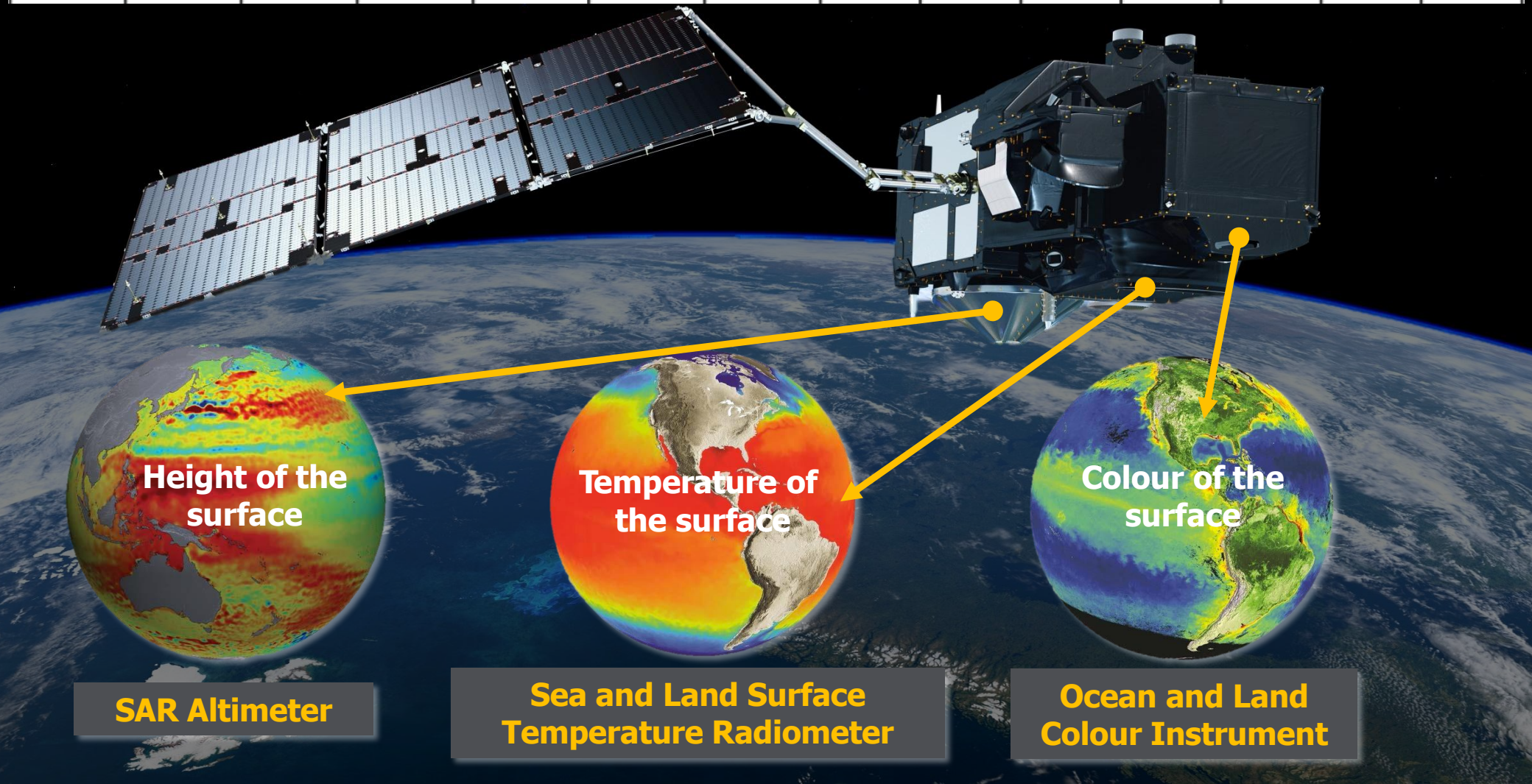
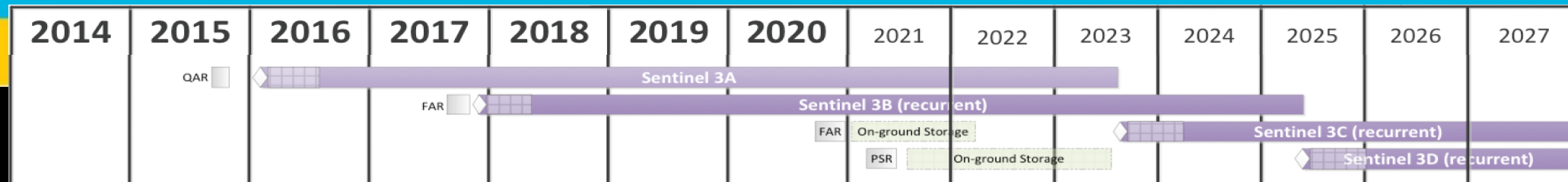




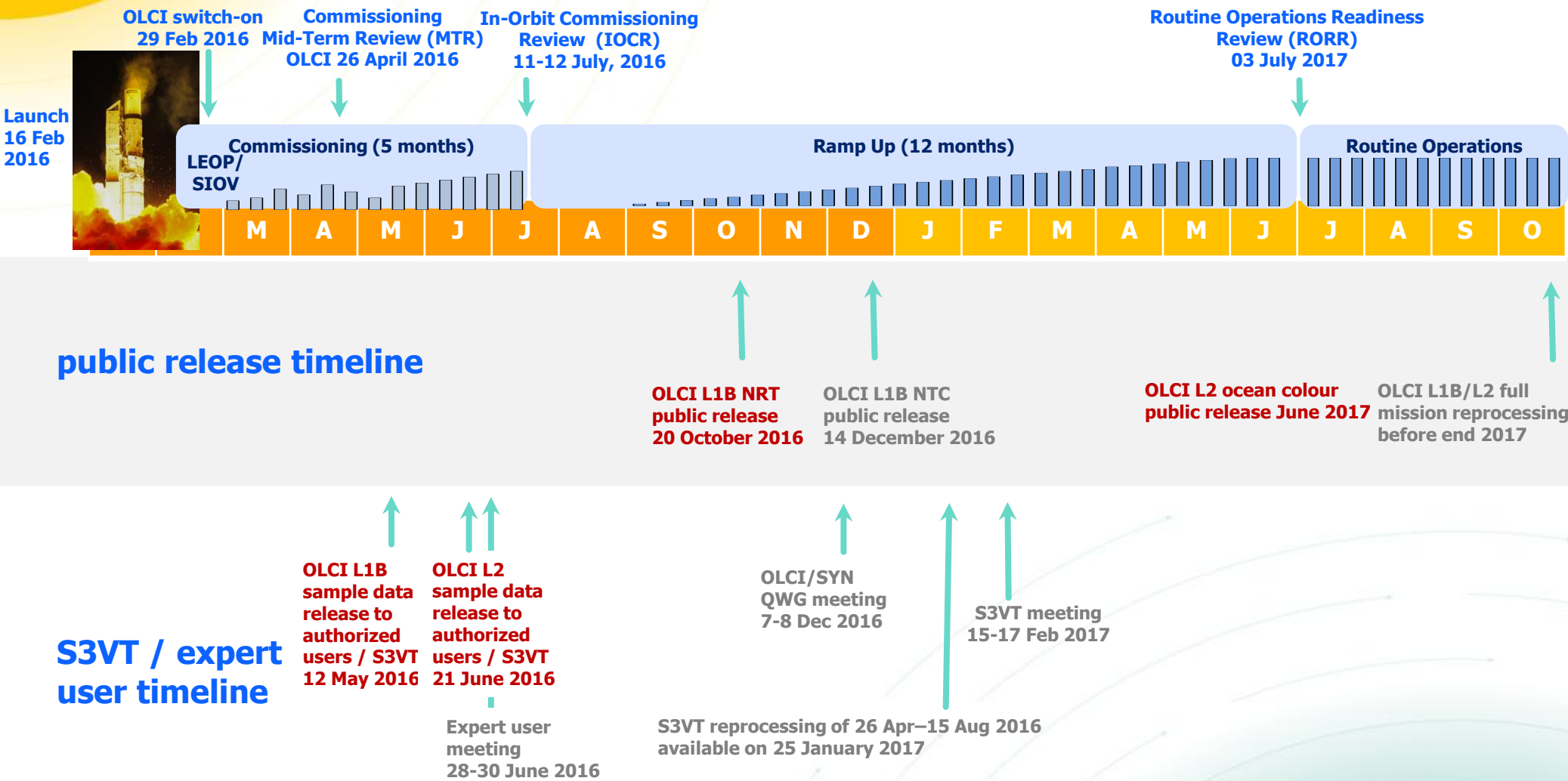
Ocean colour radiometry from Copernicus Sentinel-3 missions



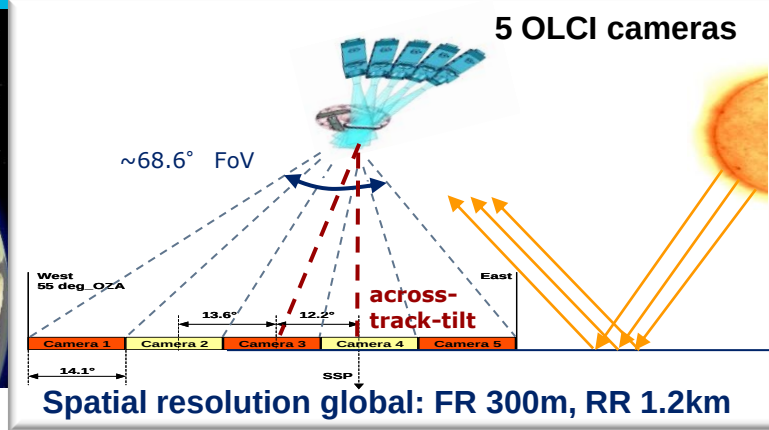
OLCI – Copernicus prime Ocean Colour sensor



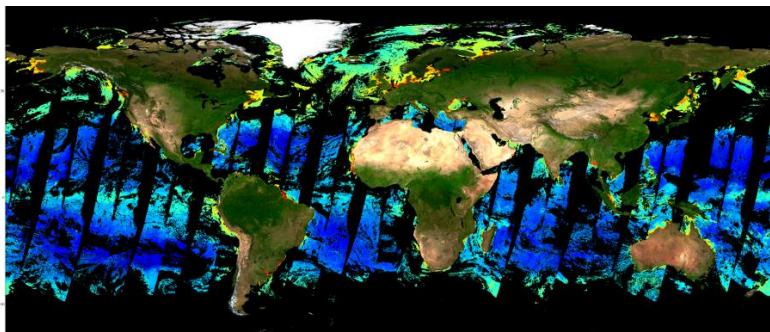
Sentinel-3A Ocean Colour timeline



OLCI instrument



#	OLCI spectral bands	λ center	Width
1	Aerosol, in-water property	400	15
2	Yellow substance/detrital pigments	412.5	10
3	Chlorophyll absorption max	442.5	10
4	Chlorophyll and other pigments	490	10
5	Suspended sediments, red tide	510	10
6	Chlorophyll absorption min	560	10
7	Suspended sediment	620	10
8	Chlorophyll absorption & fluorescence	665	10
9	Fluorescence retrieval	673.75	7.5
10	Chlorophyll fluorescence peak	681.25	7.5
11	Chlorophyll fluorescence ref., atm. corr.	708.75	10
12	Vegetation, clouds	753.75	7.5
13	O ₂ R-branch absorption	761.25	2.5
14	Atmospheric parameters	764.375	3.75
15	Cloud top pressure	767.5	2.5
16	O ₂ P-branch absorption	778.75	15
17	Atmospheric correction	865	20
18	Vegetation, water vapour reference	885	10
19	Water vapour, land	900	10
20	Atmospheric/aerosol correction	940	20
21	Atmospheric/aerosol correction	1020	40



S3A+S3B daily coverage, global coverage in 3 days

OLCI instrument and L1B product operational status

OLCI L1B products released 20 Oct 2016

S3 OLCI L1B products	OL_1_E	spatial resolution	file name	parameter name
Top-Of-Atmosphere calibrated radiances in 21 bands		FR 300 m, RR 1.2 km	Oa##_radiance	Oa##_radiance
Annotation data: quality flags, geo_coordinates, time, instrument data, tie-point coordinates, geometries and meteo				

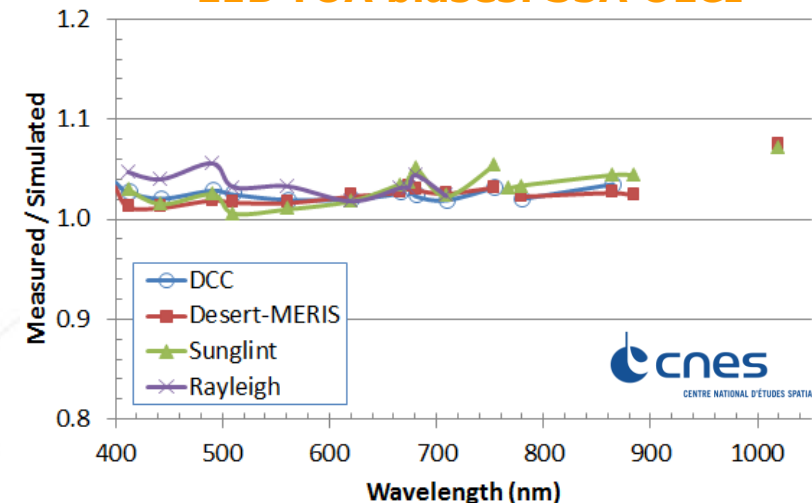
• Status

- OLCI instrument fully functional and operating nominally
- Regular monitoring of radiometric gains, offsets, ageing of the on-board diffusers
- On-orbit characterization of diffuser BRDF with dedicated S3A yaw manoeuvres in Dec-2016
- Monitoring of spectral response – performance nominal (measured SRFs available)
- Monitoring of geo-location accuracy – performance nominal

• Product limitations

- Absolute and inter-band radiometric calibration not fully compliant with requirements: 2% absolute / 1% inter-band uncertainty < 900nm [MRTD, 2011]
- Instrument temporal evolution not modelled
- Verification of straylight correction ongoing
- Verification of L1B product flags ongoing
- Per-pixel error estimates not yet available
- Minor effects: prompt particle events near the South Atlantic Anomaly, and periodic noise in longer bands at first 100 camera pixels

L1B TOA biases: S3A OLCI



OLCI L2 Ocean Colour operational products

S3 OLCI L2 marine products OL_2_W	spatial resolution	file name	parameter name	algorithm
Water Leaving Reflectances in 16 spectral bands	FR 300 m, RR 1.2 km	Oa##_reflectance	Oa##_reflectance	Antoine Morel 1999
Algal Pigment Concentration in open ocean	FR 300 m, RR 1.2 km	chl_oc4me	CHL_OC4ME	Morel 2007 OC4Me
Diffuse attenuation coefficient	FR 300 m, RR 1.2 km	trsp	KD490_M07	Morel 2007
Algal Pigment Concentration in turbid waters	FR 300 m, RR 1.2 km	chl_nn	CHL_NN	Doerffer NN
Total Suspended Matter concentration	FR 300 m, RR 1.2 km	tsm_nn	TSM_NN	Doerffer NN
Coloured Detrital and Dissolved Material absorption	FR 300 m, RR 1.2 km	iop_nn	ADG443_NN	Doerffer NN
Photosynthetically Active Radiation	FR 300 m, RR 1.2 km	par	PAR	iPAR Aiken Moore 1997
Aerosol Optical Depth over water	FR 300 m, RR 1.2 km	w_aer	T865	Antoine Morel 1999
Aerosol Angstrom exponent over water	FR 300 m, RR 1.2 km	w_aer	A865	Antoine Morel 1999
Integrated Water Vapour Column	FR 300 m, RR 1.2 km	iwv	IWV	Lindstrot 2012 1-D Var
Annotation data: quality flags, geo_coordinates, time, instrument data, tie-point coordinates, geometries and meteo				

• Status

- Currently, L2 products available only to the Sentinel-3 Validation Team, since 21 June 2016
- Public L2 release in June 2017

• Recent product baseline changes for S3VT (baseline 2.13 from 4 May 2017)

- Implemented turbid water products (CHL_NN, TSM_NN, ADG443_NN)
- Updated Bright Pixel Atmospheric Correction (BPAC, i.e. NIR correction)
- Updated atmospheric correction of inland waters

<http://www.eumetsat.int/website/home/Data/CopernicusServices/Sentinel3Services/index.html>

OLCI L2 outlook for the public release in June 2017

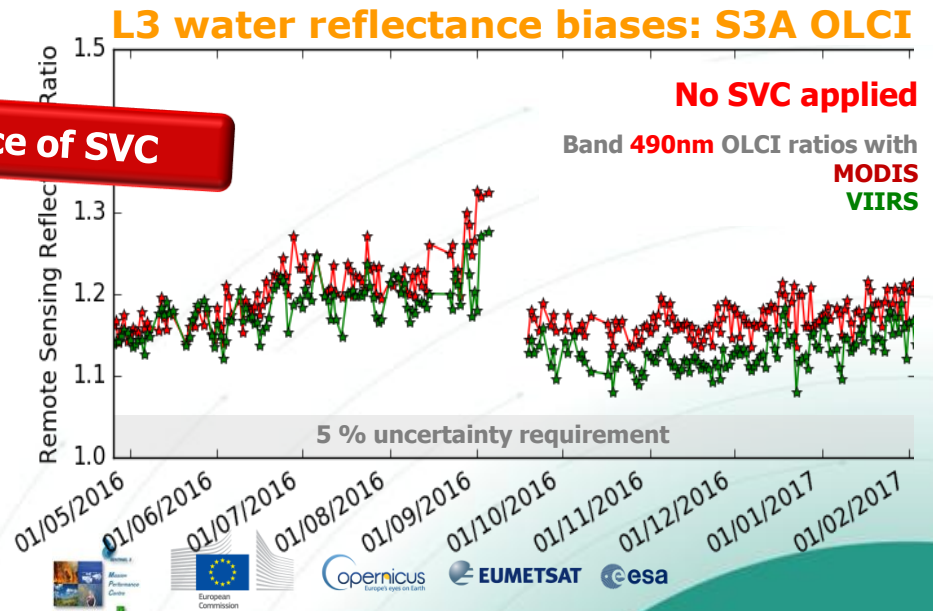
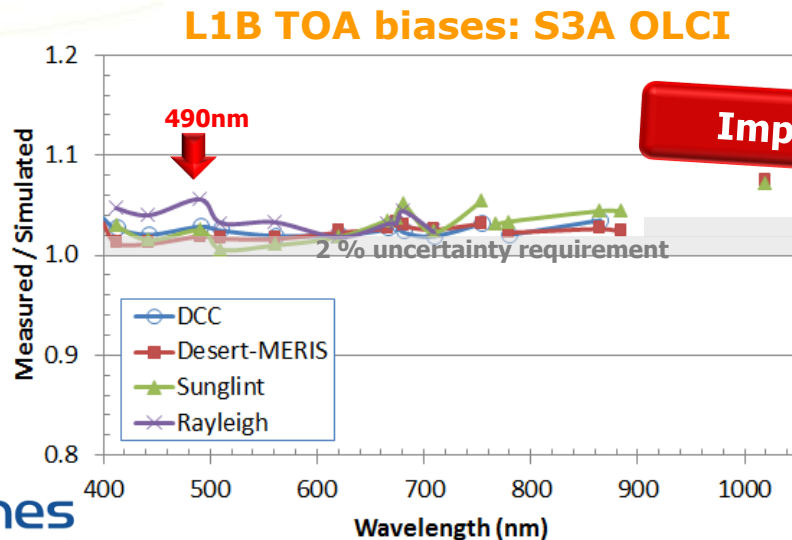
- **L1 product updates**

- New solar diffuser BRDF model derived from S3A yaw manoeuvres
- Instrument response temporal evolution with the improved diffuser BRDF model

- **L2 product updates**

- Implementation of System Vicarious Calibration (SVC): reduction of biases
- Improvements in turbid water NN products (reduction of biases and saturation)
- Improvements in cloud flagging

- **Product quality assessment**

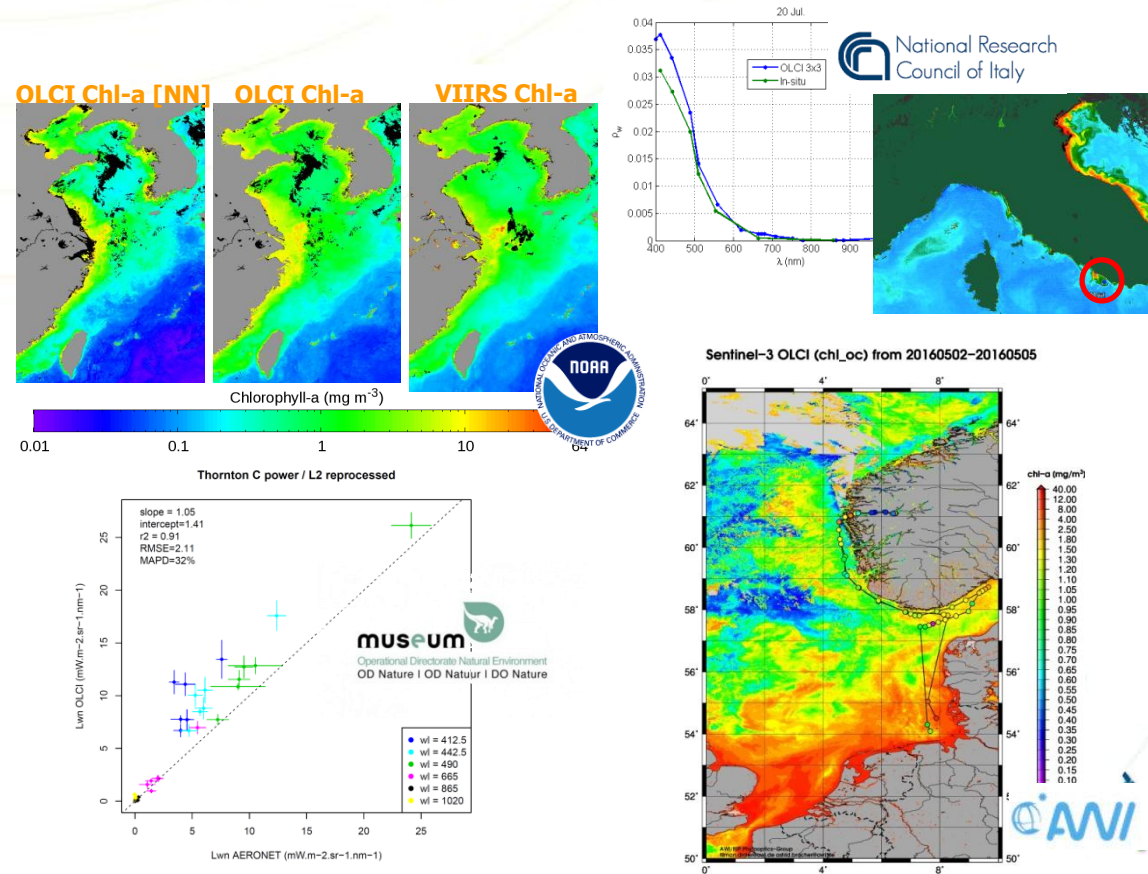


Sentinel-3 Validation Team

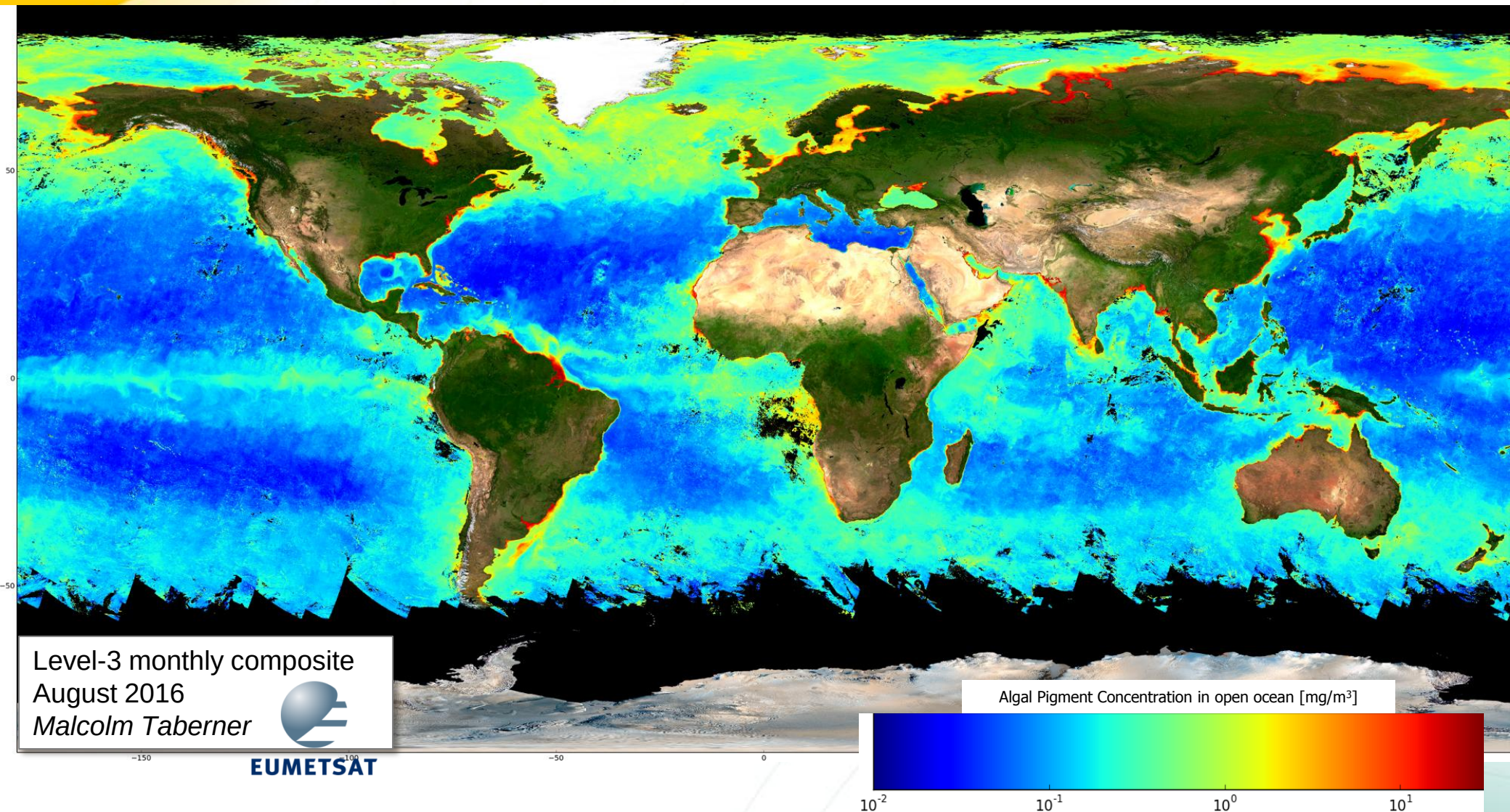
- S3VT is based on a rolling announcement of opportunity, ESA AO call is [continuously open](#)
- S3VT has been providing independent validation evidence on quality of OLCI products
- S3VT has received early access to Sentinel-3 data
- Monthly S3VT-OC teleconferences
- Last S3VT meeting 15-17 Feb 2017 at ESA ESIRIN, Italy

for more information on S3VT-OC
marc.bouvet@esa.int
ewa.kwiatkowska@eumetsat.int

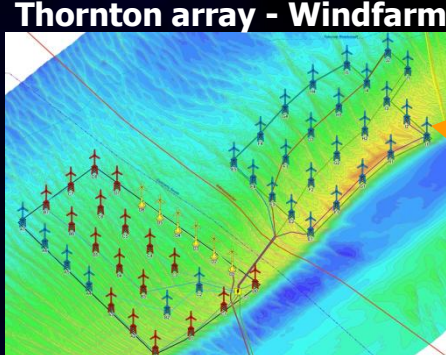
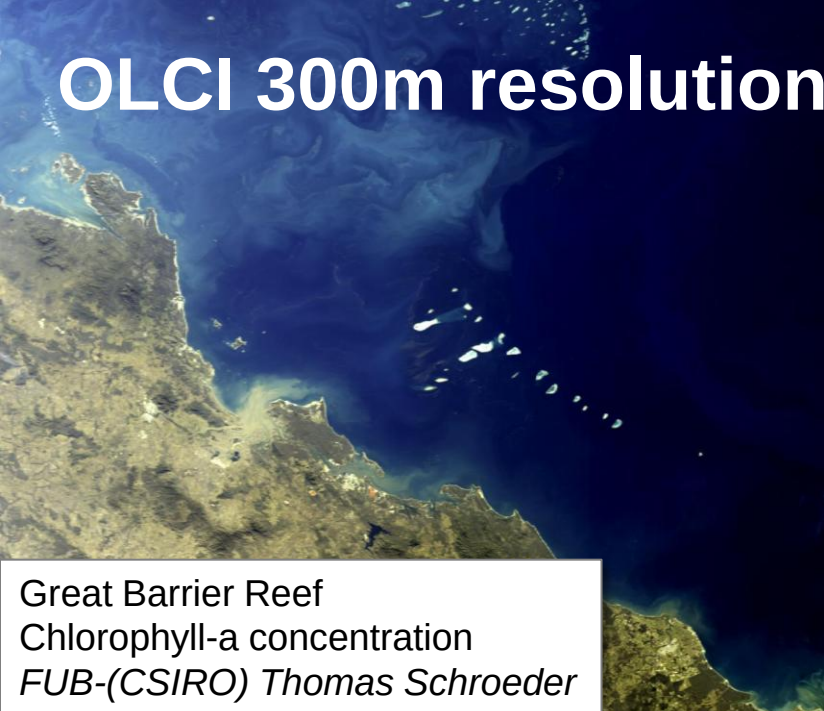
"to engage world-class validation expertise and activities to complement Sentinel-3 routine validation and ensure the best possible outcomes for the Sentinel-3 Mission"



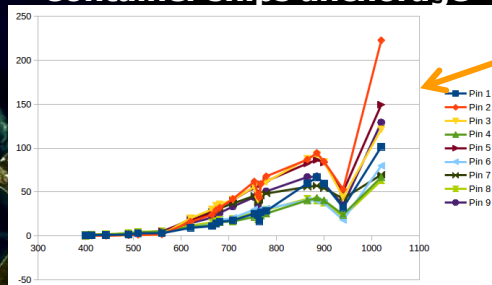
OLCI algal pigment concentration first monthly composite



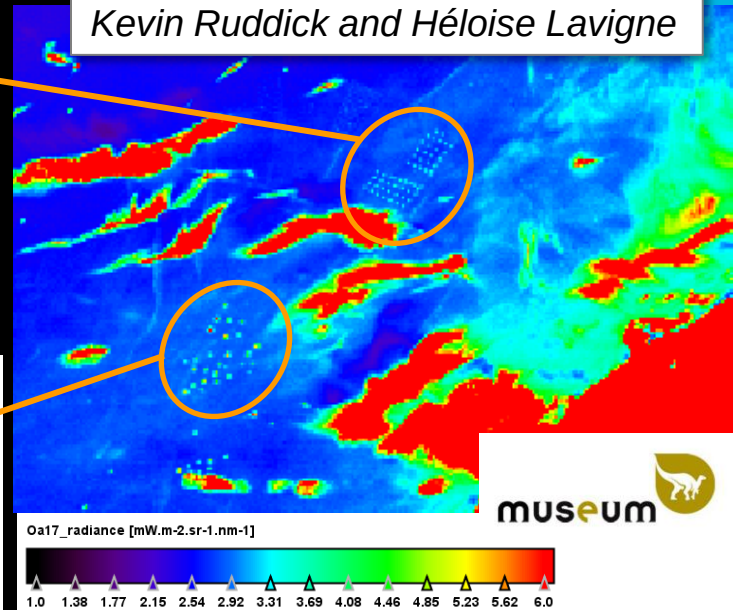
OLCI 300m resolution



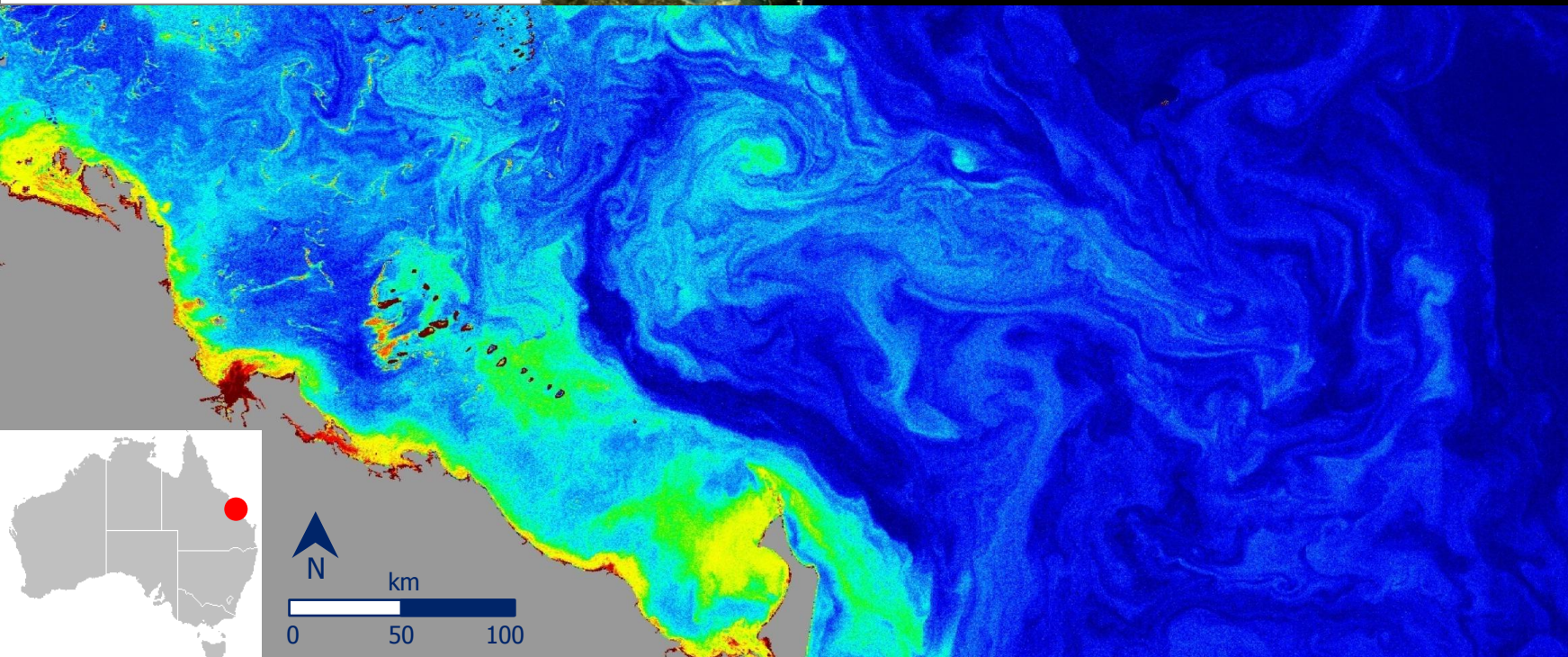
Container ships anchorage



Belgian coast L1B TOA 865 nm
Kevin Ruddick and Héloïse Lavigne



museum



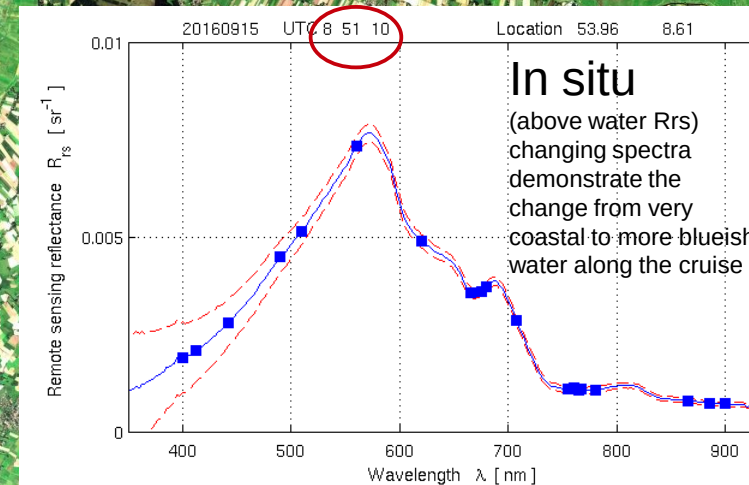
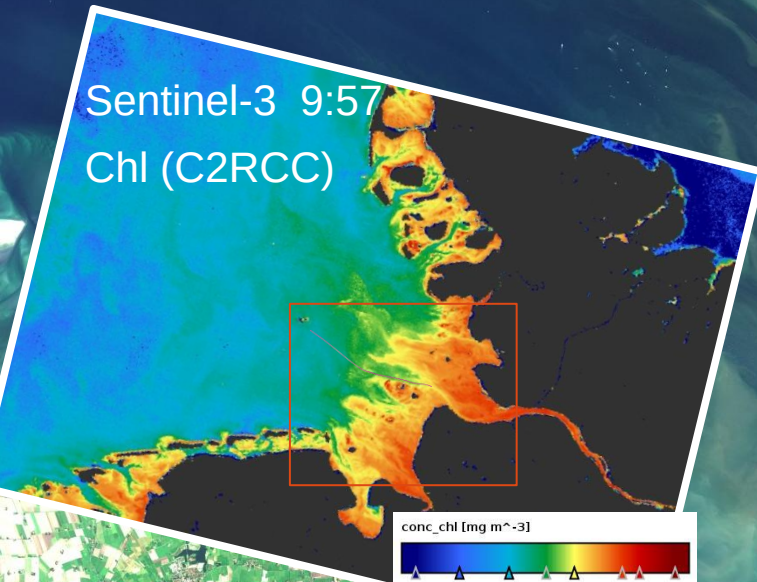
Coastal water monitoring with high spectral resolution of S3 OLCI and high spatial resolution of S2 MSI

Helmholtz-Zentrum
Geesthacht
Zentrum für Material- und Küstenforschung

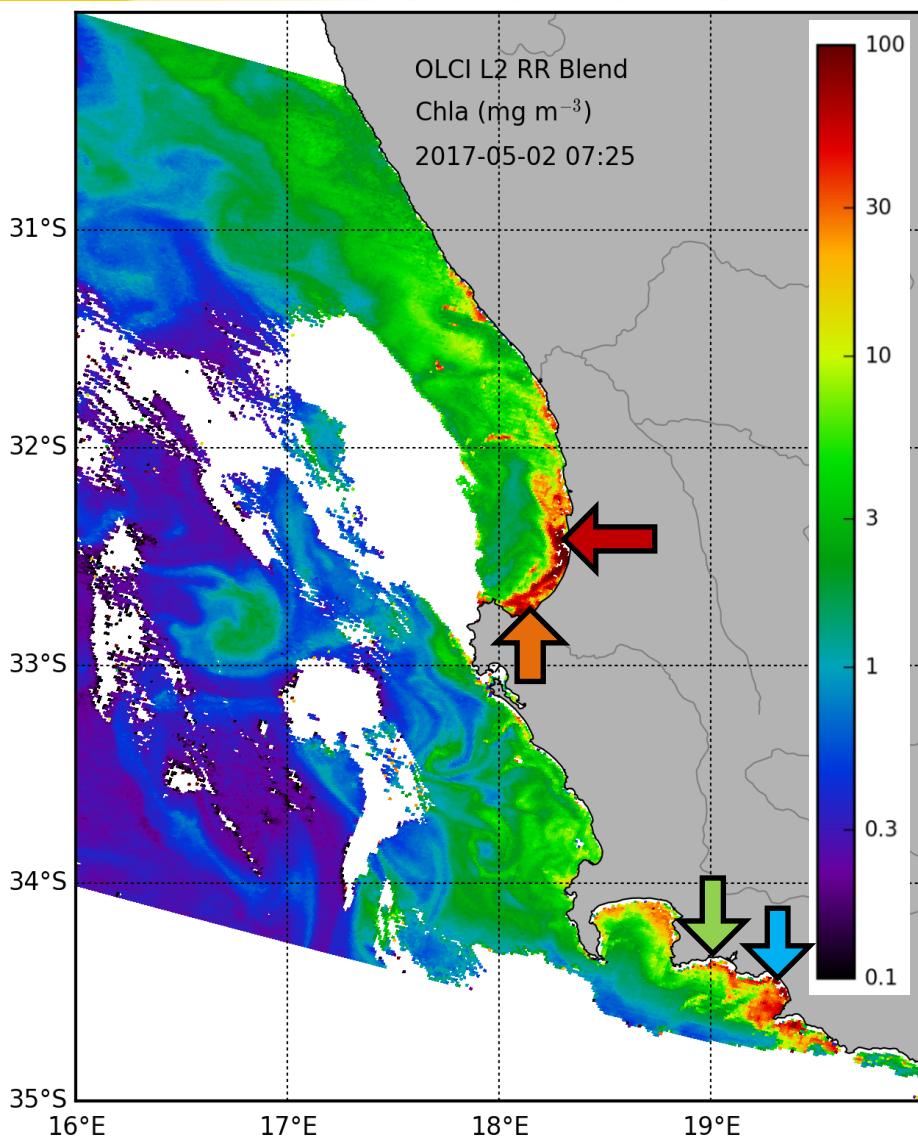
OLCI capability for coastal water monitoring in German Bight, *Hajo Krasemann*

2016-09-15

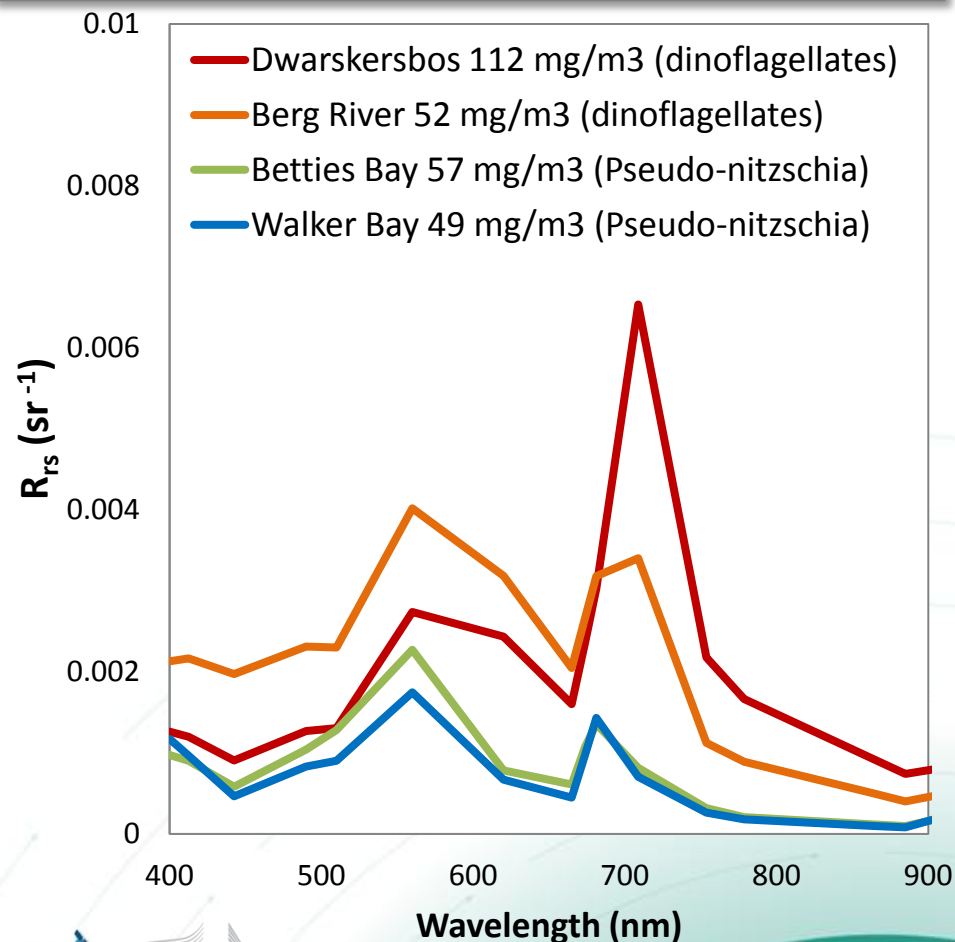
Sentinel-2 10:40



Capabilities to characterize different bloom types

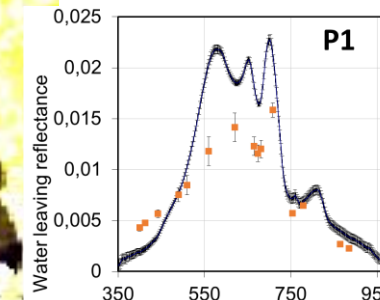
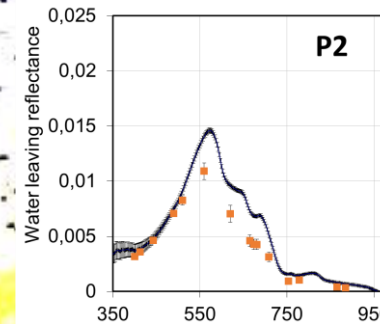
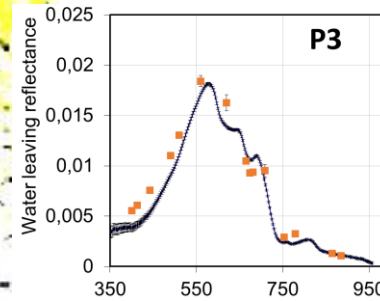
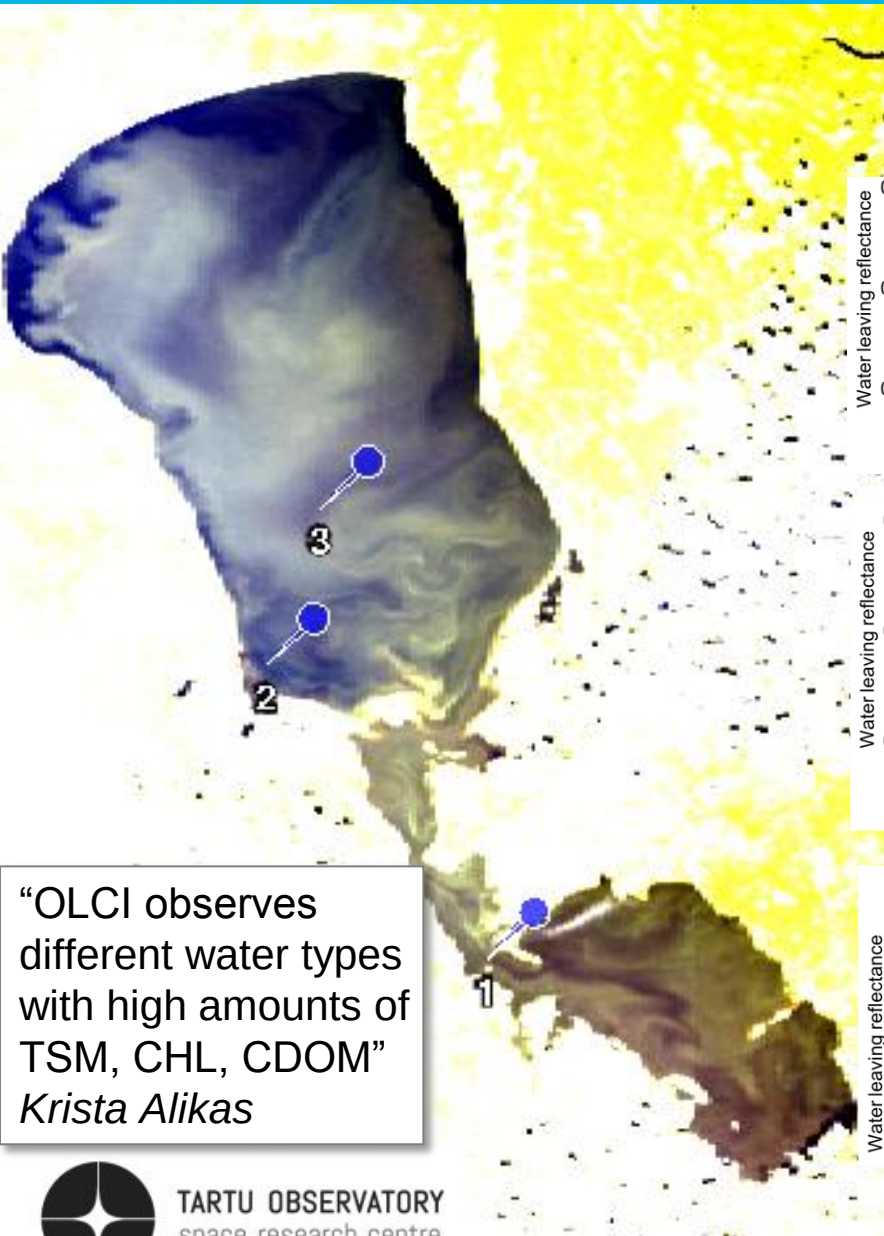


“The excellent spectral and radiometric resolution of OLCI allows the characterization of different bloom types in the southern Benguela”
Marié Smith and Stewart Bernard

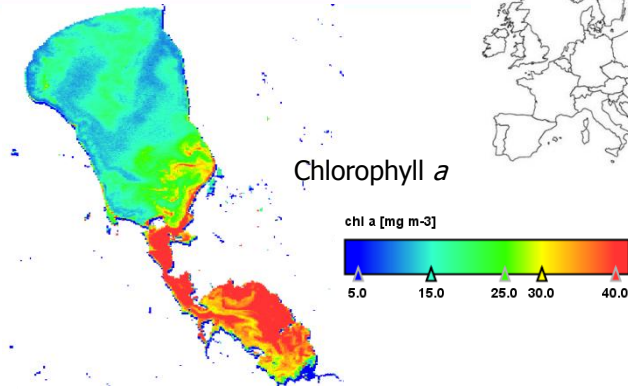


Capabilities for inland water monitoring

Lake Peipsi, Estonia

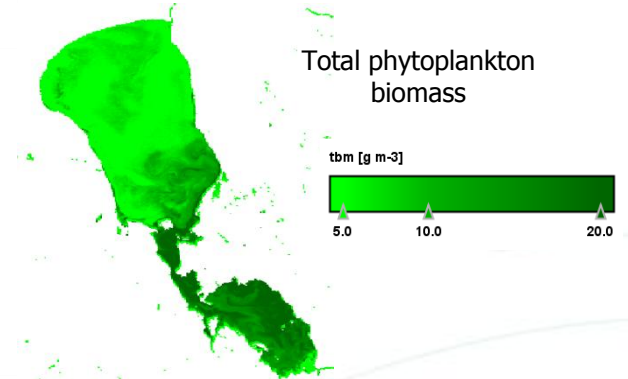
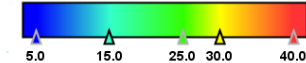


—in situ ■ OLCI



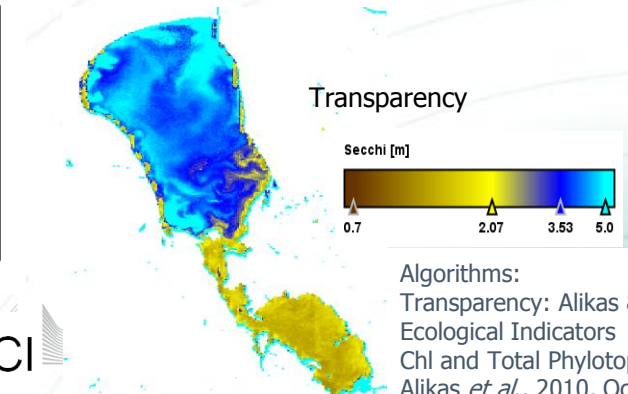
Chlorophyll *a*

chl *a* [mg m⁻³]



Total phytoplankton biomass

tbn [g m⁻³]



Transparency

Secchi [m]

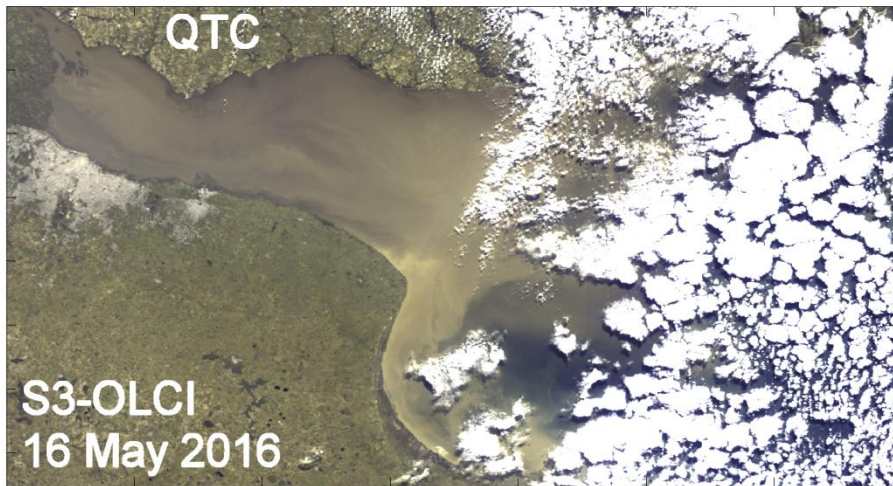


Algorithms:

Transparency: Alikas & Kratzer, 2017,
Ecological Indicators

Chl and Total Phytoplankton Biomass:
Alikas *et al.*, 2010, Oceanologia

Turbidity monitoring and improved atmospheric correction capabilities over turbid waters

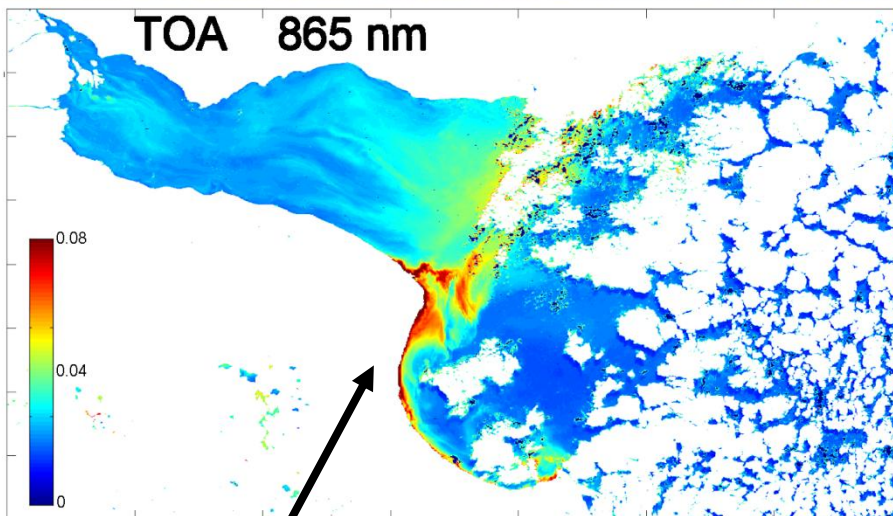


“In highly turbid Rio de la Plata:

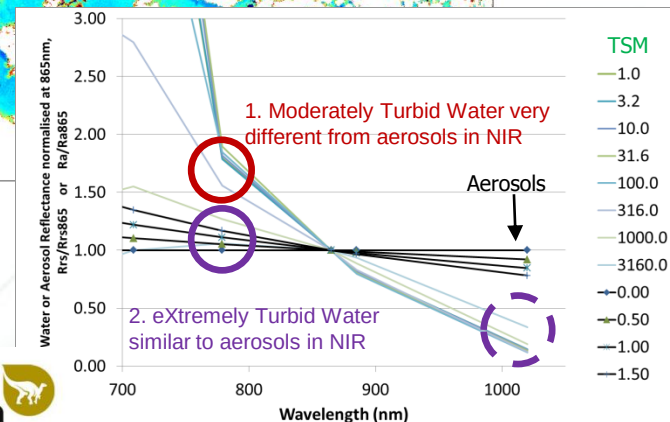
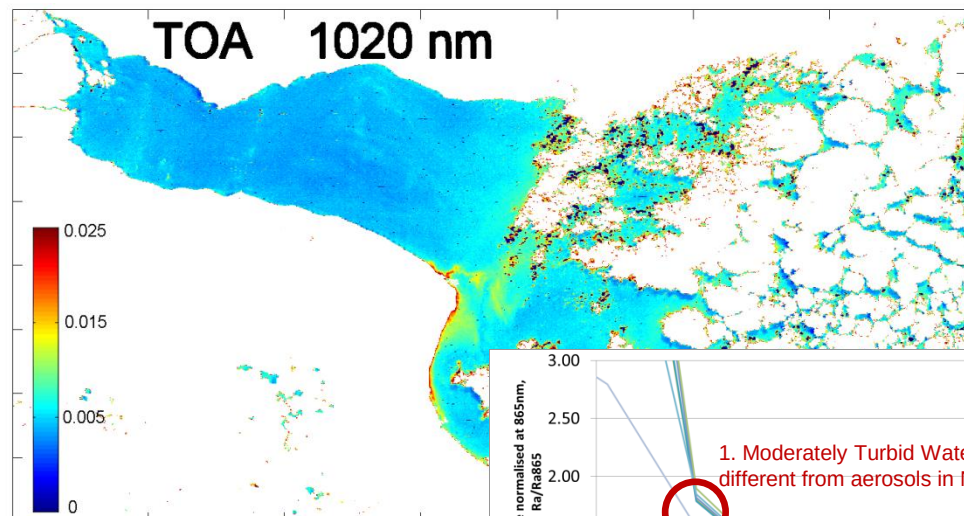
- Detailed turbidity features like filaments and turbidity fronts thanks to OLCI higher spatial resolution.
- Low signal at 1020 nm in most of the estuary demonstrates band’s capability for atmospheric correction”

Ana I. Dogliotti

“Band 1020 nm can be used to separate extremely turbid waters from aerosols” *Kevin Ruddick*

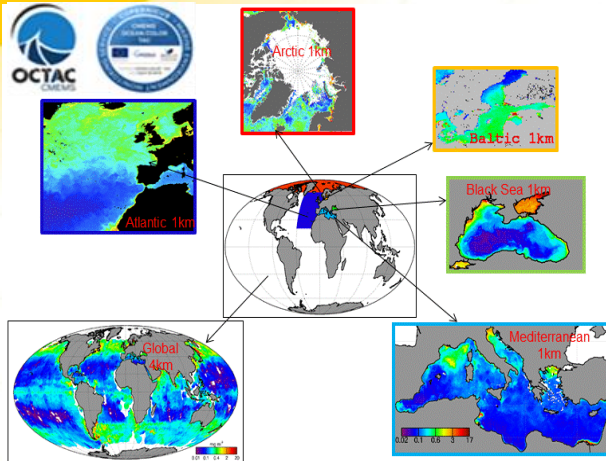


Detailed turbidity features like filaments and a turbidity front



Copernicus Marine Environment Monitoring Service

Please attend CMEMS lunch session for more details



Input OLCI data:

- L2 global ocean data generated by EUMETSAT
- L1B data, to produce CMEMS OC regional products (if needed / under evolution)

Sentinel-3 OLCI use by CMEMS OCTAC:

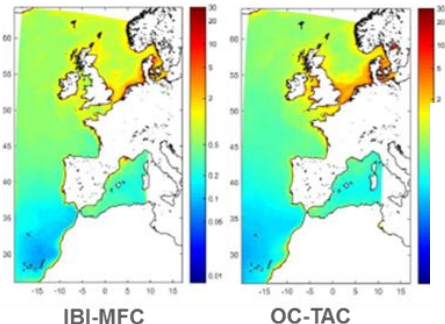
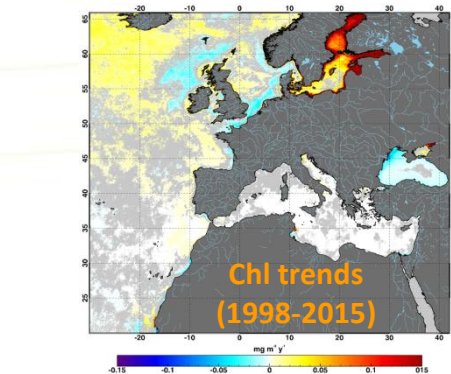
- Production of **OLCI global L3 and L4 products**
- Production of **OLCI tuned L3 and L4 regional products** (*single Case1-Case2 Chl product with selected algorithm*)
- Integration in multi-sensor OC global and regional processing chains
- Integration in multi-sensor reprocessing system to produce consistent time series of OC products from 1997 to today

Dissemination of OLCI data in CMEMS:

- **single sensor OLCI L3 regional and global products**
- Variables: Chla, IOPs, attenuation coefficient, reflectances
- **L4 OLCI regional and global products (weekly, monthly)**
- **Multi-sensors** (including OLCI) L3 and L4 global and regional OC products (**L4 include daily Chl interpolated fields**)

Use of OLCI data inside CMEMS:

- **Modelling quality assessment and data assimilation**
- **Indicators to monitor the marine environment** (eg. MSFD)



MERCATOR OCEAN
OCEAN FORECASTERS



Copernicus

EUMETSAT

esa

OLCI Ocean Colour outlook

Please support respective
IOCS'17 breakout sessions

- **Calibration and validation activities**
 - Continuous on-orbit OLCI instrument calibration
 - System Vicarious Calibration
 - Development of Copernicus operational System Vicarious Calibration capabilities
 - FRM4SOC SVC workshop Feb 2017
 - Ongoing study on Scientific, Technical and Operational SVC Requirements
 - Working towards a Copernicus programmatic approach for SVC infrastructure
 - S3VT-OC
 - FRM4SOC
 - Operational validation at ESA Mission Performance Centre, EUMETSAT, CMEMS
- **Algorithm and product development**
 - Continuous gradual improvement of algorithms and products
 - Atmospheric correction overall update
 - New products: Inherent Optical Properties, Fluorescence Line Height (max chl index)
 - Potential further products: carbon products, multi-water products for open-ocean / coastal / inland, Phytoplankton Functional Types
- **Full reprocessing of S3A OLCI by the end of 2017**
- **S3B upcoming launch and S3B commissioning phase tandem with S3A**

state-of-the-art algorithms
utilization of OLCI extended capabilities

Conclusions

- OLCI has excellent monitoring capabilities for open ocean, coastal water, and inland water
- S3A OLCI L1B products have been available for public use since Oct 2016
 - S3A OLCI L2 Ocean Colour products will become available for public use in June 2017
- S3A OLCI L3 products and marine services will be subsequently released from CMEMS

MONITORING THE OCEANS FROM SPACE

Course run by EUMETSAT in support of the
Copernicus Programme

