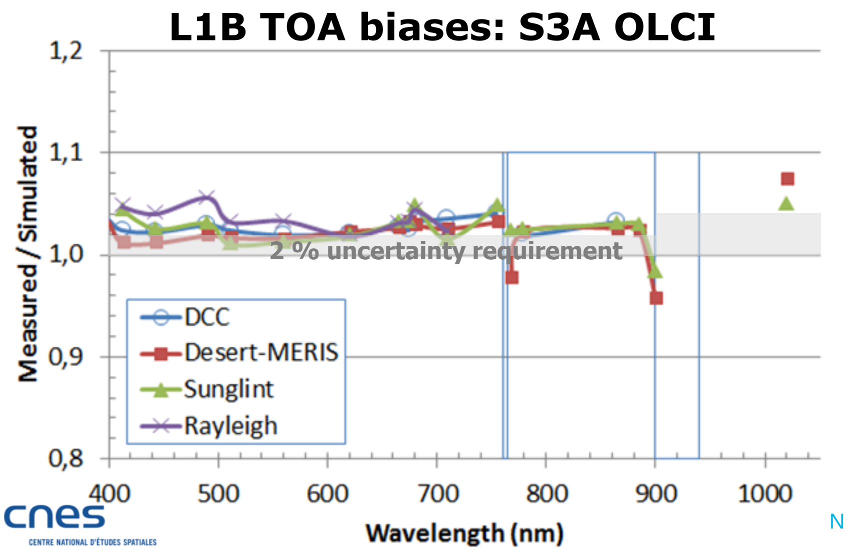
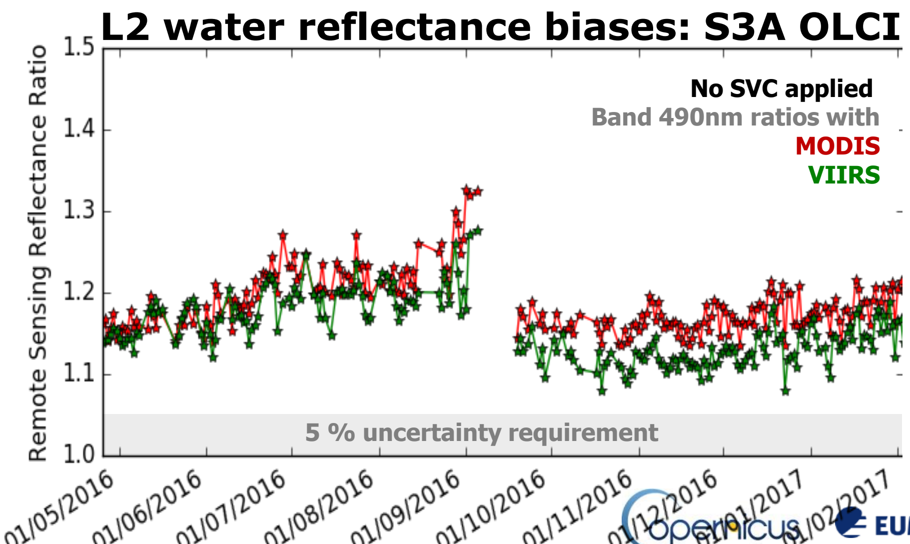
Definition of the system vicarious calibration requirements for the EC's Copernicus programme

Ewa Kwiatkowska

Ocean Colour System Vicarious Calibration (OC–SVC)

- Integral part of Ocean Colour earth observation programmes
- Prerequisite for meeting Ocean Colour mission requirements: accuracy, consistency and stability of data records [S3-MRTD]
- Task in the joint ESA-EUMETSAT Calibration and Validation Plan [S3-CVP] (task OLCI-WLR-CV-200)
- Critical to making the best use of Copernicus Programme assets, i.e. providing quality Ocean Colour Services [CMEMS OC-TAC]





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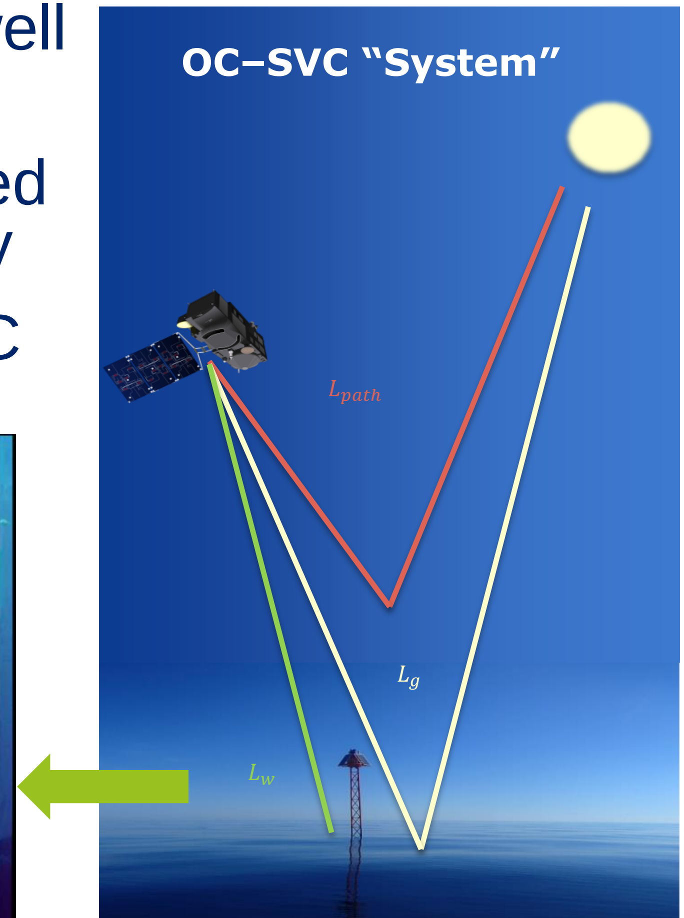
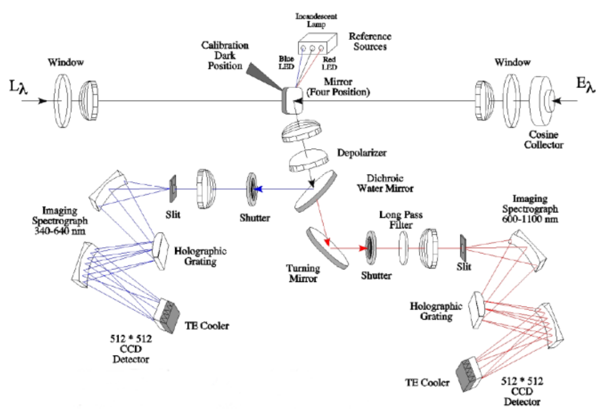
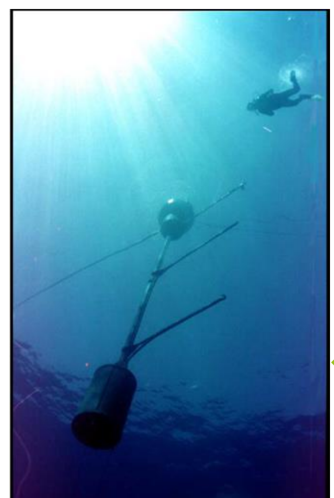
Ocean Colour System Vicarious Calibration needs

- OC–SVC Programme has to satisfy the Copernicus long-term perspective and current/evolving user needs for products & services
- OC–SVC requires minimization of all uncertainties of the “System”
- OC–SVC requires extremely accurate and well characterized FRMs
- OC–SVC FRMs are obtained from specialized infrastructure, typically an instrumented buoy
- Need for sustained and operational OC–SVC infrastructure in Europe







EUMETSAT planning for Copernicus OC–SVC solution

- Planning and development are required for decades of upcoming Copernicus ocean colour operations
- International cooperation is needed to achieve standardization, embedding in existing activities
  - ESA's FRM4SOC
  - BOUSSOLE experience
  - NOAA's Marine Optical Buoy (MOBY) operations and technology refresh
  - NASA's Vicarious Calibration ROSES-14 Call
  - CEOS OCR – VC recommendations
  - EC's JRC papers and reports
- Planned development phases:
  - Step 1: Scientific, Technical and Operational Requirements (pre-phase A)
  - Step 2: Preliminary Design, Project Plan and Costing (phase-A)
  - Step 3: Technical Definition, Specifications, Detailed Design (phase B)
  - Step 4: Development, Testing and Demonstration in the Field (phase C/D)
  - Step 5: Operations (phase E)

Steps 4 and 5 require a wide programmatic approach and significant investment

Step-1: OC–SVC Requirements

- Step 1: Scientific, Technical and Operational Requirements
- EUMETSAT's Copernicus study
- Study deliverables:
  - ❶ requirements document
  - ❷ document review process
- Requirements document purpose
  - to form the basis for all aspects of the OC–SVC Programme: planning, design, technical definitions, development, testing and long-term operations
  - to justify and outline the OC–SVC Programme for the EC's Copernicus Office

Step 1 ongoing: Copernicus study OC-SVC requirements

Requirements document to provide

❶ Clear justification of OC–SVC for Copernicus missions

❷ Listing of OC–SVC science and high-level technical requirements

- metric that itemizes error budget categories of the OC–SVC System

❸ Listing of OC–SVC operational and service requirements

- in-depth consideration of current and long-term operations and service needs of the Copernicus space and ground segments

Error budget must be justification for the requirements

OC-VCAL ID	Uncertainty source	rel_unc(400)	rel_unc(412)	rel_unc(443)	rel_unc(490)
	Marine in situ component				
OC-VCAL-RU-xx	Spectral resolution	1.00%	1.00%		
	Spectral calibration	0.10%	0.10%		
	Stray-light	0.75%	0.75%		
	Radiometric calibration & stability	2.00%	2.00%		
	Angular response				
	Thermal stability				
	Dark current				
	Polarisation sensivity				
	Non-linearity response				
	Noise characterisation				
	Shading	0.50%	0.50%		
	Depth-extrapolation	1.00%	1.00%		
	Surface propagation	0.50%	0.50%		
	Data reduction				
	Total uncertainty on in situ Lw	2.66%	2.66%		
	Atmospheric component				
OC-VCAL-RU-xx	Transmittance	1.00%	1.00%		
	Path radiance	3.00%	3.00%		
	Total uncertainty on atmospheric component (Eq. 21, atmospheric term)	57.01%	57.01%		
	Post-processing and gains computation				
OC-VCAL-RU-xx					
	In situ Lw spectral integration	0.20%	0.20%		
	In situ Lw BRDF correction	1.00%	1.50%		
	Total uncertainty on post-processed in situ Lw	2.84%	3.05%		
OC-VCAL-RU-xx	Individual gains (Eq. 21)	2.85%	2.85%		
	Spatial variability				
	Averaging (Eq. 20)	0.40%	0.40%		

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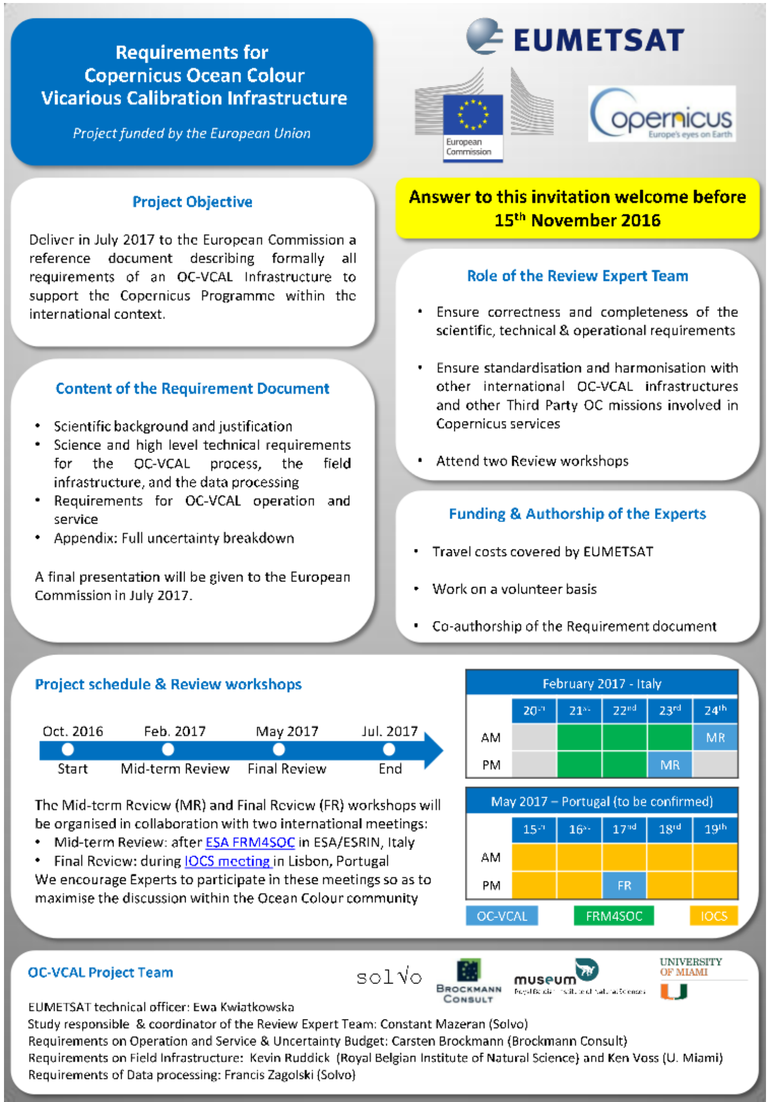
Step 1 ongoing: Copernicus study OC-SVC reviews

- Two review meetings by a Review Expert Team with the draft document provided in advance
  - 1st review: FRM4SOC workshop (21-23 Feb 2017), 23-24 Feb
  - 2nd review: IOCS'17 breakout workshop
- International Expert Review Team
  - Agnieszka Bialek (cc. Nigel Fox) (NPL) – metrology
  - Bryan Franz (NASA) – vicarious calibration method
  - Carol Johnson (NIST) – metrology, MOBY calibration
  - Craig Donlon (ESA) – FRM4SOC
  - David Antoine (LOV) – in situ infrastructure BOUSSOLE
  - Giuseppe Zibordi (JRC) – in situ infrastructures
  - Hiroshi Murakami (JAXA) – space instruments
  - Menghua Wang (NOAA) – atmospheric correction
  - Vittorio Brando (CMEMS) – Copernicus marine service
  - Young Je Park (KIOST) – operational requirements



Requirements for Copernicus Ocean Colour Vicarious Calibration Infrastructure

Project funded by the European Union

EUMETSAT

European Commission

Copernicus Europe's eyes on Earth

Answer to this invitation welcome before 15th November 2016

Project Objective

Deliver in July 2017 to the European Commission a reference document describing formally all requirements of an OC-VCAL Infrastructure to support the Copernicus Programme within the international context.

Role of the Review Expert Team

- Ensure correctness and completeness of the scientific, technical & operational requirements
- Ensure standardisation and harmonisation with other international OC-VCAL infrastructures and other Third Party OC missions involved in Copernicus services
- Attend two Review workshops

Content of the Requirement Document

- Scientific background and justification
- Science and high level technical requirements for the OC-VCAL process, the field infrastructure, and the data processing
- Requirements for OC-VCAL operation and service
- Appendix: Full uncertainty breakdown

A final presentation will be given to the European Commission in July 2017.

Funding & Authorship of the Experts

- Travel costs covered by EUMETSAT
- Work on a volunteer basis
- Co-authorship of the Requirement document

Project schedule & Review workshops

The Mid-term Review (MR) and Final Review (FR) workshops will be organised in collaboration with two international meetings:

- Mid-term Review: after ESA FRM4SOC in ESA/ESRIN, Italy
- Final Review: during IOCS meeting in Lisbon, Portugal

We encourage Experts to participate in these meetings so as to maximise the discussion within the Ocean Colour community

February 2017 - Italy

	20th	21st	22nd	23rd	24th
AM					MR
PM				MR	

May 2017 – Portugal (to be confirmed)

	15th	16th	17th	18th	19th
AM					
PM			FR		

OC-VCAL FRM4SOC IOCS

OC-VCAL Project Team

solvo Brockmann Consult museum University of Miami

EUMETSAT technical officer: Ewa Kwiatkowska
Study responsible & coordinator of the Review Expert Team: Constant Mazeran (Solvo)
Requirements on Operation and Service & Uncertainty Budget: Carsten Brockmann (Brockmann Consult)
Requirements on Field Infrastructure: Kevin Ruddick (Royal Belgian Institute of Natural Science) and Ken Voss (U. Miami)
Requirements of Data processing: Francis Zagolski (Solvo)

Step 1: Copernicus study conclusion

- Final OC–SVC requirement document will be jointly presented to the EC's DG GROW in July 2017 by
  - EUMETSAT
  - ESA
  - JRC
  - CMEMS
- Options for implementation will be discussed

1. Introduction
2. Traceability chain and uncertainty approach
3. Requirements on the SVC process
4. Requirements on field infrastructure
5. Requirements on the data processing
6. Requirements on the operation and service
7. Conclusion