NOAA NESDIS
CENTER for SATELLITE APPLICATIONS and RESEARCH

The NOAA Suomi-NPP Data Exploitation (NDE)
SO2 Corrected Version 8 Total Ozone (V8TOS) Environmental Data Record (EDR)
NDEV8S

External Users' Manual

Version 1.2

TITLE: NDE SO2 CORRECTED VERSION 8 TOTAL OZONE EDR EXTERNAL USERS' MANUAL VERSION 1.3

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DOCUMENT HISTORY
DOCUMENT REVISION LOG

The Document Revision Log identifies the series of revisions to this document since the baseline release. Please refer to the above page for version number information.

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1.1	March 11, 2016	L. Flynn, STAR	Added content to Table 1-3
1.2	June 2016	L.Flynn, J. Niu, B. Das	Added LFSO2 content
1.3	November 2016	L.Flynn, J. Niu, B. Das	Modified with details of LFSO2 content

LIST OF CHANGES

Significant alterations made to this document are annotated in the List of Changes table.

DOCUMENT TITLE: External Users Manual Template					
LIST OF CHANGE-AFFECTED PAGES/SECTIONS/APPENDICES					
Version Number	**Date**	**Changed By**	**Page**	**Section**	**Description of Change(s)**
1.0	03/09/16	JPSS	Original	All	Original
1.1	03/10/16	Flynn	All	All	Created Version 1.1
1.2	06/30/16	Flynn			Created Version 1.2
1.3	11/02/16	Das, Flynn, Niu			Created Version 1.3

TABLE OF CONTENTS

LIST OF TABLES AND FIGURES

Page

PRODUCTS

This is an External Users Manual (EUM) document describing the operational NOAA NDE Total Column Ozone Environmental Data Record product and output file after LFSO2 algorithm implementation.

The LFSO2 provides the Ozone Mapping and Profiler (OMPS) Ozone bundled EDR product as created by the Version 8 Total Ozone retrieval algorithm with additional content including SO_2-corrected total column ozone estimates and total column SO_2 estimates. The algorithm transition from NASA to NOAA operations was completed as part of the NOAA JPSS Product Development, Calibration and Validation program led by the NOAA NESDIS Center for Satellite Applications and Research (STAR). It will be delivered to the Suomi NPP Data Exploitation (NDE) team and integrated into the NDE Data Handling System (DHS) where it will be run in a pre-operational manner. After a preliminary testing period, the NDE DHS will, in turn, be delivered to the Office of Satellite and Product Operations (OSPO) to be run operationally.

The intended users of this EUM are end users of the operational output products and files, and the product verification and validation (V&V) teams. The purpose of the EUM is to provide product users and product testers with information that will enable them to acquire the product, understand its features, and use the data. External users are defined as those users who do not have direct access to the processing system (those outside of the OSPO and NDE). The output files are defined as those leaving the NDE DHS (running within ESPC) as opposed to those that are output by the NDEV8TOS processing, but available only internally within the NDE.

Product Overview

Product Requirements

All NDEV8TOS basic and derived requirements are available in the NDEV8TOS Requirements Allocation Document (RAD). These requirements identify the users and their needs with respect to file content, format, latency, and quality. They are based on the Level 1 Requirements for Total Column Ozone EDRs from the JPSS program. (The current version is available at http://www.jpss.noaa.gov/technical_documents.html.)

Product Team

The NDEV8S Development product team consists of members from STAR, NASA GSFC, and OSPO. The roles and contact information for the different product team members are identified in Table 1.

Table 1: Product Team Members

Team Member	Organization	Role	Contact Information
Lawrence Flynn	STAR	STAR Product Lead	5830 University Research Court College Park, MD. 20740 Phone: 301-683-3612 Email: Lawrence.E.Flynn@noaa.gov
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Product Description

The LFSO2 adaptation provides the Ozone Mapping and Profiler (OMPS) SO_2-corrected Total Column Ozone bundled EDR product as created by the Version 8 Total Ozone

retrieval algorithm. Details on the NetCDF EDR product content are provided in Table 3 below and in the V8TOz EUM.

Product History

The LFSO2 program was originally developed by NASA and delivered to NOAA. The new development and simplification to meet the NOAA volcanic eruption alert requirement have been completed at STAR.

The NDEV8S is a new implementation of the LFSO2 algorithm in conjunction with the Version 8 Total Column Ozone developed by NASA GSFC for the Total Ozone Mapping Spectrometer (TOMS) series of instruments and refined for use with the NASA EOS Aura Ozone Monitoring Instrument (OMI). The new product couples the Linear Fit SO2 algorithm to provide corrections to the total column ozone estimates for elevated atmospheric SO_2 amounts.

The algorithm transition from NASA to NOAA operations was completed as part of the NOAA JPSS Product Development, Calibration and Validation program led by the NOAA NESDIS Center for Satellite Applications and Research (STAR). It will be delivered to the Suomi NPP Data Exploitation (NDE) team and integrated into the NDE Data Handling System (DHS) where it will be run in a pre-operational manner. After a preliminary testing period, the NDE DHS will, in turn, be delivered to the Office of Satellite and Product Operations (OSPO) to be run operationally.

Product Access

All NDEV8S output data files will be made available by the NDE DHS on the NDE data distribution server at ESPC in a near real time manner. For access to this server, information about data files, and associated documentation, the NDEV8S PAL should be contacted (see Table 1).

The NESDIS Policy on Access and Distribution of Environmental Data and Products is provided at: http://www.ospo.noaa.gov/Organization/About/access.html. Users need to fill out the Data Access Request Form located on this site and submit to the PAL with a copy to nesdis.data.access@noaa.gov. This address provides the OSPO Data Access Team a copy of the correspondence. Once the request is approved by the OSPO management the data will be delivered by the Data Distribution System (DDSProd) currently distributing the ESPC data products and later by the Product Distribution and Access (PDA) system. The ESPC Data Distribution Manager, Donna McNamara (donna.mcnamara@noaa.gov) should be contacted for any data accessibility and data distribution problems. The data format is defined in the Table 2.

In order to obtain the near real time data users needs to fill out the Data Access Request Form located on http://www.ospo.noaa.gov/Organization/About/access.html and submits to the PAL with a copy to nesdis.data.access@noaa.gov. CLASS will be archiving the NDEV8S data products for distributing to the non-real-time users. NDE pushes the data to CLASS with the associated metadata in the standard formats. CLASS will archive the NDEV8S product in netCDF4 format with associated metadata.

Table 2 describes the external distributed NDEV8S file and Table 3 lists its content. Details of the derivation of all of the products are described in the NDE Version 8 Total Ozone Algorithm Theoretical Basis Document.

Table 3 describes the new variables in the EDR file. The ozone total column is defined as the amount of Ozone in a vertical column of the atmosphere measured in Dobson Units (1 DU = 1 milli-atm-cm). The key EDR product is the ColumnAmountO3 estimate. The content provided Table 3 is the new content added by the LFSO2 process. The results of the V8TOz EDR file used as input are passed through and reproduced in the final file. This additional content is described in Table 6 below and in more detail in the **NOAA Suomi-NPP Data Exploitation (NDE) Version 8 Total Ozone (V8TOz) Environmental Data Record (EDR) NDEV8T External Users' Manual**.

Table 2: NDE SO_2 Corrected Total Column Ozone File

File	Description	Format	Size/file
V8TOS-EDR_v1r0_npp_s201601120127494_e201601120128268_c201603221503000.nc	This is the granule output file containing all the derived variables of the NDEV8S product.	netCDF4	0.9 MB/granule file, ~1009 files/day

Table 3: SO_2 Corrected Total Column Ozone Output Granule File Content

Name	Type	Description	Dimension	Units	Range
s_AlgorithmFlag_PBL	32 bit integer	PBL algorithm flag	105 x 15	Unit less	0, 1, 11
s_AlgorithmFlag_STL	32 bit integer	STL algorithm flag	105 x 15	Unit less	0, 1, 2, 11, 12
s_AlgorithmFlag_TRL	32 bit integer	TRL algorithm flag	105 x 15	Unit less	0, 1, 2, 11, 12
s_AlgorithmFlag_TRM	32 bit	TRM	105 x 15	Unit less	0, 1, 2, 11,

	integer	algorithm flag			12
s_QualityFlags_PBL	32 bit integer	PBL quality flag	105 x 15	Unit less	0 ~ 65535
s_QualityFlags_STL	32 bit integer	STL quality flag	105 x 15	Unit less	0 ~ 65535
s_QualityFlags_TRL	32 bit integer	TRL quality flag	105 x 15	Unit less	0 ~ 65535
s_QualityFlags_TRM	32 bit integer	TRM quality flag	105 x 15	Unit less	0 ~ 65535
s_STLO3	32 bit float	STL corrected total column of O3	105 x 15	Dobson	0 ~ 1000
s_TRLO3	32 bit float	TRL corrected total column of O3	105 x 15	Dobson	0 ~ 1000
s_TRMO3	32 bit float	TRM corrected total column of O3	105 x 15	Dobson	0 ~ 1000
s_ColumnamountSO2_STL	32 bit float	STL total column of SO2	105 x 15	Dobson	-10 ~ 2000
s_ColumnamountSO2_TRL	32 bit float	TRL total column of SO2	105 x 15	Dobson	-10 ~ 2000
s_ColumnamountSO2_TRM	32 bit float	TRM total column of SO2	105 x 15	Dobson	-10 ~ 2000
s_deltaRefl331	32 bit float	Delta Reflectivity at 331 nm	105 x 15	Percent	-100 ~ 100
s_ChiSquareLfit	32 bit float	Chi-square of linear fit	105 x 15	Unit less	> 0
s_dN_dSO2_STL	32 bit float	dN/dSO2(STL)	12 x 105 x 15	Per Dobson	-1 ~ 100
s_dN_dSO2_TRL	32 bit float	dN/dSO2(TRL)	12 x 105 x 15	Per Dobson	-1 ~ 1000
s_dN_dSO2_TRM	32 bit	dN/dSO2(TR	12 x 105 x 15	Per	-1 ~ 100

	float	M)		Dobson	
s_Slope	32 bit float	C_1 in linear equation	105 x 15	Unit less	-1 ~ 1
s_Qterm	32 bit float	C_2 in linear equation	105 x 15	Unit less	-1 ~ 1
s_ResidualAdjustment	32 bit float	Averaged residual of nvalue	12 x 105 x 15	Unit less	-10 ~ 10
s_ColumnamountSO2_PBL	32 bit float	Planetary Boundary Layer (PBL) SO2	105 x 15	Dobson	-300 ~ 1000
s_ColumnamountSO2_PBLbrd	32 bit float	PBL SO2 by BRD method	105 x 15	Dobson	-10 ~ 2000
s_ColumnamountSO2_STLbrd	32 bit float	STL SO2 by BRD method	105 x 15	Dobson	-10 ~ 2000
s_ColumnamountSO2_TRMbrd	32 bit float	TRM SO2 by BRD method	105 x 15	Dobson	-10 ~ 2000
s_SO2indexP1	32 bit float	Partial adjust residual for 310 and 311	105 x 15	Unit less	-100 ~ 100
s_SO2indexP2	32 bit float	Partial adjust residual for 311 and 313	105 x 15	Unit less	-100 ~ 100
s_SO2indexP3	32 bit float	Partial adjust residual for 313 and 314	105 x 15	Unit less	-100 ~ 100

The following table decodes the total ozone error flag values.

Table 4: Details of the Error Flag

	s_AlgorithmFlag_PBL		s_AlgorithmFlag_TRL		s_AlgorithmFlag_TRM		s_AlgorithmFlag_STL	
Flags value	**0**	1	0	1,2(11,12)	0	1,2(11,12)	0	1,2(11,12)
s_ColumnAmountSO2_STL							Fill value	VCD
s_ColumnAmountSO2_TRM					Fill value	VCD		

s_ColumnAmount SO2_TRL			Fill value	VCD				
s_ColumnAmount SO2_PBL	Fill value	VCD						

ALGORITHM

Algorithm Overview

The Linear Fit SO_2 algorithm is designed to use the results (retrieval parameters and forward model estimates) from the Version 8 Total Ozone algorithm. The algorithm uses the results at wavelength channels with varying SO_2 sensitivity to generate esitmates of the column amount of SO_2. It thens uses the relative sensitivity of channels to ozone and SO_2 to make adjustments to the retrieved total column ozone amounts.

The LFSO2 program includes three separated algorithms. The first one is a simplistic band residual difference algorithm. The second is a sophisticated band residual difference algorithm. The third one is the Linear Fit algorithm which will meet NOAA requirements for corrected O3 and volcano eruption alerts.

The simple band residual difference algorithm uses three pairs of N-value differentials from the V8TOZ output and three corresponding differential absorption coefficients to get a SO_2 slant column density average. This algorithm provides estimates of the planetary boundary layer (PBL) SO_2 vertical column density (VCD) by dividing SO_2 slant column density average to a constant air mass factor (AMF) of 0.36 assuming that most of the SO_2 concentrated in a 2-km thick layer free of cloud, and aerosol sitting at sea level. This simple band residual difference algorithm provides one output named s_ColumnamountSO2_PBL.

The sophisticated band residual difference algorithm is similar to the simple one but included many corrections to the AMF and others. This algorithm was developed for OMI analysis and has not been adapted to OMPS sensor yet. It provides three PBL, TRM and STL products named as s_ColumnamountSO2_PBLbrd, s_ColumnamountSO2_TRMbrd, and s_ColumnamountSO2_STLbrd. Since the previous reason, these three products are not quantitatively suitable as an assessment of the SO2 in the atmosphere.

The Linear fit algorithm uses N-value residuals from V8TOZ output to analyze SO_2 VCD in the atmosphere, and provide corrected O_3 VCD when large amount SO_2 appears in the atmosphere.
The Linear Fit algorithm provides three SO_2 VCDs based on three previously assumed SO_2 height distribution in the atmosphere. The first assumption is that the most of SO_2 is

concentrated in the layer of lower troposphere (TRL) from sea level to 5 km. The second assumption is that the most of SO_2 is concentrated in the layer of mid troposphere (TRM) from 5 to 10 km (0 km at sea level). The third assumption is that most of SO_2 is concentrated in the layer of lower stratosphere (STL) from 15 to 20 km (0 km at sea level). These three SO_2 VCDs are s_ColumnamountSO2_TRL, s_ColumnamountSO2_TRM, and s_ColumnamountSO2_STL.
In addition, the Linear Fit algorithm also provide three corrected Ozone VCDs corresponding to the three SO2 distributions respectively. They are s_TRLO3, s_TRMO3, and s_STLO3 corresponding to SO2 plume located at TRL, or TRM, or STL layer respectively.
The Linear Fit algorithm also provides surface reflectivity corrections that are reported as three polynomial parameters, namely, s_deltaRefl331, s_slope, and s_Qterm, assuming the SO_2 plume is located in the STL layer.

The NDEV8S SO2 corrected Ozone product is generated by the Linear Fit SO2 algorithm (LFSO2) [Yang et al. 2007]. The algorithm uses the V8TOz as a starting point as a linearization step to derive an initial estimate of total ozone assuming zero SO_2. The residuals at the twelve wavelengths are then calculated as the difference between the measured and computed N-values ($N=-100*log_{10}(I/F)$, I is Earth radiance and F is solar irradiance) using a forward model radiative transfer code.

- In the presence of SO_2, the residuals contain spectral structures that correlate with the SO_2 absorption cross-section. To reduce this interference, a median residual for a sliding group of SO_2-free and cloud-free scenes, radiative cloud fraction < 0.15 covering fifteen consecutive OMPS granules (approximately 30 degrees of latitude along-track).
- For each OMPS scene, the product provides three different estimates of the column density of SO_2 in Dobson Units (1DU=2.69 $\cdot 10^{16}$ molecules/cm^2) obtained by making different assumptions about the vertical distribution of the SO_2:
    - Lower tropospheric SO_2 column (**ColumnAmountSO2_TRL**, height ~2.5 km)
    - Middle tropospheric SO_2 column, (**ColumnAmountSO2_TRM**, height ~7.5 km),
    - Upper tropospheric and Stratospheric SO_2 column (**ColumnAmountSO2_STL**, height ~17.5 km).
- The V8TOz total ozone estimates are adjusted to correct for the SO_2 impacts on the measurements.

Input Satellite Data

Satellite Instruments

NDEV8S is a system operated within the NDE DHS by OSPO. It uses measurements from the Ozone Mapping and Profiler Suite (OMPS) Nadir Mapper (NM) on the Suomi National Polar-orbiting Partnership (S-NPP) platform and will continue with OMPS on future satellites of the Joint Polar Satellite System (JPSS). S-NPP was launched on October 28, 2011. It is in a sun synchronous orbit with a 1:30pm ascending-node orbit at an altitude of 829 km.

The OMPS NM instrument is a pushbroom spectrometer with a 2-dimensional CCD array detector. The telescope images a 105º cross-track FOV onto the array, providing full daily coverage of the sunlit Earth. It has 196 spectral bands covering the spectrum between 300 nm to 380 nm with 1.1 nm FWHM and 0.42-nm sampling. The instrument is highly flexible and is current operated to aggregate approximately 20 spatial pixels into 35 cross-track bin and to integrate for approximately 7.8 S. This produces 50x50 km^2 size products at nadir. Plans for J-01 are to reduce both dimensions by a factor of three and create 103 cross track bins every 2.6 S with 17X17 km^2 size products at nadir.

The grating spectrometer and focal plane for total column measurements provide 0.42 nm spectral sampling across the wavelength range of 300 to 380 nm. The radiance/irradiance ratios for the 12 wavelengths for the V8TOz EDR algorithm are obtained by interpolating the values at adjacent measurement wavelengths to provide them at the following 12 wavelengths:

[308.7,310.8,311.9,312.61,313.2,314.4, 317.6,322.4,331.3,345.4,360.2,372.8] nm

The LFSO2 algorithm applies SO_2 corrections on the V8TOZ EDR product and produces The V8TOS product.

Satellite Data Preprocessing Overview

The OMPS Raw Data Records (RDRs) are processed at IDPS into Sensor Data Records (SDRs) by the OMPS NM SDR and OMPS NM geolocation algorithms. This processing includes the geolocation and radiometric calibration of the raw sensor output. Details of the OMPS SDR algorithm are described in the JPSS OMPS SDR ATBD. The files are used as input for the V8TOz algorithm to create the V8TOz EDR files.

Input satellite data description

The NDE-V8TOS uses the three input files listed in the Table 5 and 15 V8TOz netCDF EDR granules (described in Table 6) files to create output files for the central five granules.

Table 5: NDE-V8TOS input files

File Type	No.	Filename	Content	Data Format
Control File	1	namelist.nml	Runtime parameters (generated by driver script)	ASCII
Ancillary File	2	OMSAO_O3_Brion_Absorption_TCelsius_OMPS_SW.coef	Ozone absorption coefficients specific to SNPP OMPS	ASCII
	3	SCIAMACHY_PFM_SO2_Absorption_TCelsius_OMPS_SW.coef	SO2 absorption coefficients specific to SNPP OMPS	ASCII

[§]IDPSTime=dyyyymndd_thhmmss0_ ehhmmss0_b21447_cyyyymnddhhmmssxxxxxx, where the first character d, t, e, b, c, indicate the date, starting time, ending time, orbital number, creation time, and yyyy, mn, dd indicate the year, month, and day, while hh and the second mm, indicate the hour, minute. The ss0 and ssxxxxx give tenths of seconds and microseconds respectively.

The *namelist* file generated by driver script contains runtime parameters that control the total SO_2 retrieval process.

Input V8TOZ EDR File (15 Files in netCDF Format)

Table 6: Contents of NDE-V8TOZ Input

Name	Type	Description	Dimension	Units	Range
Latitude	32 bit Float	Latitude	15 x 105	Degrees	-90 ~ 90
Longitude	32 bit	Longitude	15 x 105	Degrees	-180 ~ 180

	Float				
SolarZenithAngle	32 bit Float	Solar Zenith Angle	15 x 105	Degrees	0 ~ 180
SatelliteViewAngle	32 bit Float	Satellite View Angle	15 x 105	Degrees	-90~ 90
RelativeAzimuth	32 bit Float	Relative Azimuth	15 x 105	Degrees	-180~ 180
AerosolIndex	32 bit Float	Aerosol Index	15 x 105	Unitless	-100~ 100
AlgorithmFlag	32 bit Integer	Algorithm Flag	15 x 105	Unitless	0 ~ 10
CloudFraction	32 bit Float	Cloud Fraction	15 x 105	Unitless	0~ 1
CloudTopPressure	32 bit Float	Pressure at top of cloud	15 x 105	hPa	10~ 2000
ColumnAmountO3	32 bit Float	V8TOZ Total Column of Ozone	15 x 105	Dobson Units	0~ 1000
EclipseFlag	32 bit Float	Eclipse Flag	15 x 105	Unitless	0~ 10
ErrorFlag	32 bit Integer	Error Flag	15 x 105	Unitless	0~ 10
O3BelowCloud	32 bit Float	Total Column of Ozone below Cloud	15 x 105	Dobson Units	0~ 1000
QualityFlag	32 bit Interger	Quality Flag	15 x 105	Unitless	0~ 10
Reflectivity331	32 bit Float	Average 331 nm Reflectivity from V8TOz retrieval	15 x 105	%	0~ 100
Reflectivity360	32 bit Float	Average 360 nm Reflectivity from V8TOz retrieval	15 x 105	%	0~ 100
So2Index	32 bit Float	So2 Index	15 x 105	Unitless	-100~ 100
Step1Ozone	32 bit Float	V8TOZ Step1 Ozone	15 x 105	Dobson Units	0~ 1000

Step2Ozone	32 bit Float	V8TOZ Step2 Ozone	15 x 105	Dobson Units	0~ 1000
SunGlintFlag	32 bit Float	Sun Glint Flag	15 x 105	Unitless	0~ 10
NvalueAdjustment	32 bit Float	N-Value adjustment for 12 V8TOZ wavelengths	105 x 12	N-Values	-20~ 20
NvalueMeasured	32 bit Float	V8TOz Measured normalized radiances for 12 V8TOZ wavelengths	15 x 105 x 12	N-Values	0~ 100
Step1Residual	32 bit Float	V8TOZ Step 1 Residuals	15 x 105 x 12	N-Values	-50~ 50
Step2Residual	32 bit Float	V8TOZ Step 2 Residuals	15 x 105 x 12	N-Values	-50~ 50
Step3Residual	32 bit Float	V8TOZ Step 3 Residuals	15 x 105 x 12	N-Values	-50~ 50
dNdOmega	32 bit Float	V8TOz ozone sensitivities	15 x 105 x 12	N-Value/Dobson unit	-20~ 50
dNdR	32 bit Float	V8TOz reflectivity sensitivities	15 x 105 x 12	N-Values	0~ 600
LayerEfficiency	32 bit Float	V8TOz Layer retrieval efficiencies	15 x 105 x 11	DU/DU	-1~ 10
TemperatureProfile	32 bit Float	Temperature Profile	15 x 105 x 11	Degrees Kelvin	100~ 400
Step2Profile	32 bit Float	Step2 Ozone Profile	15 x 105 x 11	Dobson Units	10~ 400
TerrPressure	32 bit Float	Terrain Pressure from LUT	15 x 105	hPa	100~ 1500
Wavelengths	32 bit Float	12 Wavelengths of Observation for V8TOz	12	nm	300~ 420
ScanTime	64 bit	Elapsed time in	15	Microsec	1.0~ 1.0E12

	Float	seconds since Jan 1, 1958 including leap seconds		onds	
Ascending_Descending	32 bit Integer	1=Descending, 0=Ascending	15	Unitless	0~ 1
quality_information	8 bit Character	Granule quality information	1	%	0.0~ 100.0

Auxiliary input files

Ozone Absorption Coefficient Table
OMSAO_O3_Brion_Absorption_TCelsius_OMPS_SW.coef (ASCII format)

This file provides three polynomial constants, c0, c1, c2, for input wavelengths for use in calculating the ozone absorption coefficients as a function of temperature about 273.15 K.

SO2 Absorption Coefficient Table
SCIAMACHY_PFM_SO2_Absorption_TCelsius_OMPS_SW.coef (ASCII Format)

This file provides polynomial constants, c0, c1, c2, for input wavelengths for calculating SO_2 absorption coefficients as a function of temperature about 273.15 K. The table was derived from SCIAMACHY instrument test data.

PERFORMANCE

Product Testing

Test Data

Description of all NDEV8S test data (input, output) used in unit and system tests is provided in the NDE V8TOS Algorithm Readiness Review Report (NESDIS/STAR, 2016). This is available by contacting the Product Area Lead (PAL) at OSPO.

Test Plans

Description of all NDEV8S test plans used in unit and system tests is provided in the NDE V8TOS Algorithm Readiness Review Report (NESDIS/STAR, 2016). These are available by contacting the Product Area Lead (PAL) at OSPO.

Product Accuracy

Test Results

Description of all NDEV8S test results from the unit and system tests is provided in the NDE V8TOS Algorithm Readiness Review Report (NESDIS/STAR, 2016). This is available by contacting the Product Area Lead (PAL) at OSPO.

Product Accuracy

The V8TOS products have been made off line for the first four years of the OMPS NM mission. Results and products have been tracked at the STAR ICVS system at
http://www.star.nesdis.noaa.gov/smcd/spb/OMPSDemo/proOMPSbeta.php
Product accuracy estimates can be also be made for the performance of the heritage OMI products.

Product Quality

The ErrorFlag listed in listed Table 4 gives the decoding for the various error flag results. Intermediate products within the output EDR can also be used to check for unusual conditions.

Analysis Tools

No external product tools are supplied. The NDEV8S output files are netCDF4 files. External users can choose their own tools to display and analyze these output files. . BUFR Versions of selected content are under development.

PRODUCT STATUS

Operations Documentation

Operational logs contain the information regarding the changes made to science, instruments, and systems. Basically the Configuration Management system will have the

detailed information about these changes, but operational logs keep the high level description of these changes.

NESDIS/STAR (2016), NDE Version 8 Total Column Ozone Algorithm (LFSO2) Theoretical Basis Document, Version 1.0.

NESDIS/STAR (2016), NDE Version 8 Total Column Ozone (LFSO2) Maintenance Manual, Version 1.0.

NESDIS/STAR (2015), NDE Version 8 Total Column Ozone (LFSO2) Readiness Review Report (ARRR)

NDE Operations Handbook Version 1.0 (2013)

Maintenance History

The System Maintenance Manual (SMM) will be updated to reflect the changes that will be required to maintain the **NDE SO2 Corrected Version 8 Total Ozone** system within the ESPC environment. Information regarding the changes to the products is tracked by the Operational logs and will be available to users on request. Product metadata will be updated as per the changes required in the product including the version number, quality flags etc.

REFERENCES

Dave, J.V. & C.L. Mateer, "A preliminary study on the possibility of estimating total atmospheric ozone from satellite measurements," *J. Atmos. Sci.,* **24**, 414-427, 1967.

Mateer, C.L., D.F. Heath, & A.J. Krueger, "Estimation of total ozone from satellite measurements of backscattered ultraviolet Earth radiance," *J. Atmos. Sci*., **28**, 1307-1311, 1971.

Yang, K., N. A. Krotkov, A. J. Krueger, S. A. Carn, P. K. Bhartia, and P. F. Levelt (2007), Retrieval of large volcanic SO2 columns from the Aura Ozone Monitoring Instrument: Comparison and limitations, J. Geophys. Res., 112, D24S43, doi:10.1029/2007JD008825.

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