Copernicus FRM4SOC FICE 2025

Training on
In Situ Ocean Colour Radiometry

The planned AAOT activities

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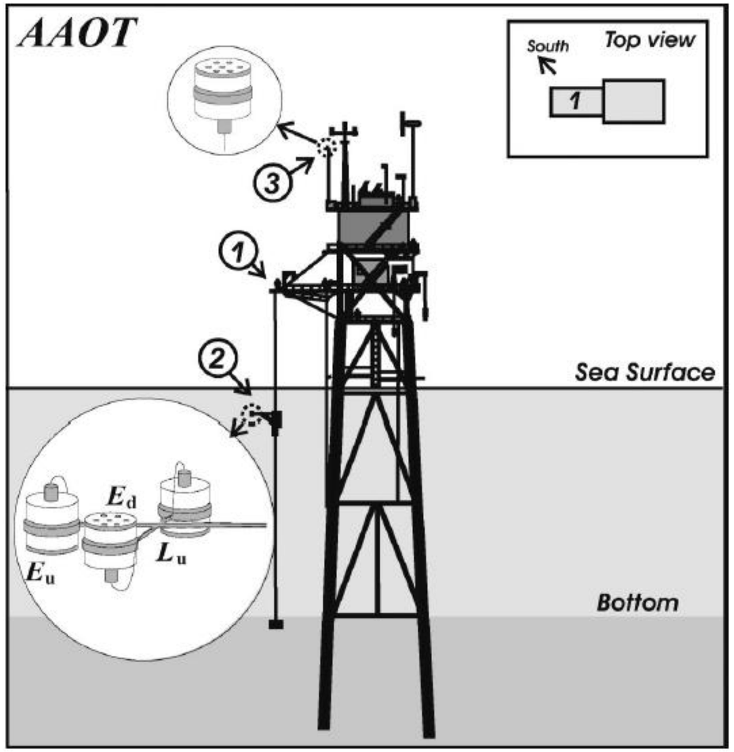
PROGRAMME OF THE EUROPEAN UNION
Copernicus Europe's eyes on Earth
IMPLEMENTED BY EUMETSAT
FRM4SOC Phase-2
fiducial reference measurements for satellite ocean colour
CNR ISMAR ISTITUTO DI SCIENZE MARINE

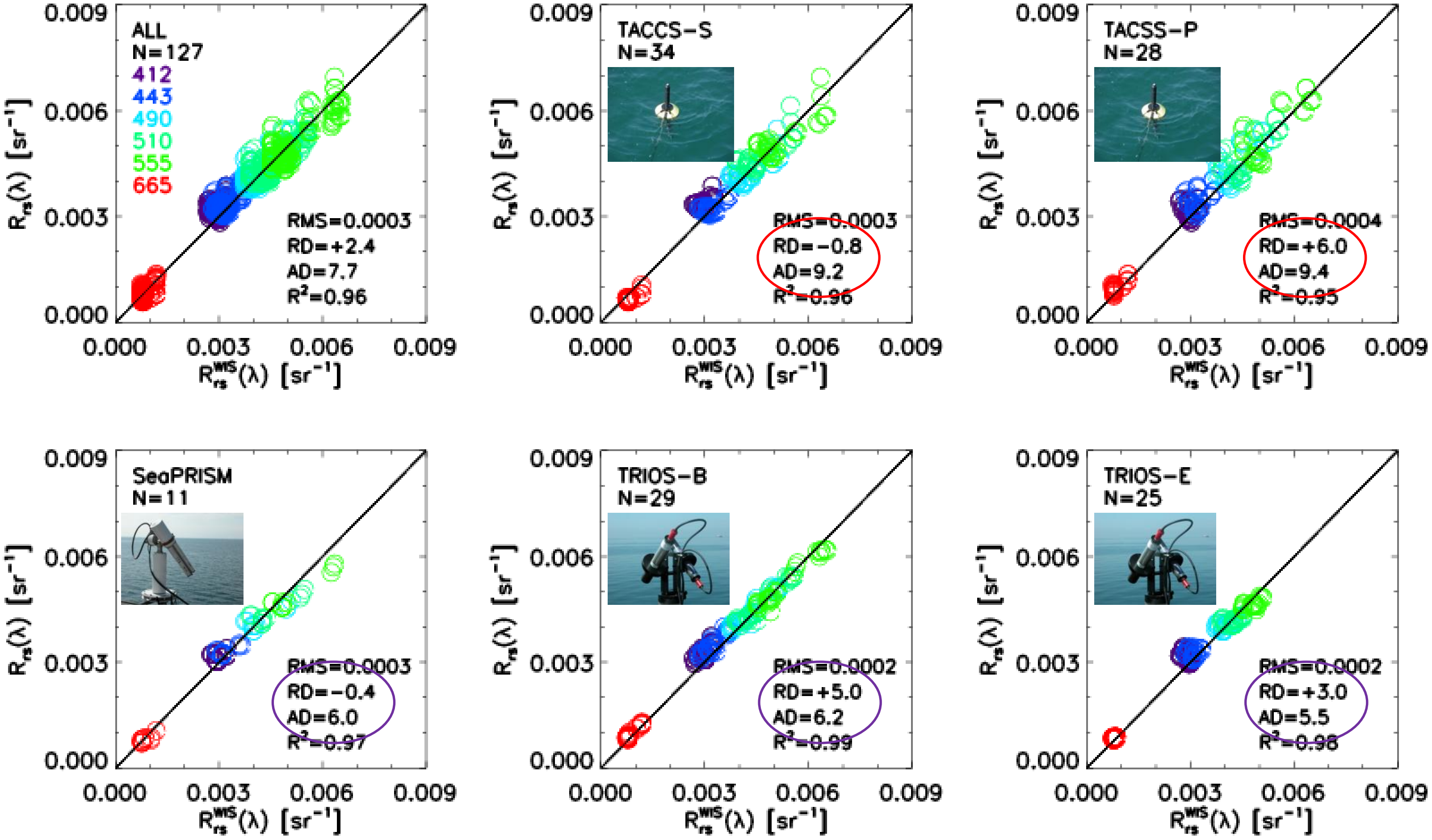
7-19 July 2025
Venice, Italy

Field Inter-comparisons at the AAOT

- Hooker, S. B., Lazin, G., Zibordi, G., & McLean, S. (2002). An evaluation of above-and in-water methods for determining water-leaving radiances. *Journal of Atmospheric and Oceanic Technology*, *19*(4), 486-515.
- Zibordi, G., Ruddick, K., Ansko, I., Moore, G., Kratzer, S., Icely, J., & Reinart, A. (2012). In situ determination of the remote sensing reflectance: an inter-comparison. *Ocean Science*, *8*(4), 567-586.
- Tilstone, G., Dall'Olmo, G., Hieronymi, M., Ruddick, K., Beck, M., Ligi, M., ... & Casal, T. (2020). Field inter-comparison of radiometer measurements for ocean colour validation. *Remote Sensing*, *12*(10), 1587.
- Tilstone, G. H., Jordan, T. M., Aurin, D., Białek, A., Deru, A., Ramsay, A., ... & Vendt, R. (2025). Radiometric field inter-comparison of fiducial reference measurements using an open source community processor. *Optics Express*, *33*(7), 15756-15781.

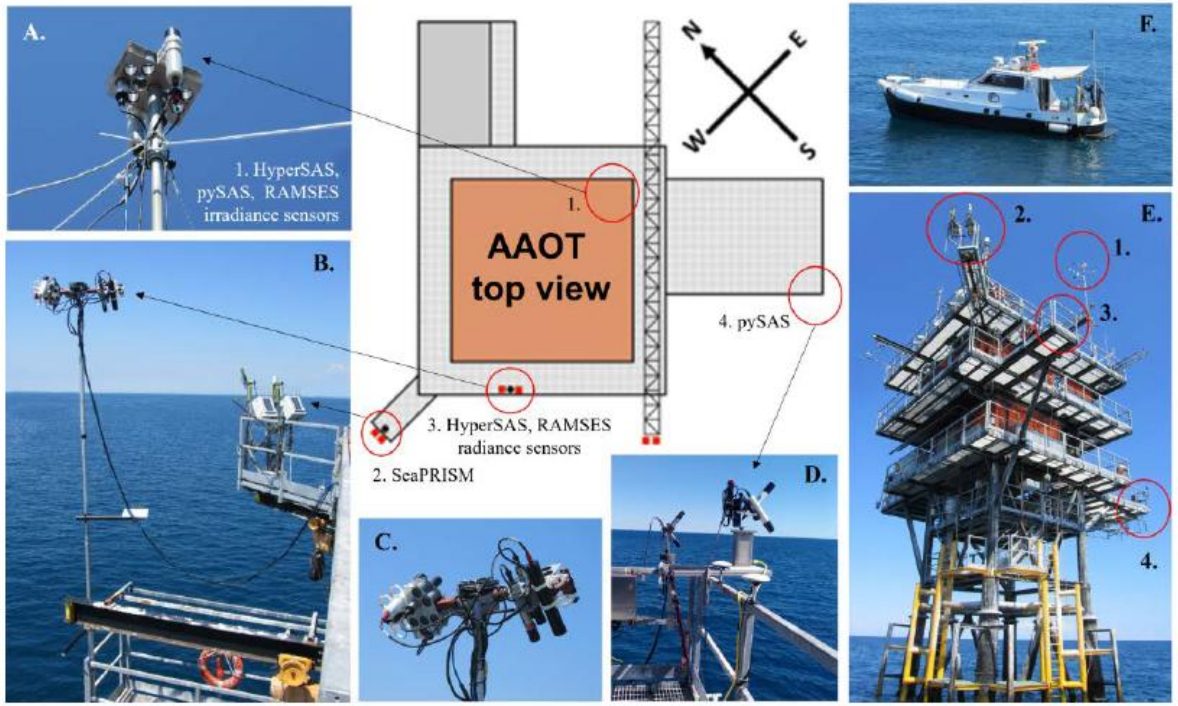
Assessment of In Situ Radiometric Capabilities for Coastal Water Remote Sensing Applications (ARC-2010)

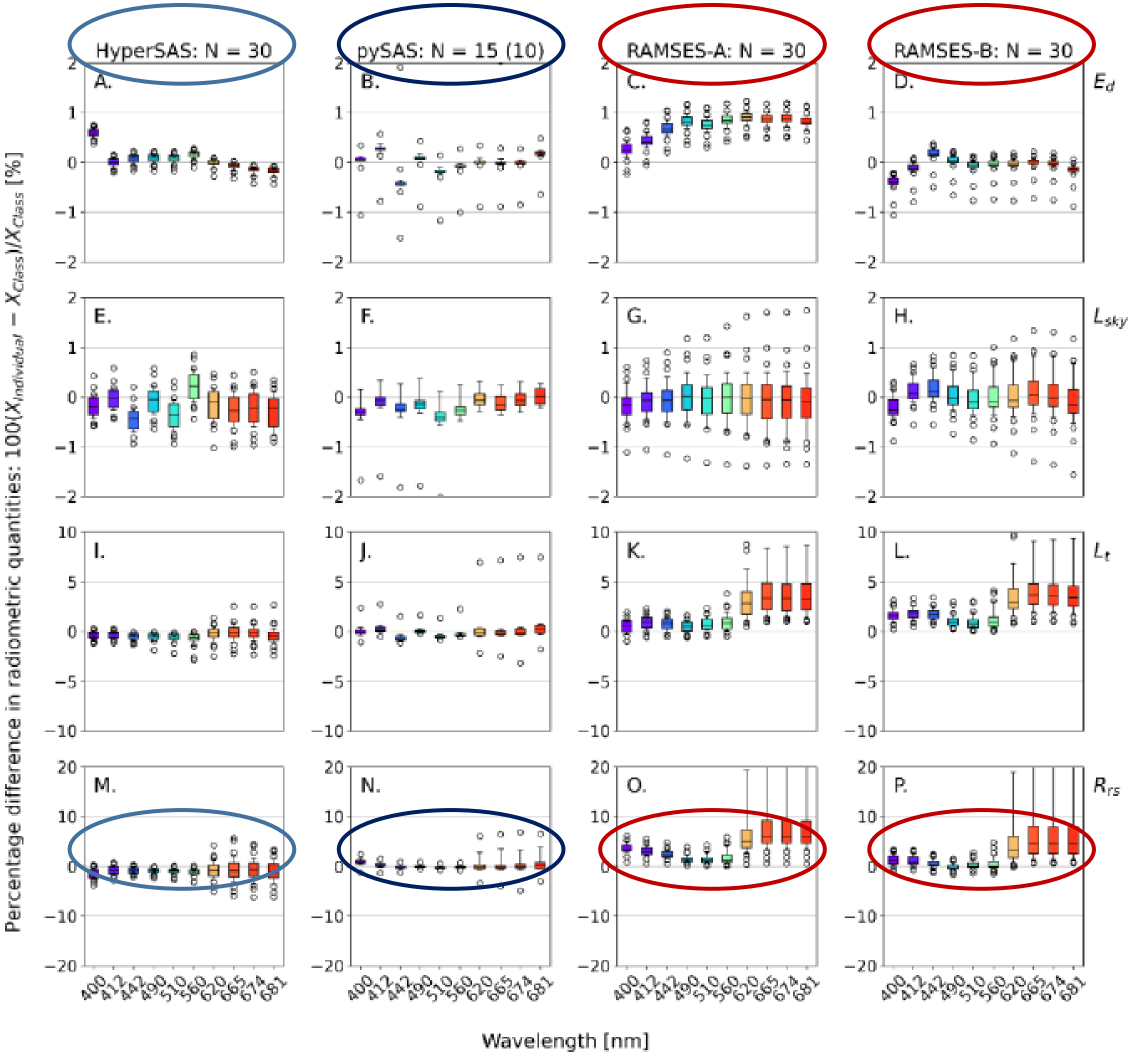




Zibordi, G., Ruddick, K., Ansko, I., Moore, G., Kratzer, S., Icely, J., & Reinart, A. (2012). In situ determination of the remote sensing reflectance: an inter-comparison. Ocean Science, 8(4), 567-586.

FICE-2022



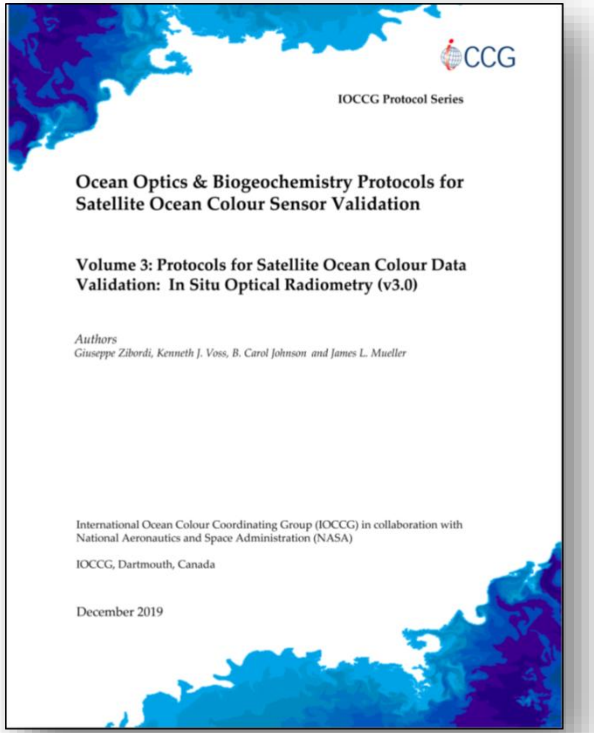


Tilstone, G. H., et al. (2025). Radiometric field inter-comparison of fiducial reference measurements using an open source community processor. Optics Express, 33(7), 15756-15781.

FICE-2025

The 2025 Field Inter-Comparison Experiment (FICE), is a side activity of the international training organized by EUMETSAT in Venice within the framework of the Copernicus project called Fiducial Reference Measurements for Ocean Color (FRM4SOC).

The objective of FICE-2025 is to stress instrument metrology and to see how much fully characterized field radiometers impact the overall measurement uncertainty in the application of above water-radiometry.


IOCCG Protocol Series

Ocean Optics & Biogeochemistry Protocols for Satellite Ocean Colour Sensor Validation

Volume 3: Protocols for Satellite Ocean Colour Data Validation: In Situ Optical Radiometry (v3.0)

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IOCCG, Dartmouth, Canada

December 2019

Objectives of FICE-2025

The key questions that FICE-2025 should address are:

- *Which is the actual impact of corrections from individual characterizations on each radiometric quantity (i.e., L_i, L_t, and E_s)?*

- *Is each radiometric correction really relevant or masked by its own uncertainty?*

- *Is there any correction that could be addressed as 'class-based' other than 'instrument specific'?*

- *Are the differences among the same radiometric quantities and products from the various sensors (i.e., L_i, L_t, E_s and R_{RS}) explained by the expected radiometric uncertainties once the sensors non-ideal performance has been corrected?*

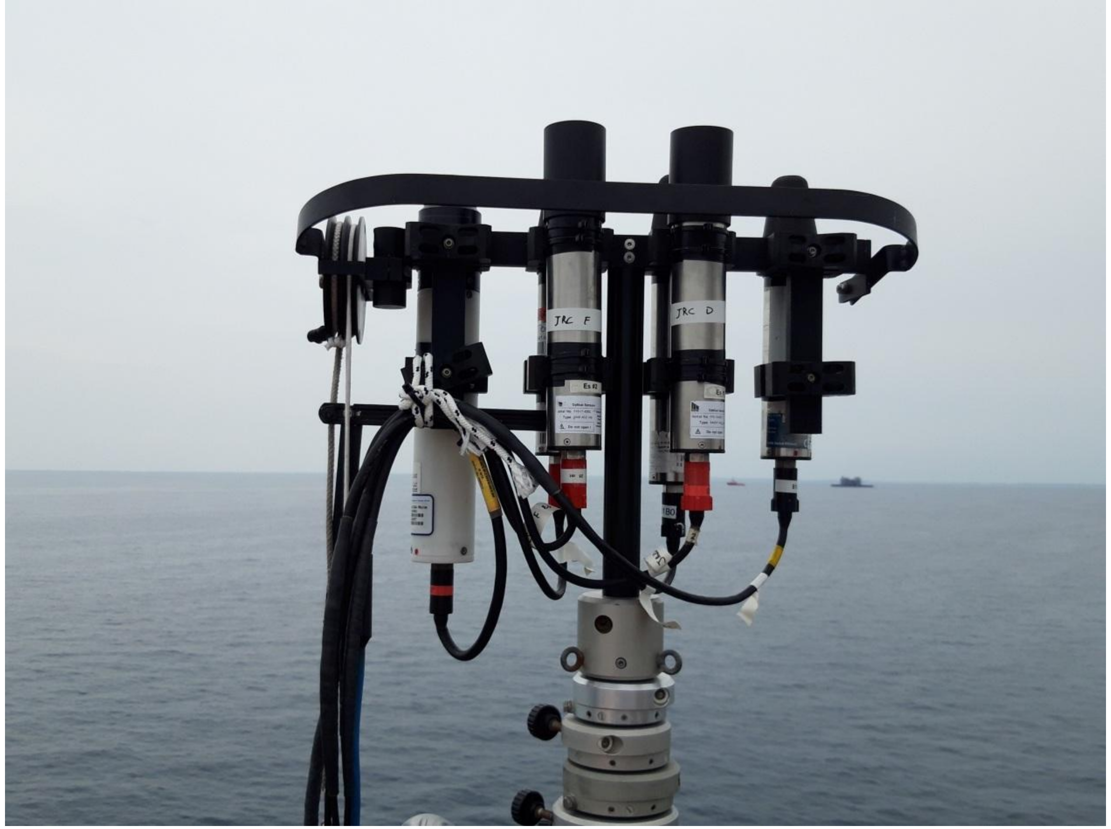
- *Is the uncertainty of current characterizations and data reduction, combined with those expected for environmental variability, corrections for bidirectional effects and deployment perturbations, satisfying the uncertainty requirements needed for ocean color validation activities?*

Implementation of FICE-2025

In view of minimizing biases increasing or cancelling differences, the field work will rely on :

- *Equivalent series of above-water systems fully characterized and with pre-field calibration*
- *Synchronous measurements performed from the same deployment location*
- *Ideal observation conditions (clear sun with cloud cover not exceeding 2 Octas)*
- *Minimization of structure perturbations by restricting measurements to favorable sun azimuth angles*
- *Application of the same processing solutions (the objective is to investigate the metrology associated with radiometry and not with the data reduction).*

Equipment operated at the AAOT



E_s units and shadow-band

L_i and L_T units

End

Example of log-form

Campaign ID:	***Campaign #:***
Station #:	Location:
Date (*dd mmm yyyy*):	Recording Time (*GMT*):
Longitude (*degrees.decimals*):	Latitude: (*degrees.decimals*):
Wind Speed (*m* s^{-1}):	Wind Direction (*degrees from N*):
Temp. air (*C°*):	Temp. water (*C°*):
Cloud cover (*octs*):	Sea state (*WMO*):
Water depth (*m*):	***Compiled by***:

Measurement cast (#):	Notes:

Viewing geometry (θ, ϕ):

L_T instrument programming:
L_i instrument programming:
E_S instrument programming:

L_T instrument cal-file:
L_i instrument cal-file:
E_S instrument cal-file:

Dark sequences (#):	Time start-end (*GMT*):
Dark file-name:	Dark sequence-index:
Signal sequences (#):	Time start-end (*GMT*):
Signal file-name:	Signal sequence-index:

Temp. L_T(C°)						
Temp. L_i(C°)						
Temp. E_S(C°)						

Additional notes

Sea state code

WMO Code	Wave height	Characteristics
0	0 m	Calm (glassy)
1	0.0 – 0.1 m	Calm (rippled)
2	0.1 – 0.5 m	Smooth (wavelets)
3	0.5 – 1.25 m	Slight
4	1.25 – 2.5 m	Moderate
5	2.5 – 4 m	Rough
6	4 – 6 m	Very rough
7	6 – 9 m	High
8	9 – 14 m	Very high
9	Over 14 m	Phenomenal

Electronic log

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! COMMENTS
!
! FRM4SOC-2 Field InterComparison Experiment (FICE)
! July 11 - 21, 2022
! Acqua Alta Oceanographic Tower (AAOT), CNR-ISMAR
!
! RelAz refer to solar-sensor relative azimuth angle.
!
! Manually operated TriOS triplet. Height: ~15 m, Tower color: Red/yellow.
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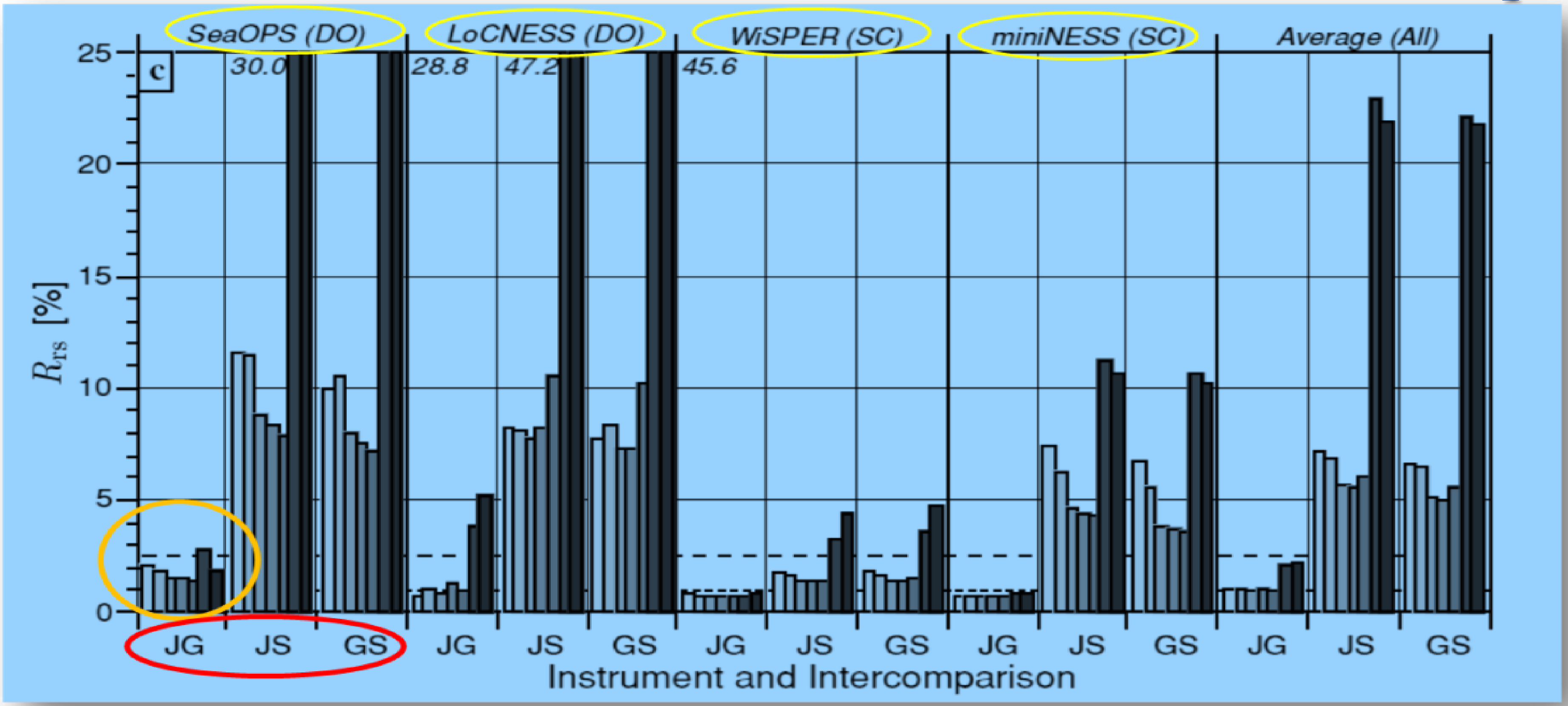
On inter-comparisons



Percent differences in spectral $R_{RS}(\lambda)$ resulting from the application of three independent codes (still, **inspired by the same protocol**) to the processing of diverse in-water profiles from different radiometer systems operated in various water types. J, G and S indicate the diverse processors. Each sub-panel in the figure, which is associated to data from a specific optical profiler (*i.e.*, *SeaOPS*, *LoCNESS*, *WiSPER*, *miniNESS*), shows the differences for pairs of processors (*i.e.*, JG, JS and GS) through histograms whose grey levels identify the spectral bands.

Hooker, S.B., G. Zibordi, J-F. Berthon, D. D'Alimonte, S. Maritorena, S. McLean, and J. Sildam, 2001: Results of the Second SeaWiFS Data Analysis Round Robin, March 2000 (DARR-00). NASA Tech. Memo. 2001–206892, Vol. 15, S.B. Hooker and E.R. Firestone, Eds., NASA Goddard Space Flight Center, Greenbelt, MD, 71 pp.