Seagrass mapping in two mudflats in the Auray River

About a rapid evolution of seagrasses

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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.

The data and scripts used for this work can be found [here](https://github.com/SigOiry/Seagrass_maps_Maxime).

# 1. Materiel & 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 (Copernicus 2024). 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](#tbl-tide-data)).

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| 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 | | 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, Davies et al. (2024)), 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, Rouse et al. (1974)), a commonly used remote sensing biomass proxy for vegetation, has been employed. The equation of Zoffoli et al. (2021) have been used to transform NDVI values into Seagrass Percent Cover ([Equation 1](#eq-std)). 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.

Maps and analysis have then been performed using the *Terra* package of R, in a *Tidyverse* workflow (Hijmans 2023; Wickham 2017)

Copernicus. 2024. “Copernicus Open Access Hub.” <https://browser.dataspace.copernicus.eu/>.

Davies, Bede Ffinian Rowe, Simon Oiry, Philippe Rosa, Maria Laura Zoffoli, Ana I. Sousa, Oliver R. Thomas, Dan A. Smale, et al. 2024. “A Sentinel Watching over Inter-Tidal Seagrass Phenology Across Western Europe and North Africa.” *Communications Earth & Environment* 5 (1): 382. <https://doi.org/10.1038/s43247-024-01543-z>.

Hijmans, R. 2023. “Terra: Spatial Data Analysis. R Package Version 1.7-39.” *The R Foundation for Statistical Computing*.

Rouse, John Wilson, Rüdiger H Haas, John A Schell, Donald W Deering, et al. 1974. “Monitoring Vegetation Systems in the Great Plains with ERTS.” *NASA Spec. Publ* 351 (1): 309.

Wickham, Hadley. 2017. “Easily Install and Load the ‘Tidyverse’.” *R Package Version* 1 (1).

Zoffoli, Maria Laura, Pierre Gernez, Laurent Godet, Steef Peters, Simon Oiry, and Laurent Barillé. 2021. “Decadal Increase in the Ecological Status of a North-Atlantic Intertidal Seagrass Meadow Observed with Multi-Mission Satellite Time-Series.” *Ecological Indicators* 130: 108033.