# Some Experience Using SEN2COR

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**Sen2Cor** is the L2A-processor for **Sentinel-2** data. **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.

The atmospheric correction software **Sen2Cor** was implemented by TPZ-D, TPZ-F and DLR on behalf of ESA. TPZ-F and DLR have teamed up in order to provide the calibration and validation of the Level-2A processor Sen2Cor.

**Sen2Cor** can be obtained downloading the S2 Toolbox (http://step.esa.int/main/download) and following plugins installation procedure.

## Sen2Cor:

- Python application, Command line tool
- Processing configuration: XML-file
- Processing on granule level
- Terrain processing:
  DEM downloaded automatically
- Adjacency correction
- Cirrus removal option
- Empirical BRDF-correction option
- LUTs: rural aerosols

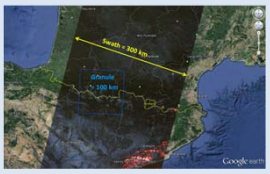


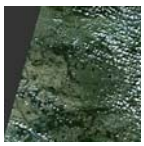

*Figure 1: Swath and Granule*
*Image source: Annex_1-S2A IOCR_image_quality_CNES_vf.pdf*

- Input: Level-1C ortho-image Top-Of-Atmosphere (TOA) reflectance products
- Output (60m, 20m, 10m):
  - Bottom-Of-Atmosphere (BOA) corrected reflectance
  - Aerosol Optical Thickness (AOT) map
  - Water Vapour (WV) map
  - Scene Classification (SC) map
  - Quality Indicators for cloud and snow probabilities

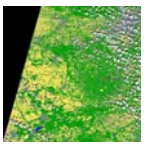

*Figure 2: SC color table*

## Level-2A processing: flat terrain

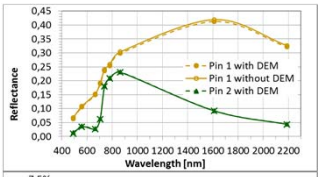
*TOA-RGB (L1C-input)*



*BOA-RGB (L2A-output)*

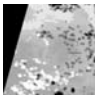


*Scene classification*

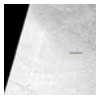




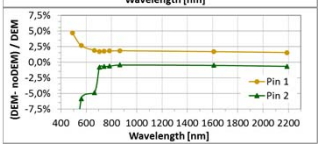
*DDV (dense dark vegetation)*



*AOT*



*WV*




Subset 9x9 km around sunphotometer

AERONET: AOT = 0.23
Sen2Cor: AOT = 0.198 ±0.001

AERONET: WV = 2.63 cm
Sen2Cor: WV = (2.46 ±0.09) cm

➔Good results for scene classification and atmospheric correction
➔sufficient DDV-pixels available
➔Processing without DEM differs less than 2% from processing with DEM in most bands.

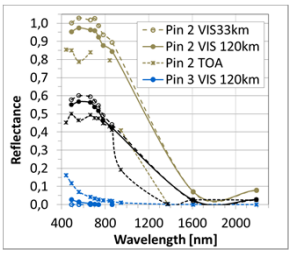
*Figure 4: Test site Belsk (Poland); August 14, 2015*

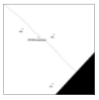
## Level-2A processing: configuration VIS_Update_Mode

*TOA-RGB (L1C-input)*

*BOA-RGB (L2A-output)*

*Scene classification*



*AOT*

*WV*

*Snow confidence*

*Cloud confidence*

Subset 9x9 km around sunphotometer

AERONET: AOT = 0.03
Sen2Cor: AOT = 0.23

AERONET: WV = 0.29 cm
Sen2Cor: WV = (0.33 ±0.07) cm

➔Good results for scene classification
➔Atmospheric correction is necessary

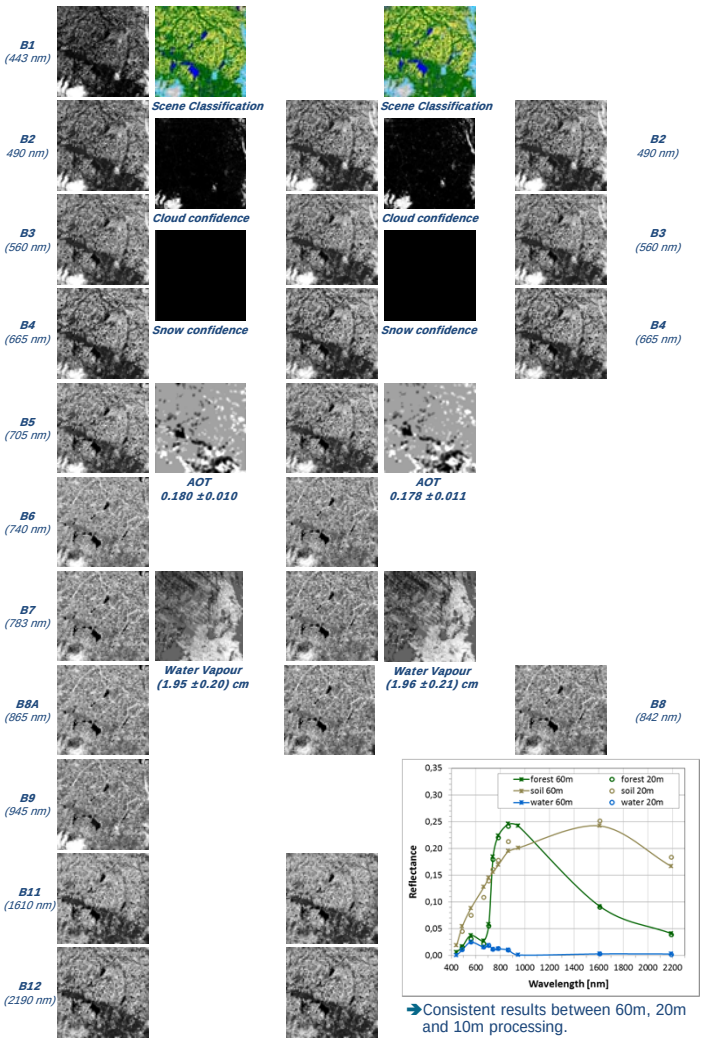
*VIS_Update_Mode = 1 (variable visibility)*

➔Aerosol estimation fails due to lack of DDV-pixels, but
➔Always clear air over Antarctica with low AOT

➔Good practise for processing atmospheric correction over Antarctica:
➔*VIS_Update_Mode = 0 (constant visibility)*
➔Process with visibility 120 km (AOT 550= 0.08)

*Figure 5: Test site McMurdo (Antarctica); February 06, 2016*

## 60m: BOA, quality  20m: BOA, quality  10m: BOA





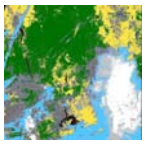


➔Consistent results between 60m, 20m and 10m processing.

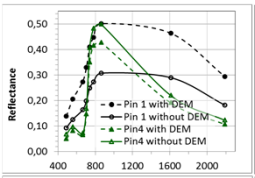
*Figure 3: Test site Demmin (Germany); April 13, 2015; L2A-product at different spatial resolution*

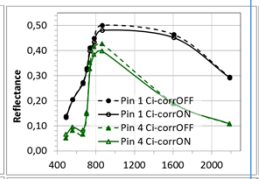
## Level-2A processing: cirrus correction

*BOA-RGB (L2A-output)*

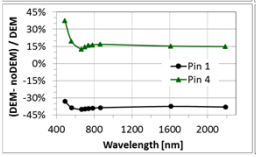


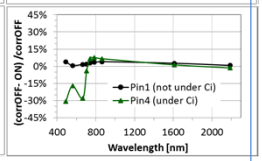
*Scene classification*




| processing | VIS [km] | AOT | WV [cm] |
|---|---|---|---|
| Without DEM CirrusCorr OFF (Granule Average) | 16.1 | 0.420 | 1.40 |
| With DEM CirrusCorr OFF (Granule Average) | 16.6 | 0.357 | 1.52 |
| With DEM CirrusCorr ON (Granule Average) | 54.0 | 0.133 | 1.56 |
| With DEM CirrusCorr ON (subset 9x9km) | | 0.143 | 1.50±0.01 |
| AERONET | | 0.100 | 1.75 |




➔Good results for scene classification and atmospheric correction
➔Good results for atmospheric correction with Cirrus correction ON, 5.1% DDV-pixels
➔Processing with DEM has larger effect on BOA-product than cirrus correction

*Figure 6: Test site Canberra (Australia); January 01, 2016*

## Outcome and credits

Scene classification works correctly with Sen2Cor.
Atmospheric correction works accurate, if DDV pixels are existing in the granule.
Aerosol estimation fails, if there are no DDV-pixels in the image.

We thank the PI investigators and their staff for establishing and maintaining the AERONET sites used in this investigation.