Mission Space Lab Phase 4 report



Team name: Team B

Chosen theme: Life on Earth

Country: [Redacted]

See the code on GitHub/apollo-1845

1. Introduction

Our team aimed to investigate the variation in concentrations of greenhouse gases around the world, and its potential correlation with various other factors, including population density, GDP per capita, and the number of vehicles in the area. This is a very important issue as the climate crisis becomes an ever more pressing issue. As our hypothesis, we expected to find that the concentration of greenhouse gases in areas with a greater GDP, population density, and number of vehicles would be far greater.

2. Method

We utilised the near IR camera to capture images of the greenhouse gases in the atmosphere below the ISS. We also recorded the location of the ISS in a text file whenever an image was taken, so that we could later cross reference and determine the concentration of greenhouses at each location. Most of the data was processed on Earth, as we only used our time on the space station to capture the images and location data, later detecting the total relative numbers of bright pixels in each image to obtain an estimate of the variation in greenhouse gases. An advantage of this method is that very little processing was required on-board the Raspberry Pi, so we just held as much data as possible – enabling us to save storage and computing power in space by post-processing on Earth instead. However, a disadvantage of our method (and most likely other teams as well) was that we were unable to get results

when it was night-time on earth. This meant that we ended up with a large number of missing images, that we could not use for post-processing (~50%).

3. Experiment results

The image below is a 3D graphic presenting the data points that we were able to plot, about greenhouse gas concentration around the world. Missing points are from potential sources of error, such as when it was night (applying our analysis to these would return 100% concentration, which is obviously incorrect).

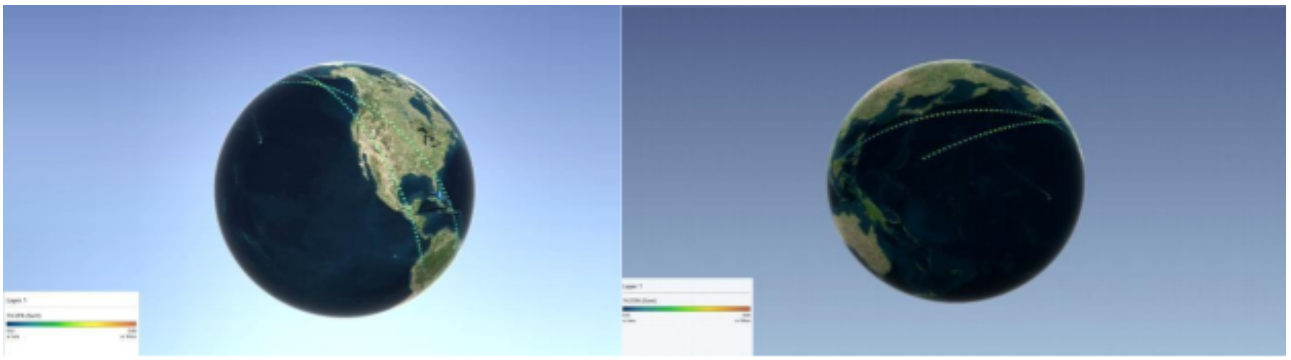


Figure 1: Two images that show stylised data points of the concentration of greenhouse gases in our environment. The key in the bottom left show that the colour changes gradually from blue to red (Lower to higher concentration).

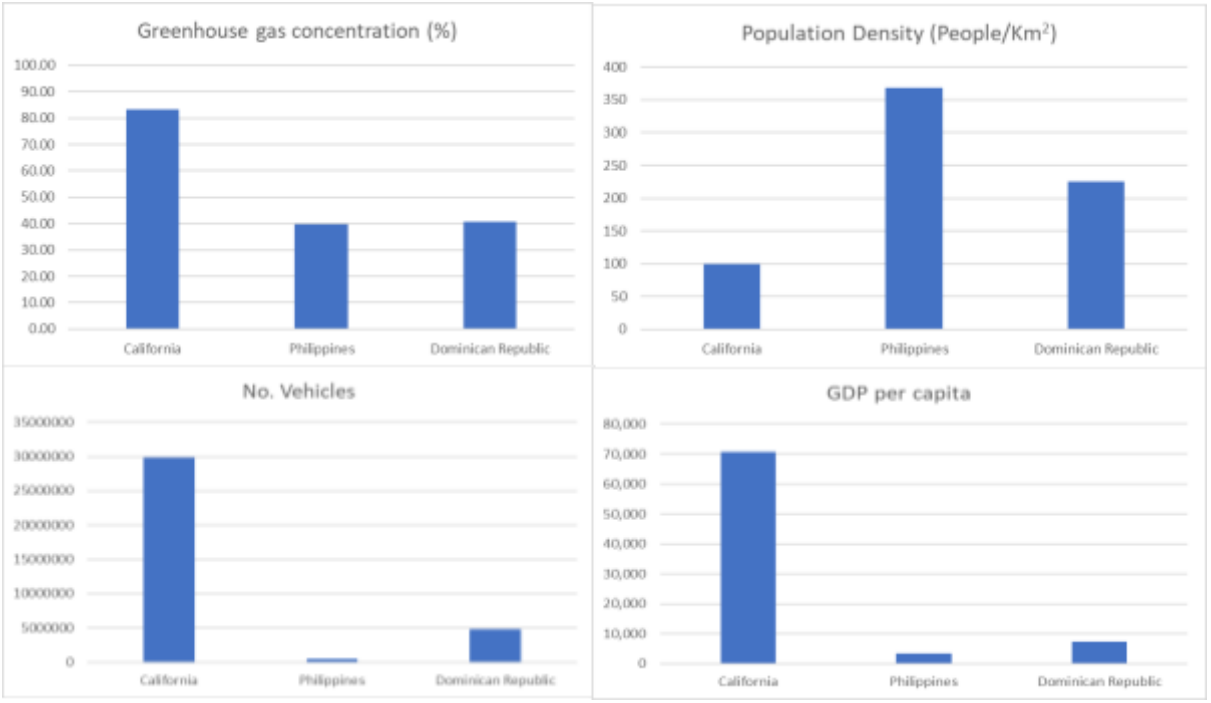
In order to best use our data, we decided to focus in on a few key areas around the world, in order to get a better understanding of the aforementioned factors on greenhouse gas concentration. We chose California/Nevada, the Dominican Islands, and the Philippines. This is due to the wide range of living conditions over these areas.

In the area of California/Nevada, we have found that the concentration of greenhouse gases is equal to 83.42%, which is one of the highest results in the neighbouring regions.

In the Philippines, we found that the greenhouse gas concentration was 39.65%, and was one of the lowest we recorded.

In the Dominican Islands, the greenhouse gas concentration was 40.84%, which was relatively close to the median of the area.

Using information sourced from a number of websites, we produced a number of charts depicting all of the factors we're studying here:



From this, we can determine that, even though the Philippines have the greatest population density, it does not appear to have any impact on greenhouse gas concentration in the air, while the number of vehicles in the area and the GDP per capita of the population seem to be the key factors – as California has the greatest results in each of these two.

4. Learnings

- We organised our work very effectively, splitting the code for each set of readings into sub-teams. We proofread and tested the code as a group to ensure no bugs slipped through the net.

- 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 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.
- 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.

5. Conclusion

In conclusion, we all thoroughly enjoyed the experience, and found it very valuable for improving both our teamwork and Python skills. Our experiment was very effective, as our code generated quite a lot of useful data from which clear conclusions can be drawn. As expected, we found that there is more pollution in more industrial areas. Somewhat more surprising is the fact that population density does not appear to have a direct impact on this, but the far lower GDP per capita in countries with a higher population density helps to explain this result. We probably could have taken readings and images more frequently than every 30 seconds given the available storage space, and this would definitely be a point for improvement in the future, as having information about how the greenhouse gas concentration varies within smaller areas would be very helpful in drawing more meaningful conclusions from the experiment.