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THE DMSP SPACE WEATHER SENSORS DATA ARCHIVE LISTING (1982-2013) AND FILE FORMATS DESCRIPTIONS

Daniel M. Ober, et al.

1 August 2014

Final Report

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14. ABSTRACT
The purpose of this document is to describe the file formats for the various file types in the Air Force Research Laboratory's (AFRL) Defense Meteorological Satellite Program (DMSP) space weather sensors data archive. While the file format descriptions of the various file types exist across a variety of sources, published and unpublished, no one publicly available document contains a comprehensive description of the file formats for all the various file types in the DMSP space weather sensors data archive. This document is intended to provide that resource. This document also contains a complete listing of all the files contained in the archive as of 1 Jan 2014. This document is not intended to provide detailed descriptions of the DMSP space weather sensors or comprehensive information on the quality of the data contained within the data files. Anyone who wishes to know more about the data that are available within AFRL's DMSP space weather sensors data archive and/or anyone who desires to write computer code for extracting information from those data files may find this document useful.

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1.0 Introduction

1.1 Purpose of This Document

The purpose of this document is to describe the file formats for the various file types in the Air Force Research Laboratory's (AFRL) Defense Meteorological Satellite Program (DMSP) space weather sensors data archive. While the file format descriptions of the various file types exist across a variety of sources, published and unpublished, no one publicly available document contains a comprehensive description of the file formats for all the various file types in the DMSP space weather sensors data archive. This document is intended to provide that resource. This document also contains a complete listing of all the files contained in the archive as of 1 Jan 2014. This document is not intended to provide detailed descriptions of the DMSP space weather sensors or comprehensive information on the quality of the data contained within the data files. Additional information can be found in the "Further Reading" section at the end of this document.

1.2 Who Should Use This Document

Anyone who wishes to know more about the data that are available within AFRL's DMSP space weather sensors data archive and/or anyone who desires to write computer code for extracting information from those data files may find this document useful.

1.3 The Defense Meteorological Satellite Program Overview

DMSP is a series of polar orbiting spacecraft assigned to monitor the meteorological, oceanographic, and solar-terrestrial environments. The principal sensor systems on the DMSP spacecraft are for observing tropospheric weather but the DMSP spacecraft also carry space environment sensors including the auroral particle spectrometer (SSJ), the fluxgate magnetometer (SSM), the topside thermal plasma monitor (SSIES) instruments, the ultraviolet spectrographic imager (SSUSI), and the ultraviolet limb imager (SSULI). Data from these instruments are widely utilized to study a wide range of auroral and low-latitude processes. AFRL's DMSP space weather sensors data archive only includes data from the SSJ, SSIES, and SSM instruments.

Typically there are 2-4 satellites in orbit at any given time. Table 1 lists the DMSP satellites, launch dates, and the on-board space environment sensors. Each DMSP satellite has a ~101 minute, near-polar 98.9 degree inclination orbit at an altitude of ~850 km above the mean surface of the earth. The DMSP orbits are all nearly circular except for F10 whose orbit was slightly elliptical. Orbit planes precess ~360 degrees per year and thus are nearly fixed in local time, typically near either the 0600-1800 LT or 0900-2100 LT planes. Figure 1 shows the DMSP geographic latitude versus local time and year in the northern hemisphere. The magnetometers on F07 and F12-F14 were body mounted but for F15 forward the magnetometers are boom mounted.

Figure 2 shows the local times of the DMSP satellites ascending nodes versus time and Figure 3 shows the local times of the DMSP satellites descending nodes versus time. Notice that F6 through F9 were launched with their ascending nodes on the morning side while F10 through F18 have their ascending nodes on the evening side. The local times of some DMSP orbit planes have remained relatively fixed (e.g., F6 through F9, and F13) while some have drifted significantly in local time over their lifetimes (e.g., F15 has drifted ~6 hours of local time since originally being placed in orbit). While the local times of the DMSP orbital planes are relatively stationary, the DMSP spacecraft do sample a wide range of magnetic local times at high latitudes each day due to the offset of the Earth's magnetic axis relative to the geographic axis.

Figure 4 shows the mean altitude of the DMSP satellites versus time. The mean altitude of the DMSP spacecraft is relatively stable, decreasing only slightly during the intervals 1989-1992, 2000-2003, and 2012-2013 during the solar maxima. The mean altitude of F10 is less than the other DMSP spacecraft and its eccentricity is greater due to the partial failure of the final boost rocket. Figure 5 shows the daily F10.7 index over the lifetime of the DMSP space weather sensors data archive. This figure highlights one of the unique features of this data set, which is that the data set spans nearly 3 full solar cycles of measurements from a common set of instruments and orbits. This makes the DMSP data set distinctively useful both for long term studies as well as event studies.

Table 1: Listing of DMSP flight numbers, launch dates, and sensors

Flight	Launch Date	Sensors
F6	December 1982	SSJ4
F7	December 1983	SSJ4, SSM
F8	June 1987	SSJ4, SSIES
F9	February 1988	SSJ4, SSIES
F10	December 1990	SSJ4, SSIES
F11	November 1991	SSJ4, SSIES2
F12	August 1994	SSJ4, SSIES2, SSM
F13	March 1995	SSJ4, SSIES2, SSM
F14	April 1997	SSJ4, SSIES2, SSM
F15	December 1999	SSJ4, SSIES2, SSM
F16	October 2003	SSJ5, SSIES3, SSM, SSUSI, SSULI
F17	November 2006	SSJ5, SSIES3, SSM, SSUSI, SSULI
F18	October 2009	SSJ5, SSIES3, SSM, SSUSI, SSULI
F19	TBD	SSJ5, SSIES3, SSM, SSUSI, SSULI
F20	TBD	SSJ5, SSIES3, SSM, SSUSI, SSULI

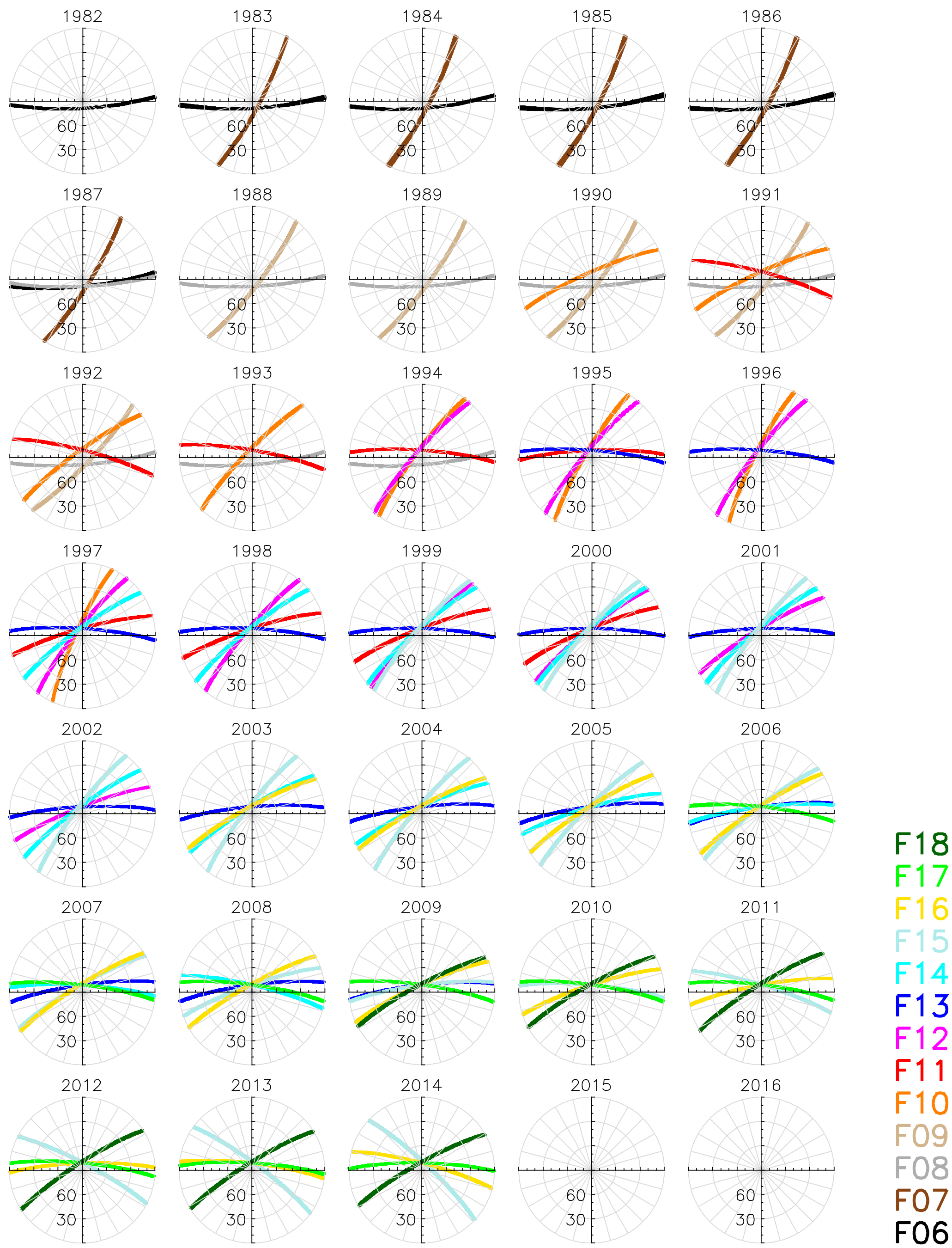

Figure 1: DMSP geographic latitude versus local time and year in the northern hemisphere

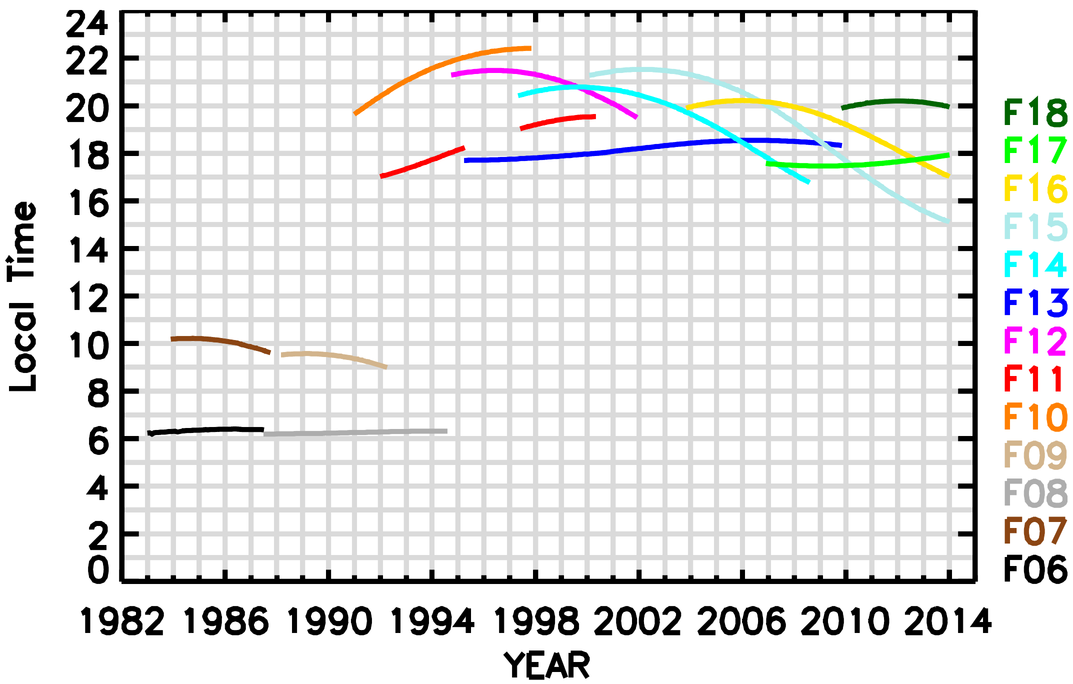

Figure 2: Local Time of DMSP ascending nodes by satellite and year

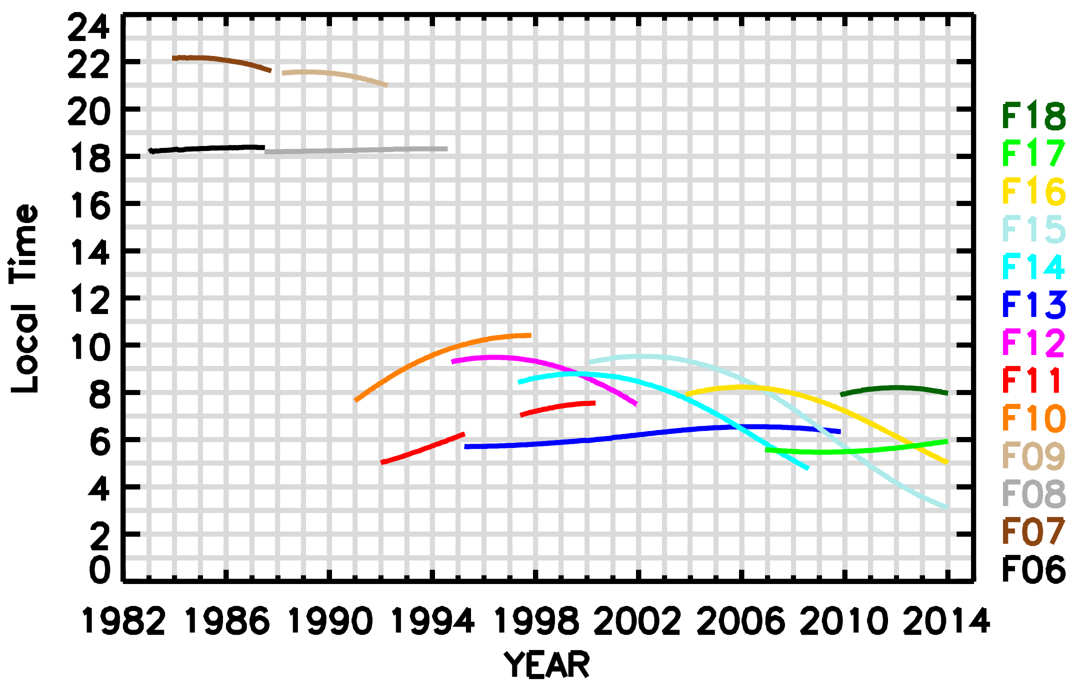

Figure 3: Local time of DMSP descending nodes by satellite and year

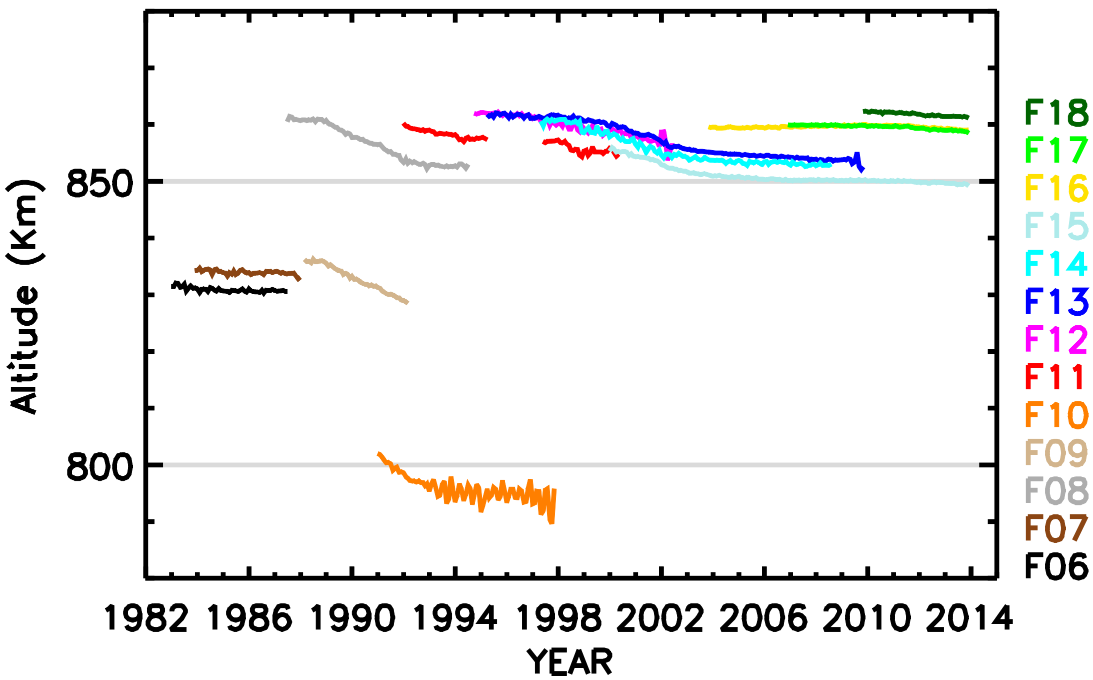

Figure 4: DMSP altitude by satellite and year

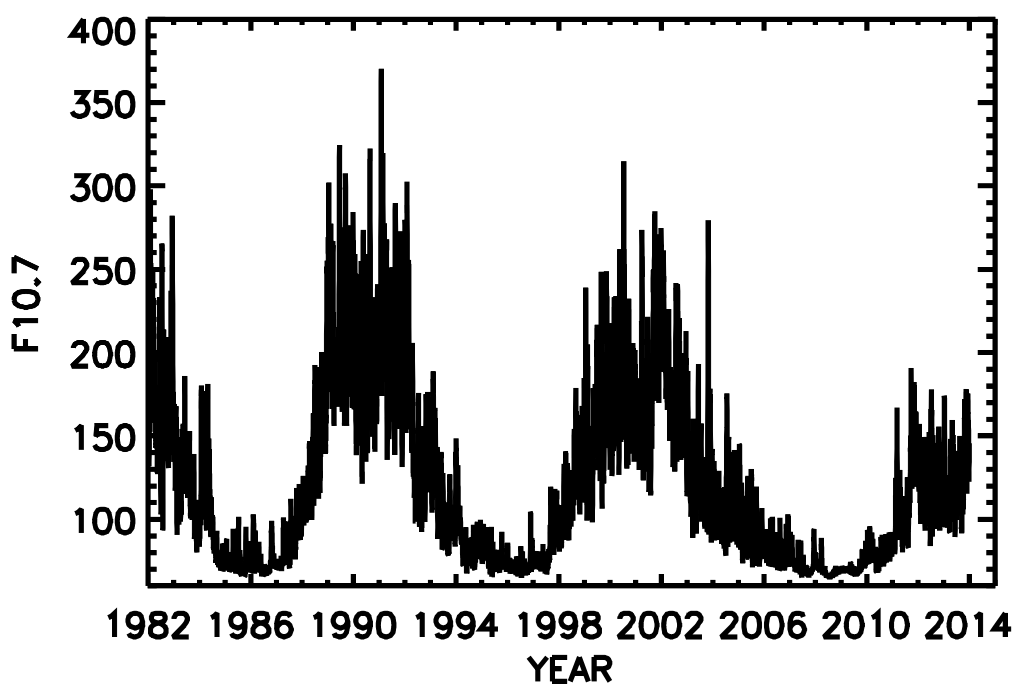

Figure 5: Daily F10.7 index

2.0 File Type Descriptions

2.1 Overview of File Types and Contents

AFRL's DMSP space weather sensors data archive includes data from the SSJ, SSIES, and SSM instruments that is stored in 11 different file types. Table 2 below lists the different file types and their contents.

Table 2: File types and contents

File Type	Data Quantities
Ephemeris Data (Binary Files)	1. Date, time, and spacecraft ID 2. Geodetic latitude, longitude, and altitude 3. Geographic latitude and longitude at 110 km altitude 4. Corrected geomagnetic latitude and longitude at 110 km altitude 5. Geomagnetic latitude and longitude 6. Geographic latitude and longitude of sub-solar point 7. Invariant latitude 8. Magnetic local time 9. Geographic x, y, and z components of satellite position unit vector 10. North, east, and down components of model magnetic field 11. Sath angle
SSIES Driftmeter Data (Binary Files)	1. Date, time, and spacecraft ID 2. Geodetic latitude, longitude, and altitude 3. Geographic latitude and longitude of sub-satellite point 4. Geographic latitude and longitude of sub-solar point 5. Geographic latitude and longitude at 110 km altitude 6. Corrected geomagnetic latitude and longitude at 110 km altitude 7. Invariant latitude 8. Magnetic local time 9. Geographic x, y, and z components of satellite position unit vector 10. North, east, and down components of model magnetic field 11. Vertical and horizontal drift speeds (6 samples per second)
SSIES Electron Langmuir Probe Data (Binary Files)	1. Date, time, and spacecraft ID 2. Geodetic latitude, longitude, and altitude 3. Geographic latitude and longitude of sub-satellite point 4. Geographic latitude and longitude of sub-solar point

	5. Geographic latitude and longitude at 110 km altitude 6. Corrected geomagnetic latitude and longitude at 110 km altitude 7. Invariant latitude 8. Magnetic local time 9. Geographic x, y, and z components of satellite position unit vector 10. North, east, and down components of model magnetic field 11. Electron density and temperature 12. Spacecraft potential
SSIES Microprocessor Data (Binary Files)	1. Date, time, and spacecraft ID 2. Geodetic latitude, longitude, and altitude 3. Geographic latitude and longitude of sub-satellite point 4. Geographic latitude and longitude of sub-solar point 5. Geographic latitude and longitude at 110 km altitude 6. Corrected geomagnetic latitude and longitude at 110 km altitude 7. Invariant latitude 8. Magnetic local time 9. Geographic x, y, and z components of satellite position unit vector 10. North, east, and down components of model magnetic field 11. Ram ion drift speed 12. H^+ and O^+ density and temperature 13. Plasma potential relative to ground 14. Electron density and temperature
SSIES Ion Retarding Potential Analyzer Data (Binary Files)	1. Date, time, and spacecraft ID 2. Geodetic latitude, longitude, and altitude 3. Geographic latitude and longitude of sub-satellite point 4. Geographic latitude and longitude of sub-solar point 5. Geographic latitude and longitude at 110 km altitude 6. Corrected geomagnetic latitude and longitude at 110 km altitude 7. Invariant latitude 8. Magnetic local time 9. Geographic x, y, and z components of satellite position unit vector 10. North, east, and down components of model magnetic field 11. Ion density by species 12. Ion temperature 13. Ram ion drift speed 14. Spacecraft potential relative to plasma
SSIES Scintillation Meter Data (Binary Files)	1. Date, time, and spacecraft ID

	2. Geodetic latitude, longitude, and altitude 3. Geographic latitude and longitude of sub-satellite point 4. Geographic latitude and longitude of sub-solar point 5. Geographic latitude and longitude at 110 km altitude 6. Corrected geomagnetic latitude and longitude at 110 km altitude 7. Invariant latitude 8. Magnetic local time 9. Geographic x, y, and z components of satellite position unit vector 10. North, east, and down components of model magnetic field 11. Ion density 12. Filter data
SSM Magnetometer Data (ASCII Files)	1. Date and Time 2. Geodetic latitude, longitude, and altitude 3. Geomagnetic latitude and longitude 4. Magnetic local time 5. Spacecraft x, y, and z components of model magnetic field 6. Spacecraft x, y, and z components of measured minus model magnetic field
SSM Magnetometer Data (Binary Files)	1. Date and time 2. Geodetic latitude, longitude, and altitude 3. Spacecraft x, y, and z components of measured minus model magnetic field
SSJ Data (Binary Files)	1. Date and time 2. Geodetic latitude, longitude, and altitude 3. Geographic latitude and longitude at 110 km altitude 4. Corrected geomagnetic latitude and longitude at 110 km altitude 5. MLT 6. Ion and electron counts in 19 energy channels (30 eV to 30 keV) every second 7. Sensor status information (J5 only)
SSIES Environmental Data Record (EDR) Data (ASCII Files)	1. Date, time, and spacecraft ID 2. Geographic latitude, longitude and altitude 3. Apex latitude, longitude, and local time 4. Total ion density 5. Spacecraft potential 6. Vertical and horizontal drift speeds 7. Electron density and temperature 8. Ion density by species 9. Ion temperature 10. Ram ion drift speed 11. Ion density filter data

SSM Magnetic Field Record (MFR) Data (ASCII Files)	1. Date, time, and spacecraft ID 2. Geographic latitude, longitude and altitude 3. Spacecraft x, y, and z components of measured magnetic field 4. Spacecraft x, y, and z components of measured minus model magnetic field

2.2 The Ephemeris (EPH) Data Files

The ephemeris data files use the following naming convention:

ephf**NNYYddd**

where the bold characters are variable and the other (not bold) characters remain fixed. The bold characters have the following meaning:

NN = 2 digit spacecraft flight number (06 through 20)
YY = 2 digit year
ddd = 3 digit day of year

For example, the data file ephf1309199 would be the ephemeris data for F13 for 18 July 2009. The ephemeris data files are binary data files with the data stored as a series of 32-bit signed integers, and 8-bit bytes representing ASCII characters. The data files were written using big endian encoding. Table 3 below gives 1) a description of each variable contained in the file including the type of variable, expected range of the variable, and the variable units, 2) any conversion if necessary to convert the stored value to scientific units, and 3) the number of bytes used to store each data word.

Table 3: File format description for the ephemeris data files

Word	Variable Description, Range, Units	Conversion	Bytes
1	Day of year, 001 to 366, days		4
2	Second of day, 0 to 86400, seconds		4
3	Integer year, 1987 to 2049, years		4
4	Geodetic latitude, -90.0 to 90.0, degrees	float(i)/100.0	4
5	Geographic longitude, 0.0 to 360.0, degrees	float(i)/100.0	4
6	Altitude, 400 to 500, nautical miles	float(i)/100.0	4
7	Geographic latitude at 110 km altitude and on the same magnetic field line as the DMSP spacecraft, -90.0 to 90.0, degrees	float(i)/100.0	4
8	Geographic longitude at 110 km altitude and on the same magnetic field line as the DMSP spacecraft, 0.0 to 360.0, degrees	float(i)/100.0	4
9	Corrected geomagnetic latitude at 110 km altitude, -90.0 to 90.0, degrees	float(i)/100.0	4
10	Corrected geomagnetic longitude at 110 km	float(i)/100.0	4

	altitude, 0.0 to 360.0, degrees		
11	Geomagnetic latitude, -90.0 to 90.0, degrees	float(i)/100.0	4
12	Geomagnetic longitude, 0.0 to 360.0, degrees	float(i)/100.0	4
13	Geographic latitude of sub-solar point, -90.0 to 90.0, degrees	float(i)/100.0	4
14	Geographic longitude of sub-solar point, 0.0 to 360.0, degrees	float(i)/100.0	4
15	Invariant latitude, 0.0 to 90.0, degrees	float(i)/100.0	4
16	Magnetic local time, 0.0 to 24.0, hours	float(i)/3600.0	4
17	Geographic x-component of satellite position unit vector, 0.0 to 1.0, unitless	float(i)/100000.0	4
18	Geographic y-component of satellite position unit vector, 0.0 to 1.0, unitless	float(i)/100000.0	4
19	Geographic z-component of satellite position unit vector, 0.0 to 1.0, unitless	float(i)/100000.0	4
20	Northward component of model magnetic field at satellite, -70000.0 to 70000.0, nT	float(i)/100.0	4
21	Eastward component of model magnetic field at satellite, -70000.0 to 70000.0, nT	float(i)/100.0	4
22	Downward component of model magnetic field at satellite, -70000.0 to 70000.0, nT	float(i)/100.0	4
23	Sath angle, 0 to 2π, radians	float(i)/100000.0	4
24	Spacecraft flight number, 6-20, unitless		4
25-26	Magnetic field model used (e.g. 'IGRF95')	Each 8 bit byte represents one character using ASCII code (i.e. where 20 Hex represents a blank space, 30 to 39 Hex represents characters 0 to 9, and 41 to 5A Hex represents characters A to Z).	8
27	Zero fill		4
28-54	Repeat of words 1-27 for next minute of data		108
55-81	Repeat of words 1-27 for next minute of data		108
.. ..	.. ..		

Table 4 below is a listing of the currently available (as of 1 Jan 2014) DMSP ephemeris data files listed by spacecraft with the total number of available data files shown in parentheses. The data base contains a total of 32684 ephemeris data files for spacecraft F8 through F18 spanning from June 1987 through the present. Figure 6 below shows the same information graphically.

Table 4: Listing of available DMSP ephemeris data files

Flight Number	Dates
F18	10/21/2009-01/01/2014 (1534)
F17	11/08/2006-01/01/2014 (2612)
F16	10/25/2003-01/01/2014 (3722)
F15	12/17/1999-01/01/2014 (5130)
F14	04/28/1997-08/23/2008 (4136)
F13	03/29/1995-06/29/1996, 07/01/1996-11/18/2009 (5348)
F12	09/03/1994-03/02/1995, 03/08/1995-08/31/1995, 10/01/1995-05/12/1997, 05/20/1997, 05/22/1997-08/10/1997, 08/13/1997-08/23/1997, 08/28/1997-01/28/2002, 01/30/2002-02/28/2002, 03/02/2002-04/01/2002, 04/04/2002-04/24/2002, 04/26/2002-05/23/2002, 05/25/2002-06/10/2002, 06/12/2002-06/23/2002, 06/25/2002-06/28/2002, 06/30/2002-07/01/2002, 07/03/2002-07/12/2002, 07/14/2002, 07/16/2002-07/18/2002, 07/20/2002-07/27/2002 (2823)
F11	12/03/1991-12/16/1991, 12/18/1991-03/02/1995, 03/08/1995-04/24/1995, 12/24/1997-01/19/1998, 01/30/1998-02/06/1998, 02/09/1998-04/04/1998, 04/06/1998-05/04/1998, 05/06/1998-05/08/1998, 05/11/1998-06/30/1999, 09/01/1999-05/16/2000 (2030)
F10	12/07/1990-12/08/1990, 12/19/1990-02/23/1991, 02/25/1991-06/15/1991, 07/01/1991-10/19/1991, 10/21/1991-09/26/1994 (1363)
F09	02/08/1988-02/17/1988, 02/19/1988-01/20/1990, 01/22/1990-03/30/1990, 04/01/1990-10/19/1991, 10/21/1991-02/27/1992, 02/29/1992-04/01/1992, 04/03/1992-04/04/1992 (1512)
F08	06/25/1987-07/16/1987, 08/27/1987-11/05/1987, 11/07/1987-10/19/1991, 10/21/1991-06/27/1993, 07/15/1993-02/28/1994, 05/01/1994-08/01/1994 (2474)

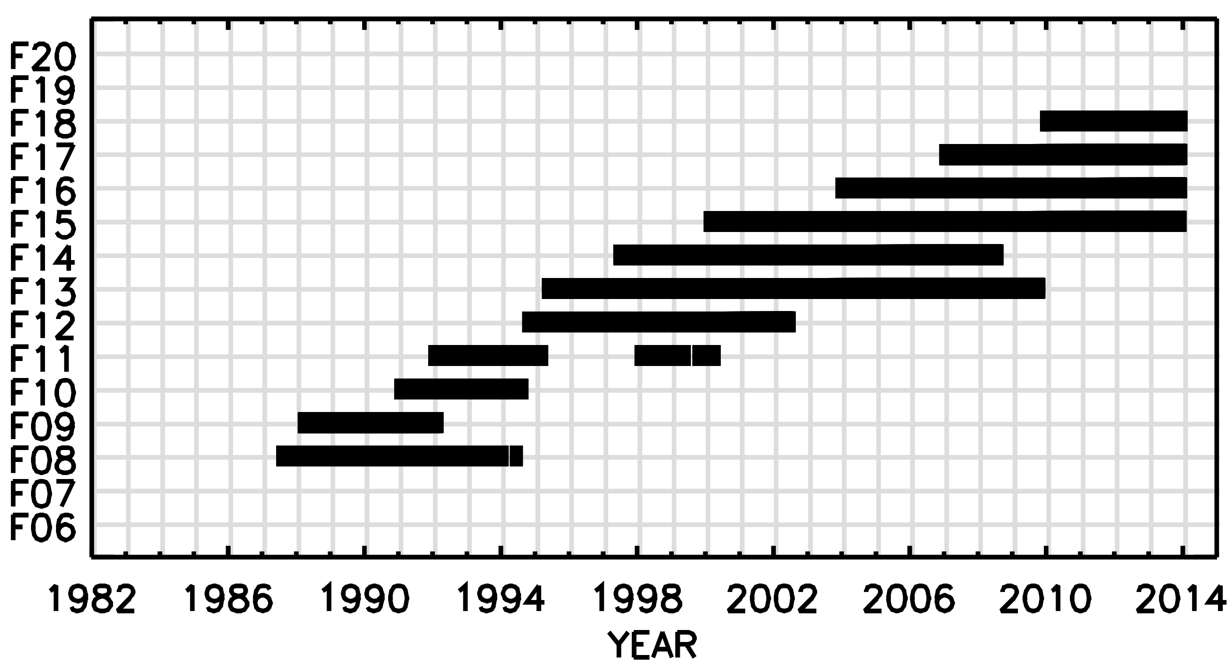

Figure 6: Graphical display of available DMSP ephemeris data files

Additional information about the sensors or the meaning of the values contained within the files can be found in the “Further Reading” section at the end of this document.

2.3 The SSIES Driftmeter (DM) Data Files

The SSIES driftmeter data files use the following naming convention:

f**NN**dm**YYmmmDD**.dat

where the bold characters are variable and the other (not bold) characters remain fixed. The bold characters have the following meaning:

NN = 2 digit spacecraft flight number (06 through 20)
YY = 2 digit year
mmm = 3 character month (jan, feb, mar, apr, etc.)
DD = 2 digit day of month

For example, the data file f13dm09jul18.dat would be the driftmeter data for F13 for 18 July 2009. The data files are binary files with the data stored as a series of 8 bit (1 byte), 16 bit (2 bytes), 24 bit (3 bytes), or 32 bit (4 bytes) unsigned integers. The data files were written using big endian encoding. Variables not within the expected range have each byte set to 255. Missing data are zero filled.

Table 5 below gives 1) a description of each variable contained in the file including the type of variable, expected range of the variable, and the variable units, 2) any conversion if necessary to convert the stored value to scientific units, and 3) the number of bytes used to store each data word.

Table 5: File format description for the SSIES driftmeter data files

Word	Variable Description, Range, Units	Conversion	Bytes
1	Spacecraft ID (‘F08 ’ through ‘F15 ’)	Each 8 bit byte represents one character using ASCII code (i.e. where 20 Hex represents a blank space, 30 to 39 Hex represents characters 0 to 9, and 41 to 5A Hex represents characters A to Z).	5
2	Data file ID (‘DM ’)	Each 8 bit byte represents one character using ASCII code.	6
3	Integer year, 1987 to 2049, years	i + 1950	2
4	Day of year, 1 to 366, days		2
5	Hour of day, 0 to 24, hours		1
6	Minute of hour, 0 to 59, minutes		1

7	Geodetic latitude, -90.0 to 90.0, degrees	(float(i)/10.0) - 90.0	2
8	Geographic longitude, 0.0 to 360.0, degrees	float(i)/10.0	2
9	Geomagnetic latitude at sub-satellite point, -90.0 to 90.0, degrees	(float(i)/10.0) - 90.0	2
10	Magnetic local time at 110 km field line intercept, 0.0 to 24.0, hours	float(i)/10.0	2
11	Geomagnetic longitude at sub-satellite point, 0.0 to 360.0, degrees	float(i)/10.0	2
12	Geographic latitude of sub-solar point, -90.0 to 90.0, degrees	(float(i)/10.0) - 90.0	2
13	Geographic longitude of sub-solar point, 0.0 to 360.0, degrees	float(i)/10.0	2
14	Geographic latitude at 110 km altitude and on the same magnetic field line as the DMSP spacecraft, -90.0 to 90.0, degrees	(float(i)/10.0) - 90.0	2
15	Geographic longitude at 110 km altitude and on the same magnetic field line as the DMSP spacecraft, 0.0 to 360.0, degrees	float(i)/10.0	2
16	Corrected geomagnetic latitude at 110 km altitude, -90.0 to 90.0, degrees	(float(i)/10.0) - 90.0	2
17	Corrected geomagnetic longitude at 110 km altitude, 0.0 to 360.0, degrees	float(i)/10.0	2
18	Invariant latitude, 0.0 to 90.0, degrees	float(i)/10.0	2
19	Altitude at the start of the minute, 400 to 500, nautical miles	float(i)	2
20	Altitude at the end of the minute, 400 to 500, nautical miles	float(i)	2
21	Northward component of model magnetic field at satellite, -70000.0 to 70000.0, nT	(float(i)/10.0) - 70000.0	4
22	Eastward component of model magnetic field at satellite, -70000.0 to 70000.0, nT	(float(i)/10.0) - 70000.0	4
23	Downward component of model magnetic field at satellite, -70000.0 to 70000.0, nT	(float(i)/10.0) - 70000.0	4
24	Geographic x-component of satellite position unit vector, 0.0 to 1.0, unitless	(float(i)/100000.0) - 1.0	3
25	Geographic y-component of satellite position unit vector, 0.0 to 1.0, unitless	(float(i)/100000.0) - 1.0	3
26	Geographic z-component of satellite position unit vector, 0.0 to 1.0, unitless	(float(i)/100000.0) - 1.0	3
27	Potential control model flag, 0 for vbias or 1 for senpot		1
28	Potential difference between spacecraft and electron probe ground, -3 to 28, volts	i-10	1
29	Potential difference between ion array and electron probe ground, -3 to 0, volts	i-3	1
30	Drift meter repeller grid functions, 0 to 16, unitless		1

31	Scintillation meter filter range commands, 0 to 16, unitless		1
32	No. of seconds of data for this minute, 1 to 60, unitless		1
33	Second of minute, 0 to 59, seconds		1
34	Vertical speed, 1st sample of sec,-3000 to 3000, meters/second	(10.0*float(i)) - 3000.0	2
35	Vertical speed, 2nd sample of sec,-3000 to 3000, meters/second; or 1st sample of raw data if H^+ mode	(10.0*float(i)) - 3000.0	2
36	Vertical speed, 3rd sample of sec,-3000 to 3000, meters/second; or 2nd sample of raw data if H^+ mode	(10.0*float(i)) - 3000.0	2
37	Vertical speed, 4th sample of sec,-3000 to 3000, meters/second; or 3rd sample of raw data if H^+ mode	(10.0*float(i)) - 3000.0	2
38	Vertical speed, 5th sample of sec (f,-3000 to 3000, meters/second; or 4th sample of raw data if H^+ mode	(10.0*float(i)) - 3000.0	2
39	Vertical speed, 6th sample of sec,-3000 to 3000, meters/second; or 5th sample of raw data if H^+ mode	(10.0*float(i)) - 3000.0	2
40	Horizontal speed, 1st sample of sec,-3000 to 3000, meters/second	(10.0*float(i)) - 3000.0	2
41	Horizontal speed, 2nd sample of sec,-3000 to 3000, meters/second; or 6th sample of raw data if H^+ mode	(10.0*float(i)) - 3000.0	2
42	Horizontal speed, 3rd sample of sec,-3000 to 3000, meters/second; or 7th sample of raw data if H^+ mode	(10.0*float(i)) - 3000.0	2
43	Horizontal speed, 4th sample of sec,-3000 to 3000, meters/second; or 8th sample of raw data if H^+ mode	(10.0*float(i)) - 3000.0	2
44	Horizontal speed, 5th sample of sec,-3000 to 3000, meters/second; or 9th sample of raw data if H^+ mode	(10.0*float(i)) - 3000.0	2
45	Horizontal speed, 6th sample of sec,-3000 to 3000, meters/second; or 10th sample of raw data if H^+ mode	(10.0*float(i)) - 3000.0	2
46	Ratio of LLA/LLB or indicates H^+ mode if equal to 511		2
47	Measured aperture potential, volts	(float(i)/100.0) - 19.0	2
48	Zero fill		8
49-64	Repeat of words 33-48 for the next second of minute		37
65-80	Repeat of words 33-48 for the next second of minute		37

.. ..	.. ..		
977-992	Repeat of words 33-48 for the last second of minute		37
993-1984	Repeat of words 1-992 for the next minute of data		2292
1985-2977	Repeat of words 1-992 for the next minute of data		2292
.. ..	.. ..		

Table 6 below is a listing of the currently available (as of 1 Jan 2014) DMSP SSIES driftmeter data files listed by spacecraft with the total number of available data files shown in parentheses. The data base contains a total of 24737 SSIES driftmeter data files for spacecraft F8 through F15 spanning from June 1987 through the present. Figure 7 below shows the same information graphically.

Table 6: Listing of available DMSP SSIES driftmeter data files

F15	12/16/1999-07/03/2012, 07/05/2012-04/08/2013, 04/13/2013-01/01/2014 (5126)
F14	04/28/1997-08/23/2008 (4136)
F13	03/29/1995-12/14/1997, 12/16/1997-11/18/2009 (5348)
F12	09/03/1994-03/02/1995, 03/08/1995-05/12/1997, 05/20/1997, 05/22/1997-08/10/1997, 08/13/1997-08/23/1997, 08/28/1997-01/30/2002, 02/01/2002-02/03/2002, 02/05/2002-02/07/2002, 02/09/2002-02/19/2002, 02/21/2002-02/26/2002, 02/28/2002, 03/02/2002-03/03/2002, 03/05/2002-04/01/2002, 04/03/2002, 04/05/2002-04/13/2002, 04/15/2002, 04/17/2002, 04/19/2002-04/23/2002, 04/25/2002, 04/27/2002-05/10/2002, 05/13/2002-05/25/2002, 05/28/2002-05/30/2002, 06/02/2002-06/10/2002, 06/12/2002, 06/14/2002-06/22/2002, 06/25/2002-06/28/2002, 06/30/2002-07/01/2002, 07/03/2002-07/12/2002, 07/14/2002-07/18/2002, 07/20/2002-07/27/2002 (2838)
F11	12/03/1991-12/16/1991, 12/18/1991-03/02/1995, 03/08/1995-04/24/1995, 12/24/1997-12/27/1997, 01/01/1998-01/19/1998, 01/30/1998-02/06/1998, 02/09/1998-04/04/1998, 04/06/1998-05/04/1998, 05/06/1998-05/08/1998, 05/11/1998-06/10/1999, 01/13/2000-05/16/2000 (1872)
F10	12/07/1990-12/08/1990, 12/19/1990-02/23/1991, 02/25/1991-10/19/1991, 10/21/1991-09/26/1994 (1378)
F09	02/08/1988-02/17/1988, 02/19/1988-03/30/1988, 04/01/1988-01/20/1990, 01/22/1990-03/30/1990, 04/01/1990-02/27/1992, 02/29/1992-03/31/1992 (1509)
F08	06/25/1987-07/10/1987, 08/27/1987-11/05/1987, 11/07/1987-06/27/1993, 07/15/1993-08/01/1994 (2530)

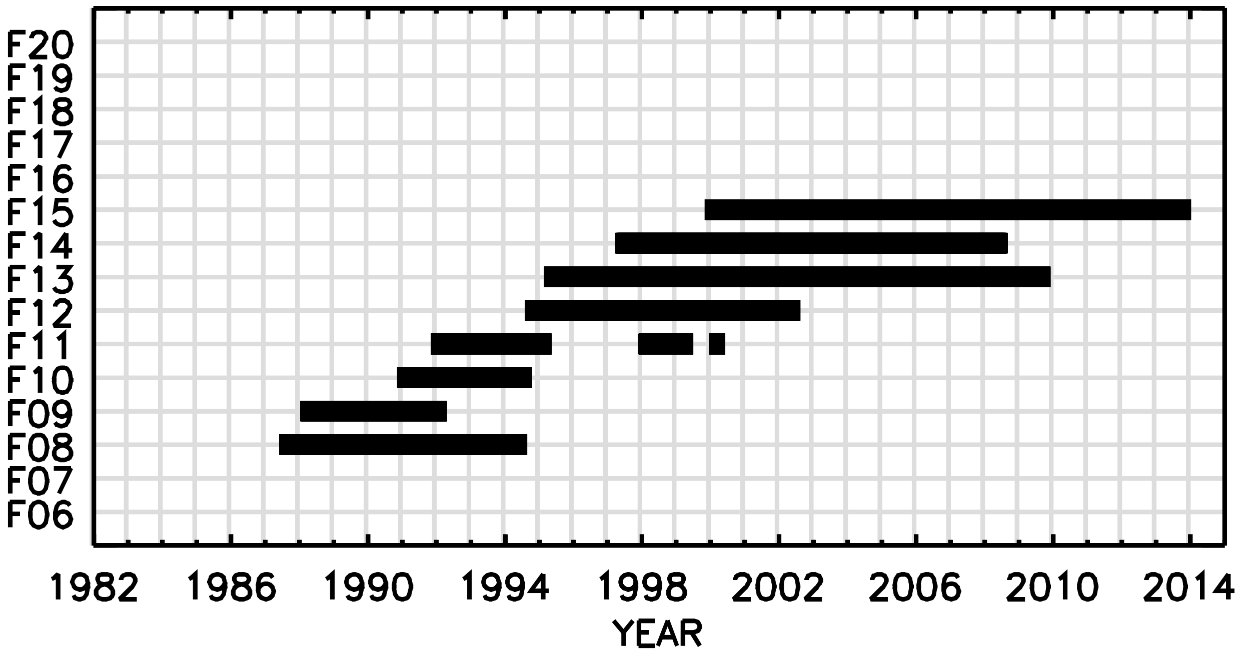

Figure 7: Graphical display of available DMSP SSIES driftmeter data files

Additional information about the sensors or the meaning of the values contained within the files can be found in the "Further Reading" section at the end of this document.

2.4 The SSIES Electron Langmuir Probe (EP) Data Files

The SSIES electron Langmuir probe data files use the following naming convention:

f**NN**ep**YYmmmDD**.dat

where the bold characters are variable and the other (not bold) characters remain fixed. The bold characters have the following meaning:

NN = 2 digit spacecraft flight number (06 through 20)
YY = 2 digit year
mmm = 3 character month (jan, feb, mar, apr, etc.)
DD = 2 digit day of month

For example, the file f13ep09jul18.dat would be the electron Langmuir probe data for F13 for 18 July 2009. The data files are binary files with the data stored as a series of 8 bit (1 byte), 16 bit (2 bytes), 24 bit (3 bytes), or 32 bit (4 bytes) unsigned integers. The data files were written using big endian encoding. Variables not within the expected range have each byte set to 255. Missing data are zero filled.

Table 7 below gives 1) a description of each variable contained in the file including the type of variable, expected range of the variable, and the variable units, 2) any conversion if necessary to convert the stored value to scientific units, and 3) the number of bytes used to store each data word.

Table 7: File format description for the SSIES electron Langmuir probe data files

Word	Variable Description, Range, Units	Conversion	Bytes
1	Spacecraft ID (‘F08 ’ through ‘F15 ’)	Each 8 bit byte represents one character using ASCII code (i.e. where 20 Hex represents a blank space, 30 to 39 Hex represents characters 0 to 9, and 41 to 5A Hex represents characters A to Z).	5
2	Data file ID (‘ELEC ’)	Each 8 bit byte represents one character using ASCII code.	6
3	Integer year, 1987 to 2049, years	i + 1950	2
4	Day of year, 1 to 366, days		2
5	Hour of day, 0 to 24, hours		1
6	Minute of hour, 0 to 59, minutes		1
7	Geodetic latitude, -90.0 to 90.0, degrees	(float(i)/10.0) - 90.0	2
8	Geographic longitude, 0.0 to 360.0, degrees	float(i)/10.0	2
9	Geomagnetic latitude at sub-satellite point, -90.0 to 90.0, degrees	(float(i)/10.0) - 90.0	2
10	Magnetic local time at 110 km field line intercept, 0.0 to 24.0, hours	float(i)/10.0	2
11	Geomagnetic longitude at sub-satellite point, 0.0 to 360.0, degrees	float(i)/10.0	2
12	Geographic latitude of sub-solar point, -90.0 to 90.0, degrees	(float(i)/10.0) - 90.0	2
13	Geographic longitude of sub-solar point, 0.0 to 360.0, degrees	float(i)/10.0	2
14	Geographic latitude at 110 km altitude and on the same magnetic field line as the DMSP spacecraft, -90.0 to 90.0, degrees	(float(i)/10.0) - 90.0	2
15	Geographic longitude at 110 km altitude and on the same magnetic field line as the DMSP spacecraft, 0.0 to 360.0, degrees	float(i)/10.0	2
16	Corrected geomagnetic latitude at 110 km altitude, -90.0 to 90.0, degrees	(float(i)/10.0) - 90.0	2
17	Corrected geomagnetic longitude at 110 km altitude, 0.0 to 360.0, degrees	float(i)/10.0	2
18	Invariant latitude, 0.0 to 90.0, degrees	float(i)/10.0	2
19	Altitude at the start of the minute, 400 to 500, nautical miles	float(i)	2
20	Altitude at the end of the minute, 400 to 500, nautical miles	float(i)	2
21	Northward component of model magnetic	(float(i)/10.0) - 70000.0	4

	field at satellite, -70000.0 to 70000.0, nT		
22	Eastward component of model magnetic field at satellite, -70000.0 to 70000.0, nT	(float(i)/10.0) - 70000.0	4
23	Downward component of model magnetic field at satellite, -70000.0 to 70000.0, nT	(float(i)/10.0) - 70000.0	4
24	Geographic x-component of satellite position unit vector, 0.0 to 1.0, unitless	(float(i)/100000.0) - 1.0	3
25	Geographic y-component of satellite position unit vector, 0.0 to 1.0, unitless	(float(i)/100000.0) - 1.0	3
26	Geographic z-component of satellite position unit vector, 0.0 to 1.0, unitless	(float(i)/100000.0) - 1.0	3
27	Potential control model flag, 0 for vbias or 1 for senpot		1
28	Potential difference between spacecraft and electron probe ground, -3 to 28, volts	i-10	1
29	Potential difference between ion array and electron probe ground, -3 to 0, volts	i-3	1
30	Drift meter repeller grid functions, 0 to 16, unitless		1
31	Scintillation meter filter range commands, 0 to 16, unitless		1
32	No. of sets of data for this minute, 1 to 30, unitless		1
33	Output type for 1st set of data ('B' for bias, 'D' for dwell, and 'S' for sweep)	ASCII code (i.e. where 41 to 5A Hex represents characters A to Z).	1
34	Repeat of word 33 for 2nd set of data		1
35	Repeat of word 33 for 3rd set of data		1
.. ..	.. ..		
62	Repeat of word 33 for last set of data		1
If output type is 'B' or 'S' then			
63	Second of minute for 1st set of data, 0 to 59, seconds		1
64	Langmuir probe mode for 1st set of data, 'A' to 'E'	ASCII code (i.e. where 41 to 5A Hex represents characters A to Z).	1
65	Electron density, #/cm^3	10^(float(i)/100.0)	2
66	Spacecraft potential, Volts	(float(i)/10.0) - 35.0	2
67	Electron Temperature, Kelvin	10^(float(i)/100.0)	2
68	Zero fill		1
If output type is 'D' then			
63	Second of minute for 1st set of data, 0 to 59, seconds		1
64	Langmuir probe mode for 1st set of data, 'A' to 'E'	ASCII code (i.e. where 41 to 5A Hex represents characters A to Z).	1
65	Mean electron density for 1st 4-seconds of	10^(float(i)/100.0)	2

	dwell, #/cm^3		
66	Standard deviation of electron density for 1st 4-seconds of dwell, #/cm^3	10^(float(i)/100.0)	2
67	Zero fill		2
68	Zero fill		1
69-74	Repeat of words 63-68 for 2nd set of data		9
75-80	Repeat of words 63-68 for 3rd set of data		9
.. ..	.. ..		
237-242	Repeat of words 63-68 for last set of data		9
243-484	Repeat of words 1-242 for the next minute of data		372
485-726	Repeat of words 1-242 for the next minute of data		372
.. ..	.. ..		

For F11 through F15, the raw SSIES EP data and the raw SSIES RPA data shared the same telemetry allocation. Only one of these two data sets could be in the telemetry at any given time. The raw RPA data was given priority over the raw EP data.

Table 8 below is a listing of the currently available (as of 1 Jan 2014) DMSP SSIES electron Langmuir probe data files listed by spacecraft with the total number of available data files shown in parentheses. The data base contains a total of 5728 SSIES electron Langmuir probe data files for spacecraft F8 through F15 spanning from June 1987 through December 2008. Figure 8 below shows the same information graphically.

Table 8: Listing of available DMSP SSIES electron Langmuir probe Data Files

F15	12/18/1999-12/19/1999, 11/06/2001-11/20/2001, 02/21/2002-02/22/2002, 11/14/2002-11/25/2002, 10/26/2008, 11/19/2008, 12/04/2008, 12/21/2008 (35)
F14	11/10/1997-12/01/1997, 11/10/1998-12/01/1998, 11/05/1999-12/01/1999, 03/14/2000-03/16/2000, 11/06/2001-11/20/2001, 03/26/2002, 11/14/2002-11/25/2002 (102)
F13	03/31/1995, 11/10/1997-12/01/1997, 09/20/1998, 11/10/1998-12/01/1998, 11/04/1999-12/01/1999, 11/06/2001-11/20/2001, 08/26/2002, 11/14/2002-11/25/2002, 07/12/2006 (103)
F12	09/04/1994-09/05/1994, 09/08/1994, 09/23/1994, 11/10/1997-12/01/1997, 11/10/1998-12/01/1998, 12/05/1998-12/06/1998, 11/05/1999-12/01/1999, 03/18/2000, 05/12/2000, 06/07/2000, 08/19/2000, 08/24/2000, 09/08/2000, 09/16/2000, 09/18/2000, 10/10/2000, 11/05/2000, 03/03/2001, 11/06/2001-11/20/2001, 11/30/2001, 12/17/2001-12/19/2001, 12/27/2001-12/28/2001, 01/04/2002, 02/10/2002, 02/18/2002, 03/08/2002, 03/11/2002, 05/17/2002 (115)
F11	12/05/1991, 01/01/1992-02/29/1992, 05/07/1992-05/08/1992, 09/23/1993-09/24/1993, 07/15/1994, 05/20/1998, 11/10/1998-12/01/1998, 12/14/1998, 04/08/1999, 01/13/2000, 01/20/2000, 01/27/2000, 02/09/2000, 02/17/2000, 02/19/2000, 02/23/2000, 02/26/2000, 03/02/2000, 03/08/2000, 03/10/2000, 03/25/2000, 04/02/2000, 04/05/2000, 04/08/2000, 04/11/2000-04/12/2000, 04/15/2000, 04/17/2000, 04/19/2000, 04/22/2000-04/25/2000, 04/30/2000-05/02/2000, 05/05/2000, 05/08/2000, 05/10/2000, 05/12/2000, 05/15/2000 (123)
F10	12/07/1990-12/08/1990, 12/19/1990-02/23/1991, 02/25/1991-10/19/1991, 10/21/1991-09/26/1994 (1378)
F09	02/08/1988-02/17/1988, 02/19/1988-03/30/1988, 04/01/1988-01/20/1990, 01/22/1990-03/30/1990, 04/01/1990-02/27/1992, 02/29/1992-03/31/1992 (1509)
F08	06/25/1987-07/10/1987, 08/27/1987-11/05/1987, 11/07/1987-02/15/1991, 03/01/1991-06/27/1993, 07/15/1993-02/28/1994 (2363)

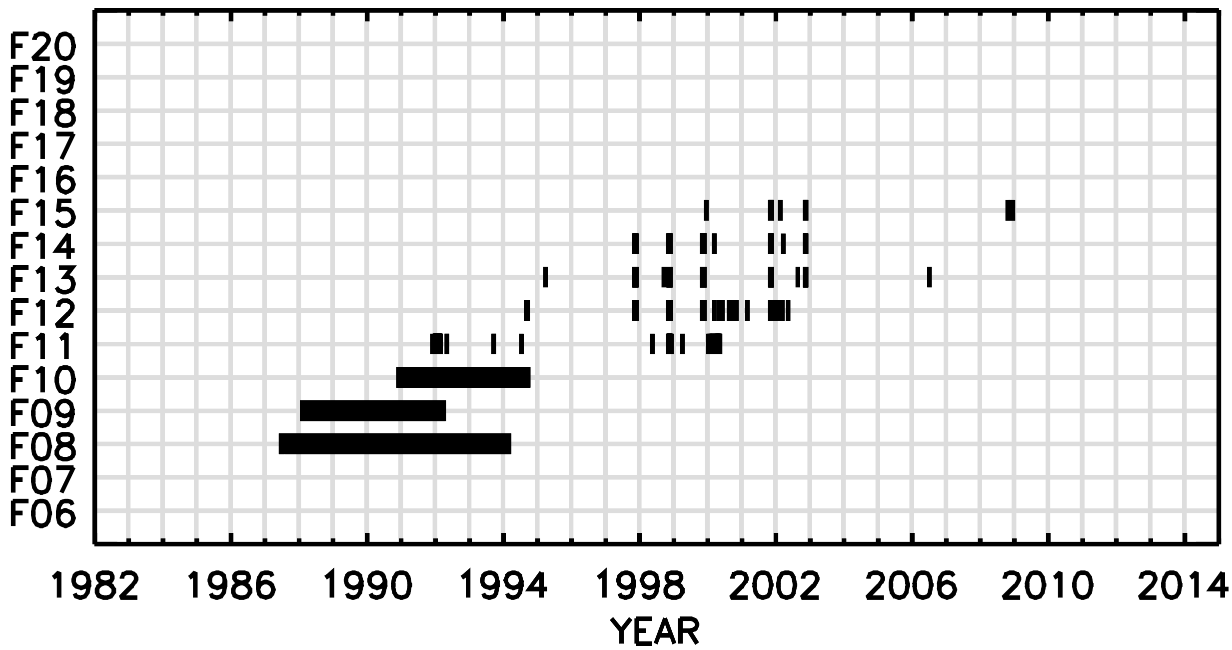

Figure 8: Graphical display of available DMSP SSIES electron Langmuir probe data files

Additional information about the sensors or the meaning of the values contained within the files can be found in the "Further Reading" section at the end of this document.

2.5 The SSIES Microprocessor (MP) Data Files

The SSIES microprocessor data files use the following naming convention:

f**NN**mp**YYmmmDD**.dat

where the bold characters are variable and the other (not bold) characters remain fixed. The bold characters have the following meaning:

NN = 2 digit spacecraft flight number (06 through 20)
YY = 2 digit year
mmm = 3 character month (jan, feb, mar, apr, etc.)
DD = 2 digit day of month

For example, the data file f13mp09jul18.dat would be the microprocessor data for F13 for 18 July 2009. The data files are binary data files with the data stored as a series of 8 bit (1 byte), 16 bit (2 bytes), 24 bit (3 bytes), or 32 bit (4 bytes) unsigned integers. The data files were written using big endian encoding. Variables not within the expected range have each byte set to 255. Missing data are zero filled.

The microprocessor file contains the results of onboard analysis of raw data by a microprocessor which uses algorithms which are less complex than the algorithms used in processing the raw data on the ground. Table 9 below gives 1) a description of each variable contained in the file including the type of variable, expected range of the variable, and the variable units, 2) any conversion if necessary to convert the stored value to scientific units, and 3) the number of bytes used to store each data word.

Table 9: File format description for the SSIES microprocessor data files

Word	Variable Description, Range, Units	Conversion	Bytes
1	Spacecraft ID ('F08 ' through 'F15 ')	Each 8 bit byte represents one character using ASCII code (i.e. where 20 Hex represents a blank space, 30 to 39 Hex represents characters 0 to 9, and 41 to 5A Hex represents characters A to Z).	5
2	Data file ID ('MICRO ')	Each 8 bit byte represents one character using ASCII code.	6
3	Integer year, 1987 to 2049, years	i + 1950	2
4	Day of year, 1 to 366, days		2
5	Hour of day, 0 to 24, hours		1
6	Minute of hour, 0 to 59, minutes		1
7	Geodetic latitude, -90.0 to 90.0, degrees	(float(i)/10.0) - 90.0	2
8	Geographic longitude, 0.0 to 360.0, degrees	float(i)/10.0	2
9	Geomagnetic latitude at sub-satellite point, -90.0 to 90.0, degrees	(float(i)/10.0) - 90.0	2
10	Magnetic local time at 110 km field line intercept, 0.0 to 24.0, hours	float(i)/10.0	2
11	Geomagnetic longitude at sub-satellite point, 0.0 to 360.0, degrees	float(i)/10.0	2
12	Geographic latitude of sub-solar point, -90.0 to 90.0, degrees	(float(i)/10.0) - 90.0	2
13	Geographic longitude of sub-solar point, 0.0 to 360.0, degrees	float(i)/10.0	2
14	Geographic latitude at 110 km altitude and on the same magnetic field line as the DMSP spacecraft, -90.0 to 90.0, degrees	(float(i)/10.0) - 90.0	2
15	Geographic longitude at 110 km altitude and on the same magnetic field line as the DMSP spacecraft, 0.0 to 360.0, degrees	float(i)/10.0	2
16	Corrected geomagnetic latitude at 110 km altitude, -90.0 to 90.0, degrees	(float(i)/10.0) - 90.0	2
17	Corrected geomagnetic longitude at 110 km altitude, 0.0 to 360.0, degrees	float(i)/10.0	2
18	Invariant latitude, 0.0 to 90.0, degrees	float(i)/10.0	2
19	Altitude at the start of the minute, 400 to 500, nautical miles	float(i)	2
20	Altitude at the end of the minute, 400 to 500, nautical miles	float(i)	2
21	Northward component of model magnetic field at satellite, -70000.0 to 70000.0, nT	(float(i)/10.0) - 70000.0	4

22	Eastward component of model magnetic field at satellite, -70000.0 to 70000.0, nT	(float(i)/10.0) - 70000.0	4
23	Downward component of model magnetic field at satellite, -70000.0 to 70000.0, nT	(float(i)/10.0) - 70000.0	4
24	Geographic x-component of satellite position unit vector, 0.0 to 1.0, unitless	(float(i)/100000.0) - 1.0	3
25	Geographic y-component of satellite position unit vector, 0.0 to 1.0, unitless	(float(i)/100000.0) - 1.0	3
26	Geographic z-component of satellite position unit vector, 0.0 to 1.0, unitless	(float(i)/100000.0) - 1.0	3
27	Potential control model flag, 0 for vbias or 1 for senpot		1
28	Potential difference between spacecraft and electron probe ground, -3 to 28, volts	i-10	1
29	Potential difference between ion array and electron probe ground, -3 to 0, volts	i-3	1
30	Drift meter repeller grid functions, 0 to 16, unitless		1
31	Scintillation meter filter range commands, 0 to 16, unitless		1
32	No. of sets of microprocessor outputs for this minute, 1 to 15, unitless		1
33	Second of minute for 1st set of data, 0 to 59, seconds		1
34	Ram ion drift speed,-3000 to 3000, meters/second	(10.0*float(i)) - 3000.0	2
35	O^+ ion temperature, Kelvin	10.0*float(i)	2
36	H^+ ion temperature, Kelvin	10.0*float(i)	2
37	O^+ ion density, #/cm^3	10^(float(i)/100.0)	2
38	H^+ ion density, #/cm^3	10^(float(i)/100.0)	2
39	Plasma potential relative to RPA ground, Volts	(float(i)/100.0) - 6.0	2
40	1st electron temperature, Kelvin	10.0*float(i)	2
41	1st electron density, #/cm^3	10^(float(i)/100.0)	2
42	1st Plasma potential relative to spacecraft ground, Volts	6.0 - (float(i)/10.0)	2
43	2nd electron temperature, Kelvin	10.0*float(i)	2
44	2nd electron density, #/cm^3	10^(float(i)/100.0)	2
45	2nd Plasma potential relative to spacecraft ground, Volts	6.0 - (float(i)/10.0)	2
46	Zero fill		3
47-60	Repeat of words 33-46 for 2nd set of data		28
61-74	Repeat of words 33-46 for 3rd set of data		28
.. ..	.. ..		
229-242	Repeat of words 33-46 for last set of data		28
243-484	Repeat of words 1-242 for the next minute		492

	of data		
485-726	Repeat of words 1-242 for the next minute of data		492
.. ..	.. ..		

Table 10 below is a listing of the currently available (as of 1 Jan 2014) DMSP SSIES microprocessor data files listed by spacecraft with the total number of available data files shown in parentheses. The data base contains a total of 24709 SSIES microprocessor data files for spacecraft F8 through F15 spanning from June 1987 through the present. Figure 9 below shows the same information graphically.

Table 10: Listing of available DMSP SSIES microprocessor data files

F15	12/16/1999-07/03/2012, 07/05/2012-02/24/2013, 03/26/2013-04/08/2013, 04/13/2013-01/01/2014 (5097)
F14	04/28/1997-08/23/2008 (4136)
F13	03/29/1995-11/18/2009 (5349)
F12	09/03/1994-03/02/1995, 03/08/1995-05/12/1997, 05/20/1997, 05/22/1997-08/10/1997, 08/13/1997-08/23/1997, 08/28/1997-01/30/2002, 02/01/2002-02/03/2002, 02/05/2002-02/07/2002, 02/09/2002-02/19/2002, 02/21/2002-02/26/2002, 02/28/2002, 03/02/2002-03/03/2002, 03/05/2002-04/01/2002, 04/03/2002, 04/05/2002-04/13/2002, 04/15/2002, 04/17/2002, 04/19/2002-04/23/2002, 04/25/2002, 04/27/2002-05/10/2002, 05/13/2002-05/25/2002, 05/28/2002-05/30/2002, 06/02/2002-06/10/2002, 06/12/2002, 06/14/2002-06/22/2002, 06/25/2002-06/28/2002, 06/30/2002-07/01/2002, 07/03/2002-07/12/2002, 07/14/2002-07/18/2002, 07/20/2002-07/27/2002 (2838)
F11	12/03/1991-12/16/1991, 12/18/1991-03/02/1995, 03/08/1995-04/24/1995, 12/24/1997-12/27/1997, 01/01/1998-01/19/1998, 01/30/1998-02/06/1998, 02/09/1998-04/04/1998, 04/06/1998-05/04/1998, 05/06/1998-05/08/1998, 05/11/1998-06/10/1999, 01/13/2000-05/16/2000 (1872)
F10	12/07/1990-12/08/1990, 12/19/1990-02/23/1991, 02/25/1991-10/19/1991, 10/21/1991-09/26/1994 (1378)
F09	02/08/1988-02/17/1988, 02/19/1988-03/30/1988, 04/01/1988-01/20/1990, 01/22/1990-03/30/1990, 04/01/1990-02/27/1992, 02/29/1992-03/31/1992 (1509)
F08	06/25/1987-07/10/1987, 08/27/1987-11/05/1987, 11/07/1987-06/27/1993, 07/15/1993-08/01/1994 (2530)

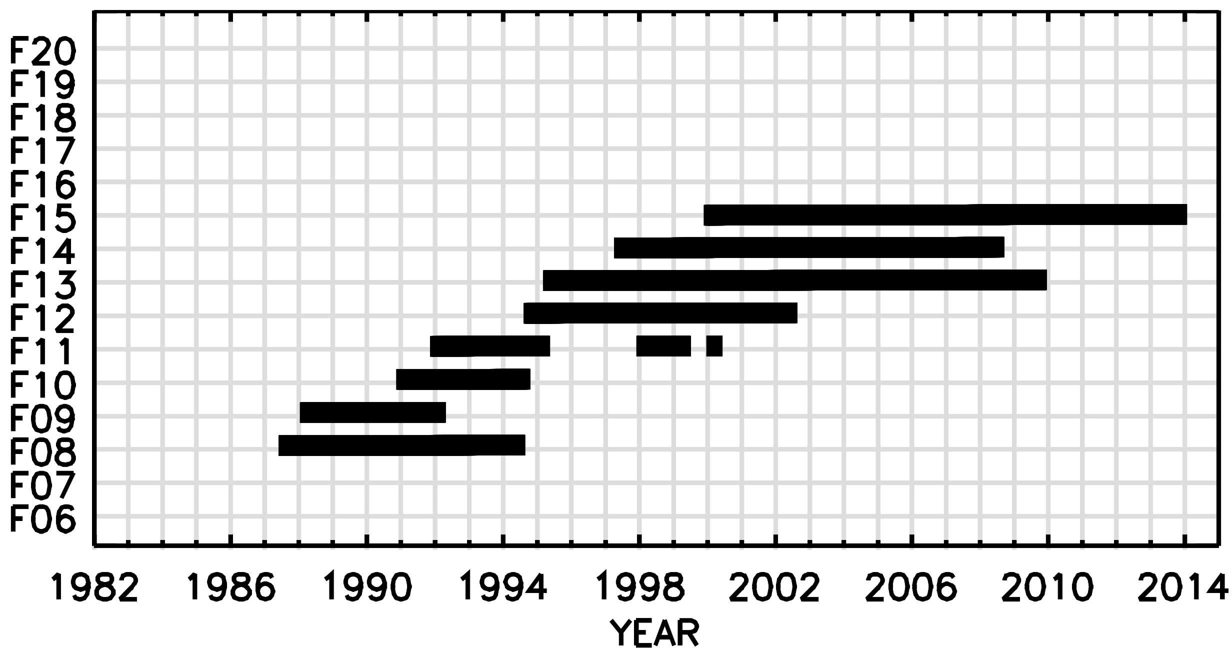

Figure 9: Graphical display of available DMSP SSIES microprocessor data files

Additional information about the sensors or the meaning of the values contained within the files can be found in the “Further Reading” section at the end of this document.

2.6 The SSIES Ion Retarding Potential Analyzer (RPA) Data Files

The SSIES RPA data files use the following naming convention:

f**NN**rp**YYmmmDD**.dat

where the bold characters are variable and the other (not bold) characters remain fixed. The bold characters have the following meaning:

NN = 2 digit spacecraft flight number (06 through 20)
YY = 2 digit year
mmm = 3 character month (jan, feb, mar, apr, etc.)
DD = 2 digit day of month

For example, the data file f13rp09jul18.dat would be the RPA data for F13 for 18 July 2009. The data files are binary files with the data stored as a series of 8 bit (1 byte), 16 bit (2 bytes), 24 bit (3 bytes), or 32 bit (4 bytes) unsigned integers. The data files were written using big endian encoding. Variables not within the expected range have each byte set to 255. Missing data are zero filled.

Table 11 below gives 1) a description of each variable contained in the file including the type of variable, expected range of the variable, and the variable units, 2) any conversion if necessary to convert the stored value to scientific units, and 3) the number of bytes used to store each data word.

Table 11: File format description for the SSIES ion retarding potential analyzer data files

Word	Variable Description, Range, Units	Conversion	Bytes
1	Spacecraft ID (‘F08 ’ through ‘F15 ’)	Each 8 bit byte represents one character using ASCII code (i.e. where 20 Hex represents a blank space, 30 to 39 Hex represents characters 0 to 9, and 41 to 5A Hex represents characters A to Z).	5
2	Data file ID (‘RPADWS’ or ‘RPADWF’)	Each 8 bit byte represents one character using ASCII code.	6
3	Integer year, 1987 to 2049, years	i + 1950	2
4	Day of year, 1 to 366, days		2
5	Hour of day, 0 to 24, hours		1
6	Minute of hour, 0 to 59, minutes		1
7	Geodetic latitude, -90.0 to 90.0, degrees	(float(i)/10.0) - 90.0	2
8	Geographic longitude, 0.0 to 360.0, degrees	float(i)/10.0	2
9	Geomagnetic latitude at sub-satellite point, -90.0 to 90.0, degrees	(float(i)/10.0) - 90.0	2
10	Magnetic local time at 110 km field line intercept, 0.0 to 24.0, hours	float(i)/10.0	2
11	Geomagnetic longitude at sub-satellite point, 0.0 to 360.0, degrees	float(i)/10.0	2
12	Geographic latitude of sub-solar point, -90.0 to 90.0, degrees	(float(i)/10.0) - 90.0	2
13	Geographic longitude of sub-solar point, 0.0 to 360.0, degrees	float(i)/10.0	2
14	Geographic latitude at 110 km altitude and on the same magnetic field line as the DMSP spacecraft, -90.0 to 90.0, degrees	(float(i)/10.0) - 90.0	2
15	Geographic longitude at 110 km altitude and on the same magnetic field line as the DMSP spacecraft, 0.0 to 360.0, degrees	float(i)/10.0	2
16	Corrected geomagnetic latitude at 110 km altitude, -90.0 to 90.0, degrees	(float(i)/10.0) - 90.0	2
17	Corrected geomagnetic longitude at 110 km altitude, 0.0 to 360.0, degrees	float(i)/10.0	2
18	Invariant latitude, 0.0 to 90.0, degrees	float(i)/10.0	2
19	Altitude at the start of the minute, 400 to 500, nautical miles	float(i)	2
20	Altitude at the end of the minute, 400 to 500, nautical miles	float(i)	2
21	Northward component of model magnetic field at satellite, -70000.0 to 70000.0, nT	(float(i)/10.0) - 70000.0	4
22	Eastward component of model magnetic	(float(i)/10.0) - 70000.0	4

	field at satellite, -70000.0 to 70000.0, nT		
23	Downward component of model magnetic field at satellite, -70000.0 to 70000.0, nT	(float(i)/10.0) - 70000.0	4
24	Geographic x-component of satellite position unit vector, 0.0 to 1.0, unitless	(float(i)/100000.0) - 1.0	3
25	Geographic y-component of satellite position unit vector, 0.0 to 1.0, unitless	(float(i)/100000.0) - 1.0	3
26	Geographic z-component of satellite position unit vector, 0.0 to 1.0, unitless	(float(i)/100000.0) - 1.0	3
27	Potential control model flag, 0 for vbias or 1 for senpot		1
28	Potential difference between spacecraft and electron probe ground, -3 to 28, volts	i-10	1
29	Potential difference between ion array and electron probe ground, -3 to 0, volts	i-3	1
30	Drift meter repeller grid functions, 0 to 16, unitless		1
31	Scintillation meter filter range commands, 0 to 16, unitless		1
32	No. of sets of data for this minute, 1 to 15, unitless		1
33	Second of minute, 0 to 59, seconds		1
34	Ion temperature for 1st RPA set, Kelvin	10^(float(i)/100.0)	2
35	Ram ion drift speed, meters/sec	(10.0*float(i)) - 3000.0	2
36	Spacecraft potential relative to plasma, Volts	(float(i)/10.0) - 35.0	2
37	Number of ion species used for 1st RPA sweep analysis, 0 to 4, unitless		1
38	Mass of 1st ion species for 1st RPA sweep analysis, AMU		1
39	Density of 1st ion species for 1st RPA sweep analysis, $\#/cm^3$	10^(float(i)/100.0)	2
40	Mass of 2nd ion species for 1st RPA sweep analysis, AMU		1
41	Density of 2nd ion species for 1st RPA sweep analysis, $\#/cm^3$	10^(float(i)/100.0)	2
42	Mass of 3rd ion species for 1st RPA sweep analysis, AMU		1
43	Density of 3rd ion species for 1st RPA sweep analysis, $\#/cm^3$	10^(float(i)/100.0)	2
44	Mass of 4th ion species for 1st RPA sweep analysis, AMU		1
45	Density of 4th ion species for 1st RPA sweep analysis, $\#/cm^3$	10^(float(i)/100.0)	2
46	Error estimate for 1st RPA sweep, $\#/cm^3$	10^(float(i)/100.0)	2
47	Total ion density based on 18 points of saturation current, $\#/cm^3$	10^(float(i)/100.0)	2

48	Standard deviation 18 points of total ion densities, #/cm^3	10^(float(i)/100.0)	2
49	Zero fill		2
50-66	Repeat of words 33-49 for the next second of minute		28
67-83	Repeat of words 33-48 for the next second of minute		28
.. ..	.. ..		
271-287	Repeat of words 33-48 for the last second of minute		28
288-574	Repeat of words 1-287 for the next minute of data		492
575-861	Repeat of words 1-287 for the next minute of data		492
.. ..	.. ..		

In the data file ID the “DW” stands for Dan Weimer who wrote the ground processing algorithm used to process the data in the current data base. The “S” and “F” stand for slow and fast respectively. The slow version is more accurate.

Table 12 below is a listing of the currently available (as of 1 Jan 2014) DMSP SSIES ion retarding potential analyzer data files listed by spacecraft with the total number of available data files shown in parentheses. The data base contains a total of 22252 SSIES ion retarding potential analyzer data files for spacecraft F8 through F15 spanning from June 1987 through the present. Figure 10 below shows the same information graphically.

Table 12: Listing of available DMSP SSIES ion retarding potential data files

F15	12/16/1999-11/06/2001, 11/20/2001-11/14/2002, 11/25/2002-07/03/2012, 07/05/2012-04/08/2013, 04/13/2013-01/01/2014 (5103)
F14	04/28/1997-11/10/1997, 12/01/1997-11/10/1998, 12/01/1998-11/05/1999, 12/01/1999-11/06/2001, 11/20/2001-11/14/2002, 11/25/2002-08/23/2008 (4048)
F13	03/29/1995-11/10/1997, 12/01/1997-11/10/1998, 12/01/1998-11/04/1999, 11/24/1999, 12/01/1999-11/06/2001, 11/20/2001-11/14/2002, 11/25/2002-11/18/2009 (5261)
F12	09/03/1994-03/02/1995, 03/08/1995-05/12/1997, 05/23/1997-08/11/1997, 08/13/1997-08/23/1997, 08/28/1997-11/10/1997, 11/13/1997, 12/01/1997-11/10/1998, 12/01/1998-11/05/1999, 11/22/1999, 12/01/1999-11/06/2001, 11/20/2001-01/30/2002, 02/01/2002-02/03/2002, 02/05/2002-02/07/2002, 02/09/2002-02/19/2002, 02/21/2002-02/26/2002, 02/28/2002, 03/02/2002-03/03/2002, 03/05/2002-04/01/2002, 04/03/2002, 04/05/2002-04/13/2002, 04/15/2002, 04/17/2002, 04/19/2002-04/23/2002, 04/25/2002, 04/27/2002-05/10/2002, 05/13/2002-05/25/2002, 05/28/2002-05/30/2002, 06/02/2002-06/10/2002, 06/12/2002, 06/14/2002-06/22/2002, 06/25/2002-06/28/2002, 06/30/2002-07/01/2002, 07/03/2002-07/12/2002, 07/14/2002-07/18/2002, 07/20/2002-07/27/2002 (2761)
F11	12/03/1991-12/16/1991, 12/18/1991-03/02/1995, 03/08/1995-04/24/1995, 12/24/1997-12/27/1997, 01/01/1998-01/19/1998, 01/30/1998-02/06/1998, 02/09/1998-04/04/1998, 04/06/1998-05/04/1998, 05/06/1998-05/08/1998, 05/11/1998-11/10/1998, 11/28/1998, 12/02/1998-06/10/1999, 01/13/2000-05/16/2000 (1852)
F10	12/07/1990-12/08/1990, 12/19/1990-02/23/1991, 02/25/1991-10/19/1991, 10/21/1991-09/26/1994 (1378)
F09	02/08/1988-02/17/1988, 02/19/1988-02/29/1988, 02/01/1989-07/31/1989, 09/01/1989-10/31/1989, 01/01/1990-01/20/1990, 01/22/1990-01/31/1990, 03/01/1990-03/30/1990, 05/01/1991-05/31/1991, 08/01/1991-08/31/1991, 10/29/1991, 11/01/1991-12/31/1991, 02/01/1992-02/27/1992, 02/29/1992-03/31/1992 (506)
F08	06/25/1987-07/10/1987, 08/27/1987-11/05/1987, 11/07/1987-12/11/1987, 01/01/1988-12/31/1988, 03/01/1989-05/31/1989, 07/01/1989-09/30/1989, 01/01/1990-08/31/1990, 05/01/1991-07/31/1991, 09/01/1991-10/02/1991, 10/29/1991-10/31/1991, 01/01/1992-04/30/1992, 06/01/1992-07/31/1992, 11/01/1992-12/31/1992, 07/15/1993-08/31/1993, 01/11/1994-01/20/1994 (1343)

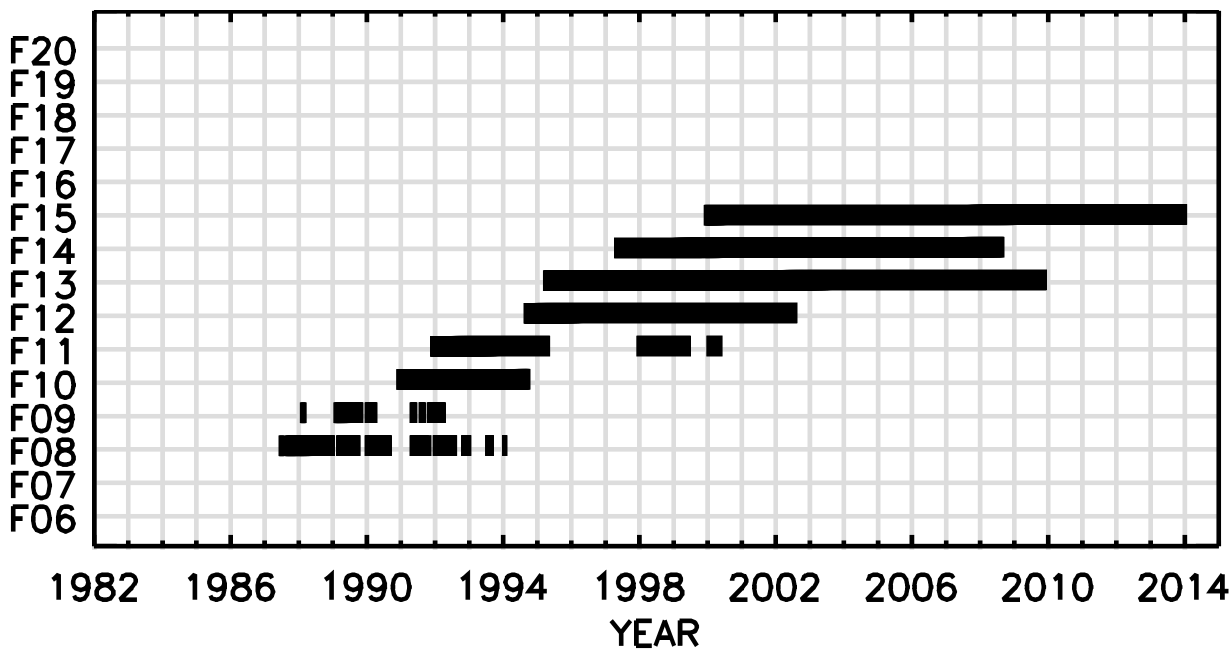

Figure 10: Graphical display of available DMSP SSIES ion retarding potential analyzer data files

Additional information about the sensors or the meaning of the values contained within the files can be found in the "Further Reading" section at the end of this document.

2.7 The SSIES Scintillation Meter (SM) Data Files

The SSIES scintillation meter data files use the following naming convention:

f**NN**sm**YYmmmDD**.dat

where the bold characters are variable and the other (not bold) characters remain fixed. The bold characters have the following meaning:

NN = 2 digit spacecraft flight number (06 through 20)
YY = 2 digit year
mmm = 3 character month (jan, feb, mar, apr, etc.)
DD = 2 digit day of month

For example, the data file f13sm09jul18.dat would be the scintillation meter data for F13 for 18 July 2009. The data files are binary data files with the data stored as a series of 8 bit (1 byte), 16 bit (2 bytes), 24 bit (3 bytes), or 32 bit (4 bytes) unsigned integers. The data files were written using big endian encoding. Variables not within the expected range have each byte set to 255. Missing data are zero filled.

Table 13 below gives 1) a description of each variable contained in the file including the type of variable, expected range of the variable, and the variable units, 2) any conversion if necessary to convert the stored value to scientific units, and 3) the number of bytes used to store each data word.

Table 13: File format description for the SSIES scintillation meter data files

Word	Variable Description, Range, Units	Conversion	Bytes
1	Spacecraft ID ('F08 ' through 'F15 ')	Each 8 bit byte represents one character using ASCII code (i.e. where 20 Hex represents a blank space, 30 to 39 Hex represents characters 0 to 9, and 41 to 5A Hex represents characters A to Z).	5
2	Data file ID ('SM ')	Each 8 bit byte represents one character using ASCII code.	6
3	Integer year, 1987 to 2049, years	i + 1950	2
4	Day of year, 1 to 366, days		2
5	Hour of day, 0 to 24, hours		1
6	Minute of hour, 0 to 59, minutes		1
7	Geodetic latitude, -90.0 to 90.0, degrees	(float(i)/10.0) - 90.0	2
8	Geographic longitude, 0.0 to 360.0, degrees	float(i)/10.0	2
9	Geomagnetic latitude at sub-satellite point, -90.0 to 90.0, degrees	(float(i)/10.0) - 90.0	2
10	Magnetic local time at 110 km field line intercept, 0.0 to 24.0, hours	float(i)/10.0	2
11	Geomagnetic longitude at sub-satellite point, 0.0 to 360.0, degrees	float(i)/10.0	2
12	Geographic latitude of sub-solar point, -90.0 to 90.0, degrees	(float(i)/10.0) - 90.0	2
13	Geographic longitude of sub-solar point, 0.0 to 360.0, degrees	float(i)/10.0	2
14	Geographic latitude at 110 km altitude and on the same magnetic field line as the DMSP spacecraft, -90.0 to 90.0, degrees	(float(i)/10.0) - 90.0	2
15	Geographic longitude at 110 km altitude and on the same magnetic field line as the DMSP spacecraft, 0.0 to 360.0, degrees	float(i)/10.0	2
16	Corrected geomagnetic latitude at 110 km altitude, -90.0 to 90.0, degrees	(float(i)/10.0) - 90.0	2
17	Corrected geomagnetic longitude at 110 km altitude, 0.0 to 360.0, degrees	float(i)/10.0	2
18	Invariant latitude, 0.0 to 90.0, degrees	float(i)/10.0	2
19	Altitude at the start of the minute, 400 to 500, nautical miles	float(i)	2
20	Altitude at the end of the minute, 400 to 500, nautical miles	float(i)	2
21	Northward component of model magnetic	(float(i)/10.0) - 70000.0	4

	field at satellite, -70000.0 to 70000.0, nT		
22	Eastward component of model magnetic field at satellite, -70000.0 to 70000.0, nT	(float(i)/10.0) - 70000.0	4
23	Downward component of model magnetic field at satellite, -70000.0 to 70000.0, nT	(float(i)/10.0) - 70000.0	4
24	Geographic x-component of satellite position unit vector, 0.0 to 1.0, unitless	(float(i)/100000.0) - 1.0	3
25	Geographic y-component of satellite position unit vector, 0.0 to 1.0, unitless	(float(i)/100000.0) - 1.0	3
26	Geographic z-component of satellite position unit vector, 0.0 to 1.0, unitless	(float(i)/100000.0) - 1.0	3
27	Potential control model flag, 0 for vbias or 1 for senpot		1
28	Potential difference between spacecraft and electron probe ground, -3 to 28, volts	i-10	1
29	Potential difference between ion array and electron probe ground, -3 to 0, volts	i-3	1
30	Drift meter repeller grid functions, 0 to 16, unitless		1
31	Scintillation meter filter range commands, 0 to 16, unitless		1
32	No. of seconds of data for this minute, 1 to 60, unitless		1
33	Second of minute, 0 to 59, seconds		1
34	1^{st} filter value for 1^{st} second of data, #/cm^3	10^(float(i)/1000.0)	2
35	2^{nd} filter value for 1^{st} second of data, #/cm^3	10^(float(i)/1000.0)	2
36	3^{rd} filter value for 1^{st} second of data, #/cm^3	10^(float(i)/1000.0)	2
37	4^{th} filter value for 1^{st} second of data, #/cm^3	10^(float(i)/1000.0)	2
38	5^{th} filter value for 1^{st} second of data, #/cm^3	10^(float(i)/1000.0)	2
39	6^{th} filter value for 1^{st} second of data, #/cm^3	10^(float(i)/1000.0)	2
40	7^{th} filter value for 1^{st} second of data, #/cm^3	10^(float(i)/1000.0)	2
41	8^{th} filter value for 1^{st} second of data, #/cm^3	10^(float(i)/1000.0)	2
42	9^{th} filter value for 1^{st} second of data, #/cm^3	10^(float(i)/1000.0)	2
43	1-sec average of ion density for 1^{st} second of data, #/cm^3	10^(float(i)/10000.0)	2
44	Variance of ion density for 1^{st} second of data, #/cm^3	10^(float(i)/10000.0)	2
45	Zero fill		9
46-58	Repeat of words 33-45 for the next second of minute		32
59-71	Repeat of words 33-45 for the next second of minute		32
.. ..	.. ..		
800-812	Repeat of words 33-45 for the last second of minute		28
813-	Repeat of words 1-812 for the next minute		1992

1624	of data		
1625-2436	Repeat of words 1-812 for the next minute of data		1992
.. ..	.. ..		

Each filter value is proportional to the log of the RMS of 1-second of ion density measurements. For SSIES there are 9 filter values and for SSIES2/SSIES3 there are 6 filter values. The frequency ranges for each filter are provided in Table 14. The filter data is generally considered unusable.

Table 14: SM filter frequency ranges

Filter #	Frequency Range (SSIES)	Frequency Range (SSIES2/SSIES3)
1	12 - 26 Hz	12 - 29 Hz
2	26 - 56 Hz	29 - 69 Hz
3	56 - 120 Hz	69 - 166 Hz
4	120 - 260 Hz	166 - 398 Hz
5	260 - 560 Hz	398 - 956 Hz
6	560 - 1200 Hz	956 - 2293 Hz
7	1.2 - 2.6 kHz	NA
8	2.6 - 5.6 kHz	NA
9	5.6 - 12 kHz	NA

Table 15 below is a listing of the currently available (as of 1 Jan 2014) DMSP SSIES scintillation meter data files listed by spacecraft with the total number of available data files shown in parentheses. The data base contains a total of 24734 SSIES scintillation meter data files for spacecraft F8 through F15 spanning from June 1987 through the present. Figure 11 below shows the same information graphically.

Table 15: Listing of available DMSP SSIES scintillation meter data files

F15	12/16/1999-07/03/2012, 07/05/2012-04/08/2013, 04/13/2013-01/01/2014 (5126)
F14	04/28/1997-08/23/2008 (4136)
F13	03/29/1995-11/18/2009 (5349)
F12	09/03/1994-03/02/1995, 03/11/1995-05/12/1997, 05/20/1997, 05/22/1997-08/10/1997, 08/13/1997-08/23/1997, 08/28/1997-01/30/2002, 02/01/2002-02/03/2002, 02/05/2002-02/07/2002, 02/09/2002-02/19/2002, 02/21/2002-02/26/2002, 02/28/2002, 03/02/2002-03/03/2002, 03/05/2002-04/01/2002, 04/03/2002, 04/05/2002-04/13/2002, 04/15/2002, 04/17/2002, 04/19/2002-04/23/2002, 04/25/2002, 04/27/2002-05/10/2002, 05/13/2002-05/25/2002, 05/28/2002-05/30/2002, 06/02/2002-06/10/2002, 06/12/2002, 06/14/2002-06/22/2002, 06/25/2002-06/28/2002, 06/30/2002-07/01/2002, 07/03/2002-07/12/2002, 07/14/2002-07/18/2002, 07/20/2002-07/27/2002 (2835)
F11	12/03/1991-12/16/1991, 12/18/1991-03/02/1995, 03/08/1995-04/24/1995, 12/24/1997-12/27/1997, 01/01/1998-01/19/1998, 01/30/1998-02/06/1998, 02/09/1998-04/04/1998, 04/06/1998-05/04/1998, 05/06/1998-05/08/1998, 05/11/1998-06/10/1999, 01/13/2000-05/16/2000 (1872)
F10	12/07/1990-12/08/1990, 12/19/1990-02/23/1991, 02/25/1991-10/19/1991, 10/21/1991-04/20/1993, 04/22/1993-09/26/1994 (1377)
F09	02/08/1988-02/17/1988, 02/19/1988-03/30/1988, 04/01/1988-01/20/1990, 01/22/1990-

	03/30/1990, 04/01/1990-02/27/1992, 02/29/1992-03/31/1992 (1509)
F08	06/25/1987-07/10/1987, 08/27/1987-11/05/1987, 11/07/1987-06/27/1993, 07/15/1993-08/01/1994 (2530)

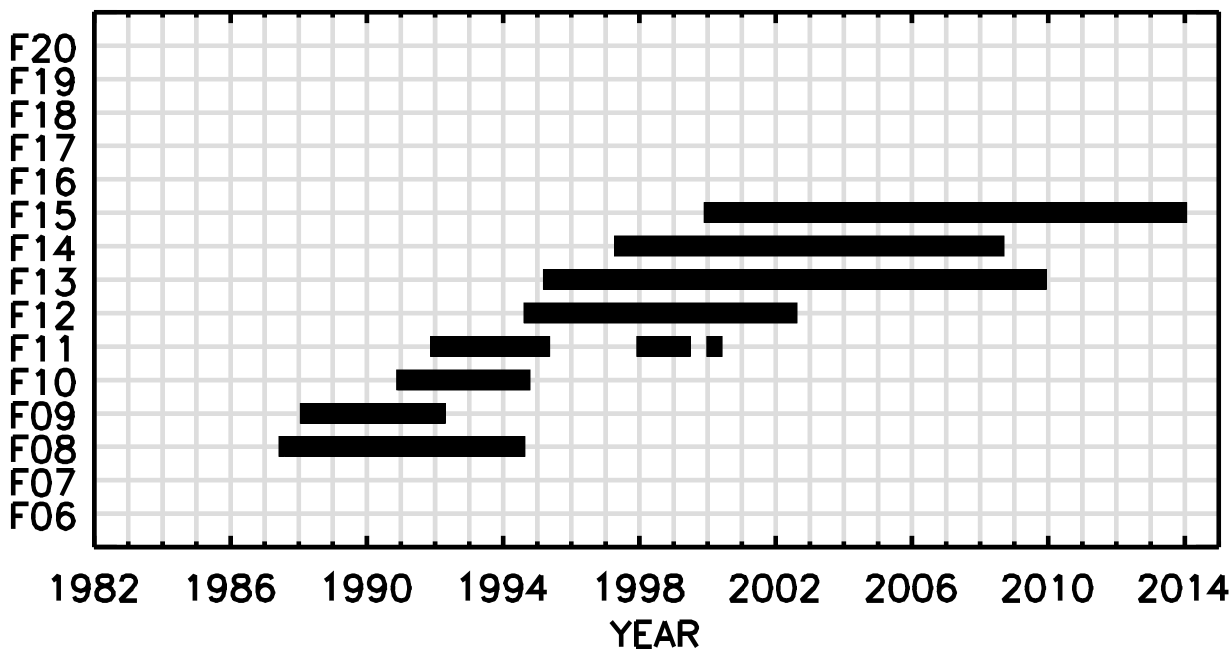

Figure 11: Graphical display of available DMSP SSIES scintillation meter data files

Additional information about the sensors or the meaning of the values contained within the files can be found in the "Further Reading" section at the end of this document.

2.8 The SSM Magnetometer Data Files

The F07 magnetometer data files use the following naming convention:

m**YYMMDD**.dat

where the bold characters are variable and the other (not bold) characters remain fixed. The bold characters have the following meaning:

YY = 2 digit year
MM = 2 digit month
DD = 2 digit day of month

For example, the data file m850814.dat would be the magnetometer data for F07 for 14 August 1985. The magnetometer data files are ASCII data files organized in line format. Each line is 120 characters long, padded with blank spaces when needed, and ending with either '*::::' or '::::'. Missing data are filled with -1000000. Table 16 gives a description of the contents of each line contained in the file.

Table 16: File format description for the SSM magnetometer data files (F07)

Line	Description	Format
1	"NO.MIN JDAY YEAR, SPACECRAFT COORDINATES *::::"	A120
2	This line contains 3 values for the: 1. Number of minutes (N) of data in the following block of data 2. Day of year 3. 2 digit year	4X, I3, 2X, I3, 3X, I2, A103
3	" TIME(SEC) GEOLAT GEOLONG GMAGLAT GMAGLONG MAG.L.T. NO.SEC. TIME(SEC) ALTITUDE BX-MODEL BY-MODEL BZ-MODEL::::"	A120
4	This line contains 12 values for the: 1. Time (second of day) 2. Geographic latitude (degrees, north) 3. Geographic longitude (degrees, east) 4. Geomagnetic latitude (degrees, north) 5. Geomagnetic longitude (degrees, east) 6. Magnetic local time (hours) 7. Number of seconds (0-60) 8. Time (second of day) 9. Altitude (km) 10. Spacecraft coordinates x-component of model magnetic field 11. Spacecraft coordinates y-component of model magnetic field 12. Spacecraft coordinates z-component of model magnetic field	6X, I5, 5(4X, F6.3), 4X, I2, 4X, F6.0, 4X, F5.1, 3(3X, F7.0), A4
5	Repeat of line 4 for next minute of data	
.. ..	.. ..	
N+3	Repeat of line 4 for last minute of data	
N+4	" SEC DELTA-BX DELTA-BY DELTA-BZ SEC DELTA-BX DELTA-BY DELTA-BZ SEC DELTA-BX DELTA-BY DELTA-BZ *::::"	A120
N+5	This line contains 12 values for the first 3 seconds of : 1. Time (second of day) 2. Spacecraft coordinates x-component of measured minus model magnetic field 3. Spacecraft coordinates y-component of measured minus model magnetic field 4. Spacecraft coordinates z-component of measured minus model magnetic field 5. Time (second of day) 6. Spacecraft coordinates x-component of measured minus model magnetic field 7. Spacecraft coordinates y-component of measured minus model magnetic field	3(1x, I5, 3(1X, F9.0)), A12

	8. Spacecraft coordinates z-component of measured minus model magnetic field 9. Time (second of day) 10. Spacecraft coordinates x-component of measured minus model magnetic field 11. Spacecraft coordinates y-component of measured minus model magnetic field 12. Spacecraft coordinates z-component of measured minus model magnetic field	
N+6	Repeat of line N+5 for the next 3 seconds of data	
.. ..	.. ..	
21N-16	Repeat of line N+5 for the last 3 seconds of data	
21N-15	Repeat of lines 1 through 21N-16 for next block of data	
.. ..	.. ..	

Each repeating block of data in the data file contains N 1-minute values of ephemeris and model magnetic field values and 60*(N-1) 1-second values of the measured minus model magnetic field values. See comments below regarding coordinate system and data quality.

The F12 through F18 magnetometer data files use the following naming convention:

m**NNYYddd**.dat

where the bold characters are variable and the other (not bold) characters remain fixed. The bold characters have the following meaning:

NN = 2 digit spacecraft flight number (06 through 20)
YY = 2 digit year
ddd = 3 digit day of year

For example, the data file m1309199.dat would be the magnetometer data for F13 for 18 July 2009. The magnetometer data files are binary files with the data stored as a series of 32-bit signed integers. The data files were written using big endian encoding. Table 17 gives 1) a description of each variable contained in the file including the type of variable, expected range of the variable, and the variable units, 2) any conversion if necessary to convert the stored value to scientific units, and 3) the number of bytes used to store each data word. Missing seconds of data have the "second of day" (word 7) set equal to -1000.0 and the subsequent magnetic field values (words 8, 9 and 10) zero filled.

Table 17: File format description for the SSM magnetometer data files (F12-F18)

Word	Variable Description, Range, Units	Conversion	Bytes
1	Integer year, 1987 to 2049, years		4
2	Day of year, 1 to 366, days		4
3	Second of day for the 1st second of the 1st minute of data, 0 to 86400, seconds	float(i)/1000.0	4
4	Geodetic latitude, -90.0 to 90.0, degrees	(float(i)/100.0) - 90.0	4
5	Geographic longitude, 0.0 to 360.0, degrees	float(i)/100.0	4
6	Altitude, kilometers	float(i)/10.0	4
7	Second of day for the 1st second of data, 0 to 86400, seconds	float(i)/1000.0	4
8	Spacecraft coordinates x-component of measured minus model magnetic field, nT		4
9	Spacecraft coordinates y-component of measured minus model magnetic field, nT		4
10	Spacecraft coordinates z-component of measured minus model magnetic field, nT		4
11-14	Repeat of words 7-10 for next second of data		16
15-18	Repeat of words 7-10 for next second of data		16
.. ..	.. ..		
243-246	Repeat of words 7-10 for the last second of data		16
247	Spacecraft flight number, 6-20, unitless		4
248-494	Repeat of words 1-247 for next minute of data		988
495-741	Repeat of words 1-247 for next minute of data		988
.. ..	.. ..		

Spacecraft coordinates are defined where x is along the local vertical measured positive in the downward direction, z is perpendicular to both the local vertical and the spacecraft velocity vector measured positive in the anti-orbit normal direction (in approximately the anti-sunward direction), and y completes a right hand coordinate system with positive y in the same general direction as the spacecraft velocity direction. Note that the positive y direction is not the same as the spacecraft velocity direction because in general the spacecraft velocity vector is not perpendicular to the local vertical; however, the local vertical direction, the spacecraft velocity vector, and the y axis are always coplanar.

The magnetometers on F07 and F12-F14 were body mounted and the magnetic field measurements contained within those data files include satellite generated noise and artifacts. Many artifacts in the horizontal components have been removed by ground processing but many were not removed. The high frequency noise is reduced by using one second averages of the measurements. From F15 forward the magnetometers are boom mounted which reduced, but did not eliminate, the amount of satellite generated noise and artifacts in the measurements. Ground processing removed most of the artifacts in the horizontal components of the measurements and averaging over one second of data reduced the noise. Most of the artifacts not removed are in the auroral zone where variations due to auroral currents and spacecraft currents are not easily distinguished.

The SSM magnetometer data files from June 2001 to current are derived from the MFR files described in Section 2.11.

Table 18 below is a listing of the currently available (as of 1 Jan 2014) DMSP SSM magnetometer data files listed by spacecraft with the total number of available data files shown in parentheses. The data base contains a total of 26582 SSM magnetometer data files for spacecraft F07 from December 1983 through August 1987 and spacecraft F12 through F18 spanning from September 1994 through the present. Figure 12 below shows the same information graphically.

Table 18: Listing of available DMSP SSM magnetometer data files

F18	10/21/2009-01/01/2014 (1534)
F17	11/07/2006-01/01/2014 (2613)
F16	10/25/2003-01/01/2014 (3722)
F15	12/19/1999-10/15/2013 (5050)
F14	04/28/1997-11/13/2006, 11/15/2006-12/31/2006, 01/02/2007-08/23/2008 (4134)
F13	03/29/1995-08/30/2001, 09/02/2001-11/18/2009 (5347)
F12	09/04/1994-03/02/1995, 03/08/1995-05/12/1997, 05/20/1997, 05/22/1997-08/10/1997, 08/16/1997-01/28/2002, 01/30/2002-02/28/2002, 03/02/2002-04/01/2002, 04/04/2002-04/24/2002, 04/26/2002-05/23/2002, 05/25/2002, 05/27/2002-06/10/2002, 06/12/2002, 06/14/2002-06/15/2002, 06/17/2002-06/21/2002, 06/25/2002-06/28/2002, 06/30/2002-07/01/2002, 07/03/2002-07/12/2002, 07/14/2002, 07/16/2002-07/18/2002, 07/20/2002-07/27/2002 (2848)
F07	12/06/1983, 12/09/1983-12/12/1983, 12/18/1983, 12/20/1983-12/21/1983, 12/23/1983-12/24/1983, 12/30/1983-01/05/1985, 01/07/1985-04/03/1985, 04/05/1985-06/01/1985, 06/03/1985-07/08/1985, 07/10/1985-08/23/1985, 08/25/1985-09/09/1985, 09/11/1985-04/07/1986, 04/09/1986-05/02/1986, 05/04/1986-12/22/1986, 12/29/1986-03/06/1987, 03/08/1987-04/08/1987, 04/10/1987-06/04/1987, 06/06/1987-08/31/1987 (1334)

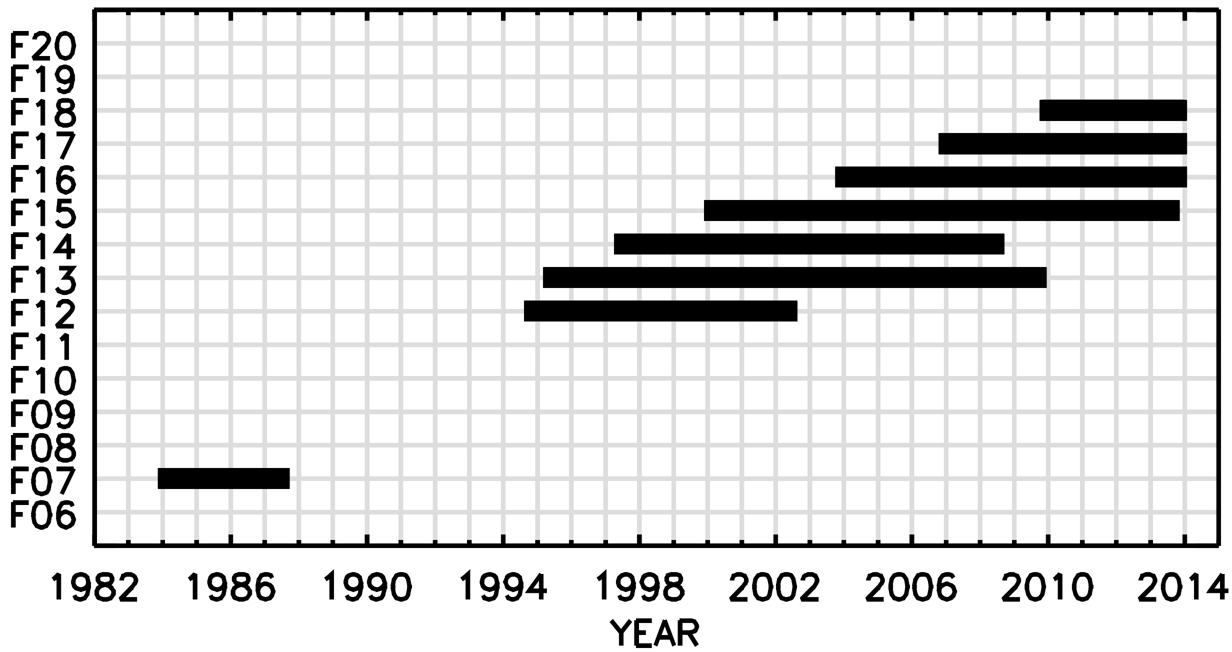

Figure 12: Graphical display of available DMSP SSM magnetometer data files

Additional information about the sensors or the meaning of the values contained within the files can be found in the "Further Reading" section at the end of this document.

2.9 The SSJ Data Files

The SSJ data files use the following naming convention:

j**n**f**NNYYddd**

where the bold characters are variable and the other (not bold) characters remain fixed. The bold characters have the following meaning:

n = 1 digit sensor number (either 4 or 5)
NN = 2 digit spacecraft flight number (06 through 20)
YY = 2 digit year
ddd = 3 digit day of year

For example, the data file j4f1309199 would be the SSJ4 data for F13 for 18 July 2009. The SSJ data files are binary files with the data stored as a series of 16-bit unsigned integers written using big endian encoding. Table 19 below gives 1) a description of each variable contained in the file including the type of variable, expected range of the variable, and the variable units, 2) any conversion if necessary to convert the stored value to scientific units, and 3) the number of bytes used to store each data word. Missing data are zero filled.

Table 19: File format description for the SSJ data files

Word	Variable Description, Range, Units	Conversion	Bytes
1	Day of year, 1 to 366, days		2
2	Hour of day, 0 to 23, hours		2
3	Minute of hour, 0 to 59, minutes		2
4	Second of minute, 0 to 59, seconds		2
5	Integer year, 1987 to 2049, years	i - 50	2
6	Geodetic latitude, -90.0 to 90.0, degrees	float(i-900)/10.0 if i > 1800 then float(i - 4995)/10.0	2
7	Geographic longitude, 0.0 to 360.0, degrees	float(i)/10.0	2
8	Altitude, nautical miles		2
9	Geographic latitude at 110 km altitude and on the same magnetic field line as the DMSP spacecraft, -90.0 to 90.0, degrees	float(i-900)/10.0 if i > 1800 then float(i - 4995)/10.0	2
10	Geographic longitude at 110 km altitude and on the same magnetic field line as the DMSP spacecraft, 0.0 to 360.0, degrees	float(i)/10.0	2
11	Corrected geomagnetic latitude at 110 km altitude, -90.0 to 90.0, degrees	float(i-900)/10.0 if i > 1800 then float(i - 4995)/10.0	2
12	Corrected geomagnetic longitude at 110 km altitude, 0.0 to 360.0, degrees	float(i)/10.0	2
13	Hour of magnetic local time, 0 to 23, hours		2
14	Minute of hour of magnetic local time, 0 to 59, minutes		2
15	Second of minute of magnetic local time, 0 to 59, seconds		2
16	Hour of day for 1st second of data, 0 to 23, hours		2
17	Minute of hour for 1st second of data, 0 to 59, minutes		2
18	Second of minute for 1st second of data, 0 to 60, seconds	If word 2596 equals 1 then float(i)/1000.0	2
19	channel 4, 9450 eV electrons, raw data	See below	2
20	channel 3, 13900 eV electrons, raw data	See below	2
21	channel 2, 20400 eV electrons, raw data	See below	2
22	Channel 1, 30000 eV electrons, raw data	See below	2
23	channel 8, 2040 eV electrons, raw data	See below	2
24	channel 7, 3000 eV electrons, raw data	See below	2
25	channel 6, 4400 eV electrons, raw data	See below	2
26	channel 5, 6460 eV electrons, raw data	See below	2
27	channel 12, 646 eV electrons, raw data	See below	2
28	channel 11, 949 eV electrons, raw data; or status word 1 if SSJ5 data	See below	2

29	channel 10, 949 eV electrons, raw data	See below	2
30	channel 9, 1392 eV electrons, raw data	See below	2
31	channel 16, 139 eV electrons, raw data	See below	2
32	channel 15, 204 eV electrons, raw data	See below	2
33	channel 14, 300 eV electrons, raw data	See below	2
34	channel 13, 440 eV electrons, raw data	See below	2
35	channel 20, 30 eV electrons, raw data	See below	2
36	channel 19, 44 eV electrons, raw data	See below	2
37	channel 18, 65 eV electrons, raw data	See below	2
38	channel 17, 95 eV electrons, raw data	See below	2
39	channel 4, 9450 eV ions, raw data	See below	2
40	channel 3, 13900 eV ions, raw data	See below	2
41	channel 2, 20400 eV ions, raw data	See below	2
42	channel 1, 30000 eV ions, raw data	See below	2
43	channel 8, 2040 eV ions, raw data	See below	2
44	channel 7, 3000 eV ions, raw data	See below	2
45	channel 6, 4400 eV ions, raw data	See below	2
46	channel 5, 6460 eV ions, raw data	See below	2
47	channel 12, 646 eV ions, raw data	See below	2
48	channel 11, 949 eV ions, raw data; or status word 2 if SSJ5 data	See below	2
49	channel 10, 949 eV ions, raw data	See below	2
50	channel 9, 1392 eV ions, raw data	See below	2
51	channel 16, 139 eV ions, raw data	See below	2
52	channel 15, 204 eV ions, raw data	See below	2
53	channel 14, 300 eV ions, raw data	See below	2
54	channel 13, 440 eV ions, raw data	See below	2
55	channel 20, 30 eV ions, raw data	See below	2
56	channel 19, 44 eV ions, raw data	See below	2
57	channel 18, 65 eV ions, raw data	See below	2
58	channel 17, 95 eV ions, raw data	See below	2
59-101	Repeat of words 16-58 for 2nd second of data		86
102-144	Repeat of words 16-58 for 3rd second of data		86
.. ..	.. ..		
2553-2595	Repeat of words 16-58 for 60th second of data		86
2596	Set to 1 to indicate that word 18 is in milliseconds, 0 or 1, unitless		2
2597-2640	Zero fill		88
2641-5280	Repeat of words 1-2640 for 2nd minute of data		5280
5281-	Repeat of words 1-2640 for 3rd minute of		5280

7920-	data		
.. ..	.. ..		

Table 20 and Table 21 below describe the meaning of the bits in status word 1 and status word 2 respectively (for the SSJ5 instrument only).

Table 20: SSJ5 sensor status word 1 description

Bit	Description
0	Boundary Detect: This bit is set to 1 if an equatorward boundary is detected. This bit remains set for 60 seconds.
1	Mode 2 Select: Indicates the logic level of the mode 2 select line from the OLS. Logical 0/1 denotes low/high voltage bias select.
2	Mode 1 Select: Indicates the logic level of the mode 1 select line from the OLS. Logical 0/1 denotes Format A/B.
3-5	Parameter Address: Indicates what is stored in bits 0-7 of status word 2.
6-8	Zone Address: In Format B the value indicates the zone, 1-6, the data came from. In format A the value is zero.
9-15	Zero fill

Table 21: SSJ5 sensor status word 2 description

Bit	Description
If the Parameter Address (bits 3-5) in status word 1 is zero	
0-2	Ion MicroChannel Plate (MCP) Bias Control: When the parameter address in status word 1 is 0 then this value is the current step of the ion MCP bias supply, ranging in value from 0 to 7.
3-5	Electron MicroChannel Plate (MCP) Bias Control: When the parameter address in status word 1 is 0 then this value is the current step of the electron MCP bias supply, ranging in value from 0 to 7.
6	Test Pulse: Set to 1 to indicate that test pulses are being injected into the preamplifiers. This bit remains set for 30 seconds.
7	Watch Dog: Set to 1 to indicate that the watch dog timer has reset the processing unit. This bit remains active for 60 seconds.
If the Parameter Address (bits 3-5) in status word 1 is nonzero	
0-7	Parameter Value: Values set in the parameter table by the ‘set parameter’ command.
8	Isotropy Detect: Set to 1 if the measured flux is isotropic.
9-15	Zero fill

The sensor counts have been log-compressed and stored as a 5 bit mantissa and a 4 bit exponent to fit within a 9 bit data word for transmission to the ground. This 9 bit data word has been stored as a 16 bit unsigned integer in the 1-day binary data files. The raw data stored in the data files can be decompressed to counts using

$$counts = (X + 32)2^Y - 33$$

where X is bits 0-4 (the first 5 least significant bits) and Y is bits 5-8 (the next 4 least significant bits) of the 16 bit integer stored in the data file. If the sensor channel raw data are read as a 16 bit unsigned integer, I, then X and Y can be computed as

$$X = I \; modulo \; 32$$

and

$$Y = \frac{I - X}{32}$$

where X and Y are both integers (e.g. if I = 4, then X = 4, Y = 0, and counts = 3; or if I = 34 then X = 2, Y = 1, and counts = 35.). Missing data are zero filled with a raw data value of 0 decompressing to a value of -1 indicating no measurement was made, a raw data value of 1 decompresses to zero meaning a measurement was made but no counts were detected, a raw data value of 2 decompresses to 1 count, etc.

Sensor counts can be converted to the geophysical quantities of differential number flux (J_i), differential energy flux (JE_i), integrated number flux (J), integrated energy flux (JE), and mean energy (E_{avg}) according to

$$\mathrm{J}_i = \frac{C_i}{G_i \cdot \Delta t}$$

$$\mathrm{JE}_i = \mathrm{J}_i E_i$$

$$\mathrm{J} = \sum_i \mathrm{J}_i \Delta E_i$$

$$\mathrm{JE} = \sum_i \mathrm{JE}_i \Delta E_i$$

$$\mathrm{E}_{avg} = \frac{JE}{J}$$

where C_i is the number of counts measured in channel i, G_i is the appropriate ion or electron channel geometric factor, Δt is the accumulation time (0.098 sec for the SSJ4 sensor, and 0.05 sec for the SSJ5 sensor), E_i is the channel central energy, and ΔE_i is the channel spacing for calculating the integrated quantities. Values for E_i, ΔE_i, and G_i are provided in Table 22, Table 23, Table 24, Table 25, Table 26, Table 27, and Table 28 below. The formula presented here for the integrated number flux and the integrated energy flux are quick methods which are often used for looking at the SSJ data. Other methods could be used such as fitting the data to a Kappa distribution.

Table 22: SSJ sensor values for the channel central energy (E_i) and channel spacing (ΔE_i)

Channel	1	2	3	4	5	6	7	8	9	10
E_i (eV)	30000	20400	13900	9450	6460	4400	3000	2040	1392	949
ΔE_i (eV)	9600	8050	5475	3720	2525	1730	1180	804	545.5	373
Channel	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
E_i (eV)	949	646	440	300	204	139	95	65	44	30
ΔE_i (eV)	373	254.5	173	118	80.5	54.5	37	25.5	17.5	14

Table 23: SSJ sensor values for the electron channels geometric factors (G_i) for F6 through F10

Electron channels geometric factors ($cm^2 \cdot eV \cdot ster$)					
Channel	**F6**	**F7**	**F8**	**F9**	**F10**
1	0.75	0.58	0.326	0.201	0.462
2	0.49	0.49	0.275	0.17	0.389
3	0.41	0.41	0.23	0.142	0.302
4	0.33	0.33	0.185	0.115	0.243
5	0.27	0.27	0.152	0.0937	0.194
6	0.21	0.21	0.118	0.0729	0.158
7	0.16	0.16	0.0899	0.0555	0.126
8	0.13	0.13	0.073	0.0451	0.102
9	0.096	0.096	0.0539	0.0333	0.0824
10	0.076	0.076	0.0427	0.0264	0.0669
11	0.0157	0.032	0.03163	0.03688	0.05206
12	0.01122	0.02424	0.02402	0.02797	0.03714
13	0.008974	0.01939	0.01917	0.02234	0.02506
14	0.005721	0.01261	0.01245	0.01455	0.0174
15	0.003814	0.008824	0.008737	0.01014	0.01219
16	0.002243	0.005624	0.005564	0.006467	0.006839
17	0.001122	0.003297	0.003261	0.003801	0.003697
18	0.0005609	0.001939	0.001917	0.002234	0.001952
19	0.0002243	0.001067	0.001057	0.001229	0.0009389
20	0.00007067	0.0005527	0.0005465	0.0006363	0.0003628

Table 24: SSJ sensor values for the electron channels geometric factors (G_i) for F11 through F15

Electron channels geometric factors ($cm^2 \cdot eV \cdot ster$)					
Channel	**F11**	**F12**	**F13**	**F14**	**F15**
1	0.631	0.4552	0.456	0.334	0.3124
2	0.544	0.3815	0.362	0.272	0.2528
3	0.428	0.3188	0.287	0.222	0.2046
4	0.349	0.2661	0.228	0.181	0.1657
5	0.278	0.2232	0.181	0.148	0.1341
6	0.226	0.1858	0.144	0.121	0.1086
7	0.182	0.1561	0.114	0.0985	0.0879
8	0.149	0.1297	0.0908	0.0803	0.07116
9	0.121	0.1088	0.0721	0.0656	0.0576
10	0.095	0.09103	0.0572	0.0535	0.04662
11	0.1092	0.06909	0.03644	0.03939	0.05072
12	0.07788	0.04888	0.02615	0.02828	0.03647
13	0.05345	0.03279	0.01777	0.0193	0.02488
14	0.03585	0.02248	0.01232	0.01345	0.01733
15	0.0246	0.01536	0.008563	0.009314	0.01205
16	0.01391	0.008516	0.004827	0.005287	0.006807
17	0.007392	0.004523	0.002598	0.002839	0.003672
18	0.003907	0.002338	0.001359	0.001488	0.001928
19	0.001846	0.001094	0.0006463	0.0007104	0.0009189
20	0.0006987	0.0004161	0.0002496	0.0002746	0.000356

Table 25: SSJ sensor values for the electron channels geometric factors (G_i) for F16 through F20

Electron channels geometric factors ($cm^2 \cdot eV \cdot ster$)					
Channel	**F16**	**F17**	**F18**	**F19**	**F20**
1	1.781	1.044	0.725	3.735	2.992
2	1.477	0.808	0.534	2.885	2.101
3	1.188	0.602	0.412	2.196	1.532
4	0.935	0.458	0.315	1.615	1.080
5	0.722	0.349	0.266	1.170	0.782
6	0.551	0.262	0.199	0.832	0.539
7	0.416	0.191	0.147	0.605	0.389
8	0.306	0.142	0.107	0.418	0.295
9	0.225	0.103	0.0803	0.280	0.186
10	0.166	0.0727	0.0562	0.197	0.128
11	-	-	-	-	-
12	0.123	0.0541	0.041	0.134	0.0825
13	0.0876	0.0394	0.0296	0.0958	0.0516
14	0.0613	0.0276	0.0203	0.0640	0.0351
15	0.0429	0.0188	0.014	0.0445	0.0235
16	0.0289	0.0134	0.0104	0.0312	0.0175
17	0.0182	0.00901	0.00708	0.0204	0.00975
18	0.0113	0.00645	0.00562	0.00830	0.00723
19	0.00621	0.00445	0.00386	0.00222	0.00410
20	0.00307	0.00294	0.00239	0.000639	0.00193

Table 26: SSJ sensor values for the ion channels geometric factors (G_i) for F6 through F10

Ion channels geometric factors ($cm^2 \cdot eV \cdot ster$)					
Channel	**F6**	**F7**	**F8**	**F9**	**F10**
1	1.8	2.4	1.15	1.14	0.567
2	1.25	1.667	0.8012	0.7939	0.4032
3	0.8439	1.146	0.5512	0.5459	0.2709
4	0.573	0.7814	0.3761	0.372	0.1823
5	0.3959	0.5418	0.2605	0.2584	0.124
6	0.2709	0.3647	0.175	0.174	0.08523
7	0.1875	0.2501	0.1198	0.1188	0.05772
8	0.125	0.1771	0.08512	0.08439	0.03938
9	0.08439	0.1146	0.05512	0.05459	0.02678
10	0.05835	0.07918	0.03803	0.03772	0.01844
11	2.437	2.058	1.096	1.266	0.5549
12	1.589	1.372	0.7315	0.8411	0.3755
13	1.483	0.9603	0.5123	0.589	0.2548
14	0.8369	0.6467	0.3445	0.3962	0.1739
15	0.5827	0.4507	0.2399	0.2765	0.1196
16	0.392	0.3038	0.1619	0.1859	0.08097
17	0.2649	0.2058	0.1096	0.1266	0.05549
18	0.1907	0.147	0.07838	0.09015	0.03821
19	0.1271	0.09799	0.05222	0.06007	0.02636
20	0.08475	0.06859	0.03653	0.04206	0.01794

Table 27: SSJ sensor values for the ion channels geometric factors (G_i) for F11 through F15

Ion channels geometric factors (cm^2·eV·ster)					
Channel	**F11**	**F12**	**F13**	**F14**	**F15**
1	0.549	0.706	0.984	1.33	0.9016
2	0.397	0.5022	0.6981	0.9408	0.6392
3	0.2709	0.3428	0.4761	0.6397	0.435
4	0.1844	0.2344	0.324	0.4355	0.296
5	0.1261	0.1594	0.2209	0.2959	0.2014
6	0.08585	0.1094	0.1511	0.2011	0.1371
7	0.05876	0.07449	0.1027	0.1365	0.09328
8	0.04032	0.05084	0.07001	0.09314	0.06347
9	0.02771	0.03469	0.04772	0.06335	0.0432
10	0.01844	0.02375	0.03251	0.04303	0.02939
11	0.5818	0.639	0.05572	1.008	0.9439
12	0.4065	0.4371	0.03798	0.6877	0.6443
13	0.2787	0.2988	0.02602	0.4705	0.4398
14	0.1939	0.2051	0.01778	0.3206	0.3002
15	0.1324	0.1402	0.01214	0.2196	0.2049
16	0.09093	0.096	0.008305	0.1499	0.1398
17	0.0612	0.06566	0.005679	0.1021	0.09454
18	0.04308	0.04499	0.003869	0.0697	0.06515
19	0.02973	0.03084	0.002651	0.04763	0.04447
20	0.02056	0.02098	0.00181	0.03253	0.03035

Table 28: SSJ sensor values for the ion channels geometric factors (G_i) for F16 through F20

Ion channels geometric factors ($cm^2 \cdot eV \cdot ster$)					
Channel	**F16**	**F17**	**F18**	**F19**	**F20**
1	13.3	5.71	10.6	3.60	7.06
2	8.51	3.81	6.9	2.29	4.80
3	5.43	2.54	4.51	1.45	3.26
4	3.43	1.7	2.81	0.913	2.06
5	2.19	1.13	1.82	0.556	1.53
6	1.4	0.715	1.19	0.360	0.988
7	0.903	0.47	0.774	0.240	0.650
8	0.575	0.306	0.485	0.156	0.416
9	0.368	0.199	0.296	0.0966	0.275
10	0.244	0.122	0.208	0.0603	0.171
11	-	-	-	-	-
12	0.162	0.0899	0.15	0.0369	0.102
13	0.105	0.0581	0.105	0.0237	0.0718
14	0.0718	0.0307	0.0725	0.0124	0.0454
15	0.0505	0.017	0.0448	0.00855	0.0214
16	0.0342	0.0101	0.0324	0.00590	0.0188
17	0.023	0.005	0.0215	0.00436	0.0144
18	0.0157	0.00302	0.0113	0.00258	0.0113
19	0.00745	0.00158	0.00448	0.00156	0.00709
20	0.00394	0.000911	0.00182	0.000929	0.00385

Table 29 below is a listing of the currently available (as of 1 Jan 2014) DMSP SSJ data files listed by spacecraft with the total number of available data files shown in parentheses. The data base contains a total of 34251 SSJ data files for spacecraft F6 through F18 spanning from December 1982 through the present. Figure 13 below shows the same information graphically.

Table 29: Listing of available DMSP SSJ data files

F18	10/21/2009-01/01/2014 (1534)
F17	11/07/2006-01/01/2014 (2613)
F16	10/24/2003-01/01/2014 (3723)
F15	12/17/1999-03/25/2009 (3387)
F14	04/28/1997-09/29/2005, 12/08/2005, 01/19/2006, 02/07/2006, 02/22/2006, 11/02/2006 (3082)
F13	03/29/1995-11/18/2009 (5349)
F12	09/03/1994-09/06/1994, 11/29/1994-11/30/1994, 12/16/1994-03/02/1995, 03/08/1995-05/12/1997, 05/20/1997, 05/22/1997-05/23/1997, 05/25/1997-08/10/1997, 08/12/1997-08/24/1997, 08/28/1997-02/07/2002, 02/09/2002-04/01/2002, 04/03/2002-04/13/2002, 04/15/2002, 04/17/2002-04/25/2002, 04/27/2002-05/10/2002, 05/12/2002-05/31/2002, 06/02/2002-06/12/2002, 06/14/2002-06/22/2002, 06/25/2002-06/28/2002, 06/30/2002-07/01/2002, 07/03/2002-07/27/2002, 08/02/2002-08/03/2002 (2759)
F11	12/03/1991-10/26/1992, 11/03/1992-03/02/1995, 03/08/1995-04/24/1995, 05/28/1997-06/23/1999, 01/01/2000-05/16/2000 (2121)
F10	12/07/1990-12/08/1990, 12/19/1990-02/23/1991, 02/25/1991-10/26/1992, 11/03/1992-09/26/1994, 10/03/1994-03/02/1995, 03/08/1995-06/21/1997, 06/30/1997-11/14/1997 (2498)
F09	02/08/1988-02/17/1988, 02/19/1988-02/27/1992, 02/29/1992-04/01/1992, 04/03/1992-04/04/1992 (1515)
F08	06/25/1987-07/16/1987, 07/22/1987-11/05/1987, 11/07/1987-10/26/1992, 11/03/1992-06/27/1993, 07/14/1993-08/01/1994 (2566)
F07	11/24/1983-01/29/1985, 02/01/1985-10/12/1985, 10/16/1985-12/22/1986, 12/29/1986-03/06/1987, 03/08/1987-10/16/1987, 11/08/1987-01/25/1988, 04/25/1988-04/26/1988 (1492)
F06	12/28/1982-01/30/1983, 02/01/1983-09/15/1983, 10/01/1983-10/28/1983, 11/01/1983-01/29/1985, 02/02/1985-07/30/1985, 08/01/1985-08/31/1985, 09/21/1985, 09/23/1985-09/25/1985, 09/27/1985, 10/01/1985-10/12/1985, 10/16/1985-12/22/1986, 12/25/1986, 12/29/1986-07/22/1987 (1612)

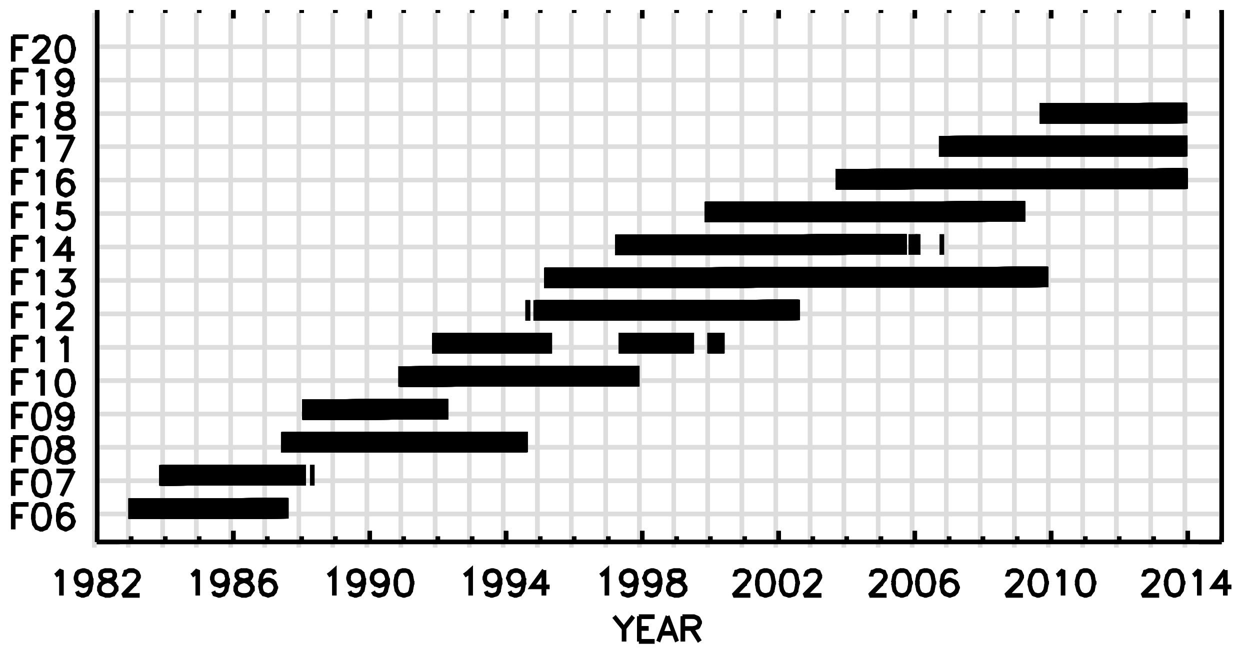

Figure 13: Graphical display of available DMSP SSJ data files

Additional information about the sensors or the meaning of the values contained within the files can be found in the "Further Reading" section at the end of this document.

2.10 The SSIES Environmental Data Record (EDR) Data Files

The SSIES EDR data files use the following naming convention:

PS.CKGWC_SC.U_DI.A_GP.SIES**n**-F**NN**-R99990-B9999090-APGA_AR.GLOBAL_DD.**YYYYMMDD**_TP.**HHMMSS-hhmmss**_DF.EDR

where the bold characters are variable and the other (not bold) characters remain fixed. The bold characters have the following meaning:

n = 1 digit sensor number (either 2 or 3)
NN = 2 digit spacecraft flight number (06 through 20)
YYYYMMDD = 4 digit year, 2 digit month, and 2 digit day
HHMMSS = 2 digit hour, 2 digit minute, and 2 digit second for start time of file
hhmmss = 2 digit hour, 2 digit minute, and 2 digit second for end time of file

For example, the data file PS.CKGWC_SC.U_DI.A_GP.SIES3-F16-R99990-B9999090-APGA_AR.GLOBAL_DD.20090718_TP.000001-235959_DF.EDR would be the SSIES EDR data for F16 for 18 July 2009. The EDR data files are ASCII data files organized in line format. Table 30 below gives a description of the contents of each line contained in the file. Missing data are filled with -0.10000E+38 for floating point values and 99999 for integer values. The data file is organized in repeating 1-minute blocks of data.

Table 30: File format description for the SSIES EDR data files

Line	Description	Format
1	Blank line	
2	"RECORD, EDR OF RECORD, DMSP #, DATE, TIME" and if first record of file then followed by software version information	A
3	This line contains 5 values for the: 1. Number of the record in the binary file from where this EDR was taken. 2. Number of the EDR within the record in the binary file (1-3). 3. Satellite Flight ID (two digit integer) 4. Date (YYYYMMDD, integer) 5. Time (HHMM, integer)	I4, 1X, I2, 1X, I3, 1X, I9, 1X, I5
4	"EPHEMERIS"	A
5	This line contains 6 values pertaining to the spacecraft location at time HHMM00 for the: 1. Geographic latitude (degrees, north) 2. Geographic longitude (degrees, east) 3. Apex latitude (degrees, north) 4. Apex longitude (degrees, east) 5. Apex local time (hours) 6. Satellite altitude (km)	4(F9.4, 1X), F13.9, 1X, F8.3
6	Location information valid for HHMM20. Same values as in line 5.	4(F9.4, 1X), F13.9, 1X, F8.3
7	Location information valid for HHMM40. Same values as in line 5.	4(F9.4, 1X), F13.9, 1X, F8.3
8	"SATELLITE POTENTIAL, LAST = SOURCE"	A
9	1-8 of 15 values for the satellite potential (Vbias+VIP) in volts every 4 seconds for times HHMM00, HHMM04, HHMM08, etc.	8(E12.5, 1X)
10	9-15 of 15 values for the satellite potential (Vbias+VIP) in volts every 4 seconds, and an integer (1-2) indicating the satellite potential source where: 1 - as set by the on-board microprocessor 2 - as set by the SENPOT sensor	8(E12.5, 1X), I2
11	"PRIMARY PLASMA DENSITY, THEN SOURCE"	A
12-21	One-second averages of the primary plasma density (#/cm^3) for times HHMM00 through HHMM59 with 6 values per line and 60 values total.	6(E12.5, 1X)
22	An integer (1-3) indicating the plasma density source where: 1 - Ion density from SM sensor 2 - Ion density from DM sensor 3 - Electron density from EP sensor (DC Mode)	I2
23	"HORIZONTAL ION DRIFT VELOCS"	A
24-33	One-second values for the horizontal drift speed (m/s) for times HHMM00 through HHMM59 with 6 values per line and 60 values total.	6(E12.5, 1X)
34	"VERTICAL ION DRIFT VELOCS"	A
35-44	One-second values for the vertical drift speed (m/s) for times	6(E12.5, 1X)

	HHMM00 through HHMM59 with 6 values per line and 60 values total.	
45	"CKL ANALYSES, THEN SOURCE"	A
46	This line contains 4 values for the 1. CKL Analysis: (RMS ΔN)/N (%) for HHMM05 2. CKL Analysis: T1 for HHMM05 3. CKL Analysis: p1for HHMM05 4. CKL Analysis: CKL for HHMM05	4(E12.5, 1X)
47	CKL Analysis: Decimated power density spectrum (PDS) for time period centered on HHMM05. 1-8 of 15 values.	8(E12.5, 1X)
48	CKL Analysis: Decimated power density spectrum (PDS) for time period centered on HHMM05 continued. 9-15 of 15 values.	7(E12.5, 1X), I2
49-51	CKL Analysis for HHMM15 in same format as lines 46-48.	
52-54	CKL Analysis for HHMM25 in same format as lines 46-48.	
55-57	CKL Analysis for HHMM35 in same format as lines 46-48.	
58-60	CKL Analysis for HHMM45 in same format as lines 46-48.	
61-63	CKL Analysis for HHMM55 in same format as lines 46-48.	
64	An integer (1-3) indicating data source used for CKL calculation where: 1 - SM density data only 2 - SM density and filter data 3 - EP DC mode density data	I2
If EP Mode value on line 112 is 0, 1, 2, or 6 then		
65	"EP SWEEP ANALYSES SETS"	A
66-80	EP Sweep analyses (every 4 seconds). There are 15 EP sweep analysis sets. Each is valid for either 4 (modes A, B and BS) or 2 (mode E) seconds centered on the time specified in the set. Each analysis set contains the following parameters: 1: Sweep center time (UT, seconds) (integer) 2: Electron density (el/cm^3) 3: Electron temperature (degrees K) 4: Satellite potential (volts) 5: Analysis qualifier (integer). Set to zero if the on-board microprocessor did not perform the analysis, per the flag in element 415. If the on-board microprocessor was in use, then it is set to the MP EP flags word from Word 11 of Cycle 1 in the telemetry. This word can also be zero. 6: EP photo-electron surrogate value.	I6, 1X, 3(E12.5, 1X), I3, 1X, E12.5
If EP Mode value on line 112 is 3, 4, or 5 then		
65	"EP AVERAGE DENSITIES"	A
66-75	EP one-second average densities (Modes C, D and DS) (el/cm^3) with 6 values per line and 60 values total.	6(E12.5, 1X)
76	"EP SWEEP ANALYSES SETS"	A
77-80	EP sweep analyses (up to three) structured as above in sweep modes, plus one line of invalid values to maintain spacing.	I6, 1X, 3(E12.5, 1X), I3, 1X, E12.5
81	"EP ANALYSES SOURCE"	A

82	An Integer (1-2) indicating EP analysis source where 1 – Ground processing analysis 2 – On-board microprocessor analysis	I2
83	“RPA SWEEP ANALYSES SETS, THEN SOURCE”	A
84-98	RPA Sweep analyses (every 4 seconds). There are 15 RPA sweep analysis sets. Each is valid for the 4 seconds centered on the time specified in the set. Each analysis set contains the following parameters: 1: Sweep center time (UT, seconds) (integer) 2: O^+ density (ion/cm3) 3: Total (H^+ + He^+) density (ion/cm3) 4: Light ion flag (integer) 0 - No light ion 1 - Light ion is H^+ 2 - Light ion is He^+ 3± = 3 + 10000 x (H^+ fraction) 5: Ion temperature (degrees K) 6: Ram ion drift velocity (m/s) 7: Analysis qualifier (integer) 0 - Analysis terminated unsuccessfully 1 - Successful analysis 8: RPA-derived total ion density Note some records may only have valid values for field 1 and 8; these will have a value of 0 in field 7.	I6, 1X, 2(E12.5, 1X), I6, 1X, 2(E12.5, 1X), I1, 1X, E12.5
99	An integer (1-2) indicating RPA analysis source where: 1 - Ground processing analysis 2 - On-board microprocessor analysis	I2
100	“DM ION DENSITY”	A
101-110	DM one-second average ion density (ion/cm^3) with 6 values per line and 60 values total.	6(E12.5, 1X)
111	“ENGINEERING DATA”	A
112	1: Unused 2: ADC temperature (degrees C) 3: SEP temperature 4: DM offset voltage (volts) if IES-2 or RPA plasma plate potential (volts) if SSIES-3 5: DM mode (integer) SSIES-2: -1: Undefined 0: Normal 1-8: H^+ 9: FIBA SSIES-3: 0: Slow 1: Normal 6: EP mode (0-6 : A,B,BS,C,D,DS,E) (integer)	4(E12.5, 1X), I2, 1X, I2, 1X, E12.5

	7: VIP at EDR start (volts)	
113	"FILLER"	A
114	Filler	7(E12.5, 1X)
115-228	Repeat of lines 1-114 for 2nd minute of data	
229-342	Repeat of lines 1-114 for 3rd minute of data	
.. ..	.. ..	

Table 31 below is a listing of the currently available (as of 1 Jan 2014) DMSP SSIES EDR data files listed by spacecraft with the total number of available data files shown in parentheses. The data base contains a total of 17546 SSIES EDR data files for spacecraft F13 through F18 spanning from January 2002 through the present. Figure 14 below shows the same information graphically.

Table 31: Listing of available DMSP SSIES EDR data files

F18	10/22/2009-10/29/2009, 11/01/2009-11/02/2009, 11/04/2009-11/18/2009, 11/20/2009-01/01/2014 (1529)
F17	11/08/2006-01/01/2014 (2612)
F16	10/25/2003-11/03/2003, 11/05/2003-01/01/2014 (3721)
F15	01/01/2002-06/20/2003, 06/26/2003-07/30/2003, 08/01/2003-01/01/2014 (4378)
F14	01/01/2002-08/23/2008 (2427)
F13	01/01/2002-11/18/2009 (2879)

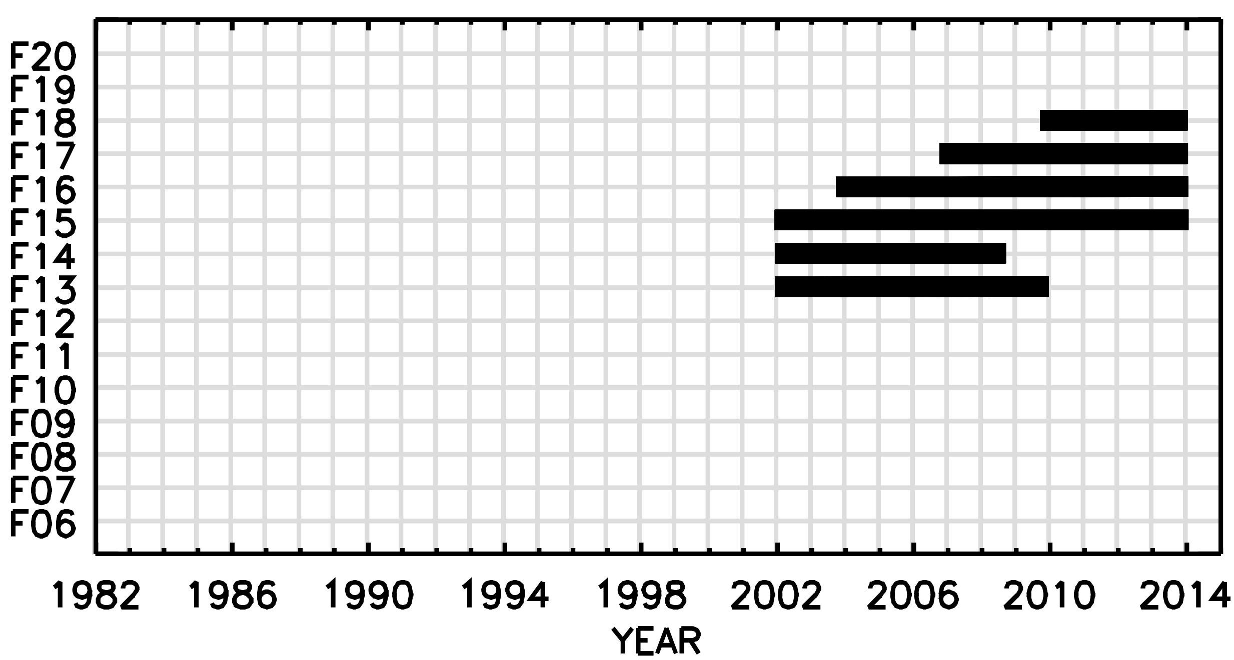

Figure 14: Graphical display of available DMSP SSIES EDR data files

Additional information about the sensors or the meaning of the values contained within the files can be found in the “Further Reading” section at the end of this document.

2.11 The SSM Magnetic Field Record (MFR) Data Files

The SSM MFR data files use the following 2 different naming conventions:

mfr**YYYYdddHHMM_YYYYdddhhmm_NNNN**.dat (old style)

and

PS.CKGWC_SC.U_DI.A_GP.SSMXX-F**NN**-R99990-B9999090-APSM_AR.GLOBAL_DD.**YYYYMMDD**_TP.**HHMMSS**-**hhmmss**_DF.MFR (new style)

where the bold characters are variable and the other (not bold) characters remain fixed. The bold characters have the following meaning:

NN = 2 digit spacecraft flight number (06 through 20)
NNNN = 4 digit spacecraft identification number (see Table 33 below)
YYYYMMDD = 4 digit year, 2 digit month, and 2 digit day
YYYYdddHHMM = 4 digit year, 3 digit day of year, 2 digit hour, and 2 digit minute for start of file
YYYYdddhhmm = 4 digit year, 3 digit day of year, 2 digit hour, and 2 digit minute for end of file
HHMMSS = 2 digit hour, 2 digit minute, and 2 digit second for start of file
hhmmss = 2 digit hour, 2 digit minute, and 2 digit second for end of file

For example, the data file PS.CKGWC_SC.U_DI.A_GP.SSMXX-F16-R99990-B9999090-APSM_AR.GLOBAL_DD.20090718_TP.000001-235958_DF.MFR would be the SSM MFR data for F16 for 18 July 2009. The MFR data files are ASCII data files organized in column format. A ‘#‘ in column 1 indicates that a line is a comment line. Typically the first 6 lines of the file are comment lines. Table 32 below gives a description of the contents of each column contained in the file.

Table 32: File format description for the SSM MFR data files

Column	Description	Format
1	Date and time (year, day of year, hour of day, minute of hour, and second of minute)	I4, I3, I2, I2, F7.4, 1X
2	Second of day	F10.4, 1X
3	Spacecraft identification number (see table below)	I4, 1X
4	One character value indicating the type of measurement: A: An averaged measurement S: A sampled measurement	A1, 1X
5	Geographic latitude in units of degrees north.	F9.5, 1X
6	Geographic longitude in units of degrees east.	F9.5, 1X
7	Altitude in kilometers.	F7.3, 1X
8	One character value indicating the source of the ephemeris: T: TLE I: interpolated from RSDR D: from data file Z: from z-bits	A1, 1X
9	One character value indicating: 1: first of 12 measurements D: 1 of 11 subsequent difference measurements If the type of measurement in column 4 indicates 'A' for an averaged measurement than the value in this column will be 'D'.	A1, 1X
10	The measured x-component of the magnetic field in nT in spacecraft coordinates.	I6, 1X
11	The measured y-component of the magnetic field in nT in spacecraft coordinates.	I6, 1X
12	The measured z-component of the magnetic field in nT in spacecraft coordinates.	I6, 1X
13	The date that the in-flight calibration was performed (4 digit year and 3 digit day-of-year separated by a decimal point, e.g. 18 July 2009 would be 2009.199).	I4, '.', I3, 1X
14	The measured x-component of the magnetic field minus the IGRF model magnetic field in nT in spacecraft coordinates.	I6, 1X
15	The measured y-component of the magnetic field minus the IGRF model magnetic field in nT in spacecraft coordinates.	I6, 1X
16	The measured z-component of the magnetic field minus the IGRF model magnetic field in nT in spacecraft coordinates.	I6, 1X
17	The epoch of the geomagnetic model field used in decimal years	F8.3, 1X
18	A one character value indicating the magnetic field model used: I: IGRF	A1

Spacecraft coordinates are defined where x is along the local vertical measured positive in the downward direction, z is perpendicular to both the local vertical and the spacecraft velocity vector measured positive in the anti-orbit normal direction (in approximately the anti-sunward direction), and y completes a right hand coordinate system with positive y in the same general direction as the spacecraft velocity direction. Note that the positive y direction is not the same as the spacecraft velocity direction because in general the spacecraft velocity vector is not perpendicular to the local vertical; however, the local vertical direction, the spacecraft velocity vector, and the y axis are always coplanar.

The magnetometers on F07 and F12-F14 were body mounted and the magnetic field measurements contained within those data files include satellite generated noise and artifacts. Many artifacts in the horizontal components have been removed by ground processing but many were not removed. The high frequency noise is reduced by using one second averages of the measurements. From F15 forward the magnetometers are boom mounted which reduced, but did not eliminate, the amount of satellite generated noise and artifacts in the measurements. Ground processing removed most of the artifacts in the horizontal components of the measurements and averaging over one second of data reduced the noise. Most of the artifacts not removed are in the auroral zone where variations due to auroral currents and spacecraft currents are not easily distinguished.

Table 33: Listing of DMSP 2-digit flight numbers and 4-digit spacecraft ID numbers

2-Digit Flight Number	4-Digit Spacecraft ID Number
F13	4547
F14	5548
F15	6549
F16	7554
F17	8551
F18	9553
F19	0552
F20	1550

Table 34 below is a listing of the currently available (as of 1 Jan 2014) DMSP SSM MFR data files listed by spacecraft with the total number of available data files shown in parentheses. The data base contains a total of 18123 SSM MFR data files for spacecraft F13 through F18 spanning from June 2001 through the present. Figure 15 below shows the same information graphically.

Table 34: Listing of available DMSP SSM MFR data files

F18	10/21/2009-01/01/2014 (1534)
F17	11/07/2006-01/01/2014 (2613)
F16	10/25/2003-01/01/2014 (3722)
F15	05/23/2001-05/27/2001, 05/29/2001-08/30/2001, 09/01/2001-10/15/2013 (4527)
F14	06/01/2001-08/30/2001, 09/02/2001-09/17/2001, 09/19/2001-11/13/2006, 11/15/2006-12/31/2006, 01/02/2007-08/23/2008 (2636)
F13	06/01/2001-08/30/2001, 09/02/2001-11/18/2009 (3091)

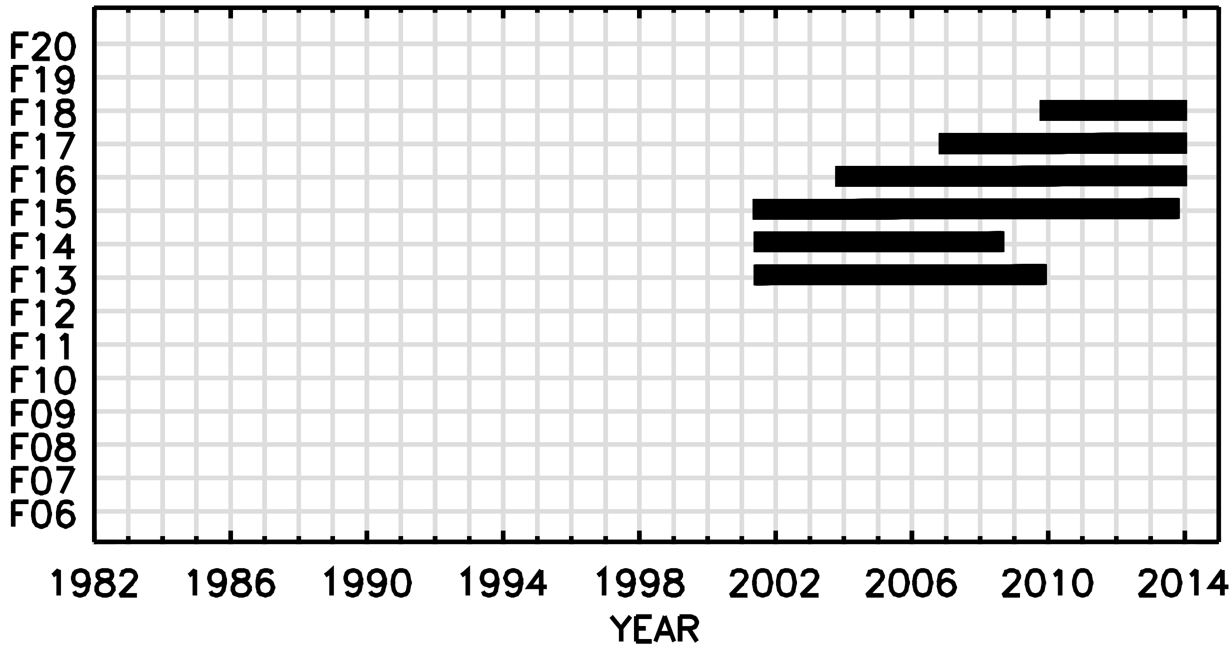

Figure 15: Graphical display of available DMSP SSM MFR data files

Additional information about the sensors or the meaning of the values contained within the files can be found in the "Further Reading" section at the end of this document.

2.12 Big Endian versus Little Endian Encoding

Big-endian systems are systems in which the most significant byte of a data word is stored in the smallest address given and the least significant byte is stored in the largest. In contrast, little-endian systems are those in which the least significant byte is stored in the smallest address. Endianness is a concern when a binary file is read on a computer with different endianness from the computer on which it was originally created. To read the contents of the DMSP binary data files on a little-endian system (the most common situation) the byte ordering of each multi-byte data word will need to be reversed. More information can be found at http://en.wikipedia.org/wiki/Endianness.

3.0 Further Reading

Delorey, D. E., Parsons, C. M., Pruneau, P. N., Delay, S. H., and Martin, K. R., Analysis System for the DMSP Satellites, PL-TR-95-2121;ADA302604, Boston College Chestnut Hill MA, Institute For Scientific Research, 1995.

Delorey, D. E., Pruneau, P. N., and Parsons, C. M., Database Development for the DMSP SSIES Experiment, GL-TR-89-0066; ADA224346, Boston College, Chestnut Hill MA, Institute for Space Research, 1989.

Greenspan, M. E., Anderson, P. B., and Pelagatti, J. M., Characteristics of the thermal plasma monitor (SSIES) for the Defense Meteorological Satellite Program (DMSP) spacecraft S8 through S10, AFGL-TR-86-0227; ADA176924, Regis Coll Research Center Weston MA, 1986.

Gustafsson, G., Papitashvili, N. E., and Papitashvili, V. O., A Revised Corrected Geomagnetic Coordinate System for Epochs 1985 and 1990, J. Atmos. Terr. Phys., 54, pp. 1609-1631, 1992.

Hagen, M. P., Holeman, E. G., Burke, W. J., and Rich, F. J., The AFRL Auroral Boundary Algorithm, AFRL-VS-HA-TR-2006-1025; ADA456205, Hanscom AFB: AFRL Space Vehicles Directorate, 2006.

Hardy, D. A., Schmitt, L. K., Gussenhoven, M. S., Marshall, F. J., Yeh, H. C., Schumaker, T. L., Huber, A., and Pantazis, J., Precipitating electron and ion detectors (SSJ/4) for the block 5D/flights 6-10 DMSP Satellites: Calibration and data presentation, AFGL-TR-84-0317; ADA083136, Hanscom AFB: AFRL Space Vehicles Directorate, 1984.

Heelis, R. A. and Hairston, M. R., Studies of Ionospheric Dynamics Utilizing Data from DMSP, GL-TR-90-0047; ADA223370, Texas University at Dallas Richardson, Center For Space Sciences, 1990.

Miller, N. I. and Sexton, L. E., Observations and Calibrations of DMSP F15 SSM Data December 1999 - October 2000, AFRL-VS-TR-2003-1576; ADA419157, RADEX INC, Bedford MA, 2001

Rich, F. J., Users Guide for the Topside Ionospheric Plasma Monitor (SSIES, SSIES-2 AND SSIES-3) on Spacecraft of the Defense Meteorological Satellite Program (DMSP) Volume 1: Technical Description, PL-TR-94-2187; ADA315731, Hanscom AFB: Phillips Lab, 1994.

Rich, F. J., Fluxgate Magnetometer (SSM) for the Defense Meteorological Satellite Program (DMSP) Block 5D-2, Flight 7, Instrument Papers, AFGL-TR-84-0225; ADA155229, Hanscom AFB: Air Force Geophysics Lab, 1984.

Richmond, A. D., Ionospheric Electrodynamics Using Magnetic Apex Coordinates, J. Geomag. Geoelectr., 47, 191-212, 1995.

List of Symbols, Abbreviations, and Acronyms

ADC	Analog-to-Digital Converter (see http://en.wikipedia.org/wiki/Analog-to-digital_converter)
AFRL	Air Force Research Laboratory (formerly Air Force Geophysics Laboratory)
Altitude	The distance from a reference ellipsoid along a straight line that is normal to the surface of the reference ellipsoid which approximates the shape of the Earth.
Ascending node	The point where the orbit crosses northward through the equatorial plane of the Earth.
CkL	Height-integrated irregularity strength parameter computed in the SSIES analysis program that outputs the EDR files.
Descending node	The point where the orbit crosses southward through the equatorial plane of the Earth.
DM	Drift Meter
DMSP	Defense Meteorological Satellite Program
EDR	Environmental Data Record
EP	Electron Langmuir Probe
EPH	Ephemeris
Ephemeris	The position of a satellite at given times
FIBA	Filter Bank Mode (see Section 4.1.1.3 of Rich (1994))
Geodetic latitude	The angle between the equatorial plane and the straight line that is normal to the surface of a reference ellipsoid which approximates the shape of the Earth.
Geographic latitude	The angle between the equatorial plane and the straight line that passes through the Earth's center.
Inclination	The angle between the plane of the orbit and the equatorial plane of the Earth.
MFR	Magnetic Field Record
MP	Microprocessor
RPA	Retarding Potential Analyzer

Sath angle	Sath angle is the angle in the orbital plane between the spacecraft position vector at the ascending node and the spacecraft position vector corresponding to the current second of data, measured in the direction of flight. Sath angle is the same as the “true anomaly” angle used in orbit mechanics.
Senpot	SSIES potential sensor and feed-back circuit. Used to bias the SSIES ion array to the floating potential.
SEP	Sensors Electronics Package
SM	Scintillation Meter
SSIES	The topside thermal plasma monitor. (Special Sensor for Ions, Electrons and Scintillation)
SSJ	The auroral particle spectrometer. (Special Sensor for Particle Flux)
SSM	The fluxgate magnetometer. (Special Sensor, Magnetometer)
SSULI	The ultraviolet limb imager
SSUSI	The ultraviolet spectrographic imager
Vbias	The electrostatic potential with respect to the spacecraft ground for the ion sensor array is Vbias + VIP. The potential of the EP is Vbias. In Senpot mode, Vbias changes continuously. If Senpot is disabled, Vbias can be set by command.
VIP	A voltage applied to the electron probe (EP) of SSIES to electrostatically separate it from the potential applied to the ion array. Typically VIP is set to -1 V. (See Section 5.1 of Rich (1994))

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