

ESA Astro Pi Mission Space Lab Challenge 2019/2020



Space Kludgers to Investigate Correlations of Astro Pi Izzy Image Datasets and a Variety of Atmospheric and Anthropogenic Parameters Provided by ESA and NASA

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Space Kludgers Project description

The purpose of this project is to gather earth images using the infrared sensor of Astro Pi Izzy in order to identify areas of vegetation, water and other types of land, and then study the correlation of vegetation and water regions to a number of other parameters, including emissions of CO₂ and other anthropogenic and biogenic emissions as recorded and provided by the Copernicus ESA project and data hub.

This **goal** will be achieved by a python generated code, designed to **capture images of the earth** through the infrared sensor of the Astro Pi Izzy, associating each picture with the exact location of the International Space Station at the time the image was taken, so as for each image to be adequately identified in time and then in location (based on ISS published orbit).

The acquired image data set will be **processed** to identify areas of vegetation, water and other types of land. As a golden standard, we will consider comparing our results with the Copernicus Global Land Service (GLS) images on vegetation and land cover provided at <https://land.copernicus.eu/global/themes/vegetation>

Further **analysis will involve** correlations of the identified terrain types to available charts of various atmospheric and other parameters, such as:

- 1) emissions of atmospheric compounds as provided by the Emissions of Atmospheric Compounds and Compilation of Ancillary Data (ECCAD), part of the Copernicus project, freely provided by: <https://eccad.aeris-data.fr/#DatasetPlace:CAMS-GLOB-BIO>,
- 2) temperature maps and other geophysical parameters as provided by the Land Monitoring Service, part of the Copernicus project, freely provided at <https://land.copernicus.eu/>, and
- 3) population density maps, as provided by the NASA Socioeconomic Data and Applications Center (SEDAC) at <https://sedac.ciesin.columbia.edu/data/set/gpw-v4-population-density-rev11/data-download>.

Contingency planning, in case of experimental data failure, will involve using imagery acquired by Astro Pi Izzy during other experiments (e.g. previous years' projects).

The **expected result** of this experiment is to identify how temperature, atmospheric and anthropogenic emissions, and population density correlate with each other in different terrain types.

Finally, the **expected learning outcomes** for Space Kludgers team members include the following: gain experience on constructing experiments with raspberry pi and related sensors, programming in Python, exploiting large, open data sets, as those provided by Copernicus and NASA, deploying image processing and analysis algorithms and tools (segmentation, texture analysis, clustering - possibly via machine learning), and implementing big data fusion and visualization.

Space Kludgers Team

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