

Spatio-temporal variability of the water quality of European and Chinese coastal waters

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Objectives

1. Characterization of the error budgets of officially distributed products of OLCI onboard Sentinel 3 satellites and COCTS/CZI onboard HY-1 satellites in coastal waters around China and Europe, e.g., Yellow Sea in China, English Channel in Europe
2. Examination of the consistency between OLCI and COCTS/CZI, and among other ocean color sensors in these waters.
3. Development and refinement regional algorithms to accurately retrieve marine environment parameters (optical and biogeochemical) in these regions of interest.
4. Utilization of OLCI and COCTS/CZI products to monitor the dynamic and quality of the Chinese and European coastal waters.

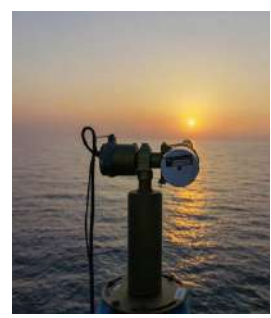
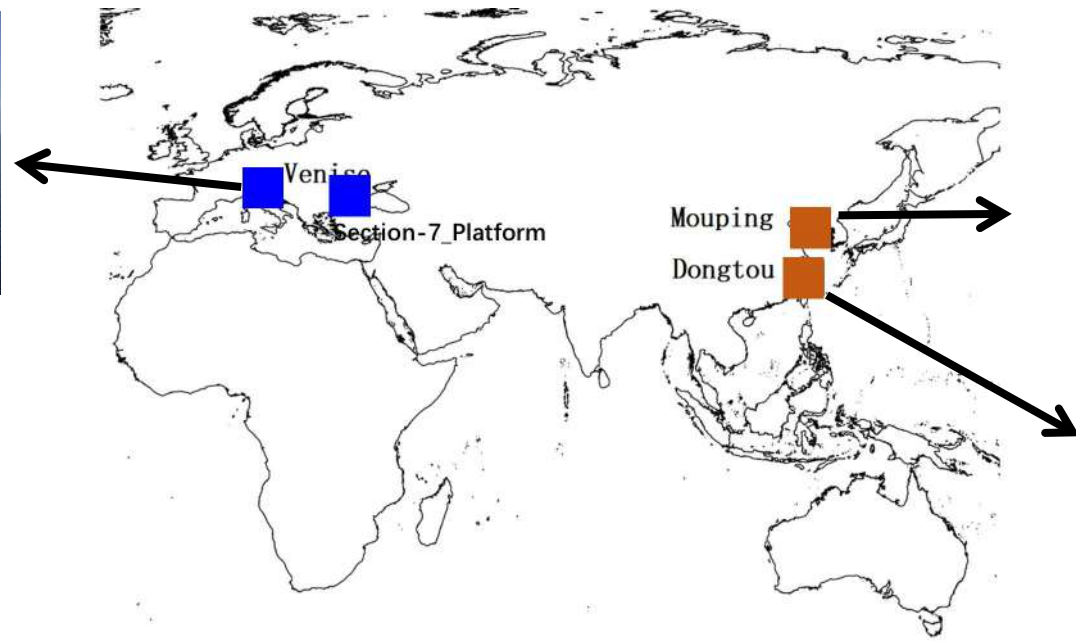


(1) In-situ data: automatic measurements by **SeaPRISM** (CIMEL Inc., France)
 sun photometer operationally deployed in **AERONET-OC**

- **Venise** Adriatic Sea, Europe Operated by **JRC, EU**
- **Section-7_Platform** Black Sea, Europe Operated by **JRC, EU**
- **Dongtou** East Sea, China Operated by **NSOAS, MNR, China**
- **Muping** Yellow Sea, China Operated by **NSOAS, MNR, China**



Venise



Muping



Dongtou

(2) EO Data (Ocean Color)

- **OLCI/Sentinel 3A/3B** (Launch: Feb 16, 2016 / Apr 25 2018) ~

L2 Full Resolution/Near-Realtime

16 spectral bands in VIS-NIR

300m spatial resolution, global coverage (~1270km swath)



- **COCTS/Haiyang 1C/1D** (Launch: Sep 7, 2018 / Jun 11, 2020) ~Local
10:30/13:30

L2A, L2B

8 spectral bands in VIS-NIR

1000m spatial resolution, global coverage (~2900km swath)

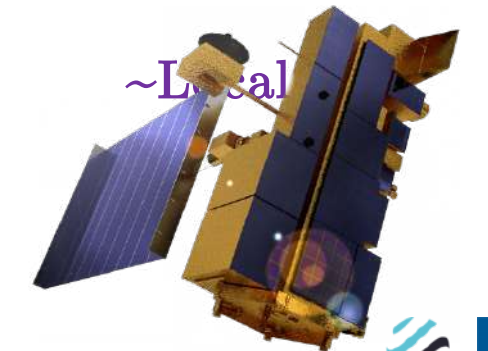


- **MODIS/AQUA** (Launch: May 4, 2002) ~Local
13:30

L2

8 spectral bands in VIS-NIR

1200m spatial resolution, global coverage (~2330km swath)



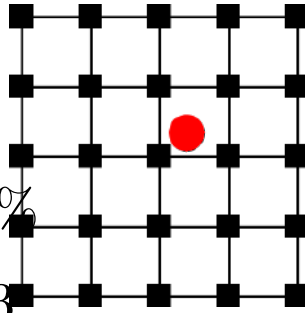


(4) Validation Protocol -- Math-up and Statistics

● In-situ data vs EO data (validation)

Match-up criteria

- ✓ Time window: 1 hour
- ✓ Spatial window: 5*5 pixels
- ✓ Percentage of valid pixels: >50%
- ✓ Spatial Homogeneity: CV < 0.3
- ✓ sun zenith and sensor zenith checked
- ✓ Product flags checked
- ✓ Average over defined box



Venise (Adriatic Sea)	E 12.508° N 45.314°
Section-7_Platform (East China Sea)	E 29°~30° N 44°~45°
Dongtou (East China Sea)	E 121.358° N 27.675°
Muping (Yellow Sea)	E 121.701° N 37.681°

Statistical Indicator

$$\overline{RPD} = \frac{\sum_{i=1}^N \frac{y_i - x_i}{x_i}}{N} \times 100\%$$

$$\overline{APD} = \frac{\sum_{i=1}^N \left| \frac{y_i - x_i}{x_i} \right|}{N} \times 100\%$$

x_i – reference measurement

y_i – target measurement

N – number of match-ups



(1) Validation Activities – Ongoing

□ Referenced with SeaPRISM measurements

- ✓ OLCI L2, Sentinel 3A/3B
- ✓ COCTS L2A/L2B, Haiyang 1C/1D
- ✓ MODIS L2, AQUA

- Venise
- Section-7_Platform
- Dongtou
- Muping

(2) Consistency Check – First Results

□ OLCI L2 (Sentinel 3A/3B) vs MODIS L2 (Terra)

□ COCTS L2A/L2B (Haiyang 1C/1D) vs MODIS L2 (Terra)

(3) Young Scientists Training

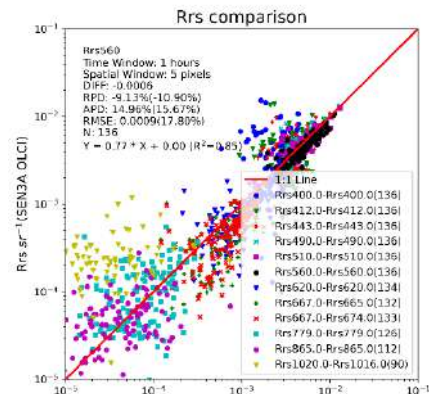


(1) Validation Activities – Ongoing

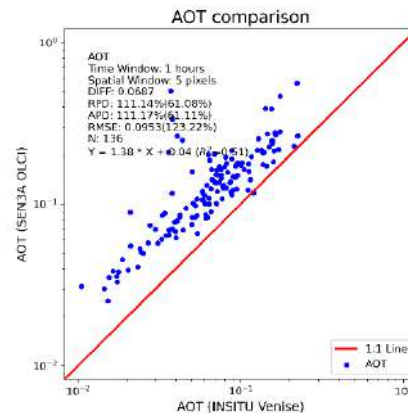
OLCI/Sentinel 3A ---- L2 FR NR
Jan/2020 – Dec/2022

- **Venise**
- **Section-7_Platform**
- **Dongtou**
- **Muping**

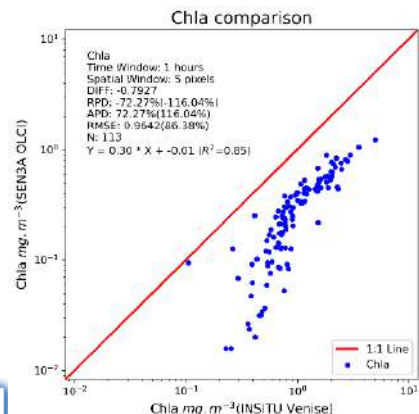
Rrs



AOT



Chla



Product	N	RPD	APD
Rrs412-Rrs412	136	11.6%	50.6%
Rrs443-Rrs443	136	8.4%	30.8%
Rrs490-Rrs490	136	0.2%	15.7%
Rrs551-Rrs560	136	-9.1%	15.0%
Rrs665-Rrs667	132	-23.6%	48.0%
Rrs865-Rrs870	112	56.7%	96.6%
Rrs1016-Rrs1020	90	1647.7%	1652.5%
		%	%
AOT	136	111.1%	111.2%
Chla	92	-72.3%	72.3%

Significantly Over-estimated

Significantly Under-estimated

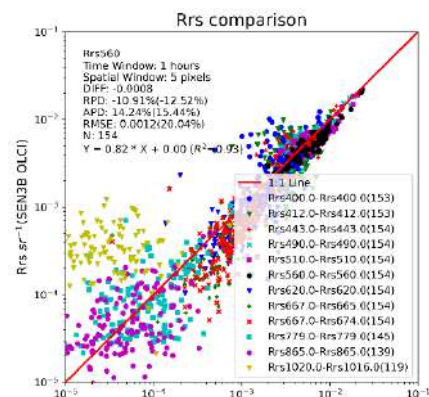


(1) Validation Activities – Ongoing

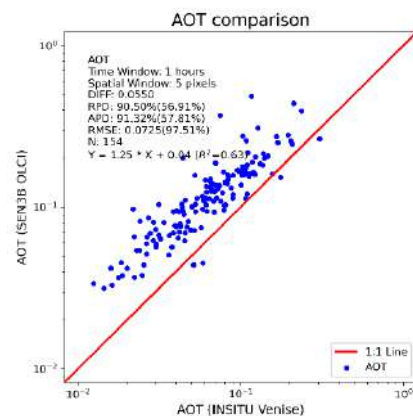
OLCI/Sentinel 3B ---- L2 FR NR
Jan/2020 – Dec/2022

- **Venise**
- **Section-7_Platform**
- **Dongtou**
- **Muping**

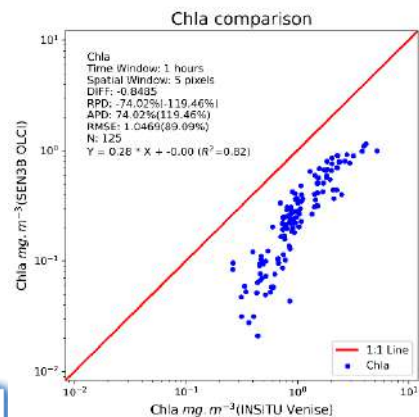
Rrs



AOT



Chla



Product	N	RPD	APD
Rrs412-Rrs412	153	11.9%	45.2%
Rrs443-Rrs443	154	7.1%	26.6%
Rrs490-Rrs490	154	-0.8%	15.4%
Rrs551-Rrs560	154	-10.9%	14.2%
Rrs665-Rrs667	154	-18.9%	54.8%
Rrs865-Rrs870	139	86.0%	132.0%
Rrs1016-Rrs1020	119	3124.5%	3126.4%
		%	%
AOT	154	90.5%	91.3%
Chla	104	-73.9%	73.9%

Significantly Over-estimated

Significantly Under-estimated

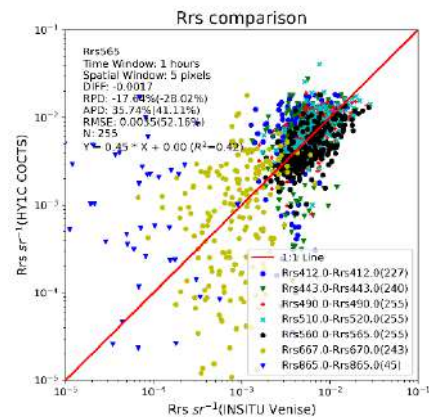


(1) Validation Activities – Ongoing

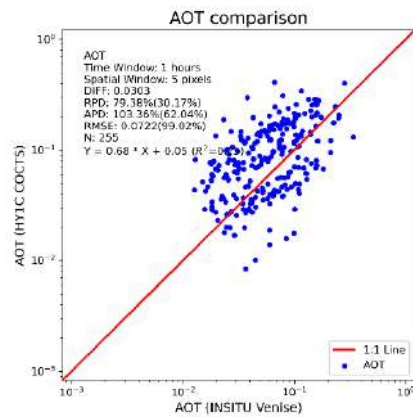
COCTS/Haiyang 1C ---- L2A
Jan/2020 – Dec/2022

- **Venise**
- **Section-7_Platform**
- **Dongtou**
- **Muping**

Rrs



AOT



Product	N	RPD	APD
Rrs412-Rrs412	123	69.6%	90.5%
Rrs443-Rrs443	128	32.4%	65.7%
Rrs490-Rrs490	130	2.7%	37.0%
Rrs565-Rrs551	130	7.2%	36.7%
Rrs670-Rrs667	124	60.7%	153.9%
AOT	139	79.4%	103.4%

Chla

Not Available

Significantly Over-estimated

Significantly Under-estimated

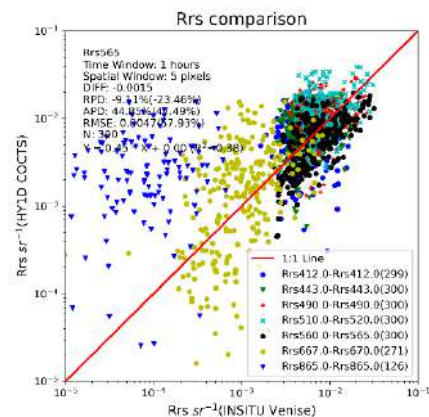


(1) Validation Activities – Ongoing

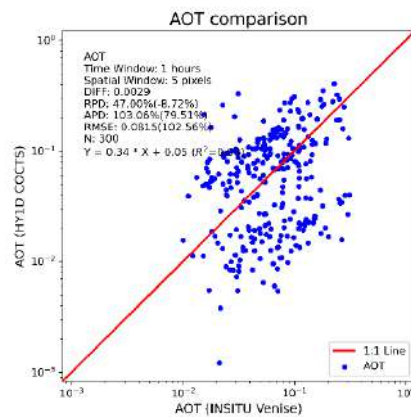
COCTS/Haiyang 1D ---- L2A
Jan/2020 – Dec/2022

- **Venise**
- Section-7_Platform
- Dongtou
- Muping

Rrs



AOT



Product	N	RPD	APD
Rrs412-Rrs412	167	54.4%	78.0%
Rrs443-Rrs443	167	46.7%	66.3%
Rrs490-Rrs490	167	25.0%	52.3%
Rrs565-Rrs551	167	41.2%	67.8%
Rrs670-Rrs667	163	152.9%	192.8%
AOT	166	47.0%	103.1%

Chla Not Available

Significantly Over-estimated

Significantly Under-estimated

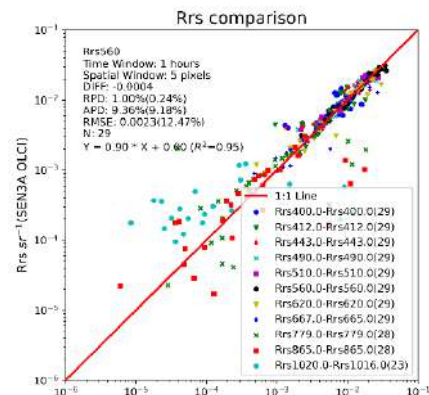


(1) Validation Activities – Ongoing

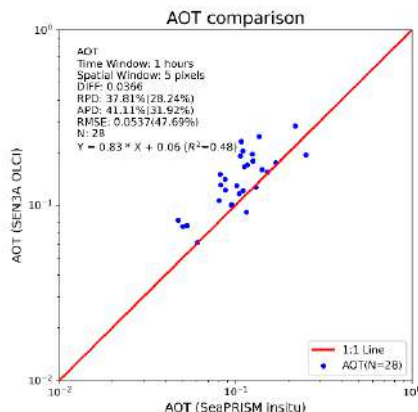
OLCI/Sentinel 3A ---- L2 FR NR
Jan/2020 – Dec/2022

- Venice
- Section-7_Platform
- **Dongtou**
- Muping

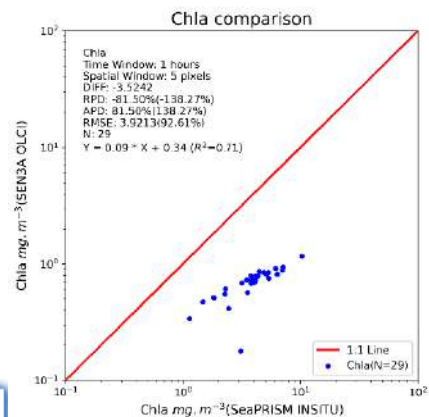
Rrs



AOT



Chla



Product	N	RPD	APD
Rrs412-Rrs412	29	24.3%	37.5%
Rrs443-Rrs443	29	19.8%	26.7%
Rrs490-Rrs490	29	8.5%	13.7%
Rrs560-Rrs560	29	1.0%	9.4%
Rrs665-Rrs667	29	1.3%	19.3%
Rrs865-Rrs865	28	29.2%	77.7%
Rrs1016-Rrs1020	23	385.6%	424.4%
AOT	28	37.8%	41.1%
Chla	29	-81.5%	81.5%

Significantly Over-estimated

Significantly Under-estimated

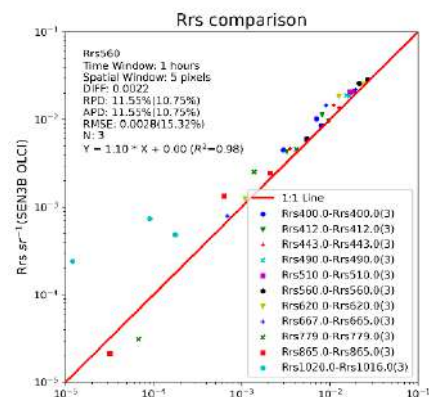


(1) Validation Activities – Ongoing

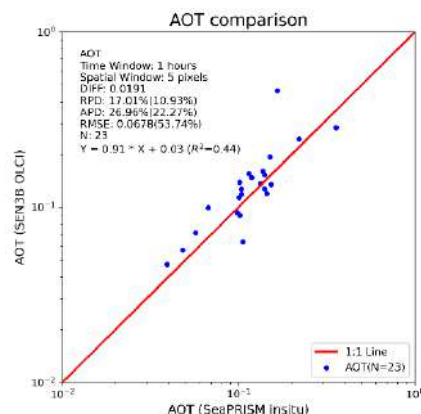
OLCI/Sentinel 3B ---- L2 FR NR
Jan/2020 – Dec/2022

- Venise
- Section-7_Platform
- **Dongtou**
- Muping

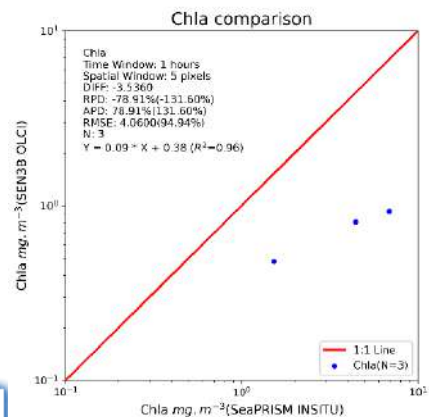
Rrs



AOT



Chla



Product	N	RPD	APD
Rrs412-Rrs412	3	24.2%	24.2%
Rrs443-Rrs443	3	23.1%	23.1%
Rrs490-Rrs490	3	14.8%	14.8%
Rrs560-Rrs560	3	11.6%	11.6%
Rrs665-Rrs667	3	29.0%	29.0%
Rrs865-Rrs865	3	31.6%	53.7%
Rrs1016-Rrs1020	3	930.5%	930.5%
AOT	23	17.0%	27.0%
Chla	3	-78.9%	78.9%

Significantly Over-estimated

Significantly Under-estimated

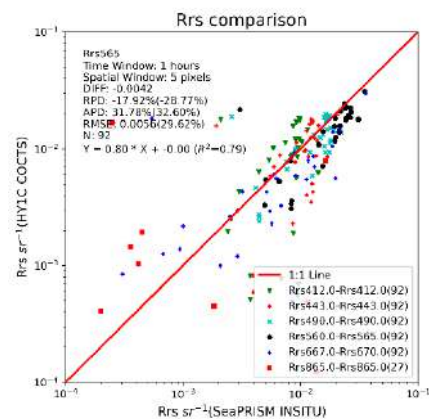


(1) Validation Activities – Ongoing

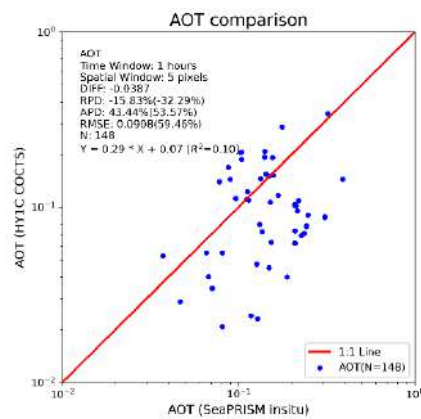
COCTS/Haiyang 1C ---- L2A
Jan/2020 – Dec/2022

- Venise
- Section-7_Platform
- **Dongtou**
- **Muping**

Rrs



AOT



Product	N	RPD	APD
Rrs412-Rrs412	24	15.7%	54.5%
Rrs443-Rrs443	24	-3.5%	35.4%
Rrs490-Rrs490	24	-8.7%	28.1%
Rrs565-Rrs551	24	-17.9%	31.8%
Rrs670-Rrs667	24	23.9%	83.1%
AOT	40	-15.8%	43.4%

Chla Not Available

Significantly Over-estimated

Significantly Under-estimated

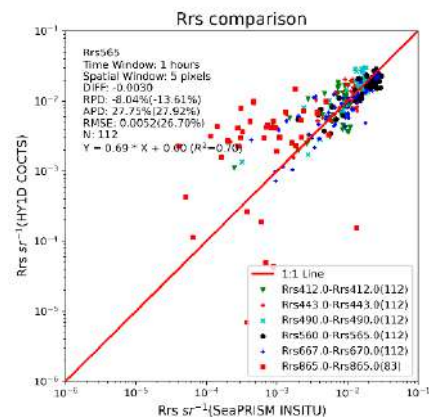


(1) Validation Activities – Ongoing

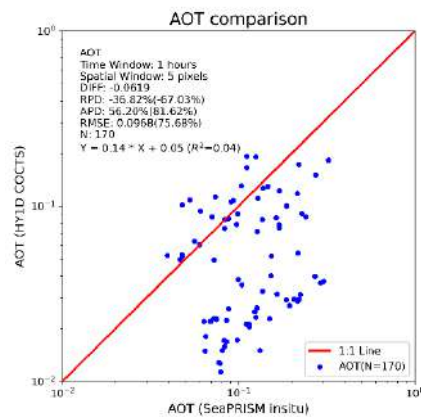
COCTS/Haiyang 1D ---- L2A
Jan/2020 – Dec/2022

- Venise
- Section-7_Platform
- **Dongtou**
- **Muping**

Rrs



AOT



Product	N	RPD	APD
Rrs412-Rrs412	45	29.5%	53.8%
Rrs443-Rrs443	45	37.5%	55.2%
Rrs490-Rrs490	45	22.8%	38.2%
Rrs565-Rrs551	45	-8.0%	27.8%
Rrs670-Rrs667	45	31.5%	62.9%
AOT	72	-36.8%	56.2%

Chla Not Available

Significantly Over-estimated

Significantly Under-estimated

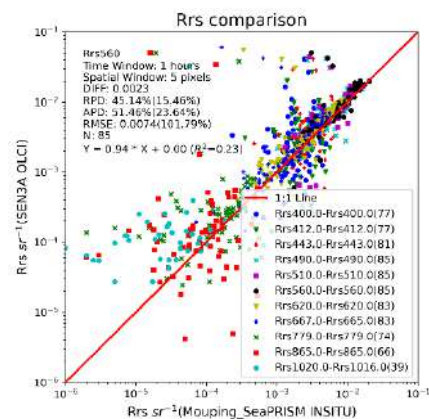


(1) Validation Activities – Ongoing

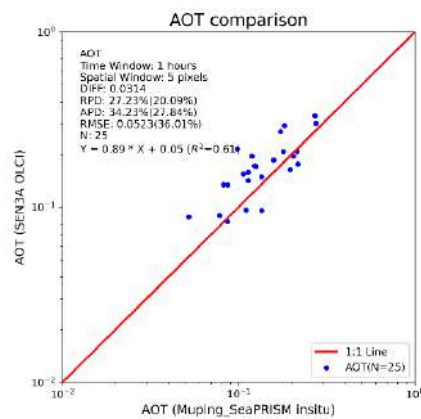
OLCI/Sentinel 3A ---- L2 FR NR
Jan/2020 – Dec/2022

- **Venise**
- **Section-7_Platform**
- **Dongtou**
- **Muping**

Rrs



AOT



Chla Not Available

Product	N	RPD	APD
Rrs412-Rrs412	77	93.4%	122.8%
Rrs443-Rrs443	81	74.6%	93.0%
Rrs490-Rrs490	85	45.2%	58.7%
Rrs560-Rrs560	85	45.1%	51.5%
Rrs665-Rrs667	83	577.0%	591.0%
Rrs865-Rrs865	66	5463.7%	5495.6%
Rrs1016-Rrs1020	39	2257.1%	2262.5%
AOT	25	27.2%	34.2%

Significantly Over-estimated

Significantly Under-estimated

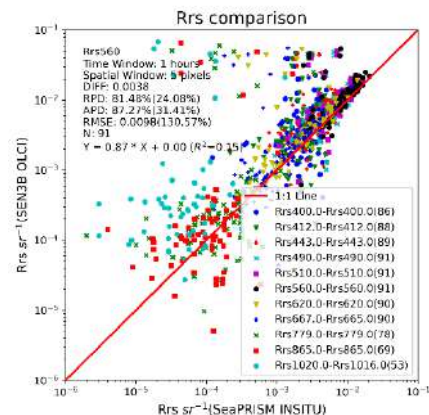


(1) Validation Activities – Ongoing

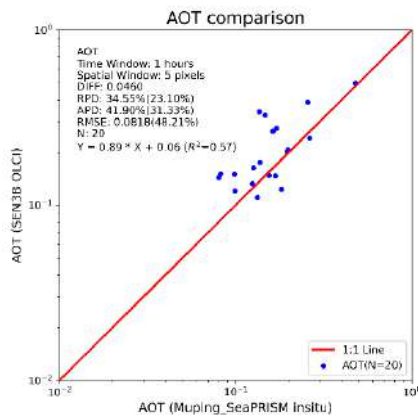
OLCI/Sentinel 3B ---- L2 FR NR
Jan/2020 – Dec/2022

- **Venise**
- **Section-7_Platform**
- **Dongtou**
- **Muping**

Rrs



AOT



Chla Not Available

Product	N	RPD	APD
Rrs412-Rrs412	88	197.5%	219.3%
Rrs443-Rrs443	89	163.6%	176.4%
Rrs490-Rrs490	91	91.5%	101.0%
Rrs560-Rrs560	91	81.5%	87.3%
Rrs665-Rrs667	90	678.2%	693.3%
Rrs865-Rrs865	69	3897.8%	3928.8%
Rrs1016-Rrs1020	53	15557.8%	15562.6%
AOT	20	34.6%	41.9%

Significantly Over-estimated

Significantly Under-estimated

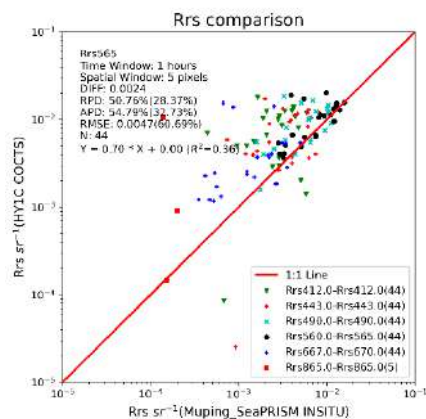


(1) Validation Activities – Ongoing

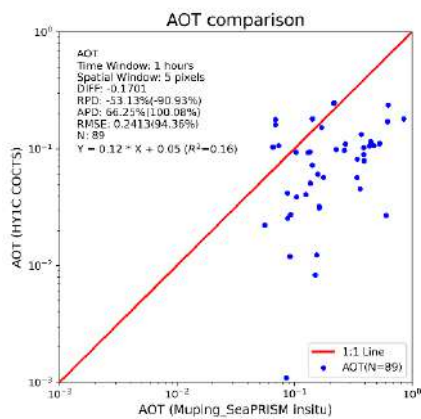
COCTS/Haiyang 1C ---- L2A
Jan/2020 – Dec/2022

- **Venise**
- **Section-7_Platform**
- **Dongtou**
- **Muping**

Rrs



AOT



Product	N	RPD	APD
Rrs412-Rrs412	19	349.3%	365.6%
Rrs443-Rrs443	19	191.1%	205.5%
Rrs490-Rrs490	19	89.1%	94.9%
Rrs565-Rrs551	19	50.8%	54.8%
Rrs670-Rrs667	19	299.6%	304.2%
AOT	37	-53.1%	66.3%

Chla Not Available

Significantly Over-estimated

Significantly Under-estimated

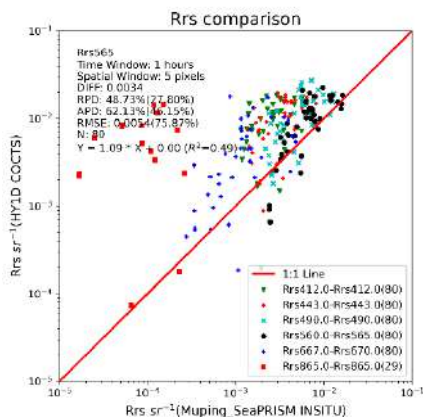


(1) Validation Activities – Ongoing

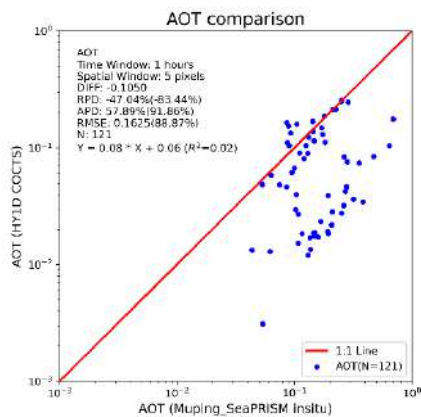
COCTS/Haiyang 1D ---- L2A
Jan/2020 – Dec/2022

- **Venise**
- **Section-7_Platform**
- **Dongtou**
- **Muping**

Rrs



AOT



Product	N	RPD	APD
Rrs412-Rrs412	33	321.0%	328.5%
Rrs443-Rrs443	33	234.3%	239.2%
Rrs490-Rrs490	33	142.5%	147.3%
Rrs565-Rrs551	33	48.7%	62.1%
Rrs670-Rrs667	33	288.7%	296.2%
AOT	44	-47.0%	57.9%

Chla Not Available

Significantly Over-estimated

Significantly Under-estimated



(2) Consistency Check – First Results

OLCI/Sentinel 3A vs MODIS/AQUA

Three-Year (Jan/2020 – Dec/2022)

Product	N	RPD	APD
Rrs412	246,212	32.84%	57.35%
Rrs490	250,396	18.57%	26.49%
Rrs560	250,401	23.61%	29.39%
AOT	250,401	115.55%	121.97%
Chla	249,812	22.77%	36.25%
Kd490	249813	8.01%	20.58%

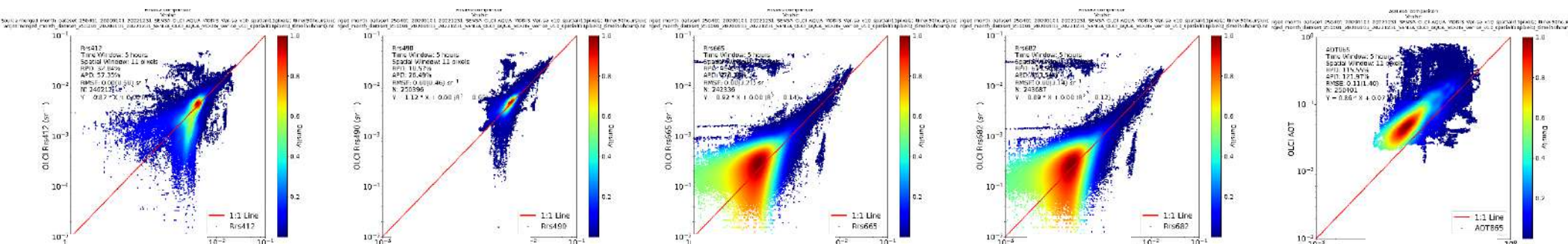
Rrs412

Rrs490

Rrs665

Rrs682

AOT



Rrs443

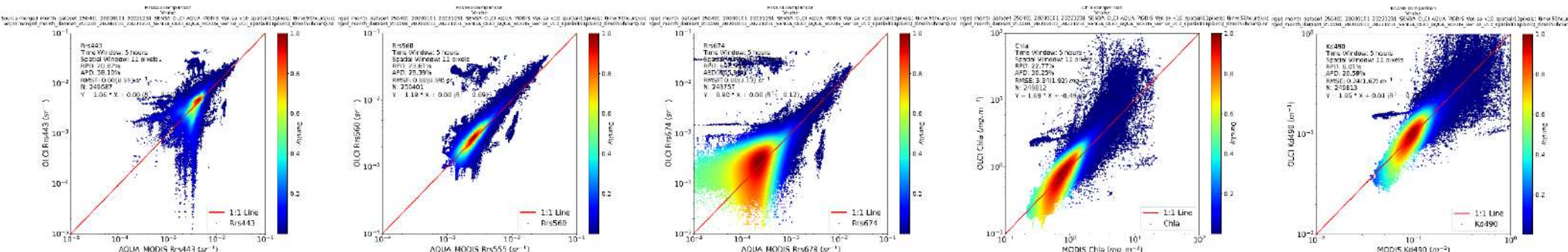
Rrs560

Rrs674

Chla

Kd490

Scatter Plot



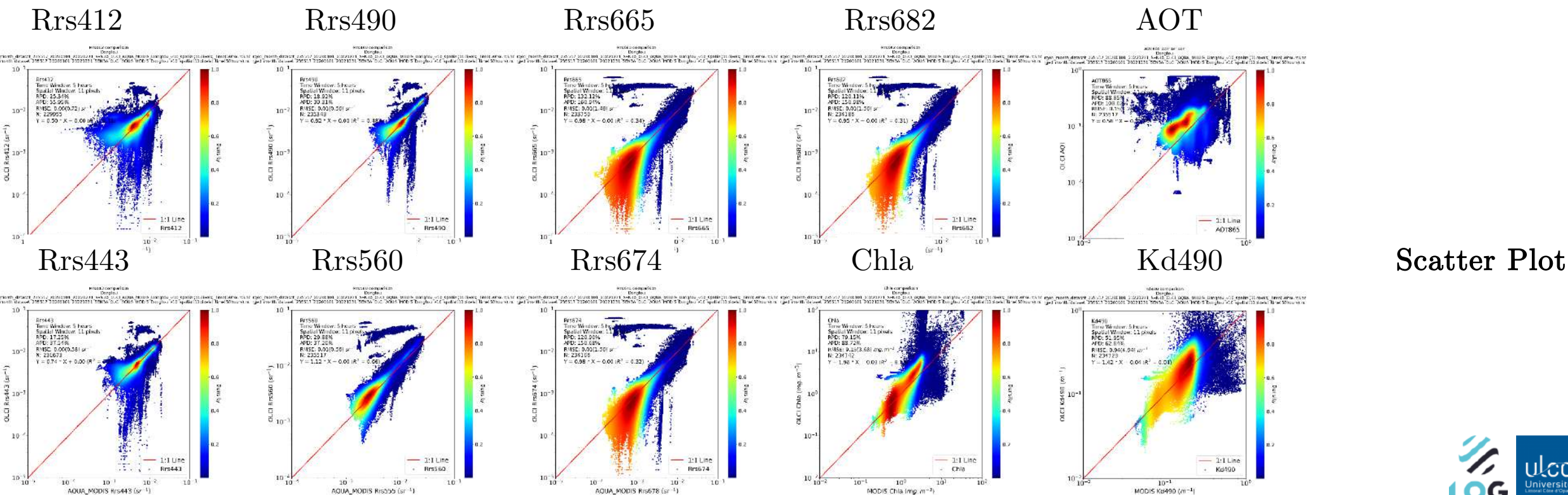


(2) Consistency Check – First Results

OLCI/Sentinel 3A vs MODIS/AQUA

Three-Year (Jan/2020 – Dec/2022)

- Venise
- Section-7_Platform
- Dongtou
- Muping





(2) Consistency Check – First Results

OLCI/Sentinel 3A vs MODIS/AQUA

Three-Year (Jan/2020 – Dec/2022)

Product	N	RPD	APD
Rrs412	229955	25.34%	55.95%
Rrs490	235343	18.92%	30.31%
Rrs560	235517	29.88%	37.20%
AOT	235517	88.85%	108.02%
Chla	234742	79.15%	88.72%
Kd490	234723	51.95%	62.84%

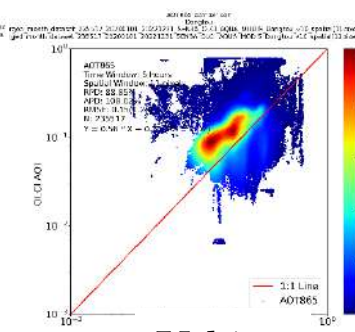
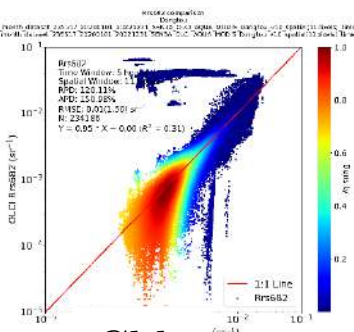
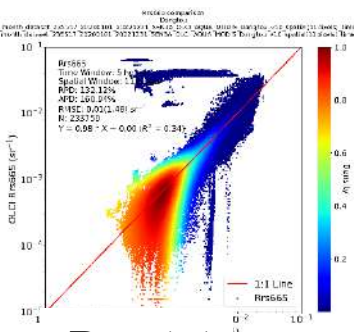
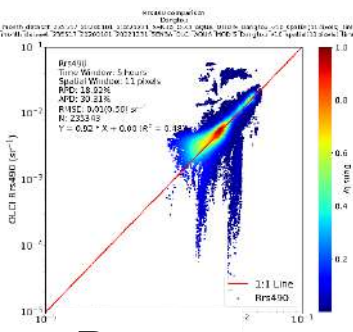
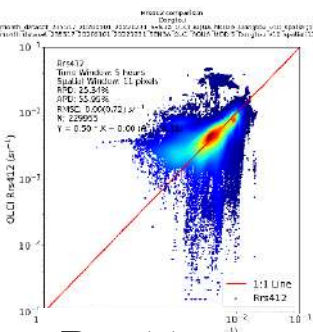
Rrs412

Rrs490

Rrs665

Rrs682

AOT



Rrs443

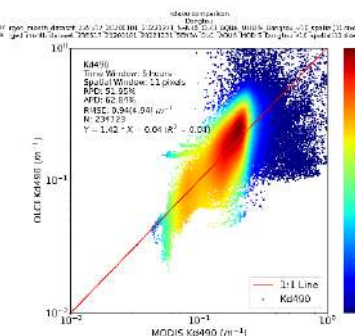
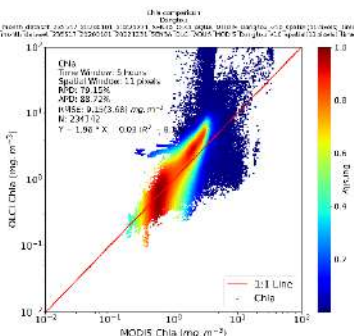
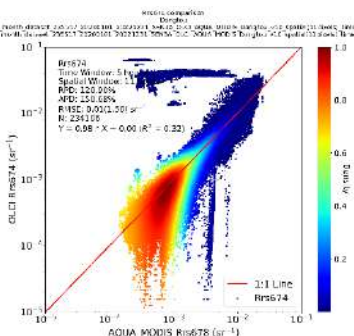
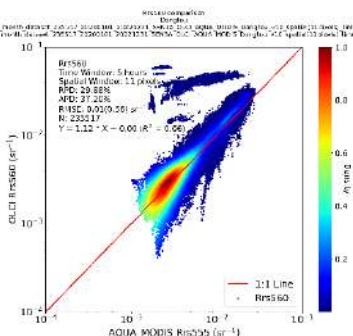
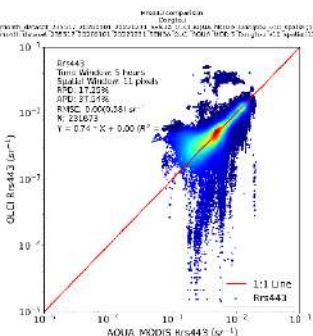
Rrs560

Rrs674

Chla

Kd490

Scatter Plot



Perspectives

- Consistency check will be extended
- To finish difference among various atmospheric correction and bio-optical algorithms
- To develop special products for COCTS/OLCI and/or CZI/MSI in special coastal waters
- To describe the dynamics and quality of Chinese and European coastal waters

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