Processing Sentinel-2 data with ATCOR

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Background

- **ATCOR** [3] is a widely used atmospheric correction tool which can process data of many optical. satellite sensors, for instance Landsat, Sentinel-2, SPOT and RapidEye.
- Atmospheric correction includes correction of molecular absorption, molecular scattering and aerosol effects. Largest uncertainties are caused by spatial and temporal variability of aerosols.
- Application of atmospheric correction algorithms requires knowledge about the uncertainty of the correction process. Validation of aerosol optical thickness and water vapor column are important for atmospheric correction.
- **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.

Table 1:
AOT(550 nm) validation results for Landsat and RapidEye satellites [2]:

	Accuracy ±sdev	samples	Max. dif.
Landsat	0.038 ± 0.024	14	0.09
5 TM	0.050 ± 0.006	2	0.05
7 ETM	0.046 ± 0.034	5	0.09
8 OLI	0.030 ± 0.016	7	0.05
RapidEye	0.038 ± 0.016	17	0.07
all together	0.038 ± 0.019	31	0.09

- About 1/3 of the samples perform with the AOT uncertainty better than 0.02 and about 2/3 perform with AOT uncertainty better than 0.05.

Processing Sentinel-2 data with ATCOR

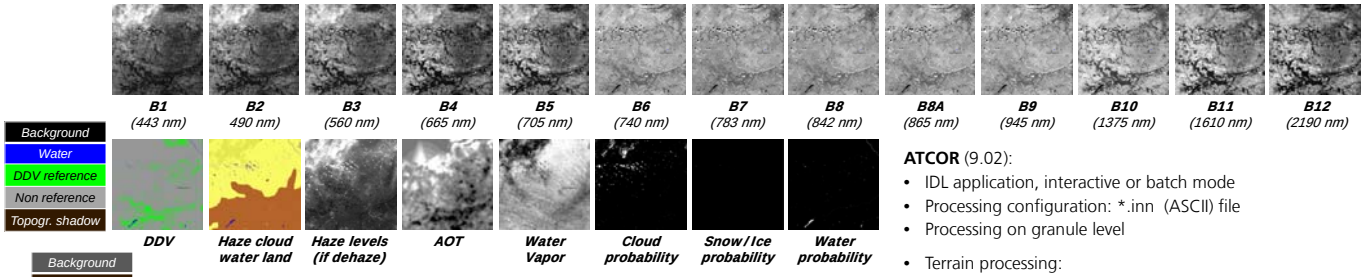


Figure 1: ATCOR outputs, 20 m spatial resolution, Test site Belsk (Poland); August 07, 2015

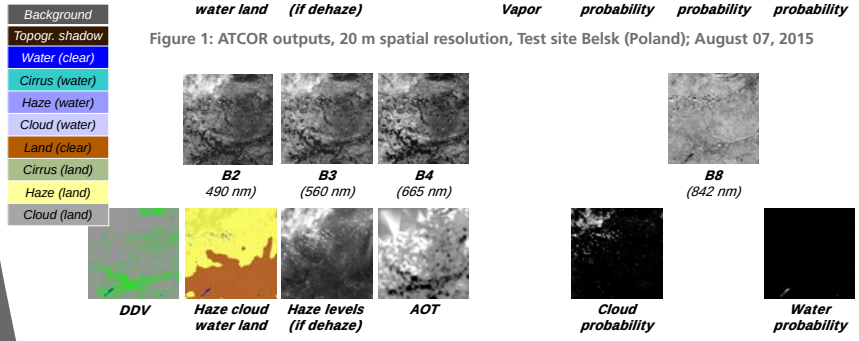
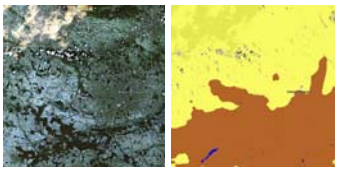


Figure 2: ATCOR outputs, 10 m spatial resolution, Test site Belsk (Poland); August 07, 2015

ATCOR (9.02):

- IDL application, interactive or batch mode
- Processing configuration: *.inn (ASCII) file
- Processing on granule level
- Terrain processing:
  DEM provision and preparation by user
- Adjacency correction
- Cirrus removal option
- Haze removal option
- De-shadowing option
- Empirical BRDF-correction option
- LUTs: MODTRAN model rural
- Input: Level-1C ortho-image Top-Of-Atmosphere (TOA) radiance
- Output (20m, 10m) :
- Bottom-Of-Atmosphere (BOA) corrected reflectance
- AOT550 nm map
- [Water Vapour (WV) map]
- Dense Dark Vegetation (DDV) map, Haze-Cloud-Water map
- Quality Indicators for cloud, snow and water probabilities

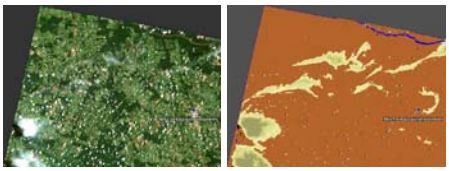
Processing results and Conclusions



BOA-RGB (L2A-output) Haze – cloud –water - land

processing	VIS [km]	AOT	WV [cm]
10m, HazeCorr ON (Granule Average)	33.5	0.241	
10m, no HazeCorr (Granule Average)	32.6	0.250	
20m, CirrusCorr ON (Granule Average)	47.5	0.179	2.75
20m, HazeCorr ON (Granule Average)	45.6	0.179	2.47
20m, no HazeCorr (Granule Average)	43.9	0.191	2.47
No HazeCorr (subset 9x9km²)		0.244^{10m}	2.62^{20m}
AERONET [1]	31.0	0.248	2.54

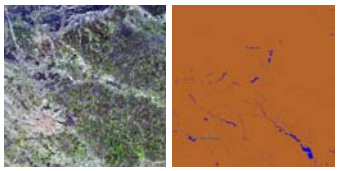
Figure 3: Test site Belsk (Poland); August 07, 2015



BOA-RGB (L2A-output) Haze – cloud –water - land

processing	VIS [km]	AOT	WV [cm]
10m, HazeCorr ON (Granule Average)	33.5	0.219	
10m, no HazeCorr (Granule Average)	33.5	0.236	
20m, CirrusCorr ON (Granule Average)	47.5	0.171	5.23
20m, HazeCorr ON (Granule Average)	42.3	0.184	4.78
20m, no HazeCorr (Granule Average)	36.8	0.211	4.78
20m, CirrusCorr ON (subset 9x9km²)		0.173	5.28
AERONET [1]	43.2	0.181	5.03

Figure 4: Test site Alta Floresta (Brazil); February 22, 2016



BOA-RGB (L2A-output) Haze – cloud –water - land

processing	VIS [km]	AOT	WV [cm]
20m, no HazeCorr (Granule Average)	73.4	0.119	1.09
20m, No HazeCorr (subset 9x9km²)		0.125	1.14
AERONET [1]	55.0	0.153	1.09

Figure 5: Test site Bucharest (Romania); March 02, 2016

- **ATCOR is ready for processing Sentinel-2 data.**
- **Aerosol AOT550 accuracy is ca. 0.03, similar to validation results for Landsat- and RapidEye.**
- **Water vapor accuracy is ca 5%.**

Acknowledgement:

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

References: (1) Holben, B.N., Eck, T.F., Slutsker, I.,Tanré, D., Buis, J.P., Setzer, A., Vermote, E., Reagan, J.A., Kaufman, Y.J., Nakajima, T., Lavenu, F., Jankowiak, I., Smirnov, A. (1998) AERONET—A Federated Instrument Network and Data Archive for Aerosol Characterization. Remote Sensing of Environment 66(1), pp. 1-16
(2) Pflug, B., Main-Knorn, M., Makarau, A. and Richter, R. (2015) Validation of aerosol estimation in atmospheric correction algorithm ATCOR. In: Proceedings of International Symposium on Remote Sensing of Environment (ISRSE) 2015, XL-7 (W3), Seiten 677-683. Copernicus Publications. 36th International Symposium on Remote Sensing of Environment (ISRSE), 11.-15. Mai 2015, Berlin, Germany. DOI: 10.5194/isprsarchives-XL-7-W3-677-2015.
(3) Richter, R., and D. Schläpfer, (2013) Atmospheric / topographic correction for satellite imagery: ATCOR-2/3 User Guide, DLR IB 565-01/13, Wessling, Germany