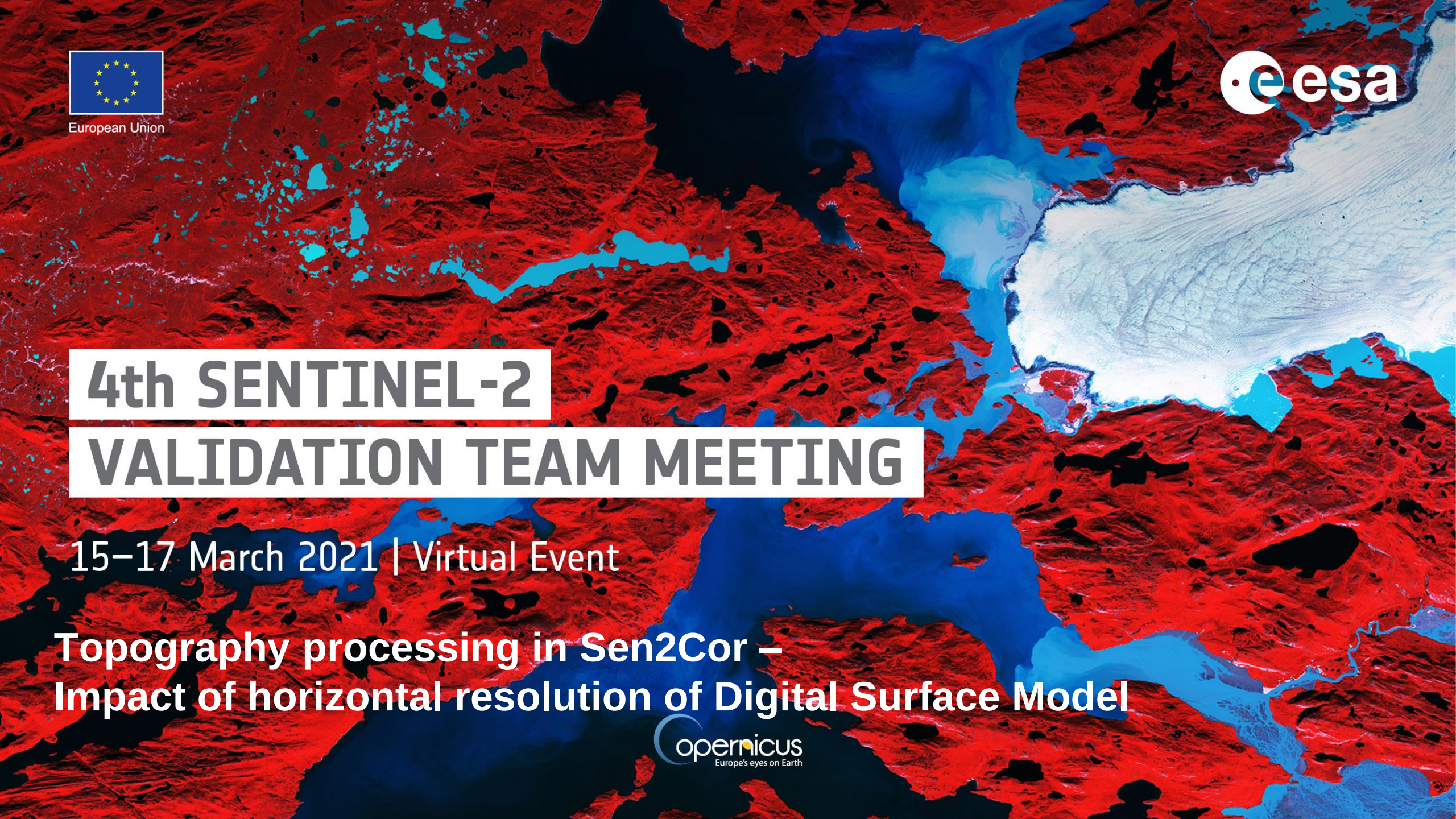
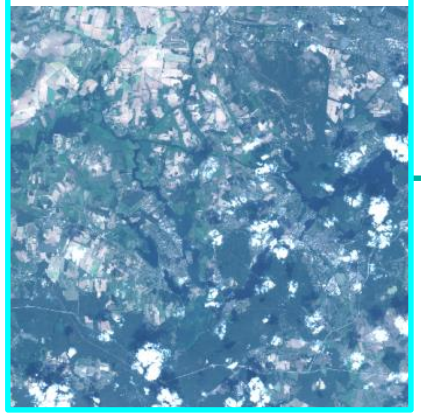

European Union
esa
4th SENTINEL-2
VALIDATION TEAM MEETING
15–17 March 2021 | Virtual Event
Topography processing in Sen2Cor –
Impact of horizontal resolution of Digital Surface Model
opernicus
Europe's eyes on Earth

Outline

1. Sen2Cor processor overview
2. Digital Elevations Models
3. Sen2Cor processing with topography
4. Differences between Copernicus DEM and PlanetDEM
5. Impact of horizontal resolution of DEM
6. References

Sen2Cor processor overview

Level-1C



CCI-data

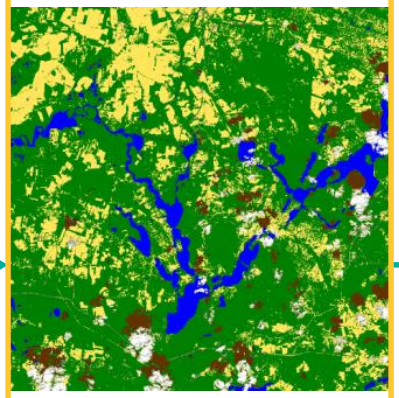
DEM

Radiative Transfer LUT (libRadtran)

optional

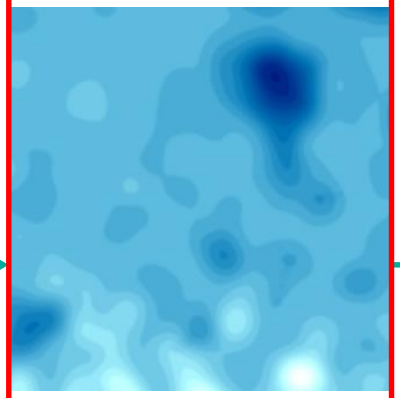
Cirrus Correction

Scene Classification (11 classes) (20m)



Series of threshold tests on L1C spectral bands, band ratios and indices

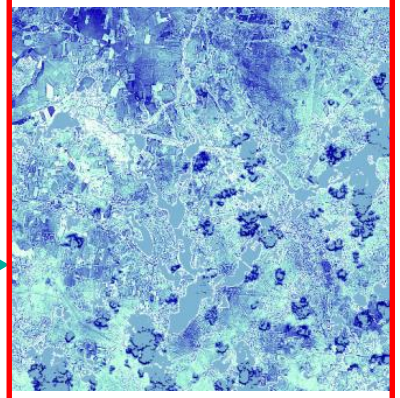
AOT Retrieval (20m)



DDV-algorithm

Fall-back: VIS fixed

Water Vapour Retrieval (20m)



Atmospheric Pre-corrected Differential Absorption Algorithm (APDA)

- terrain correction
- adjacency corr.
- BRDF correction

TOA to BOA conversion

European Union

esa

Level-2A

10m:
- 4 bands
- AOT, WV maps

20m (60m):
- 9 (11) bands
- SCL, AOT, WV
- cloud probability
- snow probability

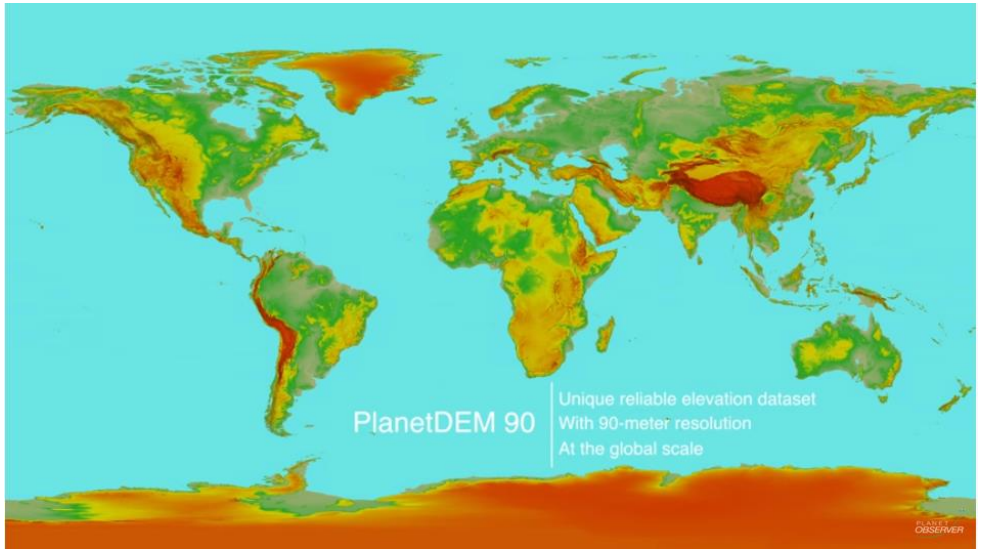
Digital Elevation Models

Source of Earth topography information inside S2PDGS:

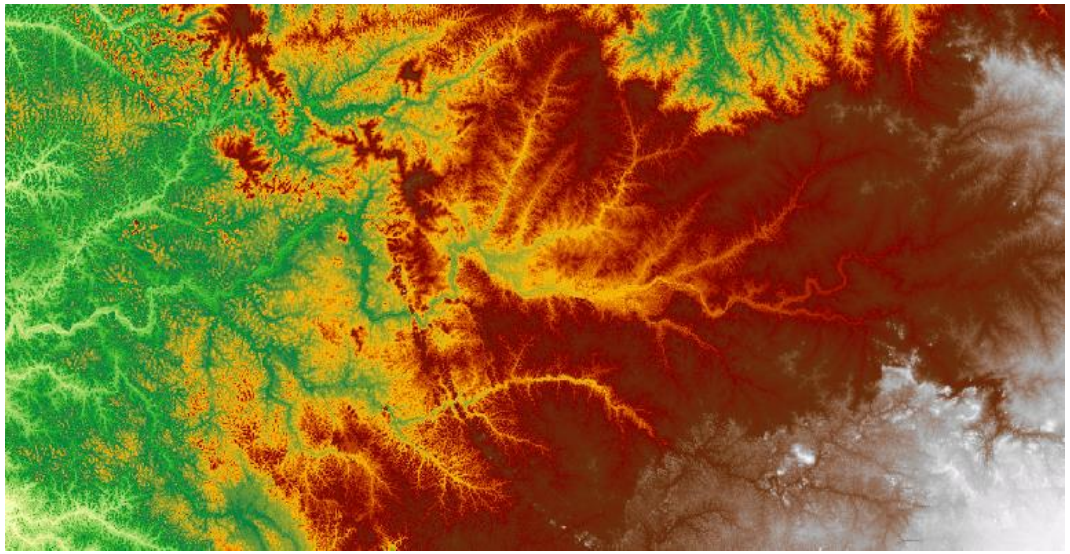
- Digital surface model "PlanetDEM 90" from Planet Observer, 90-meter planimetric resolution, based on SRTM data filled and corrected for 40% of Earth surface.

Main source of Earth topography information for users:

- Original SRTM 90m DEM (V4 from CGIAR)



PlanetDEM 90 [1]



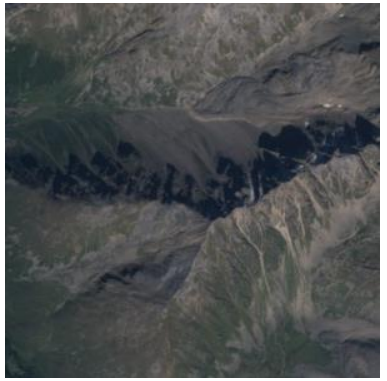
SRTM 90m Digital Elevation Database v4.1 [2]

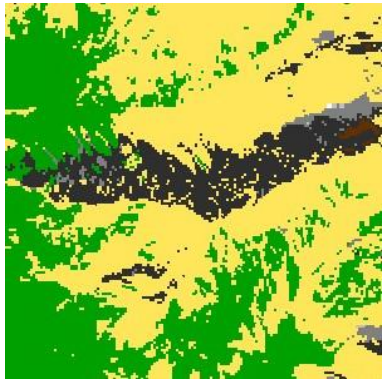
DEM usage in Sen2Cor

In scene classification module:

- Topographic shadows computation

L1C TOA





L2A SCL

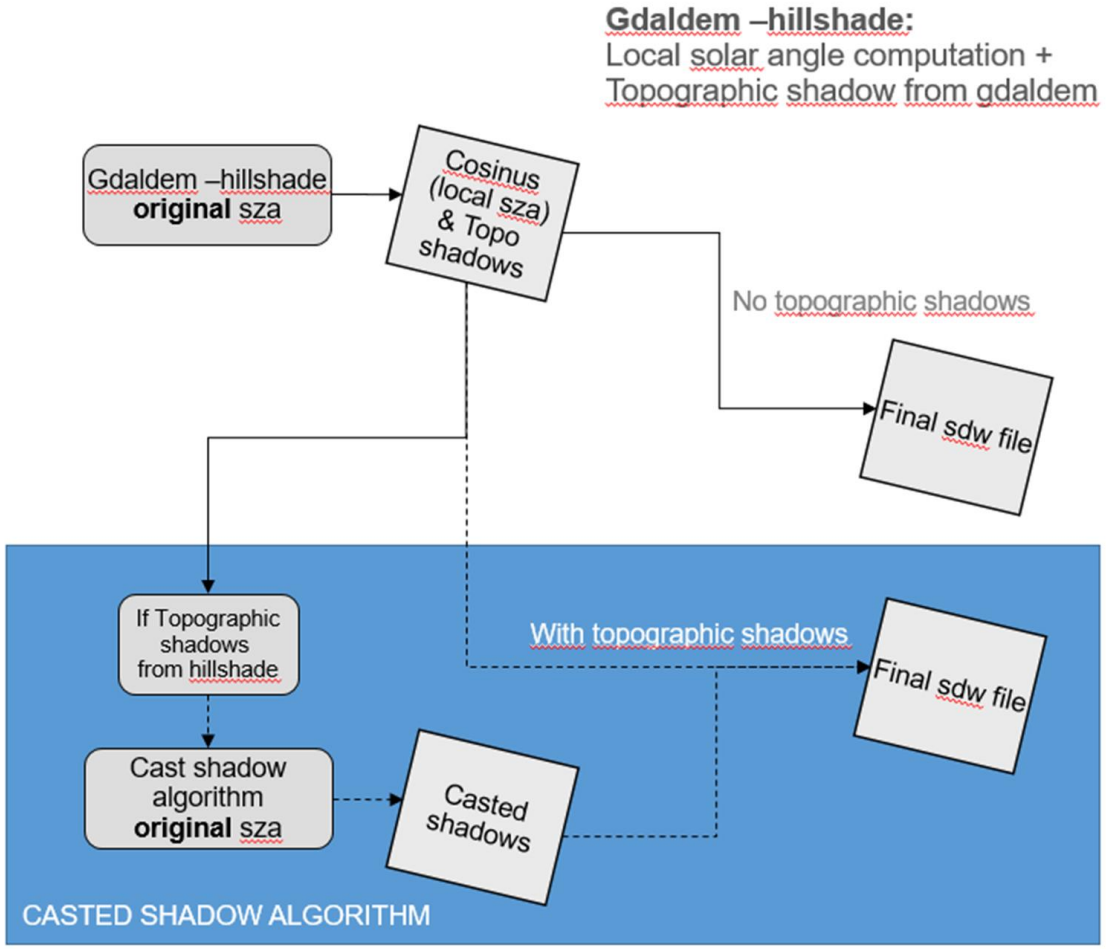
In atmospheric correction module:

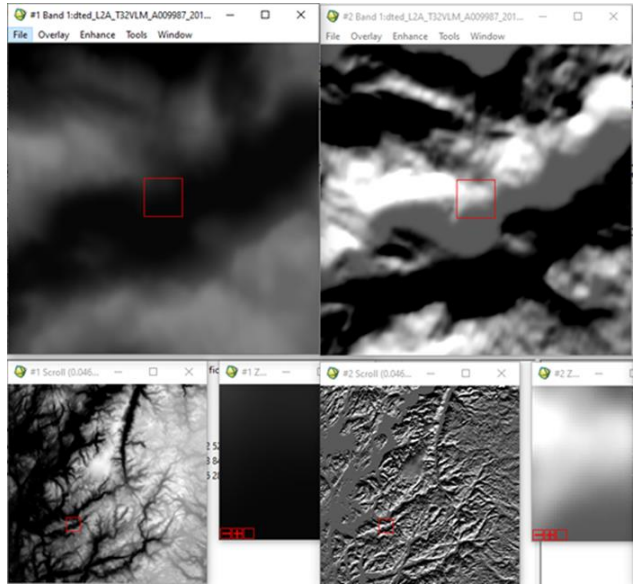
- Altitude
- Terrain correction

L1C TOA

L2A SR

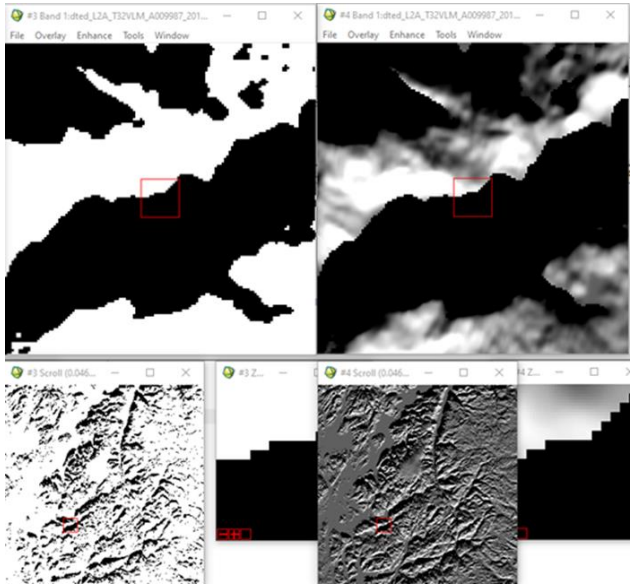
Sen2Cor processing with topography





Current versions 2.8 & 2.9

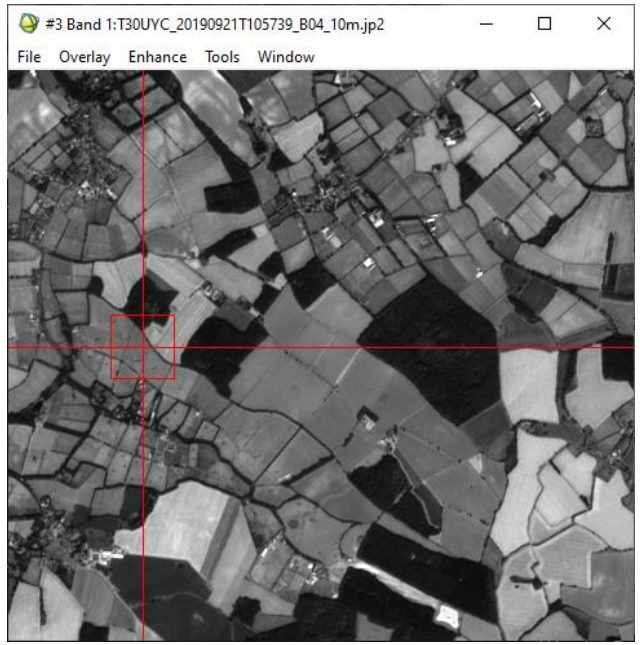
Next version 2.10



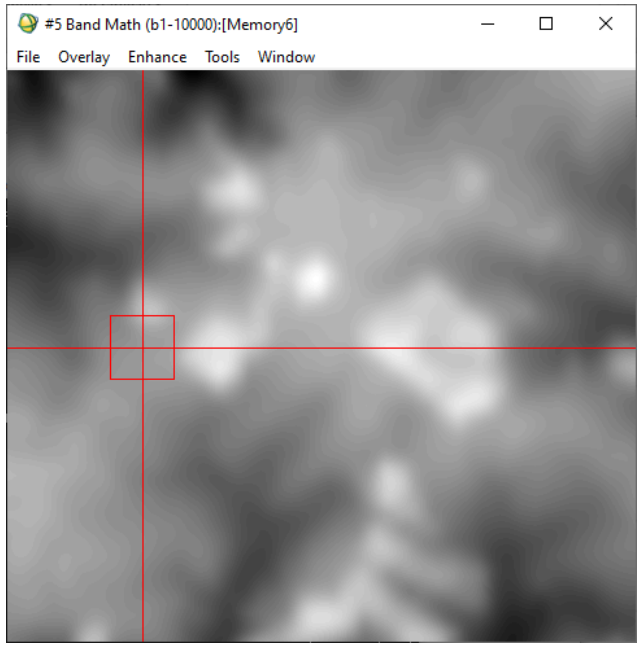
Differences between Copernicus DEM and PlanetDEM

- Impact of higher resolution DEM on terrain correction (forests)

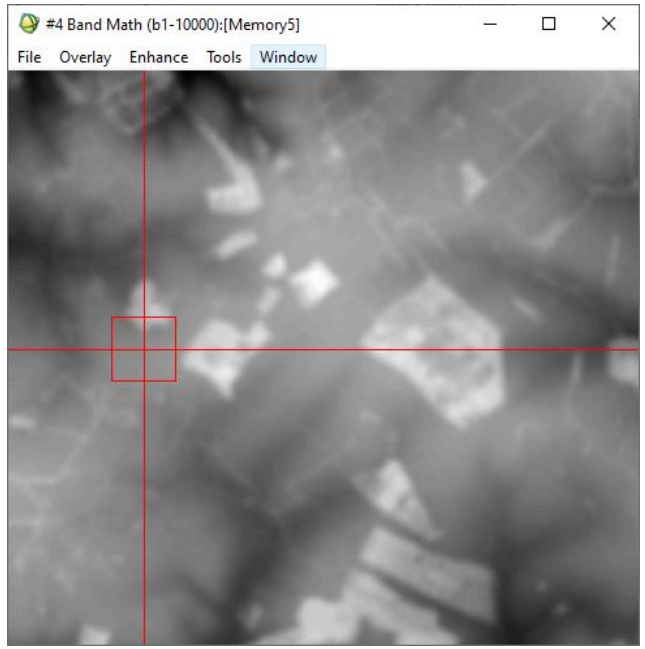
England tile: 30UYC



L2A B04
no terrain correction



Copernicus DEM 90m
internal resampling at 10m

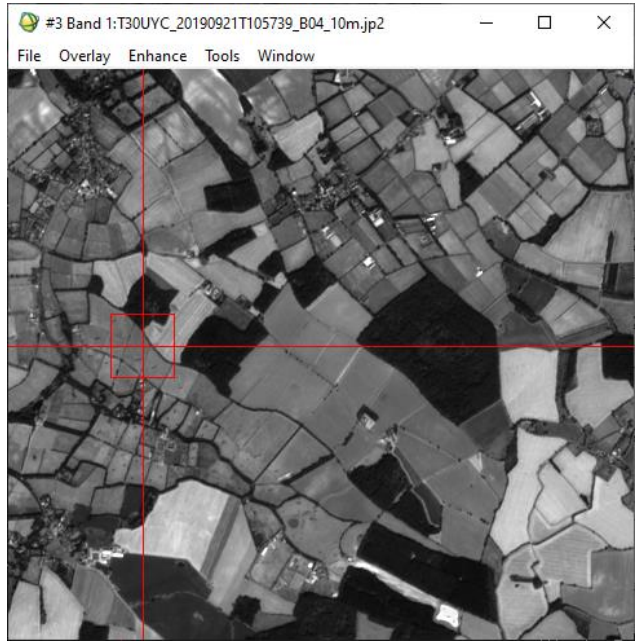


Copernicus DEM 30m
internal resampling at 10m

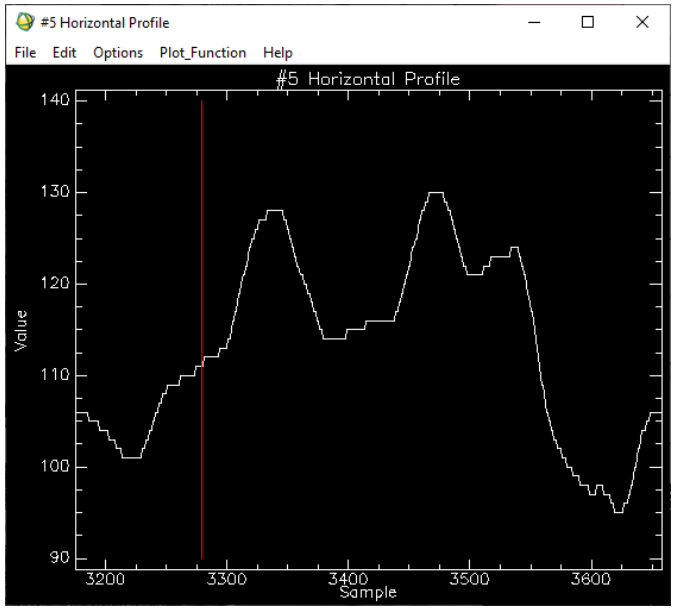
Differences between Copernicus DEM and PlanetDEM

- Impact of higher resolution DEM on terrain correction (forests)

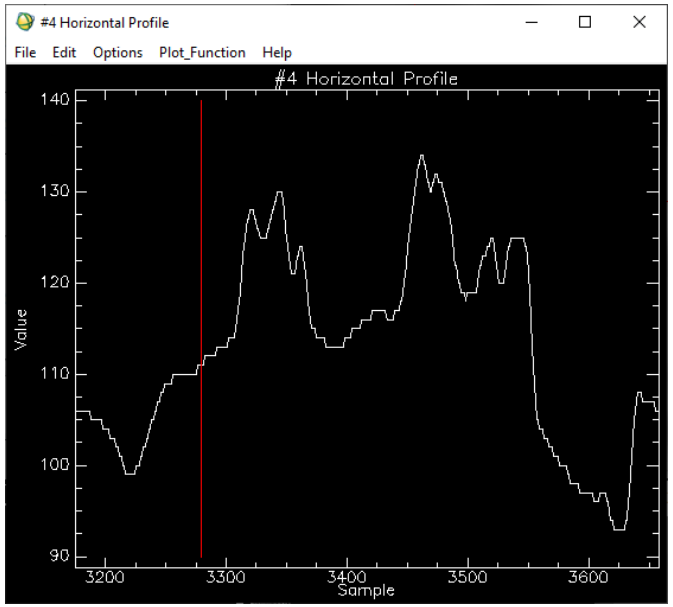
England tile: 30UYC



L2A B04
no terrain correction



Copernicus DEM 90m
X-axis profile

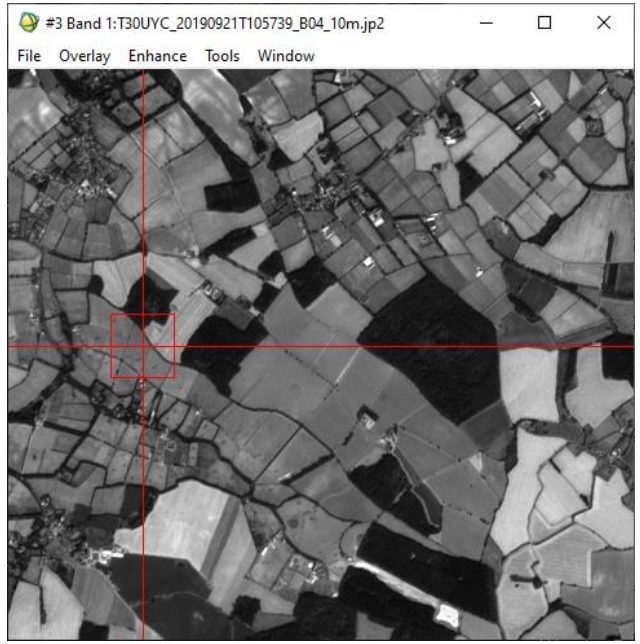


Copernicus DEM 30m
X-axis profile

Differences between Copernicus DEM and PlanetDEM

- Impact of higher resolution DEM on terrain correction (forests)

England tile: 30UYC



L2A B04
no terrain correction

L2A B04 terrain corrected with Copernicus DEM 90m

L2A B04 terrain corrected with Copernicus DEM 30m

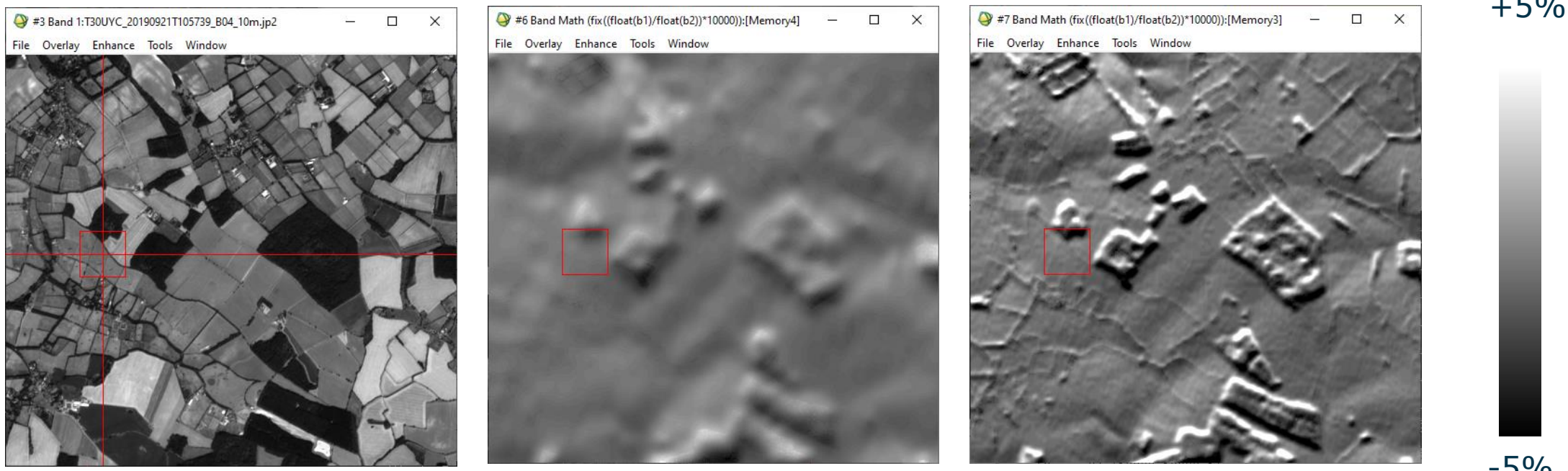
Differences between Copernicus DEM and PlanetDEM

- Impact of higher resolution DEM on terrain correction (forests)

England tile: 30UYC

Stdev
3.3%

Stdev
5.7 %



L2A B04
no terrain correction

Ratio of
L2A B04 terrain corrected with Copernicus DEM 90m / Ref

Ratio of
L2A B04 terrain corrected with Copernicus DEM 30m/ Ref

Differences between Copernicus DEM and PlanetDEM

- Impact of higher resolution DEM on terrain correction (forests)

  England tile: 30UYC

  Lessons learned:

  <u>Advantages:</u>
  More precise definition of forest edges
  Better definition of high resolution variations of terrain
  (spatial frequencies in the range of 1/90 m to 1/30m)

  <u>Drawbacks:</u>
  Risk of overcorrection in case of DEM/image geolocation inaccuracy

  Terrain correction is stronger but more localized

Differences between Copernicus DEM and PlanetDEM

- Impact of higher resolution DEM on terrain correction (mountains)

  Alps tile: 32TNS

  Lessons learned:

  <u>Advantages:</u>
  More accurate definition of crests
  Better definition of high resolution variations of terrain
  (spatial frequencies in the range of 1/90 m to 1/30m)

  <u>Drawbacks:</u>
  Risk of overcorrection of steep slopes for very high solar local angles
  Risk of overcorrection in case of geolocation inaccuracy

  Terrain correction is stronger but more localized

References

- [1] PlanetDEM90 from PlanetObsever https://www.planetobserver.com/
- [2] Jarvis A., H.I. Reuter, A. Nelson, E. Guevara, 2008, Hole-filled seamless SRTM data V4, International Centre for Tropical Agriculture (CIAT), available from https://srtm.csi.cgiar.org
- [3] "Vectorial algebra algorithms for calculating terrain parameters from DEMs and solar radiation modelling in mountainous terrain", JAVIER G. CORRIPIO, Int. J. Geographical Information Science, 2003, vol.17, no 1, 1-23."
- [4] Copernicus Digital Elevation Model. Product Handbook. AO/1-9422/18/I-LG. 28.Nov. 2019. v1.0

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

Thank you for attention !

Topography processing in Sen2Cor – Impact of horizontal resolution of Digital Surface Model

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Sentinel-2 Mission Performance Centre

Level-2A Expert Support Laboratory