NeXOS OCEAN SENSORS

NeXOS has received funding from the European Union's Seventh Programme for research, technological development and demonstration under grant agreement No 614102

NeXOS acoustic system - Integration of the acoustic sensors into fixed and mobile platforms & demonstrations

For more information, please visit **www.nexosproject.eu** or contact NeXOS Coordinator, Eric Delory at: info@nexosproject.eu

WAVE GLIDER & A1

PROVOR/A1

ESTOC MOORING

SEA EXPLORER GLIDER/A1

INTEGRATIVE SCENARIO

Characterizing the underwater soundscape with focus on human activities

Platform/Sensor	Demo site
Wave Glider /A1	Canary Islands
Provor/A1	Canary Islands
Estoc/A1	Canary Islands
Sea Explorer/A1	Norway
Buoy/A1	Mediterranean
OBSEA/A2	Mediterranean

Data From SoS Server:

A1/Sea Explorer Demo

A1/Provor Dataflow

TOWED SEA EXPLORER GLIDER/A1

OBSEA/A2 MASTER UNIT

SHALLOW WATER BEACON WITH A1

PARTNERS

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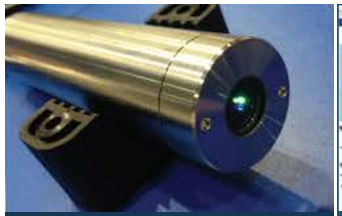
Multifunctional Web Enabled Acoustic Sensors for the Monitoring of a Changing Ocean

- Lower Capital and Operating Expenses for Observing Systems
- Multifunctional Sensor Packages Configured for Multiple Platforms
- Standard Web Interfaces
- Extended Deployment Duration

NeXOS Innovative Technologies Improve End-to-End Ocean Information for Users



Compact/Cost-efficient Sensors

- Optical sensors for greenhouse gases, contaminants, and phytoplankton
- **Passive acoustic sensors for noise/bioacoustics**
- New robust EAF sensors

Effortless Information Access

- Smart sensor interface and web components
- Plug and play sensors
- Real-time standard Web Services
- End-to-end operable chain

Reliability and Availablility

- Biofouling prevention
- Detection of the earliest stage of biological growth on sensor surface
- Conductive coating on the transducing interface of the sensor
- Instrument with coated biofouling protection operates since Sept 2014

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NeXOS — A1 Passive Acoustic Sensor

Compact, low power consumption digital hydrophone with embedded pre-processing of acoustic data, using the OGC PUCK and Sensor Web Enablement (SWE) interoperability. A1 consists of one transducer and two A/D converters (channel A & B), simultaneously sampled, with different gain, to measure a broad range of acoustic source levels from 50 dB to 180 dB.

Hydrophone Type & Specifications	Neptune Sonar D/70	Technology Limited SQ26-01	JS-B100-CADP Acoustic Sensor
Sensitivity CHA	-138/-158 DB	-133.5/-153.5 dB	-141/-161 dB
Sensitivity CHB	-178 dB	-173 dB	-181 dB
Frequency range ffl1.5 dB	1 Hz to 50 kHz	.151Hz to 28 kHz	1 Hz to 50 kHz
Max Depth	1500 m	2000 m	3600 m
Weight	333 g	317 g	480 g
Size	Φ 34X255mm	Φ 34X 255mm	Φ 34X255mm

Applications

- Noise from human activities
- Ambient noise and bioacoustics
- marine mammal population
- fish reproduction areas
- Ice-cracking
- Detection of Green-House Gas (GHG) seeps (pipelines and carbon storage)
- Gasification of methane clathrates
- Estimation of rainfall
- Detection of seismic events
- Acoustic communication.

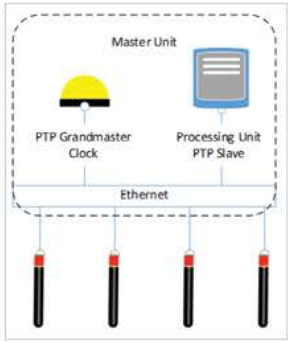
MARINE MAMMALS

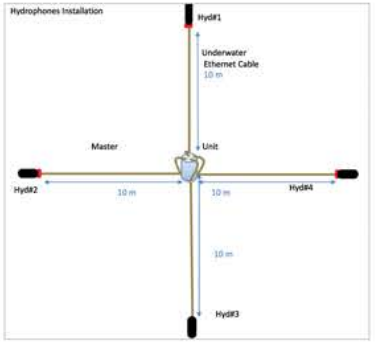
WAVE ENERGY

RAINFALL ESTIMATE

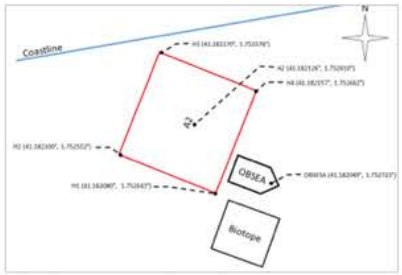
NeXOS — A2 Passive Acoustic Sensor Array

Compact volumetric hydrophone system, for real-time measurement of underwater noise. A2 is an array of four digital JS-B100 hydrophones (A2hyd) with Ethernet interface connected to Master Unit for data processing.





A2 installation at OBSEA



A1 AND A2 DEVELOPMENT PARTNERS

PLOCAN consorcio PLATAFORMA OCEÁNICA DE CANARIAS — Gobierno de Canarias

UPC

ISMAR

SMID TECHNOLOGY

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ALSEAMAR ALCEN

Transition to commercial Production SMID

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WAVE GLIDER & O1 MATRIXFLU

RESEARCH VESSEL/01-03

SAIL BUOY/03

WAVE GLIDER O1 PAYLOAD (MATRIXFLU)

INTEGRATIVE SCENARIO

- Hydrocarbon observations with gliders
- Carbon sequestration observation with Ferrybox
- Detection and characterization of phytoplankton blooms

Platform/Sensor	Demo site
Sea explorer/O1	Norway
Ferry Box/O1, O2, O3	Norway
Sail Buoy, O3	Norway
Wave Glider, O1	Canary Islands

SAIL BUOY O3 PAYLOAD

SEA EXPLORER GLIDER (O1 MINIFLUO)

TOWED SEA EXPLORER GLIDER (O1 MINIFLUO)

PARTNERS

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Multifunctional Web Enabled Optical Sensors for the Monitoring of a Changing Ocean

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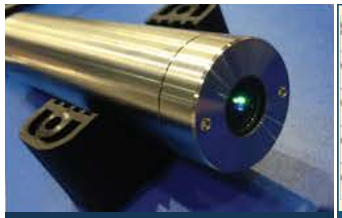

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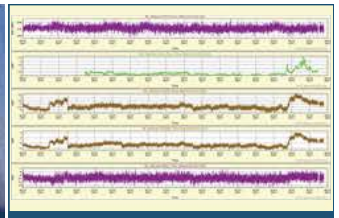

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NeXOS — Optical Sensors – Hydrocarbons and Fluorescent Dissolved Organic Matters

NeXOS 01 — Fluorescence Sensors

Sensors provide detailed information on water constituents and other contaminants that are optically active in the applicable spectral region.

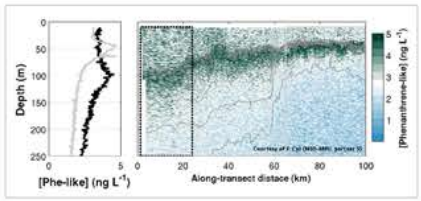
Three classes of fluorescence sensors were developed:
(1 & 2) The MatrixFlu-UV and MatrixFlu-VIS use different combinations of three or four narrow band excitation and emission wavelengths.
3)The MiniFluo, consists of two separate single channel fluorescence detectors within a single housing.

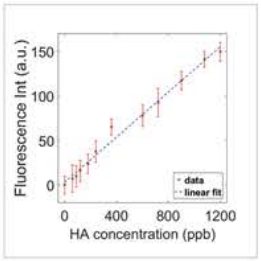
The MatrixFlu-UV and MatrixFlu-VIS:

- Have four detection channels in an ultracompact seawater-resistant housing (available in stainless steel and titanium, depth rated for 300 or 6,000 m)
- Include an excitation light source of three or four LEDs surrounded by semi-conductor detectors collecting fluorescence signals that pass through adaptable, selectable narrow bandwidth filters
- Power consumption is below 1.8 W at 12 to 24 Vdc and weight is less than 600 g in air.

The MiniFluo:

- Can detect and quantify four polycyclic aromatic hydrocarbons (PAH): naphtalene (NAPH), phenanthrene (PHE), fluorene (FLU), and pyrene (PYR) together with tryptophan (TRY an aromatic amino acid)
- Single-band bandpass filters allow for detection through a quartz double-convex lens.





	Excitation (NM)	Emission
Naphtalene	275	340
Tryptophane	275	340
Phenanthrene	255	360
Pyrene	270	380
Flourene	260	315

NeXOS — Phytoplankton Identification and Carbon Sensor System

NeXOS 02 — Phytoplankton Identification Sensor

Two devices for continuous flow-through measurements of water absorption coefficients have been developed, the OSCAR-G2 and the Hyperspectral Absorption Sensor (HyAbS). Both use an integrating cavity and provide reliable identification of at least 7 phytoplankton groups

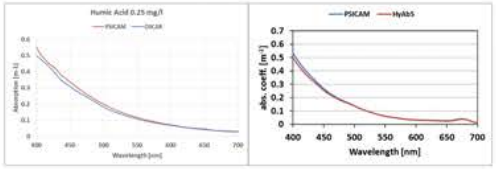
OSCAR-G2

- Compact, submersible, and commercially available
- Operate as bench-top or profiling instrument

HyAbs

- Completely automated absorption sensor dedicated for long term usage as bench top instrument in location with no restriction with power consumption

HyAbs 1 PC; 2 spectrometer; 3 light source; 4 integrating cavity



Comparison of NeXOS Sensors with lab based PSICAM instrument; on left OSCAR-G2, on right HYAbs

NeXOS 03 — Carbon Sensor System

Automated embedded spectrophotometry unit based on a miniaturized flow-through arrangement and absorbance detection at 435 and 596 nm. There are three sensor configurations for measurements on ferry and sail buoy vessels.

O3-Cbon-2 and O3-Cbon-3

Measure Carbon cycle relevant parameters such as pH, CO2, and alkalinity using photochemical reactions. For the sail-buoy, the spectrophotometry unit is coupled with a submersible device located below the keel of the host vessel.

OPTICAL SENSORS DEVELOPMENT PARTNERS

Carl von Ossietzky Universität Oldenburg · cmr Christian Michelsen Research · Aix Marseille université · Helmholtz-Zentrum Geesthacht Zentrum für Material- und Küstenforschung · NIVA · FRANATECH · TriOS Optical Sensors

Transition to commercial Production TRIOS

NeXOS

OCEAN SENSORS

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Integration of the EAF Sensors into Fishing Fleet and Demonstration

ITALIAN FISHING BOTTOM TRAWLER WITH EAF

FRENCH FISHING BOTTOM TRAWLER WITH EAF

NORWEGIAN FISHING BOAT WITH NETS AND EAF

INTEGRATIVE SCENARIO

Observations for sustainable fisheries

SENSOR INSTALLED ON OTTER DOOR/TRAWL DOOR

STPFLUO DISPLAYED ON NET

EAF INSTALLATION

PARTNERS

NeXOS

OCEAN SENSORS

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Multifunctional Web Enabled EAF* Sensors for the Monitoring of a Changing Ocean

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* Ecosystem Approach to Fisheries (EAF)

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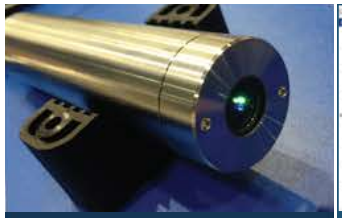

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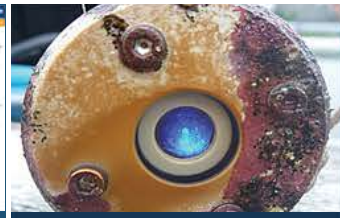

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NeXOS EAF — Sensor System for an Ecosystem Approach to Fisheries

The NeXOS developed EAF sensor system:

- Is a multifunctional cost efficient sensor system that builds upon the RECOPESCA concept and technologies[1]
- Measures Dissolved oxygen (STPO2)[2] and Fluorescence (STPFluo)[2]
- Includes in-hull sensor of Temperature for permanent measurement of these parameters during the fishing activities
- The system is tough enough to be placed on fishing gear, is self-powered and autonomous, modular and scalable.

Low Cost Robust sensors

To achieve a low cost, existing sensor components were evaluated and inexpensive components offering adequate accuracy were selected. The robustness of sensors were improved by mechanical modifications, and calibration and processing improvements were implemented to assure good quality measurements

Concentrator

The concentrator is installed on board of fishing vessels. It includes:

- An electronic board with a microprocessor, memory storage, embedded software and a 868 MHz radio transmitter/receiver circuit board
- A radio GSM/GPRS modem
- A GPS

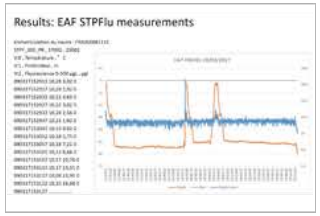
1) RECOPESCA includes
- pressure, temperature, salinity and turbidity,
- a hauler counter, on ship weighting scale.
- data concentrator to store and transmit the data for shore management

2) The STPO2 and the STPFluo sensors were selected for their applications to fish population assessments and because they are reported as Essential Ocean Variables by the operational oceanographic community

NeXOS EAF – Sensor System for an Ecosystem Approach to Fisheries

The sensors were constructed to detect dissolved oxygen and fluorescence concentrations in coastal waters at depths ranging from 0 to 300 meters

STPO2, STPFluo and concentrator



Performances of the EAF STPO2 probes for oxygen measurements

Sensor	Resolution (Minimum Detection Limit)	Range	Accuracy	Response Time		Maintenance Priority	Memory Capacity
				Stationary	Profiler		
Pressure	10 cm	0-300 m	50-100 cm	<3 s at 63%	<0.5 s at 63%	6 months - 1 year	6 months
Temperature	0.01°C	-2 to 35°C	<0.05°C	<3 s at 63%	<0.5 s at 63%	6 months - 1 year	6 months
Oxygen (OEM)	0.02% (0.01 mg/L)	0-100% O_2 (from 0 to 45 mg/L)	(**)	~10 sec		3 months	3 months

(*) That means 63% of the expected value will be reached after less than 3 or 0,5 seconds
(**) Will be determined at the end of the project according to the results obtained

Performances of the EAF STPO2 probes for flourescence measurements

Sensor	Resolution (Minimum Detection Limit)	Range	Accuracy	Response Time		Maintenance Priority	Memory Capacity
				Stationary	Profiler		
Pressure	10 cm	0-300 m	50-100 cm	<3 s at 63%	<0.5 s at 63%	6 months - 1 year	6 months
Temperature	0.01°C	-2 to 35°C	<0.05°C	<3 s at 63%	<0.5 s at 63%	6 months - 1 year	6 months
Chlorophyll a OEM (Flourescence)	0.025 µg/L	0-500 µg/L	(**)			3 months	3 months

(*) That means 63% of the expected value will be reached after less than 3 or 0,5 seconds

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EAF DEVELOPMENT PARTNERS

Transition to commercial production, IFREMER

Transition to commercial production, NKE