



Sentinel-2 Sen2Cor Status and Outlook



Jérôme Louis⁽¹⁾, Vincent Debaecker⁽¹⁾, Bringfried Pflug⁽²⁾, Magdalena Main-Knorn⁽²⁾, Uwe Mueller-Wilm⁽³⁾, Ferran Gascon⁽⁴⁾, Valentina Boccia⁽⁴⁾



(1) Telespazio France - A Leonardo / Thales Company, 26 Av. JF Champollion, 31023 Toulouse Cedex 1 (France), Phone: +33 534352109, Email: jerome.louis@telespazio.com, vincent.debaecker@telespazio.com
 (2) German Aerospace Centre, Remote Sensing Technology Institute, (3) TPZV-D - Telespazio Vega Deutschland, (4) European Space Agency, ESRIN

Sentinel-2 is a polar orbiting satellite constellation of two units carrying each one an optical imaging sensor called MSI (Multi-Spectral Instrument). Sentinel-2A was launched on June 23, 2015 and Sentinel-2B was launched on March 7, 2017.

Sentinel-2 **Level-2A processor Sen2Cor** is applied to Top-Of-Atmosphere (TOA) Level 1C ortho-image reflectance products. Sen2Cor Level-2A outputs are a scene classification image, aerosol and water vapor maps and a surface reflectance product.

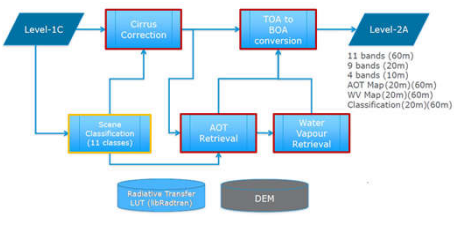
This poster presents an overview of the Level-2A product contents and up-to-date information about the data quality of the Level-2A products generated by Sentinel-2 PDGS since March 2018, in terms of Cloud Screening and Atmospheric Correction.

An outlook is given on the upcoming improvements available in the Sen2Cor development branch: the novel method using meteorological information from the Copernicus Atmosphere Monitoring Service (CAMS) and the on-going work on Scene Classification improvements.

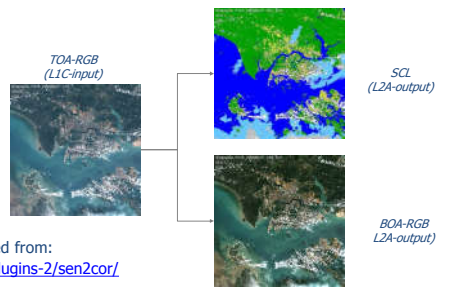
Sen2Cor Processor Overview

Two main modules :
 > Scene Classification (SCL)
 > Atmospheric Correction (AC)

Radiative Transfer Model:
 > **libRadtran**



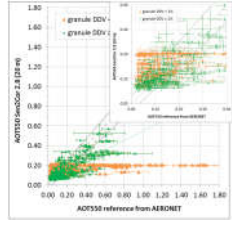
Sen2Cor can be run from:
 → Command line
 → Plugin of the Sentinel-2 Toolbox (**SNAP-S2TBX**).



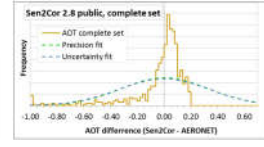
Sen2Cor processor can be downloaded from:
<http://step.esa.int/main/third-party-plugins-2/sen2cor/>

L2A Product Quality Overview

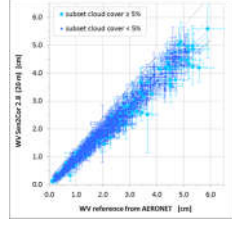
L2A Product Performance reported in the monthly L2A Data Quality Reports:
<https://sentinels.copernicus.eu/web/sentinel/data-product-quality-reports>



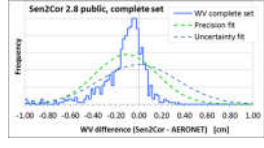
Legend:
 > solid lines: Accuracy requirement
 > Dashed line: Sen2Cor_output = Reference
 > Green triangles: Results for DDV algorithm
 > Orange triangles: fall-back processing
 > Linear trend line for DDV processing



Trend: Underestimation of higher AOT550 values (AOT > 0.3)
 Applied fallback processing (with configured start VIS=40 km) can give large outliers -> see Sen2Cor-CAMS prototype



Legend:
 > solid lines: Accuracy requirement
 > Dashed line: Sen2Cor_output = Reference
 > Blue Circles: Results for cloud cover < 5%
 > Cyan circles: Results for cloud cover >= 5%
 > Linear trend line



Trend: very slight underestimation of Water Vapour

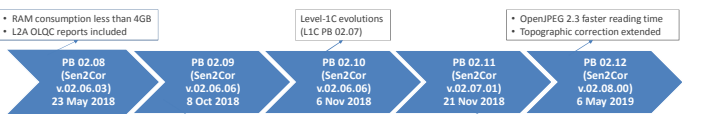
Aeronet data is used as absolute reference in the L2A validation
 The authors thank the PI investigators and their staff for establishing and maintaining the AERONET sites used in this investigation.

Sen2Cor Versions & Processing Baselines

General User's version:
 Version 2.5.5 released on March 19, 2018 (publicly available)
 Version 2.8.0 released on May 7, 2019 (publicly available)

Category of difference	Difference	L2A DHUS	L2A TOOLBOX
Product format	HHTML folder	Yes	No
Product format	Manifest	Generated by L2A packager	Generated by Sen2Cor
Product format	Product Quality Metadata	Generated by L2A OLQC	Copied from L1C
Radiometry at pixel level	Digital Elevation Model	PlanetDEM	e.g. SRTM
Radiometry at pixel level	JPEG2000 encoding library	Kakadu	OpenJPEG

S2 PDGS versions:
 Version 2.6.x released to ESA on April 24, 2018
 ...
 Version 2.7.1 released to ESA on November 8, 2018
 Version 2.8.0 released to ESA on February 20, 2019



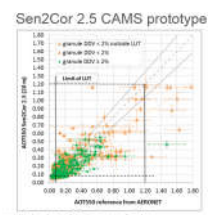
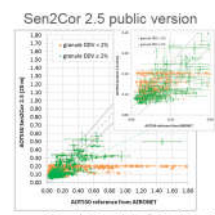
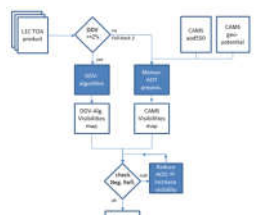
- RAM consumption less than 4GB
- L2A OLQC reports included
- Level-1C evolutions (L1C PB 02.07)
- OpenJPEG 2.3 faster reading time
- Topographic correction extended
- Single retrieval of atmospheric parameters (AOD & WV) at 20 m
- Resampling of 20 m to 60 m
- Scene Classification using ESA CCI Data package
- Spatial homogeneity improved: blue path radiance rescaling -> OFF
- Topographic correction under clouds disabled
- PDGS Optimizations (dual databases)

Worldwide L2A production since 14 December 2018

Future Evolutions

Future evolution for Atmospheric Correction

> Sen2Cor-CAMS prototype



Correlation plot of Sen2Cor AOT₅₅₀ retrieval at 20 m resolution versus AOT₅₅₀ reference from AERONET (25 AERONET sites)

Future evolutions for Scene Classification:

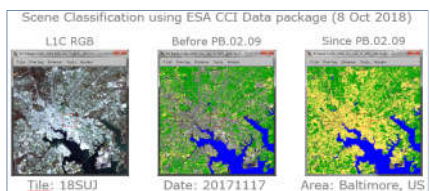
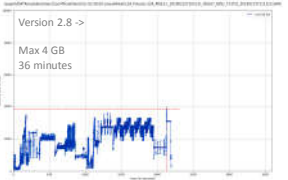
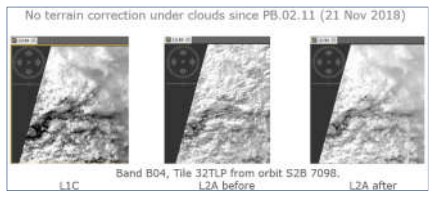
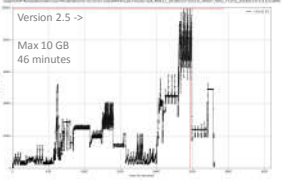
- > Dark area pixels class limited to: topographic shadows, tree shadows, building shadows
- > Improved casted shadow algorithm with support of next 30 m DEM
- > Limit false cloud detection on bright pixels
- > Limit false snow detection in clouds
- > Improve cloud shadow detection

Future evolutions for L2A Metadata:

- > Additional Quality Information parameters (not limited to):
 - o Source of Ozone content information, Ozone content, AOT retrieval method, CAMS source files, Mean AOD, Mean WVP, Very High SZA flag, Flag for ground elevation higher than 3 km, Flag for visibility less than 5 km, Maximum terrain slope, Percentage of DDV-pixels in the granule,...

Last Evolutions

RAM consumption & processing time optimizations with OpenJPEG 2.3 support for L1C bands reading



Recommendations

Recommendations:

- > Use of a Digital Elevation Model (DEM) in Sen2Cor to improve scene classification
- > Download and install ESA CCI auxiliary data package
- > Use the default configuration shipped with Sen2Cor v.02.08.00
- > Be cautious with L2A products acquired with Sun Zenith Angle (SZA) higher than 70°