

# Monthly Report (00)

## 2023.07 Data Set

Monday 14<sup>th</sup> August, 2023

Prepared for

**Statistics for Physical and Engineering Sciences**

by

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## 1 Introduction

The process of reporting monthly Sunspot numbers consists of submitting individual observer's daily counts for a specific month to the AAVSO Solar Section. These data are maintained in a SQL database. The monthly data then are extracted for analysis using the R statistics package (<http://www.R-project.org/>). This report is the portion of the analysis concerned with both the raw daily average counts and the data Accuracy, Consistency, and Completeness measures for a particular month. The checks are used to scrub or filter the data to assure only error-free data are used to determine the monthly sunspot number.

This report consists of four sections: the raw daily average counts (Section 2), the known data errors (Section 3), the processed counts using a Generalized Linear Mixed Model to produce the relative sunspot numbers (Section 4), and supporting information on the model construction (Section 5).

The raw daily average of counts consist of submitted counts from all observers who provided data in the particular month. These averaged counts are reported by the day of the month, and are either from data not scrubbed or corrected data. The table captions indicate which. The errors, if any, are reported according to type.

The Error Tables section contains reported errors on missing data, inconsistencies in year and month, inconsistencies in the reported day number (1-31), seeing coding errors, number of annual observations by observer, and inconsistencies between the reported Wolf number and the calculated Wolf number from the group counts and sunspot counts, among other errors that are given in that section.

The relative sunspot numbers  $R_a$  section contains the sunspot numbers after the submitted data are scrubbed and modeled by a Generalized Linear Mixed Model (GLMM). The GLMM is a statistical model that accounts for variation due to random effects and fixed effects. For the  $R_a$  model random effects include the AAVSO observer as these observers are a selection from all possible observers, and the fixed effects include seeing conditions at one of four possible levels. More details on GLMM are available in a paper (GLMM05) on the sunspot counts research page. The paper title is *A Generalized Linear Mixed Model for Enumerated Sunspots*.

The supporting information for the model is provided for clarification.

## 2 Raw Daily Average Counts

The reported raw daily average counts have been checked for errors and inconsistencies, and no known errors are present. All observers whose submissions qualify through this month's scrubbing process are represented in Figure 1 and Table 1.

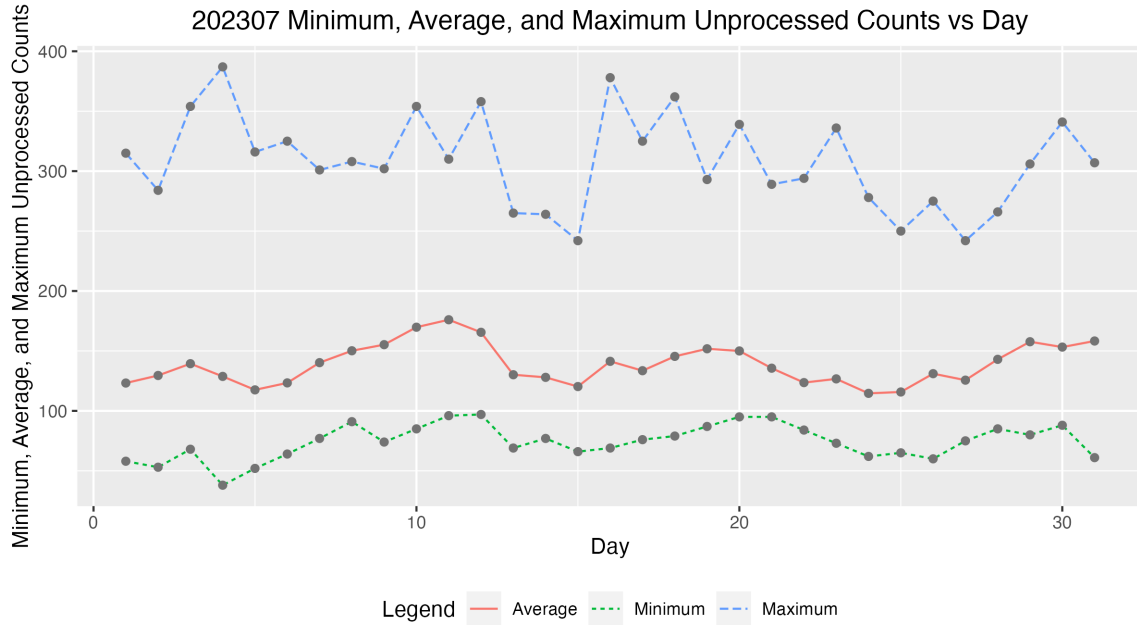


Figure 1: Raw average sunspot count by day of the month.

Table 1: 202307 Daily Raw Counts

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Day	Submissions	Minimum	Average	Maximum
1.0000	35.0000	58.0000	123.2286	315.0000
2.0000	41.0000	53.0000	129.5366	284.0000
3.0000	37.0000	68.0000	139.3784	354.0000
4.0000	41.0000	38.0000	128.7561	387.0000
5.0000	38.0000	52.0000	117.5263	316.0000
6.0000	46.0000	64.0000	123.3478	325.0000
7.0000	45.0000	77.0000	140.2444	301.0000
8.0000	40.0000	91.0000	150.1500	308.0000
9.0000	40.0000	74.0000	155.2500	302.0000
10.0000	40.0000	85.0000	169.8000	354.0000
11.0000	32.0000	96.0000	176.0312	310.0000
12.0000	38.0000	97.0000	165.5526	358.0000
13.0000	40.0000	69.0000	130.1500	265.0000
14.0000	39.0000	77.0000	127.9744	264.0000
15.0000	37.0000	66.0000	120.2973	242.0000
16.0000	35.0000	69.0000	141.3429	378.0000
17.0000	40.0000	76.0000	133.5250	325.0000
18.0000	44.0000	79.0000	145.4773	362.0000
19.0000	32.0000	87.0000	151.8125	293.0000
20.0000	45.0000	95.0000	150.0000	339.0000
21.0000	36.0000	95.0000	135.6111	289.0000
22.0000	44.0000	84.0000	123.5909	294.0000
23.0000	40.0000	73.0000	126.7000	336.0000
24.0000	38.0000	62.0000	114.6316	278.0000
25.0000	39.0000	65.0000	115.7692	250.0000
26.0000	42.0000	60.0000	131.0476	275.0000
27.0000	30.0000	75.0000	125.6333	242.0000
28.0000	37.0000	85.0000	143.0000	266.0000
29.0000	36.0000	80.0000	157.6944	306.0000
30.0000	41.0000	88.0000	153.2195	341.0000
31.0000	37.0000	61.0000	158.2973	307.0000

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### 3 Error Tables

Data are for the month of July 2023. No errors were found, and hence no errors are reported.

### 4 Relative Sunspot Numbers

All data errors, if any, have been corrected prior to determining the following relative sunspot numbers. A Generalized Linear Mixed Model (GLMM) was constructed to provide monthly sunspot numbers (see Table 2). The GLMM treats observer as a random effect, with year, month, seeing conditions, observer rank, and dual submission to both AAVSO and SILSO as fixed effects.

Figure 2 shows the monthly  $R_a$  numbers for the years and months (ym) in Table 2. The solid cyan curve that connects the cyan X's are the GLMM model estimates given in 2. The dotted black curves on either side of the cyan curve depict a 99% confidence band about the GLMM estimates. The confidence band uses the large sample approximation based on the Gaussian distribution. The dashed red curve connecting the red O's are the SILSO values for the monthly sequence.

The tan box plots for each month are the actual observations submitted by the AAVSO observers. The heavy solid lines approximately midway in the boxes represent the count medians. The box of the box plot represents the InterQuartile Range (IQR), which depicts from the 25<sup>th</sup> through the 75<sup>th</sup> quartiles. The lower and upper whiskers extend 1.5 times the IQR below the 25<sup>th</sup> quartile, and 1.5 times the IQR above the 75<sup>th</sup> quartile. The black circles below and above the whiskers traditionally are considered outliers, but with GLMM modeling, they are observations that comprise overdispersion. Overdispersion skews the counts data from a true Poisson distribution. The GLMM adjusts for this overdispersion.

Table 2: Year Month (ym) Relative Sunspot Numbers with 99% CI

ym	Ra	lci99	uci99	aavso	sidc
2008.12	2.7705	2.4284	3.1126	0.5000	1.0000
2009.01	5.1805	4.6515	5.7095	1.3000	1.3000
2009.02	4.6309	4.1434	5.1184	0.7000	1.2000
2009.03	5.9937	5.7730	6.2144	0.3000	0.6000
2009.04	6.4907	6.2749	6.7065	0.4000	1.2000
2009.05	6.8833	6.6260	7.1405	1.6000	2.9000
2009.06	6.7790	6.4557	7.1023	3.2000	6.3000
2009.07	6.4694	6.2171	6.7217	3.6000	5.5000
2009.08	6.6517	6.4125	6.8910	0.0000	0.0000
2009.09	7.3306	7.0863	7.5749	4.5000	7.1000
2009.10	6.8557	6.5075	7.2040	4.5000	7.7000
2009.11	6.8647	6.6702	7.0593	3.3000	6.9000
2009.12	7.3241	7.1050	7.5432	10.4000	16.3000
2010.01	19.5723	17.4774	21.6672	13.3000	19.5000
2010.02	15.8354	13.8179	17.8529	19.4000	28.5000

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Table 2: Year Month (ym) Relative Sunspot Numbers with 99% CI

ym	Ra	lci99	uci99	aavso	sidc
2010.03	17.5082	15.4577	19.5587	15.4000	24.0000
2010.04	18.6015	16.5332	20.6699	7.0000	10.4000
2010.05	22.7687	22.3414	23.1960	8.4000	8.7000
2010.06	21.0957	20.7081	21.4833	11.0000	13.6000
2010.07	22.0454	21.6810	22.4099	15.2000	16.1000
2010.08	21.7988	21.3910	22.2066	18.3000	19.6000
2010.09	25.1169	24.6460	25.5879	22.8000	25.2000
2010.10	23.8781	23.4008	24.3553	21.0000	23.5000
2010.11	24.2301	23.7552	24.7050	20.9000	21.6000
2010.12	24.9611	24.4222	25.4999	13.9000	14.5000
2011.01	70.3070	68.7762	71.8377	17.7000	18.7000
2011.02	61.8824	60.4744	63.2904	29.1000	29.6000
2011.03	66.0672	64.7032	67.4312	48.0000	55.8000
2011.04	71.6416	70.1551	73.1282	47.3000	54.4000
2011.05	75.7807	74.3571	77.2043	37.3000	41.5000
2011.06	69.8608	68.5244	71.1972	35.2000	37.0000
2011.07	71.9371	70.6280	73.2461	41.5000	43.8000
2011.08	71.9218	70.6710	73.1726	42.4000	50.5000
2011.09	81.8876	80.3316	83.4437	73.8000	78.0000
2011.10	77.6101	76.1864	79.0339	78.9000	88.0000
2011.11	78.8073	77.1156	80.4990	84.6000	96.7000
2011.12	79.4669	77.7850	81.1487	65.8000	73.0000
2012.01	75.6295	74.0721	77.1869	55.8000	58.2000
2012.02	65.5192	64.1089	66.9295	29.2000	33.1000
2012.03	70.4927	69.1849	71.8005	53.1000	64.1000
2012.04	74.8178	73.3872	76.2484	51.4000	55.2000
2012.05	81.0301	79.5752	82.4850	61.8000	69.0000
2012.06	74.2599	72.9074	75.6123	59.7000	64.5000
2012.07	77.1516	75.7843	78.5189	64.2000	51.3000
2012.08	74.1892	72.8914	75.4869	57.7000	63.1000
2012.09	84.7522	83.2019	86.3025	57.7000	61.5000
2012.10	81.2773	79.7046	82.8501	48.3000	53.3000
2012.11	82.9191	81.1865	84.6518	56.7000	61.4000
2012.12	83.4584	81.5985	85.3183	37.4000	40.8000
2013.01	83.8222	82.1544	85.4901	63.8000	62.9000
2013.02	72.7351	71.1967	74.2735	37.8000	38.0000
2013.03	75.8942	74.2848	77.5037	50.6000	57.9000
2013.04	81.5681	80.0428	83.0934	70.6000	72.4000
2013.05	86.2881	84.6326	87.9436	77.4000	78.7000

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Table 2: Year Month (ym) Relative Sunspot Numbers with 99% CI

ym	Ra	lci99	uci99	aavso	sidc
2013.06	80.6823	79.1374	82.2272	51.0000	52.5000
2013.07	82.8664	81.4173	84.3154	57.0000	57.0000
2013.08	81.4238	80.0106	82.8370	60.0000	66.0000
2013.09	91.4314	89.7066	93.1562	34.6000	36.9000
2013.10	86.5633	84.8701	88.2565	74.5000	85.6000
2013.11	86.9546	84.8890	89.0202	73.9000	77.6000
2013.12	89.9490	87.9750	91.9230	77.8000	90.3000
2014.01	97.9923	95.8599	100.1248	77.4000	82.0000
2014.02	86.9102	85.0820	88.7383	93.9000	102.8000
2014.03	92.6718	90.8939	94.4497	80.9000	92.2000
2014.04	99.7302	97.8635	101.5969	76.9000	84.7000
2014.05	106.0479	104.1342	107.9617	72.3000	75.2000
2014.06	99.0463	97.2416	100.8510	67.2000	71.0000
2014.07	101.2967	99.4735	103.1199	72.5000	72.5000
2014.08	99.5969	97.9344	101.2593	71.2000	74.7000
2014.09	113.1374	111.0045	115.2703	83.2000	87.6000
2014.10	106.5504	104.4973	108.6036	59.5000	60.6000
2014.11	108.0542	105.6896	110.4188	65.8000	71.1000
2014.12	109.0573	106.5025	111.6121	75.8000	78.0000
2015.01	60.5880	59.3488	61.8272	65.9000	67.0000
2015.02	52.5904	51.3564	53.8243	42.4000	44.8000
2015.03	56.8468	55.7535	57.9401	38.0000	38.4000
2015.04	60.8542	59.6871	62.0214	49.0000	54.4000
2015.05	64.6954	63.5627	65.8281	56.3000	58.8000
2015.06	59.9970	58.8979	61.0961	50.2000	68.3000
2015.07	60.7191	59.6847	61.7534	47.9000	65.8000
2015.08	60.9113	59.8867	61.9359	39.5000	57.2000
2015.09	68.5310	67.2810	69.7811	49.2000	72.1000
2015.10	64.9932	63.7342	66.2522	39.3000	48.3000
2015.11	66.4587	64.9947	67.9226	39.6000	55.9000
2015.12	67.7832	66.2626	69.3038	36.4000	44.8000
2016.01	33.1466	32.4495	33.8437	33.7000	43.3000
2016.02	28.7423	28.1380	29.3466	38.3000	46.8000
2016.03	30.6300	30.0119	31.2481	30.5000	38.9000
2016.04	32.5647	31.9376	33.1918	26.6000	30.9000
2016.05	34.7839	34.1450	35.4228	33.7000	48.4000
2016.06	32.0326	31.4815	32.5837	13.1000	19.5000
2016.07	33.1180	32.5817	33.6544	21.2000	27.5000
2016.08	32.8066	32.2243	33.3890	33.0000	47.9000

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Table 2: Year Month (ym) Relative Sunspot Numbers with 99% CI

ym	Ra	lci99	uci99	aavso	sidc
2016.09	37.7484	37.0539	38.4429	27.7000	37.1000
2016.10	35.5075	34.8191	36.1959	22.7000	31.7000
2016.11	35.9108	35.1553	36.6662	14.0000	22.2000
2016.12	37.0807	36.2785	37.8829	11.1000	20.0000
2017.01	17.8552	17.4752	18.2353	18.4000	26.2000
2017.02	15.5450	15.1996	15.8903	14.4000	20.6000
2017.03	16.6796	16.3580	17.0013	11.3000	15.5000
2017.04	17.9134	17.5941	18.2327	21.6000	33.2000
2017.05	18.8915	18.5619	19.2210	12.5000	18.1000
2017.06	17.3538	17.0641	17.6436	15.5000	19.3000
2017.07	18.0142	17.7242	18.3043	11.5000	16.3000
2017.08	17.8164	17.5044	18.1284	22.8000	35.7000
2017.09	20.8103	20.3739	21.2468	34.6000	42.9000
2017.10	19.0476	18.6563	19.4389	10.5000	11.0000
2017.11	19.1717	18.7642	19.5792	4.2000	5.6000
2017.12	19.6861	19.3848	19.9874	4.0000	4.6000
2018.01	4.9787	4.8717	5.0857	3.1000	6.3000
2018.02	4.2950	4.1911	4.3990	6.8000	11.8000
2018.03	4.5394	4.4478	4.6311	1.1000	1.2000
2018.04	4.8168	4.7201	4.9134	4.7000	7.5000
2018.05	5.1513	5.0556	5.2471	8.4000	14.0000
2018.06	4.7537	4.6700	4.8374	10.2000	13.6000
2018.07	4.9467	4.8913	5.0021	0.5000	1.7000
2018.08	4.8341	4.7512	4.9169	5.9000	9.5000
2018.09	5.4451	5.3433	5.5470	1.6000	2.9000
2018.10	5.2526	5.1502	5.3549	2.5000	5.6000
2018.11	5.2966	5.1861	5.4072	3.1000	4.2000
2018.12	5.5337	5.4259	5.6414	1.6000	2.3000
2019.01	3.3059	3.2430	3.3687	5.4000	2.3000
2019.02	2.9060	2.8487	2.9633	0.1000	1.2000
2019.03	3.0401	2.9884	3.0917	6.1000	12.1000
2019.04	3.2663	3.2050	3.3276	6.2000	9.3000
2019.05	3.3846	3.3257	3.4434	7.0000	11.9000
2019.06	3.1377	3.0848	3.1907	0.7000	1.5000
2019.07	3.2547	3.2065	3.3029	0.4000	2.2000
2019.08	3.2320	3.1842	3.2798	0.3000	0.8000
2019.09	3.7161	3.6579	3.7744	0.5000	1.0000
2019.10	3.4786	3.4197	3.5375	0.2000	0.5000
2019.11	3.5905	3.5216	3.6593	0.3000	0.6000

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Table 2: Year Month (ym) Relative Sunspot Numbers with 99% CI

ym	Ra	lci99	uci99	aavso	sidc
2019.12	3.6578	3.5849	3.7307	0.8000	1.0000
2020.01	7.3158	7.1729	7.4587	4.0000	5.3000
2020.02	6.3694	6.2419	6.4969	0.1000	0.0000
2020.03	6.7247	6.5994	6.8500	1.2000	1.5000
2020.04	7.2703	7.1518	7.3889	3.0000	5.1000
2020.05	7.5926	7.4751	7.7101	0.1000	0.4000
2020.06	7.0789	6.9704	7.1875	3.9000	6.4000
2020.07	7.2393	7.1326	7.3459	4.2000	7.7000
2020.08	7.0866	6.9882	7.1850	5.3000	7.8000
2020.09	8.1175	7.9870	8.2480	0.4000	0.9000
2020.10	7.7803	7.6519	7.9086	9.9000	13.6000
2020.11	7.9366	7.8072	8.0660	21.2000	33.1000
2020.12	8.1214	7.9755	8.2673	15.4000	19.8000
2021.01	25.5498	25.0947	26.0049	7.0000	15.8000
2021.02	22.6555	22.2551	23.0559	5.8000	10.7000
2021.03	24.0679	23.6900	24.4457	11.0000	17.2000
2021.04	26.1771	25.7198	26.6343	18.5000	28.8000
2021.05	27.6386	27.1981	28.0791	15.9000	22.9000
2021.06	25.5862	25.1689	26.0034	19.9000	24.1000
2021.07	26.0644	25.6245	26.5043	23.8000	35.6000
2021.08	26.3562	25.9172	26.7952	15.7000	19.5000
2021.09	29.8532	29.3363	30.3701	39.1000	52.5000
2021.10	28.9599	28.4456	29.4741	27.1000	37.0000
2021.11	29.1078	28.5730	29.6426	27.2000	35.1000
2021.12	30.6079	29.9839	31.2320	50.6000	69.0000
2022.01	72.8491	71.5132	74.1851	43.9000	62.0000
2022.02	64.3024	63.0832	65.5216	48.8000	60.5000
2022.03	69.0536	67.7586	70.3486	58.4000	80.6000
2022.04	71.6510	70.4547	72.8473	59.1000	83.9000
2022.05	78.3088	77.0276	79.5899	72.5000	0.4000
2022.06	70.4936	69.3600	71.6272	58.9000	0.4000
2022.07	73.8950	72.6617	75.1283	76.7000	102.5000
2022.08	73.1621	71.9720	74.3521	63.3000	86.0000
2022.09	82.8328	81.2609	84.4047	72.6000	94.5000
2022.10	78.7696	77.3355	80.2037	66.4000	112.1000
2022.11	79.5144	77.9281	81.1007	54.3000	82.1000
2022.12	82.1303	80.3072	83.9535	93.7000	165.0000
2023.01	132.0639	129.1240	135.0039	112.9000	173.8000
2023.02	113.6762	111.2201	116.1324	89.6000	152.3000

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Table 2: Year Month (ym) Relative Sunspot Numbers with 99% CI

ym	Ra	lci99	uci99	aavso	sidc
2023.03	118.0482	115.5331	120.5632	85.0000	126.8000
2023.04	126.9553	124.4735	129.4371	72.1000	114.3000
2023.05	134.9256	132.2765	137.5746	105.0000	140.0000
2023.06	126.7139	125.3054	128.1224	118.5000	173.0000
2023.07	127.0473	124.7264	129.3682	124.7000	161.2000

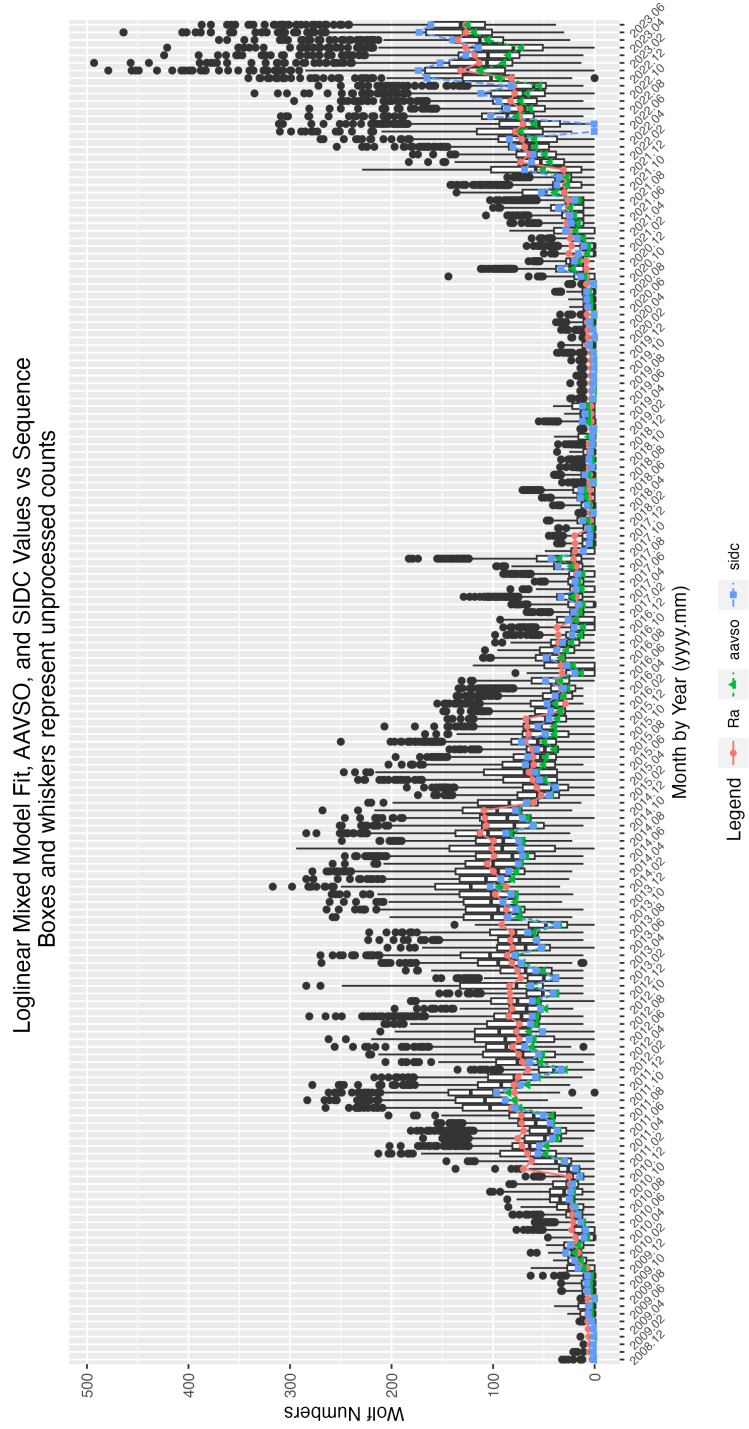


Figure 2: GLMM fitted data for  $R_a$ . AAVSO data: <https://www.aavso.org/category/tags/solar-bulletin>. SILSO data: WDC-SILSO, Royal Observatory of Belgium, Brussels

The GLMM parameter estimates and measures of importance in the determining the monthly  $R_a$  values are given in Table 3. The parameter estimates and levels of statistical significance are determined for the residual error size combined with the observer random effect error size. Thus, the parameter estimates are adjusted for the random effect of observer. The significance level is set at 0.05. Any  $\Pr(>|z|)$  values equal to or less than 0.05 are considered statistically significant.

The year effect levels are given as year2011, year2012, and year2013. The yearly effect is significant as  $\Pr(>|z|) < 0.05$ . So the year in which the observations are made is commensurate with the expected rise toward and anticipated sunspot number maximum. Similarly, the monthly effect, denoted as mon2 through mon12, is significant at the 0.05 level.

The seeing conditions account for a significant amount of deviation in sunspot numbers. The seeing conditions are denoted as seeF (Fair), seeG (Good), and seeP (Poor), and are significant at the 0.05 level. Therefore, seeing conditions influence the reported sunspot numbers, as intuition anticipates.

The level of observer experience (denoted r1000B through r5000H, which is least to most experience) is not significant at the 0.05 significance level. It therefore does not contribute to changes in the monthly sunspot numbers.

Whether an observer contributes counts to the SILSO as well as the AAVSO (silsoy) is not significant at the 0.05 level, and hence we conclude that those observers who contribution to both institutions tend to differ from those observers contributing only to the AAVSO.

## 5 Supporting Information

Table 3: 202307 Parameter Estimates

	Estimate	Std. Error	t-value	Pr(> t )
(Intercept)	1.1764	0.3147	3.7381	0.0002
seeG	-0.1136	0.0043	-26.3093	0.0000
seeF	-0.2284	0.0049	-46.1728	0.0000
seeP	-0.3183	0.0071	-44.6215	0.0000
seeM	-0.1830	0.0243	-7.5438	0.0000
sidc1	0.0469	0.0112	4.1835	0.0000
year2009	0.7656	0.3162	2.4209	0.0155
year2010	1.9998	0.3140	6.3681	0.0000
year2011	3.1506	0.3139	10.0359	0.0000
year2012	3.1940	0.3139	10.1744	0.0000
year2013	3.2888	0.3139	10.4765	0.0000
year2014	3.4881	0.3139	11.1114	0.0000
year2015	3.0085	0.3139	9.5835	0.0000
year2016	2.3928	0.3140	7.6213	0.0000
year2017	1.7795	0.3140	5.6671	0.0000
year2018	0.4964	0.3143	1.5793	0.1143
year2019	0.0851	0.3145	0.2707	0.7866
year2020	0.8912	0.3142	2.8370	0.0046
year2021	2.1720	0.3140	6.9176	0.0000
year2022	3.1671	0.3139	10.0882	0.0000
year2023	3.7385	0.3139	11.9080	0.0000
mon2	-0.1339	0.0077	-17.4223	0.0000
mon3	-0.0751	0.0073	-10.3339	0.0000
mon4	-0.0154	0.0071	-2.1757	0.0296
mon5	0.0397	0.0069	5.7812	0.0000
mon6	-0.0387	0.0067	-5.7872	0.0000
mon7	-0.0153	0.0069	-2.2308	0.0257
mon8	-0.0241	0.0072	-3.3649	0.0008
mon9	0.1133	0.0072	15.8024	0.0000
mon10	0.0619	0.0073	8.4403	0.0000
mon11	0.0894	0.0076	11.7104	0.0000
mon12	0.1170	0.0076	15.4005	0.0000

Table 4: 202307 Summary of Sunspot Numbers

year	mon	day	obs	sidc
Min. :2008	Min. : 1.000	Min. : 0.0	Length:173048	Min. :0.0000
1st Qu.:2013	1st Qu.: 4.000	1st Qu.: 8.0	Class :character	1st Qu.:0.0000
Median :2017	Median : 7.000	Median :16.0	Mode :character	Median :0.0000
Mean :2017	Mean : 6.533	Mean :15.7		Mean :0.2409
3rd Qu.:2020	3rd Qu.: 9.000	3rd Qu.:23.0		3rd Qu.:0.0000
Max. :2023	Max. :12.000	Max. :31.0		Max. :1.0000

Table 5: 202307 Summary of Sunspot Numbers

g	s	w	see	method
Min. : 0.000	Min. : 0.00	Min. : 0.0	E:36259	Length:173048
1st Qu.: 1.000	1st Qu.: 1.00	1st Qu.: 11.0	G:71031	Class :character
Median : 2.000	Median : 10.00	Median : 35.0	F:50714	Mode :character
Mean : 3.093	Mean : 17.97	Mean : 48.9	P:14259	
3rd Qu.: 5.000	3rd Qu.: 27.00	3rd Qu.: 78.0	M: 785	
Max. :30.000	Max. :295.00	Max. :493.0		

Table 6: 202307 Summary of Sunspot Numbers

inst	filter	unit
Length:173048	Length:173048	Length:173048
Class :character	Class :character	Class :character
Mode :character	Mode :character	Mode :character

Table 7: 202307 Summary of Sunspot Numbers

aperture	eyep	foclen	mag
Min. : 0.00	Min. : 0.00	Min. : 0.0	Min. : 0.0
1st Qu.: 60.00	1st Qu.: 4.00	1st Qu.: 150.0	1st Qu.: 40.0
Median : 80.00	Median : 14.00	Median : 900.0	Median : 57.0
Mean : 93.03	Mean : 38.79	Mean : 889.6	Mean : 180.5
3rd Qu.: 104.00	3rd Qu.: 23.00	3rd Qu.:1200.0	3rd Qu.: 72.0
Max. :1524.00	Max. :2010.00	Max. :9990.0	Max. :4591.0

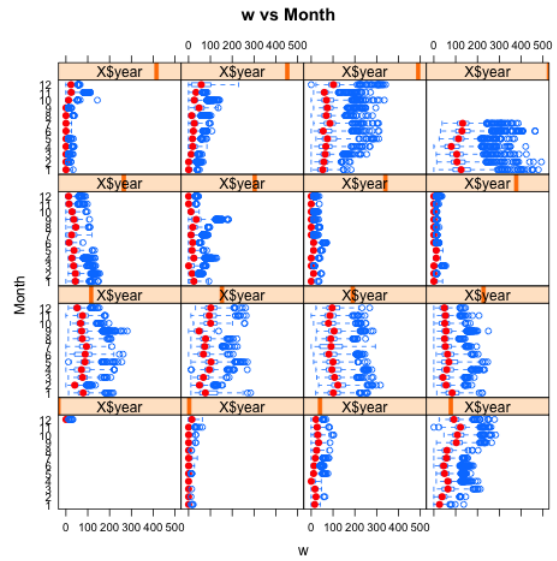
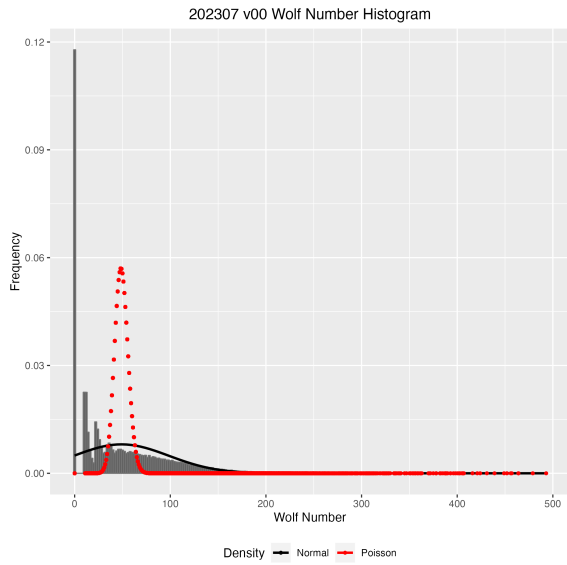


Figure 3: Box plots of raw Wolf number (w) by observer rank.

Figure 4: Box plots of raw Wolf number (w) by month and year.

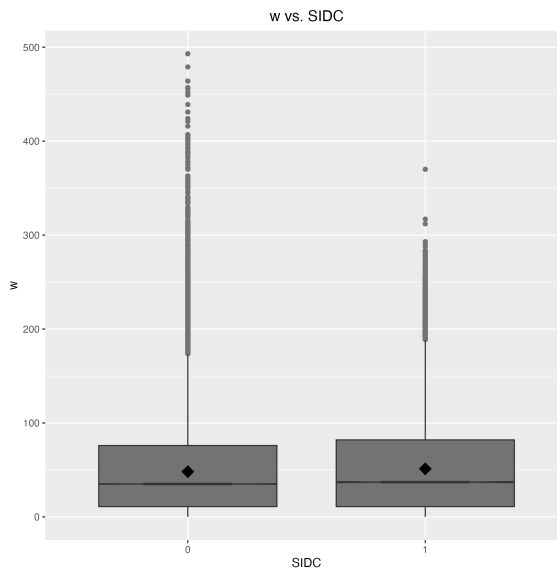
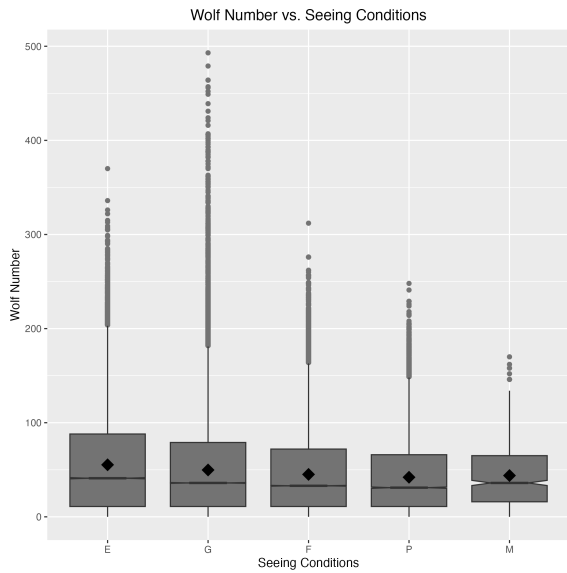


Figure 5: Box plots of raw Wolf number (w) by seeing condition.

Figure 6: Box plots of raw Wolf number (w) by organization.



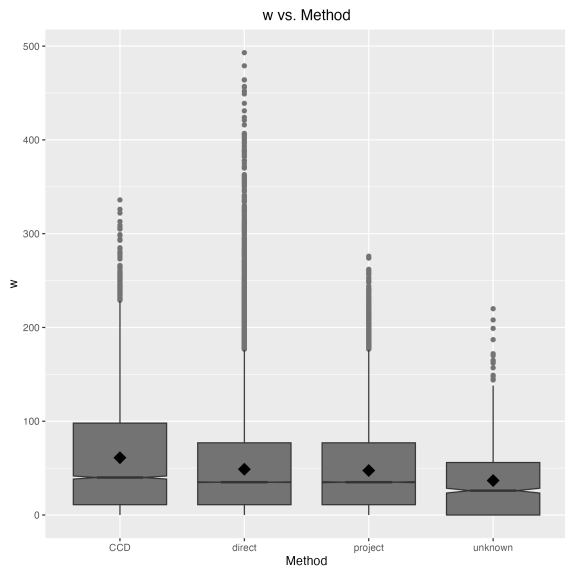


Figure 7: Box plots of raw Wolf number (w) by observer rank.

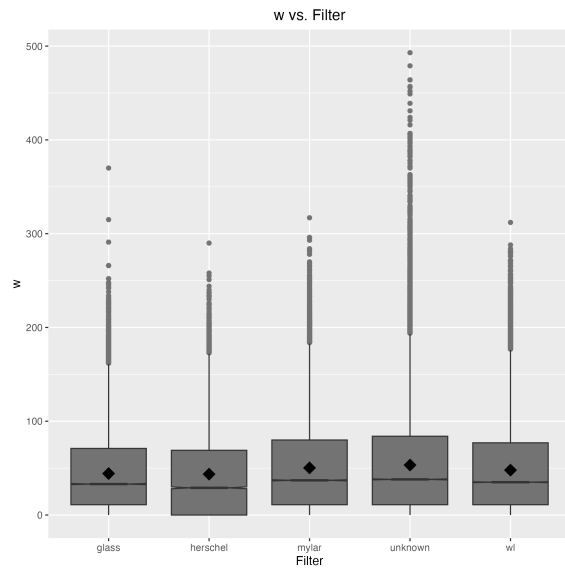


Figure 8: Box plots of raw Wolf number (w) by month and year.

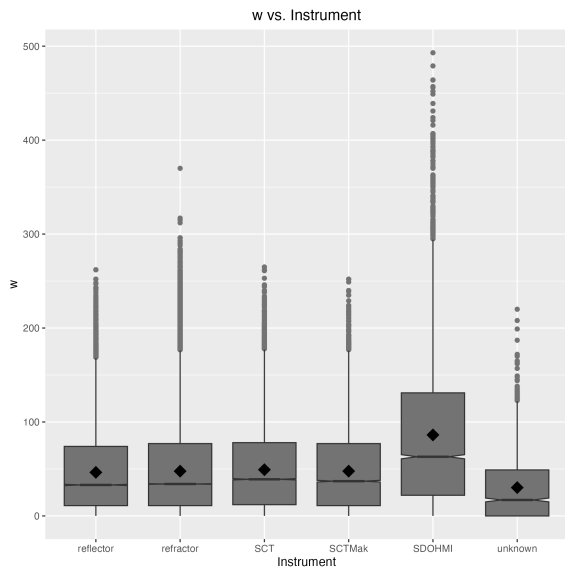


Figure 9: Box plots of raw Wolf number (w) by seeing condition.

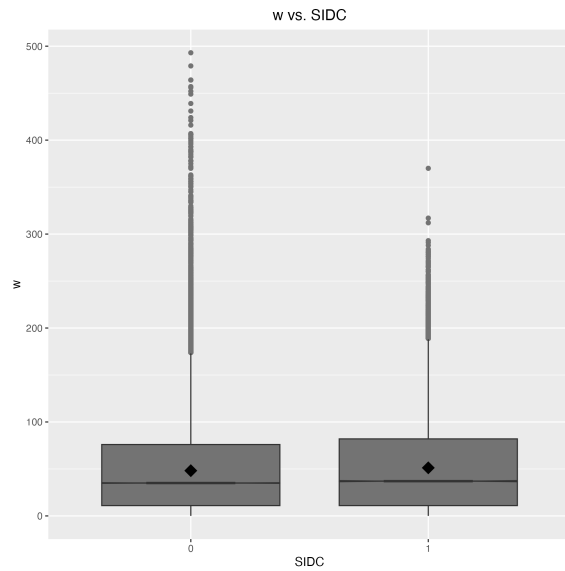


Figure 10: Box plots of raw Wolf number (w) by organization.

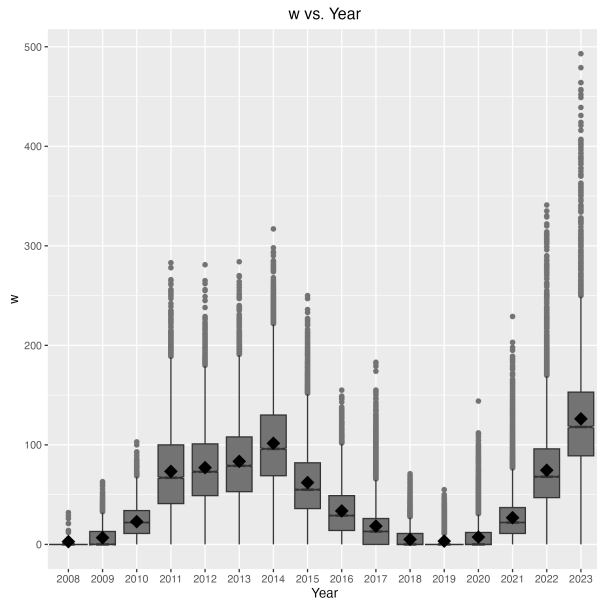


Figure 11: Box plots of raw Wolf number ( $w$ ) by year.

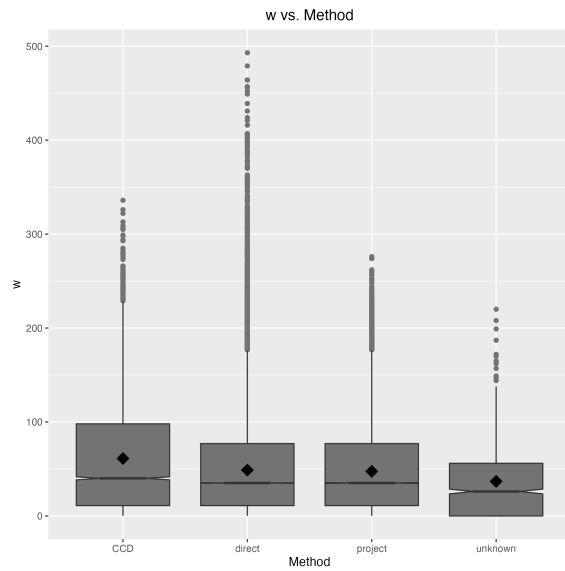


Figure 12: Box plots of raw Wolf number ( $w$ ) by observing method.