Background Air Monitoring of Persistent Organic Pollutants in East Asian Countries 2004-2007

POPs Monitoring Project in East Asian Countries, 2007

CONTENTS

List of Expert Working Group Members

Expert Working Group Members on POPs Monitoring Project in East Asian Countries

Mr. Peou VUTHYRAK	Cambodia	Vice Chief, Office of Air Quality, Noise and Vibration Management, Environmental Pollution Control Department, Ministry of Environment
Ms. Rina APRISHANTY	Indonesia	Researcher, Environment Management Center (EMC), Ministry of Environment
Dr. Yasuyuki SHIBATA	Japan	Division Head, Environmental Chemistry Division, National Institute for Environmental Studies (NIES)
Dr. Jong-Woo CHOI	Republic of Korea	Researcher Environmental Measurement Standards Division National Institute of Environmental Research (NIER)
Ms. Phakkavanh PHISSAMAY	Lao PDR	Technical Officer, Environment Quality Monitoring Center, Environment Research Institute (ERI), Science Technology and Environment Agency (SETA)
Mr. Mohd. Fauzan YUNUS	Malaysia	Principal Assistant Director, Department of Agriculture, Ministry of Agriculture and Agro-based Industry
Dr. Enkhsaruul Byambajav	Mongolia	Associate Professor, Department of Organic Chemistry, Faculty of Chemistry, National University of Mongolia
Mr. Koh Chin YONG	Singapore	Senior Scientific Officer, Pollution Control Department, National Environment Agency
Ms. Nuchida RUNGTHAWORNWONG	Thailand	Environmental Officer, Waste and Hazardous Substance Management Bureau, Pollution Control Department, Ministry of Natural Resources and Environment
Prof., Dr. Evangeline SANTIAGO	The Philippines	Head, Research and Analytical Service Laboratory, Natural Sciences Research Institute, University of the Philippines
Prof., Dr. Pham Hung VIET	Vietnam	Director of Research Centre for Environmental Technology and Sustainable Development (CETASD), Hanoi University of Science, Vietnam National University

Secretariat

Ministry of the Environment of Japan (MOE)

Mr. Ichiro TSUNOI	Assistant Director, Environmental Health and Safety Division, Environmental Health Department, Environmental Policy Bureau

Japan Environmental Sanitation Center (JESC)

Dr. Takuya SHIOZAKI	Primary Researcher, Environmental Science Department

1. Background and Objectives

Persistent organic pollutants (POPs) such as PCBs and DDTs are toxic, persistent and bioaccumulative and are transferred through the air, water and migratory species across international boundaries and deposited far from their location of emission and accumulate in terrestrial and aquatic ecosystems. It came to be internationally recognised that there were concerns about health impacts, *inter alia*, upon women and future generations due to exposure to POPs especially in developing countries.

It had been increasingly stressed that actions by only a limited number of countries were insufficient for the worldwide elimination and/or reduction of POPs, thus the Stockholm Convention on Persistent Organic Pollutants (hereinafter referred to as "Stockholm Convention") was adopted at the Conference of Plenipotentiaries held in Stockholm in May 2001. The Stockholm Convention entered into force on 17 May 2004. Approximately 2/3 countries in Asia among the five United Nations regions were parties to the Stockholm Convention.

Whereas increase of the parties is highly welcome, evaluating effectiveness of the Convention should be further recognised as crucial to its successful implementation. According to Article 16 of the Stockholm Convention, its effectiveness shall be evaluated starting four years after the date of entry into force of the Convention, i.e. before 17 May 2008. Furthermore, the 2nd Conference of the Parties of the Stockholm Convention (COP2) agreed to complete the first effective evaluation at its 4th meeting (COP4) in 2009[1].

For achieving broader coverage of the Convention over the world including developing countries and obtaining at least "core" representative data from all regions for the first effectiveness evaluation, various actions will be taken under the guidance of COPs in accordance with its decision (SC-2/13). Given the above-mentioned timing constraints, however, the first effectiveness evaluation is expected to be based primarily on existing programmes and sources of information, and this evaluation will also be the opportunity to establish a large scale "base line" of information on POPs levels in the environment[2].

Third Conference of the Parties of the Stockholm Convention (COP3[3]) agreed as the decision (SC-3/19) that the Parties will report flexibly through the five UN regions for the purpose of coordinating global coverage for the first global monitoring report.. For monitoring programmes that cover more than one UN region the results will be reported through on of the UN regions and the other involved UN regions will be informed.

The participating countries in the POPs Monitoring Project in East Asian Countries are convinced that its framework, as one of the existing sub-regional initiatives of POPs monitoring that contribute to the effectiveness evaluation of the Stockholm Convention recognised in COP2[4], will provide comparable and scientifically sound data on the media considered to be essential (i.e. air deposition), and will contribute to further operationalising the global monitoring programme.

[1] SC2/13, paragraph 1.
[2] UNEP/POPS/COP.2/INF/15
[3] UNEP/POPS/COP.3/30
[4] UNEP/POPS/COP.2/21

2. POPs Monitoring Project in East Asian Countries

The operation of the POPs Monitoring Project in East Asian Countries comprises of two parts: (1) organising workshops to which the participating countries are invited to discuss and guide the Project; and (2) providing technical assistance for background(*) field monitoring of POPs in air in terms of: (a) sampling; (b) high resolution GC/MS analysis including relevant capacity building elements; and (c) data validation, QA/QC and treatment and reporting of the obtained data. The treatment and reporting of the data are to be communicated and finalised among participating countries.

In December 2002, a representative of the host declared a kickoff at the opening of the 1st Workshop on Environmental Monitoring of POPs in East Asian Countries saying as follows: "…We think, in order to identify the levels of POPs remaining in the environment in East Asian Countries as required by the Convention, regional cooperative efforts are indispensable." The Workshop recognised insufficient information on levels of POPs in the environment, agreed that further efforts should be made to fill in the data gaps, and stressed that regional cooperative efforts in East Asia are crucial for identifying the environmental levels of POPs. The chairperson's summary of the Workshop noted that *"the Workshop recommended that regional efforts should be promoted* ***to establish a framework for environmental monitoring of POPs that suits the East Asian region*** *by taking into account all the various conditions relevant to the countries in the region."* This fundamental motivation shared among the participating countries has embodied the Project through the following Workshops. The history of the Workshops is summerised in **Table 1**. The Chairperson's Summaries were attached as Annex.

The 2nd Workshop, held in December 2003, agreed that further discussions on designing regional monitoring of POPs in East Asian sub region should be continued.

Reflecting the discussions and conclusions of the 1st, 2nd, 3rd and 4th Workshops on Environmental Monitoring of Persistent Organic Pollutants in East Asian Countries, and the course of Trial Air Monitoring of POPs Chemicals at Background Sites in East Asian Countries, a plan for the POPs monitoring was revised by the Ministry of the Environment of Japan (MOE) and the National Institute for Environmental Studies of Japan (NIES). The present structure of the Project is shown in **Figure 1**.

At the 5th Workshop, held in November 2007, the monitoring data in 2006 - 2007 and/or QA/QC information from Cambodia, Mongolia and Thailand were shared in the Expert Working Group, and the Workshop had common views that summary results from the monitoring would be made available to the public as a part of the proceedings from the 4th Workshop, subject to the confirmation by the countries where the data were obtained. And also the compiled monitoring data in each participating countries from 2004 to 2006 were published and submitted to the COP3. Furthermore, it has been agreed that the previous report should be revised by adding the monitoring data which were obtained in 2006 – 2007.

Table 1 Workshops and Meetings on POPs Monitoring in East Asian Countries

	Date and Venue	Participants	Other Experts and Observers
1st Workshop	2-4 December 2002 Tokyo and Tsukuba, Japan	Cambodia, China, Indonesia, Japan, Republic of Korea, Malaysia, the Philippines, Singapore, Thailand, Vietnam	AMAP[5], UNEP[6] Chemicals, UNEP/ROAP, GEF, UNEP/GEF PTS programme (region VII & VIII), UNU, Members of POPs Monitoring Committee of Japan, Japan Coast Guard, Peking Univ., Ehime Univ.
2nd Workshop	14-15 December 2003, Tsukuba, Japan	Cambodia, China, Indonesia, Japan, Republic of Korea, Malaysia, the Philippines, Singapore, Thailand, Vietnam	AMAP, GEF, AMAP, WWF, Stockholm Univ., UNU, Pref. Univ. Kumamoto, UNEP/GEF PTS programme (region VIII), JICA
1st Expert Working Group (EWG) Meeting	24 January 2004 Tokyo, Japan	Indonesia, Japan, Republic of Korea, the Philippines, Vietnam	UNU, Members of POPs Monitoring Committee of Japan

[5] Arctic Monitoring and Assessment Programme
[6] United Nations Environment Plan

Table 1 Workshops and Meetings on POPs Monitoring in East Asian Countries (cont'd)

	Date and Venue	Participants	Other Experts and Observers
3rd Workshop 1st Policy Group (PG) Meeting 2nd EWG Meeting	11-13 October 2005, Tokyo, Japan	Cambodia, China, Indonesia, Japan, Republic of Korea, Lao PDR, Malaysia, Mongolia, the Philippines, Singapore, Thailand, Vietnam	UNEP, AMAP, NOWPAP [7], UNU [8], Stockholm Univ., Members of POPs Monitoring Committee of Japan
4th Workshop 2nd PG Meeting 3rd EWG Meeting	20-22 September 2006, Kyoto, Japan	Cambodia, Indonesia, Japan, Republic of Korea, Lao PDR, Malaysia, Mongolia, the Philippines, Singapore, Thailand, Vietnam	UNEP NOWPAP UNU
5th Workshop 3rd PG Meeting 4th EWG Meeting	20-22 November 2007, Kyoto, Japan	Cambodia, Indonesia, Japan, Republic of Korea, Lao PDR, Malaysia, Mongolia, the Philippines, Thailand, Vietnam	

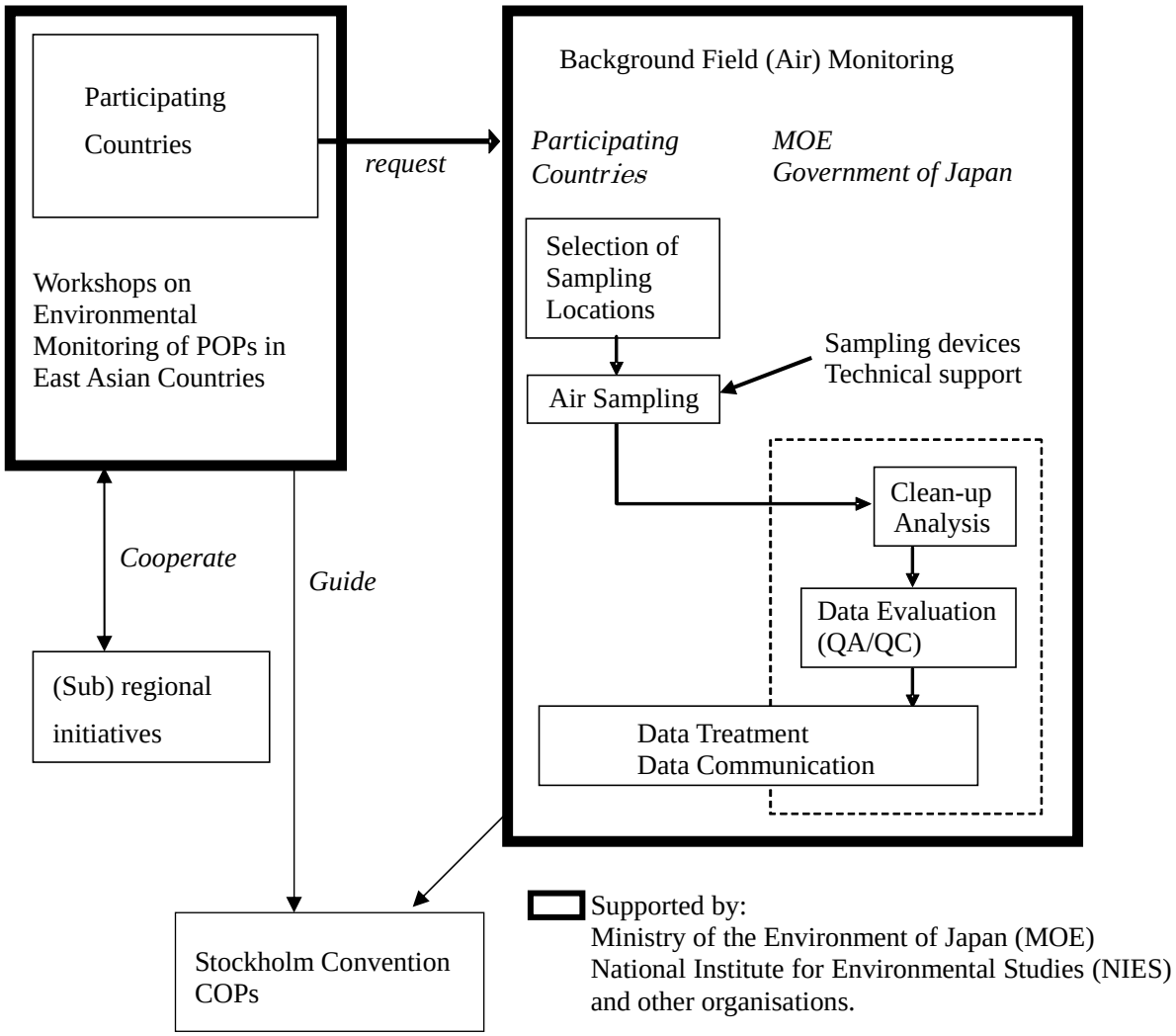


Figure 1 Structure of the POPs Monitoring Project in East Asian Countries

[7] Northwest Pacific Action Plan
[8] United Nations University

3. Field Monitoring

(1) POPs to be Covered

Target substances and media of the field monitoring under the POPs Monitoring Project in East Asian Countries are shown in **Table 2**.

Table 2 Target POPs of Field Monitoring under the Project

No.	"12 POPs" listed in Annexes to the Stockholm Convention	Atmospheric Air & Precipitation
1	Aldrin	**X**
2	Dieldrin	**X**
3	Endrin	**X**
4	Heptachlor Heptachlor *cis*-Heptachlor epoxide *trans*-Heptachlor epoxide	**X**
5	Chlordanes *cis*-Chlordane *trans*-Chlordane Oxychlordane *cis*-Nonachlor *trans*-Nonachlor	**X**
6	HCB	**X**
7	Mirex	**X**
8	Toxaphenes Parlar-26 Parlar-50 Parlar-62	**X**
9	PCBs	
10	DDTs *p,p'*-DDT *o,p'*-DDT *p,p'*-DDE *o,p'*-DDE *p,p'*-DDD *o,p'*-DDD	**X**
11	PCDDs	
12	PCDFs	

(2) Criteria for Selecting Sampling Locations

Sampling sites were selected on the basis of the following criteria on background air sampling sites at present. In fact, however, it was practically difficult to comply with all of its requirements when selecting sampling locations for the field monitoring performed in 2004, 2005 and 2006.

- To be located on islands or at continental margins to gain an insight into transport across the sub regions.
- To be located so as to obtain information on temporal trends of regional sources.
- To be sufficiently remote from urban centres and industrial and other sources of POPs as to reflect concentrations typical of a large area around the location (at least 100 km radius).
- To be ensured that meteorological observations and trained personnel for sampling are available and back-trajectory analysis can be performed.

(3) Protocol for Sampling and Analysis

A typical air sampling is composed of duplicate twenty four-hour sampling by the two high volume (HV) air samplers for the three consecutive days.

Sampling, clean-up procedures and quantification using HRGC/HRMS were conducted according to the established protocols – "Monitoring Manual for POPs and their Related Substances" 2006 (herein after referred to as "Monitoring Manual 2006").

The sampling method is based on the conventional HV air sampling method for dioxins by using a combination of a quartz fibre filter (QFF) and polyurethane foam (PUF) plugs. A thin, soft disk of active carbon fibre felt (ACF), a strong absorbent for POPs and other chemicals, was sandwiched between the two PUF plugs to avoid breakthrough of relatively volatile chemicals, such as HCB and lower-chlorinated PCBs, during air sampling. The QFF, the first PUF plug and ACF were extracted for analyzing POPs. The second PUF plug behind the ACF was not analysed.
For large volume sampling using QFF, PUF and ACF combination, the HV sampler which allowed an airflow rate of 700 L/min was used. Total sampling volume of air was approximately 1,000 m^3 per sample. The result of an analysis obtained by using HV air samplers shall be the average of the three consecutive days' data.
The samples shall be prepared and analysed according to the procedure shown in Figure 2.

(4) Quality Control

Quality control (QC) should be carried out according to the Monitoring Manual 2006.
The analysis was conducted by the isotope-dilution method. Known amounts of isotope-labelled surrogate standards were added to PUF (typically several mm depth by a syringe) just prior to sampling. Quantification was conducted by comparing native/surrogate ratios of each chemical in the extracts of samples to those of standard solutions containing known concentrations of both native and isotope-labelled standards.

Recoveries of each chemical during clean-up procedure was calculated separately from surrogates and were described in the results. In addition a travel blank was checked by conducting clean-up and analysis of blank absorbents, which were transported to the sampling sites and handled in the same way as real samples except for HV sampling process. The final data was presented by subtracting travel blanks. The reliability of the data was finally checked by duplicate analysis in this monitoring.

Four different limit values were defined in this programme; i.e., instrument detection limit (IDL). instrument quantification limit (IQL), method detection limit (MDL) and method quantification limit (MQL). The data exceeding MQL will be accepted while those equal or above MDL but below MQL will be presented as reference values. The values below MDL will be shown as not detected (n.d.). Also the data showing recoveries between 40 and 120 % will be accepted while those between 25 to 40 and 120 to 150 % will be shown as reference values.

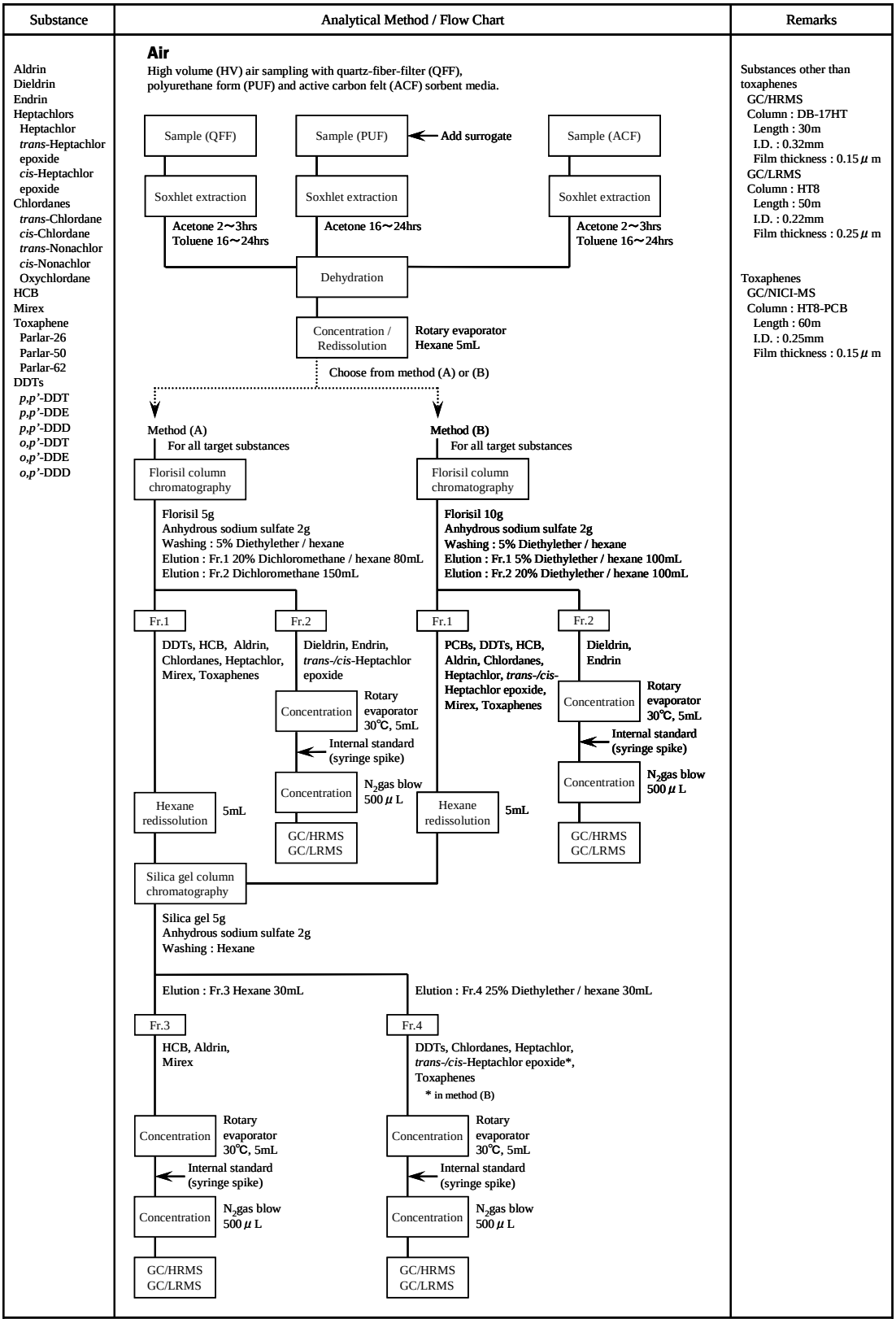


Figure 2 Flow Chart of Analytical Method for POPs in Air Samples

(5) Data Communication and Ownership

All of the air samples were collected in cooperation with each organisation listed in **Table 3** and transported to Japan Environmental Sanitation Center for the analyses. The reliability of the obtained data and quality control information were verified by National Institute for Environmental Studies (NIES of Japan), and then sent to each participating country.

The data obtained were reviewed on their reliability in the 3rd Workshop on Environment Monitoring of POPs in East Asian Countries and the 2nd Expert Working Group meeting. And the data in 2006 were reviewed on the reliability in the 4th Workshop on Environmental Monitoring of POPs in East Asian Countries and 3rd Expert Working Group meeting.
The participating countries agreed that the ownership of these monitored data shall belong to each of the participating country, and assumed responsibility to keep, to disclose and to evaluate monitored data.

(6) Capacity Building and Technology Transfer Elements

MOE dispatched its officials and technical experts visited to several countries that participated in the field monitoring of the Project and carried out air sampling and the technological transfer. Training opportunities were provided for analytical methods for POPs. HRGC/HRMS determination was provided for scientists invited from two countries (Vietnam and Indonesia) for twelve days in Japan Environmental Sanitation Centre (JESC) and National Institute for Environmental Studies (NIES). The organisations which technological transfer was given are shown in **Table 3**.

Table 3 Capacity Building Opportunities

year	Country	Local Organisation	Technology Transfer
2005	Vietnam	Research Centre for Environmental Technology and Sustainable Development (CETASD), Hanoi University of Science	Sampling method using a high volume air sampler POPs analysis including clean-up procedure and the determination by HRGC/HRMS: one researcher
2005	Indonesia	Environmental Management Center (EMC-SARPEDAL)	Sampling method using a high volume air sampler POPs analysis including clean-up procedure and the determination using HRGC/HRMS: one researcher
2006	The Philippines	Research and Analytical Service Laboratory, Natural Sciences Research Institute, University of the Philippines	Sampling method by High volume air sampler
2006	Thailand	Pollution Control Department, Ministry of Natural Resources and Environment	Sampling method by High volume air sampler
2006 2007	Mongolia	Ministry of Nature and Environment	Sampling method by High volume air sampler
2006	Cambodia	Environmental Pollution Control Department, The Ministry of Environment	Sampling method by High volume air sampler
2007	Lao PDR	Environmental Quality Monitoring Centre, Environment Research Institute	Sampling method by High volume air sampler
2007	Malaysia	Department of Agriculture, Ministry of Agriculture and Agro-based Industry	Sampling method by High volume air sampler

4. Monitoring Data in East Asian Countries

4.1 POPs Concentrations in Ambient Air Samples in East Asian Countries

The monitoring of POPs in ambient air at Background sites were conducted in six countries where are Indonesia, Japan, Republic of Korea, the Philippines and Vietnam in 2004 through 2006. The sampling sites on the basis of the following criteria on background air sampling sites at present were chosen. In fact, however, it was difficult to comply with all the following criteria for sampling location in the research performed in 2004 through 2006.
- Some may be sited on islands or at continental margins to gain an insight into transport between regions.
- Others may be located centrally so as to obtain information on time trends of regional sources.
- The sites need to be sufficiently remote from urban centres and industrial and other sources of POPs as to reflect concentrations typical of a large area around the site (at least 100 km radius).
- Requirements include availability of meteorological observations, ability to perform back-trajectory analysis and trained personnel for sampling.

Air sampling were duplicately carried out with HV air samplers for 24 hours and then repeated for three days.

Target chemicals of this project were shown in **Table 2**. The air samples were analysed according to Monitoring Surveillance Manual for POPs and Their Related Compound (MOE Japan). Data measured in 2005 has already been discussed on the reliability in 3rd Workshop on Environment Air Monitoring of POPs in East Asian Countries and 2nd Expert Working Group Meeting at Tokyo in October 2005. And the data measured in 2006 has also discussed on the reliability in 4th workshop in Environmental Air Monitoring of POPs in East Asian Countries and 3rd Expert Working Group Meeting held at Kyoto in September 2006.

4.2 POPs Concentrations in Ambient Air Samples in Cambodia

1) Ownership of Data and a Person in Charge

Mr. Chea Sina, Deputy Director , Department of Pollution Control
Pollution Control Department, Ministry of Environment
Kingdom of Cambodia

2) Air Monitoring Data in 2007

a) Sampling Location (see **Figure 3**)
The sampling location for air monitoring was selected in Sihanoukville, that is a coastline town about 230 Km south-west of Phnom Penh (see Figure 3).
Sihanoukville is an international port, and with population density approximately 50 person / km^2. It is a tourist site mostly for local people. In the Sihanoukville there are few agricultural activities, light industries, garment and sea food processing for export. This sampling location is available some meteorological data and full day electricity supply.
For sampling collection, it was set up in the town water-treatment plant, where locate on top of the high land.
This sampling point is far away from dumping site about 15 Km, and there are no any open burning closed this site.

- Sihanoukville, Cambodia.
- Latitude: N10°38.036', Longitude: E103°31.350'
- Above Sea Level: 130m

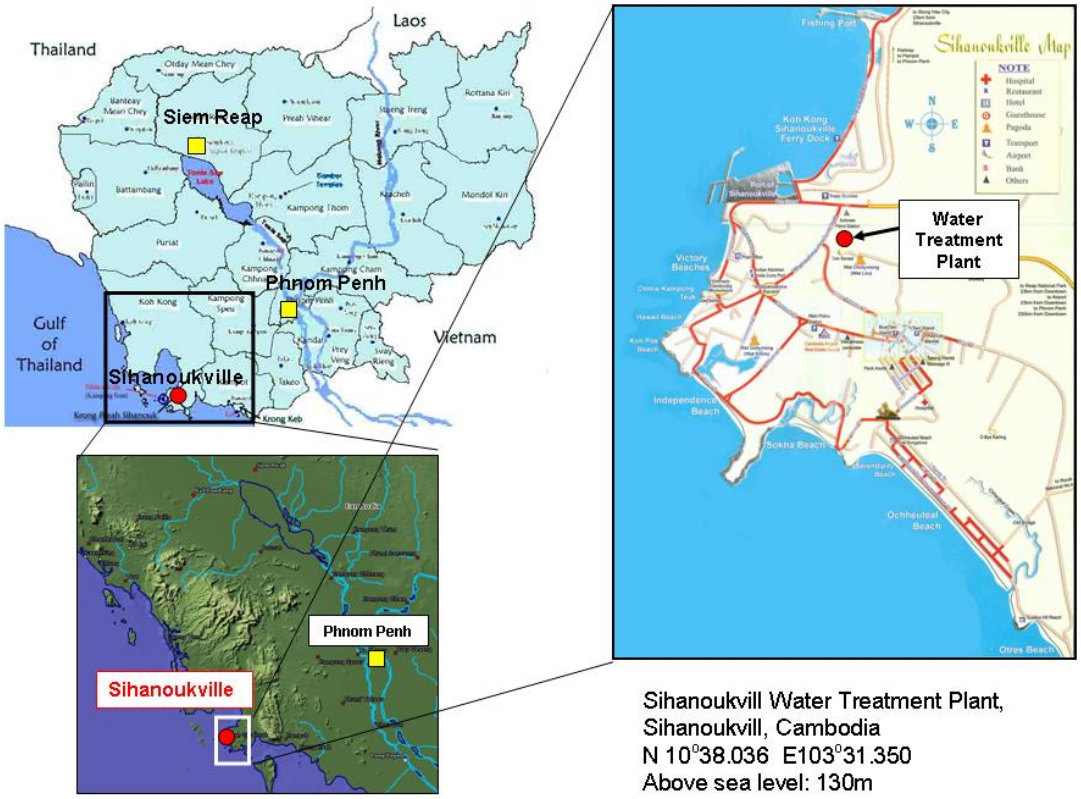


Figure 3 Map of Sampling Location in the Cambodia in 2007

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 Sihanoukville, Cambodia

		5 - 6 December 2006		6 - 7 December 2006		7 - 8 December 2006	
Sample No.*1		A	B	A	B	A	B
Sampling time	Start	9:41	9:44	10:40	10:44	11:35	11:31
	End	9:41	9:44	10:40	10:44	11:35	11:31
Temperature (^{o}C)	Start	30.9	30.1	37.9	35.5	36.1	34.3
	End	35.8	33.9	35.2	33.3	33.4	31.6
Atmospheric Pressure (hPa)	Start	998.8	999.6	997.6	997.7	997.6	998.4
	End	997.6	997.7	997.6	998.4	997.6	998.4
Weather	Start	fine	fine	fine	fine	fine	Fine
	End	fine	fine	fine	fine	fine	Fine
Flow rate (L/min)		700	700.1	700	700	700	700
Sampling volume (m^3)		1010.4	1007.9	1008.6	1008.6	1007.9	1007.9

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

Table 5 Meteorological Information Observed in Sihanoukville

Date	Time	Avergage temp. (DegC)	Avergage RH (DegC)	Wind direction	Wind velocity (m/s)	rain precipitation (mm)
2006/12/5	1:00	27	88.0	N	3	-
	7:00	27	88.0	N	3	2
	13:00	31.0	72.0	NE	3	-
	19:00	25	96.0	NE	3	-
2006/12/6	1:00	25	91.0	Calm	-	-
	7:00	27	84.0	Calm	-	-
	13:00	30.5	75.0	NE	2	-
	19:00	27	88.0	NE	2	-
2006/12/7	1:00	25.5	90.0	NE	2	-
	7:00	26	84.0	NE	1	-
	13:00	31	72.0	N	3	-
	19:00	27	84.0	S	2	-
2006/12/8	1:00	26	84.0	Calm	-	-
	7:00	27	84.0	Calm	-	-
	13:00	32	69.0	S	4	-
	19:00	27	84.0	S	1	-

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

- The analysed values of HCB, chlordanes and *trans*-nonachlor were not accepted, since the deviation of two data obtained by duplicate sampling from these average value were bigger than 30%. The causes of this deviation were examined but it was difficult to identify.

Table 6 Concentrations of POPs in Ambient Air in Sihanoukvill, Cambodia on 9-12 January 2006.

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	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Aldrin	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Dieldrin	1.9	1.8	2.1	1.9	1.2	0.93	*1.3*	1.1	1.6	1.4	1.7	1.5
Endrin	<0.38	<0.38	<0.38	<0.38	*<0.38*	<0.38	<0.38	<0.38	<0.38	<0.38	<0.38	<0.38
p,p'-DDT	*17*	36	*30*	28	17	34	*31*	27	17	35	31	28
p,p'-DDE	18	30	27	25	18	28	26	24	18	29	27	25
p,p'-DDD	(1.1)	2	1.9	1.7	(1.0)	1.8	4.8	2.5	(1.0)	1.9	3.4	2.1
o,p'-DDT	6.3	9.2	9.3	8.3	6.2	8.3	*8.8*	7.8	6.3	8.8	9.1	8.0
o,p'-DDE	1.7	2.5	2.1	2.1	1.4	2.1	2	1.8	1.6	2.3	2.1	2.0
o,p'-DDD	(0.73)	(1.0)	(0.93)	0.89	(0.62)	(0.93)	1.9	1.2	(0.68)	(0.97)	1.4	1.0
trans-Chlordane	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
cis-Chlordane	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
trans-Nonachlor	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
cis-Nonachlor	(0.59)	(0.70)	<0.56	0.65	<0.56	<0.56	<0.56	<0.56	<0.56	<0.56	<0.56	<0.56
Oxychlordane	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8
Heptachlor	(0.72)	(0.93)	(0.89)	0.85	<0.52	<0.52	*<0.52*	<0.52	0.72	0.93	0.89	0.85
trans-Heptachlorepoxide	<0.19	<0.19	<0.19	<0.19	<0.19	<0.19	<0.19	<0.19	<0.19	<0.19	<0.19	<0.19
cis-Heptachlorepoxide	(0.33)	(0.33)	(0.36)	(0.34)	(0.35)	(0.27)	(0.29)	(0.30)	(0.34)	(0.30)	(0.33)	(0.32)
Mirex	<0.41	<0.41	<0.41	<0.41	<0.41	<0.41	*<0.41*	<0.41	<0.41	<0.41	<0.41	<0.41
Toxaphene (Parlar-26)	<0.86	<0.86	<0.86	<0.86	<0.86	<0.86	<0.86	<0.86	<0.86	<0.86	<0.86	<0.86
Toxaphene (Parlar-50)	<2.6	<2.6	<2.6	<2.6	<0.86	<2.6	<2.6	<2.6	<0.86	<2.6	<2.6	<2.6
Toxaphene (Parlar-62)	<6.8	<6.8	<6.8	<6.8	<0.86	<6.8	<6.8	<6.8	<0.86	<6.8	<6.8	<6.8

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 METEX programs. NCEP reanalysis dataset and 3D-wind model in METEX programs were used for the trajectory analysis. 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 4**.

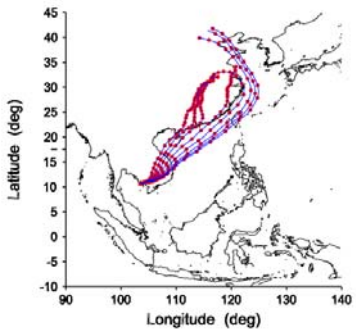
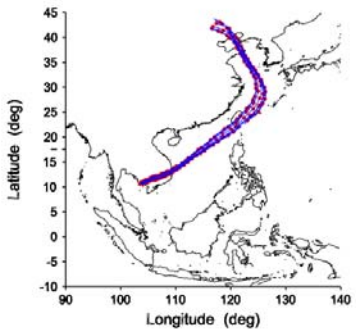
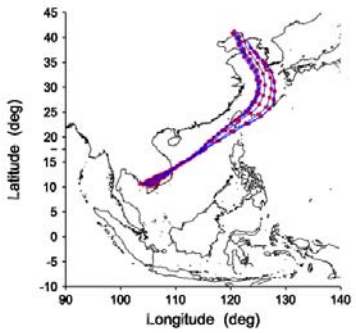
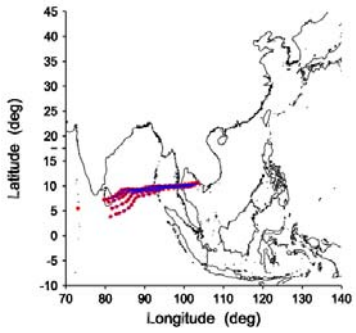
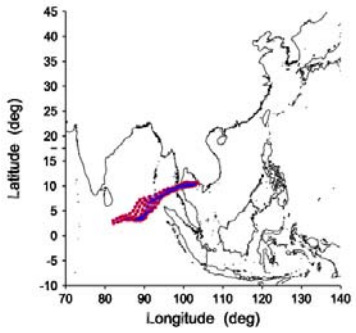
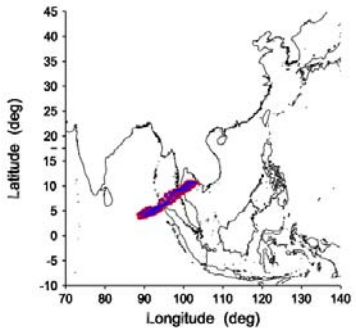
		
Back trajectory mode Simulation period: 28 Nov. to 5 Dec. 2006	Back trajectory mode Simulation period: 29 Nov. to 6 Dec. 2006	Back trajectory mode Simulation period: 30 Nov. to 7 Dec. 2006
		
Forward trajectory mode Simulation period: 5 Dec. to 12 Dec. 2006	Forward trajectory mode Simulation period: 6 Dec. to 13 Dec. 2006	Forward trajectory mode Simulation period: 7 Dec. to 14 Dec. 2006

Figure 4 Trajectory Analysis of Ambient Air Collected in Sihanoukvill, Cambodia on 5–8 December 2006.

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.

4.3 POPs Concentrations in Ambient Air Samples in Republic of Indonesia

1) Responsible Local Organisation

Ministry of Environment, Republic of Indonesia
Mrs. Rina APRISHANTY, Researcher, Environment Management Center (EMC), Ministry of Environment

2) Air Monitoring Data in 2005

a) Sampling Location

This sampling site is located about 30 km northwest of Jakarta (see **Figure 5**)

- Environmental Management Center (EMC /SARPEDAL),
  Kawasan PUSPIPTEK, Serpong Tangerang 15310, Indonesia
- Latitude: S 06°21.385' Logitude: E 106°40.067'
- Above sea level: approximately 100 m (Above ground level: 8.3 m)

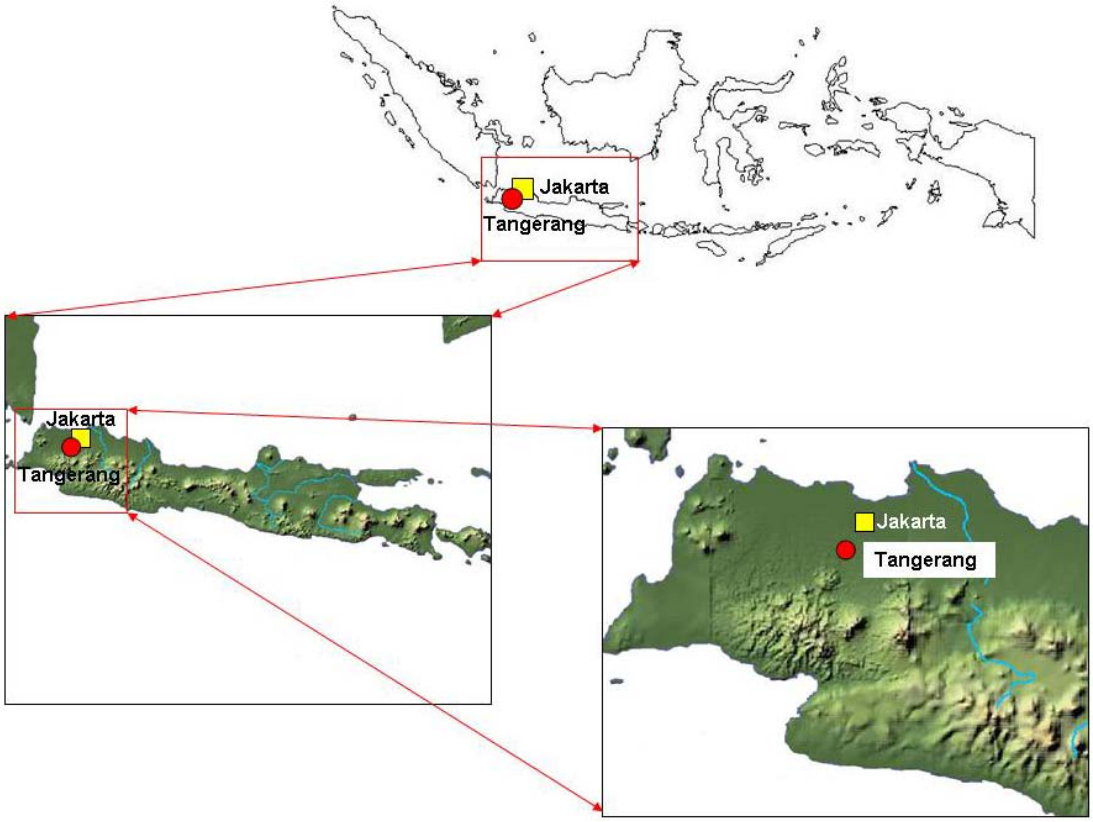


Figure 5 Map of Sampling Location in Indonesia in 2005

b) Sampling Records

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

Table 7 Sampling Record in Serpnog Tangerang, Indonesia

		6 - 7 February 2006 (1st day)		7 - 8 February 2006 (2nd day)		8 - 9 February 2006 (3rd day)	
Sampler No. *1		A	B	A	B	A	B
Sampling time	Start	17:30	17:40	18:15	17:30	18:50	18:55
	End	17:30	17:40	18:15	17:30	18:50	18:55
Temperature (degC)	Start	32.2	30.9	33.8	32.2	27.2	26.8
	End	32.1	31.6	26.2	32.1	29.1	27.1
Atmospheric Pressure (hPa)	Start	999.7	1000.5	997.8	999.7	999.7	1000.5
	End	997.8	998.6	999.1	997.8	998.4	998.6
Weather	Start	rainy	rainy	cloudy	cloudy	rainy	rainy
	End	cloudy	cloudy	rainy	rainy	cloudy	cloudy
Flow Rate (L/min)		700	700	700	700	700	700
Sampling Volume (m^3)		1008	1007.9	1007.7	1007.9	1007.5	1007.7

*1: Both A and B is 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).

Table 8 Concentrations of POPs in Ambient Air in Serpnog Tangerang, Indonesia on 1-4 June 2005.

Chemicals	Sample A		Sample B		Average	
	Conc. (pg/m^3)	Recovery (%)	Conc. (pg/m^3)	Recovery (%)	Conc. (pg/m^3)	Recovery (%)
HCB	100	47	110	44	110	46
Aldrin	n.a.	14	n.a.	7.6	n.a.	11
Dieldrin	34	58	34	60	34	59
Endrin	(1.5)	61	(1.5)	81	(1.5)	71
p,p'-DDT	*12*	*145*	*13*	*150*	*13*	*145*
p,p'-DDE	18	39	12	45	15	42
p,p'-DDD	1.9	82	2.1	82	2.0	82
o,p'-DDT	9.2	73	9.3	71	9.3	72
o,p'-DDE	1.6	49	1.5	50	1.6	50
o,p'-DDD	0.94	82	1.0	82	1.0	82
trans-Chlordane	18	88	18	83	18	86
cis-Chlordane	11		12		11	
trans-Nonachlor	9.4	94	9.3	90	9.3	92
cis-Nonachlor	2.4	76	2.2	75	2.3	76
Oxychlordane	(0.61)	71	(0.61)	73	(0.61)	72
Heptachlor	6.6	68	6.6	61	6.6	65
trans-Hepachlorepoxide	<0.09	71	<0.09	70	<0.09	71
cis-Hepachlorepoxide	0.77		0.80		0.79	
Mirex	0.33	41	0.23	42	0.28	42
Toxaphene (Parlar-26)	<0.07	51	<0.07	51	<0.07	51
Toxaphene (Parlar-50)	<0.08		<0.08		<0.08	

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.

d) Results of Trajectory Analysis

To speculate the source of POPs in the collected air, trajectory analysis of the collected air was performed using the METEX programs. NCEP reanalysis dataset and 3D-wind model in METEX programs were used for the trajectory analysis. 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 6**.

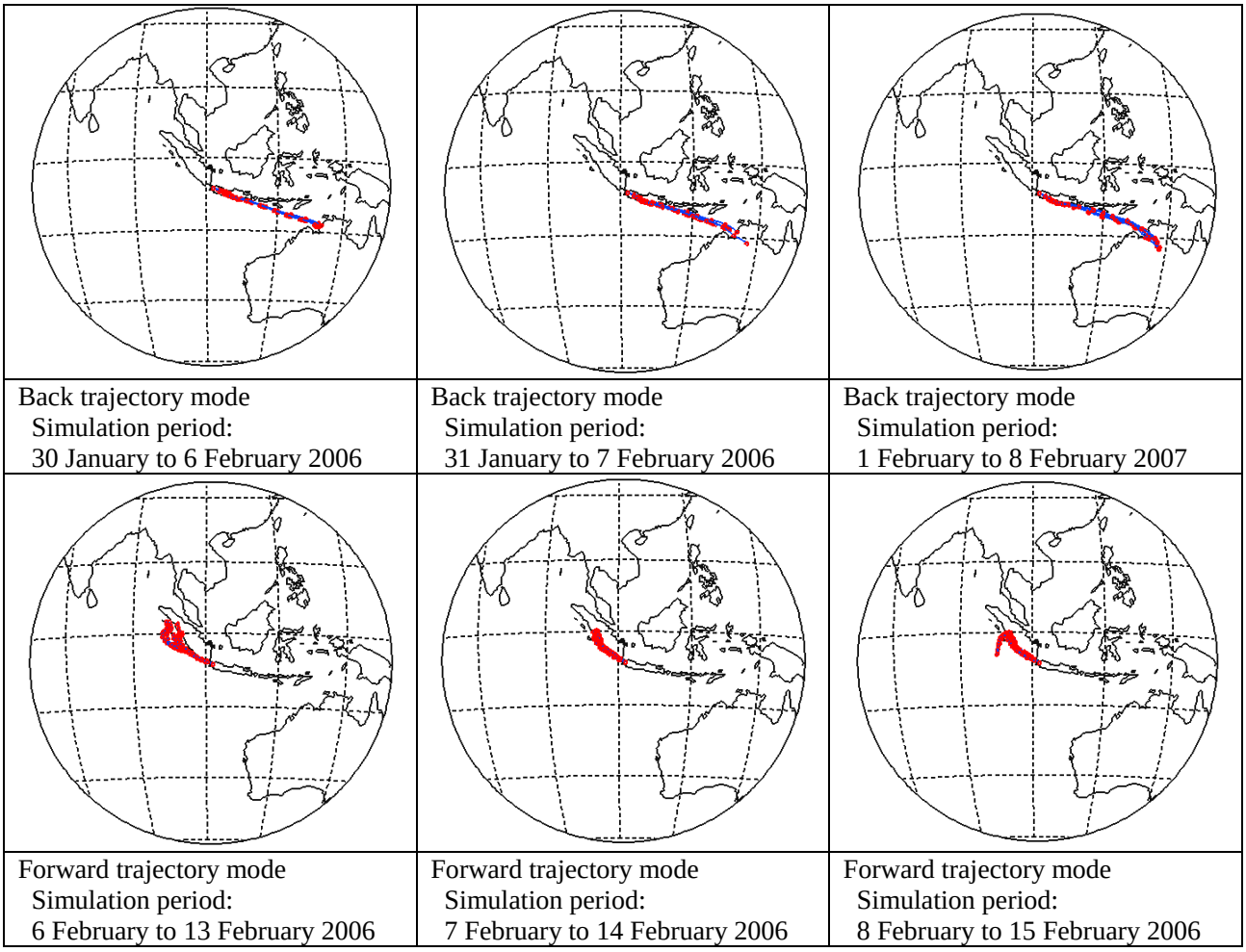


Figure 6 Trajectory Analysis of Ambient Air Collected in Serpnog Tangerang, Indonesia

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.

e) Questions and Requests from Relevant Persons in Indonesia

- They hope that the POPs monitoring survey will be continued in the future. If it is possible, the period of duration should be about five years.
- A definition of the background should be given because the definition of the point of the background is vague. They think that the reason should be given.
- They want the monitoring survey to be carried out not only in the background location but also in the polluted locations in Indonesia.
- They hope that the investigation of PCDD/Fs and PCBs as well as the other POPs will be carried out.
- As EMC doesn't have any surrogate substances except DDT at the present time, when they collect samples without our help, they can use only DDT as a surrogate. This may create a disadvantage from the viewpoint of quality control. It is very difficult to obtain POPs standard solution and surrogate substances in Indonesia. Regarding this problem, especially the standard solutions such as PCBs, the transport (contained hand-carry) of the standards supplied in Japan to Indonesia is very difficult. At present a breakthrough is difficult in principle unless a manufacturer (AccuStandard, CIL, or Wellington) has a market directly in Indonesia and the Indonesian government appreciates the need fully. From now on, when we work for the technological transfer of POPs analysis in each country of the East Asian area, this

will be an important problem to be tackled at the government level.

- Initially we had planned to collect samples in Medan, but we changed to EMC near Jakarta due to the occurrence of an earthquake caused by volcanic activity. However, we will try to collect samples in Medan, if EMC is inappropriate as a background location.

3) Air Monitoring Data in 2006

a) Sampling Location

This sampling site in Berastagi is located about 50 km southeast of Medan in Sumatra island in Indonesia and about 350km west of Kuala Lumpur (see **Figure 7**). Further, above sea level of Berastagi is about 1,500m and the industry is mainly agriculture.

- Gundaling Hill, Berastagi, Indonesia
- Latitude: N03°11.321' Logitude: E098°30.109'
- Sea Level: 1470m

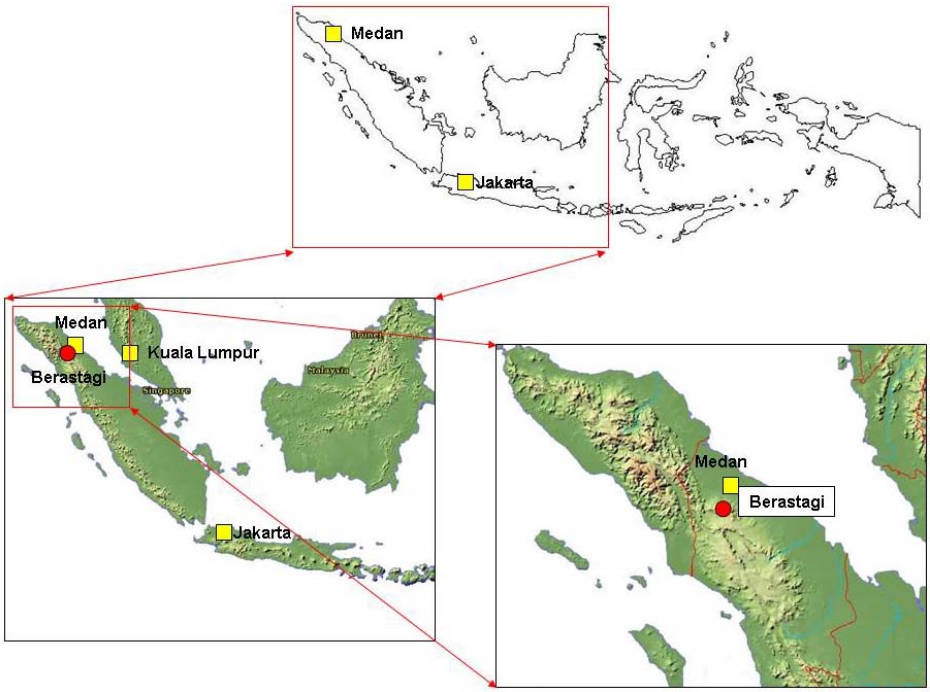


Figure 7 Map of Sampling Location in Indonesia in 2006

b) Sampling Records and Meteorological Information

Air sampling records are summarized in **Table 9** and meteorological information shows in **Table 10.**

Table 9 Sampling Record in Gundaling Hill, Berastagi, Indonesia

		6-7 February 2006 (1st day)		7 - 8 February 2006 (2nd day)		8 - 9 February 2006 (3rd day)	
Sampler No.[*1]		A	B	A	B	A	B
Sampling time	Start	17:15	17:20	17:48	17:55	20:18	20:20
	End	17:15	17:20	19:30[*2]	17:37	20:18	20:20
Temperature (DegC)	Start	24.4	21.2	26.8	25.3	23.2	25.1
	End	26.9	28.9	23.4	26.3	22	21
Atmospheric Pressure (hPa)	Start	857.2	860.1	853.4	856.9	856.6	859.4
	End	853.4	856.3	855.9	858.8	856.6	859.4
Weather	Start	fine	fine	cloudy	cloudy	rainy	rainy
	End	cloudy	rainy	rainy	rainy	fine	cloudy
Flow Rate (L/min)		700	700	700	700	700	700
Sampling Volume (m^3)		1008.1	1008.2	1008.6	998.4[*3]	1008	1008.1

*1: Both A and B is HV-700F.
*2: End time of sampling was delayed because electric supply had stopped from 14:00 to 15:30.
*3: PUF of entrance side was pressed flat.

Table 10 Meteorological Information Observed in Kuta Gadung Station - Karo District North Sumatra

Date	Precipitation	Temp. (DegC)	Wind Velocity (m/s)	Relative Humidity (%)
2006/2/3	0	18.7	0.82	87
2006/2/4	2	19.0	0.84	87
2006/2/5	0	15.7	0.77	89
2006/2/6	3	18.7	0.29	87
2006/2/7	0	18.2	0.90	85
2006/2/8	3	16.2	0.80	83
2006/2/9	9	18.8	1.21	83
2006/2/10	0	18.1	0.88	89
2006/2/11	0	19.1	0.74	90

c) Results of HRGC/MS Analysis

Concentrations of POPs in ambient air collected by duplicate sampling are shown in **Table 11.** These concentrations were determined according to Monitoring Surveillance Manual for POPs and Their Related Compounds (2006).

Table 11 **Concentrations of POPs in Ambient Air in Berastagi, Indonesia on 6-9 February 2006.**

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	110	110	100	110	n.a.	n.a.	100	100	110	110	100	110
Aldrin	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Dieldrin	16	14	22	17	n.a.	23	23	23	16	19	23	19
Endrin	8.4	7.1	13	9.5	n.a.	15	15	15	8.4	11	14	11
p,p'-DDT	32	40	43	38	n.a.	51	47	49	32	46	45	41
p,p'-DDE	79	71	110	87	n.a.	120	110	120	79	96	110	95
p,p'-DDD	3.2	3.1	3.0	3.1	n.a.	2.3	1.8	2.1	3.2	2.7	2.4	2.8
o,p'-DDT	19	18	27	21	n.a.	30	28	29	19	24	28	24
o,p'-DDE	2.4	2.1	2.9	2.5	n.a.	2.6	2.6	2.6	2.4	2.4	2.8	2.5
o,p'-DDD	1.3	1.3	1.6	1.4	n.a.	1.0	1.1	1.1	1.3	1.2	1.4	1.3
trans-Chlordane	2.7	2.0	2.7	2.5	n.a.	1.8	2.3	2.1	2.7	1.9	2.5	2.4
cis-Chlordane	1.8	1.6	1.9	1.8	n.a.	1.4	1.7	1.6	1.8	1.5	1.8	1.7
trans-Nonachlor	1.3	1.1	1.3	1.2	n.a.	0.84	1.1	0.97	1.3	0.97	1.2	1.2
cis-Nonachlor	0.23	0.22	0.25	0.2	n.a.	0.15	0.17	0.16	0.23	0.19	0.21	0.21
Oxychlordane	0.28	0.29	0.22	0.3	n.a.	0.29	0.22	0.26	0.28	0.29	0.22	0.26
Heptachlor	1.6	1.3	1.4	1.4	n.a.	1.0	1.2	1.1	1.6	1.2	1.3	1.4
trans-Heptachlorepoxide	<0.05	<0.05	<0.05	<0.05	n.a.	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
cis-Heptachlorepoxide	0.48	0.44	0.51	0.48	n.a.	0.37	0.39	0.38	0.48	0.41	0.45	0.45
Mirex	0.25	0.45	0.22	0.31	n.a.	0.27	0.29	0.28	0.25	0.36	0.26	0.29
Toxaphene (Parlar-26)	13	10	21	14.48	n.a.	24	19	22	13	17	20	17
Toxaphene (Parlar-50)	13	10	22	15.15	n.a.	27	21	24	13	19	21	18
Toxaphene (Parlar-62)	<16	<16	<16	<16	n.a.	<16	<16	<16	<16	<16	<16	<16

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.

d) Results of Trajectory Analysis

To speculate the source of POPs in the collected air, trajectory analysis of the collected air was performed using the METEX programs. NCEP reanalysis dataset and 3D-wind model in METEX programs were used for the trajectory analysis. 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 8**.

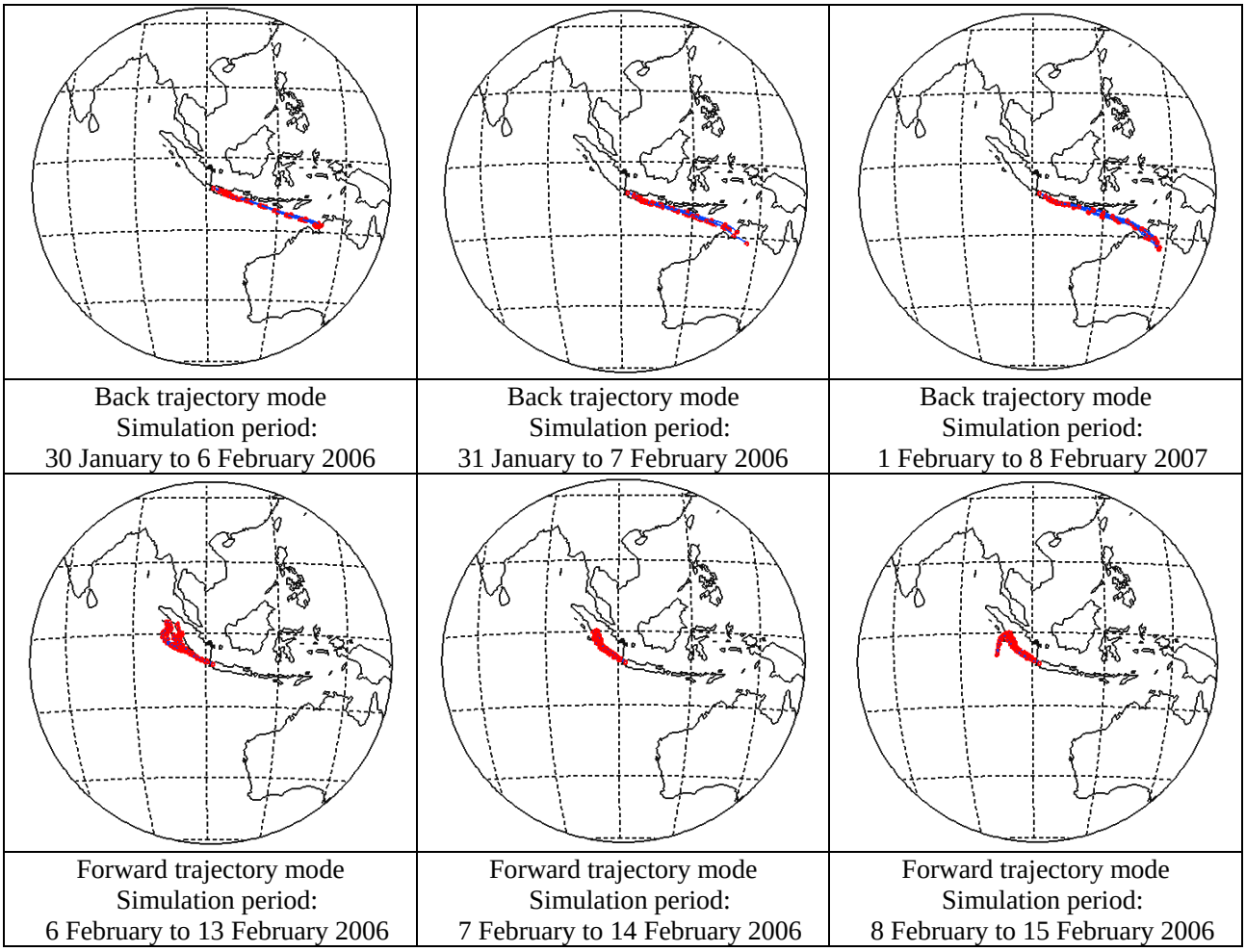


Figure 8 Trajectory Analysis of Ambient Air Collected in Berastagi, Indonesia

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.

e) Issues in This Sampling and in the Future

- The sampling site is Berastagi located about 50 km southeast of Medan in Sumatra island in Indonesia in this research. Further, above sea level of Berastagi is about 1,500m and the industry is mainly agriculture. As referred to above, we thought this sampling point has the proper conditions to background air monitoring site.

However, the results that I conducted interview for local agent staffs of Forestry and Environmental Service and plantation owner, DDTs and HCHs have been still irregularly sold and used. In particular, it is very difficult for control and regulation of pesticide used irregularly because these pesticides have been mixed with approved pesticides and then sold.

Therefore, to assess effect due to the pesticides used irregularly for POPs concentrations in Air samples from Berastagi, monitoring survey of agricultural soil, river water, and river sediment need to be simultaneously carried out.

4.4 POPs Concentrations in Ambient Air Samples in Japan

The monitoring of POPs in ambient air in Japan at Hateruma Island was conducted by Japanese Environmental Monitoring Project. Actual collection of air mass is carrying out with HV air samplers for 24 hours. The frequency is set to once at a month.

1) Responsible Local Organisation

National Institute for Environmental Studies (NIES),
Dr. Yasuyuki Shibata, Division Head, Environmental Chemistry Division, National Institute for Environmental Studies.

2) Air Monitoring in 2004, 2005, 2006 and 2007

a) Sampling locations

The sampling site is located about 1,600 km south west of Tokyo (see **Figure 9**). The site is available micro meteorological information provided by the NIES Air Monitoring Station.

- Rooftop of Monitoring Station, Hateruma Island, Okinawa-Pref., Japan
- Latitude: N 24°03’ Logitude: E 123°48’

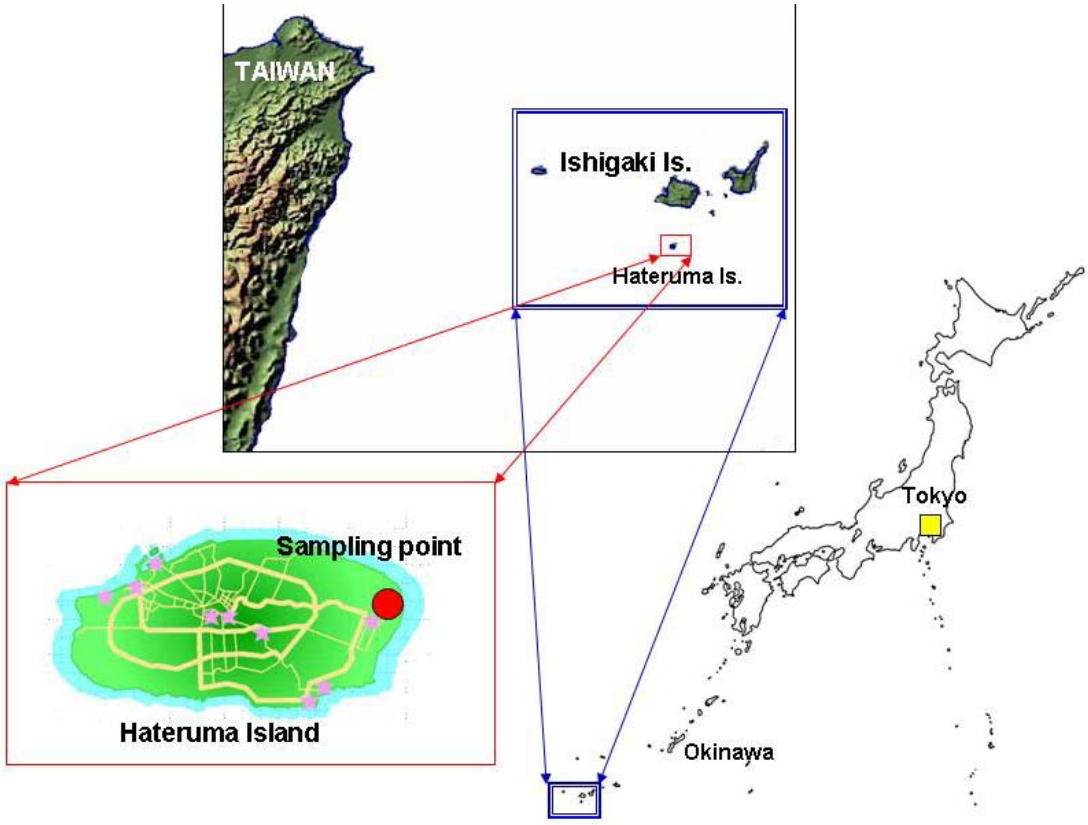


Figure 9 Map of Sampling Locations of Hateruma Island in Japan

b) Sampling Records and Meteorological Information
Air sampling records are summarized in **Table 12-1 – 12-4.**

Table 12-1 Sampling Record at Hateruma Island in Japan in 2004.

	Apr. 12-13	July 12-13	Aug. 9-10	Sept. 8-9	Oct. 12-13	Nov. 16-17	Dec. 14-15
sampling time (start)	11:36	10:51	11:51	12:25	12:43	15:31	12:07
sampling time (finish)	12:05	11:00	12:32	12:45	13:27	15:38	12:48
sampling volume (m^3)	1028.3	1014.3	1036.3	1021.7	1038.9	1013.2	1036.2
temp. max	-	-	42.3	36.4	35.0	29.1	34.4
temp. min	-	-	31.9	27.9	27.3	25.0	27.3
humidity max	-	-	68	80	59	65	80
humidity min	-	-	46	59	41	56	61
atmos. pressure (hPa)	-	-	1006.8	1013.8	1018.3	1024.0	1021.5
flow rate (L/min)	700	700	700	700	700	700	700

Table 12-2 Sampling Record at Hateruma Island in Japan in 2005.

	Jan 19-20	Mar. 15-16	May 18-19	June 14-15	July 12-13	Aug. 9-10	Sept. 13-14	Nov. 8-9	Dec. 12-13
sampling time (start)	16:36	14:25	9:40	12.20	12:28	12.36	12:39	12:37	15:56
sampling time (finish)	16:19	14:07	9:07	12:34	13:17	12:40	12:28	13:36	17:04
sampling volume (m^3)	988.5	995.5	985.3	1017.8	1042.0	1010.8	1000.1	1049.2	1072.9
temp. max	23.4	31.5	39.3	38.3	41.6	39.3	40.4	37.8	32.1
temp. min	-	23.9	28.7	29.1	32.8	28.2	30.2	29.4	24.8
humidity max	74	68	68	67	70	71	74	74	66
humidity min	-	42	51	53	48	52	50	50	46
atmos. pressure (hPa)	1027.8	1025.9	1014.4	1014.3	1015.1	1017.6	1018.9	1018.9	1022.7
flow rate (L/min)	700	700	700	700	700	700	700	700	700

Table 12-3 Sampling Record at Hateruma Island in Japan in 2006.

	Mar. 15-16	Apr. 11-12	May 16-17	July 16-17	Aug. 15-16	Oct. 10-11	Nov. 7-8	Dec. 12-13
sampling time (start)	11:34	11:52	12:48	11:45	17:41	18:05	14:10	15:45
sampling time (finish)	12:11	13:58	12:30	12:12	18:52	18:47	15:43	16:33
sampling volume (m^3)	1033.9	1096.2	995.4	1026.9	1057.7	1037.8	1073.0	1041.4
temp. max	36.7	33.2	37.3	38.3	38.9	36.5	33.9	33.0
temp. min	28.7	26.3	29.3	30.1	29.9	27.9	25.4	26.7
humidity max	84	68	84	84	83	77	64	83
humidity min	57	50	60	58	56	49	45	63
atmos. pressure (hPa)	1017.7	1023.4	1020.2	1012.0	1015.1	1023.4	1029.7	1027.1
flow rate (L/min)	700	700	700	700	700	700	700	700

Table 12-4 Sampling Record at Hateruma Island in Japan in 2007.

	Feb. 13-14	Mar. 13-14	Apr. 10-11	May 15-16	June 12-13	July 10-11
sampling time (start)	15:54	17:51	11:29	11:43	10:49	13:46
sampling time (finish)	16:18	18:29	12:49	12:04	12:34	14:18
sampling volume (m^3)	1024.9	1034.9	1063.3	1022.6	1081.1	1064.8
temp. max	33.9	29.8	28.7	35.3	38.3	43.1
temp. min	22.0	22.1	21.0	27.1	29.0	32.3
humidity max	89	78	93	85	84	75
humidity min	55	62	59	56	58	49
atmos. pressure (hPa)	1024.6	1023.4	1027.8	1024.6	1015.8	1012.0
flow rate (L/min)	700	700	700	700	700	700

c) Results of HRGC/MS Analysis

Concentrations by using Japanese method (combination of a quartz fiber filter, double PUF and an activated carbon felt) are shown in **Table 13-1, 13-2**, **13-3 and 13-4.** These concentrations were determined according to Monitoring Surveillance Manual for POPs and Their Related Compounds (2006).

Table 13-1 Concentrations of POPs in Ambient Air at Hateruma Island, Japan in 2004.

unit: pg/m^3

	Apr.	July	Aug.	Sept.	Oct.	Nov.	Dec.
HCB	42	108	16	99	65	43	115
Aldrin	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Dieldrin	2.2	4.1	3.7	2.6	n.d.	(0.86)	n.d.
Endrin	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
p,p'-DDT	n.d.	n.d.	n.d.	3.0	1.7	n.d.	n.d.
p,p'-DDE	1.5	(0.48)	(0.43)	8.0	0.82	0.94	2.9
p,p'-DDD	(0.32)	(0.44)	(0.27)	2.0	n.d.	5.9	n.d.
o,p'-DDT	3.1	n.d.	n.d.	26	1.8	3.8	3.7
o,p'-DDE	2.1	0.26	(0.037)	12	0.66	0.85	3.3
o,p'-DDD	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
trans-Chlordane	22	4.4	4.8	14	1.8	4.6	19
cis-Chlordane	17	5.2	4.9	12	2.0	3.6	15
trans-Nonachlor	12	3.1	3.1	8.7	1.8	3.0	13
cis-Nonachlor	1.5	(0.62)	(0.54)	(1.22)	n.d.	n.d.	1.4
Oxychlordane	(0.83)	n.d.	n.d.	n.d.	n.d.	n.d.	(0.80)
Heptachlor	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
trans-Heptachlorepoxide	1.7	0.53	0.43	0.65	0.71	0.68	0.41
cis-Heptachlorepoxide	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Mirex	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Toxaphene (Parlar-26)	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Toxaphene (Parlar-50)	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Toxaphene (Parlar-62)	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.

n.d.: not detected.
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.

Table 13-2 Concentrations of POPs in Ambient Air at Hateruma Island, Japan in 2005.

unit: pg/m^3

	Jan.	Mar.	May	June	July	Aug.	Sept.	Nov.	Dec.
HCB	305	57	114	71	41	39	44	52	49
Aldrin	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Dieldrin	19	n.d.	2.9	n.d.	(1.8)	n.d.	n.d.	(0.98)	n.d.
Endrin	n.d.	n.d.	n.d.	n.d.	(0.42)	n.d.	n.d.	n.d.	n.d.
p,p'-DDT	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
p,p'-DDE	5.2	0.40	1.3	0.50	(0.40)	n.d.	(0.31)	(0.60)	4.7
p,p'-DDD	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
o,p'-DDT	6.0	n.d.	1.8	n.d.	(1.3)	n.d.	(0.48)	1.8	(1.1)
o,p'-DDE	4.3	n.d.	0.70	0.30	0.28	(0.10)	(0.11)	0.46	1.9
o,p'-DDD	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
trans-Chlordane	30	n.d.	2.3	(0.60)	n.d.	n.d.	n.d.	(1.3)	n.d.
cis-Chlordane	20	(0.60)	2.4	(0.70)	(0.52)	(0.50)	(0.74)	1.7	(0.55)
trans-Nonachlor	15	(0.40)	1.5	3.7	(0.39)	(0.33)	(0.45)	1.0	(0.47)
cis-Nonachlor	3.3	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Oxychlordane	1.0	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Heptachlor	5.2	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	(0.57)	n.d.
trans-Heptachlorepoxide	1.2	n.d.	n.d.	n.d.	n.d.	0.50	0.80	0.55	n.d.
cis-Heptachlorepoxide	n.d.	n.d.	n.d.	n.d.	(0.13)	(0.14)	(0.12)	(0.15)	n.d.
Mirex	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Toxaphene (Parlar-26)	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Toxaphene (Parlar-50)	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Toxaphene (Parlar-62)	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.

n.d.: not detected.
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.

Table 13-3 Concentrations of POPs in Ambient Air at Hateruma Island, Japan in 2006.

unit: pg/m^3

	Mar.	Apr.	May	July	Aug.	Oct.	Nov.	Dec.
HCB	47	26	25	13	35	94	88	65
Aldrin	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Dieldrin	n.d.	n.d.	n.d.	n.d.	(0.76)	3.5	0.24	0.41
Endrin	n.d.	n.d.	n.d.	n.d.	n.d.	0.33	n.d.	n.d.
p,p'-DDT	n.d.	n.d.	n.d.	n.d.	n.d.	1.1	n.d.	n.d.
p,p'-DDE	n.d.	n.d.	n.d.	n.d.	n.d.	1.6	2.2	0.9
p,p'-DDD	2.3	2.9	1.8	1.6	0.84	n.d.	n.d.	n.d.
o,p'-DDT	(0.55)	2.3	1.9	2.2	(0.90)	2.1	0.84	1.6
o,p'-DDE	0.55	0.57	0.31	0.46	(0.15)	1.1	0.53	0.88
o,p'-DDD	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
trans-Chlordane	(0.66)	(0.60)	n.d.	(0.67)	(1.6)	2.1	2.2	1.8
cis-Chlordane	(0.76)	(0.59)	n.d.	(0.58)	1.4	1.9	1.5	1.5
trans-Nonachlor	n.d.	n.d.	n.d.	n.d.	n.d.	0.9	1.3	1.1
cis-Nonachlor	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	(0.17)	n.d.
Oxychlordane	n.d.	n.d.	n.d.	n.d.	n.d.	(0.51)	(0.50)	(0.33)
Heptachlor	n.d.	n.d.	(0.66)	2.9	n.d.	0.44	0.35	n.d.
trans-Heptachlorepoxide	0.57	0.68	0.71	0.68	0.77	n.d.	n.d.	n.d.
cis-Heptachlorepoxide	n.d.	n.d.	n.d.	n.d.	n.d.	0.72	0.62	0.49
Mirex	n.d.	n.d.	n.d.	n.d.	n.d.	0.15	0.17	0.23
Toxaphene (Parlar-26)	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Toxaphene (Parlar-50)	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Toxaphene (Parlar-62)	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.

n.d.: not detected.
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.

Table 13-4 Concentrations of POPs in Ambient Air at Hateruma Island, Japan in 2007.

unit: pg/m^3

	Feb	Mar.	Apr.	May	June	July
HCB	95	125	108	94	68	64
Aldrin	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Dieldrin	3.2	4.5	4.3	3.5	6.7	5.4
Endrin	0.34	0.22	0.25	0.34	0.23	0.67
p,p'-DDT	1.1	n.d.	2.1	n.d.	1.2	n.d.
p,p'-DDE	2.3	1.8	1.4	0.48	1.1	0.57
p,p'-DDD	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
o,p'-DDT	2.5	4.8	2.9	0.58	1.6	(0.17)
o,p'-DDE	0.63	1.2	0.94	0.21	0.17	(0.054)
o,p'-DDD	n.d.	0.38	n.d.	n.d.	(0.12)	n.d.
trans-Chlordane	1.2	4.8	2.8	1.3	2.3	1.8
cis-Chlordane	1.4	4.4	2.8	1.8	2.2	1.8
trans-Nonachlor	0.77	2.7	1.8	1.0	0.96	1.3
cis-Nonachlor	n.d.	(0.15)	n.d.	(0.15)	n.d.	n.d.
Oxychlordane	(0.32)	(0.52)	(0.51)	(0.47)	(0.44)	n.d.
Heptachlor	0.51	3.80	0.45	0.46	n.d.	0.22
trans-Heptachlorepoxide	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
cis-Heptachlorepoxide	0.36	1.1	0.72	0.62	0.49	0.81
Mirex	0.18	0.20	0.16	0.21	0.13	0.32
Toxaphene (Parlar-26)	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Toxaphene (Parlar-50)	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Toxaphene (Parlar-62)	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.

n.d.: not detected.
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.

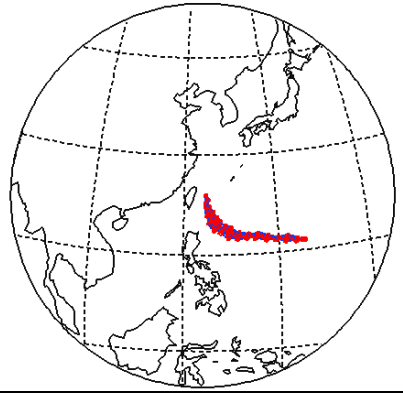
d) Results of Trajectory Analysis

To speculate the source of POPs in the collected air, trajectory analysis of the collected air was performed using the METEX programs. NCEP reanalysis dataset and 3D-wind model in METEX programs were used for the trajectory analysis. With reference to vertical coordinate in the 3D-wind model, the sigma coordinate was used for trajectory calculation in both forward and backward mode.

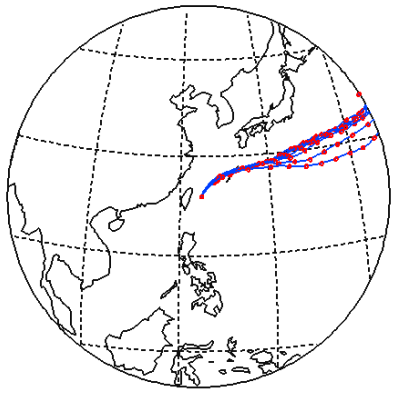
And also to speculate the source of POPs in the collected air, trajectory analysis of the collected air was performed using the HYSPLIT programs. The HYSPLIT (HYbrid Single-Particle Lagrangian Integrated Trajectory) model is the newest version of a complete system for computing simple air parcel trajectories to complex dispersion and deposition simulations. This programme has been developed and provided by Air Resources Laboratory of U.S. National Oceanic and Atmospheric Administration. The results of analysis showed in **Figure 10 - 17**.

These results of back and forward trajectory analyses play an important role of understanding the long-rage transportation of POPs. In case of we guess the background of the measuring concentrations, the back trajectory mode is better than another one.

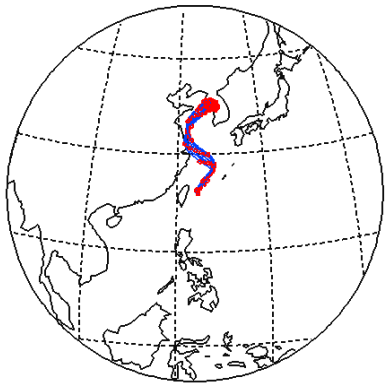
Back trajectory mode
Simulation period:
6 Apr. to 13 Apr. 2004



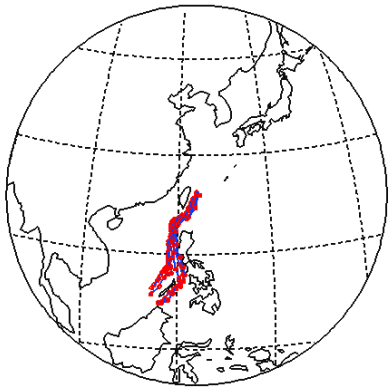
Back trajectory mode
Simulation period:
6 July to 13 July 2004



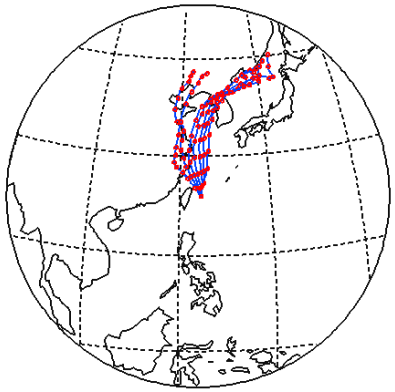
Back trajectory mode
Simulation period:
3 Aug. to 10 Aug. 2004



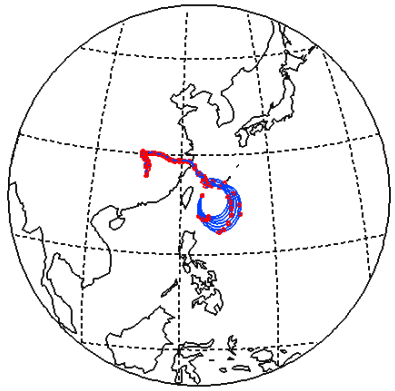
Back trajectory mode
Simulation period:
2 Sept. to 9 Sept. 2004



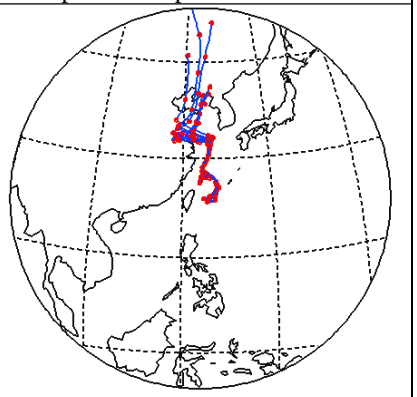
Forward trajectory mode
Simulation period:
12 Apr. to 19 Apr. 2004



Forward trajectory mode
Simulation period:
12 July to 19 July 2004

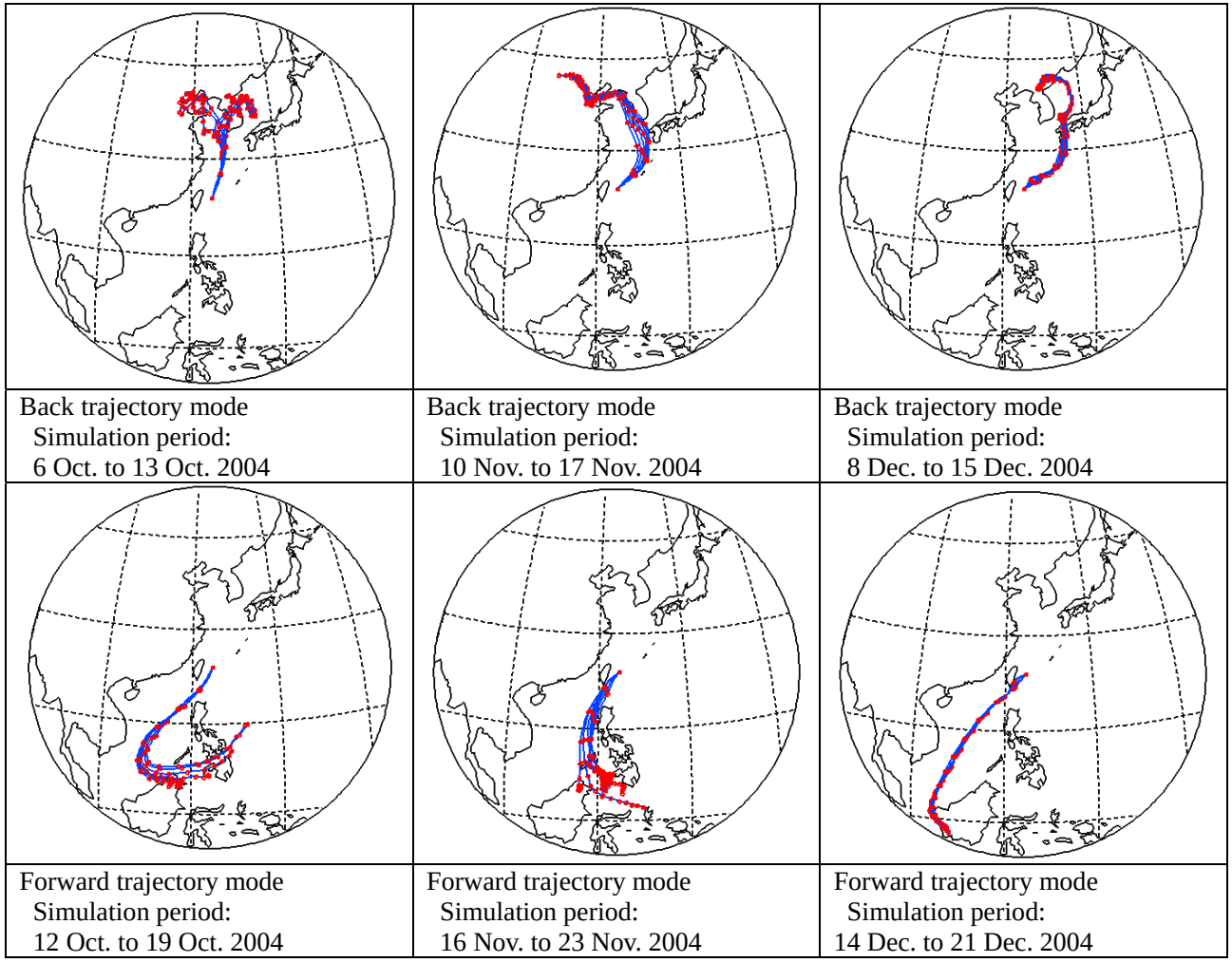


Forward trajectory mode
Simulation period:
9 Aug. to 13 Aug. 2004



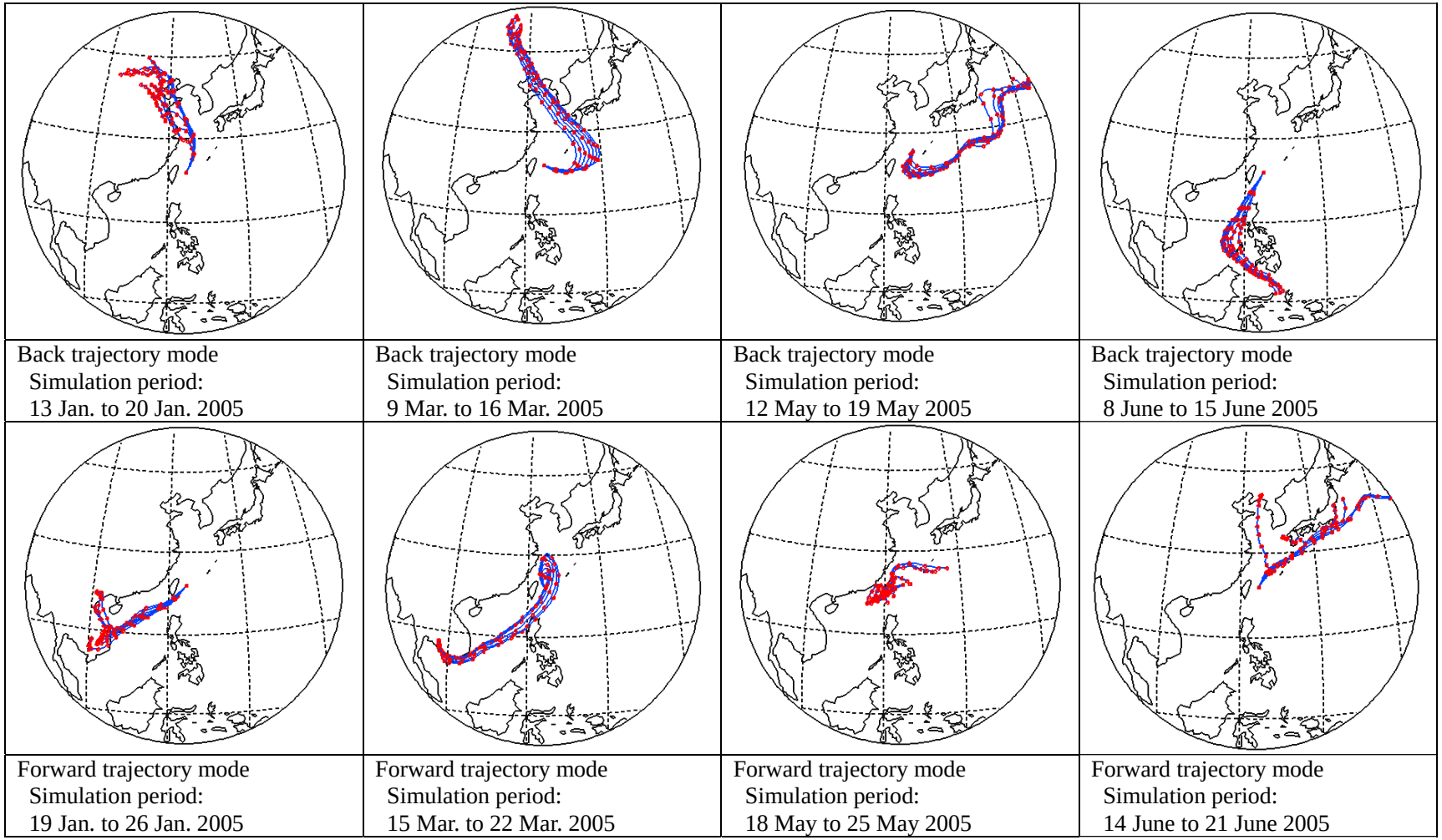
Forward trajectory mode
Simulation period:
8 Sept. to 15 Sept. 2004

Figure 10 **Trajectory Analysis of Ambient Air Collected at Hateruma Island in Japan.**



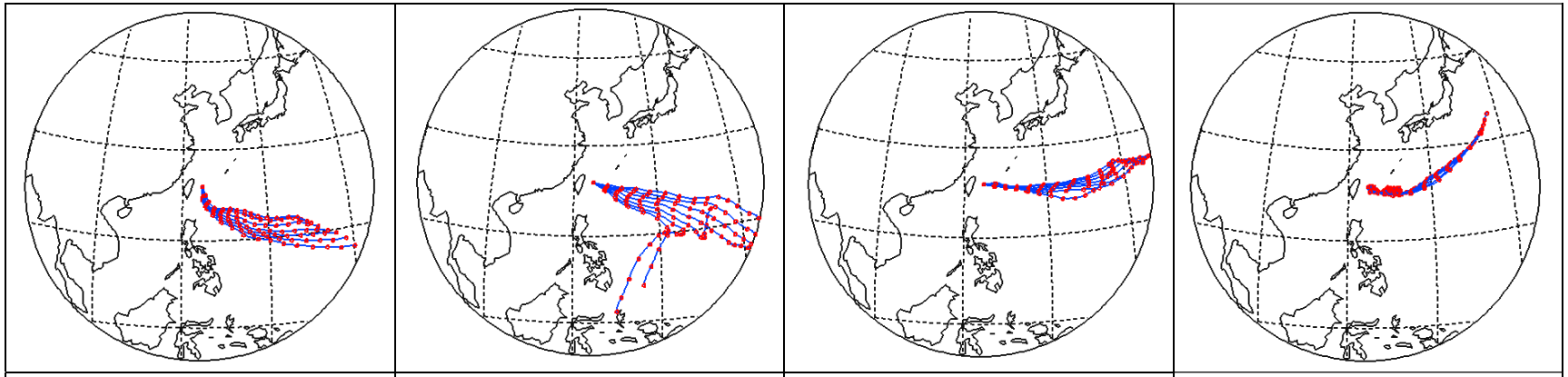
Back trajectory mode Simulation period: 6 Oct. to 13 Oct. 2004	Back trajectory mode Simulation period: 10 Nov. to 17 Nov. 2004	Back trajectory mode Simulation period: 8 Dec. to 15 Dec. 2004
Forward trajectory mode Simulation period: 12 Oct. to 19 Oct. 2004	Forward trajectory mode Simulation period: 16 Nov. to 23 Nov. 2004	Forward trajectory mode Simulation period: 14 Dec. to 21 Dec. 2004

Figure 11 **Trajectory Analysis of Ambient Air Collected at Hateruma Island in Japan.**



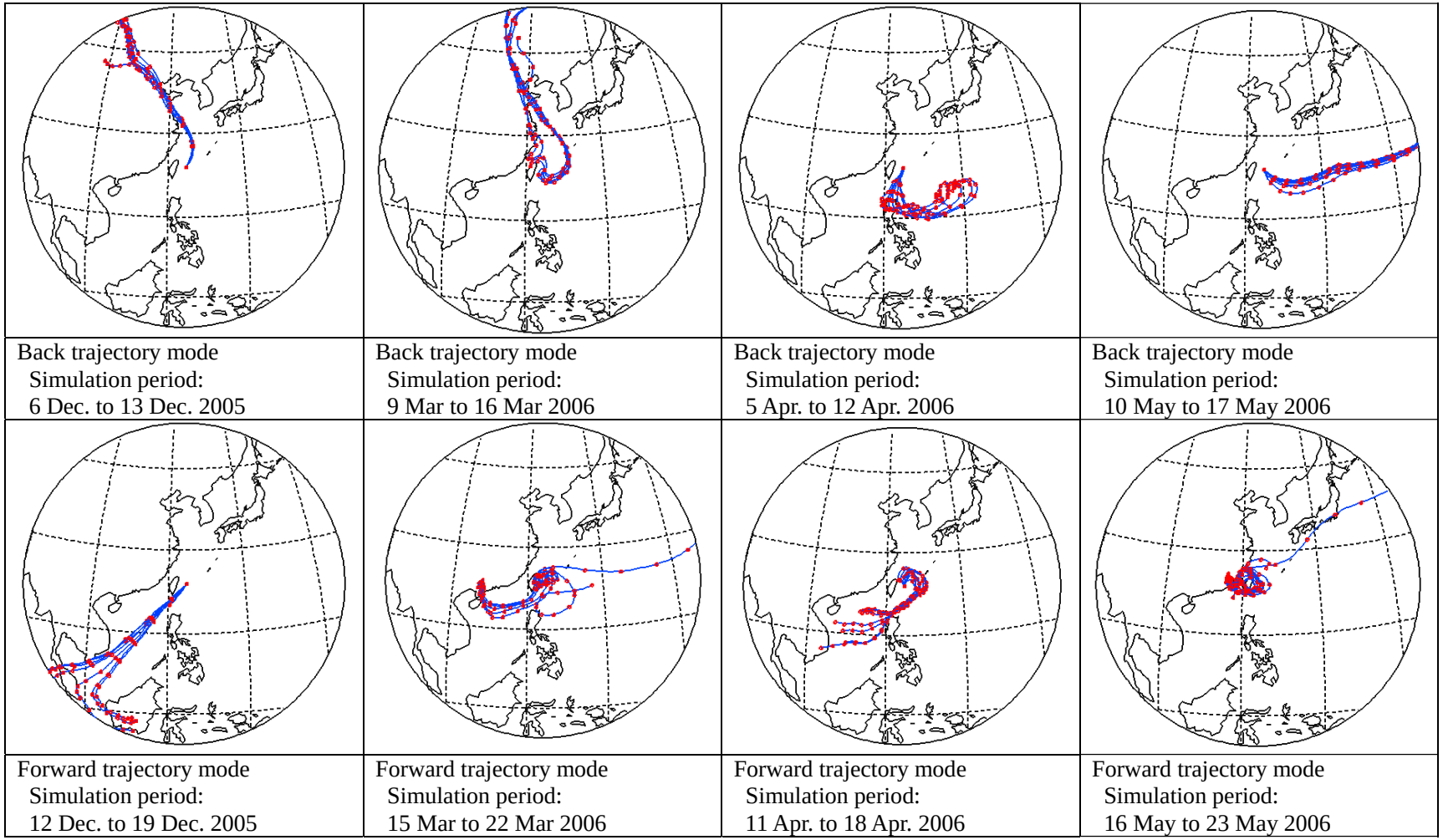
Back trajectory mode Simulation period: 13 Jan. to 20 Jan. 2005	Back trajectory mode Simulation period: 9 Mar. to 16 Mar. 2005	Back trajectory mode Simulation period: 12 May to 19 May 2005	Back trajectory mode Simulation period: 8 June to 15 June 2005
Forward trajectory mode Simulation period: 19 Jan. to 26 Jan. 2005	Forward trajectory mode Simulation period: 15 Mar. to 22 Mar. 2005	Forward trajectory mode Simulation period: 18 May to 25 May 2005	Forward trajectory mode Simulation period: 14 June to 21 June 2005

Figure 12 Trajectory Analysis of Ambient Air Collected at Hateruma Island in Japan.



Back trajectory mode Simulation period: 6 July to 13 July 2005	Back trajectory mode Simulation period: 3 Aug. to 10 Aug. 2005	Back trajectory mode Simulation period: 7 Sept. to 14 Sept 2005	Back trajectory mode Simulation period: 2 Nov. to 9 Nov. 2005
Forward trajectory mode Simulation period: 12 July to 19 July 2005	Forward trajectory mode Simulation period: 9 Aug. to 16 Aug. 2005	Forward trajectory mode Simulation period: 13 Sept. to 20 Sept. 2005	Forward trajectory mode Simulation period: 8 Nov. to 15 Nov. 2005

Figure 13 Trajectory Analysis of Ambient Air Collected at Hateruma Island in Japan.



Back trajectory mode Simulation period: 6 Dec. to 13 Dec. 2005	Back trajectory mode Simulation period: 9 Mar to 16 Mar 2006	Back trajectory mode Simulation period: 5 Apr. to 12 Apr. 2006	Back trajectory mode Simulation period: 10 May to 17 May 2006
Forward trajectory mode Simulation period: 12 Dec. to 19 Dec. 2005	Forward trajectory mode Simulation period: 15 Mar to 22 Mar 2006	Forward trajectory mode Simulation period: 11 Apr. to 18 Apr. 2006	Forward trajectory mode Simulation period: 16 May to 23 May 2006

Figure 14 **Trajectory Analysis of Ambient Air Collected at Hateruma Island in Japan.**

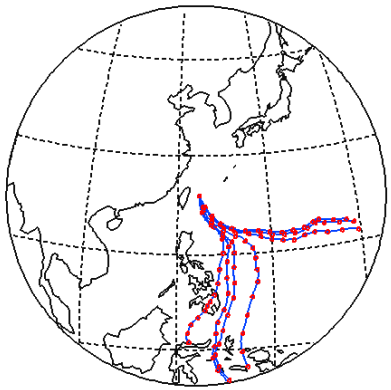
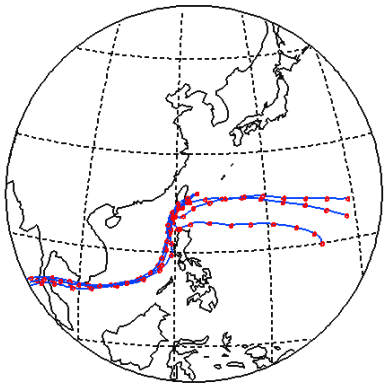
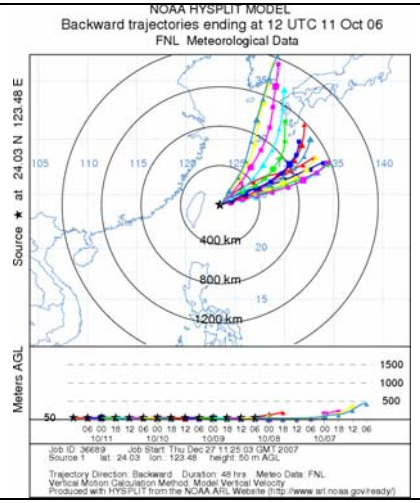
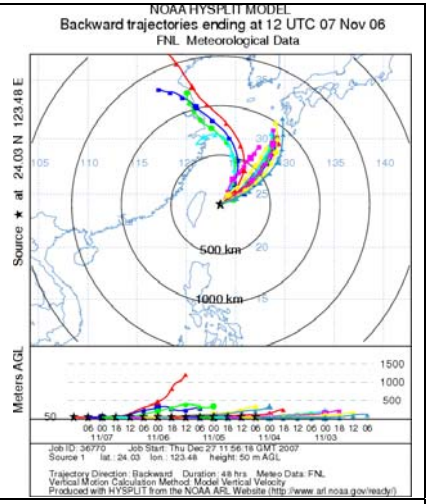
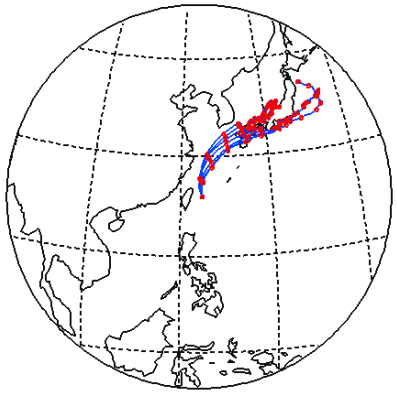
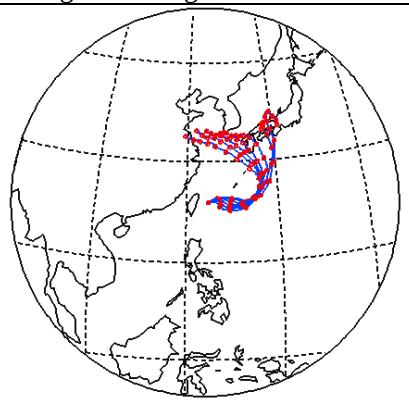
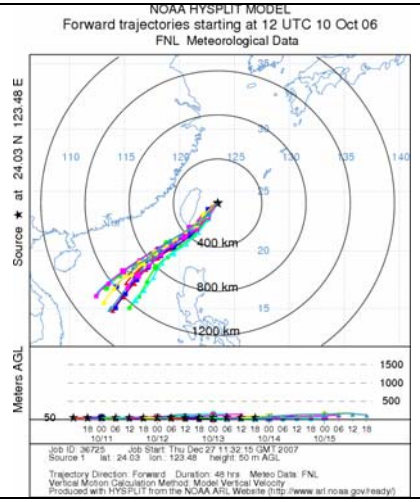
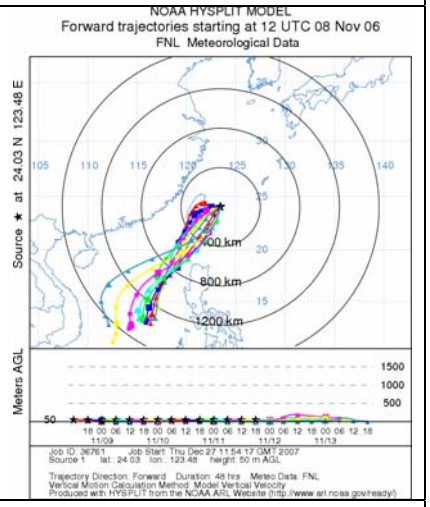
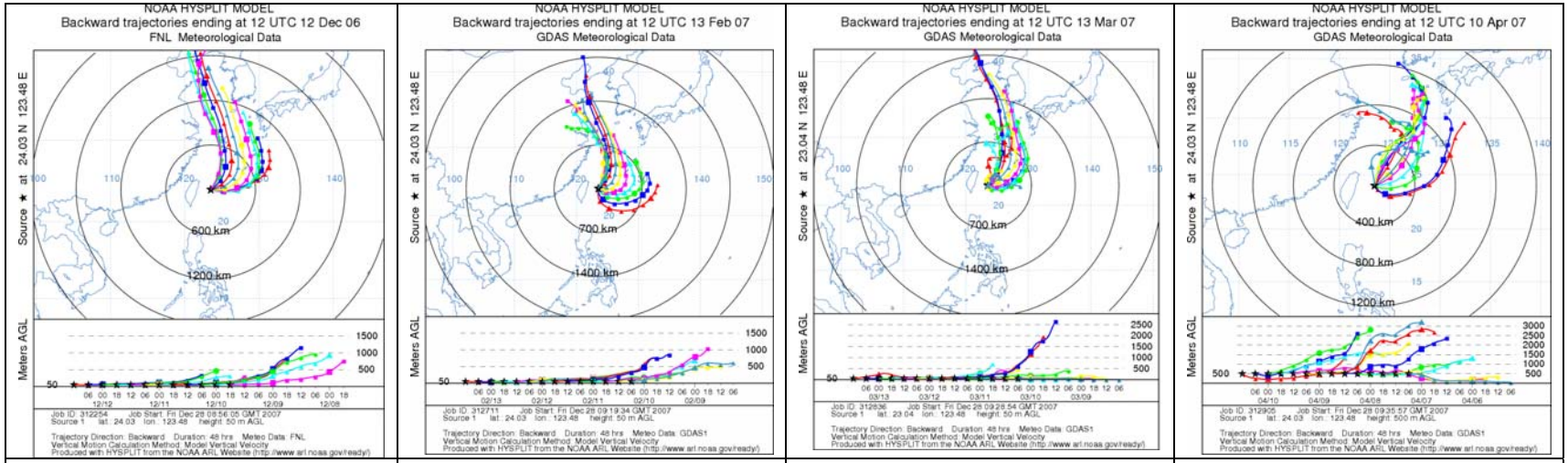
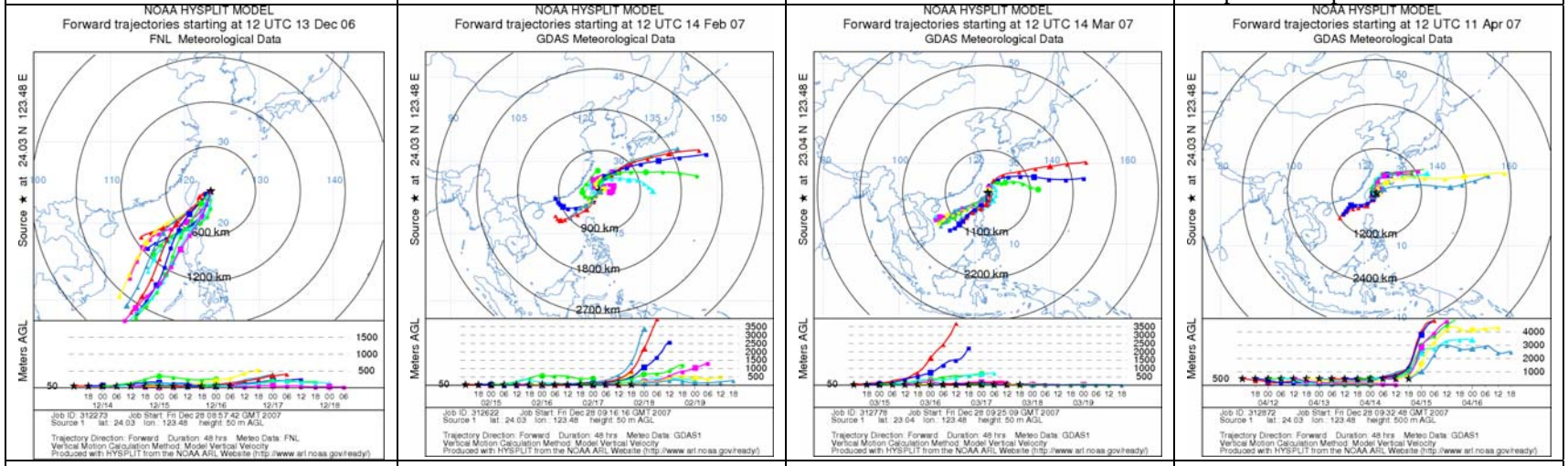
			
Back trajectory mode Simulation period: 10 July to 17 July 2006	Back trajectory mode Simulation period: 9 Aug. to 16 Aug. 2006	Back trajectory mode Simulation period: 4 Oct. to 11 Oct. 2006	Back trajectory mode Simulation period: 1 Nov. to 8 Nov. 2006
			
Forward trajectory mode Simulation period: 16 July to 23 July 2006	Forward trajectory mode Simulation period: 15 Aug. to 22 Aug. 2006	Forward trajectory mode Simulation period: 10 Oct. to 17 Oct. 2006	Forward trajectory mode Simulation period: 7 Nov. to 14 Nov. 2006

Figure 15 **Trajectory Analysis of Ambient Air Collected at Hateruma Island in Japan.**

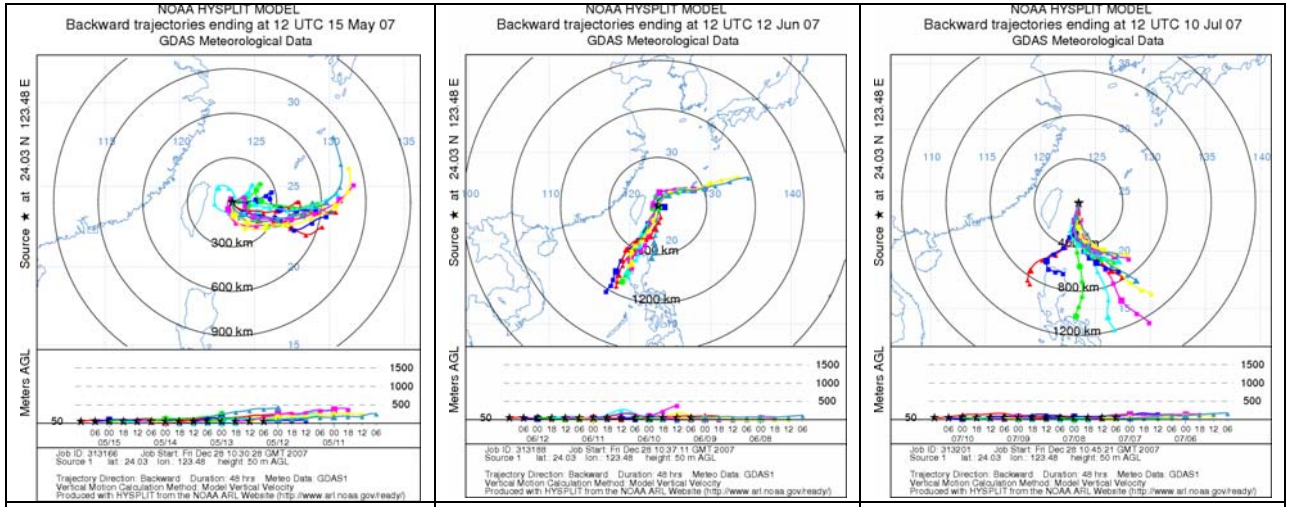


Back trajectory mode Simulation period: 6 Dec. to 13 Dec. 2006	Back trajectory mode Simulation period: 7 Feb. to 14 Feb. 2007	Back trajectory mode Simulation period: 7 Mar. to 14 Mar. 2007	Back trajectory mode Simulation period: 4 Apr. to 11 Apr. 2007



Forward trajectory mode Simulation period: 13 Dec. to 20 Dec. 2006	Forward trajectory mode Simulation period: 13 Feb. to 20 Feb. 2007	Forward trajectory mode Simulation period: 13 Mar. to 20 Mar. 2007	Forward trajectory mode Simulation period: 10 Apr. to 17 Apr. 2007

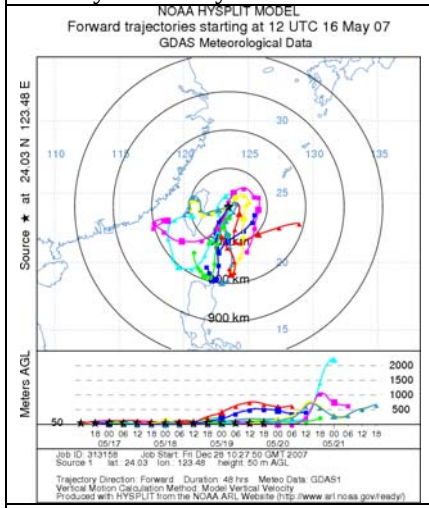
Figure 16 Trajectory Analysis of Ambient Air Collected at Hateruma Island in Japan.



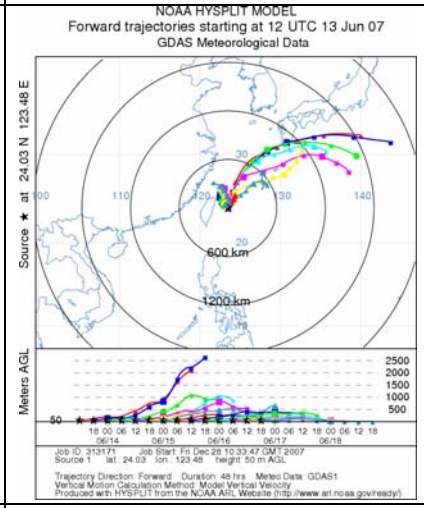
Back trajectory mode
Simulation period:
9 May to 16 May 2007

Back trajectory mode
Simulation period:
6 June to 13 June 2007

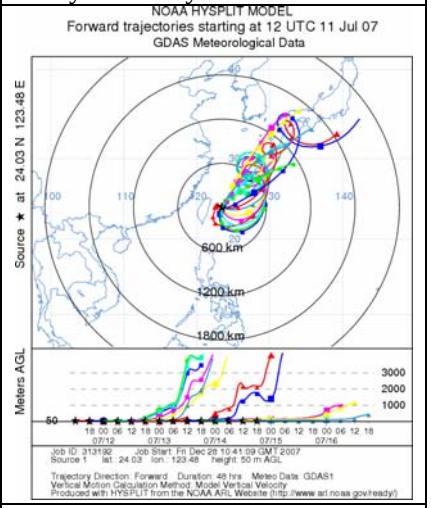
Back trajectory mode
Simulation period:
4 July to 11 July 2007



Forward trajectory mode
Simulation period:
15 May to 22 May 2007



Forward trajectory mode
Simulation period:
12 June to 19 June 2007



Forward trajectory mode
Simulation period:
10 July to 17 July 2007

Figure 17 Trajectory Analysis of Ambient Air Collected at Hateruma Island in Japan.

4.5 POPs Concentrations in Ambient Air Samples in Republic of Korea

The trial monitoring of POPs in ambient air in Republic of Korea at two sampling sites were conducted by their own activities. Air samplings were carried out with HV air samplers for 24 hours.

1) Responsible Local Organisation

Republic of Korea
Dr. Jong-Woo CHOI, Researcher, Environmental Measurement Standards Division, National Institute of Environmental Research

2) Air Monitoring in 2006 and 2007

a) Sampling locations

These sampling sites are located at about 160km southeast (Goisan) and 150 km southwest of Seoul (Taean), respectively (see **Figure 18**). These sampling sites are available micro-meteorological information because there are Background Air Monitoring Station of Korea.

<**Goisan**>

This place is a rural area surrounded by mountain, of which population is approximately 300, located at about 160 km apart to the southeast from Seoul. At this place, for checking a background air quality, 'Local Ambient Air Monitoring Station' is installed and operated (Duckpyungri Chungchunmyun Goisangun Choongchungbukdo, Republic of Korea) (Fig.1). From the station, meteorological information, such as temperature, humidity, wind direction and velocity, can be obtained together with SO_2, CO, O_3, NOx, PM-10, etc.

- Latitude: N 36° 43′ 41.407″ Longitude: E 127° 48′ 35.066″
- Approximately 172m above sea level
- Air Quality : SO_2 0.002 ppm/year, NO_2 0.005~0.007 ppm/year, O_3 0.017~0.028 ppm/year, CO 0.6~0.7 ppm/year, and PM-10 45~54 pg/m^3/year

<**Taean**>

This place is a coastal area of West Sea, of which population is approximately 200, located at abo ut 150 km apart to the southwest from Seoul. Also, in order to check a background air quality, 'National Ambient Air Monitoring Station' is installed and operated (Padori Sowonmyun Taeangun Choongchungnamdo) (Fig.1). From the station, meteorological information, such as temperature, humidity, wind direction and wind velocity, can be obtained together with SO_2, CO, O_3, NOx, PM-10, etc.

- Latitude: N 36° 44′ 03.661″ Longitude: E 126° 08′ 05.381″
- Approximately 12m above sea level
- Air Quality : SO_2 0.002~0.003 ppm/year, NO_2 0.003~0.006 ppm/year, O_3 0.035~0.042 ppm/year, CO 0.1~0.4 ppm/year, and PM-10 51~57 pg/m^3/year

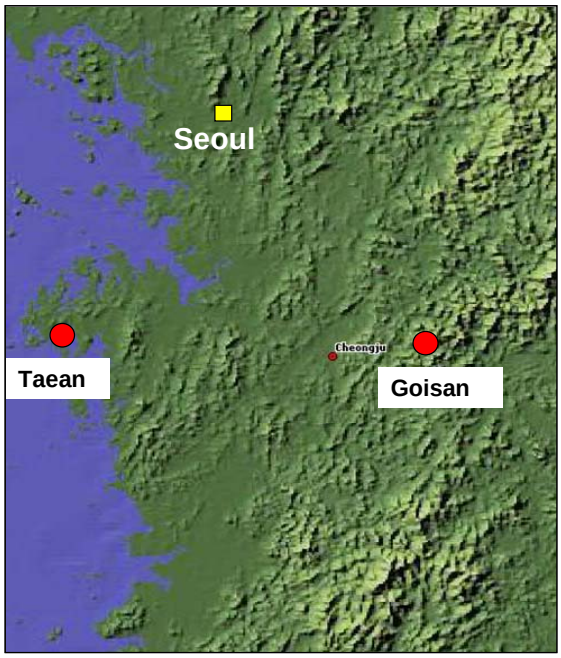


Figure 18 Map of Sampling Location in the Republic of Korea

b) Sampling Conditions

Air samplings were carried out two times at each sampling site, using two methods: one is U.S. EPA Method, the other is Japanese method proposed. To compare the sampling efficiencies or recovery rates between two methods, two method's samplings were simultaneously done for 24hr per each run, using two different types of high volume air sampler (HVAS): one is of TISCH Environmental, Inc.(model TE1000PUF), the other is of Sibata Ltd. (model 700F). Prior to starting a sampling, 2~4 ng of ^{13}C-surrogates of all target POPs were spiked onto the quartz fiber filter. The air sampling conditions are summarized in **Table 14-1 to 3.**

Table 14-1 Ambient Air Sampling Conditions in the Republic of Korea

Year		2005 (winter)		2006 (summer)			
Site		Goisan		Goisan		Taean	
Sampling Methods		EPA	Japan	EPA	Japan	EPA	Japan
Sampling time	Start	11:00 22 Feb.	11:00 22 Feb.	15:00 29 Aug.	15:00 29 Aug.	15:00 18 Aug.	15:00 18 Aug.
	End	12:25 24 Feb.	12:25 24 Feb.	16:45 31 Aug.	16:45 31 Aug.	16:45 20 Aug.	16:45 20 Aug.
Temperature (deg C)	Start	2.0	2.0	30	30	31	31
	End	1.4	1.4	29	29	28	28
Atmospheric pressure (hPa)	Start	1001	1001	989	989	999	999
	End	996	996	985	985	1002	1002
Weather	Start	Sunny	Sunny	Sunny	Sunny	Sunny	Sunny
	End	Cloudy	Cloudy	Sunny	Sunny	Sunny	Sunny
Flow rate (L/min)		245	700	250	700	255	700
Sampling volume (m^3)		355	1015	362	948	340	938

Table 14-2 Ambient Air Sampling Conditions in the Republic of Korea

Year		2007 (spring)					
Site		Goisan					
Sampling Methods		EPA	Japan	EPA	Japan	EPA	Japan
Sampling time	Start	10:00 14 Mar.	10:00 14 Mar.	10:10 15 Mar.	10:10 15 Mar.	10:15 16 Mar.	10:15 16 Mar.
	End	10:00 15 Mar.	10:00 15 Mar.	10:10 16 Mar.	10:10 16 Mar.	10:15 17 Mar.	10:15 17 Mar.
Temperature (deg C)	Start	6.6	6.6	9.8	9.8	10.2	10.2
	End	9.6	9.6	10.1	10.1	9.9	9.9
Atmospheric pressure (hPa)	Start	999.2	999.2	995.4	995.4	999.2	999.2
	End	995.3	995.3	999.1	999.1	999.5	999.5
Weather	Start	Sunny	Sunny	Sunny	Sunny	Cloudy	Cloudy
	End	Sunny	Sunny	Sunny	Sunny	Cloudy	Cloudy
Flow rate (L/min)		225	700	225	700	225	700
Sampling volume (m^3)		387	1009	387	1009	387	1009

Table 14-3 Ambient Air Sampling Conditions in the Republic of Korea

Year		2007 (spring)							
Site		Taean							
Sampling Methods		EPA	Japan	EPA	Japan	EPA	Japan	EPA	Japan
Sampling time	Start	10:00 27 Mar.	10:00 27 Mar.	10:10 28 Mar.	10:10 28 Mar.	10:00 30 Mar.	10:00 30 Mar.	10:15 31 Mar.	10:15 31 Mar.
	End	10:00 28 Mar.	10:00 28 Mar.	10:10 29 Mar.	10:10 29 Mar.	10:00 31 Mar.	10:00 31 Mar.	10:15 1 Apr.	10:15 1 Apr.
Temperature (deg C)	Start	13.9	13.9	11.8	11.8	12.7	12.7	11.1	11.1
	End	11.7	11.7	12.6	12.6	11.2	11.2	12.2	12.2
Atmospheric pressure (hPa)	Start	1013.5	1013.5	1007.8	1007.8	1015.4	1015.4	1006.5	1006.5
	End	1007.3	1007.3	1015.3	1015.3	1006.3	1006.3	1013.6	1013.6
Weather	Start	Cloudy	Cloudy	Cloudy	Cloudy	Cloudy	Cloudy	Cloudy	Cloudy
	End	Cloudy	Cloudy	Cloudy	Cloudy	Cloudy	Cloudy	Cloudy	Cloudy
Flow rate (L/min)		225	700	225	700	700	700	700	700
Sampling volume (m^3)		376	1009	393	1009	1015	1009	1006	1009
Others				Weak Yellow Sand (PM-10 : 475 ug/ m^3)				Strong Yellow Sand (PM-10 : 1250 ug/ m^3 more than)	

c) Comparison of Recovery Rates of U.S. EPA to Japanese method

An aspiration was made at a speed of 225 L/min through quartz fiber filter (ϕ10.2 cm), double-layer PUF, and XAD-2(15 g) for EPA method, and 700 L/min through quartz fiber filter (20 x 25 cm), double-layer PUF, and active carbon fiber felt (ACF, ϕ84 mm) for Japanese method.

As a result, we got the fairly good recovery rates of ^{13}C-surrogates on target POPs except for aldrin and hexachlorobenzene (HCB). The recovery rates of whole processes, including sampling and clean-up procedures, on target POPs were 63.5% as U.S. EPA method and 88.9% as Japanese method on average, respectively. And, the recovery rates of clean-up process only were 105.7 % as EPA method and 112.4 % as Japan method on average. Also, we were able to get a good correlation between two methods with a little standard deviation to the ratio of recovery rate of EPA method to Japan method. On the whole, as for the standard deviations of recovery rates of either whole or clean-up process, EPA method showed somewhat smaller values than Japanese method.

A noticeable fact is that winter season showed the relatively smaller values of standard-deviation than summer season in recovery rates of whole process (**Table 15** and **16**).

Table 15 Comparison of U.S. EPA method and Japanese method proposed during winter season on 22-24 Feb. 2005

Surrogate Chemicals	Recovery Rates of Whole Process (%)		Recovery Rates of Clean-up Process (%)		Ratio of Recovery Rate of EPA Method to Japan Method	
	EPA Method	Japan Method	EPA Method	Japan Method	Whole Process	Clean-up Process
HCB	27	46	71	66	0.59	1.1
Aldrin	0	0	90	95		0.95
Dieldrin	82	112	110	113	0.73	0.97
Endrin	77	123	86	104	0.63	0.83
p,p'-DDE	62	85	109	111	0.73	0.98
o,p'-DDT	79	133	136	180	0.59	0.76
o,p'-DDE	62	83	102	105	0.75	0.97
trans-Chlordane	74	97	120	126	0.76	0.95
trans-Nonachlor	71	95	116	118	0.75	0.98
cis-Nonachlor	65	89	105	110	0.73	0.95
Oxychlordane	76	89	120	126	0.85	0.95
Heptachlor	70	106	72	75	0.66	0.96
Heptachlor-epoxide	74	98	103	104	0.76	0.99
Mirex	68	89	135	141	0.76	0.96
Average	64	89	106	112	0.76	0.95
S.D.	22	32.7	19.5	26.5	0.08	0.07

Table 16 Comparison of U.S. EPA method to Japanese method proposed during the summer season on 29-31 Aug. 2006

(unit: pg/m^3)

Surrogate Chemicals	Recovery Rates of Whole Process (%)		Recovery Rates of Clean-up Process (%)		Ratio of Recovery Rate of (EPA / Japan)	
	EPA Method	Japan Method	EPA Method	Japan Method	Whole Process	Clean-up Process
HCB	26	37	66	71	0.70	0.93
Aldrin	7	9	96	99	0.78	0.97
Dieldrin	106	77	76	94	1.4	0.81
Endrin	119	155	89	119	0.77	0.75
o,p'-DDD	131	136	89	112	0.96	0.79
p,p'-DDD	137	165	80	113	0.83	0.71
o,p'-DDE	97	82	109	111	1.2	0.98
p,p'-DDE	152	122	87	116	1.3	0.75
o,p'-DDT	116	127	72	85	0.91	0.85
p,p'-DDT	81	121	88	96	0.67	0.92
Trans-Chlordane	121	144	87	159	0.84	0.55
Trans-Nonachlor	121	120	108	112	1.0	0.96
Oxychlordane	113	132	88	118	0.86	0.75
Heptachlor	63	65	86	103	0.97	0.83
Heptachlor-epoxide	95	90	100	110	1.1	0.91
Mirex	96	136	100	113	0.71	0.88
Average	104.9	113.9	88.8	108.2	0.93	0.83
S.D.	31.2	35.9	11.9	19.5	0.20	0.12

d) Results of HRGC/MS Analysis

The concentrations of target POPs were determined by high resolution gas chromatograph/ high resolution mass spectrometer (HRGC/HRMS): Hewlett Packard 6890 GC coupled with AutoSpec Ultima (Micromass Co.). Selected ion monitoring for 2 ions was performed with electron impact of 36 eV above a resolution of 10,000, using a HT8 SGE column of 50 m x 0.22 mm ID x 0.25 μm. POPs concentration in ambient air samples were shown in **Table 17-1 and 17-2.**

Table 17-1 Concentrations of POPs in Ambient Air in the Republic of Korea

(unit: pg/m^3)

Chemicals	2005 (Winter)		2006 (Summer)			
	Goisan (rural area)		Goisan (rural area)		Taean (coastal area)	
	EPA	Japan	EPA	Japan	EPA	Japan
HCB	-	-	109*	70*	94*	75*
Aldrin	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Dieldrin	<0.2	<0.1	<0.2	<0.1	<0.2	<0.1
Endrin	<0.3	<0.1	<0.3	<0.1	<0.3	<0.1
o,p'-DDD	<0.1	<0.05	<0.1	<0.05	2.0*	<0.05
p,p'-DDD	<0.2	<0.1	<0.2	<0.1	<0.2	<0.1
o,p'-DDE	<0.1	0.4	<0.1	<0.05	<0.1	<0.05
p,p'-DDE	2.6	2.0	<0.06	<0.02	<0.06	<0.02
o,p'-DDT	<0.1	<0.05	<0.1	<0.05	<0.1	<0.05
p,p'-DDT	<0.3	<0.1	<0.3	<0.1	<0.3	<0.1
trans-Chlordane	<0.06	<0.02	<0.06	1.4*	<0.06	2.3*
trans-Nonachlor	<0.1	<0.05	<0.1	<0.05	<0.1	<0.05
Oxychlordane	<0.2	<0.1	<0.2	<0.1	<0.2	<0.1
Heptachlor	<0.1	<0.05	<0.1	<0.05	1.9	<0.05
Heptachlor-epoxide	<0.1	<0.05	<0.1	<0.05	<0.1	1.1
Mirex	<0.1	<0.05	<0.1	<0.05	<0.1	<0.05
Toxaphene (Parlar-26)	<3	<1	<3	<1	<3	<1
Toxaphene (Parlar-50)	<3	<1	<3	<1	<3	<1
Toxaphene (Parlar-62)	<20	<10	<20	<10	<20	<10

* : 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.

Table 17-2 Concentrations of POPs in Ambient Air in the Republic of Korea

(unit: pg/m^3)

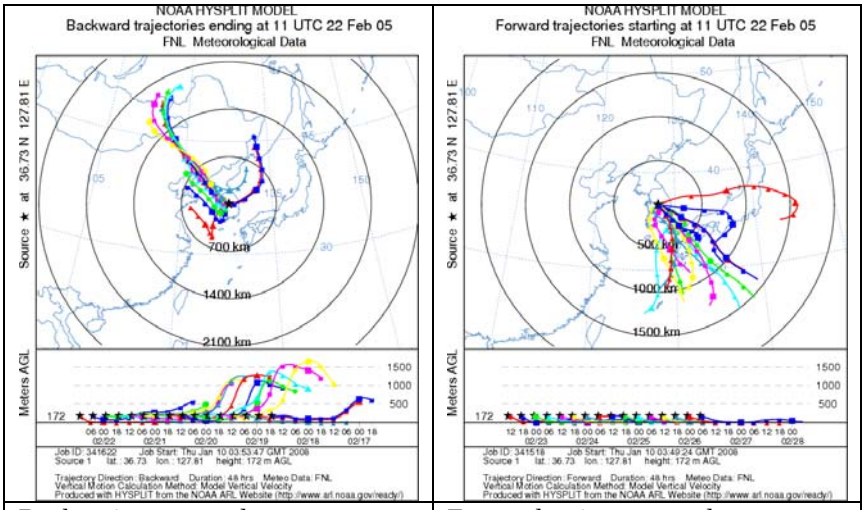
Chemicals	2007 (spring)			
	Goisan (rural area)		Taean (coastal area)	
	EPA	Japan	EPA	Japan
HCB	87.4	81.5	98.3	103.2
Aldrin	n.a.	n.a.	n.a.	n.a.
Dieldrin	<0.2.	<0.1.	<0.2.	<0.1.
Endrin	<0.3.	<0.1	<0.3.	<0.1
o,p'-DDD	<0.1	<0.05	<0.1	<0.05
p,p'-DDD	<0.2	<0.1	<0.2	<0.1
o,p'-DDE	<0.1	<0.05	1.2	1.3
p,p'-DDE	<0.06	1.8	3.9	4.8
o,p'-DDT	<0.1	<0.05	1.1	1.6
p,p'-DDT	<0.3	<0.1	1.4	1.5
trans-Chlordane	1.6	1.4	0.6	1.0
cis-Chlordane	1.5	1.3	0.5	1.1
trans-Nonachlor	<0.1	<0.05	1.4	1.2
cis-Nonachlor	<0.2.	<0.1	<0.2.	1.4
Oxychlordane	<0.2.	<0.1	<0.2.	<0.1
Heptachlor	0.3	0.4	0.9	0.5
Heptachlor-epoxide	<0.1	<0.05	<0.1	<0.05
Mirex	<0.1	<0.05	<0.1	<0.05
Toxaphene (Parlar-26)	<3	<1	<3	<1
Toxaphene (Parlar-50)	<3	<1	<3	<1
Toxaphene (Parlar-62)	<20	<10	<20	<10

n.a.: not available because surrogate recovery was out of 25 to 150 percent.

e) Results of Trajectory Analysis

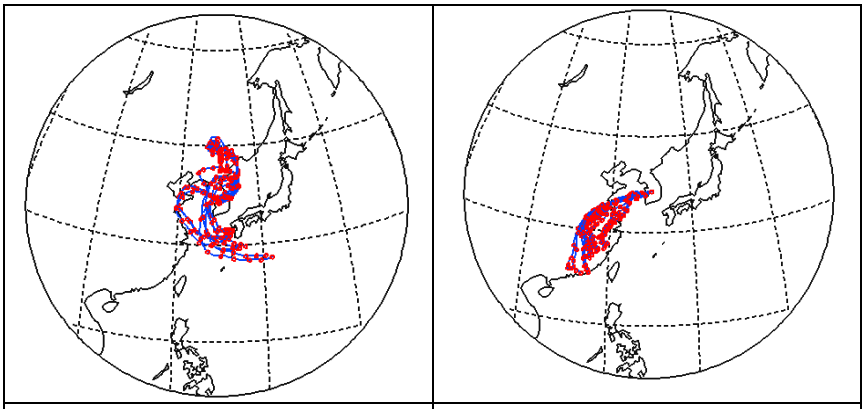
To conjecture the source of POPs in the collected air, the trajectory analysis of collected air was performed using the METEX programs. NCEP reanalysis dataset and 3D-wind model in METEX programs were used for the trajectory analysis. As a reference to vertical coordinate in the 3D-wind model, the sigma coordinate was used for trajectory calculation in both forward and backward mode.

And also to guess the source of POPs in collected air, the trajectory analysis of collected air was performed using the HYSPLIT programs. The HYSPLIT (HYbrid Single-Particle Lagrangian Integrated Trajectory) model is the latest version of a complete system for computing simple air parcel trajectories to complex dispersion and deposition simulations. This programme was developed and provided by Air Resources Laboratory of U.S. National Oceanic and Atmospheric Administration. The results of analysis were shown in **Figure 19 to 23**.



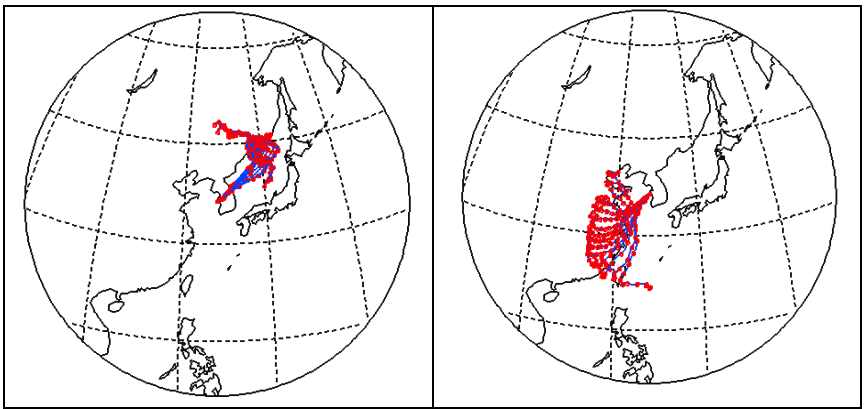
Back trajectory mode Simulation period: 15 Feb. to 22 Feb. 2005	Forward trajectory mode Simulation period: 22 Feb. to 1 Mar. 2006

Figure 19 **Trajectory Analysis of Ambient Air Collected at Goisan in the Republic of Korea in February 2005.**



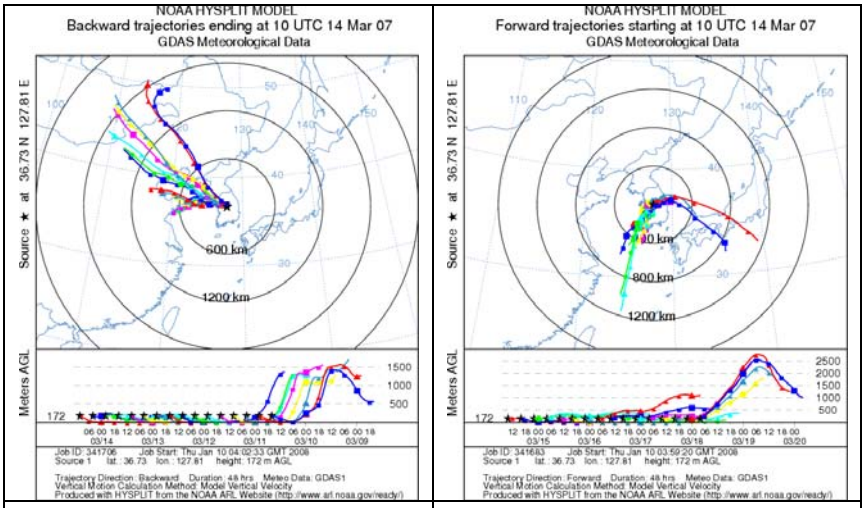
Back trajectory mode Simulation period: 24 Aug. to 31 Aug. 2006	Forward trajectory mode Simulation period: 29 Aug. to 5 Sept. 2006

Figure 20 **Trajectory Analysis of Ambient Air Collected at Goisan in the Republic of Korea in August to September 2006.**



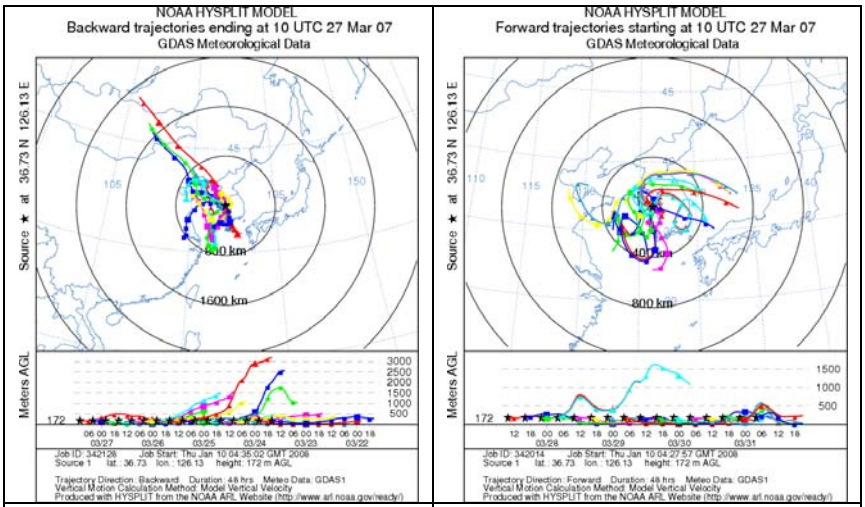
Back trajectory mode Simulation period: 13 Aug. to 20 Aug. 2006	Forward trajectory mode Simulation period: 18 Aug. to 25 Aug. 2006

Figure 21 **Trajectory Analysis of Ambient Air Collected at Taean in the Republic of Korea in August 2006.**



Back trajectory mode Simulation period: 7 Mar. to 14 Mar. 2007	Forward trajectory mode Simulation period: 14 Mar. to 21 Mar. 2007

Figure 22 Trajectory Analysis of Ambient Air Collected at Goisan in the Republic of Korea in March 2007.



Back trajectory mode Simulation period: 20 Mar. to 27 Mar. 2007	Forward trajectory mode Simulation period: 27 Mar. to 3 Apr. 2007

Figure 23 Trajectory Analysis of Ambient Air Collected at Taean in the Republic of Korea on 27 March - 1 April 2007.

These results of back and forward trajectory analyses indicated the possibilities of long-range transportation of POPs. The transport speed of air mass was relatively faster in upper atmosphere than lower. Long-range transportation of POPs was possibly assumed by back trajectory analysis. However, the trajectory data of more than 3 days before or after (might) demand caution in the data analysis due to its less reliability.

f) Consumption of OCPs in Republic of Korea

Korean government had already banned the usage, production, and import of organo-chlorine pesticides (OCPs) before 1980. **Table 18** shows the consumption of OCPs in the Republic of Korea.

Table 18 Consumption of POPs (OCPs) at agriculture in the Republic of Korea

Chemicals	Consumption (ton, A.I.)	Period
Drins(Aldrin, Dieldrin, Endrin, Isodrin)	**147.2**	**1962~1972**
Chlordane	**3**	**1965~1969**
Heptachlor	**597.4**	**1962~1979**
Hexachlorobezene	**0**	**-**
Mirex	**0**	**-**
Toxaphene	**200.7**	**1969~1980**
DDT	**1,063.5**	**1948~1971**

*** A.I. : Active Ingredient**

g) In future issues

- Both Korea and Japan will try to solve the low recovery rates of aldrin.
- In order to guess the source of POPs in the region of East Asia, Korea will keep on the POPs monitoring in ambient air with increasing the sampling sites, including Goisan, Taean, and Kosan located at Jeju Island.

4.6 POPs Concentrations in Ambient Air Samples in Mongolia

1) Ownership of Data and a Person in Charge

Mongolia
Mr. Purevdorj Battulga, Department of International Cooperation, Ministry of Nature and Environment
Dr. Enkhsaruul Byambajav, Department of Organic Chemistry, Faculty of Chemistry, National University of Mongolia

2) Air Monitoring Data in 2006

a) Sampling Location (see **Figure 24**)
This sampling site is located about 80 km north-east of Uulaanbaatar.
- 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 - Uulaanbaatar.
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.

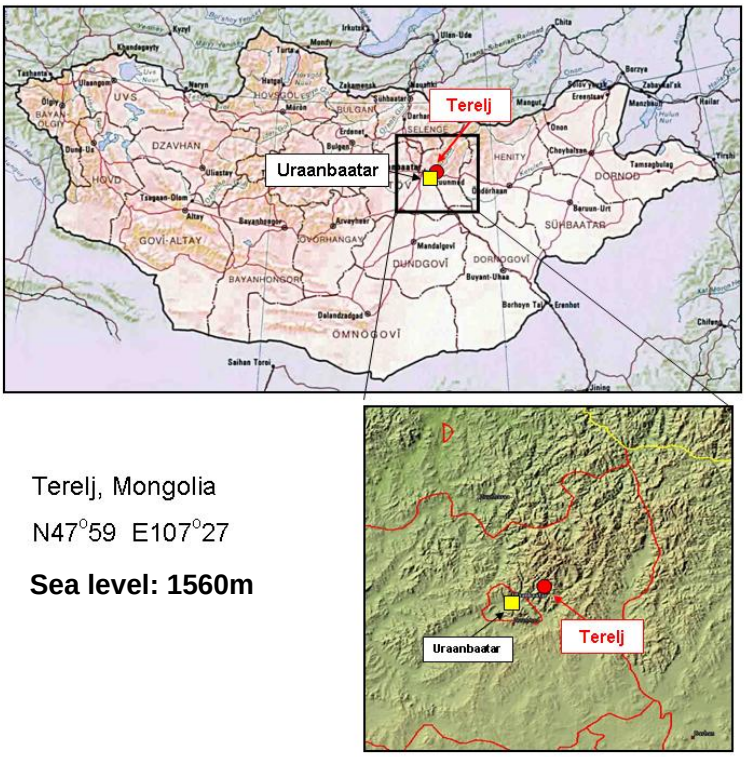


Figure 24 **Map of Sampling Location in Mongolia in 2006**

b) Sampling Records and Meteorological Information

Air sampling records were summarized in **Table 19** and meteorological information were shows in **Table 20.**

Table 19 Sampling Record in Terelj, Mongolia

		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 (°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 20 Meteorological Information Observed in Terelj

	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. (°C)	17.4	16.8	6	2.8
Min. temp. (°C)	-6.9	-3.6	-1.5	-8.2
Dry-bulb temp. . (°C)	8.3	6.9	2.1	-2.8
Wet-bulb temp. . (°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 21.** 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, *p,p'*-DDT (1.7 pg/m^3) and *cis*-heptachlorepoxide (0.64 pg/m^3) were detected. All other pesticides were not detected except HCB which was detected in very high concentration (73-114 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, 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. It shows that Mongolia is expected as a background site for air monitoring in East Asia.

Table 21 Concentrations of POPs in Ambient Air in Terelj, Mongolia on 4-6 September 2006.

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	*180*	100	62	*114*	*86*	79	54	73	*133*	90	58	*94*
Aldrin	*<0.17*	*<0.17*	*<0.17*	*<0.17*	*<0.17*	*<0.17*	*<0.17*	<0.17	*<0.17*	*<0.17*	*<0.17*	*<0.17*
Dieldrin	(0.40)	<0.29	<0.29	<0.29	(0.62)	<0.29	<0.29	(0.62)	(0.67)	<0.29	<0.29	(0.67)
Endrin	<0.38	<0.38	<0.38	<0.38	<0.38	<0.38	<0.38	<0.38	(0.48)	<0.38	<0.38	<0.38
p,p'-DDT	(1.5)	*<0.63*	<0.63	1.5	1.9	<0.63	<0.63	1.9	1.7	<0.63	<0.63	1.7
p,p'-DDE	0.53	<0.38	<0.38	0.53	0.65	(0.40)	<0.38	0.53	0.59	<0.38	<0.38	0.59
p,p'-DDD	<0.45	<0.45	<0.45	<0.45	<0.45	<0.45	<0.45	<0.45	<0.45	<0.45	<0.45	<0.45
o,p'-DDT	0.60	<0.46	<0.46	<0.46	0.52	<0.46	<0.46	<0.46	<0.46	<0.46	<0.46	<0.46
o,p'-DDE	<0.19	<0.19	<0.19	<0.19	<0.19	<0.19	<0.19	<0.19	<0.19	<0.19	<0.19	<0.19
o,p'-DDD	<0.43	<0.43	<0.43	<0.43	<0.43	<0.43	<0.43	<0.43	<0.43	<0.43	<0.43	<0.43
trans-Chlordane	<0.58	<0.58	<0.58	<0.58	<0.58	<0.58	<0.58	<0.58	<0.58	<0.58	<0.58	<0.58
cis-Chlordane	(0.52)	(0.57)	<0.49	(0.55)	(0.79)	(0.74)	<0.49	(0.77)	(0.66)	(0.66)	<0.49	(0.66)
trans-Nonachlor	<0.65	<0.65	<0.65	<0.65	(0.66)	<0.65	<0.65	(0.66)	(0.66)	<0.65	<0.65	(0.66)
cis-Nonachlor	<0.56	<0.56	<0.56	<0.56	<0.56	<0.56	<0.56	<0.56	<0.56	<0.56	<0.56	<0.56
Oxychlordane	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8
Heptachlor	<0.52	<0.52	<0.52	<0.52	<0.52	<0.52	<0.52	<0.52	<0.52	<0.52	<0.52	<0.52
trans-Heptachlorepoxide	<0.19	<0.19	<0.19	<0.19	<0.19	<0.19	<0.19	<0.19	<0.19	<0.19	<0.19	<0.19
cis-Heptachlorepoxide	0.54	0.75	0.54	0.61	0.58	0.93	0.52	0.68	0.56	0.84	0.53	0.64
Mirex	<0.41	<0.41	<0.41	<0.41	<0.41	<0.41	<0.41	<0.41	<0.41	<0.41	<0.41	<0.41
Toxaphene (Parlar-26)	<0.86	<0.86	<0.86	<0.86	<0.86	<0.86	<0.86	<0.86	<0.86	<0.86	<0.86	<0.86
Toxaphene (Parlar-50)	<2.6	<2.6	<2.6	<2.6	<0.86	<2.6	<2.6	<2.6	<0.86	<2.6	<2.6	<2.6
Toxaphene (Parlar-62)	<6.8	<6.8	<6.8	<6.8	<0.86	<6.8	<6.8	<6.8	<0.86	<6.8	<6.8	<6.8

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 METEX programs. NCEP reanalysis dataset and 3D-wind model in METEX programs were used for the trajectory analysis. 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 25**.

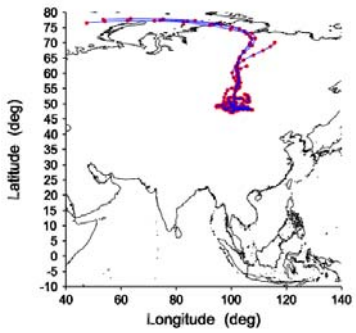
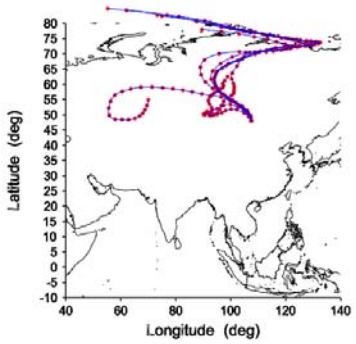
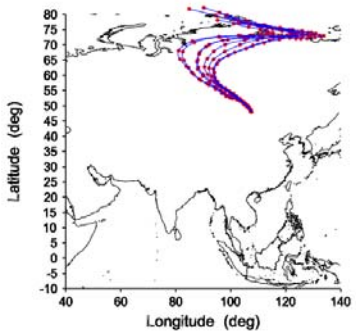
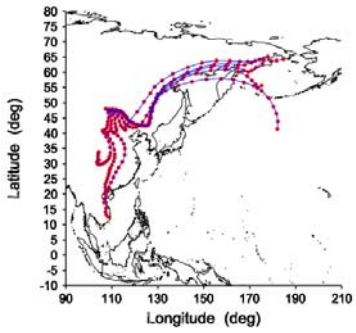
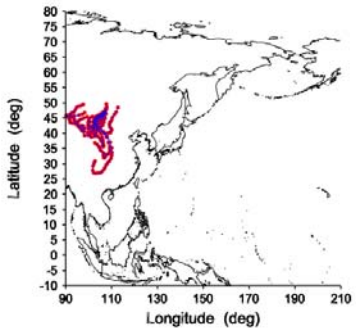
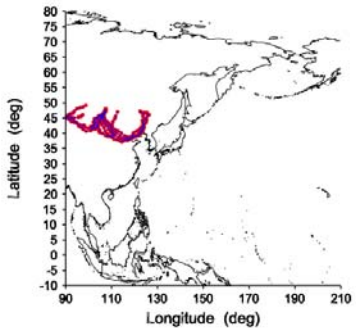
		
Back trajectory mode Simulation period: 3 Jan. to 10 Jan. 2006	Back trajectory mode Simulation period: 4 Jan. to 11 Jan. 2006	Back trajectory mode Simulation period: 5 Jan. to 12 Jan. 2006
		
Forward trajectory mode Simulation period: 9 Jan. to 16 Jan. 2006	Forward trajectory mode Simulation period: 10 Jan. to 17 Jan. 2006	Forward trajectory mode Simulation period: 11 Jan. to 18 Jan. 2006

Figure 25 Trajectory Analysis of Ambient Air Collected in Terelj, Mongolia on 4-7 September 2006.

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.

4.7 POPs Concentrations in Ambient Air Samples in the Philippines

1) Ownership of Data and a Person in Charge

Republic of the Philippines
Dr., Prof. Evangeline Santiago, Head, Research and Analytical Service Laboratory, Natural Sciences Research Institute

2) Air Monitoring Data in 2006

a) Sampling Location (see **Figure 26**)
This sampling site is located about 200 km north of Manila.
- Sto Tomas Mountaine, Baguio City, Philippines
- Latitude: N16°21.488', Logitude: E120°33.456'
- Above Sea Level: 2,040m

The sampling site in Sto Tomas Mountain is used as background site for monitoring pollution from precipitation studies. The site has a structure that houses equipment (radar) for tracking low pressure area and similar weather disturbances. The site has electric generators as supplementary source of electricity for its equipment. Although it is quite far from the population center (about 30 minutes drive from Baguio City), vegetable (leafy) and fruit (strawberry) farming activities can be observed at the slopes of the mountain area.
The sampling location in the Philippines in this research has the proper conditions to background air monitoring site as follows;
1) Although this location is near from Baguio city of which population is about two hundred thirty-thousand, the above sea level is 2,000m and very high.
2) This location is available micro meteorological information such as temperature, humidity, wind direction, and wind velocity because there is precipitation observed station.
3) The electric supply is stable because there are two private power generators in this station.

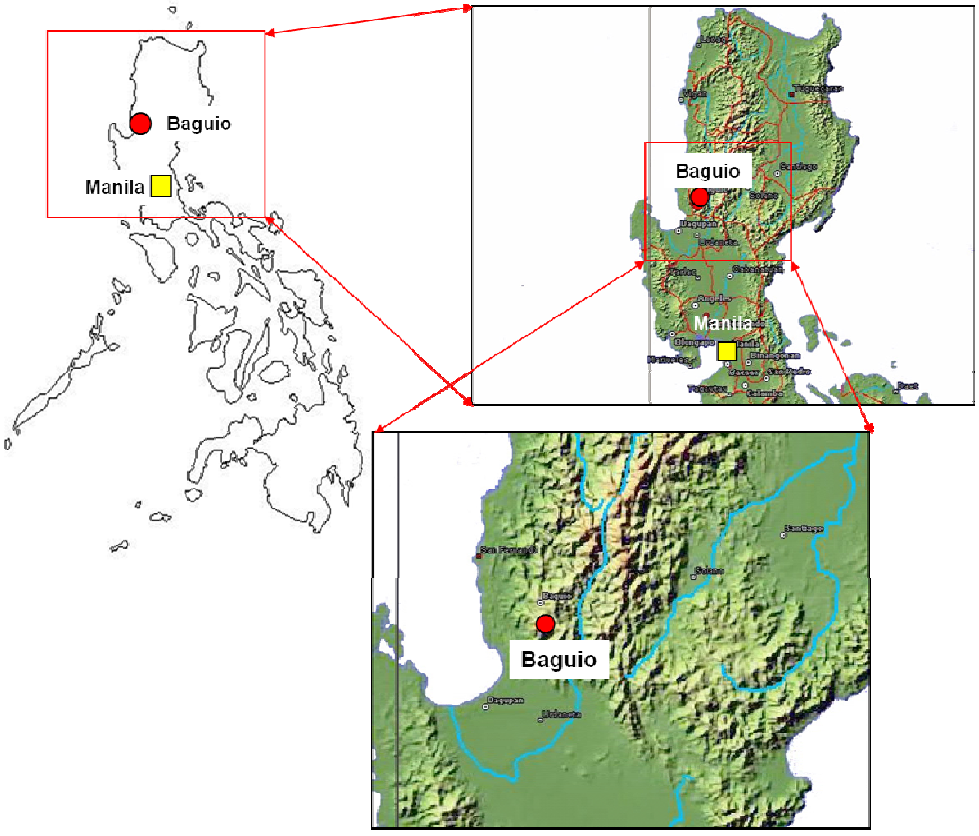


Figure 26 Map of Sampling Location in the Philippines in 2006

b) Sampling Records and Meteorological Information

Air sampling records are summarized in **Table 22** and meteorological information shows in **Table 23.**

Table 22 Sampling Record in Baguio, Philippines

		9 - 10 January 2006 (1st day)		10 - 11 January 2006 (2nd day)		11 - 12 January 2006 (3rd day)	
Sampler No.[*1]		A	B	A	B	A	B
Sampling time	Start	12:52	13:01	20:30	20:18	21:05	21:12
	End	19:21*	19:21[*2]	20:30	20:18	21:05	21:12
Temperature (DegC)	Start	19.7	19.2	17.2	14.2	15.1	15.5
	End	15.7	15	16.3	14.7	15.6	14.9
Atmospheric Pressure (hPa)	Start	801	798.9	799.5	803.6	804.2	800.1
	End	798.9	803.6	800.1	804.6	799.5	804.2
Weather	Start	foggy	foggy	foggy	foggy	fine	fine
	End	foggy	foggy	fine	fine	foggy	foggy
Flow Rate (L/min)		700	700	650	700	650	700
Sampling Volume (m^3)		943.6[*2]	1008	954.2[*2]	1007.9	935.9	1007.8

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

*2: Power supply was cut off at 7:30 a.m. because of the failure of private power generator.
It took long to repair the generator for 6 hours. Air sampling was restarted without replacing of filter at 1:21 p.m.

*3: PUF was pressed flat.

Table 23 Meteorological Information Observed in Sto Tomas Observing Station

	2006/1/9	2006/1/10	2006/1/11	2006/1/12
Wind direction	SW	SW	N	SE
Wind velocity (m/s)	1	2	0	1
Max. temp. (DegC)	17.2	18.5	19	22
Min. temp. (DegC)	9.2	10.8	9.8	11.3
Dry-bulb temp.(℃)	12.2	14	13	19
Wet-bulb temp.(℃)	10.1	13.3	11.6	12.5

c) Results of HRGC/MS Analysis

Concentrations of POPs in ambient air collected by duplicate sampling are shown in **Table 24.** These concentrations were determined according to Monitoring Surveillance Manual for POPs and Their Related Compounds (2006).

d) Discussion

- Average %Recovery in samples for surrogates of Aldrin (8.3), Heptachlor (36) were below acceptable values. The average % Recovery for HCB (50) was lower than most surrogate OCPs (62-96).
- % Recovery in blanks for surrogates of Aldrin (49) and Heptachlor (23) and HCB (27) were also low.
- Chlordanes were detected in highest concentrations (1.6-4.3 pg/m^3) in air samples
- Nonachlors were second highest (1.2- 2.6 pg/m^3).
- Heptachlor is third most prevalent (0.9-1.8 pg/m^3).
- p,p' DDT and p,p' DDE were detected in concentrations from 0.73-1.4 pg/m^3 and o,p' DDT and o,p' DDE 0.18-1.0 pg/m^3.
- Dieldrin was detected in concentrations from 0.50-1.3 pg/m^3.
- Mirex was detected at concentrations slightly higher than the travel and method blank levels.
- All other pesticides were not detected except HCB which was detected in very high concentration. HCB was detected in high concentrations (83-140 pg/m^3), however, this compound was never registered in the Philippines as a pesticide.

Table 24 Concentrations of POPs in Ambient Air in Baguio, Philippines on 9-12 January 2006.

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	140	140	100	130	130	83	99	91	140	110	100	110
Aldrin	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Dieldrin	0.97	0.86	1.3	1	0.54	0.50	0.93	0.715	0.76	0.68	1.1	0.88
Endrin	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
p,p'-DDT	1.1	1.4	1.0	1.2	0.73	0.87	0.92	0.90	0.92	1.1	0.96	1.0
p,p'-DDE	0.95	1.2	0.82	1.0	0.77	0.76	0.76	0.8	0.86	1.0	0.79	0.88
p,p'-DDD	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07
o,p'-DDT	0.77	1.0	0.71	0.83	0.58	0.58	0.55	0.57	0.68	0.79	0.63	0.70
o,p'-DDE	0.33	0.30	0.18	0.27	0.26	0.17	0.18	0.18	0.30	0.24	0.18	0.22
o,p'-DDD	(0.055)	(0.071)	(0.049)	(0.058)	(0.066)	(0.070)	(0.061)	(0.066)	(0.061)	(0.071)	(0.055)	(0.062)
trans-Chlordane	4.3	3.8	3.8	4.0	3.6	2.4	3.5	3.0	4.0	3.1	3.7	3.5
cis-Chlordane	2.6	2.5	2.4	2.5	2.4	1.6	2.5	2.1	2.5	2.1	2.5	2.3
trans-Nonachlor	1.9	2.1	1.8	2	1.8	1.2	1.9	1.6	1.9	1.7	1.9	1.7
cis-Nonachlor	0.45	0.46	0.35	0.42	0.30	0.29	0.32	0.31	0.38	0.38	0.34	0.36
Oxychlordane	0.31	0.29	0.26	0.29	0.25	0.20	0.25	0.23	0.28	0.25	0.26	0.26
Heptachlor	*1.5*	1.6	*1.7*	*1.6*	1.3	*0.9*	*1.8*	*1.4*	*1.4*	1.3	*1.8*	*1.5*
trans-Heptachlorepoxide	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
cis-Heptachlorepoxide	0.41	0.44	0.33	0.39	0.34	0.27	0.32	0.30	0.38	0.36	0.33	0.34
Mirex	0.013	0.082	0.12	0.072	(0.011)	0.13	0.11	0.12	0.012	0.11	0.12	0.10
Toxaphene (Parlar-26)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Toxaphene (Parlar-50)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Toxaphene (Parlar-62)	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14

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 METEX programs. NCEP reanalysis dataset and 3D-wind model in METEX programs were used for the trajectory analysis. 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 25**. The results of analysis showed in **Figure 27**.

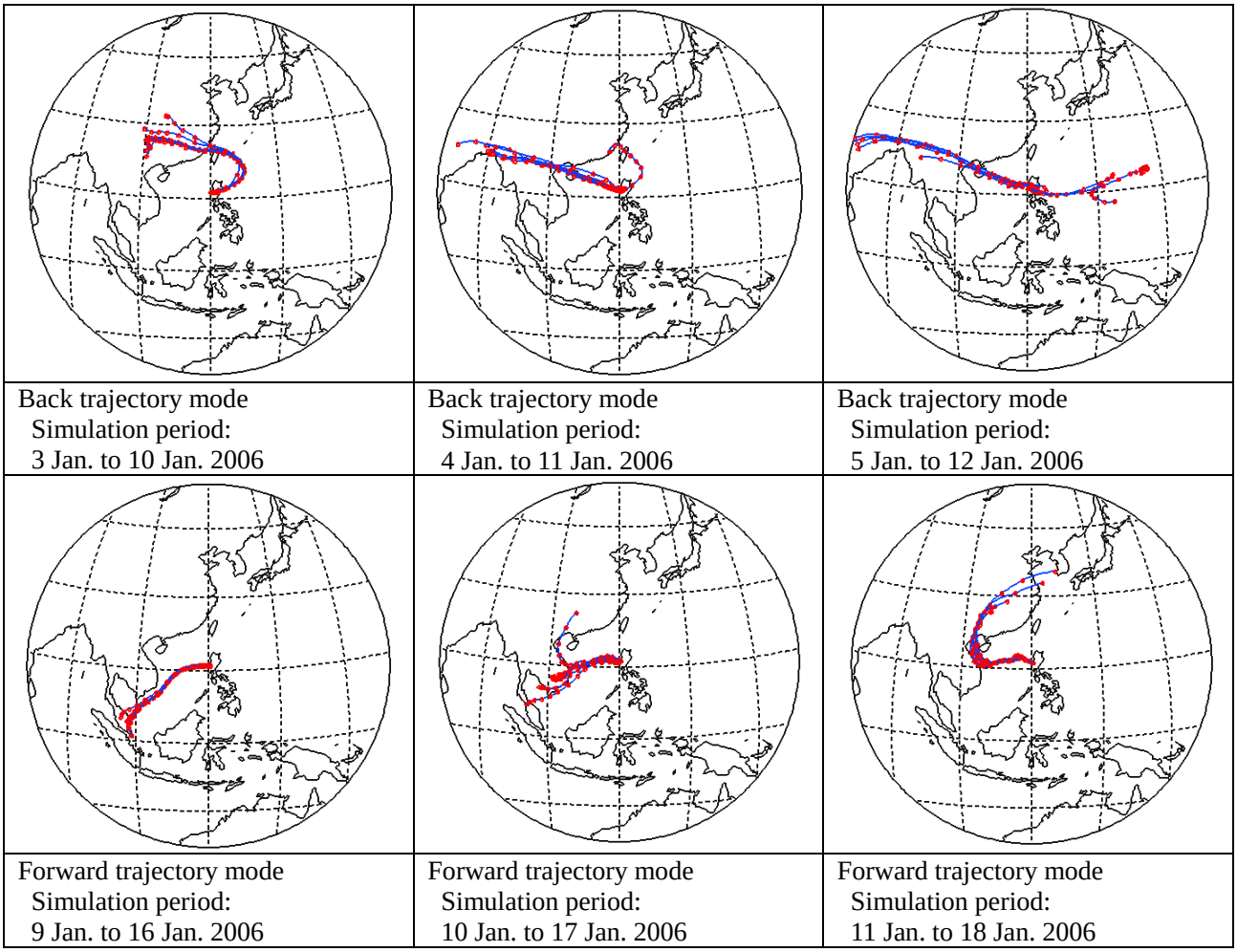


Figure 27 Trajectory Analysis of Ambient Air Collected in Baguio, Philippines on 9–12 January 2006.

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.

4.8 POPs Concentrations in Ambient Air Samples in Thailand

1) Ownership of Data and a Person in Charge

Thailand
Ms. Nuchida Rungthawornwong, Environmental Officer, Waste and Hazardous Substance Management Bureau, Pollution Control Department, Ministry of Natural Resources and Environment.

2) Air Monitoring Data in 2006

a) Sampling Location

This sampling site is located about 70 km north of Bangkok (see **Figure 28**)
- Ayutthaya, Thailand
- Latitude: N14°21.3' Logitude: E100°21.3'
- Above sea level: 300m

This sampling site, Ayutthaya, is located in the flat river plain of the Chao Phraya River valley making the province a major rice farming area. Ayutthaya covers the area of 2,556.6 km^2 and there are 727,277 inhabitants. The population density is 284 inhabitants/km^2. The sampling site is located in town surrounded by tourist attractions. The micro meteorological information is available such as temperature, humidity, wind direction, and wind velocity as it is a permanent air sampling station. The electric supply is generally stable.

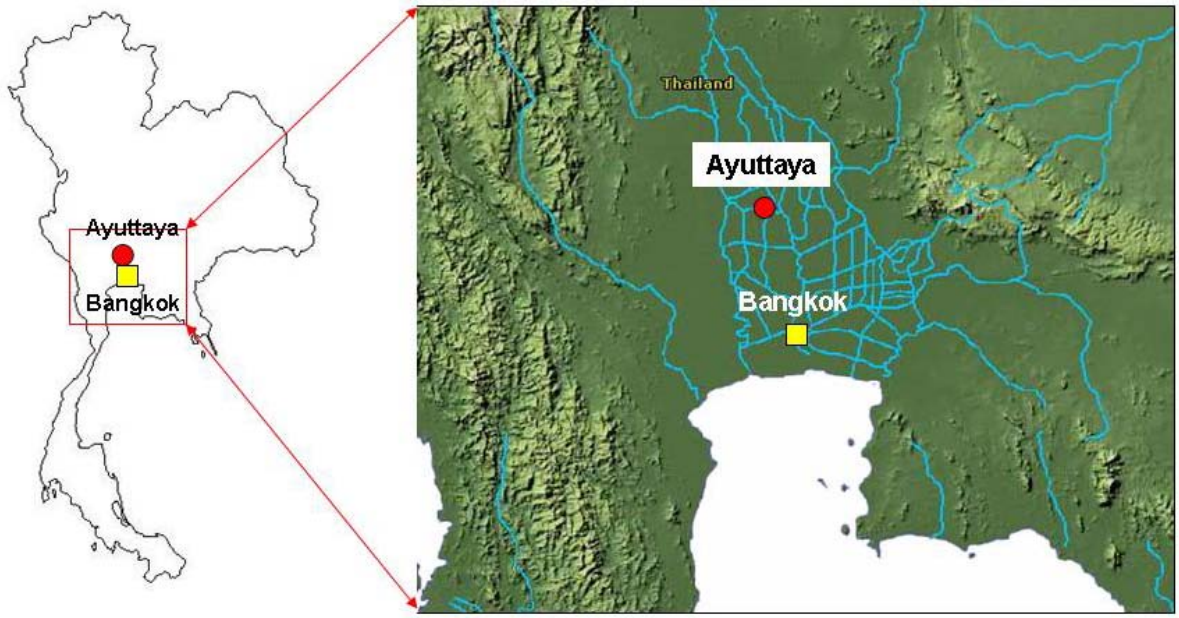


Figure 28 Map of Sampling Location in Thailand in 2006

b) Sampling Records and Meteorological Information

Air sampling records are summarized in **Table 25**, and meteorological information is shown in **Table 26.**

Table 25 Sampling Record in Ayutthaya, Thailand

		17 - 18 January 2006 (1st day)		18 - 19 January 2006 (2nd day)		19 - 20 January 2006 (3rd day)	
Sampler No.*1		A	B	A	B	A	B
Sampling time	Start	12:46	12:46	13:59	13:59	14:58	14:58
	End	12:46	12:46	13:59	13:59	14:58	14:58
Temperature (DegC)	Start	36.9	37.4	36.1	37.6	34.1	34.1
	End	34.5	35.6	36.5	37.4	32.8	32.8
Atmospheric Pressure (hPa)	Start	1022.1	1016.8	1020.2	1013.2	1018.9	1013.8
	End	1021.5	1016.2	1019.6	1015	1018.9	1013.2
Weather	Start	fine	fine	fine	fine	fine	fine
	End	fine	fine	fine	fine	fine	fine
Flow Rate (L/min)		700	700	700	700	700	700
Sampling Volume (m^3)		1008.6	1008.4	1007.9	1007.9	1007.9	1007.9

*1: Both A and B were HV-1000F.

Table 26 Meteorological Information Observed in Ayutthaya Observing Station

	2006/1/17 13:00 to 1/18 13:00		2006/1/18 13:00 to 1/19 13:00		2006/1/19 13:00 to 1/20 13:00	
Avergage temp. (DegC)	26.2		26.2		25.5	
Avergage RH (DegC)	75.3		74.2		67.1	
Wind direction Wind velocity	Wind direction	Wind velocity (m/s)	Wind direction	Wind velocity (m/s)	Wind direction	Wind velocity (m/s)
13:00	S	1.3	S	1.8	S	1.8
19:00	S	1.4	S	1.4	S	1
1:00	S	1.4	SE	0.9	SE	0.9
7:00	S	1.7	S	0.9	S	2

c) Results of HRGC/MS Analysis

Concentrations of POPs in ambient air collected by duplicate sampling are shown in **Table 27.** These concentrations were determined according to Monitoring Surveillance Manual for POPs and Their Related Compounds (2006).

Table 27 Concentrations of POPs in Ambient Air in Ayutthaya, Thailand on 17-20 January 2006.

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*	*320*	*250*	*343*	*450*	*350*	*270*	*310*	*460*	*340*	*260*	*330*
Aldrin	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Dieldrin	35	40	31	35	36	32	40	36	36	36	36	36
Endrin	1.4	0.93	0.79	1.0	1.3	0.76	0.91	0.84	1.4	0.85	0.85	0.94
p,p'-DDT	23	24	19	22	23	21	24	23	23	23	21.5	22
p,p'-DDE	16	15	12	14	16	12	15	14	16	14	13.5	14
p,p'-DDD	2.4	2.5	2.1	2.3	2.2	1.8	2.3	2.1	2.3	2.15	2.2	2.2
o,p'-DDT	7.1	7.7	5.8	6.9	7.5	6.1	7.8	7.0	7.3	6.9	6.8	6.9
o,p'-DDE	4.0	2.9	2.0	3.0	4.1	2.1	2.9	2.5	4.1	2.5	2.5	2.7
o,p'-DDD	0.92	1.1	0.74	0.92	0.98	0.78	1.2	1.0	0.95	0.9	1.0	1.0
trans-Chlordane	47	48	37	44	50	38	52	45	49	43	45	45
cis-Chlordane	28	29	22	26	30	23	31	27	29	26	27	27
trans-Nonachlor	21	20	16	19	22	17	22	20	22	19	19	19
cis-Nonachlor	3.7	3.4	2.6	3.2	3.4	2.6	3.6	3.1	3.6	3.0	3.1	3.2
Oxychlordane	1.9	1.9	1.3	1.7	1.8	1.5	1.7	1.6	1.9	1.7	1.5	1.7
Heptachlor	19	25	21	22	21	27	23	25	20	26	22	23
trans-Heptachlorepoxide	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
cis-Heptachlorepoxide	2.5	2.7	2.3	2.5	2.6	2.1	2.9	2.5	2.6	2.4	2.6	2.5
Mirex	1.7	1.7	1.6	1.7	1.8	1.7	2.0	1.9	1.8	1.7	1.8	1.8
Toxaphene (Parlar-26)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Toxaphene (Parlar-50)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Toxaphene (Parlar-62)	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14

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 MDL to MQL.

d) Results of Trajectory Analysis

To speculate the source of POPs in the collected air, trajectory analysis of the collected air was performed using the METEX programs. NCEP reanalysis dataset and 3D-wind model in METEX programs were used for the trajectory analysis. 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 for the monitoring in 2006 was shown in **Figure 29**.

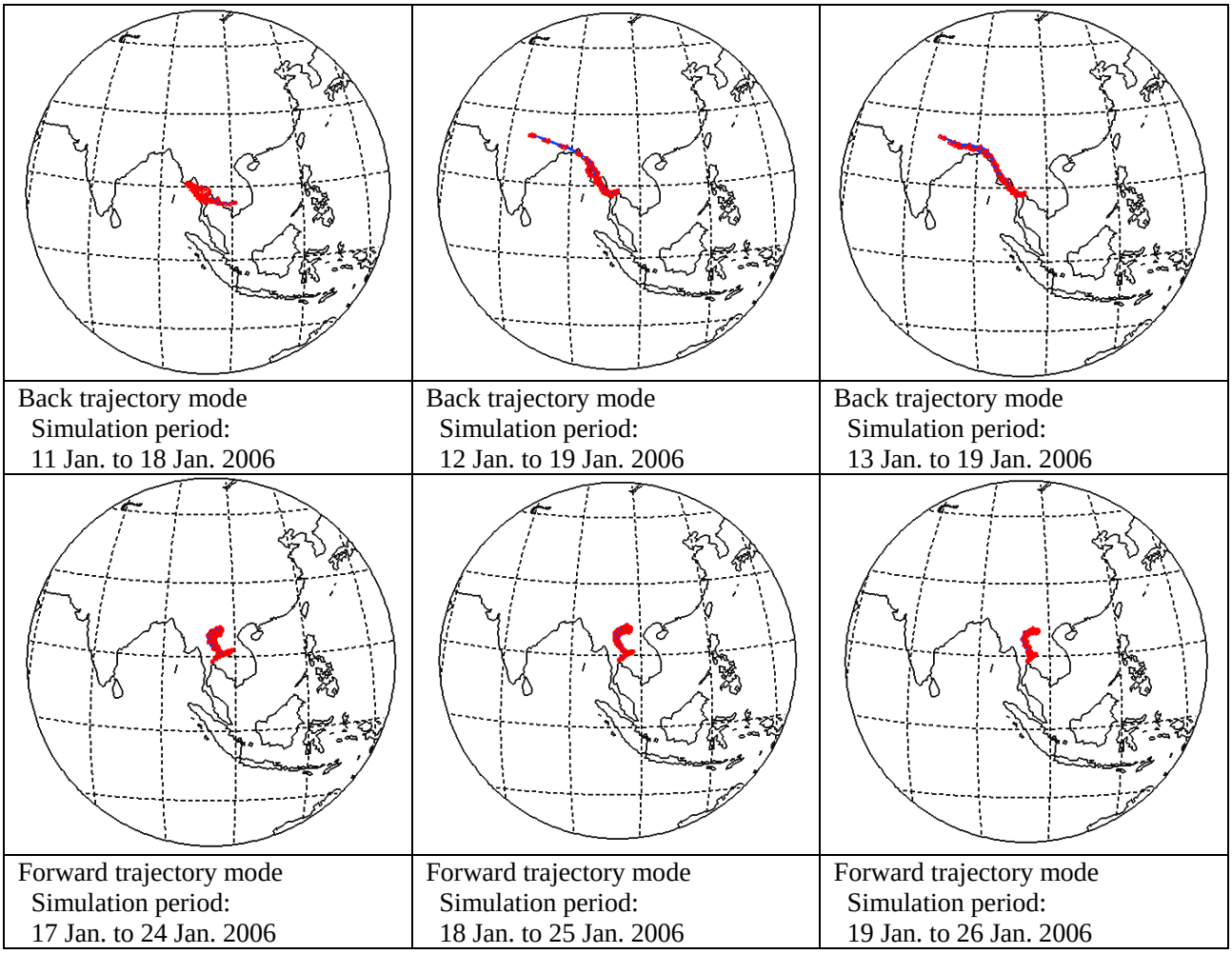


Figure 29 Trajectory Analysis of Ambient Air Collected in Ayutthaya, Thailand on 17-20 January 2006.

These results of back and forward trajectory analysis 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 then 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 the trajectory analysis derived from more than 3 days of input data before and after the sampling period should be noticed.

3) Air Monitoring Data in 2007

a) Sampling Location

This sampling site is located about 60 km south-west of Chiangmai (see **Figure 30**)
- Summit of Mt. Inthanon, Thailand
- Latitude: - Logitude: -*
- Above sea level: 2,565m

This sampling site, summit of Mt. Inthanon, is located in the Doi Inthanon National Park of Thailand. There are few tribe villages located around the root and mountainside of Mt. Inthanon. The Major activities in this area are sightseeing and agriculture conducted under the Royal Projects of Thailand. The micro meteorological information is available such as temperature, humidity, wind direction, and wind velocity as it is a center for astronomical seeing test belonging to National Astronomical Research Institute, Ministry of Science and Technology. The electric supply is generally stable.

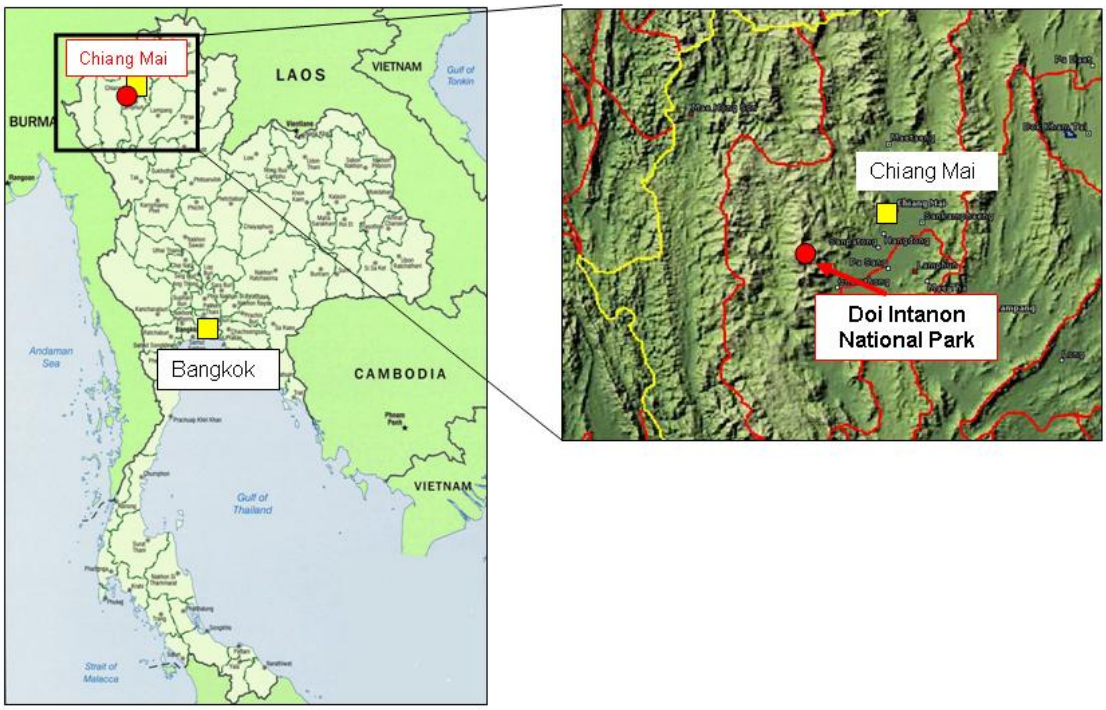


Figure 30 **Map of Sampling Location in Thailand in 2007**

* This sampling point is located in a sensitive area of Thailand. For a security reason, latitude and longitude are confidential.

b) Sampling Records and Meteorological Information

Air sampling records are summarized in **Table 28**, and meteorological information is shown in **Table 29.**

Table 28 Sampling Record at the summit of Mt. Inthanon, Thailand

		29 - 30 January 2007		30 - 31 January 2007		31 January - 1 February 2007	
Sample No.[*1]		A	B	A	B	A	B
Sampling time	Start	11:30	11:30	12:06	12:06	12:44	12:44
	End	11:30	11:30	12:06	12:06	12:44	12:44
Temperature (^{o}C)	Start	15.5	15.0	21.6	20.8	19.3	19.0
	End	19.9	18.7	17.4	17.4	14.5	14.6
Atmospheric Pressure (hPa)	Start	758.0	769.0	759.8	769.6	759.2	769.0
	End	760.4	769.6	759.8	769.6	758.6	768.4
Weather	Start	fine	fine	fine	fine	cloudy	cloudy
	End	fine	fine	fine	fine	fine	fine
Flow rate (L/min)		695.0	698.2	701.4	694.0	696.4	700
Sampling volume (m^3)		1007.9	1007.9	1007.9	1007.8	1007.9	1007.8

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

Table 29 Meteorological Information Observed the summit of Mt. Inthanon

Date	Time	Average temp.(^{o}C)	Average RH (%)	Wind direction	Wind velocity (m/s)	Rain precipitation
29 Jan.2007	1:00	1.4	82.0	WNW	0	0
	7:00	1.6	99.7	-	0.5	0
	13:00	6.0	73.5	W	1.6	0
	19:00	1.1	93.1	WNW	0	0
30 Jan.2007	1:00	-0.2	97.7	-	0	0
	7:00	7.8	70.0	WNW	0.5	0
	13:00	1.9	90.8	-	0	0
	19:00	-0.1	97.6	-	0	0
31 Jan.2007	1:00	0.3	84.3	-	0	0
	7:00	5.5	71.9	NNW	1.1	0
	13:00	1.9	78.6	-	0	0
	19:00	0.5	84.1	-	0	0
1 Feb.2007	1:00	-1.3	93.3	-	0	0
	7:00	6.3	66.3	SW	0	0
	13:00	1.4	82.0	WNW	0	0
	19:00	1.6	99.7		0.5	0

c) Results of HRGC/MS Analysis

Concentrations of POPs in ambient air collected by duplicate sampling are shown in **Table 30.** These concentrations were determined according to Monitoring Surveillance Manual for POPs and Their Related Compounds (2006).

Table 30 **Concentrations of POPs in Ambient Air in Mt. Inthanon, Thailand on 29 January -1 February 2007.**

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	*98*	*92*	79	90	89	84	*81*	*85*	94	*88*	80	87
Aldrin	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Dieldrin	(0.41)	<0.29	(0.33)	0.37	<0.29	0.78	<0.29	0.78	0.41	(0.78)	(0.33)	(0.51)
Endrin	<0.38	<0.38	<0.38	<0.38	<0.38	<0.38	*<0.38*	<0.38	<0.38	<0.38	<0.38	<0.38
p,p'-DDT	3.9	*3.9*	*2.3*	*3.4*	*4.0*	3.0	*3.1*	3.4	4.0	3.5	*2.7*	*3.4*
p,p'-DDE	1.7	1.5	1.2	1.5	1.8	1.5	1.5	1.6	1.8	1.5	1.4	1.5
p,p'-DDD	<0.45	<0.45	*<0.45*	<0.45	<0.45	<0.45	<0.45	<0.45	<0.45	<0.45	<0.45	<0.45
o,p'-DDT	2.2	*2.0*	*1.3*	*1.8*	2.0	1.8	1.6	1.8	2.1	1.9	1.5	1.8
o,p'-DDE	(0.40)	(0.33)	(0.27)	(0.33)	(0.39)	(0.33)	(0.37)	(0.36)	(0.40)	(0.33)	(0.32)	(0.35)
o,p'-DDD	<0.43	<0.43	<0.43	<0.43	<0.43	<0.43	<0.43	<0.43	<0.43	<0.43	<0.43	<0.43
trans-Chlordane	<0.58	<0.58	<0.58	<0.58	<0.58	<0.58	<0.58	<0.58	<0.58	<0.58	<0.58	<0.58
cis-Chlordane	(0.52)	<0.49	(0.59)	0.56	(0.49)	<0.49	<0.49	(0.49)	(0.51)	<0.49	(0.59)	(0.55)
trans-Nonachlor	<0.65	<0.65	<0.65	<0.65	<0.65	<0.65	<0.65	<0.65	<0.65	<0.65	<0.65	<0.65
cis-Nonachlor	<0.56	<0.56	<0.56	<0.56	<0.56	<0.56	<0.56	<0.56	<0.56	<0.56	<0.56	<0.56
Oxychlordane	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8
Heptachlor	<0.52	<0.52	<0.52	<0.52	<0.52	<0.52	<0.52	<0.52	<0.52	<0.52	<0.52	<0.52
trans-Heptachlorepoxide	<0.19	<0.19	<0.19	<0.19	<0.19	<0.19	<0.19	<0.19	<0.19	<0.19	<0.19	<0.19
cis-Heptachlorepoxide	<0.19	<0.19	<0.19	<0.19	<0.19	<0.19	<0.19	<0.19	<0.19	<0.19	<0.19	<0.19
Mirex	<0.41	<0.41	<0.41	<0.41	<0.41	<0.41	<0.41	<0.41	<0.41	<0.41	<0.41	<0.41
Toxaphene (Parlar-26)	<0.86	<0.86	<0.86	<0.86	<0.86	<0.86	<0.86	<0.86	<0.86	<0.86	<0.86	<0.86
Toxaphene (Parlar-50)	<2.6	<2.6	<2.6	<2.6	<2.6	<2.6	<2.6	<2.6	<2.6	<2.6	<2.6	<2.6
Toxaphene (Parlar-62)	<6.8	<6.8	<6.8	<6.8	<6.8	<6.8	<6.8	<6.8	<6.8	<6.8	<6.8	<6.8

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 MDL to MQL.

d) Results of Trajectory Analysis

To speculate the source of POPs in the collected air, trajectory analysis of the collected air was performed using the METEX programs. NCEP reanalysis dataset and 3D-wind model in METEX programs were used for the trajectory analysis. 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 for the monitoring in 2007 are shown in **Figure 31**.

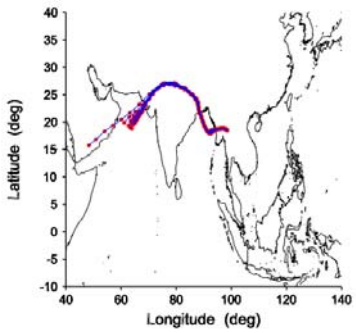
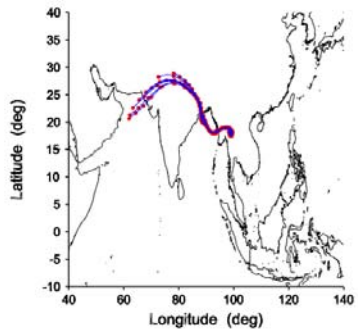
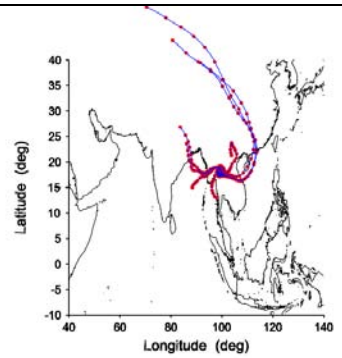
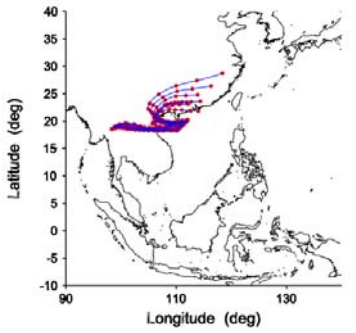
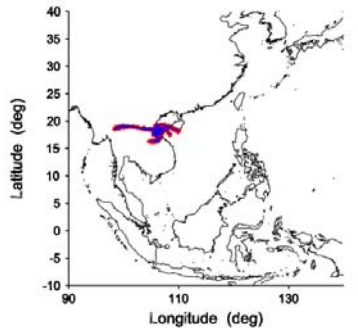
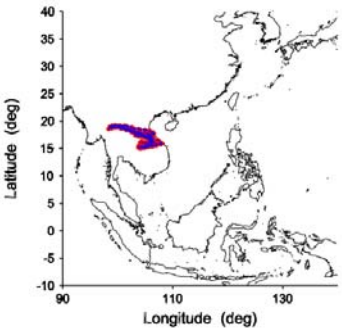
		
Back trajectory mode Simulation period: 22 Jan. to 29 Jan. 2007	Back trajectory mode Simulation period: 23 Jan. to 30 Jan. 2007	Back trajectory mode Simulation period: 24 Jan. to 31 Jan. 2007
		
Forward trajectory mode Simulation period: 29 Jan. to 5 Feb. 2007	Forward trajectory mode Simulation period: 30 Jan. to 6 Feb. 2007	Forward trajectory mode Simulation period: 31 Jan. to 7 Feb. 2007

Figure 31 Trajectory Analysis of Ambient Air Collected in Mt. Inthanon, Thailand on 29 January – 1 February 2007.

These results of back and forward trajectory analysis indicated the possibilities of the long-rage transportation of POPs. In the first two days, the mass of the air has been come through northern India and Bangladesh, and then through southern China and northern Vietnam in third day. These results indicated that more effective background monitoring could be done at this sampling point to evaluate the long-range transportation of POPs from South Asia and Southeast Asia. The level of reliability of 3 days back and forward trajectory analysis should be noticed.

e) Issues in the Sampling and in the Future

- The first sampling site, Ayutthaya, is located about 70 km north of Bangkok. The sampling point was usually used as an environmental monitoring station of Thailand and located in the area of Secondary School. This sampling point was surrounded by the roads, however the density of the traffic was relatively low.

The monitoring results of chlordanes might be caused by the vaporization from the old wooden houses surrounding the sampling point.

- The second sampling site, summit of Inthanon Mountain, is located about 60 km south-west of Chiangmai. It is in a National Park covering various climatic and ecological parts within 482 square kilometers. The national park consists of high mountains, several rivers, waterfalls. It has the cold weather and high humidity throughout the year. Currently, several Royal Projects have been conducted to help villagers in growing cold-climate fruits, vegetables and flowers.

The monitoring result of most POPs was considerably low, bellow the MDL, except for HCB. This might caused by the unintentional production and the long-rage transportation of HCB across region.

4.9 POPs Concentrations in Ambient Air Samples in Socialist Republic of Vietnam

1) Ownership of Data and a Person in Charge

Vietnam
Prof., Dr. Pham Hung Viet, Director of Centre of Environmental Technology and Sustainable Development (CETASD), Hanoi University of Science, Vietnam National University

2) Sampling Location

<2005>
This sampling site is located about 50 km north of Hanoi (see **Figure 32**).
- Green World Hotel, Khu Du Lich Tam Dao, VinH Phuc, Vietnam
- Latitude: N 21° 27.220’ Longitude: E 105° 38.714’:
- Above sea level: approximately 950 m (Above ground level: 8 m)

<2006>
This sampling site is located about 50 km north of Hanoi (see **Figure 32**). The sampling site is available micro meteorological information because there is Tam Dao observing station now.
- Rooftop of Green Hotel, Khu Du Lich Tam Dao, VinH Phuc, VIETNAM
- Latitude: N 21° 27.492’ Logitude: E 105° 38.741’
- Above Sea Level: 934m (above ground level: 20m)

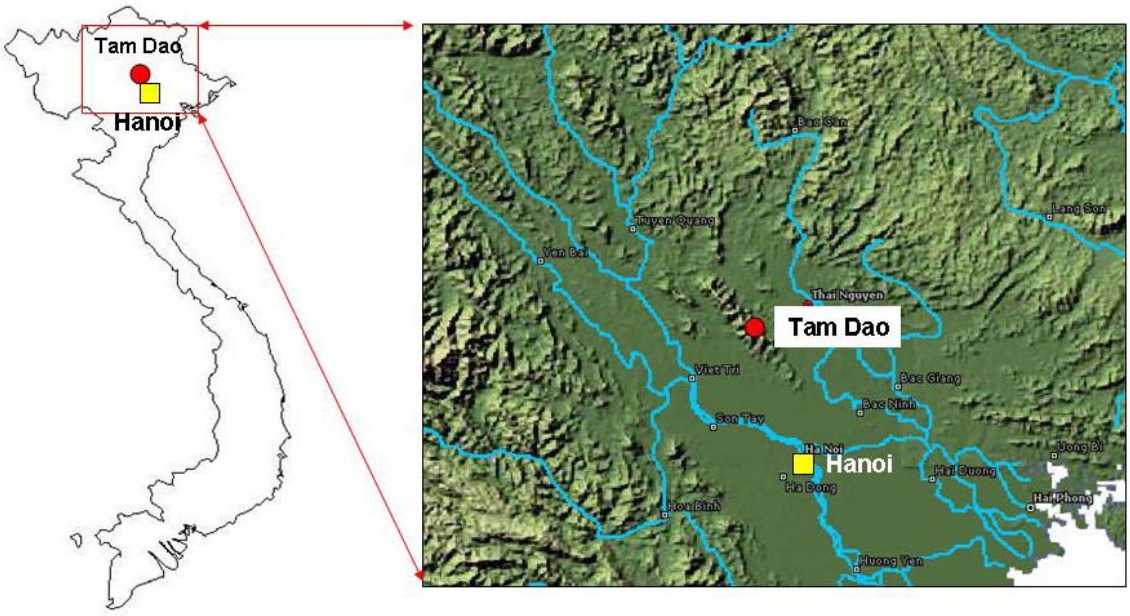


Figure 32 Map of Sampling Location in Vietnam in 2005

3) Air Monitoring Data in 2005

a) Sampling Records

Air sampling records are summarized in **Table 31**

Table 31 Air Sampling Record in Tam Dao, Vietnam

		7 - 8 March 2005 (1st day)		8 - 9 March 2005 (2nd day)		9- 10 March 2005 (3rd day)	
Sampler No.[*1]		A	B	A	B	A	B
Sampling time	Start	19:00	19:03	19:52	20:00	20:33	20:41
	End	19:00	19:03	19:52	20:00	21:20[*2]	21:27[*2]
Temperature (DegC)	Start	15	14.8	16.6	16.2	18	18.3
	End	16.7	16.3	19.2	18.6	22.5	24.2
Atmospheric pressure (hPa)	Start	913.2	912.7	909.4	908.9	906.2	905.7
	End	908.8	908.2	906.2	905.7	903.6	900.6
Weather	Start	foggy	foggy	foggy	foggy	foggy	foggy
	End	cloudy	cloudy	foggy	foggy	foggy	foggy
Flow rate (L/min)		700	700	700	700	700	700
Sampling Volume (m^3)		1007.8	1007.8	1007.9	1007.7	1008.3	1008.7

*1: Both A and B is HV-7000F.

*2: End time of sampling was delayed because electric supply had stopped and had not restarted automatically until about 17:00

b) Results of HRGC/MS Analysis

Concentrations of POPs in ambient air samples collected by duplicate sampling were shown in **Table 32** The concentrations were determined according to Monitoring Surveillance Manual for POPs and Their Related Compounds (2006).

Table 32 Concentrations of POPs in Ambient Air in Tam Dao, Vietnam on 7-10 March 2005.

Chemicals	Sample A		Sample B		Average	
	Conc. (pg/m^3)	Recovery (%)	Conc. (pg/m^3)	Recovery (%)	Conc. (pg/m^3)	Recovery (%)
HCB	91	69	94	69	92	69
Aldrin	0.14	4.1	0.083	2.9	0.11	3.5
Dieldrin	1.2	52	1	71	1.1	61
Endrin	n.d.	44	n.d.	73	n.d.	59
p,p'-DDT	29	68	12	90	21	79
p,p'-DDE	12	65	11	59	11	62
p,p'-DDD	3.7	68	2.1	85	2.9	76
o,p'-DDT	39	60	30	79	35	69
o,p'-DDE	6.2	57	5.5	60	5.8	59
o,p'-DDD	13	68	1.3	85	7.1	76
trans-Chlordane	3.0	83	2.6	79	2.8	81
cis-Chlordane	2.2		2.0		2.1	
trans-Nonachlor	1.8	81	1.5	83	1.7	82
cis-Nonachlor	0.42	53	0.34	69	0.38	61
Oxychlordane	n.d.	74	n.d.	84	n.d.	79
Heptachlor	0.76	75	0.80	79	0.78	77
trans-Hepachlorepoxide	n.d.	66	n.d.	77	n.d.	71
cis-Hepachlorepoxide	0.42		0.39		0.40	
Mirex	0.42	45	0.20	57	0.31	51
Toxaphene (Parlar-26)	n.d.	48	n.d.	51	n.d.	50
Toxaphene (Parlar-50)	n.d.		n.d.		n.d.	

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.

c) Results of Trajectory Analysis

To speculate the source of POPs in the collected air, trajectory analysis of the collected air was performed using the METEX programs. NCEP reanalysis dataset and 3D-wind model in METEX programs were used for the trajectory analysis. 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 33**.

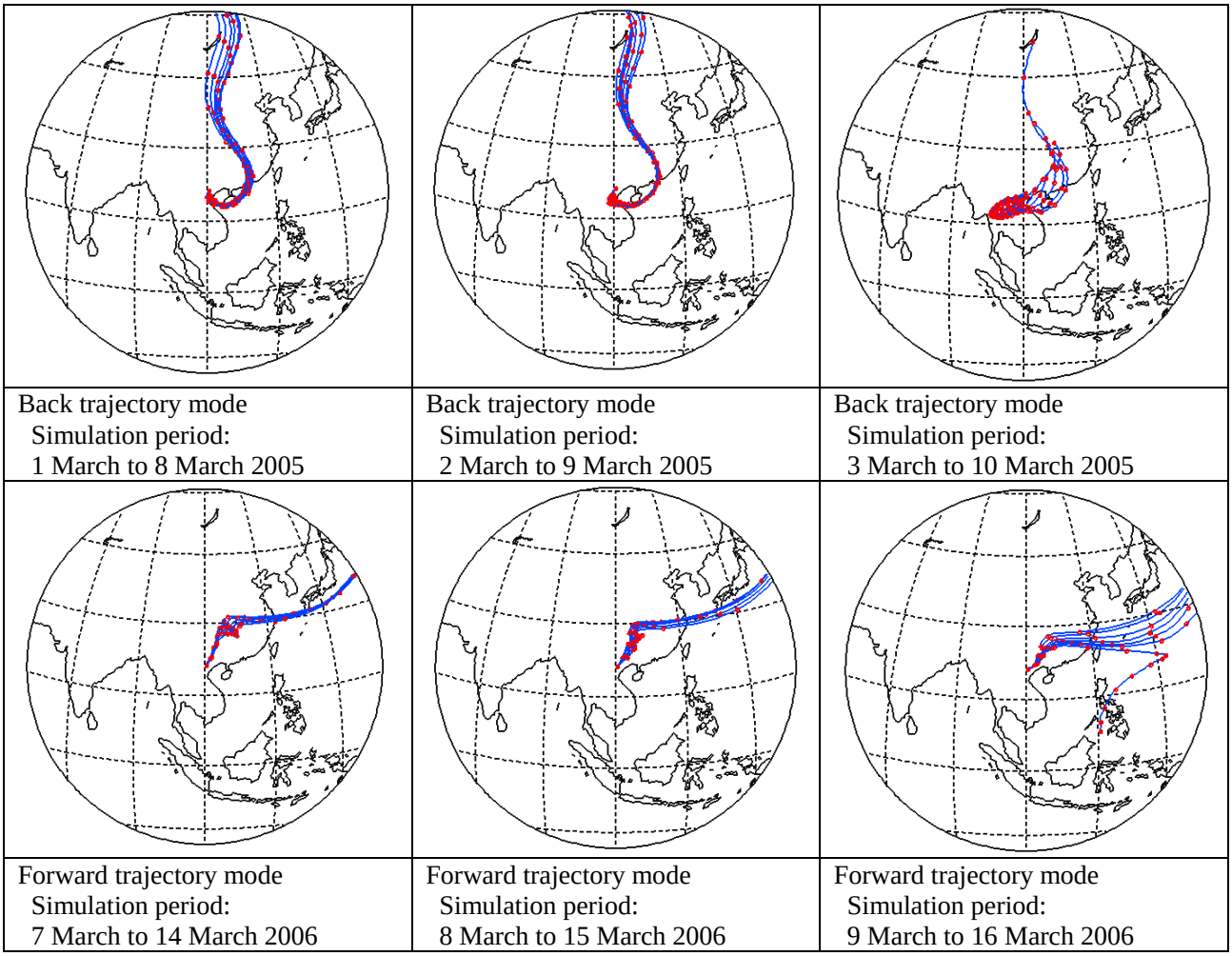


Figure 33 Trajectory Analysis of Ambient Air Collected in Tam Dao, Vietnam on 7-10 March 2005.

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.

d) Issues in This Sampling and in the Future

- It is of concern that the transformers and capacitors have a high possibility of becoming PCB hot spots because a great number of those in Tam Dao were decrepit.
- There is a problem securing a power supply to run the HV air sampler in the background location.
- In fact, the power supply was cut off in the primary sampling point (small hotel) and the HV air sampler stopped. Therefore, the sampling point was changed to another hotel with a private electric generator. However, the power supply was cut off in the hotel again and then the HV did not restart automatically.
- It is reasonable to expect that the electric power will not be supplied stably, especially in the background areas in developing countries. Therefore, it is considered that we should show local researchers the stance that unless we regularly monitor the equipment's running status during the sampling term except for during the lunch hour, at night, and at meal times, we cannot be confident of the actual operating results of the HV sampling.
- The HV air sampler used in this monitoring can be restarted automatically when the electric supply stops. However, the equipment was not restarted automatically when the electric supply failed in this monitoring in Vietnam. We guessed that it had some relation with not reverting automatically to transform from 100V

to 220V because the model which was brought and used in this monitoring was made in Japan. On this matter, we got the following answer from the manufacturer which made the sampler: The reason is not the transformer connected to the sampler because the export model for foreign countries only has a miniature transformer connected to the model. According to the manufacturer, a similar case was reported in China. Therefore, the controller with the sampler might not recognize an electric power failure because the degree of the voltage decline in developing countries is different to the rapid voltage decline that occurs due to a blackout in Japan. There is no solution to the problem with the machine at present. We are waiting for confirmation of the phenomenon and then improvement on the manufacturer's side.

- As for the sampling point in a background area, it is desirable that the power supply is steady wherever possible and that new types of transformers and capacitors which do not include PCBs are installed for avoiding the contamination from hot spots.
- From now on, it is important that related concrete information such as photographs of the sampling location is collected on the expected area as background study before a trainer visits the field from Japan.

4) Air Monitoring Data in 2006

a) Sampling Records and Meteorological Information

Air sampling records are summarized in **Table 33** and meteorological information shows in **Table 34.**

Table 33 Sampling Record in Tam Dao, Vietnam.

		24 - 25 February 2006 (1st day)		25 - 26 February 2006 (2nd day)		26 - 27 February 2006 (3rd day)	
Sampler No.[*1]		A	B	A	B	A	B
Sampling time	Start	7:40	7:46	8:26	8:32	8:56	9:12
	End	7:40	7:46	8:31[*2]	8:32	8:56	9:12
Temperature (DegC)	Start	13.9	14.8	15.7	15.4	16	15.8
	End	15.3	16.3	15.5	15.2	15.8	15.3
Atmospheric Pressure (hPa)	Start	910.7	912.7	907.5	906.3	906.8	905.7
	End	907.5	908.2	906.8	905.7	905.6	904.4
Weather	Start	foggy	foggy	foggy	foggy	foggy	foggy
	End	foggy	foggy	foggy	foggy	foggy	foggy
Flow Rate (L/min)		700	700	700	700	700	700
Sampling Volume		1007.9	1007.7	1012.5	1008.1	1007.9	1008

*1: Both A and B is HV-700F.
*2: HV sampler stopped at 5 min after the beginning of sampling but was immediately restarted.

Table 34 Meteorological Information Observed in Tam Dao Observing Station

	2006/2/24 7:00 to 2/25 7:00		2006/2/25 7:00 to 2/26 7:00		2006/2/26 7:00 to 2/27 7:00	
Avergage temp. (DegC)	11.9		12.1		12.3	
Avergage RH (DegC)	100		100		100	
Precipitation (mm)	4		4		7	
Wind direction Wind velocity	Wind direction	Wind velocity	Wind direction	Wind velocity	Wind direction	Wind velocity
7:00	NE	3	S	1	S	2
13:00		0	SE	1		0
18:00	SE	4	SE	2	E	2
1:00	NE	6	SW	1	E	3

b) Results of HRGC/MS Analysis

Concentrations of POPs in ambient air collected by duplicate sampling are shown in **Table 35.** These concentrations were determined according to Monitoring Surveillance Manual for POPs and Their Related Compounds (2006).

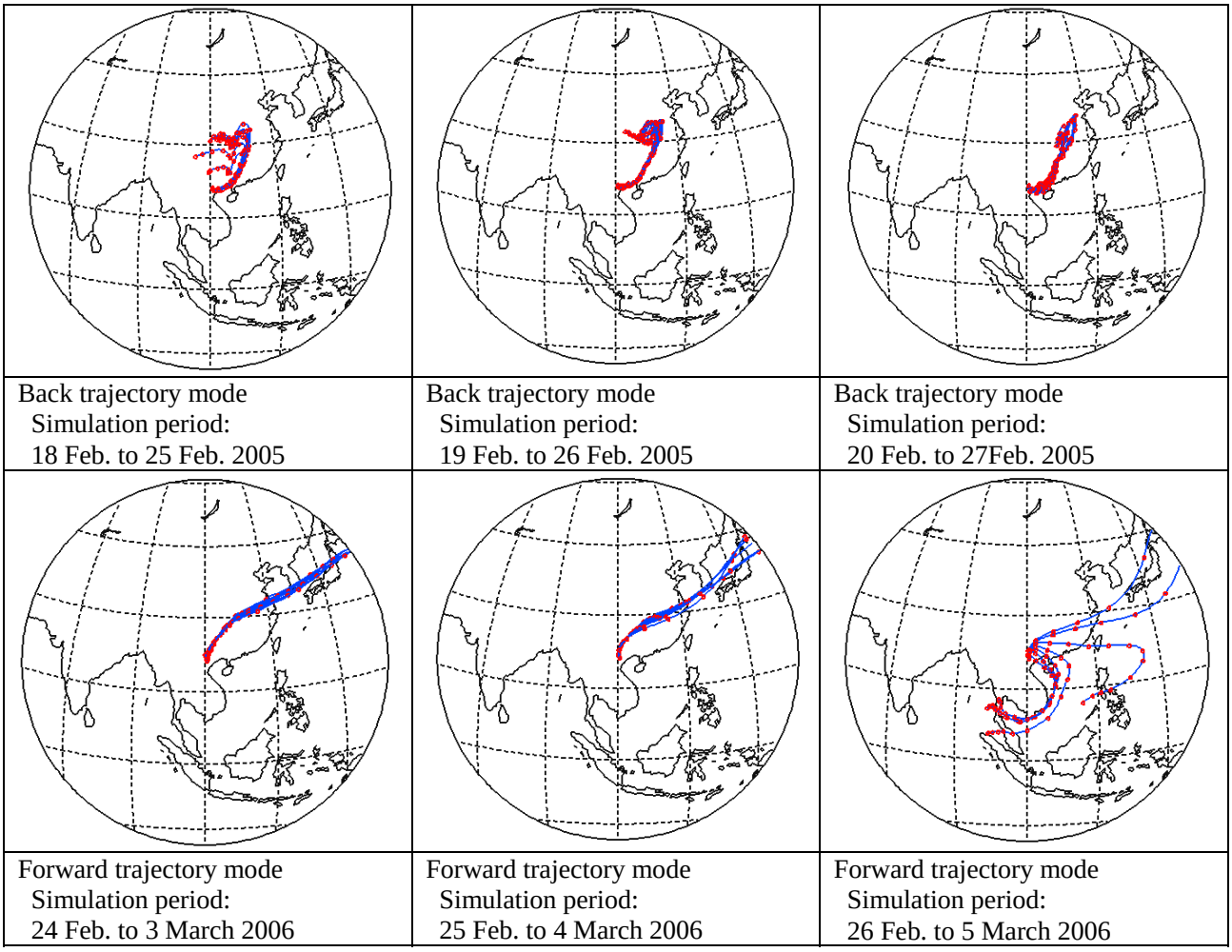
Table 35 Concentrations of POPs in Ambient Air in Tam Dao, Vietnam on 24-27 February 2006.

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	380	330	320	340	370	330	320	330	380	330	320	330
Aldrin	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Dieldrin	0.46	0.94	0.47	0.62	0.4	0.78	0.73	0.76	0.43	0.86	0.60	0.69
Endrin	*<0.1*	*<0.1*	<0.1	<0.1	*<0.1*	<0.1	<0.1	<0.1	*<0.1*	<0.1	<0.1	<0.1
p,p'-DDT	*16*	*15*	*18*	*16*	13	12	17	15	15	*14*	18	15
p,p'-DDE	16	13	15	15	13	12	13	13	15	13	14	14
p,p'-DDD	*2.7*	2.0	*3.7*	2.8	2.5	*1.9*	3.5	2.7	2.6	2.0	3.6	2.8
o,p'-DDT	*25*	*20*	*21*	*22*	23	*18*	20	19	24	*19*	21	21
o,p'-DDE	11	8.1	*8.7*	9.3	11	8.1	8.5	8.3	11	8.1	8.6	8.8
o,p'-DDD	2.0	1.7	*2.4*	2.0	1.9	*1.6*	2.1	1.9	2.0	1.7	2.3	1.9
trans-Chlordane	3.5	3.0	2.2	2.9	3.7	2.8	2.4	2.6	3.6	2.9	2.3	2.8
cis-Chlordane	2.9	2.4	1.8	2.4	3.1	2.3	2.0	2.2	3.0	2.4	1.9	2.3
trans-Nonachlor	1.0	0.92	0.67	0.86	1.2	0.90	0.73	0.82	1.1	0.91	0.70	0.84
cis-Nonachlor	0.08	0.05	0.05	0.06	0.13	0.04	0.07	0.05	0.11	0.04	0.06	0.06
Oxychlordane	0.28	0.23	0.21	0.24	0.22	(0.16)	0.23	0.20	0.25	0.20	0.22	0.22
Heptachlor	1.4	1.3	0.7	1.1	1.4	1.2	0.9	1.0	1.4	1.3	0.8	1.1
trans-Heptachlorepoxide	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
cis-Heptachlorepoxide	0.31	0.29	0.28	0.29	0.33	0.29	0.29	0.29	0.32	0.29	0.29	0.29
Mirex	0.64	0.46	0.41	0.50	0.67	0.47	0.40	0.44	0.66	0.47	0.41	0.47
Toxaphene (Parlar-26)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Toxaphene (Parlar-50)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Toxaphene (Parlar-62)	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14	<14

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.

c) Results of Trajectory Analysis

To speculate the source of POPs in the collected air, trajectory analysis of the collected air was performed using the METEX programs. NCEP reanalysis dataset and 3D-wind model in METEX programs were used for the trajectory analysis. 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 34**.



Back trajectory mode Simulation period: 18 Feb. to 25 Feb. 2005	Back trajectory mode Simulation period: 19 Feb. to 26 Feb. 2005	Back trajectory mode Simulation period: 20 Feb. to 27Feb. 2005
Forward trajectory mode Simulation period: 24 Feb. to 3 March 2006	Forward trajectory mode Simulation period: 25 Feb. to 4 March 2006	Forward trajectory mode Simulation period: 26 Feb. to 5 March 2006

Figure 34 Trajectory Analysis of Ambient Air Collected in Tam Dao, Vietnam on 24 - 27 February 2006.

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.

d) Issues in This Sampling and in the Future

- The hotel where was installed HV air samplers in last research was exchanged to new neighboring hotel in this research because the new hotel is more stable for electric supply and more multistory than the hotel installed air samplers in last research.
- In this research, we sent materials such as polyurethane foam, quarts fibre filter, and activated carbon fibre felt from Japan to Vietnam. The air sampling with these matters was conducted by some researchers in Hanoi University. However, it required about one month until they had received these materials in order to procedure for tax free import. These materials had left to stand in airport during the procedure. Because this case might be caused the contamination of POPs, we need to take care for timing of their transportation.