



HAL
open science

Spatially-explicit modelling of the salt marsh wave attenuation using pressure measurements, UAV imagery and LIDAR data

Antoine Mury, Antoine Collin, Dorothée James, Yves Pastol, Samuel Etienne

► To cite this version:

Antoine Mury, Antoine Collin, Dorothée James, Yves Pastol, Samuel Etienne. Spatially-explicit modelling of the salt marsh wave attenuation using pressure measurements, UAV imagery and LIDAR data. European Geoscience Union General Assembly 2019, Apr 2019, Vienna, Austria. 21, 2019. hal-02176747

HAL Id: hal-02176747

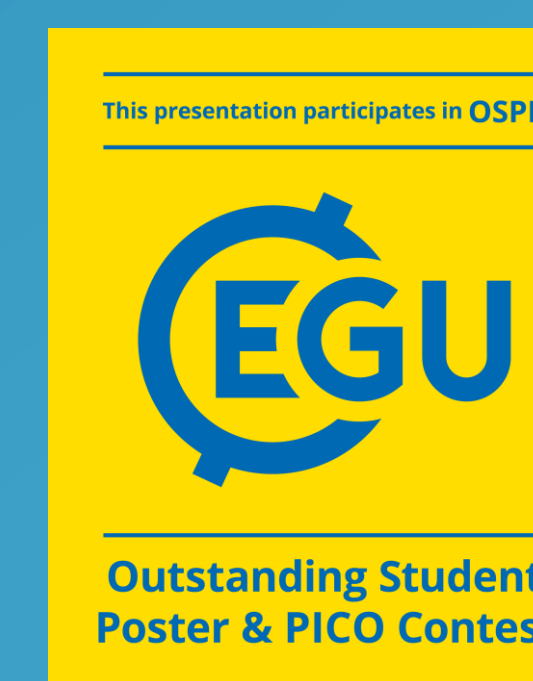
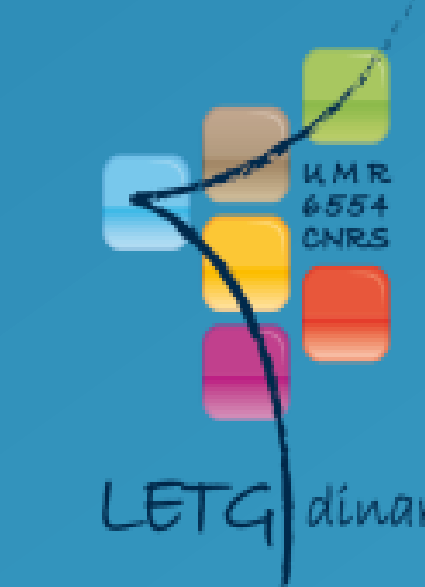
<https://hal.science/hal-02176747v1>

Submitted on 8 Jul 2019

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

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



Antoine MURY^{1*}, Antoine COLLIN¹, Dorothée JAMES¹, Yves PASTOL², Samuel ETIENNE¹

¹ Ecole Pratique des Hautes Etudes, PSL Research University, UMR LETG, Dinard, France

² Naval Hydrographic and Oceanographic Service, Brest, France.

* Corresponding author : antoine.mury@etu.ephe.psl.eu

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**.

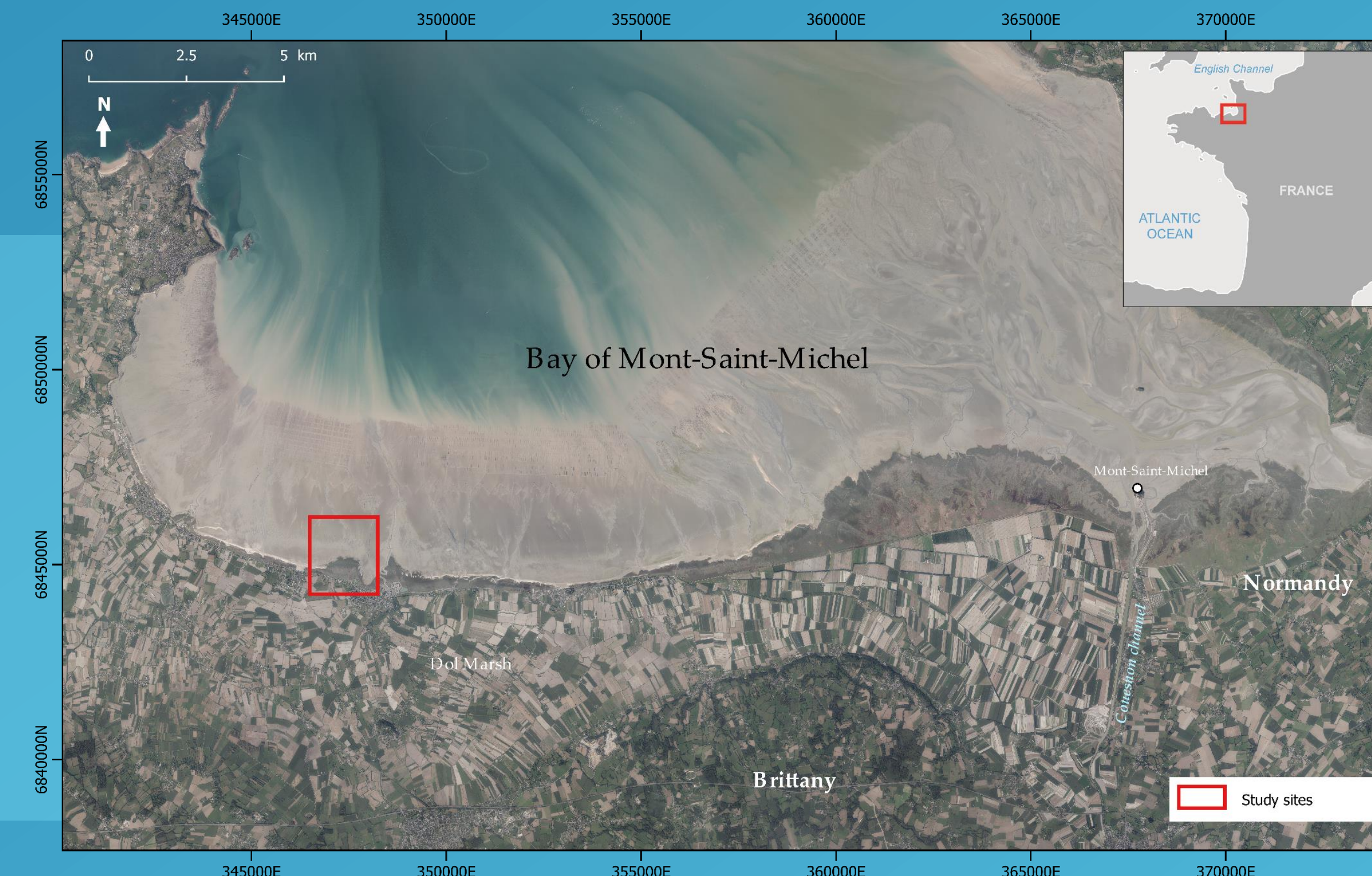


Figure 1. Location of the study area in the megatidal bay of Mont-Saint-Michel (France)

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.

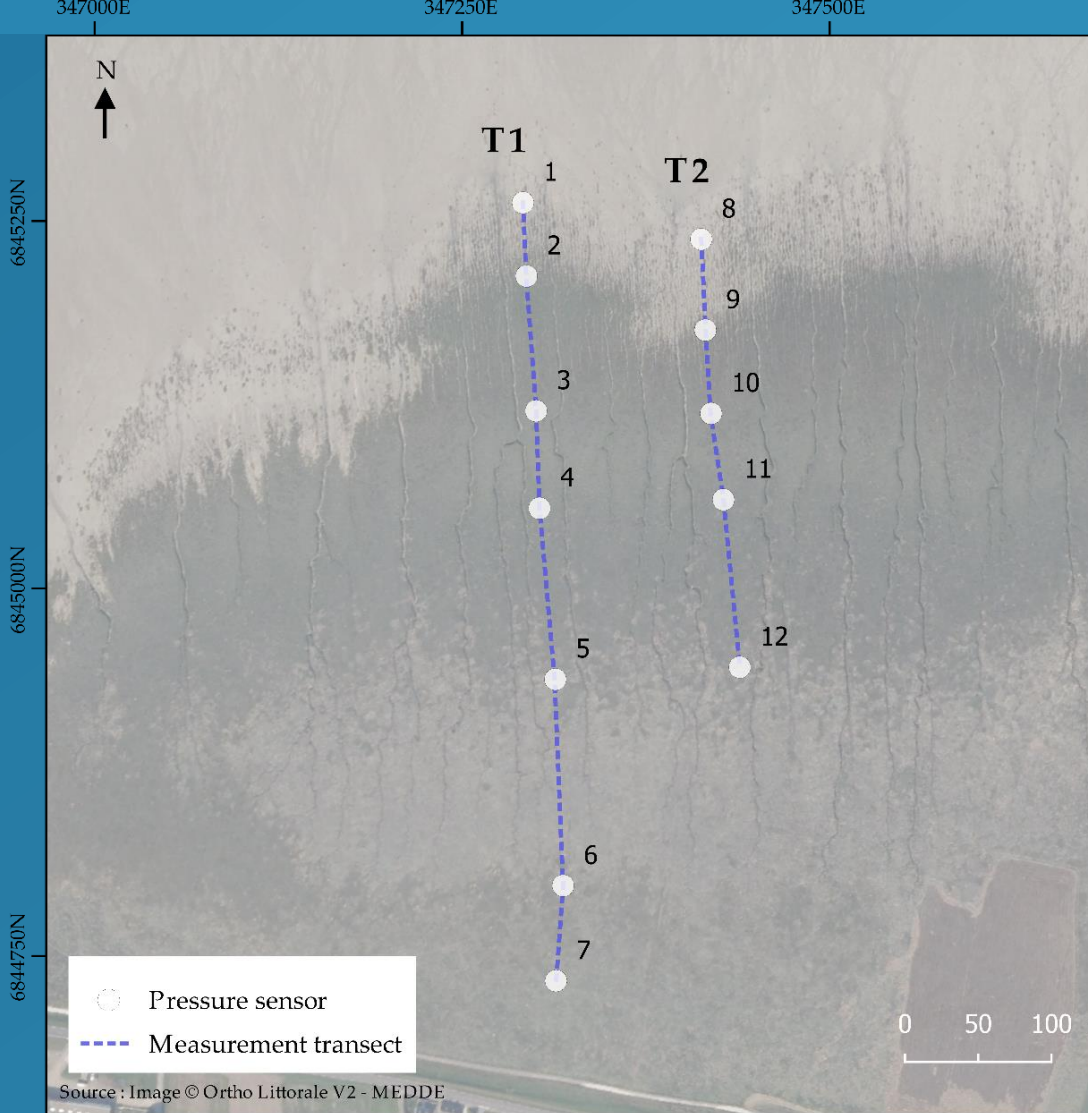
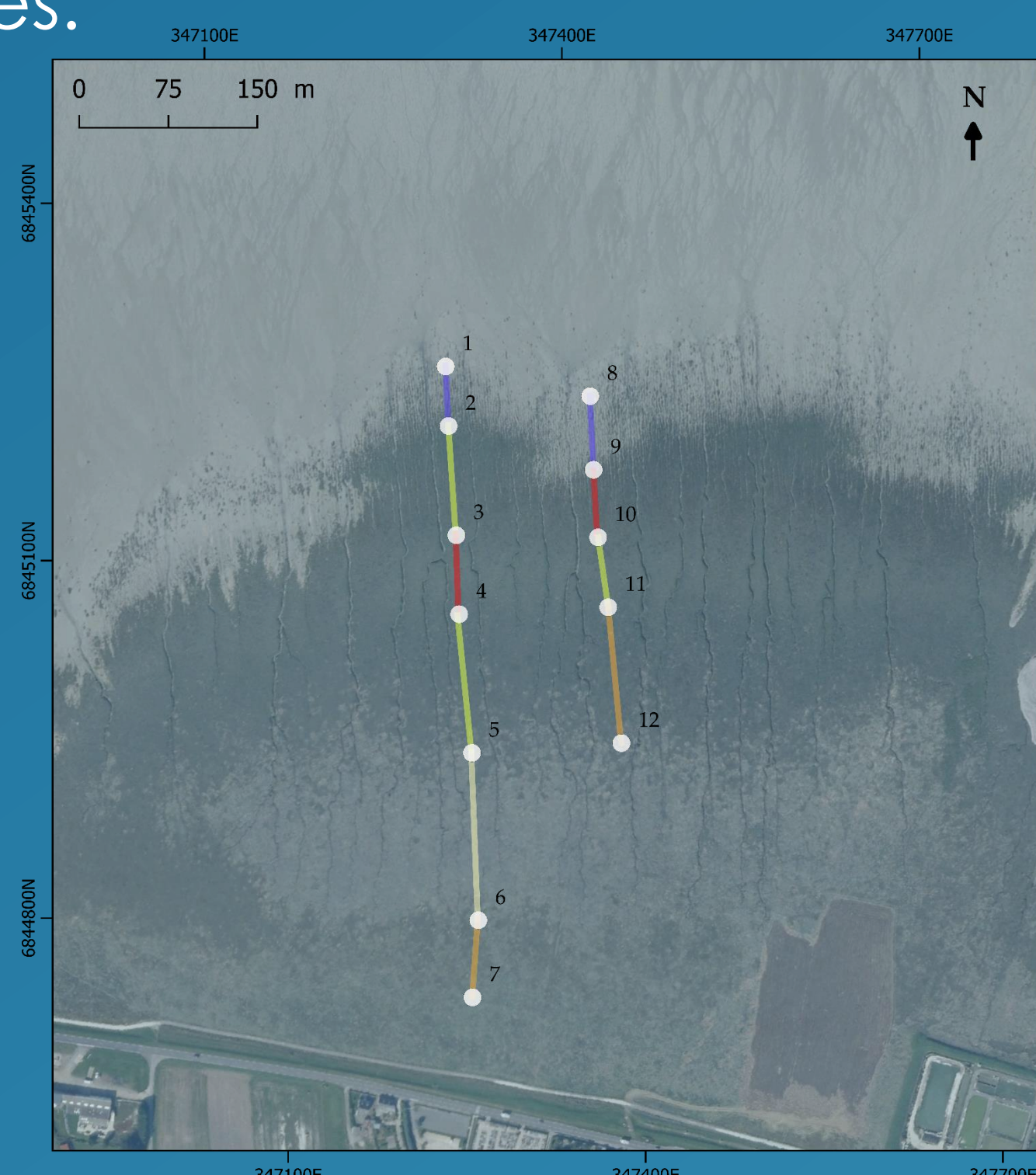


Figure 2. Location map of the several measurement points

Wave attenuation results

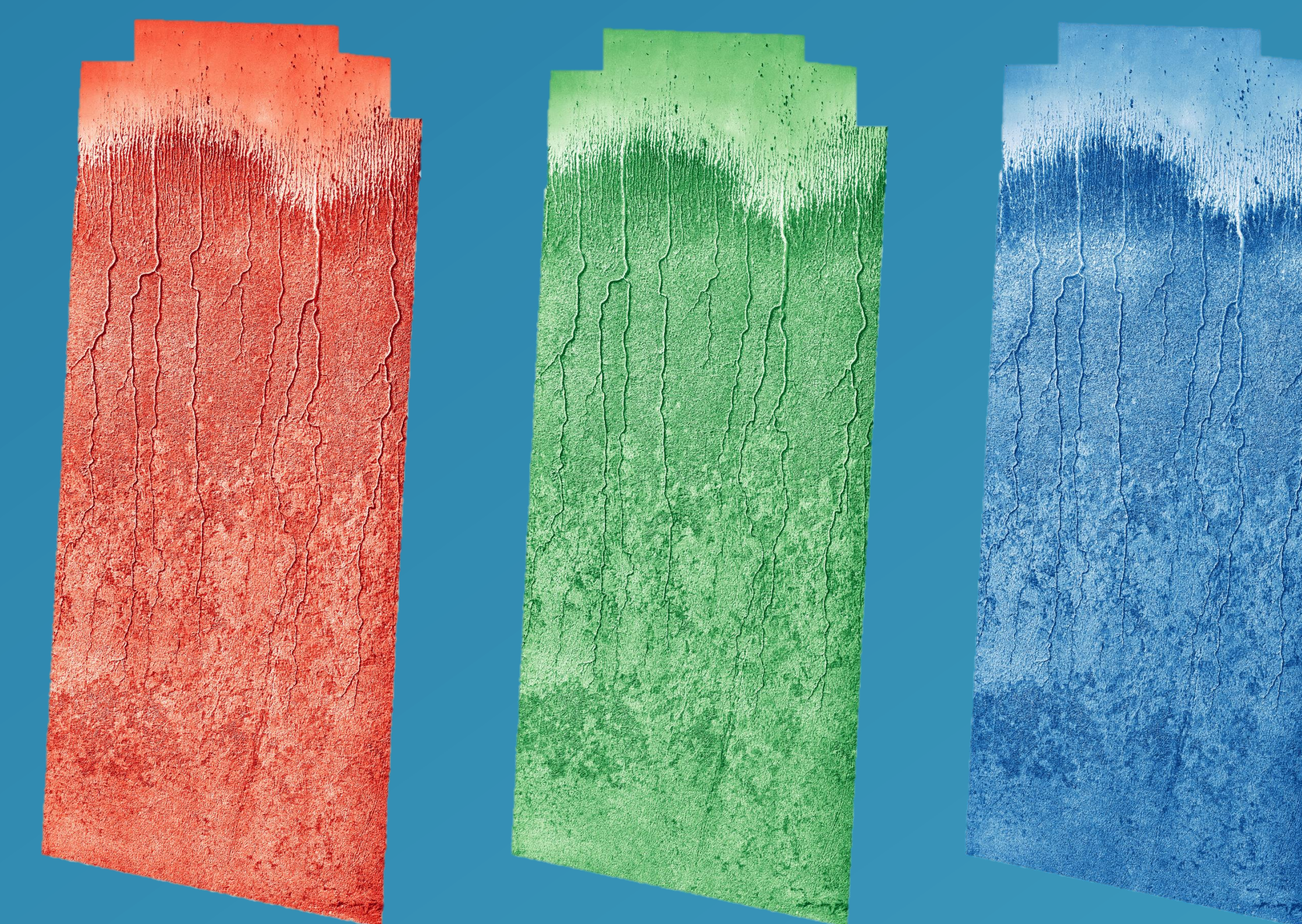


Attenuation values (%/m)

- 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)

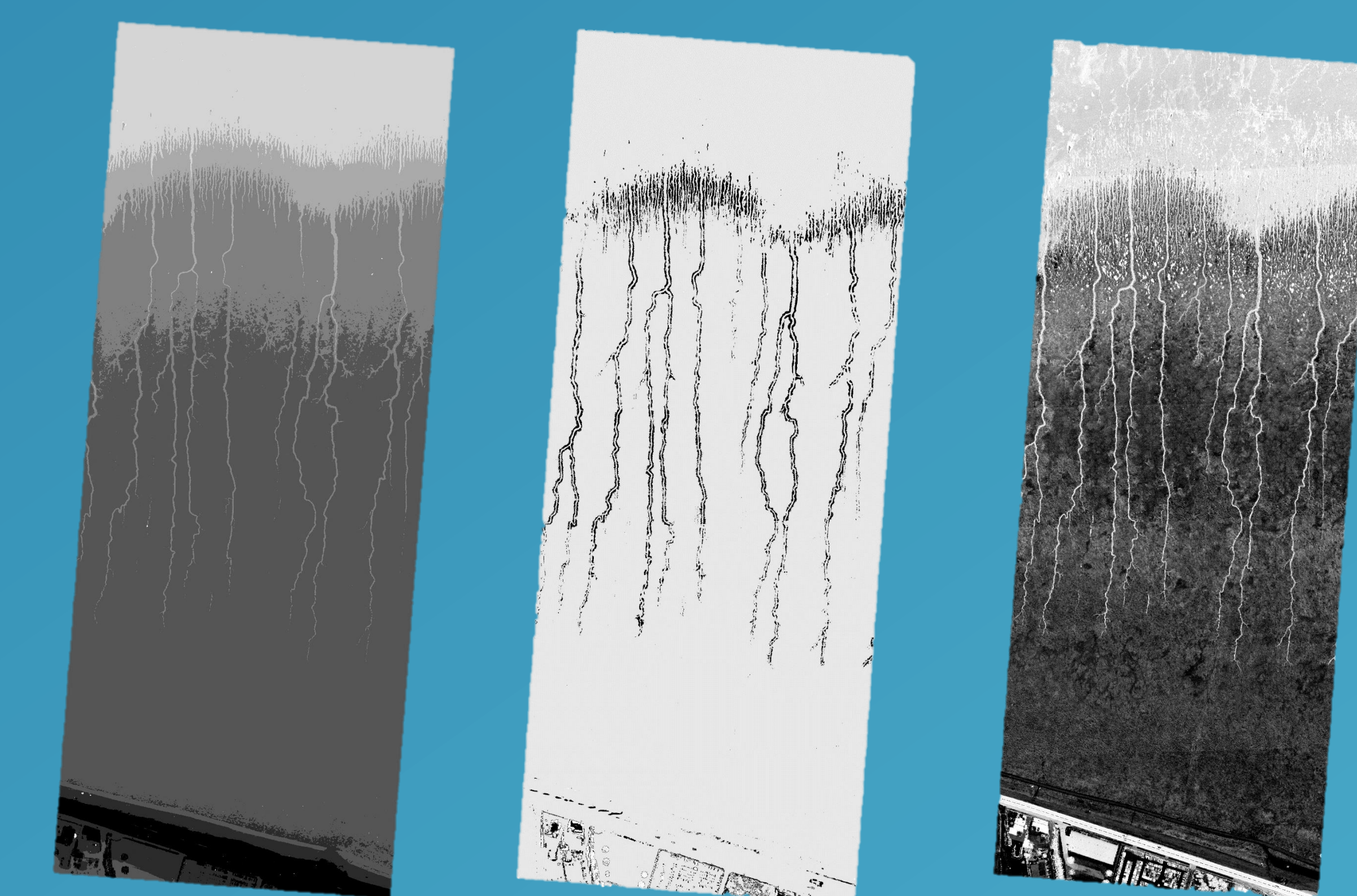


Red band

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 :

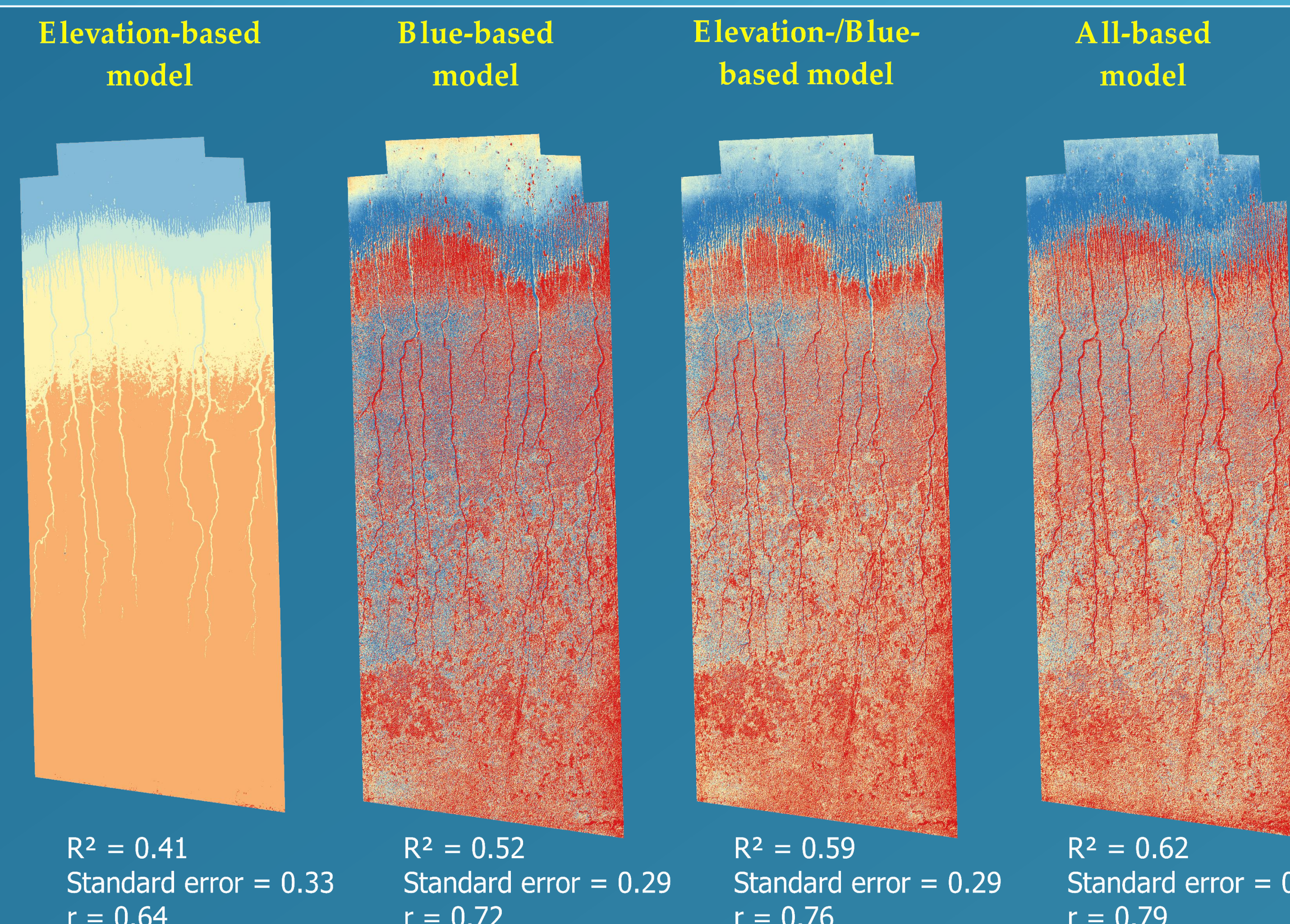
Collin, A. et al., 2018, Mapping wave attenuation induced by salt marsh vegetation using WorldView-3 satellite imagery. *Revista de Investigacion Marina*, Unidad de Investigación Marina de AZTI, 25 (2), pp.67-69.
 Mury, A. et al., 2018, Wave attenuation service of saltmarshes and shelly cheniers: a spatio-temporal study in Mont-Saint-Michel Bay, France, Proceedings of the EGU General Assembly Conference, Vienna, Austria, 2018, poster session

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