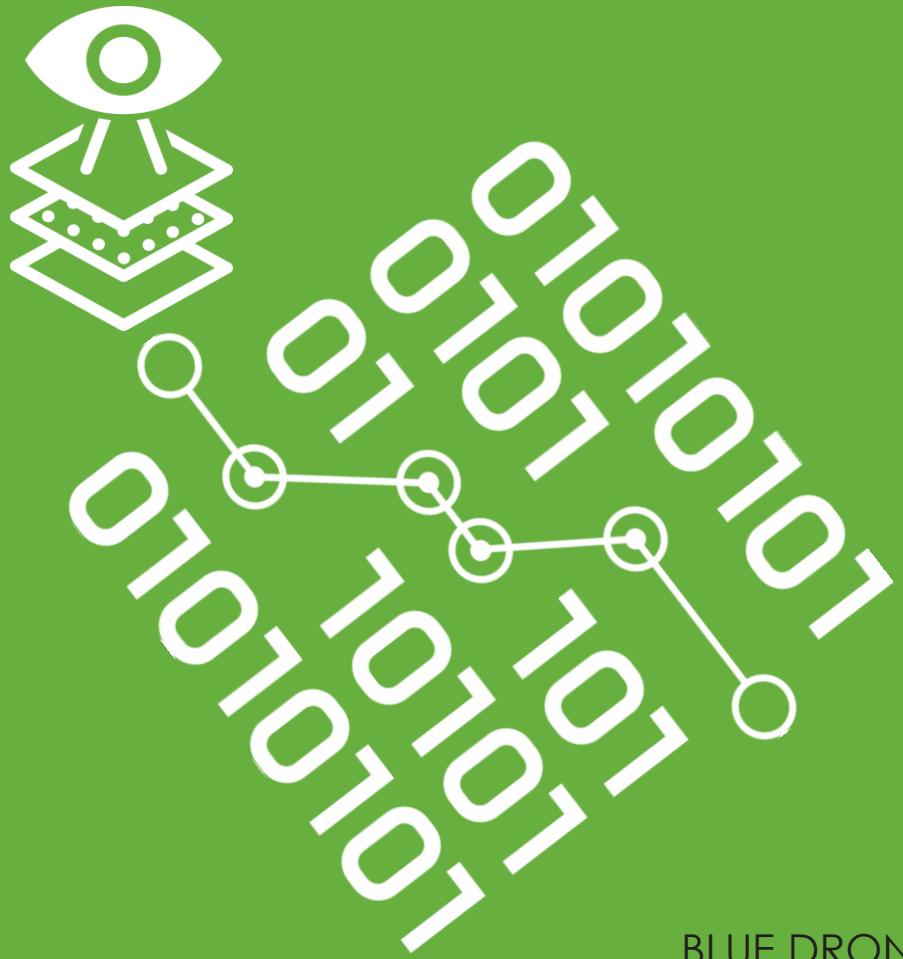


Airborne drones image processing:

challenges & solutions

BLUE DRONES
Port House Antwerp
24/10/2019

Robrecht Moelans
robrecht.moelans@vito.be

Introduction: Drones vs Satellites

- Some advantages
  - **High spatial resolution** over local area
  - Nearly **continuous** daily measurements possible
  - Flying under **clouds**

- Some disadvantages
  - Local **legislation** and permits
  - **Weather** conditions (wind & rain)
  - Relatively **small area** coverage

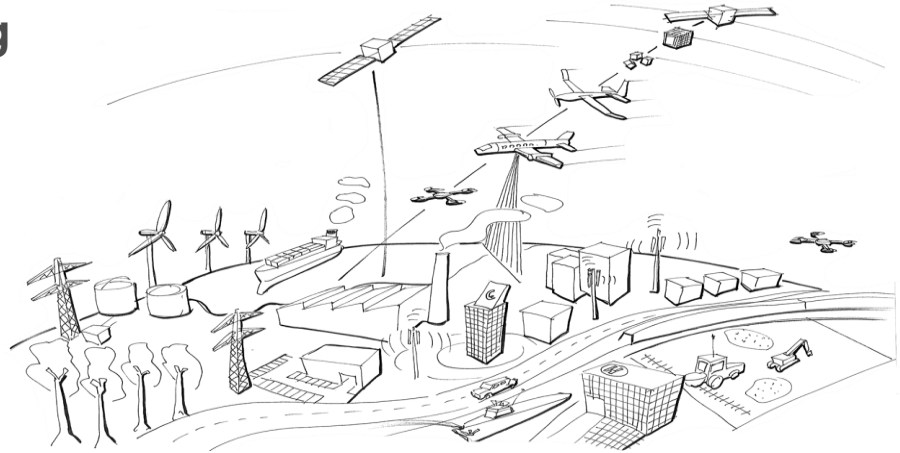
MAPEO WATER
-
In the Cloud Processing of Aerial Drone Images

remotesensing.vito.be

SEE THE BIGGER PICTURE

mapEO water

- Platforms, Cameras, Auxiliary Sensors
- Concept
- Radiometric Correction
- Direct Georeferencing
- Complete Workflow
- Commercial



Platforms

mapEO Water

UAV

CRUISER

AIRBORNE

HAPS

esa.int

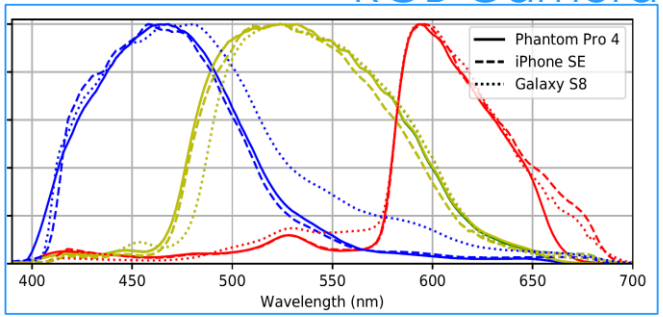
CUBESATS

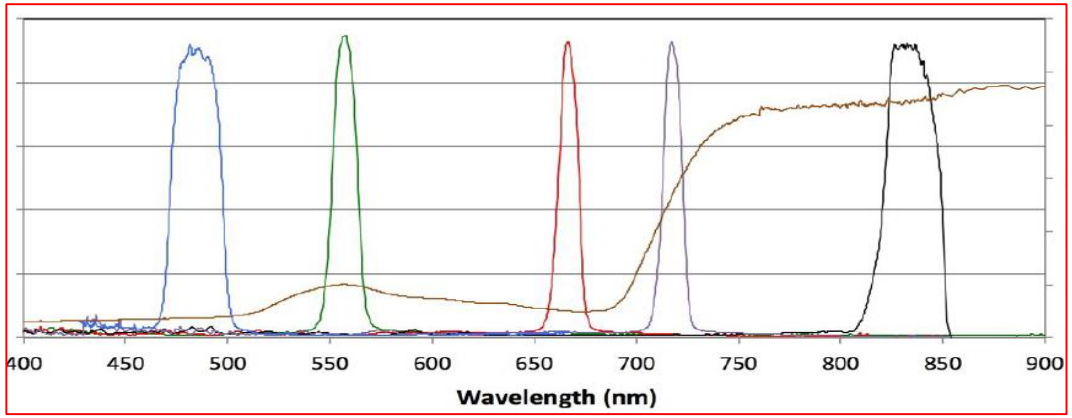
SATELLITE

Deployment cost ↑
Altitude ↑

Cameras

RGB Camera





Multispectral Camera

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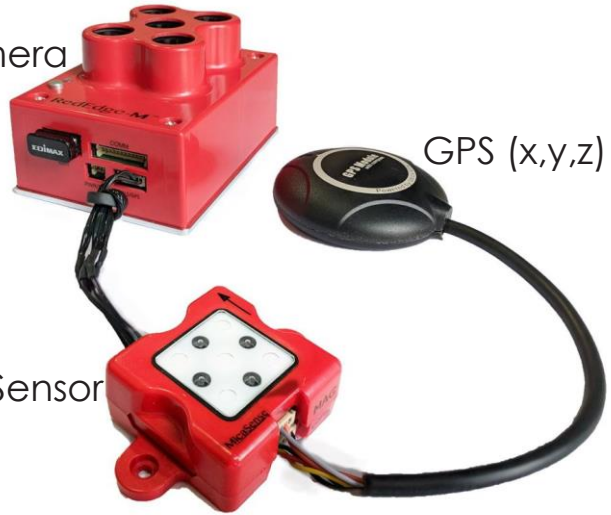
Auxiliary Sensors

Camera

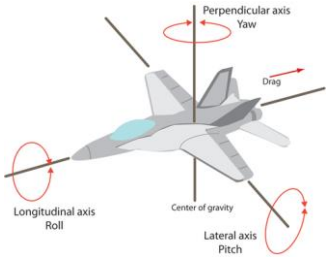
GPS (x,y,z)

Light Sensor



Integrated under DJI Phantom4 Pro

Motion Sensor (Roll / Pitch / Yaw)



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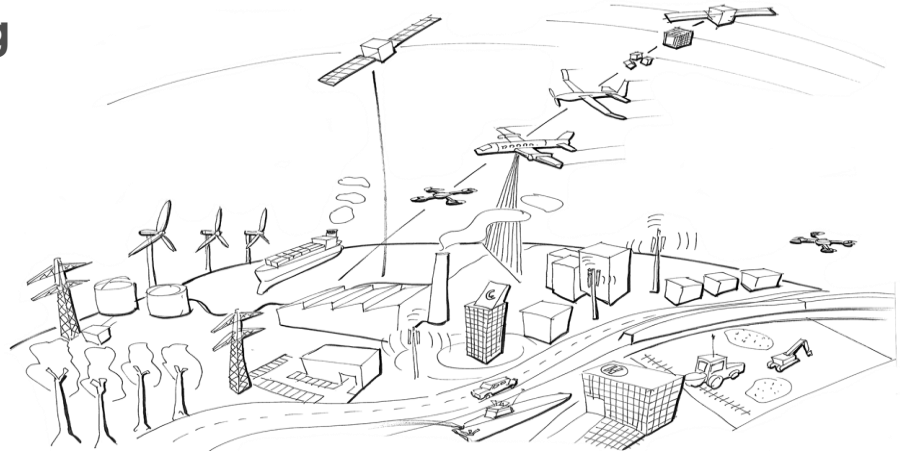
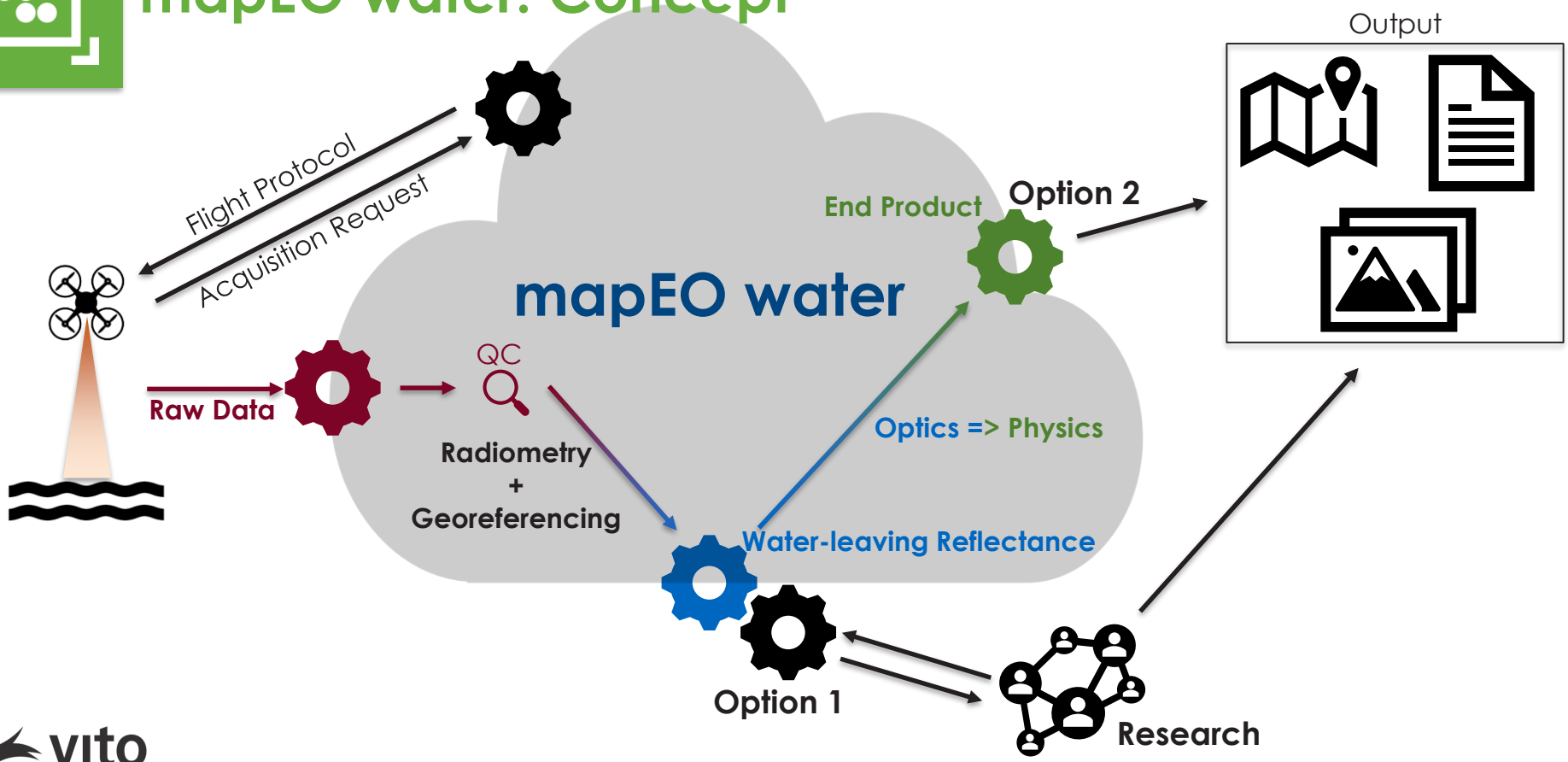


mapEO water: Concept



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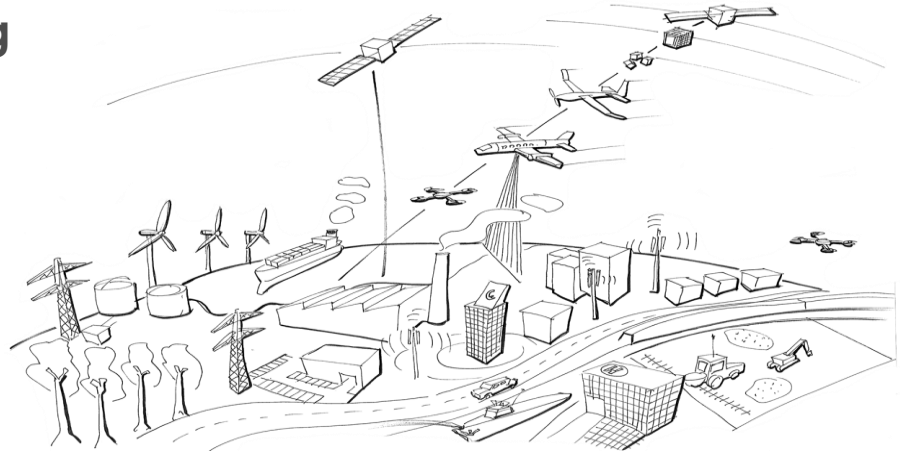
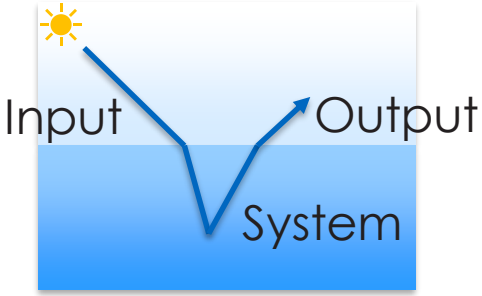


Target Quantity: Water-leaving Reflectance

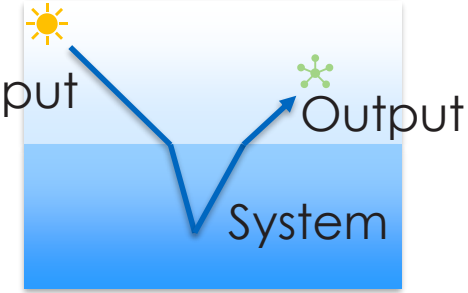


Water-leaving Reflectance $\sim \frac{Output_{water\ column}}{Input_{sun\ light}}$ within [1% ; 10%]

Link with physics of water column

- Chlorophyll-a
- Suspended sediments
- …

Measuring Water-leaving Reflectance

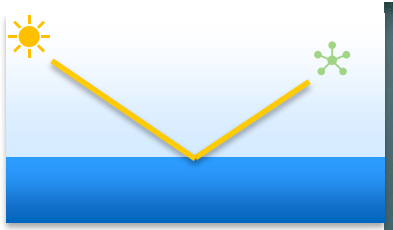


Light Sensor: Input$_{\text{sun light}}$

Camera: Output$_{\text{water column}}$

In theory straightforward
but
many practical issues…

Issue 1: Sun Glint



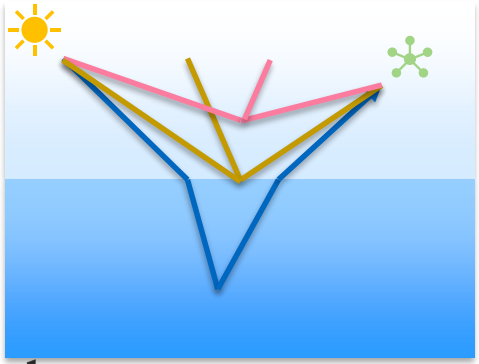
- Sun glint = mirror-like reflection
- Difficult to filter out in post-processing
  => important to avoid during drone flight
- Solution
  - Adapt flight pattern: camera **looking away** from the sun
  - Camera **view ≠ nadir**

Issue 2: $Output_{water\ column}$ not directly measurable

Problem

Besides $output_{water\ column}$, also:

- Scattering by atmosphere
- Reflection at water surface



Solution

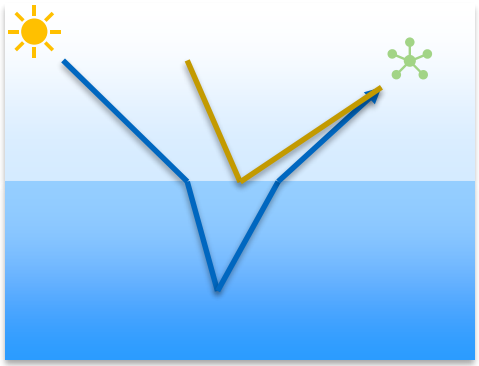
- **Drones at limited altitude**
- **Appropriate camera set-up & flight protocol**

Camera = $output_{water\ column}$ + sky glint

II

Modelled

iCOR



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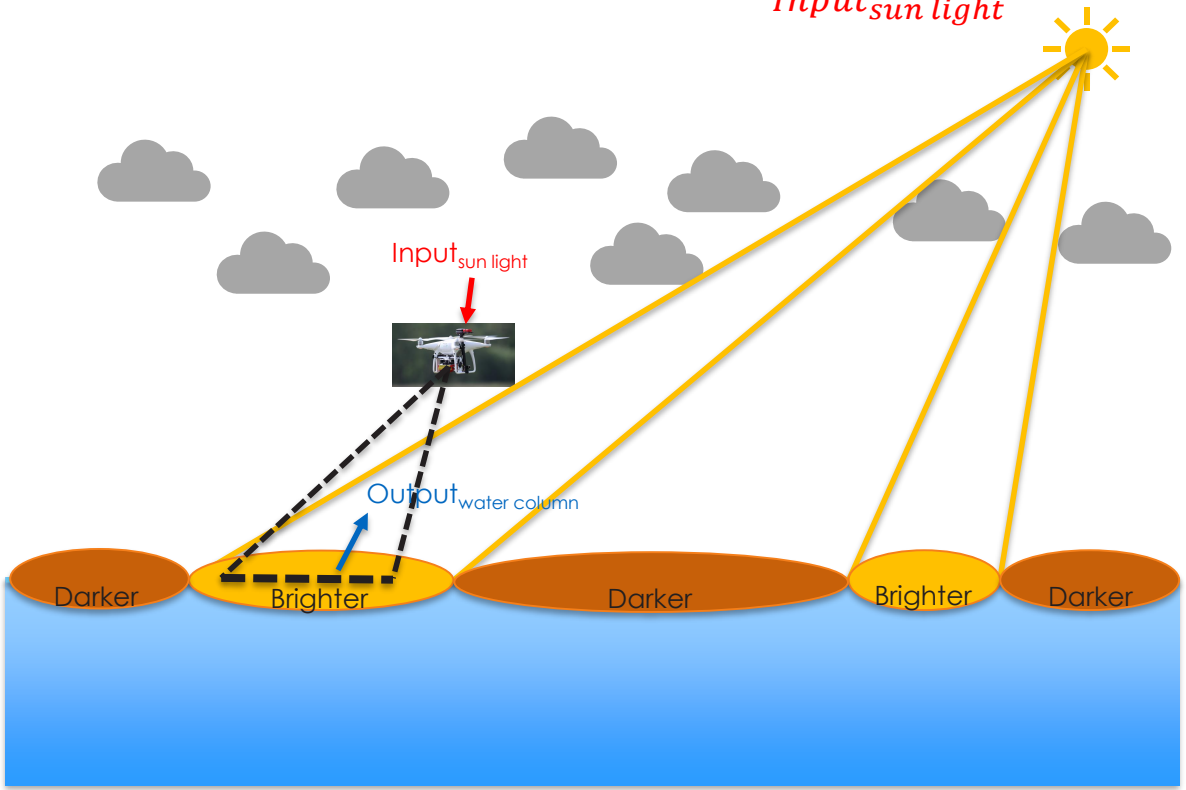
Issue 3: Two Quantities – Two Sensors

Water-leaving Reflectance $\sim \frac{Output_{water\ column}}{Input_{sun\ light}}$



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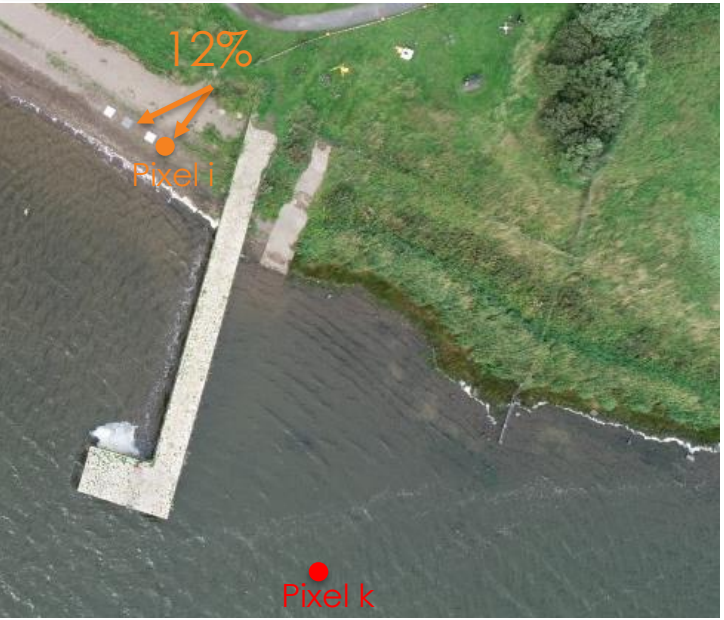
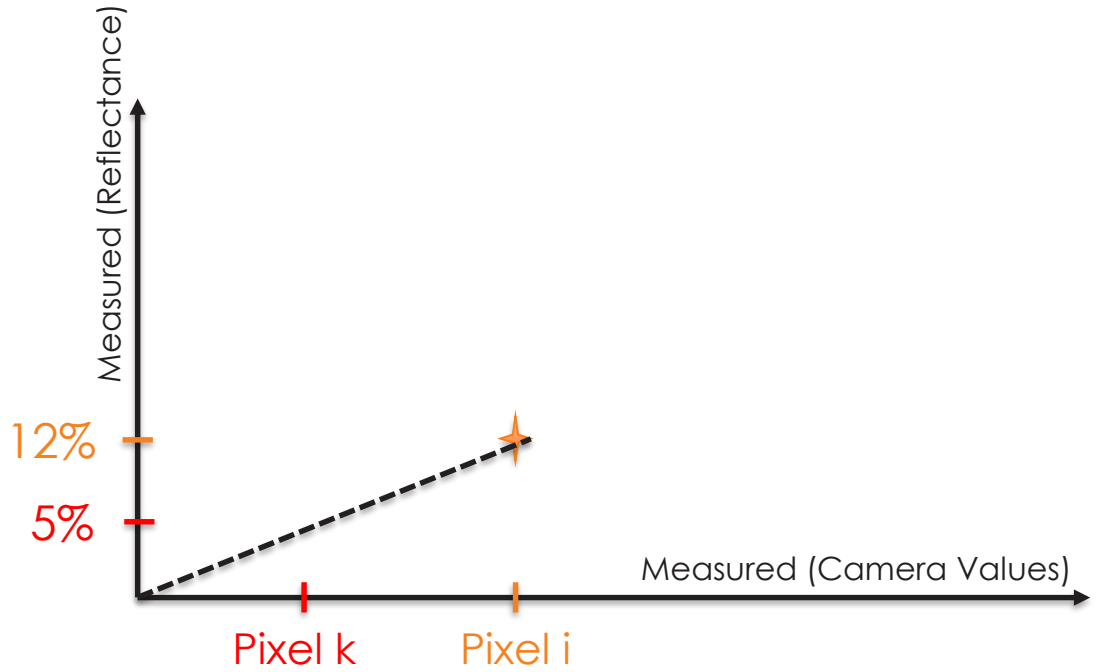
Additional Tool: Reflectance Panels

Lake Loch Leven (Scotland)



Light sensor still to be improved by manufacturer!



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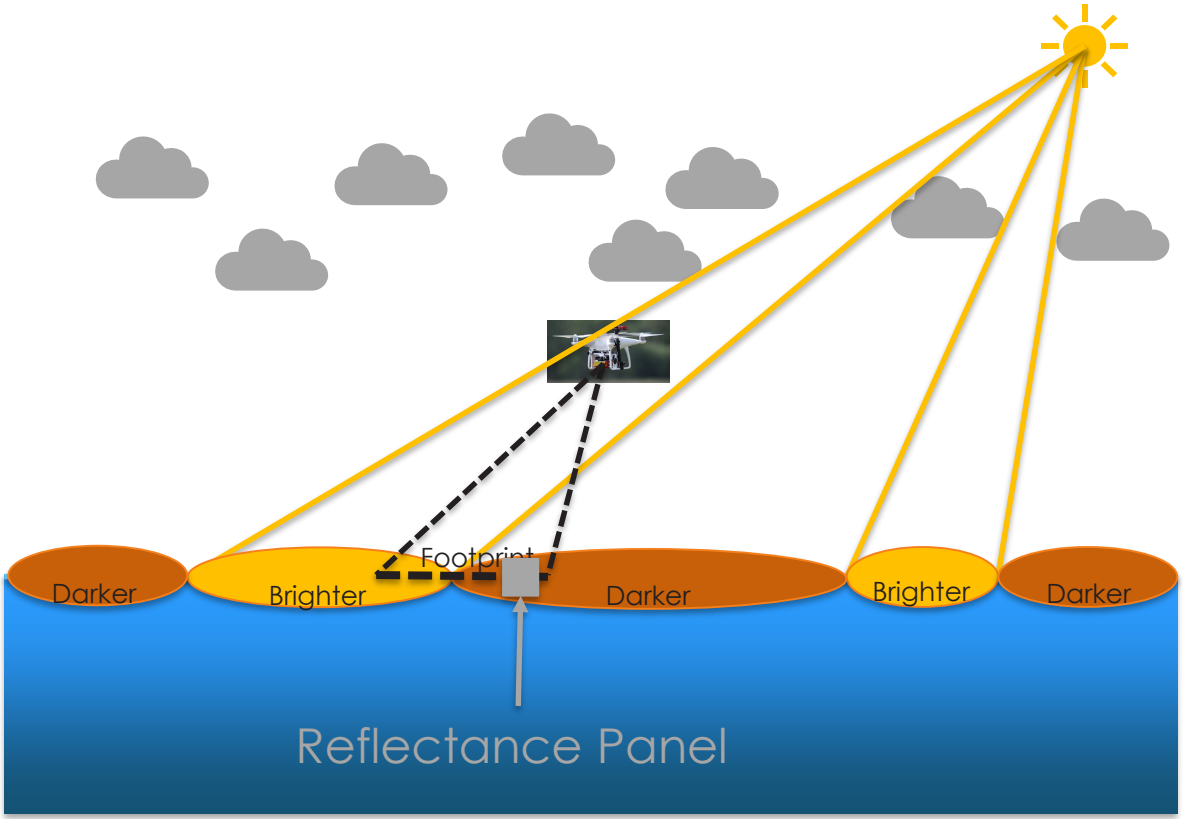
Additional Tool: Reflectance Panels



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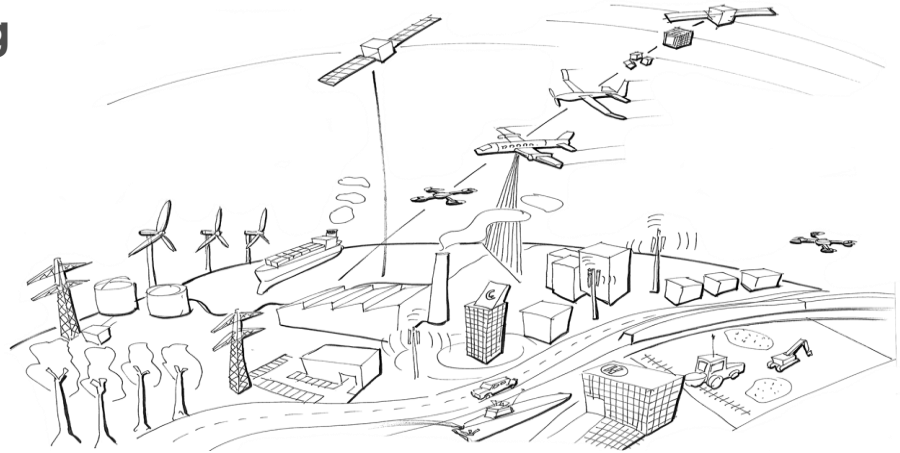
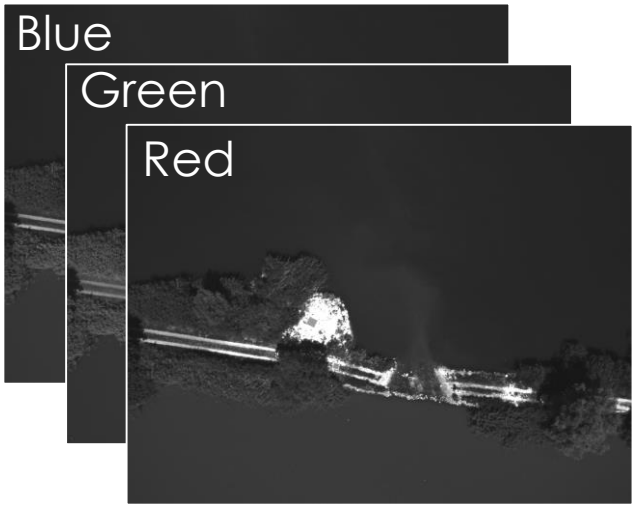
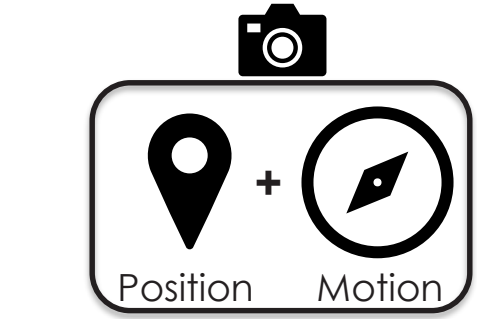


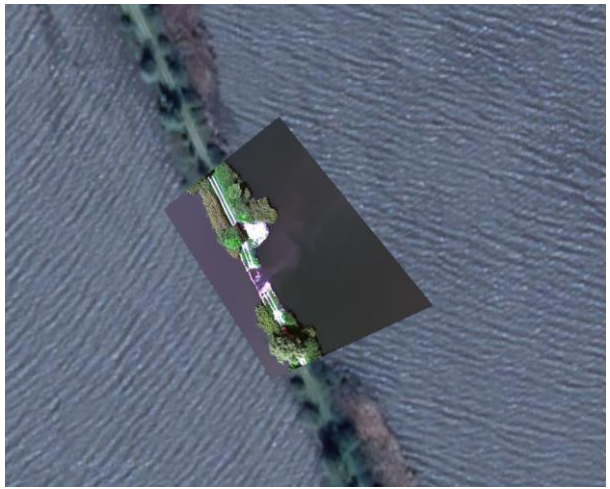
Direct-Georeferencing

Raw





Georeferenced
True Colour



Background image from Google Maps (Kis-Balaton)

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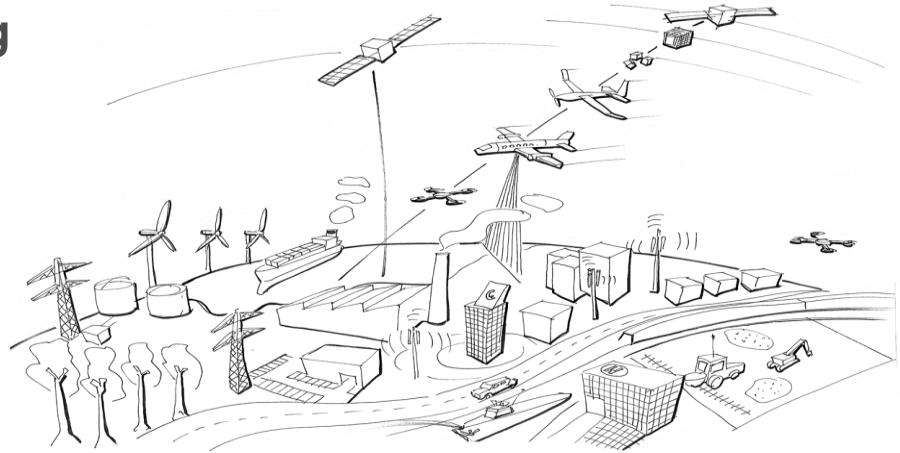


mapEO water: Processing Workflow

Radiometric Correction

Raw

Blue
Green
Red
NIR
Red Edge

Camera Parameters

Light Conditions

iCOR

-

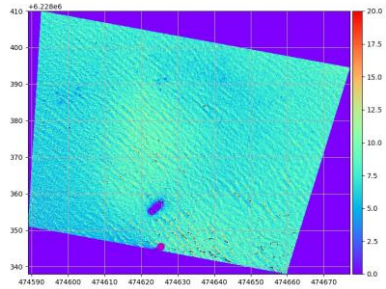
Water-leaving Reflectance

Optics => Physics

End Product

Direct Georeferencing

Direct Georeferencing



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Drone Imagery: Challenges above Water

Lake Loch Leven (Scotland)

- Vignetting
  - **Camera settings**
- White caps
  - **Masking / Resizing**
- Varying light conditions
  - **Light sensor**
  - **Reflectance Panel**
- No reflectance panel in image
  - **Light sensor**
- Bottom visible

Drone Imagery: Challenges above Water

- Sun glint
  - **Camera orientation** & **flight protocol**
- Low reflectance (dark image)
  - Low S/N ratio: **camera settings**
  - Sky glint correction (**iCOR4drones**)
- Dynamic scene
  - Visualisation: **include time component**
- Direct georeferencing
  - **Precision** GPS & motion sensor
- Coastal operations
  - **Equipment maintenance**

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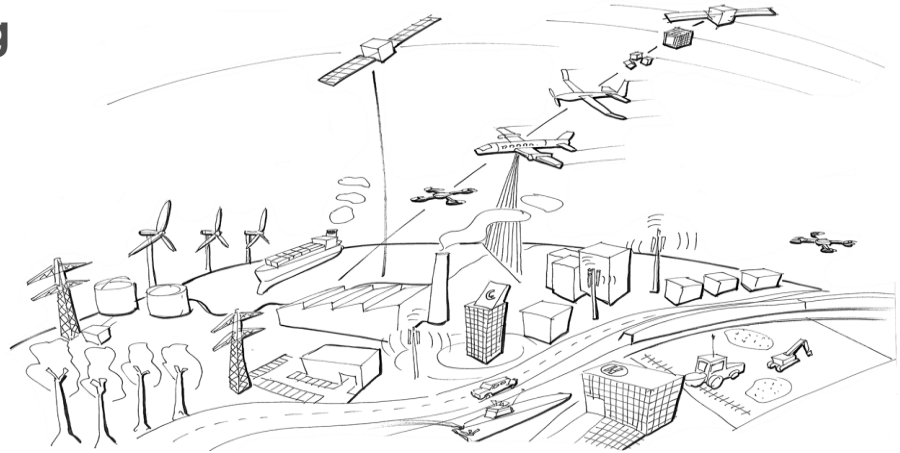
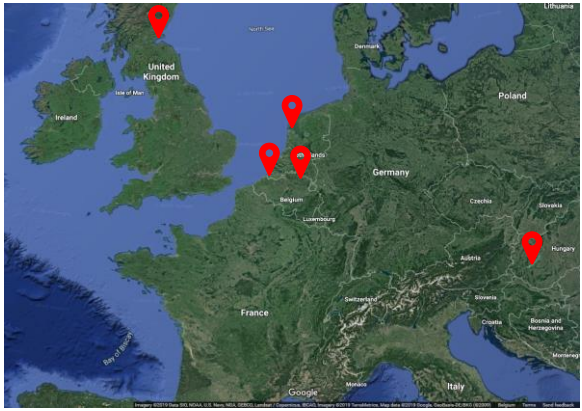


mapEO water: Commercial

- Depending on camera type
- Workflow validated on different sites
- Prime users
  - Limited amount of processing for free
- Output format
  - WMS/WMTS
  - GeoTIFF
  - CSV



Background image from Google Maps

For more information:
remotesensing.vito.be/case/mapeo-water

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Collaboration with SME

- High quality drone for water applications

PRODEM Vlaamse overheid AIRobot


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remotesensing.vito.be/case/mapeo-water
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