Background Air Monitoring of Persistent Organic Pollutants in East Asian Countries

Supplementary Report - 2008

POPs Monitoring Project in East Asian Countries, 2008

Table of contents

1. Monitoring Data in East Asian Countries

1.1 POPs Concentrations in Ambient Air Samples in Lao PDR

1) Ownership of Data and a Person in Charge

Lao PDR
Ms. Setouvanh Phanthavongsa, Technical Officer, Environment Quality Monitoring Center, Environmental Research Institute (ERI), Water Resources and Environment Administration (WREA), Lao PDR

2) Air Monitoring Data in 2008

a) Sampling Location (see **Figure 1**)
This sampling site is located about 60 km north-north-west of Vientiane.
- Na Lng Koun Village, Lao PDR.
- Latitude: N18°29.575', Logitude: E102°26.943'
- Above Sea Level: 174m

The sampling location in Mongolia has the proper conditions to background air monitoring site as follows;
1) The sampling site is situated on 60 km to the north-north west of capital city - Vientiane.
2) The sampling point was located in the meteorological observatory in Na Long Koun Village.

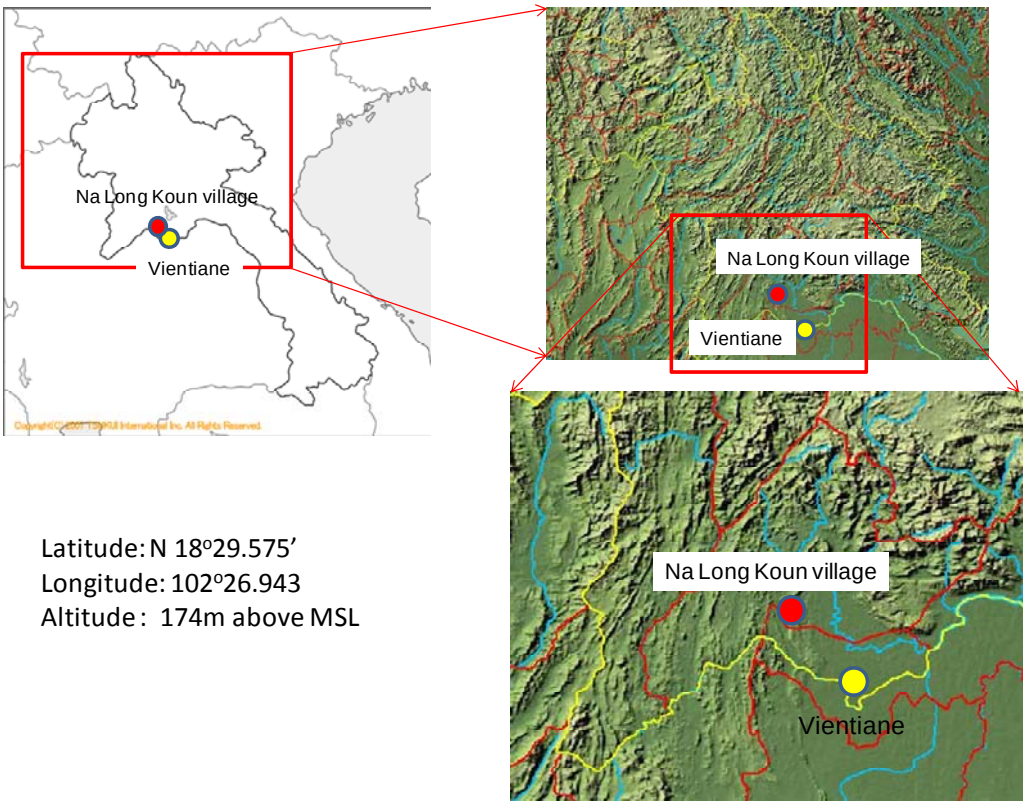


Figure 1 **Map of Sampling Location in Lao PDR in 2008**

b) Sampling Records and Meteorological Information

Air sampling records were summarized in **Table 1** and meteorological information were shows in **Table 2.**

Table 1 Sampling Record in Na Long Koun Village, Lao PDR

		4 - 5 September 2006		5 - 6 September 2006		6 - 7 September 2006	
Sample No.*1		A	B	A*2	B	A	B
Sampling time	Start	11:11	11:13	11:35	11:35	11:50	11:50
	End	11:11	11:13	11:35	11:35	11:50	11:50
Temperature (^{o}C)	Start	10.3	12.8	16.1	20.3	7.8	6.5
	End	16.1	20.3	3.8	5.0	3.3	4.6
Atmospheric Pressure (hPa)	Start	854.6	853.8	844.4	842.4	850.1	850.1
	End	844.4	842.4	844.4	842.4	852.7	851.3
Weather	Start	fine	fine	fine	fine	cloudy	cloudy
	End	fine	fine	cloudy	cloudy	fine	fine
Flow rate (L/min)		698.8	701.5	701	700	700.8	699.2
Sampling volume (m^3)		1008.6	1007.9	1007.9	1008.5	1007.9	1007.9

*1: HV sampler A was HV-1000F and B was HV-700FT.

*2: HV Sampler A was stopped for 1 minute at 11:51.

Table 2 Meteorological Information Observed in Na Long Koun Village

	4 Sep, 2006	5 Sep, 2006	6 Sep, 2006	7 Sep, 2006
Wind direction	west north	west north	north	west
Wind velocity (m/s)	3	4	5	3
Max. temp. (^{o}C)	17.4	16.8	6	2.8
Min. temp. (^{o}C)	-6.9	-3.6	-1.5	-8.2
Dry-bulb temp. . (^{o}C)	8.3	6.9	2.1	-2.8
Wet-bulb temp. . (^{o}C)	5.4	5.8	3.8	4.7

c) Results of HRGC/MS Analysis

Concentrations of POPs in ambient air collected by duplicate sampling are shown in **Table 3.** These concentrations were determined according to Monitoring Surveillance Manual for POPs and Their Related Compounds (2006).

d) Discussion

- During the background air monitoring of POPs in Na Long Koun Village, Lao PDR, HCB (360pg/m^3), *p,p'*-DDT (8.0pg/m^3), *p,p'*-DDE (7.3pg/m^3), *o,p'*-DDT (3.0pg/m^3), *o,p'*-DDE (0.86pg/m^3), chlordanes (10pg/m^3 for *trans*- and 7.7pg/m^3 for *cis*-), nonachlors (6.3pg/m^3 for *trans*- and 0.70pg/m^3 for *cis*-), heptachlor (3.4pg/m^3) and *cis*-heptachlorepoxide (0.47pg/m^3) were detected.
- Concentration of HCB in each period was similar to those in Vietnam (2006) and Thailand (2006).
- The sampling point was located at the boundary of Lao PDR and Cambodia and according to the results from back trajectory analysis, the block of air was come through the surface of Vietnam.
- The concentration of HCB was suggested to be influenced by transportation over the boundary.

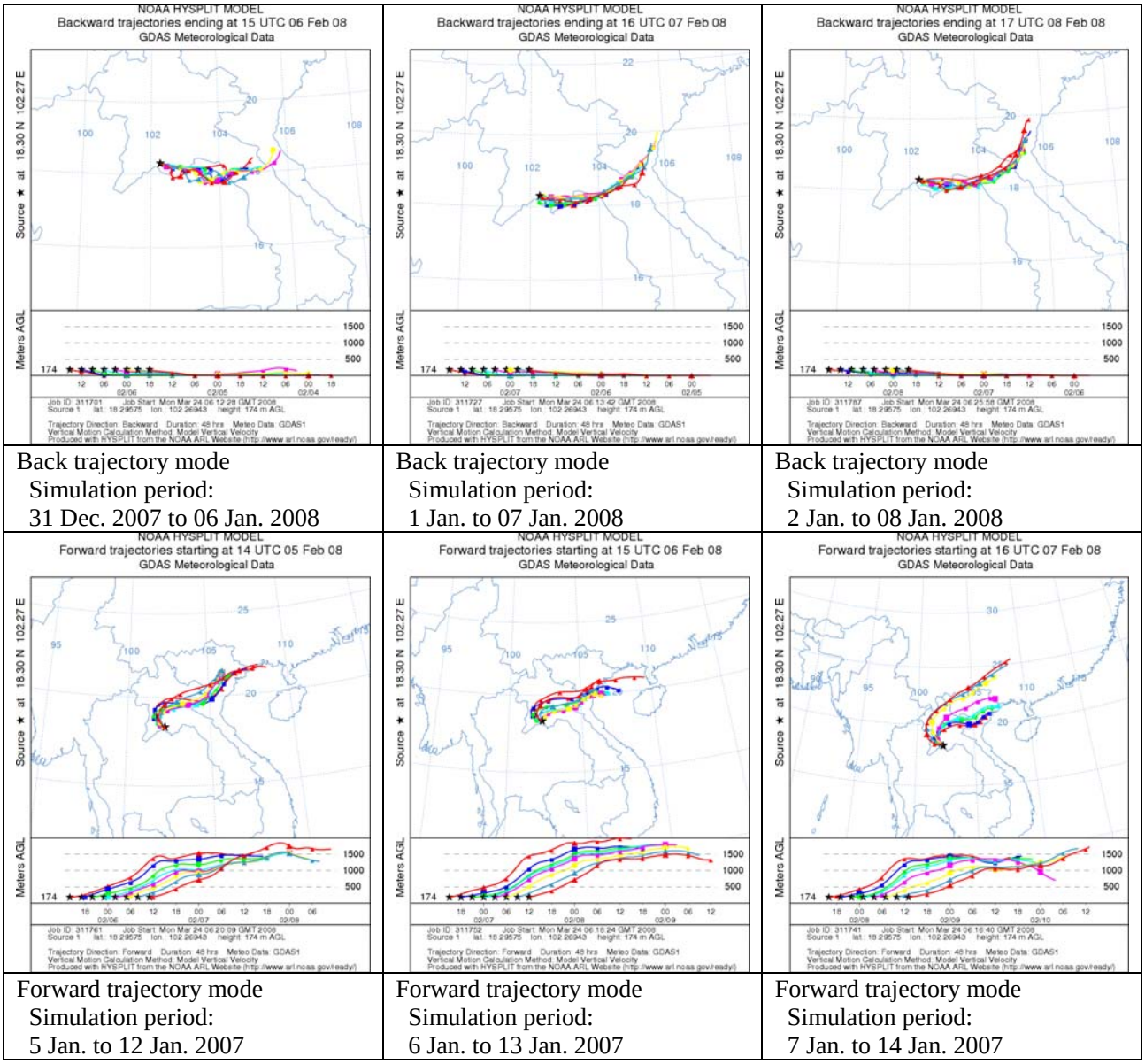
Table 3 **Concentrations of POPs in Ambient Air in Na Long Koun village, Vientiane Province, Lao PDR on 6-8 Feburary 2008.**

Chemicals	Sample A (pg/m^3)				Sample B (pg/m^3)				Average (pg/m^3)			
	1st day	2nd day	3rd day	Average	1st day	2nd day	3rd day	Average	1st day	2nd day	3rd day	Average
HCB	460	380	310	383	420	310	290	340	440	345	300	362
Aldrin	*<0.71*	*<0.71*	*<0.71*	*<0.71*	*<0.71*	*<0.71*	*<0.71*	*<0.71*	*<0.71*	*<0.71*	*<0.71*	*<0.71*
Dieldrin	(1.4)	<0.62	<0.62	1.4	(1.5)	<0.62	<0.62	1.5	1.5	<0.62	<0.62	1.5
Endrin	*<0.59*	*<0.59*	*<0.59*	*<0.59*	*<0.59*	*<0.59*	*<0.59*	*<0.59*	*<0.59*	*<0.59*	*<0.59*	*<0.59*
p,p'-DDT	9.4	7.7	6.6	7.9	8.7	8.1	7.2	8.0	9.1	7.9	6.9	8.0
p,p'-DDE	9.3	6.9	6.6	7.6	8.8	6.1	6.2	7.0	9.1	6.5	6.4	7.3
p,p'-DDD	(0.57)	<0.44	<0.44	0.57	(0.54)	<0.44	(0.47)	0.51	0.555	<0.44	0.47	0.51
o,p'-DDT	3.8	2.9	2.6	3.1	3.6	2.6	2.7	3.0	3.7	2.8	2.7	3.0
o,p'-DDE	1.0	0.86	0.69	0.85	1.0	0.82	0.77	0.86	1	0.84	0.73	0.86
o,p'-DDD	<0.62	<0.62	<0.62	<0.62	<0.62	<0.62	<0.62	<0.62	<0.62	<0.62	<0.62	<0.62
trans-Chlordane	9.9	8.2	12	10	11	8.0	11	10	10	8.1	12	10
cis-Chlordane	7.5	6.5	8.5	7.5	7.9	6.3	9.1	7.8	7.7	6.4	8.8	7.6
trans-Nonachlor	6.3	5.1	6.9	6.1	6.7	5.4	7.3	6.5	6.5	5.3	7.1	6.3
cis-Nonachlor	0.68	0.63	0.75	0.69	0.87	0.55	0.7	0.71	0.78	0.59	0.73	0.70
Oxychlordane	<0.89	<0.89	<0.89	<0.89	<0.89	<0.89	<0.89	<0.89	<0.89	<0.89	<0.89	<0.89
Heptachlor	3.4	2.7	4.2	3.4	3.4	3.2	3.6	3.4	3.4	3.0	3.9	3.4
trans-Heptachlorepoxide	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16
cis-Heptachlorepoxide	0.47	0.45	0.45	0.46	0.57	0.37	0.51	0.48	0.52	0.41	0.48	0.47
Mirex	(0.17)	(0.19)	(0.15)	0.17	(0.18)	(0.16)	(0.17)	0.17	0.18	0.18	0.16	0.17
Toxaphene (Parlar-26)	<1.4	<1.4	<1.4	<1.4	<1.4	<1.4	<1.4	<1.4	<1.4	<1.4	<1.4	<1.4
Toxaphene (Parlar-50)	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5
Toxaphene (Parlar-62)	<3.3	<3.3	<3.3	<3.3	<3.3	<3.3	<3.3	<3.3	<3.3	<3.3	<3.3	<3.3

italic letter.: reference value because surrogate recovery was out of 40 to 120 percent.
n.a.: not available because surrogate recovery was out of 25 to 150 percent.
Values in parenthesis show that it was within IDL to IQL.

e) Results of Trajectory Analysis

To speculate the source of POPs in the collected air, trajectory analysis of the collected air was performed using the HYSPLIT programs. With reference to vertical coordinate in the 3D-wind model, the sigma coordinate was used for trajectory calculation in both forward and backward mode. The results of analysis showed in **Figure 2**.



Back trajectory mode Simulation period: 31 Dec. 2007 to 06 Jan. 2008	Back trajectory mode Simulation period: 1 Jan. to 07 Jan. 2008	Back trajectory mode Simulation period: 2 Jan. to 08 Jan. 2008
Forward trajectory mode Simulation period: 5 Jan. to 12 Jan. 2007	Forward trajectory mode Simulation period: 6 Jan. to 13 Jan. 2007	Forward trajectory mode Simulation period: 7 Jan. to 14 Jan. 2007

Figure 2 Trajectory Analysis of Ambient Air Collected in Na Long Koun Village, Lao PDR on 5-7 February 2008.

These results of back and forward trajectory analyses indicated the possibilities of the long-rage transportation of POPs. When the height data was high, the transport speed of POPs in the air was relatively fast and long-range or trans-border transportation of POPs were possibly assumed at back trajectory mode and affected to far distant leeward. The less reliability of more than 3 day before or after of the trajectory data should be noticed.

1.2 POPs Concentrations in Ambient Air Samples in Malaysia

1) Ownership of Data and a Person in Charge

Mr. Mohd Fauzan Yunus: Principal Assistant Director, Department of Agriculture, Ministry of Agriculture and Agro-based Industry, Malaysia.
Ms. Rohani Jusoh: Environmental Control Officer, Department of Environment, Ministry of Natural Resources and Environment.

2) Air Monitoring Data in 2008

a) Sampling Location (see **Figure 3**) ***(PLEASE CHECK THIS PART)***
The sampling location for air monitoring was selected in Muda Dam, that is a Dam facility area about 340 km north of Kuala Lumpur (see Figure 3).
Muda Dam is an dam-side area. In the Muda Dam human activities such as agriculture or habitation were not observed. This sampling location is available some meteorological data and full day electricity supply.
For sampling collection, it was set up in the area of meteorological observatory.
This sampling point is far away from residential area about 90 km, and there are no any open burning closed this site.

- Muda Dam, Kedah Province, Malaysia.
- Latitude: N06°06.148', Longitude: E100°50.454'
- Above Sea Level: 110m

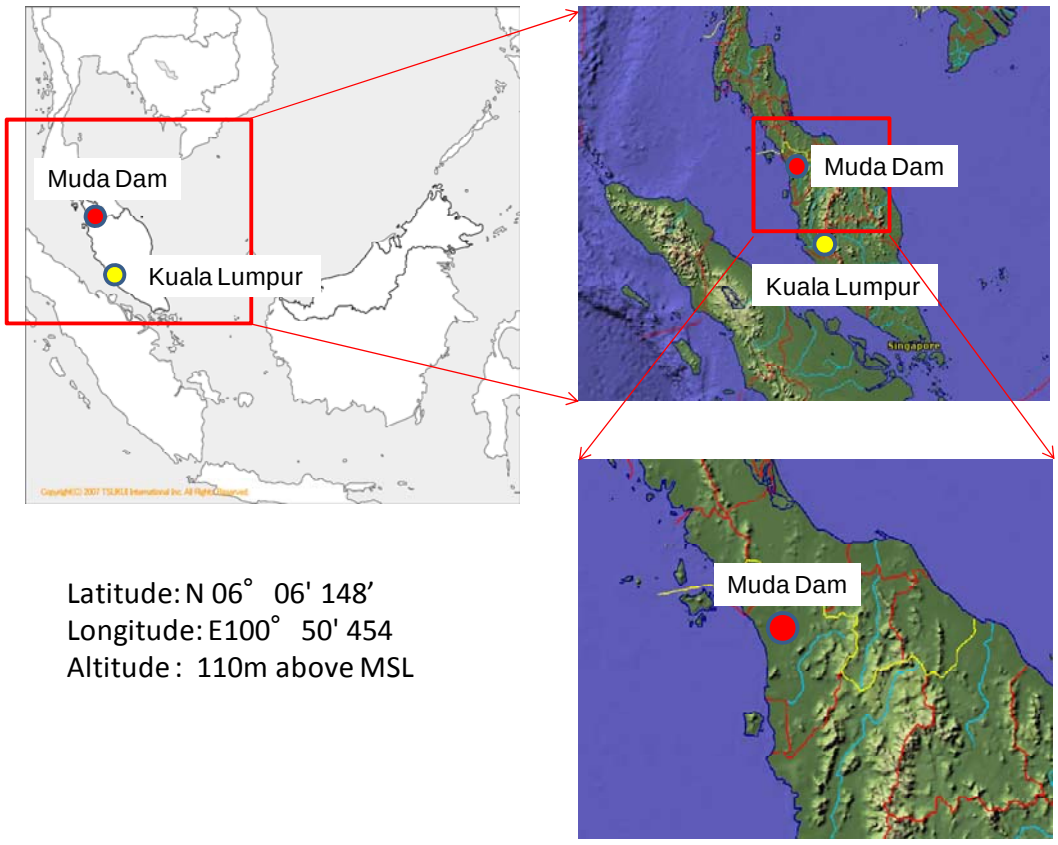


Figure 3 Map of Sampling Location in Malaysia in 2008

b) Sampling Records and Meteorological Information
Air sampling records are summarized in **Table 4** and meteorological information shows in **Table 5.**

Table 4 Sampling Record in Muda Dam, Malaysia

		14 – 15 January 2008	15 – 16 January 2008	16 – 17 January 2008
Sampling time	Start	10:12	10:53	11:50
	End	10:12	10:53	11:50
Temperature (°C)	Start	27.9	34.1	36.2
	End	34.6	34.0	32.8
Atmospheric Pressure (hPa)	Start	1000.2	998.3	998.3
	End	998.3	998.6	998.3
Weather	Start	fine	fine	fine
	End	fine	fine	fine
Flow rate (L/min)		700	700	700
Sampling volume (m^3)		1009.2	1008.0	1007.9

*1: HV sampler was HV-700F.

Table 5 Meteorological Information Observed in Malaysia

Station name		Alor Star				Kota Bharu			
		Lat.: 6°12'N, Long.: 100°24'E, Altitu: 3.9m				Lat.: 6°10'N, Long.: 1021°17'E, Altitu: 4.6m			
date	hour (ST)	Mean surface wind		Temp.	Relative Humidity	Mean surface wind		Temp.	Relative Humidity
		Direction (°)	Speed (m/s)	24 hour Mean (°C)	24 hour Mean (%)	Direction (°)	Speed (m/s)	24 hour Mean (°C)	24 hour Mean (%)
13-Jan-08	6	10	1.2	27.6	74.3	0	0.0	25.9	82.5
	12	350	1.8			50	2.9		
	18	240	2.3			50	1.5		
	24	30	1.6			0	0.0		
14-Jan-08	6	340	1.2	27.0	75.4	0	0.0	26.2	81.7
	12	10	2.3			120	3..7		
	18	300	2.2			90	2.5		
	24	360	0.4			110	0.9		
15-Jan-08	6	360	0.9	27.5	73.2	0	0.0	27.0	78.7
	12	50	2.			40	2.4		
	18	330	1.4			50	1.5		
	24	360	0.7			230	0.9		
16-Jan-08	6	330	1.3	27.7	71.3	250	1.3	26.5	76.8
	12	50	3.0			330	3.1		
	18	360	1.9			330	2.4		
	24	10	0.3			250	2.2		
17-Jan-08	6	40	0.3	26.8	78.8	210	2.2	25.5	81.0
	12	350	3.7			10	2.5		
	18	310	0.5			40	2.9		
	24	0	0.0			60	4.6		
18-Jan-08	6	40	1.4	27.2	73.5	90	3.2	27.1	77.5
	12	40	3.3			70	5.9		
	18	30	2.8			80	4.9		
	24	20	1.9			80	4.5		

c) Results of HRGC/MS Analysis

Concentrations of POPs in ambient air collected by duplicate sampling are shown in **Table 6.** These concentrations were determined according to Monitoring Surveillance Manual for POPs and Their Related Compounds (2006).

d) Discussion

- Since one of the high volume air sampler was broken by misconnection to the power supply, only one series of sampling was conducted by using another sampler.
- ***PLEAS FILL IN THIS PART OF DISCUSSION***

Table 6 Concentrations of POPs in Ambient Air in Muda Dam, Malaysia on 14-18 January 2008.

Chemicals	Sample B (pg/m^3)			
	1st day	2nd day	3rd day	Average
HCB	510	320	270	367
Aldrin	17	*19*	*24*	*20*
Dieldrin	200	200	190	197
Endrin	*1.8*	*(1.1)*	*(0.94)*	*1.3*
p,p'-DDT	*17*	14	11	14
p,p'-DDE	14	7.9	7.0	10
p,p'-DDD	1.4	(0.75)	(0.65)	(0.93)
o,p'-DDT	6.2	3.3	2.8	4.1
o,p'-DDE	1.9	0.6	0.63	1.0
o,p'-DDD	<0.62	<0.62	<0.62	<0.62
trans-Chlordane	10	4.0	5.4	6.5
cis-Chlordane	7.1	3.4	4.2	4.9
trans-Nonachlor	5.2	2.8	3.2	3.7
cis-Nonachlor	1.1	0.47	<0.13	0.79
Oxychlordane	<0.89	<0.89	<0.89	<0.89
Heptachlor	5.4	2.1	1.6	3.0
trans-Heptachlorepoxide	<0.16	<0.16	<0.16	<0.16
cis-Heptachlorepoxide	1.3	0.51	0.60	0.80
Mirex	2.2	0.80	0.88	1.3
Toxaphene (Parlar-26)	<1.4	<1.4	<1.4	<1.4
Toxaphene (Parlar-50)	<1.5	<1.5	<1.5	<1.5
Toxaphene (Parlar-62)	<3.3	<3.3	<3.3	<3.3

italic letter.: reference value because surrogate recovery was out of 40 to 120 percent.
n.a.: not available because surrogate recovery was out of 25 to 150 percent.
Values in parenthesis show that it was within IDL to IQL.

e) Results of Trajectory Analysis

To speculate the source of POPs in the collected air, trajectory analysis of the collected air was performed using the HYSPLIT programs. With reference to vertical coordinate in the 3D-wind model, the sigma coordinate was used for trajectory calculation in both forward and backward mode. The results of analysis showed in **Figure 3**.

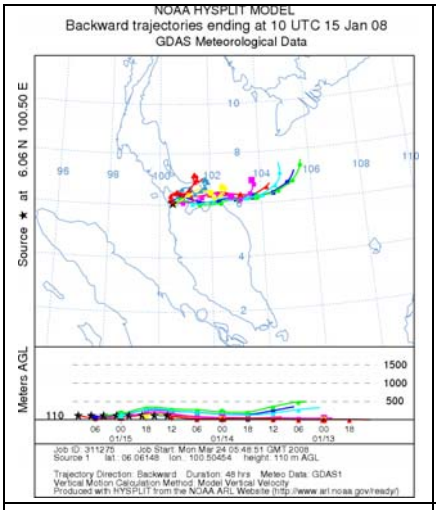
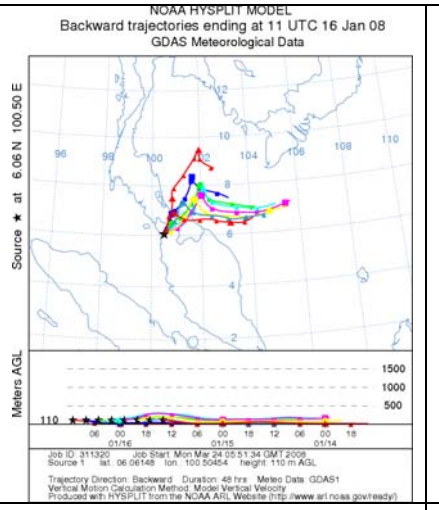
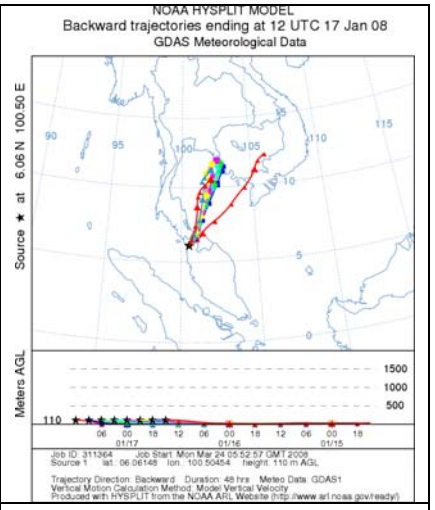
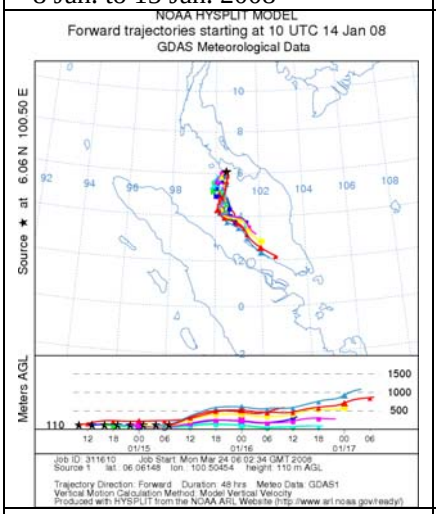
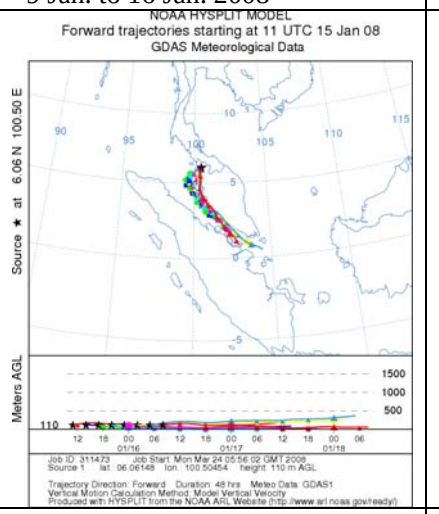
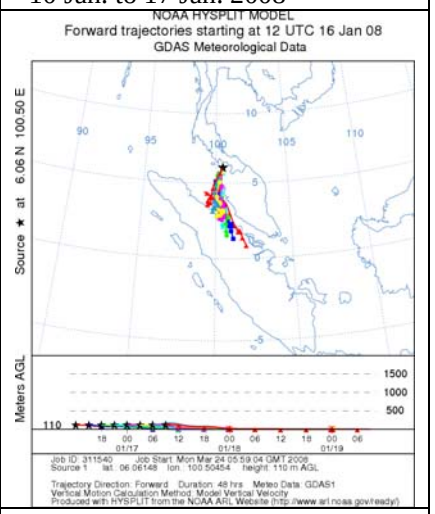
		
Back trajectory mode Simulation period: 8 Jan. to 15 Jan. 2008	Back trajectory mode Simulation period: 9 Jan. to 16 Jan. 2008	Back trajectory mode Simulation period: 10 Jan. to 17 Jan. 2008
		
Forward trajectory mode Simulation period: 14 Jan. to 21 Jan. 2008	Forward trajectory mode Simulation period: 15 Jan. to 22 Jan. 2008	Forward trajectory mode Simulation period: 16 Jan. to 23 Jan. 2008

Figure 4 Trajectory Analysis of Ambient Air Collected in Muda Dam Malaysia on 14–17 January 2008.

These results of back and forward trajectory analyses indicated the possibilities of the long-rage transportation of POPs. When the height data was high, the transport speed of POPs in the air was relatively fast and long-range or trans-border transportation of POPs were possibly assumed at back trajectory mode and affected to far distant leeward. The less reliability of more than 3 day before or after of the trajectory data should be noticed.

1.3 POPs Concentrations in Ambient Air Samples in Mongolia

1) Ownership of Data and a Person in Charge

Mongolia
Dr. Enkhsaruul Byambajav, Department of Organic Chemistry, Faculty of Chemistry, National University of Mongolia

2) Air Monitoring Data in 2007

a) Sampling Location (see **Figure 5**)
This sampling site is located about 80 km north-east of Ulaanbaatar.
- Terelj, Mongolia.
- Latitude: N47°59', Logitude: E107°27'
- Above Sea Level: 1560m

The sampling location in Mongolia has the proper conditions to background air monitoring site as follows;
1) The sampling site is situated on 80 km to the north east of capital city - Ulaanbaatar.
2) Terelj - sampling site is the largest tourist camp and national park which has beautiful nature, mountain area and grassland.
3) There is no significant toxic emission sources and traffics in Terelj.
4) There are a few of livestock and households in Terelj.

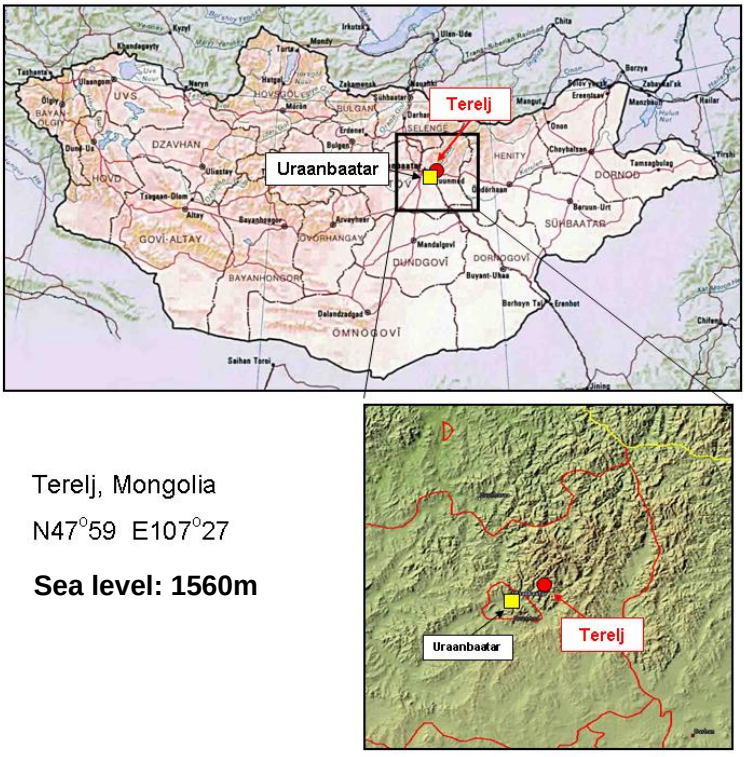


Figure 5 **Map of Sampling Location in Mongolia in 2007**

b) Sampling Records and Meteorological Information

Air sampling records were summarized in **Table 7.**

Table 7 Sampling Record in Terelj, Mongolia

		18 – 19 December 2007	19 – 20 December 2007	20 – 21 December 2007
Sampling time	Start	12:41	13:04	13:27
	End	12:41	13:04	13:27
Temperature (^{o}C)	Start	-10.3	-7.5	-11.0
	End	-.8	-10	-7.9
Atmospheric Pressure (hPa)	Start	843.7	841.8	848.9
	End	841.8	848.2	843.7
Weather	Start	fine	fine	fine
	End	fine	fine	cloudy
Flow rate (L/min)		702.1	702.3	702.1
Sampling volume (m^3)		1007.9	1007.9	1007.9

*1: HV sampler was HV-1000F.

c) Results of HRGC/MS Analysis

Concentrations of POPs in ambient air collected by duplicate sampling are shown in **Table 8.** These concentrations were determined according to Monitoring Surveillance Manual for POPs and Their Related Compounds (2006).

d) Discussion

- During the East Asia background air monitoring analysis in Mongolia, most of POPs pesticides were not detected except HCB which was detected in relatively high concentration (43-53 pg/m^3). Usage of HCB pesticide was the highest in Mongolia during 1970-2003. Another source of HCB may be from coal-fired power plant and domestic stoves, since mazut is usually used as a starter material of combustion of coal, but the waste oil is also sometimes used.
- The POPs concentrations detected were below MQL excluding HCB.
- Since the pressure sensor attached to the one of the high volume air sampler was out of order, it was impossible to conduct duplicate sampling and only one series of monitoring data could be obtained.

Table 8 Concentrations of POPs in Ambient Air in Terelj, Mongolia on 18-21 December 2007.

Chemicals	Sample A (pg/m^3)			
	1st day	2nd day	3rd day	Average
HCB	53	43	49	48
Aldrin	*<0.71*	*<0.71*	*<0.71*	*<0.71*
Dieldrin	<0.62	<0.62	<0.62	<0.62
Endrin	*<0.59*	*<0.59*	*<0.59*	*<0.59*
p,p'-DDT	<0.99	<0.99	<0.99	<0.99
p,p'-DDE	(0.77)	<0.72	<0.72	0.77
p,p'-DDD	<0.44	<0.44	<0.44	<0.44
o,p'-DDT	*<0.75*	<0.75	<0.75	<0.75
o,p'-DDE	(0.13)	<0.08	<0.08	0.13
o,p'-DDD	<0.62	<0.62	<0.62	<0.62
trans-Chlordane	<0.29	(0.46)	<0.29	(0.46)
cis-Chlordane	<0.22	<0.22	<0.22	<0.22
trans-Nonachlor	<0.14	(0.15)	<0.14	(0.15)
cis-Nonachlor	<0.13	<0.13	<0.13	<0.13
Oxychlordane	<0.89	<0.89	<0.89	<0.89
Heptachlor	<0.21	<0.21	<0.21	<0.21
trans-Heptachlorepoxide	<0.16	<0.16	<0.16	<0.16
cis-Heptachlorepoxide	(0.20)	(0.13)	(0.16)	0.16
Mirex	<0.13	<0.13	<0.13	<0.13
Toxaphene (Parlar-26)	<1.4	<1.4	<1.4	<1.4
Toxaphene (Parlar-50)	<1.5	<1.5	<1.5	<1.5
Toxaphene (Parlar-62)	<3.3	<3.3	<3.3	<3.3

italic letter.: reference value because surrogate recovery was out of 40 to 120 percent.
n.a.: not available because surrogate recovery was out of 25 to 150 percent.
Values in parenthesis show that it was within IDL to IQL.

e) Results of Trajectory Analysis

To speculate the source of POPs in the collected air, trajectory analysis of the collected air was performed using the HYSPLIT programs. With reference to vertical coordinate in the 3D-wind model, the sigma coordinate was used for trajectory calculation in both forward and backward mode. The results of analysis showed in **Figure 5**.

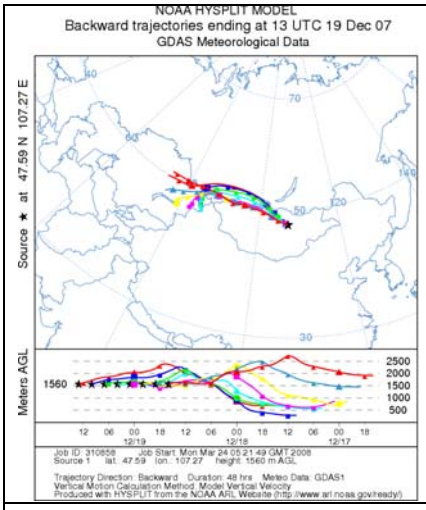
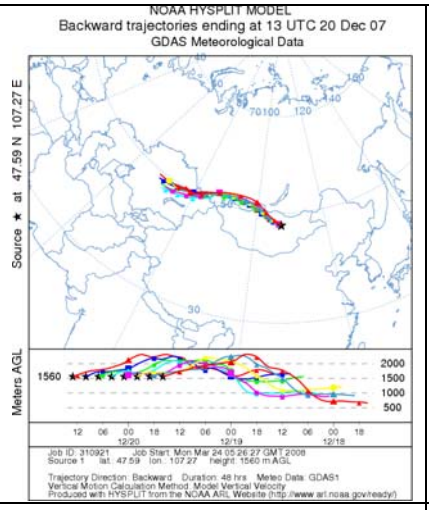
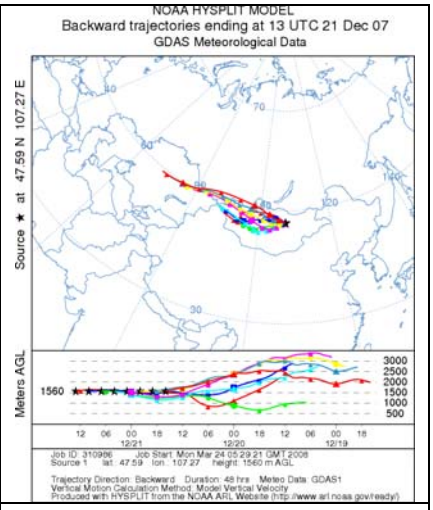
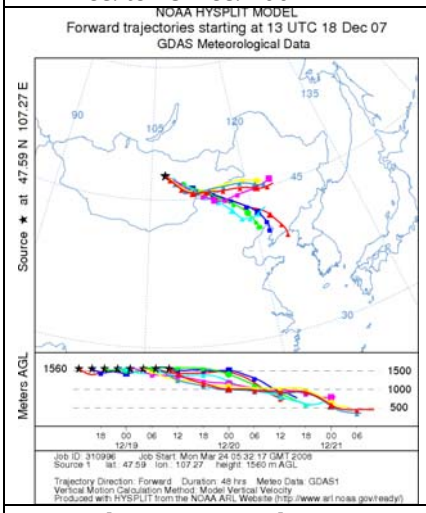
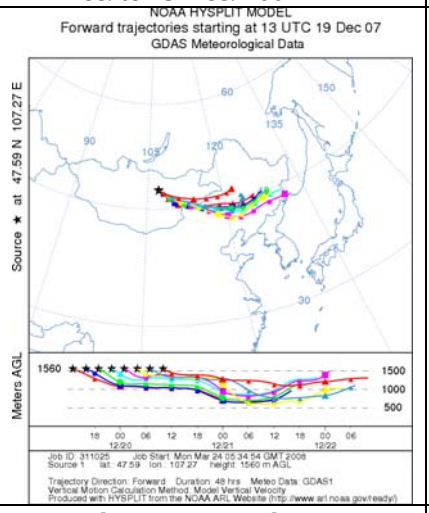
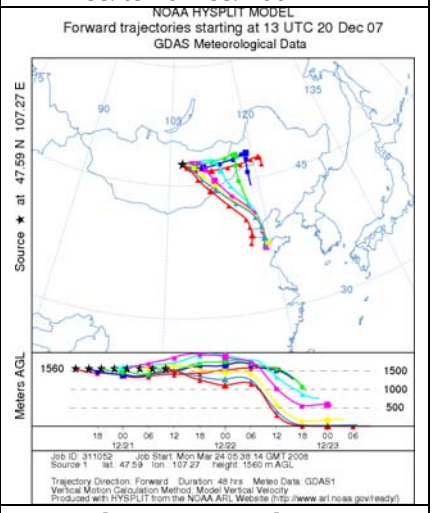
		
Back trajectory mode Simulation period: 11 Dec. to 18 Dec. 2007	Back trajectory mode Simulation period: 12 Dec. to 19 Dec. 2007	Back trajectory mode Simulation period: 14 Dec. to 20 Dec. 2007
		
Forward trajectory mode Simulation period: 18 Dec. to 25 Dec. 2007	Forward trajectory mode Simulation period: 19 Dec. to 26 Dec. 2007	Forward trajectory mode Simulation period: 20 Dec. to 27 Dec. 2007

Figure 6 Trajectory Analysis of Ambient Air Collected in Terelj, Mongolia on 18-21 December 2007.

These results of back and forward trajectory analyses indicated the possibilities of the long-rage transportation of POPs. When the height data was high, the transport speed of POPs in the air was relatively fast and long-range or trans-border transportation of POPs were possibly assumed at back trajectory mode and affected to far distant leeward. The less reliability of more than 3 day before or after of the trajectory data should be noticed.