Marine Matters

Initial results with automated ship-borne reflectance measurements and data processing in near-coastal waters in the Western Channel

Victor Martinez-Vicente[1],S.G.H.Simis[2], R. Alegre[1], P.E.Land[1], S.B. Groom[1]

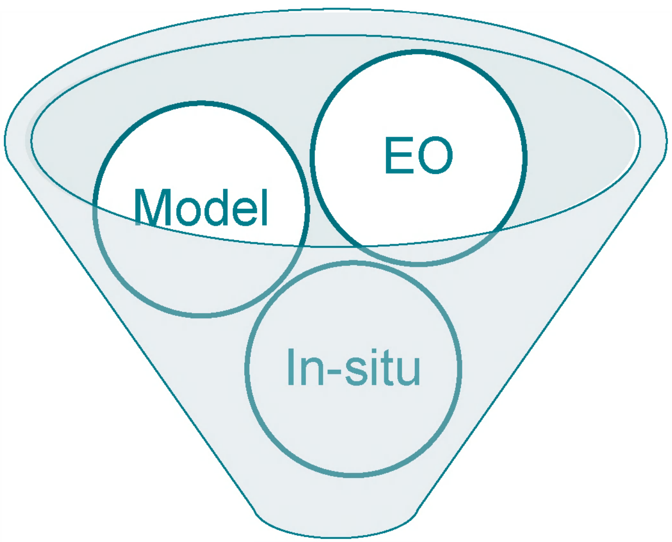
[1]Plymouth Marine Laboratory , UK

[2]Finnish Environment Institute SYKE, Finland

iseca
INFORMATION SYSTEM
ON THE EUTROPHICATION
OF OUR COASTAL AREAS

Interreg project (2010-2014)
AIMS to *"develop and promote a web-based tool to improve the evaluation of the coastal water quality and analyse eutrophication in the 2Seas coastal areas"*

http://www.iseca.eu



Web information system

Can chlorophyll from EO be used to do Eutrophication assessments?

USERS

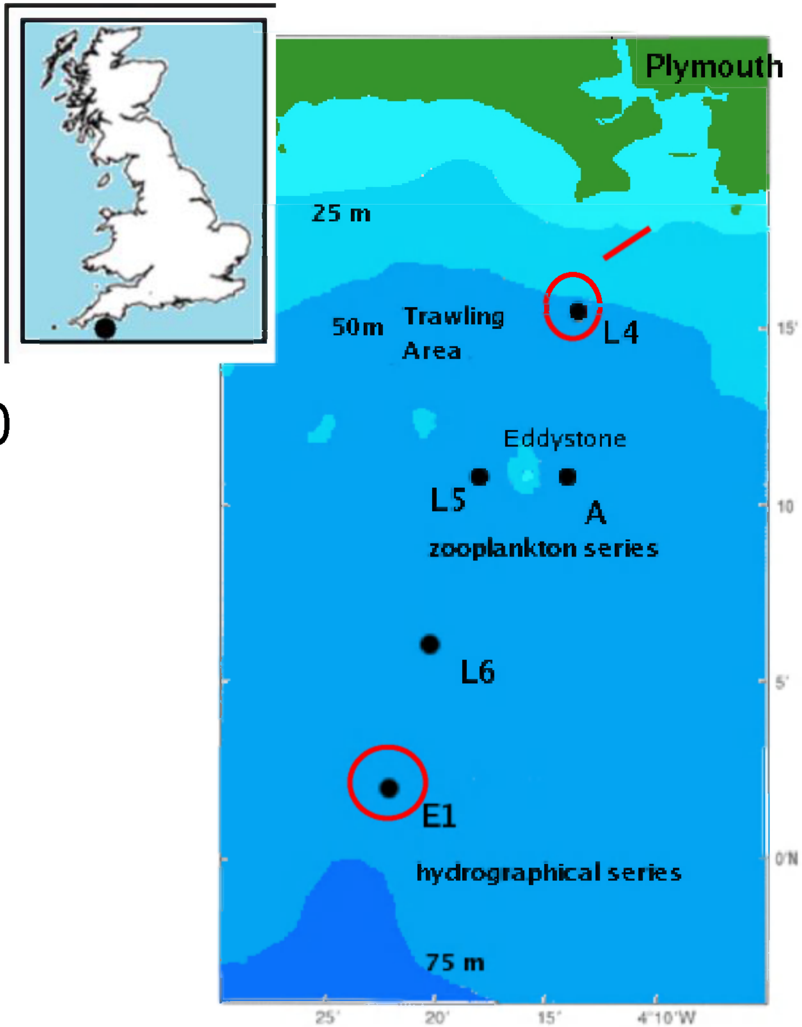
Question 1:What are the uncertainties of EO coastal products?

Question 2: How close to the coast can EO products be "trust"?

Plymouth Marine Laboratory

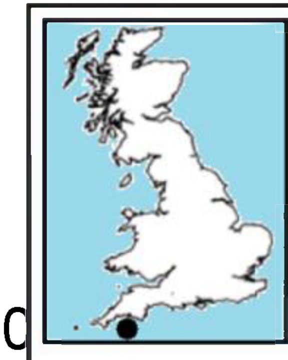
ISECA in-situ database

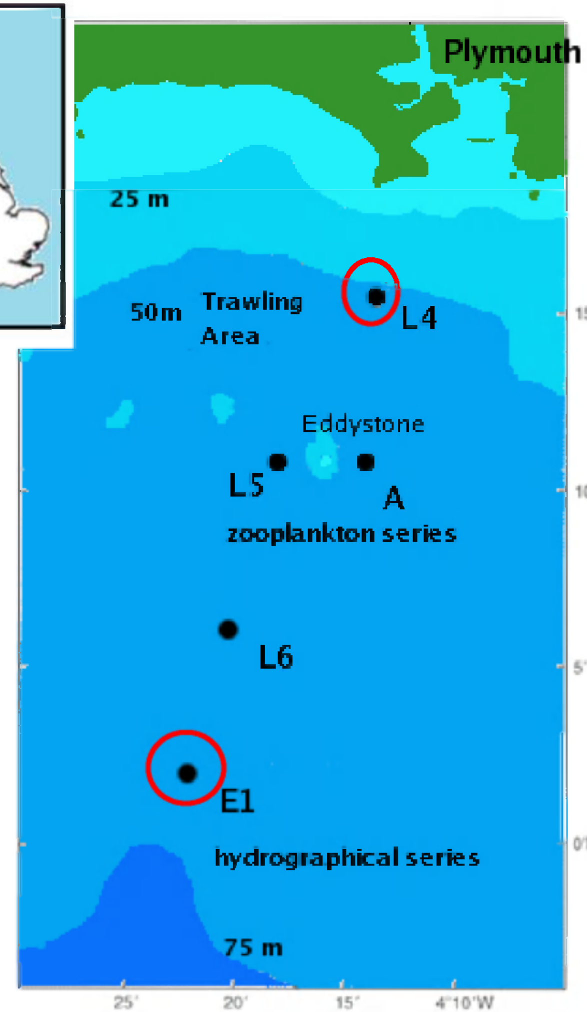
- **Question 1:**
  - **Biological data** and **In-water bio-optical data:** long term (+10 years) measurements at fixed stations
- **Question 2:**
  - **Above water optics:** dataset to test atmospheric correction and adjacency effects

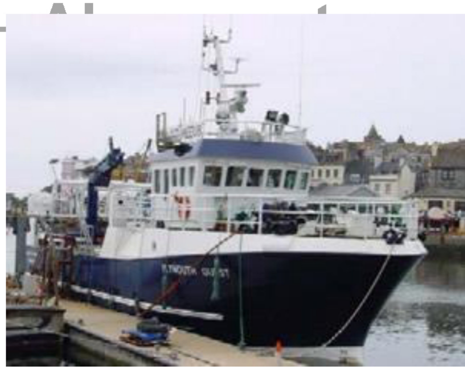


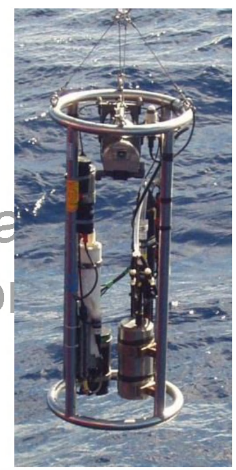
ISECA in-situ database

- **Question 1:**
  - **Biological data** and **In-water bio-optical data:** long term (+10 years) measurements at fixed stations
- **Question 2:**
  - tics: data correctio s









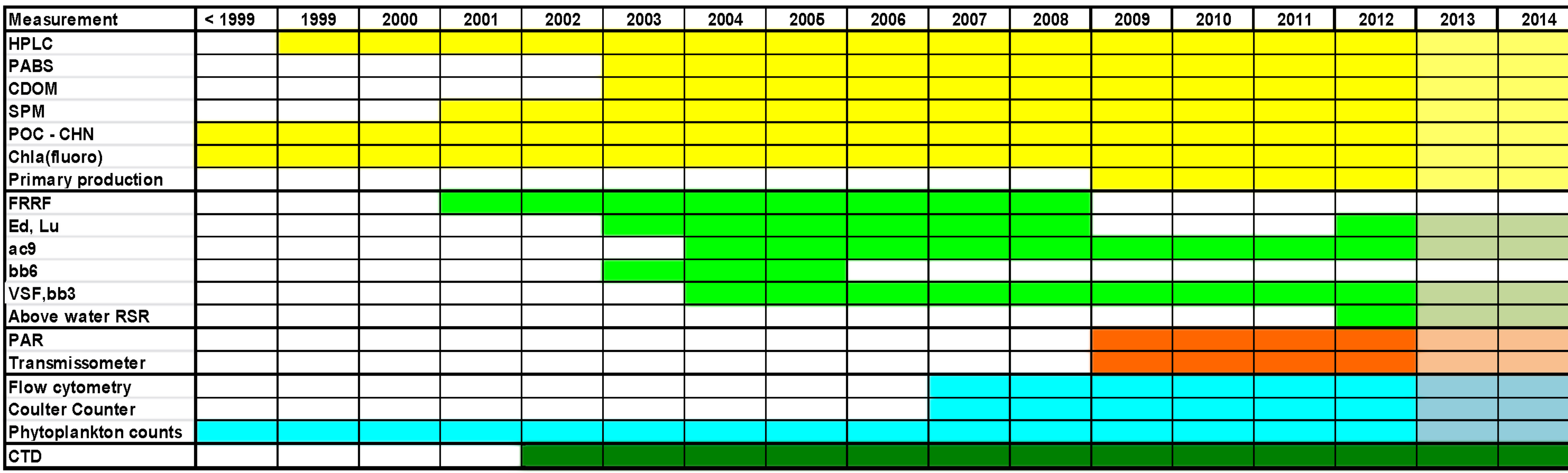
WetLabs ac-9; *a & c*
Seabird 19 CTD; *T & S*
WetLabs ECO-VSF3 : b_{bp}
Satlantic HyperOCR; E_d

Time series at WEC: Biological and optics

-Historically L4 originated as a biological monitoring station.

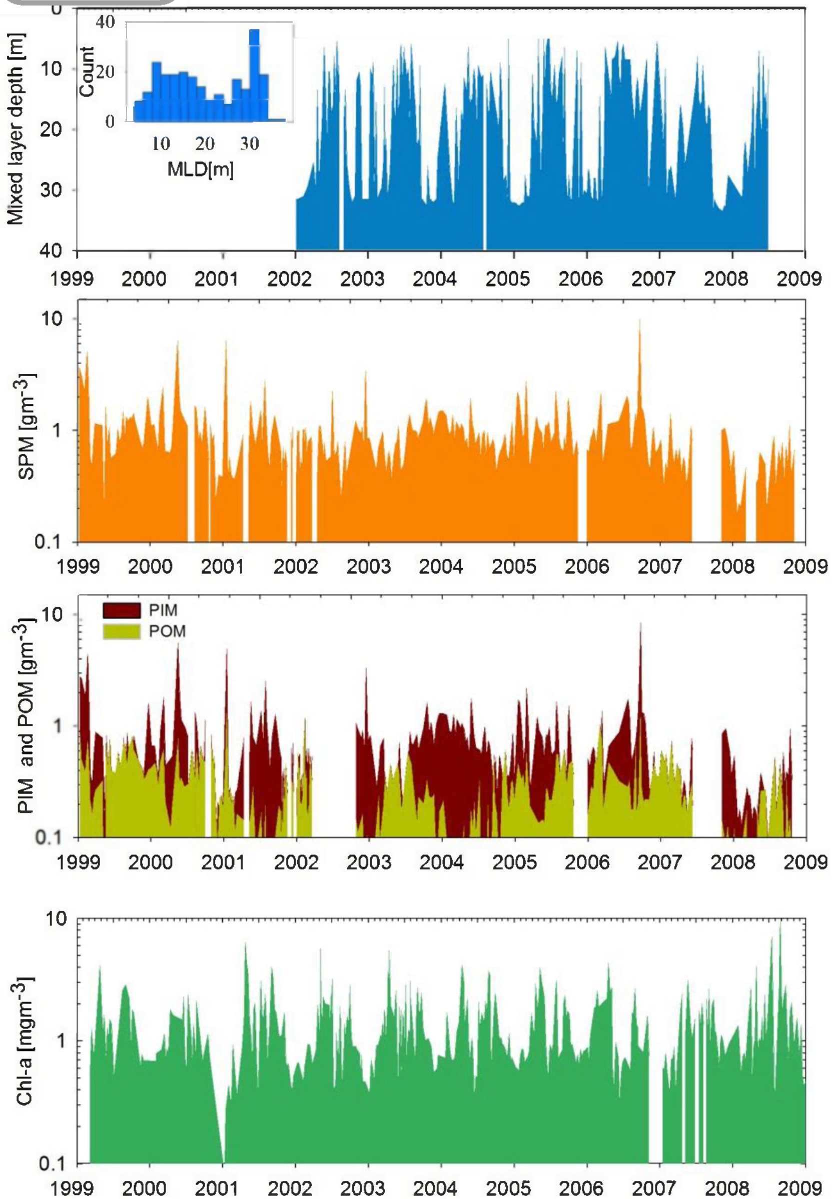
-Developed into bio-optical time series during the 2000's.

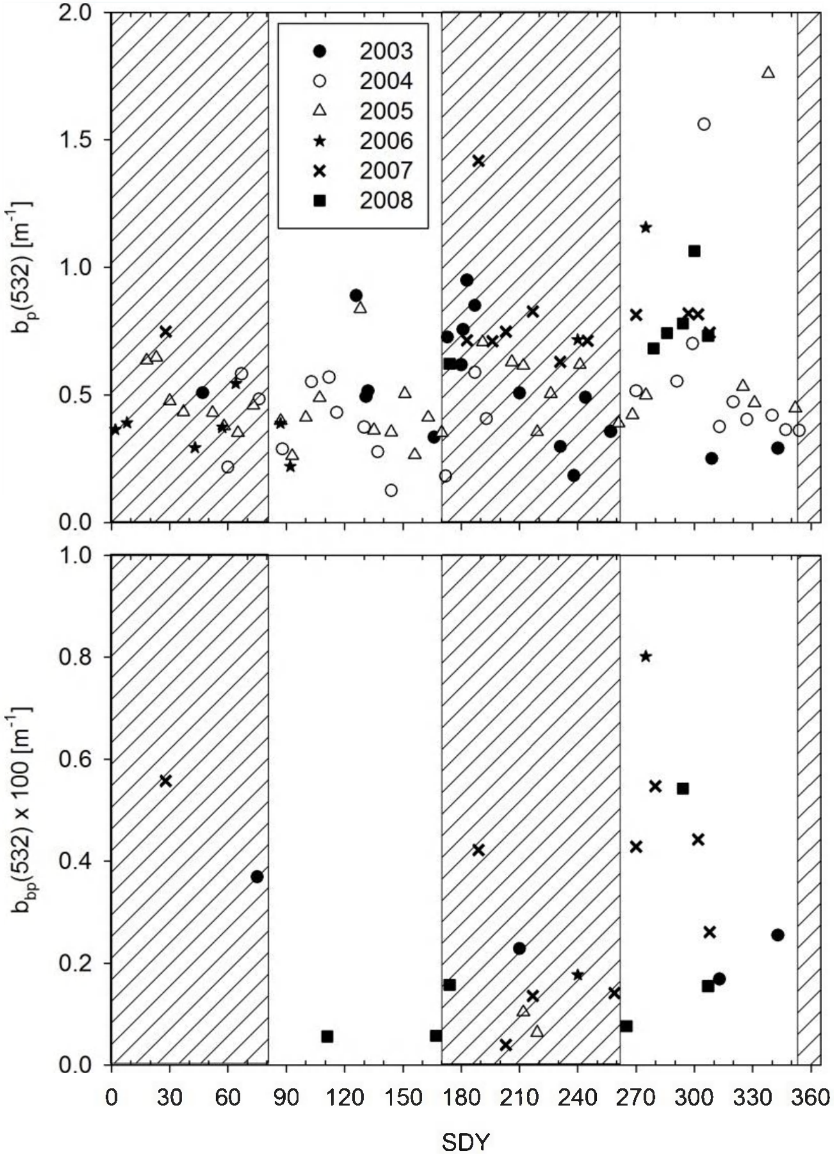
-Weekly sampling of biological and optical parameters



Alegre, J. Bruun, S.B. Groom, V. Martinez-Vicente, G.H. Tilstone, M. Taberner (2012) ESA Conf

Biological and bio-optical data

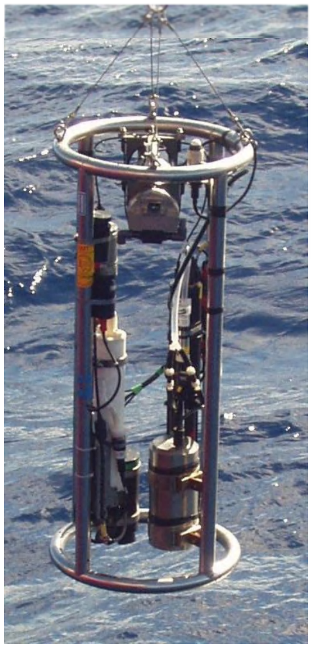


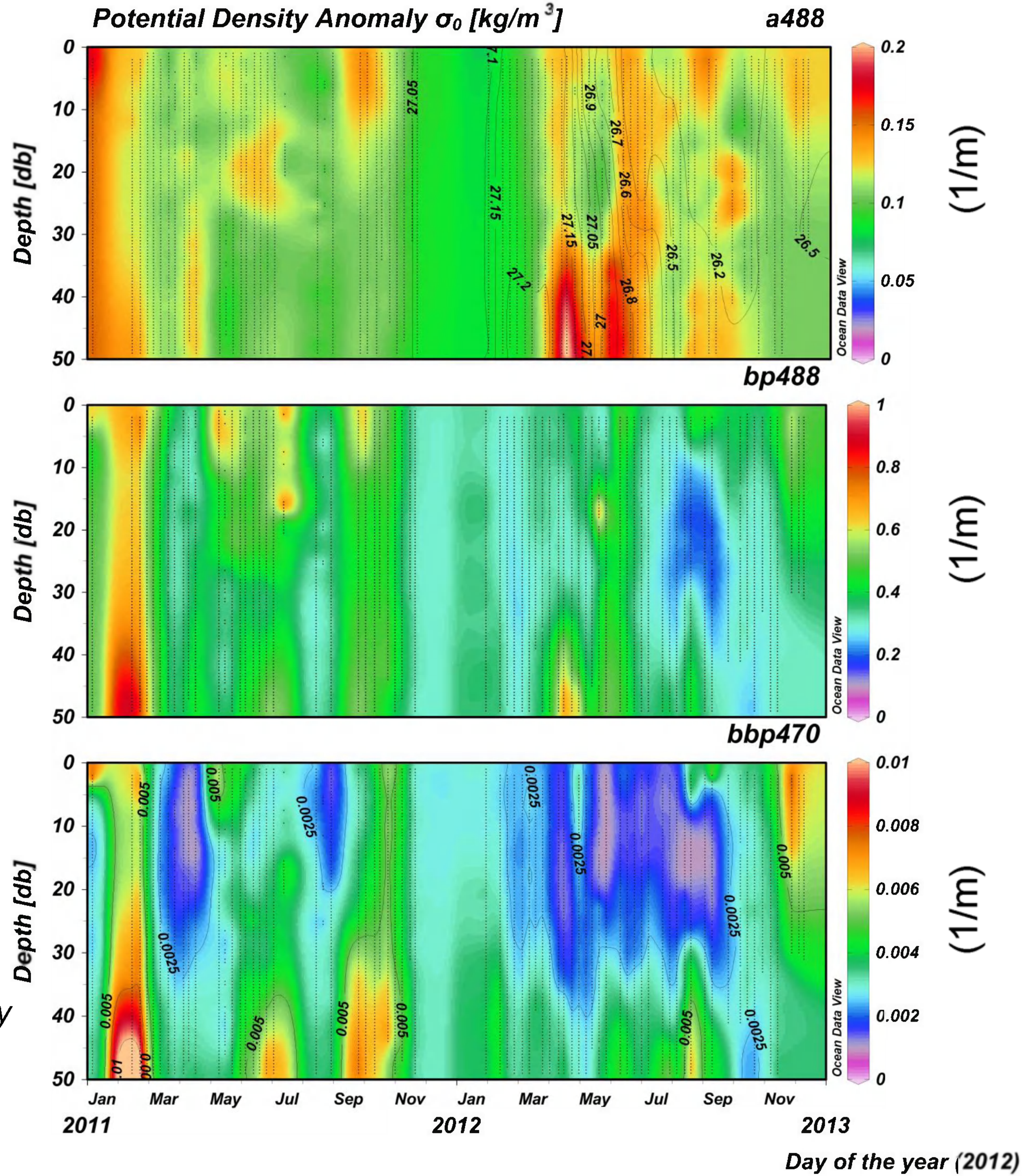


Martinez-Vicente et al. (2010)

PML | Plymouth Marine Laboratory **Optics**

L4





WetLabs ac-9;*Absorption & attenuation*

Seabird 19 CTD*; Temperature & salinity*

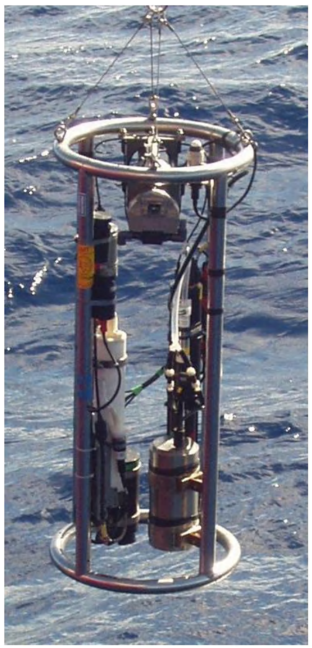
WetLabs ECO-VSF3 ; backscatter

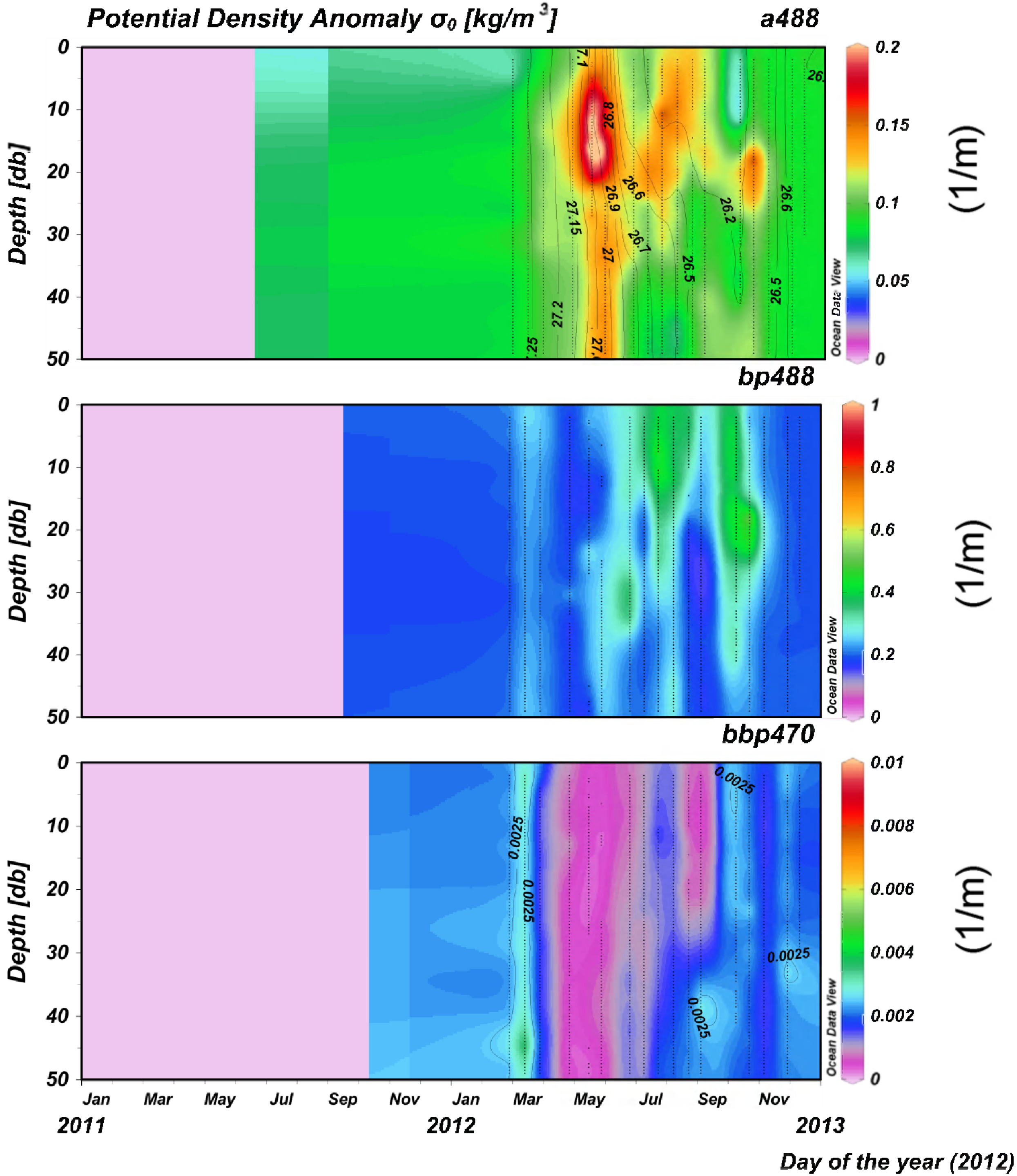
Satlantic HyperSAS; Downwelling irradiance

PML Plymouth Marine Laboratory

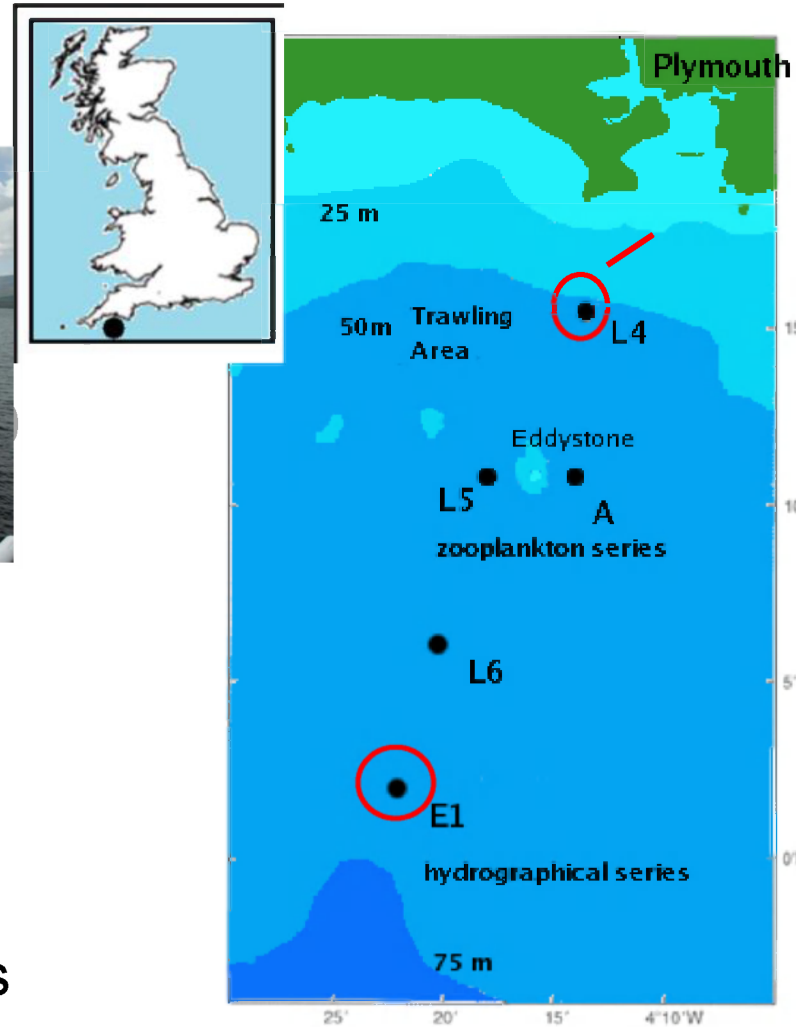
Optics

E1





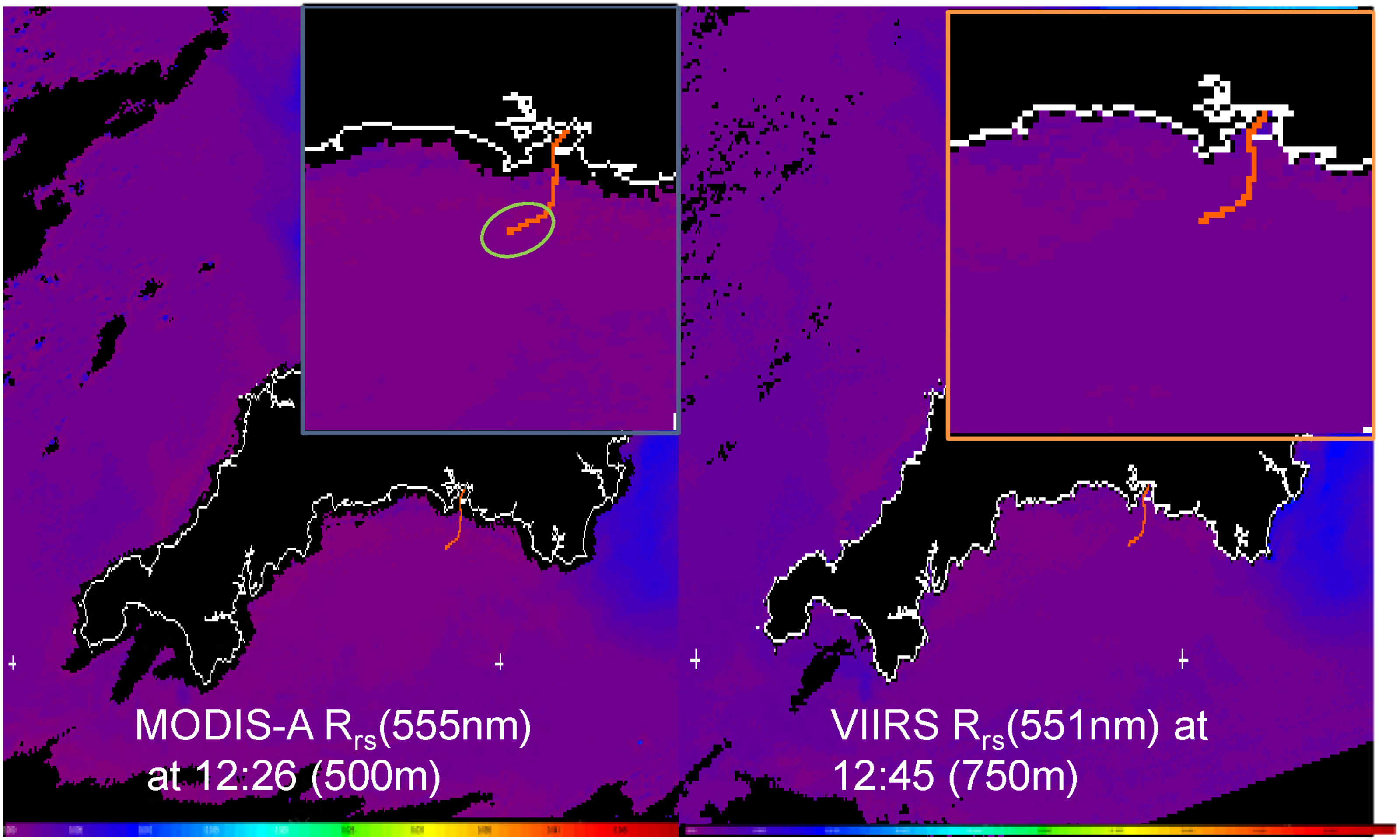
ISECA in-situ database
A common tool to test and develop EO products for eutrophication



stations

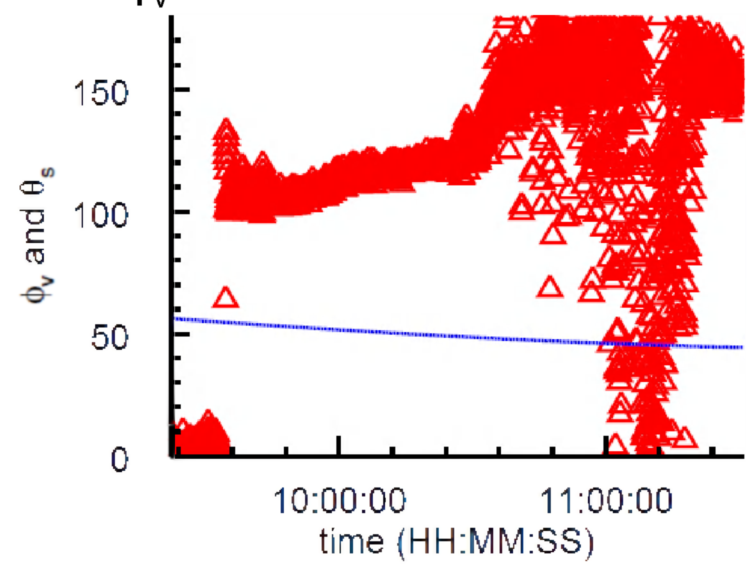
- **Question 2:**
  - **Above water optics:** dataset to test atmospheric correction and adjacency effects (~2h of data)
  - Quantify the uncertainty sources from the in-situ data

Transect : 5th Sept. 2012 (9:30 – 11:20)



Methods

Effective ϕ_v ~100 -170°



Sampling conditions

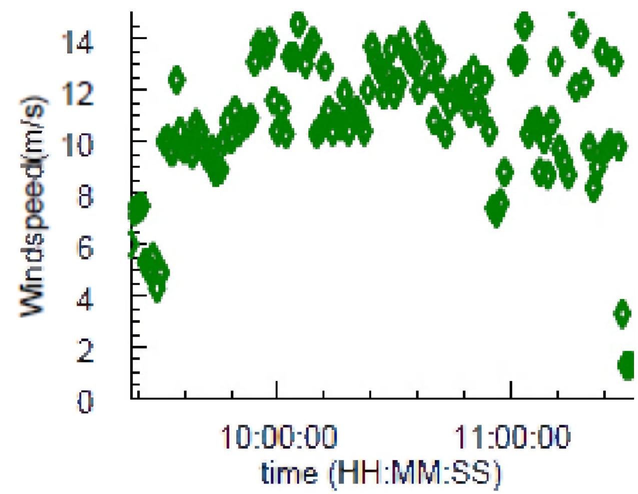
- ~40 ° from nadir (θ_v)
- Solar zenith angle (θ_s) ~ 50°
- Crew "instructed" to maintain 135° away from sun (azimuth viewing direction ϕ_v)
- 7 m above the water surface
- Clear sky

Satlantic HyperSAS above water system

Hyperspectral sensors (350-800 nm):

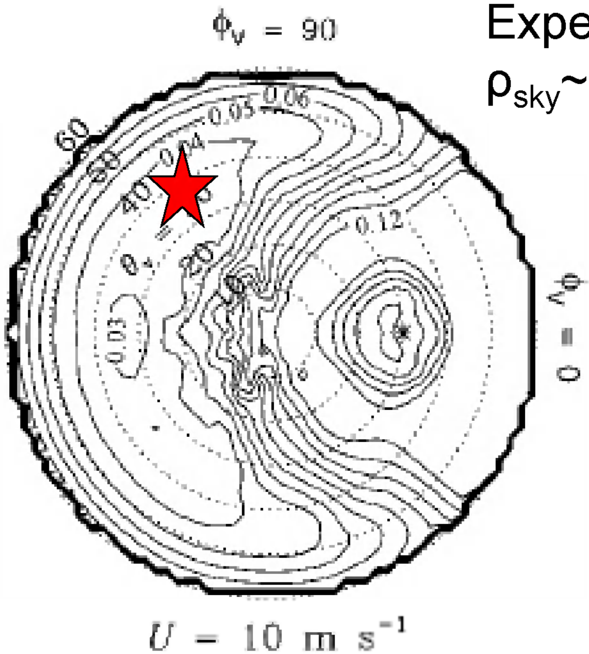
- Downwelling Irradiance (E_d)
- Upwelling radiance (L_u)
- Sky radiance (L_s)
- Tilt and Heading sensor (THR)
- Sampling frequency ~0.5Hz
- FOV ~3 °

Median Wind speed = 11ms^{-1}



Expectation of reflectance factor, ρ_{sky}

Mobley (1999)



Expected
ρ_{sky}~0.032

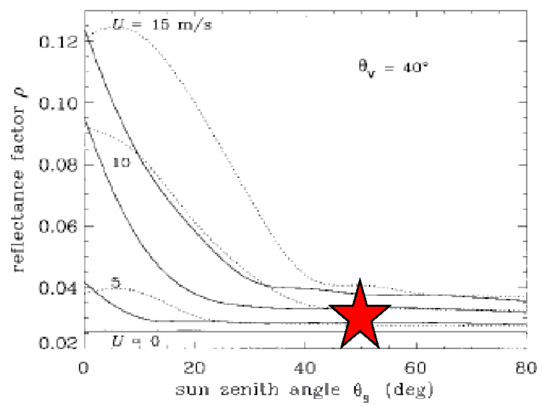
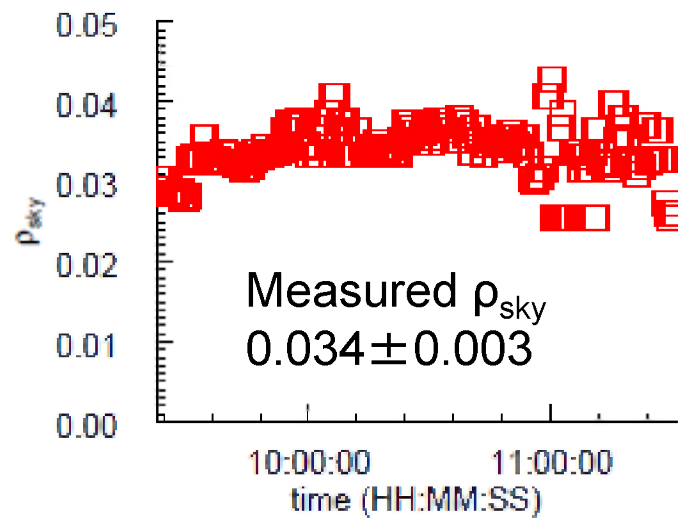
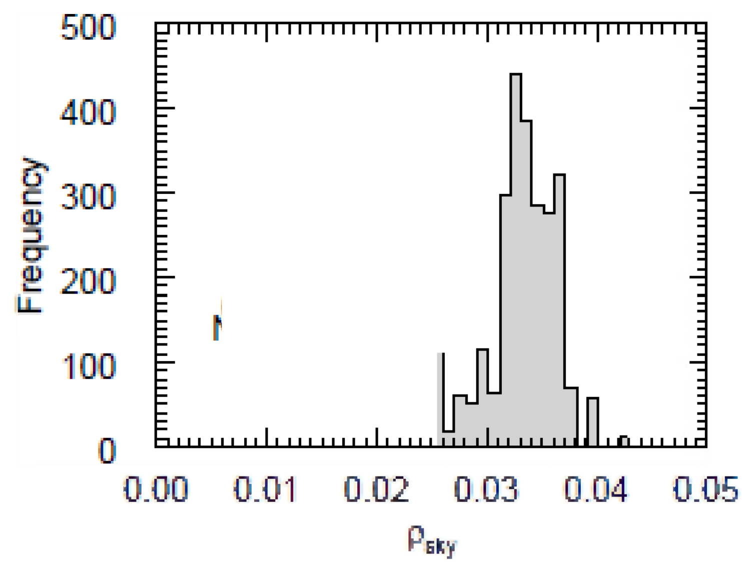


Fig. 9. Effect of wind speed and Sun zenith angle on ρ for a viewing direction of θ_v = 40 deg and a clear-sky radiance distribution. The solid curves are for an azimuthal viewing direction of ϕ_v = 135 deg and the dotted curves are for ϕ_v = 90 deg.

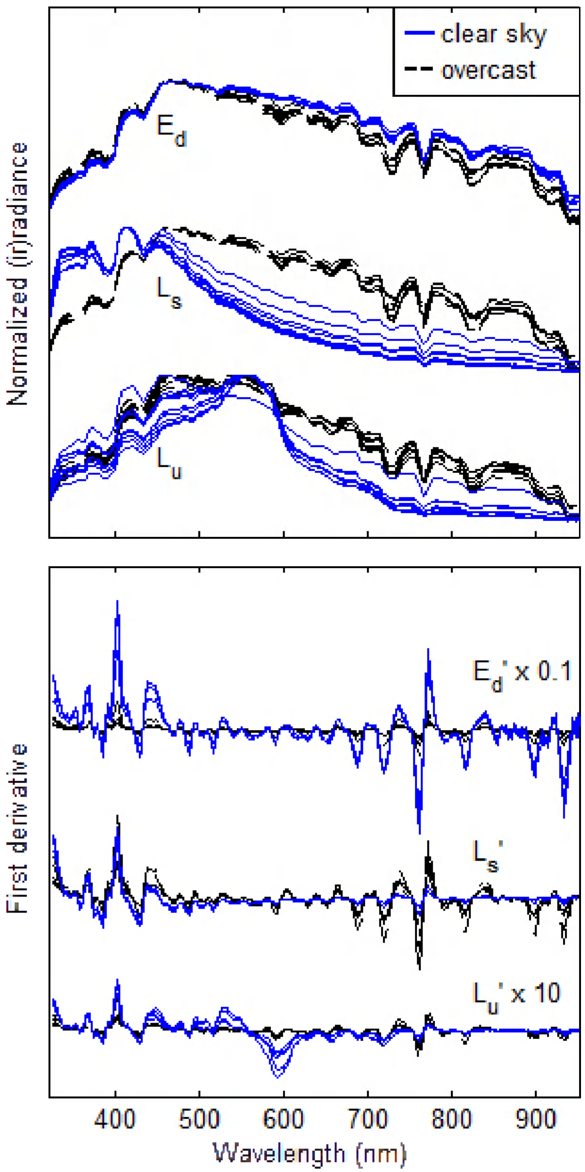




Processing

- Standard processing (S95, with reflectance factor of Mobley, 1999)
- Similarity spectra (Ruddick et al.2006)
- Automated QC (Simis & Olsson, 2012)

Simis & Olsson (2012) -RFLEX



Method overview

1. Find atmospheric gas absorption features in L_s and L_u

   use derivative spectra, locate 10-15

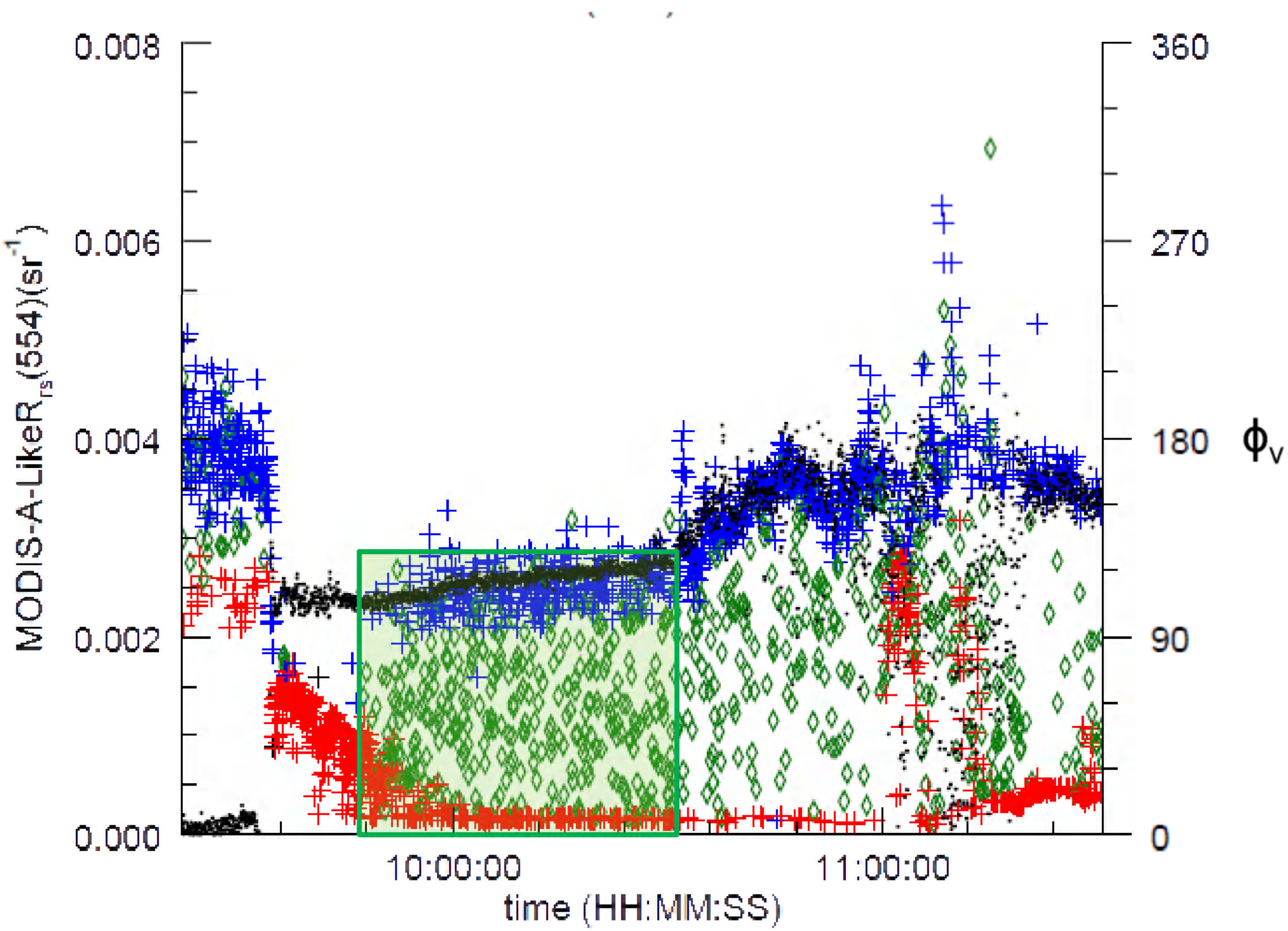
2. define limits for ρ_{sky}

   min: 0.0247 – max: R_{rs} not negative

3. Optimize ρ_{sky} in $R_{rs} = [L_u - (\rho_{sky} L_{sky})]/E_d$

   so that R_{rs} is curved but smooth:
   gas absorption features are narrow but water absorption features are broad.

Simis & Olsson (2012)



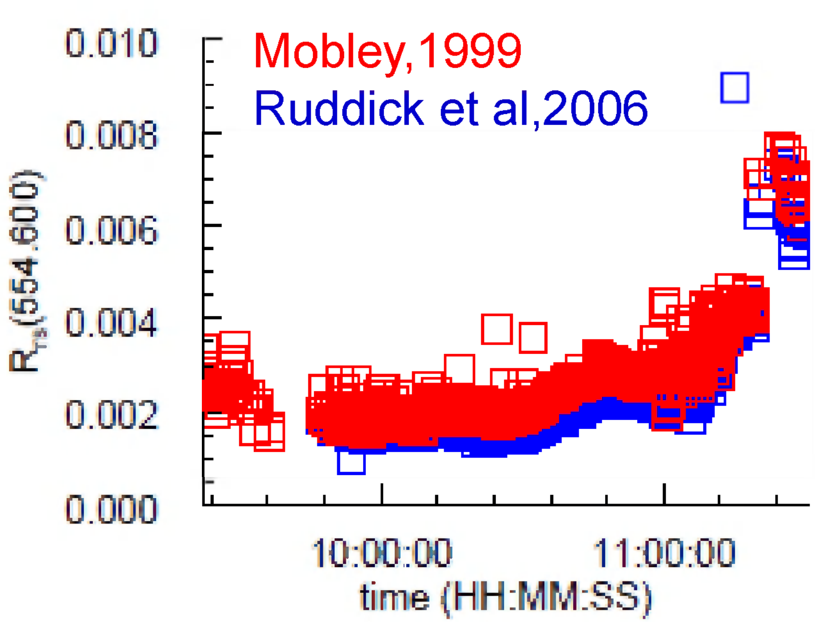
Black – viewing azimuth, ϕ_v

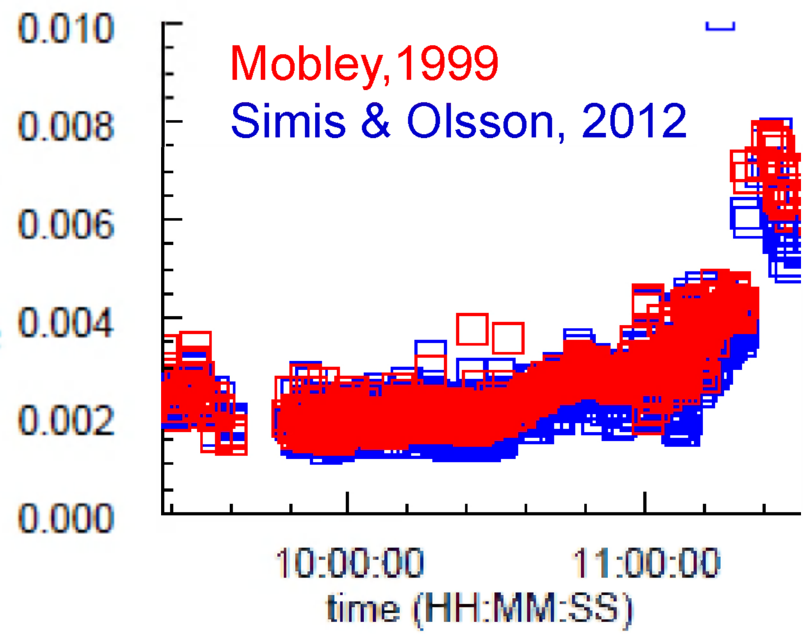
Green - Valid estimates of ρ_{sky}

Blue and red – Invalid estimates of ρ_{sky}

PML | Plymouth Marine Laboratory

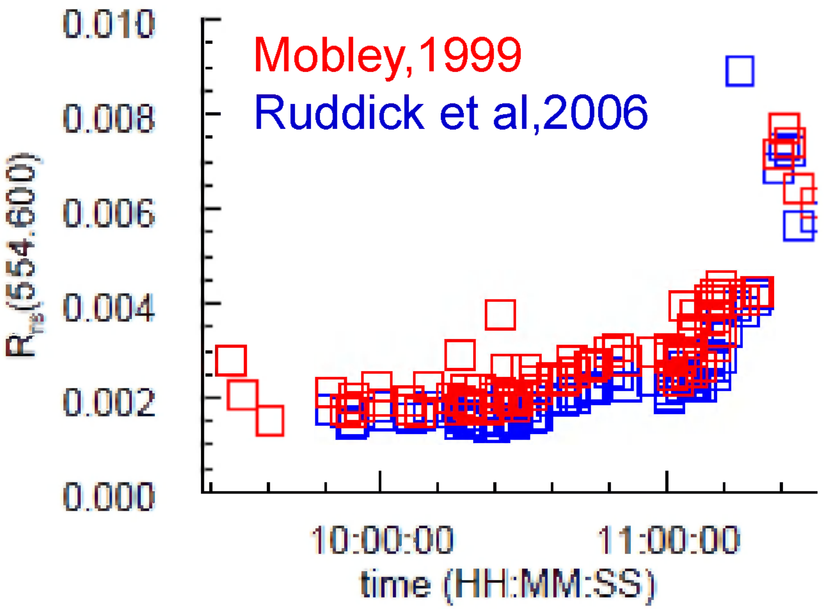
Valid ρ_{sky}, N=1876

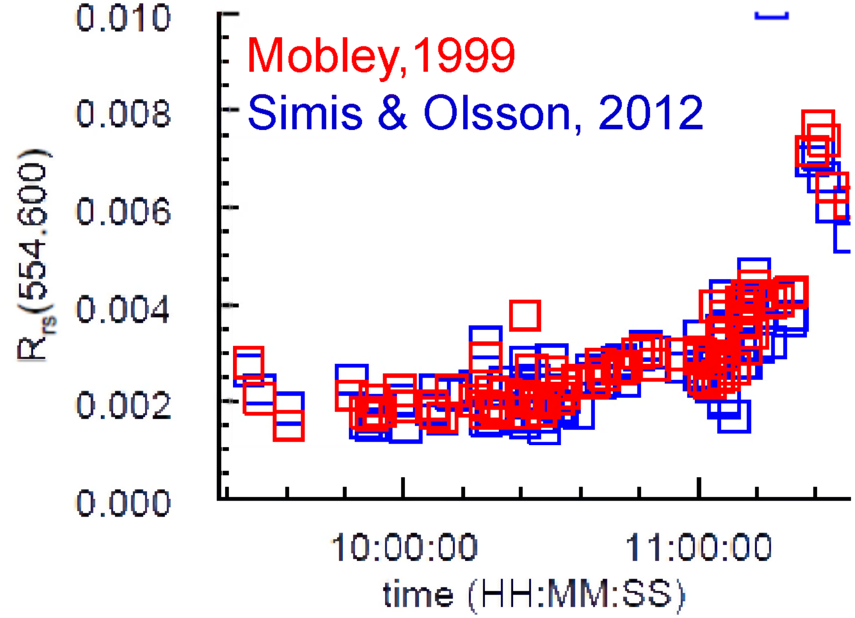




Median UPD (%)	412	442	466	488	530	547	554	Average
Ruddick et al.(2006)	22	20	19	16	18	19	20	19
Simis & Olsson (2012)	19	15	12	9	8	8	8	11

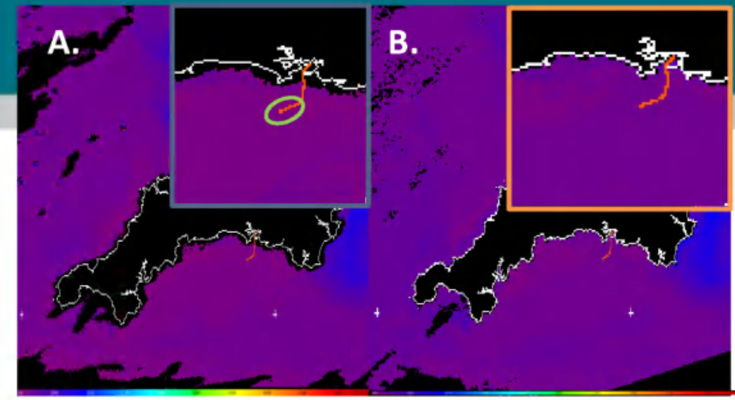
Valid ρ_{sky} & 25% difference in 551nm, N=248





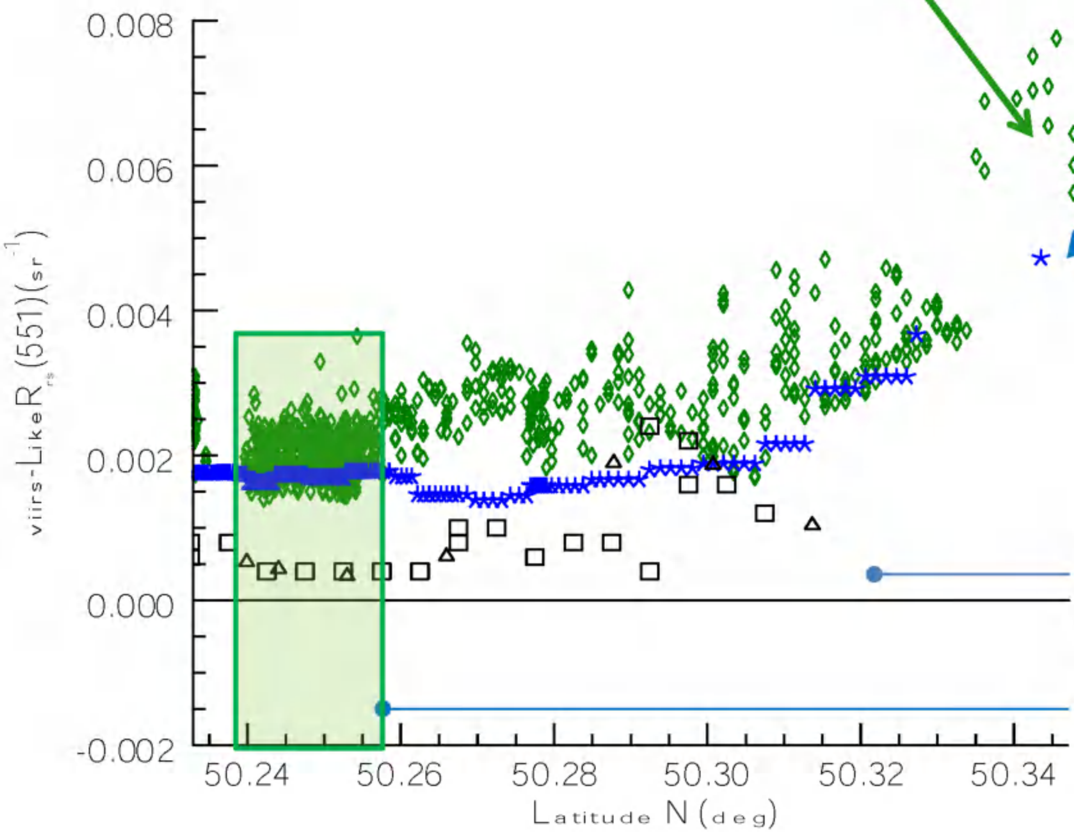
Median UPD (%)	412	442	466	488	530	547	554	Average
Ruddick et al.(2006)	34	30	28	26	28	30	30	29
Simis & Olsson (2012)	24	19	15	13	11	11	11	15

PML | Plymouth Marine Laboratory



In-situ HyperSAS

VIIRS
(values repeated for same pixel)



2Km to land

7.2Km to land

Squares – MODIS- A Full resolution

Triangles – MODIS-A Reduced resolution

Conclusions and future work

- In-situ bio-optical coastal work on-going
- Double approach:
  - -Long term bio-optical monitoring
  - -Occasional testing with other data
- Preliminary results show large differences just by processing methods.
  - First adaptation of this method on Satlantic. Not >800nm
  - SEAPOL correction (Santer & Zagolski, 2012)
  - Do comparisons with other above water/in-water systems.
- Routine measurements for 2013
- Coupling to azimuth adjusting system (S. Simis, OOXXI-2012)

PML | Plymouth Marine Laboratory

Acknowledgements

Funding

iseca
INFORMATION SYSTEM ON THE EUTROPHICATION OF OUR COASTAL AREAS

2 Mers Seas Zeeën INTERREG IV A
FRANCE - ENGLAND - VLAANDEREN - NEDERLAND

http://www.iseca.eu

Disclaimer:The document reflects the author's views. The INTERREG IVA 2 Seas Programme Authorities are not liable for any use that may be made of the information contained therein.

NERC National Capability: Western Channel Observatory

ProTool COOPERATION WaterS PEOPLE http://sourceforge.net/projects/rflex

People

Master and crew of RV *Plymouth Quest*, James R. Fishwick for wind and underway data.
Partners in ISECA:

ADRINORD vito vision on technology PML Plymouth Marine Laboratory UNIVERSITY of GREENWICH VLIZ Nausicaá La Mer est sur Terre University of Portsmouth CEMARE NIOZ