THE ACTIVE REGION NOAA 12665

The Sun is heading to the minimum of cycle 24, there are fewer and fewer spots and those that do not develop much. On the other hand, the southern hemisphere has been off for a long time, this is another factor by which solar activity has fallen, however, it is in this southern hemisphere that on June 6, 2017 a particularly active region appeared, the **AR12665**, following the **NOAA** notation.

OBSERVATIONS

The observations for the study of this active region were made with a three inches refractor telescope (f/13), a Thousand Oaks Optical +2 glass solar filter and a Canon EOS 600D camera. All of them were made from the city of **San Cristóbal de la Laguna (Tenerife)**.

The reduction of these images was done using the software **SOL** (http://www.parhelio.com/docsoftware.html) created by *Javier Ruiz Fernández*, it works through the software **IRIS** (http://www.astrosurf.com/buil/iris-software.html). This software allows us to calculate the area of the spots, its heliographic position and its proper motion, although this last value is calculated with a spreadsheet, also created by *Javier Ruiz Fernández* and modified and adapted by the author.

The observations began to be taken on July 7, 2017, the previous days could not have observations, even on July 6, which was the first observation, as can be seen in **Image 1**, the wind and clouds do not allowed to take good data that correlated with the subsequent days. As the bad weather continued, until the 10th of July there are no observations again and this time they can be consecutive: on July 11, 12 and 13; and finally the July 15, 16 and 17. On July 18, the region had already disappeared through the west limb of the Sun.

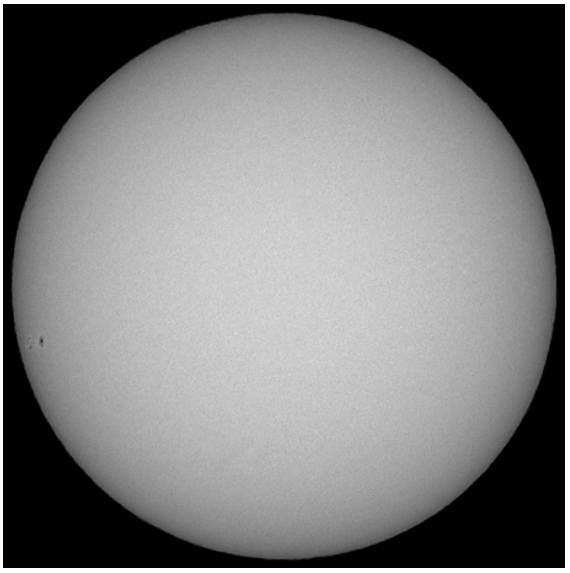


Image 1

In the following links to *YouTube* you can see some animations of the images taken, where you can see the evolution of the active region, *animation 1* shows the visible hemisphere of the Sun over time, while *animation 2* is the same, but with the mapped sun: animation 1 y animation 2.

THE REGION AR 12665 (NOAA)

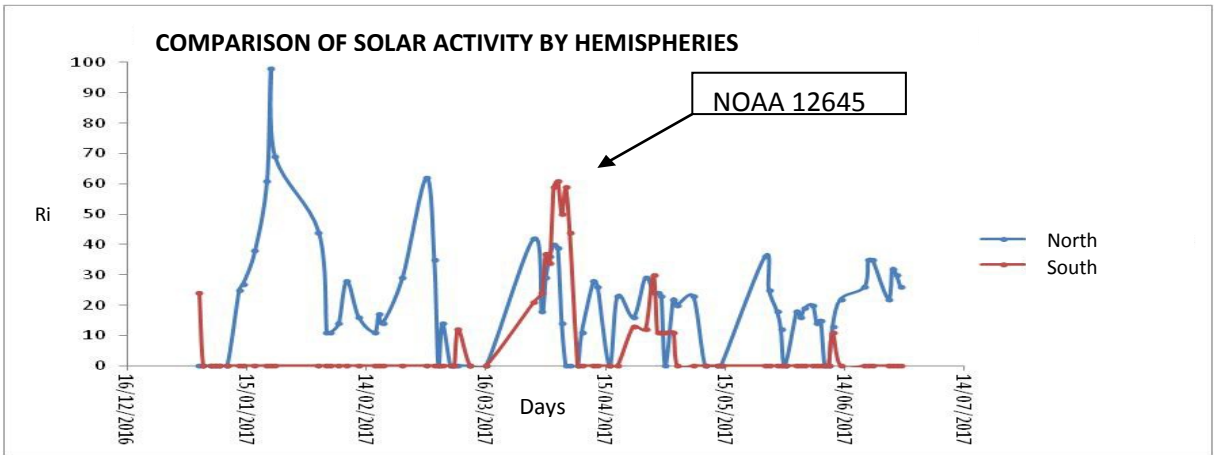
The active region **AR12665** becomes visible by the solar limb on July 5, 2017, it already appears very developed, which a *Zürich* classification of type **D**, on July 7 it can be seen that the active region matures until it reaches a classification of type **E**, for later, on July 16, decay to type **G**. For latter, disappear on July 18.

The quantity of flares that could be measured was also abundant: 34 of type **C1**, 3 of type **C2**, 2 of type **C3**, 2 of type **C4**, 4 of type **C5**, 1 of type **M1** and 2 of type **M2**. According to the data provided by Solar Monitor

This active region meets all the characteristics to overcome *Carrington's* half rotation more and to be seen again in the next rotation by the east limb.

This type of active regions surprise by the lack of them at the time of the cycle in which we are. The beginning of the descent towards the minimum coincides with the sharp fall in activity in the southern hemisphere, while in the northern hemisphere small groups of sunspots do not stop appearing, in the south the activity can be considered null, the few sunspots that appear to contribute a lot of activity as in this case.

The daily activity curve for hemispheres from January 2017 to June 2017 is show below.

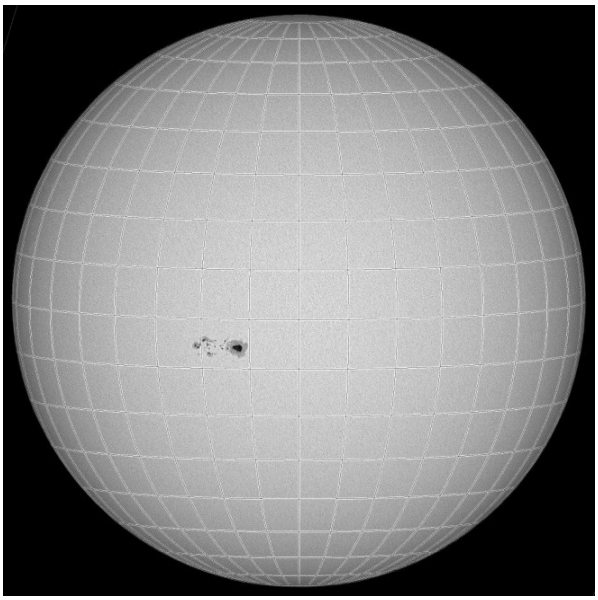


It can be clearly seen that the activity in the southern hemisphere is null, with exceptions that correspond to highly developed active regions of the style we are studying, such as the increase in activity around March 31, 2017, which was due to the active region (NOAA) **AR12645**.

OBTAINING DATA

With the software **SOL** we can obtain the position of the sunspots on the solar surface, calculating their heliographic coordinates; we can also calculate the area of the active regions, measured in millionths of the solar hemisphere, and finally, we can measure the length of the active regions in kilometers. While with the spreadsheet we obtain the proper motions of the sunspots.

The sun mapped in **Image 2** has been made with the software **SOL** and corresponds to July 10, 2017.



The following table shows the calculated latitudes and longitudes. The designation "**p**" y "**f**" correspond to the sunspot of the west and the east respectively (In the image the west is to the right and the north to the top).

Image 2

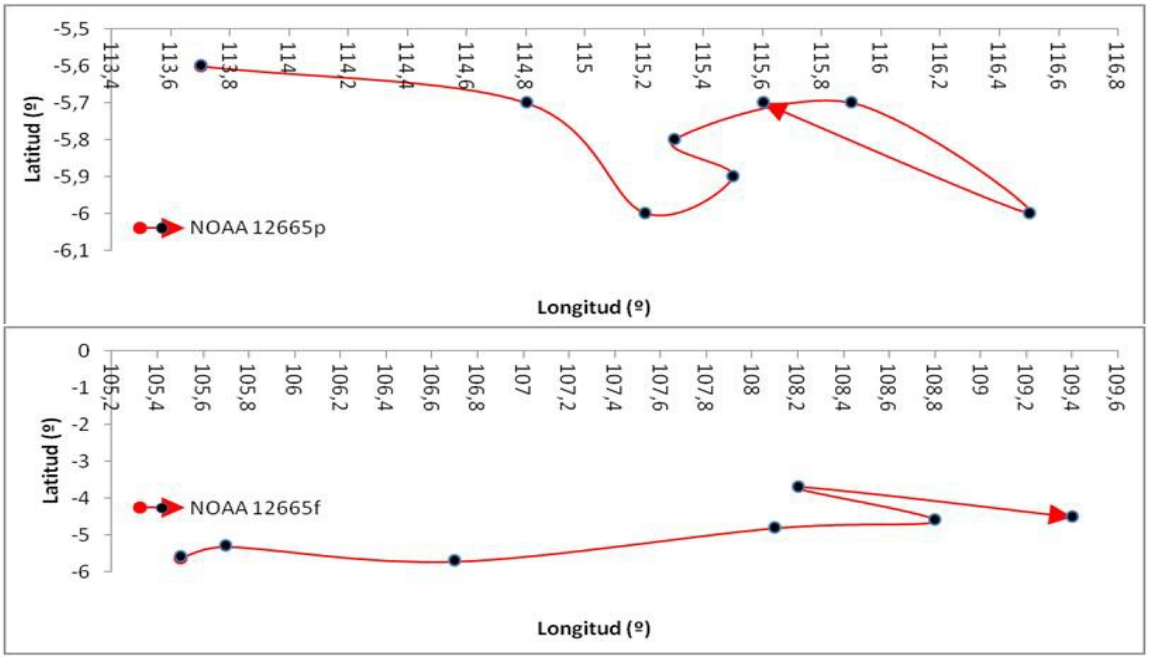
Date	Time	NOAA	Longitudes (°)	Latitudes (°)
07/07/2017	9:15	12665p	113,7	-5,6
07/07/2017	9:15	12665f	105,5	-5,6
10/07/2017	15:54	12665p	114,8	-5,7
10/07/2017	15:54	12665f	105,7	-5,3
11/07/2017	8:42	12665p	115,2	-6
11/07/2017	8:42	12665f	106,7	-5,7
12/07/2017	10:08	12665p	115,5	-5,9
12/07/2017	10:08	12665f	108,1	-4,8
13/07/2017	9:32	12665p	115,3	-5,8
13/07/2017	9:32	12665f	108,8	-4,6
15/07/2017	10:16	12665p	115,9	-5,7
15/07/2017	10:16	12665f	108,2	-3,7
16/07/2017	10:26	12665p	116,5	-6
16/07/2017	10:26	12665f	109,4	-4,5
17/07/2017	9:30	12665p	115,6	-5,7

The latitude of the active region is very low, that is, it is very close to the equator, a very common characteristic of the sunspots that appear close to the minimum of solar activity (Butterfly Diagram).

With these coordinates we can calculate the proper motion of the sunspots in the active region, saving the relative movements of the Sun - Earth and the differential rotation of the Sun. In the following animation made with the images of the Sun taken daily we can see the movement of the active region during its passage through the visible

hemisphere of the Sun. The image is a cylindrical projection calculated by the software **SOL**. Link to YouTube video: AR12665.

In the following graphs we can see how each of the poles of the active region has moved, the "**p**" and the "**f**".

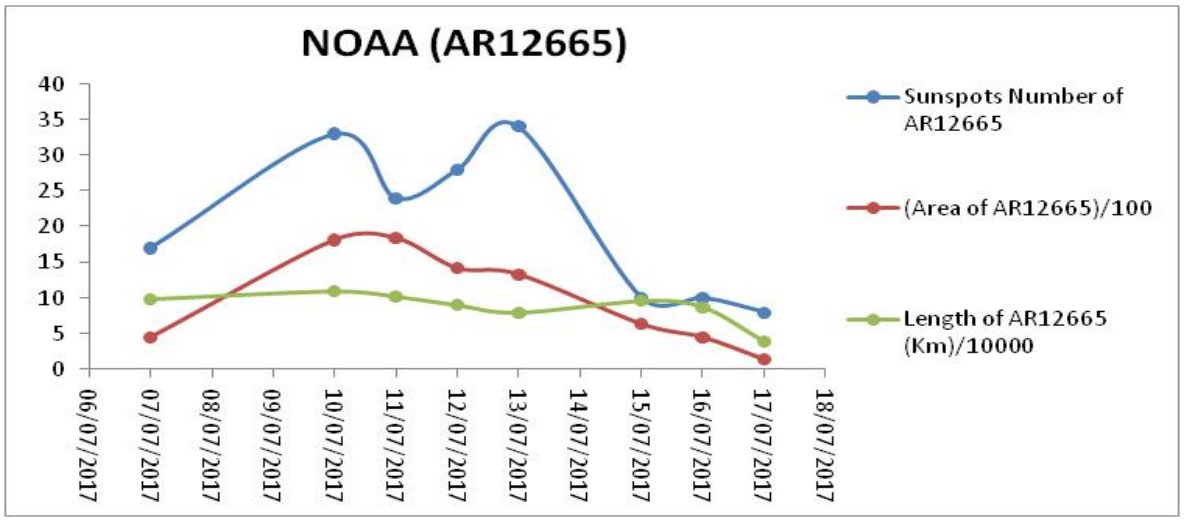


On July 11, 12 and 13, the "**p**" sunspot drops in latitude and then continues with its march westward, a couple of days later, on July 15 the "**f**" sunspot recedes and then continues with its westward motion.

Date	Sunspots	Area	Length (Km)
07/07/2017	17	452	99133
10/07/2017	33	1823	110139
11/07/2017	24	1849	102779
12/07/2017	28	1425	90490
13/07/2017	34	1337	79972
15/07/2017	10	639	96330
16/07/2017	10	453	87794
17/07/2017	8	141	38998

The "**p**" sunspot reaches a speed of about 82 km/h, while the "**f**" reaches a speed of 150 Km/h, almost double that of the first, this causes the active region to reduce its size. The table shows the calculated sizes, as well as the number of sunspots that form the active region and its area.

If we graphically represent this table we can clearly see the evolution of the active region, where the number of sunspots and the area of the active region increases until July 13 when it begins to decay, decreasing both the sunspots and the area. On the other hand, the size of the region is decreasing its length as we discussed earlier.



It is curious to verify that the maximum calculated area coincides with a partial minimum in the number of spots, in addition to the disturbance in the movement of the active region.

CONCLUSIONS

1.- The southern hemisphere has a null activity that occasionally shows its concentrated activity in a very active region.

2.- The position of the active region is typical of a minimum of solar activity, located near the solar equator.

3.- Its evolution also complies with the canons, increase in activity and area with its evolution, and then decrease.

4.- We will have to wait fifteen more days to see if one more rotation is able to remain on the surface of the Sun.

BIBLIOGRAPHY

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