

# C.M.C.

## Short presentation ...

Hi, we are the C.M.C. team (Clouds and Magnetic field Correlation) and we come from Cuneo.

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## What we expect ...

The objectives of our project are the following:

- to better understand the indirect influence of the magnetic field on life on planet Earth;
- confirm the relationship between geomagnetic field, cosmic rays and clouds formation;
- understand the influence of the sun (solar wind) on the Earth's climate and atmospheric conditions;
- better study the SAA (South Atlantic Anomaly);
- observe the change in the magnetic field from the latest detections of it;

## A little theory ...

Cosmic rays are charged particles so they interfere with the Earth's magnetic field and can get there in two ways regarding the field, near the Equator or near the poles:

- near the Equator, the particles of which cosmic rays are composed are deflected backwards, but before being deflected by the magnetic field these particles that arrive at high speed react with the Earth's atmosphere, forming a particle, the neutrino, which like the name suggests is neutral and therefore doesn't interact with the magnetic field, and passes through it.

Later the free neutrons are unstable and then decay into electrons and protons that are trapped in the radiation belts. And this is why there are charged particles trapped in the atmosphere that hasn't been deflected by the geomagnetic field.

- near the poles, the particles follow the lines of the magnetic field until they reach the poles without undergoing any deflection. When cosmic rays arrive towards the magnetic poles and lose altitude they interact with the Earth's ionosphere. In this way, they excite the atoms in the atmosphere and emit light, forming the Northern Lights.

Another important relationship was observed between the flux of cosmic rays arriving on Earth and the increase or decrease in the Earth's cloud cover.

Cosmic rays are very fast charged particles from the sun and intergalactic space. Given their high impact energy, they have the property of ionizing the atmosphere, especially where it is denser like in the part closest to the ground. The air molecules electrified by cosmic rays can go to constitute nucleation centres, together with the atmospheric dust, obtaining to coagulate the surrounding water vapour on themselves, thus favouring the formation of clouds in the lower atmosphere. In turn, low clouds have the property of cooling the Earth.

The amount of cosmic rays arriving on Earth mainly depends on two factors: the sun and the Earth's magnetic field.

The sun affects it because as solar activity increases, so does the solar wind, a flow of charged particles that travels through space along with its strong magnetic field. But this magnetic field placed between the Sun and the Earth deflects cosmic rays.

### The project

Our project consists of verifying a correlation between the magnetic field, the formation of clouds, the climate and cosmic rays as we have treated in the previous point.

Based on the numerous studies mentioned above, the hypothesis we would like to test in this experiment is the following:

- The formation of clouds at low altitude in the period of the low solar wind, therefore with a greater influx of cosmic rays on the Earth's surface and especially in the SAA where the magnetic field is no longer able to deflect cosmic rays.

On our part, there will then be a verification of the data received to try to understand if the observed phenomenon depended on the aforementioned elements analyzed by us or if it is attributable to chance.

In other words, aware that we will not be in the presence of optimal conditions, our analysis would like to try to analyze the data received to understand if these phenomena are dependent on them or are pure chance, or still linked by information different from what we think.

### Data collection ...

During phase 2 of the test, with the experimentation of the Astro-pi we had thought of obtaining information on two particular phenomena: namely the clouds and the Earth's magnetic field.

Since our experiment is focused on the identification of low-altitude clouds to ensure that the Astro-pi can recognize them, we decided to photograph the Earth using Izzy's noIR camera and through a machine learning procedure to make sure that the Astro-pi understands through a series of images previously provided which are the clouds to recognize.

We also thought that to save memory, you could avoid photographic shots in absence of cloud cover.

As for the Earth's magnetic field, it will also be necessary to verify our theory, so we thought that every photo taken by the noIR camera is then accompanied by a measurement of the magnetic field.

Furthermore, if there is a moment of absence of cloud cover, we will still detect the Earth's magnetic field so that during the data analysis we can also take this absence as important information.

### Data analysis ...

Once we have received the data, at the end of the experiment, we will divide them according to the latitude and we will make an average calculation of the cloud presence for each value.

After that, we will make a graph in which we will compare the cloud presence on the different latitudes, in order to verify our initial theory.

If the results are as expected then we will make further checks on the amount of solar wind in that period, the arrival of cosmic rays and we will observe if there is a real correlation or if this was only the result of chance.

If, on the other hand, the results were very far from our expectations, then we will try to understand the reason why our theory didn't work, looking for the elements already mentioned above among the causes.

In addition, we will also observe if the magnetic field measurements have changed from the last ones (2019), we will import them into a graph and observe the variations of it compared to the magnetic field of the past years.

### Where will we do our analyses ...

For this project, we have decided to open a new account on the GitHub platform for several reasons.

The first, and probably the most significant one, is to keep each other always up-to-date on the developments that the teammate has brought to the project. Another point in favour of this method is being able to work together remotely given the very difficult period we are facing.

A further reason is to keep our coach and our classmates up-to-date in what we have planned to do and to let all those passionate and curious people know what we are doing.