SENTINEL 2

Mission Performance Centre

CalVal needs for S2/S3 data normalisation

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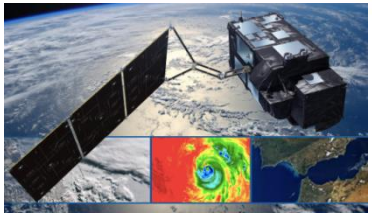
with support of R. Serra & V. Vellucci

ACRI ST ARGANS ACRI HE LOV

presentation by FR Martin-Lauzer

esa EUMETSAT



Goal:

EO synergy

Sentinel-2/MSI, &
Landsat8/OLI, &
Sentinel-3/OLCI & SLSTR, &
NPP-VIIRS & MODIS A

for L2 data merging

1- inter & co –validation of EO systems, *i.e.*
sensors & data processors

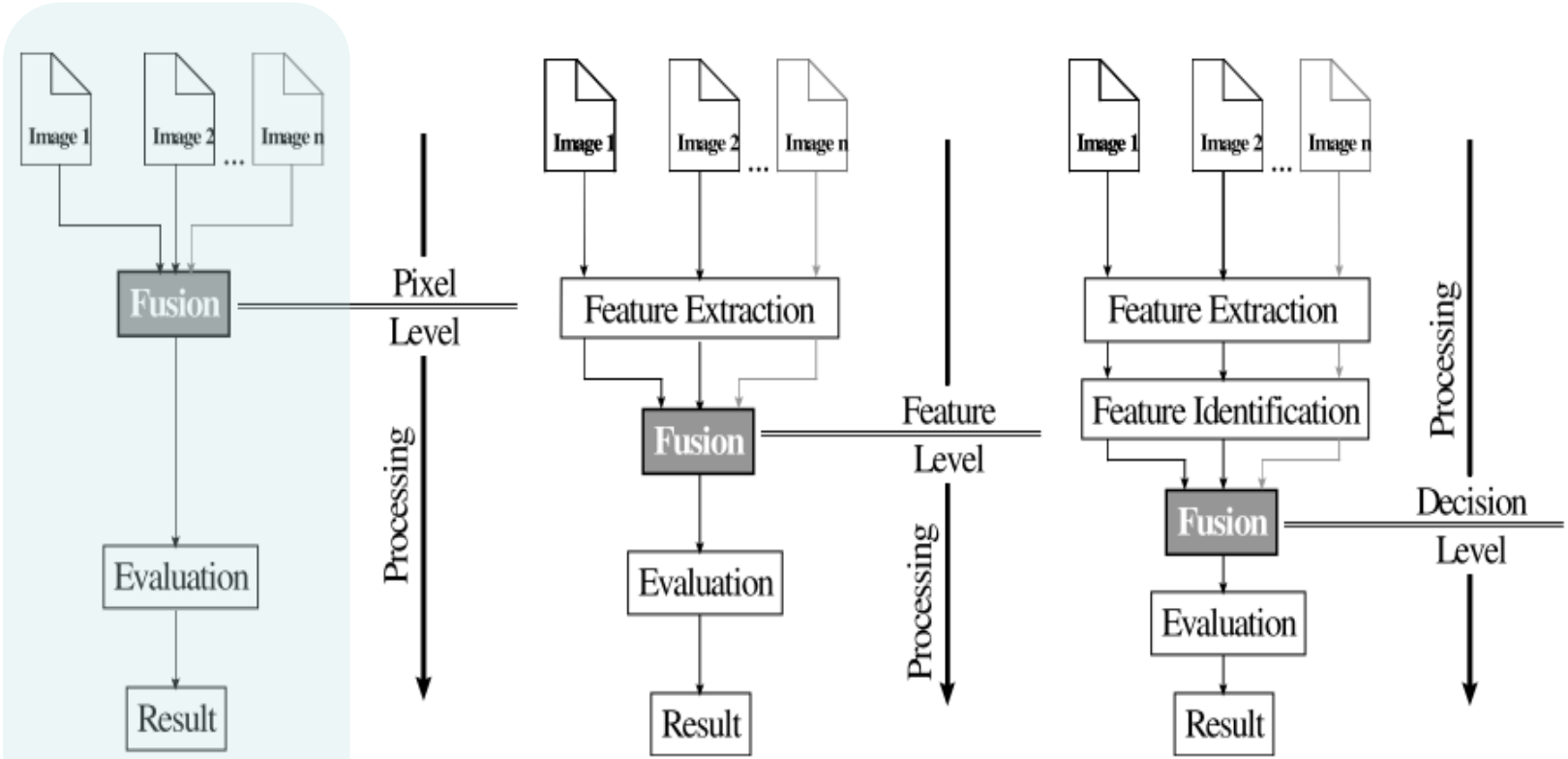
→ ***mitigation of sparse revisit time (EO HR and VHR missions vs. MR missions)***

2- co-adjustment of L2 processors, *i.e.*

- data integration
- data fusion

} production of L3 and L4 data sets

A 3-Tier data fusion process

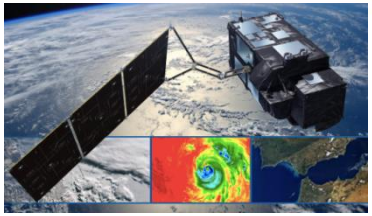


signal → pixel → feature → knowledge

EO products' fusion

to improve feature extraction

MR data sets have the spectral resolution and HR data sets have the spatial resolution



Requirements for data fusion

- Consistency between data sets (to apply operations)
- Differential Significance of data sets
- Accuracy & precision of data in each data sets
- Information retrieval & merging methodology

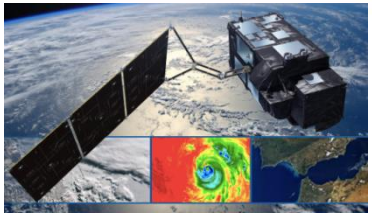
→ e.g. geometric and radiometric intercalibration

statistical consistency ←

temporal consistency (everything move the same way)
spatial consistency (same geostatistics)

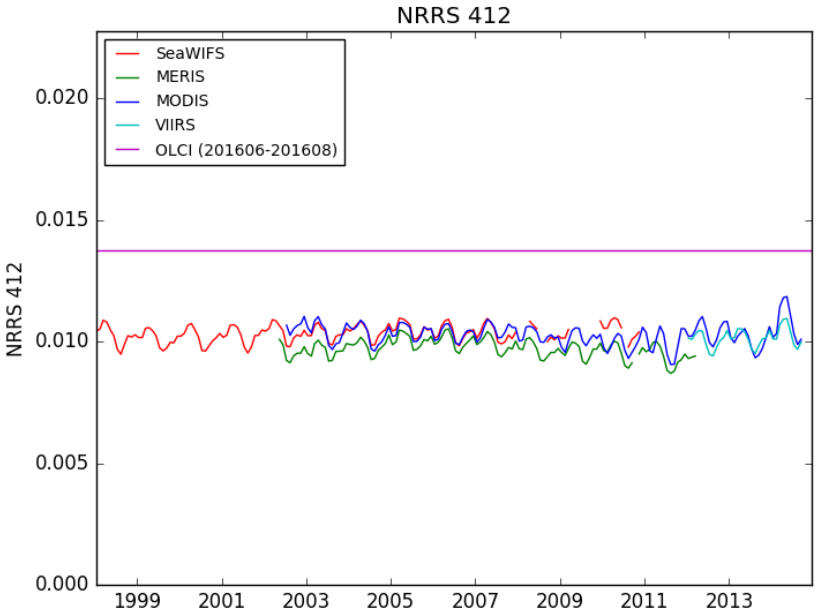
→ EO data sets = different « views » / details of the same stochastic process

at L1 and L2

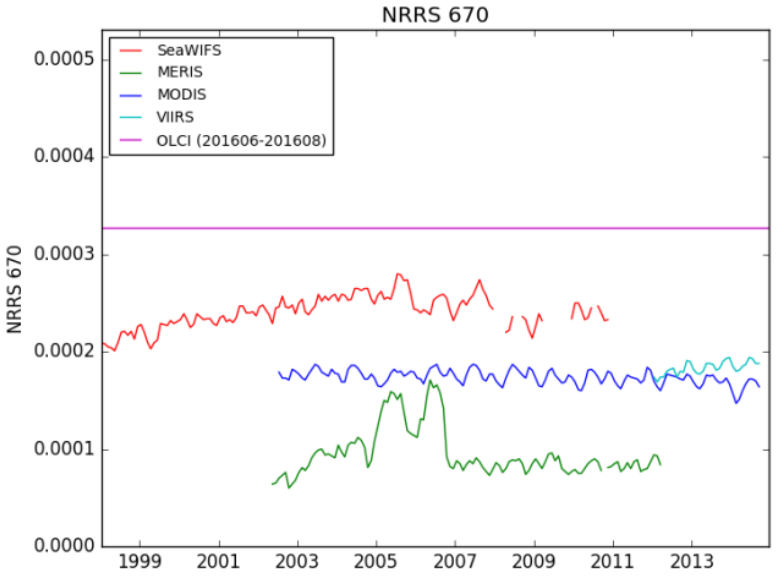


Examples

climatological time-series of NRRS



+/- easily merged



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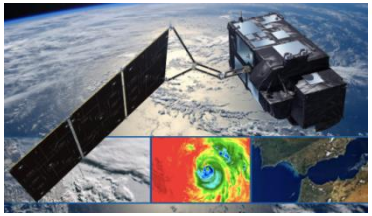
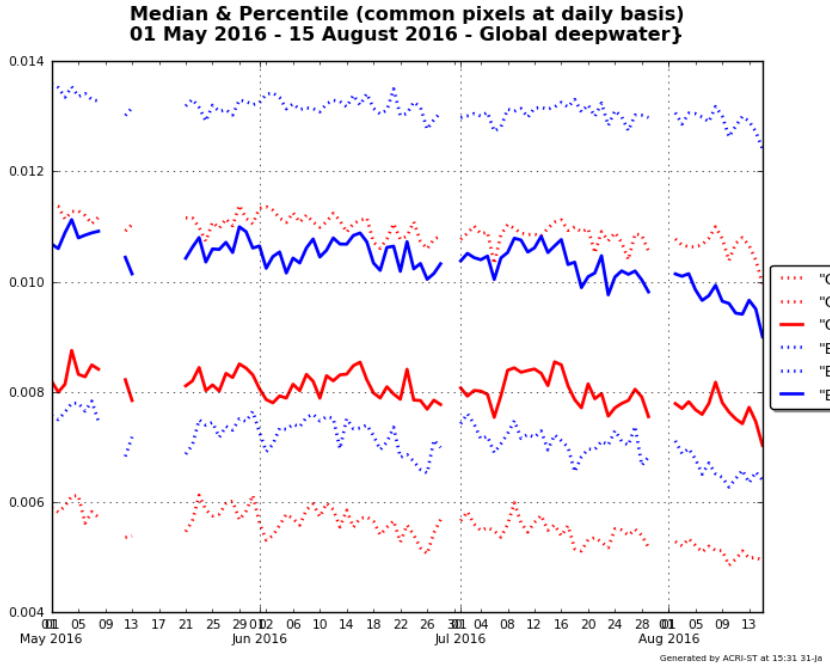
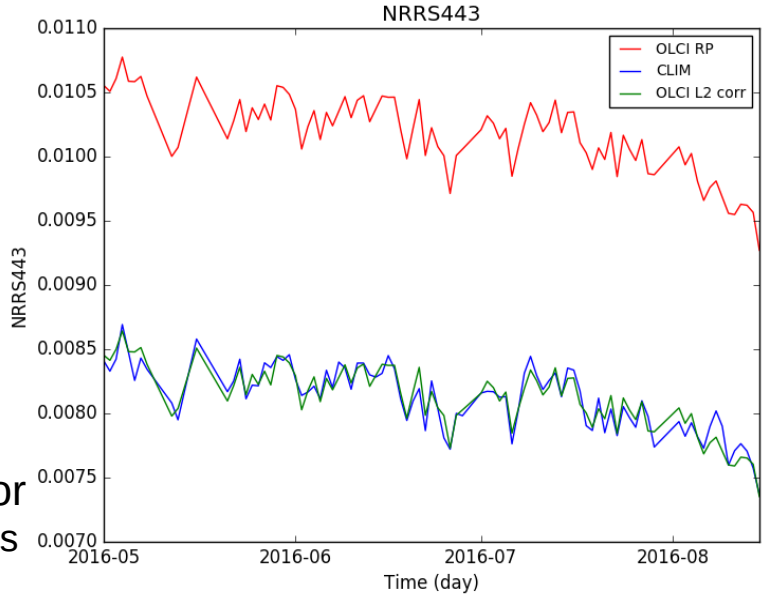


Example (suite)

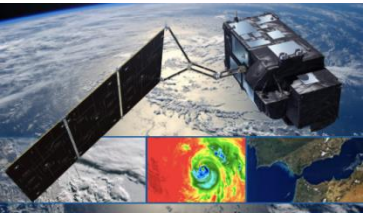
contribution of OLCI to the NRRS climatology



median NRRS of the deep ocean
(OLCI RP Apr-Aug 2016)

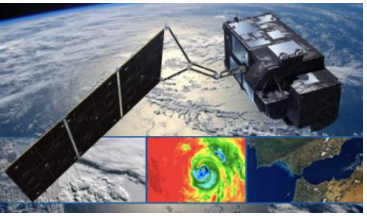


adjustment of the OLCI L2 processor
to contribute to the climatology estimates



Overview of OLCI/MSI/OLI/MODIS characteristics

SENSOR	Spectral density (nb of bands)	Spatial-resolution (m)	Temporal resolution (Day)	Viewing Geometry	PDGS Product-Type
MSI_A	13 (VIS/NIR/SWIR)	10/20/60	10/5 (twin)	quasi-nadir	L1C (SAFE)
OLCI_A	21 (VIS/NIR)	300-1200	4/2 (twin)	off-nadir/Max(VZA) =55°	L1B (NCDF) L2 (NCDF
OLI-TIRS	15 (VIS/NIR/SWIR/TIRS)	15/30	16	Nadir	L1T (TIF)
MODIS_A	36 (VIS/NIR/SWIR/TIRS)	250/500/1000	1-2	Nadir-Off Nadir	L1B (HDF), etc.



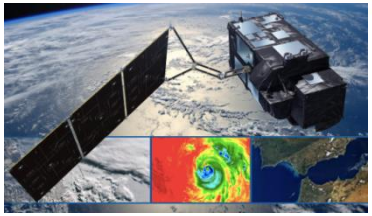
OLCI-MSI bands

bands	Ccetral wavelength (nm)
B01	443
B02	490
B03	560
B04	665
B05	705
B06	740
B07	775
B08	842
B8A	865
B09	940
B10	1375
B11	1610
B12	2190

Sentinel-2A/MSI

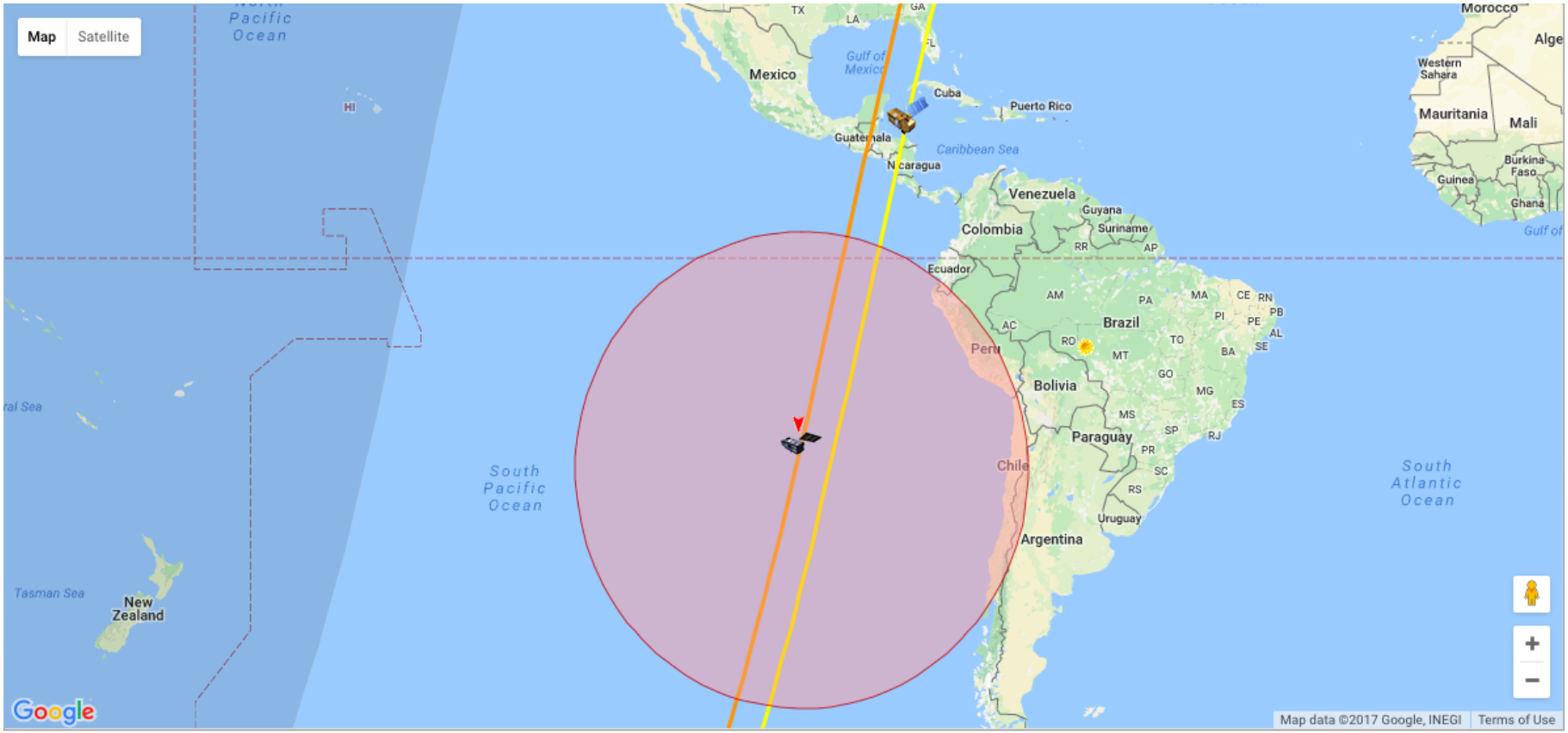
bands	nm
0a01	400
Oa02	412
0a03	443
0a04	490
0a05	510
0a06	560
0a07	620
Oa08	665
0a09	674
0a10	681
0a11	709
0a12	754
0a143	761
0a143	764
0a15	768
0a16	779
0a17	865
0a18	885
0a19	900
0a20	940
0a21	1210

Sentinel-3A/OLCI

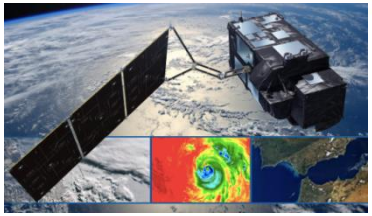


OLCI/MSI/characteristics

Overpasses the target area (temporal-shift)



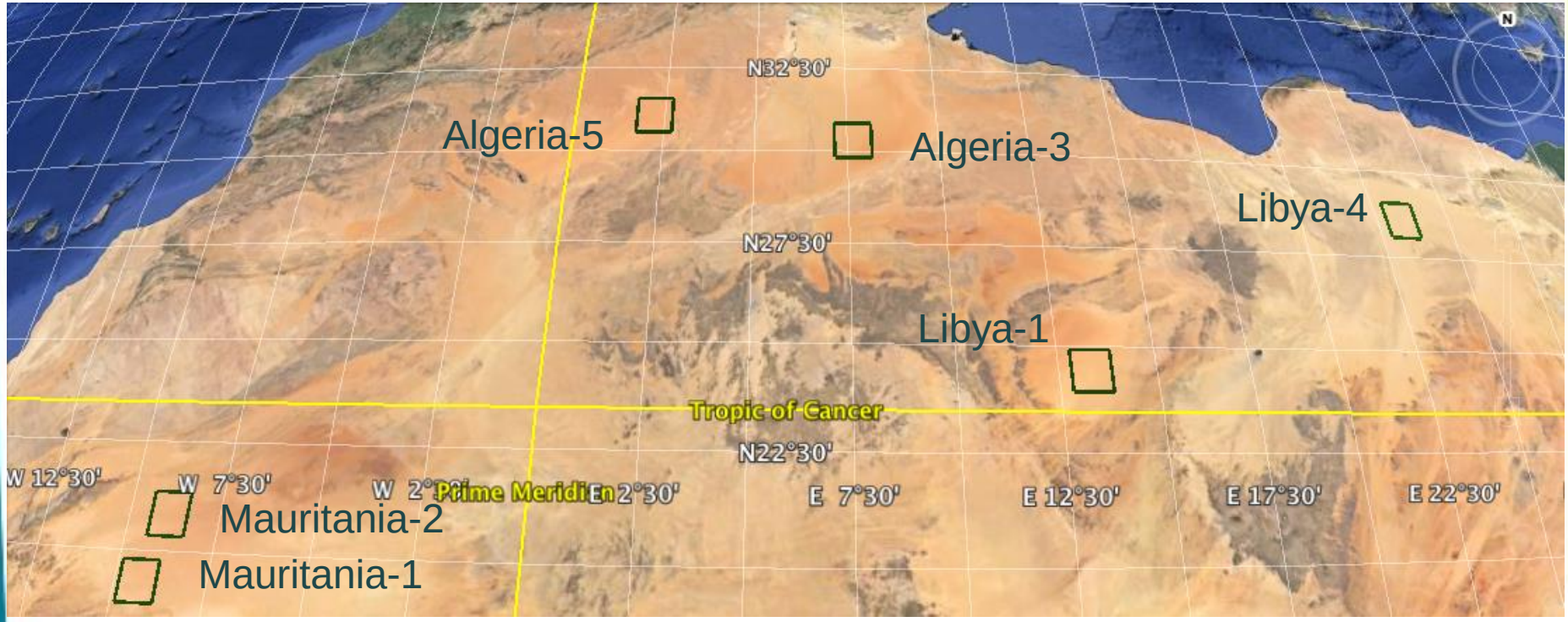
Credit: n2yo.com

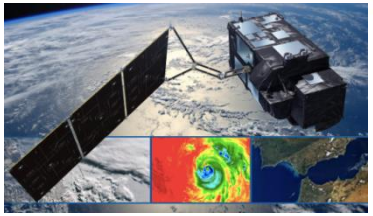


Desert Method: Application on MSI-OLCI-MODIS A-OLI

Desert Cal/Val sites -PICS

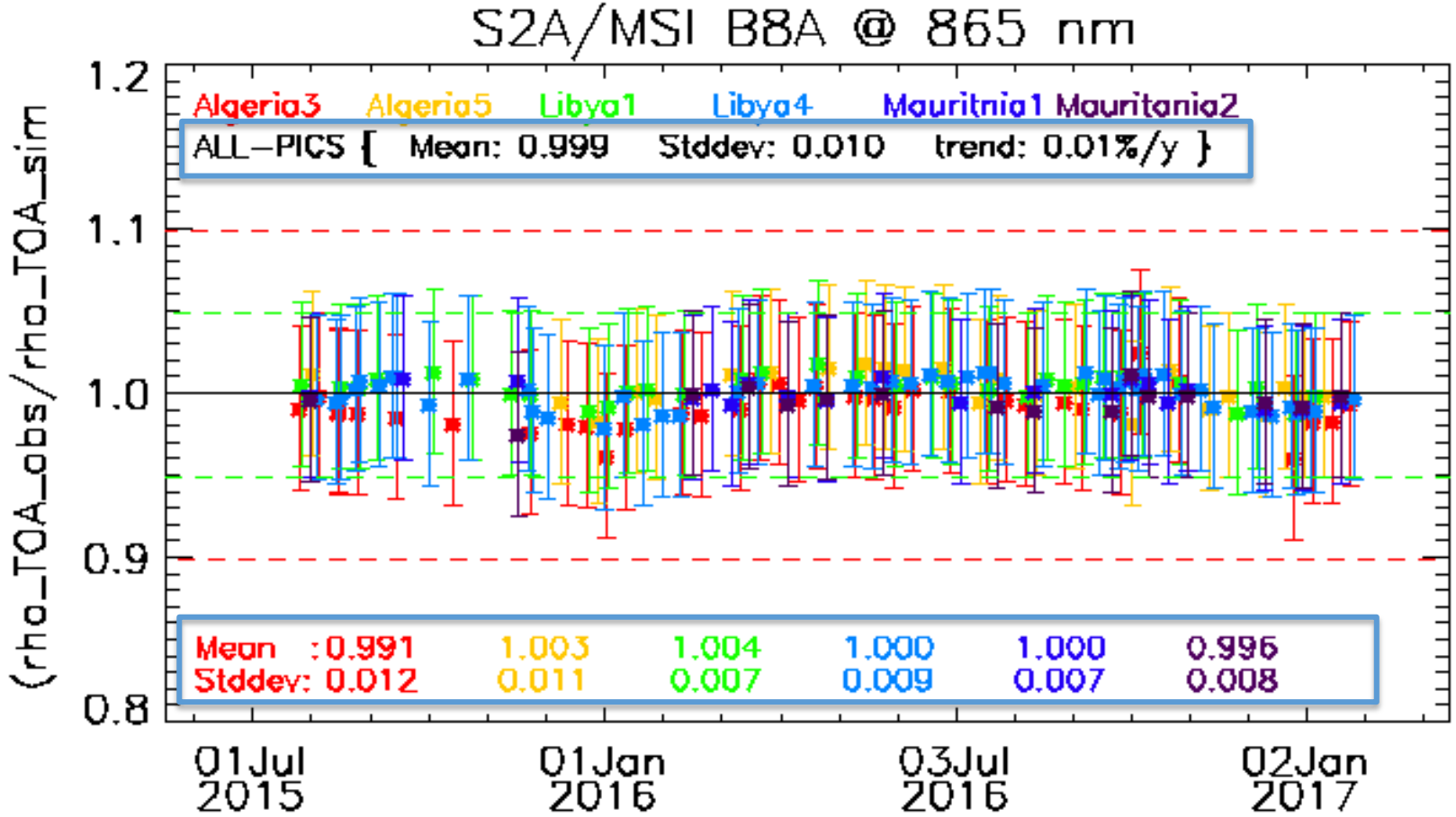
Sub-sampled for MSI

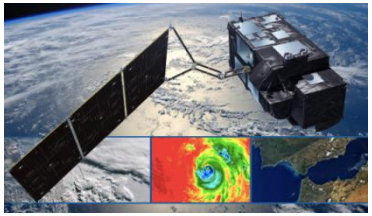




Results from S2A/MSI over PICS

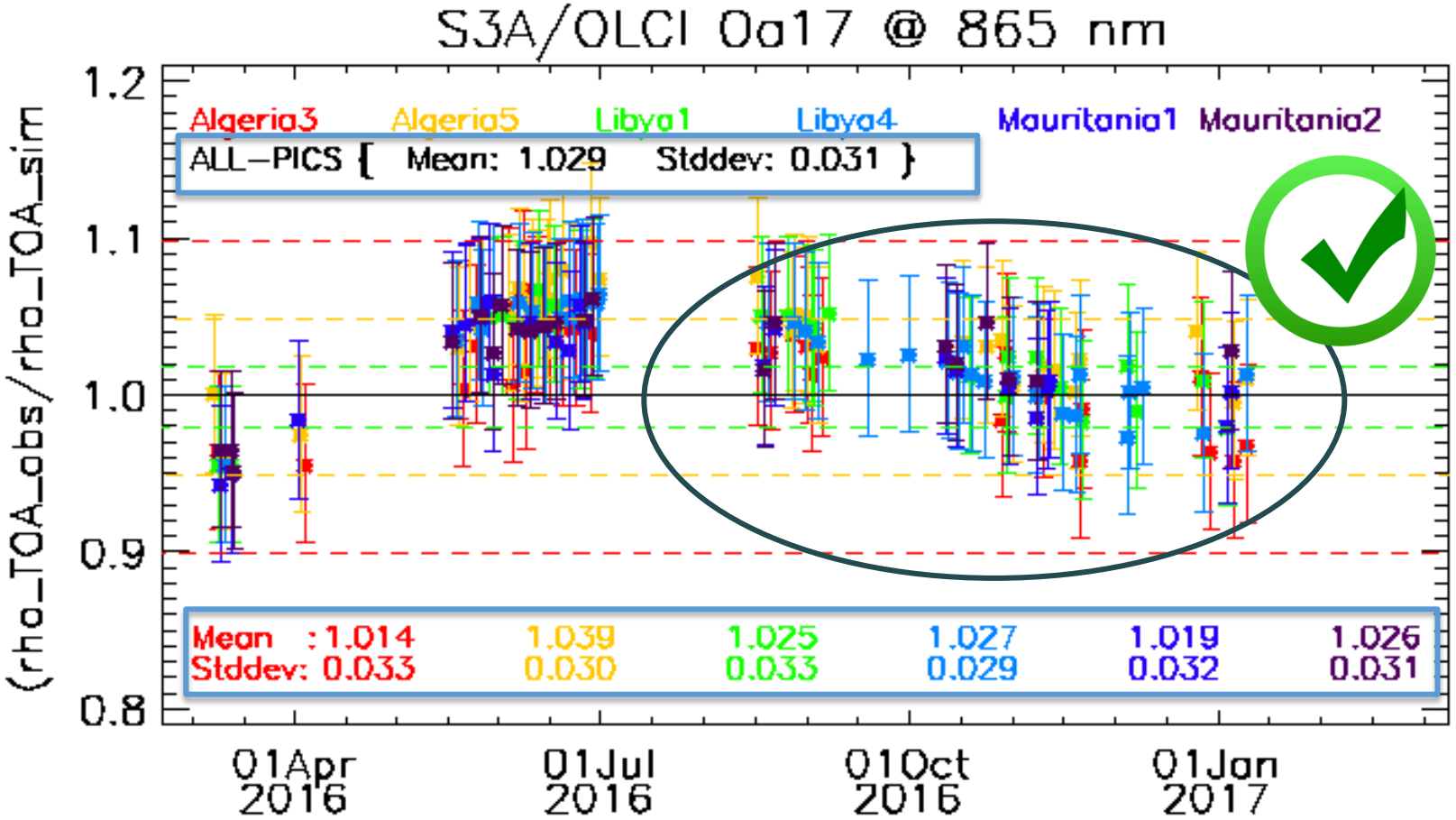
- The ratio of EO vs. simulated TOA reflectance

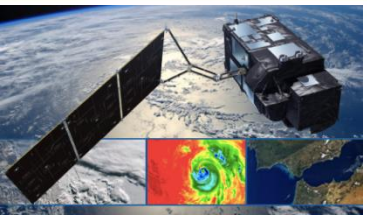




Results from S3A/OLCI over PICS

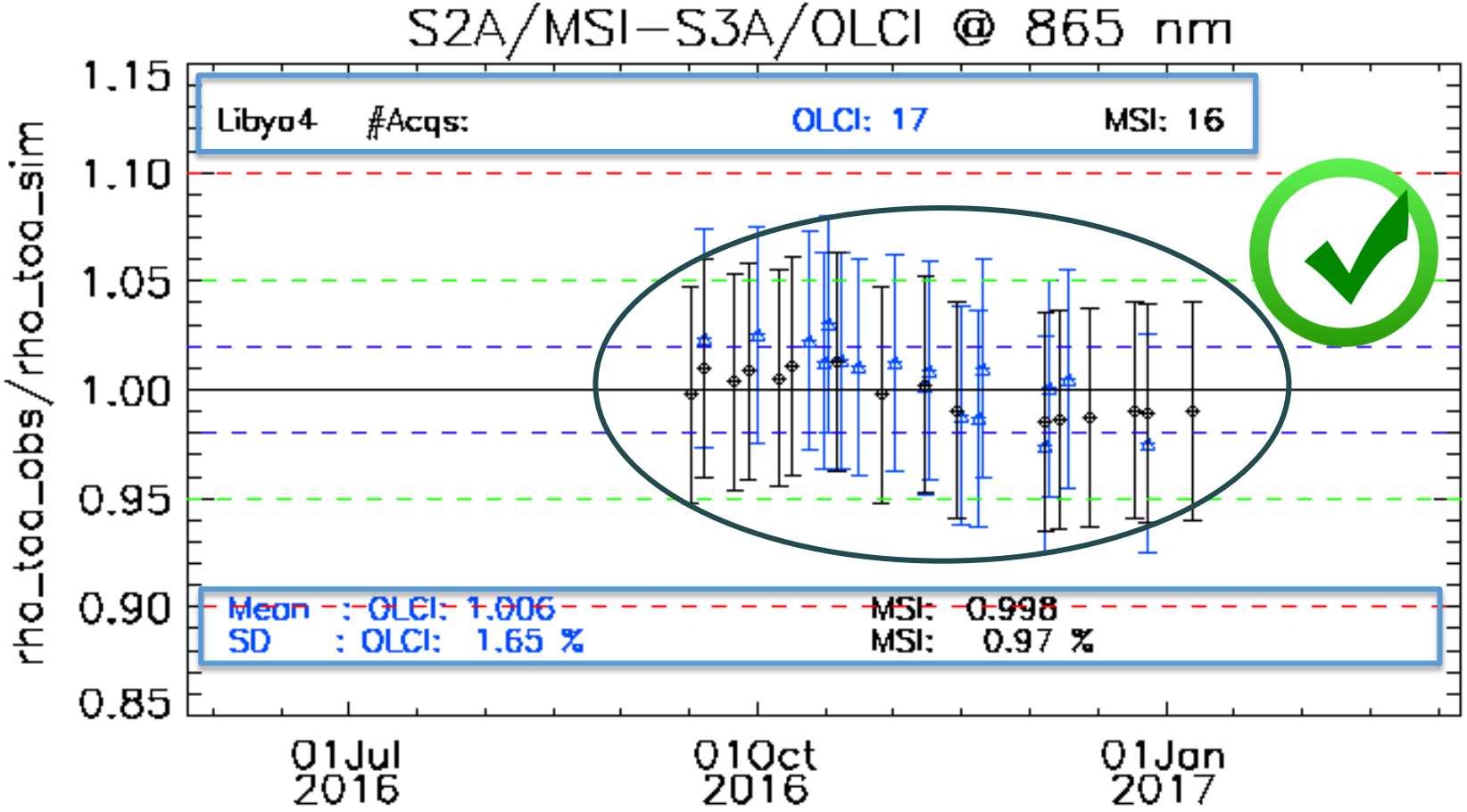
- The ratio of EO vs. simulated TOA reflectance

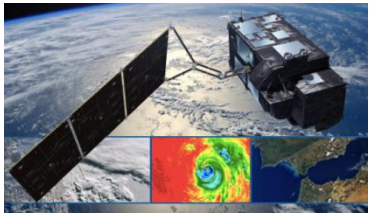




Intercomparison MSI-OLCI over PICS

- The ratio of EO vs. simulated TOA reflectance (LIBYA4)

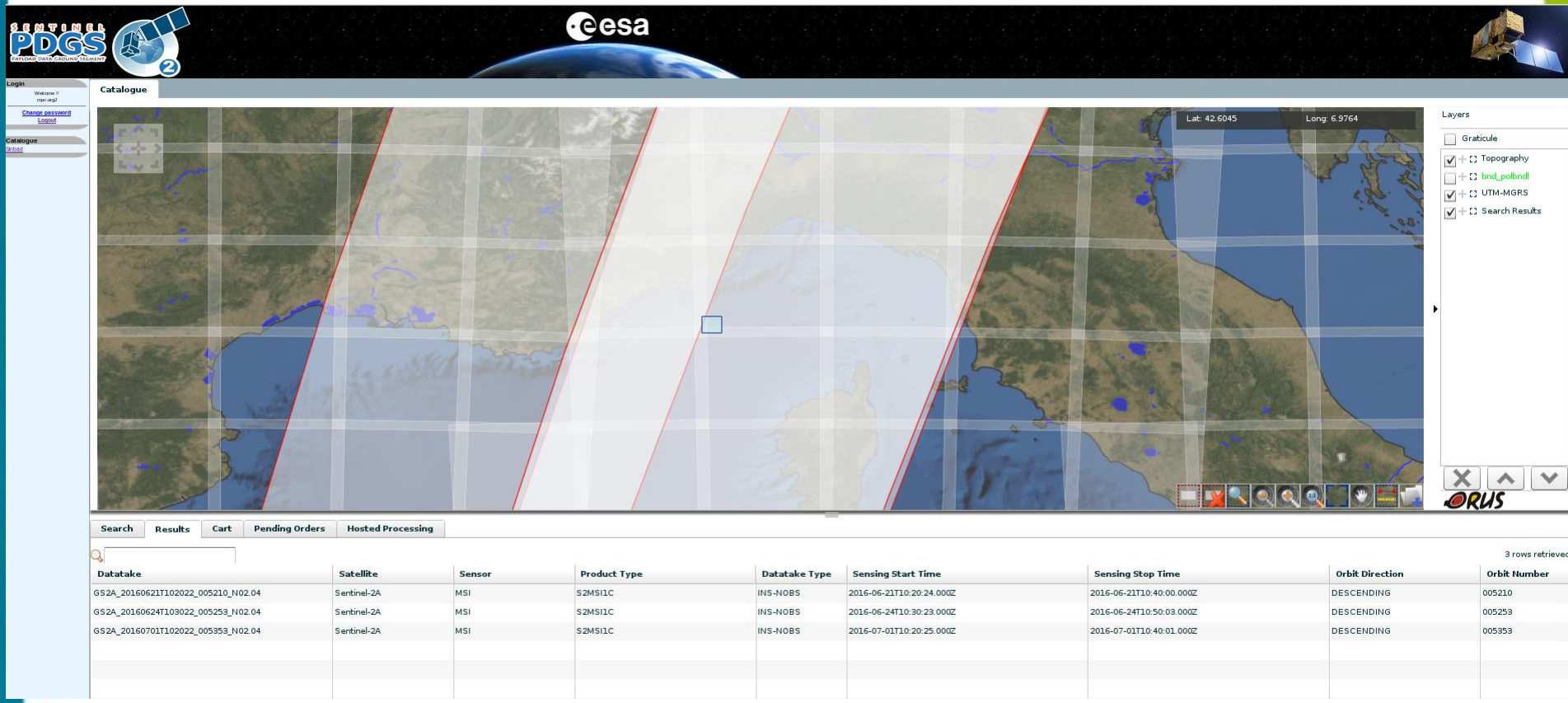




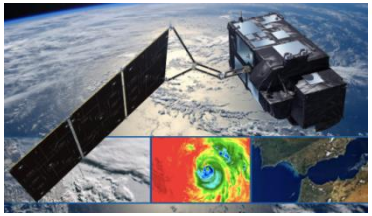
OLCI-MSI SVC

Number of Sentinel-2 overpasses

Repeat frequency of: 10 days (geometric revisit)



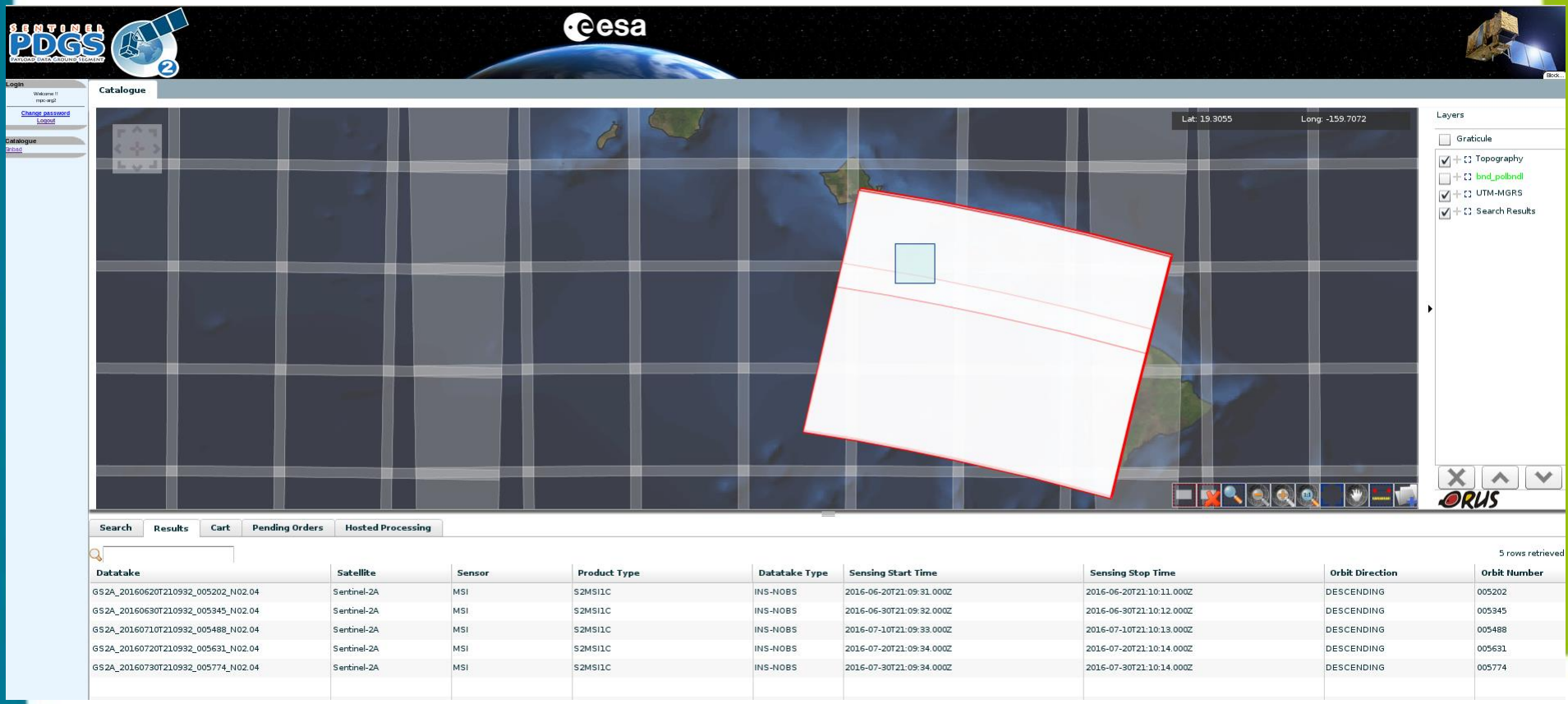
Boussole site –revisit frequency 7 days (instead of expected 4 days)



OLCI-MSI SVC

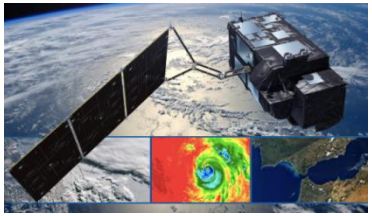
Number of Sentinel-2 overpasses

Repeat frequency: 10 days



Datatake	Satellite	Sensor	Product Type	Datatake Type	Sensing Start Time	Sensing Stop Time	Orbit Direction	Orbit Number
GS2A_20160620T210932_005202_N02.04	Sentinel-2A	MSI	S2MSI1C	INS-NOBS	2016-06-20T21:09:31.000Z	2016-06-20T21:10:11.000Z	DESCENDING	005202
GS2A_20160630T210932_005345_N02.04	Sentinel-2A	MSI	S2MSI1C	INS-NOBS	2016-06-30T21:09:32.000Z	2016-06-30T21:10:12.000Z	DESCENDING	005345
GS2A_20160710T210932_005488_N02.04	Sentinel-2A	MSI	S2MSI1C	INS-NOBS	2016-07-10T21:09:33.000Z	2016-07-10T21:10:13.000Z	DESCENDING	005488
GS2A_20160720T210932_005631_N02.04	Sentinel-2A	MSI	S2MSI1C	INS-NOBS	2016-07-20T21:09:34.000Z	2016-07-20T21:10:14.000Z	DESCENDING	005631
GS2A_20160730T210932_005774_N02.04	Sentinel-2A	MSI	S2MSI1C	INS-NOBS	2016-07-30T21:09:34.000Z	2016-07-30T21:10:14.000Z	DESCENDING	005774

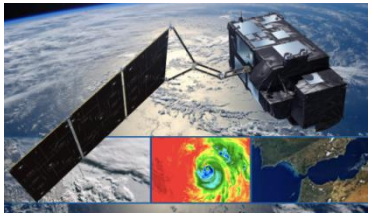
MOBY site –revisit frequency 10 days (instead of expected 6 days)



Level-2 OLCI-MSI SVC intercomparison

Difficulties/limitation:

- Data availability (ex. Fall 2016 – only 2 matchups on Boussole site, 3 if not considering OLCI)
- Products consistency (different transfer functions BOA→TOA)
- Glint on waves for MSI = great variability if not properly corrected



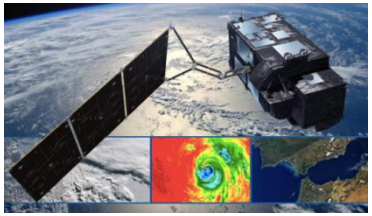
Level-2 MSI

# Region	Band	rho_w				
		average	maximum	median	minimum	sigma
BOUSSOLE	band_1	0,0108	0,1085	0,0107	0,004	0,0016
BOUSSOLE	band_2	0,0101	0,1251	0,0101	0,0045	0,0013
BOUSSOLE	band_3	0,0049	0,1464	0,0049	0	0,0011
BOUSSOLE	band_4	0,0026	0,1318	0,0025	0	0,0011
BOUSSOLE	band_5	0,0007	0,0253	0,0006	0	0,0006

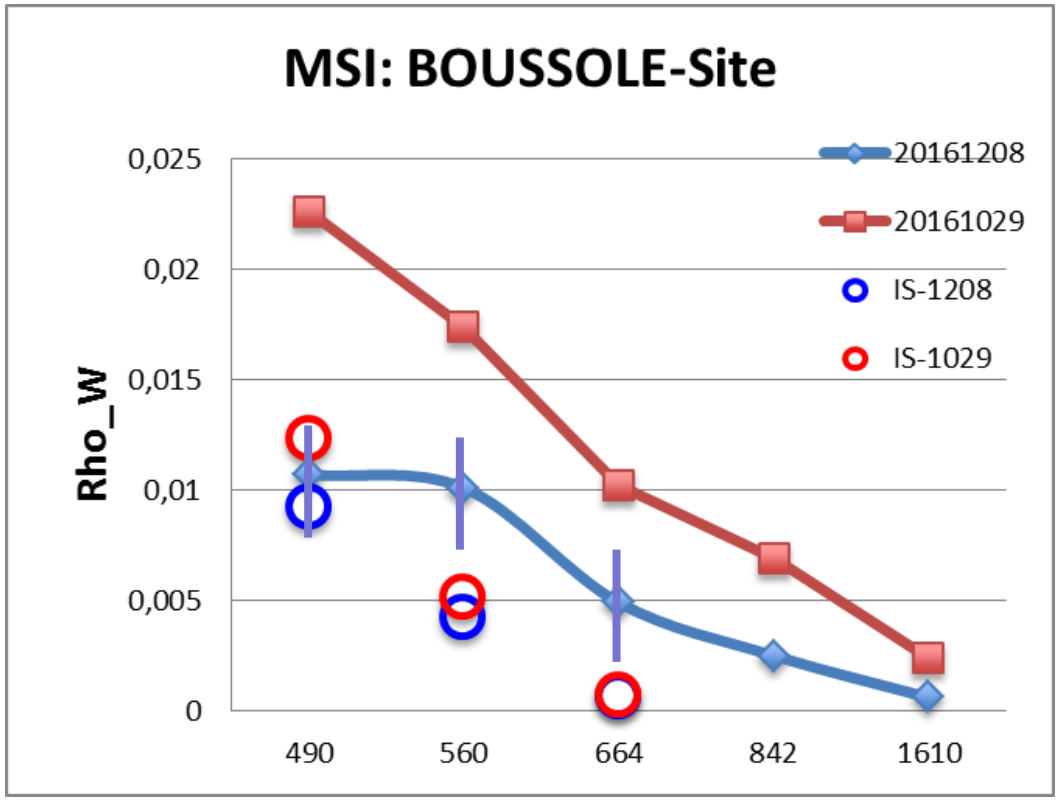
on a 1 km² plate

# Region	Band	average	maximum	median	minimum	sigma
BOUSSOLE	band_1	0,0225	0,0645	0,0226	0,0173	0,0012
BOUSSOLE	band_2	0,0173	0,0705	0,0174	0,0131	0,0009
BOUSSOLE	band_3	0,0102	0,0585	0,0102	0,007	0,0007
BOUSSOLE	band_4	0,0068	0,0112	0,0069	0,0038	0,0007
BOUSSOLE	band_5	0,0024	0,0091	0,0024	0,0003	0,0005

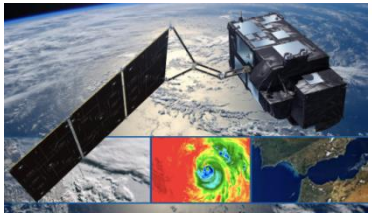
# Region	Band	average	maximum	median	minimum	sigma
BOUSSOLE	band_1	0,0145	0,1946	0,014	0,0037	0,006
BOUSSOLE	band_2	0,0079	0,0652	0,0078	0,0043	0,0016
BOUSSOLE	band_3	0,0019	0,0599	0,0018	-0,0003	0,0014
BOUSSOLE	band_4	0,0012	0,0587	0,0011	-0,001	0,0014
BOUSSOLE	band_5	0,0009	0,0434	0,0008	-0,0008	0,0013



Level-2 MSI



with the L2a processor used in coastal waters
–without sun glint correction



Level-2 OLCI/MSI intercomparison

Potential match-ups:

Site	In-Situ (day)	OLCI (scenes)	MSI (scene)
BOUSSOLE /C-OPS	5 / 13	5	3
Black Sea	13	3	2
SAGRES	3	3	2 (with 1 day shift)

preliminary conclusions

1- number of EO OC validation sites and FRMs to be increased by a factor 5

- **if the QC level of MSI L2 processors is to be similar to OLCI's, or**
- **If the L1 SVC of MSI is to be similar to OLCI's**

2- specific measurements required on sites:

- **sunglint at 10m spatial resolution** (sea surface roughness, i.e. swell and wind waves)

in addition to AOT