LPVE23 - WORKSHOP ON LAND PRODUCT VALIDATION AND EVOLUTION

Intercomparisons of sentinel 3 SYNERGY surface directional reflectance - First Results and plans for the OPT-MPC routine service evaluation

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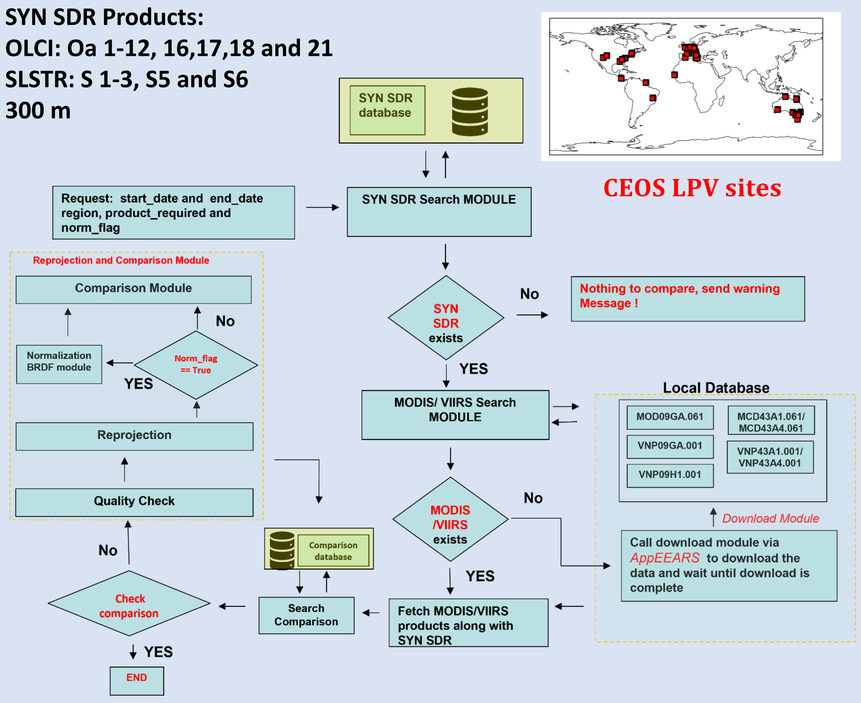
(1) Summary

- A methodology is developed for the routine service evaluation of sentinel 3 derived SYNERGY SDR reflectance products with respect to VIIRS and MODIS.
- The satellite derived surface reflectance products used in intercomparison might suffer from differences due to observational geometry and differences due to spectral response functions.
- Necessary correction procedures are hence implemented in the methodology to minimize the differences between surface reflectance products used in intercomparison.
- First results of intercomparison are shown between SYNERGY SDR and MODIS (VIIRS) surface reflectance products, as observed over CEOS LPV sites during the period 2022-2023 and are discussed.

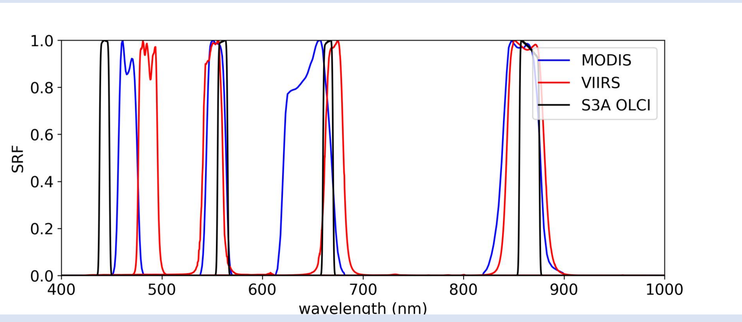
2) Methodology and Data metrics

SYN SDR Products:
OLCI: Oa 1-12, 16,17,18 and 21
SLSTR: S 1-3, S5 and S6
300 m



Methodology for intercomparison

CEOS LPV sites



Spectral Response Functions plotted for several satellite sensors

Correction of BRDF

$$\rho_{est} = fiso + fvolKvol + fgeo\,Kgeo$$

f_{vol} Ross thick kernel (for dense leaf canopy assumption)

f_{geo} Li - Sparse (parse ensemble of surface objects)

$$\rho_{corrected} = \rho_{sensor} * c(\lambda);\ \text{where } c(\lambda) = \frac{\rho_{est}(\theta_v = 0, \theta_s = 45)}{\rho_{est}(\theta_v = \theta_v, \theta_s = \theta_s)}$$

Quality check (based on quality flags):

SYN SDR: SYN_aerosol_filled, SYN_high_error, SYN_snow_risk, SYN_AOT_climato, CLOUD, SNOW_ICE.

MODIS: Based on surface reflectance quality flags, MODLAND, and individual band QA bits (32-bit flags).

VIIRS: Based on surface reflectance quality flags (QF. 1 to 7, 8-bit).

Reprojection:

Based on intersection grid of products and reprojection on regular 0.01-degree resolution.

BRDF correction:

RTLS-R formulation and BRDF product information from MODIS and VIIRS.

Metrics of evaluation:

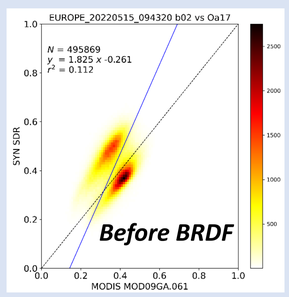
Accuracy, Precision and Uncertainty along with correlation statistics (R-squared).

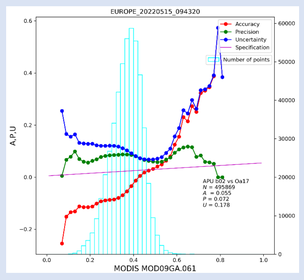
Accuracy (A) *represents the mean bias of the estimates*

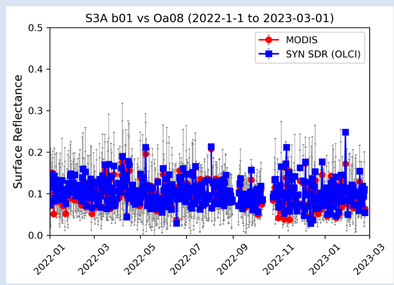
Precision (P) *represents the repeatability of the estimates corrected for the mean bias*

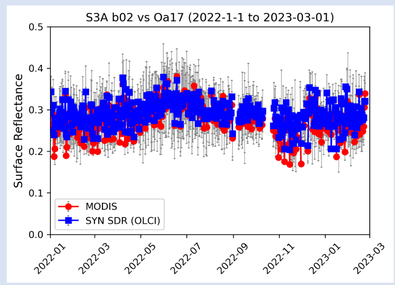
Uncertainty (U) *represents the statistical deviation including the mean bias*

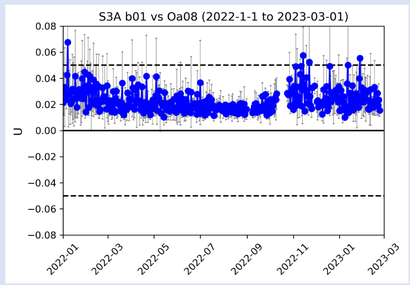
3) Results and Discussion

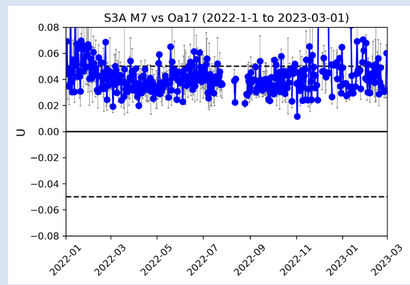


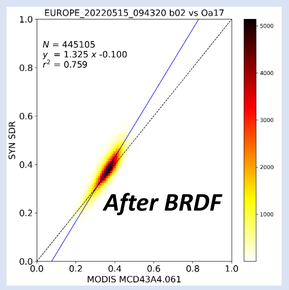


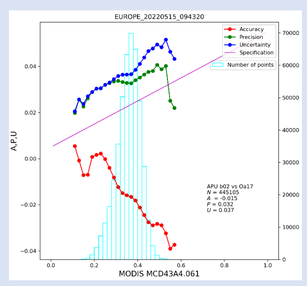


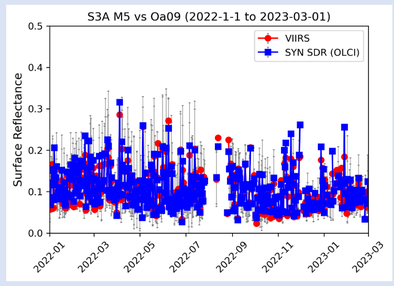


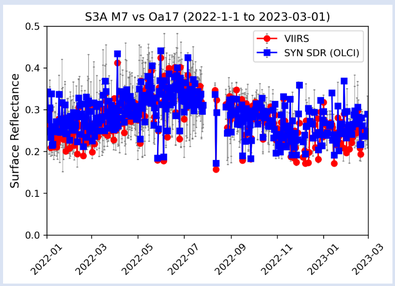


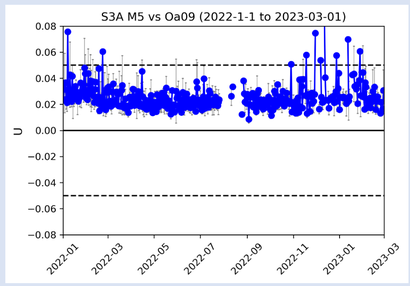


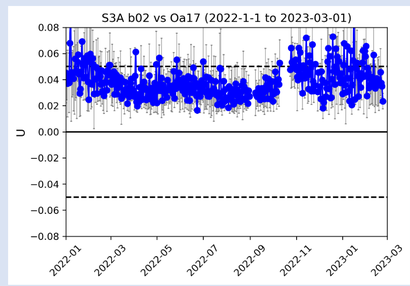




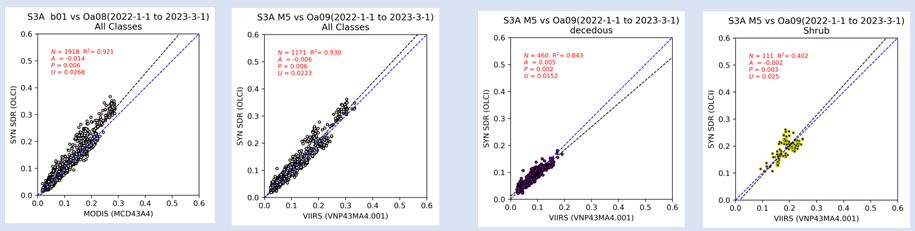


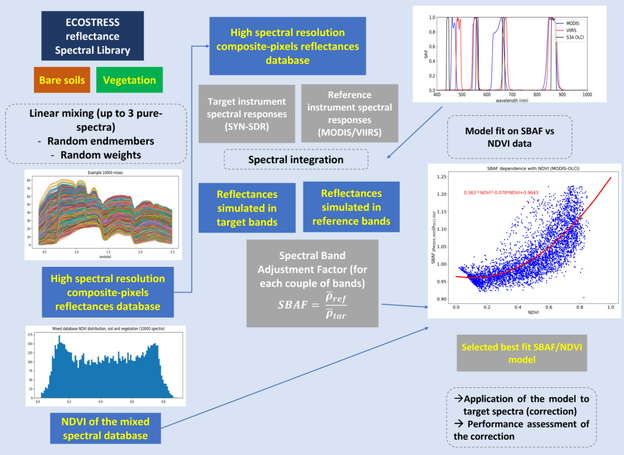




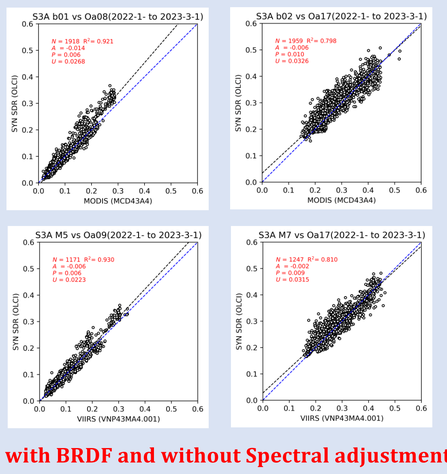


MODIS **VIIRS** **Biome separation**

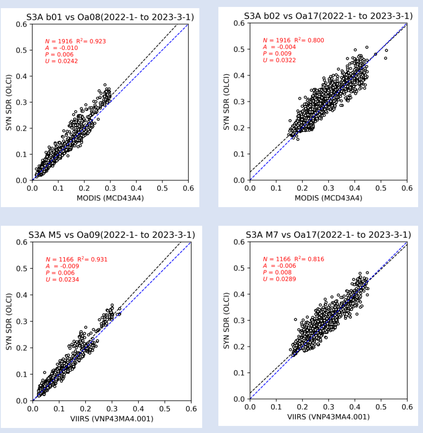




Methodology for spectral adjustment



with BRDF and without Spectral adjustment



with BRDF and with Spectral adjustment

Conclusion and Plans:

- Implementation of BRDF coefficients improved the overall correlation and APU statistics as observed from the intercomparison exercise shown for different regions of the globe.
- The relative mean statistics (%) between the statistical scores (before and after BRDF correction) of intercomparison showed an improvement of more than 50% for A,P,U metrics and an overall improvement in R-squared value.
- Inter-comparison of time series of surface reflectance (SR) between SYN SDR and VIIRS (MODIS) and for the period 2022-2023, although showed a good stability between the satellite derived surface reflectance products, the match was better with respect to VIIRS products.
- Surface biome class has impact on the correlation statistics of intercomparison, where better agreement was found with respect to broad and needle leaved evergreen biome types, and as compared to crop or cultivation type.
- Spectral convolution methods based on Ecostress high spectral resolution data improved the correlation statistics (RMSE or U), marginally by 8%.
- The usage of several mathematical models for spectral adjustment procedures are further envisaged for performance assessment.

References:

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- Vermote and Kotchenova, Atmospheric correction for the monitoring of land surfaces 2008, JGR, (https://doi.org/10.1029/2007JD009662).
- Roy et al., Examination of Sentinel-2A multi-spectral instrument (MSI) reflectance anisotropy and the suitability of a general method to normalize MSI reflectance to nadir BRDF adjusted reflectance, RSE, Volume 199, 2017, https://doi.org/10.1016/j.rse.2017.06.019.

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