2018-2019 Earth Sciences Seminar Series

Earth Sciences UNIVERSITY OF TORONTO

October 17th 2018

UNIVERSITÉ DE NANTES

OSUNA planètes et environnement

Monitoring shifting sands and low-growing vegetation in shallow turbid coastal water with LIDAR (LIght Detection And Ranging) and HIS (HyperSpectral Imagery)

- Material
  - Hyperspectral (HSI)
  - topo-bathymetric LiDAR of Nantes Rennes
- Coupling HSI – IR LiDAR for dune vegetation mapping
- Green LiDAR for sandbank tracking in a sandy bay

Patrick Launeau[1], Manuel Giraud[1], Marc Robin[2], Agnès Baltzer[2]
Dimitri Lague[3] and Laurence Huber Moy[2]

1 LPG Nantes

2 UMR 6554 CNRS LETG Nantes Rennes

3 GEOSCIENCES Rennes

Terre, Écosystèmes et Sociétés

Observatoire des Sciences de l'Univers de Rennes

Members of DYNALIT

CNRS

remote sensing

MDPI

Article

Full-Waveform LiDAR Pixel Analysis for Low-Growing Vegetation Mapping of Coastal Foredunes in Western France

Patrick Launeau [1,*], Manuel Giraud [1], Antoine Ba [1], Saïd Moussaoui [2], Marc Robin [3], Françoise Debaine [3], Dimitri Lague [4] and Erwan Le Menn [1]

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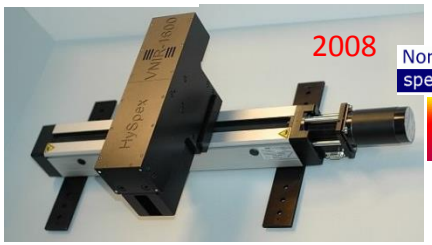
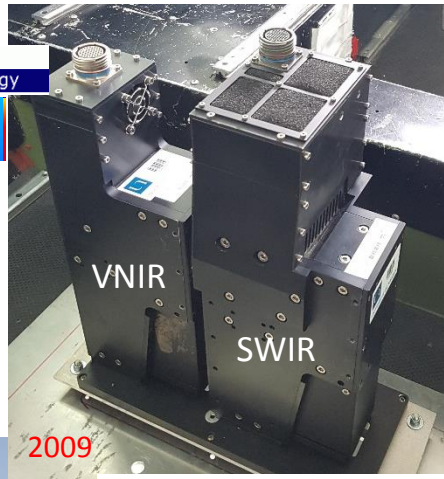
osuna planètes et environnement

Hyperspectral camera & field spectrometer
for chemical analysis of surfaces



Norsk Elektro Optikk AS
specialists in electro optic technology
HySpex



l'Europe s'engage en Pays-de-la-Loire avec le FEDER

Liberté • Égalité • Fraternité
RÉPUBLIQUE FRANÇAISE
Opération soutenue par l'État
FONDS NATIONAL D'AMÉNAGEMENT ET DE DÉVELOPPEMENT DU TERRITOIRE

Loire Atlantique

Malvern Panalytical

VNIR-1600	**SWIR-320m-e**
CCD (Si)	MCT (HgCdTe)
1600 x 1200	320 x 256
0.4 – 1.0 µm	1.0 – 2.5 µm
1600	320
17°	14°

ASD FieldSpec 3 1.0 – 2.5 µm

CPER 2007-2013

GÉNIE CIVIL, ENVIRONNEMENT ET GESTION DURABLE DE LA VILLE
R51_p6
Axe 3 : Application de la télédétection au génie civil environnemental et à la gestion durable de la ville

Région PAYS DE LA LOIRE

Nantes Métropole

CPER 2014-2020

MER – ENVIRONNEMENT – VILLES ET TERRITOIRES
RI6
Action : Suivi et Surveillance de l'Environnement en Pays de la Loire

2017 complementary field equipment
2019 new airborne camera
VNIR-SWIR at once

Antoine Ba

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OSUNA planètes et environnement

Lidar 532nm
&1064 nm

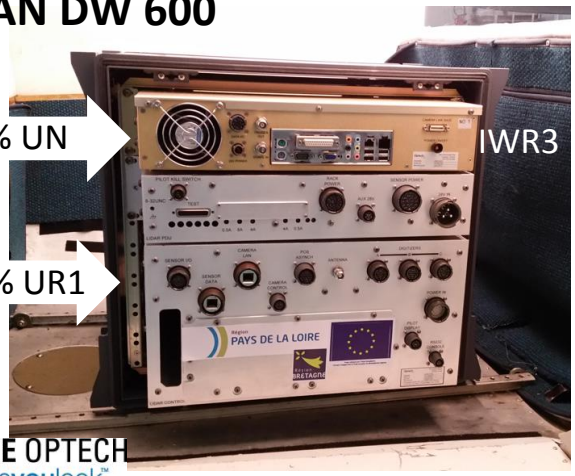
TELEDYNE OPTECH
Everywhereyoulook™

TITAN DW 600

Full-waveform recorder

100% UN

IMU 100% UR1



OSUNA planètes et environnement — Région PAYS DE LA LOIRE

Terre, Écosystèmes et Sociétés — Observatoire des Sciences de l'Univers de Rennes

Région BRETAGNE — l'Europe s'engage en Bretagne avec le FEDER

50% OSUNA 50% OSUR

OUEST VALORISATION

The LiDAR Nantes-Rennes platform is driven by a GENERAL CONVENTION OF RESEARCH COOPERATION
between
GEOFIT Expert, Université de Nantes, Université Rennes 1, Université Rennes 2 and CNRS

Plateforme LIDAR topo-bathymétrique Nantes-Rennes

Green IR DW LiDAR
For the analysis of physical properties of surfaces

UNIVERSITÉ DE NANTES

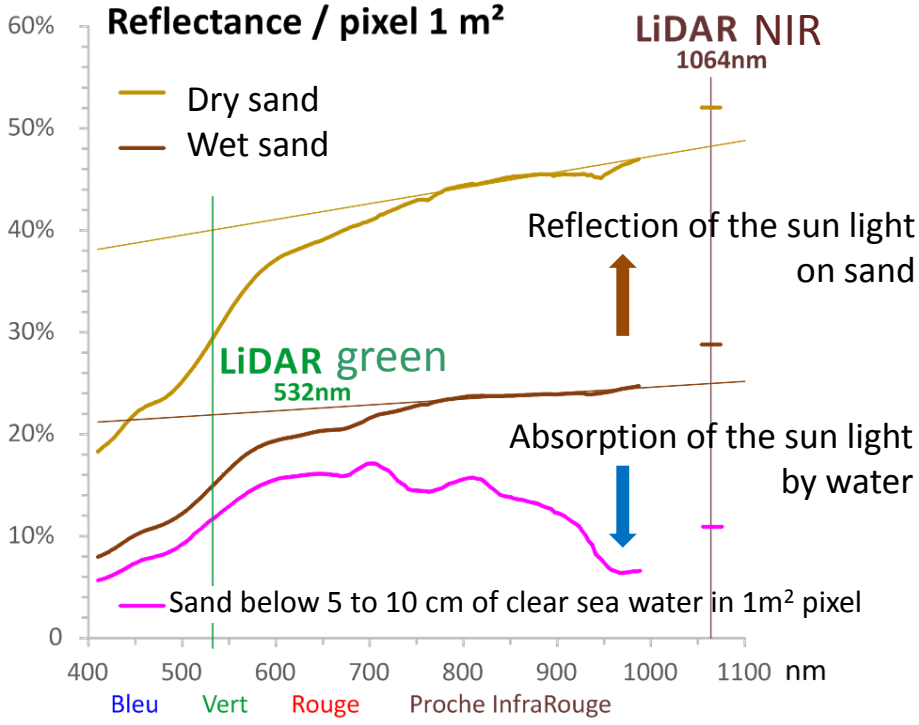
UNIVERSITÉ DE RENNES 1

RENNES 2 UNIVERSITÉ HAUTE BRETAGNE

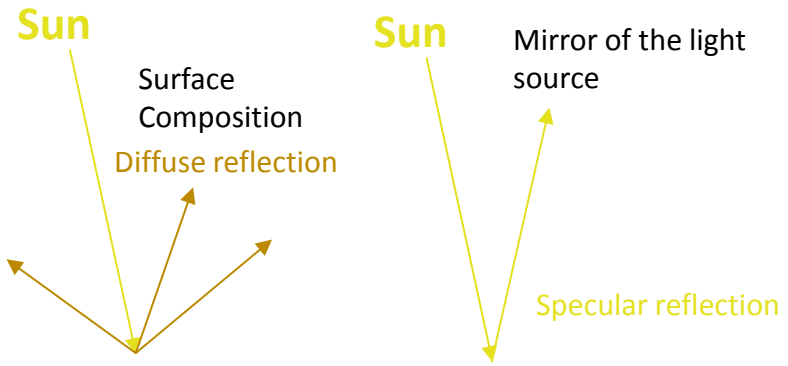
cnrs

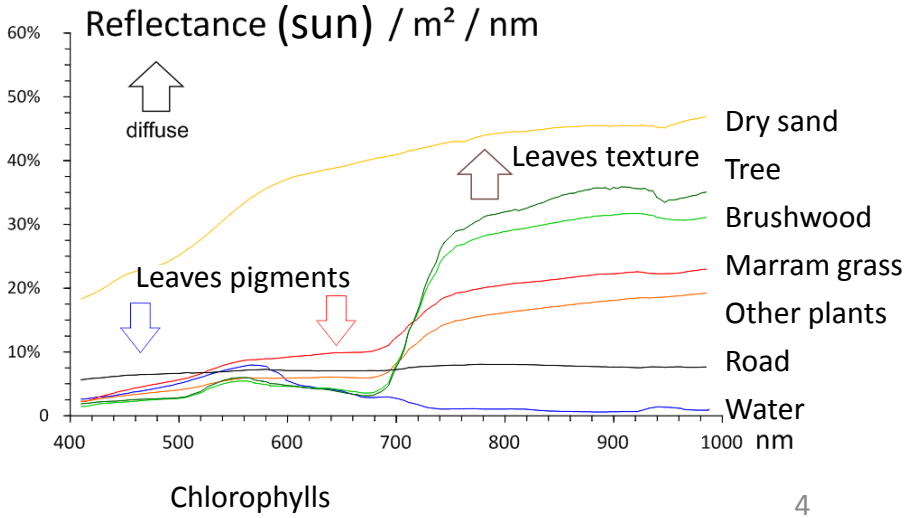
GEOFIT EXPERT

Hyperspectral remote sensing based on field sampling



Multispectral → 4 bands
Hyperspectral → 160 bands (≤10nm/channel)





Chlorophylls

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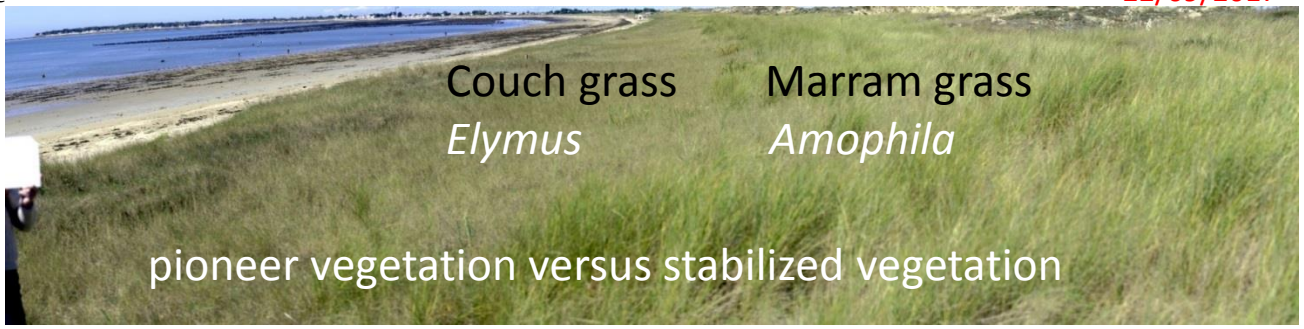
osuna planètes et environnement

Ground panoramic image

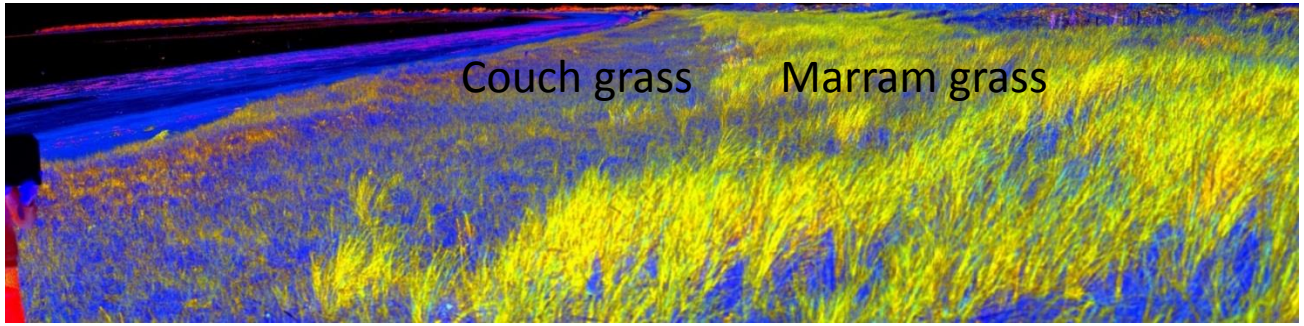
Reflectance
440
546
597

22/09/2017



1) Quick analysis with **index** of spectral shapes

NDRLI
NDGLI
NDVI

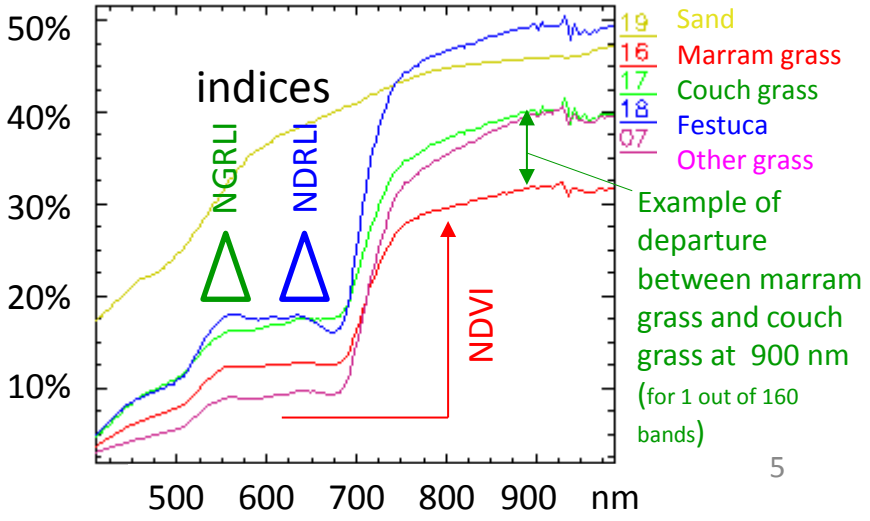


Intensity of green
Intensity of red
Intensity of infrared

2) Spectrometry careful analysis of absorption features by the calculation of departures between reference spectra and image spectra averaged on 160 bands

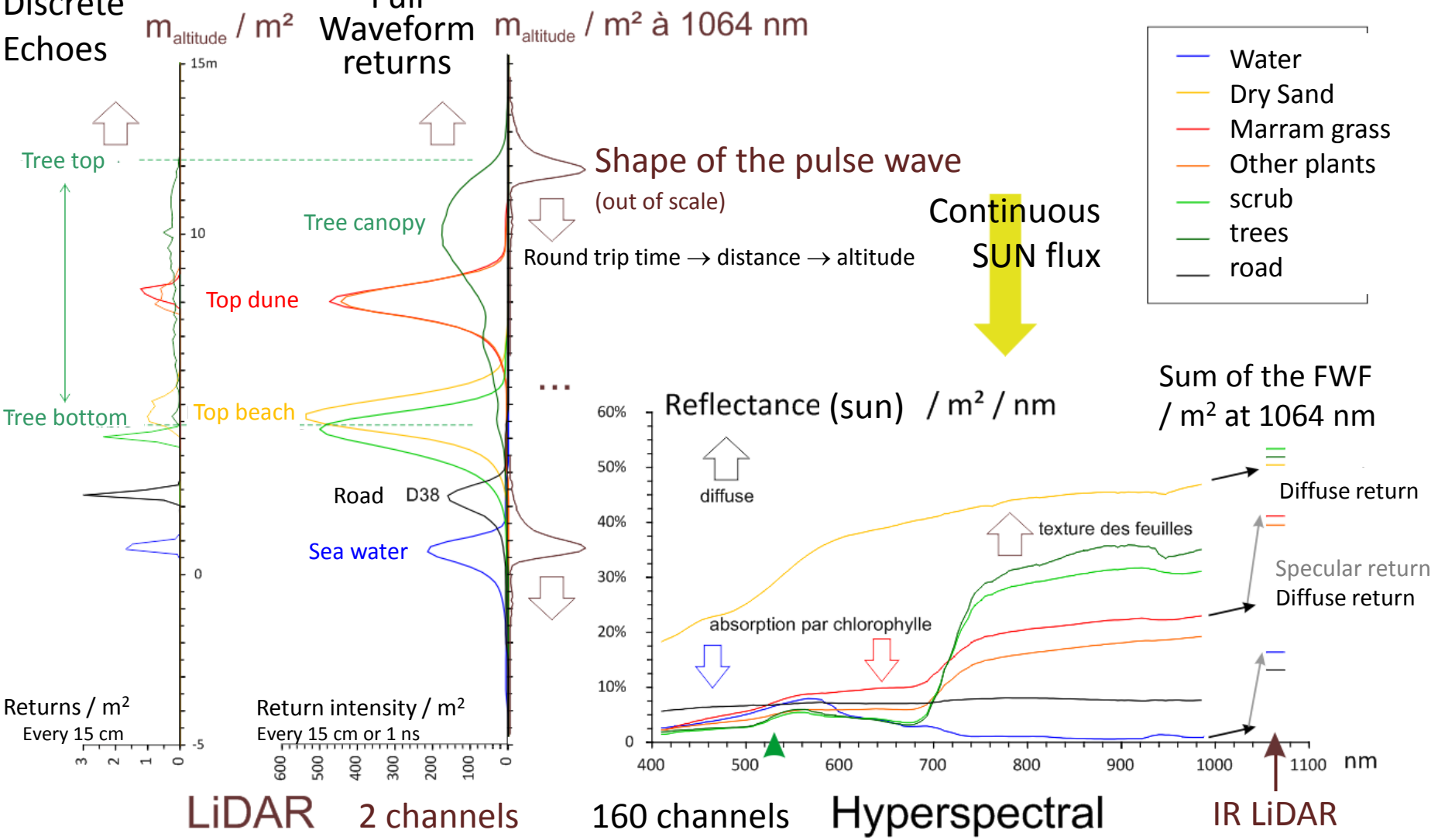
But, when the physiological stat is not optimum, the grasses cannot be separated

09/02/2017



Discrete Echoes

Full Waveform returns

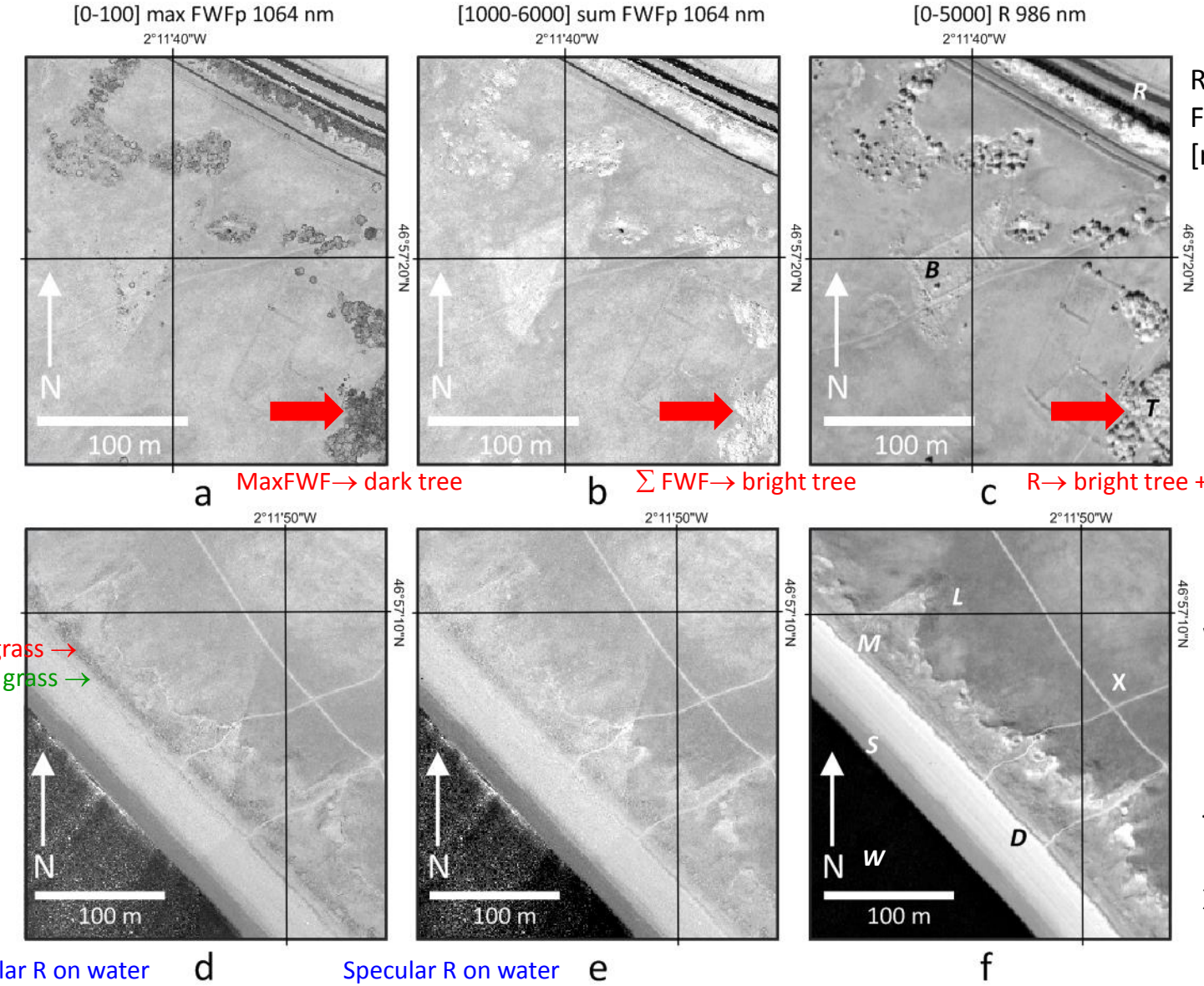


LiDAR 2 channels

160 channels Hyperspectral

IR LiDAR

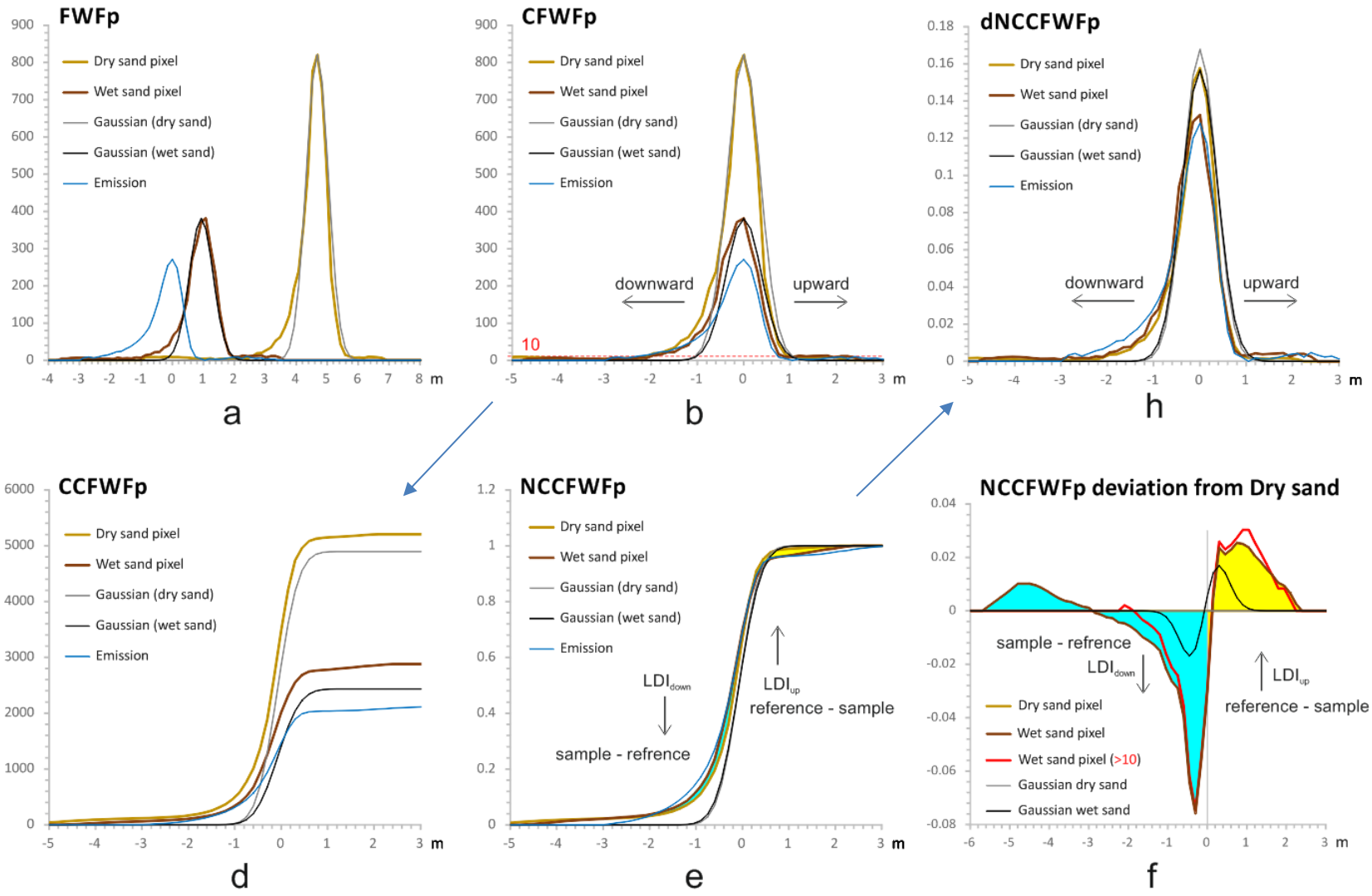
Resolution z 0.15 m (1 nanosecond) xy 1 m²



R Reflectance
FWF Full-waveform
[relative intensity]

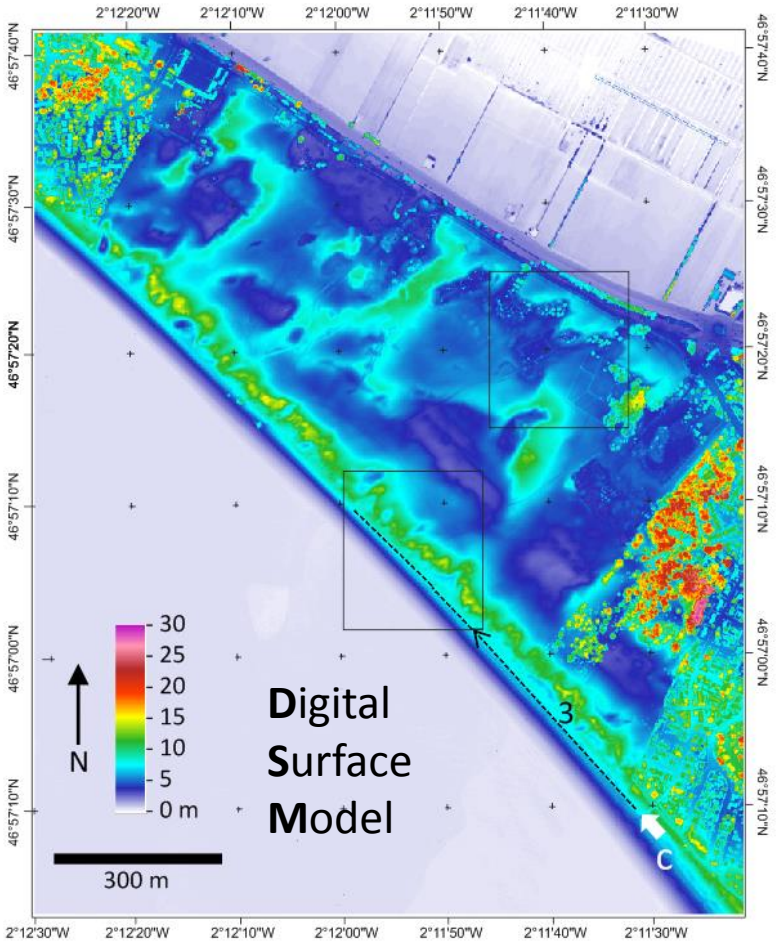
Marram grass →
Couch grass →

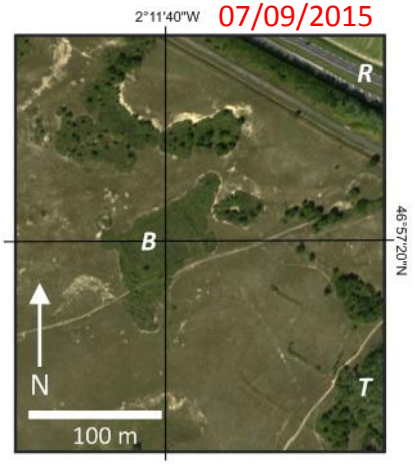
Water
Dry Sand
Marram grass
L other plants
Brushwood
Trees
Road
X crossing of path

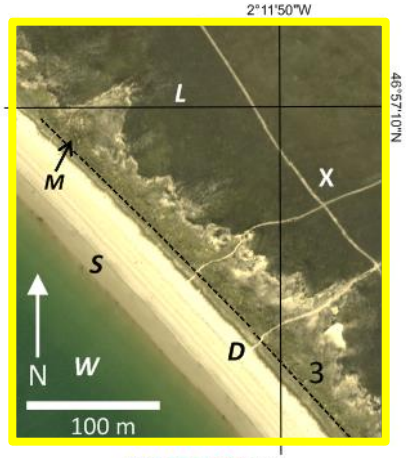


Normalized **C**umulative **C**entered **F**ull **W**ave**F**orm (**p** for pixel mean, **d** for derivative)

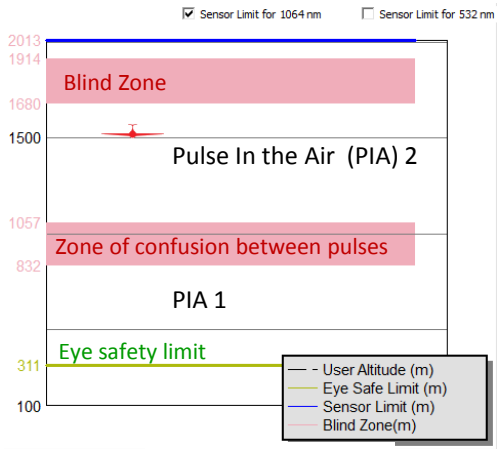
Topographic mode 1064 nm with hyperspectral at 1500 m







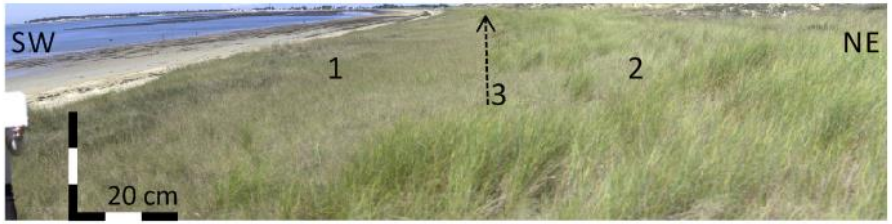
450 555 606 nm

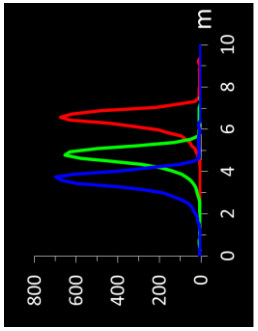


- W: Water
- D: Dry Sand
- M: Marram grass
- L: Other plants
- B: Brushwood
- T: Trees
- R: Road

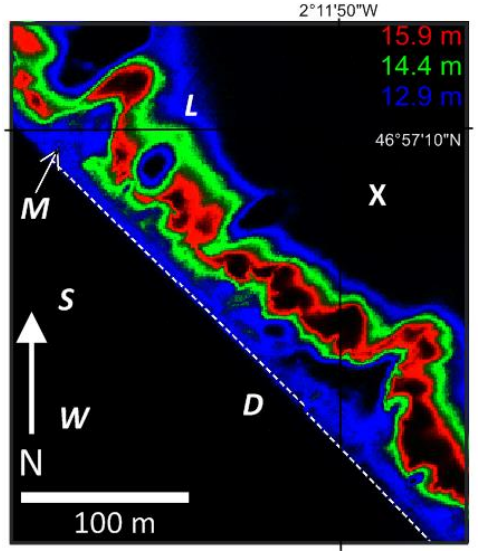
22/09/2017

1 Couche grass (*Elymus*)
2 Marram grass (*Ammophila*)
3 Limit of the stabilized dune



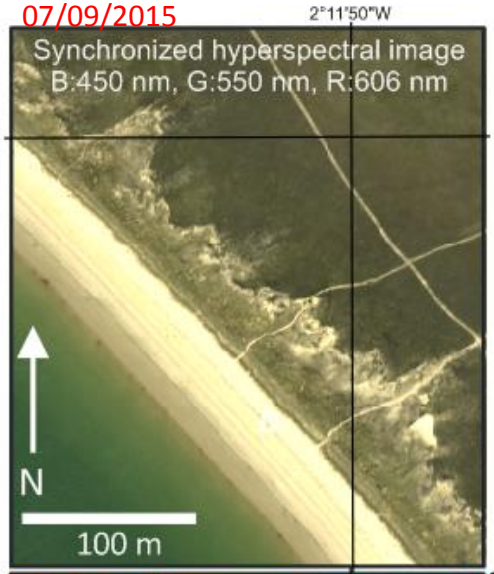


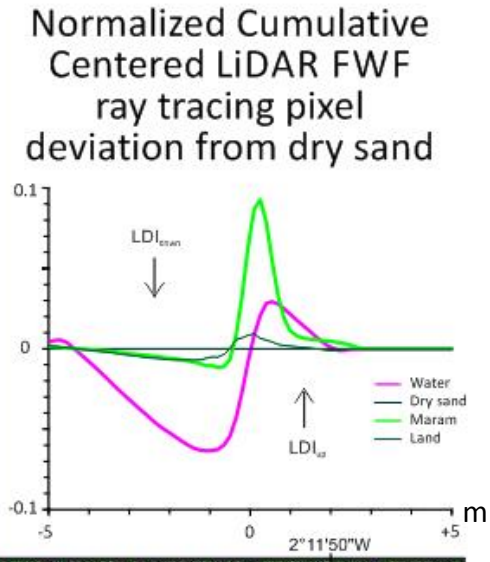
FWF raw display at 3 altitudes

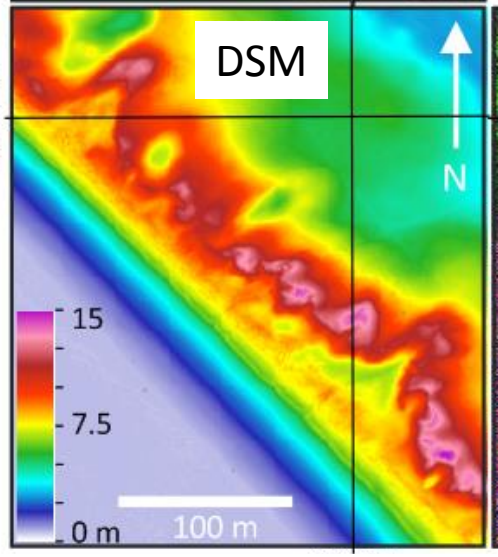


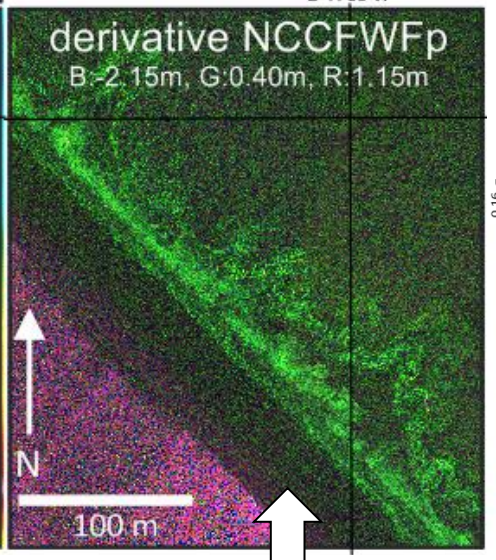
The maximum (1st echo) of the FWF has an altitude providing the DSM

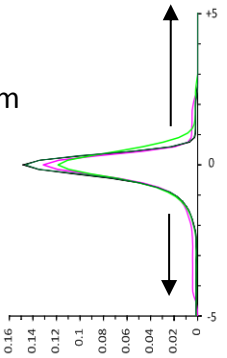
07/09/2015



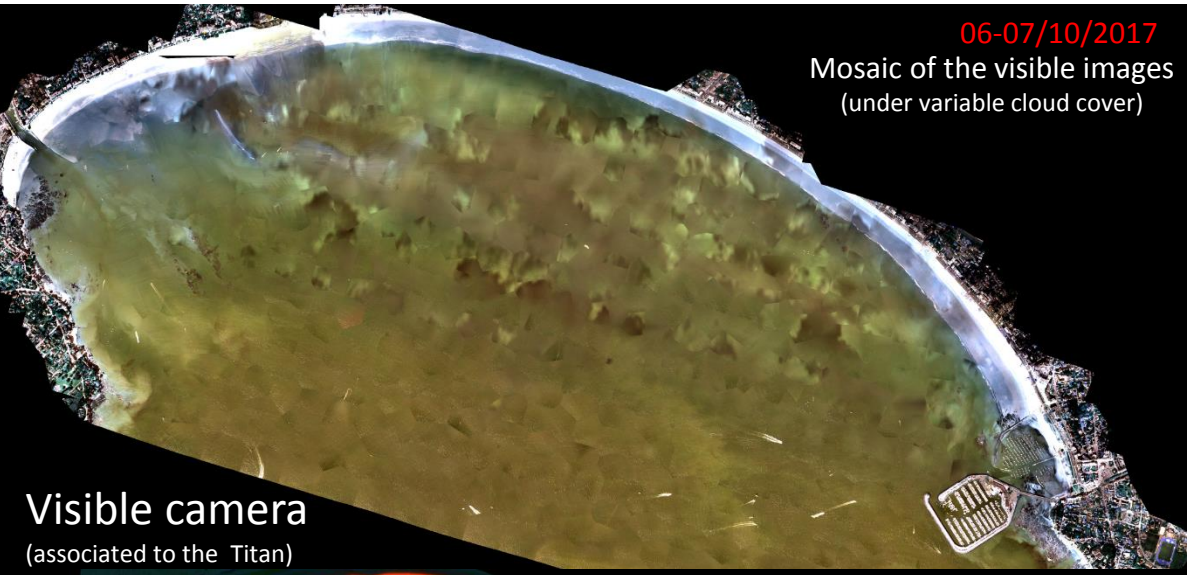


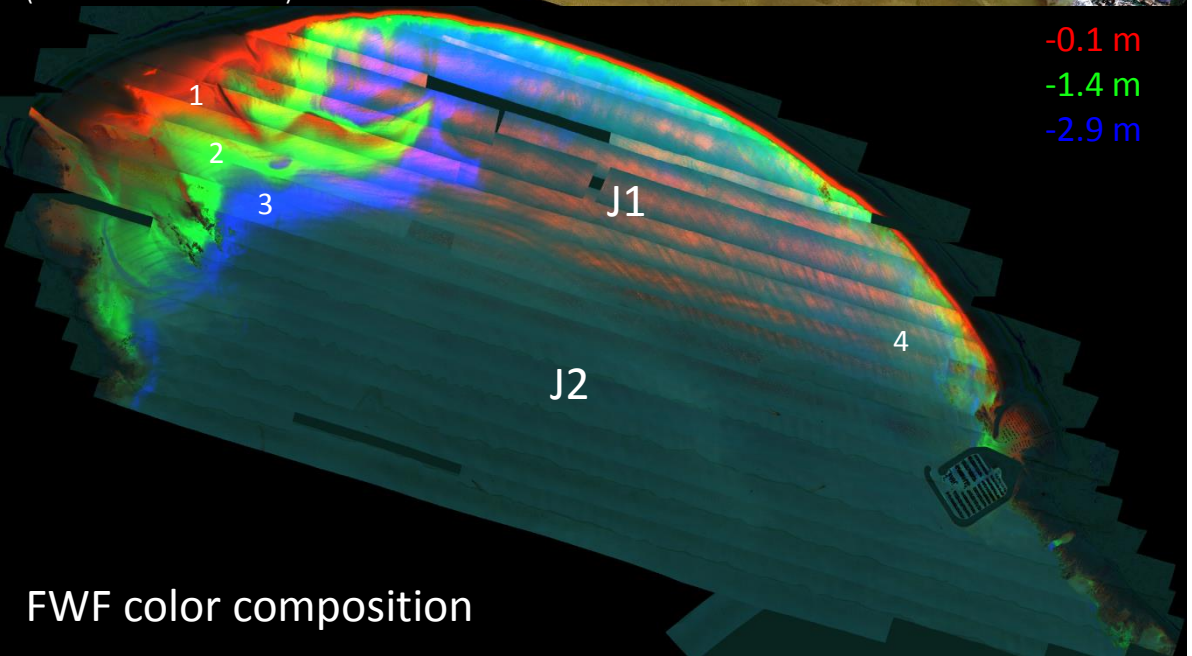




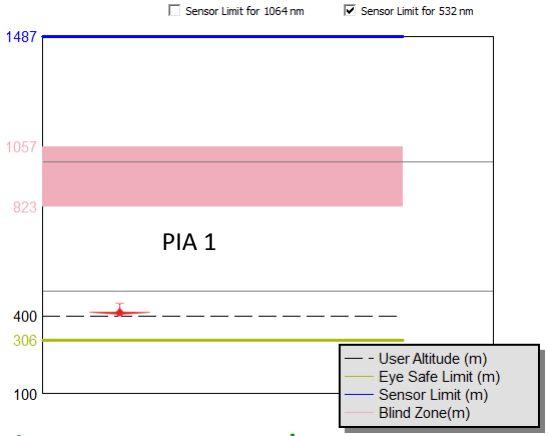


Centering FWF erase the relief and lets appear the diffusion properties et of the surfaces

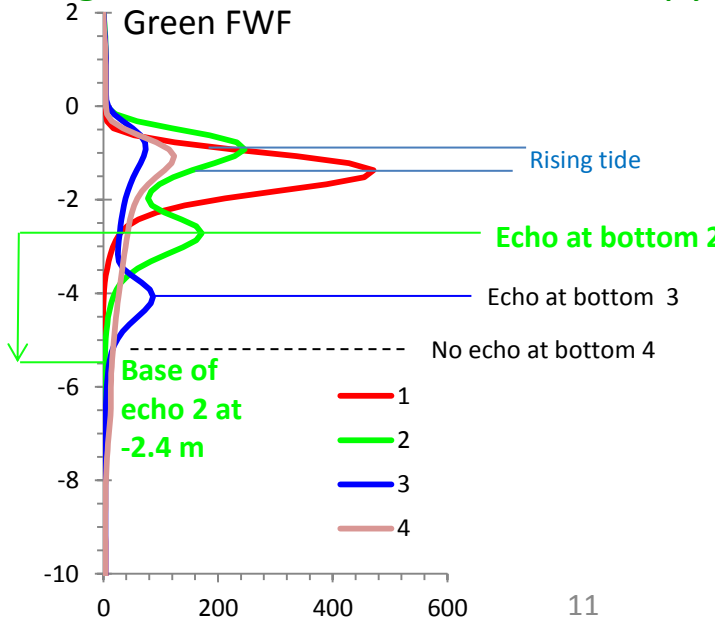




Bathymetric mode 532 nm at 400 m



Imagine a water column as a canopy

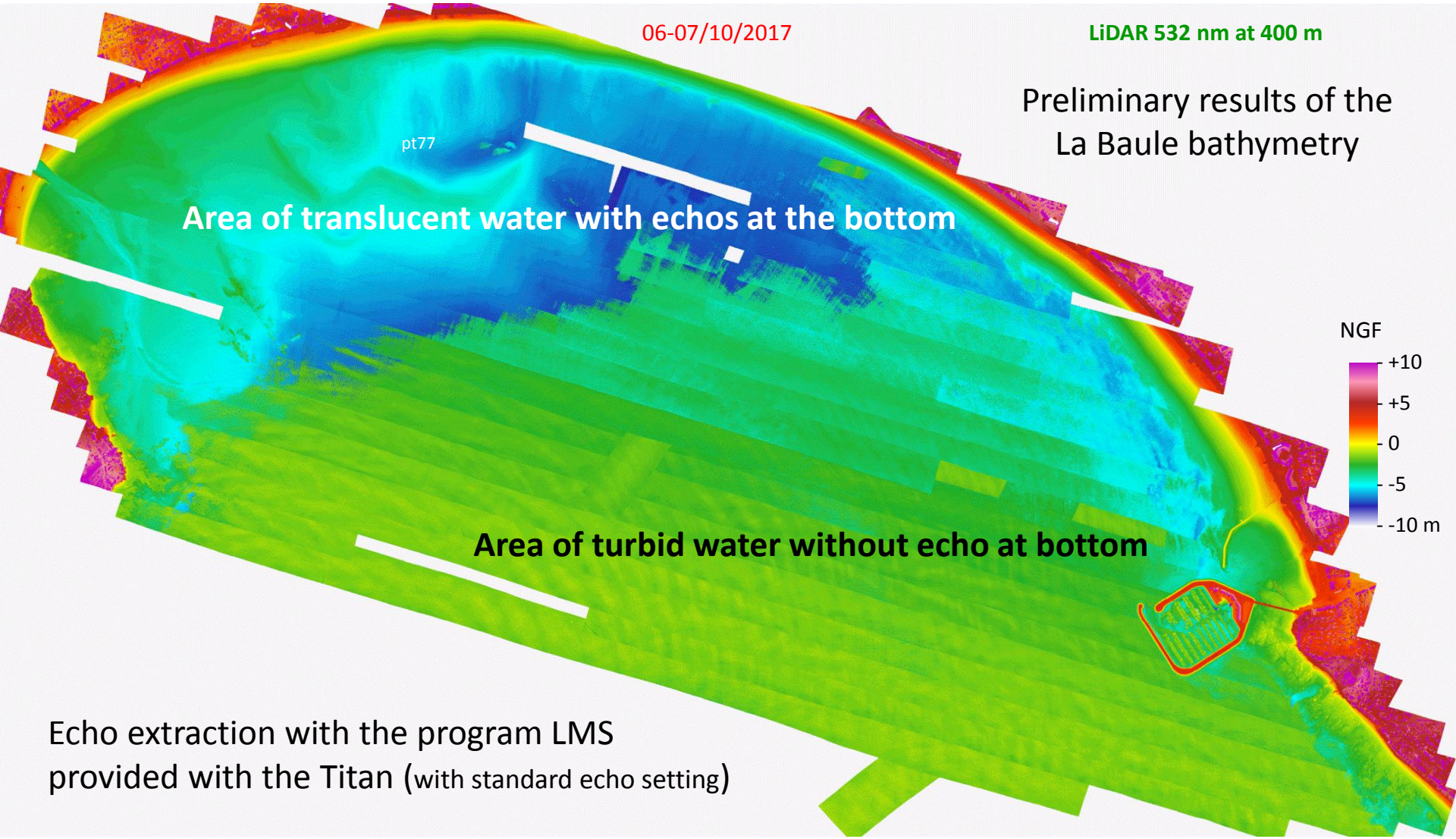


Maximum penetration in water : -10 m (from 400 m)

06-07/10/2017

LiDAR 532 nm at 400 m

Preliminary results of the La Baule bathymetry



Echo extraction with the program LMS provided with the Titan (with standard echo setting)

06-07/10/2017

LiDAR 532 nm at 400 m

Preliminary results of the La Baule bathymetry

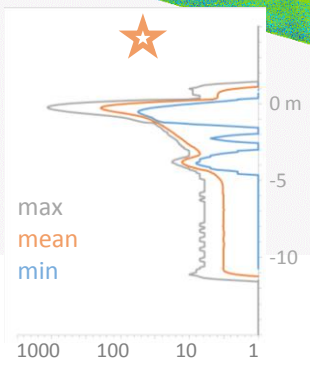
(IR aligned on Green echoes)

pt77

NGF
+10
+5
0
-5
-10 m

Search for weak echoes on FWF.

Echoes are not well separated in shallow water.



Waves

Baseline drop

Bathymetric correction with a sea water index of 1.34

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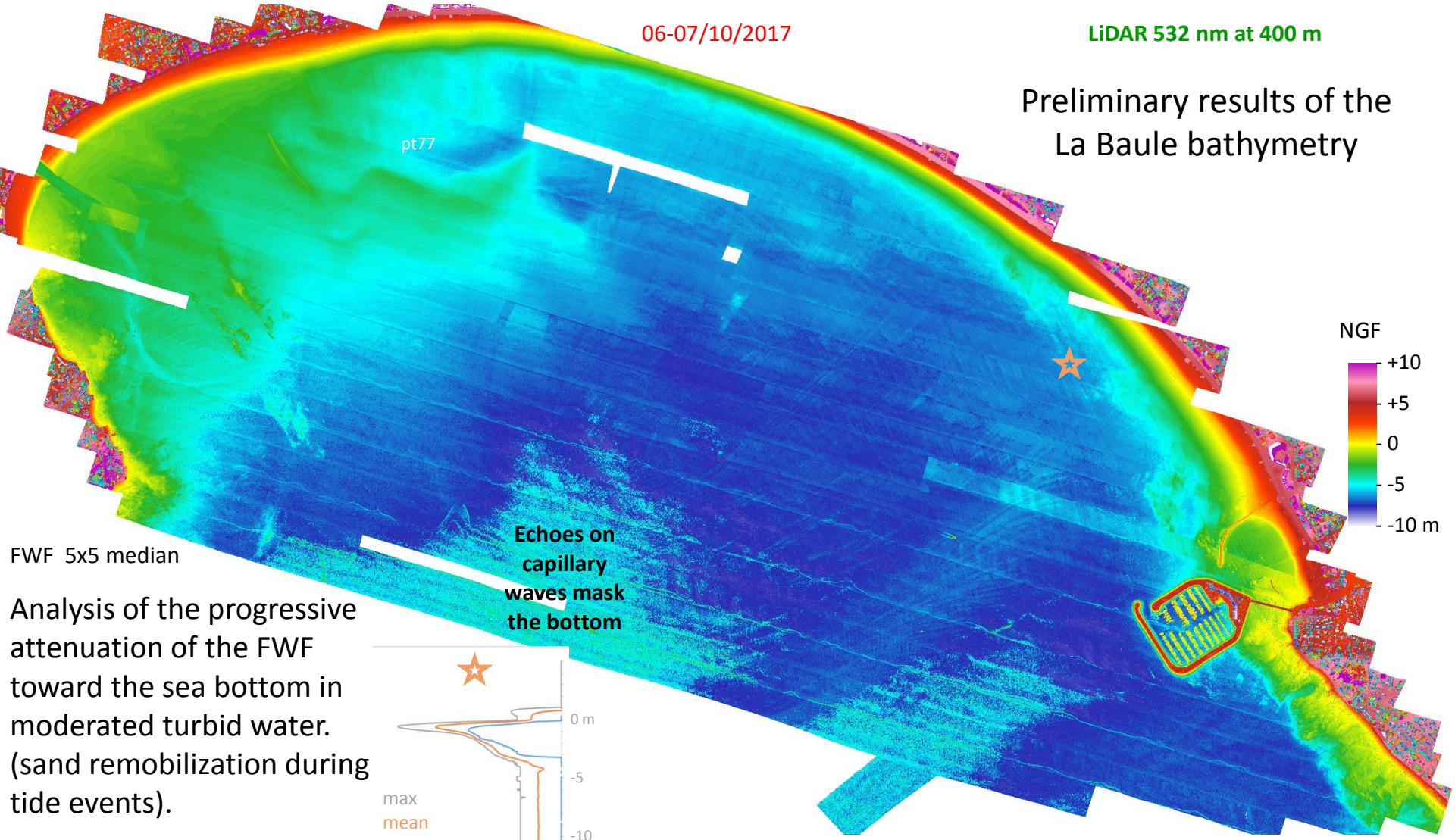
06-07/10/2017

LiDAR 532 nm at 400 m

Preliminary results of the La Baule bathymetry



Analysis of the progressive attenuation of the FWF toward the sea bottom in moderated turbid water. (sand remobilization during tide events).

Bathymetric correction with a sea water index of 1.34

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IR NCCFWF DSM

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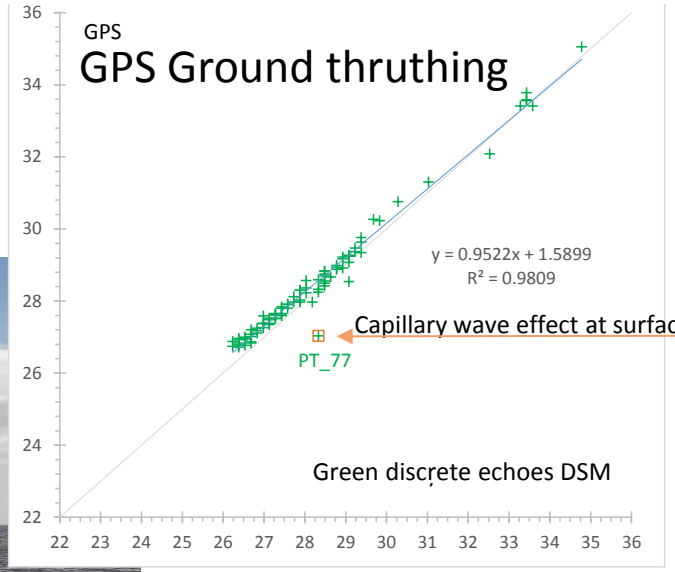
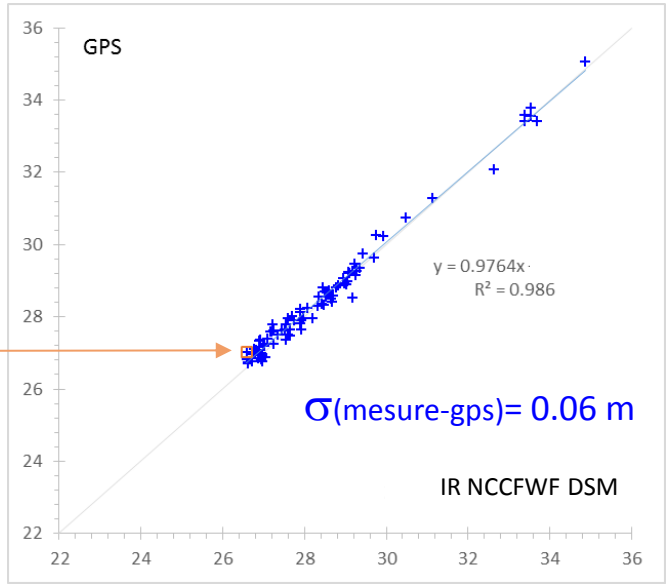
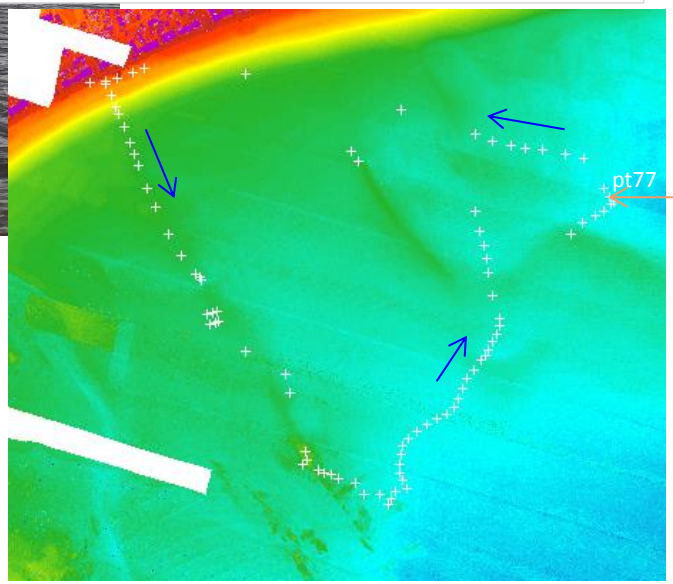
LMS echoes in clear water area

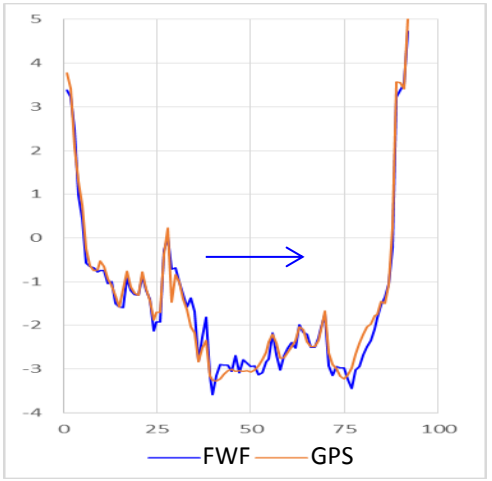
Martin Juigner, Marc Robin and Morgane Audère





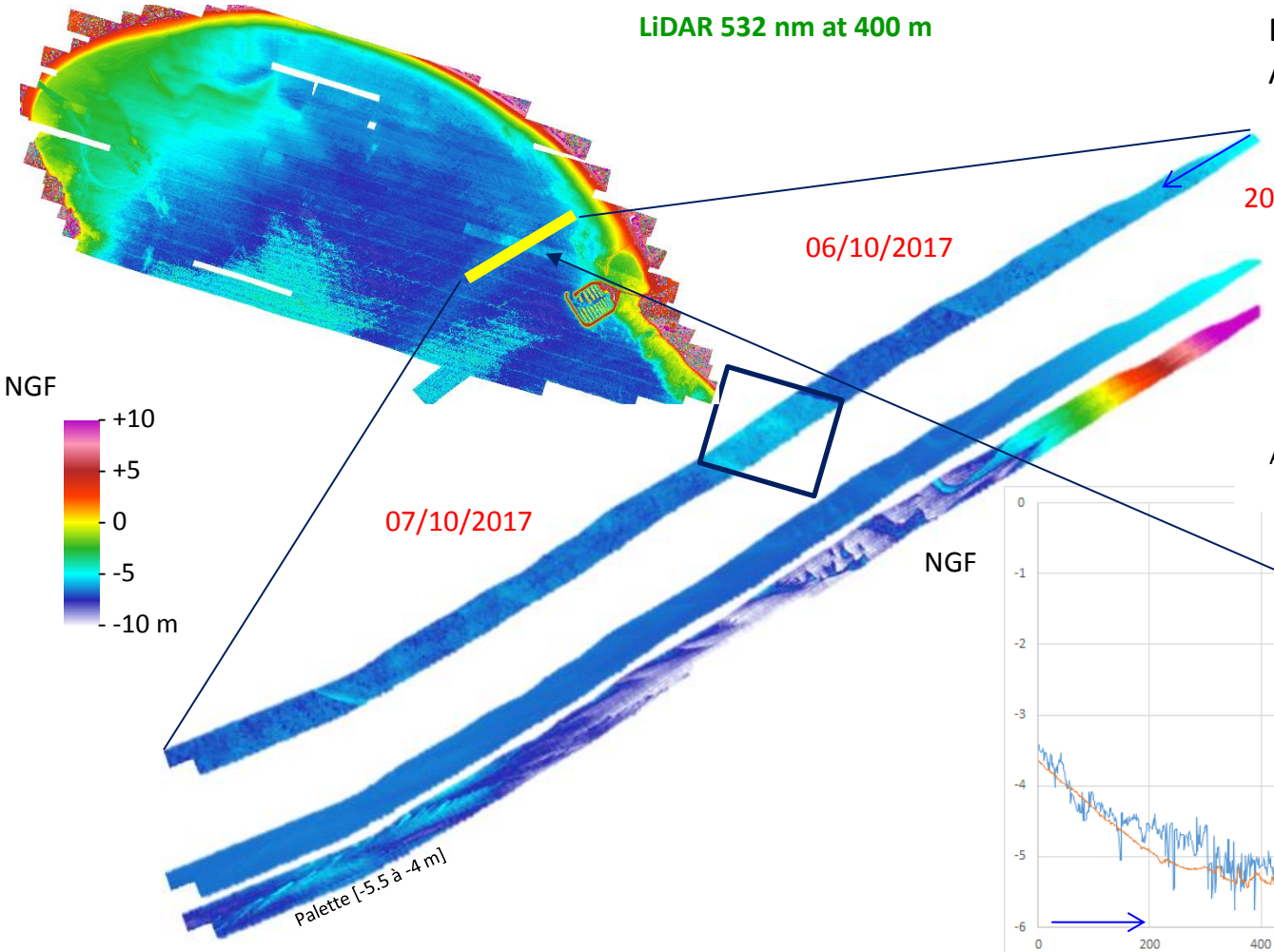
FWF shape analysis of echoes presenting a 2.4 m damping function





Preliminary results of La Baule bathymetry

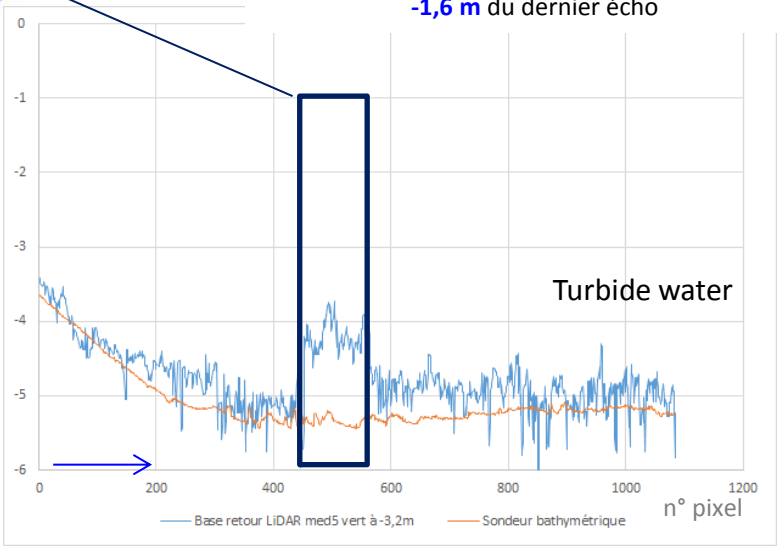
LiDAR 532 nm at 400 m



Echo sounder
Agnès Baltzer

Ifremer

Avec hypothèse d'une base de retour d'onde à **-1,6 m** du dernier écho



Preliminary results of the La Baule bathymetry

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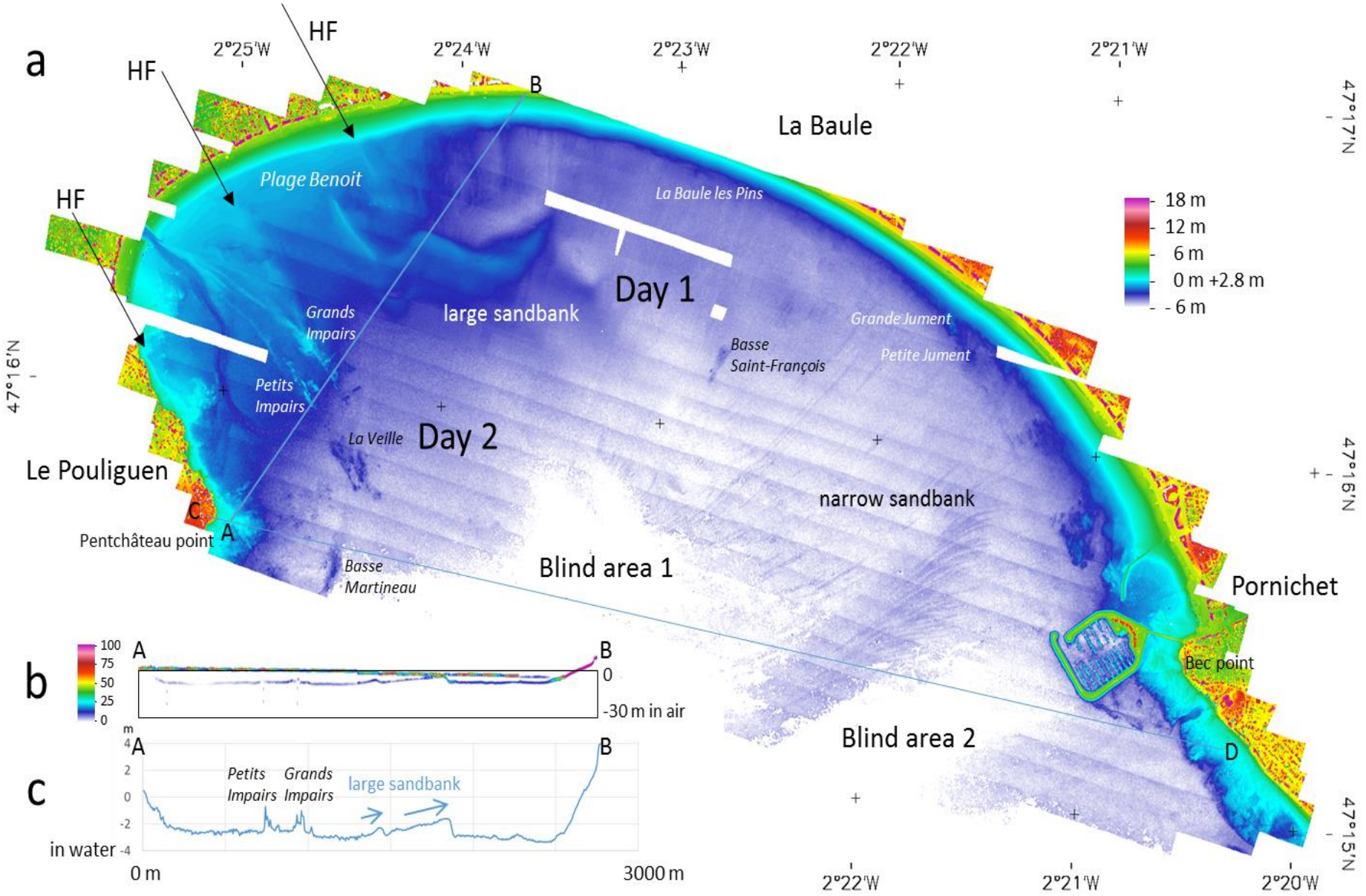

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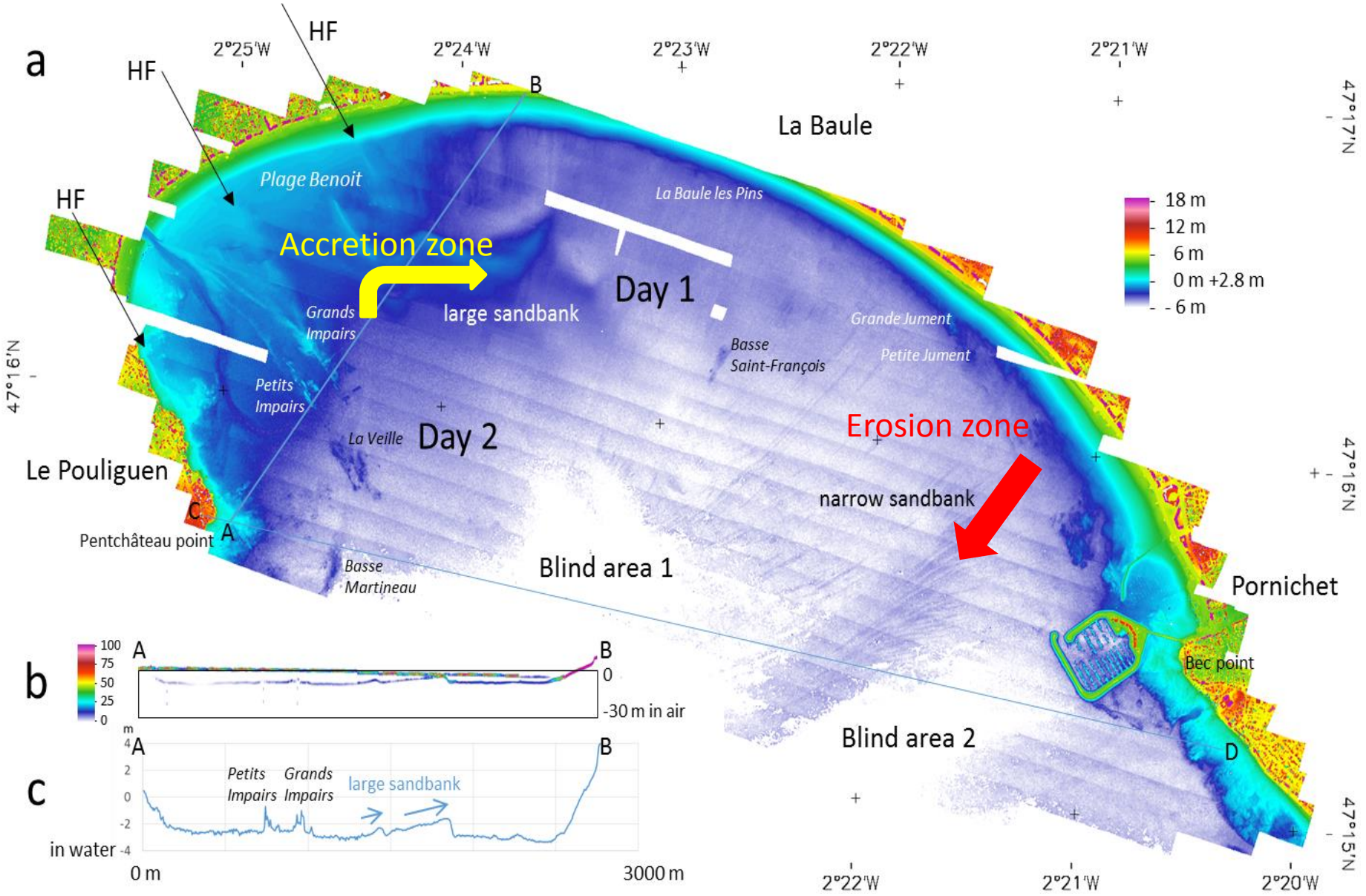

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OSUNA planètes et environnement

Thanks to Pierre-Yves Robin from U of T

Special thanks to TELEDYNE OPTECH Everywhereyoulook™

Mark Topping

Paul Laroque
Anca Dobrinescu
Michael Perdue
Michel Stanier
Alex Yeryomin

Testing flight in Oshawa