HYPERMAQ
Hyperspectral and multi-mission high resolution optical remote sensing of aquatic environments

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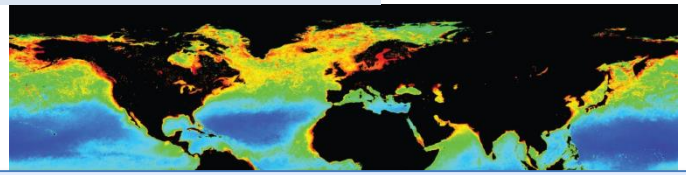
Contributions of multi-spectral ocean colour sensors to the understanding of open ocean and coastal waters

Global picture of phytoplankton abundance

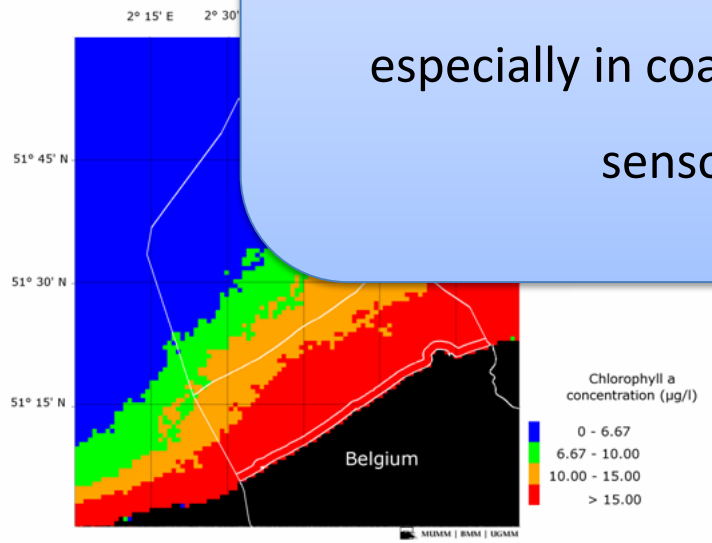


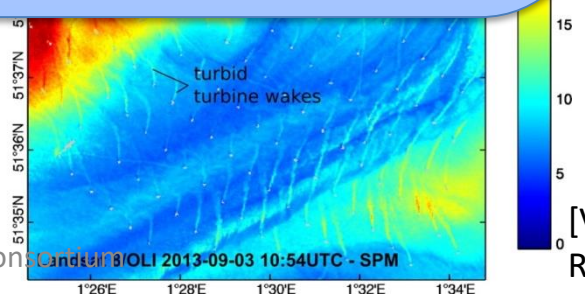
CZCS Chl-a climatology from https://oceancolor.gsfc.nasa.gov/

Information derived from multi-spectral ocean colour is often limited to bulk parameters (chlorophyll-a concentration, non algal particulate concentration, …), especially in coastal complex waters. Hyperspectral sensors can help to go further.

Eutrophicati

mill farm at L8-OLI)



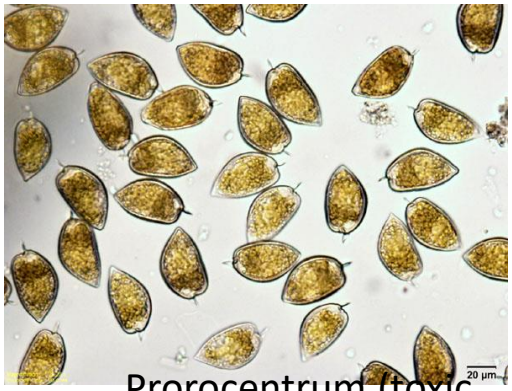


[Vanhellemont & Ruddick K (2014).

1. Determination of micro-algae (phytoplankton) species

- Different phytoplankton species have different impacts on the ecosystem
- Monitoring harmful algal blooms

Diatom bloom



Prorocentrum (toxic dinoflagellate) bloom

Phaeocystis colony and beach foam

2. Identification of macro-algae coverage, species, life cycle

Ulva Qingdao? China

Emerged/submerged vegetation, Spuikom [O. De Clerk]

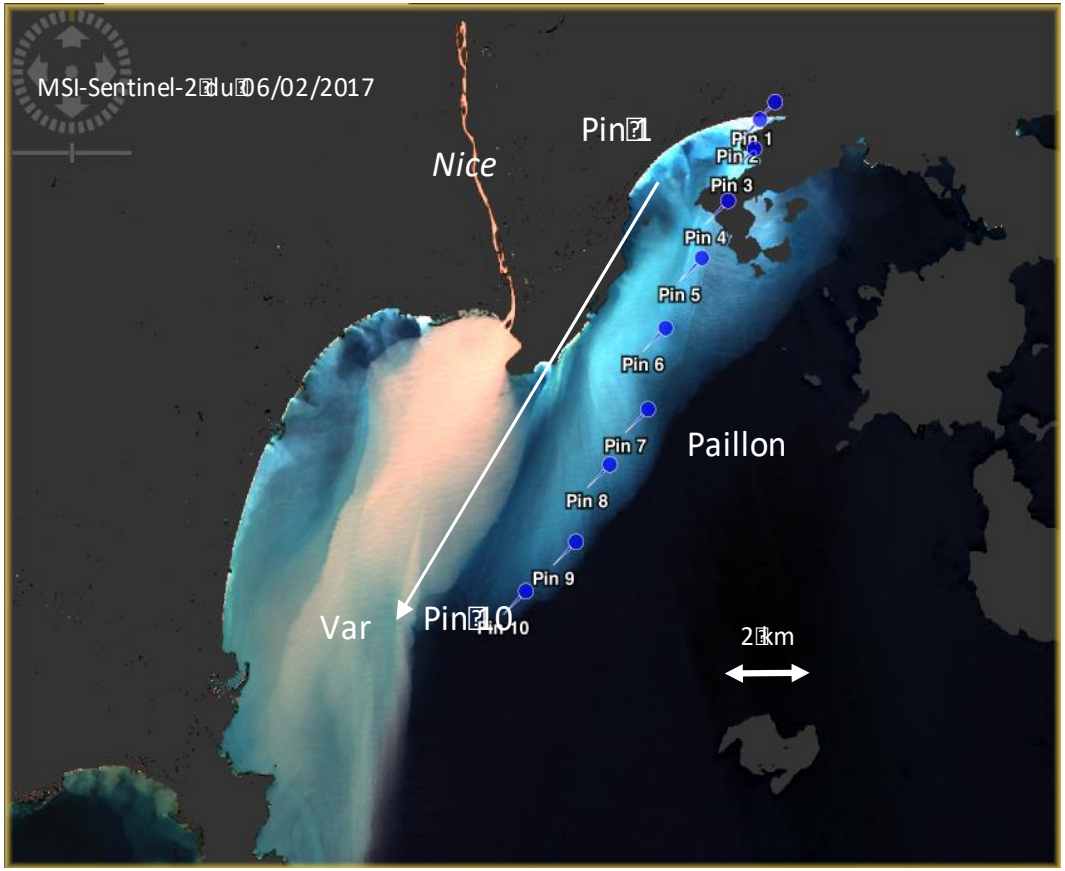
Floating plants invasion in Río de la Plata reaches Bueno Aires in 2016

- Transfer dangerous species (snakes, etc)
- block drinking water intakes
- Block ferry harbor

Buenos Aires Ferry port blockage

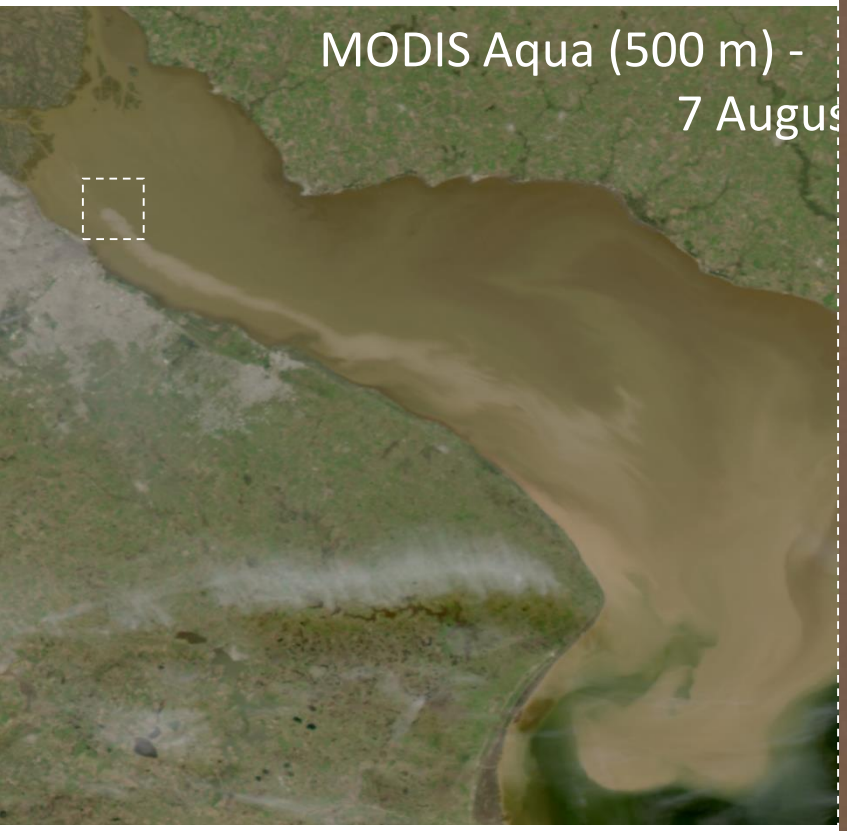
3. Identification of sediment type/origin

➔ Colors of the water in the Paillon (P) and Var (V) river plumes in the Baie eds Anges (Nice, SE France) detecetd by eyes (on the left) and from space using the S2-MSI satellite sensor (right)

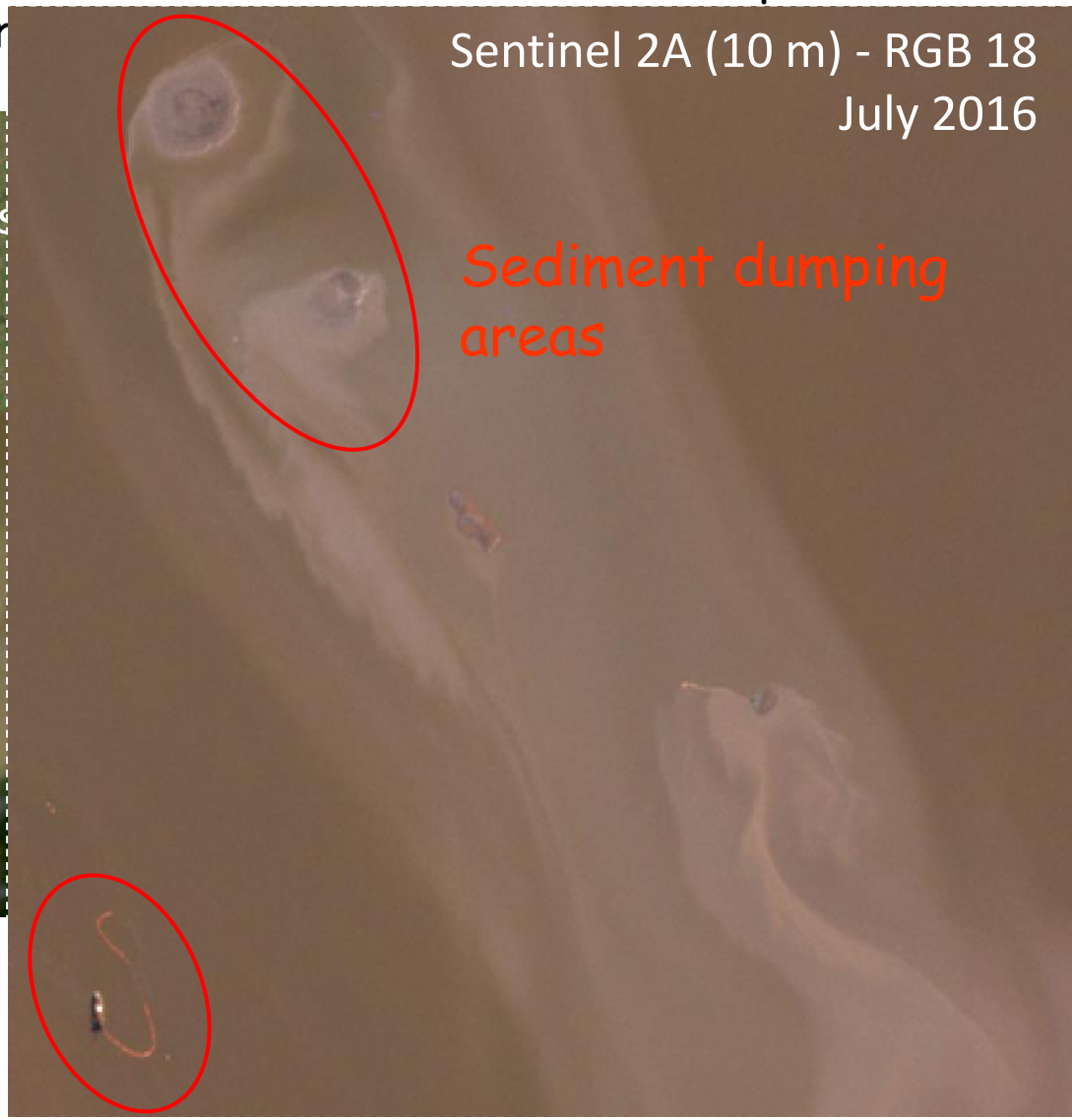


- A conspicuous plume (associated to intense dredging activities) with different color in the RGB composite was detected in the Río de la Plata (Argentina) in mid-2016 looking brighter and more yellow compared to adjacent waters.

- These waters had different spectral characteristics, smaller median particle size, and turbidity values ten times higher



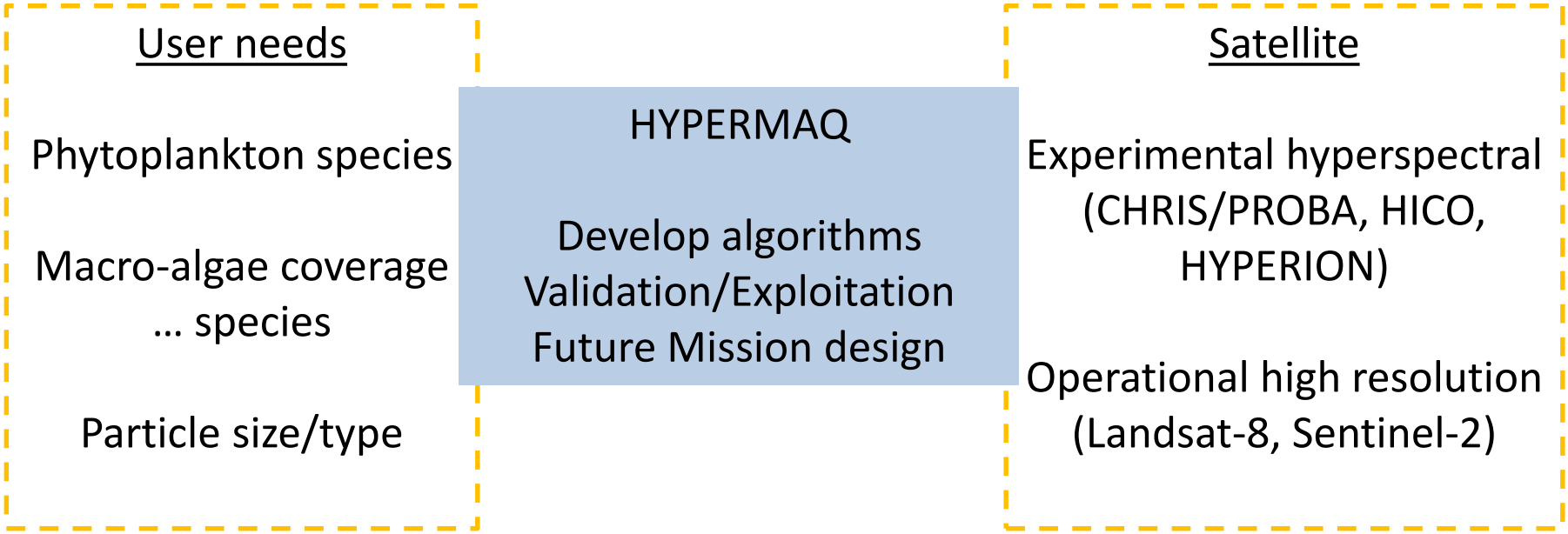
dredging ship



HYPERMAQ Objectives

GENERAL OBJECTIVE

More than “just” concentration: algal species, particle size/type with hyperspectral observations



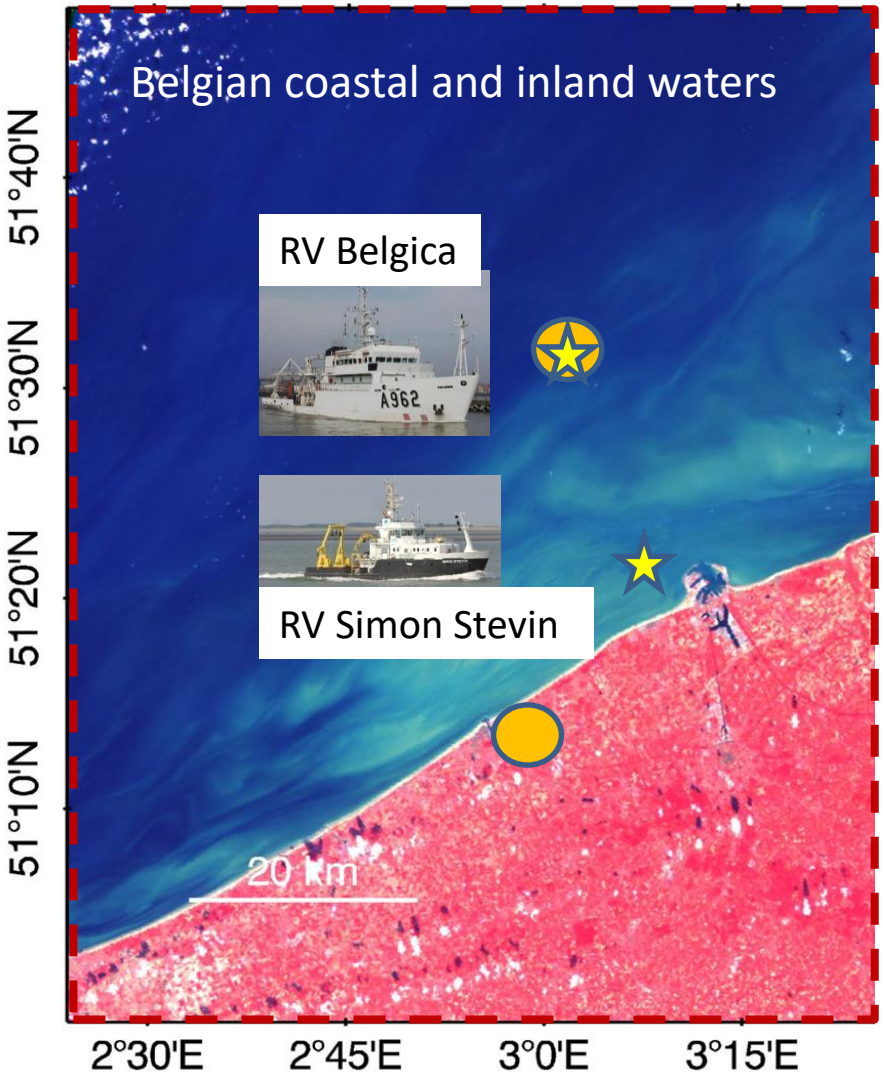
HYPERMAQ Specific Objectives

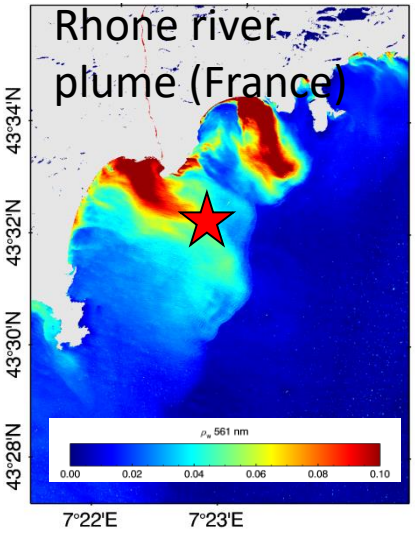
- Design hyperspectral algos for
  - phytoplankton species (turbid)
  - macro-algae cover and type
  - non-algae particle size/type
- Refine multispectral algos for high spatial res
- Design hyperspectral validation network
- Exploit data for studying micro- and macro-algae
- Recommendations for future satellites (bands, signal:noise, etc.)

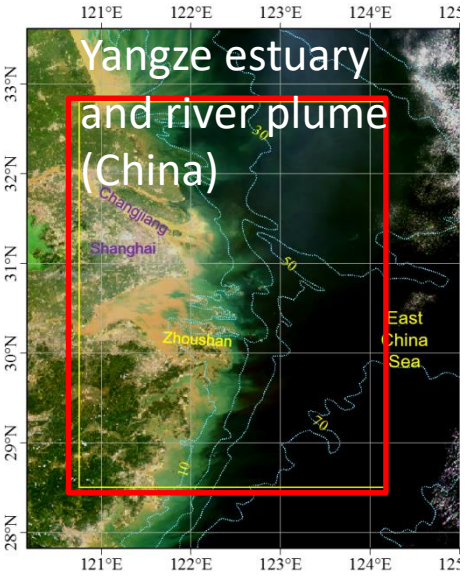
!NEW Copernicus Phase A/B Hyperspectral imaging mission!

Design hyperspectral validation network

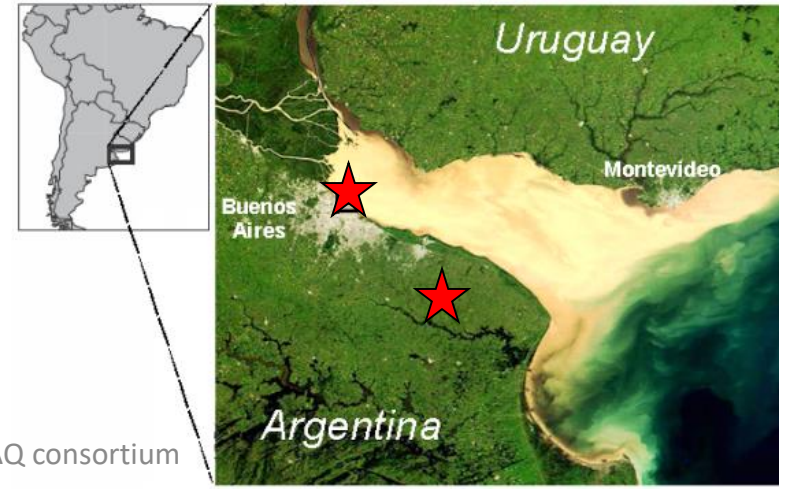
Test sites





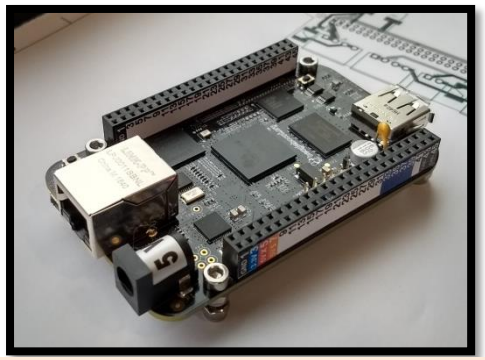


Rio de la plata estuary (Argentina)



Design hyperspectral validation network instrumental design

GPS: position and date / time



Computer designed to command measurements every 30 minutes with the right pan and tilt angles. Current works from VLIZ

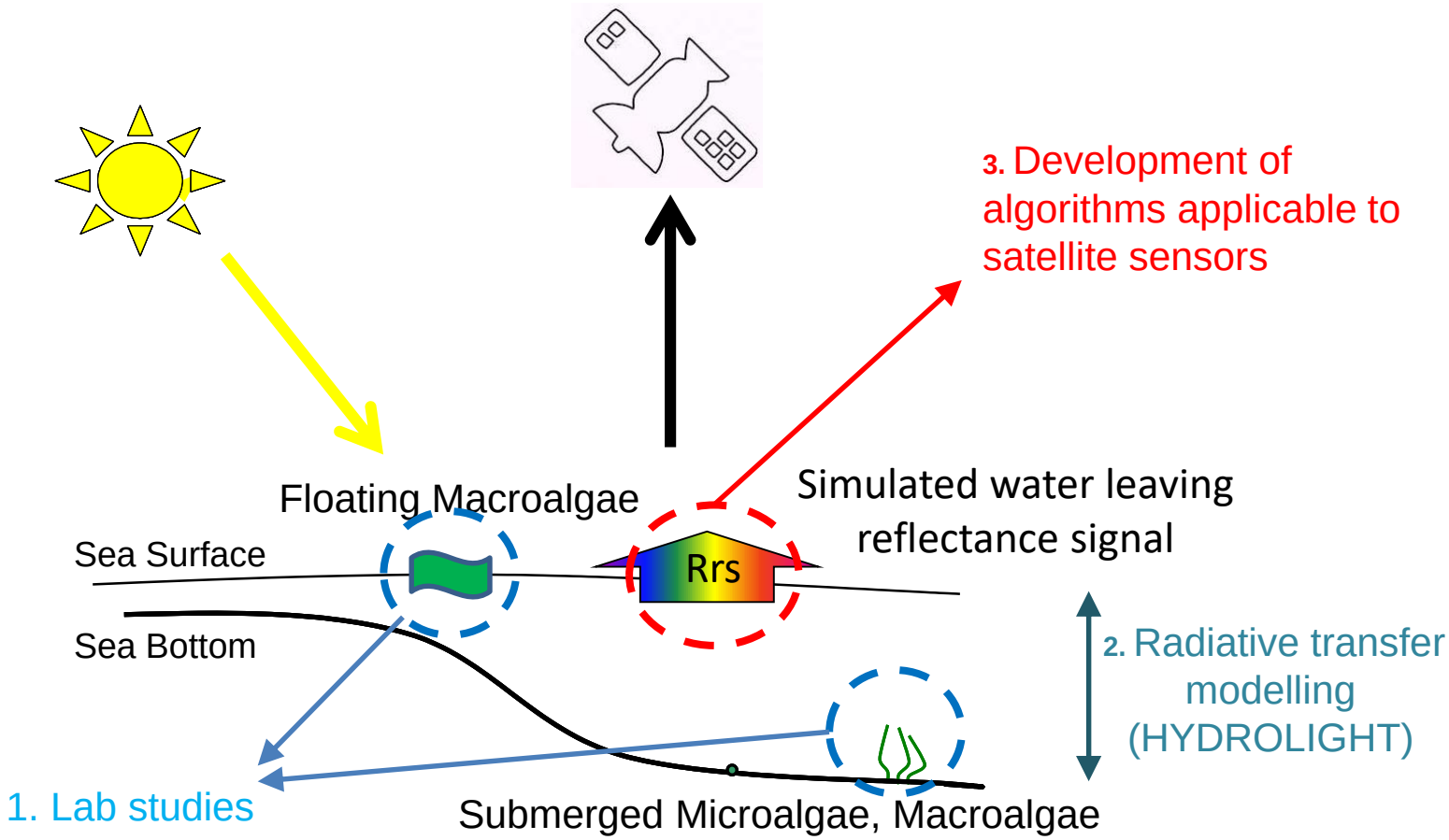
Ed

Lsky

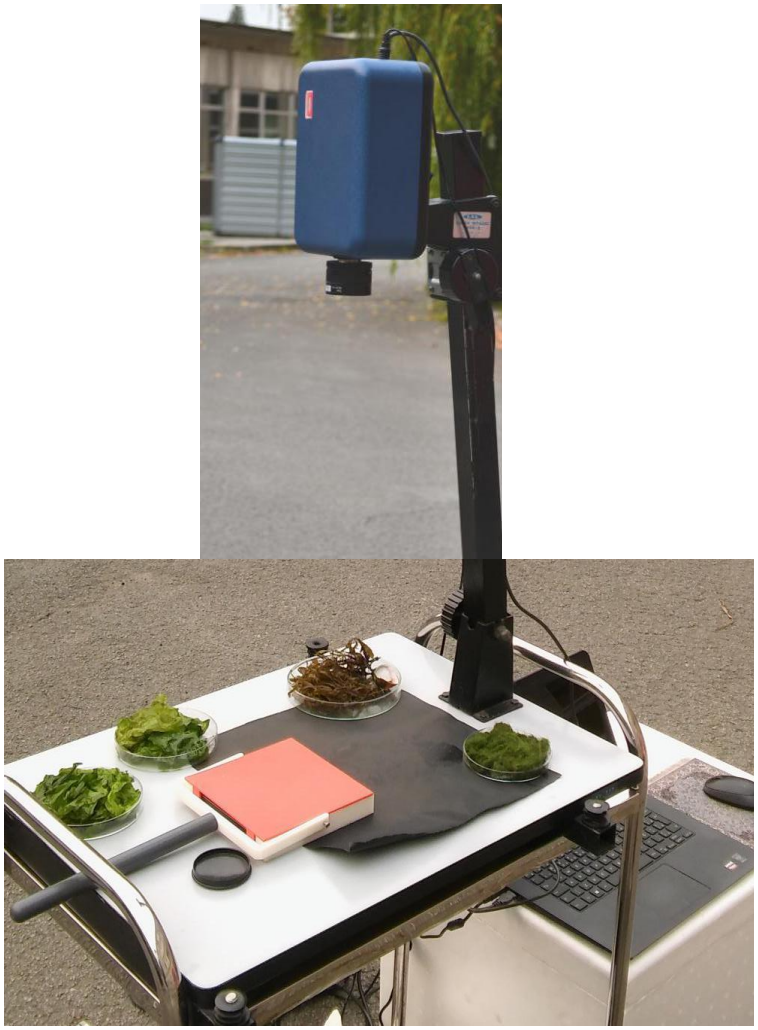
Lup

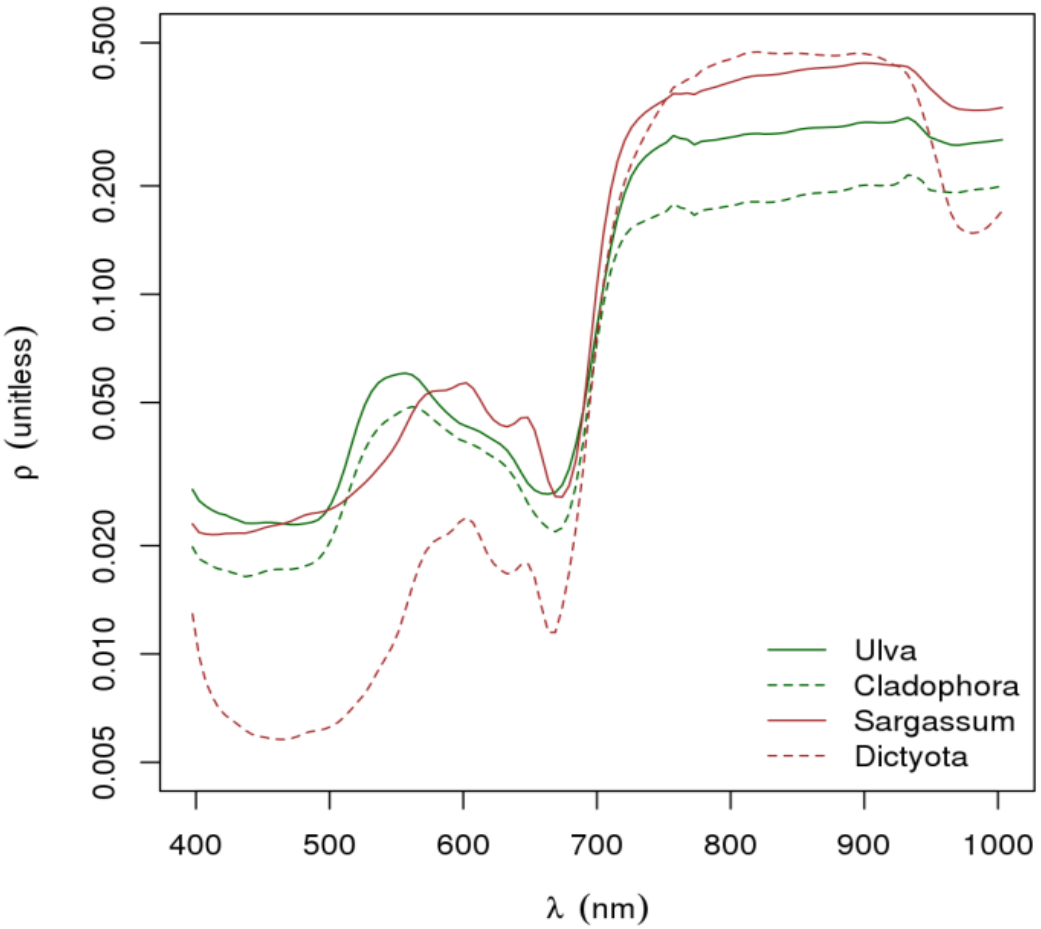
2 Trios sensors

Design hyperspectral algorithm



Design hyperspectral algorithm: algal lab studies (Ugent): Characterisation of macro-algae with hyperspectral camera





Exploit data on available hyperspectral satellite images

- HICO: 90m, 400-900nm (~40 cloud-free BE)
- Hyperion: 30m, “350-2600nm” (3 cloud-free BE)
- CHRIS/PROBA-1: 30m, 411-977nm (>2 cloud-free BE)

Acquisition plan for CHRIS in 2018
Accepted by ESA:
1 to 3 images per month for the HYPERMAQ test sites:

- ✓ Spuikom (Belgium)
- ✓ Belgium coastal waters
- ✓ Rhone river plume (France)
- ✓ Rio de la Plata estuary (Argentina)
- ✓ Yangtze estuary and river plume (China)

- GF-5 chinese hyperspectral satellite mission is launched scheduled in 2018, data available from 2019

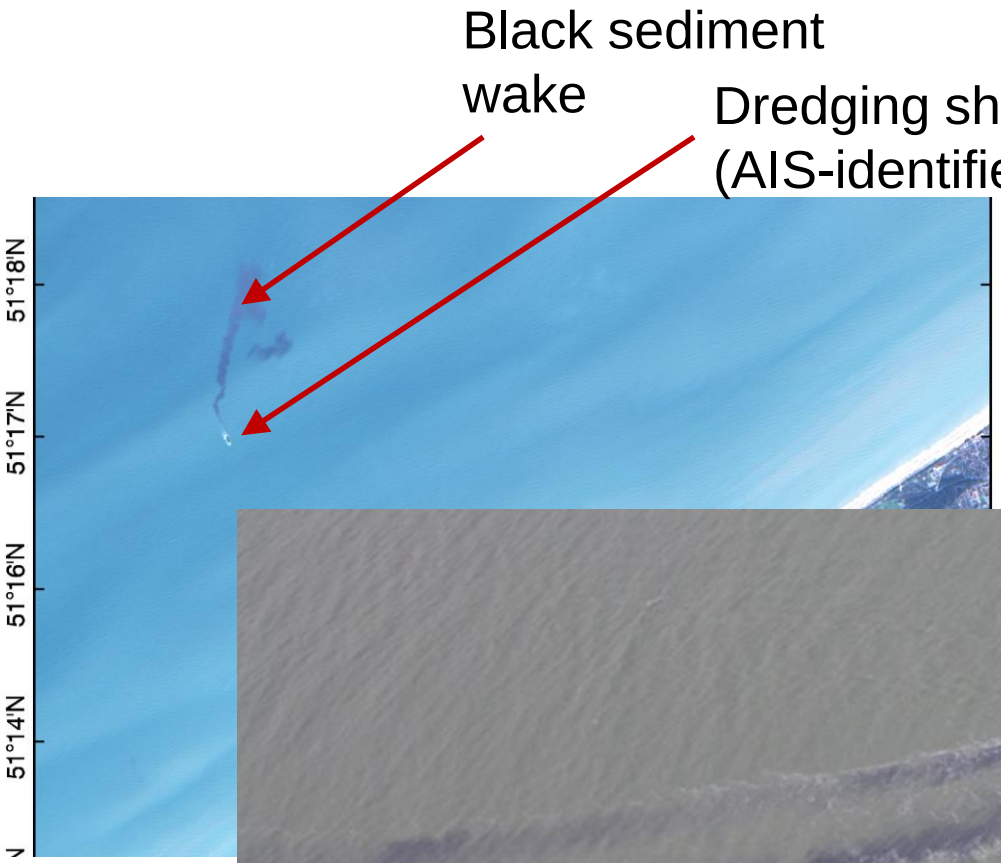
HICO image of the North Sea on 24 June 2014

Summary

- HYPERMAQ will develop hyperspectral algorithms to go beyond “just” concentration
  - micro-algae species
  - macro-algae species
  - suspended particulate matter size/type
- Strengths:
  - Multidisciplinary expertise
  - Strong link to users and applications
  - Innovation in algorithm design
  - International visibility and collaborations

Thank you for your attention

3. Identification of sediment type/origin



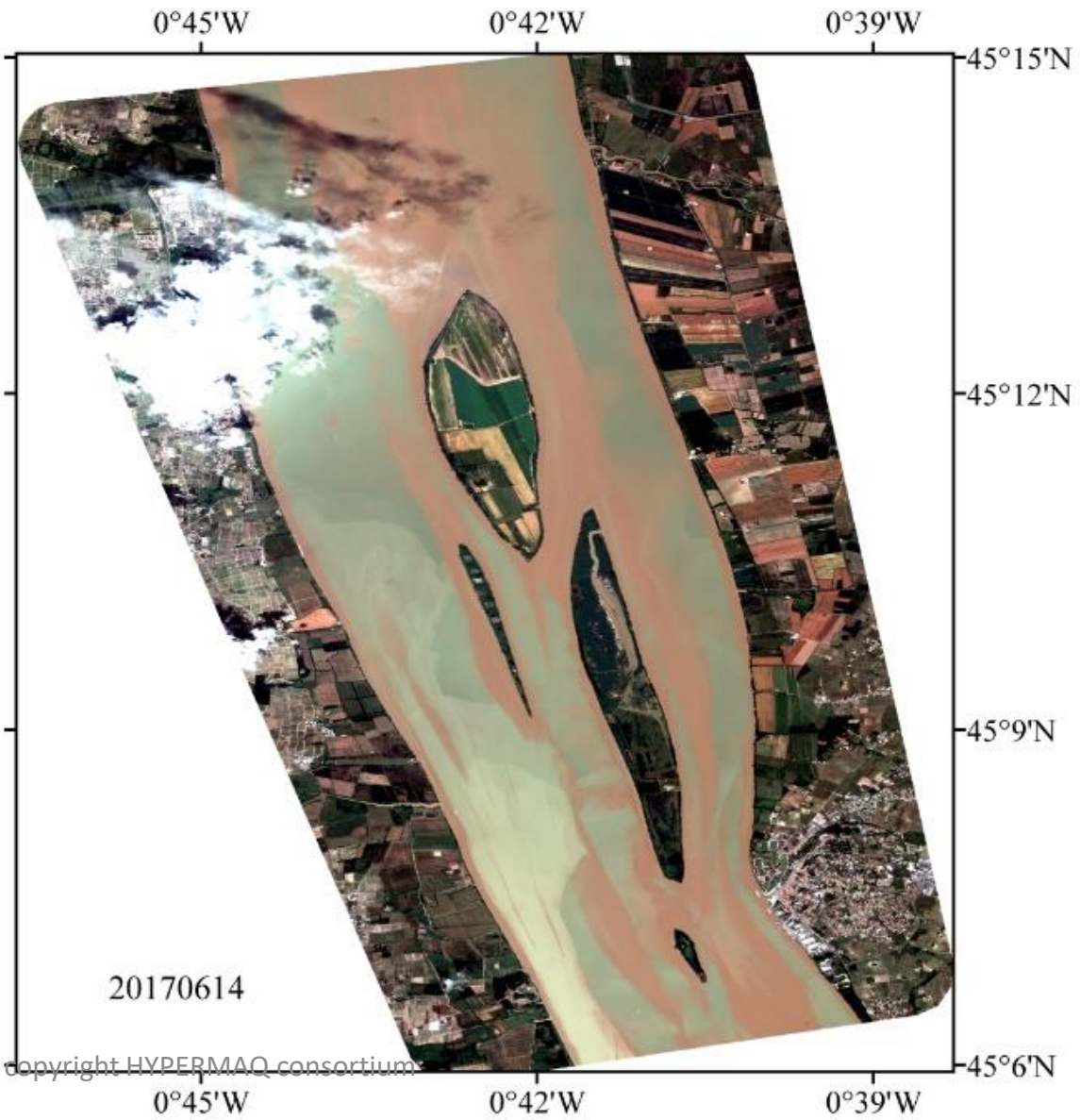
Landsat-8
30.10.2013

[JP. Vogt, RBINS, 28.1.2014]

[Vanhellemont Q. & Ruddick K. Advantages of high quality SWIR bands for ocean colour processing: Examples from Landsat-8 (2015) Remote Sensing of Environment, Vol. 161 pp. 89–106.]

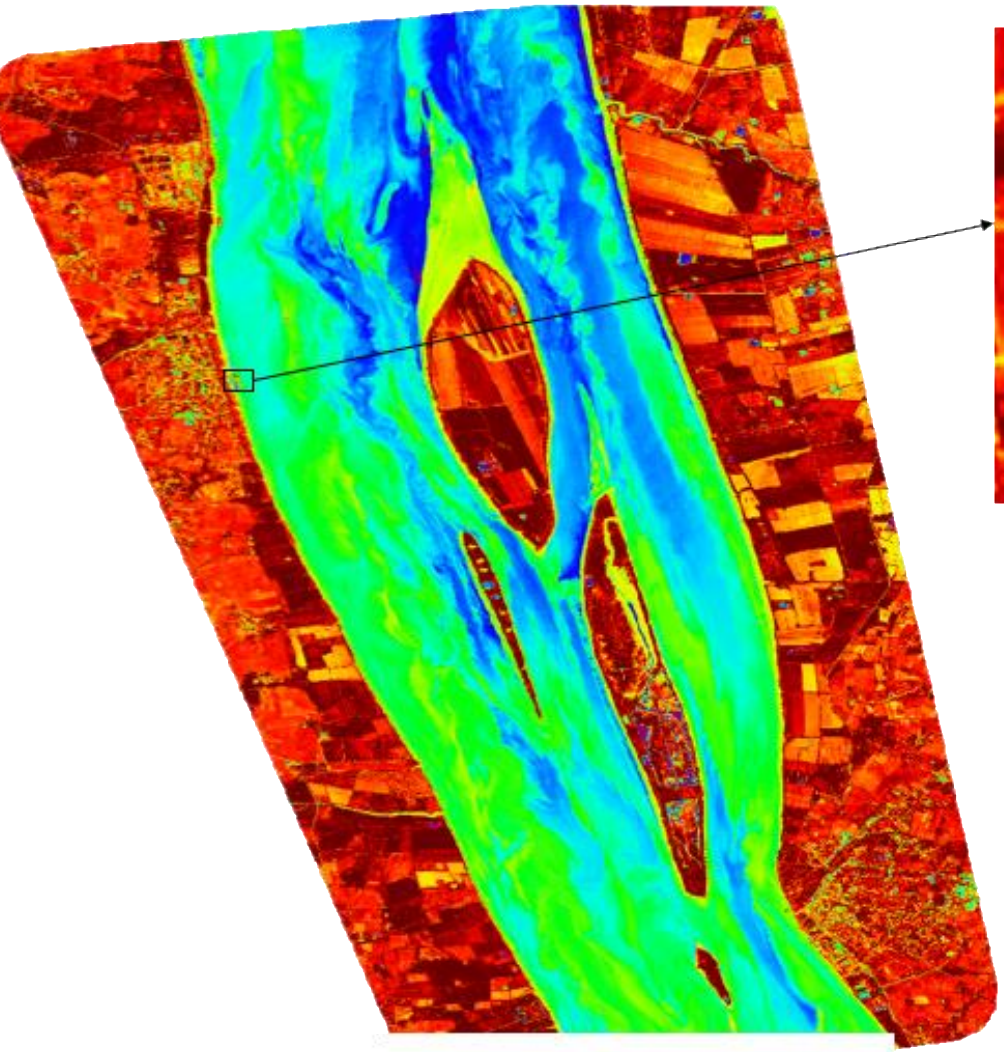
PONDER : très haute résolution spatiale

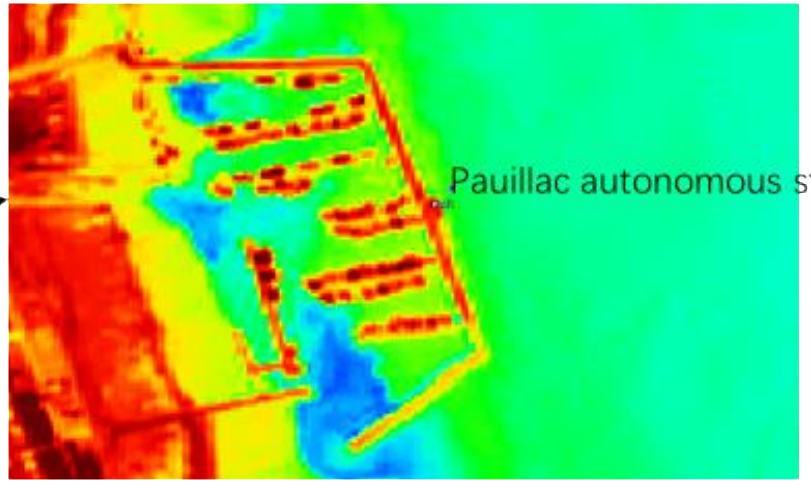
- **The Gironde estuarine waters can display quite different colors (from green to different types of brown) depending on the nature (size distribution and composition) of suspended particles (RGB image from Pléiades acquisition corrected for atmospheric effects)**

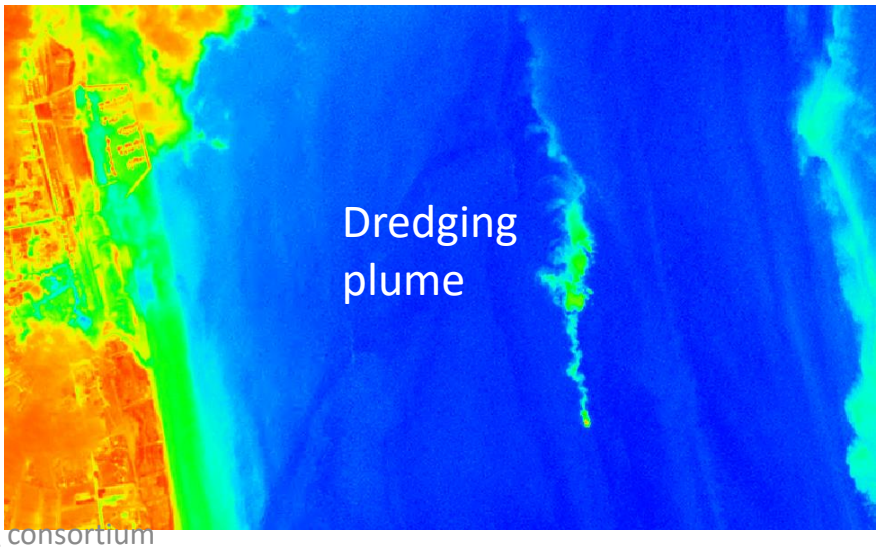


PONDER : très haute résolution spatiale

➢ **Cartographie des MES à 2m de érsolution spatiale (Pléiades)**







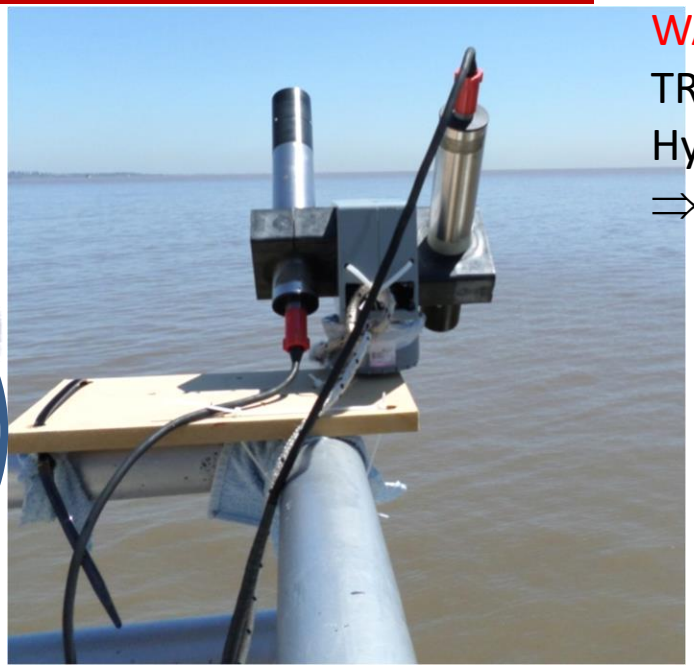
A. Turbidity retrieval algorithm (in situ data measured near Pauillac station in 2013)

Design hyperspectral validation network
instrumental design

Ocean Colour validation is achieved mainly by AERONET-OC network
We are setting up a new **hyperspectral** international network (WATERHYPERNET)

+slide from Dieter/VLIZ?

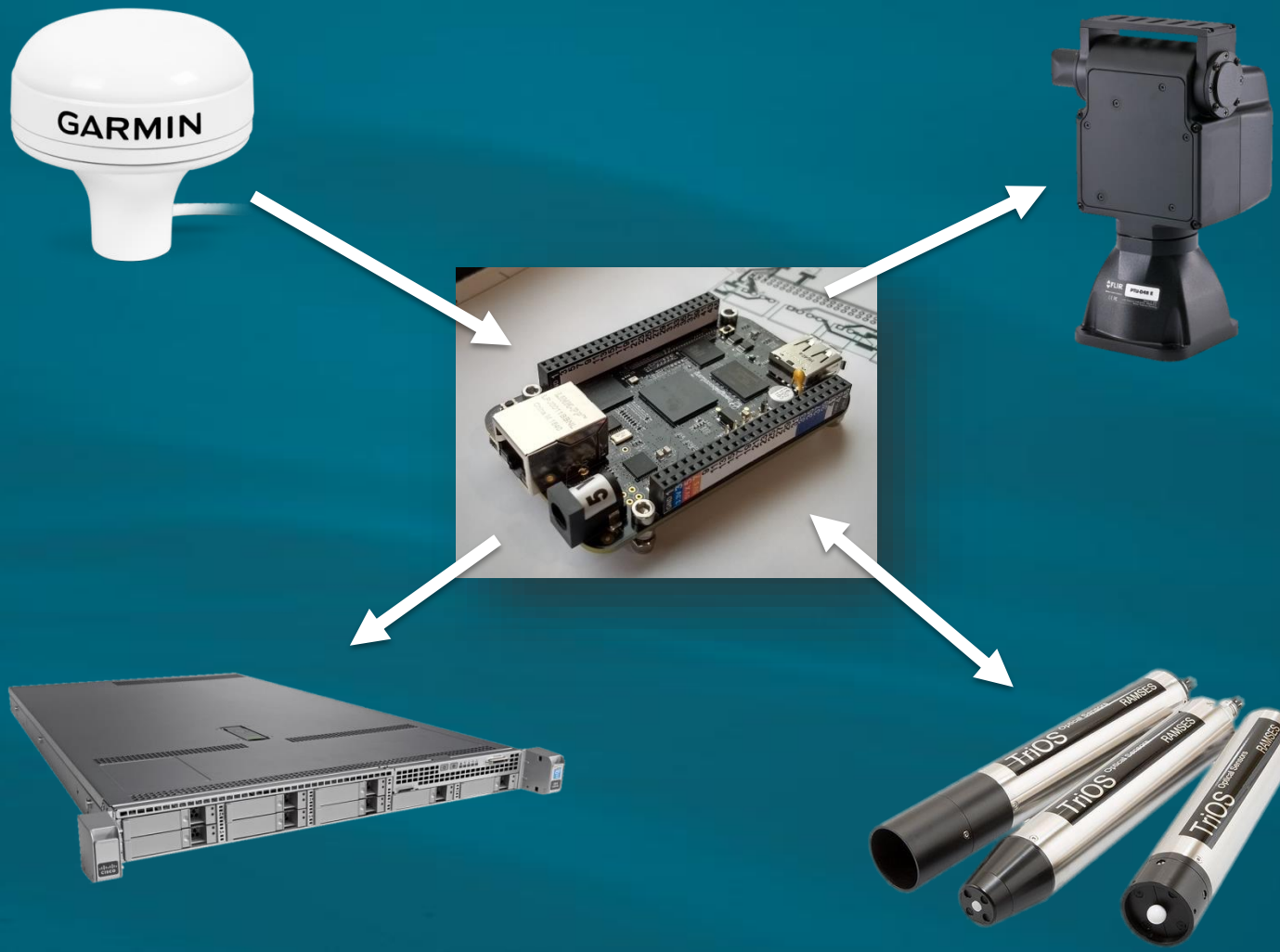
HYPERMAQ
Automated
Rotating
System



WATERHYPERNET
TRIOS/RAMSES instrument
Hyperspectral 350-900nm
⇒ All bands, all sensors

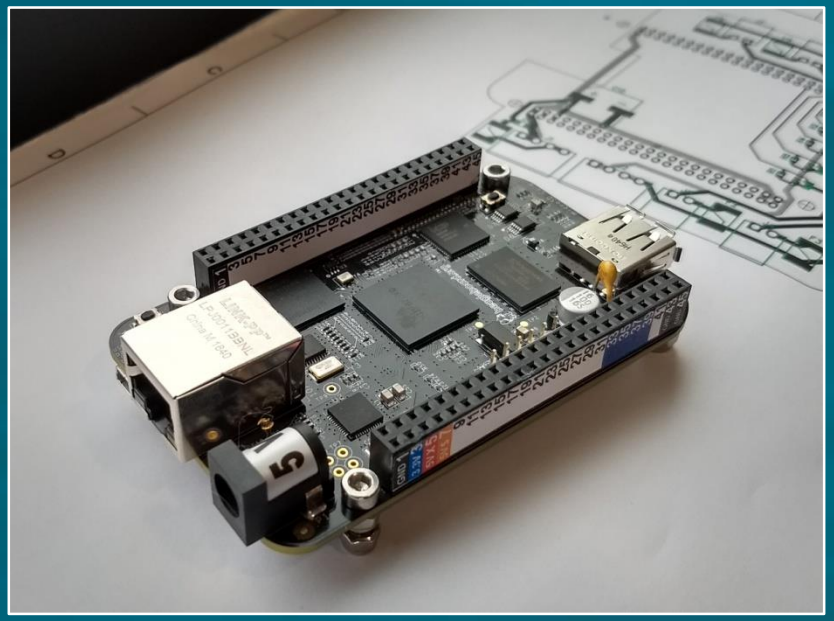
HYPERMAQ/VLIZ is designing new rotating “pan-and-tilt” system & test with partners (RBINS/Thornton+Spuikom, LOV/Rhone, IAFE/FPier)

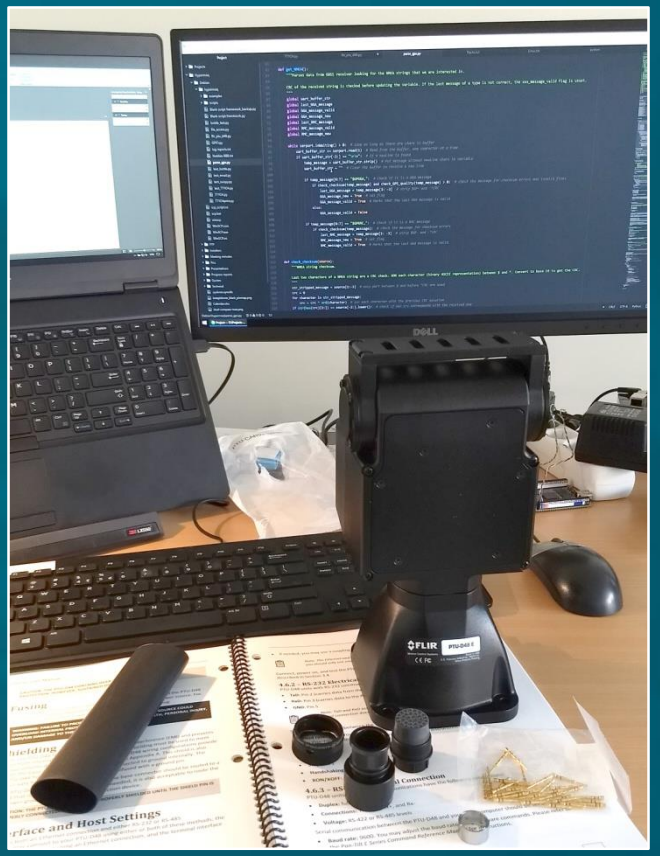
How does it work?



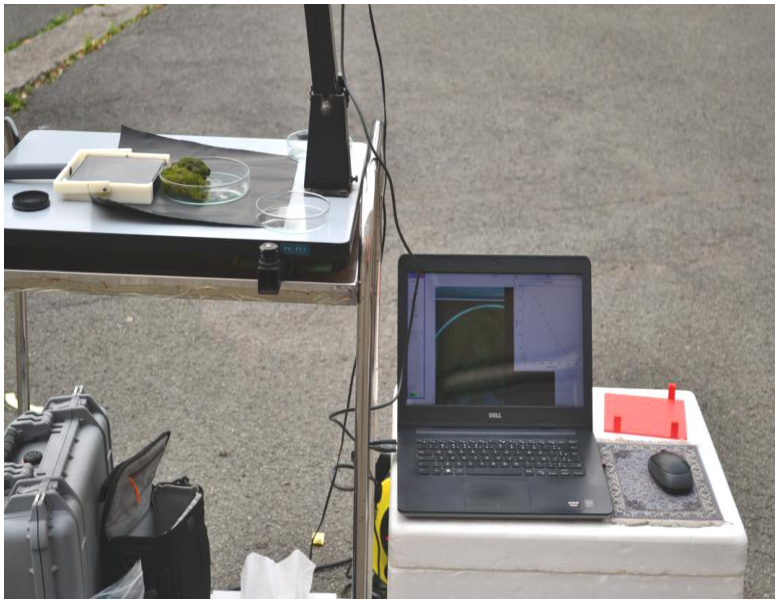
VLIZ

Controller and FLIR PTU-48D pan/tilt





Pan/tilt test setup



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