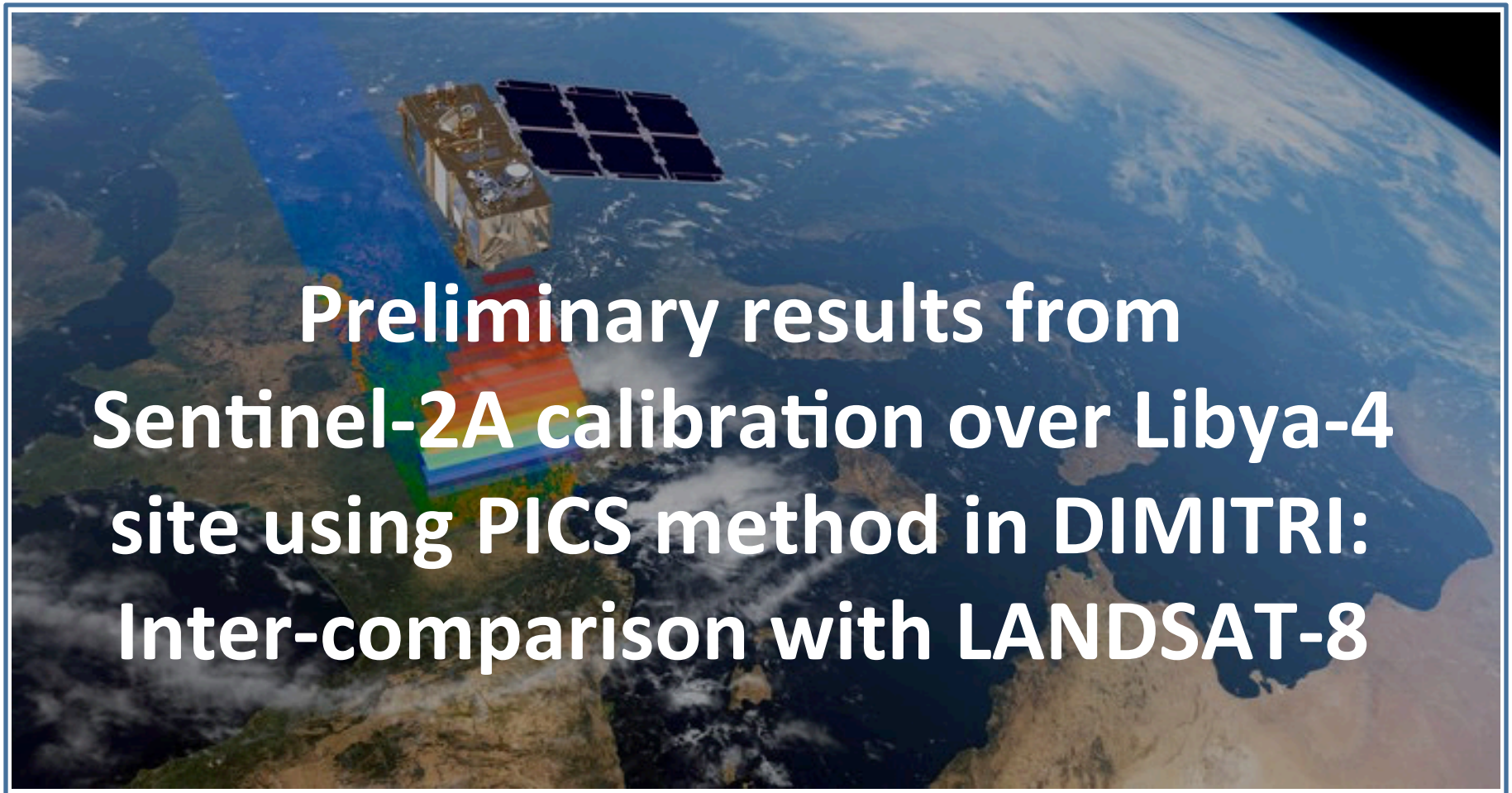


Preliminary results from Sentinel-2A calibration over Libya-4 site using PICS method in DIMITRI: Inter-comparison with LANDSAT-8

Bahjat Alhammoud

BAlhammoud@argans.co.uk

ARGANS

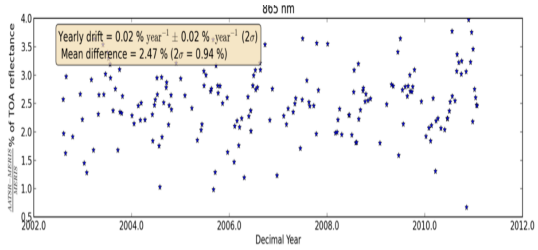
SENTINEL 2

esa

The power of innovation
SENTINEL 2
European Commission
esa
Sentinel-2A MPC-CC : L1-VAL-RAD Activities
✓ Multi-temporal Relative Radiometry Vicarious Validation
✓ Absolute Radiometry Cross-Mission Inter-Comparison : S2A & LS8
ACRI ST
ARGANS
elecnor deimos
gmv
AIRBUS DEFENCE & SPACE
ThalesAlenia Space
IGN
ONERA

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

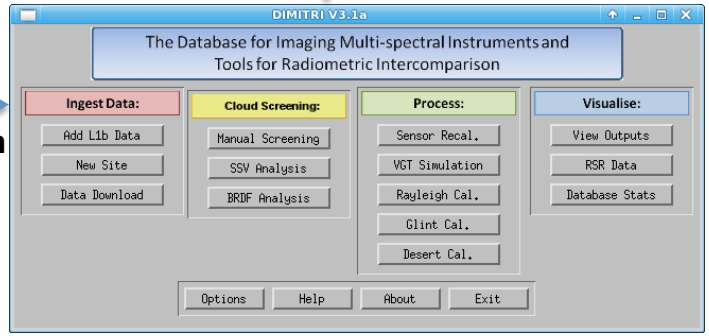
USER & GUI



VISU

Database

OpenSearch
Sensor
ROI
Year



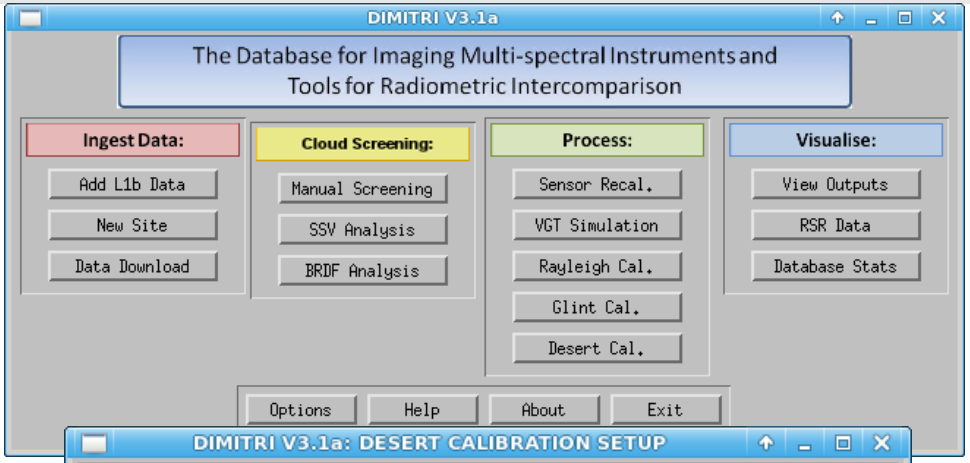
Tools

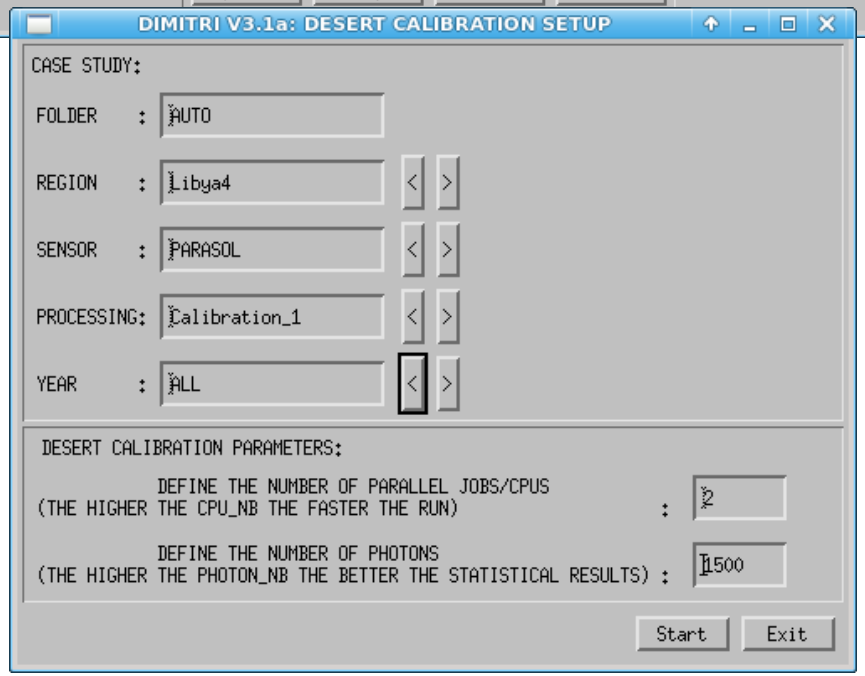
L1B-Archive

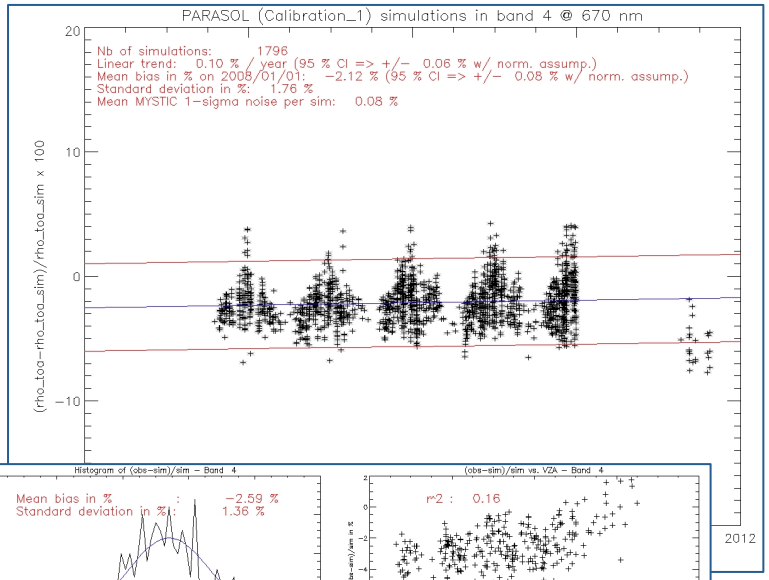
Database

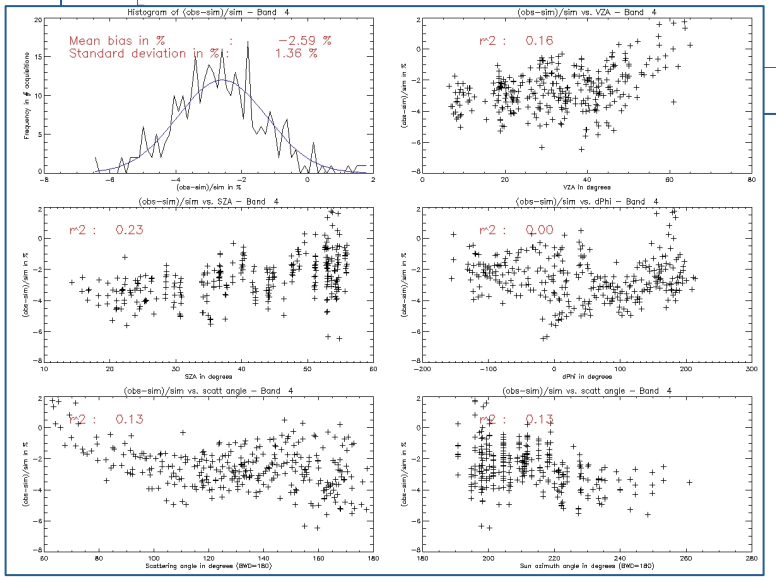
http://calvalportal.ceos.org/tools

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







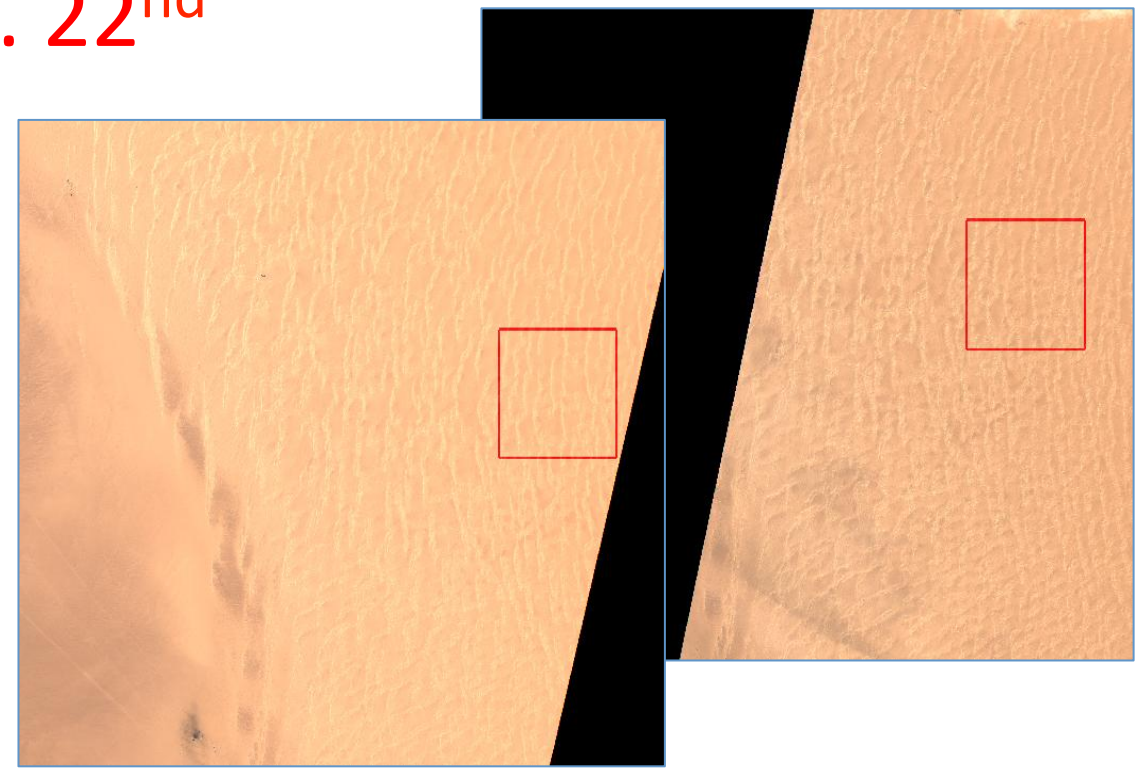


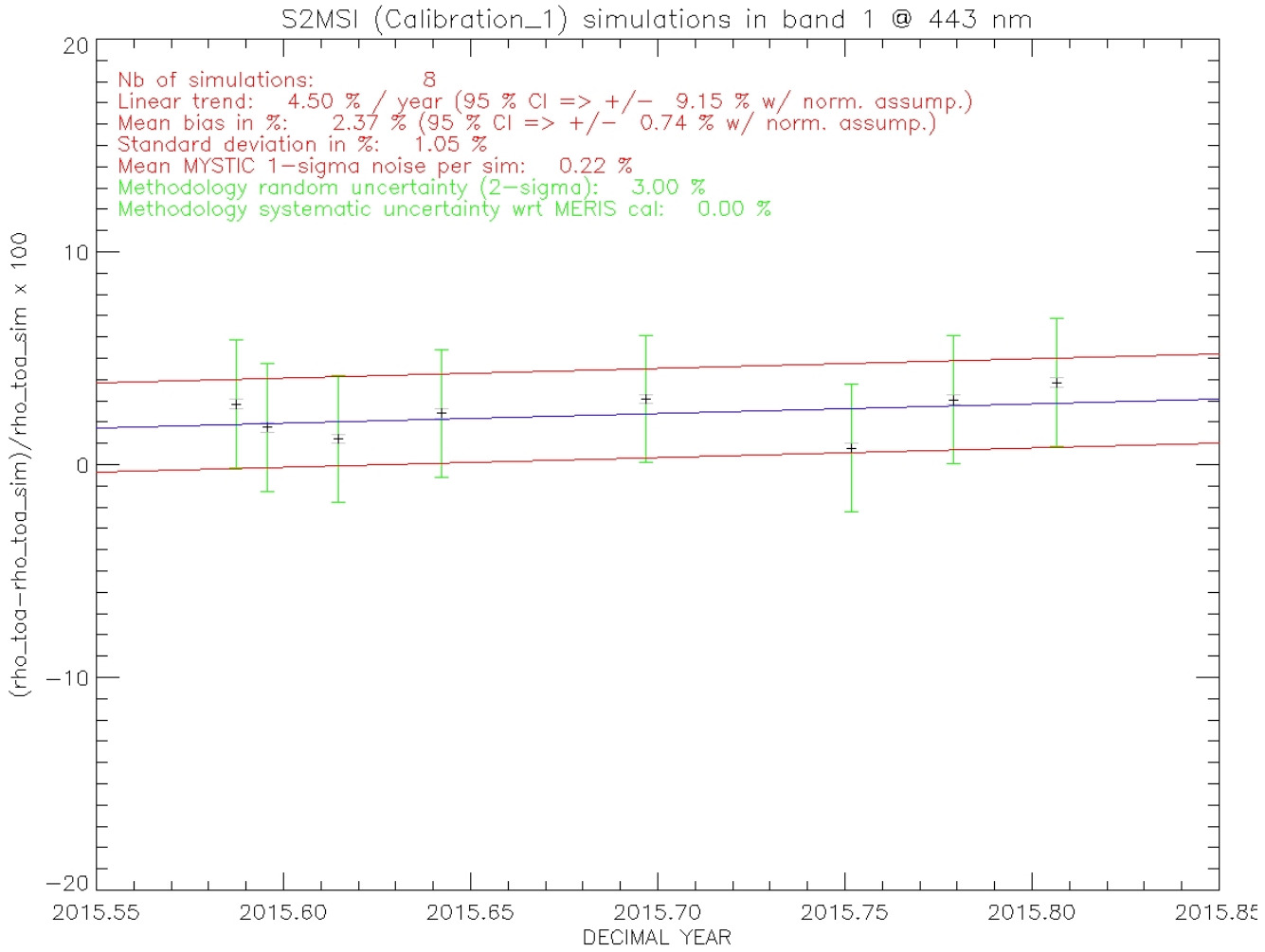
S2A/MSI over Libya-4

AOI: 0.2° x 0.2°

Aug. 2nd – Oct. 22nd

02-08-2015
05-08-2015
12-08-2015
22-08-2015
11-09-2015
01-10-2015
11-10-2015
21-10-2015




S2MSI (Calibration_1) simulations in band 1 @ 443 nm
Nb of simulations: 8
Linear trend: 4.50 % / year (95 % CI => +/- 9.15 % w/ norm. assump.)
Mean bias in %: 2.37 % (95 % CI => +/- 0.74 % w/ norm. assump.)
Standard deviation in %: 1.05 %
Mean MYSTIC 1-sigma noise per sim: 0.22 %
Methodology random uncertainty (2-sigma): 3.00 %
Methodology systematic uncertainty wrt MERIS cal: 0.00 %
(rho_toa-rho_toa_sim)/rho_toa_sim x 100
20
10
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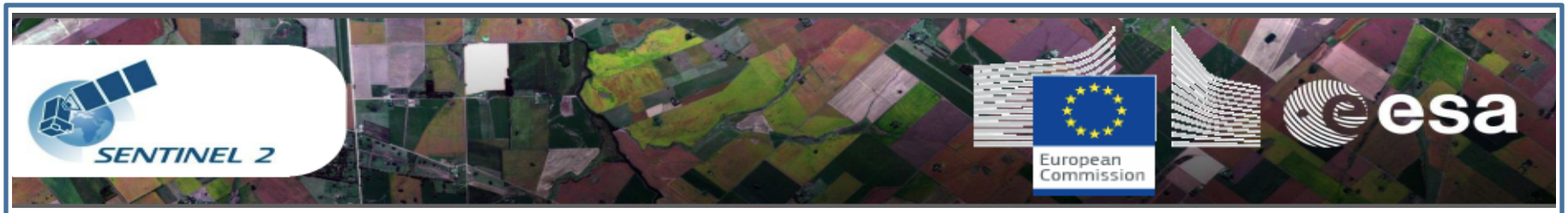
-10
-20
2015.55
2015.60
2015.65
2015.70
2015.75
2015.80
2015.85
DECIMAL YEAR


SENTINEL 2
European Commission
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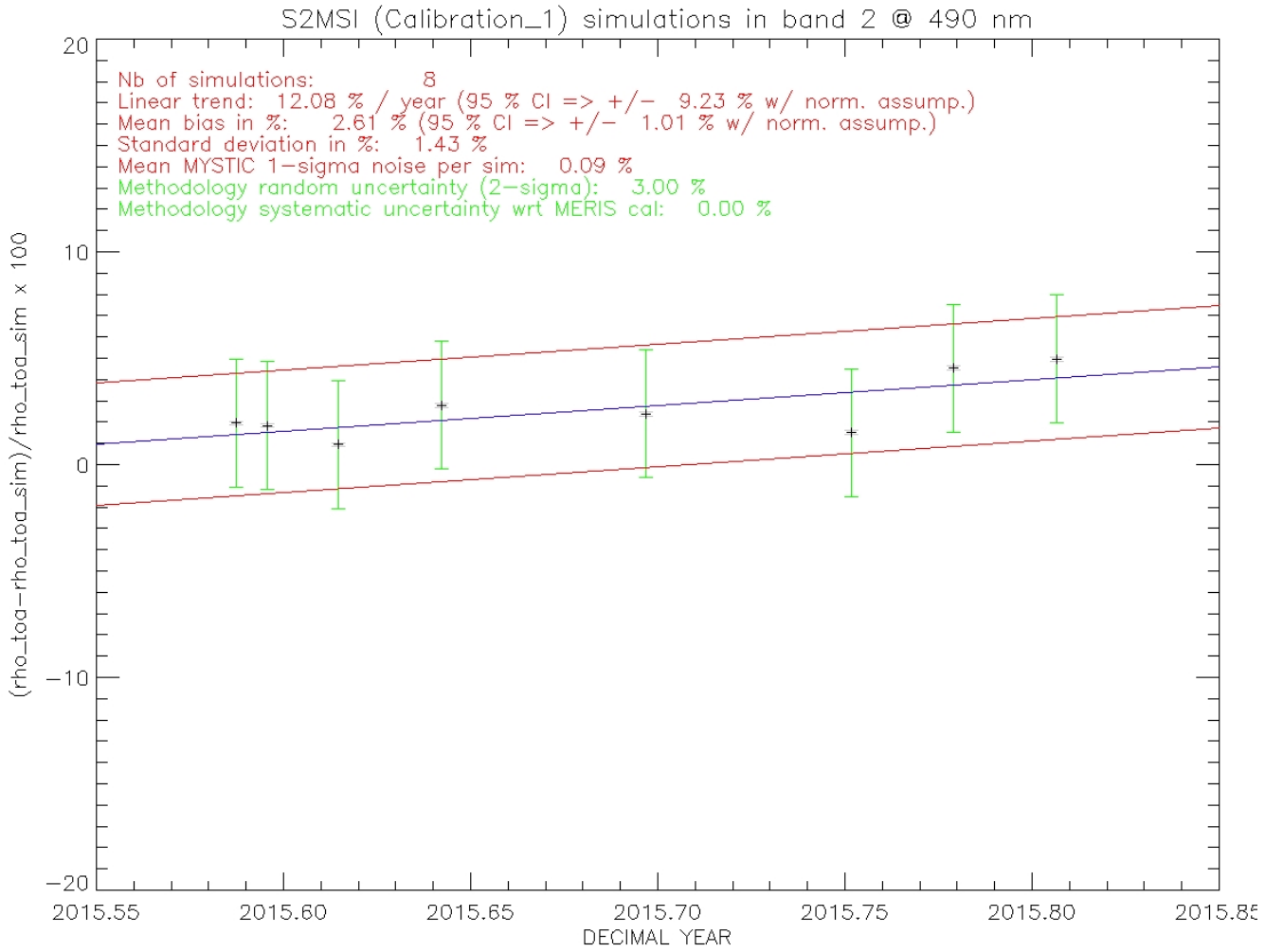
S2MSI (Calibration_1) simulations in band 2 @ 490 nm
Nb of simulations: 8
Linear trend: 12.08 % / year (95 % CI => +/- 9.23 % w/ norm. assump.)
Mean bias in %: 2.61 % (95 % CI => +/- 1.01 % w/ norm. assump.)
Standard deviation in %: 1.43 %
Mean MYSTIC 1-sigma noise per sim: 0.09 %
Methodology random uncertainty (2-sigma): 3.00 %
Methodology systematic uncertainty wrt MERIS cal: 0.00 %
(rho_toa-rho_toa_sim)/rho_toa_sim x 100
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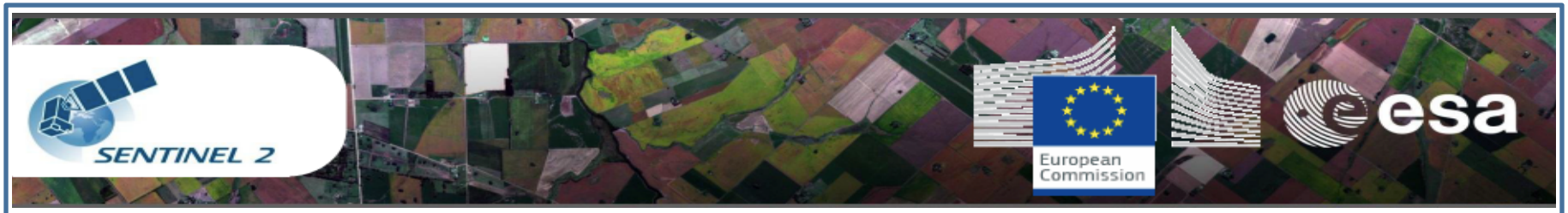
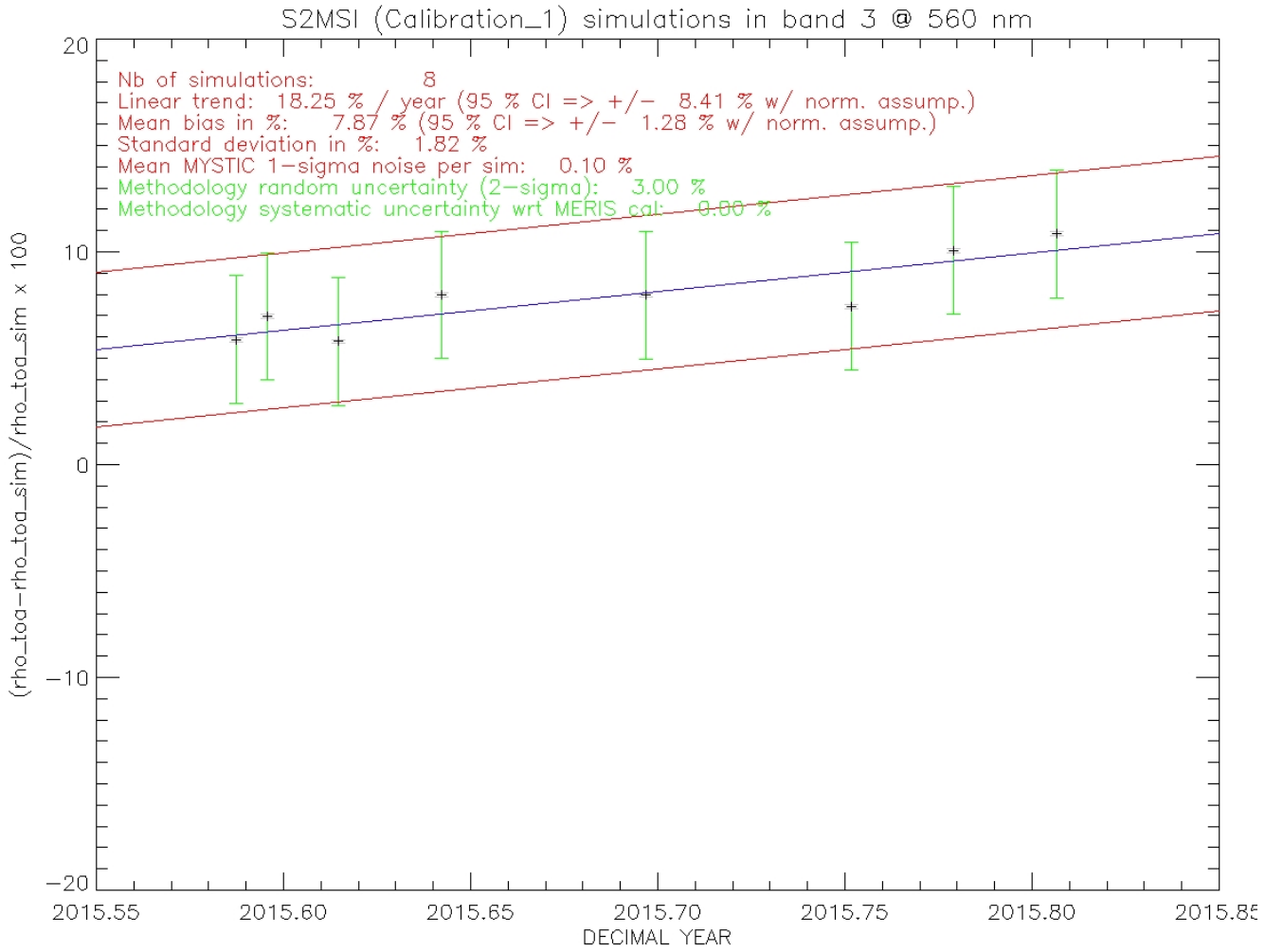
2015.85
DECIMAL YEAR


SENTINEL 2
European Commission
esa


S2MSI (Calibration_1) simulations in band 3 @ 560 nm
Nb of simulations: 8
Linear trend: 18.25 % / year (95 % CI => +/- 8.41 % w/ norm. assump.)
Mean bias in %: 7.87 % (95 % CI => +/- 1.28 % w/ norm. assump.)
Standard deviation in %: 1.82 %
Mean MYSTIC 1-sigma noise per sim: 0.10 %
Methodology random uncertainty (2-sigma): 3.00 %
Methodology systematic uncertainty wrt MERIS cal: 0.00 %
(rho_toa-rho_toa_sim)/rho_toa_sim x 100
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2015.55
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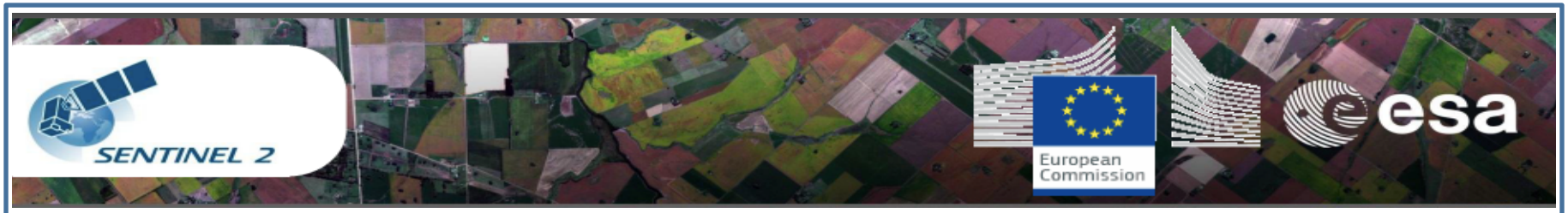
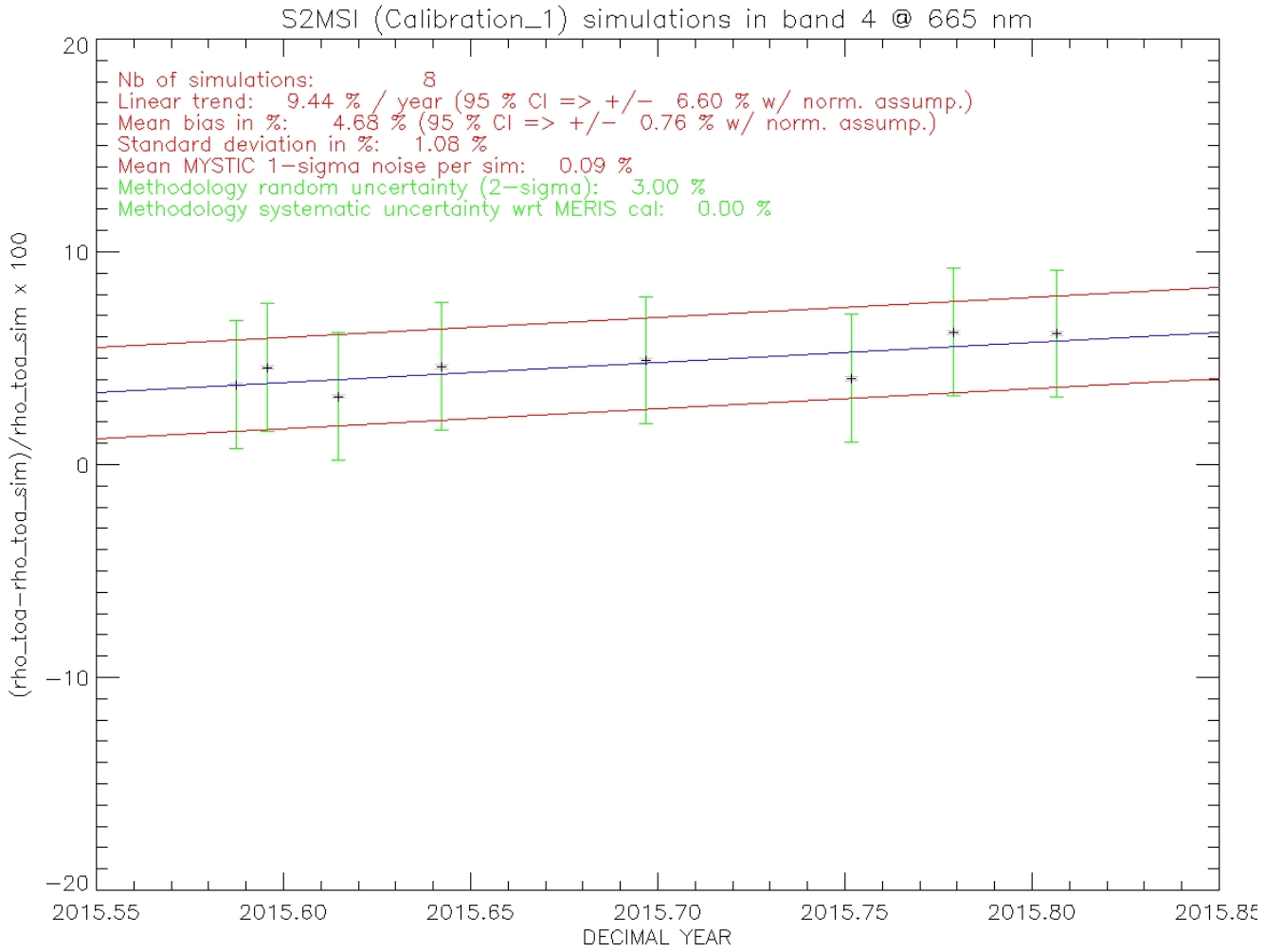
2015.85
DECIMAL YEAR


SENTINEL 2
European Commission
esa


S2MSI (Calibration_1) simulations in band 4 @ 665 nm
Nb of simulations: 8
Linear trend: 9.44 % / year (95 % CI => +/- 6.60 % w/ norm. assump.)
Mean bias in %: 4.68 % (95 % CI => +/- 0.76 % w/ norm. assump.)
Standard deviation in %: 1.08 %
Mean MYSTIC 1-sigma noise per sim: 0.09 %
Methodology random uncertainty (2-sigma): 3.00 %
Methodology systematic uncertainty wrt MERIS cal: 0.00 %
(rho_toa-rho_toa_sim)/rho_toa_sim x 100
20
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2015.55
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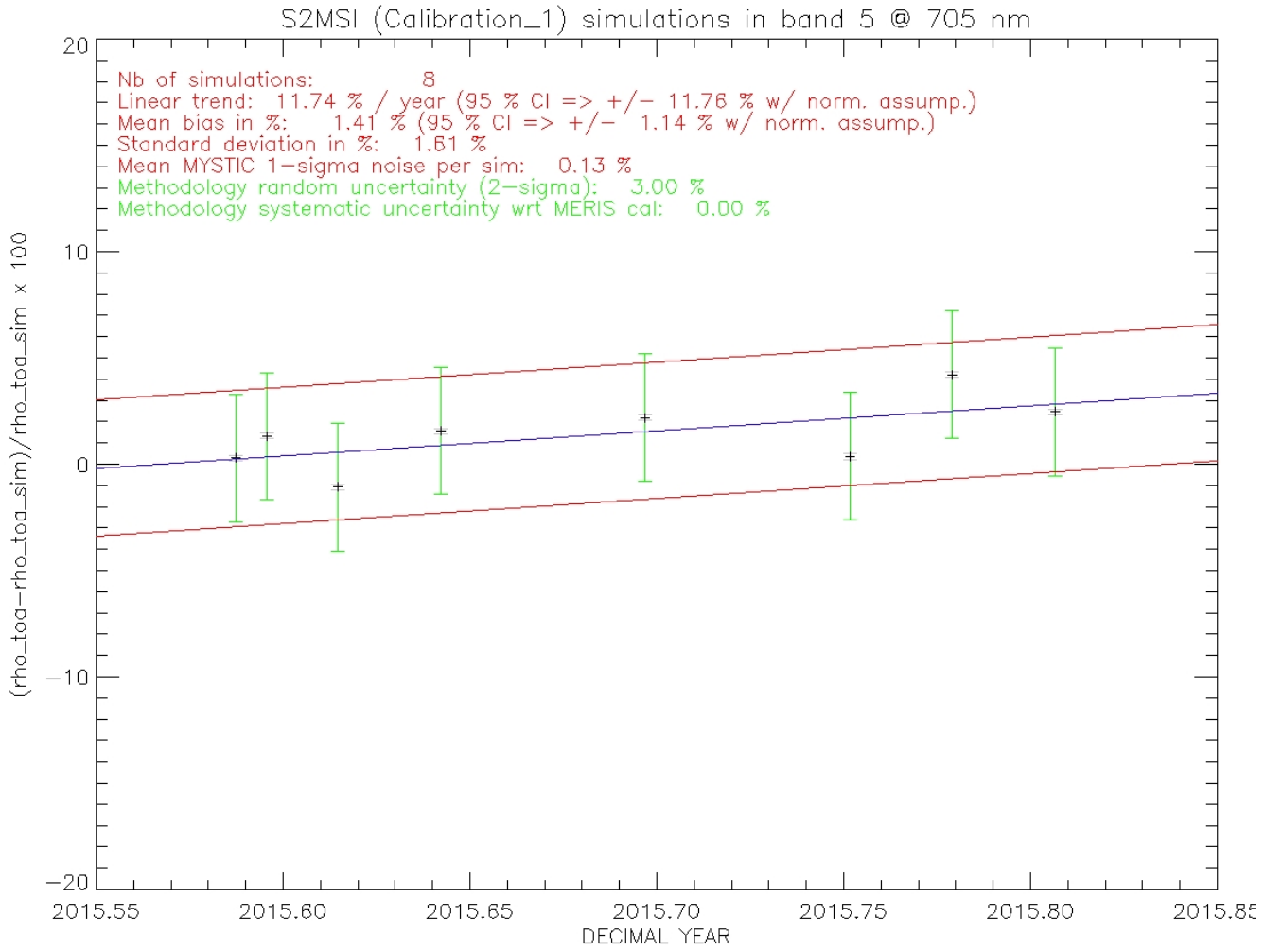
2015.80
2015.85
DECIMAL YEAR


S2MSI (Calibration_1) simulations in band 5 @ 705 nm
Nb of simulations: 8
Linear trend: 11.74 % / year (95 % CI => +/- 11.76 % w/ norm. assump.)
Mean bias in %: 1.41 % (95 % CI => +/- 1.14 % w/ norm. assump.)
Standard deviation in %: 1.61 %
Mean MYSTIC 1-sigma noise per sim: 0.13 %
Methodology random uncertainty (2-sigma): 3.00 %
Methodology systematic uncertainty wrt MERIS cal: 0.00 %
(rho_toa-rho_toa_sim)/rho_toa_sim x 100
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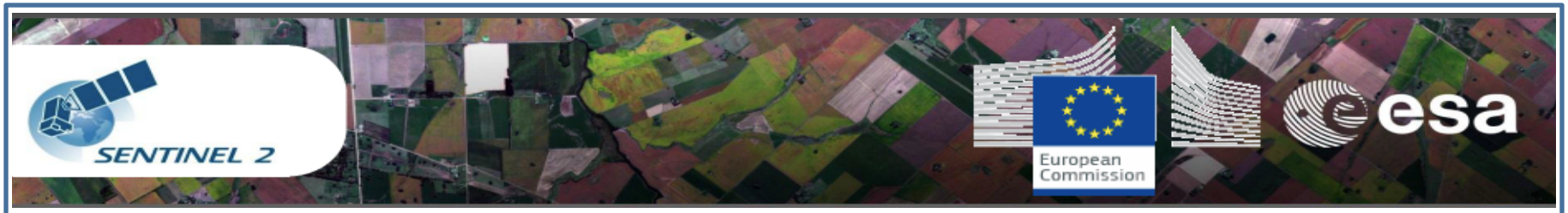
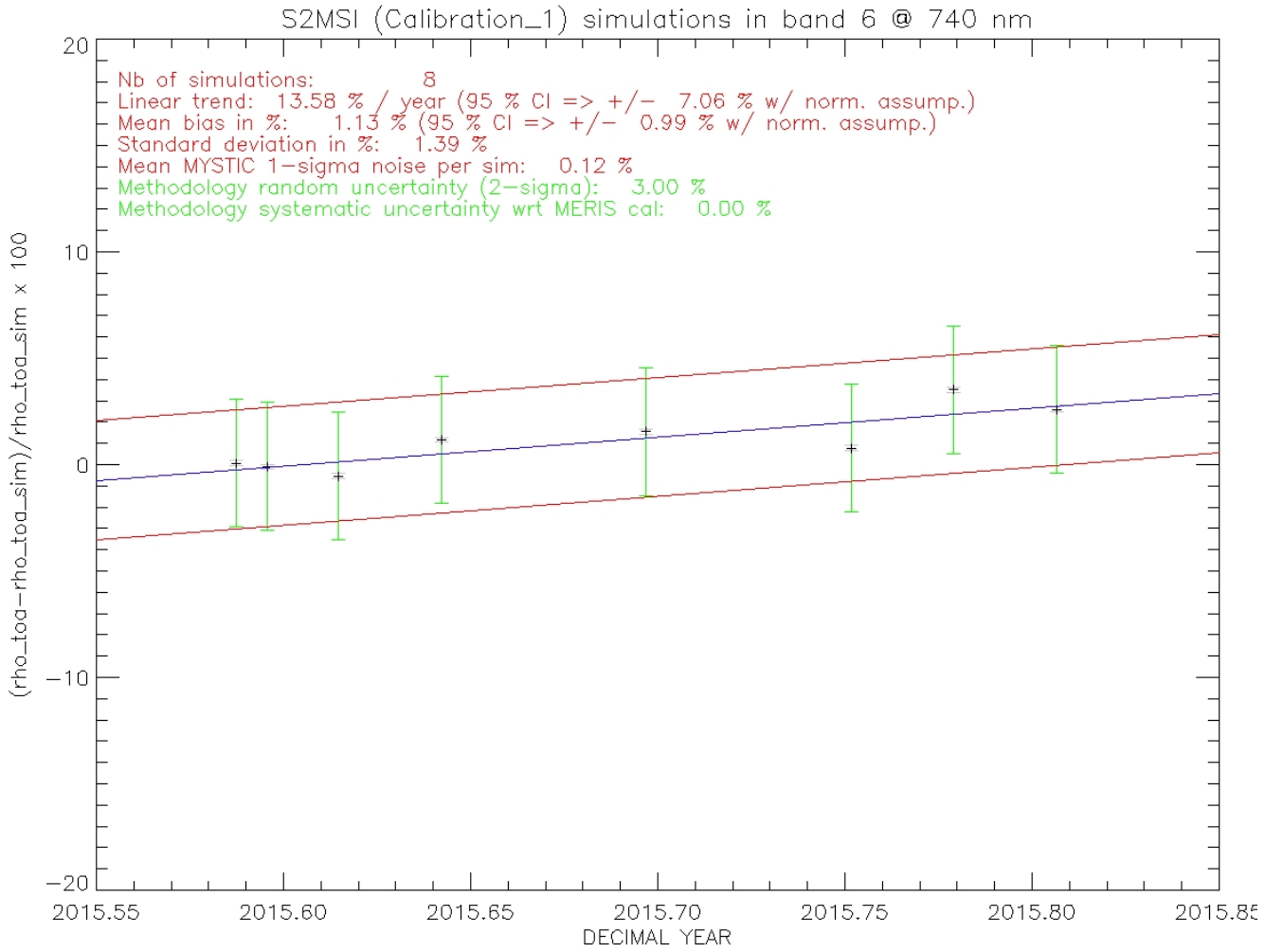
2015.85
DECIMAL YEAR


SENTINEL 2
European Commission
esa


S2MSI (Calibration_1) simulations in band 6 @ 740 nm
Nb of simulations: 8
Linear trend: 13.58 % / year (95 % CI => +/- 7.06 % w/ norm. assump.)
Mean bias in %: 1.13 % (95 % CI => +/- 0.99 % w/ norm. assump.)
Standard deviation in %: 1.39 %
Mean MYSTIC 1-sigma noise per sim: 0.12 %
Methodology random uncertainty (2-sigma): 3.00 %
Methodology systematic uncertainty wrt MERIS cal: 0.00 %
(rho_toa-rho_toa_sim)/rho_toa_sim x 100
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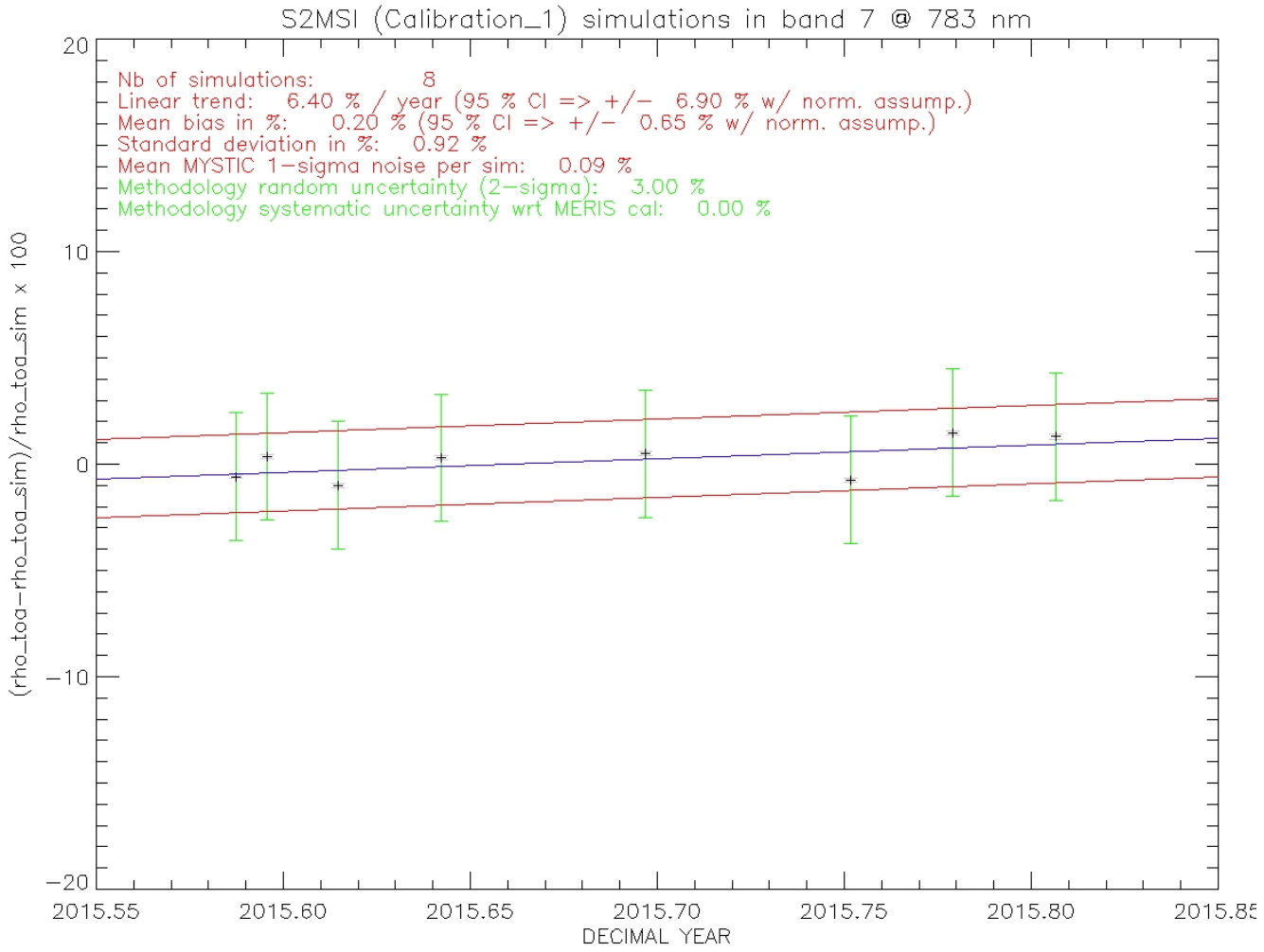
2015.80
2015.85
DECIMAL YEAR


S2MSI (Calibration_1) simulations in band 7 @ 783 nm
Nb of simulations: 8
Linear trend: 6.40 % / year (95 % CI => +/- 6.90 % w/ norm. assump.)
Mean bias in %: 0.20 % (95 % CI => +/- 0.65 % w/ norm. assump.)
Standard deviation in %: 0.92 %
Mean MYSTIC 1-sigma noise per sim: 0.09 %
Methodology random uncertainty (2-sigma): 3.00 %
Methodology systematic uncertainty wrt MERIS cal: 0.00 %
(rho_toa-rho_toa_sim)/rho_toa_sim x 100
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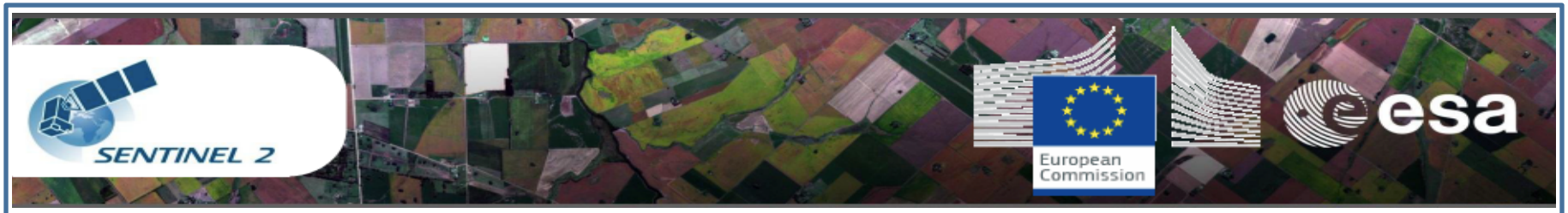
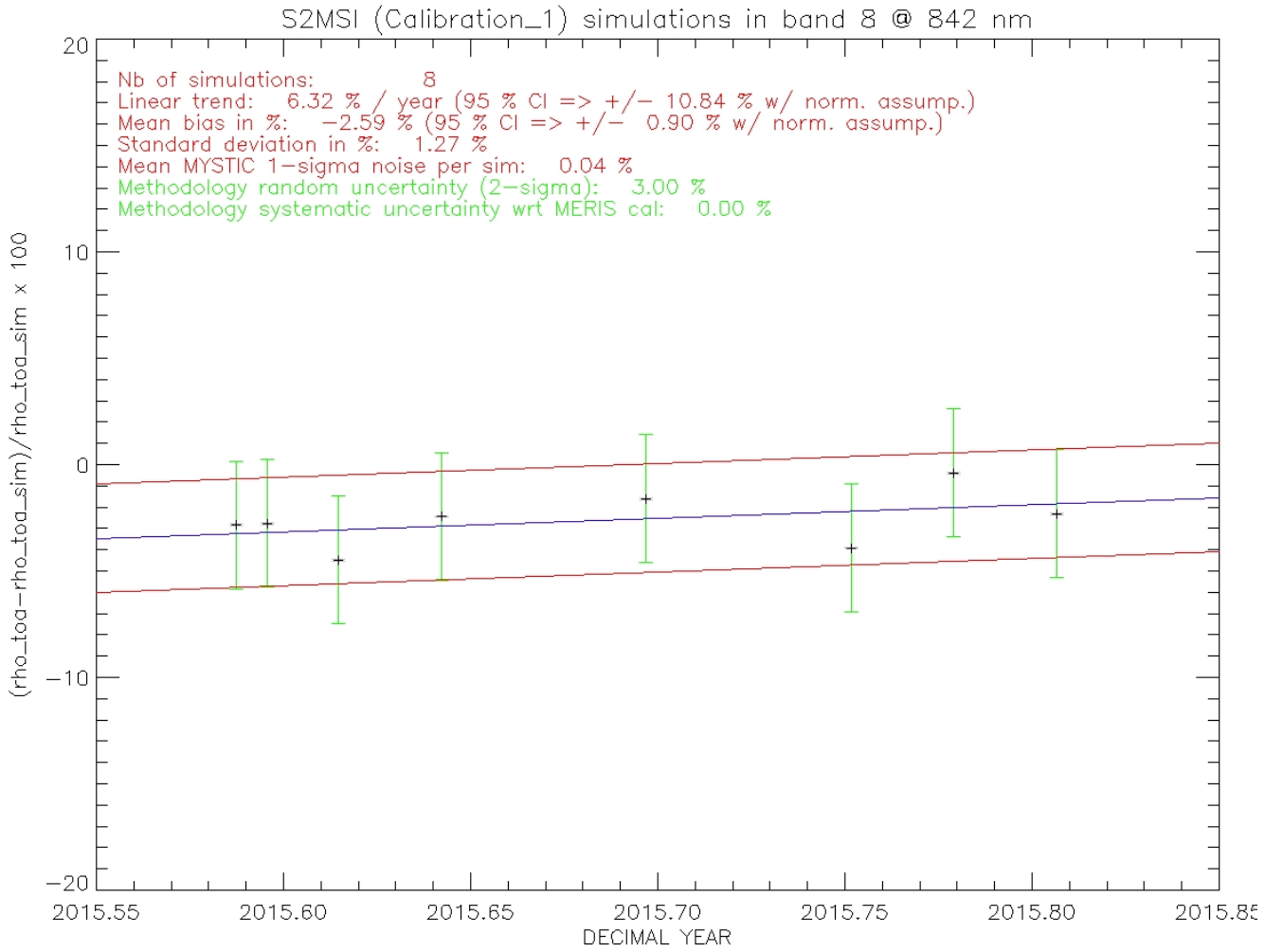
2015.85
DECIMAL YEAR


SENTINEL 2
European Commission
esa


S2MSI (Calibration_1) simulations in band 8 @ 842 nm
Nb of simulations: 8
Linear trend: 6.32 % / year (95 % CI => +/- 10.84 % w/ norm. assump.)
Mean bias in %: −2.59 % (95 % CI => +/- 0.90 % w/ norm. assump.)
Standard deviation in %: 1.27 %
Mean MYSTIC 1−sigma noise per sim: 0.04 %
Methodology random uncertainty (2−sigma): 3.00 %
Methodology systematic uncertainty wrt MERIS cal: 0.00 %
(rho_toa−rho_toa_sim)/rho_toa_sim x 100
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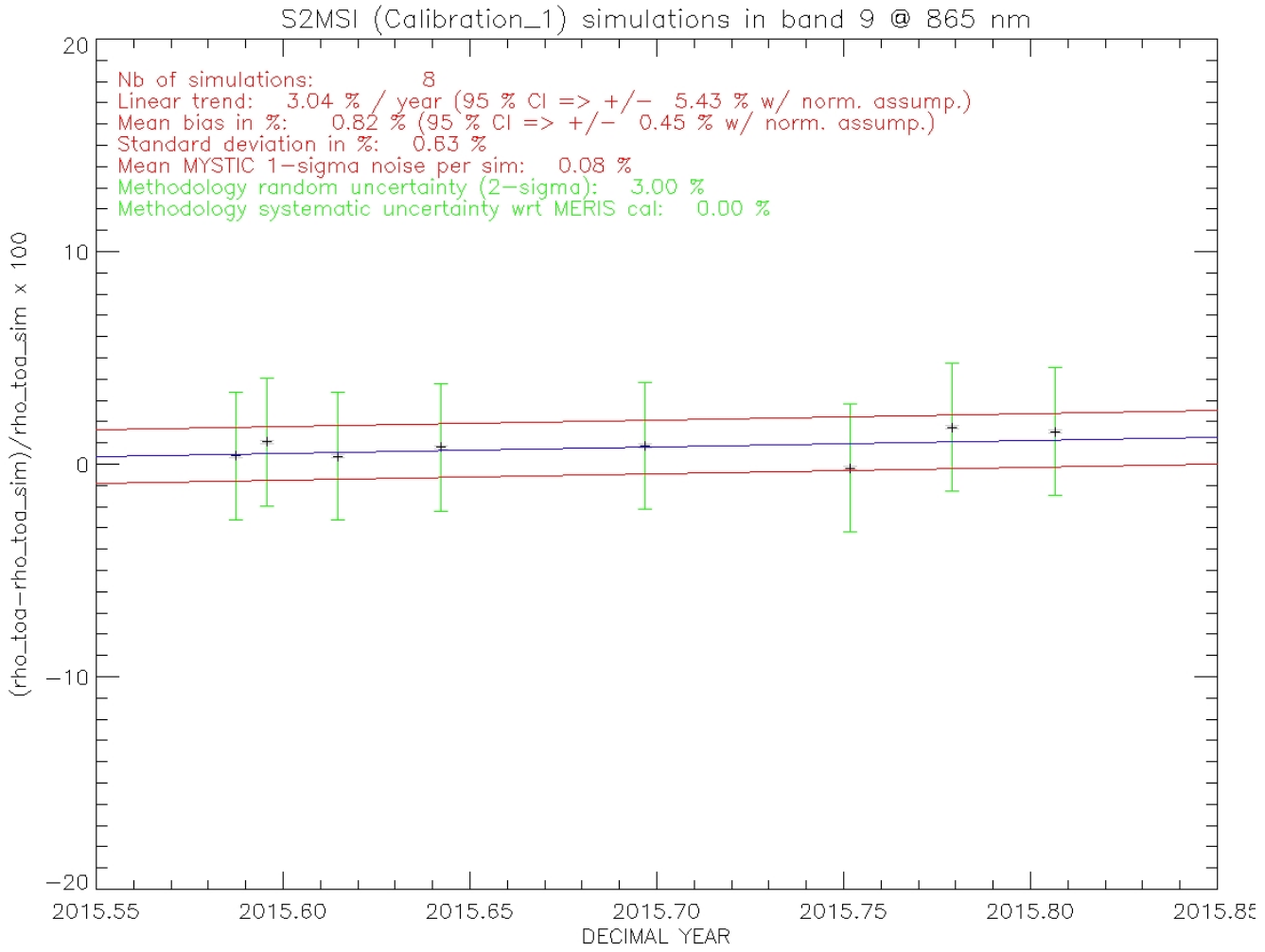
2015.80
2015.85
DECIMAL YEAR


S2MSI (Calibration_1) simulations in band 9 @ 865 nm
Nb of simulations: 8
Linear trend: 3.04 % / year (95 % CI => +/- 5.43 % w/ norm. assump.)
Mean bias in %: 0.82 % (95 % CI => +/- 0.45 % w/ norm. assump.)
Standard deviation in %: 0.63 %
Mean MYSTIC 1-sigma noise per sim: 0.08 %
Methodology random uncertainty (2-sigma): 3.00 %
Methodology systematic uncertainty wrt MERIS cal: 0.00 %
(rho_toa-rho_toa_sim)/rho_toa_sim x 100
20
10
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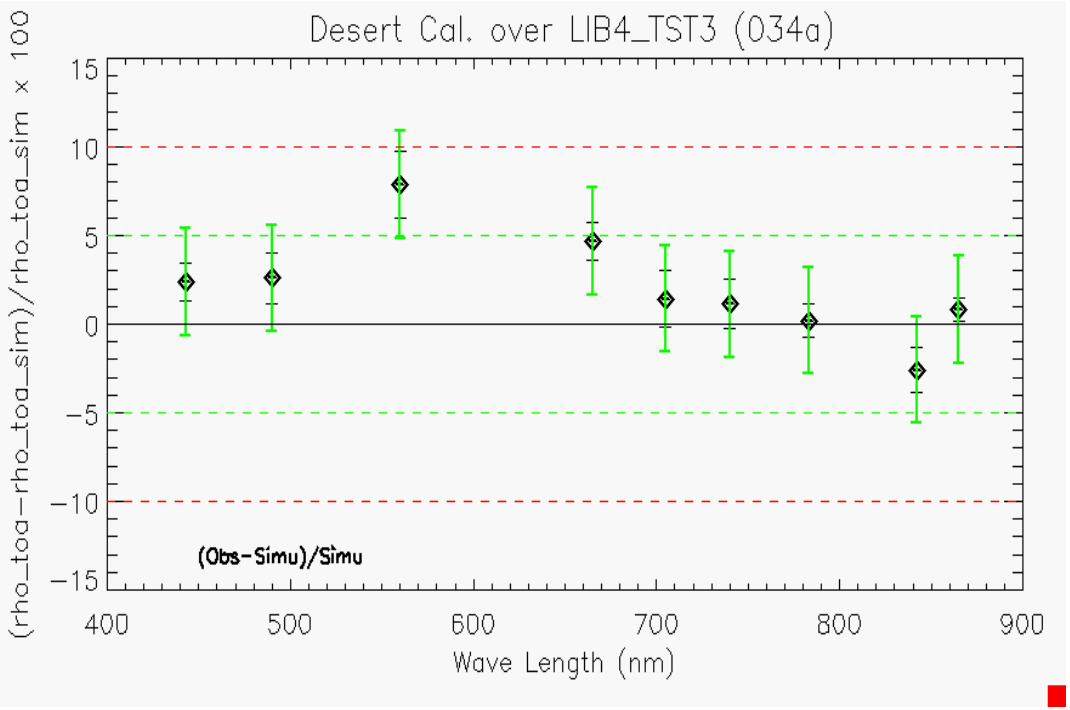
2015.55
2015.60
2015.65
2015.70
2015.75
2015.80
2015.85
DECIMAL YEAR

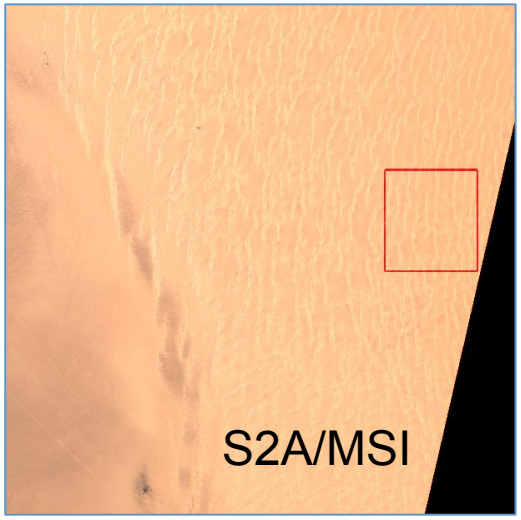
Mean Bias S2A/MSI over Libya-4

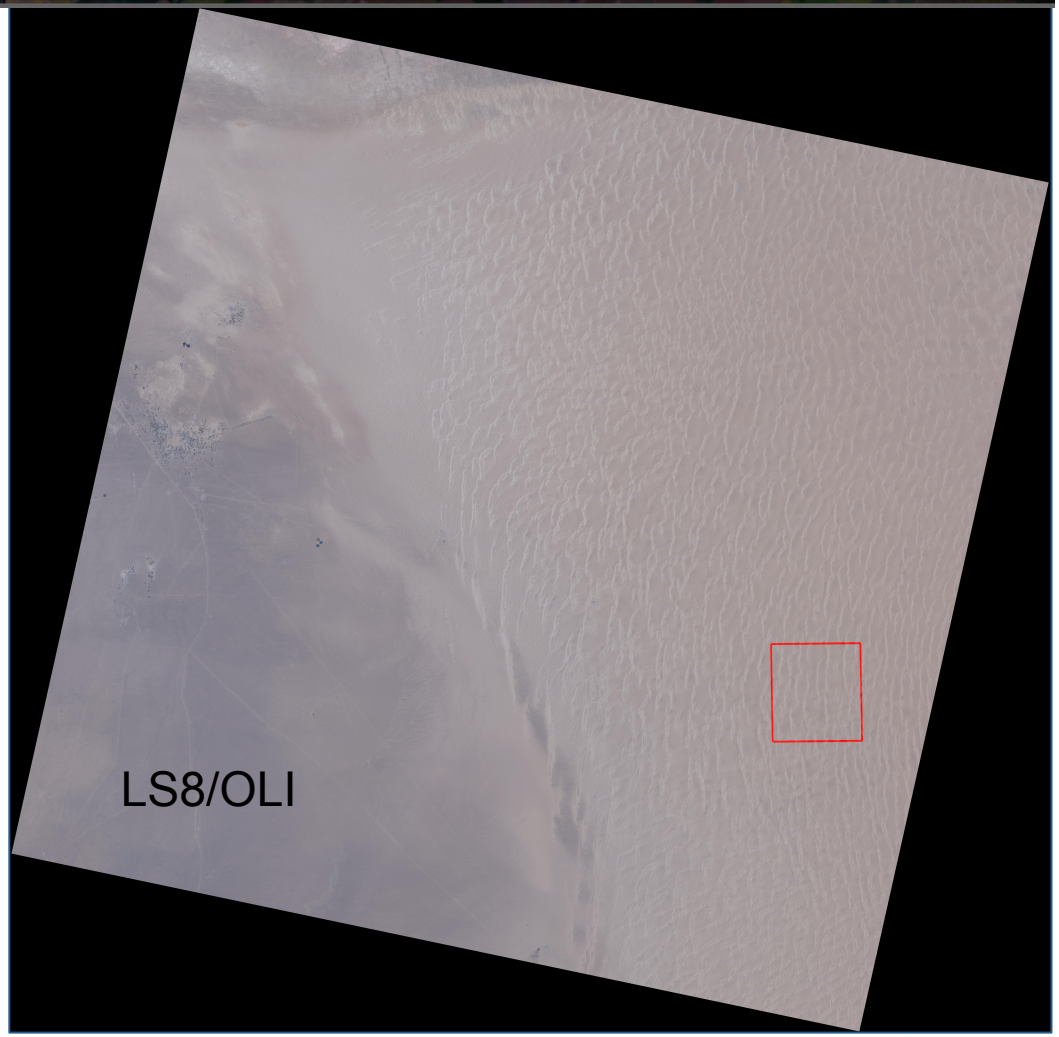
Aug. 2nd – Oct. 22nd

S2A MSI	Wave length (nm)	Trend (%)	Mean bias (%)	STDV (%)
B01	443	+4.5	+2.37	1.05
B02	490	+12.8	+2.61	1.43
B03	560	+18.25	**+7.87**	1.87
B04	665	+9.44	+4.68	1.08
B05	705	+11.74	+1.41	1.61
B06	740	+13.58	+1.13	1.39
B07	783	+6.40	+0.20	0.92
B08	842	+6.32	-2.59	1.27
B8A	865	+3.04	+0.82	0.63



S2A vs. LS8
Libya-4





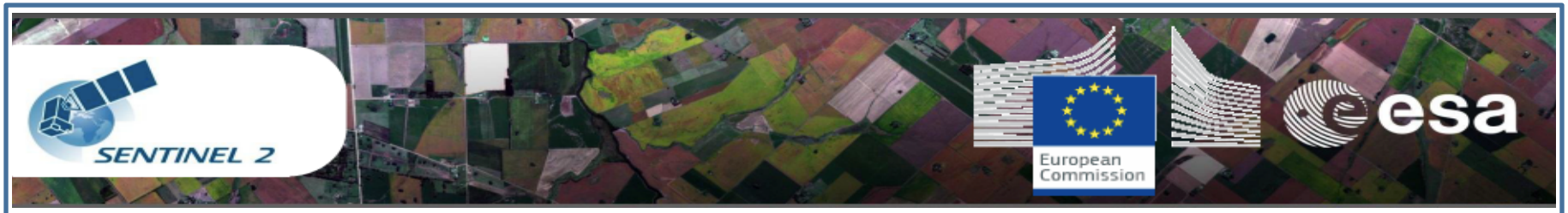
S2A/MSI & LS8/OLI over Libya-4 Aug. 2nd – Oct. 22nd

02-08-2015	03-08-2015
05-08-2015	12-08-2015
12-08-2015	28-08-2015
22-08-2015	13-09-2015
11-09-2015	20-09-2015
01-10-2015	29-09-2015
11-10-2015	06-10-2015
21-10-2015	15-10-2015

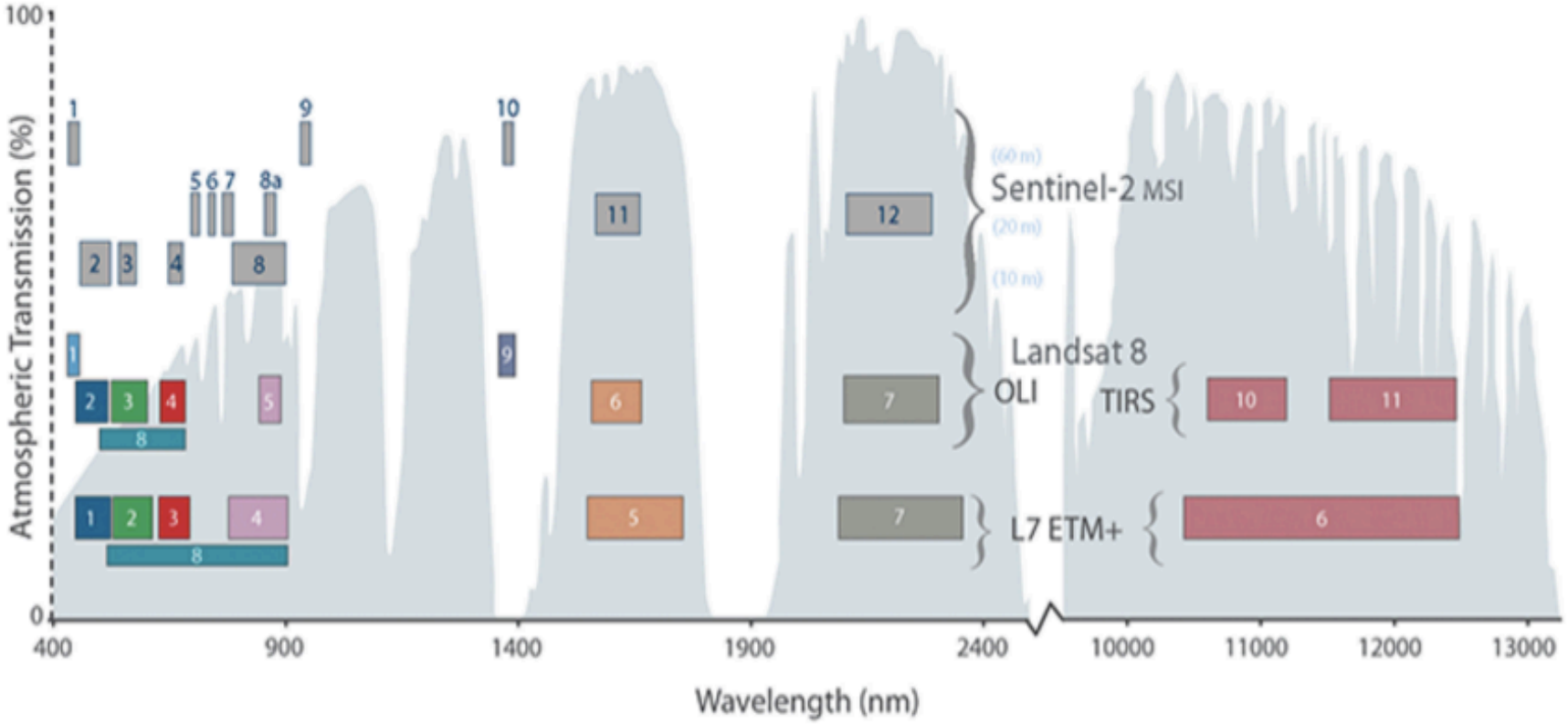
1 Matchup (Δd=0)

2 Matchups (Δd=1)

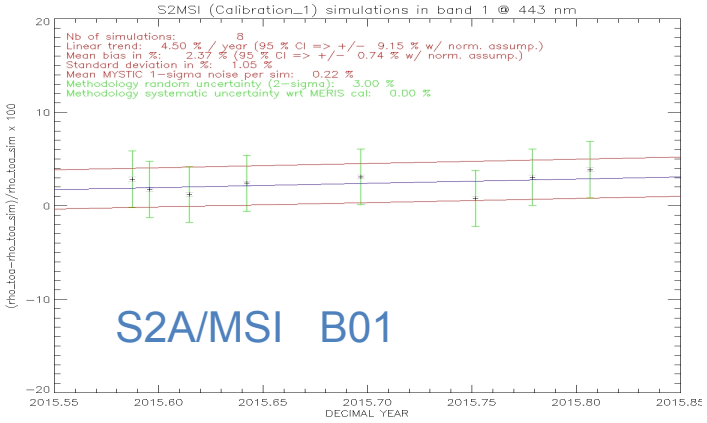
4 Matchups (Δd=2)

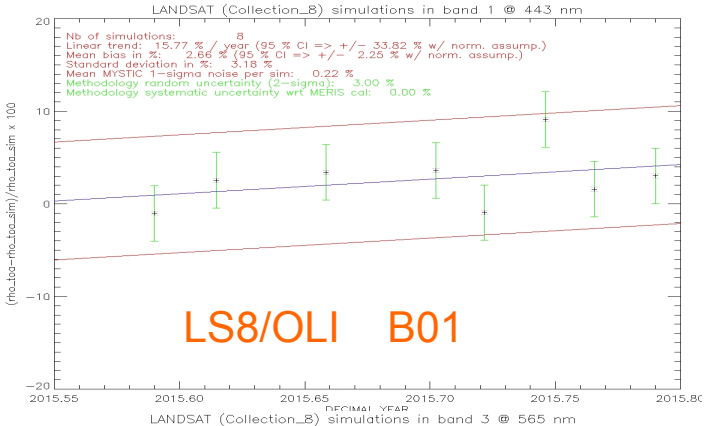


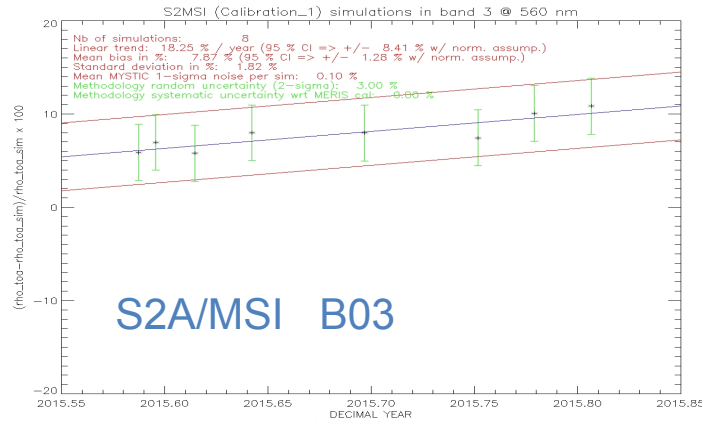
S2A/MSI & LS8/OLI over Libya-4 Aug. 2nd – Oct. 22nd

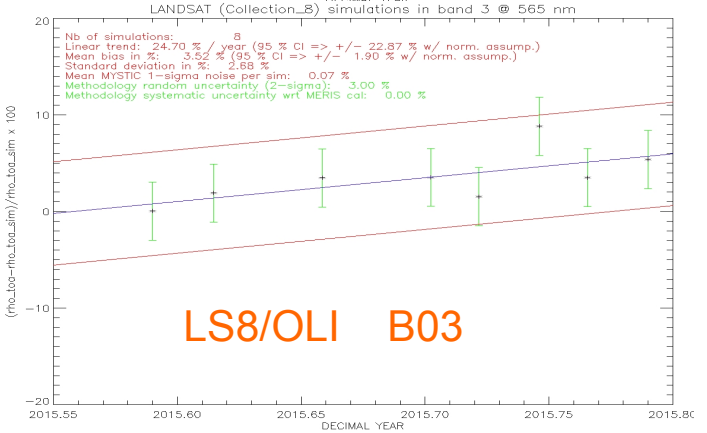


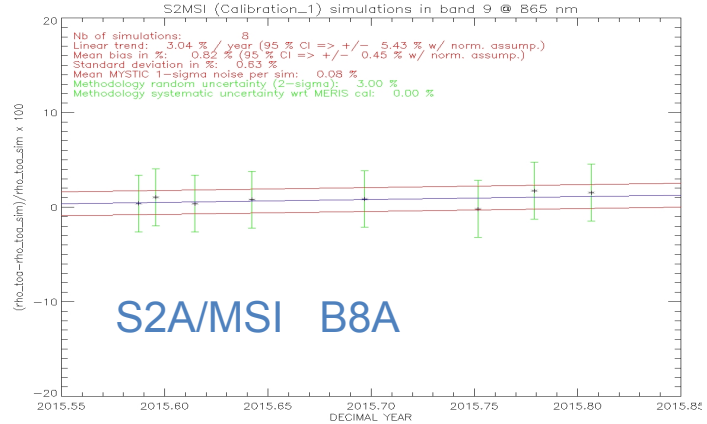
(From landsat.gsfc.nasa.gov)

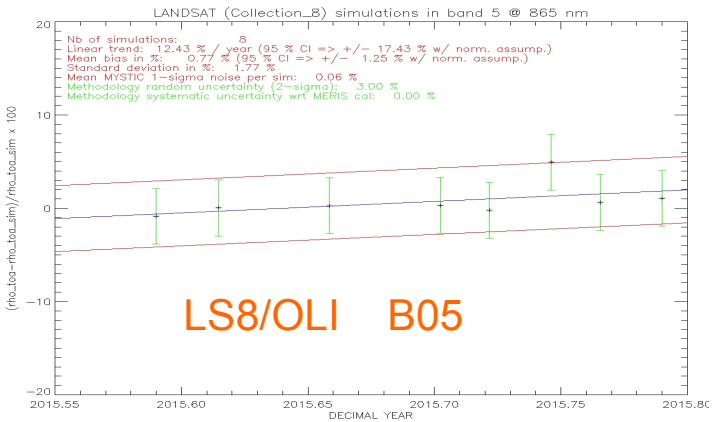

S2MSI (Calibration_1) simulations in band 1 @ 443 nm
Nb of simulations: 8
Linear trend: 4.50 % / year (95 % CI => +/- 9.15 % w/ norm. assump.)
Mean bias in %: 2.37 % (95 % CI => +/- 0.74 % w/ norm. assump.)
Standard deviation in %: 1.05 %
Mean MYSTIC 1-sigma noise per sim: 0.22 %
Methodology random uncertainty (2-sigma): 3.00 %
Methodology systematic uncertainty wrt MERIS cal: 0.00 %
(rho_toa-rho_toa_sim)/rho_toa_sim x 100
DECIMAL YEAR
S2A/MSI B01

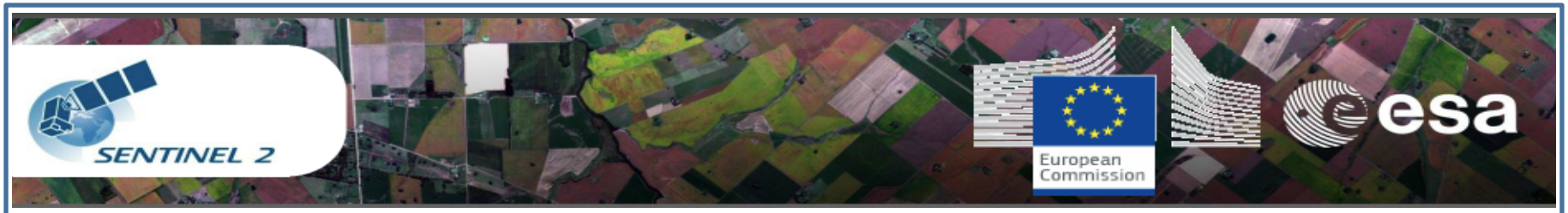

LANDSAT (Collection_8) simulations in band 1 @ 443 nm
Nb of simulations: 8
Linear trend: 15.77 % / year (95 % CI => +/- 33.82 % w/ norm. assump.)
Mean bias in %: 2.66 % (95 % CI => +/- 2.25 % w/ norm. assump.)
Standard deviation in %: 3.18 %
Mean MYSTIC 1-sigma noise per sim: 0.22 %
Methodology random uncertainty (2-sigma): 3.00 %
Methodology systematic uncertainty wrt MERIS cal: 0.00 %
(rho_toa-rho_toa_sim)/rho_toa_sim x 100
DECIMAL YEAR
LS8/OLI B01


S2MSI (Calibration_1) simulations in band 3 @ 560 nm
Nb of simulations: 8
Linear trend: 18.25 % / year (95 % CI => +/- 8.41 % w/ norm. assump.)
Mean bias in %: 7.87 % (95 % CI => +/- 1.28 % w/ norm. assump.)
Standard deviation in %: 1.82 %
Mean MYSTIC 1-sigma noise per sim: 0.10 %
Methodology random uncertainty (2-sigma): 3.00 %
Methodology systematic uncertainty wrt MERIS cal: 0.00 %
(rho_toa-rho_toa_sim)/rho_toa_sim x 100
DECIMAL YEAR
S2A/MSI B03


LANDSAT (Collection_8) simulations in band 3 @ 565 nm
Nb of simulations: 8
Linear trend: 24.70 % / year (95 % CI => +/- 22.87 % w/ norm. assump.)
Mean bias in %: 3.52 % (95 % CI => +/- 1.90 % w/ norm. assump.)
Standard deviation in %: 2.68 %
Mean MYSTIC 1-sigma noise per sim: 0.07 %
Methodology random uncertainty (2-sigma): 3.00 %
Methodology systematic uncertainty wrt MERIS cal: 0.00 %
(rho_toa-rho_toa_sim)/rho_toa_sim x 100
DECIMAL YEAR
LS8/OLI B03


S2MSI (Calibration_1) simulations in band 9 @ 865 nm
Nb of simulations: 8
Linear trend: 3.04 % / year (95 % CI => +/- 5.43 % w/ norm. assump.)
Mean bias in %: 0.82 % (95 % CI => +/- 0.45 % w/ norm. assump.)
Standard deviation in %: 0.63 %
Mean MYSTIC 1-sigma noise per sim: 0.08 %
Methodology random uncertainty (2-sigma): 3.00 %
Methodology systematic uncertainty wrt MERIS cal: 0.00 %
(rho_toa-rho_toa_sim)/rho_toa_sim x 100
DECIMAL YEAR
S2A/MSI B8A


LANDSAT (Collection_8) simulations in band 5 @ 865 nm
Nb of simulations: 8
Linear trend: 12.43 % / year (95 % CI => +/- 17.43 % w/ norm. assump.)
Mean bias in %: 0.77 % (95 % CI => +/- 1.25 % w/ norm. assump.)
Standard deviation in %: 1.77 %
Mean MYSTIC 1-sigma noise per sim: 0.06 %
Methodology random uncertainty (2-sigma): 3.00 %
Methodology systematic uncertainty wrt MERIS cal: 0.00 %
(rho_toa-rho_toa_sim)/rho_toa_sim x 100
DECIMAL YEAR
LS8/OLI B05

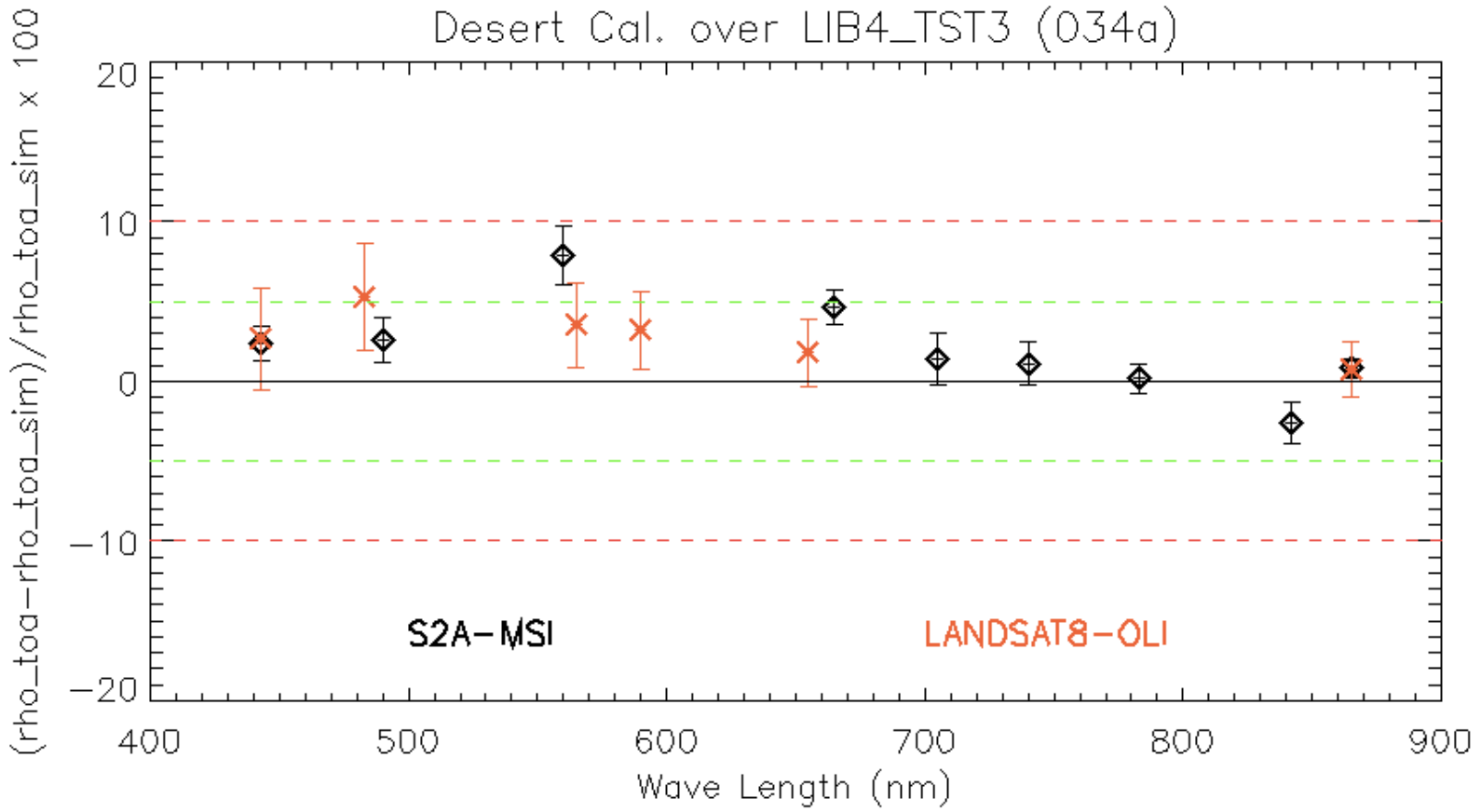


S2A/MSI & LS8/OLI over Libya-4 Aug. 2nd – Oct. 22nd

S2A MSI	Wave length (nm)	Trend (%)	Mean bias (%)	STDV (%)
B01	443	+4.5	+2.37	1.05
B02	490	+12.8	+2.61	1.43
B03	560	+18.25	**+7.87**	1.87
B04	665	+9.44	+4.68	1.08
B05	705	+11.74	+1.41	1.61
B06	740	+13.58	+1.13	1.39
B07	783	+6.40	+0.20	0.92
B08	842	+6.32	-2.59	1.27
B8A	865	+3.04	+0.82	0.63

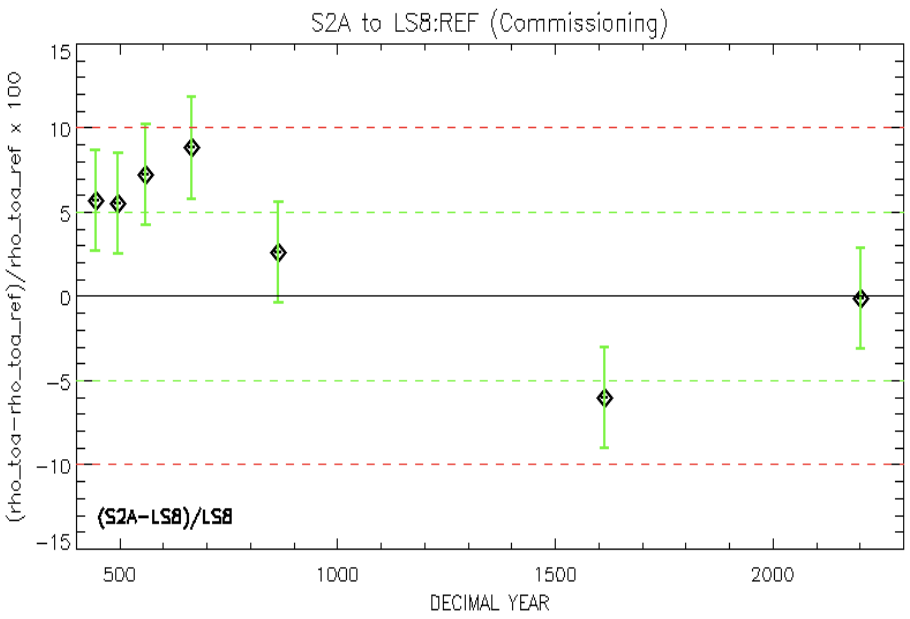
LS8 OLI	Wave length (nm)	Trend (%)	Mean bias (%)	STDV (%)
B01	443	+15.77	+2.66	3.18
B02	483	+21.25	+5.28	3.34
B03	565	+24.70	+3.52	2.68
B04	665	+19.99	+1.79	2.14
NA				
B08	590	+22.57	+3.19	2.45
NA				
NA				
B05	865	+3.04	+0.82	0.63

Mean bias S2A/MSI & LS8/OLI over Libya-4

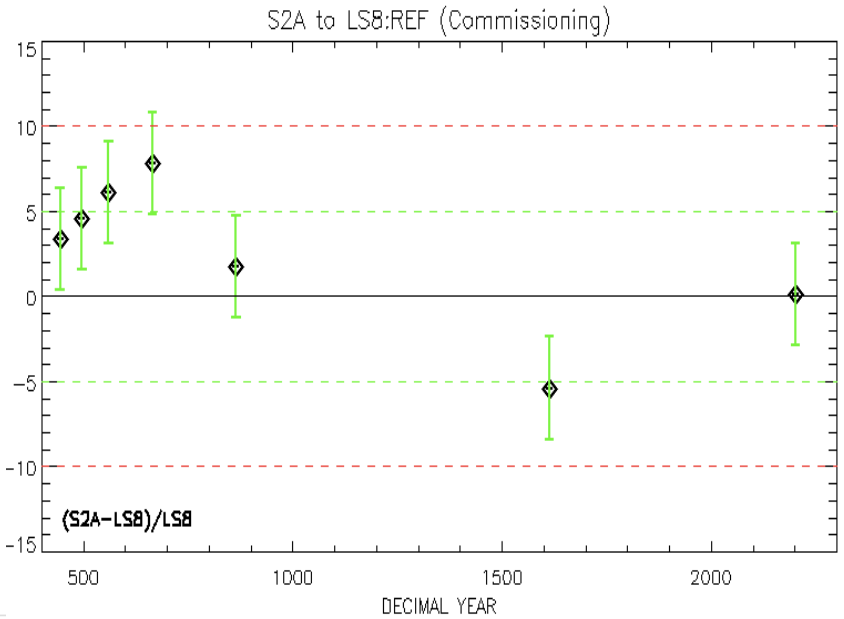


Relative difference S2A/MSI & LS8/OLI over Libya-4

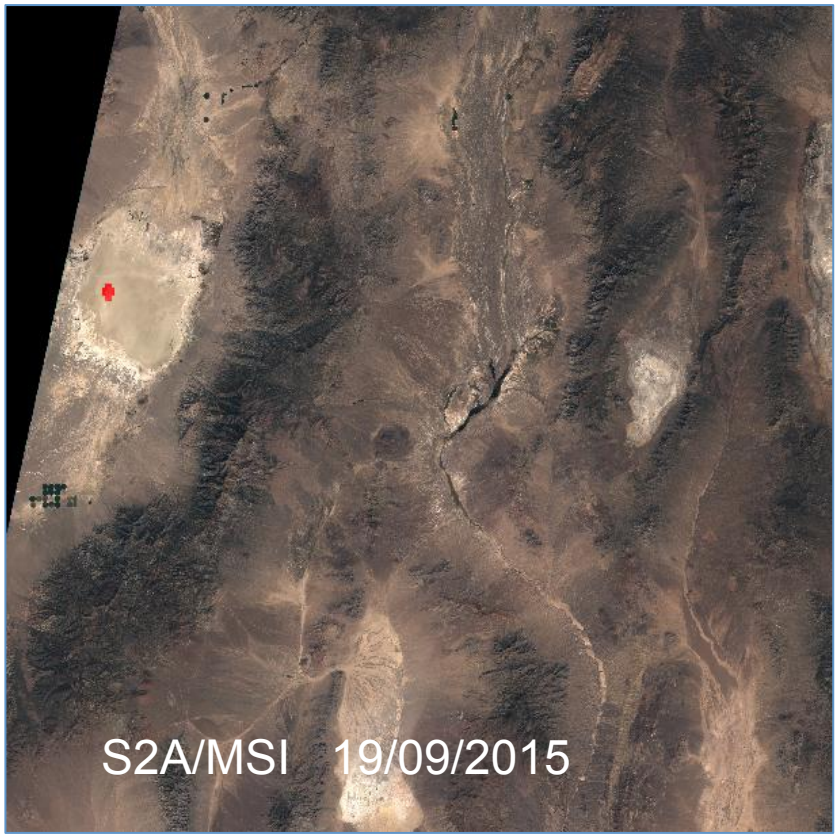
12/08

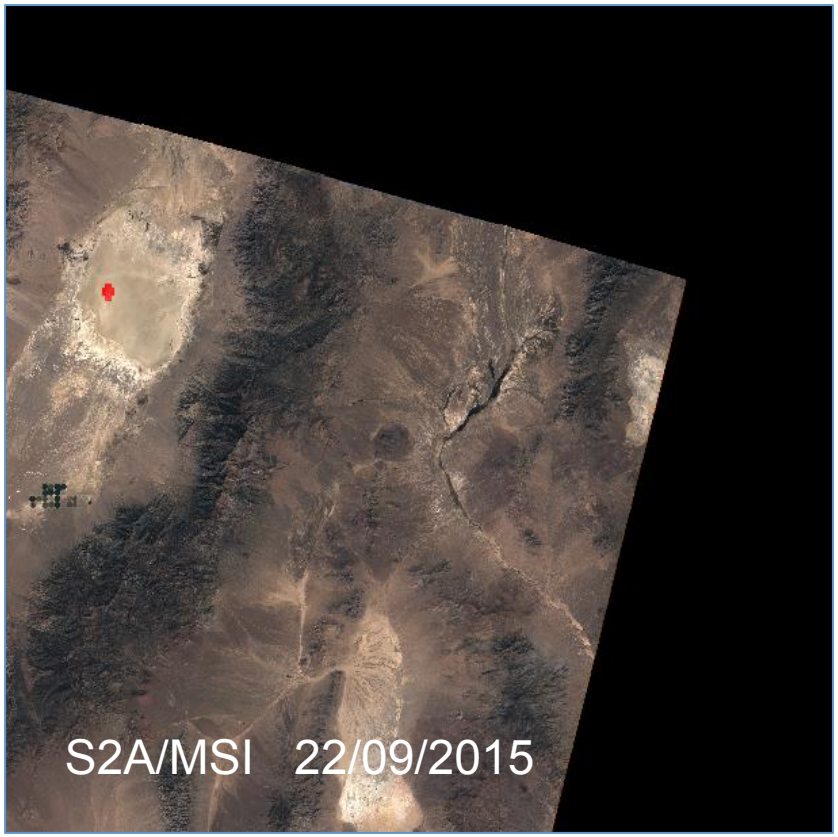


Aug. 2nd – Oct. 22nd



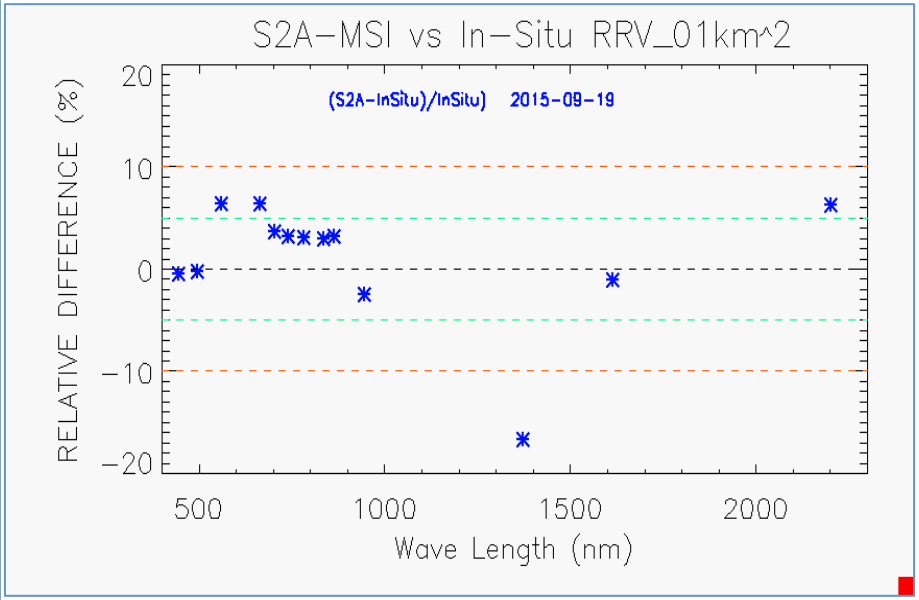
S2A vs. In-Situ over Railroad Valley



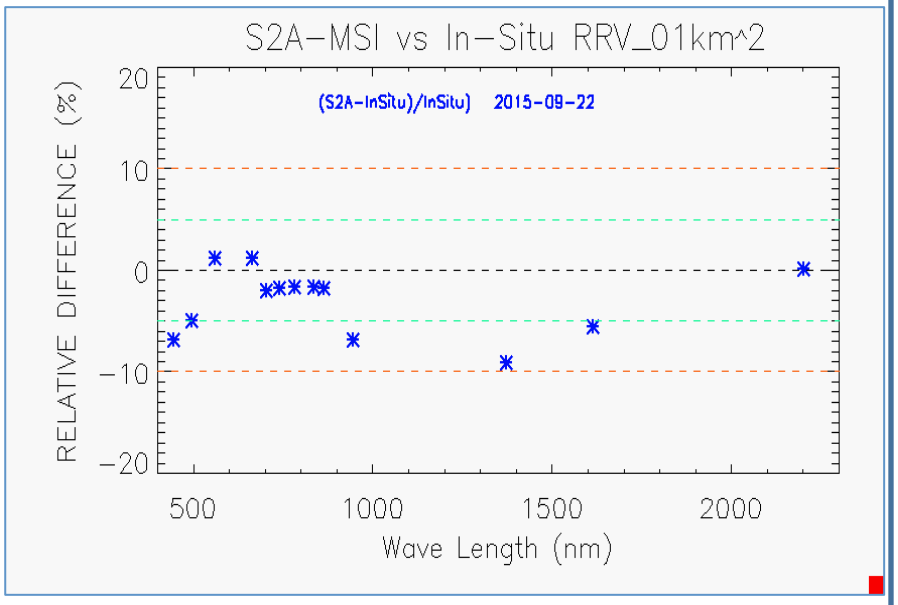


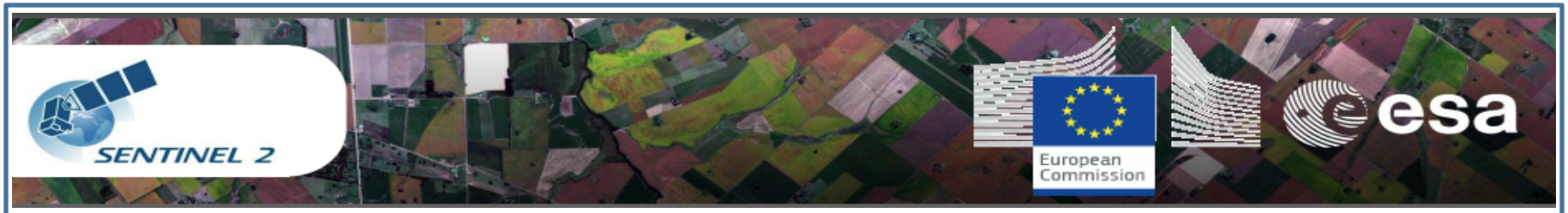
Relative difference S2A/MSI & In-situ over RRV

19/09/2015



22/09/2015





Remarks and future work

✧ These are a preliminary results.

✧ Keep in mind the temporal difference of the acquisitions for the inter-comparison.

✧ S2A/MSI performing well

✧Error budget to be done

Thanks for your attention,