MONOCLE

Multiscale Observation Networks for Optical monitoring of Coastal waters, Lakes and Estuaries

Project overview

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This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 776480

MONOCLE Consortium

MONOCLE

www.monocle-h2020.eu

PML Plymouth Marine Laboratory

Universiteit Leiden

vito

GeoEcoMar

CSIC Consejo Superior de Investigaciones Científicas

Water Insight

University of Stirling

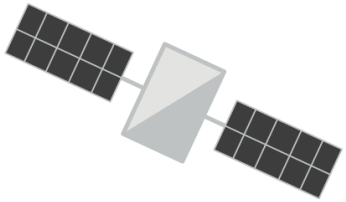
EarthWatch Institute

DRONEGRID Aerial Intelligence

DDQ innovative mobile projects

Peak Design

MONOCLE objectives

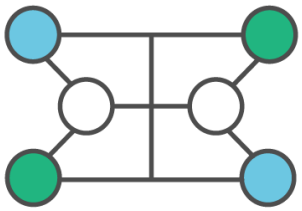


Improved in situ components to support Earth Observation of optically complex waters

- Connected high-end and low-cost sensors
- Innovative deployment strategies
- Focus on reflectance + atmospheric transmissivity

Cost-effectiveness of in situ observation services

- Develop low-end sensors for gap-filling (time, space)
- Support existing sensors
- Review calibration and quality assurance strategies



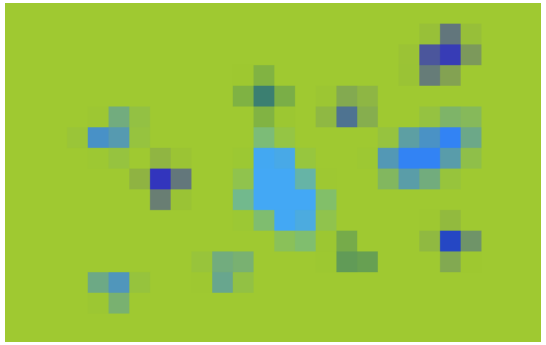
Sustainable networks and services

- Support data exchange and downstream usage
- Transparent sharing and licencing
- Training and capacity building materials

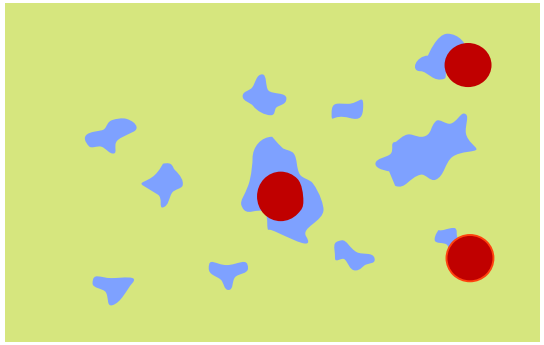
MONOCLE objectives

Multi-scale observations

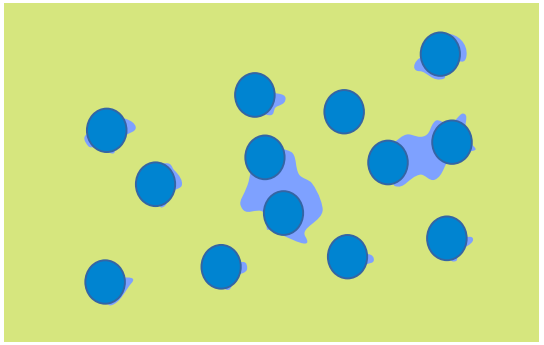
Remote Sensors



High accuracy & frequency in-situ sensor network



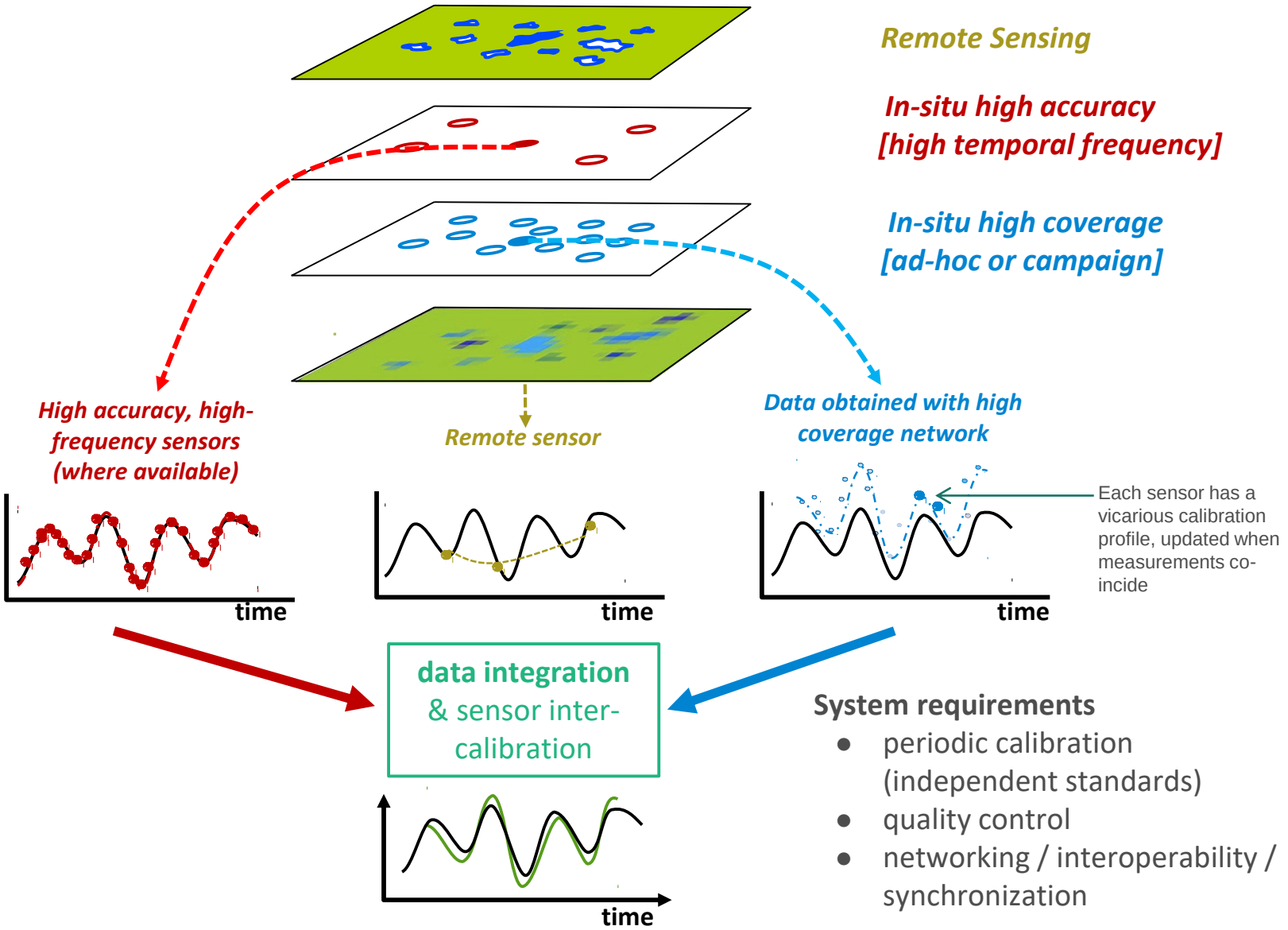
High coverage, low frequency, low-cost in-situ sensing network (ad-hoc or campaigns)



R&D requirement:
Data quality assurance and statistical methods to integrate low-cost and reference measurements

MONOCLE objectives

Self-calibrating network concept



System requirements

- periodic calibration (independent standards)
- quality control
- networking / interoperability / synchronization

Sensor and Platform innovations

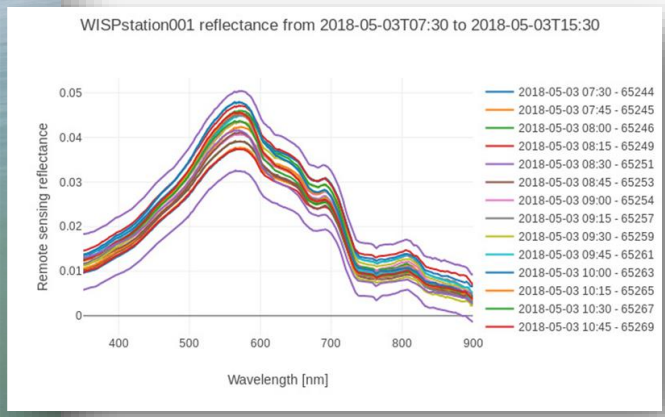
Hyperspectral water-leaving reflectance

Water-leaving reflectance measured in situ provides:

- **Validation of sensor and atmospheric correction system**
- **Hyperspectral** data: simulate any satellite sensor

Innovations:

- Modular system for **handheld and automated** use
- Integration on buoys, ships, offshore platforms
- Integration with MONOCLE network i.e. pairing with other sensors
- Multiple azimuth angles (fixed or solar-tracking)

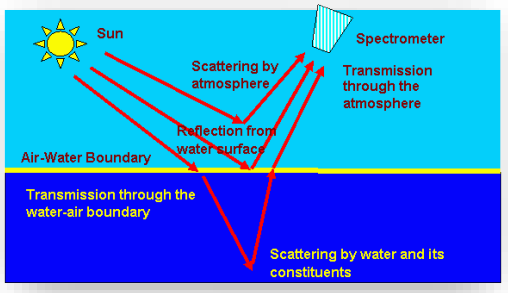


Water Insight

Sensor & Platform innovations

Direct/diffuse irradiance for water + atmosphere

- Direct solar radiance and diffuse (scattered) radiance
- Derive atmospheric absorption properties and model the underwater light field by **measuring direct and diffuse field**
- Robotic Sunphotometers are available. The HSP1 uses **a novel optical head at ~25% of the cost**.



CIMEL Sunphotometer

HSP1 Hyperspectral Pyranometer

Innovation:

- Hyperspectral
- Prototype ready

Peak Design

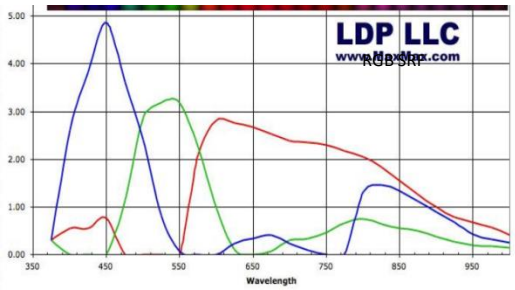
Sensor & Platform innovation

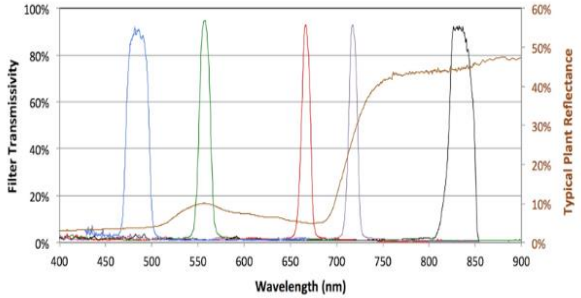
Airborne cameras

Low-medium cost (€100 - €1 000)
Small drone + Integrated RGB camera

Medium-high cost (€1k - €20k)
Larger drone + Multispectral camera and irradiance sensor

Prohibitive cost (> €20k)
Hyperspectral imaging camera





380-1000 nm

Tested applications:
Sediment concentrations

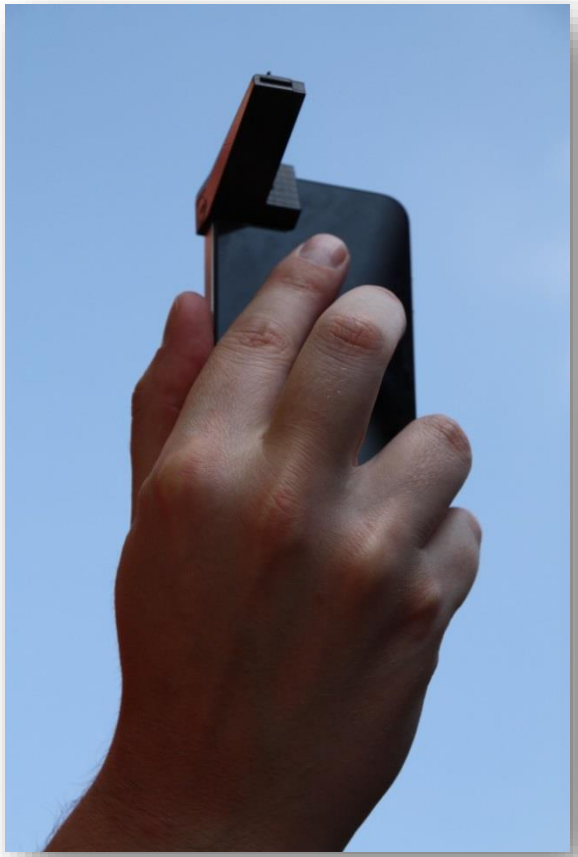
Sediment concentrations
Chlorophyll-*a*

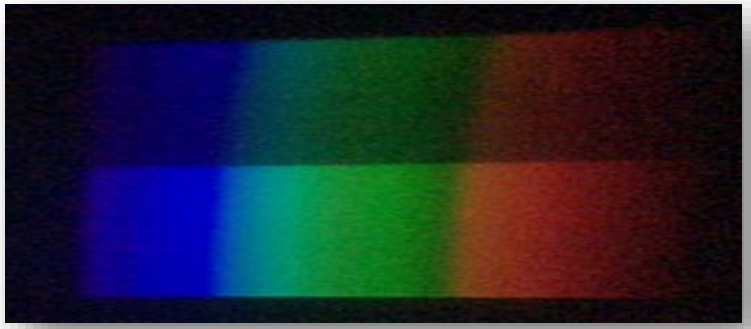
Sediment concentrations
Chlorophyll-*a*
Phytoplankton functional types?

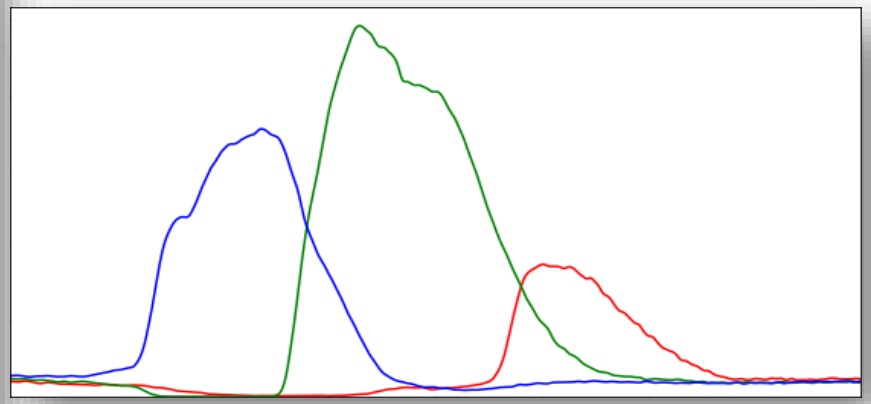
vito DRONEGRID AERIAL INTELLIGENCE

Sensor & Platform innovation

Handheld spectropolarimetry: iSPEX







Researchers measure atmospheric aerosols with iSPEX optical devices and smartphones.

TECHNOLOGY

Smartphone science

Researchers are learning how to convert devices into global laboratories.

BY JEN EARTHRIGHT

A decade ago, Dutch astronomer Frans Snik invented a simple optical device to measure the density of dust, soot and other particles, or aerosols, in the atmosphere that affect human health and the climate. He hoped to launch it into orbit around Earth aboard a satellite. But one afternoon in 2011, Snik held up a demonstration version of his device to an iPhone camera. The smartphone's screen displayed a rainbow of colours: Snik's optical device was converting incoming light into a spectrum that contained polarization information and channelling it into the camera. Snik realized that he could pair smartphones with the optical device and make the same kind of measurements that he and his colleagues planned to record from space.

An idea was born. "We thought, why not make use of a technology that trillions of people carry around in their pockets anyway?"

By 2013, Snik and his colleagues at Leiden University in the Netherlands had given or sold a version of the optical device — called iSPEX — to more than 8,000 willing iPhone users across the country. The users followed instructions provided by an associated app to attach the optical devices to their iPhone cameras and photographed the sky in their local areas. Within a day, swarm of crowdsourced spectra had stacked up in an online database, ready for analysis. It resulted in a Netherlands-wide map of atmospheric particles with unprecedented resolution (F. Snik *et al. Geophys. Res. Lett.* **41**, 7351–7358; 2014) — several years before the proposed satellite launch and for a fraction of the original estimated cost. The team has since received funding from the European Union to repeat the project in 11 European cities.

CITIZEN SCIENCE

Many researchers are finding ways to exploit smartphones. Snik's project, and those of some geophysicists, astronomers and other scientists who need huge data sets, go one step further. They recruit citizen scientists who use their own smartphones to collect data that would be difficult — if not impossible — to obtain in conventional ways. The various internal sensors that smartphones carry, such as cameras, »

iSPEX < 10 €

More on linking Earth Observation and Citizen Science:
2nd MONOCLE Webinar – 11 June 2018
See www.monocle-h2020.eu/webinars

Universiteit Leiden

DDQ | innovative mobile projects

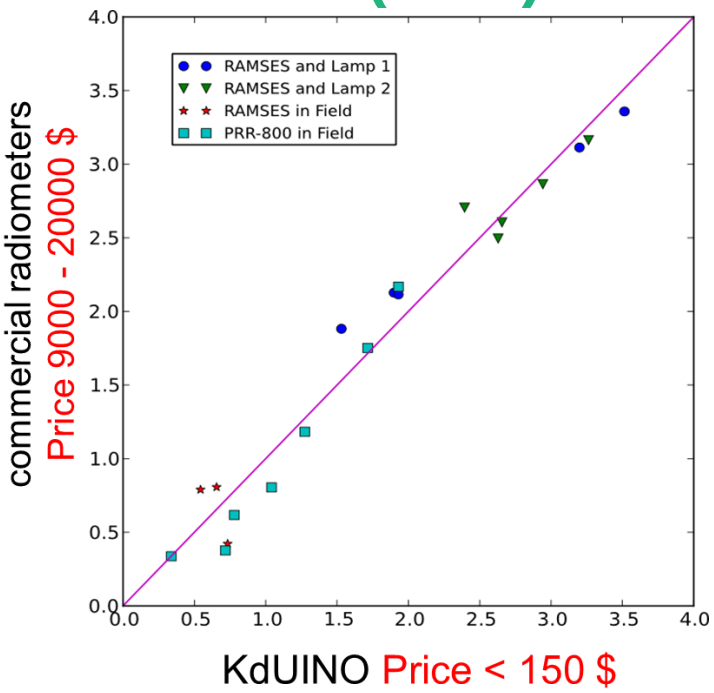
Complementing satellite imagery

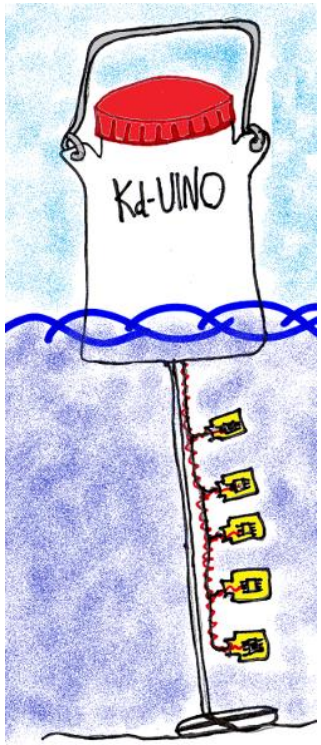
Light attenuation coefficient

Vertical attenuation is scarcely measured in situ:

- Access to optically deep water required
- Specialist equipment required

Alternatively, low-cost buoys are developed which may double as indicators of stratification

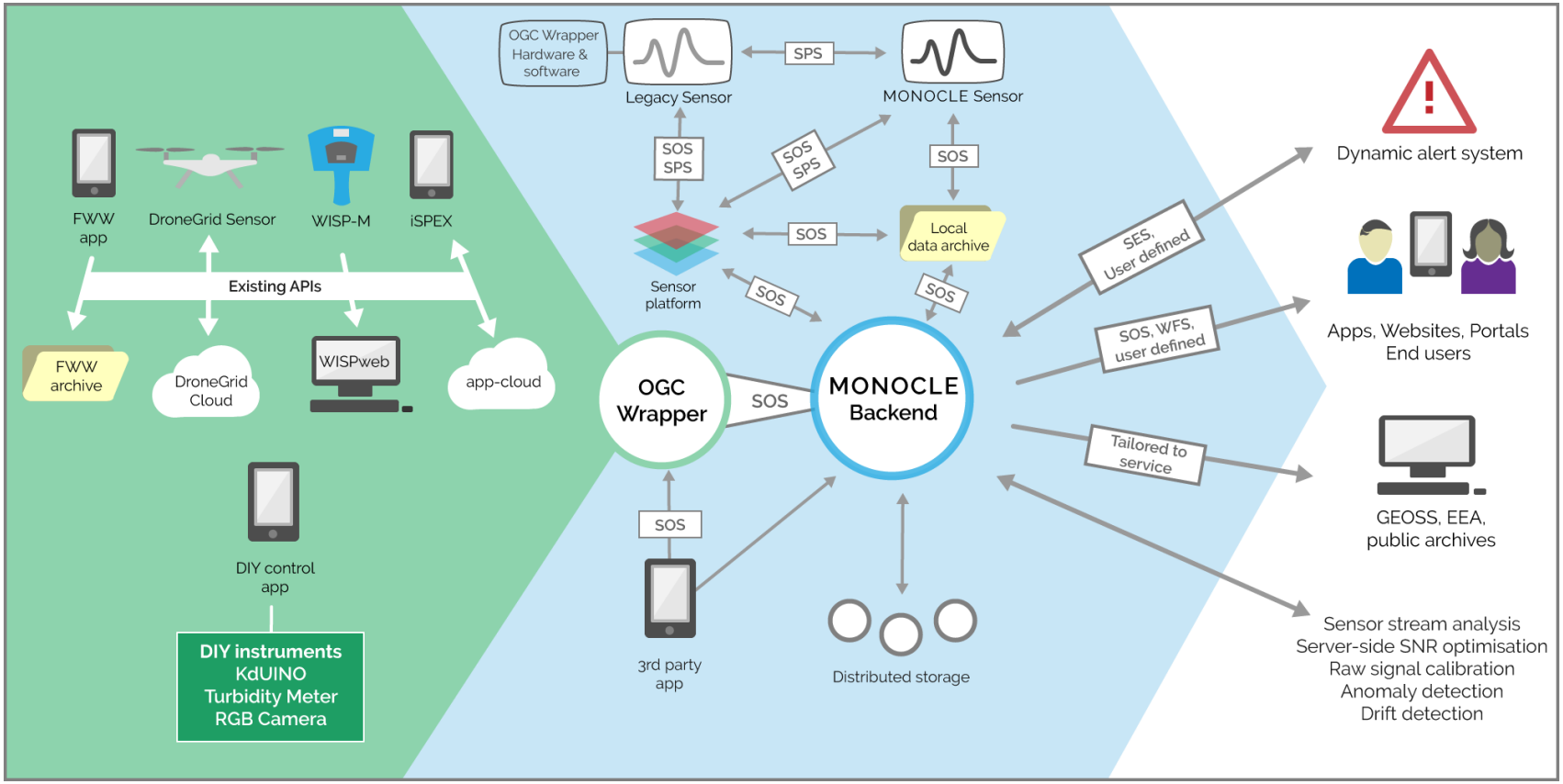




Bardaji et al. (2006). Sensors

Network innovation

Interoperability, licensing, and real-time sharing



Webinar on sustainability of monitoring networks: **24 October 2018**
See www.monocle-h2020.eu/webinars for updates

MONOCLE

Opportunities and challenges (for discussion)

MONOCLE focusses on developing sensor, deployment and data processing solutions while supporting collaboration with:
- site operators (**network compatibility**)
- sensor manufacturers (**data interface development**)
- citizen science initiatives (**test new sensors**)

Improved **data accessibility** through connected sensors supports anomaly detection, response times, sensor auditing, live visualization, and supports satellite observation: everyone wins but only some profit.

Who compensates site operators? New paradigm on data licensing and sharing needed. Move towards hybrid EO - in situ observation services.