

TMI Profiling 2A-12 Swath Data [L2A_12_SWATHDATA]

The following parameters are used in describing the formats:

- nscan: the number of scans within one granule ($2891 + 50 + 50 = 2991$, on average).
- npixel: the number of high resolution pixels within one scan line (208).
- nlayer: the number of profiling layers within one pixel (14).
- ngeo: the number of geolocation data (2).

Scan Time (Vdata Table, record size 9 bytes, nscan records):

The Scan Time is the time associated with each scan.

Name	Name in the TOOLKIT	Format	Description
Year	scanTime.year	2-byte integer	4-digit year, e.g., 1998.
Month	scanTime.month	1-byte integer	The month of the Year.
Day of Month	scanTime.dayOfMonth	1-byte integer	The day of Month.
Hour	scanTime.hour	1-byte integer	The hour (UTC) of the Day.
Minute	scanTime.minute	1-byte integer	The minute of the Hour.
Second	scanTime.second	1-byte integer	The second of the Minute.
Day of Year	scanTime.dayOfYear	2-byte integer	The day of the Year.

Geolocation (SDS, array size ngeo x npixel x nscan, 4-byte float):

Name	Name in the TOOLKIT	Format	Description
Geolocation	geolocation(2,208)	4-byte float	The earth location of the center of the IFOV of the high resolution (85 GHz) channels (channels 8 and 9) at the altitude of the earth ellipsoid. The first dimension is latitude and longitude, in that order. The next dimensions are high resolution pixel and scan. Values are represented as floating point decimal degrees. Off-earth is represented as less than or equal to -9999.9 Latitude is positive north, negative south. Longitude is positive east, negative west. A point on the 180th meridian is assigned to the western hemisphere.

Scan Status (Vdata Table, record size 21 bytes, nscan records):

The status of each scan is represented in terms of quality, platform and instrument control data, and fractional

orbit number. All bytes in the Scan Status are copied from the 1B-11 Scan Status including the Missing byte. 2A-12 should reset the Missing byte if it determines data is missing or there is no-rain.

Name	Name in the TOOLKIT	Format	Description
Missing	scanStatus.missing	1-byte integer	Missing indicates whether information is contained in the scan data. The values are: 0: Scan data elements contain information 1: Scan was missing in the telemetry data

			2: Scan data contains no elements with rain
Validity	scanStatus.validity	1-byte integer	<p>Validity is a summary of status modes. If all status modes are routine, all bits in Validity = 0. Routine means that scan data has been measured in the normal operational situation as far as the status modes are concerned. Validity does not assess data or geolocation quality. Validity is broken into 8 bit flags. Each bit = 0 if the status is routine but the bit = 1 if the status is not routine. Bit 0 is the least significant bit (i.e., if bit i = 1 and other bits = 0, the unsigned integer value is $2^{(8-i)-1}$). The non-routine situations follow:</p> <p>Bit Meaning if bit = 1</p> <ul style="list-style-type: none"> 0: Spare (always 0) 1: Non-routine spacecraft orientation (2 or 3) 2: Non-routine ACS mode (other than 4) 3: Non-routine yaw update status (0 or 1) 4: Non-routine TMI status (Bit 0 = 0 or 1 = 0) 5: Non-routine QAC (non-zero) 6: Spare (always 0) 7: Spare (always 0)
QAC	scanStatus.qac	1-byte integer	<p>The Quality and Accounting Capsule of the Science packet as it appears in Level-0 data. If no QAC is given in Level-0, which means no decoding errors occurred, QAC in this format has a value of zero.</p>
Geolocation Quality	scanStatus.geoQuality	1-byte integer	<p>Geolocation Quality is broken into 8 one-bit flags. Bit 0 is the most significant bit (i.e., if bit i = 1 and other bits = 0, the unsigned integer value is $2^{(8-i)-1}$). A value of 0 indicates 'good' quality, and 1 indicates 'bad' quality. Each flag is listed below. Note that ranges indicated will be refined in early-orbit check out.</p> <p>Bit Meaning if bit = 1</p> <ul style="list-style-type: none"> 0: Grossly bad geolocation results: <ul style="list-style-type: none"> • Spacecraft position vector magnitude outside range 6720 to 6740 km. • Z component of midpoint of scan outside range - 4100 to 4100 km. • Distance from S/C to midpoint of scan outside range 340 to 360 km. 1: Unexpectedly large scan to scan jumps in geolocated positions in along and cross track directions for first, middle, and last pixels in each scan. Allowed duration from nominal jump in along track motion = 0.06 km (first pixel), 0.04 km (middle pixel), and 0.06 km (last pixel). Allowed duration from nominal jump in cross track motion = 0.05 km (first pixel), 0.04 km (middle pixel), and 0.05 km (last pixel). Bit set in normal mode only. 2: Scan to scan jumps in yaw, pitch, and roll exceed maximum values. Values are : yaw = 0.0001 radians; pitch = 0.0001 radians; roll = 0.0001 radians. Bit set in normal control mode only.

			<p>3: In normal mode, yaw outside range (-0.003, 0.003) radians; pitch outside range (-0.007, 0.007) radians; roll outside range (-0.007, 0.007).</p> <p>4: Satellite undergoing maneuvers during which geolocation will be less accurate.</p> <p>5: Questionable ephemeris quality (including use of predicted Ephemeris for quicklook) or questionable UTCF quality.</p> <p>6: Geolocation calculations failed (fill values inserted in the per pixel geolocation products, but not in metadata).</p> <p>7: Missing attitude data. ACS data gap larger than 20 seconds.</p>
Data Quality [9]	scanStatus.ch1 scanStatus.ch2 scanStatus.ch3 scanStatus.ch4 scanStatus.ch5 scanStatus.ch6 scanStatus.ch7 scanStatus.ch8 scanStatus.ch9	9 x 1-byte integer	The Quality of Channel Data for a given channel on a given scan line is the percentage of pixels whose values are within the acceptable range listed in the Metadata. Quality is given for each channel in the order of the channel number.
Current Spacecraft Orientation	scanStatus.scOrient	1-byte integer	Value Meaning 0: +x forward 1: -x forward 2: -y forward 3: Inertial - CERES Calibration 4: Unknown Orientation
Current ACS Mode	scanStatus.acsMode	1-byte integer	Value Meaning 0: Standby 1: Sun Acquire 2: Earth Acquire 3: Yaw Acquire 4: Nominal 5: Yaw Maneuver 6: Delta-H (Thruster) 7: Delta-V (Thruster) 8: CERES Calibration
Yaw Update Status	scanStatus.yawUpdateS	1-byte integer	Value Meaning 0: Inaccurate 1: Indeterminate 2: Accurate
TMI Instrument Status	scanStatus.tmiISstatus	1-byte integer	Bit 0 is the most significant bit (i.e., if bit i = 1 and other bits = 0, the unsigned integer value is 2** (8-i) - 1). Bit Meaning 00 Receiver Status (1=ON, 0=OFF) 01 Spin-up Status (1=ON, 0=OFF) 02 Spare Command 1 Status 03 Spare Command 2 Status 04 1 Hz Clock Select (1=A, 0=B) 05 21 GHz Cold Count Flag 06 Spare Command 4 Status 07 Spare Command 5 Status

Fractional Orbit Number	scanStatus.fracOrbitN	4-byte float	The orbit number and fractional part of the orbit at Scan Time. The orbit number will be counted from the beginning of the mission. The fractional part is calculated as: (Time - Orbit Start Time) / (Orbit End Time - Orbit Start Time)
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Navigation (Vdata, record size 88 bytes, nscan records):

Name	Name in the TOOLKIT	Format	Description
Spacecraft Geocentric Position [3]	navigate.scPosX navigate.scPosY navigate.scPosZ	3 X 4-byte float	The position (m) of the spacecraft in Geocentric Inertial Coordinates at the Scan mid-Time (i.e., time at the middle pixel/IFOV of the active scan period). The order of components is: x, y, and z. Geocentric Inertial Coordinates are also commonly known as Earth Centered Inertial coordinates. These coordinates will be True of Date (rather than Epoch 2000 which are also commonly used), as interpolated from the data in the Flight Dynamics Facility ephemeris files generated for TRMM.
Spacecraft Geocentric Velocity [3]	navigate.scVelX navigate.scVelY navigate.scVelZ	3 X 4-byte float	The velocity (ms^{-1}) of the spacecraft in Geocentric Inertial Coordinates at the Scan mid-Time. The order of components is: x, y, and z.
Spacecraft Geodetic Latitude	navigate.scLat	4-byte float	The geodetic latitude (decimal degrees) of the spacecraft at the Scan mid-Time.
Spacecraft Geodetic Longitude	navigate.scLon	4-byte float	The geodetic longitude (decimal degrees) of the spacecraft at the Scan mid-Time. Range is -180 to 179.999999.
Spacecraft Geodetic Altitude	navigate.scAlt	4-byte float	The altitude (m) of the spacecraft above the Earth Ellipsoid at the Scan mid-Time.
Spacecraft Attitude [3]	navigate.scAttRoll navigate.scAttPitch navigate.scAttYaw	3 X 4-byte float	The satellite attitude Euler angles at the Scan mid-Time. The order of the components in the file is roll, pitch, and yaw. However, the angles are computed using a 3-2-1 Euler rotation sequence representing the rotation order yaw, pitch, and roll for the rotation from Orbital Coordinates to the spacecraft body coordinates. Orbital Coordinates represent an orthogonal triad in Geocentric Inertial Coordinates where the Z-axis is toward the geocentric nadir, the Y-axis is perpendicular to the spacecraft velocity opposite the orbit normal direction, and the X-axis is approximately in the velocity direction for a near circular orbit. Note this is geocentric, not geodetic, referenced, so that pitch and roll will have twice orbital frequency components due to the onboard control system following the oblate geodetic Earth horizon. Note also that the yaw value will show an orbital frequency component relative to the Earth fixed ground track due to the Earth rotation relative to inertial coordinates.
Sensor Orientation Matrix [3 X 3]	navigate.att1 navigate.att2 navigate.att3 navigate.att4 navigate.att5	3 X 3 X 4-byte float	The rotation matrix from the instrument coordinate frame to Geocentric Inertial Coordinates at the Scan mid-Time.

	navigate.att6 navigate.att7 navigate.att8 navigate.att9		
Greenwich Hour Angle	navigate.greenHourAng	4-byte float	The rotation angle (degrees) from Geocentric Inertial Coordinates to Earth Fixed Coordinates.

Data Flag (SDS, array size npixel x nscan, 1-bytes integer):

Name	Name in the TOOLKIT	Format	Description
Data Flag	dataFlag(208)	1-byte integer	The Data Flag indicates the quality of data. Values greater than or equal to zero indicate good data quality. Values less than zero indicate bad data quality. Specific values are: 0: Good data quality -9: Channel brightness temperature outside valid range -15: The neighboring 5 x 5 pixel array is incomplete due to edge or bad data quality -21: Surface type invalid -23: Date time invalid -25: Latitude or longitude invalid

Rain Flag (SDS, array size npixel x nscan, 1-byte integer):

Name	Name in the TOOLKIT	Format	Description
Rain Flag	rainFlag(208)	1-byte integer	The Rain Flag indicates if rain is possible. If the value is greater than or equal to zero rain is possible. If the value is less than zero the pixel has been pre-screened as non-raining; the exact value is used to identify the screen itself.

Surface Flag (SDS, array size npixel x nscan, 1-byte integer):

Name	Name in the TOOLKIT	Format	Description
Surface Flag	surfaceFlag(208)	1-byte integer	The Surface Flag indicates the type of surface and has the following values: 0: ocean; 1: land; 2: coast; 3: other.

Surface Rain (SDS, array size npixel x nscan, 4-byte float):

Name	Name in the TOOLKIT	Format	Description
Surface Rain	surfaceRain(208)	4-byte float	The Surface Rain is the instantaneous rain rate (mm/h) at the surface for each pixel. It ranges between 0.0 and 3000.0 mm/h.

Confidence (SDS, array size npixel x nscan, 4-byte float):

Name	Name in the TOOLKIT	Format	Description
Confidence	confidence(208)	4-byte float	The Confidence is that associated with the surface rain. It is measured as an rms deviation in temperatures with units in degrees (K). The data range is 0.0 to 300.0K

The following five variables represent profiled quantities at 14 layers. The top of each layer is given at 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 5.0, 6.0, 8.0, 10.0, 14.0, and 18.0 km above the surface.

Cloud Liquid Water (SDS, array size nlayer x npixel x nscan, 2-byte integer):

Name	Name in the TOOLKIT	Format	Description
Cloud Liquid Water	cldWater(14,208)	2-byte integer	This is the cloud liquid water content for each pixel at 14 layers. It ranges from 0.00 to 10.00 g/m ³ and is multiplied by 1000 and stored as a 2-byte integer.

Precipitation Water (SDS, array size nlayer x npixel x nscan, 2-byte integer):

Name	Name in the TOOLKIT	Format	Description
Precipitation Water	precipWater(14,208)	2-byte integer	This is the precipitation water content for each pixel at 14 layers. It ranges from 0.00 to 10.00 g/m ³ and is multiplied by 1000 and stored as a 2-byte integer.

Cloud Ice Water (SDS, array size nlayer x npixel x nscan, 2-byte integer):

Name	Name in the TOOLKIT	Format	Description
Cloud Ice Water	cldIce(14,208)	2-byte integer	This is the cloud ice water content for each pixel at 14 layers. It ranges from 0.00 to 10.00 g/m ³ and is multiplied by 1000 and stored as a 2-byte integer.

Precipitation Ice (SDS, array size nlayer x npixel x nscan, 2-byte integer):

Name	Name in the TOOLKIT	Format	Description
Precipitation Ice	precipIce(14,208)	2-byte integer	This is the precipitation content for each pixel at 14 layers. It ranges from 0.00 to 10.00 g/m ³ and is multiplied by 1000 and stored as a 2-byte integer.

Latent Heating (SDS, array size nlayer x npixel x nscan, 2-byte integer):

Name	Name in the TOOLKIT	Format	Description
Latent Heating	latentHeat(14,208)	2-byte integer	This is the latent heating release (°C/day) for each pixel at 14 layers. It is multiplied by 10 and stored as a 2-byte integer. Ranges are -256 deg/hour to 256 deg/hour.