Satellite and Underwater in-situ Data Processing and Integration for Environmental Crimes Detection and Monitoring

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W • SENSE

Ocean Data Challenge
***TOP INNOVATOR** World Economic Forum, Davos 2023*

Short Introduction… it’s a pleasure to be here!

Maria Angelucci, Sales Manager
17+ years' experience in Earth Observation, Satellite Data, Maritime Sector, Security and Defense relevant matters, including geospatial relevant services provision within the maritime and land services domains, project management and product innovation, customers satisfaction.

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Michele Nati, PhD, Head of Special Projects Unit
15+ years’ experience in IoT Research and Innovation, working with blockchain layer-1 companies (like IOTA) to promote the adoption of blockchain in various industries, defining use cases and leading their development. He is also expert on data security.

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The Need

- **Copernicus programme** and its Contributing Missions, key to access **Earth Observation Satellite Data** at **wide spatial scales**
- However, **satellite observations are discontinuous in time**

- To date, **in-situ data** mainly operate offshore, where the integration of new sensors requires long development cycles, data collection is mostly delay-tolerant, the objective is to build models for future climate trends prediction

→ **Holistic approach needed !**

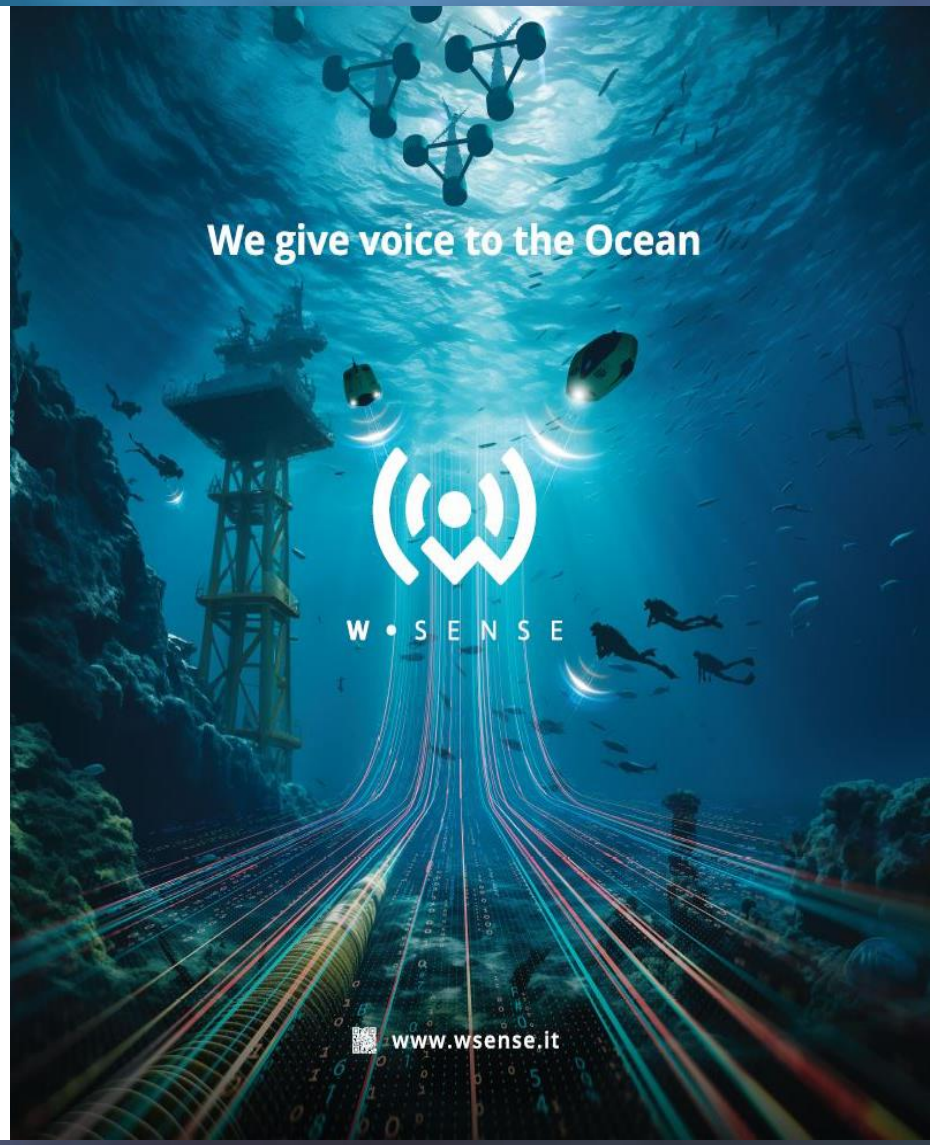
- **WSense's patented underwater wireless networking solution**, both for inland waters and near- and offshore sites, integrates vendor-agnostic sensors

- The **Internet of Underwater Things (IoUT)**

- Data ***cross-validation***

- ***Tip and cue techniques***

- **Toolbox managing Big Data generated from the integration of real-time in-situ underwater observations with wide spatial scale Earth Observation satellite data**



High Level In-Situ & Satellite Monitoring Concept

Remote, Earth Observation Satellite Data Acquisition

- **Bio-Chemical KPI**
  Optical/HyperSpectral Satellite data
- **Drifting**
  SAR Satellite data

  Phenomena evolution in space and time/drifting

Bidirectional
Tip and Cue for Calibration and Data Validation

In-Situ and Satellite Data interoperability

In Situ, real time continuous data acquisition (water column)

- **Bio-Chemical KPI**
- **Activities**
  Vendor-agnostic probes, cameras
- **Drifting**

  Current Profiling

Main Operational Advantages

- Highly **calibrated** measures in situ and satellite
- Unique data access **Control room**
- Consistent **alerting**
- Double checked Actionable **Insights**
- **Optimize** time to intervene
- Plotting **time series**

In-situ Underwater Sensors Families

WSense integrates and interface 20+ sensors families, to name a few:

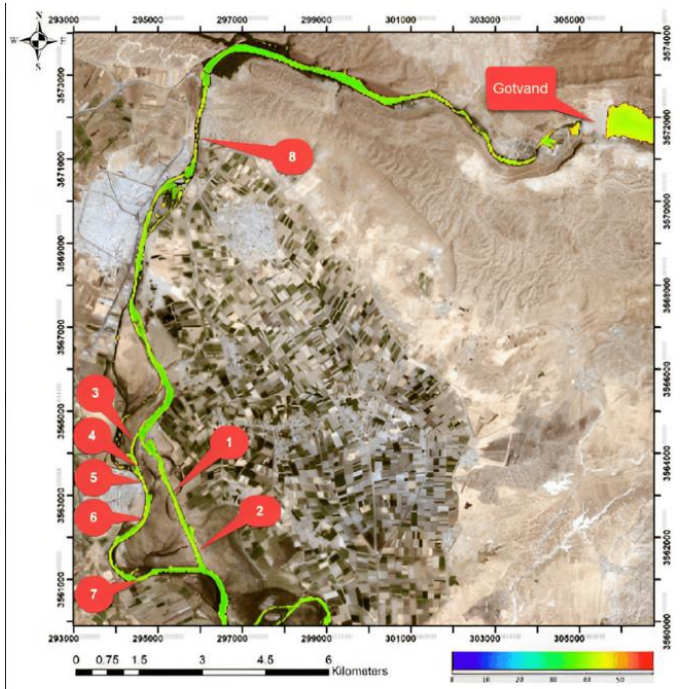
- Dissolved Oxygen (DO)
- Temperature
- Ph
- Salinity
- Chlorophyll-a
- Phycoerythrin
- Turbidity
- Currents
- pCO2
- Cyanobacteria
- Colored dissolved organic matter (CDOM)
- Nutrients (Nitrite, Nitrate, Phosphate)
- Hydrophones
- Cameras

Use Case: Thermal Pollution at Sea/Rivers

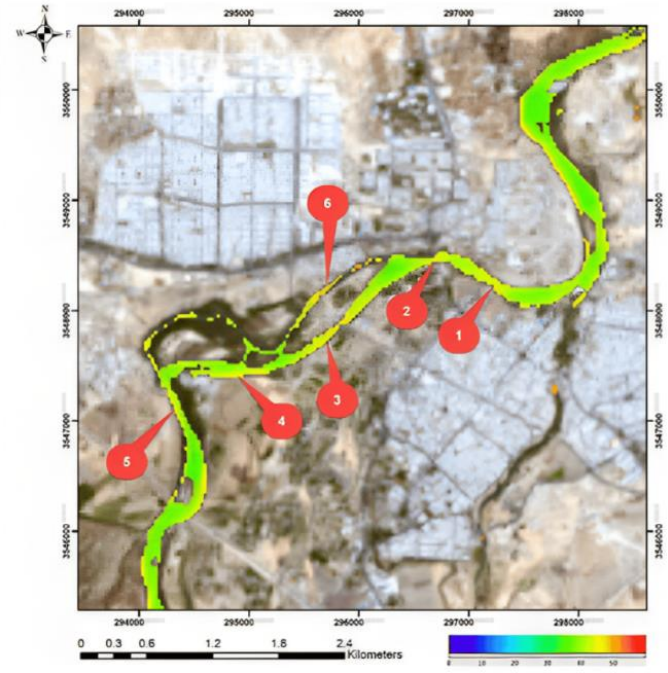
Industrial machinery and power plants can be large contributors to thermal pollution, occurring when the temperature of a natural water body suddenly changes (increases/decreases).

IMPACTS:

1. Decrease in **dissolved oxygen (DO)** levels, anoxia impacting fishes
2. Increase in **toxins** coming from the water that is brought back into water bodies from industrial sites
3. Ecological impact: **temperature changes** affecting some aquatic species.



(A) Shushtar town.



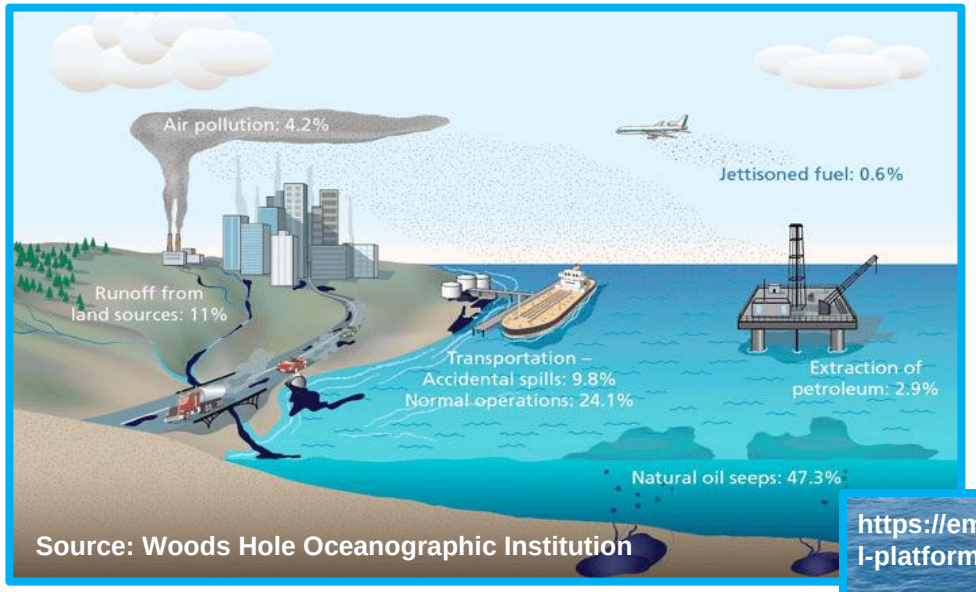
(B) Gotvand, Jannat Makan, and Somaleh towns.

Source: https://www.mdpi.com/2071-1050/16/2/646#

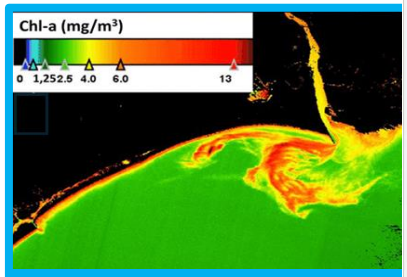
(A) Shushtar town (Iran), where points depict transient temperature increases. **(B)** The towns of Gotvand, Jannat Makan, and Somaleh (Iran), where points depict instantaneous temperature increases (Landsat Data)

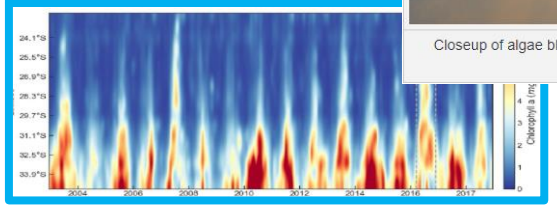
In-situ data provide **early warning and notification** for immediate actions and countermeasures.

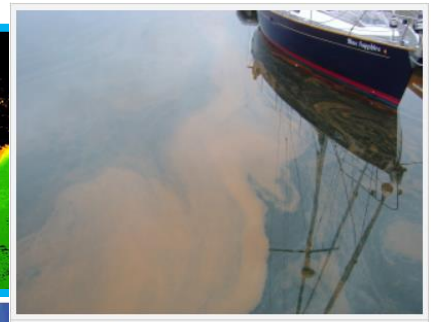
Use Case: Oil Spills from Pipelines or Offshore Platforms



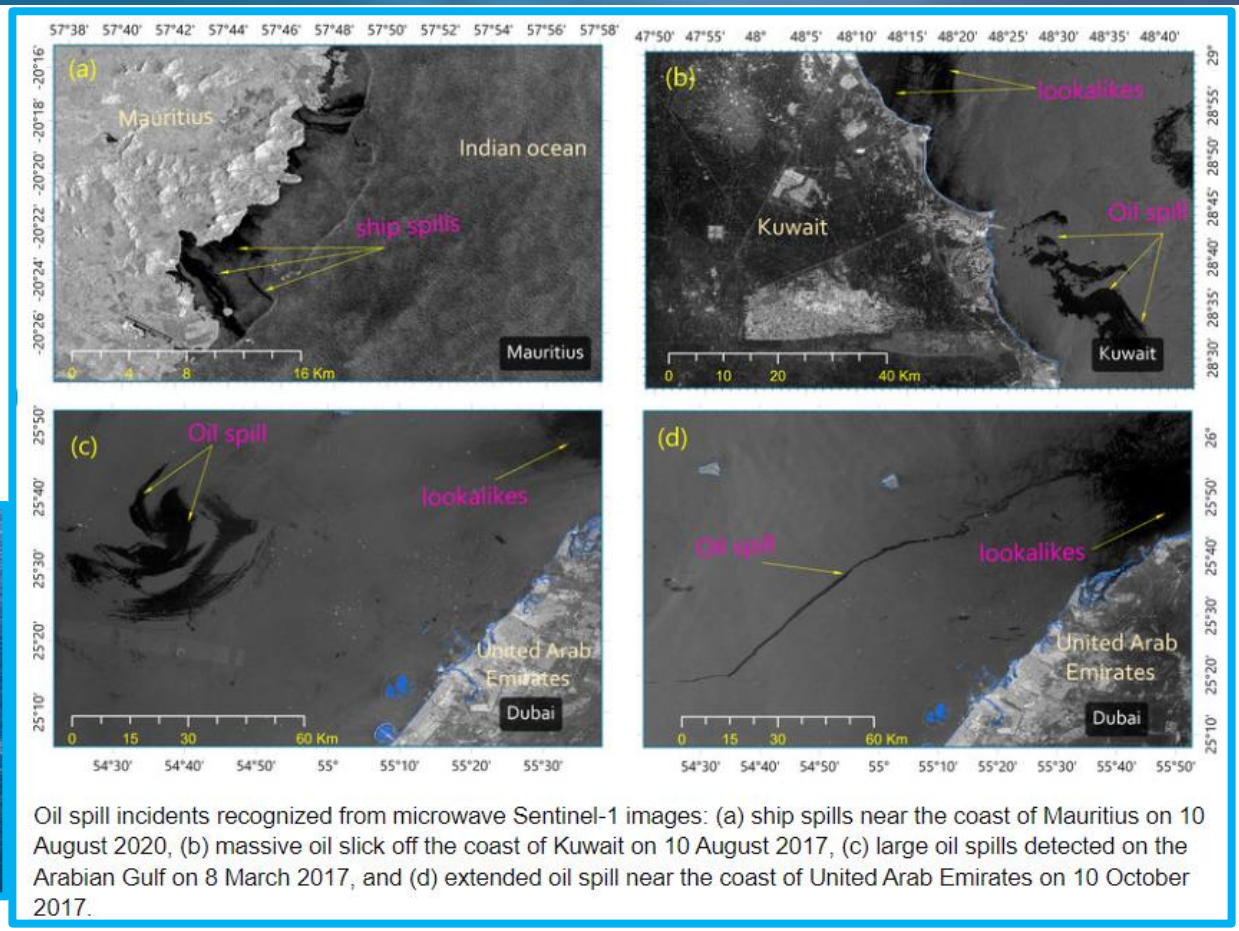
Source: Woods Hole Oceanographic Institution






Closeup of algae bloom in marina near Whidbey Island, Washington.


https://emodnet.ec.europa.eu/en/oil-platform-leaks-3



Oil spill incidents recognized from microwave Sentinel-1 images: (a) ship spills near the coast of Mauritius on 10 August 2020, (b) massive oil slick off the coast of Kuwait on 10 August 2017, (c) large oil spills detected on the Arabian Gulf on 8 March 2017, and (d) extended oil spill near the coast of United Arab Emirates on 10 October 2017.

(Source: https://www.researchgate.net/figure/Oil-spill-incidents-recognized-from-microwave-Sentinel-1-images-a-ship-spills-near-the_fig2_344664016)

In-situ data provide **early warning** detection of oil at sea and allow **discrimination** with respect to other factors like low wind areas, natural seepages, algal blooms, seagrass.

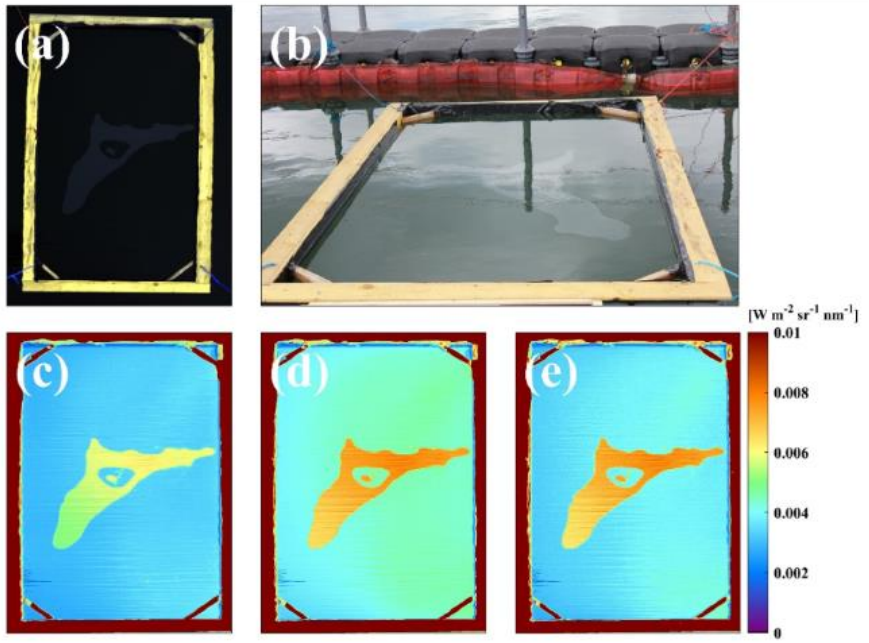
Use Case: Chemicals Pollution

Industrial plants and vessels can be large contributors to chemicals pollutions at sea and rivers, by releasing e.g. Hazardous and Noxious Substances (HNS).
Sectors: raw materials extraction, distillation, synthesis, tannery, refinery industries, shipping.

IMPACTS:

1. **Health**: penetration into human and animals' body, toxicity
2. **Environment**: bioaccumulation, lethal/sublethal effect
3. **Economic**: direct/indirect, tourism, aquaculture, healthcare system, compensation.

Figure 4. (**a**) Styrene red, green and blue (RGB) composite image observed with a hyperspectral camera; (**b**) digital camera imagery taken simultaneously; (**c**–**e**) spatial distribution of radiance in the red, green, and blue channels.

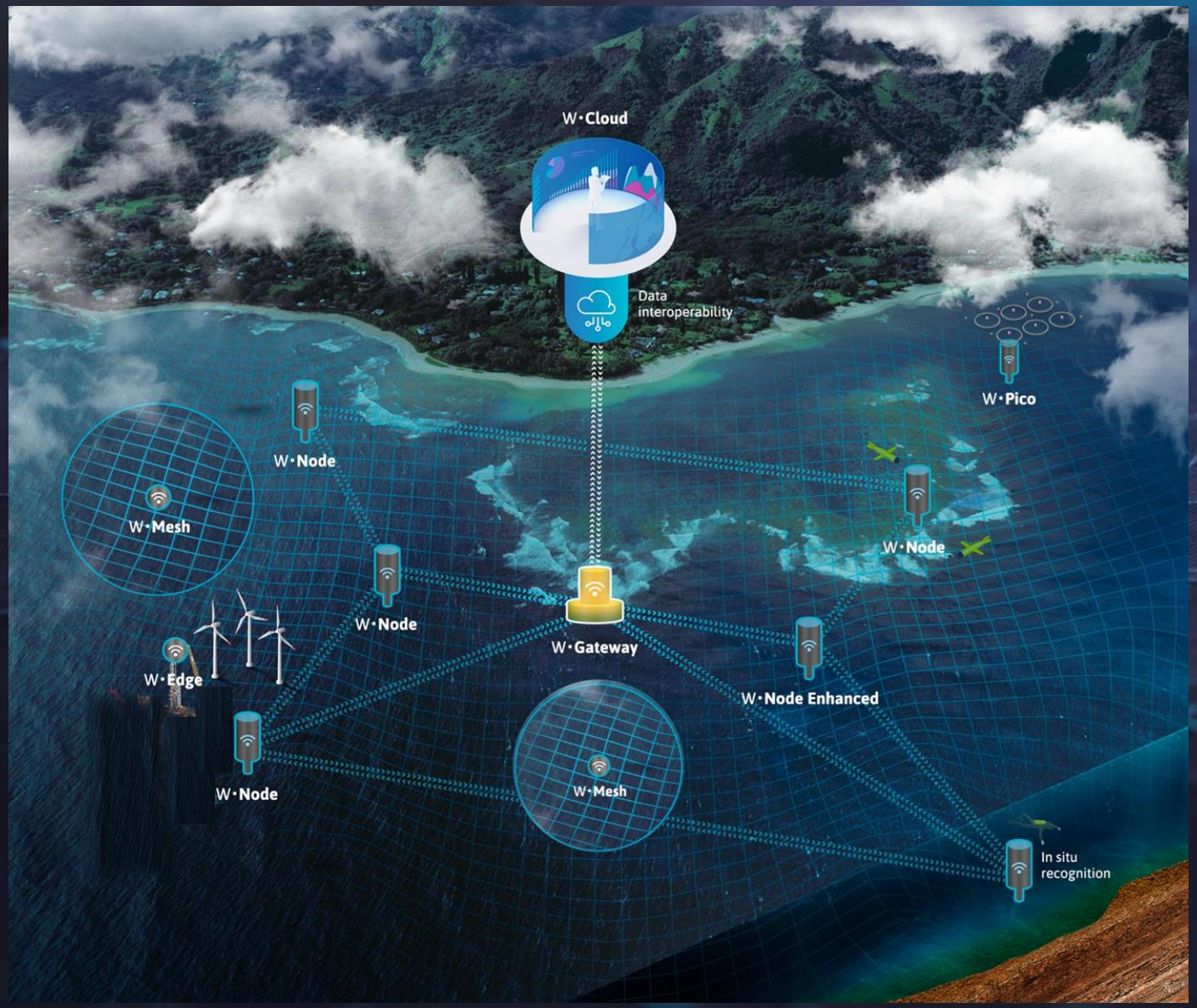


(Source: https://www.mdpi.com/2072-4292/13/2/318
Experimentation with hyperspectral data-camera)

→ Liquefied natural gas loading terminal

In-situ data provide **early warning and notification** for immediate actions and countermeasures.

WSense Underwater IoT System Components



W-Cloud: highly customizable cloud-based data collection and visualization platform for data analytics

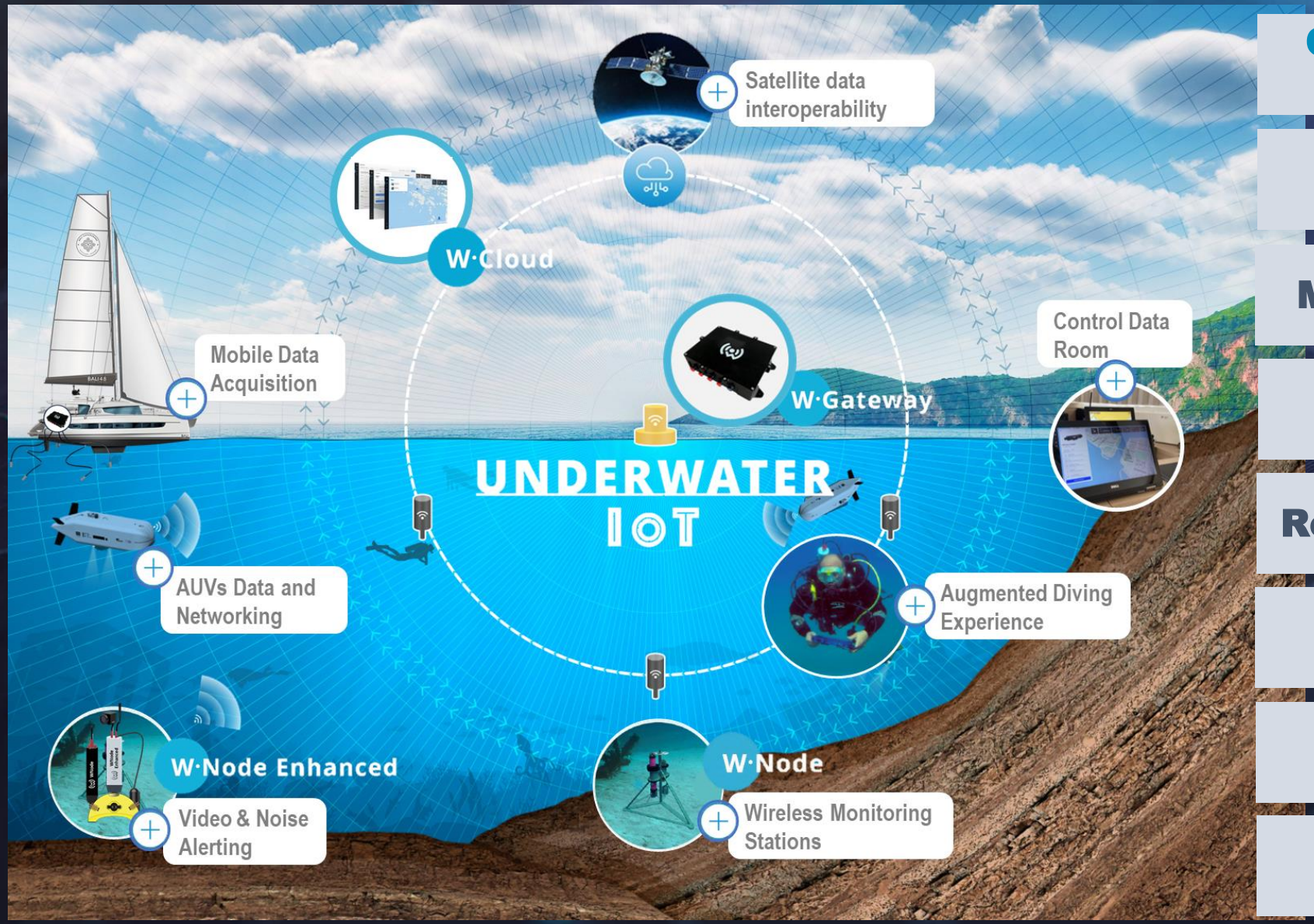
W-Gateway: bridge between underwater and terrestrial networks

W-Mesh: patented multi protocol underwater adaptive networking & multivendor interoperability layer for wireless data reliability and security

W-Node: underwater multi-sensor node with acoustic modem for shallow water

W-Node Enhanced: underwater multi Sensor node for Deep water and onboarded AI

WSense IoT Solutions Key Benefits

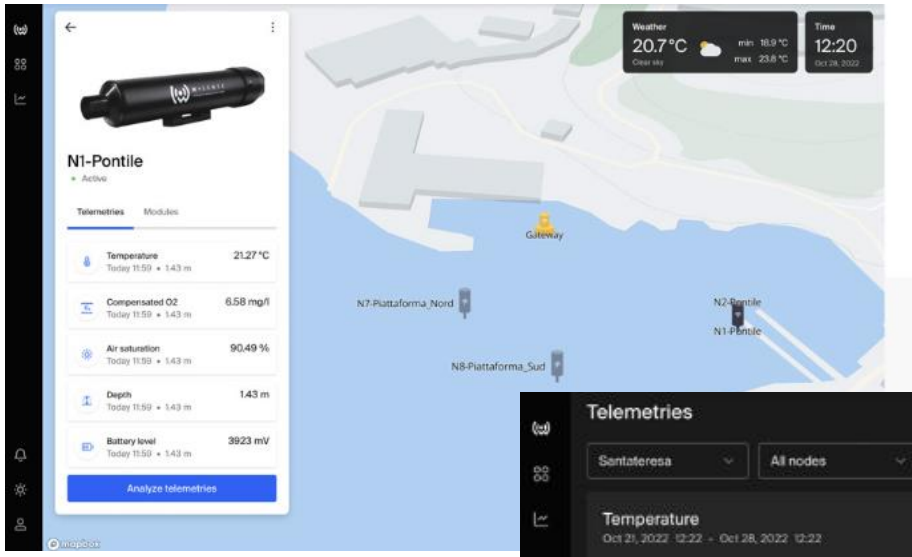


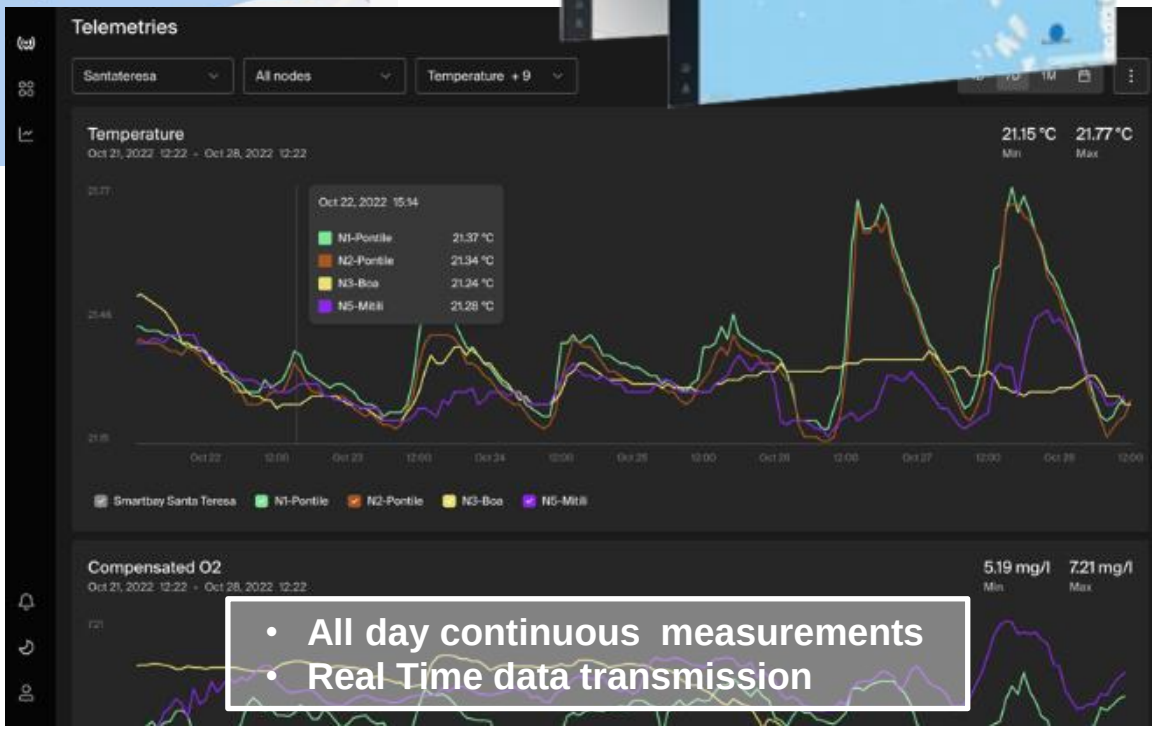
- **Cableless** for large area coverage
- **Flexible** re-deployment
- Multi-sensors **Scalability**
- Real-Time **Alerting**
- Remote **duty cycle setting**
- Satellite **data/telecom integration**
- **AUVs** Interoperability
- **Localization** for divers

WCloud Platform

WSense's proprietary SW platform

- Based on Cloud services
- **Real time** and **continuous** data transmission and processing
- Trends, graphs and interactive dashboards





- Definition of **alarm thresholds** for the set-up of a reporting system
- View the exact location of the deployed architecture components, including the WNodes and WGateways, as well as their **operational status**.
- **Interfacing with third-party platforms**, allowing to import or export data according to standard protocols (REST, MQTT, FTP), guaranteeing **security and reliability** in the transmission of information. It is possible to access the WCloud platform and its functions via the web with dedicated User accounts.

WSense

COMPANY KEY FACTS

- **Headquarters: Rome, Italy**

- **Deep-Tech scale up**
  - It was born as a Spin-off of La Sapienza University (Rome)
  - **+ €15M raised by global** VCs: CDP, Swen's Blue Ocean, Runway FBU, Axon Partners, Katapult Ocean, Coreangels Climate.
  - **Leading European Ocean Tech**
  - **Patented technologies**
  - 50+ Employees, **40% PhDs** (Italy, Norway, UK)
  - 20+ sensors families integrated/interfaced

- **Business sector**
  - Internet of Underwater Things (IoUT)
  - multi-modal secure Underwater Wi-Fi communications networking, monitoring and communication systems

https://wsense.it/
https://www.linkedin.com/company/wsense/

CUSTOMERS AND PARTNERS

LEONARDO, AkerBP, Terna, FINCANTIERI, SAIPEM, ENEA, MARINA MILITARE, LEROY, National Oceanography Centre, e-geos, eni, AANDERAA, ALCATEL SUBMARINE NETWORKS

WSense IoT Solutions – Application Fields

- Critical Infrastructures Monitoring
- Marine Environmental Monitoring
- Off-shore Energy
- Cultural Heritage
- Carbon Capture and Storage
- Aquaculture
- Robotics, AUVs Comms

International Awards

DeepTech Alliance.
Clean Energy Program 2023

eit Digital
Winner
Top 5 deep tech scaleups in Europe!

THE OCEAN RACE
GENOVA THE GRAND FINALE 2022-23

W • SENSE
WINNER
OF BLUEINVEST 2022
OCEAN OBSERVATION AWARD

uplink
The open innovation platform of the World Economic Forum
Top Innovator
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https://www.linkedin.com/feed/update/urn:li:activity:7121134019877969920/

European Investment Bank (EIB) 'EU Blue Champion' 2024

European Commission

https://oceans-and-fisheries.ec.europa.eu/news/eu-blue-champions-unveiled-20-companies-will-receive-advisory-support-grow-their-business-2024-05-13_en

@COP28

https://vimeo.com/893334913

@WEF23 Ocean Data Challenge

https://youtu.be/SM3NXKzhIKA

Call to action

- Open to cooperate !

- Support to policy makers

- Let’s jointly evaluate requirements and Use Cases !


https://wsense.it/