Monitoring the Marine Environment using a low-cost Colorimetric Optical Sensor

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Sensorcomm
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Outline

1. The problem: Marine pollution events
2. Current Detection Methods
3. Sensor development
4. Testing & Results
5. Conclusions & future work

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The problem:

- Marine pollution events
- Current detection methods
- Proposed solution

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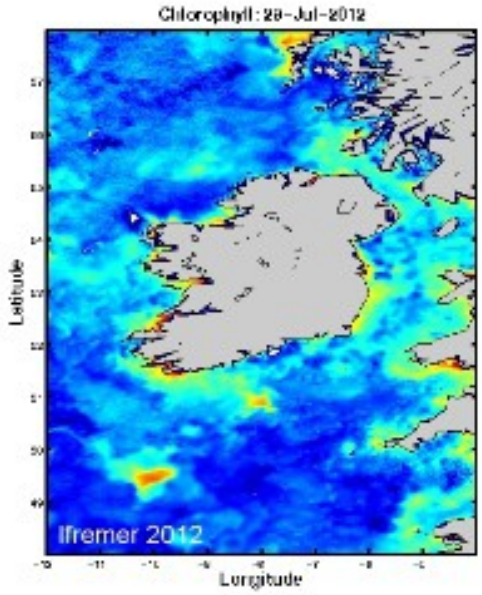
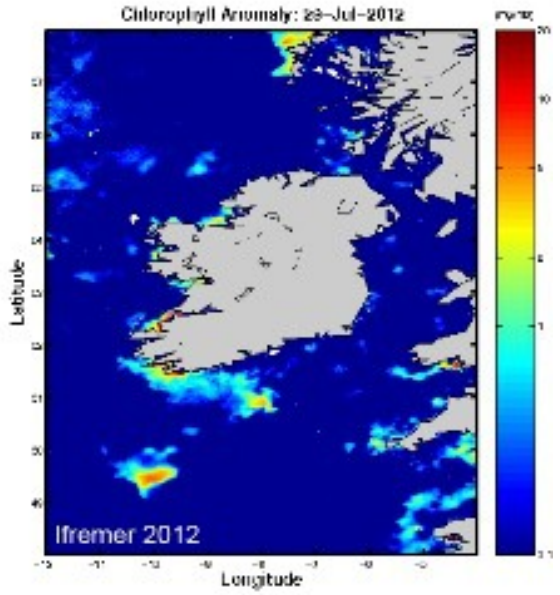
Marine Pollution Events

Coastal Eutrophication
Leads to algal blooms
Some Toxic
Turbid waters

<u>Occurances</u>
Red, Gulf of Mexico, Aug 2012
Green, QuigDao, China, 2008-2012
Green, Ireland, Aug 2012





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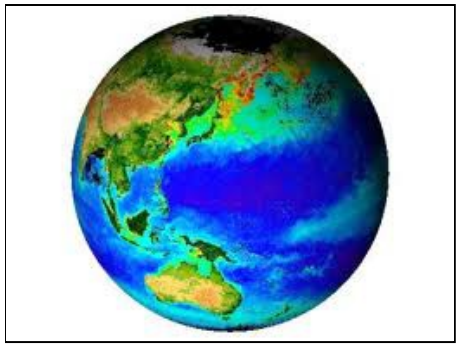
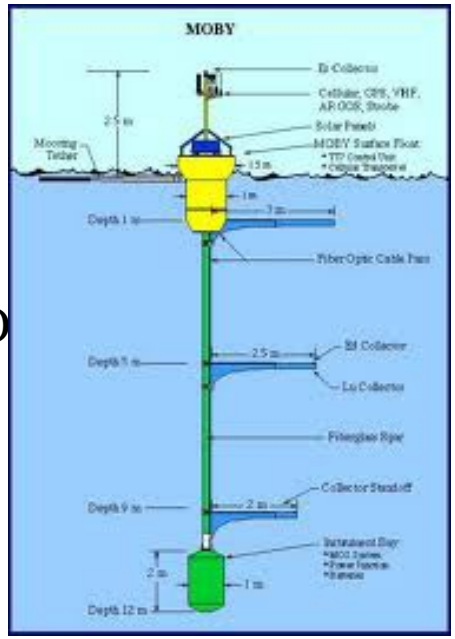
Detection

<u>Manual</u>
Grab sample

<u>Remote</u>
MERIS
MODIS
SeaWiFS

<u>In-situ</u>
NOAA, Marine Optical Buoy (MO
WetLabs Ac9
Satlantic radiometer
Mestech OCS





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Proposed solution

Event detection sensor to inform traditional sampling regimes.

Features

- Measures Inherent Optical Properties (IOP)
- High sample rate (1/15 min)
- Low resolution
- Long term deployable (6 months)
- Multiple deployments
- Low cost
- Intelligent data handling (Alarms, etc)

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Sensor Development

- Sensing principle
- Communications
- Prototypes

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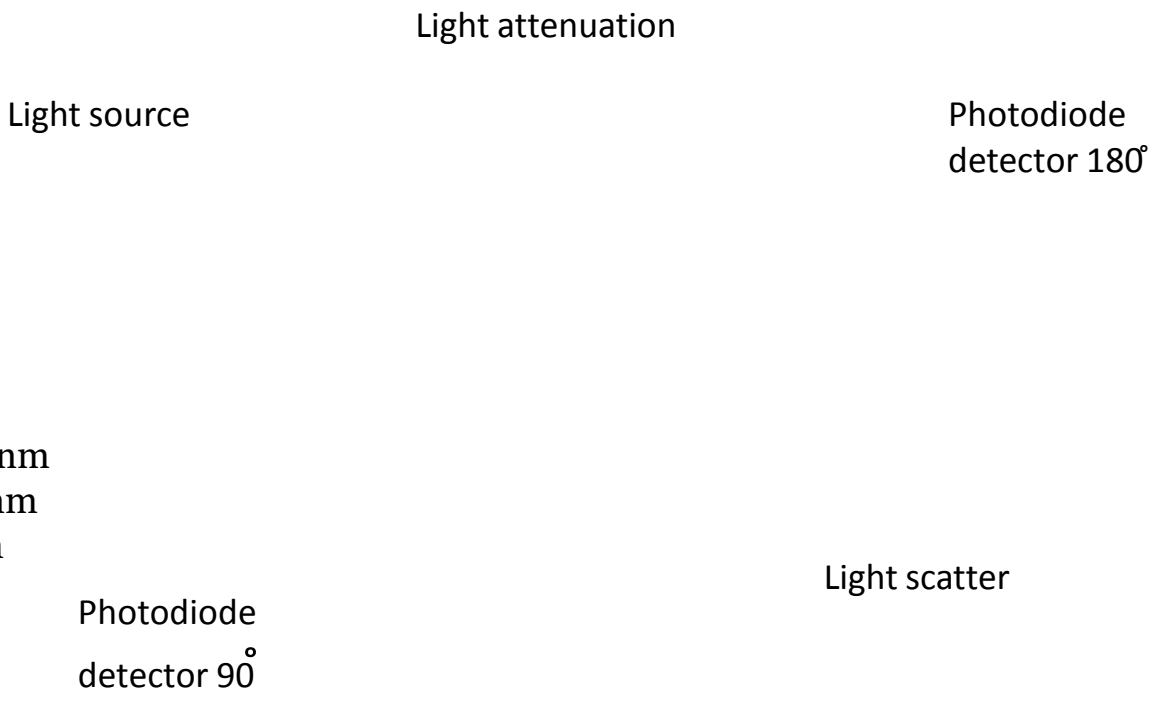
Sensing principle:

Measurements

- Transmittance @ 5 wavelengths
- 90˚ Scatter @ 5 wavelength
  - IR 850 nm
  - Red 625 nm
  - Amber 590 nm
  - Green 520 nm
  - Blue 430 nm



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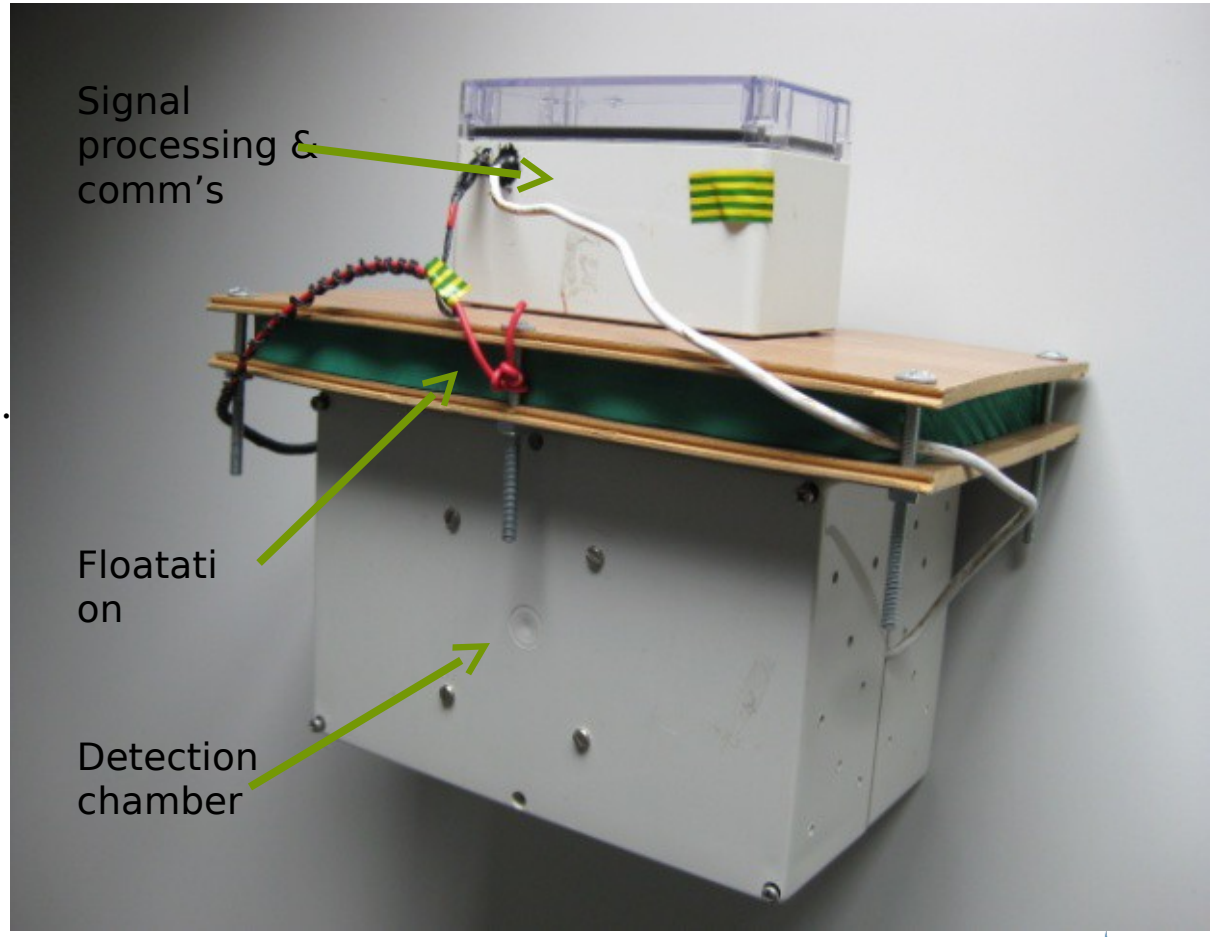
Prototype 1:

Features:

- Laboratory version.
- LED array light source (IR, red, amber, green, blue).
- Photodiodes detectors (90 ˚and 180˚ to light source).
- Short-range wireless .



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Prototype 2 :

Features

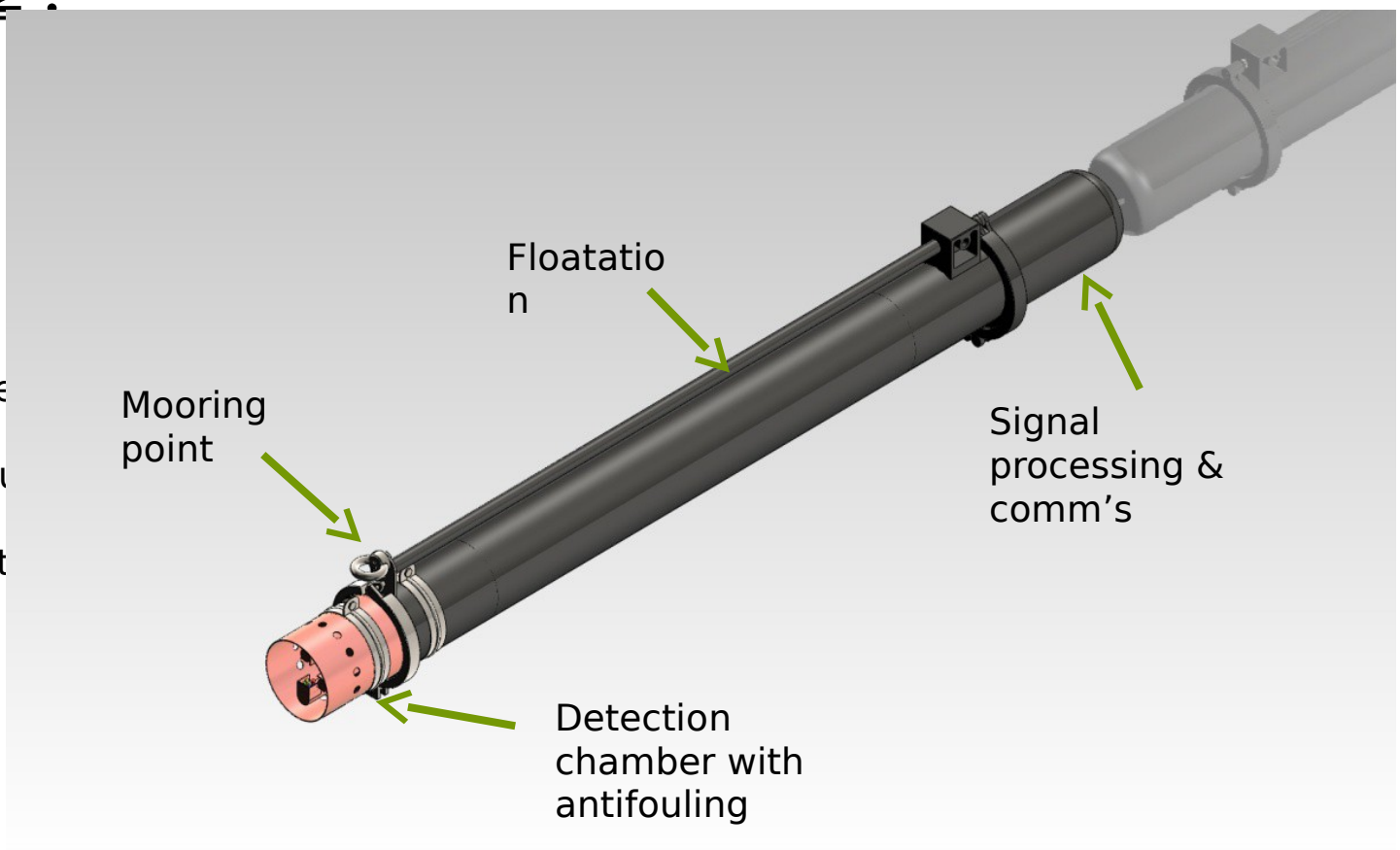
•Field version.

•Robust deployable

• Antifouling measu

• GSM communicat

• Life, 5000 SMS



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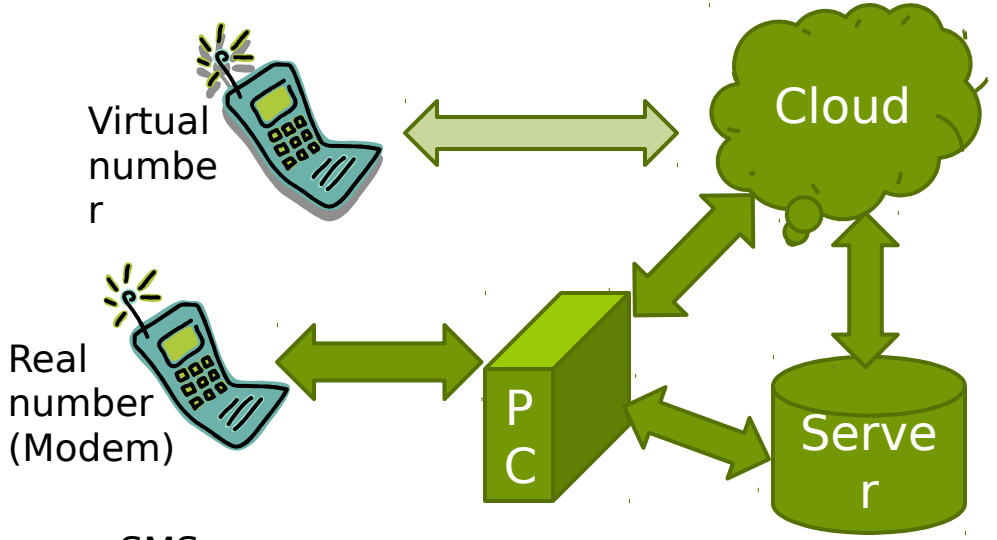
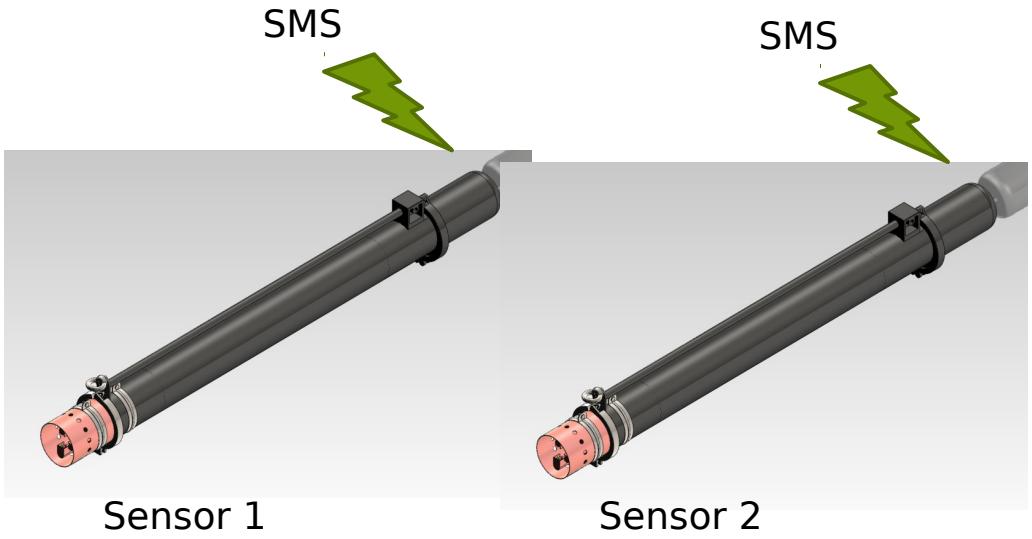
Communications & Data Management

- Short range wireless
- GSM
- Serial Rs232 to third party communications (Wi-Fi)





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Testing and results

- Colour
- Turbidity
- Environmental
- Deployments

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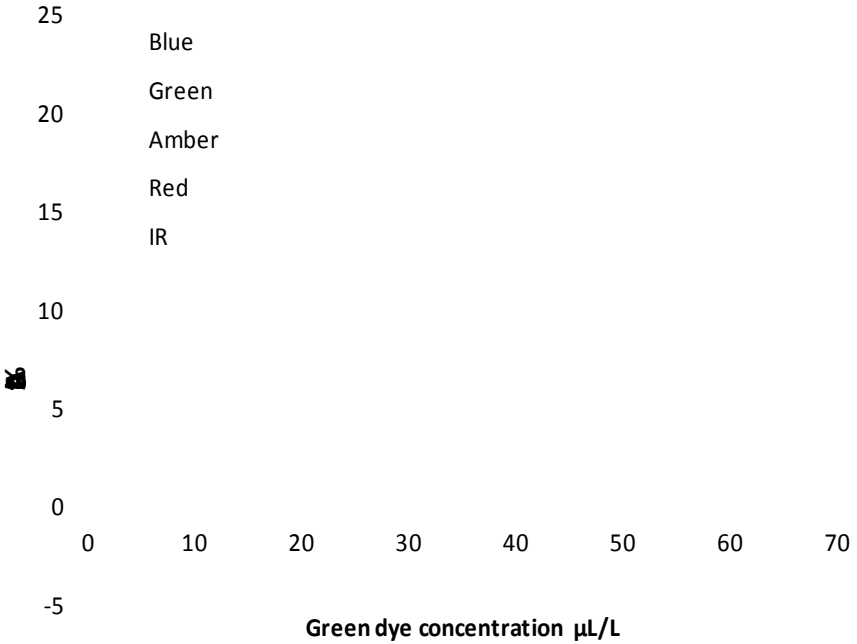
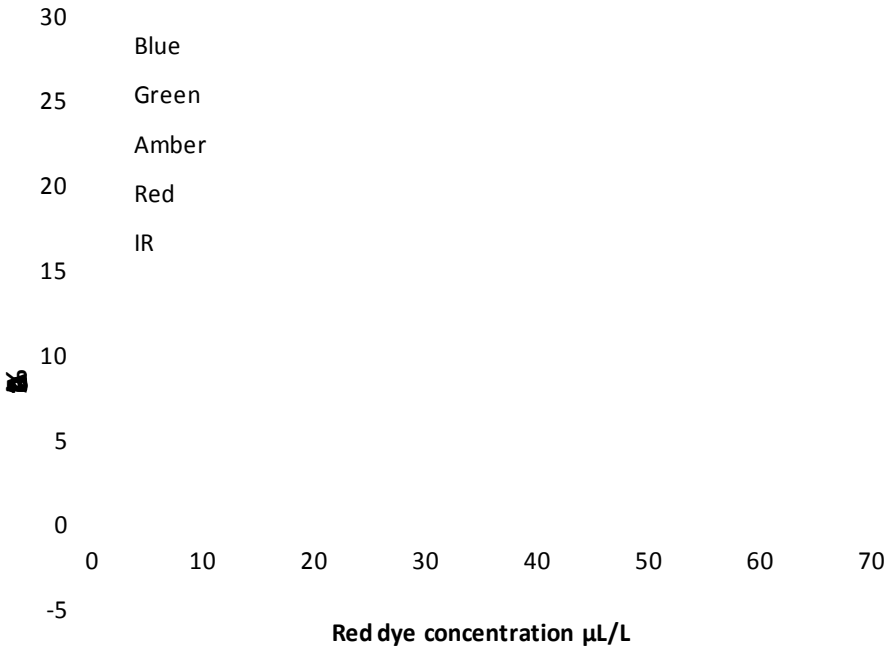
Stage 1 tests: Dye study

<u>Dyes</u>
Red (Ponceau 4R E124)
Green (Tartrazine E102, Green S E142)





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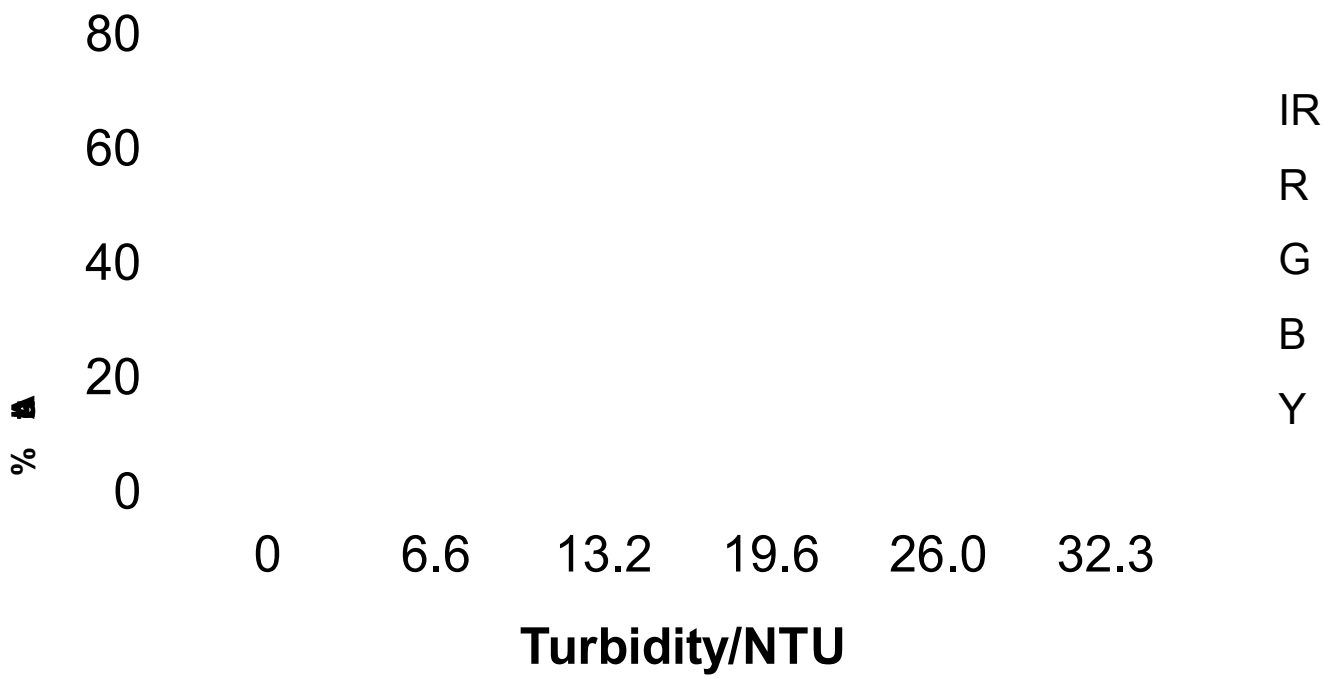
Stage 1 tests: Turbidity

- Hach turbidity standard
- Range found in coastal waters



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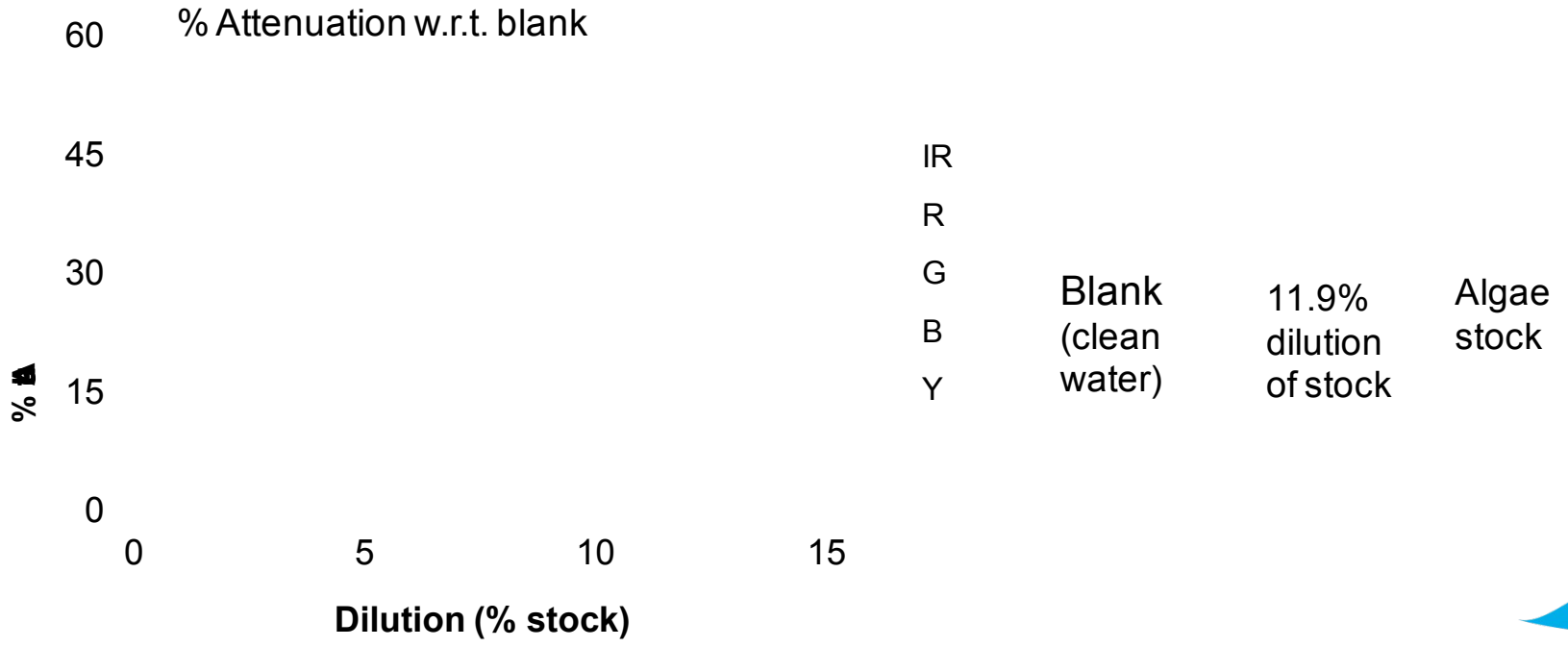
Stage 1 tests: Algal bloom simulation

- Cultured green algae
- Dilutions in clean water



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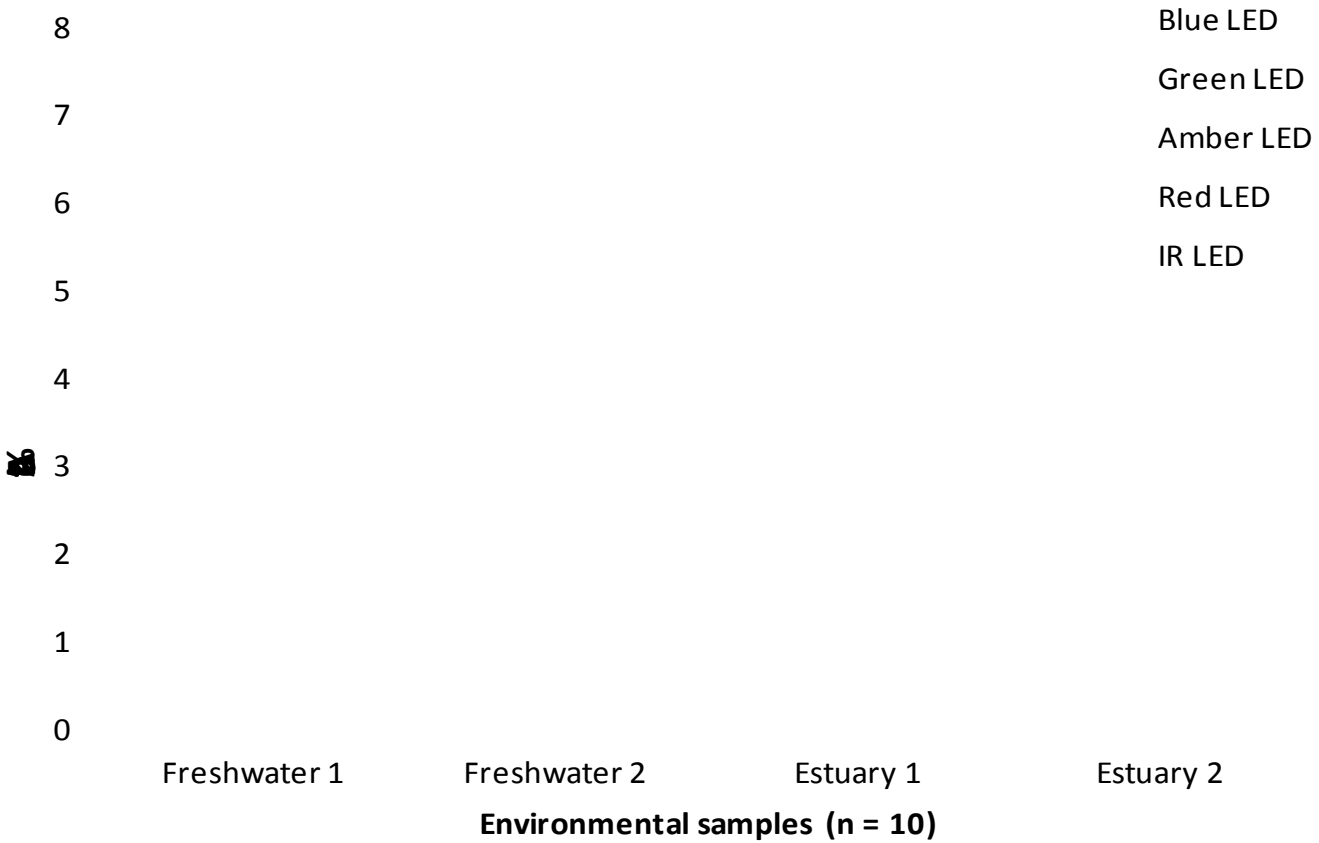
Stage 2 tests: Environmental

Samples
2 X Freshwater
2 X Estuarine



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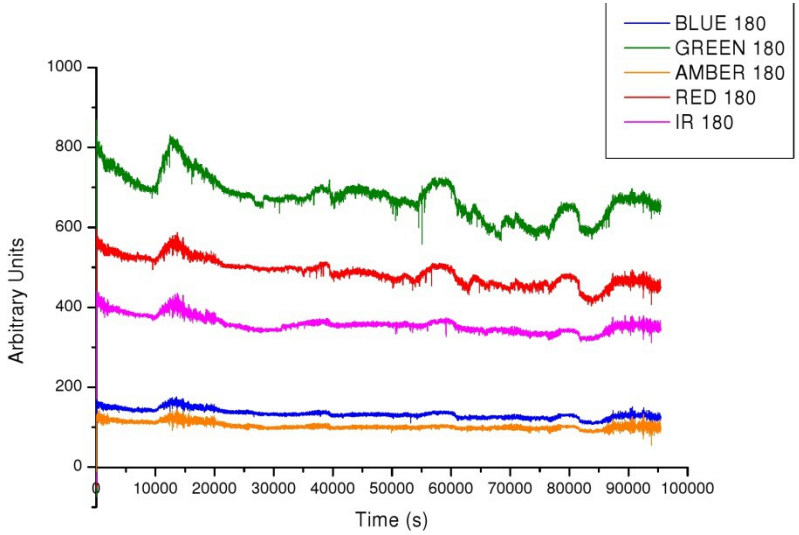
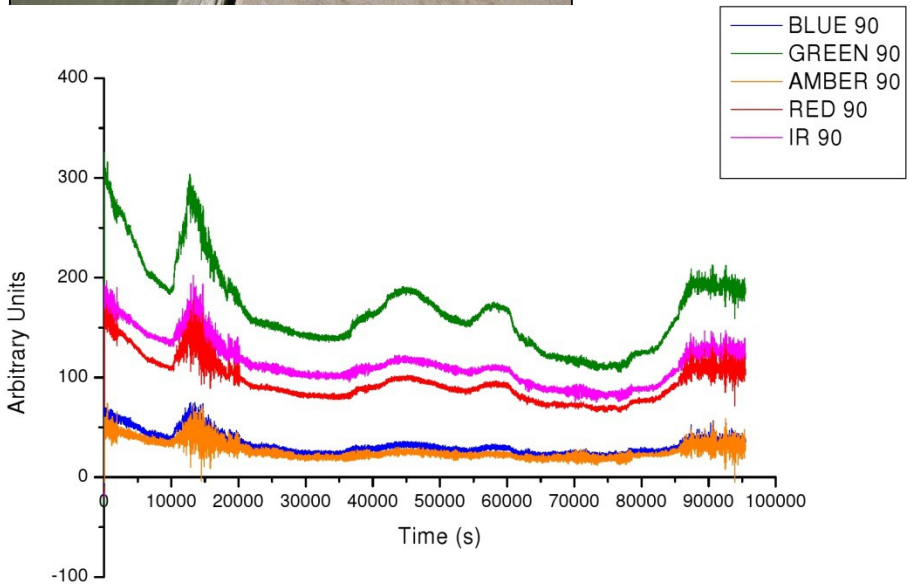
Stage 3 test: 24-hr deployment





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Stage 3 tests: 1 month sea trial at SmartBay Galway

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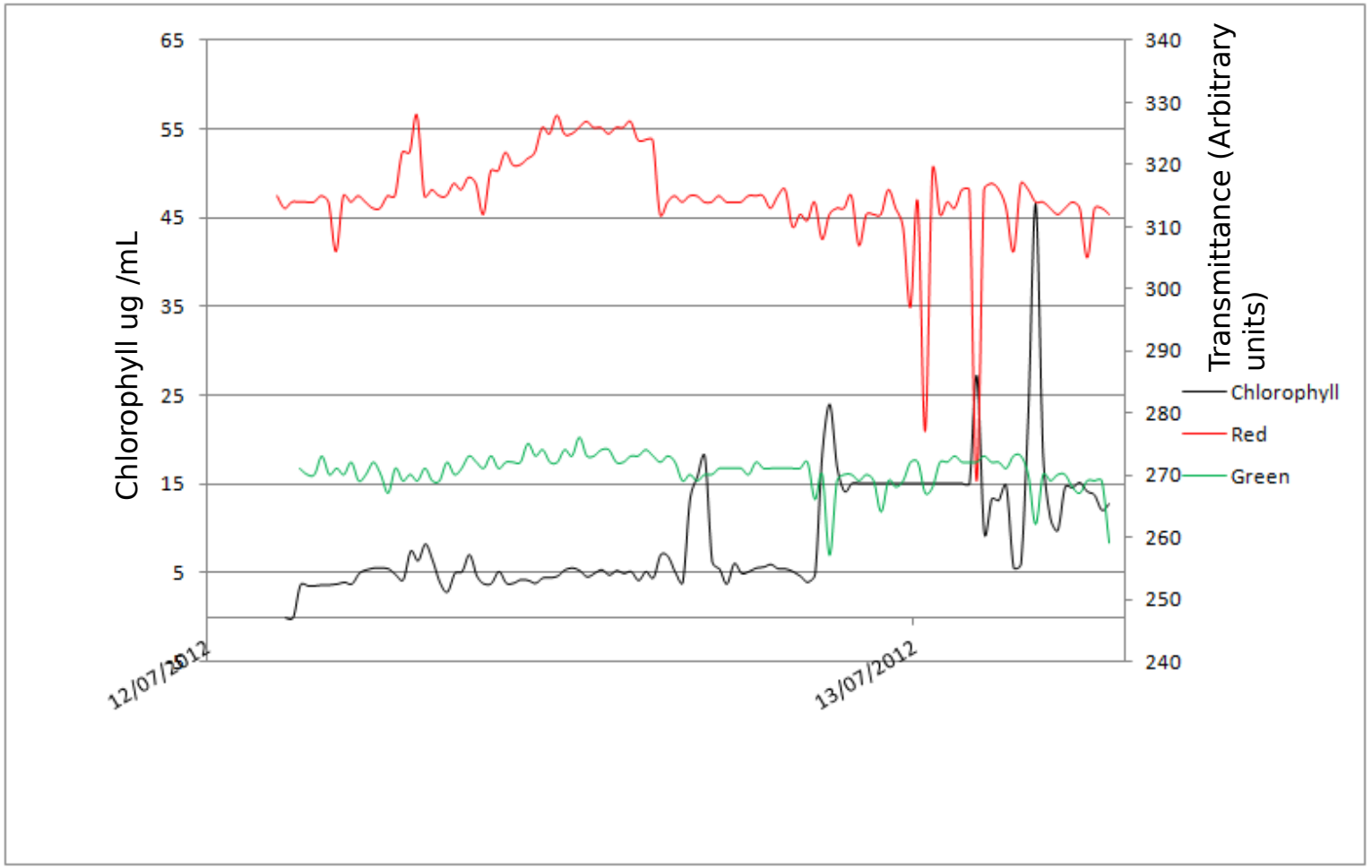
Sea trial data



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Scale-up

- 5 units built.
- Cost < €500 per unit

Allows

- Simultaneous deployments
- Repeatability testing
- Spatial resolution

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Conclusions

OCS

- Low cost: Sub €500 per unit (Parts only)
- Detects colour & turbidity change in marine environment
- Temporal and spatial data
- Robust, long-term deployable
- Potential early warning system
- Can inform traditional sampling regimes

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Future work

<u>Field deployments</u>
5 x Proto type 2
Spatial & temporal data
Stand alone
Buoy mounted

<u>Data handling</u>
Machine learning
Early warning system

<u>Validation</u>
Commercial Sonde data
Satellite data

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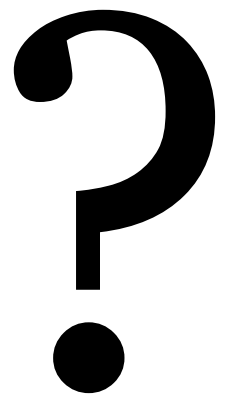
Questions & Acknowledgements



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