Using overlapping VIIRS scenes to observe short term variations in dissolved and particulate matter in the North Adriatic Sea

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RATIONALE

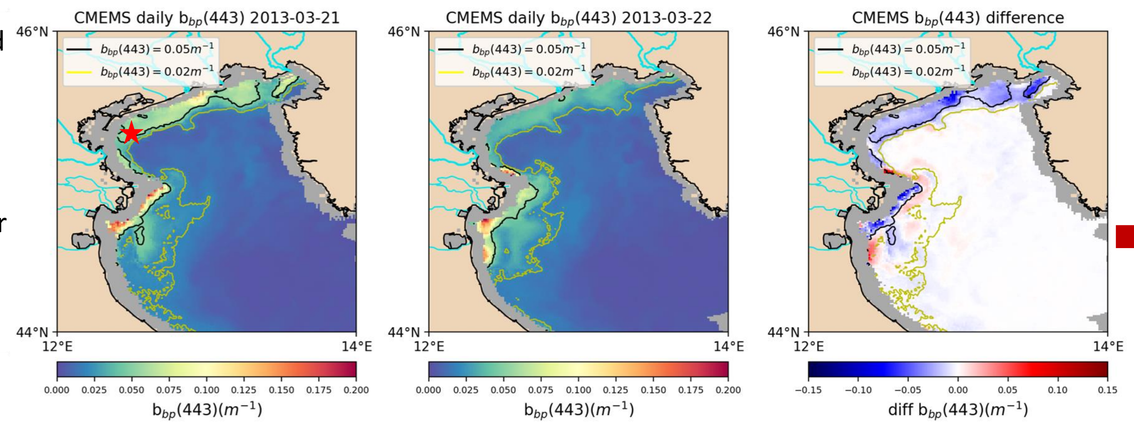
- VIIRS sensor: due to its large swath orbits can overlap during the same day within 1 hour and 42 minutes, with a spatial resolution of 750 m, thus providing multiple observations of an area in the same day (Arnone et al. 2017)
- The aim of the work is to prove the feasibility of VIIRS in adequately capture short time scale biogeochemical processes

INTRODUCTION

- Daily monitoring not suitable for small-scale dynamics in coastal areas
- Coastal pixels masked by Stray-light flag

North Adriatic Sea (NAS):

- Shallow and semi-enclosed regional sea in the Mediterranean Sea
- Optically complex waters
- Bio-optical properties strongly influenced by river inputs and by meteo-marine conditions
- Acqua Alta Oceanographic Tower (AAOT), part of the Aeronet-OC network (red star)



IOPs via Quasi Analytical Algorithm (QAA.v6)

1) $u(\lambda) = \dfrac{-g_0 + \sqrt{{g_0}^2 + 4g_1 r_{rs}(\lambda)}}{2g_1}$

2) If $R_{rs}(671) < 0.0015$:

$\lambda_0 = 551\ nm$

else:

$\lambda_0 = 671\ nm$

$a(\lambda_0)$=F(band ratio)

3) $b_{bp}(\lambda_0) = \dfrac{u(\lambda_0)a(\lambda_0)}{1-u(\lambda_0)} - b_{bw}(\lambda_0)$

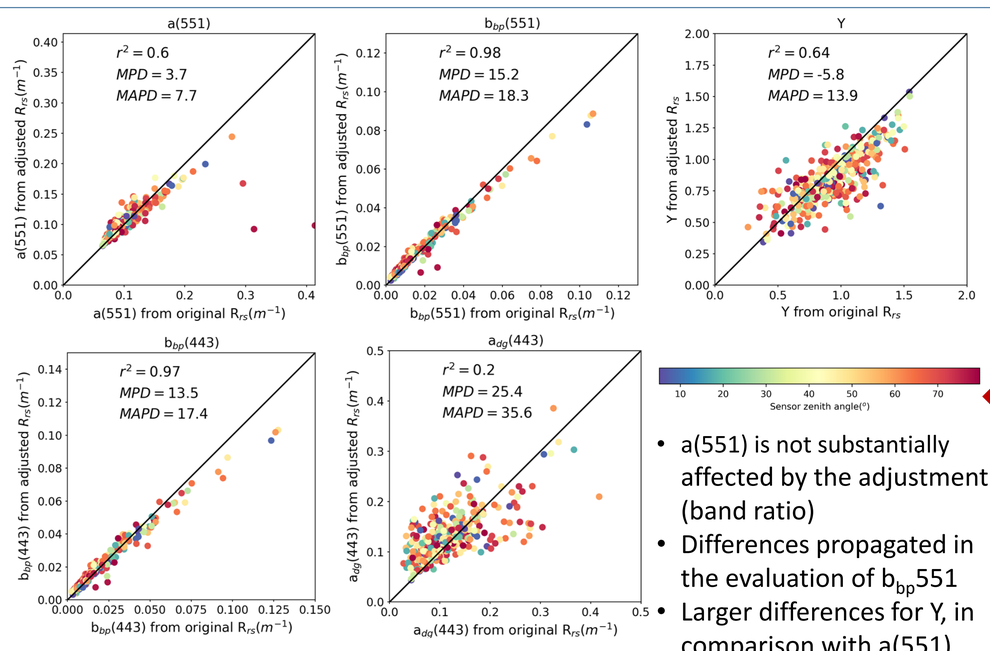
4) $Y = 2.0\{1 - 1.2\exp[-0.9\dfrac{r_{rs}(443)}{r_{rs}(551)}]\}$

5) $b_{bp}(\lambda) = b_{bp}(\lambda_0)(\dfrac{\lambda_0}{\lambda})^Y$

⋮

9) $a_{dg}(443) = H(\ldots)$

$g_0 = 0.089 \qquad g_1 = 0.1245$



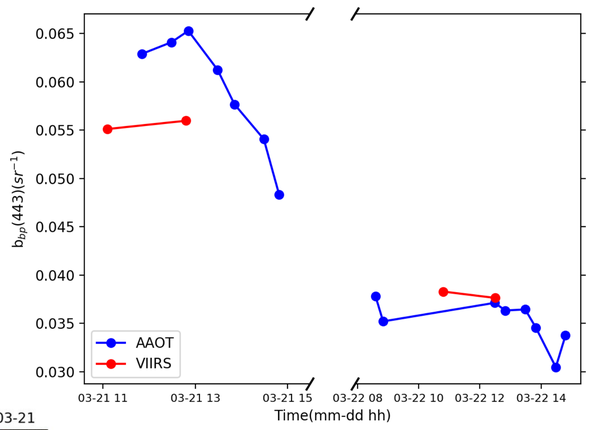
- Differences for $b_{bp}443$ of the same order of the ones for $b_{bp}551$
- $a_{dg}443$ strongly influenced by the adjustment (H depends from large number of uncertainty sources)

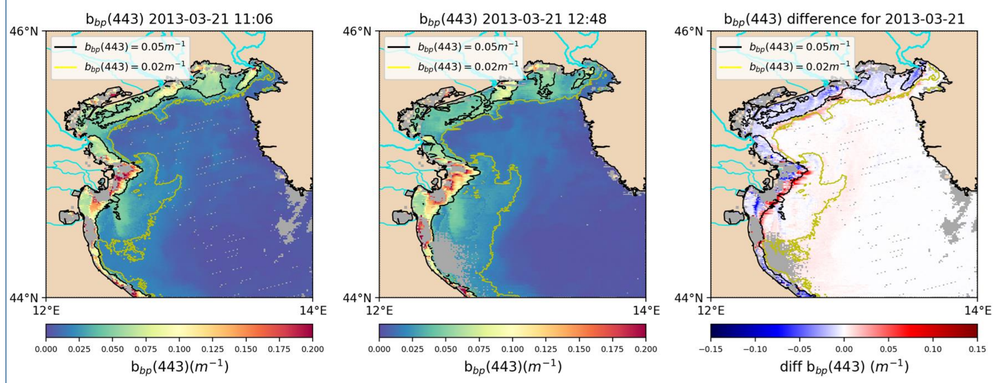
- a(551) is not substantially affected by the adjustment (band ratio)
- Differences propagated in the evaluation of $b_{bp}551$
- Larger differences for Y, in comparison with a(551) (exponential ratio at step 4)

Lee et al. 2002; Lee et al.,2014

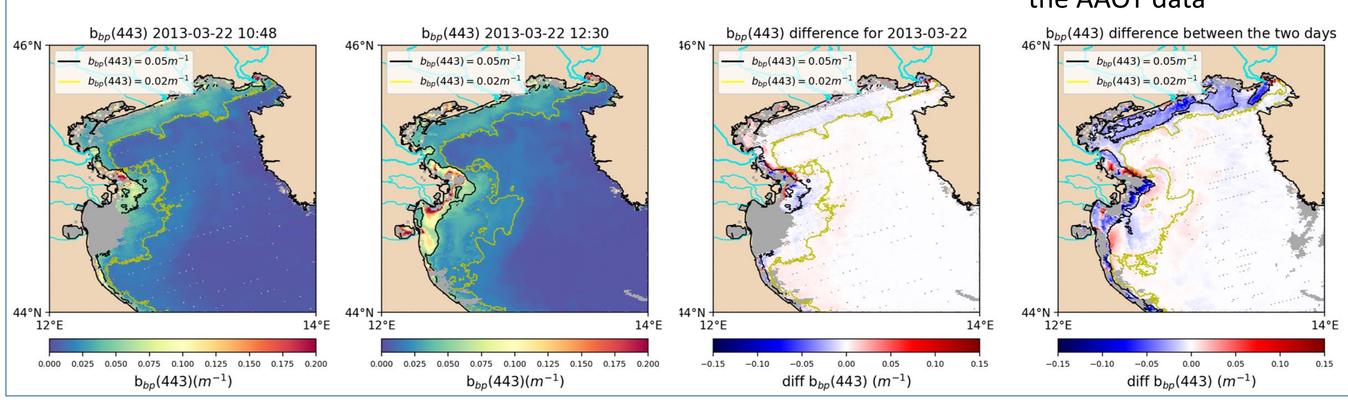
A case study

Day of the VIIRS orbital cycle	Date	Time	Sensor zenith angle (°)
12	2013/03/20	11:06	59.4-66.8
12	2013/03/20	12:48	65.7-71.8
13	2013/03/21	10:48	70.9-75.9
13	2013/03/21	12:30	49.7-59.8



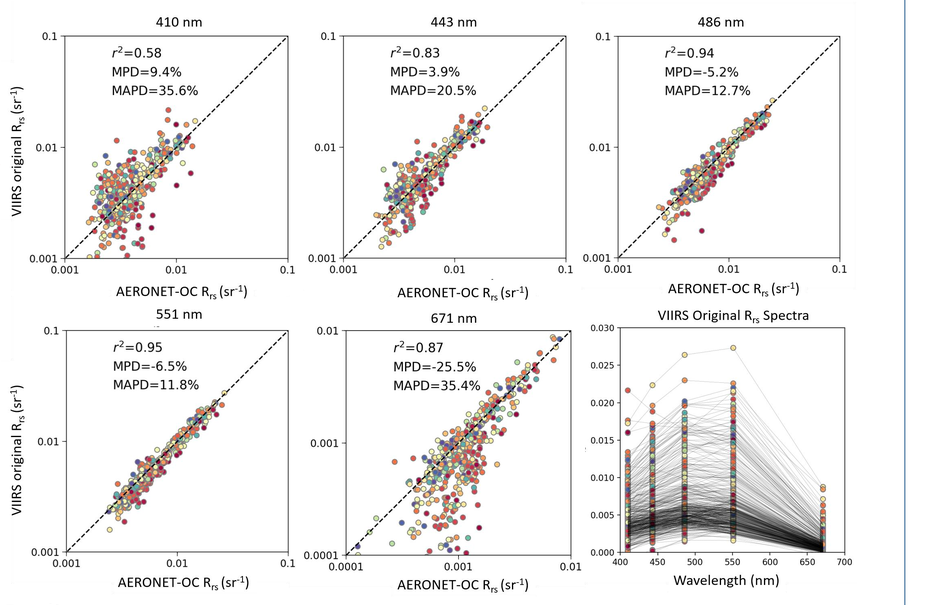


- No SL flag → unmasked coastal areas
- 21 of March 2013:
  - Large reduction of $b_{bp}(443)$ in 1h and 42 minutes on 21 March 2013, in the Northern area
  - Eastward shift of the fronts in Po area.
- Smaller variability on 22 March 2013
- Similar behaviour observed also for the AAOT data



R_{rs} adjustment

In order to minimize systematic differences between in situ (AAOT) and satellite observations (VIIRS), we adjust the VIIRS R_{rs} using a multi-linear regression (MLR) scheme (D'Alimonte et al. , 2008).

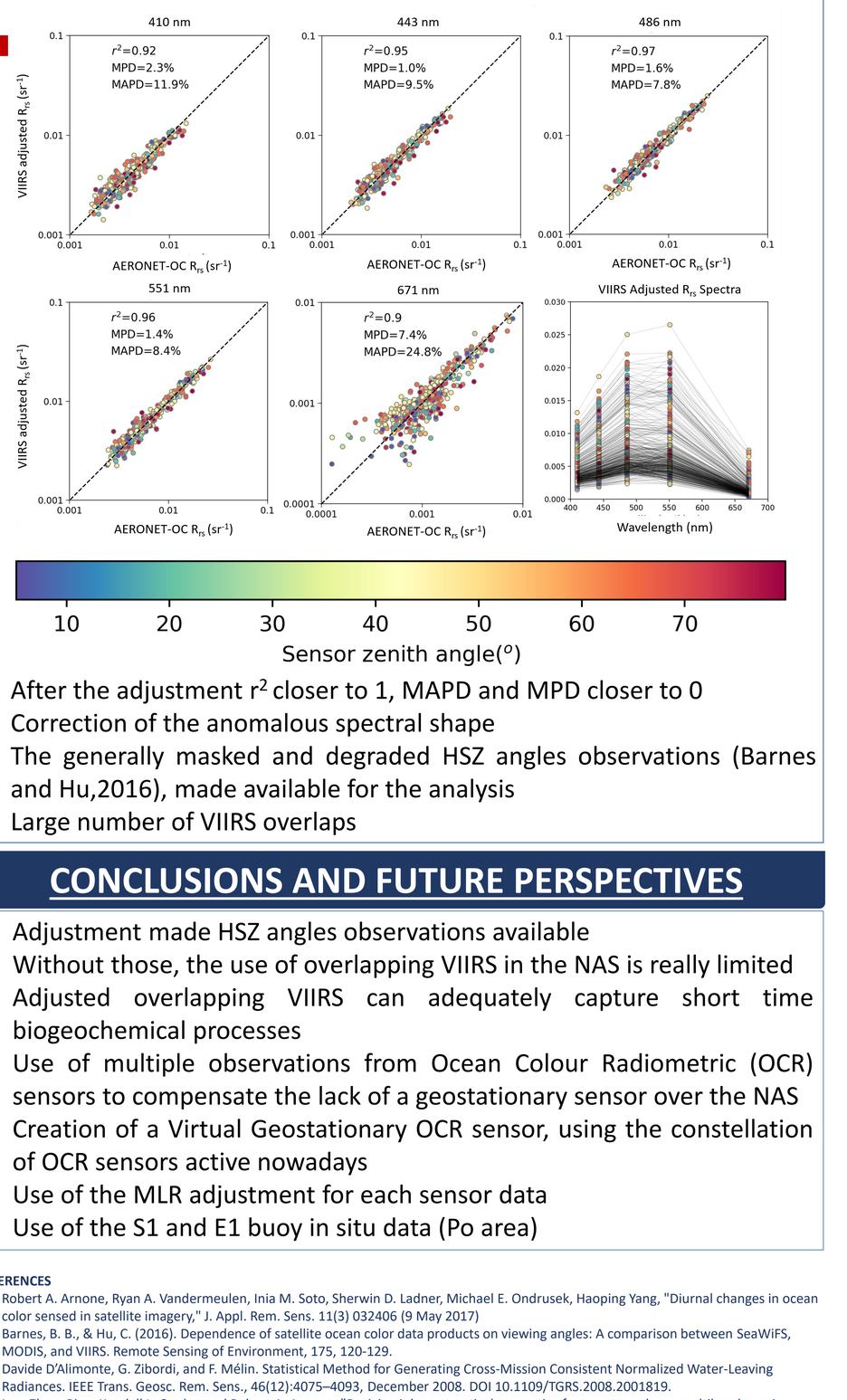


MLR adjustement

- Input vectors:
  - Satellite Rrs
  - Observation geometry
- Coefficients a0 and ai retrieved from MLR between ΔRrs and input vectors

$$f_\lambda^{sat}(\boldsymbol{x}) = a_0^{sat} + \sum_{i=1}^{5} a_i^{sat} x_i$$

$$R_{rs}^{adj}(\lambda) = R_{rs}^{or}(\lambda) + < \Delta R_{rs}(\lambda) >$$



- After the adjustment r^2 closer to 1, MAPD and MPD closer to 0
- Correction of the anomalous spectral shape
- The generally masked and degraded HSZ angles observations (Barnes and Hu,2016), made available for the analysis
- Large number of VIIRS overlaps

CONCLUSIONS AND FUTURE PERSPECTIVES

- Adjustment made HSZ angles observations available
- Without those, the use of overlapping VIIRS in the NAS is really limited
- Adjusted overlapping VIIRS can adequately capture short time biogeochemical processes
- Use of multiple observations from Ocean Colour Radiometric (OCR) sensors to compensate the lack of a geostationary sensor over the NAS
- Creation of a Virtual Geostationary OCR sensor, using the constellation of OCR sensors active nowadays
- Use of the MLR adjustment for each sensor data
- Use of the S1 and E1 buoy in situ data (Po area)

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