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► To cite this version:

Antoine Mury, Antoine Collin, Dorothée James, Yves Pastol, Samuel Etienne. Spatially-explicit modeling of the salt marsh wave attenuation using pressure measurements, UAV imagery and LiDAR data. European Geosciences Union, Apr 2019, Vienne, Austria. hal-02135528

HAL Id: hal-02135528

<https://hal.science/hal-02135528>

Submitted on 21 May 2019

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SPATIALLY-EXPLICIT MODELLING OF THE SALT MARSH WAVE ATTENUATION USING PRESSURE MEASUREMENTS, UAV IMAGERY AND LIDAR DATA

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Introduction

Among the consequences of global changes, an increase of **coastal risks** is widely expected. Indeed, The sea-level rise conjugated with spring tides and hazardous storms, can lead to extreme sea-levels, in worldwide coastal areas subject to unprecedented demographic exposure, thus risks. In this context, **many methods**, using **conventional engineering** or **soft management**, are used or experimented **to reduce the coastal risk of marine flooding**, thus protecting the human stakes.

Coastal wetlands and especially **salt marsh** areas, can play a major role into the **risk mitigation** by acting as a **natural buffer zone**. So, we propose here a simple but robust solution **to quantify and map the very high resolution wave attenuation service** offered by a coastal marsh using **an easy-to-implement combinaison of in situ pressure measurements and in silico optical imagery**.

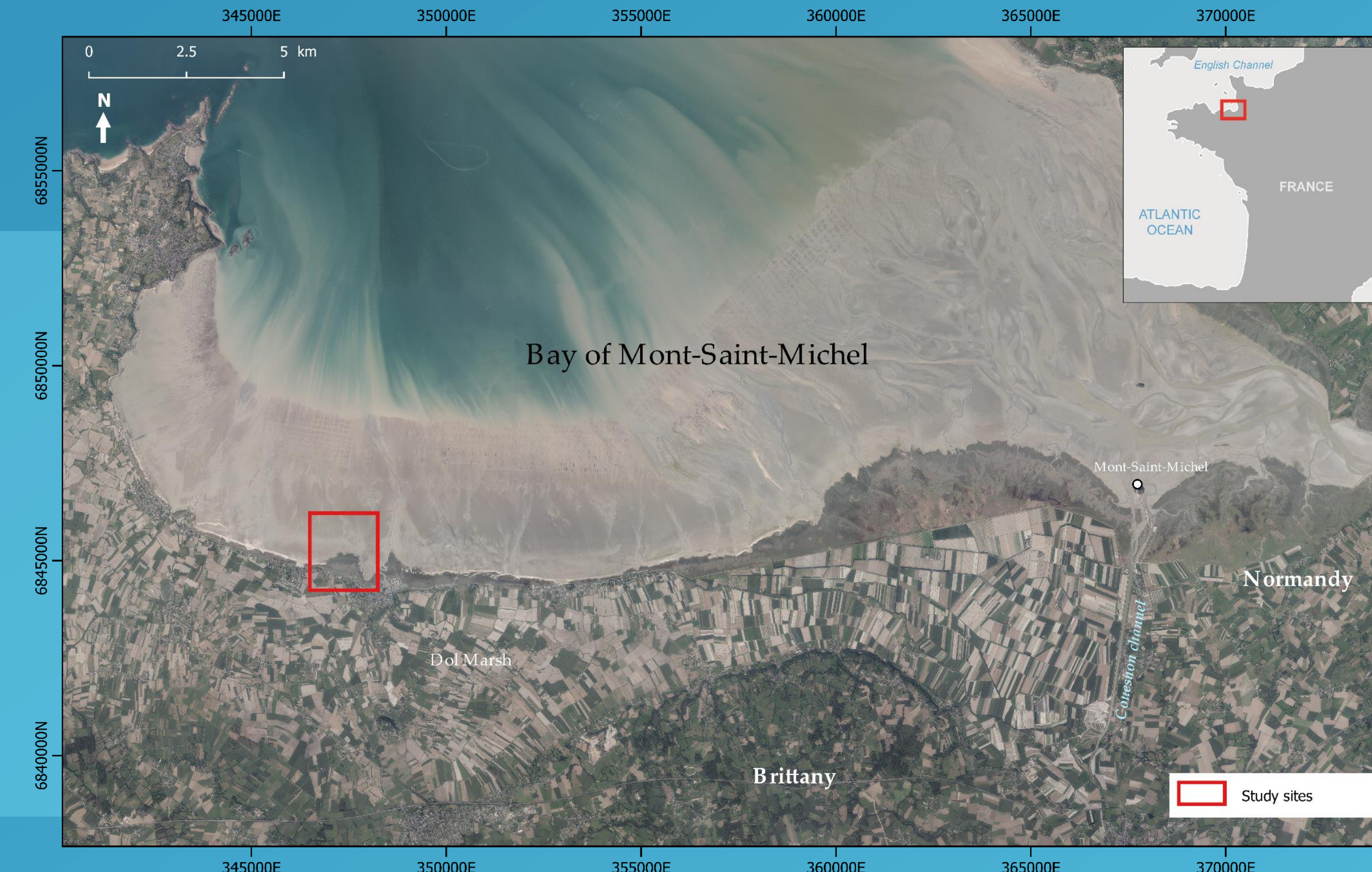


Figure 1. Location of the study area in the megatidal bay of Mont-Saint-Michel (France)

Wave attenuation measurements

Material and methods

1. Deployment of **pressure sensors** NKE SP2T10 (Figure 2) along two cross-shore transects (T1 and T2)
2. Pressure data acquired at a frequency of 2 Hz are corrected and converted into water heights, from which the wave signal is extracted for the determination of **significant wave heights (Hs)**.
3. The wave attenuation is determined from the average of significant wave height calculated over two hours of high tide, then turn into **attenuation per unit of distance (%/m)** to be easily compared between study sites.

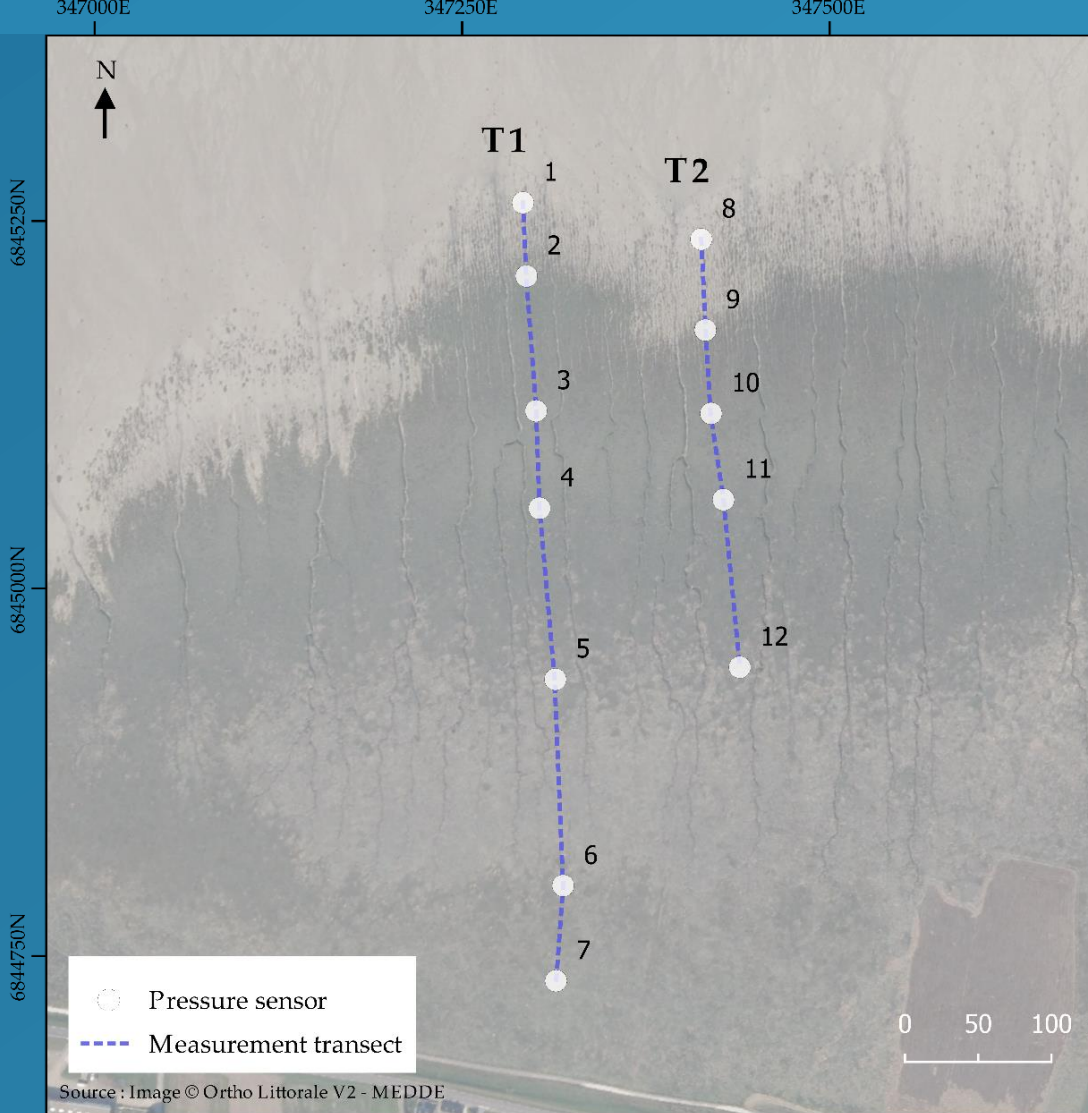
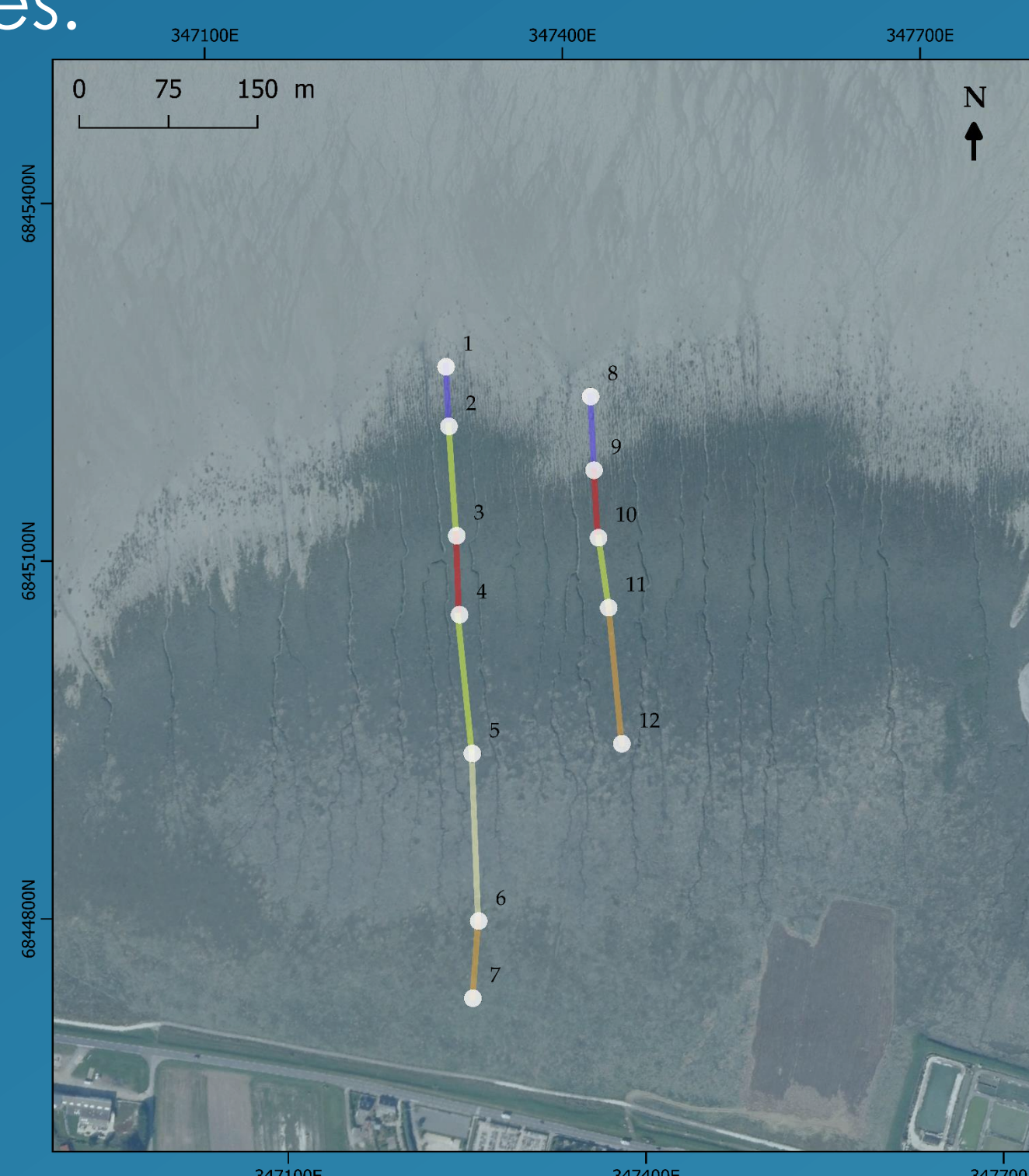


Figure 2. Location map of the several measurement points

Wave attenuation results

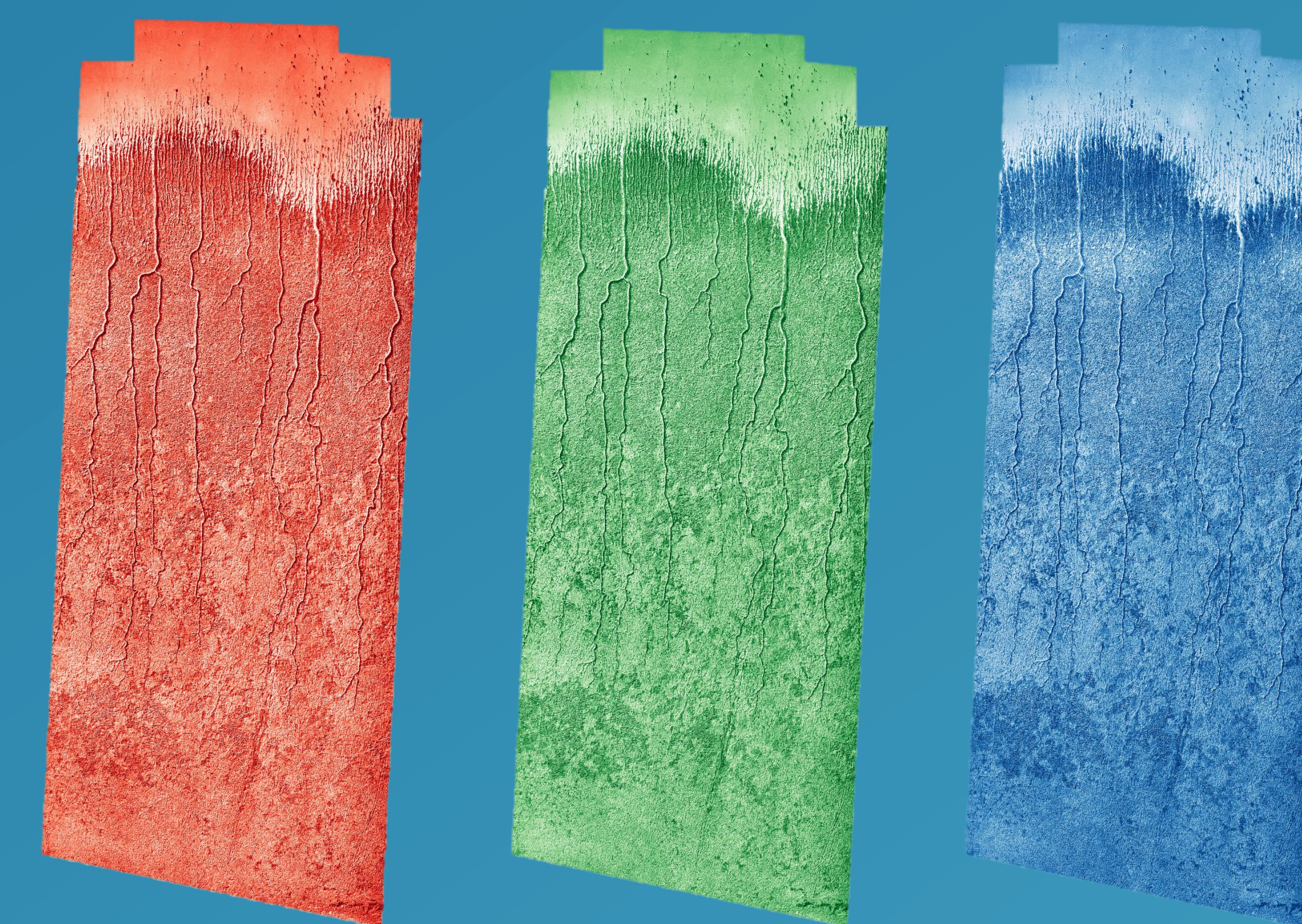


Attenuation values (%/m)

- 0.01 - 0.00
- 0.00 - 0.50
- 0.50 - 0.75
- 0.75 - 1.00
- 1.00 - 1.12

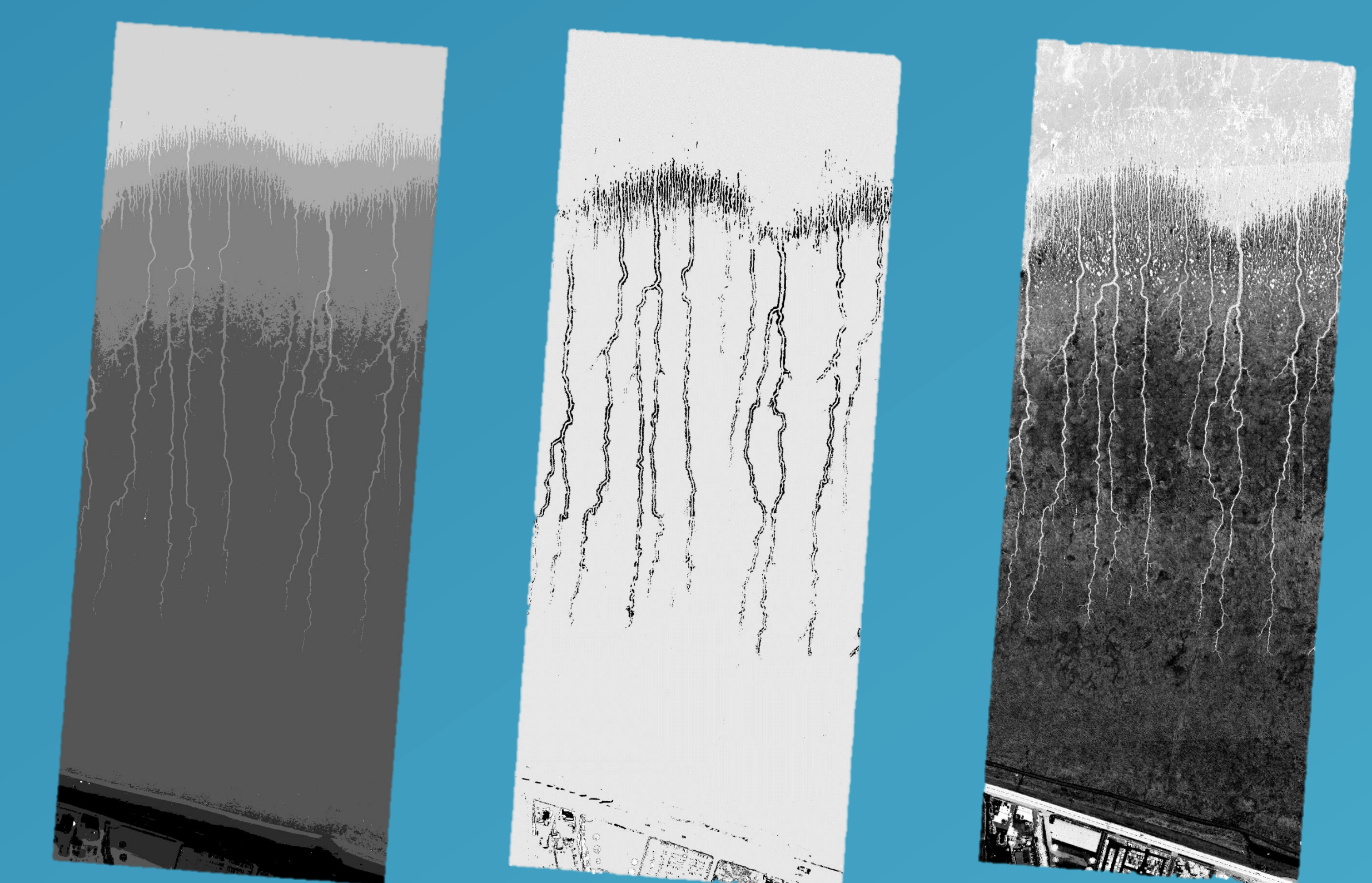
Figure 3. Mapping of the wave attenuation along two cross-shore transects

UAV imagery (0.1 m × 0.1 m)



Red band Green band Blue band

LiDAR data (0.1 m × 0.1 m)



Elevation Height Intensity

Simple and Multiple regression models

Predictors

Conclusion

- **The salt marsh wave attenuation can be mapped at very high resolution using UAV and LiDAR predictors modeled by regression models**
- **Blue is the best UAV predictor** (representing the absorption peak of chlorophyll pigments)
 $R^2 = 0.52$ Standard error = 0.29 $r = 0.72$
- **Elevation is the best LiDAR predictor** (representing the topography)
 $R^2 = 0.41$ Standard error = 0.33 $r = 0.64$
- **Blue + Elevation is the best predictor's combination**
 $R^2 = 0.59$ Standard error = 0.29 $r = 0.76$
- **Highest wave attenuations are located at the salt marsh edge, channels and high marsh**

References :

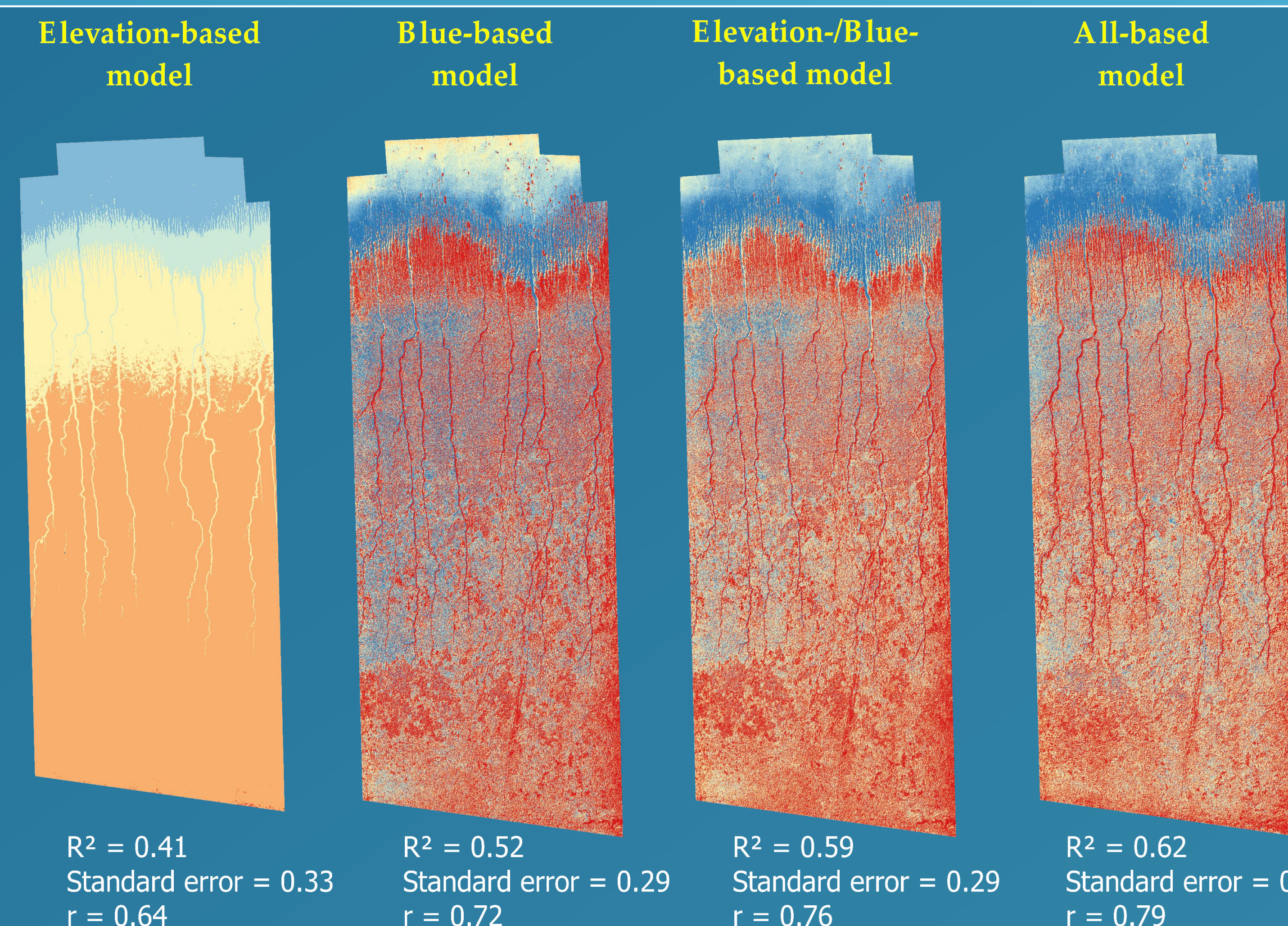
Collin, A. et al., 2018, Mapping wave attenuation induced by salt marsh vegetation using WorldView-3 satellite imagery. *Revista de Investigacion Marina*, Unidad de Investigación Marina de AZTI, 25 (2), pp.67-69.
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Mapping results

Attenuation values (%/m)

- 0.1
- 0.117
- 0.333
- 0.55
- 0.767
- 0.983
- 1.2

R^2 : Linear coefficient of determination
 r : Linear coefficient of correlation (Pearson)



$R^2 = 0.41$ Standard error = 0.33 $r = 0.64$
 $R^2 = 0.52$ Standard error = 0.29 $r = 0.72$
 $R^2 = 0.59$ Standard error = 0.29 $r = 0.76$
 $R^2 = 0.62$ Standard error = 0.43 $r = 0.79$

Figure 4. Spatially-explicit models



Photography encouraged