Monthly Report (00)

202212 Data Set

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Prepared for

Statistics for Physical and Engineering Sciences

by

Jamie Riggs, Ph.D.

Principal Statistician
Statistics for Physical and Engineering Sciences Institute

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.

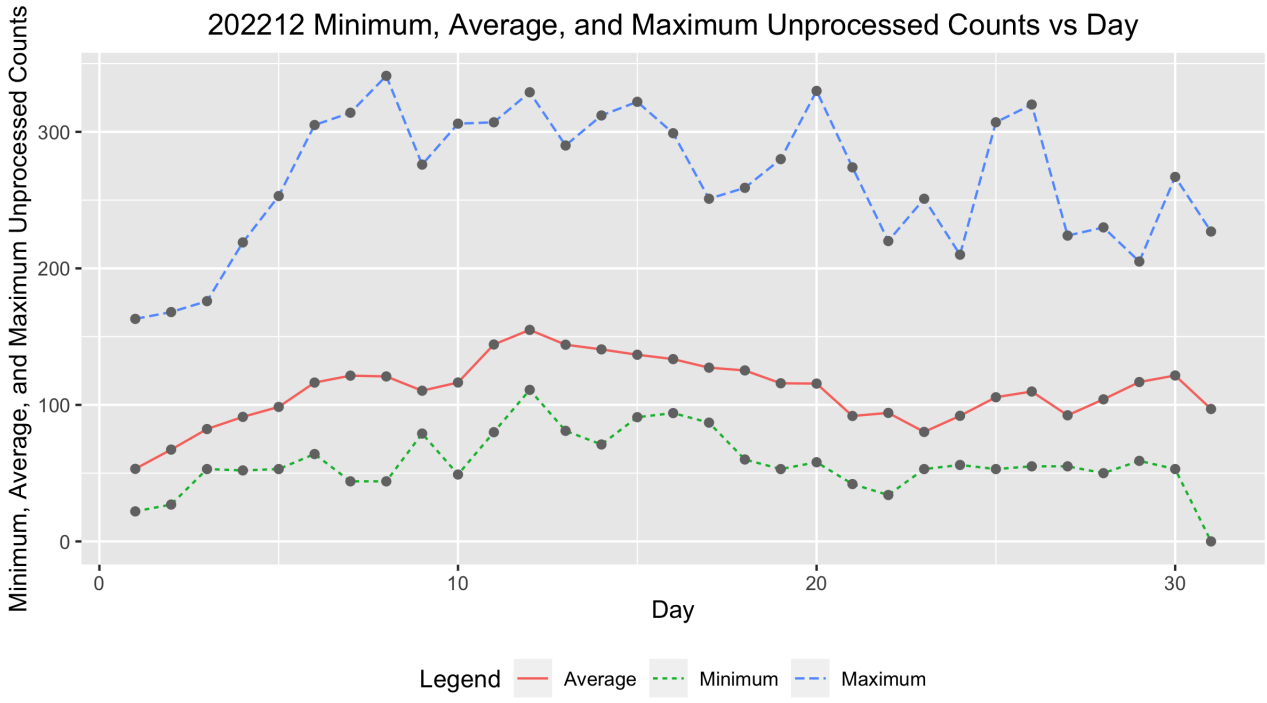

Figure 1: Raw average sunspot count by day of the month.

Table 1: 202212 Daily Raw Counts

Day	Submissions	Minimum	Average	Maximum
1.0000	33.0000	22.0000	53.1515	163.0000
2.0000	28.0000	27.0000	67.2500	168.0000
3.0000	20.0000	53.0000	82.3000	176.0000
4.0000	27.0000	52.0000	91.2222	219.0000
5.0000	21.0000	53.0000	98.5238	253.0000
6.0000	26.0000	64.0000	116.3462	305.0000
7.0000	26.0000	44.0000	121.4231	314.0000
8.0000	32.0000	44.0000	120.8438	341.0000
9.0000	26.0000	79.0000	110.3846	276.0000
10.0000	27.0000	49.0000	116.4074	306.0000
11.0000	17.0000	80.0000	144.2353	307.0000
12.0000	19.0000	111.0000	154.9474	329.0000
13.0000	21.0000	81.0000	144.0952	290.0000
14.0000	32.0000	71.0000	140.6562	312.0000
15.0000	27.0000	91.0000	136.7407	322.0000
16.0000	28.0000	94.0000	133.5357	299.0000
17.0000	33.0000	87.0000	127.2727	251.0000
18.0000	33.0000	60.0000	125.2424	259.0000
19.0000	18.0000	53.0000	115.8333	280.0000
20.0000	25.0000	58.0000	115.6000	330.0000
21.0000	34.0000	42.0000	91.8824	274.0000
22.0000	22.0000	34.0000	94.1364	220.0000
23.0000	30.0000	53.0000	80.2000	251.0000
24.0000	25.0000	56.0000	92.0000	210.0000
25.0000	36.0000	53.0000	105.6111	307.0000
26.0000	35.0000	55.0000	109.8000	320.0000
27.0000	30.0000	55.0000	92.3667	224.0000
28.0000	29.0000	50.0000	104.0690	230.0000
29.0000	23.0000	59.0000	116.7391	205.0000
30.0000	22.0000	53.0000	121.5455	267.0000
31.0000	24.0000	0.0000	97.0000	227.0000

3 Error Tables

Data are for the month of December 2022. 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^{th} through the 75^{th} quartiles. The lower and upper whiskers extend 1.5 times the IQR below the 25^{th} quartile, and 1.5 times the IQR above the 75^{th} 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	2.4243	3.1167	0.5000	1.0000
2009.01	5.1431	4.6115	5.6747	1.3000	1.3000
2009.02	4.5752	4.0886	5.0617	0.7000	1.2000
2009.03	6.0957	5.8712	6.3202	0.3000	0.6000
2009.04	6.8816	6.6513	7.1120	0.4000	1.2000
2009.05	7.0717	6.8074	7.3360	1.6000	2.9000
2009.06	6.3584	6.0517	6.6652	3.2000	6.3000
2009.07	6.3437	6.0972	6.5902	3.6000	5.5000
2009.08	6.6357	6.3940	6.8774	0.0000	0.0000
2009.09	7.3404	7.0943	7.5864	4.5000	7.1000
2009.10	6.8667	6.5179	7.2154	4.5000	7.7000
2009.11	6.8637	6.6747	7.0527	3.3000	6.9000
2009.12	7.3226	7.1124	7.5329	10.4000	16.3000
2010.01	19.5009	17.3848	21.6170	13.3000	19.5000
2010.02	15.7181	13.6860	17.7501	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	17.7625	15.6579	19.8671	15.4000	24.0000
2010.04	19.7196	17.5008	21.9384	7.0000	10.4000
2010.05	23.5693	23.1453	23.9933	8.4000	8.7000
2010.06	19.9166	19.5709	20.2624	11.0000	13.6000
2010.07	21.7493	21.4150	22.0836	15.2000	16.1000
2010.08	21.9322	21.5509	22.3135	18.3000	19.6000
2010.09	25.2825	24.8443	25.7208	22.8000	25.2000
2010.10	23.9967	23.5570	24.4364	21.0000	23.5000
2010.11	24.4014	23.9475	24.8552	20.9000	21.6000
2010.12	25.0946	24.5815	25.6078	13.9000	14.5000
2011.01	69.9349	68.4872	71.3827	17.7000	18.7000
2011.02	61.3216	60.0046	62.6387	29.1000	29.6000
2011.03	67.0501	65.7385	68.3617	48.0000	55.8000
2011.04	75.6654	74.2144	77.1164	47.3000	54.4000
2011.05	77.7057	76.3428	79.0686	37.3000	41.5000
2011.06	65.5186	64.3375	66.6997	35.2000	37.0000
2011.07	70.5901	69.3640	71.8162	41.5000	43.8000
2011.08	71.9843	70.8002	73.1683	42.4000	50.5000
2011.09	81.8514	80.3882	83.3146	73.8000	78.0000
2011.10	77.6183	76.2752	78.9615	78.9000	88.0000
2011.11	78.8759	77.2354	80.5164	84.6000	96.7000
2011.12	79.5316	77.8965	81.1668	65.8000	73.0000
2012.01	75.1664	73.6688	76.6640	55.8000	58.2000
2012.02	64.8149	63.4712	66.1586	29.2000	33.1000
2012.03	71.5392	70.2559	72.8225	53.1000	64.1000
2012.04	79.2126	77.7701	80.6552	51.4000	55.2000
2012.05	83.1544	81.7366	84.5722	61.8000	69.0000
2012.06	69.5607	68.3548	70.7667	59.7000	64.5000
2012.07	75.5738	74.3028	76.8448	64.2000	51.3000
2012.08	74.1735	72.9418	75.4051	57.7000	63.1000
2012.09	84.7624	83.2655	86.2593	57.7000	61.5000
2012.10	81.2455	79.7301	82.7609	48.3000	53.3000
2012.11	82.8066	81.1222	84.4909	56.7000	61.4000
2012.12	83.5098	81.6835	85.3361	37.4000	40.8000
2013.01	83.3821	81.7649	84.9992	63.8000	62.9000
2013.02	72.0224	70.5469	73.4978	37.8000	38.0000
2013.03	77.0500	75.4555	78.6446	50.6000	57.9000
2013.04	86.3558	84.7960	87.9155	70.6000	72.4000
2013.05	88.5345	86.9073	90.1616	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	75.5762	74.1961	76.9563	51.0000	52.5000
2013.07	81.1237	79.7715	82.4759	57.0000	57.0000
2013.08	81.3539	80.0017	82.7061	60.0000	66.0000
2013.09	91.4016	89.7326	93.0707	34.6000	36.9000
2013.10	86.5592	84.9192	88.1992	74.5000	85.6000
2013.11	86.7669	84.7698	88.7641	73.9000	77.6000
2013.12	89.9273	87.9852	91.8693	77.8000	90.3000
2014.01	97.4151	95.3375	99.4926	77.4000	82.0000
2014.02	85.9511	84.2102	87.6920	93.9000	102.8000
2014.03	93.9959	92.2459	95.7458	80.9000	92.2000
2014.04	105.5001	103.6007	107.3995	76.9000	84.7000
2014.05	108.7753	106.8780	110.6725	72.3000	75.2000
2014.06	92.7295	91.1150	94.3441	67.2000	71.0000
2014.07	99.1406	97.4342	100.8469	72.5000	72.5000
2014.08	99.5001	97.9070	101.0933	71.2000	74.7000
2014.09	113.0807	111.0345	115.1269	83.2000	87.6000
2014.10	106.5718	104.5760	108.5676	59.5000	60.6000
2014.11	107.9351	105.6450	110.2253	65.8000	71.1000
2014.12	109.2297	106.6906	111.7688	75.8000	78.0000
2015.01	60.1688	58.9564	61.3811	65.9000	67.0000
2015.02	51.9019	50.7276	53.0762	42.4000	44.8000
2015.03	57.5233	56.4510	58.5955	38.0000	38.4000
2015.04	64.2266	63.0465	65.4068	49.0000	54.4000
2015.05	66.3112	65.1906	67.4318	56.3000	58.8000
2015.06	56.2582	55.2443	57.2721	50.2000	68.3000
2015.07	59.5539	58.5454	60.5623	47.9000	65.8000
2015.08	60.9459	59.9281	61.9636	39.5000	57.2000
2015.09	68.5379	67.2952	69.7805	49.2000	72.1000
2015.10	65.0343	63.7820	66.2866	39.3000	48.3000
2015.11	66.4381	64.9875	67.8888	39.6000	55.9000
2015.12	67.6865	66.1786	69.1944	36.4000	44.8000
2016.01	32.9306	32.2440	33.6172	33.7000	43.3000
2016.02	28.4283	27.8349	29.0218	38.3000	46.8000
2016.03	31.0411	30.4205	31.6617	30.5000	38.9000
2016.04	34.4793	33.8209	35.1378	26.6000	30.9000
2016.05	35.7468	35.0943	36.3993	33.7000	48.4000
2016.06	30.0589	29.5456	30.5721	13.1000	19.5000
2016.07	32.4683	31.9476	32.9890	21.2000	27.5000
2016.08	32.8345	32.2573	33.4117	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	37.7853	37.0962	38.4743	27.7000	37.1000
2016.10	35.5452	34.8617	36.2288	22.7000	31.7000
2016.11	35.9162	35.1658	36.6666	14.0000	22.2000
2016.12	37.0629	36.2666	37.8592	11.1000	20.0000
2017.01	17.7440	17.3690	18.1190	18.4000	26.2000
2017.02	15.3779	15.0392	15.7166	14.4000	20.6000
2017.03	16.9229	16.5996	17.2462	11.3000	15.5000
2017.04	18.9822	18.6468	19.3176	21.6000	33.2000
2017.05	19.4090	19.0732	19.7449	12.5000	18.1000
2017.06	16.2751	16.0047	16.5455	15.5000	19.3000
2017.07	17.6538	17.3710	17.9366	11.5000	16.3000
2017.08	17.8136	17.5027	18.1245	22.8000	35.7000
2017.09	20.8343	20.3986	21.2699	34.6000	42.9000
2017.10	19.0824	18.6900	19.4748	10.5000	11.0000
2017.11	19.1626	18.7556	19.5696	4.2000	5.6000
2017.12	19.6656	19.3650	19.9661	4.0000	4.6000
2018.01	4.9617	4.8555	5.0679	3.1000	6.3000
2018.02	4.2576	4.1542	4.3610	6.8000	11.8000
2018.03	4.6094	4.5161	4.7026	1.1000	1.2000
2018.04	5.1146	5.0118	5.2175	4.7000	7.5000
2018.05	5.3048	5.2057	5.4040	8.4000	14.0000
2018.06	4.4712	4.3926	4.5498	10.2000	13.6000
2018.07	4.8544	4.7997	4.9091	0.5000	1.7000
2018.08	4.8456	4.7627	4.9286	5.9000	9.5000
2018.09	5.4574	5.3552	5.5596	1.6000	2.9000
2018.10	5.2656	5.1623	5.3689	2.5000	5.6000
2018.11	5.3050	5.1940	5.4159	3.1000	4.2000
2018.12	5.5487	5.4406	5.6567	1.6000	2.3000
2019.01	3.2839	3.2215	3.3463	5.4000	2.3000
2019.02	2.8788	2.8224	2.9352	0.1000	1.2000
2019.03	3.0831	3.0308	3.1354	6.1000	12.1000
2019.04	3.4562	3.3914	3.5210	6.2000	9.3000
2019.05	3.4740	3.4137	3.5343	7.0000	11.9000
2019.06	2.9392	2.8899	2.9886	0.7000	1.5000
2019.07	3.1870	3.1399	3.2341	0.4000	2.2000
2019.08	3.2322	3.1844	3.2800	0.3000	0.8000
2019.09	3.7195	3.6614	3.7777	0.5000	1.0000
2019.10	3.4815	3.4224	3.5405	0.2000	0.5000
2019.11	3.5840	3.5154	3.6525	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	3.6523	3.5802	3.7244	0.8000	1.0000
2020.01	7.2685	7.1267	7.4103	4.0000	5.3000
2020.02	6.3023	6.1760	6.4286	0.1000	0.0000
2020.03	6.8127	6.6855	6.9399	1.2000	1.5000
2020.04	7.6860	7.5601	7.8120	3.0000	5.1000
2020.05	7.7931	7.6718	7.9144	0.1000	0.4000
2020.06	6.6350	6.5338	6.7362	3.9000	6.4000
2020.07	7.0884	6.9848	7.1921	4.2000	7.7000
2020.08	7.0812	6.9831	7.1794	5.3000	7.8000
2020.09	8.1222	7.9923	8.2521	0.4000	0.9000
2020.10	7.7869	7.6589	7.9149	9.9000	13.6000
2020.11	7.9393	7.8109	8.0677	21.2000	33.1000
2020.12	8.1168	7.9714	8.2622	15.4000	19.8000
2021.01	25.4448	24.9902	25.8993	7.0000	15.8000
2021.02	22.4253	22.0249	22.8257	5.8000	10.7000
2021.03	24.4042	24.0162	24.7922	11.0000	17.2000
2021.04	27.5796	27.1338	28.0255	18.5000	28.8000
2021.05	28.2781	27.8588	28.6975	15.9000	22.9000
2021.06	23.9165	23.5536	24.2794	19.9000	24.1000
2021.07	25.4962	25.0883	25.9041	23.8000	35.6000
2021.08	26.3227	25.9043	26.7412	15.7000	19.5000
2021.09	29.8704	29.3800	30.3608	39.1000	52.5000
2021.10	28.9376	28.4452	29.4299	27.1000	37.0000
2021.11	29.2281	28.7377	29.7186	27.2000	35.1000
2021.12	30.6799	30.1051	31.2546	50.6000	69.0000
2022.01	72.2794	71.0476	73.5111	43.9000	62.0000
2022.02	63.5519	62.4323	64.6715	48.8000	60.5000
2022.03	69.8313	68.6159	71.0467	58.4000	80.6000
2022.04	75.9244	74.7539	77.0949	59.1000	83.9000
2022.05	80.5455	79.2854	81.8056	72.5000	0.4000
2022.06	66.3450	65.3209	67.3692	58.9000	0.4000
2022.07	72.5734	71.4156	73.7311	76.7000	102.5000
2022.08	73.1773	72.0247	74.3299	63.3000	86.0000
2022.09	82.7046	81.2258	84.1833	72.6000	94.5000
2022.10	78.6037	77.2680	79.9395	66.4000	112.1000
2022.11	79.5913	78.1479	81.0347	54.3000	82.1000
2022.12	81.8598	80.2370	83.4826	93.7000	165.0000

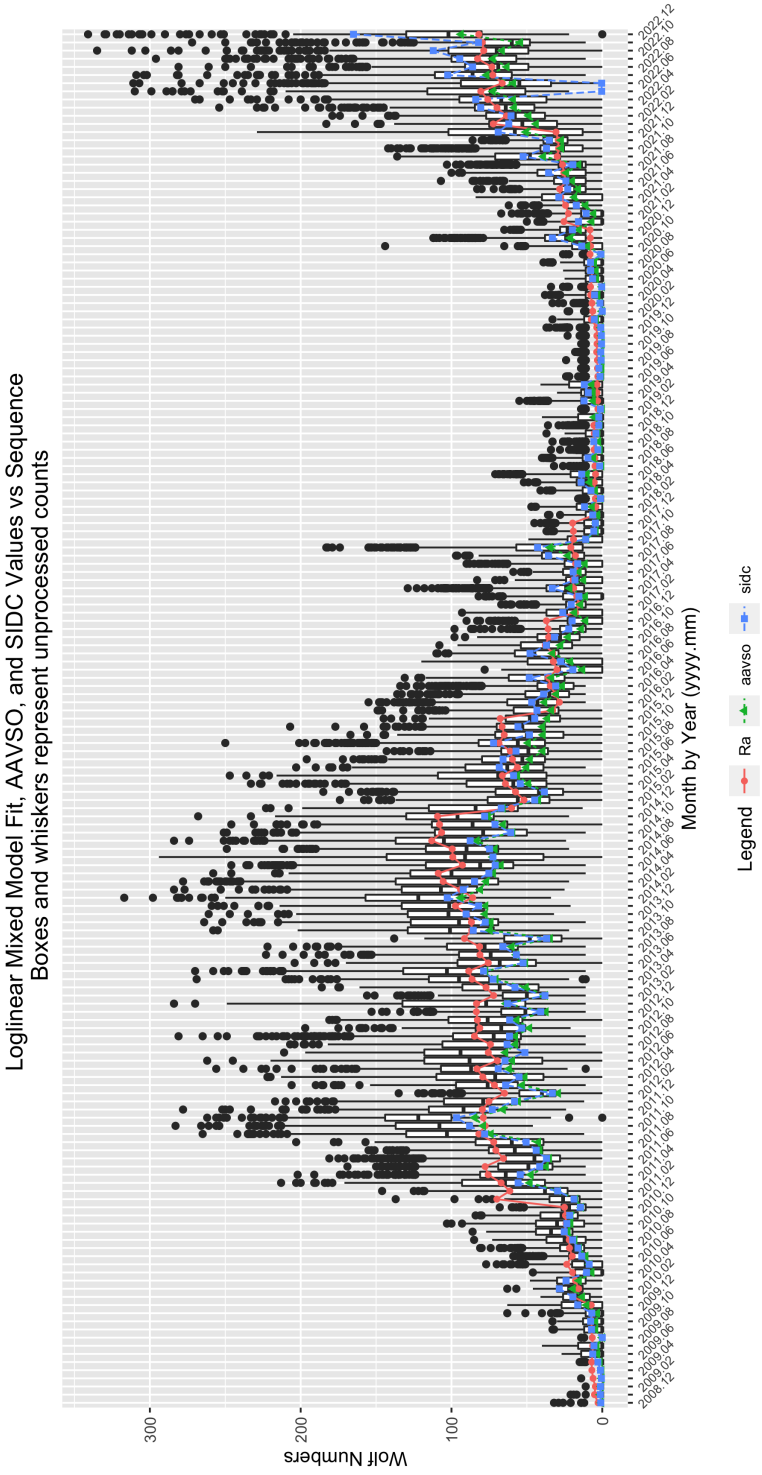

Figure 2: GLMM fitted data for R_a. AAVSO data: https://www.aavso.org/category/tags/solar-bulletin. SILSO data: WDC-SILSO, Royal Observatory of Belgium, Brussels

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: 202212 Parameter Estimates

	Estimate	Std. Error	t-value	Pr(>|t|)
(Intercept)	1.1941	0.3155	3.7844	0.0002
seeF	-0.2264	0.0053	-42.5401	0.0000
seeG	-0.1184	0.0046	-25.4733	0.0000
seeM	-0.1879	0.0244	-7.7127	0.0000
seeP	-0.3220	0.0076	-42.1513	0.0000
sidc1	0.0572	0.0133	4.3144	0.0000
year2009	0.7647	0.3170	2.4123	0.0159
year2010	2.0027	0.3148	6.3619	0.0000
year2011	3.1460	0.3147	9.9972	0.0000
year2012	3.1872	0.3147	10.1281	0.0000
year2013	3.2822	0.3147	10.4300	0.0000
year2014	3.4809	0.3147	11.0617	0.0000
year2015	2.9980	0.3147	9.5268	0.0000
year2016	2.3822	0.3147	7.5693	0.0000
year2017	1.7682	0.3148	5.6176	0.0000
year2018	0.4866	0.3151	1.5445	0.1225
year2019	0.0707	0.3153	0.2242	0.8226
year2020	0.8765	0.3149	2.7833	0.0054
year2021	2.1581	0.3147	6.8567	0.0000
year2022	3.1473	0.3147	10.0008	0.0000
mon2	-0.1380	0.0086	-16.0715	0.0000
mon3	-0.0547	0.0080	-6.8074	0.0000
mon4	0.0485	0.0077	6.2811	0.0000
mon5	0.0729	0.0076	9.6229	0.0000
mon6	-0.0972	0.0079	-12.3178	0.0000
mon7	-0.0292	0.0076	-3.8220	0.0001
mon8	-0.0177	0.0076	-2.3389	0.0193
mon9	0.1197	0.0076	15.7991	0.0000
mon10	0.0682	0.0077	8.8258	0.0000
mon11	0.0944	0.0080	11.7681	0.0000
mon12	0.1220	0.0080	15.2914	0.0000

Table 4: 202212 Summary of Sunspot Numbers

year	mon	day	obs	sidc
Min. :2008	Min. : 1.000	Min. : 0.00	Length:163816	Min. :0.0000
1st Qu.:2013	1st Qu.: 4.000	1st Qu.: 8.00	Class :character	1st Qu.:0.0000
Median :2017	Median : 7.000	Median :16.00	Mode :character	Median :0.0000
Mean :2016	Mean : 6.641	Mean :15.71		Mean :0.2448
3rd Qu.:2020	3rd Qu.: 9.000	3rd Qu.:23.00		3rd Qu.:0.0000
Max. :2022	Max. :12.000	Max. :31.00		Max. :1.0000

Table 5: 202212 Summary of Sunspot Numbers

g	s	w	see	method
Min. : 0.000	Min. : 0.00	Min. : 0.00	Length:163816	Length:163816
1st Qu.: 1.000	1st Qu.: 1.00	1st Qu.: 11.00	Class :character	Class :character
Median : 2.000	Median : 8.00	Median : 32.00	Mode :character	Mode :character
Mean : 2.824	Mean : 16.31	Mean : 44.54		
3rd Qu.: 5.000	3rd Qu.: 24.00	3rd Qu.: 71.00		
Max. :21.000	Max. :204.00	Max. :341.00		

Table 6: 202212 Summary of Sunspot Numbers

inst	filter	unit
Length:163816	Length:163816	Length:163816
Class :character	Class :character	Class :character
Mode :character	Mode :character	Mode :character

Table 7: 202212 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.: 5.00	1st Qu.: 150.0	1st Qu.: 40.0
Median : 80.00	Median : 14.00	Median : 900.0	Median : 57.0
Mean : 92.53	Mean : 37.02	Mean : 890.6	Mean : 180.3
3rd Qu.: 104.00	3rd Qu.: 23.00	3rd Qu.:1200.0	3rd Qu.: 75.0
Max. :1524.00	Max. :2010.00	Max. :9990.0	Max. :4591.0

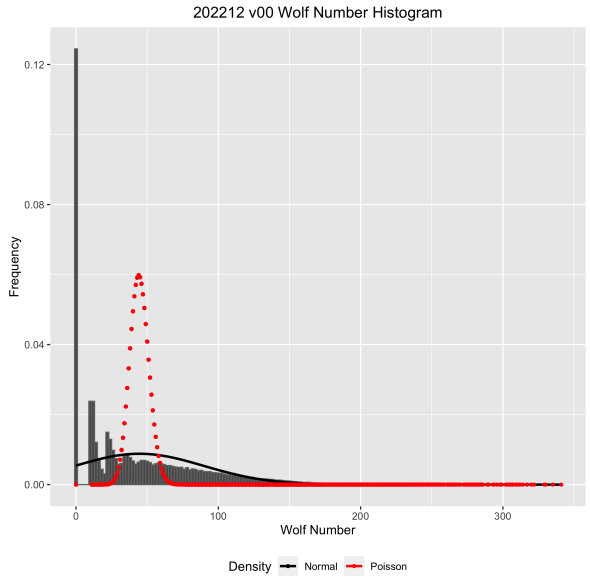

Figure 3: Box plots of raw Wolf number (w) by observer rank.

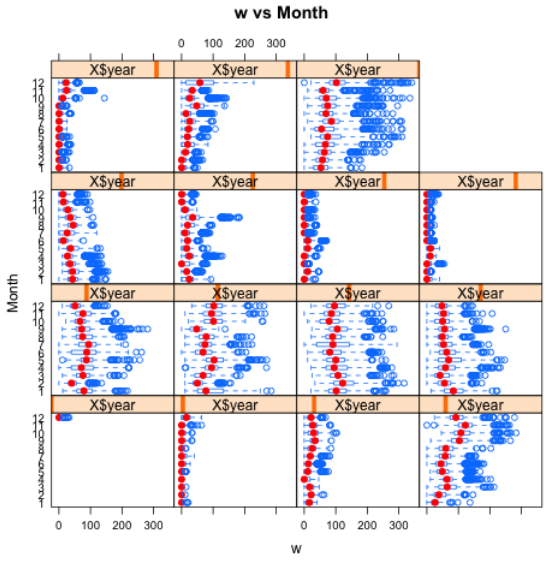

Figure 4: Box plots of raw Wolf number (w) by month and year.

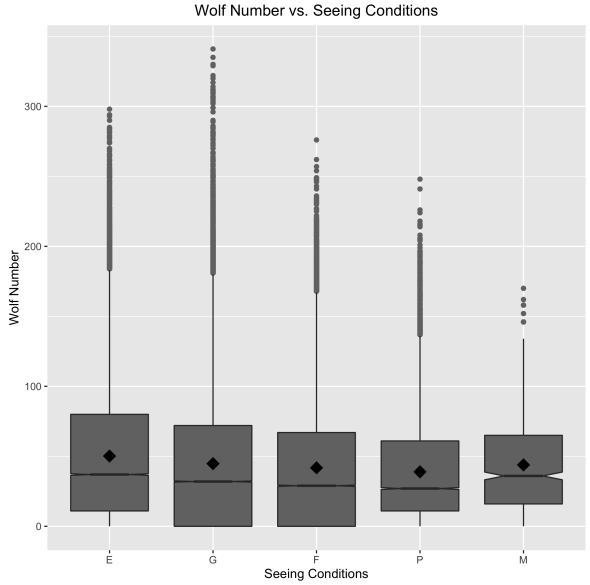

Figure 5: Box plots of raw Wolf number (w) by seeing condition.

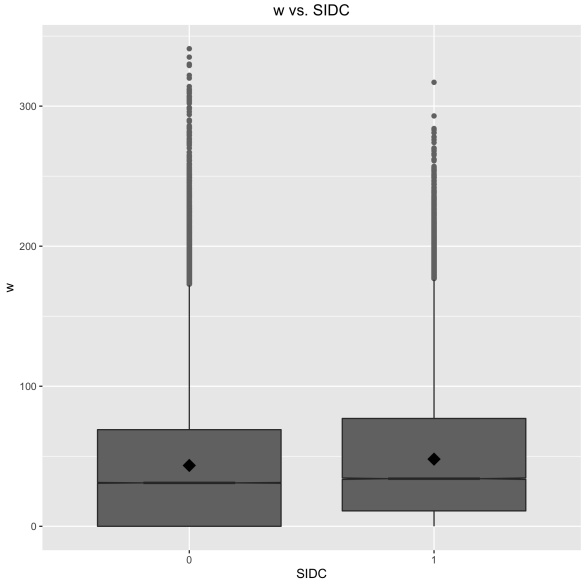

Figure 6: Box plots of raw Wolf number (w) by organization.

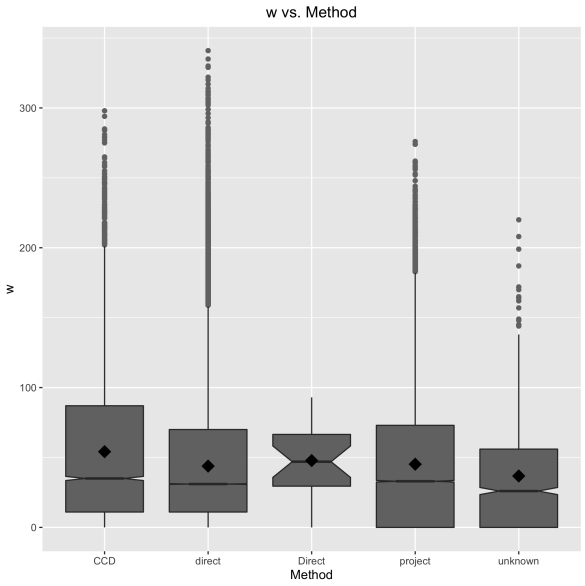

Figure 7: Box plots of raw Wolf number (w) by observer rank.

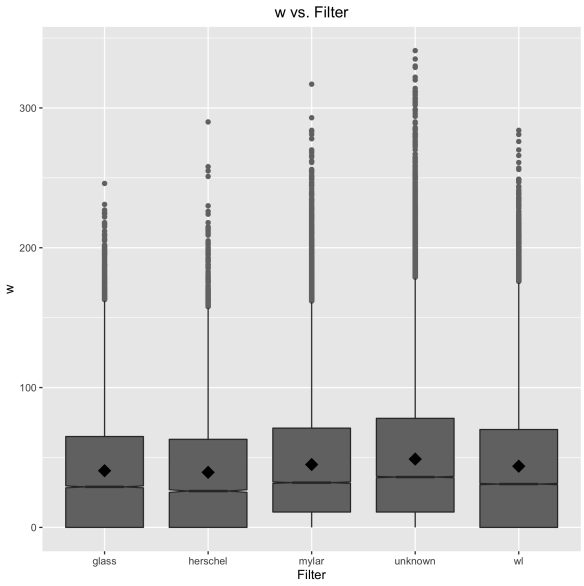

Figure 8: Box plots of raw Wolf number (w) by month and year.

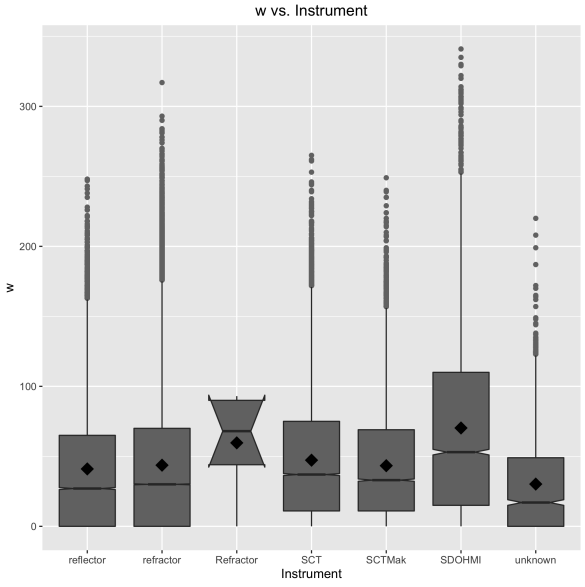

Figure 9: Box plots of raw Wolf number (w) by seeing condition.

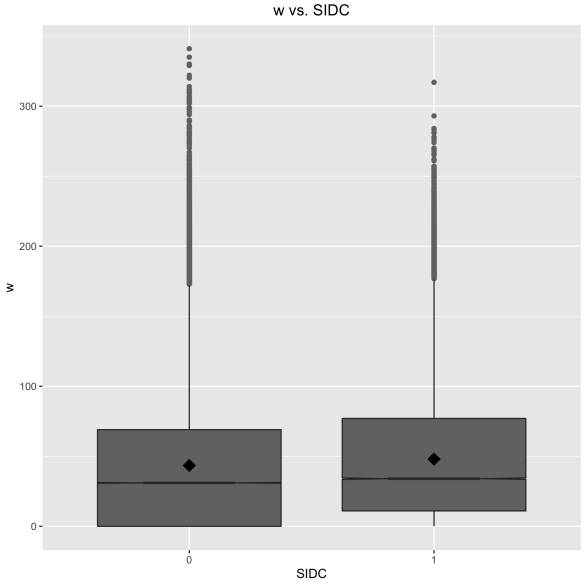

Figure 10: Box plots of raw Wolf number (w) by organization.

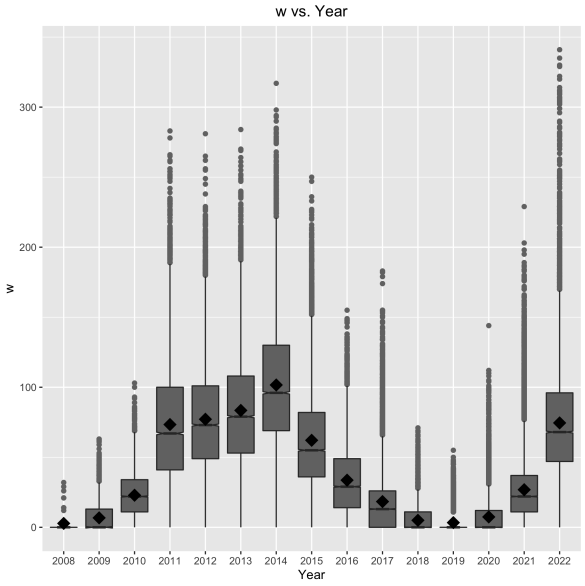

Figure 11: Box plots of raw Wolf number (w) by year.

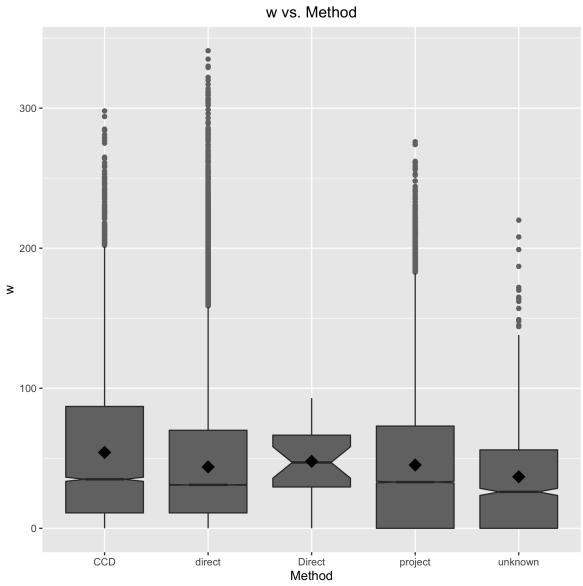

Figure 12: Box plots of raw Wolf number (w) by observing method.