PITTCON CONFERENCE & EXPO 2015

COMMON SENSE
MARINE SENSORS - MARINE MONITORING

DCU

Development of cost effective sensors for the in-situ monitoring of Eutrophication

Margaret McCaul, Eoghan McNamara, and Dermot Diamond

Pittcon, New Orleans, 2015



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Project Overview

Title: Cost-effective sensors, interoperable with international existing ocean observing systems, to meet EU policies requirements

Total Budget: €6,074,497

Duration: 40 months

Consortium: 15 partners from seven different countries

(the COMMON SENSE consortium comprises six SMEs, five research development institutes, three universities and one foundation)

This project has received funding from the European Union's Seventh Programme for research, technological development and demonstration under grant agreement No 614155.

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Consortium Overview

PROJECT PARTNERS

SPAIN
- LEITAT Tecnological Center (LEITAT)
- Agencia Estatal Consejo Superior De Investigaciones Cientificas (CSIC)
  - Institut de Ciències del Mar (ICM)
  - Institut de Ciència de Materials de Barcelona (ICMAB)
- DropSens S.L. (DropSens)
- Fundacion Privada Per La Navegacio Oceanica Barcelona (FNOB)
- Simulacions Optiques Sl (Snelloptics)

ITALY
- Consiglio Nazionale delle Ricerche (CNR)
  - Institute for Marine Sciences (ISMAR)
  - Institute for Marine and Coastal Environment (IAMC)
  - Institute of Chemistry and Technology of Polymers (ICTP)
- Idronaut Srl

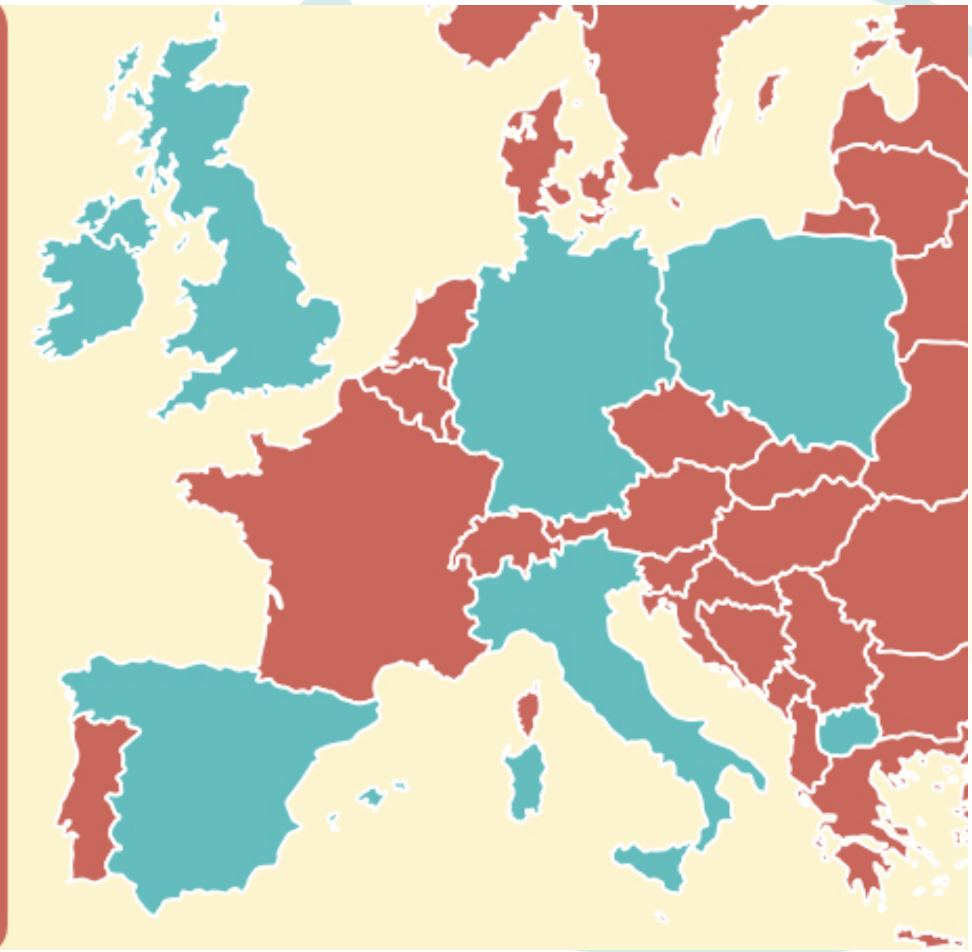
IRELAND
- AquaTT UETP (AquaTT)
- T.E.Laboratories Limited (TELAB)
- Dublin City University (DCU)
- University College Cork, National University of Ireland (UCC)
  - Tyndall National Institute (Tyndall)
  - Coastal and Marine Research Centre (CMRC)

POLAND
- Instytut Oceanologii Polskiej Akademii Nauk (IOPAN)

GERMANY
- Subctech Gmbh (SubCtech)

FORMER YUGOSLAV REPUBLIC OF MACEDONIA
- Ss. Cyril And Methodius University In Skopje (FTM-UCIM)

UNITED KINGDOM
- The Secretary Of State For Environment, Food And Rural Affairs (CEFAS)



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www.commonsenseproject.eu

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EU policies

COMMONSENSE and the Marine Framework directive

Under the **Marine Strategy Framework Directive (MSFD)**, EU Member States are expected to assess the overall status of their marine environments and to put in place the necessary measures to achieve **Good Environmental Status (GES) by 2020**. Member States must implement cost-effective monitoring programmes in order to achieve MSFD monitoring objectives, as well as other European maritime and environmental policies such as the Common Fisheries Policy (CFP).

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What will the COMMON SENSE project do:

Develop innovative, cost-effective sensors that will increase the availability of standardised data on:

- Eutrophication
- Concentrations of heavy metals;
- Micro-plastic fraction within marine litter;
- Underwater noise
- Parameters such as temperature and pressure.

Sensors will assess environmental conditions affecting marine ecosystems:

- Mitigating the anthropogenic impacts
- Climate change impacts
- Promoting basic research of marine science

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Nutrients in Marine Environments

Elevated levels of nutrients causes Eutrophication which is an extensive problem within European marine waters (Baltic and Mediterranean Seas)

Impacts include:

- Increased biomass of phytoplankton and algae
- Formation of harmful algal blooms (HAB)
- Reduced water clarity
- Elevated pH and dissolved oxygen depletion in the water colum
- Increased likelihood of kills of recreationally and commercially important species

Descriptor 5 of the Marine Strategy Framework Directive addresses Eutrophication:

- 5.1.1 Nutrient concentration in the water column
- 5.1.2 Nutrient ratios

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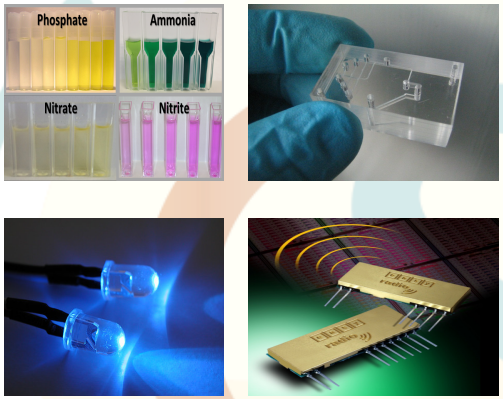
NCSR
National Centre for Sensor Research

TelLab

Sensor Development

Develop Sensors for nutrients (nitrite, nitrate, phosphate and ammonia) based on:

- Colorimetric chemical assays
- LED-based optical detectors
- Microfluidic analytical systems
- Wireless communications



Phosphate sensors has been developed within DCU and validated in freshwater, wastewater deployments

Marinisation of existing sensors

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Colorimetric Chemistries

Nitrite & Nitrate

- Nitrite determination using Griess Reagent
- Nitrate determination using Vanadium Chloride (VCl_3) as reduction reagent. Methods adapted from García-Robledo et al[1] and Schnetger B et al[2].

Advantages:

- One reagent solution added for Total N determination
- No apparent interferences from Marine Matrix
- Low detection limit (1µM Nitrate 0.05µM Nitrite)
- Uses small volumes (µL)

Disadvantages:

- Reaction time temperature dependant

1.García-Robledo E, Corzo A, Papaspyrou S. A fast and direct spectrophotometric method for the sequential determination of nitrate and nitrite at low concentrations in small volumes. Mar Chem 2014;162:30-6.
2.Schnetger B, Lehners C. Determination of nitrate plus nitrite in small volume marine water samples using vanadium(III)chloride as a reduction agent. Mar Chem 2014 3/20;160:91-8.

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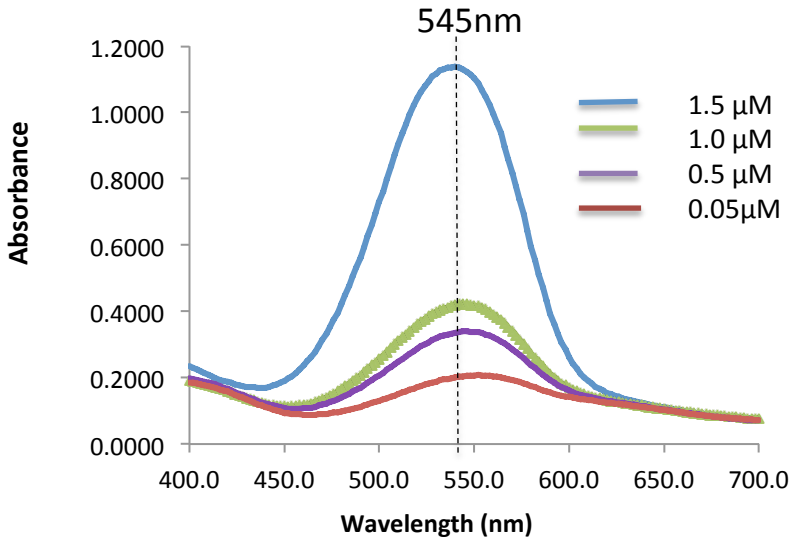
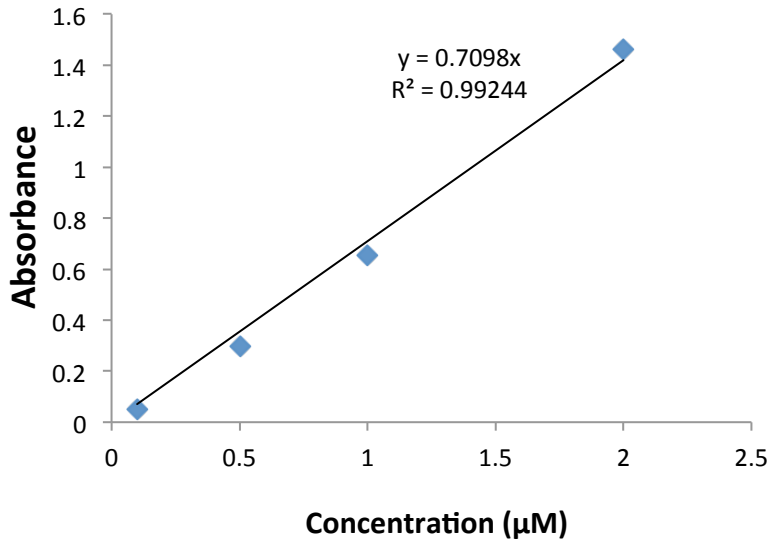
Nitrite analysis in salt water matrix





- Wavelength scan from 400 nm to 700 nm.
- Maximum absorbance was observed at 545 nm
- Linear range from 0.05 to 1.5µM .

- Linear response for nitrite analysis in artificial sea water. Reactions were carried out at ambient temperature (approximately 25°C).
- This experiment was carried out in triplicate error bars minimal
- Standard Deviation <0.001

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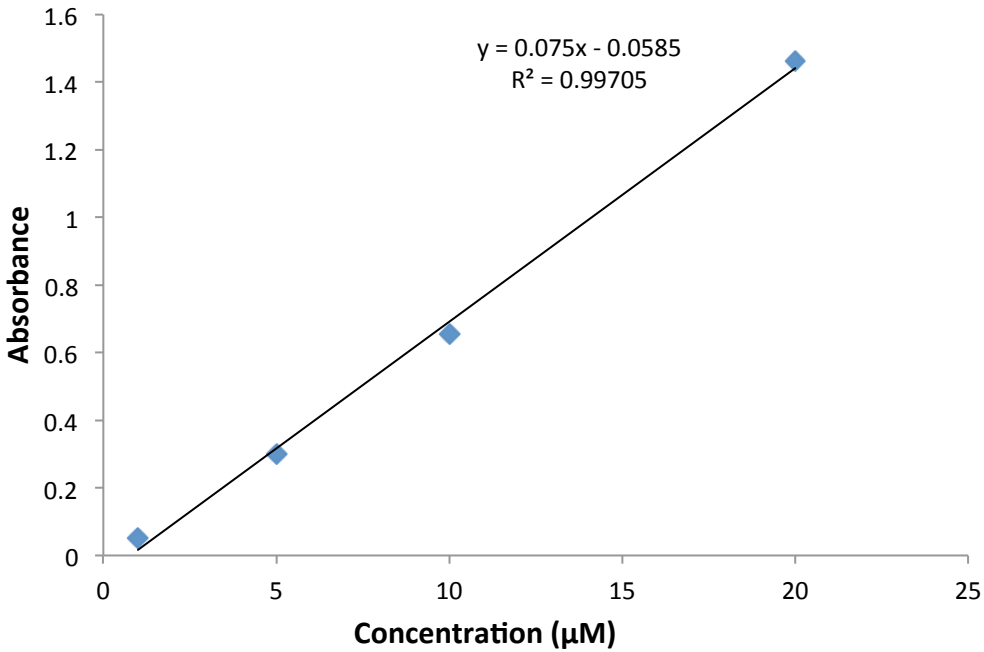
Nitrate analysis in salt water matrix



- Maximum absorbance approx 545 nm
- Linear range from 1-20 µM
- Artificial Seawater was spiked with known concentrations of Nitrate
- Analysis carried out in triplicate
- Standard Deviation <0.001

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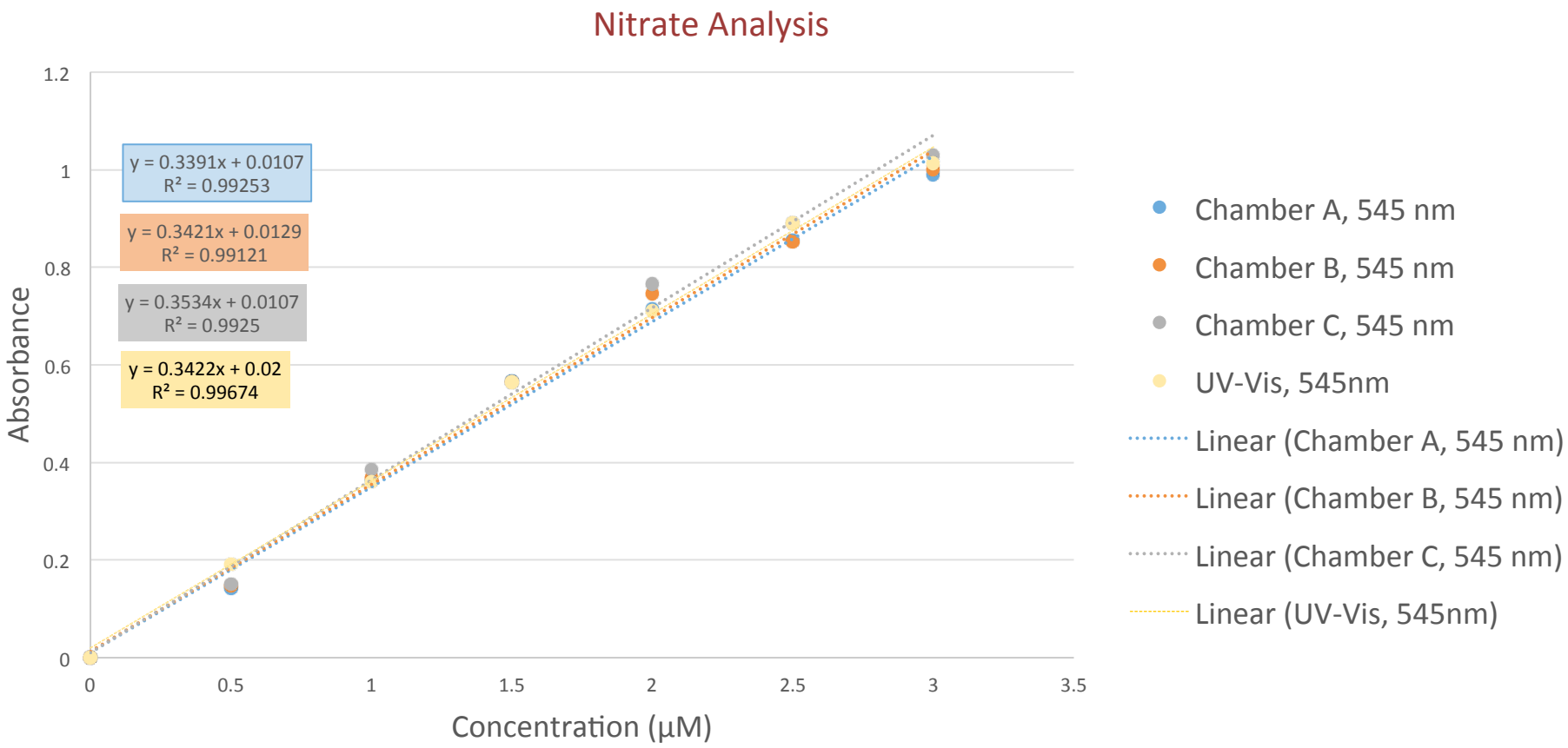
In-house developed bench top system calibration



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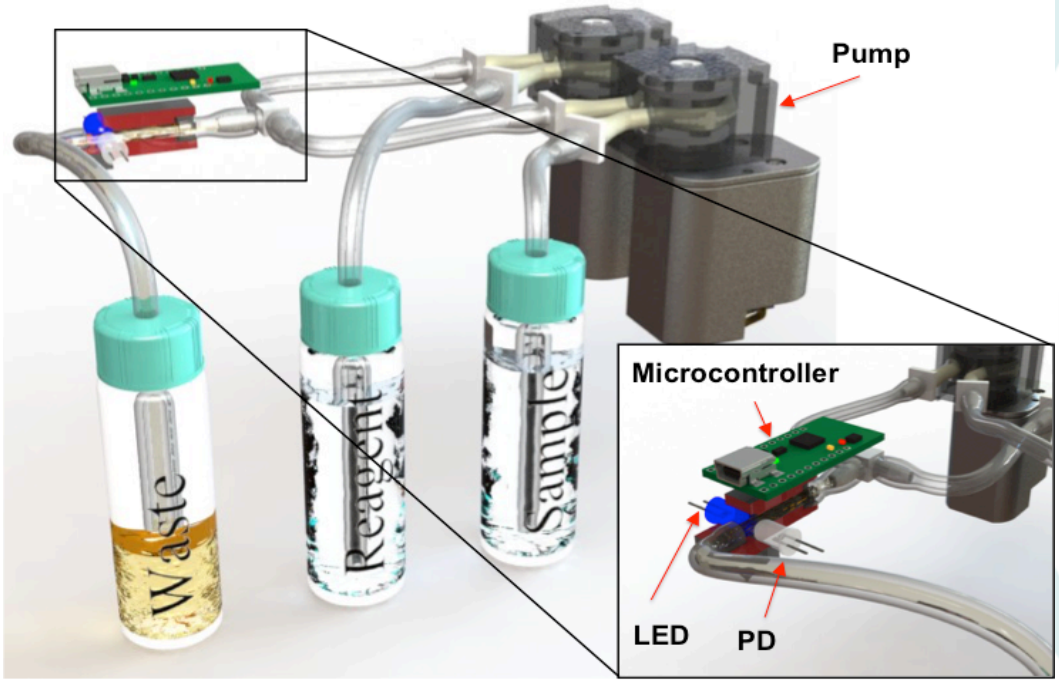
Fluidic system



A rendered image of the concept behind the dynamic flow measurement set up. This dynamic measurement will be performed in a microfluidic chip.

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On going and Future Work

Assays

Ammonia (Berthelot reaction), Phosphate (Yellow or Blue method)

- Detection limit
- Detectable range
- Accuracy

System development

- Miniaturisation
  - Microfluidics
- Fluidic handling
- Power
  - Analysis
  - Harvesting

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Acknowledgements

Adaptive Sensors Group

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Insight

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The COMMONSENSE consortium

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Thank you for your Attention

margaret.mccaul@dcu.ie

eoghan.mcnamara@dcu.ie

dermot.diamond@dcu.ie

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