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DIMITRI toolbox advancements: Use with Sentinel-2/MSI and Sentinel-3/OLCI radiometry vicarious-validation

Bahjat Alhammoud

with support from S2MPC, S3MPC & DIMITRI teams

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DIMITRI toolbox advancements: Use with Sentinel-2/MSI and Sentinel-3/OLCI radiometry vicarious-validation

Disclaimer

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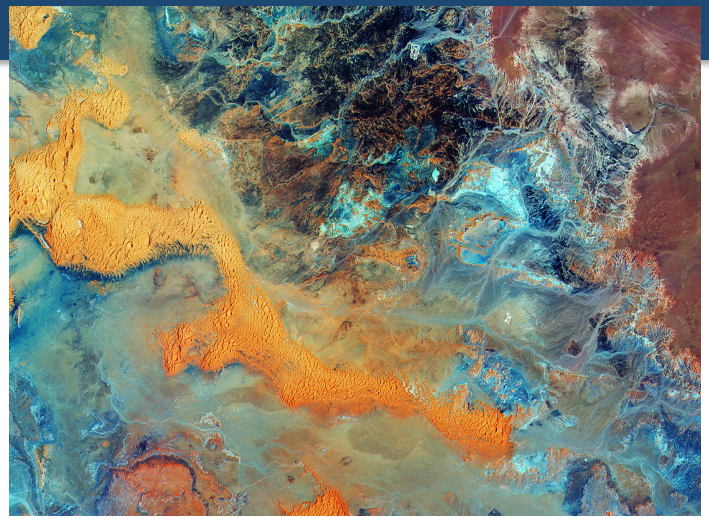
AGENDA

- DIMITRI-Tools & improvements
- Preliminary results on MERIS 3RP
- Sentinels Radiometry validation
- Cross-mission Intercomparison over PICS
- Conclusions



http://sentinels.copernicus.eu

What is DIMITRI Toolbox?

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DIMITRI

Database for Imaging Multi-spectral Instruments and Tools for Radiometric Intercomparison

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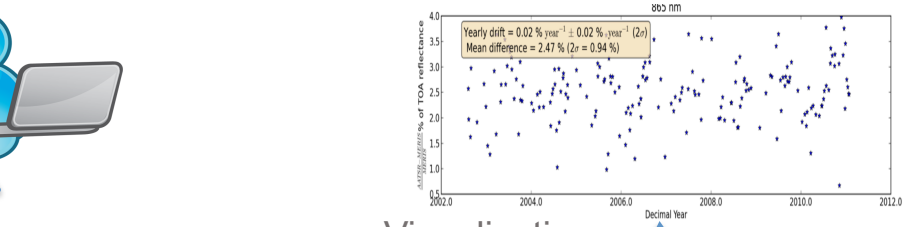
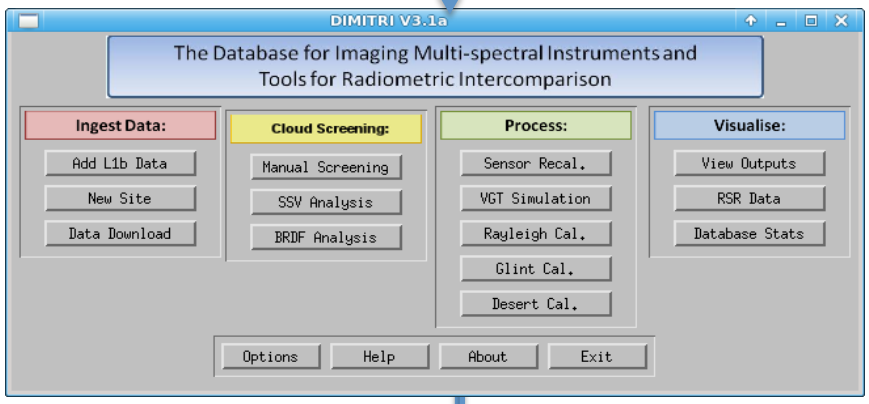
USER & GUI

Input Database:
L1B (L1B, L1C, L1T…)

OpenSearch
Sensor
Site
Year



Visualization



Process
& Tools

CSV-Archive

Binary Database

http://calvalportal.ceos.org/tools
https://dimitri.argans.co.uk

Overview of the VC methods in DIMITRI Toolbox

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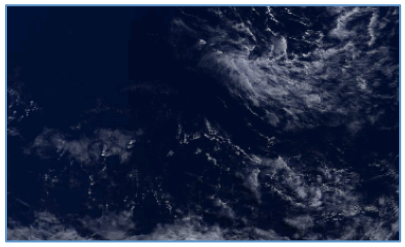

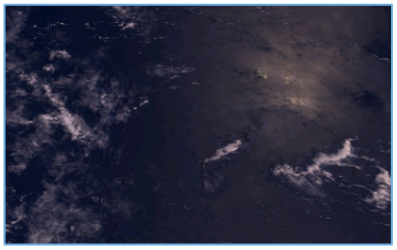

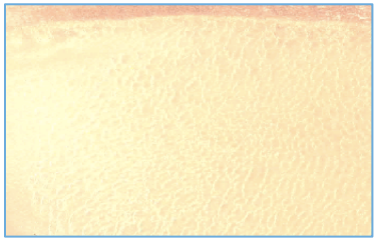

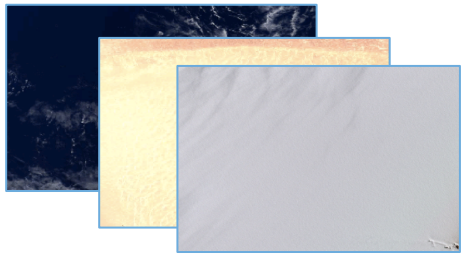

Rayleigh scattering calibration	Sun-Glint inter-bands calibration	Desert (PICS) calibration	Sensor-to-Sensor intercalibration
Absolute calibration coefficient: as ρ^{obs}/ρ^{sim}	Absolute Inter-band calibration coefficient: as $\rho^{B(i)}/\rho^{B(ref)}$	Absolute calibration coefficient: as ρ^{obs}/ρ^{sim}	Absolute inter-calibration coefficient: as ρ^{obs}/ρ^{REF}
Vermote et al (1992); Hagolle et al (1999)	Hagolle et al (1999; 2004); Nicolas et al (2006)	Bouvet (2014)	Bouvet et al. (2006)
- Over VIS bands - Uncertainty <5% - Very stringent criteria	- Over VNIR bands - Uncertainty <2% - Very stringent criteria	- Over VNIR bands - Uncertainty <5% - Uses surface BRDF	- VIS, NIR & SWIR bands - Uncertainty <5% - Limited matchups

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Improvement of DIMITRI Toolbox?

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Database for Imaging Multi-spectral Instruments and Tools for Radiometric Intercomparison

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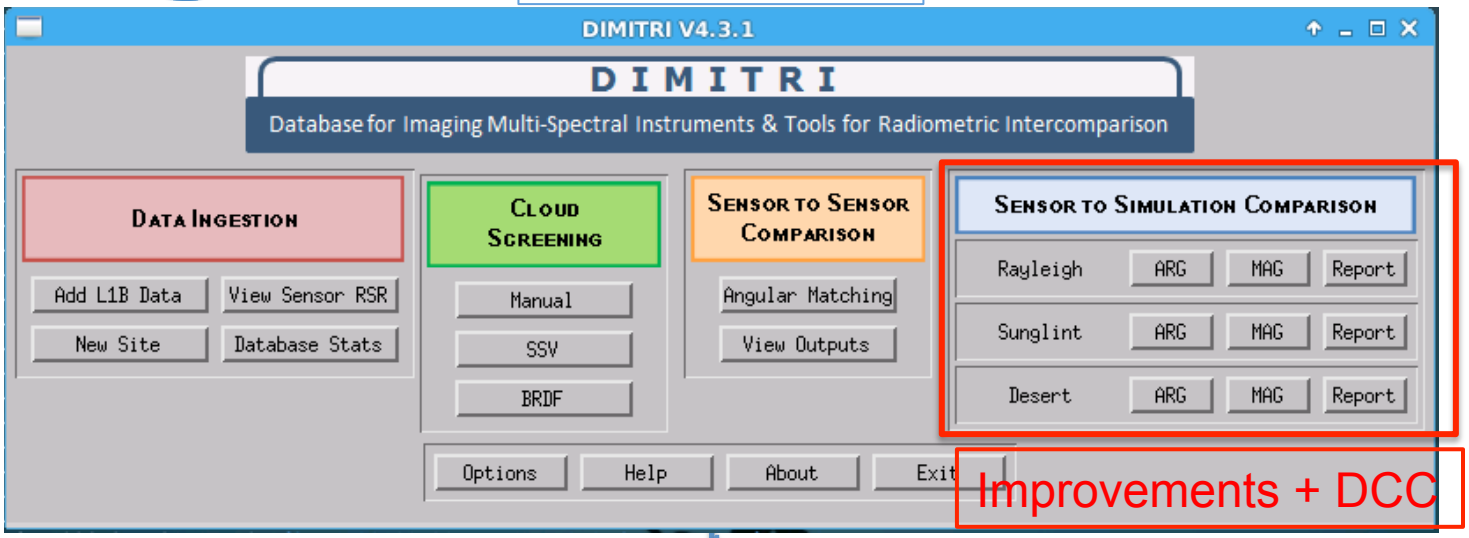
DIMITRI v4.x.y



Improvements + DCC

CSV-Archive

NCDF-Database

http://calvalportal.ceos.org/tools
https://dimitri.argans.co.uk

Improvement of DIMITRI Toolbox

Current/Future Improvements to DIMITRI v4.x.y

Rayleigh & Glint (ARGANS):

- Hyperspectral-LUTs for Atmos-reflectance
- Atmos-Pressure Adjustment (Bodhaine et al. 1999)
- Development of Water leaving reflectance BRDF using HE 5.2 model

PICS & DCC (Magellium):

- Improvements of BRDF-modelling and extension up to SWIR
- Development of DCC method

ALL:

- Uncertainty Analysis/Propagation following the GUM

Preliminary results over MERIS 3RP:
RAYLEIGH; SPG-OPT

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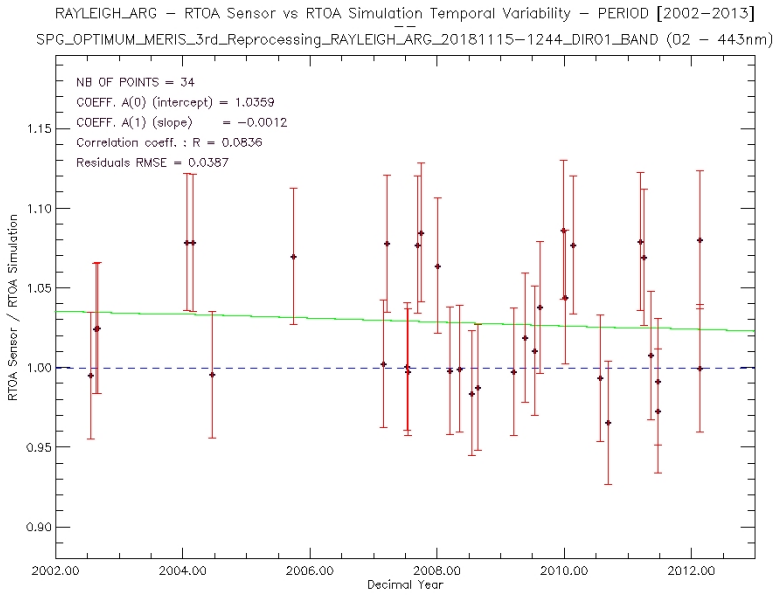
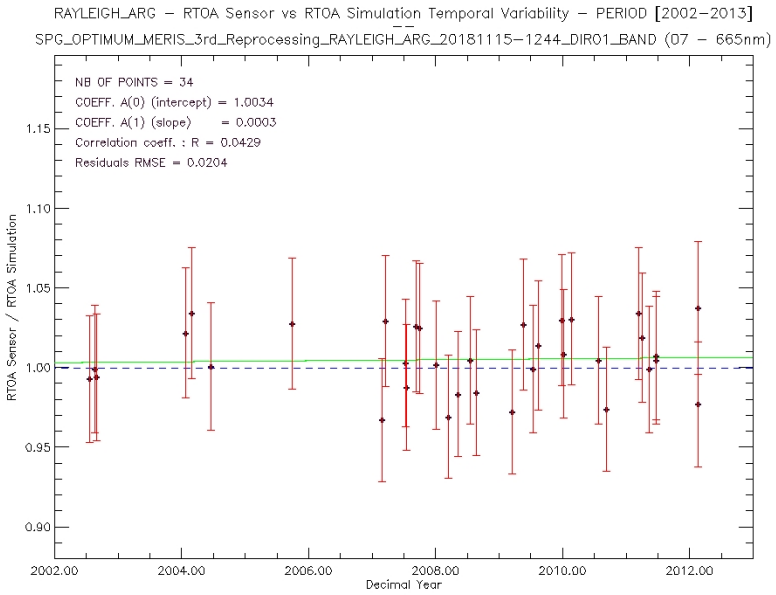
Database for Imaging Multi-spectral Instruments and Tools for Radiometric Intercomparison

Before : HS-LUTs + Atmos-P-adjustment

(N: 34)



(443 nm)



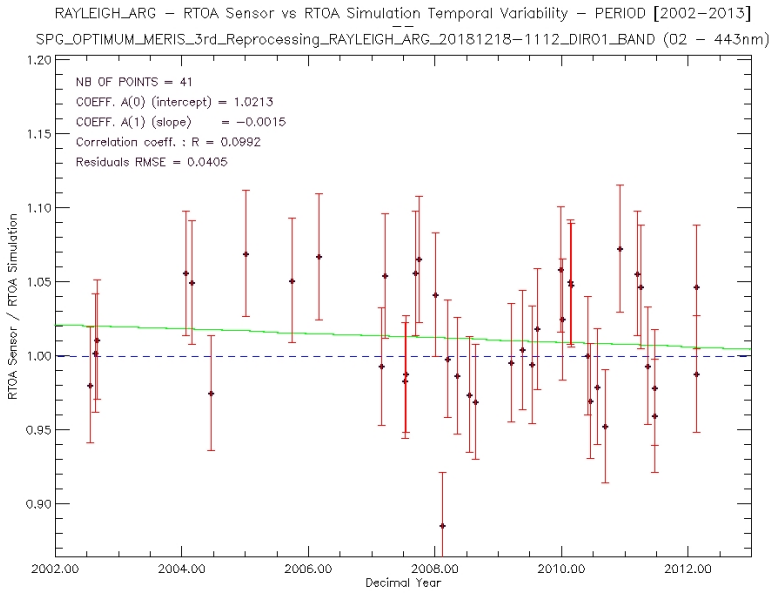
(665 nm)

Preliminary results over MERIS 3RP:
RAYLEIGH; SPG-OPT

DIMITRI
Database for Imaging Multi-spectral Instruments and Tools for Radiometric Intercomparison

After : HS-LUTs + Atmos-P-adjustment

(N: 41)



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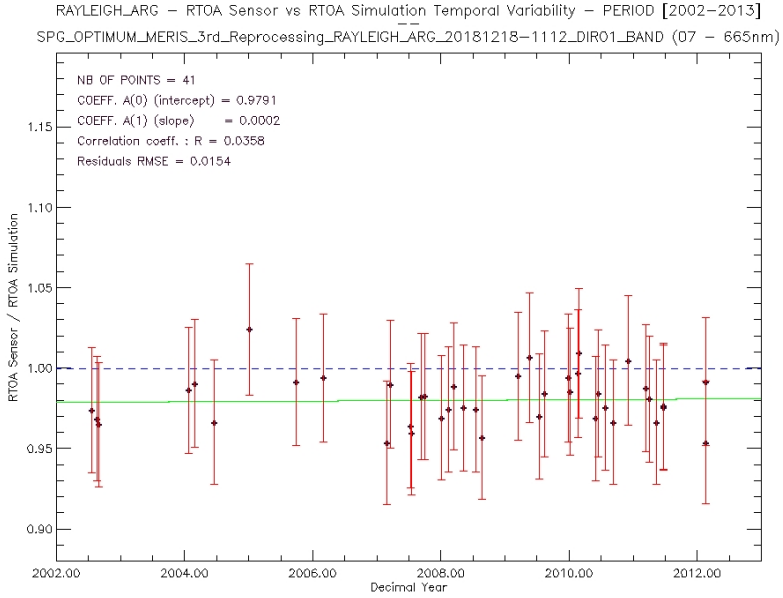

(665 nm)

Preliminary results over MERIS 3RP:

SUNGLINT; SIO-OPT

DIMITRI

Database for Imaging Multi-spectral Instruments and Tools for Radiometric Intercomparison

Before : HS-LUTs + Atmos-P-adjustment

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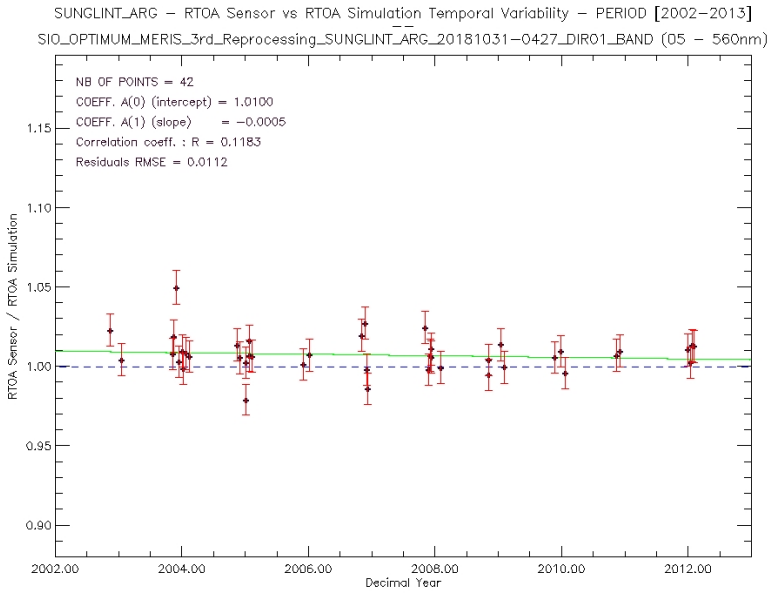
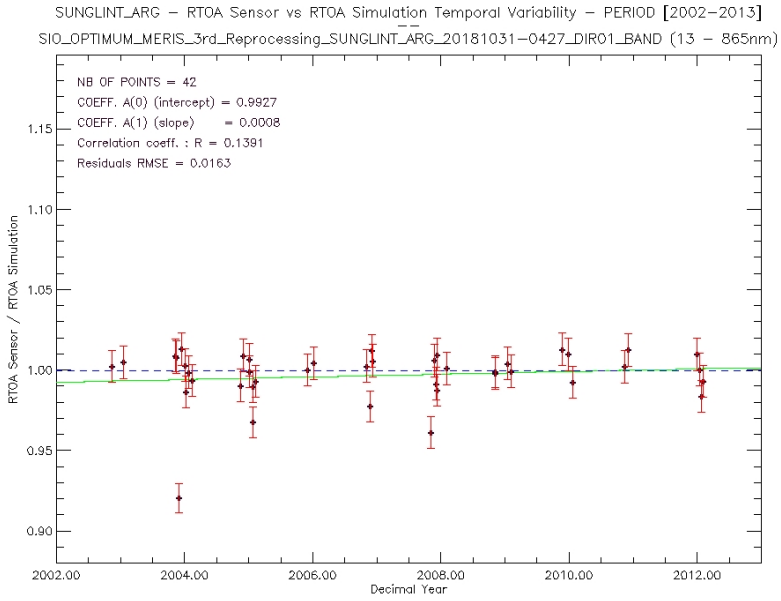


(560 nm)



(865 nm)

Preliminary results over MERIS 3RP:

SUNGLINT; SIO-OPT

DIMITRI

Database for Imaging Multi-spectral Instruments and Tools for Radiometric Intercomparison

After : HS-LUTs + Atmos-P-adjustment

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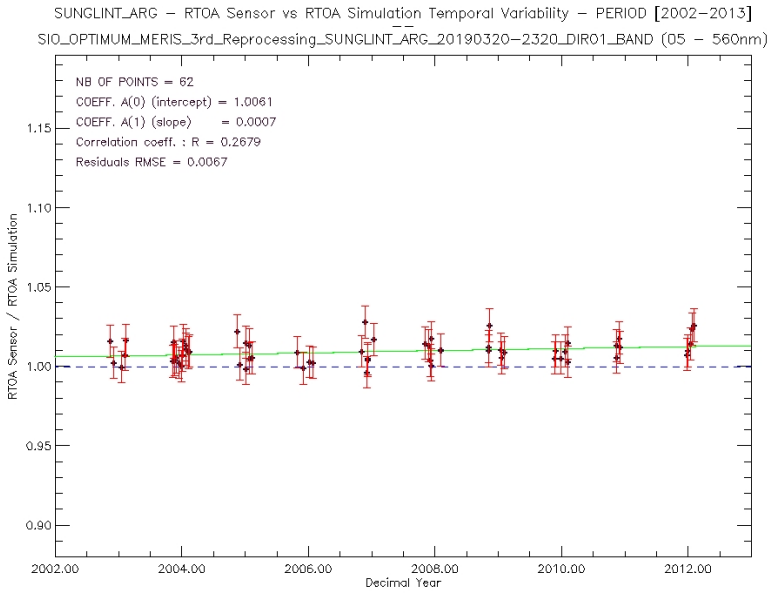

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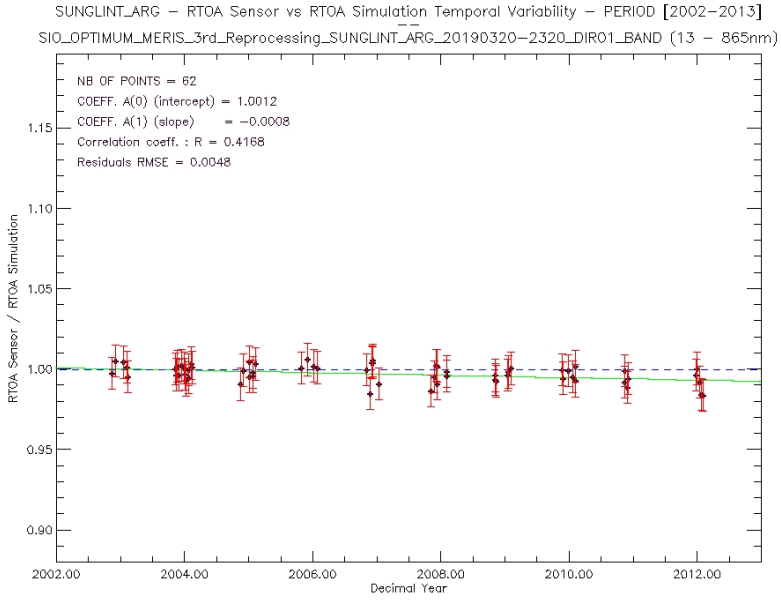

(865 nm)

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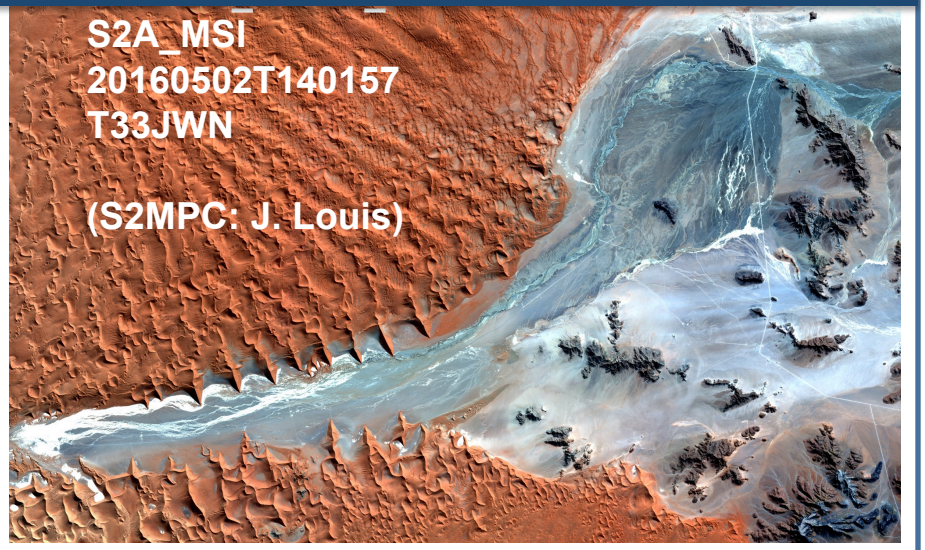
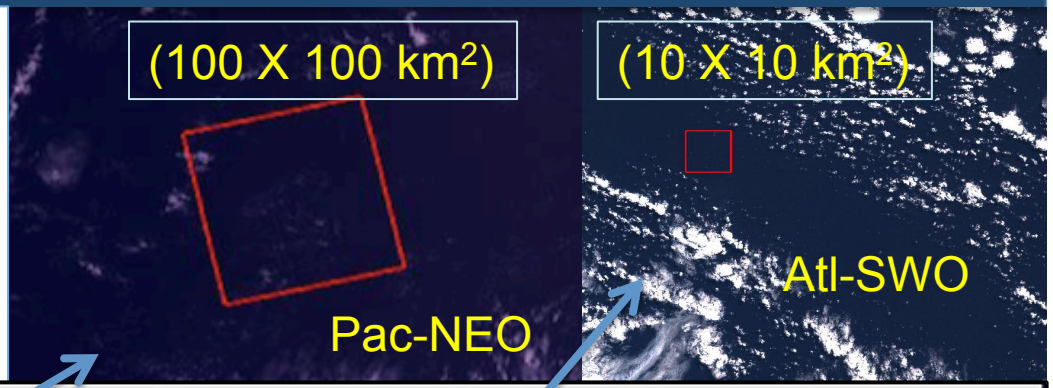
Sentinel-2/MSI and Sentinel-3/OLCI Validation

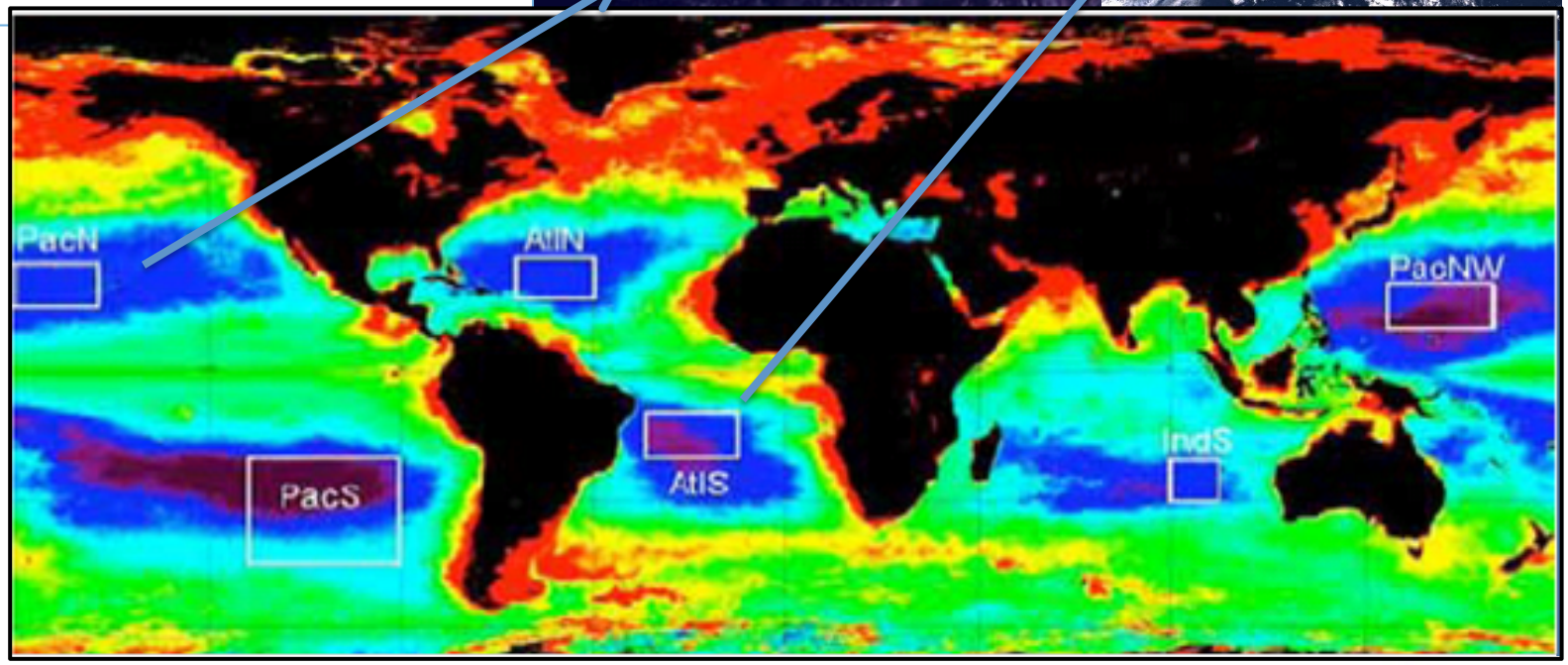
- Rayleigh and PICS methods over Sentinel-2/MSI
- Sentinel-2/MSI and Sentinel-3/ OLCI Intercomparison over PICS
- Conclusions



OCEAN CalVal Sites

- Acquisitions over 6 OCEANS CalVal sites
- Small-sites for MSI-A/B and large for OLCI

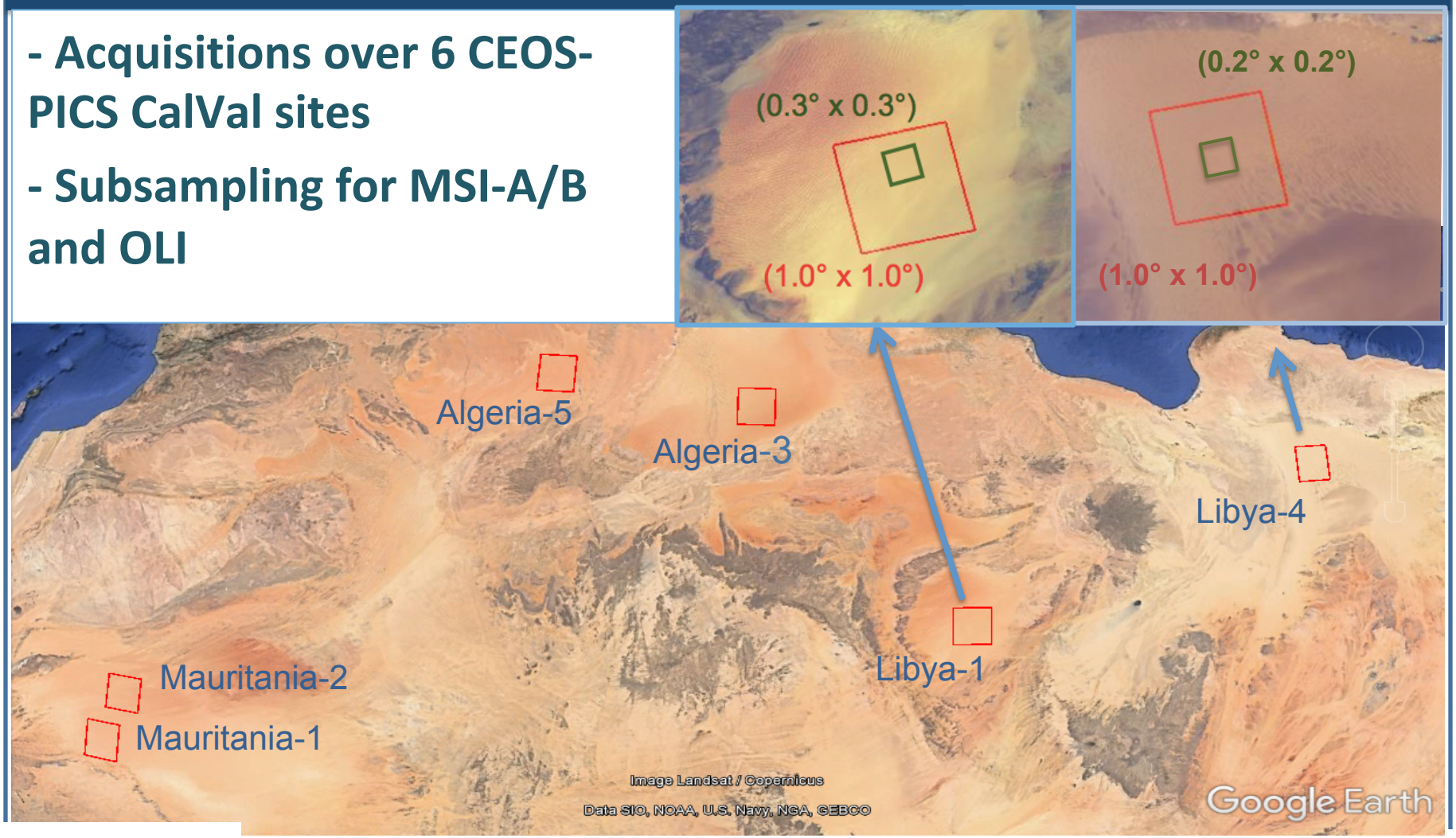




(Fougnie and Henry 2002)

PICS-CEOS CalVal Sites

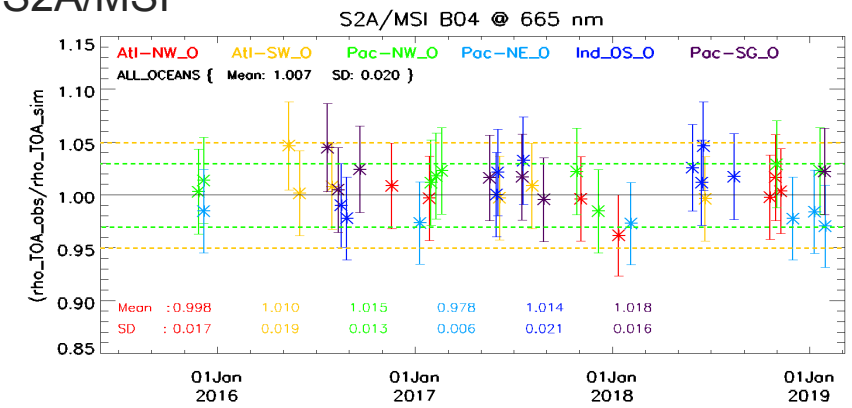
- Acquisitions over 6 CEOS-PICS CalVal sites
- Subsampling for MSI-A/B and OLI

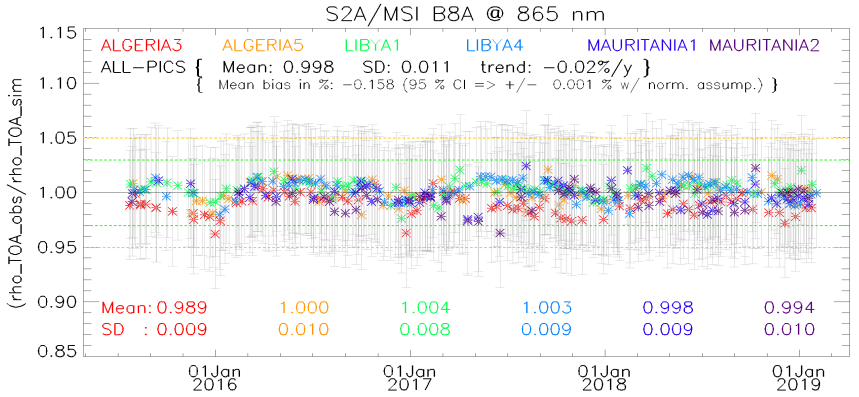


Radiometry Vicarious Validation Results: MSI-A and MSI-B

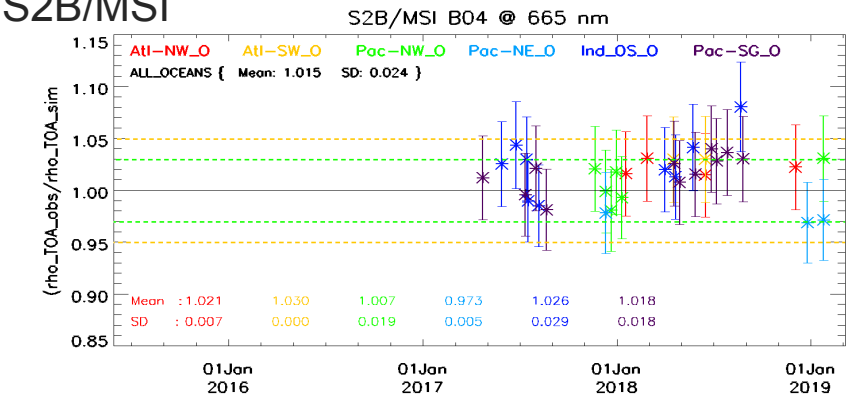
- **Rayleigh and PICS Methods**: over **6 Ocean** sites and **6 PICS** sites

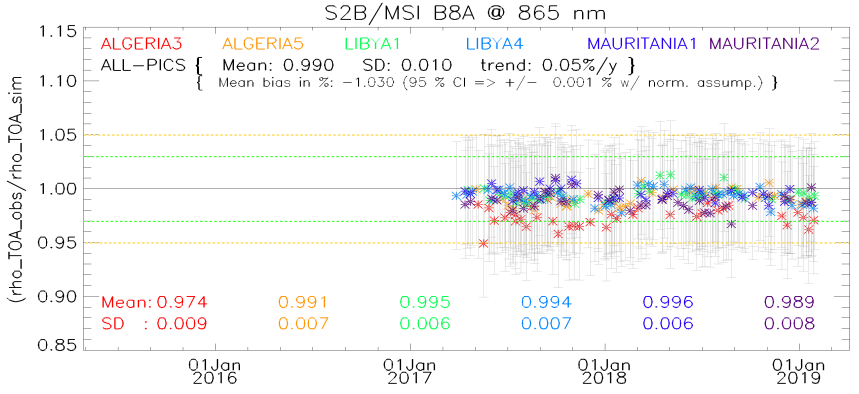
S2A/MSI





S2B/MSI

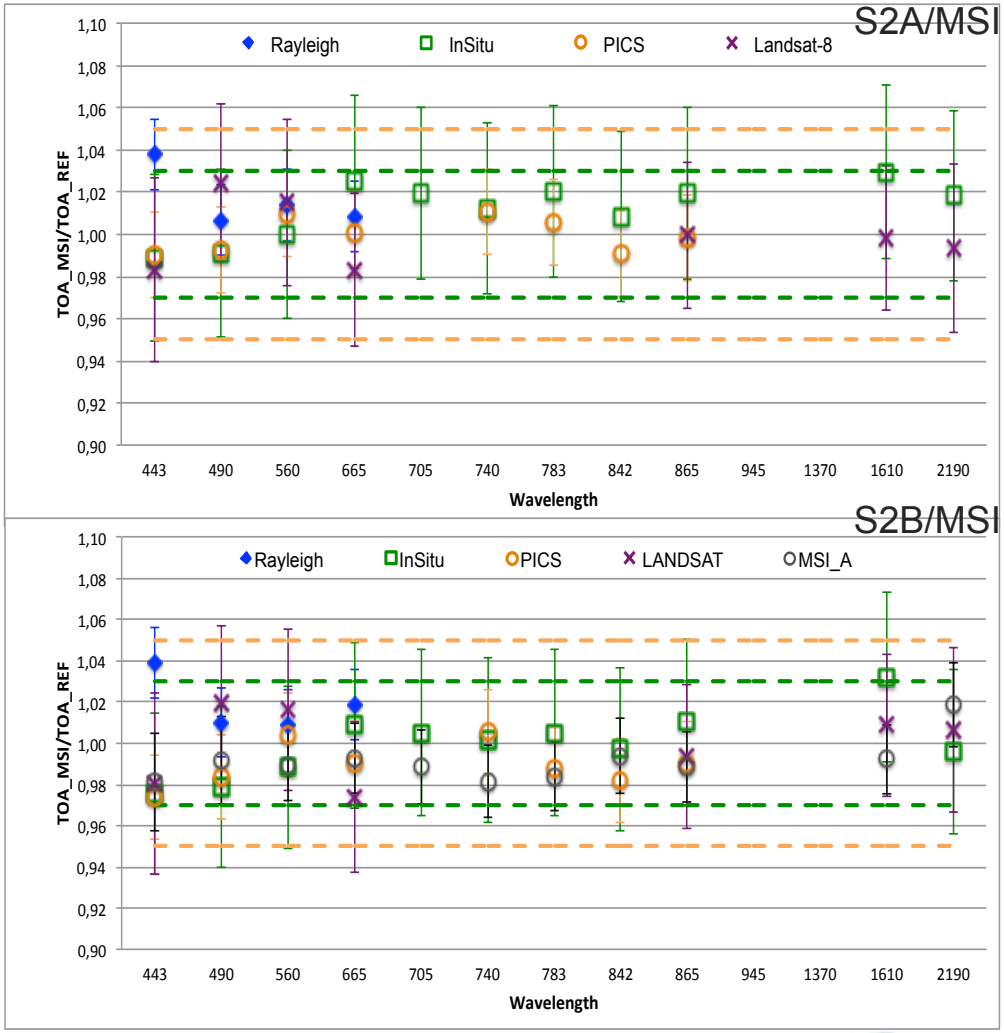




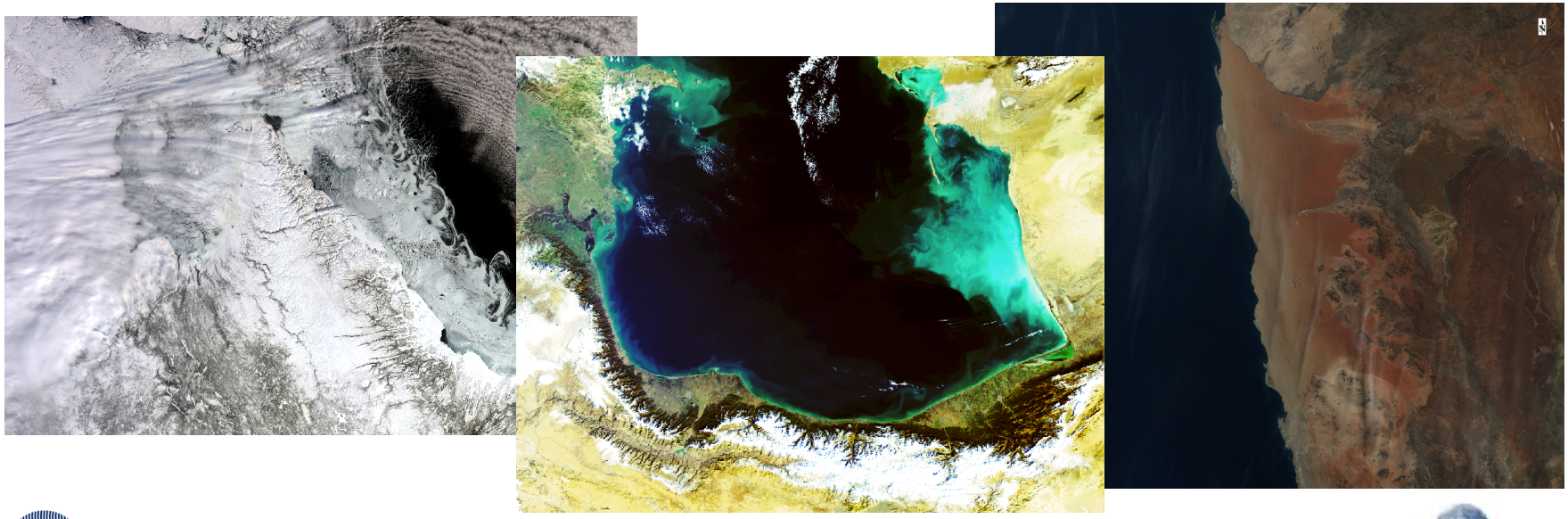
VNIR: <3% ; No trend detectable

Synthesis over the Radiometry Vicarious Validation Results: MSI-A/B

- Good consistency over all methods
- Results are within 5% (mission req.)
- Maximum discrepancy is observed over Rayleigh B01 > 3%
- No trend detectable.



Sentinel-2/MSI and Sentinel-3/OLCI Intercomparison over PICS

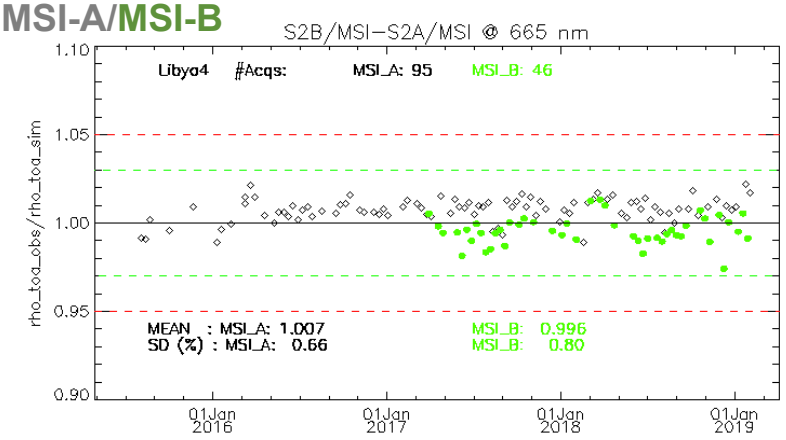


Credit: Courtesy to S3MPC

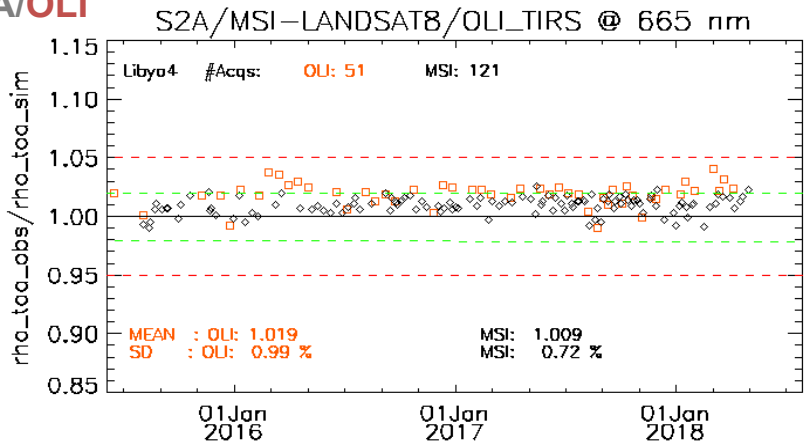
Cross-Mission Intercomparison: MSI-A/MSI-B/OLCI-A/OLCI-B/OLI

- **The ratio of observed/simulated TOA reflectance**

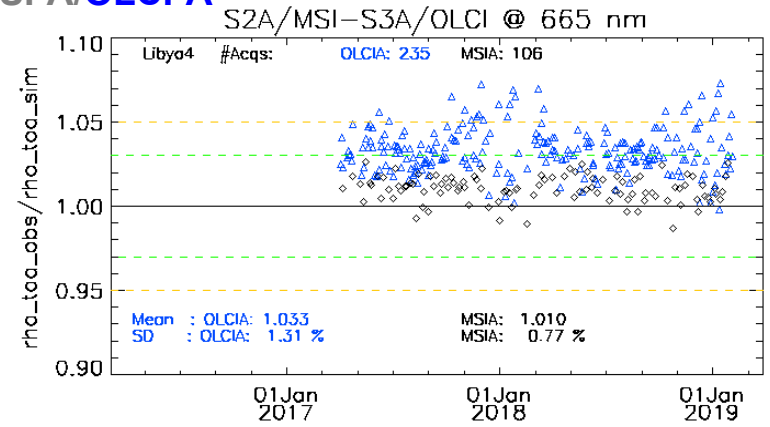
MSI-A/MSI-B



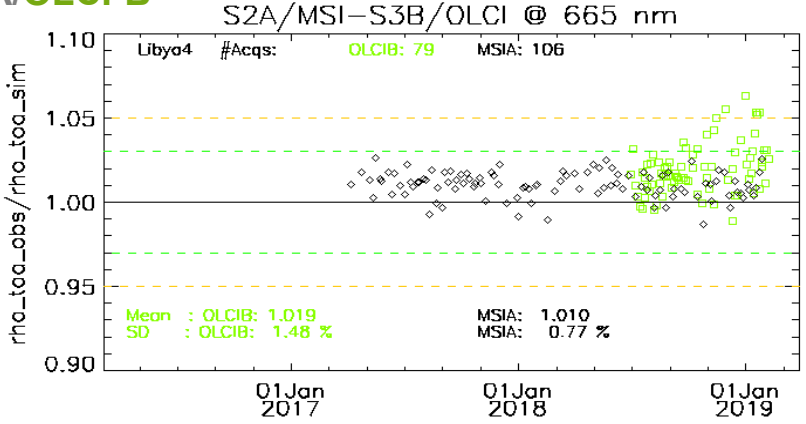
MSI-A/OLI



MSI-A/OLCI-A



MSI-A/OLCI-B



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CONCLUSION

- MSI-A/B show an excellent calibration, image quality and very good temporal stability
- Both sensors show a good agreement with OLI and OLCI-B over PICS
- MSI-A shows brighter reflectance than MSI-B of ~1% over PICS

- OLCI-A/B show an excellent image quality & very good temporal stability
- OLCI-A shows higher reflectance wrt. MSI-A, MSI-B and OLCI-B over PICS
- OLCI-A shows brighter reflectance than OLCI-B of ~2% over PICS

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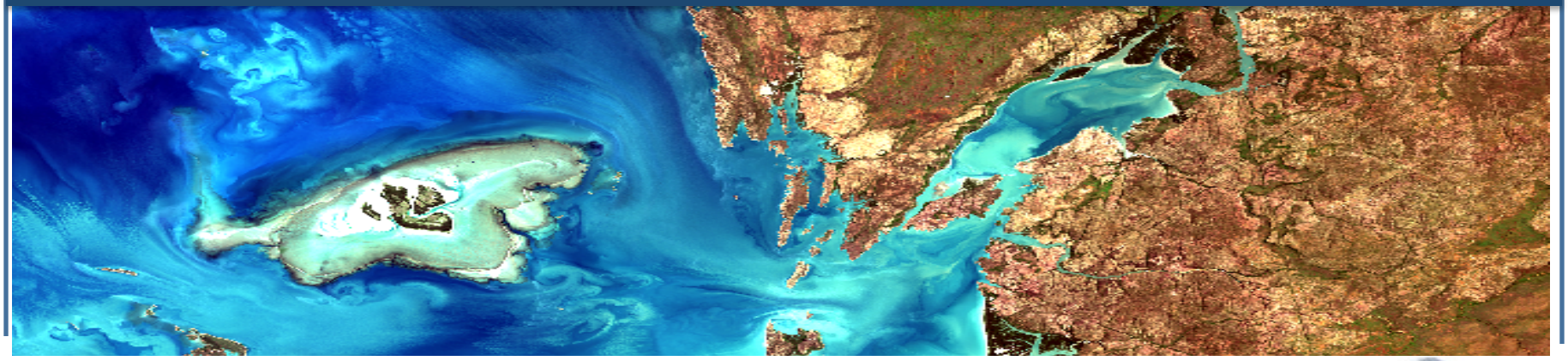
Thank you for listening

THANKS TO

ESA, EUMETSAT, COPERNICUS;

S2MPC, S3MPC AND DIMITRI TEAMS

RADCATS DATASET WERE PROVIDED BY THE NASA LANDSAT CAL/VAL TEAM AS PART OF THE ESA EXPERT USERS EFFORT



Australian coasts as seen by S2A/MSI, L1C-20190307, Courtesy to J. Jackson (S2MPC).

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