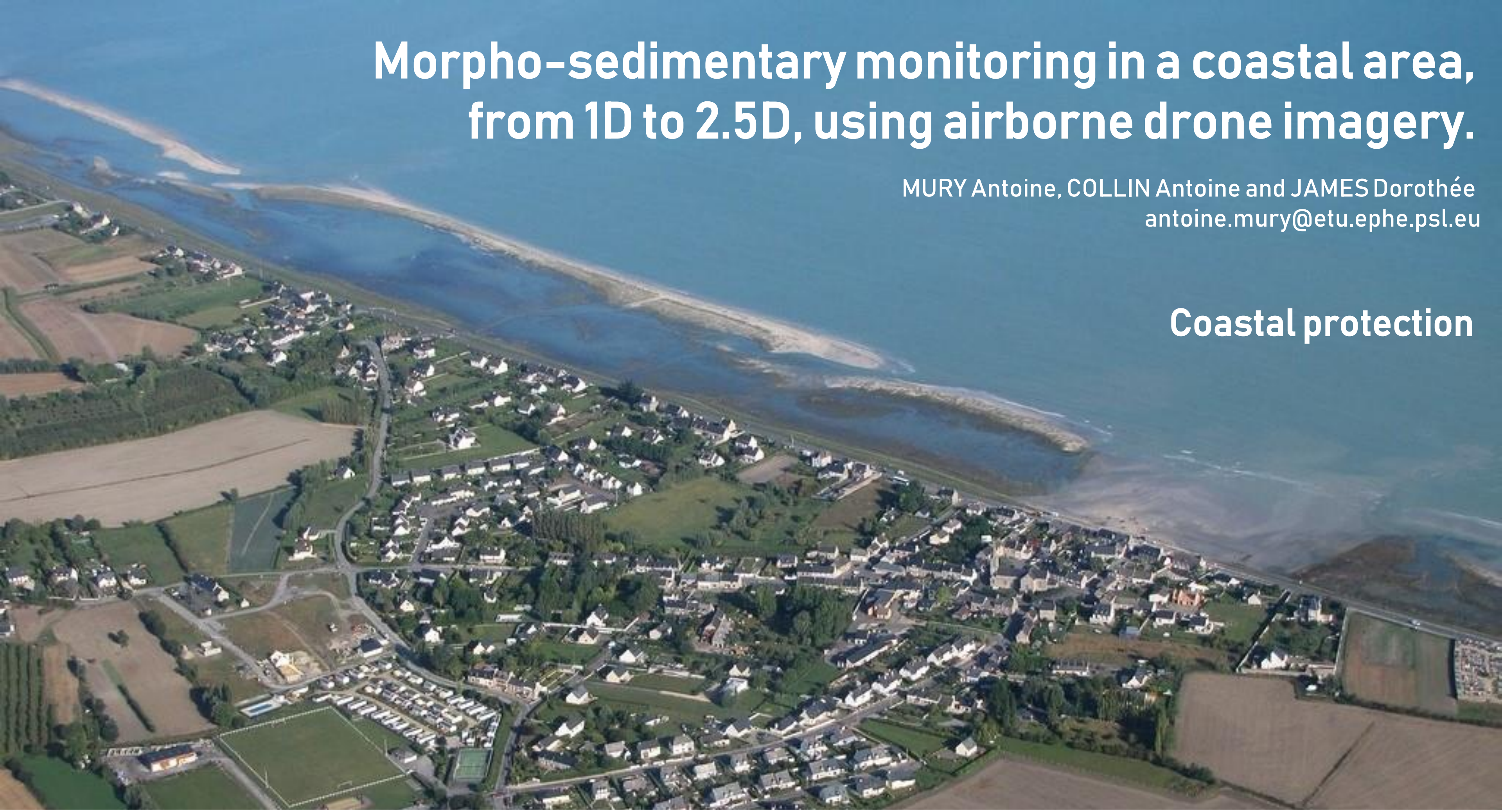


Morpho-sedimentary monitoring in a coastal area, from 1D to 2.5D, using airborne drone imagery.

MURY Antoine, COLLIN Antoine and JAMES Dorothée
antoine.mury@etu.ephe.psl.eu

Coastal protection

vito

24 October 2019 | Port House, Antwerp

École Pratique des Hautes Études | PSL

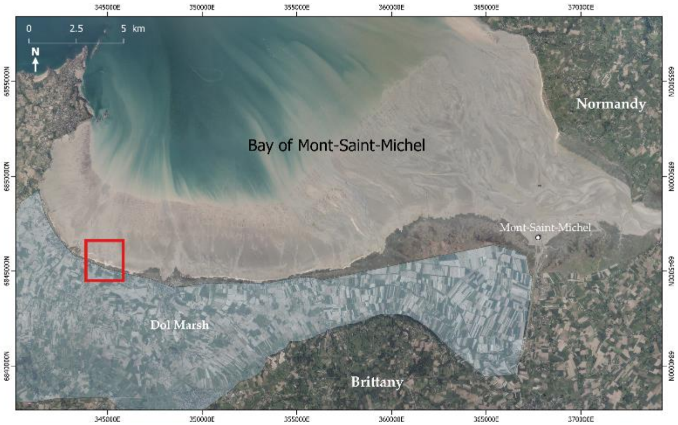
cnrs dépasser les frontières

UMR 6554 CNRS LETG

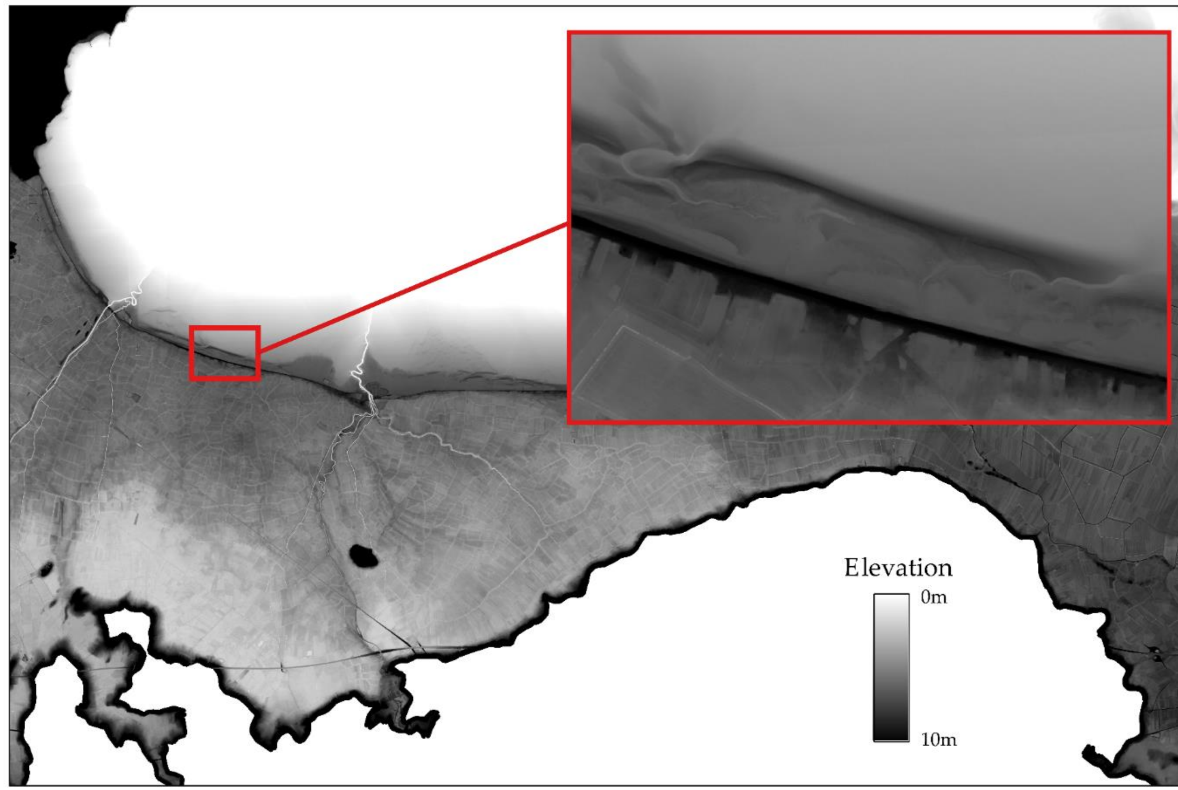
- Why to monitor the coastal sediment deposits ?
  - Study site context of low elevation coastal zone
  - An ecosystem service of coastal protection
- The interest of drone technology for coastal monitoring
  - An « all-in-one » tool
  - A very high spatial resolution monitoring
  - A very high temporal resolution monitoring
- Comparison with others monitoring tools
  - Handborne tools
  - MAV tools
  - Spaceborne tools
- Use of drone for remote sensing and spatial modelling

Why to monitor the coastal sedimentary deposits ?

Study site context



Shelly ridges = natural barrier



Low elevation coastal zone

Why to monitor the coastal sedimentary deposits ?

An ecosystem service of coastal protection

Journal of Coastal Research	SI	75	398-402	Coconut Creek, Florida	2016

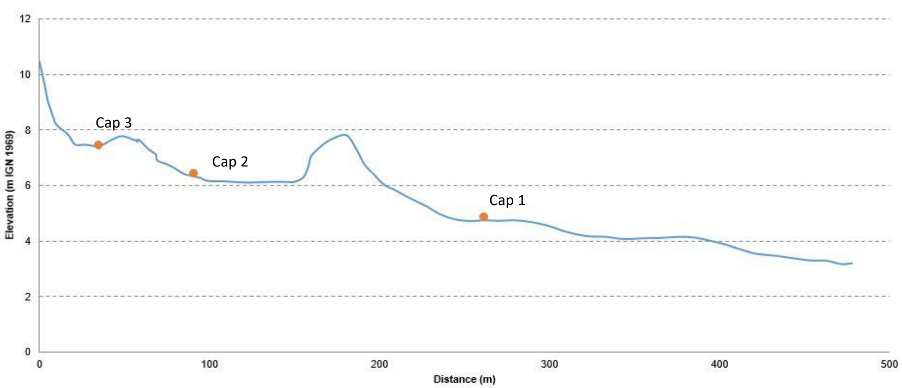
Wave attenuation and Coastal Protection by Shelly Ridges: Mont-Saint-Michel Bay, France

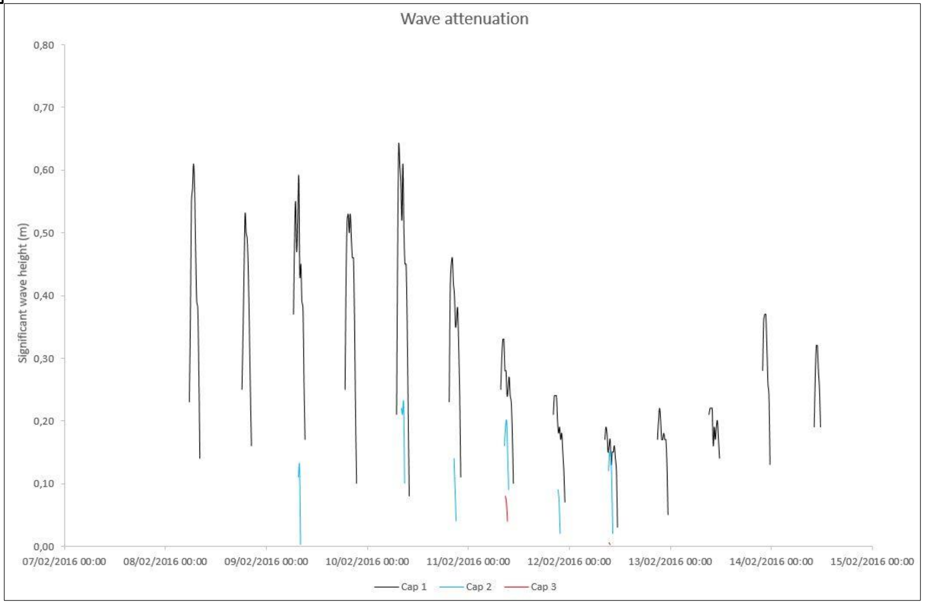
Matthieu Jeanson [†*], Samuel Etienne [†], Antoine Collin [†]

[†]Laboratoire de Géomorphologie et Environnement Littoral, CNRS UMR 8586 Prodig, Ecole Pratique des Hautes Etudes, France

www.cerf-jcr.org

Wave attenuation from 64 to 100%





Specifications of the rotary-wing UAV used.

UAV model	DJI Mavic Pro Platinum
Sensor	1/2.3" (CMOS)
No. of pixel	Total pixels: 12.71 MP Effective pixels: 12.35 MP
Lens	FOV 78.8°, Focus : 28 mm (35 mm format equivalent) Aperture: f/2.2
Flight planning and control software	DJI GS Pro

Specifications of the flight plan used.

Flight planning software	DJI GS Pro
Front overlap ratio	60%
Side overlap ratio	60%
Height	50 m
Gimbal pitch angle	-90°
Shutter interval	2.0 sec.
Flying time	12 mn

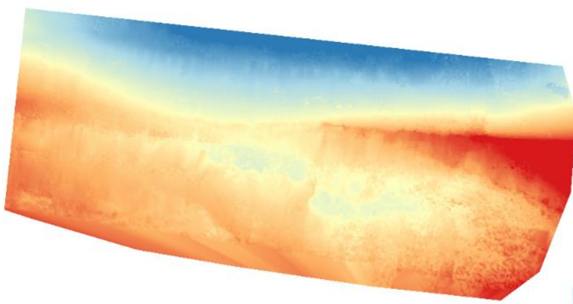
The interest of drone technology for coastal monitoring

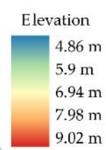
An « all-in-one » tool

Drone by-products

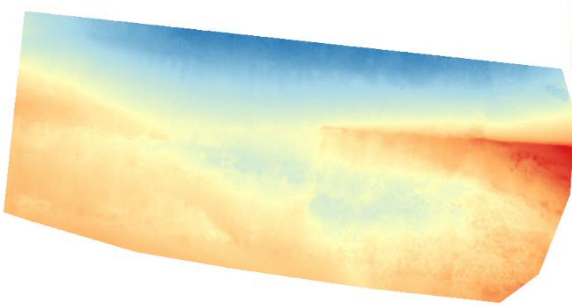
Orthomosaïc

DSM

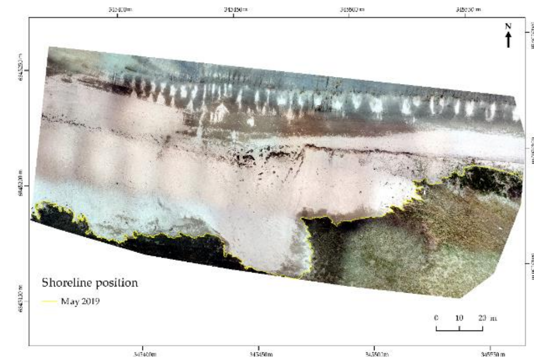




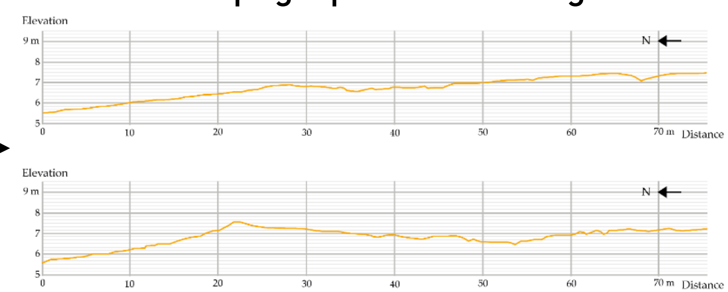
DEM



Shoreline monitoring



Topographic monitoring

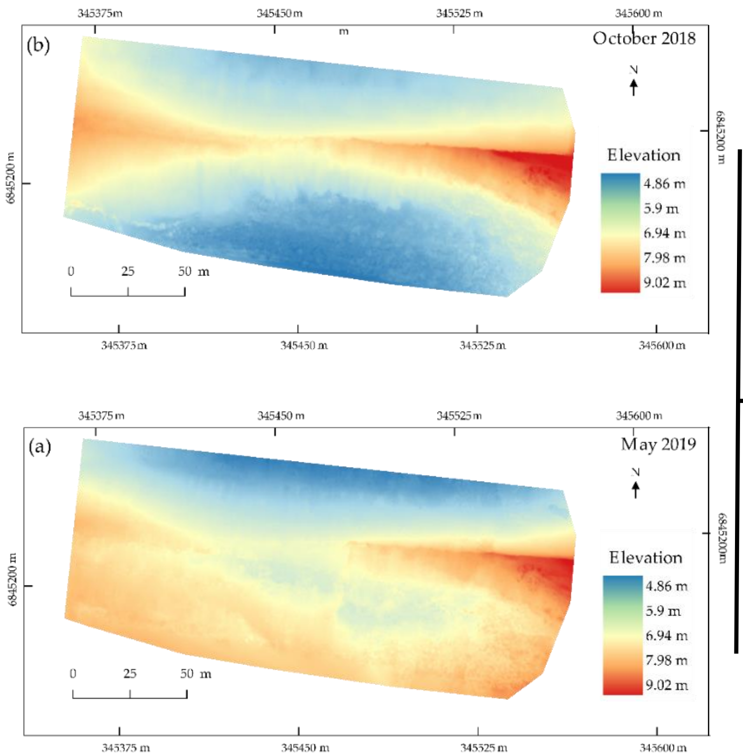


The interest of drone technology for coastal monitoring

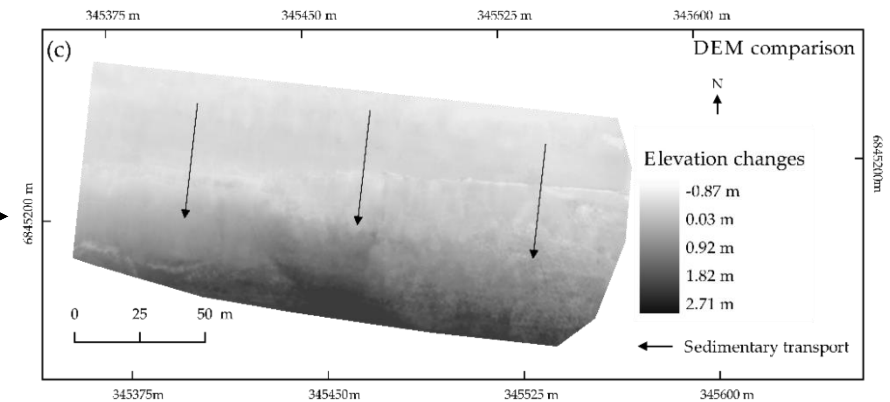
An « all-in-one » tool

Drone by-products

DEM

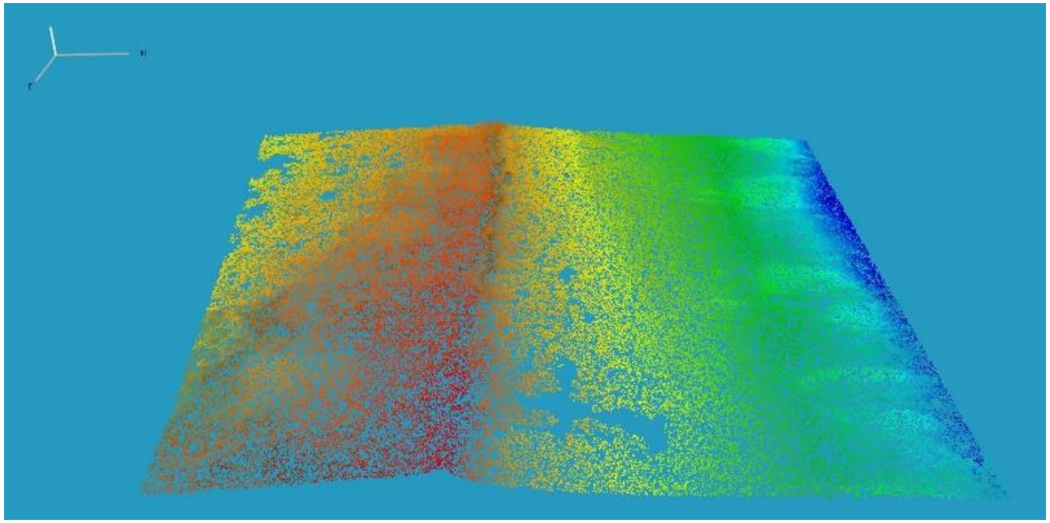


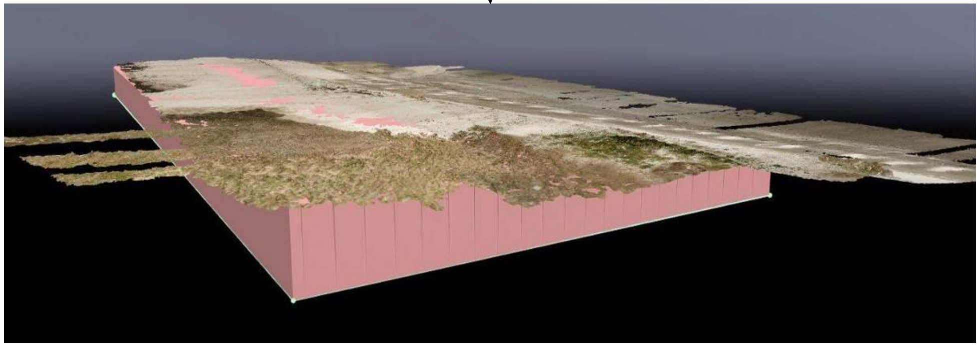
Sediment migration monitoring



Drone by-products

Dense point cloud





Sediment volume calculation and comparison

The interest of drone technology for coastal monitoring

A very high spatial and temporal resolution monitoring

By-products	Spatial resolution (m)	Horizontal accuracy (m)	Vertical accuracy (m)	Point density (pt/m²)
Dense cloud point	/	0.032	0.048	2571.86
Orthomosaïc	0.016	0.032	0.048	/
DEM/DSM	0.016	0.032	0.048	/

- Easy deployment
- Quick data acquisition campaign (20mn for this case study)

Allow to acquire data after each event that affect the sediment deposits

Comparison with others monitoring tools

Handborne tools

- DGNSS and tachometer
  - Shoreline tracking
  - Topographic monitoring
    - Topographic profiles
    - DEM

Tools	Spatial resolution (m)	Horizontal accuracy (m)	Vertical accuracy (m)	Point density (pt/m^2)
DGNSS	/	<0.1	<0.1	N/A
Tachometer	/	<0.1	<0.1	N/A
Drone	0.016	0.032	0.048	2571.86

Not time effective monitoring method

Comparison with others monitoring tools

Airborne MAV tools

Optical imagery and LiDAR

- Shoreline tracking
- Topographic monitoring
  - Topographic profiles
  - DEM

Tools	Spatial resolution (m)	Horizontal accuracy (m)	Vertical accuracy (m)	Point density (pt/m²)
Optical imagery	>0.2	N/A	N/A	N/A
LiDAR	>0.2	<0.1	0.15-0.20	30
Drone	0.016	0.032	0.048	2571.86

Do not allow a very high spatial and temporal monitoring
Expensive LiDAR acquisition campaign

Comparison with others monitoring tools

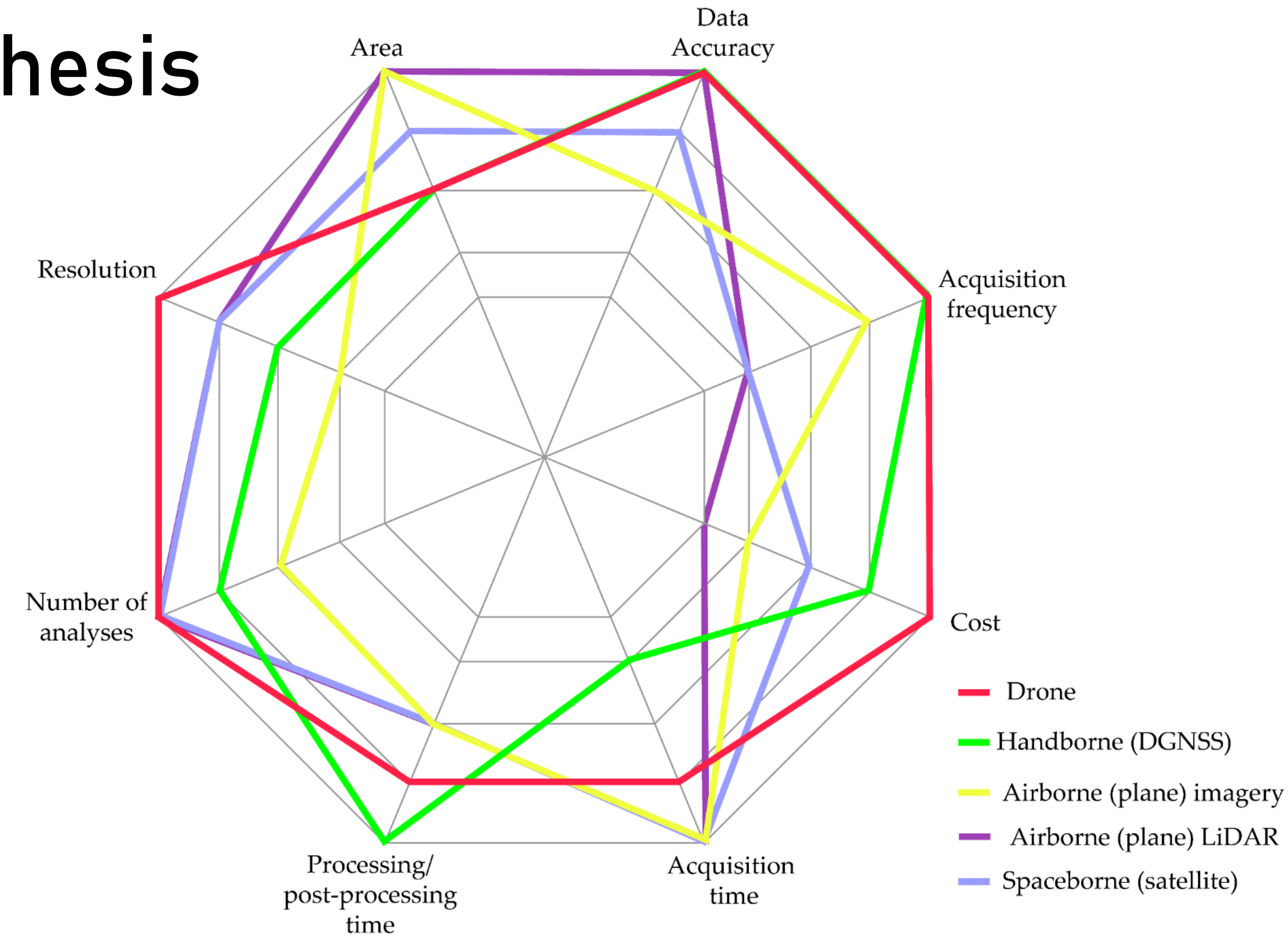
Spaceborne tools

Tools	Spatial resolution (m)	Horizontal accuracy (m)	Vertical accuracy (m)	Point density (pt/m²)
Landsat 8	15 (panchromatic) / 30 (multispectral)	12	N/A	N/A
SPOT 6-7	1.5 (panchromatic) / 6 (multispectral)	10	N/A	N/A
Worldview-2	0.46 (panchromatic) / 1.84 (multispectral)	3,5	N/A	N/A
Worldview-3	0.31 (panchromatic) / 1.24 (multispectral)	3,5	N/A	N/A
Pleiades-1	0.5 (panchromatic) / 2 (multispectral)	3	N/A	N/A
GeoEye-1	0.41 (panchromatic) / 1.65 (multispectral)	5	N/A	N/A
Drone	0.016	0.032	0.048	2571.86

⚠ Do not allow a very high spatial and temporal monitoring

Comparison with others monitoring tools

Synthesis



The more eccentric the curve is, the better the method is in the concerned criterion.

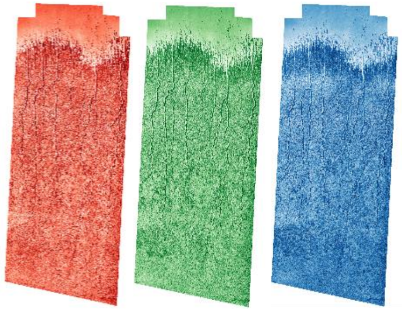
Use of drone for remote sensing and spatial modelling*

Data acquisition

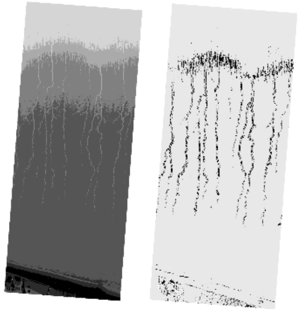
+

Significant wave height measurement

Spectral and topographic predictors from drone (or LiDAR)

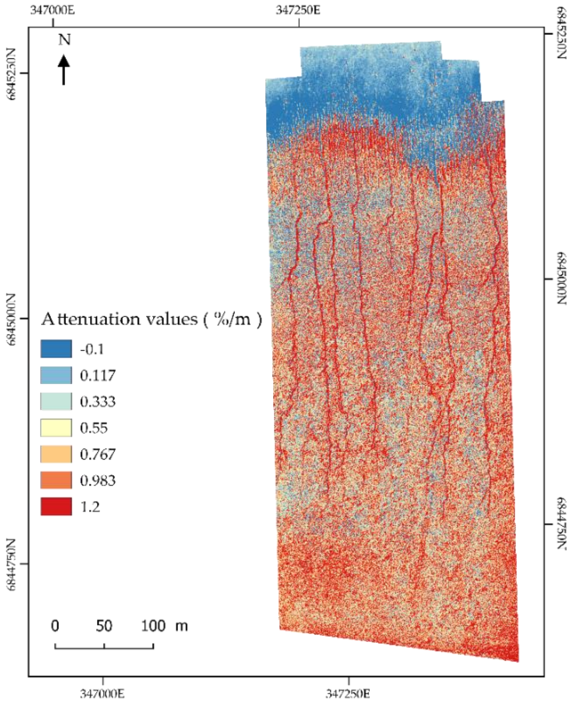


Red *Green* *Blue*



DEM *Height above ground*

Spatially-explicit model of wave attenuation



* Mury et al, 2019 - Spatially-explicit Modelling of the salt marsh wave attenuation using pressure measurements, UAV imagery and LiDAR data - DOI: 10.13140/RG.2.2.29122.32960

Thank you for your attention

24 October 2019 | Port House, Antwerp

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