The use of HICO in the Southern Benguela: Saldanha Bay case study

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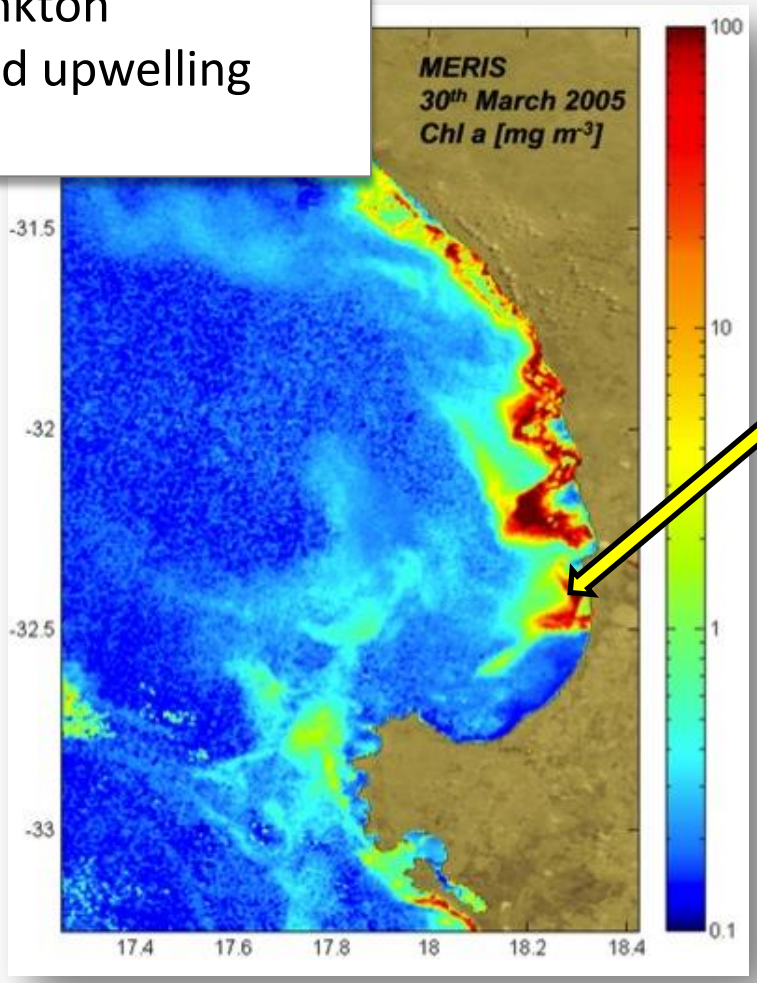
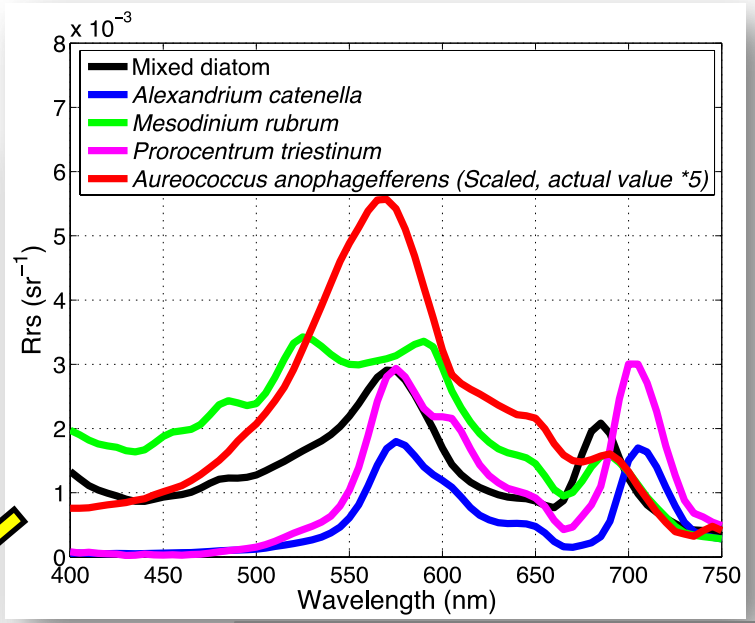
Setting the scene: Southern Benguela

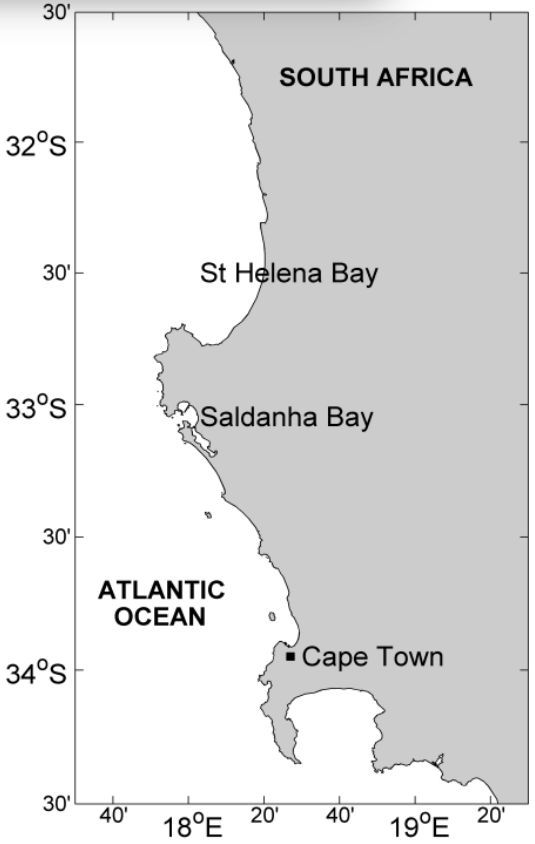
The southern Benguela is a dynamic, productive, phytoplankton dominated upwelling system

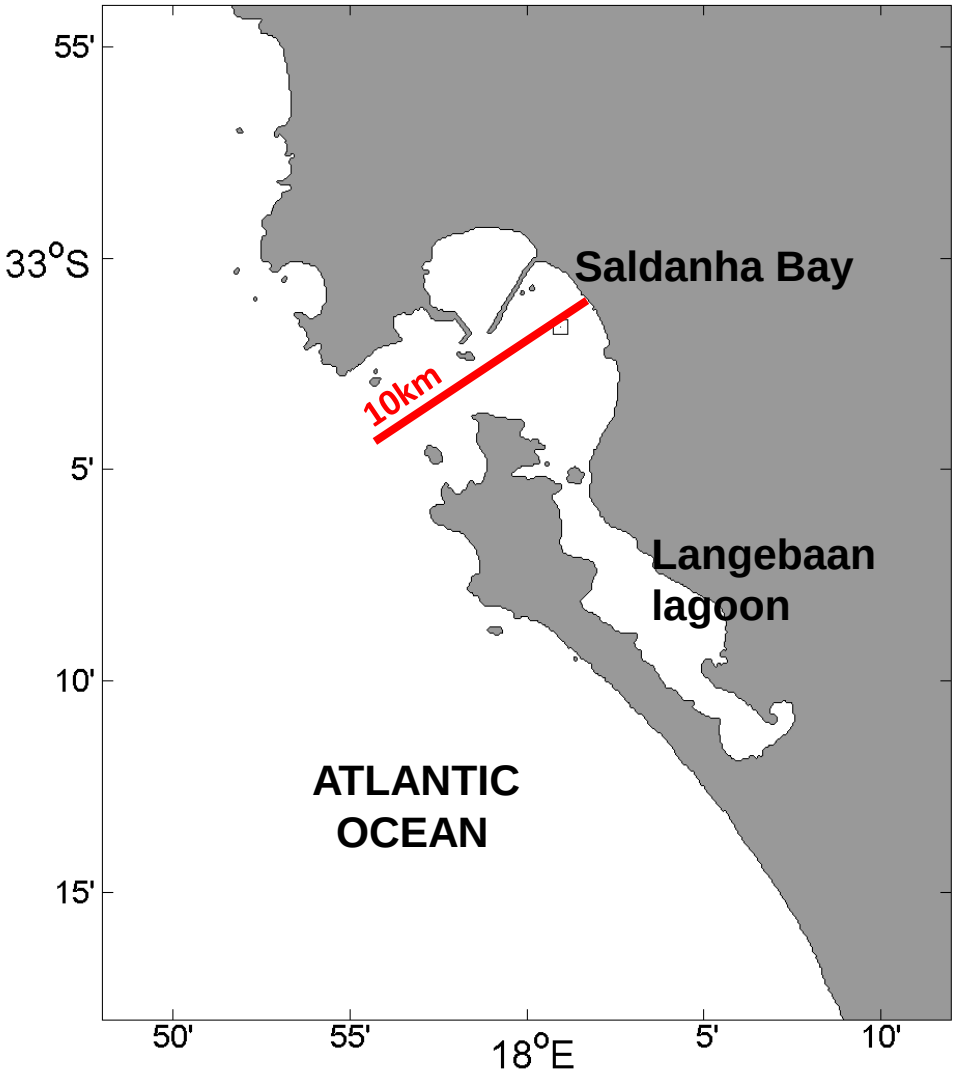




Variety of high biomass blooms in the retentive inshore waters.
(Bernard et al, in press.)

Study location: Saldanha Bay





Importance of Saldanha Bay: Mariculture

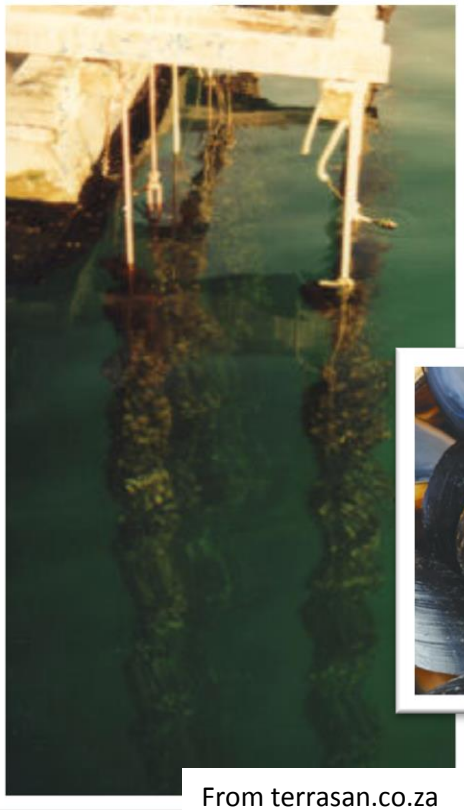
In close proximity to productive Southern Benguela = Filter feeder buffet!

One of four sites used for the culture of Pacific oysters (*Crassostrea gigas*) in South Africa.

From THINKSTOCK

From harvestsa.co.za

Nearly the entire black mussel (*Mytilus galloprovincialis*) industry of South Africa is located in Saldanha Bay



From terrasan.co.za

From nefcorp.co.za

Saldanha Bay phytoplankton dynamics

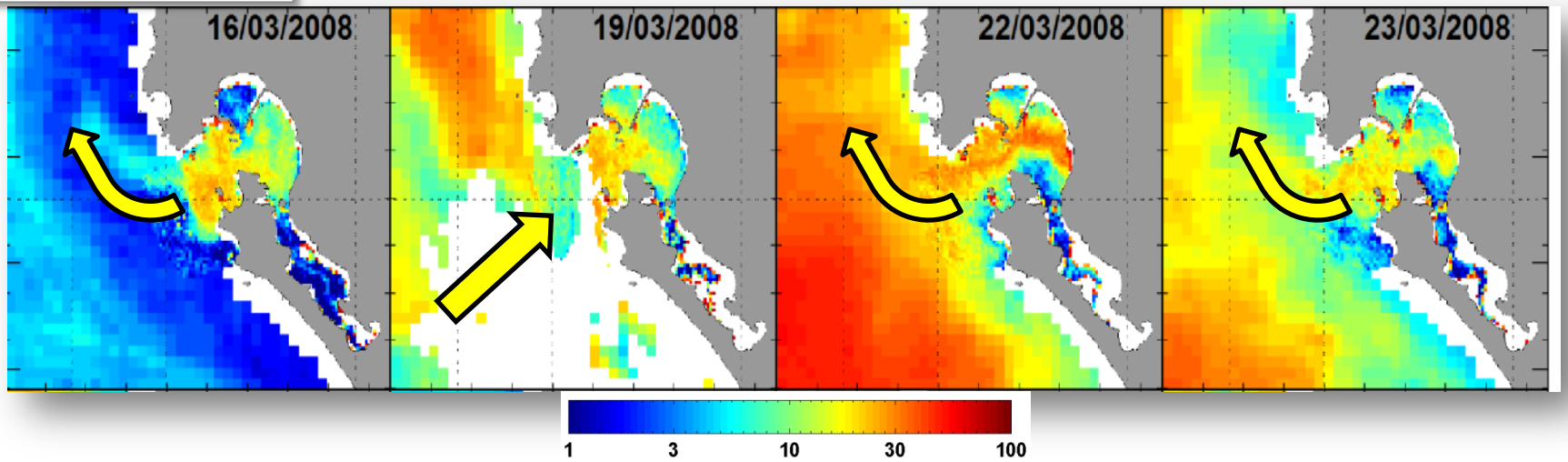
During the upwelling season there is a constant set-up of bay-ocean biomass exchange

⇒ Potential mechanism for the import of harmful algal blooms into Saldanha Bay

Develop strategy for monitoring HABs around Saldanha bay, find best chlorophyll product for the area

⇒ Maximum Peak-height algorithm (MPH, Matthews et al 2012) using MERIS full resolution data

MPH Chl-a product



Saldanha Bay fieldwork

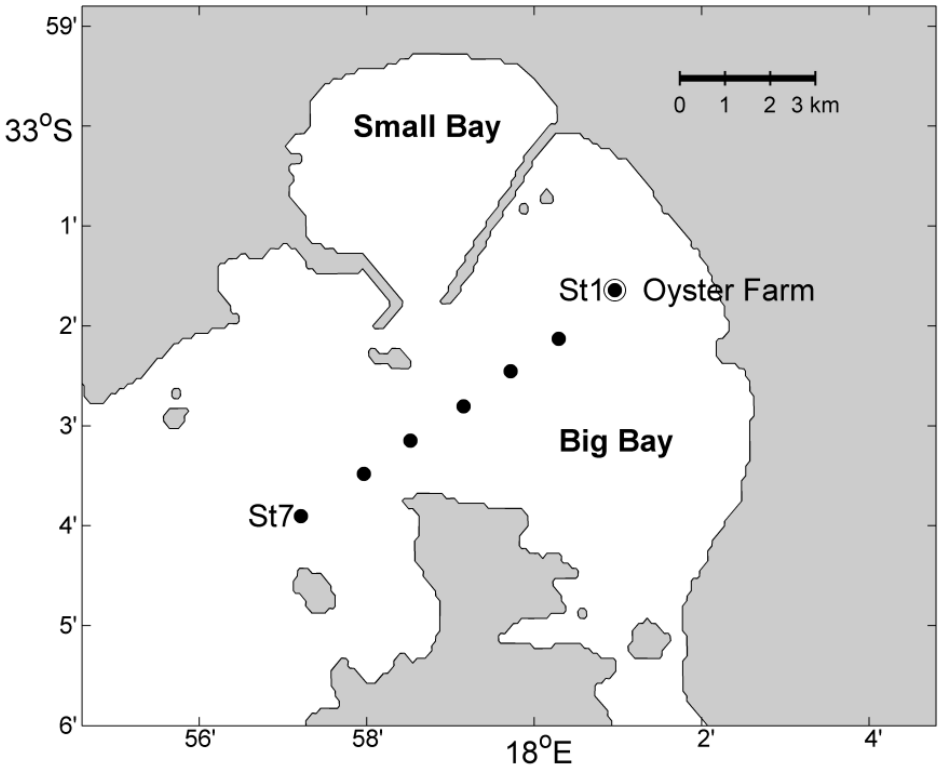
In collaboration with Department of agriculture, forestry and fisheries of South Africa

⇒ Carrying capacity of Saldanha bay for Mariculture

Jan 2012 – Jan 2013 (4 day fieldtrips every 2 months)

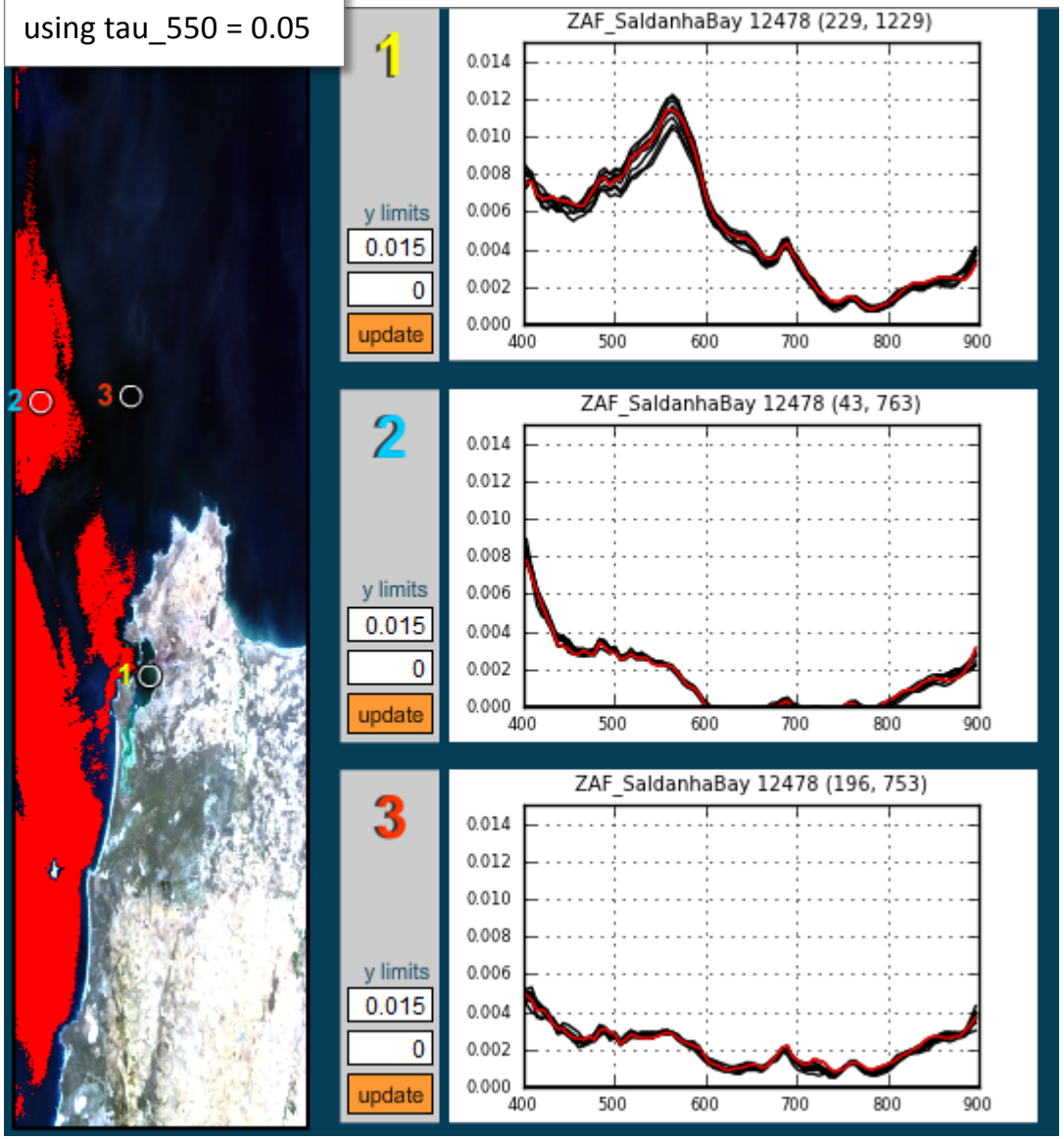
Measurements included:

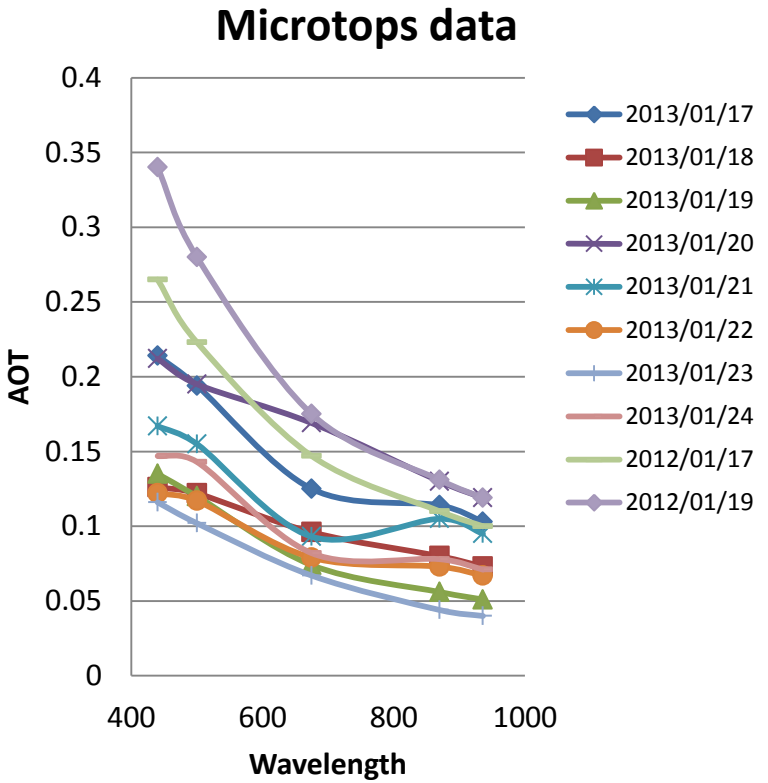
- C-OPS radiometer casts
- Chl-a
- Microtops
- Permanent mooring with temp and fluorometer
- CDOM
- QFT absorption
- Kinetics & nutrients
- O_2 incubations
- Phytoplankton counts



Methods: online L2 processing to R_{rs}

20 Jan 2013 R_{rs}:
using tau_550 = 0.05

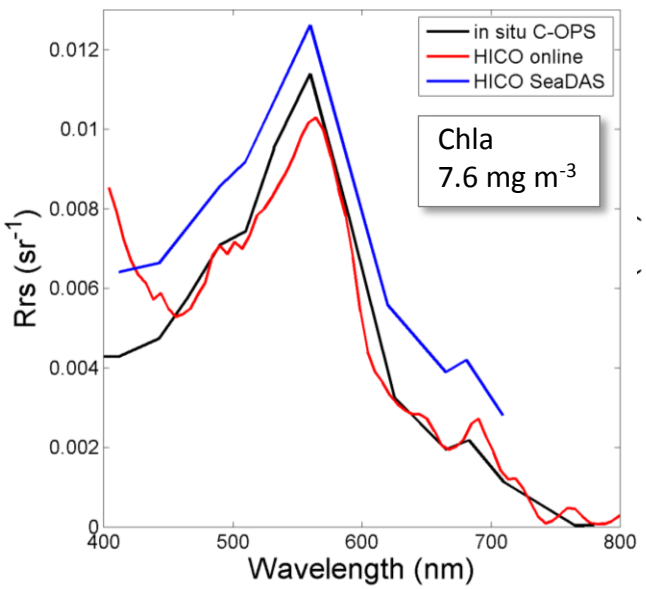


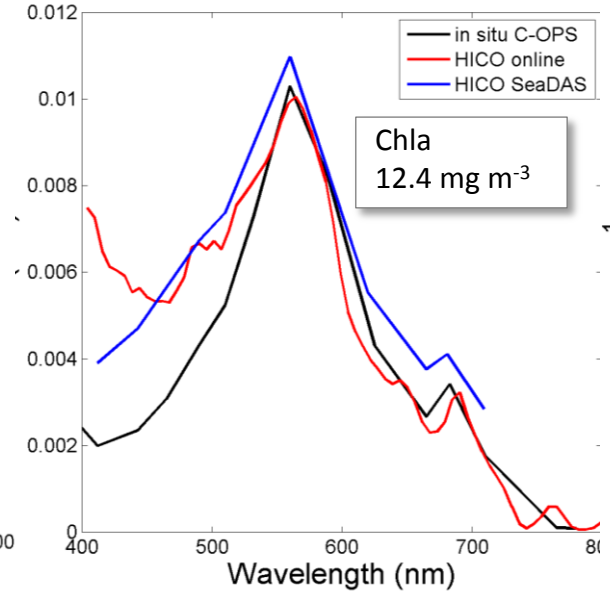


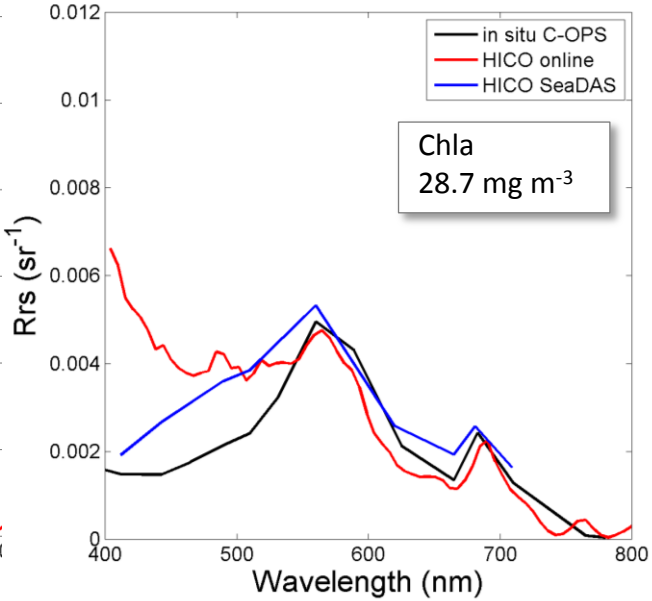
Often had to use (unrealistic?) very low AOT to avoid negative reflectances

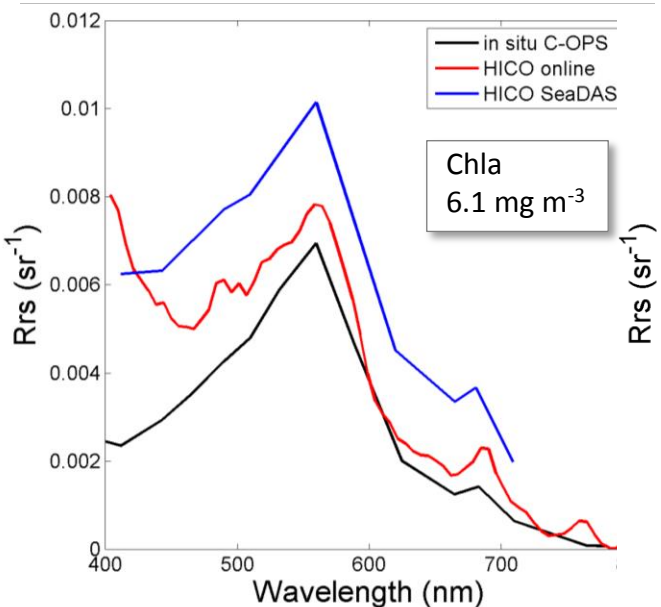
Offset the resulting high reflectance in the red with the cirrus correction?

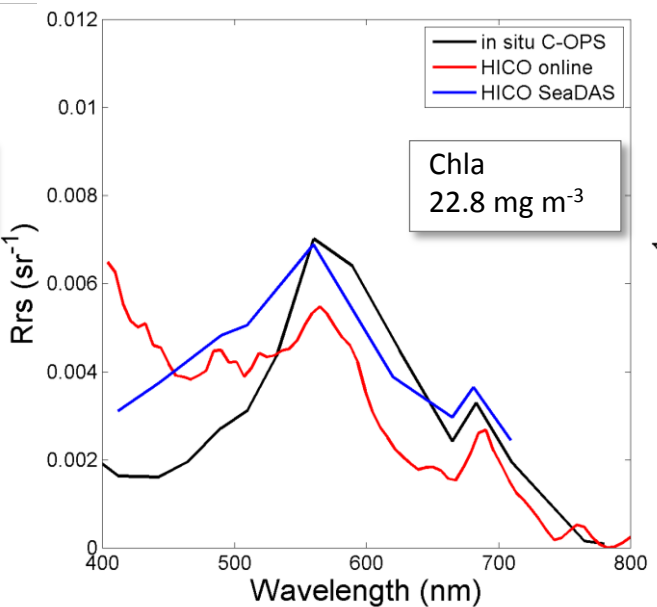
Radiometric data: C-OPS vs HICO

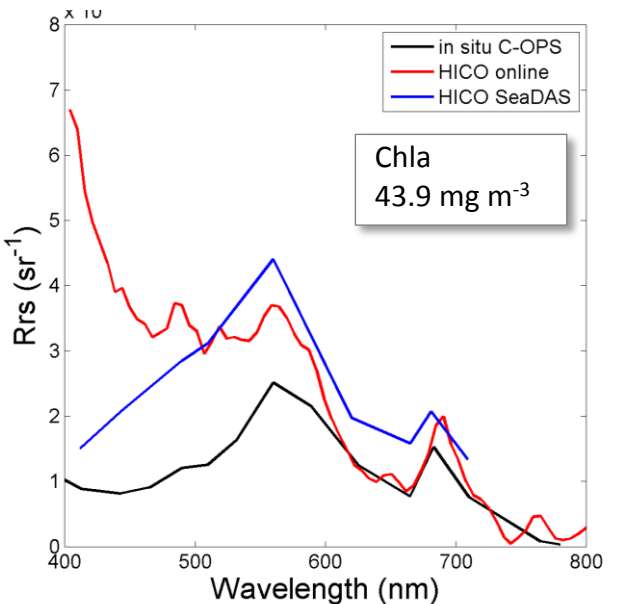






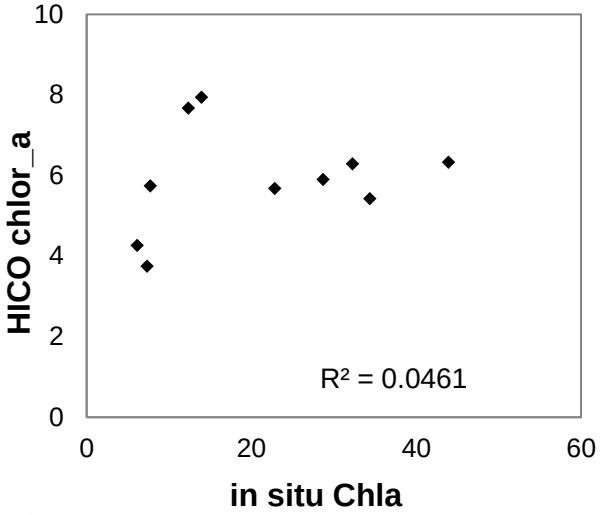






SeaDAS processing: chlor_a

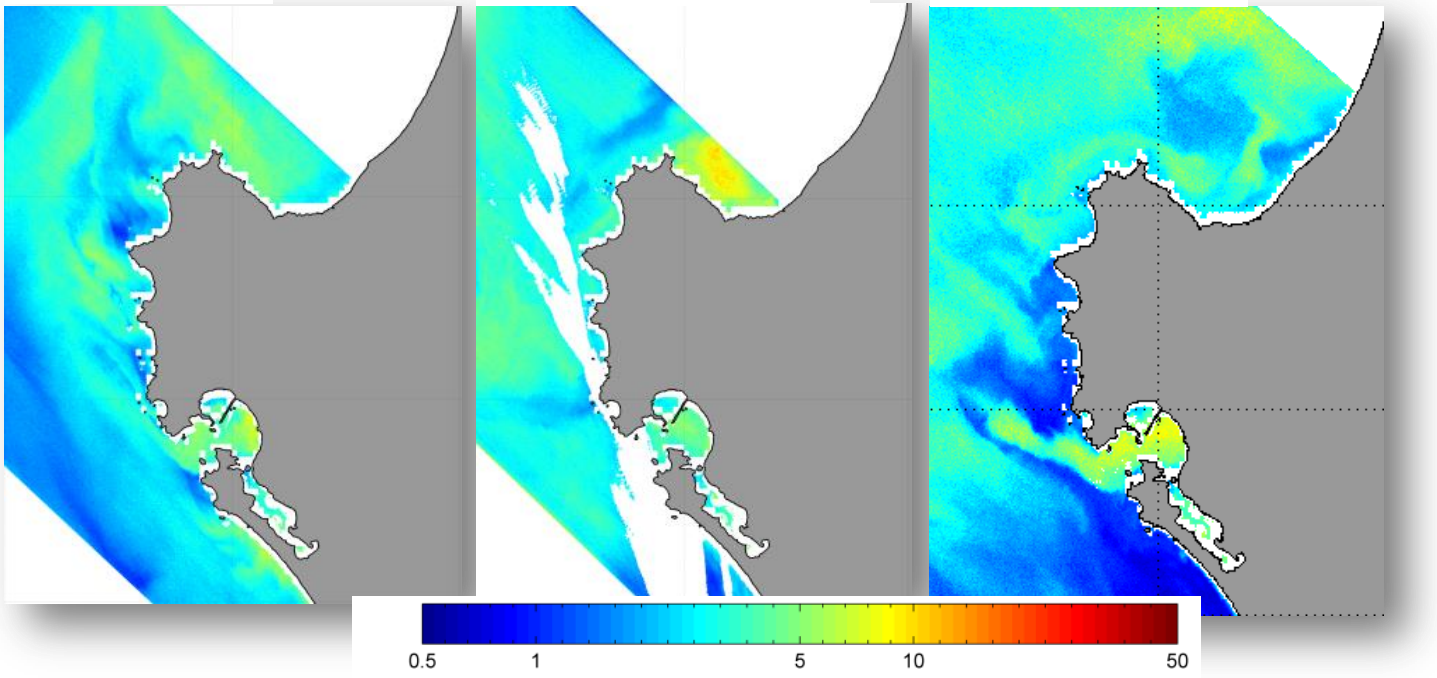
chlor_a product tended to underestimate Chl-a values inside Saldanha Bay by an average of 363% and showed a poor correlation with in situ data



21 Nov 2012

17 Jan 2013

20 Jan 2013

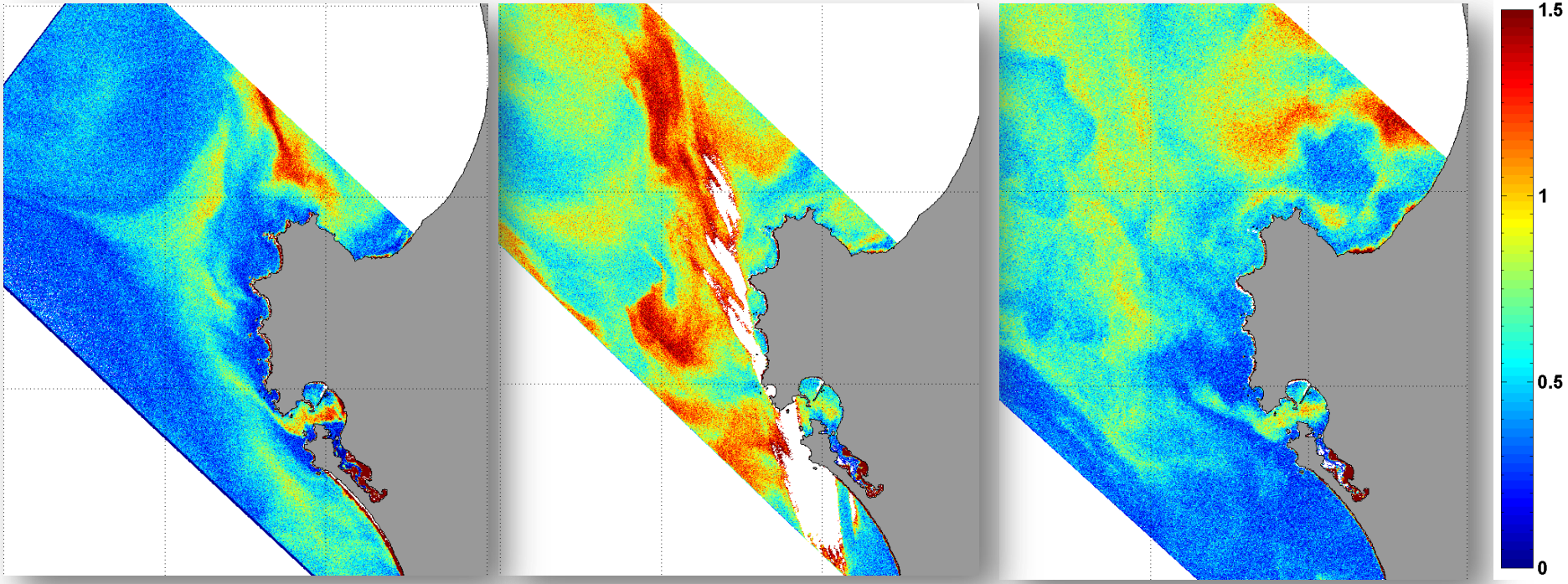


Phytoplankton biomass detection techniques

Approach similar to FLH, MPH, adaptive reflectance peak height (ARPH). Basically a “sliding linear baseline algorithm” using at-sensor reflectance:

$$\mathrm{SLB} = \mathrm{Rt2} - \mathrm{Rt1} - (\mathrm{Rt3} - \mathrm{Rt1})\frac{(\lambda_2 - \lambda_1)}{(\lambda_3 - \lambda_1)}$$

Where λ_1=656nm, λ_3= 753nm and λ_2= {max of lineheight between 662 & 719nm}



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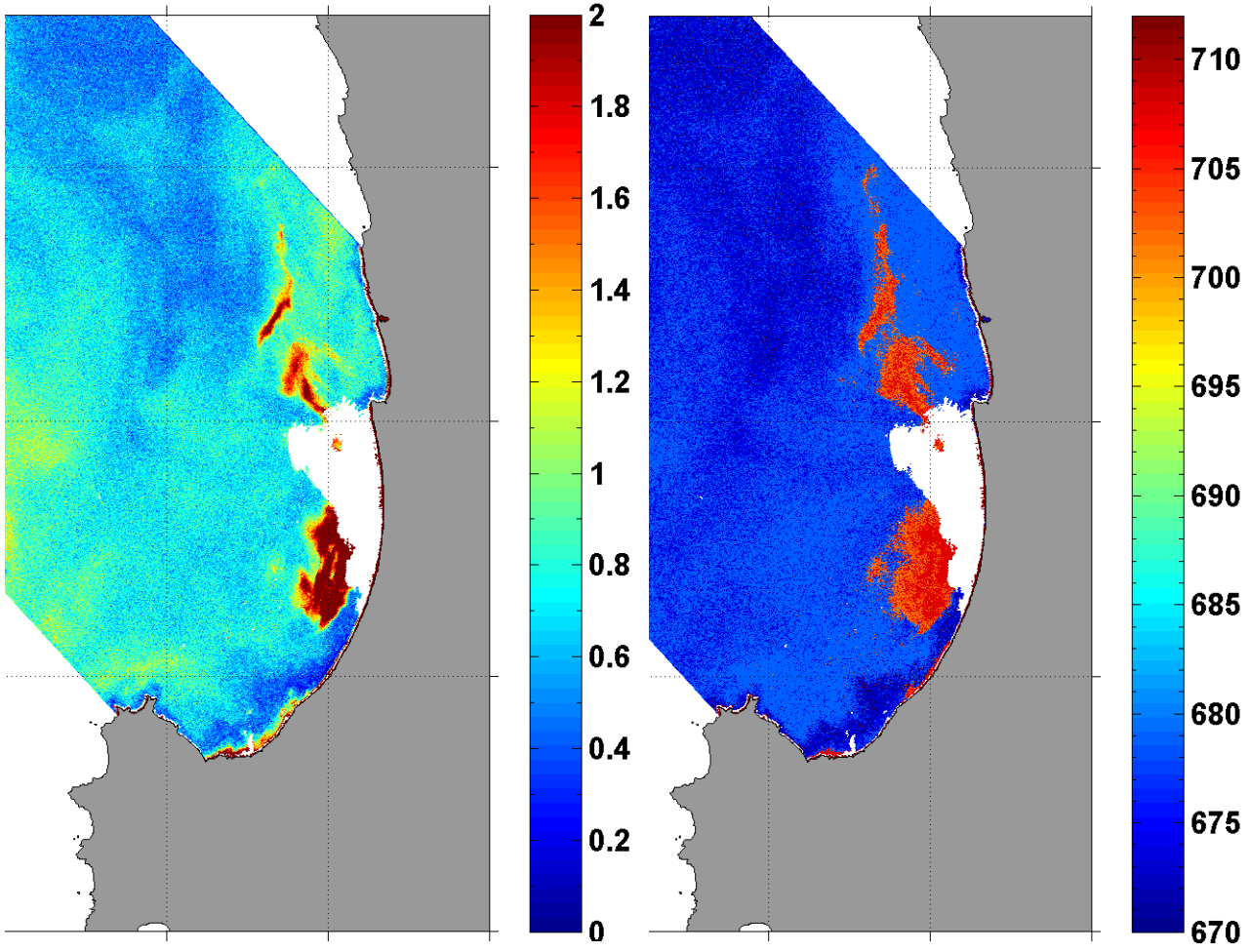

St Helena Bay bloom during Mar 2013 with Chla >100 mg m^{-3} (patches >1000 mg m^{-3})

Need to account for the fluorescence peak shift in these red tides

Future work

- No correction for gaseous absorption or Raleigh scattering
  => possible to get a product with these corrections (without aerosol correction)?

- Relate biomass detection algorithms to Chl-a concentrations

- Investigate whether “sliding” algorithm is needed
  => potentially only a few key wavelengths

- Continue in situ data collection and validation efforts, focus more on the St Helena bay area and HABs

- If/when we have more confidence in R_{rs} products:
  => Spectral classification
  => 2^{nd} derivative analysis