# S5P Mission Performance Centre
# Readme OFFL/RPRO Total Ozone
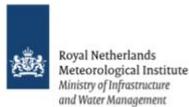
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|---|---|---|
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| date | 2023-07-20 | |
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| status | Released | |
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# CHANGE LOG

| Reason for change | Issue | Revision | Date |
|---|---|---|---|
| Table 2: addition of version 01.01.08 | 1 | 6 | 27/03/2020 |
| Updates for processor version 02.01.03 | 2 | 0 | 16/07/2020 |
| • Table 2: addition of version 02.01.04<br>• Section 3.1: put back the data selection criteria for V1.x.x, as this data are still available | 2 | 1 | 27/11/2020 |
| • Table 2: adapting to version 02.02.01 of the processor<br>• Section 4.1 & section 4.2: some text moved from section 4.1 (Known Data Quality Issues) to section 4.2 (Solved Data Quality Issues)<br>• Section 6.1: added format changes related to version 02.02.01 | 2 | 2 | 05/07/2021 |
| • Table 2: addition of version 02.03.00<br>• Section 7: addition of link to major S5p mission data gaps | 2 | 3 | 09/03/2022 |
| • Table 2: updates for version 02.04.01<br>• Section 4.2: addition of a "Solved Data Quality Issue" related to version 02.04.01<br>• Section 6.1: added minor format changes related to version 02.04.01 | 2 | 4 | 20/07/2022 |
| Table 2: addition of reprocessed data with version 02.04.01 | 2 | 5 | 25/11/2022 |
| • Table 2: extend dates of reprocessed dataset availability with version 02.04.01 (from 31 March to 3 August 2022)<br>• Section 7: updates with information related to gaps on the reprocessed dataset | 2 | 6 | 23/02/2023 |
| Table 2: updates for version 02.05.00 | 2 | 7 | 20/07/2023 |

# 1     Summary

This is the Product Readme File (PRF) for the public release of the Copernicus Sentinel 5 Precursor Tropospheric Monitoring Instrument (S5p/TROPOMI) Total Ozone Level 2 data product and is applicable for the Offline (OFFL) and Reprocessed (RPRO) timeliness product.

Product Identifier: **L2__O3____**

Example filename:

S5P_OFFL_L2__O3_____20190729T012853_20190729T031221_09274_01_020103_20200520T121402.nc
S5P_RPRO_L2__O3_____20220331T145841_20220331T164011_23129_03_020401_20221016T100647.nc

This product for v2.x has the following Digital Object Identifier (DOI): https://doi.org/10.5270/S5P-ft13p57

The Readme file describes the current processing baseline, product and quality limitations, and product availability status. More information on this data product is available from the Sentinel product webpage:

https://sentinels.copernicus.eu/web/sentinel/technical-guides/sentinel-5p/products-algorithms,

and from the TROPOMI product webpage http://www.tropomi.eu/data-products.

The data file contains the `ozone_total_vertical_column` which gives the total atmospheric column between the surface and the top of atmosphere. The respective random uncertainty originating from the spectral fit is given in the `ozone_total_vertical_column_precision` field.

As a user guideline for the data quality a `qa_value` is given with the data. In order to avoid misinterpretation of the data quality, it is recommended at the current stage to only use those pixels with `qa_value` above 0.5.

**Note:** starting from this processor version 2.4.1, new improved Level 1b version 2.1 data products are used as input [RD04].

Independent validation by Mission Performance Centre (MPC) Cal/Val experts and the Sentinel-5 Precursor Validation Team (S5PVT) conclude that the OFFL ozone data is compliant with the requirements as defined in the **S5P Calibration and Validation Plan** [RD01], see Table 1.

Up to date validation results are available in the Routine Operations Consolidated Validation Reports (ROCVR) that are accessible through the MPC Validation Data Analysis Facility (VDAF) website at http://mpc-vdaf.tropomi.eu. The ROCVR reports are issued quarterly.

| Parameter | Data product | Vertical Resolution | Bias | Random |
|-----------|--------------|---------------------|------|--------|
| Ozone | Total ozone OFFL | Total column | 5% | 2.5% |

Table 1: Ozone Offline data products uncertainty requirements

## 2      Processing baseline description

Table 2 contains the history of the processor versions. Note that the processor version for O3 OFFL is changing when there is a change to any of the products belonging to the UPAS processor suite (SO2, HCHO, O3 NRTI, O3 OFFL, Tropospheric O3, CLOUD) even if the change is not affecting the O3 OFFL product.

Please note that the processor version annotation in the filenames of orbits **4147** to **4158** are not correct. Those products are actually processed with the UPAS version 01.01.02, but in the filename it is written 01.01.01.

| Processor Version | In operation from | In operation until | Relevant Improvements |
|---|---|---|---|
| 02.05.00 | OFFL: orbit 29818, 2023-07-16 | Current version | No change in OFFL O3 algorithm |
| 02.04.01 | OFFL: orbit 24655, 2022-07-17 RPRO: orbit 2818, 2018-04-30 | Orbit 29817, 2023-07-16 Orbit 24898, 2022-08-03 | • No change in OFFL O3 algorithm<br>• The variable `surface_temperature` is now written correctly (was set to fill-value in the previous version)<br>**Note 1**: It is recommended to use the RPRO products in the orbit range **24655 - 24898**, period for which also OFFL products are available. This, in order to avoid products with possible instabilities, because generated during the first days of the operational switch to version 2.4.1<br>**Note 2**: starting from this processor version 2.4.1, new improved Level 1b version 2.1 data products are used as input [RD04]. |
| 02.03.00 | OFFL: orbit 22768, 2022-03-06 | Orbit 24654, 2022-07-17 | The variables `satellite_altitude, satellite_latitude, satellite_longitude, satellite_orbit_phase` are now written correctly (were set to fill-value in the previous versions) |

| 02.02.01 | OFFL: orbit 19258, 2021-07-01 | Orbit 22767, 2022-03-06 | - The variable `surface_altitude_precision` is now correctly written (previous versions reported fill-value) <br> - Updates impacting the CLOUD input product: <br>   o New cloud-free maps based on 3 years of TROPOMI data <br>   o Improved handling of snow / ice conditions <br>   o Improved scan angle correction <br>   o Optimized for the new L1b V2.0 input <br>   o New fallback surface albedo climatology based on 3 years of TROPOMI data <br>   o Improved clear-sky filtering in background correction <br>   o Added the variable `surface_temperature` (see section 6.1) <br><br> **Note:** starting from this processor version 2.2.1, new improved Level 1b version 2.0 data products are used as input [RD04]. |
| 02.01.04 | OFFL: orbit 16213, 2020-11-29 | Orbit 19257, 2021-07-01 | No changes with respect to previous version |
| 02.01.03 | OFFL: orbit14239, 2020-07-13 | Orbit 16212, 2020-11-29 | - New surface albedo retrieval algorithm (GE_LER) from TROPOMI for the CLOUD product (affects CLOUD input product) <br> - New OCRA cloud-free maps based on S5P instead of OMI (affects CLOUD input product) <br> - New cloud flags have been introduced (e.g. ice-clouds) <br> - The required interpolation of cloud properties co-registration between band 3-4 and band 6 due to the instrument co-registration issues has been improved in the CLOUD product <br> - Updated metadata generation to reflect the improved spatial resolution after 6th Aug 2019 <br> - Improved handling of the ECMWF information, reading and deriving snow-ice information and propagating wind-information in the level 2 products (see section 6.1) <br> - Fixed inconsistency in the surface / effective scene pressure calculation in the O3 OFFL algorithm <br> - Improve the `qa_value` determination <br> - Improve the prior value of the effective scene albedo <br> - Fixed inconsistency in the surface/effective scene pressure calculation in the algorithm |

| | | | - Invalid values of `geolocation_flags` set to correct values |
|---|---|---|---|
| | | | - New metadata added (see section 6.1) |
| 01.01.08 | OFFL: orbit 12432, 2020-03-07 | Orbit14238, 2020-07-12 | No changes with respect to previous version |
| 01.01.07 | OFFL: orbit 7907, 2019-04-23<br>RPRO: orbit 2818, 2018-04-30 | Orbit 12431, 2020-03-07<br>Orbit 7906, 2019-04-23 | Correction of the CLOUD product handling when cloud fractions were less than 5%. This caused evident gaps in data with version 01.01.06 (see section 4.2) |
| 01.01.06 | OFFL: orbit 7542, 2019-03-28 | Orbit 7906, 2019-04-23 | - Correction of occasional Cloud as Reflecting Boundaries (CRB) cloud top pressure field too high in Tropical regions that caused the OFFL total ozone columns to be biased low (see section 4.2)<br>- Unit of `smoothing_error` parameter is $mol.cm^{-2}$, consistently with the other variables since this version. In previous versions it was provided in Dobson Units (see section 4.2)<br>- Surface classification climatology updated<br>- Fixed a bug in the interpolation of the surface albedo climatology |
| 01.01.05 | OFFL: orbit 5833, 2018-11-28 | Orbit 7541, 2019-03-28 | Inconsistency between pressure grid and averaging kernel values has been resolved (see section 4.2) |
| 01.01.02 | OFFL: orbit 4147, 2018-08-01 | Orbit 5832, 2018-11-28 | Initial operational version |

Table 2: History of Ozone OFFL processor versions. In orange, the data versions that are no longer available to the users on the Pre-operations hub.

# 3    Product Quality

## 3.1    Recommendations for data usage

The quality of the individual observations depends on many factors, including cloud cover, presence of snow-ice, saturation, geometry etc. These aspects are taken into account in the definition of the "quality assurance value" (`qa_value`), available for each individual observation, which provides the users of the data with an easy filter to remove less accurate observations. The `qa_value` is a continuous variable, ranging from 0 (error) to 1 (all is well).

- For data Version 1.x.x: the `qa_value` had still to be optimized, therefore the recommendation is to use, instead, the following selection rules:

    o `ozone_total_vertical_column` out of [0 to 0.45]
    o `ozone_effective_temperature` out of [180 to 260]
    o `ring_scale_factor` out of [0 to 0.15]
    o `effective_albedo` out of [-0.5 to 1.5]

- For data Version 2.x.x onwards: the `qa_value` has been adjusted as to reflect the selection criteria listed above (for V1.x.x) and can be used without any additional selection criteria. Therefore, users are recommended to use TROPOMI pixels associated with a `qa_value` above 0.5.

For further details, data users are encouraged to read the Product User Manual (PUM) and Algorithm Theoretical Basis Document (ATBD) associated with this data product, both available on https://sentinels.copernicus.eu/web/sentinel/technical-guides/sentinel-5p/products-algorithms.

## 3.2    Validation results

Independent validation by Mission Performance Centre (MPC) Cal/Val experts and the Sentinel-5 Precursor Validation Team (S5PVT) conclude that the OFFL ozone data is in good overall agreement with (i) reference measurements collected from global ground-based networks, and (ii) the corresponding satellite data product from Ozone Mapper and Profiling Suite (OMPS). The global bias with respect to the ground-based measurements is found to be below 1%, which is well within the mission requirements of maximum 5%. The biases at individual stations also satisfy this requirement. The scatter of the differences around this bias also complies with mission requirements of ±2.5%.

Up to date validation results are available in the ROCVR reports that are accessible through the MPC VDAF website at http://mpc-vdaf.tropomi.eu. The reports are issued quarterly.

# 4        Data Quality Remarks

## 4.1       Known Data Quality Issues

Currently, the following data quality issues are known, not covered by the quality flags, and should be kept in mind when looking at the total ozone product itself and also at preliminary validation results.

**Bands 3-4 and 6 spatial misalignment**

The band 3-4 (450 pixels per scanline) footprints are not fully aligned with the band 6 (448 pixels per scanline) footprints. In the worst case, the misalignment can be of the order of half a ground pixel. The OCRA algorithm retrieves the Cloud Fraction at Bands 3 and 4 and interpolates it linearly, according to the covered area, to band 6. This is an *a priori* to the ROCINN algorithm which works in band 6. Over heterogeneous scenes this miss-registration might have a large impact on the data quality. The cloud height and optical thickness retrieved in band 6 are interpolated back to the band 3 footprints. Due to missing overlap with the band 6 footprints, the first pixel in band 3 (no overlap) and the second pixel in band 3 (only partial overlap), do not contain cloud products with full quality. This is also reflected in the cloud data `qa_value`.

**Outliers**

It has been identified that the product includes some rare outliers with unphysical retrieved effective temperature and total ozone columns, or poor fit quality (high fitted_root_mean_square). Those pixels are in principle removed when using a `qa_value` larger than 0.5.

## 4.2       Solved Data Quality Issues

**Pressure/AK/Profiles grids (solved in version 01.01.05)**

In case of clear cases (cloud fraction=0), there is one layer less in the forward model and the pressure, a-priori profiles and averaging kernels grids are given in an inconsistent way in the output files. This was solved since version 01.01.05 (see Table 2).

**Orbit numbering in NRTI and OFFL (solved in version 01.01.05)**

Note that NRTI orbit numbers are set with respect to the downlink orbit while OFFL orbit numbers are set with respect to the equator crossing time. This creates an inconsistency between the NRTI and OFFL orbit numbers, which is removed with the activation of processor version 01.01.05 (see Table 2).

**Impact of cloud product (solved in version 01.01.06)**

The OFFL product makes use of the Cloud as Reflecting Boundaries (CRB) parameters from the CLOUD operational product. Some occasional outliers have been identified in the CRB cloud top pressure fields (CTP too high) in Tropical regions. For such events, the OFFL total ozone columns are biased low. A correction in the cloud algorithm has been developed and was implemented in version 01.01.06 (see Table 2).

**Smoothing error (solved in version 01.01.06)**

The smoothing error representing the systematic error estimate due to the usage of the a-priori profile is provided in Dobson Unit instead of $mol.cm^{-2}$. Values consistent with the other variables are obtained by dividing them by 2241.15. From version 01.01.06 (see Table 2), the unit of this variable is $mol.cm^{-2}$, consistently with the other variables.

**Data gaps at activation of V01.01.06 (solved in version 01.01.07)**

Ozone data processed with version 01.01.06 (between 28-03-2019 and 23-04-2019, see Table 2) show evident gaps due to an inconsistency in the input cloud parameters: when the cloud fraction is very low (between 0 and 5%) the correlated cloud parameters (cloud top height, etc) are set to fill values (invalid). But because the cloud fraction was not 0%, the Ozone algorithm assumed that the cloud parameters were valid causing problems during the retrieval and leading to gaps in the final Ozone products. This inconsistency has been corrected with version 01.01.07 of the processor (see Table 2) where original cloud fractions < 5% are set to 0% during the cloud processing. Note that the original cloud-fraction is still saved in the `cloud_fraction_a_priori` variable of the CLOUD product.

**Metadata/Attributes (solved in version 02.01.03)**

The spatial resolution of the TROPOMI measurements is improved by bringing the along track ground pixel size from 7.0 to 5.5 Km starting on 6th August 2019. Note that, after this operations change, some metadata/Attributes fields related to the spatial resolution, remained **unchanged** (hence not aligned to the improved resolution) – but with version 02.01.03 this is corrected

**Metadata values exchanged (solved)**

The global attributes `geospatial_lon_min` and `geospatial_lon_max`  values are exchanged; therefore, the user is advised to switch the values for these fields, making note that the `geospatial_lat_min` and `geospatial_lat_max` values are correct. This is an issue traceable to L1b data (version 01.00.00) and is corrected since the switch to version 02.00.00 of the Level 1B processor on July 2021.

**Flagging of Saturation (solved)**

Some TROPOMI pixels in band 6 might be affected by saturation. Those pixels should be flagged and their quality is reflected in the `qa_value`. Nevertheless, in the vicinity of saturated pixels there might be pixels also affected by saturation due to the so-called blooming effect. The pixels affected by blooming effect have been flagged since version 02.00.00 of the level 1b processor, operational since July 2021. This effect is not visible in the band 3 used for total ozone retrievals, but the product may nevertheless be impacted via the CLOUD parameters.  In such cases, the total ozone column values are usually underestimated.

**Variable `surface_temperature` with fill-value (solved in version 02.04.01)**

Since version 02.04.01 the variable `surface_temperature` is filled in correctly (it was set to fill-value in the previous version).

## 4.3    Data Features

This section describes some characteristics of the data that might seem anomalous, however they are physically correct and not related to any problem.

**Pixel geolocation around North Pole (feature)**

The solar irradiance is measured on a daily basis over the North Pole at a reference azimuth angle to remove seasonal effects on the measurements. To this end, a yaw manoeuvre is executed when the instrument is still in radiance mode, causing possible distortion on the scanlines observed during this manoeuvre (i.e. crossing scanlines, "bow-tie" ground pixel shape instead of rectangular). This occurs at most during the last 26 seconds of radiance measurements in few orbits (7-9 per week). Though this may seem anomalous, it is physically correct, and not related to any problem on the data geolocation.

## 4.4    Mission Operations Changes

A change in the Copernicus Sentinel 5P operations scenario, increasing the spatial resolution from 7.0 km to 5.5 km along track for all measurements, became operational starting from 6 August 2019, orbit 9388.

# 5     Algorithm Change Record

For a detailed description of the L2__O3____ algorithms, please refer to the ATBD [RD02].

# 6    Data Format

The product is stored as NetCDF4 file. The NetCDF4 file contains both the data and the metadata for the product.

For OFFL data the product is stored as a single file per satellite orbit, for NRTI data the product is stored as multiple files per orbit.

Details of the data format are provided in the Product User Manual (PUM) [RD03].

## 6.1    Data format changes

### 6.1.1    Version 02.04.01

**New fields added**
```
/METADATA/GRANULE_DESCRIPTION/CollectionIdentifier
/METADATA/QA_STATISTICS/number_of_thermal_instability_warning_occurrences
```

In variable:
```
/PRODUCT/SUPPORT_DATA/DETAILED_RESULTS/processing_quality_flags
```

Added element to attribute 'flag_meanings': [success, radiance_missing, irradiance_missing, input_spectrum_missing, …, **thermal_instability_warning**]
Added element to attribute 'flag_masks': [255, 255, 255, …, **1073741824**]
Added element to attribute 'flag_values': [0, 1, 2, 3, 4, …, **1073741824**]

In variable:
```
/PRODUCT/SUPPORT_DATA/GEOLOCATIONS/geolocation_flags
```

Added element to attribute 'flag_meanings': [no_error, solar_eclipse, sun_glint_possible, descending, night, geo_boundary_crossing, **spacecraft_manoeuvre,** geolocation_error]
Added element to attribute 'flag_masks': [0, 1, 2, 4, 8, 16, **32**, 128]
Added element to attribute 'flag_values': [0, 1, 2, 4, 8, 16, **32**, 128]
The attribute 'long_name' has been updated to 'geolocation flags'
**Other changes**
- Date time string: A "Z" is added to explicitly indicate UTC
- Text changed in the attribute containing the name of the processor
  `gmd:lineage/gmd:processStep/gmi:processingInformation/gmi:softwareRef erence/gmd:title`
- Updated content of the built date of the software (it was empty):
  `gmd:lineage/gmd:processStep/gmi:processingInformation/gmi:softwareRef erence/gmd:date/gmd:date`
- `/METADATA/GRANULE_DESCRIPTION`: changed from possible values "NRTI", "OFFL" or "RPRO" to "Near-realtime", "Offline" or "Reprocessing"

### 6.1.2    Version 02.03.00

There are no format changes with respect to the previous version.

### 6.1.3    Version 02.02.01

**New fields added**

```
/PRODUCT/SUPPORT_DATA/INPUT_DATA/surface_temperature
```

### 6.1.4    Version 02.01.04

There are no format changes with respect to the previous version.

### 6.1.5    Version 02.01.03

**New fields added**

```
/PRODUCT/SUPPORT_DATA/INPUT_DATA/northward_wind
/PRODUCT/SUPPORT_DATA/INPUT_DATA/eastward_wind
/PRODUCT/SUPPORT_DATA/INPUT_DATA/sea_ice_cover
/PRODUCT/SUPPORT_DATA/INPUT_DATA/snow_cover
```

**New Metadata added**

Added "`Status_BG`" as global attribute.

# 7    Product Availability

The S5p Ozone OFFL data are available on the Copernicus S5p Open Access Hub https://scihub.copernicus.eu.

Also, the full mission reprocessed products can be found on the mentioned Open Access Hub and can be identified by the file class 'RPRO' in the filenames. The collection identifier is '03', the same used for the operational dataset that is available since mid-July 2022 (all with version 2.4.1).

The list of major mission data gaps due to acquisition faults or satellite/instrument disruption is available at https://sentinel.esa.int/web/sentinel/missions/sentinel-5p/mission-status. For those periods the data are permanently lost.

**RPRO dataset gaps**: additional gaps are present on the reprocessed dataset (see Table 3) due to the unavailability of Level 0 (L0) input data during the full mission reprocessing campaign.

| Orbit | Gap start time | Gap stop time |
|---|---|---|
| 3546 | 20/06/2018 08:31:35 | 20/06/2018 08:51:37 |
| 9755 | 31/08/2019 23:46:24 | 01/09/2019 00:06:25 |
| 10782 | 12/11/2019 08:39:57 | 12/11/2019 09:29:55 |
| 19782 | 07/08/2021 18:09:52 | 07/08/2021 18:27:54 |
| 19785 | 07/08/2021 22:34:02 | 07/08/2021 22:50:52 |
| 20254 | 10/09/2021 00:01:42 | 10/09/2021 00:21:43 |

Table 3: Gaps on RPRO dataset due to the unavailability of L0 input data during the full mission reprocessing campaign

Information on data handling tools is available from the web page http://www.tropomi.eu/tools.

For further questions regarding S5p/TROPOMI data products please contact: EOSupport@Copernicus.esa.int.

The access and use of any Copernicus Sentinel data available through the Copernicus Sentinel Data Hub are governed by the Legal Notice on the use of Copernicus Sentinel Data and Service Information and is given here: https://sentinels.copernicus.eu/documents/247904/690755/Sentinel_Data_Legal_Notice.

# 8    References

[RD01]    Sentinel-5 Precursor Calibration and Validation Plan for the Operation Phase;
          **source**: ESA; **ref**: ESA-EOPG-CSCOP-PL-0073;
          https://sentinels.copernicus.eu/documents/247904/2474724/Sentinel-5P-Calibration-
          and-Validation-Plan.pdf

[RD02]    Sentinel-5 precursor/TROPOMI Level 2 Algorithm Theoretical Basis Document O3 Total
          Column;
          **source**: DLR; **ref**: S5P-L2-DLR-ATBD-400A;
          https://sentinels.copernicus.eu/documents/247904/2476257/Sentinel-5P-TROPOMI-
          ATBD-Total-Ozone

[RD03]    Sentinel-5 precursor/TROPOMI Level 2 Product User Manual O3 Total Column;
          **source**: DLR; **ref**: S5P-L2-DLR-PUM-400A;
          https://sentinels.copernicus.eu/documents/247904/2474726/Sentinel-5P-Level-2-
          Product-User-Manual-Ozone-Total-Column

[RD04]    Algorithm theoretical basis document for the TROPOMI L01b data processor
          **source**: KNMI; ref: S5P-KNMI-L01B-0009-SD;
          **url**: https://sentinels.copernicus.eu/documents/247904/2476257/Sentinel-5P-
          TROPOMI-Level-1B-ATBD

More information on this data product is available from the Sentinel product webpage:

https://sentinels.copernicus.eu/web/sentinel/technical-guides/sentinel-5p/products-algorithms,

and from the corresponding TROPOMI product webpage http://www.tropomi.eu/data-products.

# Abbreviations and acronyms

| | |
|---|---|
| AMF | Air Mass Factor |
| ATBD | Algorithm Theoretical Basis Document |
| BIRA-IASB | Royal Belgian Institute for Space Aeronomy |
| CF | Cloud Fraction (fractional cloud cover) |
| COT | Cloud Optical thickness |
| CRB | Cloud as Reflecting Boundaries |
| CTH | Cloud Top Height |
| DLR | German Aerospace Center / Deutsches Zentrum für Luft- und Raumfahrt |
| DOAS | Differential Optical Absorption Spectroscopy |
| DOI | Digital Object Identifier |
| ESA | European Space Agency |
| ESL | Expert Support Laboratory |
| EU | European Union |
| GB | Ground Based |
| GOME(-2) | Global Ozone Monitoring Experiment(-2) |
| KNMI | Royal Netherlands Meteorological Institute / Koninklijk Nederlands Meteorologisch Instituut |
| MetOp | polar orbiting Meteorological Operational satellite |
| MPC | Mission Performance Centre |
| NASA | National Aeronautics and Space Administration |
| NDACC | Network for the Detection of Atmospheric Composition Change |
| OMPS | Ozone Mapper and Profiling Suite |
| PRF | Product Readme File |
| PUM | Product User Manual |
| QWG | Quality Working Group |
| ROCVR | Routine Operations Consolidated Validation Report |
| S5p | Sentinel-5 Precursor |
| S5PVT | Sentinel-5 Precursor Validation Team |
| Suomi NPP | Suomi National Polar-orbiting Partnership |
| SZA | Solar Zenith Angle |
| TROPOMI | Tropospheric Monitoring Instrument |
| VDAF | Validation Data Analysis Facility |
| VIIRS | Visible Infrared Imaging Radiometer Suite |
| WMO | World Meteorological Organization |