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

Toni L. Nau and Sara K. Conrad, Editors

NASA TGB-7 Dry Deposition
Chloroform and Dichloromethane

NASA/Goddard Space Flight Center
Greenbelt, Maryland 20771
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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

Don Waite
Environment Canada, Regina, Saskatchewan

National Aeronautics and Space Administration
Goddard Space Flight Center
Greenbelt, Maryland 20771

November 2000
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 at 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 diclofop-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
Don Waite
Environment Canada

Allan Cessna
Agriculture and Agri-Foods Canada

Narine Gurprasad
Environment Canada

2.2 Title of Investigation
Atmospheric Transport of Agricultural Pesticides into the Boreal Ecosystem

2.3 Contact Information

Contact 1:
Dr. Don Waite
Environment Canada
Room 300 park Plaza
2365 Albert Street
Regina, Saskatchewan
S4P 4K1 Canada
(306) 780-6438
(306) 780-7614 (fax)
Don.Waite@EC.GC.CA
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-(m 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:

<table>
<thead>
<tr>
<th>Longitude</th>
<th>Latitude</th>
</tr>
</thead>
<tbody>
<tr>
<td>106.067° W</td>
<td>53.917° N</td>
</tr>
</tbody>
</table>

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:

<table>
<thead>
<tr>
<th>Column Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>SITE_NAME</td>
</tr>
<tr>
<td>SUB_SITE</td>
</tr>
<tr>
<td>START_DATE</td>
</tr>
<tr>
<td>END_DATE</td>
</tr>
<tr>
<td>BROMOXYNIL_FLUX</td>
</tr>
<tr>
<td>DICAMBA_FLUX</td>
</tr>
<tr>
<td>2,4-D_FLUX</td>
</tr>
<tr>
<td>MCPA_FLUX</td>
</tr>
<tr>
<td>DICLOFOP_FLUX</td>
</tr>
<tr>
<td>TRIALLATE_FLUX</td>
</tr>
<tr>
<td>TRIFLURALIN_FLUX</td>
</tr>
<tr>
<td>ALACHLOR_FLUX</td>
</tr>
</tbody>
</table>
### Variable Description/Definition

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

<table>
<thead>
<tr>
<th>Column Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>SITE_NAME</td>
<td>The identifier assigned to the site by BOREAS, in the format SSS-TTT-CCCCC, 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 CCCCC is the identifier for site, exactly what it means will vary with site type.</td>
</tr>
<tr>
<td>SUB_SITE</td>
<td>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.</td>
</tr>
<tr>
<td>START_DATE</td>
<td>The date on which the collection of data commenced.</td>
</tr>
<tr>
<td>END_DATE</td>
<td>The date on which the collection of the data was terminated.</td>
</tr>
<tr>
<td>BROMOXYNIL_FLUX</td>
<td>Dry Deposition of bromoxynil.</td>
</tr>
<tr>
<td>DICAMBA_FLUX</td>
<td>Dry Deposition of dacamba.</td>
</tr>
<tr>
<td>2,4-D_FLUX</td>
<td>Dry deposition of 2,4-dichlorophenoxyacetic acid</td>
</tr>
<tr>
<td>MCPA_FLUX</td>
<td>Dry Deposition of MCPA.</td>
</tr>
<tr>
<td>DICLOFOP_FLUX</td>
<td>Dry Deposition of diclofop.</td>
</tr>
<tr>
<td>TRIALLATE_FLUX</td>
<td>Dry Deposition of triallate.</td>
</tr>
<tr>
<td>TRIFLURALIN_FLUX</td>
<td>Dry Deposition of trifluralin.</td>
</tr>
<tr>
<td>ALACHLOR_FLUX</td>
<td>Dry Deposition of alachlor.</td>
</tr>
<tr>
<td>ATRAZINE_FLUX</td>
<td>Dry Deposition of atrazine.</td>
</tr>
<tr>
<td>METOLACHLOR_FLUX</td>
<td>Dry Deposition of metolachlor.</td>
</tr>
<tr>
<td>ALPHA-HCH_FLUX</td>
<td>Dry Deposition of alpha-hexachlorocyclohexane.</td>
</tr>
<tr>
<td>GAMMA-HCH_FLUX</td>
<td>Dry Deposition of gamma-hexachlorocyclohexane.</td>
</tr>
<tr>
<td>4,4'-DDE_FLUX</td>
<td>Dry Deposition of 4,4' DDE.</td>
</tr>
<tr>
<td>4,4'-DDD_FLUX</td>
<td>Dry Deposition of 4,4' DDD.</td>
</tr>
<tr>
<td>4,4'-DDT_FLUX</td>
<td>Dry Deposition of 4,4' DDT.</td>
</tr>
<tr>
<td>TETRACHLORO-BIPHENYL_FLUX</td>
<td>Dry Deposition of tetrachloro-biphenyl.</td>
</tr>
</tbody>
</table>
### 7.3.3 Unit of Measurement

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

<table>
<thead>
<tr>
<th>Column Name</th>
<th>Units</th>
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<tbody>
<tr>
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<tr>
<td>SUB_SITE</td>
<td>[none]</td>
</tr>
<tr>
<td>START_DATE</td>
<td>[DD-MON-YY]</td>
</tr>
<tr>
<td>END_DATE</td>
<td>[DD-MON-YY]</td>
</tr>
<tr>
<td>BROMOXYNIL_FLUX</td>
<td>[nanograms][meters^-2][day^-1]</td>
</tr>
<tr>
<td>DICAMBA_FLUX</td>
<td>[nanograms][meters^-2][day^-1]</td>
</tr>
<tr>
<td>2,4-D_FLUX</td>
<td>[nanograms][meters^-2][day^-1]</td>
</tr>
<tr>
<td>MCPA_FLUX</td>
<td>[nanograms][meters^-2][day^-1]</td>
</tr>
<tr>
<td>DICLOFOP_FLUX</td>
<td>[nanograms][meters^-2][day^-1]</td>
</tr>
<tr>
<td>TRIALLATE_FLUX</td>
<td>[nanograms][meters^-2][day^-1]</td>
</tr>
<tr>
<td>TRIFLURALIN_FLUX</td>
<td>[nanograms][meters^-2][day^-1]</td>
</tr>
<tr>
<td>ALACHLOR_FLUX</td>
<td>[nanograms][meters^-2][day^-1]</td>
</tr>
<tr>
<td>ATRAZINE_FLUX</td>
<td>[nanograms][meters^-2][day^-1]</td>
</tr>
<tr>
<td>METOLACHLOR_FLUX</td>
<td>[nanograms][meters^-2][day^-1]</td>
</tr>
<tr>
<td>ALPHA-HCH_FLUX</td>
<td>[nanograms][meters^-2][day^-1]</td>
</tr>
<tr>
<td>GAMMA-HCH_FLUX</td>
<td>[nanograms][meters^-2][day^-1]</td>
</tr>
<tr>
<td>4,4'-DDE_FLUX</td>
<td>[nanograms][meters^-2][day^-1]</td>
</tr>
<tr>
<td>4,4'-DDD_FLUX</td>
<td>[nanograms][meters^-2][day^-1]</td>
</tr>
<tr>
<td>4,4'-DDT_FLUX</td>
<td>[nanograms][meters^-2][day^-1]</td>
</tr>
<tr>
<td>TETRACHLORO-BIPHENYL_FLUX</td>
<td>[nanograms][meters^-2][day^-1]</td>
</tr>
<tr>
<td>PENTACHLORO-BIPHENYL_FLUX</td>
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<td>DICHLORO-BIPHENYL_FLUX</td>
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<td>TRICHLORO-BIPHENYL_FLUX</td>
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<td>REVISION_DATE</td>
<td>[DD-MON-YY]</td>
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</tbody>
</table>

### 7.3.4 Data Source

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

<table>
<thead>
<tr>
<th>Column Name</th>
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</thead>
<tbody>
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<td>[Assigned by BORIS Staff]</td>
</tr>
<tr>
<td>SUB_SITE</td>
<td>[Assigned by BORIS Staff]</td>
</tr>
<tr>
<td>START_DATE</td>
<td>Investigator</td>
</tr>
<tr>
<td>END_DATE</td>
<td>Investigator</td>
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</table>
### 7.3.5 Data Range

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

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<th>Unrel Data Value</th>
<th>Below Data Limit</th>
<th>Not Clip Ltd</th>
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</thead>
<tbody>
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<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>SUB_SITE</td>
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<td>TGB07-FLX01</td>
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<td>None</td>
<td>None</td>
<td>None</td>
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<tr>
<td>START_DATE</td>
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<td>13-JUL-94</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>END_DATE</td>
<td>21-JUN-93</td>
<td>20-JUL-94</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>BROMOXYNIL_FLUX</td>
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<td>None</td>
<td>-777</td>
<td>None</td>
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<tr>
<td>DICAMBA_FLUX</td>
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<td>-777</td>
<td>None</td>
</tr>
<tr>
<td>2,4-D_FLUX</td>
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<td>149.3</td>
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<td>None</td>
<td>-777</td>
<td>None</td>
</tr>
<tr>
<td>MCPA_FLUX</td>
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<td>135</td>
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HEXACHLORO-BIPHENYL_  2.04  96.76  -999  None  -777  None
OCTACHLORO-BIPHENYL_ 1.02  65.84  -999  None  -777  None
DICHLORO-BIPHENYL_  9.98  41.9  -999  None  -777  None
TRICHLORO-BIPHENYL_ -999  None  -777  None

CRTFCN_CODE  CPI  CPI  None  None  None  None
REVISION_DATE  28-AUG-98  28-AUG-98  None  None  None  None

Minimum Data Value -- The minimum value found in the column.
Maximum Data Value -- The maximum value found in the column.
Missing Data Value -- The value that indicates missing data. This is used to indicate that an attempt was made to determine the parameter value, but the attempt was unsuccessful.
Unrel Data Value -- The value that indicates unreliable data. This is used to indicate an attempt was made to determine the parameter value, but the value was deemed to be unreliable by the analysis personnel.
Below Detect Limit -- The value that indicates parameter values below the instruments detection limits. This is used to indicate that an attempt was made to determine the parameter value, but the analysis personnel determined that the parameter value was below the detection limit of the instrumentation.
Data Not Collected -- This value indicates that no attempt was made to determine the parameter value. This usually indicates that BORIS combined several similar but not identical data sets into the same data base table but this particular science team did not measure that parameter.

Blank -- Indicates that blank spaces are used to denote that type of value.
N/A -- Indicates that the value is not applicable to the respective column.
None -- Indicates that no values of that sort were found in the column.

7.4 Sample Data Record
The following are wrapped versions of data record from a sample data file on the CD-ROM.

SITE_NAME, SUB_SITE, START_DATE, END_DATE, BROMOXNIL FLUX, DICAMBA_FLUX, 2,4-D_FLUX, MCPA_FLUX, DICLOFOP_FLUX, TRIALLATE_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, -777.0, -777.0, -777.0, -777.0, -777.0, -777.0, -777.0, -777.0, -777.0, -777.0, -777.0, 'CPI', 16-APR-97
'SSA-999-WSK05', 'TGB07-FLX01', 16-JUN-93, 21-JUN-93, -777.0, -777.0, -777.0, -777.0, -777.0, -777.0, -777.0, -777.0, -777.0, -777.0, -777.0, -777.0, -777.0, -777.0, '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

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


17.3 Archive/DBMS Usage Documentation
None.

18. Glossary of Terms
None given.

19. List of Acronyms

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
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<tr>
<td>ASCII</td>
<td>American Standard for Information Interchange</td>
</tr>
<tr>
<td>BOREAS</td>
<td>BOReal Ecosystem-Atmosphere Study</td>
</tr>
<tr>
<td>BORIS</td>
<td>BOREAS Information System</td>
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<tr>
<td>CD-ROM</td>
<td>Compact Disk-Read-Only Memory</td>
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<td>DAAC</td>
<td>Distributed Active Archive Center</td>
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<tr>
<td>EOS</td>
<td>Earth Observing System</td>
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<td>EOSDIS</td>
<td>EOS Data and Information System</td>
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<tr>
<td>GC-MSD</td>
<td>Gas Chromatograph - Mass Selective Detector</td>
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<tr>
<td>GIS</td>
<td>Geographic Information System</td>
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<tr>
<td>GSFC</td>
<td>Goddard Space Flight Center</td>
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<tr>
<td>HTML</td>
<td>HyperText Markup Language</td>
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<tr>
<td>NASA</td>
<td>National Aeronautics and Space Administration</td>
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<tr>
<td>NMHC</td>
<td>Nonmethane Hydrocarbon</td>
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<tr>
<td>NSA</td>
<td>Northern Study Area</td>
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<td>OBS</td>
<td>Old Black Spruce</td>
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<td>Old Jack Pine</td>
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<tr>
<td>ORNL</td>
<td>Oak Ridge National Laboratory</td>
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<td>Prince Albert National Park</td>
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<td>PUF</td>
<td>Polyurethane Foam</td>
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<td>TGB</td>
<td>Trace Gas Biogeochemistry</td>
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20. Document Information

20.1 Document Revision Date
Written: 04-Dec-1997
Last updated: 04-Aug-1999

20.2 Document Review Date(s)
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:


Also, cite the BOREAS CD-ROM set as:


20.5 Document Curator

20.6 Document URL
### Technical Report Series on the Boreal Ecosystem-Atmosphere Study (BOREAS)

**BOREAS TGB-7 Dry Deposition Herbicide and Organocide Flux Data**

**AUTHOR(S)**
Don Waite  
Forrest G. Hall and Sara K. Conrad, Editors

**PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)**
Goddard Space Flight Center  
Greenbelt, Maryland 20771

**SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES)**
National Aeronautics and Space Administration  
Washington, DC 20546-0001

**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-dichlorophenoxyacidic 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.