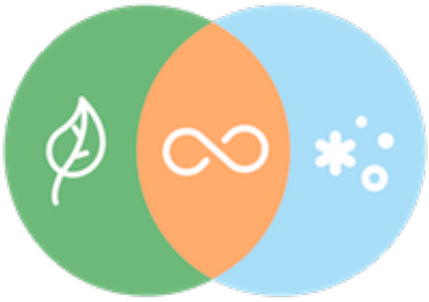

SPAR@MEP

SPOT-PROBA-V Surface Aerosol Retrieval at MEP

SPAR@MEP - Product Specification Document

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Document Change Record

Doc. Version	Date	CISAR Release	Remarks
Version 1.0	September 2020	-	First released version

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List of Acronyms

AOD	Aerosol Optical Depth
BHR	BiHemispherical Reflectance
BRF	Bidirectional Reflectance Factor
CISAR	Combined Inversion of Surface and AeRosol
COD	Cloud Optical Depth
ESA	European Space Agency
FM	Fine Mode
GEDAP	GEneric DAta Processing Chain
MEP	Mission Exploitation Platform
PROBA-V	Project for On-Board Autonomy – Vegetation
PSD	Product Specifications Document
QI	Quality Indicator
ROI	Region of Interest
RPV	Rahman - Pinty - Verstraete BRF model
RTM	Radiation Transfer Model
SPAR@MEP	Spot-Proba-V surface and Aerosol Retrieval at MEP
TMA	Three-Mirror Anastigmatic
TOA	Top Of Atmosphere

1 Introduction

1.1 Purpose

The purpose of the Product Specifications Document (PSD) is to describe in detail the SPAR@MEP User Products delivered by the GEDAP-CISAR algorithm. This first version of the document is limited to the Products obtained from PROBA-V observations.

1.2 Scope

GEDAP primary objective is to feed the CISAR algorithm with the data needed to perform the inversion of a physically-based Radiative Transfer Model (RTM) and to generate Earth system components products based on these retrievals in standard format.

1.3 Reference Documents

RD1	Govaerts, Y. and Luffarelli, M. (2018) “Joint retrieval of surface reflectance and aerosol properties with continuous variations of the state variables in the solution space: Part 1: theoretical concept”, Atmospheric Measurement Techniques, 11, no. 12, 6589–6603.
RD2	Luffarelli, M. and Y. Govaerts. (2019). “Joint Retrieval of Surface Reflectance and Aerosol Properties with Continuous Variation of the State Variables in the Solution Space – Part 2: Application to Geostationary and Polar-Orbiting Satellite Observations." Atmospheric Measurement Techniques 12 (2): 791–809.

2 Instrument Overview

The PROBA-V (Project for On-Board Autonomy – Vegetation) remote-sensing satellite mission is intended to ensure the continuation of the SPOT 5 VEGETATION products after May 2014. PROBA-V flies at an altitude of $820\,\mathrm{km}$. The microsatellite is designed to offer a global coverage of land surfaces at four spectral bands at a spatial resolution of $1/3\,\mathrm{km}$ and $1\,\mathrm{km}$ with a daily revisit for latitudes from +75°N to 56°S (Sterckx et al. 2014). To cover the wide angular field of view (101°) in a small-sized platform, the optical design of PROBA-V is made up of three cameras (identical three-mirror anastigmatic (TMA) telescopes). The three cameras have an equal field of view, the center camera pointing down covers a swath of $500\,\mathrm{km}$, while the right and left cameras cover $875\,\mathrm{km}$ each. Each camera has two focal planes, one for the short wave infrared (SWIR) band and one for the visible and near-infrared (VNIR) bands. The VNIR detector consists of four lines of 5200 pixels. Three spectral bands are selected, compatible with SPOT-VEGETATION (SPOT-VGT): blue, red, and near infrared (NIR). The SWIR detector is a linear array composed of three mechanically staggered detectors of 1024 pixels. The ground sampling distance (GSD) for the central camera is $100\,\mathrm{m}$ in the across-track direction, while for the side cameras it varies from $300\,\mathrm{m}$ to more than $660\,\mathrm{m}$ at the swath edges. The SWIR imaging pixels are twice as large but result in a similar geometry: $200\,\mathrm{m} \times 200\,\mathrm{m}$ in the centre varying to $200\,\mathrm{m} \times 600\,\mathrm{m}$ at the edge of the side cameras. Because of the omission of on-board calibration devices, such as Light emitting Diode (LED) lamps, due to the constraints on size, weight and power consumption, the PROBA-V in-flight calibration relies only on vicarious methods.

3 Product overview

The SPAR@MEP User Products are daily atmospheric and 10-days surface products consisting in separate NetCDF files, following the official ESA Aerosol-CCI format (de Leeuw et al. 2017). Each Product is obtained by aggregating all the Tiles intersecting or touching the Region Of Interest (ROI). Tiles are defined as static units of temporal invariant geographical 2D properties (longitude,latitude) forming a geographical grid and are used to store data. Each Tile has a unique identification number. The Products are obtain from the GEDAP-CISAR algorithm applied to PROBA-V observations.

3.1 Naming convention

The SPAR@MEP GEDAP-CISAR User Products follow the following naming convention:

`YYYYMMDD-SPARatMEP-PPP-L2A-PROBAV-RAY-vX.X.X.nc`

where

`YYYY`	is the year of the current retrieval
`MM`	is the month of the current retrieval
`DD`	is the day of the current retrieval
`PP`	Product type: AOT for Atmosphere and BHR for surface products, respectively
`X.X.X`	us the version of the algorithm

For the surface product, the date specified in the file name refers to the starting date of a 10-days period.

3.2 Parameter to be provided

The GEDAP-CISAR algorithm retrieves a set of daily atmospheric variables and 10-day surface variables from the satellite observations. The atmospheric parameters contained in the products are the Aerosol Optical Depth (AOD), the Fine Mode (FM) AOD, the Cloud Optical Depth (COD), and the ice COD at every PROBA-V wavelength and interpolated at $0.55\,\mu\mathrm{m}$. The surface products is available only for land pixels. It contains the number of available satellite observations for the considered accumulation period, the isotropic BiHemispherical Reflectance (BHR) and the 4 Rahman-Pinty-Verstraete RPV parameters describing the surface reflectance model (Rahman et al. 1993) at every PROBA-V wavelength. GEDAP-CISAR delivers a Quality Indicator (QI) contained in the atmospheric product. The latter contains the land cover type as well, indicating whether the pixel is land or water. Additionally, both products contain the acquisition time, the pixel number, the central latitude and longitude and the coordinates of each pixel corners.

All the GEDAP-CISAR retrieved variables are delivered with their retrieval uncertainty, computed from the Optimal Estimation theory.

4 Product content

4.1 Atmospheric Product

Each daily atmospheric product contains the following fields:

Name	Description
AOD464	Total AOD in PROBA-V band BLUE
AOD550	Total AOD at 0.55 µm
AOD655	Total AOD in PROBA-V band RED
AOD837	Total AOD in PROBA-V band NIR
AOD1603	Total AOD in PROBA-V band SWIR
AOD464_uncertainty	Estimated total AOD uncertainty in PROBA-V band BLUE
AOD550	Estimated total AOD uncertainty at 0.55 µm
AOD655_uncertainty	Estimated total AOD uncertainty in PROBA-V band RED
AOD837_uncertainty	Estimated total AOD uncertainty in PROBA-V band NIR
AOD1603_uncertainty	Estimated total AOD uncertainty in PROBA-V band SWIR
FM_AOD464	Fraction of fine mode AOD in PROBA-V band BLUE
FM_AOD550	Fraction of fine mode AOD at 0.55 µm
FM_AOD655	Fraction of fine mode AOD in PROBA-V band RED
FM_AOD837	Fraction of fine mode AOD in PROBA-V band NIR
FM_AOD1603	Fraction of fine mode AOD in PROBA-V band SWIR
FM_AOD464_uncertainty	Estimated fraction of fine mode AOD uncertainty in PROBA-V band BLUE
FM_AOD550_uncertainty	Estimated fraction of fine mode AOD uncertainty at 0.55 µm
FM_AOD655_uncertainty	Estimated fraction of fine mode AOD uncertainty in PROBA-V band RED
FM_AOD837_uncertainty	Estimated fraction of fine mode AOD uncertainty in PROBA-V band NIR
FM_AOD1603_uncertainty	Estimated fraction of fine mode AOD uncertainty in PROBA-V band SWIR
COD464	Total COD in PROBA-V band BLUE

COD550	Total COD at 0.55 µm
COD655	Total COD in PROBA-V band RED
COD837	Total COD in PROBA-V band NIR
COD1603	Total COD in PROBA-V band SWIR
COD464_uncertainty	Estimated total COD uncertainty in PROBA-V band BLUE
COD550_uncertainty	Estimated total COD uncertainty at 0.55 µm
COD655_uncertainty	Estimated total COD uncertainty in PROBA-V band RED
COD837_uncertainty	Estimated total COD uncertainty in PROBA-V band NIR
COD1603_uncertainty	Estimated total COD uncertainty in PROBA-V band SWIR
ICE_COD464	Fraction of ice COD in PROBA-V band BLUE
ICE_COD550	Fraction of ice COD at 0.55 µm
ICE_COD655	Fraction of ice COD in PROBA-V band RED
ICE_COD837	Fraction of ice COD in PROBA-V band NIR
ICE_COD1603	Fraction of ice COD in PROBA-V band SWIR
ICE_COD464_uncertainty	Estimated fraction of ice COD uncertainty in PROBA-V band BLUE
ICE_COD550_uncertainty	Estimated fraction of ice COD uncertainty at 0.55 µm
ICE_COD655_uncertainty	Estimated fraction of ice COD uncertainty in PROBA-V band RED
ICE_COD837_uncertainty	Estimated fraction of ice COD uncertainty in PROBA-V band NIR
ICE_COD1603_uncertainty	Estimated fraction of ice COD uncertainty in PROBA-V band SWIR
QI	Quality indicator
time	Acquisition time in second since 01/01/1970
surface_type_number	Land/sea flag
latitude	Pixel center latitude in degree
longitude	Pixel center longitude in degree
pixel_corner_latitude1	Latitude 1st corner in degree
pixel_corner_latitude2	Latitude 2nd corner in degree
pixel_corner_latitude3	Latitude 3rd corner in degree
pixel_corner_latitude4	Latitude 4th corner in degree
pixel_corner_longitude1	Longitude 1st corner in degree
pixel_corner_longitude1	Longitude 2nd corner in degree
pixel_corner_longitude1	Longitude 3rd corner in degree

pixel_corner_longitude1	Longitude 4th corner in degree
pixel_number	Pixel number

4.2 Surface Product

Name	Description
BHRiso464	Isotropic BHR in band BLUE
BHRiso655	Isotropic BHR in band RED
BHRiso837	Isotropic BHR in band NIR
BHRiso1603	Isotropic BHR in band SWIR
BHRiso464_uncertainty	Estimated isotropic BHR uncertainty in band BLUE
BHRiso655_uncertainty	Estimated isotropic BHR uncertainty in band RED
BHRiso837_uncertainty	Estimated isotropic BHR uncertainty in band NIR
BHRiso1603_uncertainty	Estimated isotropic BHR uncertainty in band SWIR
rho0_464	RPV parameter ρ_0 in band BLUE
rho0_655	RPV parameter ρ_0 in band RED
rho0_837	RPV parameter ρ_0 in band NIR
rho0_1603	RPV parameter ρ_0 in band SWIR
rho0_464_uncertainty	Estimated RPV parameter ρ_0 uncertainty in band BLUE
rho0_655_uncertainty	Estimated RPV parameter ρ_0 uncertainty in band RED
rho0_837_uncertainty	Estimated RPV parameter ρ_0 uncertainty in band NIR
rho0_1603_uncertainty	Estimated RPV parameter ρ_0 uncertainty in band SWIR
k_464	RPV parameter k in band BLUE
k_655	RPV parameter k in band RED
k_837	RPV parameter k in band NIR
k_1603	RPV parameter k in band SWIR
k_464_uncertainty	Estimated RPV parameter k uncertainty in band BLUE
k_655_uncertainty	Estimated RPV parameter k uncertainty in band RED

k_837_uncertainty	Estimated RPV parameter k uncertainty in band NIR
k_1603_uncertainty	Estimated RPV parameter k uncertainty in band SWIR
theta_464	RPV parameter θ in band BLUE
theta_655	RPV parameter θ in band RED
theta_837	RPV parameter θ in band NIR
theta_1603	RPV parameter θ in band SWIR
theta_464_uncertainty	Estimated RPV parameter θ uncertainty in band BLUE
theta_655_uncertainty	Estimated RPV parameter θ uncertainty in band RED
theta_837_uncertainty	Estimated RPV parameter θ uncertainty in band NIR
theta_1603_uncertainty	Estimated RPV parameter θ uncertainty in band SWIR
rhoc_464	RPV parameter ρ_c in band BLUE
rhoc_655	RPV parameter ρ_c in band RED
rhoc_837	RPV parameter ρ_c in band NIR
rhoc_1603	RPV parameter ρ_c in band SWIR
rhoc_464_uncertainty	Estimated RPV parameter ρ_c uncertainty in band BLUE
rhoc_655_uncertainty	Estimated RPV parameter ρ_c uncertainty in band RED
rhoc_837_uncertainty	Estimated RPV parameter ρ_c uncertainty in band NIR
rhoc_1603_uncertainty	Estimated RPV parameter ρ_c uncertainty in band SWIR
surface_type_number	Land/sea flag
latitude	Pixel center latitude in degree
pixel_corner_latitude1	Latitude 1st corner in degree
pixel_corner_latitude2	Latitude 2nd corner in degree
pixel_corner_latitude3	Latitude 3rd corner in degree
pixel_corner_latitude4	Latitude 4th corner in degree
pixel_corner_longitude1	Longitude 1st corner in degree
pixel_corner_longitude1	Longitude 2nd corner in degree
pixel_corner_longitude1	Longitude 3rd corner in degree
pixel_corner_longitude1	Longitude 4th corner in degree
pixel_number	Pixel number

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