USER'S MANUAL: SSM/I ANTENNA TEMPERATURES, VERSION 6

1. INRODUCTION

This document describes the Version-6 SSM/I Antenna Temperature (T_A) Dataset and should be read in conjunction with the earlier versions of the T_A Users Manuals, which give more details on the SSM/I data.

Over the years, numerous issues and problems relating to the SSM/I data have been identified. These problems were related to geolocation error, sensor calibration, and quality control. We refer the user to two previous documents that discuss these issues and how they were subsequently handled:

User's Manual: SSM/I Antenna Temperature Tapes, Rev. 1, December 1991
User's Manual: SSM/I Antenna Temperature Tapes, Rev. 2, December 1993

These documents are available from Remote Sensing Systems.

The Version-6 T_A dataset has incorporated all these past geolocation corrections, sensor calibration (including cross-scan biases), and quality control procedures in a consistent way for the entire 16-year SSM/I dataset. In addition, the six SSM/Is (F08, F10, F11, F13, F14, and F15) have been carefully intercalibrated. This now allows investigators to confidently use these SSM/I products for detailed interannual and decadal trend studies.

In earlier version of the SSM/I T_A dataset, the various correction and quality control procedures were provided to the user, and these corrections were then applied to the data we provided. For Version-6 all corrections have been applied beforehand, and the dataset can be used as is.

2. DATA FORMAT

The SSM/I data are stored in orbital files. The file names have the form:

f@@_r#####.dat

where @@ is the SSM/I satellite number (i.e. 08, 10, 11, 13, 14, or 15) and ##### is the orbit number (i.e., 10000). By definition, an SSM/I orbit begins at the spacecraft ascending equatorial node. Each file contains additional data at the beginning and end of each orbit. For example, the file for orbit 10,000 contains scans starting with orbit position 9,9999.98 and ending with orbit position 10,001.02. The data at the end of orbit file 10,000 are then given again in orbit file 10,001. This 2% overlap of the orbit files facilitates user requirements that involve scan averaging.

Each file contains a series of 3768-byte records. The records are in simple binary format with no record marks. The files can be opened as direct access files with file length = 3768 or as a binary, unformatted file, depending on compiler. The first record gives satellite number, orbit number, and number of SSM/I scans within the file, followed by 3756-byte pad at the end. The remaining records contain the data for an A/B pair of SSM/I scans. A typical file will contain the header record plus about 1676 scan records, and hence the total file size will be 6,318,936 bytes.

All data words within a file are signed integers except for the scan time that is a 16-byte character sting. The data were generated on an Intel-PC-based system and hence the integer format has the least-significant byte stored first (i.e. the little-endian convention).

The subroutine READ_SSMI_L1A_FILE is a tool for reading one of the data files. Before calling this routine the file must be opened by the user and assigned a logical unit number (ILU). The routine is then called, with the one input argument being ILU. The routine does all the necessary conversions and stores the data in the common /L1A_SSMI/. The next section describes the content of this common.

3. Description of Variables

The first three variables in the common /L1A_SSMI/ are:

KSAT	integer(4)	satellite number (08, 10, 11, 13, 14, or 15)
IORBIT	integer(4)	orbit number
NUMSCAN	integer(4)	number of scans in file

The remaining variables are all arrays, with the last dimension corresponding to the scan number. We have set this last dimension to 1700, which is a little more than the maximum number of scans that can occur within an orbit. In the following description of these arrays, we suppress the notation of this last dimension.

BTIME	char(16)	Time for the begin of the b-scan (see below)
IFLAGS(12)	integer(1)	Quality flags (see below)
FRCREV	real(4)	Fractional orbit position (goes from –0.02 to 1.02)
SCLAT	real(4)	Spacecraft latitude at time=BTIME (deg)
SCLON	real(4)	Spacecraft east longitude at time=BTIME (deg)
SCALT	real(4)	Spacecraft altitude at time=BTIME (km)
XLAT(128,2)	real(4)	Latitude of SSM/I 85-GHz footprints (deg). 1st dimension is cell position across the swath 2nd dimension corresponds to 1 = A-scan, 2 = B-scan.
XLON(128,2)	real(4)	East longitude of SSM/I 85-GHz footprints (deg) 1st dimension is cell position across the swath 2nd dimension corresponds to 1 = A-scan, 2 = B-scan.
ISUR(128,2)	integer(1)	Land/coast/ocean flag for SSM/I 85-GHz footprints. 0=open ocean, 1=near coast, 2=land 1st dimension is cell position across the swath 2nd dimension corresponds to 1 = A-scan, 2 = B-scan.
IICE(128,2)	integer(1)	Sea-ice monthly climatology flag for SSM/I 85-GHz footprints 0=no possibility of sea ice, 1=sea ice is possible 1st dimension is cell position across the swath 2nd dimension corresponds to 1 = A-scan, 2 = B-scan.
THT(128)	real(4)	Earth incidence angle for SSM/I 85-GHz footprint (deg). 1st dimension is cell position across the swath Only given for A-scan.
AZIMUTH(128)	real(4)	Earth azimuth angle for SSM/I 85-GHz footprint (deg). Measured clockwise from North. 1st dimension is cell position across the swath Only given for A-scan.
SUNANG(128)	real(4)	Sun glitter angle for SSM/I 85-GHz footprint (deg). 1st dimension is cell position across the swath Only given for A-scan.
TA_LO(5,64)	real(4)	Antenna temperature values for lower five channels (Kelvin) 1st dimension is channel (19V, 19H, 22V, 37V, 37H) 2nd dimension is cell position for lower frequency channels
TA_HI(6:7,128,2)	real(4)	Antenna temperature values for 85 GHz channels (Kelvin) 1st dimension is channel (85V, 85h) 2nd dimension is cell position across the swath 3rd dimension corresponds to 1 = A-scan, 2 = B-scan.

The time BTIME is a 16-byte character string formatted as follows:

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READ(BTIME,'(I4,I3.3,4I2.2,F9.6)') LYEAR,IDAYJL,IMON,IDAYMO,IHOUR,IMINUTE,SECOND
LYEAR        year (1987–2003)
IDAYJL       Julian day (1–366)
IMON         month (1–12)
IDAYMO       day of month (1–31)
IHOUR        hour of day (0-23)
IMINUTE      minute of hour (0-59)
SECOND       second of minute (0-59.999999)
```

The 12 quality flags IFLAGS have a value of 0 or 1. The first four flags refer to the scan in general, and they have the following meaning if set to 1:

IFLAGS(1)=1 Scan is missing, there are no data. Missing scans that occur in the middle of an orbit are included in the orbital file as zero-filled spacers. However, missing scans that occur at the beginning or end of the orbit are not included.

IFLAGS(2)=1 Scan occurs during a period of erroneous data (see SSM/I T_A User's Manual, Revision 2, December 1993.)

IFLAGS(3)=1 Scan affected by calibration errors due to scan averaging (see SSM/I T_A User's Manual, Revision 2, December 1993.)

IFLAGS(4)=1 Thermistor readings for scan are out-of-bounds

The next 7 flags, IFLAGS(5) through IFLAGS(11), are channel flags and refer respectively to the to 7 SSM/I channels: 19V, 19H, 22V, 37V, 37H, 85V, 85H. If the flag is set to 1, then observations for that channel may be erroneous. Our advice to the user is to exclude all scans for which any of the first 4 flags are set to 1. Furthermore, do not use any channels for which the channel flag is set to 1. IFLAG(12) is not used.

The lower frequency SSM/I observations (19V, 19H, 22V, 37V, and 37H) are only taken during odd scan positions along the A-scan. Thus there are 64 low frequency observations as compared to 256 85-GHz observations. For example, the latitudes for the 64 low-frequency observations are XLAT(1,1), XLAT(3,1), ... , XLAT(127,1).

The Earth incidence angle, Earth azimuth angle, and sun-glitter angle are only given for the A-scan. The values vary slowly from scan to scan, and the B-scan values are well approximated by the A-scan values.

The sun-glitter angle is defined as the angle between two vectors **a** and **b**. Vector **a** is the vector going from the SSM/I footprint to the SSM/I antenna. Vector **b** is the vector pointing in the direction of sunlight reflected of the Earth surface at the location of the SSM/I footprint, assuming that the earth surface is a specular reflector. Low sun-glitter angles mean that reflected sunlight is being received by the SSM/I.

Antenna temperatures are stored in the data files. The conversion from antenna temperature to brightness temperature is relatively simple and is discussed in length in the T_A User's Manual, Revision 1, December 1991. We are providing the user with the routine TA_TO_TB that will perform this conversion.