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Intercomparisons of SYNERGY surface directional reflectance – methodology and plans for the OPT-MPC routine service validation

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Objectives

To develop an automatic software for SYN SDR routine service validation.

- *Datasets used for routine service validation.*
- *Methodology and Software development.*
- *First results.*

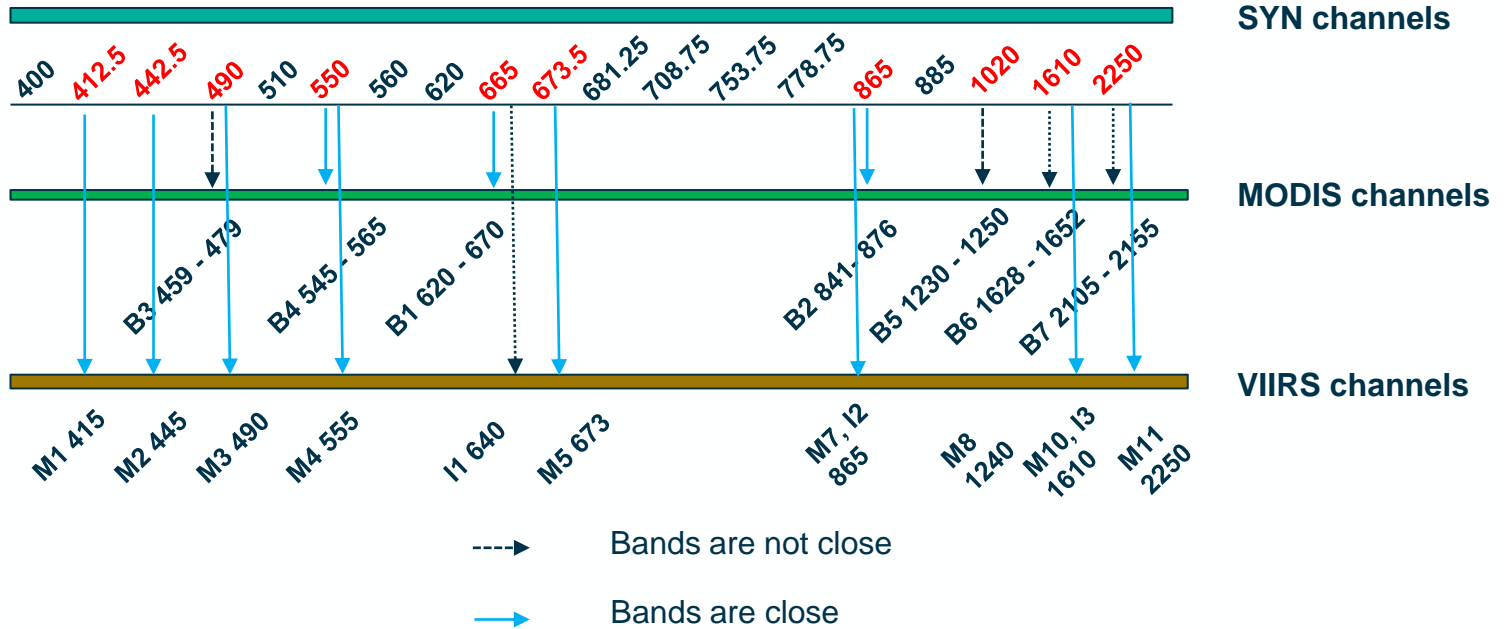


Datasets used for routine service validation





Datasets used for routine service validation



SYN SDR Products:

OLCI: Oa 1-12, 16,17,18 and 21
 SLSTR: S 1-3, S5 and S6

300 m

MODIS Products:

Terra: MOD09A1.061
 Aqua: MYD09A1.061
 500 m

VIIRS Products:

VNP09GA daily
 1km (M-bands)
 VNP09H1 daily
 500m (I-bands)

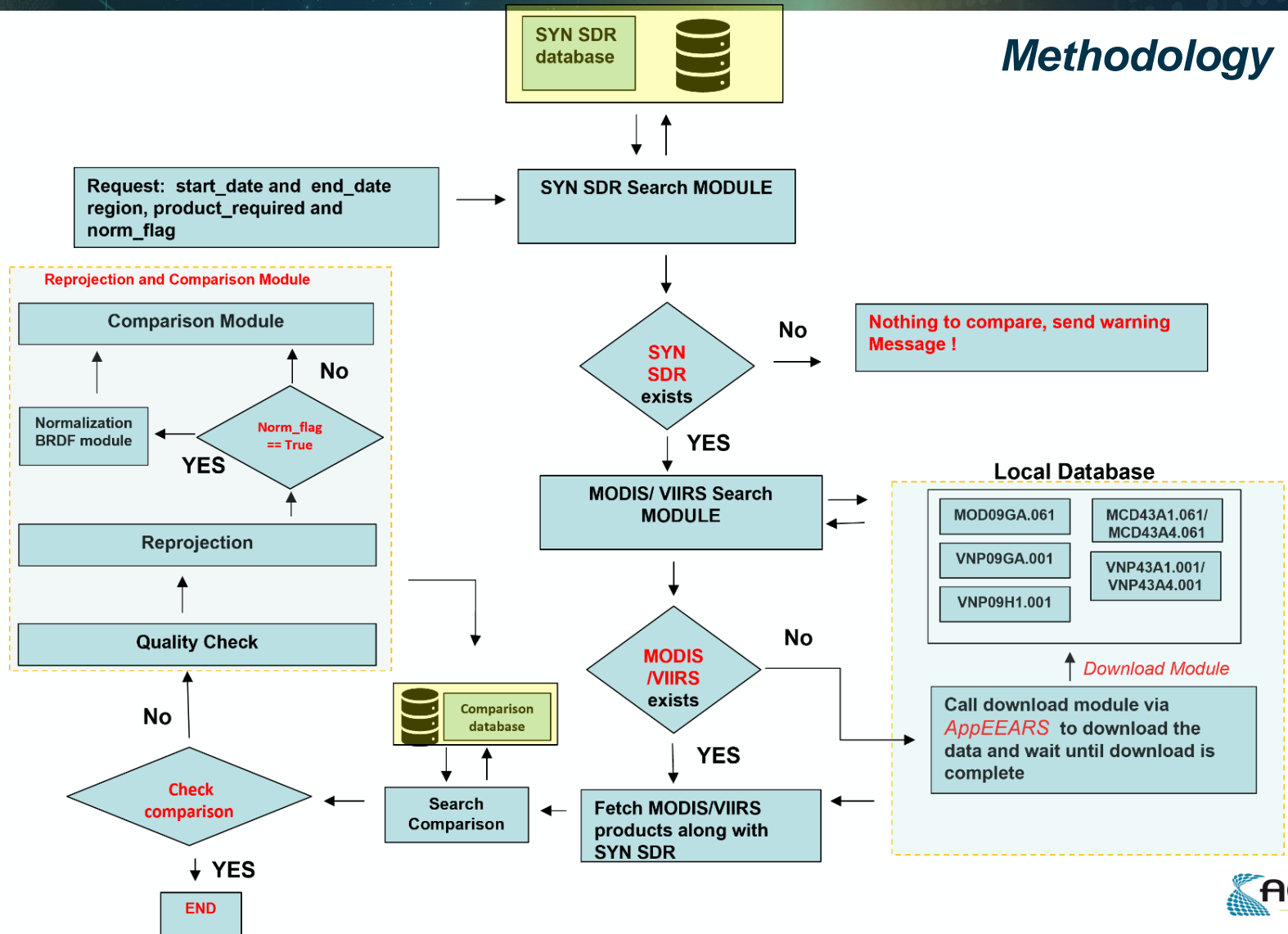




Methodology



Methodology





Data and Metrics

Data Filtering (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).

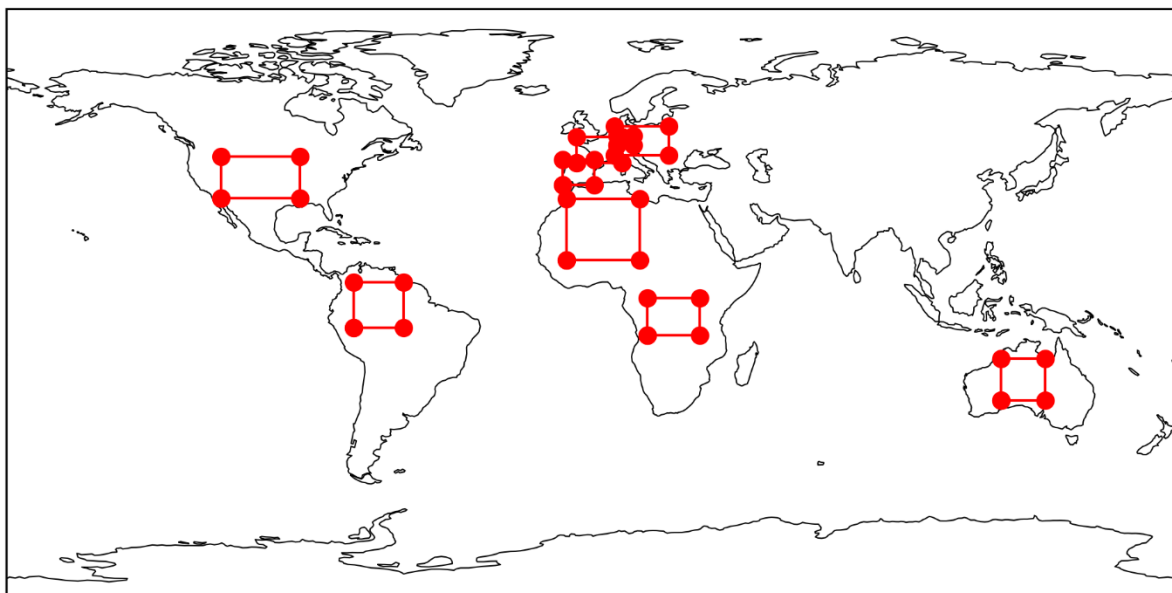
Accuracy (A) represents the mean bias of the estimates

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

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

Reference: Vermote and Kotchenova, 2008 (<https://doi.org/10.1029/2007JD009662>)

Selected AREA polygons for selection of products



Regions include:

- 1) United States
- 2) Amazonia
- 3) Europe
- 4) France
- 5) Spain
- 6) Africa
- 7) Congo
- 8) Australia



BRDF correction of SYN SDR

$$\rho_{est} = f_{iso} + f_{vol}K_{vol} + f_{geo}K_{geo}$$

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

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

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

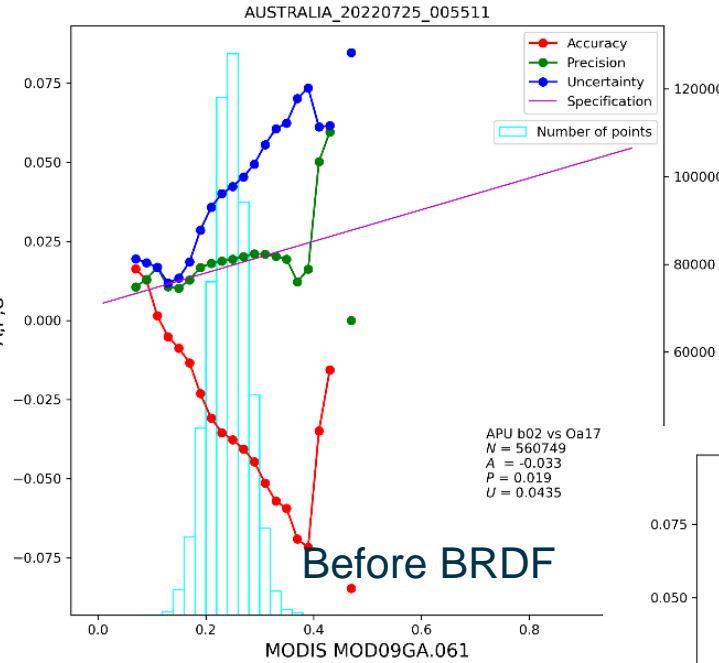
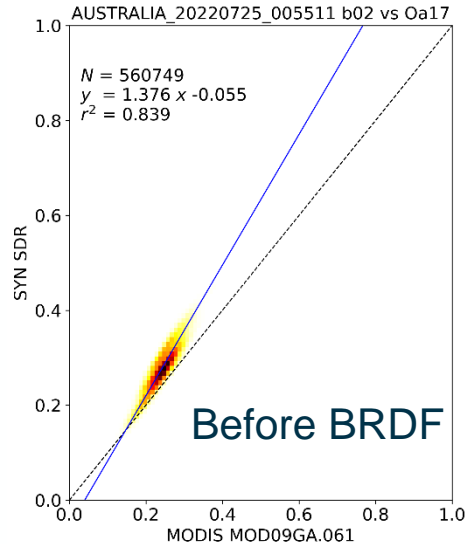
References: <https://ladsweb.modaps.eosdis.nasa.gov/missions-and-measurements/science-domain/brdf-albedo-and-nbar/>
https://lpdaac.usgs.gov/documents/97/MCD43_ATBD.pdf
Vermote et al., 2009 ([10.1109/TGRS.2008.2005977](https://doi.org/10.1109/TGRS.2008.2005977));
Roy et al., 2016 (<https://doi.org/10.1016/j.rse.2016.01.023>),
Vermote and Kotchenova, 2008 (<https://doi.org/10.1029/2007JD009662>)



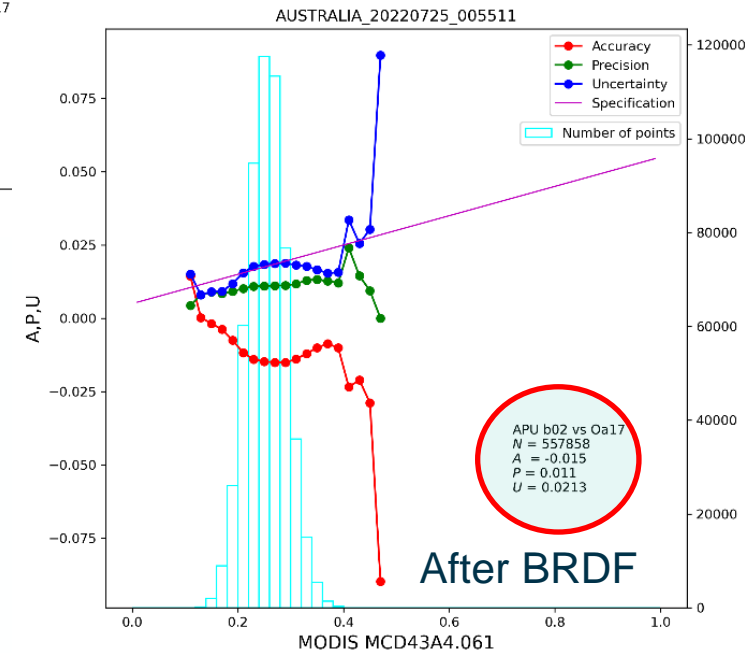
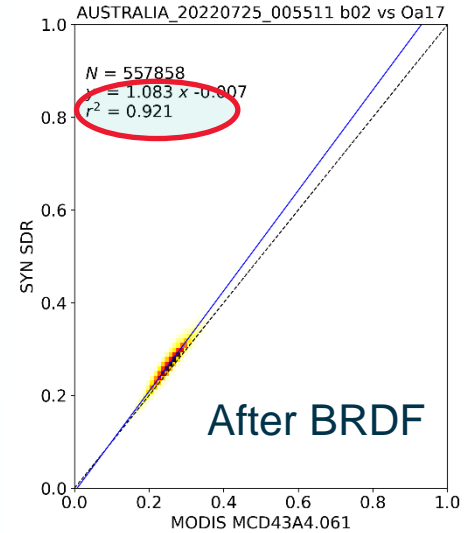
First Results



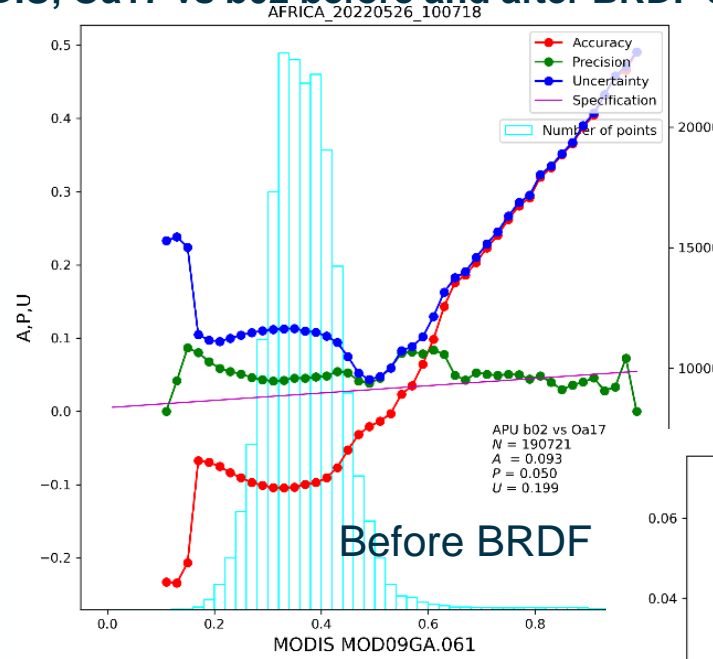
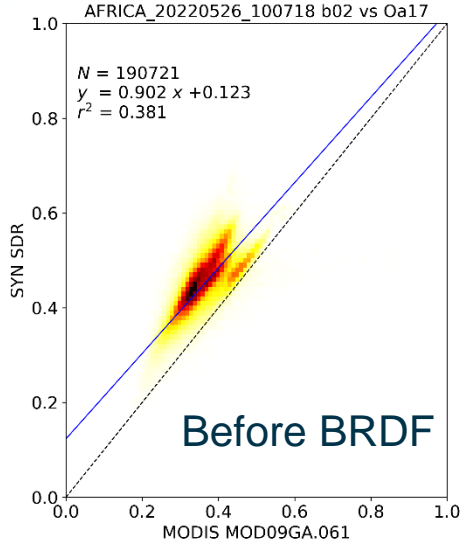
Comparison SYN SDR vs MODIS; Oa17 vs b02 before and after BRDF correction



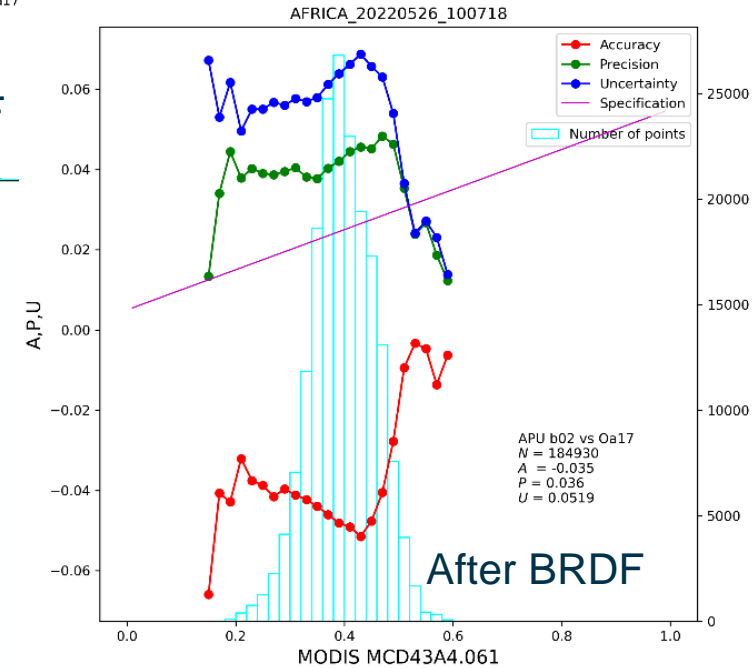
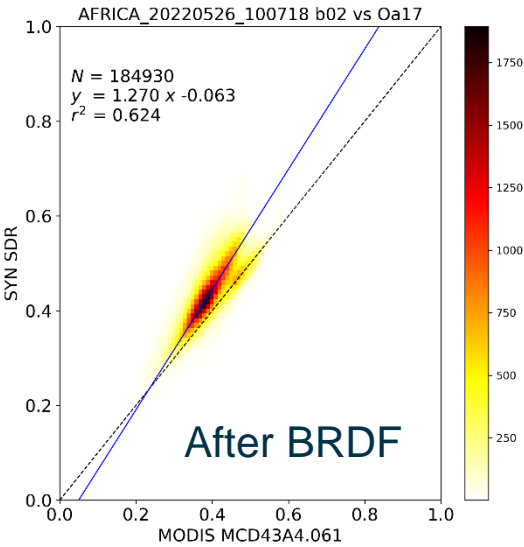
Region: Australia



Comparison SYN SDR vs MODIS; Oa17 vs b02 before and after BRDF correction

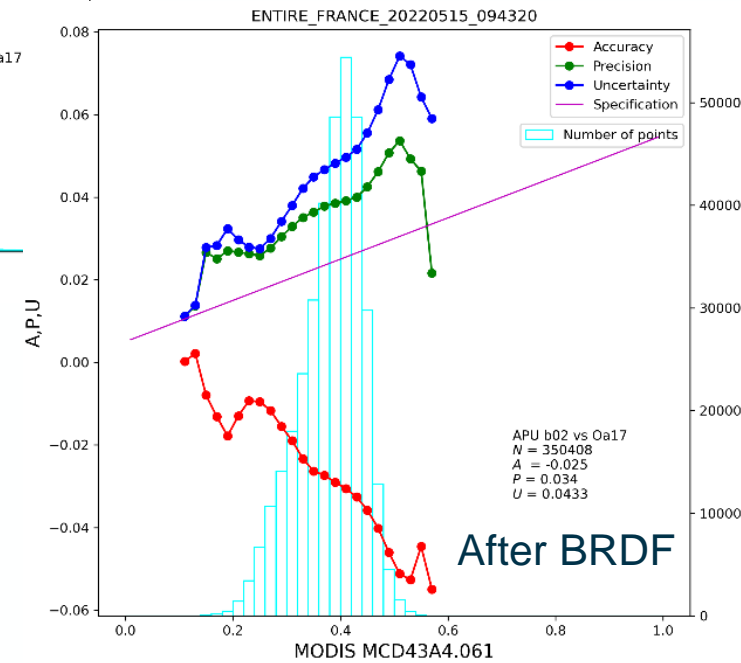
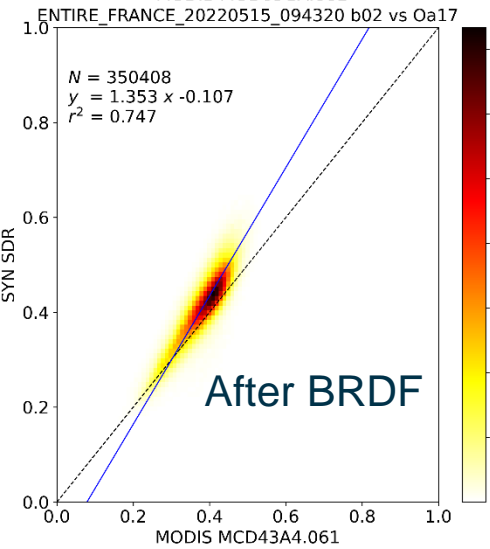
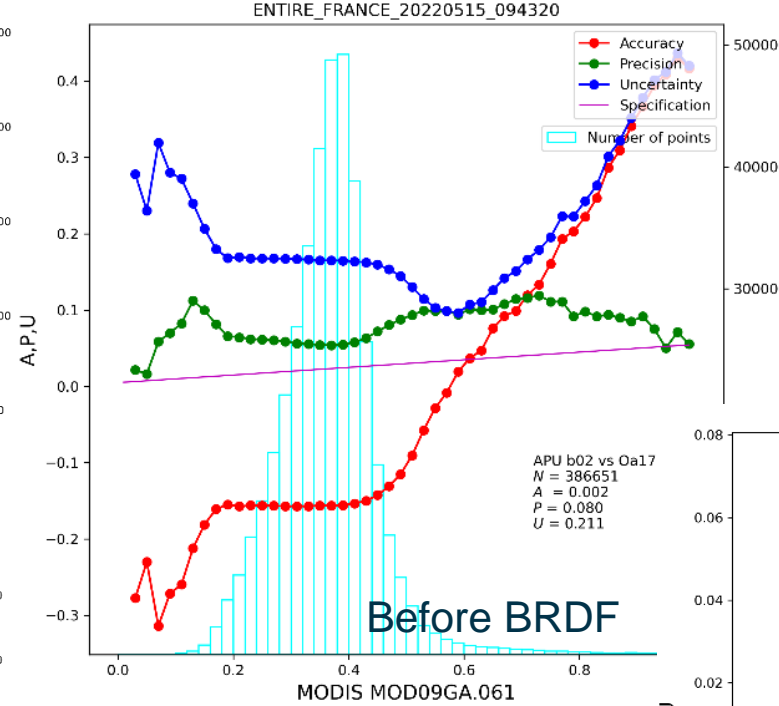
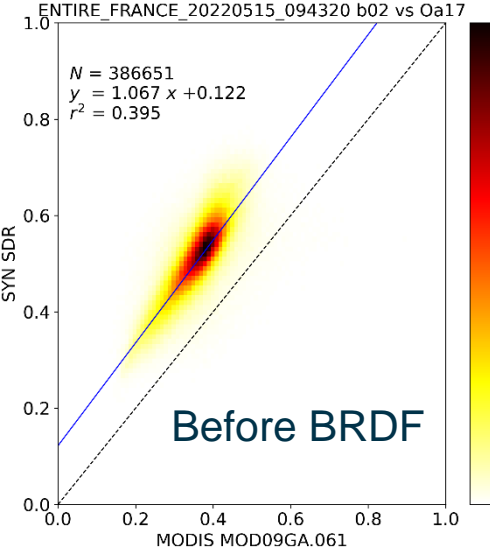


Region: Africa



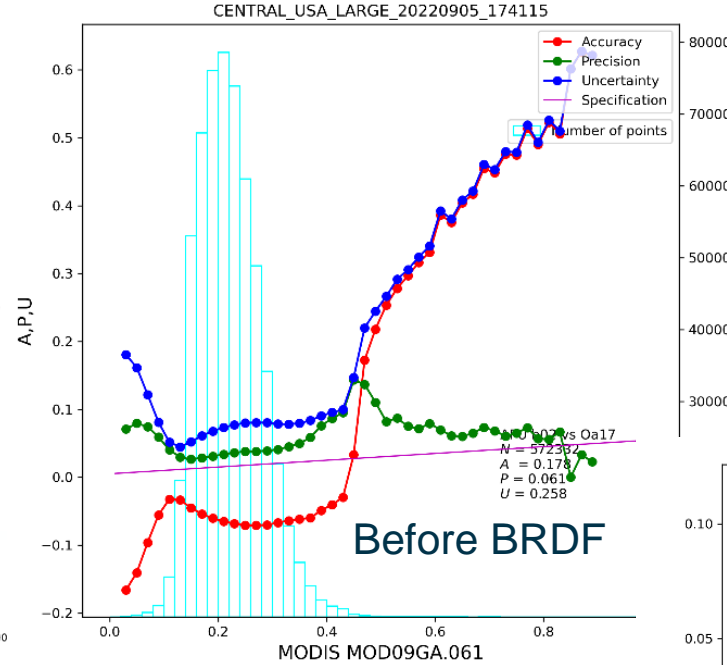
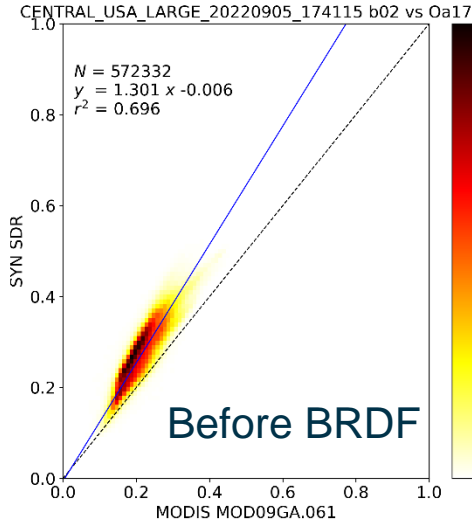
Comparison SYN SDR vs MODIS; Oa17 vs b02 before and after BRDF correction

Region: France

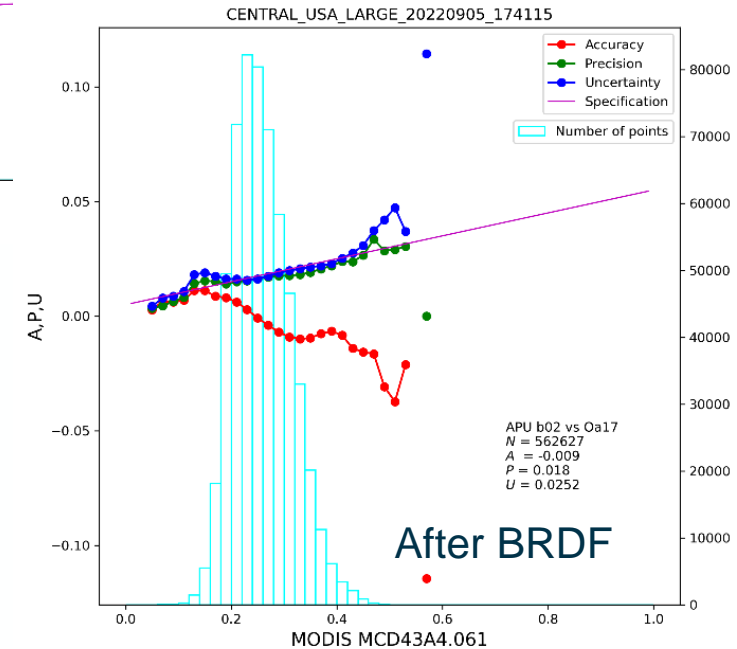
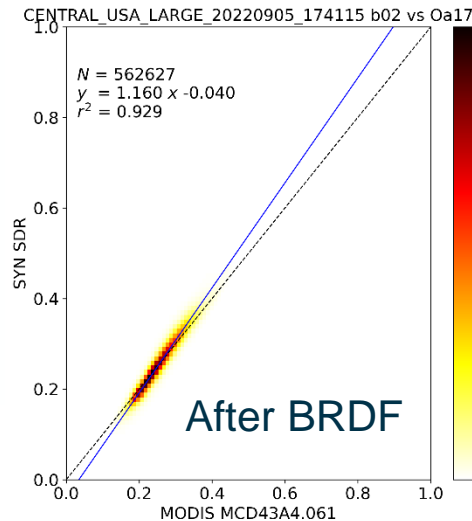




Comparison SYN SDR vs MODIS; Oa17 vs b02 before and after BRDF correction

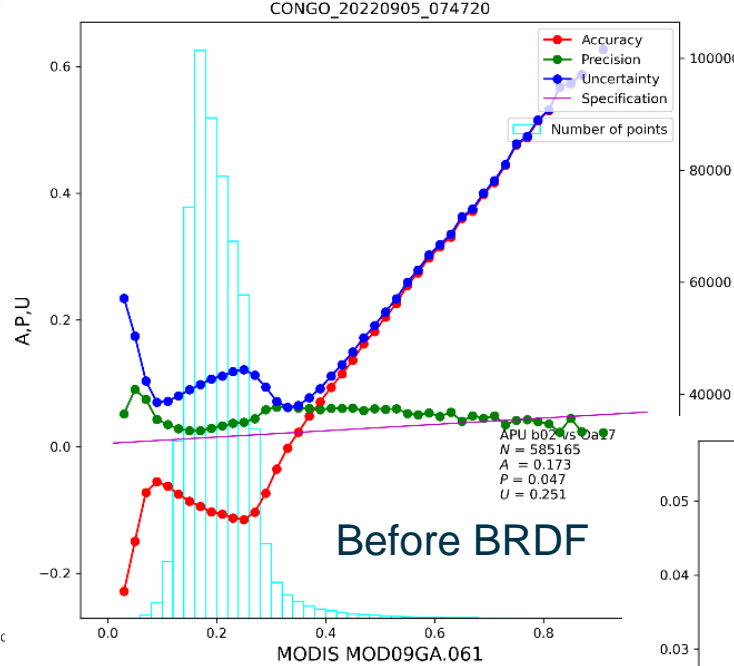
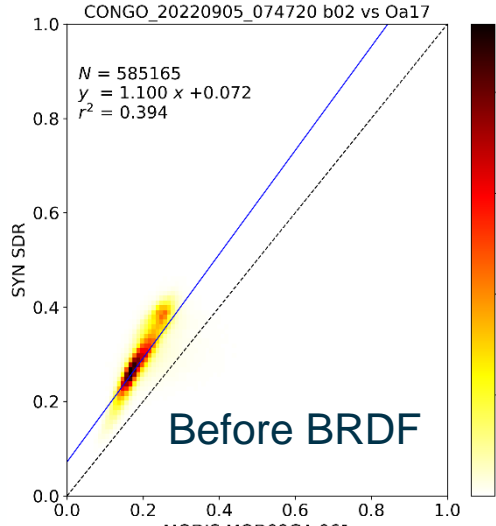


Region: USA

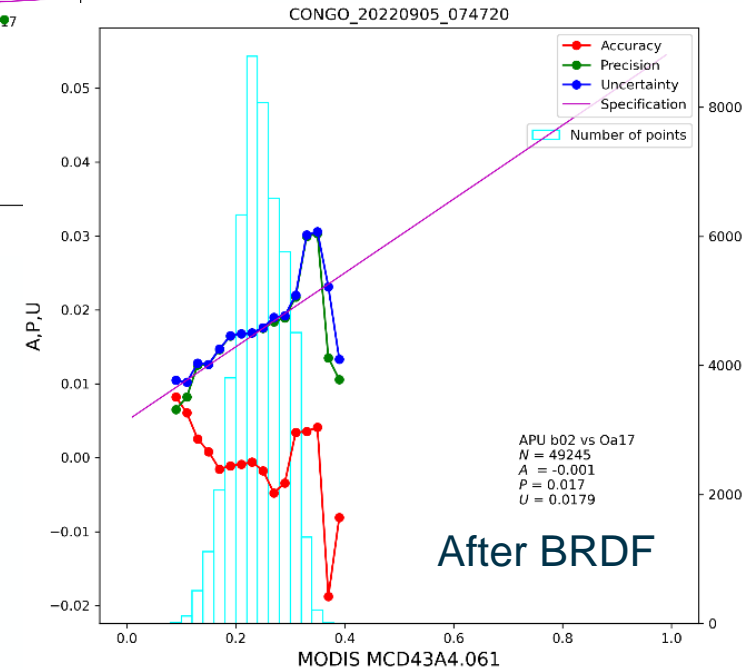
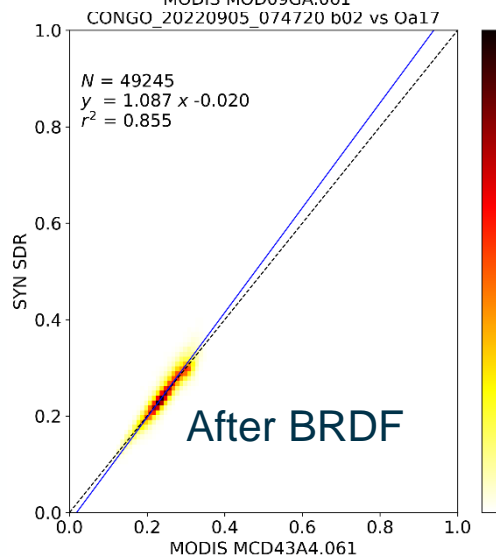




Comparison SYN SDR vs MODIS; Oa17 vs b02 before and after BRDF correction



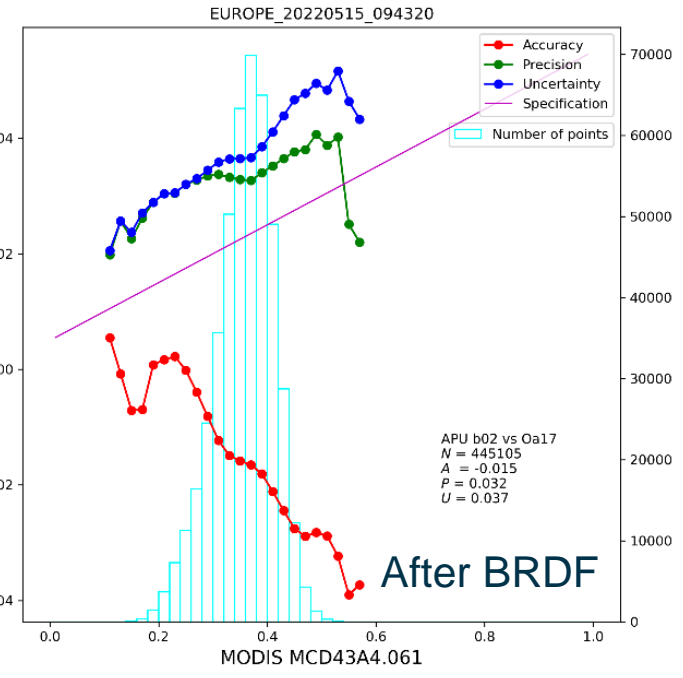
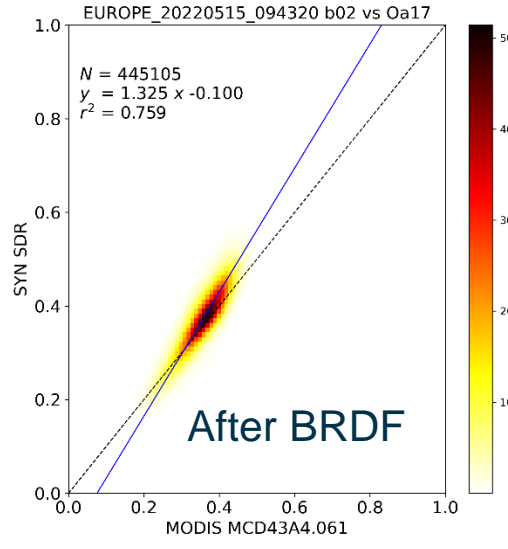
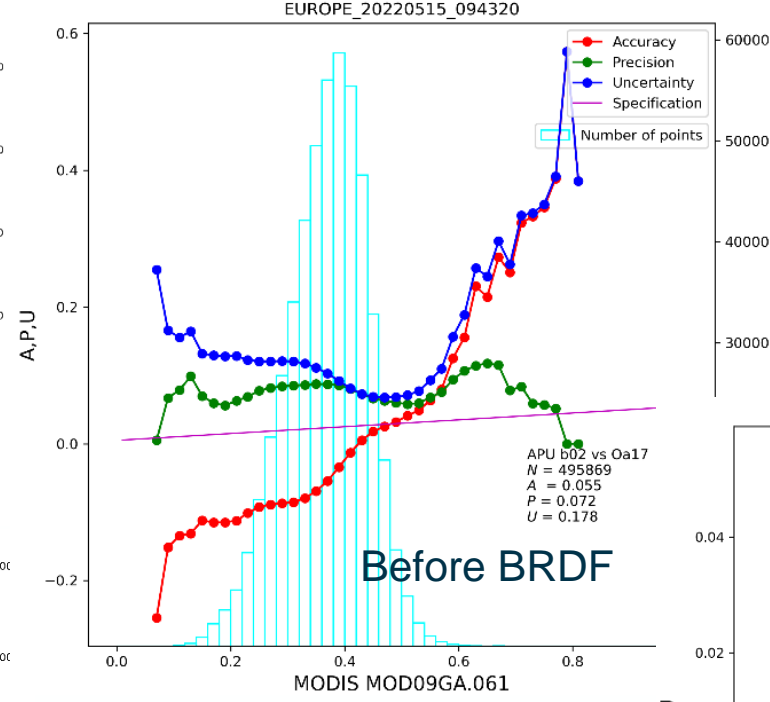
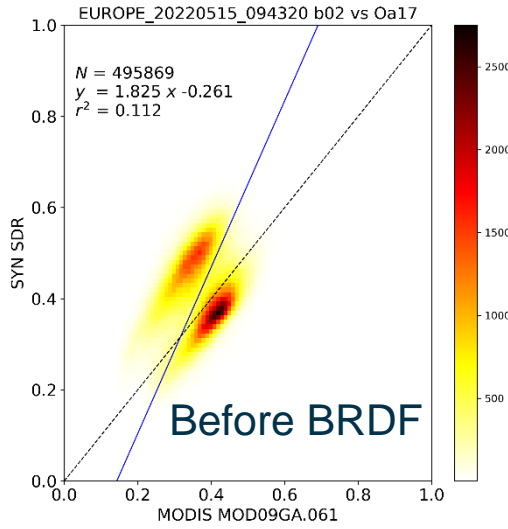
Region: Congo





Comparison SYN SDR vs MODIS; Oa17 vs b02 before and after BRDF correction

Region: Europe

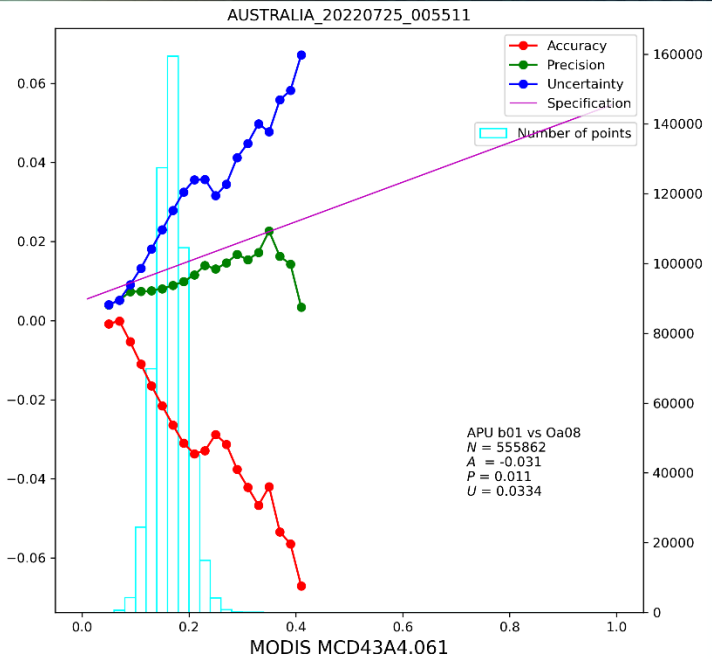
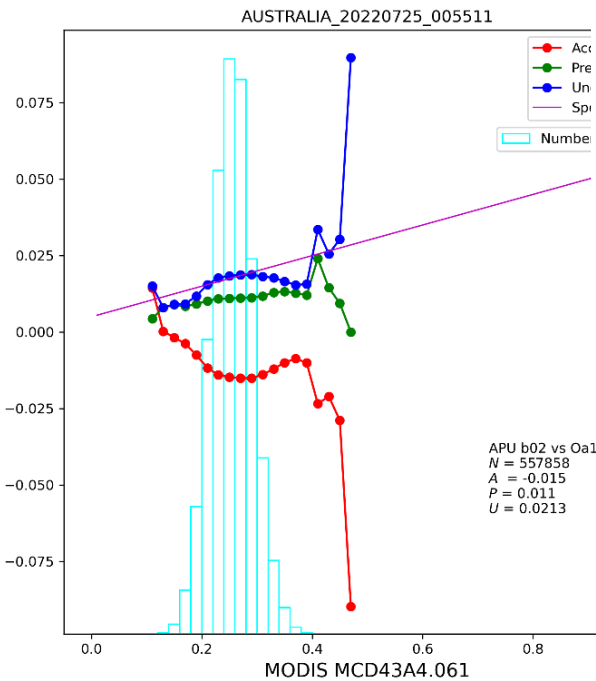
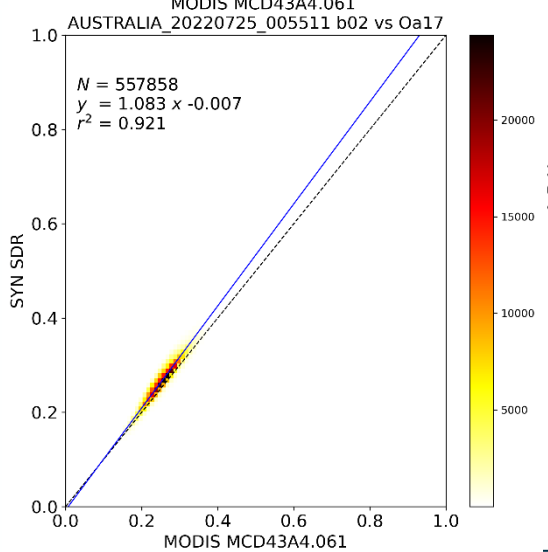
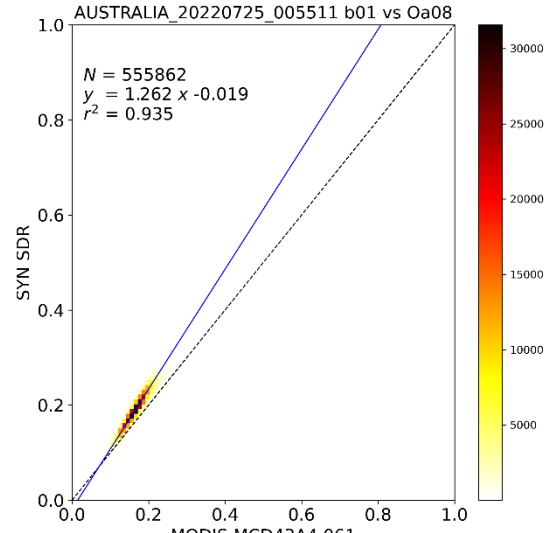




Comparison SYN SDR vs MODIS for other bands



Comparison SYN SDR vs MODIS for other bands



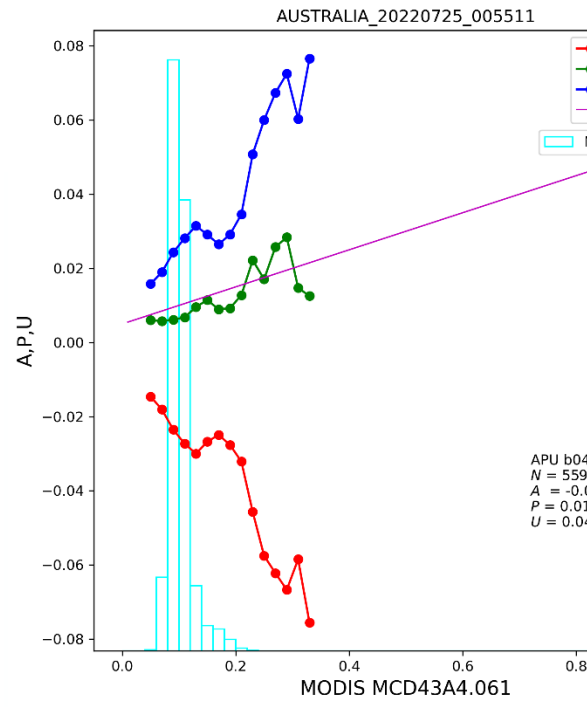
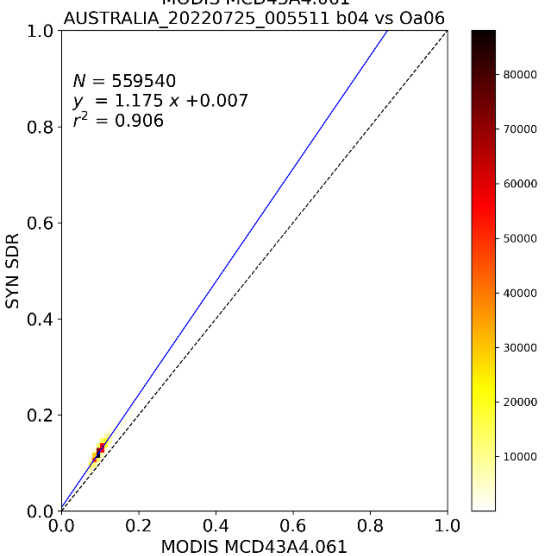
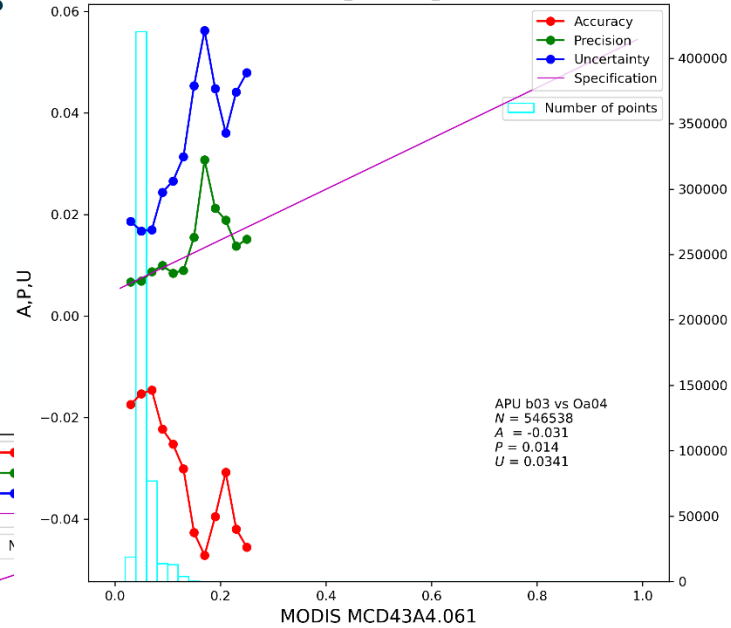
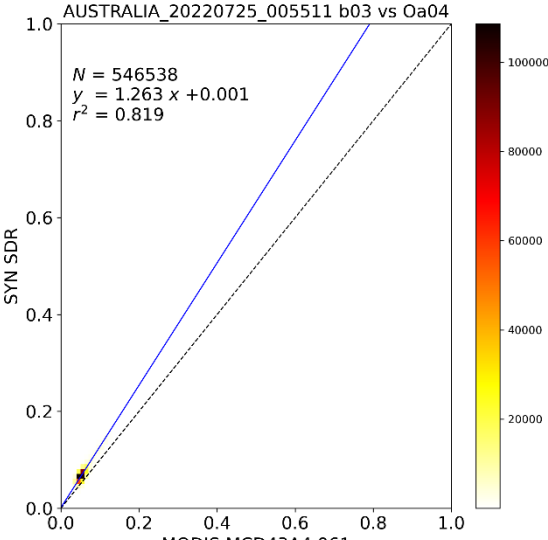
Region: Australia





Comparison SYN SDR vs MODIS for other bands

AUSTRALIA_20220725_005511



Region: Australia

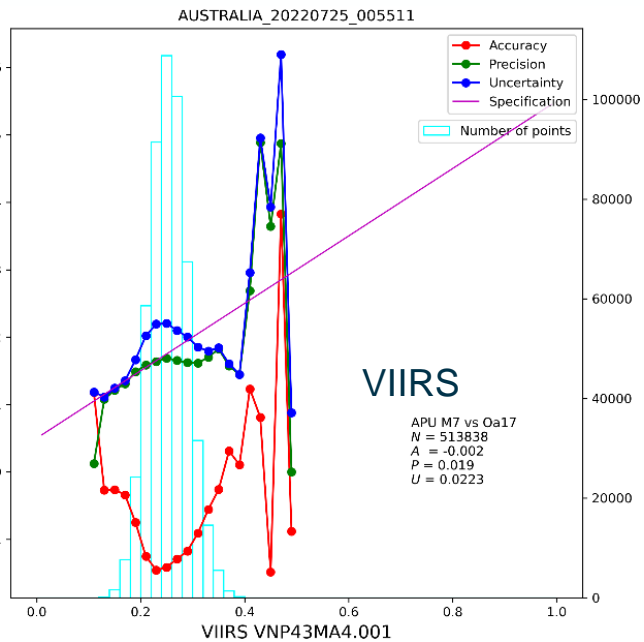
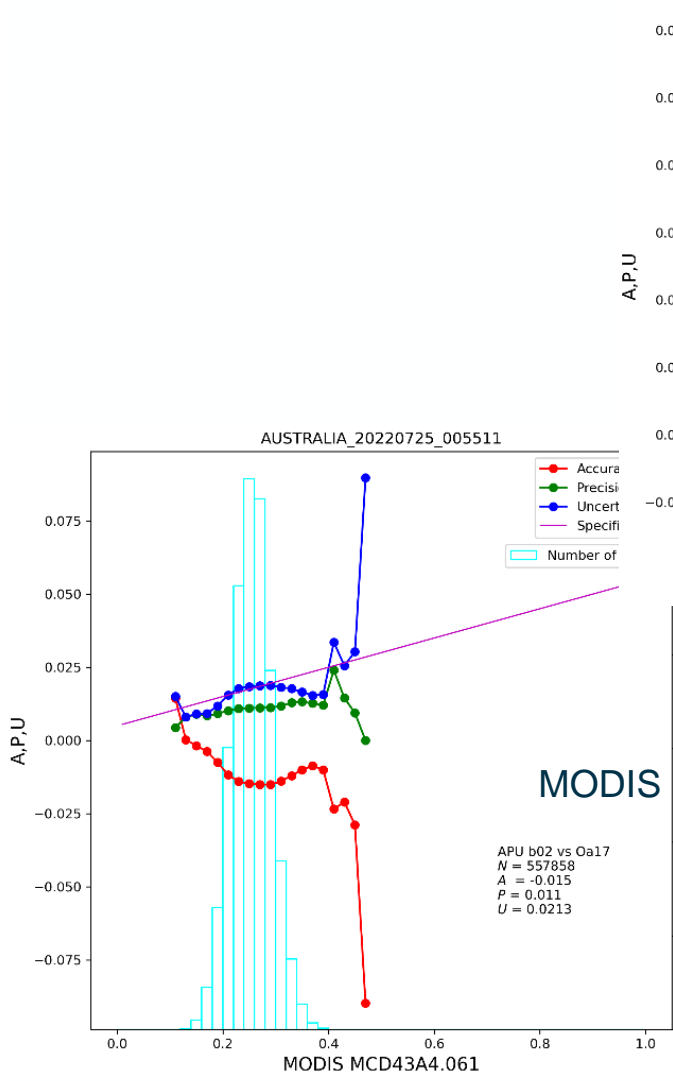
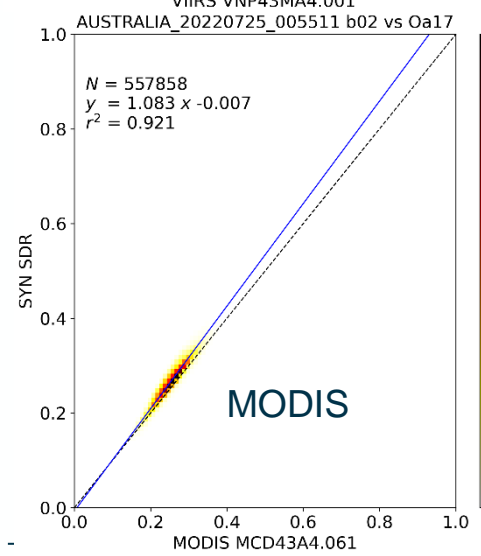
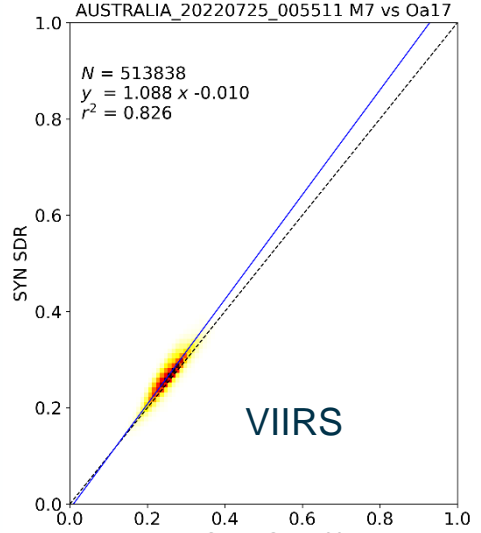




Comparison SYN SDR vs MODIS and VIIRS; Oa17 vs b02; Oa17 vs M7



Comparison SYN SDR vs MODIS and VIIRS; Oa17 vs b02; Oa17 vs M7

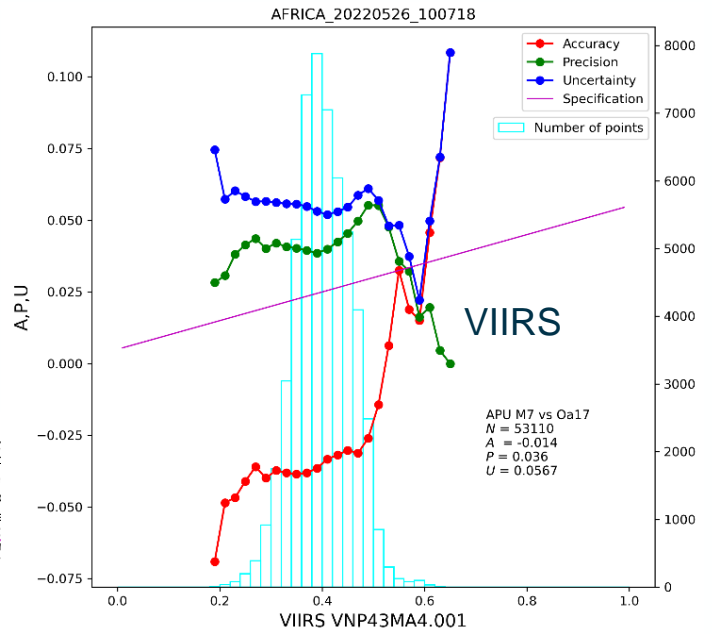
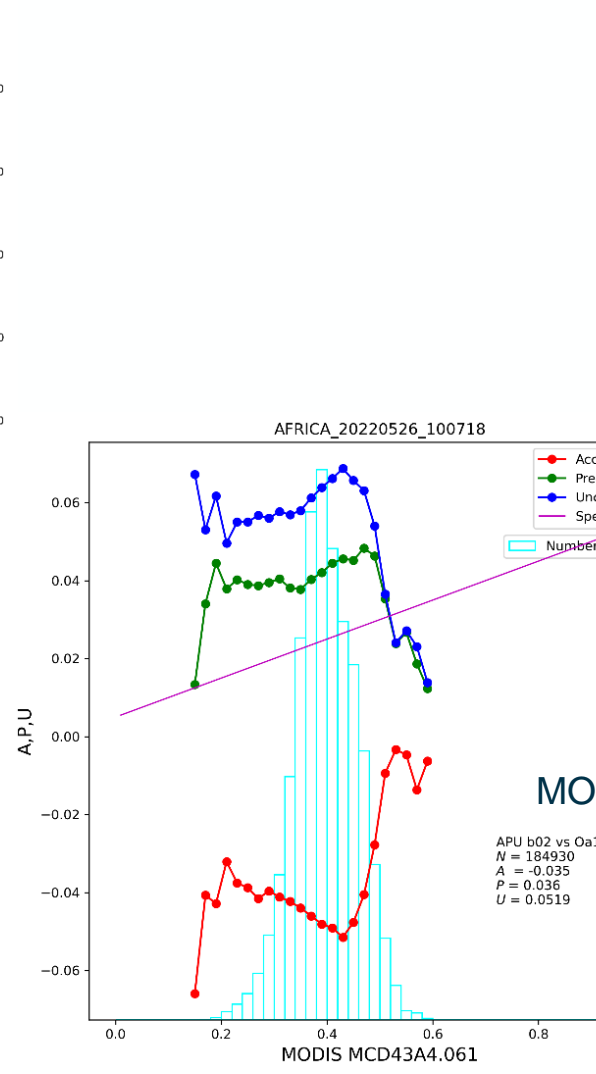
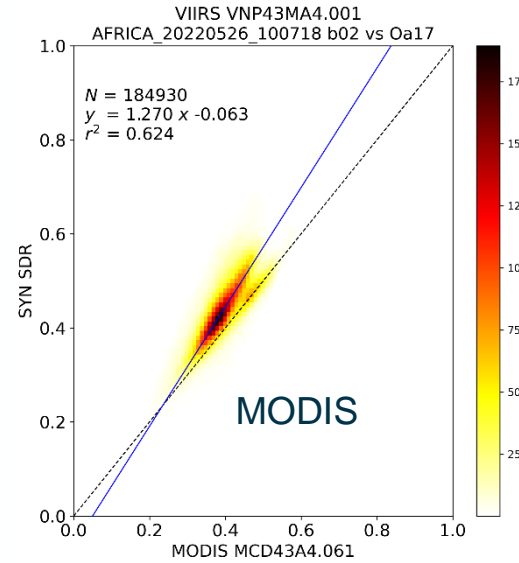
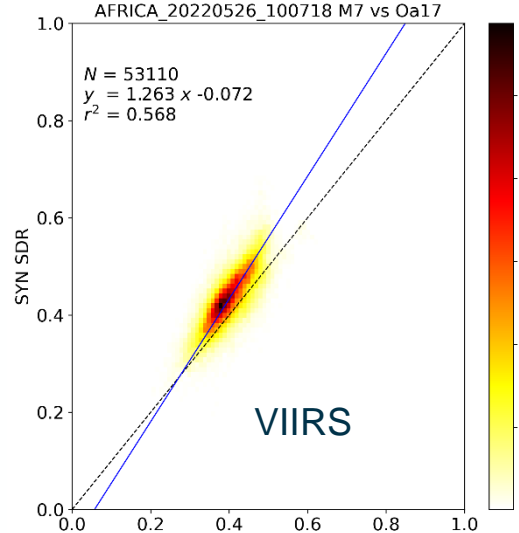


Region: Australia





Comparison SYN SDR vs MODIS and VIIRS; Oa17 vs b02; Oa17 vs M7



Region: Africa





Discussion and Conclusion

What is learnt:

- First results of the Intercomparison exercise, performed between SYN SDR and satellite products (MODIS and VIIRS) showed a reasonable comparison.
- 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) showed an improvement of more than 50% for A,P,U metrics and an overall improvement in R-squared value for all the regions shown in the exercise.
- From visual inspection, it was observed that the current results are inline with previous validation results of SYN SDR with respect to MODIS.
- Although, the BRDF correction for SYN SDR using the respective MODIS and VIIRS BRDF products improved the overall metrics of evaluation, the presence of data voids in the BRDF products can impact the evaluation and the derived metrics.
- The results will be included in the Data Quality Report OLCI-SYN after a robust evaluation and will be made publicly available in SentinelOnline.

What is envisaged :

- To study the impact of varying biome classes with respect to seasonal changes on the BRDF correction of SYN SDR and subsequent evaluation of the product.
- To continue the evaluation of SYN SDR with respect to MODIS products in first phase and later to evaluate against VIIRS products after decommissioning of MODIS surface reflectance products.
- To work on temporal intercomparison of surface reflectance products, SYN SDR, MODIS and VIIRS





Thank you for Listening

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