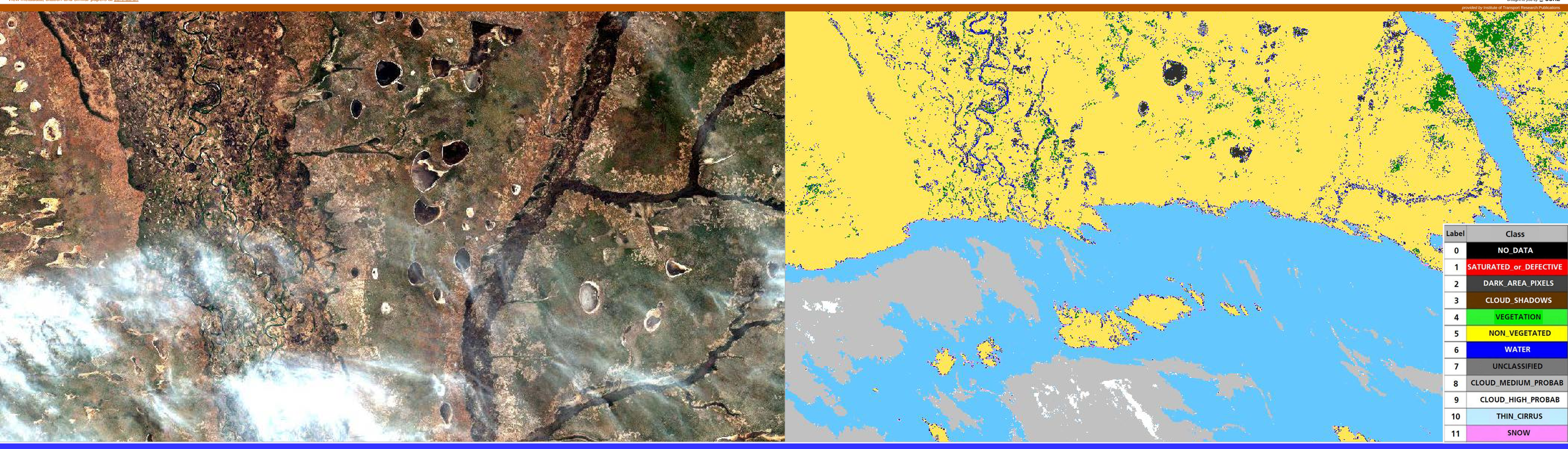

German Aerospace Center
Earth observation center

Protocol for validation and quality assessment of L2A-products
Validation activities for Sentinel-2 and Landsat-8

Summary

The presentation reports on the methods and protocols used for validation of L2A-products on basis of reference data (AERONET sites) and provides examples of the final statistics.

Validation should provide simple plots and statistical measures to characterize the performance of atmospheric correction algorithms.

Validation of valid and invalid pixels classification relies on visual interpretation supported by statistical methods to ensure representativeness.

Validation based on AERONET sites must be supplemented by using surface reflectance measurements provided by ad-hoc-campaigns and permanently operating stations (like

RADCALNET for L2A-targets).

Validation data sets

Should cover all continents and different:
- Atmospheric conditions (AOT, WV, aerosol type)
- Latitudes (various solar angles & seasons)
- Topography and altitudes
- Land cover types (agricultural area, forests, water bodies, arid area, urban area, deserts)

L1C-data selection criteria for SCL-Validation:
- Data set has to cover all classes

L1C-data selection criteria for AOT / WV /SR validation on AERONET [1] sites:
- sunphotomer measurements are available within overpass time ±1 hour
- Data set duplicated with regard to cloudiness
  1. Including all data (all cloud coverages)
  2. Limited to data with cloud cover <5%

Reference data processing

- Spectral interpolation to AOT_{550} by a (geometric) fit $AOT_{AERONET} = a0 \cdot \lambda_{AERONET}^{a1} + a2$

$$AOT_{550} = a0 \cdot 0.55^{a1} + a2$$

- Temporal co-location: favourable linear interpolation to satellite overpass time over averaging over any time window

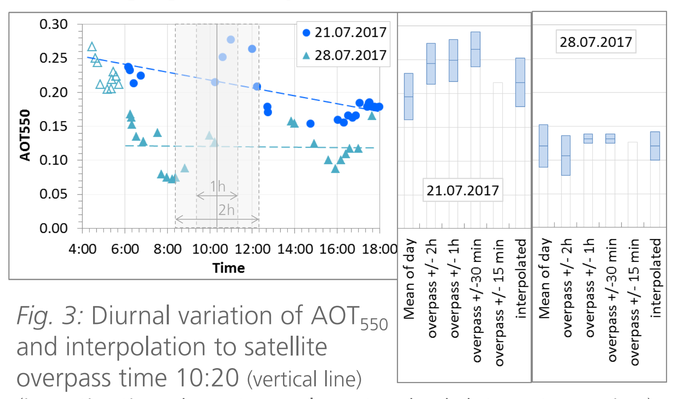

Fig. 3: Diurnal variation of AOT_{550} and interpolation to satellite overpass time 10:20 (vertical line) (investigations how to apply a standard data cut ongoing)

Validation of Scene Classification (SCL)

Cloud and shadow screening is a critical step prior to the atmospheric correction of all optical satellite data. Generally SCL algorithms allow to detect and separate valid (land, water) from invalid pixels (clouds, shadows, etc.) for earth observation.

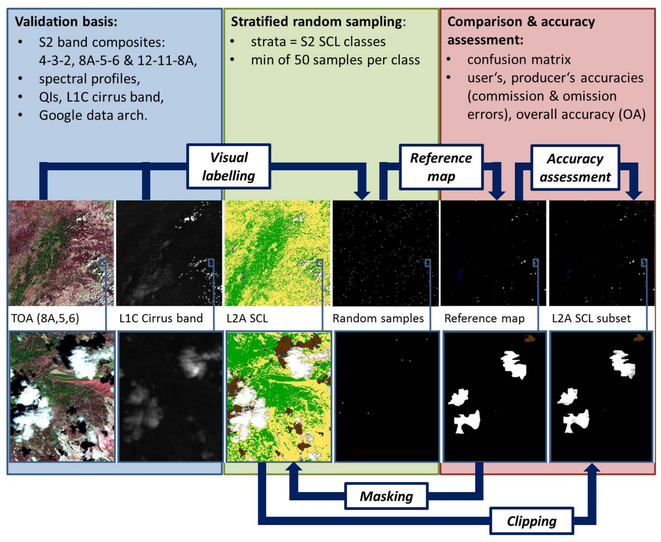

Fig. 1: Method for Quality assessment of SCL

Tab. 1: Example of accuracy assessment for Sen2Cor SCL on Sentinel-2A image (Barrax, Spain, May, 19th 2017)

Class name	user's accuracy	producer's accuracy	OA
saturated_or_defective	0	none	
dark_area_pixels	0,06	25,00	
clouds_shadows	99,99	56,12	
vegetation	93,33	99,41	
non_vegetated	97,80	98,69	
water	99,96	55,64	
unclassified	6,34	26,12	
cloud_medium_probability	5,68	29,67	
cloud_high_probability	99,75	92,66	
thin_cirrus	0	none	
snow	none	none	
			83,6
Pixel validated:			104803
Simplified statistics:			
Valid pixels (Land-Water)	98,19	84,59	
Invalid pixels (Others)	99,59	98,33	
			91,4

Validation of AOT_{550} and WV product

- Average over 9km x 9km area around sunphotometer, direct compared with sunphotometer data provided by AERONET [1]
- Mask applied for averaging: vegetation or non-vegetated pixels
- Negligible dependency on co-location angle

[Poster De los Reyes et.al]

Report:

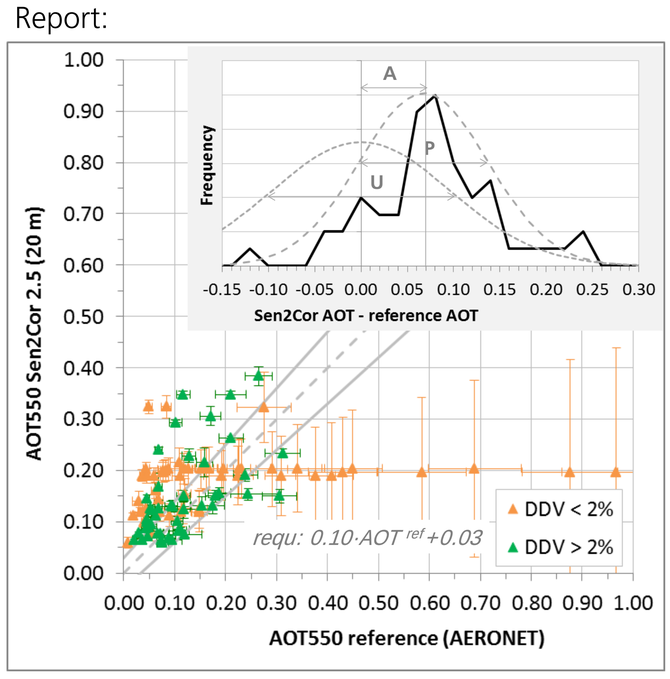

Fig. 2: Correlation plots of AOT from satellite data over reference AOT. Dotted and dashed distributions show what is accuracy, precision and uncertainty.

Tab. 2: Statistical measures to report on algorithm performance

	AOT_{550} complete	AOT_{550} (only DDV)	WV
Total No. of products	99	55	68
within requirement	24	14	67
R^2	0.09	0.37	0.99
Accuracy (A)	0.02	0.07	-0.09 cm
Precision (P)	0.16	0.07	0.17 cm
Uncertainty (U)	0.16	0.10	0.19 cm

Validation of Surface Reflectance Product (SR)

Is based on pixel-by-pixel comparison with AERONET [1] corrected (surface reflection) data.

Report:
- Plots of A, P and U per band computed per 0.02-bins [2]
- Plot of overall values of A, P and U per band for entire SR range relative to average SR (Fig. 4)
- Statistics on conversation of spectral shape (Investigations are ongoing)

Accuracy (A): mean difference to reference value
Precision (P): rms around mean value
Uncertainty (U): rms around reference value

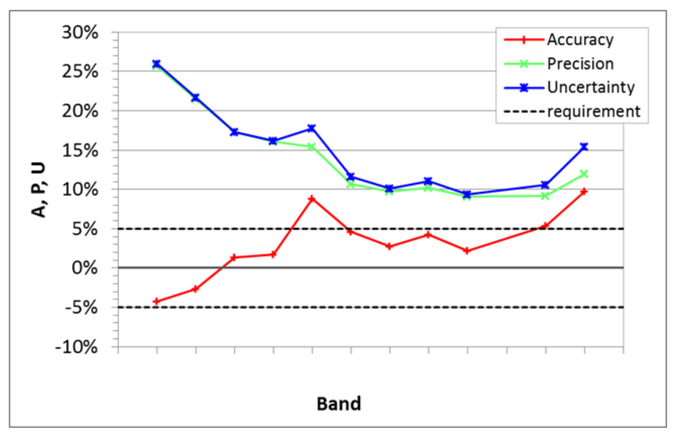

Fig. 4: Plot of overall values of A, P and U per band for entire SR range relative to average SR per band
[based on APU-plots per band provided by Eric Vermote]

References:
1. Holben B. N. et al, 1998, Remote Sens. Environ., 66, 1-16
2. Claverie M. et al, 2015, Remote Sens. Environ., 169, 390–403

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