Mission Space Lab Phase 4 report outline

Team name: FiatLux

Chosen theme: Life on Earth

Organisation name: Biskupské gymnázium a mateřská škola Brno

Country: Czech Republic

1. Introduction

In our project, we initially wanted to focus on identifying the properties that change the colour of the oceans. However, because we had few photos of the oceans or they were almost always covered by clouds, we decided to choose other photos and try to find something interesting about them.

We managed to get many nice photos of South America, so we did both of our explorations on these photos.

The first exploration was of salt lakes in the Argentine deserts. We were interested in the white areas that represent salt pans where salt is mined. These salt pans are directly related to the second investigation.

In the second investigation, we analysed a photograph showing how the clouds do not reach the interior with rainfall because of the high Andes, which leads to drying, higher salt concentrations in the lakes and the formation of salt pans. Both surveys and photo analyses are described in detail in the Experiment results section.

We find it very interesting how a factor such as a high mountain range can affect the climate and conditions in such a large area, in our case in the west of Argentina.

2. Method

For our investigation we utilized a visible light camera. The Skyfield library helped us locate the ISS and determine if it is on the bright side of the Earth or not. We took photos every 17 seconds during sunlight and every 23 seconds in dark. These timings were determined based on the previous year's photo sizes, as we had a 3 GB data storage limit. We collected 1.9 GB of photos at a resolution 4056x3040, including EXIF data for location.

We used machine learning directly on the ISS with our trained Coral model. While our neural network sometimes struggled with distinguishing between land and ocean, it performed well in dark areas.

Image 31: Our model determined this being 88.28% ocean.

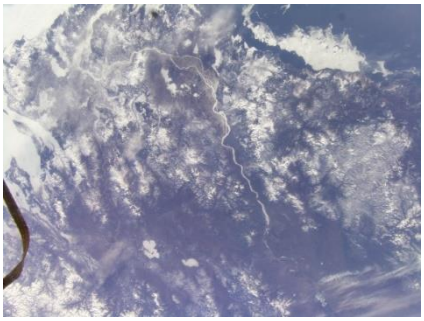


Image 308: This image was determined to be 99.6% ground.

We also created a data.csv file that included location, time, sunlight conditions, ISS elevation and Coral model decisions. To organize the images, we developed a program that sorted them based on the Coral model decisions.

To investigate our findings, we compared the photos with historical satellite images from Google Earth and used Ventusky for cloud and weather data. Our GitHub repository (https://github.com/NewtonWasTaken/FiatLux) contains the main code and additional code for our project.

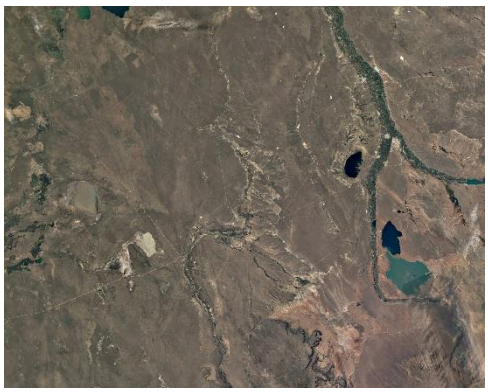
3. Experiment results

Due to the lack of photos of the ocean surface, we had to decide to change our initial plan. So, we will show you a few photos that best demonstrate our findings.

In this photo you can see a picture of the desert in western Argentina with several salt lakes. These salt lakes, along with the surrounding salt pans, periodically dry up and leave a salty coating on the ground until they re-water. Comparing photos from previous years, we could notice that the re-watering of the salt lake occurs, each year later and to a lesser extent. Due to this phenomenon, the salt lakes become more concentrated and contain less water. These phenomena are mainly promoted by more evaporation than by the accumulation of water from rainfall.

In the photo we can also see on the right side a couple of lakes with river inflow and form an interesting contrast between river and saline lakes[1].

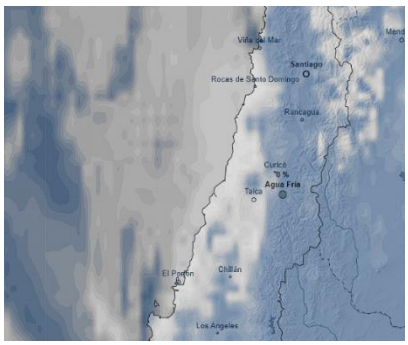
Image 162: On the left side you can see Salitral de la Perra (the brown one) and Lago Salinas Grande (the white one).



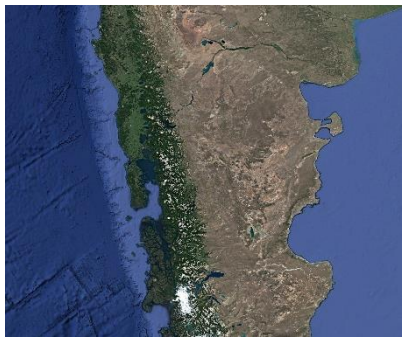
Google Earth 1984: You can see that the lakes contain much more water than nowadays.

Next, we analysed a photo that shows us how the climate works in the south-central part of South America. On the western side, South America borders the Pacific Ocean. From this, the coast receives a lot of moisture and rainfall that makes the area a rainforest. However, the Andes form a natural barrier that prevents moisture and rainfall from penetrating inland. This is the so-called rain shadow. The clouds rise to a high altitude, where they cool and dry out. Inland, the climate is very dry, which has given rise to our salt marsh. In the photo you can see perfectly how the rainfall hits the Andes and does not penetrate further inland. The second image is from Ventusky[2], where we can see the rainfall on the radar. The third image is just to compare the difference between the two sides of the Andes[3].

Image 158: From our photo we can clearly see that the clouds are stopped by Andes.



Ventusky: Here we can see that the rainfall is stopped by the Andes on the radar.



Google Earth 2023: You can see Andes on the left side of South America, and the desert on the right side.

[1] *Wang, Jida; Song, Chunqiao; Reager, John T.; Yao, Fangfang; Famiglietti, James S.; Sheng, Yongwei; MacDonald, Glen M.; Brun, Fanny; Schmied, Hannes Müller; Marston, Richard A.; Wada, Yoshihide (December 2018). "Recent global decline in endorheic basin water storages". Nature Geoscience. 11 (12): 926–932.*

[2] *www.ventusky.com*

[3] *Whiteman, C. David (2000). Mountain Meteorology: Fundamentals and Applications. Oxford University Press. ISBN 0-19-513271-8.*

4. Learnings

After entering the competition, we participated in the AstroPi Hackathon in our city, where we formulated our plan and prepared to work together. We also experienced working under pressure, dividing the work and presenting it.

Then we created a Discord server and a Trello board where we assigned work and communicated. In the second phase, we set up a GitHub repository and started designing the main program. We learned how to search in Python libraries documentations and find materials to create the Coral model. About it, we found that it would be better to work with a larger dataset of photos for better results.

In the last phase, we faced some problems like changing the original plan or time pressure. Eventually we managed to overcome them by finding a good alternative and getting the team to meet more often, mainly by preparing at the Hackathon. We learned how to search for verified information and the ability to process it into a factual text. In the future, we know what to expect from the photos and can adjust our plan accordingly. This project was a good experience for us where we learned a lot.

5. Conclusion

At the beginning, we made a plan together, then wrote the code and created our own machine learning model. We sorted the photos using our additional code and since we didn't have much luck, we had to change the initial plan.

Even though we were not able to process our project the way we originally wanted to, we were able to discover the decreasing levels of the salt lakes in western Argentina with a few photos. By examining photos from Google Earth, we were not only able to see that the salt lakes in this part of the Earth are regularly evaporating, but we were also able to capture the gradual decline in the volume of these lakes over the last decade. The natural rain shadow of the Andes, which we have also captured, and the climate change, caused mainly by negative human actions, are certainly contributing to this.

Through this project we have improved our teamwork and the ability to compromise. We learned to create our own Coral model and developed our programming skills.

Next year we would improve our machine learning model and generalize the topic of the initial plan to give us more options.