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Data Product Specification for the GroundMSPI Level 1B2 Products (V009)

David J. Diner (PI)
Michael J. Garay
Felix C. Seidel
Carol J. Bruegge
Veljko M. Jovanovic
Michael A. Bull
Irina N. Tkatcheva
Brian E. Rheingans
Gerard van Harten
Abigail M. Nastan
Christine L. Bradley
Earl G. Hansen

Corresponding author: Abigail.m.nastan@jpl.nasa.gov

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California Institute of Technology

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Ground-based Multiangle SpectroPolarimetric Imager
(GroundMSPI)

Data Product Specification for the GroundMSPI Level 1B2 Products (V009)

APPROVALS:

David J. Diner
AirMSPI Principal Investigator

Approval signatures are on file with the AirMSPI Project.
To determine the latest released version of this document, consult the AirMSPI website
(http://airbornescience.jpl.nasa.gov/instruments/airmspi/).

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Document Change Log

Revision	Date	Affected Portions and Description
	1 September 2018	Original release for V009

Which Product Versions Does this Document Cover?

Product Filename Prefix	Version Number in Filename	Brief Description
GroundMSPI_L1B2	V009	L1B2 Rectified and Co-Registered Radiance and Polarization Data

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1   INTRODUCTION

1.1   GroundMSPI L1B2 Products

The Ground-based Multiangle SpectroPolarimetric Imager (GroundMSPI) Level 1B2 products contain radiometric and polarimetric observations of clouds, aerosols, and the surface of the Earth, acquired from the vantage point of the Earth's surface. The GroundMSPI instrument is mounted on a two-axis gimbal to point in view elevation and azimuth directions, and is capable of both upward- and downward-looking measurements. GroundMSPI scans in view elevation to acquire two-dimensional pushbroom images. Files are distributed in HDF-EOS-5 format.

The instrument reports for eight spectral bands (355, 380, 445, 470, 555, 660, 865, and 935 nm) the incident radiance (Stokes *I*), complemented with the linear polarization state (Stokes *Q* and *U*) in three of the bands (470, 660, and 865 nm) for a total of 14 channels.

1.2   GroundMSPI Data Processing and Distribution

The MISR Science Computing Facility (SCF) at the Jet Propulsion Laboratory (JPL) supports the development of GroundMSPI science algorithms and software, instrument calibration and performance assessment, and also provides quality assessment and data validation services with respect to GroundMSPI Science Data Processing (SDP). The MISR SCF is used to perform the standard processing of the GroundMSPI data. After GroundMSPI data processing is complete, the standard output products are archived and made available to users via the Langley Research Center (LaRC) Atmospheric Science Data Center (ASDC) client services. See https://eosweb.larc.nasa.gov/project/airmspi/airmspi_table.

1.3   Controlling Documents

1) Multiangle Spectropolarimetric Imager (MSPI) Algorithm Theoretical Basis Document Rev. B Draft, November 2009 (or latest version).

1.4   Related Documents

1) GroundMSPI Data Quality Statement: ACEPOL Campaign, JPL D-102349, September 2018.

2   GroundMSPI LEVEL 1B2 DATA PRODUCT SPECIFICATION

2.1   GroundMSPI Level 1B2 Product Granule Brief Description

The GroundMSPI L1B2 Product contains radiance information in eight spectral bands (nominally 355, 380, 445, 470, 555, 660, 865, and 935 nm) as well as polarimetric information in three of these bands (470, 660, 865 nm) – representing 14 total channels. Solar and view geometry, and temporal information associated with the acquired imagery are provided.

2.2   GroundMSPI Level 1B2 Product Granule Components

Each granule of the GroundMSPI L1B2 Product corresponds to a single data acquisition. Table 1 shows some example product file names and describes the naming conventions.

Table 1 – L1B2 Example Product Files and Grid

Collection (Shortname)	Local Granule ID[1]
GroundMSPI_ACEPOL_Radiance_Data	GroundMSPI_L1B2_yyyymmdd_hhmmssZ_tttt_aaa[U,D]_Fff_Vvvv.hdf

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1   Where yyyy is the year, mm is the month, dd is the day, hh is the hour, mm is the minute, ss is the second in UTC of the central observation, tttt corresponds to the target name, aaa is the view azimuth angle, U is upward, D is downward, Fff is the file format version, and Vvvv is the version number. The view angle aaa is reported to the nearest integer value in degrees.

2.3   GroundMSPI Level 1B2 Product

2.3.1   Granule Metadata Description (.met File)

Table 2 – Metadata (.met)

Field Name	Definition	Example Contents
DatasetName	Name of dataset	GroundMSPI_ACEPOL_Radiance_Data_9
GranuleName	Name of specific data granule	GroundMSPI_L1B2_20171025_170926Z_Rosamond_Principal_Plane_0deg_315U_F01_V009.hdf5
StartDate	UTC date at start of data acquisition for this granule (yyyy-mm-dd)	2017-10-25
StartTime	UTC time at start of data acquisition for this granule (hh:mm:ss.ssssssZ)	17:09:26.671518Z
EndDate	UTC date at end of data acquisition of this granule (yyyy-mm-dd)	2017-10-25
EndTime	UTC time at end of data acquisition for this granule (hh:mm:ss.ssssssZ)	17:11:25.297625Z
MaxLat	Maximum geographic latitude of data in this granule (degrees N)	34.862247
MaxLong	Maximum geographic longitude of data in this granule (degrees E)	-118.078234
MinLat	Minimum geographic latitude of data in this granule (degrees N)	34.862227
MinLong	Minimum geographic longitude of data in this granule (degrees E)	-118.078254
GeoPoint	Latitude and longitude of the location on Earth where this observation was taken (degrees N, degrees E)	((34.8622,-118.078))
GranuleSize	Size of data granule (bytes)	1148312217
Processing Date	UTC date and time of data processing (yyyy-mm-dd)	2017-10-25
VersionID	Product version number	009
Browse	Indicates existence of .jpeg browse product	Y
Browsjpeg	Filename of .jpeg browse product	GroundMSPI_L1B2_20171025_170926Z_Rosamond_Principal_Plane_0deg_315U_F01_V009.jpg
jpegsize	Size of .jpeg browse product (bytes)	569728
Resolution	Pixel resolution of data in granule (arcmin)	1.03
TargetType	Text description of target type for this granule (Sky or Playa)	Sky

2.3.2 HDF-EOS-5 Format Description

HDF-EOS-5 files are organized into groups and subgroups. The tables below describe the content of a GroundMSPI HDF-EOS-5 file in a manner consistent with this organization.

Table 3 – Top Level Contents

Field Name	Description
Channel_Information	Contains information about the GroundMSPI spectral channels and solar constant values
HDFEOS	Contains the primary data contents of the file
HDFEOS INFORMATION	Contains ancillary information (metadata) about the file

Table 4 – HDFEOS Contents

Field Name	Description
ADDITIONAL	Contains additional information useful to users of the L1B2 data products
GRIDS	Contains the gridded HDF-EOS data

Table 5 – HDFEOS/ADDITIONAL Contents

Field Name	Description
FILE_ATTRIBUTES	Contains additional information useful to users of the L1B2 data products

Table 6 – HDFEOS/ADDITIONAL/FILE_ATTRIBUTES Contents

Field Name	Description
Band Table	Provides the band number (1-8), the associated band name, spectral wavelength, solar irradiance.

Table 7 – HDFEOS/ADDITIONAL/FILE_ATTRIBUTES Attributes Contents

Field Name	Description
Epoch (UTC)	UTC time used as the reference epoch for this data granule
[config]	Configuration parameters used in data processing
[history]	Processing history information
[input]	Input information used in data processing

granule_id	ID name for this data granule

Table 8 – HDFEOS/GRIDS Contents

Field Name	Description
355nm_band	Parameters associated with the 355 nm (UV) spectral channel (I)
380nm_band	Parameters associated with the 380 nm (UV) spectral channel (I)
445nm_band	Parameters associated with the 445 nm (VIS) spectral channel (I)
470nm_band	Parameters associated with the 470 nm (VIS) polarized spectral channels (I, Q, and U)
555nm_band	Parameters associated with the 555 nm (VIS) spectral channel (I)
660nm_band	Parameters associated with the 660 nm (VIS) polarized spectral channels (I, Q, and U). This group also contains solar geometry, view geometry, and time information.
865nm_band	Parameters associated with the 865 nm (NIR) polarized spectral channels (I, Q, and U)
935nm_band	Parameters associated with the 935 nm (NIR) spectral channel (I)

Note: Each Field at the HDFEOS/GRIDS level, with the exception of XDim and YDim, contains its own *Data Fields* Subdirectory described below

Table 9 – HDFEOS/GRIDS/Data Fields Contents for Unpolarized Spectral Channels

Field Name Parameter Description	Dimension List	Number Type	Units	Flag Values
I Radiance	XDim, YDim	FLOAT32	W m^{-2} sr^{-1} nm^{-1}	FillValue =-999.0
The following additional fields are provided in the 660 band only				
Scattering_angle The angle between the vector pointing in the direction of photon travel for direct sunlight and the vector pointing toward the instrument	XDim YDim	FLOAT32	Degrees	FillValue = -999.0
Sun_azimuth Angle measured clockwise relative to local North of the projection of the solar illumination vector onto a horizontal plane. The illumination vector points in the direction of photon travel. Note that for a vector pointing *toward* the position of the Sun in the sky the azimuth relative to local North is given by [(Sun_azimuth + 180°) mod 360°]	XDim, YDim	FLOAT32	Degrees	FillValue = -999.0
Sun_zenith Solar zenith angle relative to overhead sun (0°)	XDim, YDim	FLOAT32	Degrees	FillValue = -999.0
Time_in_seconds_from_epoch Time in seconds from the epoch	XDim, YDim	FLOAT64	Seconds	FillValue = -999.0

View_azimuth Angle measured clockwise relative to local North of the projection of the view vector onto a horizontal plane. The view vector points in the direction of photon travel.	XDim, YDim	FLOAT32	Degrees		FillValue = -999.0
View_zenith View zenith angle relative to nadir (0°)	XDim, YDim	FLOAT32	Degrees		FillValue = -999.0

Table 10 – Additional HDFEOS/GRIDS/Data Fields Contents for Polarized Spectral Channels

Field Name Parameter Description	Dimension List	Number Type	Units	Flag Values
AOLP_meridian Angle of linear polarization (AOLP) relative to the meridian plane (the plane containing the observed beam and the z-axis of the surface) $AOLP = 0.5\tan^{-1}\left(\dfrac{U}{Q}\right)$	XDim, YDim	FLOAT32	Degrees	FillValue =-999.0
AOLP_scatter AOLP relative to the scattering plane (the plane containing the incident beam and the scattered beam)	XDim, YDim	FLOAT32	Degrees	FillValue = -999.0
DOLP Degree of linear polarization $DOLP = \sqrt{\left(\dfrac{Q}{I}\right)^2 + \left(\dfrac{U}{I}\right)^2}$	XDim, YDim	FLOAT32	None (Range 0.0 – 1.0)	FillValue = -999.0
IPOL The polarized radiance = I × DOLP	XDim YDim	FLOAT32	W m^{-2} sr^{-1} nm^{-1}	FillValue = -999.0
Q_meridian Q Stokes parameter relative to the meridian plane	XDim, YDim	FLOAT32	W m^{-2} sr^{-1} nm^{-1}	FillValue = -999.0
Q_scatter Q Stokes parameter relative to the scattering plane	XDim, YDim	FLOAT32	W m^{-2} sr^{-1} nm^{-1}	FillValue = -999.0
U_meridian U Stokes parameter relative to the meridian plane	XDim, YDim	FLOAT32	W m^{-2} sr^{-1} nm^{-1}	FillValue = -999.0
U_scatter U Stokes parameter relative to the scattering plane	XDim, YDim	FLOAT32	W m^{-2} sr^{-1} nm^{-1}	FillValue = -999.0

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Table 11 – HDFEOS INFORMATION Contents

Field Name	Description
StructMetadata.0	Structural metadata for the file. This is ancillary information regarding the HDF-EOS contents of the grids within the file, including field names, dimensions, and data types, in a human readable format.
StructMetadata.1	Continuation of the structural metadata.

3   APPENDIX

Acronym List:

ACEPOL	Aerosol Characterization from Polarimeter and Lidar
AirMSPI	Airborne Multiangle SpectroPolarimetric Imager
AOLP	Angle of Linear Polarization
ASDC	Atmospheric Science Data Center
AU	Astronomical Unit
BRF	Bidirectional Reflectance Factor
DOLP	Degree of Linear Polarization
EOS	Earth Observing System
GCTP	General Cartographic Transformation Package
GroundMSPI	Ground-based Multiangle SpectroPolarimetric Imager
HDF-EOS	Hierarchical Data Format for EOS
JPL	Jet Propulsion Laboratory
LaRC	Langley Research Center (NASA)
MISR	Multi-angle Imaging SpectroRadiometer
NASA	National Aeronautics and Space Administration
NetCDF	Network Common Data Form
NIR	Near Infrared
SCF	Science Computing Facility
SDP	Science Data Processing
UTC	Coordinated Universal Time
UTM	Universal Transverse Mercator
UV	Ultraviolet
VIS	Visible
WGS84	World Geodetic System 1984