AMSR-E Level-1B Processing Software for Direct Broadcast Data from AQUA.

Originally written by Peter Ashcroft of Remote Sensing Systems (RSS http://www.remss.com/) and modified by Kathleen Strabala for use with direct broadcast AMSR-E L1B production software release March 2005.

(1) Platforms:

The binaries were compiled and tested on SUN sparc Ultra-250 using the Sun Forte Developer 7 Fortran 95 7.0 compiler and on a Linux RedHat 2.4.18-27.7.xsmp platform using the Lahay Lahey/Fujitsu Fortran 95 Express Release L6.10e compilers.

(2) Inputs:

This software requires two time ordered PDS (Production Data Set) files as inputs. One for the AMSR-E science data (APID 402) and the other for the GBAD one-second data (APID 957). The third input argument is the name of the directory to which the data is to be written. The fourth input is a name tag which will become a prefix to the standard binary and text output file names. There is a shell script (amsre_leve1b.csh) included in this release which can be used to help automate L1B production.

(3) Outputs:

Outputs produced by this software are two binary data files and a text status file. All the science data will be written to a file named <prefix date time>_science_data.dat. Scan start time for the observations, corresponding position and velocity of the spacecraft, and geo locations for the observation points will be written to a file named <prefix date time>_scantime_pos_vel_geoloc.dat. The program also outputs the data type for the observation counts, and the length of a record for each output data set as part of the <prefix date time>_ program_status.txt. The reason for doing this is that some compilers may not support two-byte integers. Each of the three files and their contents are explained below. Individual data items explained under each binary data file follows the order that they are written in the file.

(a) program_status.txt

Contains information with regard to the science and GBAD files:

Any sequence breaks, number of scans, number of bad scans, number of science scans for which geo locations are calculated etc.,

Contain the record length of each binary file produced, and the data type. Some compilers may not support two byte integers. Therefore, this information will be needed to read the output data.

File name: program_status.txt

(b) scantime_pos_vel_geoloc.dat

Scan Time

Scan time corresponding to the first observation point of a scan. This value is the total TAI seconds from zero hours January 1 1993.

Length of each record = 8 bytes (a double)

Navigation Data in ECI frame

The position and velocity of the spacecraft expressed in J2000 Cartesian co-ordinate system at the beginning of a scan. Units are meters and meters/sec respectively.

Length of each record = 24 bytes (6 four byte reals)

Order written: position (x, y, z cords) first and velocity (V_x, V_y, V_z) next.

Latitudes of observation points for 6Ghz to 52Ghz

Length of each record = 243 * 4 (243, 4 byte REAL)

Order written: first observation point to 243rd observation point for each scan

Cannot be computed using available GBAD data = 99.99

Longitudes of observation points for 6Ghz to 52Ghz

Length of each record = 243 * 4 (243, 4 byte REAL)

Order written: first observation point to 243rd observation point for each scan

Cannot be computed using available GBAD data = 999.0

Latitudes of observation points for 89AGHz

Length of each record = 486 * 4 (486, 4 byte REAL)

Order written: first observation point to 486th observation point for each scan

Cannot be computed using available GBAD data = 99.99

Longitudes of observation points for 89AGHz

Length of each record = 486 * 4 (486, 4 byte REAL)

Order written: first observation point to 486th observation point for each scan

Cannot be computed using available GBAD data = 999.0

Latitudes of observation points for 89BGHz

Length of each record = 486 * 4 (486, 4 byte REAL)

Order written: first observation point to 486th observation point for each scan

Cannot be computed using available GBAD data = 99.99

Longitudes of observation points for 89BGHz

Length of each record = 486 * 4 (486, 4 byte REAL)

Order written: first observation point to 486th observation point for each scan

Cannot be computed using available GBAD data = 999.0

Earth Azimuth

Defined as the angle between the north vector and the projection of the observation vector of AMSR-E at an observation point. Same as the NASDA definition, as shown in Figure 1. This data is calculated corresponds to the observation points of 6.6GHz to 52GHz. Unit is degree.

Length of each record = 243 * 4 (243, 4 byte REAL)

Order written: first observation point to 243rd observation point for each scan

Cannot be computed using available GBAD data = 999.0

Earth Incidence

Defined as the angle between the vertical vector of the Earth surface and the observation vector of AMSR-E. This value denotes offset from 55.0 degree and the range of value is between ±25.6. This data calculated corresponds to the observation points of 6.6GHz to 52GHz. Unit is degree.

Length of each record = 243 * 4 (243, 4 byte REAL)

Order written: first observation point to 243rd observation point for each scan

Cannot be computed using available GBAD data = 99.99

(c) science_data.dat

6GHz - 52GHz Brightness Temperature

For each scan, data is stored in a 12x243 array. Number of data points per scan are 243. Twelve rows represent the 12 frequencies, and the order is shown in Table 1. Data type will be four-byte real.

Lack of data: -9999.9

89AGHz – 89BGHz Brightness Temperature

For each scan, data is stored in a 4x486 array (in the program data is stored in a 8x243 array. There are two sets of data and they are ordered as 89A-Vertical(1st set), 89A-Horizontal(1st set), 89B-Vertical(1st set), 89B-Horizontal(1st set), 89A-Vertical(2nd set), 89A-Horizontal(2nd set), 89B-Vertical(2nd set), and 89B-Horizontal(2nd set). By reading them into a 4x486 array, they can be correctly ordered). Number of data points per scan are 486. Four frequencies are ordered in the following order. 89-AGHz-Vertical, 89-AGHz-Horizontal, 89-BGHz-Vertical, 89-BGHz-Horizotal (last four rows in Table 1). Data type will be four-byte real.

Lack of data: -9999.9

6GHz - 52GHz Antenna Temperature Count

For each scan, data is stored in a 12x243 array. Number of data points per scan are 243. Twelve rows represent the 12 frequencies, and the order is shown in Table 1.

Data type will be either two byte integer or four-byte integer, depending on the compiler. The raw data for 6GHz is 12bit 2’s complement, therefore the count data range is normally from –2048 to 2047, and for other frequencies 10bit 2’s complement, therefore the count data range is normally from –512 to 511. Following values mean “bad” case.

Lack of data: -9999

Parity error: -32768

89AGHz – 89BGHz Antenna Temperature Count

For each scan, data is stored in a 4x486 array (in the program data is stored in a 8x243 array. There are two sets of data and they are ordered as 89A-Vertical(1st set), 89A-Horizontal(1st set), 89B-Vertical(1st set), 89B-Horizontal(1st set), 89A-Vertical(2nd set), 89A-Horizontal(2nd set), 89B-Vertical(2nd set), and 89B-Horizontal(2nd set). By reading them into a 4x486 array, they can be correctly ordered). Number of data points per scan are 486. Four frequencies are ordered in the following order. 89-AGHz-Vertical, 89-AGHz-Horizontal, 89-BGHz-Vertical, 89-BGHz-Horizotal (last four rows in Table 1). Data type will be either two byte integer or four-byte integer, depending on the compiler. The raw data is 10bit 2’s complement, therefore the count data range is normally from –512 to 511 and the following values mean “bad” case.

Lack of data: -9999

Parity error: -32768

6GHz-52GHz Cold Sky Mirror Counts

There are 16 points in a scan for each frequency. Data is written as 12x16 array. Ordering of frequencies is same as observation counts. Data type will be either two byte integer or four-byte integer, depending on the compiler. The raw data for 6GHz is 12bit 2’s complement, therefore the count data range is normally from –2048 to 2047, and for other frequencies 10bit 2’s complement, therefore the count data range is normally from –512 to 511. Following values mean “bad” case.

Lack of data: -9999

Parity error: -32768

89-AGHz – 89-BGHz Cold Sky Mirror Counts

There are 32 points in a scan for each frequency. Data is written as 4x32 array (in the program data is stored in a 8x16 array. There are two sets of data and they are ordered as 89A-Vertical(1st set), 89A-Horizontal(1st set), 89B-Vertical(1st set), 89B-Horizontal(1st set), 89A-Vertical(2nd set), 89A-Horizontal(2nd set), 89B-Vertical(2nd set), and 89B-Horizontal(2nd set). By reading them into a 4x32 array, they can be correctly ordered). Ordering of frequencies is same as observation counts. Data type will be either two byte integer or four-byte integer, depending on the compiler. The raw data is 10bit 2’s complement, therefore the count data range is normally from –512 to 511 and the following values mean “bad” case.

Lack of data: -9999

Parity error: -32768

6GHz-52GHz Hot Load Counts

There are 16 points in a scan for each frequency. Data is written as 12x16 array. Ordering of frequencies is same as observation counts (first 12 rows Table 1). Data type will be either two byte integer or four-byte integer, depending on the compiler. The raw data for 6GHz is 12bit 2’s complement, therefore the count data range is normally from –2048 to 2047, and for other frequencies 10bit 2’s complement, therefore the count data range is normally from –512 to 511.The following values mean “bad” case.

Lack of data: -9999

Parity error: -32768

89-AGHz – 89-BGHz Hot Load Counts

There are 32 points in a scan for each frequency. Data is written as 4x32 array (in the program data is stored in a 8x16 array. There are two sets of data and they are ordered as 89A-Vertical(1st set), 89A-Horizontal(1st set), 89B-Vertical(1st set), 89B-Horizontal(1st set), 89A-Vertical(2nd set), 89A-Horizontal(2nd set), 89B-Vertical(2nd set), and 89B-Horizontal(2nd set). By reading them into a 4x32 array, they can be correctly ordered). Ordering of frequencies is same as observation counts. Data type will be either two byte integer or four-byte integer, depending on the compiler. The raw data is 10bit 2’s complement, therefore the count data range is normally from –512 to 511 and the following values mean “bad” case.

Lack of data: -9999

Parity error: -32768

SPC Temperature Data

There are 24 points in a scan. Data is written to 24x1 array. Ordering of Thermistors is shown in Table 2. Data type will be two or four byte integer, depending on the compiler.

Lack of data: -9999

SPS Temperature Data

There are 32 points in a scan. Data is written to 32x1 array. Ordering of thermistors and sensors are shown in Table 3. Data type will be two or four byte integer, depending on the compiler.

Lack of data: -9999

Parity error: -32768

Rx Offset/Gain

There are 16 points in a scan. Data is written to 16x2 array. First column is offset, and the second column is gain. Sixteen frequencies are ordered as shown in Table 1. Data type will be two or four byte integer, depending on the compiler.

Lack of data: -9999

Parity error: -32768

Antenna Temperature Coefficient (Slope)

There are 16 points in a scan. One for each frequency. Data is written as 16x1 array. Sixteen frequencies are ordered as shown in Table 1. Data type will be four byte real. Zeros will be written for bad cases.

Antenna Temperature Coefficient (Offset)

There are 16 points in a scan. One for each frequency. Data is written as 16x1 array. Sixteen frequencies are ordered as shown in Table 1. Data type will be four byte real. Zeros will be written for bad cases

6.92GHz Vertical
6.92GHz Horizontal
10.65GHz Vertical
10.65GHz Horizontal
18.7GHz Vertical
18.7GHz Horizontal
23.8GHz Vertical
23.8GHz Horizontal
36.5GHz Vertical
36.5GHz Horizontal
50.3GHz Vertical N/A
52.3GHz Vertical N/A
89.0-AGHz Vertical
89.0-AGHz Horizontal
89.0-BGHz Vertical
89.0-BGHz Horizontal

Table 1

Thermistor #1 SPC A Temperature
Thermistor #2 SPC B Temperature
Thermistor #3 TCC Temperature
Thermistor #4 PDUC Temperature
Thermistor #5 ADA STATOR Temperature
Thermistor #7 MWA Wheel Temperature
Thermistor #8 MWA Bearing Temperature
Thermistor #9 ADE Temperature
Thermistor #11 Control STR Temperature3
Thermistor #12 Control STR Temperature4
Thermistor #13 Control STR Temperature1
Thermistor #14 Control STR Temperature2
Platinum Sensor#1 HTU Temperature1
Platinum Sensor#2 HTU Temperature2
Platinum Sensor#3 HTU Temperature3
Platinum Sensor#4 HTU Temperature4
Platinum Sensor#5 HTU Temperature5
Platinum Sensor#6 HTU Temperature6
Platinum Sensor#7 HTU Temperature7
Platinum Sensor#8 HTU Temperature8
Thermistor #6 N/A
Thermistor #10 N/A
Thermistor #15 N/A
Thermistor #16 N/A

Table 2: SPC temperature data

Thermistor #1 SPS Temperature
Thermistor #2 PUDS Temperature
Thermistor #3 TCSTemperature
Thermistor #4 DC/DC RX1 Temperature
Thermistor #5 DC/DC RX2 Temperature
Thermistor #6 6G LNA Temperature
Thermistor #7 10G LNA Temperature
Thermistor #8 50G OBE Temperature
Thermistor #9 89G H LNA1 Temperature
Thermistor #10 89G H LNA2 Temperature
Thermistor #11 89G V LNA1 Temperature
Thermistor #12 89G V LNA2 Temperature
Thermistor #13 Sensor STR3 Temperature
Thermistor #14 Sensor STR4 Temperature
Thermistor #15 ADA ROT A Temperature
Thermistor #16 ADA ROT B Temperature
Platinum Sensor#1 6G RX Temperature
Platinum Sensor#2 10G RX Temperature
Platinum Sensor#3 18G RX Temperature
Platinum Sensor#4 23G RX Temperature
Platinum Sensor#5 36G RX Temperature
Platinum Sensor#6 SENS STR5 Temperature
Platinum Sensor#7 89G RX1 Temperature
Platinum Sensor#8 89G RX2 Temperature
Platinum Sensor#9 89G HNG1 Temperature
Platinum Sensor#10 89G HNG2 Temperature
Platinum Sensor#11 ELB1 Temperature
Platinum Sensor#12 ELB2 Temperature
Platinum Sensor#13 FEED1 Temperature
Platinum Sensor#14 FEED2 Temperature
Platinum Sensor#15 Sensor STR1 Temperature
Platinum Sensor#16 Sensor STR2 Temperature

Table 3: SPS temperature Data

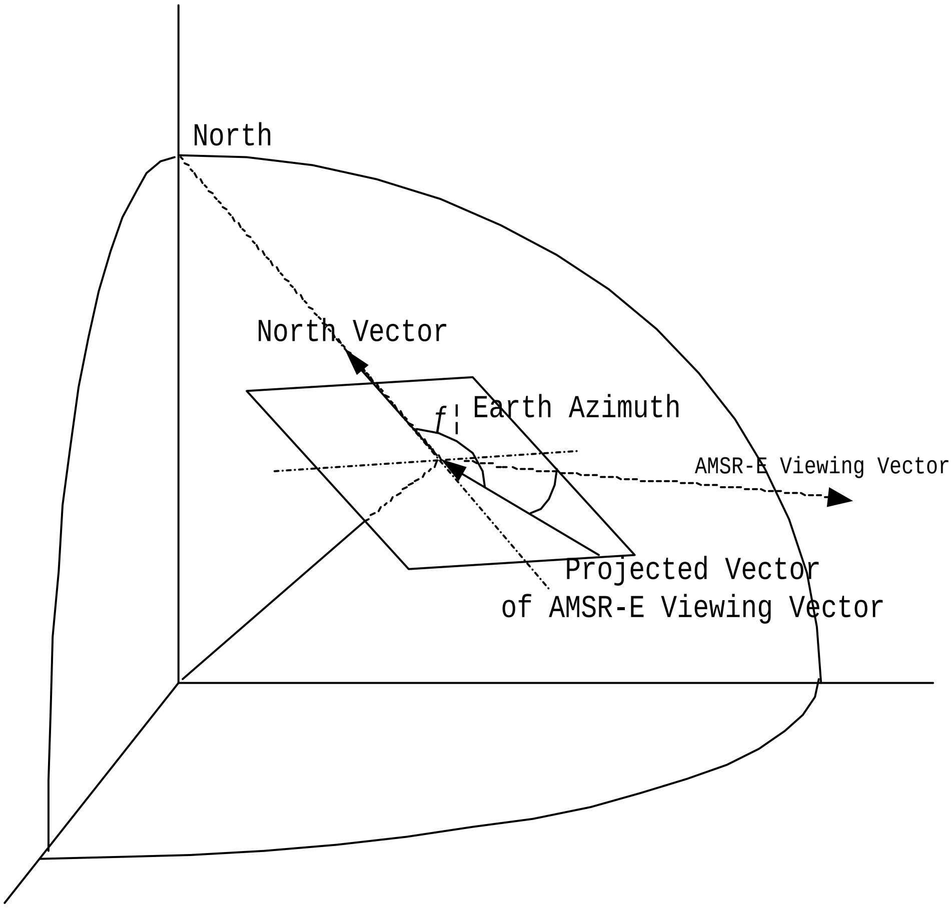

Figure 1: NASDA definition of Earth Azimuth