

Mission Space Lab Phase 4 report



Team name: WeEagles

Chosen theme: Life on Earth

Organisation name: Szkoła Podstawowa Nr 12 w Jasle

Country: Poland

1. Introduction

Our goal was to check the condition of forest areas, water bodies (oceans, seas and lakes) and the degree of cloudiness on the Earth with NDVI. The areas covered by vegetation are marked by higher NDVI values because they reflect much infrared radiation but relatively little visible light, compared to areas with no vegetation. Spectral reflectance for water is characterized by high absorption in the near, medium and far infrared - light reflection decreases from ultraviolet to infrared. As a result, water reservoirs can be easily detected and their boundaries carefully examined. Contaminated water has a higher reflectivity in the visible range than pure water. This dependence is also true for water with high chlorophyll content. That's why our measurements can be used to detect algae colonies as well as water pollution caused by for example, oil spills.

We've chosen this topic, because members of our team are keen on both geography and biology. We wanted to compare our research with results from professional satellites (e.g. Sentinel2) as well as investigate variation of forest areas and water bodies' condition. We expected results to be comparable with professional ones.

2. Method

In the experiment we used the NoIR camera. We took 213 images recorded on the SD card for further analysis. The file name contains timestamps. The names was recorded in the csv file together with other data (coordinates, temperature, humidity, pressure, magnetic field data, orientation, accelerometer. All daytime images were processed on board the ISS for NDVI and Color mapped. A Coral dongle was used to identify whether they were night or day images.

After submitting photos to the Earth we carried out further analysis.

It turned out that photos taken from the orbit contained illuminator and its case as well as a piece of wall, which caused wrong image processing in some cases. The crop and reprocessing of the photos on the Earth were needed. The percentage cloud coverage and vegetation areas was counted. The file used to reanalysis was put on GitHub along

with sample pictures.

<https://github.com/JadwigaM/WeEagles/tree/main/On%20Earth>

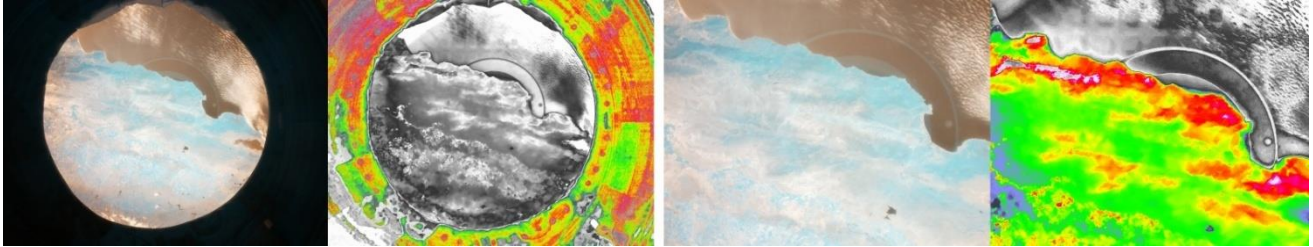


Figure 1: On the left original and processed color mapped during the mission photo, on the right crop of the photo processed on Earth.

3. Experiment results

Our experiment took place 24th of April in 2022. We got 213 photos therefrom 98 daytime photos.



Figure 2: ISS track during our mission.

At first we chose some of the most interesting photos and searched for their location using Google Earth. It let us pick the same areas from the databases:

<https://browser.creodias.eu/> (Sentinel and Landsat) and
<https://earthexplorer.usgs.gov/> (different satellites).

In comparison with Sentinel 2's photos, it shows that we were able to detect green areas reasonably well (Figure 3).

Bigger differences were seen in the cloud coverage checked for 10 years, however, huge cloudiness changes had occurred even within a few days (Figure 5). We coded a program to study cloud cover based on the detection of white pixels (similar values of R G and B). Its results are satisfactory (Figure 4), the only problem is the detection of sunlight reflections as clouds.

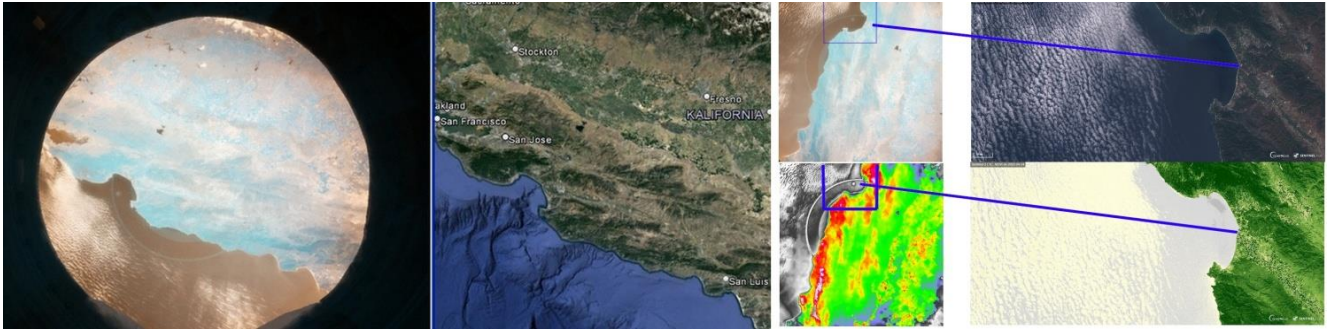


Figure 3: Our photos compared with the ones from Sentinel. Area between San Francisco and San Luis, California. From left: photo and position according to Google Earth, our photo (original and NDVI) of 24.04.2022, Sentinel photos (Visual and NDVI) of 24.04.2022

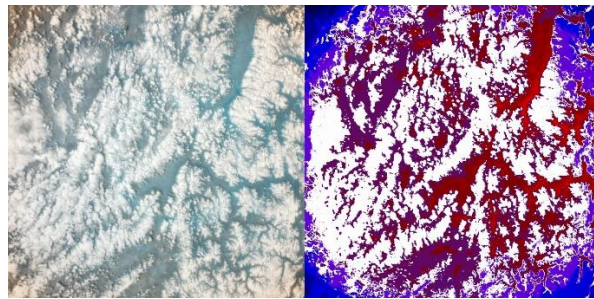


Figure 4: Cloud coverage. Original photo compared with colour mapped (clouds are white).



Figure 5: Changes in cloud coverage, source: <https://browser.creodias.eu>

Checking historical data shows there did not occur noticeable vegetation changes on the experimental areas.



Figure 6: Historical NDVI photos. Area between San Francisco and San Luis, source: <https://browser.creodias.eu>

Water pollution, detected by us, did not show the presence of chlorophyll (Fig. 7).

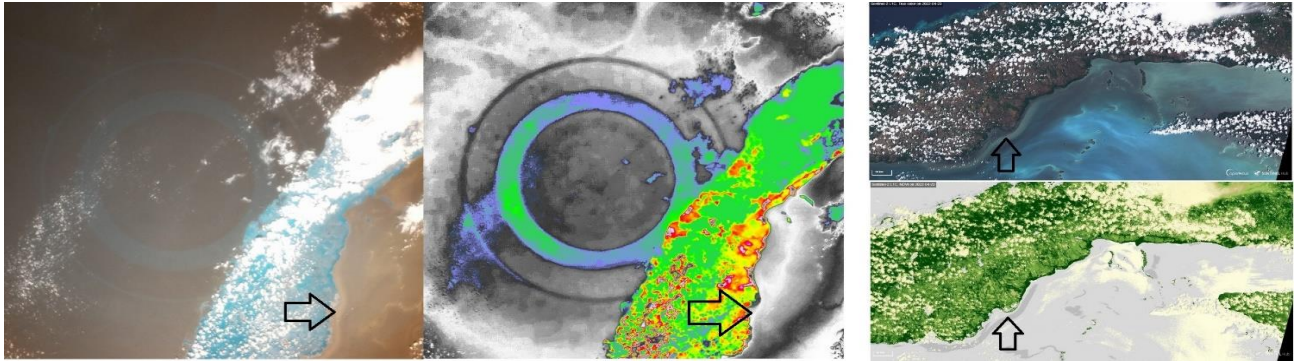


Figure 7: Western part of Cuba, by the southern coast pollution without chlorophyll is visible.

4. Learnings

Each member of our group is interested in different things, so we divided our work among us. Antoni focused on programming while the girls keen on biology and geography searched information and in the last stage they analysed obtained results. However, it is worth noticing that all the time we shared our just gained knowledge.

Although our research was more difficult because of switching to e-learning and no possibility of live meetings, we dealt with it by using different ways of online contacts such as Google Classroom and Messenger. The second problem that we faced was the difference between NDVI palettes applied in the Sentinel project and our experiment, as well as circular artifacts appearing on our photos. However, they didn't prevent us from drawing the conclusion. We found out that night time photos didn't show us any lights so we don't intend to take them during the next mission and pay more attention to daytime ones instead.

Huge benefits derived from the AstroPi project are: development of our teamwork especially during tough Covid times, learning the methods of analysing satellite photographs, broadening knowledge of English (especially scientific and technical vocabulary) as well as improving programming skills.

5. Conclusion

Working on AstroPi Mission Space Lab project was both great fun and study for us. We realised that we were able to carry out scientific experiments. Machine Learning module divided the night and daytime photos correctly.

In six areas being analysed (near: Sao Paulo — Brasil, Santa Cruz — California — presented in this report, Mexican Bay, Seattle — Washington state, Western part of Cuba and Santa Marta — Colombia) we didn't spot significant changes in the vegetation level. We noticed pollution of coastal waters and those from rivers, but through NDVI analysis we weren't able to detect algae colonies, probably those were sediments and other contaminants carried by the water. The degree of cloudiness was characterized by strong variability, so it was hard to interpret our results — observations had to be made for a long time and the results were averaged.

Working on this project made us really happy and we are looking forward to the next 2022/2023 edition.