MISSION SPACE LAB PHASE 4 REPORT

Team name : Les Robotiseurs
Chosen theme : Life on Earth
Team members' names : Jane Bagnol, Pauline Davin, Agathe Secq, Timothé Chastan, Tom Carvin, Pablo Maiorani
Organisation name : Ecole Primaire Publique de Saint-André d'Embrun / Saint-André d'Embrun Public Primary School
Country : France

Introduction

The main objective of the project was to check if the magnetic field is different according to the day / night alternation on the Earth. The team thought that the sun has an influence on the magnetic field of the Earth and that the latter is stronger on the sunny side than on the night side. The team wanted to measure the magnetic field from the ISS and study its variations during the revolutions of the ISS around the Earth. The team has also documented the aurora borealis because of the weakness of the protective magnetic field at the poles to complete the investigations.

Method

The team used Astropi captors to retrieve the magnetic field data in µTesla and saved them in a file containing date and time as well as the 3 data of the magnetic field; at the same time, the team used the IR camera to take pictures every time they read the magnetic field (every 30 seconds).

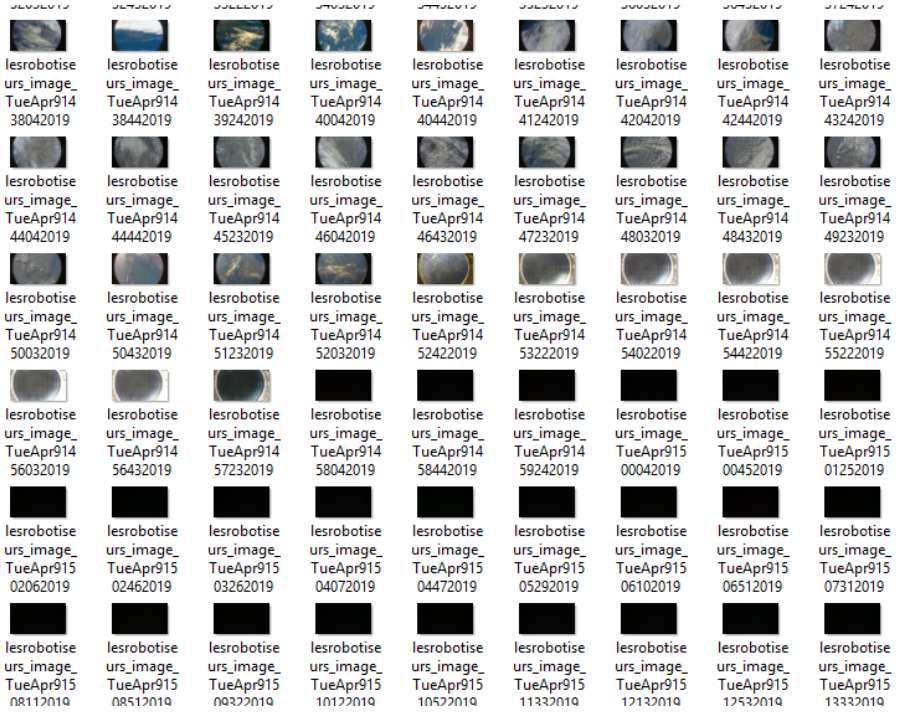


Illustration 1: photos files to detect day/night

These photos are used to determine when the ISS is on the sunny side or not, to be able to know if the recorded data of the magnetic field are made when we are sun side or not. In order for us to know that Astropi is working right now, camera, magnet and Earth image displays are alternating with the scrolling of magnetic field data

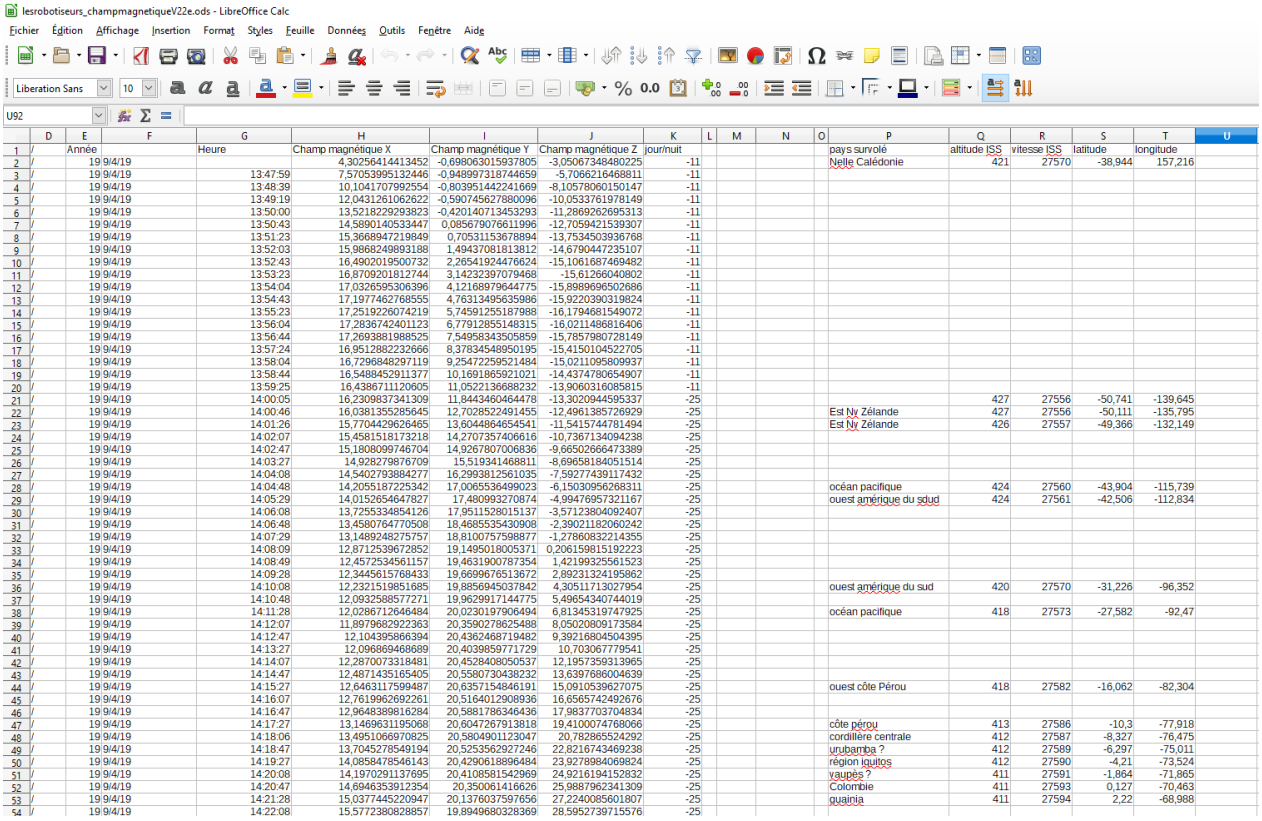
In classroom, students imported data into a spreadsheet. They added day/night parameter by analyzing the photos taken by the astropi camera.

They made a graph from these data to better visualize the variations of the data. The decision not to geotag photos in Python is related to the fact that it was too hard to code it with 9-11 years old. We had to use thereafter http://www.isstracker.com/historical to know the position of the ISS (illustration 5).

Results

It was very easy to determine the day / night alternation with the photos taken every 30-40 seconds: the python program ran on the 9th of April from 13:47:59 to 16:45:07 and it was obtained 267 photos: 19 nights, 87 days, 51 nights, 87 days and 23 nights (illustration 1).

At the same time, it was obtained 267 lines of data x, y and z of the magnetic field in microTesla every 30 seconds (illustration 2)


lesrobotiseurs_champmagnetiqueV22e.ods - LibreOffice Calc

	Année	Heure	Champ magnétique X	Champ magnétique Y	Champ magnétique Z	jour/nuit	pays survolé	altitude ISS	vitesse ISS	latitude	longitude
2	19/4/19		4,30256414413452	-0,698063015937805	-3,050673484802225	-11	Nelle Calédonie	421	27570	-38,944	157,216
3	19/4/19	13:47:59	7,570539951324 46	-0,948997187444659	-5,70662164688 11	-11					
4	19/4/19	13:48:39	10,10417079925 54	-0,803951442241669	-8,105780601501 47	-11					
5	19/4/19	13:49:19	12,04312610626 22	-0,590745627880096	-10,05337619781 49	-11					
6	19/4/19	13:50:00	13,52182292938 23	-0,420140713453293	-11,28692626953 13	-11					
7	19/4/19	13:50:43	14,5890140533447	0,085679076611996	-12,705942153930 7	-11					
8	19/4/19	13:51:23	15,3668947219849	0,70531153678894	-13,753450393676 8	-11					
9	19/4/19	13:52:03	15,9868249893188	1,49437081813812	-14,679044723510 7	-11					
10	19/4/19	13:52:43	16,4902019500732	2,26541924476624	-15,106168746948 2	-11					
11	19/4/19	13:53:23	16,8709201812744	3,14232397079468	-15,61266040802	-11					
12	19/4/19	13:54:04	17,0326595306396	4,121689796447 75	-15,898969650268 6	-11					
13	19/4/19	13:54:43	17,1977462768555	4,76313495635986	-15,922039031982 4	-11					
14	19/4/19	13:55:23	17,2519226074219	5,74591255187988	-16,179468154907 2	-11					
15	19/4/19	13:56:04	17,2836742401123	6,77912855148315	-16,021148681640 6	-11					
16	19/4/19	13:56:44	17,2693881988525	7,54958343505859	-15,785798072814 9	-11					
17	19/4/19	13:57:24	16,9512882232666	8,37834548950195	-15,415010452270 5	-11					
18	19/4/19	13:58:04	16,7296848297119	9,25472259521484	-15,021109580993 7	-11					
19	19/4/19	13:58:44	16,5488452911377	10,16918659210 21	-14,437480654907	-11					
20	19/4/19	13:59:25	16,4386711120605	11,05221366882 32	-13,906031608581 5	-11					
21	19/4/19	14:00:05	16,2309837341309	11,84434604644 78	-13,302094459533 7	-25		427	27556	-50,741	-139,645
22	19/4/19	14:00:46	16,0381355285645	12,70285224914 55	-12,496138572629 29	-25	Est Nv Zélande	427	27556	-50,111	-135,795
23	19/4/19	14:01:26	15,7704429626465	13,60448646545 41	-11,541574478149 4	-25	Est Nv Zélande	426	27557	-49,366	-132,149
24	19/4/19	14:02:07	15,4581518173218	14,27073574066 16	-10,736713409423 8	-25					
25	19/4/19	14:02:47	15,1808099746704	14,92678070068 36	-9,665026664733 89	-25					
26	19/4/19	14:03:27	14,928279876709	15,51934146881 1	-8,696581840515 14	-25					
27	19/4/19	14:04:08	14,5402793884277	16,29938125610 35	-7,592774391174 32	-25					
28	19/4/19	14:04:48	14,2055187225342	17,00655364990 23	-6,150309562683 11	-25	océan pacifique	424	27560	-43,904	-115,739
29	19/4/19	14:05:29	14,0152654647827	17,480993270874	-4,994769573211 67	-25	ouest amérique du sdud	424	27561	-42,506	-112,834
30	19/4/19	14:06:08	13,7255334854126	17,95115280151 37	-3,571238040924 07	-25					
31	19/4/19	14:06:48	13,4580764770508	18,46855354309 08	-2,390211820602 42	-25					
32	19/4/19	14:07:29	13,1489248275757	18,81007575988877	-1,278608322143 55	-25					
33	19/4/19	14:08:09	12,8712539672852	19,14950180053 71	0,206159815192223	-25					
34	19/4/19	14:08:49	12,4572534561157	19,46319007873 54	1,421993255615 23	-25					
35	19/4/19	14:09:28	12,3445615768433	19,66996765136 72	2,892313241958 62	-25					
36	19/4/19	14:10:08	12,2321519851685	19,88569450378 42	4,305117130279 54	-25	ouest amérique du sud	420	27570	-31,226	-96,352
37	19/4/19	14:10:48	12,0932588577271	19,96299171447 75	5,496543407440 19	-25					
38	19/4/19	14:11:28	12,0286712646484	20,02301979064 94	6,813453197479 25	-25	océan pacifique	418	27573	-27,582	-92,47
39	19/4/19	14:12:07	11,8979682922363	20,35902786254 88	8,050208091735 84	-25					
40	19/4/19	14:12:47	12,104395866394	20,43624687194 82	9,392168045043 95	-25					
41	19/4/19	14:13:27	12,096869468689	20,40398597717 29	10,70306777954 1	-25					
42	19/4/19	14:14:07	12,2870073318481	20,45284085505 37	12,195735931396 5	-25					
43	19/4/19	14:14:47	12,4871435165405	20,55807304832 32	13,639768600463 9	-25					
44	19/4/19	14:15:27	12,6463117599487	20,63571548461 91	15,091053962707 5	-25	ouest côte Pérou	418	27582	-16,062	-82,304
45	19/4/19	14:16:07	12,7619962692261	20,51640129089 36	16,656574249267 6	-25					
46	19/4/19	14:16:47	12,9648389816284	20,58817863464 36	17,983770370483 4	-25					
47	19/4/19	14:17:27	13,1469631195068	20,60472679138 18	19,410007476806 6	-25	côte pérou	413	27586	-10,3	-77,918
48	19/4/19	14:18:06	13,4951066970825	20,58049011230 47	20,78286552422 92	-25	cordillère centrale	412	27587	-8,327	-76,475
49	19/4/19	14:18:47	13,7045278549194	20,52535629272 46	22,821674346923 8	-25	urubamba ?	412	27589	-6,297	-75,011
50	19/4/19	14:19:27	14,0858478546143	20,42906188964 84	23,927898406982 4	-25	région iquitos	412	27590	-4,21	-73,524
51	19/4/19	14:20:08	14,1970291137695	20,41085815429 69	24,921619415283 2	-25	yaupes ?	411	27591	-1,864	-71,865
52	19/4/19	14:20:47	14,6946353912354	20,35006141662 6	25,988796234130 9	-25	Colombie	411	27593	0,127	-70,463
53	19/4/19	14:21:28	15,0377445220947	20,13760375976 56	27,224008560180 7	-25	guainia	411	27594	2,22	-68,988
54	19/4/19	14:22:08	15,5772380828857	19,89496803283 69	28,595273971557 6	-25					

Illustration 2: Import CSV in spreadsheet + localization photo test LAT/LONG

They observe a significant increase in the magnetic field (especially in Z) during the day. It even takes negative values (in Z and Y) at night

It is also observed that the elevated magnetic field data are mainly in the Northern Hemisphere during sun exposure, and are low in the Southern Hemisphere during the night (illustrations 3,4).

The magnetic field « x » is always above zero with a small variation over time with maxima reached when the magnetic field is at a minimum.

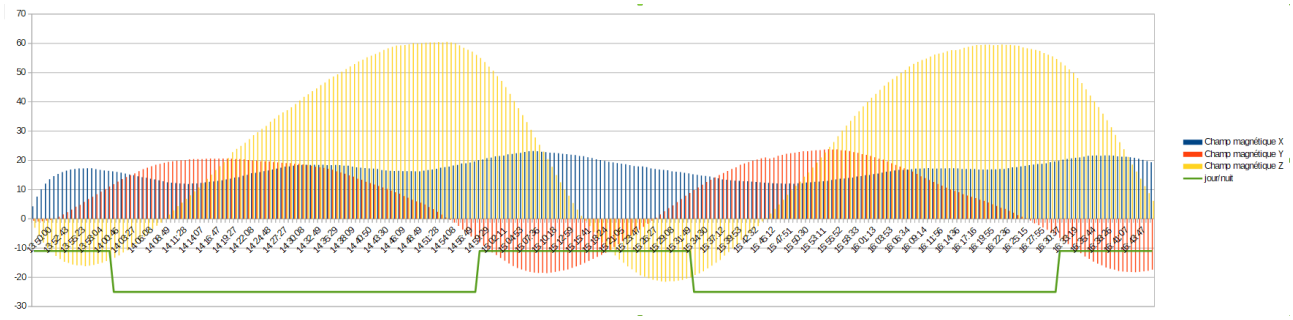


Illustration 3: Magnetic Field (X,Y,Z) + day/night Graph

The trajectory recovered of the ISS during the 3 hours (illustration 5) made it possible to superimpose the variations of the magnetic field with the ISS route and thus to be able to note the important variations between the northern and southern hemispheres: very strong above latitude 40, neutral at a latitude of -30 and negative below latitude -40

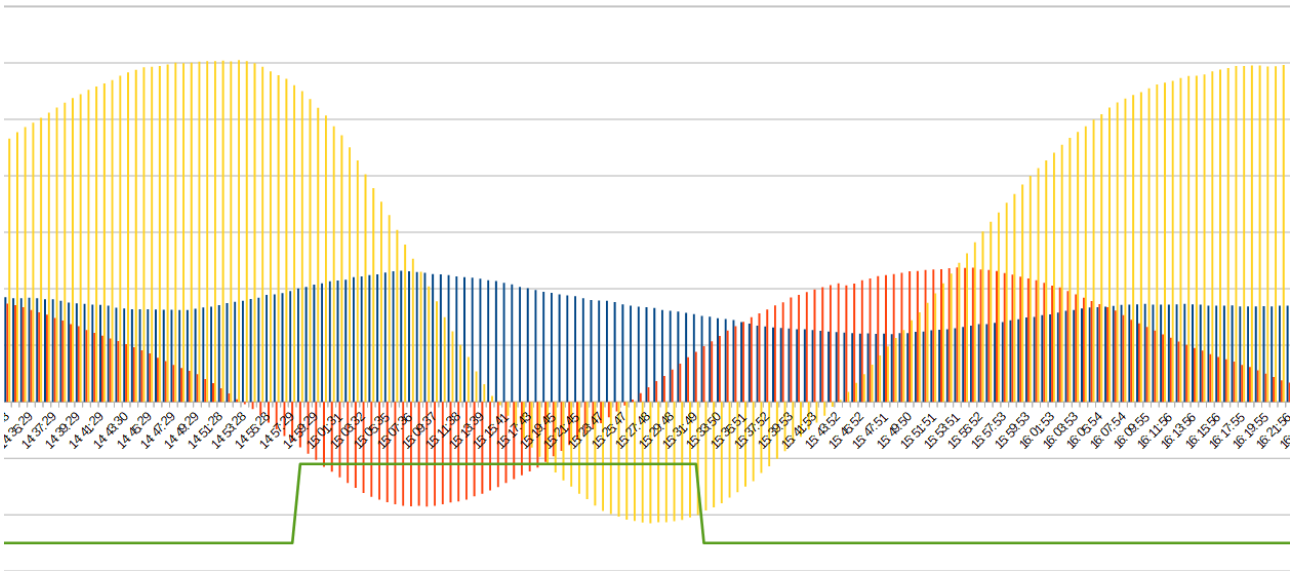


Illustration 4: zoom on day/night/day magnetic fields (x : blue; y: red; z:yellow;green:day/night)

Conclusion

The students'initial hypothesis (the magnetic field on sunny side of the Earth is stronger than night side) is not really confirmed.. Students think that the magnetic field is denser on the sun side to protect the earth from solar particles. The night side the magnetic field does not meet (or few) solar particles and therefore has a tendency to "dilute".

But students asked themself whether the latitude position of the ISS could also have an impact on the magnetic field data, and the fact of the inclination of the Earth, the solar radiation is different according to the hemispheres (currently spring in the north and autumn in the south).

To be really able to invalidate or not the hypothesis, it would be necessary to obtain the magnetic field data when the ISS passes at night in the northern hemisphere to compare them with those obtained. This would eliminate magnetic field variations as a function of latitude (Z magnetic field) and longitude (Y magnetic field).

Illustration 5: reconstitution of the ISS course on 9 April 2019 for 3 hours

Our Python program on Github :
https://github.com/ecolestandre/astropi2019
Our project on Twitter :https://twitter.com/i/moments/1127620975196102656

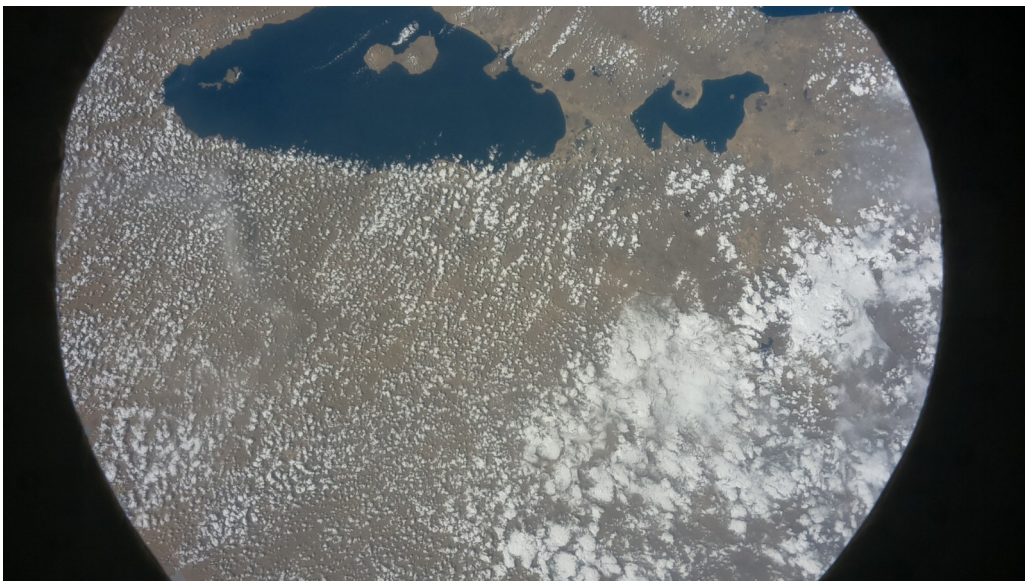


Illustration 6: Best photo selected by students : Nicaragua Lake