The Mediterranean Ocean Colour Level 3 Operational Multi-Sensor Processing

Gianluca Volpe[1], Simone Colella[1], Vittorio Brando[1], Vega Forneris[1], Flavio La Padula[1], Annalisa Di Cicco[1], Michela Sammartino[1], Marco Bracaglia[1,2], Florinda Artuso[3], Rosalia Santoleri[1]

[1] Istituto di Scienze dell'Atmosfera e del Clima, Via Fosso del Cavaliere 100, 00133, Roma, Italy
[2] Università degli Studi di Napoli Parthenope,Via Amm. F. Acton 38, 80133, Naples, Italy
[3] Ente per le Nuove tecnologie l'Energia e l'Ambiente, Dipartimento Ambiente, Centro Ricerche Frascati, Frascati, Italy

Correspondence to: Gianluca Volpe (gianluca.volpe@cnr.it)

Supplementary Material

Name	Definition
In situ data average	$\overline{X}^M = \frac{1}{N}\sum_{i=1}^{N} X_i^M$
Satellite data average	$\overline{X}^E = \frac{1}{N}\sum_{i=1}^{N} X_i^E$
Type-2 slope	$S = \frac{\sum_{i=1}^{N}(X_i^E-\overline{X}^E)^2 - \sum_{i=1}^{N}(X_i^M-\overline{X}^M)^2 + \left[\left\{\sum_{i=1}^{N}(X_i^E-\overline{X}^E)^2 - \sum_{i=1}^{N}(X_i^M-\overline{X}^M)^2\right\}^2 + 4\left\{\sum_{i=k}^{N}(X_k^E-\overline{X}^E)(X_k^M-\overline{X}^M)\right\}^2\right]^{1/2}}{2\sum_{i=k}^{N}(X_k^E-\overline{X}^E)(X_k^M-\overline{X}^M)}$
Type-2 intercept	$I = \overline{X}^E - S\cdot\overline{X}^M$
Determination coefficient	$r^2 = \frac{\left[\sum_{i=1}^{N}\left(X_i^E-\overline{X}_i^E\right)\left(X_i^M-\overline{X}_i^M\right)\right]^2}{\sum_{i=1}^{N}\left(X_i^E-\overline{X}_i^E\right)^2\sum_{i=1}^{N}\left(X_i^M-\overline{X}_i^M\right)^2}$
Root Mean Square Difference	$RMSD = \sqrt{\frac{\sum_{i=1}^{N}(X_i^E-X_i^M)^2}{N}}$
Centre-pattern Root Mean	$cRMSD = \sqrt{\frac{\sum_{i=1}^{N}\left\{\left[X_i^E-\left(\sum_{j=1}^{N}X_j^E\right)\right]-\left[X_i^M-\left(\sum_{k=1}^{N}X_k^M\right)\right]\right\}^2}{N}}$

Square Difference	
Bias	$bias = \frac{1}{N}\sum_{i=1}^{N}(X_i^E - X_i^M)$
Mean Absolute Error	$MAE = \frac{1}{N}\sum_{i=1}^{N}\lvert X_i^E - X_i^M \rvert$
Relative percentage Difference	$RPD = 100 \cdot \frac{1}{N}\sum_{i=1}^{N}\frac{X_i^E - X_i^M}{X_i^M}$
Absolute percentage Difference	$APD = 100 \cdot \frac{1}{N}\sum_{i=1}^{N}\frac{\lvert X_i^E - X_i^M \rvert}{X_i^M}$

Table S.1: Metrics used to compare the estimated (satellite-based) dataset XE to a reference, measured in-situ dataset XM. The centre-pattern (or unbiased) Root Mean Square Distance (cRMSD) describes the error of the estimated values with respect to the measured ones, regardless of the average bias between the two distributions.

RRS	$\overline{X}^M$	$\overline{X}^E$	SLOPE	INTERCEPT	R^2	RMSD	CRMSD	BIAS	MAE	RPD	APD	N
412	0.0059	0.0056	1.01	-0.0004	0.75	0.0013	0.0013	-0.00029	0.00098	-3	19	156
443	0.0056	0.0056	0.94	0.0003	0.80	0.0009	0.0009	-0.00003	0.00071	3	15	156
488	0.0052	0.0050	0.96	0.0000	0.79	0.0007	0.0007	-0.00025	0.00056	-3	12	156
490	0.0052	0.0050	0.96	0.0000	0.79	0.0007	0.0006	-0.00025	0.00056	-3	12	156
510	0.0040	0.0035	1.08	-0.0009	0.79	0.0008	0.0006	-0.00057	0.00072	-13	19	156
531	0.0033	0.0029	1.05	-0.0005	0.88	0.0006	0.0005	-0.00037	0.00053	-11	18	156
547	*0.0027*	*0.0024*	*1.02*	*-0.0004*	*0.91*	*0.0005*	*0.0004*	*-0.00030*	*0.00044*	*-11*	*18*	*156*
555	0.0024	0.0022	1.03	-0.0003	0.92	0.0005	0.0004	-0.00028	0.00041	-12	18	156
667	0.0003	0.0003	1.57	-0.0002	0.88	0.0002	0.0002	-0.00001	0.00010	-3	35	117
670	0.0003	0.0003	1.54	-0.0002	0.89	0.0002	0.0002	-0.00001	0.00009	-5	34	127

Table S.2: Statistics associated with the MODIS-AQUA Rrs computed over the MedBiOp dataset.

RRS	$\overline{X}^M$	$\overline{X}^E$	SLOPE	INTERCEPT	R^2	RMSD	CRMSD	BIAS	MAE	RPD	APD	N
410	0.0049	0.0043	1.40	-0.0026	0.45	0.0011	0.0009	-0.00065	0.00092	-13	19	93
412	0.0049	0.0043	1.39	-0.0026	0.45	0.0011	0.0009	-0.00065	0.00092	-13	19	93
443	0.0049	0.0048	0.97	0.0000	0.63	0.0007	0.0007	-0.00018	0.00054	-3	11	93
486	0.0052	0.0049	0.92	0.0001	0.86	0.0006	0.0005	-0.00034	0.00049	-6	9	93
490	0.0052	0.0049	0.94	0.0000	0.87	0.0006	0.0005	-0.00036	0.00050	-6	9	93
510	0.0044	0.0038	1.02	-0.0007	0.92	0.0008	0.0005	-0.00064	0.00069	-15	16	93
551	0.0031	0.0027	0.99	-0.0003	0.95	0.0006	0.0005	-0.00035	0.00044	-12	15	93
555	0.0030	0.0027	1.00	-0.0003	0.95	0.0006	0.0005	-0.00035	0.00044	-13	15	93
670	0.0005	0.0005	1.14	-0.0001	0.95	0.0002	0.0002	-0.00003	0.00010	-11	20	50
671	0.0005	0.0005	1.14	-0.0001	0.95	0.0002	0.0002	-0.00003	0.00010	-10	20	49

Table S.3: Statistics associated with the VIIRS Rrs computed over the MedBiOp dataset.

RRS	$\overline{X}^M$	$\overline{X}^E$	SLOPE	INTERCEPT	R^2	RMSD	CRMSD	BIAS	MAE	RPD	APD	N
412	0.0085	0.0082	1.05	-0.0007	0.64	0.0019	0.0018	-0.00031	0.00147	1	21	97
443	0.0079	0.0076	0.92	0.0003	0.61	0.0016	0.0016	-0.00028	0.00121	3	21	97
490	0.0059	0.0056	0.68	0.0015	0.31	0.0014	0.0013	-0.00035	0.00092	-1	18	97
510	0.0040	0.0035	0.14	0.0029	0.02	0.0012	0.0011	-0.00054	0.00084	-8	22	97
555	0.0019	0.0018	0.26	0.0013	0.03	0.0008	0.0007	-0.00008	0.00039	0	21	97
670	0.0002	0.0003	11.16	-0.0017	0.08	0.0002	0.0001	0.00011	0.00012	76	80	40

Table S.4: Statistics associated with the SeaWiFS Rrs computed over the MedBiOp dataset.

RRS	$\overline{X}^M$	$\overline{X}^E$	SLOPE	INTERCEPT	R^2	RMSD	CRMSD	BIAS	MAE	RPD	APD	N
412	0.0083	0.0092	0.97	0.0011	0.90	0.0012	0.0009	0.00089	0.00104	13	14	90
443	0.0076	0.0081	0.85	0.0016	0.86	0.0010	0.0009	0.00046	0.00072	9	12	90
490	0.0060	0.0057	0.56	0.0023	0.79	0.0011	0.0010	-0.00031	0.00056	-3	8	90
510	0.0042	0.0036	0.54	0.0014	0.87	0.0011	0.0010	-0.00051	0.00061	-10	13	90
560	0.0022	0.0019	0.54	0.0008	0.95	0.0012	0.0012	-0.00022	0.00030	-5	10	90
670	0.0002	0.0002	1.17	-0.0001	0.74	0.0001	0.0001	-0.00003	0.00005	-13	28	72

Table S.5: Statistics associated with the MERIS Rrs computed over the MedBiOp dataset.

RRS	$\overline{X}^M$	$\overline{X}^E$	SLOPE	INTERCEPT	R^2	RMSD	CRMSD	BIAS	MAE	RPD	APD	N
412	0.0069	0.0060	0.97	-0.0007	0.83	0.0015	0.0012	-0.00087	0.00112	-12	17	262
443	0.0066	0.0063	0.86	0.0006	0.82	0.0011	0.0011	-0.00030	0.00077	-1	13	262
490	0.0057	0.0053	0.75	0.0010	0.72	0.0010	0.0009	-0.00040	0.00067	-4	12	262
510	0.0042	0.0037	0.80	0.0003	0.74	0.0010	0.0009	-0.00051	0.00067	-9	16	262
555	0.0025	0.0023	0.80	0.0003	0.84	0.0008	0.0008	-0.00017	0.00038	-3	14	262
670	0.0003	0.0003	0.97	0.0000	0.87	0.0001	0.0001	-0.00001	0.00009	5	38	223

Table S.6: Statistics associated with the CCIv3 Rrs computed over the MedBiOp dataset.

RRS	$\overline{X}^M$	$\overline{X}^E$	SLOPE	INTERCEPT	R^2	RMSD	CRMSD	BIAS	MAE	RPD	APD	N
412	0.0070	0.0064	0.99	-0.0006	0.78	0.0015	0.0014	-0.00060	0.00113	-7	17	272
443	0.0066	0.0064	0.85	0.0007	0.73	0.0013	0.0013	-0.00022	0.00089	1	15	272
490	0.0057	0.0052	0.66	0.0015	0.55	0.0013	0.0012	-0.00047	0.00077	-5	13	272
510	0.0042	0.0037	0.65	0.0009	0.57	0.0013	0.0011	-0.00059	0.00076	-11	18	272
555	0.0025	0.0022	0.68	0.0005	0.71	0.0012	0.0012	-0.00027	0.00044	-6	16	272
670	0.0003	0.0003	1.19	-0.0001	0.91	0.0002	0.0002	-0.00001	0.00009	-1	35	194

Table S.7: Statistics associated with the Multi Rrs computed over the MedBiOp dataset.

CHL	$\overline{X}^M$	$\overline{X}^E$	SLOPE	INTERCEPT	R2	RMSD	CRMSD	BIAS	MAE	RPD	APD	N
REP	0.0999	0.0905	0.737	-0.306	0.75	0.253	0.250	-0.043	0.200	7	47	708
MULTI	0.0999	0.0870	0.752	-0.308	0.74	0.259	0.252	-0.060	0.207	3	47	708
REPAV	0.2708	0.1970	1.052	-0.108	0.57	0.242	0.198	-0.138	0.218	-18	43	44
MULTIAV	0.2708	0.1911	1.183	-0.047	0.50	0.273	0.227	-0.151	0.246	-17	48	44

Table S.8: Statistics associated with satellite Chl computed over the MedBiOp dataset. Satellite Chl is the REP (derived by the application of the MedOC4.2017 to the Rrs derived from the CCIv3 processor) and NRT (derived from the Multi processing). A subset of matchups on the period in which VIIRS and MODIS co-exist (REPAV and MultiAV) is also reported.