Comparison between Landsat-8 OLI and PROBA-V over Libya-4 Pseudo Invariant Calibration Site (PICS)

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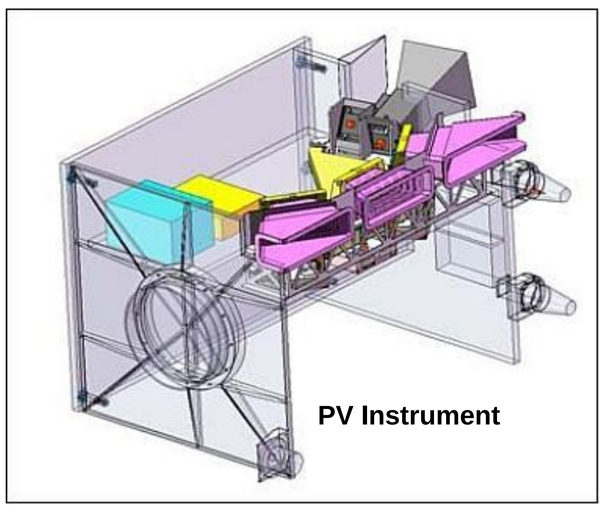
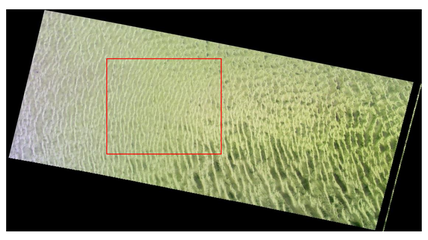
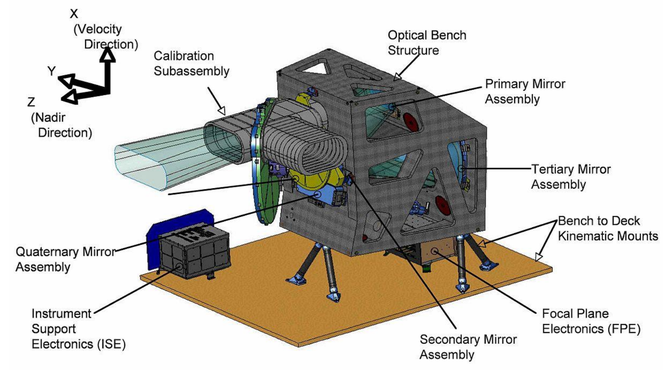




Libya 4 scene with Region Of Interest



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Landsat 8 OLI and PROBA-V

Sensor intercomparison is a technique often used for vicarious calibration. It is essential to estimate the performance of a spectral instrument with respect to others. Different initiatives exist, like the ESA/CEOS IVOS intercomparison workgroup, giving calibration and validation teams the opportunity to intercompare methods and sensors [1].
It is obvious to make a comparison between instruments that have equal or even overlapping response curves.
With the Landsat8 OLI and PROBA-V instruments, such overlap is present for three visible (BLUE, RED,NIR) and one SWIR band.
Direct comparison of both instruments is done using the OSCAR desert method. For OLI, the model of the South Dakota State University applied to all bands, as well the OSCAR method.
The comparison has been done over the so called Lybia-4 PICS site. It is a well known site, often used for vicarious calibration.

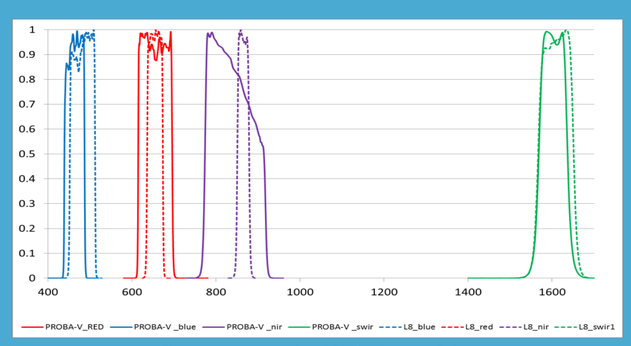

Figure 1 : overlapping RSR for PV and OLI.

Comparison between PROBA-V and OLI using OSCAR

Method

The method used in the comparison between PROBA-V and OLI is described in [2] and is part of the OSCAR facilities developed at Vito [3]. This method compares simulated top of atmosphere (TOA) reflectances with the observed reflectances acquired by the instrument. A characterisation of the surface BRF and aerosol phase function for Libya-4 was part of the PROBA-V pre-launch preliminary work. The method is applicable for any sensor, provided the RSR is known. The result of one scene is the spectral band absolute calibration parameter, which is the fraction of measured and simulated TOA reflectances.

$$A_k = \frac{\rho_{k\,meas}}{\rho_{k\,sim}}$$

With k spectral band. Figure 2a shows for both sensors monthly averages of Ablue. Figure 2b is the fraction of the overall average Ak for both sensors.

Results

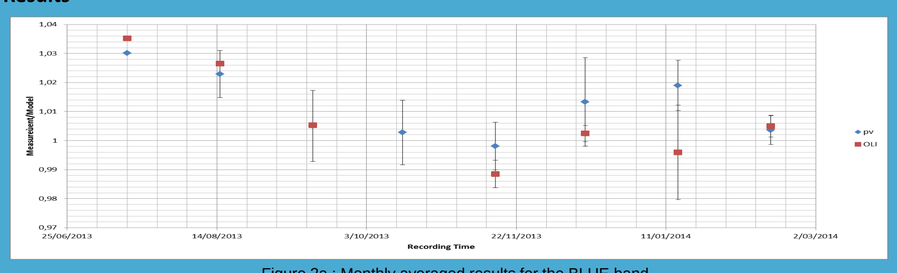

Figure 2a : Monthly averaged results for the BLUE band.

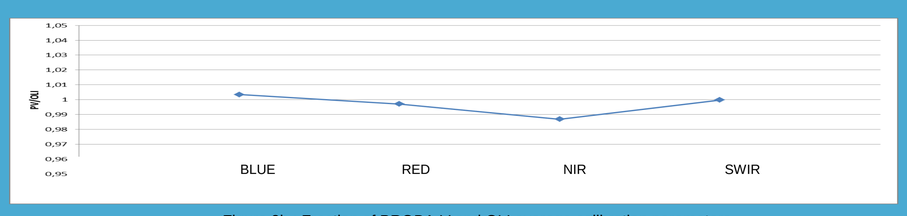

Figure 2b : Fraction of PROBA-V and OLI average calibration parameters

Comparison of both models applied to OLI

Method

This empirical method is described in [4] and [5] and uses Terra MODIS as a calibrated radiometer and EO-1 Hyperion to derive the spectral signature of the target (Libya 4). Empirical BRDF model has been derived using Terra MODIS ans EO-1 Hyperion for Solar Zenith Angle and Viewing Zenith Angle (upto 18 Degrees). The model has been validated with different suites of sensors such as Landsat 7 ETM+, Aqua MODIS, Rapid Eye, UK-2 DMC with an accuracy of ~3% and uncertainty of 2%.
The resulting model is of the form

$$\rho_{Libya\,4}(\lambda, SZA, VZA) = \frac{K(\lambda) * \rho_h(\lambda) * f_A(t)}{[1 - (SZA - 30°) * m_1(\lambda) - VZA(\lambda) * m_2(\lambda) - (VZA)^2 * m_3(\lambda)]}$$

K = scaling factor, ρ_h= spectral content of the scene, $f_A(t)$ = atmospheric model
The BRDF was scaled to 30 degrees solar zenith angle, The BRDF coefficients for view zenith angle were derived using Hyperion measurements (± 18 deg)

Results

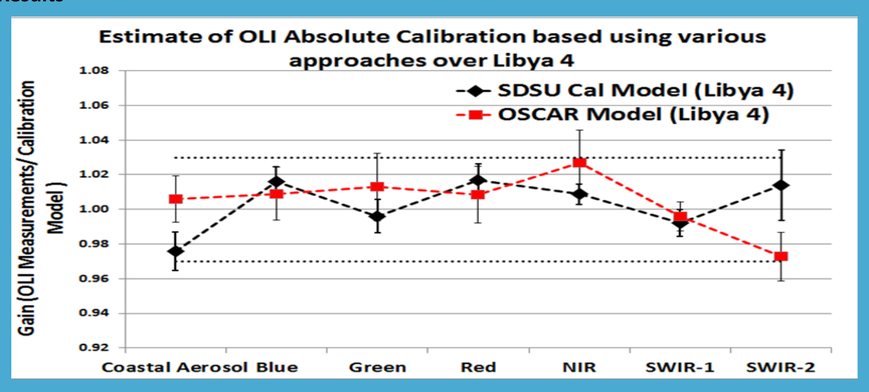

Figure 3 : Results from both methods for Landsat 8 OLI all bands

Conclusion

After inter comparing both PROBA-V and OLI instruments with the OSCAR desert absolute calibration method above the Libya-4 PICS, it can be concluded that both sensors have radiometric performances which are well within requirements. All comparable bands are, on average, well within 3% for absolute calibration.
With Landsat 8 OLI, both methods reproduce quite well the same calibration factor, with deviations within 3%, apart from SWIR-2.

References

1. Adriaensen, S., et al. (2012). “CEOS IVOS WG4 intercomparisons”, CEOS Cal/Val Portal
2. Sterckx, S. , S. Livens, S. Adriaensen (2013). “Rayleigh, Deep Convective Clouds, and Cross-Sensor Desert Vicarious Calibration Validation for the PROBA-V Mission”. IEEE Transactions on Geoscience and Remote Sensing **51: 3**, pp.1-16.
3. Govaerts, Y., S. Sterckx, S. Adriaensen (2013). “Use of simulated reflectances over bright desert target as an absolute calibration reference”. Remote Sensing Letters **4:6**, pp. 523-531.
4. D. L. Helder, K. J. Thome, N. Mishra, G. Chander, X. Xiong, A. Angal and T. Choi, "Absolute Radiometric Calibration of Landsat Using a Pseudo Invariant Calibration Site," *IEEE Transactions on Geosciences and Remote Sensing,* vol. 51, no. 3, pp. 1360-1369, 2013.
5. N. Mishra, D. L. Helder, A. Angal, T. Choi and X. Xiong, "Absolute Calibration of optical satellite sensors using Libya 4 Pseudo Invariant Calibration site," *Remote Sensing,* vol. 6, no. 2, pp. 1327-1346, 2014.

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