-particulate phase | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | detection frequency (%) | MDL (pg m$^{-3}$) | 1/2 MDL (pg m$^{-3}$) | detection frequency (%) | MDL (pg m$^{-3}$) | 1/2 MDL (pg m$^{-3}$) | detection frequency (%) | MDL (pg L$^{-1}$) | 1/2 MDL (pg L$^{-1}$) | detection frequency (%) | MDL (pg L$^{-1}$) | 1/2 MDL (pg L$^{-1}$) |
| **α-HCH** | 100 | 0.31 | 0.16 | 2 | 0.23 | 0.12 | 100 | 1.4 | 0.7 | 10 | 0.70 | 0.35 |
| **β-HCH** | 43 | 0.33 | 0.17 | 2 | 0.33 | 0.17 | 100 | 2.3 | 1.1 | 17 | 1 | 0.5 |
| **γ-HCH** | 96 | 0.12 | 0.06 | 19 | 0.09 | 0.04 | 100 | 2.4 | 1.2 | 53 | 0.26 | 0.13 |
| **HCB** | 100 | 2.68 | 1.34 | 5 | 2.11 | 1.05 | 79 | 1.3 | 0.7 | 37 | 6.32 | 3.16 |
| ***o,p'*-DDE** | 68 | 0.33 | 0.17 | 0 | 0.33 | 0.17 | 0 | 1.0 | 0.5 | 3 | 1 | 0.5 |
| ***p,p'*-DDE** | 66 | 0.70 | 0.35 | 7 | 0.59 | 0.30 | 10 | 0.6 | 0.3 | 13 | 1.78 | 0.89 |
| ***o,p'*-DDT** | 91 | 0.33 | 0.17 | 23 | 0.33 | 0.17 | 3 | 0.3 | 0.2 | 10 | 1 | 0.5 |
| ***p,p'*-DDT** | 72 | 0.33 | 0.17 | 21 | 0.33 | 0.17 | 3 | 0.5 | 0.3 | 33 | 1 | 0.5 |
| **PCB-28** | 100 | 0.03 | 0.02 | 23 | 0.03 | 0.02 | 72 | 0.2 | 0.1 | 50 | 0.1 | 0.05 |
| **PCB-52** | 83 | 0.10 | 0.05 | 0 | 0.08 | 0.04 | 17 | 0.3 | 0.2 | 27 | 0.23 | 0.12 |
| **PCB-101** | 98 | 0.03 | 0.02 | 74 | 0.03 | 0.02 | 3 | 0.4 | 0.2 | 93 | 0.1 | 0.05 |
| **PCB-153** | 81 | 0.03 | 0.02 | 28 | 0.03 | 0.02 | 0 | 0.3 | 0.1 | 47 | 0.1 | 0.05 |
| **PCB-138** | 79 | 0.03 | 0.02 | 21 | 0.03 | 0.02 | 7 | 0.1 | 0.06 | 53 | 0.1 | 0.05 |
| **PCB-180** | 19 | 0.03 | 0.02 | 5 | 0.03 | 0.02 | 0 | 0.2 | 0.09 | 10 | 0.1 | 0.05 |
| **Acel** | 100 | 1.25 | 0.63 | 23 | 0.75 | 0.37 | 100 | 14 | 7 | 100 | 2.25 | 1.12 |
| **Ace** | 100 | 0.85 | 0.42 | 72 | 1.13 | 0.57 | 100 | 21 | 10 | 100 | 3.40 | 1.70 |
| **Flu** | 100 | 0.33 | 0.17 | 100 | 0.33 | 0.17 | 100 | 149 | 75 | 100 | 1 | 0.5 |
| **Phe** | 100 | 1.39 | 0.70 | 100 | 1.12 | 0.56 | 100 | 638 | 319 | 100 | 3.37 | 1.69 |
| **Ant** | 100 | 0.62 | 0.31 | 100 | 0.77 | 0.39 | 48 | 670 | 335 | 97 | 2.31 | 1.16 |
| **Fla** | 100 | 0.33 | 0.17 | 100 | 0.33 | 0.17 | 56 | 255 | 128 | 100 | 1 | 0.5 |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Pyr** | 100 | 0.17 | 0.08 | 100 | 0.17 | 0.08 | 93 | 152 | 76 | 100 | 0.5 | 0.25 |
| **BaA** | 100 | 0.17 | 0.08 | 100 | 0.17 | 0.08 | 48 | 12 | 6 | 97 | 0.5 | 0.25 |
| **Chr** | 100 | 0.17 | 0.08 | 100 | 0.17 | 0.08 | 56 | 26 | 13 | 97 | 0.5 | 0.25 |
| **Bbf** | 100 | 0.33 | 0.17 | 86 | 0.33 | 0.17 | 52 | 1 | 0.5 | 55 | 1 | 0.5 |
| **Bkf** | 98 | 0.17 | 0.08 | 100 | 0.17 | 0.08 | 100 | 0.5 | 0.3 | 97 | 0.5 | 0.25 |
| **BaP** | 98 | 0.17 | 0.08 | 98 | 0.17 | 0.08 | 100 | 0.5 | 0.3 | 97 | 0.5 | 0.25 |
| **IcdP** | 49 | 0.17 | 0.08 | 56 | 0.17 | 0.08 | 0 | 0.5 | 0.3 | 55 | 0.5 | 0.25 |
| **DahA** | 31 | 0.33 | 0.17 | 33 | 0.33 | 0.17 | 0 | 1 | 0.5 | 48 | 1 | 0.5 |
| **BghiP** | 96 | 0.33 | 0.17 | 100 | 0.33 | 0.17 | 100 | 1 | 0.5 | 97 | 1 | 0.5 |

**Table S5. Breakthrough estimation: the percentage of OCPs, PCBs and PAHs in the second PUF to the total Plugs ($PUF_2/(PUF_1+PUF_2)$)**

| | **α-HCH** | **β-HCH** | **γ-HCH** | **HCB** | ***o,p'*-DDE** | ***p,p'*-DDE** | ***o,p'*-DDT** | ***p,p'*-DDT** | **PCB-28** | **PCB-52** | **PCB-101** | **PCB-153** | **PCB-138** | **PCB-180** | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| breakthrough 1 | 15% | 0% | 11% | 24% | 5% | 13% | 5% | 6% | 11% | 10% | 13% | 12% | 8% | 0% | |
| breakthrough 2 | 20% | 4% | 14% | 18% | 0% | 2% | 1% | 1% | 14% | 7% | 7% | 0% | 3% | 0% | |
| breakthrough 3 | 25% | 8% | 17% | 25% | 0% | 12% | 8% | 6% | 14% | 11% | 13% | 0% | 16% | 11% | |
| breakthrough 4 | 26% | 7% | 22% | 30% | 4% | 5% | 3% | 2% | 19% | 7% | 5% | 3% | 5% | 0% | |
| breakthrough 5 | 28% | 0% | 12% | 26% | 3% | 0% | 1% | 1% | 10% | 5% | 6% | 3% | 1% | 0% | |
| breakthrough 6 | 16% | 25% | 31% | 20% | 26% | 25% | 10% | 19% | 24% | 0% | 13% | 10% | 9% | 0% | |
| breakthrough 7 | 17% | 15% | 25% | 25% | 14% | 16% | 14% | 16% | 18% | 17% | 15% | 18% | 15% | 26% | |
| breakthrough 8 | 13% | 18% | 22% | 16% | 22% | 24% | 14% | 11% | 17% | 14% | 15% | 15% | 15% | 9% | |
| breakthrough 9 | 13% | 16% | 14% | 20% | 14% | 17% | 15% | 16% | 13% | 16% | 18% | 18% | 19% | 19% | |
| breakthrough 10 | 22% | 20% | 19% | 32% | 27% | 22% | 20% | 23% | 23% | 17% | 20% | 21% | 45% | 11% | |
| breakthrough 11 | 15% | 20% | 10% | 20% | 4% | 5% | 3% | 13% | 10% | 7% | 8% | 16% | 7% | 9% | |
| **average** | **19%** | **12%** | **18%** | **23%** | **11%** | **13%** | **9%** | **10%** | **16%** | **10%** | **12%** | **11%** | **13%** | **8%** | |
| | **Acel** | **Ace** | **Flu** | **Phe** | **Ant** | **Fla** | **Pyr** | **BaA** | **Chr** | **Bbf** | **Bkf** | **Bap** | **IcdP** | **DahA** | **BghiP** |
| breakthrough 1 | 1% | 1% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% |
| breakthrough 2 | 33% | 34% | 32% | 31% | 26% | 20% | 19% | 31% | 25% | 39% | 33% | 38% | 0% | 0% | 37% |
| breakthrough 3 | 16% | 17% | 15% | 19% | 16% | 23% | 23% | 12% | 26% | 6% | 17% | 16% | 0% | 0% | 21% |
| breakthrough 4 | 15% | 10% | 22% | 23% | 23% | 20% | 18% | 19% | 14% | 12% | 8% | 11% | 0% | 0% | 22% |
| breakthrough 5 | 24% | 23% | 28% | 34% | 31% | 28% | 24% | 21% | 19% | 21% | 24% | 32% | 26% | 19% | 24% |
| breakthrough 6 | 20% | 21% | 20% | 19% | 23% | 14% | 22% | 22% | 22% | 23% | 19% | 28% | 21% | 18% | 20% |
| breakthrough 7 | 23% | 21% | 17% | 13% | 14% | 13% | 14% | 14% | 14% | 12% | 12% | 10% | 15% | 14% | 15% |
| breakthrough 8 | 22% | 23% | 24% | 19% | 13% | 20% | 23% | 33% | 30% | 33% | 35% | 34% | 35% | 27% | 32% |
| breakthrough 9 | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% |
| breakthrough 10 | 22% | 22% | 23% | 32% | 30% | 30% | 31% | 17% | 24% | 26% | 21% | 31% | 50% | 0% | 23% |
| breakthrough 11 | 6% | 7% | 10% | 13% | 12% | 11% | 8% | 26% | 25% | 17% | 18% | 28% | 19% | 32% | 13% |
| **average** | **17%** | **16%** | **17%** | **18%** | **17%** | **16%** | **17%** | **18%** | **18%** | **17%** | **17%** | **21%** | **15%** | **10%** | **19%** |

## Text S4. Correction of the dissolved POPs concentrations by dissolved organic carbon (DOC)

In order to obtain the concentrations of truly freely dissolved POPs ($C_w$), results of dissolved concentrations retained by the XAD should be corrected by the estimated influence of sorption by DOC in water as follows (Ruge et al., 2015):

$$C_{w}=C_{XAD}/[1+K_{DOC}*C_{DOC}]$$

where $C_{XAD}$ (pg $L^{-1}$) is the POPs concentration derived from XAD samples, $K_{DOC}$ is the DOC-water equilibrium partitioning coefficient ($m^3$ $kg^{-1}$), and $C_{DOC}$ is the concentration of DOC in water (kg $m^{-3}$). $K_{DOC}$ can be estimated from octanol-water partition coefficient ($K_{OW}$) by using correlation of log $K_{DOC}$ versus log $K_{OW}$ derived by Burkhard et al. (2000):

$$\log K_{DOC}=0.85*\log K_{OW}-0.25$$

For the Nam Co Lake, a $C_{DOC}$ of 4.23 mg $L^{-1}$ was adopted from previous literature (Liu et al., 2010).

## Text S5. Temperature and salinity-corrected Henry's law constant (*H*)

(1) By using the equations below, *H* values (unit: Pa $m^3$ $mol^{-1}$) were corrected for the measured water temperature in this study.

| Compound | Regression equations | References |
|---|---|---|
| α-HCH | logH=10.13-3098/T(K) | (Sahsuvar et al., 2003) |
| β-HCH | logH=9.96-3400/T(K) | (Sahsuvar et al., 2003) |
| γ-HCH | logH=10.14-3208/T(K) | (Sahsuvar et al., 2003) |
| HCB | logH=11.6-3013/T(K) | (Jantunen et al., 2006) |
| PCB-28 | logH=10.11-2547.1/T(K) | (Paasivirta et al., 2009) |
| Acel | logH=10.47-2798/T(K) | (Ma et al., 2010) |
| Ace | logH=9.37-2443.3/T(K) | (Ma et al., 2010) |
| Flu | logH=10.66-2887.8/T(K) | (Ma et al., 2010) |
| Phe | logH=8.13-2230.3/T(K) | (Ma et al., 2010) |
| Pyr | logH=8.61-2528.7/T(K) | (Ma et al., 2010) |
| BaA | logH=8.46-2568.7/T(K) | (Ma et al., 2010) |
| Chr | logH=17.71-5384.2/T(K) | (Ma et al., 2010) |
| Bbf | logH=6.76-2366.8/T(K) | (Ma et al., 2010) |
| Bkf | logH=7.3-2541.4/T(K) | (Ma et al., 2010) |
| Bap | logH=5.54-2051/T(K) | (Ma et al., 2010) |
| IcdP | logH=3.85-1580.5/T(K) | (Ma et al., 2010) |
| DahA | logH=11.23-3371/T(K) | (Ma et al., 2010) |
| BghiP | logH=3.167-1384/T(K) | (Ma et al., 2010) |

(2) The aqueous solubility of a nonelectrolyte has been found generally to be dependent on the concentration and type of salt present in solution. The salt effect on *H* is frequently described by the Setschenow equation (Cetin et al., 2006):

$$\log\left(H^{*}/H\right)=K_{S}C_{S}$$

where $H^*$ and *H* are the Henry's law constant in saline water and deionized water, respectively; *K*s is the Setschenow or the salting-out constant (L $mol^{-1}$); $C_S$ is the molar concentration of salt in lake water (mol $L^{-1}$). $K_S$ was estimated from $K_{OW}$ using a linear relationship derived by Ni et al. (2003):

$$K_S=0.040*\log K_{OW}+0.114$$

For Nam Co Lake, the measured salinity ranged between 0.8‰ and 1.2‰, thus a corresponding $C_S$ of 0.02 mol $L^{-1}$ was used. Finally, the corrected $H^*/H$=1.01 or 1.02.

**Text S6. Flux calculation of air-water gas exchange**

The fluxes of air-water gas exchange ($F_{\mathrm{AW}}$, ng m$^{-2}$ day$^{-1}$) were calculated using the two-film model which has been used in many previous studies (Qiu et al., 2008; Xie et al., 2011):

$$F_{\mathrm{AW}}=K_{\mathrm{ol}}\left(C_{\mathrm{w}}\text{-}\mathrm{C}_{\mathrm{a}}R\,T_{\mathrm{a}}/H\right)$$

where $C_{\mathrm{w}}$ and $C_{\mathrm{a}}$ are the dissolved and gaseous concentrations of the target compounds, which are considered to be the measured air and DOC-corrected water concentrations; $R$ is the gas constant (8.314 Pa m$^3$ mol$^{-1}$ K$^{-1}$), $T$a (K) is the absolute temperature, and $H$ (Pa m$^3$ mol$^{-1}$) is the Henry's law constant. $K_{\mathrm{ol}}$ (m s$^{-1}$) is the overall mass transfer coefficient, which contains contributions from the mass transfer coefficients of the water layer and the air layer, namely $K_{\mathrm{w}}$ and $K_{\mathrm{a}}$. The value of $K_{\mathrm{ol}}$ is given by (Khairy et al., 2014):

$$\frac{1}{K_{\mathrm{ol}}}=\frac{RT}{H}\times\frac{1}{K_{\mathrm{a}}}+\frac{1}{K_{\mathrm{w}}}$$

where $K_{\mathrm{w}}$ and $K_{\mathrm{a}}$ are the water-side and air-side mass transfer coefficients, respectively. They are related to the wind speed and compound-specific molecular diffusivity. In the present study, $K_{\mathrm{w}}$ and $K_{\mathrm{a}}$ of target compounds were estimated from those of reference substances as follows.

$K_{\mathrm{a}}$ (cm s$^{-1}$) for water vapour and $K_{\mathrm{w}}$ (cm h$^{-1}$) for $CO_2$ can be calculated according to the following relations:

$$K_{\mathrm{a}}(\mathrm{H_2O})=0.2\times U_{10}+0.3$$

$$K_{\mathrm{w}}(\mathrm{CO_2})=0.45\times {U_{10}}^{1.64}$$

where $U_{10}$ (m s$^{-1}$) is the wind speed above the water surface at 10 m. It was calculated by using the wind speed ($U_{\mathrm{Z}}$, m s$^{-1}$) at any given height ($Z$, m) by following equation (Schwarzenbach et al., 2003):

$$U_{10}=U_{\mathrm{Z}}\left(\frac{10.4}{\mathrm{LN}(Z)+8.1}\right)$$

Because rates of transfer is related to the molecular diffusivity, these estimates for $K_{\mathrm{a}}$ ($H_2O$) and $K_{\mathrm{w}}$ ($CO_2$) allow prediction of $K_{\mathrm{a}}$ and $K_{\mathrm{w}}$ for other compounds of interest with the following relationships (Schwarzenbach et al., 2003):

$$K_{\mathrm{a}}(\mathrm{analyte})=K_{\mathrm{a}}(\mathrm{H_2O})\times\left\{\frac{D_{\mathrm{a}}(\mathrm{analyte})}{D_{\mathrm{a}}(\mathrm{H_2O})}\right\}^{0.67}$$

$$K_w(\text{analyte})=K_w(CO_2)\times\left\{\frac{S_c(\text{analyte})}{S_c(CO_2)}\right\}^{-0.5.}$$

where $D_a$ is the molecular diffusivity in air and $Sc$ is the Schmidt number, calculated by dividing the kinematic viscosity of water ($V_w$, cm$^2$ s$^{-1}$) at a given temperature by the molecular diffusivity in water ($D_w$):

$$S_c(\text{analyte})=\frac{V_w}{D_w(\text{analyte})}$$

$D_a$ and $D_w$ values were estimated using the compound molecular mass to simplify the relationship (Schwarzenbach et al., 2003). We can derive the unknown diffusivity of target compounds in the present study by using the diffusivity of a reference substance, such as $D_a$ ($H_2O$) and $D_w$ ($CO_2$) according to the following equation (Schwarzenbach et al., 2003):

$$\frac{D_a(\text{analyte})}{D_a(H_2O)}\approx\left[\frac{M(\text{analyte})}{M(H_2O)}\right]^{-0.5}$$

$$\frac{D_w(\text{analyte})}{D_w(CO_2)}\approx\left[\frac{M(\text{analyte})}{M(CO_2)}\right]^{-0.5}$$

**Table S6. Equations used for temperature-corrected $P_L$ for each compound**

| Compound | Regression equations( log$P_L$) | References |
|---|---|---|
| Acel | 9.93-2855/T | (Odabasi et al., 2006) |
| Ace | 10.17-2979/T | (Odabasi et al., 2006) |
| Flu | 10.61-3233/T | (Odabasi et al., 2006) |
| Phe | 11.43-3726/T | (Odabasi et al., 2006) |
| Ant | 11.54-3780/T | (Lei et al., 2002) |
| Fla | 12.47-4382/T | (Odabasi et al., 2006) |
| Pyr | 11.7-4164/T | (Lei et al., 2002) |
| BaA | 10.87-4269/T | (Lei et al., 2002) |
| Chr | 13.87-5294/T | (Odabasi et al., 2006) |
| Bbf | 12.48-5148/T | (Odabasi et al., 2006) |
| Bkf | 12.5-5165/T | (Odabasi et al., 2006) |
| Bap | 12.59-5252/T | (Odabasi et al., 2006) |
| IcdP | 13.13-5691/T | (Odabasi et al., 2006) |
| DahA | 13.31-5794/T | (Odabasi et al., 2006) |
| BghiP | 13.15-5737/T | (Odabasi et al., 2006) |

**Table S7. Concentrations of gas phase POPs (pg m$^{-3}$) in the atmosphere of Nam Co**

**Part 1. Concentrations of gas phase OCPs and PCBs (pg m$^{-3}$) in air:**

| **Start Date** | **End Date** | **α-HCH** | **β-HCH** | **γ-HCH** | **HCB** | ***o,p'*-DDE** | ***p,p'*-DDE** | ***o,p'*-DDT** | ***p,p'*-DDT** | **PCB-28** | **PCB-52** | **PCB-101** | **PCB-153** | **PCB-138** | **PCB-180** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2012.09.03 | 2012.09.15 | 4.8 | BDL | 2.5 | 12.2 | 0.6 | 2.1 | 0.7 | ***0.2*** | 0.4 | 0.25 | 0.44 | 0.17 | 0.35 | 0.03 |
| 2012.09.16 | 2012.09.20 | 3.2 | BDL | 1.3 | 15.5 | 0.5 | 1.3 | 2.8 | 0.8 | 0.8 | 0.22 | 0.37 | 0.06 | 0.12 | BDL |
| 2012.10.24 | 2012.10.31 | 3.4 | BDL | 0.7 | 12.2 | ***0.17*** | ***0.35*** | 3.4 | 1.3 | 0.3 | ***0.05*** | 0.05 | ***0.02*** | ***0.02*** | BDL |
| 2012.11.01 | 2012.11.15 | 4.6 | BDL | 0.6 | 38.4 | ***0.17*** | ***0.35*** | 0.8 | 0.5 | 0.3 | 0.14 | 0.08 | 0.03 | 0.03 | BDL |
| 2012.11.16 | 2012.11.30 | 2.5 | BDL | 0.4 | 36.7 | ***0.17*** | ***0.35*** | 0.4 | ***0.17*** | 0.4 | 0.19 | 0.08 | 0.03 | ***0.02*** | BDL |
| 2012.12.01 | 2012.12.15 | 1.4 | BDL | 0.2 | 26.7 | ***0.17*** | ***0.35*** | ***0.17*** | ***0.17*** | 0.1 | ***0.05*** | 0.04 | ***0.02*** | ***0.02*** | BDL |
| 2012.12.16 | 2012.12.31 | 0.7 | BDL | 0.3 | 20.8 | ***0.17*** | ***0.35*** | ***0.17*** | ***0.17*** | 0.4 | 0.14 | 0.07 | 0.03 | ***0.02*** | BDL |
| 2013.01.03 | 2013.01.15 | 1.5 | BDL | 0.3 | 37.3 | ***0.17*** | ***0.35*** | 0.5 | 0.4 | 0.5 | 0.19 | 0.11 | ***0.02*** | ***0.02*** | BDL |
| 2013.01.16 | 2013.01.31 | 1.3 | BDL | 0.6 | 29.8 | ***0.17*** | ***0.35*** | 0.5 | ***0.17*** | 0.7 | 0.21 | 0.08 | ***0.02*** | ***0.02*** | BDL |
| 2013.02.06 | 2013.02.16 | 0.8 | BDL | 0.2 | 14.1 | ***0.17*** | ***0.35*** | 0.6 | ***0.17*** | 0.1 | ***0.05*** | ***0.02*** | ***0.02*** | ***0.02*** | BDL |
| 2013.02.21 | 2013.03.01 | 3.9 | BDL | 1.2 | 25.6 | 0.4 | 0.8 | 2.9 | 2.4 | 0.4 | 0.17 | 0.08 | 0.03 | ***0.02*** | BDL |
| 2013.03.02 | 2013.03.15 | 1.2 | 0.3 | 0.4 | 18.1 | ***0.17*** | ***0.35*** | 0.4 | ***0.17*** | 0.5 | 0.16 | 0.09 | ***0.02*** | ***0.02*** | BDL |
| 2013.03.15 | 2013.03.31 | 3.2 | 0.5 | 1.0 | 24.3 | ***0.17*** | ***0.35*** | 0.7 | 0.4 | 0.5 | 0.15 | 0.08 | ***0.02*** | ***0.02*** | BDL |
| 2013.04.01 | 2013.04.15 | 3.6 | 0.5 | 1.0 | 17.0 | ***0.17*** | ***0.35*** | 1.0 | 0.6 | 0.6 | 0.17 | 0.08 | ***0.02*** | 0.03 | BDL |
| 2013.04.15 | 2013.04.30 | 6.5 | 0.9 | 2.2 | 19.4 | 0.5 | ***0.35*** | 6.6 | 2.1 | 0.9 | 0.33 | 0.19 | 0.06 | 0.05 | BDL |
| 2013.05.01 | 2013.05.15 | 9.0 | 0.6 | 1.9 | 25.7 | 0.3 | ***0.35*** | 4.8 | 2.4 | 0.9 | 0.29 | 0.15 | 0.04 | 0.05 | BDL |
| 2013.05.15 | 2013.06.04 | 7.7 | 1.4 | 4.2 | 15.5 | 0.4 | 0.8 | 6.1 | 2.2 | 1.4 | 0.56 | 0.23 | 0.05 | 0.05 | BDL |
| 2013.06.06 | 2013.06.15 | 3.8 | 0.8 | 1.6 | 12.1 | ***0.17*** | ***0.35*** | 2.2 | 0.7 | 0.7 | 0.29 | 0.16 | ***0.02*** | 0.04 | BDL |
| 2013.06.15 | 2013.06.30 | 8.1 | 1.3 | 4.8 | 11.9 | 0.7 | 1.2 | 12.0 | 3.9 | 1.5 | 0.56 | 0.29 | 0.08 | 0.09 | BDL |
| 2013.07.01 | 2013.07.19 | 6.9 | 0.6 | 2.3 | 12.8 | 0.4 | 0.6 | 7.9 | 1.9 | 0.8 | 0.30 | 0.19 | 0.08 | 0.07 | BDL |
| 2013.07.19 | 2013.08.03 | 6.7 | 0.9 | 1.7 | 15.1 | 1.4 | 1.4 | 6.0 | 2.0 | 1.4 | 0.44 | 0.39 | 0.06 | 0.09 | 0.03 |
| 2013.08.04 | 2013.08.15 | 3.7 | 0.7 | 0.9 | 15.9 | ***0.17*** | ***0.35*** | 1.0 | 0.6 | 1.4 | 0.44 | 0.39 | 0.04 | 0.05 | 0.13 |
| 2013.08.15 | 2013.08.31 | 5.3 | 0.4 | 1.2 | 14.6 | 0.5 | 0.9 | 14.1 | 4.9 | 0.6 | 0.23 | 0.28 | 0.08 | 0.06 | BDL |

| **Start Date** | **End Date** | **α-HCH** | **β-HCH** | **γ-HCH** | **HCB** | ***o,p'*-DDE** | ***p,p'*-DDE** | ***o,p'*-DDT** | ***p,p'*-DDT** | **PCB-28** | **PCB-52** | **PCB-101** | **PCB-153** | **PCB-138** | **PCB-180** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2013.09.01 | 2013.09.15 | 5.4 | BDL | ***0.06*** | 11.7 | 3.1 | 3.4 | 1.6 | ***0.17*** | 2.7 | ***0.05*** | 0.13 | 0.07 | 0.09 | BDL |
| 2013.10.01 | 2013.10.15 | 4.6 | BDL | 2.8 | 11.4 | 2.2 | 3.8 | 4.4 | 1.1 | 0.8 | 0.44 | 0.28 | 0.54 | 0.14 | BDL |
| 2013.10.15 | 2013.10.30 | 3.5 | BDL | 5.4 | 17.5 | 0.6 | 1.0 | 3.2 | 0.9 | 0.3 | 0.38 | 0.24 | 0.33 | 0.11 | BDL |
| 2013.11.01 | 2013.11.15 | 2.2 | BDL | 1.0 | 40.5 | 0.5 | 1.3 | 1.0 | 1.0 | 0.7 | 0.96 | 0.31 | 0.24 | 0.12 | BDL |
| 2013.11.15 | 2013.11.30 | 1.9 | BDL | 0.4 | 24.5 | ***0.17*** | 0.9 | ***0.17*** | 0.2 | 0.6 | 0.66 | 0.30 | 0.14 | 0.07 | BDL |
| 2013.12.01 | 2013.12.15 | 1.2 | BDL | 3.3 | 23.4 | 4.1 | 2.7 | 1.5 | ***0.17*** | 1.0 | ***0.05*** | 0.28 | 0.08 | 0.07 | BDL |
| 2013.12.16 | 2013.12.30 | 2.6 | BDL | 7.2 | 27.6 | 1.9 | 5.3 | 1.5 | 0.9 | 1.8 | 1.08 | 1.06 | 0.33 | 0.18 | BDL |
| 2014.01.05 | 2014.01.31 | 1.3 | BDL | 2.7 | 16.4 | 2.3 | 1.9 | 1.2 | 0.2 | 0.9 | ***0.05*** | 0.32 | 0.11 | 0.06 | BDL |
| 2014.02.01 | 2014.02.15 | 0.7 | BDL | 0.7 | 12.4 | ***0.17*** | ***0.35*** | ***0.17*** | ***0.17*** | 0.5 | 0.62 | 0.40 | 0.15 | 0.07 | BDL |
| 2014.02.15 | 2014.02.28 | 2.7 | 0.5 | 4.9 | 33.0 | 0.6 | 1.4 | 0.6 | ***0.17*** | 1.9 | 0.59 | 0.71 | 0.18 | 0.08 | BDL |
| 2014.03.01 | 2014.03.15 | 1.7 | BDL | 1.4 | 20.4 | 0.4 | 1.0 | 1.6 | 0.4 | 0.5 | 0.81 | 0.51 | 0.18 | 0.07 | BDL |
| 2014.03.15 | 2014.03.31 | 2.3 | BDL | 3.7 | 18.3 | 0.5 | 0.9 | 0.7 | ***0.17*** | 0.8 | ***0.05*** | 0.45 | 0.14 | 0.07 | BDL |
| 2014.04.01 | 2014.04.15 | 4.5 | BDL | ***0.06*** | 16.1 | 1.4 | 3.1 | 3.2 | 0.4 | 1.9 | ***0.05*** | 0.48 | 0.05 | 0.09 | BDL |
| 2014.04.15 | 2014.04.30 | 2.9 | BDL | 1.6 | 18.6 | 0.6 | 0.8 | 1.6 | 1.0 | 0.7 | 1.02 | 0.57 | 0.36 | 0.15 | BDL |
| 2014.05.01 | 2014.05.15 | 4.2 | 0.4 | 2.2 | 15.8 | 0.6 | 1.3 | 1.8 | 1.1 | 0.7 | 0.96 | 0.54 | 0.26 | 0.12 | BDL |
| 2014.05.15 | 2014.05.28 | 2.3 | 0.5 | 4.3 | 14.8 | 1.5 | 2.9 | 4.4 | 1.7 | 0.7 | 0.93 | 0.75 | 0.49 | 0.22 | 0.05 |
| 2014.06.02 | 2014.06.15 | 7.1 | 1.4 | 3.1 | 26.8 | 3.6 | 6.9 | 6.3 | 1.8 | 2.0 | 1.30 | 0.97 | 0.86 | 0.39 | 0.08 |
| 2014.06.22 | 2014.06.30 | 4.7 | 0.5 | 2.1 | 15.1 | 0.7 | 2.1 | 8.0 | 2.4 | 0.8 | 0.68 | 0.43 | 0.26 | 0.10 | BDL |
| 2014.07.01 | 2014.07.15 | 6.5 | BDL | 5.3 | 12.6 | 2.4 | 4.9 | 4.5 | ***0.17*** | 3.7 | 5.47 | 0.74 | 0.09 | 0.03 | 0.05 |
| 2014.07.15 | 2014.07.31 | 7.4 | 1.0 | 3.0 | 24.3 | 1.3 | 2.2 | 6.6 | 1.7 | 1.9 | 1.40 | 0.80 | 0.38 | 0.97 | BDL |
| 2014.08.01 | 2014.08.15 | 8.4 | 1.5 | 6.7 | 21.7 | 13.9 | 12.8 | 17.9 | 1.8 | 6.9 | 4.15 | 1.75 | 0.41 | 0.45 | 0.05 |
| 2014.08.15 | 2014.08.31 | 7.5 | 1.4 | 1.7 | 25.6 | 1.7 | 4.8 | 6.4 | 2.8 | 2.9 | 1.59 | 1.22 | 0.29 | 0.46 | 0.06 |
| 2014.09.02 | 2014.09.15 | 4.0 | 0.6 | 1.8 | 12.0 | 2.3 | 6.1 | 9.8 | 3.7 | 3.1 | 0.71 | 0.84 | 0.33 | 0.27 | 0.03 |
| 2014.09.15 | 2014.09.30 | 4.1 | BDL | 2.3 | 17.3 | 1.5 | 4.1 | 6.0 | 3.5 | 3.1 | 0.47 | 0.48 | 0.15 | 0.16 | BDL |

***Entries in bold and italics are substituted values at 1/2 MDL.***

## Part 2. Concentrations of gas phase PAHs (pg m$^{-3}$) in air:

| Start Date | End Date | Acel | Ace | Flu | Phe | Ant | Fla | Pyr | BaA | Chr | Bbf | Bkf | Bap | IcdP | DahA | BghiP |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2012.09.16 | 2012.09.20 | 52 | 123 | 607 | 1170 | 121 | 256 | 204 | 13 | 68 | 4 | 9 | 6 | BDL | BDL | 7 |
| 2012.10.01 | 2012.10.15 | 19 | 31 | 540 | 2037 | 347 | 383 | 223 | 3 | 18 | 1 | 1 | 1 | BDL | BDL | 1 |
| 2012.10.24 | 2012.10.31 | 8 | 21 | 115 | 264 | 24 | 51 | 30 | 2 | 6 | 1 | 1 | 1 | BDL | BDL | 1 |
| 2012.11.01 | 2012.11.15 | 4 | 6 | 85 | 267 | 20 | 65 | 40 | 3 | 8 | 1 | 3 | 2 | BDL | BDL | 2 |
| 2012.11.16 | 2012.11.30 | 5 | 7 | 80 | 291 | 21 | 52 | 31 | 2 | 5 | 0.3 | 1 | 1 | BDL | BDL | 1 |
| 2012.12.01 | 2012.12.15 | 4 | 6 | 85 | 252 | 19 | 53 | 33 | 3 | 7 | 0.3 | 1 | 1 | BDL | BDL | 1 |
| 2012.12.16 | 2012.12.31 | 14 | 55 | 273 | 701 | 118 | 274 | 167 | 9 | 12 | 2 | 2 | 1 | BDL | BDL | 2 |
| 2013.01.03 | 2013.01.15 | 11 | 37 | 189 | 328 | 32 | 59 | 38 | 4 | 10 | 2 | 4 | 2 | BDL | BDL | 4 |
| 2013.01.16 | 2013.01.31 | 27 | 62 | 544 | 1120 | 85 | 147 | 87 | 3 | 10 | 0.5 | 2 | 1 | BDL | BDL | 2 |
| 2013.02.06 | 2013.02.16 | 5 | 9 | 109 | 320 | 33 | 94 | 54 | 2 | 6 | 0.2 | 0.3 | 0.3 | BDL | BDL | ***0.17*** |
| 2013.02.21 | 2013.03.01 | 8 | 13 | 171 | 684 | 138 | 314 | 192 | 9 | 13 | 0.3 | 1 | 1 | BDL | BDL | 1 |
| 2013.03.02 | 2013.03.15 | 11 | 31 | 199 | 636 | 66 | 194 | 126 | 2 | 8 | 0.1 | 0.3 | 0.5 | BDL | BDL | 1 |
| 2013.03.15 | 2013.03.31 | 7 | 11 | 161 | 726 | 124 | 308 | 192 | 7 | 12 | 1 | 1 | 1 | BDL | BDL | 1 |
| 2013.04.01 | 2013.04.15 | 5 | 7 | 102 | 470 | 34 | 107 | 54 | 2 | 8 | 1 | 2 | 1 | BDL | BDL | 2 |
| 2013.04.15 | 2013.04.30 | 4 | 4 | 137 | 1048 | 195 | 453 | 274 | 10 | 16 | 0.4 | 1 | 1 | BDL | BDL | 1 |
| 2013.05.01 | 2013.05.15 | 4 | 5 | 102 | 540 | 69 | 148 | 120 | 32 | 53 | 9 | 22 | 31 | 1 | 1 | 28 |
| 2013.05.15 | 2013.06.04 | 4 | 5 | 98 | 817 | 97 | 269 | 157 | 8 | 17 | 1 | 3 | 3 | BDL | BDL | 3 |
| 2013.06.06 | 2013.06.15 | 3 | 4 | 96 | 694 | 181 | 415 | 262 | 14 | 18 | 1 | 1 | 1 | BDL | BDL | 1 |
| 2013.06.15 | 2013.06.30 | 4 | 5 | 147 | 1316 | 301 | 577 | 356 | 13 | 23 | 0.4 | 1 | 1 | BDL | BDL | 1 |
| 2013.07.01 | 2013.07.19 | 5 | 8 | 145 | 1016 | 225 | 530 | 350 | 14 | 24 | 2 | 1 | 1 | BDL | BDL | 2 |
| 2013.07.19 | 2013.08.03 | 19 | 44 | 286 | 817 | 100 | 178 | 150 | 13 | 27 | 2 | 6 | 7 | BDL | BDL | 5 |
| 2013.08.04 | 2013.08.15 | 44 | 87 | 675 | 1124 | 106 | 205 | 206 | 11 | 33 | 4 | 4 | 5 | BDL | BDL | 5 |
| 2013.08.15 | 2013.08.31 | 8 | 14 | 162 | 565 | 90 | 124 | 80 | 2 | 11 | 0.3 | 1 | 0.3 | BDL | BDL | 1 |
| 2013.09.01 | 2013.09.15 | 170 | 226 | 2068 | 3844 | 382 | 176 | 813 | 6 | 34 | 2 | 5 | 4 | 3 | BDL | 7 |
| 2013.10.01 | 2013.10.15 | 10 | 20 | 206 | 829 | 90 | 162 | 145 | 2 | 11 | 2 | 1 | 1 | 1 | 0.4 | 1 |

| Start Date | End Date | Acel | Ace | Flu | Phe | Ant | Fla | Pyr | BaA | Chr | Bbf | Bkf | Bap | IcdP | DahA | BghiP |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2013.10.15 | 2013.10.30 | 3 | 6 | 142 | 453 | 33 | 106 | 60 | 7 | 14 | 9 | 7 | 5 | 4 | 1 | 3 |
| 2013.11.01 | 2013.11.15 | 14 | 22 | 265 | 550 | 31 | 75 | 40 | 2 | 8 | 2 | 1 | 0.4 | 1 | BDL | 1 |
| 2013.11.15 | 2013.11.30 | 15 | 25 | 236 | 613 | 39 | 115 | 63 | 3 | 8 | 2 | 2 | 0.4 | 1 | BDL | 1 |
| 2013.12.01 | 2013.12.15 | 37 | 71 | 491 | 659 | 67 | 58 | 80 | 4 | 8 | 3 | 2 | 1 | 2 | 0.4 | 2 |
| 2013.12.16 | 2013.12.30 | 53 | 92 | 709 | 1429 | 112 | 176 | 132 | 10 | 21 | 8 | 6 | 5 | 6 | 1 | 6 |
| 2014.01.05 | 2014.01.31 | 34 | 58 | 422 | 758 | 79 | 70 | 78 | 3 | 8 | 2 | 1 | 2 | 1 | BDL | 2 |
| 2014.02.01 | 2014.02.15 | 4 | 6 | 137 | 518 | 24 | 84 | 42 | 2 | 8 | 2 | 1 | 1 | 1 | BDL | 1 |
| 2014.02.15 | 2014.02.28 | 43 | 67 | 547 | 969 | 55 | 70 | 72 | 3 | 9 | 3 | 2 | 1 | 1 | 0.3 | 2 |
| 2014.03.01 | 2014.03.15 | 4 | 9 | 153 | 590 | 44 | 173 | 86 | 4 | 11 | 3 | 3 | 1 | 1 | 0.3 | 2 |
| 2014.03.15 | 2014.03.31 | 8 | 18 | 146 | 389 | 23 | 72 | 54 | 1 | 4 | 1 | 1 | 0.4 | 0.5 | BDL | 1 |
| 2014.04.01 | 2014.04.15 | 56 | 80 | 750 | 1454 | 119 | 148 | 182 | 9 | 20 | 5 | 5 | 5 | 6 | 1 | 7 |
| 2014.04.15 | 2014.04.30 | 10 | 18 | 165 | 436 | 93 | 112 | 68 | 4 | 9 | 3 | 2 | 1 | 1 | 0.3 | 2 |
| 2014.05.01 | 2014.05.15 | 8 | 16 | 124 | 449 | 40 | 111 | 65 | 3 | 10 | 3 | 3 | 1 | 1 | 0.4 | 2 |
| 2014.05.15 | 2014.05.28 | 5 | 8 | 100 | 540 | 62 | 178 | 111 | 13 | 28 | 18 | 13 | 9 | 7 | 1 | 7 |
| 2014.06.02 | 2014.06.15 | 11 | 15 | 236 | 989 | 107 | 154 | 119 | 19 | 32 | 27 | 13 | 19 | 9 | 2 | 9 |
| 2014.06.22 | 2014.06.30 | 15 | 19 | 586 | 1370 | 173 | 190 | 110 | 3 | 11 | 0.4 | 2 | 1 | BDL | BDL | 1 |
| 2014.07.01 | 2014.07.15 | 118 | 159 | 1632 | 4270 | 381 | 104 | 338 | 4 | 68 | 0.5 | 2 | 2 | 0.5 | BDL | 3 |
| 2014.07.15 | 2014.07.31 | 36 | 45 | 716 | 1687 | 199 | 176 | 111 | 2 | 11 | 0.3 | 1 | 1 | 0.3 | BDL | 2 |
| 2014.08.01 | 2014.08.15 | 198 | 311 | 2580 | 7057 | 1310 | 760 | 946 | 22 | 79 | 14 | 8 | 13 | 7 | 2 | 11 |
| 2014.08.15 | 2014.08.31 | 16 | 28 | 743 | 4716 | 1137 | 1621 | 1242 | 269 | 698 | 29 | ***0.08*** | ***0.08*** | 8 | 9 | ***0.17*** |

***Entries in bold and italics are substituted values at 1/2 MDL.***

**Table S8. Concentrations of POPs (pg m$^{-3}$) in the total suspended particulates (TSP) of Nam Co**

**Part 1. Concentrations of particulate phase OCPs and PCBs (pg m$^{-3}$) in air:**

| **Start Date** | **End Date** | **α-HCH** | **β-HCH** | **γ-HCH** | **HCB** | **o,p'-DDE** | **p,p'-DDE** | **o,p'-DDT** | **p,p'-DDT** | **PCB-28** | **PCB-52** | ***PCB-101*** | **PCB-153** | **PCB-138** | **PCB-180** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2012.09.03 | 2012.09.15 | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | ***0.02*** | BDL | BDL | BDL |
| 2012.09.16 | 2012.09.20 | BDL | BDL | 0.20 | 3.14 | BDL | BDL | BDL | BDL | 0.06 | BDL | 0.13 | BDL | BDL | BDL |
| 2012.10.01 | 2012.10.15 | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | 0.03 | BDL | BDL | BDL |
| 2012.10.24 | 2012.10.31 | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | ***0.02*** | BDL | BDL | BDL |
| 2012.11.01 | 2012.11.15 | BDL | BDL | 0.10 | BDL | BDL | BDL | BDL | BDL | BDL | BDL | 0.03 | BDL | BDL | BDL |
| 2012.11.16 | 2012.11.30 | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | ***0.02*** | BDL | BDL | BDL |
| 2012.12.16 | 2012.12.31 | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | 0.05 | BDL | 0.05 | BDL | BDL | BDL |
| 2013.01.03 | 2013.01.15 | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | 0.06 | BDL | 0.06 | BDL | BDL | BDL |
| 2013.01.16 | 2013.01.31 | BDL | BDL | BDL | BDL | BDL | BDL | 0.38 | 0.33 | 0.09 | BDL | 0.04 | BDL | BDL | BDL |
| 2013.02.06 | 2013.02.16 | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | 0.03 | BDL | BDL | BDL |
| 2013.02.21 | 2013.03.01 | BDL | BDL | 0.16 | BDL | BDL | BDL | BDL | 0.55 | BDL | BDL | 0.04 | BDL | BDL | BDL |
| 2013.03.02 | 2013.03.15 | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | 0.03 | BDL | 0.04 | BDL | BDL | BDL |
| 2013.03.15 | 2013.03.31 | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | ***0.02*** | BDL | BDL | BDL |
| 2013.04.01 | 2013.04.15 | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | 0.03 | BDL | BDL | BDL |
| 2013.05.01 | 2013.05.15 | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | ***0.02*** | BDL | BDL | BDL |
| 2013.05.15 | 2013.06.04 | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | ***0.02*** | BDL | BDL | BDL |
| 2013.06.06 | 2013.06.15 | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | 0.03 | BDL | BDL | BDL |
| 2013.06.15 | 2013.06.30 | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | 0.04 | BDL | ***0.02*** | BDL | BDL | BDL |
| 2013.07.01 | 2013.07.19 | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | 0.04 | BDL | BDL | BDL |
| 2013.07.19 | 2013.08.03 | 0.40 | BDL | 0.14 | 3.71 | BDL | BDL | 0.43 | BDL | BDL | BDL | 0.04 | BDL | 0.08 | 0.03 |
| 2013.09.01 | 2013.09.15 | BDL | BDL | BDL | BDL | BDL | BDL | BDL | 0.60 | BDL | BDL | 0.04 | 0.05 | BDL | BDL |
| 2013.10.01 | 2013.10.15 | BDL | BDL | BDL | BDL | BDL | 1.01 | 1.58 | 2.38 | BDL | BDL | 0.04 | 0.04 | 0.04 | BDL |
| 2013.10.15 | 2013.10.30 | BDL | BDL | 0.34 | BDL | BDL | BDL | 0.47 | BDL | BDL | BDL | 0.03 | BDL | BDL | BDL |

| Start Date | End Date | α-HCH | β-HCH | γ-HCH | HCB | o,p'-DDE | p,p'-DDE | o,p'-DDT | p,p'-DDT | PCB-28 | PCB-52 | ***PCB-101*** | PCB-153 | PCB-138 | PCB-180 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2013.11.01 | 2013.11.15 | BDL | BDL | BDL | BDL | BDL | BDL | 0.39 | 0.43 | BDL | BDL | 0.05 | 0.03 | 0.03 | BDL |
| 2013.11.15 | 2013.11.30 | BDL | BDL | BDL | BDL | BDL | BDL | 0.43 | BDL | 0.03 | BDL | 0.08 | 0.09 | 0.04 | BDL |
| 2013.12.01 | 2013.12.15 | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | 0.09 | 0.11 | 0.04 | BDL |
| 2013.12.16 | 2013.12.30 | BDL | BDL | BDL | BDL | BDL | 0.70 | BDL | BDL | BDL | BDL | 0.14 | 0.16 | 0.08 | 0.04 |
| 2014.01.05 | 2014.01.31 | BDL | BDL | BDL | BDL | BDL | BDL | 0.36 | 0.58 | BDL | BDL | 0.04 | BDL | BDL | BDL |
| 2014.02.01 | 2014.02.15 | BDL | BDL | 0.16 | BDL | BDL | 1.31 | 0.93 | 0.51 | 0.08 | BDL | 0.12 | 0.07 | 0.05 | BDL |
| 2014.02.15 | 2014.02.28 | BDL | BDL | BDL | BDL | BDL | BDL | 0.85 | 0.66 | 0.03 | BDL | 0.07 | 0.09 | 0.04 | BDL |
| 2014.03.01 | 2014.03.15 | BDL | BDL | BDL | BDL | BDL | BDL | 0.91 | 1.01 | 0.03 | BDL | 0.07 | 0.17 | 0.06 | BDL |
| 2014.03.15 | 2014.03.31 | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | 0.04 | 0.05 | BDL | BDL |
| 2014.04.01 | 2014.04.15 | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | 0.04 | 0.04 | BDL | BDL |
| 2014.04.15 | 2014.04.30 | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | 0.03 | BDL | BDL | BDL |
| 2014.05.01 | 2014.05.15 | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | ***0.02*** | BDL | BDL | BDL |
| 2014.05.15 | 2014.05.28 | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | 0.03 | BDL | BDL | BDL |
| 2014.06.02 | 2014.06.15 | BDL | 0.47 | 0.42 | BDL | BDL | BDL | BDL | BDL | BDL | BDL | 0.05 | 0.06 | BDL | BDL |
| 2014.06.22 | 2014.06.30 | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | 0.03 | BDL | BDL | BDL |
| 2014.07.01 | 2014.07.15 | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | 0.03 | BDL | BDL | BDL |
| 2014.07.15 | 2014.07.31 | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | ***0.02*** | BDL | BDL | BDL |
| 2014.08.01 | 2014.08.15 | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | ***0.02*** | BDL | BDL | BDL |
| 2014.08.15 | 2014.08.31 | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | 0.03 | BDL | BDL | BDL |
| 2014.09.02 | 2014.09.15 | BDL | BDL | 0.10 | BDL | BDL | BDL | BDL | BDL | BDL | BDL | ***0.02*** | BDL | BDL | BDL |

***Entries in bold and italics are substituted values at 1/2 MDL.***

## Part 2. Concentrations of particulate phase PAHs (pg $m^{-3}$) in air:

| Start Date | End Date | Acel | Ace | Flu | Phe | Ant | Fla | Pyr | BaA | Chr | Bbf | Bkf | Bap | IcdP | DahA | BghiP |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2012.09.03 | 2012.09.15 | 1 | 1 | 51 | 519 | 33 | 360 | 239 | 11 | 19 | 2 | 4 | 3 | BDL | BDL | 8 |
| 2012.09.16 | 2012.09.20 | 4 | 6 | 148 | 1392 | 216 | 966 | 606 | 34 | 45 | 3 | 5 | 3 | BDL | BDL | 7 |
| 2012.10.01 | 2012.10.15 | 2 | 2 | 58 | 525 | 75 | 428 | 287 | 20 | 38 | 4 | 16 | 17 | BDL | BDL | 29 |
| 2012.10.24 | 2012.10.31 | 2 | 2 | 58 | 571 | 70 | 463 | 307 | 23 | 49 | 5 | 19 | 20 | BDL | BDL | 30 |
| 2012.11.01 | 2012.11.15 | 2 | 3 | 58 | 552 | 76 | 411 | 285 | 21 | 44 | 1 | 21 | 21 | BDL | BDL | 28 |
| 2012.11.16 | 2012.11.30 | BDL | 1 | 16 | 74 | 4 | 56 | 43 | 8 | 20 | ***0.17*** | 9 | 10 | BDL | BDL | 13 |
| 2012.12.16 | 2012.12.31 | 2 | 2 | 26 | 123 | 8 | 82 | 61 | 11 | 25 | 2 | 11 | 12 | BDL | BDL | 15 |
| 2013.01.03 | 2013.01.15 | 4 | 6 | 74 | 306 | 15 | 198 | 159 | 27 | 58 | 3 | 30 | 27 | 1 | BDL | 39 |
| 2013.01.16 | 2013.01.31 | 2 | 3 | 33 | 156 | 7 | 95 | 69 | 11 | 25 | 1 | 11 | 12 | BDL | BDL | 16 |
| 2013.02.06 | 2013.02.16 | BDL | 2 | 18 | 95 | 7 | 110 | 101 | 28 | 61 | 11 | 34 | 36 | 3 | 1 | 37 |
| 2013.02.21 | 2013.03.01 | BDL | 1 | 17 | 105 | 7 | 86 | 75 | 18 | 40 | 3 | 19 | 22 | BDL | BDL | 30 |
| 2013.03.02 | 2013.03.15 | BDL | 2 | 60 | 676 | 90 | 618 | 464 | 70 | 146 | 6 | 59 | 74 | BDL | 1 | 87 |
| 2013.03.15 | 2013.03.31 | BDL | 2 | 31 | 173 | 12 | 124 | 106 | 23 | 59 | 3 | 28 | 33 | BDL | BDL | 45 |
| 2013.04.01 | 2013.04.15 | BDL | 1 | 19 | 106 | 11 | 71 | 58 | 13 | 28 | 21 | 21 | 18 | 18 | 2 | 24 |
| 2013.05.01 | 2013.05.15 | BDL | 1 | 21 | 117 | 10 | 61 | 49 | 10 | 25 | 21 | 16 | 17 | 17 | 1 | 27 |
| 2013.05.15 | 2013.06.04 | BDL | 1 | 21 | 116 | 8 | 67 | 52 | 10 | 25 | 19 | 17 | 12 | 16 | 2 | 22 |
| 2013.06.06 | 2013.06.15 | BDL | 1 | 18 | 103 | 10 | 57 | 46 | 9 | 22 | 17 | 15 | 10 | 12 | 1 | 18 |
| 2013.06.15 | 2013.06.30 | BDL | 2 | 27 | 148 | 10 | 69 | 50 | 8 | 17 | 2 | 8 | 10 | BDL | BDL | 15 |
| 2013.07.01 | 2013.07.19 | BDL | 1 | 24 | 125 | 6 | 48 | 33 | 4 | 11 | 2 | 4 | 3 | 0.5 | BDL | 6 |
| 2013.07.19 | 2013.08.03 | BDL | 1 | 39 | 379 | 61 | 179 | 125 | 11 | 46 | 2 | 8 | 8 | BDL | BDL | 14 |
| 2013.09.01 | 2013.09.15 | BDL | 2 | 25 | 116 | 7 | 74 | 51 | 9 | 25 | 23 | 10 | 8 | 12 | 2 | 15 |
| 2013.10.01 | 2013.10.15 | BDL | ***0.57*** | 19 | 106 | 5 | 105 | 82 | 16 | 62 | 58 | 26 | 23 | 34 | 4 | 38 |
| 2013.10.15 | 2013.10.30 | BDL | 2 | 26 | 123 | 5 | 74 | 54 | 8 | 20 | 17 | 17 | 14 | 16 | 1 | 17 |
| 2013.11.01 | 2013.11.15 | BDL | 2 | 20 | 104 | 5 | 87 | 64 | 12 | 28 | 8 | 14 | 16 | 1 | 1 | 20 |
| 2013.11.15 | 2013.11.30 | BDL | 1 | 20 | 139 | 4 | 197 | 116 | 15 | 41 | ***0.17*** | 17 | 20 | BDL | BDL | 23 |

| Start Date | End Date | Acel | Ace | Flu | Phe | Ant | Fla | Pyr | BaA | Chr | Bbf | Bkf | Bap | IcdP | DahA | BghiP |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2013.12.01 | 2013.12.15 | BDL | 1 | 18 | 115 | 5 | 104 | 68 | 9 | 22 | 2 | 9 | 11 | BDL | BDL | 11 |
| 2013.12.16 | 2013.12.30 | 2 | 2 | 32 | 117 | 6 | 80 | 54 | 8 | 25 | ***0*** | 8 | 10 | BDL | BDL | 10 |
| 2014.01.05 | 2014.01.31 | BDL | ***0.57*** | 15 | 96 | 5 | 100 | 75 | 13 | 31 | ***0*** | 15 | 18 | BDL | BDL | 20 |
| 2014.02.01 | 2014.02.15 | BDL | 1 | 24 | 180 | 9 | 186 | 93 | 12 | 27 | ***0.17*** | 11 | 13 | BDL | BDL | 12 |
| 2014.02.15 | 2014.02.28 | 3 | 3 | 49 | 184 | 7 | 151 | 105 | 21 | 48 | ***0.17*** | 24 | 26 | BDL | BDL | 30 |
| 2014.03.01 | 2014.03.15 | BDL | 1 | 20 | 95 | 4 | 94 | 76 | 18 | 45 | 8 | 22 | 29 | 1 | 1 | 30 |
| 2014.03.15 | 2014.03.31 | BDL | 1 | 28 | 125 | 6 | 95 | 77 | 16 | 41 | 29 | 21 | 24 | 24 | 2 | 28 |
| 2014.04.01 | 2014.04.15 | BDL | ***0.57*** | 9 | 43 | 2 | 20 | 14 | 2 | 5 | 3 | 2 | 2 | 2 | BDL | 3 |
| 2014.04.15 | 2014.04.30 | BDL | ***0.57*** | 9 | 46 | 5 | 37 | 32 | 8 | 20 | 16 | 12 | 11 | 12 | 1 | 12 |
| 2014.05.01 | 2014.05.15 | BDL | ***0.57*** | 5 | 28 | 2 | 21 | 17 | 4 | 12 | 11 | 8 | 8 | 7 | 0.4 | 9 |
| 2014.05.15 | 2014.05.28 | BDL | ***0.57*** | 9 | 55 | 2 | 26 | 18 | 2 | 8 | 5 | 3 | 3 | 2 | BDL | 3 |
| 2014.06.02 | 2014.06.15 | BDL | 2 | 13 | 54 | 2 | 24 | 17 | 2 | 7 | 4 | 2 | 2 | 1 | BDL | 3 |
| 2014.06.22 | 2014.06.30 | BDL | ***0.57*** | 10 | 53 | 2 | 22 | 15 | 2 | 5 | 3 | 2 | 2 | 1 | BDL | 2 |
| 2014.07.01 | 2014.07.15 | BDL | ***0.57*** | 13 | 65 | 8 | 33 | 22 | 3 | 10 | 4 | 3 | 2 | 1 | BDL | 3 |
| 2014.07.15 | 2014.07.31 | BDL | ***0.57*** | 15 | 75 | 7 | 34 | 23 | 4 | 15 | 8 | 6 | 2 | 3 | BDL | 5 |
| 2014.08.01 | 2014.08.15 | BDL | ***0.57*** | 24 | 110 | 7 | 48 | 29 | 3 | 7 | 4 | 2 | 0.4 | 1 | BDL | 2 |
| 2014.08.15 | 2014.08.31 | BDL | ***0.57*** | 9 | 49 | 2 | 20 | 12 | 1 | 3 | 1 | 1 | ***0.08*** | 0.2 | BDL | 1 |
| 2014.09.02 | 2014.09.15 | BDL | ***0.57*** | 13 | 60 | 9 | 23 | 18 | 2 | 5 | 3 | 3 | 2 | 0.3 | BDL | 3 |

***Entries in bold and italics are substituted values at 1/2 MDL.***

**Table S9. Concentrations of dissolved phase POPs (pg $L^{-1}$) in the lake water of Nam Co (after corrected by DOC)**

**Part 1. Concentrations of dissolved phase OCPs and PCBs (pg $L^{-1}$) in the water from different sites of the lake (S1-S15):**

| | **S1** | **S2** | **S3** | **S4** | **S5** | **S6** | **S7** | **S8** | **S9** | **S10** | **S11** | **S12** | **S13** | **S14** | **S15** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **α-HCH** | 5.0 | 11.8 | | 8.0 | 9.5 | 7.5 | 8.7 | 9.3 | 9.3 | 9.8 | 6.3 | 14.7 | 11.5 | 8.6 | 18.4 |
| **β-HCH** | 79.9 | 104.2 | | 100.3 | 105.5 | 116.9 | 77.9 | 76.2 | 70.3 | 71.7 | 44.0 | 100.2 | 82.7 | 85.2 | 77.2 |
| **γ-HCH** | 5.4 | 7.5 | | 5.8 | 10.2 | 8.2 | 6.7 | 7.3 | 3.7 | 4.4 | 2.7 | 9.0 | 7.5 | 8.0 | 11.6 |
| **HCB** | 2.9 | 4.3 | | 4.7 | 3.7 | 5.1 | 5.3 | 15.1 | 6.6 | 3.3 | 4.3 | 5.8 | 18.0 | 7.2 | 19.6 |
| ***o,p'*-DDE** | BDL | BDL | | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL |
| ***p,p'*-DDE** | BDL | BDL | | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | 0.9 | BDL | BDL | 1.2 |
| ***o,p'*-DDT** | BDL | BDL | | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL |
| ***p,p'*-DDT** | BDL | BDL | | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL |
| **PCB-28** | 2.1 | 1.8 | | 1.6 | 1.6 | 1.6 | 0.9 | 1.2 | 1.8 | 0.9 | 1.0 | 1.8 | 1.0 | 2.9 | 4.3 |
| **PCB-52** | 0.3 | 0.2 | | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | 0.2 | BDL | 1.6 | 1.0 |
| **PCB-101** | BDL | BDL | | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | 0.3 |
| **PCB-153** | BDL | BDL | | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL |
| **PCB-138** | BDL | BDL | | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | 0.03 | BDL | BDL | 0.2 |
| **PCB-180** | BDL | BDL | | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL |

**Part 2. Concentrations of dissolved phase PAHs (pg $L^{-1}$) in the water from different sites of the lake (S1-S15):**

| | **S1** | **S2** | **S3** | **S4** | **S5** | **S6** | **S7** | **S8** | **S9** | **S10** | **S11** | **S12** | **S13** | **S14** | **S15** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Acel** | 338 | 685 | | 685 | 291 | 543 | 571 | 309 | 1326 | 411 | 283 | | 539 | 1076 | 990 |
| **Ace** | 274 | 244 | | 282 | 167 | 183 | 150 | 102 | 236 | 155 | 103 | | 195 | 468 | 815 |
| **Flu** | 1549 | 1833 | | 1726 | 1742 | 1638 | 1376 | 2148 | 2801 | 1646 | 1619 | | 3275 | 4219 | 4118 |
| **Phe** | 2515 | 4311 | | 5065 | 5497 | 7423 | 5732 | 13822 | 73236 | 5791 | 7499 | | 15907 | 9883 | 17748 |
| **Ant** | BDL | 1130 | | 1178 | 1301 | 1500 | 1176 | 5159 | 1829 | 1045 | 1978 | | 6781 | 3035 | 7778 |
| **Fla** | 934 | 1865 | | 2118 | 1984 | 3314 | 2883 | 10946 | 2179 | 3085 | 4397 | | 12413 | 5525 | 14099 |
| **Pyr** | 751 | 1266 | | 1390 | 1311 | 1553 | 1293 | 7633 | 1589 | 2445 | 3585 | | 8871 | 3738 | 10669 |
| **BaA** | 48 | 55 | | 105 | 87 | 94 | 70 | 380 | 98 | 199 | 302 | | 337 | 134 | 401 |
| **Chr** | 484 | 265 | | 358 | 291 | 521 | 446 | 514 | 255 | 518 | 595 | | 463 | 469 | 2078 |
| **Bbf** | BDL | BDL | | BDL | 6 | 5 | BDL | 17 | BDL | BDL | 16 | | 3 | 2 | BDL |
| **Bkf** | 15 | 14 | | 52 | 32 | 42 | 36 | 89 | 41 | 88 | 97 | | 18 | 15 | 62 |
| **Bap** | 3 | 7 | | 27 | 19 | 17 | 9 | 84 | 34 | 22 | 78 | | 11 | 8 | 38 |
| **IcdP** | BDL | BDL | | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | | BDL | BDL | BDL |
| **DahA** | BDL | BDL | | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | | BDL | BDL | BDL |
| **BghiP** | 7 | 7 | | 19 | 12 | 15 | 7 | 51 | 16 | 24 | 40 | | 11 | 4 | 19 |
| **$\sum_{15}$PAHs (pg $L^{-1}$)** | 6918 | 11680 | | 13005 | 12739 | 16848 | 13747 | 41255 | 83641 | 15429 | 20592 | | 48825 | 28575 | 58817 |
| **$\sum_{15}$PAHs (ng $L^{-1}$)** | 7 | 12 | | 13 | 13 | 17 | 14 | 41 | 84 | 15 | 21 | | 49 | 29 | 59 |

### Part 3. Concentrations of dissolved phase OCPs and PCBs (pg $L^{-1}$) in different months from May to September:

| | α-HCH | β-HCH | γ-HCH | HCB | *o,p'*-DDE | *p,p'*-DDE | *o,p'*-DDT | *p,p'*-DDT | PCB-28 | PCB-52 | PCB-101 | PCB-153 | PCB-138 | PCB-180 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **May-1** | 6.0 | 44.7 | 4.1 | 5.1 | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL |
| **May-2** | 4.4 | 35.2 | 2.6 | ***0.7*** | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL |
| **May-3** | 4.0 | 32.3 | 2.4 | 1.5 | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL |
| **June-1** | 12.5 | 83.0 | 8.5 | 4.4 | BDL | BDL | BDL | BDL | 0.2 | BDL | BDL | BDL | BDL | BDL |
| **June-2** | 5.8 | 62.0 | 4.1 | ***0.7*** | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL |
| **June-3** | 7.0 | 58.0 | 3.8 | 2.8 | BDL | BDL | 0.3 | BDL | BDL | BDL | BDL | BDL | BDL | BDL |
| **July-1** | 0.7 | 60.0 | 4.6 | 1.8 | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL |
| **July-2** | 11.3 | 66.9 | 5.5 | 1.9 | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL |
| **July-3** | 9.7 | 66.0 | 4.8 | 2.1 | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL |
| **Aug-1** | 7.2 | 45.4 | 4.0 | 1.7 | BDL | BDL | BDL | BDL | 0.3 | BDL | BDL | BDL | BDL | BDL |
| **Aug-2** | 7.2 | 66.8 | 4.6 | ***0.7*** | BDL | BDL | BDL | BDL | 0.2 | BDL | BDL | BDL | BDL | BDL |
| **Aug-3** | 9.8 | 83.2 | 4.3 | 1.8 | BDL | BDL | BDL | BDL | 0.4 | BDL | BDL | BDL | BDL | BDL |
| **Sep-1** | 10.6 | 108.9 | 7.2 | ***0.7*** | BDL | 0.6 | BDL | 0.4 | 1.7 | BDL | BDL | BDL | BDL | BDL |
| **Sep-2** | 9.2 | 93.0 | 5.1 | ***0.7*** | BDL | BDL | BDL | BDL | 0.9 | BDL | BDL | BDL | BDL | BDL |
| **Sep-3** | 3.5 | 32.3 | 1.8 | ***0.7*** | BDL | BDL | BDL | BDL | 0.2 | BDL | BDL | BDL | BDL | BDL |

***Entries in bold and italics are substituted values at 1/2 MDL.***

**Part 4. Concentrations of dissolved phase PAHs (pg L$^{-1}$) in different months from May to September:**

| | Acel | Ace | Flu | Phe | Ant | Fla | Pyr | BaA | Chr | Bbf | Bkf | Bap | IcdP | DahA | BghiP | $\sum_{15}$PAHs (pg L$^{-1}$) | $\sum_{15}$PAHs (ng L$^{-1}$) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **May-1** | 64 | 116 | 1510 | 2755 | BDL | BDL | 264 | BDL | BDL | BDL | 3 | 1 | BDL | BDL | 1 | 4715 | 4.7 |
| **May-2** | 35 | 74 | 771 | 1677 | BDL | BDL | 226 | BDL | BDL | 4 | 3 | 1 | BDL | BDL | 1 | 2793 | 2.8 |
| **May-3** | 87 | 105 | 697 | 1608 | BDL | BDL | 172 | BDL | BDL | 2 | 2 | 1 | BDL | BDL | 1 | 2674 | 2.7 |
| **June-1** | 309 | 220 | 1913 | 3358 | BDL | BDL | 352 | BDL | 26 | BDL | 4 | 2 | BDL | BDL | 2 | 6187 | 6.2 |
| **June-2** | 36 | 76 | 560 | 1153 | BDL | BDL | ***74*** | BDL | BDL | BDL | 1 | 1 | BDL | BDL | 1 | 1901 | 1.9 |
| **June-3** | 186 | 131 | 885 | 1501 | BDL | BDL | ***74*** | BDL | BDL | BDL | 1 | 1 | BDL | BDL | 1 | 2779 | 2.8 |
| **July-1** | 138 | 106 | 844 | 1034 | BDL | BDL | ***74*** | BDL | BDL | 1 | 0 | 1 | BDL | BDL | 1 | 2198 | 2.2 |
| **July-2** | 314 | 196 | 1744 | 2211 | BDL | BDL | 150 | BDL | BDL | BDL | 1 | 1 | BDL | BDL | 1 | 4617 | 4.6 |
| **July-3** | 214 | 120 | 1562 | 2142 | BDL | BDL | 167 | BDL | BDL | 2 | 1 | 1 | BDL | BDL | 1 | 4211 | 4.2 |
| **Aug-1** | 281 | 131 | 900 | 1281 | BDL | BDL | ***74*** | BDL | BDL | 2 | 1 | 1 | BDL | BDL | 1 | 2673 | 2.7 |
| **Aug-2** | 316 | 140 | 1233 | 1578 | BDL | BDL | ***74*** | BDL | BDL | 3 | 3 | 1 | BDL | BDL | 1 | 3349 | 3.3 |
| **Aug-3** | 463 | 193 | 1226 | 1645 | BDL | BDL | ***74*** | BDL | BDL | 3 | 2 | 1 | BDL | BDL | 1 | 3608 | 3.6 |
| **Sep-1** | | | | | | | | | | | | | | | | | |
| **Sep-2** | 448 | 188 | 1529 | 2120 | 1430 | BDL | 226 | BDL | 26 | BDL | 0 | 2 | BDL | BDL | 2 | 5972 | 6.0 |
| **Sep-3** | 315 | 166 | 1220 | 1779 | BDL | BDL | ***74*** | BDL | BDL | 2 | 1 | 2 | BDL | BDL | 0 | 3560 | 3.6 |

***Entries in bold and italics are substituted values at 1/2 MDL.***

**Table S10. Concentrations of particulate phase POPs (pg L$^{-1}$) in the SPM of the water samples from Nam Co Lake**

**Part 1. Concentrations of particulate phase OCPs and PCBs (pg L$^{-1}$) in the lake water:**

| | α-HCH | β-HCH | γ-HCH | HCB | o,p'-DDE | p,p'-DDE | o,p'-DDT | p,p'-DDT | PCB-28 | PCB-52 | PCB-101 | PCB-153 | PCB-138 | PCB-180 | PCBs |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **S1** | BDL | BDL | 0.5 | BDL | BDL | 2.3 | BDL | BDL | 1.3 | 0.7 | 0.8 | 0.3 | 0.7 | 0.1 | 3.9 |
| **S2** | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | 0.3 | BDL | 0.4 | BDL | 0.5 | BDL | 1.3 |
| **S3** | BDL | 1.1 | BDL | BDL | BDL | BDL | BDL | BDL | 0.5 | BDL | 0.2 | BDL | BDL | BDL | 0.7 |
| **S4** | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | 0.2 | BDL | 0.3 | BDL | 0.1 | BDL | 0.6 |
| **S5** | BDL | BDL | 0.5 | BDL | BDL | BDL | BDL | BDL | 0.8 | 0.3 | 0.2 | BDL | BDL | BDL | 1.3 |
| **S6** | BDL | BDL | 0.7 | BDL | BDL | BDL | BDL | BDL | 0.6 | BDL | 0.3 | BDL | 0.2 | BDL | 1.1 |
| **S7** | BDL | BDL | 0.5 | BDL | BDL | BDL | BDL | BDL | 0.5 | BDL | 0.3 | BDL | 0.1 | BDL | 0.9 |
| **S8** | BDL | BDL | 0.4 | BDL | BDL | BDL | BDL | BDL | 0.5 | 0.2 | 0.3 | BDL | 0.2 | BDL | 1.3 |
| **S9** | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | 0.4 | BDL | 0.2 | BDL | BDL | BDL | 0.6 |
| **S10** | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | 0.2 | 0.3 | 0.4 | BDL | 0.2 | BDL | 1.1 |
| **S11** | BDL | BDL | BDL | BDL | BDL | BDL | BDL | 1.8 | 0.2 | BDL | 0.2 | BDL | BDL | BDL | 0.4 |
| **S12** | BDL | BDL | 0.6 | BDL | BDL | BDL | BDL | BDL | 0.4 | 0.3 | 0.5 | 0.1 | 0.4 | BDL | 1.7 |
| **S13** | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | 0.3 | BDL | 0.3 | BDL | BDL | BDL | 0.5 |
| **S14** | BDL | 2.2 | 3.3 | BDL | BDL | BDL | BDL | BDL | 7.3 | BDL | 1.6 | BDL | 0.8 | BDL | 9.8 |
| **S15** | BDL | BDL | 1.0 | BDL | BDL | BDL | BDL | BDL | 0.7 | 0.5 | 0.7 | 0.2 | 0.7 | 0.1 | 3.0 |

## Part 2. Concentrations of particulate phase PAHs (pg $L^{-1}$) in the lake water:

| | **Acel** | **Ace** | **Flu** | **Phe** | **Ant** | **Fla** | **Pyr** | **BaA** | **Chr** | **Bbf** | **Bkf** | **Bap** | **IcdP** | **DahA** | **BghiP** | **$\sum_{15}$PAHs (pg $L^{-1}$)** | **$\sum_{15}$PAHs (ng $L^{-1}$)** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **S1** | 12 | 29 | 145 | 641 | 136 | 927 | 777 | 240 | 980 | 114 | 185 | 232 | 8 | 20 | 297 | 4742.7 | 4.7 |
| **S2** | 11 | 27 | 161 | 727 | 107 | 549 | 442 | 107 | 248 | BDL | 102 | 81 | BDL | BDL | 140 | 2700.2 | 2.7 |
| **S3** | 9 | 19 | 128 | 639 | 107 | 338 | 229 | 38 | 141 | BDL | 31 | 25 | BDL | BDL | 28 | 1732.6 | 1.7 |
| **S4** | 13 | 37 | 169 | 870 | 170 | 1240 | 1052 | 406 | 768 | BDL | 277 | 380 | 6 | BDL | 336 | 5723.1 | 5.7 |
| **S5** | 46 | 135 | 387 | 9800 | 151 | 613 | 488 | 64 | 162 | 38 | 40 | 57 | BDL | BDL | 50 | 12030.6 | 12.0 |
| **S6** | 16 | 42 | 352 | 1607 | 329 | 920 | 717 | 187 | 521 | 32 | 165 | 184 | BDL | BDL | 241 | 5312.4 | 5.3 |
| **S7** | | | | | | | | | | | | | | | | | |
| **S8** | 9 | 11 | 135 | 787 | 232 | 2185 | 2005 | 830 | 1380 | BDL | 605 | 827 | 19 | BDL | 910 | 9935.9 | 9.9 |
| **S9** | 11 | 17 | 111 | 597 | 121 | 796 | 665 | 281 | 561 | BDL | 266 | 363 | 8 | BDL | 396 | 4192.7 | 4.2 |
| **S10** | 9 | 15 | 252 | 1696 | 699 | 5404 | 4308 | 2835 | 4159 | BDL | 2050 | 3242 | 31 | 47 | 3437 | 28184.3 | 28.2 |
| **S11** | 6 | 11 | 188 | 1155 | 301 | 2163 | 1818 | 1025 | 1652 | BDL | 620 | 1052 | BDL | 9 | 1105 | 11104.4 | 11.1 |
| **S12** | 5 | 8 | 139 | 972 | 148 | 563 | 441 | 54 | 269 | BDL | 58 | 65 | BDL | BDL | 74 | 2794.8 | 2.8 |
| **S13** | 6 | 13 | 122 | 668 | 121 | 379 | 237 | 43 | 103 | 5 | 25 | 35 | 2 | BDL | 29 | 1788.2 | 1.8 |
| **S14** | 28 | 56 | 266 | 1517 | 316 | 1296 | 1299 | 149 | 1432 | BDL | 217 | 331 | BDL | BDL | 328 | 7235.7 | 7.2 |
| **S15** | 9 | 23 | 216 | 1313 | 204 | 753 | 628 | 49 | 599 | 88 | 23 | 92 | BDL | BDL | 120 | 4117.8 | 4.1 |

**Table S11. Comparisons of OCPs and PCBs in the air of this study and data reported for other remote areas (pg m$^{-3}$)**

| **Location** | **Nam Co Lake, TP** | **Nam Co, TP** | **Lhasa, TP** | **Lulang, southeast TP** | **Mt. Everest** | **Rocky Mountains** | **Central Pyrenees** | **Antarctic** | **Alert, Arctic** |
|---|---|---|---|---|---|---|---|---|---|
| **Sampling Year** | 2012-2014 | 2006-2008 | 2006-2007 | 2008-2011 | 2002 | 2000 | 2001-2003 | 2007-2010 | 2000-2003 |
| **Sampler** | AAS | FTS | AAS | AAS | AAS | AAS | AAS | AAS | AAS |
| **α-HCH** | 4 (0.7-9) | 48.7 (4.0-144) | 2.3 (BDL-9.2) | 12.1 (0.61-51) | 19.2 | 21 | 8 | 0.2 | 22 (1.4-66) |
| **β-HCH** | 0.8 (BDL-1.5) | | | | 7.7 | | | | 0.1 (0.018-1.0) |
| **γ-HCH** | 2.1 (0.1-7.2) | 7.9 (0.9-19.9) | 10.3 (3.7-20.9) | (BDL-7.07) | | 2.3 | 22 | | 5.6 (0.43-19) |
| **HCB** | 20 (11.4-40.5) | 17.1 (7.3-31.7) | | 7.87 (0.05-27.1) | 8.9 | 42 | 49 | 22.9 | 64 (20-130) |
| ***o,p′*-DDE** | 1.2 (0.2-13.9) | 0.6 (BDL-0.99) | | (BDL-7.3) | | | | 0.03 | 0.089 (0.013-0.36) |
| ***p,p′*-DDE** | 1.9 (0.3-12.8) | 0.6 (BDL-1.0) | 2.9 (BDL-12.1) | 6.4 (0.08-23.8) | 5.1 | | 33 | | 0.41 (0.051-3.6) |
| ***o,p′*-DDT** | 3.6 (0.2-17.9) | 8.2 (0.3-19.7) | 5.8 (BDL-34.3) | (BDL-60.5) | 5.1 | | | | 0.14 (0.016-0.56) |
| ***p,p′*-DDT** | 1.2 (0.2-4.9) | 3.9 (0.3-12.67) | 3.2 (BDL-9.7) | (BDL-33.6) | 3.7 | | BDL | | 0.09 (0.015-1.1) |
| **∑PCBs** | 2.5 (0.2-13.7) | 1.4 (0.1-2.6) | 10.6 (3.4-45.4) | (BDL-16.7) | | | 34 | 0.5 | |
| **Reference** | This study | (Xiao et al., 2010) | (Gong et al., 2010) | (Sheng et al., 2013) | (Li et al., 2006) | (Wilkinson et al., 2005) | (Van Drooge et al., 2004) | (Kallenborn et al., 2013) | (Su et al., 2006 and 2008) |

AAS: active air sampler; FTS: flow-through sampler.

**Table S12. Comparisons of PAHs concentrations from this study and data reported for other remote areas (ng m$^{-3}$)**

| Location | Sampling Year | Sampler | Gaseous (G)/ Particulate (P) | ∑PAHs (ng/m$^3$) | Reference |
|---|---|---|---|---|---|
| Nam Co, central TP | 2012-2014 | AAS | G | 2.2 (0.5-13) | This study |
| | | | P | 0.6 (0.1-3.4) | |
| Nam Co, central TP | 2006-2008 | FTS | G+P | 0.7 (0.08-2.2) | (Xiao et al., 2010) |
| Lulang, southeast TP | 2008-2011 | AAS | P | 2.0 (0.2-5) | (Wang et al., 2015) |
| Lahsa, TP | 2006-2007 | AAS | G+P | 35.7 (11.4-72.5) | (Gong et al., 2011) |
| Pyrenees, Europe | 1996-1997 | AAS | G | (1.3-2.6) | (Fernandez et al., 2002) |
| Alps, Europe | 1996-1997 | AAS | G | (2.7-3.7) | |
| Open water of Lake Superior | 2011 | PE-PAS | G | (BDL-1.9) | (Ruge et al., 2015) |
| Mediterranean Sea | 2006-2007 | AAS | G | 38.38 (25.84-86.47) | (Castro et al., 2012) |
| | | | P | 1.4 (0.9-1.8) | |
| Pacific and Arctic Ocean | 2010 | AAS | G | (0.91-7.4) | (Ma et al., 2013) |
| | | | P | (0.0002-0.36) | |
| Atlantic Ocean | 2005 | AAS | G+P | 0.6 (0.02-2.8) | (Nizzetto et al., 2008) |
| Terra Nova Bay, Antarctica | 2009-2010 | AAS | G | 0.004 (0.0004-0.01) | (Piazza et al., 2013) |
| | | | P | 0.13 (0.02-0.3) | |
| Arctic | 2003 | AAS | G | 3.3 (0.9–6.3) | (Ding et al., 2007b) |
| | | | P | 0.5 (0.02–2.6) | |

AAS: active air sampler; PE-PAS: polyethylene passive air sampler; FTS: flow-through sampler.

**Table S13. Dissolved concentrations of OCPs and PCBs in lake water of Nam Co Lake and other remote sites (pg $L^{-1}$).**

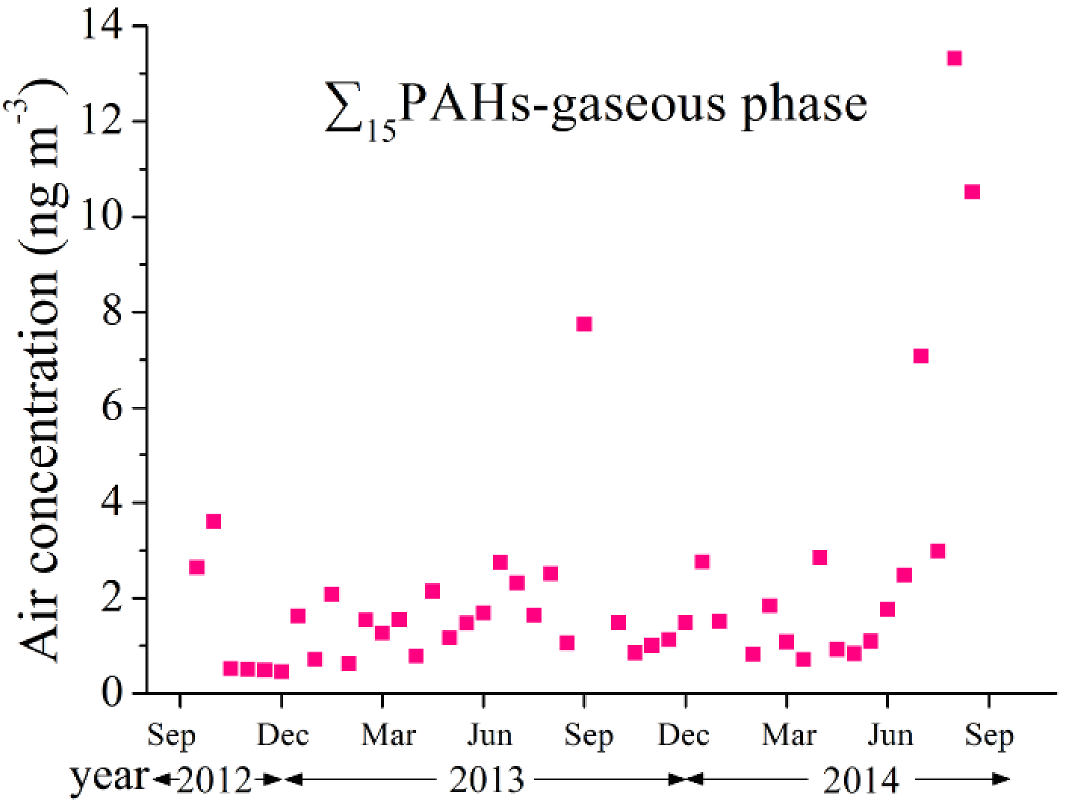
| Location | Year | α-HCH | β-HCH | γ-HCH | HCB | *o,p'*-DDE | *p,p'*-DDE | *o,p'*-DDT | *p,p'*-DDT | $\sum_6$PCBs | Reference |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Nam Co Lake | 2013 | 9.9±3.4 | 85.2±18.8 | 7±2.5 | 7.6±5.6 | BDL | BDL-1.2 | BDL | BDL | 2.0±1.4 | This study |
| Yamdro, TP | 2002 | 850 | 2400 | | | | 260 | | | | (Zhang et al., 2003) |
| Co Ngoin, TP | 2002 | 550 | 810 | | | | | | 190 | | (Zhang et al., 2003) |
| Taihu Lake, China | 2004-2005 | 1887±1372 | 1773±944 | 484±373 | | 53±113 | 77±91 | 135±287 | 12±4 | | (Qiu et al., 2008) |
| Chaohu Lake, China | 2010-2011 | 460±460 | 900±480 | 280±310 | 170±70 | 1640±1820 | 20±40 | 140±390 | 220±220 | | (Ouyang et al., 2013) |
| European mountain lake | 2000 | 68±35 | | 139±89 | 8.5±3.2 | | 12±3 | | | | (Fernandez et al., 2005) |
| North Pacific | 2010 | 101.6 | 27.7 | 17.9 | 2.8 | | | | | | (Cai et al., 2012) |
| Indian Ocean | 2011 | 3.2±0.8 | 5.4±2.2 | 2.2±1.3 | | 48±120 | 37±85 | 330±840 | 1600±4000 | | (Huang et al., 2013) |
| Ross Sea, Antarctic | 2003-2004 | 1.4±0.9 | | 2.9±2.2 | | | | | | | (Cincinelli et al., 2009) |
| North Atlantic and Arctic | 2004 | 13.0±16.3 | | 4.7±5.6 | 0.9-9.6 | BDL | 0.15±0.08 | BDL | BDL-0.2 | | (Lohmann et al., 2009) |
| | | | | | | | | | | <1 | (Gioia et al., 2008) |

**Table S14. Concentrations of PAHs in lake water of Nam Co Lake and other remote sites (ng $L^{-1}$).**

| Location | Year | ∑PAHs | | Reference |
|---|---|---|---|---|
| | | dissolved phase | particulate phase | |
| Nam Co Lake | 2013 | 28.6 (6.9-83.6) | 7.3 (1.7-28) | This study |
| Lakes in Himalayan region, Nepal | 2007 | 1.96 ± 1.86 | | (Guzzella et al., 2011) |
| Lake Redo, Pyrenees | 2000 | 0.27 ± 0.19 | 0.41 ± 0.13 | (Vilanova et al., 2001) |
| Lake Gossenkolle, Alps | 2000 | 0.35 ± 0.19 | 0.57 ± 0.34 | (Vilanova et al., 2001) |
| Lake Ladove, High Tatras | 2000 | 3.4 ± 0.4 | 8.5 ± 0.7 | (Fernandez et al., 2005) |
| Lake Ontario | 2011-2012 | 5.5 ± 3.2 | | (Venier et al., 2014) |
| Lake Erie | 2011-2012 | 4.8 ± 1.4 | | (Venier et al., 2014) |
| Lake Superior | 2011-2012 | 1.1 ± 0.5 | | (Venier et al., 2014) |
| Atlantic Ocean | 2005 | (0.058-1.07) | | (Nizzetto et al., 2008) |
| North Pacific and Arctic | 2010 | (0.014-0.76) | | (Ma et al., 2013) |
| Gerlache Inlet Sea, Antarctica | 2001 | 2.4 (2.1-2.9) | 3.6 (2.8-4.7) | (Stortini et al., 2009) |

**Table S15. Comparison of isomer ratios of OCPs in this study and the source region**

| **Sampling site** | **α/r-HCH** | ***p,p'*-DDT/*p,p'*-DDE** | **Reference** |
|---|---|---|---|
| Nam Co, TP | 2.7±1.7 | 1.3±1.6 | This study |
| Lulang, TP | 3.7±1.99 | >1 | (Sheng et al., 2013) |
| Indian major cities | 0.67±0.5 | 0.9±0.5 | (Chakraborty et al., 2010) |
| Indian coastal region | 0.11-4 | 2 | (Zhang et al., 2008) |
| Bay of Bengal | | >1 | (Gioia et al., 2012) |



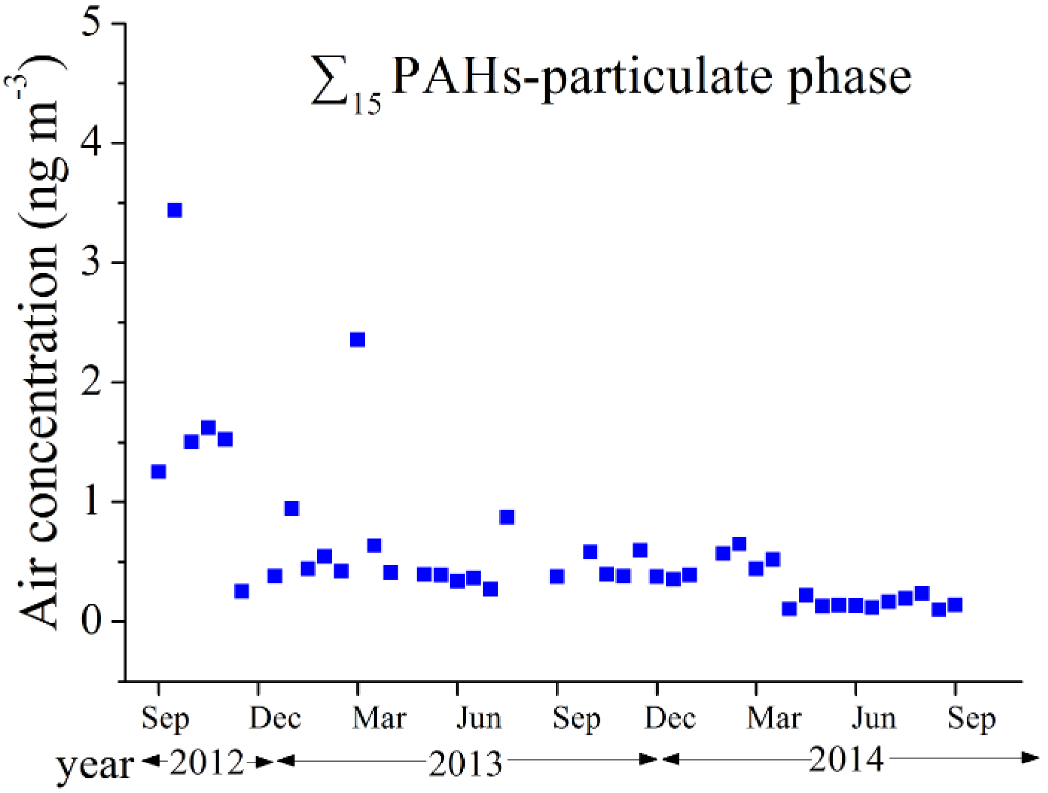


**Figure S3. Seasonal patterns of the gaseous and particulate phase of $\sum_{15}$PAHs in the atmosphere of Nam Co.**

**Table S16. Results of randomized block ANOVA to test the concentration difference of POPs in the lake water from different regions of the Nam Co Lake.**

(a) Before the ANOVA analysis, the sampling sites of surface water in the present study were classified as four regions according to the different locations:

| **Site** | **Region** |
|---|---|
| S1 | south |
| S2 | south |
| S3 | south |
| S4 | south |
| S5 | south |
| S6 | south |
| S7 | south |
| S8 | northwest |
| S9 | northwest |
| S10 | north |
| S11 | north |
| S12 | north |
| S13 | east |
| S14 | east |
| S15 | east |

(2) *p* values derived from the ANOVA test:

| | | ***p* values** | | |
|---|---|---|---|---|
| **Location** | | **HCHs** | **HCB** | **PAHs** |
| south | northwest | 0.161 | ***0.05*** | ***0.001*** |
| | north | 0.106 | 0.96 | 0.303 |
| | east | 0.518 | ***0.002*** | ***0.005*** |
| northwest | north | 0.983 | 0.086 | ***0.007*** |
| | east | 0.424 | 0.25 | 0.16 |
| north | east | 0.361 | ***0.006*** | ***0.068*** |

(The values of $p < 0.05$ were highlighted in bold and italics, which indicates that the levels of pollutants significantly differ between two regions)

**Table S17. Results of Clausius–Clapeyron regression**

Clausius-Clapeyron (C.C.) equation is often used for assessing the relative contribution of re-volatilization from local surface versus long range atmospheric transport:

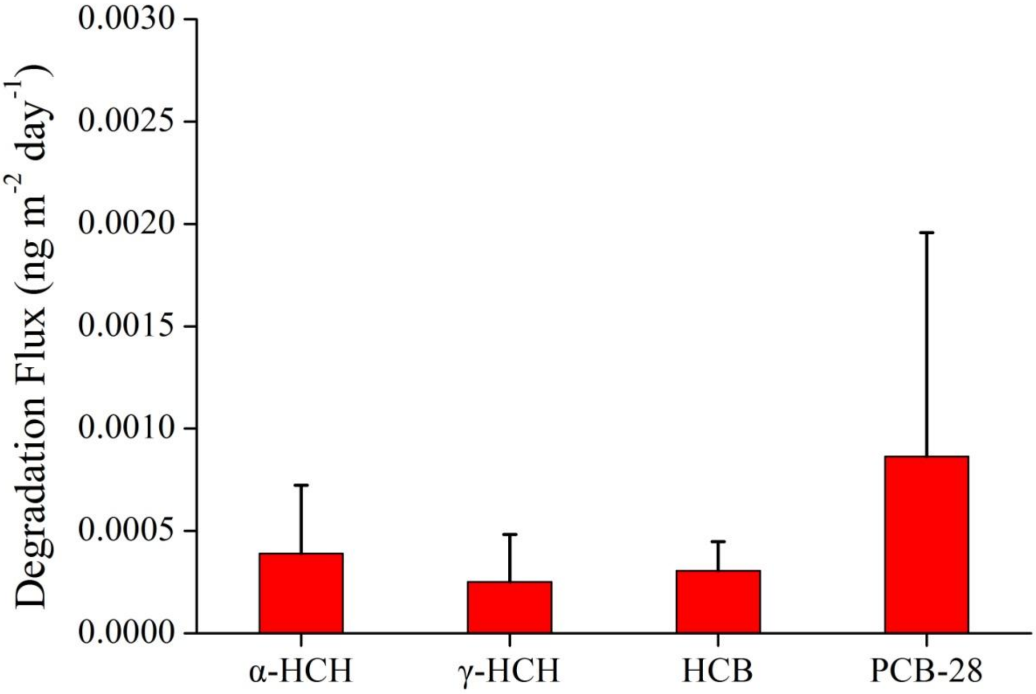
$$\ln P = \frac{m}{T} + b$$

where $P$ is the partial pressure of pollutants in air (Pa), $T$ is the air temperature (K), m and b are slopes and intercepts derived from C.C. regression for each compound. Carlson and Hites (2005) found that the temperature dependence will reduce or disappear when $T$ is below the freezing point. Thus, the sampling periods with $T<0$ ℃ were excluded in the present study. Results included slope $m$, $R^2$, $p$-value, and number of data points, $n$, as shown in the table below.

| **Compound** | **slope (*m*)** | **$R^2$** | ***p*-value** | ***n*** | **Compound** | ***m*** | **$R^2$** | ***p*-value** | ***n*** |
|---|---|---|---|---|---|---|---|---|---|
| α-HCH | -7893 | 0.29 | ***0.01***[a] | 18 | Acel | \ | \ | 0.83 | 14 |
| β-HCH | \[b] | \ | 0.27 | 14 | Ace | \ | \ | 0.93 | 14 |
| γ-HCH | \ | \ | 0.50 | 17 | Flu | \ | \ | 0.56 | 14 |
| HCB | \ | \ | 0.55 | 18 | Phe | \ | \ | 0.37 | 14 |
| o,p'-DDE | \ | \ | 0.90 | 18 | Ant | \ | \ | 0.13 | 14 |
| p,p'-DDE | \ | \ | 0.58 | 18 | Fla | \ | \ | 0.17 | 14 |
| o,p'-DDT | \ | \ | 0.06 | 18 | Pyr | \ | \ | 0.37 | 14 |
| p,p'-DDT | \ | \ | 0.33 | 18 | BaA | \ | \ | 0.71 | 14 |
| PCB-28 | \ | \ | 0.78 | 18 | Chr | \ | \ | 0.87 | 14 |
| PCB-52 | \ | \ | 0.61 | 18 | Bbf | \ | \ | 0.28 | 14 |
| PCB-101 | \ | \ | 0.96 | 18 | Bkf | \ | \ | 0.15 | 13 |
| PCB-153 | \ | \ | 0.61 | 18 | Bap | \ | \ | 0.61 | 13 |
| PCB-138 | \ | \ | 0.89 | 18 | IcdP | \ | \ | 0.91 | 6 |
| PCB-180 | \ | \ | 0.60 | 18 | DahA | \ | \ | 0.28 | 4 |
| | | | | | BghiP | \ | \ | 0.60 | 13 |

a: Numbers in bold font stand for $p < 0.05$, indicating that the relationship is significant.

b: “\” stands for the unavailable slope and $R^2$ for some compounds which showed insignificant correlation ($p > 0.05$).



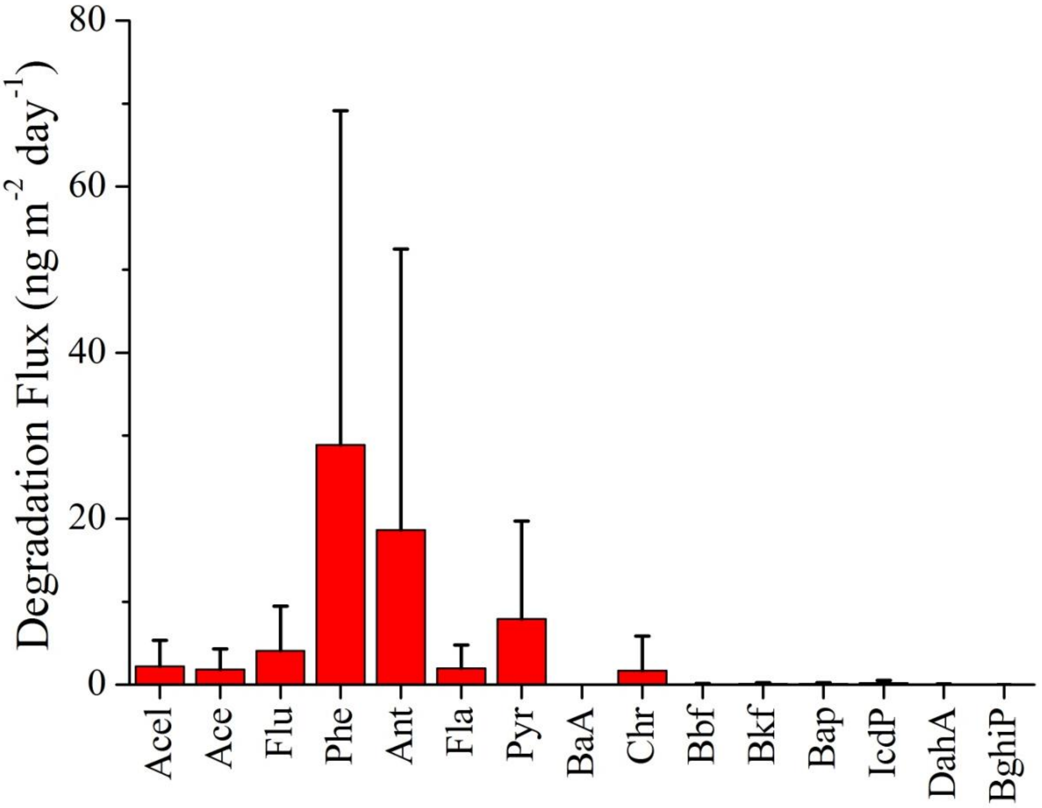


**Figure S4. Average atmospheric degradation fluxes of individual POPs.**

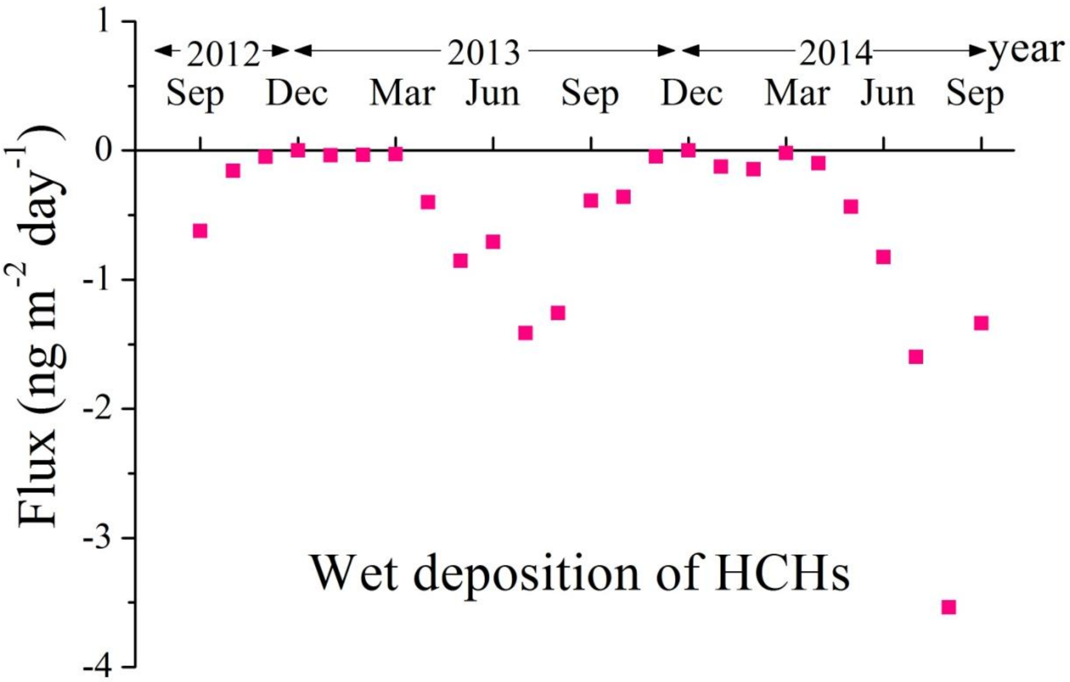


**Figure S5. Seasonality of the wet deposition fluxes for HCHs in Nam Co Lake.**

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