SMAP L1B Radiometer Half-Orbit Radio Frequency Interference and Calibration Data, Version 6

USER GUIDE

How to Cite These Data

As a condition of using these data, you must include a citation:

Piepmeier, J. R., P. Mohammed, J. Peng, E. J. Kim, G. De Amici, J. and C. Ruf. 2026. *SMAP L1B Radiometer Half-Orbit Radio Frequency Interference and Calibration Data, Version 6*. [Indicate subset used]. Boulder, Colorado USA. NASA National Snow and Ice Data Center Distributed Active Archive Center. https://doi.org/10.5067/Q2K1EIRKY7SI. [Date Accessed].

FOR QUESTIONS ABOUT THESE DATA, CONTACT NSIDC@NSIDC.ORG

FOR CURRENT INFORMATION, VISIT https://nsidc.org/data/SPL1BTB_RFICAL

TABLE OF CONTENTS

1 DATA DESCRIPTION

1.1 Summary

The SMAP L1B Radiometer Half-Orbit Radio Frequency Interference and Calibration Data (SPL1BTB_RFICAL) product is an intermediate Level 1B radiometer data product generated by NASA's Soil Moisture Active Passive (SMAP) mission. SPL1BTB_RFICAL provides unaveraged, time-ordered antenna temperature measurements along with associated radio frequency interference (RFI) diagnostics, calibration parameters, and geolocation information.

Data are provided in half-orbit granules and represent radiometer measurements prior to RFI mitigation and spatial averaging. This product is intended for users performing instrument calibration assessment, RFI characterization, and algorithm development. It is not intended for direct geophysical analysis.

NOTE: As of April 2026, forward processing has been published for this data set. Reprocessed data for 2015 – 2026 will be added over the coming months.

1.2 Parameters

Each SPL1BTB_RFICAL product granule contains data categorized into the following groups of parameters:

- **Subband RFI Cal Group**
  - The Subband RFI Cal Group provides the time ordered unaveraged brightness temperatures for 16 subbands referenced to the feedhorn without error sources removed and before radio frequency interference filtering. The 3rd and 4th Stokes parameters of the two polarizations are also included for each of the 16 subbands. In addition, the group contains geolocation information, RFI flags, kurtosis values, and gain and offset values used in TA calibration. The Subband RFI Cal Group includes the RFI flags for the reference and reference plus noise diode counts.
  - Parameters: kurt16_h, kurt16_v, RFI_ref_flag, RFI_refnd_flag, subband_calibration_gain16, subband_calibration_offset16, subband_latitude, subband_longitude, subband_RFI_flag, ta16_3, ta16_4, ta16_h, and ta16_v
- **Subband Footprint Group**
  - The Subband Footprint Group provides the RFI flag from the cross-frequency algorithm that uses antenna temperatures averaged to 9.6 ms. The flag provides bits for both horizontal and vertical polarizations in that order.
  - Parameters: subband_footprint_flag
- **Fullband RFI Cal Group**
  - The Fullband RFI Cal Group contains similar information to that in the Subband RFI Cal Group except for the fullband signal which is data obtained for the entire 24 MHz radiometer bandwidth.

    - Parameters: fullband_calibration_gain, fullband_calibration_offset, fullband_kurt_h, fullband_kurt_v, fullband_latitude, fullband_longitude, fullband_RFI_flag, fullband_ta_3, fullband_ta_4, fullband_ta_h, fullband_ta_v, RFI_ref_flag, and RFI_refnd_flag
- **Fullband MaxPD Cal Group**
    - The Fullband MaxPD Cal Group contains a 3-bit RFI flag which is a logical OR of all the fullband RFI flags when subband data is not present. Before the radar failed, the radiometer operated in a high-rate mode where both fullband and subband data streams were obtained over land and only fullband data over the ocean. Once the radar failed, the radiometer data began to operate in high-rate mode globally.
    - Parameters: fullband_MaxPD_flag
- **Intermediary Temperature Data Group**
    - The Intermediary Temperature Data Group provides the time ordered footprint averaged antenna temperatures referenced to the feedhorn after RFI detection and filtering without error sources removed.
    - Parameters: tap_toa_3, tap_toa_4, tap_toa_h, tap_toa_v, tap_toi_3, tap_toi_4, tap_toi_h, tap_toi_v
- **Geolocation Group**
    - The Geolocation Group provides latitude and longitude for the time ordered footprints and the antenna azimuth and scan angles.
    - Parameters: antenna_azimuth_angle, antenna_scan_angle, tb_lat, and tb_lon
- **Metadata Group**
    - Each subgroups represents one of the major classes in the ISO structure. These groups contain a set of HDF5 attributes. Each HDF5 Attribute represents a specific ISO attribute of the associated ISO class. Although this representation inherits design from the ISO model, it does not completely conform to the model. In many cases, the names of the HDF5 Attributes match those used in the ISO model. In some situations, names were changed to provide greater clarity to SMAP users who are not familiar with the ISO model.
    - Subgroups: DatasetIdentificaiton, Extent, OrbitMeasuredLocation

Each individual parameter also includes metadata attributes describing units and valid ranges. A full list of all parameters, their definitions, and valid input values can be found in the Appendix of this document.

NOTE: Information in the metadata attributes for each parameter may be inaccurate within the data files. Users are encouraged to consult the Product Specification Document and this User Guide for the most accurate information.

1.3 File Information

Format

Data are provided in Hierarchical Data Format version 5 (HDF5) format.

File Contents

Each SPL1BTB_RFICAL file contains a single half-orbit granule and includes radiometer antenna temperature datasets, calibration gain and offset datasets, RFI diagnostic and flag datasets, geolocation and observation geometry datasets, and product-level and dataset-level metadata.

The HDF5 Groups in SPL1BTB_RFICAL (as seen in Figure 1) include: Fullband_MaxPD_Cal, Fullband_RFI_Cal, Geolocation, Intermediary_Temperature_Data, Subband_Footprint, Subband_RFI_Cal, and Metadata.

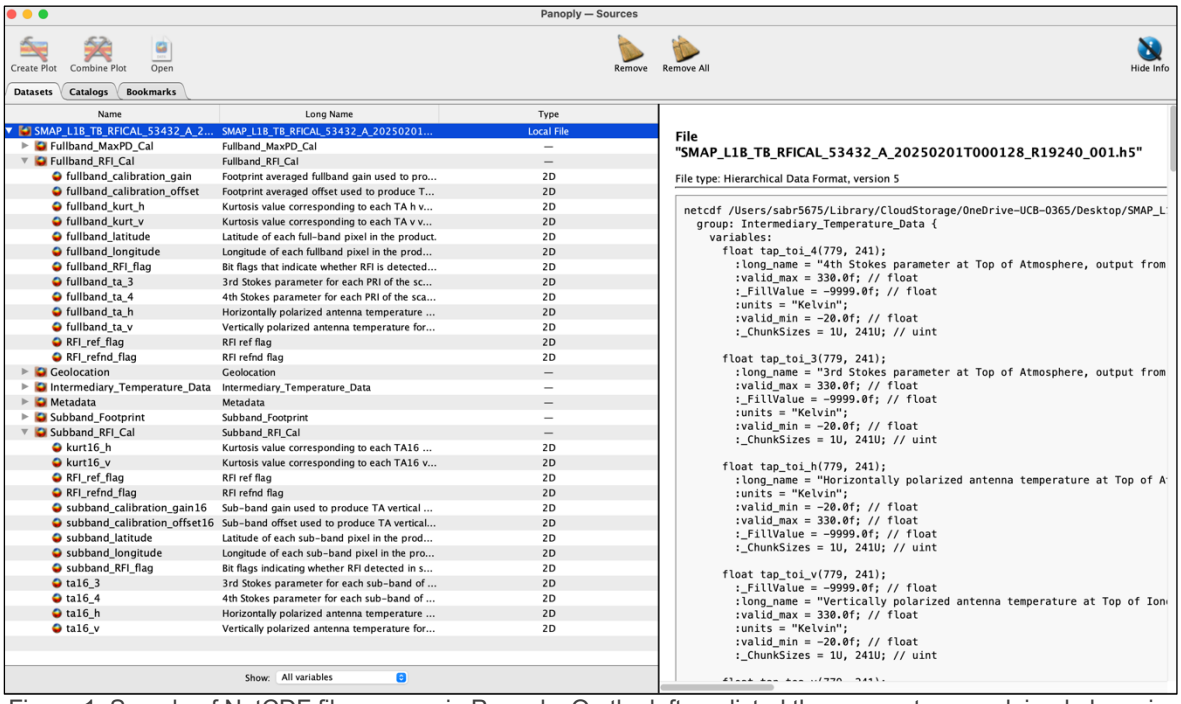

Figure 1. Sample of NetCDF file as seen in Panoply. On the left are listed the parameters, explained above in section 1.2. On the right, detailed metadata for each parameter.

Naming Convention

Files are named according to the following convention:

`SMAP_L1B_TB_RFICAL_[Orbit#]_[A/D]_yyyymmddThhmmss_RLVvvv_NNN.[ext]`

For example:

`SMAP_L1B_TB__RFICAL_53432_A_20250201T000128_R19240_001.h5`

Table 1 describes the variables within a file name:

Table 1. File Naming Convention

<table>
<tr><th>Variable</th><th>Description</th></tr>
<tr><td>SMAP</td><td>Indicates SMAP mission data</td></tr>
<tr><td>L1B_TB_RFICAL</td><td>Indicates the specific data product</td></tr>
<tr><td>[Orbit#]</td><td>5-digit sequential number of the orbit flown by the SMAP spacecraft when data were acquired. Orbit 00000 began at launch. Orbit numbers increment each time the spacecraft flies over the southernmost point in the orbit path.</td></tr>
<tr><td>[A/D]</td><td>Half-orbit pass of the satellite, such as:
A: Ascending (where satellite moves from South to North, and 6:00 p.m. is the local solar time)
D: Descending (where satellite moves from North to South, and 6:00 a.m. is the local solar time)</td></tr>
<tr><td>yyyymmddThhmmss</td><td>Date/time in Universal Coordinated Time (UTC) of the first data element that appears in the product, where:
<table>
<tr><td>yyyymmdd</td><td>4-digit year, 2-digit month, 2-digit day</td></tr>
<tr><td>T</td><td>Time (delineates the date from the time, i.e. yyyymmddThhmmss)</td></tr>
<tr><td>hhmmss</td><td>2-digit hour, 2-digit minute, 2-digit second</td></tr>
</table></td></tr>
<tr><td>RLVvvv</td><td>Composite Release ID, where:
<table>
<tr><td>R</td><td>Release</td></tr>
<tr><td>L</td><td>Launch Indicator (1: post-launch standard data)</td></tr>
<tr><td>V</td><td>1-Digit CRID Major Version Number (Note: the data set's major version does not necessarily coincide with the CRID major version)</td></tr>
<tr><td>vvv</td><td>3-Digit CRID Minor Version Number</td></tr>
</table>
Example: R19240 indicates a post-launch data product with a version of 9.240.</td></tr>
<tr><td>NNN</td><td>Number of times the file was generated under the same version for a particular date/time interval (001: 1st time)</td></tr>
<tr><td>.[ext]</td><td>File extensions include: .h5 (HDF5 data file)</td></tr>
</table>

1.4 Spatial Information

Coverage

SPL1BTB_RFICAL spans from 180°W to 180°E, and from approximately 86.4°N to 86.4°S. The swath width is 1000 km, enabling nearly global coverage every two to three days.

Resolution

The SMAP radiometer records microwave emissions with a spatial resolution of about 40 km. Since the data are unaveraged and time-ordered, individual samples are not provided on a regular grid.

Geolocation

Geolocation information is provided for each radiometer observation, including latitude, longitude, and associated geometry parameters. The World Reference System WGS84 ellipsoid is used

define the horizontal Earth reference coordinates and the WGS84 geoid is used for the vertical Earth reference coordinates.

1.5 Temporal Information

Coverage

As of April 2026, forward processing has been published for this data set. Reprocessed data for 2015 – 2016 will be added over the coming months, for an eventual temporal coverage that spans from 31 March 2015 to present.

Resolution

Each Level-1B half-orbit file spans approximately 49 minutes. The SMAP orbit yields a 2-3 day average revisit frequency and repeats the exact swath every 8 days.

2 DATA ACQUISITION AND PROCESSING

2.1 Background

The SMAP mission carries an L-band radiometer designed to measure microwave emissions from the Earth's surface. These measurements are sensitive to soil moisture but can be affected by RFI and instrument calibration effects. The SPL1BTB_RFICAL product was developed to provide transparency into these intermediate measurement stages.

For an in-depth description of the theory of these measurements, refer to the Product Specification Document for this data set (Mohammed-Tano, 2025).

2.2 Acquisition

Radiometer measurements are acquired continuously along the SMAP orbit using a conically scanning antenna. Observations are collected at L-band (1.41 GHz) in both horizontal and vertical polarizations, with data recorded for fullband and subband channels.

2.3 Processing

This product is generated by the SMAP Science Data Processing System (SDS) at the Jet Propulsion Laboratory (JPL) in Pasadena, California USA. To generate this product, the processing software ingests both descending and ascending half-orbit files of the Level-1A brightness

temperature data. The descending half orbits contain data acquired at very nearly 6:00 a.m. local solar time. The ascending half orbits contain data acquired at very nearly 6:00 p.m. local solar time.

SMAP orbits begin at the southernmost point on the orbit path. The SMAP spacecraft launched into orbit 0 and orbit 1 began as the spacecraft crossed the southernmost location for the first time. Based on acquired thermal emissions from the Earth's surface, the radiometer performs sub-channelization, cross-correlation for measurement of the 3rd and 4th Stokes parameters, as well as detection and integration of the first four raw moments of the horizontal and vertical polarization signals. These data are packetized and sent to the ground for calibration and further processing.

Each set of data is associated with a pulse repetition interval(PRI)/packet of radiometer counts. For every PRI of the radar, the radiometer integrates ~300 µs within the receive window. The exact integration time varies based on the radar PRI length and blanking time length chosen by the instrument designers. Radiometer packets are made up of 4 PRIs. Each science data packet includes both fullband data for each of the four PRIs as well as subbanded data, which have been further integrated into 4 PRIs or ~1.2 ms.

The SPL1BTB_RFICAL product contains calibrated unaveraged antenna temperatures (TAs) which are inputs to the SPL1BTB radio frequency interference detection and mitigation algorithms. SPL1BTB_RFICAL includes both the fullband (24-MHz wide) and 16 subband (each 1.5 MHz wide) unaveraged antenna temperatures for both polarizations and the 3rd and 4th Stokes parameters with RFI detection method applied. Pulse detection is implemented on the fullband data while cross-frequency is implemented on subband data. RFI flags from the individual detection algorithms, the combined RFI flag, and calibration coefficients are part of the SPL1BTB_RFICAL product. Some products from the SPL1BTB product are also included, such as top of the ionosphere footprints, top of the atmosphere footprints, and geolocation.

2.4 Quality, Errors, and Limitations

Key limitations of the SPL1BTB_RFICAL product include:

- Data are intermediate and unaveraged
- RFI is identified but not removed
- Calibration parameters are subject to instrument performance uncertainties
- Not suitable for direct geophysical interpretation

Users should consult higher-level SMAP products for science applications.

3 VERSION HISTORY

Table 2. Version History Summary

Version	Release Date	Description of Changes
V006	April 2026	Initial public data release.

4 RELATED DATA SETS

SMAP Data at NSIDC | Overview

SMAP Radar Data at the ASF DAAC

5 REFERENCES

Mohammed-Tano. 2025. Soil Moisture Active Passive (SMAP) Project Radiometer Level 1B_RFICAL Product Specification Document. Jet Propulsion Laboratory, Pasadena, CA. (see PDF).

6 DOCUMENT INFORMATION

6.1 Publication Date

April 2026

6.2 Date Last Updated

April 2026

7 APPENDIX - PARAMETERS

RFI_ref_flag (Subband_RFI_Cal)

RFI flags indicate which pixels have been flagged by the cross frequency and subband kurtosis RFI detection algorithms for the subband reference counts. Table A1 specifies the meaning of individual bits in the *RFI_ref_flag*.

Table A1: RFI_ref_flag

Bits	Value	Interpretation
0		**V-pol in phase cross-frequency detection**
	0	RFI not detected
	1	RFI detected
1		**V-pol quadrature cross-frequency detection**
	0	RFI not detected
	1	RFI detected
2-5		**Undefined**
6		**H-pol in phase cross-frequency detection**
	0	RFI not detected
	1	RFI detected
7		**H-pol quadrature cross-frequency detection**
	0	RFI not detected
	1	RFI detected
8		**V-pol subband kurtosis detection**
	0	RFI not detected
	1	RFI detected
9		**H-pol subband kurtosis detection**
	0	RFI not detected
	1	RFI detected.
10-15		**Undefined**

RFI_ref_flag is a three-dimensional array. The slowest moving dimension index represents the antenna scan. The second-dimension index represents the number of packets in the reference radiometric state in the antenna scan and the third index represents the 16 subbands.

Type: Uint16
Group: Subband RFI Cal
Shape: AntennaScan_RefPacket_Subband_Array
Units: n/a

RFI_refnd_flag (Subband_RFI_Cal)

RFI flags indicate which subband packets have been flagged by the cross frequency and the subband kurtosis RFI detection algorithms for the subband reference plus noise diode counts. Table A2 specifies the meaning of individual bits in the *RFI_refnd_flag*.

Table A2: RFI_refnd_flag

Bits	Value	Interpretation
0		**V-pol in phase cross-frequency detection**
	0	RFI not detected
	1	RFI detected
1		**V-pol quadrature cross-frequency detection**
	0	RFI not detected
	1	RFI detected
2-5		**Undefined**
6		**H-pol in phase cross-frequency detection**
	0	RFI not detected
	1	RFI detected
7		**H-pol quadrature cross-frequency detection**
	0	RFI not detected
	1	RFI detected
8		**V-pol subband kurtosis detection**
	0	RFI not detected
	1	RFI detected
9		**H-pol subband kurtosis detection**
	0	RFI not detected

Bits	Value	Interpretation
	1	RFI detected.
10-15		**Undefined**

RFI_refnd_flag is a three-dimensional array. The slowest moving dimension index represents the antenna scan. The second-dimension index represents the number of packets in the reference plus noise diode radiometric state in the antenna scan and the third index represents the 16 subbands.

Type: Uint16
Group: Subband RFI Cal
Shape: AntennaScan_RefNdPacket_Subband_Array
Units: n/a

kurt16_h

k*urt16_h* is a three-dimensional array of the subband kurtosis values for the horizontal polarization. The slowest moving dimension index represents the antenna scan, the second-dimension index represents the number of packets in the antenna radiometric state in the antenna scan and the third index represents the 16 subbands.

Type: Float32
Group: Subband RFI Cal
Shape: AntennaScan_AntPacket_Subband_Array
Valid_min: 1
Valid_max: ∞
Units: n/a

kurt16_v

k*urt16_v* is a three-dimensional array of the subband kurtosis values for the vertical polarization. The slowest moving dimension index represents the antenna scan, the second-dimension index represents the number of packets in the antenna radiometric state in the antenna scan and the third index represents the 16 subbands.

Type: Float32
Group: Subband RFI Cal
Shape: AntennaScan_AntPacket_Subband_Array
Valid_min: 1
Valid_max: ∞

Units: n/a

subband_RFI_flag

The RFI flags indicate which subband packets have been flagged by the RFI detection algorithms for the subband antenna temperatures. Table A3 specifies the meaning of individual bits in the *subband_RFI_flag*.

Table A3: subband_RFI_flag

Bits	Value	Interpretation
0		**V-pol cross frequency detection**
	0	RFI not detected
	1	RFI detected
1		**H-pol cross frequency detection**
	0	RFI not detected
	1	RFI detected
2		**V-pol kurtosis subband detection**
	0	RFI not detected
	1	RFI detected
3		**H-pol kurtosis subband detection**
	0	RFI not detected
	1	RFI detected
4		**T3 subband detection**
	0	RFI not detected
	1	RFI detected
5		**T4 subband detection**
	0	RFI not detected
	1	RFI detected
6		**V-pol MAXPD subband**
	0	RFI not detected
	1	RFI detected
7		**H-pol MAXPD subband**
		RFI not detected
		RFI detected

Bits	Value	Interpretation
8-15		**Undefined**

subband_RFI_flag is a three-dimensional array. The slowest moving dimension index represents the antenna scan, the second-dimension index represents the number of antenna temperature packets in the antenna scan and the third index represents the 16 subbands.

Type: Uint8
Group: Subband RFI Cal
Shape: AntennaScan_AntPacket_Subband_Array
Units: n/a

subband_calibration_gain16

This is the subband calibration gain used to derive antenna temperature values. s*ubband_calibration_gain16* is a four-dimensional array. The first dimension or the slowest moving dimension index represents the antenna scan. The second-dimension index represents the number of antenna temperature packets in the antenna scan. The third index represents the 16 subbands and the fourth index is the polarization with the order of storage being v, h.

Type: Float32
Group: Subband RFI Cal
Shape: AntennaScan_AntPacket_Subband_Polarization_Array
Valid_min: -1.41×10^{16}
Valid_max: 1.41×10^{16}
Units: Counts/Kelvin

subband_calibration_offset16

This is the subband calibration offset used to derive antenna temperature values. s*ubband_calibration_offset16* is a four-dimensional array. The first dimension or the slowest moving dimension index represents the antenna scan. The second-dimension index represents the number of antenna temperature packets in the antenna scan. The third index represents the 16 subbands and the fourth index is the polarization with the order of storage being v, h.

Type: Float32
Group: Subband RFI Cal
Shape: AntennaScan_AntPacket_Subband_Polarization_Array
Valid_min: -4.49×10^{18}

Valid_max: 7.37×10^{18}
Units: Counts

subband_latitude

This is the latitude of the antenna look packet on the surface of the Earth.

subband_latitude is a two-dimensional array. The slower moving dimension index represents the antenna scan. The faster moving dimension index represents the number of packets in the antenna state in the scan.

Type: Float32
Group: Subband RFI Cal
Shape: AntennaScan_AntPacket_Array
Valid_min: -90
Valid_max: 90
Units: degrees

subband_longitude

This is the longitude of the antenna look packet on the surface of the Earth.

subband_longitude is a two-dimensional array. The slower moving dimension index represents the antenna scan. The faster moving dimension index represents the number of packets in the antenna state in the scan.

Type: Float32
Group: Subband RFI Cal
Shape: AntennaScan_AntPacket_Array
Valid_min: -180
Valid_max: 180
Units: degrees

ta16_3

This is the subband 3rd Stokes parameter with a resolution of 4 pulse repetition intervals (PRIs) or ~1.2 ms. *ta16_3* is a three-dimensional array. The first dimension or the slowest moving dimension index represents the antenna scan. The second-dimension index represents the number of packets with data in the antenna scan and the third index represents the 16 subbands.

Type: Float32

Group: Subband RFI Cal
Shape: AntennaScan_AntPacket_Subband_Array
Valid_min: -50
Valid_max: 50
Units: Kelvin

ta16_4

This is the subband 4th Stokes parameter with a resolution of 4 pulse repetition intervals (PRIs) or ~1.2 ms. *ta16_4* is a three-dimensional array. The first dimension or the slowest moving dimension index represents the antenna scan. The second-dimension index represents the number of packets with data in the antenna scan and the third index represents the 16 subbands.

Type: Float32
Group: Subband RFI Cal
Shape: AntennaScan_AntPacket_Subband_Array
Valid_min: -50
Valid_max: 50
Units: Kelvin

ta16_h

The subband horizontal antenna temperature with a resolution of 4 pulse repetition intervals (PRIs) or ~1.2 ms. *ta16_h* is a three-dimensional array. The first dimension or the slowest moving dimension index represents the antenna scan. The second-dimension index represents the number of packets with data in the antenna scan and the third index represents the 16 subbands.

Type: Float32
Group: Subband RFI Cal
Shape: AntennaScan_AntPacket_Subband_Array
Valid_min: 0
Valid_max: 310
Units: Kelvin

ta16_v

This is the subband vertical antenna temperature with a resolution of 4 pulse repetition intervals (PRIs) or ~1.2 ms. *ta16_v* is a three-dimensional array. The first dimension or the slowest moving dimension index represents the antenna scan. The second-dimension index represents the number of packets with data in the antenna scan and the third index represents the 16 subbands.

Type: Float32
Group: Subband RFI Cal
Shape: AntennaScan_AntPacket_Subband_Array
Valid_min: 0
Valid_max: 310
Units: Kelvin

subband_footprint_flag

The RFI flags indicate which pixels have been flagged by the cross frequency RFI detection algorithm for the subband antenna temperatures averaged to 9.6 ms. Table A4 specifies the meaning of individual bits in the *subband_footprint_flag*.

Table A4: subband_footprint_flag

Bits	Value	Interpretation
0		**V-pol cross-frequency detection**
	0	RFI not detected
	1	RFI detected
1		**H-pol cross-frequency detection**
	0	RFI not detected
	1	RFI detected
2-15		**Undefined**

Type: Uint8
Group: Subband Footprint
Shape: AntennaScan_Footprint_Subband_Array
Units: n/a

RFI_ref_flag (Fullband_RFI_Cal)

The RFI flags indicate which pixels have been flagged by the time domain and the fullband kurtosis RFI detection algorithms for the fullband reference counts. Table A5 specifies the meaning of individual bits in the *RFI_ref_flag*.

Table A5: RFI_ref_flag

Bits	Value	Interpretation
0		**V-pol in phase time domain detection**

Bits	Value	Interpretation
	0	RFI not detected
	1	RFI detected
1		**V-pol quadrature time domain detection**
	0	RFI not detected
	1	RFI detected
2		**H-pol in phase time domain detection**
	0	RFI not detected
	1	RFI detected
3		**H-pol quadrature time domain detection**
	0	RFI not detected
	1	RFI detected
4		**V-pol fullband kurtosis detection**
	0	RFI not detected
	1	RFI detected
5		**H-pol fullband kurtosis detection**
	0	RFI not detected
	1	RFI detected.
6-15		**Undefined**

RFI_ref_flag is a two-dimensional array. The slowest moving dimension index represents the antenna scan. The second-dimension index represents the number of PRIs in the reference radiometric state in the antenna scan.

Type: Uint16
Group: Fullband RFI Cal
Shape: AntennaScan_RefPRI_Array
Units: n/a

RFI_refnd_flag (Fullband_RFI_Cal)

The RFI flags indicate which pixels have been flagged by the tie domain and the fullband kurtosis RFI detection algorithms for the fullband reference plus noise diode counts. Table A6 specifies the meaning of individual bits in the *RFI_refnd_flag*.

Table A6: RFI_refnd_flag

Bits	Value	Interpretation
0		**V-pol in phase time domain detection**
	0	RFI not detected
	1	RFI detected

Bits	Value	Interpretation
1		**V-pol quadrature time domain detection**
	0	RFI not detected
	1	RFI detected
2		**H-pol in phase time domain detection**
	0	RFI not detected
	1	RFI detected
3		**H-pol quadrature time domain detection**
	0	RFI not detected
	1	RFI detected
4		**V-pol fullband kurtosis detection**
	0	RFI not detected
	1	RFI detected
5		**H-pol fullband kurtosis detection**
	0	RFI not detected
	1	RFI detected.
6-15		**Undefined**

RFI_refnd_flag is a two-dimensional array. The slowest moving dimension index represents the antenna scan. The second-dimension index represents the number of PRIs in the reference plus noise diode radiometric state in the antenna scan.

Type: Uint16
Group: Fullband RFI Cal
Shape: AntennaScan_RefNdPRI_Array
Units: n/a

fullband_RFI_flag

The RFI flags indicate which fullband antenna temperatures have been flagged by the fullband RFI detection algorithms. Table A7 specifies the meaning of individual bits in the *fullband_RFI_flag*.

Table A7: fullband_RFI_flag

Bits	Value	Interpretation
0		**V-pol time domain detection**
	0	RFI not detected
	1	RFI detected
1		**H-pol time domain detection**
	0	RFI not detected
	1	RFI detected

Bits	Value	Interpretation
2		**V-pol kurtosis fullband detection**
	0	RFI not detected
	1	RFI detected
3		**H-pol kurtosis fullband detection**
	0	RFI not detected
	1	RFI detected
4		**T3 fullband detection**
	0	RFI not detected
	1	RFI detected
5		**T4 fullband detection**
	0	RFI not detected
	1	RFI detected
6-15		**Undefined**

fullband_RFI_flag is a two-dimensional array. The slowest moving dimension index represents the antenna scan. The second-dimension index represents the number of antenna temperature PRIs in the antenna scan.

Type: Uint8
Group: Fullband RFI Cal
Shape: AntennaScan_AntPRI_Array
Units: n/a

fullband_calibration_gain

The fullband calibration gain is used to derive fullband antenna temperature values. *fullband_calibration_gain* is a three-dimensional array. The first dimension or the slowest moving dimension index represents the antenna scan. The second-dimension index represents the number of antenna temperature PRIs in the antenna scan and the third index is the polarization. The order of storage is v, h.

Type: Float32
Group: Fullband RFI Cal
Shape: AntennaScan_AntPRI_Polarization_Array
Valid_min: -5.99×10^{16}
Valid_max: 5.99×10^{16}
Units: Counts/Kelvin

fullband_calibration_offset

The fullband calibration offset is used to derive fullband antenna temperature values. *fullband_calibration_offset* is a three-dimensional array. The first dimension or the slowest moving dimension index represents the antenna scan. The second-dimension index represents the number of antenna temperature PRIs in the antenna scan and the third index is the polarization. The order of storage is v, h.

Type: Float32
Group: Fullband RFI Cal
Shape: AntennaScan_AntPRI_Polarization_Array
Valid_min: -1.88×10^{19}
Valid_max: 3.06×10^{19}
Units: Counts

fullband_kurt_h

This is the fullband kurtosis values for the horizontal polarization. *fullband_kurt_h* is a two-dimensional array. The slowest moving dimension index represents the antenna scan, and the second-dimension index represents the number of PRIs in the antenna radiometric state in the antenna scan.

Type: Float32
Group: Fullband RFI Cal
Shape: AntennaScan_AntPRI_Array
Valid_min: 1
Valid_max: ∞
Units: n/a

fullband_kurt_v

This is the fullband kurtosis values for vertical the polarization. *fullband_kurt_v* is a two-dimensional array. The slowest moving dimension index represents the antenna scan, and the second-dimension index represents the number of PRIs in the antenna radiometric state in the antenna scan.

Type: Float32
Group: Fullband RFI Cal
Shape: AntennaScan_AntPRI_Array
Valid_min: 1
Valid_max: ∞
Units: n/a

fullband_latitude

This is the latitude of the antenna-look PRI on the surface of the Earth. *fullband_latitude* is a two-dimensional array. The slower moving dimension index represents the antenna scan, and the faster moving dimension index represents the number of PRIs in the antenna state in the scan.

Type: Float32
Group: Fullband RFI Cal
Shape: AntennaScan_AntPRI_Array
Valid_min: -90
Valid_max: 90
Units: degrees

fullband_longitude

This is the longitude of the antenna-look PRI on the surface of the Earth. *fullband_longitude* is a two-dimensional array. The slower moving dimension index represents the antenna scan, and the faster moving dimension index represents the number of PRIs in the antenna state in the scan.

Type: Float32
Group: Fullband RFI Cal
Shape: AntennaScan_AntPRI_Array
Valid_min: -180
Valid_max: 180
Units: degrees

fullband_ta_3

This is the fullband 3rd Stokes parameter of radiometer data with a resolution of ~300 μs or one pulse repetition interval (PRI). *fullband_ta_3* is a two-dimensional array. The first dimension or the slowest moving dimension index represents the antenna scan, and the second-dimension index represents the number of PRIs with data in the antenna scan.

Type: Float32
Group: Fullband RFI Cal
Shape: AntennaScan_AntPRI_Array
Valid_min: -50
Valid_max: 50
Units: Kelvin

fullband_ta_4

This is the fullband 4th Stokes parameter with a resolution of ~300 µs or one pulse repetition interval (PRI). f*ullband_ta_4* is a two-dimensional array. The first dimension or the slowest moving dimension index represents the antenna scan, and the second-dimension index represents the number of PRIs with data in the antenna scan.

Type: Float32
Group: Fullband RFI Cal
Shape: AntennaScan_AntPRI_Array
Valid_min: -50
Valid_max: 50
Units: Kelvin

fullband_ta_h

This is the fullband horizontal antenna temperatures with a resolution of ~300 µs or one pulse repetition interval (PRI). *fullband_ta_h* is a two-dimensional array. The first dimension or the slowest moving dimension index represents the antenna scan, and the second-dimension index represents the number of PRIs in the antenna scan.

Type: Float32
Group: Fullband RFI Cal
Shape: AntennaScan_AntPRI_Array
Valid_min: 0
Valid_max: 310
Units: Kelvin

fullband_ta_v

This is the fullband vertical antenna temperature with a resolution of ~300 µs or one pulse repetition interval (PRI). *fullband_ta_v* is a two-dimensional array. The first dimension or the slowest moving dimension index represents the antenna scan, and the second-dimension index represents the number of PRIs with data in the antenna scan.

Type: Float32
Group: Fullband RFI Cal
Shape: AntennaScan_AntPRI_Array
Valid_min: 0

Valid_max: 310
Units: Kelvin

fullband_MaxPD_flag

The RFI flags indicate which pixels have been flagged by the fullband RFI detection algorithms for the fullband antenna temperatures. This is a composite flag which is a logical OR of all the bits in **fullband_RFI_flag**. Table A8 specifies the meaning of individual bits in the *fullband_MaxPD_flag*. These flags are only enabled when the antenna scan is in low resolution mode.

Table A8: subband_footprint_flag

Bits	Value	Interpretation
0		**V-pol fullband MaxPD flag**
	0	RFI not detected
	1	RFI detected
1		**H-pol fullband MaxPD flag**
	0	RFI not detected
	1	RFI detected
3		**High resolution bit**
	0	Antenna scan is not in high resolution (low resolution)
	1	Antenna scan is in high resolution
4-15		**Not defined**

Type: Uint8
Group: Fullband MaxPD Cal
Shape: AntennaScan_AntPRI_Array
Units: n/a

tap_toa_3

This is the apparent 3rd Stokes parameter at the top of the atmosphere after RFI detection and filtering. The top of atmosphere is equivalent to the bottom of the ionosphere.

The Faraday Rotation Correction algorithm in the L1B_TB executable sets the 3rd Stokes to zero and then recalculates the apparent top of atmosphere temperature vector with non-zero vertical and horizontal brightness temperatures. Thus, this element always displays a value of 0. Users who are interested in 3rd Stokes measure derived from instrument data should inspect either the

antenna temperatures or the top of ionosphere temperatures. Details of the Faraday Rotation Correction algorithm appear in the Algorithm Theoretical Basis Document for the SMAP Level 1B Radiometer Data Product.

tap_toa_3 is a 2-dimensional array. The slower moving dimension index represents the antenna scan, and the faster moving dimension index represents each of the footprints in the scan.

Type: Float32
Group: Intermediary Temperature Data
Shape: AntennaScan_Tb_Array
Valid_min: -50
Valid_max: 50
Units: Kelvin

tap_toa_4

This is the apparent 4th Stokes parameter at the top of the atmosphere after RFI detection and filtering. The top of atmosphere is equivalent to the bottom of the ionosphere.

tap_toa_4 is a 2-dimensional array. The slower moving dimension index represents the antenna scan, and the faster moving dimension index represents each of the footprints in the scan.

Type: Float32
Group: Intermediary Temperature Data
Shape: AntennaScan_Tb_Array
Valid_min: -50
Valid_max: 50
Units: Kelvin

tap_toa_h

This is the horizontally polarized apparent brightness temperature at the top of the atmosphere after RFI detection and filtering. The top of atmosphere is equivalent to the bottom of the ionosphere.

tap_toa_h is a 2-dimensional array. The slower moving dimension index represents the antenna scan, and the faster moving dimension index represents each of the footprints in the scan.

Type: Float32
Group: Intermediary Temperature Data

Shape: AntennaScan_Tb_Array
Valid_min: 0
Valid_max: 310
Units: Kelvin

tap_toa_v

This is the vertically polarized apparent brightness temperature at the top of the atmosphere after RFI detection and filtering. The top of atmosphere is equivalent to the bottom of the ionosphere.

tap_toa_v is a 2-dimensional array. The slower moving dimension index represents the antenna scan, and the faster moving dimension index represents each of the footprints in the scan.

Type: Float32
Group: Intermediary Temperature Data
Shape: AntennaScan_Tb_Array
Valid_min: 0
Valid_max: 310
Units: Kelvin

tap_toi_3

This is the apparent 3rd Stokes parameter at the top of the ionosphere after RFI detection and filtering.

tap_toi_3 is a 2-dimensional array. The slower moving dimension index represents the antenna scan, and the faster moving dimension index represents each of the footprints in the scan.

Type: Float32
Group: Intermediary Temperature Data
Shape: AntennaScan_Tb_Array
Valid_min: -50
Valid_max: 50
Units: Kelvin

tap_toi_4

This is the apparent 4th Stokes parameter at the top of the ionosphere after RFI detection and filtering.

tap_toi_4 is a 2-dimensional array. The slower moving dimension index represents the antenna scan, and the faster moving dimension index represents each of the footprints in the scan.

Type: Float32
Group: Intermediary Temperature Data
Shape: AntennaScan_Tb_Array
Valid_min: -50
Valid_max: 50
Units: Kelvin

tap_toi_h

This is the horizontally polarized apparent brightness temperature at the top of the ionosphere after RFI detection and filtering.

tap_toi_h is a 2-dimensional array. The slower moving dimension index represents the antenna scan, and the faster moving dimension index represents each of the footprints in the scan.

Type: Float32
Group: Intermediary Temperature Data
Shape: AntennaScan_Tb_Array
Valid_min: 0
Valid_max: 310
Units: Kelvin

tap_toi_v

This is the vertically polarized apparent brightness temperature at the top of the ionosphere after RFI detection and filtering.

tap_toi_v is a 2-dimensional array. The slower moving dimension index represents the antenna scan, and the faster moving dimension index represents each of the footprints in the scan.

Type: Float32
Group: Intermediary Temperature Data
Shape: AntennaScan_Tb_Array
Valid_min: 0
Valid_max: 310
Units: Kelvin

antenna_azimuth_angle

The antenna_azimuth_angle records the clockwise rotation from the projection of the Earth's North polar axis onto the XY plane of the SMAP Spacecraft Coordinate System to the projection of the antenna boresight vector onto the XY plane of the SMAP spacecraft coordinate system. The vertex of the angle is at the origin of the Spacecraft Coordinate System.

antenna_azimuth_angle is a 2-dimensional array. The slower moving dimension index represents the antenna scan, and the faster moving dimension index represents each of the footprints in the scan.

Type: Float32
Group: Geolocation
Shape: AntennaScan_Tb_Array
Valid_min: 0
Valid_max: 359.999
Units: degrees

antenna_scan_angle

The angular position of the antenna boresight projected onto the X-Y plane of the spacecraft coordinate system. The antenna_scan_angle is zero when the antenna boresight aligns with the X axis of the spacecraft coordinate system. Angular measure increases as the antenna rotates counterclockwise.
antenna_scan_angle is a 2-dimensional array. The slower moving dimension index represents the antenna scan, and the faster moving dimension index represents each of the footprints in the scan.

Type: Float32
Group: Geolocation
Shape: AntennaScan_Tb_Array
Valid_min: 0
Valid_max: 359.999
Units: degrees

tb_lat

This is the geodetic latitude of the intersection of the antenna boresight vector and the Earth’s surface.

tb_lat is a 2-dimensional array. The slower moving dimension index represents the antenna scan, and the faster moving dimension index represents each of the footprints in the scan.

Type: Float32
Group: Geolocation
Shape: AntennaScan_Tb_Array
Valid_min: -90
Valid_max: 90
Units: degrees

tb_lon

This is the longitude of the intersection of the antenna boresight vector and the Earth's surface.

tb_lon is a 2-dimensional array. The slower moving dimension index represents the antenna scan, and the faster moving dimension index represents each of the footprints in the scan.

Type: Float32
Group: Geolocation
Shape: AntennaScan_Tb_Array
Valid_min: -180
Valid_max: 179.999
Units: degrees