Seagrass mapping in two mudflats in the Auray River
About a rapid evolution of seagrasses

Simon Oiry[a,*], Bede Ffinian Rowe Davies[a,*]

[a] *Nantes Université, UR 2160, F-44000 Nantes, France, Institut des Substances et Organismes de la Mer, ISOMer, 2 chemin de la houssinière, Nantes, 44300*

Abstract

Maps of seagrass in two sites in the Auray River. These two sites were studied by Maxime Daviray during his PhD. Seagrass appeared very quickly during his PhD. This work aims to describe this rapid evolution of seagrasses.

Keywords: Remote Sensing, Sentinel-2, Seagrass

The data and scripts used for this work can be found here.

1. Materials & Methods

1.1. Seagrass mapping using Sentinel-2

To map the seagrass extent over time, the Sentinel-2 constellation has been used. Level-2 images, which are already orthorectified and atmospherically corrected using Sen2Cor, have been downloaded using the Copernicus Platform [1]. One low tide, cloud-free image per year, nearest to the period of maximum seagrass biomass at this latitude, has been used. A total of 8 images have beed used (Table 1).

Table 1: Acquisition dates of Sentinel-2 images used to map seagrass in the Auray River. Tide times were retrieved from the SHOM and correspond to the tides at the Locmariaquer tide gauge, situated approximately 2 km from the study sites.

Acquisition Date (UTC)	Low Tide Time (UTC)	Time Difference with Low tide
2016-11-03 11:12	12 : 08	+ 00 : 56
2017-10-04 11:08	09 : 09	- 01 : 59

*Corresponding author

Email addresses: oirysimon@gmail.com (Simon Oiry), bedeffinian@gmail.com (Bede Ffinian Rowe Davies)

Acquisition Date (UTC)	Low Tide Time (UTC)	Time Difference with Low tide
2018-09-29 11:08	12 : 43	+ 01 : 35
2019-09-14 11:06	10 : 28	+ 00 : 38
2020-08-04 11:06	10 : 45	+ 00 : 21
2021-10-08 11:09	11 : 18	- 00 : 09
2022-08-29 11:06	11 : 27	- 00 : 21
2023-09-03 11:06	12 : 28	- 01 : 22

The *Intertidal Classification of Europe: Categorising Reflectance of Emerged Areas of Marine vegetation with Sentinel-2* model (ICE CREAMS, [2]), a neural network classifier designed to identify and discriminate intertidal vegetation in Europe, has been applied to each Sentinel-2 image. Pixels of the Magnoliopsida class (seagrasses) have been isolated, and the Normalized Difference Vegetation Index (NDVI, [3]), a commonly used remote sensing biomass proxy for vegetation, has been employed. The equation of [4] have been used to transform NDVI values into Seagrass Percent Cover (Equation 1). SPC values below 20%, corresponding to low biomass pixel, with a high risk of confusion with other vegetation classes, have been remove from the rest of the analysis.

$$SPC = 172.06 \times NDVI - 22.18 \tag{1}$$

Maps and analysis have then been performed using the *Terra* package of R, in a *Tidyverse* workflow [5, 6].

2. Results

2.1. Evolution of the spatial distribution of seagrasses over time

A time series of the seagrass percent cover was conducted between 2016 and 2018 (see Figure 1). A consistent cover of seagrass can be observed at Fort Espagnol since the beginning of the time series. From 2019 onwards, the meadows appear to become denser at that site, especially in the northern part of the mudflat, with the exception of 2020, when green algae covered the meadow in August. Concerning Kerouarc'h, the meadow was absent from the mudflat between 2016 and 2019. As for Fort Espagnol, in 2020 ICE CREAMS predicted almost exclusively green algae in Kerouarc'h. From 2020 onward, the seagrass meadows have seen a rapid extension, covering almost the entirety of the mudflat since 2021, and then becoming denser in 2022.

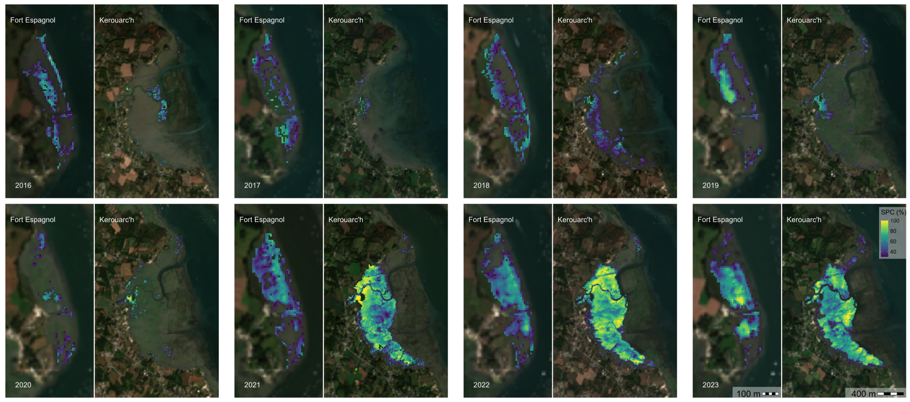

Figure 1: Time Serie of the Seagrass Percent cover between 2016 and 2023 in Fort Espagnol and Kerouarc'h, two sites of the Auray river.

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