



Mission Space Lab Phase 4 Report

Team Name: Greta in the Space

Chosen theme: Life on Earth

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Introduction

During our experiment, we wanted to see whether we could individuate plastic islands in the oceans.

When plastic enters the oceans, more than half is less dense than water, so it doesn't sink. Plastic is very resistant and it can be transported over extended distances by converging currents and finally accumulating in "islands" [\(1\)](#).

Those islands are very big, one of them, *The Great Pacific Garbage Patch*, situated in the Pacific ocean, covers an estimated area of 1.6 million square kilometres, an area three times the size of France [\(1\)](#). Despite this, such islands are really difficult to locate from the space, because plastics are very small and scattered.

By researching information in internet, we have individuated a range of coordinates where those islands approximately are [\(3\)](#). Unfortunately, they are not stationary, and move across the oceans changing form and size due to currents and winds.

To individuate plastic, the NDVI index can be useful to calculate the quantity of infrared rays that is reflected in a single pixel of the photo. This index is specific for detecting healthy vegetation, but it was also used to individuate plastic in coastal water by Biermann et al. [\(2\)](#)

Method

In the first phases of the challenge we wrote code for RaspberryPi "*Life on Earth*" to take pictures of Earth surface every 13 seconds.

For each photo, we also collected latitude, longitude, timestamp, magnitude, temperature, humidity and gyroscope. We saved the data in a CSV file.

Once we received data and photos, we analyzed them:



- First, we made a manual analysis of photos, searching if plastic islands were visible in photos taken at coordinates where plastic is supposed to be present (3).
- Then, for more accurate results, we used Python code to analyze the photo: for each pixel, we calculated the value of the NDVI index and produced another picture with a map of the index, taking inspiration from Biermann et al (2)
- We also saved the average NDVI value to a csv file

We ran the code on photos at different coordinates, specifically in zones where we know there isn't much plastic (Middle of Pacific) and compared the results with zones where we suppose there is plastic, like North-pacific (1)

Code and data are available at

github.com/CoderDojoTrento/astropi-19-20/tree/master/gretainthespace

We put on Umap the ISS route:

umap.openstreetmap.fr/en/map/astropi-2020-greta-in-the-space_460915#2

Results



photo 427: the zone of interest is highlighted	photo 427 detail: a grey spot is visible where we think there is a plastic island
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First we found a photo that could have a plastic island, for these reasons:

- the photo shows a zone in the North Pacific ocean at the coordinates (31.114 N; 179.778 E), near the biggest known plastic region called the Great Pacific Garbage Patch, located roughly between 135°W to 155°W and 35°N and 42°N. (3)
- it isn't an island reported on the maps; in fact, after searching on Google Earth, we have not detected any islands at those coordinates.
- We thought it could be a cloud because there are many, but in all photos clouds are represented either with small white dots, or white-grey larger spots. Moreover, the grey spot we have individuated is under the clouds, so it should be something at sea-level.



We then tried to calculate the NDVI index on this photo, and made a comparison, but the results aren't relevant, because the clouds also have high reflection in the infrared.

All photos present lots of red spots for the clouds, and a red zone for light reflection of ISS porthole.

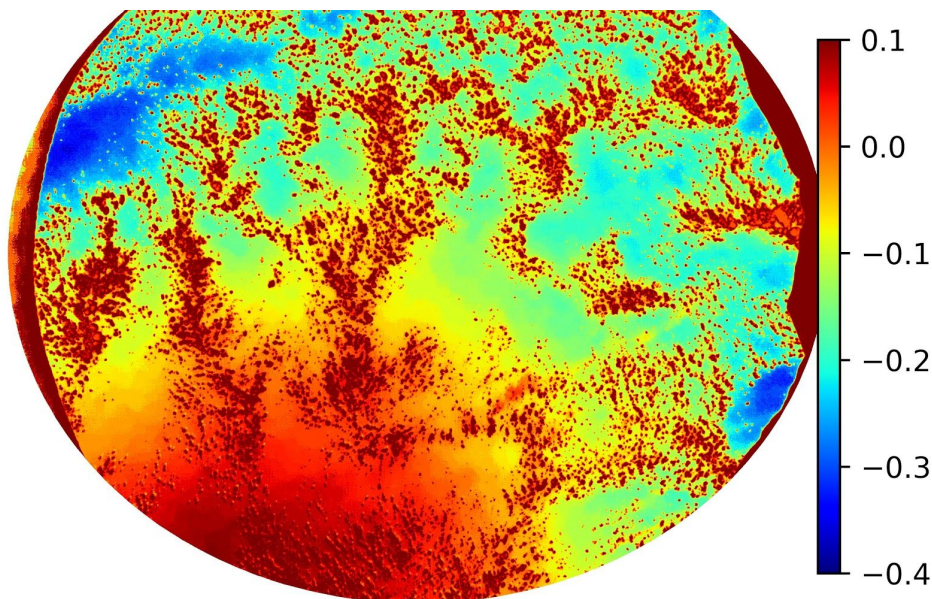


Photo 427: as said above, it is a zone where we suppose there is plastic

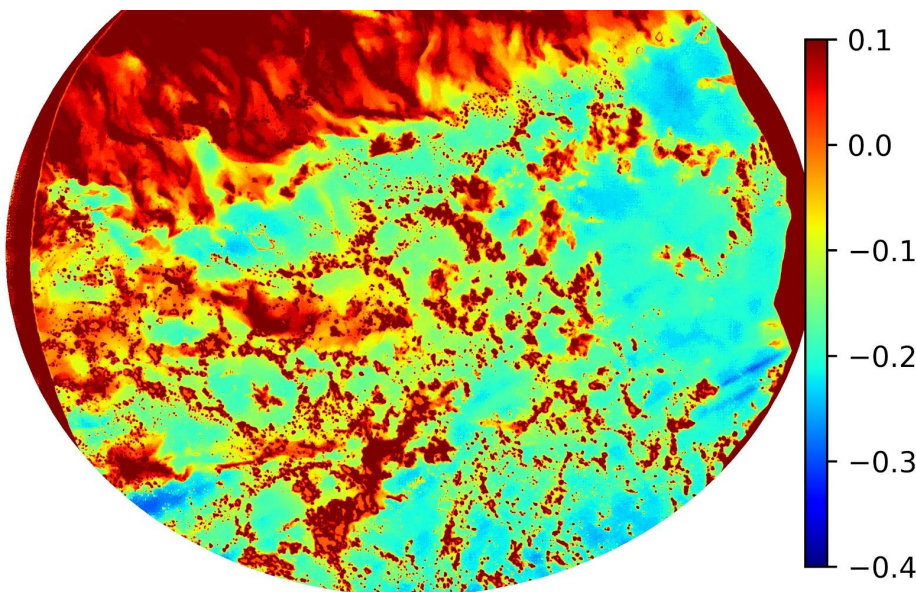
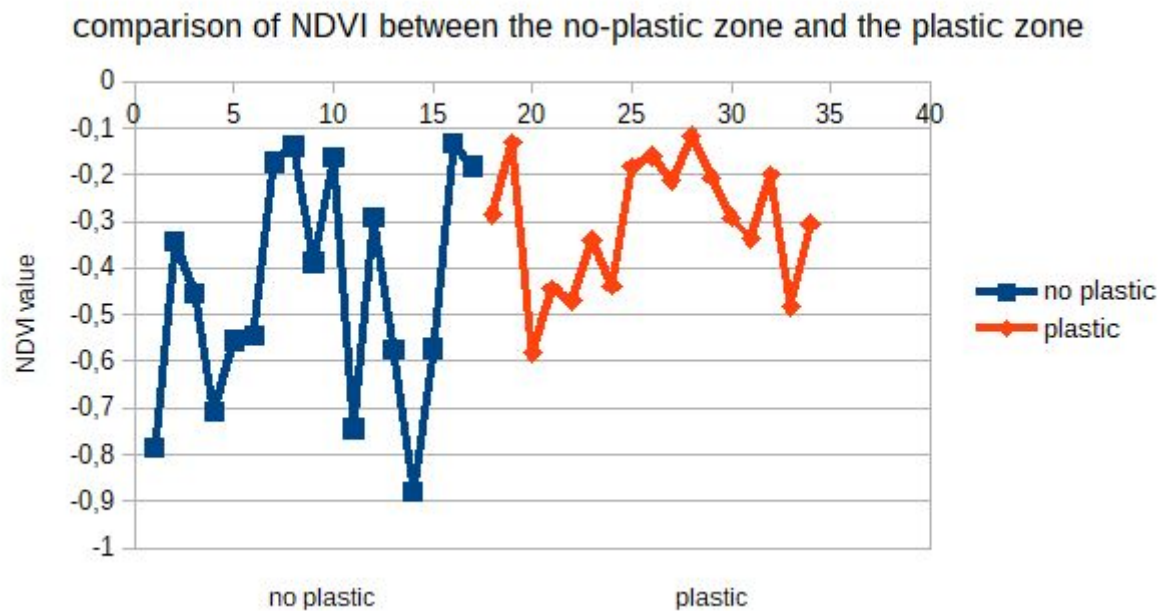


photo 510: should be a zone without plastic, but the clouds don't allow a precise comparison

To avoid the cloud problem, we cut 34 cloudless areas from "plastic" and "no-plastic" photos; the "plastic" photos were taken in the North-Pacific near the Great Pacific Garbage Patch (175°W, from 33°N to 22°N) (17 cuts) and the "no plastic" in the South-Pacific (165°W, from 21°N to 17°N) (17 cuts). we plotted its average NDVI of each area:



In some no-plastic photos the average NDVI is lower (less infrared ray) than in the plastic photos: the total average of NDVI in no-plastic is -0.46 and in plastic is -0.30, higher.

Conclusion

Unfortunately, the ISS hasn't flown over The Great Pacific Garbage Patch, so we couldn't individuate it and calculate the NDVI. Also, the ISS hasn't flown over other zones where other plastic islands are concentrated, like South Pacific and Indian Ocean. So, we only had a zone in North Pacific that could be analyzed.

Finding photos that could be interesting was very difficult. We suspected a grey spot in photo 427 could be a real plastic island, but there were many clouds so we couldn't confirm the hypothesis. After many attempts we decided to focus on calculating the average NDVI for cloudless areas of selected pics from zones with supposedly more plastic and zones with supposedly less plastic. The graphs and the two total NDVI averages show us that in the "plastic" photos there are more infrared rays. This could be a sign of plastic islands presence, but we are not 100% sure, because the sea foam and seaweed have high NDVI too.

References

- (1) <https://theoceancleanup.com/great-pacific-garbage-patch/#content-tabs-panel-77373-2>
- (2) <https://www.nature.com/articles/s41598-020-62298-z>
- (3) <https://latitude.to/articles-by-country/general/337/great-pacific-garbage-patch#:~:text=GPS%20coordinates%20of%20Great%20Pacific,Latitude%3A%2038.0000%20Longitude%3A%20%2D145.0000>