Senti-water final demo

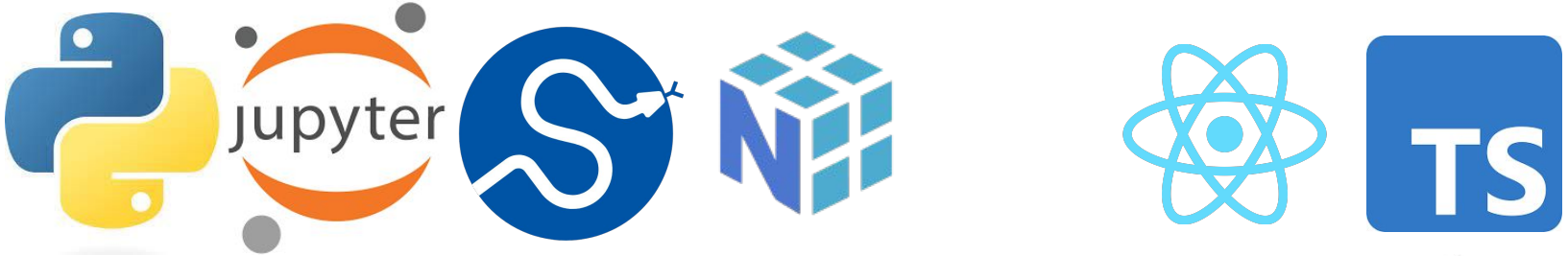
About the project

We have created a data analysis system that, based on satellite images, determines large water reservoirs in Poland and allows to save information about them in a database.

Our project includes:

- data processing pipeline which also allows to save data in database
- web application for viewing and adding information about water reservoirs

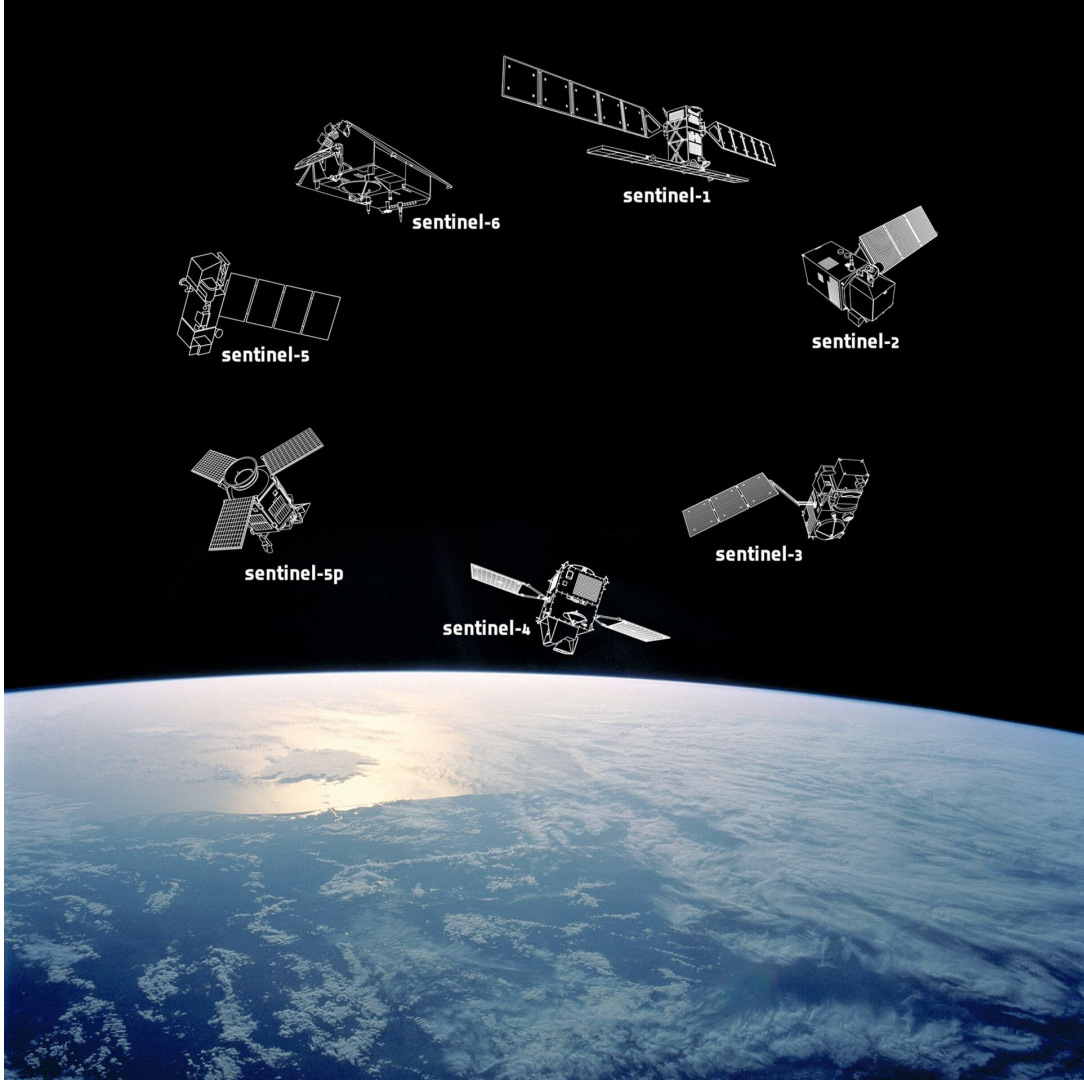
Technologies used in the project



About Copernicus programme

Copernicus is the European Union's Earth observation programme coordinated and managed by European Space Agency.

The program uses a group of Sentinel satellites, the images of which we process in our pipeline.



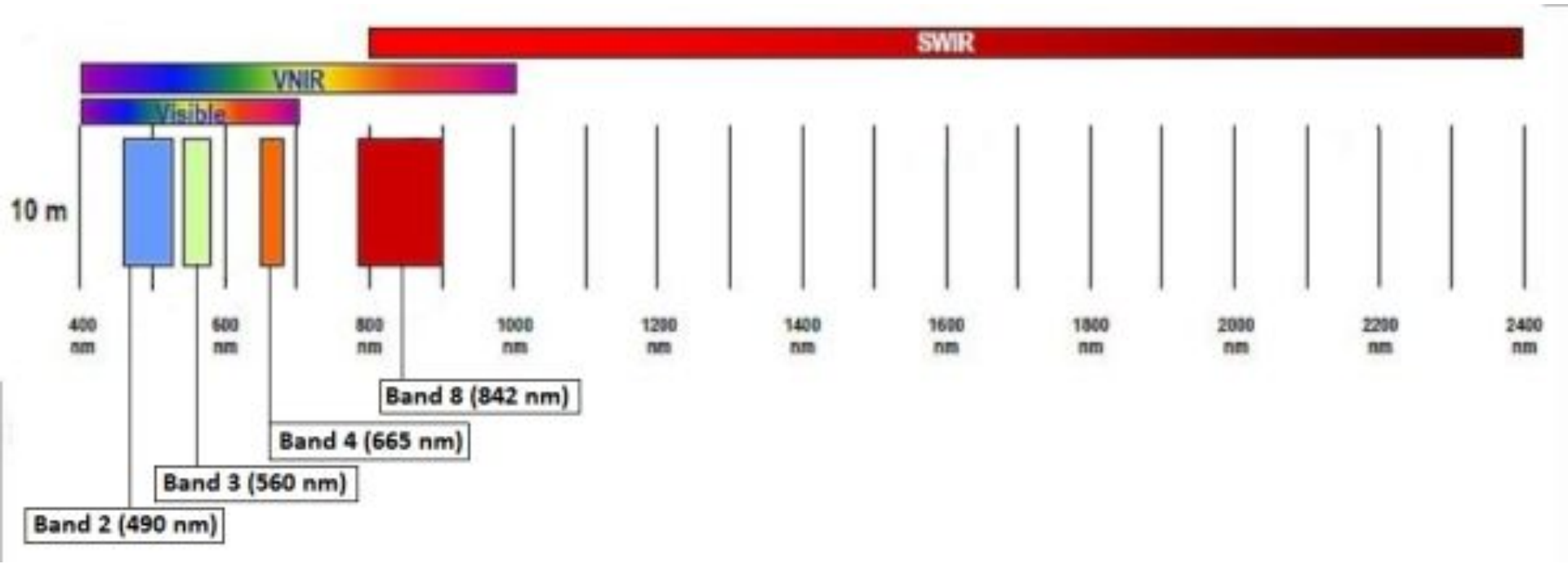
About the Sentinel

Sentinel is a satellite system with the task of making satellite data publicly available in different frequency bands. It gives images of Poland every 5-6 days.

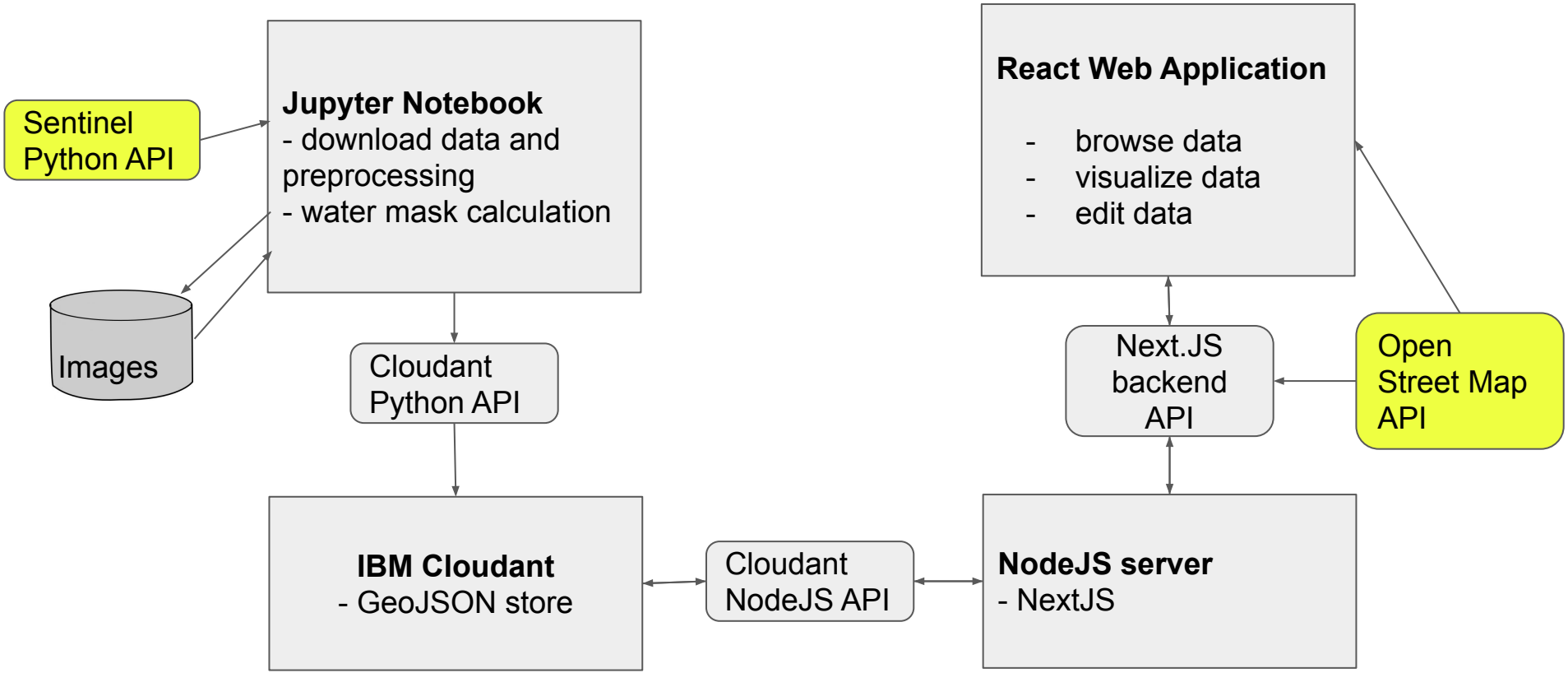
Sentinel-2

- SENTINEL-2 is a wide-swath, high-resolution, multi-spectral imaging mission, supporting Copernicus Land Monitoring studies
- Including the monitoring of vegetation, soil and water cover, as well as observation of inland waterways and coastal areas
- The SENTINEL-2 Multispectral Instrument (MSI) samples 13 spectral bands: four bands at 10 metres, six bands at 20 metres and three bands at 60 metres spatial resolution.

Sentinel-2 10 m bands

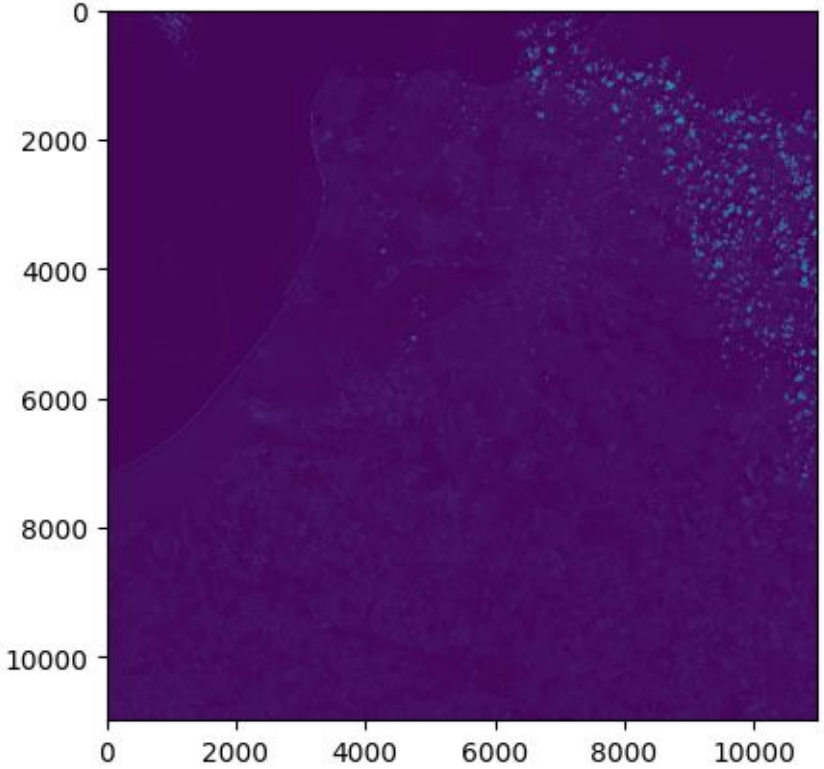


System architecture - data flows

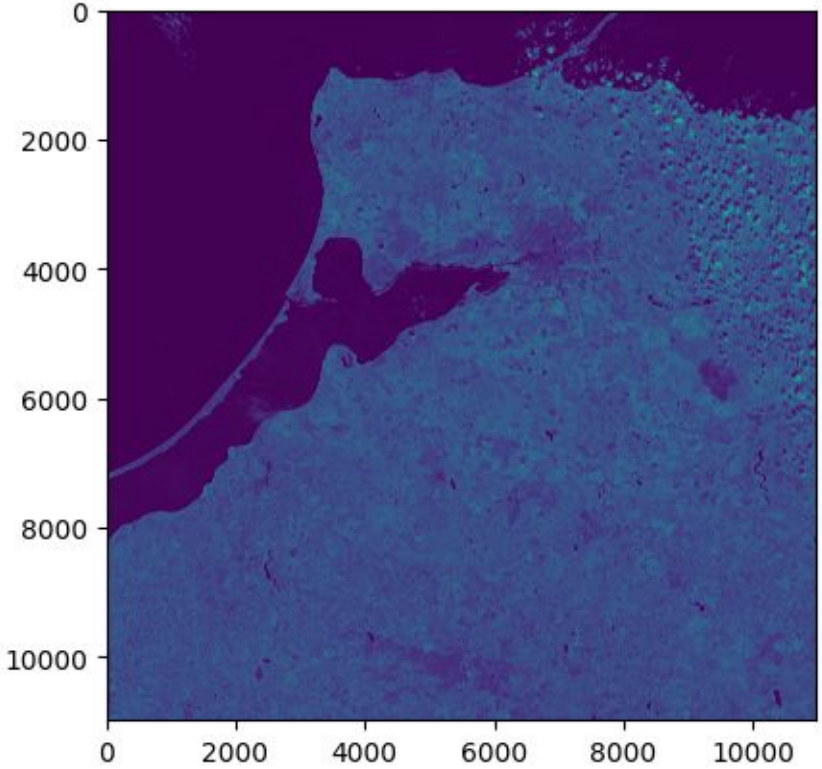


Preprocessing

BAND 03 (GREEN)



BAND 08 (NIR)



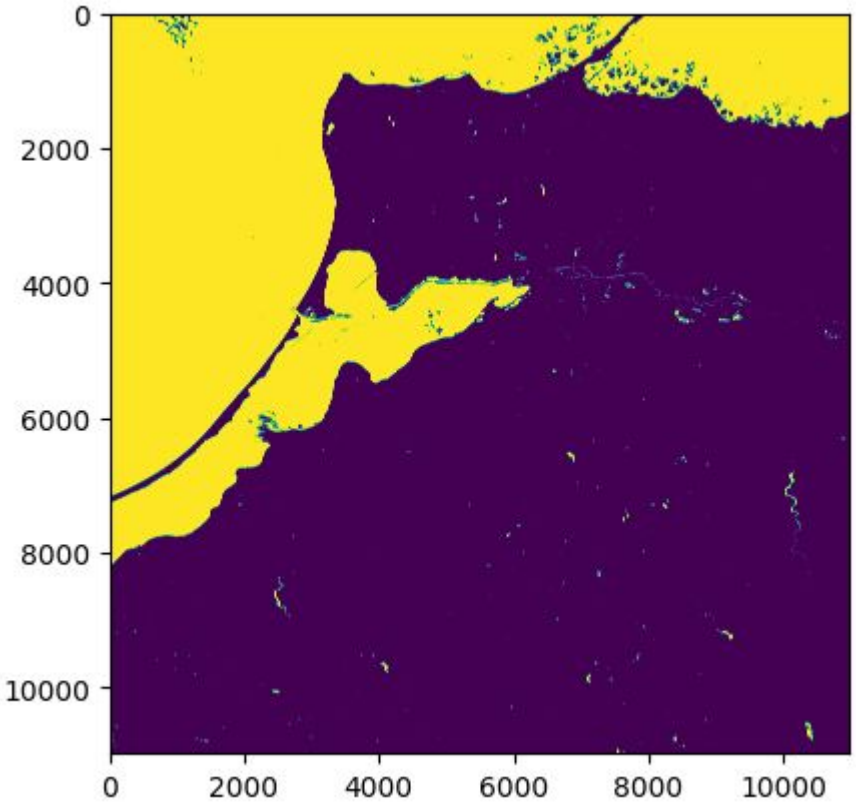
NDWI technique

$$\mathrm{NDWI} = \frac{(Xgreen - Xnir)}{(Xgreen + Xnir)}$$

NDWI - relative difference pixel value

X_{green} - pixel value in green band

X_{nir} - pixel value in near infrared band

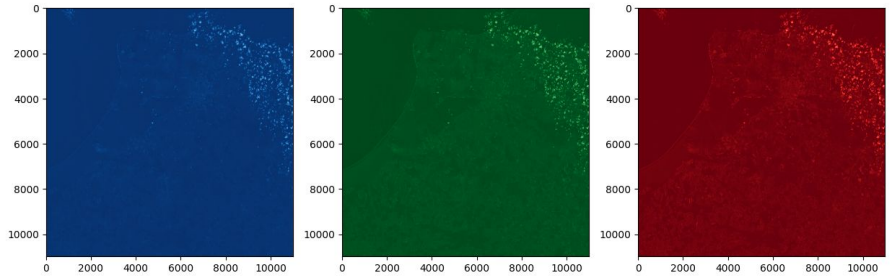


NDWI technique

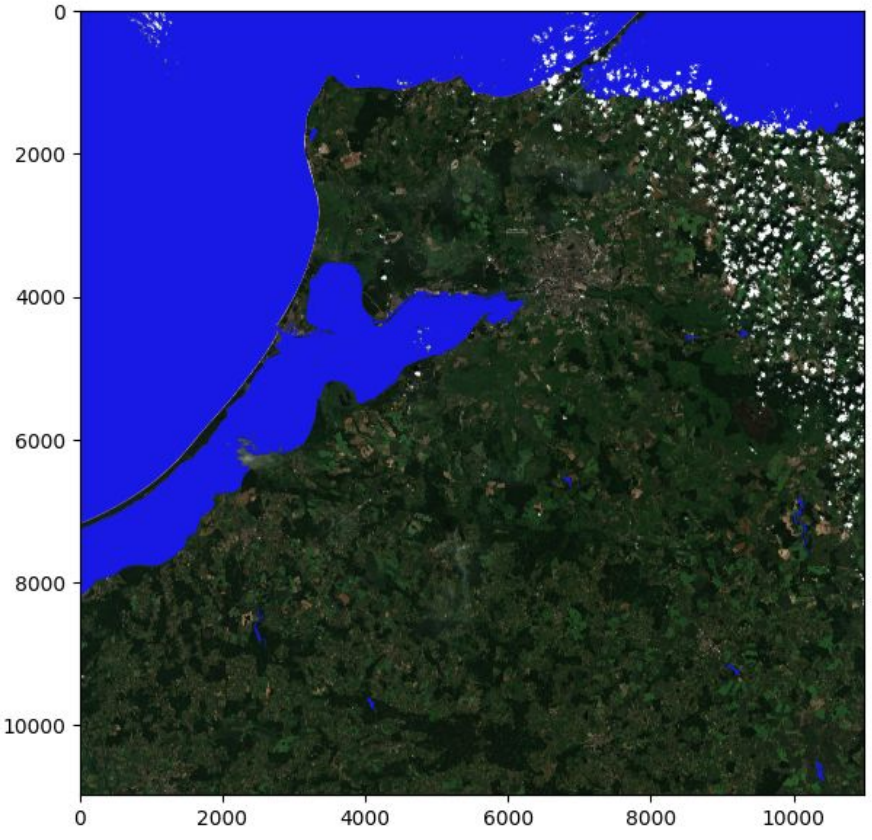
Green band maximize the reflectance of the water surface.
NIR band maximize the high reflectance of terrestrial vegetation and soil features, and minimizes the low reflectance of water features.

NDWI equation gives positive values for water features and negative (or small) for soil and terrestrial vegetation.

Color photo creation

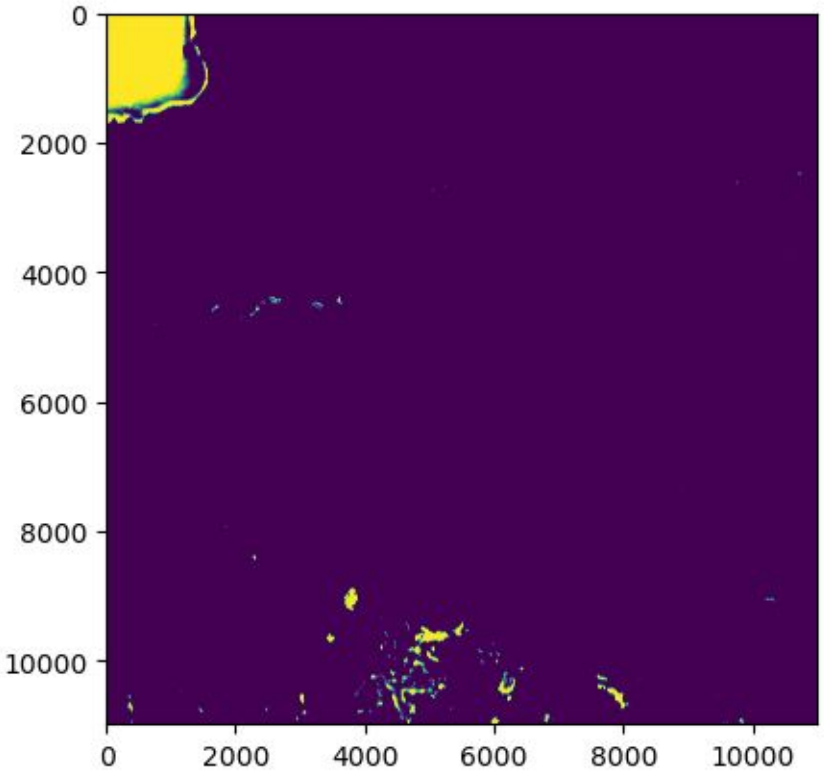


Water mask layer and cluster creation



MNDWI and its weaknesses

Modified NDWI (MNDWI) is an alternative to NDWI. During the implementation, we noticed that it detects water more accurately, but there was a problem with clouds - they were also detected. Due to the problems with the clouds, we gave up using it in favor of NDWI.


0
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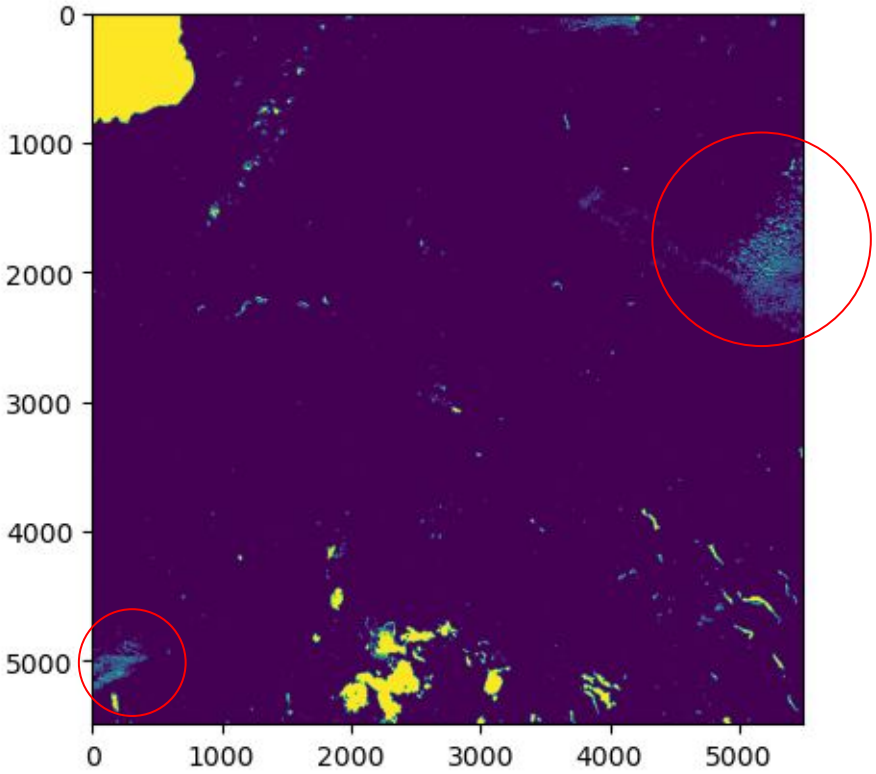
NDWI


0
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1000
2000
3000
4000
5000

MNDWI

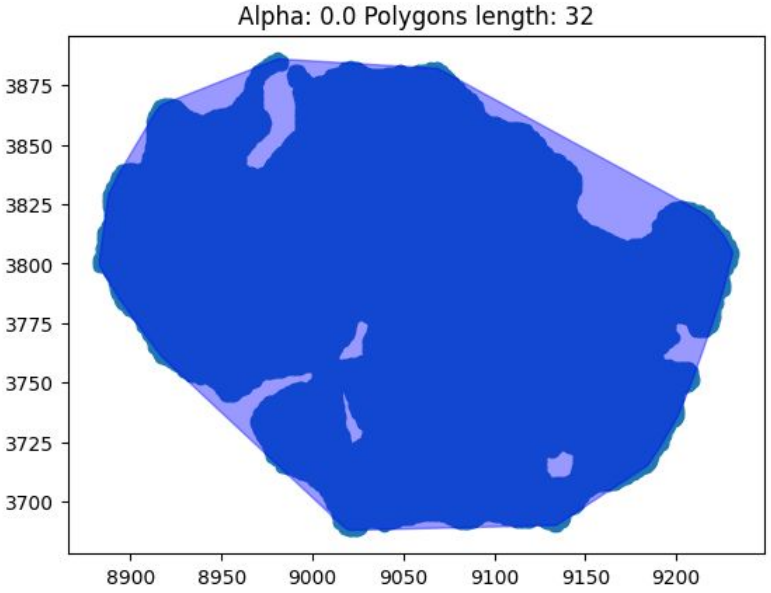
Clustering - why we chose convex hull?

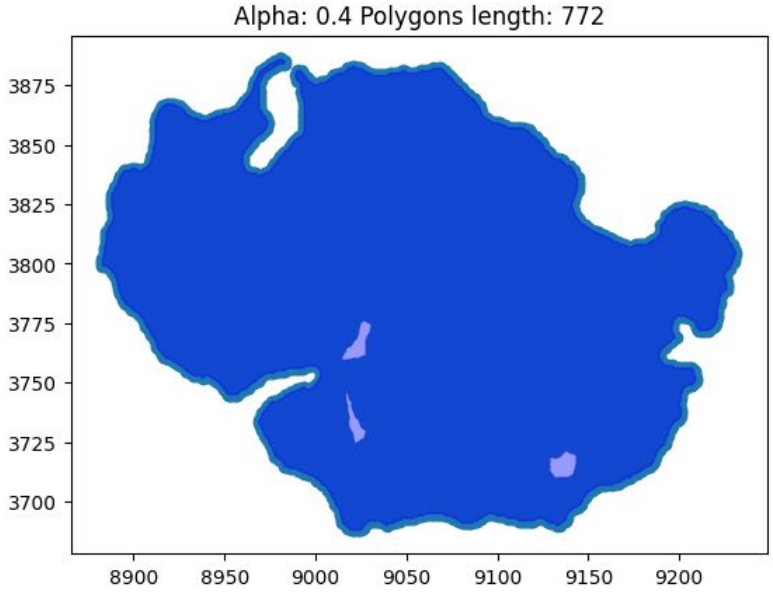
Convex hull

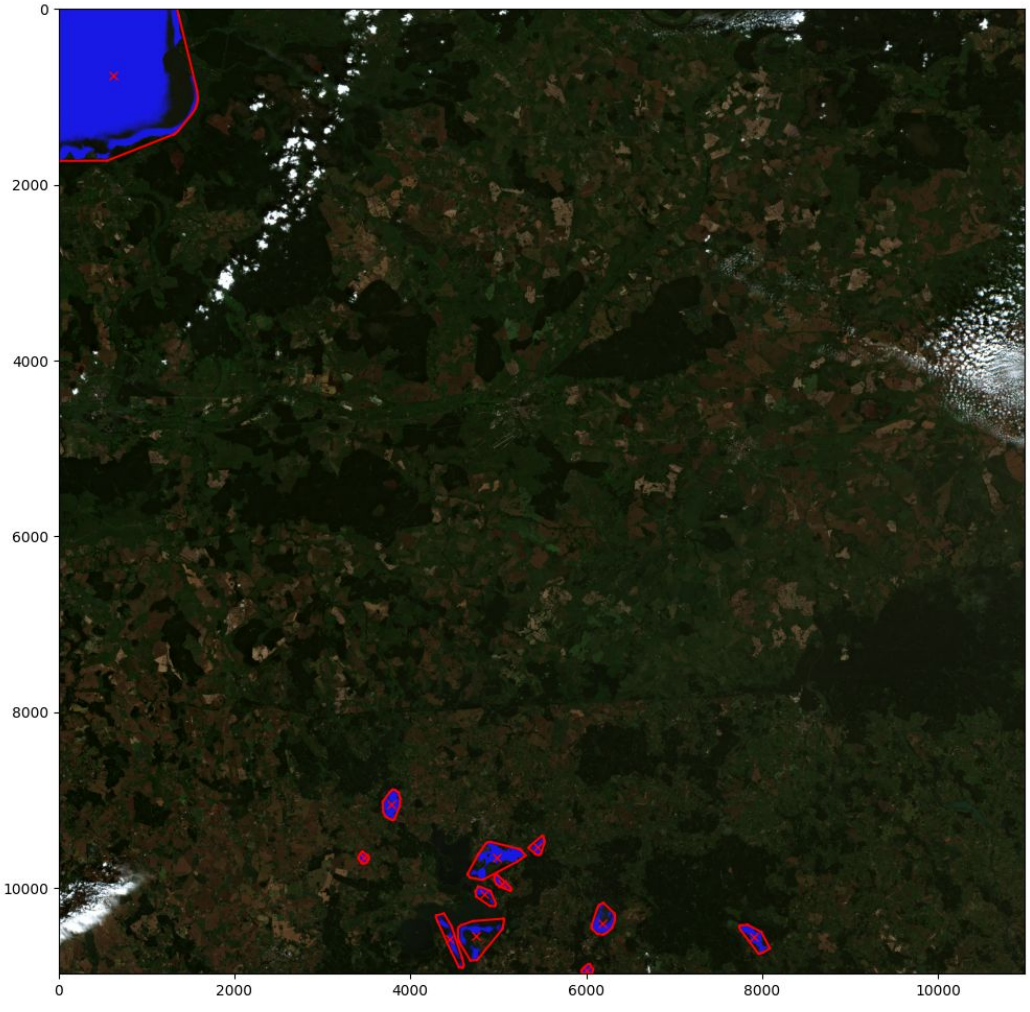
+ faster, less data in database
- less accurate

Concave hull

+ more accurate
- too slow, more data in database



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React application

Our application based on React.js allows users to search, view and change basic information about water bodies, such as name and description, surface area and coordinates of its centroid.

Its appearance was created as a result of using a library created by IBM - Carbon Design System.

Water bodies

Table ID	Name	Lattitude	Longitude	area (km^2)
1	some13	50.51204	23.74132	0.05808
2	malopolska_2022_108	50.30577	20.94359	0.25094
3	malopolska_2022_194	50.09881	20.79987	0.08062
4	malopolska_2022_283	50.048	20.84361	0.08247
5	malopolska_2022_460	49.86713	20.05126	0.74319
6	malopolska_2022_519	49.73742	20.6966	0.9357
7	malopolska_2022_525	49.71214	20.65303	0.10453
8	edited3	50.51204	23.74132	0.05808
9	test2	50.42072	21.32543	0.95372
10	malopolskie_set_2021_02323191261593	50.52698	21.59706	0.13694

Water bodies per page: 10 | 1–10 of 50 items | 1 of 5 pages

Details

Name

malopolska_2022_460

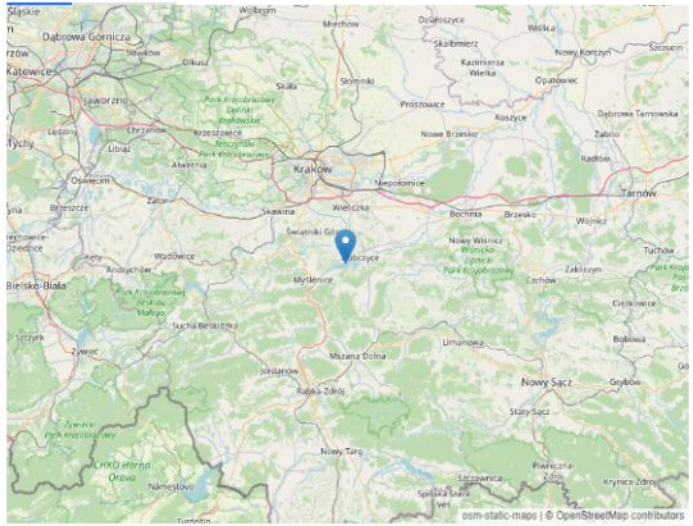
Description

Jezioro Dobczyckie

Cancel | Save

Centroid coordinates
49.867°N, 20.051°E
Surface area
0.7432 km²
Satellite data timestamp
2022-08-27 09:36:01
Polygon length
11

Big | Detailed



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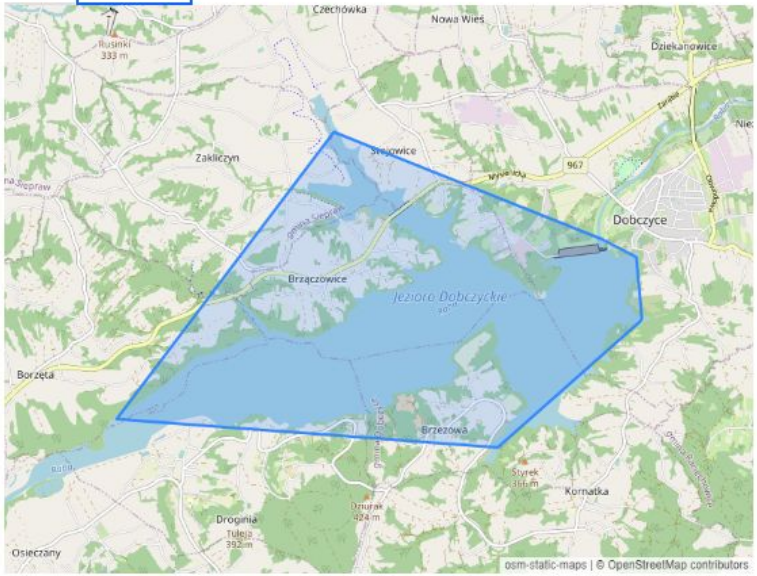
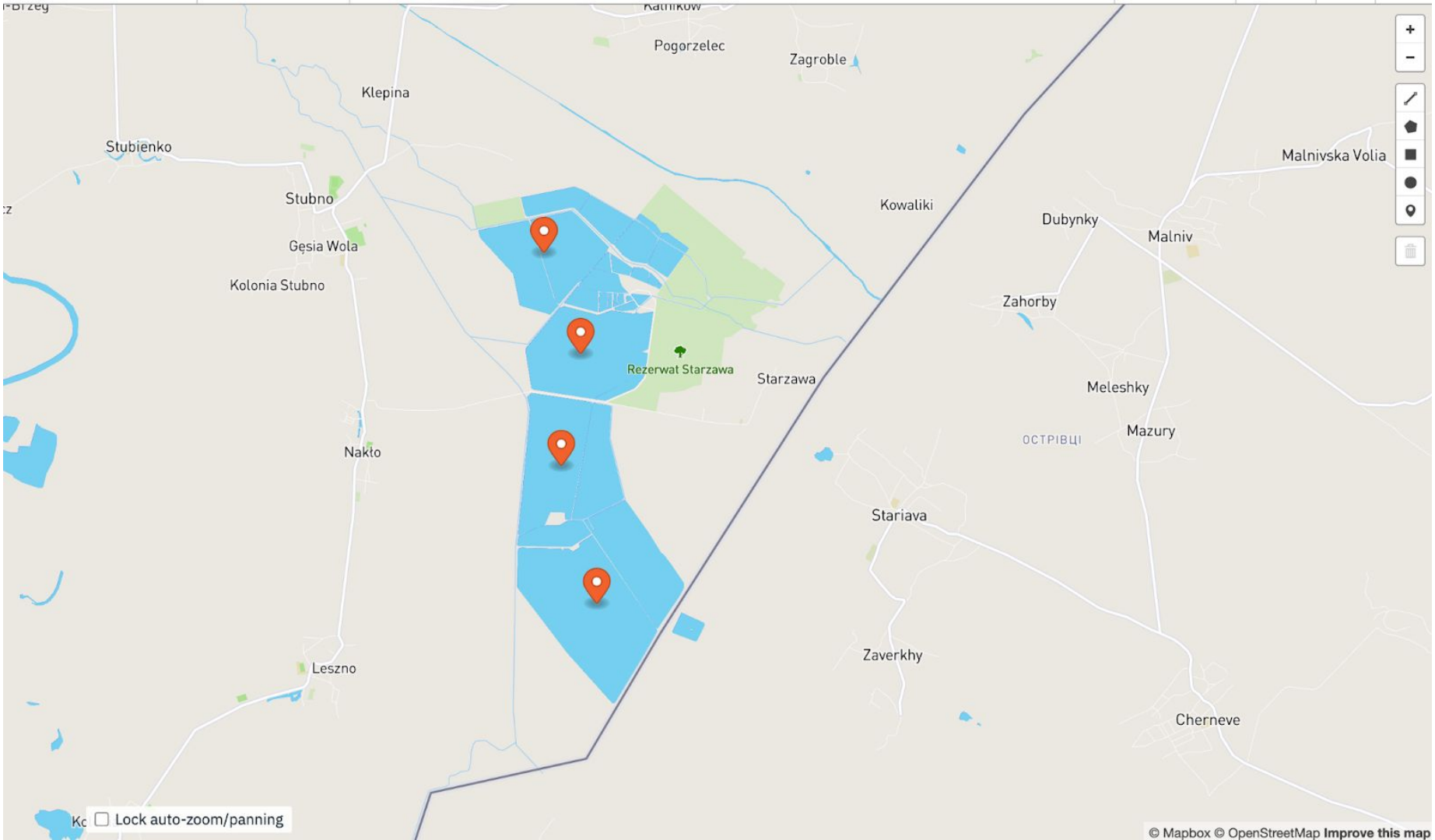
Big | **Detailed**




Pogorzelec
Zagroble
Klepina
Stubienko
Malnivska Volia
Stubno
Kowaliki
Dubynky
Malniv
Gęsia Wola
Kolonia Stubno
Zahorby
Rezerwat Starzawa
Starzawa
Meleshky
Mazury
ОСТРІВЦІ
Nakło
Stariava
Leszno
Zaverkhy
Cherneve
Lock auto-zoom/panning
© Mapbox © OpenStreetMap Improve this map

How our work looked like?

We worked in the AGILE system. We knew what we wanted to achieve in the project and what to focus on to implement it.

Together, we agreed that we would meet every day for short meetings - scrums, during which we would discuss what we managed to achieve, what we had problems with, as well as what we intend to do on a given day and later.

We set up sprints in which we planned what we wanted to achieve in a given week (sprint) and we tried to complete tasks on time

Every Monday we came to the office and we presented the effect of our work during demos.

What have we learned during the internships

- How big organizations organize work in software engineering projects
- Basic principles of Agile methodology
- Introduction to career building in IT
- Improved GitHub usage (Git, task management)
- Develop skills in problem solving, programming, teamwork, learning advanced concepts in software engineering and science
    - Image processing
    - Working with geospatial data
    - Working with external APIs
    - Javascript, ReactJS, NextJS, NodeJS
    - Python, Jupyter, numpy, scipy
    - Cloudant document DB
    - IBM Cloud

Our GitHub repositories:

https://github.com/rafalgrm/senti-water

https://github.com/rafalgrm/senti-water-ui