Mission Space Lab Phase 4 report

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Chosen theme: Life in Space

Organisation name: Institution Notre-Dame la Riche

Country: France

1. Introduction

We had left on two different research in case one of the two was not doable, the first one was about movement of astronauts and the second one about earth's magnetic field.

In the first one we expected to see the impact of the ISS's state on the astronauts but our astropi didn't capture any movement of them so we decided to analyse the earth's magnetic field.

In this second experiment we wanted to answer our main question :

"How earth's magnetic field is evolving ?"

We thought that the observation of the evolution of the earth's magnetic field was important because it could inform us about certain dangers that our planet may face. We expected to notice weirdness into the evolution of the earth's magnetic field because we already heard about the South Atlantic Anomaly and the magnetic pole division but our main objective was to show the "instability" of the Earth's magnetic field and to warn of the danger that this division into poles represents, especially for satellites in high Earth orbit but also for the ISS crew.

2. Method

Our code recorded the x,y and z magnetism in intensity (from the ISS) so we were able to create a vector and calculate its norm which represent the intensity of the earth's magnetic field. Our code also recorded the realtime ISS position and linked the different parameter like the magnetism with their respective location. Thanks to that we were able to know the variations of the earth's magnetic field. We had also collected other data but they proved to be useless in the continuation of our research.

Once data was collected our code stored it in different csv files every 5 seconds

(approximately) to ensure that our data was saved. This is why we used another code to join them into one big csv file. (code available on this github : https://github.com/trueHandyman/AstroPiAdditionnalCode/blob/main/additionnalCode.py)

We first decided to use google earth to place positions of our data and see which trajectory the ISS have done. We were first frightened by the fact that the ISS did not pass through South America but we after see that the South Atlantic Anomaly also include south Africa so we decided to study this part of the SAA.

To verify that the magnetic poles were indeed splitting we decided to take measurements of the intensity of the earth's magnetic field near the poles. If the poles were not splitting then they would be relatively evenly distributed throughout the southern geographic pole. Luckily the ISS was passing through the south at the level of Australia where the division of the poles is very visible, so we took a low latitude and compared the magnetic intensity at two different points but of the same latitude.
We used the same process to highlight the SAA in South Africa. The advantage with this method is that the experiment is easy to process numerically by simply taking two points of the same latitude and different longitude.

3. Experiment results

To Get an overview of our collected data we created a map and placed a point for each minute of travel in the ISS so we colored the points according to the intensity of the earth's magnetic field to start working on it.
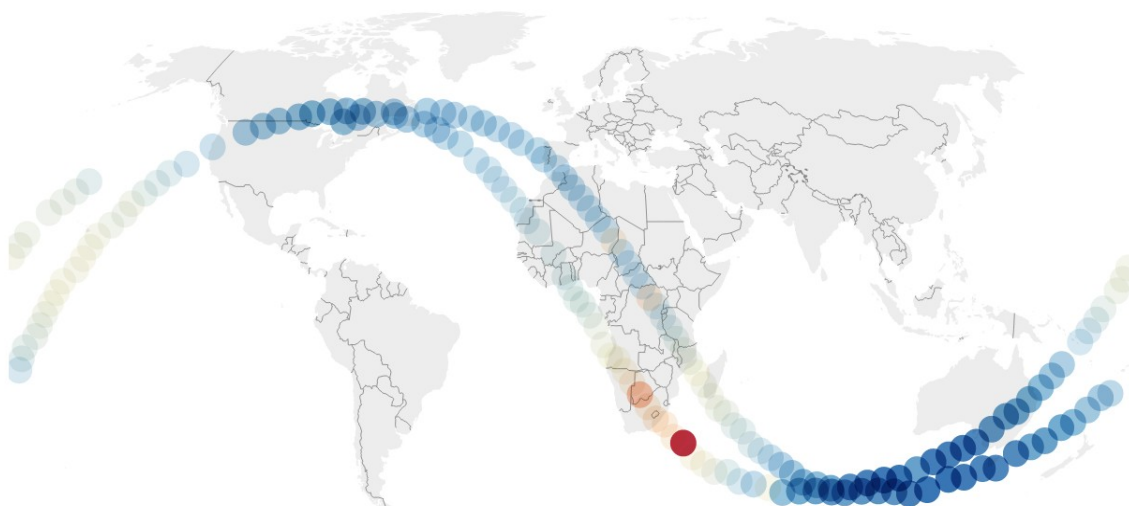
Source: Data Provided by an AstroPi on the ISS • Created with Datawrapper

Illustration 1: show the Intensity of the magnetism caught from the ISS

With that overview we were able to see that the earth's magnetic field was not uniformly distributed (at least in the south pole).

We wanted to observe this phenomenon more precisely, so we took two point recorded by the ISS in South Africa to observe the South Atlantic Anomaly
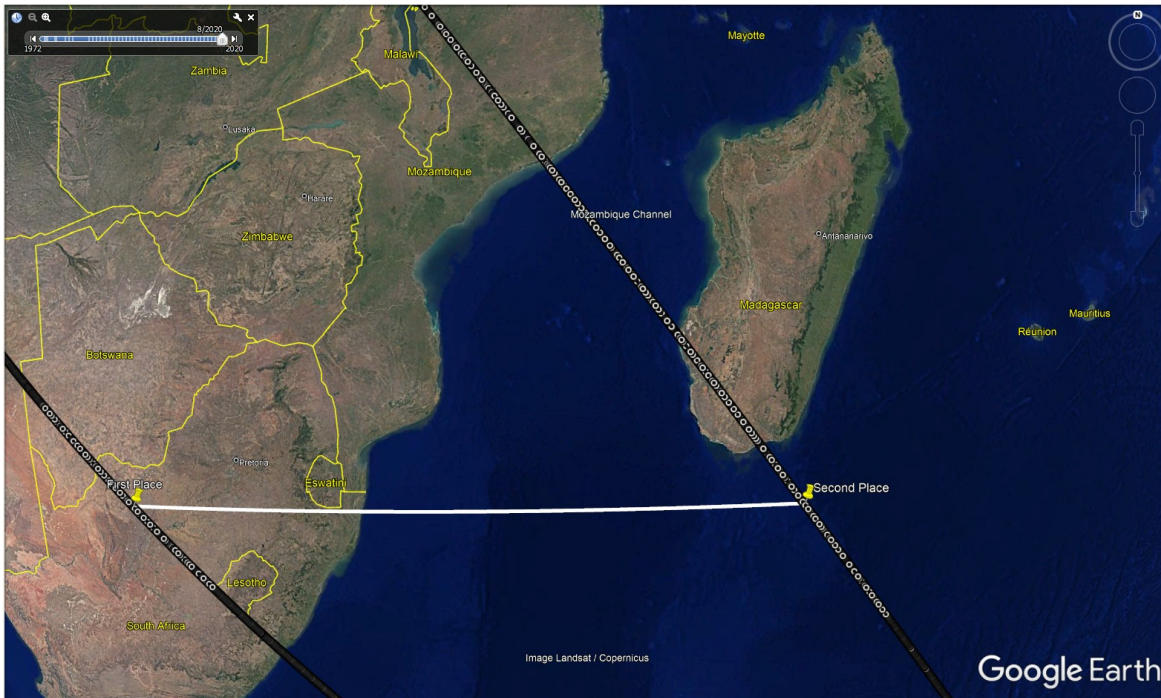

Illustration 2: Two places of the same latitude but one is not affected by the SAA

Then when we compared magnetism intensity we found out that these one were different !

We have indeed discovered that the first place had a magnetic intensity vector with a norm of 41 while the second had one equal to 46 !

latitude	longitude	elevation	intensiteDuMagnetisme(normeDuVecteur)
-26.9963055555556	24.1433333333333	427.346824439973	41.6253417757869
-26.9825555555556	47.7501111111111	427.350778346836	46.0802435630052

Illustration 3: Extract of our dataset

Then we gave a look at the south pole division,

Illustration 4: Two places of the same latitude but one is not as strong affected as the other by the south magnetic pole

And, again, we found out that these one were different.

This time, the first place were at an intensity of 49 whereas the second one were at 61 ! This time the gap was more important and we understood that the earth's magnetic field was moving and volatile.

4. Learnings

One day before the registration of our code we had to face a major problem, the registration of the data. We had indeed had a data logging problem because of a poorly constructed for loop, we learned to take a step back to understand our problem and send our code while there was still time.

We also learn to use data through python but also excel and we also learn that google earth allows us to show data on the earth globe and use them.
The newt time we will study something we think that we will manage to study a specific topic and know exactly where to go when studying the datas (but we already do it with the problematic that we have committed ourselves to answer)

5. Conclusion

Then we can answer our question "How earth's magnetic field is evolving ?", and we can deduce that earth's magnetic field is dividing itself and some anomaly appears like the SAA. This study was important because if we see that the earth's magnetic field is dividing itself it can weaken and thus the crew present on the iss can be put in danger by a bad protection of solar wind.

This experience was amazing we didn't expect to be chosen so we were very happy when we discovered that our experiment was able to be done. This event was really helpful to us because we discover "the experimental world" and how scientists can manage to answer questions. If this experiment was to be redone we could have taken more time to study the eddy currents to see if the earth's magnetic field has an impact on the speed of the ISS

To verify the veracity of our data we have checked our sample with a complete ESA map which displays the magnetic intensities and found out that we were not wrong because we can see the SAA and the magnetic pole division ! (SAA : South Atlantic Anomaly)
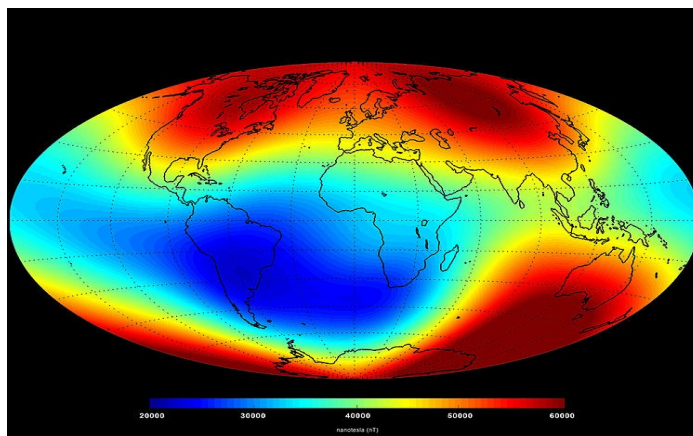
Source :

https://www.esa.int/
ESA_Multimedia/Images/
2014/06/
June_2014_magnetic_field

Illustration 5: ESA earth's magnetic field intensity