Water applications of Landsat and Sentinel-2

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RBINS/DO Nature

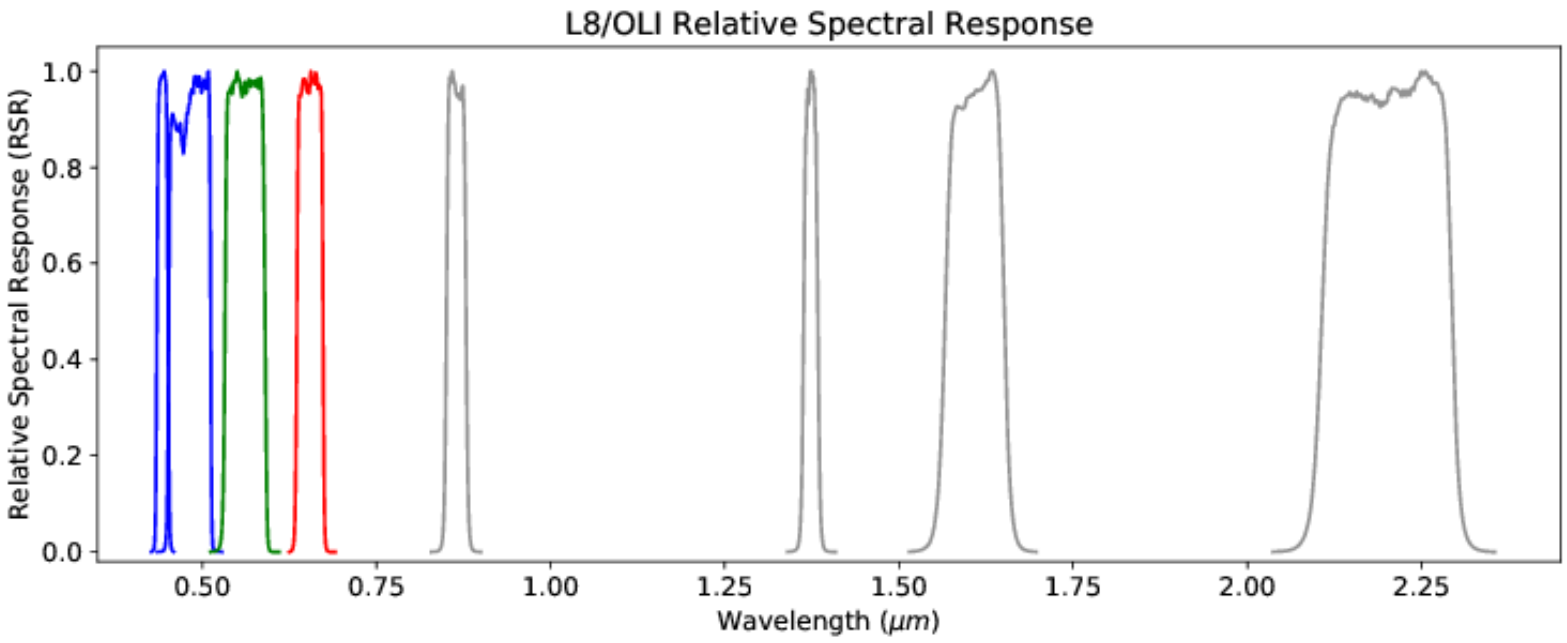
For 2018 IOCCG Summer School

http://odnature.naturalsciences.be/remsem/
http://odnature.naturalsciences.be/remsem/acolite-forum/

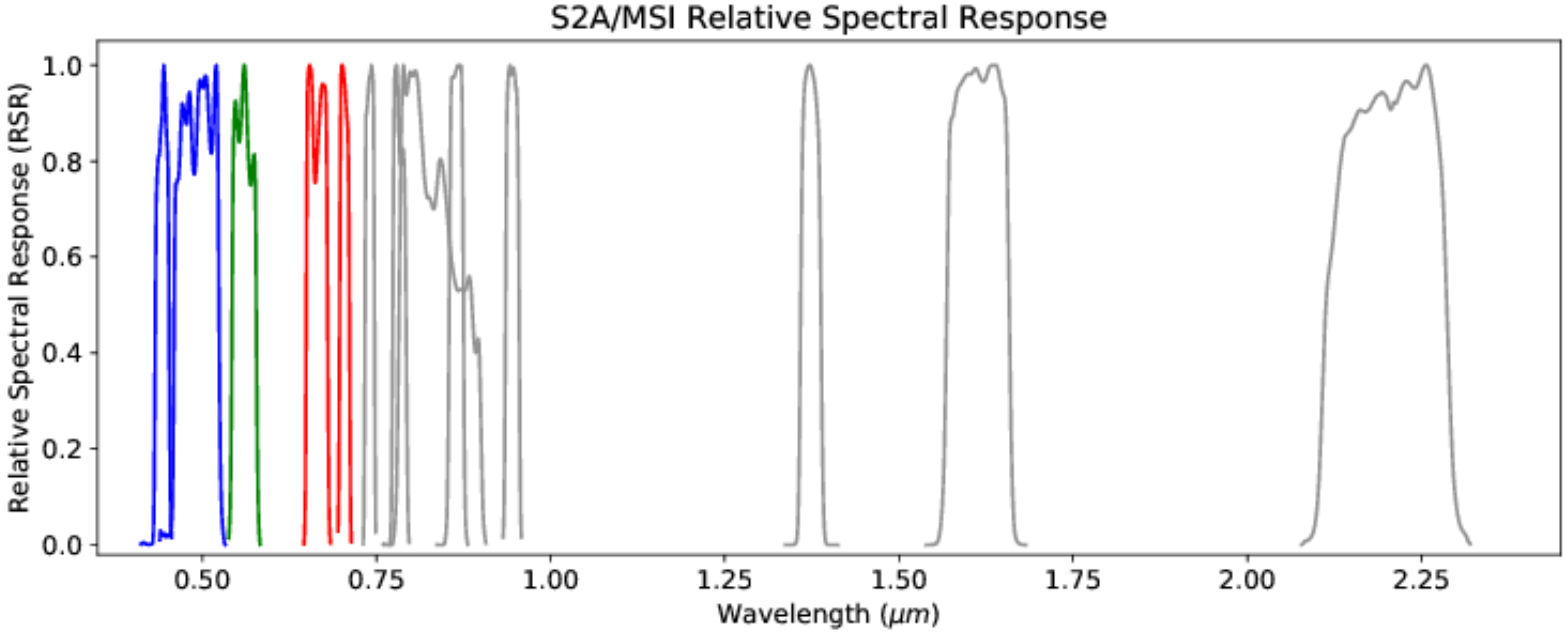
museum

Landsat 8 and Sentinel-2

- Launched in 2013 (L8), 2015 (S2A) and 2017 (S2B)
- High spatial resolution: 30 m (L8) 10-60 m (S2)
- Revisit time of 16 days (L8), 10 days (S2), 5 days with S2A+S2B
  - and overlapping orbits at higher latitudes
- VIS/NIR spectral coverage, including SWIR bands for A/C



Visible **NIR** cirrus **SWIR1** **SWIR2**



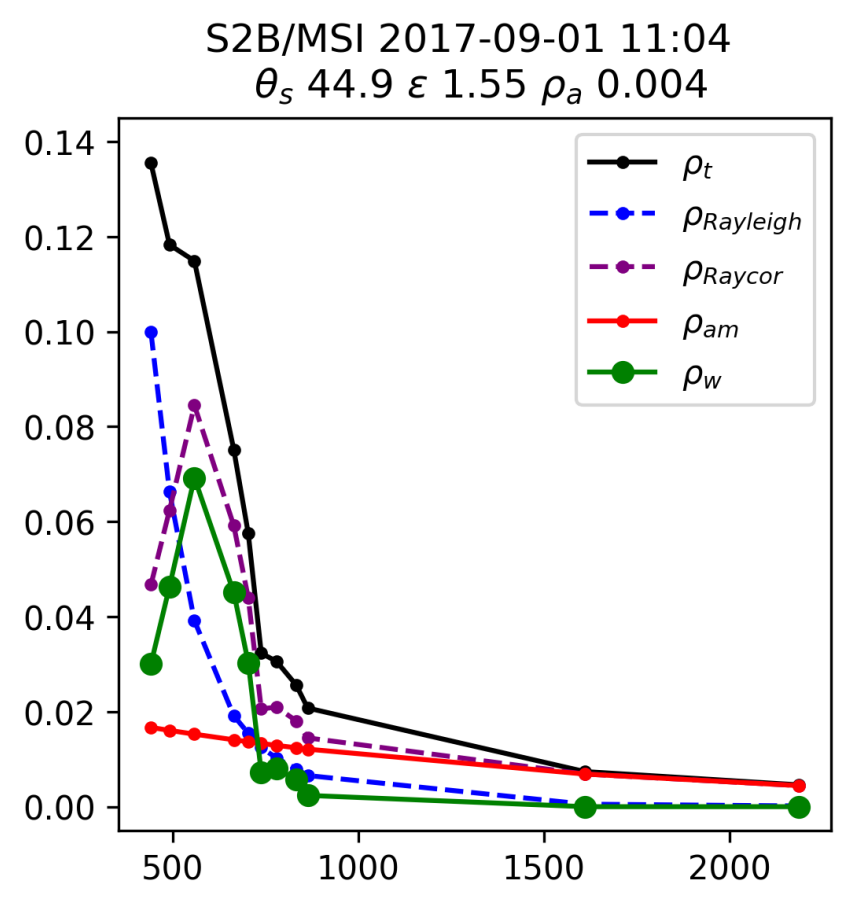
SWIR based atmospheric correction

S2B/MSI 2017-09-01
London Array wind farm

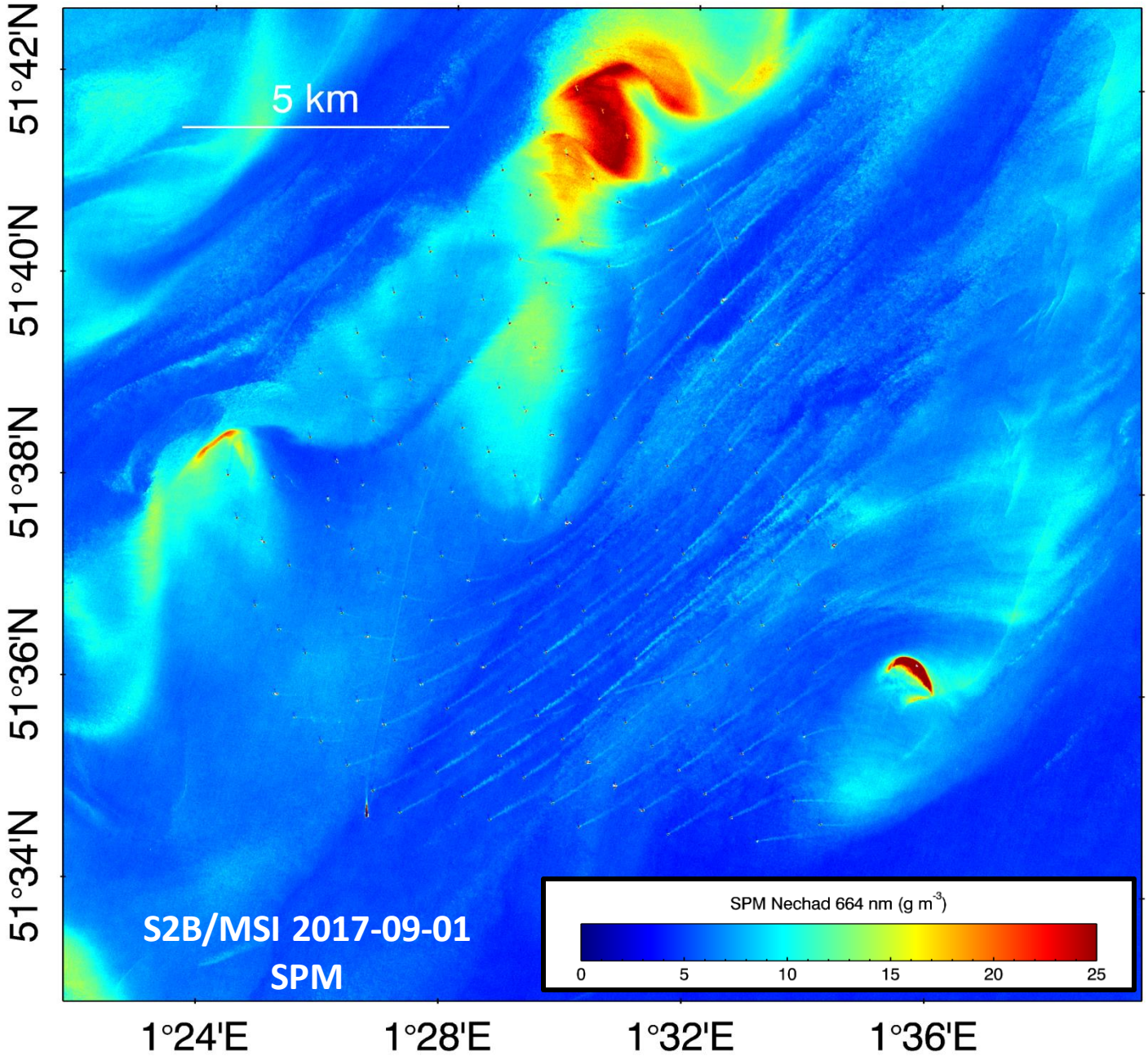
S2B/MSI 2017-09-01

London Array wind farm

EXP

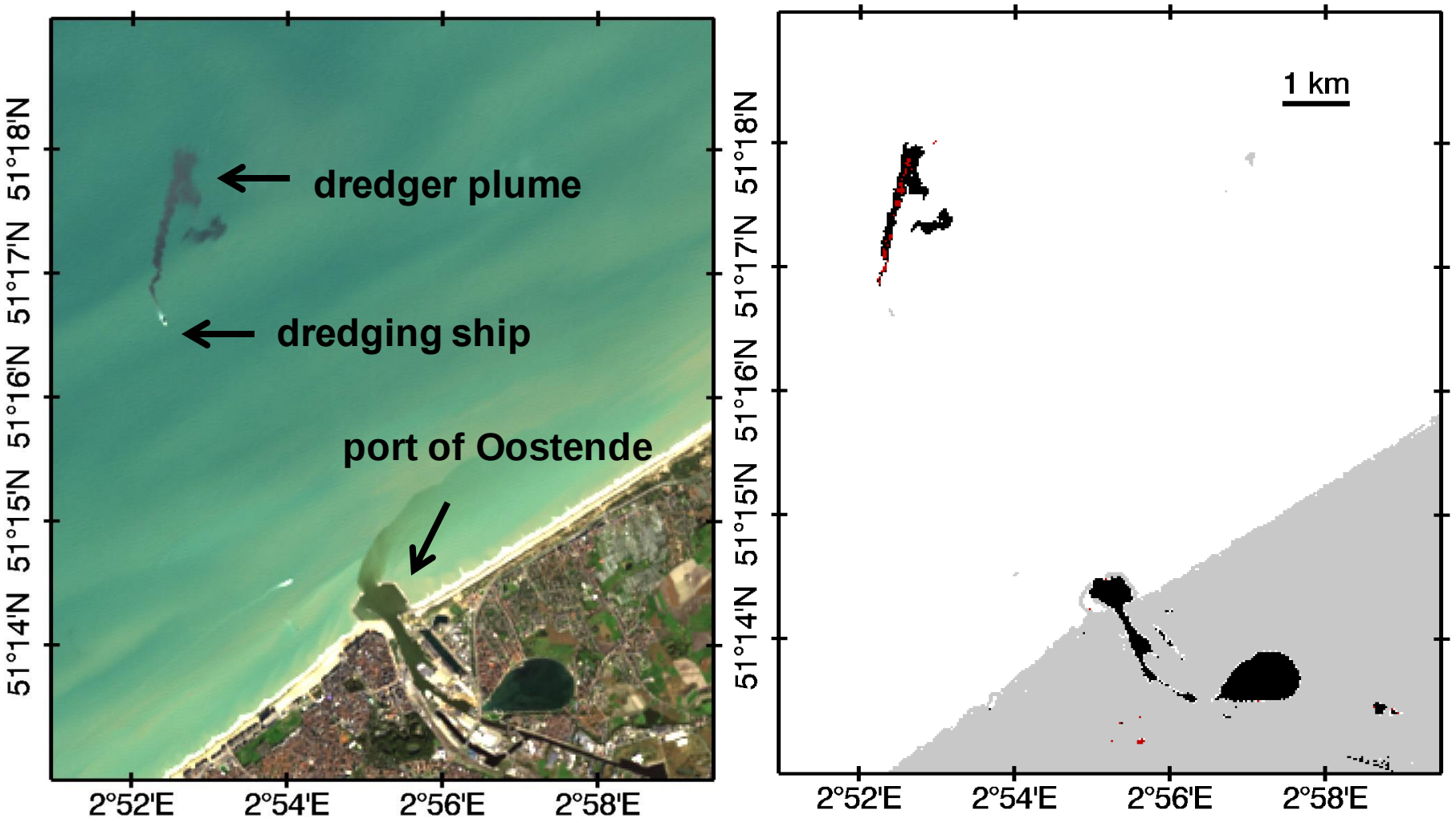


Applications



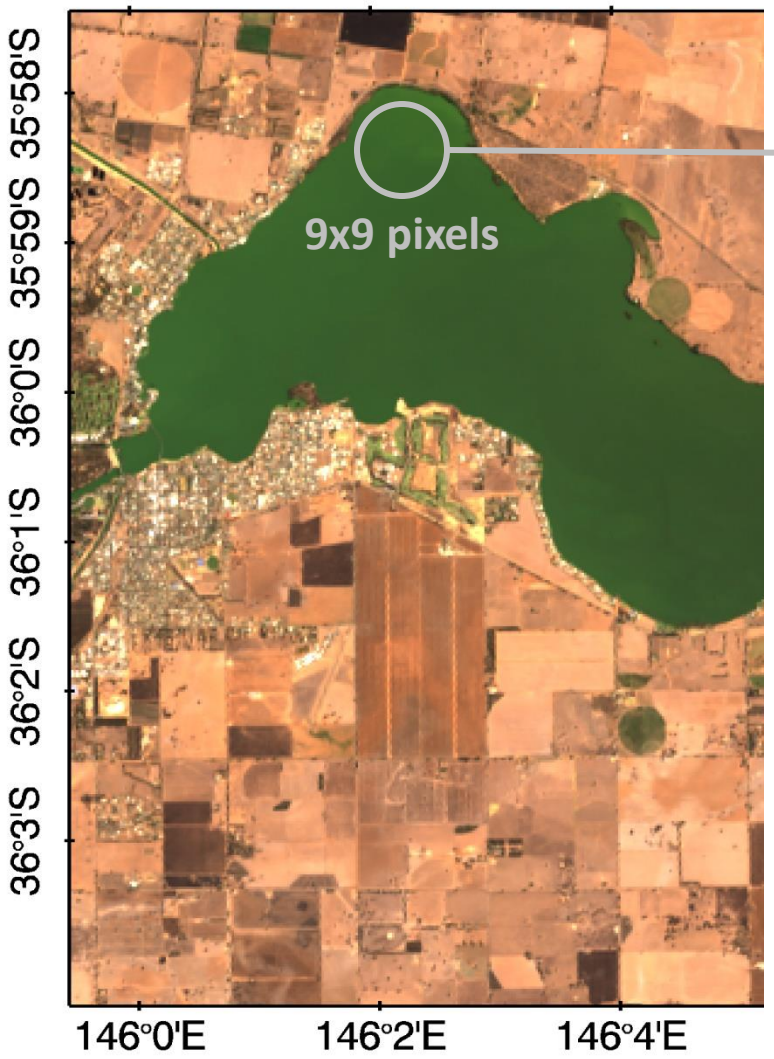
Vanhellemont, Q., Ruddick, K., (2014). **Turbid wakes associated with offshore wind turbines observed with Landsat 8** http://dx.doi.org/10.1016/j.rse.2014.01.009

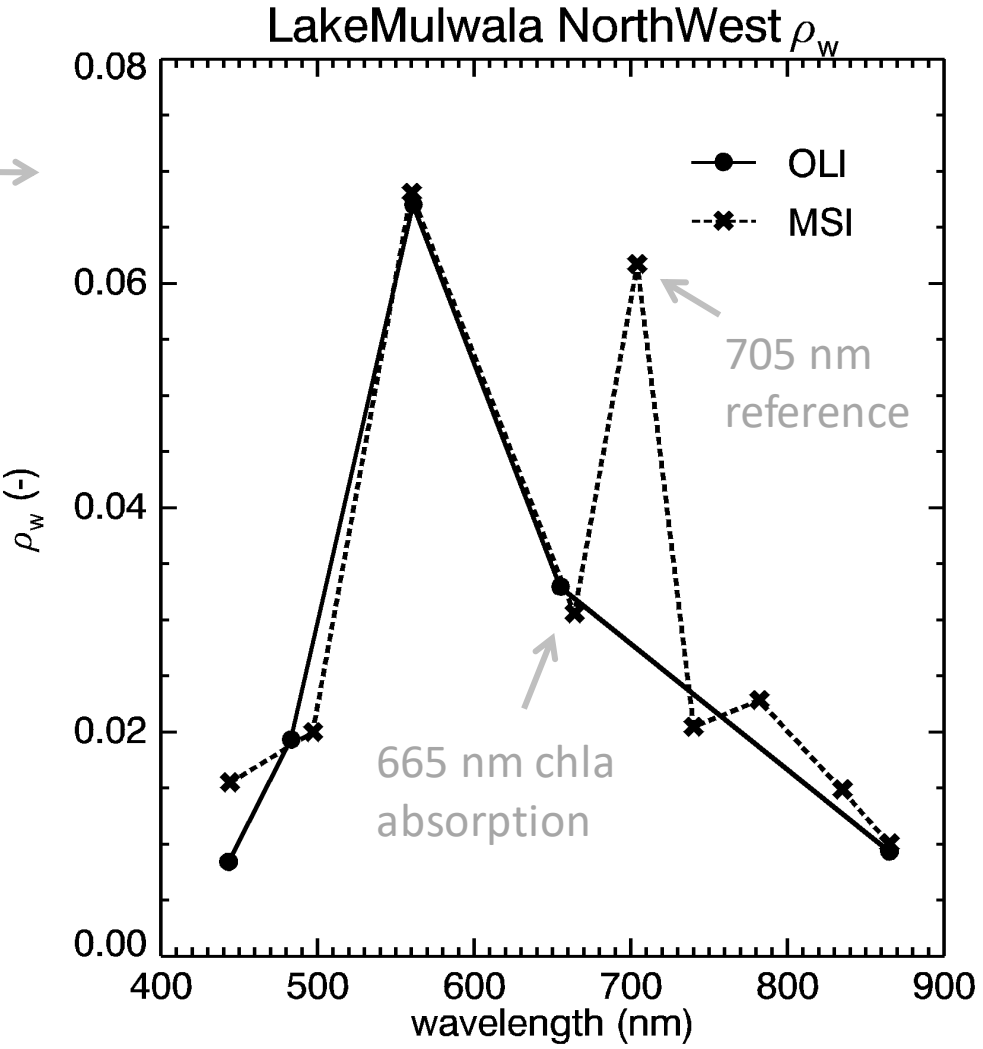
Landsat-8/OLI 2013-10-30



Vanhellemont, Q., Ruddick, K., (2015). **Advantages of high quality SWIR bands for ocean colour processing: examples from Landsat-8.** http://dx.doi.org/10.1016/j.rse.2015.02.007

Cyanobacterial bloom in Lake Mulwala, Australia





Vanhellemont, Q., Ruddick, K., (2016) **ACOLITE for Sentinel-2: Aquatic Applications of MSI imagery** Submitted for the ESA Living Planet 2016 proceedings, ESA Special Publication 740

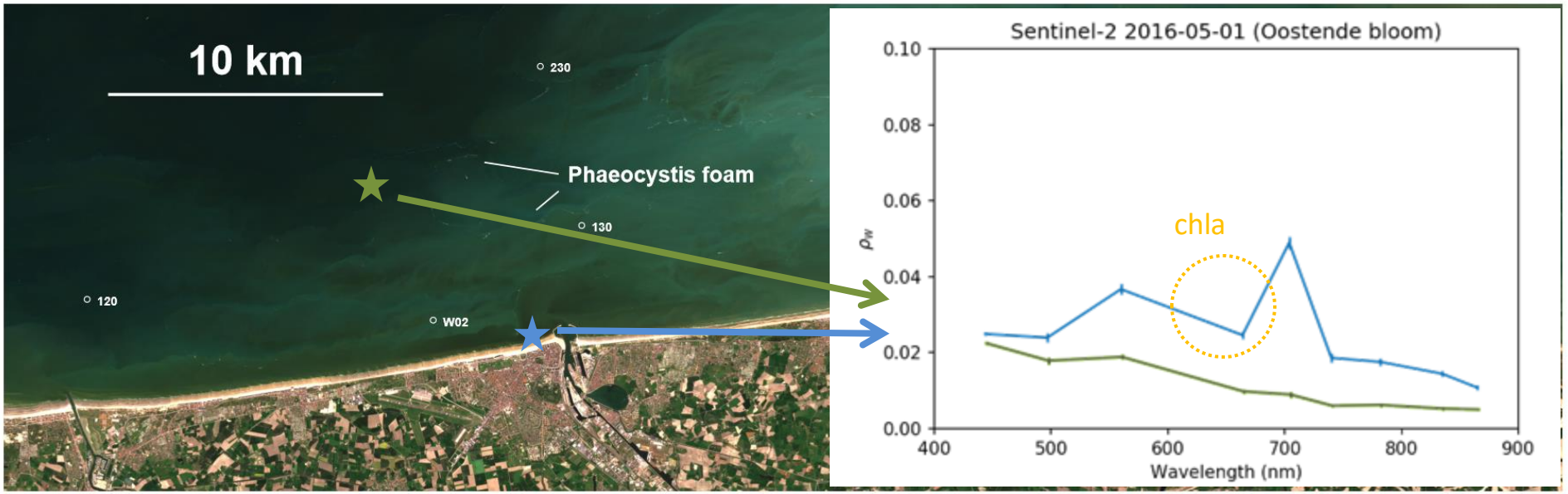


Figure 1 Sentinel-2A/MSI Rayleigh-corrected RGB composite of the Belgian coastal zone on 2016-05-01 (10:53 UTC). Common sampling stations are annotated.

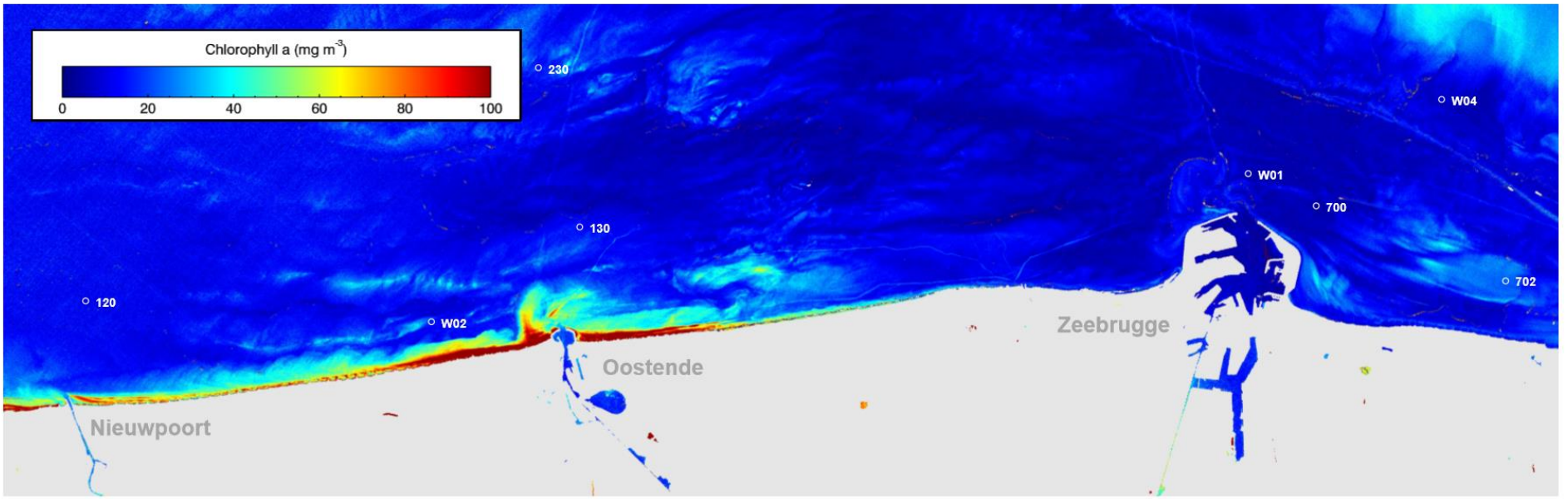


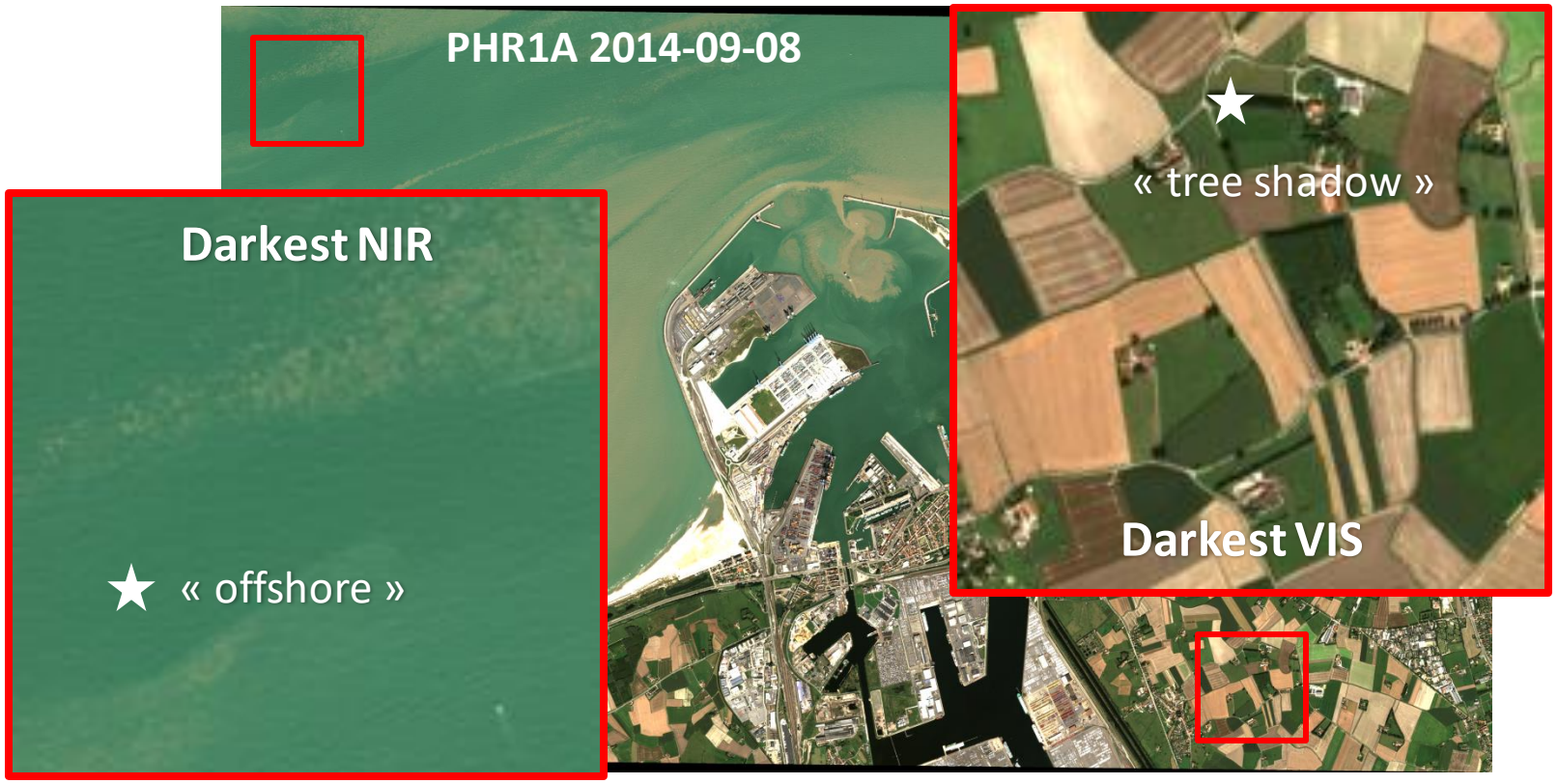
Figure 2 Chlorophyll a concentration derived using the algorithm of Gons (2005), showing an intense bloom between Nieuwpoort and Oostende

Vanhellemont, Q. & Ruddick, K. (2017) **A near-shore phytoplankton bloom in Belgian waters observed from space** VLIZ MSD 2017

Generic atmospheric correction

Vanhellemont, Q., Ruddick K. (submitted). **Atmospheric correction of metre-scale optical satellite data for inland and coastal water applications**

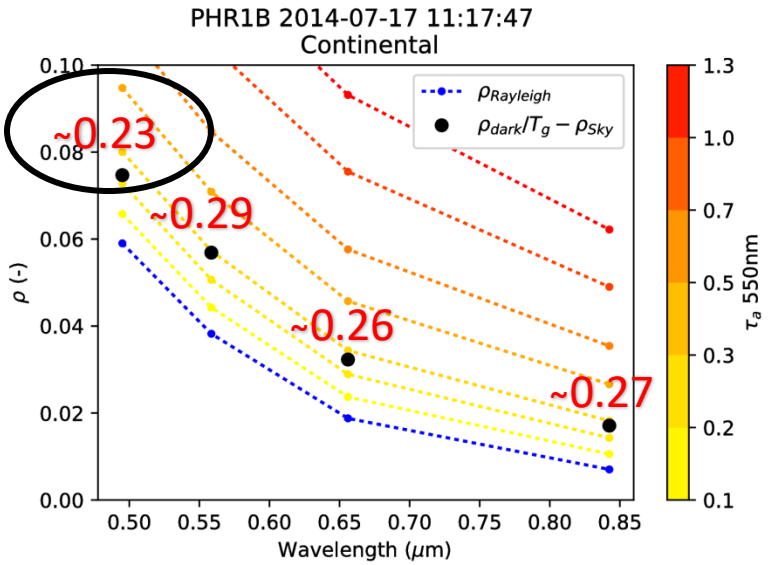
Dark Spectrum Fitting algorithm - Originally developed for metre-scale satellites, which have typically no 'black' bands over water



Vanhellemont, Q., Ruddick K. (submitted). **Atmospheric correction of metre-scale optical satellite data for inland and coastal water applications**

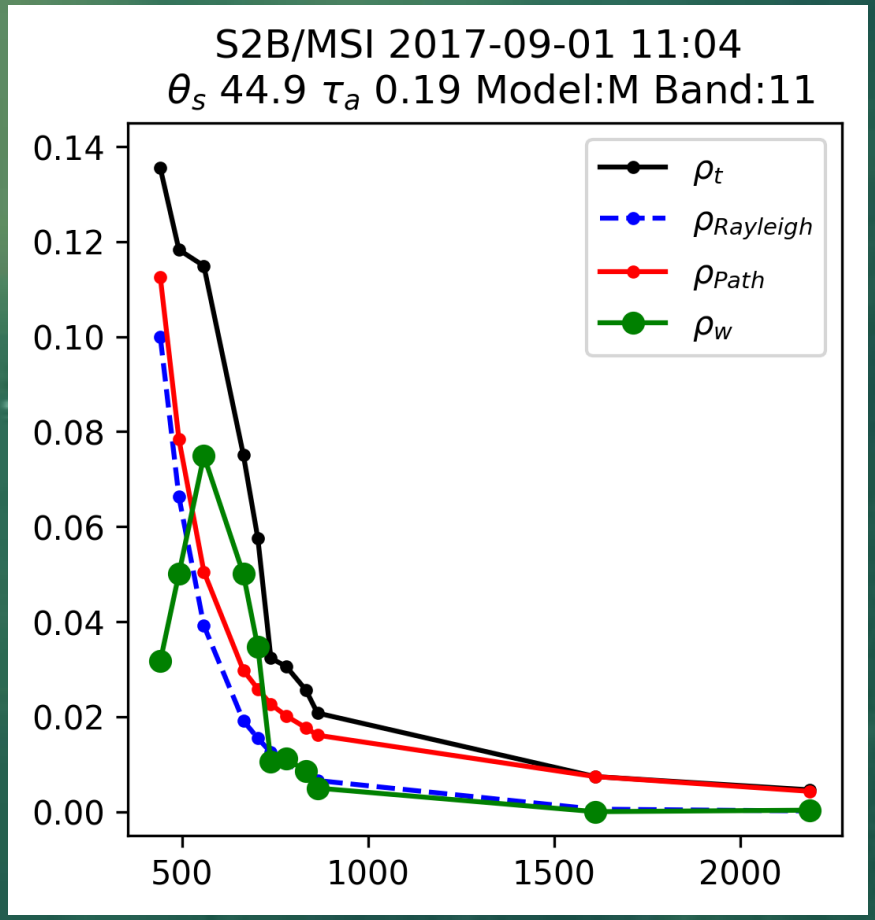
Dark Spectrum Fitting algorithm - Originally developed for metre-scale satellites, which have typically no 'black' bands over water

Continental aerosol: lowest τ_a550 for Blue



Vanhellemont, Q., Ruddick K. (submitted). **Atmospheric correction of metre-scale optical satellite data for inland and coastal water applications**

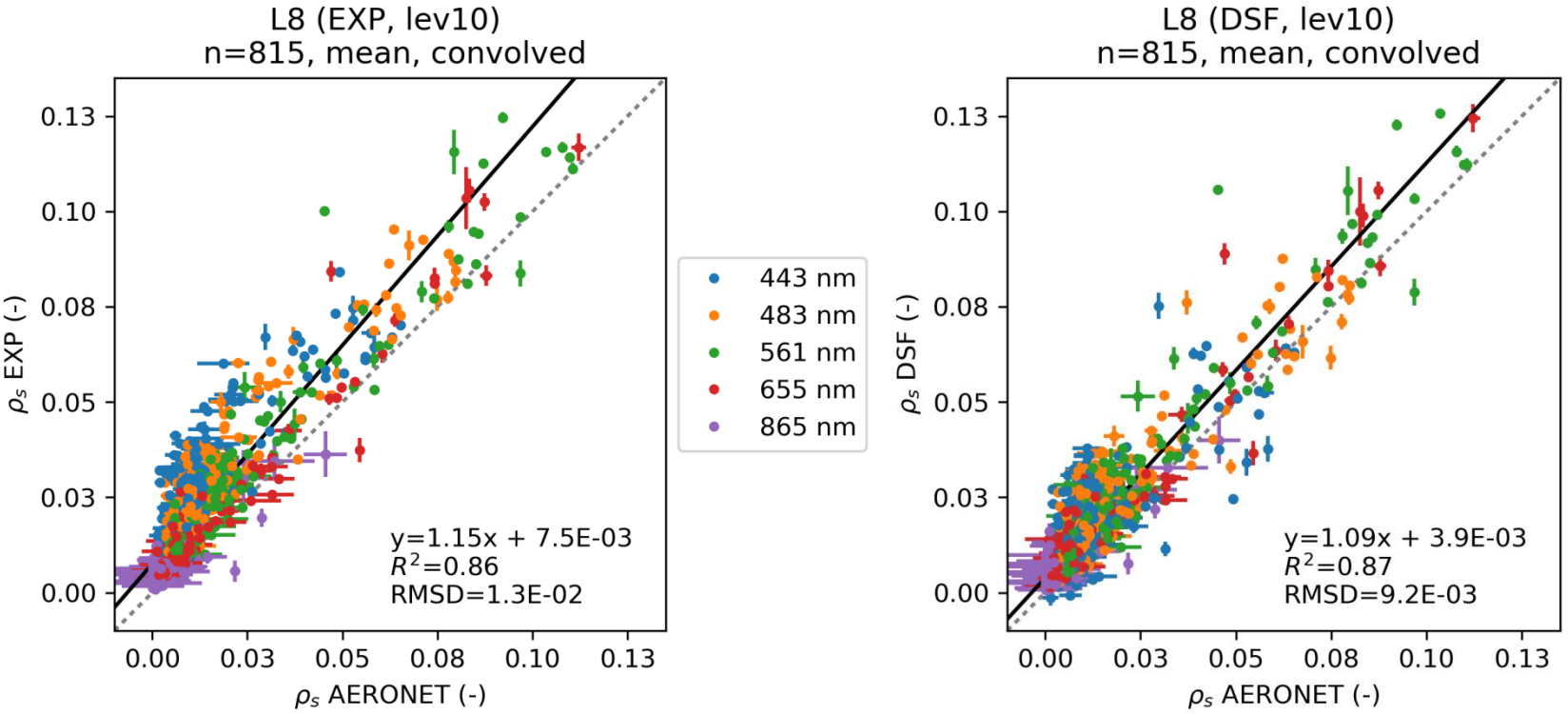
DSF


S2B/MSI 2017-09-01 11:04
θ_s 44.9 τ_a 0.19 Model:M Band:11
ρ_t
$\rho_{Rayleigh}$
ρ_{Path}
ρ_w
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
500
1000
1500
2000

Validation

Vanhellemont, Q., Ruddick, K., (in prep.). **DSF for Landsat and Sentinel-2**

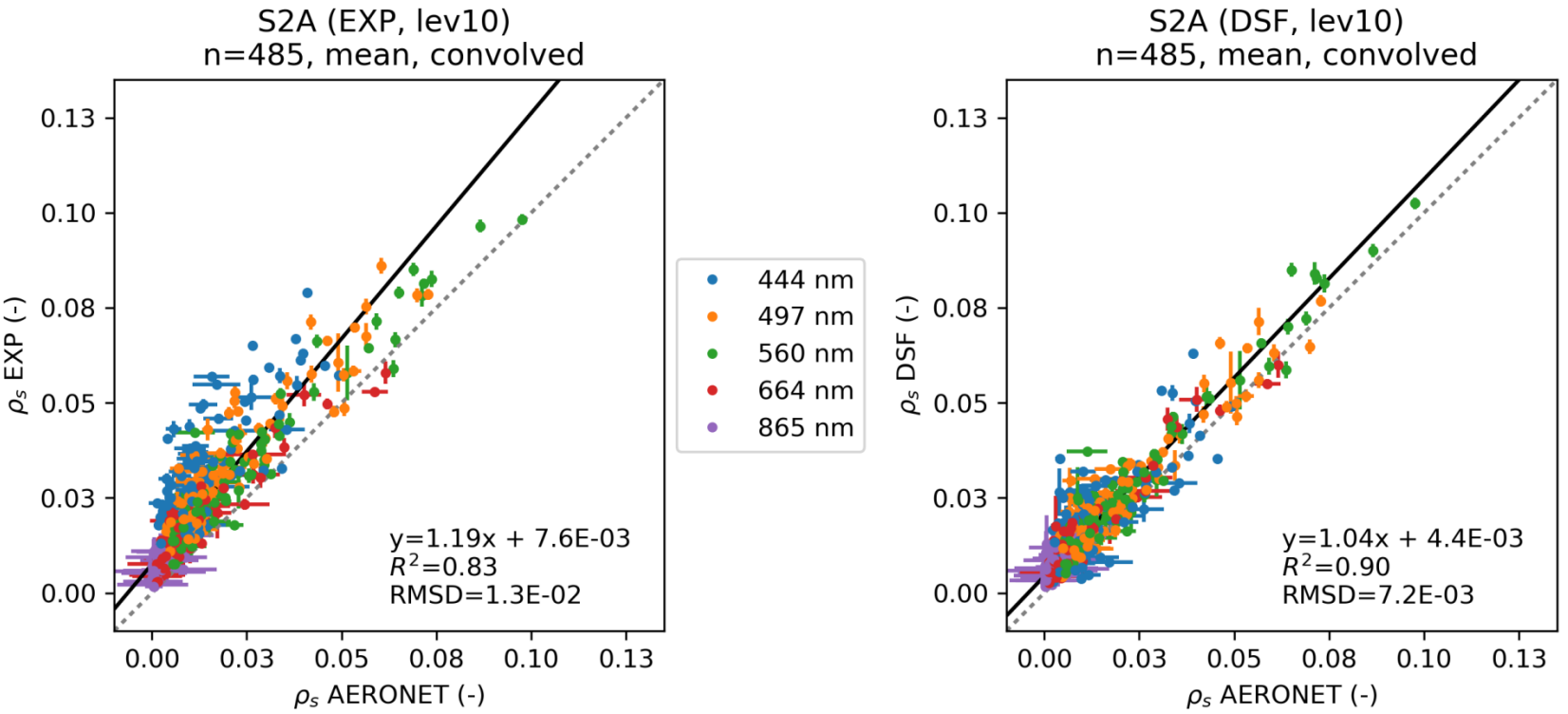
EXP or DSF?



Using all global AERONET-OC sites

Vanhellemont, Q., Ruddick, K., (in prep.). **DSF for Landsat and Sentinel-2**

EXP or DSF?



Using all global AERONET-OC sites

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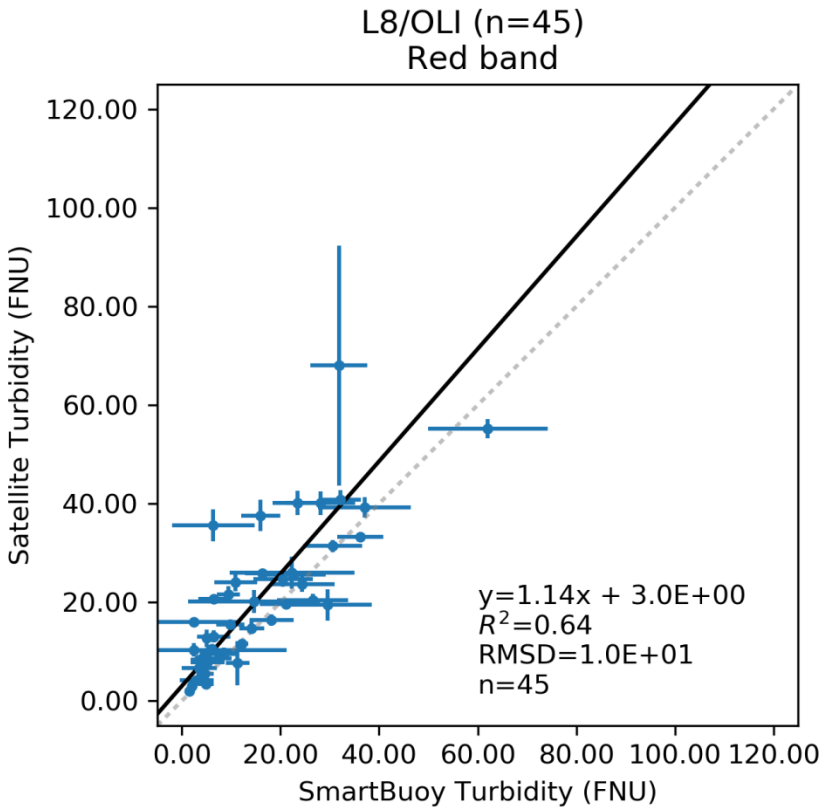
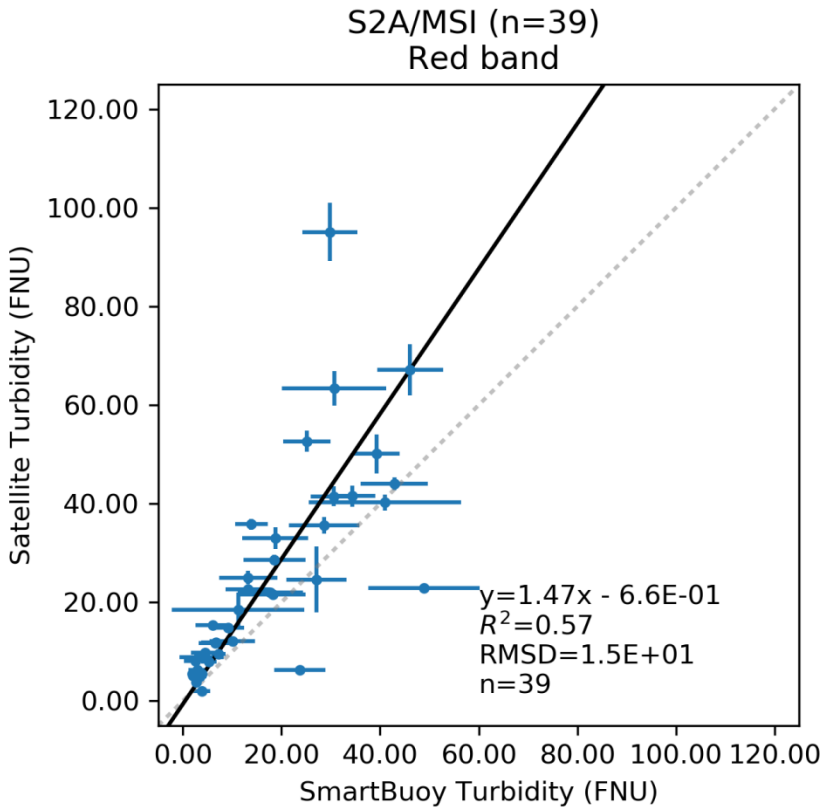
Turbidity





Using CEFAS Warp Smartbuoy data

Vanhellemont, Q., Ruddick, K., (in prep.). **DSF for Landsat and Sentinel-2**

Conclusions

- “New” processes can be observed with high spatial resolution Landsat & Sentinel-2 data, for example sediment transport around ports and offshore constructions, and dredging activities

- Sentinel-2 has a red-edge band, allowing for the estimation of chlorophyll a absorption in the red band, and hence chlorophyll a concentration

- SWIR bands are very useful for atmospheric correction in turbid coastal waters, but may be sensitive to glint and adjacency effects

- Even though the satellites are designed for land applications, accurate coastal and inland water reflectances are obtained using the DSF atmospheric correction algorithm