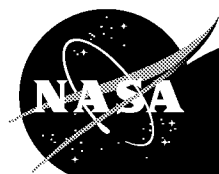


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Technical Report Series on the Biosystem-Air Atmosphere Study (BOREAS)

William L. Munn and Sara K. Conrad, Editors

236

BOREAS TGB-7 Rainwater Herbicide Concentration

Aeronautics and
Administration

Space Flight Center
Baltimore, Maryland 20771

November

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

Forrest G. Hall and Sara K. Conrad, Editors

Volume 236

**BOREAS TGB-7 Rainwater Herbicide
and Organochlorine Concentration
Data**

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National Aeronautics and
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Available from:

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Price Code: A10

BOREAS TGB-7 Rainwater Herbicide and Organochlorine Concentration Data

Don Waite

Summary

The BOREAS TGB-7 team measured the concentration and flux of several agricultural pesticides in air and rainwater samples in order to determine the associated yearly deposition rates. This data set contains information on the rainwater concentration 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 Rainwater Herbicide and Organochlorine Concentration Data

1.2 Data Set Introduction

This data set contains herbicide concentrations in rainwater collected from Waskesiu.

1.3 Objective/Purpose

The objective of this study was to measure the wet deposition (in rainfall) of herbicides in the boreal forest at Waskesiu.

1.4 Summary of Parameters and Variables

This data set contains herbicide concentrations in rainwater collected from 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 diclof-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 Dry Deposition Herbicide and Organochlorine Flux Data

BOREAS TGB-09 Above-Canopy NMHC at SSA-OBS, SSA-OJP, and SSA-OA Sites

BOREAS TGB-10 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

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3. Theory of Measurements

Rain samples are collected by the dry deposition sampler (dust collector), which consists of a 1-m x 0.5-m, stainless steel (316-grade) tray, with 5-cm-high sides. When rainfall is detected on the conductivity-type rain detector, the dust collector pump shuts down and two valves operate to divert rainwater into an exterior, stainless steel container. When the rainfall stops, the rain detector dries with the help of a built-in heater. The pump restarts and dry deposition sampling is resumed. Rain time is recorded on an integrated timer. Rain volume is measured separately with a standard rain gauge. The rainwater is solvent extracted, following published procedures, and the extracts analyzed for target chemicals. Rain samples were collected as 7-day composite samples.

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 concentration in composite rainwater samples.

4.1.5 Principles of Operation

Rain was sampled by the dust collector, a sampler designed to collect dry and wet atmospheric deposits of trace organics. The collecting surface is a 0.5- x 1.0-m² stainless tray. During dry conditions, acidified water was constantly circulated across this surface, collecting dry deposits. Rainfall triggers a sensor, stopping the water flow. Rain falling on the clean collecting tray is diverted into a stainless steel container that is emptied, manually, at the end of the sampling period (7 days). At the end of the rainfall, the sampler reverts to dry deposition sampling. Rain duration is recorded by a timer in the sampler and rain volume by a standard rain gauge.

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.

4.1.7 Manufacturer of Sensor/Instrument

None given.

4.2 Calibration

None given.

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

None given.

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).

Rain samples (500 mL each) were acidified to pH 2 with dilute H₂SO₄ solution, extracted with dichloromethane and the extract methylated with diazomethane and subjected to Florisil column prior to GC-MSD analysis for extracted herbicides (Cessna et al., 1985). A second 500-mL aliquot was extracted with dichloromethane, subjected to Florisil column, and analyzed for insecticides and organochlorines by GC-MSD (Cessna et al., 1985).

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 |
| PRECIP |
| BROMOXYNIL_CONC |
| DICAMBA_CONC |
| 2,4-D_CONC |
| MCPA_CONC |
| DICLOFOP_CONC |
| TRIALATE_CONC |
| TRIFLURALIN_CONC |

ALACHLOR_CONC
 ATRAZINE_CONC
 METOLACHLOR_CONC
 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-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. |
| SUB_SITE | The identifier assigned to the sub-site by BOREAS, in the format GGGGG-III, where GGGGG is the group associated with the sub-site instrument, e.g. HYD06 or STAFF, and III 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. |
| PRECIP | Amount of precipitation during the sample period. |
| BROMOXYNIL_CONC | Concentration of bromoxynil. |
| DICAMBA_CONC | Concentration of dacamba. |
| 2,4-D_CONC | Concentration of 2,4-DICHLOROPHENOXYACIDIC_ACID. |
| MCPA_CONC | Concentration of MCPA. |
| DICLOFOP_CONC | Concentration of diclofop. |
| TRIALATE_CONC | Concentration of triallate. |
| TRIFLURALIN_CONC | Concentration of trifluralin. |
| ALACHLOR_CONC | Concentration of alachlor. |
| ATRAZINE_CONC | Concentration of atrazine. |
| METOLACHLOR_CONC | Concentration of metolachlor. |
| 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] |
| PRECIP | [millimeters] |
| BROMOXYNIL_CONC | [picograms] [meter ⁻³] |
| DICAMBA_CONC | [picograms] [meter ⁻³] |
| 2,4-D_CONC | [picograms] [meter ⁻³] |
| MCPA_CONC | [picograms] [meter ⁻³] |
| DICLOFOP_CONC | [picograms] [meter ⁻³] |
| TRIALATE_CONC | [picograms] [meter ⁻³] |
| TRIFLURALIN_CONC | [picograms] [meter ⁻³] |
| ALACHLOR_CONC | [picograms] [meter ⁻³] |
| ATRAZINE_CONC | [picograms] [meter ⁻³] |
| METOLACHLOR_CONC | [picograms] [meter ⁻³] |
| 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 |
| PRECIP | dust collector |
| BROMOXYNIL_CONC | GC-MSD |
| DICAMBA_CONC | GC-MSD |
| 2,4-D_CONC | GC-MSD |
| MCPA_CONC | GC-MSD |
| DICLOFOP_CONC | GC-MSD |
| TRIALATE_CONC | GC-MSD |
| TRIFLURALIN_CONC | GC-MSD |
| ALACHLOR_CONC | GC-MSD |
| ATRAZINE_CONC | GC-MSD |
| METOLACHLOR_CONC | 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-CON01 | TGB07-CON01 | 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 |
| PRECIP | 0 | 56.7 | -999 | None | None | None |
| BROMOXYNIL_CONC | .1 | .1 | None | None | -777 | None |
| DICAMBA_CONC | | | None | None | -777 | None |
| 2,4-D_CONC | .1 | .2 | None | None | -777 | None |
| MCPA_CONC | .1 | .1 | None | None | -777 | None |
| DICLOFOP_CONC | | | None | None | -777 | None |
| TRIALATE_CONC | | | None | None | -777 | None |
| TRIFLURALIN_CONC | | | None | None | -777 | None |
| ALACHLOR_CONC | | | None | None | -777 | None |
| ATRAZINE_CONC | | | None | None | -777 | None |
| METOLACHLOR_CONC | | | None | 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.

Missng 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 Cllctd -- 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, PRECIP, BROMOXYNIL_CONC, DICAMBA_CONC,  
2, 4-D_CONC, MCPA_CONC, DICLOFOP_CONC, TRIALLATE_CONC, TRIFLURALIN_CONC,  
ALACHLOR_CONC, ATRAZINE_CONC, METOLACHLOR_CONC, CRTFCN_CODE, REVISION_DATE  
'SSA-999-WSK05', 'TGB07-CON01', 04-MAY-94, 11-MAY-94, -999.0, -999.0, -999.0, .01,  
-999.0, -999.0, -999.0, -999.0, -999.0, -999.0, -999.0, 'CPI', 16-APR-97  
'SSA-999-WSK05', 'TGB07-CON01', 11-MAY-94, 18-MAY-94, 47.2, -999.0, -999.0, .02, -999.0,  
-999.0, -999.0, -999.0, -999.0, -999.0, -999.0, -999.0, 'CPI', 16-APR-97  
'SSA-999-WSK05', 'TGB07-CON01', 18-MAY-94, 25-MAY-94, 56.7, -999.0, -999.0, -999.0,  
-999.0, -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 rainwater 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

None given.

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 rainwater herbicide and organochlorine concentration 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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Cessna, A.J., R. Grover, L.A. Kerr, and M.L. Aldred. 1985. A multiresidue method for the analysis and verification of several herbicides in water. *J. Agric. Food Chem.* 33, 504-507.

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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.

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

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 |
| SSA | - Southern Study Area |
| TGB | - Trace Gas Biogeochemistry |
| URL | - Uniform Resource Locator |

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