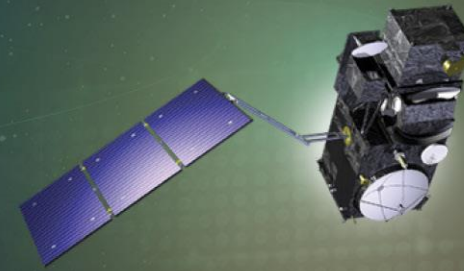




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# 7<sup>th</sup> Sentinel-3 Validation Team Meeting 2022

18-20 October 2022 | ESA-ESRIN | Frascati (Rm), Italy

## Consistency between Sentinel-3 SYN VGT products and PROBA-V

Carolien Toté, Else Swinnen

*VITO Remote Sensing, Belgium*

[carolien.tote@vito.be](mailto:carolien.tote@vito.be)



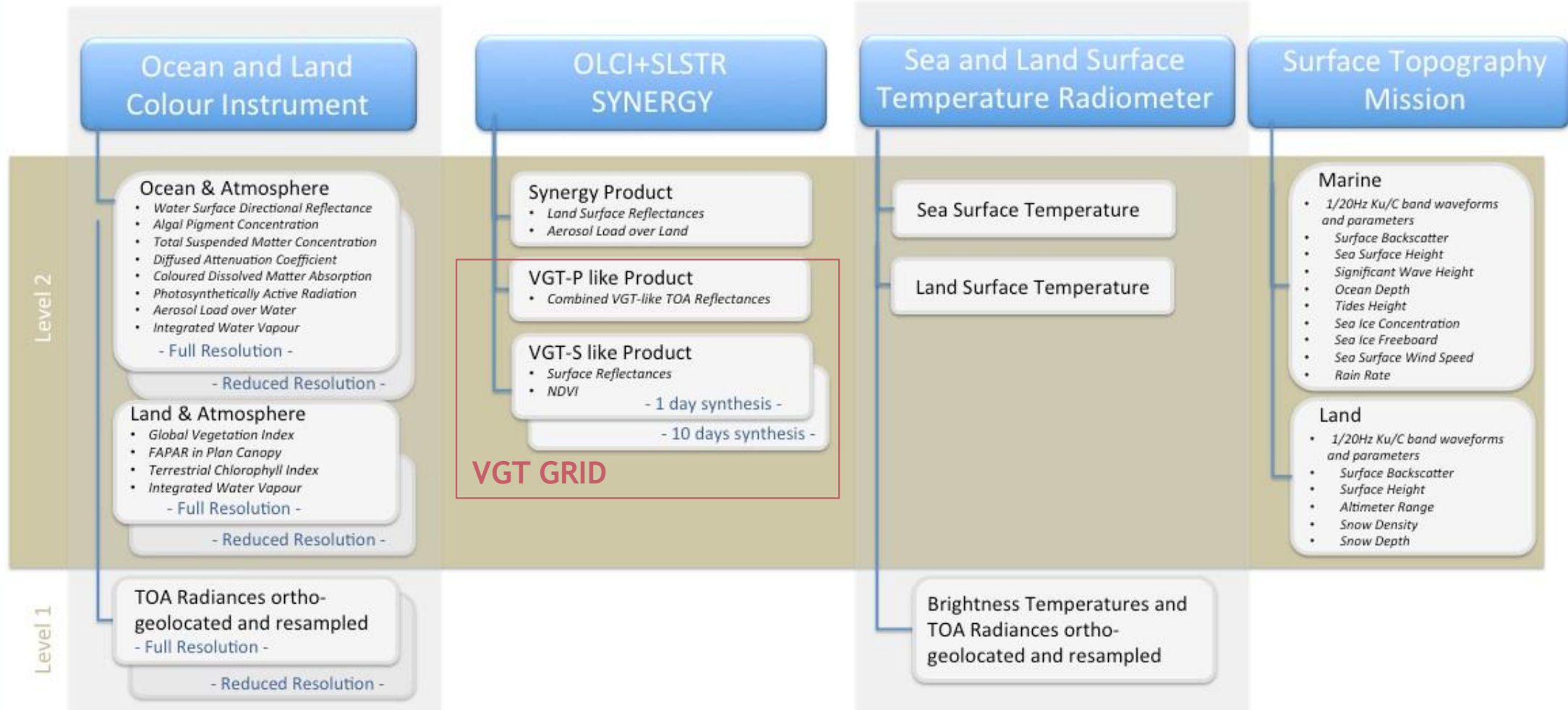
ESA UNCLASSIFIED – For ESA Official Use Only



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## S3 SYN VGT product





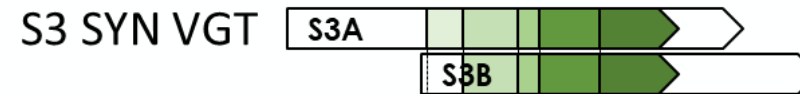
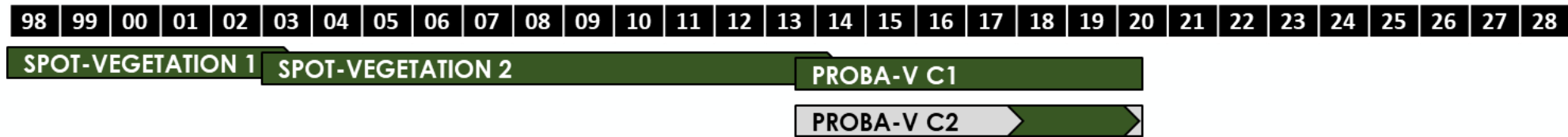
# Context within OPT-MPC

## Consistency with SPOT/Vegetation and PROBA-V archives?

- Direct comparison with PROBA-V C2 (but no overlap!) → operational quality monitoring
- Indirect comparison with climatology of SPOT-VGT C3 / PROBA-V C2
- Indirect comparison using a reference time series

## Verification of SYN VGT processor updates

- After processing baseline updates
- Formulation of recommendations for improvements

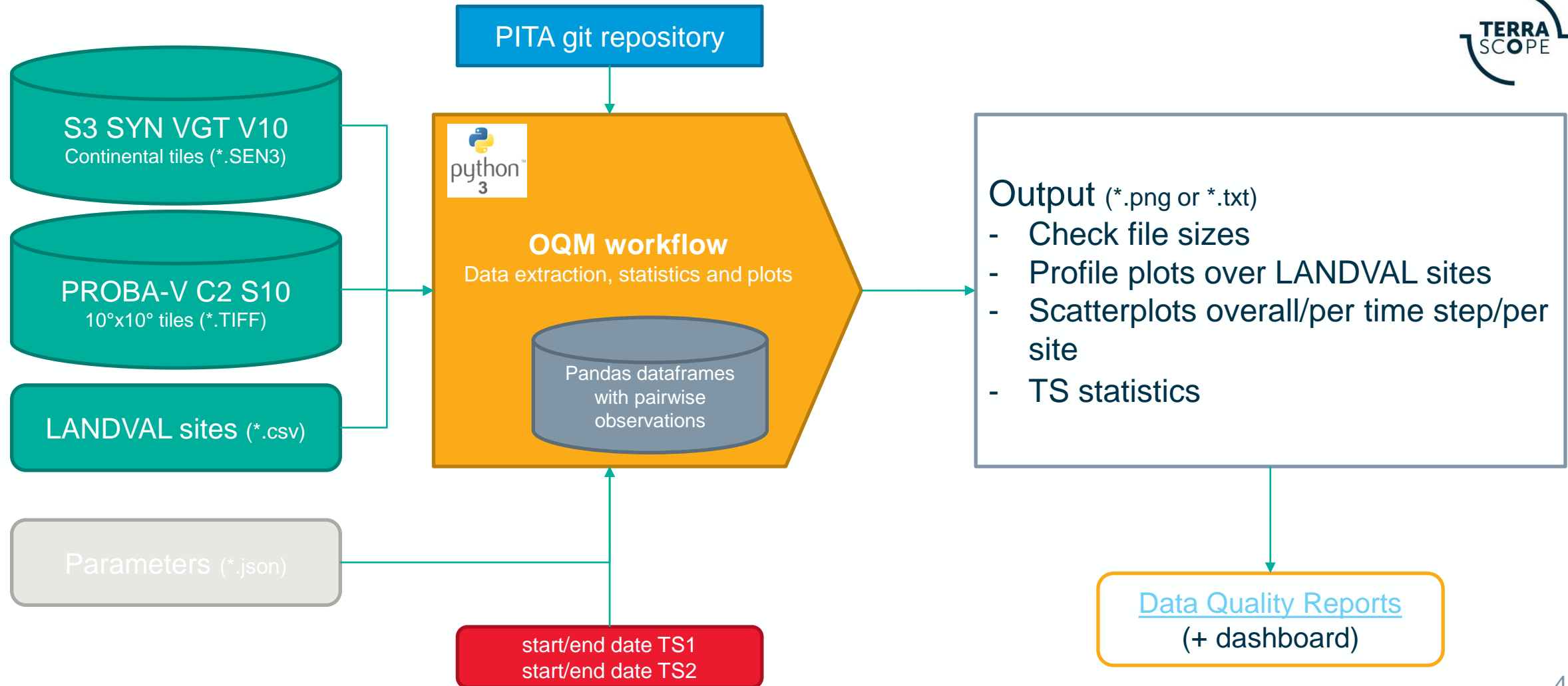


**PB updates** Oct 2018, Jan-Feb 2019, Jan 2020, Jun 2021, Aug 2022

**PDGS update** June 2020



# Operational quality monitoring





# Metrics for statistical intercomparison

Accuracy (A) = average bias

$$A = \frac{1}{n} \sum_{i=1}^n (X_i - Y_i) = \bar{X} - \bar{Y}$$

Precision (P) = repeatability, or standard deviation of the bias

$$P = \sqrt{\frac{1}{n-1} \sum_{i=1}^n (X_i - Y_i - A)^2}$$

Uncertainty (U) = root mean squared difference

$$U = \text{RMSE} = \sqrt{\frac{1}{n} \sum_{i=1}^n (X_i - Y_i)^2}$$





# Latest data quality report

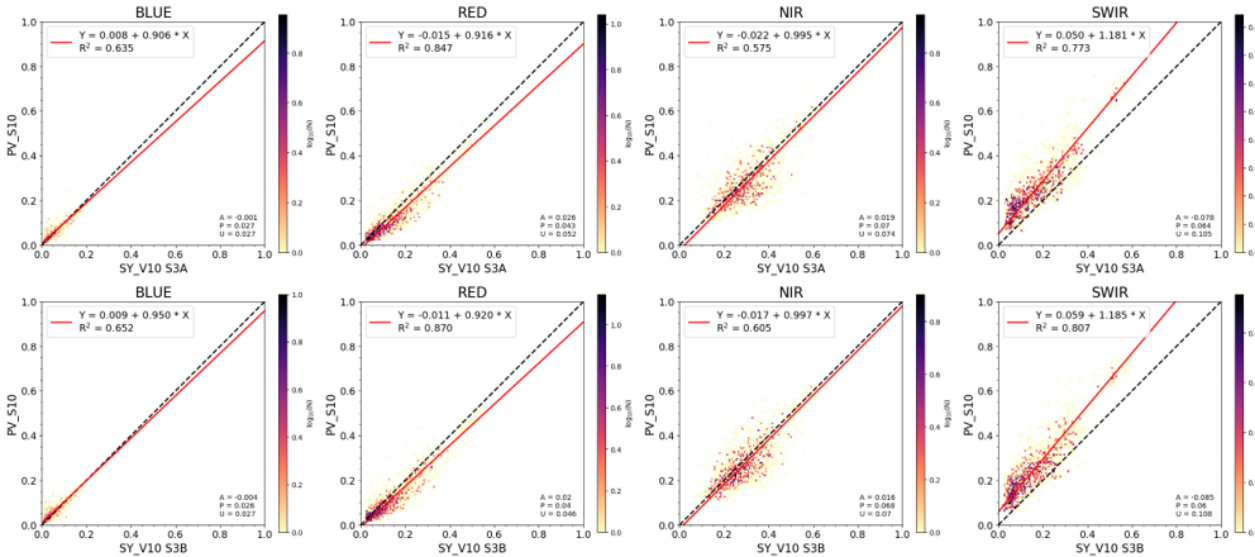


Figure 1: Scatter density plots between SY\_V10 S3A (top) or S3B (bottom) and PROBA-V C2 S10-TOC for BLUE, RED, NIR and SWIR bands (left to right), September/2022 vs. September/2019

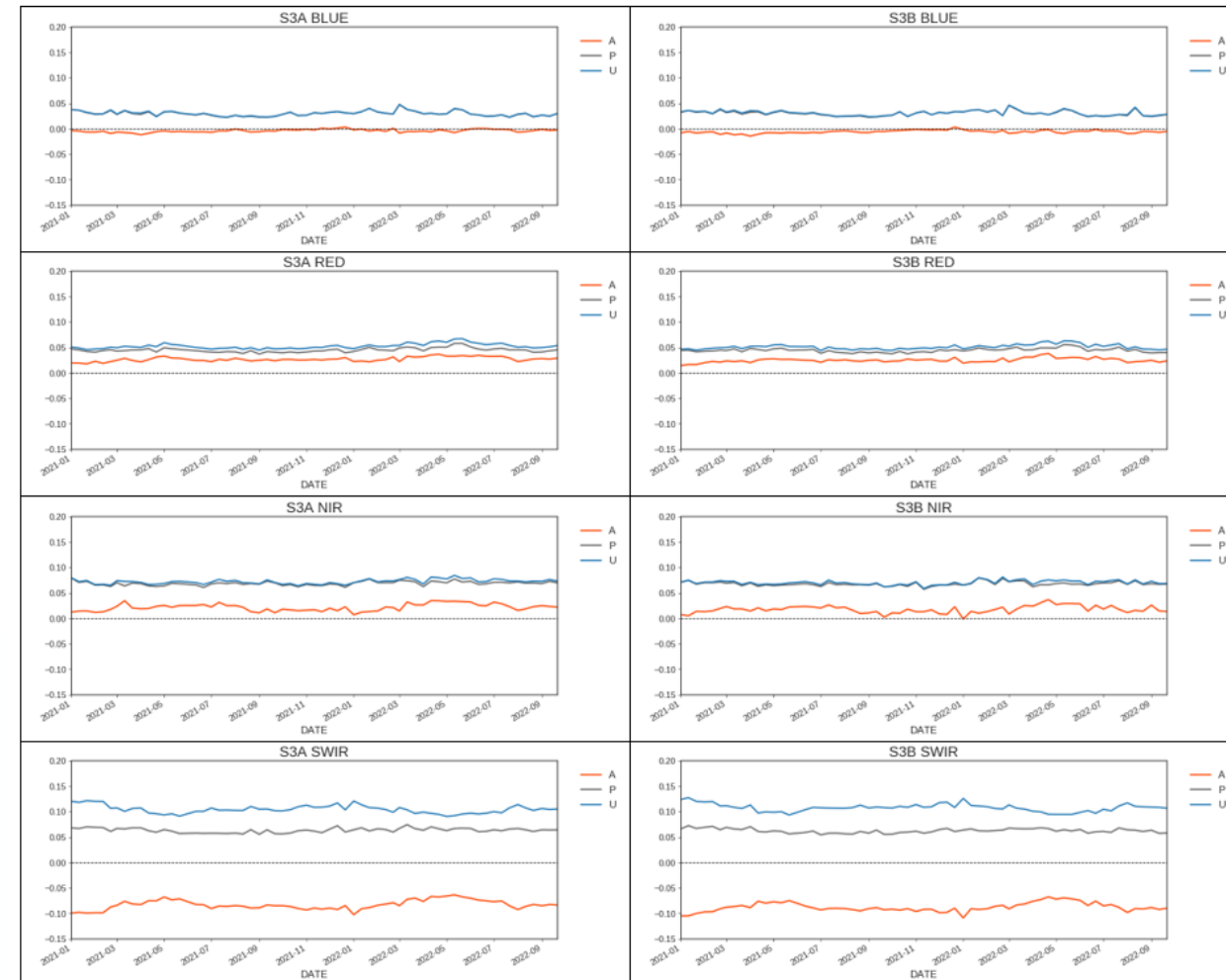
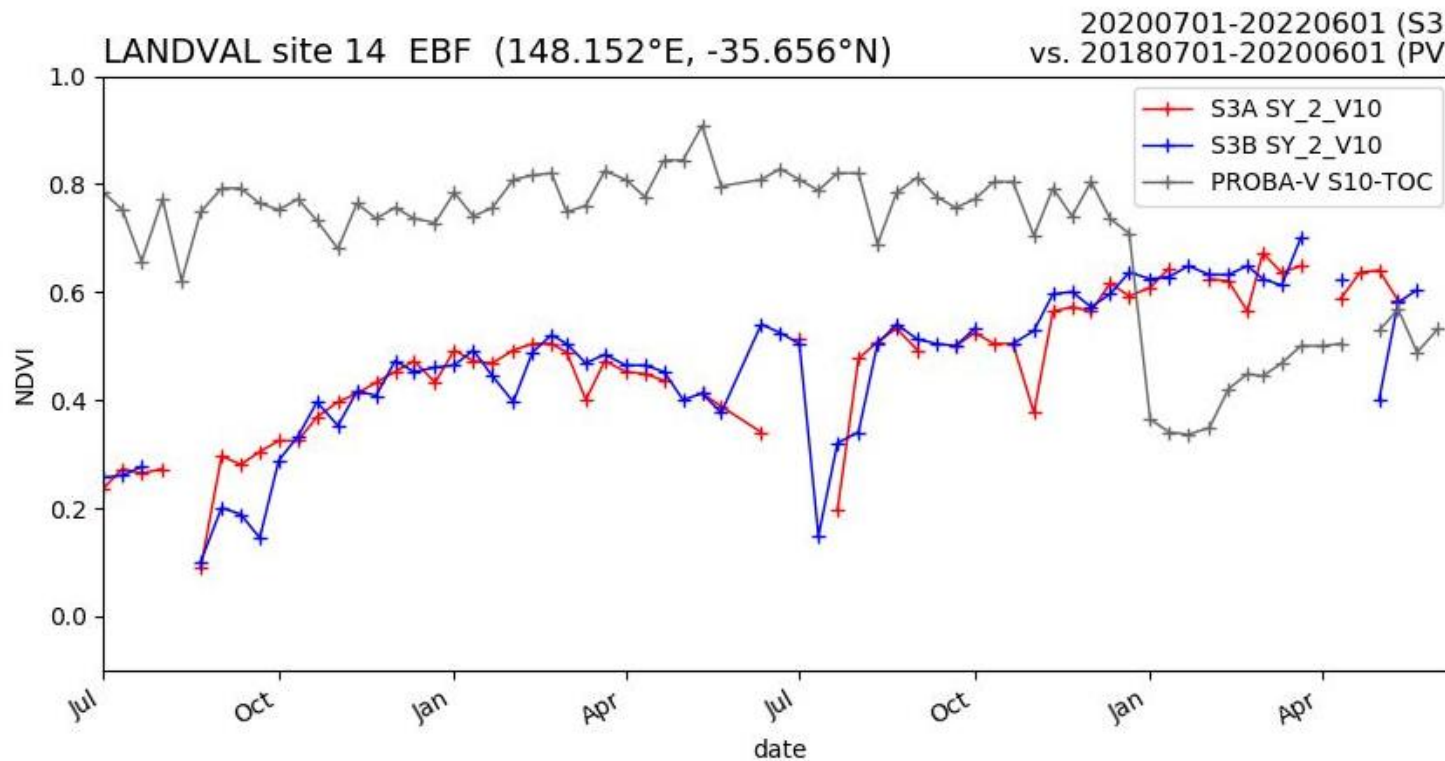


Figure 2: Temporal evolution of APU statistics between SY\_2\_V10 S3A (left) or S3B (right) and PROBA-V S10-TOC for BLUE, RED, NIR and SWIR bands (top to bottom), January/2021- September/2022 vs. January/2018- September/2019





# Apples and oranges?



Busy period ahead to make site safe & restore data stream, but we're ready! 🙌🙌 Fires at TERN monitoring sites are devastating but new #fire & #ecology #science is reason to remain positive! '19 recovery report from our Tassie SuperSite here: [tern.org.au/Newsletter-201...](https://tern.org.au/Newsletter-201...) #NCRISimpact

**Will Woodgate** @w\_woodgate · Jan 9, 2020

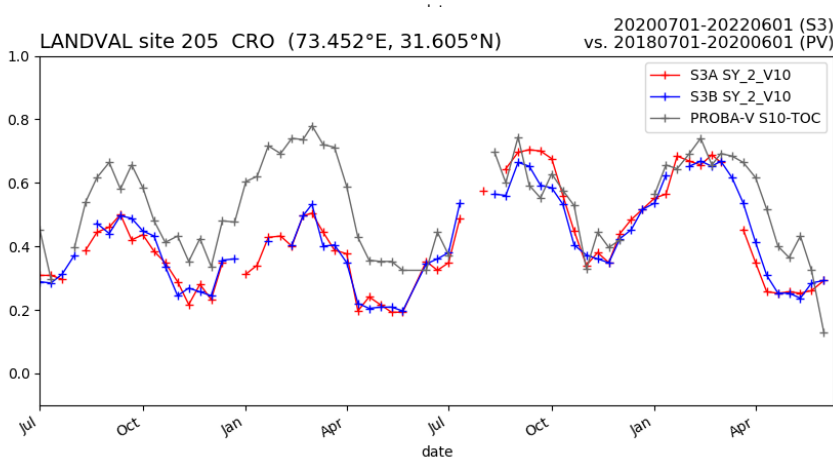
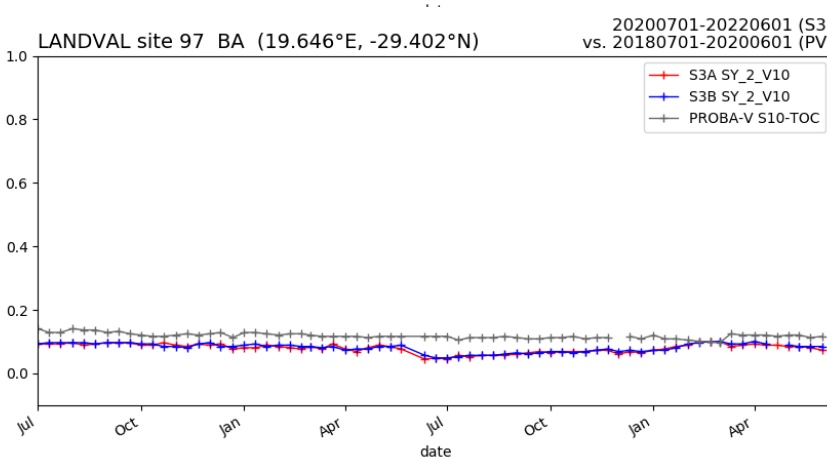
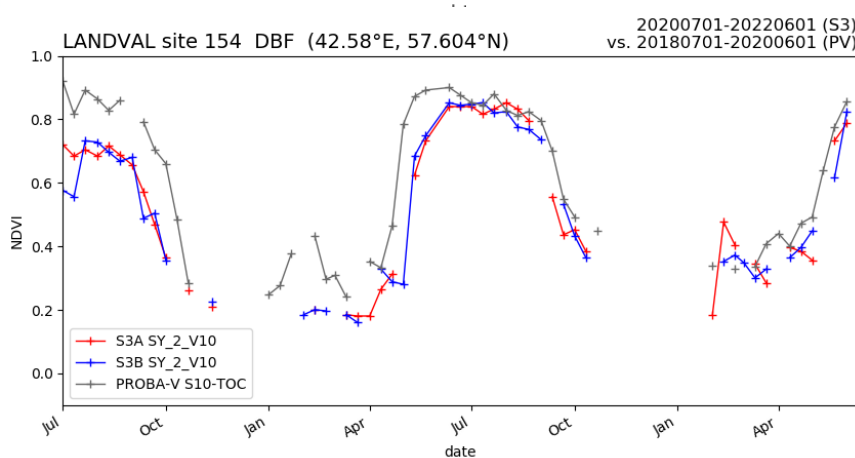
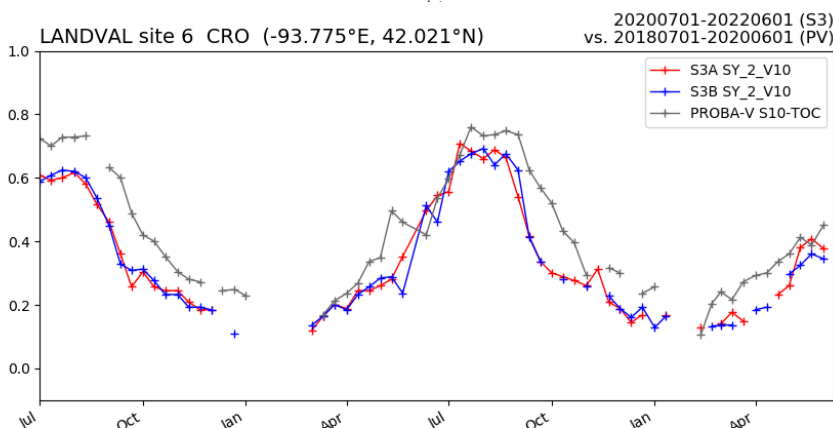
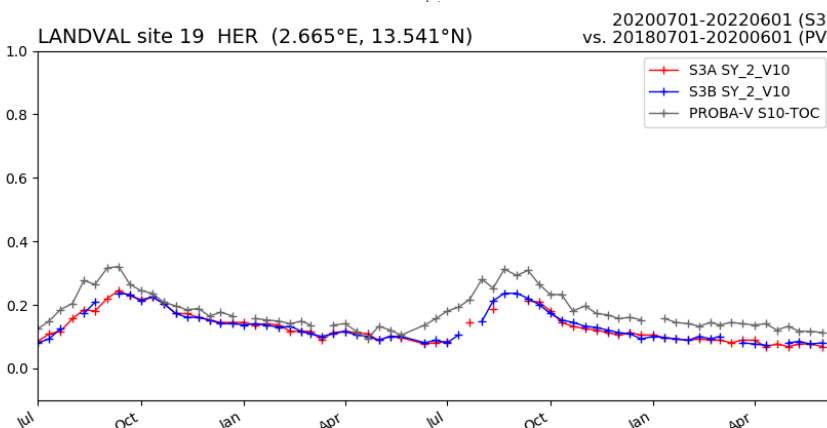
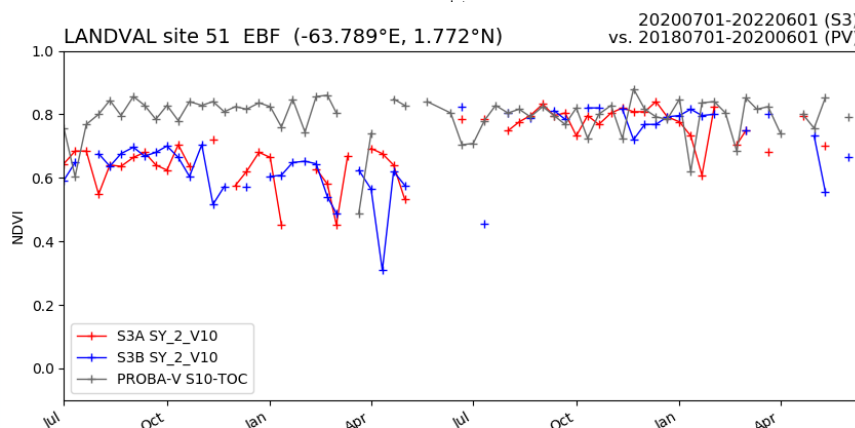
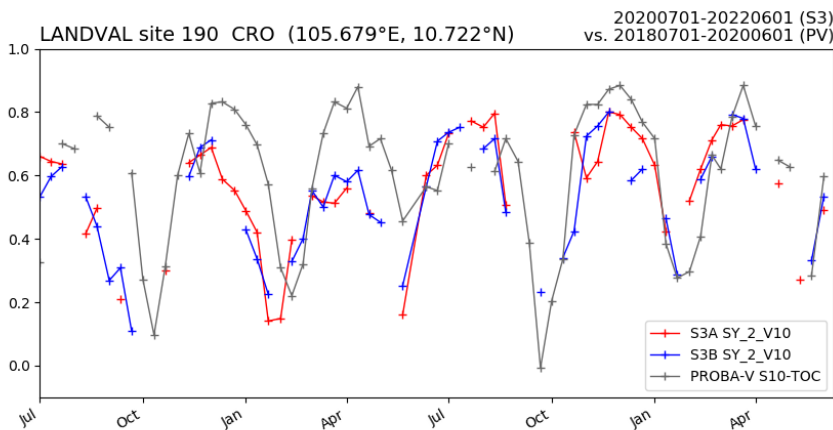
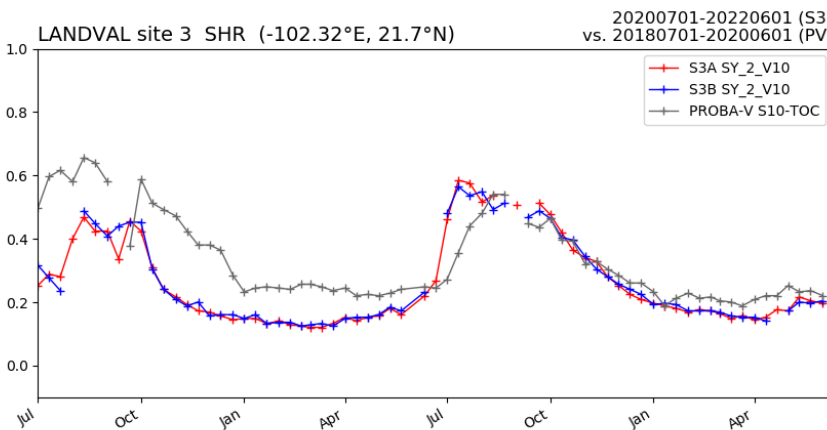
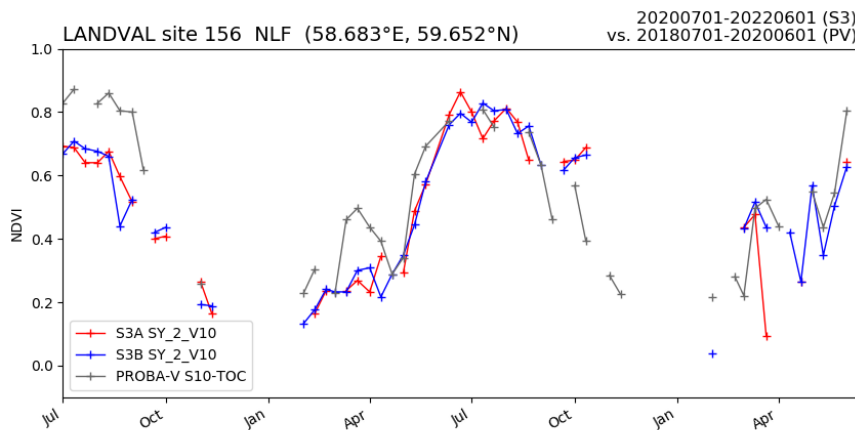
First post-fire on-ground photos from Tumberumba SuperSite show the tower upright and canopy mainly intact. The understory fire will have caused damage to ground-based infrastructure, and it may take some weeks before it's safe to enter. Photo credit: NSW FC @CSIRO @TERN\_Aus



12:58 AM · Jan 10, 2020 · Twitter Web App









## Sources of inconsistencies

- Differences in relative spectral response
- Differences in absolute calibration
- Differences in illumination and viewing angles
- Atmospheric correction
- Cloud, cloud shadow, snow screening
- ...

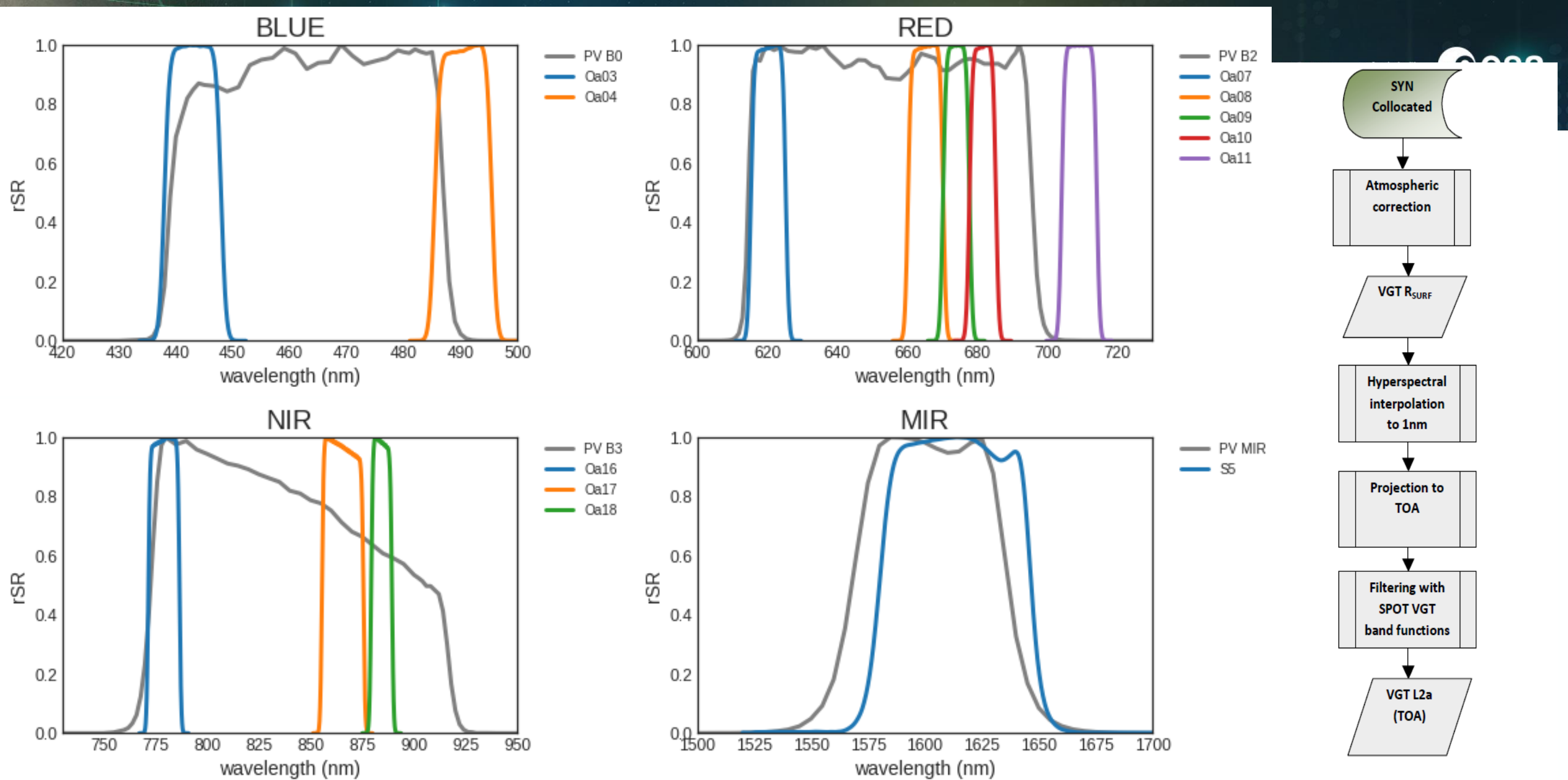
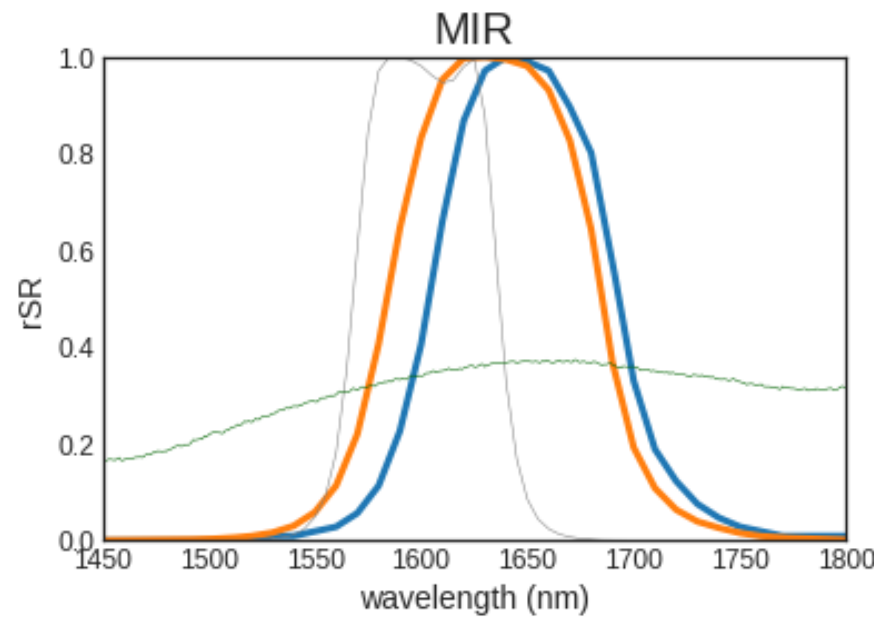
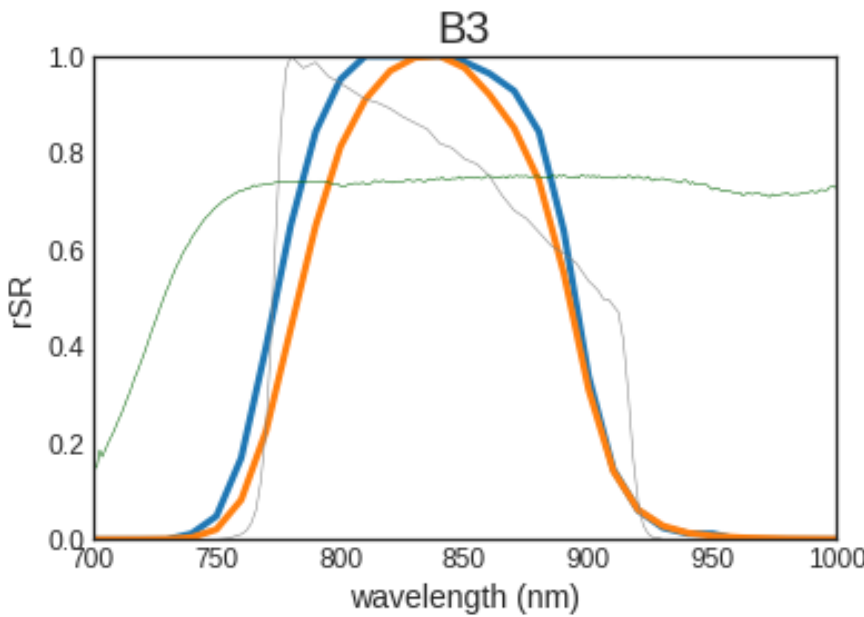
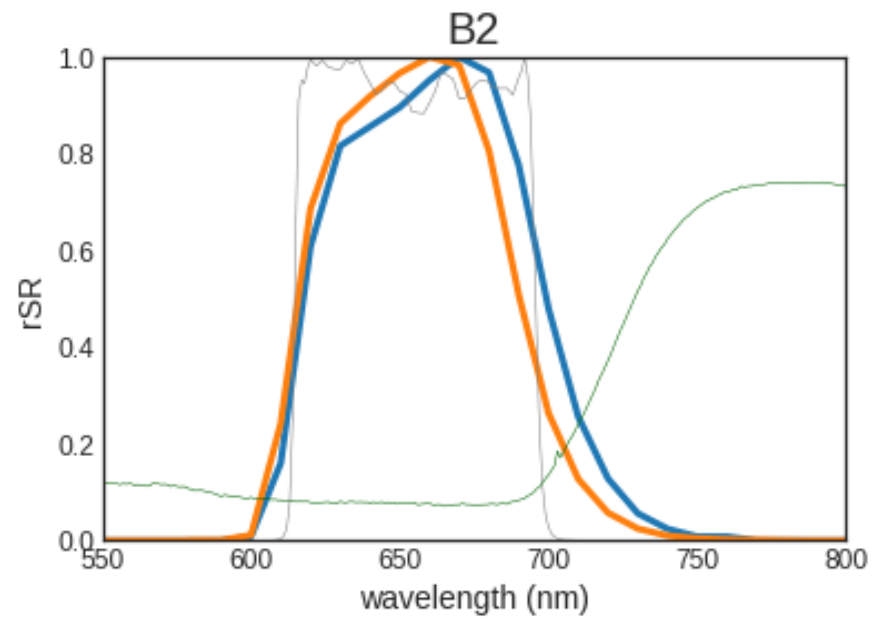
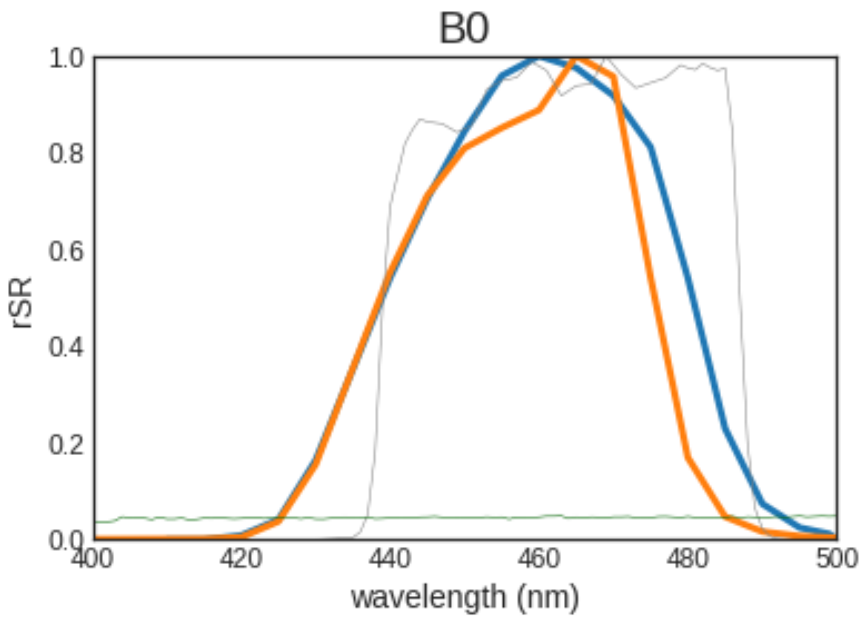


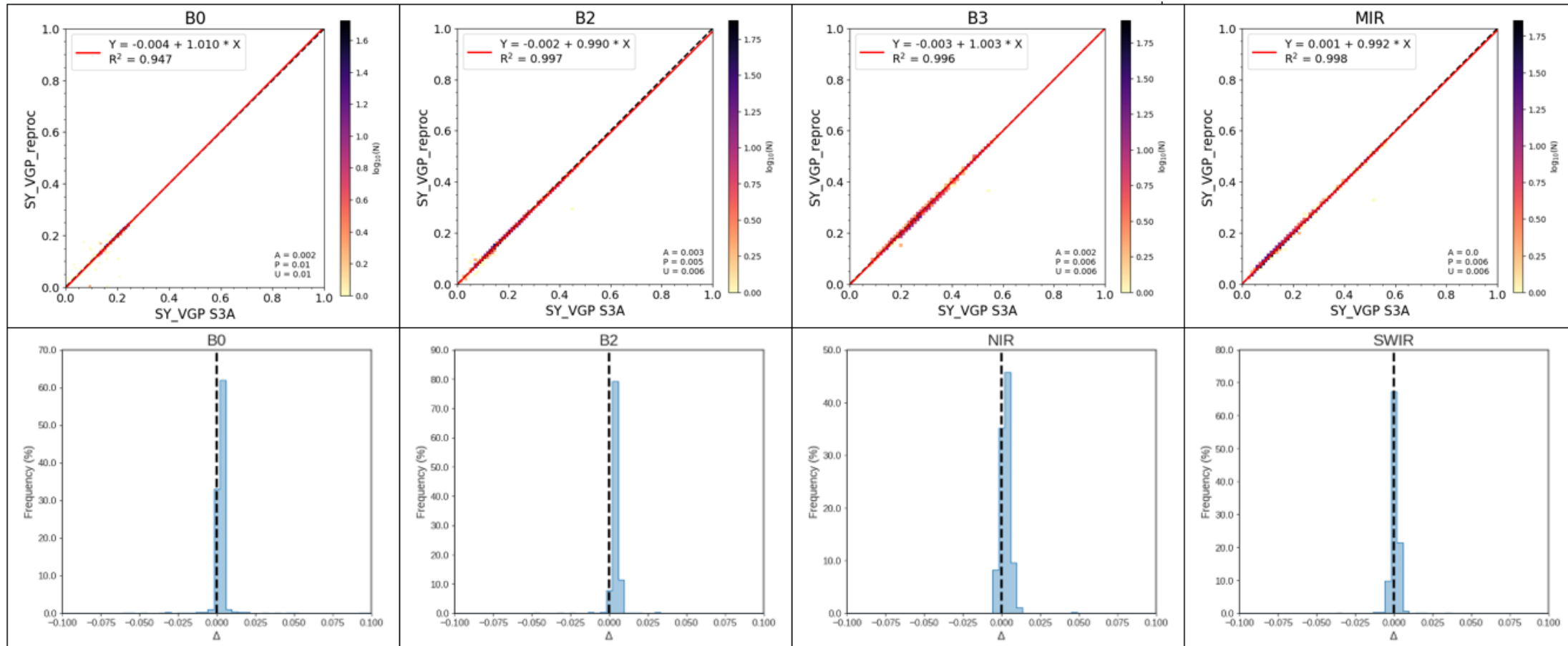
Figure 14. Overview of SPOT-VGT spectral band mapping procedure





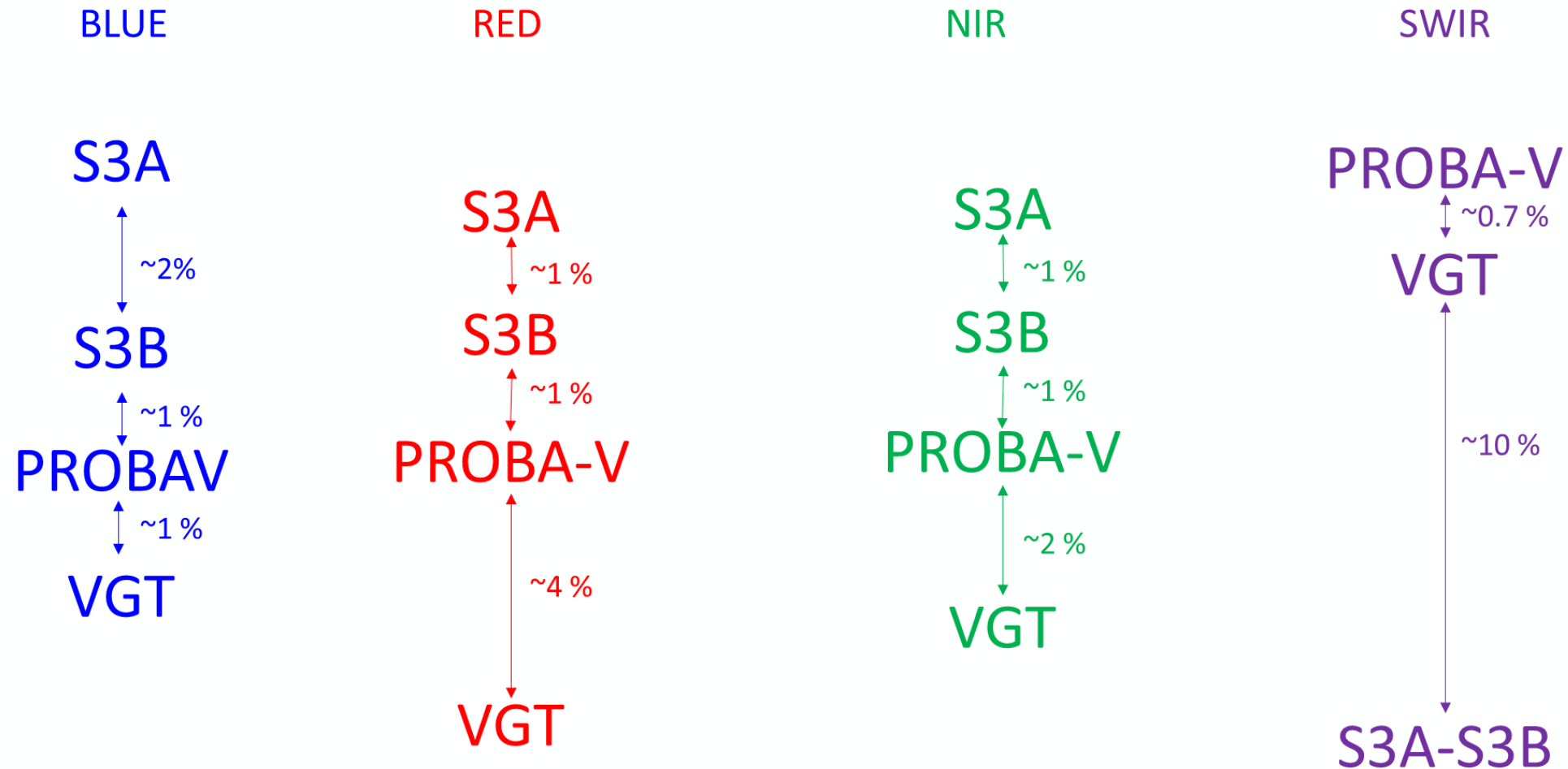


# Effect of adopting PROBA-V SRFs (vs. SPOT/VGT1)



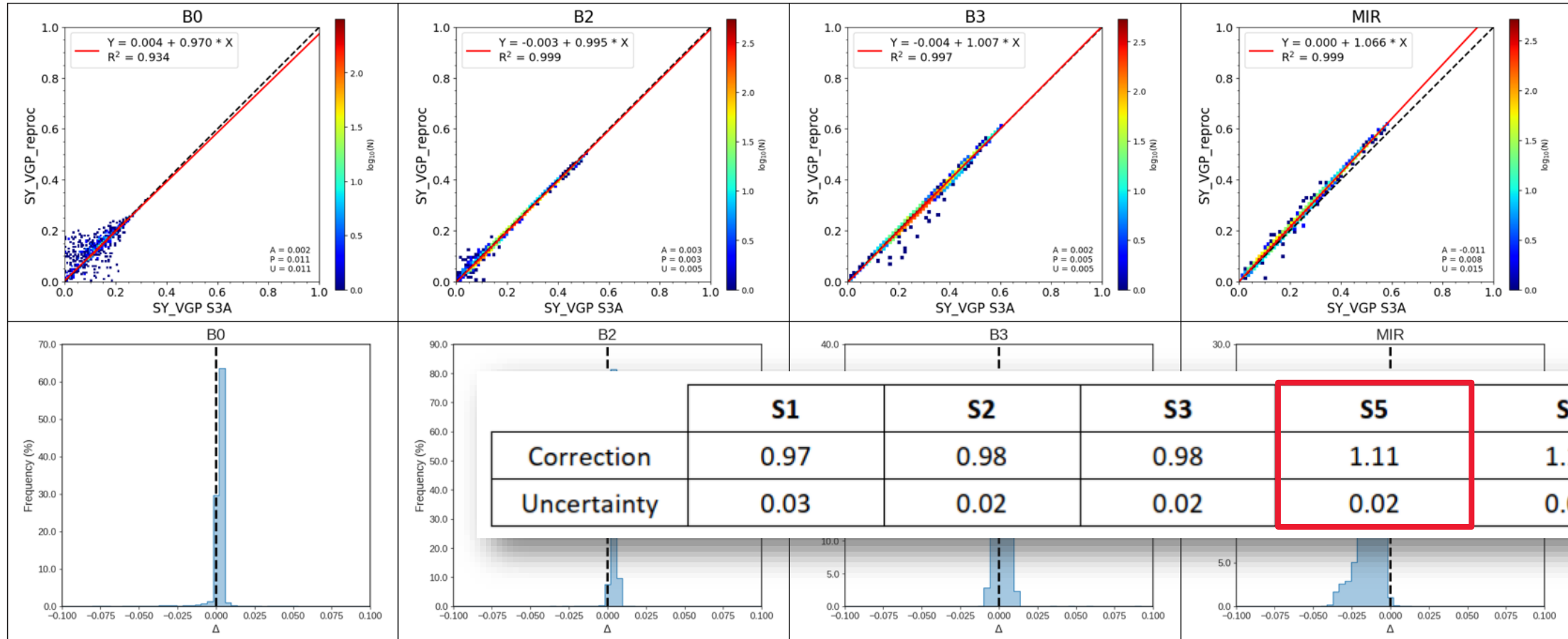
Global subsample (every  $1^\circ \times 1^\circ$ ), S3A VGP 20220314. Only observations with good radiometric quality over clear land pixels are considered.

# Relative differences in absolute radiometric calibration





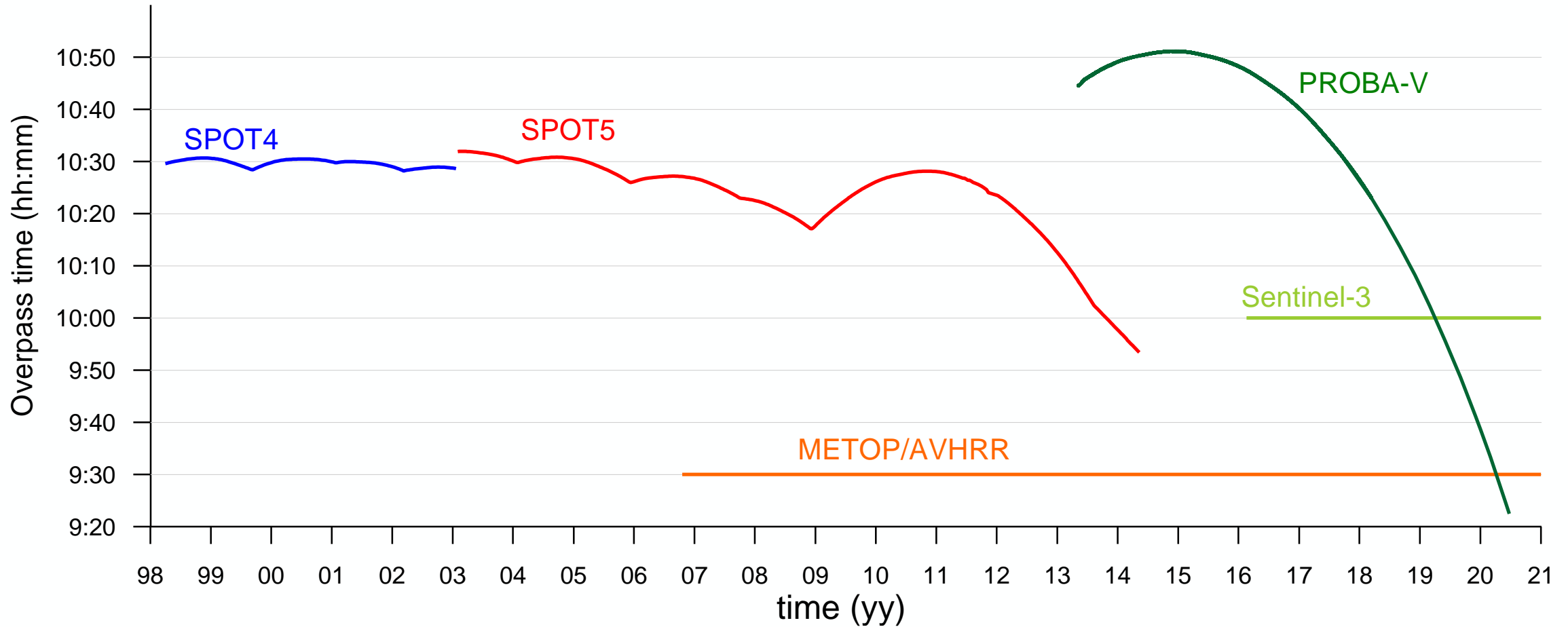
# Effect of applying radiometric calibration adjustments



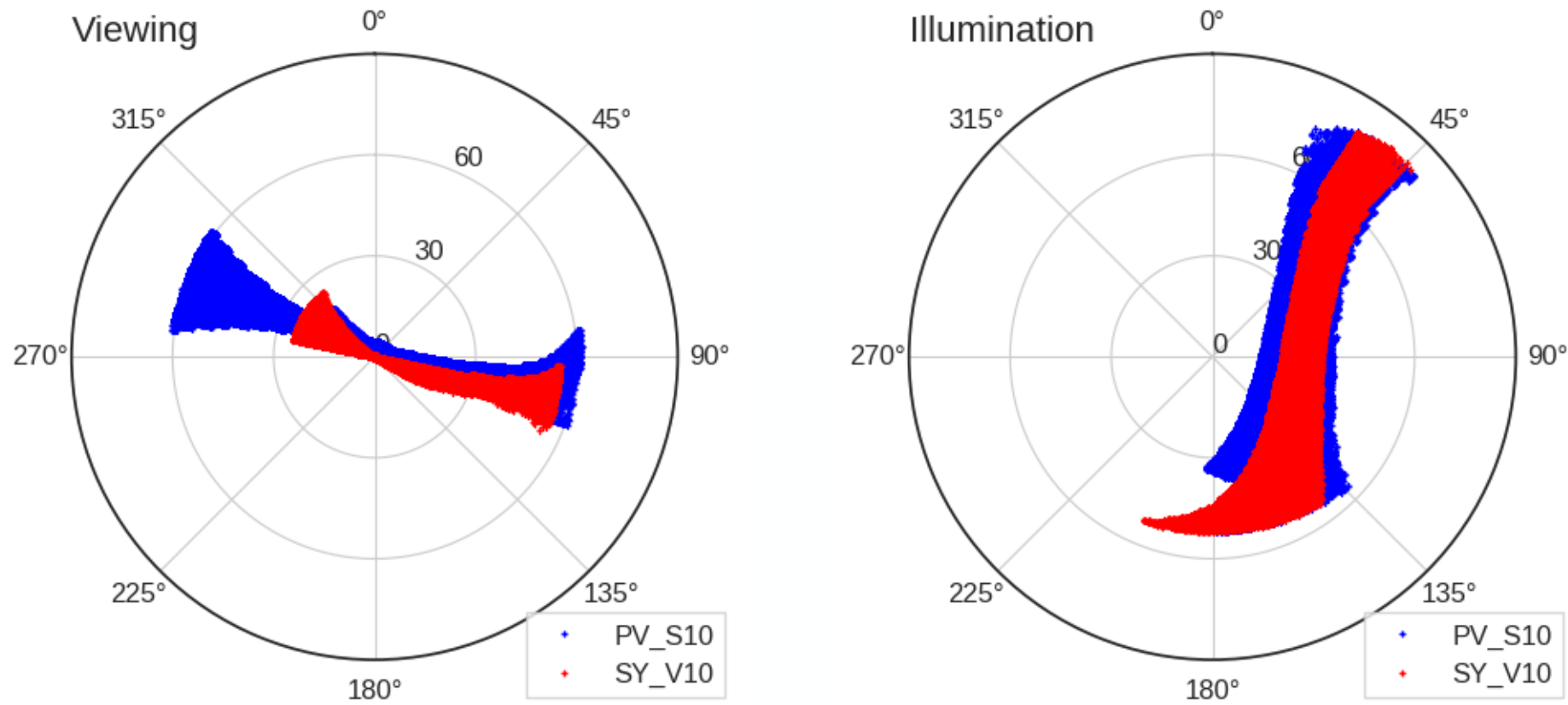
Global subsample (every 1° x 1°), S3A VGP 202203[02-05-08-11-14-17-20-23-26-29]. Only observations with good radiometric quality over clear land pixels are considered.



# Differences in illumination and viewing angles



# Differences in illumination and viewing angles



Based on global subsample SY\_2\_V10 and PROBA-V S10 over June/2019



# Differences in atmospheric correction

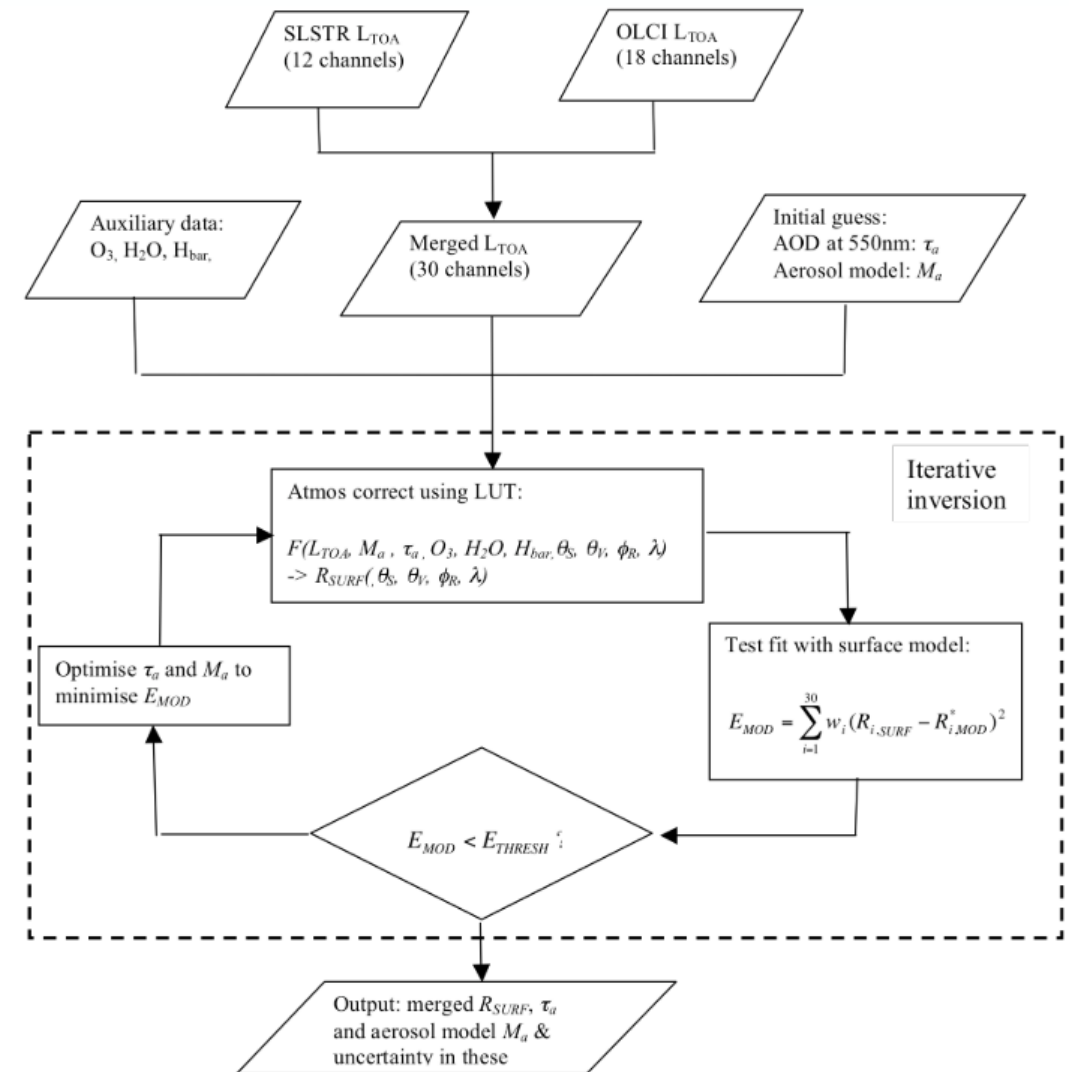
## SYN VGT

- Iterative inversion process for retrieval of atmospheric parameters and surface reflectances
- Only one aerosol model (continental)

VS.

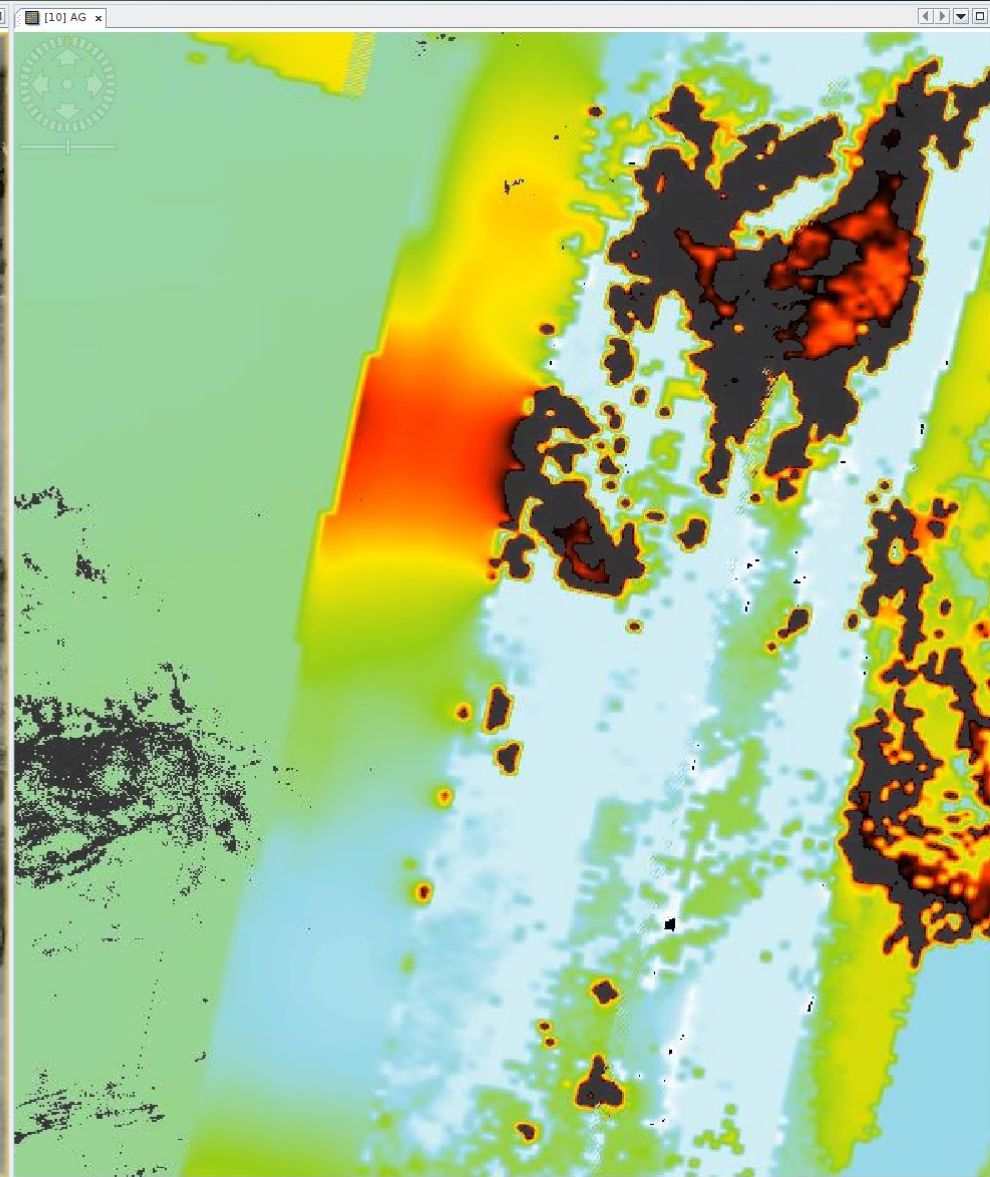
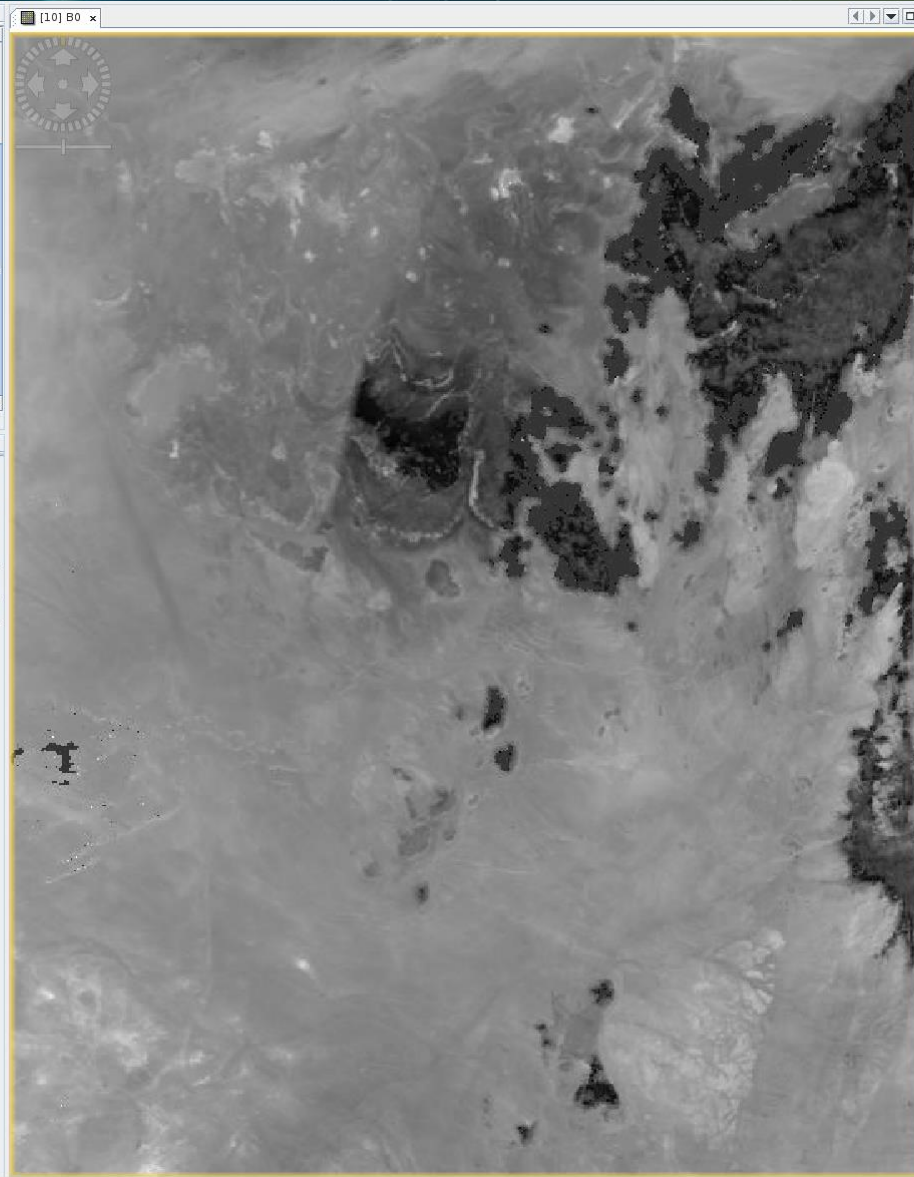
## PROBA-V Collection 2

- SMAC
- MERRA-2 input parameters
- Aerosol model based on AOT input



Product Explorer X Mask Manager Pixel Info Layer Manager

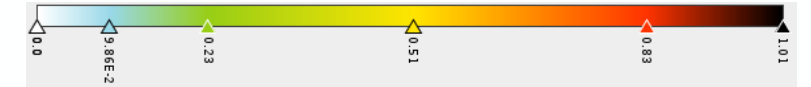
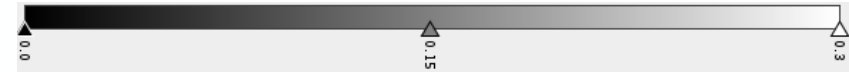
- [10] S3B\_SY\_2\_VG1\_20220405T000000\_20220405T235959\_20220407T143022\_AFRICA
  - Metadata
  - Flag Codings
  - Vector Data
  - Bands
    - AG
    - B0 (450 nm)
    - B2 (645 nm)
    - B3 (835 nm)
    - MIR (1665 nm)
    - NDVI
    - OG
    - SAA
    - SM
    - SZA
    - TG
    - TOA\_NDVI
    - VAA
    - VZA
    - WVG
  - Masks



Navigation X World View Colour Manipu... Uncertainty Vi... Layer Editor Time Series

186.45 : 1 0°

S3B\_SY\_2\_VG1 20220405 AFRICA

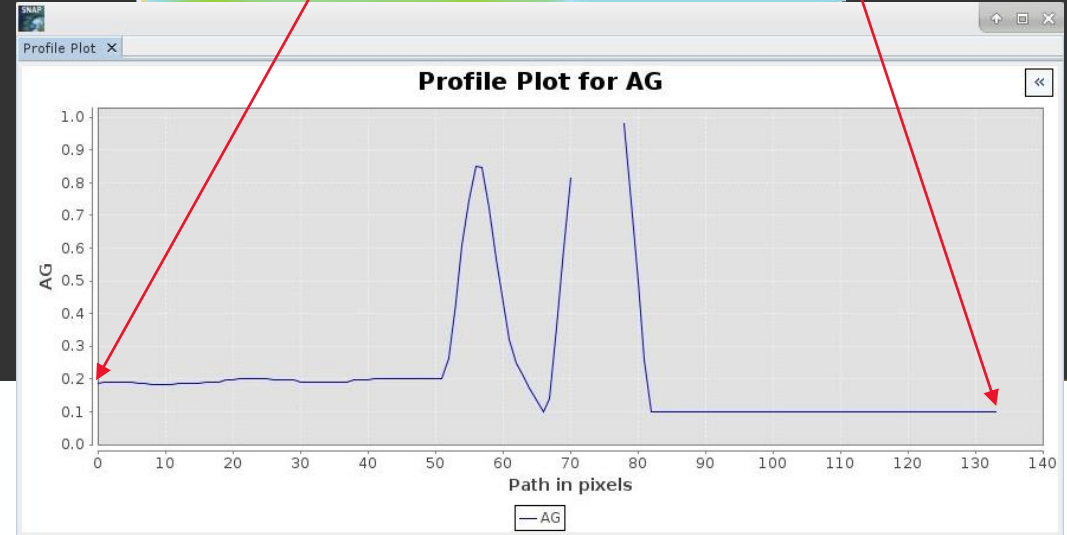
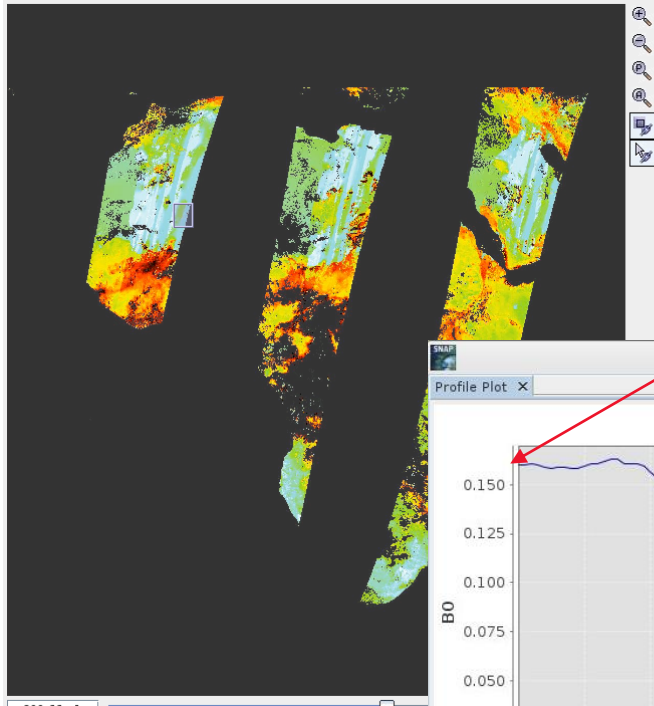
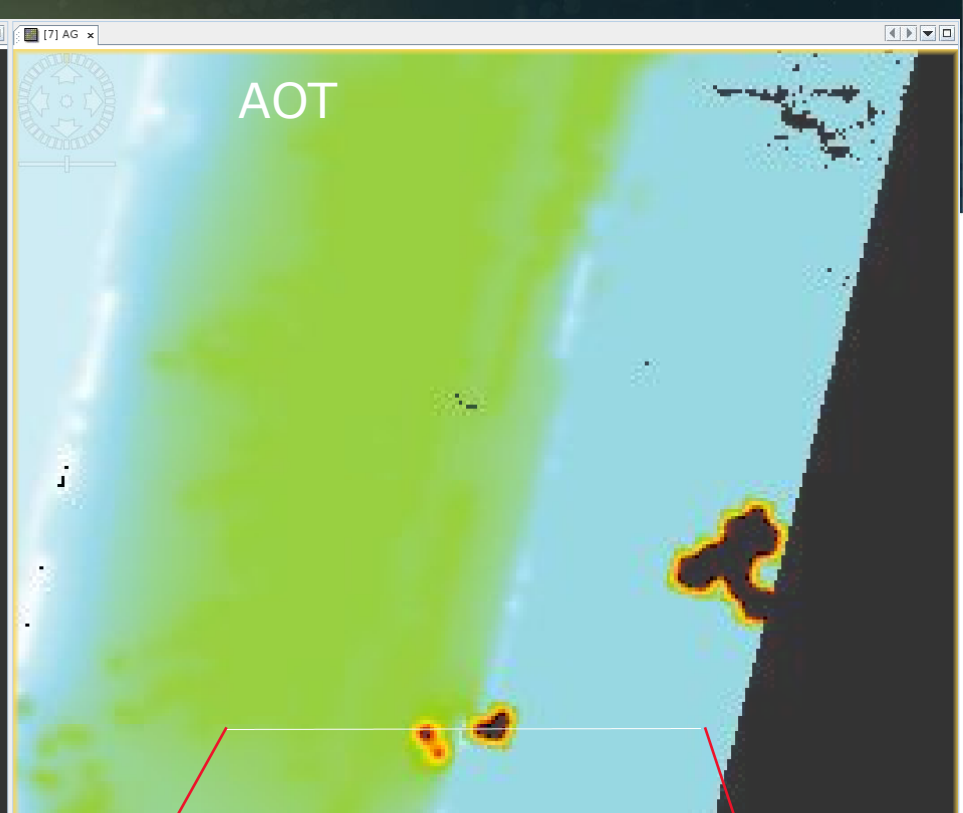
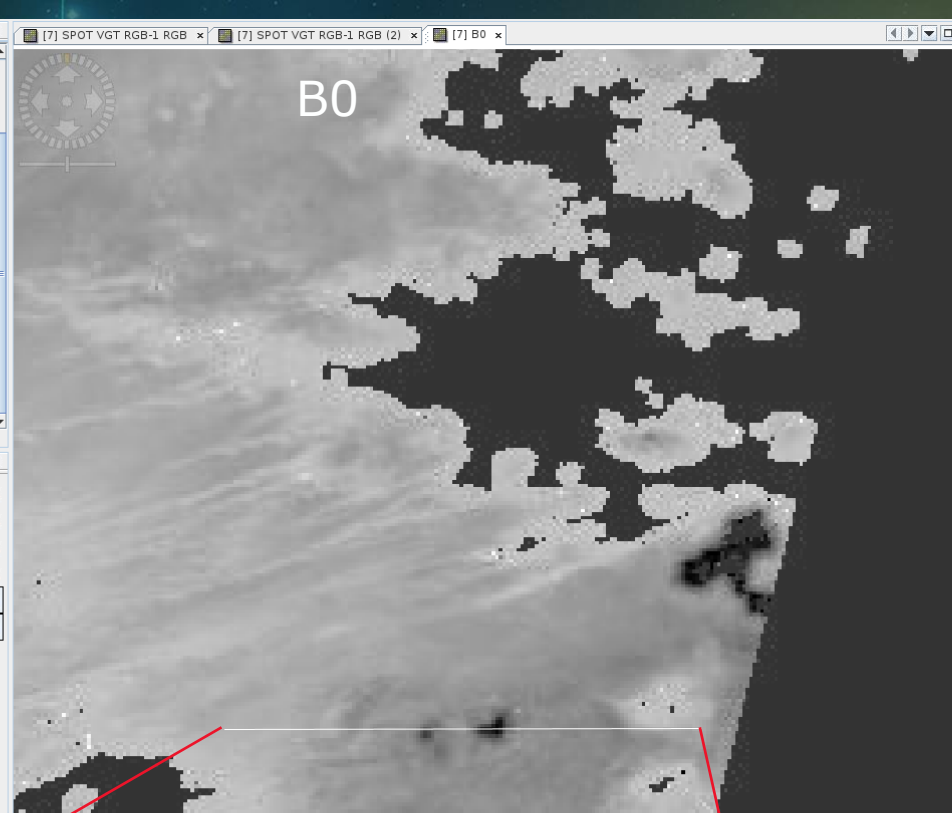


Product Explorer

- Mask Manager
- Pixel Info
- Layer Manager

[7] S3A\_SY\_2\_VG1\_20220405T000000\_20220405T235959\_20220407T201245\_AFRICA PS1

- Metadata
- Flag Codings
- Vector Data
- Bands
  - AG
  - B0 (450 nm)
  - B2 (645 nm)
  - B3 (835 nm)
  - MIR (1665 nm)
  - NDVI
  - OG
  - SAA
  - SM
  - SZA
  - TG
  - TOA\_NDVI
  - VAA
  - VZA
  - WVG
- Masks



S3B\_SY\_2\_VG1 20220405  
AFRICA







# Conclusions

- Large improvements in SYN VGT, leading to better consistency with the PROBA-V archive, but some quality issues remain open
- Adaptation of SRFs OK; Adaptation of radiometric calibration adjustment needs further analyses
- Continuous and consistent +25 years [SPOT VGT – PROBA-V – SYN VGT] archive requires SYN VGT reprocessing action
- Future validation activities in OPT-MPC
  - Continue improving OQM, automated runs, feed QM dashboard
  - Indirect comparison SYN VGT vs. PROBA-V C2 climatology
  - Indirect comparison using an external reference time series
- Release SYN VGT products on Terrascope
  - User documentation (consistency, limitations)

OPT-MPC



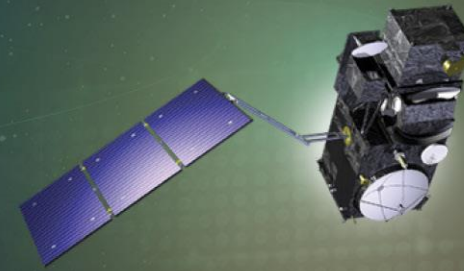




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