Team Name: CMC
Chosen theme: Life on Earth
Organisation name: ITIS Delpozzo
Country: Italy

Introduction

Our project consists of verifying a correlation between the magnetic field, the formation of clouds, the climate and cosmic rays. Based on numerous studies, the hypothesis we wanted to verify is the formation of clouds at low altitude in the period of low solar wind, therefore with a greater influx of cosmic rays on the Earth's surface and especially in the SAA and in the low latitude areas where the magnetic field is no longer able to deflect cosmic rays.

Method

To try to verify the correlation previously explained, our program, sent during Phase 2 of the experiment, was organized as follows:

- it took a photo through the Izzy's noIR camera;
- it classified the image in low clouds, high clouds or other through a machine learning algorithm (this algorithm is described in our Github in the *Insghts* section);
- in the *data.csv* file, it saved other data such as the date and time, the magnetic field value thanks to the Izzy's SenseHat sensor, the latitude, the longitude and the position of the nearest city.

It saved *a*ny errors on one of these instructions in the *file_info_error.csv*.

Unfortunately, due to an incompatibility between the versions of the libraries of our FlightOS and those used during the mission, the machine learning algorithm did not work. For this reason we had to reprocess the images on Earth. In addition, to have a larger sample, we decided to use also the data of the other ITIS Mario Delpozzo team who participated in this initiative, the *MyWay* team.

This is the link of our GitHub where there is both the code sent in phase two of the experiment and the one we performed to reprocess the data on Earth.
https://github.com/CMC-AstroPi/Report

Results

When we reprocessed our data on Earth we did the following on all of our photos:

- we executed the random forest machine learning algorithm so that it classified the images in the categories listed above. As you can see in the following graphs, a different color is assigned to each type of cloud recognized by the algorithm;
- we used *iss.compute()* to which we passed the date of the error that we identified as the date and time when the photo was taken, so that latitude and longititude returned;
- we used the site below to obtain the value of the magnetic field present in the position where we took the photo. (https://www.ngdc.noaa.gov/geomag/calculators/magcalc.shtml#igrfwmm)

After that we used the *mathplotlib.pyplot, geopandas* and *pandas* libraries to make some graphs in order to make a possible and easily identifiable correlation.

The first type of graph we made is a correlation plot where the value of the magnetic field in μT is shown on the abscissa axis and the latitude in degrees on the ordinate axis.

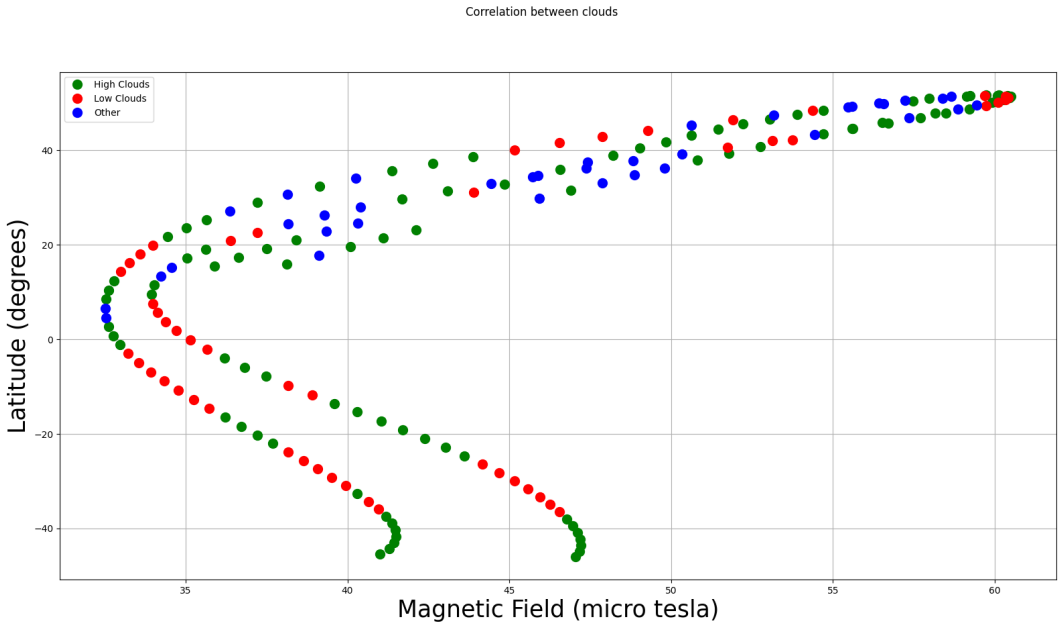

Figure 1: correlation plot with CMC data (red: low clouds, blue: other and green: high clouds)

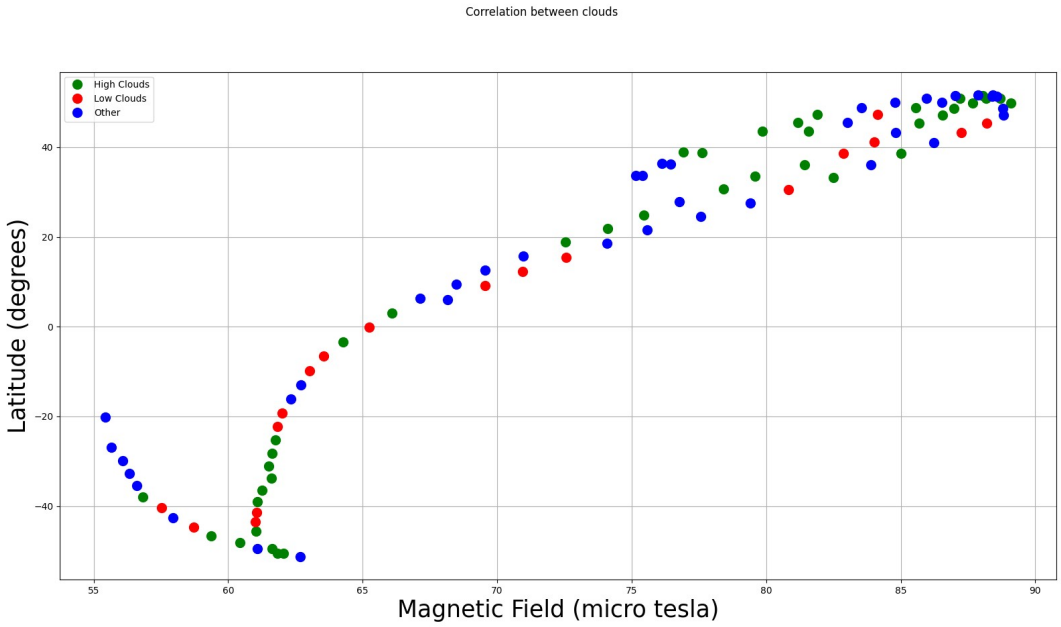

Figure 2: correlation plot with MyWay data (red: low clouds, blue: other and green: high clouds)

In the graphs below each point is a geolocated photo based on its latitude and longitude and the color depends on the type of clouds present *(red: low clouds, blue: other and green: high clouds).*

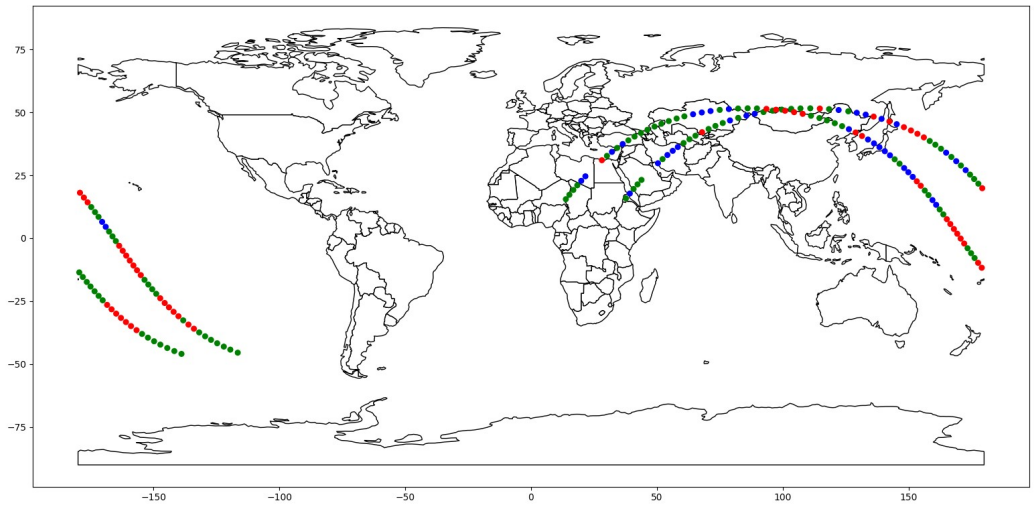

Figure 3: world plot with CMC data

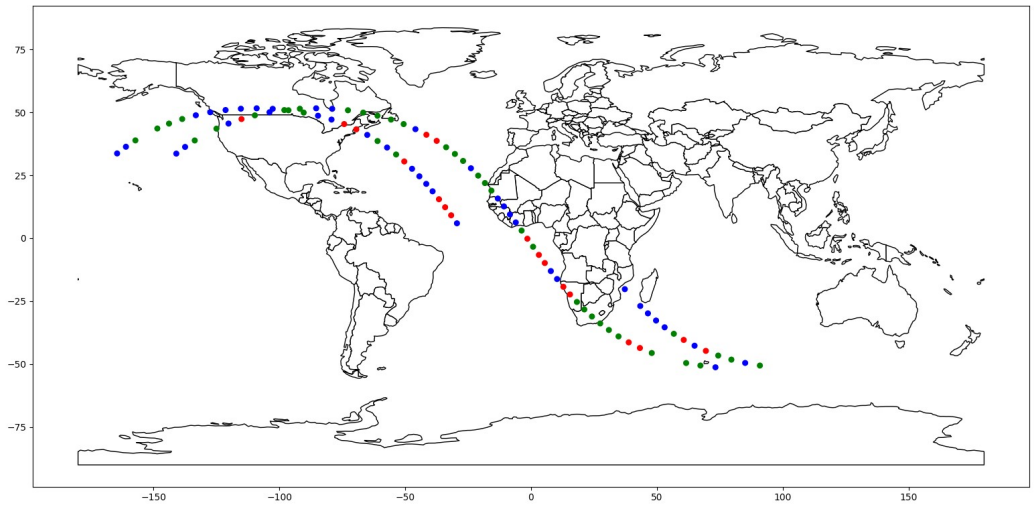

Figure 4: world plot with MyWay data

The program we wrote to create these graphics is present on our Github repository.

Conclusion:

By analyzing the first type of graph we note that there is a correlation between cloud typology and low magnetic field/low latitude so we can validate our initial hypothesis according to which the low latitude and the less intense magnetic field favors the formation of clouds at low altitude.

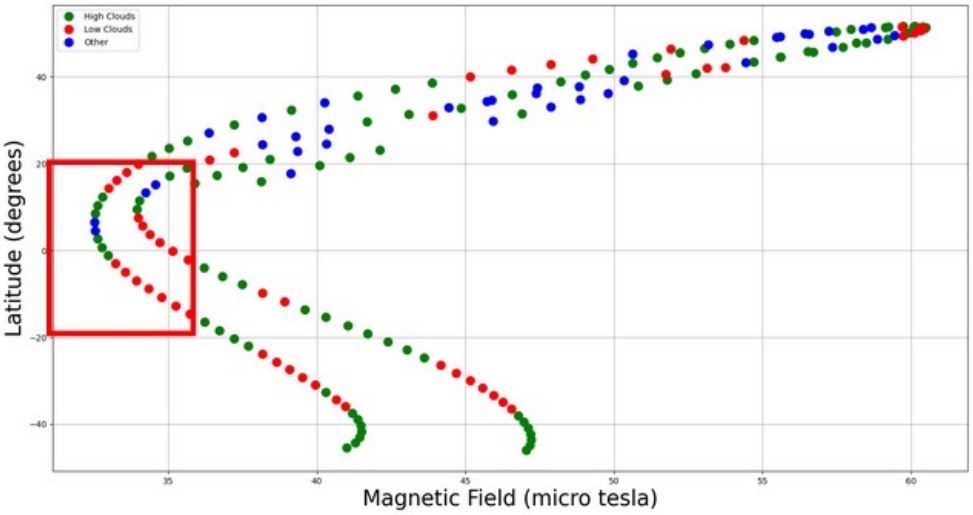

Figure 5: CMC data

We cannot say the same thing by analyzing the data of the *MyWay* team because there is no data in our range of interest (magnetic field/latitude).

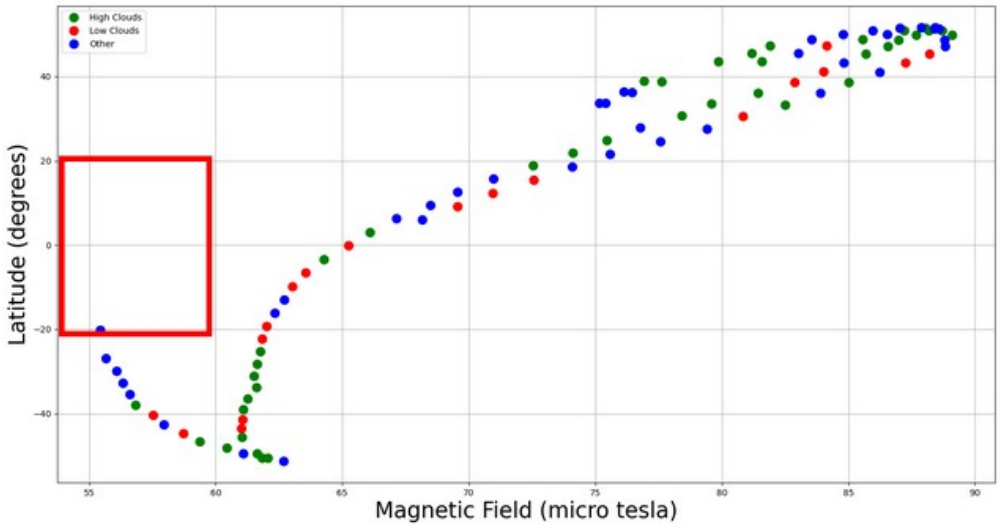

Figure 6: MyWay data

By analyzing the world plots instead, we can validate the consideration made previously regarding low altitude clouds. Unfortunately we cannot verify if there is a similar behavior in the SAA because at the time our experiment was in that area, the Earth was dark. Furthermore, even the *MyWay* team experiment did not fly over the SAA.
Finally, we can say that there is a correlation between the Earth's magnetic field and the formation of clouds at low altitude. We realized that this correlation must be validated through an experiment of longer duration and that we must also take into account the meteorological peculiarities of the overflown areas.

It is very striking that phenomena such as solar wind, cosmic rays and magnetic field affect the Earth's climate.