MERIS Workshop

User Observations and Recommendations

MERIS launched Mar 2002; Commissioning phase – Dec 02
➔Initial operations phase to Sept 03
➔Routine operations phase to start Oct 03
➔Assessment at MERIS User Workshop, Nov 2003
➔MERIS re-processing to be completed by April 2004
Re-calculate NN with revised version of bio-optical model
Adjust atmospheric correction for abs aerosols and BP flag

MERIS Workshop

User Observations and Recommendations

Pros: Five cameras; FR 300m; RR 1200m;
15 vis/near IR bands; programmable;
B.P. atmospheric correction.

Cons: 10 am overpass time
No tilt, 50% sun glitter (east of image)

Names: Mike Rast, Earth Sciences. Chair of SAG
J-P Huot Leader MAVT; Steven Delwart technical for MERIS;
Henri Laur, Envisat M.M.; Peter Regner, ESRIN, data man.

MERIS Workshop

User Observations and Recommendations

Major outstanding issues:
Tweeking algorithms etc.
Absorbing aerosols, ocean and shelf seas (Antoine & Morel
B.P. atmospheric correction (Moore, Aiken, J-P Huot, ESA.
At PML:
Moore, Smyth, Hirata, Tilstone, Blondeau, Hardman-Mountford.
U o Plymouth: Sam Lavender et al.

Observed Issues and Recommendations

Standard ESA Products

Documentation

- ATBDs and User Handbook are generally diffucult to use. Documentation is not consistent and does not reflect the current implementation status of processing algorithms in the ground segment. More frequent updates are required. Executive summary and FAQ would be of much help.
- There should be a coordinated validation report with global match-up analysis.

Product Quality: General

- Validation of flags is needed, especially PCD flags.
- Level 2 geophysical parameters for which the PCD is raised should not be used. The sometimes too restrictive setting of PCDs will be improved with next MERIS processor version.
- Cloud flagging is still an issue and needs to be improved.
- The relevance of MERIS spatial resolution (RR and FR products) depends on the application, although it seems to be a limiting factor on FR related to the registration between images.
- MERIS co-registration should be improved to help the use of FR products
- Similar products from different sensors would be of valuable use for inter-comparisons. The issue of inter-sensor products comparison should be addressed by CEOS?

Observed Issues and Recommendations

Product Quality: Case 1 Waters

- Validation of the MERIS water-leaving reflectance does not show major problems over oceanic Case 1 waters : the goal of a 5% accuracy in the blue is at reach.
- Some improvements remain needed, in the red in particular (be careful when interpreting the fluorescence band).
- Some artefacts are still appearing here and there: camera limits, high frequency line-to-line noise. This should be improved.
- Glint correction must be improved as far as possible, because glint is affecting large portions of the MERIS images.
- Some specific aspects of the algorithms have not yet been tested, such as the dust aerosol detection ==> should not trust for the moment the flags indicating their presence.
- Continuing the validation effort (buoy, cruises) remains necessary in different parts of the ocean.

Observed Issues and Recommendations

Product Quality: Case 2 and Inland Waters

- Of the existing ocean colour sensors MERIS is best-designed (spectral bands and algorithms) for products in turbid coastal and inland waters, partly due to the presence of a 705 nm band (please do not change this!!)
- The red and near infrared (NIR) bands are particularly important for CHL retrieval in waters with strong yellow substance absorption and for TSM retrieval in turbid waters.
- Uncertainties in 412nm water-leaving reflectance product for turbid waters have no impact on the red/NIR algorithms.
- MERIS can bring added resolution to the 660 to 720 nm chlorophyll fluorescence/absorption/red edge region of the spectrum. MODIS, the alternative satellite sensor, lacks this ability.
- The analysis of bio-optical measurements revealed a systematic overestimation of chlorophyll-*a* concentration by global algorithms.
- The ocean colour algorithm proposed for MERIS still needs to be refined for the Mediterranean case.
- Inland water pixels very often misclassified as land or invalid pixels; classification based on a land atlas. Pixel classification algorithm needs to be improved including radiometric tests.

Product Quality: Case 2 and Inland Waters (continued)

- Many of the pixels correctly classified as inland water show zero reflectance due to the applied atmospheric correction processing. Correction fails if lakes are too high.
- Inland water areas seem to be affected by adjacency effects. Further study need to be done to quantify this effects.
- Tailored regional products shall show better performance, but not proven.
- Validation of both standard and regional CHL and TSM products is inconclusive at present. Further analysis of match-ups for global validation of TSM and CHL is required.
- Qualitative impression: MERIS-TSM products are both reasonable and robust; MERIS-algal2 products are less certain.
- Stray light is low level and if compared to adjacency effects is marginal. Adjacency effect is an issue.
- Atmospheric correction algorithms for turbid and inland waters need to be improved.

Observed Issues and Recommendations

atmosphere

Product Quality: Atmosphere

- MERIS water vapour measurements show high accuracy when compared to microwave radiometer, radiosonde and GPS measurements.
- High spatial resolution offers new possibilities in the investigation of water vapour fields, level 3 products will help to monitor temporal variability.
- Quality of WV product can be improved by better characterising the surface albedo spectral slope.
- Aerosol products over land need to be improved. Specifically the quality of the epsilon product needs to be improved in such a way that ocean and land results are consistent.

Observed Issues and Recommendations

land

Product Quality: Land

- Difficult to compare MERIS and MODIS products over land since MERIS provides only Top of Aerosol reflectance. Full atmospheric correction is needed.
- Saturation of bands has never been observed over land pixels based on few images to date. Also dynamic response of instrument exceeds expectation.
- Classification quality is related to geometric fidelity. Problems found to fit MERIS to national grid and also multi-temporal mis-registration. Need high accuracy better than 0.5/1km. ESA must improve co-registration to help use FR product.
- Would be useful to get for wide area classification a correction performed for the BRDF.
- Projected land products shall be provided for users to make product simpler to use or tools for re-projection shall be provided as an alternative.

Observed Issues and Recommendations

R&D

- MERIS observations with a modified spectral band set is a major capability of MERIS which has yet to be adequately demonstrated. Modified MERIS bands should be used to study the 650 to 720 spectral region
  - ESA response:
    - Dedicated spectral campaigns with altered MERIS bands covering different user requirements for vegetation, water, and also atmosphere are under implementation. ESA needs to consider from an operational point of view that during these campaigns no nominal mission data will be acquired which will affect operational tasks. So these missions must be short.
    - Users must be aware that no L2 data will be provided – just recalibrated Level 1b will be available.
- The synergetic use of AATSR and MERIS, ASAR and MERIS, MERIS and MWR should be further exploited.
- Existing radiative transfer tools used to generate auxiliary data should be made available to the user community.

Observed Issues and Recommendations

New L2 products

Mostly land

- Need for defining new L2 land products by fully exploiting the capabilities of the MERIS instrument not available from other sensors.
  - ➢ ESA response:
  - for the land community at present we have MGVI, NDVI, rectified reflectances at 665 and 865nm, DDV AOT, surface pressure.
  - new MERIS Terrestrial Chlorophyll Index (MTCI) will be provided in the L2 product replacing the NDVI.
  - algorithms for experimental MERIS products, i.e.LAI, fraction cover, chlorophyll content, surface reflectance under development; shall be made available in source code under the BEAM software
- Need for defining new atmospheric L2 products:
  - Aerosol path radiance at 665 nm
  - Particular Matter: PM 10
  - Aktinic fluxes

Observed Issues and Recommendations

L3 products

- Need to provide L3 temporal composites on the basis of already existing L2 products; examples would be:
  - Ocean: weekly averaged maps of Algal 1, AOT, normalized water leaving radiance at 443, 490, 510, 560 nm;
  - Land: 10 days composite of rectified bands, MGVI;
  - Atmosphere: daily, weekly, monthly composites of water vapour, cloud albedo, cloud optical thickness, cloud type (+cloud fraction)
    - ESA response:

      -Level 3 product generation is a major task. Product specifications shall reflect clear needs from committed users.

      -Generation of new Level 3 products following MERIS User Workshop recommendations will be considered case by case as appropriate, starting in priority with those Level 3 derived from existing Level 2 products.

      -Several ways to produce L3 data can be envisaged: Envisat Ground segment, GMES and/or DUE projects (e.g. Coastwatch, ROSES, GMFS, Clobcarbon, Globcolour, Globcover), as well as Users initiative (**BEAM routines**, etc).

Observed Issues and Recommendations

Services

- Data availability:
  - ✓ MODIS data are easily available and can be acquired from local receiving stations. MERIS data accessibility is far too complicated and needs to be improved.
  - ✓ Need for Near Real Time data delivery at regional scale.
- Data ordering is amazingly difficult. The DESCW step in the ordering renders the procedure overly complicated. Information on cloud coverage percentage should be available from the catalogue before ordering a product. FR data ordered via EOLI came with wrong sub-image. ESA to considerably improve the data ordering.
  - ➢ ESA response: On-line ordering system EOLI Web is progressively made available to MERIS users. Bugs on MERIS FR sub-image location has been fixed.
- Data delivery performance still not as good as it should be. Distribution through the WWW should be envisaged.

Observed Issues and Recommendations

User Tools

- BEAM is an excellent initiative. It shall evolve. Follow the Seadas approach and include L2 processing modules in BEAM to enable individual processing such as atmospheric correction, improved pixel classification, or regional water constituents retrieval. Most important element is the atmospheric correction.
  - ESA response:
    - Major improvements and expansions planned for 2004. Users are encouraged to join the Open Source Software Development team and enrich the Toolbox with new algorithms.
- Provide tool for co-registration and map projections.
  - ESA response:
    - BEAM version 2.2 already presents some of these tools.

Observed Issues and Recommendations

MERIS Follow-up

- The user community is convinced that MERIS should be a test bed for future missions, and the continuation of a MERIS mission is of great importance.
- Continuity of data for future ocean and terrestrial observations and sciences is a major concern, as there is no guarantee of follow-on capability to MERIS.
  - ESA response: The issue is taken seriously. ESA recognizes that the MERIS and MODIS sensors will end at similar time. ESA and the EC along with the GMES partners are addressing the issue of long-term observations needed to achieve sustainable operational services. A first major step in this respect is the GMES Interim Report (2001-2003, V.3.5, pg. 19).
- MERIS like follow-up instrument is required.
- New IR channels would be useful for land and atmospheric applications.
- Outstanding MERIS radiometric accuracy should be kept in new sensors dedicated to earth observation.

Observed Issues and Recommendations

Data Policy

- Setting quota is not supporting the use of MERIS data. Also the restriction to distribute the images to others does not support the use of MERIS. Free exchange of processed MERIS images should be allowed and even encouraged.

Validation of MERIS surface reflection and chlorophyll 1 and 2 products during the BENCAL cruise (2002).

J. R. Fishwick[1], R. Barlow[2], and J. Aiken[1].

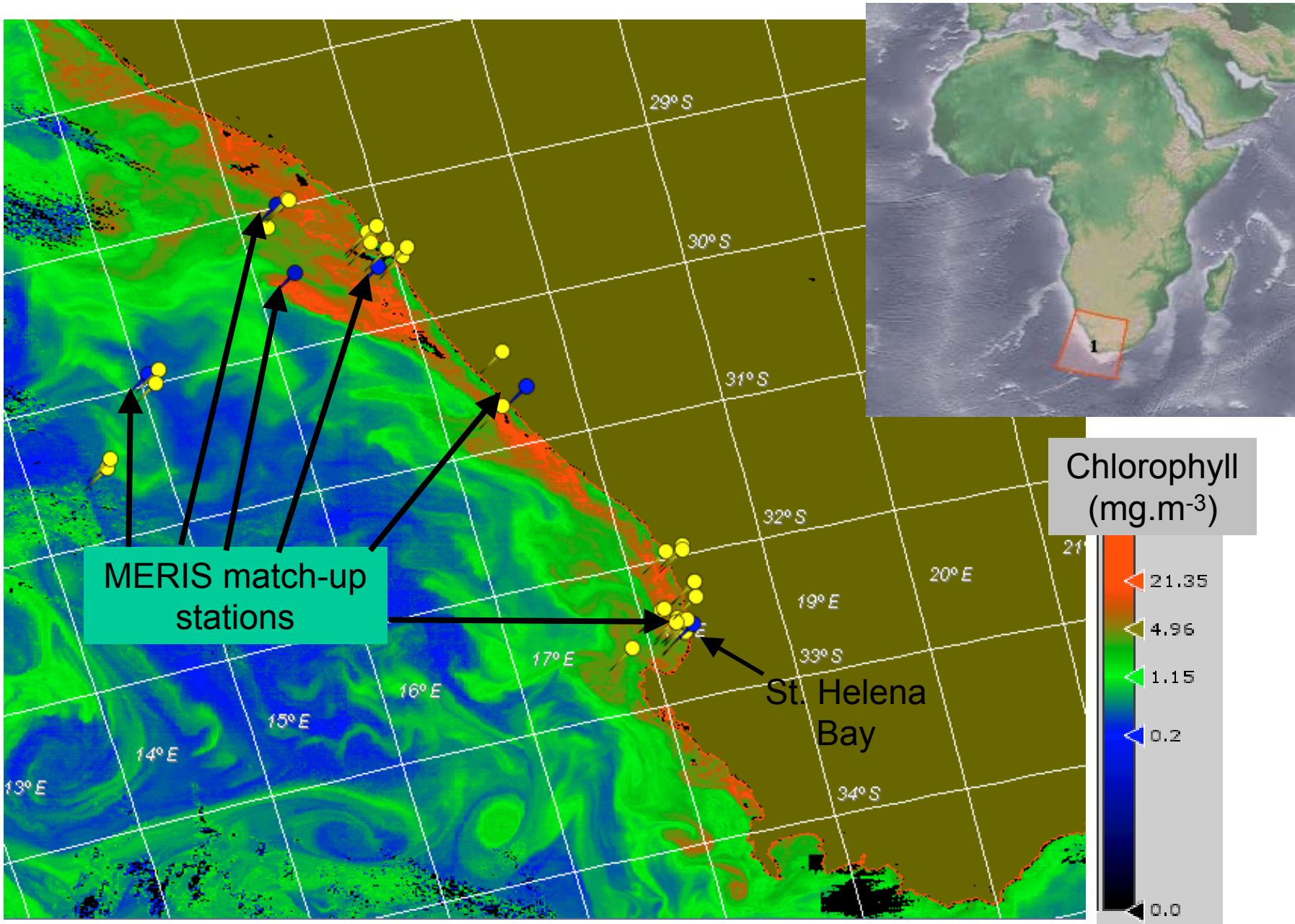
- *Plymouth Marine Laboratory,*
  Prospect Place,
  The Hoe,
  Plymouth,
  U.K.
  Email: J.Fishwick@pml.ac.uk

OTHER:
LOV – Morel
NASA - Hooker

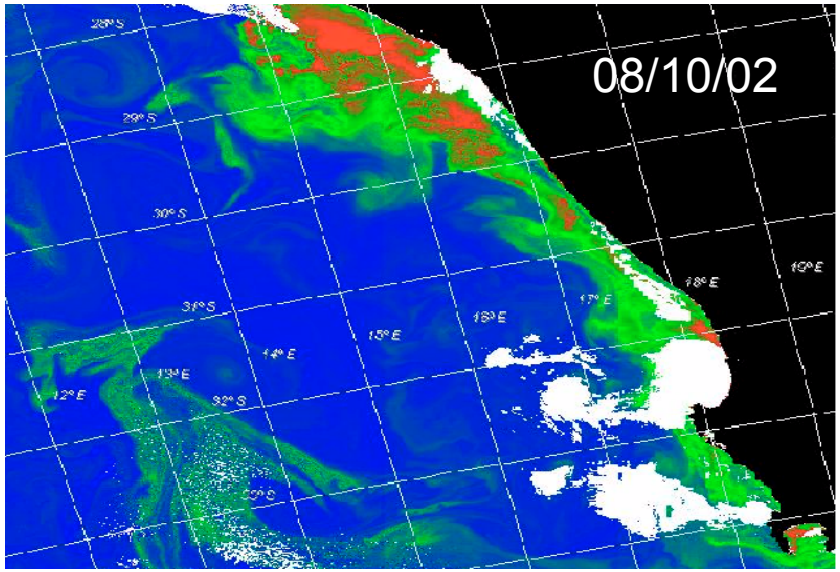
BENCAL Cruise (2002)

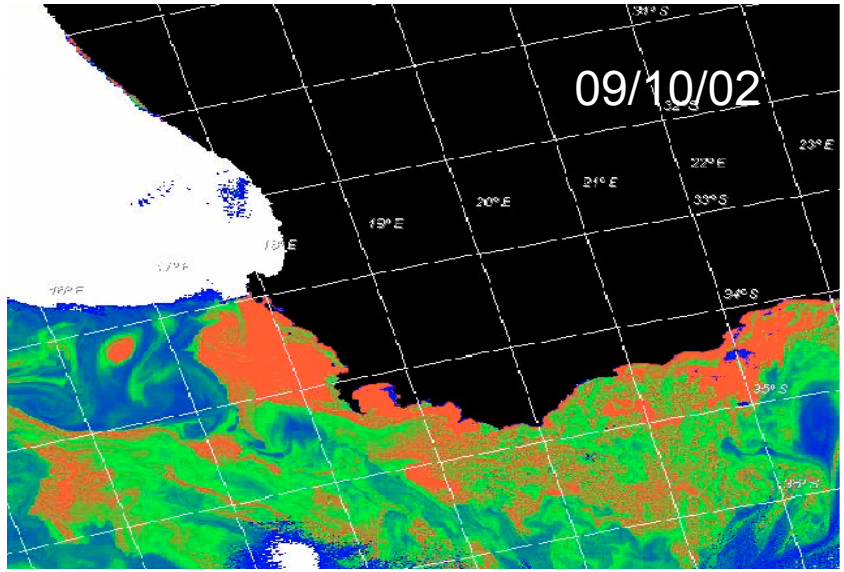
- Benguela ecosystem, 4 – 18 October 2002 onboard F.R.S. Africana.
- Validation of MERIS, SeaWiFS, and MODIS sensors
- Bio-optical teams representing ESA:
  - PML (UK)
  - LOV (Fr) Morel
  - NASA (USA) Hooker
- 41 stations sampled, Chla range 0.25 to 35 mg.m-3
- 33 CTD casts for pigment analysis
- 381 casts at 34 stations with the PML MicroPro optical profiler
- NASA (Hooker) over 1000 casts

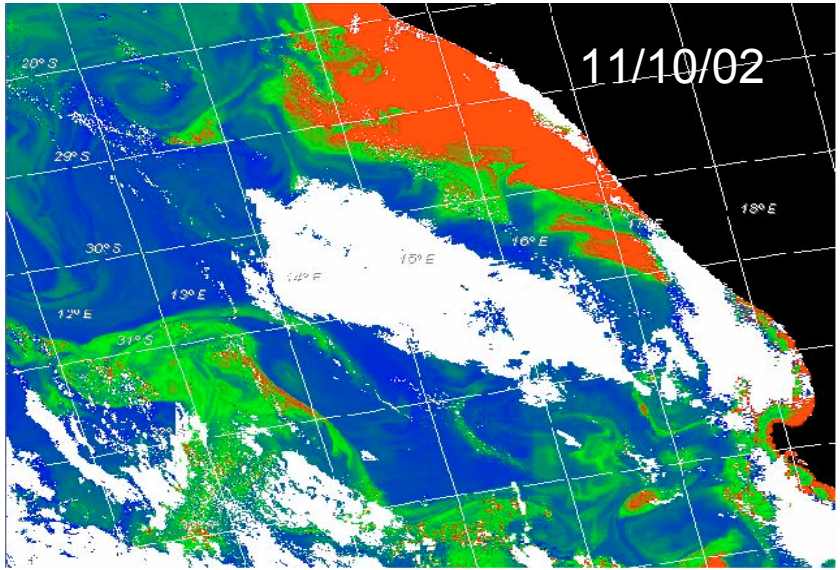
BENCAL station locations

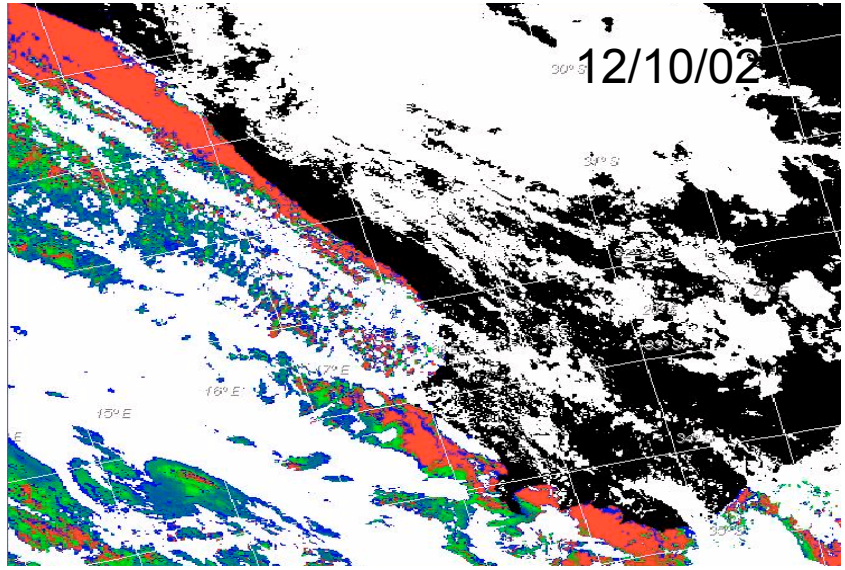


BENCAL MERIS images

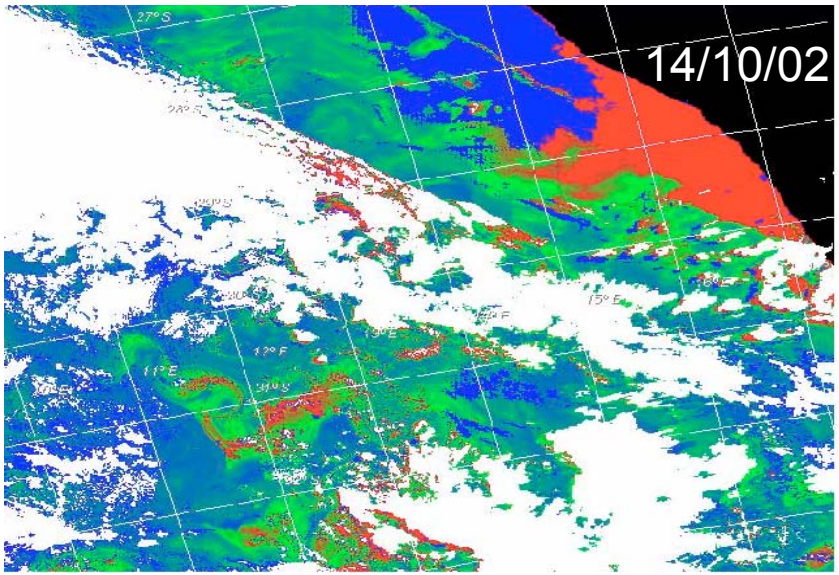


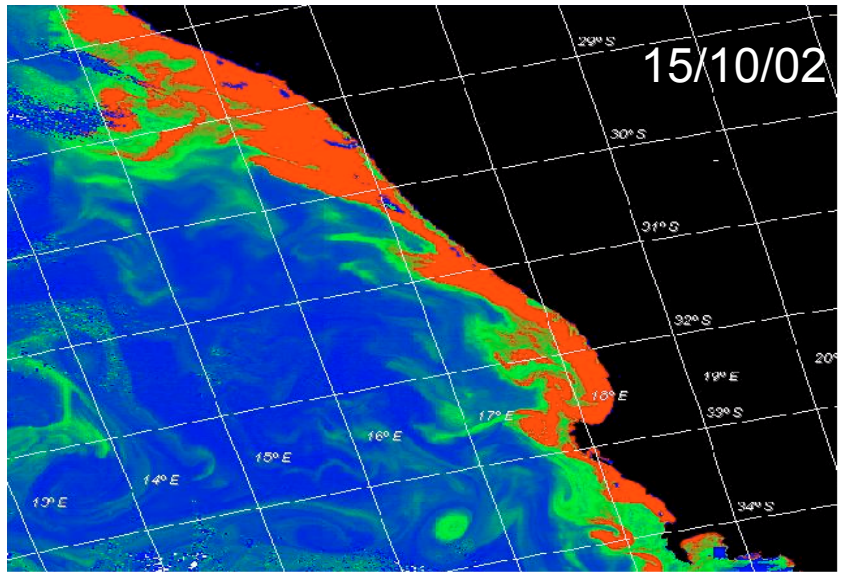


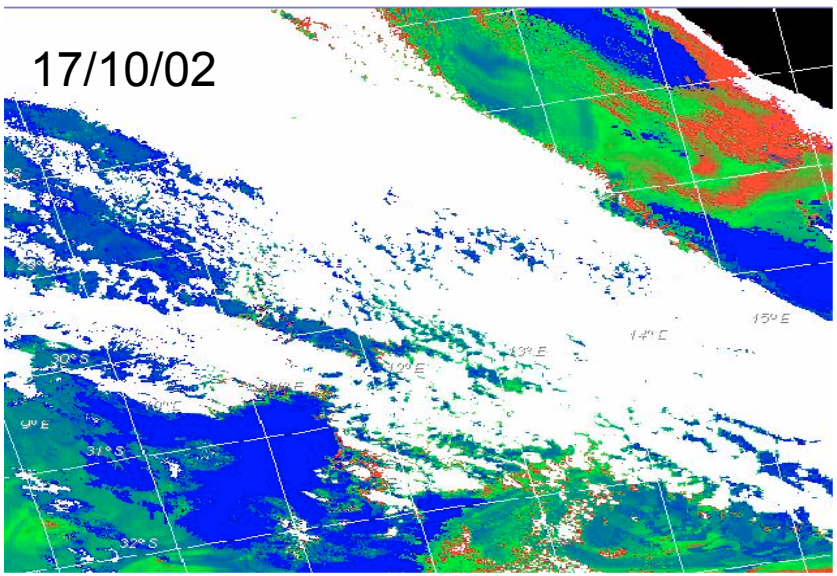




BENCAL MERIS images

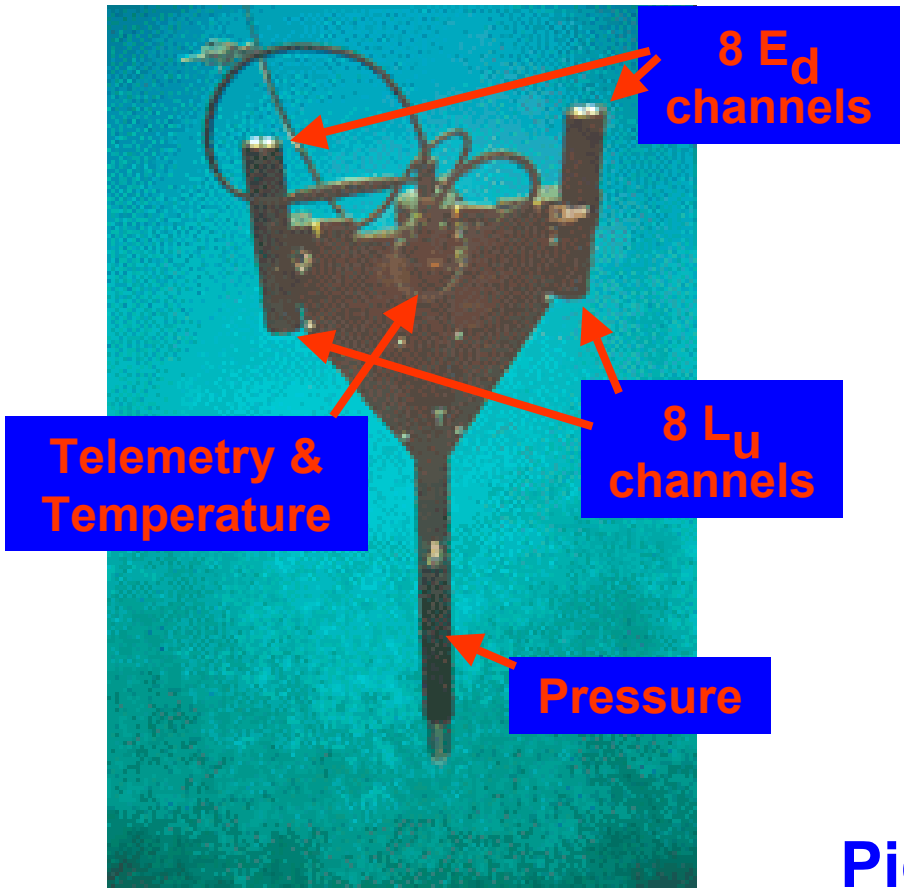






- Out of seven images only three station match-ups achieved
- 11/10/02, Station 22
- 14/10/02, Station 29
- 15/10/02, Station 32
- All other images affected by either cloud cover or high glint

Methods



Optics

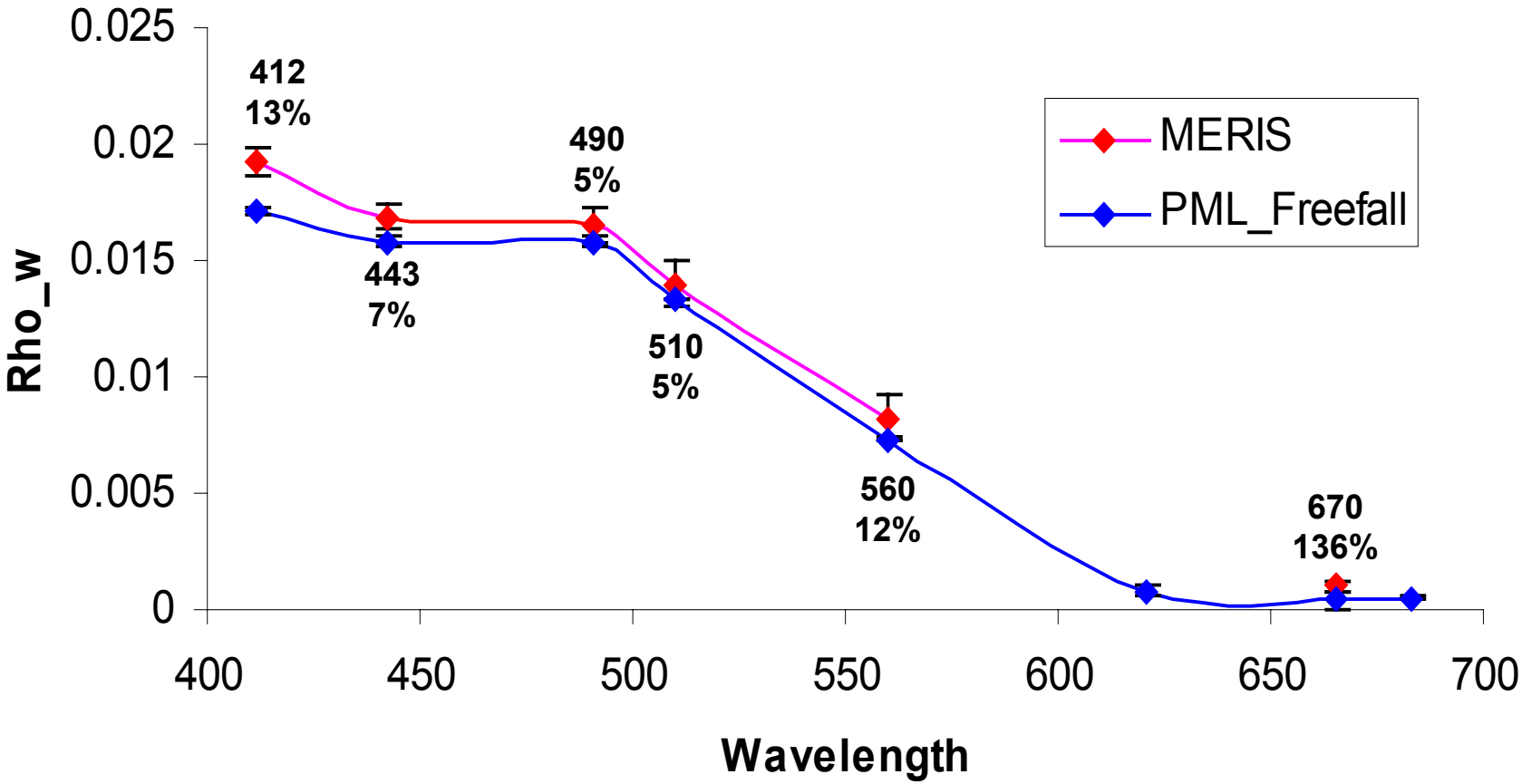
- **Satlantic MicroPro 030**
- **Above water downward irradiance (E_s), below water downward irradiance (E_d), and below water upward radiance (L_u), measured at 8 MERIS matched wavelengths**
- **>20m from stern of vessel**
- **Instrument allowed to freefall through the water column whilst data is logged live up the wire**

Pigments (HPLC)

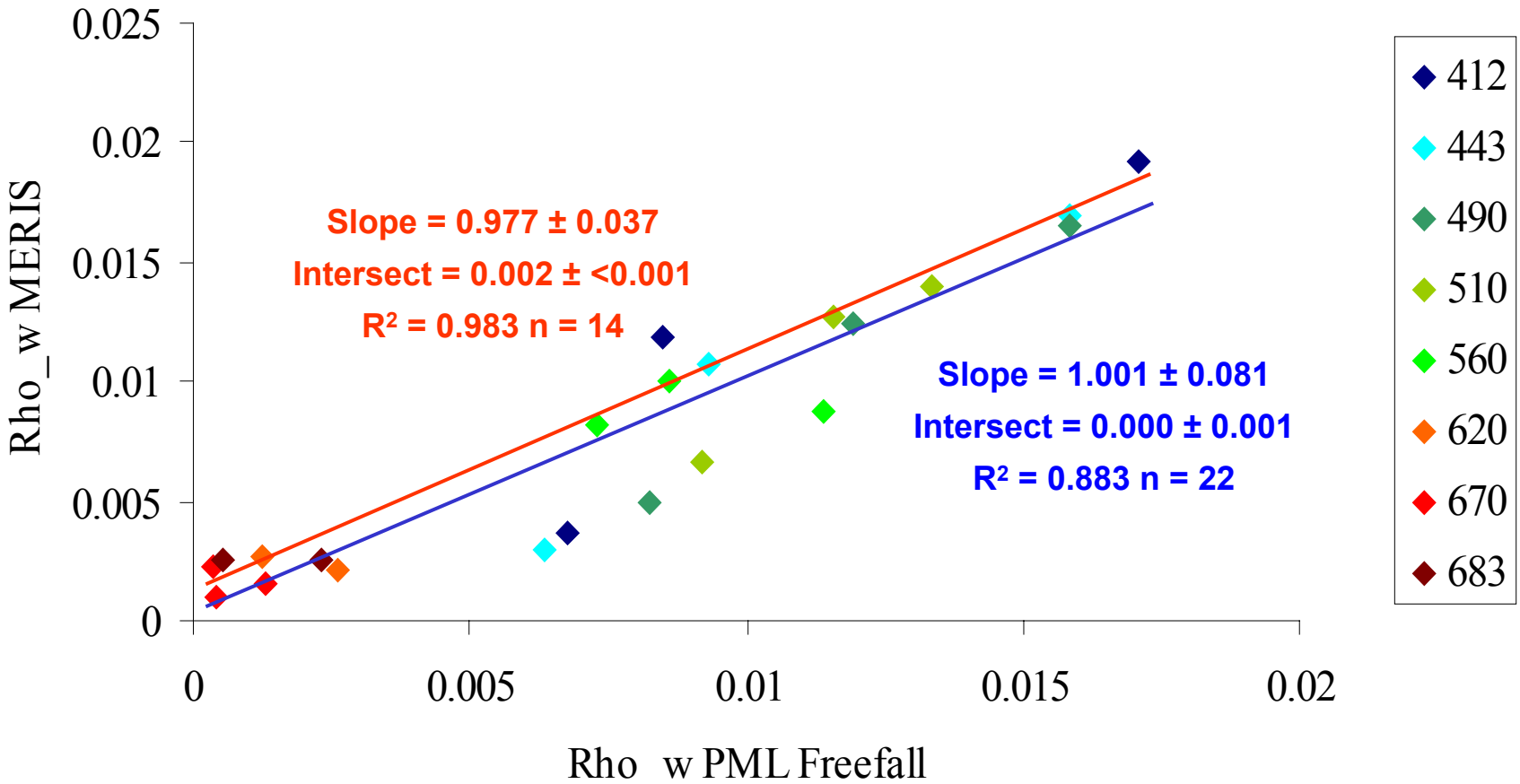
Barlow, R.G., D.G. Cummings, and S.W. Gibb, 1997: Improved resolution of mono- and Divinyl chlorophylls a and b and Zeaxanthin and Lutein in phytoplankton extracts using reverse phase C-8 HPLC. *Mar. Ecol. Prog. Ser.,* **161,** 303-307

Station 22

- Two in-situ profiles averaged for this station
- Nine pixels on a 3x3 grid used for MERIS data



Comparison between MERIS and PML in-situ data



Chlorophyll Validation

Station 22, 11 October 2002

	MERIS Chl ($mg.m^{-3}$)	Standard Deviation	In-Situ Chl ($mg.m^{-3}$)
Chl 2	0.5248	0.0661	0.650
Chl 1	-	-	0.692

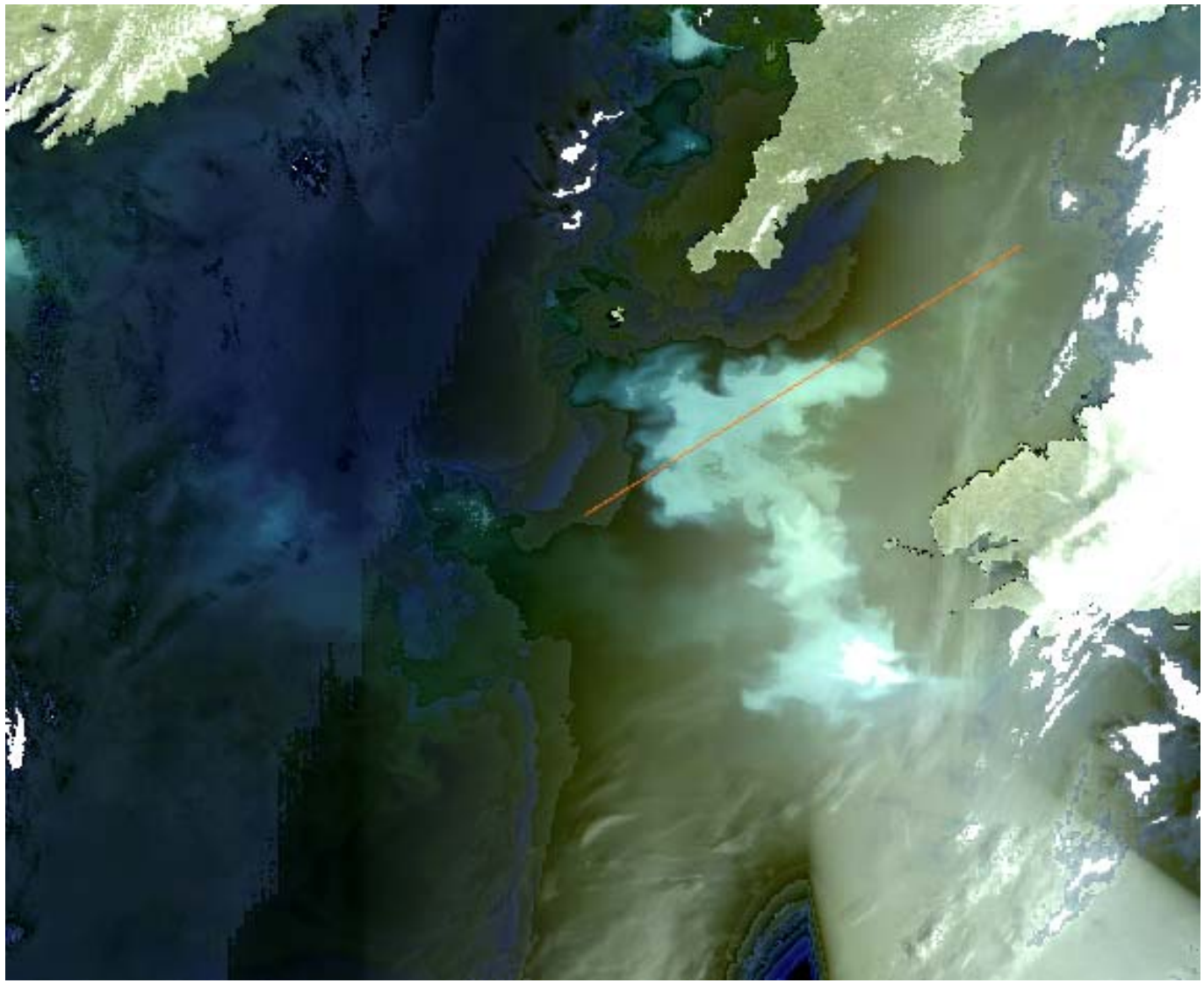
Station 29, 14 October 2002

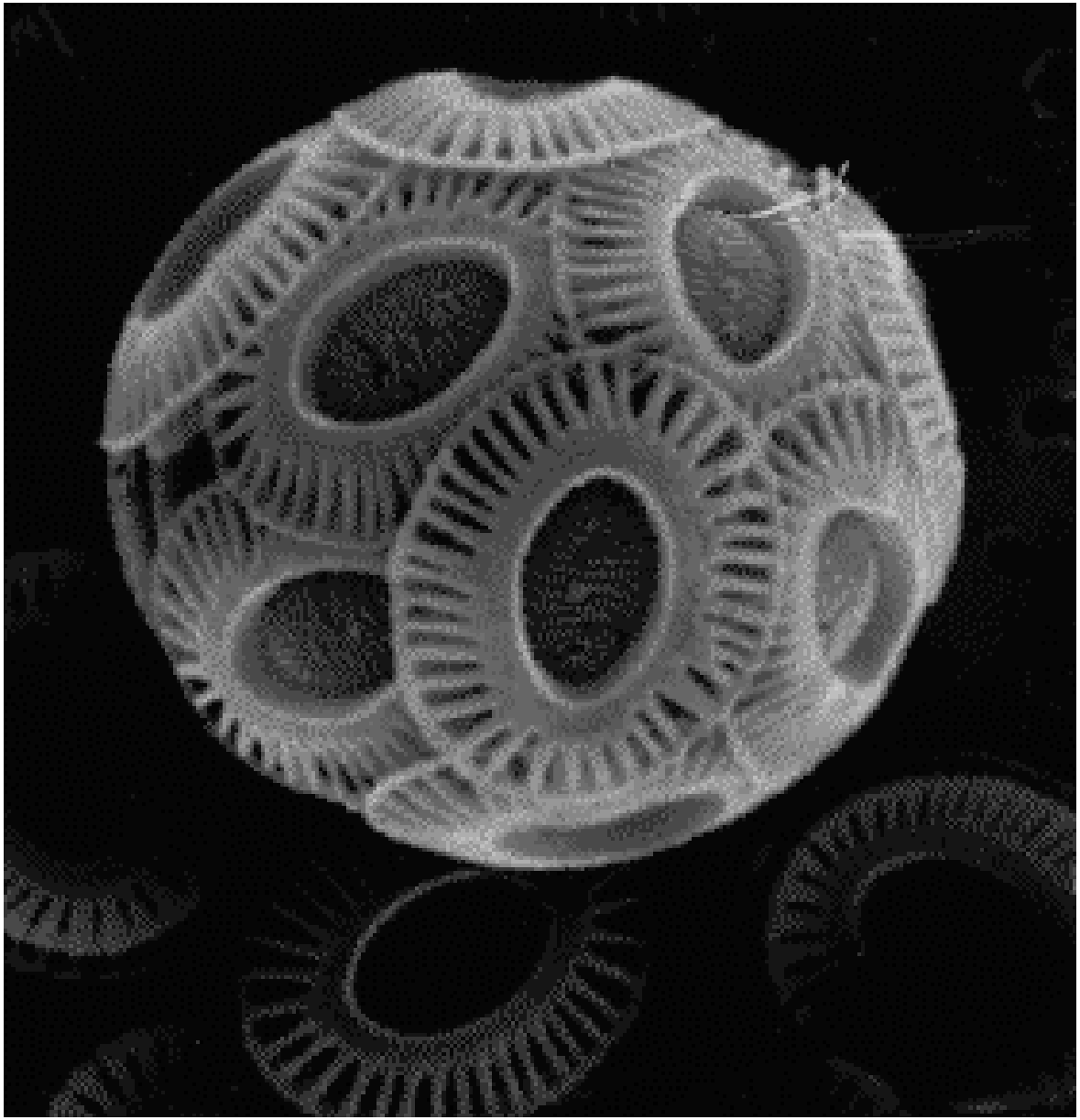
	MERIS Chl ($mg.m^{-3}$)	Standard Deviation	In-Situ Chl ($mg.m^{-3}$)
Chl 2	1.3733	0.1156	1.020
Chl 1	4.1898	0.7272	1.152

Station 32, 15 October 2002

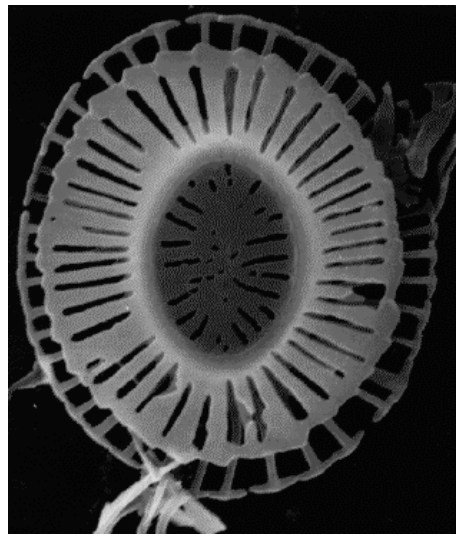
	MERIS Chl ($mg.m^{-3}$)	Standard Deviation	In-Situ Chl ($mg.m^{-3}$)
Chl 2	12.2282	4.2689	5.891
Chl 1	14.4755	1.8599	6.278

AMT 13
June 2003
Western
English
Channel






Portugal
EXPO'98
100
Cocolitoforídeo Calcidiscus leptoporus
Design : Pedro Salgado
Imp : Lito Maia 97




CASIX
Centre for Observation of Air-Sea Interactions and Fluxes