

Annual Report on Sunspot Counting Program

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This *Annual Report on Sunspot Counting Program 2021* has been compiled by A. J. P. Aparicio, V. M. S. Carrasco, I. Tovar, N. Bravo-Paredes, and J. M. Vaquero.

Introduction

This program was born in late 2012 at the University of Extremadura (Badajoz, $38^{\circ}53'$ N $6^{\circ}58'$ W) in order to further extend our research in the reconstruction of past solar activity (see, for example, Vaquero, 2007). Since 1st January 2013, our sunspot counts have been submitted to the Royal Observatory of Belgium (ROB) as a contribution to the international effort of maintaining and updating the International Sunspot Number. For this purpose, we use a small apochromatic refractor –80 mm of objective diameter and 550 mm of focal length– to project a 150 mm diameter image onto a template. Then, a drawing is done so we obtain our sunspot counts from it. Moreover, solar observations from secondary stations are carried out some days when the main station (in Badajoz) fails. One of these stations is in Badajoz too (in a different part of the city) and is equipped with a refractor –90 mm of objective diameter and 900 mm of focal length–, and the other one is in Valencia de las Torres ($38^{\circ}24'$ N $6^{\circ}00'$ W) and is equipped with a smaller refractor –70 mm of objective diameter and 700 mm of focal length–.

In this report, we provide a complete set of data obtained throughout the year 2021, with four tables including our data. Moreover, the reference sunspot number index is compared with our results.

We hope that this publication is useful to the scientific community studying the sunspot number: the longest solar index series derived from direct observation of the Sun.

Data

Table 1 lists all the observations made in 2021. A few days reflect more than one observation. In such cases, we follow the ROB criteria to choose the best drawing of each day, that is, we choose the observation presenting (in order of priority):

- Highest number of groups
- Highest Wolf number
- Highest Quality
- Smallest time-difference with respect to 12:00 UT (solar culmination)
- Early-in-the-morning counts are best

The drawing quality is represented as an integer number between 1 and 5, according to the following rule (USSPS code):

- 1 = very poor
- 2 = poor
- 3 = fair
- 4 = good
- 5 = exceptional

Note that when the main and the secondary stations record a solar observation for the same day, that from the main station is chosen as the best observation of the day.

Tables 2 and 3 list daily, monthly, and yearly values of the number of groups and spots over 2021. From the group count G and the sunspot count S , we define the UEx sunspot number (or UEx Wolf number) as follows: $SN_{UEx} = 10G + S$. Additionally, we define the UEx group number as: $GN_{UEx} = G$. These definitions are in agreement with the classical ones and their updates (Clette *et al.*, 2014, 2015, 2016). Thus, Table 4 lists daily, monthly, and yearly values of SN_{UEx} , while Figure 1 displays the evolution of the time series of the above two indices.

Table 1. Data on sunspot counting over 2021, including month, day, time (UT), observer, quality, number of groups (G), number of spots (S), and UEx sunspot number (SN_{UEx}). One asterisk in the last column indicates that the solar observation was registered at the secondary station in Badajoz and two asterisks correspond to the secondary station in Valencia de las Torres.

Month	Day	Time (UT)	Observer	Quality	G	S	SN_{UEx}	Station
1	1	11:20	V.M.S. Carrasco	4	2	4	24	*
1	2	11:00	V.M.S. Carrasco	3	1	1	11	*
1	3	10:40	V.M.S. Carrasco	3	0	0	0	*
1	4	10:15	V.M.S. Carrasco	2	0	0	0	*
1	6	11:15	V.M.S. Carrasco	3	0	0	0	*
1	7	13:15	V.M.S. Carrasco	2	0	0	0	*
1	10	10:50	V.M.S. Carrasco	3	0	0	0	*
1	11	13:40	J.M. Vaquero	4	0	0	0	
1	12	9:41	N. Bravo-Paredes	3	0	0	0	
1	13	14:28	A.J.P. Aparicio	4	0	0	0	
1	14	16:10	N. Bravo-Paredes	3	1	2	12	
1	15	14:07	A.J.P. Aparicio	3	1	4	14	
1	16	16:50	J.M. Vaquero	3	1	4	14	
1	17	10:25	N. Bravo-Paredes	3	2	3	23	
1	18	13:30	J.M. Vaquero	2	1	3	13	
1	20	11:25	V.M.S. Carrasco	4	2	6	26	*
1	21	10:50	V.M.S. Carrasco	4	2	9	29	*
1	22	10:10	V.M.S. Carrasco	4	3	8	38	*
1	23	10:10	V.M.S. Carrasco	2	3	4	34	*
1	24	10:10	V.M.S. Carrasco	3	2	3	23	*
1	25	15:15	V.M.S. Carrasco	2	2	5	25	*
1	28	14:40	V.M.S. Carrasco	4	0	0	0	*
1	30	10:00	V.M.S. Carrasco	1	0	0	0	*
2	1	9:20	V.M.S. Carrasco	4	0	0	0	*
2	3	14:15	V.M.S. Carrasco	3	0	0	0	*
2	4	12:10	V.M.S. Carrasco	3	0	0	0	*
2	7	10:00	V.M.S. Carrasco	2	0	0	0	*
2	8	10:25	V.M.S. Carrasco	2	0	0	0	*

2	9	17:00	V.M.S. Carrasco	2	0	0	0	*
2	10	9:55	V.M.S. Carrasco	4	0	0	0	*
2	11	12:15	V.M.S. Carrasco	1	0	0	0	*
2	12	9:50	V.M.S. Carrasco	2	0	0	0	*
2	13	12:00	V.M.S. Carrasco	3	0	0	0	*
2	14	10:00	V.M.S. Carrasco	4	0	0	0	*
2	15	9:45	V.M.S. Carrasco	4	0	0	0	*
2	16	10:15	V.M.S. Carrasco	3	0	0	0	*
2	17	11:00	V.M.S. Carrasco	4	0	0	0	*
2	18	13:15	V.M.S. Carrasco	3	1	1	11	*
2	19	11:00	V.M.S. Carrasco	3	0	0	0	*
2	21	16:15	V.M.S. Carrasco	3	1	1	11	*
2	22	10:40	V.M.S. Carrasco	4	2	5	25	*
2	23	11:25	V.M.S. Carrasco	5	2	13	33	*
2	24	14:30	V.M.S. Carrasco	5	2	18	38	*
2	25	12:30	V.M.S. Carrasco	1	2	6	26	*
2	26	15:00	V.M.S. Carrasco	1	1	4	14	*
2	27	10:20	V.M.S. Carrasco	3	1	4	14	*
2	28	10:30	V.M.S. Carrasco	5	1	3	13	*
3	1	10:20	N. Bravo-Paredes	3	1	2	12	
3	2	10:30	V.M.S. Carrasco	3	1	2	12	
3	3	9:43	A.J.P. Aparicio	2	2	12	32	
3	4	17:25	V.M.S. Carrasco	1	1	2	12	*
3	5	15:45	V.M.S. Carrasco	1	0	0	0	*
3	6	9:10	V.M.S. Carrasco	5	1	2	12	*
3	7	10:00	V.M.S. Carrasco	3	1	5	15	*
3	8	12:57	A.J.P. Aparicio	1	0	0	0	
3	9	10:25	N. Bravo-Paredes	3	2	2	22	
3	10	10:40	V.M.S. Carrasco	3	1	1	11	
3	12	10:20	N. Bravo-Paredes	3	1	1	11	
3	13	10:30	V.M.S. Carrasco	3	1	1	11	*
3	14	9:50	V.M.S. Carrasco	4	2	4	24	*
3	15	11:15	V.M.S. Carrasco	3	1	1	11	
3	16	12:20	A.J.P. Aparicio	3	1	1	11	
3	17	9:40	N. Bravo-Paredes	4	1	2	12	
3	18	11:10	V.M.S. Carrasco	4	1	2	12	
3	19	12:45	V.M.S. Carrasco	2	0	0	0	*
3	20	11:00	V.M.S. Carrasco	3	1	1	11	*
3	21	11:05	V.M.S. Carrasco	2	1	1	11	*
3	22	11:25	A.J.P. Aparicio	4	0	0	0	
3	23	10:25	N. Bravo-Paredes	2	2	3	23	
3	24	11:15	V.M.S. Carrasco	3	2	6	26	
3	25	10:09	A.J.P. Aparicio	4	2	3	23	
3	26	16:15	V.M.S. Carrasco	1	1	1	11	*
3	27	10:45	V.M.S. Carrasco	3	1	1	11	*

3	28	12:10	V.M.S. Carrasco	2	1	1	11	*
3	29	12:05	V.M.S. Carrasco	2	1	1	11	*
3	30	14:30	V.M.S. Carrasco	1	0	0	0	*
3	31	11:10	V.M.S. Carrasco	3	0	0	0	*
4	1	11:20	V.M.S. Carrasco	3	0	0	0	*
4	2	10:00	V.M.S. Carrasco	4	0	0	0	*
4	3	13:55	V.M.S. Carrasco	4	1	2	12	*
4	4	9:10	V.M.S. Carrasco	4	1	3	13	*
4	5	10:20	N. Bravo-Paredes	3	1	1	11	
4	6	9:32	A.J.P. Aparicio	3	0	0	0	
4	7	9:50	N. Bravo-Paredes	2	0	0	0	
4	9	11:38	A.J.P. Aparicio	4	0	0	0	
4	10	10:00	V.M.S. Carrasco	2	0	0	0	*
4	11	11:00	V.M.S. Carrasco	3	0	0	0	*
4	13	12:30	V.M.S. Carrasco	2	1	4	14	*
4	14	16:00	V.M.S. Carrasco	2	1	7	17	*
4	15	12:15	V.M.S. Carrasco	2	1	8	18	*
4	16	14:50	V.M.S. Carrasco	5	2	4	24	*
4	17	9:10	V.M.S. Carrasco	4	1	3	13	*
4	18	10:05	V.M.S. Carrasco	4	1	8	18	*
4	19	10:38	A.J.P. Aparicio	4	2	14	34	
4	20	14:30	V.M.S. Carrasco	4	3	13	43	*
4	21	11:50	V.M.S. Carrasco	2	3	9	39	*
4	22	8:47	A.J.P. Aparicio	4	3	12	42	
4	23	10:00	N. Bravo-Paredes	2	2	11	31	
4	24	11:15	V.M.S. Carrasco	4	4	13	53	*
4	25	10:20	V.M.S. Carrasco	5	3	14	44	*
4	26	9:55	N. Bravo-Paredes	3	1	19	29	
4	27	17:35	I. Tovar	2	4	12	52	
4	29	16:28	I. Tovar	1	2	2	22	
4	30	10:50	A.J.P. Aparicio	4	2	2	22	
5	1	8:50	V.M.S. Carrasco	4	1	1	11	*
5	2	9:00	V.M.S. Carrasco	4	0	0	0	*
5	3	16:15	I. Tovar	3	0	0	0	
5	4	16:35	I. Tovar	3	0	0	0	
5	5	15:00	I. Tovar	4	0	0	0	
5	6	16:50	I. Tovar	4	0	0	0	
5	7	16:55	I. Tovar	4	0	0	0	
5	8	15:24	V.M.S. Carrasco	3	1	6	16	*
5	9	12:22	V.M.S. Carrasco	3	1	5	15	*
5	10	12:31	A.J.P. Aparicio	2	2	6	26	
5	11	16:33	I. Tovar	2	2	5	25	
5	12	9:48	I. Tovar	2	2	6	26	
5	13	10:10	I. Tovar	3	2	5	25	
5	14	10:12	I. Tovar	3	1	2	12	

5	17	10:39	I. Tovar	3	1	1	11	
5	18	11:00	I. Tovar	3	1	1	11	
5	19	10:22	I. Tovar	3	1	1	11	
5	20	10:09	I. Tovar	4	1	1	11	
5	21	9:08	I. Tovar	3	1	1	11	
5	24	11:01	I. Tovar	1	1	1	11	
5	25	10:25	I. Tovar	3	2	7	27	
5	26	10:31	I. Tovar	3	2	11	31	
5	28	10:16	I. Tovar	3	2	5	25	
6	2	10:03	I. Tovar	3	1	4	14	
6	3	10:38	I. Tovar	4	2	9	29	
6	4	10:04	I. Tovar	3	2	7	27	
6	7	9:44	I. Tovar	4	2	7	27	
6	8	11:15	I. Tovar	4	1	5	15	
6	9	9:58	I. Tovar	3	1	2	12	
6	10	11:33	I. Tovar	2	2	8	28	
6	11	9:00	I. Tovar	3	0	0	0	
6	14	9:15	I. Tovar	3	1	1	11	
6	16	11:06	I. Tovar	3	1	1	11	
6	18	8:54	I. Tovar	1	1	1	11	
6	22	10:36	I. Tovar	2	1	1	11	
6	23	10:54	I. Tovar	2	1	1	11	
6	25	8:40	I. Tovar	2	2	3	23	
6	28	10:20	I. Tovar	3	1	8	18	
6	29	9:02	I. Tovar	4	2	15	35	
6	30	10:01	I. Tovar	3	2	12	32	
7	1	9:58	I. Tovar	4	3	11	41	
7	2	8:33	I. Tovar	3	3	16	46	
7	5	8:30	I. Tovar	2	2	3	23	
7	7	9:00	I. Tovar	3	2	6	26	
7	8	9:15	I. Tovar	3	0	0	0	
7	9	8:15	I. Tovar	4	1	1	11	
7	10	10:00	V.M.S. Carrasco	4	1	2	12	*
7	11	12:00	V.M.S. Carrasco	2	2	2	22	*
7	12	8:55	I. Tovar	3	2	2	22	
7	13	9:40	I. Tovar	4	2	4	24	
7	14	10:13	I. Tovar	4	2	3	23	
7	15	8:38	I. Tovar	3	1	1	11	
7	16	8:39	I. Tovar	4	3	4	34	
7	17	10:40	V.M.S. Carrasco	5	2	9	29	*
7	18	11:00	V.M.S. Carrasco	5	4	11	51	*
7	19	18:45	I. Tovar	4	3	8	38	
7	20	9:45	I. Tovar	3	2	7	27	
7	21	9:00	I. Tovar	4	4	10	50	
7	22	8:30	I. Tovar	2	4	7	47	

7	23	9:10	I. Tovar	3	4	7	47	
7	24	17:40	V.M.S. Carrasco	5	2	10	30	
7	25	17:10	V.M.S. Carrasco	4	2	8	28	
7	26	8:49	I. Tovar	3	2	4	24	
7	28	8:55	I. Tovar	2	1	1	11	
7	29	8:41	I. Tovar	3	0	0	0	
7	30	9:10	I. Tovar	4	0	0	0	
8	3	9:45	J.M. Vaquero	3	1	4	14	**
8	4	7:50	J.M. Vaquero	2	1	4	14	**
8	5	9:45	J.M. Vaquero	3	2	4	24	**
8	6	8:50	J.M. Vaquero	2	0	0	0	**
8	7	17:10	J.M. Vaquero	3	0	0	0	**
8	8	17:10	J.M. Vaquero	3	0	0	0	**
8	9	17:30	J.M. Vaquero	2	0	0	0	**
8	10	14:10	J.M. Vaquero	1	0	0	0	**
8	11	17:30	J.M. Vaquero	2	1	1	11	**
8	12	11:30	J.M. Vaquero	2	0	0	0	**
8	13	11:15	J.M. Vaquero	2	0	0	0	**
8	14	17:25	V.M.S. Carrasco	3	3	4	34	*
8	15	16:30	J.M. Vaquero	3	1	5	15	**
8	16	9:15	J.M. Vaquero	2	1	5	15	**
8	17	18:00	J.M. Vaquero	2	1	2	12	**
8	18	9:15	J.M. Vaquero	3	1	2	12	**
8	19	16:50	V.M.S. Carrasco	5	1	3	13	*
8	20	9:30	J.M. Vaquero	3	1	3	13	**
8	21	17:45	J.M. Vaquero	3	1	3	13	**
8	22	10:00	J.M. Vaquero	2	1	3	13	**
8	23	10:00	J.M. Vaquero	2	1	4	14	**
8	24	10:15	J.M. Vaquero	2	1	4	14	**
8	25	10:15	J.M. Vaquero	2	2	6	26	**
8	26	10:30	J.M. Vaquero	2	3	13	43	**
8	27	9:40	J.M. Vaquero	3	4	23	63	**
8	28	8:50	J.M. Vaquero	2	3	22	52	**
8	29	11:30	J.M. Vaquero	2	2	25	45	**
8	30	8:00	J.M. Vaquero	3	2	16	36	**
8	31	10:15	J.M. Vaquero	2	2	14	34	**
9	1	8:50	I. Tovar	1	1	8	18	
9	2	10:30	I. Tovar	3	2	12	32	
9	3	9:30	I. Tovar	3	1	9	19	
9	4	10:00	J.M. Vaquero	3	4	16	56	**
9	5	11:30	J.M. Vaquero	3	4	22	62	**
9	7	17:10	I. Tovar	2	4	22	62	
9	8	16:45	J.M. Vaquero	2	5	35	85	**
9	9	10:35	I. Tovar	2	5	30	80	
9	10	11:15	I. Tovar	2	4	16	56	

9	11	11:45	J.M. Vaquero	3	4	27	67	**
9	12	17:30	J.M. Vaquero	2	2	14	34	**
9	16	10:32	I. Tovar	2	0	0	0	
9	17	10:38	A.J.P. Aparicio	4	0	0	0	
9	18	9:45	J.M. Vaquero	3	0	0	0	**
9	19	11:50	J.M. Vaquero	2	1	2	12	**
9	20	9:50	N. Bravo-Paredes	4	3	15	45	
9	21	10:20	N. Bravo-Paredes	3	3	15	45	
9	22	9:31	A.J.P. Aparicio	3	5	24	74	
9	23	15:00	V.M.S. Carrasco	3	3	19	49	*
9	24	10:00	A.J.P. Aparicio	2	2	22	42	
9	25	17:00	V.M.S. Carrasco	3	2	5	25	*
9	26	15:55	V.M.S. Carrasco	3	4	20	60	*
9	27	10:15	N. Bravo-Paredes	1	2	6	26	
9	28	12:05	N. Bravo-Paredes	2	4	9	49	
9	29	9:45	A.J.P. Aparicio	3	2	24	44	
9	30	11:30	V.M.S. Carrasco	3	2	17	37	
10	3	15:40	V.M.S. Carrasco	3	2	10	30	*
10	4	10:25	N. Bravo-Paredes	2	2	8	28	
10	5	10:10	N. Bravo-Paredes	3	2	7	27	
10	6	10:36	A.J.P. Aparicio	5	2	4	24	
10	7	10:15	V.M.S. Carrasco	4	1	1	11	
10	8	9:22	A.J.P. Aparicio	4	1	7	17	
10	10	11:45	J.M. Vaquero	3	3	10	40	
10	12	11:20	J.M. Vaquero	3	1	4	14	
10	13	9:52	A.J.P. Aparicio	5	2	4	24	
10	14	15:16	V.M.S. Carrasco	2	1	1	11	*
10	15	10:10	A.J.P. Aparicio	2	1	1	11	
10	18	11:55	N. Bravo-Paredes	2	1	1	11	
10	19	9:35	N. Bravo-Paredes	3	1	1	11	
10	20	9:22	A.J.P. Aparicio	4	1	1	11	
10	21	12:00	V.M.S. Carrasco	2	1	1	11	
10	22	9:56	A.J.P. Aparicio	3	2	3	23	
10	23	14:50	V.M.S. Carrasco	3	2	8	28	*
10	25	14:35	V.M.S. Carrasco	3	2	20	40	
10	26	9:55	N. Bravo-Paredes	1	4	32	72	
10	27	10:36	A.J.P. Aparicio	3	5	40	90	
10	28	11:12	A.J.P. Aparicio	3	5	35	85	
11	3	12:22	A.J.P. Aparicio	2	2	5	25	
11	4	11:16	A.J.P. Aparicio	2	2	6	26	
11	5	9:55	N. Bravo-Paredes	3	3	7	37	
11	6	14:10	V.M.S. Carrasco	3	3	6	36	
11	7	11:20	V.M.S. Carrasco	3	2	6	26	
11	8	10:56	A.J.P. Aparicio	2	3	6	36	
11	9	10:10	N. Bravo-Paredes	3	3	6	36	

11	10	10:36	A.J.P. Aparicio	2	3	5	35	
11	11	9:50	N. Bravo-Paredes	4	3	12	42	
11	12	10:48	A.J.P. Aparicio	3	3	6	36	
11	13	11:10	V.M.S. Carrasco	4	3	4	34	*
11	16	10:55	N. Bravo-Paredes	2	3	3	33	
11	17	11:12	A.J.P. Aparicio	4	3	3	33	
11	18	10:43	A.J.P. Aparicio	4	2	2	22	
11	19	12:45	N. Bravo-Paredes	2	2	2	22	
11	22	10:55	N. Bravo-Paredes	2	2	2	22	
11	24	11:13	A.J.P. Aparicio	3	1	9	19	
11	25	11:26	A.J.P. Aparicio	2	1	11	21	
11	26	11:25	N. Bravo-Paredes	3	2	16	36	
11	29	11:30	N. Bravo-Paredes	2	3	9	39	
12	2	10:54	A.J.P. Aparicio	4	2	8	28	
12	3	10:40	A.J.P. Aparicio	4	2	3	23	
12	13	12:05	N. Bravo-Paredes	3	1	1	11	
12	14	12:14	A.J.P. Aparicio	4	3	11	41	
12	15	10:30	N. Bravo-Paredes	2	5	36	86	
12	16	10:19	A.J.P. Aparicio	3	5	48	98	
12	17	11:22	A.J.P. Aparicio	3	6	50	110	
12	17	12:07	D. Rodríguez	4	6	18	78	
12	27	11:35	N. Bravo-Paredes	2	4	37	77	
12	31	11:00	N. Bravo-Paredes	3	5	16	66	

Total number of observations: 276

Total number of days recorded: 275

Table 2. Daily, monthly, and yearly values of number of groups in 2021.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	2	0	1	0	1		3		1			
2	1		1	0	0	1	3		2			2
3	0	0	2	1	0	2		1	1	2	2	2
4	0	0	1	1	0	2		1	4	2	2	
5			0	1	0		2	2	4	2	3	
6	0		1	0	0			0		2	3	
7	0	0	1	0	0	2	2	0	4	1	2	
8		0	0		1	1	0	0	5	1	3	
9		0	2	0	1	1	1	0	5		3	
10	0	0	1	0	2	2	1	0	4	3	3	
11	0	0		0	2	0	2	1	4		3	
12	0	0	1		2		2	0	2	1	3	
13	0	0	1	1	2		2	0		2	3	1
14	1	0	2	1	1	1	2	3		1		3
15	1	0	1	1			1	1		1		5
16	1	0	1	2		1	3	1	0		3	5
17	2	0	1	1	1		2	1	0		3	6
18	1	1	1	1	1	1	4	1	0	1	2	
19		0	0	2	1		3	1	1	1	2	
20	2		1	3	1		2	1	3	1		
21	2	1	1	3	1		4	1	3	1		
22	3	2	0	3		1	4	1	5	2	2	
23	3	2	2	2		1	4	1	3	2		
24	2	2	2	4	1		2	1	2		1	
25	2	2	2	3	2	2	2	2	2	2	1	
26		1	1	1	2		2	3	4	4	2	
27		1	1	4				4	2	5		4
28	0	1	1		2	1	1	3	4	5		
29			1	2		2	0	2	2		3	
30	0		0	2		2	0	2	2			
31			0					2				5
Monthly mean	1.0	0.5	1.0	1.4	1.0	1.4	2.1	1.2	2.7	2.0	2.5	3.7
Yearly mean	1.6											

Table 3. Daily, monthly, and yearly values of number of spots in 2021.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	4	0	2	0	1		11		8			
2	1		2	0	0	4	16		12			8
3	0	0	12	2	0	9		4	9	10	5	3
4	0	0	2	3	0	7		4	16	8	6	
5			0	1	0		3	4	22	7	7	
6	0		2	0	0			0		4	6	
7	0	0	5	0	0	7	6	0	22	1	6	
8		0	0		6	5	0	0	35	7	6	
9		0	2	0	5	2	1	0	30		6	
10	0	0	1	0	6	8	2	0	16	10	5	
11	0	0		0	5	0	2	1	27		12	
12	0	0	1		6		2	0	14	4	6	
13	0	0	1	4	5		4	0		4	4	1
14	2	0	4	7	2	1	3	4		1		11
15	4	0	1	8			1	5		1		36
16	4	0	1	4		1	4	5	0		3	48
17	3	0	2	3	1		9	2	0		3	50
18	3	1	2	8	1	1	11	2	0	1	2	
19		0	0	14	1		8	3	2	1	2	
20	6		1	13	1		7	3	15	1		
21	9	1	1	9	1		10	3	15	1		
22	8	5	0	12		1	7	3	24	3	2	
23	4	13	3	11		1	7	4	19	8		
24	3	18	6	13	1		10	4	22		9	
25	5	6	3	14	7	3	8	6	5	20	11	
26		4	1	19	11		4	13	20	32	16	
27		4	1	12				23	6	40		37
28	0	3	1		5	8	1	22	9	35		
29			1	2		15	0	25	24		9	
30	0		0	2		12	0	16	17			
31			0					14				16
Monthly mean	2.4	2.3	1.9	6.0	2.8	5.0	5.3	5.9	15.0	9.5	6.3	23.3
Yearly mean	6.2											

Table 4. Daily, monthly, and yearly values of SN_{UEx} in 2021.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	24	0	12	0	11		41		18			
2	11		12	0	0	14	46		32			28
3	0	0	32	12	0	29		14	19	30	25	23
4	0	0	12	13	0	27		14	56	28	26	
5			0	11	0		23	24	62	27	37	
6	0		12	0	0			0		24	36	
7	0	0	15	0	0	27	26	0	62	11	26	
8		0	0		16	15	0	0	85	17	36	
9		0	22	0	15	12	11	0	80		36	
10	0	0	11	0	26	28	12	0	56	40	35	
11	0	0		0	25	0	22	11	67		42	
12	0	0	11		26		22	0	34	14	36	
13	0	0	11	14	25		24	0		24	34	11
14	12	0	24	17	12	11	23	34		11		41
15	14	0	11	18			11	15		11		86
16	14	0	11	24		11	34	15	0		33	98
17	23	0	12	13	11		29	12	0		33	110
18	13	11	12	18	11	11	51	12	0	11	22	
19		0	0	34	11		38	13	12	11	22	
20	26		11	43	11		27	13	45	11		
21	29	11	11	39	11		50	13	45	11		
22	38	25	0	42		11	47	13	74	23	22	
23	34	33	23	31		11	47	14	49	28		
24	23	38	26	53	11		30	14	42		19	
25	25	26	23	44	27	23	28	26	25	40	21	
26		14	11	29	31		24	43	60	72	36	
27		14	11	52				63	26	90		77
28	0	13	11		25	18	11	52	49	85		
29			11	22		35	0	45	44		39	
30	0		0	22		32	0	36	37			
31			0					34				66
Monthly mean	12.4	7.7	11.9	20.4	13.3	18.5	26.0	18.3	41.5	29.5	30.8	60.0
Yearly mean	22.0											
Days recorded	23	24	30	27	23	17	26	29	26	21	20	9
Total days recorded	275											

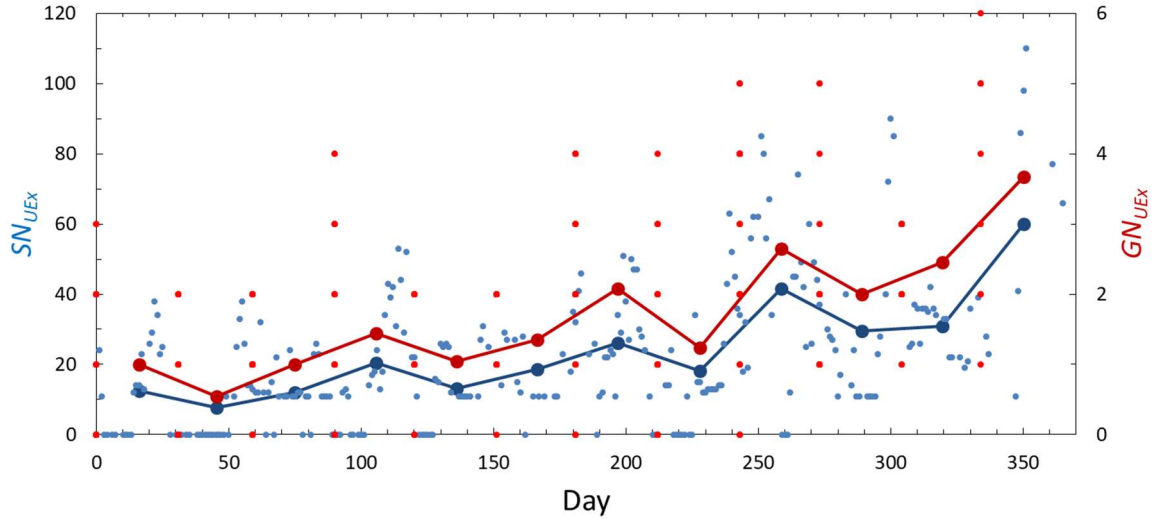


Figure 1. Daily (small dots) and monthly (big dots and lines) UEx sunspot number (SN_{UEx}) (blue) and UEx group number (GN_{UEx}) (red) in 2021.

Relationship with the reference sunspot number index

We have compared SN_{UEx} with the sunspot number (S_N , version 2.0) provided by the World Data Center SILSO, Royal Observatory of Belgium, Brussels (see Figure 2).

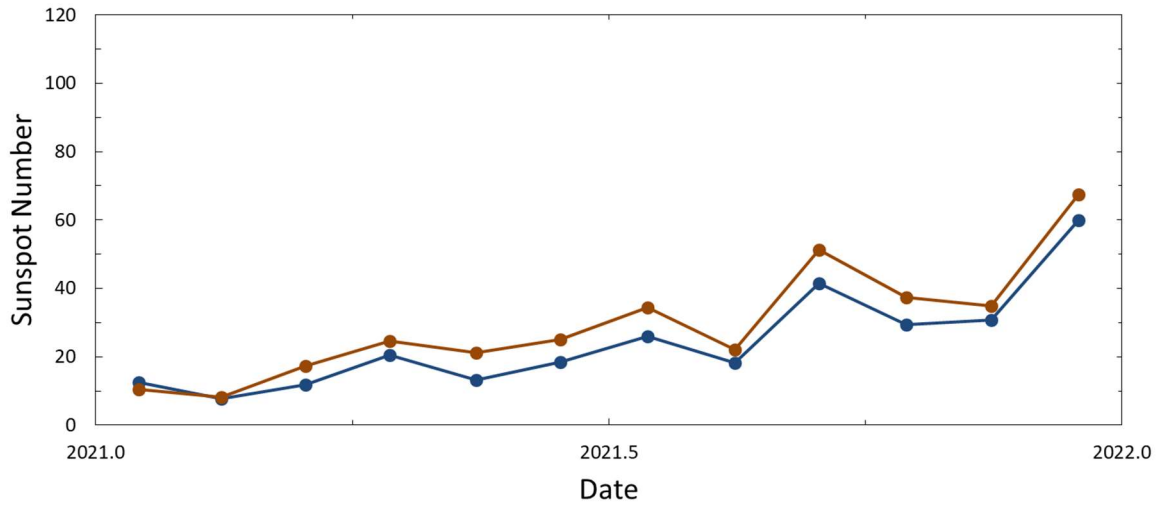


Figure 2. Monthly SN_{UEx} (blue) and sunspot number (S_N) (brown) in 2021.

Figure 3 shows a scatter plot of daily SN_{UEx} versus S_N . The corresponding linear fit equation is:

$$SN_{UEx} = (0.81 \pm 0.02) S_N + (-0.19 \pm 0.63) \quad (r = 0.942; p\text{-value} < 0.001)$$

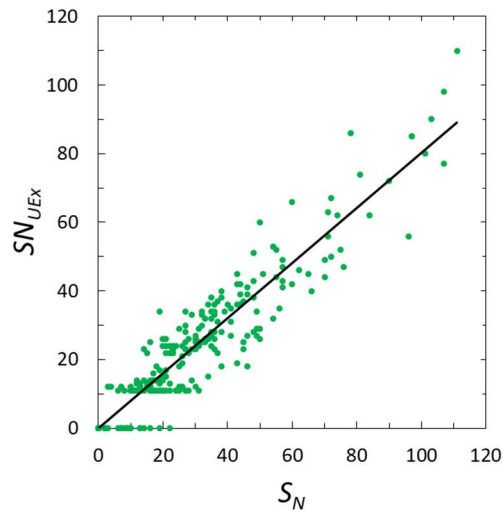


Figure 3. Scatter plot of daily SN_{UEX} versus S_N in 2021.

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References

- Clette, F., Cliver, E.W., Lefèvre, L., Svalgaard, L., Vaquero, J.M.: 2015, *Sp. Weather* **13**, 529. <https://doi.org/10.1002/2015SW001264>
- Clette, F., Cliver, E.W., Lefèvre, L., Svalgaard, L., Vaquero, J.M., Leibacher, J.W.: 2016, *Sol. Phys.* **291**, 2479. <https://doi.org/10.1007/s11207-016-1017-8>
- Clette, F., Svalgaard, L., Vaquero, J.M., Cliver, E.W.: 2014, *Space Sci. Rev.* **186**, 35. <https://doi.org/10.1007/s11214-014-0074-2>
- SILSO, World Data Center - Sunspot Number and Long-term Solar Observations, Royal Observatory of Belgium, on-line Sunspot Number catalogue: <http://www.sidc.be/silso/>, ‘2021’.
- Vaquero, J.M.: 2007, *Adv. Sp. Res.* **40**, 929. <https://doi.org/10.1016/j.asr.2007.01.087>