



Spectral Signatures

Presentation
for
CIWEM
Warrington

- **Non-contact sensing:**
The technology can deliver.
Can the benefits be harvested?

Eon O'Mongain

11/11/2005



Spectral Signatures

- Developer of innovative optical instruments.

Addressing the measurement needs of environmental water monitoring agencies and water processing companies internationally.

Specialising in real time on-line applications with flow-through and non-contact technologies.



Spectral Signatures

Eon O'Mongain/Andrew Colliins

- Company Background
- Our path towards non-contact monitoring in the Water Industry?
- Demonstrating the technology
- Establishing Real benefit



Spectral Signatures -Background

Eon O'Mongain

PhD in Astrophysics from UCD Dublin

Astrophysicist with Smithsonian Institution, U.S.A.

Calibration Specialist: Satellite Instrument Design Projects, E.S.A.

Applied Physics Research Group , University College Dublin

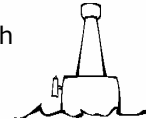
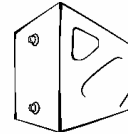
Remote Sensing,
Optical instrumentation for Environmental Monitoring

Campus Company established for research exploitation



Products

- Transferred Chlorophyll measurement out of the laboratory.
- Airborne Chlorophyll measurements
- **ChloroFlow**, a chlorophyll measuring product for Lab/Field/Ship or monitoring/research vessel. (<1 ppb chlorophyll sensitivity)
- From Airborne to non-contact technology
- **ChloroPod**, for Remote/Unsupervised chlorophyll and water optical properties monitoring
- **AguaPod**, for continuous [unsupervised non-contact] Dissolved Organic and Suspended Matter monitoring (DOM and SPM).



Clients

- Scottish E.P.A.
Dept. Agriculture N.I. (DANI)
Environment Agency (England & Wales)
Countryside Commission for Wales
Japan
E.P.A. Ireland
Marine Institute, Ireland,



R and D. Background: Spectroscopy of Environmental Waters

1990-2003

- Spectroscopy- within the water column
 - **The MARAS Submersible Spectroscopy System:**
Validated optical properties of constituents
Demonstrated in-vivo quantification capability
Led to ChloroFlow as a replacement for laboratory extraction methods.
- Spectroscopy- above the water
 - **Airborne Reflection Spectroscopy:**
Validated for airborne monitoring of lakes
Utilises known absorption properties of water
Led to ChloroPod for in-situ Chlorophyll monitoring
Led to AguaPod for Suspended matter monitoring



The MARAS Submersible Spectroscopy System:





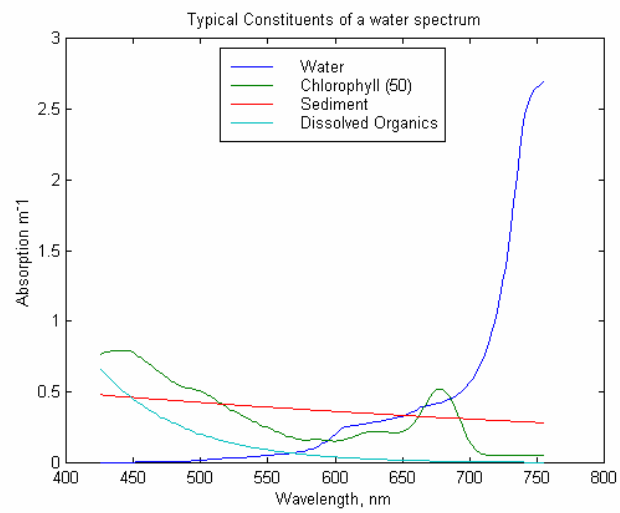
Spectroscopy above the water



- Airborne spectral reflectance measurement

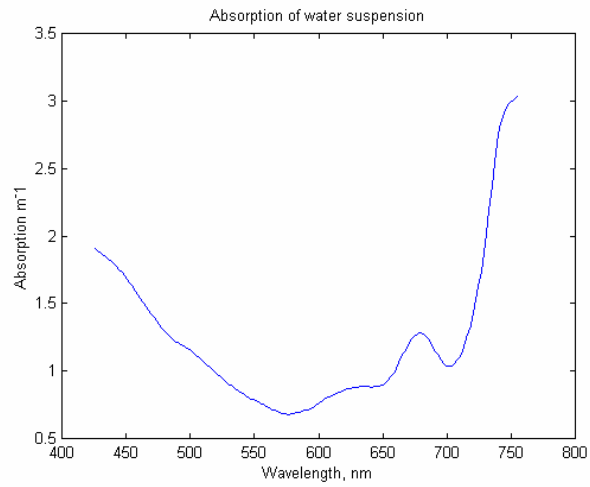


Basics of Absorption of Water Constituents





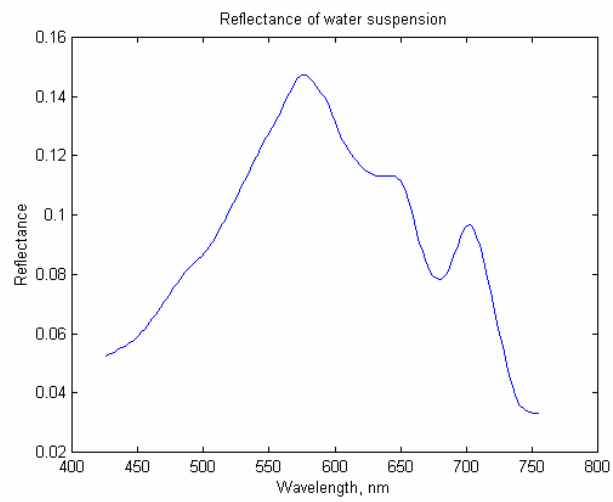
Combined Absorption of Water Constituents



A typical mixture of DOM, suspended matter and chlorophyll



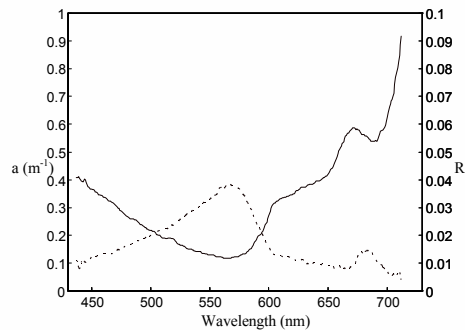
Reflectance of Combined Water Constituents





The MARAS Submersible Spectroscopy System:

- The spectral absorption coefficient and spectral reflectance Coastal water with Algal content



Absorption, $a(\lambda)$, (solid) and Reflection, $R(\lambda)$ (dashed) for site f3 (depth 1.5m), with green algae. (Chlorophyll a, 6.9₋₁ ug/l; suspended matter, 4.7 mg/l; yellow substance, 0.3m absorbance of filtered sample at 420 nm).

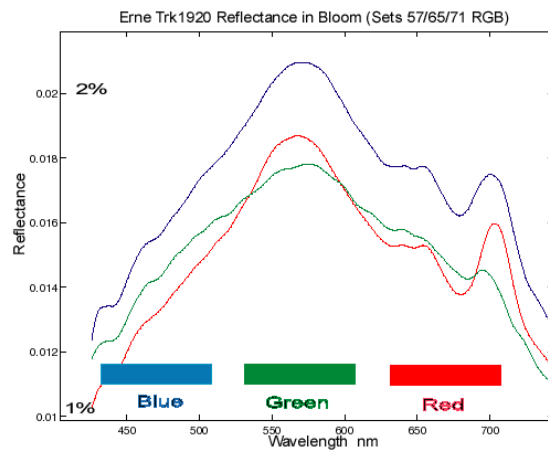
Published [Applied Optics 1997](#)



Spectroscopy above the water



- Spectral reflectance - Lough Erne.





Spectroscopy above the water



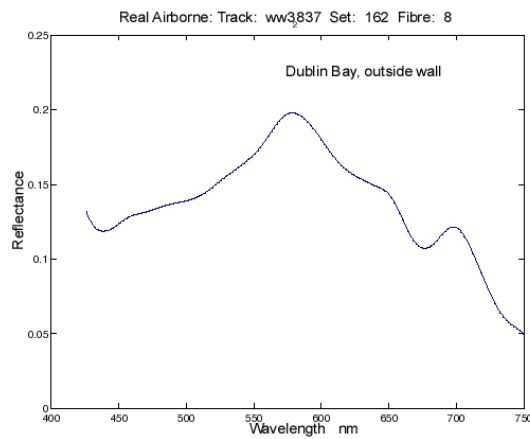
Spectral reflectance – Dublin Bay



Spectroscopy above the water



Spectral reflectance – Dublin Bay

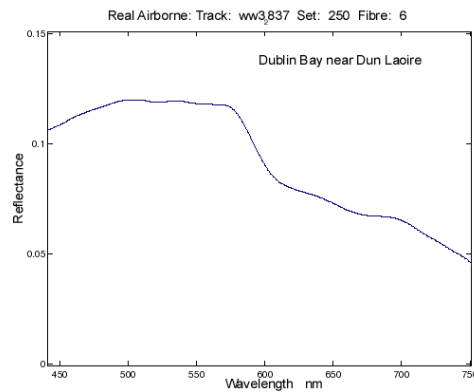




Spectroscopy above the water



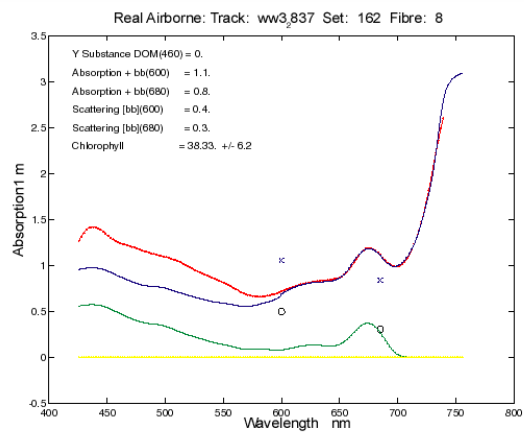
Spectral reflectance – Dublin Bay



Spectroscopy above the water



Spectral reflectance analysis – Dublin Bay

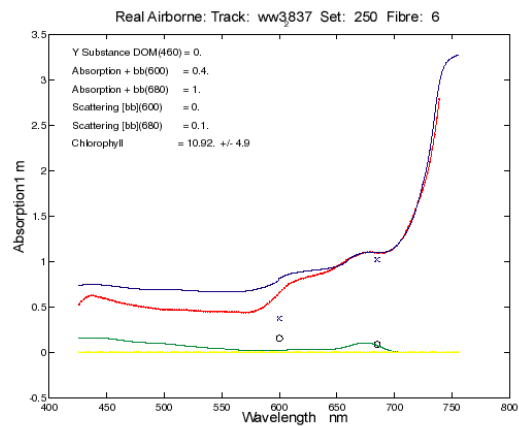




Spectroscopy above the water



Spectral reflectance – Dublin Bay



AguaPod from Spectral Signatures



- Package airborne technique for near-surface applications giving:
- Accurate real-time measurement of colour and suspended materials
- Continuous, unsupervised, rugged and reliable optically based measurements communicated directly to where they are needed.
- Cost effective; replaces sampling, reduces calibration and laboratory costs, provides key information for improved operator productivity and dosing control.
- Non-contact, fouling free capability slashes maintenance costs



AguaPod what does it do?



Install over water

- Simultaneously Yields Water quality parameters:

Dissolved Organic Matter content

(as DOM absorption at 400 nm in units of m^{-1}).
Easily converted to Hazen or other units

Suspended matter absorption

(as absorption in 600-700 nm band in units of m^{-1})

Suspended matter scattering

(as backscatter in 600-700 nm band in engineering units)

Chlorophyll-a concentration (in microgrammes per litre)



AguaPod Technical features



Spectrometer, 400-800 nm, <5 nm resolution
Multiple fibre inputs, monitor source and target
Reflectance reference for scattering calibration
Absorption calibration is automatic
CCD Array camera,
Long integration times (1 to 10 secs) for low light levels
Rugged, stable and sensitive measurement strategy
Full Linux PC operating system with communications
and data-logger capability
24 hour continuous operation, remote supervision
Web server functionality, on-site or remote



AguaPod Main features



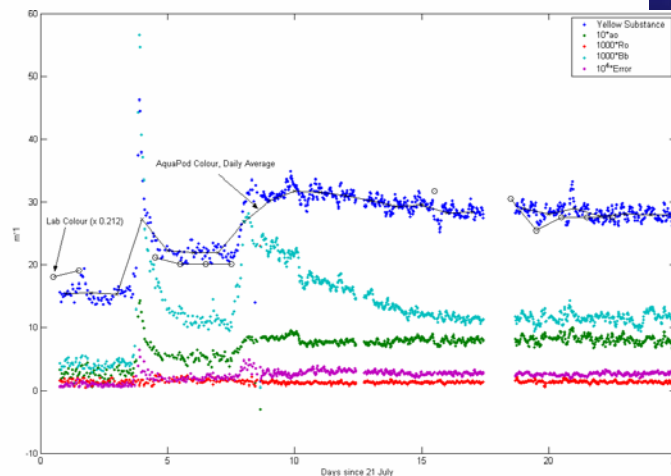
- *-in-situ* real time water monitoring
- where optical measurements (e.g. turbidity) are required without fouling effects: the 'non-contact' advantage
- sampling and analysis more frequently with less cost.
- continuous change detection and alarm function.
- the feedback of more parameters in real time to improve operations and productivity.



AguaPod Applied to colour in intake waters



Dublin City Water, Potable water treatment plant, Ballyboden, July/August 2005





AguaPod Colour in Intake waters

What does this show?

Colour; Dissolved organic matter quantified by blue/green spectral absorption shape.

Suspended matter: At this plant the suspended matter varies from absorbent peaty particles to washed down sediment particles after rain events. Peaty particles are mainly absorbant. Sediment scatters light more efficiently. More comprehensive monitoring than turbidity alone, classifying particles into 'soft' and 'hard' in the optical sense.

How can it be utilised?



Water Processing Requirements

Are there cost driving applications for which AguaPod is suited, bearing in mind its benefits?

No cleaning, low maintenance

No plumbing connections

Relies on optical properties of water and its constituents.

No need for test and calibration expenditure

Improves operator productivity

Lowers data collection costs,

Increases information flow to improve productivity.

Allows for fully integrated measurement and dosing applications



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www.spectral.ie shortly