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

Forrest G. Hall and David E. Knapp, Editors

Volume 119

BOREAS AES READAC Surface Meteorological Data

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National Aeronautics and
Space Administration

Goddard Space Flight Center
Greenbelt, Maryland 20771

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BOREAS AES READAC Surface Meteorological Data

G. Barrie Atkinson, Barry Funk

Summary

Canadian AES personnel collected and processed data related to surface atmospheric meteorological conditions over the BOREAS region. This data set contains 15-minute meteorological data from one READAC meteorology station in Hudson Bay, Saskatchewan. Parameters include day, time, type of report, sky condition, visibility, mean sea level pressure, temperature, dewpoint, wind, altimeter, opacity, minimum and maximum visibility, station pressure, minimum and maximum air temperature, a wind group, precipitation, and precipitation in the last hour. The data were collected non-continuously from 24-May-1994 to 20-Sep-1994. The data are provided in tabular ASCII files, and are classified as AFM-Staff data.

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1. Data Set Overview

1.1 Data Set Identification

BOREAS AES READAC Surface Meteorological Data

1.2 Data Set Introduction

This data set contains 15-minute meteorological data from one Remote Environmental Automated Data Acquisition Concept (READAC) meteorology station in the BOREal Ecosystem-Atmosphere Study (BOREAS) region in Canada. Parameters include day, time, type of report, sky condition, visibility, mean sea level pressure, temperature, dewpoint, wind, altimeter, opacity, minimum and maximum visibility, station pressure, minimum and maximum air temperature, a wind group, precipitation, and precipitation in the last hour.

1.3 Objective/Purpose

These monitoring sites were established by Environment Canada to provide hourly weather reports, input to the operational program of forecasts and warnings, input to operational weather prediction models, and climate data. The frequency of observation was increased to 15 minutes at the request of BOREAS. Data collection for BOREAS occurred during Intensive Field Campaigns (IFCs) 1, 2, and 3.

1.4 Summary of Parameters

Included parameters are day, time, type of report, sky condition, visibility, mean sea level pressure, temperature, dewpoint, wind, altimeter, opacity, minimum and maximum visibility, station pressure, minimum and maximum air temperature, wind group, precipitation, and precipitation in the last hour.

1.5 Discussion

This station was installed before BOREAS began in order to meet the goals of Environment Canada, and it conforms to Environment Canada's criteria for accuracy and exposure.

1.6 Related Data Sets

BOREAS AFM-07 SRC Surface Meteorological Data
BOREAS AES MARSII Surface Meteorological Data
BOREAS AES Campbell Scientific Surface Meteorological Data

2. Investigator(s)

2.1 Investigator(s) Name and Title

G. Barrie Atkinson BOREAS AES Project Scientist

2.2 Title of Investigation

Environment Canada 15-Minute Autostation Data

2.3 Contact Information

Contact 1:

G. Barrie Atkinson (Retired)
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(204) 983-4884 (fax)

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Contact 3:

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Raytheon ITSS
NASA GSFC
Code 923
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(301) 286-0239 (fax)
David.Knapp@gsfc.nasa.gov

3. Theory of Measurements

None given.

4. Equipment

4.1 Sensor/Instrument Description

<u>Parameter</u>	<u>Instrumentation</u>
Pressure	Sentra 270 (2) -- the two are compared for each reading.
Cloud	Model 8329A Qualimetrics laser ceilometer
Visibility	Belfort 6200
Temperature	YSI READAC thermister
Dewcel Probe	AES type E
Radiation Shield	Wooden Stevenson screen with wooden stand
	Height 119 cm
Precipitation	Weighing gauge (Fisher and Porter)
	Height 194 cm
	Alter shield 196 cm
Wind	Direction 78D
	Speed detector 78D
	Cupwheel height 10 m -- tower tilting

4.1.1 Collection Environment

The instruments operated during the summer of 1994 in the environmental conditions shown in the data.

4.1.2 Source/Platform

None given.

4.1.3 Source/Platform Mission Objectives

None given.

4.1.4 Key Variables

Temperature, pressure, humidity, wind.

4.1.5 Principles of Operation

None given.

4.1.6 Sensor/Instrument Measurement Geometry

None given.

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

None given.

5. Data Acquisition Methods

Since there is no provision for onboard storage of observations, the station was telephoned approximately every 15 minutes from a computer in Winnipeg and the data were downloaded.

6. Observations

6.1 Data Notes

None given.

6.2 Field Notes

Location	Date of Visit	Actions During Visit
ZHB Hudson Bay, Saskatchewan (SK)	Installation 21-Jun-1992	All instruments were verified after installation. The average differences from the inspection were: barometer was -0.01 mb for 10 readings; dry bulb temperature, -0.1 degrees C for 10 readings; dewpoint +0.46 degrees C for 10 readings. The Fisher and Porter weighing gauge was tested at 25-mm increments over the range 0-300 mm. The difference ranged from +1.2 mm to -0.8 mm with an average of +0.05 mm.

7. Data Description

7.1 Spatial Characteristics

7.1.1 Spatial Coverage

The following description of the Hudson Bay site gives latitude and longitude coordinates as degrees and minutes under the North American Datum of 1983 (NAD83).

ZHB Hudson Bay SK

The Hudson Bay site (ZHB) is located at a latitude of 52 degrees, 49 minutes N; at a longitude of 102 degrees, 19 minutes W; and at an elevation of 358.1 meters. The site is located at the Hudson Bay airport, approximately 5 km south of the town of Hudson Bay, SK. The instruments are located in the 75-m (northwest to southeast) by 60-m (southwest to northeast) instrument area of the formerly manned weather station. The instrument area is level and grassed, with open exposure in all directions. The surrounding countryside is generally flat and forested. The Red Deer River is located approximately 0.7 km to the south. The airport is located in the shallow valley of the Red Deer River, which runs generally southwest to northeast. The valley is paralleled to the south by the Porcupine Hills, which rise to a height of 760 m above sea level approximately 48 km southeast, and to the north by the Pasquia Hills, which achieve a height of 817 m approximately 48 km northwest.

7.1.2 Spatial Coverage Map

Not available.

7.1.3 Spatial Resolution

These data were collected at a point location.

7.1.4 Projection

Not applicable.

7.1.5 Grid Description

Not applicable.

7.2 Temporal Characteristics

7.2.1 Temporal Coverage

Data are available from 24-May-1994 to 25-Jun-1994 and from 19-Jul-1994 to 20-Sep-1994.

7.2.2 Temporal Coverage Map

Not available.

7.2.3 Temporal Resolution

Data were collected approximately every 15 minutes.

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
DATE_OBS
TIME_OBS
REPORT
SKY_COVER
VISIBILITY
AIR_TEMP_1_5M
DEW_TEMP_1_5M
MEAN_WIND_10M_2MIN
ALTIMETER
OPACITY
```

VISIBILITY_MIN_MAX
 STN_PRESS
 AIR_TEMP_MIN
 AIR_TEMP_MAX
 WIND_GROUP_10M
 ACCUM_PRECIP
 PRECIP_LAST_HOUR
 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-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.
DATE_OBS	The date on which the data were collected.
TIME_OBS	The Greenwich Mean Time (GMT) when the data were collected.
REPORT	The report type. Regular (SA) or special (SP).
SKY_COVER	The sky condition in hundreds of feet, up to four cloud layers and up to one surface layer.
VISIBILITY	The Meteorological Optical Range. A V may be appended if visibility is variable.
AIR_TEMP_1_5M	The instantaneous air temperature at a height of 1.5 meters above the surface.
DEW_TEMP_1_5M	The instantaneous dewpoint temperature at a height of 1.5 meters above the surface.
MEAN_WIND_10M_2MIN	The first two digits denote the two minute mean true wind direction in tens of degrees at a height of ten meters above the surface. The next two or three digits denote the two minute mean wind speed in knots at a height of ten meters above the surface.
ALTIMETER	The altimeter reading.
OPACITY	The summation (cumulative) opacity. Percentage in each layer reported. For example, 1246 means ten percent for first layer, twenty percent for first two layers, forty percent for first three layers, and sixty percent for first four layers. An 'E' indicates that the values are estimated.
VISIBILITY_MIN_MAX	The first group is the minimum visibility over

	the last ten minutes in tenths of nautical miles except where greater than nine when it will show 9+. A V in between means visibility is variable. The second group is the maximum visibility over the last ten minutes in tenths of nautical miles except where greater than nine when it will show 9+.
STN_PRESS	The measured instantaneous atmospheric pressure at station level.
AIR_TEMP_MIN	The minimum air temperature over the last sixty minutes.
AIR_TEMP_MAX	The maximum air temperature over the last sixty minutes.
WIND_GROUP_10M	The first two digits denote the ten minute mean true wind direction in tens of degrees at a height of ten meters above the surface. The next three digits denote the ten minute mean wind speed in knots at a height of ten meters above the surface. The G denotes gust; the next three digits denote the five second mean wind speed in knots over ten minutes at a height of ten meters above the surface. The next two digits denote the peak wind speed direction in tens of degrees over sixty minutes at a height of ten meters above the surface. The next three digits denote the maximum five second mean wind speed in knots over sixty minutes at a height of ten meters above the surface. The last digit denotes the units digit from the two minute mean wind direction in degrees.
ACCUM_PRECIP	The total amount of precipitation that has fallen since a relative date. This variable is measured at the start of every hour but given for every fifteen-minute time period.
PRECIP_LAST_HOUR	The accumulated precipitation (liquid water equivalent of liquid or solid precipitation) over the last sixty minutes.
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]
DATE_OBS	[DD-MON-YY]
TIME_OBS	[HHMM GMT]
REPORT	[none]

SKY_COVER	[hundreds of feet]
VISIBILITY	[nautical miles]
AIR_TEMP_1_5M	[degrees Celsius]
DEW_TEMP_1_5M	[degrees Celsius]
MEAN_WIND_10M_2MIN	[unitless]
ALTIMETER	[inches of mercury]
OPACITY	[tens of percent]
VISIBILITY_MIN_MAX	[tenths of nautical miles]
STN_PRESS	[kiloPascals]
AIR_TEMP_MIN	[degrees Celsius]
AIR_TEMP_MAX	[degrees Celsius]
WIND_GROUP_10M	[unitless]
ACCUM_PRECIP	[millimeters]
PRECIP_LAST_HOUR	[millimeters]
CRTFCN_CODE	[none]
REVISION_DATE	[DD-MON-YY]

7.3.4 Data Source

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

Column Name	Data Source
SITE_NAME	[Assigned by BORIS]
SUB_SITE	[Assigned by BORIS]
DATE_OBS	[Supplied by Investigator]
TIME_OBS	[Supplied by Investigator]
REPORT	[Supplied by Investigator]
SKY_COVER	[Supplied by Investigator]
VISIBILITY	[Supplied by Investigator]
AIR_TEMP_1_5M	[Supplied by Investigator]
DEW_TEMP_1_5M	[Supplied by Investigator]
MEAN_WIND_10M_2MIN	[Supplied by Investigator]
ALTIMETER	[Supplied by Investigator]
OPACITY	[Supplied by Investigator]
VISIBILITY_MIN_MAX	[Supplied by Investigator]
STN_PRESS	[Supplied by Investigator]
AIR_TEMP_MIN	[Supplied by Investigator]
AIR_TEMP_MAX	[Supplied by Investigator]
WIND_GROUP_10M	[Supplied by Investigator]
ACCUM_PRECIP	[Supplied by Investigator]
PRECIP_LAST_HOUR	[Supplied by Investigator]
CRTFCN_CODE	[Assigned by BORIS]
REVISION_DATE	[Assigned by BORIS]

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 Clldtd
SITE_NAME	REG-999-ZHB03	REG-999-ZHB03	None	None	None	None
SUB_SITE	STAFF-AES03	STAFF-AES03	None	None	None	None

DATE_OBS	24-MAY-94	20-SEP-94	None	None	None	None
TIME_OBS	2	2348	None	None	None	None
REPORT	SA	SP	None	None	None	None
SKY_COVER	N/A	N/A	-999	None	None	None
VISIBILITY	-999	9.+	-999	None	None	None
AIR_TEMP_1_5M	.3	30.1	-999	None	None	None
DEW_TEMP_1_5M	-.2	19.9	None	None	None	None
MEAN_WIND_10M_2MIN	0	914	None	None	None	None
ALTIMETER	29.18	30.34	None	None	None	None
OPACITY	-999	E6	-999	None	None	None
VISIBILITY_MIN_MAX	-999	90 9+	-999	None	None	None
STN_PRESS	94.67	98.48	None	None	None	None
AIR_TEMP_MIN	.2	29.5	-999	None	None	None
AIR_TEMP_MAX	.9	30.8	-999	None	None	None
WIND_GROUP_10M	N/A	N/A	None	None	None	None
ACCUM_PRECIP	37	244.1	None	None	None	None
PRECIP_LAST_HOUR	0	10.4	None	None	None	None
CRTFCN_CODE	CPI	CPI	None	None	None	None
REVISION_DATE	22-JAN-96	22-JAN-96	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 records from a sample data file on the CD-ROM.

```
SITE_NAME, SUB_SITE, DATE_OBS, TIME_OBS, REPORT, SKY_COVER, VISIBILITY, AIR_TEMP_1_5M,
DEW_TEMP_1_5M, MEAN_WIND_10M_2MIN, ALTIMETER, OPACITY, VISIBILITY_MIN_MAX, STN_PRESS,
AIR_TEMP_MIN, AIR_TEMP_MAX, WIND_GROUP_10M, ACCUM_PRECIP, PRECIP_LAST_HOUR,
CRTFCN_CODE, REVISION_DATE
'REG-999-ZHB03', 'STAFF-AES03', 19-JUL-94, 503, 'SA', 'CLR BLO 100', '9.+', 22.2, 19.3,
'703', 29.55, '0', '9+ 9+', 95.88, 21.8, 22.4, '07004G0000000008', 180.8, 0.0, 'CPI',
22-JAN-96
'REG-999-ZHB03', 'STAFF-AES03', 19-JUL-94, 531, 'SA', 'CLR BLO 100', '9.+', 22.0, 19.4,
'605', 29.54, '0', '9+ 9+', 95.84, 22.0, 22.4, '06004G0000000005', 180.8, 0.0, 'CPI',
22-JAN-96
```

8. Data Organization

8.1 Data Granularity

The smallest unit of data is a monthly set of 15-minute records for one station.

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

None given.

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

'RAW' data have many extraneous characters, which were removed. Each record was checked for completeness.

9.3 Calculations

No calculations were performed on the data.

9.3.1 Special Corrections/Adjustments

None given.

9.3.2 Calculated Variables

None given.

9.4 Graphs and Plots

None.

10. Errors

10.1 Sources of Error

None given.

10.2 Quality Assessment

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

Some automated quality assessment was done to identify spikes and other anomalies in the data. These anomalies are also present in the original data and are not due to BOREAS Information System (BORIS) processing.

11. Notes

11.1 Limitations of the Data

None given.

11.2 Known Problems with the Data

Weighing gauges are known to give readings of poorer quality than tipping bucket gauges. However, they do work in winter.

Some automated quality assessment was done to identify spikes and other anomalies in the data. These anomalies are also present in the original data and are not due to BORIS processing. The following are a few examples of some anomalies that were detected for the various columns of data. This is not meant to be a comprehensive list.

REPORT

Because this column contains character data, no quantitative assessment was done. The data appear to be correct.

SKY_COVER

Because this column contains character data, no quantitative assessment was done. The data appear to be correct.

VISIBILITY

Because this column contains character data, no quantitative assessment was done. The data appear to be correct.

AIR_TEMP_1_5_M

No problems were identified.

DEW_TEMP_1_5M

No problems were identified.

MEAN_WIND_10M_2MIN

Because this column contains character data, no quantitative assessment was done. The data appear to be correct.

ALTIMETER

These data appear to be reasonable.

OPACITY

Because this column contains character data, no quantitative assessment was done. The data appear to be correct.

VISIBILITY_MIN_MAX

Because this column contains character data, no quantitative assessment was done. The data appear to be correct.

STN_PRESS

No anomalies were identified.

AIR_TEMP_MIN

No serious anomalies were identified, but some questionable values were found that could not be verified for accuracy.

AIR_TEMP_MAX

No serious anomalies were identified, but some questionable values were found that could not be verified for accuracy.

WIND_GROUP_10M

Because this column contains character data, no quantitative assessment was done. The data appear to be correct.

ACCUM_PRECIP

No serious anomalies were identified.

PRECIP_LAST_HOUR

No serious anomalies were identified.

11.3 Usage Guidance

None given.

11.4 Other Relevant Information

None given.

12. Application of the Data Set

These data in conjunction with other surface meteorological data can be used to monitor and model the near-surface conditions on a diurnal and seasonal basis.

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 AES READAC surface meteorological 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/> [Internet Link].

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

21X Micrologger Operator's Manual, Revision 8/91. Campbell Scientific, Inc.

17.2 Journal Articles and Study Reports

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. 2000. Collected Data of The Boreal Ecosystem-Atmosphere Study. NASA. CD-ROM.

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

Sellers, P. and F. Hall. 1996. Boreal Ecosystem-Atmosphere Study: Experiment Plan. Version 1996-2.0, NASA BOREAS Report (EXPLAN 96).

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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17.3 Archive/DBMS Usage Documentation

None.

18. Glossary of Terms

None.

19. List of Acronyms

AES	- Atmospheric and Environment Service
AFM	- Airborne Fluxes and Meteorology
ASCII	- American Standard Code for Information Interchange
BOREAS	- BOReal Ecosystem-Atmosphere Study
BORIS	- BOREAS Information System
CD-ROM	- Compact Disk-Read-Only Memory
CGR	- Certified by Group
CPI	- Checked by PI
CPI-???	- CPI but questionable
DAAC	- Distributed Active Archive Center
EOS	- Earth Observing System
EOSDIS	- EOS Data and Information System
GIS	- Geographic Information System
GMT	- Greenwich Mean Time
GSFC	- Goddard Space Flight Center
HTML	- HyperText Markup Language
IFC	- Intensive Field Campaign
MARSII	- Meteorological Automatic Reporting System II
MB	- Manitoba
NAD83	- North American Datum of 1983
NASA	- National Aeronautics and Space Administration
NSA	- Northern Study Area
ORNL	- Oak Ridge National Laboratory
PANP	- Prince Albert National Park
PI	- Principal Investigator
PRE	- Preliminary
READAC	- Remote Environmental Automated Data Acquisition Concept
SK	- Saskatchewan
SSA	- Southern Study Area
T/RH	- Temperature/Relative Humidity
TBRG	- Tipping Bucket Rain Gauge
URL	- Uniform Resource Locator

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