# Mission Space Lab Phase 4 report


Team name: Plankton

Chosen theme: Life on Earth

Organisation name: [Redacted]

Country: [Redacted]

See the code on GitHub/apollo-1845

## 1. Introduction

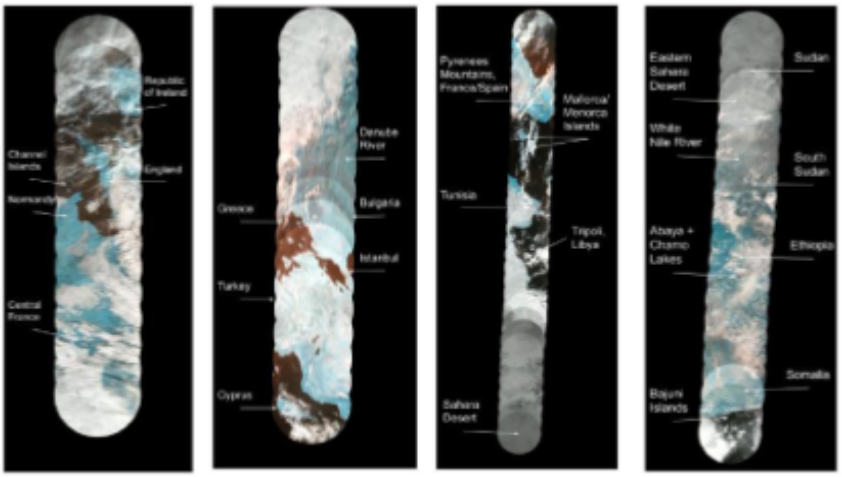
We decided to focus on the effects of urbanisation on the environment on the Earth's landscape and on plant health. Fortunately, the data collected on the ISS contained many useful locations to aid our investigation, including urbanisation in Istanbul and deforestation in Madagascar.

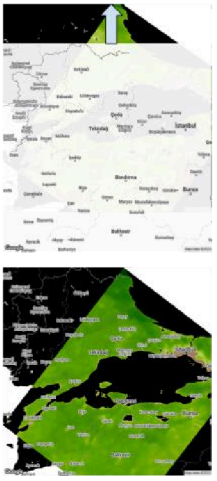
Through using Google Maps and Google Earth data, as well as NASA's Worldview website, we were able to compare our data with previous historical datasets which greatly helped our quest to analyse the ways urbanisation has changed our world. Our hypothesis was that urbanisation would have a significant negative impact on plant health, on forest cover and on pollution.

## 2. Method

On the ISS, we needed a strategy that would not run into an error, corrupting our data. We elected to take a photo every 18 seconds, saving coordinate data with our photos as EXIF tags

When analysing the data, we aimed to get as much useful data as possible while remaining flexible with our analysis, and finally create visual conclusions. Therefore, we used code to piece together our images on Earth (a), using the ORB algorithm to find frames' relative locations, combining these with the OpenCV library. We used the NDVI algorithm to analyse plant health, with pixel value thresholds to remove clouds and the sea, and OpenCV to annotate smaller image sections with location data from Google Static Maps API.



*(a-d) Combining Images* *(e) Adding Google Maps Annotations*

We decided to compare our experimental data with map data collected by NASA Worldview, so we could investigate changes in NDVI, ensuring the data collected was from the same time of year, to avoid seasonal changes in plant health.

Our post-processing and ISS code are public GitHub repositories. Code to calculate NDVI for each image is in "scripts/generate_ndvi.py"; code to overlay google static maps data is in "scripts/overlay_google_data.py"; code to combine images into one long image is in "scripts/combine_images.py".

## 3. Experiment results

One of the most interesting locations on our flight path was Istanbul, Turkey. A city with more than 15 million inhabitants, Istanbul provided a useful case study to investigate the effects of urbanisation. We were able to compare our experimental data (photo #84) with NASA Worldview data from May 2000.

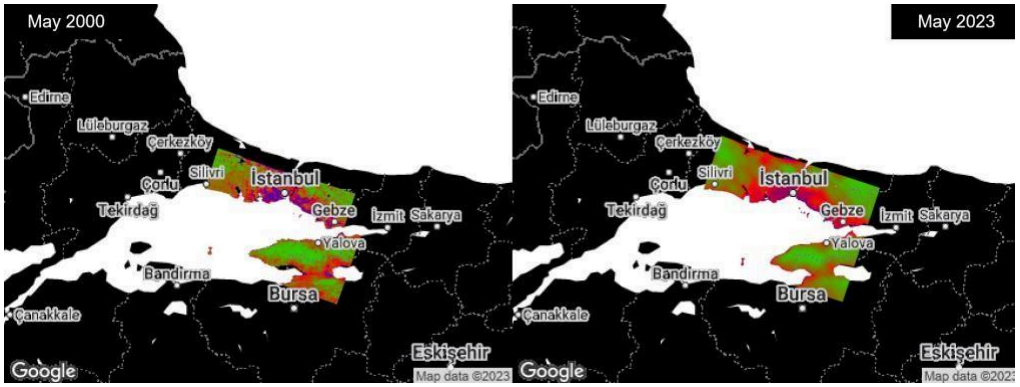



*Fig. 1: NDVI in North-Eastern Turkey, May 2000 vs. May 2023*

Despite Istanbul's population almost doubling between 2000 and 2023, NDVI in the metropolitan area of Istanbul has remained unchanged in this period, however this area

still had the lowest NDVI values out of any region in the area, suggesting that urbanisation has a negative effect on vegetation health.

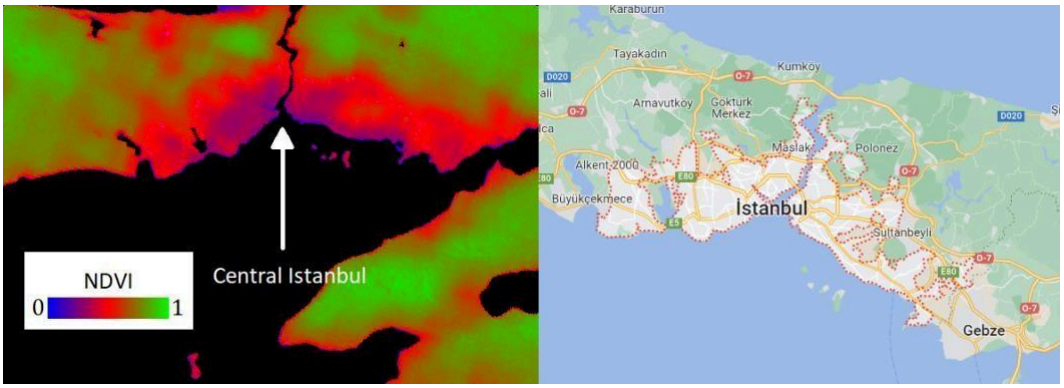



*Fig. 2: Low NDVI values in central Istanbul*

Perhaps the most pronounced change in the area was around the *Istanbul Havalimani* Airport. Opening in 2019, the airport was the busiest in Europe in 2022.

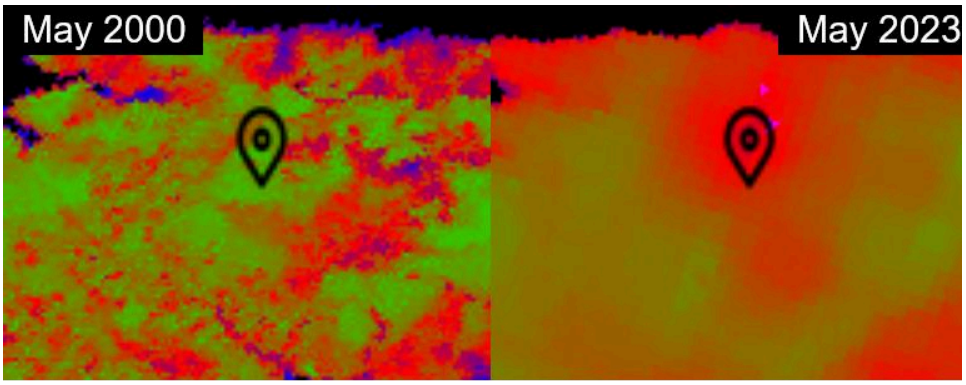



*Fig. 3: A decrease in NDVI around the site of Istanbul airport*

NDVI at the site of the airport experienced a significant decline, suggesting that largescale infrastructure and urbanisation projects have an adverse effect on plant health.

Photo #333 gave insights into the deforestation on the North and East sides of Madagascar. In the period 1953-2014, forest cover on the island decreased by 44%. Causes of the deforestation include 'slash-and-burn' agriculture and urbanisation.


*Fig. 4: Forest cover in North-Eastern Madagascar*

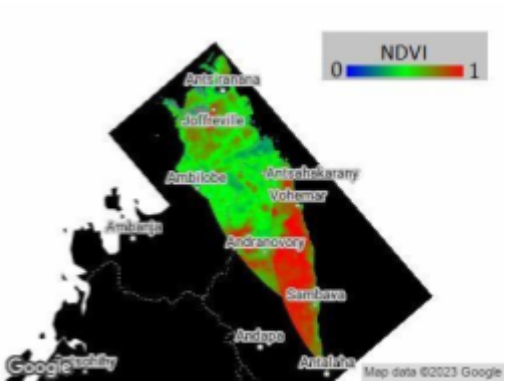



*Fig. 5: NDVI for Madagascar's East coast (#333 (in this graphic, red represents high NDVI values and green represents lower NDVI values)*

Fig. 4, taken from Google Earth, shows some of the deforestation on the island as forests were cleared for agriculture and infrastructure.

Analysing NDVI values of the North-eastern region revealed a stark contrast between it and Madagascar's East coast. The North-East is the most densely populated area after the country's capital and, although most of the population is rural, human factors certainly have played a significant part in the deforestation of the island.

## 4. Learnings

As a team, we all found the Astro Pi project engaging and exciting. We became familiar with Raspberry Pi hardware, but we also gained a lot of experience in data analysis. Most importantly, the project allowed us to work together and develop skills in teamwork and collaboration.

Beginning our Astro Pi adventure by delegating research around the team, we got to a great start in phase 1. Initially, our plan was to investigate phytoplankton concentrations in the sea, however when we discovered that this was unlikely to be viable, we shifted our focus towards urbanisation. Our most difficult challenge at this stage was trying to find times to meet and discuss plans, however communicating on online chat groups (e.g. Discord) helped us.

For phases 2 and 4, we gave the code-writing tasks to those who were more experienced programmers, meanwhile the rest worked on analysis and further research. Phase 4 coincided with exams for many people, however we overcome this by closely managing our time to be able to fit Astro Pi into our schedule.

Next time, we hope to get everyone involved in the coding aspect of the challenge, as this is an immensely valuable skill to develop.

## 5. Conclusion

Overall, we found that our data supported our hypothesis. While there was no evidence that a surge in population directly causes adverse effects in plant health and

deforestation, it was clear that infrastructure and human activity created problems for the surrounding environment. We were pleased that our data consisted of large cities and major industrial projects – these greatly assisted our analysis of urbanisation

We still believe that there is greater scope for the investigation of this issue – our data only really had clear images of one large population centre and in order to properly conduct a conclusive experiment more data across a longer time period would be required. Nevertheless, we were able to compensate for this by using historical datasets.

Exploring and investigating human impacts on the Earth has been an insightful and intriguing process. As a team, we hope that it will give us a basis to move towards more complex projects to do with space and programming.