



Technical Report Series on the Biosystem-Aerosphere Study (BOREAS)

William L. Munn and Sara K. Conrad, Editors

235

BOREAS TGB-7 Dry Deposition of Methylchlorine

Aeronautics and
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NASA/TM—2000–209891, Vol. 235



Technical Report Series on the Boreal Ecosystem-Atmosphere Study (BOREAS)

Forrest G. Hall and Sara K. Conrad, Editors

Volume 235

BOREAS TGB-7 Dry Deposition Herbicide and Organochlorine Flux Data

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November 2000

Available from:

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BOREAS TGB-7 Dry Deposition Herbicide and Organochlorine Flux Data

Don Waite

Summary

The BOREAS TGB-7 team measured the concentration and flux of several agricultural pesticides in air, rainwater, and dry deposition samples in order to determine the associated yearly deposition rates. This data set contains information on the dry deposition flux of seven herbicides [2,4-dichlorophenoxyacetic acid (2,4-D), bromoxynil, dicamb, 2-methyl-4-chlorophenoxyacetic acid (MCPA), triallate, trifluralin, and diclop-methyl] known to appear in the atmosphere of the Canadian prairies. Also, the concentration of three herbicides (atrazine, alachlor, and metolachlor), two groups of insecticides (lindane and breakdown products and dichloro-diphenyl-trichloroethane (DDT) and breakdown products), and several polychlorinated biphenyls commonly used in the central United States was measured. All of these chemicals are reported, in the literature, to be transported in the atmosphere. Many have been reported to occur in boreal and arctic food chains. The sampling was carried out from 16-Jun to 13-Aug-1993 and 04-May to 20-Jul-1994 at the BOREAS site in the Prince Albert National Park (Waskesiu). The data are stored in tabular ASCII files.

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1. Data Set Overview

1.1 Data Set Identification

BOREAS TGB-07 Dry Deposition Herbicide and Organochlorine Flux Data

1.2 Data Set Introduction

This data set contains herbicide and organochlorine quantities in dry deposition collected from Waskesiu.

1.3 Objective/Purpose

The objective of this study was to measure the dry deposition of herbicides and organochlorines in the boreal forest at Waskesiu.

1.4 Summary of Parameters and Variables

This data set contains herbicide and organochlorine quantities in dry deposition data collected Waskesiu.

1.5 Discussion

The deposition into the boreal forest of seven herbicides [2,4-dichlorophenoxyacetic acid (2,4-D), bromoxynil, dicamba, 2-methyl-4-chlorophenoxyacetic acid (MCPA), triallate, trifluralin, and diclop-methyl] known to appear in the atmosphere of the Canadian prairies, three herbicides (atrazine, alachlor, and metolachlor) commonly used in the central United States, two groups of insecticides (lindane and breakdown products and dichloro-diphenyl-trichloroethane (DDT) and breakdown products), plus several polychlorinated biphenyls was measured. All of these chemicals are reported, in the literature, to be transported in the atmosphere. Many have been reported to occur in boreal and arctic food chains. The sampling was carried out at the BOREal Ecosystem-Atmosphere Study (BOREAS) site in the Prince Albert National Park (PANP) (Waskesiu).

1.6 Related Data Sets

BOREAS TGB-07 Ambient Air Herbicide and Organochlorine Concentration Data
BOREAS TGB-07 Tower Herbicide Concentration in Rainwater Data
BOREAS TGB-09 Above-canopy NMHC at SSA-OBS, SSA-OJP and SSA-OA
BOREAS TGB-10 Oxidant Concentration Volatile Organic Carbon Data over the SSA
BOREAS TGB-10 Oxidant Concentration Data over the SSA
BOREAS TGB-10 Oxidant Flux Data over the SSA

2. Investigator(s)

2.1 Investigator(s) Name and Title

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2.2 Title of Investigation

Atmospheric Transport of Agricultural Pesticides into the Boreal Ecosystem

2.3 Contact Information

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3. Theory of Measurements

The dry/wet deposition sampler employs an XAD-2 resin column to extract dry deposits from a continuously flowing sheet of water and also collects separate rain samples. The sampler consists of a 1-m x 0.5-m, stainless steel (316 grade) tray, with 5-cm-high sides, onto which water is sprayed from a header pipe located at one end. The water runs down the tray, collecting any particles that fall onto it. In addition, aerosols and vapor phase chemicals that contact the water surface may be absorbed. As the water moves through the apparatus, it passes from the tray down into reservoir within the body of the sampler. Water from this reservoir is pumped through a composite column (glass wool/XAD-2 resin) that retains the particulates and dissolved organic chemicals, and then returns back to the header pipe where it recirculates across the collecting surface. At the end of the sampling period, the glass wool/XAD-2 resin column is extracted with acetone and the extract analyzed for target chemicals.

4. Equipment

4.1 Sensor/Instrument Description

4.1.1 Collection Environment

The data were collected under all environmental conditions.

4.1.2 Source/Platform

Ground.

4.1.3 Source/Platform Mission Objectives

None given.

4.1.4 Key Variables

The key variable is herbicide or organochlorine quantity in dry deposits per day.

4.1.5 Principles of Operation

As the water moves through the apparatus, it passes from the tray down into a 32-L reservoir within the body of the sampler. Water from this reservoir is pumped through a composite column (glass wool/XAD-2 resin) that retains the particulates and dissolved organic chemicals, and then returns back to the header pipe where it recirculates across the collecting surface. The tray slopes (5%) from about 105 to 100 cm above the ground surface. A constant speed, stainless steel centrifugal pump is used to circulate the water. The flow rate to the header is adjustable by means of a ball valve located between the pump and resin column. Water flow is from 3.5 to 4 L min⁻¹, which produces enough water to cover the entire tray surface without causing splash at the header. This flow rate results in the circulation or turnover of the water contained in the reservoir every 8-9 minutes. This turnover rate, combined with the design whereby water is returned to the top and drawn off from the bottom of the reservoir, reduces the potential for particle trapping within the reservoir. All parts of the sampler in contact with the water flow are constructed of either 316-grade stainless steel or Teflon.

The deionized water used is acidified to pH 1.8, using sulphuric acid to facilitate the adsorption of acidic pesticides by the XAD-2 resin. Because such a large volume (~30 L) of deionized water circulates through the XAD-2 resin, it is imperative that the water be free of even very small concentrations of the compounds to be monitored. This is achieved by circulating, for 30 min at the beginning of each sampling period, the acidified deionized water through the sampler and through an XAD-2 cleanup cartridge (described below) identical to the one used to collect the samples. A sample of the process water is taken for analysis just prior to replacing the cleanup column. This process water sample is extracted and analyzed to verify that no residual contamination is still present. If detectable background contamination is found in the process water, the sample can be rejected or corrections can be made.

The structure and reproducible packing of the XAD-2 resin column are critical to the operating efficiency of the sampler. The column consists of a 5 cm inside diameter, stainless steel pipe fitted at one end with a coupling. From two to several layers of glass marbles are placed into the bottom or inlet of the column to diffuse the flow of water entering the column. By varying the volume of glass marbles, the volume of resin can be changed. Our columns contained two layers of marbles and 250 mL of resin, the maximum volume available in the length of pipe used.

Resting on the marbles is a perforated disc of 50-mm-thick Teflon followed by a plug of approximately 2 g of Pyrex brand borosilicate glass wool. The glass wool retains the 250 mL of XAD-2 resin (Caledon Laboratories Ltd., Georgetown, ON), which is packed into the column as a slurry in deionized water. The resin is capped with approximately 12 g of glass wool that is compressed with the upper sieve plate (50-mm Teflon), which also functions as a washer. The upper sieve plate/washer is held in place by a short section of pipe attached to the lower section with three stainless steel bolts. The upper section of pipe permits the water to leave the resin with a free and unrestricted flow, reducing the possibility of channeled flow within the resin. Tests of water flow in the column, conducted using dyes, showed uniform contact with the resin. The upper or outlet section of column connects directly with a tube leading to the header pipe.

4.1.6 Sensor/Instrument Measurement Geometry

- Dust Collector: A newly designed sampler employing an XAD-2 resin column to extract dry deposits from a continuously flowing sheet of water and collecting separate rain samples.
- Polyurethane Foam (PUF) Sampler: A high-volume air sampler collecting ambient concentrations of material on a sampling unit consisting of a glass fiber filter followed by a PUF plug and XAD-2 resin cartridge.

4.1.7 Manufacturer of Sensor/Instrument

None given.

4.2 Calibration

4.2.1 Specifications

None given.

4.2.1.1 Tolerance

None given.

4.2.2 Frequency of Calibration

None given.

4.2.3 Other Calibration Information

The water flow through the sampler was from 3.5 to 4.0 L min⁻¹.

5. Data Acquisition Methods

The herbicide analyses were carried out at the Agriculture and Agri-Food Canada Research Station at Regina, Saskatchewan, whereas insecticide and organochlorine analysis was carried out by the Environment Canada laboratory in Edmonton, Alberta. All residues were quantified and confirmed using a Hewlett-Packard gas chromatograph equipped with a mass selective detector (GC-MSD).

Elution of XAD-2 Resin Columns Used in the Dust Collector:

The wet XAD-2 resin columns were vacuum aspirated for 30 minutes to remove as much residual water as possible. Air entering the columns was passed through a PUF plug to remove organic contaminants. The columns were then extracted by back flushing with 1000 mL of acetone at a rate of 10 mL/min. This extracted both the organic compounds of interest and any remaining residual water from the resin. The acetone extract was concentrated to ~100 mL using a rotary evaporator (water bath at 30 °C) and then transferred to a 250-mL evaporating flask and further concentrated as an aqueous phase to ~50 mL. This aqueous phase was then made up to volume (100 mL) with water and divided into 50 mL aliquots. One aliquot was acidified to pH 2 with dilute H₂SO₄ solution, extracted with dichloromethane and the extract methylated with diazomethane and subjected to Florisil column cleanup prior to GC-MSD analysis for extracted herbicides (Cessna et al., 1985). The second aqueous aliquot was extracted with dichloromethane, subjected to Florisil column cleanup, and analyzed for insecticides and organochlorines by GC-MSD.

Extraction of PUF/XAD-2 Sampling Units:

On alternate weeks, the PUF/XAD-2 sampling units were extracted for herbicide or for insecticide and organochlorine content. For herbicide analysis, the sampling unit was soxhlet extracted for 8 h with acetone (Grover et al., 1994). The acetone extract was concentrated to ~0.5 mL using a rotary evaporator (water bath 30 °C) and then methylated with ethereal diazomethane. The methylated extract was subjected to Florisil column cleanup prior to analysis by GC-MSD. For insecticide and organochlorine analysis, the PUF sampling unit was soxhlet extracted for 12 h with dichloromethane. The extract was concentrated using a rotary evaporator and then subjected to Florisil column cleanup prior to analysis by GC-MSD.

Residue Analysis and Confirmation:

The Hewlett-Packard GC-MSD system and operating conditions used for herbicide residue analysis have been described previously (Cessna et al., 1997). A similar GC/MSD system was used for insecticide and organochlorine analysis; however, the column employed was a 30 m x 0.25 mm I.D. Rtx-5 column (0.25-μm film thickness). For operation of the GC, helium was used as the carrier gas and the temperature program was initially held at 80 °C for 1 minute and then ramped to 200 °C at 15 °C/min; then it was held at 200 °C for 5 minutes, increased at 8 °C/min to 300 °C, and held for 10 minutes. A split/splitless injector was used in the splitless mode. Injection port and transfer line temperatures were 270 °C and 280 °C, respectively.

Depending on the compound, from two to four ions were monitored on the MSD. The presence of each compound was considered to be confirmed if all ions monitored were present, a peak appeared at the retention time (± 0.02 min) obtained for a standard solution of the pesticide in the reconstructed chromatograms of all ions, and the peak area ratio was within 30% of the ratio obtained using a standard solution of the pesticide.

6. Observations

6.1 Data Notes

None.

6.2 Field Notes

None.

7. Data Description

7.1 Spatial Characteristics

7.1.1 Spatial Coverage

The North American Datum of 1983 (NAD83) coordinates for the Southern Study Area (SSA) measurement site are:

	Longitude	Latitude
	-----	-----
Waskesiu	106.067° W	53.917° N

7.1.2 Spatial Coverage Map

None given.

7.1.3 Spatial Resolution

The measurements were made at a single location in the SSA.

7.1.4 Projection

Not applicable.

7.1.5 Grid Description

Not applicable.

7.2 Temporal Characteristics

7.2.1 Temporal Coverage

The data were collected from 16-Jun to 13-Aug-1993 and 04-May to 20-Jul-1994.

7.2.2 Temporal Coverage Map

All the data were collected at the same location.

7.2.3 Temporal Resolution

The samplers operated 24 hours per day over each 7-day sampling period.

7.3 Data Characteristics

7.3.1 Parameter/Variable

The parameters contained in the data files on the CD-ROM are:

Column Name

SITE_NAME
SUB_SITE
START_DATE
END_DATE
BROMOXYNIL_FLUX
DICAMBA_FLUX
2,4-D_FLUX
MCPA_FLUX
DICLOFOP_FLUX
TRIALATE_FLUX
TRIFLURALIN_FLUX
ALACHLOR_FLUX

ATRAZINE_FLUX
 METOLACHLOR_FLUX
 ALPHA-HCH_FLUX
 GAMMA-HCH_FLUX
 4,4'-DDE_FLUX
 4,4'-DDD_FLUX
 4,4'-DDT_FLUX
 TETRACHLORO-BIPHENYL_FLUX
 PENTACHLORO-BIPHENYL_FLUX
 HEXACHLORO-BIPHENYL_FLUX
 OCTACHLORO-BIPHENYL_FLUX
 DICHLORO-BIPHENYL_FLUX
 TRICHLORO-BIPHENYL_FLUX
 CRTFCN_CODE
 REVISION_DATE

7.3.2 Variable Description/Definition

The descriptions of the parameters contained in the data files on the CD-ROM are:

Column Name	Description
SITE_NAME	The identifier assigned to the site by BOREAS, in the format SSS-TTT-CCCC, where SSS identifies the portion of the study area: NSA, SSA, REG, TRN, and TTT identifies the cover type for the site, 999 if unknown, and CCCC is the identifier for site, exactly what it means will vary with site type.
SUB_SITE	The identifier assigned to the sub-site by BOREAS, in the format GGGGG-IIIII, where GGGGG is the group associated with the sub-site instrument, e.g. HYD06 or STAFF, and IIIII is the identifier for sub-site, often this will refer to an instrument.
START_DATE	The date on which the collection of data commenced.
END_DATE	The date on which the collection of the data was terminated.
BROMOXYNIL_FLUX	Dry Deposition of bromoxynil.
DICAMBA_FLUX	Dry Deposition of dacamba.
2,4-D_FLUX	Dry deposition of 2,4-dichlorophenoxyacidic_acid
MCPA_FLUX	Dry Deposition of MCPA.
DICLOFOP_FLUX	Dry Deposition of diclofop.
TRIALATE_FLUX	Dry Deposition of triallate.
TRIFLURALIN_FLUX	Dry Deposition of trifluralin.
ALACHLOR_FLUX	Dry Deposition of alachlor.
ATRAZINE_FLUX	Dry Deposition of atrazine.
METOLACHLOR_FLUX	Dry Deposition of metolachlor.
ALPHA-HCH_FLUX	Dry Deposition of alpha-hexachlorocyclohexane.
GAMMA-HCH_FLUX	Dry Deposition of gamma-hexachlorocyclohexane.
4,4'-DDE_FLUX	Dry Deposition of 4,4' DDE.
4,4'-DDD_FLUX	Dry Deposition of 4,4' DDD.
4,4'-DDT_FLUX	Dry Deposition of 4,4' DDT.
TETRACHLORO-BIPHENYL_FLUX	Dry Deposition of tetrachloro-biphenyl.

PENTACHLORO-BIPHENYL_FLUX	Dry Deposition of pentachloro-biphenyl
HEXACHLORO-BIPHENYL_FLUX	Dry Deposition of hexachloro-biphenyl.
OCTACHLORO-BIPHENYL_FLUX	Dry Deposition of octachloro-biphenyl.
DICHLORO-BIPHENYL_FLUX	Dry Deposition of dichloro-biphenyl.
TRICHLORO-BIPHENYL_FLUX	Dry Deposition of trichloro-biphenyl.
CRTFCN_CODE	The BOREAS certification level of the data. Examples are CPI (Checked by PI), CGR (Certified by Group), PRE (Preliminary), and CPI-??? (CPI but questionable).
REVISION_DATE	The most recent date when the information in the referenced data base table record was revised.

7.3.3 Unit of Measurement

The measurement units for the parameters contained in the data files on the CD-ROM are:

Column Name	Units
SITE_NAME	[none]
SUB_SITE	[none]
START_DATE	[DD-MON-YY]
END_DATE	[DD-MON-YY]
BROMOXYNIL_FLUX	[nanograms] [meters ⁻²] [day ⁻¹]
DICAMBA_FLUX	[nanograms] [meters ⁻²] [day ⁻¹]
2,4-D_FLUX	[nanograms] [meters ⁻²] [day ⁻¹]
MCPA_FLUX	[nanograms] [meters ⁻²] [day ⁻¹]
DICLOFOP_FLUX	[nanograms] [meters ⁻²] [day ⁻¹]
TRIALATE_FLUX	[nanograms] [meters ⁻²] [day ⁻¹]
TRIFLURALIN_FLUX	[nanograms] [meters ⁻²] [day ⁻¹]
ALACHLOR_FLUX	[nanograms] [meters ⁻²] [day ⁻¹]
ATRAZINE_FLUX	[nanograms] [meters ⁻²] [day ⁻¹]
METOLACHLOR_FLUX	[nanograms] [meters ⁻²] [day ⁻¹]
ALPHA-HCH_FLUX	[nanograms] [meters ⁻²] [day ⁻¹]
GAMMA-HCH_FLUX	[nanograms] [meters ⁻²] [day ⁻¹]
4,4'-DDE_FLUX	[nanograms] [meters ⁻²] [day ⁻¹]
4,4'-DDD_FLUX	[nanograms] [meters ⁻²] [day ⁻¹]
4,4'-DDT_FLUX	[nanograms] [meters ⁻²] [day ⁻¹]
TETRACHLORO-BIPHENYL_FLUX	[nanograms] [meters ⁻²] [day ⁻¹]
PENTACHLORO-BIPHENYL_FLUX	[nanograms] [meters ⁻²] [day ⁻¹]
HEXACHLORO-BIPHENYL_FLUX	[nanograms] [meters ⁻²] [day ⁻¹]
OCTACHLORO-BIPHENYL_FLUX	[nanograms] [meters ⁻²] [day ⁻¹]
DICHLORO-BIPHENYL_FLUX	[nanograms] [meters ⁻²] [day ⁻¹]
TRICHLORO-BIPHENYL_FLUX	[nanograms] [meters ⁻²] [day ⁻¹]
CRTFCN_CODE	[none]
REVISION_DATE	[DD-MON-YY]

7.3.4 Data Source

The source of the parameter values contained in the data files on the CD-ROM are:

Column Name	Data Source
SITE_NAME	[Assigned by BORIS Staff]
SUB_SITE	[Assigned by BORIS Staff]
START_DATE	Investigator
END_DATE	Investigator

BROMOXYNIL_FLUX	GC-MSD
DICAMBA_FLUX	GC-MSD
2,4-D_FLUX	GC-MSD
MCPA_FLUX	GC-MSD
DICLOFOP_FLUX	GC-MSD
TRIALATE_FLUX	GC-MSD
TRIFLURALIN_FLUX	GC-MSD
ALACHLOR_FLUX	GC-MSD
ATRAZINE_FLUX	GC-MSD
METOLACHLOR_FLUX	GC-MSD
ALPHA-HCH_FLUX	GC-MSD
GAMMA-HCH_FLUX	GC-MSD
4,4'-DDE_FLUX	GC-MSD
4,4'-DDD_FLUX	GC-MSD
4,4'-DDT_FLUX	GC-MSD
TETRACHLORO-BIPHENYL_FLUX	GC-MSD
PENTACHLORO-BIPHENYL_FLUX	GC-MSD
HEXACHLORO-BIPHENYL_FLUX	GC-MSD
OCTACHLORO-BIPHENYL_FLUX	GC-MSD
DICHLORO-BIPHENYL_FLUX	GC-MSD
TRICHLORO-BIPHENYL_FLUX	GC-MSD
CRTFCN_CODE	[Assigned by BORIS Staff]
REVISION_DATE	[Assigned by BORIS Staff]

7.3.5 Data Range

The following table gives information about the parameter values found in the data files on the CD-ROM.

Column Name	Minimum Data Value	Maximum Data Value	Missng Data Value	Unrel Data Value	Below Detect Limit	Data Not Cllctd
SITE_NAME	SSA-999-WSK05	SSA-999-WSK05	None	None	None	None
SUB_SITE	TGB07-FLX01	TGB07-FLX01	None	None	None	None
START_DATE	16-JUN-93	13-JUL-94	None	None	None	None
END_DATE	21-JUN-93	20-JUL-94	None	None	None	None
BROMOXYNIL_FLUX	4.2	47.7	None	None	-777	None
DICAMBA_FLUX	6.3	60.6	None	None	-777	None
2,4-D_FLUX	39.9	149.3	None	None	-777	None
MCPA_FLUX	135	135	None	None	-777	None
DICLOFOP_FLUX			None	None	-777	None
TRIALATE_FLUX			-999	None	-777	None
TRIFLURALIN_FLUX			None	None	-777	None
ALACHLOR_FLUX			None	None	-777	None
ATRAZINE_FLUX			None	None	-777	None
METOLACHLOR_FLUX	15.2	15.2	None	None	-777	None
ALPHA-HCH_FLUX			-999	None	-777	None
GAMMA-HCH_FLUX	4.29	463.6	-999	None	-777	None
4,4'-DDE_FLUX	30.69	219.45	-999	None	-777	None
4,4'-DDD_FLUX			-999	None	-777	None
4,4'-DDT_FLUX	66.3	538.65	-999	None	-777	None
TETRACHLORO- BIPHENYL_FLUX	8.5	32.2	-999	None	-777	None
PENTACHLORO- BIPHENYL_FLUX	13.1	13.1	-999	None	-777	None

HEXACHLORO-BIPHENYL_	2.04	96.76	-999	None	-777	None
FLUX						
OCTACHLORO-BIPHENYL_	1.02	65.84	-999	None	-777	None
FLUX						
DICHLORO-BIPHENYL_	9.98	41.9	-999	None	-777	None
FLUX						
TRICHLORO-BIPHENYL_			-999	None	-777	None
FLUX						
CRTFCN_CODE	CPI	CPI	None	None	None	None
REVISION DATE	28-AUG-98	28-AUG-98	None	None	None	None

7.4 Sample Data Record

```

SITE_NAME,SUB_SITE,START_DATE,END_DATE,BROMOXYNIL_FLUX,DICAMBA_FLUX,2,4-D_FLUX,
MCPA_FLUX,DICLOFOP_FLUX,TRIALATE_FLUX,TRIFLURALIN_FLUX,ALACHLOR_FLUX,
ATRAZINE_FLUX,METOLACHLOR_FLUX,ALPHA-HCH_FLUX,GAMMA-HCH_FLUX,4,4'-DDE_FLUX,
4,4'-DDD_FLUX,4,4'-DDT_FLUX,TETRACHLORO-BIPHENYL_FLUX,PENTACHLORO-BIPHENYL_FLUX,
HEXACHLORO-BIPHENYL_FLUX,OCTACHLORO-BIPHENYL_FLUX,DICHLORO-BIPHENYL_FLUX,
TRICHLORO-BIPHENYL_FLUX,CRTFCN_CODE,REVISION_DATE
'SSA-999-WSK05','TGB07-FLX01',16-JUN-93,21-JUN-93,-777.0,-777.0,-777.0,135.0,
-999.0,-777.0,-777.0,-999.0,-999.0,-999.0,,,,,,,,,'CPI',16-APR-97
'SSA-999-WSK05','TGB07-FLX01',21-JUN-93,25-JUN-93,-777.0,-999.0,-777.0,-777.0,
-999.0,-777.0,-777.0,-999.0,-999.0,-999.0,-777.0,4.29,-777.0,-999.0,-999.0,,
-999.0,-999.0,-999.0,-999.0,'CPI',16-APR-97

```

8. Data Organization

8.1 Data Granularity

The smallest unit of data tracked by the BOREAS Information System (BORIS) was the herbicide concentration in dry deposition for a given site in a given sampling period.

8.2 Data Format(s)

The Compact Disk-Read-Only Memory (CD-ROM) files contain American Standard Code for Information Interchange (ASCII) numerical and character fields of varying length separated by commas. The character fields are enclosed with single apostrophe marks. There are no spaces between the fields.

Each data file on the CD-ROM has four header lines of Hyper-Text Markup Language (HTML) code at the top. When viewed with a Web browser, this code displays header information (data set title, location, date, acknowledgments, etc.) and a series of HTML links to associated data files and related data sets. Line 5 of each data file is a list of the column names, and line 6 and following lines contain the actual data.

9. Data Manipulations

9.1 Formulae

9.1.1 Derivation Techniques and Algorithms

None given.

9.2 Data Processing Sequence

9.2.1 Processing Steps

None given.

9.2.2 Processing Changes

None given.

9.3 Calculations

9.3.1 Special Corrections/Adjustments

None given.

9.3.2 Calculated Variables

None given.

9.4 Graphs and Plots

None given.

10. Errors

10.1 Sources of Error

Irreproducible packing of the XAD-2 resin column.

10.2 Quality Assessment

Standard laboratory procedures involving blanks, spikes, and replicates.

10.2.1 Data Validation by Source

None given.

10.2.2 Confidence Level/Accuracy Judgment

None given.

10.2.3 Measurement Error for Parameters

None given.

10.2.4 Additional Quality Assessments

None given.

10.2.5 Data Verification by Data Center

The data were examined for general consistency and clarity.

11. Notes**11.1 Limitations of the Data**

None given.

11.2 Known Problems with the Data

None given.

11.3 Usage Guidance

None given.

11.4 Other Relevant Information

None given.

12. Application of the Data Set

The data can be used to quantify the trace organic contaminants entering the site from atmospheric transport and identify chemicals that require further research.

13. Future Modifications and Plans

None given.

14. Software**14.1 Software Description**

None given.

14.2 Software Access

None given.

15. Data Access

The dry deposition herbicide and organochlorine flux data are available from the Earth Observing System Data and Information System (EOSDIS) Oak Ridge National Laboratory (ORNL) Distributed Active Archive Center (DAAC).

15.1 Contact Information

For BOREAS data and documentation please contact:

ORNL DAAC User Services
Oak Ridge National Laboratory
P.O. Box 2008 MS-6407
Oak Ridge, TN 37831-6407
Phone: (423) 241-3952
Fax: (423) 574-4665
E-mail: ornldaac@ornl.gov or ornl@eos.nasa.gov

15.2 Data Center Identification

Earth Observing System Data and Information System (EOSDIS) Oak Ridge National Laboratory (ORNL) Distributed Active Archive Center (DAAC) for Biogeochemical Dynamics
<http://www-eosdis.ornl.gov/>.

15.3 Procedures for Obtaining Data

Users may obtain data directly through the ORNL DAAC online search and order system [<http://www-eosdis.ornl.gov/>] and the anonymous FTP site [<ftp://www-eosdis.ornl.gov/data/>] or by contacting User Services by electronic mail, telephone, fax, letter, or personal visit using the contact information in Section 15.1.

15.4 Data Center Status/Plans

The ORNL DAAC is the primary source for BOREAS field measurement, image, GIS, and hardcopy data products. The BOREAS CD-ROM and data referenced or listed in inventories on the CD-ROM are available from the ORNL DAAC.

16. Output Products and Availability

16.1 Tape Products

None.

16.2 Film Products

None.

16.3 Other Products

These data are available on the BOREAS CD-ROM series.

17. References

17.1 Platform/Sensor/Instrument/Data Processing Documentation

None given.

17.2 Journal Articles and Study Reports

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Sellers, P. and F. Hall. 1994. *Boreal Ecosystem-Atmosphere Study: Experiment Plan*. Version 1994-3.0, NASA BOREAS Report (EXPLAN 94).

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Sellers, P., F. Hall, and K.F. Huemmrich. 1996. *Boreal Ecosystem-Atmosphere Study: 1994 Operations*. NASA BOREAS Report (OPS DOC 94).

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Sellers, P., F. Hall, H. Margolis, B. Kelly, D. Baldocchi, G. den Hartog, J. Cihlar, M.G. Ryan, B. Goodison, P. Crill, K.J. Ranson, D. Lettenmaier, and D.E. Wickland. 1995. The boreal ecosystem-atmosphere study (BOREAS): an overview and early results from the 1994 field year. *Bulletin of the American Meteorological Society.* 76(9):1549-1577.

Sellers, P.J., F.G. Hall, R.D. Kelly, A. Black, D. Baldocchi, J. Berry, M. Ryan, K.J. Ranson, P.M. Crill, D.P. Lettenmaier, H. Margolis, J. Cihlar, J. Newcomer, D. Fitzjarrald, P.G. Jarvis, S.T. Gower, D. Halliwell, D. Williams, B. Goodison, D.E. Wickland, and F.E. Guertin. 1997. BOREAS in 1997: Experiment Overview, Scientific Results and Future Directions. *Journal of Geophysical Research* 102(D24): 28,731-28,770.

Thompson, T.S., R.G. Treble, D.T. Waite, and A.J. Cessna. 1997. Identification of pentachloronitrobenzene in ambient air extracts. *Bull. Environ. Contamin. Chem.* 58:939-944.

Waite, D.T., A.J. Cessna, N.P. Gurprasad, and J. Banner. _____. Evaluation of a new sampler for collecting separate dry and wet atmospheric depositions of trace organic chemicals. *Atmos. Environ.* Accepted.

Waite, D.T., N.P. Gurprasad, A.J. Cessna, and D.V. Quiring. _____. Atmospheric pentachlorophenol concentrations in relation to air temperature at five Canadian locations. *Chemosphere* Accepted.

Waite, D.T., N.P. Gurprasad, and M.B. Constable. 1996. Concentrations of pentachlorophenol and some related compounds in seasonally collected atmospheric samples from five Canadian locations. *Organohalogen Compds.* 28:482-489.

17.3 Archive/DBMS Usage Documentation

None.

18. Glossary of Terms

None given.

19. List of Acronyms

ASCII	- American Standard for Information Interchange
BOREAS	- BOReal Ecosystem-Atmosphere Study
BORIS	- BOREAS Information System
CD-ROM	- Compact Disk-Read-Only Memory
DAAC	- Distributed Active Archive Center
EOS	- Earth Observing System
EOSDIS	- EOS Data and Information System
GC-MSD	- Gas Chromatograph - Mass Selective Detector
GIS	- Geographic Information System
GSFC	- Goddard Space Flight Center
HTML	- HyperText Markup Language
NASA	- National Aeronautics and Space Administration
NMHC	- Nonmethane Hydrocarbon
NSA	- Northern Study Area
OA	- Old Aspen
OBS	- Old Black Spruce
OJP	- Old Jack Pine
ORNL	- Oak Ridge National Laboratory
PANP	- Prince Albert National Park
PUF	- Polyurethane Foam
SSA	- Southern Study Area
TGB	- Trace Gas Biogeochemistry
URL	- Uniform Resource Locator

20. Document Information

20.1 Document Revision Date

Written: 04-Dec-1997

Last updated: 04-Aug-1999

20.2 Document Review Date(s)

BORIS Review: 27-Aug-1998

Science Review:

20.3 Document ID

20.4 Citation

When using these data, please contact one of the individuals listed in Section 2.3 and as well as citing relevant papers in Section 17.2.

If using data from the BOREAS CD-ROM series, also reference the data as:

Waite, D., A. Cessna, and N. Gurprasad, "Atmospheric Transport of Agricultural Pesticides into the Boreal Ecosystem." In *Collected Data of The Boreal Ecosystem-Atmosphere Study*. Eds. J. Newcomer, D. Landis, S. Conrad, S. Curd, K. Huemmrich, D. Knapp, A. Morrell, J. Nickeson, A. Papagno, D. Rinker, R. Strub, T. Twine, F. Hall, and P. Sellers. CD-ROM. NASA, 2000.

Also, cite the BOREAS CD-ROM set as:

Newcomer, J., D. Landis, S. Conrad, S. Curd, K. Huemmrich, D. Knapp, A. Morrell, J. Nickeson, A. Papagno, D. Rinker, R. Strub, T. Twine, F. Hall, and P. Sellers, eds. *Collected Data of The Boreal Ecosystem-Atmosphere Study*. NASA. CD-ROM. NASA, 2000.

20.5 Document Curator

20.6 Document URL

REPORT DOCUMENTATION PAGE			Form Approved OMB No. 0704-0188	
Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.				
1. AGENCY USE ONLY (Leave blank)		2. REPORT DATE November 2000		3. REPORT TYPE AND DATES COVERED Technical Memorandum
4. TITLE AND SUBTITLE Technical Report Series on the Boreal Ecosystem-Atmosphere Study (BOREAS) BOREAS TGB-7 Dry Deposition Herbicide and Organocide Flux Data			5. FUNDING NUMBERS 923 RTOP: 923-462-33-01	
6. AUTHOR(S) Don Waite Forrest G. Hall and Sara K. Conrad, Editors				
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS (ES) Goddard Space Flight Center Greenbelt, Maryland 20771			8. PERFORMING ORGANIZATION REPORT NUMBER 2000-03136-0	
9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS (ES) National Aeronautics and Space Administration Washington, DC 20546-0001			10. SPONSORING / MONITORING AGENCY REPORT NUMBER TM—2000—209891 Vol. 235	
11. SUPPLEMENTARY NOTES D. Waite: Environment Canada, Regina, Saskatchewan; S.K. Conrad: Raytheon ITSS				
12a. DISTRIBUTION / AVAILABILITY STATEMENT Unclassified—Unlimited Subject Category: 43 Report available from the NASA Center for AeroSpace Information, 7121 Standard Drive, Hanover, MD 21076-1320. (301) 621-0390.			12b. DISTRIBUTION CODE	
13. ABSTRACT (Maximum 200 words) The BOREAS TGB-7 team measured the concentration and flux of several agricultural pesticides in air, rainwater, and dry deposition samples in order to determine the associated yearly deposition rates. This data set contains information on the dry deposition flux of seven herbicides [2,4-dichlorophenoxyacetic acid (2,4-D), bromoxynil, dicamb, 2-methyl-4-chlorophenoxyacetic acid (MCPA), triallate, trifluralin, and diclop-methyl] known to appear in the atmosphere of the Canadian prairies. Also, the concentration of three herbicides (atrazine, alachlor, and metolachlor), two groups of insecticides (lindane and breakdown products and dichloro-diphenyl-trichloroethane (DDT) and breakdown products), and several polychlorinated biphenyls commonly used in the central United States was measured. All of these chemicals are reported, in the literature, to be transported in the atmosphere. Many have been reported to occur in boreal and arctic food chains. The sampling was carried out from 16-Jun to 13-Aug-1993 and 04-May to 20-Jul-1994 at the BOREAS site in the Prince Albert National Park (Waskesiu). The data are stored in tabular ASCII files.				
14. SUBJECT TERMS BOREAS, trace gas biogeochemistry.			15. NUMBER OF PAGES 16	
			16. PRICE CODE	
17. SECURITY CLASSIFICATION OF REPORT Unclassified	18. SECURITY CLASSIFICATION OF THIS PAGE Unclassified	19. SECURITY CLASSIFICATION OF ABSTRACT Unclassified	20. LIMITATION OF ABSTRACT UL	

