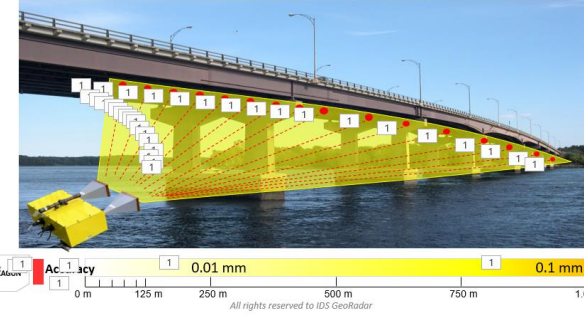
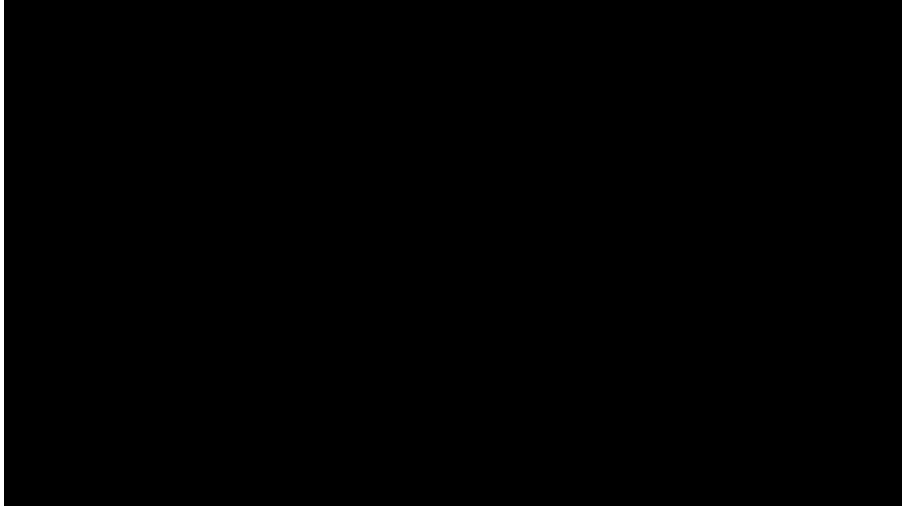




# Who is Jasper Schmeits? @Tauw Group



TruDefender FTX

### FTIR

#### SUITABLE FOR:

- Colored samples
- Fluorescent samples

Both identify light-colored samples.

FTIR & Raman serve as complementary and confirmatory analysis for many samples.

### Raman

#### SUITABLE FOR:

- Aqueous solutions
- Point-and-shoot through semi-transparent containers

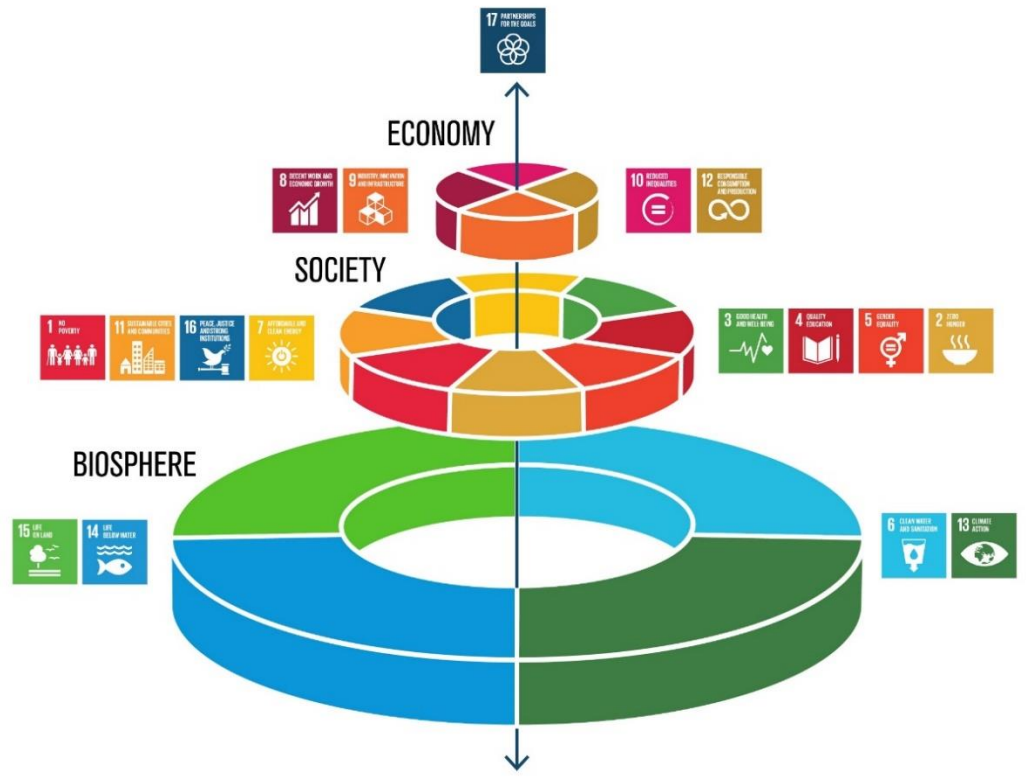
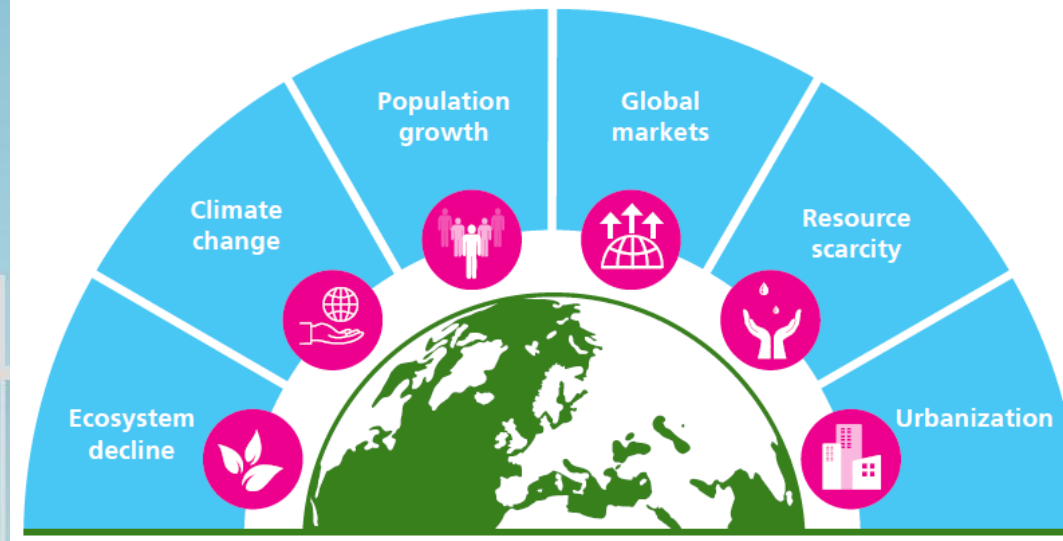


FirstDefender RMX and FirstDefender RM

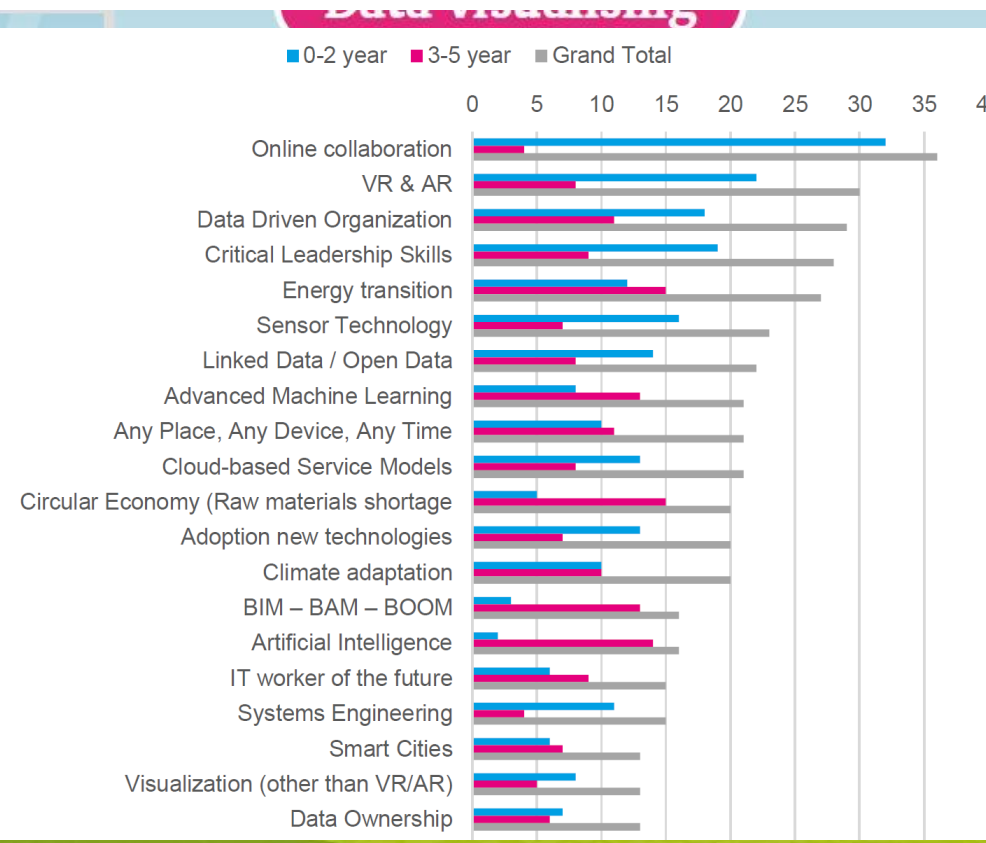
Figure 1. Complementary FTIR and Raman spectroscopy address a range of unknown substances.



# SUSTAINABLE DEVELOPMENT GOALS



Graphics by Jenker Lokantobane



# First experience

Experience on using innovative techniques within remediation of polluted sediments:

- Remediation of river “Vecht”:
  - Pollutants:
    - Zinc, lead, arsenic, mercury and PAH
  - Creating Digital Terrain model
    - Top: multibeam echosounder
    - Bottom: subbottom profiler
  - Use of XRF to determine the boundary and for validating end-result

Based on this experience curious about:  
Added value of getting sensors into the water

Besparing m  
Meerv  
(XRF)



FIGUUR 3. HET UITEINDELIJK BAGGEREN VAN DE WATERBODEM.



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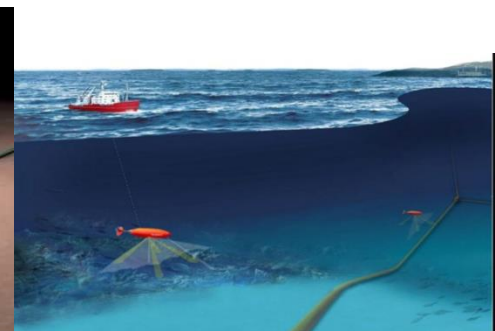
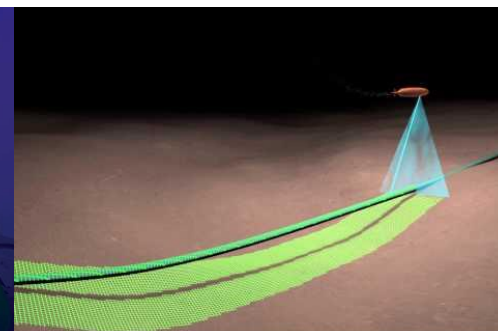
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# Applications of aquatic drones

- Maintenance of offshore systems (Oil&Gas; subsea telecommunication cables)
- Inspection/assessment of underwater infrastructure
- Support and assistance during drilling/dredging/construction operations
- Cleaning and debris removal
- Access locations such as nuclear power plants
- Archeology (ship wrecks)
- Object location and recovery for with tragedies and disasters
- **Environmental: benthic, geophysical and sedimentation surveys (visual, acoustic, water quality)**



# Aquatic drones - variations

## Aquatic Drones

### Unmanned Underwater Vehicles (UUV)

### Unmanned Surface Vehicle (USV)

### Aerial Drones (Interacting with aquatic environments)

### Seabed Working Vehicles

#### Remotely Operated Vehicles (ROV)



#### Tethered

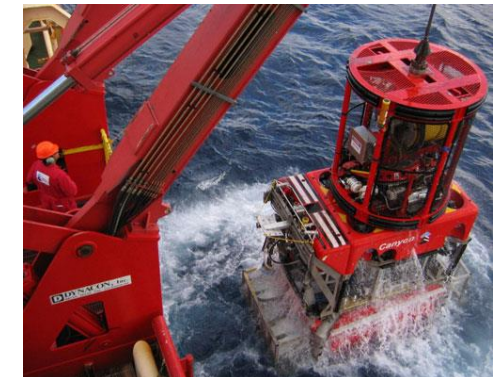
#### Observation Class (Mini/Micro)



#### Inspection/Work Class



#### Medium/Heavy Work Class



# Technological development

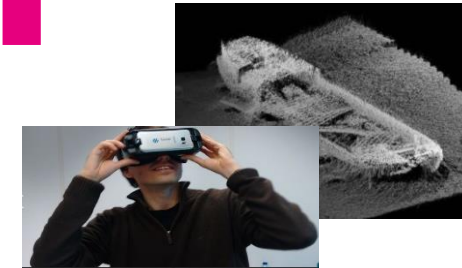
2020 - ...

2017-2019

Underwater communications and positioning



New sensors, sonars, water sampler, ...



2017-2019

Combination with automated surface vehicles



2017

New features and robustness



2015-2016

Open source drone kits



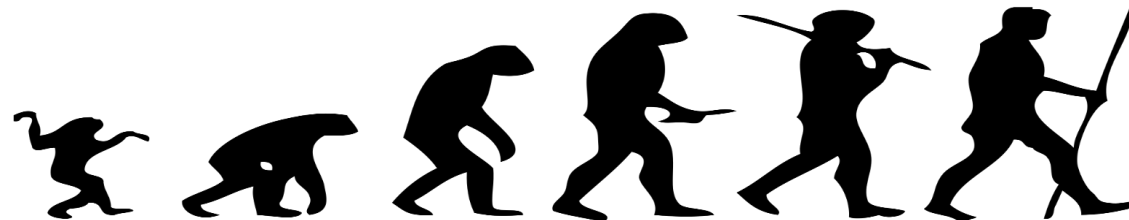
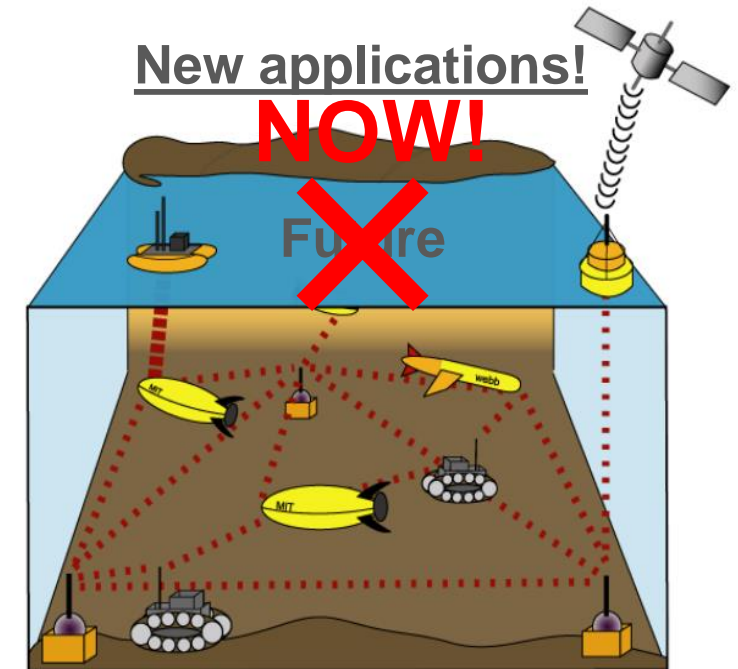
2014

Basic RC submarines



New applications!

**NOW!**



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DYNAMIC  
MONITORING



# First advantage:

- Camera under water



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# Examples:

- Underwater inspections



# Examples:

- Underwater inspections



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# Second advantage:

- Equip system with sensors



## Attached Equipment:

### (1) In-situ TROLL 9500 Sensors:

- Nitrate and Ammonium ISE
- Rugged Dissolved Oxygen

### (2) CTD Diver :

- Temperature
- Pressure
- Conductivity

### (3) Diving light

### (4) HD Video Camera (GoPro 3+)

### (5) Algae sensor (chlorophyll and blue/green algae)

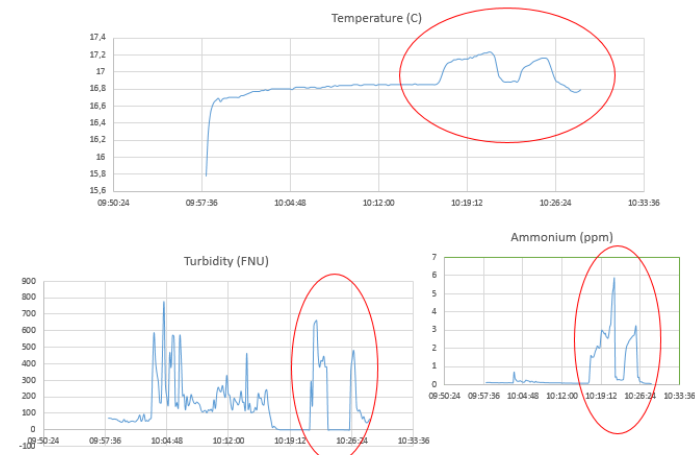
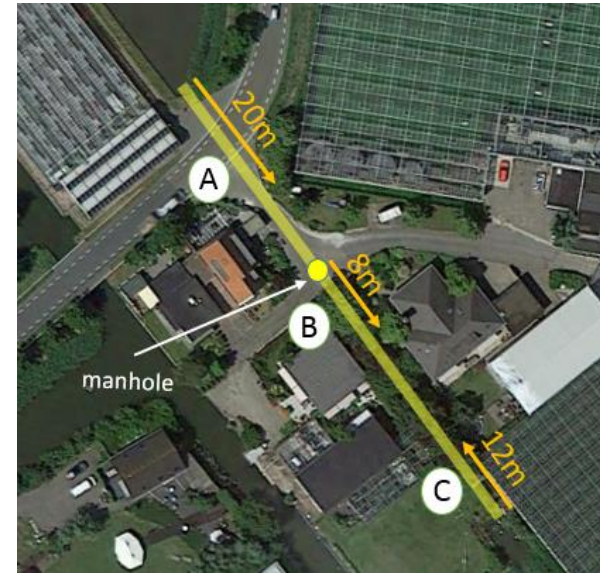
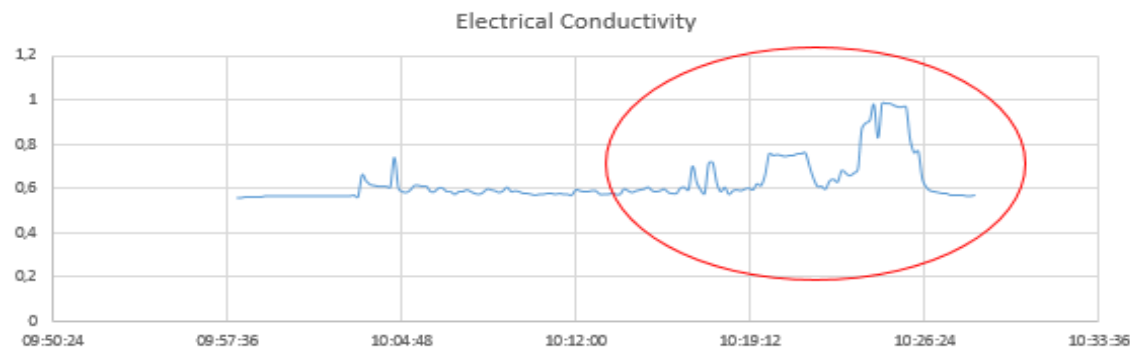
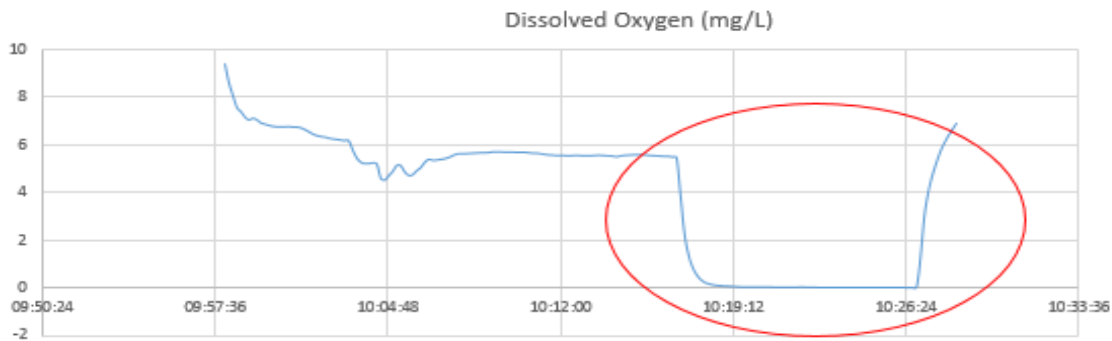
- More options!



# Examples: - Pollution source

## Discharges of Household / Industries

- Measurements inside culvert (up to 20m)

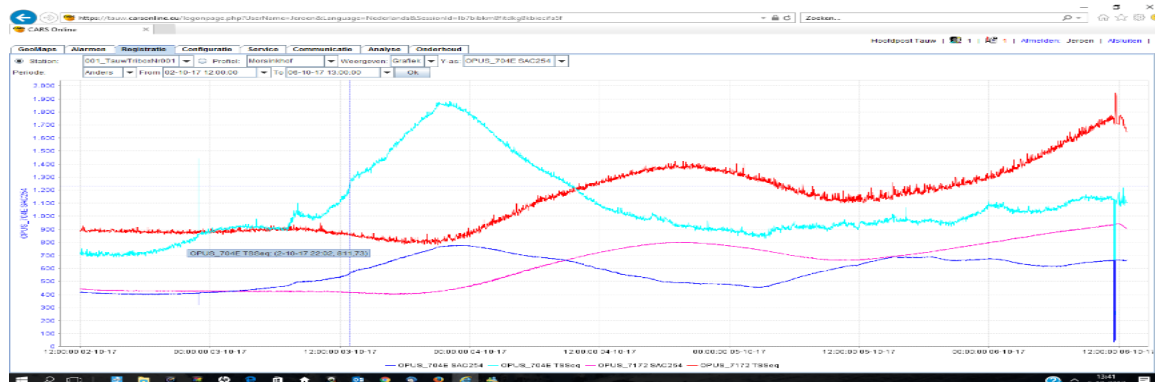


# Examples:

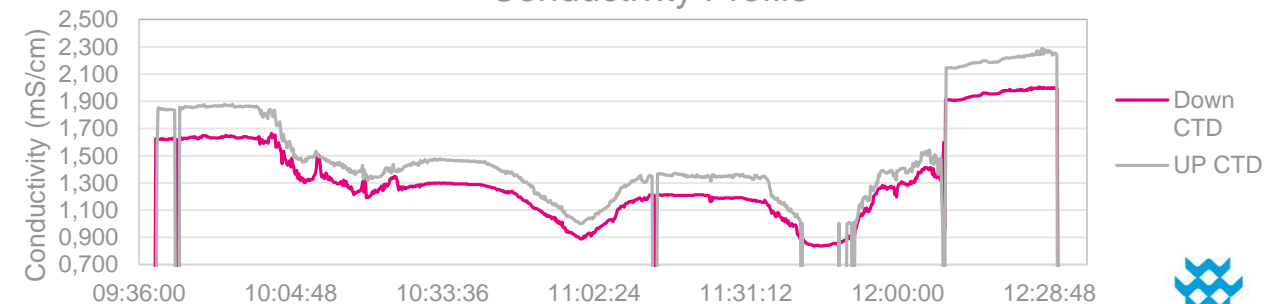
- Spatial distribution

## Mapping of spatial distribution of parameters

- Electric conductivity, Temperature, DO, etc.
- Specific parameters like:
  - Chlorophyll and Cyanobacteria sensor (blue-green algae)
  - Multi parameter sensor (COD/BOD, NO3/NO2, HS-, oil-components, Suspended dust, etc.)



Conductivity Profile

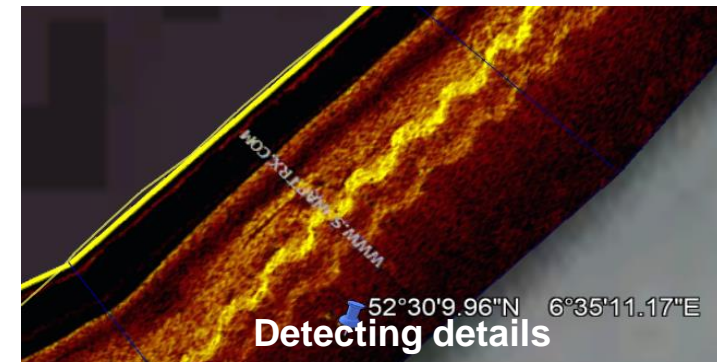
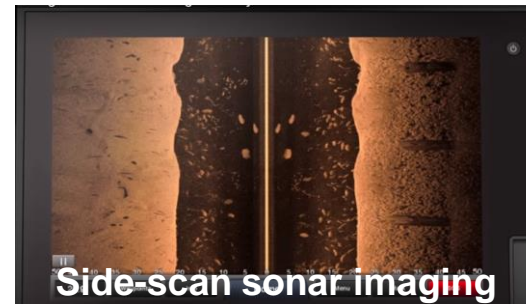
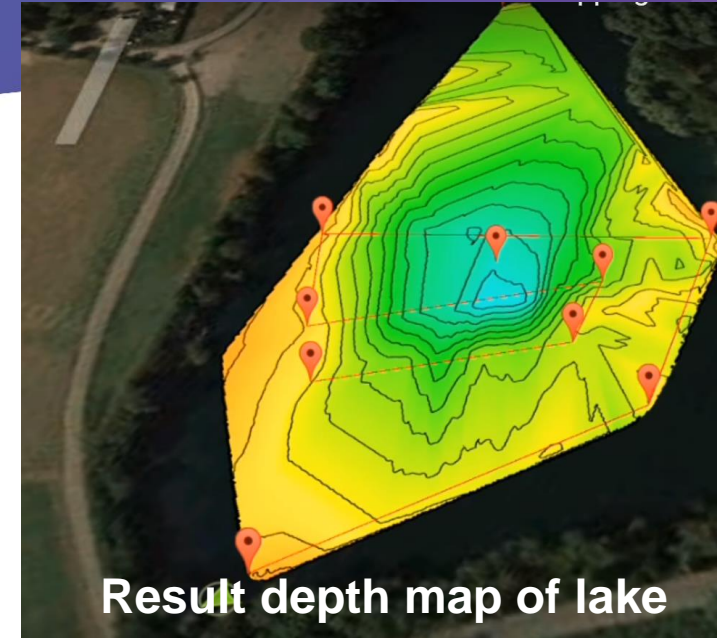
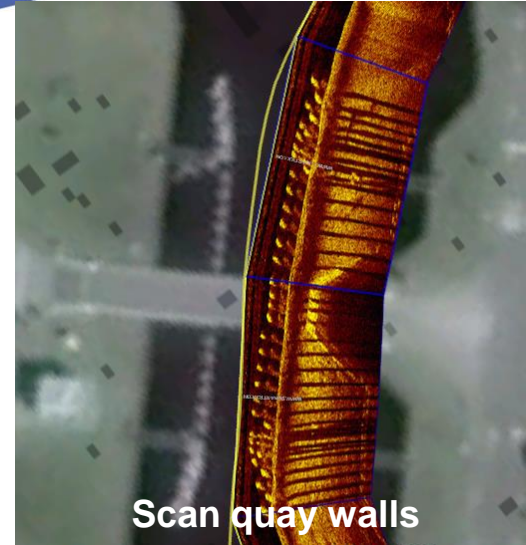


# Examples:

- Geophysical search

Combination with sonar scan:

- Scan of quay walls
  - Identification of inconsistencies or discontinuities that may indicate problems.
- Depth measurements
- Side-scan imaging
- Fish-finder:
  - Useful to easily detect debris material on sub-surface

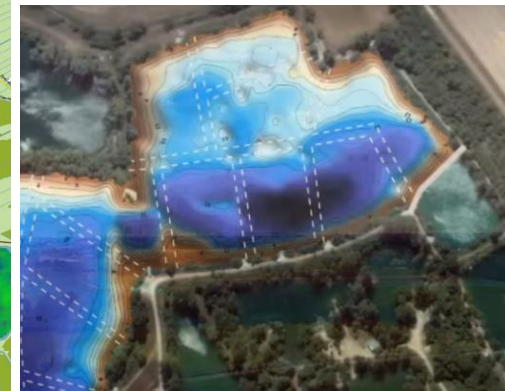
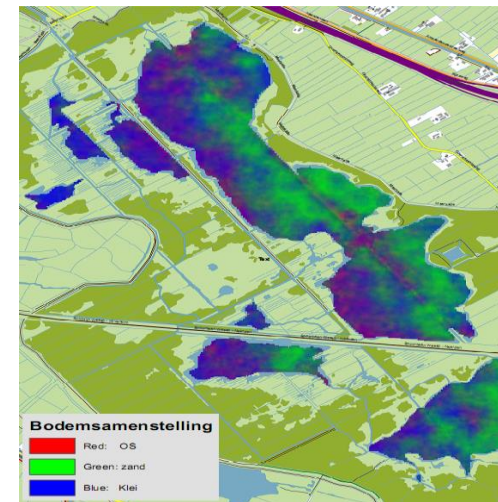
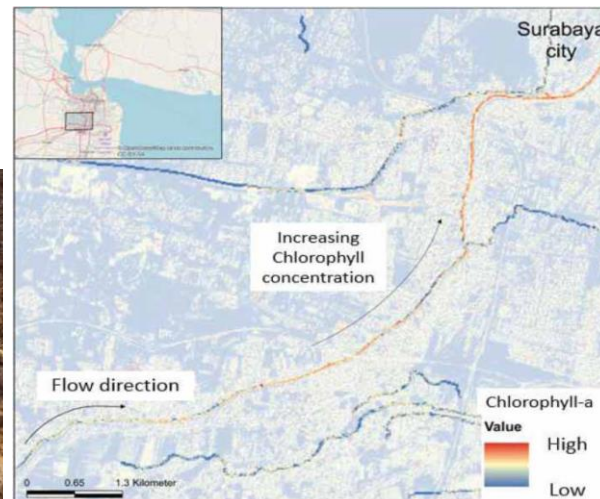
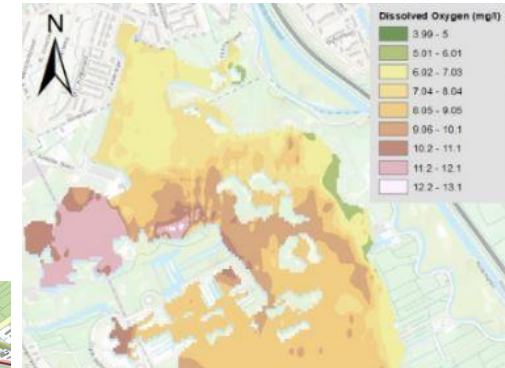


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# Tirth advantage:

- Connecting data to other data collection systems

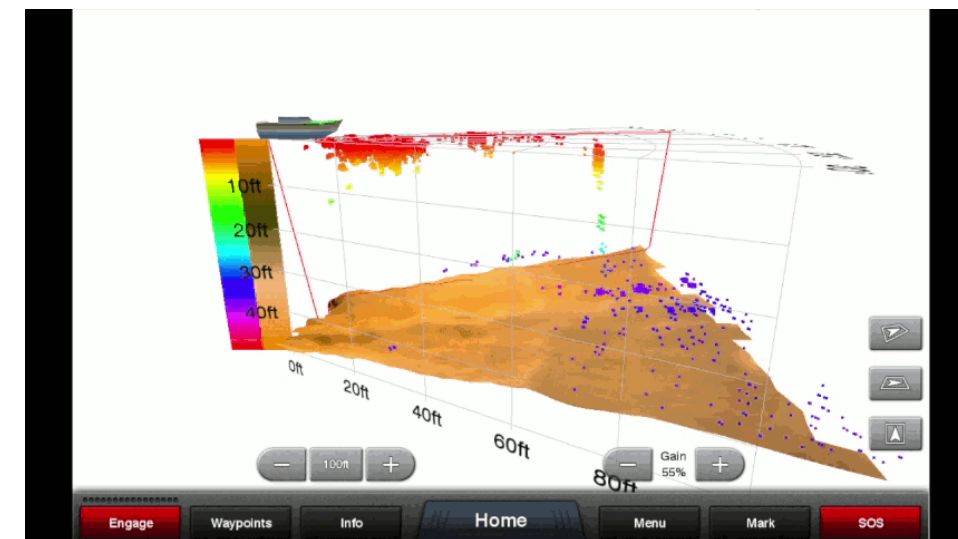
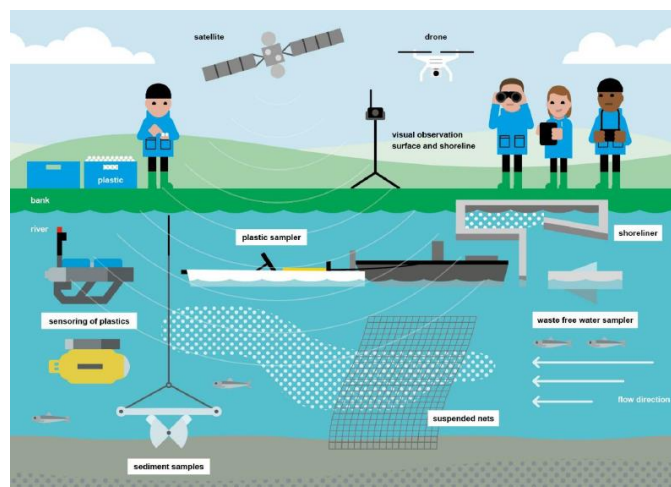
- Connecting water quality to sediment in lake:
  - Output gamma spectrometer (Medusa)
    - Insight in sediment variation and spatial distribution
  - Quality results of XRF
    - Insight in quality of Heavy Metals in samples
  - Connecting to Satellite data
    - Low resolution data for larger area



# New developments

Currently testing/implementing:

- Water sampler
- New tests using 3D multibeam sonar
- Connecting to Virtual Reality
- Underwater GPS
  - Real-time info:
    - distance of drone to bottom
- Real-time data readings
- Sensoring of plastics



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# Wrap up of possibilities

1. Visibility under water
2. Putting sensors on system:
  - Macro-parameters
  - Specific pollutants
  - Sonar systems
3. Connecting data to other data collection equipment
  - Gamma spectrometer
  - XRF
  - Satellite data
4. More developments are possible
  - Use of new technologies simultaneously to collect better data
  - Possibility to add other equipment allow several other future applications



# Grazie per l'attenzione!

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[www.tauw.nl](http://www.tauw.nl)

[Tauw test lab op youtube](#)

