Mission Space Lab Phase 4 report

Team name: Asteria

Chosen theme: Life on Earth

Organisation name: [Redacted]

Country: [Redacted]

See the code on GitHub/apollo-1845

1. Introduction

As this is our second year in the competition, we have come back with a refined perspective, and better understanding of what we set out to achieve. This year, we aimed to investigate vegetation levels using NDVI values and compare these against population density and temperature at the measured locations. We also aimed to investigate how the GDP of countries would affect the vegetation levels. We expected to find that vegetation would decrease over more heavily populated areas such as cities. We also thought that lower GDP countries would have lower vegetation levels as there is less pressure for developing countries to consider the effect they have on the environment. We found this topic particularly interesting as we were excited to see just how much of an affect these factors have on vegetation and how much this agreed to what is spoken about so much in global discussions. We were also keen to see how urbanisation affects the natural world first hand by creating a 3D map with our colour coded NDVI results displayed.

2. Method

We decided to measure the NDVI values of various locations around the planet, as we deemed that this was the best way to gain an accurate assessment of the levels of vegetation in a region. We did this using a Raspberry Pi camera without an NIR filter, so that we could receive images that essentially showed us the health of plants, through the ratios of light wavelengths emitted. While on-board, we took

pictures every 5 seconds, and recorded the position of the ISS into a text file using the skyfield library. To optimise our algorithm, we decided to post-process the results on earth, without any kind of processing onboard the craft. When we received our results, we wrote our own algorithm for 1) converting the images into NDVI images and 2) gathering an average NDVI value for each image, which we then outputted into a text file. We used this, alongside the location (latitude and longitude) data to plot our results in an excel 3D map, to produce a 3-dimensional heatmap of the NDVI values, where red represents extremely high levels of vegetation (>0.7), and blue represents cloud or ocean (negative NDVI). This code is available on our GitHub repository.

3. Experiment results

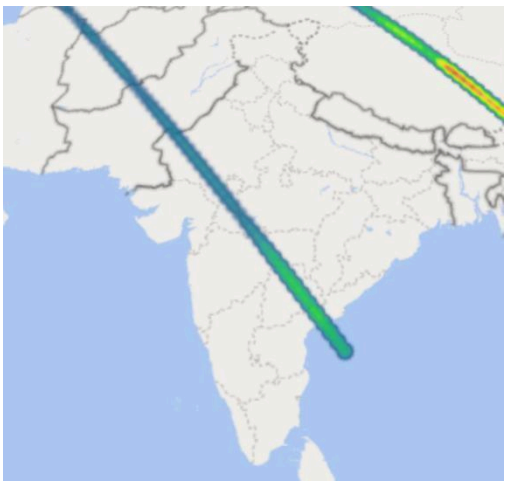
We plotted our results in a 3D heatmap of NDVI values across the planet. We were able to capture images covering significant amounts of landmass, resulting in wide and varied data.

In this section, we will be focusing on the following regions: Central Europe, India, and Australia.

Central Europe

As can be clearly seen, there is a large red region in the centre of the continent – which is unexpected, due to the severe urbanisation present there. We suspected that the economic development of these countries is the reason for such high vegetation levels. Germany and Poland both have high vegetation levels despite their large populations of 83.2 and 37.75 million. This, together with their high Human Development Indices of 0.876 and 0.942 respectively, helped us to develop a hypothesis that higher HDIs corresponded with higher vegetation levels.

India



Although India has a large populace, we found that the vegetation levels were unexpectedly low for such a rural location (70% of India's population live in rural areas). Thus, we considered development, and found that, together with the

significantly hotter climate (which could inhibit plant growth during summer and late spring), India had a HDI of 0.633 – low in comparison to those of the European countries.

Australia

Looking at Australia, we found that the location of the Outback (rather unsurprisingly) significantly impacted the vegetation index, but where it was more populated and urbanised, the vegetation levels once again rose to high levels, greater than 0.8 in some places! We think that the position of these high vegetation levels corresponds to the more developed parts of Australia, which strengthens the idea that development is a factor in vegetation, as shown by the high and low HDI scores of the other two regions.

4. Learnings

One of the challenges was merging the code from the sub teams to produce a final product, but we learnt how to use Git and were eventually able to combine the changes from different branches easily. We stored our code and images on a GitHub repository, that everybody could clone to access and commit to.

We all improved our python skills and learnt how to analyse real-world data in a meaningful way, working with important libraries such as numpy, which are widely used in data science. The experience in using opencv to process the images, and the skills we learnt in the python file processing suite are likely to be extremely helpful.

It would have been nice to do more via code, such as plotting the graphs with matplotlib instead of using Excel afterwards, as this would help develop our Python skills further whilst familiarising ourselves with more libraries that get lots of use in the real world.

To work efficiently as a team, we created a discord server through which we set up regular meetings and discussions to determine the trajectory of the project and ensure that we remained on-course.

5. Conclusion

Firstly, we met in person at school straight away and were quick to set up a discord which allowed us to easily share ideas and meant we quickly agreed on a topic and divided the workload. Also, as a team we enjoyed deepening our knowledge of the incredible utility available in GitHub. Our results seemed to prove our predictions true,

most notably on how population density has a negative impact on vegetation as seen clearly through our results over India, a country with a well-known overpopulation problem. Our results also confirmed our idea that vegetation increases in countries with higher GDP. This is seen in central Europe and in better developed areas of Australia compared to the developing and overpopulated parts of India. It was very interesting to see just how much of an effect this seemed to have as even near Berlin in Germany our results showed high vegetation. In conclusion, the results of our experiments suggest that the overpopulation problem faced by most countries in the modern world decreases vegetation levels suggesting it is a factor leading to climate change and efforts made by developed country to combat this are not completely futile.