JPL D-106616

Earth Observing System

MISR

Multi-angle
Imaging
Spectro-
Radiometer

Data Quality Statement for the MISR NRT Level 2 Aerosol Product

Marcin L. Witek
Michael J. Garay
Ralph A. Kahn
Michael A. Bull
Abigail M. Nastan
Felix C. Seidel
David J. Diner
James A. Limbacher
Olga V. Kalashnikova

Jet Propulsion Laboratory
California Institute of Technology

April 30, 2021

JPL D-106616

Multi-angle Imaging SpectroRadiometer (MISR)

Data Quality Statement for the MISR NRT Level 2 Aerosol Product

APPROVALS:

David J. Diner
MISR Principal Investigator

Earl Hansen
MISR Project Manager

Approval signatures are on file with the MISR Project.
To determine the latest released version of this document, consult the MISR web site (http://misr.jpl.nasa.gov).

Jet Propulsion Laboratory
California Institute of Technology

April 30, 2021

The research described in this publication was carried out at the Jet Propulsion Laboratory, California Institute of Technology, under a contract with the National Aeronautics and Space Administration.

Document Change Log

Revision	Date	Affected Portions and Description
	April 30, 2021	All, original release

Which Product Versions Does this Document Cover?

Product Filename Prefix	Version Number in Filename	Brief Description
MISR_AM1_AS_AEROSOL	F13_0023	Near Real-Time Level 2 Aerosol

Table of Contents

1 EXECUTIVE SUMMARY

This document applies to the Version 23 (V23) MISR Level 2 (L2) Near Real-Time (NRT) Aerosol Product. Information on the Multi-angle Imaging SpectroRadiometer (MISR) aerosol retrieval approach can be found in the Data Product Specification for the MISR NRT L2 Aerosol Product (DPS) and the MISR L2 Aerosol Retrieval Algorithm Theoretical Basis Document (ATBD).

Table 1 – MISR Level 2 Aerosol Quality Designations*

Maturity Level	Definition	Field Names
Validated Stage 3	Uncertainties are estimated from independent measurements representing global conditions.	Aerosol_Optical_Depth
Validated Stage 2	Uncertainties are estimated from widely distributed independent measurements.	Angstrom_Exponent_550_860nm Absorption_Aerosol_Optical_Depth Nonspherical_Aerosol_Optical_Depth Small_Mode_Aerosol_Optical_Depth Medium_Mode_Aerosol_Optical_Depth Large_Mode_Aerosol_Optical_Depth

The purpose of the MISR NRT L2 aerosol product is to provide quality satellite data within a 3-hour time window from acquisition that is required in operational forecasting and in support to decision making. The MISR NRT retrieval strategy builds upon the MISR standard aerosol algorithm. NRT employs the same ancillary datasets as the initial FIRSTLOOK (see Figure 1) version of the standard product which is available within 2 days from acquisition. A key algorithmic modification adopted in NRT processing is adjusting the Aerosol Retrieval Screening Flag (ARCI) threshold to 0.18; the equivalent threshold in FIRSTLOOK and standard processing is 0.15. An analysis of three months of data from the NRT and standard aerosol (SA) products shows equivalent statistical performance of both algorithms (Witek et al., 2021). Given these findings as well as the fact that the NRT and SA algorithms are very similar, the corresponding data quality statement (DQS) for the SA product is expected to generally hold for the NRT product. Some key findings regarding the quality of the standard product are repeated here for conveninece. Based on a global comparison of retrieved total column aerosol optical depths (AOD) for coincident MISR Level 2 (V23) and Aerosol Robotic Network (AERONET) data for over 60,000 collocations, 66.1% of the MISR SA retrievals over both land (85% of data points) and water (15% of data points) fall within the expected error envelope (EE) of ±(0.03 + 10%), with a correlation coefficient of 0.81, a root mean squared error (RMSE) of 0.154, and a bias of -0.002 [*Garay et al.*, 2020]. When dark water scenes are considered separately, comparison statistics (based on over 11,000 MISR/AERONET collocations) improve, with 77.4% of the MISR AOD retrievals within EE of the AERONET observations, a correlation coefficient of 0.90, a RMSE of 0.068, and a bias of +0.007 [*Witek et al.*, 2019]. Comparisons against Maritime Aerosol Network (MAN) indicate a correlation coefficient of 0.98, a RMSE of 0.041, a bias of -0.002, and 87.2% of MISR retrievals falling within the EE from MAN observations [*Witek et al.*, 2019]. Validation results against

* Based on work published so far with V23 data and on studies with Version 22 of the product.

AERONET also show that the AOD uncertainties reported in V23 realistically represent retrieval errors as they exhibit behavior similar to that of the standard deviation of a Gaussian distribution [*Witek et al*., 2019]. Other evaluations of the V23 AOD are found in *Choi et al*. [2019], *Sogacheva et al*. [2020], *Si et al*. [2019], *Sayer et al*. [2020], and *Tao et al.*, [2020]. Validation of the previous version of the MISR aerosol product (V22) can be found in *Kahn et al*. [2010].

The Ångström exponent (AE) is related to the spectral slope of the AOD and provides some information about the size of the aerosol particles. A comparison of MISR and AERONET AE for nearly 17,000 collocations found a correlation coefficient of 0.71, a RMSE of 0.41, and a bias of +0.002 [*Garay et al*., 2020]. This performance is slightly improved relative to V22. *Kahn and Gaitley* [2015] considered 11 years of MISR V22 particle property information relative to AERONET over a variety of different types of sites. Unlike the direct-sun AOD observations and the derived Ångström exponent, the conditions required for high-quality AERONET retrievals of particle properties dramatically limit the number of MISR-AERONET coincidences, making statistical comparisons challenging. Even so, *Kahn and Gaitley* [2015] found that the MISR particle property information is suitable for qualitative, regional-to-global-scale aerosol air mass-type mapping. They further demonstrated that MISR particle property retrievals are more sensitive to scene conditions than AOD retrievals, and the derived properties are more reliable when the mid-visible AOD is greater than about 0.15. In comparison with AERONET observations, the MISR product effectively discriminates small, medium, and large particles. With respect to single scattering albedo (SSA), the MISR retrievals show qualitative agreement with AERONET SSA retrievals (i.e., discrimination among about four groupings over the natural range of darker and lighter particles). Finally, the MISR algorithm tends to report non-spherical aerosols in places where they are climatologically expected, particularly when the AOD is large. Initial assessments with V23 retrievals suggest that the latest version of the algorithm has similar performance, and formal validation is ongoing. A first regional insight into V23 retrieved particle properties shows the MISR generally captures the distinct spatial and temporal features of aerosol type in East Asia [*Tao et al.*, 2020], which is in agreement with previous studies [e.g., *Kahn and Gaitley*, 2015].

2 NRT AEROSOL PRODUCT ACQUISITION

MISR NRT processing is based on L0 radiance data that is downlinked in observational sessions. These session-based files, representing portions of a single orbit, usually cover between 10 to 50 minutes of observations, as compared to the full orbit period of 98.9 minutes. L1 (calibrated and geo-referenced) session data might not have the same characteristics as the data processed as full orbits, ***for example due to geolocation accuracy***. Furthermore, there is a ***possibility of gaps between NRT sessions***, which could result from the staggered camera footprint (i.e., forward and aft cameras seeing different ground locations) at the start/end of each session. The session-based processing, however, is necessary to allow for fast product delivery for NRT applications.

The MISR NRT L2 processing stream utilizes the same ancillary datasets that are used in MISR L2 FIRSTLOOK processing. These are the monthly gridded 1° × 1° snow-ice mask and surface wind speed data from the Terrestrial Atmosphere and Surface Climatology (TASC) dataset and the temporal Radiometric Camera-by-camera Threshold Dataset (RCTD). The RCTD is updated based on observations within a month or a 3-month time period depending on a particular threshold (Diner et al., 1999, L1 Cloud Detection Algorithm Theoretical Basis). Both NRT and FIRSTLOOK products are generated ***using the TASC and RCTD datasets from the same month/season but in the previous year***. When the updated TASC and RCTD become available, the standard product processing is run.

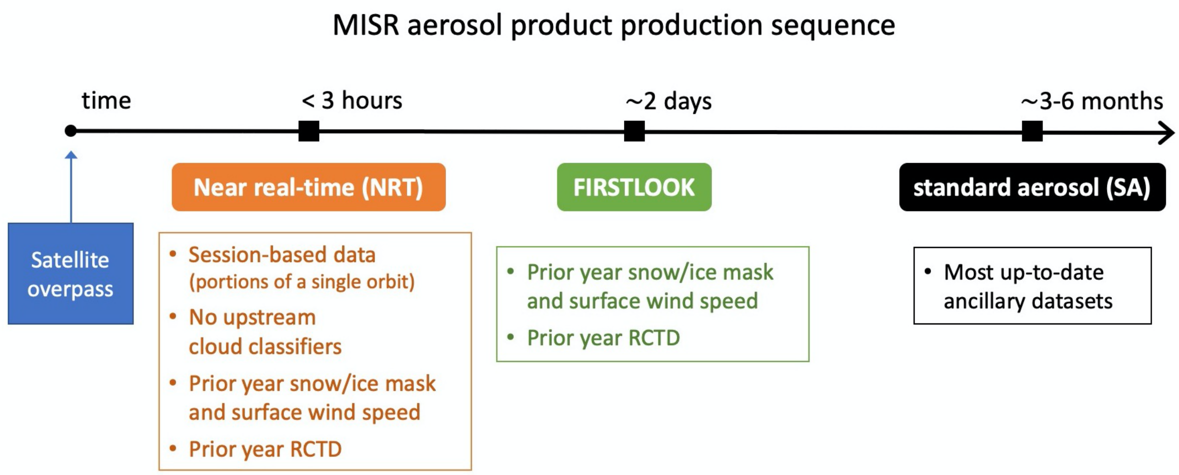

Figure 1 Schematic showing MISR L2 aerosol product delivery timeline. Snow/ice mask and surface wind speed data are monthly averages. RCTD stands for Radiometri Camera-by-camera Threshold Dataset. MISR final production (standard product) is processed on a seasonal cycle and is often deleyed a couple months past the end of each season, which results in up to 6-month latency.

The MISR NRT L2 Aerosol Product file name convention is:

MISR_AM1_AS_AEROSOL_T{yyyymmddHHMMSS}_P{ppp}_O{oooooo}_F13_0023.nc,

where {yyyymmddHHMMSS} is the aquisition time group (year, month, day, hour, minute, second), {ppp} is the path identifier, and {oooooo} is the orbit number.

The files are distributed in the NetCDF-4 format. The V23 NRT L2 Aerosol Product file content is equivalent to the one of the standard V23 L2 Aerosol Product.

3 NRT VS. STANDARD PRODUCT

The standard MISR V23 aerosol algorithm utilizes several cloud classifiers that are generated in L1 and L2 cloud processing. These are the Radiometric Camera-by-camera Cloud Mask (RCCM), the Stereoscopically-Derived Cloud Mask (SDCM), and the Angular Signature Cloud Mask (ASCM). The masks are used to determine whether a particular 1.1 km x 1.1 km subregion is clear or cloudy and whether this subregion can be used in aerosol retrieval. In NRT processing, however, these cloud classifiers are not available since they take up to 18 hours to generate. Consequently, the NRT algorithm relies on (a) ***build-in cloud detection methods*** to identify cloudy pixels and (b) ***retrieval screening procedures*** that eliminate potentially cloud-contaminated retrievals. The build-in cloud detection methods include the brightness test, the angle-to-angle smoothness test, and the angle-to-angle correlation test (Martonchik et al, 2002; Diner et al., 2008). These methods in large part mitigate the negative consequences of the lack of upstream cloud classifiers in NRT processing (Witek et al., 2021). Further improvements in the NRT user product performance are obtained by adjusting a threshold on the Aerosol Retrieval Confidence Index from 0.15 in SA to 0.18 in NRT processing. The revised ARCI threshold leads to a NRT product that has very similar statistical characteristics to the SA product (Witek et al., 2021).

Another implication of the lack of upstream cloud classifiers in NRT processing is that for the ***snow/ice surface type*** the cloud/clear decision pathway defaults to the "cloud" outcome. This means that the NRT algorithm will not attempt AOD retrievels over 1° × 1° grid points designated as snow/ice in the TASC dataset. This is well illustrated in Figure 2 which shows MISR RGB imagery (left), NRT AOD retrievals (center), and Aerosol Retrieval Screening Flag (right) values in a sample scene. The grid-like cloudy areas (index 5, dark blue color) clearly show the effects of the TASC snow/ice exclusion rule. Since efforts to mitigate this problem proved to be only partially successful, the default cloud decision logic over snow/ice is retained, even at the cost of prohibiting potentially valid NRT retrievals in cloud-free conditions.

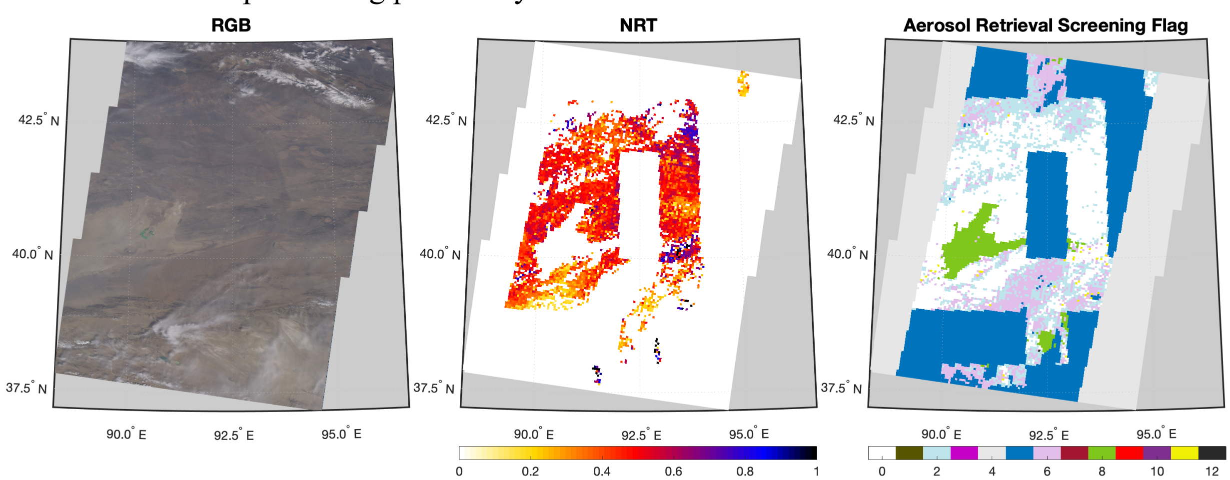

Figure 2 *Example of snow/ice masking in NRT AOD retrievals. (Left) Visible image of the retrieval area. (Center) Corresponding NRT AOD retrievals. (Right) NRT Aerosol Retrieval Screening Flag for the same area; the dark blue color denotes regions designated as cloudy.*

4 KNOWN ISSUES WITH THE NRT PRODUCT

As it must be run for the entire global MISR data stream, the L2 aerosol retrieval algorithm attempts to compromise among retrieval accuracy, coverage, and efficiency. Prior to launch, sensitivity studies were performed that provide guidance regarding the optimal performance of multi-angle retrievals from MISR [*Kahn et al*., 1997; 1998; 2001]. These authors found the following:

- Under good, but not necessarily ideal, retrieval conditions, the MISR observations contain information capable of distinguishing three to five size groupings, two to four categories of SSA, and spherical versus non-spherical particles.
- The information contained in the MISR observations diminishes when the total mid-visible AOD is below about 0.15.
    - As MISR samples a wide range of scattering angles (particularly away from the solar equator), information content can also vary due to sunglint, geometry, or topography.
- Particle property retrievals are more reliable over Dark Water, and retrieval sensitivity degrades with increasing scene brightness.
- Individual component particles must make up at least 20% of the total column AOD in order to be retrieved.

These conclusions have been bolstered by subsequent studies using actual MISR observations as well as further sensitivity studies. Users are refered to *Garay et al.* [2020] and *Witek et al*. [2019] for assessments of the MISR V23 4.4 km aerosol retrievals. Interested readers are also invited to consult *Kahn et al*. [2010] and *Kahn and Gaitley* [2015], both of which provide detailed assessments of the MISR V22 17.6 km aerosol retrievals.

A number of issues and practical limitations of the operational MISR NRT L2 Aerosol Product are listed in Table 2. Note that this list is not exhaustive and users may encounter other issues. In these situations, please contact User Services at the Atmospheric Science Data Center (ASDC), NASA Langley Research Center (LaRC) to report anomalies: support-asdc@earthdata.nasa.gov.

Table 2 – List of Known Issues and Practical Limitations

Issue or Limitation	Description
Faint ghost images in in high-contrast scenes	The simple veiling light correction does not account for the full range of ghosting artifacts that may be present in the MISR cameras. These are particularly evident in high-contrast scenes [*Limbacher and Kahn*, 2015; *Witek et al*., 2018a].
Cloud screening – unresolved or unscreened clouds	Although multiple cloud screening algorithms are applied to the MISR aerosol retrievals, some clouds may be missed or otherwise unresolved by the algorithms, occasionally resulting in high biases in the retrieved AOD [*Witek et al*., 2013].
Cloud screening – thin cirrus	Optically thin (< 0.3) cirrus clouds are difficult to screen without eliminating some types of aerosols, such as dust and smoke plumes. Thin cirrus contamination can appear as bands of enhanced non-sphericity due to the multi-angle light scattering of cirrus particles [*Pierce et al*., 2010; *Kalashnikova et al*., 2013].
Cloud screening – thick plumes	Optically thick plumes will often be mis-classified as clouds by the cloud screening algorithms. Although the current Aerosol Product allows users to inspect retrievals with less strict cloud screening (see the DPS), in some cases these retrievals are still screened even with minimal cloud screening applied and, therefore, cannot be recovered.

Residual calibration effects	MISR Level 1B2 radiances are corrected using bi-monthly observations of Spectralon calibration panels. Small, residual calibration artifacts may remain, including variation across the camera field of view and slow temporal variations in the absolute calibration [*Limbacher and Kahn*, 2015; 2017].
Poor retrievals over uniform ice and snow	Retrievals over homogeneous ice and snow surfaces are adversely affected by high surface reflectance and low spatial variability, leading to anomalously high retrieved AODs. For this reason, retrievals over Greenland and Antarctica are screened in the user fields, but can be examined in the “raw” auxiliary fields (see the DPS).
No AOD retrievals for values greater than 3.0	The current look up table (LUT) used for MISR aerosol retrievals, the Simulated MISR Ancillary Radiative Transfer (SMART), allows a maximum AOD at 550 nm of 3.0. In cases with AOD > 3.0, the retrieval will either fail or underestimate the actual AOD.
Limited aerosol mixtures	The aerosol mixtures in the SMART currently represent 74 possible combinations of up to three of eight “pure” particle types [*Kahn and Gaitley*, 2015]. Comparisons with AERONET, other satellite, and field data have shown that this mixture set is not rich enough to account for the full range of naturally appearing aerosols [*Kahn et al*., 2009; 2010; *Kahn and Gaitley*, 2015]. Dust model assumptions and limitations are discussed in *Kalashnikova and Kahn* [2006] and *Kalashnikova et al.* [2013].

5 TOOLS FOR WORKING WITH THE NRT PRODUCT

The new NetCDF-4 format of the MISR NRT L2 Aerosol Product is compatible with HDF5. This means that the product can also be read by invoking the appropriate NetCDF libraries in various programming languages, such as Python, C++, or R. A simple to use, Java-based viewer called Panoply is available for Mac OS, Windows, and Linux from the NASA Goddard Institute for Space Studies at (http://www.giss.nasa.gov/tools/panoply/). Files can also be browsed using another Java-based tool, HDFView, from the HDF Group (http://support.hdfgroup.org/products/java/hdfview/).

Please note that some legacy MISR tools, including misr_view (http://eosweb.larc.nasa.gov/project/misr/tools/misr_view) and the MISR INteractive eXplorer (MINX, http://github.com/nasa/MINX), do not currently work with new NetCDF-4 files.

6 REFERENCES

Choi, M., H. Lim, J. Kim, S. Lee, T. F. Eck, B. N. Holben, M. J. Garay, E. J. Hyer, P. E. Saide, and H. Liu (2019), Validation, comparison, and integration of GOCI, AHI, MODIS, MISR, and VIIRS aerosol optical depth over East Asia during the 2016 KORUS-AQ campaign, *Atmos. Meas. Tech.*, *12*, 4619–4741, https://doi.org/10.5194/amt-12-4619-2019.

Diner, D. J., L. Di Girolamo, and E. E. Clothiaux (1999), Level 1 cloud detection algorithm theoretical basis, *Jet Propuls. Lab. Calif. Inst. Technolo.*, JPL D-13397, Rev. B.

Diner, D. J., W. A. Abdou, T. P. Ackerman, K. Crean, H. R. Gordon, R. A. Kahn, et al. (2008), Level 2 aerosol retrieval algorithm theoretical basis, *Jet Propuls. Lab. Calif. Inst. Technolo.*, JPL D-11400, Rev. G.

Garay, M. J., O. V. Kalashnikova, and M. A. Bull (2017), Development and assessment of a higher-spatial-resolution (4.4 km) MISR aerosol optical depth product using AERONET-DRAGON data, *Atmos. Chem. Phys., 17*, 5095–5106, https://doi.org/10.5194/acp-17-5095-2017.

Garay, M. J., M. L. Witek, R. A. Kahn, F. C. Seidel, J. A. Limbacher, M. A. Bull, D. J. Diner, E. G. Hansen, O. V. Kalashnikova, H. Lee, A. M. Nastan, and Y. Yu (2020), Introducing the 4.4 km spatial resolution Multi-Angle Imaging SpectroRadiometer (MISR) aerosol product, *Atmos. Meas. Tech., 13*, 593–628, https://doi.org/10.5194/amt-13-593-2020.

Kahn, R., P. Banerjee, and D. McDonald (2001), Sensitivity of multiangle imaging to natural mixtures of aerosols over ocean, *J. Geophys. Res., 106*, 18219–18238, https://doi.org/10.1029/2000JD900497.

Kahn, R., P. Banerjee, D. McDonald, and D. J. Diner (1998), Sensitivity of multiangle imaging to aerosol optical depth and to pure-particle size distribution and composition over ocean, *J. Geophys. Res., 103*, 32195–32213, https://doi.org/10.1029/97JD01752.

Kahn, R., R. West, D. McDonald, B. Rheingans, and M. I. Mishchenko (1997), Sensitivity of multiangle remote sensing observations to aerosol sphericity, *J. Geophys. Res., 102*, 16861–16870, https://doi.org/10.1029/96JD01934.

Kahn, R. A., and B. J. Gaitley (2015), An analysis of global aerosol type as retrieved by MISR, *J. Geophys. Res. Atmos., 120*, 4248–4281, https://doi.org/10.1002/2015JD023322.

Kahn, R. A., B. J. Gaitley, M. J. Garay, D. J. Diner, T. F. Eck, A. Smirnov, and B. N. Holben (2010), Multiangle Imaging SpectroRadiometer global aerosol product assessment by comparison with the Aerosol Robotic Network, *J. Geophys. Res., 115*, D23209, https://doi.org/10.1029/2010JD014601.

Kahn, R. A., D. L. Nelson, M. J. Garay, R. C. Levy, M. A. Bull, D. J. Diner, J. V. Martonchik, S. R. Paradise, E. G. Hansen, and L. A. Remer (2009), MISR aerosol product attributes and statistical comparisons with MODIS, *IEEE Trans. Geosci. Remote Sens., 47*, 4095–4114, https://doi.org/10.1109/TGRS.2009.2023115.

Kalashnikova, O. V., M. J. Garay, J. V. Martonchik, and D. J. Diner (2013), MISR Dark Water aerosol retrievals: operational algorithm sensitivity to particle non-sphericity, *Atmos. Meas. Tech., 6*, 2131–2154, https://doi.org/10.5194/amt-6-2131-2013.

Kalashnikova, O. V., and R. Kahn (2006), Ability of multiangle remote sensing observations to identify and distinguish mineral dust types: 2. Sensitivity over dark water, *J. Geophys. Res., 111*, D11207, https://doi.org/10.1029/2005JD006756.

Limbacher, J. A., and R. A. Kahn (2015), MISR empirical stray light corrections in high-contrast scenes, *Atmos. Meas. Tech., 8*, 2927–2943, https://doi.org/10.5194/amt-8-2927-2015.

Limbacher, J. A., and R. A. Kahn (2017), Updated MISR dark water research aerosol retrieval algorithm – Part 1: Coupled 1.1 km ocean surface chlorophyll *a* retrievals with empirical calibration corrections, *Atmos. Meas. Tech., 10*, 1539–1555, https://doi.org/10.5194/amt-10-1539-2017.

Martonchik, J.V., D.J. Diner, C.A. Crean, and M.A. Bull (2002), Regional Aerosol Retrieval Results From MISR. *IEEE Trans. Geosci. Remt. Sens. 40 (7), 1520-1531*, doi: 10.1109/TGRS.2002.801142.

Pierce, J. R., R. A. Kahn, M. R. Davis, and J. M. Comstock (2010), Detecting thin cirrus in Multiangle Imaging Spectroradiometer aerosol retrievals, *J. Geophys. Res., 115,* D08201, https://doi.org/10.1029/2009JD013019.

Sayer, A.M., Y. Govaerts, P. Kolmonen, A. Lipponen, M. Luffarelli, T. Mielonen, F. Patadia, T. Popp, A.C. Povey, K. Stebel, and M.L. Witek, 2020: A review and framework for the evaluation of pixel-level uncertainty estimates in satellite aerosol remote sensing. *Atmos. Meas. Tech.*, **13**, 373–404.

Si, Y., L. Chen, X. Xiong, S. Shi, L. Husi, and K. Cai, 2019: Evaluation of the MISR fine resolution aerosol product using MODIS, MISR, and ground observations over China. *Atmos. Environ*. in press, https://doi.org/10.1016/j.atmosenv.2019.117229.

Sogacheva, L., T. Popp, A. M. Sayer, O. Dubovik, M. J. Garay, A. Heckel, N. C. Hsu, H. Jethva, R. A. Kahn, P. Kolmonen, M. Kosmale, G. de Leeuw, R. C. Levy, P. Litvinov, A. Lyapustin, P. North, and O. Torres (2020), Merging regional and global aerosol optical depth records from major available satellite products, *Atmos. Chem. Phys.*, 20, 2031-2056, https://doi.org/10.5194/acp-20-2031-2020.

Tao, M., J. Wang, R. Li, L. Chen, X. Xu, L. Wang, J. Tao, Z. Wang, and J. Xiang (2020), Characterization of aerosol type over East Asia by 4.4 km MISR product: First insight and general performance, *J. Geophys. Res.: Atmos*, 125, e2019JD031909. https://doi.org/10.1029/2019JD031909

Witek, M. L., D. J. Diner, M. J. Garay, F. Xu, M. A. Bull, and F. C. Seidel (2018a), Improving MISR AOD retrievals with low-light-level corrections for veiling light, *IEEE Trans. Geosci. Remote Sens., 56*, 1251–1268, https://doi.org/10.1109/TGRS.2017.2727342.

Witek, M. L., M. J. Garay, D. J. Diner, M. A. Bull, and F. C. Seidel (2018b), New approach to the retrieval of AOD and its uncertainty from MISR observations over dark water, *Atmos. Meas. Tech., 11,* 429–439, https://doi.org/10.5194/amt-11-429-2018.

Witek, M. L., M. J. Garay, D. J. Diner, and A. Smirnov (2013), Aerosol optical depths over oceans: A view from MISR retrievals and collocated MAN and AERONET in situ observations, *J. Geophys. Res. Atmos., 118,* 1–14, https://doi.org/10.1002/2013JD020393.

Witek, M. L., D. J. Diner, M. J. Garay, M. A. Bull, F. C. Seidel, E. G. Hansen (2021), Introducing the MISR level 2 near real-time aerosol product, to be submitted to AMT.

7 Appendix

7.1 ACRONYM LIST

AE ....Ångström Exponent
AERONET...........Aerosol Robotic Network
AOD.....................Aerosol Optical Depth
ARCI....................Aerosol Retrieval Confidence Index
ASCM ....Angular Signature Cloud Mask
ASDC...................Atmospheric Science Data Center
ATBD...................Algorithm Theoretical Basis Document
DPS ....Data Product Specification
EE.........................Error Envelope
HDF ....Hierarchical Data Format
JPL ....Jet Propulsion Laboratory
LaRC....................Langley Research Center
L0/L1/L2.............Level 0/Level 1/Level 2
LUT......................Look Up Table
MAN ....Maritime Aerosol Network
MINX...................MISR Interactive eXplorer
MISR....................Multi-angle Imaging SpectroRadiometer
NASA...................National Aeronautics and Space Administration
NRT......................Near Real-Time
NetCDF-4.............Network Common Data Format Version 4
OS ....Operating System
RCTD...................Radiometric Camera-by-camera Threshold Dataset
RCCM..................Radiometric Camera-by-camera Cloud Mask
RGB ....Red Green Blue
RMSE...................Root Mean Square Error
SA ....Standard Aerosol
SDCM ....Stereoscopically-Derived Cloud Mask
SMART................Simulated MISR Ancillary Radiative Transfer
SSA ....Single Scattering Albedo
TASC ....Terrestrial Atmosphere and Surface Climatology
V22/V23...............Version 22/Version 23