Quantifying aquatic vegetation with NDAVI

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Outline

Bourgneuf Bay

- French Atlantic Coast
- Department of Loire-Atlantique
- Wetland zone protected by the Ramsar Convention

Why this site?

- The presence of Zostera noltii and other photosynthetic aquatic organisms
- Site protected by the Noirmoutier island
- Already used for the same type of studies

Outline

Data

All the images used for this project were downloaded from the website `https://browser.dataspace.copernicus.eu` using the follow criteria:

- An area was selected that covers a portion of the entire geographical site previously studied (Maria Laura Zoffoli et al.).
- The time period is the same for all three years chosen: September.
- Cloud cover less than 30 percent
- Download of bands 2,3,4 and 8 in .tiff extension in 8 bit

Normalized Difference Aquatic Vegetation Index

$$NDAVI = \frac{NIR - BLUE}{NIR + BLUE} \tag{1}$$

Packages

- `library(terra)`
- `library(imageRy)`
- `library(viridis)`
- `library(ggplot2)`
- `library(patchwork)`

Functions

```
setwd()
list.files()
seq_along()
rast()
c()
par()
im.plotRGB()
plot()
im.classify()
ncell()
```

```
freq()
data.frame()
View()
ggplot()
aes()
geom_bar()
scale_color_viridis_d()
ylim()
xlab()
ylab()
```

Creation of 4 bands Images

```
for (j in seq_along(i_20))
  {
    bn_20[[j]] <- rast(i_20[j])
  }
## let's transform it in a spat raster!
rbn_20 <- rast(bn_20)
rbn_20


## September 2023
```

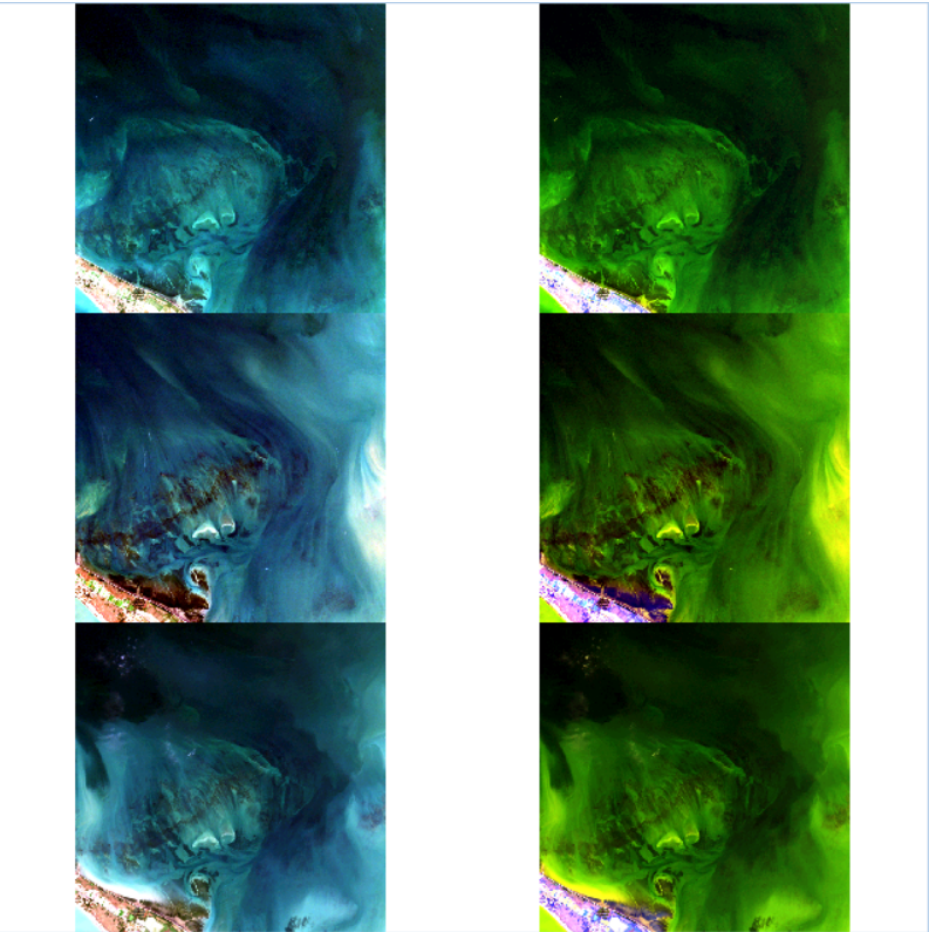
TrueColor vs. FalseColor - Code

```
par(mfrow=c(3,2))
# plotting the rbn_20 in true color
im.plotRGB(rbn_20, 1,2,3)
# plotting the rbn_20 whit NIR band in red
im.plotRGB(rbn_20, 4,2,3)

# plotting the rbn_23 in true color
im.plotRGB(rbn_23, 1,2,3)
# plotting the rbn_23 whit NIR band in red
im.plotRGB(rbn_23, 4,2,3)

# plotting the rbn_25 in true color
im.plotRGB(rbn_25, 1,2,3)
# plotting the rbn_25 whit NIR band in red
im.plotRGB(rbn_25, 4,2,3)
```

TrueColor vs. FalseColor - Images



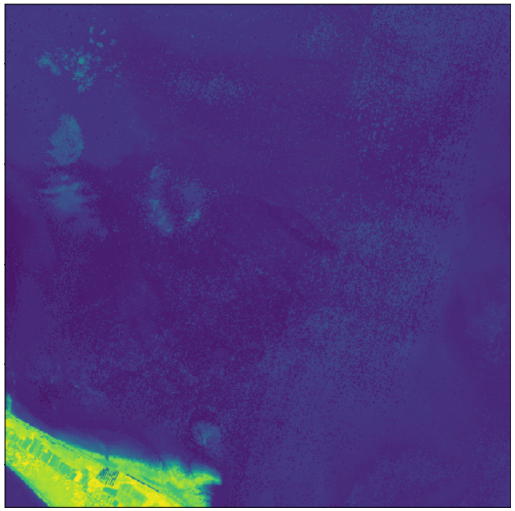
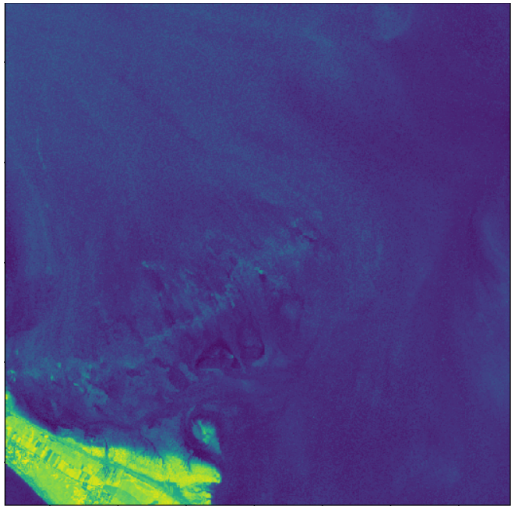
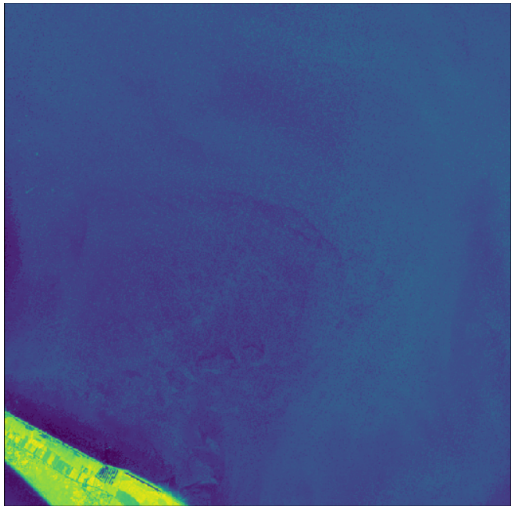
NDAVI - Code

```
# calculating NDAVI bn20
rbn_20_dif = rbn_20[[4]] - rbn_20[[3]]
rbn_20_sum = rbn_20[[4]] + rbn_20[[3]]
rbn_20_NDAVI = rbn_20_dif / rbn_20_sum

# calculating NDAVI bn23
rbn_23_dif = rbn_23[[4]] - rbn_23[[3]]
rbn_23_sum = rbn_23[[4]] + rbn_23[[3]]
rbn_23_NDAVI = rbn_23_dif / rbn_23_sum

# calculating NDAVI bn25
rbn_25_dif = rbn_25[[4]] - rbn_25[[3]]
rbn_25_sum = rbn_25[[4]] + rbn_25[[3]]
rbn_25_NDAVI = rbn_25_dif / rbn_25_sum
```

NDAVI - Images

Classification - Code

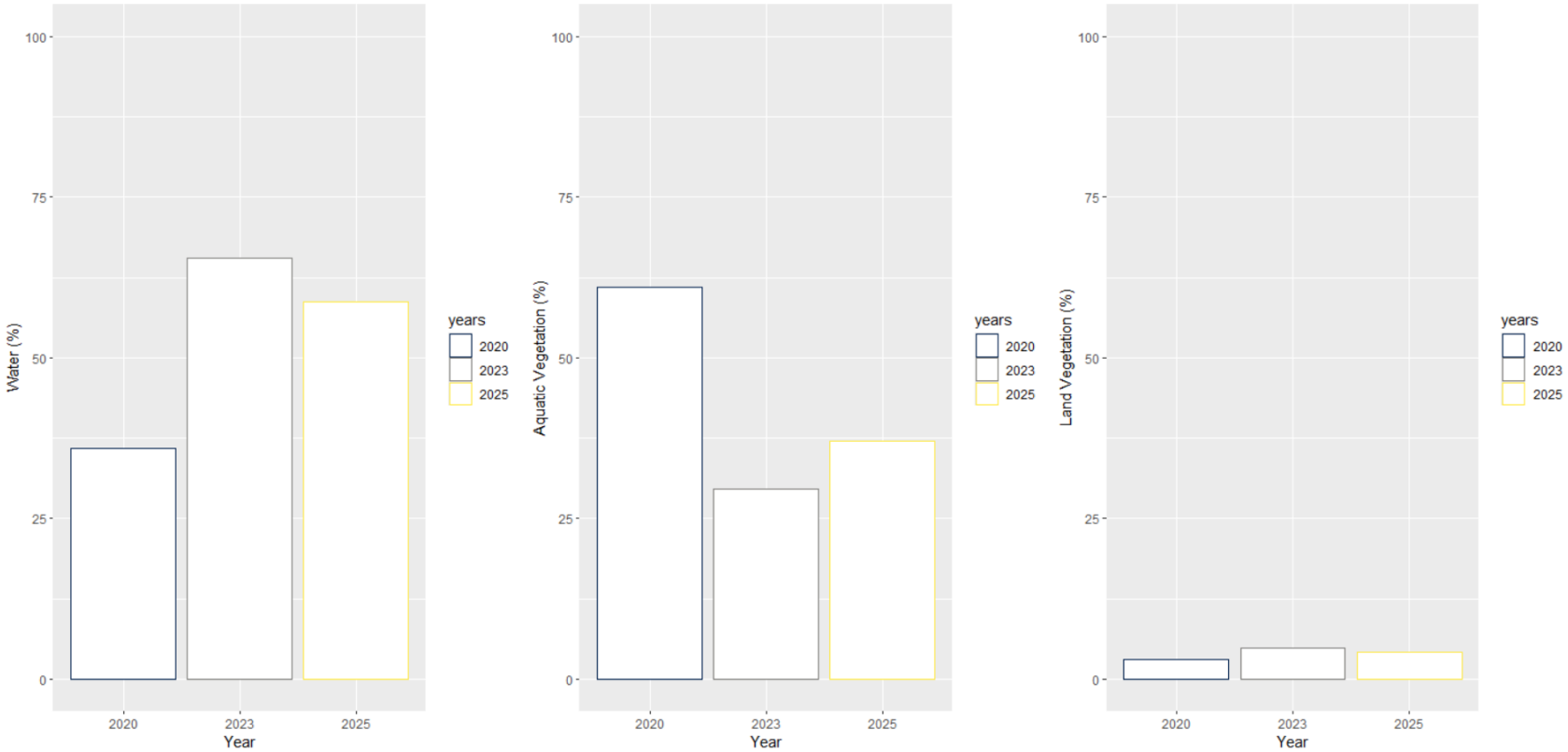
```
# classification
par(mfrow=c(2,3))
cl_rbn_20_NDAVI <- im.classify(rbn_20_NDAVI, num_cluster=3)
cl_rbn_23_NDAVI <- im.classify(rbn_23_NDAVI, num_cluster=3)
cl_rbn_25_NDAVI <- im.classify(rbn_25_NDAVI, num_cluster=3)
```

Percentages of Covers for each Class

Data: tab

	years	water	a_veg	l_veg
1	2020	35.96	61.01	3.04
2	2023	65.54	29.59	4.87
3	2025	58.80	36.98	4.22

Surfaces Classification



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Conclusions

During 2020, the aquatic photosynthetic component was much more present than in the other two years, when it decreased by at least a third. This could be explained by a possible difference in water level in the last two years compared to the first, or by the presence of more turbid waters that masked the marine vegetation component.
Perhaps masking the terrestrial portion of the image, the part involving the island of Noirmoitier, would have provided more consistent data. The use of other indices such as WAVI (Water-Adjusted Vegetation Index) might be more appropriate in these cases, but it requires field studies to measure.

Outline

Websites

- https://browser.dataspace.copernicus.eu
- https://en.wikipedia.org/wiki/Bay_of_Bourgneuf
- https://www.earthdata.nasa.gov/learn/trainings/spectral-indices-land-aquatic-applications