

National Aeronautics and Space Administration

Langley Research Center

**Stratospheric Aerosol and Gas Experiment on the International Space Station**

**(SAGE III/ISS)**

**Data Products User’s Guide**

**Version 3.0**

**April 2021**

Change Record

|  |  |  |  |
| --- | --- | --- | --- |
| **Issue** | **Date** | **Sections Affected** | **Description** |
| Version 1.0 | Oct 2017 | All | Baseline |
| Version 1.1 | Dec 2017 | Product Content and Formats, Appendices | Lunar information added |
| Version 2.0 | Oct 2018 | All | New data format |
| Version 3.0 | Apr 2021 | All | New data format |

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# Acronyms and Abbreviations

|  |  |
| --- | --- |
| ASDC | Atmospheric Sciences Data Center |
| ATBD | Algorithm Theoretical Basis Document |
| CCD | Charge-Coupled Device |
| Ch | Channel |
| EFOV | Effective Field of View |
| EOS | Earth Observing System |
| ETOS | Elapsed Time on Station |
| EVA | Extravehicular Activity |
| FOV | Field of View |
| GAMS | Gas and Aerosol Measurement Sensor |
| GMAO | Global Modeling and Assimilation Office |
| HDF | Hierarchical Data Format |
| IFOV | Instantaneous Field of View |
| InGaAs | Indium Gallium Arsenide |
| IR | Infrared |
| ISS | International Space Station |
| LOS | Line of Sight |
| MERRA-2 | Modern-Era Retrospective analysis for Research and Applications, Version 2 |
| QA | Quality Assurance |
| SAGE | Stratospheric Aerosol and Gas Experiment |
| SAM | Stratospheric Aerosol Measurement |
| SCF | Science Computing Facility |
| SP | Slant Path |
|  |  |
|  |  |
|  |  |

# Information for using the SAGE III/ISS Data Product User’s Guide

This Data Products User’s Guide (Version 3.0) provides a general description of the measurement technique, instrument, mission, and sampling coverage.  Additional information on these topics or details on the retrieval algorithms are provided at the websites specified below. This document also provides information on the CCD pixel assignments used for the retrieval algorithms. These assignments and the periods they represent are described in Appendix A. Instructions for accessing the SAGE III/ISS Data Product files are also provided, with detailed descriptions of their content and format given in Appendices B, C, and D.

|  |  |
| --- | --- |
| **Reference Material** | **Website Location** |
| SAGE III Algorithm Theoretical Basis Documents | https://eospso.gsfc.nasa.gov/atbd-category/50 |
| SAGE III/ISS Mission Web Site | https://sage.nasa.gov/ |

## Introduction

The Stratospheric Aerosol and Gas Experiment on the International Space Station (SAGE III/ISS) is an extension of the successful SAM II, SAGE I, SAGE II, and SAGE III Meteor-3M satellite experiments and is designed to acquire measurements of aerosols and gases in the stratosphere and upper troposphere [1]. These measurements are needed to enhance our understanding of natural and human-derived atmospheric processes. The experiment is a component of NASA’s Earth Observing System (EOS) and is mounted on the ISS. The mission is managed by NASA’s Langley Research Center.

The design for the SAGE III instruments included some advances which permit measurement of additional wavelengths over SAGE II. These added measurement capabilities resulted in

* improved aerosol characterization
* improved gaseous retrievals of O3, H2O, and NO2
* extended vertical range of measurements
* self-calibration of the instrument, independent of external data
* expanded sampling coverage

## Measurement Technique

The SAGE III instrument measures the attenuation of solar radiation resulting from the scattering and absorption by atmospheric constituents in the Earth’s atmosphere as the spacecraft observes a sunrise or sunset event.

The viewing geometry of the satellite and the radiant target (Sun) during an occultation is illustrated in Figure 1. Measurement opportunities occur when the satellite ascends or descends from behind the Earth. Measurement begins when the instrument acquires the radiant target and uses a mirror to, in the local vertical direction, scan the target image across the instrument field-of-view (FOV) aperture. A measurement is considered to occur at the point along the line of sight from the instrument to the target that comes closest to the Earth’s surface (i.e., the subtangent point). The altitude of that point above the Earth’s surface is commonly referred to as the tangent altitude.

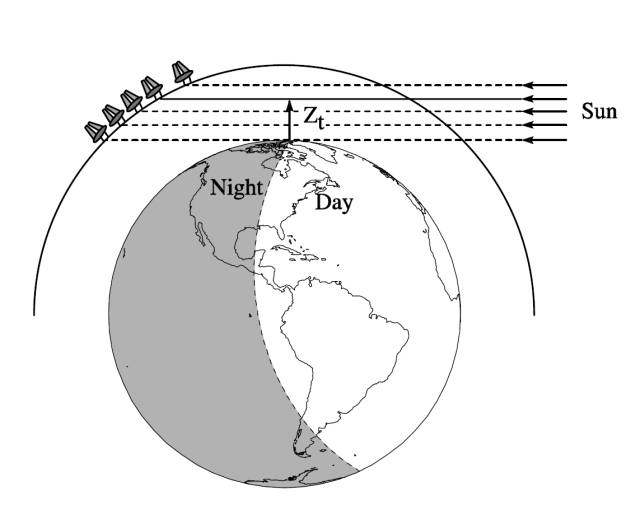


Figure 1. Occultation Geometry

The use of a scanning mirror provides multiple samples at each tangent altitude that are combined to construct transmission profiles from the Earth’s surface (or cloud top) to an altitude of 100 km. Above this altitude, irradiance measurements are acquired between 100 and 300 km to characterize the instrument’s performance across its wavelength range. This information is used to calibrate the instrument for each solar occultation event. By using this procedure, SAGE III data are relatively unaffected by changes in the instrument characteristics over the lifetime of the mission. A general description of the solar occultation measurement technique is provided by McCormick et al., 1979 [2].

The atmospheric extinction at any point along the line-of-sight typically includes contributions from aerosols and several gas constituents. Figure 2 illustrates the principal extinction contributions for an altitude of 18 km. Both aerosol and molecular (Rayleigh) scattering contribute to extinction at all wavelengths. Ozone has strong absorption in the Hartley-Huggins band in the ultraviolet region of the spectrum and in the Chappius band in the visible spectrum. NO2 absorbs between 350 and 600 nm. Water vapor has absorption lines throughout the visible spectrum, with an additional strong band near 940 nm. Although they are not depicted in this figure, NO3 has absorption features between 500 and 650 nm, and OClO has a strong band between 380 and 400 nm.

## Instrument Description and Operation

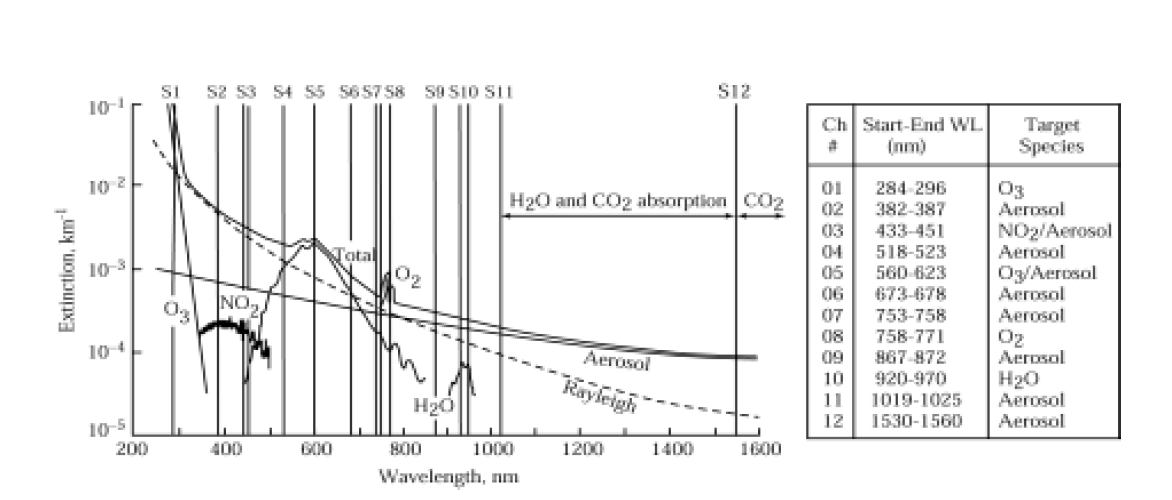


Figure 2. Principal Extinction Contributions at 18 km   
Vertical lines (S1-S12) denote spectral bands measured during solar events by SAGE III.

The design of the SAGE III sensor relies heavily upon the flight-proven designs used in the SAM II and SAGE I and II instruments. The SAGE III sensor assembly is illustrated in Figure 3. It consists of a pointing subsystem, an imaging subsystem, and a spectrometer. The pointing subsystem uses a scan mirror to acquire radiant energy from either the Sun or the Moon by vertically scanning across the target’s image. The imaging subsystem produces a focused image of the target at the focal plane where the science aperture is located. The aperture defines the instrument’s instantaneous field of view (IFOV). A removable neutral-density filter is located along the optical path of this subsystem. The filter is inserted into the optical path to attenuate the solar signal by approximately a factor of 106 and is removed for lunar measurements.

The spectrometer is located behind the science aperture and uses an 809 × 10 pixel CCD array to measure target radiation. The solar radiance between 280 and 1040 nm is measured with a spectral resolution of 1 to 2 nm along the 809 pixel array. An additional InGaAs infrared (IR) photodiode measures light near 1550 nm with a bandwidth of 30 nm for near infrared aerosol extinction measurements. This spectral coverage permits the measurement of multiple absorption features of each gaseous species and multiwavelength measurements of broadband extinction by aerosols. Because of limitations in the telemetry bandwidth, only 87 pixel groups (86 from the CCD and 1 from the photodiode) are transmitted from the satellite for solar occultations. These pixel groups are divided among 12 channels for solar observations and 3 channels for lunar observations. One of the features of the SAGE III/ISS instrument is the ability to reassign CCD pixels among these channels during flight to optimize instrument and retrieval performance. A listing of the different pixel assignments is provided in Appendix A.

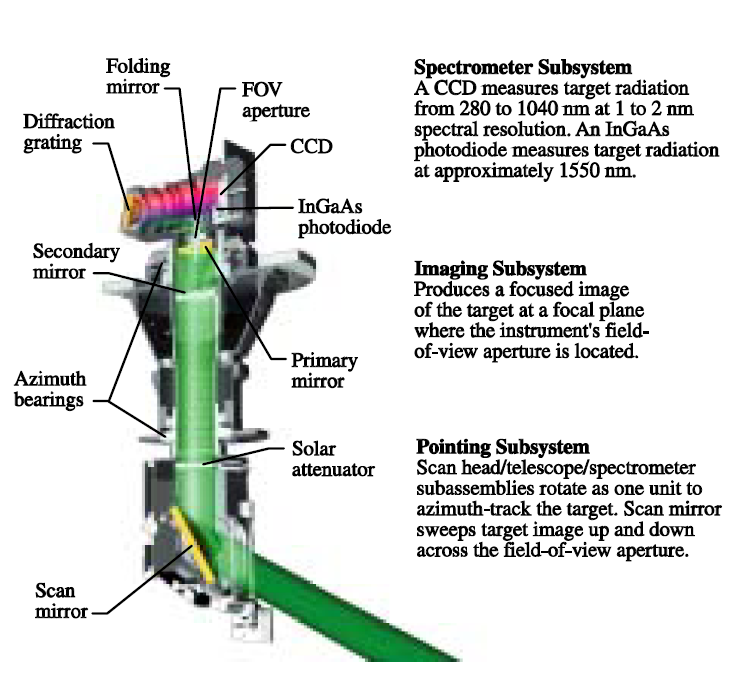


Figure 3. SAGE III Sensor Subsystems

As noted above, the CCD has 11 pixels in the horizontal direction for each of the 809 wavelength segments. The number of pixels utilized, consequently, defines the effective field of view (EFOV) in the horizontal direction. For solar measurements, 5 of the pixels are averaged at 64 samples per second, which results in an EFOV 2.3 arc-min in the horizontal. With an instantaneous field of view of 0.5 arc-min in the vertical, a vertical scan rate of 15 arc-min/sec from an orbital altitude of 400 km results in a vertical resolution of 0.6 km and a horizontal resolution of 1.5 km at the tangent point location.

For lunar measurements, the measurement integration time is increased, the sample rate is decreased to 16 samples per second, and the EFOV is widened to include all 11 elements of the CCD to improve the measurement’s signal-to-noise ratio. The increased integration time results in an increase in the EFOV to 2.4 arc-min in the vertical (or 1.6 km at the tangent point). The use of all 11 pixels increases the horizontal view to 5 arc-min (or 3.3 km at the tangent point).

## SAGE III/ISS Mission

The SAGE III/ISS mission is a joint research experiment between NASA, the European Space Agency (ESA), Thales Alenia Space-Italia (TAS-I), and Ball Aerospace & Technologies Corp. (BATC) [3]. The instrument was launched as part of a resupply mission to the ISS on February 19, 2017. The ISS travels in a Low-Earth orbit at an altitude of 330-435 km at an inclination of 51.6°. With these orbital parameters, solar occultation measurement opportunities cover a large range of latitudes (between 70° S and 70° N). Solar observations are limited by beta angles in the range of -60° to +60°. Nominal sampling coverage for this mission is shown in Figure 4.

Additionally, observations are limited by ISS component obstructions, visiting vehicles, ISS maneuvers, and extravehicular activity (EVA, i.e. spacewalks). Lastly, onboard ISS activities occasionally cause vibrations that may increase the uncertainty of observations.

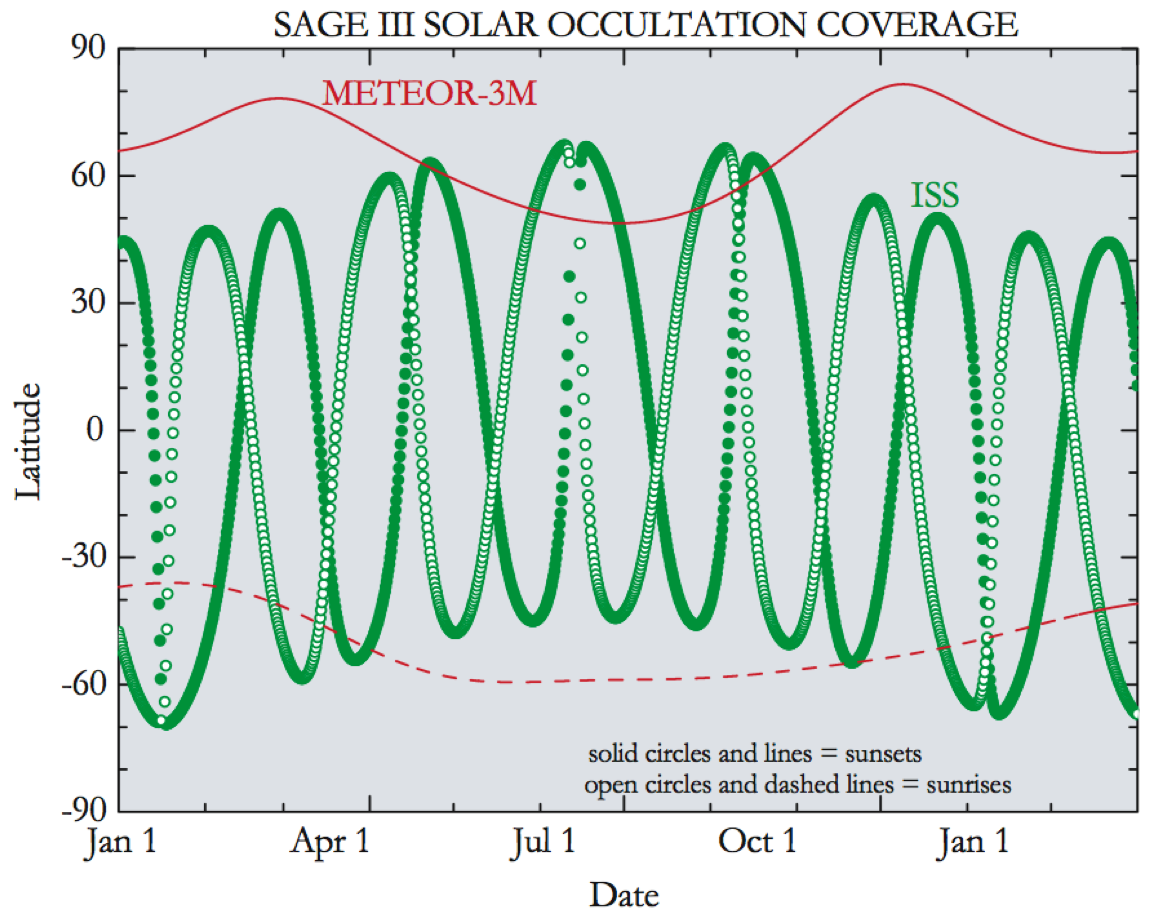


Figure 4. Nominal SAGE III/ISS Coverage Compared to SAGE III Meteor-3M Coverage

## Data Products and Availability

A list of the profile measurements contained in the science data products produced for the SAGE III/ISS mission is provided in Table 1. The reporting interval for all species is 0.5 km. These data products, with attendant metadata, are archived and available in either HDF5 or binary format from the Atmospheric Science Data Center (ASDC).

Most data products are organized into individual solar or lunar events. This data retrieval system allows the user to select Level 1B and Level 2 products based on specified periods of time and measurement locations. SAGE III/ISS product files may be requested through the ASDC at any time.

Table 1. SAGE III Measurement Inventory

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Reported Measurement** | **Status\*** | **Units** | **Vertical Range** | **Mid/Lower Stratosphere Precision** | **Product Residence** |
| **Transmission** Slant Path Transmission | Provisional | none | 0 - 100 km | 0.05% | Level 1B Transmission |
| **Aerosol (9 spectral bands)**  Extinction Coefficient | Validated Stage 1 | km-1 | 0 - 45 km | 8% | Level 2 Solar |
| **Ozone (MLR)**  Concentration | Validated Stage 2 | cm-3 | 0 - 70 km | 5% | Level 2 Solar |
| **Ozone (AO3)**  Concentration | Validated Stage 2 | cm-3 | 0 - 70 km | 5% | Level 2 Solar |
| **Ozone (Mesospheric)**  Concentration | Beta | cm-3 | 50 - 100 km | 10% | Level 2 Solar |
| **NO2**  Concentration | Validated Stage 1 | cm-3 | 0 - 70 km | 15% | Level 2 Solar |
| **Water Vapor** Concentration | Validated Stage 2 | cm-3 | 0 - 60 km | 20% | Level 2 Solar |
| **Ozone** Concentration | Validated Stage 1 | cm-3 | 0 - 70 km | 10% | Level 2 Lunar |
| **NO2**  Concentration | Research | cm-3 | 0 - 70 km | 10% | Level 2 Lunar |
| **NO3**  Concentration | Research | cm-3 | 0 - 70 km | 10% | Level 2 Lunar |
|  |  |  |  |  |  |
| **\* Release Status Definitions** | | | | | |
| **Validated Stage 2** – Product uncertainty is estimated over a significant set of locations/time periods by comparison with suitable reference data. Results are published in the peer-reviewed literature. | | | | | |
| **Validated Stage 1** – Product uncertainty is estimated using a small number of independent measurements obtained from suitable reference data. | | | | | |
| **Provisional** – These data are partially validated and improvements are continuing; quality may not be optimal since validation and quality assurance are ongoing. | | | | | |
| **Research** – Suitable for validation, potentially usable for science and publication. Users cautioned. | | | | | |
| **Beta** – Products intended to enable users to gain familiarity with the parameters and the data. Comment to the SAGE III team is appreciated. | | | | | |

## Product Content and Formats

This section provides a description of the content and format for the HDF-EOS5 and binary Level 1B and Level 2 data products. The data formats for all binary product files are listed in detail in Appendices B, C, and D. This section also provides a description of the file-naming convention.

Reader software for SAGE III/ISS product files is available for download from the ASDC website. These readers are currently available for the IDL and Python programming languages. Due to changes in data format, readers for SAGE III products prior to version 5.1 are not compatible with later data releases.

### Level 1B Transmission Product

*Note: Transmission profiles currently use two different values for “fill”. One is the large fill value defined in the product file (~3.4E38) to indicate missing data, the other is a small fill value (=1E-12) to indicate the calculated transmission value was zero or negative.*

The Level 1B Transmission product contains the SAGE III/ISS atmospheric slant path transmission profiles at 87 spectral channels, as listed in Appendix B. The profiles are skewed vertically and extend from sea level to an altitude of 100 km in 0.5 km intervals. The standard deviation of the binned transmission data is also provided for each reported altitude and channel. These datasets have been geolocated and normalized against exoatmospheric solar measurements to produce slant path transmission profiles. Algorithm retrievals outlined in the Algorithm Theoretical Basis Document (ATBD) are used to reduce and invert this data into the Level 2 products listed in Appendix C. The Level 1B product is only available for solar measurements.

In the construction of the transmission profiles, atmospheric density information is used to correct for refraction effects. This information is derived from temperature profiles interpolated to the location and time of each SAGE III/ISS event from global gridded meteorological analyses provided by NASA GMAO’s MERRA-2. These data sets extend from the surface to a pressure-altitude of 0.1 hPa (~65 km). Above this altitude, climatological temperature data are used from GRAM95. The composite temperature profile information is included in the Level 1B data product.

### Level 2 Solar Species Products

The Level 2 Solar Species products are produced from the Level 1B Transmission profiles by using algorithms described in the ATBD. Gas absorption data sources are identified in Appendix E. A description of the Level 2 Solar Species format is provided in Appendix C. This section discusses the content of the Level 2 Solar Species organized by species. Each species includes information on its relative uncertainty. Species are reported in profiles on a geometric altitude coordinate system with a vertical resolution of 0.5 km. Diurnal corrections are not applied to the retrieved constituent values.

#### Aerosol

Profiles of aerosol extinction at 9 wavelengths are provided from the surface or opaque cloud top to an altitude of 45 km, where the contribution due to aerosols becomes negligible at all wavelengths. In practice, the lower altitude of an aerosol extinction profile may be limited by the dynamic range of the detector and a high, integrated slant path optical depth. This detection limit occurs near a slant path optical depth of about 8, which translates to a column optical depth of approximately 0.02.

Two additional aerosol products are provided and Rayleigh extinction cross section at the center wavelength of each aerosol channel.  Stratospheric optical depth values are only provided for profiles that extend below the altitude of the tropopause.

#### Nitrogen Dioxide

Profiles of nitrogen dioxide are provided in units of concentration over the altitude range 0 to 100 km. These profile measurements are derived from the multiple linear regression retrieval algorithm as described in the ATBD.

#### Ozone

Three different profiles of ozone are provided in units of concentration over the altitude range 0 to 100 km. One profile is based upon measurements made at short wavelengths in the Hartley-Huggins band (denoted Mesospheric Ozone), a second profile is based upon measurements made at visible wavelengths in the Chappius band (denoted MLR Ozone), and a third profile is obtained using a similar approach utilized to process SAGE II data (denoted AO3 Ozone). Please note that the Mesospheric Ozone product is currently in a beta state (see Table 1).

#### Water Vapor

Profiles of water vapor are provided in units of concentration over the altitude range 0 to 60 km. The water vapor products are retrieved by using a nonlinear least-squares approach from the solar occultation measurements of slant path transmission.

### Level 2 Lunar Species Products

The retrieval of constituent profiles from irradiance measurements acquired during lunar occultation events are more complex than those employed for solar events because they account for the spatial non-uniformity of the surface albedo of the moon and the much lower measurement signal. One important difference between the solar and lunar retrieval techniques is the absence of a Level 1B slant path transmission profile product for lunar occultation retrievals, a consequence of not being able to determine limb-darkening curves with sufficient accuracy to calibrate each lunar occultation event. The inaccuracies in the registration of the limb-darkening curve arise from small uncertainties in the pointing knowledge of the instrument in the presence of large variations in albedo across the lunar surface.

As a result of these challenges, the retrieval of lunar Level 2 products uses a different approach than is used for solar. A multiple linear regression is performed on the spectrum of relative optical depth for each packet, with the species absorption cross sections evaluated as the independent variables. Gas absorption data sources are identified in Appendix E. The resulting slant-path column densities are then bin-averaged, onion peeled, and reported on a geometric coordinate system with a vertical resolution of 0.5 km to maintain grid spacing compatibility with the solar Level 2 products. The tangent height registration of data for lunar profiles is accomplished by two methods, an ephemeris-based calculation and a comparison to a forward model of the oxygen A-band. The offset between the two methods is reported in the product.

A description of the content of these products is provided below and organized by species. Each product includes information on its relative uncertainty and a data quality assurance flag set.

A description of the lunar data product format and content is provided in Appendix D.

#### Ozone

Profiles of ozone are provided in units of concentration from 0 to 100 km. Profile measurements are derived from the multiple linear regression retrieval algorithm used for GAMS described in Reference [4].

#### Nitrogen Trioxide

Profiles of nitrogen trioxide are provided in units of concentration from 0 to 100 km. Profile measurements are derived from the multiple linear regression retrieval algorithm used for GAMS described in Reference [4]. This data product is currently in a research state (see Table 1).

#### Nitrogen Dioxide

Profiles of nitrogen dioxide are provided in units of concentration from 0 to 100 km. Profile measurements are derived from the multiple linear regression retrieval algorithm used for GAMS described in Reference [4]. This data product is currently in a research state (see Table 1).

## File-Naming Convention

Following is a list of products and the file- naming convention for each product that shall be generated by SAGE III/ISS SCF processing.

**L1B Solar Transmission Binary Products:** g3b.tb.YYYYMMDDEETTvzz.zz

* **L1B Solar Transmission HDF Products:** g3b.t.YYYYMMDDEETTvzz.zz
* **Level 2 Solar Binary Products:** g3b.sspb. YYYYMMDDEETTvzz.zz
* **Level 2 Solar HDF Products:** g3b.ssp.YYYYMMDDEETTvzz.zz
* **Level 2 Lunar Binary Products:**g3b.lspb.YYYYMMDDEETTvzz.zz
* **Level 2 Lunar HDF Products:**  
  g3b.lsp.YYYYMMDDEETTvzz.zz
* **where:**

|  |  |
| --- | --- |
| YYYYMMDDEETT | Event ID (12 character string: YYYY=year, MM=month, DD=day of month, EE=event number of the day, and TT=event type : where SR = sunrise, SS = sunset, MR = moonrise, MS = moonset) |
| **vzz.zz** | Data Product Version Number |

**Example: g3b.tb.2017060702SSv05.20**

Refers to a transmission binary file for SAGE III/ISS captured on June 7, 2017 during the second event of the day, which was a sunset, and released as a product of SCF Data Product Version 05.20

**Example: g3b.ssp.2017060703S Rv05.20**

Refers to a solar HDF5 file for SAGE III/ISS captured on June 7, 2017 during the third event of the day, which was a sunrise, and released as a product of SCF Data Product Version 05.20

## Quality Assurance Bit Flags

SAGE III Data Products are reviewed prior to their release. Profiles have values reported only for those species and altitudes where there is confidence in the ability of the algorithms to produce representative products. Each file contains bit flags that convey information about processing decisions to the user.

### Event Condition QA Flags (Solar Events)

A binary bit in this 32-bit integer is set to “1” when the following event conditions occur:

*Bit 0 –* Nadir pointing by the hexapod platform could not be achieved.

*Bit 1 –* Instrument contamination door was closed.

*Bit 2 –* Packet-time assignments were questionable.

*Bit 3 –* Large ISS vibrational disturbances were detected when collecting exoatmospheric data.

*Bit 4 –* Obstruction of the target by an ISS element was detected when collecting exoatmospheric data.

*Bit 5 –* Nominal CCD pixel-wavelength assignments were used (no exoatmospheric calibration).

*Bit 6 –* The sun was obstructed by the moon.

### Event Condition QA Flags (Lunar Events)

A binary bit in this 32-bit integer is set to “1” when the following event conditions occur:

*Bit 0 –* Nadir pointing by the hexapod platform could not be achieved.

*Bit 1 –* Instrument contamination door was closed.

*Bit 2 –* Packet-time assignments were questionable.

*Bit 3 –* Large ISS vibrational disturbances were detected when collecting exoatmospheric data.

*Bit 4 –* Nominal CCD pixel-wavelength assignments were used (no exoatmospheric calibration).

### Altitude Dependent QA Flags

Each altitude bin is assigned a 32-bit integer. A binary bit in an integer is set to “1” when the following conditions occur:

*Bit 0 –* Large ISS vibrational disturbances were detected when collecting data for this altitude bin.

### Retrieved Profile QA Flags

For version 5.2, the retrieved profile QA flags contain fill values. These flags previously contained information about vertical smoothing of the product. **There is no vertical smoothing applied to the v5.2 profiles**.

# References

|  |  |
| --- | --- |
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# Appendix A. SAGE III/ISS Nominal CCD Pixel Assignments

**Table A1. Nominal CCD Assignments for Solar Data Collection (CCD Table Version 4)**

| Science Pixel Group | CCD Start Pixel | CCD End Pixel | Pixel Group Center Wavelength | Comment |
| --- | --- | --- | --- | --- |
| 0 | 2 | 2 | 281.916 |  |
| 1 | 3 | 10 | 286.124 | 8-pixel sum |
| 2 | 11 | 17 | 293.138 | 7-pixel sum |
| 3 | 109 | 113 | 384.12 | 5-pixel average |
| 4 | 163 | 163 | 433.091 |  |
| 5 | 164 | 164 | 434.034 |  |
| 6 | 165 | 165 | 434.977 |  |
| 7 | 166 | 166 | 435.921 |  |
| 8 | 167 | 167 | 436.864 |  |
| 9 | 168 | 168 | 437.807 |  |
| 10 | 169 | 169 | 438.751 |  |
| 11 | 170 | 170 | 439.694 |  |
| 12 | 171 | 171 | 440.637 |  |
| 13 | 172 | 172 | 441.581 |  |
| 14 | 173 | 173 | 442.525 |  |
| 15 | 174 | 174 | 443.468 |  |
| 16 | 175 | 175 | 444.412 |  |
| 17 | 176 | 176 | 445.356 |  |
| 18 | 177 | 177 | 446.299 |  |
| 19 | 178 | 178 | 447.243 |  |
| 20 | 179 | 179 | 448.187 |  |
| 21 | 180 | 180 | 449.131 |  |
| 22 | 181 | 181 | 450.075 |  |
| 23 | 254 | 258 | 520.504 | 5-pixel average |
| 24 | 299 | 301 | 562.042 | 3-pixel sum |
| 25 | 306 | 308 | 568.648 | 3-pixel sum |
| 26 | 313 | 315 | 575.255 | 3-pixel sum |
| 27 | 320 | 322 | 581.861 | 3-pixel sum |
| 28 | 327 | 329 | 588.466 | 3-pixel sum |
| 29 | 334 | 336 | 595.071 | 3-pixel sum |
| 30 | 341 | 343 | 601.674 | 3-pixel sum |
| 31 | 348 | 350 | 608.277 | 3-pixel sum |
| 32 | 355 | 357 | 614.879 | 3-pixel sum |
| 33 | 362 | 364 | 621.481 | 3-pixel sum |
| 34 | 419 | 423 | 676.133 | 5-pixel average |
| 35 | 504 | 508 | 756.037 | 5-pixel average |
| 36 | 509 | 509 | 758.852 |  |
| 37 | 510 | 510 | 759.79 |  |
| 38 | 511 | 511 | 760.728 |  |
| 39 | 512 | 512 | 761.666 |  |
| 40 | 513 | 513 | 762.604 |  |
| 41 | 514 | 514 | 763.542 |  |
| 42 | 515 | 515 | 764.48 |  |
| 43 | 516 | 516 | 765.418 |  |
| 44 | 517 | 517 | 766.356 |  |
| 45 | 518 | 518 | 767.294 |  |
| 46 | 519 | 519 | 768.232 |  |
| 47 | 520 | 520 | 769.169 |  |
| 48 | 521 | 521 | 770.107 |  |
| 49 | 522 | 522 | 771.045 |  |
| 50 | 625 | 629 | 869.207 | 5-pixel average |
| 51 | 682 | 682 | 920.354 |  |
| 52 | 696 | 696 | 933.339 |  |
| 53 | 697 | 697 | 934.266 |  |
| 54 | 698 | 698 | 935.193 |  |
| 55 | 699 | 699 | 936.12 |  |
| 56 | 700 | 700 | 937.046 |  |
| 57 | 701 | 701 | 937.973 |  |
| 58 | 702 | 702 | 938.9 |  |
| 59 | 703 | 703 | 939.826 |  |
| 60 | 704 | 704 | 940.752 |  |
| 61 | 705 | 705 | 941.679 |  |
| 62 | 706 | 706 | 942.605 |  |
| 63 | 707 | 707 | 943.531 |  |
| 64 | 708 | 708 | 944.457 |  |
| 65 | 709 | 709 | 945.383 |  |
| 66 | 710 | 710 | 946.309 |  |
| 67 | 711 | 711 | 947.235 |  |
| 68 | 712 | 712 | 948.161 |  |
| 69 | 713 | 713 | 949.086 |  |
| 70 | 714 | 714 | 950.012 |  |
| 71 | 715 | 715 | 950.937 |  |
| 72 | 716 | 716 | 951.863 |  |
| 73 | 717 | 717 | 952.788 |  |
| 74 | 718 | 718 | 953.714 |  |
| 75 | 719 | 719 | 954.639 |  |
| 76 | 720 | 720 | 955.564 |  |
| 77 | 721 | 721 | 956.489 |  |
| 78 | 722 | 722 | 957.414 |  |
| 79 | 737 | 737 | 971.279 |  |
| 80 | 789 | 789 | 1019.19 |  |
| 81 | 790 | 790 | 1020.11 |  |
| 82 | 791 | 791 | 1021.03 |  |
| 83 | 792 | 792 | 1021.95 |  |
| 84 | 793 | 793 | 1022.87 |  |
| 85 | 794 | 794 | 1023.79 |  |
| 86 | - | - | 1543.76 | Photodiode |

**Table A2. Nominal CCD Assignments for Lunar Data Collection (CCD Table Version 2)**

| Science Pixel Group | CCD Start Pixel | CCD End Pixel | Pixel Group Center Wavelength | Comment |
| --- | --- | --- | --- | --- |
| 0 | 105 | 105 | 378.478 |  |
| 1 | 106 | 106 | 379.418 |  |
| 2 | 107 | 107 | 380.358 |  |
| 3 | 108 | 108 | 381.298 |  |
| 4 | 109 | 109 | 382.239 |  |
| 5 | 110 | 110 | 383.179 |  |
| 6 | 111 | 111 | 384.119 |  |
| 7 | 112 | 112 | 385.06 |  |
| 8 | 113 | 113 | 386 |  |
| 9 | 114 | 114 | 386.941 |  |
| 10 | 115 | 115 | 387.882 |  |
| 11 | 116 | 116 | 388.822 |  |
| 12 | 117 | 117 | 389.763 |  |
| 13 | 118 | 118 | 390.704 |  |
| 14 | 119 | 119 | 391.645 |  |
| 15 | 120 | 120 | 392.585 |  |
| 16 | 121 | 121 | 393.526 |  |
| 17 | 122 | 122 | 394.467 |  |
| 18 | 123 | 123 | 395.408 |  |
| 19 | 124 | 124 | 396.349 |  |
| 20 | 125 | 125 | 397.291 |  |
| 21 | 126 | 126 | 398.232 |  |
| 22 | 127 | 127 | 399.173 |  |
| 23 | 128 | 128 | 400.114 |  |
| 24 | 129 | 129 | 401.056 |  |
| 25 | 130 | 130 | 401.997 |  |
| 26 | 131 | 131 | 402.938 |  |
| 27 | 132 | 132 | 403.88 |  |
| 28 | 133 | 133 | 404.821 |  |
| 29 | 144 | 144 | 415.182 |  |
| 30 | 145 | 145 | 416.124 |  |
| 31 | 146 | 146 | 417.066 |  |
| 32 | 147 | 147 | 418.008 |  |
| 33 | 148 | 148 | 418.95 |  |
| 34 | 149 | 149 | 419.893 |  |
| 35 | 150 | 150 | 420.835 |  |
| 36 | 151 | 151 | 421.778 |  |
| 37 | 152 | 152 | 422.72 |  |
| 38 | 153 | 153 | 423.663 |  |
| 39 | 154 | 154 | 424.605 |  |
| 40 | 155 | 155 | 425.548 |  |
| 41 | 156 | 156 | 426.491 |  |
| 42 | 157 | 157 | 427.433 |  |
| 43 | 158 | 158 | 428.376 |  |
| 44 | 159 | 159 | 429.319 |  |
| 45 | 160 | 160 | 430.262 |  |
| 46 | 161 | 161 | 431.205 |  |
| 47 | 162 | 162 | 432.148 |  |
| 48 | 163 | 163 | 433.091 |  |
| 49 | 164 | 164 | 434.034 |  |
| 50 | 165 | 165 | 434.977 |  |
| 51 | 166 | 166 | 435.921 |  |
| 52 | 167 | 167 | 436.864 |  |
| 53 | 168 | 168 | 437.807 |  |
| 54 | 169 | 169 | 438.751 |  |
| 55 | 170 | 170 | 439.694 |  |
| 56 | 171 | 171 | 440.637 |  |
| 57 | 172 | 172 | 441.581 |  |
| 58 | 173 | 173 | 442.525 |  |
| 59 | 174 | 174 | 443.468 |  |
| 60 | 175 | 175 | 444.412 |  |
| 61 | 176 | 176 | 445.356 |  |
| 62 | 177 | 177 | 446.299 |  |
| 63 | 178 | 178 | 447.243 |  |
| 64 | 179 | 179 | 448.187 |  |
| 65 | 180 | 180 | 449.131 |  |
| 66 | 181 | 181 | 450.075 |  |
| 67 | 182 | 182 | 451.019 |  |
| 68 | 183 | 183 | 451.963 |  |
| 69 | 184 | 184 | 452.907 |  |
| 70 | 185 | 185 | 453.852 |  |
| 71 | 186 | 186 | 454.796 |  |
| 72 | 187 | 187 | 455.74 |  |
| 73 | 188 | 188 | 456.684 |  |
| 74 | 189 | 189 | 457.629 |  |
| 75 | 190 | 190 | 458.573 |  |
| 76 | 191 | 191 | 459.518 |  |
| 77 | 192 | 192 | 460.462 |  |
| 78 | 193 | 193 | 461.407 |  |
| 79 | 194 | 194 | 462.352 |  |
| 80 | 195 | 195 | 463.296 |  |
| 81 | 196 | 196 | 464.241 |  |
| 82 | 197 | 197 | 465.186 |  |
| 83 | 198 | 198 | 466.131 |  |
| 84 | 199 | 199 | 467.076 |  |
| 85 | 200 | 200 | 468.021 |  |
| 86 | 201 | 201 | 468.966 |  |
| 87 | 202 | 202 | 469.911 |  |
| 88 | 203 | 203 | 470.856 |  |
| 89 | 204 | 204 | 471.801 |  |
| 90 | 205 | 205 | 472.746 |  |
| 91 | 206 | 206 | 473.691 |  |
| 92 | 207 | 207 | 474.637 |  |
| 93 | 208 | 208 | 475.582 |  |
| 94 | 209 | 209 | 476.527 |  |
| 95 | 210 | 210 | 477.473 |  |
| 96 | 211 | 211 | 478.418 |  |
| 97 | 212 | 212 | 479.364 |  |
| 98 | 213 | 213 | 480.31 |  |
| 99 | 214 | 214 | 481.255 |  |
| 100 | 215 | 215 | 482.201 |  |
| 101 | 216 | 216 | 483.147 |  |
| 102 | 217 | 217 | 484.093 |  |
| 103 | 218 | 218 | 485.039 |  |
| 104 | 219 | 219 | 485.984 |  |
| 105 | 220 | 220 | 486.93 |  |
| 106 | 221 | 221 | 487.876 |  |
| 107 | 222 | 222 | 488.823 |  |
| 108 | 233 | 233 | 498.789 |  |
| 109 | 234 | 234 | 499.733 |  |
| 110 | 235 | 235 | 500.677 |  |
| 111 | 236 | 236 | 501.621 |  |
| 112 | 237 | 237 | 502.565 |  |
| 113 | 238 | 238 | 503.509 |  |
| 114 | 239 | 239 | 504.453 |  |
| 115 | 240 | 240 | 505.398 |  |
| 116 | 241 | 241 | 506.342 |  |
| 117 | 242 | 242 | 507.286 |  |
| 118 | 243 | 243 | 508.23 |  |
| 119 | 244 | 244 | 509.174 |  |
| 120 | 245 | 245 | 510.118 |  |
| 121 | 246 | 246 | 511.062 |  |
| 122 | 247 | 247 | 512.007 |  |
| 123 | 248 | 248 | 512.951 |  |
| 124 | 249 | 249 | 513.895 |  |
| 125 | 250 | 250 | 514.839 |  |
| 126 | 251 | 251 | 515.783 |  |
| 127 | 252 | 252 | 516.727 |  |
| 128 | 253 | 253 | 517.672 |  |
| 129 | 254 | 254 | 518.616 |  |
| 130 | 255 | 255 | 519.56 |  |
| 131 | 256 | 256 | 520.504 |  |
| 132 | 257 | 257 | 521.448 |  |
| 133 | 258 | 258 | 522.392 |  |
| 134 | 259 | 259 | 523.336 |  |
| 135 | 260 | 260 | 524.28 |  |
| 136 | 261 | 261 | 525.225 |  |
| 137 | 262 | 262 | 526.169 |  |
| 138 | 263 | 263 | 527.113 |  |
| 139 | 264 | 264 | 528.057 |  |
| 140 | 265 | 265 | 529.001 |  |
| 141 | 266 | 266 | 529.945 |  |
| 142 | 267 | 267 | 530.889 |  |
| 143 | 268 | 268 | 531.833 |  |
| 144 | 269 | 269 | 532.777 |  |
| 145 | 270 | 270 | 533.722 |  |
| 146 | 271 | 271 | 534.666 |  |
| 147 | 272 | 272 | 535.61 |  |
| 148 | 273 | 273 | 536.554 |  |
| 149 | 274 | 274 | 537.498 |  |
| 150 | 275 | 275 | 538.442 |  |
| 151 | 276 | 276 | 539.386 |  |
| 152 | 277 | 277 | 540.33 |  |
| 153 | 278 | 278 | 541.274 |  |
| 154 | 279 | 279 | 542.218 |  |
| 155 | 280 | 280 | 543.162 |  |
| 156 | 281 | 281 | 544.106 |  |
| 157 | 282 | 282 | 545.05 |  |
| 158 | 283 | 283 | 545.994 |  |
| 159 | 284 | 284 | 546.938 |  |
| 160 | 285 | 285 | 547.882 |  |
| 161 | 292 | 292 | 554.49 |  |
| 162 | 293 | 293 | 555.434 |  |
| 163 | 294 | 294 | 556.378 |  |
| 164 | 295 | 295 | 557.322 |  |
| 165 | 296 | 296 | 558.266 |  |
| 166 | 297 | 297 | 559.21 |  |
| 167 | 298 | 298 | 560.154 |  |
| 168 | 299 | 299 | 561.098 |  |
| 169 | 300 | 300 | 562.042 |  |
| 170 | 301 | 301 | 562.985 |  |
| 171 | 302 | 302 | 563.929 |  |
| 172 | 303 | 303 | 564.873 |  |
| 173 | 304 | 304 | 565.817 |  |
| 174 | 305 | 305 | 566.761 |  |
| 175 | 306 | 306 | 567.705 |  |
| 176 | 307 | 307 | 568.649 |  |
| 177 | 308 | 308 | 569.592 |  |
| 178 | 309 | 309 | 570.536 |  |
| 179 | 310 | 310 | 571.48 |  |
| 180 | 311 | 311 | 572.424 |  |
| 181 | 312 | 312 | 573.367 |  |
| 182 | 313 | 313 | 574.311 |  |
| 183 | 314 | 314 | 575.255 |  |
| 184 | 315 | 315 | 576.199 |  |
| 185 | 316 | 316 | 577.142 |  |
| 186 | 317 | 317 | 578.086 |  |
| 187 | 318 | 318 | 579.03 |  |
| 188 | 319 | 319 | 579.974 |  |
| 189 | 320 | 320 | 580.917 |  |
| 190 | 321 | 321 | 581.861 |  |
| 191 | 322 | 322 | 582.805 |  |
| 192 | 323 | 323 | 583.748 |  |
| 193 | 324 | 324 | 584.692 |  |
| 194 | 325 | 325 | 585.635 |  |
| 195 | 326 | 326 | 586.579 |  |
| 196 | 327 | 327 | 587.522 |  |
| 197 | 328 | 328 | 588.466 |  |
| 198 | 329 | 329 | 589.41 |  |
| 199 | 330 | 330 | 590.353 |  |
| 200 | 331 | 331 | 591.297 |  |
| 201 | 332 | 332 | 592.24 |  |
| 202 | 333 | 333 | 593.184 |  |
| 203 | 334 | 334 | 594.127 |  |
| 204 | 335 | 335 | 595.071 |  |
| 205 | 336 | 336 | 596.014 |  |
| 206 | 337 | 337 | 596.957 |  |
| 207 | 338 | 338 | 597.901 |  |
| 208 | 339 | 339 | 598.844 |  |
| 209 | 340 | 340 | 599.788 |  |
| 210 | 341 | 341 | 600.731 |  |
| 211 | 342 | 342 | 601.674 |  |
| 212 | 343 | 343 | 602.618 |  |
| 213 | 344 | 344 | 603.561 |  |
| 214 | 345 | 345 | 604.504 |  |
| 215 | 346 | 346 | 605.448 |  |
| 216 | 347 | 347 | 606.391 |  |
| 217 | 348 | 348 | 607.334 |  |
| 218 | 349 | 349 | 608.277 |  |
| 219 | 350 | 350 | 609.221 |  |
| 220 | 351 | 351 | 610.164 |  |
| 221 | 352 | 352 | 611.107 |  |
| 222 | 353 | 353 | 612.05 |  |
| 223 | 354 | 354 | 612.993 |  |
| 224 | 355 | 355 | 613.936 |  |
| 225 | 356 | 356 | 614.879 |  |
| 226 | 357 | 357 | 615.823 |  |
| 227 | 358 | 358 | 616.766 |  |
| 228 | 359 | 359 | 617.709 |  |
| 229 | 360 | 360 | 618.652 |  |
| 230 | 361 | 361 | 619.595 |  |
| 231 | 362 | 362 | 620.538 |  |
| 232 | 363 | 363 | 621.481 |  |
| 233 | 364 | 364 | 622.424 |  |
| 234 | 365 | 365 | 623.366 |  |
| 235 | 366 | 366 | 624.309 |  |
| 236 | 367 | 367 | 625.252 |  |
| 237 | 368 | 368 | 626.195 |  |
| 238 | 369 | 369 | 627.138 |  |
| 239 | 370 | 370 | 628.081 |  |
| 240 | 371 | 371 | 629.024 |  |
| 241 | 372 | 372 | 629.966 |  |
| 242 | 373 | 373 | 630.909 |  |
| 243 | 374 | 374 | 631.852 |  |
| 244 | 375 | 375 | 632.795 |  |
| 245 | 376 | 376 | 633.737 |  |
| 246 | 377 | 377 | 634.68 |  |
| 247 | 378 | 378 | 635.623 |  |
| 248 | 379 | 379 | 636.565 |  |
| 249 | 380 | 380 | 637.508 |  |
| 250 | 381 | 381 | 638.45 |  |
| 251 | 382 | 382 | 639.393 |  |
| 252 | 383 | 383 | 640.336 |  |
| 253 | 384 | 384 | 641.278 |  |
| 254 | 385 | 385 | 642.221 |  |
| 255 | 386 | 386 | 643.163 |  |
| 256 | 387 | 387 | 644.105 |  |
| 257 | 388 | 388 | 645.048 |  |
| 258 | 389 | 389 | 645.99 |  |
| 259 | 390 | 390 | 646.933 |  |
| 260 | 391 | 391 | 647.875 |  |
| 261 | 392 | 392 | 648.817 |  |
| 262 | 393 | 393 | 649.76 |  |
| 263 | 394 | 394 | 650.702 |  |
| 264 | 395 | 395 | 651.644 |  |
| 265 | 396 | 396 | 652.586 |  |
| 266 | 397 | 397 | 653.528 |  |
| 267 | 398 | 398 | 654.471 |  |
| 268 | 399 | 399 | 655.413 |  |
| 269 | 400 | 400 | 656.355 |  |
| 270 | 401 | 401 | 657.297 |  |
| 271 | 402 | 402 | 658.239 |  |
| 272 | 403 | 403 | 659.181 |  |
| 273 | 404 | 404 | 660.123 |  |
| 274 | 405 | 405 | 661.065 |  |
| 275 | 406 | 406 | 662.007 |  |
| 276 | 407 | 407 | 662.949 |  |
| 277 | 408 | 408 | 663.891 |  |
| 278 | 409 | 409 | 664.833 |  |
| 279 | 410 | 410 | 665.775 |  |
| 280 | 411 | 411 | 666.716 |  |
| 281 | 412 | 412 | 667.658 |  |
| 282 | 413 | 413 | 668.6 |  |
| 283 | 414 | 414 | 669.542 |  |
| 284 | 415 | 415 | 670.483 |  |
| 285 | 416 | 416 | 671.425 |  |
| 286 | 417 | 417 | 672.367 |  |
| 287 | 418 | 418 | 673.308 |  |
| 288 | 419 | 419 | 674.25 |  |
| 289 | 420 | 420 | 675.191 |  |
| 290 | 421 | 421 | 676.133 |  |
| 291 | 422 | 422 | 677.074 |  |
| 292 | 423 | 423 | 678.016 |  |
| 293 | 424 | 424 | 678.957 |  |
| 294 | 425 | 425 | 679.899 |  |
| 295 | 426 | 426 | 680.84 |  |
| 296 | 427 | 427 | 681.781 |  |
| 297 | 428 | 428 | 682.723 |  |
| 298 | 429 | 429 | 683.664 |  |
| 299 | 430 | 430 | 684.605 |  |
| 300 | 431 | 431 | 685.547 |  |
| 301 | 432 | 432 | 686.488 |  |
| 302 | 433 | 433 | 687.429 |  |
| 303 | 434 | 434 | 688.37 |  |
| 304 | 435 | 435 | 689.311 |  |
| 305 | 436 | 436 | 690.252 |  |
| 306 | 437 | 437 | 691.193 |  |
| 307 | 438 | 438 | 692.134 |  |
| 308 | 439 | 439 | 693.075 |  |
| 309 | 440 | 440 | 694.016 |  |
| 310 | 441 | 441 | 694.957 |  |
| 311 | 442 | 442 | 695.898 |  |
| 312 | 443 | 443 | 696.839 |  |
| 313 | 505 | 506 | 755.568 | 2-pixel average |
| 314 | 507 | 508 | 757.444 | 2-pixel average |
| 315 | 509 | 509 | 758.852 |  |
| 316 | 510 | 510 | 759.79 |  |
| 317 | 511 | 511 | 760.728 |  |
| 318 | 512 | 512 | 761.666 |  |
| 319 | 513 | 513 | 762.604 |  |
| 320 | 514 | 514 | 763.542 |  |
| 321 | 515 | 515 | 764.48 |  |
| 322 | 516 | 516 | 765.418 |  |
| 323 | 517 | 517 | 766.356 |  |
| 324 | 518 | 518 | 767.294 |  |
| 325 | 519 | 519 | 768.232 |  |
| 326 | 520 | 520 | 769.169 |  |
| 327 | 521 | 521 | 770.107 |  |
| 328 | 522 | 522 | 771.045 |  |
| 329 | 523 | 523 | 771.982 |  |
| 330 | 524 | 524 | 772.92 |  |
| 331 | 525 | 525 | 773.858 |  |
| 332 | 526 | 526 | 774.795 |  |
| 333 | 527 | 527 | 775.732 |  |
| 334 | 528 | 528 | 776.67 |  |
| 335 | 529 | 529 | 777.607 |  |
| 336 | 530 | 530 | 778.544 |  |
| 337 | 531 | 531 | 779.482 |  |

# Appendix B. SAGE III/ISS Level 1B Solar Transmission Products

**Table B1. Binary File Format Sheet: SAGE III/ISS Level 1B Solar Transmission Product**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Field Start | Field End | Num Values | F90 Type | Start Byte | End Byte | Description | | Units |
| 0 | 0 | 1 | C12 | 0 | 11 | EVENT\_ID | | \* |
| 1 | 1 | 1 | I4 | 12 | 15 | OLD\_EVENT\_ID | | \* |
| 2 | 2 | 1 | I4 | 16 | 19 | DATE | | \* |
| 3 | 3 | 1 | R4 | 20 | 23 | YEAR\_FRACTION | | \* |
| 4 | 4 | 1 | R4 | 24 | 27 | LATITUDE | | degrees |
| 5 | 5 | 1 | R4 | 28 | 31 | LONGITUDE | | degrees |
| 6 | 6 | 1 | I4 | 32 | 35 | TIME | | \* |
| 7 | 7 | 1 | I4 | 36 | 39 | INT\_FILL\_VALUE | | \* |
| 8 | 8 | 1 | R4 | 40 | 43 | FLT\_FILL\_VALUE | | \* |
| 9 | 9 | 1 | I4 | 44 | 47 | MISSION\_ID | | \* |
| 10 | 10 | 1 | R4 | 48 | 51 | L0DO\_VERSION | | \* |
| 11 | 11 | 1 | I4 | 52 | 55 | CCDVERSION | | \* |
| 12 | 12 | 1 | R4 | 56 | 59 | L0\_VERSION | | \* |
| 13 | 13 | 1 | R4 | 60 | 63 | SOFTWARE\_VERSION | | \* |
| 14 | 14 | 1 | R4 | 64 | 67 | DATAPRODUCT\_VERSION | | \* |
| 15 | 15 | 1 | R4 | 68 | 71 | SPECTROSCOPIC\_DATABASE\_VERSION | | \* |
| 16 | 16 | 1 | R4 | 72 | 75 | GRAM95\_VERSION | | \* |
| 17 | 17 | 1 | R4 | 76 | 79 | MET\_VERSION | | \* |
| 18 | 18 | 1 | R4 | 80 | 83 | BIN\_HEIGHT | | km |
| 19 | 19 | 1 | I4 | 84 | 87 | PROFILE\_COUNT | | \* |
| 20 | 20 | 1 | I4 | 88 | 91 | NUM\_GRND\_TRK | | \* |
| 21 | 21 | 1 | I4 | 92 | 95 | NUM\_PRESS\_GRID | | \* |
| 22 | 22 | 1 | I4 | 96 | 99 | NUM\_CCDPXLGRPS | | \* |
| 23 | 23 | 1 | I4 | 100 | 103 | NUM\_ALT\_BINS | | \* |
| 24 | 24 | 1 | I4 | 104 | 107 | SC\_EVT\_TYPE *(Sunrise = 1; Sunset = 2)* | | \* |
| 25 | 25 | 1 | I4 | 108 | 111 | GND\_EVT\_TYPE *(Sunrise = 1; Sunset = 2)* | | \* |
| 26 | 26 | 1 | R4 | 112 | 115 | BETAANGLE\_SOLAR | | degrees |
| 27 | 27 | 1 | I4 | 116 | 119 | AURORA\_FLAG *(N/A)* | | \* |
| 28 | 28 | 1 | I4 | 120 | 123 | EPHEMERIS\_SOURCE *(GPS = 5)* | | \* |
| 29 | 39 | 11 | I4 | 124 | 167 | GT\_DATE | *Ground track-indexed data for 11 tangent altitudes from 0km to 100km at 10km intervals* | \* |
| 40 | 50 | 11 | I4 | 168 | 211 | GT\_TIME | \* |
| 51 | 61 | 11 | R4 | 212 | 255 | GT\_LATITUDE | \* |
| 62 | 72 | 11 | R4 | 256 | 299 | GT\_LONGITUDE | \* |
| 73 | 83 | 11 | R4 | 300 | 343 | GT\_RAY\_DIR | degrees |
| 84 | 94 | 11 | R4 | 344 | 387 | SPACE\_CRAFT\_LAT | degrees |
| 95 | 105 | 11 | R4 | 388 | 431 | SPACE\_CRAFT\_LON | degrees |
| 106 | 116 | 11 | R4 | 432 | 475 | SPACE\_CRAFT\_ALT | degrees |
| 117 | 316 | 200 | R4 | 476 | 1275 | ALTITUDE | | km |
| 317 | 516 | 200 | R4 | 1276 | 2075 | GEOPOTENTIAL\_ALT | | km |
| 517 | 716 | 200 | R4 | 2076 | 2875 | PRESSURE | | hPa |
| 717 | 916 | 200 | R4 | 2876 | 3675 | PRESSURE\_UNCERT | | hPa |
| 917 | 1116 | 200 | R4 | 3676 | 4475 | TEMPERATURE | | K |
| 1117 | 1316 | 200 | R4 | 4476 | 5275 | TEMPERATURE\_UNCERT | | K |
| 1317 | 1516 | 200 | R4 | 5276 | 6075 | NEUTRAL\_DENSITY | | cm-3 |
| 1517 | 1716 | 200 | R4 | 6076 | 6875 | NEUTRAL\_DENSITY\_UNCERT | | cm-3 |
| 1717 | 1916 | 200 | I4 | 6876 | 7675 | TEMP\_PRESSURE\_SOURCE *(GRAM95 = 0; MERRA-2 = 2)* | | \* |
| 1917 | 1917 | 1 | R4 | 7676 | 7679 | TROP\_TEMP | | K |
| 1918 | 1918 | 1 | R4 | 7680 | 7683 | TROP\_ALT | | km |
| 1919 | 1919 | 1 | R4 | 7684 | 7687 | TROP\_PRESS | | hPa |
| 1920 | 1961 | 42 | R4 | 7688 | 7855 | MET\_PRESSURE | Pressure surface-indexed data | hPa |
| 1962 | 2003 | 42 | R4 | 7856 | 8023 | MET\_TEMP | K |
| 2004 | 2045 | 42 | R4 | 8024 | 8191 | MET\_TEMP\_UNC | K |
| 2046 | 2087 | 42 | R4 | 8192 | 8359 | MET\_ALTITUDE | km |
| 2088 | 2088 | 1 | I4 | 8360 | 8363 | MET\_SOURCE *(GRAM95 = 0; MERRA-2 = 2)* | | \* |
| 2089 | 2089 | 1 | R4 | 8364 | 8367 | CCD\_TEMPERATURE | | °C |
| 2090 | 2090 | 1 | R4 | 8368 | 8371 | SPECTROMETER\_ZENITH\_TEMPERATURE | | °C |
| 2091 | 2091 | 1 | R4 | 8372 | 8375 | CCD\_TEMPERATURE\_MINUS\_TEC | | °C |
| 2092 | 2092 | 1 | I4 | 8376 | 8379 | EPHEMERIS\_QUALITY *(N/A)* | | \* |
| 2093 | 2093 | 1 | R4 | 8380 | 8383 | SPECCALSHIFT | | nm |
| 2094 | 2094 | 1 | R4 | 8384 | 8387 | SPECCALSTRETCH | | nm/pixel |
| 2095 | 2096 | 2 | R4 | 8388 | 8395 | AZIMUTHANGLE | | degrees |
| 2097 | 2097 | 1 | I4 | 8396 | 8399 | QAFLAG | | \* |
| 2098 | 2297 | 200 | I4 | 8400 | 9199 | QAFLAG\_ALTITUDE | | \* |
| 2298 | 2383 | 86 | I4 | 9200 | 9543 | START\_PIXEL\_NUM | | \* |
| 2384 | 2469 | 86 | I4 | 9544 | 9887 | END\_PIXEL\_NUM | | \* |
| 2470 | 2556 | 87 | R4 | 9888 | 10235 | CENTRAL\_WAVELENGTH | | nm |
| 2557 | 2643 | 87 | R4 | 10236 | 10583 | HALF\_BANDWIDTH | | nm |
| 2644 | 2843 | 200 | R4 | 10584 | 11383 | TRANSMISSION Pixel Group 0 | | \* |
| 2844 | 3043 | 200 | R4 | 11384 | 12183 | TRANSMISSION Uncertainty Pixel Group 0 | | \* |
| 3044 | 3243 | 200 | I4 | 12184 | 12983 | TRANSQA Pixel Group 0 | | \* |
| 3244 | 3443 | 200 | R4 | 12984 | 13783 | TRANSMISSION Pixel Group 1 | | \* |
| 3444 | 3643 | 200 | R4 | 13784 | 14583 | TRANSMISSION Uncertainty Pixel Group 1 | | \* |
| 3644 | 3843 | 200 | I4 | 14584 | 15383 | TRANSQA Pixel Group 1 | | \* |
| 3844 | 4043 | 200 | R4 | 15384 | 16183 | TRANSMISSION Pixel Group 2 | | \* |
| 4044 | 4243 | 200 | R4 | 16184 | 16983 | TRANSMISSION Uncertainty Pixel Group 2 | | \* |
| 4244 | 4443 | 200 | I4 | 16984 | 17783 | TRANSQA Pixel Group 2 | | \* |
| 4444 | 4643 | 200 | R4 | 17784 | 18583 | TRANSMISSION Pixel Group 3 | | \* |
| 4644 | 4843 | 200 | R4 | 18584 | 19383 | TRANSMISSION Uncertainty Pixel Group 3 | | \* |
| 4844 | 5043 | 200 | I4 | 19384 | 20183 | TRANSQA Pixel Group 3 | | \* |
| 5044 | 5243 | 200 | R4 | 20184 | 20983 | TRANSMISSION Pixel Group 4 | | \* |
| 5244 | 5443 | 200 | R4 | 20984 | 21783 | TRANSMISSION Uncertainty Pixel Group 4 | | \* |
| 5444 | 5643 | 200 | I4 | 21784 | 22583 | TRANSQA Pixel Group 4 | | \* |
| 5644 | 5843 | 200 | R4 | 22584 | 23383 | TRANSMISSION Pixel Group 5 | | \* |
| 5844 | 6043 | 200 | R4 | 23384 | 24183 | TRANSMISSION Uncertainty Pixel Group 5 | | \* |
| 6044 | 6243 | 200 | I4 | 24184 | 24983 | TRANSQA Pixel Group 5 | | \* |
| 6244 | 6443 | 200 | R4 | 24984 | 25783 | TRANSMISSION Pixel Group 6 | | \* |
| 6444 | 6643 | 200 | R4 | 25784 | 26583 | TRANSMISSION Uncertainty Pixel Group 6 | | \* |
| 6644 | 6843 | 200 | I4 | 26584 | 27383 | TRANSQA Pixel Group 6 | | \* |
| 6844 | 7043 | 200 | R4 | 27384 | 28183 | TRANSMISSION Pixel Group 7 | | \* |
| 7044 | 7243 | 200 | R4 | 28184 | 28983 | TRANSMISSION Uncertainty Pixel Group 7 | | \* |
| 7244 | 7443 | 200 | I4 | 28984 | 29783 | TRANSQA Pixel Group 7 | | \* |
| 7444 | 7643 | 200 | R4 | 29784 | 30583 | TRANSMISSION Pixel Group 8 | | \* |
| 7644 | 7843 | 200 | R4 | 30584 | 31383 | TRANSMISSION Uncertainty Pixel Group 8 | | \* |
| 7844 | 8043 | 200 | I4 | 31384 | 32183 | TRANSQA Pixel Group 8 | | \* |
| 8044 | 8243 | 200 | R4 | 32184 | 32983 | TRANSMISSION Pixel Group 9 | | \* |
| 8244 | 8443 | 200 | R4 | 32984 | 33783 | TRANSMISSION Uncertainty Pixel Group 9 | | \* |
| 8444 | 8643 | 200 | I4 | 33784 | 34583 | TRANSQA Pixel Group 9 | | \* |
| 8644 | 8843 | 200 | R4 | 34584 | 35383 | TRANSMISSION Pixel Group 10 | | \* |
| 8844 | 9043 | 200 | R4 | 35384 | 36183 | TRANSMISSION Uncertainty Pixel Group 10 | | \* |
| 9044 | 9243 | 200 | I4 | 36184 | 36983 | TRANSQA Pixel Group 10 | | \* |
| 9244 | 9443 | 200 | R4 | 36984 | 37783 | TRANSMISSION Pixel Group 11 | | \* |
| 9444 | 9643 | 200 | R4 | 37784 | 38583 | TRANSMISSION Uncertainty Pixel Group 11 | | \* |
| 9644 | 9843 | 200 | I4 | 38584 | 39383 | TRANSQA Pixel Group 11 | | \* |
| 9844 | 10043 | 200 | R4 | 39384 | 40183 | TRANSMISSION Pixel Group 12 | | \* |
| 10044 | 10243 | 200 | R4 | 40184 | 40983 | TRANSMISSION Uncertainty Pixel Group 12 | | \* |
| 10244 | 10443 | 200 | I4 | 40984 | 41783 | TRANSQA Pixel Group 12 | | \* |
| 10444 | 10643 | 200 | R4 | 41784 | 42583 | TRANSMISSION Pixel Group 13 | | \* |
| 10644 | 10843 | 200 | R4 | 42584 | 43383 | TRANSMISSION Uncertainty Pixel Group 13 | | \* |
| 10844 | 11043 | 200 | I4 | 43384 | 44183 | TRANSQA Pixel Group 13 | | \* |
| 11044 | 11243 | 200 | R4 | 44184 | 44983 | TRANSMISSION Pixel Group 14 | | \* |
| 11244 | 11443 | 200 | R4 | 44984 | 45783 | TRANSMISSION Uncertainty Pixel Group 14 | | \* |
| 11444 | 11643 | 200 | I4 | 45784 | 46583 | TRANSQA Pixel Group 14 | | \* |
| 11644 | 11843 | 200 | R4 | 46584 | 47383 | TRANSMISSION Pixel Group 15 | | \* |
| 11844 | 12043 | 200 | R4 | 47384 | 48183 | TRANSMISSION Uncertainty Pixel Group 15 | | \* |
| 12044 | 12243 | 200 | I4 | 48184 | 48983 | TRANSQA Pixel Group 15 | | \* |
| 12244 | 12443 | 200 | R4 | 48984 | 49783 | TRANSMISSION Pixel Group 16 | | \* |
| 12444 | 12643 | 200 | R4 | 49784 | 50583 | TRANSMISSION Uncertainty Pixel Group 16 | | \* |
| 12644 | 12843 | 200 | I4 | 50584 | 51383 | TRANSQA Pixel Group 16 | | \* |
| 12844 | 13043 | 200 | R4 | 51384 | 52183 | TRANSMISSION Pixel Group 17 | | \* |
| 13044 | 13243 | 200 | R4 | 52184 | 52983 | TRANSMISSION Uncertainty Pixel Group 17 | | \* |
| 13244 | 13443 | 200 | I4 | 52984 | 53783 | TRANSQA Pixel Group 17 | | \* |
| 13444 | 13643 | 200 | R4 | 53784 | 54583 | TRANSMISSION Pixel Group 18 | | \* |
| 13644 | 13843 | 200 | R4 | 54584 | 55383 | TRANSMISSION Uncertainty Pixel Group 18 | | \* |
| 13844 | 14043 | 200 | I4 | 55384 | 56183 | TRANSQA Pixel Group 18 | | \* |
| 14044 | 14243 | 200 | R4 | 56184 | 56983 | TRANSMISSION Pixel Group 19 | | \* |
| 14244 | 14443 | 200 | R4 | 56984 | 57783 | TRANSMISSION Uncertainty Pixel Group 19 | | \* |
| 14444 | 14643 | 200 | I4 | 57784 | 58583 | TRANSQA Pixel Group 19 | | \* |
| 14644 | 14843 | 200 | R4 | 58584 | 59383 | TRANSMISSION Pixel Group 20 | | \* |
| 14844 | 15043 | 200 | R4 | 59384 | 60183 | TRANSMISSION Uncertainty Pixel Group 20 | | \* |
| 15044 | 15243 | 200 | I4 | 60184 | 60983 | TRANSQA Pixel Group 20 | | \* |
| 15244 | 15443 | 200 | R4 | 60984 | 61783 | TRANSMISSION Pixel Group 21 | | \* |
| 15444 | 15643 | 200 | R4 | 61784 | 62583 | TRANSMISSION Uncertainty Pixel Group 21 | | \* |
| 15644 | 15843 | 200 | I4 | 62584 | 63383 | TRANSQA Pixel Group 21 | | \* |
| 15844 | 16043 | 200 | R4 | 63384 | 64183 | TRANSMISSION Pixel Group 22 | | \* |
| 16044 | 16243 | 200 | R4 | 64184 | 64983 | TRANSMISSION Uncertainty Pixel Group 22 | | \* |
| 16244 | 16443 | 200 | I4 | 64984 | 65783 | TRANSQA Pixel Group 22 | | \* |
| 16444 | 16643 | 200 | R4 | 65784 | 66583 | TRANSMISSION Pixel Group 23 | | \* |
| 16644 | 16843 | 200 | R4 | 66584 | 67383 | TRANSMISSION Uncertainty Pixel Group 23 | | \* |
| 16844 | 17043 | 200 | I4 | 67384 | 68183 | TRANSQA Pixel Group 23 | | \* |
| 17044 | 17243 | 200 | R4 | 68184 | 68983 | TRANSMISSION Pixel Group 24 | | \* |
| 17244 | 17443 | 200 | R4 | 68984 | 69783 | TRANSMISSION Uncertainty Pixel Group 24 | | \* |
| 17444 | 17643 | 200 | I4 | 69784 | 70583 | TRANSQA Pixel Group 24 | | \* |
| 17644 | 17843 | 200 | R4 | 70584 | 71383 | TRANSMISSION Pixel Group 25 | | \* |
| 17844 | 18043 | 200 | R4 | 71384 | 72183 | TRANSMISSION Uncertainty Pixel Group 25 | | \* |
| 18044 | 18243 | 200 | I4 | 72184 | 72983 | TRANSQA Pixel Group 25 | | \* |
| 18244 | 18443 | 200 | R4 | 72984 | 73783 | TRANSMISSION Pixel Group 26 | | \* |
| 18444 | 18643 | 200 | R4 | 73784 | 74583 | TRANSMISSION Uncertainty Pixel Group 26 | | \* |
| 18644 | 18843 | 200 | I4 | 74584 | 75383 | TRANSQA Pixel Group 26 | | \* |
| 18844 | 19043 | 200 | R4 | 75384 | 76183 | TRANSMISSION Pixel Group 27 | | \* |
| 19044 | 19243 | 200 | R4 | 76184 | 76983 | TRANSMISSION Uncertainty Pixel Group 27 | | \* |
| 19244 | 19443 | 200 | I4 | 76984 | 77783 | TRANSQA Pixel Group 27 | | \* |
| 19444 | 19643 | 200 | R4 | 77784 | 78583 | TRANSMISSION Pixel Group 28 | | \* |
| 19644 | 19843 | 200 | R4 | 78584 | 79383 | TRANSMISSION Uncertainty Pixel Group 28 | | \* |
| 19844 | 20043 | 200 | I4 | 79384 | 80183 | TRANSQA Pixel Group 28 | | \* |
| 20044 | 20243 | 200 | R4 | 80184 | 80983 | TRANSMISSION Pixel Group 29 | | \* |
| 20244 | 20443 | 200 | R4 | 80984 | 81783 | TRANSMISSION Uncertainty Pixel Group 29 | | \* |
| 20444 | 20643 | 200 | I4 | 81784 | 82583 | TRANSQA Pixel Group 29 | | \* |
| 20644 | 20843 | 200 | R4 | 82584 | 83383 | TRANSMISSION Pixel Group 30 | | \* |
| 20844 | 21043 | 200 | R4 | 83384 | 84183 | TRANSMISSION Uncertainty Pixel Group 30 | | \* |
| 21044 | 21243 | 200 | I4 | 84184 | 84983 | TRANSQA Pixel Group 30 | | \* |
| 21244 | 21443 | 200 | R4 | 84984 | 85783 | TRANSMISSION Pixel Group 31 | | \* |
| 21444 | 21643 | 200 | R4 | 85784 | 86583 | TRANSMISSION Uncertainty Pixel Group 31 | | \* |
| 21644 | 21843 | 200 | I4 | 86584 | 87383 | TRANSQA Pixel Group 31 | | \* |
| 21844 | 22043 | 200 | R4 | 87384 | 88183 | TRANSMISSION Pixel Group 32 | | \* |
| 22044 | 22243 | 200 | R4 | 88184 | 88983 | TRANSMISSION Uncertainty Pixel Group 32 | | \* |
| 22244 | 22443 | 200 | I4 | 88984 | 89783 | TRANSQA Pixel Group 32 | | \* |
| 22444 | 22643 | 200 | R4 | 89784 | 90583 | TRANSMISSION Pixel Group 33 | | \* |
| 22644 | 22843 | 200 | R4 | 90584 | 91383 | TRANSMISSION Uncertainty Pixel Group 33 | | \* |
| 22844 | 23043 | 200 | I4 | 91384 | 92183 | TRANSQA Pixel Group 33 | | \* |
| 23044 | 23243 | 200 | R4 | 92184 | 92983 | TRANSMISSION Pixel Group 34 | | \* |
| 23244 | 23443 | 200 | R4 | 92984 | 93783 | TRANSMISSION Uncertainty Pixel Group 34 | | \* |
| 23444 | 23643 | 200 | I4 | 93784 | 94583 | TRANSQA Pixel Group 34 | | \* |
| 23644 | 23843 | 200 | R4 | 94584 | 95383 | TRANSMISSION Pixel Group 35 | | \* |
| 23844 | 24043 | 200 | R4 | 95384 | 96183 | TRANSMISSION Uncertainty Pixel Group 35 | | \* |
| 24044 | 24243 | 200 | I4 | 96184 | 96983 | TRANSQA Pixel Group 35 | | \* |
| 24244 | 24443 | 200 | R4 | 96984 | 97783 | TRANSMISSION Pixel Group 36 | | \* |
| 24444 | 24643 | 200 | R4 | 97784 | 98583 | TRANSMISSION Uncertainty Pixel Group 36 | | \* |
| 24644 | 24843 | 200 | I4 | 98584 | 99383 | TRANSQA Pixel Group 36 | | \* |
| 24844 | 25043 | 200 | R4 | 99384 | 100183 | TRANSMISSION Pixel Group 37 | | \* |
| 25044 | 25243 | 200 | R4 | 100184 | 100983 | TRANSMISSION Uncertainty Pixel Group 37 | | \* |
| 25244 | 25443 | 200 | I4 | 100984 | 101783 | TRANSQA Pixel Group 37 | | \* |
| 25444 | 25643 | 200 | R4 | 101784 | 102583 | TRANSMISSION Pixel Group 38 | | \* |
| 25644 | 25843 | 200 | R4 | 102584 | 103383 | TRANSMISSION Uncertainty Pixel Group 38 | | \* |
| 25844 | 26043 | 200 | I4 | 103384 | 104183 | TRANSQA Pixel Group 38 | | \* |
| 26044 | 26243 | 200 | R4 | 104184 | 104983 | TRANSMISSION Pixel Group 39 | | \* |
| 26244 | 26443 | 200 | R4 | 104984 | 105783 | TRANSMISSION Uncertainty Pixel Group 39 | | \* |
| 26444 | 26643 | 200 | I4 | 105784 | 106583 | TRANSQA Pixel Group 39 | | \* |
| 26644 | 26843 | 200 | R4 | 106584 | 107383 | TRANSMISSION Pixel Group 40 | | \* |
| 26844 | 27043 | 200 | R4 | 107384 | 108183 | TRANSMISSION Uncertainty Pixel Group 40 | | \* |
| 27044 | 27243 | 200 | I4 | 108184 | 108983 | TRANSQA Pixel Group 40 | | \* |
| 27244 | 27443 | 200 | R4 | 108984 | 109783 | TRANSMISSION Pixel Group 41 | | \* |
| 27444 | 27643 | 200 | R4 | 109784 | 110583 | TRANSMISSION Uncertainty Pixel Group 41 | | \* |
| 27644 | 27843 | 200 | I4 | 110584 | 111383 | TRANSQA Pixel Group 41 | | \* |
| 27844 | 28043 | 200 | R4 | 111384 | 112183 | TRANSMISSION Pixel Group 42 | | \* |
| 28044 | 28243 | 200 | R4 | 112184 | 112983 | TRANSMISSION Uncertainty Pixel Group 42 | | \* |
| 28244 | 28443 | 200 | I4 | 112984 | 113783 | TRANSQA Pixel Group 42 | | \* |
| 28444 | 28643 | 200 | R4 | 113784 | 114583 | TRANSMISSION Pixel Group 43 | | \* |
| 28644 | 28843 | 200 | R4 | 114584 | 115383 | TRANSMISSION Uncertainty Pixel Group 43 | | \* |
| 28844 | 29043 | 200 | I4 | 115384 | 116183 | TRANSQA Pixel Group 43 | | \* |
| 29044 | 29243 | 200 | R4 | 116184 | 116983 | TRANSMISSION Pixel Group 44 | | \* |
| 29244 | 29443 | 200 | R4 | 116984 | 117783 | TRANSMISSION Uncertainty Pixel Group 44 | | \* |
| 29444 | 29643 | 200 | I4 | 117784 | 118583 | TRANSQA Pixel Group 44 | | \* |
| 29644 | 29843 | 200 | R4 | 118584 | 119383 | TRANSMISSION Pixel Group 45 | | \* |
| 29844 | 30043 | 200 | R4 | 119384 | 120183 | TRANSMISSION Uncertainty Pixel Group 45 | | \* |
| 30044 | 30243 | 200 | I4 | 120184 | 120983 | TRANSQA Pixel Group 45 | | \* |
| 30244 | 30443 | 200 | R4 | 120984 | 121783 | TRANSMISSION Pixel Group 46 | | \* |
| 30444 | 30643 | 200 | R4 | 121784 | 122583 | TRANSMISSION Uncertainty Pixel Group 46 | | \* |
| 30644 | 30843 | 200 | I4 | 122584 | 123383 | TRANSQA Pixel Group 46 | | \* |
| 30844 | 31043 | 200 | R4 | 123384 | 124183 | TRANSMISSION Pixel Group 47 | | \* |
| 31044 | 31243 | 200 | R4 | 124184 | 124983 | TRANSMISSION Uncertainty Pixel Group 47 | | \* |
| 31244 | 31443 | 200 | I4 | 124984 | 125783 | TRANSQA Pixel Group 47 | | \* |
| 31444 | 31643 | 200 | R4 | 125784 | 126583 | TRANSMISSION Pixel Group 48 | | \* |
| 31644 | 31843 | 200 | R4 | 126584 | 127383 | TRANSMISSION Uncertainty Pixel Group 48 | | \* |
| 31844 | 32043 | 200 | I4 | 127384 | 128183 | TRANSQA Pixel Group 48 | | \* |
| 32044 | 32243 | 200 | R4 | 128184 | 128983 | TRANSMISSION Pixel Group 49 | | \* |
| 32244 | 32443 | 200 | R4 | 128984 | 129783 | TRANSMISSION Uncertainty Pixel Group 49 | | \* |
| 32444 | 32643 | 200 | I4 | 129784 | 130583 | TRANSQA Pixel Group 49 | | \* |
| 32644 | 32843 | 200 | R4 | 130584 | 131383 | TRANSMISSION Pixel Group 50 | | \* |
| 32844 | 33043 | 200 | R4 | 131384 | 132183 | TRANSMISSION Uncertainty Pixel Group 50 | | \* |
| 33044 | 33243 | 200 | I4 | 132184 | 132983 | TRANSQA Pixel Group 50 | | \* |
| 33244 | 33443 | 200 | R4 | 132984 | 133783 | TRANSMISSION Pixel Group 51 | | \* |
| 33444 | 33643 | 200 | R4 | 133784 | 134583 | TRANSMISSION Uncertainty Pixel Group 51 | | \* |
| 33644 | 33843 | 200 | I4 | 134584 | 135383 | TRANSQA Pixel Group 51 | | \* |
| 33844 | 34043 | 200 | R4 | 135384 | 136183 | TRANSMISSION Pixel Group 52 | | \* |
| 34044 | 34243 | 200 | R4 | 136184 | 136983 | TRANSMISSION Uncertainty Pixel Group 52 | | \* |
| 34244 | 34443 | 200 | I4 | 136984 | 137783 | TRANSQA Pixel Group 52 | | \* |
| 34444 | 34643 | 200 | R4 | 137784 | 138583 | TRANSMISSION Pixel Group 53 | | \* |
| 34644 | 34843 | 200 | R4 | 138584 | 139383 | TRANSMISSION Uncertainty Pixel Group 53 | | \* |
| 34844 | 35043 | 200 | I4 | 139384 | 140183 | TRANSQA Pixel Group 53 | | \* |
| 35044 | 35243 | 200 | R4 | 140184 | 140983 | TRANSMISSION Pixel Group 54 | | \* |
| 35244 | 35443 | 200 | R4 | 140984 | 141783 | TRANSMISSION Uncertainty Pixel Group 54 | | \* |
| 35444 | 35643 | 200 | I4 | 141784 | 142583 | TRANSQA Pixel Group 54 | | \* |
| 35644 | 35843 | 200 | R4 | 142584 | 143383 | TRANSMISSION Pixel Group 55 | | \* |
| 35844 | 36043 | 200 | R4 | 143384 | 144183 | TRANSMISSION Uncertainty Pixel Group 55 | | \* |
| 36044 | 36243 | 200 | I4 | 144184 | 144983 | TRANSQA Pixel Group 55 | | \* |
| 36244 | 36443 | 200 | R4 | 144984 | 145783 | TRANSMISSION Pixel Group 56 | | \* |
| 36444 | 36643 | 200 | R4 | 145784 | 146583 | TRANSMISSION Uncertainty Pixel Group 56 | | \* |
| 36644 | 36843 | 200 | I4 | 146584 | 147383 | TRANSQA Pixel Group 56 | | \* |
| 36844 | 37043 | 200 | R4 | 147384 | 148183 | TRANSMISSION Pixel Group 57 | | \* |
| 37044 | 37243 | 200 | R4 | 148184 | 148983 | TRANSMISSION Uncertainty Pixel Group 57 | | \* |
| 37244 | 37443 | 200 | I4 | 148984 | 149783 | TRANSQA Pixel Group 57 | | \* |
| 37444 | 37643 | 200 | R4 | 149784 | 150583 | TRANSMISSION Pixel Group 58 | | \* |
| 37644 | 37843 | 200 | R4 | 150584 | 151383 | TRANSMISSION Uncertainty Pixel Group 58 | | \* |
| 37844 | 38043 | 200 | I4 | 151384 | 152183 | TRANSQA Pixel Group 58 | | \* |
| 38044 | 38243 | 200 | R4 | 152184 | 152983 | TRANSMISSION Pixel Group 59 | | \* |
| 38244 | 38443 | 200 | R4 | 152984 | 153783 | TRANSMISSION Uncertainty Pixel Group 59 | | \* |
| 38444 | 38643 | 200 | I4 | 153784 | 154583 | TRANSQA Pixel Group 59 | | \* |
| 38644 | 38843 | 200 | R4 | 154584 | 155383 | TRANSMISSION Pixel Group 60 | | \* |
| 38844 | 39043 | 200 | R4 | 155384 | 156183 | TRANSMISSION Uncertainty Pixel Group 60 | | \* |
| 39044 | 39243 | 200 | I4 | 156184 | 156983 | TRANSQA Pixel Group 60 | | \* |
| 39244 | 39443 | 200 | R4 | 156984 | 157783 | TRANSMISSION Pixel Group 61 | | \* |
| 39444 | 39643 | 200 | R4 | 157784 | 158583 | TRANSMISSION Uncertainty Pixel Group 61 | | \* |
| 39644 | 39843 | 200 | I4 | 158584 | 159383 | TRANSQA Pixel Group 61 | | \* |
| 39844 | 40043 | 200 | R4 | 159384 | 160183 | TRANSMISSION Pixel Group 62 | | \* |
| 40044 | 40243 | 200 | R4 | 160184 | 160983 | TRANSMISSION Uncertainty Pixel Group 62 | | \* |
| 40244 | 40443 | 200 | I4 | 160984 | 161783 | TRANSQA Pixel Group 62 | | \* |
| 40444 | 40643 | 200 | R4 | 161784 | 162583 | TRANSMISSION Pixel Group 63 | | \* |
| 40644 | 40843 | 200 | R4 | 162584 | 163383 | TRANSMISSION Uncertainty Pixel Group 63 | | \* |
| 40844 | 41043 | 200 | I4 | 163384 | 164183 | TRANSQA Pixel Group 63 | | \* |
| 41044 | 41243 | 200 | R4 | 164184 | 164983 | TRANSMISSION Pixel Group 64 | | \* |
| 41244 | 41443 | 200 | R4 | 164984 | 165783 | TRANSMISSION Uncertainty Pixel Group 64 | | \* |
| 41444 | 41643 | 200 | I4 | 165784 | 166583 | TRANSQA Pixel Group 64 | | \* |
| 41644 | 41843 | 200 | R4 | 166584 | 167383 | TRANSMISSION Pixel Group 65 | | \* |
| 41844 | 42043 | 200 | R4 | 167384 | 168183 | TRANSMISSION Uncertainty Pixel Group 65 | | \* |
| 42044 | 42243 | 200 | I4 | 168184 | 168983 | TRANSQA Pixel Group 65 | | \* |
| 42244 | 42443 | 200 | R4 | 168984 | 169783 | TRANSMISSION Pixel Group 66 | | \* |
| 42444 | 42643 | 200 | R4 | 169784 | 170583 | TRANSMISSION Uncertainty Pixel Group 66 | | \* |
| 42644 | 42843 | 200 | I4 | 170584 | 171383 | TRANSQA Pixel Group 66 | | \* |
| 42844 | 43043 | 200 | R4 | 171384 | 172183 | TRANSMISSION Pixel Group 67 | | \* |
| 43044 | 43243 | 200 | R4 | 172184 | 172983 | TRANSMISSION Uncertainty Pixel Group 67 | | \* |
| 43244 | 43443 | 200 | I4 | 172984 | 173783 | TRANSQA Pixel Group 67 | | \* |
| 43444 | 43643 | 200 | R4 | 173784 | 174583 | TRANSMISSION Pixel Group 68 | | \* |
| 43644 | 43843 | 200 | R4 | 174584 | 175383 | TRANSMISSION Uncertainty Pixel Group 68 | | \* |
| 43844 | 44043 | 200 | I4 | 175384 | 176183 | TRANSQA Pixel Group 68 | | \* |
| 44044 | 44243 | 200 | R4 | 176184 | 176983 | TRANSMISSION Pixel Group 69 | | \* |
| 44244 | 44443 | 200 | R4 | 176984 | 177783 | TRANSMISSION Uncertainty Pixel Group 69 | | \* |
| 44444 | 44643 | 200 | I4 | 177784 | 178583 | TRANSQA Pixel Group 69 | | \* |
| 44644 | 44843 | 200 | R4 | 178584 | 179383 | TRANSMISSION Pixel Group 70 | | \* |
| 44844 | 45043 | 200 | R4 | 179384 | 180183 | TRANSMISSION Uncertainty Pixel Group 70 | | \* |
| 45044 | 45243 | 200 | I4 | 180184 | 180983 | TRANSQA Pixel Group 70 | | \* |
| 45244 | 45443 | 200 | R4 | 180984 | 181783 | TRANSMISSION Pixel Group 71 | | \* |
| 45444 | 45643 | 200 | R4 | 181784 | 182583 | TRANSMISSION Uncertainty Pixel Group 71 | | \* |
| 45644 | 45843 | 200 | I4 | 182584 | 183383 | TRANSQA Pixel Group 71 | | \* |
| 45844 | 46043 | 200 | R4 | 183384 | 184183 | TRANSMISSION Pixel Group 72 | | \* |
| 46044 | 46243 | 200 | R4 | 184184 | 184983 | TRANSMISSION Uncertainty Pixel Group 72 | | \* |
| 46244 | 46443 | 200 | I4 | 184984 | 185783 | TRANSQA Pixel Group 72 | | \* |
| 46444 | 46643 | 200 | R4 | 185784 | 186583 | TRANSMISSION Pixel Group 73 | | \* |
| 46644 | 46843 | 200 | R4 | 186584 | 187383 | TRANSMISSION Uncertainty Pixel Group 73 | | \* |
| 46844 | 47043 | 200 | I4 | 187384 | 188183 | TRANSQA Pixel Group 73 | | \* |
| 47044 | 47243 | 200 | R4 | 188184 | 188983 | TRANSMISSION Pixel Group 74 | | \* |
| 47244 | 47443 | 200 | R4 | 188984 | 189783 | TRANSMISSION Uncertainty Pixel Group 74 | | \* |
| 47444 | 47643 | 200 | I4 | 189784 | 190583 | TRANSQA Pixel Group 74 | | \* |
| 47644 | 47843 | 200 | R4 | 190584 | 191383 | TRANSMISSION Pixel Group 75 | | \* |
| 47844 | 48043 | 200 | R4 | 191384 | 192183 | TRANSMISSION Uncertainty Pixel Group 75 | | \* |
| 48044 | 48243 | 200 | I4 | 192184 | 192983 | TRANSQA Pixel Group 75 | | \* |
| 48244 | 48443 | 200 | R4 | 192984 | 193783 | TRANSMISSION Pixel Group 76 | | \* |
| 48444 | 48643 | 200 | R4 | 193784 | 194583 | TRANSMISSION Uncertainty Pixel Group 76 | | \* |
| 48644 | 48843 | 200 | I4 | 194584 | 195383 | TRANSQA Pixel Group 76 | | \* |
| 48844 | 49043 | 200 | R4 | 195384 | 196183 | TRANSMISSION Pixel Group 77 | | \* |
| 49044 | 49243 | 200 | R4 | 196184 | 196983 | TRANSMISSION Uncertainty Pixel Group 77 | | \* |
| 49244 | 49443 | 200 | I4 | 196984 | 197783 | TRANSQA Pixel Group 77 | | \* |
| 49444 | 49643 | 200 | R4 | 197784 | 198583 | TRANSMISSION Pixel Group 78 | | \* |
| 49644 | 49843 | 200 | R4 | 198584 | 199383 | TRANSMISSION Uncertainty Pixel Group 78 | | \* |
| 49844 | 50043 | 200 | I4 | 199384 | 200183 | TRANSQA Pixel Group 78 | | \* |
| 50044 | 50243 | 200 | R4 | 200184 | 200983 | TRANSMISSION Pixel Group 79 | | \* |
| 50244 | 50443 | 200 | R4 | 200984 | 201783 | TRANSMISSION Uncertainty Pixel Group 79 | | \* |
| 50444 | 50643 | 200 | I4 | 201784 | 202583 | TRANSQA Pixel Group 79 | | \* |
| 50644 | 50843 | 200 | R4 | 202584 | 203383 | TRANSMISSION Pixel Group 80 | | \* |
| 50844 | 51043 | 200 | R4 | 203384 | 204183 | TRANSMISSION Uncertainty Pixel Group 80 | | \* |
| 51044 | 51243 | 200 | I4 | 204184 | 204983 | TRANSQA Pixel Group 80 | | \* |
| 51244 | 51443 | 200 | R4 | 204984 | 205783 | TRANSMISSION Pixel Group 81 | | \* |
| 51444 | 51643 | 200 | R4 | 205784 | 206583 | TRANSMISSION Uncertainty Pixel Group 81 | | \* |
| 51644 | 51843 | 200 | I4 | 206584 | 207383 | TRANSQA Pixel Group 81 | | \* |
| 51844 | 52043 | 200 | R4 | 207384 | 208183 | TRANSMISSION Pixel Group 82 | | \* |
| 52044 | 52243 | 200 | R4 | 208184 | 208983 | TRANSMISSION Uncertainty Pixel Group 82 | | \* |
| 52244 | 52443 | 200 | I4 | 208984 | 209783 | TRANSQA Pixel Group 82 | | \* |
| 52444 | 52643 | 200 | R4 | 209784 | 210583 | TRANSMISSION Pixel Group 83 | | \* |
| 52644 | 52843 | 200 | R4 | 210584 | 211383 | TRANSMISSION Uncertainty Pixel Group 83 | | \* |
| 52844 | 53043 | 200 | I4 | 211384 | 212183 | TRANSQA Pixel Group 83 | | \* |
| 53044 | 53243 | 200 | R4 | 212184 | 212983 | TRANSMISSION Pixel Group 84 | | \* |
| 53244 | 53443 | 200 | R4 | 212984 | 213783 | TRANSMISSION Uncertainty Pixel Group 84 | | \* |
| 53444 | 53643 | 200 | I4 | 213784 | 214583 | TRANSQA Pixel Group 84 | | \* |
| 53644 | 53843 | 200 | R4 | 214584 | 215383 | TRANSMISSION Pixel Group 85 | | \* |
| 53844 | 54043 | 200 | R4 | 215384 | 216183 | TRANSMISSION Uncertainty Pixel Group 85 | | \* |
| 54044 | 54243 | 200 | I4 | 216184 | 216983 | TRANSQA Pixel Group 85 | | \* |
| 54244 | 54443 | 200 | R4 | 216984 | 217783 | TRANSMISSION Pixel Group 86 | | \* |
| 54444 | 54643 | 200 | R4 | 217784 | 218583 | TRANSMISSION Uncertainty Pixel Group 86 | | \* |
| 54644 | 54843 | 200 | I4 | 218584 | 219383 | TRANSQA Pixel Group 86 | | \* |

# Appendix C. SAGE III/ISS Level 2 Solar Species Products

**Table C1. Binary File Format Sheet: SAGE III/ISS Level 2 Solar Species Product**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Field Start | Field End | Num Values | F90 Type | Start Byte | End Byte | Description | | Units |
| 0 | 0 | 1 | C12 | 0 | 11 | EVENT\_ID | | \* |
| 1 | 1 | 1 | I4 | 12 | 15 | OLD\_EVENT\_ID | | \* |
| 2 | 2 | 1 | I4 | 16 | 19 | DATE | | \* |
| 3 | 3 | 1 | R4 | 20 | 23 | YEAR\_FRACTION | | \* |
| 4 | 4 | 1 | R4 | 24 | 27 | LATITUDE | | degrees |
| 5 | 5 | 1 | R4 | 28 | 31 | LONGITUDE | | degrees |
| 6 | 6 | 1 | I4 | 32 | 35 | TIME | | \* |
| 7 | 7 | 1 | I4 | 36 | 39 | INT\_FILL\_VALUE | | \* |
| 8 | 8 | 1 | R4 | 40 | 43 | FLT\_FILL\_VALUE | | \* |
| 9 | 9 | 1 | I4 | 44 | 47 | MISSION\_ID | | \* |
| 10 | 10 | 1 | R4 | 48 | 51 | L0DO\_VERSION | | \* |
| 11 | 11 | 1 | I4 | 52 | 55 | CCDTABLE\_VERSION | | \* |
| 12 | 12 | 1 | R4 | 56 | 59 | L0\_VERSION | | \* |
| 13 | 13 | 1 | R4 | 60 | 63 | SOFTWARE\_VERSION | | \* |
| 14 | 14 | 1 | R4 | 64 | 67 | DATAPRODUCT\_VERSION | | \* |
| 15 | 15 | 1 | R4 | 68 | 71 | SPECTROSCOPIC\_DATABASE\_VERSION | | \* |
| 16 | 16 | 1 | R4 | 72 | 75 | GRAM95\_VERSION | | \* |
| 17 | 17 | 1 | R4 | 76 | 79 | MET\_VERSION | | \* |
| 18 | 18 | 1 | R4 | 80 | 83 | BIN\_HEIGHT | | km |
| 19 | 19 | 1 | I4 | 84 | 87 | NUM\_BINS | | \* |
| 20 | 20 | 1 | I4 | 88 | 91 | NUM\_MET\_GRID | | \* |
| 21 | 21 | 1 | I4 | 92 | 95 | NUM\_AER\_CHANNELS | | \* |
| 22 | 22 | 1 | I4 | 96 | 99 | NUM\_GRND\_TRK | | \* |
| 23 | 23 | 1 | I4 | 100 | 103 | NUM\_AER\_BINS | | \* |
| 24 | 24 | 1 | I4 | 104 | 107 | SC\_EVT\_TYPE *(Sunrise = 1; Sunset = 2)* | | \* |
| 25 | 25 | 1 | I4 | 108 | 111 | GND\_EVT\_TYPE *(Sunrise = 1; Sunset = 2)* | | \* |
| 26 | 26 | 1 | R4 | 112 | 115 | BETAANGLE\_SOLAR | | degrees |
| 27 | 27 | 1 | I4 | 116 | 119 | AURORA\_FLAG *(N/A)* | | \* |
| 28 | 28 | 1 | I4 | 120 | 123 | EPHEMERIS\_SOURCE *(GPS = 5)* | | \* |
| 29 | 39 | 11 | I4 | 124 | 167 | GT\_DATE | *Ground track-indexed data for 11 tangent altitudes from 0km to 100km at 10km intervals* | \* |
| 40 | 50 | 11 | I4 | 168 | 211 | GT\_TIME | \* |
| 51 | 61 | 11 | R4 | 212 | 255 | GT\_LATITUDE | degrees |
| 62 | 72 | 11 | R4 | 256 | 299 | GT\_LONGITUDE | degrees |
| 73 | 83 | 11 | R4 | 300 | 343 | GT\_RAY\_DIR | degrees |
| 84 | 94 | 11 | R4 | 344 | 387 | SPACE\_CRAFT\_LAT | degrees |
| 95 | 105 | 11 | R4 | 388 | 431 | SPACE\_CRAFT\_LON | degrees |
| 106 | 116 | 11 | R4 | 432 | 475 | SPACE\_CRAFT\_ALT | degrees |
| 117 | 316 | 200 | I4 | 476 | 1275 | HOMOGENEITY | | \* |
| 317 | 516 | 200 | R4 | 1276 | 2075 | ALTITUDE | | km |
| 517 | 716 | 200 | R4 | 2076 | 2875 | GEOPOTENTIAL\_ALT | | km |
| 717 | 916 | 200 | R4 | 2876 | 3675 | TEMPERATURE | | K |
| 917 | 1116 | 200 | R4 | 3676 | 4475 | TEMPERATURE\_UNCERT | | K |
| 1117 | 1316 | 200 | R4 | 4476 | 5275 | PRESSURE | | hPa |
| 1317 | 1516 | 200 | R4 | 5276 | 6075 | PRESSURE\_UNCERT | | hPa |
| 1517 | 1716 | 200 | R4 | 6076 | 6875 | NEUTRAL\_DENSITY | | cm-3 |
| 1717 | 1916 | 200 | R4 | 6876 | 7675 | NEUTRAL\_DENSITY\_UNCERT | | cm-3 |
| 1917 | 2116 | 200 | I4 | 7676 | 8475 | TEMP\_PRESSURE\_SOURCE *(GRAM95 = 0; MERRA-2 = 2)* | | \* |
| 2117 | 2117 | 1 | R4 | 8476 | 8479 | TROP\_TEMP | | K |
| 2118 | 2118 | 1 | R4 | 8480 | 8483 | TROP\_ALT | | km |
| 2119 | 2119 | 1 | R4 | 8484 | 8487 | TROP\_PRESS | | hPa |
| 2120 | 2161 | 42 | R4 | 8488 | 8655 | MET\_PRESSURE | Pressure surface-indexed data | hPa |
| 2162 | 2203 | 42 | R4 | 8656 | 8823 | MET\_TEMP | K |
| 2204 | 2245 | 42 | R4 | 8824 | 8991 | MET\_TEMP\_UNC | K |
| 2246 | 2287 | 42 | R4 | 8992 | 9159 | MET\_ALTITUDE | km |
| 2288 | 2288 | 1 | I4 | 9160 | 9163 | MET\_SOURCE *(GRAM95 = 0; MERRA-2 = 2)* | | \* |
| 2289 | 2289 | 1 | R4 | 9164 | 9167 | CCD\_TEMPERATURE | | °C |
| 2290 | 2290 | 1 | R4 | 9168 | 9171 | SPECTROMETER\_ZENITH\_TEMPERATURE | | °C |
| 2291 | 2291 | 1 | R4 | 9172 | 9175 | CCD\_TEMPERATURE\_MINUS\_TEC | | °C |
| 2292 | 2292 | 1 | I4 | 9176 | 9179 | EPHEMERIS\_QUALITY *(N/A)* | | \* |
| 2293 | 2293 | 1 | R4 | 9180 | 9183 | SPECCALSHIFT | | nm |
| 2294 | 2294 | 1 | R4 | 9184 | 9187 | SPECCALSTRETCH | | nm/pixel |
| 2295 | 2296 | 2 | R4 | 9188 | 9195 | AZIMUTHANGLE | | degrees |
| 2297 | 2297 | 1 | I4 | 9196 | 9199 | QAFLAG | | \* |
| 2298 | 2497 | 200 | I4 | 9200 | 9999 | QAFLAG\_ALTITUDE | | \* |
| 2498 | 2697 | 200 | R4 | 10000 | 10799 | OZONE\_COMPOSITE | | cm-3 |
| 2698 | 2897 | 200 | R4 | 10800 | 11599 | OZONE\_COMPOSITE\_UNCERT | | cm-3 |
| 2898 | 3097 | 200 | I4 | 11600 | 12399 | OZONE\_COMPOSITE\_QA | | \* |
| 3098 | 3297 | 200 | R4 | 12400 | 13199 | OZONE\_MES | | cm-3 |
| 3298 | 3497 | 200 | R4 | 13200 | 13999 | OZONE\_MES\_UNCERT | | cm-3 |
| 3498 | 3697 | 200 | I4 | 14000 | 14799 | OZONE\_MES\_QA | | \* |
| 3698 | 3897 | 200 | R4 | 14800 | 15599 | OZONE\_MLR | | cm-3 |
| 3898 | 4097 | 200 | R4 | 15600 | 16399 | OZONE\_MLR\_UNCERT | | cm-3 |
| 4098 | 4297 | 200 | I4 | 16400 | 17199 | OZONE\_MLR\_QA | | \* |
| 4298 | 4497 | 200 | R4 | 17200 | 17999 | OZONE\_AO3 | | cm-3 |
| 4498 | 4697 | 200 | R4 | 18000 | 18799 | OZONE\_AO3\_UNCERT | | cm-3 |
| 4698 | 4897 | 200 | I4 | 18800 | 19599 | OZONE\_AO3\_QA | | \* |
| 4898 | 5097 | 200 | R4 | 19600 | 20399 | H2O | | cm-3 |
| 5098 | 5297 | 200 | R4 | 20400 | 21199 | H2O\_UNCERT | | cm-3 |
| 5298 | 5497 | 200 | I4 | 21200 | 21999 | H2O\_QA | | \* |
| 5498 | 5697 | 200 | R4 | 22000 | 22799 | NO2 | | cm-3 |
| 5698 | 5897 | 200 | R4 | 22800 | 23599 | NO2\_UNCERT | | cm-3 |
| 5898 | 6097 | 200 | I4 | 23600 | 24399 | NO2\_QA | | \* |
| 6098 | 6297 | 200 | R4 | 24400 | 25199 | RETTEMP | *Retrieved meteorological profiles (currently disabled)* | K |
| 6298 | 6497 | 200 | R4 | 25200 | 25999 | RETTEMP\_UNCERT | K |
| 6498 | 6697 | 200 | R4 | 26000 | 26799 | RETPRESS | hPa |
| 6698 | 6897 | 200 | R4 | 26800 | 27599 | RETPRESS\_UNCERT | hPa |
| 6898 | 7097 | 200 | I4 | 27600 | 28399 | RETTP\_QA | \* |
| 7098 | 7106 | 9 | R4 | 28400 | 28435 | AER\_WAVELENGTH | | nm |
| 7107 | 7115 | 9 | R4 | 28436 | 28471 | AER\_WIDTH | | nm |
| 7116 | 7124 | 9 | R4 | 28472 | 28507 | MOLECULAR\_SCT | | cm3/km |
| 7125 | 7133 | 9 | R4 | 28508 | 28543 | MOLECULAR\_SCT\_UNCERT | | cm3/km |
| 7134 | 7142 | 9 | R4 | 28544 | 28579 | STRAT\_AER\_OD | | \* |
| 7143 | 7151 | 9 | R4 | 28580 | 28615 | STRAT\_AER\_OD\_UNCERT | | \* |
| 7152 | 7160 | 9 | I4 | 28616 | 28651 | STRAT\_AER\_OD\_QA (32 = STRAT\_AER\_OD is Fill) | | \* |
| 7161 | 7250 | 90 | R4 | 28652 | 29011 | AEREXT Channel 1 | | km-1 |
| 7251 | 7340 | 90 | R4 | 29012 | 29371 | AEREXT\_UNCERT Channel 1 | | km-1 |
| 7341 | 7430 | 90 | I4 | 29372 | 29731 | AERQA Channel 1 | | \* |
| 7431 | 7520 | 90 | R4 | 29732 | 30091 | AEREXT Channel 2 | | km-1 |
| 7521 | 7610 | 90 | R4 | 30092 | 30451 | AEREXT\_UNCERT Channel 2 | | km-1 |
| 7611 | 7700 | 90 | I4 | 30452 | 30811 | AERQA Channel 2 | | \* |
| 7701 | 7790 | 90 | R4 | 30812 | 31171 | AEREXT Channel 3 | | km-1 |
| 7791 | 7880 | 90 | R4 | 31172 | 31531 | AEREXT\_UNCERT Channel 3 | | km-1 |
| 7881 | 7970 | 90 | I4 | 31532 | 31891 | AERQA Channel 3 | | \* |
| 7971 | 8060 | 90 | R4 | 31892 | 32251 | AEREXT Channel 4 | | km-1 |
| 8061 | 8150 | 90 | R4 | 32252 | 32611 | AEREXT\_UNCERT Channel 4 | | km-1 |
| 8151 | 8240 | 90 | I4 | 32612 | 32971 | AERQA Channel 4 | | \* |
| 8241 | 8330 | 90 | R4 | 32972 | 33331 | AEREXT Channel 5 | | km-1 |
| 8331 | 8420 | 90 | R4 | 33332 | 33691 | AEREXT\_UNCERT Channel 5 | | km-1 |
| 8421 | 8510 | 90 | I4 | 33692 | 34051 | AERQA Channel 5 | | \* |
| 8511 | 8600 | 90 | R4 | 34052 | 34411 | AEREXT Channel 6 | | km-1 |
| 8601 | 8690 | 90 | R4 | 34412 | 34771 | AEREXT\_UNCERT Channel 6 | | km-1 |
| 8691 | 8780 | 90 | I4 | 34772 | 35131 | AERQA Channel 6 | | \* |
| 8781 | 8870 | 90 | R4 | 35132 | 35491 | AEREXT Channel 7 | | km-1 |
| 8871 | 8960 | 90 | R4 | 35492 | 35851 | AEREXT\_UNCERT Channel 7 | | km-1 |
| 8961 | 9050 | 90 | I4 | 35852 | 36211 | AERQA Channel 7 | | \* |
| 9051 | 9140 | 90 | R4 | 36212 | 36571 | AEREXT Channel 8 | | km-1 |
| 9141 | 9230 | 90 | R4 | 36572 | 36931 | AEREXT\_UNCERT Channel 8 | | km-1 |
| 9231 | 9320 | 90 | I4 | 36932 | 37291 | AERQA Channel 8 | | \* |
| 9321 | 9410 | 90 | R4 | 37292 | 37651 | AEREXT Channel 9 | | km-1 |
| 9411 | 9500 | 90 | R4 | 37652 | 38011 | AEREXT\_UNCERT Channel 9 | | km-1 |
| 9501 | 9590 | 90 | I4 | 38012 | 38371 | AERQA Channel 9 | | \* |

# Appendix D. SAGE III/ISS Level 2 Lunar Species Products

**Table D1. Binary File Format Sheet: SAGE III/ISS Level 2 Lunar Species Product**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Field Start | Field End | Num Values | F90 Type | Start Byte | End Byte | Description | | Units |
| 0 | 0 | 1 | C12 | 0 | 11 | EVENT\_ID | | \* |
| 1 | 1 | 1 | I4 | 12 | 15 | OLD\_EVENT\_ID | | \* |
| 2 | 2 | 1 | I4 | 16 | 19 | DATE | | \* |
| 3 | 3 | 1 | R4 | 20 | 23 | YEAR\_FRACTION | | \* |
| 4 | 4 | 1 | R4 | 24 | 27 | LATITUDE | | degrees |
| 5 | 5 | 1 | R4 | 28 | 31 | LONGITUDE | | degrees |
| 6 | 6 | 1 | I4 | 32 | 35 | TIME | | \* |
| 7 | 7 | 1 | I4 | 36 | 39 | INT\_FILL\_VALUE | | \* |
| 8 | 8 | 1 | R4 | 40 | 43 | FLT\_FILL\_VALUE | | \* |
| 9 | 9 | 1 | I4 | 44 | 47 | MISSION\_ID | | \* |
| 10 | 10 | 1 | R4 | 48 | 51 | L0DO\_VERSION | | \* |
| 11 | 11 | 1 | I4 | 52 | 55 | CCDTABLE\_VERSION | | \* |
| 12 | 12 | 1 | R4 | 56 | 59 | L0\_VERSION | | \* |
| 13 | 13 | 1 | R4 | 60 | 63 | SOFTWARE\_VERSION | | \* |
| 14 | 14 | 1 | R4 | 64 | 67 | DATAPRODUCT\_VERSION | | \* |
| 15 | 15 | 1 | R4 | 68 | 71 | SPECTROSCOPIC\_DATABASE\_VERSION | | \* |
| 16 | 16 | 1 | R4 | 72 | 75 | GRAM95\_VERSION | | \* |
| 17 | 17 | 1 | R4 | 76 | 79 | MET\_VERSION | | \* |
| 18 | 18 | 1 | R4 | 80 | 83 | LUN\_MODEL\_VER | | \* |
| 19 | 19 | 1 | R4 | 84 | 87 | LUN\_ALBEDO\_VER | | \* |
| 20 | 20 | 1 | R4 | 88 | 91 | BIN\_HEIGHT | | km |
| 21 | 21 | 1 | I4 | 92 | 95 | NUM\_ALT\_BINS | | \* |
| 22 | 22 | 1 | I4 | 96 | 99 | NUM\_PRESS\_GRID | | \* |
| 23 | 23 | 1 | I4 | 100 | 103 | NUM\_GRND\_TRK | | \* |
| 24 | 24 | 1 | I4 | 104 | 107 | SC\_EVT\_TYPE *(Moonrise = 3; Moonset = 4)* | | \* |
| 25 | 25 | 1 | I4 | 108 | 111 | GND\_EVT\_TYPE *(Moonrise = 3; Moonset = 4)* | | \* |
| 26 | 26 | 1 | R4 | 112 | 115 | BETAANGLE\_LUNAR | | degrees |
| 27 | 27 | 1 | R4 | 116 | 119 | LUNARPHASE | | \* |
| 28 | 28 | 1 | R4 | 120 | 123 | ZENITHANGLE | | degrees |
| 29 | 29 | 1 | I4 | 124 | 127 | AURORA\_FLAG *(N/A)* | | \* |
| 30 | 30 | 1 | I4 | 128 | 131 | EPHEMERIS\_SOURCE *(GPS = 5)* | | \* |
| 31 | 41 | 11 | I4 | 132 | 175 | GT\_DATE | *Ground track-indexed data for 11 tangent altitudes from 0km to 100km at 10km intervals* | \* |
| 42 | 52 | 11 | I4 | 176 | 219 | GT\_TIME | \* |
| 53 | 63 | 11 | R4 | 220 | 263 | GT\_LATITUDE | degrees |
| 64 | 74 | 11 | R4 | 264 | 307 | GT\_LONGITUDE | degrees |
| 75 | 85 | 11 | R4 | 308 | 351 | GT\_RAY\_DIR | degrees |
| 86 | 96 | 11 | R4 | 352 | 395 | SPACE\_CRAFT\_LAT | degrees |
| 97 | 107 | 11 | R4 | 396 | 439 | SPACE\_CRAFT\_LON | degrees |
| 108 | 118 | 11 | R4 | 440 | 483 | SPACE\_CRAFT\_ALT | km |
| 119 | 318 | 200 | R4 | 484 | 1283 | ALTITUDE | | km |
| 319 | 518 | 200 | R4 | 1284 | 2083 | GEOPOTENTIAL\_ALT | | km |
| 519 | 718 | 200 | R4 | 2084 | 2883 | TEMPERATURE | | K |
| 719 | 918 | 200 | R4 | 2884 | 3683 | TEMPERATURE\_UNCERT | | K |
| 919 | 1118 | 200 | R4 | 3684 | 4483 | PRESSURE | | hPa |
| 1119 | 1318 | 200 | R4 | 4484 | 5283 | PRESSURE\_UNCERT | | hPa |
| 1319 | 1518 | 200 | R4 | 5284 | 6083 | NEUTRAL\_DENSITY | | cm-3 |
| 1519 | 1718 | 200 | R4 | 6084 | 6883 | NEUTRAL\_DENSITY\_UNCERT | | cm-3 |
| 1719 | 1918 | 200 | I4 | 6884 | 7683 | TEMP\_PRESSURE\_SOURCE *(GRAM95 = 0; MERRA-2 = 2)* | | \* |
| 1919 | 1919 | 1 | R4 | 7684 | 7687 | TROP\_TEMP | | K |
| 1920 | 1920 | 1 | R4 | 7688 | 7691 | TROP\_ALT | | km |
| 1921 | 1921 | 1 | R4 | 7692 | 7695 | TROP\_PRESS | | hPa |
| 1922 | 1963 | 42 | R4 | 7696 | 7863 | MET\_PRESSURE | Pressure surface-indexed data | hPa |
| 1964 | 2005 | 42 | R4 | 7864 | 8031 | MET\_TEMP | K |
| 2006 | 2047 | 42 | R4 | 8032 | 8199 | MET\_TEMP\_UNC | K |
| 2048 | 2089 | 42 | R4 | 8200 | 8367 | MET\_ALTITUDE | km |
| 2090 | 2090 | 1 | I4 | 8368 | 8371 | MET\_SOURCE *(GRAM95 = 0; MERRA-2 = 2)* | | \* |
| 2091 | 2091 | 1 | R4 | 8372 | 8375 | CCD\_TEMPERATURE | | °C |
| 2092 | 2092 | 1 | R4 | 8376 | 8379 | SPECTROMETER\_ZENITH\_TEMPERATURE | | °C |
| 2093 | 2093 | 1 | R4 | 8380 | 8383 | CCD\_TEMPERATURE\_MINUS\_TEC | | °C |
| 2094 | 2094 | 1 | I4 | 8384 | 8387 | EPHEMERIS\_QUALITY *(N/A)* | | \* |
| 2095 | 2095 | 1 | R4 | 8388 | 8391 | SPECCALSHIFT | | nm |
| 2096 | 2096 | 1 | R4 | 8392 | 8395 | SPECCALSTRETCH | | nm/pixel |
| 2097 | 2098 | 2 | R4 | 8396 | 8403 | AZIMUTHANGLE | | degrees |
| 2099 | 2099 | 1 | I4 | 8404 | 8407 | QAFLAG | | \* |
| 2100 | 2299 | 200 | I4 | 8408 | 9207 | QAFLAG\_ALTITUDE | | \* |
| 2300 | 2499 | 200 | I4 | 9208 | 10007 | ABANDALTREGQA (N/A) | | \* |
| 2500 | 2500 | 1 | R4 | 10008 | 10011 | ABANDALTREGOFFSET | | km |
| 2501 | 2700 | 200 | R4 | 10012 | 10811 | OZONE | | cm-3 |
| 2701 | 2900 | 200 | R4 | 10812 | 11611 | OZONE\_UNCERT | | cm-3 |
| 2901 | 3100 | 200 | I4 | 11612 | 12411 | OZONEQA | | \* |
| 3101 | 3300 | 200 | R4 | 12412 | 13211 | NO2 | | cm-3 |
| 3301 | 3500 | 200 | R4 | 13212 | 14011 | NO2\_UNCERT | | cm-3 |
| 3501 | 3700 | 200 | I4 | 14012 | 14811 | NO2QA | | \* |
| 3701 | 3900 | 200 | R4 | 14812 | 15611 | NO3 | | cm-3 |
| 3901 | 4100 | 200 | R4 | 15612 | 16411 | NO3\_UNCERT | | cm-3 |
| 4101 | 4300 | 200 | I4 | 16412 | 17211 | NO3QA | | \* |
| 4301 | 4500 | 200 | R4 | 17212 | 18011 | OCLO | | cm-3 |
| 4501 | 4700 | 200 | R4 | 18012 | 18811 | OCLO\_UNCERT | | cm-3 |
| 4701 | 4900 | 200 | I4 | 18812 | 19611 | OCLOQA | | \* |

# Appendix E. Reference Absorption Cross Sections for Gas Retrievals

**Table E1. Absorption Spectrum Data Source by Species**

|  |  |
| --- | --- |
| **Gas Species** | **Source** |
| Ozone | SCIAMACHY O3 Version 3.0, Dec. 2004 [5] |
| Nitrogen Dioxide | SCIAMACHY NO2 Version 1.0, Aug. 2000 [5] |
| Nitrogen Trioxide | Yokelson 1994 [6] |
| Water Vapor | HITRAN 2004 [7] |
| Chlorine Dioxide | SCIAMACHY OClO Version 1.0, Aug. 2000 [5] |
| Dioxygen | HITRAN 2004 [7] |
| Tetraoxygen | Greenblatt 1990 [8] |
| Rayleigh-Scattering | Bucholtz 1995 [9] |