LPVE23 - WORKSHOP ON LAND PRODUCT VALIDATION AND EVOLUTION

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Sentinel-2 web page @ ESA

Time series noise of Copernicus Sentinel-2 operational L2A-Products of year 2022

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INTRODUCTION

Copernicus Sentinel-2 is the main European land surface observing mission. The Sentinel-2 mission consists of a constellation of two polar orbiting satellite units both equipped with an identical optical imaging sensor MSI (Multi-Spectral Instrument). Operational Sentinel-2 Level-2A (L2A) data contain Bottom-of-Atmosphere (BOA) surface reflectance (SR) products together with Aerosol Optical Thickness at 550 nm (AOT), integrated Water Vapour (WV) and Scene Classification (SCL) maps. They are generated with atmospheric correction processor Sen2Cor [1]. In this presentation we study SR time series smoothness, for several test sites, using L2A products from year 2022. These data are equivalent to reprocessed Sentinel-2 Collection-1 data. So, the noise of that time series is used as an indicator of data quality of the reprocessed products.

DATA AND METHODOLOGY

Granule	Site	Location	Cimate zone	Type	DDV; CAMS	U (AOT_{DDV})	U (AOT_{CAMS})	U (WV)
T11SLV	Bakersfield	US (CA)	Midlat. N	vegetated	77 ; 10	0.10	0.03	1.8 kg/m²
T34TFL	Thessaloniki	Greece	Midlat. N	vegetated	26;	0.05		2.6 kg/m²
T31TGJ	OHP Observatoire	France	Midlat. N	vegetated	37;	0.06		0.8 kg/m²
T30TUM	Valladolid	Spain	Midlat. N	vegetated	19; 17	0.06	0.06	1.5 kg/m²
T52SDG	Gangneung_WNU	Korea	Midlat. N	vegetated	39; 7	0.10	0.12	1.6 kg/m²
T18LVM	Huancayo-IGP	Peru	Tropical	vegetated	20; 18	0.08	0.05	0.7 kg/m²
T31QGF	Tamanrasset_INM	Algeria	Subtrop. N	arid	; 36		0.14	1.1 kg/m²
T37QEE	KAUST_Campus	Saudi Arabia	Subtrop. N	arid	; 45		0.13	5.3 kg/m²
T14TMT	NEON_WOOD	US (ND)	Boreal	tmp. Snow	29; 18	0.03	0.04	1.5 kg/m²
T23VMH	Narsarsuaq	Denmark	Polar	tmp. snow	48; 17	0.09	0.12	2.2 kg/m²

Data selection:

- AERONET sites with largest time series available at in 2022
- BOA processing doesn't accounted for BRDF-effects. (Sen2Cor ATBD [1])
  → only data from the same relative orbit
- Time series noise [2]:

$$noise = \sqrt{\frac{\sum_{i=1}^{n-2}\left(\rho_{i+1} - \frac{d_{i+1}-d_i}{d_{i+2}-d_i}(\rho_{i+2}-\rho_i) - \rho_i\right)^2}{n-2}}$$

RESULTS

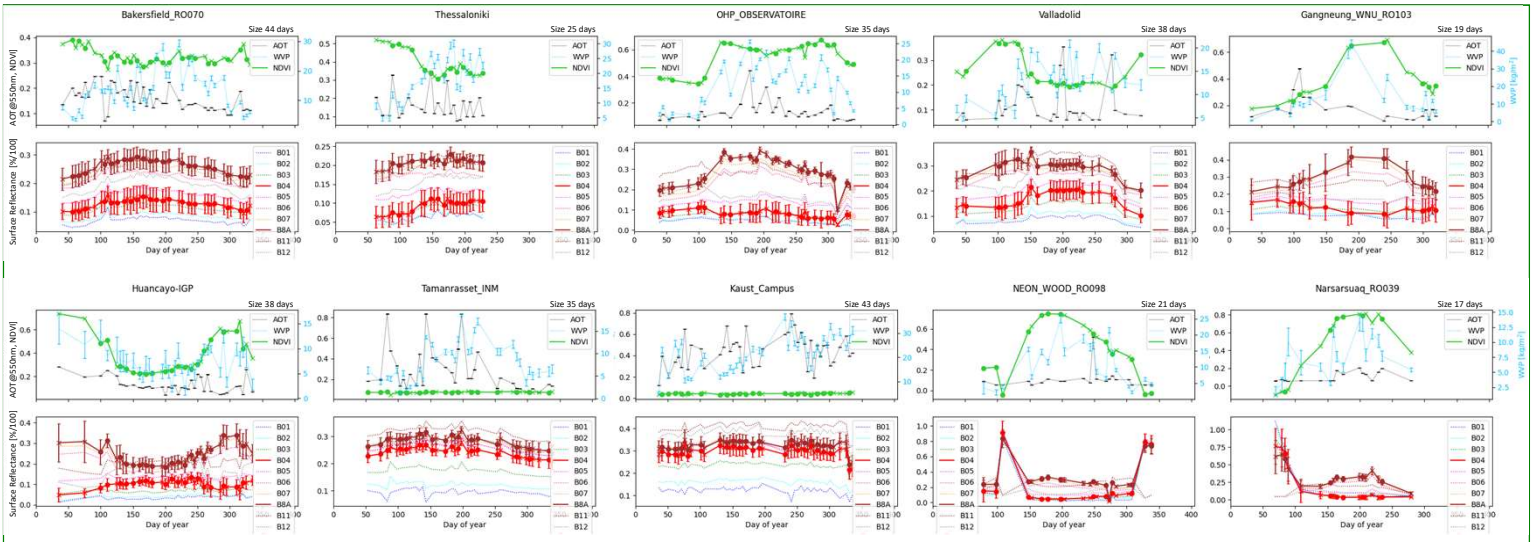

Fig. 1: SR time series for vegetated, arid and temporary snow covered sites. The results are plotted with spectral bands at 20m spatial resolution averaged over ROI of 9x9 pixels (pixel position x:=200, y:=280). Error bars are the variation in the ROI. Acquisitions of S2A and S2B are marked different by x (S2A) and circle (S2B) for B04, B8A.

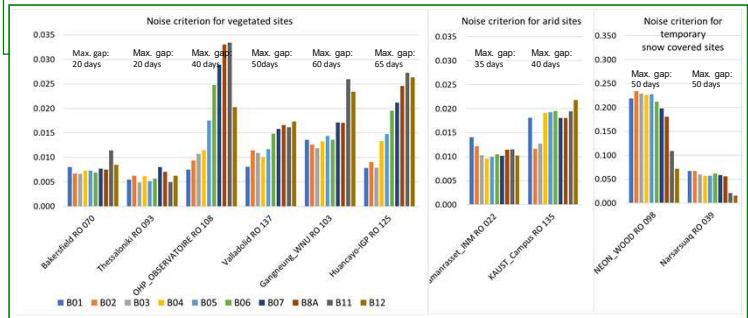

Fig. 2: Noise criterion over SR time series for vegetated, arid and temporary snow covered sites. The results are plotted with spectral bands at 20m spatial resolution averaged over 9x9 pixels. Note the different scale for temporary snow covered sites. Numbers give the maximum time gap between (day i) and (day i+2).

CONCLUSIONS

- Sen2Cor atmospheric correction smooth out large variations of AOT- and WVP
- No systematic bias between SR retrievals from S2A and S2B data
- No larger noise of time series when relying on CAMS data as fallback-option
- Noise comparable for vegetated and arid sites, higher with temporal snow cover
- Study on limited data amount, to be continued

[1] S2 Level-2A Algorithm Theoretical Baseline Document (ATBD) version 2.10, https://step.esa.int/thirdparties/sen2cor/2.10.0/docs/S2-PDGS-MPC-L2A-ATBD-V2.10.0.pdf (accessed 17.06.2022).
[2] Doxani, G., et al. (2023). "Atmospheric Correction Inter-comparison eXercise, ACIX-II Land: An assessment of atmospheric correction processors for Landsat 8 and Sentinel-2 over land." Remote Sensing of Environment 285: 113412.

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