

PICSCAR

WGCV/IVOS Working Group on

Pseudo Invariant Calibration Sites Characterization

- PICSCAR Summary IVOS#31 -

PICSCAR

Main objectives:

- **Sharing experience acquired on PICS by different ‘calibration’ teams**
- **Update PICS characterization, assess sites performance and display them on an open website**
- **Provide access to methods description and tools for calibration and cross calibration over PICS**

First focus on Libya 4

PICSCAR activity since IVOS#30

Regular webex meetings:

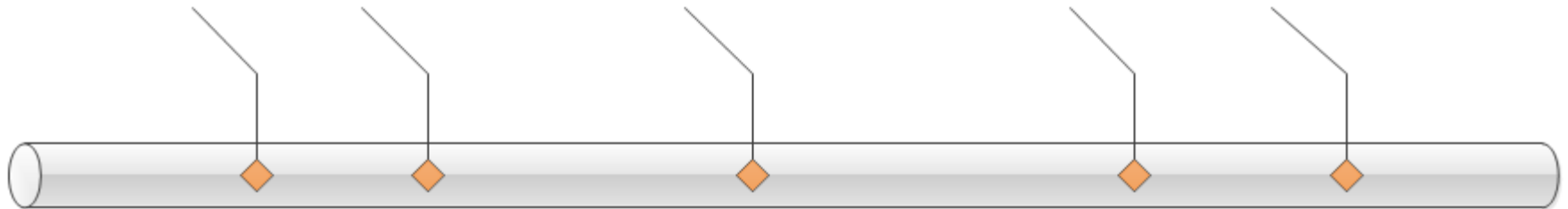
22/05/2018

02/07/2018

18/09/2018

19/12/2018

08/02/2019



27/03/2018

IVOS30

27/03/2019

IVOS31

with: SDSU, CNES, JPL, Argans, ESA

+ Dedicated bilateral meetings (phone discussion)

PICSCAR IVOS#31 overview

PICSCAR Working Group Report:

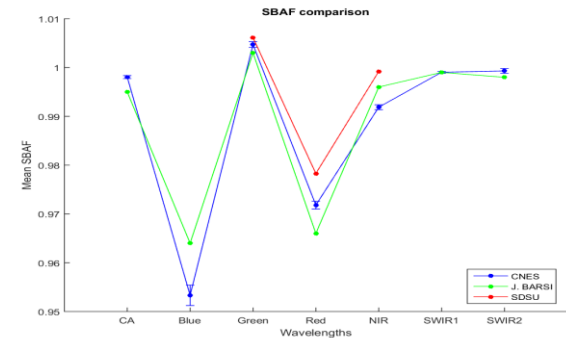
- **Overview of one year of PICSCAR activities**
 - Spectral correction for intercalibration over PICS
 - Libya_4 stability assessment
 - PICSCAR intercalibration exercises
 - Set up of a multi 'team' Landsat_8 / Sentinel_2A intercalibration monitoring
- **The PICSCAR WebSite**

Presentation of complementary activities relative to PICS:

- **Last results of the PICSAND study – ONERA/NOVELTIS/LSCE - ESA**
- **PICS quality assessment based on Sentinel_3A – CNES**
- **PICS trending analysis – USGS/SDSU**
- **Sentinel_2 / Landsat_8 intercalibration over PICS – Argans - S2MPC**

Main conclusions about spectral correction

- **Strong impact of spectral correction for intercalibration**
 - Depends on spectral bands width and on position in the spectrum
 - Different methods:
 - Generic SBAF (Spectral Band Adjustment Fonction) computation
 - Direct spectral resampling using sensors measurements
 - Band to band comparison (no spectral correction)
 - Difference in SBAF computation according to:
 - Reference spectral profiles (Hyperion or...)
 - Spectral resampling and spectral bands shape assumptions
 - TOA or BOA
 - **Direct spectral resampling**
 - Only possible for **multispectral** reference sensor
 - Band to band comparison
 - Can induce 10% error...
 - **Major interest for a better spectral characterization**
 - Laboratory measurements (PICSAND)
 - Hyperspectral sensors (AHSI, PRISMA...)



Main conclusions about sites stability

- **Through analysis of different sets of data (different sensors, different teams)**
 - **Good confidence in site stability for several PICS including Libya_4, Libya_1, Algeria_3, Algeria_5...**
 - **But... difficult to assess precisely this stability**
 - **Several interpretation for 'stability'**
 - **Pertinent parameters to be defined and assessed**
 - **Top priority for the PICSCAR Working Group**

- **Through analysis of different calibration methods (different teams)**
 - **Site stability not always mandatory**
 - **Important for absolute calibration monitoring**
 - **Often little or less important for sensors cross calibration (site homogeneity may be more important)**
 - **BRDF stability to be considered**
 - **TOA or BOA stability ?**

Completion of intercalibration exercise#1

Calibration exercise#1:

- Comparison of calibration method using a common provided dataset
- Landsat 8 calibration vs Sentinel 2a calibration

Results are expressed as the ratio of band L8/S2A

IC L8/S2A	Green	Red	NIR
CNES	1.005	0.997	0.996
SDSU	0.992	0.987	0.992
JAXA/EORC	0.991	0.972	0.989
PICSCAR	0.993	0.996	0.993
TPZ	1.007	0.973	0.997
Argans MPC	1.002	1.009	0.994

Results presented on the PICSCAR WebSite with calibration methods description

'Multi team' L8/S2A intercalibration monitoring over Libya_4

- Extension of PICSCAR exercise#1 for intercalibration monitoring over Libya_4
- Publication, every 6 months, of the L8/S2A intercalibration results over Libya_4 performed by the different PICSCAR teams
 - Already accepted by 4 teams: SDSU, CNES, Argans/S2MPC, PICSCAR
- Results available through the PICSCAR Web Site

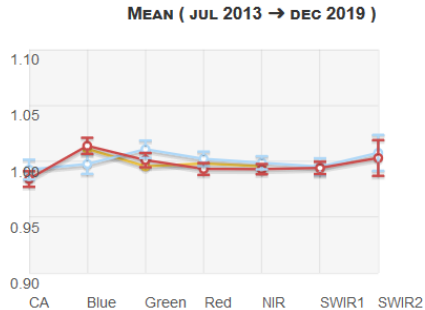
Calibration over Libya4

Intercomparison of S2A/MSI and L8/OLI

The monitoring of the ratio of equivalent bands of S2A/MSI and L8/OLI sensors is provided for the team involved in the E1 exercise. Results of different teams are provided.

Teams to compare: PICSCAR CNES SDSU MPC2A All None

Comparison by band **Means over all dates** Comparison by date Tables with all values



Band name	PICSCAR	CNES	SDSU	MPC2A
CA	()	0.9925 (0.0089)	0.9841 (0.007)	()
Blue	1.01104 (0)	0.9975 (0.0088)	1.0138 (0.0072)	()
Green	0.995446555 (0)	1.0107 (0.0078)	1.001 (0.0064)	()
Red	0.997963933 (0)	1.0021 (0.0065)	0.9931 (0.0053)	()
NIR	0.995403573 (0)	0.9986 (0.0059)	0.9929 (0.0046)	()
SWIR1	()	0.9951 (0.0075)	0.994 (0.0055)	()
SWIR2	()	1.0075 (0.0161)	1.0029 (0.016)	()

PICSCAR Web Site

CEOS
Committee on Earth Observations Satellite

PICSCAR

CEOS WGCV IVOS initiative on the characterization of PICS

Sign In

Site characteristics

- Algeria3
- Algeria5
- Libya1
- Libya4
- Mauritania1
- Mauritania2

Simulation tools

PICSCAR Exercises

Calibration over Libya4

Pseudo invariant calibration sites have been widely and successfully used on-orbit radiometric trending of optical satellite systems for more than 20 years. At the IVOS 27 meeting in November 2015, a new initiative was established to facilitate coordination and help prioritise research on PICS and their usage for the benefit of the EO community as a whole.

A roadmap has been set up at IVOS 28 in March 2017 where the subjects have been identified and priorities given to:

- PICS's BRDF characterization
- Spectral characterization
- Atmosphere properties
- Temporal stability
- Combining multiple sites calibration results
- Revisiting the sites

This portal contains general and detailed information about 6 PICS. It provides also a tool simulate the reflectance normalised to nadir. Please register to have access to the document.

Newsletter

2019/03/26 - Please note that the next PICSCAR meeting will be held in CSIRO/Perth on March 26th, 2019.

2018/02/08 - On going activity : PICSCAR intercalibration exercise.

- Exercise 1: Intercalibrating S2A and Landsat 8. Sentinel 2 should be the reference sensor.
- Exercise 2: Intercalibrating MERIS and MODIS Aqua for a 10 years period. MERIS should be the reference sensor.
- Exercise 3: Assessing the BRDF of the site to normalise MERIS TOA reflectance to the following geometry using BRDF model for the following geometry: SZA = 30°, VZA = 0°, relative azimuth angle=0.

Please see the invitation letter to get the instructions and data.

- **First 'draft' version open after IVOS#30**
- **New version available including exercise#1 results and L8/S2A intercalibration monitoring over Libya_4: ask to be registered**

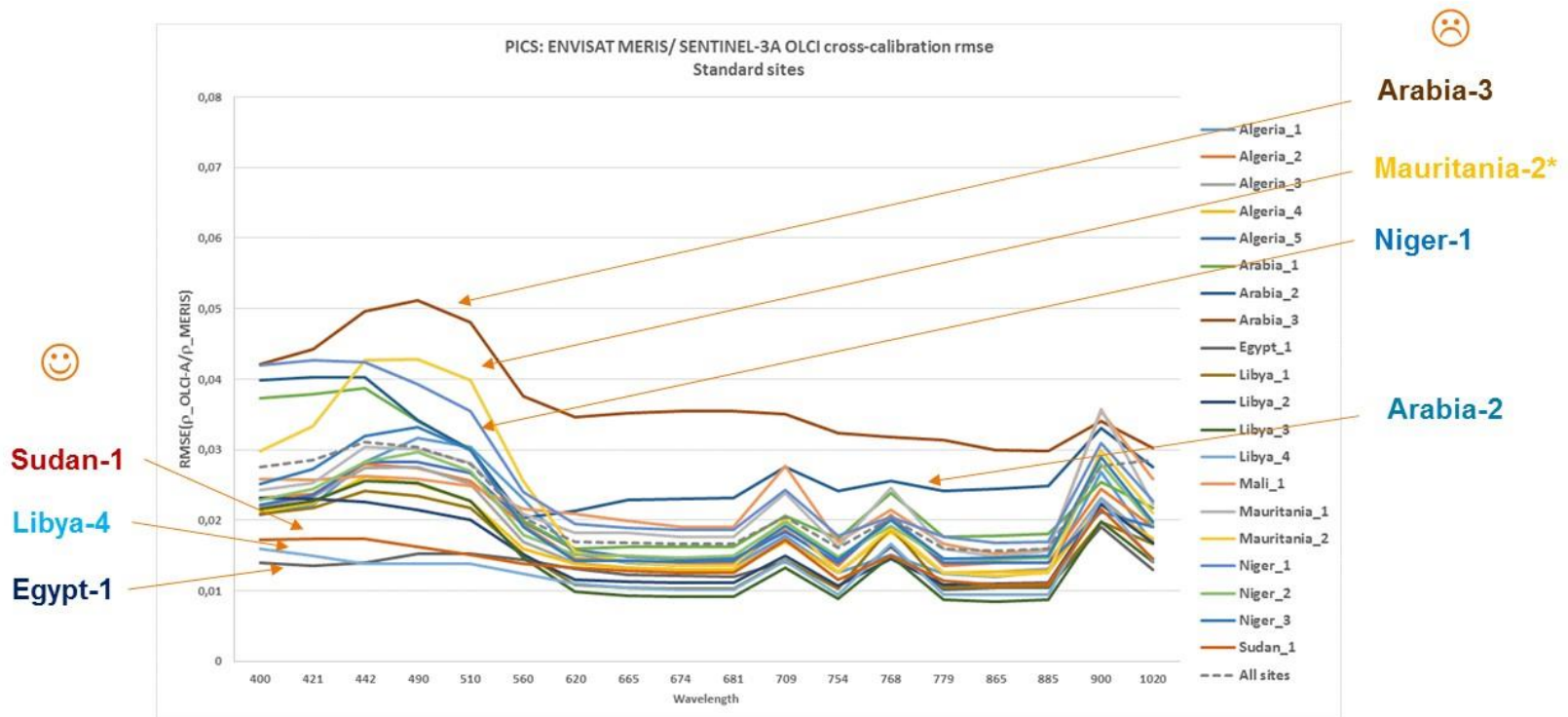
PICSAND Study ONERA/NOVELTIS/LSCE - ESA

- **Laboratory spectral and directional characterization of many sand samples**
 - Some CEOS PICS sites: Algeria_3, Algeria_4, Algeria_5
 - Other sandy areas over the world: Namibia, Morocco, Niger, Australia, Arabia, US...
- **Determination of the physical properties of the sand samples**
- **Re-assessment of PICS**
 - Rather good results for CEOS PICS sites
 - 2 new sites: Namibia, Arabia
- **Climatology of the sites**
- **Directional behaviour of the sites using PARASOL collection**

All results soon available through the Cal/Val Portal

PICS Quality Study using Sentinel_3 CNES

- PICS quality estimation through Sentinel_3A calibration results
- RMSE computation of elementary calibration results (april 2016 and january 2019): 87376 calibration points distributed over 20 sites



- Good score for some CEOS PICS sites : Libya_1 and _8, Algeria_3 and _5
- Bad score for Mauritania_1 and _2
- New potential good sites: Sudan_1, Egypt_1, Libya_2

PICS Trending Analysis – USGS/SDSU

- **Validation of some sites stability using calibration monitoring of Landsat_8, Sentinel_2A and _2B**
 - OK for Libya_1, Libya_4, Niger_1, Niger_2, Sudan_1
 - To be validated for Egypt_1...
- **Temporal uncertainties for all bands are within 2.0%**
- **Cross calibration of Landsat_8, Sentinel_2A and Sentinel_2B over these sites**
 - Agreement between all sensors is within 1%
 - Except blue-coastal band 2%
- **Study of ‘patched’ african PICS using clustering method over North Africa**
 - Very good results for calibration trending (even better than individual sites)
 - Probably more difficult to use for intercalibration (TBC)
 - **Main interests:**
 - Image acquisition can be as frequent as every 1.5 days
 - Large number of acquisitions helps beat down uncertainties
 - Especially useful for quick commissioning and continually observing for short lived missions
 - **Main drawback: computation time**

Landsat_8 Sentinel_2A Comparison over Libya_4 – Argans

- **2 different methods applied**
- **Good consistency of the intercalibration results**
 - Better than 1% for Red and NIR bands
 - 2% for the Green band
 - 2.5% for the Blue band
- **Despite seasonal effects, discrepancies seems to be bias (low RMS error)**
- **No trend detectable**
- **To be continued in the frame of PICSCAR calibration monitoring over Libya_4**

Main actions issued from this workshop

- Organise a PICSCAR webex meeting dedicated to sites stability
- Provide AHSI hyperspectral profile over CEOS PICS (at least Libya_4)
- Provide sand lab spectral measurement (compatible with Libya_4)
- Try to obtain sensors datasets over the new sites proposed through the PICSAND study
- Update site characterization with information provided by PICSAND study, but also CNES and SDSU studies
- Play PICSCAR Exercise#3 with the PICSAND BRDF model over Libya_4
- Open the PICSCAR web site to the CEOS community and work with Cal/Val portal team
- Extend the mailing list for PICSCAR webex meeting

Remark : Still one major LEO sensor missing in our Libya_4 dataset: VIIRS...

Way forward

- **Finalize intercalibration exercises #2 and #3**
- **Finalize the set up of the L8/S2A intercalibration monitoring and open it to public**
- **Extend Libya_4 results to other sites**
- **Provide calibration community with consensually assessed performances**
- **Revisit the list of CEOS PICS according to recent results (PICSAND, CNES, USGS, S2MPC...)**

Many thanks to PICSCAR Working Group members

PICSCAR Chu still to be caught...

