National Aeronautics and Space Administration

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CSDA Program – Radiometric Assessment of PlanetScope Surface Reflectance

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February 2025

Introduction

This presentation documents the NASA Commercial Satellite Data Acquisition (CSDA) Program's assessment of the radiometric quality of PlanetScope data provided by Planet Labs, Inc. The CSDA Program focused on assessment of the PlanetScope NIR band and used data from NASA's well-calibrated MODIS instrument aboard the Aqua satellite as the primary calibration reference source.

Numerous "match-ups", or comparisons expressed as the ratio of the surface reflectance from various instruments, are provided in the following charts. The match-ups were performed using the globally distributed BELMANIP sites.

BELMANIP = Benchmark Land Multi-Site Analysis and Intercomparison of Products (Baret et al, 2006)
https://calvalportal.ceos.org/web/olive/site-description

Match-ups of PlanetScope SuperDove (PSB.SD) NIR surface reflectance & NASA Aqua MODIS NIR surface reflectance

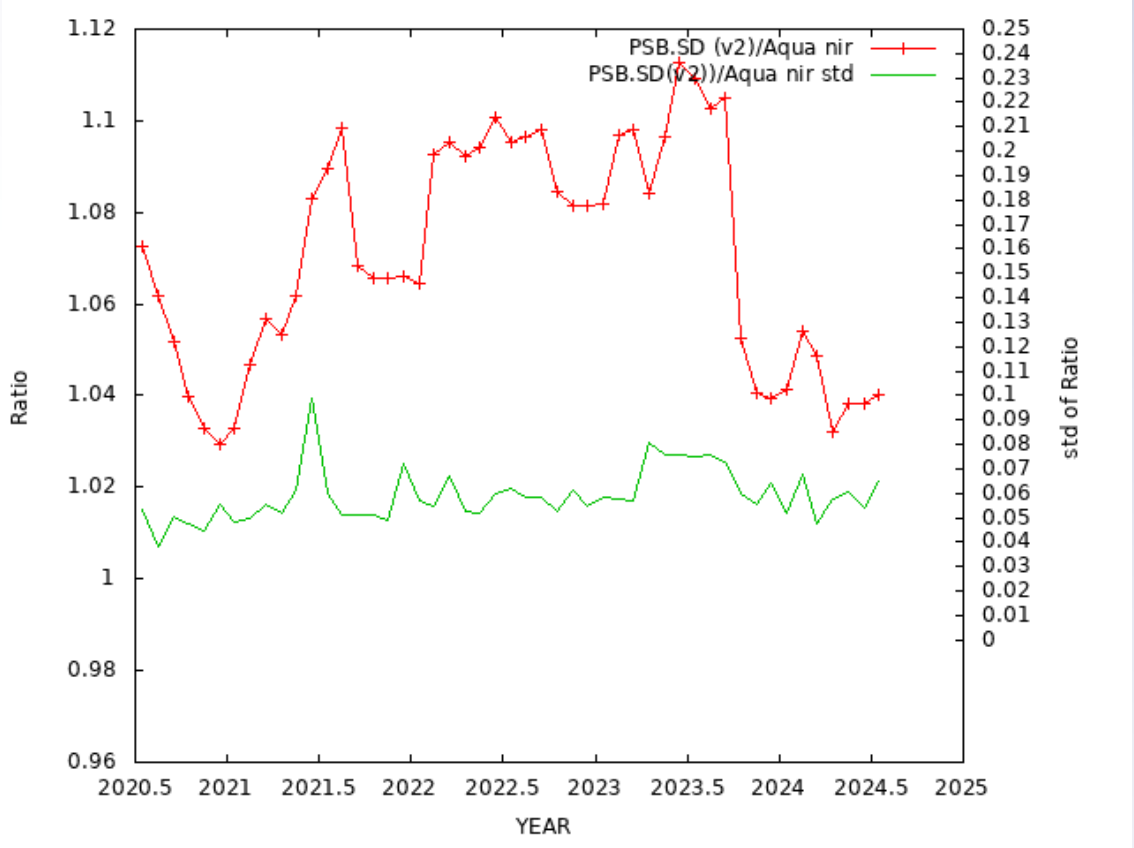


Fig. 1 Planet and Aqua MODIS NIR band 2 match-ups

Note - Planet updated their PlanetScope radiometric calibration and reprocessed their data on 7/18/23

The calibration ratio for each satellite is approximately stable over time, but differs from satellite to satellite

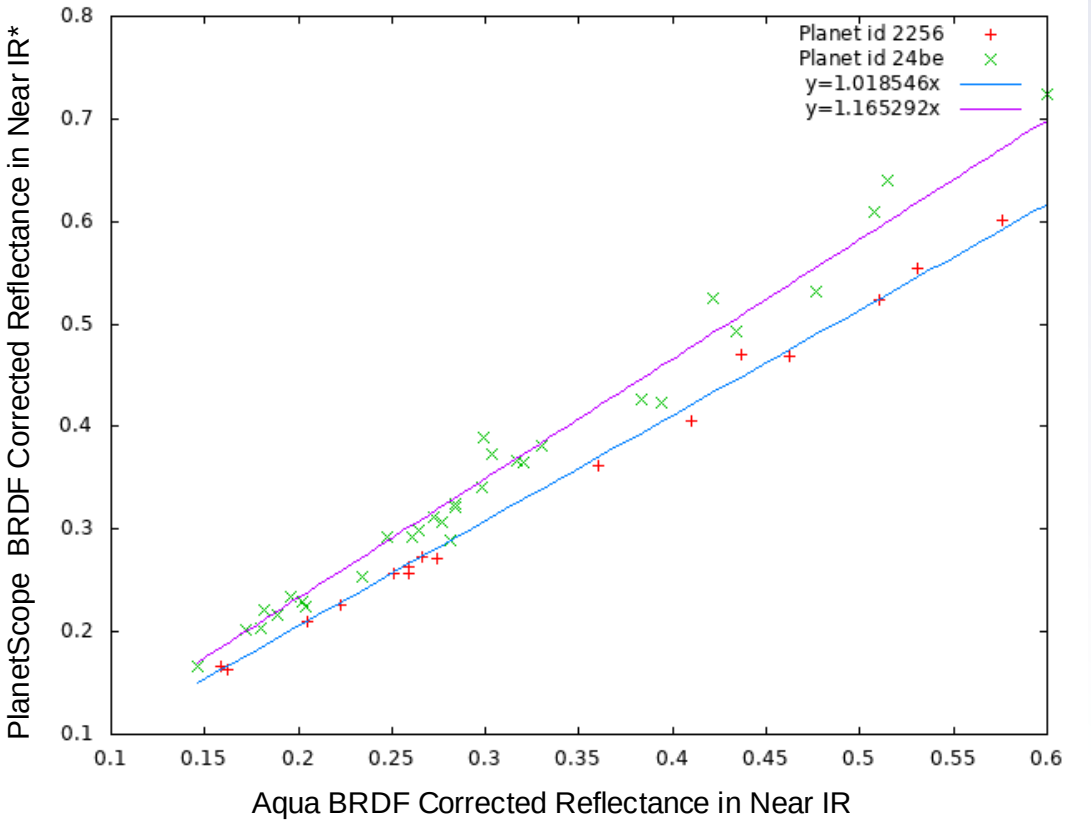


Fig. 2 Comparison of Aqua and PlanetScope BRDF-Corrected Reflectance in NIR for multiple sites and times for 2 PlanetScope satellites

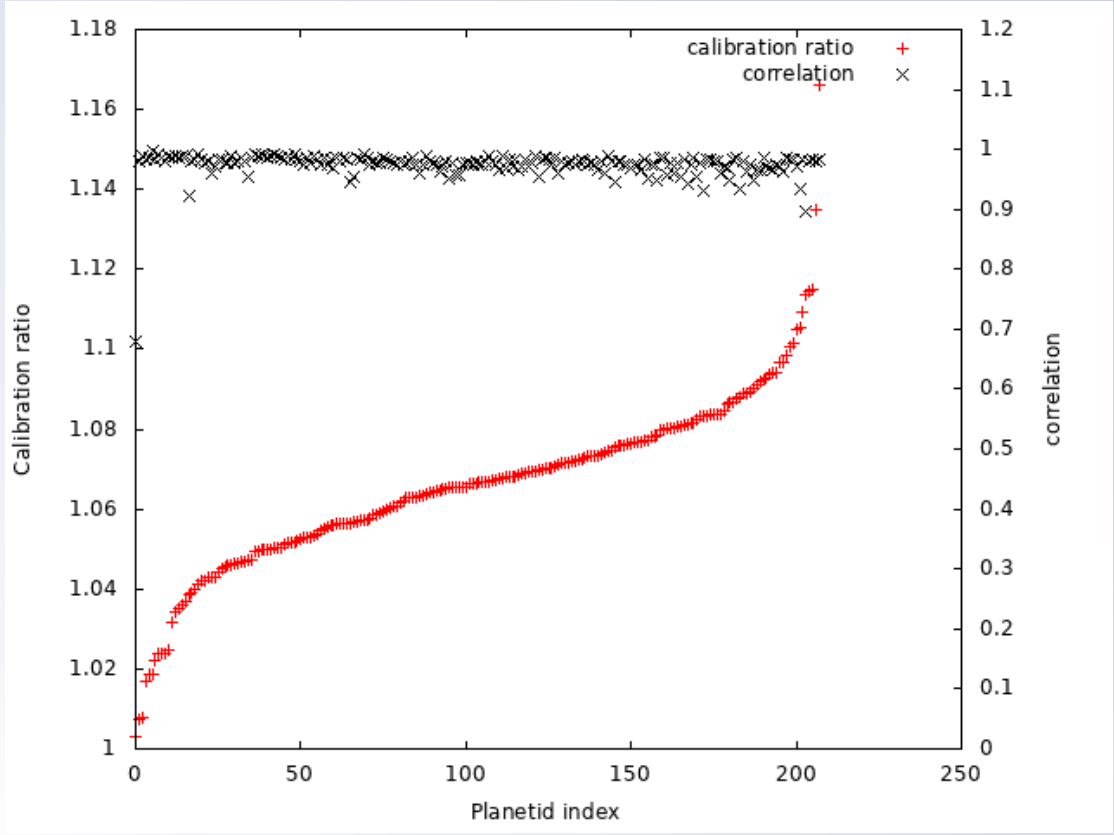


Fig. 3 Calibration ratio* and correlation** for PlanetScope satellites***

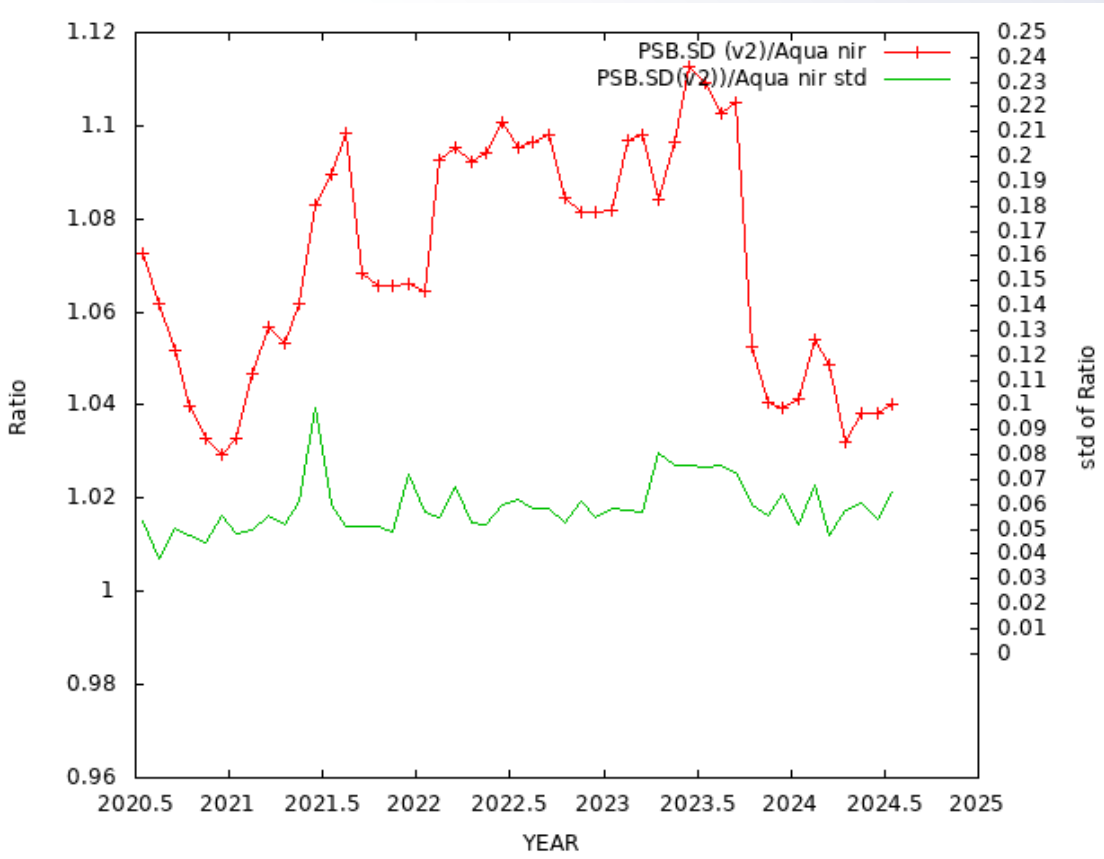
* Calibration ratio: ratio of Planetscope SuperDove (PSB.SD) NIR surface reflectance to MODIS Aqua NIR surface reflectance

** Correlation – timeseries are correlated between Aqua and Superdove reflectance for multiple sites – **correlation is Pearson (r^2)**

*** Each Planetid index corresponds uniquely to a Planetscope satellite

Recalibration by NASA of each PlanetScope satellite

Recalibration uses a fixed calibration ratio for the full time period



Original data (Fig. 1)

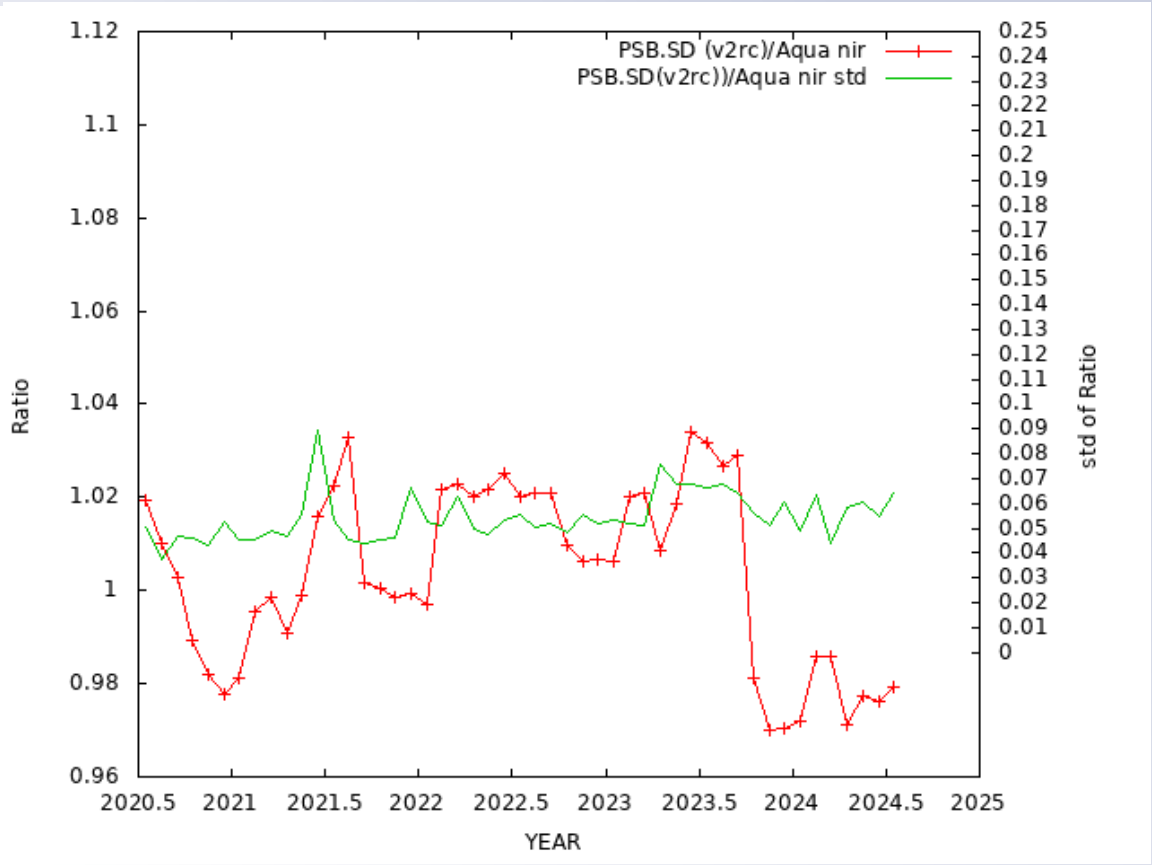


Fig. 4 Recalibration by NASA of data from Fig. 1

Calibration ratio:
ratio of PlanetScope SuperDove (PSB.SD) NIR surface reflectance to NASA Aqua MODIS NIR surface reflectance

Summary

- PlanetScope overall calibration shows important month to month variation when compared to Aqua over BELMANIP sites from 1.03 (min) to 1.11 (max) so a range of +/- 0.04
- Sentinel 2 calibration assessed using the same method is more stable showing variation from 1.00 (min) to 1.02 (max) so a range of +/- 0.01
- PlanetScope individual satellite calibrations are relatively stable over time (the mean of the standard deviations is 0.06 based on individual matchups)
- PlanetScope data recalibrated by NASA shows improved performance with variation from 0.97 (min) to 1.03 (max), a range of +/- 0.03
- Additional results using Terra/Aqua show variation from 0.985 (min) to 1.00 (max), a range of 0.0075 (see Appendices A and B)

Appendix A
Terra/Aqua Match Ups & PlanetScope/Aqua Match Ups

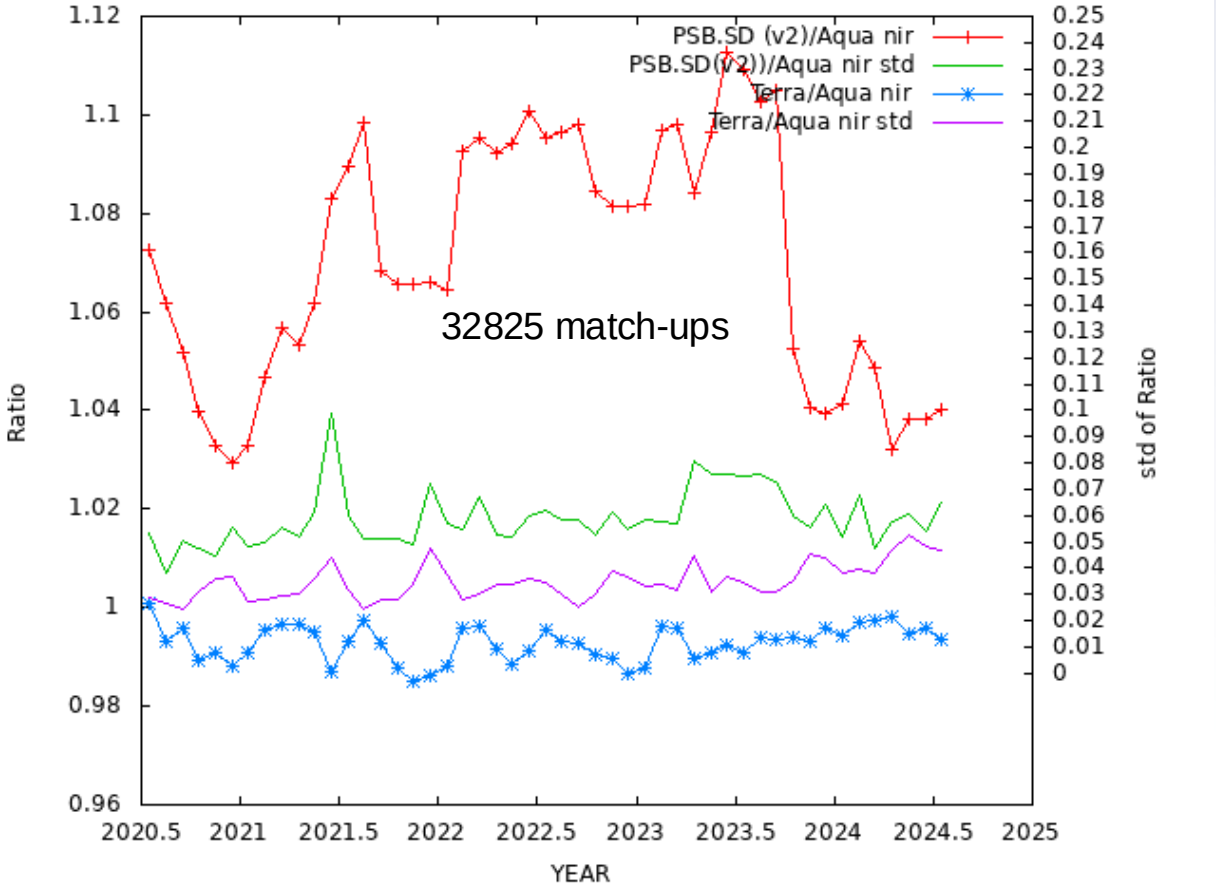


Fig. 1 Planet and Aqua MODIS NIR band 2 match-ups and Terra/Aqua MODIS NIR band 2 match-ups

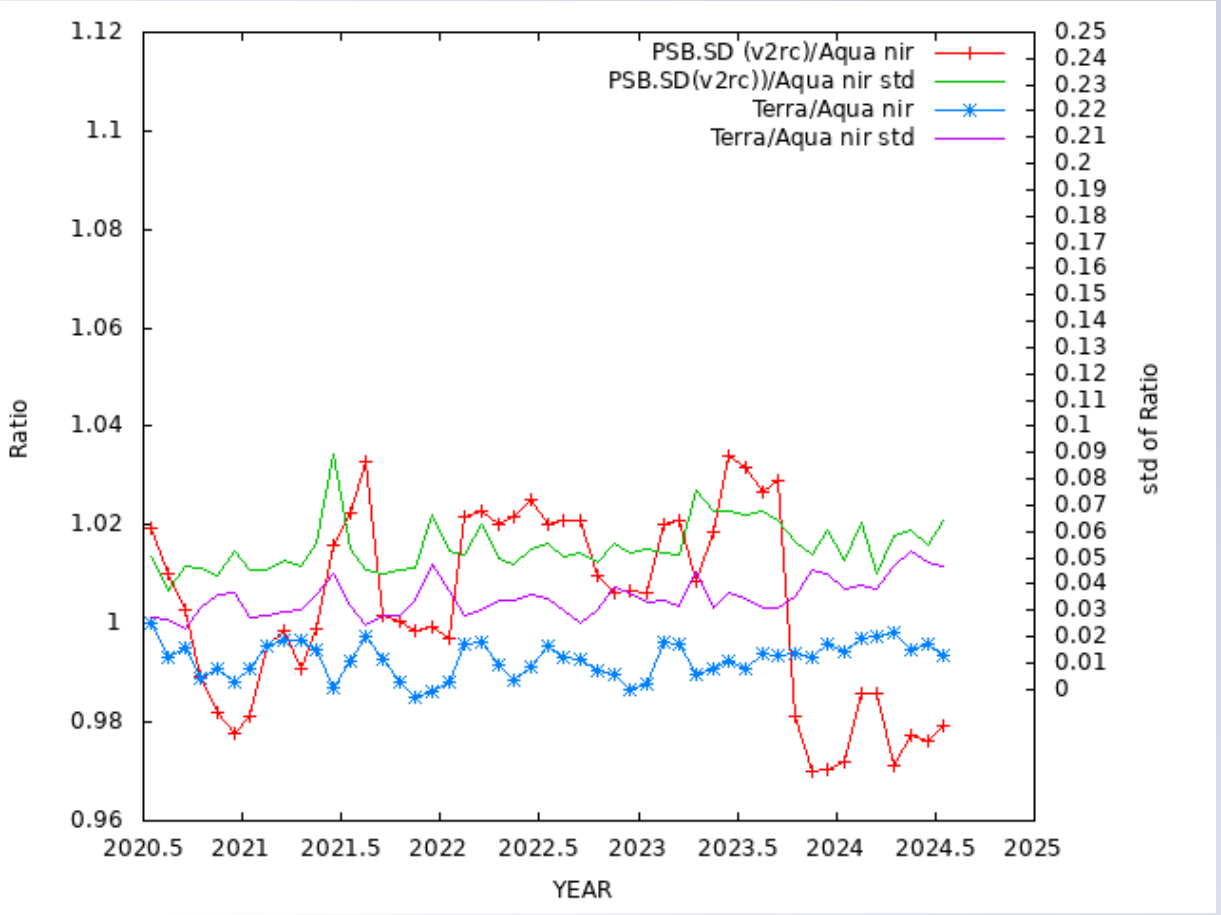


Fig. 2 Recalibration of the Planet data from Fig. 1

Appendix B - Sentinel-2 and MODIS Match-ups

Below are the ratios of the ESA Sentinel-2 NIR surface reflectance (SR) to NASA Aqua MODIS NIR SR (red) and NASA Terra to Aqua MODIS NIR SR (blue) for both Sentinel Narrow (left) and Wide NIR bands (right)

This slide demonstrates that the SR from Sentinel-2 and MODIS (Terra & Aqua), for an invariant target, are very similar and are relatively constant over time.

In the previous slide, NASA uses MODIS Terra & Aqua SR as the standard for evaluating the PlanetScope SR. NASA understands that Planet uses Sentinel-2 for radiometric calibration of PlanetScope data.

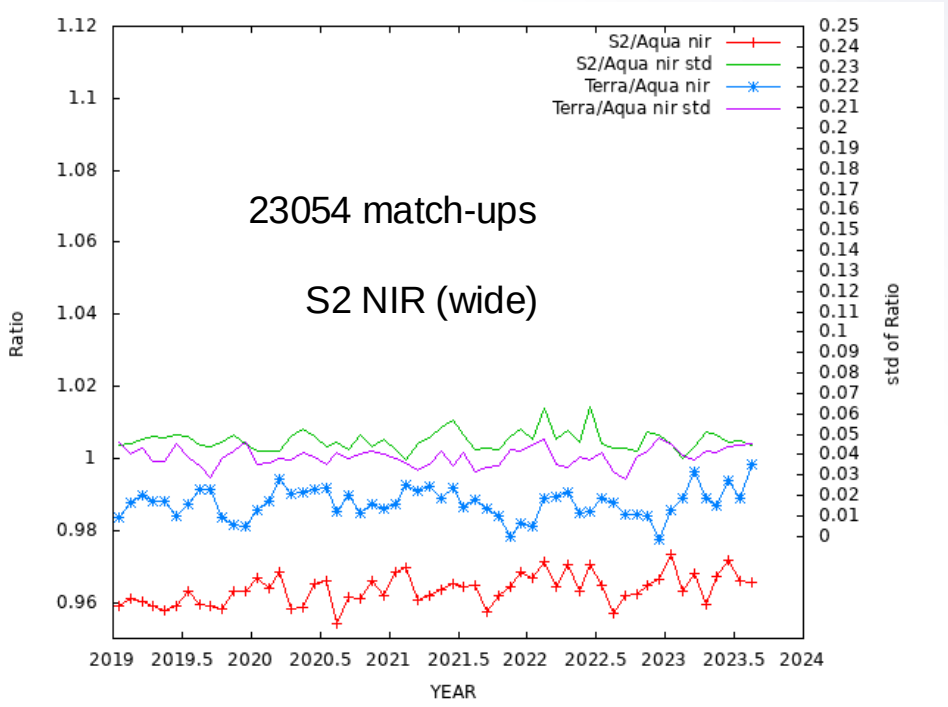


Fig. 1 Sentinel-2 NIR and Aqua MODIS NIR match-ups and Terra/Aqua MODIS NIR match-ups

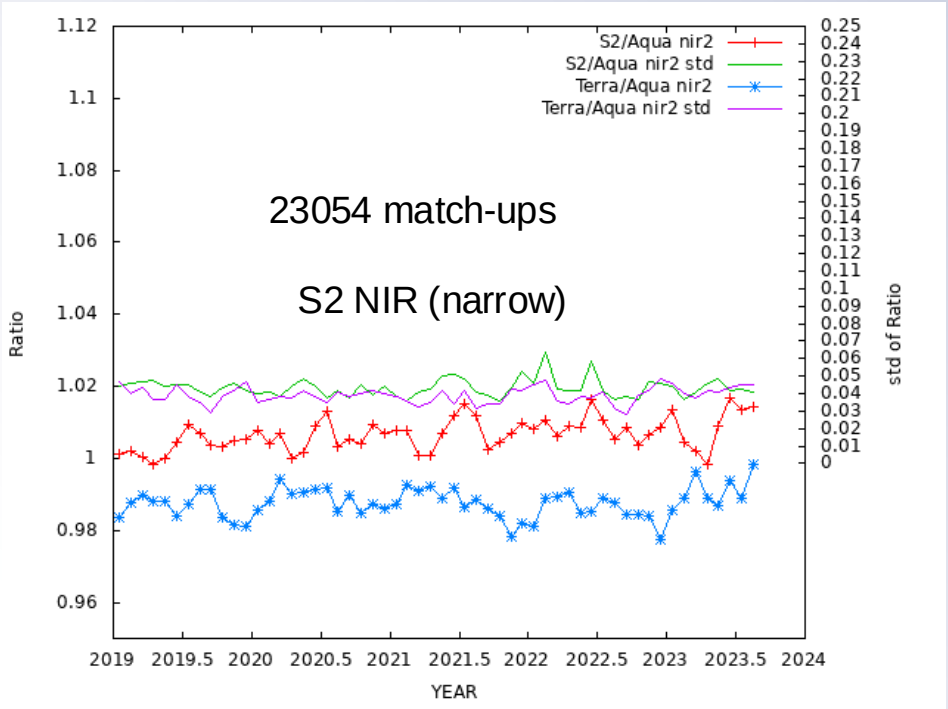


Fig. 2 Sentinel-2 NIR2 and Aqua MODIS NIR match-ups and Terra/Aqua MODIS NIR match-ups

Questions?

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