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

Forrest G. Hall, Editor

Volume 111

SERM Forest Fire Chronology of Saskatchewan in Vector Format

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National Aeronautics and
Space Administration

Goddard Space Flight Center
Greenbelt, Maryland 20771

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SERM Forest Fire Chronology of Saskatchewan in Vector Format

Ott Naelapea, Jaime Nickeson

Summary

The BOREAS staff personnel worked with several Canadian agencies to obtain various GIS data for use in the research efforts. This data set is a series of ARC/INFO export files of the fire history of Saskatchewan by year from 1945 to 1996, with a few missing years. The data set was compiled and provided by the SERM Wildlife Branch.

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1. Data Set Overview

1.1 Data Set Identification

SERM Forest Fire Chronology of Saskatchewan in Vector Format

1.2 Data Set Introduction

The Forest Fire Chronology of Saskatchewan (FFCS) data set provides temporal snapshots of large fires throughout Saskatchewan forests. Gross delineation of boundaries alone was intended. This data set is a series of ARC/INFO export files of the fire history of Saskatchewan. It a spatial data base of forest fires 1,000 hectares or larger in Saskatchewan from 1945 to 1996. The data were compiled and provided by the Saskatchewan Environment and Resource Management (SERM) Wildlife Branch.

1.3 Objective/Purpose

These data are provided as part of the BOReal Ecosystem-Atmosphere Study (BOREAS) Staff Science Geographic Information System (GIS) Data Collection Program, which included the collection of pertinent map data, in both hardcopy and digital form.

While developing management parameters for woodland caribou, the SERM Wildlife Branch saw the need for a spatial data set of large forest fires of Saskatchewan. Such a data set was seen as useful

for determining the role of fire in woodland caribou migration and habitat usage patterns. It was also clear that this data set would be a valuable tool for the management of other boreal forest wildlife species. Finally, the data set was seen as useful for other applications, such as demonstrating the role of wildfire in the boreal forest.

The FFCS data provide temporal snapshots of large fires throughout Saskatchewan forests. Gross delineation of boundaries alone was intended.

1.4 Summary of Parameters and Variables

This data set includes polygons of fires in Saskatchewan 1,000 hectares or larger for the period 1945-96.

1.5 Discussion

Detailed analyses of the content of the gross burn area (amount of burned timber/treed muskeg, etc.) should be performed using larger (1:50,000 to 1:12,500) scale maps on a burn-by-burn basis. With the possible exception of some of the 1995 fires, the FFCS was not compiled to allow for detailed analyses. Only fires 1,000 hectares or larger are included in the data set (with the exception of a few fires over 900 hectares.

Most fire boundaries were delineated at a medium-to-small scale (1:250,000), thereby prohibiting mapping of small fires. As expected, a certain amount of feature generalization occurred in the mapping process.

1.6 Related Data Sets

SERM Forest Cover Data Layers of the SSA in Vector Format
BOREAS Forest Cover Data Layers over the SSA in Raster Format
SERM Forest Cover Data of Saskatchewan in Vector Format

2. Investigator(s)

2.1 Investigator(s) Name and Title

The FFCS project was initiated and largely carried out by Terry Rock. While with the Wildlife Branch, Terry spent innumerable hours organizing and directing the fire record filtering and entry process. Wildlife Branch maintains the responsibility for the data set.

2.2 Title of Investigation

BOREAS Staff Science GIS Activities

2.3 Contact Information

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3. Theory of Measurements

While developing management parameters for woodland caribou, Wildlife Branch saw the need for a spatial data set of large forest fires of Saskatchewan. Such a data set was seen as useful for determining the role of fire in woodland caribou migration and habitat usage patterns. It was also clear that this data set would be a valuable tool for the management of other boreal forest wildlife species. Finally, the data set was seen as useful for other applications, such as demonstrating the role of wildfire in the boreal forest. The FFCS data provide temporal snapshots of large fires throughout Saskatchewan forests. Gross delineation of boundaries alone was intended.

The year-by-year coverage nomenclature currently used with this data set is not reflective of a normalized data base. A normalized data set would have the fire year as a field in the master coverage rather than in the coverage name. The coverage per year format offers two advantages over using "regions" to combine all coverages into a single coverage. First, many GIS packages or geographic data viewing utilities lack "region"-like functions. Second, a normalized data base would result in awkward data handling: if all fire year coverages were placed into a single coverage, the resultant master coverage would have numerous tiny polygons. Each of these wedges would replicate information for every fire fragment that they depict. Simple analyses such as area-to-perimeter ratio calculations for a given fire could therefore not be performed easily. Thus, the data are distributed in the individual coverage per year format. Users have the option of converting the individual coverages into GIS "regions," or they can normalize the data base themselves. However, the data are best distributed in non-normalized form.

4. Equipment

4.1 Sensor/Instrument Description

- Gentian digitizing tables (models Altek C30 and C31) connected to a 286 PC with the EM4105 Tektronix 4105 terminal emulator package. (A), (C), and (D)
- Gentian digitizing tables (models Altek C30 and C31) connected to Tektronix 4207 terminals.
- PC-ARC/INFO v.3.4D on a NEC 386. (A)
- ARC/INFO v5 on a Prime. (A)
- ARC/INFO v6 and v7 on a Sun SPARC Station 10 Model 30 (B) and those fires occurring north of the commercial forest. (C)
- ARC/INFO v7 on a Sun 670MP server. Only those fires in the commercial forest. (D)
- Trimble Pro XL Global Positioning System (GPS), Basic Plus GPS & CMT Data logger, CMT-GPS. (D)

The letter designations refer to groups of years in the data set that have been processed differently. See Section 9.2.1 for descriptions of the letter designations.

4.1.1 Collection Environment

Not known.

4.1.2 Source/Platform
Aerial surveys, ground crew estimates, and/or GPS boundaries.

4.1.3 Source/Platform Mission Objectives
The objective was to map areal extent of historical fire activity 1,000 hectares or larger in the province of Saskatchewan.

4.1.4 Key Variables
Fire extent.

4.1.5 Principles of Operation
Not known.

4.1.6 Sensor/Instrument Measurement Geometry
Not known.

4.1.7 Manufacturer of Sensor/Instrument
See Section 4.1.

4.2 Calibration
Not known.

4.2.1 Specifications
Not known.

4.2.1.1 Tolerance
Not known.

4.2.2 Frequency of Calibration
Not known.

4.2.3 Other Calibration Information
Not known.

5. Data Acquisition Methods

Most fire boundaries were delineated at a medium-to-small scale (1:250,000), thereby prohibiting mapping of small fires. As expected, a certain amount of feature generalization occurred in the mapping process. The FFCS data set was generated using several methods and a myriad of source map types. The methods used for digitizing the fire boundaries are categorized by grouping the years of the fires:

(A) 1945-89, excluding 1972-76
(B) 1972-76
(C) 1990-94
(D) 1995-96

It was initially attempted to digitize only fires that were individual polygons of at least 1,000 hectares. For example, if a "NO-NAME" fire was based on two noncontiguous areas of 500 hectares each, the 1,000-hectare minimum was not satisfied. This rule applied more to the 1945-89 data set than for those in the 1990s. Most of this document describes the burn data digitization with these category letters referred to in the text.

Fire boundaries were provided primarily on 1:50,000 and 1:250,000 source maps (categories (A)

and (C)). However, burn perimeters were also depicted at other scales (1:12,500, 1:15,840, and 1:unknown), particularly for fires that occurred in the 1940s, 1950s, and 1960s, which were provided on a variety of source scales. Most category (B) fires were on a 1:1,000,000 source map. Some category (D) fires were on 1:12,500 forest inventory maps and were digitized from those source maps. A few category (D) fire boundaries were recorded using GPS receivers and thus have no source scale.

Source map scales were not maintained in the FFCS data set; almost all fire boundaries were transcribed to National Topographic Series 1:250,000 (NTS250) basemaps for digitizing. The NTS250 basemaps varied from Series 1 to Series 4, depending on the version available. In most cases, the transcribing of burn boundaries to 1:250,000 was done visually, but a few maps were ported using a device such as a pantograph. These preparations pertain to category (A) and (C) burns as well as to the vast majority of (D) fires that were not in the commercial forest.

Master burn boundary mylar maps were coordinated to NTS250 reference tics. The tics were in extended Universal Transverse Mercator (UTM) zone 13 coordinates. Editing tolerances used were the default values.

Category (A), (B), and (D) fires were digitized according to basic manual tracing procedures: wherever a line was depicted on the map was where the line was digitized. Most category (C) fire perimeters were digitized using a method that would have facilitated achieving perfect vertical integration with NTS250 water bodies. For these fires, the digitizer intentionally strayed into the water body whenever the fire boundary was shared by the land/water interface. Thus, these fires have noticeable V-shaped arc segments where the boundary enters a lake.

Some fires were delineated directly into digital form using GPS receivers. While flying the perimeter of a fire, GPS data loggers tracked the flight path. Note that the flight path may have approximated the burn boundary it may have followed bulldozer fireguards rather than the true boundary. The GPS boundaries pertain to a few category (D) fires.

Some fires were digitized at a 1:12,500 scale. These are easily distinguishable from all other burn boundaries in that they are surrounded by ARC/INFO georeferencing tics that are based on 10-km grids. Almost all of these category (D) fires occurred in the commercial forest and are called "project fires" by the Forestry Branch.

For details on how the source data for 1:12,500 category (D) fires were collected and digitized, contact the Forestry Branch. Details about how the 1:1,000,000 category (B) fires were digitized can also be obtained from the Forestry Branch.

Fire boundaries that crossed NTS250 neat lines were edge matched and brought into a master year coverage. (At most, the master coverages span the forested region of Saskatchewan; at the least, they span only the areas burned.) Fire labels were assigned to every polygon, and the associated attribute data base fields were filled. Basic topology checks (dangles, label errors, redundant nodes) were performed for category (A) and (B) fires.

6. Observations

6.1 Data Notes

Although areas delineated in the data set are considered as "burns," it should not be assumed that these entire areas were burned. Pockets of nonburn areas within the burns may have occurred. Nonburn area land types include:

- lakes and rivers
- marshes, muskegs, and other wetlands
- exposed rock (in the Canadian shield)
- "green" nonburned timber areas
- timber harvest areas (regenerating)
- cleared areas (nonregenerating)
- brushland, meadows, riparian areas
- areas of value (resource improvement areas, resorts)

Detailed analyses of the content of the gross burn area (amount of burned timber/treed muskeg, etc.) should be made using larger (1:50,000 to 1:12,500) scale maps on a burn-by-burn basis. With the possible exception of some of the 1995 fires, the FFCS was not compiled to allow for detailed analyses.

6.2 Field Notes

Not given.

7. Data Description

7.1 Spatial Characteristics

Most fire boundaries were delineated at a medium-to-small scale (1:250,000), thereby prohibiting mapping of small features. As expected, a certain amount of feature generalization occurred in the mapping process.

The fire seasons of 1951, 1954, 1962, and 1965 either lacked fires of at least 1,000 hectares or had no records for fires of that size. In this version of the FFCS data set, there are 48 coverages, starting with 1945 and ending with 1996. The coverage summary is listed in chronological order.

Coverage	Number of Fires	AREA (Ha) Smallest fire	Largest fire	Mean size	Total burned
SK_1945	1	2440	2440	2440	2440
SK_1946	3	1817	3342	2680	8040
SK_1947	1	1637	1637	1637	1637
SK_1948	8	991	14132	4516	36127
SK_1949	20	1235	53210	12080	241608
SK_1950	6	950	6639	4354	26124
*					
SK_1952	4	839	3077	1544	6176
SK_1953	6	3468	15584	7784	46701
*					
SK_1955	16	816	134215	25054	400862
SK_1956	5	838	5567	2913	14564
SK_1957	4	1891	19327	7178	28712
SK_1958	1	4352	4352	4352	4352
SK_1959	2	981	9143	5062	10124
SK_1960	14	978	36851	11057	154792
SK_1961	26	1111	192462	19674	511519
*					
SK_1963	9	1146	36165	7229	65059
SK_1964	24	1171	75760	13944	334646
*					
SK_1966	5	1126	4647	2501	12507
SK_1967	22	1079	35981	8656	190427
SK_1968	6	2342	40534	10260	61558
SK_1969	14	974	226976	21769	304762
SK_1970	33	826	289768	32303	1066014
SK_1971	6	2328	44956	14513	87079
SK_1972	24	1046	67885	6601	158419
SK_1973	38	1031	50598	12869	489011
SK_1974	3	1622	9324	5889	17668
SK_1975	10	1452	38824	12256	122562

SK_1976	9	1849	33448	10357	93215
SK_1977	15	928	70503	8255	123818
SK_1978	6	1458	47885	15800	94800
SK_1979	30	1137	58079	16610	498298
SK_1980	82	919	361787	25312	2075561
SK_1981	71	807	486330	26103	1853287
SK_1982	10	1124	20877	7060	70595
SK_1983	12	1176	12865	3954	47445
SK_1984	21	1024	72055	13113	275372
SK_1985	11	915	23103	9288	102163
SK_1986	2	2346	3777	3062	6123
SK_1987	20	1549	81162	11587	231736
SK_1988	10	1476	34915	7189	71887
SK_1989	64	928	47244	7050	451229
SK_1990	25	638	37479	8013	200324
SK_1991	22	1009	31798	9753	214576
SK_1992	8	1780	62321	15732	125855
SK_1993	25	1013	373701	29554	738857
SK_1994	41	1437	166766	24669	1011439
SK_1995	49	789	234677	29430	1442056
SK_1996	3	1617	4655	3563	10690

Notes:

- Area totals are rounded to the nearest hectare from GIS square meter totals, but these figures must not be construed as having that high a level of numerical significance.
- Area totals do not include fires initially recorded as smaller than 1,000 hectares (fires that the GIS shows as slightly less than 1,000 hectares were not discarded, particularly for the latter years).
- Area summaries do not account for errors inherent with source maps or digitizing.

7.1.1 Spatial Coverage

The extent of the burn coverages is based on recorded wildfires that occurred within provincial jurisdiction forests in Saskatchewan. Consequently, fires that occurred strictly within federal lands (i.e., within the Primrose Lake Air Weapons Range and Prince Albert National Park (PANP)) are not part of the data set. Fires that crossed provincial federal jurisdictional boundaries (such as the Deer fire of 1993), however, are included in the data set in their entirety.

The spatial extent of individual fire coverages from year to year is highly variable. This variability is the function of the distribution, frequency, and size of fires in a given year. The overall latitude and longitude boundaries (UTM zone 13, North American Datum of 1927 (NAD27)) are:

```
Minimum Longitude: 110.0 W
Maximum Longitude: 101.6 W
Minimum Latitude: 49.0 N
Maximum Latitude: 60.0 N
```

7.1.2 Spatial Coverage Map

Not available.

7.1.3 Spatial Resolution

Fire boundaries were provided primarily on 1:50,000 and 1:250,000 source maps (categories (A) and (C); see Section 9.2.1). However, burn perimeters were also depicted at other scales (1:12,500, 1:15,840, and 1:unknown), particularly for fires that occurred in the 1940s, 1950s, and 1960s. Most category (B) fires were provided on a 1:1,000,000 source map.

Only fires 1,000 hectares or larger are included in the data set (with the exception of a few fires over 900 hectares).

Most fire boundaries were delineated at a medium-to-small scale (1:250,000), thereby prohibiting mapping of small fires. As expected, a certain amount of feature generalization occurred in the mapping process.

7.1.4 Projection

UTM zone 13, NAD27.

7.1.5 Grid Description

Not applicable.

7.2 Temporal Characteristics

The data base of fire history for Saskatchewan maintained by SERM is updated annually. The data are distributed in the individual coverage per year format. Users have the option of converting the individual coverages into GIS "regions," or they can normalize the data base themselves. However, the data are best distributed in non-normalized form.

7.2.1 Temporal Coverage

This data set covers fires that occurred between 1945 and 1996. The fire seasons of 1951, 1954, 1962, and 1965 either lacked fires of at least 1,000 hectares or had no records for fires of that size.

7.2.2 Temporal Coverage Map

Not available.

7.2.3 Temporal Resolution

Except for a few missing years, these data are provided on a yearly basis.

7.3 Data Characteristics

7.3.1 Parameter/Variable

The SK_FIRES data base (burn attributes) This data base contains the name of each fire, the area of the fire, and simple spatial summaries. The fields in SK_FIRES are:

```
Field          Definition     Example
----------------------------------------
FIRE_NO        8, 8, C        "1990-002"
FIRE_NAME      35, 35, C      "EASTSIDE"
NR22_HECTARE   6, 6, I        10,000
GIS_HECTARE    6, 6, I        12,964
NTS250         15, 15, C      "74O/74"'

Redefined fields:
YEAR           4, 4, C        "1990"
DIGNUMBER      3, 3, C        "002"
GIS_SQKM       4, 4, I        129
PRIMARY_NTS    3, 3, C        "74O"
```

Note that the INFO data base format redefined fields are not necessarily ported across to other data bases (for example, dBASE cannot handle the redefined fields). Other techniques may have to be used to achieve redefine-like functionality in such data base software packages.

7.3.2 Variable Description/Definition

FIRE_NO (fire identifier assigned during GIS operations)

- A completely arbitrary number assigned when the data base was initially constructed. The first four characters represent the fire year, and the last three represent the arbitrary fire number.
- There may be gaps in FIRE_NO values (e.g., there may be a "1948-002" and a "1948-004" but no "1948-003"). These gaps are the result of removing fires from the data base that were primarily in agricultural land, were smaller than 1,000 hectares, or were revealed upon subsequent investigation, to have fire maps of questionable quality
- Every fire has a FIRE_NO entry, without exception.

FIRE_NAME (the name assigned to a fire)

- Usually an arbitrary name assigned to a fire. It may be tied to geographical characteristics ("Esker"), mapped names ("Round Lake," "Wapiskau River"), the shape of the fire ("Football"), the start day or time of the fire ("Monday," "Morning"), or to any number of impulsive fire-naming quirks ("Pizza," "Trolley").
- Naming of fires that have merged involves a modified naming system in the data base. Usually (but not always), all fire names are provided, with the names separated by slashes. For example, the single boundary for the merged Ira and Isaac fires has a FIRE_NAME value of "IRA/ISAAC". Typically (but not always), the larger of the pre-merged fires is listed first.
- Many fires lack names; these fires have either "UNKNOWN" or a blank value in the FIRE_NAME field.

NR22_HECTARE (estimated area burned)

- Contains the Forest Fire Management Branch (FFMB) estimate of the size of the fire. As with the GIS_HECTARE field, these numbers do not necessarily indicate the number of hectares burned.
- The NR22_HECTARE estimate may have been provided by field staff or could have been calculated by FFMB in the office. Because these values were generated by a number of people using various measurement techniques, it is very unlikely that they were calculated consistently throughout the span of the FFCS or perhaps even within a single fire season.
- Not all fires have an NR22_HECTARE estimate. This is particularly applicable for fires occurring in the 1940s, 1950s, and 1960s. If an NR22_HECTARE value is unknown, the field contains a value of zero.

GIS_HECTARE (area within a burn perimeter, hectares)

- Fire area totals derived from a UTM extended zone 13 GIS coverage. Note that this number does not necessarily equate to the number of hectares burned, as green islands within the burn are usually not accounted for. Furthermore,depict the true perimeter.
- The GIS_HECTARE area totals are usually different than those in the NR22_HECTARE field. Extended UTM zone area summation errors notwithstanding, the GIS provides area totals that are derived using a consistent methodology.
- The area totals for multipolygon fires are summarized into a grand total. The GIS_HECTARE area totals are truncated from the square meter area numbers used by the GIS. They are not rounded. The error associated with the truncation is trivial: many fire area totals cannot be considered accurate even to the nearest 10 hectares, so rounding error to the nearest hectare is considered acceptable.
- Every fire has a GIS_HECTARE value, without exception.

NTS250 (National Topographic Series reference)

- This field was inserted for data base users who do not have a GIS, thereby providing a semispatial touch to an aspatial data base. The NTS250 field also allows for quick queries of fires within an NTS250 mapsheet of interest by using a "contained in" query.
- The format of the NTS250 field (e.g., "73G/73F") lists the mapsheets in which the fire occurred in order of relative proportions and NOT in alphabetical order. In the example given, more land burned in 73G than in 73F.
- Every fire has at least one (and as many as four) NTS250 mapsheet names associated with it.

YEAR (the year that a fire occurred)

- A redefined field that is rather straightforward; indicates the year of the burn. Being a redefined field of FIRE_NO, every fire has a YEAR value.

DIGNUMBER (arbitrary numerical fire label)

- A redefined field that contains the arbitrary fire number assigned during the burn digitization process. This field can be used instead of FIRE_NO if data presented are for only 1 year and the year prefix in FIRE_NO becomes redundant. As with the FIRE_NO field, the DIGNUMBER field is always populated.

GIS_SQKM (area within a burn perimeter, square kilometers)

- A redefined field that truncates the GIS_HECTARE total into square kilometer format. Being a redefined field of GIS_HECTARE, every fire has an associated GIS_SQKM entry, without exception.

PRIMARY_NTS (predominant NTS250 in a multi-NTS250 fire)

- A redefined field that indicates the NTS250 mapsheet that contains the highest proportion of the burned area. Every fire has a PRIMARY_NTS entry associated with it.

7.3.3 Unit of Measurement

Defined above (Section 7.3.2) where applicable.

7.3.4 Data Source

The FFCS project has hinged upon the fire records gathered during the various incarnations of the Department. These records were handled by innumerable people: field staff in district offices, FFMB personnel, and Forestry Branch employees. The hardcopy burn map sources are:

- 1945-1971 and 1977-1994 -- FFMB maps at various scales, typically between 1:50,000 and 1:250,000.
- 1972-1976 -- Forestry Branch 1:million provincial fire overview (source maps at larger scales were unavailable).
- 1995 and on -- FFMB, primarily at 1:250,000 but with some 1:50,000 maps and forest inventory maps at 1:12,500. Some boundaries delineated using GPS receivers in aircraft.
- Miscellaneous - Category (A) -- The Forestry Branch canvassed its staff for fires that may have been missed in an earlier version of the FFCS data set. Based on that survey, The Forestry Branch provided 1:250,000 maps of the following fires:

  1961 - Bertwell (year of fire uncertain)
  1961 - (two name unknowns, 1961-003 and 1961-020)
  1968 - Armstrong
  1970 - McCusker
  1980 - Kennedy Creek
  1991 - Scorcher
  1992 - Trolly
  1993 - Thursday

- Miscellaneous - Category (B) -- Various maps that surfaced from other sources were added to the data set. For example, the "Weitzel" and "Lansdowne" fire boundaries for 1973 were provided by Martin Chartier (via Mickey Desjarlais of the SERM "Buffalo Narrows Fire Centre").

All of the data design work and data set documentation was performed by the Wildlife Branch. The vast majority of the digital compilation of the fire maps was performed by the Wildlife Branch. Listing of digital compilation authors is presented via burn year groupings:

- 1945-1971, 1977-1994, and 1996 -- Wildlife Branch (linework and attributes)
- 1972-1976 -- Forestry Branch (linework) and Wildlife Branch (attributes)
- 1995 -- Forestry Branch:
  - most "project" fires in the commercial forest, some in the far north
  - linework and basic attributes 1995 -- Wildlife Branch
  - fires not digitized by the Forestry Branch above, including all linework and all attributes
  - attributes for project fires not recorded by the Forestry Branch

7.3.5 Data Range

Not available.

7.4 Sample Data Record

Not applicable.

8. Data Organization

8.1 Data Granularity

The smallest unit of data tracked by BORIS is the entire set of export files for all available years as well as the associated documentation files provided by SERM.

8.2 Data Format(s)

This data set consists of a total of 70 files. The Forest Fire Chronology of Saskatchewan data are provided as ARC/INFO export files. Because these export files contain both coverages and data files, use the "Arc: import auto <interchange_file> <output>" command format.

The file names are constructed as in the following example:

```
sk_f1972.e00

sk for Saskatchewan
_ an underscore
f#### an f, followed by the 4-digit year
.e00 the .e00 extension, an ARC convention for export files
```

There are also 19 documentation files associated with this data set. This document was compiled mostly from these 19 documents. The documents have the following file names:

```
all.txt        coveragS.txt   dataqual.txt   futrwork.txt   miscnote.txt
authors.txt    datadict.txt   digitizn.txt   geogspec.txt   readme.1st
backgrnd.txt   dataform.txt   disclaim.txt   history.txt    scripts.txt
copyinfo.txt   dataissu.txt   documnts.txt   metadata.txt   topology.txt
```

The following is an overview of the data set files and their order on the archive tape:

File	Description	Logical Record Size (Bytes)
1	Header File	80
2	sk_f1945.e00	80
3	sk_f1946.e00	80
4	sk_f1947.e00	80
5	sk_f1948.e00	80
6	sk_f1949.e00	80
7	sk_f1950.e00	80
8	sk_f1952.e00	80
9	sk_f1953.e00	80
10	sk_f1955.e00	80
11	sk_f1956.e00	80
12	sk_f1957.e00	80
13	sk_f1958.e00	80
14	sk_f1959.e00	80
15	sk_f1960.e00	80
16	sk_f1961.e00	80
17	sk_f1963.e00	80
18	sk_f1964.e00	80
19	sk_f1966.e00	80
20	sk_f1967.e00	80
21	sk_f1968.e00	80
22	sk_f1969.e00	80
23	sk_f1970.e00	80
24	sk_f1971.e00	80
25	sk_f1972.e00	80
26	sk_f1973.e00	80
27	sk_f1974.e00	80
28	sk_f1975.e00	80
29	sk_f1976.e00	80
30	sk_f1977.e00	80
31	sk_f1978.e00	80
32	sk_f1979.e00	80
33	sk_f1980.e00	80
34	sk_f1981.e00	80
35	sk_f1982.e00	80
36	sk_f1983.e00	80
37	sk_f1984.e00	80
38	sk_f1985.e00	80
39	sk_f1986.e00	80
40	sk_f1987.e00	80
41	sk_f1988.e00	80
42	sk_f1989.e00	80
43	sk_f1990.e00	80
44	sk_f1991.e00	80
45	sk_f1992.e00	80
46	sk_f1993.e00	80
47	sk_f1994.e00	80
48	sk_f1995.e00	80
49	sk_f1996.e00	80
50	sk_fires	80
51	sk_readme	80

```
52   readme.1st            80
53   coveragS.txt          80
54   dataqual.txt          80
55   futrwork.txt          80
56   miscnote.txt          80
57   authors.txt           80
58   datadict.txt          80
59   digitizn.txt          80
60   geogspec.txt          80
61   backgrnd.txt          80
62   dataform.txt          80
63   disclaim.txt          80
64   history.txt           80
65   scripts.txt           80
66   copyinfo.txt          80
67   dataissu.txt          80
68   documnts.txt          80
69   metadata.txt          80
70   topology.txt          80
```

Each file contains a series of 80-byte logical records. All the files are American Standard Code for Information Interchange (ASCII). There are 48 export files containing burn polygon coverages for each year, 2 INFO export files, and 19 SERM documentation files (.txt). The export files must have the .e00 extension to be imported in ARC/INFO.

9. Data Manipulations

9.1 Formulae

Not applicable.

9.1.1 Derivation Techniques and Algorithms

Not applicable.

9.2 Data Processing Sequence

9.2.1 Processing Steps

The reader is referred to Sections 4.1, 5., and 7.3.4 for information regarding compilation of the data.

9.2.2 Processing Changes

None.

9.3 Calculations

9.3.1 Special Corrections/Adjustments

See Sections 4.1, 5., and 7.3.4.

9.3.2 Calculated Variables

Not applicable.

9.4 Graphs and Plots

None.

10. Errors

10.1 Sources of Error

Because the fire chronology spans a 50-year period, many of the fire boundaries overlap because of repeat burns of given areas. Some overlaps, however, are a result of inaccurate mapping of fire boundaries.

10.2 Quality Assessment

10.2.1 Data Validation by Source

The fire boundaries have NOT been ground truthed, primarily because it would be far too expensive. Alternatively, fire boundaries could be compared against other map sources that would reflect the occurrence of wildfire. Such sources include forest inventory maps, field records, and other aerial survey information. Satellite imagery could also be a useful tool for verifying fire boundaries.

Regardless of available burn boundary verification sources, it is clear that perimeter verification would result in accentuating the already inconsistent quality levels within the data base. (Data inconsistency sources are listed in the next section.)

The positioning of burn boundaries on the source maps is implicitly assumed to be correct. Yet their positioning may be significantly inaccurate. Similarly, fire boundaries defined using GPS data loggers may have been generated by tracking the approximate boundary of the fire; corners may have literally been cut while tracking.

Given the medium-to-small scale of the source maps and the errors inherent in the original mapped boundaries, check plots were not used to verify the digital boundaries. A standard level of digitizing error is simply assumed.

10.2.2 Confidence Level/Accuracy Judgment

The accuracy of the source maps is variable. In addition to a large number of staff delineating fire boundaries using a variety of mapping methods, data consistency variations are a function of spatial and temporal factors as well as fire mapping limitations:

- Some smaller burns in or north of the Canadian shield may go undetected, and as such, might not be mapped. Burns in the commercial forest and around high value areas are usually mapped more accurately than those further north.
- Conditions at present do not reflect those 50 years ago; water levels in lakes and marshes have fluctuated in the 50-year span, timber harvesting has not been accounted for, etc. Burns may have been delineated using base maps that reflect only the conditions at the time the base maps were generated.
- Aerial reconnaissance of burn perimeters is biased toward fires that consumed understory or canopy fuels. Because ground burn perimeters may be obstructed by foliage, ground-level fires are not mapped as accurately as the other fires.

The use of GPSs, lightning strike detectors, and better communication equipment means that more fires today are detected, monitored, and mapped than in the 1940s, 1950s, and 1960s.

Because the FFCS data set spans a 50-year period, the administrative codes used in FFMB's fire numbering scheme will NOT necessarily represent the same administrative boundaries. (The administrative codes have been added only to fires from 1990 onward.) The administrative boundaries have often been shifted, aggregated, or split and they are unlikely ever to be permanent. Thus, they are not a basis for summarizing data over extended periods of time.

10.2.3 Measurement Error for Parameters

Not available.

10.2.4 Additional Quality Assessments

This data set was generated using a wide range of observation quality levels, input sources, compilation methods, and data sources. Most boundaries are approximate.

10.2.5 Data Verification by Data Center

BORIS personnel have looked at some of the data layers contained in the data set; those reviewed seemed appropriate.

11. Notes

11.1 Limitations of the Data

The author of the FFCS makes no guarantees, stated or implied, as to the correctness, accuracy, or completeness of the data or associated documentation. Users choosing to use the data or documentation do so at their own risk, understanding that the Wildlife Branch and the Province of Saskatchewan will have no liability for any loss, monetary or otherwise, that may be incurred. This data set is provided AS IS.

11.2 Known Problems with the Data

Many fires are not in the data base because of missing records. Some (but not all) of these have been listed by Terry Rock in the report associated with this data set (see AUTHORS.TXT). The FFCS data base is only as complete as the fire records available to be entered. By no means should the FFCS be viewed as a totally exhaustive data set. If you are aware of any fires that are missing and have a source map for those fires, please contact the data manager listed in METADATA.TXT.

Should you find any errors in the documentation, the spatial data base, or the attribute data bases, please notify the data manager (as listed in METADATA.TXT). Every attempt has been made to avoid topological and typographical errors. Nevertheless, the FFCS data set may be missing some fires or it may contain inaccurate information. By contacting the data author about such errors, corrections can be made at the source, and subsequent distributions of the data set will contain the corrected information.

11.3 Usage Guidance

Copying the data is permissible as long as all data and documentation files are provided in their entirety and in their original form. Because the author does not charge royalties for the data, nonauthors may not sell the data set in whole or in part.

It is recommended that anyone interested in using this data set contact the author directly for the latest official versions of the data set and the associated documentation.

Data format modifications (such as adding a new numbering system) are acceptable, as long as the original format of the data is maintained. By sustaining a permanent data relationship to the original format, compatibility with the existing data set as well as with revised and updated data can be ensured.

Data content changes made without the consent of the data author are permissible. However, such data sets would no longer be sanctioned by SERM. Any changes to the original data set or its associated documentation must be noted clearly on any written report, graphical output, or numerical summary derived from the altered data set.

Modification of the data set using any value-added process does not transfer authorship of the original data set; only the modifications to the data set may be considered as proprietary, but not the entire modified data set that originated from the source data set.

11.4 Other Relevant Information

Because the fire chronology spans a 50-year period, many of the fire boundaries overlap because of repeat burns of given areas. Some overlaps, however, are a result of inaccurate mapping of fire boundaries. In some instances, fires occurring in the same year had significant boundary overlaps. These fires were usually merged into one fire with multiple fire names stored in the data base. For example, fire number 1981-030 represents two fires: IRA/ISAAC.

12. Application of the Data Set

These data could be used for land cover mapping ("dating" stand age based on time of disturbance); woodland caribou, elk, and moose habitat analyses; and determining of fire action priorities

13. Future Modifications and Plans

Burn boundaries from subsequent fire seasons will be added to the data set. Additions will be either in the form of GPS boundaries or via manual trace digitizing. Depending on the update source, additions will be made after fire-out status or during the fall/winter after a fire season. Data entry will be performed annually.

An ambitious goal of establishing a new data set of fires 100-1,000 hectares in size has been set. Implementing this data set will require considerably more resources than did the 1,000-hectare or larger data set. The 100-1,000-hectare data set will not contain fires from previous years; it will contain only the fires for the year that the data set was implemented and for all subsequent years. There have been so many fires in this size range in the past that generating a data set of these fires would be far too monumental of a task.

Suggestions for improving the FFCS data set and its associated documentation are welcome.

14. Software

14.1 Software Description

- PC-ARC/INFO v.3.4D on a NEC 386 (A)
- ARC/INFO v5 on a Prime. (A)
- ARC/INFO v6 and v7 on a Sun SPARC Station 10 Model 30 (B) and those fires occurring north of the commercial forest (C)
- ARC/INFO v7 on a Sun 670MP server. Only those fires in the commercial forest (D)

Questions about the software should be directed to:

Environmental Systems Research Institute, Inc.
380 New York Street
Redlands, CA 92373-8100

14.2 Software Access

ARC/INFO is a commercial package; contact ESRI for details.

15. Data Access

The SERM forest fire chronology data in vector format 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

Computer-Compatible Tape (CCT), 8-mm tape.

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

Forest fire chronology of Saskatchewan digital data documentation. 1996. Wildlife Branch, Saskatchewan Environment & Resource Management. Prince Albert, Saskatchewan. 17 text files.

Documentation files associated with this data set (many of which were used to create this documentation file):

```
AUTHORS.TXT  - organizations and staff involved in
               generating the FFCS data set.  1 pp.
BACKGRND.TXT - background information (data content and
               origin, acronyms).  3 ppp.
COPYINFO.TXT - data ownership and copying information.  2 pp.
```

```
COVERAGS.TXT - list of ARC/INFO coverages and summary of
               their features.  2 pp.
DATADICT.TXT - data dictionary (data base fields and
               linkages).  5 pp.
DATAFORM.TXT - data file formats.  2 pp.
DATAISSU.TXT - data base and GIS issues (normalization,
               regions, vertical integration, derived data).
               3 pp.
DATAQUAL.TXT - data quality and usability info.  3 pp.
DIGITIZN.TXT - digitization methods and equipment.  3 pp.
DISCLAMR.TXT - disclaimer.  1 pp.
DOCUMNTS.TXT - the file that you are now reading.  2 pp.
FUTRWORK.TXT - realistic and ambitious plans for future
               work.  3 pp.
GEOGSPEC.TXT - geographic parameter listing.  5 pp.
HISTORY.TXT  - project history. 2 pp.
METADATA.TXT - description of the FFCS data set (who, what,
               when, why, where) in Canadian General
               Standards Board metadata format.  Somewhat
               overlaps the content of the other readme
               files but is often too abridged.  6 pp.
MISCNOTE.TXT - miscellaneous notes.  1 pp.
README.1ST   - documentation guide.  2 pp.
SCRIPTS.TXT  - programming code used and/or available for
               generating or manipulating the data set.  1 pp.
TOPOLOGY.TXT - description of topological features.  2 pp.
```

17.2 Journal Articles and Study Reports

A fire history for Saskatchewan. 1996. Wildlife Branch, Saskatchewan Environment & Resource Management. Prince Albert, SK. 6 pp. and appendices.

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).

Sellers, P., F. Hall, and K.F. Huemmrich. 1997. Boreal Ecosystem-Atmosphere Study: 1996 Operations. NASA BOREAS Report (OPS DOC 96).

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.

17.3 Archive/DBMS Usage Documentation

None.

18. Glossary of Terms

None.

19. List of Acronyms

```
AAT     - Arc Attribute Table
ASCII   - American Standard Code for Information Interchange
BOREAS  - BOReal Ecosystem-Atmosphere Study
BORIS   - BOREAS Information System
CCT     - Computer-Compatible Tape
CD-ROM  - Compact Disk - Read-Only Memory
DAAC    - Distributed Active Archive Center
EOS     - Earth Observing System
EOSDIS  - EOS Data and Information System
ESRI    - Environmental Systems Research Institute, Inc.
FFCS    - Forest Fire Chronology of Saskatchewan
FFMB    - Forest Fire Management Branch
GIS     - Geographic Information System
GPS     - Global Positioning System
GSFC    - Goddard Space Flight Center
NAD27   - North American Datum of 1927
NAD83   - North American Datum of 1983
NASA    - National Aeronautics and Space Administration
NSA     - Northern Study Area
NTS     - National Topographic Series
ORNL    - Oak Ridge National Laboratory
PANP    - Prince Albert National Park
PAT     - Polygon Attribute Table
SERM    - Saskatchewan Environment and Resource Management
SSA     - Southern Study Area
URL     - Uniform Resource Locator
UTM     - Universal Transverse Mercator
```

20. Document Information

20.1 Document Revision Dates

Written: 10-Mar-1997
Updated: 03-Nov-1999

20.2 Document Review Date(s)

BORIS Review: 15-May-1997
Science Review:

20.3 Document

20.4 Citation

When using these data, please note the following usage guidelines and conditions. In addition to following these guidelines, please include citations of relevant papers in Section 17.2.

The digital FFCS data set and associated documentation are the property of Government of Saskatchewan.

The digital FFCS data and documentation may be used in the preparation of reports, estimates, and proposals and in other digital data bases, subject to the following conditions:

- All the data and material displayed, referenced, or distributed in whole, in part, or in combination with any other data must clearly indicate the author along with the date of the data origin and the date of the most recent update or revision as supplied by the author.
- Wildlife Branch authorizes users to subject the data to value-added activities and, if these value-added activities have occurred, they must be clearly stated in any reports, analyses, references, or depictions produced by the user.

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

Saskatchewan Environment and Resource Management, Wildlife Branch. "BOREAS Staff Science GIS Activities." 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

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13. ABSTRACT *(Maximum 200 words)*
The BOREAS staff personnel worked with several Canadian agencies to obtain various GIS data for use in the research efforts. This data set is a series of ARC/INFO export files of the fire history of Saskatchewan by year from 1945 to 1996, with a few missing years. The data set was compiled and provided by the SERM Wildlife Branch.

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